



## Test and Tune-up Kit Version 2.0

20110

Copyright

Expand All

Collapse All

Frequently Asked Questions



**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Improving System Performance**



## Test and Tune-up Kit

Copyright

Expand All

Collapse All

Frequently Asked Questions



### Installing Wintune®

[Why Wintune®?](#)

[The Tools We Used To Build This Help File](#)

[Our Disclaimer](#)



### Installing Wintune®

[Installing Wintune® Normally](#)

[Setting Last Test Saved Switch](#)

[Setting TRF File Switch](#)

[Setting Memory Test Defeat](#)

[Setting Time Delay Switch](#)

[Setting Video Test Defeat Switch](#)

[Setting Cache Size Switch](#)

[Installing On A Network](#)



### Using Wintune®

[General Test Procedures](#)

[What Wintune® Does](#)

[Running Low-Level Benchmarks](#)

[Preventing General Protection Faults](#)

[Solving Video Problems](#)

[Getting Help With General Problems](#)



## Wintune® Commands

### Toolbar



**File Menu**



**Edit Menu**



**Test Menu**



**Help Menu**



## Understanding The Test Results



**Understanding Specific Tests**



**Using Test Results/Understanding Theory**



## Improving System Performance

### Before You Upgrade: Checklist



**Adjusting CPU/Video/System Software**



**Improving Disk Performance**



**Upgrading Processors**



**Upgrading Hardware**



## Test and Tune-up Kit

Copyright

Expand All

Collapse All

Frequently Asked Questions



### Why Wintune®?



#### Installing Wintune®

[Installing Wintune® Normally](#)

[Setting Last Test Saved Switch](#)

[Setting TRF File Switch](#)

[Setting Memory Test Defeat](#)

[Setting Time Delay Switch](#)

[Setting Video Test Defeat Switch](#)

[Setting Cache Size Switch](#)

[Installing On A Network](#)



#### Using Wintune®



#### Wintune® Commands



#### Understanding The Test Results



#### Improving System Performance



## Test and Tune-up Kit

Copyright

Expand All

Collapse All

Frequently Asked Questions



### Why Wintune®?



### Installing Wintune®



### Using Wintune®

[General Test Procedures](#)

[What Wintune® Does](#)

[Running Low-Level Benchmarks](#)

[Preventing General Protection Faults](#)

[Solving Video Problems](#)

[Getting Help With General Problems](#)



### Wintune® Commands



### Understanding The Test Results



### Improving System Performance



## Test and Tune-up Kit

Copyright

Expand All

Collapse All

Frequently Asked Questions



**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**

Toolbar



**File Menu**



**Edit Menu**



**Test Menu**



**Help Menu**



**Understanding The Test Results**



**Improving System Performance**



## Test and Tune-up Kit

Copyright

Expand All

Collapse All

Frequently Asked Questions



**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Understanding Specific Tests**



**Using Test Results/Understanding Theory**



**Improving System Performance**



**Test and Tune-up Kit**

**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Improving System Performance**



Before You Upgrade: Checklist



**Adjusting CPU/Video/System Software**



**Improving Disk Performance**



**Upgrading Processors**



**Upgrading Hardware**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### File Menu

[File Menu: Expert Mode](#)

[File Menu: Save Present Results](#)

[File Menu: Open a Result File](#)

[File Menu: Save Result File As](#)

[File Menu: Merge in a Result File](#)

[File Menu: Print](#)

[File Menu: Printer Setup](#)

[File Menu: User Information](#)

[File Menu: Exit](#)



**Edit Menu**



**Test Menu**



**Help Menu**



**Understanding The Test Results**



**Improving System Performance**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### File Menu



### Edit Menu

Edit Menu: Copy

Edit Menu: Select All

Edit Menu: Preferences



**Test Menu**



**Help Menu**



**Understanding The Test Results**



**Improving System Performance**



**Test and Tune-up Kit**

**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**File Menu**



**Edit Menu**



## **Test Menu**

[Test Menu: CPU Test](#)

[Test Menu: FPU Test](#)

[Test Menu: Memory Test](#)

[Test Menu: Video Test](#)

[Test Menu: Disk Test](#)

[Test Menu: All Tests](#)



## **Help Menu**



## **Understanding The Test Results**



## **Improving System Performance**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### File Menu



### Edit Menu





## **Test Menu**



## **Help Menu**

[Help Menu: Expert Mode](#)

[Help Menu: Contents](#)

[Help Menu: Help Using Help](#)

[Help Menu: Search for Help On](#)

[Help Menu: Frequently Asked Questions](#)

[Help Menu: About the Test-Tune-up Kit](#)

[Help Menu: Full Tips](#)



## **Understanding The Test Results**



## **Improving System Performance**



**Test and Tune-up Kit**



**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Understanding Specific Tests**

[As Compared With...](#)

[Video Test Results](#)

[Video Test Details](#)

[CPU and FPU Test Results](#)

[CPU Test Details](#)

[Disk Test Results](#)

[Disk Test Details](#)

[Memory Test Results](#)

[Memory Test Details](#)



**Using Test Results/Understanding Theory**



**Improving System Performance**



**Test and Tune-up Kit**

**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Understanding Specific Tests**



## **Using Test Results/Understanding Theory**

[Performance](#)

[Comparisons](#)

[Comparison Charts](#)

[Benchmark Theory and Explanation](#)

[Multiple Linear Regression and Benchmarks](#)



## **Improving System Performance**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### Understanding The Test Results



### Improving System Performance

[Before You Upgrade: Check List](#)



### **Adjusting CPU/Video/System Software**

[Improving CPU and FPU Performance](#)

[Improving Video Performance](#)

[Installing Video Drivers](#)

[Updating Video Drivers](#)



### **Improving Disk Performance**



### **Upgrading Processors**



### **Upgrading Hardware**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### Understanding The Test Results



### Improving System Performance



[Before You Upgrade: Checklist](#)



**Adjusting CPU/Video/System Software**



**Improving Disk Performance**

[Improving Disk Performance](#)

[Reducing Swapping](#)

[Adjusting SMARTDRV Settings](#)

[Adjusting File Structure/Defragmentation](#)

[Adjusting Cache Settings](#)



**Upgrading Processors**



**Upgrading Hardware**



## Test and Tune-up Kit

### Why Wintune®?



### Installing Wintune®



### Using Wintune®



### Wintune® Commands



### Understanding The Test Results



### Improving System Performance

[Before You Upgrade: Checklist](#)



**Adjusting CPU/Video/System Software**



**Improving Disk Performance**



**Upgrading Processors**

[Upgrading the CPU](#)

[Installing /Upgrading an FPU](#)



**Upgrading Hardware**



**Test and Tune-up Kit**

**Why Wintune®?**



**Installing Wintune®**



**Using Wintune®**



**Wintune® Commands**



**Understanding The Test Results**



**Improving System Performance**

[Before You Upgrade: Check List](#)



**Adjusting CPU/Video/System Software**



**Improving Disk Performance**



**Upgrading Processors**



**Upgrading Hardware**

[Upgrading the Motherboard](#)

[Upgrading/Installing RAM](#)

[Selecting/Installing A New Disk](#)

[Selecting Video Boards](#)



## Test and Tune-up Kit



### **Why Wintune®?**

[Why Wintune®?](#)

[The Tools We Used To Build This Help File](#)

[Our Disclaimer](#)



### **Installing Wintune®**



### **Using Wintune®**



### **Wintune® Commands**



### **Understanding The Test Results**



**Improving System Performance**



## **Disclaimer**

While **WINDOWS Magazine** has gone to great lengths to make Wintune® as accurate as possible, we do not guarantee it will work properly on all systems all the time, and therefore offer the software "as-is" without warranty or guarantee as to merchantability or suitability to task. You use this software at your own risk. If you aren't sure of the suitability to task of the software on this disk, or are uncertain about your ability to perform any of the tasks suggested by the software, seek additional advice before proceeding. In any case, CMP Publications, Inc., its employees or freelancers are not responsible for any injury, damage, or loss resulting from your use of this disk or the software or information it contains.





## **HelpBreeze**

HelpBreeze turns Microsoft Word 6.0x or 2.0x into a complete, point-and-click environment for developing Windows help files.

Price: \$279

Solutionsoft

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408-736-1431

Fax: 408-736-4013

e-mail: CompuServe 75210,2214

Internet 75210.2214@compuserve.com



## Why Wintune®?

Wintune® is [WINDOWS Magazine](#)'s test and tune-up kit for users of Microsoft Windows and Windows for Workgroups. It is **not** a benchmark (though it does incorporate some benchmarking code). Instead, it's an end-user tool designed to help you configure and tune your system for optimal performance.

To facilitate optimizing your system, Wintune® includes several help files that contain information from published **WINDOWS Magazine** features, including our annual compilation of [Tips and Tricks](#), as well as our Upgrade Guide. Tuning your system to improve performance may be as simple as \*changing a setting in your WIN.INI file, or as complex as replacing the central processor.

Wintune®'s major components are:

- Low-level performance tests, implemented as a Windows dynamic link library (HELL16.DLL). This module performs tests of your CPU, FPU, Disk, Video and Memory performance using standardized low-level benchmarks. It is based on the public domain Dhrystone and Whetstone benchmarks, combined with original code written by Dr. Martin Heller and John D. Ruley of **WINDOWS Magazine**.
- A system information acquisition engine, implemented as a Windows dynamic link library (GETINFO.DLL). This module acquires "static" information about your system, such as how much memory is installed, whether your hard disk is 32-bit disk access-capable, and so on. It is called by the Visual Basic front end. It is an original work by John D. Ruley and David W. Methvin of **WINDOWS Magazine**, with assistance from the other individuals mentioned here.
- A unique Tip Advisor engine, implemented as a Windows dynamic link library (TIPADW16.DLL). This module takes information from HELL16.DLL and GETINFO.DLL, compares it with predefined norms, and emits a prioritized list of indices into a specially written help file. It is a completely original work by David W. Methvin of **WINDOWS Magazine**, with assistance from the other individuals mentioned here.
- The Wintune® front end, written in Microsoft Visual Basic, ties together all the DLLs and help files, making Wintune® 2.0 a completely integrated application. It was written by Enis Moran of [Graphical Bytes Inc.](#), with assistance from all the other individuals mentioned here.
- Several Windows help files, including the one you are viewing now. Wintune® 2.0 makes extensive use of the Microsoft Windows Help engine (WinHelp) to display information--including all output from the Wintune® Tip Advisor. Our Help files were generated by Paul E. Schindler, Jr. of **WINDOWS Magazine**; with assistance from the other individuals mentioned here as well as the **WINDOWS Magazine** editorial staff.
- Information on several standard systems is provided in a file (WINTUNE®.TRF) on your disk. This gives you a set of known standards you can compare against your own system's performance. You can add to this file, or create new files, with the results you measure yourself.







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## **Fixing Video GPF Problems**

[Click Here](#) to see how to update your video driver, which will usually solve this problem.



## **Disclaimer**

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## **Search from the Tip Help File**

Topics in the Tip help file are designed to be accessed from Wintune®'s Tip window. We recommend you search this, the main help file, for further information on how to fine-tune your system. Push the Back button to return to the tip that brought you here.



## **Graphical Bytes**

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## Unable to Generate Tips

There is something about your system that has left us unable to generate tips. We'll be happy to try to help you figure out what it is. Because of the large volume of Wintune® users, we ask you not to call; instead, please contact us electronically:

**Online Access**

or via US Mail

**U.S. Mail**

Tell us as much about your system as you can. We will try to help.



## **Glossary of Terms**

[32-Bit File Access](#)

[benchmarks](#)

[BIOS](#)

[blit](#)

[cached](#)

[check box](#)

[color depth](#)

[CPU](#)

[CMOS](#)

[control panel](#)

[defragment](#)

[degauss](#)

[DIP switch](#)

[Dhrystone](#)

[disk interface specifications](#)

[driver](#)

[expanded memory](#)

[expert mode](#)

[extended memory](#)

[flicker](#)

[FPU](#)

[freeware](#)

[MFLOPS](#)

[MHz](#)

[MIPS](#)

[motherboard](#)

[pixel](#)

[radio button](#)

[RAM](#)

[refresh](#)

[SIMM](#)

[swapping](#)

[swap file](#)

[tab](#)

[Tips and Tricks](#)

[Upgrade Guide](#)

[video resolution](#)

[wait state](#)

[Whetstone](#)

[Windows GDI](#)

[WINDOWS Magazine](#)

[WFWG 3.11](#)

## Tips and Tricks



See the Winter 1995 issue of [WINDOWS Magazine](#)

**benchmarks**



Software programs that can be used to test a computer's performance.

## cached

Buffered between two types of storage that operate at different speeds. Disk drives, for example, are physical devices and, as such, are much slower than chip-based main memory or processors. To compensate, large amounts of disk data (more than the application actually requests) are read into cache memory. Often, the next disk request will already be in cache, greatly improving performance. In the same way, cache memory on a processor chip is much faster than main memory and compensates for the speed difference between slow main memory and speedy processors by bringing in more data than the application requested, in the hopes of putting the next needed memory location into high-speed cache memory.



## **color depth**



The maximum number of colors that can be displayed simultaneously, or the number of bits required to store that much color information. In Windows, this is determined by the number of bits used to store color information for each picture element (pixel). Common color depths are 4-bit (16 colors displayed simultaneously), 8-bit (256 colors), 15-bit (32,000 colors or high color), 16-bit (65,000 colors, also called high color) and 24-bit (16.7 million colors, also called true color).



central processing unit. In a personal computer, the microprocessor chip. For Windows, an Intel chip (286, 386, 486 or Pentium); for Windows NT, any of a number of Intel or RISC processor chips.

**degauss** 

To remove built-up and undesirable magnetic fields from the display tube in a monitor.

## **Dhrystone**



A synthetic benchmark computer program used to measure integer CPU performance, it is a generally accepted standard. It is synthetic in that it does nothing useful: it just runs typical kinds of code sequences, which are intended to have the same sort of statistical distribution found in real code. The program is primarily the brainchild of Reinhold Weicker of Siemens AG.

**driver** 

A software program that tells Windows how to interact with a piece of hardware, such as a video display or a peripheral storage or input device. Frequently it has a .DRV extension.

## **expanded memory**



(also EMS) is a specialized form of memory that lets DOS apps use more than 640KB of memory. EMS was originally a hardware standard used by memory expansion boards, but on 386 and newer CPUs DOS and Windows can use extended memory (XMS) to emulate EMS for those DOS apps that require it. (Note that with DOS 5 you had to allocate a specific amount of XMS to EMS emulation, while DOS 6 reallocates on the fly, as needed.) Windows apps, Windows itself, and newer DOS apps use extended memory directly.

## **extended memory**



Standard memory above the 1MB line used by Windows and by DOS extenders, as well as by caching programs and RAM disks. Older DOS programs used memory differently; see also [expanded memory](#).



When a monitor appears to alternate between bright and dark screens at a very rapid rate.



## **FPU**

floating-point unit. A second processor that assists the main processor (or CPU) in the performance of mathematically intensive calculations of the type frequently found in scientific software, and less often in spreadsheet recalculation or drawing program screen operations. In 486 and Pentium chips, the FPU is built in; in 386 and earlier systems, it was a separate chip (the math coprocessor).

**freeware** 

In general, free software. In this case, benchmarks and tools that are distributed at no charge (except, in some cases, the cost of the actual media) but are, nevertheless, **Copyright © 1994 by CMP Publications, Inc.** All rights reserved.

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## **MFLOPS**

Millions of floating-point operations per second. It is a measure of CPU speed for floating-point calculations (decimal numbers), as used in spreadsheets.

## MHz

Megahertz or millions of cycles per second. A measurement of clock speed that is a rough indicator of performance, though only among CPUs of the same family. For example, a 100MHz 486DX4 is about 50 percent faster than a 66MHz 486DX2, but about the same speed as a 60MHz Pentium.

## **MIPS**

Millions of instructions per second. It is a basic measure of CPU performance--the more millions of instructions per second, the faster the CPU.

## **motherboard**

The central circuit board in a PC, containing the microprocessor, bus and associated circuitry; sometimes referred to as a system board, motherboard is the preferred term.

**pixel** 

picture element. A monitor contains thousands of these "dots," which can either be monochrome or color.

## **RAM**

random access memory. The kind of memory in which programs and operating systems are stored while in use. As opposed to ROM, read-only memory.



## refresh

Usually expressed in Hz (hertz or cycles per second). The refresh (or vertical scan) rate indicates the number of times per second a monitor redraws the screen. Typical refresh rates on contemporary monitors are 60Hz to 75Hz. Older Super VGA monitors displayed 1024x768 at 45Hz but were also **interlaced** (odd lines refreshed on one pass, even lines on the next) for an effective refresh rate of only 22.5Hz, resulting in a pronounced flicker. (Hence the term "flicker-free" for noninterlaced monitors.)

## swapping

Writing one or more program segments from RAM memory to the hard disk to make room for another program segment in RAM; also known as paging.

## Upgrade Guide

See the special Summer 1993 issue of [WINDOWS Magazine](#).

## **video resolution**

The number of pixels (picture elements or dots) displayed horizontally and vertically on the video display. Common resolutions supported by 14- to 15-inch monitors are 640 horizontal pixels by 480 vertical pixels (640x480-- standard VGA), 800x600, and 1024x768. 17 inch and larger monitors often support 1280x1024 and occasionally 1600x1200 as well. See also [color depth](#).

## Whetstone

A software test of computer hardware performance consisting of 10 tight-loop tests that simulate the code found in real numerical programs, performed in moderately complex expressions that test the compiler as well as the hardware. It does not consist solely of instruction timings.

## Windows GDI

The Graphics Device Interface is used by Windows applications to create graphical output on the screen, printer or other output peripheral. Applications desiring to create a graphical element (a circle or box for example) call the GDI, which performs the actual work of drawing the element.

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## **BIOS/ROM BIOS**

ROM is read-only memory. BIOS is Basic Input/Output System. ROM BIOS consists of a set of instructions (written on a [CMOS](#) chip that does not lose its memory when the power is turned off) that tell your CPU how to interact with your input/output devices, such as your CPU, monitor, hard disk, serial and parallel ports, clock and keyboard. It tests your system at start-up and then hands control over to your operating system (DOS in the case of Windows 3.1; the host operating system in the case of Windows NT, or Windows itself in the case of Windows 95.)



## **SIMM**

The single in-line memory module is a small piece of plastic that has multiple memory chips mounted on it, and which plugs into a slot in your computer. SIMMs generally hold nine [RAM](#) memory chips. Older 30-pin (x9) SIMMs generally come in 1MB, 4MB and 16MB sizes; newer 72-pin (x36) SIMMs come in 2MB, 8MB and 32MB as well.

## DIP Switch

A dual in-line package (DIP) switch is a set of small switches (usually white), placed in various ill-marked and hard-to-find locations on a circuit board, used to set select hardware settings (typically ports, DMA channels, IRQ, and other bit-and-byte voodoo). Unless you have very small fingers, you will find it easier to set DIP switches with a pen or small screwdriver. It is *not* a good idea to change these switch settings without having the circuit board documentation on hand, or else tech support on the telephone. Usually OFF=OPEN and ON=CLOSED. NEVER reset DIP switches with the power turned on.

## **defragment**

The DOS/Windows File System (prior to Windows NT and Windows 95) was based on the File Allocation Table (FAT). After a while, creating and erasing files with this file system "fragments" a disk; that is, places files all over the physical disk leaving small, almost useless empty spaces between them. New files are written all over the disk, which slows down disk access. Defragmentation is the process of reorganizing a disk so all the files are contiguous. It reduces the time it takes to load program and data files into memory.

## swap file

A disk file that contains programs or data too large to fit into physical memory. Windows is capable of running programs and holding data files that are larger than its available physical [RAM](#) memory. It does this with virtual memory, a concept that takes advantage of relatively speedy hard disk storage. When Windows runs out of memory, it takes all or part of items in memory it hasn't used lately and "swaps" them to disk. This material is read back into memory when and if it is needed.

## Disk Interface Specifications

There are many "languages" or interface specifications that govern the communications between a hard disk controller and its associated peripheral devices (one or more hard disks, backup devices, CD-ROM drives). Currently popular interfaces are IDE (integrated drive electronics, AKA ATA), Enhanced IDE (also known as ATA-2), SCSI (small computer system interface), and SCSI-2. Obsolete standards you may encounter in older systems include ESDI, MFM and RLL.

## CMOS

complementary metal-oxide semiconductor. A kind of electronic chip with especially low power consumption. Because of this characteristic, it is often used to store [BIOS](#) setup information, since it imposes less of a drain for the battery, which keeps the information from disappearing when the main power to the computer is shut off.

## **radio button**

Two or more interconnected buttons that appear on- screen at the same time. When one is selected, the other (or others) are deselected.

## **check box**

A box associated with a single yes/no option; if a check mark appears in the box, the option has been selected. If no check mark appears, the option has not been selected.



## Control Panel

A Windows program (actually a collection of programs) used to control settings in the Windows environment. You can open Control Panel by double-clicking on this icon:



usually found in your Main program group. Or:

- Select File/Run from the Program Manager menu
- Enter CONTROL.EXE as the command line
- Push the OK button.

## blit

A blit is a **block t**ransfer, rendered pronounceable by the addition of the letter i. It is a method of rendering graphics, implemented in hardware or software, which involves the rapid transfer of blocks of bits from the memory to the display. Blitting, then, is the act of performing blits.

## 32-Bit File Access

The term 32-bit doesn't have anything to do with the type of expansion bus in your system. It refers to the ability of 386 and later CPUs to handle data 32 bits, rather than 16 bits, at a time. By using its own 32-bit code running in the CPU's protected mode, Windows can bypass the ancient 16-bit BIOS and DOS code to move more data in less time. Since it doesn't depend on your hardware bus, it works just fine on a 386 PC with a 16-bit ISA bus as well as a hot-off-the-line Pentium PCI system. (If somebody gives you a choice, though, take the Pentium.)

The documentation for Windows for Workgroups 3.11 describes 32-bit file access (32BFA) with uncharacteristic understatement: "You can use 32-bit file access to write and read files from the hard disk more quickly." What is not mentioned is that 32BFA is on loan from the Windows 95 project.

## **WFWG 3.11**

Windows for Workgroups 3.11. A version of Windows for single users, regardless of whether or not they are connected to a network; it contains some technology improvements over Windows 3.1 that improve performance.

## **wait state**

A pause of one or more clock cycles during which a CPU (or bus) pauses to wait for data from slow external RAM. Wait states are normally not noticeable by humans because clock cycles are very short; but the necessity for a CPU to execute wait states when accessing RAM can slow overall system performance. A "zero wait-state" system is one in which the CPU requires no more than one clock cycle to access the RAM, while 1, 2 or more wait states indicates an inferior secondary cache design or that the memory installed is too slow for your CPU.

