EK-0TU81-PS-002

TU81 Magnetic Tape Subsystem

Pocket Service Guide

Prepared by Educational Services
of
Digital Equipment Corporation

1st Edition, August 1984
2nd Edition, May 1986

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PREFACE

This pocket service guide provides servicing information for the TU81 magnetic tape subsystem. The procedures are brief and support the maintenance philosophy of module replacement.

The first two chapters provide product overview and installation information for quick review. Chapter 3 describes the troubleshooting procedures. By using diagnostics and control panel features, you can quickly locate malfunctions. Chapter 3 also includes a description of the ASCII port. Chapter 4 provides removal and replacement procedures.

This guide does not include programming information, but Appendix A does provide information on sense bytes. A troubleshooting flowchart is in Appendix B, and a malfunction matrix is in Appendix C. Appendix D describes the procedure for address selection when installing additional UNIBUS adapter modules.

1 INTRODUCTION

1.1 GENERAL

The TU81 Magnetic Tape Subsystem is a dual-speed, nine-track streaming tape data storage system. The TU81 tape transport is a fully integrated tape transport, packaged with all its control and power electronics in a standard H9643 cabinet. The transport communicates with a host system by means of a shielded interface cable connected to an M8739 UNIBUS/Q-Bus adapter, plugged into the SPC slot of the host CPU.

1.2 SUBSYSTEM OVERVIEW

Figure 1-1 is a cabling diagram of the TU81 tape transport. Figure 1-2 is a functional block diagram of the TU81 subsystem. Figure 1-3 is a simplified diagram of the locations of the printed circuit boards (PCBs) in the TU81, with the tape deck in the maintenance (vertical) position.

> **NOTE**
> **You can connect up to four TU81 tape transports to a single host CPU (Figure 1-4). Each TU81 interfaces with the CPU through a dedicated UNIBUS/Q-Bus adapter module (M8739) and interface cable assembly.**
>
> **Refer to Paragraph 2.2.2 for M8739 installation and setup.**

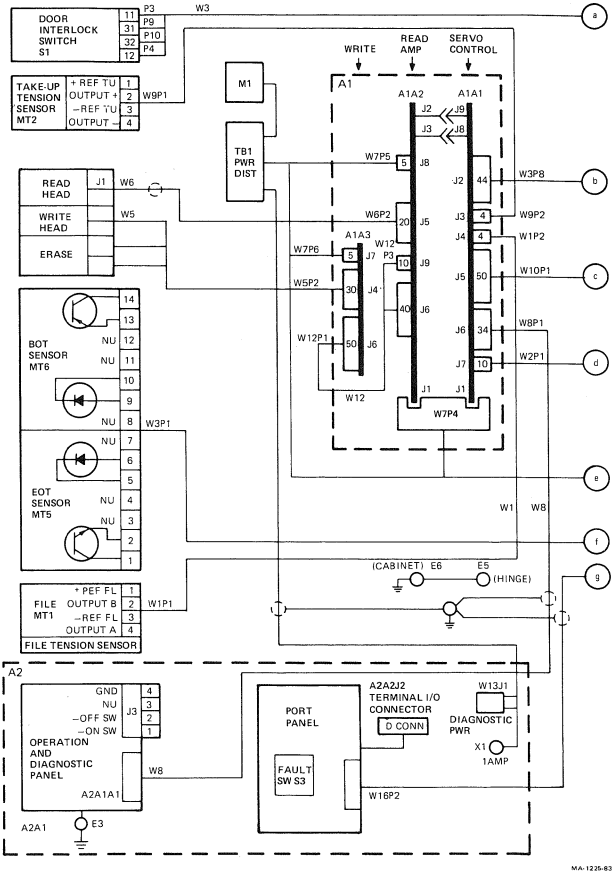

Figure 1-1 TU81 Cabling Diagram
(Sheet 1 of 2)

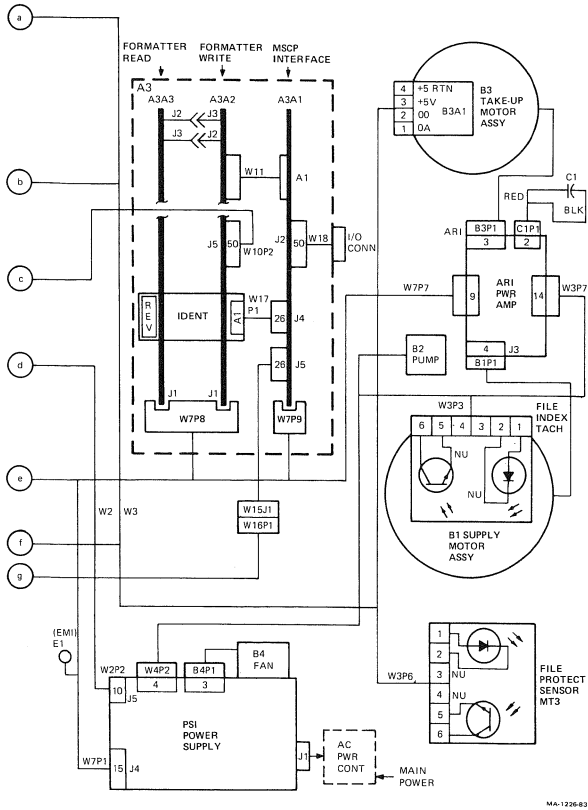

Figure 1-1 TU81 Cabling Diagram
(Sheet 2 of 2)

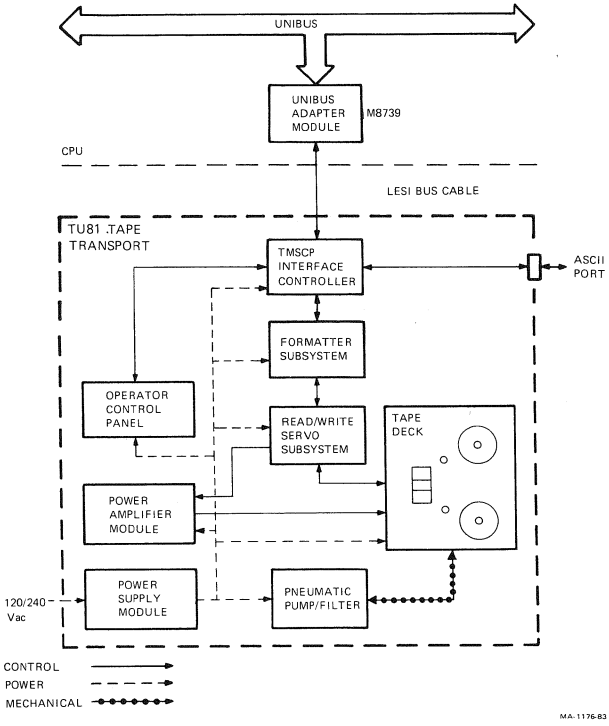

Figure 1-2 TU81 Block Diagram

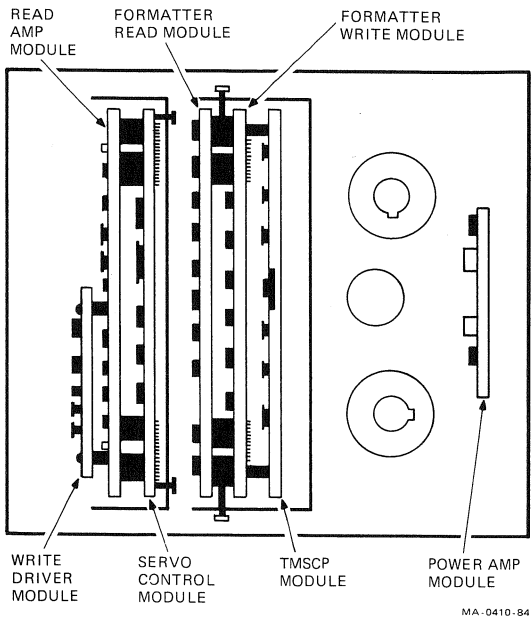

Figure 1-3 Logic Module Locations (Tape Deck in the Maintenance Position)

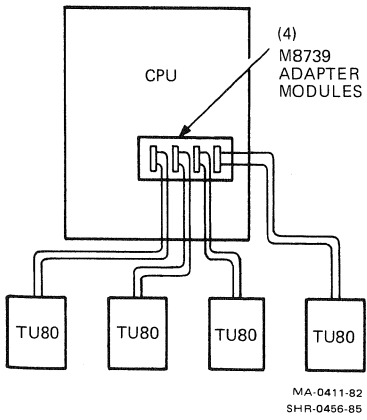

Figure 1-4 Maximum TU81 Configuration

1.3 TU81 CONFIGURATION

Figure 1-5 shows the TU81 subsystem basic components. The transport is compactly mounted in the upper portion of the H9643 cabinet. Figure 1-6 shows the tape deck.

> **NOTE**
> **To make TU81 transport maintenance easier, the transport deck is mounted on a pivot. The deck can be rotated from the horizontal (operating) position to the vertical (maintenance) position. A special service lock (tape deck latch) on the left side of the cabinet under the tape deck keeps the deck in one of these positions. (For more maintenance information, refer to Chapter 4.)**

The TU81 models are as follows.

TU81-CA 120 Vac, 60 Hz
TU81-CB 240 Vac, 50 Hz

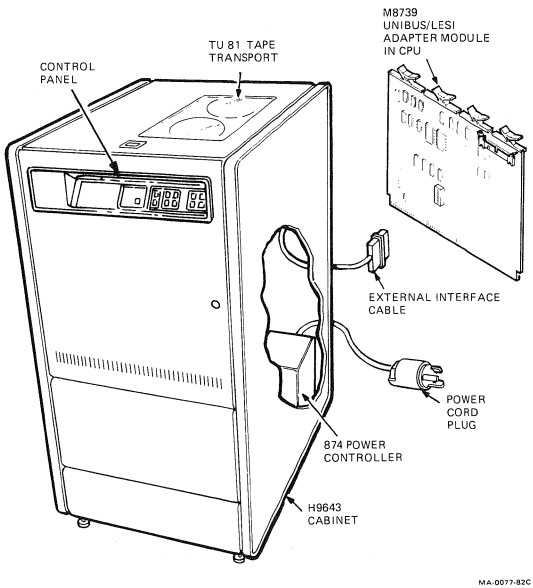

Figure 1-5 TU81 Tape Subsystem

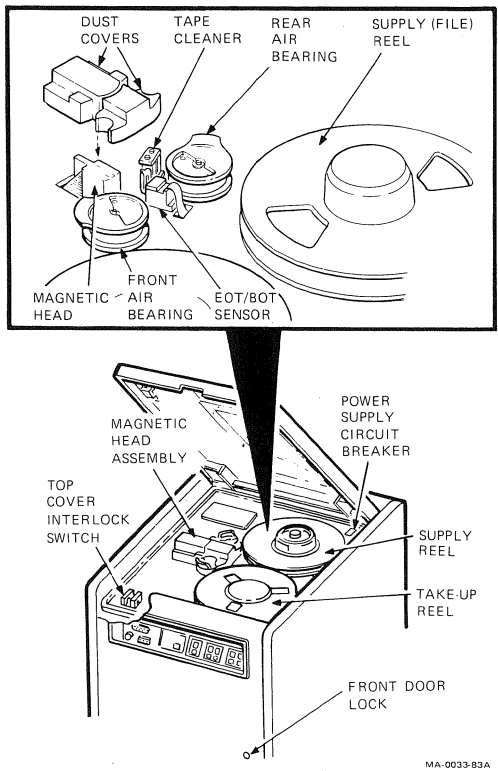

Figure 1-6 Tape Deck

1.3.1 Power Supply

AC power from a single ac power outlet is supplied through a standard three-wire power cable (60 Hz only) to the 874 power controller located at the bottom rear of the transport cabinet (Figure 1-7).

NOTE
The 50 Hz power cable must be provided by the user.

The 874 controller features a 12 A (50 Hz) or 24 A (60 Hz) circuit breaker and provides switched 120 Vac (60 Hz) or 240 Vac (50 Hz) to the transport's power supply located at the top rear of the cabinet. The 874 power controller is connected to the host CPU by a power switching cable. This gives the CPU control over the TU81 power supply.

The power supply accepts regulated inputs of 120 Vac (60 Hz) or 220/240 Vac (50 Hz) power. The only change in configuration is the positioning of the voltage select PC board. The main functions of the power supply are to provide ac power to the cooling fan and pneumatic pump, to generate dc voltages used throughout the transport, and to shut down the system in the event of an abnormal voltage condition.

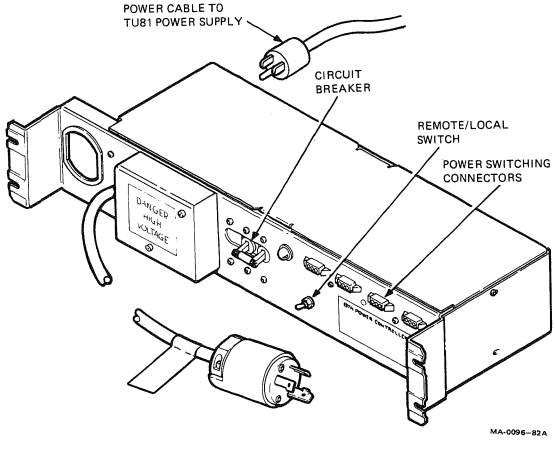

Figure 1-7 874 Power Controller

The dc voltages generated by the power supply, for use throughout the transport, are as follows.

Voltage	Used On
+5 V	All modules as a supply voltage for TTL circuits
−6 V	Read amplifier circuits
+15 V	Servo control, power amplifier, and read recovery circuits
−15 V	Servo control and power amplifier circuits
+25 V	Write driver circuits
+38 V	Power amplifier circuits

The power supply shuts down in two cases – when an overvoltage or low voltage condition occurs. The power supply fault condition is shown by the LOGIC OFF indicator being on.

1.3.2 Pressure Pump Shutdown

If the TU81 does not receive a new command from the CPU within one minute, the transport will automatically shut down its pressure pump (compressor) and remove power from the reel motors. The tape position will continue to be monitored by the control microprocessor, and if motion of the take-up reel is detected, power will be reapplied to the take-up reel to renull its position.

If the transport has entered the shutdown mode, execution of the first command received from the CPU will be delayed by approximately one second.

1.4 SPARES KIT

The TU81 CD kit (PN A2-W0619-10) contains the *TU81/TA81 Pathfinder* (EK-TUA81-SV), the cover interlock defeat tool, and all spares. Table 1-1 lists the field replaceable units (FRUs) and spare parts on the recommended spares list (RSL). Refer to the figures in Chapter 4 (Removal and Replacement) and use the *Illustrated Parts Breakdown* (IPB) when you try to locate a particular part or assembly.

Table 1-1 Recommended Spares List (RSL)

Description	Digital Part Number
Tape cleaner assembly	29-24210
Sensor	29-24211
Hub assembly, take-up reel	29-24212
Motor installation kit	29-24213
Compressor, 60 Hz	29-24214
Compressor, 50 Hz	29-24718
Magnetic head installation kit	29-24752
Operator panel assembly	29-24755
Blower	29-24228
Power supply	29-24753
Power amplifier module	29-24223
Hub assembly, supply reel	29-24224
Filter	29-24227
Tachometer, 1 line	29-24358
EOT/BOT sensor	29-24356
Door interlock switch	29-24355
Capacitor	29-24357
Air bearing refurbishing kit	29-24359
Pressure regulator	29-24354
Write driver module	29-24706
Servo control module	29-24705
Read amplifier module	29-24704
Formatter read module	29-24709
Formatter write module	29-24708
Velostat* kit	29-11762
TMSCP module	29-24707
Buffered TMSCP module	29-25797
UNIBUS adapter (LESI)	M8739
Hand-held ASCII terminal	

*Trademark of 3M Company.

1.5 TOOLS

In addition to the Digital tool kit and the TUC01 tape cleaning kit, you should have a number of BOT/EOT markers (PN 90-09177-00). You need a special 3/8 inch socket set (PN 29-22445-00) to remove the reel motors.

You do not need any other tools or instruments to *service* the TU81 tape transport. However, to install the TU81 you need the following tools.

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
No. 2 phillips screwdriver

1.6 DOCUMENTATION

If you need more information on the TU81 subsystem, refer to the list of related documents in Table 1-2.

Also, use manuals and handbooks appropriate for the PDP-11 and VAX computer systems and processors.

Table 1-2 Related Documents

Document/PN	Description
TU81/TA81 Subsystem User Guide (EK-TUA81-UG)	Contains a functional overview and installation, operating, and programming information.
TU81/TA81 Technical/ Service Manual (EK-TUA81-TM)	Contains a system functional description, installation and acceptance procedures, theory of operation, and maintenance information.
TU81/TA81 Pathfinder (EK-TUA81-SV)	Contains detailed troubleshooting information including troubleshooting procedures, tests, and subfault codes.
TU81/TA81 Illustrated Parts Breakdown (EK-TUA81-IP)	Provides a list and illustrations of replaceable parts.
874 Power Controller Illustrated Parts Breakdown (EK-00874-IP)	Provides a list and illustrations of replaceable parts.
TU81 Field Maintenance Print Set (MP-01618)	Provides unit assembly (UA) drawings and interconnect schematics.

1.7 CONTROL PANEL

The following paragraphs discuss the control panel, diagnostic/maintenance panel operation, and on-line system diagnostics.

Figure 1-8 shows the control panel of the TU81 tape transport.

All panel switches are pushbutton type. These switches and their corresponding functions are discussed below.

The central part of the control panel (operator) contains the operator switches and indicators. The three-digit display shows the unit number during normal operation. If an error occurs, during on-line operation or off-line diagnostic routine, the display indicates the three-character fault code (for example, E31). While the off-line resident diagnostic is running, the display shows the number of the test in progress.

The right part of the control panel (maintenance) contains the switches and indicators for running the resident diagnostic test routines.

The left part of the control panel (special) contains special purpose switches, connectors, and indicators. These are the FAULT/CONTROLLER switch/indicator and the ASCII test panel used by Field Service.

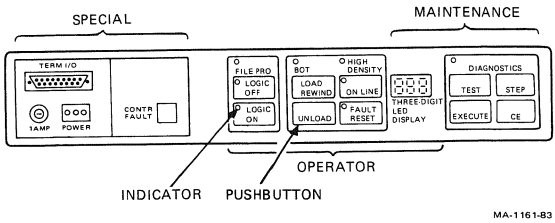

Figure 1-8 Control Panel

1.7.1 Operator Controls

The following chart describes the operator controls.

Switch/Indicator	Function
LOGIC OFF	**Indicator** – When on, indicates a power fault condition, that is, a failure in the transport's power supply operation.
LOGIC ON	**Indicator** – When on, indicates a normal power-on condition with all dc voltages applied to the transport's control system and circuits.

NOTE
The LOGIC OFF and LOGIC ON pushbuttons do not operate.

FILE PRO	**Indicator** – When on, indicates that there is no write enable ring in the supply reel and write operation is inhibited. Otherwise, write operations are allowed.
BOT	**Indicator** – When on, indicates that the tape is loaded and positioned at the beginning-of-tape (BOT) marker.
LOAD/REWIND	**Switch** – If the transport is powered on and the tape is threaded, pressing this switch causes a load operation to be performed. If the tape is already loaded, pressing the switch causes a rewind operation to BOT.
UNLOAD	**Switch** – If the tape is loaded at BOT, pressing this switch causes the tape to unload from the take-up reel and tape path onto the supply reel. If the tape is loaded beyond BOT, it rewinds to BOT and unloads the tape. If the tape is threaded but not loaded, pressing the switch causes the transport to slowly unload the tape onto the supply reel.

Switch/Indicator	Function
ON-LINE	**Switch** – If the tape is loaded, pressing this switch causes the transport to become available to the host system. Press the RESET switch to take the TU81 off-line. **Indicator** – When on, ON-LINE indicates that the TU81 is ready for on-line operation. All switches except RESET are inhibited.
HIGH DENSITY	**Indicator** – When on, indicates that the transport is selected by the host system for GCR operation.
FAULT/RESET	**Indicator** – When on, indicates that the transport is in fault or diagnostic status. The three-digit display may contain a fault or diagnostic code.
RESET	**Switch** – When pressed, the RESET 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 FAULT/RESET indicator and clears the diagnostic test condition.

1.7.2 Diagnostic Controls

The following chart describes the diagnostic controls.

Switch/Indicator	Function
DIAGNOSTIC	**Indicator** – When on, indicates that the transport is in the diagnostic/test mode. The indicator remains on until you press the RESET switch.
TEST	**Switch** – If the transport is not on-line and/or the tape is threaded but not loaded, pressing this switch places the unit in the diagnostic/test mode. It is also used as an X10 multiplier in the diagnostic mode.

Switch/Indicator	Function
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 three-digit display to increment by one to a required digit.
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 in the three-digit display.
CE	**Switch** – If the transport is in the diagnostic/test mode, the CE (customer engineer) switch helps to recall and run Field Service diagnostics. Press CE and TEST simultaneously to put the transport in resident diagnostic mode.

1.7.3 Special Controls

The following chart describes the special purpose controls.

Switch/Indicator	Function
CONTR FAULT	**Indicator** – When on, indicates the TMSCP interface controller fault condition until the condition is cleared by the TU81 or the host. **Switch** – With the CONTR FAULT indicator on, pressing this switch causes the TU81 transport to attempt to clear the fault condition. If the fault is corrected (through either the transport or the host), the CONTR FAULT indicator goes off and the TU81 is available to the host again.

1.7.4 Diagnostic/Maintenance Panel Operation

The TU81 has internal (resident) diagnostics that can be initiated through the transport's control panel. The internal diagnostics include an operator diagnostic test (test 01) and a set of Field Service diagnostic tests (customer engineer tests), described in Chapter 3.

To get into diagnostic mode and initiate operator or Field Service diagnostic tests, use the diagnostic panel as follows.

1. To recall operator diagnostic test 01, press TEST. The number 01 will appear on the three-digit display. If you need test 02 or 03, use STEP. Each time you press STEP, the display number increments by one. Press EXECUTE to initiate the test you want.
2. To recall Field Service resident diagnostics, press and hold CE and press TEST.
   a. The DIAGNOSTICS indicator lights.
   b. The number 00 appears on the three-digit display.
   c. Press STEP.

