

# TU78 Magnetic Tape Transport User's Guide



# **TU78 Magnetic Tape Transport User's Guide**

1st Edition, December 1980  
2nd Edition, May 1981

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# CONTENTS

## CHAPTER 1 GENERAL DESCRIPTION

1.1	Introduction . . . . .	1-1
1.2	Physical Description . . . . .	1-2
1.3	Functional Description . . . . .	1-7
1.4	Applicable Documents . . . . .	1-10
1.5	Mechanical and Electrical Specifications . . . . .	1-10

## CHAPTER 2 OPERATION

2.1	Controls and Indicators . . . . .	2-1
2.2	Operating Procedures . . . . .	2-3
2.2.1	Power . . . . .	2-3
2.2.2	Autoload/Manual Load Selection . . . . .	2-3
2.2.3	Autoload . . . . .	2-4
2.2.4	Manual Load . . . . .	2-4
2.2.5	Probable Causes of Load Failure . . . . .	2-7
2.2.6	Midreel Load . . . . .	2-8
2.2.7	Unload . . . . .	2-8
2.2.8	Rewind . . . . .	2-8
2.2.9	On-Line/Off-Line . . . . .	2-8

## CHAPTER 3 INSTALLATION

3.1	Site Planning . . . . .	3-1
3.1.1	Space Requirements . . . . .	3-1
3.1.2	Power Requirements . . . . .	3-1
3.1.3	Environmental Requirements . . . . .	3-2
3.2	Unpacking and Inspection . . . . .	3-2
3.2.1	Unpacking . . . . .	3-2
3.2.2	Inspection . . . . .	3-3
3.3	Single Transport Installation . . . . .	3-4
3.3.1	Mechanical Installation . . . . .	3-4
3.3.2	Power and Cabling . . . . .	3-7
3.4	Multiple Transport Installation . . . . .	3-11
3.4.1	Mechanical Installation . . . . .	3-11
3.4.2	Power and Cabling . . . . .	3-15
3.5	Acceptance Testing . . . . .	3-17
3.5.1	Turn-On and Loading Checkout . . . . .	3-18
3.5.1.1	Power-On . . . . .	3-18
3.5.1.2	Load Sequence Without Tape . . . . .	3-18
3.5.1.3	Inhibited Autoload Sequence . . . . .	3-20
3.5.1.4	Autoload Sequence . . . . .	3-20

3.5.1.5	Manual Load Sequence .....	3-22
3.5.1.6	Unload Sequence .....	3-22
3.5.1.7	Manual Load Repeatability .....	3-22
3.5.1.8	Autoload Repeatability .....	3-24
3.5.2	Subsystem Quick Check .....	3-24
3.5.3	TM78/TU78 System Level Diagnostics .....	3-25
3.5.3.1	DECsystem 10/20 Diagnostics .....	3-26
3.5.3.2	VAX-11/780 Diagnostics .....	3-26

## CHAPTER 4 CUSTOMER CARE AND PREVENTIVE MAINTENANCE

4.1	Customer Responsibilities .....	4-1
4.2	Magnetic Tape Care .....	4-1
4.3	Preventive Maintenance .....	4-2
4.3.1	General .....	4-2
4.3.2	Preventive Maintenance .....	4-2
4.3.3	Magnetic Tape Transport Cleaning Kit .....	4-2
4.3.4	TU78 Tape Transport .....	4-3
4.4	Ordering Supplies, Accessories and Documentation .....	4-5

## APPENDIX A GLOSSARY

### FIGURES

1-1	Basic System Configuration .....	1-1
1-2	TU78 Master Tape Transport .....	1-2
1-3	Base Assembly .....	1-4
1-4	Card Cage Area .....	1-6
1-5	Power Pack Assembly (Rear View) .....	1-6
1-6	Possible TU78 Configurations .....	1-7
1-7	Master TU78 Functional Block Diagram .....	1-8
2-1	TU78 Control Panel .....	2-1
2-2	Autoload/Manual Load Selection .....	2-3
2-3	Tape Content Limit .....	2-3
2-4	Autoload Sequence with Operator Troubleshooting .....	2-5
2-5	Tape Path and Controls .....	2-6
2-6	Manual Load Sequence with Operator Troubleshooting .....	2-7
3-1	Space and Service Clearance (Top View) .....	3-1
3-2	Unpacking the TU78 .....	3-3
3-3	TU78 Mounting for Shipment .....	3-4
3-4	Location of Stabilizer Arm and Leveler Feet .....	3-5
3-5	PCB Shipping Bracket (Side View) .....	3-6
3-6	TU78 Power Distribution .....	3-7
3-7	874-E Power Controller .....	3-8
3-8	Rear of Power Pack with Pulley Cover Removed .....	3-9
3-9	Cabinet Placement for Maintenance Display Visibility .....	3-11
3-10	Top Cover Fastener .....	3-13
3-11	Cabinet with Side Panels and Top Cover Removed .....	3-13
3-12	TU Bus Cable Routing for a Multiple Transport Configuration .....	3-14
3-13	Radial TU Bus Connections .....	3-16
3-14	Cable Orientation on TU78 MIA PCBA (Slave Only) .....	3-17
3-15	TM78 Maintenance Keypad .....	3-19

3-16	Load Sequence Without Tape .....	3-19
3-17	Inhibited Autoload Sequence .....	3-20
3-18	Autoload Sequence .....	3-21
3-19	Manual Load Sequence .....	3-22
3-20	Unload Sequence .....	3-23
4-1	Transport Items for Daily Cleaning .....	4-4

**TABLES**

1-1	Related Documents .....	1-11
1-2	Mechanical and Electrical Specifications .....	1-11
2-1	TU78 Controls .....	2-1
2-2	TU78 Indicators .....	2-2
3-1	Primary Power Connections .....	3-9
3-2	Pulley/Belt Part Numbers for Altitude Changes .....	3-10
3-3	TM78/TU78 Diagnostics for Acceptance Testing .....	3-25
3-4	Maximum Error Rate Per Pass .....	3-27



# CHAPTER 1 GENERAL DESCRIPTION

## 1.1 INTRODUCTION

The TU78 magnetic tape transport writes and reads data in 9-track phase-encoded (PE) or group code recording (GCR) format. Bit density is 1600 bits per inch (bits/in) for the PE format and 6250 bits/in for the GCR format. The transport can read data in the forward or reverse direction. The read/write tape speed for both directions is 125 inches per second (in/s). Nominal rewind time for a 731.5 m (2400 ft) reel is 65 seconds.

The TU78 interfaces with the system processor via the MASSBUS, a MASSBUS controller, and a TM78 tape formatter. Up to four TU78s may be driven by a single TM78 formatter. Figure 1-1 illustrates the basic TU78 system configuration. The TM78 tape formatter and its power supply (H7422-AB) are housed in the TU78 cabinet, an H9500 corporate cabinet. (The specific model of the H9500 cabinet series used for the TU78 is H9602-KA. However, this manual refers to the cabinet as the H9500.) The TU78s containing a TM78 are called master units; TU78s without the TM78 are called slave units. Both master and slave units contain an 874-E power controller. Earlier TU78 models contain an 872-E power controller. The two types are electrically identical, but differ slightly in the location of remote control jacks.

