

72-144 Gbyte 4 mm DDS-3 Autoloader Installation and User's Guide



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Preface

The *72-144 Gbyte 4 mm DDS-3 Autoloader Installation and User's Guide* provides installation and user instructions for the DDS-3 4 mm autoloader. The installation procedures should be performed by an experienced technician.

Using UNIX Commands

Brief descriptions of some UNIX commands commonly used with tape devices are in the following table:

Table P-1 UNIX Tape Device Commands

Command	Description
<code>ufsdump</code>	Creates incremental or full backups. The <code>-1</code> option is used to sequence tape cartridges for large back ups
<code>ufsrestore</code>	Retrieves data backed up using <code>ufsdump</code>
<code>tar</code>	Creates tape archives and adds or extracts files
<code>mt</code>	Sends commands to magnetic tape devices
<code>tapetool</code>	OpenWindows™ tool that reads files from tape or archives files to tape
<code>cpio</code>	Copies file archives in and out

For more information about these commands, as well as tasks such as:

- Shutting down the system
- Booting the system
- Configuring devices
- Other basic software procedures

See one or more of the following:

- *Solaris 2.x Handbook for SMCC Peripherals*
- AnswerBook™ online documentation for the Solaris™ 2.x software environment
- Other software documentation that you received with your system

Typographic Conventions

Table P-2 Typographic Conventions

Typeface or Symbol	Meaning	Examples
AaBbCc123	The names of commands, files, and directories; on-screen computer output.	Edit your <code>.login</code> file. Use <code>ls -a</code> to list all files. % You have mail.
AaBbCc123	What you type, when contrasted with on-screen computer output.	% su Password:
<i>AaBbCc123</i>	Book titles, new words or terms, words to be emphasized. Command-line variable; replace with a real name or value.	Read Chapter 6 in the <i>User's Guide</i> . These are called <i>class</i> options. You <i>must</i> be root to do this. To delete a file, type <code>rm filename</code> .

Shell Prompts

Table P-3 Shell Prompts

Shell	Prompt
C shell	<i>machine_name%</i>
C shell superuser	<i>machine_name#</i>
Bourne shell and Korn shell	\$
Bourne shell and Korn shell superuser	#

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Table P-4 SunExpress Contact Information

Country	Telephone	Fax
Belgium	02-720-09-09	02-725-88-50
Canada	1-800-873-7869	1-800-944-0661
France	0800-90-61-57	0800-90-61-58
Germany	01-30-81-61-91	01-30-81-61-92
Holland	06-022-34-45	06-022-34-46
Japan	0120-33-9096	0120-33-9097
Luxembourg	32-2-720-09-09	32-2-725-88-50
Sweden	020-79-57-26	020-79-57-27
Switzerland	0800-55-19-26	0800-55-19-27
United Kingdom	0800-89-88-88	0800-89-88-87
United States	1-800-873-7869	1-800-944-0661

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1-415-786-6443

This chapter describes how to install the DDS-3 4 mm autoloader into a system or enclosure.

1. Determine your operating system using the `uname -rs` command.

Note – The following operating environments require modifications to configuration files before installing this tape device:

SunOS 5.4, 5.5, and 5.5.1 operating environments
SunOS 4.1.4 operating environment

If your operating system is listed above, perform the procedures in Appendix A, “Configuration File Modifications,” before continuing with this chapter.

2. Shut down the operating environment.

Refer to the Solaris AnswerBook online documentation or the *Solaris Handbook for SMCC Peripherals* that corresponds to your operating system.

3. Determine the SCSI address (target ID) for the tape drive.

Tape drives are usually set to a SCSI address of 4 or 5. To check for an available SCSI address, enter `probe-scsi-all` at the OK prompt. For more information, refer to the Solaris AnswerBook online documentation or the *Solaris Handbook for SMCC Peripherals* that corresponds to your operating system.

Note – For SunOS 4.x operating systems, you can only use SCSI address 4 or 5.

4. Turn off the power to your system and then to your peripherals.
5. Prepare your system or enclosure for servicing.
Follow the procedures in the service manual for your system or enclosure.
6. Connect the y-power cable to the embedded tape drive and the autoloader mechanism (Figure 1-1).

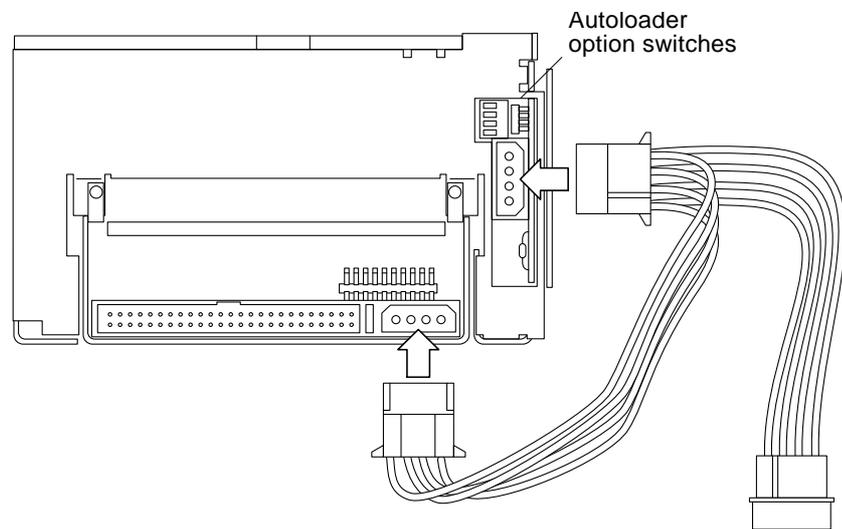


Figure 1-1 Rear of Autoloader

7. Set the autoloader option switches according to the following table:

Table 1-1 Autoloader Option Switches

Switch	Setting 1 (Normal Operation)	Setting 2 (Circular Mode)
1	On	Off
2	On	On
3	On	Off
4	Off	Off

8. Set the autoloader's SCSI address

The autoloader's SCSI address is set by the connector shown in Figure 1-2.

- a. For systems that have a SCSI address cable, connect the adapter as shown in Figure 1-2.

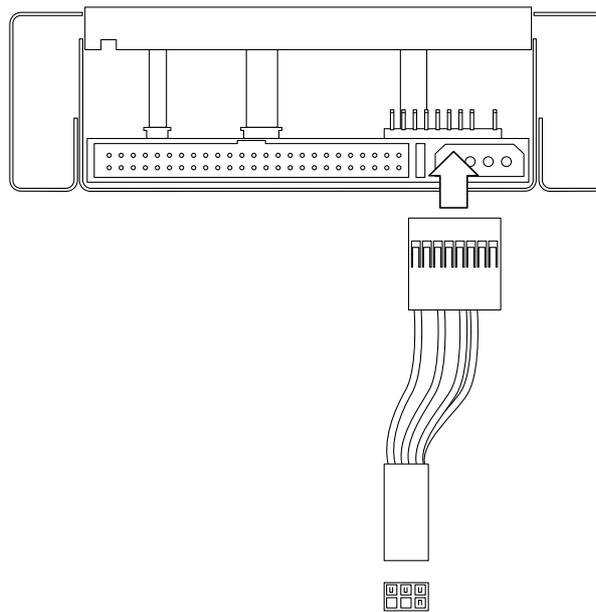


Figure 1-2 Location of SCSI Address Connector

- b. For systems that do not have a SCSI address cable, connect the jumpers as shown in Figure 1-3.

