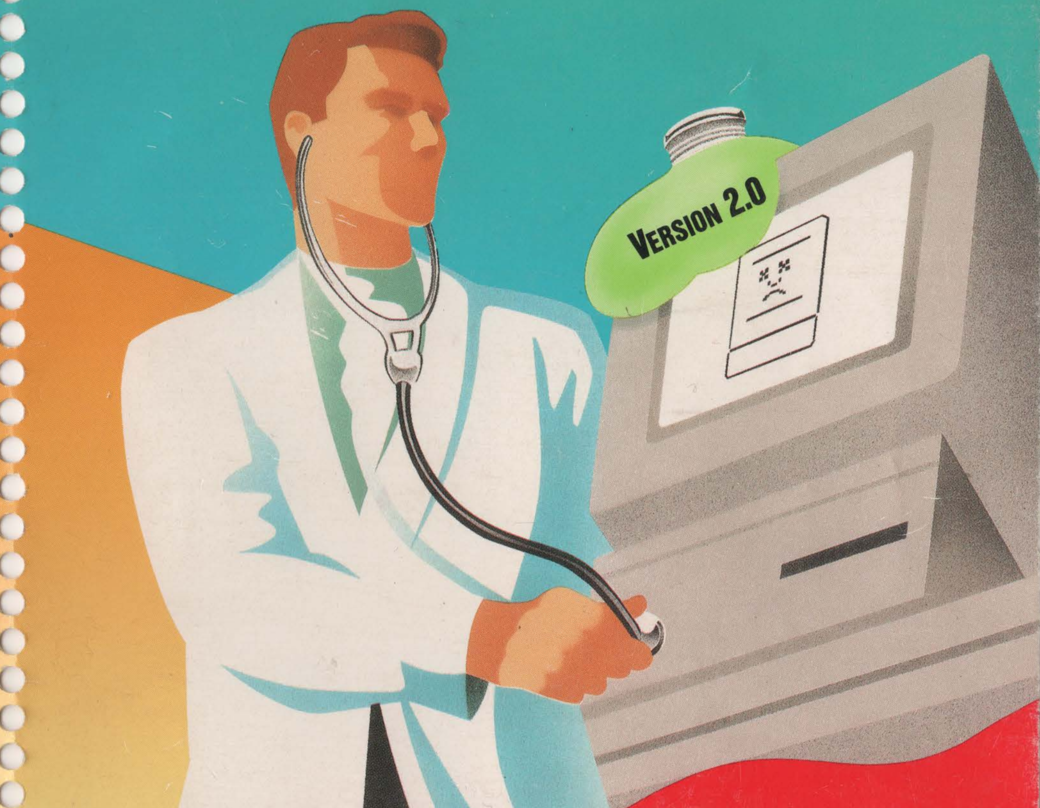
SNOOPER™

DESKTOP DIAGNOSTICS



DIAGNOSTIC
SOFTWARE
MANUAL

MAXA™

First in desktop diagnostics

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SNOOPER™

DIAGNOSTIC SOFTWARE MANUAL

MAXA™

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CHAPTER 1 **INTRODUCTION**

1-1 What is SNOOPER?

Snooper is diagnostic software for the Macintosh. It will help you detect hidden problems in your computer hardware, and help you locate the source of intermittent failures. Snooper can also tell you a lot about the machine on which you are running it. It has windows that will tell you what processor and co-processors the machine has and tell you everything that is connected to the machine via the various buses. Snooper will also show you how the machine on which it is running compares with other machines for various types of tasks. In short, Snooper will greatly enhance your communication with your machine, whether it is healthy… or not so healthy.

1-2 What SNOOPER is not

Snooper can help you save on diagnostic service costs, but shouldn't be thought of as a "technician in a box." Apple-certified technicians have gone through two weeks of in-depth training from Apple Computer and, often, other general electronics training. Apple authorized dealers and service providers also maintain a large library of updated binders with repair instructions geared toward the service technician's advanced knowledge of the subject. They also have tools that most people don't have and don't know how to use. If you are already an accomplished Macintosh technician, Snooper will become one of your everyday tools. If you are not an Apple-certified technician, you should weigh your knowledge of the subject and the possibility of voiding your warranty before using the diagnostic clues provided by Snooper to rationalize grabbing a soldering iron and going after a bad chip on the motherboard.

1-3 What's in the box?

You should have received a Snooper Master floppy disk, two serial loopback plugs, a registration card and this manual.

1-4 SNOOPER software requirements

The Snooper diagnostic software will work correctly on the entire line of Macintosh computers, starting with the Mac Plus. Snooper does require that the computer under test be running Apple's System Software version 6.0.3 or later, and at least 2MB of RAM are recommended. While Snooper is compatible with all System Software versions from 6.0.3 forward, some of the informational attributes of the software make use of System Software features that were not implemented until System 6.0.7. For this reason, we recommend using System 6.0.7 or later, if possible. To check the System Software version and RAM configurations, select "About This Macintosh" under the Apple () menu. **Figure 1** shows where the information is found in the "About this Macintosh" window.

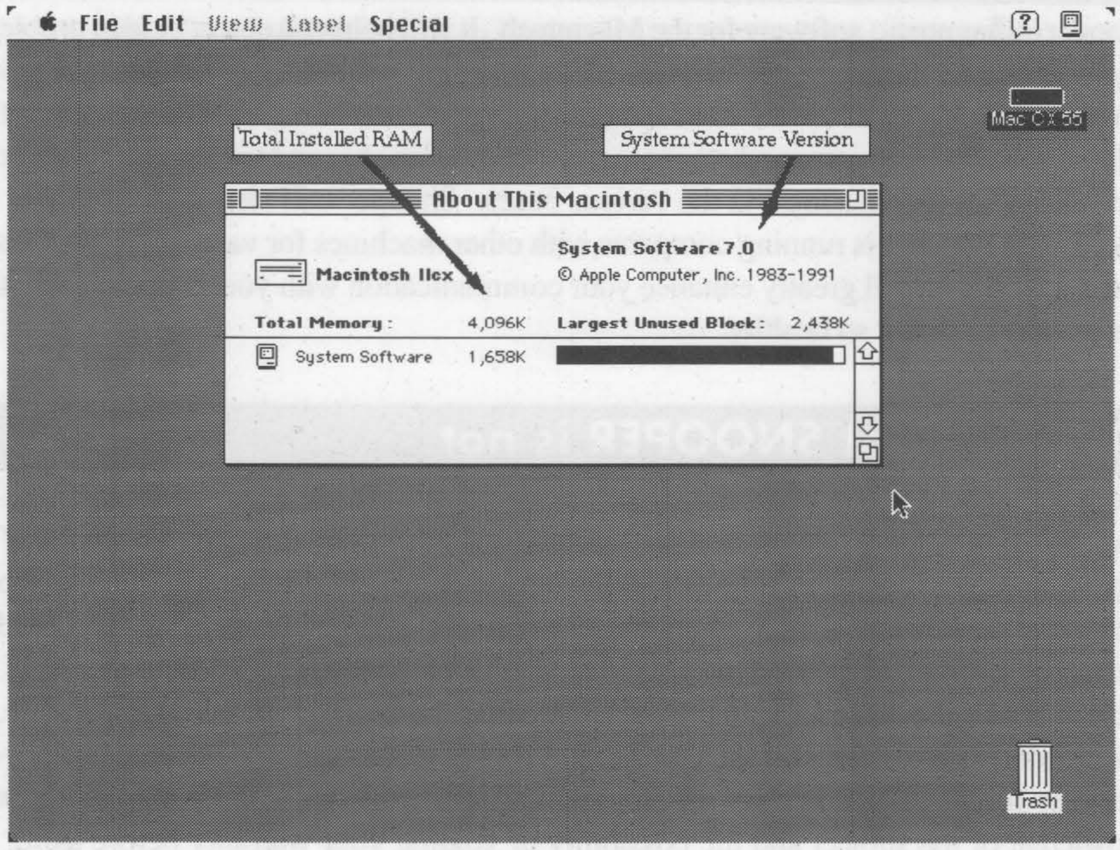


Figure 1. The "About This Macintosh" Window.

1-5 Registration card

Before you use the Snooper hardware and software, fill out the registration card and send it to Maxa. Without this card, Maxa will not be able to notify you when updates or upgrades are available. Also, take a few minutes to read the license agreement so you know your obligations.

1-6 Master disk

Make a copy of the Snooper Master disk that is in the sealed envelope. This is cheap insurance against loosing Snooper to an unforeseen catastrophe. Because Snooper is diagnostic software, it is assumed that it will eventually be used on a machine that is not functioning correctly. Unhealthy Macintosh computers tend to have a very bad temper, and are prone to corrupting files and committing various other types of mayhem. If a catastrophe occurs and the copy is damaged, you still have the Master disk to duplicate (on a healthy machine!). Don't say we didn't warn you!

1-7 Installing SNOOPER on your hard drive

For best performance, we recommend copying Snooper to your hard drive in addition to making the above copy of the master disk. While Snooper runs from a floppy, it can be a little sluggish (OK, a lot sluggish), just as any other software that uses lots of windows and pictures.

Short note from the Lawyer:

Hereinafter the aforementioned Party of the first part shall....

(Enough of that! We translated it into English for you.)

Snooper is sold as single-user software (contact Maxa for information on group or site licenses). It is intended that each "user" have his own copy of the software. If you are a user who is in charge of maintaining a large number of machines, you can use your copy of Snooper on any number of machines so long as you are the only one using it on all those machines. There should be a purchased copy of Snooper for each user of the product, though not necessarily one for each machine.

CHAPTER 2 GETTING STARTED WITH SNOOPER

2-1 Introduction

Snooper is very easy to use (a welcome departure from other diagnostic products that are intended only for use by trained technicians). This section will guide you through a few steps needed to properly set up your machine for use with Snooper. Even if you really know your way around a Macintosh, reading this section will help you avoid some confusion later when it comes to the tests that require a certain setup to function properly. Once these few details are out of the way, we believe that the interface is intuitive enough that most seasoned users will not need to read the rest of the manual.

2-2 Setting up the disk drives

Because Snooper tests many facets of the hardware on which it runs, there are a few important points about the setup of the computer which you should take note of before you attempt to use the Snooper diagnostic software. First, the floppy drive test writes to the disk that is inserted in the drive being tested. You should insert an unimportant, unlocked floppy in the drive with at least 10K of available space on it before using this test. This should be a floppy that does not contain important documents or applications, since the computer under test may be defective in such a way as to destroy the contents of the floppy when written to by the diagnostic software. We cannot guarantee the safety of your data in the event of a major malfunction of the computer or floppy drive during the testing.

While it is much more unusual for a serious problem to occur in writing to a hard drive, some caution should be observed regarding data stored on either internal or external hard drives on a computer that is acting erratically. It is suggested that any SCSI devices not required for the testing be disconnected until the testing has been completed and the source of malfunction has been repaired. This precaution should not be necessary on a properly functioning computer when Snooper is being used for configuration or benchmark purposes.

2-3 Installing the serial 'loopback' plugs

One setup requirement necessary to complete the full array of tests on the computer concerns the serial ports (the modem port and the printer port). Snooper comes with two "loopback plugs" that should be inserted in the modem and printer ports when the Snooper software is being used for testing purposes.

These plugs make it possible for each of the two serial ports to "talk to itself" when tested. If the plugs are not used during testing, it will not affect any of the tests that are not related to the modem or printer ports. If these ports are known to be in good working order and the serial port test results are of no interest, the plugs can be left disconnected with no adverse consequences.

Another requirement for proper operation of the modem and printer port test is that any other programs which use either the modem or printer port need to be disabled while Snooper is in use. This would include modem communication programs, fax modem software, AppleTalk®, music programs, printing, and any other program which makes use of the modem or printer port of the computer to be tested. Again, if you test a computer for other reasons, and do not suspect a malfunction of the modem or printer ports, this setup need not be performed. The only drawback will be an annoying message that will appear should you decide to try testing these ports without the plugs installed.

Another related situation can occur (although rarely) that will prevent the serial port tests from being performed. This situation gives the same annoying message as the above situation even after all other serial-related software has been disabled, making it appear that you have missed something. The Macintosh has a type of storage called parameter RAM (PRAM for short) that stores information even when the power is off. Most of the settings in the "General" control panel are stored in this small amount of permanent memory. There is another setting (not available through the control panel) that controls the use of the serial ports, and the default speed settings, etc. for these ports. This information is generally not used for much of anything, but if a strange and unworkable setting finds its way into these storage locations, it can prevent Snooper from using the ports. The only known fix for this problem is to "zap" the PRAM (that sounds ominous, but it just means set it all to default values that are safe). To zap the PRAM when running System Software version 6.0.7, just hold down the Command and Shift keys while selecting "Control Panels" from the Apple menu. To zap PRAM with System 7, hold down the Command, Option, P and R keys while restarting the computer. Don't bother to do this unless you have disabled all of the serial port software on a machine and still get the annoying message about the serial ports being in use. Zapping the PRAM has the unfortunate side effect of changing the mouse speed, desktop pattern, etc. back to the poorly chosen default values.

2-4 Optional equipment tests

No other particular hardware setup is necessary for the proper operation of the Snooper software. There are, however, a few functions of Snooper that are not available on Macintosh computers that do not contain certain optional equipment. On these computers, Snooper will still operate correctly, as the functions that require hardware that is not present will be disabled and cannot be selected by the user.

One example of this is the Video RAM test. Not all machines have dedicated VRAM. This test (on machines that do not have dedicated VRAM) will not be selectable.

The following sections of this manual give more detail about tests and functions that require a piece of optional hardware or special system software setup.

2-5 System software setup

Apart from the serial port setup in Section 2-4 above, all of the system software setup required by Snooper is accomplished via the Memory Control Panel under System 7. If you are running under System 6, you can ignore this section, as it does not apply to you. If you are using Snooper with System 6 and a third-party utility that gives you a RAM disk (see glossary), quasi-32-bit mode or virtual memory (see glossary), beware that Snooper may not be compatible with that utility software. It is best to disable them while using Snooper.

One of the options available in the Memory Control Panel on those machines equipped to use it is "virtual memory" (see Glossary). Virtual memory is only available if your machine has a PMMU chip (see Glossary) installed. All Macintosh systems equipped with a 68030 or 68040 microprocessor have a PMMU. Virtual memory must be OFF to test memory.

Another option in the Memory Control Panel is "32-bit Mode." This mode allows a Macintosh to make full use of up to 128 MegaBytes (1000 times as much as the original Mac 128K). Very few people have the need or the money to install that much memory in their machine, but if you have more than 8 MB installed you need to pay attention to the setting of this option. The memory tests in Snooper will only be able to test a maximum of 8 MB unless you turn on the 32-bit option. With 8 MB or less of memory installed, this setting is not relevant.

The other important option in the Memory Control Panel that concerns the memory tests in Snooper is the RAM disk option. This is only available under System 7 and only if your machine has enough memory to support it. This option *must be off* when using Snooper to test RAM. Using Snooper with the RAM disk option turned on would cause a system crash when Snooper tried to access the RAM acting as a hard drive. The System protects RAM disk memory to prevent other programs from corrupting the contents of the RAM disk. For this reason, the RAM tests would not be able to test any of the memory used by the RAM disk.

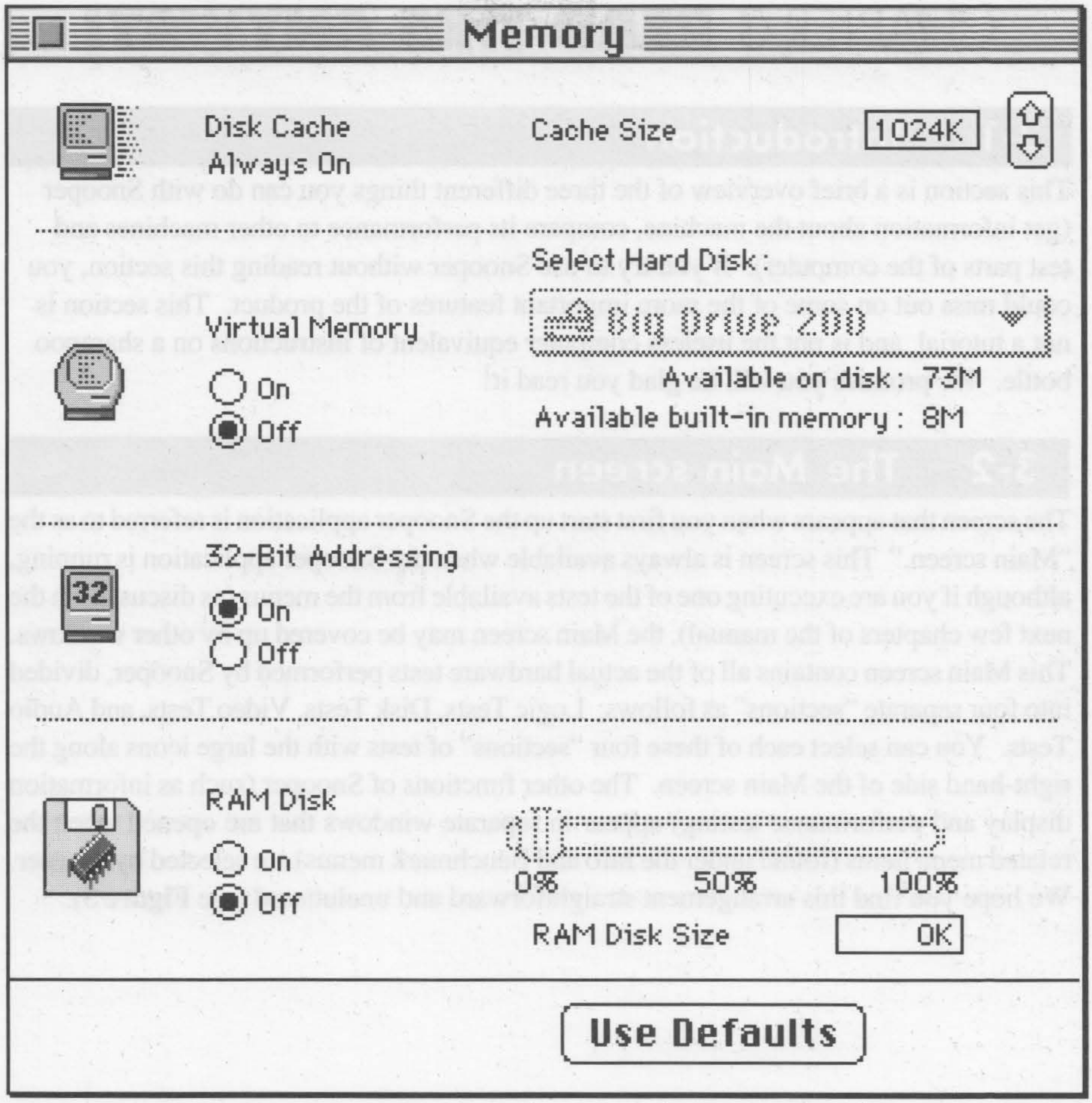


Figure 2. Memory Control Panel in System 7

CHAPTER 3 **READ THIS ANYWAY!**

3-1 Introduction

This section is a brief overview of the three different things you can do with Snooper (get information about the machine, compare its performance to other machines and test parts of the computer). If you try to use Snooper without reading this section, you could miss out on some of the more important features of the product. This section is not a tutorial, and is not the useless computer equivalent of instructions on a shampoo bottle. We promise you will be glad you read it!

3-2 The Main screen

The screen that appears when you first start up the Snooper application is referred to as the "Main screen." This screen is always available when the Snooper application is running, although if you are executing one of the tests available from the menus (as discussed in the next few chapters of the manual), the Main screen may be covered up by other windows. This Main screen contains all of the actual hardware tests performed by Snooper, divided into four separate "sections" as follows: Logic Tests, Disk Tests, Video Tests, and Audio Tests. You can select each of these four "sections" of tests with the large icons along the right-hand side of the Main screen. The other functions of Snooper (such as information display and performance testing) appear in separate windows that are opened when the related menu items (found under the Info and Benchmark menus) are selected by the user. We hope you find this arrangement straightforward and uncluttered (see **Figure 3**).

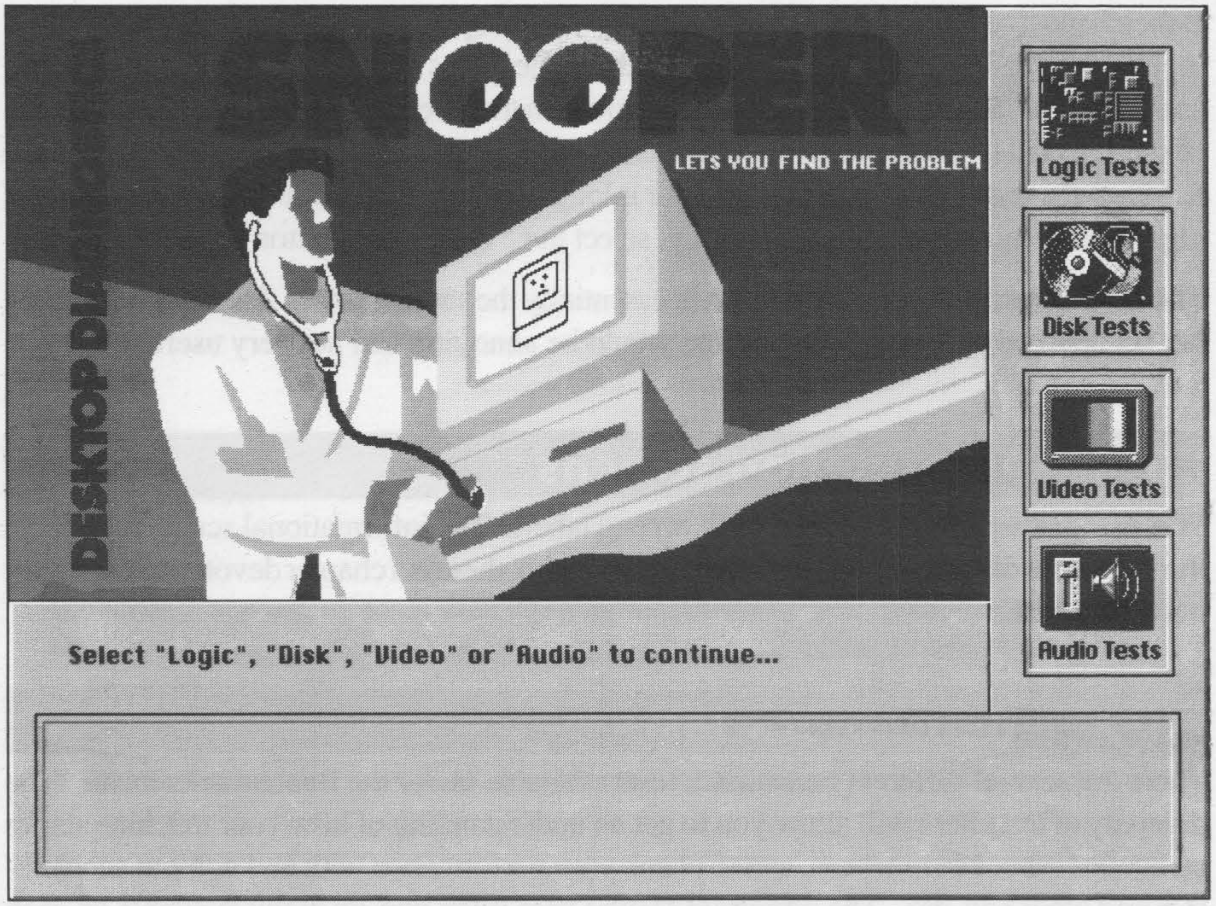


Figure 3. The Main Screen.

