

Windows Memory Diagnostic User Guide

Microsoft Corporation

Introduction

The Windows Memory Diagnostic tests the Random Access Memory (RAM) on your computer for errors. The diagnostic includes a comprehensive set of memory tests. If you are experiencing problems while running Windows, you can use the diagnostic to determine whether the problems are caused by failing hardware, such as RAM or the memory system of your motherboard. Windows Memory Diagnostic is designed to be easy and fast. On most configurations, you can download the diagnostic, read the documentation, run the test and complete the first test pass in less than 30 minutes.

To run Windows Memory Diagnostic, you must reboot your computer with the disk or CD-ROM on which you installed Windows Memory Diagnostic in the drive. After the reboot, Windows Memory Diagnostic will load and its interface will appear. After loading, the first test pass will begin, using the default standard test suite, and continue until complete, unless Windows Memory Diagnostic is either paused or exited. Once the first test pass is complete, Windows Memory Diagnostic will begin a second test pass using the same settings as before. Windows Memory Diagnostic will continue to run test passes until you exit.

This users' guide provides necessary information and step-by-step instructions that you can use to run Windows Memory Diagnostic. It is important to read the information and instructions in this guide before you use Windows Memory Diagnostic.

Quick Start Information

- Windows Memory Diagnostic user interface is currently available only in English. However, you can still use the Windows Memory Diagnostic tool on computers configured to use languages other than English.
- To use Windows Memory Diagnostic, your computer must have either a 3.5-inch floppy drive or CD-ROM drive.
- We recommend that you print this users' guide, so that you have it available as a reference when running Windows Memory Diagnostic. While Windows Memory Diagnostic is running, you will be unable to access this file.
- Microsoft would like your feedback on Windows Memory Diagnostic. Once you have used Windows Memory Diagnostic, please let us know what you think by completing the short survey at the Microsoft Web site.

Windows Memory Diagnostic tests the Random Access Memory (RAM) on your computer for errors. If you are experiencing problems while running Windows, you can use Windows Memory Diagnostic to determine whether the problems are caused by failing hardware, such as RAM or the memory system of your motherboard. If Windows Memory Diagnostic reports any errors, then one or more memory components is failing.

To run Windows Memory Diagnostic, you must first set up Windows Memory Diagnostic on a 3.5-inch floppy disk or CD-ROM:

Windows Memory Diagnostic User Guide

Microsoft Corporation

1. Go to the directory where you saved the Windows Memory Diagnostic executable file, **mtinst.exe**.
2. Double-click **mtinst.exe** to start Windows Memory Diagnostic Setup. Depending on your security settings, the **File Download** dialog box might appear when you run **mtinst.exe**. If it appears, click **Open** to start Windows Memory Diagnostic Setup. Other security dialog boxes might also appear. This can happen, for example, if you try to install Windows Memory Diagnostic from a Universal Naming Convention (UNC) shared folder. These dialog boxes are related to your security settings and not to Windows Memory Diagnostic. If you experience problems when you are trying to install Windows Memory Diagnostic, either be sure to run **Mtinst.exe** from your local computer, or review your security settings and the documentation included in your version of Windows.
3. Do either of the following:
 - Click **Create Startup Disk** to install Windows Memory Diagnostic on a floppy disk. Select the floppy disk drive that you want to use from the list provided. Insert a formatted floppy disk into this drive and then click **Create**. When the installation is complete, the **Success** dialog box will appear.
 - Or, click **Save CD Image to Disk** if you want to create a CD-ROM that you can use to start your computer. Select a location where you want to save the International Organization for Standardization (ISO) 9660 image and then click **Save**. When the file has been saved, the **Success** dialog box will appear. For more information about creating a CD-ROM that you can boot from, see the Note at the end of this section.
4. Restart your computer with the disk on which you installed Windows Memory Diagnostic (either the floppy or CD-ROM drive). Important : In the boot sequence, the drive with the Windows Memory Diagnostic disk must precede any other devices on which there is a bootable program, such as a hard disk on which Windows is installed. You can configure the boot sequence in the BIOS settings. On most computers, the default boot sequence includes the floppy drive. For more information about configuring the boot sequence, see the documentation for your motherboard.

