EK-0TU80-UG-002

TU80 Subsystem

User Guide

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User Guide

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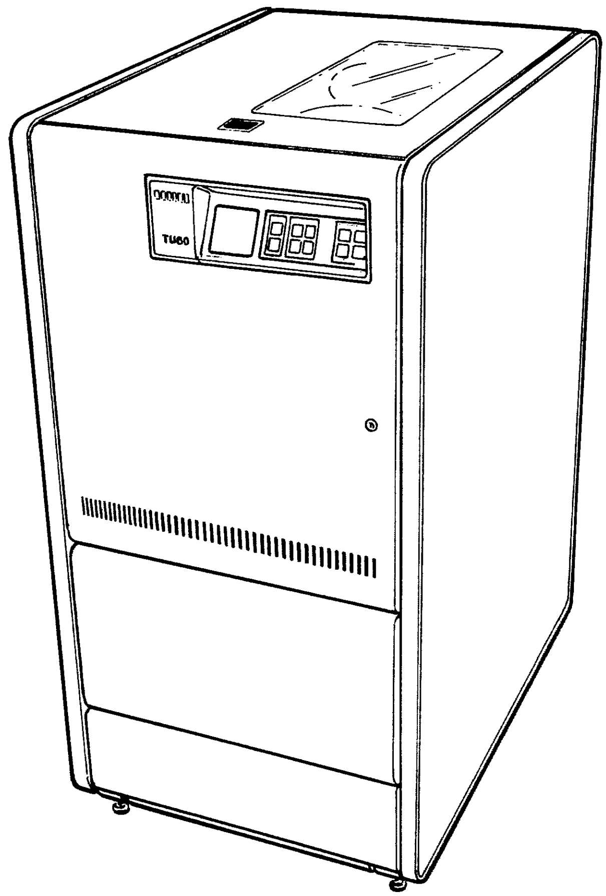

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PREFACE

The TU80 Subsystem User Guide provides all information necessary to install, accept, and operate the TU80 Magtape Tape Subsystem.

The manual is divided into six chapters.

Chapter 1 gives the general functional and physical transport description, system overview, and basic specifications.

Chapter 2 describes all operator controls and indicators and gives instructions for routine, fault-free transport operation. It also provides fault codes and operator corrective actions to be taken in the event of transport failure.

Chapter 3 provides troubleshooting information and customer diagnostics (tests, fault codes, and operator actions).

Chapter 4 provides complete care/preventive maintenance (PM) information including customer responsibilities, magnetic tape care, and customer PM procedures, accessories and supplies.

Chapter 5 describes TU80 programming concepts, registers, and data processing flow.

Chapter 6 provides complete unpacking and installation information including power and signal cabling and acceptance test procedures.

CHAPTER 1
INTRODUCTION

GENERAL
The TU80 Magnetic Tape Subsystem is a low-cost, dual-speed 9-track tape data storage system. It features microprocessor-based electronic control systems and streaming techniques for high data transfer rates, data reliability, and maintainability.

The horizontally-mounted TU80 Tape Transport is a fully integrated tape storage system. It is packaged with its formatter and power controller in a standard 40-inch high H9643 cabinet. The TU80 writes and reads data in ANSI-compatible phase-encoded (PE) 9-track 1600-bit/inch format. The tape speed is 25 in/s (63.5 cm/s) in Start/Stop mode and 25 in/s (63.5 cm/s) or 100 in/s (254 cm/s) in Streaming mode.

The TU80 Subsystem consists of the standalone tape transport and a UNIBUS adapter module. This module is designed for UNIBUS-equipped PDP-11 and VAX processors. It plugs into a host computer's UNIBUS small peripheral controller (SPC) slot and provides communication with the corresponding tape transport.

NOTE

The TU80 cabinet may hold an optional disk drive mounted under the tape transport at the bottom of the cabinet. Consult the User Guide of the appropriate disk drive for user information.

The TU80 can operate either as a conventional, low-speed, start/stop tape transport, or as a high-speed streaming tape unit.

The TU80 does not have a capstan, tension arms, or vacuum columns in its tape drive mechanism. Instead, the TU80 uses a microprocessor-controlled servo that directly controls the motors to maintain a constant tape speed and tension.

TU80 BASIC FEATURES
The following are some features of the TU80.

- Short tape path
- No capstan, no moving parts in the tape path
- Tape contacts only the tape cleaner and magnetic head
- Air bearings and solid-state tape tension sensor

- Microprocessor control of all main operating functions
- Built-in diagnostics automatically initiated during power-on sequence and manually initiated by an operator or customer engineer from the front control panel
- Resident adaptive speed control
- No mechanical or electronic adjustments
- No scheduled preventive maintenance
- Long-life magnetic head

TAPE MEDIA REQUIREMENTS

All of DIGITAL's tape drive products are designed and manufactured for high performance and reliability. The considerations that are given to produce such products must include the tape media that is to be used on them.

The TU80 has been designed to meet the format and recording requirements for 1/2 inch, 9-track magnetic tape as set in American National Standards Institute (ANSI) standard X3.54-1976. This design requires that the magnetic tapes used on this tape drive strictly adhere to ANSI standard X3.40-1981. This standard defines the minimum physical and magnetic requirements for 1/2 inch wide magnetic tape. In addition to meeting ANSI requirements, all DIGITAL recommended tapes must conform to DIGITAL's own magnetic tape specifications. This specification is used in the evaluation and qualification of magnetic tapes for DIGITAL's use and sale to its customers.

DIGITAL is constantly evaluating tape media in an ongoing effort to ensure a high quality product. To date, there are no back-coated magnetic tapes that meet DIGITAL's specfication. Back-coating has been found to cause such problems as tape slippage, auto-load failures, false EOT (End Of Tape) and BOT (Beginning Of Tape) sensing and more frequent drive cleaning due to the residue left on the tape drive by the back coating. As a result of these problems, back-coated magnetic tapes are not recommended for use on the TU80 tape drive.

To ensure the best performance and maximum reliability of the TU80 tape drive, only those magnetic tapes that meet both ANSI requirements and DIGITAL's specification should be used.

NOTE

ANSI standards can be obtained through:

American National Standards Institute
1430 Broadway Street
New York, New York 10018
(212) 354-3300.

TU80 VARIATIONS

The following are two variations of the TU80.

TU80-AA 120 Vac, 60 Hz	TU80-AB 220/240 Vac, 50 Hz

Figure 1-1 shows the TU80 and its major components.

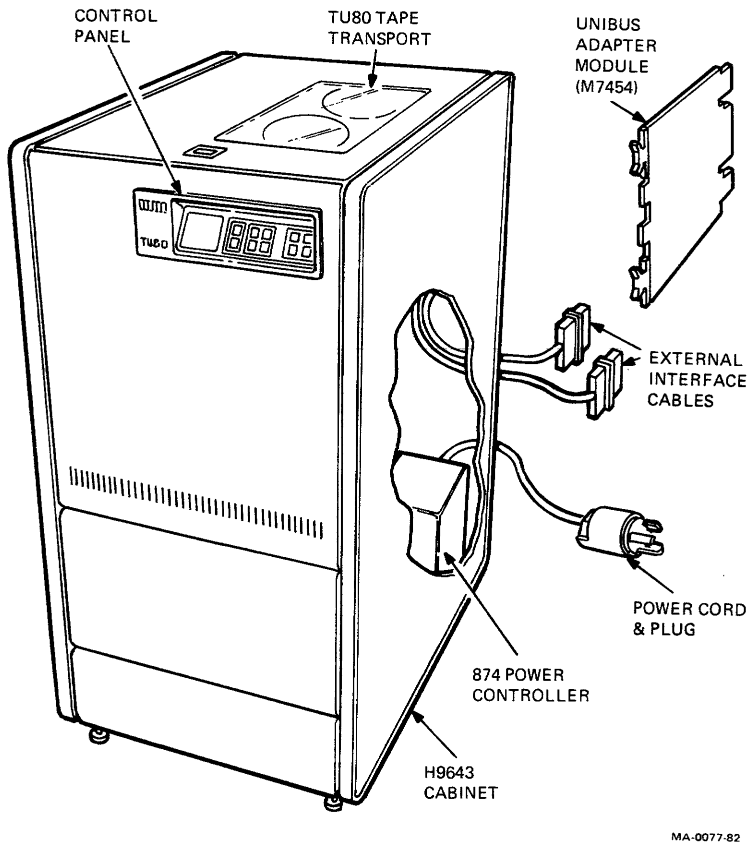

Figure 1-1 TU80 Tape Subsystem

RELATED DOCUMENTS

The documents listed in Table 1-1 are applicable to the TU80 and are available through the local DIGITAL Sales and Service Office or the Accessories and Supplies Group. Refer to the Ordering section in Chapter 4 for details.

Also, use applicable manuals and handbooks for the appropriate PDP-11 or VAX computer systems and processors, and RA80, RA81, and RA60 disk drives.

TU80 SPEED MODES AND SPEED SELECTION

The TU80 operates at one of three speeds. Speed is selected automatically by the TU80 to optimize data throughput.

- 25 in/s start/stop
- 25 in/s streaming
- 100 in/s streaming

In the 25 in/s start/stop speed, the TU80 can stop and start within an ANSI minimum interblock gap of 0.6 inches when reading. A stop or a start in this mode is similar to operation of a ''conventional'' (nonstreaming) tape transport.

Table 1-1 Related Documents

TU80 Subsystem User Guide	EK-0TU80-UG	Contains the functional overview, installation, operating, and programming information
TU80 Pocket Service Guide	EK-0TU80-PS	Provides a quick reference to maintenance and repair procedures for the trained trained service personnel
TU80 Technical/ Service Manual	EK-0TU80-TM	Contains the system functional description, installation, and acceptance procedures, theory of operation maintenance information
TU80 Pathfinder	EK-0TU80-SV	Contains test documentation (troubleshooting procedures, diagnostic tests, fault codes and sub-fault codes) for use by trained service personnel
TU80 Illustrated Parts Breakdown	EK-0TU80-IP	Provides a listing and illustrations of TU80 assemblies and replaceable parts
874 Power Controller IPB	EK-00874-IP	
TU80 Field Maintenance Print Set	MP01603	Contains unit assemblies, circuit schematics, revision matrix, and transport interconnect drawings for the TU80 subsystem.

In the 25 in/s or 100 in/s streaming speeds, the TU80 always writes ANSI minimum gaps of 0.6 inches, but is operating as a ''streaming tape'' transport. When streaming, the TU80 cannot start and stop in the interblock gap (IBG), as conventional tape drives do. When a streaming drive does have to stop, the TU80 does the following.

- Slowly moves 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 IBG, it is at full speed.

This cycle is called repositioning. An entire repositioning cycle takes approximately 0.2 seconds at 25 in/s and 0.7 seconds at 100 in/s to complete. 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), then the drive repositions when it runs out of commands to execute. This results in very long repositioning time and poor data throughput.

The TU80's microprocessor-based adaptive speed control system *automatically* changes the TU80 speed from 100 in/s streaming to 25 in/s streaming if excessive repositioning is sensed. Conversely, if the TU80 has been successfully streaming at 25 in/s for a determined time period, the adaptive speed control changes the speed to 100 in/s. A similar algorithm controls speed changing from 25 in/s start/stop to 25 in/s streaming, and vice versa.

For more information on TU80 programming and performance, refer to Chapter 5 – Programming.

SYSTEM OVERVIEW

Figure 1-2 shows the TU80 subsystem block diagram. The subsystem consists of one tape transport, one UNIBUS adapter module, and an interface cabling set.

Table 1-2 gives the basic operating specifications for the TU80 magtape subsystem.

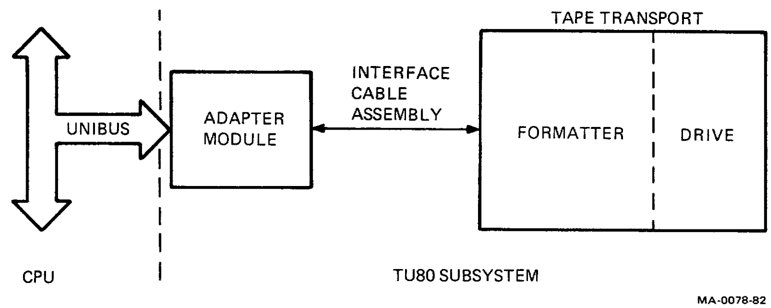

Figure 1-2 TU80 Subsystem Block Diagram

Table 1-2 Specifications

Functional Characteristics	
Tape speed (nominal)	
Low speed start/stop mode	25 in/s
Low speed streaming mode	25 in/s
High speed streaming mode	100 in/s
Tape capacity (maximum)	40 Mbytes
Data transfer rate (burst)	
Low speed modes	40 Kbyte/s
High speed streaming mode	160 Kbyte/s
Data format/recording	9 track, phase-encoding, 1600 bit/inch
Rewind time (nominal)	2.5 minutes
Load time (maximum)	15 seconds

Table 1-2 Specifications (Cont)

Physical Characteristics	
Electronics	Solid-state
Tape width	12.65 mm (0.5 in)
Tape thickness	38.1 micron (1.5 mil)
Tape tension	2.23 N (8 oz)
Reel diameter	26.7 cm* (10.5 in)
Reel capacity	732 m* (2400 ft)
Transport dimensions	105.7 cm (H) × 54.6 cm (W) × 76.2 cm (D) 41.6 in (H) × 21.5 in (W) × 30 in (D)
Transport weight (in cabinet)	127 kg (280 lbs)
UNIBUS adapter	Standard quad-size module
Power requirement	4 A at +5 Vdc
Operational Characteristics	
Power requirements	
Voltage	93–128 Vac, 120 Vac nominal, 60 Hz, single phase 187–256 Vac, 220 or 240 Vac nominal, 50 Hz, single phase
Current	Average input current 2.0 A rms at 100 in/s
Power consumption	300 VA – Standby and loaded 550 VA max – Start/stop
Power controller	Model 874B, 50 Hz, 240 V, 12 A Model 874D, 60 Hz, 120 V, 24 A
Power cord	3 wire number 12 AWG 16 ft long; plug – NEMA 6-15P (50 Hz) NEMA 5-30 (60 Hz)
Operating temperature†	10° C (50° F) to 40° C (104° F)‡
Storage temperature	−10° C (14° F) to 50° C (122° F)
Relative humidity	20% to 80% (10% to 90% in storage)

* Smaller tape reels are also allowed.
† Restricted by the operating temperature of the media.
‡ Operating temperature will be limited by the temperature limitations of the media.

Table 1-2 Specifications (Cont)

Altitude	Up to 3048 m (10,000 ft) or 688 millibar (9.98 psi)
Heat dissipation (average)	1024 BTU/hr
Acoustical noise	51 dba for open office environment
Data Reliability	
Recoverable write error	1 in 10^8 bits
Recoverable read-forward error	1 in 10^9 bits
Recoverable read-reverse error	1 in 10^8 bits
Unrecoverable read error	1 in 10^{10}
Unrecoverable write error	Not allowed

Functional Description

The tape transport is interfaced to the host Central Processing Unit (CPU) via the UNIBUS adapter module. This module is plugged into a UNIBUS I/O slot in the CPU. The module processes data using the packet processing protocol as described in Chapter 5. The adapter module-to-transport communication link is accomplished via the interface cable assembly which connects the adapter module to the TU80 control system.

The *tape transport control system* (Figure 1-3) consists of two logic modules and a power amplifier module. The two logic modules are functionally partitioned and each module contains a microprocessor for control of all module functions.

First is the formatter/control module. It provides high-speed data interchange between the transport and the host system including such functions as data fetching and formatting, and read/write operation. It also handles single-track "on-the-fly" data error correction and initiates and monitors the built-in diagnostic routines.

The second logic module is the Read/Write/Servo module. This module controls the tape drive electromechanical operation.

The third module is the power amplifier. This module receives low voltage analog signals from the logic modules and outputs higher voltages to the reel motors.

The transport logic is compactly mounted in a metal cage under the tape deck.

The power supply, mounted at the rear of the tape deck, provides all required ac/dc voltages to the transport modules and mechanisms.

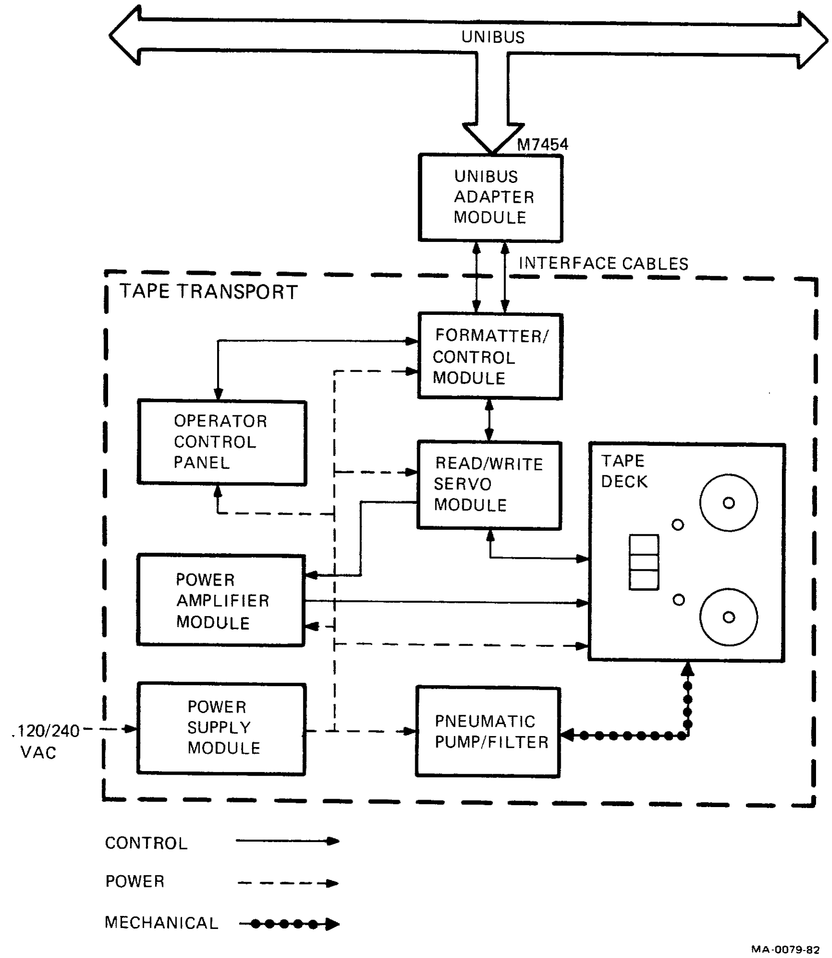

Figure 1-3 TU80 Functional Diagram

TU80 UNIBUS Adapter Module (M7454) – The UNIBUS adapter module (Figure 1-4) provides a functional interface between the transport and PDP-11/VAX computers. The M7454 controls command decoding, data fetchings and storing, and data transmission to and from the transport.