○○○○○○○○ ○ SCSI ID0	○○○○○■ ○ SCSI ID1	○○○■○○ ○ SCSI ID2	○○○■ ■ ○ SCSI ID3
○○■○○○ ○ SCSI ID4	○○■○○■ ○ SCSI ID5	○○■ ■○○ ○ SCSI ID6	

Figure 1-3 Setting SCSI Address Jumpers

Note - Although there are other switches and connectors on the autoloader, they are inactive in Sun configurations.

9. Install the tape drive.

Refer to the procedures in your system or enclosure service manual. Install this drive as you would any full-height device.

10. Power on your peripherals and then your system.

11. Reboot your system using the `boot` command.

Note - For SunOS 5.x operating environments, reboot using the `boot -r` command

This chapter gives details of the basic operation of the DDS-3 autoloader, and the meaning of the front panel displays.

For information about software commands, refer to the *Solaris Handbook for SMCC Peripherals* or the AnswerBook documentation for your operating system.

Front Panel

The front panel of the autoloader has the following features (Figure 2-1):

- A door through which the magazine is loaded
- The Select button
- The Eject button
- The Load Tape button
- A liquid crystal display (LCD)
- Three light-emitting diodes (LEDs)

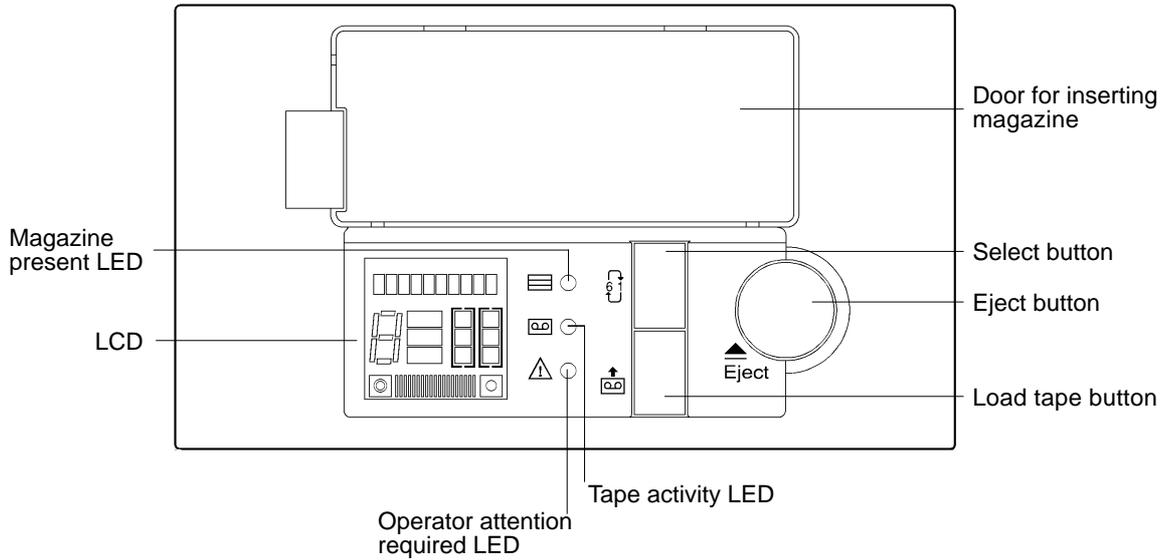


Figure 2-1 Autoloader Front Panel

Front Panel Buttons

Select Button

The Select button enables you to select any of the cartridges in the magazine after the magazine has been automatically loaded into the unit. If you press the Select button repeatedly, the display cycles through the cartridges available in the magazine. You then press the Load Tape button to load the selected cartridge.

Load Tape Button

Use the Load Tape button to load the selected cartridge from the magazine into the drive. This puts the drive into Stacker mode; when the selected cartridge is ejected following a host UNLOAD command, the drive will automatically load the next highest numbered cartridge.

Note – If circular mode is selected (See Table 1-1 on page 2) the tape is loaded automatically at time of power-up.

Eject Button

The Eject Button starts the unload process. The drive unloads any currently loaded cartridge, and the changer mechanism returns the cartridge to the magazine. The magazine is then ejected. The button can also be used to force ejection in an emergency. See “Forcing Ejection” on page 14.

Note – The host computer can disable the Eject Button by sending a SCSI PREVENT MEDIA REMOVAL command.

Front Panel LEDs

The autoloader has three front panel LEDs (Figure 2-1). The LEDs are described in Table 2-1:

Table 2-1 Front Panel LEDs

Magazine Present (top LED)—green

Steady	A magazine is inserted.
Flashing	A magazine is in the process of being inserted, checked or ejected. The light also flashes during the autoloader’s self-test routine.

Tape Activity (middle LED)—green

Steady	A cartridge is present in the drive.
Flashing (4Hz)	Data is being read or written, or activity other than the cartridge being loaded or unloaded is occurring.
Flashing (2 Hz)	A cartridge is being loaded or unloaded. The light also flashes during the autoloader’s self-test routine.

Table 2-1 Front Panel LEDs (Continued)

Operator Attention Required (lower LED)—amber

Flashing (4 Hz) ¹	A firmware upgrade is taking place.
Flashing (2 Hz)	The tape is nearing the end of its useful life.
Flashing (2 Hz)	The heads need cleaning.
Flashing (2 Hz)	Self-test in progress.
Flashing (1 Hz) ²	A hard fault condition has occurred that the drive cannot clear.
Flashing (1 Hz)	There is a tape in the autoloader but no magazine.
Flashing (1 Hz)	The front panel door is open when it should not be.
Steady ³	A serious hardware error has occurred.

1. See Table 3-2, "Status Message Descriptions," on page 20, for more information.

2. See Table 3-5, "Error Messages (OAR LED Flashing)," on page 25, for more information.

3. See Table 3-6, "Error Messages (OAR LED Steady)," on page 27, for more information.

Front Panel LCDs

The five display regions of the LCD provides information about the autoloader (Figure 2-2).

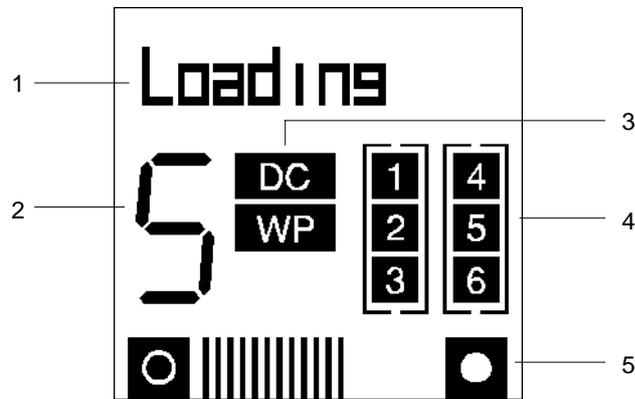


Figure 2-2 Front Panel LCD

Note - The exact display shown in Figure 2-2 can never occur; all the sections are showing at the same time so that you can see where they are.