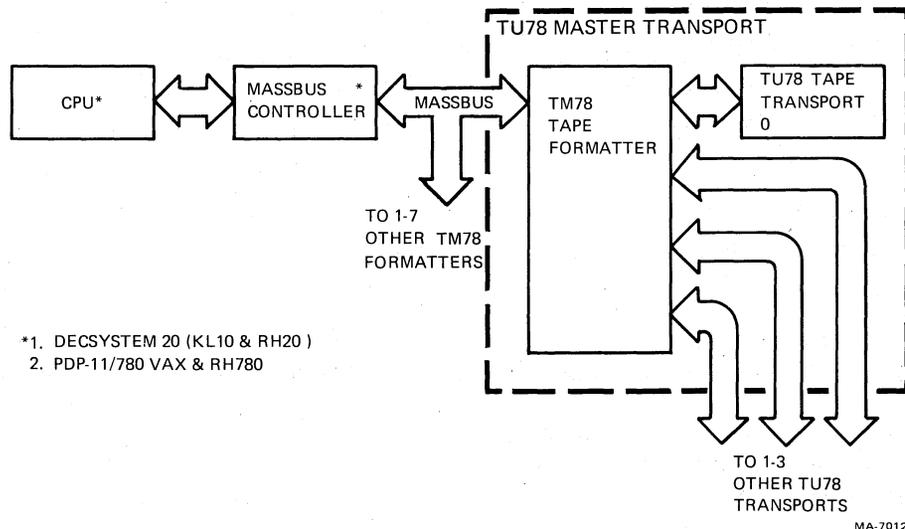
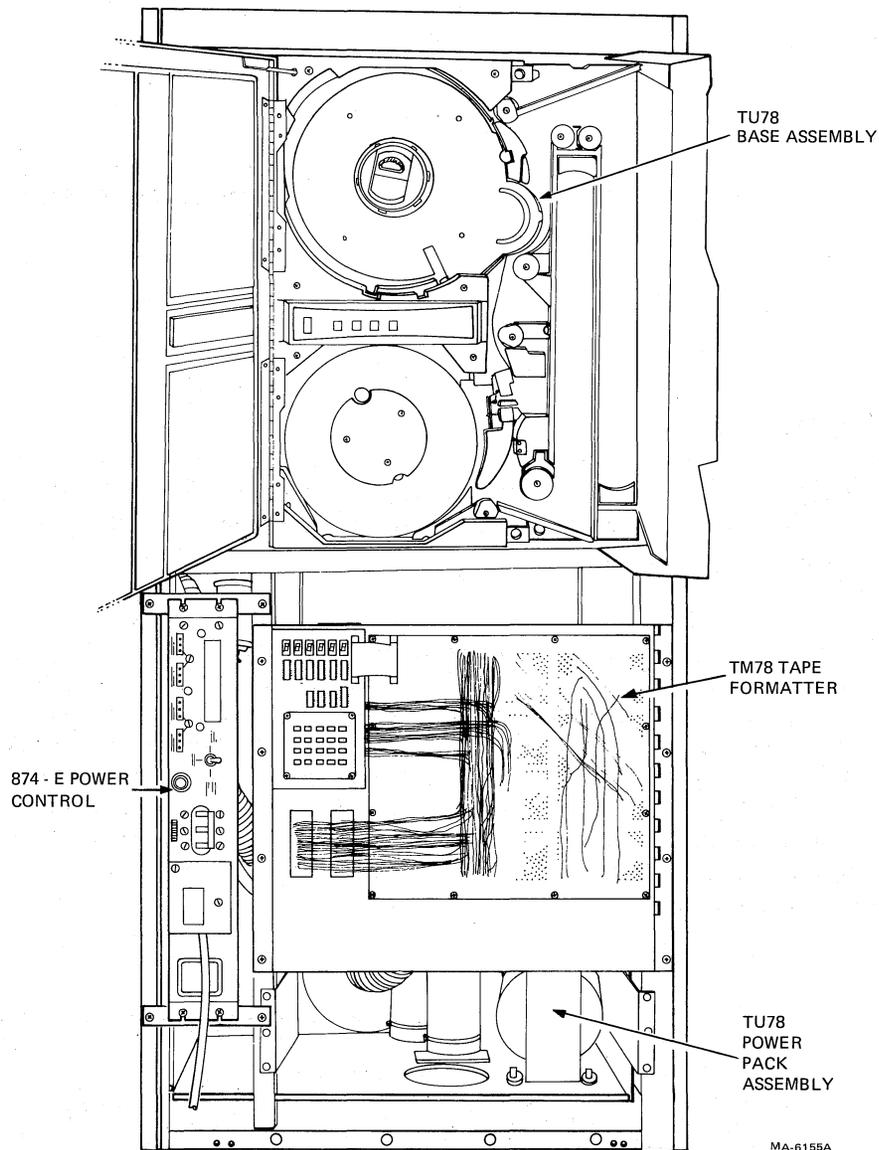


Figure 1-1 Basic System Configuration



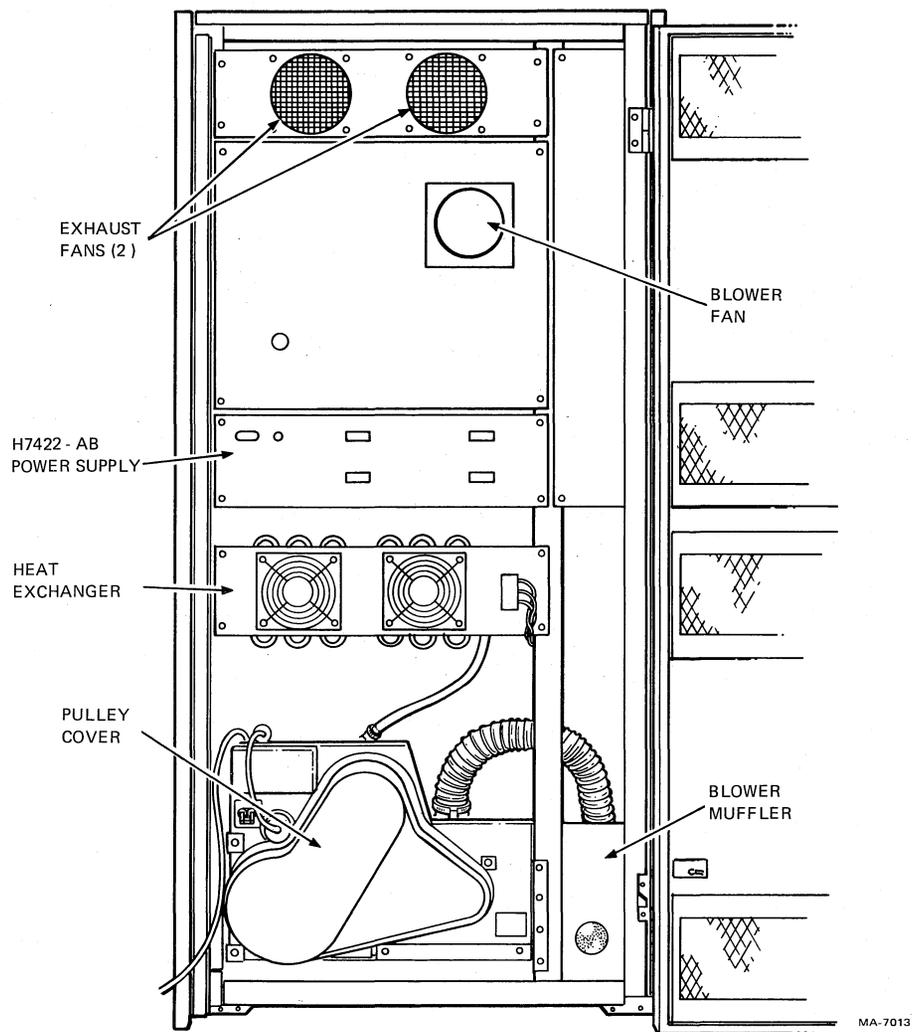
a. Front View

Figure 1-2 TU78 Master Tape Transport (Sheet 1 of 2)

## 1.2 PHYSICAL DESCRIPTION

Figure 1-2 illustrates the locations of the major subassemblies of the TU78. They are listed below.