The quad-size M7454 module plugs directly into any small peripheral controller (SPC) slot in the UNIBUS backplane of the DIGITAL host CPU. A set of the internal (ribbon) and external (shielded) cables connect the adapter module to the tape transport. The standard external interface cable length is 3.66 m (12 ft). Effective external cabling length is 2.7 m (9 ft). Longer external cables are needed for configurations of three or four tape drives on one CPU.

Each adapter module supports one tape transport. Maximum configuration is four TU80 transports radially connected to a single CPU.

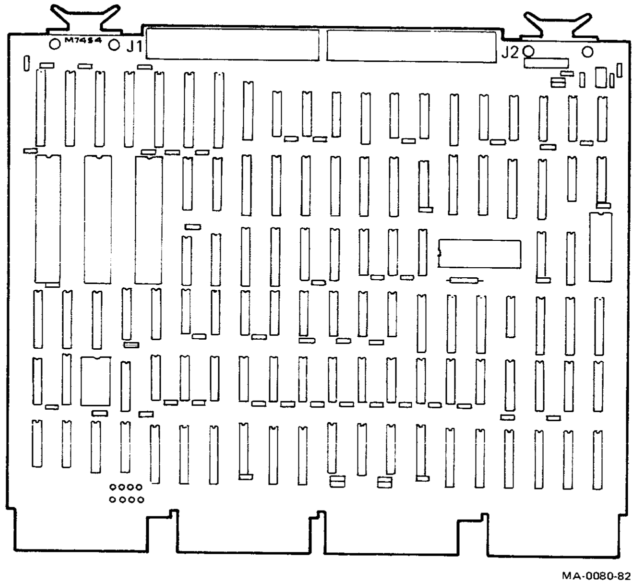

Figure 1-4 UNIBUS Adapter Module M7454

TRANSPORT PHYSICAL DESCRIPTION

The TU80 is a manual load, reel-to-reel tape transport and includes the following major assemblies.

1. Tape deck with Read/Write/Erase head, servo motors, air bearings and solid-state tension sensors
2. Electronic control logic cage
3. Control panel
4. Pneumatic pump/air filter
5. Power supply and cooling fan

Tape Deck

The following is a brief description of the deck components and their functions (Figure 1-5 and 1-6).

Reel Motors and Hubs – The reel servo motors are mounted under the tape deck and are covered by an acoustic, cooling and electrical cover. The servo motors drive the supply and take-up reels. The supply (rear) hub has a manual, mechanical latch that secures the reel to the hub face by pressing the periphery of the hub face while the reel is positioned against the bottom flange of the hub. The reel is released by pressing the center button on the hub face.

The supply reel motor works in conjunction with the supply and take-up air bearings to control tape tension across the recording surface of the magnetic head.

The take-up (front) reel is permanently mounted on the take-up motor shaft. The take-up motor/reel speed is controlled to maintain constant tape velocity across the read/write head.

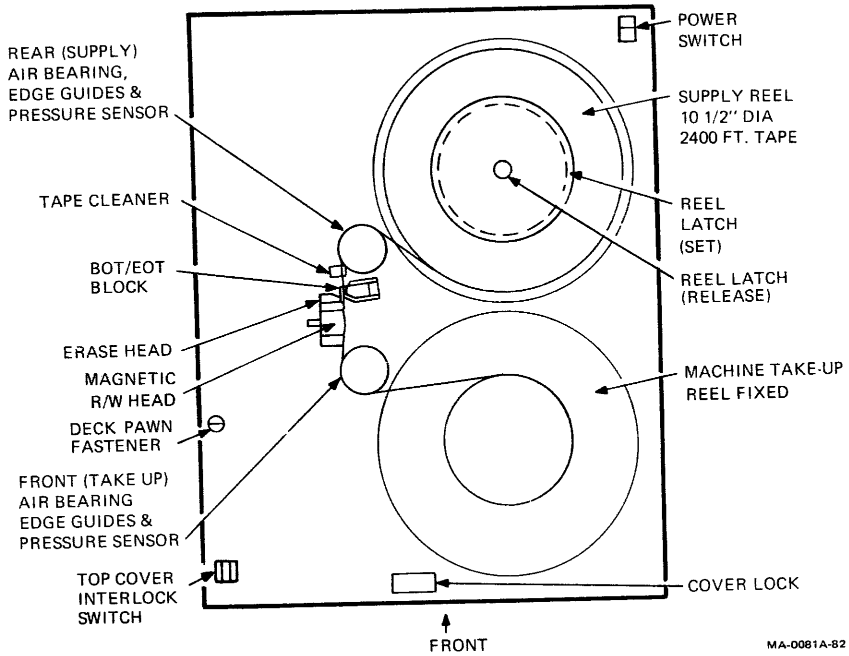

Figure 1-5 Tape Deck Components

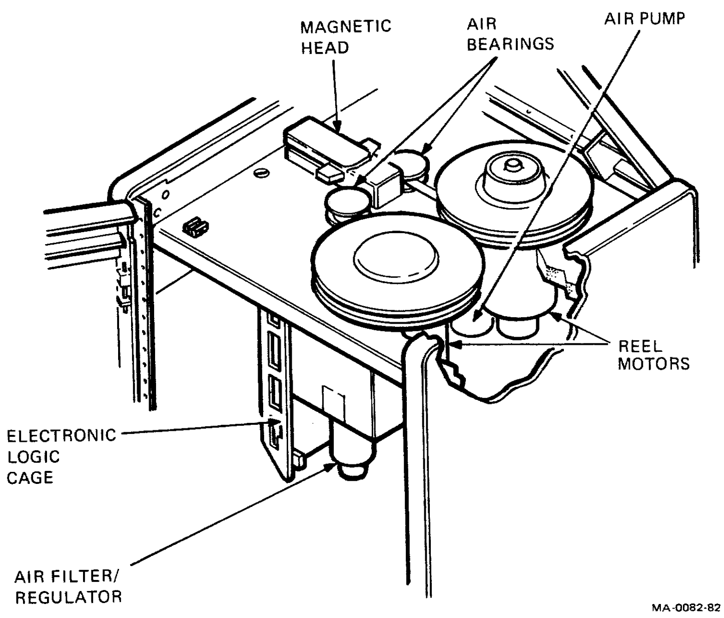

Figure 1-6 Major Transport Assemblies

Power Amplifier Module – This module is also mounted under the tape deck within the motor acoustic cover.

Air Bearings – Two air bearing/tension sensor assemblies are used to guide the tape across the magnetic head on an air cushion and to measure air pressure reflection. The pressure signal is processed by the TU80's control system that maintains constant tape velocity and air pressure by an appropriate change in reel motor speed.

Magnetic Head Assembly – This assembly consists of a read/write head and an erase head.

The dual-gap read/write head unit is designed to perform the read/write functions in a 9-track format. The dual-gap head allows a write-to-tape operation, read-only operation or read-after-write operation. A full-width erase head erases the tape during a write operation while it moves in forward direction before passing over the write head.

Tape Cleaner – This cleaner consists of two blades and a vacuum port to strip unwanted particles off the tape surface. The cleaner is designed so that one blade cleans tape in the forward direction and the second cleans tape in reverse direction. The vacuum system directs the stripped particles through a screen and into an air filter.

BOT/EOT Assembly – This assembly is adjacent to the magnetic head assembly. Beginning-of-tape (BOT) and end-of-tape (EOT) markers are detected optically. Photosensors detect light reflected from BOT and EOT markers on tape. An absence-of-tape (AOT) condition is detected when either one of the BOT and EOT photosensors detects a reflective marker normally blocked by the presence of a tape.

File Protect Sensor – This sensor consists of a reflective ring around the supply hub and an adjacent photosensor that are used to detect the presence or absence of the write-enable ring on the supply reel.

Power Switch – The main power switch (circuit breaker) is at the rear right corner of the tape deck. In OFF position (0 side pressed), input ac voltage is removed from the tape transport power supply. In ON position (1 side is pressed), the transport is powered on.

Cover Interlock – The top cover interlock switch is a safety device that allows reel motion only when the top cover is closed and latched.

Electronic Logic Cage
This metal cage, vertically mounted under the tape deck, is used as a security and mounting enclosure for the formatter/control and read/write/servo modules. The external I/O cables are plugged into the connectors on the cage mounting plate.

Pneumatic Pump/Air Filter
The pump and air filter together with the plenums are a pressure/vacuum system. This system provides specified air pressure/vacuum at the air bearings and the tape cleaner. The pneumatic system turns on and operates continuously when the tape is loaded.

Power Supply and Cooling Fan
The power supply is mounted at the rear of the tape deck. The power supply provides ac/dc voltages when the TU80 is powered on. A fan cools the power supply and provides air circulation for the TU80 logic modules.

Control Panel
The TU80 control panel is in the upper right corner of the TU80 cabinet front panel. The control panel has operational and diagnostic membrane-type switches, functional indicators, and 2-digit LED display. (Chapter 2 details control panel functions).

CHAPTER 2
OPERATING INSTRUCTIONS

INTRODUCTION

This chapter explains the control panel and provides operating instructions for tape reel installation, and loading and placing the TU80 on-line to the host computer.

CONTROL PANEL

Figure 2-1 shows the TU80 control panel switches and status indicators. These switches are all pushbutton switches. Switch functions, and the conditions required for enabling the corresponding functions, are given below.

The left part of the control panel contains operator switches and indicators. The 2-digit display indicates a fault code related to an abnormal operating condition or a test code when in the diagnostic mode. The right part of the panel contains the switches for diagnostic test procedures.

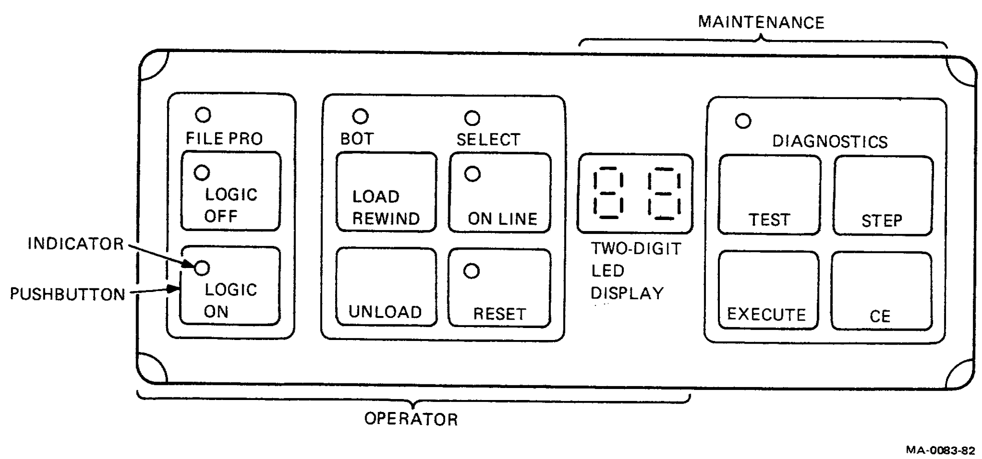

Figure 2-1 Control Panel

Operator Controls
The following describes operator controls.

Switch/ Indicator	Function
LOGIC OFF	*Switch* – When pressed, power is removed from the transport logic and LOGIC OFF indicator goes on. *Indicator* – When on, LOGIC OFF indicates a standby power condition exists (power supply is on, transport logic is off). If the indicator is off and no other indicators are on, then power switch is set off (0) or there is a power supply problem. If this indicator is off and LOGIC ON indicator is on, all transport circuitry is in the power-on condition.
LOGIC ON	*Switch* – If LOGIC ON is pressed when the power switch is on (1), the transport logic and control system is powered up and the TU80 is ready for operation. *Indicator* – When on, LOGIC ON indicates the transport is powered up and ready for use.
FILE PRO	*Indicator* – When on, FILE PRO indicates absence of a write-enable ring in the supply reel and write operation is inhibited. Otherwise, write operations are allowed.
BOT	*Indicator* – When on, BOT indicates the tape is positioned at the beginning-of-tape (BOT) marker.
LOAD/REWIND	*Switch* – If the transport is powered on and tape is threaded, pressing this switch causes a load operation to be performed. If tape is loaded, pressing the switch causes a rewind operation to BOT.
UNLOAD	*Switch* – If tape is loaded at BOT, pressing this switch causes tape to unload from the take-up reel and tape path onto the supply reel. If tape is loaded *beyond* BOT, it rewinds to BOT and unloads tape onto the supply reel. If tape is threaded, but not loaded, pressing the switch causes the transport to slowly unload tape onto the supply reel.
ON-LINE	*Switch* – If tape is loaded, pressing this switch causes the transport to go on-line to the host system. Press the RESET switch to take the TU80 off-line. *Indicator* – When on, ON-LINE indicates that the TU80 is ready for on-line operation. All switches except RESET and LOGIC OFF are inhibited.
SELECT	*Indicator* – When on, indicates the following. • The address in TU80 and CPU are the same. • When the two I/O cables are disconnected, the address decoder in TU80 is functional. • Pin 1 in I/O cables and Pin 1 on the M7454 are assembled correctly. • TU80 is not in diagnostic mode.

RESET	*Switch* – When pressed, this switch places the transport off-line, stops tape motion and clears error status. The switch can stop a LOAD or REWIND operation. It also turns off the RESET indicator and clears diagnostic test condition. *Indicator* – When on, RESET indicates that the transport is in fault or diagnostic status. Two-digit display may contain a fault or diagnostic code.

Diagnostic Controls
The following describes diagnostic controls.

Switch/ Indicator	Function
DIAGNOSTIC	*Indicator* – When on, DIAGNOSTIC indicates that the transport is in the diagnostic/test mode. The indicator remains on until the RESET switch is pressed.
TEST	*Switch* – If the transport has tape threaded but not loaded, pressing this switch places the unit in the diagnostic/test mode.
STEP	*Switch* – If the transport is in the diagnostic/test mode (and the test number is displayed), pressing this switch allows the diagnostic/test sequence numbers in the two-digit display to increment by one.
EXECUTE	*Switch* – If the transport is in the diagnostic/test mode (and the test number is displayed), pressing this switch initiates the internal diagnostic test shown on the two-digit display.
CE	*Switch* – If the transport is in the diagnostic/test mode, this switch helps run Field Service Diagnostics.

Operator's Hints

1. When LOGIC ON indicator is on, all control panel switches and indicators are functional except the LOGIC OFF indicator.

2. The ON-LINE switch can be pressed while tape is loading. The TU80 goes on-line immediately when loaded.

3. When RESET indicator is on, the control panel is not operable except for the LOGIC OFF and RESET switches. To turn the indicator off, press the RESET switch.

4. Tape unloading is performed at low speed. If there is a lot of tape on the take-up reel and you wish to do it more quickly, you can do it faster by pressing LOAD REWIND first and then UNLOAD.

OPERATING PROCEDURE

The operating procedure includes preparing and loading the tape reel, powering on the transport, placing it on-line to the host computer and checking its operational status. If a fault code appears on the two-digit display during loading or routine operation, refer to Operator Corrective Actions in this chapter.

Inserting Write-Enable Ring

Before mounting the reel of tape onto the supply hub, determine whether or not the tape is to be recorded (write operation performed). If write operations are to be performed, place a write-enable ring into the bottom recessed portion of the reel (Figure 2-2).

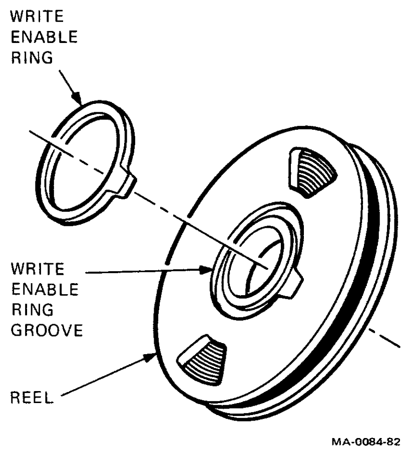

Figure 2-2 Write-Enable Ring

When the reel is prepared, proceed as follows.

Tape Threading and Loading
Perform this procedure to thread and load tape.

NOTE
The circuit breaker on 874 Power Controller must be ON.

1. Pull the cover latch towards the front and lift the top access cover. Check that the power switch is in ON position (1 pressed). The LOGIC OFF indicator should be on.

NOTE
The power switch can be in the ON position all the time to enable the TU80 transport to be powered on under CPU control.

2. Press the LOGIC ON switch. The power-up health check is initiated. The LOGIC OFF indicator goes off and all other indicators momentarily go on. The LOGIC ON and FILE PRO indicators should remain on.

NOTE
Pressing the LOGIC ON switch enables the transport power amplifier module, control logic, and support circuits. If a fault code displays at this time, press the RESET and LOGIC OFF switches and then the LOGIC ON switch again to repeat the check.

3. Press the inner button on the face of the supply reel hub.

4. Mount the supply reel onto the hub so that the reel is seated on the bottom flange. Secure the reel by pressing the periphery of the hub face to latch the reel.