1. The 10-character dot matrix display provides information on the autoloader's operating status and potential error conditions. See Chapter 3, "LCD Messages" for details of the messages which can be displayed here.
2. The 7-segment display shows the number of the current cartridge loaded in the drive, or the cartridge selected when you press the Select button repeatedly.
3. "DC" (Data Compression) and "WP" (Write-Protected) in the center of the LCD indicate when data compression is being used for writing, and whether the cartridge is write-protected.
4. The six numbered boxes on the right of the LCD are individually lit to show which magazine slots contain a cartridge.
5. The Odometer lines appear at the bottom of the LCD. These lines show how much tape has been used in the current partition. The more lines shown, the more tape has been used.

Cartridges and Magazines

Compatibility

The autoloader can read and write to DDS-1, DDS-DC, DDS-2, and DDS-3 tape cartridges.

Only use cartridges labeled "DDS" in the drive. To exploit the full potential of the drive, make sure that they are DDS-3 cartridges.



Caution – Do not use DAT cartridges. These cartridges can get stuck in the autoloader mechanism.

Storage Capacities

The storage capacity of the autoloader depends on the format and the length of the tape cartridges (Table 2-2).

Table 2-2 Tape Formats and Capacities (Six Tape Cartridges)

Format	Length	Native Capacity	Compressed Capacity¹
DDS-1	60m	7.80 Gbytes	15.6 Gbytes
DDS-DC	90m	12.0 Gbytes	24.0 Gbytes
DDS-2	120m	24.0 Gbytes	48.0 Gbytes
DDS-3	125m	72.0 Gbytes	144.0 Gbytes

1. Assumes a typical compression ratio of 2:1. The compression ratio will vary depending upon the type of data being compressed.

Handling and Storage

To avoid mechanism jams, use labels properly:

- Only stick labels in the label areas (Figure 2-3).
- Ensure that the corners of the labels stick firmly and do not curl.
- Never stick labels on top of other labels.

Note – Store cartridges in their magazines so that cartridges belonging to a multi-volume backup are kept together and in the correct order.

Loading Cartridges and Magazines

1. Place as many cartridges as you need into the magazine, pointing towards the center of the magazine (Figure 2-3). Make sure that the small arrows on the magazine and cartridge line up.

You can use any number of cartridges from 1 to 6, and place them in any of the magazine slots. However, for ease and speed of use, start by using slot 1. During a sequential backup, by default the drive will attempt to load the first cartridge from slot 1.

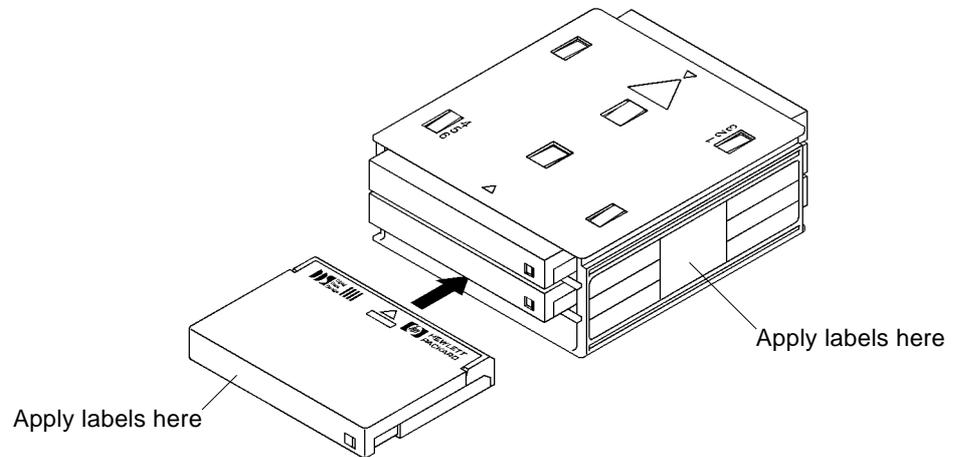


Figure 2-3 Loading Cartridges into the Magazine

2. Insert the magazine into the autoloader with the large arrow on top and pointing towards the autoloader (Figure 2-4). Apply steady pressure until the mechanism takes the magazine and pulls it into the autoloader.

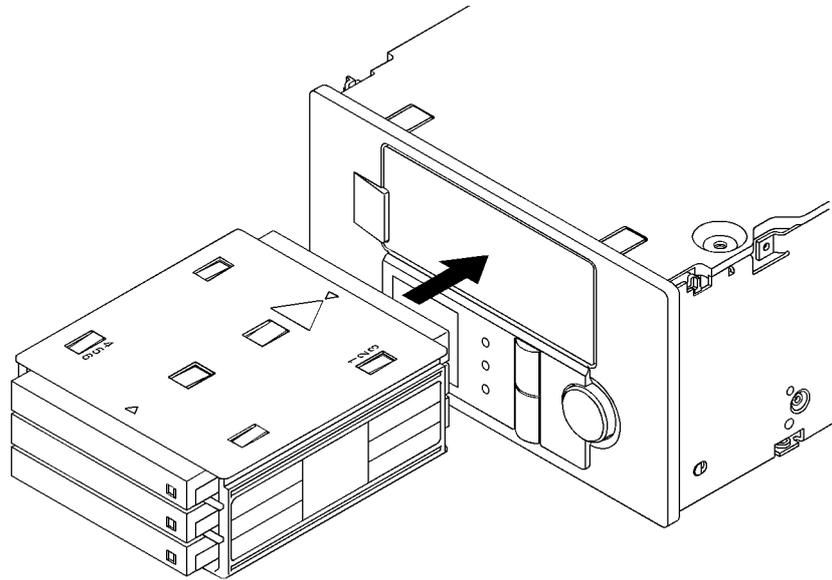


Figure 2-4 Inserting the Magazine into the Autoloader

3. The autoloader then performs a self-test routine.

This also checks which magazine slots contain cartridges.

Note - During the self-test routine, all three LEDs flash at a rate of 2 Hz (twice a second). If the self-test fails, the Operator Attention Required light changes to steady amber and the other lights extinguish. The results of these tests are reported to the host through the `SCSI RECEIVE DIAGNOSTICS` command.

4. When the self-test and magazine check is complete, select the cartridge with which you want the sequence to start by pressing the Select button.

