EK-0TK25-UG-001

TK25 TAPE DRIVE SUBSYSTEM

USER GUIDE

Prepared by Educational Services
of
Digital Equipment Corporation

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PREFACE

This guide is for the user and operator of the TK25 Tape Drive Subsystem. Chapters are arranged by function so you can refer to a specific chapter for information on the function you want to perform.

Chapter 1 - Introduction to the TK25 - tells you about the tape drive subsystem, its features and specifications.

Chapter 2 - Site Preparation - describes what to plan for when installing the TK25.

Chapter 3 - Operator Information - shows the operator controls and indicators on the TK25. It also provides procedures for loading and unloading the tape.

Chapter 4 - Customer Care - identifies operator maintenance procedures for the TK25 tape drive and the tape cartridges.

Chapter 5 - Solving Problems - provides procedures for checking and identifying failures in the TK25. You may be able to solve some problems before calling for service.

Chapter 6 - Programmer Information - describes the programming concepts, information interchange protocol, and data processing flow.

Appendix A - Accessories, Supplies, and Services - describes additional products for the TK25. It includes a short description of each product, part numbers, and ordering information. Also included is a summary of the many supporting services available from Digital Equipment Corporation.

The glossary lists and describes some of the technical words and concepts introduced in this guide.

CHAPTER 1
INTRODUCTION

This chapter introduces you to the TK25 Tape Drive Subsystem. It also includes descriptions of the documents that support the TK25, and a summary of operating and performance specifications.

DESCRIPTION

The TK25 is a low-cost mass storage system that can be used with a host computer in a wide range of applications. The media used are 600-foot magnetic tapes; each with a data storage capacity of **XX** million characters. The tape drive of the TK25 subsystem is a customer-installable tabletop unit.

FEATURES

The TK25 subsystem has a small, light-weight tape drive (Figure 1-1) with the following features.

Performance

- o Low power consumption
- o Low acoustical noise
- o Manual write protection for media

Data Integrity

- o Powerful error detection before transmission to the host computer
- o Automatic retry when an error is encountered

Reliability/Availability

- o Self-tests allow verification of tape operation
- o Internal fault detection and isolation diagnostics that lower mean time to repair
- o No adjustments

Options

Table 1-1 lists the options available with the TK25. Options are specified according to the type of host system.

SUBSYSTEM COMPONENTS

The TK25 tape drive subsystem consists of two major components. The first component is the tape drive unit containing the tape mechanism with supporting mechanics, electronics, and power supply. The second component is the adapter module. The adapter module is an electronic package that allows a specific host computer system to communicate with the tape drive. For example, Digital's LSI-11 bus system uses the TQK25 Q-Bus adapter.

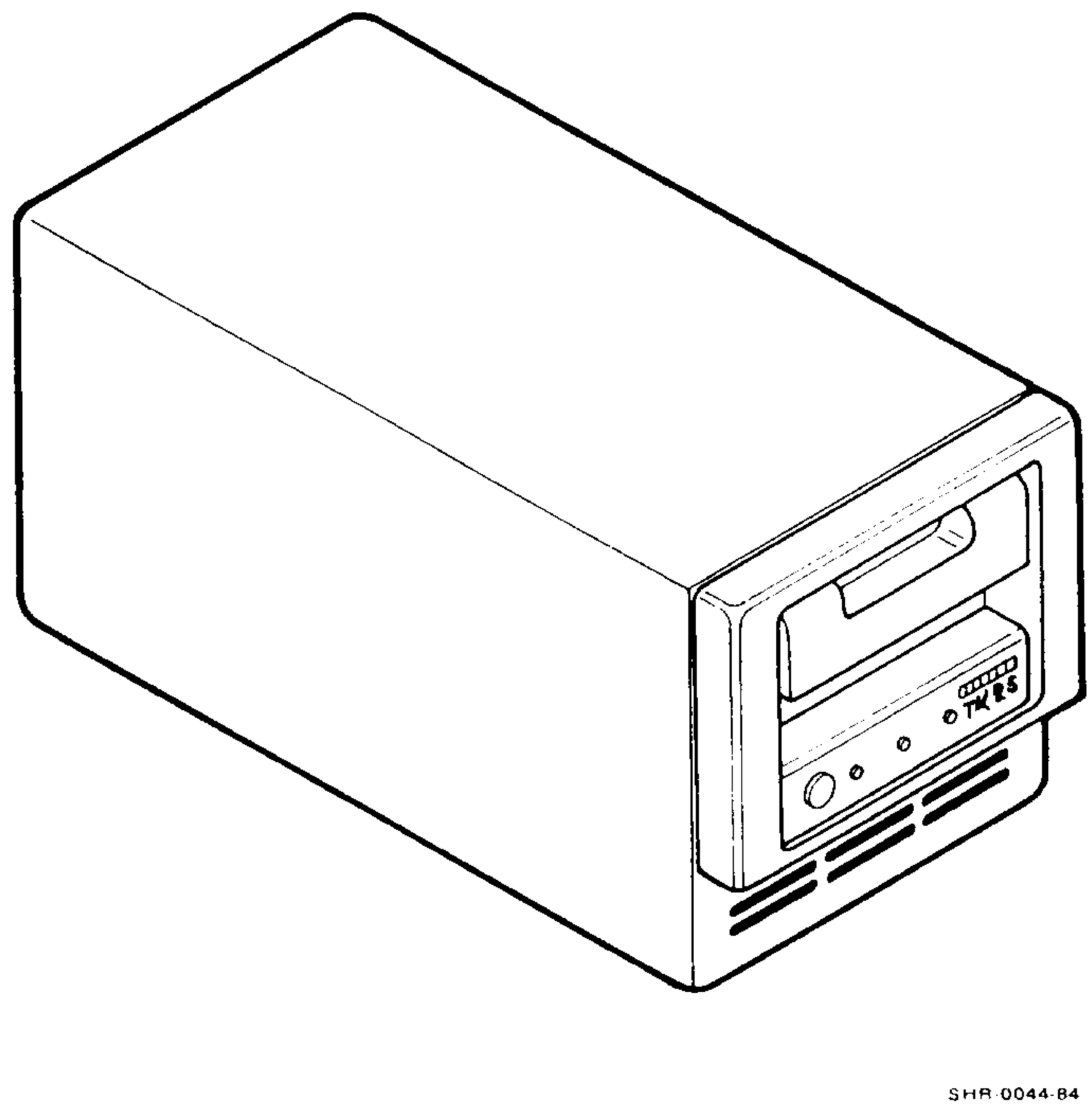


Figure 1-1 TK25 Tape Drive Unit

Figure 1-2 shows a typical TK25 tape drive subsystem. The adapter module plugs into the host computer system bus. The tape drive, in turn connects to the adapter via interface cables.

RELATED DOCUMENTATION
Table 1-2 lists documents that add to the information in this guide.

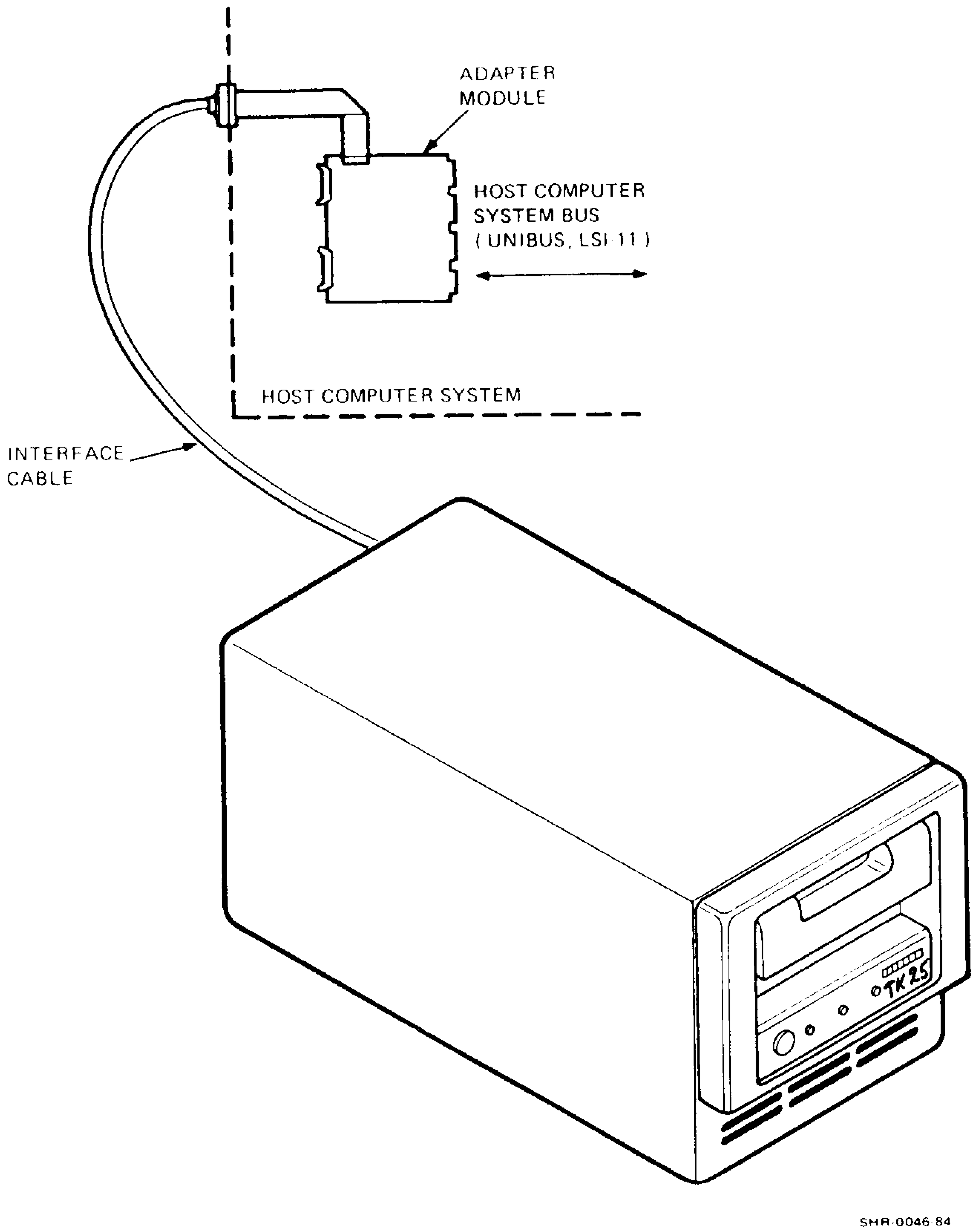


Figure 1-2 Typical TK25 Tape Drive Subsystem

SPECIFICATIONS

The following list covers the specifications for the TK25 tape drive subsystem.

Mode of operation -- streaming

Media: 1/4 inch wide unformatted magnetic tape
600 foot long cartridge similar to
ANSI Standard X3.55-1982.

Start/stop distance:

Minimum:	1.2 in.	(30.5 mm)
Nominal:	1.4 in.	(35.5 mm)
Maximum:	1.9 in.	(48.3 mm)

Recording specification

Recording density:

8000 bits per inch
10000 flux reversals per inch

Number of tracks: 11
Data rate: 440 kbits per second
Tape speed: 55 inches per second

Recording format: single track of serial NRZI data in a serpentine pattern. A 4-to-5 run length limited code similar to GCR is utilized.

Access time:

From insertion of a new data cartridge:

Maximum:	270 seconds	(4 min. 30 seconds)
Minimum:	100 seconds	(1 min. 40 seconds)

From rest with a cartridge inserted:

Nominal: 61 milliseconds

Error rate:

Recoverable write data error: 1x 10 (7)
Recoverable read data error: 1x 10 (8)
Unrecoverable read data error: 1x 10 (10)

Capacity:

Block size	Capacity
8k blocks	61 megabytes
4k blocks	56 megabytes
2k blocks	48 megabytes
1k blocks	37 megabytes

Input voltages:

Universal 60 hz/50 hz power supply with switch selectable voltage ranges of 120v/220v.

Environmental Requirements

Non-operating (storage)

Temperature: 14° F. (-10 °C.) to 122° F. (50 °C.)
Humidity: 10% to 90% Rel. Hum. (No condensation)
Temperature change per hour: 27 °F. (15 °C.) maximum
Altitude: -983 Ft. (-300 M.) to 12000 Ft. (3655 M.)

Non-operating (transit)

Temperature: -40 °F. (-40 °C.) to 140 °F. (60 °C.)
Humidity: 5% to 95% Rel. Hum. (no condensation)

Temperature change per hour: 36 °F. (20 °C.) maximum
Altitude: -983 Ft. (-300 M.) to 30000 Ft. (9144 M.)

Operating (DEC Std 102 Class-A Device)

Temperature: 60 °F. (16 °C.) to 90 °F. (32 °C.)

Humidity. 20% to 80% Rel. Hum. (no condensation) with dew point temperature of 25 °F. (-4 °C.) to 79 °F. (25 °C.)

Temperature change per hour: 18 °F. (10 °C.) maximum
Relative humidity change per hour: 10%
Altitude: -983 Ft. (-300 M.) to 12000 Ft. (3655 M.)

Heat dissipation.

Typical during idle: 45 Watts
Maximum during tape motion: 55 Watts
Maximum (worst case) during tape motion: 75 Watts

(Has cooling fan)

Table 1-1 TK25 Tape Drive Options

Option	Host System Bus	Description
TUK25-AA	LSI-11 bus	Single ØTK25-AA tape cartridge drive, 12Ø/24Ø Vac power, LSI-11 CPU cabinet kit (TQK25-CP), interface cable, power cord (1Ø Hz, 12Ø V), one TK25-K tape cartridge, tape cartridge cleaning kit
TK25-AA	---	Single ØTK25-AA tape cartridge drive, 12Ø/24Ø Vac power, interface cable power cord (6Ø Hz,12Ø V), one TK25-K tape cartridge, tape cartridge cleaning kit
TQK25	Q(LSI-11) bus	Q-Bus CPU cabinet kit including Q-bus adapter module, flat ribbon cable, insert I/O plate

Table 1-2 TK25 Tape Drive Subsystem Documentation

Part Number	Description
EK-ØTK25-UG	TK25 Tape Drive Subsystem User Guide -- covers site planning, operation, care, programming, ordering accessories, and first-level problem diagnosis.
EK-T25TD-IN	TK25 Tape Drive Customer Installation Guide -- has procedures for installing the tabletop tape drive and connecting the external interface cable.
EK-T25QA-IN	TQK25 Q-Bus CPU Kit Installation Guide -- has procedures for setting up the Q-bus adapter module, installing the module, installing the insert I/O plate and connecting the flat ribbon cable.
EK-ØTK25-PS	TK25 Tape Drive Subsystem Pocket Service Guide -- has procedures for troubleshooting and repairing the TK25 subsystem to the field replaceable unit.

CHAPTER 2
SITE PREPARATION

This chapter contains information for preparing your computer site for the TK25 tape drive subsystem. When first installing the TK25 or when moving it to a different location, you must consider the following factors.

Environment -- cleanliness, temperature, humidity, acoustics
Power -- available voltage and current
Space -- room for the tape drive

ENVIRONMENT

The TK25 can operate in a computer room, business office, or light industry environment. Although cleanliness is important in the installation of any computer system, it is even more significant for tape drives. The TK25 should not be operated in a contaminated atmosphere, specifically one with abrasive, airborne particles.

The part of the subsystem most effected by environment is the tape media. The operating ambient temperature range for the subsystem is based primarily on the tape and must not be exceeded. Humidity control is important not only for the media but for control of static electricity which may cause errors. Water vapor must not condense on the tape whether or not it is operating.

POWER

The TK25 operates in one of two switch-selectable voltage ranges. The selection is made during installation by setting a switch at the rear of the tape drive. The low voltage range is 90 to 128 Vac single phase (57 to 63 Hz), and the high voltage range is 180 to 256 Vac single phase (47 to 53 Hz). A single tape drive, when operating in either range, uses less than 75 W.

SPACE

The TK25 is packaged as a standalone tabletop unit.

The drive dimensions are as shown in (Figure 2-1). Allow clearance at the front of the drive for inserting and removing the tape cartridge as well as for the cooling air inlet. Provide clearance at the rear of the drive for cable connections, air exhaust, and access to the ON/OFF switch.