      The display number increments by one each time you press STEP, or increments automatically if you press and hold STEP. The display can show 00 through 09.
   d. To select a test number, use the STEP and TEST switches. When you press TEST after you press STEP, the number is multiplied by 10.

      Example: Test 39 is required.

Step	Display
1. Press CE and TEST.	00
2. Press STEP three times.	03
3. Press TEST.	30
4. Press STEP until 9 is displayed.	39

   e. Press EXECUTE to initiate the test.

After the fault code appears on the display, you can recall the subfault code by pressing CE. The subfault code is displayed as long as you hold CE.

1.7.5 Unit Number

The unit number is a number from 0 to 255. It is used as a unit address feature giving each tape transport a unique code to be recognized by the host. This number is especially useful for system error logging and in multidrive configurations, because it enables you to re-address your peripheral device from one drive to another in case of tape drive failure, connection breakdown, and so on.

The unit number is a three-digit code that is manually entered from the transport's control panel using procedure 04 shown below. This unit number is stored in the transport's nonvolatile memory (that retains stored data in case of any power fluctuations or failure) until you enter a new unit number. The unit number is continuously indicated on the transport's display when the drive is powered on and is in its normal on-line, off-line, or tape-unloaded status. Only when there is a fault condition, or the diagnostic test is run from the control panel, is the unit number replaced by the fault code or test number.

To enter the unit number, use procedure 04.

Example: To enter unit number 201, proceed as follows.

Step	Display
1. Press **TEST**.	DIAGNOSTICS indicator on
	01
2. Press **STEP** three times.	04
3. Press **EXECUTE** to initiate procedure 04.	000
4. Press **STEP** twice.	002
5. Press **TEST** twice.	200
6. Press **STEP** once.	201
7. Press **EXECUTE**.	
8. Press **RESET**.	201

1.7.6 ASCII Port Diagnostics

These diagnostics are run using any RS232-compatible terminal (including Digital's hand-held terminal) plugged into the ASCII signal port on the TU81's control panel. Refer to Paragraph 3.4 for detailed information.

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31

1.8 MAINTENANCE

NOTE
The TU81 does not need any mechanical and/or electrical adjustments or alignments for corrective or preventive maintenance.

The only maintenance required is regular cleaning of the tape path components. Also, the TU81 has several safety features as described below.

1.8.1 Removing Shipping and Safety Brackets

The TU81 has three sets of shipping and safety brackets that are used to secure the tape deck and PC boards during shipment. The front bar and rear bracket are removed when the transport is installed at the user's site (refer to Chapter 5, Mechanical Installation, in the *TU81/TA81 Subsystem User Guide*).

The shipping and safety brackets on the logic cage must be removed and the retaining latch released from the shipping position when any of the PC boards are replaced. For additional information on board replacement, refer to Paragraph 4.20. Proceed as follows (Figure 1-9).

1. With the tape deck in the maintenance (vertical) position (Paragraph 4.1), loosen the mounting screws and remove the lower shipping bracket from the logic cage.
2. Using a screwdriver, pull the retaining latch from the shipping position to the operating (middle) position.
3. On the top of the logic cage, release the mounting nut and remove the holding (safety) bracket.

NOTE
This bracket may be put back when the PC board has been replaced.

Store all the brackets for future reshipments.

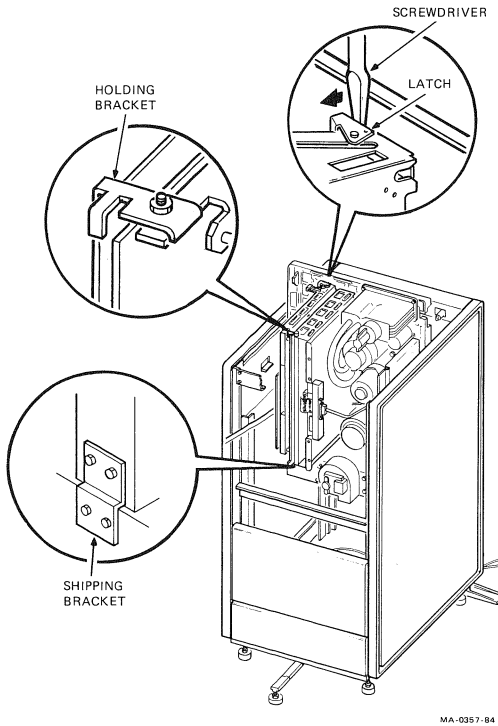


Figure 1-9 Shipping and Holding Bracket Removal

1.8.2 Quick Disconnect Tabs

Most of the cable connectors in the drive have "quick disconnect tabs" to make cable connection quick and safe. Figure 1-10 shows how the tabs work.

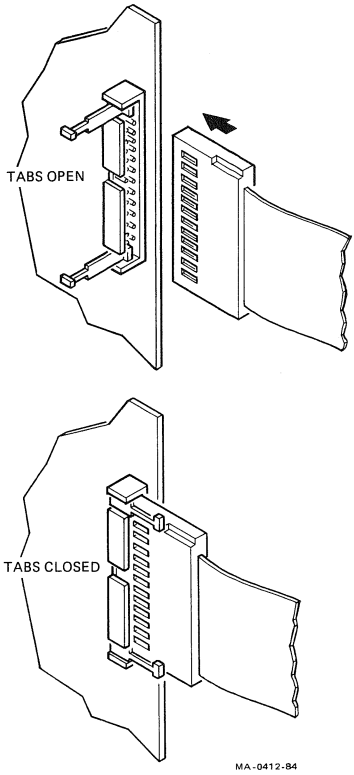


Figure 1-10 Quick Cable Disconnect Tabs

1.8.3 Top Cover Interlock Switch Defeat

When servicing the TU81, you may have to operate the unit and run diagnostic tests with the top cover open. To bypass the safety interlock switch, use the interlock defeat tool supplied in the TU81 CD kit. Insert this tool into the interlock latch and turn it 90 degrees to keep it locked in the latch cutouts. This keeps the interlock switch depressed, simulating the top cover closed condition (Figure 1-11).

1.9 SUBSYSTEM DIAGNOSTICS

The TU81 is used with VAX or PDP-11 systems. You can use on-line and off-line host diagnostics to check and troubleshoot the TU81 subsystem. Paragraphs 3.3 and 3.4 describe these tests.

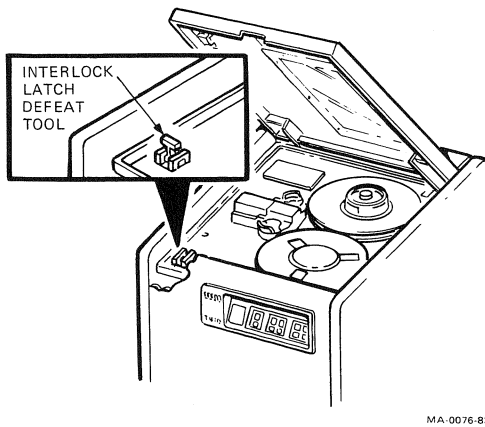


Figure 1-11 Cover Interlock Defeat Tool

2 INSTALLATION

This chapter provides information on how to select and check the transport configuration (transport addresses and options), and install or replace the M8739 UNIBUS/low-end storage interconnect (LESI) adapter module.

2.1 INTERBLOCK GAP CONFIGURATION SETTING

During transport repair, check the transport's formatter write (FW) module for correct setting of the transport interblock gap (IBG) selection jumper W1.

Table 2-1 and Figure 2-1 identify this feature and the jumper location on the FW module.

> **NOTE**
> **This is the standard, factory-set jumper setting, used for normal operation.**

2.2 TU81-TO-HOST INTERFACING

The TU81 tape transport communicates with the host via the UNIBUS LESI interface, which consists of the LESI I/O cables and the M8739 LESI module. The M8739 is a standard quad-height double-length PC card that plugs into any small peripheral controller (SPC) slot of the host computer backplane. The module contains a switchpack and jumper for setting the desired I/O address. The interrupt vector cannot be set by the hardware, but is set by the host software.

The M8739 is connected to the TU81 tape transport by a set of I/O cables. The interface cable connections are shown in Figures 2-2 through 2-4.

Table 2-1 Interblock Gap Setting

Function	Jumper/Switch
Variable long gap (0.6 to 1.2 in)	W1 positions 1 and 2

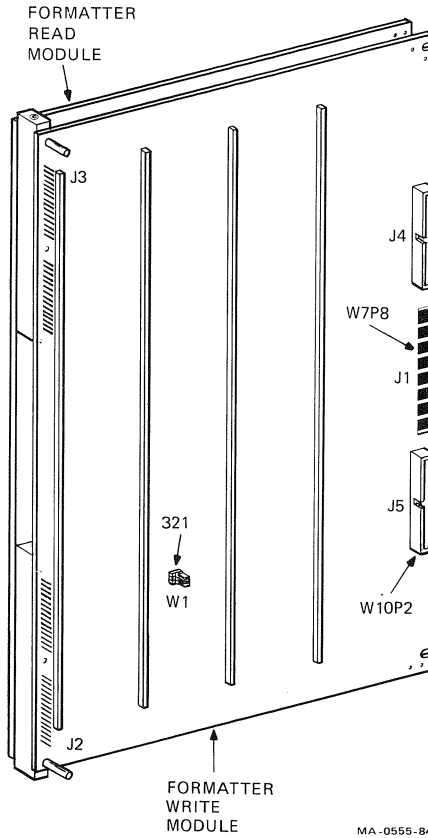


Figure 2-1 Formatter Write Module

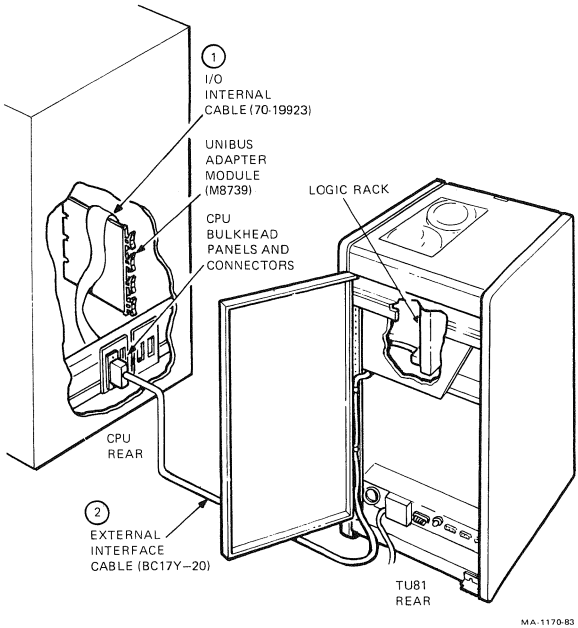


Figure 2-2 Interface Cabling

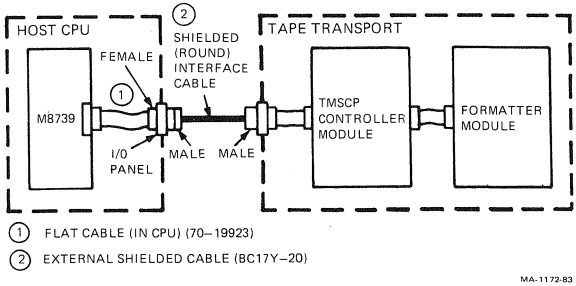


Figure 2-3 Cable Connections

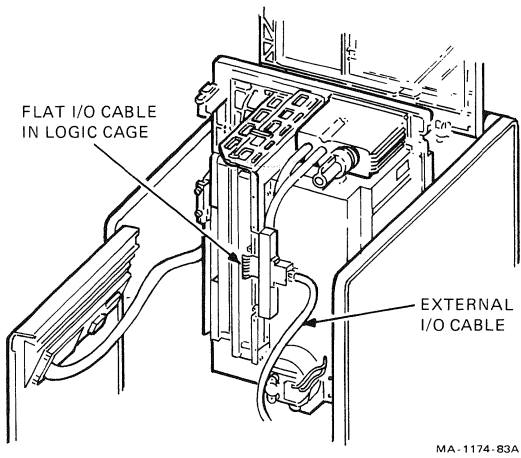


Figure 2-4 External I/O Cable Connection to the Logic Cage

2.2.1 TU81-to-Host External Cabling

Use the following procedure to connect the host to the TU81.

1. On the TU81, open the rear door and free the external I/O cable (PN BC17Y-20). The TU81 is shipped with this cable plugged in and secured in the socket on the logic cage panel (Figure 2-4). The flat ribbon cable connects the external I/O cable to the TMSCP interface controller module inside the logic cage.

   NOTE
   Verify proper connection of both I/O cables. Check for loose connections, loose mounting screws, and dangling cables or wires. To do this, tilt the tape deck into the maintenance position as described in Paragraph 4.1.

2. Insert and secure the other plug of the external I/O cable (PN BC17Y-20) in the designated connector on the CPU I/O bulkhead as shown in Figure 2-2. Refer to Paragraph 2.2.4 on how to properly install the I/O frame or panel on the CPU rack.

2.2.2 UNIBUS Adapter Module Installation and Replacement

When you have to install the M8739 in the CPU (during subsystem installation or module replacement), the procedure includes: preparing the M8739 (address switch checking or setting), installing the M8739 in the SPC slot, and interface cabling. Refer to the following paragraphs and figures for the required procedures.

NOTE

The following procedures must be performed by a qualified Field Service technician. Use the CPU kit (TU81K-CP) and accessory kit (TU81K-AC) in this procedure.

1. Remove the M8739 module, ribbon I/O cable, CPU bulkhead connector panels, and mounting hardware from the TU81K-CP shipping container. Unwrap and examine them for any physical damage.
2. On the M8739 module, select the proper UNIBUS address using a single 10-position DIP switchpack (location E44) and jumper W2 (location E68). Refer to Figures 2-5 and 2-6 and Tables 2-2 and 2-3 for the address settings.

NOTES

1. **If this is the first TU81 on the host CPU, check the DIP switchpack and the jumper, to make sure that the module is set for address 774500(8).**
2. **The typical UNIBUS address and vector for a single TU81 subsystem configuration are specified in Table 2-2.**

   On VAX systems when more than one (up to four) TU81s are installed, the UNIBUS addresses are selected using the SYSGEN procedure. Refer to Table 2-3 for an example.

   On PDP-11 systems when more than one (up to four) TU81s are installed, follow the procedure described in Appendix D to select UNIBUS addresses.

3. Use the address setting diagram (Figure 2-6) to set the UNIBUS address. The M8739 will only recognize two UNIBUS addresses: for the interrupt priority (IP) and status address (SA) registers. The base address (IP register) is 774XXX. The status address (SA register) is 774XXX +2. The interrupt vector is set by system software.
4. Set the switches on the 10-position DIP switchpack according to the diagram. Address bits 12 through 3 are specified by the DIP switch. Address bits 17 through 13 are hardwired to be 1s. Address bit 2 is set by the W2 jumper (Figure 2-6). Address bits 1 and 0 are ignored.
5. Plug the ribbon I/O cable (PN 70-19923) into edge connector J1 on the M8739 module (Figure 2-5).
6. Turn off power to the CPU.

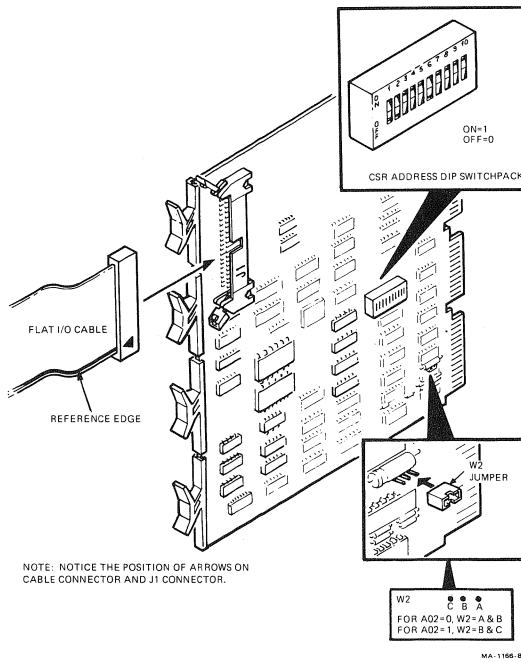


Figure 2-5A M8739 UNIBUS Adapter Module (Style A)

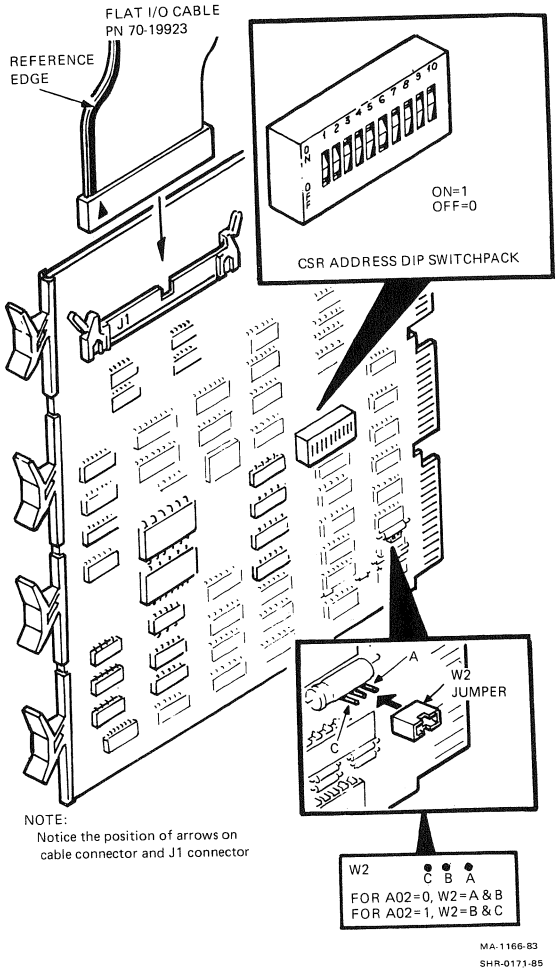


Figure 2-5B M8739 UNIBUS Adapter Module (Style B)

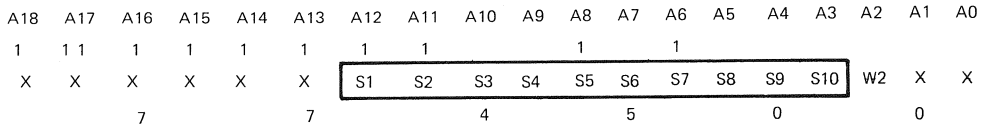


Figure 2-6 UNIBUS Address Selection Diagram

Table 2-2 Single-TU81 Address Selection

Unit Number	Address	Vector
0	774500_8 $F940_{16}$	260_8 $B0_{16}$

Table 2-3 Address Selection in Multi-TU81 Configuration

Transport	Unit Number	Address	Vector	Configuration
1	0	774500_8 $F940_{16}$	260_8 $B0_{16}$	1 (unit 0)
2 to 4		CSR range 760000-777774 $_8$	Vector range* 300-700 $_8$	2 to 4 (units 1 to 3)

Example:

For TU81 subsytem(s) installed on a VAX system, use the following SYSGEN procedure to find the available CSR addresses and vectors. Then select the CSR address on the UNIBUS DIP switchpack (Figures 2-5 and 2-6).

```
$ MCR SYSGEN
SYSGEN>CONFIG
DEVICE>RK611
DEVICE>DZ11
DEVICE>TU81, 3
DEVICE>^Z

DEVICE:TK611 NAME:DMA CSR:777400 VECTOR:210
DEVICE:TU81  NAME:PTA CSR:774500 VECTOR:260
DEVICE:DZ11  NAME:TTA CSR:760100 VECTOR:300
DEVICE:TU81  NAME:PTB CSR:760444 VECTOR:310
DEVICE:TU81  NAME:PTC CSR:760450 VECTOR:314
SYSGEN>^Z
$
```

Appendix D describes the procedure to find CSR addresses for TU81 subsystem(s) installed on PDP-11 systems.

* The vector is set automatically in the range from 300 to $700_{(8)}$ by the system software.

7. On the CPU backplane, remove the G727 bus grant card from the desired SPC slot (Figure 2-7). A bus grant (continuity) card must be in connector D of any unused SPC slot. Otherwise, bus grant continuity will be lost.
8. Also in the same SPC slot, remove the nonprocessor grant (NPG) jumper (CA1 to CB1) on the pin side of the backplane (Figure 2-8).
9. Carefully insert the M8739 module into the SPC slot, as shown in Figure 2-9.

   WARNING

   Make sure that the module is installed in backplane connector rows C, D, E, and F. Installing the module in any other connector rows will damage the module.

   NOTE

   Examine the CPU for compliance with the FCC installation specifications. To meet these requirements, the CPU should have the I/O bulkhead connector frame. If this frame is not installed, refer to Paragraph 2.2.4, Installing the I/O Bulkhead Frame.

10. Install and secure the I/O panel (PN 74-26407-13) on the CPU's bulkhead frame at the bottom of the CPU cabinet (Figures 2-2 and 2-10).