5. When the correct number is displayed, press the Load Tape button to load the cartridge.

The drive now performs a load sequence. This takes a maximum of 25 seconds from the time the cartridge is inserted to the time the drive is ready to start acting upon the next command from the host. The sequence is as follows:

- a. The drive mechanism threads the tape and rewinds it to Beginning of Media (BOM). It checks the tape format (such as DDS-2 or DDS-3) and the number of partitions. If the tape is blank, the drive leaves the tape at Beginning of Media (BOM) and awaits the next command.
 - b. If the tape is in DDS format and is write-enabled, the drive performs write and read tests. If the error rate is high, the Operator Attention Required light flashes and Clean Me is displayed on the LCD.
 - c. The drive copies the Tape log from the tape into RAM.
 - d. The drive rewinds to BOP (Beginning of Partition) and goes online, awaiting a command from the host.
- 6. Once the drive is online, it sends a CHECK CONDITION on receipt of the next SCSI command from the host. The UNIT ATTENTION key is set in the returned REQUEST SENSE data to indicate that the tape may have been changed.**

Ejecting the Magazine and Cartridges

To eject a cartridge from the autoloader, press the Eject button. The following sequence of events occurs:

1. The tape is rewound to BOP (Beginning of Partition).
2. If the tape is write-enabled, the copy of the Tape log held in RAM is written back to tape.
3. The tape is then rewound to BOM (Beginning of Media) and unthreaded.
4. The changer mechanism replaces the cartridge in the magazine.
5. The magazine is ejected.

If the host sends an Unload command (LOAD/UNLOAD with the LOAD bit set to 0), the same procedure is followed but the magazine is not ejected at the end.

If you press the Eject button during the 30 seconds when the autoloader checks magazine slots following insertion of a magazine, the magazine will be ejected immediately, even if Medium Removal Prevention is in force.

Note – If the host has previously sent a `PREVENT MEDIA REMOVAL` command, the Eject button will be disabled and the tape will not unload. However, the drive will be put in a semi-loaded state (the drive is offline and the tape is unthreaded). The effects of `PREVENT MEDIA REMOVAL` continue until an `ENABLE MEDIA REMOVAL` command is received, or the drive is reset.

Forcing Ejection



Caution – You can lose data if you force ejection of a tape. The tape may also end up invalidly formatted, because EOD (End of Data) may not have been written. Only force ejection as a last resort to recover a cartridge. *Never use it as a quick way of ejecting the cartridge.*

If you press the Eject button when the drive is busy, it may be a long time before the drive will respond to the request, because it will finish the task it is performing first. This ensures that the task is terminated in a controlled manner, and no data is lost.

However, if you need to unload a cartridge urgently, even at the risk of losing data, you must force ejection as follows:

- 1. Hold the Eject button down for at least 5 seconds.**
The LCD will display Force Eject.
- 2. The autoloader waits 35 seconds to give the normal ejection procedure a chance to occur.**
- 3. Once this time has elapsed, if there is a tape loaded in the drive, it is immediately unthreaded and the cartridge is ejected, regardless of what operation the drive was performing.**
The cartridge is then returned to its slot in the magazine, and the drive is reset as though the power had been cycled.

Because the forced ejection may interrupt any operation, it is possible that the drive will not write EOD before the cartridge is ejected. This will cause loss of data, and result in a cartridge with an invalid format. However, it should still be possible to read such a cartridge up to the point where the ejection interrupted the writing.

4. If no cartridge is loaded in the drive, the autoloader assumes that you want to eject the magazine.

Following the 35 seconds, it does this. The autoloader is then reset as though power had been cycled.

Note – Forced ejection overrides any SCSI PREVENT MEDIA REMOVAL which may be in effect, and can abort any SCSI operations in which the autoloader is engaged.

Head Cleaning

Clean the tape heads at the following times:

- After every 25 hours of use
- When a Clean Me message is displayed in the front panel LCD and the Operator Attention Required light is flashing amber.

As a rough guideline, the frequency of cleaning is likely to be as follows:

Table 2-3 Estimate Head Cleaning Frequency

Number of cartridges used each day:	≤1	2	3	4
Cleaning frequency:	8 weeks	4 weeks	3 weeks	Weekly

Cleaning cartridges can only be used about 50 times. Software applications can warn you that a cleaning cartridge has expired by polling the TapeAlert log.

An expired cleaning cartridge will be ejected in less than 20 seconds instead of the usual 30 seconds. If the “Clean Me” message was showing before the attempt to clean the heads, it will still be showing afterwards.

Clean the heads using a DDS cleaning cartridge as follows:

- 1. Place the cleaning cartridge into one of the magazine slots (for example, slot 1) and insert the magazine into the autoloader.**
- 2. Use the Select button to select the magazine slot in which you placed the cleaning cartridge.**
- 3. Press the Load Tape button to load the cleaning cartridge into the drive. The autoloader will then automatically perform a cleaning cycle.**

4. At the end of the cleaning cycle, the drive automatically ejects the cartridge and the changer mechanism replaces it in the magazine.
5. Note the date on the label on the cleaning cartridge, so that there is a record of how many times it has been used. After 50 uses, discard the cartridge.

Environmental Guidelines

Condensation is bad for tape drives, where a thin tape is passing across a rapidly spinning head.

To avoid temperature problems, follow these guidelines:

- Position the autoloader in a position where the temperature is relatively stable, for example, away from open windows, fan heaters and doors.
- Avoid leaving cartridges in severe temperature conditions, for example in a car standing in bright sunlight.
- Avoid transferring data (reading from and writing to cartridges) when the temperature is changing by more than 10°C (50°F) per hour.
- After either cartridge or autoloader has experienced an extreme change of temperature (more than 15°C, 59°F), do not use the autoloader for at least two hours to allow the temperature of the autoloader and cartridges to stabilize.

Upgrading Firmware From Tape

The autoloader allows you to upgrade its firmware by inserting a Firmware Upgrade tape. The process will take at least 3 minutes to complete.



Caution – Do not disconnect power at any time during the upgrade, or it may result in the autoloader having corrupt firmware, or no firmware at all. The autoloader will then have to be returned to the factory.

Note – If the firmware upgrade is incompatible with your hardware, no upgrade will take place. The LCD will show the message Wrong FW, the upgrade cartridge will be return to the magazine, and the magazine will eject.

Note – The upgrade tape must not be write-protected.

The upgrade tape can only be used a certain number of times. After that, an autoloader or drive will reformat it. Discard the upgrade tape once this has occurred. Firmware tapes should not be used to store data.

- 1. Ensure that the drive is not engaged in any SCSI activity (the Tape Activity light is off and the host is not going to be accessing the drive).**
- 2. Place the Firmware Upgrade tape into magazine slot 1, and insert the magazine into the autoloader.**
- 3. Use the front panel Select button to select magazine slot 1.**
- 4. Press the Load Tape button to load the upgrade tape into the drive.**
The autoloader will then automatically upgrade the firmware.
- 5. When the LCD shows the message New FW!!!, the firmware has been successfully upgraded and the upgrade tape has been returned to the magazine.**
Press the Eject button to eject the magazine. Remove the Firmware Upgrade tape, and replace it in its box.

Messages displayed by the LCD are divided into three categories:

- Normal operation status messages
- Information messages
- Error messages

Normal Operation Status Messages

The status messages that appear on the LCD cover five functional states of the autoloader operation. The functional states will always appear in the order shown Table 3-1. Only one of the states has control of the LCD text display at any one time.