5. Thread magnetic tape through the tape path as shown in Figure 2-3.

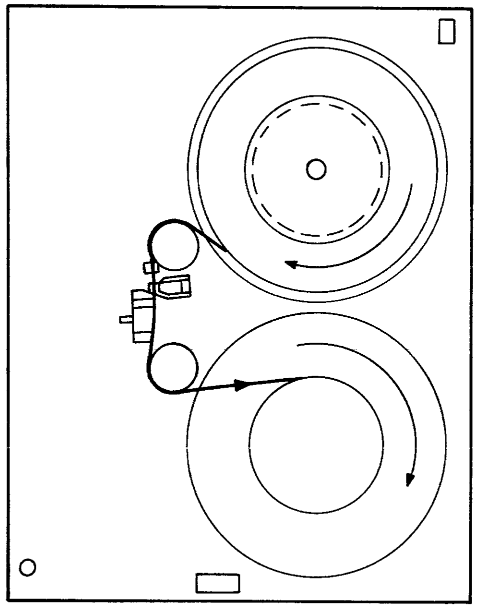

Figure 2-3 Tape Path

6. Wrap the tape leader (a length of tape before the BOT marker) onto the take-up reel for several turns.

CAUTION
Make sure that the tape is positioned correctly over all tape path components, otherwise, tape damage may occur.

7. Close and latch the top cover.

8. Press the LOAD/REWIND switch. In one second air pressure builds at the air bearings and tape starts moving in the forward direction. This motion stops when the BOT marker on the tape is detected. If the tape was over-threaded and the BOT marker was positioned after the sensor, forward tape motion continues for approximately 40 feet. Then the transport initiates reverse tape motion until the BOT marker is detected. At this moment, tape motion stops and the BOT indicator is on.

NOTE
If LOAD fails and tape does not move to BOT, check for the BOT marker on the tape. If there is no BOT marker, attach one by following the instructions in Chapter 4.

9. Press the ON-LINE switch to place the unit on-line to the host. The switch may be pressed while the load operation is in progress. On completion of a load operation, the transport indicates ON-LINE status by turning the ON-LINE indicator on. (If the transport is ready for a write operation, the FILE PRO indicator goes off.) Now the transport is ready for use.

Tape Unloading
The following are procedures for unloading tape manually or in on-line mode.

Manual Mode – Perform this procedure to unload tape manually.

1. Press the RESET switch to place the transport off-line.

2. Press the UNLOAD switch. Tape moves in reverse direction (rewind) gently winding onto the supply tape reel until it clears the take-up reel and the tape path.

NOTE
If loaded beyond the BOT marker, tape rewinds to BOT.

3. Open the top cover and press the center button of the supply reel hub. The hub unlatches and the supply reel can be removed.

4. Close the top cover to prevent dust accumulation on the tape deck components.

On-Line Mode – When on-line to the host CPU, the UNLOAD operation can be performed under CPU control. To remove the reel, perform steps 3 and 4 above.

OPERATOR CORRECTIVE ACTIONS

When you press the LOGIC ON switch, the TU80 transport initiates a built-in power-on health check. If a failure is detected during this check, and a fault code is indicated on the display, the tape loading procedure stops. Reset and repeat the check (refer to Power-On Health Check in Chapter 6) and then report any displayed fault code to service personnel.

CAUTION
Do not try to locate and correct the malfunction yourself.

During a load or read/write operation, if a fault occurs that cannot be corrected by the host computer and the transport takes itself off-line, the operator is informed of the fault by the fault code in the two-digit display. Refer to Table 2-1 for the list of fault codes and corresponding corrective actions.

The operator has an opportunity to check the TU80 transport operating condition using the built-in basic Diagnostic Test 01 (refer to Chapter 3). This test can be used to check the basic operating functions of the transport, or to verify a malfunction when a fault code indicates transport failure.

Refer to Chapter 3, Customer Diagnostics, for test information. Table 2-1 lists fault codes and operator corrective actions.

Table 2-1 Operator Corrective Actions

Fault Code	Corrective Action
01–09	Clean the magnetic head and tape path following instructions in Chapter 4 of this manual.
10	Make sure the top cover is securely closed.
11	Thread the tape.
12	Latch the supply reel hub.
13	Thread the tape correctly as shown on the tape threading diagram.
14	Check for BOT marker on tape. Attach BOT/EOT marker following instructions in Chapter 4.
15	This fault code indicates that the RESET switch was pressed inadvertently. Reinitiate the test.
16	Check for presence of the write-enable ring in the supply tape reel. Install the ring if not present.
17	Check for presence of EOT marker. Attach EOT marker following instructions in Chapter 4.
18	Indicates that the tape was loaded when the test was initiated. Thread the tape, but DO NOT press LOAD switch.
20–29	Mount a tape of known good quality.
All others	Attempt to run Diagnostic Test 01 (refer to Chapter 3) and then report a fault code to Field Service.

CHAPTER 3
CUSTOMER DIAGNOSTICS

INTRODUCTION

The built-in operator diagnostics allow the operator to functionally test transport performance, to run operator diagnostics if there is a failure, or to check the transport condition after a long idle period.

OPERATOR TROUBLESHOOTING

If the transport fails, an operator can make a few minor checks to try to isolate an easily correctable malfunction before calling Field Service.

1. Make sure that the tape has a BOT marker.
2. If a write operation is to be performed, make sure that the tape reel has the write-enable ring installed.
3. Verify that the tape path is clean.
4. Verify that the power switch is ON (1).
5. In case of power failure, verify that the power controller circuit breaker is ON.
6. Make sure that the top cover door is closed and latched.

If data (Read/Write) errors are reported by the host computer, "first-aid" action is to clean the tape path as described in Chapter 4, Care and Preventive Maintenance.

NOTE

During cleaning, take the time to inspect the tape path components for defects; e.g., damaged tape cleaner blades, loose air bearings, cracked or misaligned reel flanges causing contact with tape edges, etc. Cleaning and inspecting components takes only minutes, but goes a long way toward maintaining the reliability of the transport and minimizing downtime.

If cleaning does not resolve the problem, then replace the reel of tape with a tape of known good quality used only for testing. If the fault persists after the above procedures are performed, then the only recourse is to report the fault to Field Service Personnel.

Error Reporting
When the TU80 is on-line, the operator may become aware of an abnormal condition through a message on the system's CRT monitor or the printer. The fault reports should be retained or logged by the host system so that Field Service can determine not only the type of malfunction but all the circumstances under which the fault occurred.

OPERATOR DIAGNOSTIC PROCEDURE

The operator diagnostics include the Power-On Health Check and one user-oriented, selectable test (01), which runs for approximately ten minutes, if a 10.5-inch tape reel is used.

Optional tests 02 and 03 are also available to the operator. They should be run only if Field Service Representative requests the operator to do so. Faults encountered during the tests stop the test and display a numerical fault code on the digital display. Any fault code should be logged by the operator and given to Field Service when the problem is reported.

Operator Diagnostic Tests

Power-On Health Check is automatically performed when the LOGIC ON switch is pressed. If this check is successful, 00 is indicated on the two-digit display and the LOGIC ON and FILE PRO indicators go on and stay on. The fault condition is indicated by a fault code on the display and the RESET indicator being on. Refer to TU80 Acceptance Tests in Chapter 6 for more information on TU80 diagnostics.

Test 01 – This test examines the operating characteristics of the transport and points to the external (operator) or internal (hardware) causes of the failure.

The following are some external causes of failure that can be corrected by the operator.

- Dirt in the tape path
- Worn, damaged, or incorrectly written tape
- Incorrectly threaded tape
- No write-enable ring when one is required
- Unlocked top cover

Internal causes are hardware (mechanical and electronics) problems which require intervention of Field Service.

CAUTION

Test 01 reads and writes on tape; therefore, remove any mounted tape to save the data on it. Replace it with a tape of known good quality reserved for this purpose.

To eliminate the possibility of false displays due to a display panel failure, the first portion of Operator Diagnostic Test 01 is an exercise of the display panel indicators. The numerical display increments from 00 through 99. Concurrent with the numerical display, the following indicators are on: FILE PRO, LOGIC ON, ON-LINE, RESET and DIAGNOSTICS.

Pre-test conditions are as follows.

1. Make sure the power switch is in ON (1) position, LOGIC ON switch is pressed to run the built-in Power-On Health Check (LOGIC ON indicator is on).

   If a fault occurs at this time, do not attempt further testing; report error code to Field Service.

2. Thread the tape through the tape path and onto the take-up reel, but DO NOT LOAD.

3. Close and latch the top cover.

Use the following procedure to perform Test 01.

1. Press the RESET switch.

2. Press the TEST switch on the diagnostic portion of the control panel.

   a. DIAGNOSTICS indicator goes on.

   b. Display indicates 01.

3. Press the EXECUTE switch.

   a. Test 01 starts with display panel incrementing from 00, 11, 22 through 99. Make sure that all segments of the numerical display are functioning.

   b. Make sure that all indicators except LOGIC OFF, BOT and SELECT are on.

   c. Test 01 continues with various tape motion and read/write exercises for approximately 10 minutes (with 2400 feet of tape).

If the test runs to completion, the transport performs a REWIND/UNLOAD operation and the digital display indicates 00, with the RESET indicator on.

Perform the following if the test is not successful.

1. The diagnostic program halts and a numerical fault code appears on the display, with the RESET indicator on. *Record this number.*

2. Refer to Operator Corrective Actions (Table 2-1) for an operator action that may resolve faults without Field Service involvement.

NOTE

Reinitiate Test 01 after performing any of the above actions. If it is successful, return the TU80 to normal operation. If the fault is not resolved, proceed with step 3.

3. If the operator action did not correct the fault, report the number recorded in step 1 and any different numbers to the Field Service.

In some cases, Field Service may ask the operator to run Diagnostic Tests 02 and 03. These are short tests used to check tape tension and the velocity control servo system respectively.

Test 02 – Pre-test conditions are as follows.

1. Make sure the transport is powered on.

2. Thread the tape but DO NOT LOAD.

3. Close and latch the top cover.

Use the following procedure to perform Test 02.

1. Press the RESET switch.

2. Press the TEST switch.

   a. DIAGNOSTICS indicator goes on.

   b. Display indicates 01.

3. Press the STEP switch one time. (Display number increments by 1 each time the STEP switch is pressed.)

   Numerical display steps from 01 to 02. If you make a mistake, press the RESET switch and repeat steps 2 and 3.

4. Press the EXECUTE switch.

   Test starts and runs for less than half a minute.

If 00 displays, the run is successful. If the test is unsuccessful, the diagnostic program halts and a certain numerical fault code appears on the display. The RESET indicator goes on. *Record this number and report the fault to Field Service.*

Test 03 – Pre-test conditions are as follows.

1. Make sure the transport is powered on.

2. Make sure the tape is NOT threaded.

3. Close and latch the top cover.

Use the following procedure to perform Test 03.

1. Press the RESET switch (this resets the fault code for Test 01, if still indicated).

2. Press the TEST switch.

   a. DIAGNOSTIC indicator goes on.

   b. Display indicates 01.

3. Press the STEP switch twice (display number increments by 1 each time the STEP switch is pressed).

   Numerical display steps from 01 to 02 to 03. If you made a mistake, press the RESET switch and repeat steps 2 and 3.

4. Press the EXECUTE switch.

   Test starts and runs for less than one minute.

00 indicates a successful run. If the test is unsuccessful, the diagnostic program halts and a numerical fault code appears on the display. The RESET indicator goes on. *Record this number and report it to Field Service.*

CHAPTER 4
CARE AND PREVENTIVE MAINTENANCE

CUSTOMER RESPONSIBILITIES

The customer is responsible for the following:

1. Obtaining operating supplies, including magnetic tape and cleaning supplies.

2. Keeping the exterior of the system and the surrounding area clean.

3. Make sure that ac power plugs are securely plugged in each time the equipment is used.

4. Performing the specific operations for equipment care described in this chapter at the suggested periods, or more often if usage and environment warrant.

Also, it is recommended that the customer:

1. Maintain the required logs and report files consistently and accurately.

2. Make the necessary documentation available in a location convenient to the system.

CARE OF MAGNETIC TAPE

Follow these precautions when using magnetic tape.

1. Do not expose magnetic tape to excessive heat or dust. Most tape read errors are caused by dust or dirt on the read/write head. It is important to keep tape clean.

2. Always store the tape reels inside containers when the tape is not in use. Keep empty containers tightly closed to guard against dust and dirt.

3. Never touch the portion of tape between the Beginning-Of-Tape (BOT) and End-Of-Tape (EOT) markers. Oil from fingers attracts dust and dirt.

4. Never use a contaminated reel of tape. This spreads dirt to the clean tape reels and could adversely affect tape transport reliability.

5. Always handle tape reels by the hub hole. Squeezing the reel flanges leads to tape edge damage when winding or unwinding tapes.

6. Do not smoke near the tape transport or storage area. Tobacco smoke and ash are especially damaging to tapes.

7. Do not place magnetic tape near lineprinters or other devices that produce paper dust.

8. Do not place magnetic tape in any location where it may be affected by hot air.

9. Do not store magnetic tape near electric motors or any other magnetic sources that may erase data.

Digital Equipment Corporation tape transports are highly reliable precision instruments that provide years of trouble-free performance when properly maintained. A program of routine inspection and maintenance is essential for optimum performance and reliability. The following information will assist the user in caring for equipment.

TAPE TRANSPORT CUSTOMER MAINTENANCE

To guarantee trouble-free operation, the user should keep a preventive maintenance schedule. Preventive maintenance consists of cleaning only a few items, but the cleanliness of these items is essential to proper tape transport operation. The frequency of maintenance operations varies with the environment and the amount of usage the transport receives. Therefore, a rigid schedule for all machines is difficult to define. Daily cleaning is recommended for units in constant operation in ordinary environments. This schedule should be modified if experience shows other periods are more suitable.

Before any cleaning, remove the supply reel and store it properly. When cleaning, be gentle but thorough.

CAUTION

Do not use acetone, lacquer thinner, rubbing alcohol, or trichlorethylene to clean the tape path.

Magnetic Tape Transport Cleaning Kit

A magnetic tape transport cleaning kit (TUC01) has been carefully assembled to provide cleaning materials that will not harm tape equipment or leave residue to interfere with data reliability. Follow the hints in the following paragraphs to get the best results from the kit.

The cleaning fluid in this kit is one of the best cleaners available. Unscrew the top and punch a small hole in the metal seal covering the pour spout.

WARNING

When using DECmagtape cleaning fluid, avoid excessive skin contact and contact with the eyes. Do not swallow it. Use the cleaning fluid only in a well-ventilated area.

CAUTION

When cleaning the tape equipment, never dip a dirty cleaning swab or wipe into the can. Instead pour a little onto the swab or wipe. Use the smallest amount of cleaning fluid necessary. DO NOT soak the swab or wipe in the cleaning fluid.

Always keep the can of fluid tightly closed when not in use; the fluid evaporates rapidly when exposed to air.

Use the cleaning materials from the kit to clean tape heads, tape guides, tape cleaner, and any part of the drive, where residue could contact the tape. To clean other parts of the drive, such as the exterior tape deck surfaces, doors, etc., use any reasonably clean, lint-free material with or without cleaning fluid.

CAUTION
To clean exterior surfaces, only use soap and water.

If you encounter any unusually stubborn dirt that resists the cleaner, try a mild soap and water solution. After using soap, be sure to wash down the area thoroughly with cleaning fluid to remove soapy residue.

Reflective Tape Markers

Every reel of magnetic tape must have a BOT and an EOT reflective marker, so that the transport can recognize starting and stopping areas. Tapes are always supplied with reflective markers installed. However, if the markers become detached for any reason or, if a tape leader is shortened because of tape damage, then the operator must install a marker at the position shown in Figure 4-1.

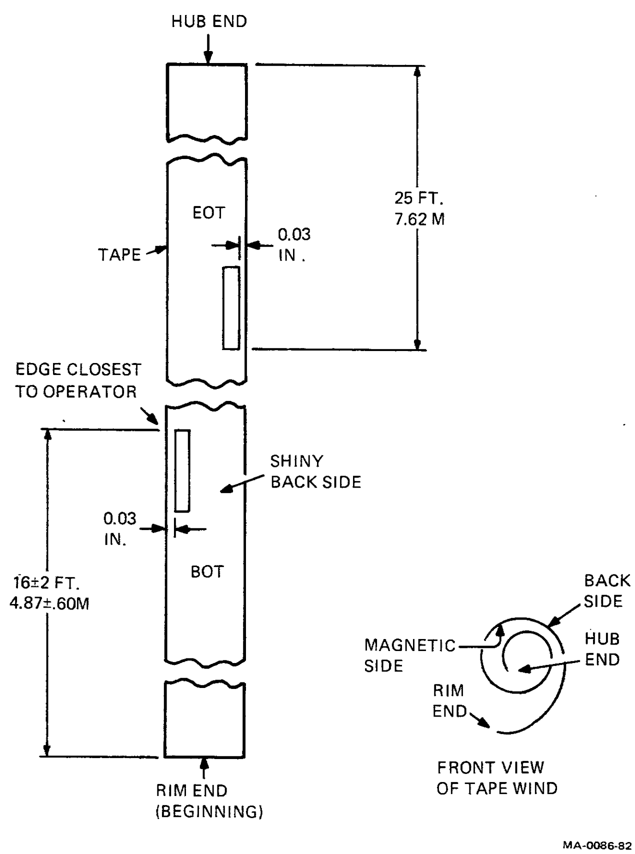

Figure 4-1 Reflective Tape Markers

Transport Cleaning
All transport components that need regular cleaning are located on the tape deck. These components include the magnetic head assembly, EOT/BOT sensor, tape cleaner, and air bearings. Also, the user should regularly examine and clean, as required, the top of the tape deck, reel hubs, and top cover door.

To access the magnetic head components (Figure 4-2), pull up the two-part head assembly dust cover from the tape deck.

Magnetic Heads – Use the following procedure to clean magnetic heads.

1. Clean the magnetic head working surface with a soft lint-free wipe moistened with the cleaning fluid.

NOTE
Wipe the head surface in the same direction that the tape travels during data recording (forward motion).