If you want to create a CD-ROM that you can start your computer from, you must use additional software to create this CD-ROM from the ISO 9660 image, which is named **Winddiag.iso**. To create this CD-ROM from the image, you can use the **Cdburn.exe** utility, which is provided as part of the Windows Server 2003 Resource Kit Tools. Instructions for downloading and installing these tools are available at the Microsoft Web site. Instructions for using **Cdburn.exe** are included in the download package. In addition, you must have a CD-ROM drive that can write to CD-ROMs. These drives are typically called CD-R or CD-RW drives. Your CD-ROM drive must also support CD-ROMs that you can boot from. Consult the documentation for your CD-ROM drive for more information.

Running Windows Memory Diagnostic

Be sure to remove the floppy disk or CD-ROM on which you installed Windows Memory Diagnostic when you finish using it. Otherwise, Windows Memory Diagnostic, and not Windows, will start again after your computer is rebooted.

Windows Memory Diagnostic User Guide

Microsoft Corporation

After creating the floppy disk or CD-ROM, you must restart your computer with the disk or CD-ROM on which you installed Windows Memory Diagnostic in the disk drive. After you restart your computer, Windows Memory Diagnostic loads and its interface appears. After loading, the first test pass begins and continues until complete, unless you pause or exit Windows Memory Diagnostic. Once the first test pass is complete, Windows Memory Diagnostic begins a second test pass using the same settings as before. Windows Memory Diagnostic continues to run test passes until you exit it.

Understanding Windows Memory Diagnostic Results

If Windows Memory Diagnostic completes the first pass and reports no errors, then your RAM is probably working correctly. It is unlikely that Windows Memory Diagnostic will find any errors with your RAM on subsequent passes using the same settings. If you want to test your RAM more completely, you can run the extended test suite by pressing **T** while Windows Memory Diagnostic is running. You should then let Windows Memory Diagnostic run overnight. If you change the test suite or any of Windows Memory Diagnostic settings, the test pass will restart from the beginning.

If Windows Memory Diagnostic detects any errors with your RAM, the screen is updated with information about the error. A result of Failed for a test indicates that particular test detected an error. If any tests fail, then your computer has failing hardware.

If Windows Memory Diagnostic detects errors in your hardware, you should correct the errors and run Windows Memory Diagnostic again until you get a report of no errors before you attempt to run Windows again. If you do not, Windows may not work correctly. You can attempt to identify the specific failing memory component. However, if errors are detected and your computer is under warranty, we recommend that you contact the manufacturer for troubleshooting.

Using Windows Memory Diagnostic To Troubleshoot

For some hardware configurations, Windows Memory Diagnostic can identify the specific failing memory component. If Windows Memory Diagnostic can successfully isolate all the errors detected to one or more corresponding memory modules, the **View errors by memory module** option will be available in the menu. You can use this option to determine which specific memory modules are failing and need to be removed or replaced. If the option is not available, you can try to manually identify the failing memory component, as described below.

Manually Identifying Failing Memory Components

To manually identify the failing memory component, you must open your computer's case and work with sensitive internal hardware. Doing this can result in damage to your hardware. If you do not have experience working with your hardware or do not want to chance damaging your hardware, you can still use Windows Memory Diagnostic to test your RAM, but you should contact a third party to do the actual work on your hardware. If your computer is not under warranty or you are experienced working with sensitive internal hardware then you can attempt to isolate the failing hardware.

Review the following recommendations and guidelines before attempting to work with your hardware:

- Review documentation for all relevant hardware, including your motherboard, RAM, and computer case.

Windows Memory Diagnostic User Guide

Microsoft Corporation

- If any of your components are "over-clocked" (that is, if their clock speed is increased above default values), reset the components to their default clock values and rerun Windows Memory Diagnostic.
- You must ground yourself before touching any internal hardware components, such as the motherboard or RAM modules. Grounding yourself removes any static electrical charge your body might be carrying. To ground yourself, you can wear antistatic wrist straps or you can do the following:
 1. Turn off the computer.
 2. Touch an unpainted metal part of your computer case with your hand.
 3. Plant your feet and do not walk around (because walking can produce static electrical build-up). If you do need to walk around after grounding yourself, you must re-ground yourself as described in this procedure.