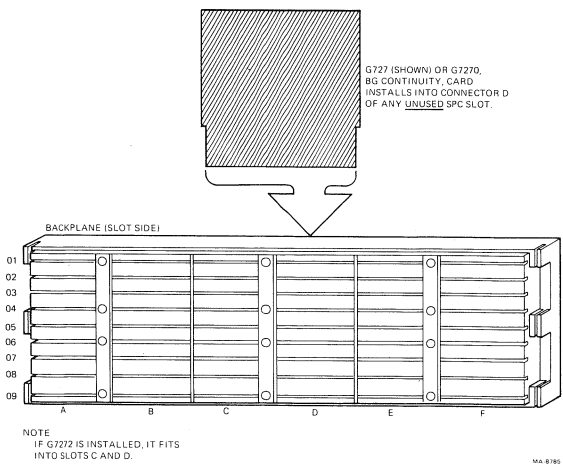


Figure 2-7 Bus Grant Continuity Card

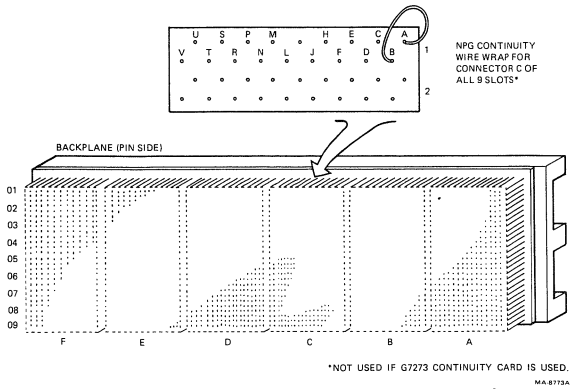


Figure 2-8 NPG Jumper

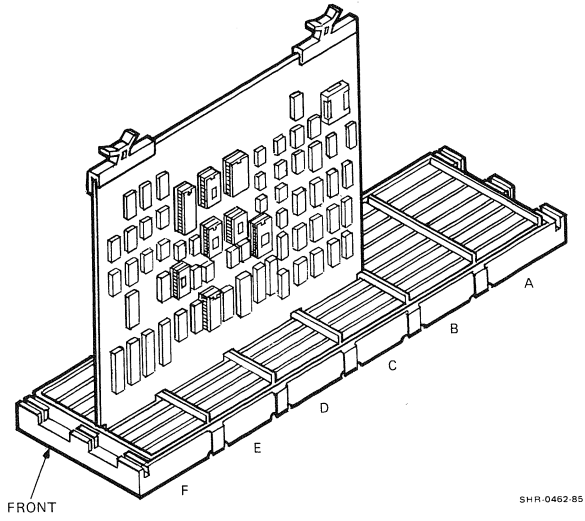


Figure 2-9 SPC Module Installation

11. Route the ribbon I/O cable from the M8739 through the CPU cabinet down to the I/O frame and insert the cable connector (female) into the I/O panel slot (PN 74-26407-13). (Secure the connector with the two 4/40 hex standoffs provided.)

    NOTE
    Be careful not to chafe the ribbon I/O cable against other PC cards and chassis parts.

12. Insert the free plug of the external shielded I/O cable from the TU81 into the I/O slot connecting both I/O cables. Secure the connection with two screws (Figure 2-10).

13. Power up the CPU and proceed with system initialization and TU81 acceptance testing.

2.2.3 Installing the I/O Bulkhead Frame

1. Mount the I/O panel (PN 74-26407-13) on the I/O frame (PN 74-27292-01) and secure it with two screws (Figure 2-10).

2. Install the I/O frame (with the I/O panel) on the CPU rack. Find the best location on the CPU rack to accommodate internal and external cables.

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

2.3 BAUD RATE SELECTION

The data transfer rate is factory set at 300 baud by jumpers W2 and W3 at J6 on the TMSCP interface module (Figure 2-11). If necessary, you can change the baud rate for transmit and receive in the range from 300 to 9600 baud. Use the W2 jumper for setting the transmit rate and the W3 jumper for setting the receive rate.

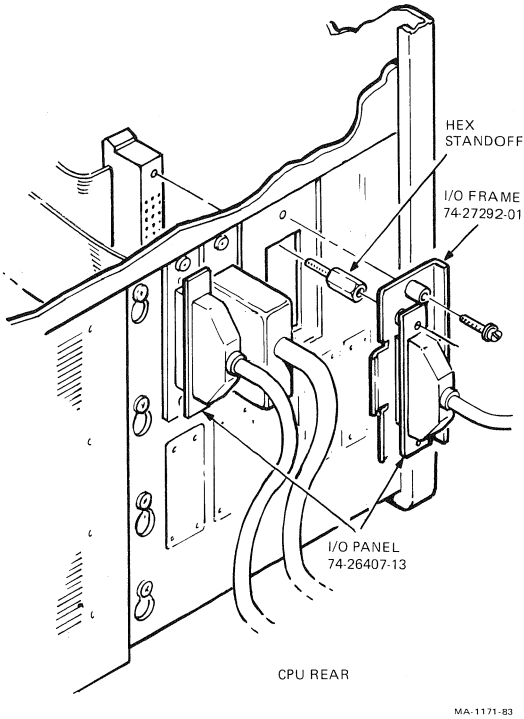


Figure 2-10 I/O Cable Installation on the CPU Bulkhead

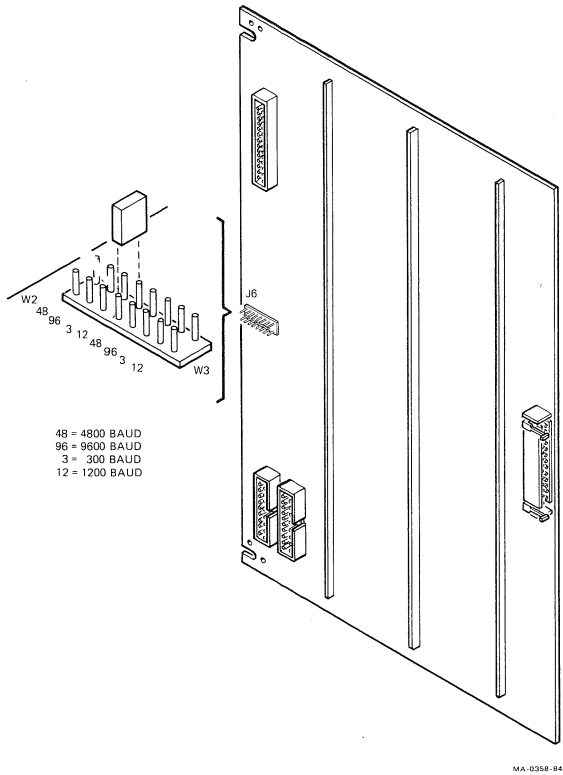


Figure 2-11 Baud Rate Selection

3 TROUBLESHOOTING

3.1 GENERAL

The troubleshooting flowchart (Appendix B) and the malfunction matrix (Appendix C) show the path you should follow when troubleshooting the TU81. Paragraph 3.2 describes the internal (resident) diagnostics; Paragraph 3.3 describes the VAX-executable diagnostics; Paragraph 3.4 describes the PDP-11-executable diagnostics; and Paragraph 3.5 provides basic information on the ASCII port usage and available diagnostics. Paragraph 3.6 describes the TU81 maintenance indicators and error codes, and Paragraph 3.7 describes the troubleshooting information provided by the operating system error log.

When you report to the site, get all the available information from the operator and operating system. You should consider fault codes, including the frequency at which they occur, and, if possible, the operation in progress at the time the fault occurred before you execute diagnostics. If the fault is intermittent, information from the operator and operating system may help direct you to the appropriate test to duplicate the fault condition.

3.2 RESIDENT DIAGNOSTICS

TU81 resident diagnostics consist of operator diagnostics and Field Service diagnostics.

> **NOTE**
> **Make sure that the TU81 power cord is plugged in and the power switch is on before you start any diagnostic routine.**

The diagnostic tests designed into the TU81 are off-line tests initiated through the control panel. There are no built-in on-line diagnostics; however, the host CPU can monitor TU81 status through the GET STATUS command. A CHANNEL LOOPBACK command is also provided to test the TU81's formatter logic.

Although host-controlled diagnostics are not part of the TU81, the control microprocessor tests for many operational fault conditions while it runs on-line. These conditions are indicated on the control panel display as fault

codes. The FAULT/RESET indicator lights to indicate the transport fault condition, and the control panel displays the appropriate fault code.

The CONTR/FAULT indicator comes on when the TMSCP controller or the M8739 UNIBUS/Q-Bus adapter module fails.

3.2.1 Corrective Fault Code Matrix

When a trouble call is received from the site, you should consult the fault code matrix (Table 3-1) and the malfunction matrix (Appendix C) as well as the fault and subfault code listings and corresponding corrective action tables in the *TU81/TA81 Pathfinder* (EK-TUA81-SV). These tables will help you determine if operator action (A, B, or C) is required. If the fault persists after appropriate operator action, consult the tables for a list of FRUs to take to the site.

Test 01 (Paragraph 3.2.4) is a lead-on for all other tests. The fault code matrix (Table 3-1) lists all malfunctions or fault codes, and assemblies that may cause the fault condition. This table is designed to provide a list of related assemblies before you report to the customer site. Assemblies listed under individual malfunction or fault codes are arranged in a "most probable fault" order.

When you are on-site, refer to the *TU81/TA81 Pathfinder* (EK-TUA81-SV) (troubleshooting procedures and diagnostic tests) to isolate and correct the malfunction.

3.2.2 Operator Troubleshooting

Before you run any tests, perform the following steps to isolate an easily correctable external malfunction.

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

NOTE

If the host computer reports data (read/write) errors, your first action should be to clean the tape path.

Table 3-1 Fault Code Matrix (Operator Test 01)

Failing Assembly \ Fault Code	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26	27	28	29
Test successful	X																												
Latch hub correctly													A									A			A				
Thread tape correctly												A		A	A			A											A
Clean head/tape path/hubs		A	A	A	A	A	A	A	A				B									B			B				
Change tape		B	B	B	B	B	B	B	B						B		A	B				C			C				B
Close top cover											A																		
Install write protect ring																	A												
Run test 02 (see note 1)																						X		X		X			
Run test 03 (see note 1)				X	X		X															X			X	X			
See note 2																X													
Servo control		4	4	4	4	4	4	4	4	1	2	2	1	3	2	2	2	1	1	2	2	4	1	2	2	4	1	1	2
PE/GCR read recovery		3	3	1	2	1	2	1	2																				
PE/GCR write driver		2	2	2	1	3	1	3	1																				
Formatter read				5	5	2	5	2	5	3																			
Formatter write		5	5	6	6	5	6	5	6	2							3	2											
Interface																													

NOTE 1. Tests 02 and 03 should not be used unless Test 01 directs their use. These tests will fail if run standalone.

NOTE 2. Fault can be caused by operator pressing RESET switch during a Load or Unload operation.

Table 3-1 Fault Code Matrix (Operator Test 01) (Cont)

Failing Assembly \ Fault Code	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26	27	28	29
Power supply														2															
Power amplifier					7		7															5		3	4	3			
Control panel																1													
Pneumatic pump														1															
Filter														4															
Supply air bearing																				1									
Take-up air bearing																					1								
Head (amplitude error)		1	1																										
Head (data reliability)			3	3	6	3	6	3																					
Supply motor/tach													3									3	2	1		2	2		
Supply hub													2				4					1			1				
Take-up motor/tach			7	8		8																2			3	1			
EOT/BOT sensor												1	4		1														1
Top cover switch											1																		
File protect sensor																	1												
Pressure regulator														5															
Cooling fan																													
Temperature sensor																													

Table 3-1 Fault Code Matrix (Operator Test 01) (Cont)

Failing Assembly \ Fault Code	30	31	32	33	34	35	36	41	42	43	47	48	49	50	51	52	53	54	55	56	60	61	62	63	64	65	66	67	68	69
Test successful																														
Latch hub correctly																A														
Thread tape correctly																														
Clean head/tape path/hubs	A	A										A																		
Change tape												B				A														
Close top cover																														
Run test 02 (see note 1)	X	X					X																							
Run test 03 (see note 1)	X	X	X	X		X	X						X								X	X								
See note 2																														
Servo control	1	1	2	1	1	1	1	1	3	3	1	1	1	1	1	2	1	3	1	2	2	2								1
PE/GCR read recovery							10											2												
PE/GCR write driver							9											1												
Formatter read							12																		1	1	1			
Formatter write							13													1			1	2	2		2	1	1	2
Interface																				3							1			3

NOTE 1. Tests 02 and 03 should not be used unless Test 01 directs their use. These tests will fail if run standalone.

NOTE 2. Fault can be caused by operator pressing RESET switch during a Load or Unload operation.

Table 3-1 Fault Code Matrix (Operator Test 01) (Cont)

Failing Assembly \ Fault Code	30	31	32	33	34	35	36	41	42	43	47	48	49	50	51	52	53	54	55	56	60	61	62	63	64	65	66	67	68	69
Power supply																														
Power amplifier	2	2	1				2														1	1								
Control panel																			1											
Pneumatic pump	4	4	4				4																							
Filter	5	5	5				5																							
Supply air bearing	7	7					7																							
Take-up air bearing	8	8					8																							
Head (amplitude error)																														
Head (data reliability)							11											4												
Supply motor/tach										2			3																	
Supply hub																														
Take-up motor/tach	3	3	3	2		2	3			3			1																	
EOT/BOT sensor																														
Top cover switch																														
File protect sensor																														
Pressure regulator	6	6	6				6																							
Cooling fan									1	1																				
Temperature sensor									2	2																				

3.2.3 Power-On Health Check

The tape transport automatically performs the power-on health check when you set the power switch in the far right corner of the tape deck in the on position (1 pressed).

This built-in diagnostic checks dc power distribution (availability of all required dc voltages on the inputs of all electronic modules), normal operation of the control panel indicators, and logic/interface initialization (Figure 3-1).

If the check is successful, all indicators momentarily turn on and off. Then the LOGIC ON and FILE PRO indicators come on, indicating the normal standby operating condition. The three-digit display will show the unit number.

> NOTE
> **The LOGIC ON and LOGIC OFF indicators are used as dc power lights. LOGIC ON shows normal power status; LOGIC OFF indicates a power failure.**

If a power failure is detected at power-up, a fault code may appear on the display, the LOGIC OFF and FAULT indicators should light up, and the LOGIC ON indicator should go off.

> NOTE
> **If a fault code appears on the display, press RESET to clear the display. Then use the power switch again to repeat the health check.**
>
> **If the fault code reappears, refer to the TU81/TA81 Pathfinder for on-site troubleshooting procedures and Field Service diagnostic tests to isolate the failure.**

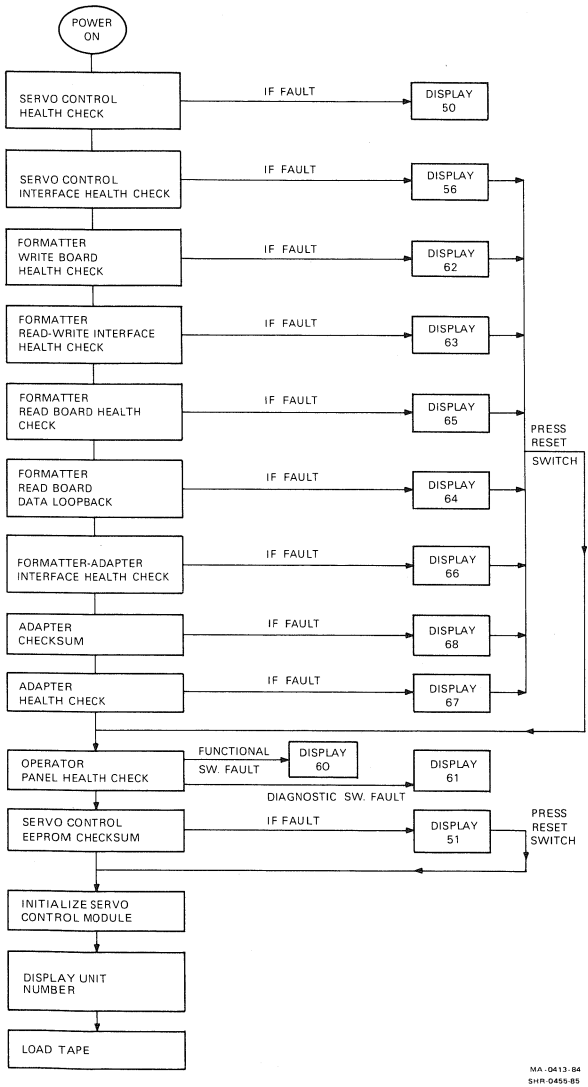


Figure 3-1 Power-On Health Check Flowchart

3.2.4 Operator/Field Service Diagnostic Test 01

This test checks basic transport functions and tape motions, including BOT/EOT tape motion, read data, and write data. Use a write-enabled known good quality tape for this test. The test takes about 10 minutes to complete (with a 2400 foot tape).

Pre-Test Conditions

1. Power switch and LOGIC ON are on (power-on health check is successful).
2. Tape path is clean.
3. Tape is threaded through tape path and onto take-up reel.
4. Tape is not loaded.
5. Top cover is closed and latched.
6. Display shows unit number for this transport.

Test Procedure

Use the following procedure to perform test 01.

1. Press the RESET switch.
2. Press the TEST switch on the diagnostics portion of the control panel.
   a. The DIAGNOSTICS indicator goes on.
   b. The display indicates 01.
3. Press the EXECUTE switch.
   a. Test 01 starts with the display panel incrementing from 000, 111, 222, through 999. Make sure that all segments of the numerical display are functioning.
   b. Make sure that all indicators except LOGIC OFF, BOT, and FAULT are on.
   c. Test 01 continues with various tape motion and read/write exercises for approximately 10 minutes (with 2400 feet of tape).

Test Successful

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

Test Unsuccessful
If the test is unsuccessful, the diagnostic program halts and a numerical fault code appears on the display, with the FAULT indicator on.

Refer to Table 3-1 and the *TU81/TA81 Pathfinder* for further instructions on how to locate and check out the probable failed FRU.

3.2.5 Tape Sticking Problem

If you have a possible tape sticking problem, run test 82. For the test description and indications, refer to the *TU81/TA81 Pathfinder*. If this test completes with the unit number flashing on the display, replace the tape.

3.2.6 Field Service Diagnostic Listing

The *TU81/TA81 Pathfinder* (EK-TUA81-SV) lists all the built-in Field Service troubleshooting procedures and tests provided by the TU81 tape subsystem. Refer to this document after you perform test 01. If there is a failure that cannot be detected by test 01, perform troubleshooting procedures 1001 through 1003 to manually check out the transport.

3.3 VAX-EXECUTABLE DIAGNOSTICS

This section lists and describes all VAX-executable diagnostics that can be used to check out and accept a TU81 subsystem when it is installed on a VAX system. The VAX-executable diagnostics are as follows.

1. VAX front-end diagnostics (EVMBB)
2. VAX data reliability diagnostic (EVMBA)

> **NOTE**
> **Refer to the documentation of the installed Digital computer for information on how to run and interpret the host diagnostics.**

3.3.1 M8739 Status Checking

Before running the VAX diagnostics, verify the TU81 and I/O connection status using the SHOW DEVICE command. Then the system checks the M8739 module in either of the following conditions.

TU81 Add-On Configuration – At system power-up, the host automatically configures the tape unit into the system. If the M8739 fails at any time afterwards, the host is unable to access the TU81, and an error message is entered in the system error log.

On-Line Operation Failure – If the M8739 fails during normal on-line operation, the host is unable to continue to access the TU81, and an error message is entered in the system error log. When the operator tries to recall the TU81, the appropriate message appears on the operator's terminal indicating the "abnormal" status of the corresponding device.

Use SHOW DEVICE PT to check the connection to the I/O controller and SHOW DEVICE MU to check out the TU81 transport connection.

3.3.2 VAX Front-End Diagnostic (EVMBB)

This diagnostic checks the subsystem in all basic modes of operation and tests the TU81 logic, interface bus, and I/O silo. It can only be performed with the host off-line.

The front-end diagnostic consists of three test sections: DEFAULT, MANUAL, and FAULT. For acceptance testing purposes, when the TU81 is checked at system initialization, transport add-on, or after repairs, only the DEFAULT and MANUAL sections are used. All three test sections are used for routine testing of the TU81 subsystem. Each section contains several tests that check various modules and functions of the TU81 subsystem.

DEFAULT Section

The DEFAULT section tests do not require magnetic tape. This section is used to check the subsystem interface. The section contains the nine tests listed below. It executes by either of these commands.

```
DS› RUN EVMBB
   or
DS› START
```

NOTE

DS> is the prompt from the diagnostic supervisor. Do not type DS>.

Tests:

1. Register existence test
2. Power-up initialization test
3. Steps 1–3 initialization test
4. Diagnostic SA wrap test
5. Vector and BR level test
6. Purge and poll test
7. Small ring buffer initialization test
8. Large ring buffer initialization test
9. Get DUST status test

To start an individual test in this section, enter

```
DS> START/TEST:n
```

where n is a test number from 1 to 9.

The diagnostic will begin at the specified test and proceed until the end of the section.

MANUAL Section

The MANUAL section test requires operator intervention to mount and remove the magnetic tape when requested by the diagnostic through the console terminal. This section runs the preselected transport microdiagnostic test 01, which is designated test 10 in this section.

To start the section, use this command.

```
DS> RUN EVMBB/SEC=MANUAL
```

FAULT Section

This section requires operator intervention to mount and remove the magnetic tape when requested by the diagnostics through the console terminal. This section runs preselected transport microdiagnostics consisting of three tests (tests 11 through 13).

To start the section, enter this command.

```
DS> RUN EVMBB/SEC=FAULT
```

The tests are as follows.

Test 11 – Tension fault isolation
(drive resident test 02)
Test 12 – Velocity fault isolation
(drive resident test 03)
Test 13 – Select a drive resident test
(tests 01 to 99)

To select an individual test, enter

```
DS> RUN EVMBB/SEC=FAULT/TEST:n
```

where n is any number from 11 to 13.

To run test 13, use the following example.

```
DS> START/SEC=FAULT/TEST=13

Testing: _MUA0
Test 13: Select a Drive Resident Test (1--99)

Enter the TU81 Drive Unit Number: 0
Enter the drive resident test number <1--99>: 91

READY? [(No), Yes] Y
```

3.3.3 VAX Data Reliability Diagnostic (EVMBA)

This diagnostic provides a complete tape subsystem check-out. It allows you to test the TU81 operation on-line without bringing the system down. The EVMBA consists of three test sections (a total of five tests) as follows.

DEFAULT Section

Acceptance test (test 1)
Qualification test (test 2)
Multidrive test (test 3)

MEDIA Section

Read interchange test (test 4)

CONVERSATION Section

Conversation mode test (test 5)

To initiate a complete EVMBA run, load EVMBA and enter either of these commands.

```
DS> RUN EVMBA
   or
DS> START
```

To run any of the sections, enter the section start command, for example:

```
DS> START/SEC=MEDIA
```

To run an individual test in the DEFAULT section, enter

```
DS> START/SEC = DEFAULT/TEST:n
```

where n is a number from 1 to 3.

