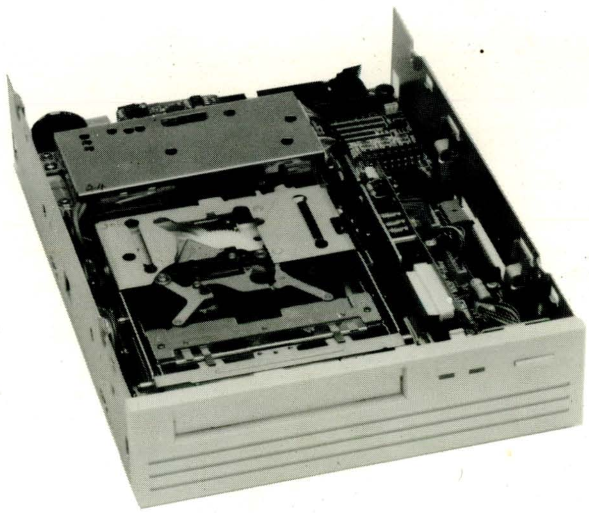
Python™

DDS DAT TAPE DRIVE

Models: 4520NT and 4521NT (5.25-Inch, Half-High Internal)

PRODUCT DESCRIPTION MANUAL



November 1990

Python™
Family of DAT Products from Archive Corporation

ARCHIVE® CORPORATION

PYTHON™
MODELS 4520NT AND 4521NT

DDS DAT 5.25-Inch Internal, Half-High Tape Drive

PRODUCT DESCRIPTION

November 1990

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REVISION RECORD

DATE	REV	REVISED PAGES
11/90	-003	i-vi, 1, 4-5, 10, 13, 16, 21, 27, 29-48, 57-59, 62

Manual Part Number 25354-003

Product features and specifications described in this manual are subject to change without notice.

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PREFACE

Archive Python™ Digital Audio Tape (DAT) 4520NT and 4521NT products are 5.25-inch, half-high, internal tape drives with an embedded small computer system interface (SCSI) controller. (The Python Model 4520NT provides a single-ended SCSI connection; the 4521NT provides a differential interface.) Designed to use the Digital Data Storage (DDS) tape format, the Python 452X tape drives store up to 1.3 gigabytes (GB) (60 meter tape) or 2.0 gigabytes (90 meter tape) of data on a 4-mm DAT cassette. For archival and secondary storage applications, these computer-DAT drives offer cost-effective performance and reliability characteristics previously unavailable in the computer industry.

This document gives you an in-depth look at the Python 452X drives. It is intended for those familiar with tape drive technology or who are evaluating DAT tape drives for integration into their products. The following paragraphs briefly outline this document:

Chapter 1, Introduction, contains a general description of the features of the Model 452X. It also provides an overview of the DAT technology and the helical scan method of recording.

Chapter 2, Technical Specifications, lists the various operational, physical and environmental specifications of the drive.

Chapter 3, Functional Description, explains helical scan recording, tape drive functions, cassette/tape characteristics, error management capabilities, and operations.

Chapter 4, Interface Specifications, briefly discusses the SCSI interface and gives pin assignments.

Chapter 5, Maintenance and Reliability, describes tape drive maintenance and reliability specifications.

The Appendices provide lists of additional information about the tape cassette and relating information sources plus commonly used abbreviations.

CHAPTER 1
INTRODUCTION

Introduction

The Archive Python 4520NT/4521NT products are a new class of computer peripherals using digital audio tape (DAT) technology. These computer DAT drives offer cost-effective performance, capacity, and reliability characteristics not previously available. The Python 4520NT/4521NT products are specifically designed as 5.25-inch, half-high, internal digital data storage tape drives with an embedded SCSI controller for high performance computer environments.

> **NOTE:** *The Python 4520NT model provides a single-ended SCSI interface. The Python 4521NT model provides the SCSI interface with a differential connection. Both models offer the same SCSI interface features except for the connection method. Throughout this manual, Python 452X refers to both models.*

Characterized by high capacity and high performance -- 1.3 gigabytes (GB) (60 meter tape) or 2.0 GB (90 meter tape) of storage with a transfer rate of 183 kilobytes/second (KB/sec) and an average random access speed of 20 seconds to any file on a 60 meter tape -- the Python 452X drives also provide unmatched reliability through three levels of error correction code (ECC) and its four-head design, which allows read-after-write (RAW) error detection and correction. The American National Standards Institute (ANSI) Digital Data Storage (DDS) format ensures interchange compatibility of digital data stored on a small (approximately 2 inches x 3 inches x 0.4 inch) removable DAT cassette using 4-mm tape.

The Python 452X computer DAT drives are a natural solution for PCs, workstations, and minicomputer systems in standalone, network, and multiuser configurations for applications such as fixed-disk backup; software distribution; archival storage; data interchange between systems; and direct-access secondary storage for text and graphics data of all types.

Built using long-wearing materials and custom large scale integration (LSI) components, the 452X's 3.5-inch DAT drive mechanism was engineered for heavy-duty computer applications. Providing carefully controlled tape handling and smooth, rapid operation, the Python design promotes long life for such key components as the rotating DAT drum, heads, and the media itself. One major benefit of this new, computer grade engineering is low power consumption -- typically below 9.5 Watts for the 452X drive.

The 5.25-inch half-high form factor is tailored for easy installation in today's computers, and the embedded LSI Small Computer System Interface (SCSI) controller facilitates easy integration into a variety of systems. Switch selectable for SCSI-1 or SCSI-2, the Python 452X products provide synchronous or asynchronous SCSI and handle a high speed burst rate of 5 MB/sec with a standard 512-KB data buffer (1-megabyte buffer model optional).

Another important feature is the onboard serial port that provides the capability for extensive testing of the Python 452X drive.

In addition to the Python 452X products, Archive also offers two external DAT drives: the Python 4330XT for the single-ended SCSI interface and Python 4331XT for the differential SCSI interface connection. The external subsystems include a built-in, worldwide power supply.

Figure 1 shows the Python 452X internal computer DAT drive.

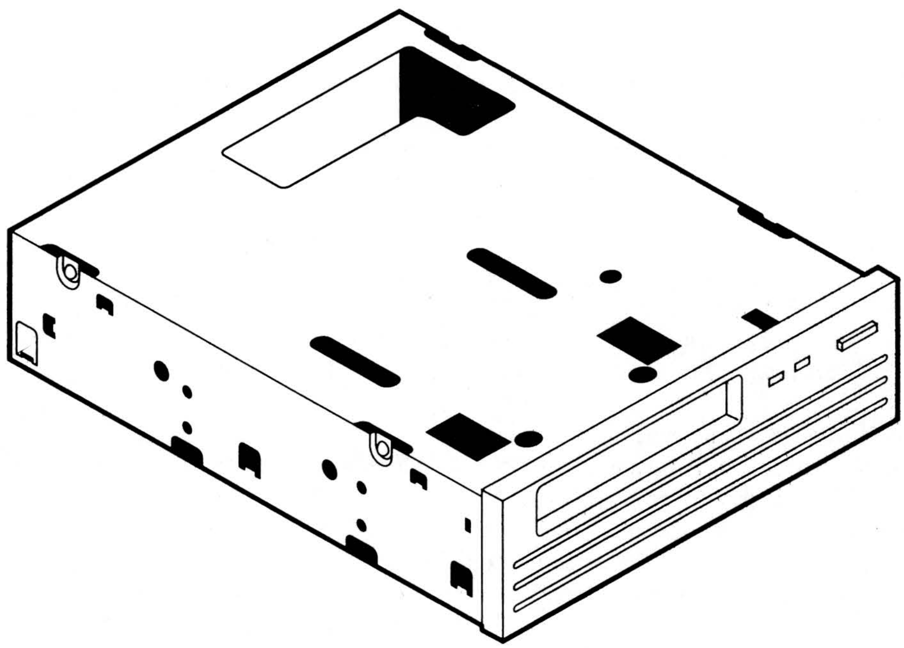

Figure 1
Python 452X Computer DAT Drive

Python Model Numbers

The six-position model numbers assigned by Archive to Python drives denote specific information as follows:

1	2	3	4	5	6
—	—	—	—	—	—

Position 1 shows the tape drive type. This character is always 4 for Archive DAT products, which refers to the 4-millimeter tape size.

Position 2 shows the form factor. This character is either a 5, which refers to the 5.25-inch internal form factor, or a 3, which refers to either the 3.5-inch internal form factor or an external Python subsystem, which (like all Archive Python drives) uses a 3.5-inch internal mechanism.

Position 3 is a marketing option.

Position 4 shows whether the drive supports a single-ended or differential SCSI interface for SCSI-based Python products. This character is an 0 for single-ended or a 1 for differential. For non-SCSI products, a number other than 0 or 1 is used.

Position 5 shows whether the drive is an internal or external unit. This character is an N for internal or an X for external.

Position 6 shows the interface type. This character is a T for the SCSI-1 or SCSI-2 compatible interface (default setting SCSI-2) or a D for the Basic interface.

Technology Overview

First developed for the audio electronics market, DAT technology is now being applied in computer peripherals. Unlike traditional magnetic tape audio cassette products, DAT technology proves inherently reliable through the *helical scan recording method*, which provides a high recording density with a very low error rate. All DAT products, including computer implementations, use the helical scan recording method. This recording method has been used in professional video tape recorders (VTRs) since 1956 and in home video cassette recorders (VCRs) since 1974. In 1986, DAT products using helical scan technology were first developed for audio applications. DAT consumer products are specifically designed for digital audio recording and playback and are intended to replace such products as analog audio cassette decks and compact disk (CD) players.

Helical Scan Recording

Helical scan recording was originally developed as method of efficiently recording high-quality television signals on a relatively slow moving tape. It requires that both the tape and the recording head move simultaneously. This recording method results in an extremely high recording density, far higher than can be achieved with stationary-head devices such as 1/2-inch open-reel or 1/4-inch cassette tapes. (See Chapter 3, "Helical Scan Recording -- Four-Head Design" for additional information.)

In helical scan recording, both the read and write heads are located on a rapidly rotating cylinder or drum. The cylinder is tilted at an angle in relation to the vertical axis of the tape. As the tape moves horizontally, it wraps around the part of the circumference of the cylinder (90°) so that the head enters at one edge of the tape and exits at the other edge before the tape unwraps.

The horizontal movement of the tape in combination with the angular movement of the cylinder causes the track to be recorded diagonally across the tape rather than straight down its length. The resulting recorded track, nearly one inch, is approximately eight times longer than the width of the tape.

DDS Format

Archive DAT products are designed to use the DDS tape format:

- *Digital Data Storage (DDS)*: This format was codeveloped by Sony Corporation and Hewlett-Packard (with participation from Archive and other members of the DDS Manufacturers Group) to support DAT devices as computer peripherals. The objectives of DDS are to maximize storage capacity and performance; to facilitate data interchange; to provide compatibility with existing tape storage command sets; and to provide extremely fast random access. It also takes advantage of the helical scan recording method and the inherent error correction capability of the DAT technology to augment error detection and correction.

This format consists of a finite sequence of data groups with each data group being a fixed-length recording area. A data group is made up of 22 data frames and 1 ECC frame; each frame is made up of two helical scan tracks. The advantages of the fixed-length data group is that ECC is easily generated, and buffering requirements are simplified. (See Chapter 3, "DDS Format", for additional information.)

Although data groups are fixed-length and always contain 22 data frames, the DDS format is designed such that variable-length computer records can be stored in the fixed-length data groups.

The fast transfer rate of 11 million bytes/minute (183 KB/sec) is a characteristic of the DDS format for computer DAT technology. At this transfer rate, the full 1.3 GB of information can be written in 120 minutes, and a full 2.0 GB of information can be written in 180 minutes. Another important speed consideration is that once the information is written it can be located at up to 200 times the speed at which it was originally written. The resulting average time to randomly access any file on a 60 meter tape is 20 seconds and on a 90 meter tape is 30 seconds.

The combination of DAT technology and the DDS format provides a solid core around which computer DAT drives with exceptional performance and reliability can be designed, as shown by the Python 452X products.

Features

The Python 452X products embody Archive's continued commitment to excellence in engineering reliable and durable tape drive products. Key features of the Python 452X drives are:

- 5.25-inch, half-high form factor for installation in many different types of computers
- High speed random access of 20 seconds (average) to any file on a 60 meter tape; 30 seconds for a 90 meter tape.
- 183 KB/sec transfer rate for fast backups
- High performance burst transfer rate of 5 MB/sec with 512-KB data buffer (1-MB buffer model optional) to facilitate the most efficient use of the host computer
- Four-head design with RAW error detection and rewrites
- Three levels of ECC to ensure data integrity

- Uncorrectable error rate of less than 1 in 10^{15} bits
- ANSI DDS tape format compliance for compatibility and interchange
- Proven 3.5-inch Archive computer grade DAT drive mechanism, which was specifically designed for heavy-duty computer applications
- Custom Archive designed LSI components to reduce the number of components and boost reliability
- Advanced, single-chip, audio formatter LSI
- Low power consumption of less than 9.5 Watts (typical)
- SCSI connection available as single-ended (Python 4520NT) or differential (Python 4521NT) for flexibility in system integration. Both models offer these features:

  -- Embedded full LSI SCSI controller to conserve space while providing maximum interface flexibility

  -- Switch selectable SCSI-1 or SCSI-2 interface (as default setting at power up) for flexibility in system integration

  -- Software selectable synchronous or asynchronous SCSI to meet various needs

  -- Onboard output jack for configuring the SCSI address in an external box

  -- Compatibility with the Archive SCSI Viper quarter-inch cartridge drive.
- Onboard serial port for internal diagnostics
- Automatic power-on self tests (switch option)
- Capstan release on power failure to prevent tape damage
- Manual emergency cassette removal procedures

Capacity, Formats, and Standards

- Provides 1.3 GB data storage capacity on a 60 meter DDS DAT cassette
- Provides 2.0 GB data storage capacity on a 90 meter DDS DAT cassette
- Uses helical scan recording method
- Uses 4-mm "qualified" DAT cassette (Archive-approved data-grade DAT media)
- Designed for ANSI DDS format
- Provides SCSI-1 (ANSI X3.131-1986) or SCSI-2 interface

System Integration

The Python 452X computer DAT drive is designed for quick installation in your computer and easy integration with the host system. Integration of a DAT peripheral into a computer system requires consideration of several points: form factor; interface; data flow between computer and peripheral; recording format; and software integration.

Form Factor

The Python 452X drive is engineered to fit the 5.25-inch half-high front panel specification. This form factor is widely sought in the industry, and numerous systems are designed to fit it. Fitting the drive into the front panel and completing the mounting is a simple procedure. A power connection and SCSI connection are required.