If you do not know how many memory modules are installed in your computer, you should review your motherboard documentation to determine where the memory sockets are. Then, open your case, locate the memory sockets, and count the number of memory modules. Once you have determined the number of memory modules, you can use the following procedures to try and isolate the source of the hardware problems.

The first step is to try reseating your memory module. In studies done at Microsoft, this fixes the problem one-third of the time on desktop systems and one-quarter of the time on laptop systems.

To reseat one or more memory modules, Do one of the following:

- If you used the **View errors by memory module** option and Windows Memory Diagnostic was able to identify the specific failing memory module(s), then remove only that module or modules. Be sure to note which slots contained those memory modules.
- Otherwise, remove all memory modules from their slots on the motherboard. Be sure to note which slots contained the memory modules.
 1. Gently remove any dust or debris from the memory module slots on the motherboard.
 2. Firmly reinsert the memory modules into their original slot on the motherboard.
 3. Rerun the Windows Memory Diagnostic tool.

If, after reseating all memory modules, Windows Memory Diagnostic continues to identify errors then you can try one of the following procedures to identify the specific failing components. To troubleshoot errors on a computer with one memory module:

1. Obtain a memory module that you know is working correctly.
2. Replace the memory module currently in your computer with the one that works correctly.
3. Rerun Windows Memory Diagnostic and then do one of the following:

Windows Memory Diagnostic User Guide

Microsoft Corporation

- If Windows Memory Diagnostic reports zero errors, you can conclude that the original memory module is failing.
- If Windows Memory Diagnostic reports errors, then your motherboard may be failing. Contact the manufacturer of the motherboard.

To troubleshoot errors on a computer with more than one memory module:

1. Remove all memory modules but one.
2. Rerun Windows Memory Diagnostic and then do one of the following:
 - If no errors are reported, remove the current memory module and add one from the set of memory modules that you previously removed.
 - If errors are reported, remove the current memory module, making sure to separate it from the other memory modules.
3. Add a new memory module from the set of memory modules that have not yet been tested.
4. Rerun Windows Memory Diagnostic.
5. Repeat this procedure until all the memory modules have been tested.

On some systems with slow floppy drives, Windows Memory Diagnostic may require more time to load before it can begin testing. The loading progress is represented by periods (.) displayed after the **Loading** message, which appears when Windows Memory Diagnostic starts.

- If Windows Memory Diagnostic reports errors on all memory modules, the motherboard may be failing. Contact the manufacturer of the motherboard.
- Be aware that there may be problems with your RAM or other hardware that Windows Memory Diagnostic cannot detect. That is, if Windows Memory Diagnostic reports no errors, it is not proof that your hardware is working correctly.
- During those tests that run with the microprocessor cache off, there can be a time delay between when a key is pressed and when Windows Memory Diagnostic responds.

To confirm its accuracy, Microsoft has tested Windows Memory Diagnostic with more than 70 different motherboard, motherboard chipset, and RAM combinations.

Appendix

System Requirements

Windows Memory Diagnostic supports x86-based computers with the following microprocessors:

- Intel - Pentium or Celeron families

Windows Memory Diagnostic User Guide

Microsoft Corporation

- AMD - K6, Athlon, or Duron families
- Microprocessors compatible with those listed above

You can test all types of RAM that run on x86-based computers with the supported microprocessors. However, if you have error checking and correcting (ECC) RAM, Windows Memory Diagnostic may not report any errors because the ECC mechanism automatically detects and corrects the error. It might still be useful to run Windows Memory Diagnostic if you have ECC RAM because it may detect errors that the ECC RAM is unable to correct (which indicates problems with the RAM).

Windows Memory Diagnostic is limited to testing only the first 4 gigabytes (GB) of RAM. If you have more than 4 GB of RAM, the remaining RAM after the first 4 GB will not be tested by Windows Memory Diagnostic.

Windows Memory Diagnostic User Interface

While Windows Memory Diagnostic is running, you will see the user interface, which is divided into five sections:

- The menu at the top of the screen provides access to configuration options.
- The top screen (below the menu options) displays information about the test that is being run and shows progress indicators for the entire pass, the current test, and the memory range.
- The left half of the middle of the screen displays a summary of the result of recent tests and passes that have been run.
- The right half of the middle of the screen is the system memory map and displays the range of memory locations currently being tested.
- The bottom of the screen displays a summary of errors. If errors are detected, then data about the error will be displayed. Otherwise, a default message is displayed, which indicates that no errors have been detected.