- TM78 tape formatter (master TU78 only)
- H7422-AB power supply (master TU78 only)
- 874-E power controller
- TU78 transport (base assembly, card cage area, and power pack assembly)

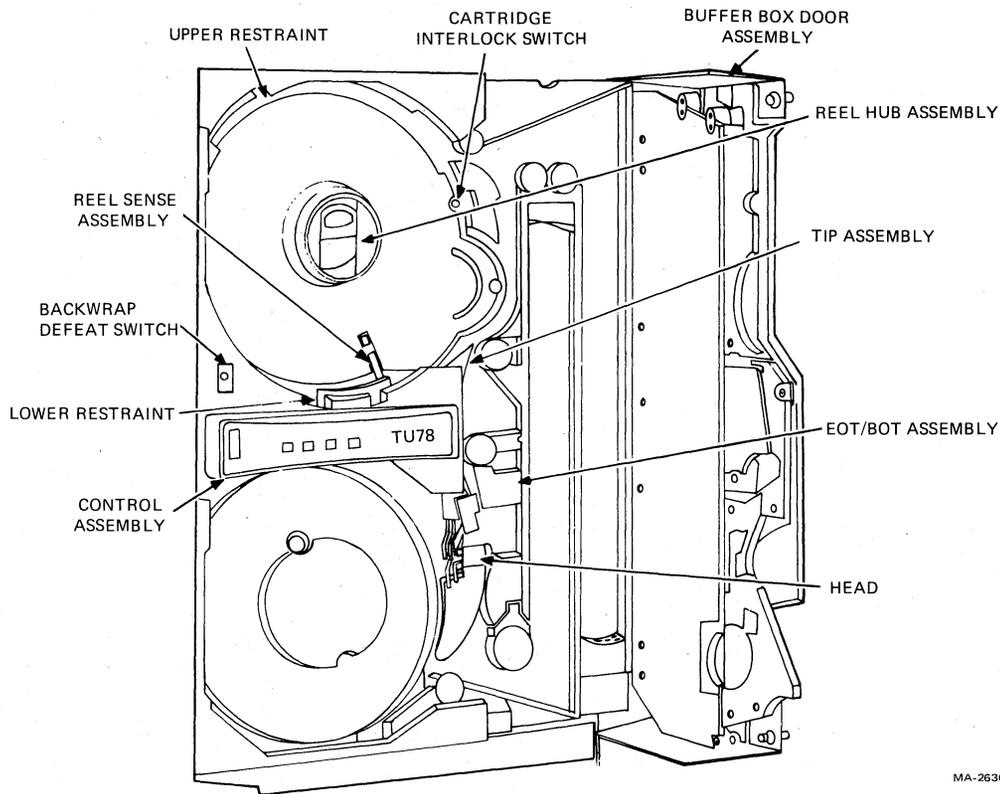


b. Rear View

Figure 1-2 TU78 Master Tape Transport (Sheet 2 of 2)

Figure 1-3 identifies the components of the base assembly. They are listed below.

- Control assembly (PN 29-23771)
- Reel sense assembly (PN 29-23216)
- Backwrap defeat switch (PN 29-23297)
- Reel hub assembly (PN 29-23475)
- Buffer box door assembly (PN 29-23215)
- Tape in path (TIP) assembly (PN 29-23243)
- EOT/BOT assembly (PN 29-23242)
- Head (PN 29-23767)
- Cartridge interlock switch (PN 29-16280)
- Upper restraint (PN 29-23225)



MA-2636A

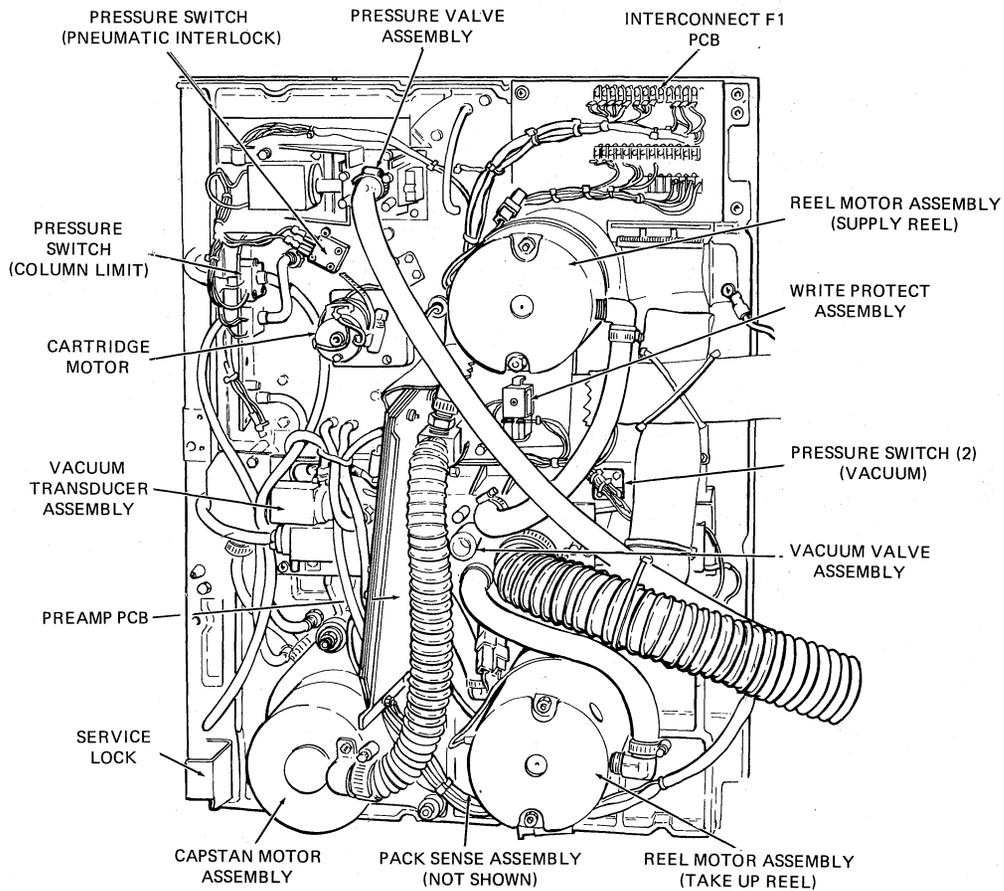
a. Front View

Figure 1-3 Base Assembly (Sheet 1 of 2)

Lower restraint (PN 29-23224)  
 Cartridge motor (PN 29-23280)  
 Pressure switch (pneumatic interlock) (PN 29-23239)  
 Pressure valve assembly (PN 29-23249)  
 Interconnect F1 printed circuit board (PCB) (PN 29-23770)  
 Reel motor assemblies (2) (PN 29-23236)  
 Write protect assembly (PN 29-23235)  
 Vacuum valve assembly (PN 29-23248)  
 Pressure switches (vacuum) (2) (PN 29-23238, 29-23239)  
 Pack sense assembly (PN 29-23217)  
 Capstan motor assembly (PN 29-23768)  
 Service lock  
 Preamp PCB (PN 29-23766)  
 Vacuum transducer assembly (PN 29-23246)  
 Pressure switch (column limit) (4) (PN 29-23238)

Figure 1-4 illustrates the card cage area containing the following items.

Multiple interface adapter (MIA) PCB (PN 29-23769)  
 Read PCB (PN 29-23762)  
 Write PCB (PN 29-23763)  
 Control M2 PCB (PN 29-23764)



b. Rear View

Figure 1-3 Base Assembly (Sheet 2 of 2)

- Capstan/regulator PCB (PN 29-23765)
- Reel servo PCB (PN 29-23231)
- Exhaust fans (2) (PN 12-17916-02)
- Interconnect D1 PCB (not shown in Figure 1-4) (PN 29-23211)

Figure 1-5 illustrates the power pack assembly containing the following items.