## tab

A rectangular block with writing on it that appears along the top or the side of a dialog box, similar to the tab atop a file folder or along the side of a loose-leaf binder. Click on a tab and the dialog box changes. This will be the standard dialog box and Windows help visual metaphor in Windows 95.

An example of tabs:



## **Expert Mode**

Wintune operates in two modes. Standard mode is the best operational mode for most users. If you are a professional computer tester, you may wish to try Expert mode (select it in the Edit/Preferences/General dialog). In Expert mode, the following behaviors change:

- 1) You can load a previously saved test as the current test
- 2) You can see all the tips in the Tip Advisor
- 3) You are not prompted to save unsaved results before exiting
- 4) Many warning messages are disabled



## **Before You Upgrade: Checklist**

Upgrading your Windows PC is easier than you might think. In most cases it's a simple matter of opening the PCs back, putting in a card, hooking it up and then making sure your computer knows it's there. It's easy if you do it right. Here's a short checklist before you begin, to make sure your upgrade is safe and successful:

- Make sure you have the right tools. You can do most upgrades with a screwdriver--both Philips head and flat--a chip inserted/extractor, a pair of needle-nose pliers and a pair of tweezers.
- Use a grounding strap. These are available at computer stores and through mail order. Without one, static electricity can destroy some kinds of integrated circuits.
- Unplug the computer before you begin.
- Know your system. Read the documentation and learn the interrupts and memory usage and locations of peripherals. This will assure that your new peripherals don't conflict with your old ones.
- After you open your system, take a moment to notice where everything is and which cables plug into what.





## **Improving CPU and FPU Performance**

**See Also**

[Adding Secondary Cache To Improve CPU Performance](#)

[Adding Memory To Improve CPU Performance](#)

[Improving CPU Performance with a Floating-Point Coprocessor](#)

[Improving Your Memory](#)

[Avoiding Expanded Memory: It Doesn't Help Performance](#)

[Checking The Turbo Switch](#)

## **Adding Secondary Cache To Improve CPU Performance**



Modern 486 and Pentium CPUs are faster than the motherboard memory in most systems, so a small amount of very fast memory acts as a cache--or buffer--between the fast CPU and the slow memory on the motherboard. On the 486 and Pentium, there is a primary cache internal to the CPU chip--8KB on the 486 and 16KB on the Pentium. This limited internal cache can be augmented by an external cache on the motherboard.

Windows applications tend to benefit from fast memory, so adding (or expanding) a secondary cache will often improve performance. Check your system's hardware documentation for information on what kind of cache memory it supports.

## Adding Memory To Improve CPU Performance



While the speed of a [CPU](#) depends on the clock rate, and is the same for machines with 1 MB or 16 MB of [RAM](#), the overall application performance on machines with different amounts of RAM will vary considerably. As we built these [benchmarks](#), we tested machines with a wide variety of processor speeds and memory amounts, and we found that memory, more than any other single factor, affects application performance. Therefore, before you consider any other step to speed up your CPU, you should check to see how much memory you have, and assure that your machine has enough to avoid [swapping](#).

[Getting More Information On Your Memory](#)

## Getting More Information On Your Memory



To get more information on your system's memory configuration

- click the Details... button on Wintune's CPU Test panel.

This will display a [text window](#) chock-full of information on CPU, memory, and math coprocessor information. The section labeled Memory Info: contains everything you need to know about your system memory. Look first at Total Pages--this is the total amount of memory available to Windows, expressed in multiples of the Page Size (usually 4KB). Free Pages is the amount of memory not currently in use (by Wintune, or by Windows itself, or by any other program you are running), and Swap File pages gives the amount of virtual memory made available by the swap file. If Free Pages is a small number (less than 1000 on a 4MB system, less than 4000 on larger systems), then you don't have enough [RAM](#) to run Windows effectively.

## Improving CPU Performance with a Floating-Point Coprocessor



If you have a 386 [CPU](#), you can improve your floating-point performance by installing a 387 floating-point coprocessor ([FPU](#)). This is an additional chip that off-loads numeric computation from the CPU, and performs complicated (and time-consuming) tasks like floating-point multiplication in hardware, rather than emulating it in multiple software steps. If you already have a 387, then the only way to improve performance is to [upgrade the motherboard](#).

If you have a 486SX, you can improve your floating-point performance by upgrading to a DX2 or DX4 CPU, which have built-in FPUs.

## Improving Your Memory



If you have less than 4MB of [RAM](#)--or run lots of Windows applications simultaneously and have less than 8MB--adding memory may be the easiest and most economical way to increase your PC's performance. Most PCs use SIMMs (single in-line memory modules) costing less than \$50 per megabyte of RAM (and if you shop around you may find SIMMs for about half that). Windows can use the extra RAM to run larger applications without [swapping](#) to disk, and the result is a much faster system.

[Making More Memory Available](#)

## Making More Memory Available



Check your CONFIG.SYS file for the presence of an EMM386.EXE statement. EMM386 is a DOS device driver that makes extended memory (above 1MB) available to older DOS applications using LIM EMS (Lotus-Intel-Microsoft Expanded Memory Specification). It may also be used to load device drivers into upper memory, which is useful for making more conventional memory available for running DOS applications--but its EMS emulation feature is never needed by Windows, which does its own EMS emulation (specified using the Program Information File (PIF) editor). If you have an EMM386.EXE line in CONFIG.SYS, try adding a NOEMS switch to disable EMS emulation--this will make more memory available to Windows. If you find that NOEMS interferes with the operation of your system, remove it.

In DOS 6.2 and later versions, EMM386 doesn't actually allocate any memory to EMS until it's needed (though the NOEMS switch will still save 64KB of upper memory). In DOS 5 and 6, EMM386 allocates a fixed amount of memory to EMS when it starts up. You can reduce that amount (it's specified by a number in kilobytes following the EMS386.EXE statement in the CONFIG.SYS file). For instance, if your CONFIG.SYS includes the statement:

- `DEVICE=C:\DOS\EMM386.EXE AUTO 1024`

You might try changing the 1024 to 512--making 512KB of EMS available to applications that need it.

## Avoiding Expanded Memory: It Doesn't Help Performance



Do not backfill the lower 640KB of [RAM](#) with [expanded memory](#) on a 386 or 486 computer running Windows--it will not help performance. Windows uses [extended memory](#) contiguously and directly with conventional memory. So backfilling with expanded memory, a feature of QEMM and various other third-party memory managers (which helps performance on some systems), can reduce speed on a 386/486 with Windows.



## Checking The Turbo Switch



Many PCs have a Turbo button, usually located on the front of the system unit. It is primarily used to ensure compatibility with older DOS programs or expansion boards that depended on machine timing to function. Typically, this switch slows the [CPU](#) down from a standard clock rate of 40MHz or 20MHz to 8MHz. If your CPU reading is very low, check to see if your Turbo button is pushed (don't depend on the light; it often burns out). If you're not sure which button changes your CPU clock speed, check your documentation.

If your Turbo switch is set to low, the performance numbers you see for your system can be reduced by 80 percent.



## Reducing Swapping

[See Also](#)

Windows is clever. It is not limited to the amount of memory available to your system in the form of [RAM](#) chips. If your RAM is full and you ask Windows to load yet another program, it will take part of some application that is not presently running and move it to your hard disk. If you access that part of the application again, it will be reloaded from the disk into memory. The process is called [swapping](#) and the file to which the memory is written is known as a swapfile. Since disk access is dozens of times slower than RAM access, frequent swapping can result in substantially slower system operation.

Memory and swapping are related in this way: if you have enough memory, swapping's never a problem. How effective is memory in improving performance? [Click Here](#) to see figures developed at **WINDOWS Magazine**. Increasing [RAM](#) from 4MB to 8MB will give **much** more benefit than, say, doubling [CPU](#) performance with an OverDrive chip.

If adding memory isn't an option, then consider attempting to [Improve your disk performance](#), since this will improve [swapping](#) performance at the same time

## Memory Versus Benchmark Speed



Memory	Benchmark Speed
8 MB	10s of seconds
4 MB	100s of seconds
2 MB	> 3600 seconds



### Upgrading the CPU

[First See: Upgrade Checklist](#)

#### 286 and 386

While there are a number of plug-in 486 upgrades for 286 and 386 systems, they're not very cost-effective, so we don't recommend them. You'll be a lot better off [upgrading to a 486 or Pentium motherboard](#), or just buying a whole new system.

#### 486DX and 486SX

You can get a big speed boost in these systems by upgrading them with one of Intel's clock-doubled [OverDrive chips](#) or a third-party equivalent.

For a 25MHz 486, check to see if there's a DIP switch or jumper on the motherboard to boost the CPU clock speed to 33MHz. If there is, use a 66MHz OverDrive instead. Otherwise, use a 50MHz model. (Note that the 50MHz OverDrive comes in two versions, a DX2 with an FPU and an SX2 version without. Avoid the latter.)

For a 33MHz 486, use a 66MHz OverDrive.

For the rare 50MHz 486DX, you're out of luck--to date there's no CPU upgrade for such systems. See: [Replacing the Processor Chip: Step by Step](#)

#### DX2, DX4 and Pentium

As we write this help file, there are no CPU upgrades for these systems. Intel's 100MHz DX4 won't work in a regular DX/DX2 socket, but it's possible Intel or third parties will make an inexpensive adapter. Intel has said it will release Pentium upgrade chips designed for the P24T socket on some 486 motherboards. How costeffective those chips will be remains to be seen. Intel says they'll be 70 percent faster than a 486/66, which would make them only about 13 percent faster than a 486/100. Look for third parties such as AMD, Cyrix and NexGen to produce upgrade chips, too. We'll review such upgrades as they become available, so stay tuned. In the meantime, if you need more speed, [upgrade the motherboard](#) or buy a new system.

#### A Note About Proprietary Upgrades

Some PCs have their CPU on a plug-in "mothercard" instead of directly on the motherboard, so you can upgrade the CPU by swapping in a new mothercard. This is appealingly easy, but due to the complexity of the design and the limited market, the cards are so expensive that you're usually better off replacing the whole system.

## Replacing The Processor Chip: Step by Step



- Use a grounding strap to safeguard yourself and your PC against static electric discharge.
- Open the computer case.
- In some cases, you may need to remove expansion boards, drives, or other components to get at the CPU socket. In rare cases you might have to dismantle the system entirely.
- Check to see if there will be room to install the new CPU and its fan or heat sink. You might have to shuffle expansion boards around to make it fit. If it flat-out won't fit, you could compensate with a fan card that plugs into an ISA slot, though running without the bundled heat sink will likely void the CPU's warranty.
- Remove the old processor with a pair of chip pullers. (This step is not necessary for a ZIF socket or a computer that's equipped with a second socket.)
- Firmly insert the new processor chip, and orient it like the old one.
- Reinstall any components you had to remove to access the CPU socket.
- Test your PC to see if it works with the new processor chip and manufacturer's diagnostic software.
- If all is well, put the cover back on the case and attach it securely.
- Test the computer once more to be sure you didn't knock anything loose while attaching the cover.
- Install any software required by the processor manufacturer that will activate the advanced features of the new processor chip. (This is not required for all chips.)
- Unground yourself and your computer, go back to work, and enjoy your new processor.

## Buying A New Processor



- Do you use applications, such as spreadsheets, data analysis software and CAD applications, that require a math coprocessor or run substantially faster with one? If so, you must have a 486DX2, DX4 or Pentium processor. If not, a 486SX2 will do.
- What's the fastest chip, in terms of clock speed, that you can afford? In general, it's advisable to get the quickest one your budget will allow. Note that the fastest chip on the market often carries a premium price that makes it less cost-effective than the runner-up.



## **Upgrading the Motherboard**

[First See: Upgrade Checklist](#)

[Motherboard](#) repairs have become prohibitively expensive for some computers. Replacing the motherboard can be cheaper than fixing it. And when you need special capabilities, such as EISA slots or local bus, it may be cheaper to change the motherboard to get that feature, rather than buying a whole new system.

As we were preparing this help file, motherboards with 486/66, DX4/100 and Pentium/90 [CPUs](#) offered good values at three different levels price and performance.

[Ensuring ROM BIOS Compatibility](#)

[Replacing Motherboards: Not For Novices](#)

## Replacing Motherboards: Not For Novices



Replacing a motherboard can be tricky. Most motherboards sold these days are "baby AT" size, which means they are smaller than the original IBM AT form factor inside the case. If you intend to use your old case, and your computer used the older large-sized motherboard, you may have to drill holes in the case. This seems to be a more common problem with name-brand computers that used in-house motherboard designs rather than generic components.

You'll have to attach and detach the power supply, remove and replace the drives and cards, and generally handle the motherboard a lot. In some cases, you may have to force the pieces a bit to get them in or out, so there's a chance you could bend or break a component. So be forewarned: Motherboard replacement is not for novices. Even experienced users often leave this one to the pros, since on top of all the things that can go wrong, your average motherboard's documentation doesn't tell you everything you need to know to install it.



## Insuring ROM BIOS Compatibility



Along with the [CPU](#) chip, the read-only memory basic input/output system ([ROM BIOS](#)) is the governing logic and "brains" of the computer. The ROM BIOS is the built-in hardware that lets the computer understand its relationship with the outside world. So making sure the ROM BIOS works is essential to the design.

Companies such as AMI, Phoenix and Award have become name brands in ROM BIOS construction. Many name brand computer manufacturers use these BIOS chips, and some use more than one of these BIOS brands. But new contenders have jumped into the fray. Getting a guarantee from your vendor that your peripherals and software will work with the new motherboard is the best you can do. Variations among brands are not as bad as they once were. But the complication of some of today's Windows systems is greater than anything seen on the desktop before. Tuning a complete system is more complex than ever thanks to sound cards, cable TV converters, CD-ROM players paying music as well as data and a host of other options. With local bus computers and SCSI cards, some of these machines have three expansion buses working at the same time in the same box.

Getting a name-brand ROM BIOS gives a little comfort, but making sure you have a reputable motherboard vendor who backs up the hardware in writing can be important. The computers (and motherboards) are better than ever, but at the same time, they are being asked to work with more different hardware and software components than ever before. Get the best and most support representations and references you can when replacing motherboards.



## Upgrading/Installing RAM

[First See: Upgrade Checklist](#)

Windows needs its space; cramp its style, and it won't behave the way you want it to. Skimping on [RAM](#) is a surefire catalyst for a Windows rebellion. With less than 6MB of RAM, Windows is probably feeling stifled. Luckily, nothing gives your system the breathing room it needs to stretch toward its full potential as cheaply and easily as adding more RAM.

Windows breaks the 640KB barrier that handicaps DOS applications, allowing access to multiple megabytes of memory at a time. Adding memory increases your system's "headroom" and the more room your system has for [swapping](#) files, the less Windows will bog it down moving items to and from virtual memory on your hard disk. In fact, giving Windows more space to move around won't just speed your system up, it will make it more stable as well. Most users report a big decrease in system crashes when they give Windows the room it needs by adding RAM.

[Determining How Much Memory You Have](#)

[Calculating How Much Memory You Need](#)

[Determining What Kind Of Memory Your System Uses](#)

[Checking SIMM Speed](#)

[Installing New RAM](#)

## Determining How Much Memory You Have



Before you release your system from the confines of meager memory, you'll need to determine how much memory you have to begin with. Finding out how many megabytes of [RAM](#) lurk inside your system is easy. Just power up or reboot your system and keep an eye out for the memory test the [BIOS](#) performs at the onset. You'll see numbers roll up until they reach the total amount of RAM in your system. Watch for lines that look like "640K base memory, 3072K extended OK," then add the two together to come up with the total memory in your system. (If the number's 384KB short of what you expect, that's because the memory test is skipping upper memory.) Divide the result by 1024 to convert kilobytes to megabytes.

You can also use DOS's MEM command if you are running DOS 5.0 or a later version. In DOS 6.2, look for the "Total memory" line and check the entry in the "total" column.

## Calculating How Much Memory You Need



Next, you'll need to calculate how much more memory is required to make the most of your system's potential. One rule of thumb for determining your minimum RAM requirement is:

- Start with 4 MB (6 MB if you are running [WFWG 3.11](#)).
- Add 1 MB for every application you plan to run concurrently.

If you plan to run both Microsoft Word and Lotus 1-2-3 at the same time, you'll want to add 2 MB to the initial four, for a total of 6 MB. Keep in mind that these are minimums for an acceptable system. **WINDOWS Magazine** considers the minimum memory configuration for a Windows-ready PC to be 8 MB.

The more memory you have, the better, especially with RAM now available for less than \$50 per megabyte (depending on the kind of SIMMs you need, the price may be closer to \$25). Memory above and beyond what your system requires can be used for disk caching or for a RAM disk, and some devices and applications will perform better if they have more memory to move around in. LaserMaster's WinPrinter, for example, will print faster. The law of diminishing returns applies, however. Anything over 16MB is probably overkill, unless you are planning to use your system to work with large desktop publishing or illustration programs, or if you're planning to run Windows NT.

## Determining What Kind Of Memory Your System Uses



Memory devices vary from system to system, but most 386- and 486-based systems use SIMMs (single in-line memory modules) installed on the [motherboard](#) or on a specially designed memory card.

There are two main types of SIMMs on the market. The older 30-pin 8-bit (x9) SIMMs are commonly found in 256KB, 1MB, 4MB and 16MB capacities, and have to be installed in banks of four matching SIMMs (except in 386SX systems, where they're installed in pairs). In a system with a single bank of four 30-pin SIMM sockets, you have to pull all the old SIMMs to upgrade, so to upgrade from 4MB you'd replace four 1MB SIMMs with four 4MB SIMMs, for a total of 16MB. In a system with eight sockets, you can upgrade one bank at a time, so to upgrade from 4MB you could add four more 1MB SIMMs for a total of 8MB. Alternatively, you could upgrade from 4MB to 20MB by adding four 4MB SIMMs, unless your motherboard requires that both banks use the same capacity (an unfortunately common restriction). Check your system manual or call your vendor to find out what configurations your system can handle.

Newer systems tend to use 72-pin 32-bit (x36) [SIMMs](#), which come in 256KB, 1MB, 2MB, 4MB, 8MB, 16MB and 32MB capacities. Many motherboards give you complete flexibility with 72-pin SIMMs, allowing you to upgrade as needed by plugging any capacity SIMM into the next vacant socket. For example, you might upgrade from 4MB to 8MB by adding a second 4MB SIMM, then later upgrade to 16MB by adding an 8MB SIMM. Not all systems are so flexible: Some support only a subset of available capacities, others require SIMMs to be installed in matching pairs. Check your system manual or call your vendor to find out what configurations your system can handle.

Many vendors will fill all of their available SIMM sockets with cheaper low-capacity SIMMs. When it's time to add more, you have to throw out at least some of what you already own to make room for the larger SIMMs. That becomes more costly in the long run, so keep this in mind when shopping for a system. Whenever possible, choose a configuration that leaves some slots open, so you'll have room for growth later on.

## Checking SIMM Speed



Another factor to fit into the equation is speed. All [SIMMs](#) are not created equal. If the [RAM](#) you choose is not fast enough to keep up with the timings on your [motherboard](#), you'll have to slow your whole system to a speed your new SIMMs can handle. Most systems today use at least 80-nanosecond (ns) RAM, which many demand faster 70 or 60ns chips. You can usually mix and match SIMMs of different speeds as long as none is slower than the minimum specified for your system, which can be useful if you want to upgrade your memory today and transplant the SIMMs into a faster system later.

## Installing New RAM



Before you start, please click on the First See Upgrade Checklist jump in the main Upgrading/Installing RAM help window.

When you're ready to snap your new chips into place, remember that memory parts are very static-sensitive. Once you have your system's case off, be sure to ground yourself before touching any memory device. Use a grounding strap if possible, or at least touch a metal part of the chassis before going further. One good spark can fry your new memory, so it's worth the precaution.

After you have the [SIMMs](#) snapped firmly in place, you may need to tell your computer what you've done so it can take advantage of its newfound breathing room. Some machines will require a change in [DIP switches](#) or jumpers on the [motherboard](#). Others need changes in their CMOS setup. Your computer may require both, only one, or neither. Whatever the case, follow the instructions in your system manual carefully, and check with the technical support department of either your system vendor or your memory vendor if you run into any problems.

That completed, boot up your system and check that the numbers in the memory self-test reflect the new amount. You'll notice a new spring in Windows' step, and, as you switch from application to application, Windows won't stop as often to catch its breath. Giving Windows the space it needs by adding more [RAM](#) will make both you and your system breathe a lot easier.



## **Installing /Upgrading an FPU**

[First See: Upgrade Checklist](#)

If you have a 486SX system, you get an FPU when you [upgrade your CPU](#) with a DX2 OverDrive. For a 386 system, you can purchase an [FPU](#) upgrade either through mail order or from a retail outlet. While it won't boost performance to contemporary standards, an IIT or Cyrix 387 chip is worth the \$40 or so it'll set you back if you have to run an app that requires an FPU but can't afford to upgrade to a 486.

First, turn off and unplug your computer. Wait for five minutes, as some power supplies can store energy for that long after being turned off. Although the FPU chip is square, there is only one right way to insert the chip. Put it in the wrong way, and you can damage it immediately. Open up your system and look for the empty FPU socket. There will be a notch or dot in one corner of the socket. You should match this mark up with the notch or dot on the FPU chip.

Place the FPU chip so that the pins on the chip line up with the contacts on the socket. Then press the chip firmly into place. Visually check that none of the pins became bent as you inserted the chip.

As you turn the power on, be prepared to turn it off quickly. If the system fails to boot, the most common problems are that the chip was inserted incorrectly or that pins were bent when the chip was put into the socket. Remove the FPU, check for bent pins and proper alignment, and reinsert it.



## About OverDrive Chips



Intel sells two basic versions. The one meant for recent OverDrive sockets contains an extra pin that prevents it from being used in a main 486 socket. Other than this, the chips are the same and both function exactly like DX2s. If you have an OverDrive chip meant to replace a DX chip that goes into the main socket, it will also work in the OverDrive socket. Actually, the OverDrive chip that goes in a regular 486 socket is just a plain old 486/66 packaged with installation instructions, a heat sink and a warranty, so if you find the same bundle cheaper from a reliable third party, all you'll be missing is the OverDrive label.

When an OverDrive chip goes into an OverDrive socket, it essentially disables the original main processor chip and takes over. These chips work at twice the internal processing speed of the chips they replace, but external communications take place at the speed of the original chip. For example, when you replace a 486/25 with an OverDrive, the new chip's internal clock rate is 50MHz, while its external clock rate (and the speed with which it communicates with the bus) is 25MHz.



## **Improving Disk Performance**

**See Also**

While we can offer you a number of tips and tricks for disk performance improvement, perhaps the most effective is one of the simplest: defragment your disk. This means running a utility program which re-arranges the files on your disk so they can be more efficiently accessed.