Table 3-1 Normal Operation Status Messages

State	Message	Description
Reset	Self Test	At power on, the Reset state has control of the LCD.
Firmware Upgrade state	FW Upgrade FW Check FW Program New FW!!!!	Following the self-test, if a firmware upgrade is taking place, the Firmware Upgrade state takes control of the LCD.

Table 3-1 Normal Operation Status Messages (Continued)

State	Message	Description
Magazine Load state	Insert Mag Mag Check Mag Eject	If no firmware upgrade is being performed, control of the LCD passes to the Magazine Load state, and remains there until the magazine has been loaded.
Cartridge Load state	Mag Loaded SemiLoaded Loading Unloading Cleaning FW Tape	After the magazine has been loaded, control of the LCD passes to the Cartridge Load state until a cartridge has been moved to the drive and loaded.
Tape Motion state	Ready xxm Read Write x.y Search >> Search << Rewind Format Erase Locate Partition	Once a cartridge has been loaded, the Tape Motion state covers activity involving the tape, including reading and writing data.

Each of these status messages is described Table 3-2.

Table 3-2 Status Message Descriptions

Message	Description
Cleaning	A cleaning cartridge has been loaded into the DDS drive.
Erase	The drive is erasing data from the tape.
Format	The drive is creating a 1- or 2-Partition tape, or changing the size of the partitions on an existing 2-Partition tape.
FW Check	The data to upgrade the firmware is being checked for compatibility.
FW Program	The embedded DDS drive is being upgraded with the new firmware.

Table 3-2 Status Message Descriptions (Continued)

Message	Description
FW Upgrade	Data to upgrade the firmware is being read, either from a tape or through the SCSI bus.
Insert Mag	Insert a magazine into the Autoloader
Loading	Either a cartridge is being moved from the magazine and placed into the drive mechanism, or the drive is loading a semi-loaded cartridge.
Locate	The drive is moving the tape to a point specified by the host.
Mag Check	The autoloader is examining the magazine to find which slots are occupied.
Mag Eject	The autoloader is ejecting the magazine.
Mag Loaded	A magazine is present in the autoloader, and the magazine check has been completed.
New FW!!!!	The firmware has been successfully upgraded.
Partition	The drive is switching to the other partition on a 2-Partition tape.
Read	The drive is reading data from the tape.
Read Only	If a write-protected tape is loaded, the Ready xxm message alternates with a Read Only message.
Ready xxm	A cartridge is loaded in the drive, and the drive is ready to respond to commands which cause tape motion. xxm is the length of the currently loaded tape, so, for example, Ready 90m will be displayed when a 90m tape is loaded. If a write-protected tape is loaded, Ready xxm alternates with a Read Only message.
Rewind	The drive is rewinding the tape to the beginning of the current partition.
Search >>	The drive is searching forwards (towards the end of the tape) for a record, filemark, setmark, or EOD (End of Data). In SCSI terms, it is responding to a SCSI <i>SPACE</i> command with a positive Count field.
Search <<	The drive is searching backwards (towards the beginning of the tape) for a record, filemark, setmark, or EOD (End of Data). In SCSI terms, it is responding to a SCSI <i>SPACE</i> command with a negative Count field.
Self Test	The autoloader is performing its power-on self-test routine.

Table 3-2 Status Message Descriptions (Continued)

Message	Description
SemiLoaded	A cartridge is in the drive, but not loaded (the tape has not been threaded).
Unloading	Either the drive is unloading a cartridge, or a semi-loaded cartridge is being ejected and moved back to its slot in the magazine.
Write x.y	The drive is writing data to tape. x.y:1 is the cumulative compression ratio since power-on, or since the compression ratio was last cleared. For example, Write 2.1 means a compression ratio of 2.1:1. The compression ratio will only be displayed after about 1 megabyte of data has been written since power-on.

Information Messages

Table 3-3 describes the information messages that can be displayed on the LCD.

Table 3-3 LCD Information Messages

Message	Description
Config: xxy	xx is the hexadecimal value of the configuration switches on the underside of the autoloader, and y is the hexadecimal value of the option switches on the rear of the autoloader. The message is displayed for 2 seconds following the SCSI ID message after power-up.
Eject Mag	The Eject Button has been pressed. It may be some time before the magazine is ejected, since the drive must first finish the operation on which it is currently engaged and then return the cartridge to the magazine.
ForceEject	Forced ejection of cartridge and magazine is in progress. It finishes when the magazine is ejected.
Load Tape	This is displayed when the Load Tape button is pressed.

Table 3-3 LCD Information Messages (Continued)

Message	Description
SCSI ID: x	x is the SCSI address of the autoloader. The message is displayed for 2 seconds following the product identifier message.
Select Tape	This is displayed when the Select button is pressed and for a short time after the button is released.
Stray Tape: Insert Empty Mag	A cartridge is present in the drive mechanism, but there is no magazine present. To retrieve the cartridge, insert an empty magazine.

Error Messages

Error messages displayed by the LCD are group according to the indication of the Operator Attention Required (OAR) LED (Figure 2-1 on page 6):

- OAR off
- OAR flashing
- OAR on steady

If the OAR LED is lit when an error message is displayed, either a fault has been detected with the autoloader mechanism, or there is a possibility that data may be lost.

Here are some of the possible error messages that might be displayed by the DDS-3 autoloader, together with their meaning and suggested course of action. Messages that are longer than ten characters scroll across the LCD.

Operator Attention Required LED Off

Table 3-4 Error Messages (OAR LED Off)

Message	Description	Action
At BOD	A <code>SPACE</code> command encountered BOD (Beginning of Data) unexpectedly. The tape is now positioned at BOD.	None
At EOD	A <code>READ</code> or <code>SPACE</code> command encountered the EOD (End of Data) area unexpectedly. The tape is now positioned at EOD.	None
Media Removal Prevented	An eject command has been attempted when Media Removal Prevention is in force.	Try again when the Media Removal Prevention has been removed (either perform a SCSI reset, or the host must send an <code>ENABLE MEDIA REMOVAL</code> command).
Partition 1 too large	A command to format the tape has failed because the requested partition 1 size is too large.	Try again with a smaller Partition 1 (controlled through the <code>MODE SELECT</code> command), or a longer tape.
SCSI Error: Check Interface	A SCSI command error has been detected.	Check the SCSI connection and try again.
Tape has DC data: Enable DC	A <code>READ</code> command has encountered compressed data on the tape, and the drive is not currently configured to decompress data. The host may have disabled data compression, or configuration switch 2 is off so that the host is unable to control the drive's response to compressed data.	Check that the host has not disabled data compression. Make sure that option switch 2 is on (the option switches are on the underside of the autoloader—see Table 1-1 on page 2).
Tape Full	A <code>READ</code> , <code>SPACE</code> , <code>WRITE</code> or <code>WRITE FILEMARKS</code> command encountered EOP (End of Partition) unexpectedly.	The required data may be on the next cartridge. Try loading it.