- Rectifiers (3) (PN 29-23311, 29-23312)
- Vacuum hose
- Fuse panel
- Air filter (PN 29-23259)
- Blower (below serial number SP002386-PN 29-23298)
- Blower (serial number SP002386 and above-PN 29-24013)
- Pulley cover
- Power transformer terminal strip
- Compressor (PN 29-23257)
- Motor (PN 29-23287)
- Transformer (PN 29-23258)
- Muffler (PN 29-23220)
- Heat exchanger fan (PN 29-17916-02)

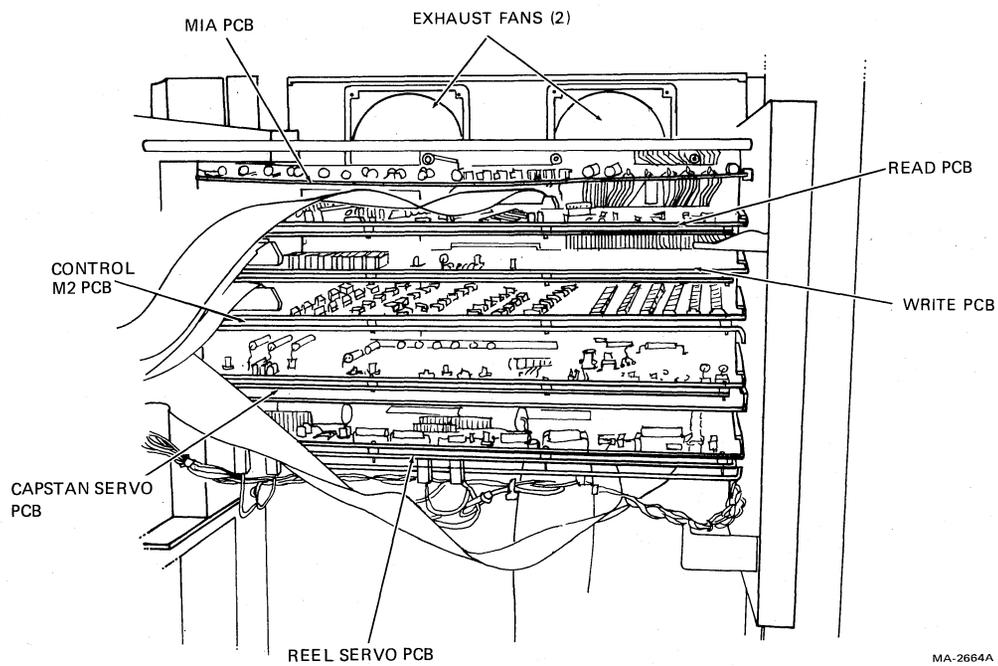


Figure 1-4 Card Cage Area

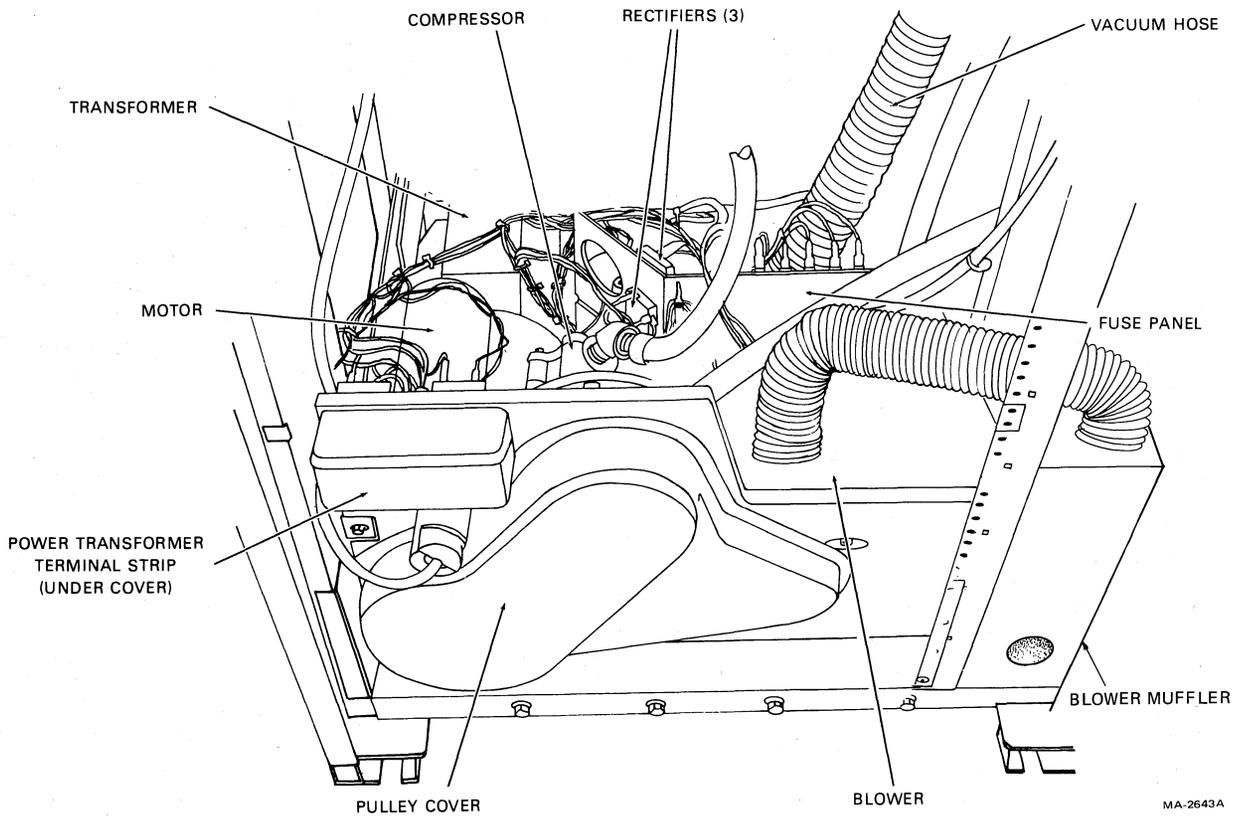


Figure 1-5 Power Pack Assembly (Rear View)