NOTE: The overall length of the tape drive is 18-7/16 inches including a connector on the rear panel.

MOVING

When moving the TK25 from one location to another, even if it is only across the room, take the following precautionary steps.

Remove the data cartridge and insert the protective shipping cartridge. The shipping cartridge was removed when the tape drive was installed. It protects the head and capstan drive from damage in case of excessive shock.

NOTE: Just insert the shipping cartridge into the drive as with any tape. The tape latch closes automatically.

After the move is complete, remove the shipping cartridge by pressing down on the tape latch and pulling out the cartridge. Store it for future use.

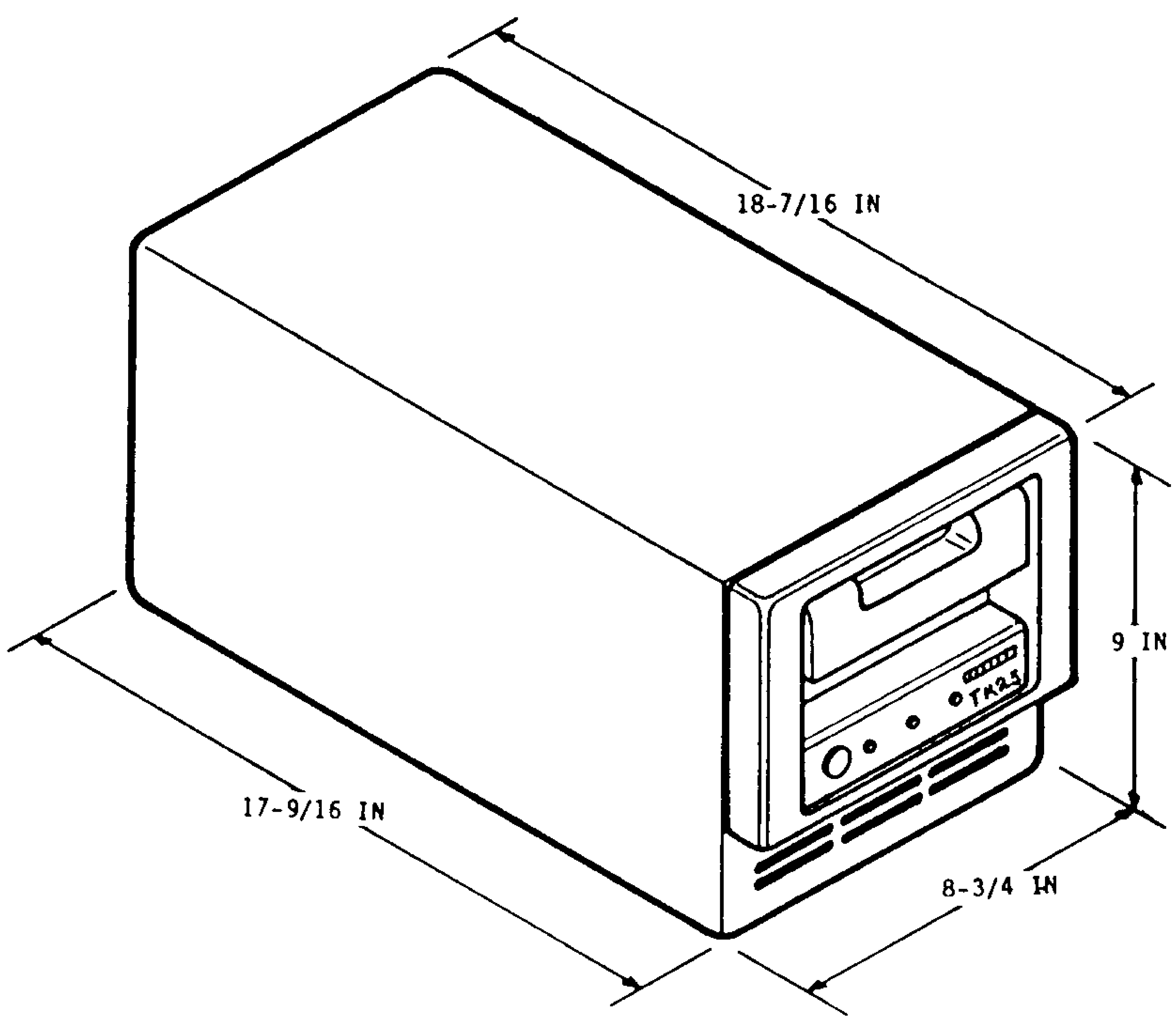


Figure 2-1 Tape Drive Dimensions

CHAPTER 3
OPERATOR INFORMATION

This chapter presents the information required to operate the TK25. The chapter is organized in two parts. The first part shows the controls and indicators and explains their functions. The second part shows how to insert and remove the tape cartridge as part of the procedure for loading/running the tape drive and stopping/unloading the drive.

OPERATOR CONTROLS AND INDICATORS

The operator controls and indicators are at the front and rear of the tabletop model.

Voltage Selection

The voltage selector switch (Figure 3-1) adapts the TK25 to the available ac input voltage range. The TK25 can operate from either 115 or 220 Vac (nominal).

CAUTION: Failure to set the voltage selector switch to 220 Vac when using a 180 to 256 Vac power source will damage the tape drive electronics.

To change the voltage setting, insert the tip of a ball point pen (or similar stylus) in the slot and slide the switch to the right or left. Move the switch to the right if the TK25 is to be used in a 115 V circuit and to the left for a 220 V circuit.

CAUTION: Never use a lead pencil because the conductive graphite can get into the switch and cause a failure.

Turning Power On and Off

After you set the voltage select switch, remove the shipping cartridge, and plug the power cord into the appropriate 115/220 Vac power source (usually done during installation), you may turn on the TK25. A power switch (1/0) at the rear of the drive (Figure 3-1) turns the power on and off. The switch must be in the on (1) position before the TK25 can operate.

The switch controls the application of primary power to the circuits and to the fan in the tape drive.

Operator Panel

An operator panel, located at the front of the TK25, contains one control switch and three visual indicators used during routine operation (Figure 3-2).

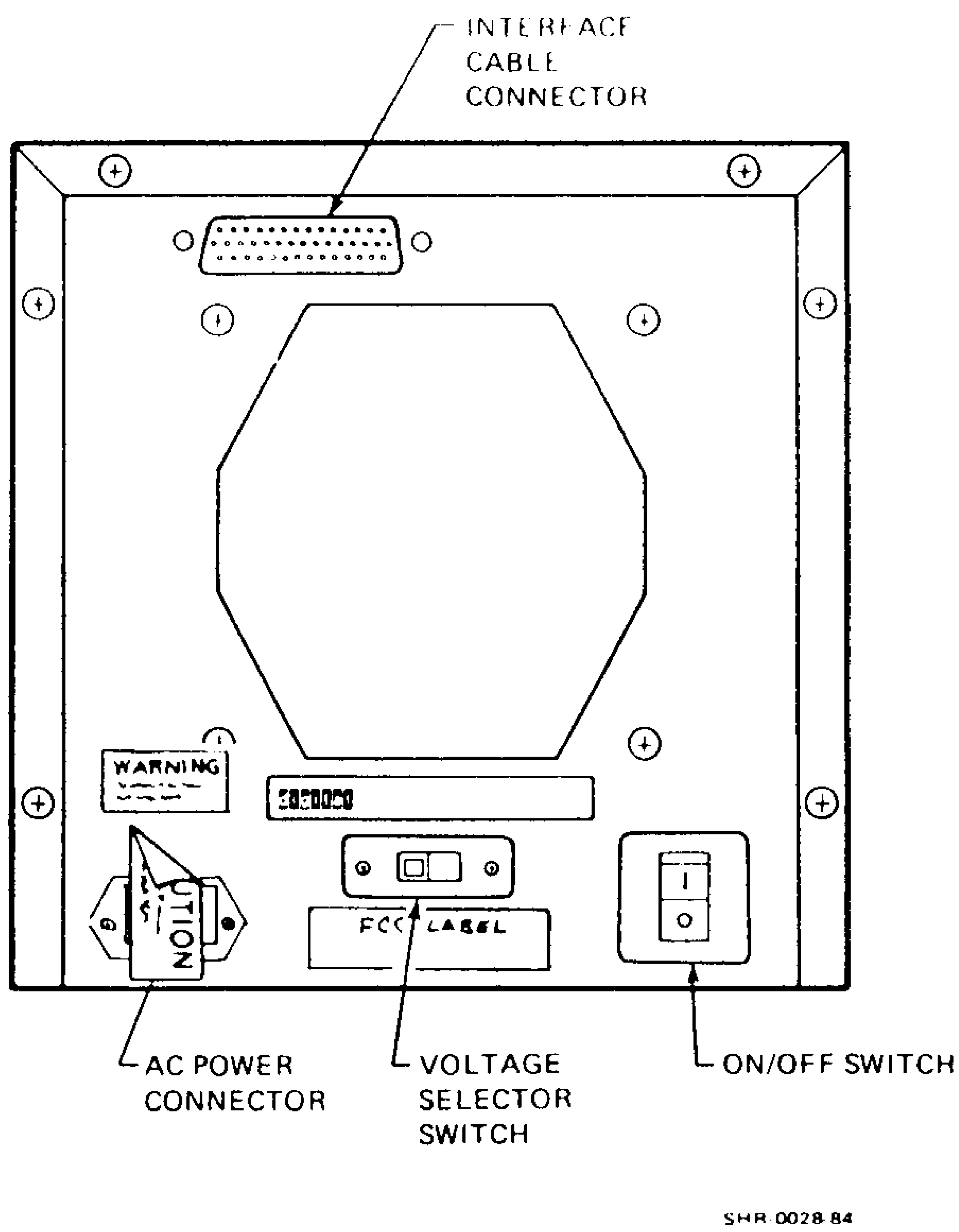


Figure 3-1 Rear Panel Controls

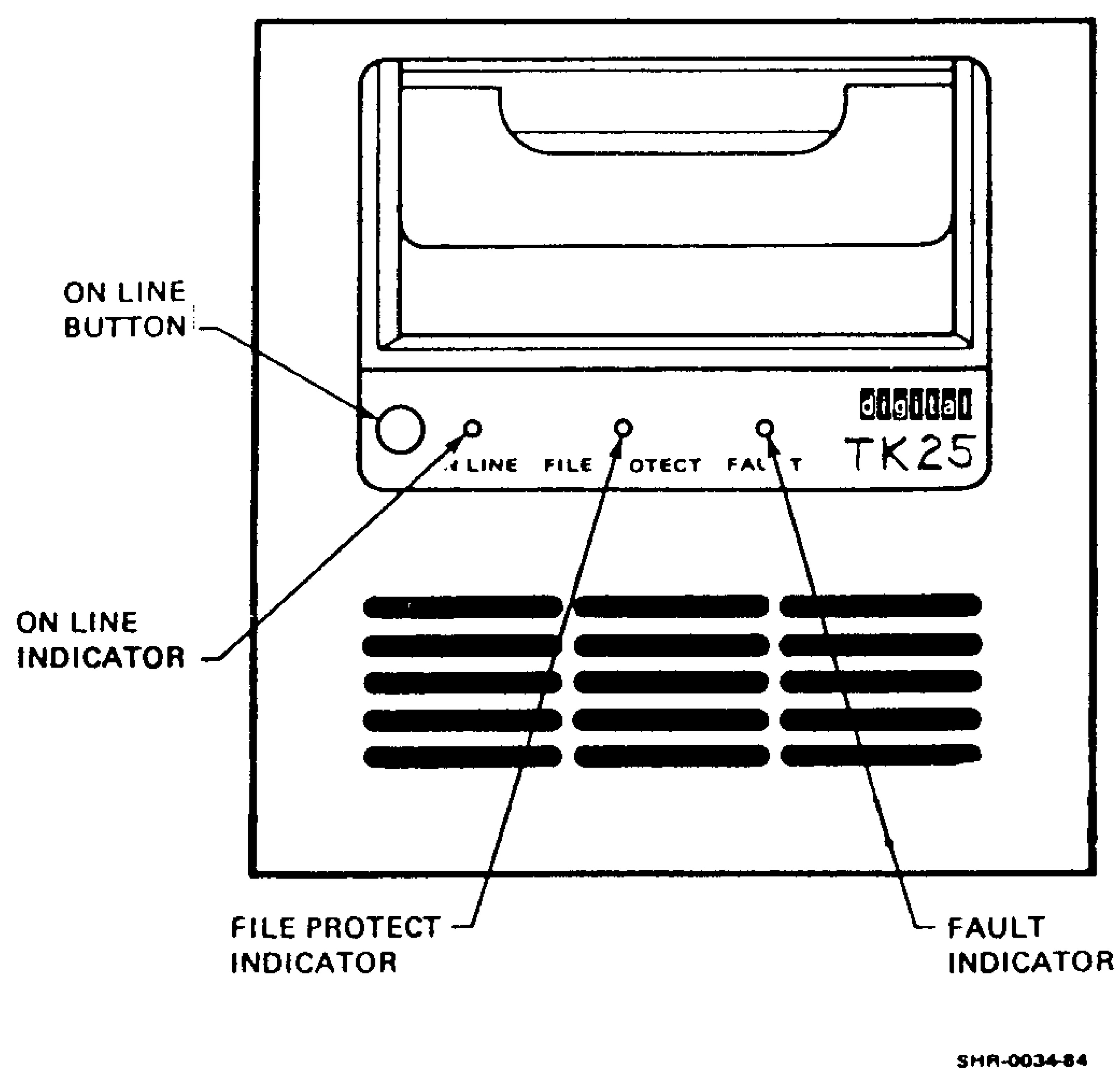


Figure 3-2 Operator Control Panel

CONTROL

ON LINE Pushbutton

The ON LINE pushbutton is the only operator control used during normal operation of the tape drive. When this button is pressed, the tape drive is placed on-line. The ON LINE indicator comes on at this time to give the operator a visual indication that the drive is on-line with the computer.

NOTE: The tape drive can only be returned to the off line condition by the computer.

INDICATORS

ON LINE (Green)

This indicator is normally used to indicate that the tape drive is on-line or off-line. When on steady, the drive is on-line. When the indicator is off, the drive is off-line.

The ON LINE indicator flashes continuously during the 4-1/2 minute period of tape initialization to provide visual indication of this automatic function. If the ON LINE pushbutton is pressed during this period, the ON LINE indicator comes on steady for a few seconds for visual indication that the computer received the signal. After INIT is complete, the ON LINE indicator comes on steady.

NOTE: The ON LINE pushbutton may be pressed any time during tape initialization. If you do this, the tape drive automatically goes on-line at the end of tape initialization.

WRITE PROTECT (Yellow)

This indicator provides visual indication that the tape cartridge has either been manually or automatically protected against any further data writing. Manual protection is provided by rotation of a small, slotted barrel at the front of the tape cartridge. Automatic protection may be provided at any time by the computer.

FAULT (Red)

When lit continuously, the Fault indicator shows that the TK25 has detected a hardware error, which you may or may not be able to correct. When the Fault indicator lights, refer to Chapter 5 for fault isolation information.

OPERATING PROCEDURES

This section tells you how to load and unload the tape cartridge. It also provides the procedures for operating the TK25.

Cartridge Loading

The TK25 is designed to make correct loading easy. To load the tape, hold it label (writing) side up and with the writing facing toward you. The opposite end has a small trap door through which the read/write heads enter. This end enters the cartridge area of the tape drive first.

Slide the cartridge straight into the cartridge area until you feel resistance. Give it a firm push in the center until the cartridge locks into place (Figure 3-3). The cartridge release lever closes automatically when the cartridge is in place.

CAUTION: Be sure to hold the cartridge as shown to prevent the release lever from closing on your fingers.

Cartridge Unloading

Unloading the cartridge is as simple as loading. Rewind the cartridge. With the tape stopped, press and lock the cartridge release lever to its down (release) position (Figure 3-4). The cartridge tape automatically slides out. Grasp the cartridge and pull it straight out of the drive.

Tape Operating Procedures

This paragraph contains procedures for starting and stopping the TK25.