[Are 32-Bit File and Disk Access Worth It?](#)

[Enabling 32-Bit Disk Access](#)

[Enabling 32-Bit File Access](#)

[Solving 32-Bit Problems](#)

[Setting Direct Memory Access Buffer Size](#)

[Buying Windows-Savvy Disk Controllers](#)

## Solving 32-Bit Problems



Sometimes, Windows will find your computer capable of 32-Bit Disk Access and 32-bit File Access when it isn't really capable of using these methods. This can prevent Windows from starting after installation. You can get Windows going by editing the [386enh] section of SYSTEM.INI. First, make a copy of SYSTEM.INI under another name. Then, launch a text editor. In recent versions of DOS there is a reasonably simple text editor called EDIT, usually found in the DOS directory. Older versions offer the difficult-to-use EDLIN program. Look for a line

```
32BitDiskAccess=ON
```

Put a semi-colon (;) in front of the line. This "comments it out," preventing SYSTEM.INI from executing that line. Then find the line

```
Device=*WDCTRL
```

This is the line that activates 32-Bit File Access. Comment it out by placing a semicolon at the beginning of the line. If you can't find either of these lines in SYSTEM.INI, disk access is not your problem. Don't add the lines if they're not in the file already.

[Troubleshooting 32-Bit Operations](#)

## Enabling 32-Bit File Access



If you are running Windows for Workgroups 3.11, turn on 32-bit File Access for the best performance payoff. Be sure to set the Cache Size in [Control Panel](#). As with SMARTDrive, a good rule of thumb is to use one-quarter of your total memory for cache. Most systems can use 32-bit File Access, although you won't be able to turn it on if you use a TSR or utility that keeps files open. Print spoolers sometimes do this.

Check the Use 32-bit File Access check box from the Change>> pushbutton in the Virtual Memory dialog of the 386 Enhanced section in the [Control Panel](#). If your system does not support 32-Bit File Access the check box will not appear. The default value is Off (unchecked).

If you use 32-bit File Access, you should reduce the cache size for SMARTDrive, or remove it altogether. Normally, Windows will automatically do this when you enable 32-Bit File Access, but it won't if you start SMARTDrive from a file other than AUTOEXEC.BAT. When 32-bit File Access is enabled, SMARTDrive is only used to cache floppy disk and CD-ROM drives.

[What is 32-Bit File Access?](#)   [Comparing SmartDRV to 32-Bit File Access](#)

[Enabling 32-Bit File Access \(details\)](#)   [Troubleshooting 32-Bit File Access](#)

## Enabling 32-Bit Disk Access



Both standard Windows 3.1 (or the latest 3.11) and Windows for Workgroups 3.11 support 32-bit disk access, which bypasses 16-bit BIOS disk code. Turning 32-bit access on will substantially improve performance on systems that support it. Windows has built-in 32-bit disk access support for systems that have a disk controller compatible with a WD1003 controller chip. If you have another type of controller, such as a SCSI adapter, you must get a separate driver from the vendor to use 32-bit disk access.

Check the Use 32-bit Disk Access check box from the Change>> pushbutton in the Virtual Memory dialog of the 386 Enhanced section in the [Control Panel](#). If your system does not support 32-Bit Disk Access the check box will not appear. The default value is Off (unchecked).

[What is 32-Bit Disk Access?](#) [How 32-Bit Disk Access Works](#)

[Enabling 32-Bit Disk Access \(details\)](#)

[Troubleshooting 32-Bit Disk Access](#)

## Setting Direct Memory Access Buffer Size



If you don't use SMARTDrive with double buffering, you may need to set the DMA buffer size for your machines. To specify the buffer size, edit the HardDiskDMABuffer= line in the [386enh] section of the SYSTEM.INI file. The default is 0 for AT architecture computers and 64 for Micro Channel computers and computers using DMA channel 3. If you're using SMARTDrive and double buffering is turned on, Windows determines the amount automatically.

## Buying Windows-Savvy Disk Controllers



Make sure your new hardware purchases support 32-bit disk access, also called FastDisk. The standard Windows package includes support for most disk controllers that are compatible with the Western Digital WD1003 chip, commonly used for IDE adapters. Some manufacturers of SCSI drives, such as Future Domain, also offer 32-bit drivers.



## Adjusting Smartdrv Settings

SMARTDRV.EXE is a disk-[caching](#) utility that is installed in the AUTOEXEC.BAT file. Begin by entering the simplest form of the line:

```
C:\WINDOWS\SMARTDRV.EXE
```

If Windows is not on your C: drive, or your Windows directory is not named Windows, you may have to modify this line to make it work). [Click Here](#) if you are not sure how to edit your AUTOEXEC.BAT file.

[Click here](#) to see how the smartdrv command line is structured and what its parameters are.

Smartdrv 4.0 replaced Smartdrv 3.x with the release of Windows 3.1. SMARTDrive 4.0 is also a write-behind cache. This adds significant performance improvement where files are being written and implements a "valid" bits scheme to avoid thrashing the disk in case of random access I/O. Smartdrv 4.1 appeared with the introduction of DOS 6.0.

The cache component of SMARTDRV.EXE is installed in AUTOEXEC.BAT and the double buffer driver is installed in CONFIG.SYS. SMARTDrive provides a memory buffer with physical and virtual addresses that are the same. To determine whether you need double buffering

- Type SMARTDRV at the C> or command prompt
- If the buffering column has all No's in it, the double buffer is not needed.

[Configuring Smartdrv](#)

[Replacing Smartdrv If Manufacturer Requires](#)

[Displaying Smartdrv Driver Parameters](#)

[Setting Smartdrv Parameters](#)



## Replacing Smartdrv If Manufacturer Requires



Use a third-party disk caching program in place of Windows 3.1's SMARTDrive 4.0 only if the hard disk or system manufacturer recommends it. Older documentation might say to replace SMARTDrive with the manufacturer's or vendor's provided cache program. SMARTDrive 4.0 is substantially more advanced than earlier versions, so be sure that the documentation making the recommendation is oriented to working with Windows 3.1. When replacing SMARTDrive with any other disk cacher, install carefully, and thoroughly test the system without putting production data at risk. Make a reliable backup before trying this. Some disk caching programs will not work correctly with Windows.

## Displaying Smartdrv Driver Parameters



To display the basic controlling parameters available for use in SMARTDRV.EXE, type SMARTDRV /? at a DOS prompt

## Setting Smartdrv Parameters



**smartdrv** [[/E:elementsize] [/B:bufferize] [drive ][-]] [size] [winsize]]

<b>drive letter</b>	Specifies the letter of the hard disk to cache.  (drive letter alone specifies read caching only)
<b>+</b>	Enables write-behind caching for the specified drive.
<b>-</b>	Disables all caching for the specified drive.
<b>size</b>	Specifies the amount of XMS memory (KB) used by the cache.
<b>winsize</b>	Specifies the amount of XMS memory (KB) used in Windows.
<b>/X</b>	Disables write-behind caching for all drives.
<b>/E</b>	element size Specifies the size of the cache elements (in bytes).
<b>/B</b>	buffer size Specifies the size of the read buffer.
<b>/C</b>	Writes all write-behind information to the hard disk.
<b>/R</b>	Clears the contents of existing cache and restarts SMARTdrive.
<b>/L</b>	Loads SMARTdrive into low memory.
<b>/Q</b>	Prevents the display of SMARTdrive

information on your screen.

**/S** Displays additional information about the status of SMARTdrive.

## Configuring Smartdrv



Smartdrv can be configured in several ways;

- To force all data to be written to the disk, type smartdrv /c at the command prompt and press ENTER.
- To enable write-behind caching for a specific drive, use the [drive]+ switch in AUTOEXEC.BAT.
- To disable **all** caching for a specific drive, use the [drive]- switch in AUTOEXEC.BAT.



## Adjusting File Structure/Defragmentation See Also

Frequently erase unnecessary files and directories, remove lost clusters and [defragment](#) the hard disk to improve disk performance. The disk performance of Windows 3.1 is dramatically better than that of 3.0. Nevertheless, disk maintenance will increase speed. Delete files you know you don't need and those with .BAK or .TMP extensions. Do **not** delete .TMP files while Windows is running.

Type scandisk (or chkdsk /f) from the DOS prompt to remove lost clusters. Unless you are looking for lost data, you can answer no when the utility asks if you want to save anything to a file. After deleting unneeded files and directories with File Manager (with the exception of .TMP files, which you must eradicate from DOS), and eliminating lost clusters, run a disk defragmentation program with Windows not running. Click on "Streamlining Your Hard Disk" for more info.

[Streamlining Your Hard Disk](#)

[Keeping Windows Near The FAT](#)

[Providing "Breathing Room" for Windows.](#)

[Defragment Your Disk Before Creating Swap Files](#)

[Swapfile Creation/Enlargement](#)

[Checking Sector Size Before Creating Swap Files](#)

[Avoiding Virtual Memory on a RAM Disk](#)

## Streamlining Your Hard Disk



Most [defragmentation](#) software vendors recommend removing disk [caching](#) programs such as FASTOPEN.EXE and SMARTDRV.EXE before defragmenting. Hold down F5 while booting to skip CONFIG.SYS and AUTOEXEC.BAT, or use a plain DOS boot disk with no CONFIG.SYS or AUTOEXEC.BAT.

Every few months, run a defragmenting utility to optimize the placement of data on your hard disk. All versions of MS-DOS newer than 6.0 include such a utility, called Defrag. Start it by typing DEFRAG at C:\ or the command prompt in DOS. Norton Utilities and PC Tools include even better defraggers. These utilities rearrange files on the hard disk so that data can be accessed with the least amount of disk activity. For safety, be sure to back up your disk before you run the defragmenting utility.

## Keeping Windows Near The FAT



Some commercial disk optimization/[defragmentation](#) utilities allow particular files, directories or types of files to move to certain areas of the hard disk. To improve overall performance, use those options to move Windows files close to the file allocation table (FAT) on the hard disk when optimizing the drive. Try to keep all files involved in booting and Windows start-up close to the FAT, even if they are not in the WINDOWS subdirectory.

## Providing "Breathing Room" for Windows



Be sure to give Windows adequate resources. Many users try to maximize their DOS memory to the last byte and in the process make their system unstable under Windows. To ensure proper operation, you should provide adequate system resources (for example, plenty of file handles, DOS buffers, stacks, DOS environment space, XMS memory and so on). The following are the minimum DOS 6 requirements for making upper memory available and letting Windows 3.1 run well. (If you edit the TEMP= variable, make sure to create the C:\TEMP directory, if there's not one already.) Due to device drivers and other necessary additions (MSCDEX.EXE for CD-ROMs, MOUSE.COM for using a mouse in DOS apps, etc.), you'll surely need a more complex setup.

[CONFIG.SYS](#)

[AUTOEXEC.BAT](#)



## **CONFIG.SYS**



DEVICE=C:\DOS\HIMEM.SYS

DEVICE=C:\DOS\EMM386.EXE NOEMS

DOS=HIGH,UMB

DEVICEHIGH=C:\DOS\SETVER.EXE

BUFFERS=4

FILES=50

STACKS=9,256

SHELL=C:\COMMAND.COM C:\DOS /E:1024 /P

## **AUTOEXEC.BAT**



@ECHO OFF

VERIFY OFF

C:\DOS\SMARTDRV.EXE

SET TEMP=C:\TEMP

PATH=C:\WINDOWS;C:\DOS

## Defragment Your Disk Before Creating Swap Files



Run DOS's DEFRAG or another disk [defragmentation](#) program on a drive with a lot of previous file activity before creating a large permanent [swap file](#) for Windows 386 Enhanced-mode virtual memory. The swap file must be on contiguous blocks.

## Creating a Swap File to Speed Windows



Customize Windows to use memory more efficiently by choosing to create a [swap file](#) in the Add/Remove Files dialog box during Custom Setup. A dialog box asks if you would like to create a swap file. A swap file increases memory by allowing you to specify a pre-determined amount of virtual memory to be used for [swapping](#) different segments of programs or data between memory and disk storage. If you create a swap file that allows your hard disk to appear to Windows as virtual memory you can multi-task between applications with greater speed.

## Swap File Creation/Enlargement



For best performance, set up a permanent swap file. If you already have one, you may want to increase its size.

- In [Control Panel](#), double-click on the Enhanced icon
- Click on the Virtual Memory button
- Click on the Change button
- In this dialog, in the New Settings section, you can change the swap file type to Permanent, and select a file size. Don't [create a swap file on a compressed disk](#).
- Click on the Help button for more information.

The best size for the swap file depends on the types of applications you use, but the recommended size is often too large. For systems with 8MB or less RAM, an 8MB swap file is usually enough. If you have more than 8MB, a 4MB swap file is generally sufficient. If you later get Out of Memory messages you can increase these values.

Your permanent [swap file](#) setting must not be larger than the largest contiguous free segment on the specified hard disk. Virtual memory swaps programs to the hard disk when [RAM](#) is full, allowing more programs to load simultaneously than otherwise possible.

### [Creating Swapfiles On Networks](#)

## Creating Swap Files On Compressed Disks



If you're running a disk compression utility like Stacker or DoubleSpace, you can't put a permanent swap file on the compressed drive. You must set aside enough space on the uncompressed drive to hold the swap file. Also, if you have Windows for Workgroups and plan to use Stacker or DoubleSpace with 32-bit file access, make sure you **don't** have the line `NoEMMDriver=ON` in the `[386Enh]` section of your `SYSTEM.INI` file. If you do, Windows will hang at the logo screen.

## Creating Swap Files on Networks



You can't create a permanent swap file on a network drive. Don't put a temporary swap file there either. Swapping to a network drive is very slow compared with a local hard disk. Since a temporary swap file is created when Windows starts, putting the file on a network can greatly increase the time it takes to start Windows. If you don't have a local hard disk, add the line `Paging=0` in the `[386Enh]` section of `SYSTEM.INI` to disable swapping.

## Checking Sector Size Before Creating Swap Files



Create a permanent [swap file](#) for Windows 386 enhanced mode virtual memory only on hard disks that use 512-byte sectors. Third-party device drivers that partition hard disks often change this standard sector size. To determine the hard disk's sector size, run the Windows-installed diagnostics program MSD in DOS with Windows deactivated.



## Avoiding Virtual Memory on a RAM Disk



To see if you have a [RAM](#) disk, check your CONFIG.SYS file for a RAMDRIVE.SYS statement. RAMDRIVE.SYS is a DOS device driver that creates a simulated disk drive in memory. It's never **required** on a Windows system and will improve performance **only** if

- You have more memory than you can use otherwise (for example, 24MB total),
- You run programs that use a lot of temporary files.

In that case, setting the TEMP environment variable to use a RAM drive **might** speed things up, though in most cases you'll get more of a boost by giving that memory to your disk cache instead. Also, setting TEMP to a RAM drive can cause trouble, since Windows often creates large temporary files that will overflow the RAM disk--in which case your system will probably hang.

In any other case, you are better off **without** the RAMDRIVE.SYS statement, since memory used by RAMdrive is not available to Windows.



## Adjusting Cache Settings

Add the line

```
pagebuffers=n
```

to the [386enh] section of SYSTEM.INI. N can be any number from 0 to 32. The default is 4, and that's not much; each buffer is a 4KB area for caching information being written to the swapfile, assuming 32-bit access is turned on. By default, you have 16KB being used to buffer access to the swapfile.

Too many buffers can actually slow your system, so experiment with the number. The improvement is slight but noticeable, especially if you are running on the ragged edge. It might be worth giving up a small amount of [RAM](#) to better buffer (and thus reduce) swapfile access.



## Selecting/Installing A New Disk

[First See: Upgrade Checklist](#)

Before You Start

Before you buy a bigger disk consider the following factors:

### Capacity

Space will quickly disappear as you load new Windows applications, clip art, sound files and all the great utilities you decide you can't live without. It's best to shoot for a total of 500MB or more, depending on the kind of work you do.

### Performance

A simple disk upgrade will get you more storage, and if your current drive is a year or two old, the new one will be significantly faster, too. However, for maximum speed, you may want to consider a high-performance controller as well--though it's usually smarter to invest in more RAM, which you can allocate to your disk cache or other purposes, as needed.

### Ease of installation

Some upgrades, like hard disk cards, are a simple plug-and-play solution. Other approaches, such as adding a second IDE hard disk, can be tricky. Even if the hardware installs easily, it may take some work to reconfigure the application software you move to the new disk.

### System expansion space

In some small-footprint desktop systems, there just isn't any space for a second hard disk or a full-length hard disk card. If you're short on internal space or power, you may want to consider an external disk, mounted in an enclosure outside the PC.

[Performing/Preparing For Backups](#)

[Using CD-ROM to save disk](#)

[Surveying Your Present Situation](#)

[Choosing What Kind Of Upgrade](#)

[Installing A Drive](#)

[Assigning Drive Letters](#)

## Read Me First



Before you start upgrading your system, back up your hard disk completely. If you're replacing your existing disk, you'll need to do this anyway. Don't count on selectively saving just your data files and then reinstalling from your application disks. Many applications keep their own configuration files that you'll lose if you try this. It could take you days to reconfigure them all and get everything back to normal.

Be sure you click on "First See: Upgrade Checklist" on the main screen(Selecting/Installing a New Disk) and read it before you start. As you remove cables, use a piece of tape to label where each was connected and how it was oriented. Flat ribbon cables usually have a red-colored edge; make sure you put the cable back on with the edge on the same side. If you're really concerned you'll make a mistake, take a few photographs to document where everything was before you started.

## Performing/Preparing For Backups



If you currently have a small hard disk, perhaps you're still backing up your files with diskettes. Or maybe you're not backing up your files at all. If you don't back up files frequently, upgrading your hard disk will just increase the amount of data at risk and make any future disk disaster much worse.

It's impractical to back up today's huge hard disks to diskettes, so buy a tape drive. For around \$200 you can get a drive that hooks to your floppy disk drive controller and backs up 250MB or more data onto a \$15-20 DC-2000 tape. Starting around \$700 you can get a drive that hooks to your SCSI adapter and backs up 2GB or more data to a \$10 to \$20 DAT tape.

## Using CD-ROM to save disk



Here's another way save some disk space: buy a CD-ROM drive. Instead of copying lots of rarely-used fonts, clip art, images, or other reference material to your hard disk, you can get it directly from the CD-ROM. A CD-ROM drive typically uses a [SCSI](#) controller, and you can use the same controller for a hard disk and the CD-ROM. If you already have a sound board, check its documentation; you may find it already has a CD-ROM interface. Beware, though: some CD-ROM interfaces on sound boards work only with specific CD-ROMs sold by that vendor.

Although SCSI controllers can usually handle multiple hard disks with no problem, adding other devices like tape or CD-ROM drives is sometimes tricky. Invariably, the problem lies with software drivers. Before you decide on a SCSI adapter, make sure there are drivers available for all the types of storage you plan to use.

## Surveying Your Present Situation



The first thing you should do before considering upgrade options is to find out what you already have and whether there's room for all the peripherals you want to add. Your system manuals may have information about the type of hard disk and controller you have in your system. If not, you may be able to contact the system vendor for further information.

A hard disk communicates with the system through a disk interface adapter. Depending on when you bought your system, these two components might use either an [MFM, RLL, ESDI, SCSI or IDE interface](#). If you bought your system in the past three years or so and it has a disk of less than 200MB, it's most likely using an IDE interface.

IDE and SCSI disks are plentiful and you can buy them from many sources. If you have an older ESDI, MFM or RLL controller, you should consider a change to IDE or SCSI. An IDE adapter will run you less than \$50, so replacing the controller doesn't have to be an expensive proposition.

SCSI interfaces are also common and growing in popularity, especially for larger disk capacities. This type of interface offers a real advantage: You can add up to six peripherals to one SCSI adapter, including removable cartridge drives like the Iomega Bernoulli, CD-ROM drives, tape drives or Floptical drives.

If you plan to install a second disk in addition to your existing one, you'll need an expansion bay inside the system. Most standard-size desktop and tower systems will have plenty of internal bays for mounting. If you don't have any expansion space but have both 5.25-inch and 3.5-inch floppy disk drives, you can now buy one floppy disk drive that handles both sizes and put the new hard disk in the bay you reclaim. The combination floppy disk drives cost about \$125 and fit in a single half-height drive bay. Alternatively, you can use an external hard disk.

A second internal disk will also require a spare power connector to plug into the new drive. If all the power connectors are already in use, you can buy a Y-connector to split power from an existing connector. However, the lack of spare connectors may also indicate that your power supply is near its limit, so beware. Most drives being sold today use less than 10 watts of power, which isn't much since a typical power supply delivers 200 watts or more. But if you've already got a system with lots of peripherals and boards in every slot, another disk could be the straw that breaks the camel's back.

## Choosing What Kind Of Upgrade



Now that you know what you've got in your system already, you can make an informed choice about which upgrade path makes the most sense. To paraphrase Paul Simon, there must be 50 ways to upgrade your hard disk. The most common alternatives are listed below, along with their good and bad points.

### Install a hard disk card

These disks fit into an expansion slot in your PC. Hardware setup is a breeze. You don't need to disturb or reconfigure your existing disk and controller at all, although you can set up most disk cards as the boot disk if you want to replace your existing disk completely. Software setup is easy too; the most any of them need is to have a driver added to the CONFIG.SYS file. However, many hard disk cards need a full-length slot and sometimes require an adjacent empty slot to accommodate the height of the hard disk. If your PC can accommodate a hard disk card, it's a painless choice--except for the relatively high price.

### Add a second disk to your existing adapter

For this option, you'll need a bay to mount the new drive, an available connector from the power supply and a bit of luck. Although most [IDE adapters](#) can handle two disks and most systems come with a cable ready for the second drive, not all IDE drives will work together. Even buying a second drive of the identical model from the same manufacturer can have problems, if the vendor has updated the drive's ROM in the meantime. Your safest bet is to contact the vendor of your existing disk to see if there are specific compatibility problems with a drive you're considering. [SCSI systems](#) generally don't have these problems, at least among SCSI-2 drives, so you can mix brands at will, provided you can get the necessary drivers for your SCSI adapter. Replace your existing disk

If you've got a recent IDE or SCSI adapter, this option shouldn't be a problem. You can install the new disk in the same bay that the old drive used. You may, however, be left with no good use for your old disk.

### Add a new disk and controller

If you buy both a disk and controller at the same time, you can be a lot more certain about compatibility. You can also upgrade to a high-performance controller. However, you'll need both an empty expansion slot and a drive bay for the new hardware if you don't plan to remove the existing disk and controller.

### Add an external disk

Although it will put yet another box on your desktop, an external disk doesn't require open drive bays or power connections in your PC. You can use either a standard disk controller in an expansion slot (SCSI is the most common here) or even a parallel-port interface. You'll pay a bit more since you need to buy the external box and cables. This solution is particularly useful if you want to move the drive between multiple systems or also use it on a portable PC.



## Installing A Drive



Once you've chosen the most logical way to upgrade your disk, it should be easy to install the hardware. Before upgrading, back up your old drive. If you don't have one already, make a DOS boot disk and copy FDISK.EXE, FORMAT.COM and SYS.COM to it. Make sure that you have a copy of your backup program's DOS restore utility on diskette, too.