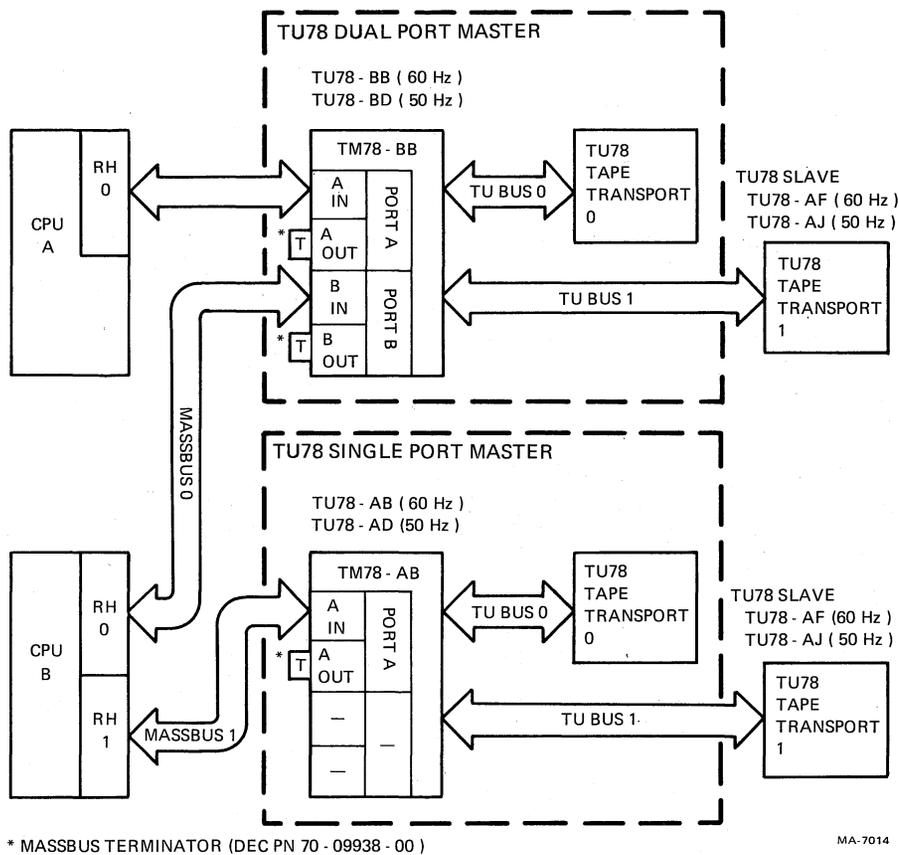


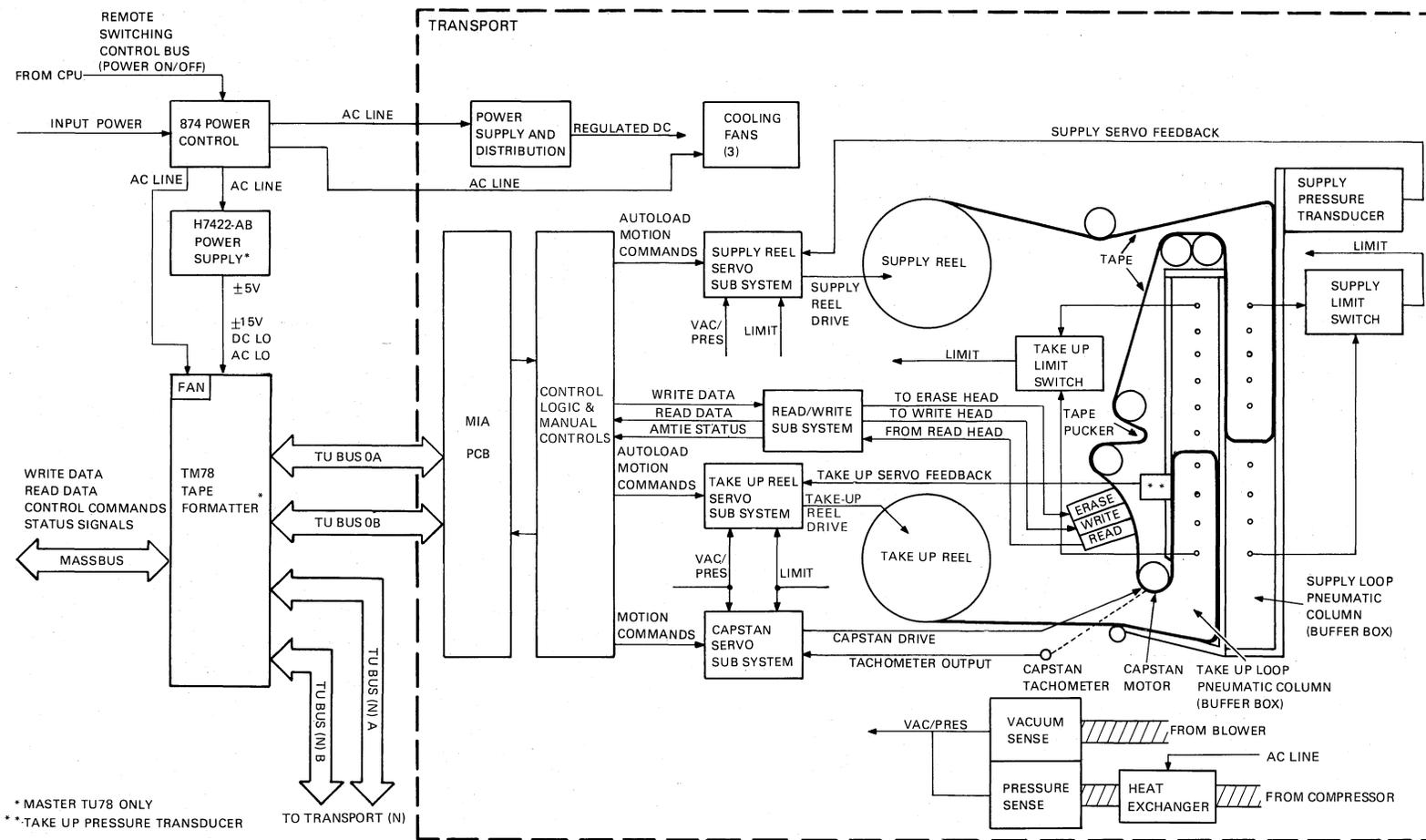
Figure 1-6 Possible TU78 Configurations

### 1.3 FUNCTIONAL DESCRIPTION

Figure 1-6 illustrates the various TU78 configurations possible from the MASSBUS. The TM78 tape formatter interfaces with up to four TU78 transports to the MASSBUS. Additional TM78s may be added (a maximum of eight), with each formatter interfacing up to four additional TU78s. Thus, the maximum configuration interfacing a MASSBUS controller consists of 8 TM78 formatters and 32 TU78 transports. A TM78 may also be dual-ported so that each subsystem can be driven by two host CPUs.

The TM78 tape formatter is housed in the TU78 cabinet. Those cabinets containing a TM78 (and its H7422-AB power supply) are called master transports. Those cabinets without the TM78 and H7422-AB are called slave transports. The TU78 master transport is identical to the TU78 slave transport.

Figure 1-7 is a functional block diagram of a TU78 master tape transport. During a write operation the TM78 accepts write data from the MASSBUS and formats it into 8-bit data characters for the TU78 transport. MASSBUS data is in the following formats: PDP-10 compatible, PDP-10 core dump, PDP-10 high-density compatible, PDP-10 high density dump, PDP-10/11/15 image, PDP-11 normal or PDP-15 normal. The TM78 disassembles Massbus data under control of the CPU which specifies the data format. During a read operation, 8-bit characters received from the transport are formatted into data words and placed on the MASSBUS. The TM78 assembles the data characters into the MASSBUS format specified by the CPU. The TM78 writes and reads data in either 1600 bits/in PE or 6250 bits/in GCR formats.



MA-2659A

Figure 1-7 Master TU78 Functional Block Diagram

During a write operation, the TM78 assembles 8-bit tape characters and sends them to the TU78 over the TU bus. Error detection is accomplished by parity checks (PE and GCR modes), and (GCR mode only) by cyclic redundancy checks (CRC) and auxiliary cyclic redundancy checks (ACRC). Error detection occurs for both read and write operations. During a write operation, a read-after-write function is performed: the TM78 reads data just written and performs error checking. During a read operation the TM78 can perform automatic error correction. Single-track errors can be corrected in PE; and using a special error correction character (ECC) double-track errors can be corrected in GCR.

The TM78 also controls and monitors tape transport operation. It receives operational commands from the host CPU, selects the desired transport, and issues functional (data transfer) and motion (non-data transfer) commands. It monitors transport operation and provides error and status information to the host CPU.

The H7422 power supply provides regulated  $\pm 5$  V and  $\pm 15$  Vdc operating voltage for the TM78. Power fail signals AC LO and DC LO are also supplied to the TM78.

The 874-E power control supplies ac power to the transport cabinet. It provides filtering for the ac input power supplied to switched outlets when the remote power on/off line is enabled from the host CPU via the remote switching control bus. There is no power on/off control on the TU78 control panel, transport power is controlled by the host CPU. The switched ac is supplied to the H7422 power supply and TM78 cooling fan (master TU78 only), the transport power pack, the three cabinet cooling fans, and the compressor heat exchanger.