3-3 Main screen operation

The operation of the Main screen is designed to offer two different types of operation. Sometimes a user might think a particular part of the machine has failed and want to quickly run a test on it to verify the situation. Other times, a machine may be exhibiting strange and unpredictable behavior. In this case, it is often helpful to run several tests over and over, and wait for something to fail. To make it easy to do either of these types of testing, and allow total control over what is tested, we had to come up with a whole new way of selecting tests.

Within each of the testing sections (Logic, Disk, Video or Audio), the available tests are each depicted by an icon. If you click on one of the icons, that begins a test of that part of the computer. Nothing could be simpler: Click on the test, Snooper tests it and tells you immediately whether the test passed or failed.

Beneath most of these icons, is a "check box." To set up a number of tests to be performed repetitively for any length of time, simply check the boxes of the tests you want to include, and select the "Start Cycle" button further down on the screen . Snooper will then run each of the selected tests, one after the other, and continue the cycle until you stop it or pause it. While the testing is underway, Snooper is logging the results. To see what has happened after several minutes or hours of testing, select the "View Log" button to see the test log.

The Disk Tests and Video Tests work in essentially the same fashion. The Audio Tests are not set up to be used in a cycle, as that would be annoying and not very useful.

3-4 Information screens

Wet hair...lather...rinse...repeat (oops, wrong label). The informational screens available through the Info menu are self-explanatory. Even so, there is a chapter devoted to them later in this manual.

3-5 Benchmark tests

There are several different benchmark tests available under the Benchmarks menu. The diversity of tests here will allow you to get an understanding of how your machine stacks up against other Macintoshes, and to check your performance with and without accelerators and other add-ons. The important feature here is the pop-up menu available on each of the screens that allows you to select the type of machine to which you compare the results. It defaults to a comparison with a stock machine of the type you are running to check for proper operation of your machine.

3-6 What's next?

Chapters 4 through 7 discuss each of the four sections of testing available through the Main Screen. These chapters will give more information about how and when to use all of the many tests in Snooper, as well as more information about what each test is doing.

Chapters 8 and 9 are more detailed information on the Info and Benchmark features of Snooper.

Chapter 10 details the operation of the various types of on-line help included in the program.

Chapter 11 is a complete description of the File menu including documentation on the reporting capabilities of Snooper.

Chapter 12 is a trouble-shooting guide for the novice.

Chapter 13, entitled "Technical Details for the Terminally Curious," is just what its name says it is–more than you ever wanted to know about some of the fine details that were glossed over in the rest of this manual.

CHAPTER 4 **LOGIC TESTING**

4-1 Introduction

This chapter describes the tests grouped together under the Logic Test Window, obtained by selecting the Logic icon along the right-hand side of the Main screen. These are all of the tests that relate to subsystems found on the main logic board of the computer. By subsystem, we are referring to all of the chips, resistors, capacitors and other components on the board that are involved with a specific function of the logic board. A good example of a subsystem would be all of the parts involved with making the modem port work. This includes, but is certainly not limited to, the SCC (serial communications controller) chip that controls this function. It also includes the driver chips that are in between the SCC and the connector on the back of the machine, and even the connector itself. On a Macintosh, it would not be possible for a software routine to pick out specific chips to test without the other components related to that same function coming into play. While there are a few hardy souls out there who actually do take components off of the logic board and replace them, most technicians and others involved with computer maintenance simply want to know if the logic board has to be swapped out. They want to verify that a particular part of the computer either is or is not working. That's Snooper's job!

The following sections detail the operation of the various tests available in the Logic Test window. For a more general discussion of how to operate the controls, and start and stop tests, please see Section 3-3.

Another prominent part of the Logic Test window is the artist's representation of the logic board in the machine being tested. This is intended as a learning tool to help the novice become more familiar with the various components that make up the logic board. By moving the cursor over the components on the board, you can find out what many of them are called and what they are doing in the machine.

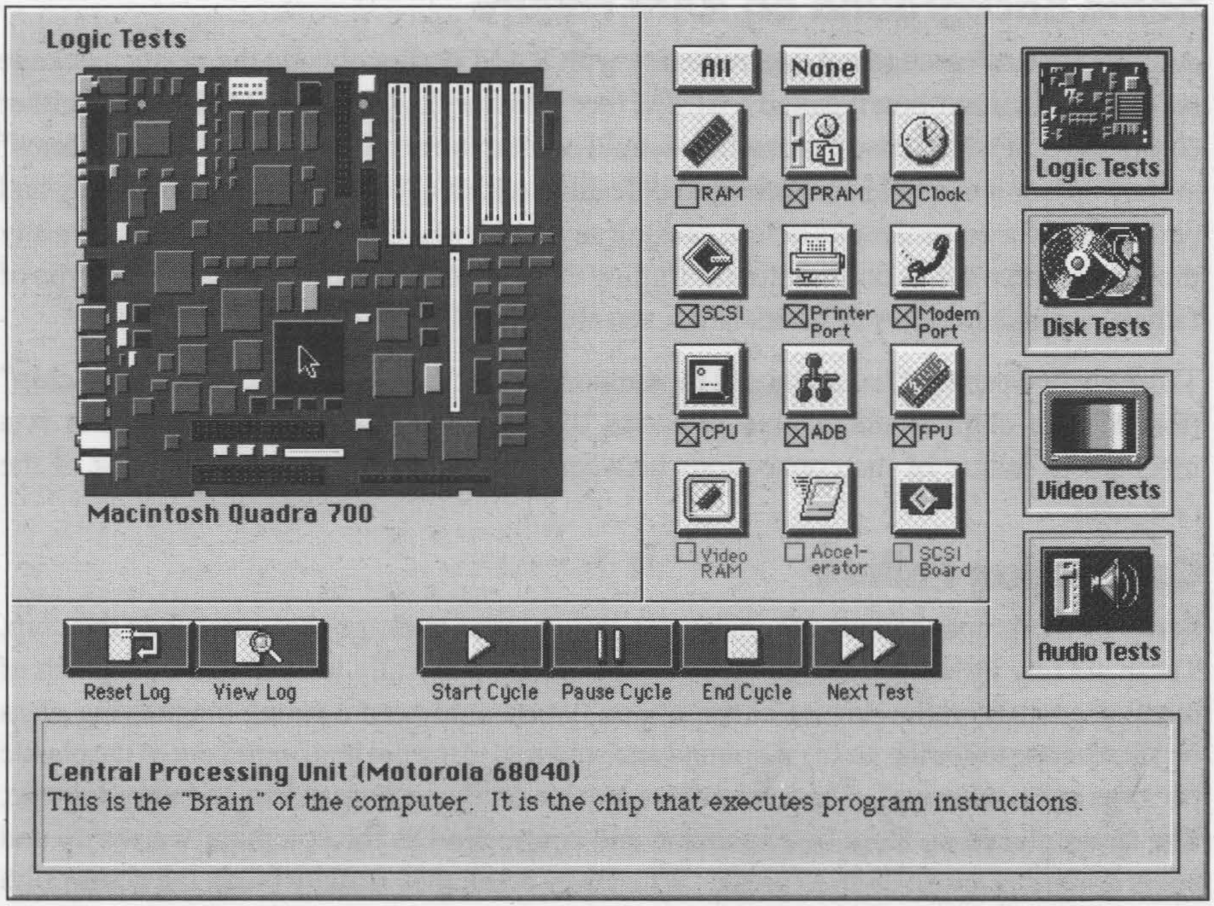


Figure 4. The Logic Test Window.

4-2 RAM testing - introduction

Snooper is able to perform several different levels of RAM testing. All of the RAM tests perform the same basic function. They save the contents of an area of RAM and replace it with a test pattern. They then read the RAM contents and verify that the test pattern was correctly stored, and replace the original contents of that area.

The level of testing, or thoroughness, with which RAM is tested can be selected with the RAM Preferences section of the Edit menu. The only variation between the three levels of testing provided is the type of test pattern used to test the RAM. All of the three levels provided test all of the RAM available. The second and third levels simply test it over and over again with different test patterns intended to uncover specific types of intermittent failures.

Some Background on RAM Failure

Another type of mechanical intermittency with RAM occurs outside the plastic package on the small circuit board called a SIMM (see Glossary). A RAM SIMM can fail either completely (in which case the machine would not start up at all, and would "blow chimes" at start-up), or it can fail in an intermittent fashion which allows it to start up normally and perhaps run for several hours before causing any problems. Snooper's RAM tests, like any diagnostic software, is only useful for finding the intermittent type of failure. This type of failure can take minutes or hours or days to show itself.

There are two primary failure modes for memory. One type is a failure of the actual "chip" (the delicate chip of silicon that performs the memory function), and the other is a mechanical failure of the connections between that piece of silicon and the rest of the computer.

Connection Failure

Some of those connections are inside the little plastic package that surrounds the chip. These are tiny little wires called "wire bonds" that are literally welded to a little patch of metal deposited on the surface of the silicon (you would need a strong magnifying glass or microscope to see the weld) at one end and soldered to the pin that comes out of the plastic package at the other end. These tiny wires are thinner than a human hair and very delicate. The stress placed on them by expansion and contraction as the computer warms up and cools down can cause them to break. When they break they usually break the connection completely, and the Macintosh will "blow chimes" (see Glossary) at start-up. Sometimes, however, a wire bond will break but not separate. When the machine warms up, the two ends come apart and an error occurs. When it cools back down, the two ends go back together and everything appears to be fine, so the machine starts up normally and passes the start-up RAM test. Snooper is very good at finding this type of RAM problem with its cycling RAM tests.

The many tiny pins on the plastic package are soldered to "traces" (see Glossary) on the SIMM. When the computer warms up, the SIMM board can warp or twist very slightly. When this happens, a weak or broken solder joint can separate just far enough to break the connection. This is often such a small gap that it cannot be seen with the naked eye (or even a scantily clad eye). This is another example of an intermittent RAM problem that would not be caught by the start-up RAM test performed by the Macintosh, but would be caught by the cyclic testing done by Snooper.

Another way this can happen is if there is a small fracture in one of the traces on the SIMM board, a situation very similar to a broken wire bond. Tiny amounts of warping and twisting occurring as the Macintosh warms up can cause one of these fractures to "open up" and lose the connection between the chip and the computer. The last of the mechanical failures which can sometimes create an intermittent situation is bad contact between the SIMM module and the connector into which it plugs. While this type of mechanical failure is usually not intermittent, the warping and twisting mentioned above can sometimes cause it to be intermittent in nature.

Chip Failure

The other type of RAM failure, when the silicon chip itself fails to operate correctly, is really much less common than the connection problems mentioned above, but it does happen. Sometimes a poorly manufactured chip can have contaminants on it that can cause a failure after many hours of operation. The contaminants act together with the heat generated by the chip and the electronic forces present to change the physical structure of a small area of the chip near the contaminant. This can cause one or more bits within the memory chip to stop working altogether, or to become "weakened" to a point where they barely work if everything is just right. If one or more bits stops working completely, the Macintosh may catch it during the next start-up check of the RAM and "blow chimes." If the chip is just made marginal by this corruption, a failure can be brought about by temperature or momentary dips in the supply voltage, or the importance of the task being performed on the computer. This type of failure is easily found by Snooper.

Note: Because Snooper would fail and crash the computer if it were to write test data into the part of the program performing the test, the section of RAM in which Snooper resides is skipped over in all of the RAM tests. Normally, this is not a large enough section of RAM to prevent the detection of bad RAM. In order to be absolutely certain you have tested all of RAM, you can simply test RAM with only the Snooper application running, then quit Snooper and launch some other program first before loading Snooper again. Running Snooper with another application launched first will cause a different part of RAM to be skipped (because Snooper is now loaded into a different spot in RAM).

4-3 Complete RAM testing (or how do I know when I'm done?")

The only accurate answer to the above question is "when you find the offending RAM SIMM, you are done testing." Of course this is a lousy answer if it turns out that the problem wasn't RAM at all. Finding an intermittent RAM problem should be considered a time-consuming process. The beauty of Snooper is that the time it consumes doesn't have to be yours. If time permits, the best way to test RAM is to set the RAM Preferences to the maximum (twenty patterns), and let the test run overnight. In lieu of answering the unanswerable question above, we will supply some of the background theory on RAM testing and let your knowledge and your patience be your guide.

The different levels of testing add more and more additional test patterns without changing the testing in any other way. The single pattern level tests all of RAM with a pattern that looks like this: 01010101. The next level of testing uses that pattern, its opposite: 10101010, and a pattern of all ones and a pattern of all zeros. The last level uses all of those test patterns plus a full complement of "walking ones" and "walking zeros." Those are four test patterns plus all possible patterns of a single one and the rest zeroes, and all possible patterns of a single zero and the rest ones (for a total of 20 patterns).

The reason this type of memory testing is regarded as superior to using an unchanging pattern is that there is a certain type of failure it can catch which an unchanging pattern might miss. This is a failure of the chip itself, not the various connections between the chip and the computer. One type of "weakening" of a bit in the chip can cause it to perform differently depending on the data stored in the bit right next to it on the silicon. This type of "crosstalk" between bits on a RAM chip can go undetected if an unchanging pattern is used to test memory. To detect these failures, it is necessary to use a combination of different patterns. The patterns chosen are arranged to test all possible combinations of data in adjacent bits. This will catch the "crosstalk" problem if it exists. With a changing pattern such as the Walking Ones Test provided by Snooper, this and all other failure modes are detected.

When an error occurs, the text box at the bottom of the window will display the malfunctioning memory address, and the bank and SIMM number of the offending SIMM. The offending SIMM on the artist's rendering of the logic board will also blink to show its location.

4-4 Parameter RAM test

This test performs a memory test on the "non-volatile" RAM that remembers system settings such as mouse speed and serial port configuration. It also tests the nonvolatile RAM that remembers NuBus configurations. The parameter RAM is the RAM that is kept "alive" by the same battery that keeps the clock running when the computer is off. In fact, some of the PRAM is actually in the clock chip.

Since the PRAM is not on a SIMM and cannot be replaced by the user, a failure in this test simply causes a message to be displayed, warning you that an error occurred. A failure in the PRAM is usually fixed by swapping out the motherboard. This would normally be done by an Apple-authorized technician.

4-5 Real time clock test

This test allows for cyclic testing of the Real Time Clock (RTC) used in the Macintosh to keep track of the time and date. The test consists of two different phases.

In the first part of the test, random times and dates are written to and read from the clock in order to test the read and write functions of the clock chip. In the second part of the test, the accuracy of the RTC is tested by comparing it with timing signals based on the more accurate timing crystal of the microprocessor clock. The crystal used for the RTC is not particularly good, and inaccuracies in the range of ± 10 to 20 minutes per year are common. For this reason, and because it would require several hours to precisely test the accuracy of the RTC, this second part is fairly loose and could be considered more a test of whether or not the clock is ticking. To get a better idea of the inaccuracy of the RTC in your Macintosh, try checking how much time is lost or gained against a good digital watch over a period of a week or two. If it is still within a minute, your RTC is better than most.

4-6 SCSI port test

The naming of this test is a bit tricky. There are some things that can be tested with software and others that can't. SCSI connection and termination is a leading cause of ulcers among Macintosh users, and we have included everything possible in the way of software-based SCSI testing to help ease this situation. There are two "SCSI tests" in Snooper. One is the in the Logic Test area and the other one is in the Disk Test area. Together, these two tests do everything that can be done from software to check out the SCSI bus and the communication with devices connected to it.

The SCSI test in the Logic Test window checks to see if all of the devices that are connected to the machine are responding to requests for data. This is a test that could show up a problem with an intermittent device that occasionally fails to answer up. The primary reason for including this test here is as a method of actuating each connected device repetitively in situations where a system is undergoing "burn-in" testing.

The SCSI test included in the Disk Test area of Snooper is more geared toward looking for SCSI connection problems. See Section 5-6 for more information on that test.

4-7 Printer port test

This test requires the installation of a serial loopback plug in the printer port. You also need to disable any other printer port software that may be using the port (see Section 2-3 for more setup information).

The test is comprised of two parts. The first part tests the hardware handshaking lines of the port, and the second part tests the data lines of the port at 300, 1200, 3600, 9600 and 19200 baud. If "Beep on Failures" (Edit menu) is turned on, there is an audible beep anytime a test fails. This enables a technician to start the test and go on with other work without keeping his eyes glued to the screen. This test doesn't test anything connected to the printer port, so don't think that you can connect a modem or printer to it and test those devices. In order for the test results to be meaningful, the loopback plug must be connected to the port.

If you are having trouble with a modem or other serial device, you can use this test to narrow the problem down to find out if it is with the serial port on the computer, or with the cable or device connected to it. It either eliminates or identifies the printer port as the source of the problem.

4-8 Modem port test

This test and the Printer Port Test (refer to Section 4-7) are virtually the same. The only difference is which port is tested. The loopback plug and port software admonitions given in that section apply equally to the Modem Port Test.

4-9 CPU test

This test puts the microprocessor through a grueling math test and checks the accuracy of the answer. The primary usefulness of this test is for additional actuation of the processor subsystem of the computer when using a cycle of tests either for burn-in testing or when looking for a hard-to-duplicate random intermittent failure. Everything the computer does requires microprocessor activity, so all of the tests performed by Snooper give the microprocessor a good workout. This is simply some additional work for it to perform to help chase an intermittent problem out of the bushes.

4-10 ADB test

This test is very similar to the SCSI test above. It does not perform any extensive testing of the ADB devices themselves. Its primary purpose in life is to actuate all of the devices on the bus for a cycle of tests for burn-in purposes.

We wanted to include keyboard and mouse tests in Snooper, but experience has shown us that the self-testing scheme included in the ADB specifications from Apple simply cannot be made to work reliably with all machines, and with all third party and Apple ADB devices. In addition to the futility of trying to get these tests to work, there is the fact that the tests don't test the parts of these devices that are most prone to failure -- the mechanical parts. They don't test the keys on the keyboard or the optical motion sensors in the mouse. Our last excuse for leaving these tests out is that you simply don't need them! Every Macintosh is shipped with a very good keyboard test called KeyCaps, found under the Apple menu. With this simple program you can test each and every key on the keyboard very easily. As for the mouse, it has only two functions to test, and without proper operation of both of those two functions you wouldn't be able to start up the Snooper application. It either moves the cursor around on the screen or it doesn't, and the button either works when you click it or it doesn't. There isn't any magical "test mode" that a diagnostic routine could use to find out if it *really* doesn't work. We prefer to use the space in Snooper for things that really test something.

4-11 FPU (floating point unit) test

The Floating Point Unit test is only available (and can only be selected) if the machine has a math co-processor installed. This test is similar to the CPU test except that in this test, the code is generated in such a way as to have the floating point unit do the math. The test gives the floating point unit a very grueling quiz and the answer is supposed to be 42. If the FPU comes back with any other answer to the ultimate question of life, happiness, and everything, it flunks the quiz, and the error is tallied in the test log. See the chapter called "Technical Details For the Terminally Curious" for a detailed explanation of the math test that is performed.

4-12 Video RAM test

The Video RAM test is only available on some machines. While it is true that all Macintosh computers use some RAM in the process of creating the images on the screen, only a few of them have separate RAM dedicated to this task on the motherboard. This test is for machines that essentially have a video board built into the motherboard. At the time this went to print, the machines that have the type of RAM tested by this test are the following: Mac IIci, Mac LC, Mac LCII, and the Quadras. In addition to the Video RAM built into these machines, this test can also test the Video RAM on a limited number of third-party video boards. Rather than trying to list them here, simply try to select the test. If your machine has Video RAM that the test can test, it will test it; otherwise, you will not succeed in starting the test.

The Video RAM test is less important than the regular RAM test in that if there is an intermittent Video RAM failure, it will not cause the machine to crash. The worst that could happen would be garbage on the screen for the duration of the failure. More commonly it would be so short in duration that you would not see its effect. A Video RAM failure would usually have to be of the hard, permanent, legs-up-in-the-air, dead-chip variety to cause a significant problem with the machine. On the other hand, some of the machines mentioned above do have replaceable Video RAM SIMMs, and if yours fails in such a way that you can still make out the results of the test on the screen (or if you hook up a video board and second monitor on which to run the test), this test can tell you if replacing the Video RAM SIMM is likely to solve the problem.

4-13 Accelerator board test

This test is designed to test specific functionality of certain selected accelerator boards. At present the only boards supported by this additional testing are the Daystar Digital Power Cache boards.

If your machine has an accelerator product other than the one mentioned above, you should understand that an accelerator "takes over" the machine in which it is installed and essentially puts to sleep the microprocessor that Apple put in your machine. The CPU test above will actually be testing the functionality of the microprocessor on the accelerator board instead of the one native to the motherboard. Rest assured that your accelerator is being tested by the other tests in Snooper.

4-14 SCSI accelerator board test

This test is intended to serve the same purpose as the SCSI test above (Section 4-6), but for an additional SCSI bus added to the machine with a SCSI accelerator board. Currently, the only boards supported by this test are the PLI QuickSCSI, and MicroNet NuPort boards.

CHAPTER 5 DISK TESTING

5-1 Introduction

To test out a SCSI or floppy disk drive, select the Disk Tests icon along the right-hand side of the Main screen. This window (see **Figure 5**) has an interface very similar to that of the Logic window. There are several icons for selecting tests, and many of them include a checkbox that will allow you to include that test in a continuous cycle of tests.

There is also a pop-up menu that can be used to select which disk drive you would like to test, if there is more than one SCSI drive connected. Only drives that the Macintosh has recognized and displayed on the desktop will be selectable. A drive that contains more than one partition will actually be represented by each of the mounted partitions. Selecting any one of the partitions for the drive will result in adequate testing of the entire drive. It is not generally necessary to test each of its partitions separately.

If the drive you select is one that uses a third-party NuBus card for connection to the computer, the Read and Write Tests will be available for that drive, but the Sector Test and the Seek Test may not be available for that drive. These tests are available only for drives connected to the built-in (native) SCSI port on the Macintosh, or on a few supported SCSI accelerator boards. If a drive passes several cycles of the Read and Write Tests with no errors, it is probably OK and the other tests are not necessary.

