S.M.A.R.T. Guard™

A complete ATA hard disk drive diagnostic utility with powerful and intelligent report-viewing capability.

Part of the Intech's SpeedTools™ Software for MacOS™ X

User's Guide

Document Revision: 1.1

License Agreement

For One Computer

READ THE FOLLOWING SOFTWARE LICENSE AGREEMENT ("LICENSE") CAREFULLY, BEFORE YOU USE THE ACCOMPANYING SOFTWARE. BY INSTALLING OR USING THE SOFTWARE OR ANY OF THE MATERIALS ENCLOSED, YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THIS LICENSE. IF YOU DO NOT WISH TO AGREE TO THE TERMS OF THIS LICENSE, (IF APPLICABLE) PROMPTLY RETURN THE UNUSED SOFTWARE TO THE PLACE WHERE YOU OBTAINED IT FOR A REFUND.

1. License. The software and documentation accompanying this License, known as the SpeedTools™ Utilities (Software), whether on disk, in read-only memory, or contained on any other media and the related documentation are licensed to you by Intech Software Corporation (Intech) and its Licensor(s). You own the disk on which the Software is recorded, but Intech retains title to the Software and related documentation. This license allows you to use the Software on a single computer and make one copy of the Software retained by you for backup purposes only. You may transfer your license rights of the Software and related documentation, the Software backup copy which you may have made, and a copy of this license to another person, provided the other person agrees to accept the terms of this license after reading its complete text and conditions.

2. Restrictions. You may not, in whole or part, copy, photocopy, reproduce, translate, reverse compile, disassemble, reverse engineer, reduce to any electronic or machine-readable form, or otherwise reduce to a human perceivable form (except for a backup copy, as stated in paragraph 1), the Software or related documentation without the prior written consent of Intech. You may not change, rent, lease, loan, distribute or create derivative works based upon the Software in any form, in whole or in part. This prohibition includes transmission of the Software over a network from one computer to another. THIS SOFTWARE IS NOT INTENDED FOR USE IN THE OPERATION OF NUCLEAR FACILITIES, AIRCRAFT NAVIGATION, COMMUNICATION SYSTEMS, OR AIR TRAFFIC CONTROL MACHINES IN WHICH CASE THE FAILURE OF THE SOFTWARE COULD LEAD TO DEATH, PERSONAL INJURY, OR SEVERE PHYSICAL OR ENVIRONMENTAL DAMAGE. Your rights under this License will terminate automatically without notice if you fail to comply with any term(s) of this License.

3. Service or Support. By using the Software and agreeing to this license, you understand and agree that Intech may not offer you any technical support regarding use of the Software or related products. Intech reserves the right to revise the Software and documentation without obligation to notify any person or organization of any such changes or revisions.

4. Warranty Disclaimer. By using the Software and agreeing to this license, you expressly acknowledge and agree that use of the Software is at your sole risk. The Software and related documentation are provided “AS IS” and without warranty of any kind. INTECH EXPRESSLY DISCLAIMS ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. INTECH DOES NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE SOFTWARE WILL MEET YOUR REQUIREMENTS, OR THAT THE OPERATION OF THE SOFTWARE WILL BE UNINTERRUPTED OR ERROR-FREE, OR THAT DEFECTS IN THE SOFTWARE OR RELATED DOCUMENTATION WILL BE CORRECTED. NO ORAL OR WRITTEN STATEMENTS OR INFORMATION OR ADVICE PROVIDED BY A INTECH REPRESENTATIVE SHALL ESTABLISH A WARRANTY OR EXPAND THE SCOPE OR TERMS OF THIS WARRANTY. IF THE SOFTWARE IS

DEFECTIVE, YOU WILL BE RESPONSIBLE FOR THE COST OF ALL NECESSARY SERVICING, REPAIRS, OR CORRECTIONS. Some jurisdictions do not allow for exclusion of implied warranties, so the above exclusion may not apply to you. The Software may not work properly with modified versions of your computers operating system, certain resident software applications, or hardware that is not 100% compatible with that provided by the computers manufacturer.

5. Limited Warranty Regarding Media. Intech warrants that the diskette(s) on which the Software are recorded shall be free from defects in materials and workmanship under normal use for a period of ninety (90) days from the date of your purchase of the Software, as established by your receipt. Intech's entire liability, as well as your sole and exclusive remedy, will be replacement of the diskette(s) which are defective. The diskette(s) must be returned to Intech with a copy of your receipt. This warranty does not include diskette(s) damaged by accident, abuse, or misapplication. ANY IMPLIED WARRANTIES ON THE DISKETTE(S) ARE LIMITED TO A PERIOD OF NINETY (90) DAYS FROM THE DATE OF DELIVERY TO YOU. THIS LIMITATION INCLUDES IMPLIED WARRANTIES SUCH AS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

6. Limitation on Liability. IN NO EVENT WILL INTECH BE LIABLE TO YOU FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM YOUR USE OR INABILITY TO USE THE SOFTWARE OR RELATED DOCUMENTATION, EVEN IF INTECH HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. INTECH SHALL HAVE NO LIABILITY FOR ANY HARDWARE, SOFTWARE OR DATA STORED OR USED IN CONJUNCTION WITH THE SOFTWARE, INCLUDING THE COSTS OF REPAIRING, REPLACING, OR RECOVERING SUCH HARDWARE, SOFTWARE OR DATA. Under no circumstances shall Intech's total liability to you for all damages, losses, and causes of action (whether in contract, tort (including negligence) or otherwise) exceed the amount paid by you to obtain the Software and related documentation.

7. Severability. Should a court of competent jurisdiction declare this license agreement, or any portion of this license agreement, to be unenforceable, that portion shall be enforced to the maximum extent possible so as to effectuate the intent of the parties, and the remainder of the agreement shall continue in full force and effect.