3.3.4 Basic Operating Instructions for VAX-Based Diagnostics

Follow these instructions when running VAX diagnostics.

1. Load the diagnostic supervisor (ENSAA, ECSAA, or ESSAA) for the applicable computer system.

   NOTE
   Use ENSAA on the VAX-11/730.
   Use ECSAA on the VAX-11/750.
   Use ESSAA on the VAX-11/780.

2. Attach and select the devices to be loaded in one of two ways.

   a. Prompt mode

      Attach the UNIBUS adapter to the appropriate bus.

      ```
      DS> Load EVMBX
      DS> Attach
      Device Type? DWXXX
         (where XXX is 780, 750, or 730)
      Device Link? HUB DW0 3 4
      ```

      Attach the tape transport.

      ```
      DS> Attach
      Device Type? TU81
      Device Link? DW0
      Device Name? MUA0
      CSR? 774500
      Vector? 260
      BR? 5
      DS> Start/Switches
      ```

   b. Explicit mode

      ```
      DS> Load EVMBX
      DS> Attach DWXXX HUB DW0 3 4
      DS> Attach TU81 DW0 MUA0 774500 260 5
      DS> Select MUA0
      DS> Start/Switches
      ```

   NOTES
   1. **In the above diagnostics, no hard errors are allowed.**

   2. **For control flags, refer to the VAX diagnostic listings.**

   3. **Load EVMBB by booting from a load media device; for example, type** `>B/10 DXXX` **(DXXX = BOOT device).**

Example:

NOTE
Operator responses are underlined in the following procedure.

1. Initialize and log in on the VAX system.
2. Check the subsystem availability using the SHOW DEVICE command.

```
$ SHOW DEV PT
```
(Checks I/O connection and status.)
```
$ SHOW DEV MU
```
(Checks TU81 transport status.)

3. Perform the EVMBA diagnostic.

```
$ R ESSAA
DIAGNOSTIC SUPERVISOR, ZZ-ESSAA-
DS> LOAD EVMBA
DS> ATTACH DW780 HUB DW0 3 4
DS> ATTACH TU81 DW0 MUA0 774500 260 5
DS> SELECT MUA0
DS> START
```

4. Continue with the EVMBB diagnostic.

   Load EVMBB by booting from a load media device.

```
>>> B/10 DUA0   (DUA0 = RA81)

DIAGNOSTIC SUPERVISOR, ZZ-ESSAA
DS> LOAD EVMBB
DS> ATTACH DW780 HUB DW0 3 4
DS> ATTACH TU81 DW0 MUA0 774500 260 5
DS> SELECT MUA0
DS> START/Switches
```

3.3.5 System Exerciser

The system exerciser (UETP) for the TU81 is fully supported under VAX/VMS Version 3.6, but it is not supported in VAX/VMS Version 3.5. However, it is possible to run TU81 under VMS Version 3.5 if you modify the UETP data file slightly.

Edit the file [UETSUPDEV.DAT] to include the new line as follows.

```
02 03 UETTAPE00.EXE !TU77
02 08 UETTAPE00.EXE !TU81   ← Add this line.
02 05 UETTAPE00.EXE !TU78
```

3.3.6 EVMBB Sample Error Printout

The following is an example of the error printout that is returned whenever the TU81 fails to execute a drive resident diagnostic while running under EVMBB.

```
****** EVMBB TU81 FRONT-END/HOST DIAGNOSTIC - 2.0 ******
PASS 1, TEST 13, SUBTEST 0, ERROR 18, 18-MAY-1984 10:53:27.13
HARD ERROR WHILE TESTING MUA0: INTERNAL DIAGNOSTIC FAILED

SA = 0000 (X)
FAULT CODE = 09
SUBFAULT CODE = 03

$ SHOW DEV PT
$ SHOW DEV MU
```

3.4 PDP-11-EXECUTABLE DIAGNOSTICS

This section lists and describes all PDP-11-executable diagnostics that can be used to check out and accept a TU81 subsystem installed on a PDP-11 system.

> **NOTE**
> **Refer to the documentation of the installed Digital computer for information on how to run and interpret the host diagnostics.**

3.4.1 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 CZTU2 or CZTU1.
   The operator entry should look like this.
   `[.R ZTU2??]`
4. Receive `DR>` prompt.

5. Enter the appropriate command.
   For example,
   `DR>STA` to start the test.
6. `Change HW(L)? Y or N`
7. `Change SW(L)? Y or N`

3.4.2 CZTU2 Front End Functional Diagnostic

CZTU2 is the first host level diagnostic run, since it tests the basic functionality of the TU81 subsystem.

CZTU2 tests up to four TU81 subsystems. To run a full pass of the program, a scratch tape must be mounted on the transport and an operator must be present to perform manual intervention.

The first pass of the program is a "quick verify". For a single unit under test, the first pass takes about 20 minutes. All subsequent passes run multiple iterations of each test listed below; these passes each take about 24 minutes for a single unit under test.

Test 001:Existence Verification Test
Test 002:Initialization Test
Test 003:Initialization Test
Test 004:SA Register Wrap Test
Test 005:Vector and BR Level Test
Test 006:Purge and Poll Test
Test 007:Small Ring Test
Test 008:Maximum Ring Buffer Test
Test 009:Get DUST Status
Test 010:Functional Fault Detection Test
(Internal Drive Test 1)
Test 011:Tension Fault Isolation Test
(Internal Drive Test 2)
Test 012:Velocity Fault Isolation Test
(Internal Drive Test 3)
Test 013:Select A Drive Resident Test
(Internal Drive Tests 1–99)

3.4.3 CZTU1 Data Reliability Test

This diagnostic tests the performance quality of the TU81 subsystem.

CZTU1 tests up to four TU81 subsystems. A scratch tape must be mounted on the transport to run this test. Each pass takes about 1 hour and 10 minutes for each unit under test.

Test 001:Basic Function Test
Test 002:Quick Verify Read/Write Test
Test 003:Complex Read/Write Test
Test 004:Write Interchange Tape
Test 005:Read Unknown Tape
Test 006:Start/Stop Write/Read Test
Test 007:Conversation Test

3.4.4 CXTUCA DEC/X11 Module

This module streams the drive in both read and write modes. Each pass begins where the previous pass left off. In effect the entire reel of tape is written and read.

CXTUCA tests a single TU81 subsystem.

3.5 ASCII PORT DIAGNOSTICS

When connected to a hand-held or console terminal, the ASCII port (Figure 3-2) serves as an input/output device to perform the following functions.

1. Run the transport resident diagnostics
2. Display or print out error log information (sense bytes)
3. Run special test 27 (conversation mode test using selective parameters)

NOTE
Appendix A lists the sense bytes and ASCII addresses.

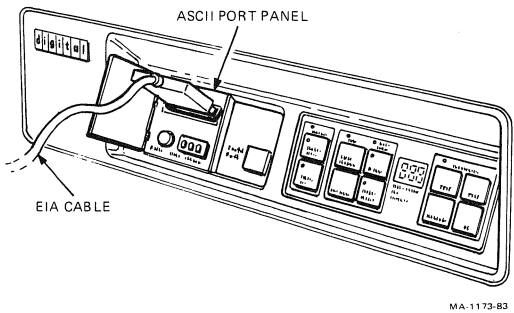


Figure 3-2 ASCII Port and EIA Cable

The ASCII port is located on the left side of the TU81 control panel (under the cover). To use the port, open the cover and plug in an RS232-compatible terminal into the EIA 25-position terminal I/O connector.

NOTE
The ASCII port accepts and generates the full ASCII character set. Certain characters are ignored or have special meaning as defined in Table 3-2.

Table 3-2 Control Commands

Control Character	Description
CONTROL/C (ETX) CONTROL/Y (EM)	Gains the attention of the ASCII control program. Other commands may follow. It can also be issued to abort the run of the current command, program, or diagnostic.
CONTROL/G (BEL)	When received by the terminal, causes an audible sound (BELL) from the terminal. The ASCII control program treats it as an illegal character.
BACKSPACE (BS) or CONTROL/H	When received by a video terminal, overwrites the previously displayed character.
LINEFEED (LF) or CONTROL/J	Used to start any line of text output.
RETURN (CR) or CONTROL/M	Used to signal the end of an input line.
CONTROL/O (SI)	Used to toggle the output to the ASCII terminal on or off. With the output toggled off, the characters that are being sent to the terminal are not displayed. The program continues to run.
XON (DX1) or CONTROL/Q	Generated by the terminal to start the output aborted by the previous CONTROL/S.

Table 3-2 Control Commands (Cont)

Control Character	Description
XOFF (DC3) or CONTROL/S	Generated by the terminal to stop the ASCII control program from sending characters to it. The program generating the output stops running until a CONTROL/Q is received.
CONTROL/U (NAK)	Generated by the terminal to tell the ASCII control program to delete and abort the current input and reissue the command prompt.
CONTROL/Z (SUB)	Generated by the terminal to signal the end of a transaction. If this command is entered at the command prompt, the ASCII control program ignores further terminal input, reversing the initial CONTROL/C or /Y command.
DELETE (DEL)	Generated by the terminal to erase the previously entered character. On a video terminal, in the default mode, DELETE is echoed as BACKSPACE, SPACE, BACKSPACE. On a hardcopy terminal (set up with the command SET TERMINAL/NOSCOPE or /HARDCOPY listed in Table 3-3), DELETE is echoed as \, echo of deleted characters, \. DELETE does not delete past the end of the prompt.

NOTE

The ASCII port's control program generates no special characters except CONTROL/G, indicating an illegal input character; and CONTROL/J and CONTROL/M for formatting the output. Any control character not mentioned in this table as valid input generates BELL if received.

3.5.1 Port Access

To communicate with the ASCII port, proceed as follows.

a. Take the TU81 off-line from the host system.

b. Type CONTROL/C or CONTROL/Y.

   Characters typed earlier will be ignored.

c. Mount a scratch tape and enter CONTROL/M (or RETURN) to continue the operation.

d. The ASCII port's control program gives the command level prompt, indicating it is ready for an input command. The prompt is TU81>.

e. Enter a command from Table 3-3.

   If you want to run the transport diagnostics, enter the default RUN DIAGNOSTICS command or RUN DIAGNOSTICS/TEST=xx to execute a particular test (for example, from the *TU81/TA81 Pathfinder* (EK-TUA81-SV). Refer to Paragraph 3.5.2 to set up specific options.

f. If the test is successful, the terminal responds with the TU81> prompt.

   If the test fails, the terminal displays the diagnostic message specifying the fault condition. (Refer to Paragraph 3.5.3.)

g. Type CONTROL/Z or EXIT to exit from the ASCII terminal mode. The TU81 echoes with ^Z.

The control program will disconnect after 10 idle minutes if there is no input at the command prompt level. Any characters typed in before the TU81> prompt are ignored.

Table 3-3 Operating Commands

Command	Description
SET TERMINAL	/SCOPE – (Default) Indicates that the terminal in use is a video display terminal. /HARDCOPY or /NOSCOPE – Indicates that the terminal in use is a hardcopy (printing) unit.
SET DIAGNOSTIC	/LOOP – Enables loop-on-error mode. /NOLOOP – (Default) Disables loop-on-error. /HALT – Enables halt-on-error; exits to TU81> prompt ending the test. /NO HALT – (Default) Disables halt-on-error.
SHOW DEVICE	Displays the device unit type and device serial number.
SHOW RADIX	Displays the number base of numeric outputs; in TU81s the radix is decimal.
SHOW VERSION	Displays the hardware and microcode version levels.
RUN DIAGNOSTICS	(Default) Starts the power-up diagnostic test.
RUN DIAGNOSTICS/ TEST=xx	Selects a diagnostic test number where xx represents two decimal digits.
EXIT	Exits the TU81 from the terminal mode. After exit, the TU81 no longer responds to the external ASCII terminal except for the CONTROL/C input command.
CONTROL/Z	Same as EXIT, echoes with ^Z. Also, used to return the SET mode to default values.

3.5.2 Diagnostic Commands

The diagnostic commands are used to check the TU81 status, and to set up and control the diagnostic execution. To set a diagnostic control parameter, you should enter the proper SET command before starting the test. Once specified, the parameter remains in effect until changed with another command or until you exit from the terminal mode.

If no SET parameters were specified, the ASCII control program automatically uses the default parameters, which remain active until you use a SET command. For example, you can run the selected test with "no loop on error" and "no halt on error" defaults. In this case the test runs for one pass only.

Type diagnostic commands immediately after the prompt with no spaces between. Separate the command from the first parameter by one space. If you invoke options, enter them after the first parameter, with a slash between the two terms. One option per command is allowed.

3.5.3 Message Format

Each input line together with the command prompt should not be greater than 64 characters. Characters beyond the 64th are ignored by the control program. All inputs from the terminal (except CONTROL/C and /Y) are prompted for.

Diagnostic Messages

Diagnostic results are reported in the following format if the test is unsuccessful (maximum 64 characters per line).

TEST:xx FAULT CODE:xx FAULT SUBCODE:xx

where

TEST:xx	= Diagnostic test number (in decimal)
FAULT CODE:xx	= Code indicating primary field replaceable unit
FAULT SUBCODE:xx	= Code indicating hardware element that failed

Successful completion of a diagnostic test causes the prompt to be displayed. Refer to the *TU81/TA81 Pathfinder* (EK-TUA81-SV) tables for additional instructions in the event of a diagnostic failure.

3.5.4 Special Diagnostic Test 27

Test 27 is not a resident microdiagnostic permanently stored in the TU81 memory. This diagnostic can only be performed using a terminal since it requires manual data input.

Test Procedure

Put unit on-line.

Enter the command

```
RUN DIAGNOSTICS/TEST=27.
```

This causes three commands to be executed in the following order.

1. Write
2. Backspace
3. Read

When the prompt appears on the terminal, enter the first input parameter, selecting speed and density. As each additional prompt appears, enter additional input parameters in the specified order.

`TU81>` Speed and density select where

1 = 25 ips PE
2 = 75 ips PE
3 = 25 ips GCR
4 = 75 ips GCR

`TU81>` Pattern identifier where

1 = all ones
2 = all zeros
3 = alternating bytes of ones and zeros
4 = worst case PE pattern

3 1s
2 0s byte 1
3 1s

3 0s
3 1s byte 2
3 0s

TU81› Bytes/block where

1 = 512 bytes
2 = 2048 bytes

TU81› Write block count: XXX where

XXX = 0 to 255

TU81› Backspace block count: XXX where

XXX = 0 to 255

TU81› Read block count where

XXX = 0 to 255

Example:

Entering the following causes 16 blocks of 2048 bytes of ones to be written at 25 ips PE. Then a backspace of 16 blocks occurs, and the 16 blocks are read.

```
TU81› 1
TU81› 1
TU81› 2
TU81› 16
TU81› 16
TU81› 16
```

If you enter zero in a block count field, the corresponding command is not executed.

Enter all parameters as decimal numbers.

After receiving the input parameters, the TU81 performs a rewind to BOT. This is necessary because a density change can only be made when the tape is positioned at BOT.

Default Parameter Values
If you type CONTROL/Z immediately after entering:

```
RUN DIAGNOSTICS/TEST = 27
```

the input parameters revert to these default values.

Speed and density select	1	(25 ips PE)
Pattern identifier	3	(alternating ones and zeros)
Bytes/block	1	(512 bytes)
Write block count	10	
Backspace block count	10	
Read block count	10	

If you enter CONTROL/Z during parameter selection, default values are assumed for the remaining parameters.

System Conflicts
If the unit is on-line to the host when the ASCII port is activated, the following message will be displayed on the terminal.

```
TU81 ONLINE TO HOST.
TO USE ASCII PORT, TAKE UNIT OFFLINE!
```

3.6 MAINTENANCE INDICATORS AND FAULT/ERROR CODES

The four methods that a TU81 subsystem uses to display error and status conditions are, in order of decreasing severity:

1. Lighting the controller fail indicator,
2. Depositing a fatal error code in the I/O page SA register,
3. Displaying a fault code on the operator panel, and
4. Sending a TMSCP error log packet with error/status code to the host.

A TU81 subsystem uses these four methods in different combinations, depending on the type and severity of the particular error.

- Fatal errors (detected by internal microdiagnostic routines or other checks in the master drive's controller) light the controller fail indicator and leave a fatal error code in the host system I/O page SA register.
- TMSCP command errors return error codes and send corresponding error log packets to the host, if enabled.

Table 3-4 lists the assigned fatal error codes and the reason for the error. Error codes in the range of 100001 through 100026 (octal) are generic TMSCP controller codes; error codes in the range of 100454 through 100460 are specific to the TU81. These codes can be printed out while running host level diagnostics, or they can be accessed by reading the SA register (default 774502(8) or F942(16)). All of these codes include bit 15 set so that any time the host finds bit 15 of the SA set, it knows that one of these errors has occurred. Host level diagnostics print out the code, including bit 15. Paragraph 3.7 and Table 3-5 describe all TMSCP end/error log packet codes.

Table 3-4 TMSCP Fatal Error Codes Deposited into SA Register

Error Code Octal	Error Code Hexadecimal	Description
100001	8001	Command packet read error (parity or timeout)
100002	8002	Response packet write error (parity or timeout)
100003	8003	Controller ROM and RAM parity
100004	8004	Controller RAM parity
100005	8005	Controller ROM parity
100006	8006	Ring read error (parity or timeout)

Table 3-4 TMSCP Fatal Error Codes Deposited into SA Register (Cont)

Error Code Octal	Error Code Hexadecimal	Description
100007	8007	Ring write error (parity or timeout)
100010	8008	Interrupt failure
100011	8009	Host access timeout (TMSCP dependent)
100012	800A	Command limit exceeded (reporting this condition optional)
100013	800B	Bus Master error
100014	800C	Diagnostic controller fatal error
100015	800D	Instruction loop timeout
100016	800E	Invalid connection identifier
100017	800F	Error on interrupt write
100022	8012	RAM error (non-parity)
100023	8013	Port initialization sequence error
100024	8014	Wrong TMSCP version
100025	8015	Perge/Poll hardware failure
100026	8016	Map table entry read error
100454	812C	TMSCP version number error
100455	812D	TMSCP hardware failure
100456	812E	Unknown interrupt
100457	812F	Own Bit not set
100460	8130	Pulse AC Clear unsuccessful

3.7 OPERATING SYSTEM ERROR LOG DECODING AND TROUBLESHOOTING

Status/error codes pass from the TMSCP server (in the TU81) to the TMSCP class driver (in the host). Hard TMSCP command errors, such as trying to read from a drive that is off-line, return a TMSCP error code in the command's end packet. Other nonfatal errors that occur during a command's execution return an error code in the command's end packet only if the error cannot be recovered after retries (hard).

Most of these nonfatal errors also try to send an error log packet to the host even if the error is recoverable or if there is a correlating TMSCP command. However, log packets are sent only if the host has explicitly enabled logging. The drive can send any combination of end/log packet status/error codes.

All status and error codes use the same format (Figure 3-3). A 5-bit major code occupies bits 04 through 00 and an 11-bit minor code occupies bits 15 through 05. (For TMSCP conventions, the major code is the device code and the minor code is the subdevice code.) Most of the error log report generators in Digital's operating system decode the packets and provide text descriptions for the major and minor codes. However, host-based diagnostics and utilities may provide only the numeric code. A full 16-bit code, or perhaps just the 11-bit minor component, may be provided.

Table 3-5 lists all major and minor codes returned to the system by the TU81. The table is broken into sections, and each major code occupies a section. The major codes are listed by name and are in numeric order. The minor codes and descriptions follow.

For example, if the system logs a 177713 (octal) error, reduce the code to a major code of 13 (bits 04 through 00) and a minor code of 3776 (bits 15 through 05). Now refer to Table 3-5. Major code 13 is a drive error. Under the drive error section, minor code 3776 is an error caused when the drive could not position for Retry.