### If you install a new SCSI adapter

You may have some tricky configuration tasks ahead. SCSI adapters can use I/O ports, interrupts, DMA channels and blocks of upper memory (the memory addresses between 640KB and 1MB). Unless the drive has a superior installation utility, you will need a good idea of the rest of your system configuration to get things up and running, so make sure you know what else is in all the slots. Also, you may need to remove or reconfigure memory management software such as NetRoom, 386Max or QEMM, which use the upper memory areas. The adapter and each of the SCSI drives attached to it must have a unique SCSI ID number between 0 and 7.

### IDE Settings

There's normally nothing to set on an IDE adapter, but you will have to set jumpers or DIP switches on the drive to indicate whether it's the only drive in the system or the "master" or "slave" in a two-drive rig. (Make the drive you want to boot from the master.) Next, unless the new drive has some kind of trick install utility, you'll need to change your system's configuration to recognize the new (or changed) drive. On some systems, you modify the setup by pressing a special key sequence (for example Ctrl+Alt+Esc) while the system is booting. On others, you boot from a diskette that contains the configuration program. You'll need to enter the drive parameters (heads, sectors, cylinders) in one of the user-configurable drive type entries.

### Install DOS on the new drive

If you have a full version of DOS 5 or later that shipped with your system (as opposed to an upgrade version purchased later), just boot from Setup Disk 1 and follow the menus. Otherwise, boot from the diskette you created earlier and run FDISK to create a primary DOS partition using 100 percent of the space on the new drive. (These days, most drives are low-level formatted at the factory. If FDISK doesn't see the new drive, perhaps yours wasn't--check the manual for instructions.) If you want to boot from the new drive, use FDISK to set the new partition active. Then use the FORMAT /S command to format the new drive.

### Add Files

Once the disk is formatted, you're ready to add files. If your new disk is the only disk, restore your files from the backup you made before starting. If this is your second disk, you can copy files from your old disk to the new one, or just start installing new applications.

## Assigning Drive Letters



If you are removing an old disk and putting in a new one and both have the same number of partitions (drive letters), then you're done once you restore all your files. However, if you are adding a second disk and plan to move existing files to it, you have some more work to do. At minimum, you will need to change the PATH statement in your AUTOEXEC.BAT file to reference the new drive letters.

The way that DOS handles more than one hard disk can cause your DOS drive letters to change when you add a second disk. For example, let's say you already had a disk with two partitions that you referenced as C: and D:. If you add a second disk with a single partition, it will become drive D: and your old D: drive will now be known as E:. You have to change any batch or configuration files that used the old D: drive to use the E: drive.

Windows and many Windows applications use configuration files that will have drive letter references in them. Typically, you can't just copy some of your applications over to the new disk and start them up immediately. The most common problem areas are INI files that have files and paths that include drive letters. After copying the files to the new drives, you can search the INI files with a text editor and change the drive letters. If this approach fails, you may just need to reinstall the application and then delete it from the old location.



## Improving Video Performance

See Also

You can run Windows faster by setting the lowest [video resolution](#) and the smallest number of simultaneous colors ([color depth](#)) acceptable for your applications. With super-resolution VGA-compatible video cards, you can use the standard VGA [driver](#) supplied with Windows for faster performance ([Installing Video Drivers](#)). The resolution or color depth or both will likely be lower, but speed improves, generally. Use the Windows Setup program to install different drivers supplied with Windows and with the video card to test the looks and performance of the modes available with your equipment. If resolution or color depth are more important than the extra speed, use the highest mode available.

[Eliminating Screen Flicker](#)

[Optimizing Monitor Performance](#)

## Eliminating Screen Flicker



If you use high-resolution video and your monitor screen [flickers](#) noticeably, you can often fix the problem with a simple adjustment to your video board. Check your video board's manual and see if it mentions a setting for a high [refresh](#) rate or a 72Hz or higher refresh that can be selected by a jumper or a software utility. If your monitor supports the higher rate, you'll get a much better picture by using this setting.

## Optimizing Monitor Performance



To get the best possible picture, take some time to check and adjust your monitor every few months. Wait at least 30 minutes for the monitor to warm up before making adjustments. Then set the brightness, contrast and image alignment controls. Since it fills the screen, the Windows desktop is a convenient image to use while making the adjustments.

### Avoiding Magnets

Multimedia sound is great, but watch carefully when you put a regular set of speakers next to your monitor. The magnets in the speakers may distort the screen image. You can resolve the problem by buying a set of speakers that are shielded to prevent stray magnetic fields.

### Degaussing Your Monitor

If your monitor has recently begun to display odd color distortions (perhaps you put your speakers too close), you may need to [degauss](#) it. Some monitors have a degauss button, but most will automatically degauss each time they are turned on. If you tend to leave your monitor on for days at a time and want to degauss it, try leaving the monitor off one night and turning it on in the morning.

### Selecting The Right Size Monitor

If you want to get the most out of Windows, use a 17-inch or larger monitor that will let you use a higher Super VGA resolution for a larger desktop. It really depends on personal preference, but many people find 800x600 a good match for 15-inch monitors, 1024x768 for 17-inch, and 1280x1024 for 20-inch. For the sharpest image, look for a monitor with a dot pitch of 0.28 millimeters or smaller. To eliminate [flicker](#), get a monitor that can handle 72Hz or higher refresh rates at the resolution you plan to use.



## Installing Video Drivers See Also

There are three reasons to install a new video [driver](#): because your vendor has updated the driver code, because you wish to change your [color depth](#) or because you wish to change your [video resolution](#). There are four ways to change your driver. Generally, any particular video card will only use one of these methods:

### 1) From Control Panel

Open [Control Panel](#), then look for an icon with the same name as your video card. Double-click on it; you should be able to control video resolution and color depth from this panel. You may also be able to install an updated driver from here.

### 2) From Program Manager

Look for a program manager group or program manager icon with the same name as your video card (it may be hidden; select "More Windows" from the Windows menu of Program Manager and scroll down the list). Double click on the icon(s) to change color depth or video resolution. You may also be able to install an updated driver from here.

### 3) From A Custom Install Program

Most drivers come with installation instructions, usually in a .TXT, WRI or READ.ME file. Sometimes these files appear only after you have unzipped (decompressed) the file. Be sure to read them before attempting installation. In other cases, there will be a file called INSTALL.EXE or FINSTALL.EXE. Executing that file should lead you through the installation process (usually in DOS).

### 4) From Windows Setup

Sometimes all you will find is an OEMSETUP.INF file along with the driver. If that is the case, use Windows Setup, usually found in the Main Program Manager Group.

- Double click the Windows Setup icon.
- Select Change System Settings under the Options menu.
- Select Display.
- Scroll down the Display List to "(Other Display, requires disk from OEM)".
- Windows will ask where the new driver is: Point it to the directory containing both the driver and the OEMSETUP.INF file. If Setup asks for a path again, point it to the same directory. If you are trying to change video resolution or color depth, look for a driver with 640x480 or 800x600 in its name (for resolution) or 256 colors/8-bit color (if you are changing color depth).
- Rarely, you will simply receive a .DRV file. From DOS, after making a backup of your existing .DRV file, copy the new one on top of it, taking care to see that the new file has the exact same name as the old one.

## TO REVERT TO STANDARD DRIVERS

Select either Super VGA or VGA from the Windows Setup Display list.

## **TO ACTIVATE A NEW DRIVER**

See if the driver you want is listed. If it is not, select Other display (Requires disk from OEM). A dialog box will appear asking you to specify which drive contains the disk with the new driver. In most cases, this will be a diskette in the A: or B: drive. In some cases, you may have downloaded a driver to a directory on your hard disk; if so, enter the entire path.

For example, if you download a driver via modem into a directory called ORCHID on your C: drive, enter C:\ORCHID. If there is no file by the name of OEMSETUP.INF in the path you specify, an error message will be displayed.

**NOTE:** Many video drivers are store on bulletin boards as compressed files. If you do not have two files, one named OEMSETUP.INF and another with an extension of .DRV, you may need to decompress the file. Compressed files have such extensions as .ZIP,.LZH and .DR\_, among others.



## Updating Video Drivers

See Also

The vendors of video cards seem to consider the creation of driver software to be an eternally unfinished task; new versions are created regularly and frequently by most vendors.

First, find the name and date of your existing driver. It will be in the WINDOWS/SYSTEM directory, and will have a suffix of .DRV. Usually, the video driver will have a name similar to that of your board or the company which makes your board (for example, ORCHID.DRV for Orchid Technology video cards).

Many video drivers can be found on CompuServe. There is no room in this help file to teach you how to sign up for or onto CompuServe. But once you have an account and have signed on, you can type GO MSWIN at nearly any prompt. Select Libraries from the MSWIN menu and Display Drivers from the Library Menu. Then browse until you find the driver for your video card. See if the date on the driver on CompuServe is later than the date on your existing driver.

[Contacting Video Card Vendors Directly](#)

[Decompressing Video Drivers](#)

[Installing Video Drivers](#)



## Contacting Video Card Vendors Directly



A vendor's bulletin board system will often yield a more recent version of their driver. Unlike CompuServe, vendor bulletin board systems do not charge you for joining or for connect time. On the other hand, they are busy/unreachable much more often than CompuServe and nearly always involve a long-distance telephone call (since downloading a driver can take a long time, even at 9600 baud, it would be a good idea to call a vendor BBS after 5 p.m., or better yet, after 11 p.m.--most BBS systems operate 24 hours a day).

If the date on the driver you have found is later than the date on the driver you are using, download the new driver. It probably has bug fixes, new features, or both. It is not generally a good idea to download an older driver.

[Click Here](#) to see the BBS numbers for the most popular video cards

## Video Card Vendor BBS Numbers



All BBS numbers operate at up to 9600 baud unless otherwise noted.

<b>Actix Systems</b>	408-970-3719
<b>Appian</b>	206-649-5363
<b>AST Research</b>	714-727-4723 (2400)
<b>AST Research</b>	714-727-4132
<b>ATI Canada</b>	416-756-4591
<b>ATI Technologies</b>	905-764-9404
<b>Cirrus Logic</b>	510-440-9080
<b>Diamond SpeedStar VGA</b>	408-524-9301
<b>Control Systems (Artist Graphics)</b>	612-631-7664 (2400)
<b>Genoa</b>	408-943-1231
<b>Hercules</b>	510-623-7449
<b>Matrox</b>	514-685-6008
<b>Miro</b>	408-562-2010
<b>Number Nine</b>	617-872-7502
<b>Orchid Technology</b>	510-683-0327 (2400)
	510-683-0555 (9600)

(note: you  
MUST turn  
MNP5 OFF  
when  
contacting  
the Orchid  
BBS)

<b>Sigma Designs</b>	510-770-0111
<b>STB Systems</b>	214-324-8750
<b>STB Systems</b>	214-437-9615 (2400)
<b>Trident Microsystems</b>	415-691-1016
<b>TrueVision Targa &amp; Vista</b>	317-577-8783
<b>Umax</b>	510-651-2550
<b>Volante (Tech Works/ National Design)</b>	512-329-6327
<b>Western Digital</b>	714-753-1234

## Decompressing Video Drivers



Drivers are generally compressed, usually with a suffix of .ZIP;a .ZIP file usually contains several files compressed together. Some compressed are self-extracting (in which case they have a .EXE extension) and require no other software. Usually, any BBS with .ZIP files will also contain a copy of PKUNZIP you can download to decompress the files (obtaining and paying for a copy of PKUNZIP is a good idea if you plan to use a modem to download software and keep your system up to date).

**When downloading or decompressing a file it is a very good idea** to do so in a directory newly created for the purpose, rather than in the WINDOWS or WINDOWS/SYSTEM directory. This gives you control over the installation and prevents the accidental overwriting of files. It is also a good idea to make a copy of your existing driver under a different name, in case the new driver does not work, so you can fall back to the older version if needed.

You can find PKUNZIP on American OnLine: in the Windows area, click on the search files buttons, and use the keyword PKZIP. On CompuServe, type GO IBMSYS, then browse Library 6 (File Utilities) for the keyword PKZIP or ZIP.





## Selecting Video Boards

See Also

[First See: Upgrade Checklist](#)

Thanks to the growing interest in graphics cards, there are now plenty to choose from. They come with varying combinations of features and functionality. With prices starting at under \$150 and reaching ten times that, there's clearly a broad range of capabilities. However, boards have improved so much over the last few years that entry-level products now provide all the features and performance needed for any mainstream application.

Though you can still buy ISA-bus video cards, the higher performance of local-bus video has made ISA obsolete. If your PC doesn't have VL-Bus or PCI slots, consider holding off on upgrading your video board until you can afford a new motherboard, too.

Though video boards are improving so fast that they sometimes become obsolete within six months of their introduction, there are three market segments with price ranges that stay relatively constant. Here's how they look currently (late 1994):

### **Low-end video boards (under \$200):**

These are the boards that are typically bundled with new systems. These days they use a 32-bit accelerator chip and come with 1MB of VRAM, which lets them do 8-bit color at resolutions up to 1024x768, and 24-bit color at 640x480. Unless you have special needs, this is plenty.

### **Midrange video boards (\$200-\$400):**

These boards are for people who have jumbo monitors or who occasionally need to do some real work in 24-bit color. Current midrange boards typically use 32- or 64-bit accelerator chips and come with 2MB of VRAM, which lets them do 8-bit color at 1280x1024 and 24-bit color at 800x600. (The cheaper end of this range includes some low-end boards configured with 2MB of VRAM.)

### **High-end video boards (over \$400):**

These are boards for graphics, DTP and CAD professionals, and aren't really worth the big bucks for anyone else. Get one with sufficient VRAM to run 24-bit color at the highest resolution you want to use (3MB for 1024x768, 4MB for 1280x1024, 6MB for 1600x1200), and make sure that the board supports any color correction software you use--for example, if you use Photoshop, you'll need an .8BX plug-in file.

[Selecting The Video Bus](#)

## Selecting The Video Bus



If you're thinking about buying a new computer or upgrading your motherboard, consider the system bus before buying a card. Video accelerators work even better if you use them in conjunction with a high-speed bus such as PCI (Peripheral Component Interconnect) or VESA (Video Electronics Standards Association) Local Bus (VLB). Either of these slots give attached peripherals (such as video, hard-disk and network controllers) 32-bit direct access to the [CPU](#). This means, data can be transferred at the same rate as the CPU's clock speed, rather than being bottlenecked by the ISA bus's 8 [MHz](#) speed limit.

If the card is made for a local bus slot, it will perform at least four times better than the same card in a 16-bit ISA slot.

In using actual applications, such as PhotoStyler and CorelDRAW!, there were obvious productivity benefits to the combination of a very fast graphics display and the computation of display list routines, a CPU on afterburners and lightning-fast hard-disk access. Virtually everything that once took seconds (sometimes closer to minutes) happened in a blink.



[Installing/Upgrading an FPU](#)

[Reducing Swapping](#)

[Understanding CPU and FPU Test Results](#)

[Upgrading/Installing RAM](#)

[Upgrading the CPU](#)

[Upgrading the Motherboard](#)



[Upgrading/Installing RAM](#)

[Improving Disk Performance](#)





[Adjusting Smartdrv Settings](#)

[Adjusting File Structure/Defragmentation](#)

[Adjusting Cache Settings](#)

[Selecting/Installing A New Disk](#)

[Disk Test Results](#)



[Selecting Video Boards](#)

[Updating Video Drivers](#)

[Installing Video Drivers](#)



[Adjusting Smartdrv Settings](#)

[Improving Disk Performance](#)

[Adjusting Cache Settings](#)

[Selecting/Installing A New Disk](#)

[Disk Test Results](#)



[Updating Video Drivers](#)

[Installing Video Drivers](#)

[Improving Video Performance](#)



[Selecting Video Boards](#)

[Installing Video Drivers](#)

[Improving Video Performance](#)



[Selecting Video Boards](#)

[Updating Video Drivers](#)

[Improving Video Performance](#)



## **Installing Wintune Normally**

In the vast majority of cases, installing Wintune is a simple matter of running SETUP.EXE from the diskette or directory in which it and the compressed program files are located. However, special instructions are required in the case of some network installations (single click on [Network Installation](#) for more details).

To avoid interference from delayed disk operations that can occur when write-behind disk [caching](#) is enabled in SMARTDrive or third-party cache software, a 10-second delay has been built into the disk drive test. This assures accurate operation with SMARTDrive's default write-cache setting of 5 seconds.



### **Setting Last Test Saved Switch (/L)**

This option loads the last test saved or appended to the .TRF file as the current test. It is nearly equivalent to the Load a Saved Test as Current option that appears under the File menu in Expert mode. As a command-line prompt, however, this feature is available to you if you are using Standard mode as well.

To load the last test saved as the current test, [change the command line](#) to:

```
C:\WT20\WINTUNE.EXE /L
```





## Setting TRF File Switch(/TRF)

This causes Wintune to load the file specified on the command line as the current file. This file does **not** get saved as the current file when the program ends, as long as it is loaded as a command-line option. Users can also now create a File Manager association for .TRF to be associated with WT20.EXE, and a double-click in File Manager on a .TRF file loads it.

To load the last test saved as the current test, [change the command line](#) to:

```
C:\WT20\WINTUNE.EXE /TRF WINTUNE.TRF
```



## **Setting Time Delay Switch (/T) (/Tnn, where nn=1 to 30, default=/T10)**

The /Tnn switch sets a variable time delay (1 to 60 seconds) between tests during Quick Test and Full Test cycles. This is designed to avoid interference from delayed disk operations that can occur when write-behind disk [caching](#) is enabled in SMARTDrive or third-party cache software.

The default value is /T10, giving a 10-second delay; this assures accurate operation with SMARTDrive's default write-cache setting of 5 seconds. If you have any reason to suspect that write cache on your system isn't being flushed within the first 10 seconds, you can set a longer delay.

For example, to institute a 20-second delay, [change the command line](#) to:

```
C:\WT20\WINTUNE.EXE /T20
```

- You can eliminate the delay if your system doesn't have write-behind caching enabled. To do so, eliminate the /Tnn setting completely, for example.:

```
C:\WT20\WINTUNE
```



## **Setting Memory Test defeat switch (/M)**

The /M switch defeats part of Wintune's Memory Test. By default, during the CPU test, Wintune performs a Global Compact of Windows memory, and observes how much free memory is left after this has been completed. On certain systems--in particular, RISC-based systems running Windows NT, systems running OS/2 and some Pentium-based systems--the global compact does not work correctly; it either takes a very long time to complete, or in rare cases it can crash the computer. In these situations, you can set the /M switch to turn memory testing off. To do so:

To disable memory testing, [change the command line](#) to:

```
C:\WT20\WINTUNE.EXE /M
```



## Changing A Command-Line Switch



- start Program Manager
- single-click on [the WINTUNE 2.0 icon](#) in the WINTUNE group to select it
- select Properties from the Run menu.
- You can then edit the command-line entry, which by default will be:

C:\WT20\WINTUNE.EXE



## Setting Video Test defeat switch (/V)

The /V switch defeats video testing, and reports a video performance of 2 million pixels per second regardless of what the actual video performance is. Some video drivers are not fully compatible with the Windows Graphic Device Interface (GDI) calls Wintune makes during its Video Test--which can cause Wintune to crash. In this situations, you can set the /V switch.

To disable video testing, [change the command line](#) to:

```
C:\WT20\WINTUNE.EXE /V
```

If Wintune runs to completion with the /V switch, but crashes without it, then there is a bug in your video display driver. Call your video hardware manufacturer, report the problem, and ask if a newer version is available. Note that with the /V switch in use, the Video Test will report a default value of 2 megapixels per second regardless of the actual video hardware installed in your system. As a result, the predicted performance displays will not be accurate.



## **Setting Cache Size Switch (/C) (/Tnn, where nn=16 to 16384)**

**IF YOU HAVE A NON-STANDARD (third-party) DISK CACHE**, or are running OS/2 or NT, then Wintune will not properly detect your cache size. You will need to manually inform Wintune of the cache size in the [Wintune command line](#). The syntax for this is:

```
C:\WT20\WINTUNE.EXE /Cnnnn
```

Where nnnn is your disk cache size in kilobytes. Legal values are 16--16384. For example, to manually set a 2MB cache size, use command-line switch:

```
C:\WT20\WINTUNE.EXE /C2048
```

If you don't set a cache size, you will get a simplified Disk Test with results that may not be comparable to those from a test with a detected cache size.

NT Users [click here](#).

OS/2 Users [click here](#).



## **NT users**



Since NT has a dynamic cache, our current test can never be completely accurate, but as a practical matter, we're getting good results on both NT 3.1 and 3.5 (in a 32MB memory configuration) with a manually set cache size of 8MB. This appears to approximately match the performance of NT's dynamic cache and the built-in Win16 emulation subsystem.



## **OS/2 users**



You should manually set Wintune's cache size to the same size as that set in the DISKCACHE line in CONFIG.SYS (for FAT drives) or to that set with CACHE= in the IFS=HPFS.IFS line of CONFIG.SYS. For instance, if you are using OS/2 with a FAT drive, and DISKCACHE = 1024,L,W set:

```
C:\WT20\WINTUNE.EXE /C1024
```

If you are running HPFS and have IFS=C:\OS2\HPFS.IFS /CACHE:512 ...Then set:

```
C:\WT20\WINTUNE.EXE /C512
```





## Installing On A Network

You cannot use the SETUP.EXE program on the Wintune distribution disk with networked Windows systems that have a locked system directory. Attempting to do so will generate an "Access to Locked System Directory" error during installation--and if you ignore this error and complete the Wintune install anyway, you will get a "Path/File Access error when you try to run Wintune.

Here's a work-around for such installations:

- A system administrator will have to unlock the shared system directory, and install one (1) copy of Wintune on a workstation.
- Lock the system directory after the Wintune installation is complete.
- Copy the following files from the WINTUNE directory on the workstation installed in step 1 to two diskettes (or compress them and copy them to one diskette):

Filename  
WT20.EXE  
HELL16C.DLL  
TIPADW16.DLL  
GETINFO.DLL  
WTHELP.HLP  
WTTIP.HLP  
WTFAQ.HLP  
WINTUNE.TRF

- Carry the files to each workstation on which you want to install Wintune. Copy the files to a WINTUNE directory, and create a Program Manager WINTUNE group with icons for WINTUNE.EXE and WINTUNE.HLP.

Wintune should now run properly from the workstations.



## Video Test Results

[Click here](#) to see typical Video Test results.

The video portion of the [WINDOWS Magazine](#) benchmark suite comprises four major tests:

- **Character scrolling**
- **Line and curve drawing**
- **Filled object drawing and dragging**
- **Color display test** (run only when the Full Test option is selected; not used in throughput calculations)

Video, CPU and memory performance are related--data is written by the CPU to the display adapter over the system memory bus (on some systems, this may include a high-speed local bus), so a slow CPU cannot make best use of a fast display.