It is possible for a connected drive to be too "messed up" for the Macintosh to recognize it and mount it. In this case Snooper will not find it either. Usually this either means that the disk drive controller card is not even communicating with the Macintosh, or the directory information on the disk drive that the Macintosh uses to make sense of the data on the disk is corrupted. If the disk drive shows up in the SCSI Info window (choose SCSI Info in the Info menu) then the drive is communicating, and it is possible that the drive can still be used after it has been reformatted with a hard disk utility.

If the drive does not show up in the SCSI Info window, there is still some hope for the drive. Some other things that could cause the drive not to show up are:

1) If there are two SCSI devices that are set to the same SCSI address or ID number, either or both of them may not show up in the SCSI Info window, and also would not mount on the desktop.

2) A bad cable can cause a device to not be recognized by the Macintosh.

3) An improper connection setup, such as terminators used incorrectly or too long of a cable, can also cause one or more devices to not be recognized by the Macintosh.

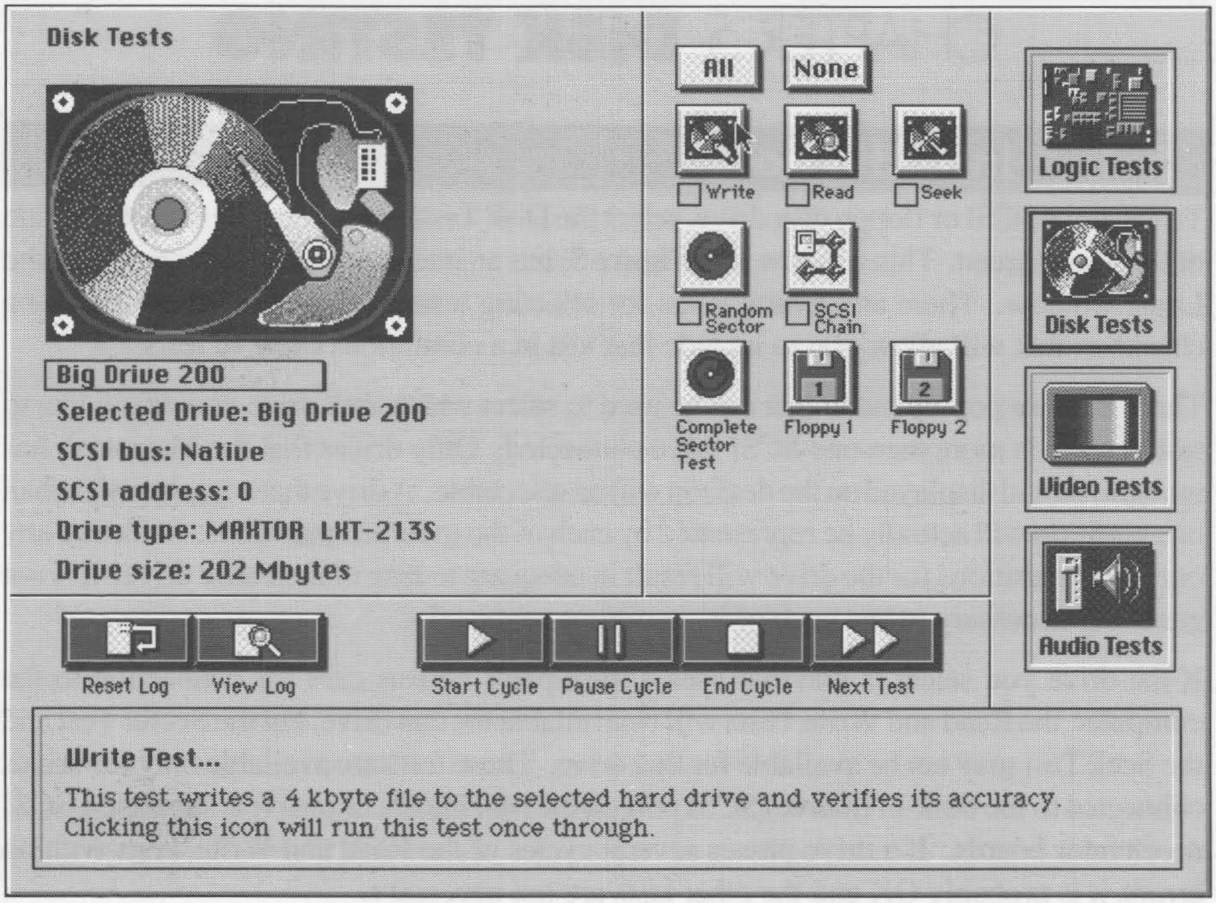


Figure 5. Disk Window.

5-2 Read test & write test

These tests are a quick way to check on a drive's condition. Both of these tests write a small amount of data to the disk, read it back, and check for the correctness of the retrieved data. The only difference between the two tests is that the Read Test reports errors on the read part of the cycle and the Write Test reports errors on the write part. These two tests together are a good "Quick Check" of a disk drive. They should also be included when you set up a cycle of tests for continuous testing of a drive.

5-3 Seek test

The Seek Test is one of the tests which does not use the file system of the Macintosh. Instead, it sends SCSI commands directly to the disk drive. For this reason, it is not supported on most third-party SCSI accelerator cards. If you have a disk that is suspected bad connected to one of these SCSI accelerator cards, it is best to move it to the built-in native SCSI bus of the machine for testing.

This test simply moves the head of the disk drive around to randomly selected tracks and watches for any errors that occur. This is actually a fairly strenuous workout for a disk drive, as seeking is much more intense than just reading or writing data. It is not recommended that this test be run all by itself in a cycle for more than about 10 minutes. If this test is included in a cycle with one or more other tests, it will get enough time to rest during the cycle so you can run the cycle as long as you want.

Continuous seeking is a fairly good workout for the power supply in an external disk drive. If you want to put an external drive through its paces, you should run this test in a cycle all by itself for up to 5 minutes to make sure that the power supply is still healthy.

5-4 Random sector test

This test, like the Seek Test, skips the Macintosh file system and sends SCSI commands directly to the disk drive. It performs a test that is very similar to a RAM test on randomly selected sectors on the drive. It picks out a sector (see glossary), saves the data stored there, writes a test pattern to that sector, reads it back and checks it for accuracy, and then puts back the original data stored in the sector.

Running this test for a while is a good way to eliminate the drive mechanism as the source of random loss of data or data corruption. If you are experiencing this difficulty with a drive, but it passes this test when it is run for several hours, the problem is most likely a virus or software problem and not the drive.

5-5 SCSI communication test

This test will help you spot errors caused by bad cabling, too much cabling, or improper termination of the SCSI Bus. It is impossible to diagnose the source of such a problem with a software-based diagnostic tool like Snooper. The best we can do is let you know that errors of this type are occurring, and leave you to the trial-and-error that goes along with finding such a problem. Running this test for several hours in a cycle, with or without other tests, will be quite adequate to eliminate SCSI cabling and termination as the source of a disk problem.

5-6 Complete sector test

We *strongly* recommend making a backup of any important data on a disk before using this test. While it is not inherently damaging to either the disk drive or the data on it, this one has the greatest potential for losing data when used on a flaky drive or flaky computer. There are two things which make this test "dangerous" on a flaky system. First, the test reads and writes to *the whole disk*, not just to the parts of the disk that are reserved for your files. Some parts of the disk are reserved for a "directory" used for keeping track of the data stored on the disk and other data that the operating system of the computer needs to use the disk. This test writes right over top of this data, and if everything works correctly, it puts back the data that it clobbered before going on to the next sector (see Glossary). If the process works correctly, the disk will have all of its data intact after the test (even if you abort the test before it is complete). If there is an error, however, you might end up with garbage in the area that tells the computer where your files are on the disk. If that happens, the data on the disk is usually lost forever. Secondly, this test uses a method of talking directly to the disk drive without the intervention of the system software of the computer. This is necessary in order to perform this low level test, but it goes around the sanity checks and protections normally provided by the system software.

To put it bluntly, don't use this test unless you need it, and back up the data first.

It is recommended that this test be performed by moving the suspected drive to a known good machine and then using Snooper on the good machine to "put the drive through its paces." This is a very complete test in that it writes to and reads from every usable sector on the disk.

Another thing you should know about this test is that because it is so thorough, it is *slow*! One pass through a 30 MB hard drive will take over two hours. If you start the test and don't want to finish it, it can be aborted at any time (by pressing any key on the keyboard or selecting the "End Cycle" button) without consequence. The Test window shows the progress of the test, but because the test takes so long, there can be a considerable length of time between "tick marks" on the progress bar. Because it takes so long to go through a disk even once, it is not very useful to run this test repetitively. That is why there is no check box under the icon to allow you to put it in a cycle with other tests. Once is enough!

5-7 Floppy disk test

This test allows you to check the condition of the floppy drives connected to your Macintosh. Before you start this test (or after being hounded by an obnoxious message in the window) you should insert an unlocked floppy disk in the drive to be tested. Make sure the disk has no important data on it and that it has at least 10K of available space for Snooper to use. While Snooper does not intentionally destroy any data already on the floppy, we cannot be held responsible for the actions of a malfunctioning floppy drive or computer.

The test consists of writing a small amount of data to the disk, reading it back, comparing the data written with that read back, getting rid of the test file, and checking the time it took to perform the test. The display gives its results as a percentage. Any percentage above 75% should be considered normal. The test result is based on both the speed with which the drive completes the task and the errors (retries) that occur during the test. Retries are not uncommon with floppies but if they get excessive, it indicates poor performance and impending doom.

If the performance falls outside the normal range during testing, you should try a different floppy before you condemn the drive. More often than not the floppy will be found to be the culprit rather than the drive. If several floppies show the same poor performance, then the drive in question probably needs cleaning, calibration, repair, or all of the above. If the drive just needs cleaning, try one of the products available from a computer dealer for cleaning the drive. More extensive problems should be handled by a repair center. Unlike hard drives, floppies can usually be repaired or readjusted to function properly.

One way to check the alignment of the drive is to compare its performance with floppies formatted on another machine with the performance on floppies formatted in that same drive. An out-of-alignment drive will usually work fine with its own floppies, but will show reduced performance when tested with floppies that were formatted or initialized on other machines.

5-8 What to do with a bad hard disk

Strangely enough, many of the things that can go wrong with a drive that cause it to not even show up on the desktop can be fixed simply by reformatting the drive. It is the intermittent garbled data type situations that are caught by the Read and Write tests and the Sector tests of Snooper that usually are a harbinger of the Grim Reaper of Hard Drives. Usually the only way to fix these problems in a hard drive is to replace it. They are sealed units built under clean-room conditions, and cannot usually be fixed unless the problem is a bad control card or another component outside of the disk's hermetically sealed enclosure. Service centers don't mess with replacing controller cards and such. If a drive is under warranty, they will usually RMA (Returned Merchandise Authorization — send it back to the guy who built it and have him worry about it) the drive.

Most service centers have a pile of bad hard disks in a corner that is two or three feet high. Such a pile can be an entertaining archeological find. The ones at the bottom have the smallest capacity and weigh several times what the newer, higher capacity drives do.

Like many things in the computer world, hard drives always get smaller, cheaper, and faster as time goes by. If your hard drive is looking a little green behind the gills, do yourself a favor and buy a new one that holds twice as much data and gives it back twice as fast, and costs half as much.

CHAPTER 6 VIDEO TESTING

6-1 Introduction

This chapter describes the use of the "Video window" (**Figure 6**) to check the accuracy and alignment of the video circuitry and monitor connected to the Macintosh. To see this window, select the "Video" icon along the right-hand side of the Main screen. This window uses the familiar icon and check box interface used in the other test windows to either run a particular test or set up a cycle of tests to run in sequence. On a black and white or small monitor (12" or smaller), there is a smaller selection of tests than those shown below.

There is a button in this window called "Select Monitors." This button will bring up a dialog box that lets you select on which monitors to display the tests screens. The dialog is set up much the same way the Monitors Control Panel is, with a rectangle representing each of the available monitors. Each rectangle shows either a "test screen," or a desktop pattern. Click on a rectangle to toggle that monitor between showing the test pattern and not showing it. The monitor represented by each rectangle showing the test pattern, will show the patterns selected in the Video Tests window.

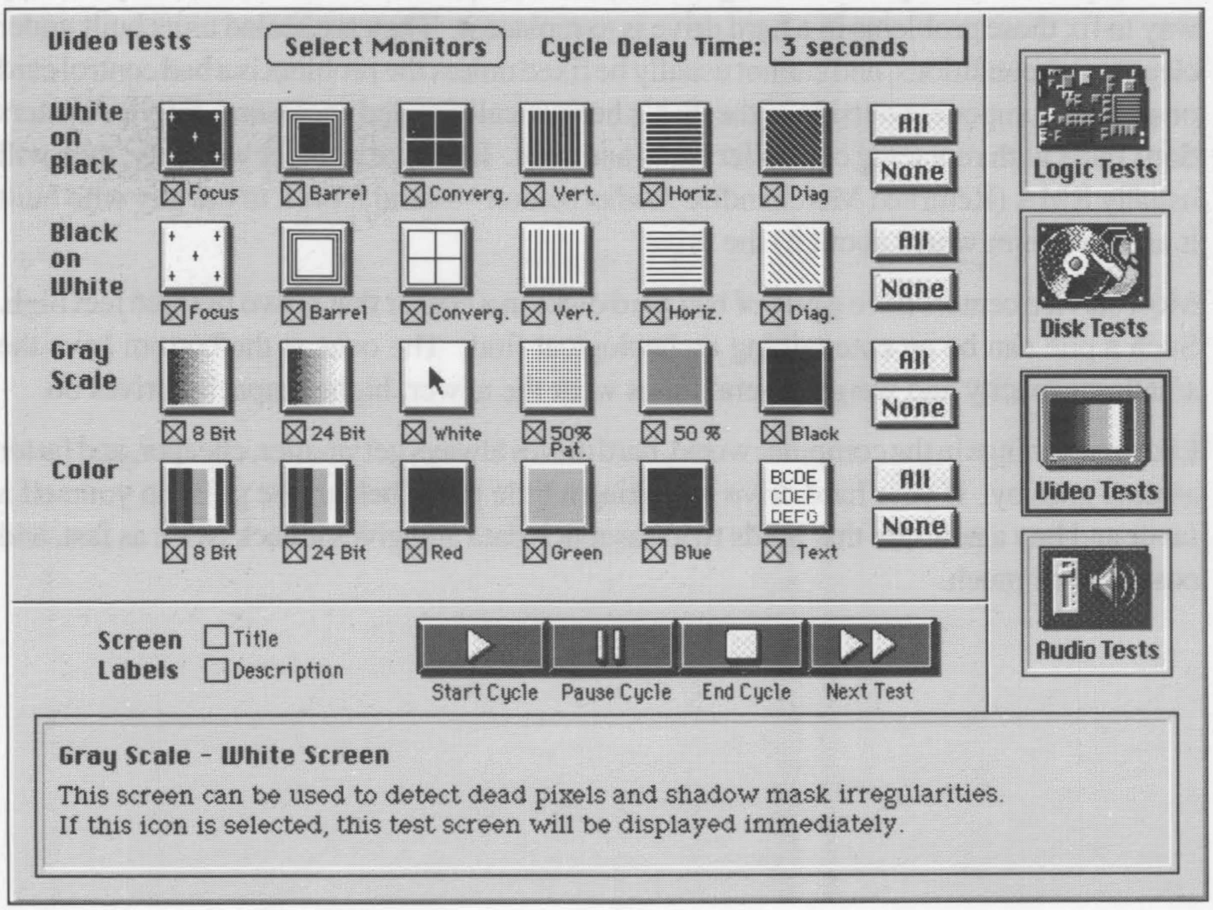


Figure 6. Video Test Window.

There is also a pop-up menu on the window that can be used to control the time that each test pattern is shown before cycling to the next one, when several test patterns are set up to run as a cycle.

The "Label" and "Description" check boxes next to the cycling control buttons enable or disable labels and descriptions that can be displayed on the monitors along with the test screen.

All of the Video tests can be used on any type of monitor including LCD screens on Power Book machines, and even LCD "projection screens" for presentations. Some of the tests are not very relevant to these types of screens. Focus and Convergence, for example, are always perfect on this type of screen.

6-2 Focus test

This menu choice will display a test screen that consists of a black screen with a white rectangle near the edges of the monitor and a "cross hair" area in the center. The focus of the monitor should be adjusted so as to obtain the best compromise between the focus at the corners of the rectangle and the dot at the center of the screen. Many monitors have an adjustment screw for focus on the back or along the lower front edge of the case. This is not a difficult adjustment to make, and a user should not be afraid to try it if the adjustment screw or knob is readily accessible.

6-3 Barrel

This test window is designed to uncover a problem known as either barrel distortion or pincushion distortion. This problem gets its name from the fact that lines are bent in a fashion similar in appearance to a pincushion or whiskey barrel. They can also be bent in the opposite direction, in which case they do not resemble either a pincushion or a barrel, but the same name is usually used for the condition.

The Barrel icon will display the test window shown in **Figure 7** that makes this type of distortion very noticeable on the screen. It is comprised of a black screen with several concentric white rectangles. All of the lines on the screen of a properly adjusted monitor will be perfectly straight. These lines should not bow in or out either along the top and bottom or along the sides. If you notice a significant bow, it can be an alignment problem or, in some cases, a faulty monitor power supply. There is often no user adjustment for this condition, and it should be referred to a qualified technician for repair.

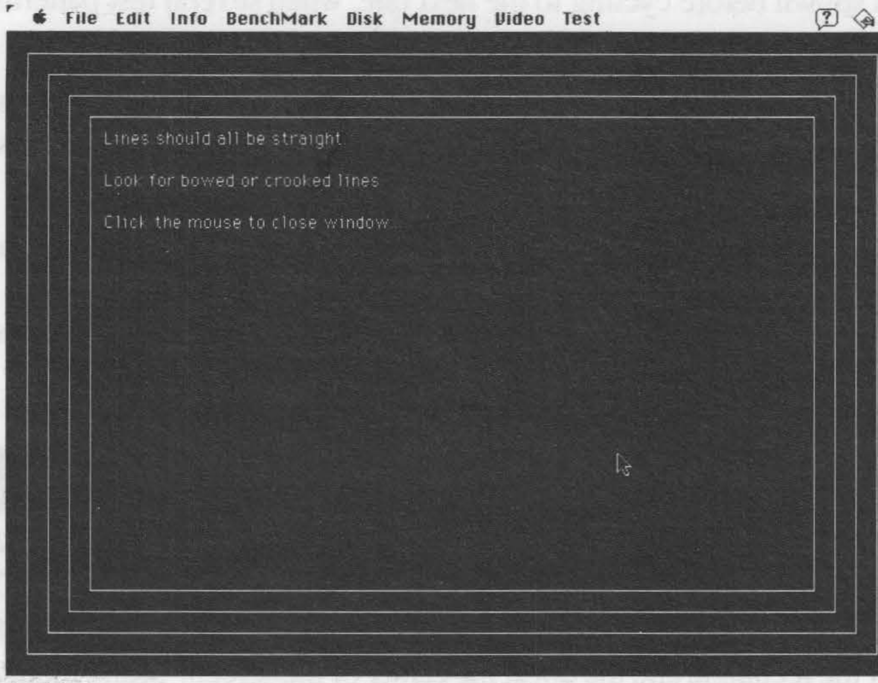


Figure 7. Barrel Test Window.

Magnetic Field Disturbances

There is another type of distortion similar to the pincushion distortion. This is a bending of the lines only in one area of the screen, with no corresponding bending in the opposite direction on the opposite portion of the screen. This type of bending is often caused by strong magnetic fields in the area surrounding the monitor. These fields can be caused by speaker magnets, electric transformers, other monitors, or just about any electronic or magnetic device. Occasionally, there is a large deposit of iron ore in the area that can create local disturbances in the Earth's magnetic field.

Most of these magnetic disturbances can be solved by moving various parts of the system around until the problem goes away. If the problem is actually in the monitor itself, it can often be solved by a technician who can adjust the alignment magnets attached to the back of the picture tube in most monitors.

6-4 Convergence

The Convergence menu choice displays a screen that can be used to check, and if necessary adjust, the convergence of a color monitor. While this is usually only relevant to systems with a color monitor, it is made available for all displays since it can also be used to check for other types of image distortion, and may still prove useful on black and white monitors.

Adjusting the Monitor's Convergence

A few monitors have front panel control knobs for making this adjustment. A few others have screw-type adjustments for it on the back or side of the monitor. If the controls are present, they are often called "V-Stat" and "H-Stat." Other monitors require removal of the monitor's case, which exposes the technician to potentially lethal electrical charges. Correcting the convergence of a monitor vastly improves the color quality of the display.

After you make the "Convergence" choice from the menu, a black screen with a single white rectangle near the edges of the monitor will be displayed. This is shown in Figure 8. Convergence is correct when the lines of the rectangle are pure white and do not show any fringes of color.

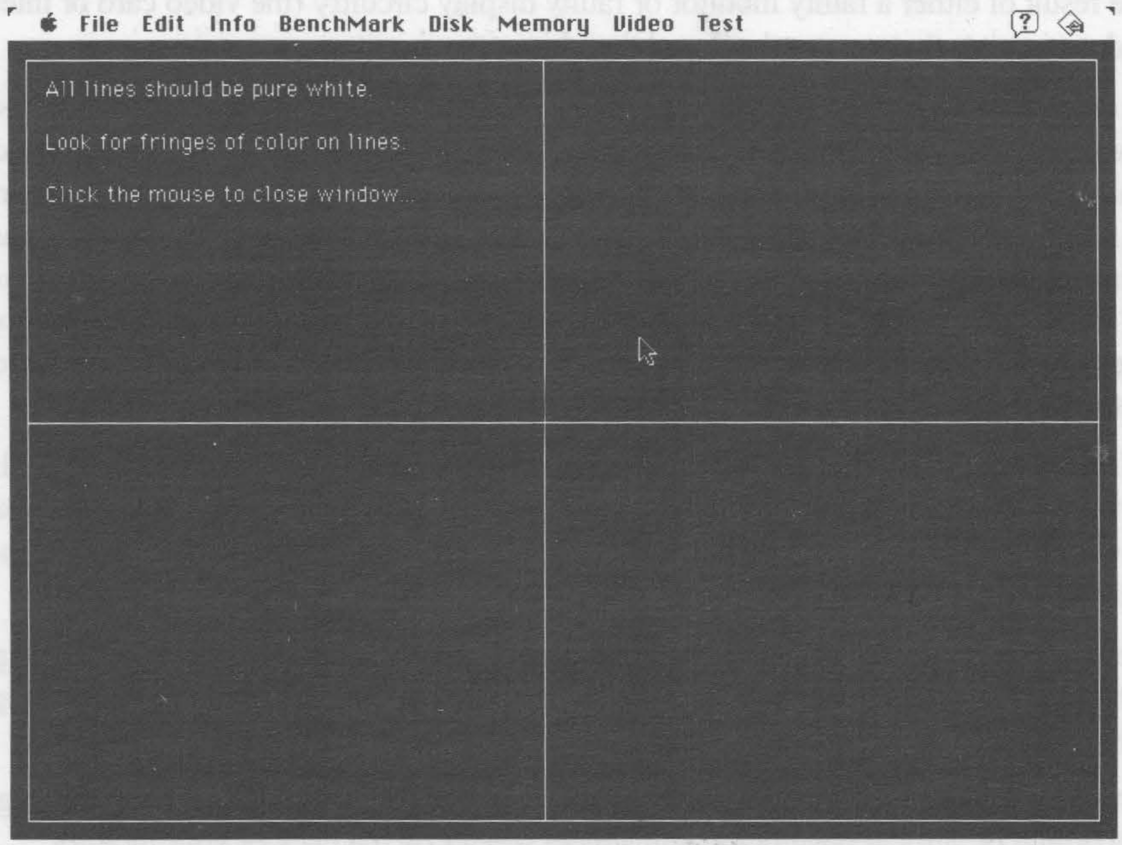


Figure 8. Convergence Test Screen.