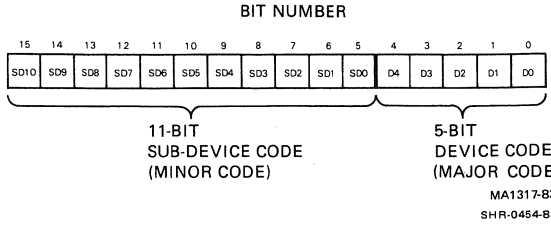


Figure 3-3 Error/Status Code Word Format

Table 3-5 TMSCP Status and Event Codes

Major Code Name	Minor Octal Code	Full Octal Code	Full Hex. Code	Minor Code Name
Success (xxxx00)	0000	000000	0000	Normal success (no error)
	0010	000400	0100	Already on-line
	0040	002000	0400	EOT detected
Invalid command (xxxx01)	0000	000001	0001	Invalid MSG length
	0100	004001	0801	Invalid opcode
	0120	005001	0A01	Invalid modifiers
	0140	006001	0C01	Invalid byte count or Invalid TMSCP version
	0160	007001	0E01	Invalid unit flags or Invalid controller flags
	0400	020001	2001	Invalid format
Command aborted (xxxx02)	No substatus codes apply			

Table 3-5 TMSCP Status and Event Codes (Cont)

Major Code Name	Minor Full Octal Code	Full Octal Code	Full Hex. Code	Minor Code Name
Unit off-line (xxxx03)	0000	000003	0003	Unit unknown or on-line to another controller
	0001	000043	0023	No media loaded
	0002	000103	0043	Unit is inoperative
Unit available (xxxx04)	No substatus codes apply			
Unit write protected (xxxx06)	0200	010006	1006	Unit is software write protected
	0400	020006	2006	Unit is hardware write protected
	0600	030006	3006	Unit is software and hardware write protected
Compare error (xxxx07)	No substatus codes used			
Data error (xxxx10)	0000	000010	0008	Long Gap encountered
	0001	000050	0028	AGC fault
	0002	000110	0048	ID fault
	0003	000150	0068	Read data check
	0004	000210	0088	Unit exception
	0005	000250	00A8	FIFO Overrun/Overflow
	0006	000310	00C8	FMTR read parity error
	0007	000350	00E8	Unrecoverable read error
	0010	000410	0108	FIFO parity error
	0011	000450	0128	I/F parity error

Table 3-5 TMSCP Status and Event Codes (Cont)

Major Code Name	Minor Code Octal	Full Octal Code	Full Hex. Code	Minor Code Name
	0012	000510	0148	LESI parity error
	3773	177550	FF68	Formatter Retry sequence exhausted
	3774	177610	FF88	Controller transfer Retry limit exceeded
	3775	177650	FFA8	Host requested Retry suppression on a K.sti detected error
	3776	177710	FFC8	Reverse Retry currently not supported
	3777	177750	FFE8	Host requested Retry suppression on a Formatter detected error
Host buffer access error (xxxx11)	0003	000151	0069	Nonexistent memory
	0004	000211	0089	Host bus/memory parity error
Controller error (xxxx12)	0000	000012	000A	Gross Time Out
	0001	000052	002A	Data late
Drive error (xxxx13)	0000	000013	000B	Device response check
	0001	000053	002B	Device hardware check
	0002	000113	004B	Velocity check
	0003	000153	006B	Device command check
	0004	000213	008B	Airflow/Temperature check
	3761	177053	FE2B	Could not save byte count
	3762	177113	FE4B	Could not write tape mark
	3763	177153	FE6B	Could not set unit characteristics

Table 3-5 TMSCP Status and Event Codes (Cont)

Major Code Name	Minor Octal Code	Full Octal Code	Full Hex. Code	Minor Code Name
	3764	177213	FE8B	Unable to position to before LEOT
	3765	177253	FEAB	Rewind failure
	3766	177313	FECB	Could not complete on-line sequence
	3767	177353	FEEB	Erase Gap failed
	3770	177413	FF0B	Erase failed
	3773	177553	FF6B	Tape drive requested error log
	3776	177713	FFCB	Could not position for (Formatter) Retry
	3777	177753	FFEB	Cannot clear drive errors
Formatter error (xxxx14)	0001	000054	002C	Equipment check
	0002	000114	004C	Intervention required
	0003	000154	006C	Command reject
	0004	000214	008C	Formatter response check
	0005	000254	00AC	Formatter sense read error
	3757	176754	FDEC	Could not get extended drive status
	3760	177014	FE0C	Could not get formatter summary status while trying to restore tape position
	3770	177414	FF0C	Topology command failed
	3773	177554	FF6C	Formatter requested error log

Table 3-5 TMSCP Status and Event Codes (Cont)

Major Code Name	Minor Octal Code	Full Octal Code	Full Hex. Code	Minor Code Name
	3776	177714	FFCC	Cannot clear formatter errors
	3777	177754	FFEC	Could not get formatter summary status during transfer error recovery
BOT Encountered (xxxx15)	No substatus codes used			
Tape Mark detected (xxxx16)	No substatus codes used			
Recorded Data truncated (xxxx20)	No substatus codes used			
Position lost error (xxxx21)	3771	177461	FF31	Retry limit exceeded when attempting to restore tape position
	3773	177561	FF71	Formatter detected position lost
	3776	177721	FFD1	Formatter and controller disagree on tape position
	3777	177761	FFF1	Controller detected position lost
Serious Exception Condition Present (xxxx22)	No substatus codes used			
LEOT detected	No substatus codes used			

4 REMOVAL AND REPLACEMENT

This chapter describes the removal and replacement procedures for the TU81 components and modules listed in the field replaceable unit table (Table 1-1). Each procedure also gives a test (or tests) to be performed that checks the replaced module.

The removal and replacement procedures follow the concept of module (assembly) replacement only. Individual circuit troubleshooting or assembly repair are not recommended and are, therefore, not discussed in this guide.

NOTE
Unless otherwise specified, in all procedures it is assumed that the tape has been unloaded, the transport is powered down, and the power cord is disconnected.

CAUTION
When replacing electronic modules (PCBs), be careful to properly ground yourself to protect MOS components from static electricity. Do not touch MOS IC pins if you are not grounded.

4.1 ACCESS TO TAPE DECK COMPONENTS

Components located on the underside of the tape deck can be accessed for maintenance purposes by placing the tape deck in the maintenance position. Using Figure 4-1 for reference, proceed as follows.

1. Open the top cover fully.
2. Using a 5/32 inch allen wrench, open the front door.
3. Using a straight slot screwdriver, rotate the pawl fastener on the front left corner of the tape deck one-quarter turn counterclockwise to release the deck. Rotate the fastener six more turns counterclockwise to disengage the pawl fully.
4. While pressing down on the front of the tape deck, pull the spring-loaded tape deck latch out. With the latch extended, pull the tape deck upward and allow the front of the tape deck to rise.

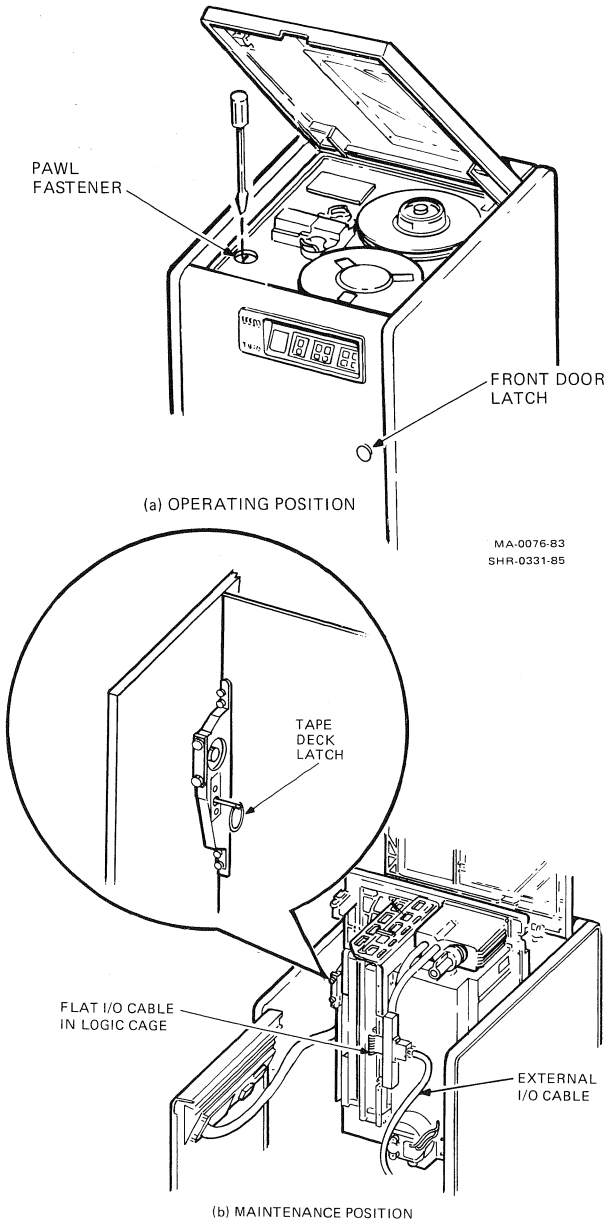


Figure 4-1 TU81 Maintenance Access

5. Release the tape deck latch and manually tilt the front of the tape deck up until the latch engages and the tape deck is locked in the vertical (maintenance) position.

   From the vertical position, the tape deck may be moved to the tilted position for maintenance if desired. To move the tape deck from the vertical to the tilted position, push the top of the tape deck back slightly to relieve pressure on the latch and pull out the latch. Keep pushing the top of the tape deck back until the latch engages in the tilted position.

   CAUTION
   Be careful not to snag or chafe the control panel cable or any other cables when positioning the tape deck.

6. To return the tape deck to the operating position, pull the tape deck latch out and manually place the deck in the horizontal position until the latch engages. Secure the tape deck by turning the pawl fastener clockwise.

   NOTE
   When servicing the transport, you may need to operate the unit and run diagnostic tests with the top cover open. To bypass the safety interlock switch, insert the interlock defeat tool (supplied in the CD kit) into the interlock latch. This keeps the interlock switch pressed down, simulating the "top cover closed" condition. Refer to Paragraph 1.8.3 and Figure 1-11.

   Figure 4-2 shows the drive's module (assembly) layout with the tape deck in the maintenance (vertical) position.

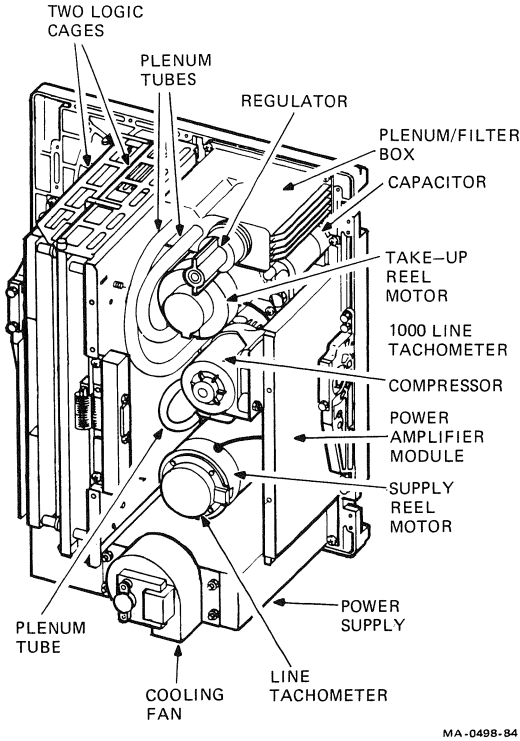


Figure 4-2 Tape Deck Layout

4.2 PROTECTIVE DRIVE COVER

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Loosen the three wing nuts and three thumbscrews securing the cover and remove the cover assembly (Figure 4-3).

Replacement

1. Place the drive cover in position so that the cooling fan wires are placed in the feed-through holes (Figure 4-3).
2. Secure the cover with the three nuts and three screws.
3. Return the tape deck to the operating position.

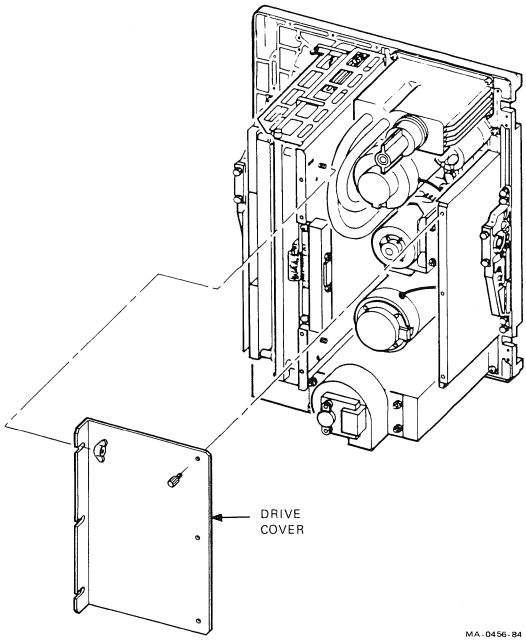


Figure 4-3 Protective Drive Cover

4.3 TAPE CLEANER ASSEMBLY

Removal

1. Remove the tape path and magnetic head covers from the tape deck.
2. Loosen the two mounting screws and remove the cleaner assembly from the tape deck (Figure 4-4).
3. Remove the screws, lockwashers, and cover plate from the blade housing.
4. Slide the platform out from the tape cleaner assembly.

CAUTION
Handle the assembly with care. The cleaner blades are both brittle and sharp.

NOTE
The defective tape cleaner must be replaced as a complete assembly.

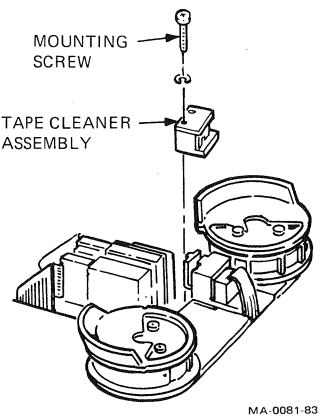


Figure 4-4 Tape Cleaner Assembly

Replacement

1. Inspect the cleaner blades for damage. If the blades are chipped or damaged, replace the entire assembly.
2. If the blades are not damaged, clean the platform and reinstall. When installing the platform, make sure that the flanges are positioned so that the platform fits firmly inside the cleaner assembly.
3. Install the cover plate, two lockwashers, and mounting screws.
4. Position the assembly onto the guide pins on the tape deck and tighten the screws.
5. Reinstall the tape path and magnetic head covers.

Verification Check

1. No functional checks are necessary.

4.4 TOP COVER INTERLOCK SWITCH

Removal

1. With the tape deck in the maintenance position, remove the four labeled slip-on connectors from the interlock switch connectors. (If any wires are not labeled, identify and mark each wire for reassembly.) See Figure 4-5.
2. Remove the two mounting screws securing the switch plate to the tape deck. Remove the switch and switch plate.
3. Press the top and bottom release tabs on the switch to separate the switch from the switch plate.

Replacement

1. Assemble the switch to the switch plate.
2. Position the switch assembly on the rear of the tape deck so that the connector numbers on the switch correspond to the numbers stenciled on the tape deck.

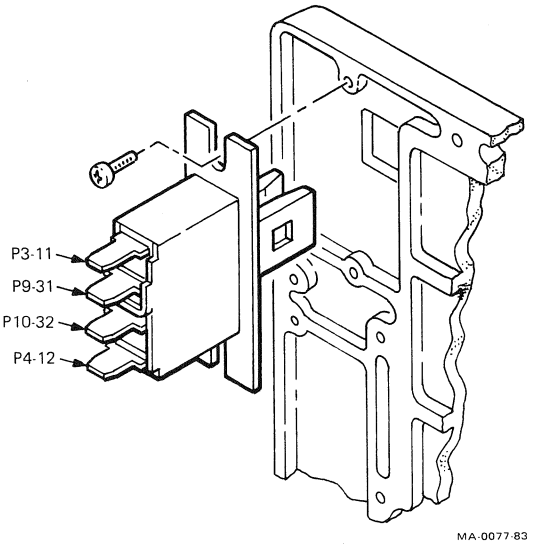


Figure 4-5 Top Cover Interlock Switch (Maintenance View)

3. Insert the two hex mounting screws. Position the top cover door so that the interlock switch can be aligned with the actuating stud on the door. Tighten the switch mounting screws when the center of the switch front is aligned with the actuating stud.
4. Attach the slip-on connectors to the appropriate studs of the interlock switch. Refer to Figure 4-5 for wire and connector positions.

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.5 FILE PROTECT SENSOR

Removal

1. Remove the tape reel from the supply hub.
2. Remove the four mounting screws (Figure 4-6) and the file protect sensor cover plate from the tape deck.
3. Remove the mounting screw and washer securing the file protect sensor to the tape deck.
4. Detach connector W3P6 from the sensor and discard the sensor.

Replacement

NOTE
Refer to Figure 4-6 for sensor alignment and cable plug connection.

1. Place the sensor on the tape deck and secure it with the mounting screw and washer.
2. Attach connector W3P6 to the sensor pins.
3. Reinstall the sensor cover plate and secure it to the tape deck with the four mounting screws.

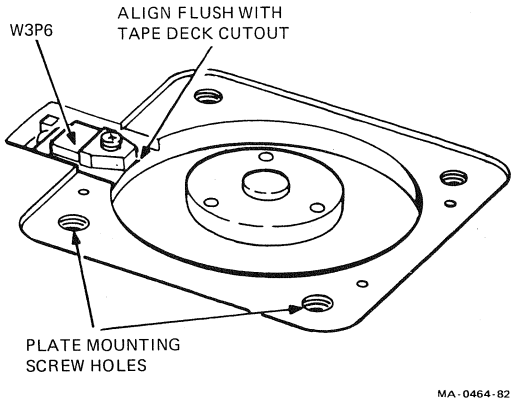


Figure 4-6 File Protect Sensor Alignment

Verification Checks

1. Thread a write enabled tape and perform a load operation. Observe that the FILE PRO indicator is not lighted.
2. Unload the tape and remove the write enable ring. Thread the tape, perform a load operation, and observe that the FILE PRO indicator is lighted.

4.6 EOT/BOT SENSOR ASSEMBLY

Removal

1. Remove the tape path and magnetic head covers from the tape deck.
2. Remove connector W3P1 from the EOT/BOT assembly.
3. Remove the flat-head phillips mounting screw from the assembly base mount and then lift the assembly from the tape deck (Figure 4-7).

NOTE
You must replace the defective sensor as a complete assembly.

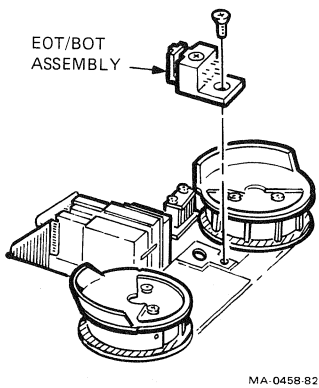


Figure 4-7 EOT/BOT Sensor Assembly

Replacement

1. Position the EOT/BOT assembly onto the tape deck and install the flat-head mounting screw.
2. Thread the tape onto the take-up reel. Align the EOT/BOT assembly with the tape.
3. Tighten the flat-head mounting screw.
4. Reattach connector W3P1 to the sensor assembly. If excess cable exists, position the cable so that the excess is at the rear of the tape deck.
5. Install the tape path and magnetic head covers.

Vertification Checks

> NOTE
> **If available, use a 600 foot reel of tape with properly installed EOT/BOT markers to reduce test time.**

1. Load a reel of tape onto the supply hub and thread the tape so that the BOT marker is located before the EOT/BOT assembly.
2. Perform a load operation and observe that the tape loads and positions itself at the BOT marker (the BOT indicator lights).
3. Execute Field Service test 44 to verify operation of the EOT sensor.

4.7 TAKE-UP REEL HUB ASSEMBLY

Removal

1. Remove the four mounting screws from the take-up reel hub cover and remove the cover from the hub assembly (Figure 4-8).
2. Remove the three allen screws, lockwashers, and plain washers securing the reel to the motor shaft assembly.
3. Remove the take-up reel from the transport.

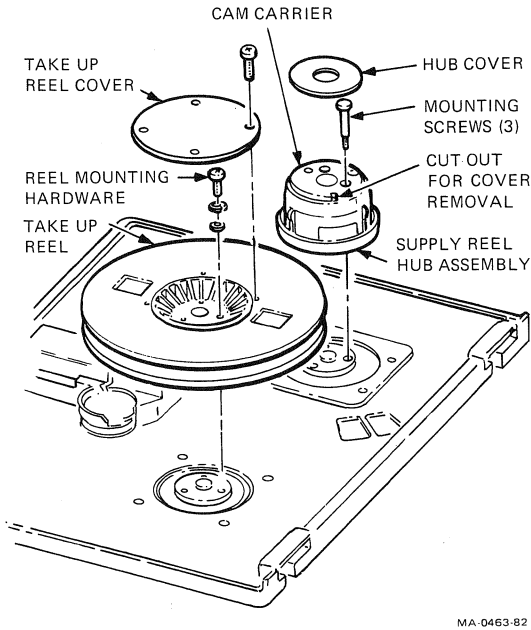


Figure 4-8 Take-Up Reel and Supply Reel Hub Assemblies

Replacement

CAUTION
If you are installing a new reel, inspect the reel edges for burrs or cracks that could cause tape damage.

1. Replace the take-up reel on the transport.
2. Replace the three allen screws, lockwashers, and plain washers securing the reel to the motor shaft assembly.
3. Replace the cover on the hub assembly and install the four mounting screws.

Verification Checks

1. Manually rotate the tape reel to make sure that the reel does not contact the tape deck.
2. Load a known good reel of tape and observe the reel during tape motion. The tape should not contact the reel flanges.

4.8 TAKE-UP REEL MOTOR ASSEMBLY

Removal

1. Perform the removal procedure for the take-up reel hub assembly (Paragraph 4.7).
2. Place the tape deck in the maintenance position and remove the drive cover (Paragraphs 4.1 and 4.2).
3. Remove connector W3P2 from the tachometer assembly on the take-up motor.
4. Remove connector B3P1 from the power amplifier module (jack J1 on the power amplifier module).
5. Remove the four mounting screws (Figure 4-9) securing the motor to the tape deck. Remove the motor from the transport.

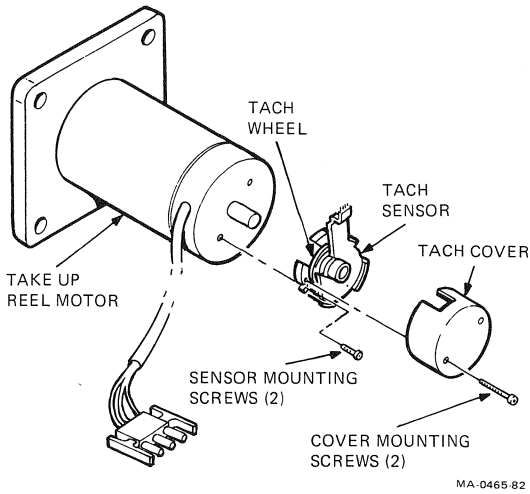


Figure 4-9 Take-Up Reel Motor Assembly

Replacement

NOTE
The reel motor and tach must be replaced as an assembly.

CAUTION
When installing the motor, make sure there are no loose wires between the motor mounting plate and tape deck.

1. Position the motor on the rear of the tape deck so that the B3P1 cable extends from the lower right. Secure the motor with the four mounting screws.
2. Attach connector B3P1 to J1 on the power amplifier module.
3. Attach connector W3P2 to the tach assembly on the motor.
4. Install the drive cover and return the tape deck to the operating position.
5. Perform the replacement procedure for the take-up reel hub assembly.

Verification Checks

1. Execute Field Service test 37. (Refer to diagnostics test 37 in the *TU81/TA81 Pathfinder* for requirements.)
2. Execute Field Service test 48.
3. Thread the tape but do not load it. Execute operator diagnostic test 01.

4.9 SUPPLY REEL HUB ASSEMBLY

Removal

1. Press the center button on the hub to unlatch it (Figure 4-8).
2. Locate the slot opening on the periphery of the cover. Insert a small-blade screwdriver into the slot and twist it to unsnap the cover from the hub assembly.
3. Latch the hub assembly by pressing the cam carrier.

CAUTION
Make sure the hub is latched before you proceed with further removal. If the hub is unlatched, parts may disassemble.

4. Remove the three large shoulder screws from the cam carrier. Remove the hub assembly from the tape deck.

Replacement

1. Position the hub assembly onto the motor shaft assembly and secure it with the three large shoulder screws.
2. Install the cover on the face of the hub assembly.