2. Clean area adjacent to the head of any dirt that can be transported with the tape.

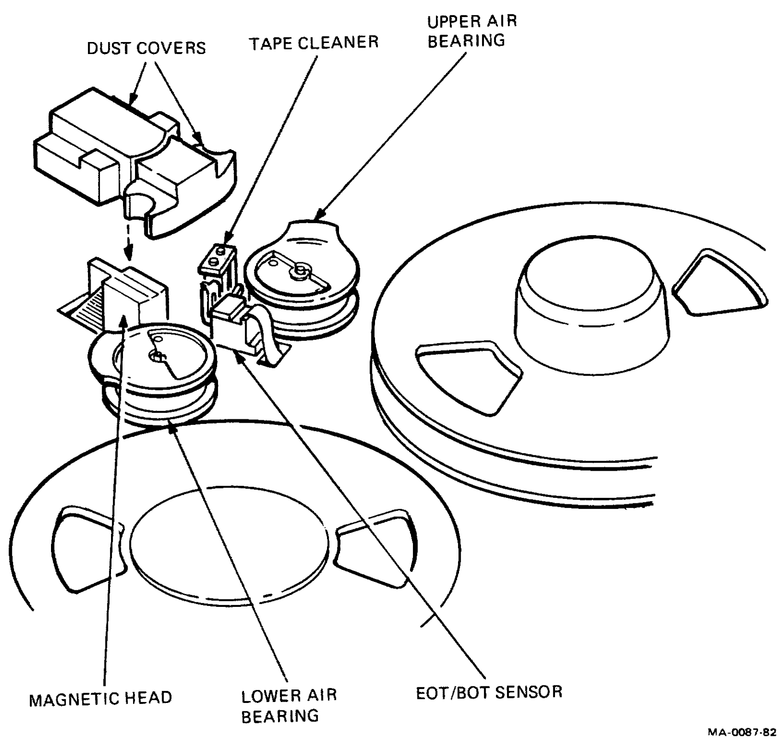

Figure 4-2 Magnetic Head/Tape Path Components

Air Bearings – Use the following procedure to clean the air bearings.

1. Clean both air bearings with a swab moistened with the cleaning fluid.

2. Make sure that foil area, guide springs, and both tape guides are cleared of any oxide/dirt build-up. If available, use a small mirror to inspect inner edge of the guides.

Top Cover, Tape Deck, and Head Assembly Dust Covers – To prevent the transfer of dirt to the tape components, DO NOT allow dust or dirt to accumulate on the inside of the dust cover. Clean the inside cover surface with a clean, lint-free wipe and any cleaning fluid that is safe for plastic, painted surfaces.

ACCESSORIES AND SUPPLIES

To use the TU80 Subsystem efficiently, the following accessories and supplies should be available for the operator.

1. Magnetic Tape Cleaning Kit (TUC01)
2. Magnetic Tapes
3. BOT/EOT Marker Tape (PN 90-09177-00)

Ordering

Purchase orders for supplies, accessories or documentation should be forwarded to:

Digital Equipment Corporation
Accessories and Supplies Group
PO Box CS2008
Nashua, New Hampshire 03061.

Contact your local sales office or call DIGITAL Direct Catalog Sales toll-free 800-258-1710 from 8:30 am to 6:00 pm eastern time (US customers only). Customers from New Hampshire, Alaska, and Hawaii should dial (603)884-6660. Terms and conditions include net 30 days and FOB DIGITAL plant. Freight charges will be prepaid by DIGITAL and added to the invoice. Minimum order is $35.00. Minimum does not apply when full payment is submitted with an order. Checks and money orders should be made out to Digital Equipment Corporation.

CHAPTER 5
PROGRAMMING

INTRODUCTION

This chapter provides operational information and a functional description of the TU80 registers and packet processing. It also gives programming techniques and performance-improving hints (with programming examples and packet formats) to show basic TU80 programming concepts and advanced performance.

TU80 PERFORMANCE EVALUATION

Speed Modes and Speed Selection

The TU80 operates at one of three speeds selected by the TU80 to optimize data throughput.

- 25 in/s start/stop
- 25 in/s streaming
- 100 in/s streaming

In the 25 in/s start/stop speed, the TU80 is capable of stopping and starting within an ANSI minimum interblock gap of 0.6 inches when reading. However, if the TU80 stops after a write in this speed mode, the gap written is 0.8 inches. A stop or a start in this mode takes 20 milliseconds (nominal), and is similar to the stopping and starting of a "conventional" (nonstreaming) tape transport.

In the 25 in/s or 100 in/s streaming speeds, the TU80 always writes ANSI minimum gaps of 0.6 inches but is operating as a "streaming tape" transport. When streaming, the TU80 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 IBG, it is at full speed.

This cycle is called repositioning. Approximately 0.2 seconds at 25 in/s and 0.7 seconds at 100 in/s are required 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 has run out of commands to execute. In this instance, thrashing can occur. (Thrashing is when extremely long reposition times overwhelm the time spent processing data. This results in poor data throughput.

The TU80 has a microprocessor-based adaptive speed control system which is designed to eliminate the thrashing phenomenon. The adaptive speed control feature automatically changes the TU80 speed from 100 in/s streaming to 25 in/s streaming if excessive repositioning is sensed. Conversely, if the TU80 has been successfully streaming at 25 in/s for a determined time period, the adaptive speed control changes the speed to 100 in/s. A similar algorithm controls speed changing from 25 in/s start/stop to 25 in/s streaming, and vice versa.

If the adaptive speed control system changes TU80 speed from 25 in/s to 100 in/s, and vice versa, too often within a determined time, the TU80 stops trying to operate at 100 in/s. The TU80 tries 100 in/s again after the algorithm is reset by the occurrence of the rewind and initialize commands, or after encountering a tape mark (read or write).

The TU80 adaptive speed control feature is not user-programmable. It can be thought of as an automatic transmission on a vehicle which matches engine RPMs (i.e., CPU data rate to the tape) to vehicle speed (i.e., speed mode of TU80) to attain best performance.

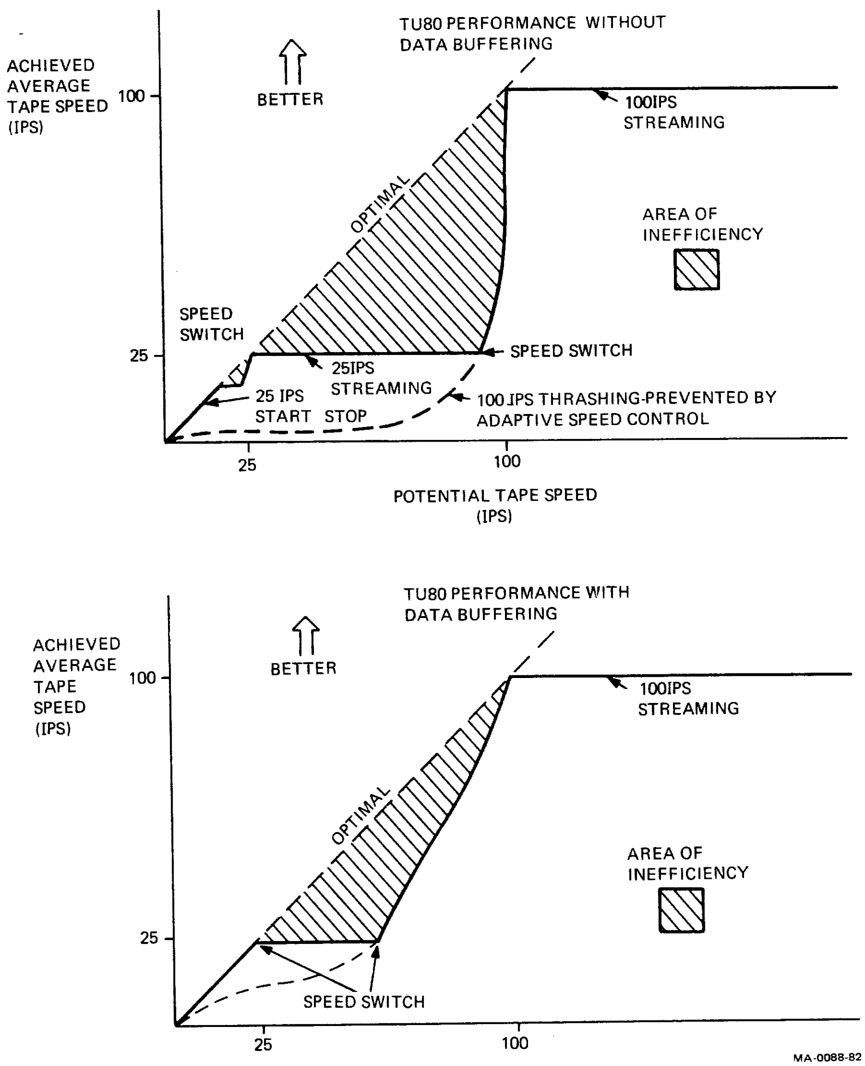

Figure 5-1 Data Buffering and TU80 Performance Upgrading

Performance Hints
The frequency of TU80 repositioning is entirely 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 100 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) prior to 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, and the adaptive speed control system is more likely to maintain a higher performance speed selection.

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, i.e., reading and writing into the buffer should occur at the same time in an attempt to prevent or delay an empty buffer condition.

Of course, 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. Figure 5-1 shows how data buffering enhances performance.

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.

TU80 REGISTERS
When using the TU80 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 UNIBUS 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 NPR transfer the command packet to the subsystem.

The following are the eight TU80 (M7454) registers.

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

TSBA (UNIBUS Address Register – Base Address – Read Only)
The TSBA is an 18-bit register. It is parallel loaded from the TSDB every time the TSDB is loaded as a UNIBUS slave by the CPU. TSDB bits 15–2 load into TSBA bits 15–2; and TSDB bits 1 and 0 load into TSBA bits 17 and 16. Zeros are loaded into TSBA bits 1 and 0. TSBA bits 17 and 16 are displayed in TSSR bits 9 and 8 respectively. TSBA can be instructed by the transport 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 5-2 shows the TSBA register. Table 5-1 lists and defines the bits. The TSBA register serves the following two major purposes.

1. The TSBA can be used as a command and message pointer to the remote transport device registers (command and message buffers). These are located somewhere in the UNIBUS address space. The content, loaded into TSDB when the M7454 is the bus slave, is considered the command or message pointer. In this mode, the M7454 receives data (initiated by the transport) at this command pointer address and sends it to the transport for storage and/or execution. The message buffer address tells the M7454 where to place the message sent to the CPU address space. When used as a message pointer, the highest message buffer address + 2 is left in the TSBA.

2. The TSBA can be used as a data pointer (NPR's bus address 0), pointing to data buffer areas located somewhere in the UNIBUS address space. [In this mode, the transport serially loads the TSDB with data (18 address bits); TSDB bits 17 through 0 load into TSBA bits 17 through 0, but bits 17 and 16 are displayed in TSSR bits 9 and 8, respectively.] The contents of TSBA are then used to point to data buffer areas while the M7454 transfers data by NPRs.

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

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Figure 5-2 TSBA Register

Table 5-1 TSBA 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
10	A10	Bus address bit 10
09	A09	Bus address bit 09
08	A08	Bus address bit 08
07	A07	Bus address bit 07
06	A06	Bus address bit 06
05	A05	Bus address bit 05
04	A04	Bus address bit 04
03	A03	Bus address bit 03
02	A02	Bus address bit 02
01	A01	Bus address bit 01
00	A00	Bus address bit 00

TSDB (UNIBUS Data Buffer Register – Base Address – Write Only)
The TSDB is an 18-bit register. It is parallel loaded from the UNIBUS or serially loaded from the transport. A 16-bit portion of this register is used as a word buffer register to the M7454 when the M7454 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 M7454 is bus master. The TSBD can be loaded when the M7454 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 M7454 responds with SSYN any time the TSDB is written to.

Figure 5-3 shows the TSDB register. Table 5-2 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 UNIBUS. Bits 16 and 17 are loaded from bits 0 and 1, respectively, from the UNIBUS. The bus address is 17XXXX, where XXXX can be any unused address from 0 through 17776. The M7454 indicates to the transport a TSDB word load when the M7454 is bus slave.

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

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Figure 5-3 TSDB Register (Loaded with a Command Pointer)

Table 5-2 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
10	P10	Command pointer bit 10
09	P09	Command pointer bit 09
08	P08	Command pointer bit 08
07	P07	Command pointer bit 07
06	P06	Command pointer bit 06
05	P05	Command pointer bit 05
04	P04	Command pointer bit 04
03	P03	Command pointer bit 03
02	P02	Command pointer bit 02
01	P01	Command pointer bit 01
00	P00	Command pointer bit 00

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 M7454 logic. The TSSR cannot be modified from the UNIBUS 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 M7454 to modify 17XXXX+2.) It can be read at any time with or without the transport unit connected. Figure 5-4 shows the bit positions and Table 5-3 describes the bits.

TSSR register bits 14 through 11 and 7 are cleared only on system power up, TU80 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 TU80 operation. Bits 10 and 6–0 are exclusively controlled by the transport and reflect the transport status as indicated.

NOTE

Any write function to the M7454 base address 1725XX is decoded as a subsystem initialize. This resets the M7454 and TU80 no matter what state they are in and causes an automatic load sequence returning the tape to BOT if the TU80 is on-line.

The TSSR register uses several bits to increase its status reporting capabilities. TSSR bits 4 and 5 report four fatal class error codes and TSSR bits 1, 2, and 3 report seven termination class status codes. Fatal error bits are valid only if the termination class equals 7.

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 MSG.) If RMR is seen in the TSSR, the CPU must have written the TSDB while the command was executing.

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

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Figure 5-4 TSSR Register

Table 5-3 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 – This bit is set by the M7454 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 – This bit is set by the M7454 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 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 TU80 Subsystem is not busy and is ready to accept a new command pointer.
06	OFL	S	Off-Line – When set, this bit indicates that the transport is off-line and unavailable for any tape motion commands.
05	–	–	Not used
04	–	–	Not used
03	TC2	S	Termination Class Bit 02 – This bit, along with the TC1 and TC0 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, as applicable, recovery procedures. 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.
02	TC1	S	Termination Class Bit 01 – Refer to TC2 (bit 03) above.
01	TC0	S	Termination Class Bit 00 – Refer to TC2 (bit 03) above.
00	–	–	Not used

XST (Extended Status Registers)

Five additional registers provide additional status information: residual frame count register (RBPCR) and extended status register 0, 1, 2, and 3. Figure 5-5 shows these registers. Tables 5-4 through 5-8 define the bits.

TU80 Register Summary

Figure 5-5 is a summary of the TU80 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	C15	C14	C13	C12	C11	C10	C09	C08	C07	C06	C05	C04	C03	C02	C01	C00
XST0	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	PED S	WLK S/3/6	BOT S/2/3	EOT S/2
XST1	DLT 4		COR S					RPE 4			IPO S/4				UNC 4	MTE 4
XST2	OPM S				TU80			DTP S	DT7 S	DT6 S	DT5 S	DT4 S	DT3 S	DT2 S	DT1 S	DT0 S
XST3	7	7	TRANSPORT ERROR CODE 7	7	7	7	7	7		OPI 6	REV S		DCK 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

Fatal Class (FC) Codes (in TSSR): (NOT USED)
NON-TERMINATION CLASS CODE: S= STATUS

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Figure 5-5 TU80 Register Summary

Table 5-4 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 5-5 XSTAT0 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 this mode of 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.
11	WLE	3, 6	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.

Table 5-5 XSTAT0 Bit Definitions (Cont)

Bit	Name	Causes Termination Class (TC)	Definition
10	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) bit being set while the volume check bit was set. 3. A write command was issued when the tape did not contain a write-enable ring [write lock status (WLS)].
09	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.
08	ILA	3	Illegal address
07	MOT	S	This bit indicates that tape was moved during an operation.
06	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.
05	IE	S	Interrupt Enable – This bit reflects the state of the interrupt enable bit supplied on the last command.
04	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.
03	PED	S	Phase Encoded Drive – When set, this bit indicates that the transport is capable of reading and writing only 1600 bit/in phase encoded data. It should always be set.
02	WLK	S/3/6	Write Locked – When set, this bit indicates that the mounted tape reel does not have a write-enable ring installed. Therefore, the tape is write protected.
01	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.
00	EOT	S/2	End of Tape – This bit is set whenever the tape is positioned at or beyond the end-of-tape reflective strip. It is not reset until the tape passes over the reflective strip in the reverse direction under program control. Subsystem initialization always resets this bit (status on read, TC2 on a write). Manually moving EOT mark over the EOT sensor will not set or reset the EOT bit.

Table 5-6 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 UNIBUS latency exceeds the transport's data transfer rate for a significant number of transfers.
14	-	-	Not used
13	COR	S	Correctable Data - This bit is set when a correctable data error has been encountered (on a read command only). It does not cause a termination class error but there is a dead track. Dead track bits indicate the error. This is used primarily as a diagnostic feature.
12	-	-	Not used
11	-	-	Not used
10	-	-	Not used
09	-	-	Not used
08	-	-	Read Bus Parity Error – Indicates a data parity error was detected by the coupler on data received from the tape transport.
07	-	-	Not used
06	-	-	Not used
05	IPO	S/4	Invalid Postamble - This bit is set during read or write if any of the first 39 characters of the postamble are not read correctly. It is status on read, TC4 on a write.
04	-	-	Not used
03	-	-	Not used
02	-	-	Not used
01	UNC	4	Uncorrectable Data – This bit is set when a parity error occurs without a corresponding dead track indication. This bit is a normal write error for any dead track.
00	MTE	4	Multitrack Error - This bit is set if more than one dead track occurs in the preamble or in the data field.

Table 5-7 XSTAT2 Bit Definitions

Bit	Name	Causes Termination Class (TC)	Definition
15	OPM	S	Operation In Progress (Tape moved)
14	–	–	Not used
13	–	–	Not used
12	CAF	7	Not used
11	TU80	–	TU80 Identifier – This is always set.
10	–	–	Not used
09	–	–	Not used
08	DTP	S	Dead Track Parity – This bit indicates which tracks went dead, if any, during the last data transfer operation. If deskew buffer fail (DBF) is set, these bits indicate which channel failed.
07	DT7	S	Dead track 7*
06	DT6	S	Dead track 6*
05	DT5	S	Dead track 5*
04	DT4	S	Dead track 4*
03	DT3	S	Dead track 3*
02	DT2	S	Dead track 2*
01	DT1	S	Dead track 1*
00	DT0	S	Dead track 0*

NOTE
On the write characteristic command, bits 07 through 00 contain the microcode revision level of the M7454.

*Refer to Bit 08, DTP.