Like other monitor adjustments, this often involves a compromise, especially on a large monitor (19" and larger). While it is usually possible to adjust the convergence to absolute perfection in one area of the screen, often it will be found to be badly out of convergence in another area of the screen at the same time. The monitor should be adjusted to provide the best compromise of convergence across the entire screen.

6-5 Lines (horizontal, vertical & diagonal)

These are multi-purpose screens that will identify many different types of monitor problems. They are included primarily for comparison purposes when evaluating or shopping for monitors.

6-6 White screen & black screen

These test windows, while very simple, can provide a number of useful tests on a monochrome or color monitor, and the associated video circuitry. The primary reason for including them is to check for "dead pixels," or "stuck pixels." These conditions can be the result of either a faulty monitor or faulty display circuitry (the video card or internal video circuitry that creates the signal that drives the monitor).

A dead pixel is one that is always black regardless of the intended color or brightness of the pixel. The test for this condition is quite simple: Open the White Screen test window and look for any dark pixels anywhere below the menu bar. It is actually quite common to find one or two dead pixels on a color screen due to manufacturing flaws in the "mask." The mask directs the three electron beams to the correct color of phosphor dot on the inside of the monitor's front glass. It is also possible for this to be caused by an imperfection in the phosphor in a small area of the screen. When dead pixels are found on a monochrome screen, this phosphor irregularity is usually the cause of it.

While these two manufacturing flaws are the most common cause of dead pixels, it is also possible for a faulty video card or built-in video circuitry to cause dead pixels. If one or more bits in the video RAM are stuck "off," the corresponding pixels on the screen will be dark.

There are two ways to tell for sure if the dead pixels are caused by the monitor or the display circuitry. The simplest way is to swap either the monitor or the video interface card (display circuitry) and see if the pixels come to life.

The other way would be to temporarily shift the image on the face of the monitor using the horizontal or vertical positioning adjustment screws on the back of your monitor.

If the dead pixel doesn't move along with the rest of the display, then the problem is in the mask or phosphor of the monitor, and cannot be fixed. If, however, the dead pixel moves around on the screen when the positioning screws are changed, the problem is in the video circuitry of the computer (either the internal video or a video card, whichever is driving the monitor).

On a color monitor, all of the above would apply equally to any pixels or small areas that are neither white nor black, but some other color. Imperfections in the phosphor or mask of a color monitor can cause small areas to have only dead "green," "red," or "blue" dots without affecting the other colors. This can also be caused by faulty drive circuitry, so this "swap and position" method can be used to determine whether the problem is in the monitor or the video circuitry.

Stuck Pixels

The other problem is called "stuck pixels." This is a condition in which pixels that are supposed to be dark are white or some other color instead. The Black Screen test window can be used to quickly find any stuck pixels on a monitor. Unlike dead pixels, stuck pixels are caused primarily by the video circuitry rather than the monitor. The most common cause is a bad bit(s) in the video RAM of the video card or display circuitry.

6-7 50% gray pattern screen

The 50% Gray Screen test window is provided primarily to detect imperfections in the sawtooth raster signals that cause the electron beams within the monitor to move back and forth, and up and down. Many people don't realize it, but only one pixel of the screen is actually lit up by this electron beam at a time. The appearance of a full screen image is caused by the persistence of your eyes and the persistence of the phosphor on the screen. If the signals that move the beam around on the screen have a glitch, it will show up on this screen as a white or black line (either horizontal or vertical) across the whole screen. The line is caused by an interruption in the otherwise consistent pattern of dots on the screen. A larger imperfection in the raster signals will produce an area of light or dark gray in the affected area of the screen, as the dots are closer or further apart.

One particularly interesting facet of this test screen is that a 50% gray pattern produces a continuous output from the video card at its maximum frequency. This could be used to determine whether or not a particular monochrome monitor really has adequate frequency response to give crisp, clear images. With the 50% Gray Screen displayed, a monochrome monitor should show every other dot totally on or totally off.

You can look with a magnifying glass to see if the dots of light and dark are clearly defined, or if they tend to just vary within a narrow range of medium brightness. A monitor with sufficient video band width will show precise dots of black and white rather than gray dots. This high frequency screen might also be useful when looking for radio interference caused by the video circuitry, as radio emission from electronic components tends to get worse as the frequency goes up.

6-8 Gray screen

A Gray Screen can be created either by turning pixels white and black in an alternating pattern across the screen (as is done on black and white monitors), or by actually using a medium shade of gray for each pixel (as on a color or gray scale monitor). The 50% Gray Pattern icon creates a test screen of the first type, as detailed in Section 6-7. The other 50% Gray icon creates a test pattern with all gray pixels for use on color and gray scale monitors. This screen can be used to see if the monitor has even brightness across the screen. It could also be used for setting exposure for photographing the monitor.

6-9 Gray scale – 8-bit & gray scale – 24-bit

These test windows can be used to test for proper calibration and setup of gray scale monitors. With the test window displayed, the brightness and contrast should be adjusted so as to achieve the whitest white possible while the darkest bar on the left side of the window is completely black. Monitors that have a gamma adjustment inside the monitor case that can be adjusted to give an even gradation of gray across the screen. Do *not* attempt this adjustment unless you are a technician trained to perform monitor repairs. A monitor contains *very* high voltages (much higher than those found inside the computer case). If the control for this adjustment requires operating the monitor with the case removed, it is very dangerous. We would like for you to be around to try out the other interesting features of Snooper!

If you have a 4- or 8-bit-per-pixel system, and you select the 24-bit Gray Scale Test window, the computer will approximate the correct display as well as it can by "dithering" the available gray scale levels to emulate the 24-bit gray scale levels. This will, by the way, take some time, and the screen will be painted slowly. When using a color monitor with these test windows, it is recommended that you use the Monitors Control Panel to set the video mode to Gray Scale. This will give you the best display with these test windows. This is not necessary if the display is set to "millions" of colors.

6-10 Color 8-bit, color 24-bit

These tests are provided for checking the color quality of the display system, and for additional calibration and setup screens. There is no specific shortcoming you should look for here. The intent is just to give you a standard screen that can be compared between different systems and any major changes noted.

6-11 Red screen

This test window is provided primarily to test the red channel of the video circuitry and monitor. Use it to look for an uneven coloration across the screen or from top to bottom with this test window. On an 8-bit video system, the color provided by this test window is the closest color to "absolute red." In other words, it is as close as the system color table comes to putting out maximum intensity on the red gun, and zero intensity on the blue and green guns. On a 24-bit system, it should be exactly maximum red, and zero green and blue. If there is a major difference in brightness between this screen and the green or blue screen, it might be a monitor problem, a weak video amplifier on the video card, or a bad video cable.

6-12 Green screen

The purpose of this test is the same as the red screen above, except it checks the green channel of the video system. You might notice that the color most of us associate with green is more of a forest green. The color this window puts on the screen is a very unattractive yellow-green color, but is nevertheless the actual color of the green phosphor used in making color monitors. As with the red screen above, an 8-bit system shows this color as the closest match to perfect green that exists in the system color table. A 24-bit system shows it as "exactly green."

6-13 Blue screen

This test window is a nice change of pace from the ugly green screen. An 8-bit system shows this shade of blue as the closest match to perfect blue that exists in the system color table. A 24-bit system shows it as "exactly blue."

CHAPTER 7 **AUDIO TESTS**

7-1 Introduction

From the beginning, the Macintosh has had a very good audio system for a personal computer. All of the Macintosh computers include three basic types of audio circuitry, each of which serves a useful function within the computer. These are the "Sampled Sound Generator," "Wave Table Synthesizer," and "Note Synthesizer." This last one is sometimes called the "Square Wave Synthesizer." Other aspects of the audio system which can be tested are the volume and stereo attributes.

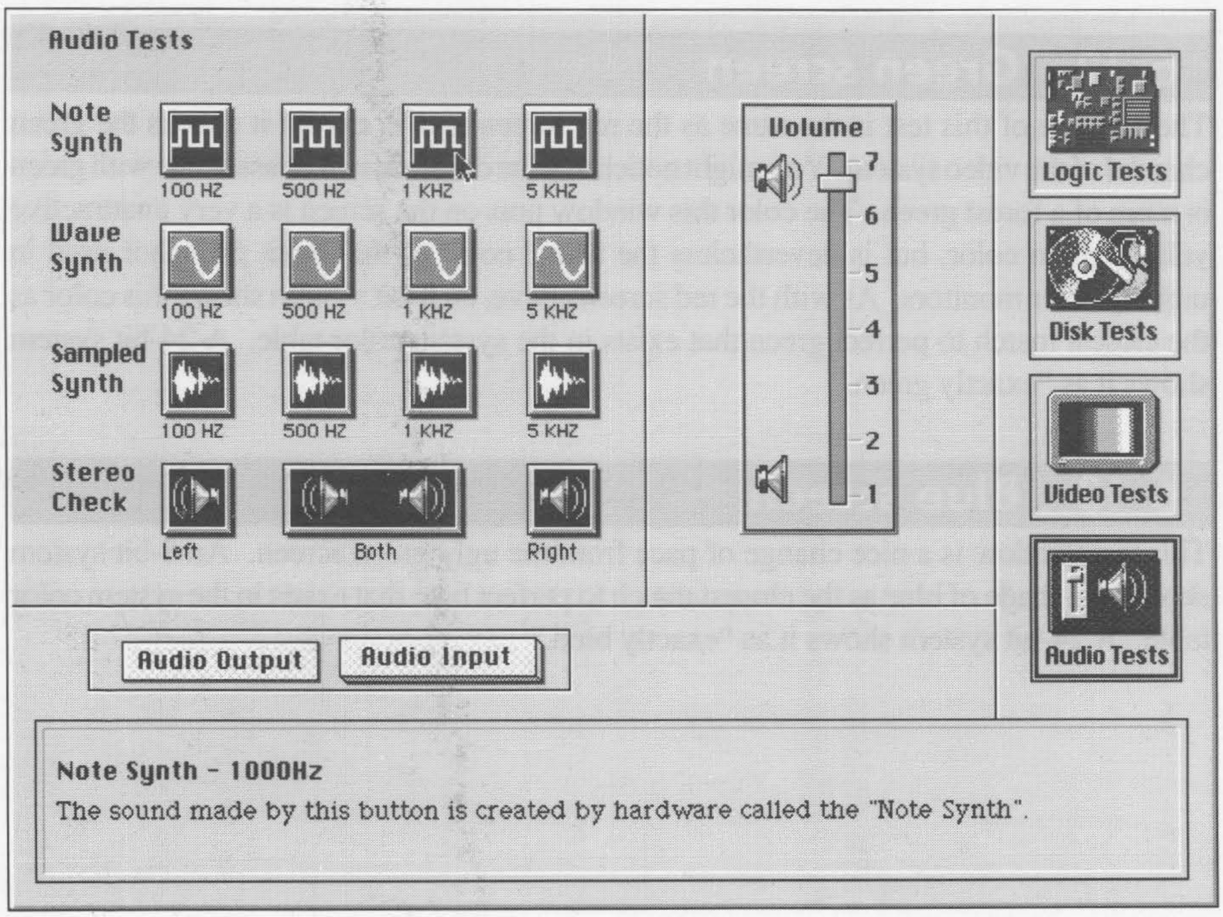


Figure 8. The Audio Test Window.

7-2 Sampled sound generator

The first type of audio, and by far the most versatile is the Sampled Sound Generator. With this audio system, developers can add digitized sounds such as speech or musical instruments to applications. While it is the most versatile sound system on the Macintosh, it also takes a fair amount of CPU time. In fact, some of the early Macintosh models such as the Mac 128K through the Mac SE were barely able to support this feature. Those slow machines can produce sampled sounds, but can't do anything else at the same time.

How Sampled Sound is Produced

Sampled sound is produced by recording the amplitude (how loud it is) of a sound several thousand times per second, and then using that information to drive the speaker. You can think of it as recording the position of the speaker cone thousands of times per second. The playback consists of the computer looking at the recorded cone positions and telling the speaker, "...go to here, now go to here, now go to here..." It is actually a very simple system, but it happens so many times per second that it takes a great deal of the computer's time.

Testing the Sampled Sound Generator

To test the part of the Macintosh sound circuitry that produces sampled sound, Snooper provides four icons that produce the same sampled sound at four different pitches, or frequencies. The sound produced is a sampled recording of a family heirloom: a 100 year-old tuning fork collected by my great grandfather. There is no way for the machine to determine whether or not the sound is being correctly produced by the speaker. It is up to the user to listen to the sound produced and determine if there is a problem. On a properly functioning machine the sound will be clear and undistorted.

7-3 Wave table synthesizer

The second type of audio produced by Macintosh computers is called "Wave Table Synthesis." This type of audio is related to the Sampled Sound Generator in that the data used is a list of amplitudes (or speaker cone positions). The difference is that with this type of sound is that only 512 separate data points exist to tell the speaker where to go. When these 512 "samples" are used up, the sound generator goes back to the beginning and starts to use the same samples over again. This is fairly useless for the production of sound that varies over time like a human voice or the sound of a toilet flush, but it is quite usable in the creation of simple noises or the sound of some musical instruments. The simple standard Macintosh beep sound is produced with this type of sound synthesis.

The samples used with this portion of the sound generator are usually synthesized (that is, made up mathematically, or by trial and error) rather than recorded with a microphone, and the list of amplitudes is called a "wave table": hence, the name Wave Table Synthesizer.

The advantage of this type of sound production is that it takes far less of the CPU's time to generate this audio. This is because most of the work is actually done by the "Apple Sound Chip" in those Macintoshes that have this chip. The CPU sends the data to the chip and says "GO." That is the end of the CPU's involvement until it is time to tell the sound chip to "STOP." As you can see, the CPU can be very busy doing other things while creating sound with the Wave Table Synthesizer.

Testing the Wave Table Synth

As with Sampled Sound above, Snooper provides four different icons for four different pitches using the Wave Table Synth. The wave table for the sound produced is a mathematically derived table of the trigonometric sin function. This is, theoretically, the "smoothest" sound possible as it contains no harmonics of the main pitch produced. If the sound is not there or is garbled, there is probably a problem with the Apple Sound Chip or the amplifier chip on the computer's motherboard or the speaker.

7-4 Note synthesizer

The third type of sound included in the Macintosh sound hardware is the simplest and least CPU intensive of the three. It is called the Note Synthesizer, and is equivalent to the sound created by most IBM® and compatible computers. It is a square wave created by a signal which turns the speaker on and off at the proper frequency.

It creates a rather unimaginative sound, as you might expect. It is also the least expensive approach to create sound on a computer, and the one that uses the least CPU time. The CPU only has to send three small pieces of information to the Apple Sound Chip to make one of these beeps. It tells it the frequency (pitch), the volume, and how long to do it. This type of audio is considered to be beneath the Macintosh, and very few developers ever use it for anything. The sound quality of this synthesizer can be adjusted to give different types of sound. The four icons for the Note Synth in Snooper use a setting that closely approximates a "Square Wave," perhaps the harshest of all possible sounds a machine can make. If you like tests of the "Emergency Broadcast System" on the radio, you will find this test to be very enjoyable.

7-5 Volume control

There is a volume control to the right of the sound icons that can be used to vary the volume of the tests. This will help you find problems that can sometimes occur when the sound is OK at low volume levels but becomes distorted at higher volume levels.

The Apple Sound Chip can become damaged in such a way that it cannot handle the higher volume levels, but still performs well at low volume levels. If the sound becomes distorted as the volume increases, it could be either the sound chip, the small amplifier chip that boosts the sound going to the speaker, or the speaker itself. Often a torn speaker cone will sound just fine at low volume levels, but will start to distort as the volume is increased.

7-6 Left/right test

The bottom row of icons make use of the fact that most Macintosh computers are capable of putting out stereo sound. That is, play two separate audio channels at the same time. While most Macintosh models support stereo sound, none of them, to date, contain two speakers.

A few of the models currently available combine the sound from the two channels and send all of it to the single speaker. Many models, however, only send the left audio channel to the internal speaker. In these systems, the right channel can only be heard when you use stereo speakers or headphones connected via the audio jack. The text in the text box at the bottom of the Audio Test window will tell you what your machine does with the right channel sound. This test uses the sampled sound generator to say "This is the left side" through the left audio channel (heard through the internal speaker on all models) and "This is the right side" through the right audio channel (available only through the audio jack on many models). The Both icon generates a sampled sound that moves back and forth between the two channels.

7-7 Audio input test

Some models of Macintosh have built in hardware for low quality sampled sound input. Those machines that support this feature will display a button on the Audio Test screen that changes the window to a different test for checking the microphone and audio input circuitry. To use the test, simply connect the microphone to your machine and use the Audio Input button to select the Audio Input Test.

This is a two part test:

First, hold the microphone two or three inches away from the speaker port on the machine. While holding the microphone there, select and hold the Set Level button. This provides a test tone that can be used to set the level of the volume control, or to move the microphone back and forth. The idea is to get the bar graph indicator somewhere near the center line of the graph.

Next, while holding the microphone in the position found above, select the Run Test button. This will generate a series of tones of increasing pitch. The bar graph will show the level of the signal obtained by the microphone for each test tone.

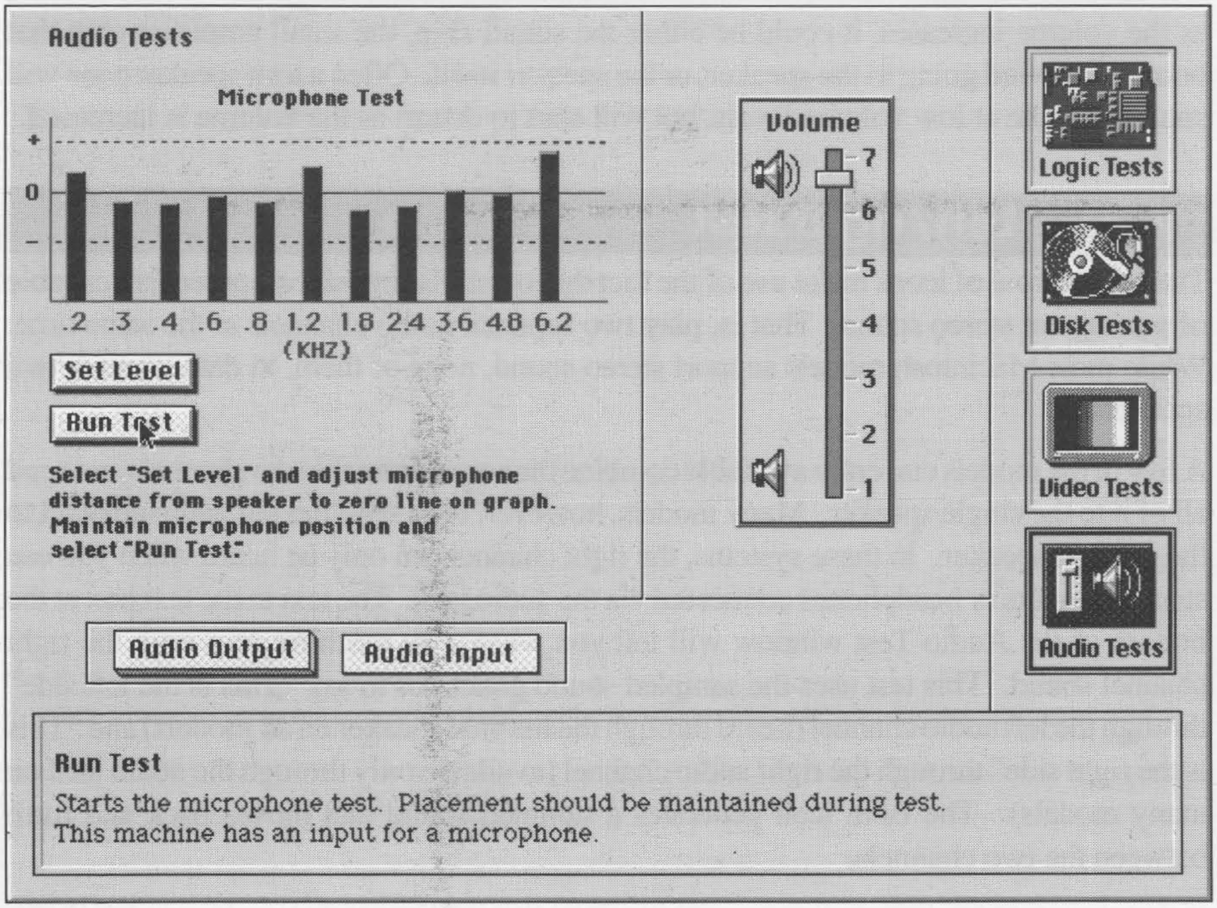


Figure 9. Audio Input Test.

This graph is a *very* rough approximation of a frequency response graph for the combination of the speaker and the microphone. Because there is a large difference in the acoustic properties of the different models and because the conditions of the test are not very well controlled (the type of table the computer is sitting on, for instance, can create a significant effect on the “frequency response,” as shown by the graph), don't expect a flat frequency response. We included this test more for fun than serious testing, but you may be able to spot a malfunctioning microphone. If, for instance, most of the graph is inside the lines, but the top three or four bars are almost zero, it would be a probable indicator of a bad microphone.

CHAPTER 8 **INFO MENU**

8-1 Introduction

One of the many uses for the Snooper software is to determine quickly what has been installed in a Macintosh computer system without the need to "open up the hood" and take a look. The choices available from the Info menu, shown in **Figure 10**, are used to obtain this information about the computer. Another use for this information is to provide those in charge of inventory control for a large number of machines with an easy way to get the information they need about each machine. For these users, all of the information in the Info windows is also available for inclusion in the printed or saved reports that Snooper generates. See Chapter 11 for more information on the reporting capabilities of Snooper.