Interface

The interface between the host computer and tape drive is the means of controlling the flow of data between the computer and the peripheral. The Python 452X drives provide an embedded SCSI controller, which is an accepted standard and popular interface in the industry. This versatile standard allows multiple different devices to be attached to a host computer.

Because of its widespread availability and popularity, the Python 452X supports the ANSI X3.131-1986 SCSI-1 standard. It also supports the emerging SCSI-2 standard and is switch-selectable between the two so you can easily select the interface that is compatible with the host system.

The Python 4520NT is the single-ended version of the drive; the Python 4521NT provides a differential connection. The differential model allows a longer cable length (up to 20 meters) so the drive can be located farther from the host computer.

The SCSI interface for the Python 452X drive supports both asynchronous and synchronous communications. The controller automatically senses which protocol is being used.

Another aid to system integration is the built-in TTL serial port that allows an extensive internal diagnostic capability. The appropriate drive connector also allows manufacturing testing.

The Python 452X's 512-KB onboard data buffer (optional 1-MB, not field upgradeable) allows the data to be rapidly stored in the peripheral drive when the computer sends a block of data quickly. The buffer accepts the data at the rate the computer sends it; then the data is written out of the buffer by the drive at a slower rate. Thus, the computer is available for other tasks while the drive writes the data from the buffer to tape.

Recording Format

Compatibility with existing tape storage command sets, performance, and a standardized tape format are important integration and data interchange issues. Because the Digital Data Storage (DDS) format meets those requirements, it is the industry standard for DAT peripherals. The Python 452X products are designed to use the DDS tape format. (Appendix A lists formal documents for the DDS specifications.)

Software

One of the most cost-effective uses of DAT drives is to back up fixed disks. The software required to perform a disk backup runs under the control of the host computer's operating system. Compatibility with a wide range of software is also an important consideration in system integration. The Python 452X computer DAT drive is designed to take advantage of the host computer's standard magnetic tape backup software or, optionally, to use backup software provided by Archive and other suppliers.

The Python 452X drive complies with the QIC-104 standard ensuring compatibility with the Archive Viper and other quarter-inch cartridge software. (Python 452X drives maintain full SCSI-interface compatibility with the Archive Viper SCSI 150-MB quarter-inch cartridge product.) Also, use of variable-length records and the ability to overwrite previously recorded data allow the Python 452X to run software originally written for 1/2-inch reel-to-reel tape backup.

In many cases, the Python 452X drive can function with the host computer's software as a "plug and play" device. Of course, technically proficient OEMs and system integrators can develop custom software to meet their needs.

NOTES

CHAPTER 2
TECHNICAL SPECIFICATIONS

Introduction

The Python 452X computer DAT drive is designed for high performance, quality, and reliability. This chapter lists various technical specifications of the 452X products.

The Python 452X products conform to the *ANSI X3.131-1986 SCSI* standard that governs the host computer interface (common command set). These products comply with the SCSI-2 standard *ANSI SCSI-2 WORKING DRAFT, Revision 10.* (SCSI-2 is switch-selectable for power-up default.)

Designed to use the DDS tape format and qualified data-grade (DDS) DAT cassettes, the Python 452X products comply with the *American National Standard Helical-Scan Digital Computer Tape Cartridge 3.81 mm (0.150 in) for Information Interchange.*

Tape Drive Operational Specifications

FEATURE	SPECIFICATION
Capacity	1.3 gigabytes on a 60 meter DAT cassette 2.0 gigabytes on a 90 meter DAT cassette
Recording Density	61,000 bits/inch
Flux Density	76,250 flux transfers/inch
Track Packing Density	1,869 tracks/inch
Areal Density	114 megabits/square inch
Error Recovery	Read-after-write Reed Solomon ECC (3 levels)
Unrecoverable Errors	Less than 1 in 10^{15} data bits
Tape Drive Type	Computer grade 4DD mechanism
Head Configuration	2 Read heads, 2 Write heads
Recording Format	ANSI Digital Data Storage (DDS)
Recording Media	4-mm DAT tape (recommend qualified media)
Recording Method	Helical scan (R-DAT)
Cassette	2.9 in. x 2.1 in. x 0.4 in.
Tape length:	60 meter (197 ft) (2-hour cassette) 90 meter (295 ft) (3-hour cassette)
Transfer Rate (Sustained)	183 KByte/second maximum
Synchronous Transfer Rate (Burst)	5 MByte/second maximum
Asynchronous Transfer Rate (Burst)	5 MByte/second maximum
Search/Rewind Speed	200 X normal speed
Average Access Time	$<$ 20 sec (60 m tape); $<$ 30 sec (90 m tape)
Drum Rotation Speed	2000 revolutions/minute (RPM)
Tape Speed	0.32 inch/second
Head-to-Tape Speed	123 inch/second

Equipment Dimensions

The following table lists Python 452X drive dimensions and weight.

DIMENSION	MEASUREMENT
Height	41.0 mm (1.6 inches)
Width	146.0 mm (5.7 inches)
Length	203.0 mm (8.0 inches)
Weight	2.5 lbs, 1.2 Kg

Figure 2 illustrates the drive showing its dimensions.

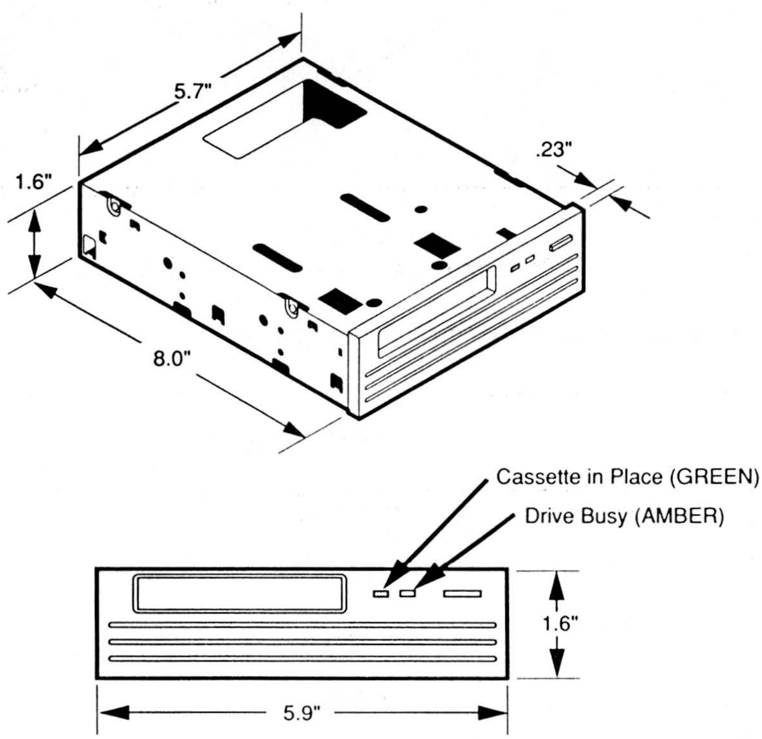

Figure 2
Python 452X Computer DAT Drive Dimensions

Power Requirements

Python 452X drives use standard voltages and power. As illustrated in Figure 3, the DC power connector is located at the rear of the printed circuit board. The connection between the +12 VDC and the +5 VDC returns is made on the tape drive circuit board. The mating connector housing requires four female contacts.

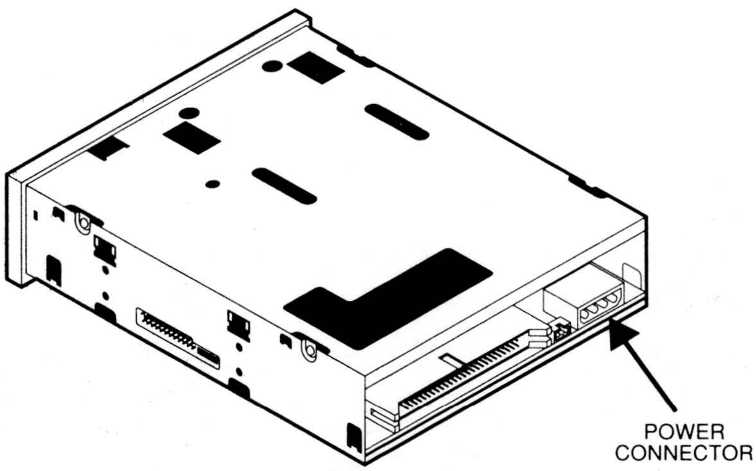

Figure 3
Python 452X Power Connector

The following table lists pin assignments for the power connector:

PIN	ASSIGNMENT
1	+12 VDC
2	+12 return
3	+5 return
4	+5 VDC

Power Specifications

The following table lists the 452X power specifications. Power specifications are measured at the tape drive power connector and are nominal values.

SPECIFICATION	MEASUREMENT	
DC Voltage	+12 VDC	+5 VDC
Voltage Tolerance	+ or - 10%	+ or - 7%
Operational Current, 4520	435 milliamps	650 milliamps
Operational Current, 4521	435 milliamps	1.35 amps
Standby Current	360 milliamps	650 milliamps
Surge (Eject)	1.35 amps	0.71 amps
Power Sequence	None	None
Ripple (peak to peak)	100 mV	100 mV
Power Dissipation, 4520 (Operating)	5.2 Watts (excluding surge)	3.3 Watts (excluding surge)

Environmental Specifications

The following sections describe environmental requirements and specifications for the Python 452X computer DAT drives.

Operating Specifications

The following table lists the operating specifications for Python 452X drives. Temperature is measured 0.5 inches from any drive surface. These specifications apply when a cassette is inserted.

CONDITION	SPECIFICATION
Temperature	+5 to +45 degrees C +41 to +113 degrees F
Relative Humidity	20 to 80% non-condensing (max wet bulb 26° C)
Thermal Gradient	2 degrees C/minute, no condensation
Altitude	-100 to 4,575 meters
Vibration, peak to peak displacement	0.9 mm (1-17 Hz)
Vibration, peak acceleration	0.73 g (17 to 500 Hz) (Sweep rate less than 1 octave/minute)
Acoustic Level, Idling	49 dBA maximum
Acoustic Level, Operational	53 dBa maximum (measured in suitable enclosure at 3-foot distance and operator height)
Attitude	Mounts horizontal (drive top up) or vertical (drive top left or or right)
Shock (1/2 sine wave)	10 g's peak, 11 msec

Non-Operating Specifications

The following table lists the non-operating specifications for Python 452X drives. Temperature is measured 0.5 inches from any drive surface. These specifications apply when the power is off, and no tape cassette is installed.

CONDITION	SPECIFICATION
Temperature	-40 to +65 degrees C -104 to +149 degrees F
Relative Humidity	0 to 90% noncondensing
Thermal Gradient	Below condensation
Altitude	-300 to +15,250 meters
Shock (1/2 sine wave)	50 g's peak, 11 msec
Vibration, peak acceleration	1.5 g (5 to 500 Hz) (Sweep Rate less than 1 Octave/minute)

Regulatory Compliance

The Python 452X computer DAT drives comply with the regulations listed in the following table.

AGENCY	REGULATION
CSA	C22.2, No. 220-M 1986
TUV-RHEINLAND	IEC 950 (EN 60 950)
UL	478
FCC	Class B
VDE	0871, Class B

VDE Compliance Statement

German Statement

Hiermit wird bescheinigt, dass der Archive Python Models 4520NT and 4521NT Ubereinstimmung mit den Bestimmungen der Vfg 1046/1984 funkentstort ist.

Der Deutschen Bundepost wurde das Inverkehrbringen dieses Gerates angezeigt und die Berechtigung zur Uberprufung der Serie aud Einhaltung der Bestimmungen eingeraumt.

Archive Corporation
1650 Sunflower Avenue
Costa Mesa, CA USA 92626

English Translation

We hereby certify that the Archive Python Models 4520NT and 4521NT comply with the RFI suppression requirements of VFG 1046/1984. The German Postal Service was notified that equipment is being marketed. The German Postal Service has the right to retest the equipment and verify compliance.

CHAPTER 3
FUNCTIONAL DESCRIPTION

Introduction

The design of the Python 452X computer DAT drive integrates the DAT technology (helical scan recording method) into a true *computer grade* data storage peripheral.

The Python 452X DAT drives are the result of:

- Combining the economies of scale from the audio electronics market for key components such as the cylinder, heads, and audio LSIs with a computer grade drive (3.5-inch) using four direct drive motors, a "no-mode change" mechanism, and electronic tape path control for the demanding computer storage environment.

- Implementing a four-head design to provide read-after-write (RAW) error correction and to maximize the benefits of the helical scan recording method, namely: (1) high density recording (all tape space is utilized by dense, overlapping tracks at alternating azimuth angles) and (2) high-speed searches.

- Using second generation audio and custom LSIs for efficient circuit layout and increased reliability with low power consumption. These LSIs are quad-flat-pack (QFP) designs using complementary metal-oxide semiconductor (CMOS) technology.

- Implementing the DDS format.

- Implementing a custom ECC C3 coprocessor and other error correction techniques.

- Embedding a full-LSI SCSI controller with capability for SCSI-1 or SCSI-2 command sets in both single-ended and differential SCSI models.

This chapter describes the Python 452X computer DAT drive in more detail and explains implementation specific information.

Block Diagram of the Drive

The electronics of the Python 452X drive are laid out on one main printed circuit board (PCB) and four small PCBs. The four small boards control specific functions:

- o The RF PCB controls the head assembly.
- o The Switch PCB contains the eject switch and the front panel LEDs, and other switches.
- o The Reel Drive PCB provides drivers for the supply-reel, takeup-reel, and mode motors.
- o The Capstan/Cylinder Drive PCB contains the cylinder servo circuits and the cylinder and capstan drivers.

Figure 4 is a simplified block diagram of the Python drive. Figure 5 shows the embedded SCSI controller. Refer to these diagrams as you read the following sections.

Python 452X Computer DAT Drive

The Python 452X computer DAT drive uses the helical scan recording method employing a four-head design. Four direct-drive motors and one brush-type motor are used in the drive. Also, the read and write functions are implemented using LSIs. Engineering decisions such as the modular partitioning of the drive electronics and use of surface mount, low power commercial and custom LSIs allow the Python 452X drives conform to the 5.25 half-high form factor. These design features are also important contributors to the overall reliability, durability, and performance of the drive.