The basic TU78 transport contains the following seven functional areas (Figure 1-7).

- Capstan servo subsystem
- Reel servo subsystem (2)
- Pneumatic subsystem
- Read/write subsystem
- Control logic and manual controls
- MIA interface
- Power supply and distribution

The capstan servo subsystem controls the speed and direction of tape movement past the read/write heads. The subsystem is a velocity servo that receives command signals from the control logic specifying forward, reverse, or rewind motion. The capstan motor responds with the appropriate velocity. The capstan tachometer generates a feedback signal proportional to speed. This signal is summed with the basic command signal in order to maintain the correct capstan velocity at all times.

The reel servo subsystems control the speed of the tape reels in order to maintain optimum tape tension between the supply and take-up reels. The supply reel and take-up reel servos are similar but separate subsystems. The path followed by the tape (in either direction) between the supply and take-up reels contains two tape loops in the buffer box (supply loop and take-up loop). The separately formed loops are maintained by a vacuum in conjunction with automatically controlled reel motor speeds. In effect, the reel servos function to feed tape into and remove tape from the buffer box at the rate required to maintain the correct loops.

Signals developed within the pneumatic subsystem initiate servo operation. The subsystem senses that the tape loop position has changed as a result of forward or reverse tape motion. Air is drawn from the closed ends of the two buffer boxes creating a vacuum and causing the tape loop to form in each box. The differential between the positive pressure inside the loop and the relatively negative pressure at the closed end of the buffer box (outside the loop) maintains the proper tension on the tape during the tape-loaded state.

There is a separate chamber behind each buffer box, connected to the box by a series of holes. The spacing and arrangement of these holes is such that, if the loop becomes larger, more holes are exposed to the positive (atmospheric) pressure inside the loop, and fewer to the lower pressure (vacuum) area outside the loop. This causes pressure in the chamber to rise. Conversely, if the loop becomes smaller, the pressure in the chamber decreases.

Pressure transducers are connected to the supply and take-up chambers. They interpret pressure variations in order to provide the supply and take-up servo feedback signals. The pressure sensitive signals feed back to the reel servos to adjust the velocity of the reel motors for the proper loop in the two buffer boxes. The uppermost and lowermost holes in each buffer column are limit ports. These connect to supply and take-up limit switches which feed back to both the supply and take-up servos. If the tape crosses a limit port in either the supply or take-up columns, a disabling signal couples back to the servos, stopping both reel motors before tape damage occurs.

A pneumatic interlock shuts down the capstan servo and reel servos if a pneumatic failure is detected. The pneumatic subsystem contains a blower which creates the vacuum for the tape columns, and a compressor which generates pressure for the tape path bearings. Sensing devices monitor vacuum and pressure. If either is lost, the sensing device sends a VAC/PRES signal to the three servo subsystems, stopping the servo motors before tape damage occurs.

The read/write subsystem processes data and transfers it to and from the magnetic tape. The read function processes data picked up from the tape by the read heads. It translates information from the recorded PE or GCR format to digital data acceptable to the external controlling circuits. The function includes the read-after-write capability that permits the formatter to verify execution of write command while writing is in progress. The write function prepares incoming data for recording in PE or GCR format and writes the information on the tape in the selected format. The read/write subsystem also develops amplitude track in error (AMTIE) status signals. It sends nine AMTIE signals to the formatter, one for each track, which become active when the strength of the analog signal read from tape falls below a specified threshold. During a write function this causes the operation to be retried. During a read function, AMTIE signals assist the formatter in developing pointers for the error correction process.

The control logic and manual control circuit interfaces other TU78 subsystems. The control logic transfers read/write data to and from the read/write subsystem. It also transfers the operational commands to the capstan servo. During the autoload sequence, logic circuits control the sequence steps by issuing appropriate commands to the reel servos. The control logic monitors and controls timing of the autoload sequence steps and other operational sequences, such as rewind. It processes commands generated by the manual controls and applies them to the appropriate subsystem. Control logic also senses transport status (e.g., transport selected, on-line, EOT, BOT, etc.), and modifies signals to the read/write and servo subsystems. Logic lights the appropriate control panel indicators to indicate transport status. Transport status is sent to the TM78 formatter via the MIA interface module.

The MIA module couples control/status, read/write, and AMTIE signals from the tape unit bus (TU bus) to the transport. The MIA adapts signals on the TU bus to the format required by the transport, and vice versa. This includes multiplexing, de-multiplexing, signal gating, latching, and timing.

Power supply functions include ac rectification, filtering, dc regulation, and distribution of power to the various subsystems.

#### **1.4 APPLICABLE DOCUMENTS**

Table 1-1 lists documents applicable to the TU78 tape transport.

#### **1.5 MECHANICAL AND ELECTRICAL SPECIFICATIONS**

Table 1-2 details the mechanical and electrical specifications of the transport.

**Table 1-1 Related Documents**

<b>Title</b>	<b>Doc No</b>	<b>Contents</b>
TM78 Magnetic Tape Formatter User Guide	EK-0TM78-UG	Description, programming, and installation information
TM78 Magnetic Tape Formatter Technical Manual	EK-0TM78-TM	Theory of operation, programming information, installation, and maintenance of the TM78 formatter and H7422 power supply
TU78 Magnetic Tape Transport Technical Manual (Volume 1)	EK-1TU78-TM	Schematics and logic prints of TU78
TU78 Magnetic Tape Transport Technical Manual (Volume 2)	EK-2TU78-TM	Description, installation, operation, theory and maintenance of TU78
TU78 Subsystem Pocket Service Guide	EK-0TU78-PS	Summary of troubleshooting and maintenance procedures
TU78/TM78 Magnetic Tape Transport/Formatter IPB	EK-0TU78-IP	Exploded views and parts lists of TU78 and TM78
TU78 Field Maintenance Print Set	MP01061	Engineering drawings for TU78 mechanics and cabinet
TM78 Field Maintenance Print Set	MP01061	Engineering drawings and parts lists for TM78 mechanics and logic
874 Power Controller IPB	EK-00874-IP	Exploded views and parts lists of 874

**Table 1-2 Mechanical and Electrical Specifications**

Tape (computer grade)	
Width	12.6492 mm $\pm$ 0.0508 mm (0.498 in $\pm$ 0.002 in)
Thickness	0.0381 mm (1.5 mil)
Tape tension	2.780 N (10.0 oz +0.0/−1.0 oz) nominal
Reel diameter (autoload)	266.7 mm (10.5 in) maximum (note 1) and Easy-Load cartridge 1 and 2
Recording modes	1600 bits/in (3200 FCI) PE 6250 bits/in (9042 FCI) GCR

**Table 1-2 Mechanical and Electrical Specifications (Cont)**

Magnetic head	Dual stack (with erase head)
Tape speed	3.2 m/s (125 in/s)
Instantaneous speed variation	± 3 percent
Long term speed variation	± 1 percent (forward) ± 2 percent (reverse)
Rewind time for 731.5 m (2400 ft) tape	65 seconds nominal (80 seconds maximum)
Tape cleaner	Dual blade type connected to vacuum supply
Interchannel displacement error	
Read	3.81 $\mu\text{m}$ (150 $\mu\text{in}$ ) maximum (note 2)
Read-after-write	8.89 $\mu\text{m}$ (350 $\mu\text{in}$ ) maximum (note 3)
Start/stop time	
Start	1.1 ms ± 0.1 ms
Stop	1.3 ms ± 0.1 ms
	1.1 ms ± 0.1 ms
Start distance	1.91 mm +0.25/−0.38 mm (0.075 in +0.010/−0.015 in)
Stop distance	2.16 mm +0.25/−0.38 mm (0.85 in +0.010/−0.015 in)
Beginning of tape (BOT) and end of tape (EOT) detectors (note 4)	Photoelectric
Tape creepage	None
Pneumatic interlock	Tape motion disabled when vacuum is lost in vacuum column
Load time	No greater than 10 seconds without a retry, and 20 seconds with a retry for 10.5 in reels
Unload time	Less than 7 seconds for 10.5 in reels
Write gap to read gap distance	0.381 cm ± 0.013 cm (0.150 in ± 0.005 in)
Weight	286 kg (630 lbs) (master unit)