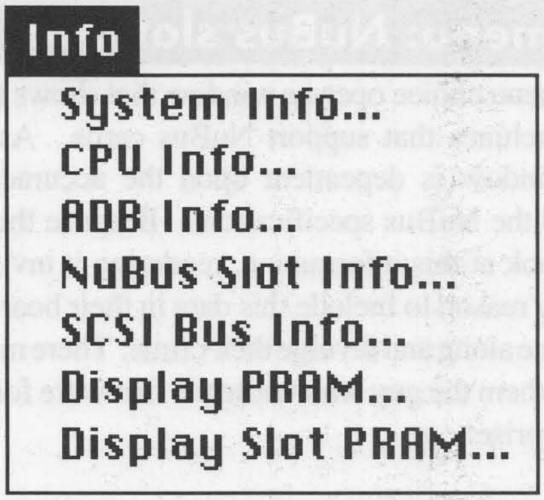


Figure 10. Contents of the Info Menu.

8-2 Info menu: system info

The first menu choice in the Info menu is System Info. This menu choice displays a window that shows configuration data that is more specifically related to the system software which started up the machine. It does not include any information about the hardware in the computer. Use the System Info menu choice when you just want to quickly check on a specific aspect of the system installed in a machine.

8-3 Info menu: CPU info

The second menu choice in the Info menu is CPU Info. This menu choice displays a window that shows configuration data that is more specifically related to the hardware in the computer. It does not include any information about the system software loaded into the computer. Use the CPU Info menu choice when you just want to quickly check to see if a particular type of hardware is installed in a machine without lifting the monitor off the top and peering inside.

8-4 Info menu: ADB info

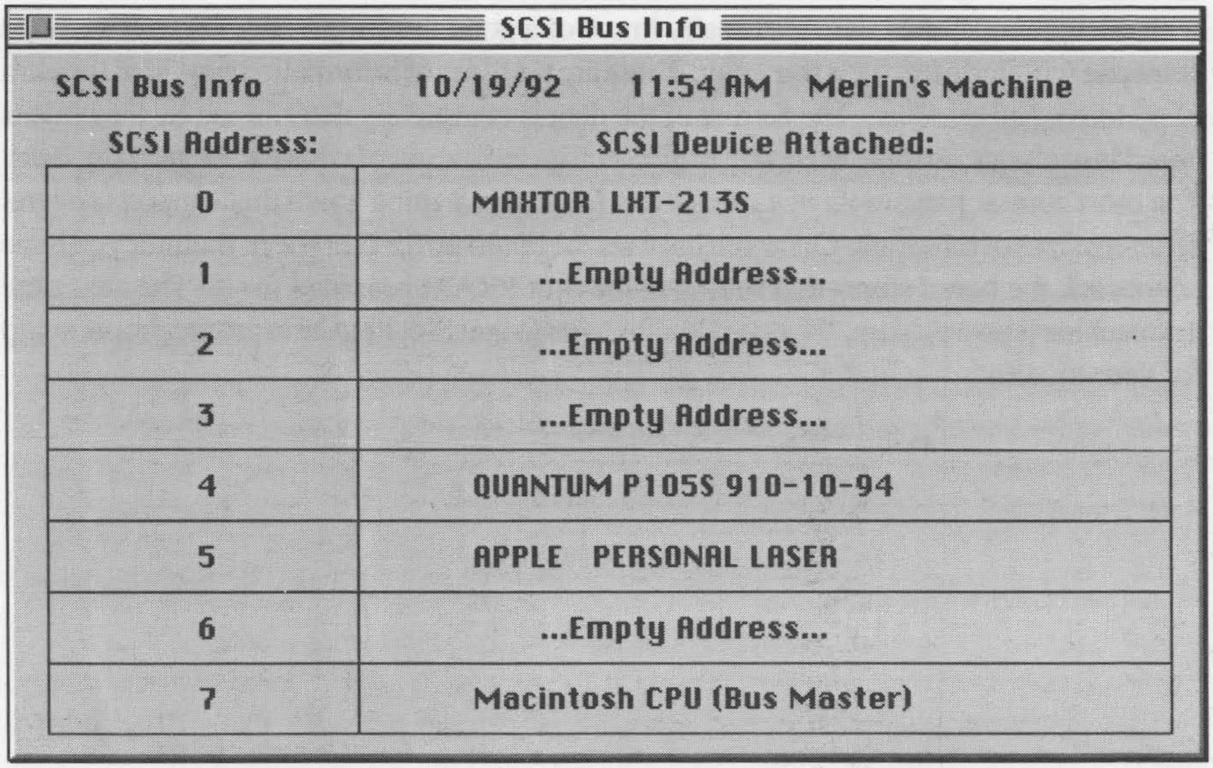
The ADB Info window displays all available information about ADB devices connected to the computer in a table format. This window is intended to display both Apple and third-party devices, but some third-party ADB devices do not follow all of the specifications set forth by Apple. If a third-party device on the ADB bus does not cough up the needed information when asked, there is no way Snooper can provide you with the information. The only use we know for this information is inventory control. See Chapter 11 for more information on the reporting facilities of Snooper.

8-5 Info menu: NuBus slot info

The NuBus Slot Info menu choice opens a window that shows the contents of the NuBus expansion slots on machines that support NuBus cards. As with ADB devices, the information in this window is dependent upon the accuracy with which the board manufacturer followed the NuBus specifications. Because the system software doesn't give you any way to look at this information, rendering it invisible to most users, some vendors did not see any reason to include this data in their boards. They never imagined that Snooper would come along and divulge their crime. There may also be boards out there that have text stored in them the guy who wrote the firmware for the board thought would be hidden forever. Surprise!

8-6 Info menu: SCSI bus info

The SCSI Bus Info menu item allows you to display a window that shows details regarding the devices attached to the SCSI bus of the computer. As with the ADB and NuBus windows, this window is simply displaying whatever information the device manufacturer put in the device. Since there have been utilities around for spying this information for a while now, this data tends to be supported more fully than the ADB or NuBus information.



SCSI Bus Info

SCSI Bus Info 10/19/92 11:54 AM Merlin's Machine

SCSI Address:	SCSI Device Attached:
0	MAXTOR LXT-213S
1	...Empty Address...
2	...Empty Address...
3	...Empty Address...
4	QUANTUM P105S 910-10-94
5	APPLE PERSONAL LASER
6	...Empty Address...
7	Macintosh CPU (Bus Master)

Figure 11. SCSI Info Window.

8-7 Info menu: PRAM display

This menu choice brings up a window that shows all of the data stored in the non-volatile (that just means it doesn't loose its data when the power is off) RAM in every Macintosh. This PRAM as it is called (the P stands for Parameter) is a very small piece of RAM that is built into the clock chip on most machines. It is used for remembering many of the settings made in the Control Panel (Desktop pattern, start-up drive, etc.).

We are not quite sure what purpose there is for having this data available in Snooper, but in keeping with the product's name, we felt it should be included for completeness. The data is given in a table format that tells the name of the parameter, the data stored there, and the cryptic explanation of the contents as given by Apple Computer. The usage of each of the parameters has varied over the years with different machines and different System Software releases.

8-8 Info menu: Slot PRAM display

There is another set of non-volatile RAM in some Macintosh computers in which NuBus boards can store needed start-up parameters. While this is its stated purpose in life, most of the newer machines have this Slot PRAM, even if they don't support NuBus boards. As with the regular PRAM, we don't really know of a good use for this display, but we hope someone will find a use for it someday. There are six bytes of information provided for each of up to six NuBus slots. The format of the data is completely determined by the NuBus board in each slot, so there is no way to give you an indication of what each byte represents. The most common example of a use for this PRAM is a video board that supports several different sizes of monitors. Once you have set the board up for the type of monitor you have connected, the board stores that setting in the Slot PRAM provided for it. The next time the machine is powered up, the board knows to go to that Slot PRAM to get the proper setup for your monitor.

CHAPTER 9 BENCHMARK MENU

9-1 Introduction

The tests found in the Benchmark menu all deal with the speed of the machine. A Benchmark is a test that performs some operation (usually a large number of times) and gives some type of performance number based on the amount of time it took the machine to complete the operation. From the dawn of the computing age, this method has been employed by both users and manufacturers to say "My machine is faster than yours!" It is likely that in the days of the abacus (a Chinese invention used for counting and doing arithmetic involving moving beads up and down on rods held in a frame – basically, a large extension of the idea of counting on one's fingers), wealthy traders had benchmarks used for comparing one "accountant" with another. They were probably timed with water dripping through a hole in a bowl. The benchmark tests performed by Snooper are somewhat more sophisticated than that, but use the same basic principle.

9-2 Apples to apples

The tests available under the Benchmarks menu are intended only for comparison of one Macintosh to another, or to compare the same machine with itself at various times. These may also be run with various optional equipment installed to compare the performance with and without accelerators and other add-ons.

No effort was made to synchronize these benchmarks with "industry standard" benchmarks. You will find no mention of "VAX MIPS" or "Sieves of Eratosthenes" (two alleged industry standards) in the test windows. Cross-platform benchmark testing (comparing one machine with another machine that does not run exactly the same software) is at best a tricky business. At its worst, it is simply a biased effort to make one machine look better than another. If you actually need comparison data between Macintosh and an IBM mainframe, you will have to look elsewhere for your benchmarks. Such benchmarks are generally acknowledged to be not very "real world" as they don't take into account the differences in the operating systems and applications available on the two platforms. For most purposes, the only relevant test across platforms would be very similar to the abacus test mentioned above. You could take a veteran Macintosh user and a veteran DOS (DOS is a type of system software used on IBM and compatible machines) user with the best program available for the task to be performed, precisely state the operations to be performed and see which finished first, or how much water dripped out of the bowl. It might be fun to do, and you could probably sell tickets to the event, and have cheerleaders and the whole bit, but that would be about the extent of its usefulness.

Snooper's intent is to provide a means to determine how much speed improvement is provided by faster CPUs and accelerator options on normal everyday types of computing, and to provide a means to compare Apples to Apples. The first four benchmarks all deal with the speed of the processor in the machine. Each of these benchmarks gives your machine a raw score and also a percentage score based on a properly functioning stock machine of the type you are running on. Each of these windows also sports a pop-up menu that you can use to compare the results to any other type of Macintosh, from a Mac Plus all the way up to the Quadra 950. If you are curious about what is really being tested in the benchmarks, there is a section with all of the sordid details in Chapter 13, "Technical Details For The Terminally Curious," later in this manual.

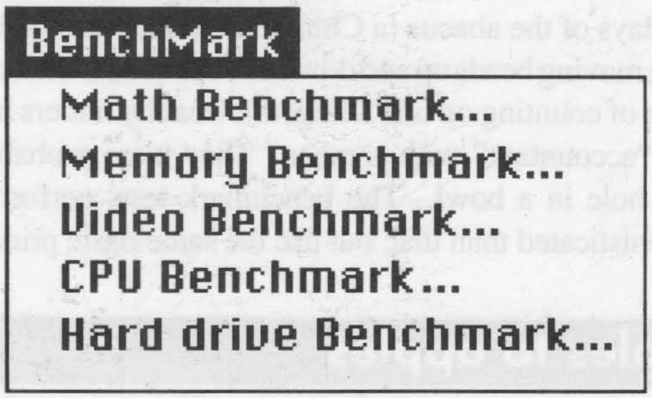


Figure 12. The Benchmark Menu.

Note: All of the benchmark tests are affected by mouse movement and background activity (i.e., background printing or a fax modem sending or receiving a fax). This is unavoidable, but also points up the fact that people who nervously move the cursor around on the screen while waiting for the computer to do something are actually slowing it down and making it take longer!

Note: Having virtual memory turned on with those machines that support it can also slow down the computer and cause lower scores on the benchmark tests -- even if there is no virtual memory-related disk activity occurring!

Note: Some INITs and CDEVs can also slow down a machine and lower its benchmark results.

9-3 Benchmark menu: math benchmark

The Math Benchmark, as its name implies, puts the machine through a rather excruciating quiz, and times the Macintosh's calculations. The Math Benchmark is really six separate benchmark tests all related to computational tasks. The six benchmarks are broken into three groups of two, where the two tests in each group perform identical calculations, but one takes advantage of special machine attributes to speed up the operation and the other does it the same way a Mac Plus or other early machines would do it. The reason for giving you such a large number of math benchmarks is that different users do different things with their Macintosh. Because there is such a difference in the speed of the three types of math represented by the six benchmarks, it is important to use the ones that are relevant to the type of computing you do on your machine.

Integer Math:

The first pair of math benchmarks, Integer Math, deal with a simple type of math that is used in all applications, even those that don't seem like math applications. An integer is any positive or negative number that does not have any fractions or decimal points involved with it. For example, 42 (the meaning of Life, Happiness and Everything) and -5280 (the number of steps it takes to Moon Walk for a mile if you wear a size-12 shoe) are integers, while 3.1415926536 is not an integer. Another factor related to integer numbers on a Macintosh is that they can only represent numbers smaller than about ±2 billion. A big number to be sure, but not even big enough to do a world census or count hamburgers sold. This type of math is used very frequently in a Macintosh. For one thing, all of the drawing that is done on the screen is based on this type of math, so even if you are using a word processor or a game, this type of math is going on in your machine.

Because this type of math is very important to the overall performance of a machine, Motorola (the company that makes the MC68000 family of microprocessors used in all Macintosh machines) included special integer math capabilities in its newer microprocessors that perform these calculations very quickly. These special integer math instructions are supported by any Macintosh that uses a 68020, 68030, or 68040 processor. Unfortunately, the application you are running has to use these special instructions in order for them to come into play and improve the performance. This is the reason that some software vendors supply a "regular" version of their software and a "68020" variety for the faster machines. Other vendors include the "smarts" in their regular version of software to see if these special math routines are supported, and use them when they are. Still others always use the old, slow way for everything. Check the manual for the software you use the most to see if it supports the 68020 integer math instructions. That will tell you if you are getting the best performance possible from that application. The two Integer Math benchmarks (regular and optimized) will show you the difference that these supercharged instructions can make if your machine has a 68020 or later microprocessor.

Floating Point Math:

Floating Point Math represents a whole different way of dealing with numbers. These numbers support much larger quantities than integers, and also support keeping track of fractional parts, or decimal points. These numbers are used wherever there is a need for greater precision. For instance, all money-related programs use floating point to keep track of money. Who wants an accounting program that only does dollars and not cents? Most scientific and engineering programs also need to use floating point numbers to get the right answers.

Just as with Integer Math, special hardware has been developed to make this type of calculation faster. In this case, the solution was to include an optional additional device in the machine called a Floating Point Unit (FPU). This is a large chip that is closely coupled with the microprocessor. Just like the Integer Math optimization, the program running has to use special instructions to take advantage of this chip. If the program is not designed to take advantage of the speedy FPU chip, no change in performance will occur. The 68040 processor — the most recent member of the 68000 family to be used in Macintosh machines — has a built in FPU. It still requires that the program use the special instructions in order for the performance improvement to occur.

The two Floating Point math benchmarks will show you the performance of your machine on this type of calculation, and also how much difference the FPU makes if you have one.

Function Math:

This type of math also uses floating point numbers, but it does a type of calculation that is even more time consuming, and even more rarely used. We split this type of math off from "regular" floating point to avoid clouding those numbers with this performance data, and also provide this specific information for those users who actually do use this type of math in their normal use of the Macintosh. By Function Math we mean things like sin and cos and other trigonometric functions, as well as logarithms and exponential calculations and roots. The number of applications that use this type of math are fairly small and include the following categories: engineering, scientific, 3D modeling, and any financial calculation involving compound interest. An interesting note about the machines that use the 68040 chip (only Macintosh Quadras, at the time of this writing) use the built in FPU in the 68040. The FPU built into the 68040 is actually a scaled-down version of the FPU used in other Macintosh computers. They didn't have room to incorporate the full feature set of the normal FPU, so they left out the parts of the chip that do function math. As a result, 68030-based Macintosh computers will actually get better performance on the FPU Function math benchmark than the Quadras do.

One interesting note about these benchmarks is that despite the fact that your machine is sometimes referred to as a "computer," normal everyday use of computers actually doesn't involve very much "computing" in the strict sense of doing arithmetic. Unless your use of the machine includes specifically math-oriented programs such as those mentioned above, you might as well call your machine a "number-mover-arounder-and-pretty-picture-maker" and ignore the results of the math benchmarks. The other three processing-related benchmarks available in Snooper will give you a better indication of overall CPU performance.

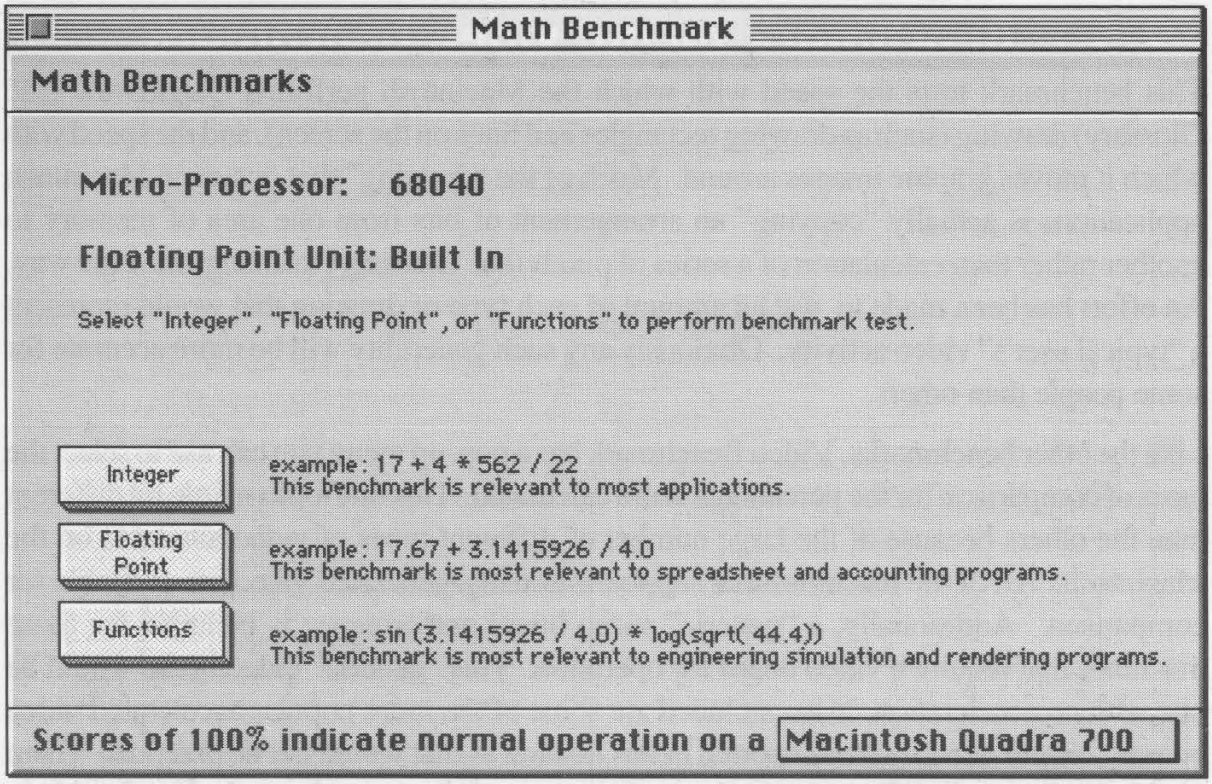


Figure 13. Math Benchmark Window.

9-4 Benchmark menu: memory benchmark

This benchmark is the most universally applicable of all the benchmarks, as all applications spend some of their time moving information around from one part of memory (RAM) to another. Whether it be a spreadsheet, a word processor or a game, it will move pieces of data around from one area of memory to another. The speed with which the machine accomplishes this task has an enormous effect on its overall performance. The primary hardware issues which govern the machine's ability to score on this benchmark are the CPU speed (i.e., the number of megahertz at which it runs), and the amount of "caching" (see Glossary) that the microprocessor performs.

As with the other benchmarks, the Memory Benchmark allows you to select some other type of Macintosh with which to compare the raw score — to get a percentage relating this machines performance with that one.

9-5 Benchmark menu: video benchmark

This benchmark tests the speed with which the Macintosh performs QuickDraw (see Glossary) drawing (such as drawing rectangles and lines on the screen), and the speed with which it moves graphic images around. Much of the "drawing" that occurs in Macintosh applications is actually "copying" an arrangement of bits from one area of memory to another rather than calculation of a series of pixels (see Glossary) to change in some way. An effort has been made to use an amount of each type of drawing that would represent a "typical user's" video activity. Obviously any such generality will be more accurate for some people than others.

Like the other benchmarks, Video Benchmark has a pop-up menu you can use to select the basis of comparison for the percentage score calculated. This one looks a little bit different than the others because of the large number of different types of video available on the Macintosh. All of the machines that support internally-generated video are available for comparison. Additionally, a "generic" video board performance is included for those machines that require a video board for operation. This "generic" video board would be one with no acceleration. Also included are some of the more popular accelerated video boards. Not all vendors are supported in this fashion as that would not be practical. There could also be small differences in the performance of these accelerated video boards in various Macintosh models. In the interest of practicality, this shortcoming will just have to be tolerated.

For convenience in testing a video setup with different pixel depths (numbers of screen colors), a pop-up menu has been provided for changing this setting. This is essentially identical to using the Monitors Control Panel to make this change.

If you have more than one monitor connected to your Macintosh, you can check the video performance of the other monitor(s) simply by moving the Video Benchmark window to the screen you wish to test before running the test.

9-6 Benchmark menu: CPU benchmark test

This test goes after the same aspect of performance appraisal as the Memory Benchmark, but from a different angle. This test is based on a very commonly used benchmarking function called a "sort." Just as its name implies, it has to do with arranging a bunch of somethings into a certain order. While you might not go around sorting things all day on your Macintosh, this benchmark would still be of interest to you in showing the performance of the machine on any repetitive type of task. Some examples of other tasks that are performed frequently on a computer that would have similar performance characteristics to the sort routine used here are: Spell Checking a document, compiling a program, using a "filter" in a paint program, sorting a database...the list is endless (another way of saying I couldn't think of any more right now).

This benchmark uses a procedure called a "Quick Sort" to sort a random arrangement of the numbers 1 through 200 into ascending order. You might enjoy watching the sort to see how the algorithm works. It is an example of a recursive routine, a strange idea wherein a routine calls itself over and over, rather like an M.C. Escher drawing of a snake eating a snake eating a snake. The first time through, the routine divides the list into two imaginary "halves," putting the small numbers in the top half and the big ones in the bottom half. Then it calls itself again to do the same thing to each of those halves, and then to each of the resulting halves and so on until the last set of sorts is just arranging each pair of numbers into"the big half" and "the small half." When each of these mini-sorts has been completed, the whole list is properly sorted.