Table 5-8 XSTAT3 Bit Definitions

Bit	Name	Causes Termination Class (TC)	Definition
15–08	TEC	7	Transport Error Code – These bits contain the error code shown on the front control panel display of the transport.
07	–	–	Not used
06	OPI	6	Operation Incomplete – This bit is set when a read, space, or skip operation has moved 25 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.
05	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.
04	–	–	Not used
03	DCK	S/6	Density Check – The current operation will be done. However, note that read, space, and skip operations complete without error (if no other errors occur) to allow tapes with a bad IDB to be read. On a write command, when a bad IDB is sensed, tape position lost occurs. **NOTE** **If you append to a tape with a bad IDB, you will receive any DCK error until a write.**
02	–	–	Not used
01	–	–	Not used
00	RIB	2	Reverse Into BOT – This bit is set when a read, space, skip, or reverse command already in progress encounters the BOT marker when moving tape in the reverse direction. Tape motion is halted at BOT.

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 UNIBUS 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 TU80 Subsystem.

To allow the drive to use only two words of address space, we allow the CPU to define a set of locations in memory. These locations (command buffers) are used to 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 from updating the message buffer while the CPU is reading the message buffer, we have defined the concept of ownership. Both the command and message buffers 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 the ownership of the two buffers.

1. Command buffer CPU to drive by the CPU
2. Command buffer drive to CPU by the drive
3. Message buffer CPU to drive by the CPU
4. Message buffer drive to the CPU by the drive.

The CPU transfers ownership of the command buffer to the drive by writing the address of the command packet into the TSDB. This write clears the TSSR subsystem ready (SSR) bit.

The drive transfers ownership of the command buffer to the CPU by setting the acknowledge (ACK) bit in the message buffer. When the drive outputs the message buffer, the drive sets SSR in the TSSR to indicate that the message is in the message buffer. If the message buffer does not contain the ACK bit, the CPU knows that the drive did not see the last command buffer and the CPU still owns the command buffer. The command may be reissued by the CPU.

The CPU transfers ownership of the message buffer to the drive by setting the ACK bit in the command buffer. If the command buffer does not contain the ACK bit, the drive knows that the CPU did not see the last message buffer and the drive still owns the message buffer. The drive outputs the TSSR again (with the SSR bit up) and interrupts (if IE is set) without sending a message.

The drive transfers ownership of the message buffer to the CPU in one of two ways. The first way is used after the end of a command: the drive sets the SSR bit in the TSSR to indicate that the command is done (and interrupts if IE is set). The second way is used during an attention (ATTN). SSR is already up because an ATTN only happens when the drive is inactive. The drive clears SSR, outputs the message, then sets SSR again and interrupts (if IE set). Note that 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 will 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 set 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 0. 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 TU80 M7454 interrupts while the CPU is servicing a TU80 M7454 interrupt. However, this case may happen, but only if the TU80 receives a fatal hardware error.

Command Packet/Header Word

Figure 5-6 shows the command packet/header word Table 5-9 defines it. Table 5-10 gives the command code and mode field 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.

Code Bits	Definition
00XXX	Four words (header, two word address, count)
01XXX	Two words (header, parameter word) or one word (header)

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

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Figure 5-6 Command Packet Header Word

Table 5-9 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 M7454 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 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 5-10.
7–5	Packet Format 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 5-10.

Table 5-10 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 TU80)
01011	Initialize	0000	Drive initialize
01111	Get Status Immediate	0000	Get status (END message only)

The swap byte bit in the command packet/header word (bit 12) instructs the M7454 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 = 0, the swapping begins with an odd byte. (This is so only for data transferring; it is ignored otherwise.)

Figures 5-7 and 5-8 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 0. Byte 0 is always the data byte at the beginning of the block (that is, the part of the block that is closest to BOT).

NOTE

When reading in 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.

Command Packet Examples

Examples of the command packets and operational programming notes used in the TU80 Subsystem are provided in this section. Refer to the figure corresponding to the command packet example you are interested in.

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.

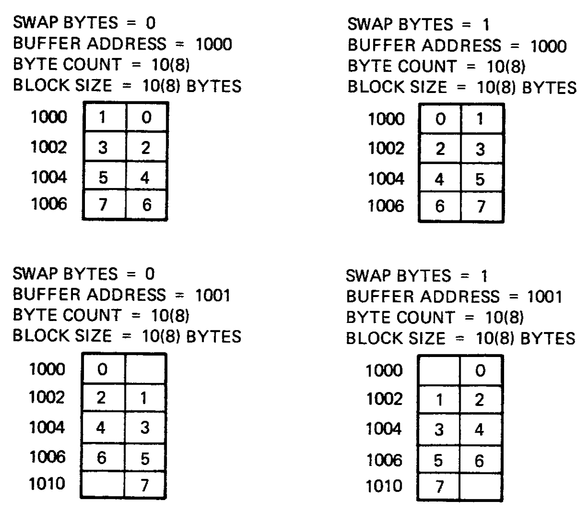

Figure 5-7 Byte Swap Sequence, Forward Tape Direction (Read or Write)

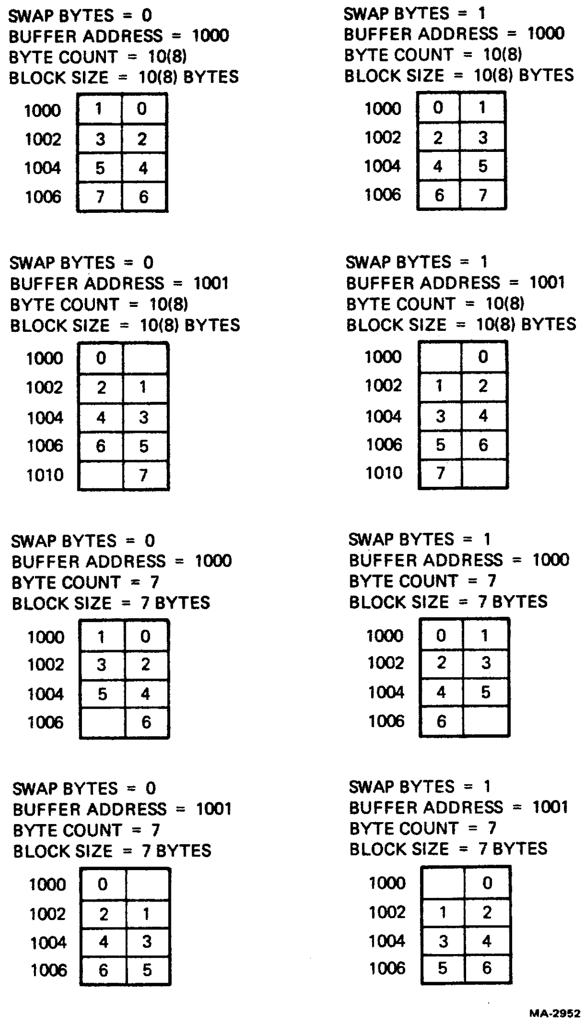

Figure 5-8 Byte Swap Sequence, Reverse Tape Direction (Read)

Command Packet Example	**Figure Number**
Get status	5-9
Read	5-10
Write characteristics	5-11
Write	5-12
Position	5-13
Format	5-14
Control	5-15
Initialize	5-16

Get Status Command – Figure 5-9 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 TU80 hardware automatically updates the extended status registers. Therefore, this command need only be used when the TU80 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 5-10 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 5-11 shows the write characteristics command packet. Its objective is to inform the TU80 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.

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.

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Figure 5-9 Get Status 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	OPP	SWB	X	X	X	X	IE	0	0	0	0	0	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 = READ NEXT (FORWARD)
0001 = READ PREVIOUS (REVERSE)
0010 = REREAD PREVIOUS (SPACE REV, READ FWD)
0011 = REREAD NEXT (SPACE FWD, READ REV)

NOTE:

THE OPPOSITE BIT (OPP) ALTERS THE EXECUTION SEQUENCE OF THE REREAD COMMAND MODES, i.e., SPACE FWD, READ REV BECOMES READ FWD, SPACE REV; SPACE REVERSE, READ FORWARD BECOMES READ REVERSE, SPACE FORWARD.

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Figure 5-10 Read 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	0	0	0	0	IE	0	0	0	0	1	0	0
A15 ← LOW-ORDER CHARACTERISTICS DATA ADDRESS → A00															
0 ← HIGH-ORDER CHARACTERISTICS DATA ADDRESS → 0														A17	A16
← BUFFER EXTENT (BYTE COUNT) (16 BIT POSITIVE INTEGER) →															

MODE: 0000 = LOAD MESSAGE BUFFER ADDRESS AND SET DEVICE CHARACTERISTICS

CHARACTERISTICS DATA

15–8	7–0
A15 ← LOW-ORDER MESSAGE BUFFER ADDRESS → A00	
0 ← HIGH-ORDER MESSAGE BUFFER ADDRESS → 0 A17 A16	
← LENGTH OF MESSAGE BUFFER (16 BIT POSITIVE INTEGER) (AT LEAST 14 BYTES LONG) →	
0 ← 0	← CHARACTERISTICS MODE BYTE 5.2.2.3 →

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Figure 5-11 Write Characteristics Command Packet Example

The write characteristics command also transfers a characteristics mode word to the transport. This word causes specific actions for certain operational modes. Table 5-11 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.

Attention Interrupts Enabled – With attention interrupts enabled, a nonfatal diagnostic failure is not reported until control of the message buffer is returned to the transport. A fatal failure may interrupt at any time as long as interrupt enable is set. It should also be noted that the drive could break in such a way that interrupts may be issued even with IE reset.

Attention Interrupts Disabled – With attention interrupts disabled, a diagnostic failure is not noticeable until the next command is issued. At this time the command is rejected.

Table 5-11 Write Characteristics Data Bit Definitions

Bit	Name	Definition
15–08	–	Not used
07	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 0, the skip tape marks command terminates only on tape mark count exhausted or if it runs into BOT.
06	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.
05	EAI	Enable Attention Interrupts: When this bit is a 0, 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.**
04	ERI	Enable Message Buffer Release Interrupts: If this bit is 0, 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.
03–00	–	Not used

Write Command – Figure 5-12 shows the write command packet. There are two modes: write data and write data retry (space, reverse, erase, write data). Each operation is straightforward and designed to transfer data onto tape in the forward direction only.

If a write command is executed at or beyond the EOT marker, a tape status alert (TSA) termination occurs. EOT remains set until passed in the reverse direction or a subsystem initialize.

If a write command is executed anywhere and the identification burst (IDB) was previously written bad or was not found when it left BOT, then density check (DCK) is set and tape position lost termination occurs.

Position Command – Figure 5-13 shows the position command packet. This command causes tape to space records forward or reverse, skip tape marks forward or reverse, and to rewind to BOT. An exact tape mark/record count must be the second word of the packet for skip tape mark and space record commands.

A space records operation automatically terminates when a tape mark is traversed. Also, record length short (RLS) is set if the record count was not decremented to zero.

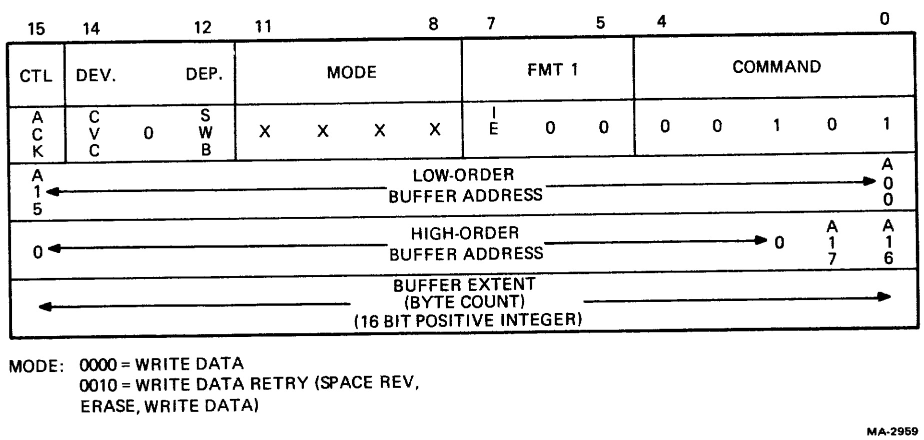

Figure 5-12 Write Command Packet Example

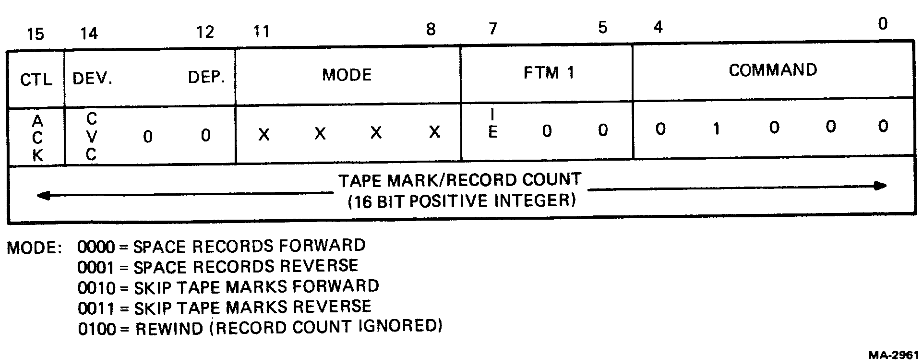

Figure 5-13 Position Command Packet Example

A skip tape marks command terminates when it encounters a double tape mark and the enable skip stop mode is specified (ESS bit set) in the characteristics word. Termination also occurs if a tape mark is the first record off BOT and ESS and ENB bits are set in the characteristics word. Record length short (RLS) is set if the record count is not decremented to zero.

A space records reverse or skip tape marks reverse (which runs into BOT) sets reverse into BOT (RIB) and causes a tape status alert termination.

NOTE

If the tape is positioned between BOT and the first record and you do a space reverse or skip reverse, RIB sets and the residual frame count equals the specified count in the original command.

Format Command – Figure 5-14 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. Also, any format command executed with density check (DCK) set causes a tape position lost termination.

Density check is set when an invalid identification burst (IDB) is read off BOT. This occurs in a read-after-write mode within the first three inches of tape and is transparent to the user's operation.

The erase command causes three 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 three inches (in three inch increments).

Control Command – Figure 5-15 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 TS11 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.

The clean tape command is a No-Op in the TU80 and immediately returns a normal termination code and message packet.

Initialize Command – Figure 5-16 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. Section 5.1.3 contains TSSR details.

15	14 — 12	11 — 8	7 — 5	4 — 0
CTL	DEV. DEP.	MODE	FTM 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)

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Figure 5-14 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

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Figure 5-15 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

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Figure 5-16 Initialize Command Packet Example

Message Packet/Header Word

Figure 5-17 shows the first message packet/header word and Table 5-12 defines it.

15	14–12			11–8				7–5			4–0				
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

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Figure 5-17 Message Packet First Header Word

Table 5-12 Message Packet First Header Word Bit Definitions

Bit	Name	Function
15	Acknowledge	This bit is used by the M7454 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
7–5	Packet Format #1 Field	The single value supported by the TU80 is as follows. **Value / Definition** 000 One word header
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

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 5-18 shows the message packet format.

OPERATIONAL INFORMATION

The following information considers the operation and programming requirements of the TU80 Subsystem.

UNIBUS Registers

Each TU80 has two UNIBUS 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 UNIBUS 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.

15	14		12	11			8	7		5	4				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															
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

Figure 5-18 Message Packet Example

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 00, 04, 10, 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 TU80 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 5-13 includes the meanings of the binary values within the termination class code field in the TSSR register.

Table 5-13 Termination Class Codes

TC2–0 Value	Msg Type	Offset	Meaning
0	END	00	Normal Termination – This bit indicates the operation completed without incident.
1	ATTN	02	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	04	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	06	Function Reject – This bit indicates the specified function was not initiated. Bits of interest include OFL, VCK, BOT, WLE, ILC and ILA.
4	ERR	10	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.

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.

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	They might occur before the interrupt enable bit
BPE	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).

M7454 Failure
If a host incurs difficulties in configuring a TU80 into the system, or a host could not access a TU80 during a normal on-line opreation, the M7454 may be at fault. Look for an appropriate message on the operator's terminal and in the system error log. Also, refer to Chapter 6 of this manual under "UNIBUS Adapter Module Diagnostic," the applicable Diagnostic Listings and CPU handbooks.

OPERATIONAL DIFFERENCES

The following describes three differences in the operation of the TU80 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 20 minutes to complete to the end of a 2,400 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.

CHAPTER 6
INSTALLATION

SITE PLANNING

Space Requirements
Figure 6-1 shows the transport dimensions and the space and service clearances required for the TU80 cabinet model H9643. There must be enough space to open the front, rear, and top doors.

Power Requirements
The TU80 tape transport can be operated within 93 to 128 Vac, 60 Hz (120 Vac nominal) or 187 to 256 Vac, 50 Hz (220 or 240 Vac nominal). Frequency should not vary more than ±3 Hz (refer to Table 1-2).

The appropriate power plugs are provided with the transport (for plug's NEMA numbers refer to Table 1-2).

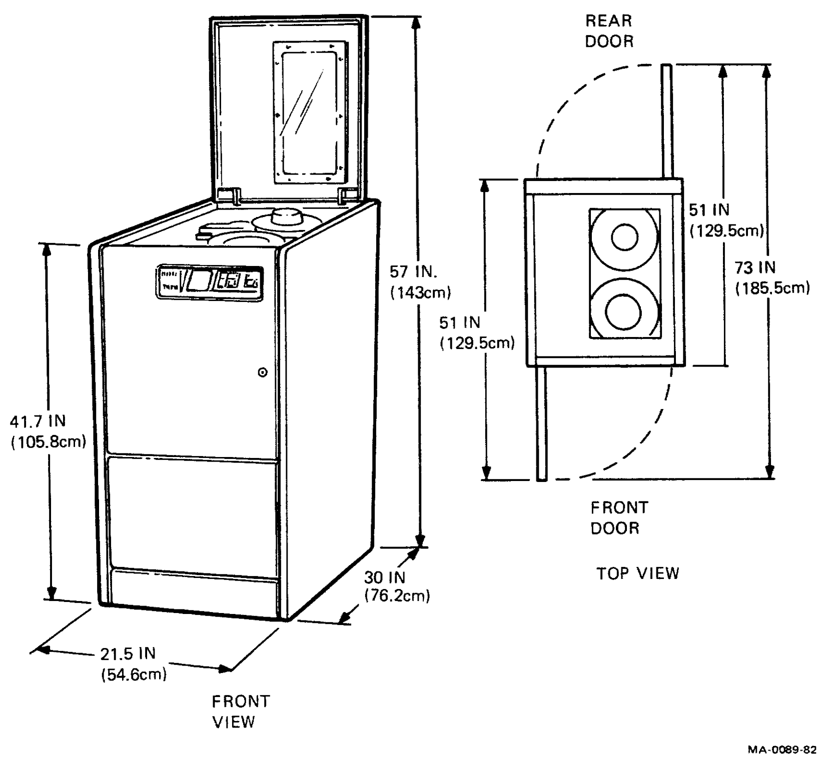

Figure 6-1 TU80 Space Requirements

The UNIBUS adapter module (M7454) typically draws 4.0 A at +5 Vdc. No other voltage is required. Power for the module is derived from the host CPU through dedicated pins of the CPU backplane.