[Click here](#) for more details on the Video tests.



## Video Test Details

Our goal: to reflect the way real applications use the [Windows GDI](#) . Well, there are applications, and applications: some work with text, some with line graphics, some with black and white, some with color. One number doesn't do all of these elements justice.

### Character Scrolling (included in single video throughput number)

Character scrolling emulates scrolling with an editor, word processor or terminal program. Among other things, we open a test window and close the test window and scroll a screen containing a variety of fonts. The scrolling test uses two common video APIs: TextOut and ScrollWindow. These APIs dominate the test times. [Blitting](#) is easy to accelerate in hardware; ScrollWindow relies primarily on blitting. Video cards and [drivers](#) that optimize blitting should do well on this test.

### Lines and Curves/Filled Objects (both included)

The line and filled object drawing test uses the [Windows GDI](#) primitives to perform on-screen drawing the same way business graphics programs perform these tasks. We clear a screen area to white. It then fills with vertical black lines from left to right. Then it fills it with horizontal white lines from top to bottom. And then it almost fills it with a clock wipe by drawing black lines from the center of the screen out at half-degree increments.

To make the tests resolution-independent, they are all run in a fixed VGA-size (640x480 [pixel](#)) window. Since we know the number of pixels in the window, and the number of times we redraw the display, it is easy to calculate throughput based on the time taken for each component of the [benchmark](#). We then report an average throughput in pixels per second.

On most machines the horizontal and vertical wipes are much faster than the clock wipe, for two reasons: Drawing lines is generally much faster for the vertical and horizontal cases than it is for an arbitrary angle, and the benchmark code calculates floating-point sines and cosines inside the clock wipe loop. It could have been done with an integer sine/cosine table lookup. But most applications don't bother with that sort of optimization in this day and age, so the benchmark doesn't either. After the radial spokes, the benchmark draws ellipses. Then, rectangles (very fast) and rounded rectangles and ellipses (not so fast).

### Color Display Test (not included)

Our color test sets up a palette for a blue-to-black fade, draws the fade, and then animates the palette if there is one; the other loads a 24-bit image, sets up a palette for the image, and displays the image using the [Windows GDI](#) function SetDIBitsToDevice(). Now displaying a 24-bit image on a 256-color palette device is tedious at best. By the way, if displaying the 24-bit image causes a fault in the display driver, you should let your display board vendor know about it. See [Updating Video Drivers](#).

It takes almost 90 seconds to draw the image on a 386/25 with a 256-color board. But it takes less than a second to display the same image--better--on a 486/50 with a 24-bit board. That difference is simply disproportionate, especially when you're trying to make the results correlate with business application benchmarks. It's all very well to tell people not to compare an 8-bit display with a 24-bit display, but the fact is they'll do it no matter what you tell them.

At the same time, 24-bit devices have no palette, so they can't perform palette animation (color rippling). That isn't as serious in its impact on the timing: When a card does palette animation, it does it fairly quickly, and when it doesn't do it, it doesn't take any time.

## **Throughput Figure**

Video throughput is based on the first three tests. They'll correlate well to the magazine's business application benchmarks. The high-level benchmarks won't, however, correlate with tests like 24-bit image display. So, for now, Wintune reports the color display results separately.



## Disk Test Results

[Click here](#) to see Typical Disk Performance figures.

The low-level numbers disk manufacturers usually quote are the seek time and the transfer rate. In the real world, the most common significant disk operations are **sequential** and **random** reads and writes. Random reads and writes often reflect a mix of seek time and the transfer rate; sequential reads and writes generally reflect the transfer rate and [caching](#) (if present). This [benchmark](#) uses sequential and random reads and writes.

Note that disk performance is tightly coupled to the DOS FILES and BUFFERS lines in CONFIG.SYS, and other factors (See: [Improving Disk Performance](#)).

[Click here](#) to see how Disk and CPU performance are related.

[Click here](#) for more details on the Disk tests.



## Disk Test Details

### The Files We Use For Disk Tests

We test disk performance using two file sizes that are intended to indicate both [cached](#) and uncached performance. The logic for doing this depends on detecting your disk cache. If you are running [WFWG 3.11](#), we check to see if [32-bit file access](#) is enabled, and if so we assume it's used to cache hard disks and networked disks--we assume that SMARTDrive is used to cache diskettes and CDs. In all other cases we use the SMARTDrive cache size (if any). We do not attempt to detect third-party disk caches.

Our first test is run at 20 percent of the size of the disk cache, and is intended to determine the cached disk performance (usually dominated by memory access speed). Our second test is run at 110 percent of the cache size, and is intended to force physical disk activity. It gives a working picture of the physical disk performance.

If we cannot detect a WFWG 3.11 32-bit file access or SMARTDrive cache, we perform the first test at 64KB (which we assume is small enough to show the benefit of whatever cache you have), and at 20 percent of the size of your physical memory (which we assume is probably larger than any cache you may have).

### How We Create A Single Performance Number

To create a single number from the two tests for front-panel display and reference in the Comparisons chart, we employ an exponential weight function, weighted by cache size. At a 2MB cache size, the weight function gives equal weight to cached and uncached performance. At smaller sizes, it gives less weight to the cached performance, and at larger sizes it gives a greater weight to the cached performance. The effect is that increasing the cache size will give you a greater indicated disk performance--which matches our experience with real applications. The weight function is:

- $\text{Cached Proportion} = 1 - \exp(-\text{Cache Size} * .67 / 2048)$
- $\text{Uncached Proportion} = 1 - \text{Cached Proportion}$
- $\text{Indicated Disk Performance} = (\text{Cached Speed} * \text{Cached Proportion}) + (\text{Uncached Speed} * \text{Uncached Proportion})$

### Functions We Test With These Files

File Open tests how long your system takes to open a file. Programs do this frequently, so it represents an important part of real-world system performance. On the other hand, this number is generally small compared with the other times measured in these disk tests.

Sequential read and write tests use data taken off the disk one record after another. Nearly all systems use hardware or software to cache data they access from disk. Some disk cache implementations assume that if you read or write data from location one, your next read or write will be in location two, then three and so on. This is called "lookahead". The more often this is the case, the more cache will improve performance, since the RAM into which the data is moved from the disk can be accessed many times more quickly than data stored on the disk.

However, a number of applications--specifically databases--also read and write randomly across the disk: that is, first from location 1, then from location 20, then from location 6, and so on. Virtually no caching system can predict or accelerate such activity, so the random

read and write tests tend to indicate the actual underlying speed of the disk storage subsystem--**if** the cache is not big enough to hold the whole file. On the other hand, if your disk cache "looks ahead" and retains the whole file, the random read and write times will reflect caching speed, not the underlying disk speed.

File Close and Delete tests how long it takes to close a file and delete it. Both are common activities. File deletion is normally a short operation. File closing, however, can be a time-consuming operation in some caching systems, for instance the one built into Windows NT, because it is only when the file is closed that the bulk of the actual data is flushed from memory and written to disk. SMARTDrive and other typical disk cache systems for Windows don't do this, but they do implement delayed writes: If your cache does delayed writes you'll see and hear disk activity on your computer after the disk benchmark completes. For this reason, we force a 10-second delay between tests.



## CPU and FPU Test Results

[Click here](#) to see typical CPU test results.

At the [processor](#) level we measure the integer arithmetic performance using a C program called the [Dhrystone](#), and floating-point arithmetic performance using a C program, the [Whetstone](#), that does a mix of floating-point operations.

We use modified versions of the Dhrystone and Whetstone benchmarks. The modifications result in data being kept on the stack, which lets the benchmarks work properly in multiple threads (in Windows NT); the standard versions keep some of their data in static and global variables. Both the Dhrystone and Whetstone benchmarks are **synthetic** benchmarks, designed to contain a representative sample of operations normally encountered.

[Click here](#) for more details on the CPU tests.





## CPU Test Details

The first entry under [CPU](#) tests shows the speed of the CPU and the type of CPU detected.

The next entry under CPU tests indicates whether there is a floating-point coprocessor, or whether floating-point operations are emulated in software.

We measure the integer arithmetic performance using a [Dhrystone](#) program.

We measure floating-point arithmetic performance using a different program, the [Whetstone](#), that does a mix of floating-point operations. We could look at [RAM](#) access time and the effects of cache explicitly, but it is easier to take advantage of the fact that the CPU benchmarks fold in some effects of RAM access time.

The Dhrystone and Whetstone benchmarks are widely used in the computer industry. We use modified versions of the Dhrystone and Whetstone benchmarks. The modifications result in data being kept on the stack, which lets the benchmarks work properly in multiple threads (in Windows NT); the standard versions keep some of their data in static and global variables.

Both the Dhrystone and Whetstone routines are synthetic benchmarks, designed to contain a representative sample of operations normally performed by applications. They don't do anything useful, but they do the sort of complicated sequences of instructions that real applications do, rather than simply timing individual instructions in a tight loop.

Integer arithmetic and memory access are the dominant CPU activities in most Windows programs. The Dhrystone benchmark combines both, although it doesn't access enough memory to simulate real programs--which is why we do a separate memory test.

Floating-point arithmetic is most significant in programs that require an FPU: mostly scientific, engineering, statistical and computer-aided design programs. It is also a small component in spreadsheet, paint and drawing programs in which certain features get a speed boost from the FPU, if available. Word processing programs typically do no floating-point computations at all. The Whetstone does a lot of floating-point arithmetic, some memory access, and a little integer arithmetic.



## Memory Test Results

[Click here](#) to see typical memory performance figures.

We test your system's [RAM](#) memory using [WINDOWS Magazine](#)'s proprietary RAMprobe test.

The actual execution speed of RAM varies with each application, and any measurement can be only an estimate. By measuring performance at both small and large array sizes, RAMprobe attempts to reflect this reality.

Wintune 2.0 uses RAMprobe in two ways: Comparing the first and last values gives a good indication of whether your CPU's primary cache is enabled, and a direct average of all the values gives a good overall figure for your system's memory performance--which is expressed on the front-panel RAM indicator and in the Comparisons/RAM chart.

[Click here](#) for more details on the Memory tests.



## Memory Test Details

RAMprobe is a basic measure of [RAM](#) memory performance that works by executing the standard C-language memcopy() API function, copying arrays of progressively larger size--starting with a size of 1KB, and doubling the size each time. The array copying is repeated (initially 10,000 times in normal mode, 50,000 times if the Full Test option is selected). The number of repeats is halved on each pass, so that the total amount of memory moved is constant:

Array Size	Repeat Count	Total Memory Moved
1KB	10,000	10MB
2KB	5,000	10MB
4KB	2,500	10MB
...	...	...
1MB	10	10MB

Since the total amount of memory moved is constant, measuring the time this process takes gives a direct measure of memory read plus write performance in megabytes per second. The significance of varying the array size lies in the complex, multistage nature of modern PC memory; beginning with Intel's first 486-series CPU, all modern processors have on-chip "primary [cache](#)" memory that operates at speeds much higher than the system motherboard. Almost all desktop PCs (and a few portables) also include an external cache, which acts as a buffer between the very fast on-chip primary cache and the slow memory on the motherboard.

It might seem that having just 8KB of primary cache plus 64KB to 256KB of external cache would have little effect in a system with several megabytes of motherboard RAM; but the overall memory performance of a system with a multistage cache turns out to be a complicated matter. Even though the amount of cache memory is small, it can have a surprisingly large impact on application performance because most of the time, applications need access only to a small part of the total code and data in use; if that small part will fit mostly (or completely) in cache, you will get much better performance than if it must be executed from motherboard RAM.

Click here to see even more [details of Memory testing](#)



## Comparisons

When you select the Comparisons [tab](#) along the top, you are offered a choice of five tabs down the side: [FPU](#), [CPU](#), Disk, Video and [RAM](#). The graphs underneath these tabs may seem complicated at first, but they are actually quite easy to understand.

Wintune 2.0 comes with a database of information on the performance of several "standard" systems that we provide as a basis for comparison so that you can tell how fast (or slow) your system really is. This initial database is provided in [WINTUNE.TRF](#), and is automatically loaded when Wintune is started (provided WINTUNE.TRF is present in your WINTUNE directory).



**Please Click on the Caution Sign and read our Comparisons Disclaimer**

Or, as the old saying goes, your mileage may vary.

Next Up: more on [Comparison Charts](#)



## Comparison Charts

Clicking on the Comparisons [tab](#) allows you to compare your system performance graphically with up to three other systems. If you click on the bars, you can see details of the system being displayed. Since Windows Help does not allow you to copy graphics to Clipboard, we have included [instructions for screen capture](#).

By default, we use comparison data from the first three entries in WINTUNE.TRF, which have been selected to show typical low-end, mid-range and high-end platforms; but you can choose other standards--or compare against measurements you take yourself; see our description of [saving results](#).

[Click here](#) to see a RAM comparison chart.

[Click here](#) to see a video comparison chart.

[Click here](#) to see a disk comparison chart.

[Click here](#) to see a CPU comparison chart.

[Click here](#) to see an FPU comparison chart.

### **Don't Stop Now!**

Knowing how your system compares with others on the low-level tests is only half the battle. To see how your system will perform on real-world applications tests--and to get some practical hints on how to maximize your system's performance--check out the section on [performance](#).



## Performance

When you click on the Performance [tab](#), the results are displayed on two kinds of graphs, represented by tabs along the left side: Application Performance and System Performance. Since Windows Help does not allow you to copy graphics to Clipboard, we have included [instructions for screen capture](#).

The Performance charts are actually very easy to understand--and they provide some of the easiest and most valuable tuning information that you can get. Click on any of the bars to see detail information on the system being displayed.

In the Application Performance graph, WINTUNE.EXE uses a set of statistically derived equations (based on [multiple linear regression](#)) to predict how fast (or slow) your machine would perform when running simulated applications.

Then there is the System Performance graph, a simple bar chart compares your system's components against the other systems you select for comparison. [Click here](#) to see it: This chart basically condenses all the information from the Comparisons tab on one display.

The second chart is more interesting. [Click here](#) to see it:

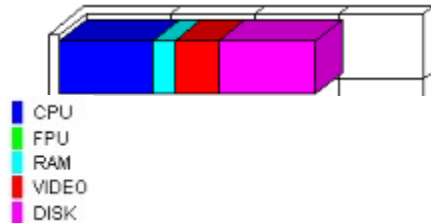
This shows a breakdown of how much time is being absorbed by each component of your system and the comparison standards, with the overall length of the bars indicating the time for a simulated application test (either Generic Spreadsheet or Generic Word Processing). The various colored sections of the bars are proportionate to the time your system spends performing integer computations, floating-point computations, moving memory, accessing the disk, and displaying video.

Now that you've seen your system performance compared with other systems at the component level and on an application basis, you'll want to learn about [tuning your system](#).



## Tuning Your System

The most efficient and effective way to tune your system is to minimize the largest section in the stacked bar chart you can see by clicking on the Performance tab, then on the Application Performance tab. Making small sections smaller won't have much effect on your performance. Let's say you see a graph like this:

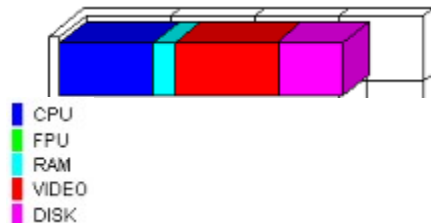


This chart gives macro execution time in seconds, and gives you a good indication of overall performance for your system in comparison with others.

The bar chart shows a breakdown of how much time is being absorbed by each component of your system. In this example the CPU and the disk are responsible for two-thirds of the time, video for most of the rest, and there's a tiny bar of time absorbed by the RAM. There is no FPU component visible. Now what does this mean to you? Read on!

### To tune your system -- Minimize the Largest Bar

Let's say that you have an otherwise fast system with a slow video card. You'll see a graph like this:



The large red bar segment means that you can get a big performance boost by [improving your video system](#).

If you double the video speed, you'll see a new pie chart -- like this:



And you'll have improved overall throughput on your system by around 25 percent! So the name of the game is make that largest bar segment smaller to improve system performance. Here are some representative charts, and hints about what you should do if you see them:

Click on the color of your largest bar:

[Light Blue: RAM](#)

[Red: Video: Video](#)

[Purple: Hard Disk](#)

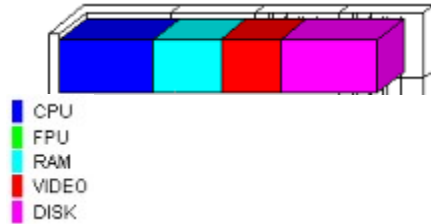
Green: Floating Point

Dark Blue: CPU



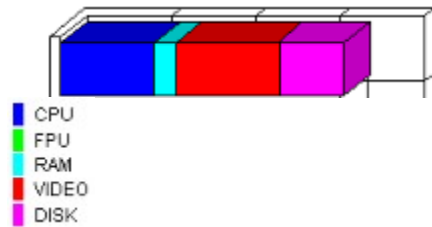
## Light Blue: RAM 📁

If you see a display that looks like this--indeed, if you **ever** see a significant light blue bar segment, it means that something's wrong.



The light blue indicates that your memory is relatively slow, meaning your system is likely to spend too much time moving data. This can slow an otherwise fast machine to a slow crawl. You may need to **add more** RAM. Perhaps you have been sold slow memory. The best thing to do is to run Wintune, follow any tips it gives about your Turbo switch, wait states or memory, then look at this chart again and see if the light blue bar is diminished.

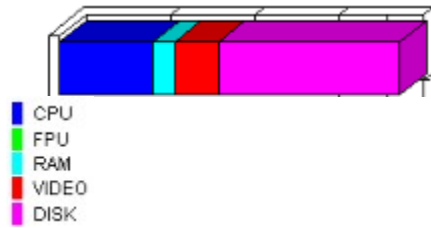
## Red: Video



This bar means that your system's otherwise plenty fast, but needs a change in video resolution, or new video drivers, or--as a last resort--a newer, faster, video card. Push the See Also button on the Tuning Your System main help screen and click (there, not here) on **Improving Video Performance**.

## Purple: Hard disk

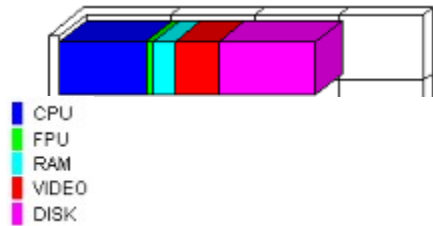
If you ever see a dominant purple bar like this it means that you have a disk problem.



First, you should run Wintune again and follow all of the tips relating to hard disks that you can afford to follow. Push the See Also button on the Tuning Your System main help screen and click (there, not here) on **Improving Disk Performance**.

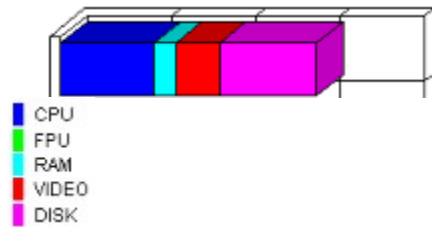
## Green: Floating-point 📁

Huh? He must've put in the wrong picture.



Nope--if you'll look carefully, you'll see a tiny bar of green between the dark blue and the light blue (I apologize to the color-blind folks out there)--but it's no more than 10 percent of the total. That's because that's all the effect we've ever seen floating-point have in business applications, and it's almost never worth making a major effort to improve. In any case, the only way to improve things is to install a floating-point coprocessor. Push the See Also button on the Tuning Your System main help screen and click (there, not here) on **CPU and FPU Performance Improvement Tips** for more information.

## Dark Blue: CPU



In general, the larger the blue bar in your graph, the better things are. Of course, it **is** possible for the CPU to be unusually slow--you'll want to try any CPU-related advice given by the Tip Advisor (most commonly to check the Turbo switch or CMOS settings). But the bad news is that there's really very little you can do at this point--there's no simple way to speed up your system's microprocessor. If you have a 486 system you may be able to install an OverDrive processor; but short of that, the only thing you can do is buy a new system! Push the See Also button on the Tuning Your System main help screen and click (there, not here) on **CPU and FPU Performance Improvement Tips** for more information.



## Test Details

The Details tab contains textual information on test details. It has five tabs along the left side, CPU (which includes FPU), RAM, Disk and Video. A fifth tab, All, combines all results from the others with system-specific information to create a complete text report. You can use the Edit menu to select all and copy the complete description to Windows Clipboard, or you can use the mouse to highlight just part of the text and use the Edit menu to copy it to Clipboard.

Explanations of the detailed results:

[Disk Test Details](#)

[CPU Test Details](#)

[Video Test Details](#)

[Memory Test Details](#)



## Benchmark Theory and Explanation

It's relatively easy to measure how fast a given computer adds two integers or divides two floating-point numbers. It's also relatively easy to measure how fast the same computer writes a block of data to disk. It's a bit harder to relate such **low-level benchmark** numbers with the performance of real-world applications, but it can be done.

This is a classic **regression** problem, which might even be linear in its parameters. That would make it a **linear regression** problem; the fact that there are multiple variables makes it a **multiple linear regression** (MLR) problem. MLR problems are easily solved if you have enough data--the answers tell you the relationships between the things you think are causes (the independent variables) and the things you think are effects (the dependent variables). The results of MLR also tell you which variables are important, which variables are unimportant and can be dropped, and how well the model explains the data. If the model doesn't fit the data well, you might have to look for other variables, or bite the bullet and try a nonlinear model.

The first step in setting up the problem is to identify the independent and dependent variables. The dependent variables are some performance measurements for your most-used applications. **Application benchmarks** measure this directly--but they take a while to run, and you don't want to have to install application suites on every machine you look at. The [WINDOWS Magazine](#) lab has done that--providing us with application benchmark data measured on a variety of platforms. We then performed a statistical analysis that links average application benchmark performance to performance on the low-level tests. Based on that analysis, we're now able to infer what the performance on the application tests would be, even though you never have to run them!

Our independent variables will be the low-level benchmark numbers. For what? The obvious answer is **for everything we can measure**.



## Multiple Linear Regression and Benchmarks

A simple additive model for the total time spent by a Windows application:

$$(1) \quad T_{total} = T_{integer} + T_{floating\ point} + T_{disk\ IO} + T_{video} + T_{memory}$$

This is certainly an oversimplification, but it should suffice for practical purposes. We can measure the aggregate speed of a given computer's integer arithmetic in MIPS, floating-point arithmetic in MFLOPS, disk I/O in megabytes per second, video output in pixels per second with our low-level benchmarks, and memory access in megabytes per second, and then the predicted speed of any given application can be written:

$$(2) \quad T_{total} = \frac{C_1}{MIPS} + \frac{C_2}{MFLOPS} + \frac{C_3}{\text{Disk MBYTES/s}} + \frac{C_4 N_{pixels}}{MPixels/s} + \frac{C_5}{\text{Memory MBYTES/s}}$$

The term  $N_{pixels}$  is here to take care of different screen resolutions, and it is simply the total number of pixels on-screen. So, for 640x480,  $N_{pixels}$  is 307200. Of course, you can predict the screen-writing speed only at the measured color depth. The variation in time with screen resolution is the reason **WINDOWS Magazine's** low-level benchmarks always do their video tests in a 640x480 window. The trick for making this useful is computing the coefficients C1 through C5. That's where linear regression comes in.