As with the Memory Benchmark, the only real factors that affect the performance on this benchmark are the speed at which the CPU is clocked (i.e., the number of megahertz at which it runs) and how much caching (see Glossary) the microprocessor does.

9-7 Benchmark menu: disk drive benchmarks

The Disk Drive Benchmarks are provided for checking the performance of hard disk drives (and also removable media drives such as Syquest drives). Unlike the CPU-related benchmarks, there really isn't any appropriate "standard of performance" against which to compare disk drives. The industry has settled on some defacto measurements that are considered to be relevant, but there is no standard on how the tests are to be set up. As a result, the numbers that are used in advertising the various disk drives from different vendors cannot really be taken on face value when comparing one drive with another. The only foolproof method of determining the speed of one drive compared to another is to run the same test on both drives and compare the numbers from that test. The Disk Drive Benchmarks provided here are a test that can be used on any disk drive that can be connected to a Macintosh to get real comparison data. Because any test of a disk drive's performance is dependent upon the size of file involved, you should not expect the number given by Snooper to be identical to the number alleged by the guy who sold you the drive. After all, he has to put food on his table...

Many people are surprised that there is sometimes a big difference between the read and write speed of a drive. The primary reason for this is that there are different things the drive maker can do to boost the performance of a read or write operation, and depending on which of these things are implemented on a given drive, either the read or the write, or both might have stellar performance. One example of such a technique would be the use of a "write cache" on a hard drive. When a disk drive uses this technique, it is storing the data sent to it in a small amount of RAM memory built into the controller board on the disk drive. It then reports that the write is complete, and takes its own merry time actually transferring the memory-based copy of the data onto the magnetic media of the disk. This will give wicked fast write times for files that are small enough to fit in this write cache, but will have no effect on large transfers, and no effect on read operations. There are many of these "tricks" that a drive-maker will use to boost the performance of a drive to its highest possible limit. The problem comes in when the maker of the drive has to confront the conflict of deciding what claims to make for the drive. He may be tempted to give performance numbers that while they are technically true, are so far from being "real world" that they give a misleading picture of the performance of the drive in normal use. Snooper gives you performance data at several different file sizes that you can use to compare one drive with another.

Aside from reading and writing, there is another factor that comes into play in determining the real world performance of a disk drive. Before you can read or write fast, you have to get the right book off the shelf! That is what the Seek benchmark is all about. The data stored on any type of disk drive is spread out over the surface of a rotating platter. A small device called the "head" is used to read and write data to and from the surface of the disk. This head can only "see" the stuff that is directly under it on the disk. As the head is moved closer or farther from the center of the rotating disk, the head is over different data on the disk. The computer keeps track of the data you store on it for you, and between the computer and the drive itself, the task of moving the head over to the right place and collecting or storing the proper data is accomplished without any help from you. You supply the name of the needed data, and the computer and the drive take care of the rest. This process of moving the head to the right place on the disk is called "seeking a track" or just "seeking." The reason any of this is relevant is that it takes some time to move the head to the right place on the disk. It is not a long time, but if the head has to be repositioned several times to get the piece of data needed, it can add up and affect the overall disk performance.

One way that this can become very important is on a disk that has become "fragmented." As you store new data on a disk and erase old files and add some more, the system software handles the task of efficiently using up all of the little pieces of disk space opened up when you delete a file you no longer need. When you go to store a large file, there may not be a piece of disk big enough to store it all in a nice continuous spread the way you would like it. If there are enough little pieces of space left to store the file in pieces, it does that for you and keeps track of where it put all the pieces. The next time you need that data, the system goes out and grabs all the little pieces and puts them together again and you are none the wiser. When this fragmentation becomes severe, your drive can end up looking all over the disk each time you try to get some data back from it. For this reason, drives which have a good seek time are less affected by disk fragmentation. If you keep your disk optimized, using one of the many disk utilities available for this purpose, the seek time of the drive becomes almost irrelevant. Any drive on the market today can seek once all the way across the disk in less time than it takes you to blink.

All the same, some people want to get every last drop of performance possible from their system, so Snooper provides a benchmark test for testing the seek time of a drive. The graph that is drawn for the seek time contains hundreds of individual data points that add up to give you an overall picture of a drive's seek performance. Each of the little dots on the graph represent the time it took to seek a certain distance across the drive (actually, to seek to a particular "sector" on the drive, but more on that later). On most drives these will form several horizontal lines across the graph, going progressively higher towards the right. This shows that small seeks take less time than longer ones. The important line on the graph is the solid line with the big square data points. This line is a "moving average" of the seek time out to that point. It shows you the average seek time for all of the data stored on the disk from the beginning (near the home position of the head) out to that point of the graph. For instance, if you look at the average line and follow it over to see the number of milliseconds for the "50%" point on the graph it is telling you the average seek time for the first half of the data on the disk. The number that many manufacturers quote for their drives is actually somewhere on that average line. They may quote the average for the first 10% of the disk or the first 20% of the disk, but rarely the correct number -- the average for the whole disk.

Many disk drives are composed of several platters stacked one above the other with a separate head for each platter. This is used as a means of creating disk drives with very large capacity. Just as a side benefit, it also creates a drive with different seek characteristics that can be used for another of the "tricks" mentioned before. With several platters at his disposal, the maker of the drive can arrange things so that the tracks near the home position on all of the platters get used up first, rather than using all of the tracks on one platter, and then moving to the next platter, etc. By doing this, he compounds the difference in performance between the first few tracks of data and the later tracks. This allows him to get an even better number for the "average seek time" (actually just the average of the first few tracks). While the data may be accurate, it paints a picture of the drive's performance which is not at all real world.

CHAPTER 10 HELP!

10-1 Introduction

Snooper contains a total of five different types of help. Two of these are help in using Snooper, the other three are help for various types of troubleshooting. Two of the help features are found on the Main screen, and the other three are found in the Help menu. The next section covers the two found in the Main screen. The following three sections cover each of the items in the Help menu.

10-2 The text box

Whenever a designer creates a help facility for a piece of software he has to walk the fine line between making it easily accessible, and having the user feel like it is "in his face all the time." The Balloon Help feature designed into System 7 succeeds in being accessible, but many users feel it is too conspicuous and annoying. We choose not to implement it for this reason, and instead chose a solution that would allow us to provide cursor-sensitive/context-sensitive help, and optionally provide other information with the same feature without confusing the user by having half a dozen different pieces of text scattered around on the screen. We also feel that it is inconspicuous enough that users won't feel like it is "in their face."

This feature is active in all four of the modes of the Main screen (i.e., Logic, Disk, Video, and Audio). As the cursor is placed over a button or icon, the text in the window is changed to describe that feature of the Main screen.

The second help feature in Snooper is also on the Main screen, and also makes use of the Text Box. This refers to the picture of the logic board (sometimes referred to as the motherboard) that is displayed in the Logic window. This picture is a close representation of the correct logic board for the computer on which Snooper is running. The picture includes most of the important chips (or integrated circuits) on the board as well as some less important features which are included as landmarks to help you find other things. Moving the cursor over a component on the board will cause the text in the Text box to display the name and function of that device. An effort was made to support as many chips and connectors as possible, but not every little component on the board is labeled in this way. The intended purpose for this display is simply to provide a means for users to become more familiar with the internals of their machine. Contrary to the old cliche, familiarity breeds understanding not contempt. We hope you enjoy getting to know your machine on a first-name basis.

10-3 SNOOPER help

This help feature, found under the Help menu, is included for those of you who are allergic to user's manuals. Since you are apparently reading the manual, this may not apply to you, but we will describe it briefly anyway.

This on-line help feature is context sensitive in the sense that when the Help window is opened (using the Snooper Help menu item, or Command-?) the topic will be already set to the one most relevant to the front-most window at the time help was selected. If for instance, you were using the Memory Benchmark window, and needed more information, the Help window would come up already set to information about that window.

The on-line Snooper Help is organized as a set of topics (selected with the popup menu at the top of the window), and one or more pages having to do with each topic. The Previous and Next buttons will allow you to "turn the pages" that belong to each topic.

10-4 System errors help

When a program crashes on a Macintosh, it usually happens in one of two ways. One of these two ways is when the program, as a result of bad data, a program bug or a malfunction of some sort, ends up in a situation we call an "infinite loop." This is where the computer is executing the same instructions over and over with no way of breaking out of that loop. When this happens, the computer is walking around in circles, and is too dumb to know something is wrong. It will just keep doing that until somebody hits the reset switch, or pulls the plug. The other type of crash is a situation where bad data, a program bug or a malfunction of some sort causes the machine to try to do something that even the computer knows is stupid. One simple example of this is when a program tries to divide a number by zero. Because there is no intelligent answer to this little math quiz, the designers of the Macintosh, in an effort to make it a kinder gentler machine, put up a dialog box that says "A System Error has occurred 4." It would be nice if the dialog box came up and said "Oops! Your program just tried to divide something by zero!" Unfortunately, it just gives you a clue, it tells you a "4" just happened. That is where the second item in the Help menu of Snooper comes in. When you get one of these cryptic messages from the bowels of the Macintosh ROM, the System Errors window will help you to convert it into something approaching English. This, of course, assumes that either the machine it happened on is reasonably healthy after you restart it, or that you have another Macintosh around that you can use with Snooper.

10-5 "Sad Mac" help

There is another type of cryptic error code that sometimes makes its way to the ordinarily friendly face of a Macintosh. This one only happens during the early phases of starting up the machine. At start-up, the Macintosh goes through a start-up diagnostic sequence to check certain key parts of the machine to see if they are there and are healthy enough for the machine to be used. If any part of this diagnostic test fails, the screen of the machine goes black (instead of the usual desktop pattern), and displays a "Sad Mac" icon—a picture of a Macintosh that got out of bed on the wrong side. At the same time, it makes a sound that is known affectionately as "blowing chimes." Underneath the picture of the unhappy Mac is an error code that only a programmer could love. On the Mac Plus and earlier machines, this is a one line message of six characters. On all of the later machines, it is two lines of eight characters each.

To decode the cryptic error code into something approaching English, start up Snooper on another machine and select the third item in the Help menu called "Sad Mac Help." In this window you will find a series of pop-up menus that you can use to set up the numbers as they appear under the Sad Mac on the sick machine. It is important to do this in order, starting with the part of the code labeled AA, then the BB part, and finally the CC part. Once all three of the pop-up menus have been set to the appropriate characters, select the Decode button to see the text that describes the malfunction.

CHAPTER 11

THE FILE MENU AND GENERATING REPORTS

11-1 Introduction

Snooper's File menu contains items that let you generate a use-defined report of Snooper's tests and information, save that report as a disk file, print the report, open a previously saved report, and also output "test prints" on a printer to check resolution and print quality.

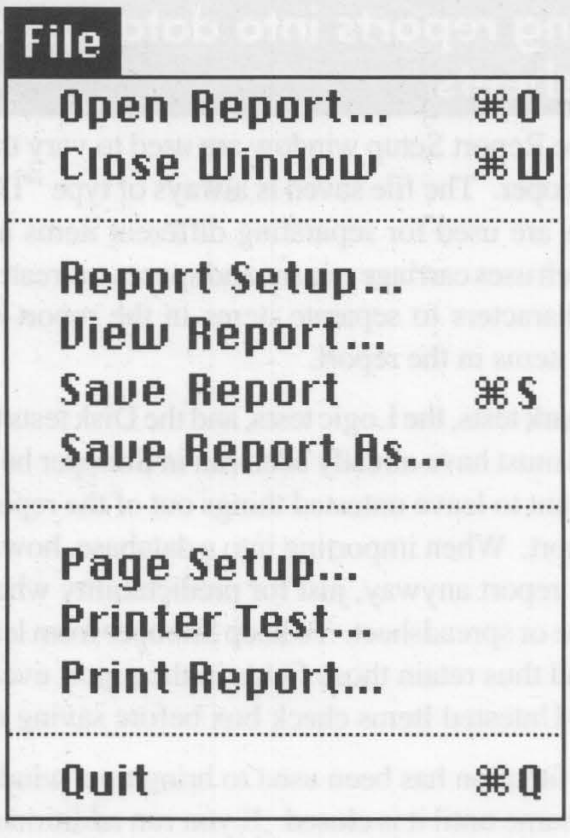


Figure 14. The File Menu

11-2 Reports...have it your way!

Since a large number of users need to generate a report from the information gathered by Snooper, and the uses for that report are widely varied, every attempt has been made to create a very flexible reporting scheme for Snooper.

The Report Setup item in the File menu opens a window that lets you in effect "roll your own" report. In this window, you will find check boxes that let you specifically include only those items you want in the report. The selections are broken up into three categories:

information (things in the Info menu), benchmarks (things in the Benchmark menu), and tests (results from tests performed in the Main screen). For a normal text report, simply select those items you wish to include in the report. There are "All" and "None" buttons to aid you in selecting the items you want to include. Once you have selected the items you want in the report, close the setup window and use either Save As to save the report to a disk file, View Report to look at the report in a window on the screen or Print Report to send the report to the printer. All three of these options use the same setup information, as determined in the Report Setup window. It is not necessary to view the report or have the View Report window open to save or print the report. In fact, a new report is generated with the latest test results each time you select View, Save or Print.

11-3 Importing reports into databases or spreadsheets

The last few items in the Report Setup window are used to vary the format of the text file that is generated by Snooper. The file saved is always of type "TEXT," but you can vary what type of characters are used for separating different items in the report. The three choices are Normal which uses carriage returns and spaces to create a readable text file, Tab which uses only tab characters to separate items in the report or ";" which uses only semicolons to separate items in the report.

In order for the Benchmark tests, the Logic tests, and the Disk tests to have meaningful data in the report, these tests must have already been run in Snooper before creating the report. Normally one would want to leave untested things out of the report, and include only the pertinent data in the report. When importing into a database, however, one might want to have those fields in the report anyway, just for predictability when setting up the import functions of the database or spreadsheet. To keep Snooper from leaving out tests that have not been performed, and thus retain those fields in the report even though the results are zero, uncheck the Skip Untested Items check box before saving the report.

Once the View Report function has been used to bring up a window showing the report, that report remains the same until it is closed. If you run additional tests after viewing the report, you will need to select View Report again to update the window with the new test results. When saving or printing a report, the report printed or saved is always a new current report with up-to-date information and using the currently set format.

11-4 Looking at previously saved reports

The "Open Report..." item in the File menu allows you to open a report that was previously saved by Snooper 2.0. Reports from version 1.0 of Snooper are entirely different in format, and are not supported by this feature. When you select "Open Report…," a standard file dialog is opened for you to locate the report you wish to open. Once you have selected the report, it will be displayed in a text window. If you wish to print this report, select Print Report while this report window is active (i.e., the front window on the screen).

11-5 Using the printer test

It may seem strange to some to have a test in the File menu, but, frankly, we couldn't find any better place for this test. Print-related things are usually found in the File menu, so we put it there. Selecting the Printer Test item in the File menu opens a dialog box that lets you select one of three different "test patterns" to print on the currently selected printer.

To print the test patterns on a different printer, use Chooser under the Apple menu to select a different printer before selecting the Printer Test menu item under File.

CHAPTER 12 TROUBLESHOOTING FOR THE NOVICE

12-1 Introduction

Troubleshooting a problem is not always an easy task. Unless you are one of those rare individuals with a sixth sense about computers, troubleshooting is almost always a matter of guessing what the problem is and then checking something that will either support or rule out your hypothesis. By eliminating one possibility after another, you eventually end up with the right solution. The first part, guessing what is wrong, is much easier if you have good methods of "snooping around" and are good at "obnosis." Obnosis is a conjunction of the words "observing the obvious," and means the ability to see what is actually there rather than seeing what everyone else sees when they look at something. The second part of the process, testing your guess to see if it is correct, can be much easier if you have the right tools at your disposal.

Snooper can help you with both of these steps. As this "tutorial" on troubleshooting branches out, we will make specific recommendations about things you can determine with Snooper that will get you closer to finding the culprit.

12-2 This road has a fork in it!

Is it a hardware or software problem? An important part of solving a computer problem is to determine whether it falls under the heading of hardware or software. Why is it important to divide the problem into one of these two categories? Let's demonstrate this fork in the road with a more familiar household gadget, the TV. Suppose you are watching your favorite sit-com, and all of a sudden the picture begins to distort and roll. What would be your first line of attack on this problem? Should you wiggle the antenna? Pound on the side of the set? Take the TV into a repair shop? The correct first step is to switch to a different channel and see if the problem persists. If the problem only exists on that single channel there is a good chance that the TV is just fine, and that the proper solution to the problem is to go get another beer and hope that the engineer at the TV station is about through with his.

OK, you say, but what does that have to do with a computer? You can't change the channel on a computer, or can you? A TV is a machine. Given a certain type of input, it will provide a certain type of output. To quote an old saying of questionable origin, "Garbage in, garbage out." If the TV is not getting the right kind of signal, it will provide you with nothing but garbage to view. This situation can give exactly the same appearance as a broken TV set, and lead you astray into expensive and time consuming "solutions" if you don't first ascertain whether the input to the system is as expected.

While a computer doesn't have a channel selector on it, the same troubleshooting approach can certainly be applied to the computer. A TV is a device for putting images on a screen. Those images are input in the form of a signal that "instructs" the TV what sort of an image to display. Give it the wrong instructions, and you get garbage on the screen.

In a computer, the same basic principle applies, but the "instructions" that determine what shows up on the screen are a combination of the programs that are being run on the computer and the interaction of the user with the computer. The programs, the mouse clicks and keyboard activity of the user combine to make up the "signal" that the computer translates into images on the screen.

A good first step in starting to troubleshoot a computer is to decide which side of this software/hardware fork to start down on the road to a working computer. There are some clues that stick out of the jumbled mess like a sore thumb if you know them. These clues can get you started down the right side of the fork in the road.

• **Did the computer start up properly, or did it "blow chimes" at start-up?** When a Macintosh starts up, there is only one software difficulty that can make it blow chimes. If the machine gets all the way through the Power On ests, and starts to load in the System Software, only to discover after it has started that the System or Finder files on the disk are "messed up," it will blow chimes and put a Sad Mac on the screen. If, on the other hand, it just doesn't find a System Folder with which to start up, it will put up a gray screen and a picture of a disk with a flashing question mark on it. To make use of this clue, if the computer displays a Sad Mac and blows chimes, turn off the power, disconnect all of your hard drives and don't put a floppy in the floppy drive. This will prevent the computer from finding any System Software. If the computer still blows chimes, you have both feet planted firmly on the hardware side of the fork, and you can walk with confidence knowing that you are on the right path. Go on to the hardware section of this tutorial for the next step on this side of the fork.

• **Did the computer blow chimes with System Software and give you the blinking question mark when you took it away?** If so, it means you have a specific type of software problem. Your System or Finder files have either been corrupted or aren't compatible with each other or this computer. You should use the System disks that came with the computer (or a newer version if you have it and want to use it) to install a whole new system on your hard drive (or if you still live in the dark ages and don't have a hard drive, install it on your start-up floppy). If this turns out to fix the problem, you may want to investigate further to find out why your start-up drive got messed up. In this case, return to the fork and use additional clues to determine which way you will go this time.

• Does the machine crash sometime between displaying the happy Macintosh icon and displaying the menu bar? This is almost always a software problem with the INITs and CDEVs that are installed in the System Folder. If this is the situation, you should go down to the Software Diagnostics section below.

• Does the machine crash every time (or even almost every time) you use a particular SCSI peripheral such as a hard drive, a printer or scanner? This smells like hardware to me. Go to the SCSI hardware section below and continue from there.

• Does the computer crash whenever you use a particular application that used to work on this machine? This is likely to be a software problem. Start with the software diagnosis section below.

• Does a new application you just got crash when you try to open it? This is almost always software. Try calling the technical support department of the software company. They might be able to give you a list of unfriendlies to look out for with their software. The Info menu items in Snooper may be helpful at this stage to get a quick look at various System Software and hardware configurations to answer the questions the technical support person asks you.

• Does the machine crash when you try to print something? (This doesn't apply to SCSI printers like the LC) This is probably a software thing. When a serial or AppleTalk® printer fails, it can generate printer errors and bad printouts, but there is little chance of it making the machine crash. One hardware check you should probably make before seeking out software gremlins is the Printer Port Test in Snooper using the loopback plug included. This will pretty much rule out the possibility that a hardware problem is causing the crash.

• Does the machine crash every time you do "this and then that and then the other thing," but only when you do them in the right order while scratching your nose? This kind of a "sequence of events" crash is almost always a software conflict.

• Does the machine just seem flaky, and sometimes it works and other times it crashes, and you can't find any pattern to its madness? Get out a quarter and flip it. Heads it's hardware, tails it's software. Check the easiest things first. Depending upon the user of the machine that may be asking the fateful "software question" below in the software section.

With other users, it may be easier to open up Snooper and start a cycle of tests to check for intermittent hardware failures. This type of testing is the most time consuming. It may take several hours of continuous testing for an intermittent hardware failure to show itself.

• **Do you notice flaky operation of anything that uses a particular part of the computer, such as the modem port, printer port, a particular hard drive or the floppy drive?** If you can easily narrow the failure down to a particular "sub-system" in the computer, it may well be a hardware problem. You should use Snooper to test that section of the hardware.

If none of these clues is available to lead you down one side of the fork, we suggest a shotgun approach to the problem, starting with a quick check of all the tests available in Snooper. If that doesn't bear any fruit, try using the machine with extensions off (or all CDEVs and INITs that are not from Apple removed from the System Folder in System 6) for a while and see if the problem goes away. If that doesn't reveal the mystery, try running some extensive cycling tests with Snooper to look for intermittent problems.

12-3 Software diagnostics

Above we saw that checking the "software" of a TV would consist of changing the channel to see if the problem was only on one channel. So, what would you do on a computer that would be analogous to changing the channel on the TV? Simple. Try some software that used to work and see if it operates correctly. Simple, right? Not always. The word processor or spreadsheet, or whatever application you are using, is just one of the programs running in the machine. It is the most obvious piece of software, but a software problem is often related to one of the other types of software that are in use in the machine "behind the scenes." What are these quasi-invisible software devils that are infesting your machine? Here is a list of things that most people don't think of right away when you ask them what software they are using on their machine:

• **The Macintosh ROM** —This is the software that is "built in" to your machine and, for all intents and purposes, is permanent and doesn't change until you buy a newer Macintosh. If it doesn't ever change, then you don't have to worry about it, right? Flunk! Because it is such a basic building block of the software in the machine, the other software in the machine is very dependent upon this software. Different models of Macintosh have different versions of this fundamental software. These different versions can make a software developer's job a nightmare, and can cause something that works fine on Fred's machine, but doesn't work on Mary's machine.