Environmental Requirements and Limits
The TU80 transport should be located in an area free from excessive dust, dirt, corrosive fumes and vapors. The bottom of cabinet and air vents on the doors must not be obstructed. The operating environment requirements are listed in Table 1-2.

Tools Required

5/32 inch allen wrench
3/4 inch combination box and open-end wrench
7/16 inch open-end wrench
9/16 inch open-end wrench
5/16 inch nut driver
Number 2 phillips screwdriver

UNPACKING AND INSPECTION

Floor Loading and Routing
The TU80 transport is shipped in a cardboard container and is mounted on a wooden skid. The shipping weight is 147 kg (325 lb). Check the route the unit will travel to the installation site to guarantee problem-free delivery. The TU80 transport net weight is 127 kg (280 lb).

Unpacking
Figure 6-2 shows the unpacking procedure. Refer to numbered instructions on Figure 6-2.

To unpack the transport proceed as follows.

1. Cut and remove the shipping straps around the cardboard container (1).

2. Lift and remove the top container cover (2).

3. Carefully lift and remove the two ramps from the top of the cabinet. Set them aside for future use.

4. Lift and remove the protective carton (3).

5. Remove the top pad and polybag (3).

6. Remove the rear stabilizer package from the rear of the cabinet.

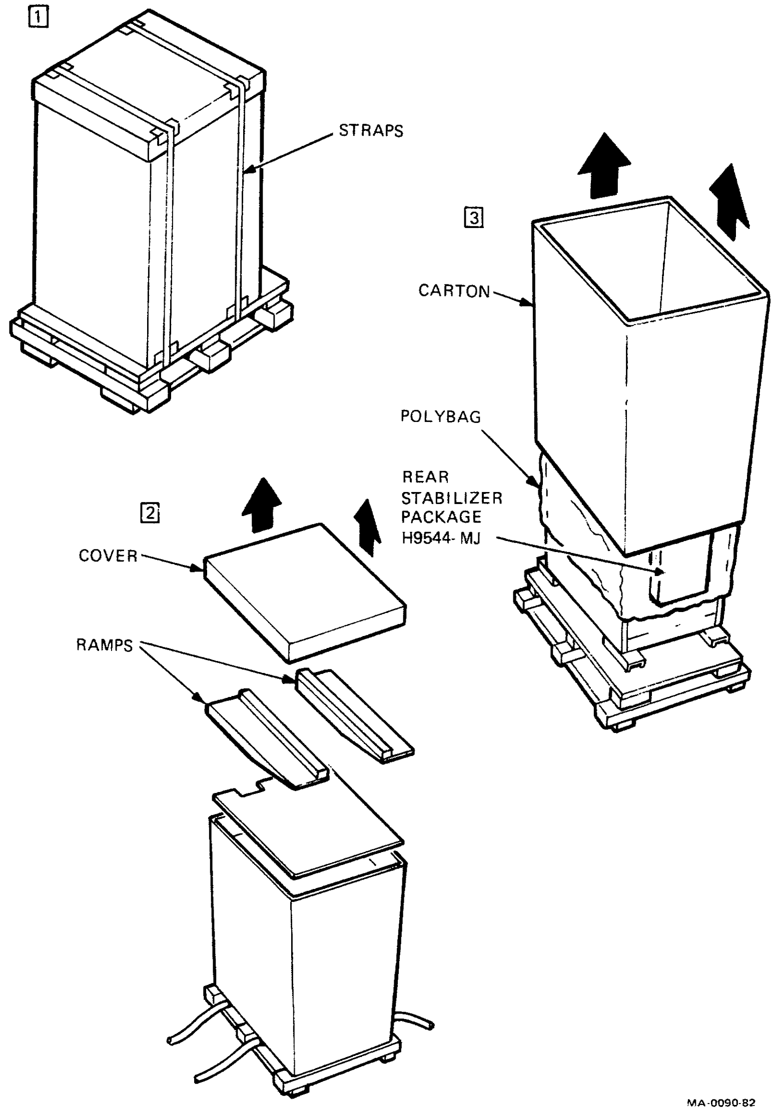

Figure 6-2 Unpacking a Transport

7. Securely attach the two ramps to the skid deck using Figure 6-3 as a guide. Engage the ramps in the groove matching the arrows.

8. Use a 9/16 inch wrench to unbolt and remove four shipping bolts and shipping brackets (Figure 6-3).

NOTE
The process of deskidding or taking the cabinet off the pallet (skid) occurs next. EXTREME CARE MUST BE TAKEN!

CAUTION
The cabinet can be rolled only when the leveler feet are raised.

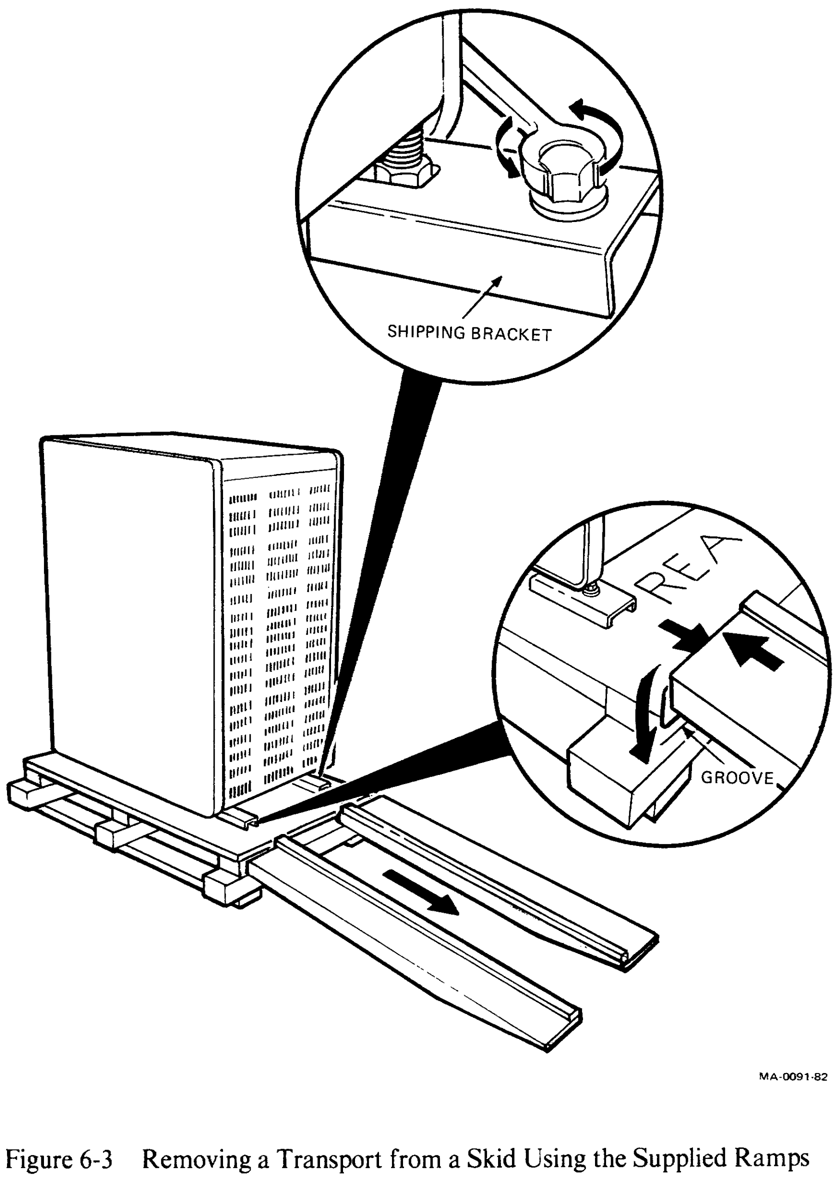

Figure 6-3 Removing a Transport from a Skid Using the Supplied Ramps

9. Roll the TU80 toward the ramp-attached side of the skid by pushing gently on the rear side of the cabinet.

10. Gently slide the cabinet forward on the ramps. Hold the TU80 firmly to prevent it from tipping. Allow it to roll off the skid, down the ramps and onto the floor.

11. Remove the wooden ramps. Store the skid, ramps, and carton for future use.

Inspection

After removing the TU80 transport from its container, inspect it and report any damage to the responsible shipper and the local DIGITAL sales office.

Inspect the TU80 as follows.

1. Inspect all panels, doors, door latches, and control panel for any obvious damage.

2. Using a 5/32 inch allen wrench, open the front and rear doors. Inspect the cabinet for any foreign material, loose or damaged components or cables.

3. Pull the top cover latch and lift the top cover. Inspect the tape deck for broken glass, damaged magnetic head components, and damaged reels.

4. Check for any foreign materials that may have lodged in the tape reels. Rotate the supply and take-up reels.

5. Check the tape path for any sharp edges. Close the top cover, the front and rear doors.

OPERATION PREPARATIONS

Place the TU80 transport not further than 2.7 m (9 ft) from the host CPU and with adequate space clearances (Figure 6-1) for air circulation and servicing. Connect the transport to the CPU by the power switching wire and two shielded interface cables. Power it on.

TU80 preparations for operation are performed as follows.

Mechanical Installation

1. Roll the transport to its correct location.

2. Open the rear door and remove the cardboard box with the TU80 Accessory Kit (TU80K-AC).

3. Remove two screws holding the shipping bracket (Figure 6-4) to the frame stabilizing bar.

4. Turn the shipping bracket around to its normal (TU80 operating) position and secure it with the two mounting screws.

Mechanical installation procedure depends on the TU80 cabinet configuration – with or without a disk drive.

NOTE

Return the shipping bracket to its original shipping position before reshipment.

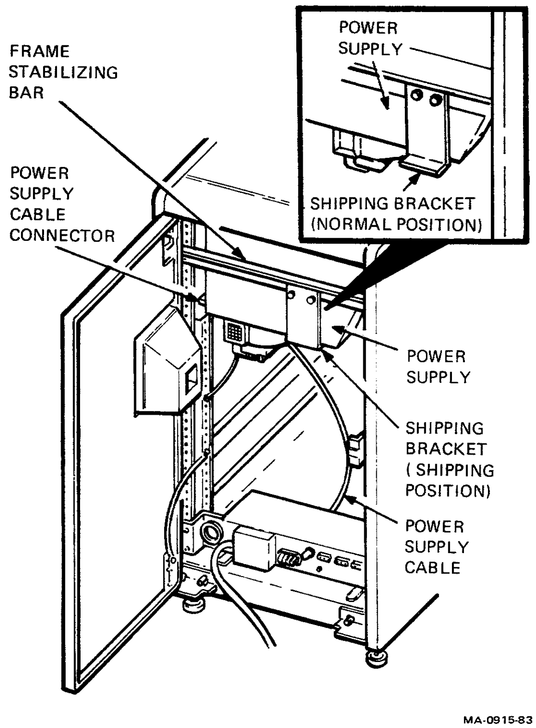

Figure 6-4 Reversing the Rear Shipping Bracket

If there is a disk drive in the TU80 cabinet, proceed as follows.

1. Install the extension stabilizer (PN H9544-HC) (Figure 6-5).

   a. Unwrap the stabilizer and mounting hardware.

   b. Slide the stabilizer in place from rear of the cabinet.

   c. Fasten the tether cable to the stabilizer using the supplied hex screw.

   d. Thread on the stabilizer's leveling foot.

2. Lower four leveler feet as shown in Figure 6-6.

   a. Lower the leveler foot to contact the floor.

   b. Using a 3/4 inch open-end wrench, turn the top nut up to top and tighten it.

   c. Repeat for the remaining feet to stabilize the unit.

   d. Continue with ''Electrical Connection.''

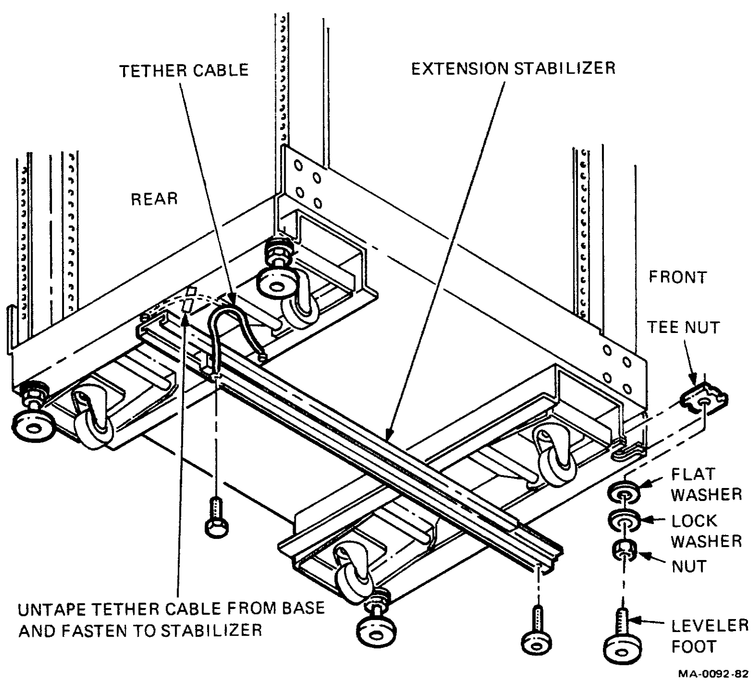

Figure 6-5 Cabinet Leveler Feet Assembly and Extension Stabilizer

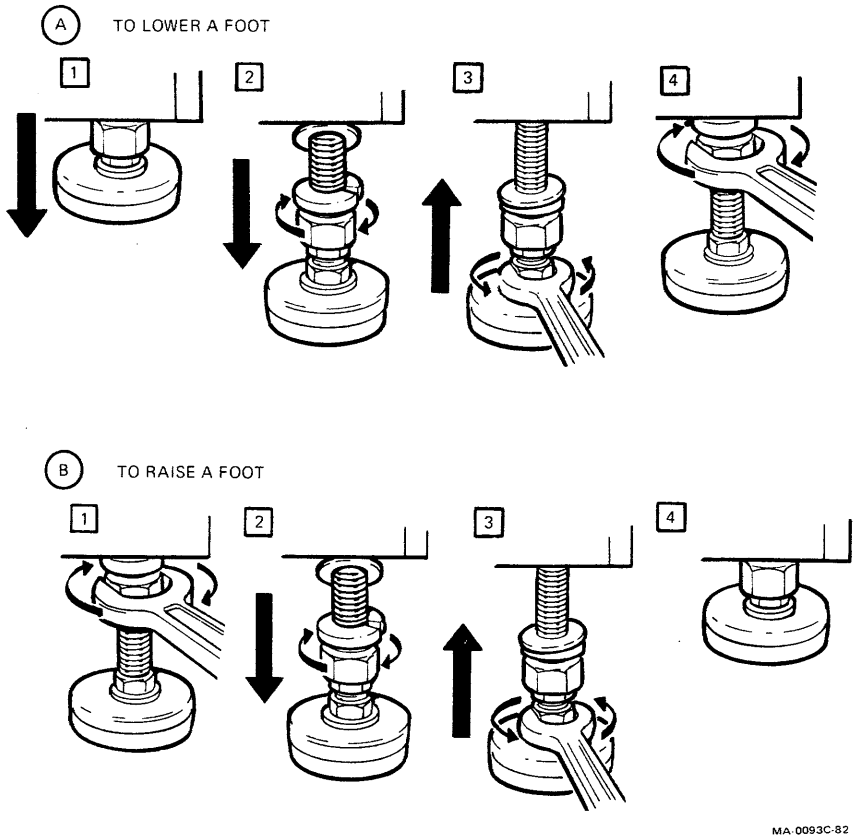

Figure 6-6 Leveler Feet Adjustments

If there is not a disk drive in the TU80 cabinet, proceed as follows.

1. Remove two end (side) panels and the rear door as shown on Figure 6-7.

   a. Pull up the spring pins and remove the rear door (Figure 6-7a). Remove the ground strap using a 5/16 inch nut driver.

   b. Remove the door hinge brackets located in the rear bottom left and right corners of the cabinet using a 7/16 inch open-end wrench (Figure 6-7b).

   c. Remove the end panels by lifting them up and away from the unit.

   d. Remove the ground straps from the side (end) panels, using a 5/16 inch nut driver.

2. Remove two rear leveler feet (Figures 6-5 and 6-6).

   a. Using a 3/4 inch open-end wrench, loosen and lower the top nut on a foot.

   b. Place a 9/16 inch open-end wrench on the bottom nut on a foot and turn the nut upward.

   c. Back the foot off the floor, then pull it outward to remove.