Options

This table describes the options that are available at the top of the screen, depending upon the current status of Windows Memory Diagnostic:

Option	Description
(P) Pause	Pauses Windows Memory Diagnostic. To access the additional menu options, you must first pause Windows Memory Diagnostic.
(X) Exit	Immediately exits Windows Memory Diagnostic and restarts the computer. You must remove Windows Memory Diagnostic from either the floppy disk drive or the CD-ROM drive to start Windows.
(T) Run extended tests	Runs the extended test suite. This collection of tests will test your RAM more thoroughly and require more time to run. This menu option is available only when the standard tests are being run.
(T) Run standard tests	Runs the standard test suite. This menu option is available only when a test suite other than

Windows Memory Diagnostic User Guide

Microsoft Corporation

	the standard test suite is being run.
(C) Resume	Returns Windows Memory Diagnostic from a paused state and resumes testing. This option is available only when Windows Memory Diagnostic is paused.
(M) Menu	Provides advanced configuration options. This option is available only when Windows Memory Diagnostic is paused.
(Tab/Arrow keys) Navigate	Using the tab key, you can navigate around the Windows Memory Diagnostic screen. Using the arrow keys, you can scroll and review the data in certain areas of the screen.

Menu Options

To access the following menu options, from the main interface screen, press **P** to pause Windows Memory Diagnostic and then press **M** (Menu). The menu options available will vary, depending upon whether errors have been detected and whether the system information is available to Windows Memory Diagnostic.

Option	Description
View errors by memory module	Displays the errors, sorted by the memory module in which the errors occurred. You can use this option to identify the specific failing memory module. This option is available only if memory errors are detected and can be isolated to a specific corresponding memory module.
View errors by test	Displays the error, sorted by the test that detected them. This option is available only if memory errors are detected.
View system information	Displays information about the memory modules installed in your computer, including the module type, the module manufacturer, and the slot on the motherboard in which the module is installed. The amount of information displayed can vary, depending upon the memory module. This option is available only if system information is detected.
Advanced options	Displays the following additional advanced configuration options: <ul style="list-style-type: none"> • Change cache settings. You can choose whether to run all tests in the selected suite with the microprocessor cache on or off. Turning the cache off will increase the time for the test to complete and provides more thorough testing. • Change the memory map. You can choose to use an extended memory map rather than the default standard map. Using the extended memory map approximately doubles the time each test takes to complete and more thoroughly tests the RAM. • Change the test suite. You can choose between the basic, standard, or extended test suite. You can also select from among all available tests to customize the test suite.
About Windows Memory Diagnostic	Displays version information about Windows Memory Diagnostic.

Selecting A Test Suite

The default test suite is the standard test suite. It begins running when you start Windows Memory Diagnostic. If you want to change the test suite, you can select the extended test suite by pressing **T** while Windows Memory Diagnostic is running. In addition to the standard and extended test suites, you can also select the basic test suite or create a custom test suite. To select a test suite other than the standard or extended test suite, go to the **Advanced Options** menu (described in the previous "Menu options" table) and then select **Change the test suite**. This will show you more information and provide additional suite configuration options.

How Windows Memory Diagnostic Works

To test the RAM on your computer, Windows Memory Diagnostic runs a test pass, which consists of all the tests that are included in the currently selected test suite. While Windows Memory Diagnostic is

Windows Memory Diagnostic User Guide

Microsoft Corporation

running, status indicators display the progress of the test pass, the individual test, and the range of memory addresses that are currently being tested. Once the test pass is complete, Windows Memory Diagnostic starts over and begins a second pass, using the same set of tests. These repeated test passes continue until you exit Windows Memory Diagnostic or change the configuration of the test suite. The default test suite is the standard test suite.

If Windows Memory Diagnostic completes the first pass using the standard test suite and reports no errors, then your RAM is probably working correctly. It is unlikely that Windows Memory Diagnostic will find any errors with your RAM on subsequent passes using the same settings. If you want to test your RAM more completely, you can run the extended test suite overnight. You can also create a custom test suite or change the test configuration using advanced options.