Starting Procedure

Operator Action	Tape Drive Response
None	Initial state of tape drive: ON LINE indicator is off. Tape drive is stopped.
Press cartridge release lever down until it locks in release position.	Tape cartridge partially ejects.
Remove cartridge.	None
Reload cartridge or replace with new cartridge.	Cartridge release lever closes.
Observe ON LINE indicator flashing.	Cartridge initialization occurs (about 4-1/2 minutes). ON-LINE indicator flashes (Figure 3-5).
Press ON LINE button (Figure 3-6)	ON LINE indicator comes on steady for a few seconds.

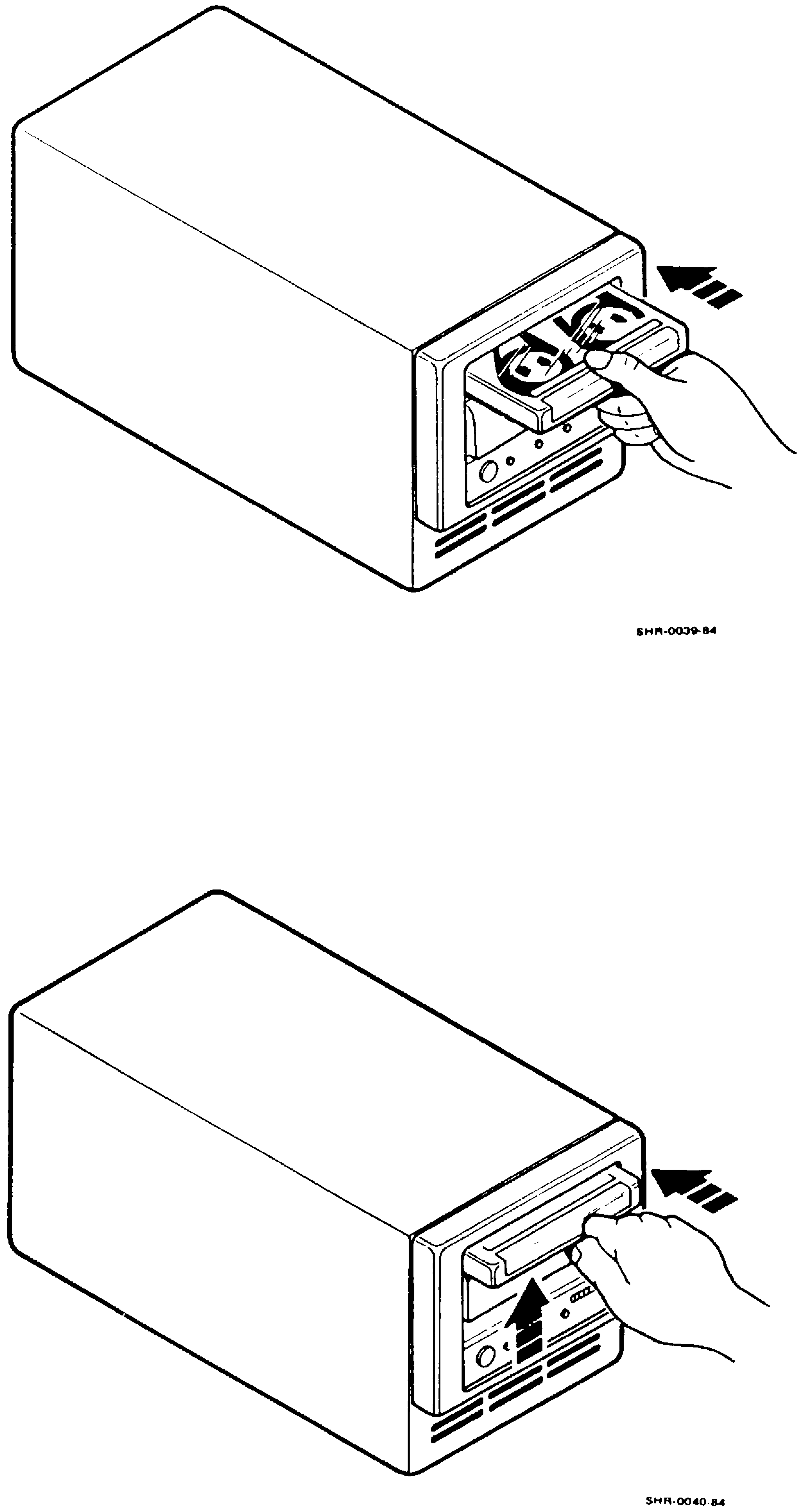
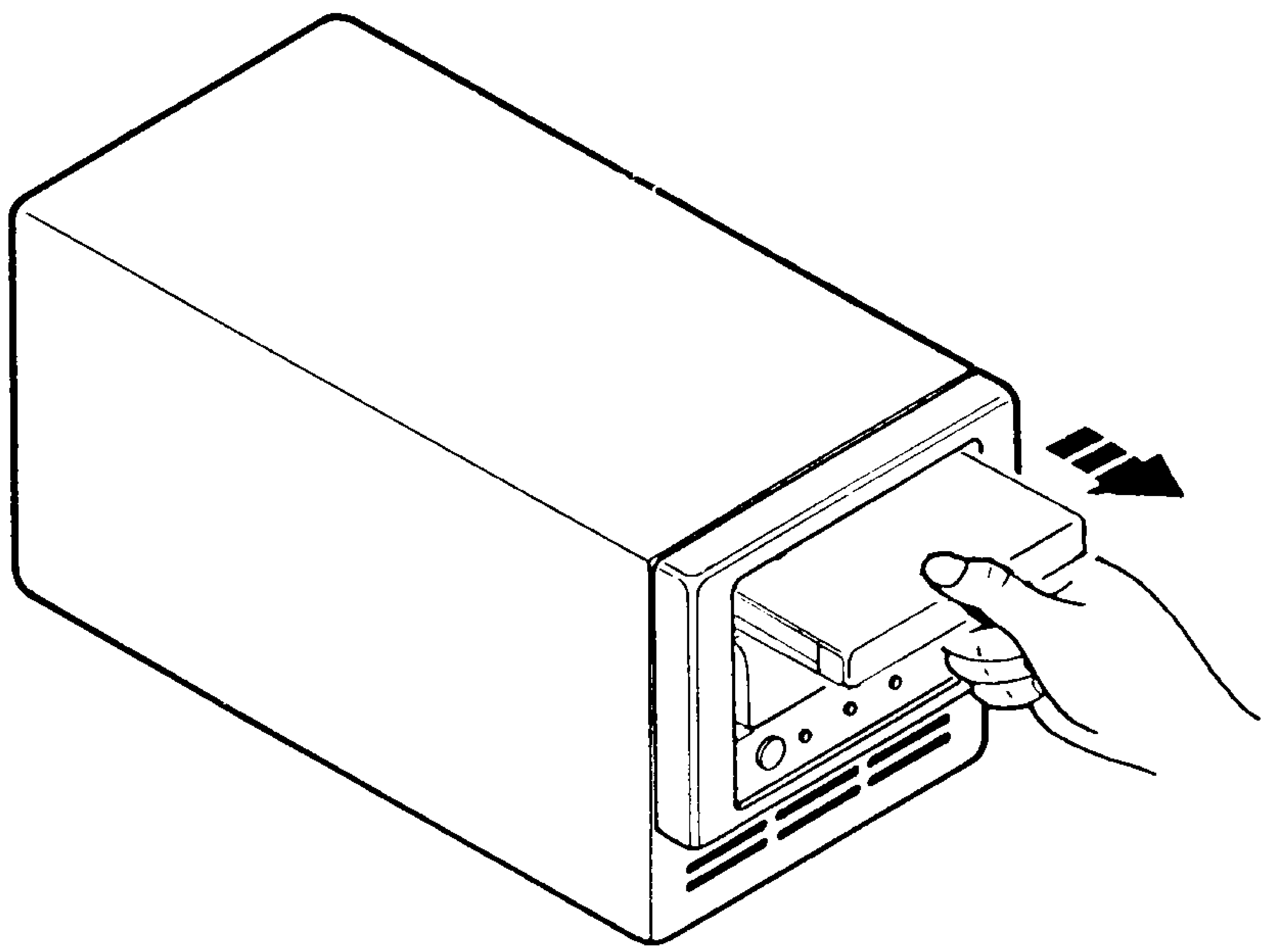


Figure 3-3 Inserting the Tape Cartridge



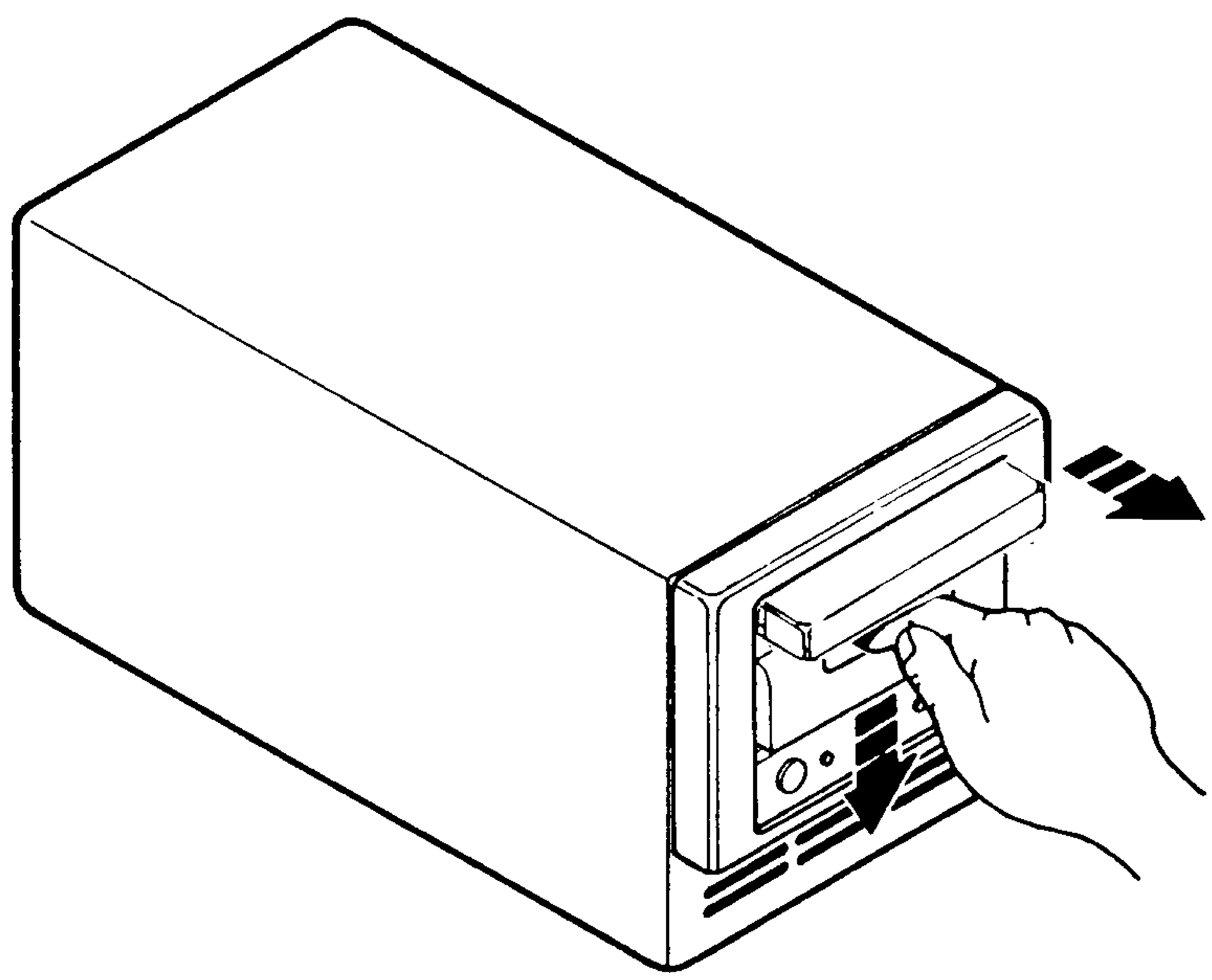


Figure 3-4 Removing the Tape Cartridge

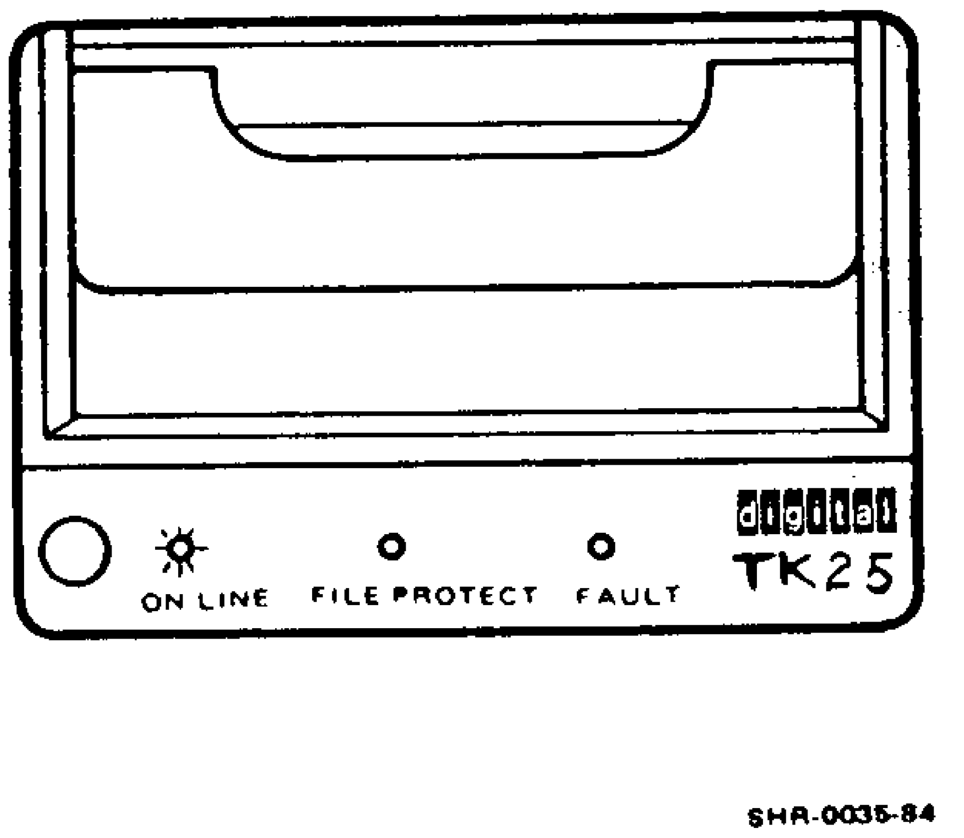


Figure 3-5 ON LINE Indicator

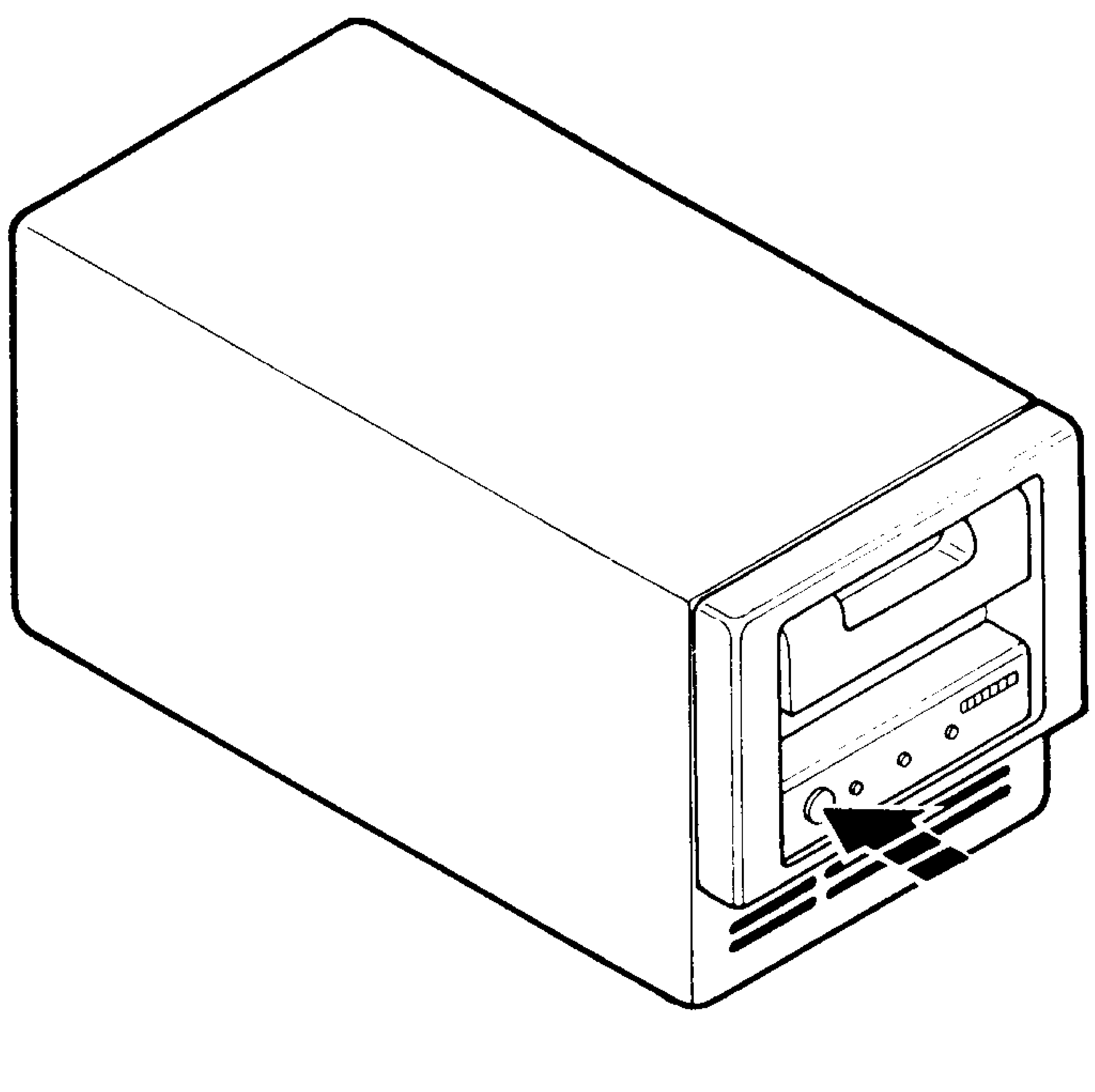


Figure 3-6 ON-LINE Pushbutton

NOTE: It is not necessary to wait until cartridge initialization is complete before you press the ON LINE button. The tape drive automatically goes on-line at the end of this period.