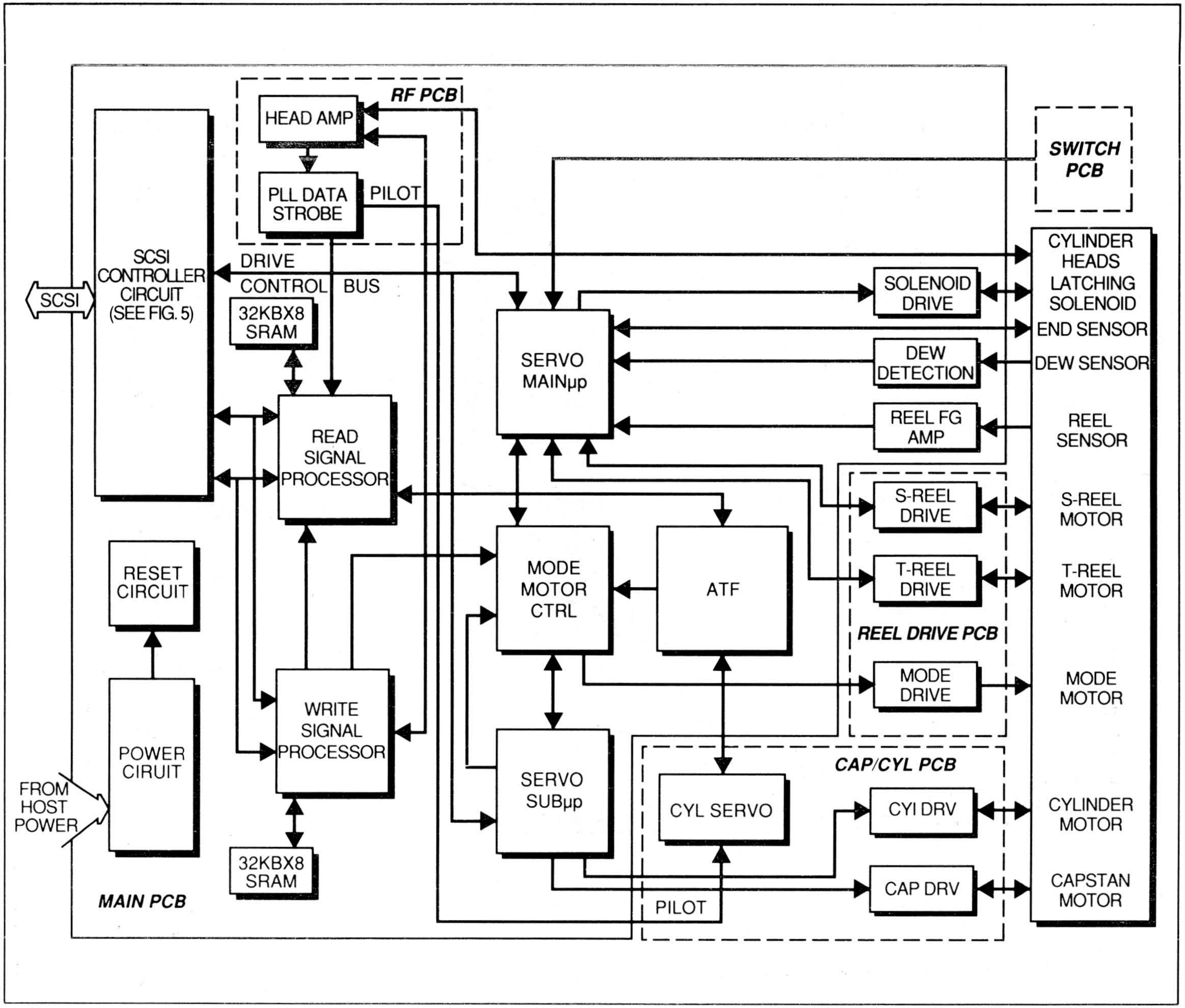

Figure 4
Simplified Block Diagram -- Python 452X.

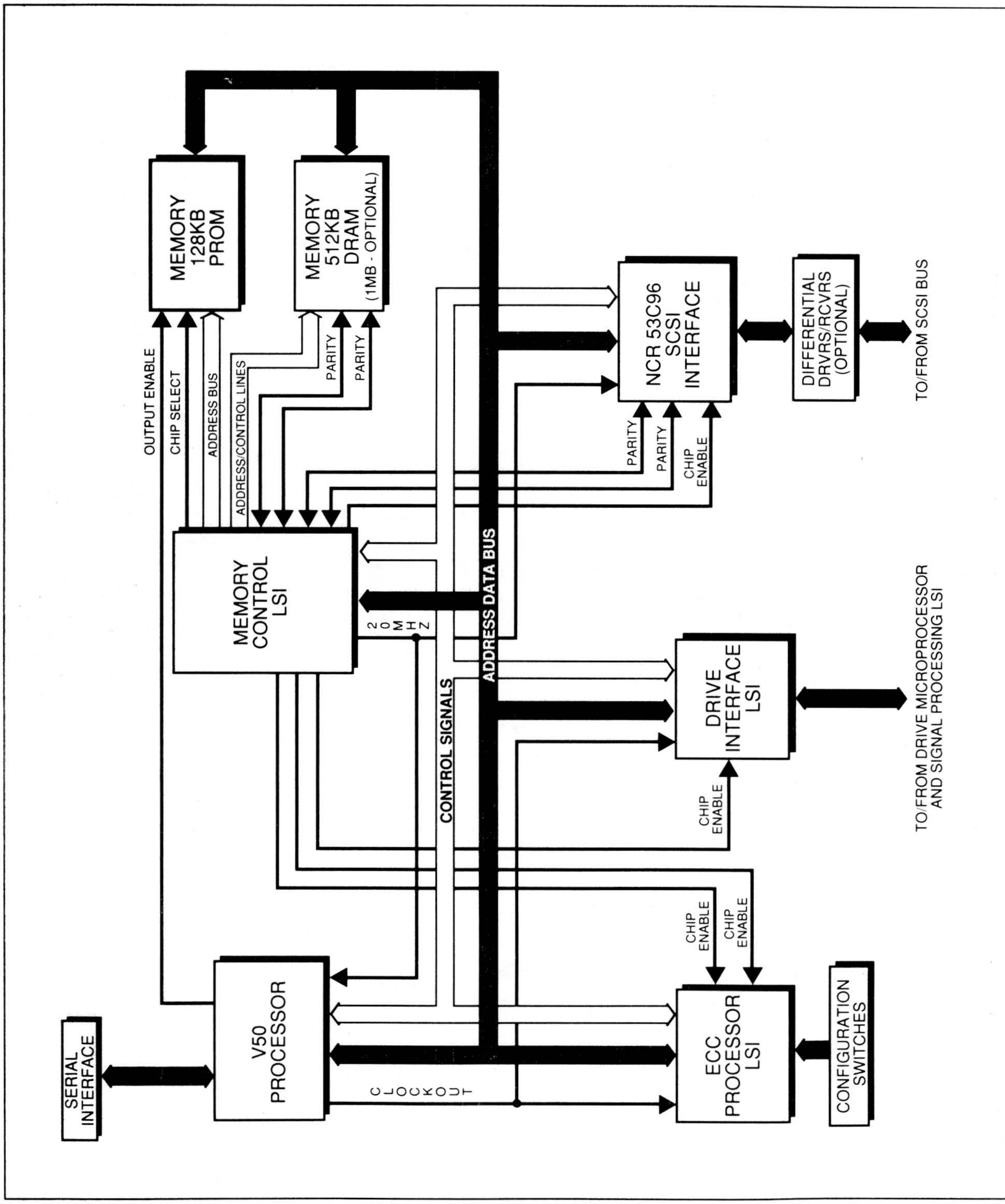

Figure 5
Block Diagram -- SCSI Controller.

Additionally, the mechanism is designed for minimum tape wear and prevention of damage to the tape. The modes or operational states, such as stop, rewind, play, and etc., are specifically implemented to reduce mechanism and tape wear. Fewer mechanical mode changes result in less wear on key drive components. In some cases, the need for a mode change is circumvented using the Pause mode, which stops the tape without activating the mechanism. Figure 6 shows the operational modes in relation to mode changes. All mode selection is performed by the controller firmware. The host computer does not directly control mode selection.

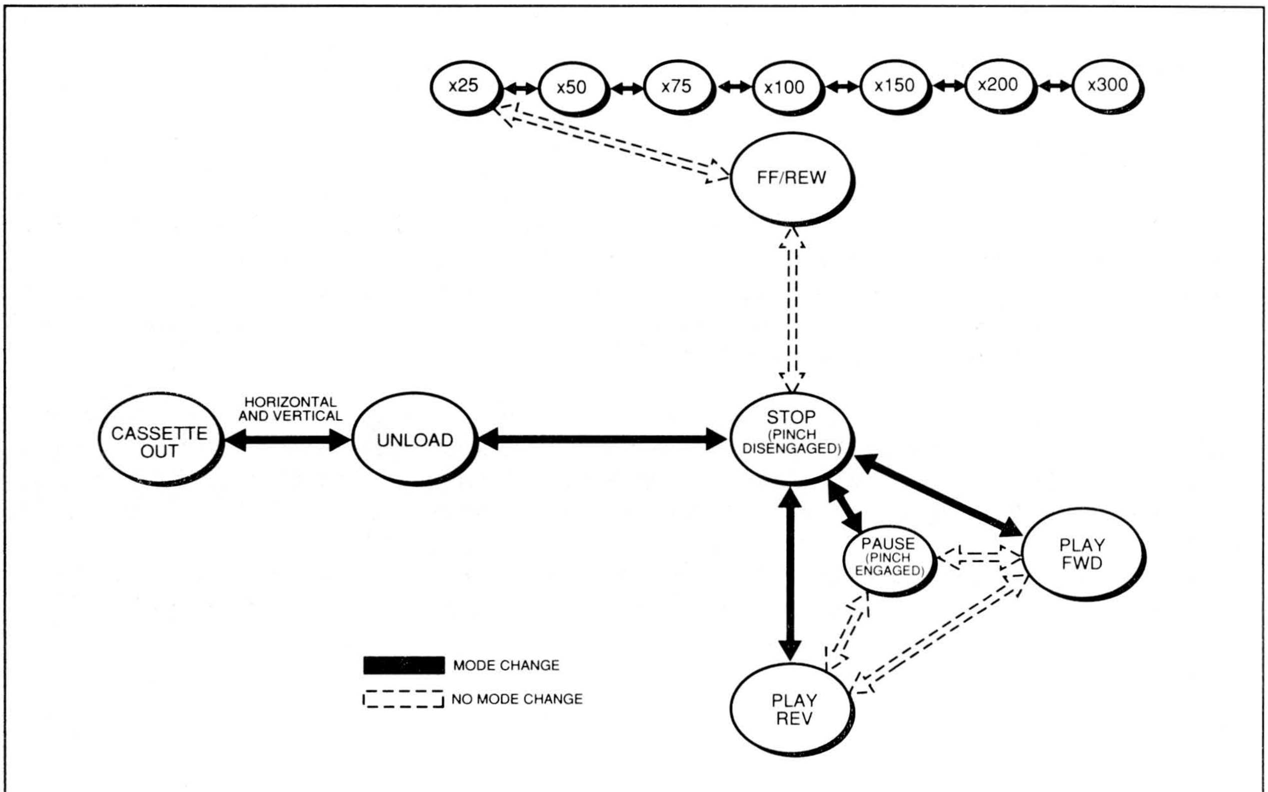

Figure 6
Python State Diagram

The custom automatic track finding (ATF) LSI combined with the four-head design implements the ANSI DDS standard specifications and provides the precision required to perform *seamless appends*, the ability to add information after a stop immediately adjacent to the last data written on the tape, with no significant loss of tape storage capacity.

An accessible switch bank lets you select certain operational options, such as a default at power up of SCSI-1 or SCSI-2 interface, SCSI parity enable, and a power-on diagnostic self-test. A serial port is provided for access to firmware that provides internal drive access. Also, a 6-pin header allows remote SCSI ID selection.

Additionally, an accessible jumper at the rear of the drive allows you to enable terminator power if needed. (The default is with terminator power disabled.)

The drive provides several sensors, both optical and mechanical, to conform to the ANSI Helical Scan Tape Cassette specification; to effectively implement mode changes; and to insert and eject the cassette.

Two front panel light-emitting-diodes (LEDs) indicate drive busy status (amber) and tape cassette in place (green) status. When blinking, these LEDs also funciton as fault indicators. (Also see the table later in this section.)

The general information above is discussed in more detail in the following sections.

Helical Scan Recording -- Four-Head Design

In helical scan recording, the heads are positioned opposite one another on a cylinder, which is tilted approximately 6 degrees from the vertical plane and rotates counterclockwise at 2000 revolutions per minute (rpm). At the same time, the tape moves slowly (0.32 inches per second) in a horizontal path around part of the cylinder. This simultaneous motion of cylinder and tape results in the head traveling across the width of the tape in a helix-shaped motion.

The Python 452X drive is designed with four, long-life ferrite heads -- two read and two write heads. These heads are set opposite one another on the cylinder with a rotation sequence of: write A, read B, write B, read A (or write A new, read B old, write B new, read A old). The advantage of this design is that a RAW check can be performed immediately after the data is written.

The cylinder rotates rapidly (2000 RPM) in the same direction that the tape moves. The wrap angle of the tape on the cylinder is approximately 90 degrees. This wrap angle plus the slow tape speed minimize tape and head wear. The combined movement of the tape and cylinder results in a relative head-tape speed of 123 ips.

Figure 7 illustrates a helix track, the four-head design, and shows the 90 degree wrap angle.

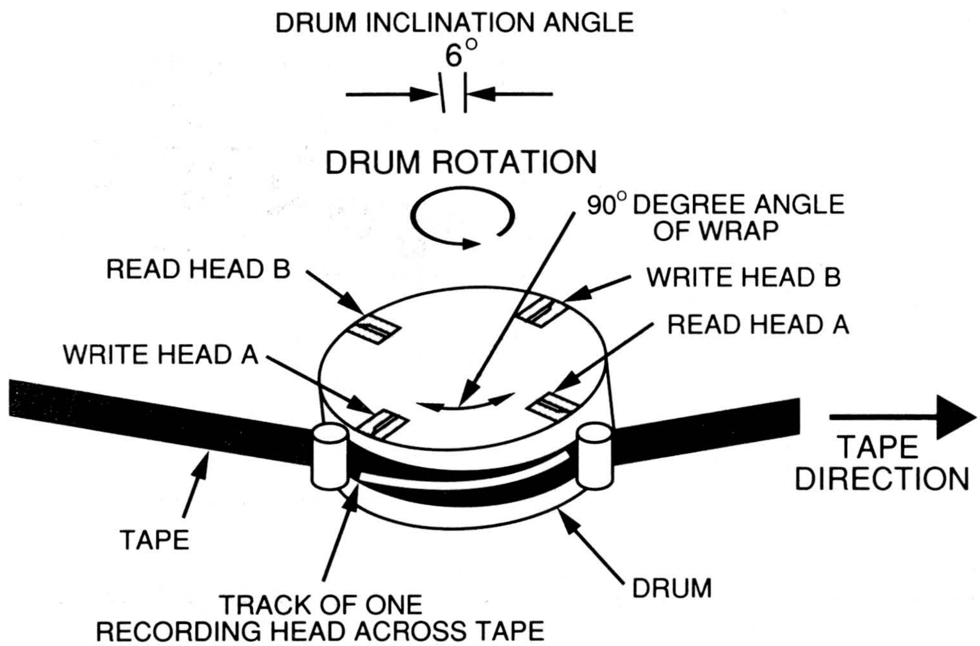

Figure 7
Four-Head Design.