8. Complete Agreement. This license constitutes the entire agreement among the parties regarding the use of the Software and related documentation. This license agreement replaces and supersedes any prior understandings or agreements, whether oral or written. No contemporaneous understandings or agreements were entered into in conjunction with this license agreement. No change to this licensing agreement will be effective against Intech unless it is in writing and signed by an authorized representative of Intech Software Corporation.

Table of Contents

1 Guide Introduction

About This Guide

The instructions and explanations in this guide assume that you understand how to operate your Macintosh computer. You should, for example, know how to choose, select, launch, and drag by using your mouse. In addition, you should also understand how the desktop, windows, dialog boxes, buttons and file/folders work within the Macintosh environment. For more information about these items, please refer to your Macintosh User's Guide.

Conventions Used In This Guide

Note: This symbol calls your attention to important information about the adjacent text. A note will always appear in standard print.

Warning: This symbol calls your attention to procedures in the adjacent text which can cause harm to you, your data or computer system. A warning will always appear in bold print.

User Registration

Please take a moment to register your copy of the SpeedTools™ software on-line via the Intech Software World Wide Web page at http://www.SpeedTools.com.

Technical Information

If you received this software with the purchase of a drive subsystem and you require technical support, Intech as made special arrangements with your drive manufacturer to support this software directly via their technical support department. For customers who have purchased this software product as stand-alone, Intech provides technical information and other late-breaking information via its web site at http://www.SpeedTools.com.

Using S.M.A.R.T. Guard

About the SpeedTools S.M.A.R.T. Guard Component

The SpeedTools S.M.A.R.T. Guard software is a complete ATA hard disk drive diagnostic utility with powerful and intelligent report-viewing capability.

S.M.A.R.T. Guard also provides a pre-failure alarm which vigilantly keeps watch over your drives and alerts you at the first sign of trouble, both locally and remotely. Think of it as an early warning system for your disk drives which will, in most cases, provide valuable warning time to backup your critical data BEFORE catastrophic drive failure occurs!

What is S.M.A.R.T.?

Today's S.M.A.R.T. represents the culmination of the effort of the major disk drive manufactures to address one of the greatest drawbacks of modern hard disk drive storage technology: hardware failure resulting in partial or total data loss. Be aware that there are two kinds of hardware failure: predictable and non-predictable. Luckily, most failures are predictable because they are the result of a gradual decline in the reliability of a drive over time. This progressive degradation of reliability can usually be detected by the drive itself and impending failure can be predicted BEFORE catastrophic data loss occurs.

The S.M.A.R.T. acronym itself stands for "Self Monitoring And Reporting Technology." As acronyms go, it is quite descriptive. "Self Monitoring" refers to the drive's ability to detect events which are outside its normal operating parameters and then store that information. "Reporting Technology" means that there are a series of commands that allow the host (i.e. your Macintosh) to query the drive and receive this stored information. Additionally, S.M.A.R.T. technology provides the host with the ability to command the drive to perform reliability tests on itself (i.e. "Self-Tests") and report these results back to the host.

The S.M.A.R.T. Guard Utility

All drive information and S.M.A.R.T. functions are accessed from the S.M.A.R.T. Guard's main window (see Figure 1, below). The main window is organized into three sections. At the top is the list of detected S.M.A.R.T. capable ATA drives attached to your Macintosh. In middle is a large tab control which provides access to all of the S.M.A.R.T. Guard utility's functions. At the bottom is a summary of the settings for the S.M.A.R.T. Guard alarm and an access button to those settings.