Tape drive is ready for operation.

Stopping Procedure

Operator Action	Tape Drive Response
None	Initial state of tape drive:
	Tape recording finishes. ON LINE indicator goes off.
Press cartridge release lever down until it locks in release position.	Cartridge partially ejects.
Remove tape cartridge.	None

NOTE: You should not move the cartridge release lever until the tape operation is completed.

CHAPTER 4
CUSTOMER CARE

This chapter explains your responsibilities for maintaining the TK25. It tells you what to do and what not to do when caring for your tape drive and media.

RESPONSIBILITIES

As the user of the TK25, it is your responsibility to make sure it is located and operated in an area that is free from excessive dust and dirt. Keep clean the external surfaces of the drive, Periodically clean the magnetic head and drive roller. Also, it is your responsibility to make sure the tape cartridges are handled and stored correctly to prevent errors or data loss.

CARE OF TAPE DRIVE

The only moving parts of the TK25 are internal and need no preventive maintenance. Its external surfaces can be cleaned when necessary with a nonabrasive sponge dampened with soap and water or any mild detergent. Do not use cleaners with solvents. Never clean or dust while the drive is running.

The TK25 packaging is not weatherproof and liquid spray can penetrate into the interior by accident This can damage electronic operation of the drive or jeopardize integrity of data on the tape. For this reason, do not put drinks on top of the enclosure or use too much water to clean the surface.

Keep all objects clear of the ventilation slots in the front panel and the air exhaust in the rear. Blocking these areas or covering the drive during operation can cause overheating.

Cleaning Magnetic Head

Clean the magnetic head <u>twice a week</u>. Use the following procedure to clean the magnetic head.

1. Remove tape cartridge.

2. Dip cotton swab in cleaner fluid supplied with tape drive cleaning kit.

3. Moving cotton swab in vertical direction (Figure 4-1), clean recording surfaces and cleaner blades of magnetic head.

<u>NOTE: Use pen light (or equivalent) to illuminate head surfaces during cleaning operation.</u>

4. Repeat step 3 with new swab.

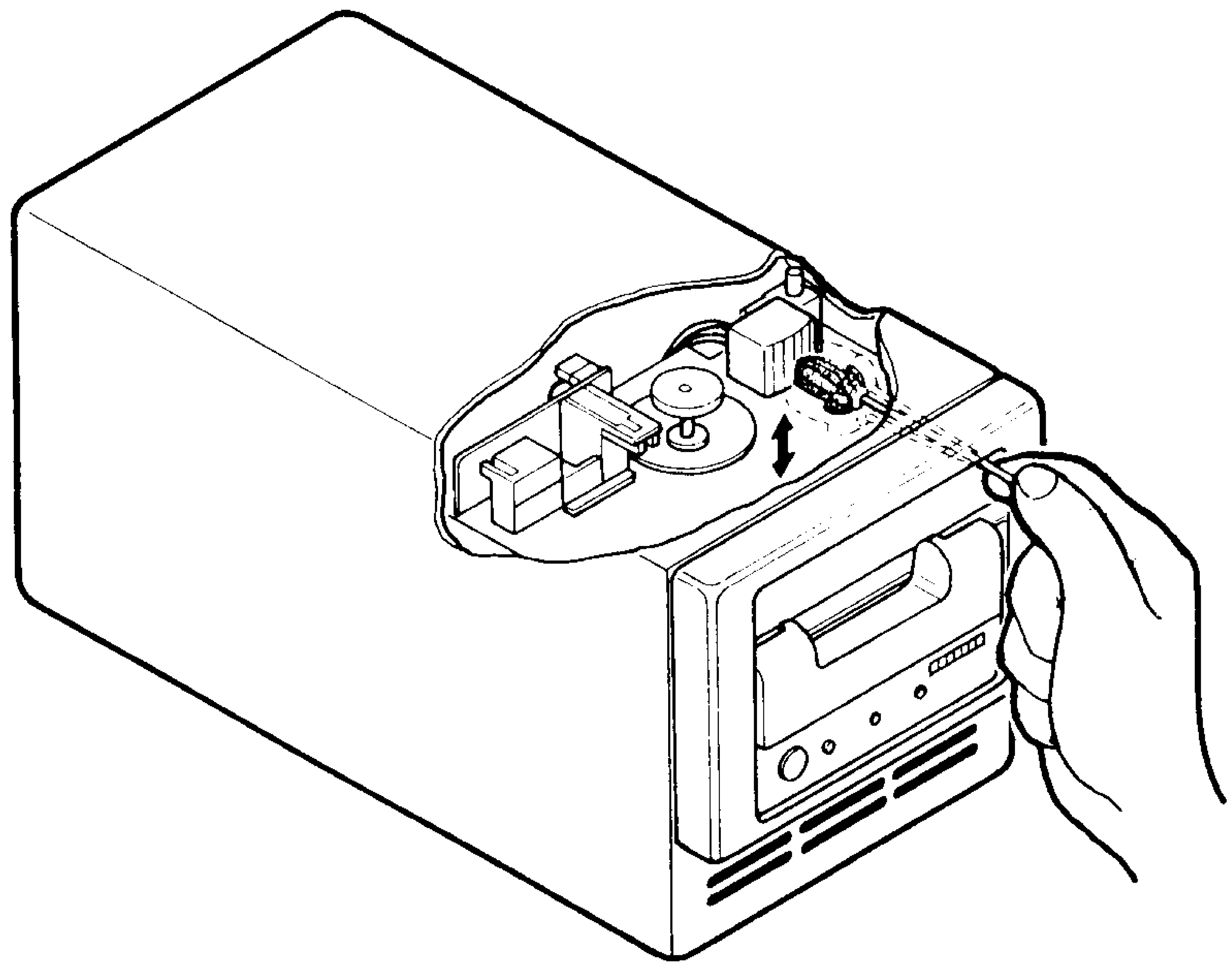


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Figure 4-1 Cleaning the Magnetic Head

CARE OF TAPE MEDIA

To prevent errors when recording or reading, take reasonable care when handling the media. The following information includes recommendations help prevent unnecessary loss of data or interruptions of system operation.

Handling Practices and Precautions

- o Allow the tape cartridge to reach room temperature before using it. If cartridges are exposed to temperature extremes, or if the temperature differential between cartridge and drive exceeds 6° C (11° F), a 2-hour stabilization period is necessary.
- o Do not use writing instruments that leave powder or flakes (such as lead or grease pencils) on the tape cartridge. Use a felt tip marker only.
- o Do not try to access the parts inside cartridge or touch the tape recording surfaces.
- o Do not try to clean the tape surface in any
- o Do not touch cartridge drive roller.

Storage

- o Store cartridges in a clean, dry area away from radiant heat and direct sunlight.
- o Whenever a cartridge is not installed in a drive, enclose it in a sealed container to exclude dust and dirt.
- o Do not store cartridges on top of a computer cabinet that has a top air intake or exhaust or in places where dirt can be blown by fans into the cartridge.
- o Keep the cartridge away from magnets or magnetized tools. Any tape exposed to a magnetic field can lose information.
- o Do not place heavy items on top of the tape cartridge.
- o Store cartridges in their protective containers on edge or stacked. However, when stacking cartridges, do not stack more than five high.

The TK25-K is the recommended cartridge for use with the TK25 Drive Subsystem. Refer to Appendix A for ordering information.

CHAPTER 5
SOLVING PROBLEMS

This chapter tells you what to do if you have a problem with the TK25. The chapter is divided into three sections. The first section has a troubleshooting chart that lists some of the problems and the steps you take to correct them. The second section has procedures to verify that the TK25 is operating correctly, in case another part of the system is causing the problem. The third section explains your options for servicing a malfunction if it cannot be remedied immediately.

IDENTIFYING AND CORRECTING PROBLEMS

Table 5-1 lists some of the symptoms, causes, and solutions for troubleshooting the TK25. To use the table, take the following steps.

1. Determine what the TK25 is or is not doing.
2. Match your symptom with one in the first column. The most probable symptoms are listed first.
3. Check the conditions listed in the second column.
4. Follow the advice given in the third column.

VERIFICATION TESTS

This section has two general procedures for verifying proper drive operation. Follow the steps in order. If the Fault indicator remains on during either test, the drive has a failure and fault isolation should be performed.

Test 1: Power-On Check

1. Eject and unload tape cartridge.
2. Remove power from drive by setting the ON/OFF switch (at the rear of the drive) to OFF (Figure 3-1).
3. Turn power back on. (Set the switch to ON).
4. The TK25 enters a short diagnostic test as soon as power is applied. When the test is complete and if the drive is working, all indicators are off.

NOTE: A portion of this diagnostic test causes the ON-LINE and fault indicator to light momentarily. This brief indicator flash is normal.

5. Continue to test 2 if the FAULT indicator does not come on. If the Fault indicator is on, refer to "Servicing Options" in this chapter for servicing information.

Test 2: Tape Initialization Check
Perform this test after the drive passes the power-on check.

1. Load a tape cartridge into the drive.

2. Observe that ON-LINE indicator flashes slowly for about 4-1/2 minutes.

3. Observe that ON-LINE indicator goes off at the end of tape initialization.

NOTE: At the completion of the tape initialization cycle, the ON-LINE indicator stops flashing and stays off. The Fault indicator should stay off. If these conditions do not occur, refer to "Servicing Options" in this chapter for servicing information.

4. Press ON-LINE button and observe that ON-LINE indicator comes on steady.

Table 5-1 Isolating and Correcting Problems

Symptom	Cause	Solution
Tape drive does not operate.	Dead socket	Check ac power by plugging in and turning on a lamp.
	Power cord connections	Check power cord connection at wall and at drive.
		Power switch off
		Set switch at rear of drive to ON.
	Wrong voltage selector switch setting	Determine available line voltage and set switch accordingly.
Power ok but drive does not operate.	Electrical or mechanical malfunction	Refer to Servicing Options" in this chapter.
Fault indicator is on.	One of many	Refer to "Servicing Options".
Abnormal noises are coming from inside drive.	Mechanical malfunction	Stop drive immediately. Do not try another cartridge in this drive and do not try to insert this cartridge in another drive. Refer to Servicing Options in Appendix A.
Excessive data errors occur when reading or writing.	Damaged or dirty tape	Try another cartridge.
	Mechanical or electrical malfunction	Refer to Servicing Options.
	Dirty magnetic head	Clean magnetic head (refer to Chapter 4).
	Incorrectly stored or handled tape cartridge	Refer to Chapter 4.
Host computer system cannot access drive.	Interface cable connections	Check cable connections at drive and at computer.

SERVICING OPTIONS

In most cases, you should maintain the TK25 the same way you maintain its host computer. For this reason, contact the person responsible for maintaining the system (system manager) to determine the correct method. Your options are as follows.

Digital Field Service

Digital offers a wide range of services. "Support Services" in Appendix A lists them. If you need Digital service for warranty, contract, or time and materials (per call) maintenance, call the Digital Field Service office nearest you.

SELF-MAINTENANCE

Digital offers a full line of support products for self-maintenance customers including service documentation and spare parts kits. if your TK25 is out of warranty and your organization performs its own corrective maintenance, contact the person who is responsible for maintaining your computer system.

CHAPTER 6
PROGRAMMING

INTRODUCTION

This chapter provides operational information and a functional description of the TK25 registers and packet processing. It also gives programming techniques and performance-improving hints (with programming examples and packet formats) to show basic TK25 programming concepts and advanced performance.

PERFORMANCE EVALUATION

Speed Modes and Speed Selection

The TK25 operates at 55 inches per second streaming speed. When streaming, the TK25 is not capable of starting and stopping in the interblock gap (IBG), as are conventional tape drives. When a streaming drive does have to stop, it:

- Slowly coasts forward to a stop.
- Backs up over a section of tape previously processed.
- Awaits the next command.
- Accelerates, taking a running start so that when it encounters the original interblock gap, it is at full speed.

This cycle is called repositioning. About 0.35 seconds (nominal) is needed to complete an entire repositioning cycle. If the CPU is not capable of supplying data to, or accepting data from, a streaming tape drive at a rate that keeps the drive constantly in motion (streaming), the drive repositions when it runs out of commands to execute.

Performance Hints

The frequency of TK25 repositioning is application-dependent -- a function of how fast the CPU can process data, relative to the tape speed of the transport while it's streaming. One way to increase the probability of 55 in/s streaming is to build a large data buffer in main memory that can deliver or accept data at tape-streaming rates. This makes sure that a known, large amount of data is processed (the data in the buffer) before a potential reposition cycle. The total percentage of time the tape drive is doing useful work is then increased relative to the time spent repositioning.

A buffer allocated by the application's program should have the capacity of at least 32K bytes (e.g., eight 4K byte records) to help attain better overall performance. Furthermore, a ring buffer type is suggested which allows reading and writing into the buffer at the same time to prevent or delay an empty buffer condition.

If the potential data rate to or from the host CPU is greater than the tape streaming rate, then the tape streams and no buffering is necessary. However, if the potential rate drops below the streaming rate, the buffer reduces the frequency of repositioning and there are enhanced opportunities for high-speed streaming.

In several cases Digital operating systems have the capability of buffering I/O channels. An example is the Multi-Buffered File Control System of RSX-11M. Wherever possible, operating system features of this type should be selected to also enhance opportunities for high-speed streaming.

TK25 Recording Method
Recording on the TK25 is done in a single-track serpentine mode. The end of each track is marked by an actual hole in the tape, called the Early Warning hole. If a record is written over this hole, an error results and is reported to the CPU. A Write Retry sequence causes a complete erasure of the record just written and 4 inches past ECC, and causes the record to be rewritten on the next track.

When a tape cartridge is inserted in the TK25 there is a retensioning cycle controlled by the drive. The tape must be moved to the far end and then back to BOT to adjust its tension on the reels. This may take up to five minutes. Any Read command which goes into early warning spends extra time to stop the tape, move the head to the next track, and restart in the opposite direction. Any command not received in time for streaming to continue causes a time penalty to reposition the tape. If the drive fails to find a servo stripe at the beginning, it must spend 25 seconds to write one on the tape when the first write type command is issued.