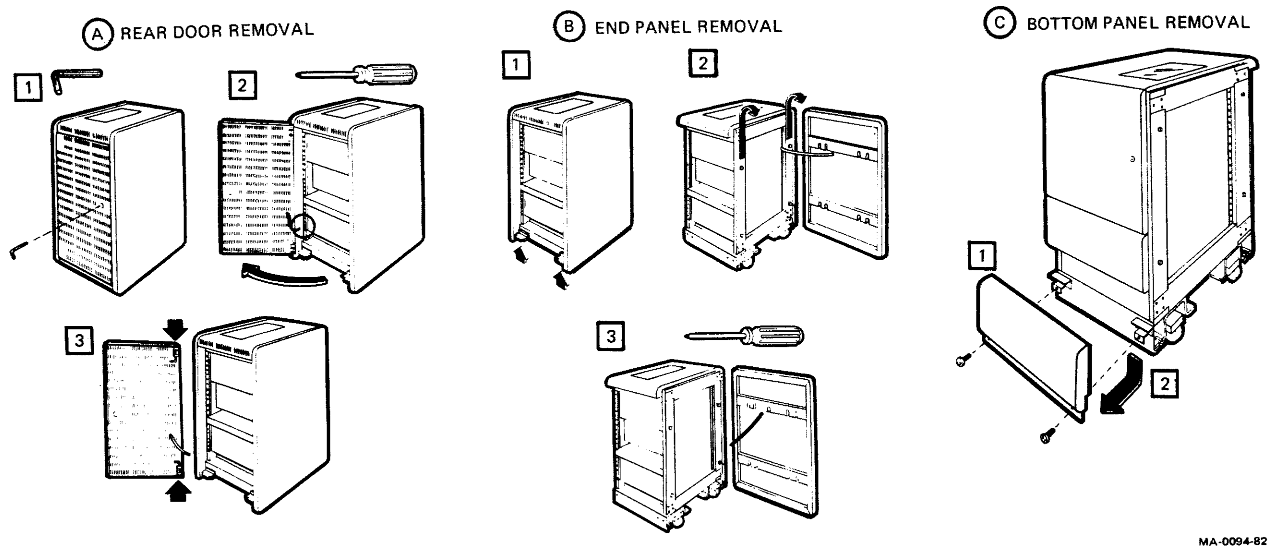

Figure 6-7 Cabinet Assembly

3. Install the rear stabilizer PN H9544-MJ (Figure 6-8).

   a. Install two couplers in the stabilizer base.

   b. Slide the stabilizer under the rear bottom of the cabinet so that the couplers are directly under the mounting slots.

   c. Install the rectangular washers, retaining washers and hex screws. Do not tighten the screw yet.

   d. Level the cabinet by adjusting the couplers. Use a screwdriver inserted into a hole in the coupler to jack it up.

NOTE
To raise the cabinet, turn the coupler counter-clockwise. To lower the cabinet, turn the coupler clockwise.

   e. Slide the shim(s) in place in the mounting slots.

   f. Tighten the hex screw(s) using a 3/4 inch box wrench and number 2 phillips screwdriver.

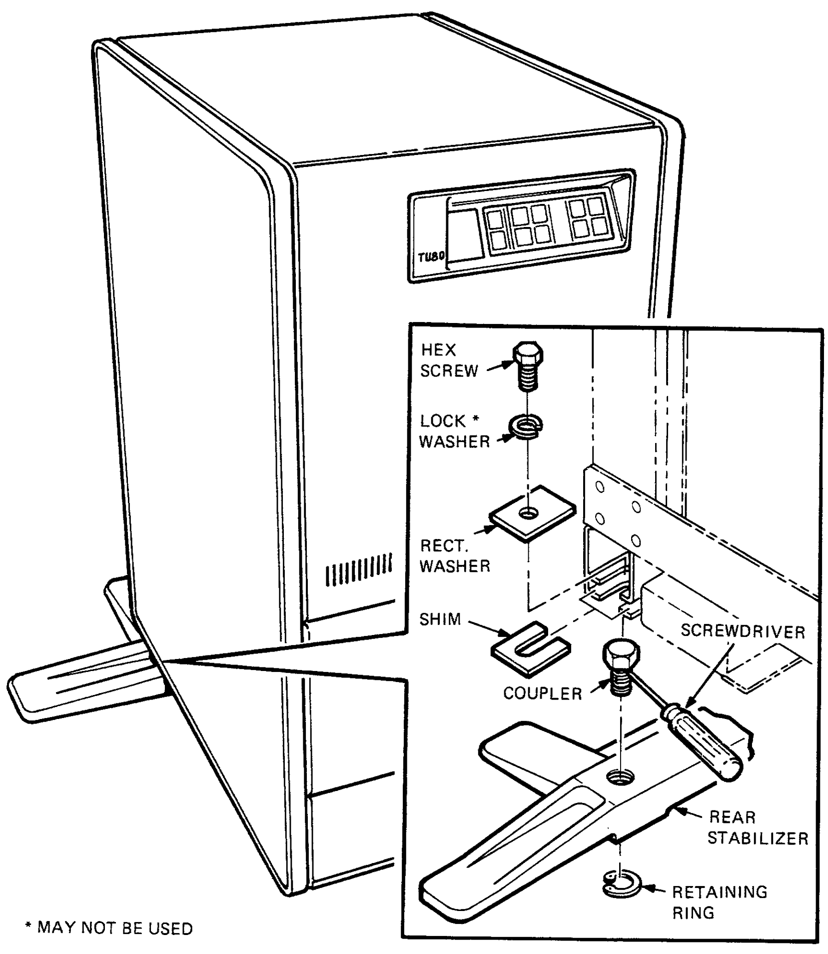

Figure 6-8 Rear Stabilizer Installation

Adjust the leveler feet to completely stabilize the cabinet (Figure 6-6) using the 3/4 inch and 9/16 inch open-end wrenches.

Replace the end panels and the rear door on the cabinet and re-attach the ground straps.

NOTE
If you need to move the transport to another location within the room, raise the leveler feet. Release the nuts on the feet using the 3/4 inch and 9/16 inch open-end wrenches (Figure 6-6). Then pull each foot up to top.

Electrical Connection

NOTE
Check the TU80 data (ID) plate for power specifications. Make sure that the local line voltage and frequency are compatible with the transport power specifications.

1. Check that the power ON/OFF circuit breaker on the 874 power controller is in OFF position, and the REMOTE/LOCAL switch is set to REMOTE position (Figure 6-9).

2. Connect the remote power switching cable from the 874 power controller (any of the four connectors) to the CPU power controller. Turn CPU's circuit breaker OFF.

3. Check that the power cable from the transport power supply is plugged into the ac connector on the power controller.

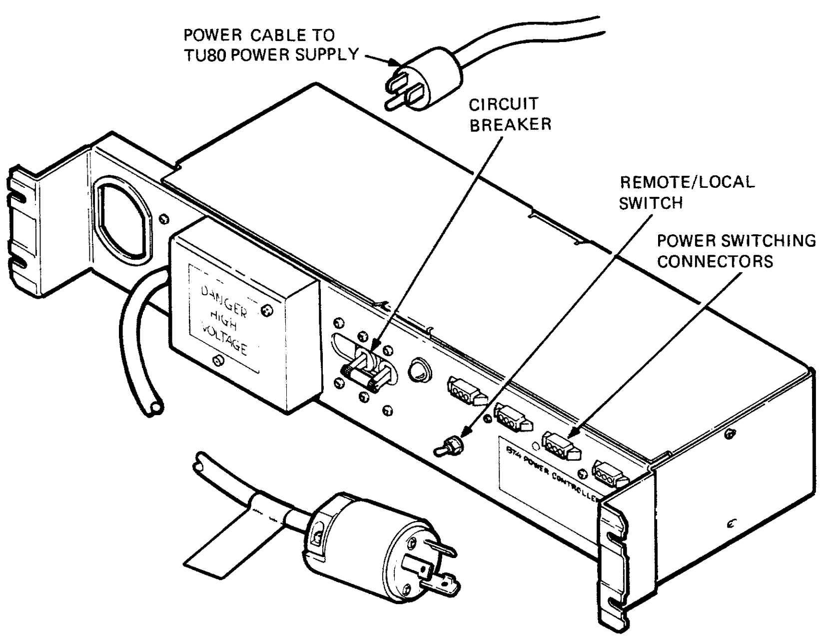

Figure 6-9 874 Power Controller

4. Plug the power cord into a local power outlet. Turn the circuit breaker on the 874 power controller to ON.

NOTE
Refer to power specifications in Table 1-2.

5. Open the TU80 top cover and set the power switch in ON (1) pressed position.

6. Turn CPU power on. The LOGIC OFF indicator on the TU80 control panel should go on.

NOTE
When installed, the TU80 should be in the remote power-on mode controlled by the CPU.

7. Turn CPU power off. Now proceed with the M7454 UNIBUS adapter installation and interfacing the TU80 with the CPU.

Grounding

The TU80 transport is grounded through the ground line in the power cable. No other grounding is needed.

UNIBUS ADAPTER MODULE INSTALLATION AND INTERFACE CABLING

The M7454 UNIBUS adapter module is a standard quad-height module and is positioned in a small peripheral controller (SPC) slot of the host computer backplane. The M7454 is connected to the TU80 transport by a set of internal and external interface cables. Cable interconnections are shown on Figures 6-10 through 6-12. Figure 6-11 shows the plug-to-plug connections of all I/O cables.

Turnkey Configuration

If the TU80 is provided with the host system, the M7454 module and CPU internal (ribbon) cables may already be installed in the SPC slot. If so, the TU80 transport is ready for external cabling to the CPU.

NOTE
Check for the CPU Kit (TU80K-CP). If it is shipped with the transport, the M7454 module has to be installed in the CPU. Call for the authorized Field Service Representative to do this installation.

Refer to the installation procedures under "Add-On Configuration."

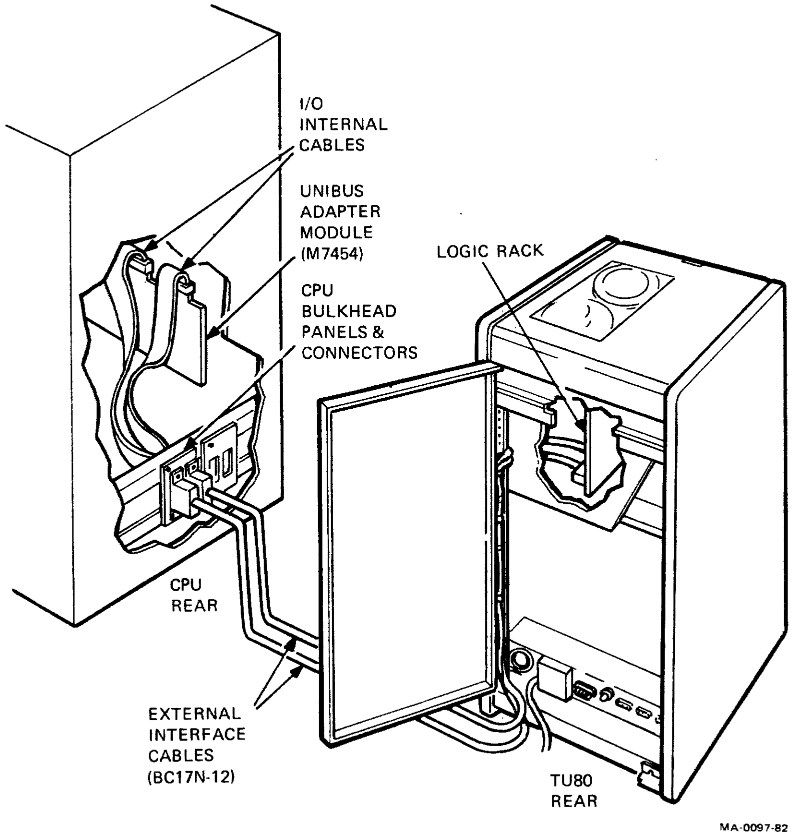

Figure 6-10 Typical Interface Cabling

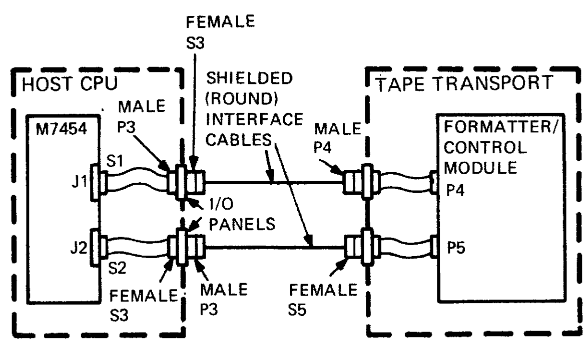

Figure 6-11 Plug-to-Plug Connections of I/O Cables

TU80 External Cabling

NOTE
External cabling is a user-oriented procedure that does not require special training.

1. Open the rear door of the TU80.
2. Route two external interface cables (PN BC17N-12) already installed in the TU80 to the designated bulkhead connectors on the CPU I/O frame. Secure each external plug in the bracket (and in the internal cable connector) with two flat-head screws as shown in Figures 6-10 and 6-16.

NOTE
In configurations with three or four TU80s on one CPU, 24 ft external cables (PN BC17N-24) must be used.

3. Close the rear door of the TU80 cabinet.
4. Now continue with the TU80 Acceptance Diagnostics.

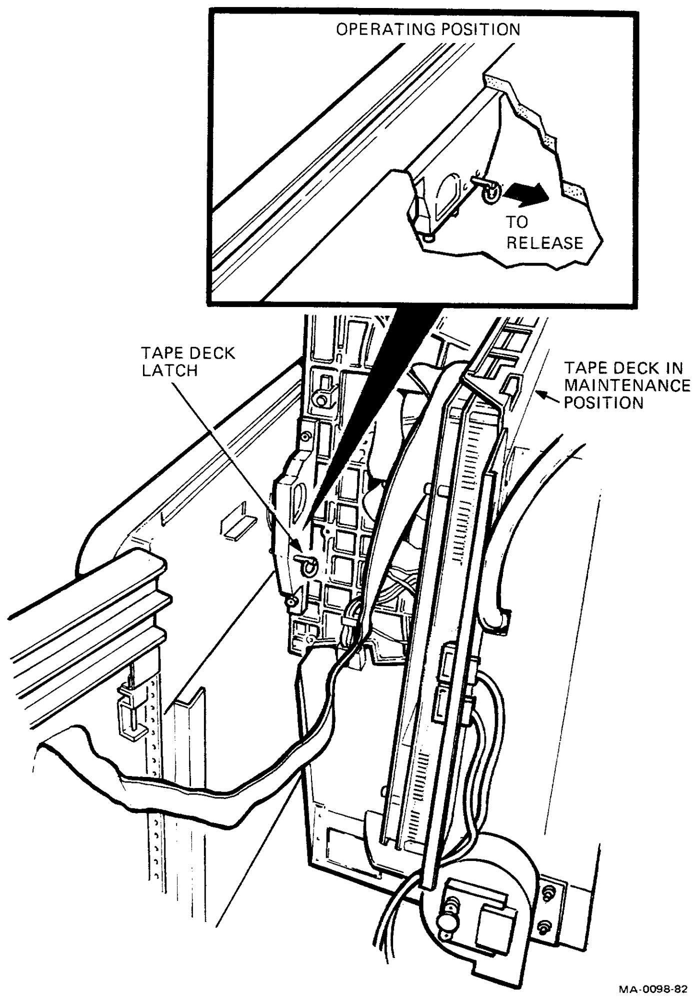

Figure 6-12 Installation of External Cables in TU80 Tape Deck

Add-On Configuration

If the TU80 is used as an add-on to the host system, the M7454 module has to be installed in the CPU using the CPU Kit (TU80K-CP), provided with the transport.

M7454 Preparation and Installation – The following procedure is for preparing and installing the M7454.

NOTE

The following procedures must be performed by an authorized DIGITAL Field Service Representative.

1. Remove the M7454 module, cables, bulkhead connector plates, frame, and mounting hardware from the shipping container. Unwrap and examine them for any physical damage.

2. On the M7454 adapter module, select the proper UNIBUS address, interrupt vector and word burst using a single 10-position DIP switch in the location 20C (Figures 6-13 and 6-14).

NOTES

1. **If this is the first TU80 on the host CPU, skip step 2 since the settings on the M7454's DIP switch are factory-set.**

2. **The typical UNIBUS address and vector for a single TU80 Subsystem configuration are specified in Table 6-1.**

   When more than one (up to four) of the TU80 Subsystems are installed with the host system, the UNIBUS addresses and vectors are selected according to Table 6-2.