Verification Checks

1. Mount the tape reel onto the hub assembly. The reel should mount easily onto the hub and against the bottom flange.
2. Latch the reel onto the hub. Make sure the reel is securely fastened.
3. Load a known good quality tape and observe the reel during tape motion. The tape should not contact the reel flanges.
4. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.10 SUPPLY REEL MOTOR ASSEMBLY

NOTE
The supply reel motor assembly is not supplied as part of the spare parts list. A spare take-up reel motor assembly must be disassembled and the motor used as a replacement for the supply motor.

Removal

1. Perform the removal procedure for the supply reel hub assembly (Paragraph 4.9). Place the tape deck in the maintenance position and remove the drive cover (Paragraphs 4.1 and 4.2).
2. Remove connector B1P1 from J3 on the power amplifier module.
3. Remove the tach cover and mounting screws from the motor (Figure 4-10). Retain them for reuse.
4. Remove connector W3P5 from the tach assembly on the motor.
5. Remove the four mounting screws securing the motor to the tape deck. Remove the motor from the tape deck.
6. Remove the mounting screw (Figure 4-10) and the sensor from the mounting plate on the supply reel motor. Retain them for reuse.

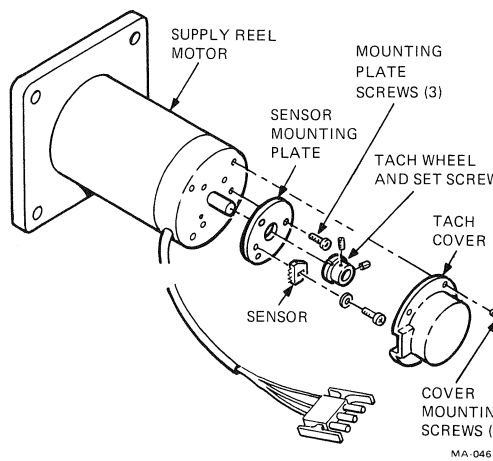


Figure 4-10 Supply Reel Motor Assembly

7. Loosen the two set screws securing the tach to the motor shaft and remove the tach from the shaft. Retain the screws and tach for reuse.
8. Remove the four screws securing the mounting plate and remove the plate from the supply reel motor. Retain the screws and mounting plate for reuse.
9. Disassemble the spare take-up reel motor assembly as follows (refer to Figure 4-9).
   a. Remove the two mounting screws and the tach cover from the motor assembly.
   b. Remove the two mounting screws securing the tach sensor to the reel motor. Remove the tach sensor from the reel shaft and the tach wheel.
   c. Loosen the set screw and remove the tach wheel from the motor shaft.

Replacement

1. Place the mounting plate (from step 8 of Removal) onto the rear of the new motor and secure it with the four mounting screws.
2. Assemble the sensor and tach wheel (from steps 6 and 7 of Removal) onto the motor mounting plate and shaft as shown in Figure 4-11 and adjust them (refer to Paragraph 4.11, Replacement).

CAUTION
When installing the new motor, make sure there are no loose wires between the motor mounting plate and tape deck.

3. Position the motor on the rear of the tape deck so that the B1P1 cable extends from the right. Secure the motor with the four mounting screws.
4. Attach connector B1P1 to J3 on the power amplifier module.
5. Attach connector W3P5 to the tach sensor pins as shown in Figure 4-11.
6. Install the tach cover and secure it with the four mounting screws.
7. Install the drive cover and return the tape deck to the operating position.
8. Perform the replacement procedure for the supply reel hub assembly (Paragraph 4.9).

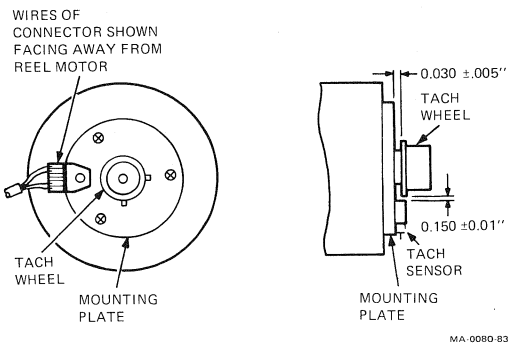


Figure 4-11 Tachometer Wheel and Sensor Alignment

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.11 SUPPLY MOTOR TACHOMETER AND SENSOR

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove the four mounting screws and the tachometer cover from the supply motor (Figure 4-10).
3. Remove connector W3P5 from the sensor pins.
4. Remove the mounting screws and the sensor from the mounting plate.
5. Loosen the two set screws securing the tachometer to the motor shaft and remove the tachometer.

Replacement

1. Insert the tachometer wheel on the motor shaft. Position the tachometer for a 0.030 ± 0.005 inch clearance between the tachometer and the sensor mounting plate (Figure 4-11).

2. Install the sensor on the mounting plate and position for a clearance of 0.150 ± 0.01 inch between the sensor and the tachometer. Tighten the sensor mounting screw.
3. Attach connector W3P5 to the sensor pins.
4. Install the tachometer cover and secure with the four mounting screws.
5. Return the tape deck to the operating position.

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.12 AIR BEARING SENSORS

Removal

NOTE
Replacement parts for the air bearing assembly are contained in the refurbishing kit (PN 29-24359). This kit contains upper and lower spring guides, a sensor, and small and large O-rings. If you are replacing the sensor, Digital recommends that you also replace the upper and lower spring guides and large and small O-rings.

1. Perform steps 1 through 8 of Paragraph 4.21 (Servo Control Module, Removal section).
2. Remove connector P1 from the sensor pins.
3. To gain access to the screws holding the air bearing, remove the screws holding the logic cage (Paragraph 4.20) and move the cage enough to access the air bearing mounting screws. Do not remove the tie wraps holding the cables to the cage.
4. Remove the mounting screws and washers (Figure 4-12) from the air bearing assembly (the tape path cover on the top of the tape deck will hold the air bearings in place).

CAUTION
Be careful not to snag or chafe the control panel cable or any other cable when positioning the tape deck.

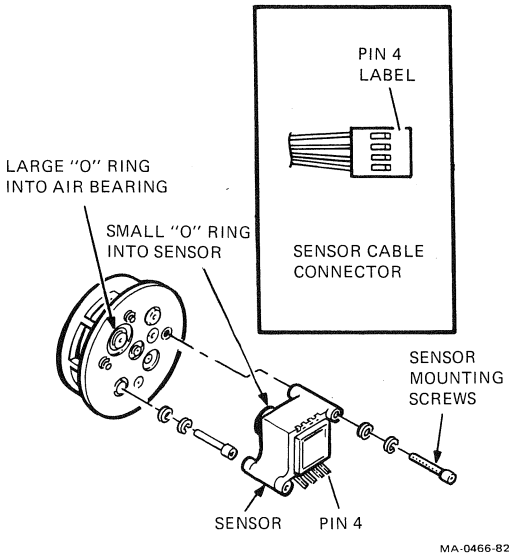


Figure 4-12 Air Bearing Sensors

5. Return the tape deck to the operating position.
6. Remove the tape path cover and lift the air bearings away from the tape deck.
7. Remove the O-ring from the air bearing housing.
8. Remove the two socket head screws and washers securing the sensor to the rear of the air bearing. Remove the sensor and the small O-ring from the air bearing housing.
9. Replace the upper and lower spring guides as described in Paragraph 4.13.

Replacement

1. Insert a new small O-ring in the opening at the rear of the sensor.
2. Position the sensor on the air bearing so that the connector pins are positioned towards the outside of the air bearing. Secure the sensor with the mounting screws and washers.

3. Insert a large O-ring into the opening at the rear of the air bearing housing.
4. Place the air bearing assembly onto the tape deck using the locating pin for positioning. Install the tape path covers to hold the air bearings in position.
5. Place the tape deck in the tilted maintenance position. Secure the air bearings with the mounting screws and washers.
6. Replace the screws holding the logic cage (Paragraph 4.20).
7. Attach connector P1 to the sensor pins. Refer to Figure 4-12 for pin orientation.
8. Perform steps 4 through 10 of Paragraph 4.21 (Servo Control Module, Replacement section).

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.13 AIR BEARING SPRING GUIDES

Removal

> **NOTE**
> **Replacement parts for the air bearing assembly are contained in the refurbishing kit (PN 29-24359). This kit contains an upper and lower spring guide, a sensor, and a small and large O-ring. If you are replacing a spring guide, Digital recommends that you replace both upper and lower guides.**

1. Remove the tape path and magnetic head covers from the tape deck.
2. Remove the two phillips head screws securing the rear spring guide and guard to the bearing housing (Figure 4-13).
3. Remove the spring guard and guide from the housing.
4. Repeat steps 2 and 3 to remove the front spring guide.

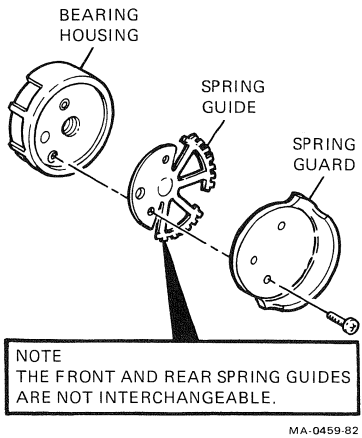


Figure 4-13 Air Bearing Spring Guide

Replacement

1. Place the new rear spring guide (PN 77004255) and guard into the bearing housing. Use the holes for the mounting screws to align both parts to the housing.
2. Secure the guide with the two phillips head screws.
3. Repeat steps 1 and 2 using the new front spring guide (PN 77004254) to replace the used guide.
4. Install the tape path and magnetic head covers on the tape deck.

Verification Checks

1. Thread but do not load the tape. Execute operator diagnostic test 01.
2. Visually check the tape for tape edge damage.

4.14 PNEUMATIC PUMP ASSEMBLY

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Detach the two pneumatic tubes from the filter box assembly (Figure 4-14).

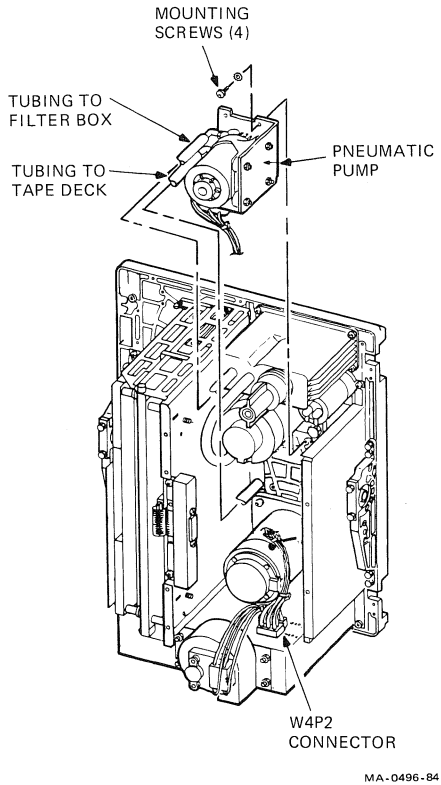


Figure 4-14 Pneumatic Pump Assembly

3. Remove the drive cover to access the pneumatic pump (Paragraph 4.2).
4. Remove connector W4P2 from the power supply.
5. Remove the pneumatic tube connected from the tape deck nipple to the pneumatic pump.

NOTE
Detach any wiring that may interfere with removal of the pneumatic pump assembly.

6. Remove the four mounting screws and washers securing the pneumatic assembly to the tape deck. Carefully withdraw the assembly from the transport.

Replacement

1. Position the pneumatic pump assembly to the rear of the tape deck and secure it with the mounting screws and washers.
2. Attach the pneumatic tubes from the compressor to the tape deck nipple.
3. Attach connector W4P2 to the power supply. Attach any wiring that was disconnected during the removal procedure.
4. Install the drive cover and attach the two pneumatic tubes to the filter box assembly.

NOTE
Make sure that the in and out tubes are attached to the proper nipples (Figure 4-14).

5. Return the tape deck to the operating position.

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

4.15 PRESSURE REGULATOR AND FILTER ASSEMBLY

Removal

CAUTION
Filter replacement should only be performed when necessary. It should not be replaced on a PM schedule. Air pressure could be lost through the seals when removing and replacing the filter box.

NOTE
If you are only replacing the pressure regulator, perform Removal steps 1 and 2, Replacement steps 4 and 5, and the Verification Check. If the filter is being replaced, perform the entire Removal, Replacement, and Verification Check procedures.

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove the pressure regulator by unscrewing the regulator from the filter box assembly (Figure 4-15).
3. Remove the two pneumatic tubes from the in and out nipples on the filter box.
4. Remove the four mounting screws securing the filter box and remove the filter box from the tape deck.
5. Remove the filter from the filter box.

Replacement

1. Insert the filter into the filter box.
2. Secure the filter box to the tape deck with the four mounting screws. Check the seals for air leaks.
3. Install the two pneumatic tubes on the in and out nipples.
4. Screw the pressure regulator clockwise onto the filter box assembly.
5. Return the tape deck to the operating position.

Verification Check

1. With the tape threaded but not loaded, execute operator diagnostic test 01.

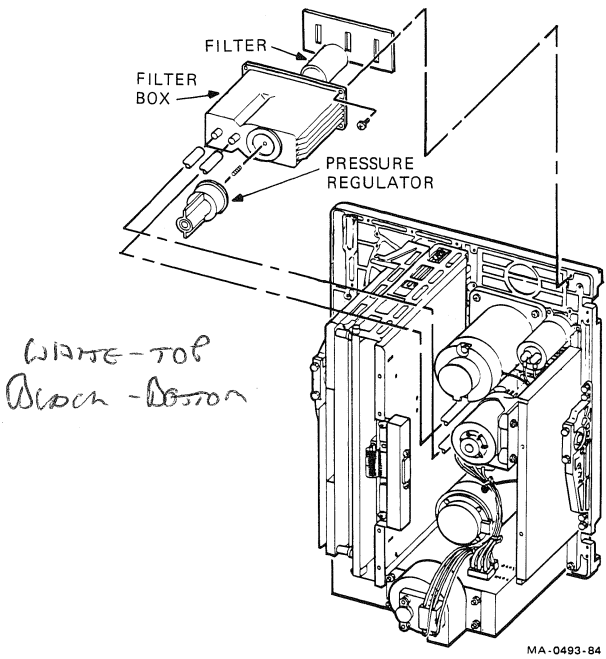


Figure 4-15 Filter Box Assembly

4.16 MAGNETIC HEAD ASSEMBLY

Removal

1. Remove the head covers from the tape deck.
2. From the top of the transport, detach read head connector W6P1, write head connector W5P1, and erase head wires P3/P4 from the magnetic head (Figure 4-16).

   NOTE
   Before removing the magnetic head, tape a piece of soft material across the recording surface.

3. Perform steps 1 through 6 of Paragraph 4.21 (Servo Control Module, Removal section).

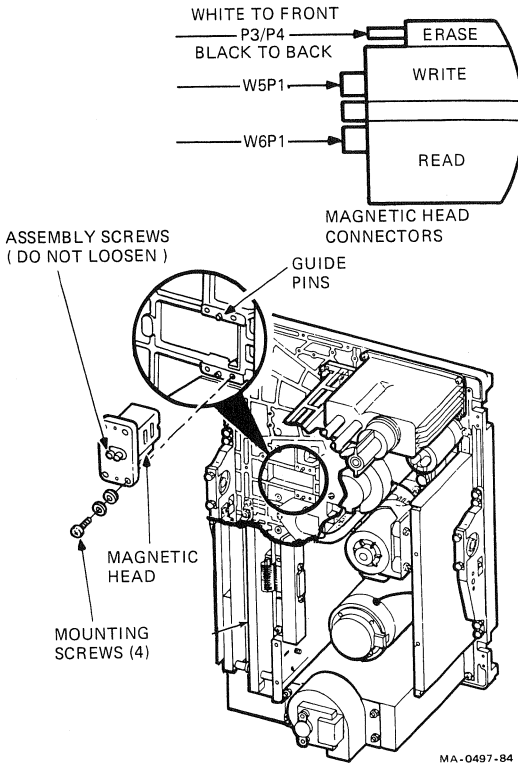


Figure 4-16 Magnetic Head Assembly

4. From the rear of the tape deck, remove the read, write, and erase connectors from the magnetic head.

CAUTION
Refer to Figure 4-16 for the location of the head mounting screws. Do not loosen the head assembly screws. Otherwise, you must replace the entire head with a new assembly.

5. Loosen the four head mounting screws. Hold the magnetic head against the tape deck while you remove the four mounting screws, lockwashers, and flatwashers.
6. Carefully withdraw the head from the tape deck.

Replacement

NOTE
Before you install the magnetic head, make sure the recording surface is protected with soft material.

1. Pull the magnetic head from inside through the tape deck and position it with the mounting surface on the guide pins.
2. While holding the head in place, insert the flatwashers, lockwashers, and mounting screws. Tighten the four mounting screws.
3. Pull the read and write/erase cables through the tape deck.
4. From the top of the tape deck, attach the read, write, and erase connectors to the magnetic head (Figure 4-16). Remove the recording surface covering.
5. Perform steps 6 through 10 of Paragraph 4.21 (Servo Control Module, Replacement procedure).
6. Install the head covers on the tape deck.
7. Proceed with the following verification checks.

Verification Checks

1. Clean the magnetic head recording surface with a soft lint-free cloth moistened with tape transport cleaner. Wipe the recording surface in the same direction as the tape motion.
2. Load a 3M777, or equivalent, write enabled tape.
3. Move jumper W1 at location D23 on the servo control module (Figure 4-27) to the 1-2 position.
4. Execute Field Service test 64. (It sets write current values.)
5. Execute Field Service test 31. The test should complete with the display 00.
6. Return jumper W1 at location D23 from the 1-2 position to the 2-3 position before you power down the unit.
7. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, refer the display number to the corresponding fault code in the *TU81/TA81 Pathfinder.*

4.17 CONTROL PANEL ASSEMBLY

1. Open the front door of the TU81 cabinet.
2. Disconnect the W8P1, W16P2, and W13J1 cable connectors from the control panel (Figure 4-17).
3. Remove the four mounting screws from the control panel bracket and the ground strap connector from the door assembly.
4. Move the bracket away from the door assembly (fault switch and +5 V cable still attached).
5. Remove the push-in clips securing the control panel to the mounting bracket.
6. Remove the connector from the indicator panel. The control panel can now be removed.

Replacement

1. Reconnect the small connector to the indicator panel. Align the mounting holes in the control panel with the holes in the bracket and secure the control panel with the four push-in clips (Figure 4-17).

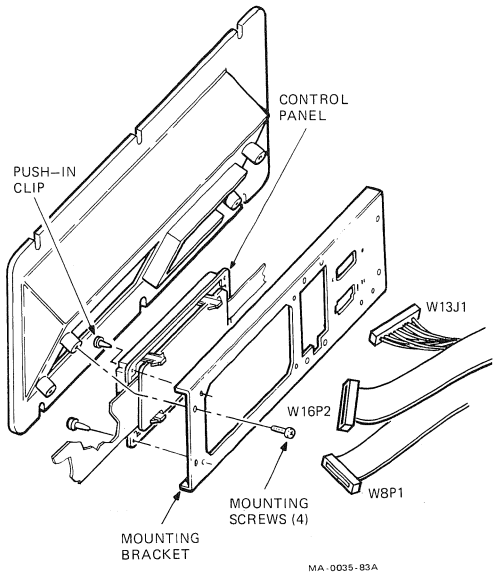


Figure 4-17 Control Panel Assembly

2. Place the control panel and bracket in position on the door assembly and install the four mounting screws. Attach the ground strap to the door assembly.
3. Attach the W8P1, W16P2, and W13J1 cable connectors to the control panel assembly.
4. Close the front door.

Verification Check

1. Thread the tape but do not load it and run operator diagnostic test 01.

4.18 COOLING FAN ASSEMBLY

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove the drive cover (Paragraph 4.2). Detach the cooling fan connector from receptacle J3 on the power supply (Figure 4-18).
3. Remove the four hex nuts and washers and withdraw the fan assembly from the mounting studs.

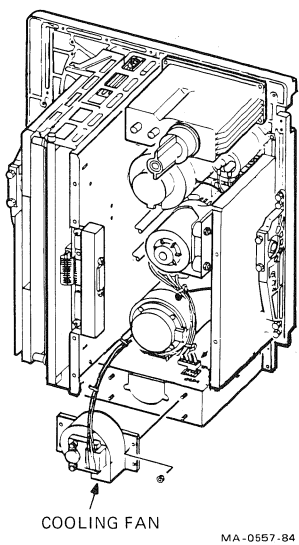


Figure 4-18 Cooling Fan Assembly

Replacement

1. Attach the cooling fan connector to receptacle J3 on the power supply.
2. Place the cooling fan in position on the mounting studs and secure it with the four nuts and washers.
3. Replace the drive cover (Paragraph 4.2).

Verification Check

1. Power the transport on and check for air flow from the fan.

4.19 POWER SUPPLY

Removal

1. Disconnect the power cable (Figure 1-7) from the power supply.
2. Tilt the tape deck into the maintenance position (Paragraph 4.1).
3. Remove the cooling fan assembly (Paragraph 4.18).
4. Detach all the connectors and cables from the power supply (Figure 4-19).
5. Place the tape deck in the operating (horizontal) position.
6. Open the rear door of the cabinet.
7. Remove the frame stabilizing bar by removing the mounting screws (Figure 4-20).

   NOTE
   The power supply is attached to the tape deck by four screws. The two screws on the left are located in slots so that you can slide the power supply out from under these screws for removal.

8. Loosen but do not remove the two mounting screws on the left side of the power supply.
9. Remove the two mounting screws on the right side of the power supply while you support the power supply from the bottom.
10. Slide the power supply out of the slots on the left and carefully remove it from the cabinet.

    NOTE
    The power supply weighs approximately 4.1 kg (9 lb). Use caution when you lift it.