The recorded tracks are written diagonally across the tape from bottom to top by each write head. Because the head is wider than the track written, tracks overlap with no tape space between them. In conventional recording, such overlap or even "close proximity" would result in *crosstalk* (signals from adjacent tracks interfering with signals from another track).

However, in helical scan recording, the heads are set at a different azimuth angles so that alternate tracks on the tape are written at alternate azimuth angles. (See Figure 8.) Because the read head is set to the same angle as its corresponding write head, it picks up a stronger signal from data written in the same azimuth angle as itself. Thus, it reads the track with minimal crosstalk. At the same time, the head is maintained centered in the track by using the ATF reference bursts.

Figure 8 shows alternate tracks and alternate azimuth angles.

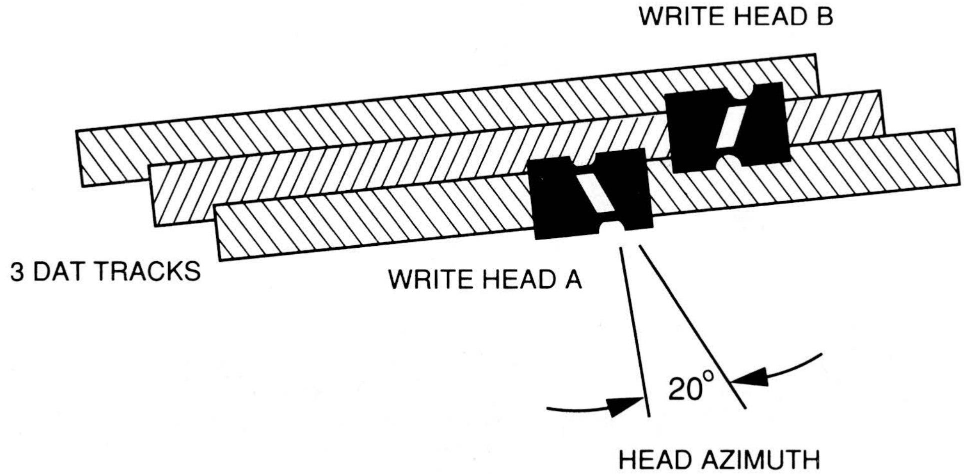

Figure 8
Alternate Azimuth Angles.

Motors and Control Circuits

The Python 452X products use four direct-drive, brushless motors: the capstan, cylinder, and two reel motors. Using these small, direct-drive motors provides maximum reliability. The cylinder motor rotates the cylinder. The capstan motor moves the tape and loads and ejects the cassette. The two reel motors turn the tape reels.

The Cylinder Servo LSI on the Capstan/Cylinder Drive PCB communicates with the ATF LSI, which, in turn, sends servo data to the Servo Sub LSI. The Servo Sub controls the Cylinder and Capstan Drivers. The Supply-Reel and Takeup-Reel motors are controlled by the Servo Main LSI.

The fifth motor in the mechanism is a brush-type mode motor. This motor controls (selects) the mechanism mode. Because the mode motor must is not frequently used, the brush type motor is best suited to this application. The mode motor performs the mode changes as directed; for example, this motor conditions the mechanism to eject the cassette. The motor is controlled by a driver that receives instructions from mode motor controller.

Servo Main Microprocessor and Servo Sub Microprocessor LSIs

Two custom LSIs (84-pin, QFPs) -- the Servo Main Microprocessor and Servo Sub Microprocessor -- provide the processing power for the various motion control circuits within the Python 452X. The Drive Control Bus connects these two LSIs with the SCSI controller circuits. These two microprocessor LSIs control all the drive motors.

Read and Write LSIs

Two single-chip, signal processor and audio DAT-formatter LSIs provide the read and write signals for the drive. Each LSI is supported by a 32-KB X 8 static RAM. These chips are controlled by the controller microprocessor.

ATF Circuitry

The ATF circuitry of the Python 452X drive is designed to provide high precision tracking and head positioning in compliance with the ANSI DDS standard. The main component for ATF is a custom ATF LSI, which, in conjunction with the four-head read-after-write (RAW) design, allows *seamless appends*, also in compliance with the ANSI DDS standard.

A seamless append is the continuation of writing frames on the end-of-media (EOM) side of existing frames (after a STOP) such that the tracks are placed as if they were in a continuous sequence. That is, the servo system must be able to read the appended tracks without encountering discontinuity or gaps between tracks.

Performing a seamless append requires the highest precision and almost absolute accuracy in repositioning the head assembly. In the Python 452X products, this level of precision is attained through the combined accuracy of the mechanical design and the ATF signal information as implemented through custom circuits.

SCSI Controller

The embedded SCSI controller circuitry in the Python 452X drive is made up of several components. The Drive Interface LSI that communicates with the Servo Main Microprocessor, Servo Sub Microprocessor , Read, and Write LSIs is a custom 80-pin, QFP component. The C3 ECC coprocessor and the Memory Control function are also custom designs using CMOS technology. The ECC LSI is an 80-pin QFP; the Memory Control LSI, a 100-pin QFP. Other components vital to this circuitry are the high-performance SCSI LSI (NCR-53C96), the microprocessor (NEC V50), and the EPROM (Intel 27C210). The standard dynamic RAM (DRAM) buffer is 512 KB; optionally, Python models with a 1-MB DRAM buffer can be ordered. Buffer parity checking is standard.

Switch-Selectable Options

An eight-position switch bank is accessible through a top-panel cutout at the rear of the drive. This switch bank allows you to set certain operational options before you install the drive. These options are:

- SCSI target identification
- SCSI-1 or SCSI-2 interface (default at power up)
- SCSI parity check enable
- Power-on self-test

Figure 9 illustrates the switch bank location.

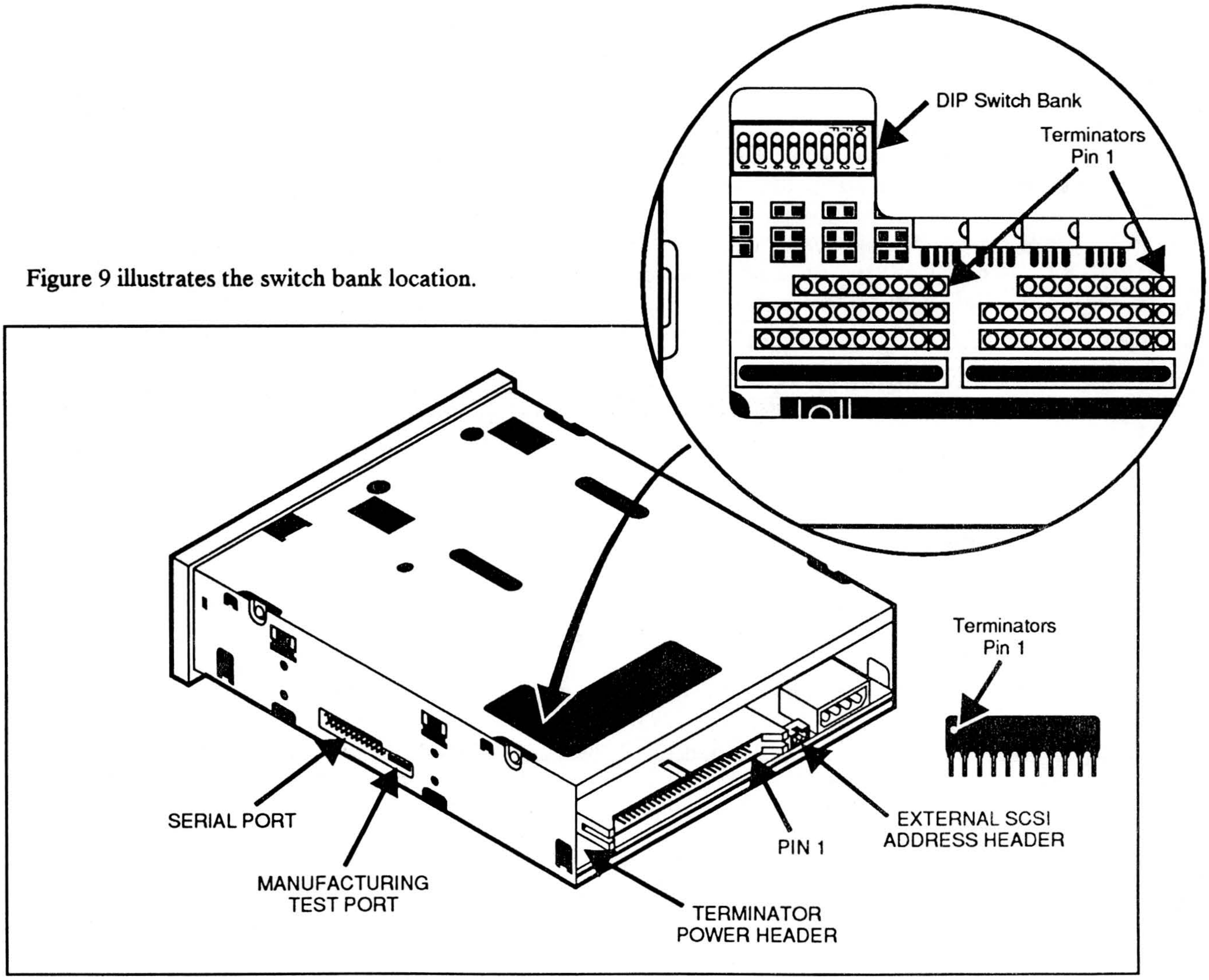

Figure 9
Switchbank Access

These switches allow you to set up the following configuration options:

- o SCSI device address (S1 through S3): Default = SCSI ID 0 (S1 through S3 = OFF)
- o SCSI mode at power-up (S4): Default = SCSI-2 (S4 = ON)
- o Parity check enable/disable (S5): Default = Parity disabled (S5 = OFF)
- o Power-on self-test enable/disable (S8): Default = Power-on self-test disabled (S8 = OFF)

NOTE: *Switches S6 and S7 are reserved and must be in the OFF position.*

Figure 10 shows the default settings for generic Python internal drives for these switches (view looking from the front of the drive).

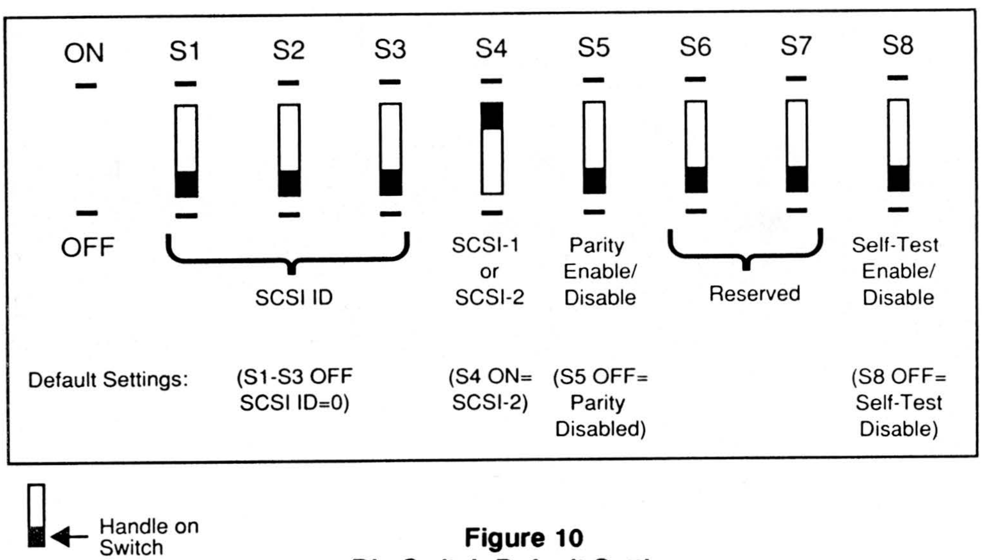

Figure 10
Dip Switch Default Settings

NOTE: *The drive must be turned OFF; then, ON in order for switch settings to take effect, or a SCSI Bus Reset must be received.*

The default settings are designed to accommodate a variety of systems. If needed, they can be easily changed.

SCSI Device Address (S1 through S3)

The three switches S1 through S3 correspond to the SCSI device address identification bits 0 (LSB) through 2 (MSB), respectively. Figure 11 shows the switch settings for the eight possible SCSI device addresses. The default setting is SCSI device address 0 (S1 through S3 = OFF). Be sure that no other device on the SCSI bus has the same SCSI address.