3. **Switch positions 1 to 7 are used to select vector bits 8 to 2. Switch position 8 is used to select two-word or four-word burst size. TU80 uses two-word burst size. Switch positions 9 and 10 are used to determine a transport number and the corresponding UNIBUS address.**

4. **Check the jumpers in Location 4F on the module. Jumpers JP11, JP12, JP13, and JP14 select the UNIBUS address range. The standard starting address is 772522_8 selected by JP11, which is etched on side two of M7454. If another address range is required, cut JP11 and install JP12 (for address range starting at 772722), JP13 (777362), JP14 (777422).**

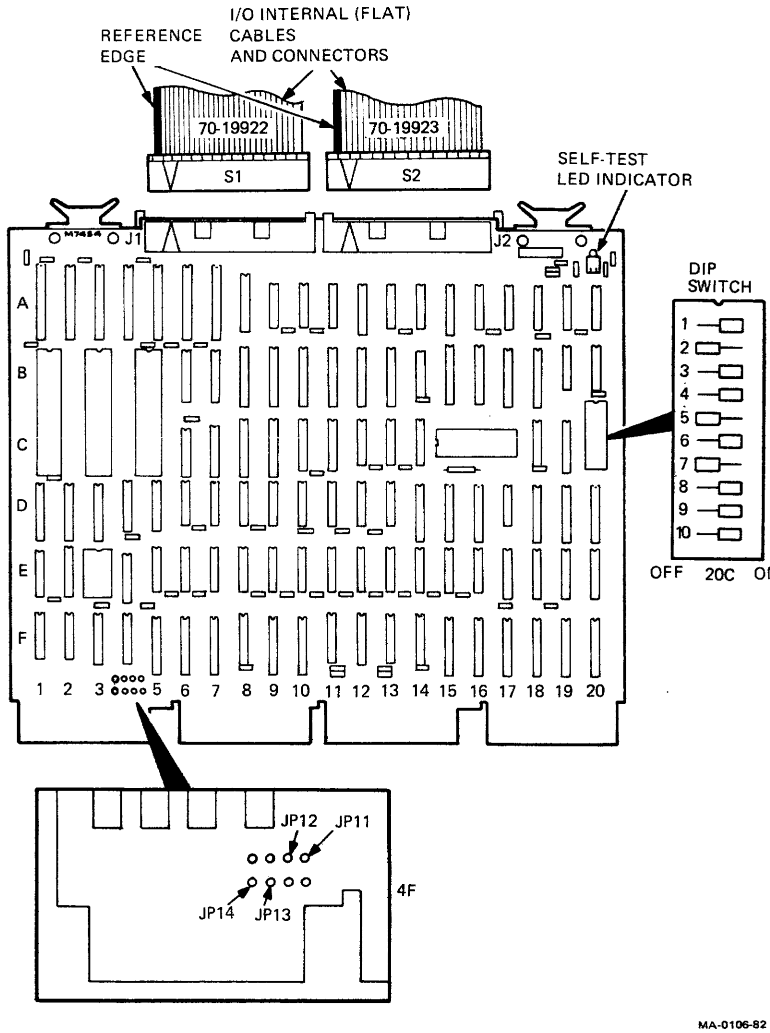

Figure 6-13 UNIBUS Adapter Module and I/O Internal Cables

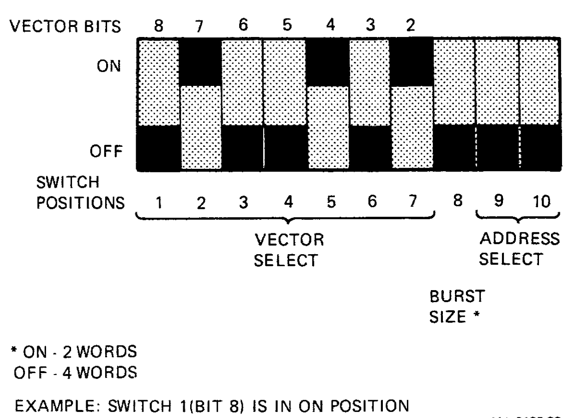

Figure 6-14 DIP Switchpack Setting for a Single TU80 Configuration (Address 172522, Vector 224)

Table 6-1 Single-TU80 Address Selection

Unit Number	Address	Vector	SW.9	SW.10
0	172522_8 $F522_{16}$	224_8 94_{16}	ON	ON

Table 6-2 Address Selection in Multi-TU80 Configuration

Transport	Unit Number	Address	Vector	SW.9	SW.10	Configuration
1	0	172522_8 $F552_{16}$	224_8 94_{16}	ON	ON	1 (Unit 0)
2	1	172526_8 $F556_{16}$	float*	ON	OFF	2 (Units 0,1)
3	2	172532_8 $F55A_{16}$	float*	OFF	ON	3 (Units 0,1,2)
4	3	172536_8 $F55E_{16}$	float*	OFF	OFF	4 (Units 0,1,2,3)

* Floating vector – 300 to 700_8.

3. Remove the G727 bus grant card from the desired SPC slot. Remove the nonprocessor grant (NPG) jumper (cut CA1 to CB1) from the backplane of the same SPC slot.

4. Plug two internal flat ribbon cables (NOT KEYED CONNECTORS) into the J1 and J2 edge connectors on the M7454 module (Figure 6-13). Plug the cable (PN 70-19922) with the male external connector into J1 and the cable (PN 70-19923) with the female external connector into J2 on the board (Figure 6-11).

NOTE

The blue stripes on the flat cables must be on the left side when you are facing the M7454 component side.

5. Carefully insert the M7454 module into the SPC slot.

CPU Internal Cabling – Examine the CPU for compliance with the FCC installation specifications. According to the FCC requirements, the CPU should have the I/O bulkhead connector frame at the rear bottom of its cabinet.

Follow the flowchart (Figure 6-15) and use the applicable procedures.

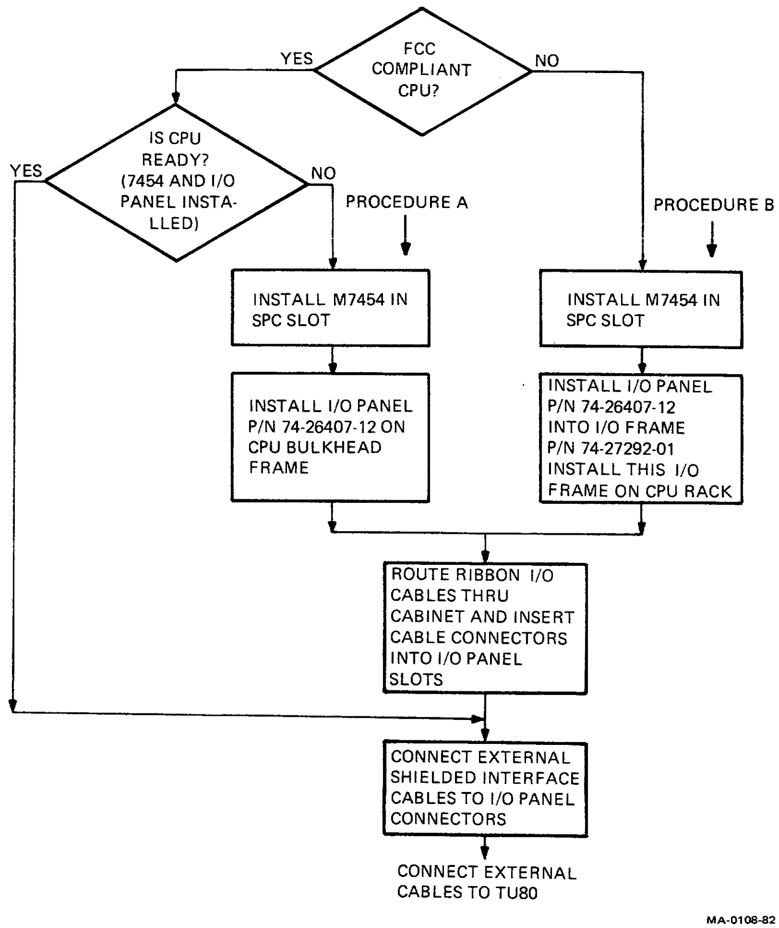

Figure 6-15 TU80 Interface Cabling Flowchart

Procedure A

1. Prepare and install the M7454 module as described above in "M7454 Preparation and Installation."

2. Install the I/O panel (PN 74-26407-12) on the CPU's I/O bulkhead frame at the bottom of the CPU cabinet (Figure 6-16a).

   Secure the I/O panel with two screws.

3. Route the internal I/O ribbon cables from the M7454 module through the CPU cabinet to the CPU frame and insert the cable connectors into the slots on the I/O panel.

4. Proceed with external interface cabling.

NOTE
Use care not to chafe the internal cables against other modules and chassis parts.

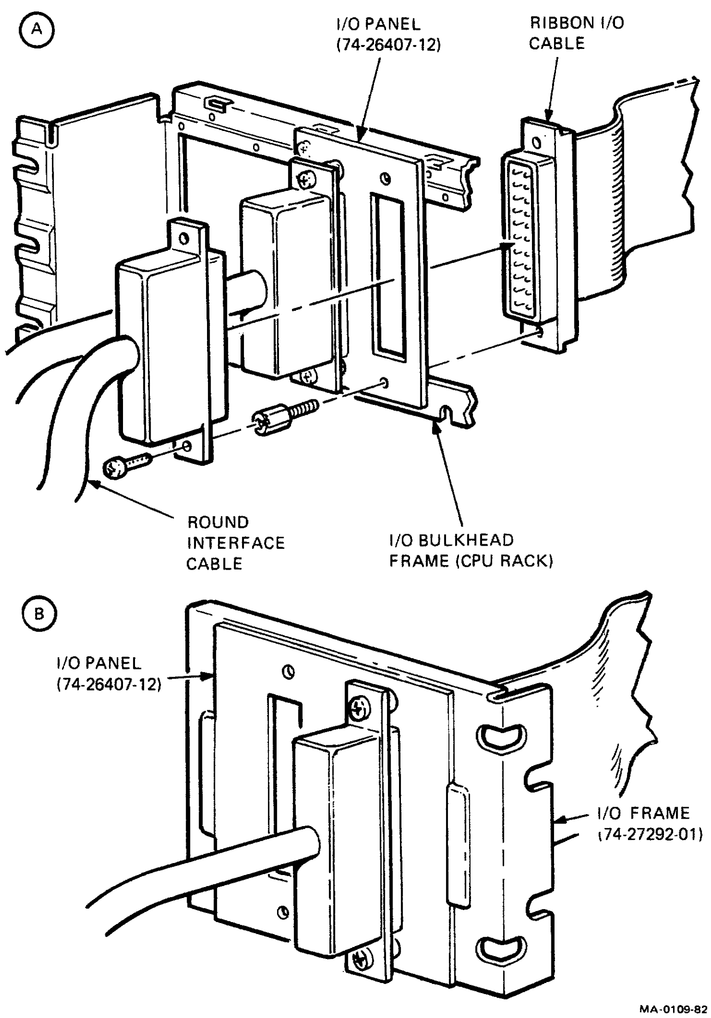

Figure 6-16 I/O Bulkhead Connector Panel and Frame

Procedure B

1. Prepare and install the M7454 module as described above in ''M7454 Preparation and Installation.''

2. Mount the I/O panel (PN 74-26407-12) on the I/O frame (PN 74-27292-01) and secure with two screws (Figure 6-16b).

3. Install the I/O frame (with I/O panel) on the CPU rack. Find the best location in the CPU rack to accommodate internal and external interface cabling.

NOTE
The recommended location for the I/O frame is at the rear bottom of the CPU cabinet.

4. Route the internal I/O ribbon cables from the M7454 module through the CPU cabinet to the CPU frame and insert the cable connectors into the slots on the I/O panel.

5. Proceed with external interface cabling.

TU80 ACCEPTANCE DIAGNOSTICS

This section lists and describes all tests necessary to properly check and accept the TU80 Subsystem.

TU80 acceptance testing includes the following resident and host diagnostics.

Resident Diagnostics

Power-on Health Check
Basic Operator Diagnostic Test (Test 01)
UNIBUS Adapter Module Resident Diagnostic

Host Remote Diagnostics

PDP-11 Front-End Diagnostic
PDP-11 Data Reliability Diagnostic
VAX Front-End Diagnostic
VAX Data Reliability Diagnostic

NOTE
Refer to the Diagnostic Documentation of the installed DIGITAL computer for the applicable information on how to run and interpret the host diagnostics.

Power-On Health Check

NOTE
Make sure that the TU80 power cord is plugged in and the transport is energized (the power switch is ON) before starting the acceptance tests.

This microdiagnostic (resident) test is performed when the TU80 is powered up by pressing the LOGIC ON switch. If this check is successful, the LOGIC OFF indicator turns off and the two-digit display momentarily shows 00. Then the BOT, RESET, ON-LINE, DIAGNOSTIC and SELECT indicators go on momentarily. The LOGIC ON and FILE PRO indicators go on and stay on. Otherwise, a fault code is indicated on the two-digit display. Press the RESET, LOGIC OFF and LOGIC ON switches to repeat the check. If the fault code reappears, proceed with fault isolation and the appropriate service actions.

Basic Operator Diagnostic Test 01
This test performs various tape motion and read/write exercises to verify transport operation.

With a 2400-foot reel of good, known-quality tape it takes approximately 10 minutes to run the test to completion. For test description, refer to Chapter 3 of this manual.

UNIBUS Adapter Module Resident Diagnostic
The M7454 UNIBUS Adapter Module performs its own internal diagnostic routine at the system power-up. To run this diagnostic, turn the CPU's circuit breaker OFF/ON. The M7454 diagnostic resides in the on-board programmable ROM. It checks only the M7454 module without any tape motion or interface testing. The diagnostic checks the M7454's microprocessor, sequencer, data paths, and buffer area. The test has completed successfully when the LED indicator on the module goes on (Figure 6-13).

M7454 Status Checking – Refer to the following paragraphs for M7454 status checking.

TU80 Turnkey Configuration/Installation
When the M7454 (and TU80) fails during new system configuration (PDP-11 or VAX), the host configures around the TU80 not recognizing it. An appropriate error message appears on a computer console terminal.

TU80 Add-On Configuration/Installation

1. If a TU80 is added to a PDP-11 system, the host system must be reconfigured by an operator using an applicable SYSGEN routine. If the M7454 fails during SYSGEN, the host will be unable to get through to the TU80, and an appropriate error message is displayed on the console terminal.

2. If a TU80 is added to a VAX system, the host automatically configures the unit into the system. If the M7454 fails at that time, the host is unable to access the TU80, and an appropriate message appears on the terminal.

On-Line Operation Failure
If the M7454 fails during normal on-line operation, the host is not able to continue to access the TU80. The error message is entered in the system error log. When the operator tries to recall the TU80, the appropriate error message appears on the operator's terminal indicating the ''not found'' status of the device and the time and status at the time of failure.

To check the TU80 operating condition and to localize the failed module, reset the unit and perform the system power-up host to run the M7454 internal diagnostic. Then place the TU80 on-line and try to access the transport through the host. If the fault condition persists (self-test LED does not come on), call Field Service.

To check the TU80 operating condition and to localize the failed module, reset the unit and perform the host system power-up to run the M7454 internal diagnostic. Then place the TU80 on-line and try to access the transport through the host. If the fault condition persists (self-test LED does not come on), call Field Service.

PDP-11-Based Remote Diagnostics

PDP-11 Front-End Diagnostics CZTUW, CZTUX, CZTUY, CZTUZ – This four-part complex test checks the subsystem in all basic modes of operation and tests the interface bus, I/O silo, and TU80 transport's logic.

CZTUW

TST : 001	Initialize #1
TST : 002	RAM Test
TST : 003	Command Reject Test
TST : 004	Write Characteristics Test
TST : 005	Volume Check
TST : 006	Completion Interrupt Test
TST : 007	Basic Packet Protocol Test
TST : 008	Non-Tape Motion Command Test
TST : 009	DMA Memory Addressing Test
TST : 010	Initialization After Write Characteristics Test
TST : 011	Basic Write Subsystem Memory Test

CZTUX

TST : 001	FIFO Exercizer Test
TST : 002	Initialize #4 Test
TST : 003	Off-Line Reject and Rewind Test
TST : 004	Basic Write Data Test
TST : 005	Basic Read Data (Forward and Reverse) Test
TST : 006	Manual Intervention Test
TST : 007	Configuration Typeout Test
TST : 008	Scope Loops Test

CZTUY

TST : 001	Space Records Test
TST : 002	Rereads Test
TST : 003	Write Data Retry Test
TST : 004	Write Tape Mark Test

CZTUZ

TST : 001	Write Tape Mark Retry Test
TST : 002	Skip Tape Marks Test
TST : 003	No-Op and Initialize Test
TST : 004	Erase and Operation Incomplete Test
TST : 005	Test of Operation at EOT Test
TST : 006	Function Tuning Test

PDP-11 Data Reliability Diagnostic (CZTUV) – This test simulates a typical customer operating environment and check data integrity when operating in both the start/stop and streaming modes. It is mainly a data confidence test.

Data Reliability Program Tests

Test 1 :	Basic Functions
Test 2 :	Data Reliability
Test 3 :	Streaming Test
Test 4 :	Write Compatability/Write Utility
Test 5 :	Read Compatability/Read Utility
Test 6 :	Operator Selected Sequence

NOTE

For Program Control Flags, refer to Diagnostic Listing.

Operating Instructions for PDP-11-Based Diagnostics

Follow this procedure when using PDP-11-based diagnostics.

1. Load XXDP + monitor

   a. Enter date

2. Answer hard core questions.

   a. 50 Hz? Y or N
   b. LSI? Y or N

   This is XXDP +. Type H or H/L for details (Help File).

   [Receive XXDP + prompt (dot)]

   •

3. Enter R (space) program name.

   The program may be CZTUV or CZTUW, CZTUX, CZTUY, CZTUZ.

   The operator entry should look like this.

   [• R ZTUV??]

4. Receive DR> prompt.

5. Enter the appropriate command.

   For example,

   DR>STA to start the test.

6. Change HW(L)? 'Y' or 'N' – To run the diagnostic, the answer must be 'Y'.

7. Change SW(L)? 'Y' or 'N'

NOTE
Refer to the Diagnostic Listing for specific program problems and instructions.

No hard errors are allowed.

Hardware Parameters – The following are the TU80 base address and vector assignments.

TSSR ADDRESS (172522)?
VECTOR (224)?

Example of commands:	STA/TES:2/FLA : IDU : LOE
Example meaning:	Start Test 2, inhibit dropping unit and loop on error.

Software Parameters – Refer to Diagnostic Listings.

VAX-Based Remote Diagnostic

VAX Front-End Diagnostics (EVMBD, EVMBE) – These two tests check the subsystem in all basic modes of operation, and test the TU80 logic, interface bus and I/O silo. These tests can be run with the host off-line only.

VAX Data Reliability Diagnostic (EVMAA) – This check is designed to thoroughly check out the tape subsystem. It allows the operator to test the TU80 on-line without bringing the system down. The diagnostic consists of the Qualification Test and the Data Reliability Test.

Data Reliability Test Sections

Test 1 : Qualification Test 1
Test 2 : Qualification Test 2
Test 3 : Data Reliability Test
Test 4 : Multi-Drive Test
Test 5 : Conversation Mode Test
Test 6 : Streaming Test

NOTE
Test 1 is not run on TU80.

Operating Instructions for VAX-Based Diagnostics
Follow this procedure when using VAX-based diagnostics.

1. Load the Diagnostic Supervisor (ECSAA, ENSAA, or ESSAA).

NOTE
ECSAA is used on VAX 11/750.
ESSAA is used on VAX 11/780.
ENSAA is used on VAX 11/730.

2. Attach and select a device to be loaded in one of two ways.

   a. Prompt mode

      DS> Attach DW7XX HUB DWO
      Device Type? TU80
      Device Link? DWO
      Device Name? MSAO
      CSR? 772520*
      Vector? 224
      BR? 5

   b. Explicit mode

      DS> Attach TU80DWOMSA07725202245
      DS> Select TU80

3. Load and start the diagnostic in one of two ways.

   a. Example 1

      DS> Load EVMAA (or EVMBD, EVMBE)
      DS> Start/Switches

   b. Example 2

      DS> Run EVMAA (or EVMBD, EVMBE)/Switches

      No hard errors are allowed.

NOTE
For control flags, refer to the Diagnostic Listings.

* Base address (TU80's starting address is 772522).

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