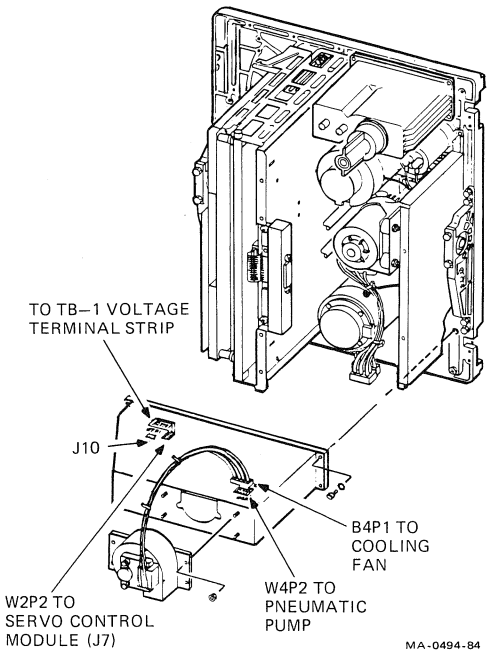


Figure 4-19 Power Supply

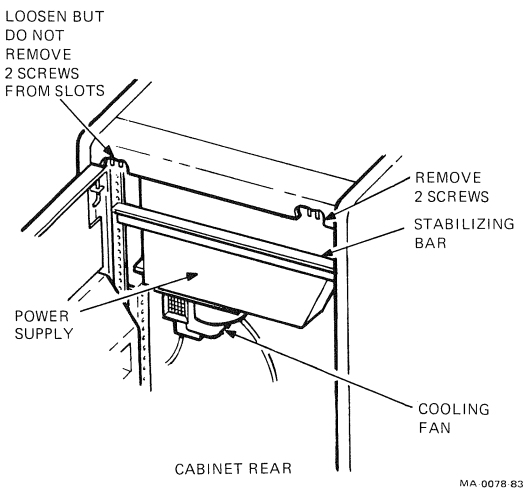


Figure 4-20 Power Supply (Rear Cabinet View)

Replacement

NOTE

If you are installing a new power supply, remove the power supply cover and observe the position of the voltage select card (Figure 4-21). The position of this card must correspond to the input voltage defined on the transport's identification plate. The ends of the card are stenciled with "120V" and "220V" and two indicating arrows. Make sure the card is connected to match the input voltage.

You can disconnect the card, turn it upside down, and reconnect it to the main power supply module if required.

1. From the rear of the transport, position the mounting slots on the left side of the power supply under the two loosened mounting screws.
2. Insert and tighten the two mounting screws on the right side of the power supply.
3. Tighten the two mounting screws on the left side.
4. Install the frame stabilizing bar and secure it with the mounting screws. Close the rear cabinet door.
5. Tilt the tape deck into the maintenance position.
6. Attach the cables to the power supply as follows.

Power Supply Connector	Cable
J2	W4P2 pneumatic pump
J3	B4P1 cooling fan
J4	W7P1 TB1 terminal block
J5	W2P2 servo control module
J10	TB1 terminal block

7. Install the cooling fan assembly (Paragraph 4.18).
8. Place the tape deck in the operating position.
9. Connect the power cable to the power supply.

Verification Check

1. **DC Voltage Check** – Connect the ground lead of a digital voltmeter to pin 5 of power terminal strip TB1 (Figure 4-22). Connect the other meter lead to the TB1 points shown in Figure 4-22 to test all dc voltages.

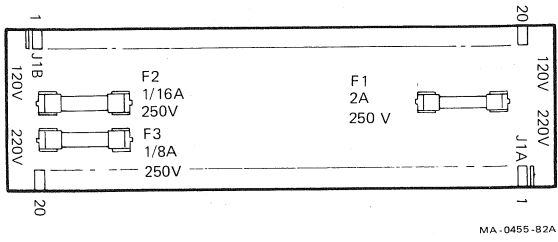


Figure 4-21 Voltage Select Card

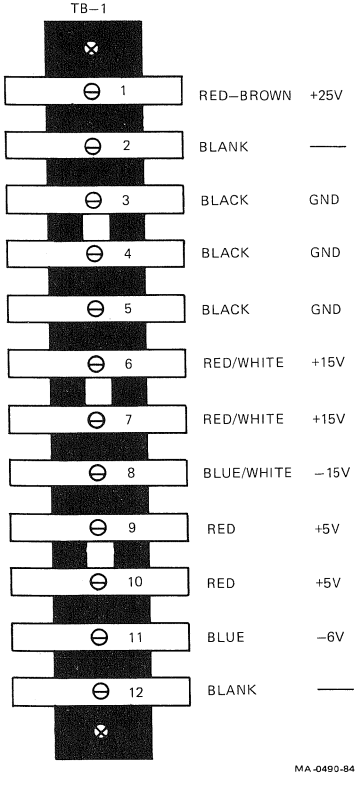


Figure 4-22 Power Terminal Strip TB1

4.20 WRITE DRIVER MODULE

NOTE
To service this module, you must separate it from the logic cage and move it to the maintenance position (Figure 4-23). Refer to Paragraph 1.8.1 to check on the shipping and safety brackets you have to remove when working with this cage.

CAUTION
Be careful not to place too much stress on the wires or modules when removing the connectors.

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove connectors W5P2, W7P6, and W12P1 (Figure 4-24) from the write driver module.
3. Pull the retaining latch at the top of the logic cage toward you to release it from the operating to the maintenance position.
4. While removing connectors W7P4 and W7P5, slide the modules to the maintenance position (Figure 4-23).
5. Remove the two standoff screws that hold the write driver module to the read amplifier module (Figure 4-25).
6. Slide the write driver module out of the two plastic clips mounted on the read amplifier module.

Replacement

1. Slide the write driver module into the two plastic clips mounted on the read amplifier module (Figure 4-25).
2. Mount the write driver module on the standoffs using the two standoff screws.
3. While sliding the modules to the right (to the operating position as in Figure 4-23), replace connectors W7P5 and W7P4 on top of the read amplifier module.
4. Engage the retaining latch at the top of the cage (return it to the operating position.
5. Replace connectors W12P1, W7P6, and W5P2 on the write driver module.
6. Place the tape deck in the operating position.

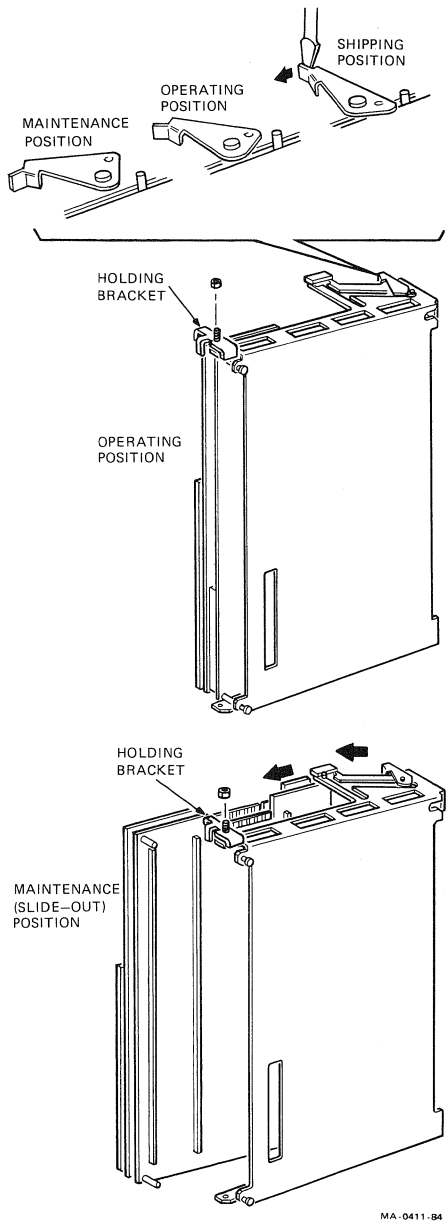


Figure 4-23 Logic Cage for Write Driver, Read Amplifier, and Servo Control Modules

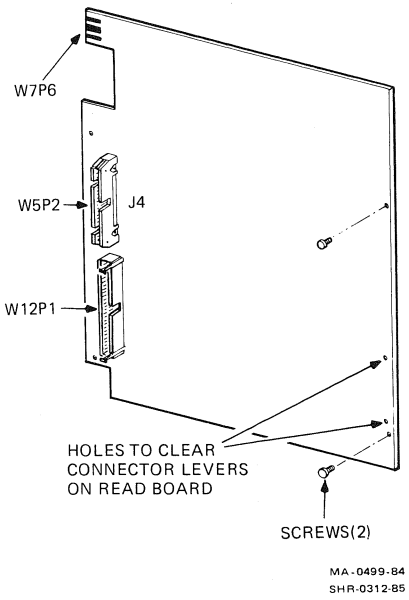


Figure 4-24 Write Driver Module

Verification Check

1. Load a 3M777, or equivalent, write enabled tape.
2. Execute Field Service test 64.
3. Execute Field Service test 31.
4. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

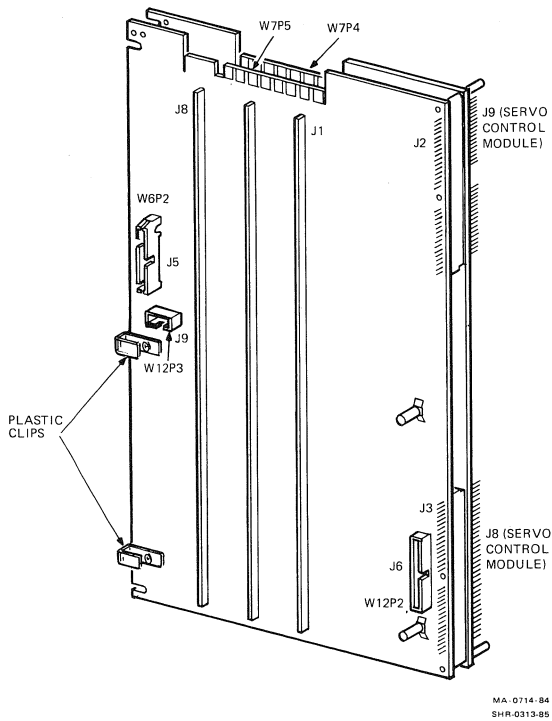


Figure 4-25 Read Amplifier Module

4.21 READ AMPLIFIER MODULE

NOTES

1. To service this module, you must separate it from the logic cage and move it to the maintenance position (Figure 4-23). Refer to Paragraph 1.8.1 to check on the shipping and safety brackets you have to remove when working with this cage.

2. Remove the write driver and read amplifier modules together and separate them after removal (Figure 4-26).

CAUTION

Be careful not to place too much stress on the wires or modules when removing the connectors.

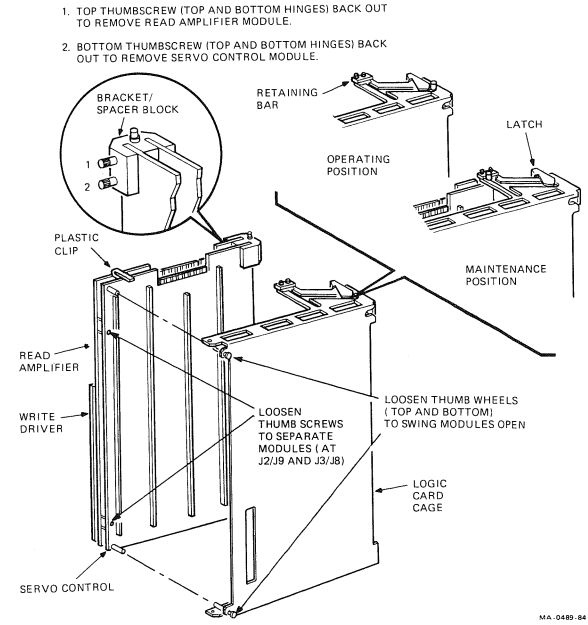


Figure 4-26 Removing Write Driver, Read Amplifier, and Servo Control Modules

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove connectors W5P2 and W7P6 (Figure 4-24) from the write driver module.
3. Remove connector W6P2 from the read amplifier module (Figure 4-25).
4. Loosen the thumb wheels on the logic cage to separate the modules from it (Figure 4-26).
5. Pull the retaining latch at the top of the logic cage toward you to release it from the operating to the maintenance position.
6. While removing connectors W7P4 and W7P5, slide the read amplifier and servo control modules to the maintenance position (Figure 4-23).
7. Loosen the upper thumbscrew 6 or 8 turns at the top and bottom brackets/spacer blocks (Figure 4-26).
8. Remove the plastic board clips at the top and bottom of the modules. Loosen the thumbscrews on the read amplifier module at J2/J9 and J3/J8. Avoid excessive stress on the modules by loosening the thumbscrews alternately and separating J2 from J9 and J3 from J8 as the screws are loosened.
9. Slide the read amplifier module with the write driver module out of the brackets and remove them from the cabinet.
10. Remove connector W12P1 from the write driver module (Figure 4-24).
11. Separate the write driver module from the read amplifier module as described in Paragraph 4.20.
12. Remove connectors W12P2 and W12P3.

Replacement

1. Install connectors W12P2 and W12P3 on the new module.
2. Mount the write driver module as described in Paragraph 4.20..
3. Replace connector W12P1 on the write driver module.
4. Slide the read amplifier module with the write driver module into the top and bottom brackets.

5. Align connector J2 with J9 and connector J3 with J8 (Figure 4-26). Press the connectors together while tightening the thumbscrews alternately. Replace the clips on the top and bottom of the modules.
6. Tighten the upper and lower thumbscrews on the top and bottom brackets.
7. While sliding the modules to the right (to the operating position as in Figure 4-23), replace connectors W7P5 and W7P4 on top of the read amplifier module.
8. Tighten the upper and lower thumbscrews holding the servo control module to the logic cage and engage the retaining latch at the top of the cage (return it to the operating position).
9. Replace connector W6P2 on the read amplifier module.
10. Replace connectors W5P2 and W7P6 on the write driver module.
11. Place the tape deck in the operating position.

Verification Check

1. Load a 3M777, or equivalent, write enabled tape.
2. Move jumper W1 at location D23 on the servo control module to the 1-2 position (Figure 4-27).
3. Execute Field Service test 31. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, refer the display number to the test description for test 31 in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).
4. After the test is successfully completed (display 00), return jumper W1 from the 1-2 position to the 2-3 position before powering down.
5. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

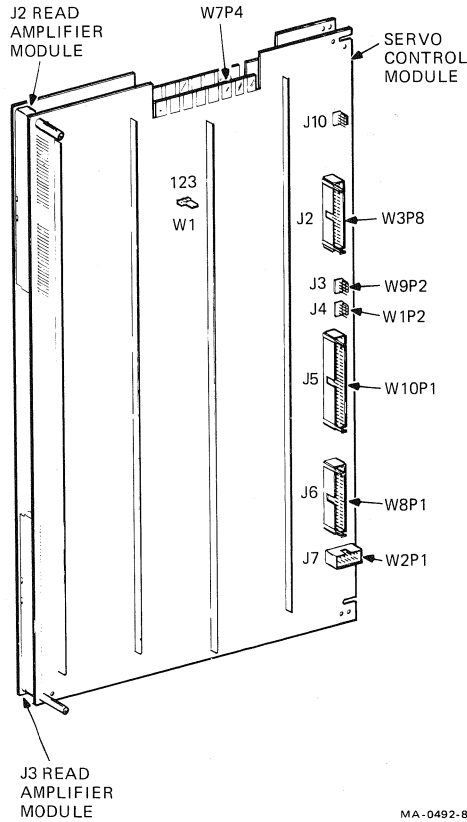


Figure 4-27 Servo Control Module

4.22 SERVO CONTROL MODULE

NOTE
Remove the servo control, read amplifier, and write driver modules together. First move all modules to the maintenance position as in Figure 4-23. Remove all the modules from the logic cage (Figure 4-26). Then separate the servo control module from the other modules.

CAUTION
Be careful not to place too much stress on the wires or modules when removing the connectors.

Removal

1. Place the tape deck in the tilted maintenance position (Paragraph 4.1).
2. Remove connectors W5P2 and W7P6 from the write driver module (Figure 4-24).
3. Remove connector W6P2 from the read amplifier module (Figure 4-25).
4. Loosen the upper and lower thumbscrews holding the servo control module to the logic cage (Figure 4-26).
5. Release (pull toward yourself) the retaining latch on the top of the logic cage to the maintenance position. While removing connectors W7P4 and W7P5, slide the servo control and read amplifier modules to the maintenance position (Figure 4-23).
6. Remove connectors W3P8, W10P1, W8P1, and W2P1 (Figure 4-27) from the servo control module. Label and remove connectors W9P2 and W1P2.
7. Remove the retaining bar from the logic cage (Figure 4-26) and remove the modules from the cabinet.
8. At the top and bottom brackets, loosen the lower thumbscrews 6 to 8 turns (Figure 4-26).
9. Remove the top and bottom board clips. Loosen the thumbscrews at edge connectors J2/J9 and J3/J8 (Figure 4-26). Avoid excessive stress on the modules by loosening the screws alternately and separating J2 from J9 and J3 from J8 as the screws are loosened.
10. Slide the servo control module out of the top and bottom brackets.

Replacement

1. Make sure that jumper W1 is in the 2-3 position on the replacement module. Slide the servo control module into the top and bottom brackets.
2. Align J2 with J9 and J3 with J8. Press the connectors together while alternately tightening the thumbscrews. Replace the top and bottom board clips.
3. Tighten the lower thumbscrews at the top and bottom brackets.
4. Place the modules in the cabinet in the maintenance position (Figure 4-23). Replace the retaining bar.
5. Replace connectors W2P1, W8P1, W10P1, W1P2, W9P2, and W3P8 on the servo control module.
6. Swing the modules to the right (to the operating position) while replacing connectors W7P4 and W7P5 on the top of the servo control and read amplifier modules.
7. Tighten the thumbscrews on the servo control module and engage (return to the operating position) the retaining latch.
8. Replace connector W6P2 on the read amplifier module.
9. Replace connectors W5P2 and W7P6 on the write driver module.
10. Return the tape deck to the operating position.

Verification Check

1. Move jumper W1 at location D23 on the servo control module to the 1-2 position.
2. With the tape not threaded, execute Field Service test 37. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, refer the display number to the test description for Field Service test 37 in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).
3. Execute Field Service test 49.
4. Execute Field Service test 64.
5. Execute Field Service test 31. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, refer the display number to the test description for Field Service test 31 in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

6. After the test is successfully completed (display 00), return jumper W1 from the 1-2 position to the 2-3 position before powering down.
7. Install and tighten the top and bottom thumbscrews to secure the modules to the logic cage.
8. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

4.23 FORMATTER READ MODULE

Removal

1. Loosen the top and bottom logic cage lockscrews and slide the cage out until the top and bottom guards engage (Figure 4-28).
2. Loosen the two thumbscrews (Figure 4-28) on the formatter read module and separate the formatter read module from the formatter write module. Avoid excessive stress on the modules by loosening the thumbscrews alternately and separating the modules as the screws are loosened.
3. Loosen the upper screws of each hinge 6 to 8 turns (Figure 4-28). Loosen the lower screws 2 turns. (Do not remove any of the screws). Hold the module in place while loosening the screws.
4. Remove the formatter read module from the logic cage.

Replacement

1. Insert the module into the top and bottom hinge slots of the logic cage. Make sure the module is fully inserted into the hinge slot and W7P8 rear connector.
2. Attach the outside pin connectors of the formatter read and formatter write modules and secure them with the two thumbscrews.
3. Tighten the upper and lower screw of the top and bottom hinges to lock the formatter read module into position. Make sure all four hinge screws are snug.
4. Release the upper and lower guards and slide the cage into the frame. Tighten the cage lockscrews.

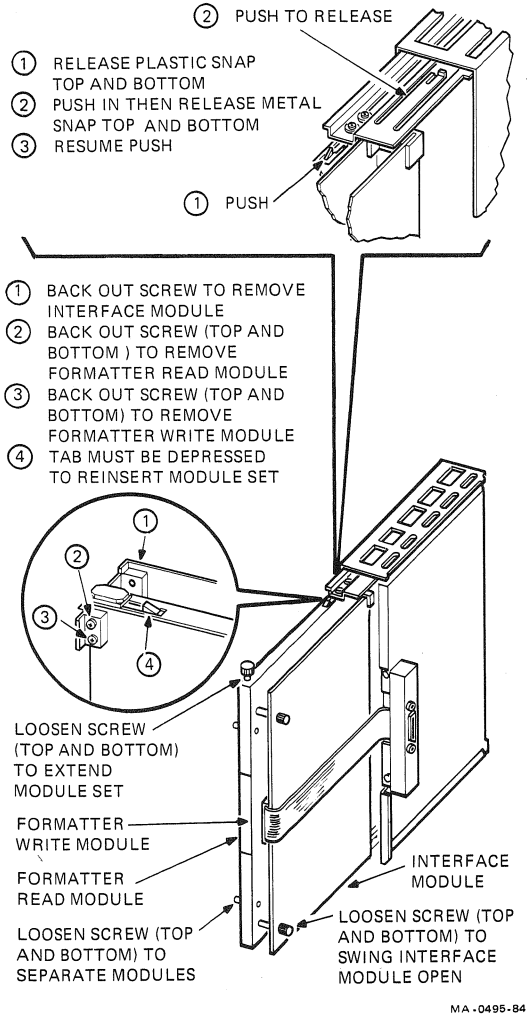


Figure 4-28 Logic Cage for Formatter Read, Formatter Write, and Interface Modules

Verification Check

1. Thread the tape but do not load it and execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

4.24 FORMATTER WRITE MODULE

Removal

1. Loosen the logic cage lockscrews and slide the cage out until the top and bottom guards engage (Figure 4-28).
2. Remove the top and bottom thumbscrews securing the interface module to the formatter write module.
3. Remove connectors W10P2 and W11P from the formatter write module (Figure 4-29) and remove power supply connector W7P8 at the rear of the module.
4. Loosen the two thumbscrews on the formatter read module (Figure 4-28) and separate the formatter read module from the formatter write module. Avoid excessive stress on the modules by loosening the thumbscrews alternately and separating the modules as the screws are loosened.
5. Loosen the lower screws of each hinge 6 to 8 turns (Figure 4-28). Hold the module in place while loosening the screws.
6. Remove the formatter write module from the cage.