REGISTERS
When using the TK25 tape transport, it is important to understand that command and data packets are used to transfer command and data information to the transport. The traditional method of writing a command or data word to a Q-BUS register is not used. A command packet consists of a command word and up to three additional words of command modifiers or qualifiers. This command packet is assembled in host CPU memory space on modulo-4 memory addresses. The beginning address of the command packet is the command pointer. Only the high 16-bits of an 18-bit word are used. This pointer is used by the controller to transfer the command packet to the subsystem via NPR (non-processor request).

The following are the eight TK25 registers on the M7605 adapter board.

TSBA	(1) --	Address Register
TSDB	(1) --	Data Buffer
TSSR	(1) --	Status Register
XST	(5) --	Extended Status Registers

Figure 6-1 is a summary of the registers.

REGISTER \ BITS	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
TSBA (R/O)	A15	A14	A13	A12	A11	A10	A09	A08	A07	A06	A05	A04	A03	A02	A01	A00
TSDB (W/O)	P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P17	P16
TSSR	SC S			RMR S	NXM 4/5	NBA S	A17 S	A16 S	SSP S	OFL S			TC2 • S	TC1 • S	TC0 • S	
RBPCR (EXTENDED STATUS REGISTERS)	C15	C14	C13	C12	C11	C10	C09	C08	C07	C06	C05	C04	C03	C02	C01	C00
XST0 (EXTENDED STATUS REGISTERS)	TMK S/2	RLS 2	LET 2	RLL 2	WLE 3/6	NEF 3	ILC 3	ILA 3	MOT S	ONL S/1/3	IE S	VCK S/3		WLK S/3/6	BOT S/2/3	EOT S/2
XST1 (EXTENDED STATUS REGISTERS)	DLT 4			CRS 4	NER 4				TN3 S	TN2 S	TN1 S	TN0 S			UNC 4	
XST2 (EXTENDED STATUS REGISTERS)	OPM S	DCF 7	DHF 7	SPD 7	0		1		← ERROR ADDR. LST. SIG. BYTE → S	S	S	S	S	S	S	S
XST3 (EXTENDED STATUS REGISTERS)	← ERROR ADDR MOST SIG. BYTE → S	S	S	S	S	S	S	S		OPI 6	REV S	TCH 7	STP S/6			RIB 2

• Termination Class Codes:

- 0 = Normal Termination
- 1 = Attention Condition
- 2 = Tape Status Alert
- 3 = Function Reject
- 4 = Recoverable Error - Tape Position - One record down tape from start of function
- 5 = Recoverable Error - Tape not removed
- 6 = Unrecoverable Error - Tape position lost
- 7 = Fatal Controller Error

NON-TERMINATION CLASS CODE: S= STATUS

MA-2845C

SHR-0125-84

Figure 6-1 TK25 Register Summary

TSBA (Address Register -- Base Address -- Read Only)
The TSBA is a 16-bit register which is parallel loaded from the TSDB with the command pointer (address) every time the controller is a slave. If the controller is a master, the TSDB contains data. The least two significant bits of the 18-bit bus address are assumed to be Ø. Bits 15 through 2 of the TSDB are loaded into bits 15 through 2 of the TSBA. Bits 1 and Ø of the TSDB contains bits 17 and 16, respectively, of the address. These bits are not loaded in the TSBA but are loaded in bits 9 and 8, respectively, of the TSSR (see Figure 6-5). Bits 1 and Ø of the TSBA are set to Ø.

NOTE

If a 22-bit Q-bus is used the command pointer must be programmed to be within the 18-bit address space. The message buffer (data) can be anywhere within the 22-bit address space.

The transport can instruct TSBA to increment or decrement by two for nonprocessor request (NPR) word transfers, or by one for NPR byte transfers. The TSBA is the base address in the read only mode and it is not cleared on power up, subsystem INIT, or bus INIT. It can also be read at any time with or without the drive unit connected.

Figure 6-3 shows the bus address. Table 6-1 lists and defines the bus address bits. The TSBA register and bits 9 and 8 of the TSSR serve the following two major purposes.

1. The TSBA can be used as a pointer to the command packet in CPU memory. The content, loaded into TSDB when the M76Ø5 is the bus slave, is considered the command or message pointer. In this mode, the M76Ø5 receives data (initiated by the transport) at this command pointer address and sends it to the transport for storage and/or execution.

2. When the M76Ø5 is bus master, the TSBA is used as a data pointer (NPR's bus address Ø), pointing to data buffer areas located somewhere in the bus address space. (In this mode, the transport loads the TSDB with 18 address bits; TSDB bits 15 through 2 load into TSBA bits 15 through 2, and bits 17 and 16 are displayed in TSSR bits 9 and 8, respectively, from TSBA bits 1 and Ø.) The contents of TSBA are then used to point to data buffer areas while the M76Ø5 transfers data by NPRs.

Table 6-1 Bus Address Bit Definitions

Bit	Name	Definition
17	A17	Bus address bit 17
16	A16	Bus address bit 16
15	A15	Bus address bit 15
14	A14	Bus address bit 14
13	A13	Bus address bit 13
12	A12	Bus address bit 12
11	A11	Bus address bit 11
1Ø	A1Ø	Bus address bit 1Ø
Ø9	AØ9	Bus address bit Ø9
Ø8	AØ8	Bus address bit Ø8
Ø7	AØ7	Bus address bit Ø7
Ø6	AØ6	Bus address bit Ø6
Ø5	AØ5	Bus address bit Ø5
Ø4	AØ4	Bus address bit Ø4
Ø3	AØ3	Bus address bit Ø3
Ø2	AØ2	Bus address bit Ø2
Ø1	AØ1	Bus address bit Ø1
ØØ	AØØ	Bus address bit ØØ

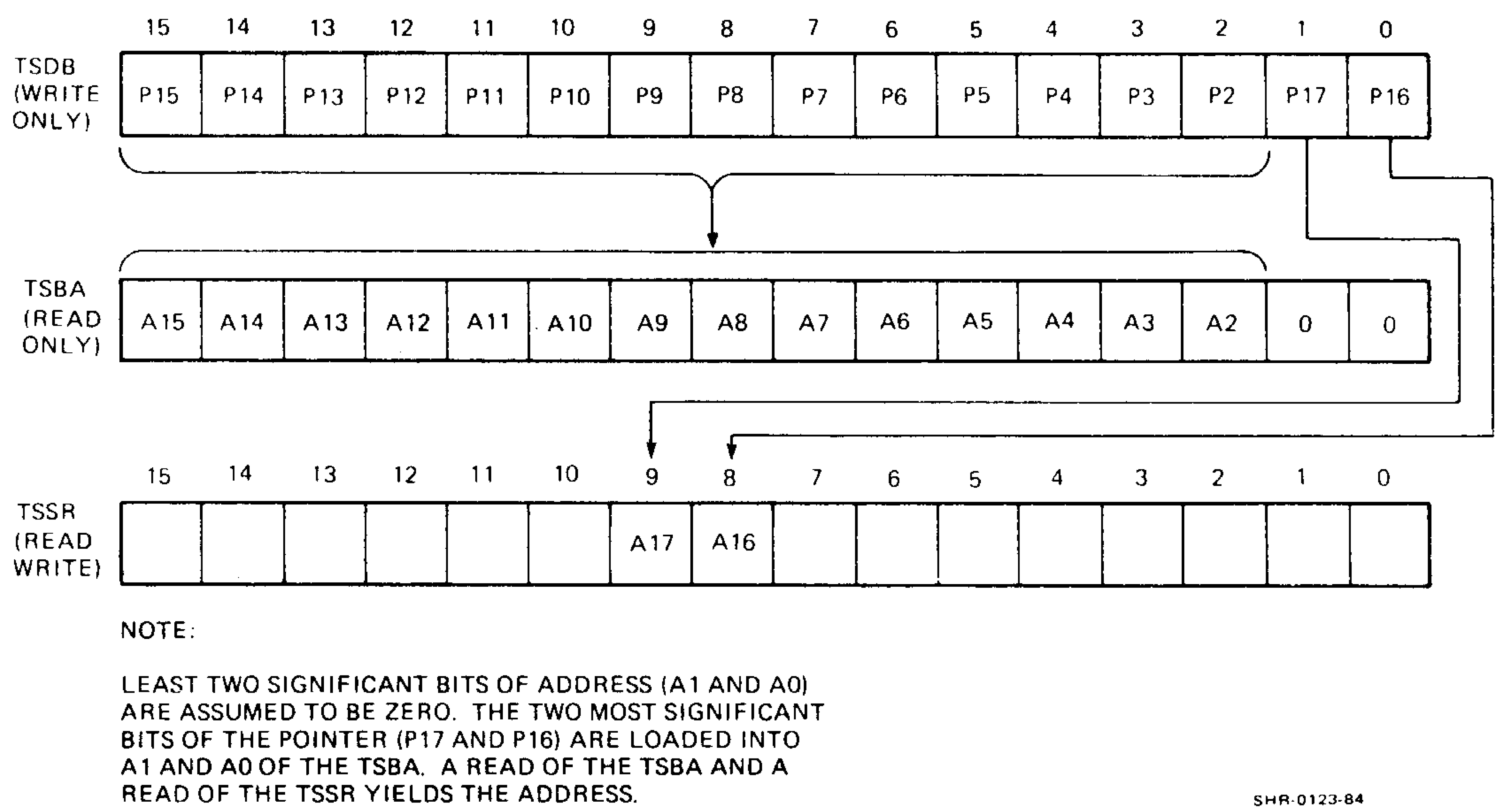

Figure 6-2 Address Loading

17	16	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
A17	A16	A15	A14	A13	A12	A11	A10	A09	A08	A07	A06	A05	A04	A03	A02	A01	A00

MA-2944
SHR-0135-84

Figure 6 3 TSBA Register

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
P15	P14	P13	P12	P11	P10	P09	P08	P07	P06	P05	P04	P03	P02	P17	P16

MA-2945
SHR-0136-84

Figure 6-4 TSDB Register

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
SC			RMR	NXM	NBA	A17	A16	SSR	OFL			TC2	TC1	TC0	
S			S	4/5	S	S	S	S	S			S	S	S	

MA-2953A
SHR-0137-84

Figure 6-5 TSSR Register

TSDB (Data Buffer Register -- Base Address -- Write Only)
The TSDB is a 16-bit register. It is parallel loaded from the bus or from the transport. The register is used as a word buffer register to the M7605 when the M7605 is the bus slave (for beginning an operation). The same word buffer register is also used by the transport (for data during NPR transfers) when the M7605 is bus master. The TSDB can be loaded when the M7605 is bus slave by three different transfers from a bus master. Two transfers are for maintenance purposes (DATOB to high byte and DATOB to low byte). The third transfer is for normal (word) operation (DATO). This register is write only and is not cleared at power up, subsystem initialize, or bus initialize. It cannot be loaded without the complete transport unit connected and a serial bus synchronous clock. The M7605 responds with SSYN any time the TSDB is written to.

Figure 6-7 shows the TSDB register. Table 6-2 lists and define the bits.

Normal Operation -- When TSDB is loaded by a DATO (write a word to TSDB) the following happens. Bit 0 and bit 1 are loaded with zeros. Bits 2 through 15 are loaded with bits 2 through 15, respectively, from the bus. Bits 16 and 17 are loaded from bits 0 and 1, respectively, from the bus. The bus address is 17XXXX, where XXXX can be any unused address from 0 through 7776. The M7605 indicates to the transport a TSDB word load when the M7605 is bus slave.

TSSR (Status Register -- Base Address + 2 -- Read/Write)
The TSSR is a 16-bit register that can only be updated from the transport or internal M7605 logic. The TSSR cannot be modified from the bus except for RMR, NXM, and SSR bits that are cleared when the TSDB is written by the host CPU. It is a read/write register at base address 17XXXX+2. (The DATO/DATOB write transfers cause the M7605 to modify 17XXXX+2.) It can be read at any time with or without the transport unit connected. Figure 6-8 shows the bit positions and Table 6-3 describes the bits.

TSSR register bits 14 through 11 and 7 are cleared only on system power up, TK25 power up, subsystem initialize, or at the beginning of any write command to the TSSR register. Bits 15 and 7 are also under control of the transport. These may be set or cleared independently of any TK25 operation. Bits 10 and 5--0 are exclusively controlled by the transport and reflect the transport status as indicated.

NOTE

Any write function to the M7605 base address 1725XX is decoded as a subsystem initialize. This resets the M7605 and TK25 no matter what state they are in and causes an automatic load sequence returning the tape to BOT if the TK25 is on-line.

The TSSR register uses several bits to increase its status reporting capabilities. TSSR bits 1, 2, and 3 report seven termination class status codes. Fatal error bits are valid only if the termination class equals 7.

Table 6-2 TSDB Bit Definitions

Bit	Name	Definition
15	P15	Command pointer bit 15
14	P14	Command pointer bit 14
13	P13	Command pointer bit 13
12	P12	Command pointer bit 12
11	P11	Command pointer bit 11
1Ø	P1Ø	Command pointer bit 1Ø
Ø9	PØ9	Command pointer bit Ø9
Ø8	PØ8	Command pointer bit Ø8
Ø7	PØ7	Command pointer bit Ø7
Ø6	PØ6	Command pointer bit Ø6
Ø5	PØ5	Command pointer bit Ø5
Ø4	PØ4	Command pointer bit Ø4
Ø3	PØ3	Command pointer bit Ø3
Ø2	PØ2	Command pointer bit Ø2
Ø1	P17	Command pointer bit Ø1
ØØ	P16	Command pointer bit ØØ

Table 6-3 TSSR Bit Definitions

Bit	Name	Causes Termination Class (TC)*	Definition
15	SC	S	Special Condition -- When set, this bit indicates that an incident occurred before the last command completed. Specifically, either an error was detected or an exception condition occurred. An exception condition could be a tape mark on read commands, reverse motion at BOT, EOT while writing, etc.
14	--	--	Not used
13	--	--	Not used
12	RMR	S	Register Modification Refused -- The M7605 sets this bit when a command pointer is loaded into TSDB and subsystem ready (SSR) is not set. This bit may set on a bug-free system if ATTN interrupts are enabled.
11	NXM	4/5	Nonexistent Memory -- The M7605 sets this bit when trying to transfer to or from a memory location that does not exist. It may occur when fetching the command packet, fetching or storing data, or storing the message packet.
10	NBA	S	Need Buffer Address -- When set, this bit indicates that the transport needs a message buffer address. This bit is cleared during the set characteristics command if the transport gets valid data. This bit is always set after subsystem initialization.
09	A17	S	Bus Address Bit 17 -- A17 and A16 (bits 08 and 09) display the values of bits 17 and 16 in the TSBA register.
08	A16	S	Bus Address Bit 16 -- Refer to A17 above (bit 09).
07	SSR	S	Subsystem Ready -- When set, this bit indicates that the TK25 Subsystem is not busy and is ready to accept a new command pointer.

* S = status; number = termination class (refer to Figure 6-4).

Table 6-3 TSSR Bit Definitions (Cont)

Bit	Name	Causes Termination Class (TC)*	Definition
Ø6	OFL	S	Off-Line -- When set, this bit indicates that the transport is off-line and unavailable for any tape motion commands.
Ø5	FC1	--	Fatal Class 1 - Not used
Ø4	FCØ	--	Fatal Class Ø - Not used
Ø3	TC2	S	Termination Class Bit Ø2 -- This bit, along with the TC1 and TCØ bits, acts as an offset value when an error or exception condition occurs on a command. Each of the eight possible values of this field represents a particular class of errors or exceptions. The conditions in each class have similar significance and, recovery procedures, as applicable. The code provided in this field is expected to be used as an offset into a dispatch table for handling the condition. These bits are valid only when special condition (SC) is set. Refer to Special Conditions and Errors.
Ø2	TC1	S	Termination Class Bit Ø1 -- Refer to TC2 (bit Ø3) above.
Ø1	TCØ	S	Termination Class Bit ØØ -- Refer to TC2 (bit Ø3) above.
ØØ	--	--	Not used

* S = status; number = termination class (refer to Figure 6-4).

On fatal errors (fatal class bits equal seven), if the need buffer address is not set (NBA=0), then the message may be valid. If the need buffer address is set (NBA=1), then there was no message.