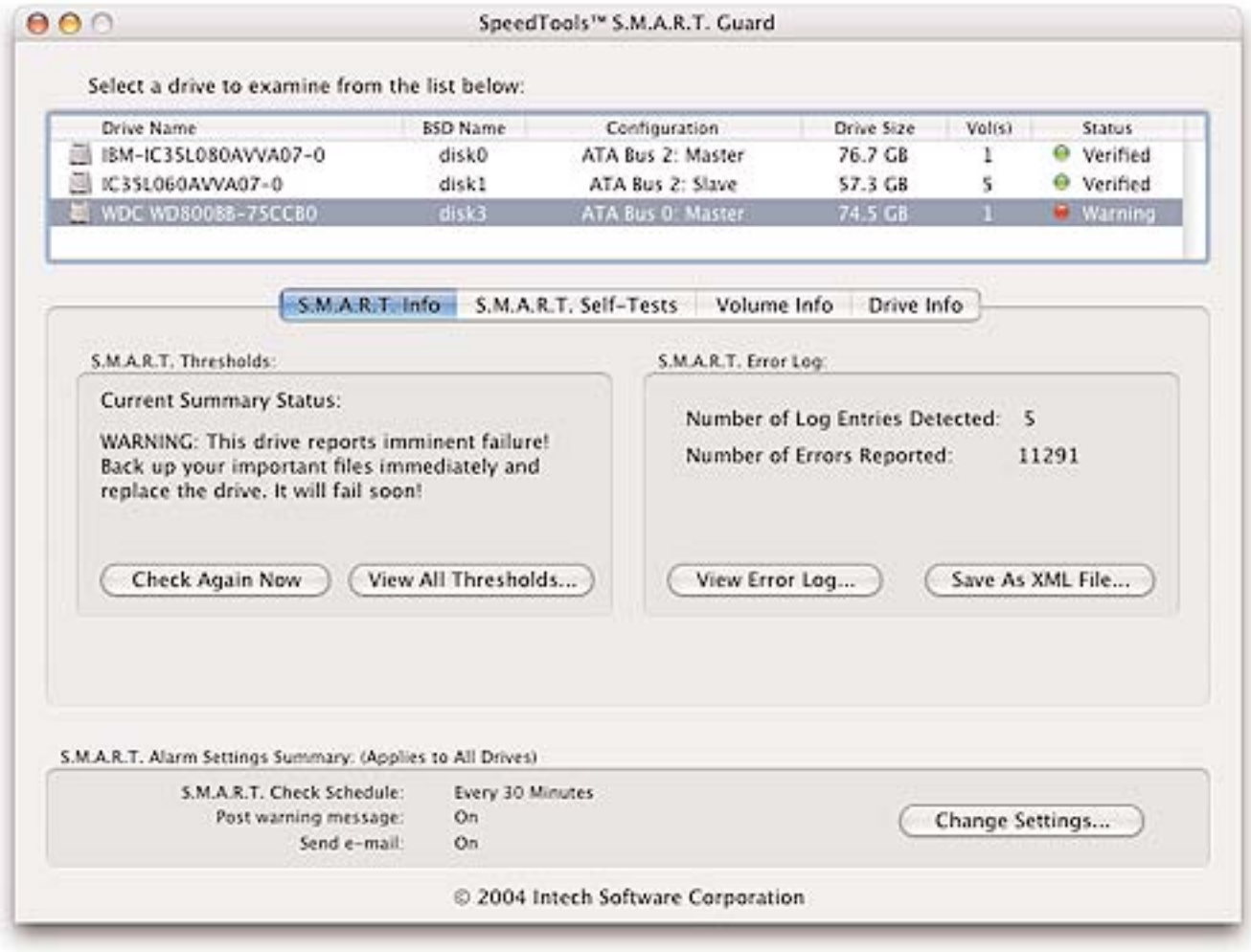

Figure 1. The S.M.A.R.T. Guard Main Window

The List of S.M.A.R.T. Capable Drives

This list in the upper part of the main window (see Figure 2, below) was designed to allow for the quick identification, verification and selection of all S.M.A.R.T. capable ATA drives connected to your computer. If you have one or more identical drive models with the same number of volumes, you may need to select the "Volume Info" tab (See Figure 8) to help you distinguish between your drives.

Note: Throughout this guide, an actual drive which has a pre-failure S.M.A.R.T. warning status will be used as an example. This drive is the third drive in the list of drives in figure 2 below. (It has been selected.)

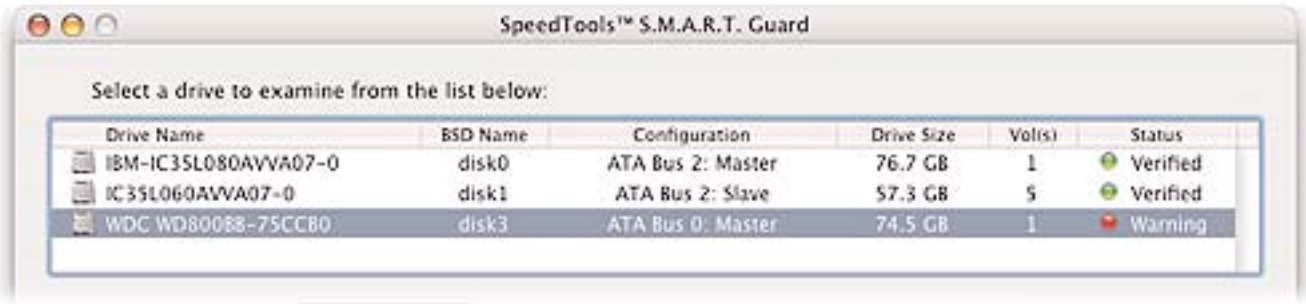

Figure 2. The List of S.M.A.R.T. Capable Drives

The Tab Pane Buttons

The "S.M.A.R.T. Info" Tab Pane. The first tab pane selection is called "S.M.A.R.T. Info" (see Figure 3, below). This pane address two particular aspects of S.M.A.R.T. functionality: thresholds and error logs.