If we set  $X_1 = \frac{1}{MIPS}$ ,

$$X_2 = \frac{1}{MFLOPS},$$

$$X_3 = \frac{1}{\text{Disk MBYTES/s}},$$

$$X_4 = \frac{N_{pixels}}{MPixels/s}, \text{ and}$$

$$X_5 = \frac{1}{\text{Memory MBYTES/s}} \text{ then we can write}$$

$$(3) \quad T_{total} = \sum_{i=1}^5 C_i \cdot X_i$$

which is clearly linear. The  $X_i$  are the low-level benchmark measurements on a given computer,  $T_{total}$  is the application benchmark time for the same computer, and the  $C_i$  are coefficients that relate the low-level terms to the high-level terms.

There is still a problem here. Disk speed and memory speed are not constants, because of the effects of caching. Memory cache speeds up memory access when the size of the memory being accessed is small (kilobytes), and disk cache speeds up disk access when the size of the file being accessed is small (hundreds of kilobytes). For each application that we



want to characterize, we need to determine an average disk access speed and an average memory access speed, which won't necessarily be the same from application to application.

### **Determining $C_i$**

The way you determine the  $C_i$  is to make a lot of measurements of both the low-level and high-level performance numbers, and then minimize the sums of the squares of the residuals, which are defined as the differences between the predicted and actual values of  $T_{total}$ . This is standard stuff that reduces to accumulating and inverting a matrix. You can read about it in virtually any statistics book. Where it gets tricky is that not all methods for inverting a matrix are unconditionally stable for this problem: That leads you away from easy, fast processes like Gaussian elimination to techniques like LU or singular value decomposition --the stuff of a graduate course in numerical methods.



## Typical Video Performance Figures



<b>CPU:</b>	<b>Video Display Type:</b>	<b>Average Throughput (MPixels/Sec)</b>
<b>386</b>	VGA (640x480x16 colors)	.3-.7
<b>486</b>	Accelerator (resolution varies, 256 colors)	2.0-3.0
<b>486SX/ 25</b>	Super VGA (resolution varies, 256 colors)	.5-1.5



[Improving Video Performance](#)

[Solving Video Problems](#)

[Test Details](#)



## **The Video Tests We Perform**





## Typical Disk Performance Figures



386SX/20 laptop with built-in 40MB disk	112-274KB/Sec.
486SX/25 laptop with built-in 80MB disk	500-800KB/Sec.
386DX/33 desktop with 100MB IDE disk	250-900KB/Sec.
486DX/33 desktop with 200MB IDE disk	1.5-2.2 MB/Sec
486DX2/66 with 500MB SCSI disk	1.5-2.5 MB/Sec

The wide range of values shown here are representative of real-world results across many machines with different configurations, but the general range of performance is essentially correct. Note that disk performance is extremely sensitive to caching, fragmentation, and how SMARTDrive, DOS buffers and so forth are configured--your mileage may vary!



## **Disk and CPU Performance Are Related**

Note that disk and CPU performance are related, since most disk activity is cached. A slow CPU will show poor disk performance even if it has a very fast physical disk. Conversely, a very fast CPU may get good results from a slow disk if the caching is fully optimized (See [Adjusting Cache Settings](#)).

Finally, in machines with less than 8MB of RAM, the disk performance may affect the CPU because of swapping (See Memory and Swapping).



[Test Details](#)

[Improving Disk Performance](#)



## Typical CPU Performance Figures



CPU:	Dhrystone e (MIPS)	Whetston e (MFLOPS)
386SX/20	8	0.1
386DX/33	14	0.2
386DX/ 33,387	14	2.0
486SX/25	17	0.3
486DX/33	22	4.0
486DX2/50	32	5.9
486DX2/66	44	7.5
Pentium-66	66	13.5
Pentium-90	90	19.6



[Test Details](#)

[Improving CPU and FPU Performance](#)



## Comparison Charts





## **Comparisons Disclaimer**

Note: Neither WINDOWS Magazine nor CMP Publications claims that these results are definitive in every case or instance: Improper comparison of one system to another may give misleading results. No single source of information can reliably answer every question about performance, every time, on every system. We encourage you to read the full Wintune documentation/help file; to use Wintune as it was intended in comparing roughly similar systems (not apples to oranges, so to speak); to verify performance information with additional and to seek confirmation of your results through independent product evaluations (such as in WINDOWS Magazine) before finally selecting one system over another.



[Adjusting SMARTDRV settings](#)

[Improving CPU and FPU Performance](#)

[Improving Disk Performance](#)

[Improving Video Performance](#)

[Test Details](#)

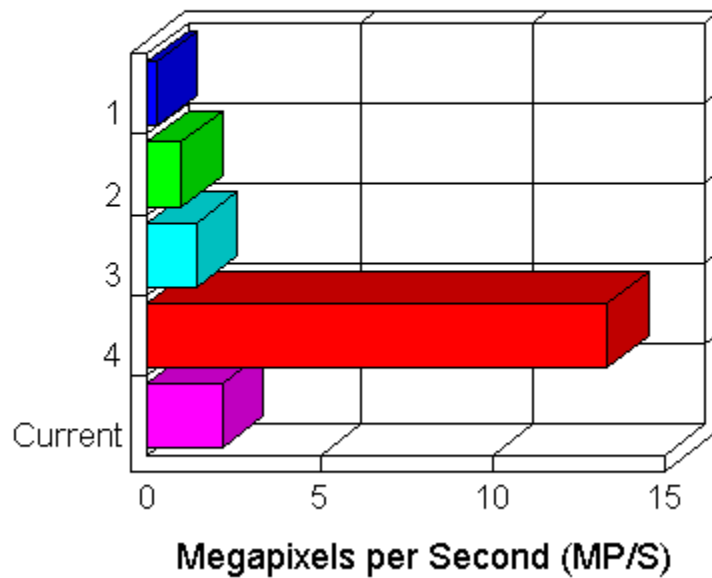


## Video Comparison Chart

This chart illustrates the relative performance of your system's video display compared with your selection of four systems from among the results stored in your .TRF file.

The chart is calibrated in millions of [pixels](#) per second (MPixels/S). You can get more details on video performance by selecting the Details tab along the top of the Home screen and the Video tab along the left side of the Details screen. You can get information on how to improve the video performance from [Improving Video Performance](#)

### System Comparisons (VIDEO) - Longer Bars Indicate Better Performance



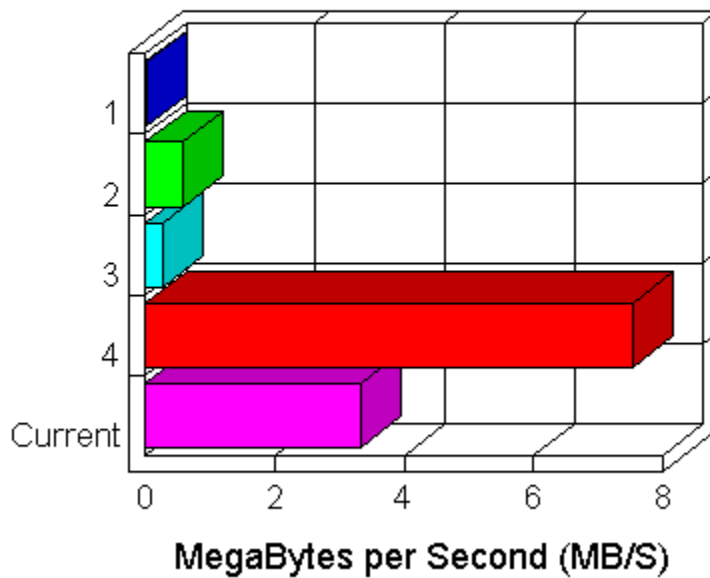


## Disk Comparison Chart

This chart illustrates the relative performance of your system's hard disk compared with your selection of four systems from among the results stored in your .TRF file.

The chart is calibrated in millions of bytes per second (MB/S). You can get more details on disk performance by selecting the Details tab along the top of the Home screen and the Disk tab along the left side of the Details screen. You can get more specific information about how to improve the disk performance from [Improving Disk Performance](#).

### System Comparisons (DISK) - Longer Bars Indicate Better Performance

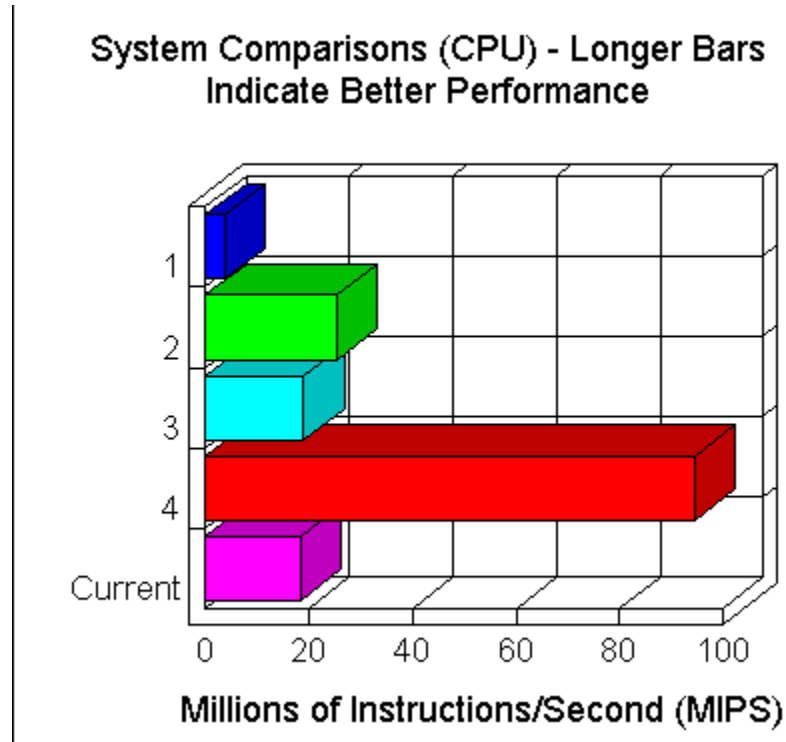




## CPU Comparison Chart

This chart illustrates the relative performance of your system's [central processor](#) compared with your selection of four systems from among the results stored in your .TRF file.

The chart is calibrated in [MIPS](#). You can get more details on CPU performance by selecting the Details tab along the top of the Home screen and the CPU tab along the left side of the Details screen. You can get information on how to improve the CPU performance from [Improving CPU and FPU Performance](#)



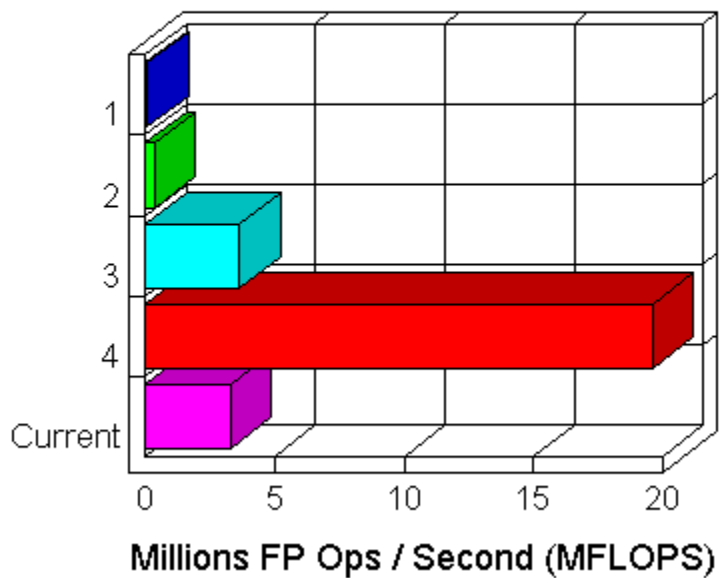


## FPU Comparison Chart

This chart illustrates the relative performance of your system's [FPU](#) (or the emulation software built into Windows, if you don't have an FPU) compared with your selection of four systems from among the results stored in your .TRF file.

The chart is calibrated in [MFLOPS](#). You can get more details on FPU performance by selecting the Details tab along the top of the Home screen and the FPU tab along the left side of the Details screen. You can get information on how to improve the FPU performance from the section on [Improving CPU and FPU Performance](#)

### System Comparisons (FPU) - Longer Bars Indicate Better Performance



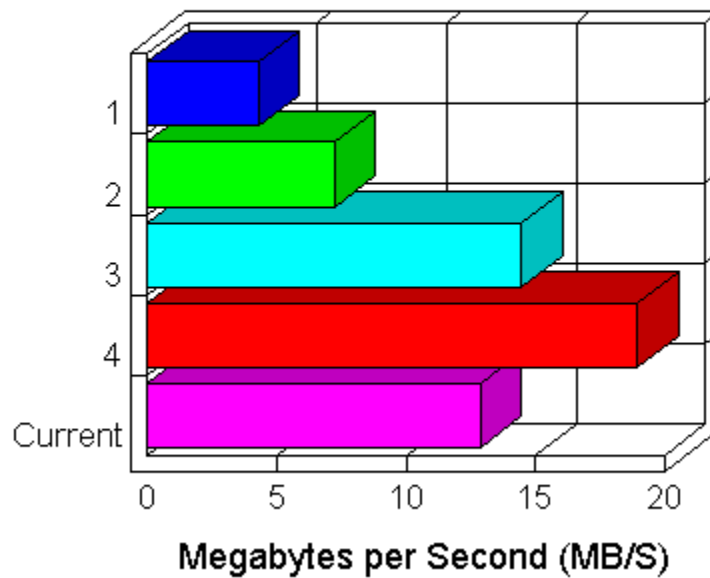


## RAM Comparison Chart

This chart illustrates the relative performance of your system's [RAM](#) compared with your selection of four systems from among the results stored in your .TRF file.

The chart is calibrated in megabytes per second (MB/S). You can get more details on RAM performance by selecting the Details tab along the top of the Home screen and the RAM tab along the left side of the Details screen. You can get information on how to improve the RAM performance from the section on [Upgrading/Installing RAM](#)

### System Comparisons (RAM) - Longer Bars Indicate Better Performance





[Adjusting SMARTDRV settings](#)

[Improving CPU and FPU Performance](#)

[Improving Disk Performance](#)

[Improving Video Performance](#)

[Multiple Linear Regression](#)

[Reducing Swapping](#)

[Upgrading/Installing RAM](#)





## Details of Memory Testing



### GlobalCompact

The result here is the amount of memory available to the Windows virtual machine after discarding and freeing any memory blocks not absolutely necessary. We do this process of compacting memory (also known as "garbage collection") to accurately read the amount of physical memory in your Windows system for the next step.

### Largest Free Block

This is the same number you'll get from the Windows Program Manager Help/About box as Memory Free. It reflects your total RAM and swap file space, less the space used by the Windows system and any running applications. In Standard mode, this number should be the same as the result from GlobalCompact. In Enhanced mode, it will most likely be larger than the GlobalCompact result.

### Detailed Memory Information

We display the following detailed memory information for technophiles who want to understand your Enhanced-mode virtual memory setup. They will be zero in Standard mode. Some day, we might understand this stuff well enough to suggest improvements based on our measurements. If you want to convert numbers expressed in pages to something more meaningful, multiply them by the page size, which is typically 4096 bytes (4KB).

### Loop Ratio

We time an empty loop twice, once using a register variable and once using a memory variable. The ratio of the two is normally slightly greater than one. A ratio much above one might indicate a CPU cache problem.



[Improving CPU and FPU Performance](#)

[Improving Disk Performance](#)

[Improving Video Performance](#)

[Multiple Linear Regression](#)



## Benchmark Theory



## Typical Memory Performance Figures



System Type:	Average Memory Performance:
386SX/16 portable, no cache	4MB/Sec.
486SX/25 portable, 8KB int. cache	7MB/Sec.
486DX/33, 256KB ext. cache	14MB/Sec.
Pentium-90, 256KB ext. cache	24MB/Sec.



## As Compared To...

Based on our research, we have developed a set of expectations with regard to the performance of typical systems. These assumptions are the basis for the suggestions provided by our Tip Advisor. You can see these assumptions in tabular form by clicking on one of the hotspots below.

[Click here](#) to see typical video performance figures.

[Click here](#) to see typical disk performance figures.

[Click here](#) to see typical CPU performance figures.

[Click here](#) to see typical memory performance figures.



[Understanding Memory Test Results](#)

[Understanding CPU Test Results](#)

[Understanding Video Test Results](#)

[Understanding Disk Test Results](#)



[Test Details](#)

[Upgrading/Installing RAM](#)



## General Test Procedures

Wintune contains a sophisticated set of [benchmark](#) tests that will characterize the performance of your system, and once the tests are conducted, it provides ways for you to compare your system's performance with others. In order for these comparisons to be meaningful, there are some things you should do first:

- Make sure that you have at least 1MB of free space on your hard disk. The Disk Test portion of Wintune creates temporary disk files, and needs at least 1MB to work properly.
- If your computer is networked, log out and disconnect the network card. This will prevent network activity from influencing the test (once you have Wintune numbers with the network card disabled, you might want to run it again with the network operating for comparison purposes--you can also execute our Disk Test on a network hard disk).
- For best results on the Disk Test, run a defragmentation program, such as The Norton Utilities' SpeedDisk or Defrag from DOS 6. Fragmentation can significantly impact disk performance, and this will show up in your results.
- Reboot your computer and restart Windows. This will assure that everything starts from a known state. We also ask that you hold down the shift key during start-up to defeat any programs that you've put in your start-up group that might influence the test results.

For more information on the low-level tests in Wintune, see [Running Low Level Benchmarks](#).

Next: [What Wintune Does](#)



## **What Wintune Does**

Wintune is also designed to predict how your machine will perform on a standard set of real-world application tests.. We did this by running both Wintune and applications on a large number of systems at \*WINDOWS Magazine,\* and performing a statistical analysis using multiple linear regression to find the mathematical relationship between Wintune results and performance.

We're interested in your results. Please e-mail your Wintune .TRF file (automatically created in your WINTUNE directory) to the benchmarking forum on:



You can also mail your results to Wintune:







## Running Low--level benchmarks

If you did not arrive here after reading [General Test Procedures](#), please read that screen first, then return here.

The low-level benchmarks exercise the basic components of your system.

To start Wintune

- double-click on Program Managers [Wintune icon](#).

If you have [other applications running](#) or [low system resources](#), you may see a warning message. Then you should see the opening screen of the WINDOWS Magazine Test and Tune-Up Kit. You'll need to press the [Start button](#) in the lower-left-hand corner before you can do anything else. This button is easy to find, as an animated "press here to start" points at it until you press it. After you have run the tests once, you can run them again by selecting All Tests under the Test menu. Wintune runs five low-level [benchmarks; Video, Disk, RAM, CPU and Floating-Point tests](#).

[Click here](#) to see what the main Wintune screen will look like after you have pushed the Start button and run the tests.

- You may run any individual test (CPU, FPU, RAM, Disk or Video) by selecting that test name under the Test menu.



## Getting Help With General Problems

We are interested in your opinion of these [benchmarks](#) and Tune-Up tools, and we welcome your comments, experiences, results and suggestions for future versions of the software in our benchmarking forum:



We also welcome your comments in the form of Letters to the Editor. Address your letters to Letters:



Because we offer these tools for free, we cannot provide personalized advice or technical support: **Please do not call us with specific questions about your system.** Instead, if you have questions, use the on-line forum listed above, and we'll do our best to answer you there.



You may freely use, copy and redistribute the software as long as you include all the original files, and as long as you make no changes to the contents of the original files.



\*Please\* push on the caution sign above to see our obligatory disclaimer



## **Solving Video Problems**

In certain circumstances, you may have trouble with Wintune during video tests. Most commonly, when running a Full Test, Wintune will complete all but the last portion, and then crash with a General Protection Fault (GPF). When this happens, try running a Quick Test rather than a Full Test--which most likely will not crash.

In the Full Test, Wintune's last video operation is to pass a 24-bit, true-color, device-independent bitmap (DIB) to the video device driver for display. If you have a 24-bit-capable video board, the driver just displays the bitmap; but when you have a non-true-color video board installed, things get a bit more complex--the driver has to interpret the 24-bit image dynamically, and generate a suitable display for your viewing.

We've found that some video drivers don't handle this process properly, causing the aforementioned GPF. If this happens, but Wintune runs properly in all other respects (which is why we suggest trying a Quick Test--because that doesn't attempt the 24-bit display), then you need to contact your video vendor and request an updated video driver--the one you have is buggy. We'd also like to hear about such problems: please post the details in the WinMag Tune-Up Kit topic in the America Online WinMag message area.



## Preventing General Protection Faults (GPFs)

As a protected, multitasking operating environment, Windows tries to prevent any one program from interfering with others that may be executing. When it detects a program that, for whatever reason, has done something it shouldn't, it stops the program, and shows you a General Protection Fault (GPF) dialog box. This indicates that things have gotten so far out of hand that Windows decided it was safest to shut down the application in question.

A GPF will usually indicate what module was executing when the problem was detected. Ones you may possibly see indicated in Wintune include:

\* HELL16.DLL: This dynamic link library (DLL) contains the actual low-level test code used by Wintune to conduct its CPU, FPU, Disk and Video tests. A GPF indicates that Wintune was not able to complete the test in question. This is most common in the video test (see [Solving Video Problems](#)), but can also happen in other tests--for instance, the disk test may fail if there's insufficient disk space.

\* VBRUN300.DLL: This DLL is the Visual Basic runtime interpreter. A GPF here indicates a Visual Basic problem. We are aware of one: If you attempt to execute Wintune on a RISC-based workstation using Windows NT, you may get a GPF if you are running an older version of VBRUN300. The reason for this is that the emulator logic in NT doesn't handle certain 386-specific instructions. A newer version of VBRUN300.DLL is available that will fix the problem--call Microsoft for details.

In any case, your best move when a GPF is encountered is to run the Dr. Watson application included with all versions of Windows (DRWATSON.EXE), which will give you a detailed report on what crashed--and then restart Windows.



[About the CPU and FPU tests](#)

[About the Disk Test](#)

[About the Video Test](#)

[About the RAM Test](#)



[Solving Video Problems](#)

[Preventing General Protection Faults](#)



[Preventing General Protection Faults](#)

[Getting Help With General Problems](#)



[Solving Video Problems](#)

[Getting Help With General Problems](#)



## **Check Item**

If you select it, a check will appear in front of it and the menu will close. Select it again, and the check mark will disappear and you will revert to the default behavior.