• **The System Software** —This is software that you load into your machine from a floppy disk. It is not built-in to the machine, and can easily be changed over the years as Apple releases new versions of the System Software. Despite the fact that it gets into the machine in a different way, it performs exactly the same function as the Macintosh ROM software. In fact, the System Software is made up mostly of "fixes" to the ROM-based software to add new features to older machines and fix bugs in the ROM-based software on the newer machines. Because this software is used by all other software that runs on the machine, a change in the System Software being used can create situations in which things that used to work don't work anymore.

• **CDEVs and INITs** (pronounced "sea-devs" and "in its") — An INIT (short for initialization) is a piece of software that you put in the System Folder (Extensions Folder in System 7). This mini-program is started up by the computer during the normal start-up sequence, and instead of running and then terminating, the INIT hangs around in memory and affects the operation of the computer while other applications are being used. These programs work by installing "hooks" into the System Software that cause the INIT to get "tickled" when a particular type of operation happens in the machine. An example of one of these "hooks" would be an INIT that needs to do something whenever a key gets pressed on the keyboard. By installing a hook (sometimes called "patching a trap"), the INIT is notified whenever a key gets pressed, so it can do whatever little piece of magic it was designed to do. A CDEV (short for "Control Panel Device") is a special type of INIT with one special difference. With some INITs, there is a need for the user to be able to modify its behavior, or turn it on and off, etc. A normal INIT does not have any windows or menus or any way for the user to interact with it. A CDEV is an INIT that has the capability of displaying a window with controls in it for the user to operate. This window is the familiar Control Panel Desk Accessory in System 6, and the window you get when double-clicking on a CDEV in System 7. Some CDEVs and INITs put up an icon on the screen while they are starting-up. This is optional, so not all INITs do this. If they do, it is a helpful troubleshooting clue for one type of software conflict.

• **Drivers** — These are small programs that are similar to INITs in many ways, but they have a special purpose in life. They are used to make other pieces of the hardware talk to the CPU. When a hard disk is started up by the computer, for instance, the computer loads in a driver from the disk, and uses that driver to control the operation of the disk drive. When you print something on a Macintosh, the item you select in the Chooser is *not* the printer you wish to print on, it is the driver for that printer.

• **Computer Virus** — Oops, even I almost forgot to include this one! "But a virus isn't software!" some would say. Flunk! The only difference between a virus and any other program is the morals and ethics of the programmer. All computer viruses are indeed software, and need to be included in this phase of the troubleshooting process.

The reason for this lengthy dissertation on the types of software in a Macintosh is that it greatly (and appropriately) broadens the meaning of "What software did you change?" Especially if you are helping someone else out with their machine, this tell tale question is often the equivalent of changing the channel on the TV. Unfortunately, without the above understanding of what constitutes "software," the question is sometimes meaningless. You may need to use this list as a "checklist" to guide yourself or the owner of the machine, through the various ways that the channel may have gotten changed from the one that used to work, to the one that crashes. There is one simple fact that can lead you to the solution of many computer problems: If it used to work, and it doesn't work now, either its broken or somebody changed something. There are no other possibilities!

The trick lies in asking the question "What software did you change?" in a way that it can be answered completely and accurately. Quite often, taking a person through the list above and asking him one by one whether he has added any of these, removed any of these or changed any of these to a different version will quickly find the villain of the piece. If this line of questioning turns up a whole list of suspects, *all* of them should be put back to their original state. If the machine is functioning normally with all of them returned to their original working order, they should be put back one at a time and tested, until the guilty party is identified.

If the user of the machine is not available for questioning, or is claiming diplomatic immunity on the grounds of computer illiteracy, one quick and dirty way to check out a large section of the possibilities is to disable or remove *all* of the CDEVs and INITs and see if the problem persists. If that fixes it, you can start the trial-and-error process to find out which piece of software is at fault. In System 7, turning off all of the CDEVs and INITs is very easy to do! Just hold down the Shift key while the machine is starting up until you see the dialog box that says "Welcome to Macintosh Extensions off." This disables *all* of the CDEVs and INITs so that you don't have to drag the critters out of the System Folder.

The most obvious problem created by an INIT conflict is when the machine crashes or freezes during the start-up sequence while it is loading the INITs and CDEVs. This type of conflict can also create havoc much later. It is quite possible for everything to go fine at start-up, only to fall apart at the seams later while running an application. Sometimes changing the order in which CDEVs and INITs load will solve the problem. If the above research shows an INIT or CDEV to be the culprit, you can try changing the order in which they are loaded to make the culprit usable on the system. Since CDEVs and INITs are loaded in alphabetical order, just changing the name of the offending CDEV or INIT by adding an "a" or "z" to the front of the name will move it toward the beginning or the end of the list. Changing the order does not always fix the problem, and this can sometimes require a fair amount of trial-and-error. It may be easier to just escort the offender to the trash can.

Software Corruption

Aside from the user knowingly and willingly changing the System Software setup on a computer, there is one other way in which the software can be changed. It is possible, though rare, for some of the data stored on a hard disk or floppy to become corrupted, or "messed up." This can happen as the result of a flaky computer, a bad disk drive or a program writing garbage to the disk either on purpose or by accident. Normally, the checking and error-correcting done by the Macintosh is sufficient to prevent bad data from getting stored on a disk drive, but these protection measures can, and do, fail. The more common way for a program to get corrupted on the disk is failure of some software to write the correct things to the disk, rather than the disk failing to write what it hasbeen told. When a program crashes, one of the things that can happen is that it can end up executing whatever garbage is sitting around in unused areas of memory as though it were a program. Since the stuff in these areas is quite random in nature, there is no telling what the computer might do while it is "running amuck" in this fashion. If it happens to execute something that causes data to be written to the disk, it is possible for programs residing on the disk to be damaged. This is rare, but it can happen. If a computer is performing strangely or not at all with just one or two programs that used to work on it, bringing a new copy of the programs affected onto the disk from the original floppy is another possible fix. Since this is more rare than the "Three new INITs and a shareware game with a deadly virus in it" type of problem above, it would normally be checked after exhausting the first possibility.

Virus!

Do you practice safe computing? Flaky behavior and crashes are sometimes caused by a computer virus infection. Corrupted files on your hard disk can be another sign of such an unwanted guest. To determine whether your Macintosh has a virus, purchase virus software or obtain public domain virus software, such as Disinfectant. Most virus software will allow you to scan your disks for viruses and clean up any infected disks.

Is the User broken?

Depending upon the Macintosh literacy of the person using the machine you are fixing, you might want to get the user to demonstrate the "flakiness" for you before you spend a lot of time trying to fix the machine. Some otherwise very intelligent users have astounded me with their ability to misunderstand how something is supposed to work, or to take literally a poorly written users manual. If any part of the user's demonstration of the problem involves standing on the desk and flapping their arms, you should at once suspect that the flaky part of the input to the machine is the user!

If you chose to go down the software side of the troubleshooting fork first, and have reached this point without finding the scoundrel that is ruining your day, this would be a good time to start some hardware diagnosis to see if some part of the machine has actually broken. With a diagnostic tool like Snooper, you can easily and quickly check to see if the components inside the machine are working properly.

12-4 Hardware troubleshooting

The Many Faces Of Macintosh

When you start-up a Macintosh, there is an orderly sequence of events that leads up to the appearance of the familiar desktop. One part of this start-up sequence is a limited set of diagnostic tests intended just to see if all of the parts of the system are there and responding. There is a limited test of RAM and tests for each of the major "controller" chips in the machine such as the serial chip and the SCSI chip. If any of the tests performed in this Power On test fail, the machine goes into a tantrum known as "Sad Mac." The screen of the machine goes all black except for an icon of a Sad Macintosh. A series of code numbers that give a hint as to the source of the failure (provided you know how to decode them) appears below the Sad Mac. When this happens, the machine also plays a series of chimes that is different from the normal chimes you hear when you start-up the machine. This leads to the other name for this situation — "blowing chimes."

Because the machine will steadfastly refuse to do anything else besides display the Sad Mac, this type of failure provides a natural division of hardware failures into two categories: those that pass the Power On tests (and don't give a Sad Mac), and those that fail the Power On tests and blow chimes.

If the machine is taking the Sad Mac route, a diagnostic application such as Snooper is of no use whatsoever for working on the machine, since you can't start Snooper up and use it. The only exception to this rule would be using Snooper on another machine to help you decode the Sad Mac codes displayed on the screen. With that exception, the only path to pursue at this point is to use a hardware testing device, such as the Snooper NuBus Card, or to try some hardware shotgunning. If you have the Snooper NuBus Card and the sick machine is a NuBus machine, you should break out the manual for the NuBus Card and continue there.

Shotgunning A Sad Mac

If you don't have access to any type of hardware testing device, there are still some things you can try that may prove useful. The first one is to eliminate the SCSI chain and the System Folder on the start-up drive as possible sources of the problem. To do this follow these steps, turning off power before executing each step of the procedure:

• If you have another machine available, use Snooper's Sad Mac Help menu item to decode the error code on the Sad Mac screen of the sick machine. This might lead you right to the problem. If not, continue with the following steps.

• First, try booting the system with a boot floppy (make sure the boot floppy is a version that will work correctly on this model of Macintosh). If the boot proceeds normally, and there is no Sad Mac, then the solution is to reinstall the system on the start-up hard disk. If the reinstallation doesn't work, the disk may be damaged, or may just need to be reformatted. In either case, one of the Hard Disk Utility packages available may be able to recover some or all of the data on the disk. This should be tried before reformatting the drive, as that will certainly loose any data that might otherwise be retrievable.

• If there is still a Sad Mac with the boot floppy, disconnect *all* of the SCSI devices, including the internal hard drive if there is one. Restart the machine again. If the machine no longer gives a Sad Mac at start-up with the SCSI devices removed, experiment with different combinations of the cables and devices originally connected to the machine to isolate the faulty cable or terminator or device. Be sure to pay attention to proper SCSI cabling technique while doing this experimentation. See the section entitled "SCSI Cabling Theory and Practice."

• If removing the SCSI devices from the machine did not solve the Sad Mac situation, next try removing all of the NuBus cards if the machine has any. Don't worry if one of the NuBus boards is the video board, you can still determine if the machine is doing a Sad Mac by listening for the "chime" sound that you have heard several times by now. If removing all of the NuBus cards solves the Sad Mac, put them back one at a time and restart the machine each time to see which one is causing the machine to fail.

• If the Sad Mac persists, you can next try troubleshooting the RAM. If the machine has more than one bank of RAM installed, remove all but the first bank and restart. If this solves the Sad Mac, you can use trial-and-error to find the bad SIMM by replacing the easiest to remove SIMM with each of the remaining SIMMs, one at a time. Restart each time to see if the Sad Mac has been resolved. Remember that all machines require that all of the SIMM slots in a bank be filled if any of the slots for that bank are filled. In other words, no partially filled banks. If the machine you are working on has some RAM soldered on to the motherboard, you can try it with all of the RAM SIMMs removed. A machine that doesn't have any motherboard RAM will not start-up with out at least the lowest numbered bank filled with SIMMs. Remember also when swapping SIMMs around that all of the SIMMs in a bank have to be the same "size." You can't mix 256K SIMMs with 1 MB SIMMs and so on. Another thing to watch out for if you swap SIMMs between machines, is that SIMMs come in different speeds. If you take RAM out of an older machine and put it in a newer model, the old SIMMs might be slower than the SIMMs used in the newer machine. The chips on the SIMM usually have a long part number on them. The last two digits of this part number are usually the "speed" of the part in nanoseconds. A smaller number is faster than a bigger number. It is okay to use a SIMM that has a smaller number than the original SIMMs for the machine, but if the replacement SIMM has a larger speed number, it is slower, and may not work. The common speeds for Macintosh RAM are: 70ns (really fast), 80ns (most of the models will work with these), 100 ns (typical for the original 030 machines like IIcx) and 120ns (slow machines like the SE and Plus).

• If swapping out RAM didn't solve the problem, it's time to throw up your hands and take the machine to a service center. It is probable at that point that the repair will require swapping out the motherboard. This is pretty easy to do if you have accomplished all of the steps above, but acquiring the replacement can be difficult.

A Totally *Dead* Machine

Another situation besides the Sad Mac that prevents using the Snooper Software is the case of a completely *dead* machine. If, when you try to start-up the machine, there is no response to pressing the Power On key on the keyboard and no response to the power button on the back of the machine, its called a *dead* machine. The first thing to check in this case is whether or not the machine is getting AC power. A circuit breaker or fuse may have blown somewhere outside the computer. There may be a bad power strip or power cord. Someone may have kicked the cord and it may be just half-way into the outlet, or may be half-way into the cord receptacle on the back of the machine. Try a different power cord from some other computer or monitor. Some models of Macintosh (most of the models that can be turned on with the Power On button on the keyboard, not any of the ones that require you to turn on a toggle switch on the back of the machine) will not start up if the battery on the motherboard is dead. The reason for this is that the power used to close a relay in the power supply that turns on the machine comes from the battery. Many of the Mac models have replaceable batteries; some, unfortunately, use a soldered-in lithium battery. Determine which it is and replace it, if possible, as a last resort before replacing the power supply. If you have the Snooper NuBus Card, you can use that to check the condition of the power supply. See the manual for that product for instructions.

A Flaky Machine That Boots OK

The most common use for Snooper is in troubleshooting a machine that boots okay, but is exhibiting some sort of random flakiness or intermittent failure. This is a very common type of machine failure, and the most difficult to diagnose without the proper tools. With Snooper, it's much easier. An intermittent failure can be caused by either a software or a hardware problem. If the problem is a hardware problem, it is often heat-related, but can be completely random. The one thing you do know is that it doesn't happen all the time (that's what intermittent means). For this reason, in order to track this type of problem down, you need to use Snooper's tests in a cycle that repeats for a period of time long enough for the error to occur. This is usually more than ten minutes, and could easily be hours. One common way to do the testing is to set it up and let it run overnight. When you come back in the morning you can check the log to see if anything failed during the night. For a flaky machine situation, we suggest the following line of attack:

• Do a quick mental check, or question the user of the machine, to consider the probability of a software versus a hardware problem, centered on the question,"What software did you change right before it started to flake out?" If this question doesn't bring up any likely software candidates, proceed with these steps.

• Set up a cycle of all of the supported Logic Board tests in the Snooper Main screen. Let this cycle of tests run until a problem is isolated, or for a time much longer than the usual length of time it takes this machine to act flaky. See Section 3-3 for instructions on setting up cycles in the Main screen.

• Set up a cycle of all of the Disk Tests in the Snooper Main screen on the start-up drive of the system. Let it run for a time similar to the logic tests above.

• Set up and run the same cycle on all other disk drives attached to the system.

• If you have not found a problem by now, it is probable that it is actually a software problem. Do a more extensive check for software or virus problems.

SCSI Cabling Theory and Practice

Because no area of Macintosh hardware is as prone to causing headaches as the SCSI bus, many users would like to terminate the bus with a Colt .45 instead of a SCSI terminator! Getting a SCSI bus to work right is easy with two or fewer external devices. Simply connect one device to the Mac, connect the second device (if there is one) to the first device, and put a SCSI terminator on the last device. Unless you have a bad cable, device or terminator, this will almost always work just fine (provided you use the standard short cables). The problems usually arise with the third or fourth (or, Heaven forbid, the fifth) device. The theory of setting up such a Pandora's box is the same: Keep adding on devices, and put just one terminator at the end. The third device is often where reality breaks with theory, and some additional black magic is needed to make it work. One technique that sometimes helps on a long SCSI chain is to install an additional terminator somewhere near the middle. If that doesn't work, you should try replacing the inexpensive SCSI cables supplied with many SCSI devices with more expensive ones. For most things, a cable is a cable is a cable; but when it comes to SCSI, it really does make a difference.

CHAPTER 13 TECHNICAL DETAILS FOR THE TERMINALLY CURIOUS

13-1 Introduction

This chapter contains information that is not needed to use the Snooper diagnostic software. It is included only for those readers who have a thirst for knowledge and for those who are bored with nothing better to do. This chapter is provided solely to quell the infinite curiosity that is common among Macintosh enthusiasts. Unlike the rest of this manual, the emphasis in this chapter is on relief of *"curiosa terminalis"* rather than using the product.

13-2 The info menu

Most of the information made available through Snooper's Info menu comes from a fairly recent addition to the Macintosh ROM called the Gestalt Manager. Gestalt is a German word which, according to Webster, means "a unified physical, psychological, or symbolic configuration having properties that cannot be derived from its part." How they came up with that name for "a thing that gives information about a machine" is beyond me. It may have more to do with the original German root meaning shape or form. Because the Gestalt Manager is fairly new, it is best supported on the newer machines, but is supported to some degree on all machines with System 6.0.7, or later. On earlier machines with System Software older than 6.0.7, Snooper does its best to gather the information by other means. One might assume then, that the information is most likely to be accurate with the later versions of System Software. Not necessarily true in all cases. There are a fair number of bugs to be found in the Gestalt Manager. If any of the data given in the Info windows is inacurate it can be blamed on the buggy Gestalt Manager. All things considered though, it is better at most things than the "SysEnviron" routine that preceeded it.

13-3 Benchmark menu

As mentioned in the earlier section on benchmarks, all of the benchmarks use the same basic principle — performing an operation (sometimes several times), and using the amount of time it took to calculate a score for the benchmark. Just to fill in some space at this juncture, we will show you what each of the benchmarks is doing. Don't be surprised if some of them are very simple. To misquote a philosopher whose name I don't even recall "Simplicity is next to Godliness."

Video Benchmark:

1) Fill the test area with multi-colored text 20 times

2) Scroll the window up and to the right 15 times

3) Draw 750 ovals

4) Draw 3000 lines

5) Draw 750 rectangles

6) Draw 600 "square circles"

Math Benchmarks:

Integer:

Do the following 1000 times using long integer numbers.

Fred = Barney/Betty + Wilma/Betty * Fred + Barney - Wilma - Betty;

Floating Point:

Do the following 500 times using double precision floating point numbers.

Larry = Moe * Curly - Larry / Moe + 2.0 * Larry;

Functions:

Do the following 100 times using double precision floating point numbers.

Larry = sin(Moe/4.0)*log(sqrt(Moe));

Memory Benchmark:

This benchmark moves 1K, 2K, 3K, 4K...9K, and 10K bytes of random garbage from one spot to another 50 times each using the Macintosh ROM routine "BlockMove," and averages the results.

CPU Benchmark:

This benchmark uses the following recursive routine to sort 200 randomly arranged numbers into an ordered list:

```
Quick(left,right)
   short left;
   short right;
   {
   register short i,j;
   unsigned char x,y;

   i = left; j = right;
   x = TheString[(left+right)/2];
   do
      {
      while(TheString[i] < x && i < right) i++;
      while(x < TheString[j] && j > left) j--;

         if(i<j)
            {
            y = TheString[i];
            TheString[i] = TheString[j];
            TheString[j] = y;
            Timing = false;         // dont increment the timer while we draw on the screen
            DrawOneNumber(i);
            DrawOneNumber(j);
            Timing = true;          // start incrementing again
            i++; j--;
            }
         else if(i==j)
            {
            i++; j--;
            }
      } while(i<=j);

      if(left < j) Quick(left,j);
      if(i < right) Quick(i,right);
      }
```

The most interesting feature of this sort routine is that it calls itself several times to sort smaller and smaller pieces of the whole list until, in the end, it is sorting just two numbers each time. When all of these pairs have been "sorted," the whole list is in order.

The Disk Benchmarks are too simple to bother with here. They just read or write a certain size piece of data and time the read or write. The Seek Benchmark just sends a SCSI seek command with the proper parameters to move the head progressively further accross the disk for each successive point on the graph.

13-4 Logic tests

The following are the sordid details of two of the logic tests performed in the Main screen of Snooper.

CPU Test and FPU Test:

```
for (count = 0; count < 30; count++)
{
    Tom = Dick = Harry = 1.0;
    Fred = Barney = 2.0;
    Larry = Darryl = OBDarryl = 3.0;
    // lets do some long doubles first
    Tom = Dick * Harry/4.000 + (Pi/2.0) - log10(42.0) + log(42.0) + sqrt(42.0);
    Dick = Dick * Harry/4.000 + (Pi/2.0) - log10(Tom) + log(Tom) + sqrt(Tom);
    Harry = Dick * Harry/4.000 + (Pi/2.0) - log10(Dick) + log(Dick) + sqrt(Dick);
    Tom = Dick * Harry/4.000 + (Pi/2.0) - log10(Harry) + log(Harry) + sqrt(Harry);
    // now we will do some short doubles
    // this calculates the distance from here to eternity
    Fred = 1234567.89 * sqrt(Barney/Pi) + (cos(Pi/2.0) + sin(Pi/4.0) / pow(Fred,Barney));
    Fred = 1234567.89 * sqrt(Barney/Pi) + (cos(Pi/2.0) + sin(Pi/4.0) / pow(Fred,Barney));
    Fred = 1234567.89 * sqrt(Barney/Pi) + (cos(Pi/2.0) + sin(Pi/4.0) / pow(Fred,Barney));
    Fred = 1234567.89 * sqrt(Barney/Pi) + (cos(Pi/2.0) + sin(Pi/4.0) / pow(Fred,Barney));
    // now some floats that are stored as registers on machines that have registers for floats
    // this calculates how many angels can dance on the head of a pin
    // it assumes they are doing the Lombada
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
    Larry = Darryl + OBDarryl - Larry * OBDarryl / Darryl;
}
return (long)((float)(Tom + Dick - Harry * Larry / Darryl - OtherBrotherDarryl)/( -2.9762));
// -2.9762 is the Universal Flatulence Constant (UFC) as derived by the author
// the ultimate answer is of course 42
```

This doesn't calculate anything useful, but it does keep the microprocessor or floating point unit busy for a while. That's all it is supposed to do.

Well, we hope that if you found it necessary to read this chapter that the above information was helpful, and that your case of *curiosa terminalis* is now in remission.

GLOSSARY

4-bit - When discussing video, pixel depth, or the number of gray shades or colors possible on a monitor, 4-bit is 16 (or 2^4) shades or 16 colors respectively. See **gray scale** or **color** for more information.

8-bit - When discussing video, pixel depth, or the number of gray shades or colors possible on a monitor, 8-bit is 256 (or 2^8) shades or 256 colors respectively. See **gray scale** or **color** for more information.

24-bit - When discussing video, pixel depth, or the number of gray shades or colors possible on a monitor, 24-bit is 16.7 million (or 2^{24}) shades or 16.7 million colors respectively. See **gray scale** or **color** for more information.

accelerator - A product that can be added to a computer in order to speed its processing. It is generally a board with a faster microprocessor on it that essentially takes over for the microprocessor in the Macintosh and performs all of its normal functions.

access time - The total time required for a disk drive to move the head to the right place on the disk so it can read or write data. It does not include the time spent reading or writing, just the preparation time required before the read or write can occur. It includes the overhead of the the communication with the drive, the seek time and the latency time. The seek time is most of it.