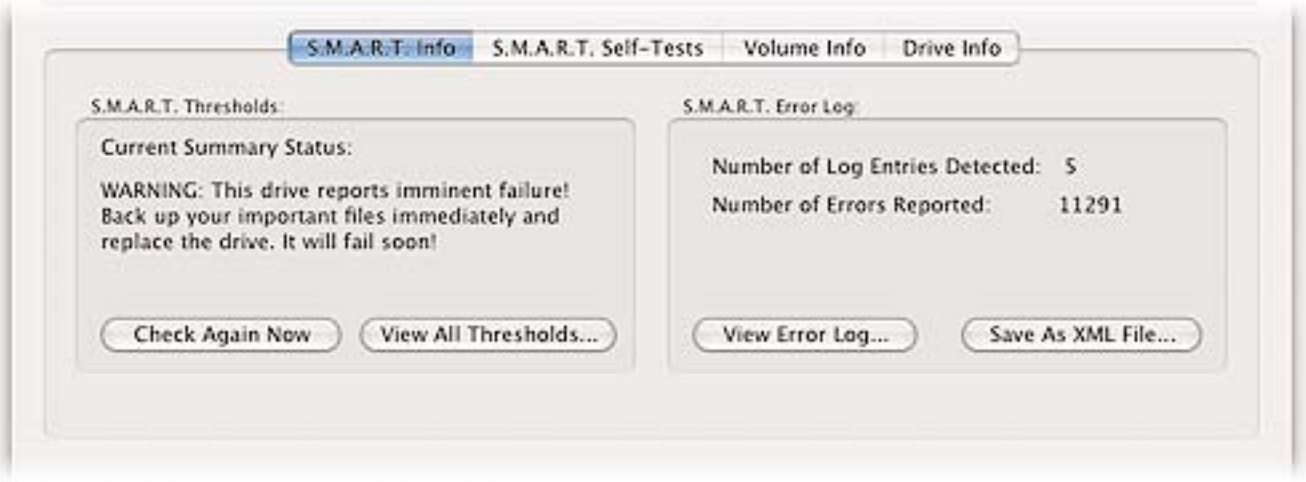

Figure 3. Figure 3. The "S.M.A.R.T. Info" Tab

S.M.A.R.T. Thresholds. On the left side of the "S.M.A.R.T. Info" tab pane is the "S.M.A.R.T. Thresholds" group box. In this box are three items. First there is a textual summary result for all the thresholds of all attributes being monitored. Second is a "Check Again Now" button which will query the drive again for any attributes which have exceeded thresholds. Third is a "View All Thresholds" button which will allow you to view the attributes and their respective threshold information individually. Clicking this button will produce a window similar to the one below in figure 4. Notice in the last row that the selected example drive has exceeded the manufacturer's reliability threshold for the attribute "Write Error Count."

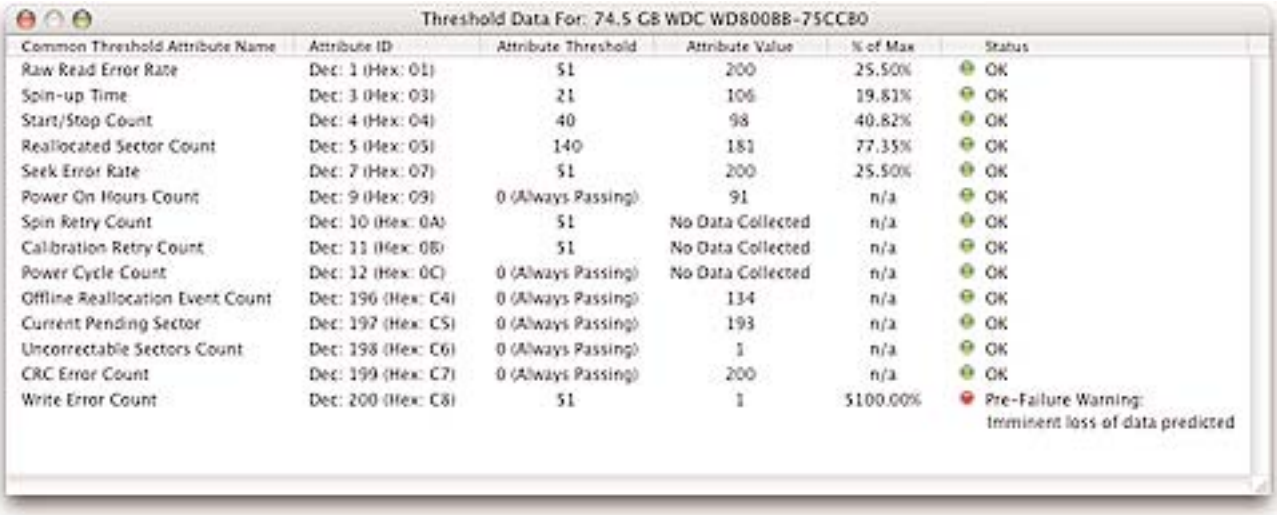

Figure 4. Individual S.M.A.R.T. Attribute Thresholds

Important Note About Individual Attribute Thresholds: Drive manufactures use the term "threshold" to denote a reliability boundary for any given S.M.A.R.T. "attribute" which is being monitored. What constitutes an "attribute" which is deemed worthy of monitoring is wholly up to the manufacturer of the drive. Individual S.M.A.R.T. attributes are not defined in any industry-standard publication so drive manufacturers are free to use any attribute ID value to denote whatever drive attribute they wish. Luckily, most of the major manufactures use many the same attribute ID's for the same attributes so we can fairly accurately label them in this utility. However, we cannot guarantee that the definition Intech has assigned to a given attribute ID will always be correct. For this reason, the actual attribute ID is shown in column to the right of its common definition. Choosing the "Skip" button will increment the Current Sector count past the bad sector and continue on with the test.

Some commonly used attributes shown in the example above are "Raw Read Error Rate", "Write Error Count", "Seek Error Rate", etc. Be aware, however, that not all attributes are directly related to errors. For example, many drives keep track of the number of hours they have been powered on: the "Power On Hours Count" attribute. If the attribute threshold value (i.e. the actual number of hours the drive has been powered on) exceeds the attribute value (i.e. the estimated power-on life-time of the drive), this will be considered a threshold exceeded condition even though the drive may still be functioning perfectly. In a situation such as this, the "Status" column will display a different message: "Advisory Condition: Attribute has exeeded intended lifespan."

It is important to keep in mind that whatever those "raw" values represent, in reality, are entirely determined by the manufacturer and should not concern us. The important point about individual attributes is that they will all have at least two values: one specifying the current value of the attribute, the other specifying the maximum threshold for that attribute. If the actual value exceeds the maximum threshold value, a threshold exceeded condition is said to exist. This is the only conclusion we can safely draw from this information. It may be quite tempting to try and interpret more from these numbers than just a threshold exceeded condition, but Intech believes this is not advisable.

S.M.A.R.T. Error Log. On the right side of the "S.M.A.R.T. Info" tab pane is the "S.M.A.R.T. Error Log" group box. The S.M.A.R.T. error log holds up to five of the most recent errors your drive has encountered. Note that in S.M.A.R.T. error logs, "errors" may refer to much more than just bad sectors. Specifically, an "error" refers to any command which was not carried out for any reason. The only defined exception to this rule is the ATA "Set Configuration" command. Many of these configuration settings have become obsolete over the years and may no longer be supported. When an unsupported configuration setting is requested but not supported by the drive, an error is not supposed to be generated in the error log. However, Intech has noted a few drives which do report these events as errors, and as a result, the error count can get very high, very quickly. If you notice "Set Configuration" errors, you are advised to simply dismiss them as meaningless.