## **File Menu (Expert Mode)**

The extra item under the File menu in Expert mode is Load a Saved Test as Current. This allows you to see what the Tip Advisor would recommend for any computer in the database. It is not included in Standard mode because it is considered confusing. For example, if you rerun any of the tests, you will have a set of results that includes one test from the computer you are running on and four sets from the computer you loaded out of the database. In addition, the tips shown will almost certainly not be appropriate for the computer on which you are running.

You can switch from Standard mode to Expert mode using the dialog box under [Edit/Preferences](#).



## **File Menu: Save Present Test In Database**

The Save Results Database command allows you to save a private copy of the WINTUNE.TRF file used to store Wintune's database of test results (.TRF files are saved in a [proprietary binary format](#)). This includes both the stored results used in the Comparisons displays, as well as any of your own results that have been saved using the Save Present Test command.

Please be aware that Wintune uses the most recently saved database as the source for comparison data. If you save a database to a diskette, and remove the diskette, Wintune won't be able to find that data until the diskette has been reinstalled. In such a case, you should use the Open Result Database command, and select WINTUNE.TRF--this will restore Wintune to its default database.

The Save command becomes available only after running all tests.



## **File Menu: Open A Results Database**

The Open command allows you to select a .TRF file from which to draw comparisons and in which to store test results. .TRF files are saved in a [proprietary binary format](#). You can save information from multiple tests in one file.



## **File Menu: Save Results Database As**

When you select File/Save Result Database As you will be presented with a standard Windows command file dialog. Select the directory you want to save the file in from the Directories list, and type the name you want in the File Name: field. The type will be .TRF by default (.TRF files are saved in a [proprietary binary format](#)). You can also select .CSV if you want to export the database in comma-separated variable format for use by other programs (please note that Wintune can only \*read\* database files in .TRF format). Then click on the OK button to save the new database.



## **File Menu: Merge In A Result Database**

The Merge In A Results Database command allows you to merge a .TRF database into the currently selected database (WINTUN.TRF by default) used to store Wintune's database of test results. This includes both the stored results used in the Comparisons displays, as well as any of your own results that have been saved using the Save Present Test command.

When you select File/Merge In A Result Database you will be presented with a standard Windows command file dialog. Select the directory where the database to be merged is using the Directories list, and select the .TRF database that you want to merge in using the File Name: field. Then click on the OK button to merge in the new database. A confirmation dialog will appear warning you that this is a one-way process that cannot be undone.



## **File Menu: Print**

This command will cause Wintune to print a simple text-only report formatted exactly like the Details/All command. It will be printed on the current default printer.



## **File Menu: Printer Setup**

This command brings up the Windows printer setup dialog box that allows you to select a page range to print, print multiple copies, and divert output to another previously defined printer.





## File Menu: User Information

This dialog box appears when you first start Wintune, and if you select User Information under the File menu. You do not have to fill it in; simply press I'll Fill This In Later. If you do fill it in, it will help you identify the machine you tested and will make it easier to compare that machine to other, similar computers. You can move from field to field in this form with a tab or a carriage return; if you are satisfied with the information you have entered, press Save This Information and it will be written to the file that contains your Wintune results.

**System Information**

Please fill in this form as completely as possible. We will use the information you provide to identify this system in our database.

*Please fill out as completely as possible! This will help us identify you and your system!*

**General Information:**

Make / Model: Gateway 2000 P4D-33

Processor(s): 486/33

Memory: 8 MB

Other Info:

Check here if this is a Laptop/Notebook Computer:

**WINDOWS**  
MAGAZINE

Save This Information    I'll Fill This In Later



## **File Menu: Exit**

The Exit command shuts down Wintune and its associated service programs.



## **Edit Menu: Copy**

Any text that appears in a Wintune screen that can be highlighted can be copied onto Windows Clipboard by selecting the Copy item from the Edit menu. There is no Paste item because it is not appropriate to paste material into Wintune. Most text that appears in the left-hand box of a screen can be highlighted and copied. So can most material that appears on the Detail screens. You cannot copy graphics to Windows Clipboard from Wintune; if you need a copy of a graphic, you can use a screen-capture program, or follow our [instructions for screen capture](#) using standard Windows tools.



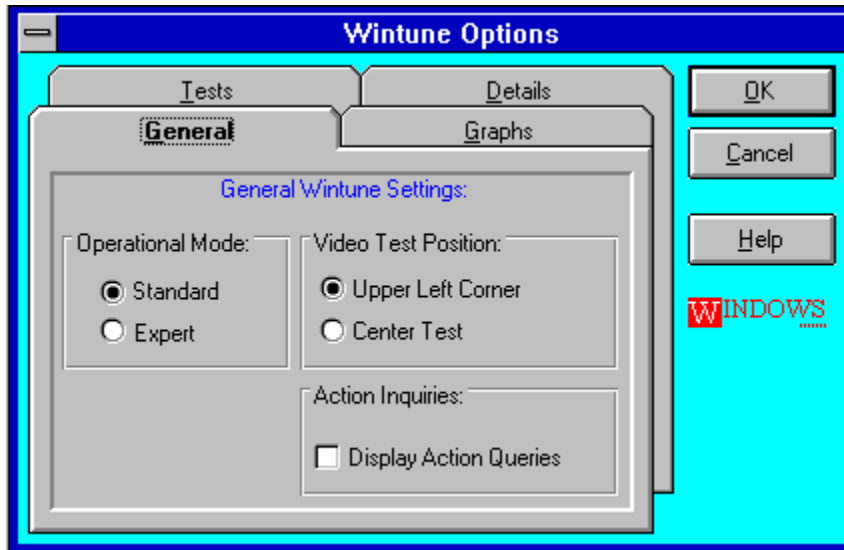
## **Edit Menu: Select All**

All text that appears in the currently visible left-hand box of a screen can be highlighted at once with the Edit/Select All command. To copy it onto Windows Clipboard, select the Copy item from the Edit menu. There is no Paste item because it is not appropriate to paste material into Wintune. Most text can be copied. You cannot select graphics. If you need a copy of a graphic, you can use a screen-capture program, or follow our [instructions for screen capture](#) using standard Windows tools.



## Edit Menu: Preferences

For more information about test preferences (whether you wish to run a Full test or Quick test, whether you wish the test to be run automatically on start-up), Detail preferences (how you wish details to appear on-screen and in printouts) or graph preferences (background colors of the charts and graphs), click on one of the tabs below.



This topic explains the choices you have under General Preferences.

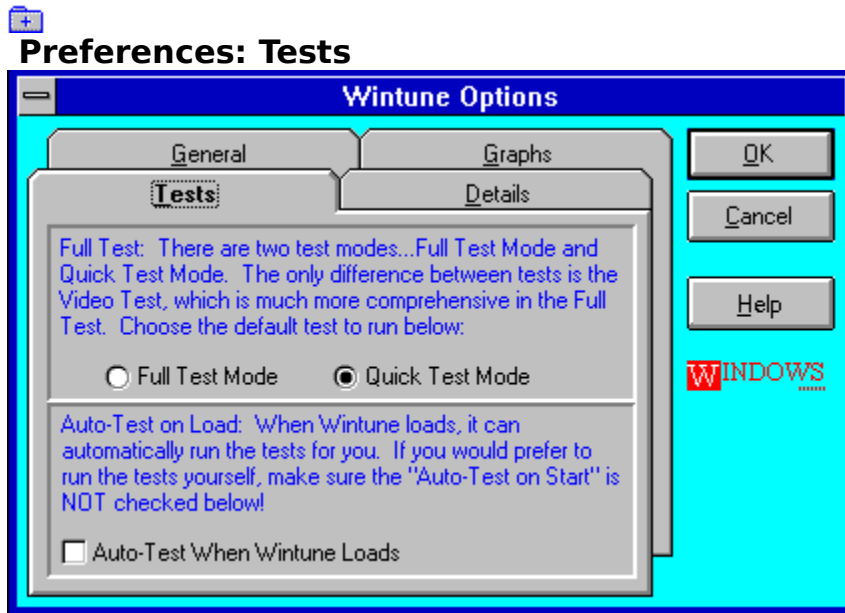
### Operational Mode

is a [radio button](#). Standard mode automatically turns over the results of your test to the Tip Advisor to offer tuning assistance for your system. Expert mode allows you to test a system and store the results without being offered system tuning tips.

### Video Test Position

is also a [radio button](#). You can choose to have Wintune run the Video test in the center of your screen or in the upper-left-hand corner.

Pushing OK accepts any changes you made; pushing Cancel exits without saving changes. Pushing Help brings you to this help screen.



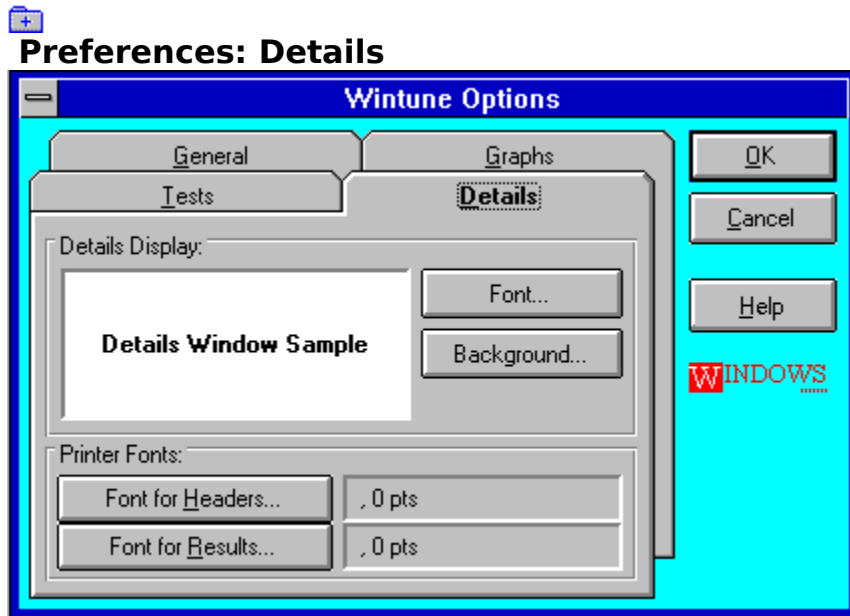
### Full Test Mode/Quick Test Mode

is a [radio button](#). The default is Quick Test mode, which tests [RAM](#), [CPU](#), [FPU](#), disk and video performance. If you check Full Test mode, Wintune will conduct a more comprehensive video test (it tests color capabilities) and memory test (it will move 50MB of data instead of 10MB) in addition to the regular disk and CPU tests.

### Auto-Test When Wintune Loads

is a [checkbox](#). If it is selected, Wintune will automatically run tests every time it is launched. The default is unchecked, which requires you to push the Start button in order to begin testing.

Pushing OK accepts any changes you made; pushing Cancel exits without saving changes. Pushing Help brings you to this help screen.



This screen is divided into two main sections, each of which contains two buttons.

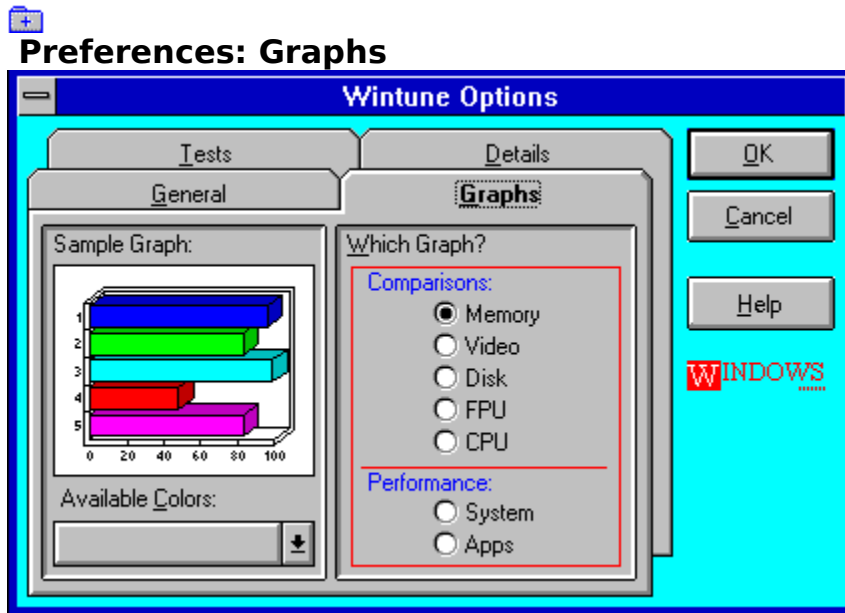
### Details Display

Push the Font button and you will see the dialog for selecting fonts. The results of your selection will be displayed in the left-hand panel that contains the words "Details Window Sample;" these words will be shown in the font and size you select. Push the Background button and you will see a common dialog for color selection.

### Printer Fonts

Push either the Font for Headers button or the Font for Results button, and you will see the common dialog for selecting fonts. There will be no on-screen display of your selection, although the font and size you select will be named in the small panels to the right of each button. These fonts will be used to format your printed output.

Pushing OK accepts any changes you made; pushing Cancel exits without saving changes. Pushing Help brings you to this help screen.



You cannot change the colors of the individual bars in Wintune's graphs, but you can change their background color. For each of the five tests under Comparisons (memory, video, disk, FPU and CPU) there are two kinds of graphs under Performance (system and apps, which is short for applications). System shows system performance measured in MB per second or millions of [pixels](#) per second; apps shows how many seconds a system would take to perform a typical application task. Comparisons and performance are both [radio buttons](#). After you select one button under Comparisons and one under Performance, you can select a color from the drop-down list marked Available Colors. The panel marked Sample Graph will reflect the new color scheme you select.

Pushing OK accepts any changes you made; pushing Cancel exits without saving changes. Pushing Help brings you to this help screen.





## **Test Menu: CPU**

This command executes the CPU test -- a 16-bit [Dhrystone](#) --and reports its results on-screen both graphically (by the relative height of the arrow on the left of the Home screen) and numerically. The graphical prediction will be relative to one of the three standard systems (386SX/16, 486SX/25,486DX2/50) stored in Wintune's performance database. You can get a comprehensive report on the test--including memory details--by clicking on the Details button in the [CPU](#) section of the main window.



## **Test Menu: FPU**

This command executes the floating-point test--a 16 bit [Whetstone](#) --and reports its results on screen both graphically (by the relative height of the arrow on the left of the Home screen) and numerically. The graphical prediction will be relative to a system you select, stored in Wintune's performance database; you can see it if you select the Comparisons tab on the top of the Home screen and the FPU tab along the left side. You can get a comprehensive report on the test by clicking the Details tab along the top and the FPU tab along the left side.



## **Test Menu: Memory**

This command executes the Memory Test (which tests both speed and size) and reports its results on-screen both graphically (by the relative height of the arrow on the left of the Home screen) and numerically. The graphical prediction will be relative to a system you select, stored in Wintune's performance database; you can see it if you select the Comparisons tab on the top of the Home screen and the Mem tab along the left side. You can get a comprehensive report on the test by clicking on the Details tab along the top and the Mem tab along the left side.



## **Test Menu: Disk**

This command executes the Disk Test--a mixed sequential and random-access disk test operating on a file containing 256 4KB records--and reports its results on-screen both graphically (by the relative height of the arrow on the left of the Home screen) and numerically. The disk to be tested may be selected using the drive selector at the top of the Home screen--but only after you have run one test on the default disk. The graphical prediction will be relative to a system you select, stored in Wintune's performance database; you can see it if you select the Comparisons tab on the top of the Home screen and the Disk tab along the left side. You can get a comprehensive report on the test by clicking on the Details tab along the top and the Disk tab along the left side.



## **Test Menu: Video**

This command executes the Video Test--a combination of text scrolling, lines and circles, filled shapes and (non-Quick mode only) 24-bit image rendering--and reports its results on-screen both graphically (by the relative height of the arrow on the left of the Home screen) and numerically. The graphical prediction will be relative to a system you select, stored in Wintune's performance database; you can see it if you select the Comparisons tab on the top of the Home screen and the Vid tab along the left side. You can get a comprehensive report on the test by clicking on the Details tab along the top and the Vid tab along the left side.




## **Test Menu: All Tests**

Selecting this menu item is the equivalent of pushing the Start button on the Home screen; it will immediately launch all of the tests in sequence.



## Help Menu (Expert Mode)

The extra item under the Help menu in Expert mode is Full Tips. This allows you to see every tip in the help engine, even those that are not appropriate to your system. It is not included in Standard mode because it is considered confusing. Most of the tips shown will almost certainly not be appropriate for the computer on which you are running. The inappropriate tips are indicated with a .

You can switch from Standard mode to Expert mode using the dialog box under [Edit/Preferences](#).



## **Help Menu: Contents**

This command executes the Windows Help program (WINHELP.EXE), loads Wintune's help file and brings up the Contents page. From here you can get to help on any topic by selecting the appropriate hotlink text.





## **Help Menu: Help Using Help**

This command executes the Windows Help program (WINHELP.EXE), then loads WINHELP.HLP, a help file that explains Help's generic features. This file contains no specific information about Wintune. .



## **Help Menu: Search for Help On**

This command executes the Windows Help program (WINHELP.EXE), loads Wintune's help file, and brings up the Search dialog. You can then search for help on any topic using the keyword list.



## **Help Menu: Frequently Asked Questions**

To open the frequently asked questions file, [Click Here](#) right now. Below is a detailed description of what happens when you click on that jump. It does the same thing as selecting the Frequently Asked Questions item from the Help menu

This command executes the Windows Help program (WINHELP.EXE), loads Wintune's Frequently Asked Questions Help file (WTFAQ.HLP), and brings up the Contents page. From here you can get to help on any topic by selecting the appropriate hotlink text. We revise this file from time to time as it becomes apparent that new questions are being asked frequently. Send an e-mail message to [wmcdfa@dnai.com](mailto:wmcdfa@dnai.com) and the latest text version of the frequently asked questions file (WT20-FAQ.TXT) will be sent back automatically.





## **Help Menu: About**

Displays the current revision number of WINTUNE.EXE, which is [copyrighted](#). You might find it interesting to click on the word "from" in this dialog box.



## Help Menu: Full Tips

Normally, when you finish running Wintune in Standard mode, the results of your benchmark are passed to the Tip Advisor, which displays relevant tips, ranked in priority order, in the box on the right-hand side of the Home screen. If you would like to see all of the available tips, even those that may not be relevant or applicable to your system, select Full Tips under the Help menu. Since the search, browse and table of contents features of the Tip help file have been disabled, the Full Tips option is the only way to see all the tips.

**CAUTION:** WINDOWS Magazine does **not** advise you to implement tips not suggested by Wintune; some of them may actually reduce your performance.



## Toolbar



Click on the menu item above and you will be shown help for that item. Note that there are two versions of the Toolbar. The toolbar on top is displayed when the tips are displayed in the right-hand panel of the Home screen. The icon on the bottom shows when Detail information about a particular test is showing in the right-hand panel of the Home screen.



## Understanding The Test Results



[Understanding The Test Results](#)

[Improving CPU and FPU Performance](#)

[CPU and FPU Test Results](#)





[Understanding The Test Results](#)

[Improving Disk Performance](#)

[CPU and FPU Test Results](#)



[Understanding The Test Results](#)

[Improving Video Performance](#)

[CPU and FPU Test Results](#)



[Understanding The Test Results](#)

[File Menu: Print](#)



## Instructions for Screen Capture

Neither Wintune nor WinHelp allows you to copy graphics to Windows Clipboard. . However, it is possible to make excellent, high-quality screen captures, suitable for printing or electronic mailing, using only tools that come with Windows. This is a proven method we use ourselves at [WINDOWS Magazine](#). It is typical of the kind of useful advice and tips we dispense regularly in the magazine.

- Bring up the screen you wish to capture and hit the Print Screen key. This transfers the screen image to Windows Clipboard. (NOTE: you may have to press the Alt or Shift key with the Print Screen key for screen capture to work with some computers.)
- Open the applet Paintbrush from within Program Managers Accessories group
- Select Options/Image attributes from the Paintbrush menu.
- Select View/Zoom out. A white area will appear in the center of your screen with gray areas on either side.
- Select Edit/Paste. A cross-hatched area called a "cutout" will appear in the white area. Move the mouse pointer to the gray area and click on the left mouse button. This pastes the image into the cutout.
- Select View/Zoom in.
- Select File/Save as. Click on the file-type combo box in the lower-left-hand corner of the dialog box and select the format you want.
- Click the mouse cursor before the filename and press the Del key. Next, type in a descriptive filename and click on OK. This will save a file of the captured screen.



## **TRF Binary Format**

Wintune 2.0 saves its results in Test Result File (.TRF) format. .TRF is a proprietary binary format developed specifically for Wintune 2.0. It essentially duplicates the internal test and system information data structures used by the Wintune 2.0 user interface in a binary file format. It cannot be read by other programs. A conversion program to import .TRF files into a database format such as dBASE is under investigation--check the Wintune 2.0 topic in the WinMag message exchange on [AOL](#) for more information.



## **Toolbar: Information or Tips**

This button toggles, so there are two versions of the Toolbar. When the informational "i" button is displayed, tips are being displayed in the right-hand panel of the Home screen. Push the "i" button and it changes into an RX button, representing prescriptions, or, in this case, tips. When the RX button is visible, detail information about a particular test is showing in the right-hand panel of the Home screen. Push the RX button and the tips appear in the right-hand panel, while the RX button again becomes the blue "i" button.



## **RAM Equals Memory**

Sometimes we use the words [RAM](#) and memory interchangeably, even though, technically, they do not mean the same thing (RAM is a specific kind of memory, usually the most abundant type). So, if you are having trouble finding a help topic, try looking under both RAM and memory.



## **Understanding The Home Screen**

Click on any element of the Home screen and either an explanation will pop up or you will jump to the explanation for that subject.



## **Start Button**

In the lower-left-hand corner of the home screen is the Start button. When you first open Wintune, you will see the "Press Here to Start" message moving to the left across the bottom of the screen.

## **File Menu**

You can save or print the results of any test run, open a new results file, merge results files, change your printer setup or modify the user information stored in your results file.

## **Edit Menu**

This menu allows you to copy informational text or explanation text from the screen to Windows Clipboard. It also includes the Preferences item, which allows you to choose between Expert mode and Standard mode, and between Quick Test and Full Test. You can also set graph background colors, and fonts used for Detail displays and printed reports.

## **Test Menu**

You can run any of the five individual tests (CPU, FPU, Video, Disk, RAM) or all of the tests by selecting items from this menu.

## **Help Menu**

This is the menu that provides access to the three help files that accompany Wintune: the main help file, which offers information about Wintune itself and about how to improve system performance; the Frequently Asked Questions help file, which contains the questions we are asked most often, and the Tips help file, which works with the Tip Advisor.

## **Status Line**

Once you have started Wintune, the animated "Press Here To Start" message disappears, and is replaced by status information on this line, such as "All Tests Completed!"

## **Medical Display**

Inspired by the overhead displays in the sick bay of the original Star Trek, these indicator arrows visually show the performance of various system components. If the arrows are green, performance is considered acceptable for the machine tested. If an arrow is red (as the RAM arrow is in the case of this screen), performance is below expectations and requires work. Clicking on any of the arrows brings up a description of the test in the right-hand window.