ADB - see Apple Desktop Bus.

Apple Desktop Bus (ADB) - User-input device bus built into every Macintosh model after the Mac Plus. These devices include the Mac mouse, keyboard, track balls, light pens and some other miscellaneous devices that have nothing to do with inputting data from the user (like software keys used to prevent unauthorized users from using a program). The ADB supports up to 15 devices, but two or three is typical.

Apple Sound Chip - Processor designed specifically to control the functions of sound output in a Macintosh.

AppleTalk - Network communication protocol built into every Macintosh. This is software that works with either the serial port or an ethernet port to provide communication between several Macintosh computers.

barrel distortion - see **pincushion**.

black and white When discussing video, pixel depth, or the number of gray shades or colors possible on a monitor, black and white (light and dark) are the only possible "colors" that can be displayed. See **gray scale** or **color** for more information.

blow chimes - The Macintosh computer performs a limited number of tests as part of its start-up procedure to determine whether or not the machine is healthy enough to be used. If the computer fails any of these start-up tests (such as the memory test) it makes a special sound. The sound is actually quite pleasant, but once you know what it means, it tends to send a cold shiver up your spine when you hear it. When the Mac makes this sound and displays a "Sad Mac" on the screen, it is said to have "blown chimes."

boot - This is another name for the procedures the computer goes through when you turn it on or restart it. If a computer successfully completes this procedure, it is ready to run a program selected by the user. Conversely, a computer that doesn't complete this procedure displays a "Sad Mac" or other painful message.

bus - Any of the various connection schemes used to connect something to the motherboard of the computer. The ADB (Apple Desktop Bus), NuBus, and SCSI bus are three examples of a bus.

cache - An area where frequently accessed information is stored and can be accessed more quickly than from ordinary storage. There are two types of this in Macintosh computers. One of them exists on all Macs and involves data that is read in from either a floppy or a hard disk. The most recently read data is remembered by the cache so that if it is accessed again right away, the data is read quickly from the cache (i.e., from memory) rather than more slowly from the disk. The other type of cache is available with machines that use either the 68030 or 68040 processor chips. This involves data that is already in main memory rather than disk data. It is similar to the first type, but employs super fast memory (either in the processor itself or on a "cache card") to remember frequently used data. The 68040 does quite a bit of this and does it in a different way that greatly speeds up processing, but can cause compatibility problems with some types of software. This cache can be turned off on 68040 machines to maintain compatibility with those programs that aren't written to withstand this type of caching.

Chooser - Part of system software that offers users selections for peripherals such as printers, modems, and file servers. You can access these resources by selecting the Chooser in the Apple () menu.

computer - If you don't know what a computer is, please put this book down and call a technician now.

Control Panel - Area collectively referred to when a need arises to adjust hardware settings for the Macintosh. These settings include monitor pixel depth, desired boot drive, internal clock/calendar, RAM cache and sound volume. You can access these "devices" by selecting the Control Panel in the Apple () menu. In System 7 and later, there is no Control Panel. It has been replaced with the ability to "Launch" the files that are included in the Control Panels Folder. These are files of type CDEV and are the same as those used previously by the Control Panel.

Control Panel device - The name given to the "mini programs" found in the Control Panel or Control Panels Folder. They are used to control the operation of optional equipment and various system settings and parameters. The other name for them is CDEVs (pronounced sea-devs).

convergence - The degree to which the three electron beams from the monitor's gun agree on the exact location of any given pixel. In other words, how well or poorly the three beams are aligned to each other. Poor convergence causes poor color and color fringing. The convergence of a monitor usually varies in different areas of the screen.

CPU - Acronym for Central Processing Unit. Executes instructions from information in RAM and ROM. The Macintosh line of computers uses CPUs designed and manufactured by Motorola Inc. which all have names based on the number 68000; for example, 68000, 68020, 68030, 68040. This is also sometimes used (incorrectly) to refer to the whole box that contains the logic board, in other words, the whole computer.

crash - When a computer experiences an error which it cannot correct or a problem it cannot resolve, and it stops functioning. The only remedy is to re-start the computer. It gets its name from the common occurrence of bizarre ugly things that happen on the screen when the computer crashes quite thoroughly.

dead pixel - A pixel that is always black regardless of the intended color or brightness of the pixel.

debug - The process of finding the cause of a problem.

desktop - The metaphor used to describe the area in which the hard drive and Trash icon appear on the Macintosh. Just as a desk in an office has filing cabinets and a nearby trash can, the term is used to make a new user quickly understand the concepts of the Mac's interface.

digitized sound - Sounds recorded and transformed into a format that can be played back on a computer. The name comes from the notion that the sound is being transformed into a series of numbers or "digits" that represent the digitized sound. This is the same thing as "sampling" a sound.

dither - Process in which colors or gray shades are combined in patterns to trick a viewer into thinking the monitor is displaying more shades of gray or colors than it really is displaying.

driver - A program used by the computer and a device, such as an expansion card or hard drive, to properly communicate with one another. A driver is usually invisible to the user in that it is put into the machine by the piece of hardware that uses it. Most hard drives and NuBus cards operate in this fashion. Some drivers take the form of a Control Panel device to allow the user to modify the operating parameters of the hardware. The items selectable from the Chooser are also a special kind of driver.

expansion slot - A receptacle inside the computer used to connect boards which add a function not already provided by the computer manufacturer as a standard. These types of boards include monitor, communication, accelerator, and video input interfaces. Macintosh expansion slots have a variety of shapes and sizes. They include NuBus, 68030 Direct (found in SE/30), SE Direct (found in SE), LC Direct (found only in the LC), Portable (found only in the Portable), Powerbook (found in the PowerBooks) and others on other machines.

floating point unit (FPU) - see **math co-processor**.

floppy drive - Magnetic mass storage media. These differ from hard drives in that hard drives contain a larger, inflexible, sealed platter on which information is stored. Floppies use a small, flexible, semi-exposed platter. It is the floppy, flexible media inside the plastic shell that gives this storage media its name.

focus - Monitor clarity or "sharpness" measure. It has to do with how well the monitor can focus the electron beam into a very small round dot on the inside of the screen. This monitor measure has more to do with monochrome screens than it does with color screens, as the shadow mask on a color screen reduces the effects of poor focus.

fragmented - The state in which a hard drive is said to be when it contains files which are stored in small scattered pieces on different tracks and non-contiguous sectors. This makes the hard drive work harder than normal (and slower) because it has to look all over the platter for the file pieces. There are various stages of severity, as there are few practical methods to prevent fragmentation. Utilities are available to "defragment" files, that is, put the file pieces together so they reside in contiguous tracks and sectors.

freeze - This is a type of crash in which rather than having strange and bizzarre things happening on the screen, the machine simply stops cold and refuses to pay any attention to mouse movement or keyboard activity. The machine is actually not frozen at all, it is screaming around in a little circle called an infinite loop. The fact that it is ignoring mouse movement tells you that interupts were disabled when it started into the infinite loop.

GPIB - Acronym for General Purpose Interface Bus. This is a standard interface used for high-speed data transfer. Typical use of this interface is with color scanners, color slide printers, and laboratory data aquisition. It is essentially synonymous with the term IEEE-488 bus.

gray scale - A collection of gray shades ranging from white to black. In the industry, this has become synonymous with the term "monochrome." Gray scale is a better appellation for this type of video in that, technically, monochrome also includes black and white video (although it is not used that way in the industry) while "gray scale" specifically excludes black and white video.

handshaking - Refers to the communication used to begin and continue a transfer of data between two machines or devices. The term is indicative of the devices agreeing to the conditions, such as transfer speed and protocol. This is sometimes done with codes imbeded in the data stream (called soft handshaking) and sometimes done with separate wires in the connecting cable (called hardware handshaking).

hard drive - Magnetic mass storage media. These differ from floppy drives in that hard drives contain a larger, inflexible, sealed platter on which information is stored. Floppies use a small, flexible, semi-exposed platter.

head - A device which reads information from and writes to any type of magnetic media (tapes, hard drives, floppy drives). Hard and floppy drive heads must glide back and forth across the surface of a disk's platter in order to go to the desired track and sector. The heads on a hard or floppy drive are similar to those found on a tape recorder but are smaller because they must be moved back and forth across the disk at high speed to acquire different pieces of data.

INITs - Short for "initialization," INITS is the generic term given to system software enhancements. These include useful utilities such as programs that add the capability to assign "hot keys" to any often repeated activity, as well as "mindless stuff" such as an INIT that shows an animated Oscar the Grouch rising from the trash can and singing after you throw a document away. Some of these INITs are poorly written and cause system crashes. A CDEV (short for Control Panel Device) is a special type of INIT that has a window that allows the user to adjust various parameters associated with the operation of the CDEV or a piece of hardware. All CDEVs and INITs are loaded in and activated during the final stages of the start-up procedure of the computer. They often display an icon along the bottom edge of the screen while they are loading in.

interrupt - Event that stops all processing activities in a computer in order to concentrate all its energies on accomplishing a particular task. A good example of an interupt is what happens when a key is pressed on the keyboard. The chip that talks to the keyboard sees that a key has been pressed and then interrupts the microprocessor, so it can take the steps necessary to inform the program which is running that the key press has occurred. Other things that cause interrupts are hard disk activity, floppy disk activity, serial port activity and an interrupt called the "vertical blanking interrupt." This interrupt happens exactly 60 times a second to allow for various system housekeeping actions to be performed. The two buttons on the Macintosh case, the Restart switch and the Programmers Key also perform their magic via the use of interrupts.

latency - This is the time it takes for the disk to rotate one half rotation. It is part of the access time because the disk has to rotate the needed data under the head. This is a very short time, and is usually ignored and considered part of the seek time.

logical address - When a program refers to a particular piece of data in RAM, it uses an "address" to name the location of the data. The addresses a program uses are called logical address. In Macintosh computers, there is also something called a physical address which refers to the electrical path to a particular piece of the computer's memory. Because a Macintosh computer can have different sizes of memory SIMMS (i.e. 256K SIMMS, 1MB SIMMS, 4MB SIMMS, etc.), the electrical address (physical address) is usually different from the logical address for the same piece of data. The physical addresses are in discontinuous "chunks" that correspond to the sizes of the SIMMS installed. The electronics of the computer "map" the messed-up physical addresses to more usable logical addresses. This all happens at a low level within the system , and is invisible to the programs used by the user. This scenario is further complicated when virtual memory is added to the machine. In this case, the logical addresses used by the programs continue to be all in one big simple chunk, but some of those logical addresses actually refer to physical addresses that are on the hard disk. When the program uses a logical address that refers to something that is temporarily sitting out on the disk, the system software reads the data in from the disk (swapping it with something in memory), and then maps the logical address to the new physical address.

loopback plugs - Plugs included with Snooper which make it possible for the two serial ports to "talk to themselves" when tested. They create a situation with each serial port somewhat analogous to placing a pipe between your ear and your mouth so that what you say gets piped right into your ear.

main monitor - The monitor which displays the menu bar. On a Macintosh that has more than one monitor connected to it, the system software of the computer includes a Control Panel which allows you to designate another available monitor as the main monitor.

mask (also shadow mask) - Directs the three separate electron beams (for red, green, and blue) to the correct color of phosphor dot on the inside of the monitor's glass front.

math co-processor - A processor chip which is optimized to solve mathematical problems at break neck speed - typically much faster than the CPU can achieve by itself. Many models of Macintosh either include one of these, or make it available as an option. The Quadra computers use a new microprocessor called the 68040 which includes the functions of a math co-processor within it, so no additional chip is needed for this function. Unfortunately, however, the version of math co-processor included in the 68040 chip is a scaled down version, and does not include the capability to do super-fast trigonometric functions, logarithmic functions or roots.

memory - see **RAM**.

microprocessor - see **CPU**.

MIPS - Acronym for Million Instructions Per Second. For example, a computer which is rated at 10 MIPS can execute 10,000,000 instructions each second. Unfortunately, the amount of work actually performed by an instruction varies greatly from one type of machine to another, so this is not a very good measure of performance when comparing different types of machines.

modem port - see **serial ports**.

Monitors - Control Panel device which allows you to control the monitor configurations of your Macintosh.

monochrome - see **gray scale** and **Black and White.**

motherboard - The printed circuit board which contains all the necessary processing components of the computer including the CPU, RAM, ROM, and expansion slots. It is the big board into which all the other stuff in the computer plugs. Boards which plug into it are sometimes referred to as "daughter boards." No explanation has ever been given as to why circuit boards are considered to be feminine. Many technicians believe it is because of their propensity for causing extra work (just kidding).

NuBus - Expansion slot technology developed by Texas Instruments. It is used in all Macintosh II systems. It is also used in the Macintosh Quadra, although with speed enhancements - called NuBus '90. NuBus '90 is backward compatible with cards designed for use in the older NuBus specification.

oscillator - Used to generate high frequency continuous signals.

oscilloscope - An instrument that allows a user to "look at" the shape and size of electronic signals.

paged memory management unit - see **PMMU**.

parameter RAM (PRAM) - Small amount of low power RAM kept alive at all times by a battery. PRAM holds information such as the major Control Panel settings for mouse speed, target start-up drive, speaker volume and the background pattern for the desktop.

partition - This refers to a method of breaking up a large hard disk into separate parts or partitions. When this has been done with a disk drive on the Macintosh, each of the partitions shows up as a separate disk on the Macintosh desktop, even though the separate partitions belong to a single piece of hardware. The reasons for doing this would be for organization of data on the drive, file protection (you can often choose to password only certain partitions on the drive, thus limiting that data to only specific personnel) or maintaining more than one operating system (Mac OS and Apple Unix, for example) on a single hard disk.

pincushion - A monitor irregularity where lines on the screen are bent in a fashion similar in appearance to a pincushion or whiskey barrel. The same term is used when the lines bow out at the top and bottom instead of bowing in.

pixel - Concatenation of "picture" and "element." A dot - the smallest dot possible - on a monitor screen. If a monitor is said to have a resolution of "640 by 480," it contains 640 pixels across and 480 pixels down for a total of 307,200 pixels. The "depth" of a pixel refers to how much memory is dedicated to each pixel in the video driver circuitry. A deep pixel can have more variety in the color or brightness of the dot. Pixels that are only one bit deep can only show one color (usually white). The number of colors or shades of gray a pixel can show is the square of the number of bits "deep" it is. The pixels shown on one monitor all have the same depth, but a Macintosh can support several monitors each with different pixel depths.

platter - The physical piece of magnetic material in a disk drive on which information can be recorded magnetically.

PMMU - Acronym for Paged Memory Management Unit. A processor chip that is used to control the virtual memory operations of a Macintosh. Machines that have one use it to map and translate physical and logical addresses for the RAM in the computer. (see logical address)

PRAM - see parameter RAM.

printer port - see serial ports.

QuickDraw - The name given to the collection of graphics routines provided to developers and built into the ROM of every Macintosh. Developers need only to include a "call" to one of these routines, for example, to draw a rectangle on the screen. QuickDraw offers a consistent means for developers to quickly and easily add graphics features to their applications - and feel secure in compatibility. The quality and versatility of these routines built into every Macintosh is the major reason for the success of the machine in graphics-related tasks.

RAM - Acronym for Random Access Memory. This is the area in the computer where data goes when it is read in from the disk. Programs and data are stored in RAM while they are being used. This storage is cleared out and lost when the machine is turned off. It is the "scratch pad" of a computer.

RAM disk - This is essentially the opposite of virtual memory. This would be used to speed up disk-related operations by using some of the RAM as a "virtual disk." When this is available and being used, the system sets aside a portion of the memory and pretends it is a disk drive. The user can copy stuff to it just like he would a hard disk, but because it is in RAM, it is lightning quick. With the Apple version of RAM disk, the storage that is set aside for the disk stays around through a restart of the machine, but does not withstand a shut down of the machine (or a power outage!). It is intended for temporary storage, with any important data to be copied back to the hard drive by the user before shutting down the system.

Real Time Clock (RTC) - Chip in the computer that keeps track of the time and date.

ROM - Acronym for Read Only Memory. Contains the core set of instructions and routines that control many of the very basic functions of the computer. These include the procedures for system booting and much of the software that makes the Macintosh different from other computers. The stuff in this kind of memory is put in at the factory and cannot be changed by the computer. Because it cannot be changed, there is additional stuff on the disk called "system software" that gets loaded into RAM at start-up. This method allows Apple to change the way things work, add features and fix bugs without replacing the ROM chips in the computer, while still retaining control of the types of machines on which its well protected operating system can be used. The stuff on disk is worthless without the ROM chips soldered to the motherboard of each Macintosh.

sampled sound - see **digitized sound**.

SCSI - (pronounced "scuzzy") Acronym for Small Computer System Interface. A standard interface which allows a computer to communicate with up to seven devices. SCSI devices are typically hard drives, scanners, CD-ROM drives and tape backups. All Macintosh models since the Mac Plus have been equipped with a SCSI connection. The Macintosh Quadra sports an updated, backward compatible and faster SCSI implementation called SCSI-2.

SCSI address - A SCSI device must identify itself by a number from 0 to 6 when connected to a computer in order to be recognized and usable. This number is its identification or address. If any SCSI device connected to a single computer uses the same address as another device on the same SCSI port, all devices with that address will be ignored by the Mac until assigned different addresses. In other words, each device connected must have its own SCSI address. This is usually changed with small switches on the back of a SCSI device.

sector - Think of this as a part of the circle defined by a track. The length of the piece of the circle varies from one disk to another, but it always corresponds to the length necessary to hold 512 bytes of usable data, and some positioning and directory data, on a Macintosh disk. If you held your finger above a spinning disk, it would represent the disk drive head. The circle on the disk that passes beneath you finger represents a track. A portion of that circle big enough to hold about 520 bytes of data would be a sector.

seek time - The time needed for a drive to move the head over to a particular track on a floppy or hard disk.

segmented (disk) - see **fragmented**.

serial ports - All Macintosh computers provide two serial ports: modem and printer. Both are asynchronous and can operate at speeds of better than 56Kbits/sec. Both can be used to connect certain peripherals (modems, printers, etc.) to the Mac or to connect the Mac to other computers on a network. They are called serial ports because the data that comes out of them is a series of bits, one at a time. A parallel port (such as SCSI) has several wires which each carry one bit of information. Thus, serial is slower, but has fewer wires and can also be translated into an audio signal that can be transmitted over a phone line. Parallel is better for short distance high speed communication.

SIMM - Acronym for Single In-line Memory Module. A SIMM is a small, small RAM to the computer in which it is installed. Each SIMM can have different amounts of total memory, such as 256K, 512K, 1MB, 2MB, and so on, by using memory chips of appropriate densities. The SIMMs plug into slots on the motherboard, and must be, depending on individual model specifications, installed in groups of two or four SIMMs. The sum of all the memory available on these SIMMs in a Macintosh (as well as any memory soldered onto the motherboard) is the system's RAM.

slot - see **expansion slot**.

stuck pixel - A condition where pixels that are supposed to be dark are white or some other color instead.

System 6 - Collection of Mac operating systems whose only differences are slight alterations and bug fixes necessary to allow it to function with new CPU features. One example is the October 1990 introduction of built-in microphones on the Mac LC and IIsi. System 6.0.5 cannot handle the sound input while System 6.0.7 can. For all intents and purposes, all these revisions have been superseded by System 7.

System 7 - Macintosh operating system shipped May 13, 1991. This version sports many dramatic improvements over its predecessor, System 6. One drawback to the operating system, however, is its 2MB RAM minimum requirement to run. Without proper RAM amounts, software cannot run under System 7.

system clock - Provides a steady flow of electronic pulses with a quartz crystal to synchronize system activity. Each "tick" of the clock corresponds to a single *opportunity* for the microprocessor to execute an instruction. The speed of these pulses is measured in megahertz (million cycles per second).

system crash - see **crash**.

terminator - Used at the beginning and end of a SCSI chain of devices in order to prevent the electronic information traveling through the chain from reflecting toward its point of origin and interfering with the transmission of data. The configuration of these can often become a trial-and-error nightmare if there are several devices connected to the SCSI bus.

trace - The small thin "lines" made of copper on a circuit board. Each trace acts as a wire to connect two or more things together on the circuit board. The traces are actually made by starting with a board that is completely covered with a thin layer of copper. The space in between the traces is then removed by a photochemical process called etching. The traces are what remains after the rest of the copper has been removed. The traces are both narrow (not very wide from one side to the other, like a thin line) and thin (not very thick from the surface of the board to the top of the trace.) Thus, they are very brittle and rely on the stiffness of the board to protect them from breakage. Sometimes the board is not stiff enough, or twists and warps slightly when it warms up and cools down. A trace broken in this way is almost impossible to detect visually because the break is so small.

track - Area on a hard drive, analogous to the grooves on a music record. Each track contains several sectors where information is stored. It refers to all of the data available with the head in one position. It is an imaginary circle on the surface of the disk, all of which is underneath the head during some part of the rotation of the disk. A single track is very narrow and hard drives have hundreds or thousands of concentric circles or "tracks."

versatile interface adapter - This chip handles all of the ADB communication. There is also another VIA in most Macintosh models that controls other hardware functions.

VIA - see **versatile interface adapter**.

virtual memory - Process in which available hard drive space is treated as though it was a set of RAM chips installed in the computer. Information is kept on the hard drive until it is needed by an application and is then swapped with something already in real memory. In order to make room in RAM for this requested information, the least-used data in physical RAM is moved to the "virtual" RAM on the hard drive. Due to the added time and sluggishness of hard drive access (when compared to physical RAM), virtual memory can be very slow. However, in a pinch, it can save the day if you need more memory.

virus - Unlike a biological virus, a computer virus is actually something planned by a diabolical or stupid person seeking revenge or sadistic pleasure at the expense of others. A virus is a program that hides in the background of a computer (much like a driver, INIT or CDEV, but with evil intentions). There tends to be some mystery surrounding the means by which computer viruses are transmitted. It is actually very simple. Computer viruses are *always* transmitted by running an apparently innocent program to which the virus is attached. An infected program can sit on your hard disk for years without spreading its curse throughout your machine as long as you don't ever run that program. This program could be either an application, or an INIT or CDEV. One of the first things the virus does, however, once it has been started by running the infected program, is to attach itself to other programs on your hard disk so that they too will now be sufficient to spread the virus when run. Thus even a "good" program from a respectable software company can infect your machine if you copy it from another machine that has been infected by a virus. The original source of a virus is almost *always* a freeware or shareware program found on a bulletin board (a modem service that allows the user to get information and free programs), or a floppy disk passed along from one person to the next with a “neat new program on it to try.” If you pay for every program that you run on your machine, your chance of getting infected with a computer virus drops almost to zero.

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