**Table 1-2 Mechanical and Electrical Specifications (Cont)**

---

Cabinet dimensions	
Height	152.4 cm (60.0 in)
Width	67.3 cm (26.5 in)
Depth (from face of front door to rear of cabinet)	81.9 cm (32.3 in)
Operating temperature	15° to 32° C (59° to 90° F) (note 5)
Nonoperating temperature	−46° to 71° C (−50° to 106° F)
Operating altitude	0 m to 2134 m (0 ft to 7000 ft) (note 6)
Nonoperating altitude	9100 m (30,000 ft) maximum
Power	
Volts ac	188 V to 264 V at 60 Hz 198 V to 264 V at 50 Hz
Frequency	50 Hz ± 1 Hz or 60 Hz ± 1 Hz
Kilovolt amp (kVA)	
Standby (loaded)	1.5 kVA maximum (note 7)
Start/stop	2.4 kVA maximum (note 7)

---

**NOTES**

- 1. 177.8 mm (7 in) and 216.0 mm (8.5 in) reels may be used but cannot be autoloaded.**
- 2. The maximum displacement between any two bits of a character when reading a master tape using the read section of the read-after-write head.**
- 3. The maximum displacement between any two bits of a character on a tape written with all ones using the write section of the read-after-write head.**
- 4. Approximate distance from detection area to write head gap is 35.6 mm (1.40 in).**
- 5. For data transfer, the operating temperature is dictated by the nature of the tape material.**
- 6. Operation above 610 m (2000 ft), in 610 m (2000 ft) increments requires installation of high altitude pulleys and belts in TU78 power pack.**
- 7. Slave unit only. Add 700 W for master units.**



## CHAPTER 2 OPERATION

### 2.1 CONTROLS AND INDICATORS

The TU78 operational controls and indicators are located on the transport control panel. The controls and indicators are illustrated in Figure 2-1. The controls are described in Table 2-1, the indicators in Table 2-2.

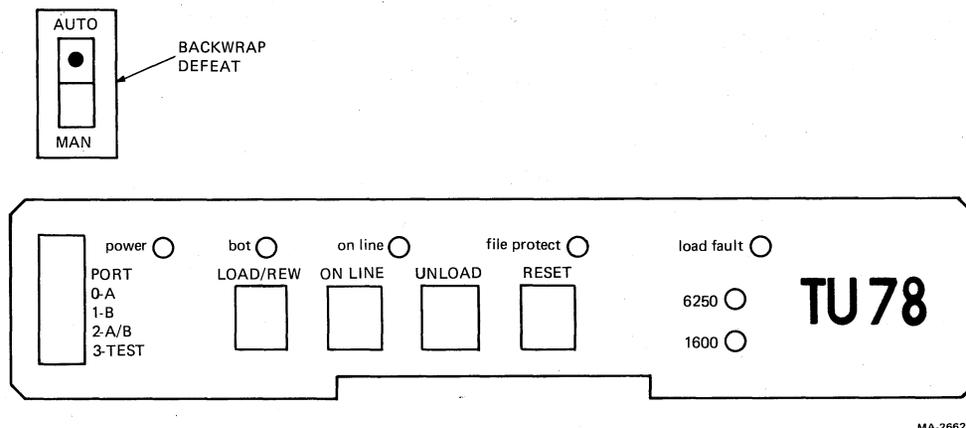


Figure 2-1 TU78 Control Panel

Table 2-1 TU78 Controls

Control	Function										
Port Select Switch	Selects the MASSBUS I/O port(s) allowed to send commands to this tape transport.										
	<table border="1"> <thead> <tr> <th>Switch Position</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Transport connected to MASSBUS port A</td> </tr> <tr> <td>1</td> <td>Transport connected to MASSBUS port B</td> </tr> <tr> <td>2</td> <td>Transport connected to both MASSBUS ports A and B</td> </tr> <tr> <td>3</td> <td>Transport disconnected from both MASSBUS ports and placed in maintenance mode (available to TM78 formatter maintenance panel)</td> </tr> </tbody> </table>	Switch Position	Function	0	Transport connected to MASSBUS port A	1	Transport connected to MASSBUS port B	2	Transport connected to both MASSBUS ports A and B	3	Transport disconnected from both MASSBUS ports and placed in maintenance mode (available to TM78 formatter maintenance panel)
Switch Position	Function										
0	Transport connected to MASSBUS port A										
1	Transport connected to MASSBUS port B										
2	Transport connected to both MASSBUS ports A and B										
3	Transport disconnected from both MASSBUS ports and placed in maintenance mode (available to TM78 formatter maintenance panel)										

**Table 2-1 TU78 Controls (Cont)**

<b>Control</b>	<b>Function</b>
LOAD/REW	Initiates one of three sequences. <ol style="list-style-type: none"> <li>1. With no tape in path, initiates a load sequence.</li> <li>2. With tape in path but not tensioned, initiates a midreel load sequence. In a midreel load sequence the tape loads and runs in reverse direction to BOT.</li> <li>3. With tape in path and tensioned, and the transport off-line, the tape rewinds to BOT. If the tape is already at BOT or if the transport is on-line, no action occurs.</li> </ol>
ON LINE	Switches the transport off-line or on-line.
UNLOAD	If the TU78 is off-line, causes the tape to rewind and unload. If the tape is already at BOT, it unloads. If the TU78 is on-line, button has no effect.
RESET	Terminates all functions and clears a load fault.
BACKWRAP DEFEAT	AUTO (automatic) position: Allows a backwrap and retry for 10.5 inch reel, with or without a cartridge  MAN (manual) position: Inhibits a backwrap and retry for 10.5 inch reel without a cartridge

**Table 2-2 TU78 Indicators**

<b>Indicator</b>	<b>Meaning</b>
Power	Presence of dc and secondary ac power.
BOT	Tape is at BOT.
On Line	TU78 is on-line. The transport reverts to the off-line mode if any of the following occur. <ol style="list-style-type: none"> <li>1. ON LINE button is pressed.</li> <li>2. External rewind unload command is received.</li> <li>3. Vacuum column interlock is broken.</li> <li>4. AC power is lost.</li> <li>5. RESET button is pressed.</li> </ol>
File Protect	Tape reel without a write enable ring has been loaded onto the transport.
Load Fault	Load fault has occurred. <ol style="list-style-type: none"> <li>1. Autoload sequence has failed to load a tape from a 267 mm (10.5 in) reel after two tries.</li> <li>2. Load sequence has failed to load tape from a 216 mm or 178 mm (8.5 in or 7 in) reels.</li> </ol>

**Table 2-2 TU78 Indicators (Cont)**

Indicator	Meaning
1600	Tape transport set to read or write at 1600 bits/in (PE mode).
6250	Tape transport set to read or write at 6250 bits/in (GCR mode).