Replacement

NOTE
Before installing the new module, make sure that the jumper blocks (W1, W2, W3) at module locations A1 and B1 are in the same positions as on the replaced module.

1. Insert the module into the top and bottom hinge slots of the logic cage. Make sure that the module is fully inserted into the hinge slot.
2. Attach the edge pin connectors of the formatter read and formatter write modules and secure them with the two thumbscrews.

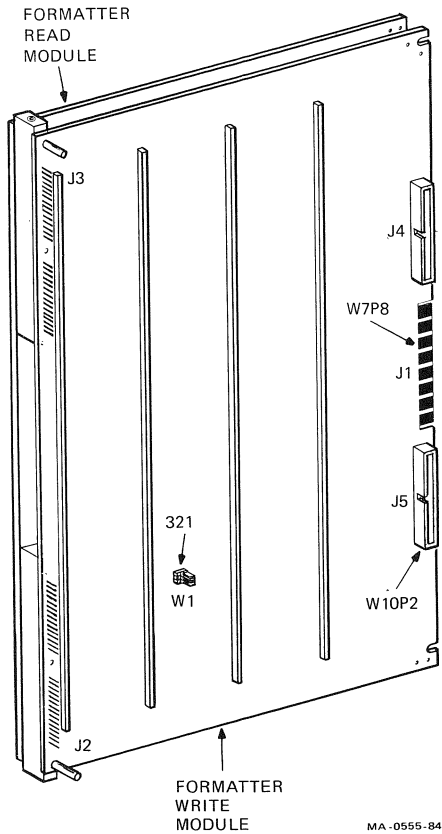


Figure 4-29 Formatter Write Module

3. Tighten the lower screw of the top and bottom hinges to lock the formatter write module into position. Make sure that all four hinge screws are snug.
4. Attach connector W10P2 to J5, W11P to J4, and power connector W7P8 to the module.
5. Secure the formatter write module to the formatter read and interface modules using the thumbscrews as shown in Figure 4-28.
6. Release the upper and lower guards and slide the modules into the cage. Secure the modules with the logic cage lockscrews.

Verification Check

1. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

4.25 TMSCP INTERFACE CONTROLLER MODULE

Removal

1. Loosen the top and bottom logic cage lockscrews and slide the cage out until the upper and lower guards engage (Figure 4-28).
2. Release the upper and lower thumbscrews securing the TMSCP interface module to the formatter write module.
3. Remove connectors W17P1 (J4), W15P1 (J5), W11P, and W18 (I/O cable) from the interface module (Figure 4-30).
4. Release the top and bottom screws from the brackets (Figure 4-28) and free the module from rear connector W7P9. Remove the module from the cage.

NOTE
Before installing the new TMSCP interface controller module, make sure that the baud rate jumpers are in the same positions as on the replaced module.

Replacement

1. Attach rear connector W7P9 to the TMSCP interface module. Insert and secure the interface module in the upper and lower brackets (Figure 4-28).
2. Install the cable connectors as follows (Figure 4-30).

W7P9 to J1
W18 to J2
W11P to A1
W17P1 to J4
W15P1 to J5

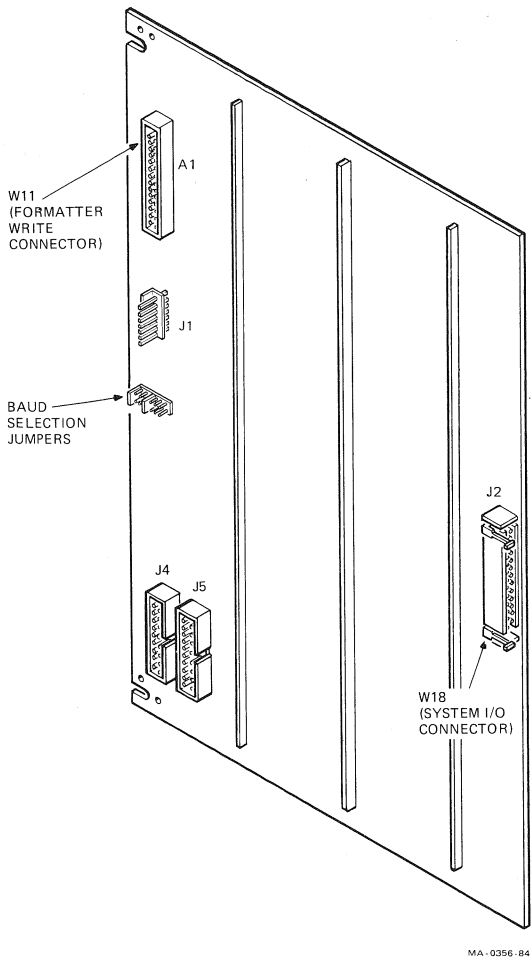


Figure 4-30 TMSCP Interface Controller Module

3. Tighten the upper and lower thumbscrews to secure the interface module to the formatter write module.
4. Release the upper and lower guards and slide the cage into the frame. Tighten the top and bottom cage lockscrews.

Verification Check

1. Applying dc power to the drive will result in the execution of the internal interface health check. If the check is successful, the unit number is displayed on the operator panel. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

4.26 POWER AMPLIFIER MODULE

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove the drive cover (Paragraph 4.2).
3. Remove the following connectors from the power amplifier module (Figure 4-31).

   B3P1 from J1
   W3P7 from J2
   B1P1 from J3
   W7P7 from J4
   C1P1 from J5

4. Release the three quick disconnect tabs along the outside edge of the module to remove the module from the mounting assembly.
5. Remove the module.

Replacement

1. Insert the power amplifier module into the mounting assembly. The inside of the mounting assembly has metal slots to receive the module.
2. Secure the module by pressing it onto the tabs along the outside edge.
3. Install the connectors as follows (Figure 4-31).

   B3P1 to J1
   W3P7 to J2
   B1P1 to J3
   W7P7 to J4
   C1P1 to J5

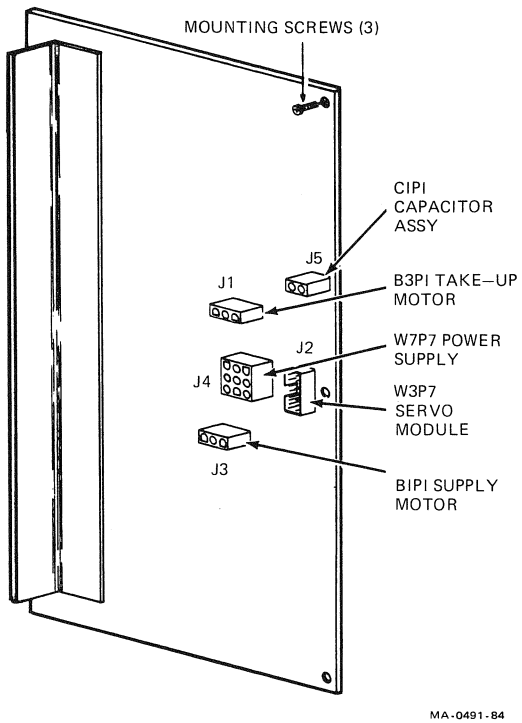


Figure 4-31 Power Amplifier Module

4. Install the drive cover (Paragraph 4.2).
5. Place the tape deck in the operating position.

Verification Check

1. With the tape threaded but not loaded, execute operator test 01. If the test is successful, it will terminate with the display 00. If the test is unsuccessful, perform troubleshooting procedures 1001 through 1003 as explained in the *TU81/TA81 Pathfinder* (EK-TUA81-SV).

4.27 CAPACITOR ASSEMBLY

Removal

1. Place the tape deck in the maintenance position (Paragraph 4.1).
2. Remove the drive cover (Paragraph 4.2).
3. Detach capacitor connector C1P1 from J5 of the power amplifier module (Figure 4-31).

CAUTION
Do not remove the protective terminal caps located on top of the capacitor during the removal or replacement procedures.

3. Remove the three mounting screws from the capacitor assembly (Figure 4-32). Remove the capacitor assembly.

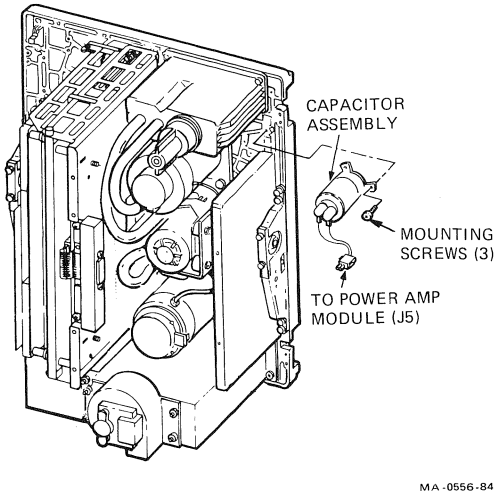


Figure 4-32 Capacitor Assembly

Replacement

1. Mount the replacement capacitor assembly as shown in Figure 4-32 and secure it with the three mounting screws.
2. Attach capacitor connector C1P1 to J5 on the power amplifier module.
3. Install the drive cover (Paragraph 4.2).

Verification Check

1. Thread but do not load the tape. Run diagnostic test 01 (and, if necessary, 02).

A SENSE BYTES

7	6	5	4	3	2	1	0	System Sense Bytes	ASCII Address
Compare error	Read parity error	RAM/FIFO overflow/ overrun		Buffer parity error	MSCP I/F parity error	RAM parity error	ROM parity error		4257
Non-existent memory	LESI I/F parity error	Most I/F parity error							4258
Command reject	Inter-vention required		Equip-ment check	Data check		Unit check	Unit exception	0	4259
Illegal channel command	Device command check		File protected	RESET key		Device not ready	Device off-line	1	425A
Channel parity error	Channel response check	Read hardware check	Write hardware check	Device response check	Device hardware check	Velocity check	Device interrupt check	2	425B

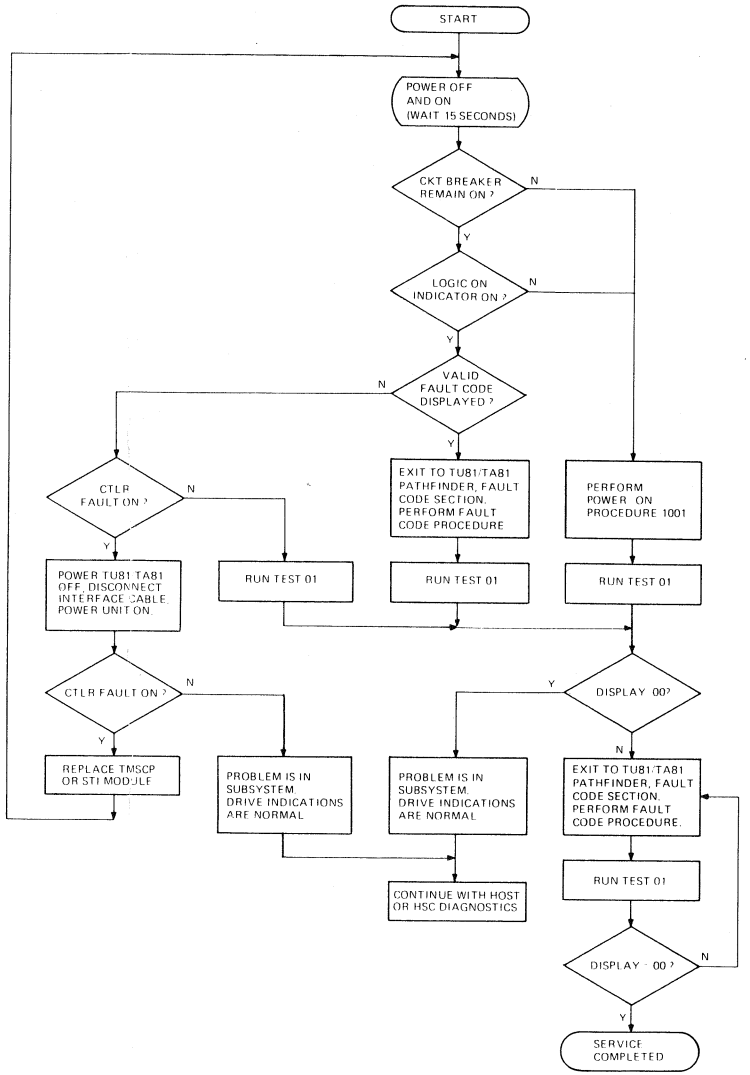
7	6	5	4	3	2	1	0	System Sense Bytes	ASCII Address
AGC fault	PE CRC check	Read data check	ID fault		Unrecovered	Error recovery code BOT	Tape moved	3	425C
			Formatter command code					4	425D
GCR mode	High speed mode	Auto speed mode	File mark detected	Diagnostic mode	Start/stop mode	Variable gap mode (long)	Variable gap mode (short)	5	425E
			Diagnostic fault code						425F
			Diagnostic fault subcode						4260
			Write error symptom code						4261
Write transfer check	Residual byte count check	Write CRC parity error	45 parity error		Write auxilliary CRC parity error			6	4262

7	6	5	4	3	2	1	0	System Sense Bytes	ASCII Address
Residual check	Read CRC check	Read auxilliary CRC check	Resynchro-nization check	ECC3 check	Uncorrected data	No track pointer	Excessive pointers	7	4263
Noise check	Postamble error	Skew error	Read time-out	Write tape mark check	ID check	ARA burst check	ARA ID check	8	4264
EC hardware check	Read buffer in parity error	Read transfer check	Read data parity error	End mark check	Dual track correction	Single track correction	Tie P	9	4265
Tie 7	Tie 6	Tie 5	Tie 3	Tie 9	Tie 1	Tie 8	Tie 2	10	4266
			Read error symptom code						4267
Ready	On-line	Rewind	File protected	Gap control	High speed	BOT	BOT	11	4268
Reverse	Write	DSE	GCR	Long gap	S/S mode			12	4269

7	6	5	4	3	2	1	0	System Sense Bytes	ASCII Address
Remote diagnostic inhibit	Remote diagnostic	LWR I/F	LWR PE	LWR GCR		Local density select	GCR default density		426A
Command reject	Inter-vention required	Diagnostic request	Density check	AGC check	RESET key	Reverse in BOT	Air flow/ temperature check	13	426B
			Command code					14	426C
			Marginal condition code					15	426D
			Fault/test completion code						426E
			Subfault/subtest completion code						426F
			Unit number						4270
			Microcode revision level						4271

Note: The TU81 provides 16 sense bytes to the system.

B TROUBLESHOOTING FLOWCHART



C MALFUNCTION MATRIX

Malfunction \ Corrective Action	Make sure TU81 is plugged into a live supply.	Make sure operation is legal.	Change tape.	Servo control	PE/GCR read recovery	PE/GCR write driver	Formatter read	Formatter write	Interface	Power supply	Power amplifier	Control panel	Pneumatic pump	Pressure regulator	Supply motor/tach	Supply hub	Take-up motor/tach	Take-up hub	Top cover switch	File protect sensor	Cooling fan
When you press the power switch on (1), the LOGIC ON indicator does not light.	A		8	5	4	7	6	9	1		3										2
TU81 displays 00 on power-up.			1						2												
TU81 powers down while in use.			3						1	2				5		4					
Control panel switch does not operate.		A	2								1										
TU81 operates with top cover open.			2																1		
FILE PRO indicator does not light when a write-protected tape is loaded.			2								3				4					1	
Take-up reel does not turn freely.																1	2				
Supply reel does not turn freely.														1	2						
Supply reel hub cannot be latched.			A												1						
Excessive pneumatic noise.												1	2								

D INSTALLING ADDITIONAL UNIBUS ADAPTERS (M8739)

Installing Additional UNIBUS Adapters (M8739)

The M8739 module is factory configured to 772150(8). This address is for a primary MSCP tape/disk used on a system.

For the first TU81 in a system, the M8739 module must be set to address 774500(8), as shown in Figure 2-5. To install additional M8739 modules, an address must be selected for each module from the floating device address range. This range includes addresses from 760010(8) through 763776(8).

The module's vector is set by software.

To configure a module for installation in a VAX system, use the SYSGEN procedure found in Table 2-3 to determine the module's address.

To configure a module for installation in a PDP-11 system, use the FLOAT utility under XXDP. In an XXDP directory, FLOAT is listed as ZFLAC0.BIN. At the XXDP prompt, use the run command to run the utility. You'll be told to input the option that you want: use FA if the devices that you need addresses for have vectors that are set by software (like the TU81); use VA if you need vector assignments in addition to addresses. Whichever option you choose, the utility prompts you to input the number of each type of device that you have in the system. The utility then displays the address that each device should be assigned.

If you cannot use SYSGEN (on a VAX system) or the FLOAT utility (on a PDP-11 system), follow these guidelines to determine the module's address.

Choosing an address from the floating address range is a process of finding a value called "nnn," and adding that value to a base address of 760000. Since the smallest nnn value that can be used is 010, the range of addresses begins at 760010.

To determine an nnn value, and then produce an address from the floating address range (760010 through 763776), list all modules to be installed in the system that require floating addresses.

Look for these modules on the following ranking table. The size column lists a number of words (in decimal), the modulus column lists a number of bytes (in octal). In addition, the modulus column must be used as a number that the nnn value of the address is divisible by, that is, nnn can be divided by the modulus value and the result is a whole number. The examples following the table show how the modulus is used.

Rank	Device	Size	Octal Modulus
1	DJ11	4	10
2	DH11	8	20
3	DQ11	4	10
4	DU11, DUV11	4	10
5	DUP11	4	10
6	LK11A	4	10
7	DMC11/DMR11	4	10
8	DZ11/DZV11, DZS11, DZ32	4	10
9	KMC11	4	10
10	LPP11	4	10
11	VMV21	4	10
12	VMV31	8	20
13	DWR70	4	10
14	RL11,RLV11	4	10
15	LPA11-K	8	20
16	KW11-C	4	10
17	Reserved	4	10
18	RX11/RX211, RXV11/RXV21	4	10
19	DR11-W	4	10
20	DR11-B	4	10
21	DMP11	4	10
22	DPV11	4	10
23	ISB11	4	10
24	DMV11	8	20
25	DEUNA	4	10

26	UDA50, RQDX1, RUC25, RUX50	2	4
27	DMF32	16	40
28	KMS11	6	20
29	VS100	8	20
30	TU81	2	4
31	KMV11	8	20
32	DHV11, DHU11	8	20
33	DMZ32, CPI (asynch)	16	40
34	CPI32 (synch)	16	40

For example, the first floating CSR address is 760010 and the first device in the table is the DJ11. If we have a DJ11, its CSR address would be at 760010. If we don't have a DJ11, address 760010 must be left blank, that is, cannot be assigned to any device.

If we do have a DJ11, we assign it the address of 760010. The size column in the table indicates that the module's size is 4 words (8 bytes). This requires addresses 760010 through 760016. The next available address is then 760020.

If we had a second DJ11, it would be assigned address 760020. There are two reasons for this assignment.

1. Since the first DJ11 is assigned address 760010 and its size requires 4 words, it uses addresses 760010 through 760016 (4 word locations). That makes the next available address 760020.
2. The DJ11, according to the table, has a modulus of 10. The states that the nnn value of the address to be used must be divisible by the modulus. For address 760020, the nnn value is 020 – this number is divisible by 10 and results in a whole number (2).

If we didn't have a second DJ11, address 760020 could not be assigned to any device. This address must be left vacant to let the system know that there is not a second DJ11 occupying a location in the floating address range. Since 760020 must be left vacant, 760022 is the next available address for use in the floating address range. The vacancy of 760020 indicates that there are no more DJ11s.

Note that the next available address (760022) has nothing to do with how many addresses a second DJ11 would require IF one was present. Only one address needs to be left vacant to indicate that there is no second DJ11 installed – as already stated, the vacant address must be 760020.

> **NOTE**
> **This is the key to assigning addresses from the floating range. Just as a response from an address identifies to the system what kind of device is present, a vacant address identifies what kind of device is not present. "Gaps" (unused addresses) must be left to tell the system which devices are NOT present.**

The next device on the list is the DH11, which is listed with a modulus of 20. The next available address (that we left off with earlier in our example) was 760022. The nnn field of 022 cannot be used for the DH11, since 22 cannot be divided by 20. In fact, the next nnn field that can be used is 040. So, to install a DH11 into this system, its address would be set to 760040. Since the size listed for the DH11 is 8 (words), the DH11 would use addresses 760040 through 760056, making the next available address 760060.

If we do not install a DH11 into this system, address 760040 has to remain vacant. This makes 760042 the next available address.

Let's take another example - one that applies to the TU81.

Suppose we have three options that require floating addresses: one DZ11 and two TU81 subsystems.

Determine the list of addresses that would be vacant, and the addresses that would be used by these modules. See if your answer agrees with the following list (vacant addresses are listed with the corresponding "missing module" that they represent).

760010 Vacant (DJ11)
760020 Vacant (DH11)*
760030 Vacant (DQ11)
760040 Vacant (DU11, DUV11)
760050 Vacant (DUP11)
760060 Vacant (LK11A)
760070 Vacant (DMC11/DMR11)
760100 Setting for the DZ11 module
760110 Vacant (no additional DZ11)
760120 Vacant (KMC11)
760130 Vacant (LPP11)
760140 Vacant (VMV21)
760160 Vacant (VMV31)*
760170 Vacant (DWR70)
760200 Vacant (RL11)
760220 Vacant (LPA11-K)*
760230 Vacant (KW11-C)
760240 Vacant (Reserved)
760250 Vacant (RX11)
760260 Vacant (DR11-W)
760270 Vacant (DR11-B)
760300 Vacant (DMP11)
760310 Vacant (DPV11)
760320 Vacant (ISB11)
760340 Vacant (DMV11)*
760350 Vacant (DEUNA)
760354 Vacant (UDA50)*
760400 Vacant (DMF32)*
760420 Vacant (KMS11)*
760440 Vacant (VS100)*
760444 Setting for a TU81 subsystem*
760450 Setting for another TU81 subsystem*

* Indicates addresses for devices where the modulus is NOT 10. Don't forget that the nnn value of the address that you select must be divisible by that device's modulus to produce a whole number.

Since these addresses include all the devices to be added for our example, all remaining addresses in the floating range are vacant.