To view the error log, click the "View Error Log" button. A window similar to the following window in figure 5 will appear.

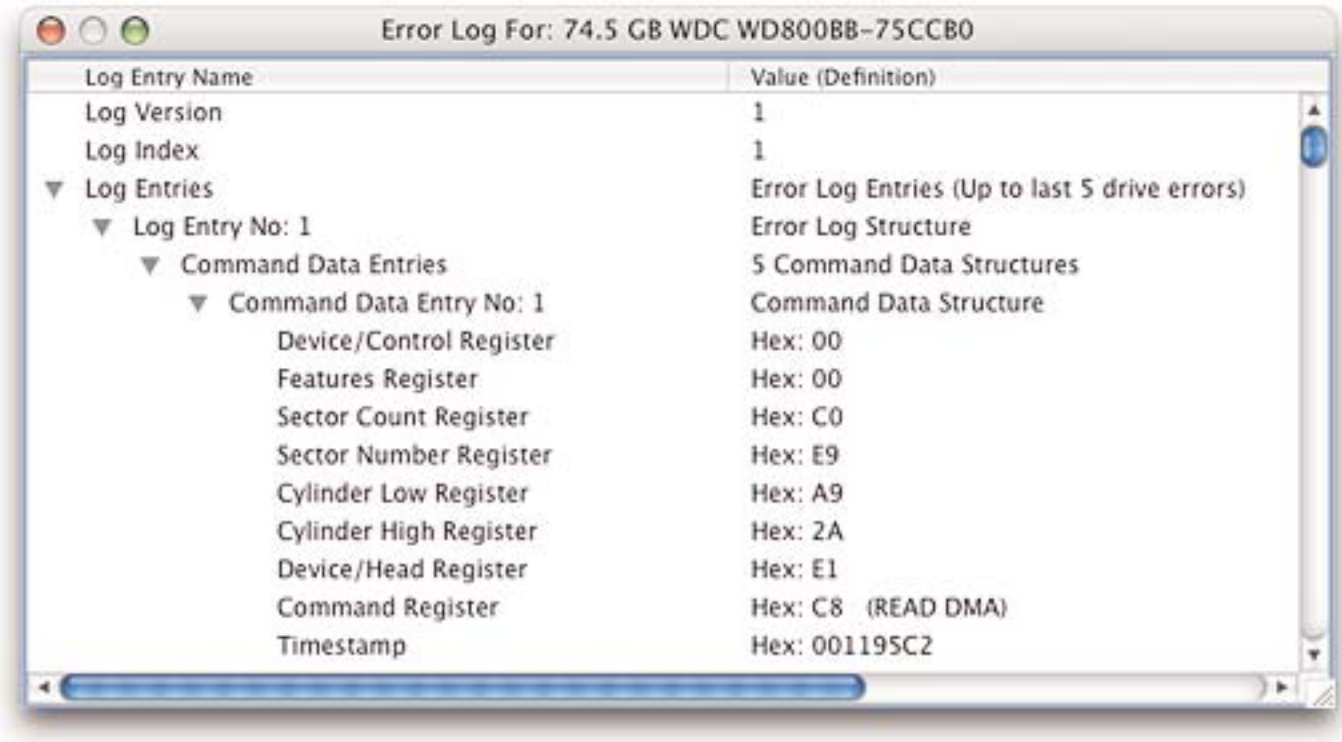

Figure 5. Error Log Window

As you can quickly see, this tends to be highly technical information. Most likely it will be of more use to the technical support staff of your drive's manufacturer (should you choose to contact them directly), but it can also provide a hint about what might be going on with a problem drive.

Let's step through a short example. Notice in the Error Log Window (figure 5) a field named "Command Register." This is the actual ID of the command which the drive failed to perform. Now look over into the "Value (Definition)" column and see that this Command ID is hexadecimal "C8" which is defined by the ATA/ATAPI specification as "Read DMA." This means that a "Direct Memory Access Read" command failed. (DMA reads and writes are the very fastest kind.) We still don't know why the command failed, but we at least know what failed. For complete list of ATA/ATAPI commands, see the "Additional Information and Reference" section at the end of this guide on how to aquire a copy.

Note about multi-byte fields in error logs and self-test logs: Some data fields in these structures are more than one byte in length. The ATA/ATAPI specifications require that these values be stored in a least significant to most significant byte order (i.e. the hexadecimal number 1234 is stored as 3412). Because this makes interpreting these fields more difficult, the SpeedTools S.M.A.R.T. Guard utility software will reverse the byte orders in these fields to make them more readable. However, any multi-byte fields which are labeled either "Reserved" or "Vendor Unique" are NOT byte reversed since there is no way of knowing what kind of information is being stored there by the drive's manufacturer.

Lastly, if you would like save this log information in a file, click the "Save As XML File" button. XML is a platform independent format which will preserve the basic hierarchy of the error log data structure. These XML files are viewable with the "Property List Editor" program available from the "Mac OS X Developer Tools" disc which was included with your MacOS X Installation software.

The "S.M.A.R.T. Self-Tests" Tab Pane

Figure 6. "S.M.A.R.T. Self-Tests" Tab

Extended Off-line Self-Test. On the left side of the self-test pane is the "Extended Off-line Self-Test" group box. This test tells the drive to perform a series of tests which examine several aspects of the drive's reliability and store those results for subsequent reporting. The actual tests performed are not defined by any ATA/ATAPI specification and are performed solely according to the discretion of the drive manufacturer.

To start at test, click the "Start Test" button. The displayed progress is solely based upon the drive's own reported progress. The drive will report its progress in increments of 10% complete (i.e. 10%, 20%, 60%, etc.). However, it is up to the drive's manufacturer to determine what level of progress translates to what percent. As a result, it may only take 5 minutes to move from 20% complete to 30%, but it may take 15 more minutes to move from 30% to 40%, for example.