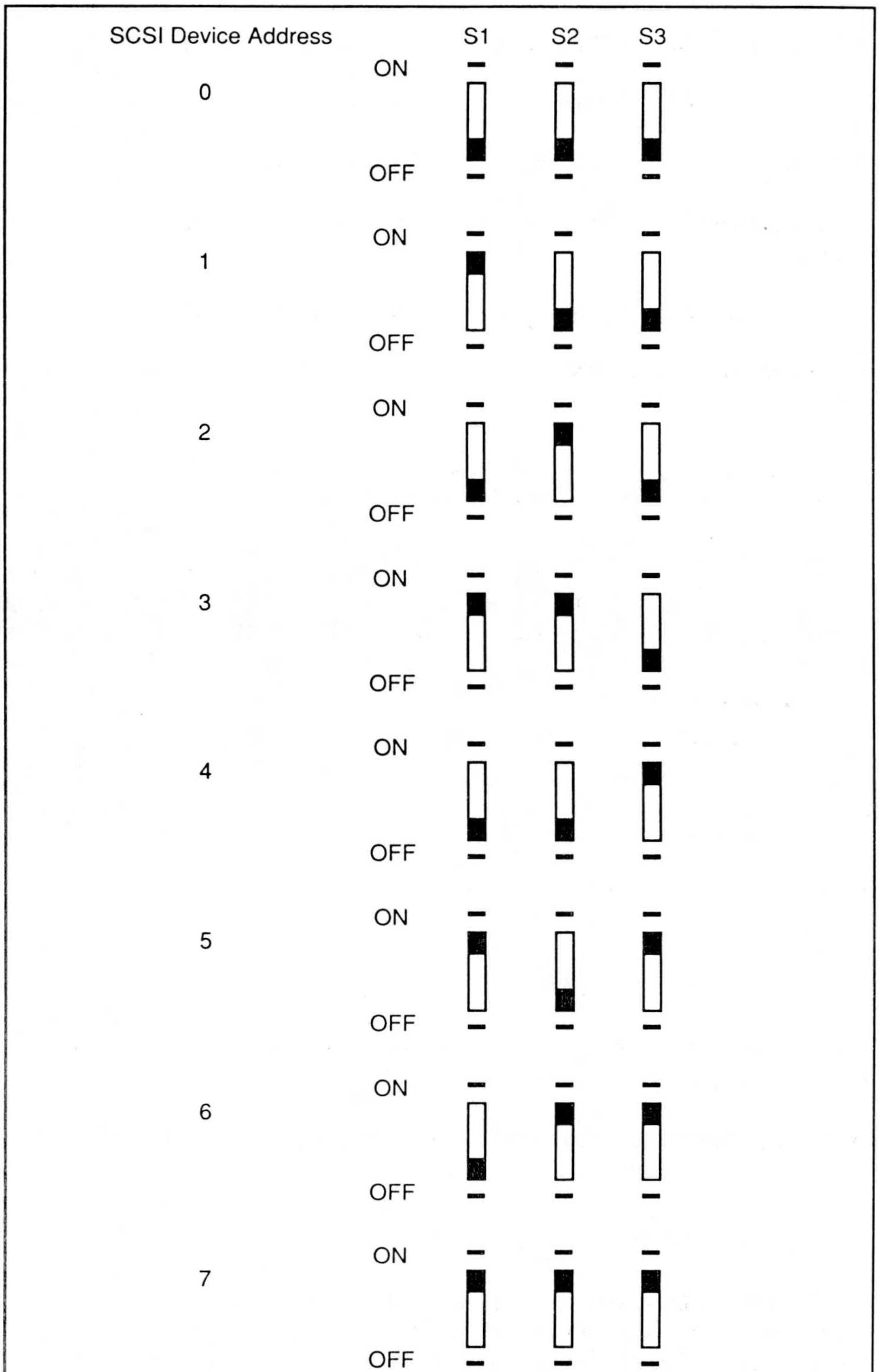

Figure 11. SCSI Device Address Selection

SCSI Mode at Power-Up (S4)

The S4 switch selects either SCSI-1 or SCSI-2 as the default operational mode for the Python SCSI bus at power-up. The default is SCSI-2 (S4 = ON), a superset of SCSI-1.

S4 = ON selects SCSI-2
S4 = OFF selects SCSI-1

Parity Check Enable/Disable (S5)

The S5 switch enables or disables parity checking for the SCSI bus. The default is parity disabled (S5 = OFF).

S5 = ON enables parity checking
S5 = OFF disables parity checking

Power-on Self-Test Mode Enable/Disable (S8)

The S8 switch enables or disables execution of power-on self-test diagnostics when the power comes ON. The default is power-on self-test mode disabled (S8 = OFF). If ON, the drive responds to SCSI commands after successful completion of the test (about 5 seconds).

S8 = ON enables power-on self-test mode
S8 = OFF disables power-on self-test mode

SCSI-1/SCSI-2 Interface

The Python 452X drive allows you to choose either SCSI-1 or SCSI-2 as the default interface with the computer system. (See Chapter 4 for detailed information about these interfaces.) The SCSI-1 interface conforms to the ANSI X3.131-1986 standard. SCSI-2 is a standard that augments the SCSI-1 command set and generally includes everything in SCSI-1. If the hardware default setting is SCSI-2 for power up, issuing a CHANGE DEFINITION command allows SCSI-1 to be selected until the next power up.

Terminators

If the Python 452X drive is the last drive in a daisy chain, it must be correctly terminated. When you receive your Python 452X drive, the terminators are in place. The configuration of terminators is different for the single-ended and differential SCSI interfaces.

In Figure 9 (looking at the rear of the unit), eight terminator locations are shown -- two side-by-side rows of four locations. Figure 9 shows two terminators (11-pin, S9 331J devices) in place for the Python 4520NT drive (single-ended) and six open locations. If your drive is the last device in the chain, leave these two terminators in place.

If your Python 4520NT drive is NOT the last device in the chain, remove these two 11-pin terminators.

If your Python 4521NT drive (differential) is the last device in the chain, eight terminators must be in place. Specific devices must be in specific locations. Starting with the shortest device (8-pin), which is closest to the switchbank (Figure 9), the devices and locations are shown below:

8-pin A4 151J	8-pin A4 151J
10-pin A5 151J	10-pin A5 151J
10-pin S9 331J	10-pin S9 331J
11-pin S9 331J	11-pin S9 331J

If your Python 4521NT is NOT the last device in the chain, remove the terminators.

Terminator Power

At the rear of the Python 452X drive, a 2-pin header allows you to enable terminator power if needed. The Factory default is with terminator power disabled (jumper shunt over one pin). To enable terminator power, place the jumper shunt over the two pins. (See Figure 9). Be sure it is firmly in place.

Serial Port

A unique feature of the Python 452X products is the 30-pin serial port available at the side of the drive unit. This serial port allows access to internal drive diagnostics stored in firmware. These internal diagnostics allow standalone testing of the drive through connection to an external computer. (The mating connector JAE LX-DC30 and Archive-supplied software are required.)

In addition to the serial port connector, another connector next to the serial port allows access to the drive for manufacturing testing.

External SCSI Address Port

A 6-pin header on a PCB at the rear of the drive allows remote SCSI address selection. For example, if an OEM chooses to enclose the Python 4320NT in an external housing, the 6-pin header allows the SCSI address selection to be brought out the rear panel. Figure 12 illustrates this 6-pin header.

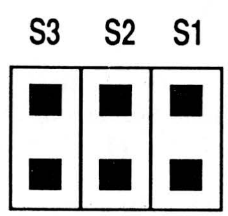

Figure 12
External SCSI Address Port JP5001 (Rear View)

NOTE: *Follow the switch settings for selecting the SCSI address as illustrated in Figure 11. To turn S1, S2, or S3 ON, place a jumper shunt over the two vertical pins for each switch required.*

To turn S1, S2, or S3 OFF, remove the jumper shunt from the two vertical pins for each switch required.

Sensors

A number of mechanical and optical sensors are integrated in the Python 452X design. The cassette in and cassette loading sensors are mechanical sensors to determine the position of the loading mechanism. The other mechanical sensors determine specific information based on detecting the open or closed state of four recognition holes in the DAT cassette. The open/closed state of these holes determine tape thickness, cleaning cassette, and whether the tape is prerecorded (write-protect) or unrecorded. These mechanical sensors plus the sensor for "cassette in" status are designed to comply with the ANSI DAT cassette specification.

The beginning-of-tape (BOT) and end-of-tape (EOT) sensors are optical sensors designed to detect the light path transmissivity of leader and trailer tapes as specified in the ANSI DDS cassette standard. The reel sensors for the two reels are optical.

Also, three optical sensors detect mechanism position during mode changes.

The capstan sensor is a magneto-resistive Hall sensor that detects a magnetic field. The cylinder sensors are coil and magnet sensors. Each reel motor contains a high-resolution optical speed encoder.

The dew sensor is a humidity sensor that uses carbon-composition film formed by a hydroscopic resin to detect humidity.

Front Panel LEDs

The front bezel of the Python 452X displays two LEDs. One LED indicates the drive status; the other, the cassette status. These two indicators provide operational information for normal as well as error conditions.

The amber Drive Busy status LED indicates the following conditions:

- When ON (lit), the drive is reading or writing the tape. (SCSI or DAT activity is present.) During a SCSI Prevent Media Removal command, the LED is always ON. The cassette may not be ejected when the amber LED is ON.
- When flashing rapidly, a hardware fault has occurred, or dew has been detected. (If dew is detected, the cassette will be ejected.) If this occurs immediately after power-on (and switch 8 is ON), the power-on self-test may have failed. In this case, the drive will not operate.

The green Cassette In Place status LED indicates the following conditions:

- When ON (lit), a cassette is inserted and does NOT generate excess errors.
- When flashing slowly, a cassette is inserted but generates excessive errors beyond a predefined DDS error threshold. A new tape should be used for future writes and/or the heads should be cleaned with an approved DDS cleaning cassette. Otherwise, operation is proceeding normally. This signal is a warning.
- When flashing slowly in conjunction with the amber LED, a prerecorded audio cassette is inserted and is being played automatically.

- When flashing rapidly, the drive could not write the tape correctly (maximum rewrite count exceeded). In this case, the user should replace the cassette. The WRITE operation failed.

The following table summarizes the operation of the two LEDs. (See the previous explanations to remedy fault conditions.)

LED	Action	Meaning
Amber	ON (lit)	The drive is reading or writing the tape.
Amber	Flashing Rapidly	A hardware fault occurred, or dew was detected.
Green	ON (lit)	A cassette is inserted and does NOT generate excess errors.
Green	Flashing Slowly	A cassette is inserted but generates excessive errors beyond a predefined DDS error threshold. (Warning only)
Green	Flashing Slowly (with amber LED ON)	A prerecorded audio cassette is inserted and being played automatically.
Green	Flashing Rapidly	The drive could not write the tape correctly. (Error)

DDS Format

The Python 452X products are designed to implement the tape format as specified in the 3.81 mm Helical-Scan Digital Computer Tape Cassette for Information Interchange, ANSI X3B5/88-185A (DDS format).

The DDS format is structured to overlay the basic audio format. Rather than a continuous stream of data like the audio format, the DDS format is made up of a sequence of finite data groups. A data group is made up of 22 data frames and 1 ECC frame; each frame is made up of two helical scan tracks.

Figure 13 shows the construction of a data group.

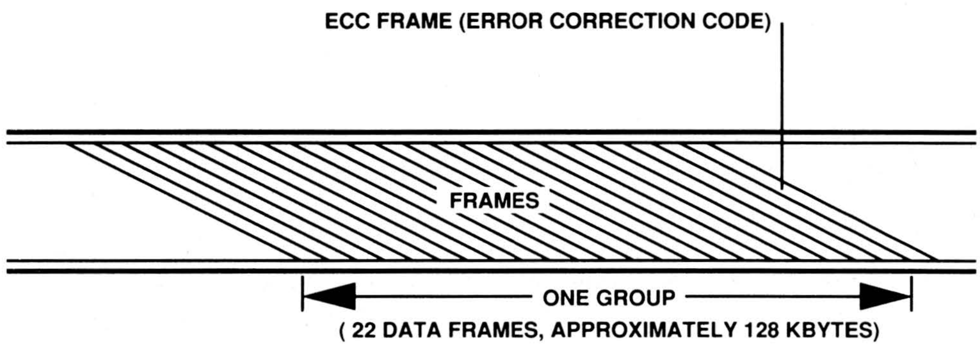

Figure 13
DDS Data Group

Although data groups are fixed-length and always contain 22 data frames, the DDS format is designed such that variable-length computer records can be stored in the fixed-length data groups. Each data group contains an index that identifies and locates the data records in that group. The index also maintains a record of file marks and save set marks in each data group without significantly affecting the total amount of data that can be stored on the cassette. (Save set marks allow the host computer's software to write any number of records and file marks to a save set and to search for any save set.)

In the event the data group does not contain enough user data to fill it, the index for the group reflects that shortage. Similarly, if a record is larger than the data area remaining in a data group, the first part of the record is stored at the end of one data group, and the last part of the record is stored at the beginning of the next data group. The indices for the groups contain the details of the split record.

Individual Track Layout

The DDS format, like the audio format, allocates 60% of each track to user data and ECC. The remaining 40% is divided between ATF signals, which are used to center the head on the track, and the subcode area. The ATF and subcode areas are collectively called subareas. The subcode areas are used to record information about the location of data records, file marks, and save set marks.

The subcode areas can be searched at 200 times the normal read/write speed. Thus, any information on the tape can be located in an average of 20 seconds on a 60 meter tape or 30 seconds on a 90 meter tape. For a sequential device, this access speed is very fast.

Figure 14 shows the layout of an individual track.

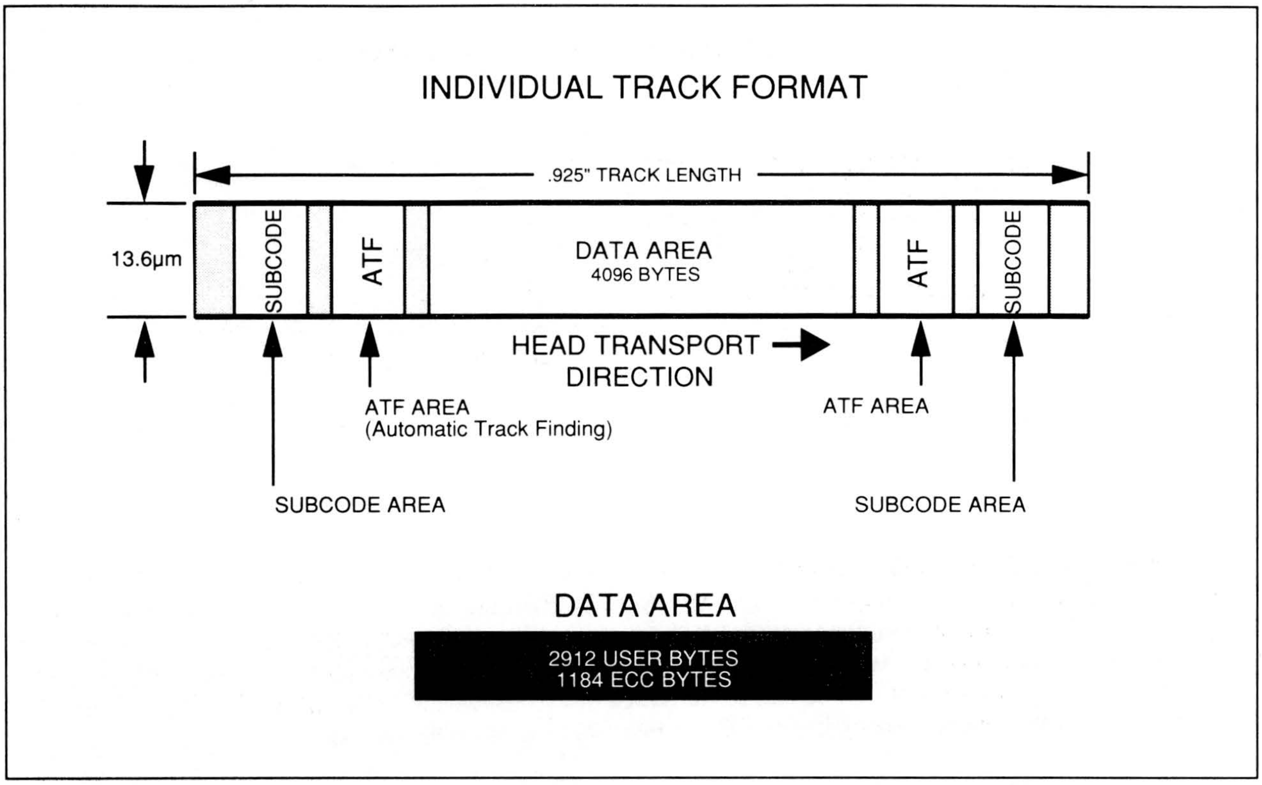

Figure 14
Layout of Individual Track

Tape Layout

The DDS format allows for tapes with one or two *data areas*. The data area is that portion of the tape containing the data groups. A tape may be divided into two partitions; that is, it may be laid out so that it appears as two logical tapes or has two separate, unique data areas.