Operator Attention Required LED Flashing Amber

Table 3-5 Error Messages (OAR LED Flashing)

Message	Description	Action
Bad Media: Use New tape	A READ or SPACE command has failed because the tape is not in DDS format.	Use a DDS-certified tape.
Cannot write Non-MRS Tape (<i>flashing</i>)	A WRITE, WRITE FILEMARK or ERASE command has been attempted on a non-MRS tape.	Remove the tape and replace it with an MRS tape.
Clean Me	A high error rate has been detected during reading or writing.	Insert a cleaning cartridge to clean the tape heads—see “Head Cleaning” on page 15.
Close Door	The front panel door is open. Any autoloader motion will be delayed until, the door is closed.	Close the front panel door.
Eject Fail: Try Forced Eject	An eject command has failed.	Use a new cartridge, or try forcing ejection (see “Forcing Ejection” on page 14). When you have retrieved the magazine or cartridge, check that any labels are correctly and firmly attached to avoid future failures.
Error x	The mechanism has jammed.	Try forcing ejection (see “Forcing Ejection” on page 14.). Try power-cycling the autoloader. If the problem persists, call for Service and tell them the value of x. Instructions for removing a jammed magazine or cartridge in an emergency are given under. When you have retrieved the magazine or cartridge, check that any labels are correctly and firmly attached to avoid future jams.
ForceEject	Forced ejection is in progress.	Allow the 35 seconds to elapse, when ejection should occur. See “Forcing Ejection” on page 14.
FW DataErr	The autoloader has failed to upgrade the drive firmware, because the new firmware is corrupt.	Obtain a good copy of the firmware upgrade.

Table 3-5 Error Messages (OAR LED Flashing) (Continued)

Message	Description	Action
FW Read Fail: Try Again	A firmware upgrade failed because of an error in reading data from the tape.	Clean the tape heads and try again. If it still fails, call for Service.
FW Tape Write Protected	A firmware upgrade failed because the tape is write-protected.	Change the write-protect switch on the tape and try again.
FW Write Fail: Try Again	A firmware upgrade failed because of an error in writing a modified upgrade count to the tape.	Clean the tape heads and try again. If it still fails, call for Service.
Illegal FW	The autoloader has failed to upgrade the drive firmware, because the new firmware is incompatible.	Obtain a correct version of the firmware upgrade.
Illegal HW	The autoloader has failed to upgrade the drive firmware, because the new firmware is incompatible with the hardware.	Obtain a correct version of the firmware upgrade.
Load Fail: Press Eject <i>or</i> Load Fail: Try New Tape	A load command has failed, or a load or change partitions command has failed to read the System area of the tape.	Try again with a new cartridge, or eject the magazine.
No EODmark (<i>flashing</i>)	A READ command has encountered blank tape, that is, no DDS-format EOD (End of Data) pattern has been recognized.	This is probably a result of a power-fail while writing to tape.
Read Fail	A read has failed.	Clean the tape heads and try again.
Tape Fault: Try New tape	The cartridge in the drive is faulty, possibly because the tape has snapped, or the cartridge has an invalid pattern of identification holes.	Use a new cartridge.
Tape Position Lost: Clean and Retry	A WRITE, READ, SPACE or REWIND command has failed to complete. The tape is positioned on the far side of the bad data.	Clean the tape heads and try again.
Tape Stuck: Try Forced Eject	The cartridge is stuck in the drive.	Try forcing ejection. See "Forcing Ejection" on page 14. If this fails, call for Service.
UpgradeErr	The autoloader has failed to download an upgrade of the firmware through SCSI.	Check the SCSI connection and try again.

Table 3-5 Error Messages (OAR LED Flashing) (Continued)

Message	Description	Action
Worn Media	A high error rate has been detected during writing, suggesting that the tape is nearing the end of its useful life.	Clean the tape heads and replace the cartridge with a new one.
Write Fail: Clean <i>or</i> Write Fail: Use New tape	A WRITE, WRITE FILEMARK or ERASE command has failed.	Clean the tape heads. Use a new cartridge.
Write Protected Tape (<i>flashing</i>)	A WRITE, WRITE FILEMARK or ERASE command has been attempted on a write-protected tape.	Remove the tape and change it to write-enabled.

The Operator Attention Required Light Steady Amber

Table 3-6 Error Messages (OAR LED Steady)

Message	Description	Action
Drive Comms Error	The autoloader has detected that the drive has stopped communicating with the changer mechanism.	Call for Service.
FRU 1 Dead	The controller board for the embedded drive has failed its self-test.	Call for Service.
FRU 2 Dead	The embedded drive mechanism has failed its self-test.	Call for Service.

Modifying Configuration Files

Depending upon the operating system you have, follow the appropriate procedures.

SunOS 5.x Operating Environments

For optimum performance on systems running SunOS releases 5.4, 5.5 and 5.5.1, you must modify the `st.conf` file.

Read this entire procedure before editing the `st.conf` file.

Note – The syntax is critical. Verify the placement of commas, semicolons, and beginning and ending quotation marks. Some numerical fields are preceded by `0x`.

- 1. Become superuser and make a copy of the original `st.conf` file/`kernel/drv/st.conf` as a backup (`st.conf.old`).**

```
%su
Password:

#cp /kernel/drv/st.conf st.conf.old
```

2. Edit the st.conf file.

Using an editor, scroll through the st.conf file to the following line:

```
#tape-config-list=
```

a. Delete the # character that begins the line, if it hasn't already been removed. (# = comment line).

b. Using the editor, continue to scroll until you come to the following line entry:

```
# "HP      C1553A",      "HP C1553A 4mm DAT",      "HP_DAT",
```

c. On the next lines, add the following entry exactly as shown:

```
"HP      C1557A",      "HP DDS-3 4mm DAT loader",      "HP_DAT",  
"HP      C1537A",      "HP DDS-3 4mm DAT",      "HP_DAT";
```

Note – Do not use a # character at the beginning of the line just added. The # character is used to comment-out a specific line entry.

Note – If multiple devices are enabled (lines uncommented) only the last uncommented line with this format needs to end with a semi-colon. All previous lines with this format *must* end with a comma.

d. Using the editor, continue to scroll until you come to the following line entry:

```
#HP_DAT      =      1,0x34,0,0x19679,1,0x0,0;
```

e. On the next line, add the following entry exactly as shown:

```
HP_DAT =      1,0x34,0,0x9639,4,0x00,0x8c,0x8c,0x8c,1;
```

Note – Do not begin these lines with a # character.

Note – This should be the last line entry and *must* end with a semi-colon.

f. **Save the file as** `st.conf`.

3. Halt the system following the normal procedure.

4. Reboot the system with the `-r` option to recognize the drive:

```
OK boot -r
```

Watch the boot messages for any indications of problems with the `st.conf` entry.

Note any indicated line numbers. If any error messages occur, edit the `st.conf` file again and then reboot.