If Windows Memory Diagnostic reports any errors, you should correct the errors in the memory system and run Windows Memory Diagnostic again until you get a report of no errors before attempting to run Windows again. Otherwise, Windows may not work correctly. There are several components that comprise the memory system including the individual RAM modules, the memory sockets on the motherboard, the motherboard chipset, the microprocessor, and the microprocessor cache. In some cases, the memory modules may not be correctly installed in the motherboard memory socket, which would cause memory errors even though the modules are not failing.

In some cases, Windows Memory Diagnostic can identify the specific memory module that is failing. If, however, Windows Memory Diagnostic is unable to identify the specific memory module that is failing, you can use the procedures described in this guide to attempt to isolate which hardware component is failing. However, only the hardware manufacturer can confirm for certain that the hardware is defective.

Be aware that there may be problems with your RAM or other hardware that Windows Memory Diagnostic cannot detect. That is, if Windows Memory Diagnostic reports no errors, it is not proof that your hardware is working correctly. If Windows Memory Diagnostic reports no errors, but you continue to experience errors that might be caused by failing hardware, you should get technical assistance to troubleshoot your hardware more extensively.

Memory Tests

Windows Memory Diagnostic includes a comprehensive set of memory tests that provide varying degrees of testing thoroughness. The tests are organized into three predefined test suites: basic, standard, and extended. These categories reflect, in increasing order, the time for each test to run as well as the probability of the test detecting errors. The standard test suite includes all of the tests in the basic and standard categories. The extended test suite includes all of the tests in the standard test suite plus the tests from the extended category. The extended test suite takes the longest time to run and is the most thorough test suite.

Each test consists of a testing algorithm, a microprocessor cache setting of either on or off, and a test pattern. Each algorithm is designed to identify a certain type of memory error. The algorithms are combined with different microprocessor cache settings and test patterns to identify different types of errors.

Windows Memory Diagnostic User Guide

Microsoft Corporation

Types Of Memory Errors

Windows Memory Diagnostic tests are designed to identify the following types of memory errors:

- An error that occurs when a memory address fails to retain its assigned value
- An error called a coupling fault, which occurs when a memory address is altered by writes to other addresses on the same memory device

To determine whether a memory address fails to retain its assigned value, Windows Memory Diagnostic writes a test pattern, such as all zeroes or all ones, into the memory address and then reads the actual value stored in the memory address. If the actual value does not match the expected value (which is the original test pattern written into the address), then there is an error in the memory system. To determine whether there is a coupling fault, Windows Memory Diagnostic writes a test pattern into a memory address. Next, several other memory addresses on the same device are written to. Finally, the value in the first memory address is read to see if it has changed. If the value in the first memory address has changed (as a result of data being written to other addresses on the device), then a coupling fault has occurred and there is an error in the memory system.

Sample Run Times

This table lists the time it takes for Windows Memory Diagnostic to run one test pass of the standard test suite:

Configuration	Amount of time required to complete the standard test pass
Pentium II, 233 MHz 128 MB RAM	8 minutes, 32 seconds
Pentium III, 1 GHz 256 MB RAM	5 minutes
Pentium 4, 2.8 GHz 1 GB RAM	7 minutes, 25 seconds
Athlon XP 2000+, 1.67 GHz 400 MB RAM	4 minutes, 30 seconds

Glossary

Microprocessor Cache

A cache is a temporary storage system that improves performance by providing quick access to data. In this document, cache refers specifically to that part of the microprocessor that is used to hold data retrieved from memory modules. If the processor needs to access memory that already resides in the cache, it can do so quickly without requiring slower access to the memory module. The type and amount of cache varies by processor. In Windows Memory Diagnostic, some diagnostic tests are performed with the cache disabled to force the processor to access the memory module for every address.

Memory Module

A small circuit board that contains multiple memory chips. Memory modules are installed on the main circuit board of a personal computer (also known as the motherboard). Memory modules are designed

Windows Memory Diagnostic User Guide

Microsoft Corporation

to be removable and many motherboards have two to four memory module sockets in which the memory modules are installed.