The tape layout consists of four areas: the Device Area, the Reference and System Area, the Data Area, and the End-of-Data (EOD) area. These areas are briefly defined in the following paragraphs. For a single data area tape, this layout is illustrated in Figure 15.

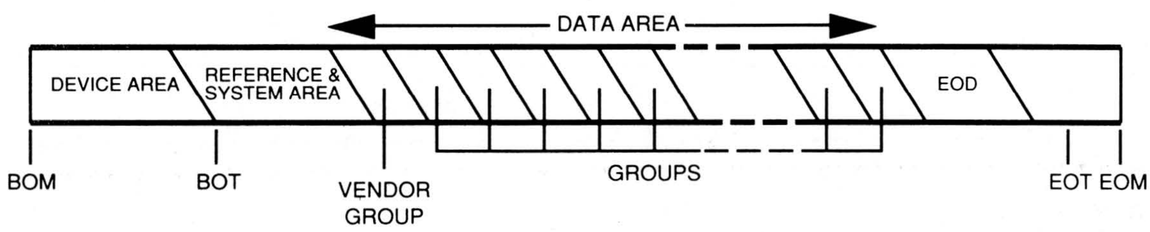

Figure 15
Layout of Tape with One Data Area.

Device Area

The Device area is the first section on the tape and is the load section, which is not used to record any user data.

Reference and System Area

The Reference and System Area contains various types of information (including the error log) relating to the Data Area as defined by the DDS format specification.

Data Area

The Data Area contains the sequence of data groups and must begin with the Vendor Group, which contains user data fields with information such as the manufacturer and model number of the drive that initialized or wrote the partition.

EOD Area

The EOD (End-of-Data) area is the point at which the computer ceases to write data. Any area beyond the EOD is logically inaccessible.

A two-partition tape consists of a Device Area, Partition 1, and Partition 0. The Device Area is the same as for a single data area tape. Each partition then consists of a Reference and System Area, a Data Area, and an EOD area. The layout for a two-partition tape is illustrated in Figure 16.

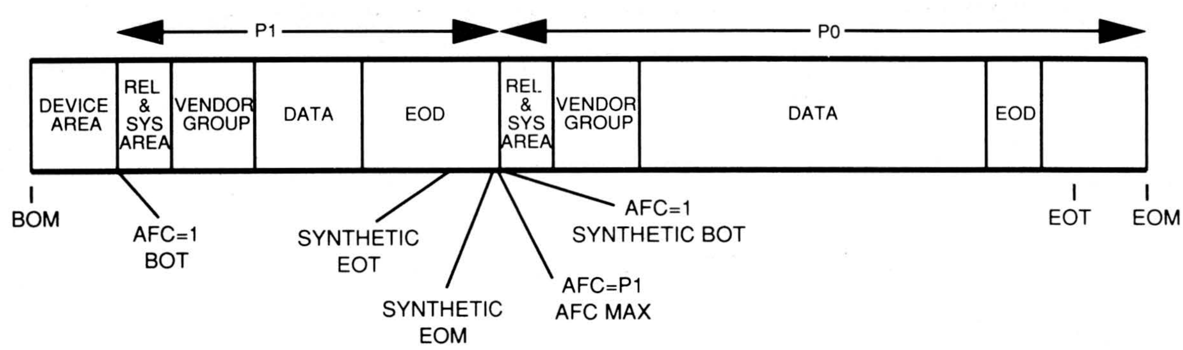

Figure 16
Layout of Two-Partition Tape.

Error Management

The Python 452X products offer multiple levels and types of error detection and correction. Inherent in the DAT technology are interleaving and two levels of ECC. The Python 452X drive implements the third level of ECC (C3) as specified in the DDS format specification. By incorporating the C3 ECC level, the user bit error rate of 10^{-15} is achieved. This error rate means that an unrecoverable reading of data will occur less frequently than once for every 10^{15} bits read from tape.

The four-head design of the Python 452X drive allows read-after-write (RAW) checking and, the DDS format provides for the M-sequence modulation (randomizing) error reduction technique. N-Group Writing may be selected through a SCSI command.

The combination of these levels and types of error reduction, detection, and correction methods ensure the maximum reliability and integrity of data.

Error Correction Code (ECC)

Error correction code involves mathematically constructing extra bytes -- called *parity bytes* -- from the digital information being stored. The parity bytes are stored with the digital information and are used to reconstruct the digital information if an error is detected. DAT technology provides two levels of ECC (C1 and C2), which can correct up to 792 bytes within a given track.

The third level of ECC (C3) implemented on the Python 452X products works across frames and can correct any two tracks in a 23-frame data group. A custom C3 ECC coprocessor implements the DDS format to provide this level of error correction in compliance with the DDS specification.

Read-After-Write

Because the Python 452X drive is designed with four heads, RAW checking can be performed to detect and correct errors. The read and write heads are alternately positioned on the drum at 90° to each other. As the data is taken from a buffer and written to tape by one head, it is read back 270° later by a read head and checked for correctness.

Randomizing Data

The DDS format also provides another error reducing technique -- M-sequence modulation. This DDS standard technique *randomizes* the data ensuring the best case possibility for reliable data. Randomizing improves the raw error rate by a factor of 10. Thus, it is a simple and effective way of preventing errors rather than correcting them after they occur.

N-Group Writing

If N-Group Writing is selected, the drive automatically writes multiple copies of the data to the tape. The user specifies how many copies (up to eight) are to be written. If the drive detects an error when reading, it goes to subsequent copies of the data until it finds one it can read. By specifying a number of copies, one copy that is readable is virtually ensured.

Using the N-Group Writing technique ensures data integrity. However, the offsets are decreased tape capacity and slower reads and writes. Although the DAT technology is inherently the most reliable method of tape backup, this technique can be used for some applications to provide an additional degree of certainty.

DAT Cassette

The Python 452X products are designed to use data-grade DDS DAT cassettes, which comply with the specifications in the 3.81 mm Helical-Scan Digital Computer Tape Cassette for Information Interchange, ANSI X3B5/89-156 standard. Archive recommends Archive-qualified, data-grade DDS DAT cassettes (Archive Model M31300, 60 meter; Archive Model 32000, 90 meter) to ensure optimal data integrity and reliability. (See Appendix A.)

Archive also recommends the use of an Archive-qualified DDS DAT head-cleaning cassette (Archive Model M7301). Chapter 5 discusses the DAT head-cleaning cassette.

Both DAT data and head-cleaning cassettes may be ordered from Archive and are packaged in multiples of five.

These small (approximately 2 inches x 3 inches x 0.4 inch) cassettes house magnetic tape that is 3.81 mm (0.150 inch) wide. The DAT cassettes are slightly bigger than a credit card. Figure 17 shows the cassette at approximately its real size.

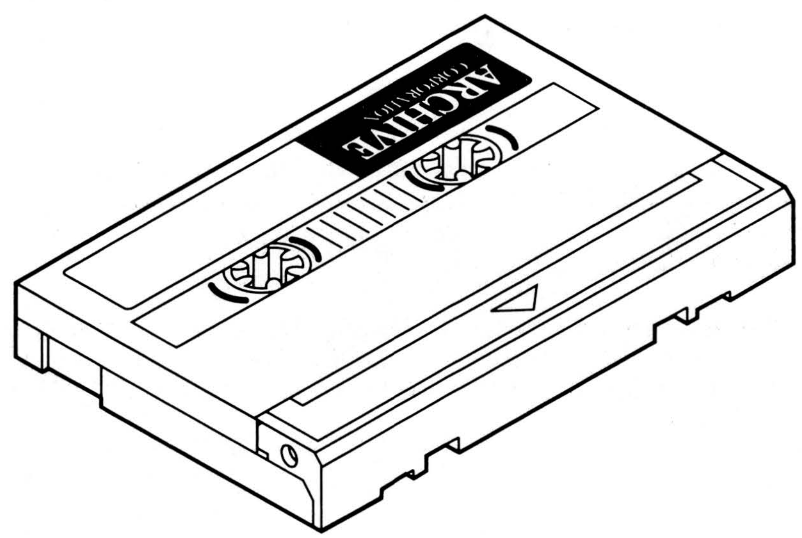

Figure 17
DAT Cassette.

Cassette Features

Qualified DAT cassettes are designed with specific file protect, lid, and other features for information interchange and are tested to comply with the ANSI DDS specifications.

Figure 18 points out the four recognition holes that allow the drive sensors to identify the type of tape, its magnetic thickness, and to determine whether the tape is prerecorded, unrecorded, or a cleaning cassette. Other cassette features to allow the drive to optically sense "cassette in", BOT, and EOT.

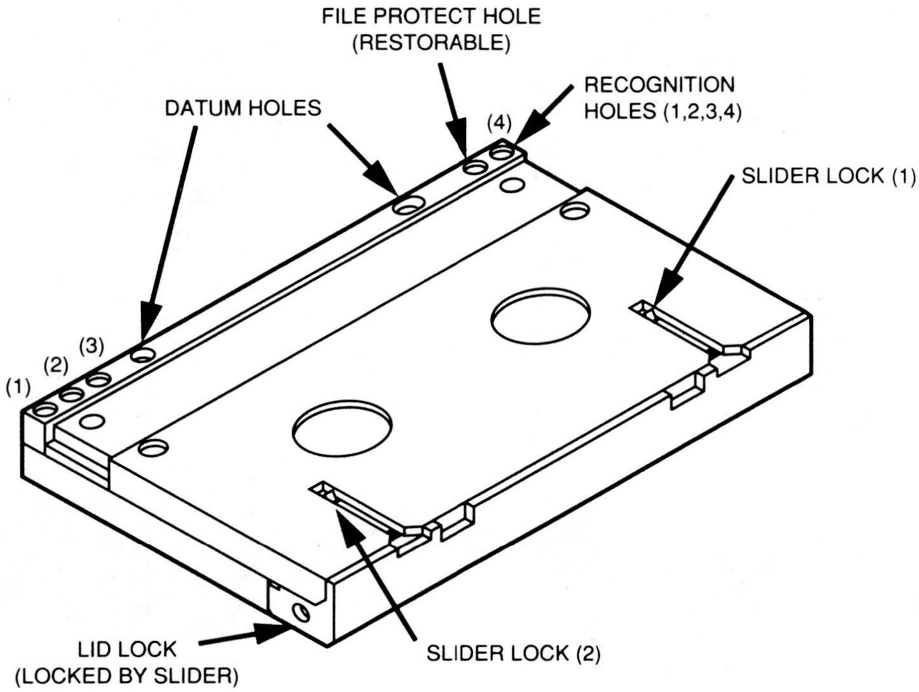

Figure 18
Cassette Design Features.

The cassette also provides for write protection so that existing data on the cassette is not overwritten. A write-protected cassette allows the existing data to be read but does not allow new data to be written to the tape.

Figure 19 shows the sliding write-protect tab on the DAT cassette and its positions for write protect and write permit. When the tab is pushed into the closed position, it allows writing to the cassette tape.

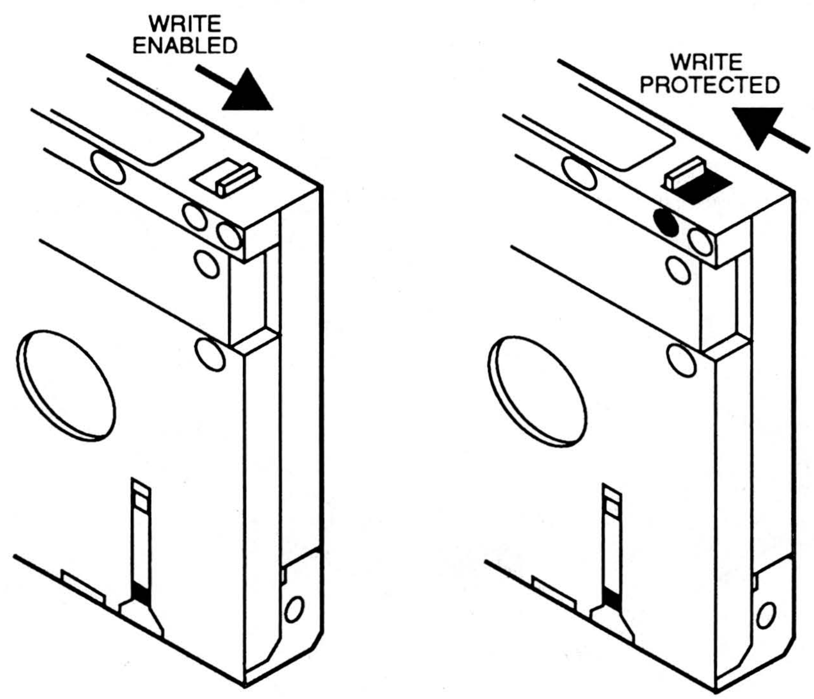

Figure 19
Write-Protect Tab on the DAT Cassette.

The following table lists the four cassette tape lengths that may be used with Python 452X products.

LENGTH (Meters)	TIME (Minutes at play or constant backup at 183 KB/sec)	FORMATTED CAPACITY (Gigabytes)
90	180	2.00
60	120	1.32
45	90	.985
30	60	.66
23	45	.488

Operations

This section outlines some simple operational procedures, such as:

- o Loading and unloading a cassette
- o Using a blank cassette
- o Using a cassette with data on it
- o Using a prerecorded audio cassette
- o Automatic drive operation

NOTE: *Cleaning cassettes are discussed in Chapter 5.*

Cassette Loading and Unloading

The cassette insertion slot on the front panel of Python drives provides easy use of the drive. This section explains loading and unloading a cassette under normal operating conditions. It also explains the manual procedure for removing a cassette abnormally lodged in the drive. Under a few exceptional conditions -- like a power outage, you may need to manually unload a cassette.

LOADING/UNLOADING A CASSETTE (NORMAL OPERATION)

Python drives have front-loading cassette insertion mechanisms that allow the operator to easily load the cassette by pushing against the middle part of the cassette until it is fully recessed into the cassette insertion slot. Insert the cassette with the arrow on the top of the cassette entering the slot first. Figure 20 illustrates cassette loading.