The off-line self-test cannot be canceled. However, since this test takes place with the drive "off-line", you are free to use your computer and other S.M.A.R.T. Guard utility functions while the test is taking place. In fact, you can run multiple simultaneous selftests by starting one test, then clicking on another drive in the drive list and starting a self-test on that drive as well. In this way you can test as many or as few drives simultaneously as you choose.

Please note, that self-tests can require a great deal of the drive's time and attention to perform. So, for example, copying 100,000 files to or from a drive in the middle of a self-test would dramatically slow down both the self-test and the file copy. In fact, if a drive gets too busy with data requests from your computer, it may abort the selftest prematurely. This will not harm the drive, but it does defeat the purpose of performing the self-test.

The S.M.A.R.T. Self-Test Log. On the right side of the self-test pane is the "S.M.A.R.T. Self-Test Log" group box. After you have performed at least one self-test on the currently selected drive, there should be a corresponding log entry detected. To view the self test log, click the "View Self-Test Log" button. A window similar to the one in figure 7 will appear.

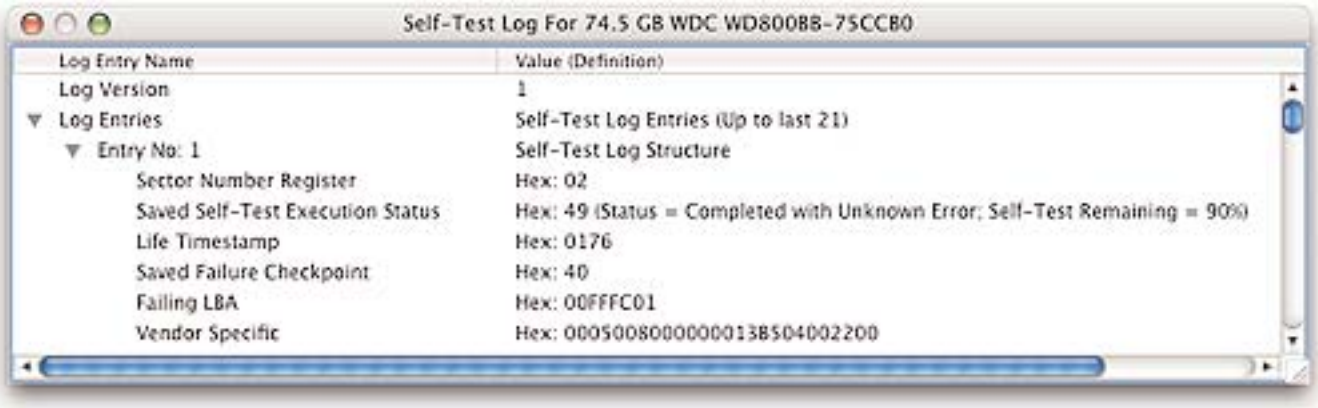

Figure 7. Self-Tests Log Window

Like the error log, the self-test log is quite technical and more likely to be of use by the technical support staff of the drive's manufacturer. Nevertheless, from the above window (figure 7) where the first log entry is disclosed, we can still learn something about this failure. The second field of the self-test log entry is called "Saved Self-Test Execution Status." This byte tells us the over all status of the drive when the self-test terminated. Looking at the corresponding "Value (Definition)" column we see that the drive completed the test with an unknown error and 90% of the test was still remaining to be performed. Whatever this error was that caused the self-test to abort, the drive seemed to have discovered it very early in the testing process.

Lastly, if you would like save this log information in a file, click the "Save As XML File" button. XML is a platform independent format which will preserve the basic hierarchy of the self-test log data structure. These XML files are viewable with the "Property List Editor" program available from the "Mac OS X Developer Tools" disc which was included with your MacOS X Installation software.

The "Volume Info" Tab Pane. Volume information is provided for informational purposes only. It is a good way to further distinguish between two or more drives which may look similar in the drive list.