The RMR bit does not affect the error class codes because RMR may occur on a bug-free system. However, RMR sets the special condition (SC). (You may have tried to perform the next command while the drive was outputting the ATTN MESSAGE.) If RMR is seen in the TSSR, the CPU must have written the TSDB while the command was executing.

Write commands to the TSSR do not write, but invoke certain specialized functions.

1. A write word (DATO) to the TSSR initializes the TK25 subsystem and rewinds the tape on the cartridge.

2. A write byte (DATOB) to the low byte of the TSSR causes the controller to execute its resident self-tests. If the controller passes the self-tests, it then initializes itself and the drive as above. The TSDB, TSBA, and the TSSR does not respond to bus transactions during the self-test (about 1ØØ microseconds). Any attempt by the host to read or write these registers during self-test results in a non-existent device register timeout.

   The Q-bus controller (TQK25) has a "Short Boot" instruction activated by a Write Byte to the TSSR with a 1 in the high order bit position. It causes the tape to rewind, space forward one record, and then read the first 256 words or 512 bytes of data to be sent to CPU memory starting at address Ø.

3. If an operation is not in progress (SSR set in the TSSR), a write byte to the high byte of the TSSR with a "1" in the high order data bit position (bit 7) causes the subsystem to boot the CPU by means of the following sequence of events (Q-bus controller only):

   o Rewind the tape.

   o Space forward one record.

   o Read the first 256 bits of the second record into CPU memory starting at address Ø.

XST (Extended Status Registers)
Five additional registers provide additional status information: residual byte positive count register (RBPCR) and extended status registers Ø, 1, 2, and 3. Figure 6-4 shows these registers. Tables 6-4 through 6-8 define the bits.

PACKET PROCESSING
The packet protocol scheme allows the drive to send a large amount of status and error information to the CPU while using up only two words of bus address space. The packet protocol also prevents the drive from updating the error and status information asynchronously, that is, while the CPU is reading the error and status information.

NOTE

This section is not intended to detail all aspects of packet protocol or packet processing. It is intended to show how these concepts are implemented in the TK25 Subsystem.

Table 6-4 RBPCR Bit Descriptions

Bit	Name	Description
15--0	C15--C0	This word contains the octal count of residual bytes, records, tape marks for the Read, Space Records, and Skip Tape Mark commands. The contents are meaningless for all other commands.

Table 6-5 XSTATØ Bit Definitions

Bit	Name	Causes Termination Class (TC)*	Definition
15	TMK	S/2	Tape Mark Detected -- This bit is set when a tape mark is detected during a read, space, or skip command and as a result of the write tape mark or write tape mark retry commands.
14	RLS**	2	Record Length Short -- This bit indicates one of the following three cases. 1. The record length was shorter than the byte count on read operations. 2. A space record operation encountered a tape mark or BOT before the position count was exhausted. 3. A skip tape marks command was terminated by encountering BOT or a double tape mark (if skip tape marks command is enabled, see LET) before exhausting the position counter.
13	LET	2	Logical End of Tape -- This is set only on the skip tape marks command under two conditions: 1. When either two contiguous tape marks are detected. 2. When moving off BOT and the first record encountered is a tape mark. The setting of this bit will not occur unless 'logical end of tape' termination is enabled through use of the set characteristics command.
12	RLL**	2	Record Length Long -- When set, this bit indicates that the record read was longer than the byte count specified.

* S = status; number = termination class (refer to Figure 6-4).

** The TK25 supports a record length of 16K bytes instead of 64K bytes. If a longer record is written and the record has a write error, the TK25 has a strong probability of getting lost when it attempts to backspace over the record for a Write Retry.

Table 6-5 XSTATØ Bit Definitions (Cont)

Bit	Name	Causes Termination Class (TC)*	Definition
11	WLE		Write Lock Error -- When set, a TC3 indicates that a write operation was issued but the mounted tape did not contain a write-enable ring. When set, TC6 indicates the WRT LOCK switch was activated during write operation.
1Ø	NEF	3	Non-Executable Function -- When set, this bit indicates that the command could not be executed due to one of the following conditions. 1. The command specified reverse tape direction but the tape was already positioned at BOT. 2. A motion command was issued without the clear volume check (CVC) while the transport was off-line. 3. A write command was issued to a write-protected tape.
Ø9	ILC	3	Illegal Command -- This bit is set when a command is issued and either its command field or its command mode field contains codes not supported by the transport.
Ø8	ILA	3	Illegal address
Ø7	MOT	S	This bit indicates that tape was moved during an operation.
Ø6	ONL	S/1/3	On-Line -- When set, this bit indicates that the transport is on-line and operable. It causes a TC1 on ATTN interrupt or a TC3 for a nonexecutable function if rejected because the transport was off-line.
Ø5	IE	S	Interrupt Enable -- This bit reflects the state of the interrupt enable bit supplied on the last command.

* S = status; number = termination class (refer to Figure 5-4).

** The TK25 supports a record length of 16K bytes instead of 64K bytes. If a longer record is written and the record has a write error, the TK25 has a strong probability of getting lost when it attempts to backspace over the record for a Write Retry.

Table 6-5 XSTATØ Bit Definitions (Cont)

Bit	Name	Causes Termination Class (TC)*	Definition
Ø4	VCK	S/3	Volume Check -- This bit is set when the transport changes state (on-line to off-line and vice versa). It is always set after initialization.
Ø3	PED	S	Phase Encoded Drive -- The TK25 is not phase encoded, so this bit is always Ø.
Ø2	WLK	S/3/6	Write Locked -- When set, this bit indicates that the tape is write protected.
Ø1	BOT	S/2/3	Beginning of Tape -- When set, this bit indicates that the tape is positioned at the load point as denoted by the BOT reflective strip on the tape. This causes TC2 if reversed in BOT, and TC3 if at BOT when a reverse command occurs.
ØØ	EOT	S/2	End of Tape -- Sets as the head passes to track 1Ø in the forward direction. It is not reset until the head passes back to track 9 in the reverse direction. (Status on Read; TC2 on Write.) Subsystem Init also resets this bit.

* S = status; number = termination class (refer to Figure 6-4).

** The TK25 supports a record length of 16K bytes instead of 64K bytes. If a longer record is written and the record has a write error, the TK25 has a strong probability of getting lost when it attempts to backspace over the record for a Write Retry.

Table 6-6 XSTAT1 Bit Definitions

Bit	Name	Causes Termination Class (TC)*	Definition
15	DLT	4	Data Late -- This bit is set when the I/O silo is full on a read or empty on a write. The conditions occur whenever the bus latency exceeds the transport's data transfer rate for a significant number of transfers.
14	--	--	Not used
13	--	--	Not used
12	CRS	4	Crease detected. Data dropped out for up to 1.8 ms (approximately Ø.2 inch).
11	NER	4	Noise detected during erase.
1Ø	--	--	Not used
Ø9	--	--	Not used
Ø8	—	—	Not used
Ø7	TN3	S	Tape Track number high order bit
Ø6	TN2	S	Tape Track number bit 2
Ø5	TN1	S	Tape Track number bit 1
Ø4	TNØ	S	Tape Track number low order bit
Ø3	EW	S/4	Early warning hole at end of track seen
Ø2	--	--	Not used
Ø1	UNC	4	Uncorrectable Data -- In the TK25, all tape errors are uncorrectable, since there is no internal error correction.
ØØ	—	—	Not used

* S = status; numbers = termination class (refer to Figure 6-4).

Table 6-7 XSTAT2 Bit Definitions

Bit	Name	Causes Termination Class (TC)**	Definition
15	OPM	S	Operation In Progress (Tape moved)
14	DCF	7	Drive communication fault. Failure of read sense command to Tape Control Subsystem (TCS) initiated after detecting INT or DER resulting from tape motion command to TCS, or health check fault received in TCS sense bytes.
13	DHF	7	Drive Hardware Fault. No lamp current status or head positioning fault returned in TCS sense bytes.
12	SPD	7	Fast or slow capstan speed error.
11	Ø	--	TK25 Identifier -- Always Ø.
1Ø	--	--	Not used
Ø9	1	--	TK25 identifier. Always one.
Ø8	—	—	Not used
Ø7-ØØ	EAD Ø7-ØØ	S	Least significant byte of error address (program counter in the drive microcode).

NOTE

On the write characteristic command, bits Ø7 through ØØ contain the microcode revision level of the M76Ø5.

NOTE

XSTAT 2 Bits Ø7 thru ØØ have a different meaning during the Set Characteristics Command: XSTAT 2 Bits Ø6 thru ØØ return the major revision level of the controller microcode (in binary). If Bit Ø7 is a 1, the Controller assumes a 22 bit Q-Bus, and if Ø, an 18 bit Q-Bus. In the latter case, Command Packets containing addresses greater than 18 bits will generate errors.

* Refer to Bit Ø8, DTP.

** S = status; numbers = termination class (refer to Figure 6-4).

Table 6-8 XSTAT3 Bit Definitions

Bit	Name	Causes Termination Class (TC)*	Definition
15--Ø8	EAD 15--Ø8	S	Most significant byte of error address.
Ø7	--	--	Not used
Ø6	OPI	6	Operation Incomplete -- This bit is set when a read, space, or skip operation has moved 16 feet of tape without detecting any data on the tape. It is also set by a write command when the read head fails to see data transitions after four feet of tape.
Ø5	REV	S	Reverse -- This bit is set when the direction of current tape operation is reversed. For multifunction retry commands, if at least one of the commands is reversed, the bit is set.
Ø4	TCH	7	No Tachs -- Indicates that capstan motor did not start or that tachs are not being generated or detected.
Ø3	STP	S/6	Stripe -- Servo stripe is faulty or missing.
Ø2	--	--	Not used
Ø1	--	--	Not used
ØØ	RIB	2	Reverse Into BOT -- Sets when reverse operations encounter the BOT early warning hole after tape is in motion. Tape motion is halted at BOT.

* S = status; numbers = termination class (refer to Figure 6-4).

To allow the drive subsystem to use only two words of address space, we allow the CPU to define a set of locations in memory. These locations (command buffers) tell the drive which operation to perform. The CPU also defines a set of locations (message buffers) in memory where the drive puts the error and status information. The CPU must give both the command buffer address and message buffer address to the drive. The CPU gives the command buffer address to the drive on every command. (The CPU writes the address of the command packet into the TSDB of the drive.) The CPU gives the message buffer address to the drive every time the CPU does a set characteristics command.

To prevent the drive subsystem from updating the message buffer while the CPU is reading the message buffer, we have defined the concept of ownership. The command and message buffers both can be owned. Each buffer may be owned by the drive or the CPU, but not by both at the same time. Ownership of a buffer can only be transferred by the current owner.

There are four different combinations that transfer ownership of the two buffers.

1. The CPU can transfer ownership of the command buffer to the drive.

2. The CPU can transfer ownership of the message buffers to the drive.

3. The drive can transfer ownership of the command buffer to the CPU.

4. The drive can transfer ownership of the message buffers to the CPU.

As an example, assume the CPU owns both the command buffer and message buffer. In general, the sequence of events is described below.

- The CPU sets up its command and message buffers in memory.

- The CPU loads the address of the command packet into the TSDB register. This step performs two functions: it clears the Subsystem Ready Bit (SSR) in the TSSR status register, and it transfers ownership of the command buffer to the Tape Control Subsystem (TCS).

  TSDB is parallel-loaded into TSBA, so that the TCS knows where in memory the command header word is.

  The command packet, among other things, tells the controller where in memory the message packet is located.

The drive subsystem can now retrieve and execute the command, and use the data provided by the message packet.

NOTE

The ACK bit (bit 15 in the command packet header word) is set when a command is issued and the CPU owns the message buffer. It informs the TCS that the message buffer is now available for writing a message packet, and transfers ownership of the message buffer to the TCS.

Now assume that the drive owns both the command buffer and message buffer. The sequence of events is described below.

- o The drive now outputs the message buffer which consists of status information to be returned to the CPU.

- o If the drive has set the ACK bit in the message buffer, ownership of the command buffer is transferred back to the CPU. This indicates that the command buffer is ready to accept another command packet. The ACK bit is never set on an ATTN condition (see class code field in message packet header word).

- o When the drive outputs the message buffer, it sets the SSR bit in the TSSR status register to indicate to the CPU that the message is in the message buffer.

- o If the message buffer does not contain the ACK bit, the CPU knows that the drive never saw the last command and, therefore, can reissue the command.

- o The drive has two ways of transferring ownership of the message buffer back to the CPU.

  At the end of the command, it can set the SSR bit in the TSSR register, to indicate that the command is complete (it can also interrupt the CPU if the interrupt enable bit has been set).

  Or, it can raise an attention (ATTN). ATTN can only occur when the drive is in an inactive state and the proper "characteristics word" has been set in the command header word. During an ATTN, the drive clears SSR, outputs the message, sets SSR again, and interrupts (if interrupts are enabled).

NOTE

If the CPU writes the TSDB while the SSR is clear during an ATTN, the register modification refused (RMR) error bit is set and that command is ignored. The ATTN message does not have the ACK bit set since the drive does not own the command buffer. Note that RMR may set in this way on a bug-free system because the CPU tried to perform a command at the same time the drive wanted to perform an ATTN. All other settings of the RMR indicate a software bug. (The CPU tried to do a command before the previous command was finished.) If the CPU command was lost because the transport was outputting an ATTN message, VOL CHK and INT ENB are not updated. If the CPU command was rejected (illegal command, etc.), VOL CHK and INT ENB are updated to the start of the rejected command.

When the drive is initialized, the drive updates the TSSR. At this time we define both the command and message buffers as belonging to the CPU. When the CPU wants to do a command (the first one must be a set characteristics to set up the message buffer address), the CPU writes the address of the command buffer into the TSDB of the drive. This command must have the ACK bit set to give ownership of the message buffer to the drive. At this point, the drive owns both the command and message buffers.

The drive executes the write characteristics command and sends out a message to the message buffer address with the ACK bit set. This indicates that the drive recognized the command and is finished with the command buffer. The drive then sets SSR and interrupt (if IE is set). At this point, the CPU owns both the message and command buffers again.

As you can see, the ownership of both buffers transfers from CPU to drive and then from drive to CPU at the same time. Now consider the case where ATTNs are enabled by the proper characteristics mode word and the drive wants to do an ATTN. An ATTN only occurs when the drive is not active. If the CPU owns both the command and message buffers, the drive must queue up the ATTN and not do anything until the CPU releases the message buffer on the next command. So when the CPU executes the next command (with the ACK bit set), the drive outputs the ATTN message with the ACK bit Ø. This indicates that the command was lost (except for the transfer of the message buffer ownership to the drive). The drive refuses to accept ownership of the command buffer. The CPU then still owns the command buffer (because the drive did not accept the command) and also owns the message buffer now filled with an ATTN message. If the CPU still wants to do the ignored command, the CPU must reissue the command (with the ACK bit set).

Now consider the case where the CPU wants to be notified of a change in status right away while the drive is inactive for a long period of time. To do this, the drive must own the message buffer for that long period of time. Everything until now has indicated that the drive gives up the message buffer at the end of every command. The message buffer release command is a special command from the CPU. It tells the drive not to give ownership of the message buffer back to the CPU at the end of the command. The drive does not output a message at the end of the command but just outputs the TSSR (with the SSR bit set) and interrupts (if the proper characteristics mode word is set up). The drive then maintains ownership of the message buffer until an ATTN condition is seen. The drive then immediately clears SSR, outputs the message (with the ACK bit not set since the drive is not responding to a command), and then sets SSR and interrupts (if IE is set). At that time the system is back to the state of the CPU owning both buffers. Another ATTN is not done until the CPU does a command with the ACK bit set to release ownership of the message buffer containing the ATTN message.

Suppose the CPU has done a message buffer release command and wants to do another command but has not received an ATTN from the drive (so that the drive still owns the message buffer from the message buffer release command). The CPU can do a command without the ACK bit set in the command buffer. At the time of the command, the CPU does not own the message buffer so the CPU cannot release the message buffer. If the CPU does set the ACK bit, nothing happens (except the CPU might miss an ATTN if the drive was sending out an ATTN at the same time that the CPU was doing a command).

Message packet protocol may be violated if the transport gets an error (e.g., NXM) during the reading in of the message packet. When one of these errors occurs, the transport always sends out a failure message (because the packet is not reliable).