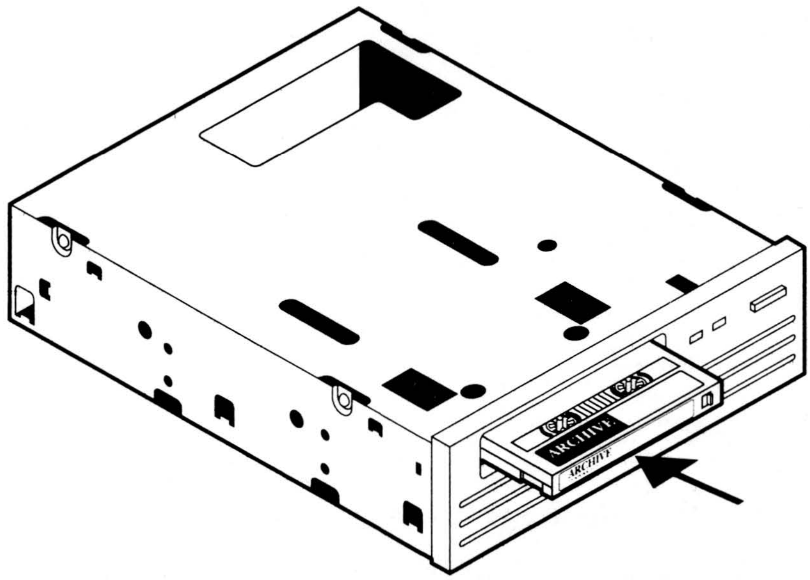

Figure 20
Cassette Loading

The operator unloads the cassette by pressing the eject (tape unloading) button at the top right of the front panel. Once you press the eject button, the Python drive updates the system log, rewinds the tape, and then ejects the cassette. It is partially ejected and can then be easily removed from the drive.

NOTE: *The time between pressing the eject button and cassette ejection may be several seconds.*

UNLOADING A CASSETTE (MANUAL OPERATION)

In some rare cases, you may need to manually unload a cassette from the Python drive. For example, if a power outage occurs while a cassette is loaded, you may want to manually remove the cassette. The following steps outline the manual cassette unloading and removal procedure.

1. Disconnect power to the computer; then disconnect the unit from the computer.

2. Remove the drive from the computer enclosure. Then disconnect the power and SCSI connections. Also, remove the drive cover and front bezel.

   Figure 21 shows the drive with the cover removed.

3. Turn the mode motor shaft counterclockwise (from front view) until the posts retract into the cassette, and the mode motor stops.

4. Push the front roller in and turn it clockwise (from top view) until the tape is wound on the supply reel, and the roller stops.

5. Rotate the rear cassette gear counterclockwise (from top view) until the cassette ejects.

6. Reassemble the drive and reconnect it to the computer.

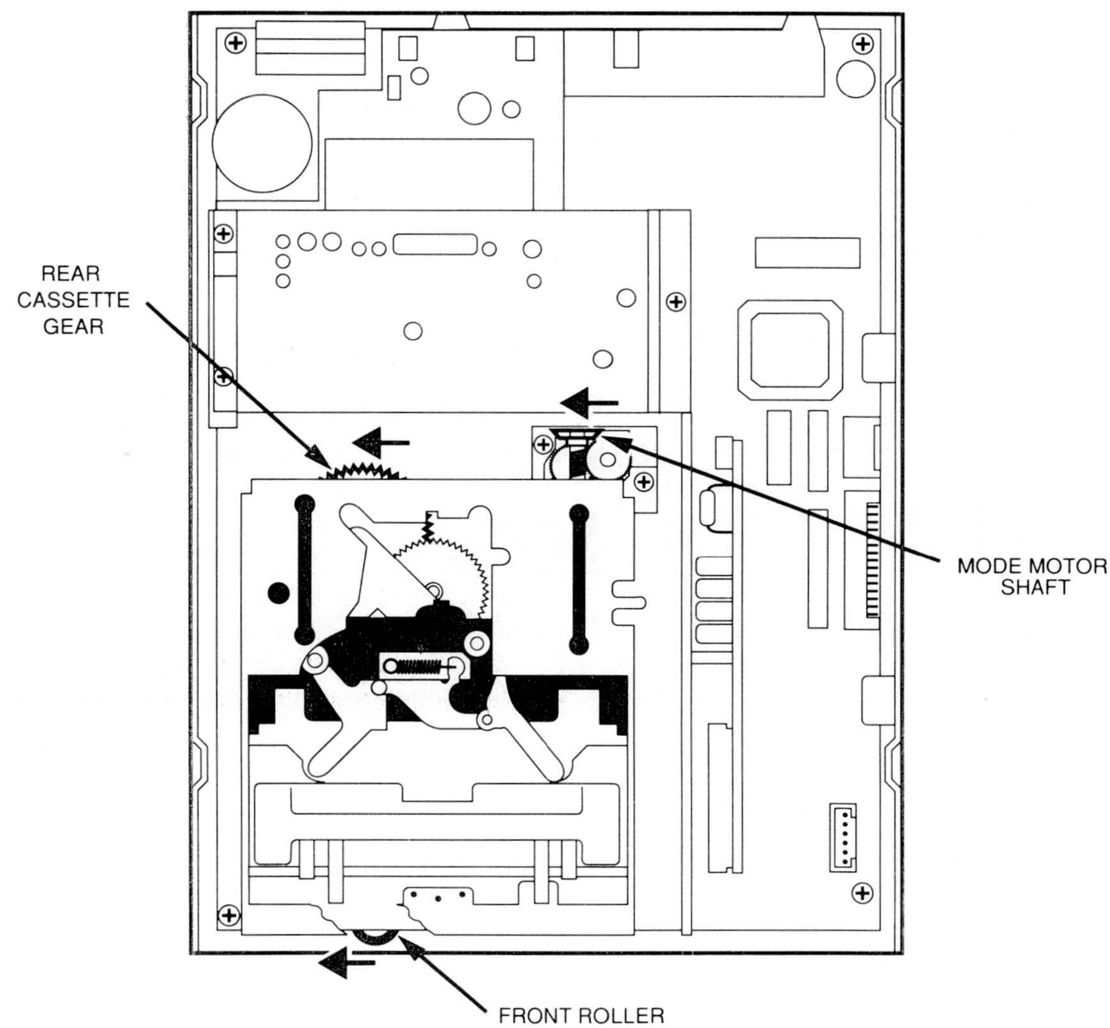

Figure 21
Manually Removing a Cassette

Using a Blank Cassette

When you insert a blank cassette into the Python drive for the first time, it will be automatically initialized. The Python drive first detects that the tape is blank (about 10-12 seconds). It then initializes the tape when it receives a command that causes writing to the tape.

> **NOTE:** *Initializing the tape takes approximately 30 seconds. Do NOT eject the cassette at this time.*

If the first WRITE command stores less than 126 kilobytes of data, the data is placed in the buffer until the next WRITE command exceeds the 126-kilobyte buffer capacity and forces the stored data to actually be written to tape.

The following steps outline a typical sequence for using a blank cassette.

1. Gently push the blank DAT cassette into the cassette insertion slot on the front panel with the arrow on the top side of the cassette entering the opening first. (See Figure 18.)

   Once the cassette is partially inserted, the drive mechanism automatically completes the cassette insertion and proper positioning.

   The amber and green LEDs on the front panel go ON as the drive checks the cassette to determine its state (blank, write-protected, prerecorded audio, etc.) and positions to the data, which takes about 10 seconds.

2. Start the software application and issue a command.

   For example, if you want to back up a file, issue the appropriate command or make the appropriate menu selections. The Python drive begins initializing the tape before completing the backup (WRITE) operation.

   The data buffer of the Python is also emptied to the tape if a REWIND command is issued, the eject button is pushed, or after the default one-minute delay with no activity.

   WRITE operations are completed during the initialization operation without delay until all internal buffers are filled.

   During the initialization operation, additional WRITE commands may be executed until the available buffers are full.

3. After completing the backup and after the amber LED on the front panel is OFF, push the eject (tape unload) button on the front panel to remove the cassette. Python will then empty its buffers to tape and rewind the tape.

   Before the Python drive ejects the cassette it automatically updates the system log, which requires a few seconds, then it rewinds and ejects the cassette. When ejected, the cassette is pushed out of the cassette insertion slot to a half-way position for easy removal.

Using a Cassette Containing Data

The sequence for writing a cassette that already contains data is similar to the blank cassette sequence except the cassette is not automatically initialized by the drive. About a 10-12 second delay occurs when the cassette is first inserted as the Python drive identifies the cassette type and state, and positions to the data area.

Automatic Drive Operation

In order to maximize tape and mechanism life, Python automatically executes the following functions when no tape READ or WRITE activity occurs:

- After 30 seconds, the capstan and pinch roller are released. Tape tension is removed.
- After 90 seconds, the tape is pulled away from the cylinder, and the cylinder is stopped.

Further READ or WRITE operation causes normal operation to resume with no affect on host operation.

If tape WRITE operations cease, a partially full data buffer may remain. After one minute with no activity, the drive automatically writes the partial buffer to the tape. This action minimizes the possibility of lost data if the power fails.

If write data remains in the buffer and the eject button is pushed, the data are written to the tape before the tape is rewound and ejected.

Firmware

The Python 452X products share common firmware that is developed as modules written in the C Programming Language and tested separately before final testing as a completed entity. The modular development philosophy provides for ease of customization if specific OEM needs are determined.

Tape Utility Software

The Python 452X products are designed to take advantage of the host computer's standard magnetic tape backup software or, optionally, to use backup software provided by Archive and other suppliers. In many cases, the Python 452X drive functions with the host computer's software as a "plug and play" device. Technically proficient OEMs and system integrators can also develop custom software to meet specific needs.

Unlike previous backup products, the Python 452X drive is compatible with both 1/4-inch streaming and 1/2-inch reel-to-reel applications. Because it conforms to the QIC-104 standard, it is compatible with the Archive Viper and other 1/4-inch cartridge software. Additionally, the variable-length records and the ability to overwrite previously recorded data allow the Python 452X drive to be run using 1/2-inch reel-to-reel backup software.

CHAPTER 4
INTERFACE DESCRIPTION

Introduction

The Python 452X products provide an embedded Small Computer System Interface (SCSI) controller for communications between the host computer and the DAT-computer drive. The Python 452X drives support SCSI-1 (ANSI Standard X3.131-1986) or SCSI-2 (ANSI SCSI-2 WORKING DRAFT Revision 10). The default interface at power up is selected by setting switches on the eight-position switch bank at the rear of the drive unit. A 50-pin connector mounted on the main printed circuit board (PCB) at the rear of the unit provides the SCSI connection to the host computer.

The Python 4520NT model provides a single-ended SCSI connection, and the Python 4521NT provides a differential SCSI connection. Both models offer the same SCSI characteristics except for the connection type. This chapter lists the SCSI connector pin assignments and summarizes the SCSI-1 and SCSI-2 status codes, message codes, and commands.

SCSI Connector

The Python 4520NT (single-ended) and 4521NT (differential) internal drives connect with the host computer through a 50-pin connector mounted on the main PCB at the rear of the drive. This connector is a right-angle, dual-row pin connector, as shown in Figure 22.

> **NOTE:** *Pin 1 on the SCSI connector of the Python DAT drive is on the top row of pins nearest the power connector as shown in Figure 20. Your SCSI cable should have the Pin 1 signal outlined in a color. Be certain to mate Pin 1 on the cable to Pin 1 on the drive. Failure to do so could render the drive inoperable.*

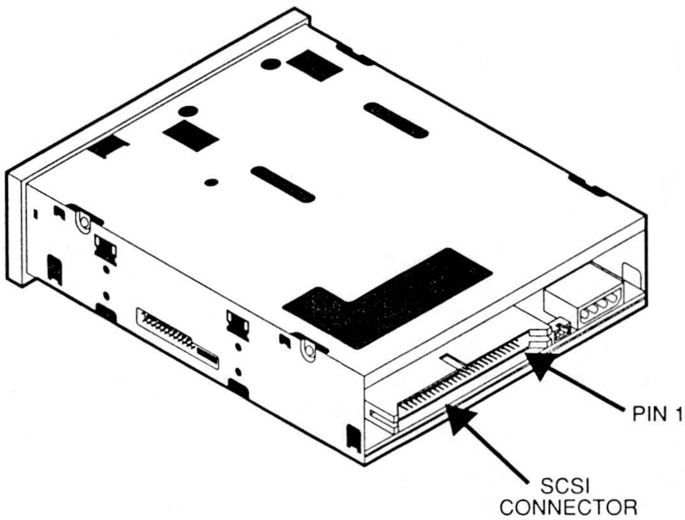

Figure 22
Python 452X SCSI 50-Pin Connector

Single-Ended Connection

The following table lists the pin assignments for the Python 4520NT single-ended connector. All odd pins except pin 25 are connected to signal ground at the host. Pin 25 is left open. The signal notation used is as follows:

o Signal name or abbreviation preceded by a - (dash) indicates that the signal is active-Low.

PIN	ASSIGNMENT
2	-DB(0)
4	-DB(1)
6	-DB(2)
8	-DB(3)
10	-DB(4)
12	-DB(5)
14	-DB(6)
16	-DB(7)
18	-DB(P)
20	GROUND
22	GROUND
24	GROUND
26	TERMINATOR POWER
28	GROUND
30	GROUND
32	-ATN
34	GROUND
36	-BSY
38	-ACK
40	-RST
42	-MSG
44	-SEL
46	-C/D
48	-REQ
50	-I/O

Differential Connection

The following table lists the pin assignments for the Python 4521NT differential connector. All odd pins except pin 25 are connected to signal ground at the host. The signal notation used is as follows:

o Signal name or abbreviation preceded by a - (dash) indicates that the signal is active-low.

PIN	ASSIGNMENT	PIN	ASSIGNMENT
1	SHIELD GROUND	2	GROUND
3	DB(0)	4	-DB(0)
5	DB(1)	6	-DB(1)
7	DB(2)	8	-DB(2)
9	DB(3)	10	-DB(3)
11	DB(4)	12	-DB(4)
13	DB(5)	14	-DB(5)
15	DB(6)	16	-DB(6)
17	DB(7)	18	-DB(7)
19	DB(P)	20	-DB(P)
21	DIFFSENS	22	GROUND
23	GROUND	24	GROUND
25	TERMINATOR POWER	26	TERMINATOR POWER
27	GROUND	28	GROUND
29	ATN	30	-ATN
31	GROUND	32	GROUND
33	BSY	34	-BSY
35	ACK	36	-ACK
37	RST	38	-RST
39	MSG	40	-MSG
41	SEL	42	-SEL
43	C/D	44	-C/D
45	REQ	46	-REQ
47	I/O	48	-I/O
49	GROUND	50	GROUND

SCSI-1 Interface

The Python 452X SCSI-1 interface conforms with the ANSI Standard X3.131-1986. The following three tables list the Status Codes, Message Codes, and Commands for this interface.