5. Install a tape cartridge in the tape drive and allow the drive to fully load the cartridge.

6. Verify that the `st.conf` entry is correct.

```
%mt -f /dev/rmt/0 status
```

You may need to replace the 0 with 1, 2, and so on, until you find the number that the system has identified for this drive.

- DAT tape drive indicates that the autoloader that is correctly recognized.
- The specific Sense Key returned is usually not an issue.
- No Additional Sense indicates that there are no error conditions.
- Unit Attention indicates that the drive has just been powered on or that a tape has just been inserted.

Undesired Responses from the Drive

- SCSI tape drive indicates the `st.conf` entry is incorrect. You must edit the `st.conf` file and reboot until you no longer see SCSI Tape Drive.
- No tape loaded or drive offline indicates there is no cartridge in the drive or that the cartridge is not yet loaded. Install a cartridge or wait for the cartridge load to complete and retry the `mt status` command.
- No such file or directory indicates there is no tape drive attached to that `rmt` (remote) number. Try another `rmt` number.

Other Sources of Information

Check the man pages for additional information on software commands. The man page for the `mt` command lists numerous helpful commands. This is accessed by typing `man mt`.

SunOS 4.1.4 Operating Environments

In order to correctly use this autoloader with the SunOS 4.1.4 operating environment, you must perform the following procedure to edit configuration files and make a new kernel.

Note – The only SunOS 4.x operating environment supported by this tape drive is SunOS 4.1.4 (Solaris 1.1.2).

- 1. Become superuser by typing `su` and pressing Return.**
The system responds with a request for your superuser password.
- 2. Type your superuser password and press Return.**
The root prompt (`#`) is displayed.

```
Isis% su
Password: Type the superuser password
#
```

3. Change directories to the device configuration directory.

```
# cd /usr/kvm/sys/scsi/targets
```

4. Change the permissions to allow editing of the `st_conf.c` and `stdef.h` files.

```
# chmod +w st_conf.c stdef.h
```

5. Edit the `st_conf.c` file in the following manner.

Use vi or any other text editor to edit the file.

- a. Find the group of lines starting with `/* Archive Python 4mm 2GB drive */`.

b. Scroll down to the end of the group (signified by a },) and add the following line:

```
{
```

On the next line, add the following entry exactly as shown:

```
/* HP DDS-3 4mm drive */
```

On the next line, add the following entry exactly as shown:

```
"HP DDS-3 4mm DAT", 2, "HP", ST_TYPE_HP DAT, 1024,
```

On the next line, add the following entry exactly as shown:

```
(ST_VARIABLE | ST_BSF | ST_BSR | ST_LONG_ERASE),
```

On the next line, add the following entry exactly as shown:

```
6000, 6000,
```

On the next line, add the following entry exactly as shown:

```
{ 0x00, 0x8C, 0x8C, 0x8C },
```

On the next line, add the following entry exactly as shown:

```
{ 0, 0, 0, 0 }
```

On the next line, add the following entry exactly as shown:

```
},
```

6. **Save your changes and exit the editor.**
7. **Edit the `stdef.h` file in the following manner.**
Use vi or any other text editor to edit the file.
 - a. **Scroll down to the following line:**

```
#define ST_TYPE_HP                0x23    /* HP */
```

On the next line, add the following entry exactly as shown:

```
define ST_TYPE_HPDAT            0x34 /* HP DDS-3 DAT*/
```

8. **Save your changes and exit the editor.**
9. **Rebuild the kernel according to the instructions in the `/usr/kvm/sys/`/usr/bin/arch -k`/conf/README` file.**
10. **Reboot your system in order to use the new kernel.**
 - a. **Type** `sync`.
 - b. **Type** `sync`.
 - c. **Type** `reboot`.

Drive Specifications



Tables B-1 through B-6 give the specifications for the DDS-3 autoloader.

Tape Formats and Capacities

Table B-1 Tape Formats and Capacities (Six Tape Cartridges)

Format	Length	Native Capacity	Compressed Capacity¹
DDS-1	60m	7.80 Gbytes	15.6 Gbytes
DDS-DC	90m	12.0 Gbytes	24.0 Gbytes
DDS-2	120m	24.0 Gbytes	48.0 Gbytes
DDS-3	125m	72.0 Gbytes	144.0 Gbytes

1. Assumes a typical compression ratio of 2:1. The compression ratio will vary depending upon the type of data being compressed.

Physical

Table B-2 Physical Specifications

Form Factor	Width	Depth	Height	Weight¹
5.25 inches	5.75 inches	8.0 inches	3.25 inches	4.8 pounds
133.35 mm	146.1 mm	203.2 mm	8.26 mm	2.2 kg

1. With no cartridge or magazine.

Mechanical

Table B-3 Mechanical Specifications

Specification	Value
Load mechanism	reels raised
Tension control	firmware
Independent reel motor control	Yes
Number of tape guides	8
Normal tape speed	0.4 ips (10.4 mm/s)
Fast-search tape speed (<i>multiple of normal speed</i>)	100x (DDS-3)
Drum speed (<i>reading and writing</i>)	3825 rpm (DDS-3)

Electrical

Table B-4 Electrical Specifications

Specification	5V (5%)	12V (10%)
Power on, idle	0.92A	0.04A
Loading or swapping a cartridge	0.88A	1.00A
Writing to cartridge	1.34A	0.06A
Reading from cartridge	1.32A	0.04A
Ejecting magazine	0.95A	0.23A

Interface and Performance

Table B-5 Interface and Performance Specifications

Specification	Value
Buffer size	2 MB
Transfer Rates (<i>maximum using DDS-3 tape cartridges</i>)	
Sustained, native:	1 MB/s
Burst, asynchronous:	3 MB/s
Burst, synchronous:	10MB/s
Mean reposition time	<2.5s
Mean time to fast-search (<i>using DDS-3 tape cartridges</i>)	40s
Power-on self-test time	
Average load times:	
Cartridge into the embedded drive	14s
Swap cartridge between magazine and the drive	15s
Minimum SCSI transfer size to guarantee streaming	6 Kbytes

Quality*Table B-6* Quality Specifications

Specification	Value
Specified MTBF (<i>at 18% duty cycle</i>)	>55,000 hrs
Drive life (tape-pulling hours)	6000
Changer life (<i>cartridge swaps</i>)	>100,000
Uncorrectable error rate	<1 in 10 ¹⁵

Glossary

ANSI

American National Standards Institute, which sets standards for SCSI and the safety of electrical devices, amongst other things.

asynchronous

See data transfer.

autoload

When a tape cartridge is inserted, a tape drive with autoload will automatically load it without the host having to send a load command. If a drive does not have autoload, the drive will take no action until it receives a load command from the host computer.

autoloader

A device embodying a tape drive and a cartridge changer mechanism, housed in a single case.

block

A logical unit of information. Called “record” in the DDS-format specification.

BOM

Beginning Of Media. The first point on the tape that can be accessed by the drive.

BOP

Beginning Of Partition. The position at the beginning of the permissible recording region of a partition.