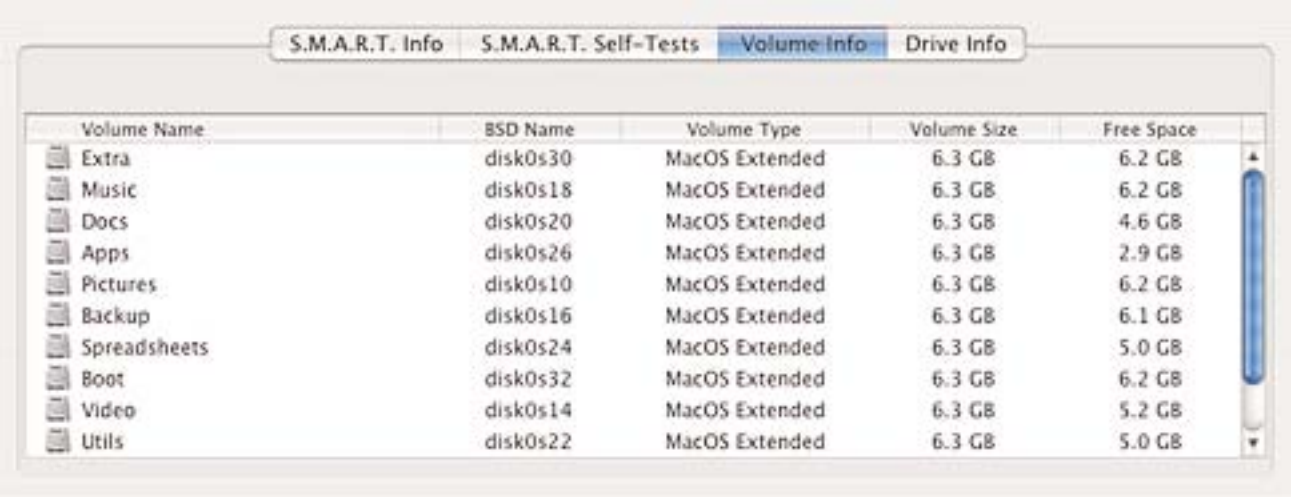

Figure 8. "Volume Info" Tab

The "Drive Info" Tab Pane. The list in this tab pane is informational only. It provides some of the interesting information about the capabilities of your drive which the drive returns in response to an "Identify Device" command (see ATA/ATAPI specifications for full details). One of the most important pieces of information in this list is contained the fifth row in the illustration below (Identify Device data: word 81). This will tell you which version of the ATA/ATAPI specification the currently selected drive conforms to. If you decide to obtain a copy of the ATA/ATAPI specification, this information will enable you to get the exact ATA/ATAPI specification version that your drive conforms to. This way you will be able most accurately interpret the information your drive provides to S.M.A.R.T. Guard.

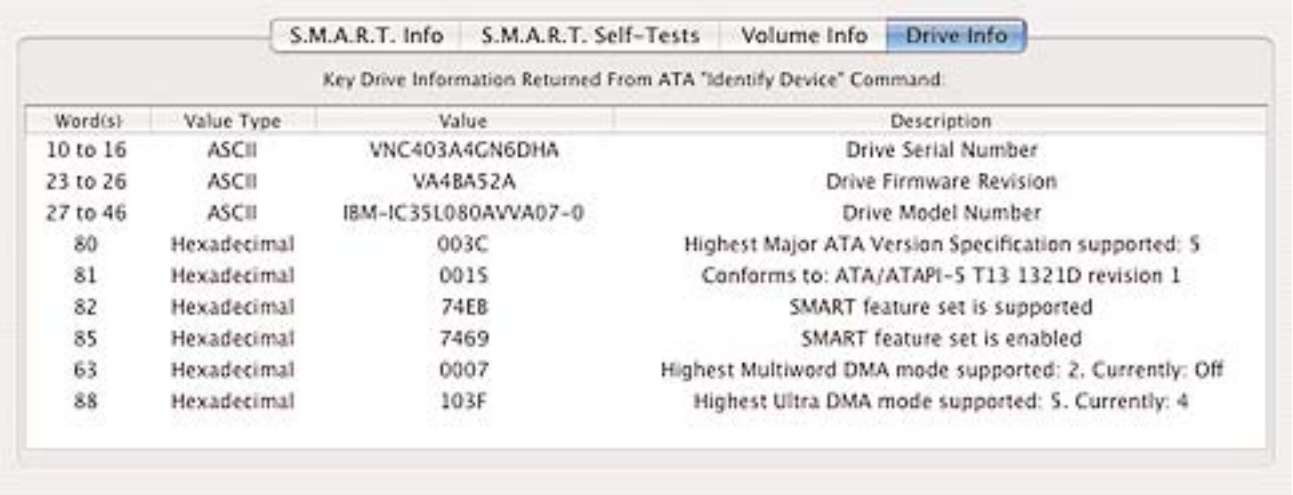

Figure 9. "Drive Info" Tab

Note: The "Drive Info" tab pane is not available for MacOS X versions prior to 10.3 because this information is not accessible.

The list in this tab pane is informational only. It provides some of the interesting information about the capabilities of your drive which the drive returns in response to an "Identify Device" command (see ATA/ATAPI specifications for full details). One of the most important pieces of information in this list is contained the fifth row (Identify Device data: word 81). This will tell you which version of the ATA/ATAPI specification the currently selected drive conforms to. If you decide to obtain a copy of the ATA/ATAPI specification, this information will enable you to get the exact ATA/ATAPI specification version that your drive conforms to. This way you will be able most accurately interpret the information your drive provides to S.M.A.R.T. Guard.

Also of potential interest are the last two rows: Ultra and Multiword DMA information. Most likely your drive will be connected to an Ultra DMA bus on your Macintosh. If this is the case, look at the last row (Identify Device data: word 88). The value on the sample drive is hexadecimal 10CF. The lower byte (hexadecimal 3F) represents the highest/fastest Ultra DMA mode the drive is capable of. Each bit number corresponds to a DMA mode. In the case of our example drive, lots of bits are set. Bit 0 is set to represent support for Ultra DMA mode 0, bit 1 is set to represent support for Ultra DMA mode 1, etc., all the way up to bit 5. Six sequential bits (bits 0 through 5) being set is equal to a binary number of 111111, which is equal to the hexadecimal value of 3F.

The upper byte (which is hexadecimal 10) represents the Ultra DMA mode drive is currently using. Since a drive can only be in one DMA mode at any given time, only one bit may be set. In this case the bit number being set is 4. This means our drive is capable of Ultra DMA mode 5 but currently only using Ultra DMA mode 4. (According to the ATA/ATAPI specification Ultra DMA mode 5 is equal to a speed of 100 Megabytes per second and Ultra DMA mode 4 is 66 Megabytes per second.) So what accounts for this? As it turns out, this situation is exactly what should be expected when an Ultra/100 (i.e. mode 5 capable maximum) drive is connected to an Ultra/66 (i.e. mode 4 capable maximum) bus. In short, the maximum DMA speed at which your drive will be able to transfer data will be equal to which ever is LOWER: your drive's DMA max or your computer ATA bus's DMA max.

Lastly, if your drive is connected to the slower Multiword DMA bus, look at the second to last row. The exact same logic pertains to Multiword DMA as Ultra. Notice in our example that the lower byte (which is hexadecimal 7) means that only three bits are set. This means the drive supports Multiword DMA modes 0, 1 and 2. This is actually the only three Multiword DMA modes defined by the ATA/ATAPI spec. Notice as well that the upper byte (hexadecimal 0) means that no bits are being set. This means that the drive is not using any form of Multiword DMA. This is as it should be since we already know the drive is currently using Ultra DMA mode 4.