The system software should be written so it will not crash if the TK25 M7605 interrupts while the CPU is servicing a TK25 interrupt. However, this may happen, but only if the TK25 receives a fatal hardware error.

Command Packet/Header Word

Figure 6-9 shows the command packet/header word and Table 6-9 defines it. Table 6-10 gives the command code and command mode definitions.

Bits 3 and 4 of the command code field determine the format and length of command packets. The command packet formats and lengths are as follows.

Table 6-9 Command Packet Header Word Bit Definitions

Bit	Name	Function
15	Acknowledge	This bit is set when a command is issued and the CPU owns the message buffer. It informs the M7605 that the message buffer is now available for any pending or subsequent message packets. This passes ownership of the message buffer to the transport.
14--12	Device Dependent Bits/Field	The following shows how these three bits are implemented. Bit / Name / Definition 14 / CVC / Clear volume check 13 / OPP / Opposite (reverse the execution sequence of the reread commands) 12 / SWB / Swap bytes
11--8	Command Mode Field	This bit acts as an extension to the command code and mode field and allows specification of extended device commands (seek, rewind, erase, write tape mark, etc.). Command code and mode field are detailed in Table 6-10.
7--5	Packet Format #1 Field	The following two values are defined in this field. Bit Values / Definition 000 / One word header; interrupt disable 100 / One word header; interrupt enable
4--0	Command Code	Refer to Table 6-10.

Table 6-10 Command Code and Mode Field Definitions

Command Code Field	Command Name	Command Mode Field	Mode Name
00001	Read	0000	Read next (forward)
		0001	Read previous (reverse)
		0010	Reread previous (space reverse, read two)
		0011	Reread next (space forward, read reverse)
00100	Write Characteristics	0000	Load message buffer address and set device characteristics
00101	Write	0000	Write data (text)
		0010	Write data retry (space reverse, erase, write data)
00110	Write Subsystem	0000	Normal (diagnostic use only)
01000	Position	0000	Space records forward
		0001	Space records reverse
		0010	Skip tape marks forward
		0011	Skip tape marks reverse
		0100	Rewind
01001	Format	0000	Write tape mark
		0001	Erase
		0010	Write tape mark entry (space reverse, erase, write tape mark)
01010	Control	0000	Message buffer release
		0001	Rewind and unload
		0010	Clean (NOP on TK25)
01011	Initialize	0000	Drive initialize
01111	Get Status Immediate	0000	Get status (END message only)

Code Bits	Definition
ØØXXX	Four words (header, two word address, count)
Ø1XXX	Two words (header, parameter word) or one word (header)

The swap byte bit in the command packet header word (bit 12) instructs the M75Ø5 to alter the sequence of storing and retrieving bytes from the CPU's memory. When swap bytes = 1, an industry compatible sequence (beginning with an even byte) is used. When swap bytes = Ø, the swapping begins with an odd byte. (This is so only for data transferring; it is ignored otherwise.)

Figures 6-1Ø and 6-11 indicate the memory positions for the bytes as they are read from or written on the tape. In these examples, the bytes of data in the record block on tape are numbered starting at Ø. Byte Ø is always the data byte at the beginning of the block (that is, the part of the block that is closest to BOT).

NOTE

Since the TK25 drive cannot actually do a read reverse, the TK25 emulates this TS11 instruction. It involves 5 passes over the record.

Space Reverse

Read Forward to count the bytes without sending them to the CPU

Space Reverse

Read Forward, sending information to the same addresses as would the TS11

Space Reverse

This process is slow and error prone because of the thrashing and instantaneous speed variations involved.

Command Packet Examples

Examples of the command packets and operational programming notes used in the TK25 Subsystem are provided in this section. Refer to the figure corresponding to the command packet example you are interested in.

15	14		12	11			8	7		5	4				0
CTL	DEVICE DEPENDENT			COMMAND MODE				PACKET FORMAT 1			COMMAND CODE				
ACK	CVC	OPP	SWB	O	O	M	M	IE	O	O	O	C	C	C	C

MA-2957
SHR-0129-84

Figure 6-6 Command Packet Header Word

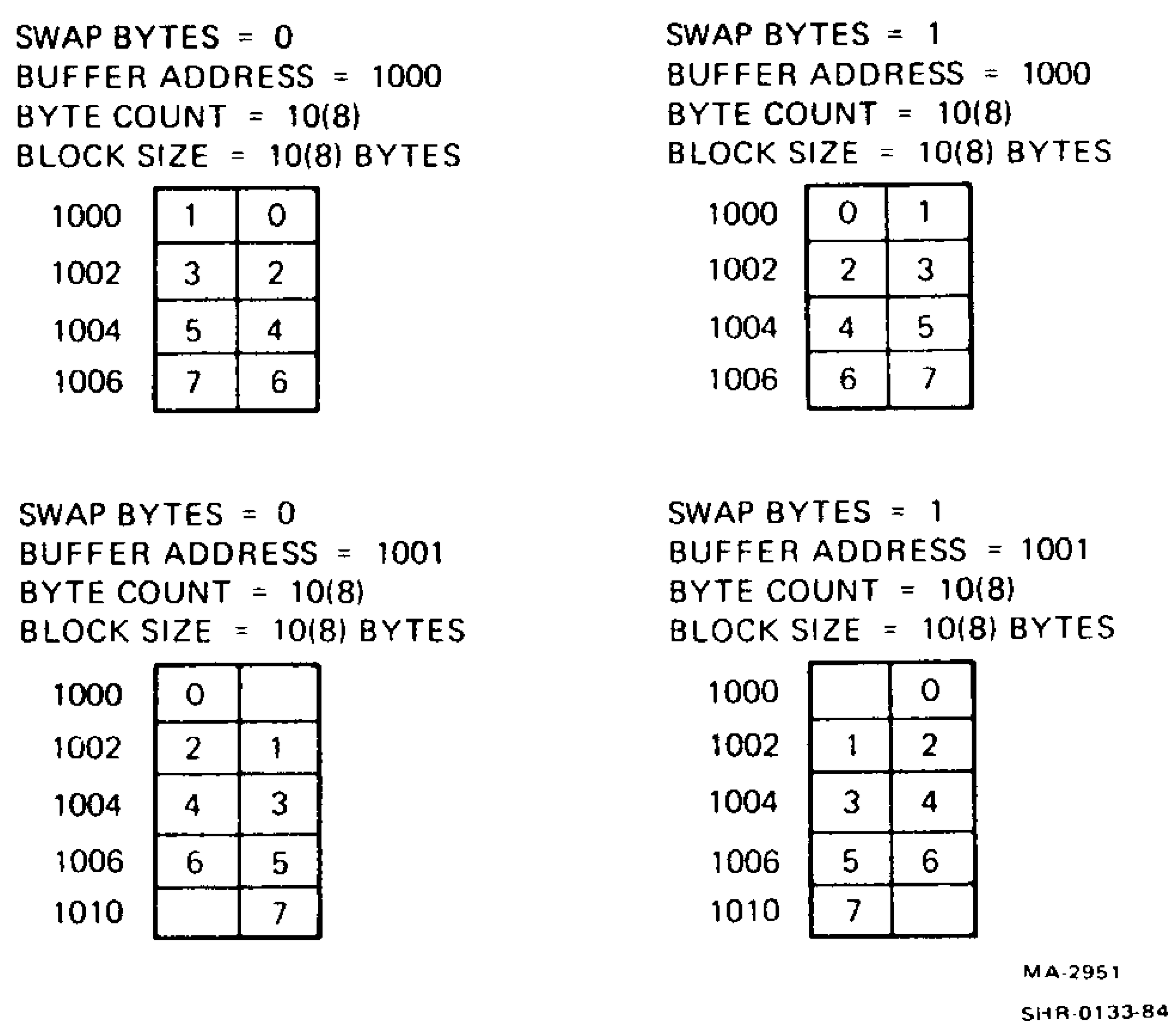

Figure 6-7 Byte Swap Sequence, Forward Tape

SWAP BYTES = 0
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	1	0
1002	3	2
1004	5	4
1006	7	6

SWAP BYTES = 1
BUFFER ADDRESS = 1000
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	1
1002	2	3
1004	4	5
1006	6	7

SWAP BYTES = 0
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000	0	
1002	2	1
1004	4	3
1006	6	5
1010		7

SWAP BYTES = 1
BUFFER ADDRESS = 1001
BYTE COUNT = 10(8)
BLOCK SIZE = 10(8) BYTES

1000		0
1002	1	2
1004	3	4
1006	5	6
1010	7	

SWAP BYTES = 0
BUFFER ADDRESS = 1000
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	1	0
1002	3	2
1004	5	4
1006		6

SWAP BYTES = 1
BUFFER ADDRESS = 1000
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	0	1
1002	2	3
1004	4	5
1006	6	

SWAP BYTES = 0
BUFFER ADDRESS = 1001
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000	0	
1002	2	1
1004	4	3
1006	6	5

SWAP BYTES = 1
BUFFER ADDRESS = 1001
BYTE COUNT = 7
BLOCK SIZE = 7 BYTES

1000		0
1002	1	2
1004	3	4
1006	5	6

MA-2952
SHR-0134-84

Figure 6-8 Byte Swap Sequence, Reverse Tape

15	14		12	11			8	7		5	4				0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	0	0	0	0	0	IE	0	0	0	1	1	1	1
NOT USED															

MODE: 0000 = GET STATUS (END MESSAGE ONLY)

NOTE:
SEE MESSAGE PACKET
EXAMPLES FOR DATA FORMAT.

MA-2956
SHR-0127-84

Figure 6-9 Get Status Command Packet Example

NOTE

All four words of the command packet are always read in, even if the command takes only one word (rewind) or two words (space). Thus, the command packet must contain four words, and it must have good parity because the transport rejects the command packet on the basis of errors in the unused words.

Command Packet Example	Figure Number
Get status	6-9
Read	6-10
Write characteristics	6-11
Write	6-12
Position	6-13
Format	6-14
Control	6-15
Initialize	6-16

Get Status Command -- Figure 6-12 shows the get status command packet. This command causes an update of the five extended status registers in the message buffer area. However, after the end of any command, the TK25 hardware automatically updates the extended status registers. Therefore, this command need only be used when the TK25 has been left idle for some time or when a status register update is desired without performing a read, write, or position tape command.

Read Command -- Figure 6-13 shows the read command packet. There are four modes of operation: read forward, read reverse, reread previous, and reread next. In all cases a read operation is assumed to be for a record of known length. Therefore, the correct record byte count must be known. If the byte count is correct, normal termination occurs. If the record is shorter than the byte count, record length short (RLS) sets and a tape status alert (TSA) termination occurs. If the record is larger than the byte count, record length long (RLL) and tape status alert (TSA) are set. Also, any read operation that encounters a tape mark does not transfer any data. In this case tape mark (TMK) and record length short (RLS) are set and a tape status alert (TSA) termination occurs.

Read reverse operations that run into BOT cause Reverse Into BOT (RIB) to set and cause a tape status alert (TSA) termination. Tape motion stops at BOT. Read reverse while at BOT causes a function reject (NEF) status, with no tape motion.

> NOTE
>
> When reading reverse, the first data byte read is the last data byte of the sequence written. The read reverse command stores this first byte in the last buffer position; the next byte in the next to last buffer position, etc. This results in having data put in memory in the right order when reading the buffer sequentially.

Write Characteristics Command -- Figure 6-14 shows the write characteristics command packet. Its objective is to inform the TK25 Subsystem of the location and size of the message buffer in CPU memory space. The message buffer must be at least seven contiguous words long and begin on a word boundary.

The write characteristics command also transfers a characteristics mode word to the transport. This word causes specific actions for certain operational modes. Table 6-11 defines the bits for this word.

If a good message buffer address has not been loaded with a write characteristics command, the need buffer address (NBA) bit in the TSSR register sets.

The following concerns bit usage in the characteristics word.

> Interrupts Enables -- If interrupts are enabled (IE), interrupts may occur at any time. This is due to the possibility of diagnostic interrupts and AC LO occurring immediately after normal terminations (even if ATTN interrupts are not enabled). The software must therefore defend against unexpected interrupts. The drive may not be usable, but the software still should not crash.

Table 6-11 Write Characteristics Data Bit Definitions

Bit	Name	Definition
15--Ø8	--	Not used
Ø7	ESS	Enable Skip Tape Marks Stop: When this bit is set, it instructs the transport to stop during a skip tape mark command when a double tape mark (two contiguous tape marks) has been detected. In the default setting of Ø, the skip tape marks command terminates only on tape mark count exhausted or if it runs into BOT.
Ø6	ENB	This bit is only meaningful if the ESS bit is set. If the drive is at BOT, when a skip tape marks command is issued and the first record seen is a tape mark, then the transport sets LET and stops after the first tape mark. If the bit is clear, the drive does not set LET but just counts the tape mark and continues.
Ø5	EAI	Enable Attention Interrupts: When this bit is a Ø, attention conditions, such as off-line, on-line, and microdiagnostic failure, do not result in interrupts to the CPU. If set to a 1, interrupts are generated.

NOTE

Transport must own the message buffer, via message buffer release, to set attention interrupts.

Bit	Name	Definition
Ø4	ERI	Enable Message Buffer Release Interrupts: If this bit is Ø, interrupts are not generated when a message buffer release command is received by the transport. Upon recognition of the command, only subsystem ready (SSR) is reasserted. If ERI is a 1, an interrupt is generated.
Ø3	--	Not used
Ø2	--	Not used
Ø1	--	Not used
ØØ	--	Not used