C3 ECC

A third level of error correction code covered by the DDS format. C3 allows any two tracks in a group to be corrected, and is used only when a raw data error is too big to be corrected by C1 and C2. C3 code is stored in an extra frame at the end of the twenty-two frames of data in each group.

changer

A mechanism within an autoloader for moving tape cartridges from the magazine into the tape drive, and back again. See also random mode, stacker mode.

checksum

The sum of a series of bytes written to the tape, which can be checked against the sum of the same series of bytes when the tape is read.

compression

A procedure in which data is transformed by the removal of redundant information in order to reduce the number of bits required to represent the data. This is done by representing strings of bytes with codewords.

DAT

Digital Audio Tape.

data randomizer

See randomizing.

data transfer phase

On a SCSI bus, devices put in requests to be able to transfer information. Once a device is granted its request, it and the target to which it wants to send information can transfer the data using one of three protocols (assuming both devices support them): asynchronous, synchronous, and wide.

In *asynchronous* transfers, the target controls the flow of data. The initiator can only send data when the target has acknowledged receipt of the previous packet. All SCSI devices must support asynchronous transfer.

In *synchronous* data transfer, the initiator and target work in synchronization, allowing transmission of a packet of data to start before acknowledgment of the previous transmission.

In *wide* data transfer, two bytes are transferred at the same time instead of a single byte.

The DDS-3 autoloader supports asynchronous, synchronous and 8-bit wide transfers.

DDS

Digital Data Storage is a recording format that builds on the DAT format to support the storage of computer data. It was developed originally by Hewlett-Packard and Sony as an industry standard. The first generation standard was DDS-1 (or simply DDS), to which was added data compression to produce the DDS-DC standard.

Further enhancements, notably narrower tracks and thinner tape, led to DDS-2, which can typically provide double the capacity of DDS-1.

DDS-3 uses a new magnetic coating on the tape that allows twice the recording density. Together with the use of time-tracking, this gives a DDS-3 tape approximately three times the capacity of a DDS-2 tape.

differential

See single-ended.

ECC

Error Correction Code. See C3 ECC.

ECMA

European Computer Manufacturers Association

EOD

End Of Data. The end of valid data in a partition on a tape.

fast-searching

The process of reading just the Sub-Code areas to locate an item on the tape at a speed significantly faster (90 to 175 times) than normal read speed.

filemark

A mark written by the host. It does not necessarily separate files. It is up to the host to assign a meaning to the mark.

forced ejection

In an emergency, you can force the drive to eject a cartridge. In doing so, data will probably be lost, and the tape may become unusable, so *be very cautious about using this emergency procedure*. To force the ejection of a cartridge, press the Unload button three times within a 5-minute period, or hold it down for at least 5 seconds.

FRU

Field replaceable unit, an assembly or group of components that is replaced in its entirety by Service Engineers when it contains a fault.

host	The host computer system acting as controller for the drive.
load	The process in which the drive takes in an inserted cartridge and goes online.
magazine	A holder for up to six tape cartridges used in the DDS-3 autoloader.
Media Recognition System (MRS)	A method by which a drive can recognize data-grade tape. The tape has a series of stripes on its transparent leader tape that the drive can detect.
offline	The drive is offline if the tape is currently unloaded or not in the drive. The host has limited access, and cannot perform any commands that would cause tape motion. The host can, however, load a tape if one is inserted, and can execute any diagnostic tests that do not require tape motion.
online	The drive is online when a tape is loaded. The host has access to all command operations, including those that access the tape, set configurations and run diagnostic tests.
partition	A part of a tape that can be treated as a complete and independent whole. A tape can have one or two partitions.
PRML	Partial Response Maximum Likelihood—a method of recovering data from a signal that can cope with the higher density of data used by the DDS-3 format (a linear density of 122,000 bits per inch, which is twice that of DDS-1 and DDS-2). The technique not only identifies data bits more accurately, but by scanning the bits surrounding a bit being read, it can deduce the correct value for dubious bits.
randomizing	A recoding of data symbols before they are written to tape in order to provide a consistently high RF envelope level. An inconsistent RF envelope is one of the criteria for rewriting a frame on read-after-write.

read-after-write (RAW)

Read-after-write improves data integrity by reading data immediately after it is written and writing the frame again if an error is found. The Audio DAT two-head drum is replaced by a four-head drum for this, with two read-only heads and two write-only heads. Frames are only re-written as necessary, so speed and capacity are affected minimally. RAW is included in the DDS format.

SCSI

Small Computer System Interface—a standard command specification and command set that enables computers and peripherals to communicate with each other.

sense data

Data returned after the execution of a SCSI command, telling the host whether the transaction was successful, and if not, what went wrong.

sequential access

Sequential Access devices store data sequentially in the order in which it is received. Tape devices are the most common sequential access devices. Devices such as disk drives are Direct Access devices, where data is stored in blocks, not necessarily sequentially. Direct Access allows for speed of retrieval, but at a price.

setmark

A special recorded element within a partition to which the drive can fast-search without having to know the number of records or filemarks that precede the setmark.

single-ended

SCSI devices can be single-ended or differential. *Single-ended* devices transmit signals by setting a line in the cable to a pattern of high and low voltages in relation to a ground line. *Differential* devices send signals by swapping over high and low states between two lines. This is more expensive to implement, but reduces interference and allows longer cable lengths. The DDS-3 autoloader only supports single-ended SCSI.

Note: Single-ended and differential devices must not be mixed on one SCSI bus.

stabilizing

Leaving a cartridge for a period of time in the room in which it is to be used in order to avoid condensation problems caused by changes in humidity and temperature. A period of two hours is recommended.

system area

A section in the Lead-in Area at the beginning of a partition used to store the tape usage information.

Tape log

The Tape log contains details of the history of a tape, the total number of groups written, of RAW retries, of groups read, of C3 ECC retries, and of loads. The log is copied into RAM when the tape is loaded into the drive, updated as the tape is used, and loaded back into the System area on the tape when it is unloaded.

Tape Alert

The TapeAlert log holds a set of flags that indicate faults with the drive or tape. For example, the Not Data Grade flag is set to indicate that the drive has detected that a tape that is not Media Recognition System is loaded. By reading this log, host software or the operating system can inform users of existing or impending conditions and can give advice. For example, the software might recommend that you use a new tape or clean the heads.

termination

A SCSI bus (or cable) can have many devices plugged into it, but the end of the cable furthest from the host computer must always be *terminated* to avoid signals being reflected back and interfering with other signals. The terminator both absorbs signals and provides power to the lines in the cable. For this reason, it must itself be provided with power.

Terminators can be of two types, active and passive. Active termination is recommended for a bus that has the tape drive on it, because although more expensive, it ensures better and more secure performance.

time-tracking

A technique of ensuring that the read head stays in the center of the track that it is reading. The drive measures the time it takes to reach a particular point on the track, and if this time is less than or greater than its expected value, the drive adjusts the tape speed to compensate.

The rate at which data is transferred from one device to another, for example from the host computer to the tape drive during backup.

vendor-unique

The addition of commands to SCSI that are not included in the standard.

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