## Tip Window



During the testing, the left-hand window displays ongoing information about the test, the status line reports on its status and the right-hand window displays information describing the test. Once the tests are completed, the Tip Advisor fills the window with applicable tips. Tips with red exclamation points are urgently needed adjustments. Tips with the blue "i" informational icon might be useful for the system tested. You can view every tip available by selecting Full Tips. If you select this option, you will see a dialog warning you that any tips shown that weren't selected by the Tip Advisor are probably not applicable to your system. You can see the text associated with a tip by either double-clicking on the tip itself or single-clicking on the tip and pushing the View Selected Tip button at the bottom of the Home screen.



## **Test Disk**

This drop-down list allows you to select which hard disk Wintune will test.

## **Tabs**

Tabbed dialogs will be the navigational metaphor of choice in the next version of Windows, so we're getting you ready for them early with Wintune. All the screens, other than the Home screen, have sub-selection tabs appearing down the left-hand side. Performance shows you the system-level and application-level performance of your system, Comparisons shows you graphically how your system compares with other systems and Details shows you text describing the detailed results of Wintune's tests.

## **WINTUNE Opening Screen**

art withheld temporarily in this version

# WINTUNE Main Screen

Wintune 2.0 - DB: c:\wt20\wintune.trf

File Edit Test Help

Test Disk: c:

Home Performance Comparisons Details

	CPU MIPS	RAM MB/S	VID MP/S	DISK MB/S
Faster:	50	50	5	5
Slower:	0	0	0	0

- Upgrade your 486 CPU
- Check Low System Resources

View Selected Tip

Start All Tests Completed!

## **Selecting WinMag WinWord Template**

art withheld temporarily in this version

**Starting WinMag WinWord Macro**  
art withheld temporarily in this version

## **Excel Macro Dialog Box**

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**WINTUNE Icon**

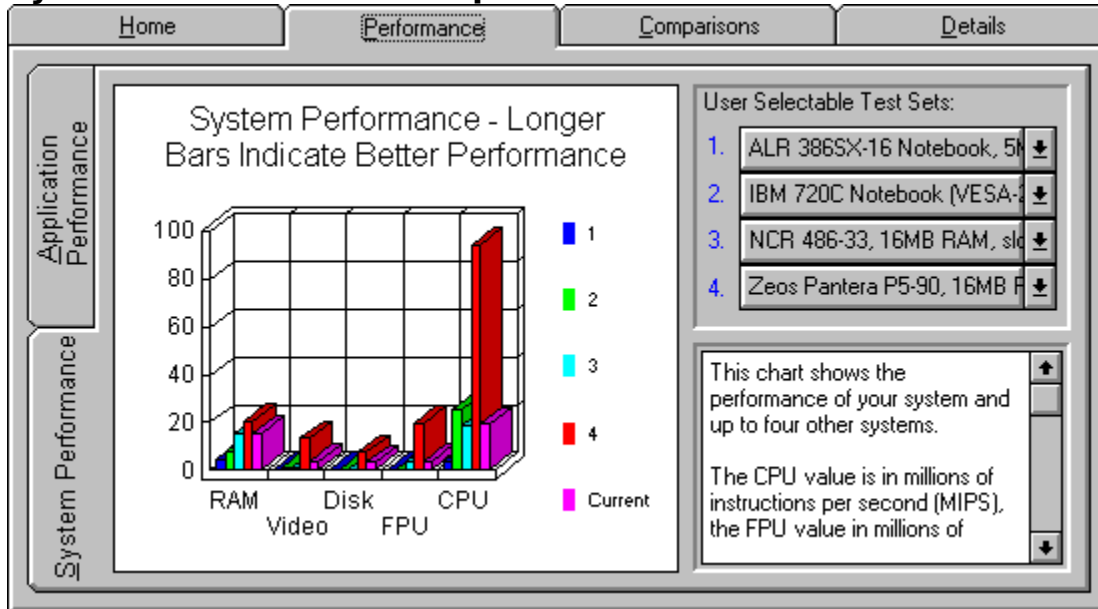




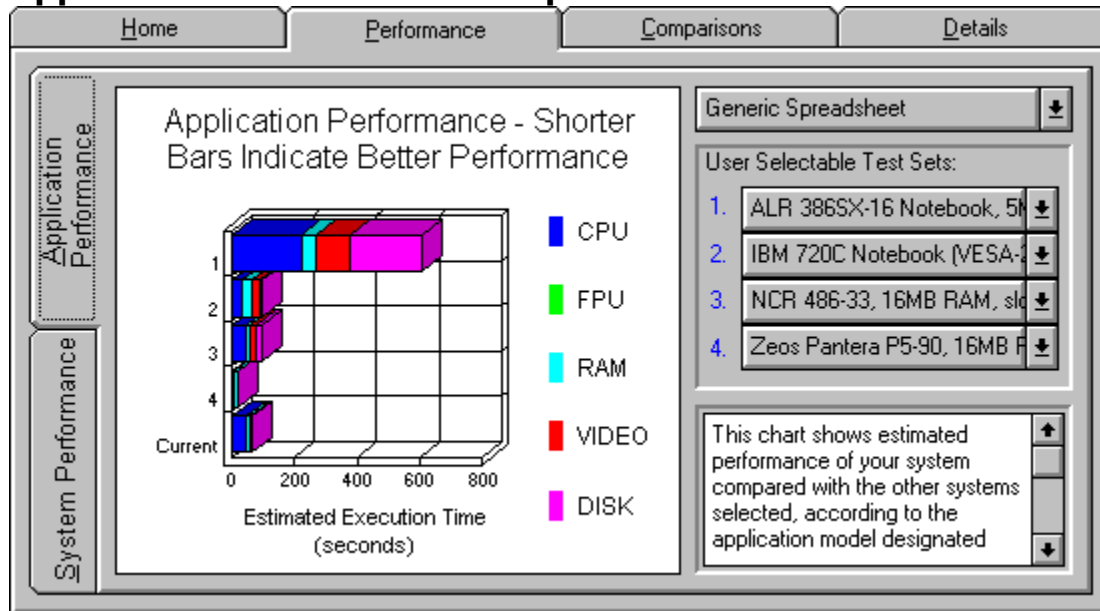
**WINTUNE Guided Tour**

art withheld temporarily in this version

# System Performance Comparison Bar Chart



# Application Performance Comparison Bar Chart



## **Slow Video Pie Chart**

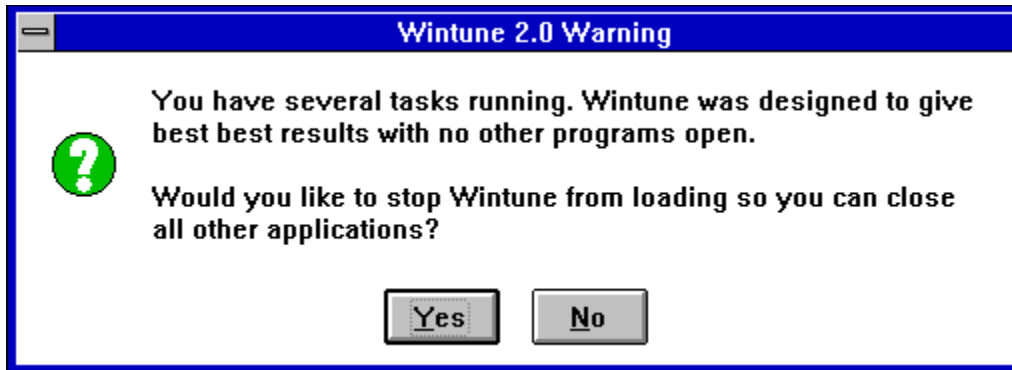
art withheld temporarily in this version

## **Memory Details**

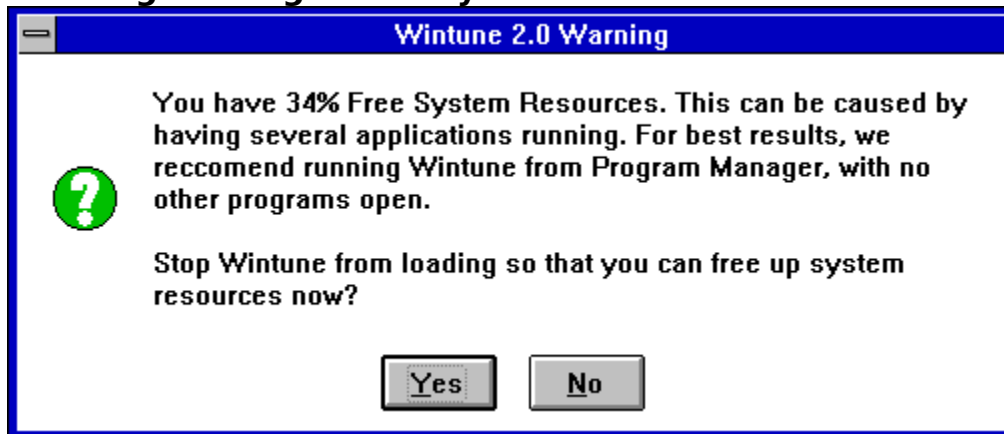
art withheld temporarily in this version

Note: You must scroll the display down to get to the memory details

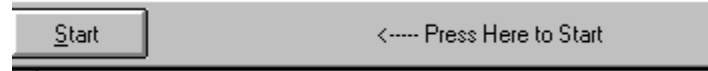
## Warning Message: Other Applications Running



## Warning Message: Low System Resources



## Start Button







## **The Author**

The material on this screen was prepared by John Woram, contributing editor of the Optimizing Windows column of WINDOWS Magazine. John is the author of Windows Configuration Handbook and The PC Configuration Handbook. Contact John care of Editor in the Letters to the Editor section of WinMag on AOL (keyword WinMag)



## What is 32-Bit Disk Access?



**Author**

Microsoft describes its 32-bit disk access system, or FastDisk for short, as a set of virtual devices that enhance disk-access performance over that provided by your system's BIOS. The devices are loaded via the following four lines in the [386Enh] section of your SYSTEM.INI file:

device=\*blockdev Coordinates I/O services between block and 32-bit disk access devices. Always installed (but subsequently deleted if 32-bit file access is enabled).

device=\*INT 13 Traps and emulates INT 13h BIOS calls. Installed if a 32-bit access device is present.

device=\*pagefile Handles the virtual memory paging file. Always installed.

device=\*wdctrl (Western Digital controller) Communicates with hard disk controllers that are compatible with the Western Digital 1003 controller interface standard.

In each case, the asterisk and absence of an extension after the name indicate that the device is an integral part of the Windows code, rather than a separate file in the SYSTEM directory.



## How 32-Bit Disk Access Works



**Author**

FastDisk speeds up disk operations by bypassing some switches between protected and real modes, and by communicating directly with the disk controller, instead of doing so via system BIOS. An improvement is most noticeable when switching between DOS applications running under Windows, especially if your PC has 4MB or less of RAM. Without FastDisk, a DOS session must be totally swapped into RAM before it can start running. In the worst case, a DOS session marked for background execution will continuously take up large amounts of RAM.

Since FastDisk provides support only for hard disks compatible with the Western Digital 1003 controller interface standard, the regular Windows setup procedure includes a compatibility check. If your controller passes the test, the `device=*wdctrl` line is written into the [386Enh] section as part of the setup procedure. Otherwise, the line is omitted and 32-bit disk access is unavailable.



## Troubleshooting 32-Bit Disk Access



Author

The most likely reason you won't get a 32-bit disk access option is that your controller isn't WD1003-compatible. That applies to most SCSI disk controllers. A few right-minded vendors, such as Future Domain, provide their own FastDisk drivers, but many do not. This option will also be unavailable if your hard disk uses nonstandard partitioning software. Usually, this software is loaded in your CONFIG.SYS file and takes over the job of processing disk requests for that drive. In either of these cases, you won't be able to use 32-bit disk access. (You may still be able to use 32-bit file access, though.)

Even if your controller is compatible and the WDCTRL device is loaded, FastDisk itself is not automatically enabled when Windows is first installed. That's because Windows has no way of knowing whether your computer cuts power to the hard disk to preserve battery life. If it does, then FastDisk is not advisable, for it might attempt a disk write to a drive whose power has just been cut. The risk of data loss far outweighs whatever performance improvements might be available. There are also some systems that appear to be compatible with WD1003, but are not. Therefore, it's up to you to turn it on once Windows is up and running.

[Click Here](#) if you have received either of these error messages:

### **Unable to Enter Protected Mode**

**WARNING: A serious disk error has occurred...**



## 32-Bit Disk Access Compatibility Problems



Author

With any luck, you won't see the following message:

### Unable to Enter Protected Mode

If you do, it means your hard disk controller is not compatible with the WDCTRL driver, and 32-bit disk access will have to be disabled. To verify that this is indeed the problem, type WIN /d:f to open Windows. If Windows now opens successfully, then that clearly indicates you cannot use 32BDA with your controller.

A more serious message may show up on some Windows for Workgroups systems:

**WARNING: A serious disk error has occurred while reading from/writing to your hard disk. Some data may have been corrupted. Your system has been stopped to prevent additional data loss. Call product support for assistance.**

Chances are this cheery little note was prompted by a corrupted virtual device in WIN386.EXE or by some other component within the 32-bit disk access system. If you have reason to suspect that WIN386.EXE is the culprit, expand a fresh copy into the SYSTEM directory and hope that takes care of it. Otherwise, it's probably easier to rerun the Windows setup procedure than to try to guess which component has gone bad.

If it turns out that problems such as these cannot be resolved because your controller is truly incompatible with the WD1003 standard, reedit SYSTEM.INI as shown here:

```
32BitDiskAccess=OFF
```

Better yet, put a semicolon in front of the line or delete it completely. In either case, the check box will be permanently disabled (grayed out or missing) so you won't accidentally get in trouble all over again.




## Enabling 32-Bit Disk Access




Author

To turn it on

 Double-click on Control Panel's 386 Enhanced icon. Perhaps in recognition of the 486 and Pentiums to come, the icon's name has been shortened to just Enhanced in Windows for Workgroups 3.11.

 Click on the Virtual Memory button

 Click on the Change button to open the full Virtual Memory dialog box.

If your system does indeed support FastDisk, you'll see a Use 32-Bit Disk Access check box at the bottom of the screen. If the box and legend are missing completely (which is the case in Windows) or grayed (in WFWG), that means the device=\*wdctrl line was not written into SYSTEM.INI because your disk controller was not recognized as being compatible with the WDCTRL driver. If so, do not add the line yourself unless you're absolutely certain Windows made a mistake and you're willing to bet all of your data on it. If you're not quite so confident, however, contact your drive manufacturer to see if an alternative 32-bit driver is available.

Before you do check the 32-bit Disk Access box, make a note of the virtual memory settings that also appear in the dialog box. In Windows 3.1, these settings may change when the box is checked. This is one of those Windows quirks, and if you don't want the new settings, just change them back again to their original values before closing the dialog box. Or bypass the entire procedure by directly editing the following line in the [386Enh] section in SYSTEM.INI:

```
32BitDiskAccess=ON
```

If you do add/edit the line by hand, FastDisk is enabled and all other settings remain undisturbed. In either case, you must exit and restart Windows for the change to take effect.



## **What is 32-Bit File Access**



The term 32-bit doesn't have anything to do with the type of expansion bus in your system. It refers to the ability of 386 and later CPUs to handle data 32 bits, rather than 16 bits, at a time. By using its own 32-bit code running in the CPU's protected mode, Windows can bypass the ancient 16-bit BIOS and DOS code to move more data in less time. Since it doesn't depend on your hardware bus, it works just fine on a 386 PC with a 16-bit ISA bus as well as a hot-off-the-line Pentium PCI system. (If somebody gives you a choice, though, take the Pentium.)

The documentation for WFWG 3.11 describes 32-bit file access (32BFA) with uncharacteristic understatement: "You can use 32-bit file access to write and read files from the hard disk more quickly." What is not mentioned is that 32BFA is on loan from the Windows 95 project.



## **Comparing SMARTDrive Cache to 32-Bit File Access Cache**



Briefly stated, 32BFA handles disk services in Windows' protected mode, rather than in MS-DOS's real mode. In addition, it replaces SMARTDrive's contiguous-sector cache with its own more efficient per-file cache.

### **The SMARTDrive Cache**

The SMARTDrive utility reads data into its cache from contiguous sectors on the hard disk. If a needed file is, in fact, stored in contiguous sectors, then this method works well. However, if a file is fragmented all over the disk (have you run Defrag lately?), then a cache full of contiguous-but-unrelated data isn't going to do much for you. If you are using DoubleSpace or Stacker, SMARTDrive is caching the data in compressed format, which lets the cache effectively hold double the amount of memory you allocate for it at the cost of decompressing the data each time it's read from the cache. Unfortunately, the SMARTDrive algorithm for searching its cache isn't great. Search time increases along with cache size, so large SMARTDrive caches are not as effective as they should be.

### **The 32-Bit File Access Cache.**

The new 32BFA cache reads the data for each file, wherever it is on the disk, and stores it uncompressed in the cache. (If you're using either DoubleSpace or Stacker, the data is decompressed before it reaches the file cache.) Therefore, the next read/write operation is more likely to find what it wants in the cache, even on a fragmented disk.

Another significant benefit is that it can cache files read across a network. The performance differences are not subtle, as they sometimes may be with 32BDA alone. A hash-coded (hash?) search is used to find cached data; this is more efficient than SMARTDrive, particularly as you specify larger cache sizes.








## Enabling 32-Bit File Access



Like 32-bit disk access, 32-bit file access is not automatically turned on during the WFWG setup procedure. To enable it,

-  Double-click on Control Panel's Enhanced icon
-  Click on Virtual Memory
-  Click on the Change button.

The 32-Bit File Access check box should appear at the bottom of the dialog box, with the current cache size shown immediately below it. If you check the 32BFA box, the cache automatically changes to a default size based on the amount of RAM installed in your system, with the selected value written into the [vcache] section of SYSTEM.INI, as shown here:

If you have:	Set RAMCache Size to:
4MB RAM (or less)	512KB (the default value)
6MB RAM (or less)	1,024KB
8MB RAM (or less)	2,048KB
12MB RAM (or less)	3,072KB
over 12MB RAM	4,096KB

MinFileCache=512

(default value, if 32BFA is not enabled)

or

MinFileCache=3072 (or other value, as appropriate, if 32BFA is enabled)

If your computer shares directories with others, double the recommended cache size for improved response time, provided you can do so and still keep 4,096KB free for other purposes.

Once you've lived with a given cache size for a while, try adjusting it up or down by 1MB or so (RAM permitting, of course). Some users report better performance at 3,072KB than at their system's default of 4,096KB. You too may or may not find better overall performance at some setting other than that chosen by Windows itself.





## Troubleshooting 32-Bit File Access



If the Use 32-Bit File Access setting is grayed out, that means Windows has detected one or more situations that prevent 32BFA from being used. The most likely reason is a TSR or utility such as a print spooler in your AUTOEXEC.BAT file. Sometimes redirecting output of a command in your AUTOEXEC file will cause this as well. Remove any TSRs or redirection, at least until you've nailed the problem. Also make sure that the line DEVICE=IFSHLP.SYS is in your CONFIG.SYS file, since 32BFA needs this to run. Restart Windows and see if the box is no longer grayed out. One other minor catch you may encounter: If you're using DoubleSpace, you need to have DOS 6.2, not 6.0, installed. Under DOS 6.0, even if you take out DoubleSpace and remove all traces of it from your CONFIG.SYS file, you won't be able to use 32BFA until you delete the hidden DBLSPACE.BIN and DBLSPACE.INI files from your root directory.

What About Max? Why is there a line called MinFileCache? Why not WINFileCache, or just VCACHE? The choice of Min certainly implies there's a MaxFileCache out there, as well, and sure enough, there is. Both the Min and Max lines hide out in the VCACHE.386 file, but Max FileCache is not yet documented. Taken together, they suggest that eventually we'll be able to specify both a lower and an upper limit to the 32-bit file cache. Perhaps this is a little piece of Windows 95 that was not ready in time for WFWG 3.11.

There's another pair of cache-related lines that did make it into WFWG 3.11, although the documentation could use a little tweaking. There's both a ForceLazyOn=xyz and ForceLazyOff=xyz. These two lines refer to the lazy writing feature, in which information is written to the cache immediately, held there until the system isn't busy, and then written to disk. The xyz in each line represents a drive, or drives, for which lazy writing is to be forced on or off. The resource kit cryptically says that "the default state is dependent upon the computer configuration."

Okay, but what does that mean? It turns out that if the drive being cached is a Stacker drive, Windows turns off lazy writes by default; otherwise lazy writes are turned on. This is because of the increased chance of damaging files if errors occur while lazy-writing compressed disk data.



## **Are 32-Bit File Access and Disk Access Worth It?**



As a quick review, note the various results reported for overall disk performance. With 32-bit file access disabled (by default under DOS 6.0, or optionally under DOS 6.2), there's not much improvement if 32-bit disk access is enabled. In fact, if you were to run a real-world comparison test on this system, odds are you wouldn't be able to detect any noticeable difference.

But look what happens when you turn on 32-bit file access. Disk operations improve by more than one order of magnitude. It would appear that 32-bit file access transforms pedestrian plodders into ultimate driving machines.

What happens when this screamer comes out of the lab for a test drive in the real world? Apparently, there are potholes even on a protected road, for here the enhancement offered by a 32-bit disk/file access combo is not as great: more like 2 to 1.



## Troubleshooting 32-Bit Operations



For routine troubleshooting, you can open Windows with 32BFA and/or 32BDA disabled by using any of the following switches:

win /d:c disable 32-bit file access only (WFWG only)

win /d:f disable 32-bit disk access

win /d:cf disable both

Note that switch usage is not exactly intuitive; c disables file access, while f kills disk access. (Think of it as c for cache, and f for FastDisk. Or just look it up.)

If a DoubleSpaced system hangs on the Windows logo when 32-bit file access is enabled, make sure the following line does not appear in the [386Enh] section:

```
NoEMMDriver=On
```

The line prevents the RMM.D32 (real-mode mapper driver) file from loading, and this file is required with both DOS 6.2 DoubleSpace and Stacker systems. The file is not explicitly cited in SYSTEM.INI, but is loaded by the VXD\LDLDR.386 virtual device.

If you encounter memory-related problems after enabling 32-bit file access, it's possible that the SMARTDRV line in AUTOEXEC.BAT did not get rewritten to reduce the size of the Windows cache. If so, you can edit it yourself:

```
C:\DOS\SMARTDRV.EXE xxxx 128 (other parameters, as needed)
```

The xxxx is the size of the DOS cache, and 128KB is the typical minimal size for the Windows cache. Adjust that value as desired for your system needs. You probably don't need several megabytes any more, but 512KB or 1024KB might be worth a try.