SCSI-1 Status Codes

	4-BIT STATUS CODE					
Bits	**4**	**3**	**2**	**1**	**0**	**DEFINITION**
	0	0	0	0	X	Good Status
	0	0	0	1	X	Check Condition
	0	1	0	0	X	Busy
	1	0	0	0	X	Intermediate Status
	1	1	0	0	X	Reservation Conflict

SCSI-1 Message Codes

CODE	DESCRIPTION	DIRECTION*
00h	Command Complete	In
02h	Save Data Pointer	In
04h	Disconnect	In
05h	Initiator Detected Error	Out
06h	Abort	Out
07h	Message Reject	In/Out
08h	No Operation	Out
0Ah	Linked Command Complete	In
0Bh	Linked Command Complete with Flag	In
0Ch	Bus Device Reset	Out
80h	Identify (No Disconnect/Reconnect)	In/Out
C0h	Identify (Disconnect/Reconnect)	In/Out
01h**	Extended Message	In/Out

* Direction: In = 452X to host; Out = Host to 452X.
** Supports only one extended message: SYNCHRONOUS DATA TRANSFER REQUEST.

SCSI-1 Commands

CODE	TYPE	COMMAND
00h	O	TEST UNIT READY
01h	M	REWIND
02h	V	REQUEST BLOCK ADDRESS
03h	M	REQUEST SENSE
05h	E	READ BLOCK LIMITS
08h	M	READ
0Ah	M	WRITE
0Ch	V	SEEK BLOCK
10h	M	WRITE FILEMARKS
11h	O	SPACE
12h	E	INQUIRY
13h	O	VERIFY
14h	O	RECOVER BUFFERED DATA
15h	O	MODE SELECT
16h	O	RESERVE UNIT
17h	O	RELEASE UNIT
19h	O	ERASE
1Ah	O	MODE SENSE
1Bh	O	LOAD/UNLOAD
1Dh	O	SEND DIAGNOSTIC
1Eh	O	PREVENT/ALLOW MEDIUM REMOVAL
40h	*	CHANGE DEFINITION

M = Mandatory Command　　O = Optional Command
E = Extended Command　　V = Vendor Unique Command
* = Defined in SCSI-2

SCSI-2 Interface

The Python 452X SCSI-2 interface conforms with the ANSI SCSI-2 Working Draft, Revision 10 standard. The following three tables list the Status Codes, Message Codes, and Commands for this interface.

SCSI-2 Status Codes

	4-BIT STATUS CODE					
Bits	**4**	**3**	**2**	**1**	**0**	**DEFINITION**
	0	0	0	0	X	Good Status
	0	0	0	1	X	Check Condition
	0	1	0	0	X	Busy
	1	0	0	0	X	Intermediate Status
	1	1	0	0	X	Reservation Conflict

SCSI-2 Message Codes

CODE	DESCRIPTION	DIRECTION*
00h	Command Complete	In
02h	Save Data Pointer	In
04h	Disconnect	In
05h	Initiator Detected Error	Out
06h	Abort	Out
07h	Message Reject	In/Out
08h	No Operation	Out
0Ah	Linked Command Complete	In
0Bh	Linked Command Complete with Flag	In
0Ch	Bus Device Reset	Out
80h	Identify (No Disconnect/Reconnect)	In/Out
C0h	Identify (Disconnect/Reconnect)	In/Out
01h**	Extended Message	In/Out

* Direction: In = 452X to host; Out = Host to 452X.
** Supports only one extended message: SYNCHRONOUS DATA TRANSFER REQUEST.

SCSI-2 Commands

CODE	TYPE	COMMAND
00h	M	TEST UNIT READY
01h	M	REWIND
02h	V	REQUEST BLOCK ADDRESS
03h	M	REQUEST SENSE
05h	M	READ BLOCK LIMITS
08h	M	READ
0Ah	M	WRITE
0Ch	V	SEEK BLOCK
10h	M	WRITE FILEMARKS
11h	M	SPACE
12h	M	INQUIRY
13h	O	VERIFY
14h	O	RECOVER BUFFERED DATA
15h	M	MODE SELECT
16h	M	RESERVE UNIT
17h	M	RELEASE UNIT
19h	M	ERASE
1Ah	M	MODE SENSE
1Bh	O	LOAD/UNLOAD
1Ch	O	RECEIVE DIAGNOSTIC RESULTS
1Dh	M	SEND DIAGNOSTIC
1Eh	O	PREVENT/ALLOW MEDIUM REMOVAL
2Bh	O	LOCATE
34h	O	READ POSITION
3Bh	O	WRITE DATA BUFFER
3Ch	O	READ DATA BUFFER
40h	O	CHANGE DEFINITION
4Ch	O	LOG SELECT
4Dh	O	LOG SENSE

M = Mandatory Command   O = Optional Command
E = Extended Command   V = Vendor Unique Command

CHAPTER 5
MAINTENANCE AND RELIABILITY

Maintenance

If excessive magnetic dust or debris collects at one or more of the heads, magnetic media may become unreadable or unwriteable. This condition may occur infrequently, or not at all, depending on the media used.

Whenever the Cassette In Place status LED flashes, you should clean the drive heads with a cleaning cassette.

As routine maintenance, the drive heads should be cleaned after every 25 hours of operation.

> **NOTE:** *The slowly flashing green LED may also refer to a damaged tape or a tape nearing the end of its life. If cleaning the head does not correct the flashing LED condition, replace the cassette. The slowly flashing LED does not indicate a loss of data, nor does it affect SCSI operation. (A slowly flashing green LED in conjunction with the amber LED indicates the presence of a prerecorded audio tape.) Also see Section 3 for a description of LED operation.*

To clean the heads of the Python drive, use only an Archive-qualified DDS DAT cleaning cassette designed for DDS drives. Archive offers a cleaning cassette Model M7301 that you may order. Cleaning cassettes are ordered (and packaged) in multiples of five.

The DDS cleaning cassette contains the correct recognition holes to allow the Python drive to recognize that it is a cleaning cassette. Follow these general guidelines to use the cleaning cassette:

o Insert the cleaning cassette. The Python immediately detects that the cassette is a cleaning cassette.

  The drive loads and runs the cassette for about 10 seconds; then ejects the cassette.

> **NOTE:** *Each time the cleaning cassette is used, the tape advances over an unused portion. Eventually, the entire tape is used, and a new cleaning cassette is required. (A cleaning cassette provides approximately 60 uses.) The Python drive will not rewind the cassette.*
>
> *Do not use an audio DAT cleaning cassette. The Python drive will not properly recognize it.*

Reliability

The Python 452X products are designed for maximum reliability and data integrity. The following table summarizes the reliability specifications.

FEATURE	SPECIFICATION
Nonrecoverable error rate	Less than 1 in 10^{15} bits
Error recovery and control techniques	Error Correction Code (C1, C2, and C3 ECC) Read-after-write (RAW)/Rewrites N-Group writing Error monitoring and reporting (Error Log) Media specification Retry on read Data randomizer Track Checksum
Mean-Time-Between-Failures (MTBF)	More than 40,000 hours at 30% duty cycle
Mean-Time-To-Repair (MTTR)	Less than 0.5 hour

The nonrecoverable error rate and error recovery techniques are discussed in Chapter 3.

Mean-Time-Between Failures

The Mean-Time-Between Failures (MTBF) is greater than 40,000 hours at 30% duty cycle. This specification includes all power-on and operational time. Operational time is assumed to be 30% of the power-on time. Operational time is the time the tape is loaded on the cylinder (tape moving or cylinder rotating).

Mean-Time-To-Repair

The Mean-Time-To-Repair (MTTR) is the average time required by as qualified service technician to diagnose a defective drive and install a replacement drive. The MTTR for the Python 452X products is less than 0.5 hour (30 minutes).

APPENDIX A
ADDITIONAL INFORMATION

Qualified DAT Cassettes

Python DAT drives provide maximum data integrity and reliability when Archive-qualified DAT cassettes are used as the recording medium. Archive maintains an ongoing program to qualify manufacturers of DAT cassettes. The following cassettes are recommended:

60 meter DAT data cassette: Archive Model M31300 (order in multiples of five)
90 meter DAT data cassette: Archive Model M32000 (order in multiples of five)

Cleaning cassette: Archive Model M7301 (order in multiples of five)

Contact your Archive representative for information on qualitifed DAT data and cleaning cassette manufacturers.

The following optional parts are also available from Archive:

Python drive terminators

Related Documents

The following documents may be helpful in providing additional information.

ANSI SCSI-2 Working Draft, Revision 10. American National Standards Institute, 1989.

ANSI Standard X3.131-1986 - Small Computer System Interface (SCSI). American National Standards Institute.

Designing a Data Storage Format for Digital Audio Tape (DAT), Revision B. DDS Manufacturers Group, 1988.

ANSI Helical-Scan Digital Computer Tape Cassette 3.81 mm (0.150 in) For Information Interchange (ANSI X3B5/89-156). (DDS Specification - Draft 5, completed June 1989.) American National Standards Institute, 1989.

The Future Today, DAT Technology Computer Peripherals. A Background Paper. Archive, 1989.

NOTES

APPENDIX B
ACRONYMS AND MEASUREMENTS

Acronyms and Abbreviations

ACRONYM	MEANING
ANSI	American National Standards Institute
ATF	Automatic Track Finding
BIOS	Basic Input Output System
BOM	Beginning of Media
BOT	Beginning OF Tape
BPI	Bits Per Inch
CD	Compact Disk
CMOS	Complementary Metal-Oxide Semiconductor
CSA	Canadian Standard Association
DAT	Digital Audio Tape
DDS	Digital Data Storage
ECC	Error Correction Code
EOD	End of Data
EOM	End of Media
FCC	Federal Communications Commission
EOT	End Of Tape
FTPI	Flux Transitions Per Inch
IEC	International Electrotechnical Commission
IPS	Inches Per Second
LED	Light Emitting Diode
LSI	Large Scale Integration
MFM	Modified Frequency Modulation
MTBF	Mean Times Between Failures
MTTR	Mean Time To Repair
OEM	Original Equipment Manufacturer
PCB	Printed Circuit Board
QFP	Quad Flat Pack
QIC	Quarter Inch Cartridge Drive Standards, Incorporated
RAW	Read-After-Write
SCSI	Small Computer System Interface
TTL	Transistor-transistor logic
UL	Underwriters' Laboratories, Inc.
VAC	Volts Alternating Current
VCR	Video Cassette Recorder
VDC	Volts Direct Current
VDE	Verband Deutscher Electrotechniker
VTR	Video Tape Recorder

Measurements

MEASUREMENT	MEANING
A	Amps
C	Celsius or Centigrade
cm	centimeters
dBa	decibels, A-weighted sound power reference one picowatt
F	Fahrenheit
ft	foot or feet
g	acceleration of a free-falling body; equal to 32.17 feet per second^2
Gbyte	gigabytes
Hz	Hertz
in.	inches
k	kilo
KB	kilobyte
kg	kilograms
KHz	kilohertz
lb(s)	pound(s)
Mbits	megabits
MB	megabyte
MHz	megaHertz
m	meter
min	minute
mm	millimeter
ms	milliseconds
V	Volts
W	Watts

GLOSSARY OF TERMS

Automatic Track Finding (ATF)--A method of ensuring the head is in the center of the track being read.

Azimuth--The angular deviation, in minutes of arc, of the mean flux transition line from the line normal to the tape reference edge.

Backup--Copy of a file or collection of files on fixed disk, diskette, or tape. Ensures against data loss.

Beginning of Media (BOM)--Equal to the physical beginning of the tape, where the leader tape is jointed to the magnetic tape.

Beginning of Tape (BOT)--Equal to the logical beginning of the tape.

Bit--A single digit in the binary numbering system.

Bit Error Rate--The number of errors divided by the total number of bits written or read.

Byte--A group of 8 binary bits operated on as a unit.

Cassette--An enclosure containing magnetic tape wound on two coplanar hubs and driven by an external drive.

Crosstalk--Signals from adjacent tracks interfering with signals from another track.

Data Density--The number of single-byte characters stored per unit length of track. Usually expressed as bits-per-inch (bpi).

Disk Drive--A peripheral storage device that rotates the disk, writes data onto it, and reads data from it as instructed by a program.

DDS Format--The Digital Data Storage format for tape cassettes developed by Sony and Hewlett Packard for DAT computer peripherals.

End-of-Data (EOD)--Indicates the point where the host stopped writing data to the tape.

End-of-Media (EOM)--Equal to the physical end of tape where the trailer tape is jointed to the magnetic tape.

End of Tape (EOT)--Equal to the logical end of the tape.

Error Correction Codes (ECC)--Information written on tape during the recording operation that can later be used to reconstruct errors during the data reading operation.

File--A logical unit of information.

Fixed Disk--A non-removable hard disk. All data must be transferred to and from the disk via the computer.

Frame--Two adjacent tracks, one A channel (positive azimuth) and one B channel (negative azimuth).

Full-high (or full-height)--Usually refers to a tape drive fitting in a vertical space of 3-1/2 inches.

Group--A fixed capacity set of frames written to or read from the tape. For the DDS format, 22 frames comprise a group.

Half-high (or half-height)--Refers to the size of tape drive occupying a vertical space of about 1-1/2 inches.

Head Clog--Particles from the tape or from outside the drive adhere to the head gap on a read or write head and obstruct the reading or writing of data.

Helical Scan Recording--A method of magnetically recording a tape in which the tape wraps around a rotating cylinder with 2 or 4 read/write heads writing at different azimuth angles across the width of the tape in a helix-shaped track.

Interleaving--The process of shuffling the order of data bytes before writing them to tape so the consecutive bytes are recorded as far away from each other as possible.

Magnetic Tape--A tape that accepts and retains magnetic signals intended for input, output, and storage of data for information processing.

N-Group Writing--Sometimes called multiple group writing. This technique repeats each group of data so that there are N consecutive copies of each group on the tape.

Noise--A disturbance of the signal caused by the read channel, write channel, head/tape interaction, or conducted or radiated sources.

Randomizing--A recoding of data symbols before they are written to tape in order to provide a consistently uniform RF envelope level.

Read-After-Write (RAW)--Reading data immediately after it is written and writing the frame again if an error is found.

Track--A storage channel on recording tape. For DAT, specifically a diagonally positioned area on the tape on which a series of magnetic transitions is recorded.

Uncorrected Bit Error Rate--The probability of a bit being in error, without using any error correction techniques.

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