The S.M.A.R.T. Alarm Settings

At the bottom of the SpeedTools S.M.A.R.T. main window (see figure 10) is displayed a summary of the settings to control the behavior of the S.M.A.R.T. alarm software.

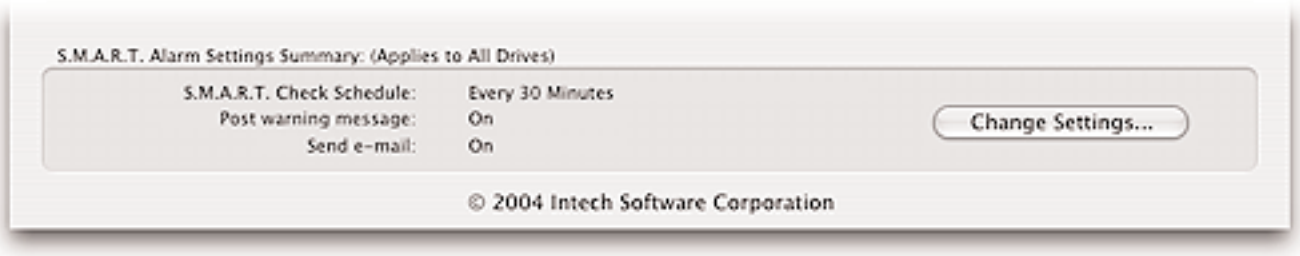

Figure 10. S.M.A.R.T. Alarm Settings Summary

To modify these settings click the "Change Settings" button. A window similar to the one shown in figure 11 below will appear.

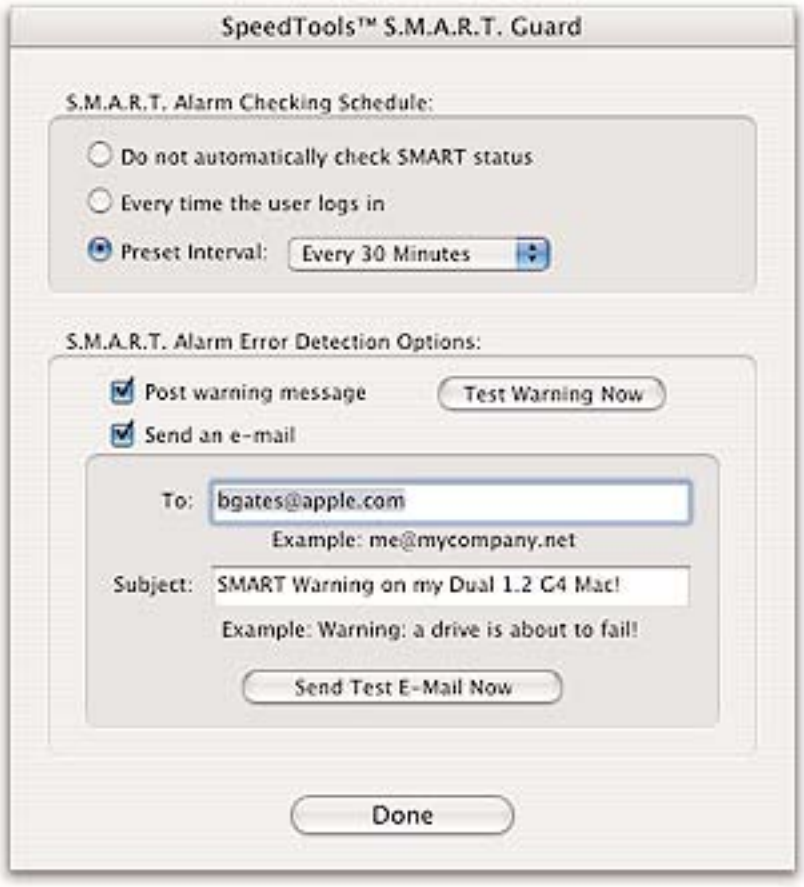

Figure 11. S.M.A.R.T. Alarm Settings

If you desire e-mail notification, it is recommended that you send at least one test email per logged in user. The e-mail warning function depends on certain internet configuration values to be set correctly. The only sure way to validate the e-mail warning functionality is to actually send a test message. All changes to the settings immediately take effect in the S.M.A.R.T. alarm software. Should the S.M.A.R.T. alarm software detect a threshold exceeded condition, one warning message and/or e-mail message will be sent per log in session (in accordance with chosen settings).

About the SpeedTools S.M.A.R.T Guard Alarm

The S.M.A.R.T. alarm runs only in the background, constantly monitoring the S.M.A.R.T. threshold status of your ATA drives and letting you know when a problem has been detected.

Note: Only one program at a time can access the S.M.A.R.T. functions provided in MacOS X. So while you are running the SpeedTools S.M.A.R.T. Guard utility program, the S.M.A.R.T. Guard alarm will be disabled.

S.M.A.R.T. Guard System Requirements:

- MacOS X, version 10.2 or later (Version 10.3 preferred to provide additional device information)
- G3, G4 or G5 Macintosh with at least one S.M.A.R.T. compatible ATA hard disk drive
- Blue & White G3 not supported
- Beige G3 not supported

Additional Information and Reference:

For draft versions of S.M.A.R.T. and all other ATA specifications see the "Technical Committee T13 AT Attachment" documents found at http://www.t13.org. T13 is a Technical Committee for the InterNational Committee on Information Technology Standards (INCITS).

Final versions of these ATA/ATAPI specifications can be purchased from Global Engineering Documents (http://global.ihs.com).