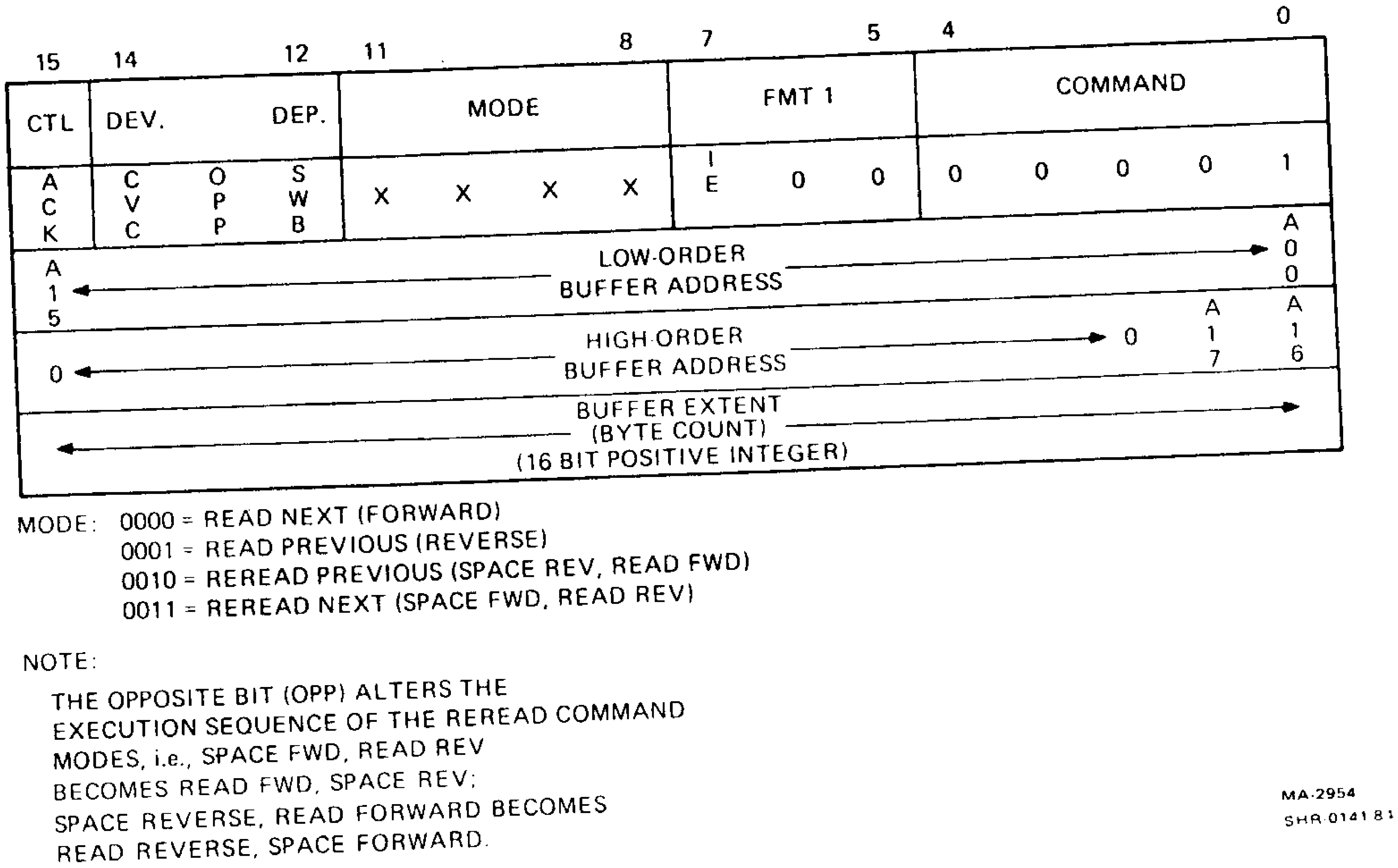

Figure 6-10 Read Command Packet Example

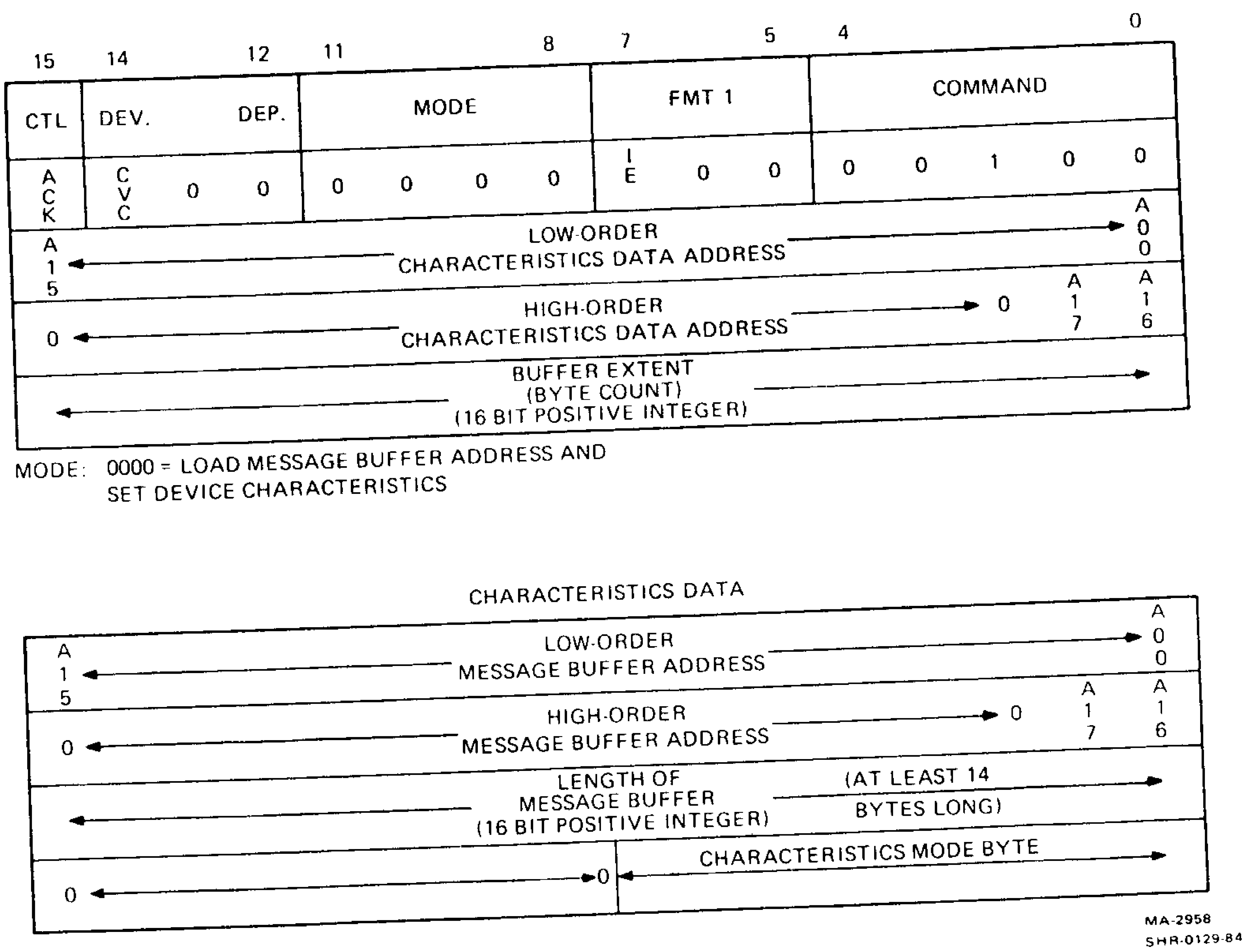

Figure 6-11 Write Characteristics Command Packet Example

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	SWB	X	X	X	X	IE	0	0	0	0	1	0	1
A15 ← LOW-ORDER BUFFER ADDRESS → A00															
0 ← HIGH-ORDER BUFFER ADDRESS → 0														A17	A16
← BUFFER EXTENT (BYTE COUNT) (16 BIT POSITIVE INTEGER) →															

MODE: 0000 = WRITE DATA
0010 = WRITE DATA RETRY (SPACE REV, ERASE, WRITE DATA)

MA-2959
SHR-0130-84

Figure 6-12 Write Command Packet Example

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	0	X	X	X	X	IE	0	0	0	1	0	0	0
← TAPE MARK/RECORD COUNT (16 BIT POSITIVE INTEGER) →															

MODE: 0000 = SPACE RECORDS FORWARD
0001 = SPACE RECORDS REVERSE
0010 = SKIP TAPE MARKS FORWARD
0011 = SKIP TAPE MARKS REVERSE
0100 = REWIND (RECORD COUNT IGNORED)

MA-2961
SHR-0131-84

Figure 6-13 Position Command Packet Example

Format Command -- Figure 6-17 shows the format command packet. This command can write a tape mark, rewrite a tape mark, and erase tape. In all cases, executing a format command at or beyond EOT causes a tape status alert (TSA) termination. The EOT bit remains set until passed in the reverse direction. A subsystem initialize can also reset the EOT bit.

The erase command causes about five inches of tape to be erased. This length is controlled automatically by the transport hardware. Successive erase commands can be used to erase more than five inches (in five inch increments).

Control Command -- Figure 6-18 shows the control command packet. The three modes of operation are message buffer release, unload, and clean. The message buffer release command, when executed with the ACK bit set, allows the transport to own the message buffer so it can update the status in the message buffer area on an ATTN. This is beneficial when the operating system is processing data in other areas not concerned with operating the TK25 Subsystem and the host wants to know the current drive status.

The unload command is designed to rewind tape completely onto the supply reel. When the command is executed, termination occurs immediately; an interrupt occurs if IE is set.

Initialize Command -- Figure 6-19 shows the initialize command packet. This command is not very useful, but is included for compatibility with packet protocol. A drive initialize can be done by a write to the TSSR, as this action does not need a command packet.

The drive initialize command is a no-op. It results in a message update, just like a get status, if there are no microdiagnostic or runaway errors. However, if errors are displayed, the command does the same thing as a write to the TSSR.

Message Packet/Header Word
Figure 6-20 shows the first message packet/header word and Table 6-12 defines it.

Message Packet Example
All message packets are identical. Each message packet contains the message packet/header word just described, plus a data length field word and the five extended status registers. Figure 6-21 shows the message packet format.

OPERATIONAL INFORMATION
The following information considers the operation and programming requirements of the TK25 Subsystem.

Table 6-12 Message Packet First Header Word Bit Definitions

Bit	Name	Function
15	Acknowledge	This bit is used by the M7605 to inform the CPU that the command buffer is now available for any pending or subsequent command packets. On an ATTN message, this bit does not set since the drive does not own the command buffer.
14--12	Reserved	These bits are reserved for future expansion.
11--8	Class Code Field	These bits define the class of failures found in the rest of the message buffer.

MSG Type	Class Value	Definition
ATTN	0000	On- or off-line
ATTN	0001	Microdiagnostic failure
FAIL	0000	Packet bad
FAIL	0001	Other (ILC, ILA, NBA)
FAIL	0010	Write lock error or non-executable function
FAIL	0011	Microdiagnostic error

Bit	Name	Function
7--5	Packet Format #1 Field	The single value supported by the TK25 is as follows.

Value	Definition
000	One word header

Bit	Name	Function
4--0	Message Code	

Term Class	Value	Definition
0,2	10000	End
3	10001	Fail
4,5,6,7	10010	Error
1,7	10011	Attention

15	14		12	11			8	7		5	4				0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	0	X	X	X	X	IE	0	0	0	1	0	0	1
NOT USED															

MODE: 0000 = WRITE TAPE MARK
0001 = ERASE
0010 = WRITE TAPE MARK RETRY (SPACE REV, ERASE, WRITE TAPE MARK)

MA-2962
SHR-0132-84

Figure 6-14 Format Command Packet Example

15	14		12	11			8	7		5	4				0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	0	X	X	X	X	IE	0	0	0	1	0	1	0
NOT USED															

MODE: 0000 = MESSAGE BUFFER RELEASE
0001 = UNLOAD
0010 = CLEAN TAPE

MA-2960
SHR-0138-84

Figure 6-15 Control Command Packet Example

15	14		12	11			8	7		5	4				0
CTL	DEV.		DEP.	MODE				FMT 1			COMMAND				
ACK	CVC	0	0	0	0	0	0	IE	0	0	0	1	0	1	1
NOT USED															

MODE: 0000 = DRIVE INITIALIZE

MA-2963
SHR-0139-84

Figure 6-16 Initialize Command Packet Example

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	RESERVED			CLASS CODE				PACKET FORMAT 1			MESSAGE CODE				
ACK	0	0	0	0	0	C	C	0	0	0	1	M	M	M	M

MA-2955
SHR-0126-84

Figure 6-17 Message Packet First Header Word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
CTL	DEV. STAT			STD. STATUS				FMT 1			MESSAGE				
ACK	0	0	0	0	0	X	X	0	0	0	M	M	M	M	M
0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
RBPCR															
XSTAT0															
XSTAT1															
XSTAT2															
XSTAT3															

MESSAGES: BITS 4:0
10000 = END
10001 = FAIL
10010 = ERROR
10011 = ATTN

STD STATUS: BITS 11:8
FAIL MSG.
0000 = SERIAL BUS PARITY ERROR
0001 = OTHER
0010 = WRITE LOCK ERROR OR NON-EXECUTABLE FUNCTION
0011 = MICRODIAGNOSTIC FAILURE
ATTN MSG
0000 = ON OR OFF LINE
0001 = MICRODIAGNOSTIC ERROR

MA-2964
SHR-0140-84

Figure 6-18 Message Packet Example

Bus Registers
Each TK25 has two bus word locations used as device registers. The base address, when written to, is the data buffer register (TSDB). When read, it is the bus address register (TSBA). The second device register (base address + 2) is the status register (TSSR). Writing to the TSSR causes a subsystem initialize command, and reading the TSSR reads device status.

The TSDB register is the only register written to during normal operations. DATO or word access must be used to properly write command pointers to the TSDB. DATOB or byte access to the TSDB causes maintenance functions.

Commands are not written to the transport's bus registers. Instead, command pointers, which point to a command packet somewhere in CPU memory space, are written to the TSDB register. The command pointer is used by the transport to retrieve the words in the command packet. The words of the command packet tell the transport the function to be performed. They also contain any function parameters such as bus address, byte count, record count, and modifier flags.

Command and Message Packets
Command packets must reside on modulo-4 address boundaries within CPU memory space. This means the starting address of the packet must be divisible by 4 (that is, octal ØØ, Ø4, 1Ø, 14, etc.).

All four words of a command packet must exist and have good memory parity, even if all four words are not used by a command. (For instance, rewind uses only one word.)

Message packets are issued by the subsystem and are deposited into the CPU's memory space. Controlled operation of the TK25 requires that it be supplied a message buffer address on a write characteristics command. The five extended status registers are stored in this message buffer area. The END message packet, which results at the end of any command, contains these extended status words.

Special Conditions and Errors
Table 6-13 includes the meanings of the binary values within the termination class code field in the TSSR register.

Status Error Handling Notes
TSSR error bits, other than the fatal class, termination class, and SC bits, are cleared by loading a command pointer into the TSDB register. SC is reset if it is due to a TSSR error (RMR or NXM). Extended status error bits are cleared after the END message is sent.

All commands (even get status command) clear the XSTAT error bits; except XSTAT3 bits 15 through 8 (transport error code) and bit LXS are not cleared.

Table 6-13 Termination Class Codes

TC2--Ø Value	Msg Type	Offset	Meaning
Ø	END	ØØ	Normal Termination -- This bit indicates the operation completed without incident.
1	ATTN	Ø2	Attention Condition -- This code indicates that the transport has undergone a status change: going off-line, coming on-line, or a microdiagnostic failure.
2	END	Ø4	Tape Status Alert -- This bit indicates a status condition has been encountered that may have significance to the program. Bits of interest include TMK, EOT, RLS, and RLL.
3	FAIL	Ø6	Function Reject -- This bit indicates the specified function was not initiated. Bits of interest include OFL, VCK, BOT, WLE, ILC and ILA.
4	ERR	1Ø	Recoverable Error -- This bit indicates tape position is one record beyond what its position was when the function was initiated. Suggested recovery procedure is to log the error and issue the appropriate retry command.
5	ERR	12	Recoverable Error -- This bit indicates tape position has not changed. Suggested recovery procedure is to log the error and reissue the original command.
6	ERR	14	Unrecoverable Error -- This bit indicates tape position has been lost. No valid recovery procedures exist unless the tape has labels or sequence numbers.
7	ATTN/ ERR	16	Fatal Subsystem Error -- This bit is not used.

If a density check condition is detected during a read, space, or skip function, the DCK bit is set, but the operation is not stopped. If DCK is the only status bit set during the operation, normal termination is reported. This allows tapes with good data but bad density check areas to be read. If a wrong density tape has been mounted, other errors are reported and the operation stops. Note that if only the density check area is bad, the density check indicator on the drive's operator panel goes on, even though the data records might be the correct density. The DCK indicator stays on until BOT is encountered again or until a subsystem initialize is performed. Note that if you begin reading a tape, get a density check condition with no other errors, then append to the tape; the write gets a termination class code of 6. This indicates that the tape position is lost because density check remains set. The whole tape should be copied over so that drives depending on the IDB will be able to read the tape.

A command is not responded to while another command is in progress (result is RMR), except in the following cases.

1. A DATO (word access) to the TSSR (subsystem initialize) brings any operation in progress to an immediate halt. All subsystem parameters that had been in the subsystem's memory (VCK reset, EOT, etc.) are erased. Also, if the on-line switch is on, the drive performs an auto-load sequence and positions the tape at BOT.

2. The transport responds to any nontape motion command while performing a rewind unload (while the drive is off-line) because SSR is still up.

The transport also responds to any nontape motion commands (get status, drive initialize, set characteristics, and message buffer release) when off-line, except when in maintenance mode. (The subsystem ready command, SSR, is not asserted in this case and results in RMR.)

The following failures can occur without resulting in an interrupt, even though the specified command had interrupt enable set.

NXM BPE	They might occur before the interrupt enable bit is fetched as part of the command packet.

These cases may result in a hung controller (SSR does not come up again until a subsystem initialize).

OPERATIONAL DIFFERENCES

The following describes three differences in the operation of the TK25 Subsystem compared to earlier DECmagtape products.

1. The skip tape marks (files) function is implemented in the hardware on this subsystem. Earlier DECmagtapes had this function emulated by the software driver through use of the space records command.

2. If a space records command is issued while positioned at or beyond EOT, the operation is not terminated after one record has been traversed. The termination criteria remains the same as for any other location on tape; that is, record count exhausted or tape mark encountered. The skip tape marks command operates in the same manner. EOT is not allowed to alter its operation.

3. A skip files command could take 15 to 23 minutes to complete to the end of a 500 foot reel of tape. There is no abort procedure other than a subsystem initialize. This causes an automatic load sequence.

NOTE

As a debugging aid, set the message buffer to all 1s (ones). This eliminates any confusion that might be caused by earlier messages.