## 2.2 OPERATING PROCEDURES

### 2.2.1 Power

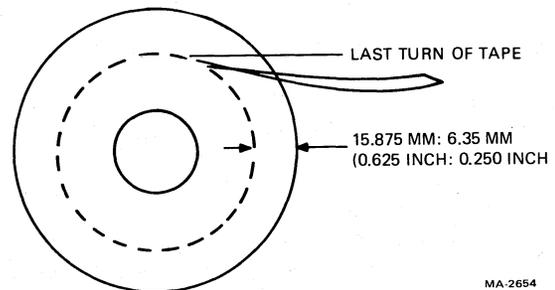
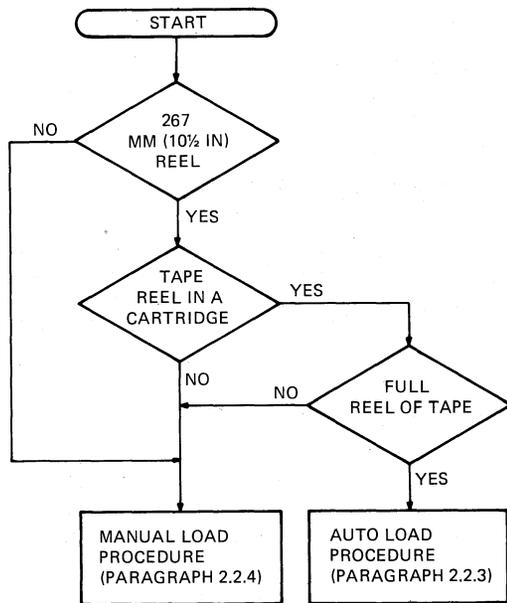
When the system CPU is turned on, power is applied to the TU78. The CPU remotely enables the 874-E power control, which in turn applies ac power to the TU78 cabinet.

### 2.2.2 Autoload/Manual Load Selection

Figure 2-2 illustrates various conditions and interlock settings that determine the selection of an autoload or manual load procedure.

The manual loading procedure must be used for a 216 mm or 178 mm (8.5 in or 7 in) reel. If a 267 mm (10.5 in) reel in a cartridge is used, the cartridge engages the cartridge interlock. This bypasses the autoload interlock and makes the autoload procedure necessary.

A full reel of tape must be used for an autoload sequence. Automatic loading requires that the outer turn of tape is between 1.59 cm and 0.64 cm (0.63 in and 0.25 in) from the outer edge of the reel (Figure 2-3). Thus 267 mm (10.5 in) reels which do not contain sufficient tape, must follow the manual load procedure.



MA-2654

Figure 2-3 Tape Content Limit

Figure 2-2 Autoload/Manual Load Selection

### 2.2.3 Autoload

Follow the steps below in order to perform the autoload procedure.

1. Check that the tape path is clean. (Refer to Paragraph 4.3.4 for cleaning procedure.)
2. Check that the tape is a 267 mm (10.5 in) reel, and that it has a full reel of tape.
3. Check that the end of tape has a clean edge and is not bent, torn, or frayed. If necessary, trim the end with the tape crimper (PN 47-00038).

#### NOTE

**Do not crimp the tape unnecessarily. Each crimping shortens the tape leader and could eventually lead to failures in the autoload sequence.**

4. Check that static charge is not causing end of tape to stick to reel. End of tape must be free of reel to accomplish autoload.
5. If a write operation is to be performed, install a write enable ring onto the rear flange of the tape reel.
6. Place the supply reel in position on the upper hub. Rotate until it slips easily into place, and press the reel retaining actuator. The reel should be positioned so that the tape unwinds if it is turned clockwise.

#### NOTE

**The supply reel may be contained in an Easy-Load® wraparound cartridge. It is not necessary to remove or open the cartridge. It opens automatically during the autoload sequence.**

7. Carefully close the buffer door. Make sure it is closed securely.
8. Close the transport front door.
9. Check that power is applied to the tape transport (power light on).
10. Follow the instructions and check for the events specified in Figure 2-4. If the tape fails to load properly, the figure contains some operator troubleshooting hints that can be tried before maintenance personnel are called. Refer to Figure 2-5 to identify tape path components.

### 2.2.4 Manual Load

Follow the steps below in order to perform the manual procedure.

1. Check that the tape path is clean. (Refer to Paragraph 4.3.4 for cleaning procedure.)
2. If a write operation is to be performed, install a write enable ring onto the rear flange of the tape reel.

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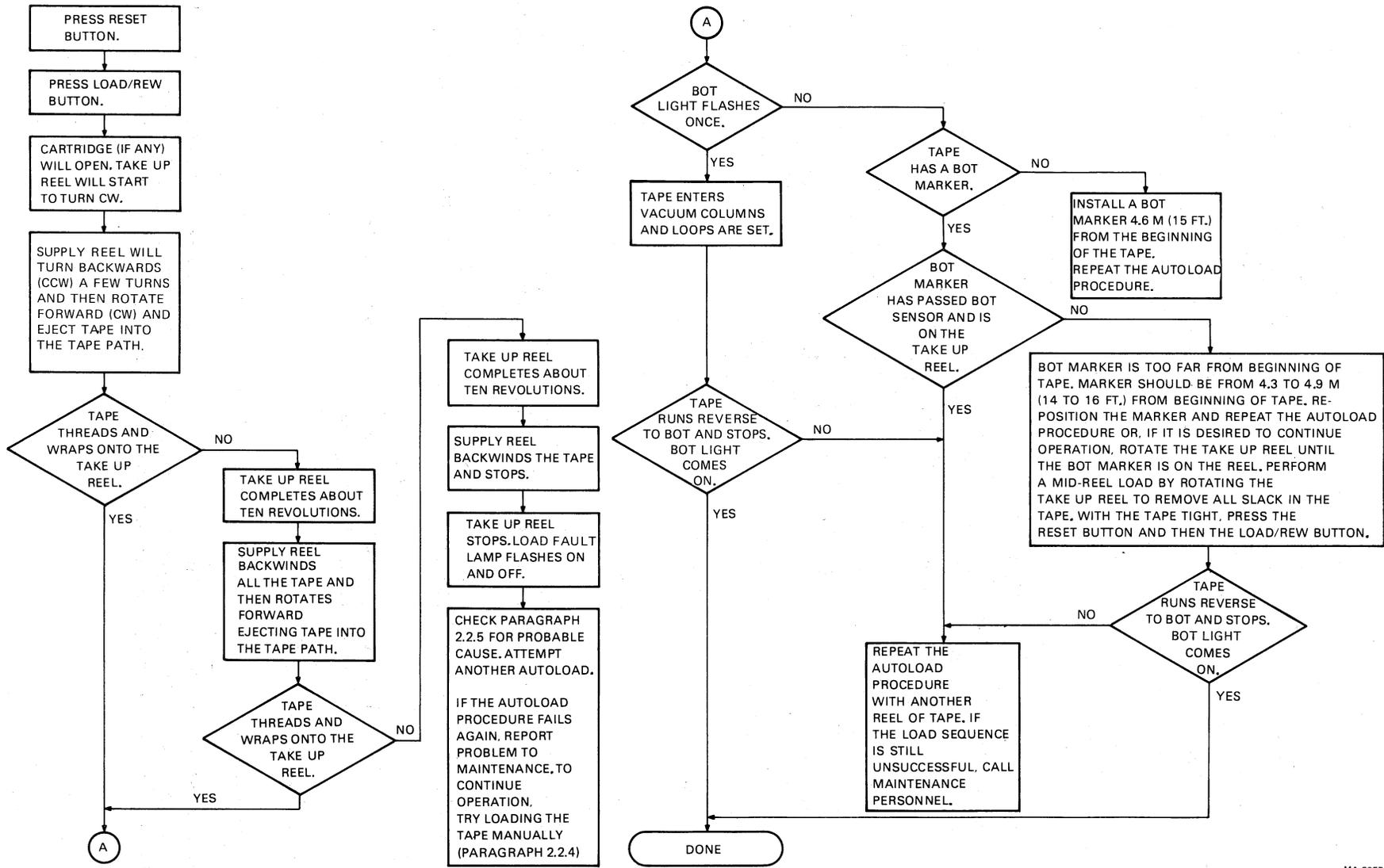
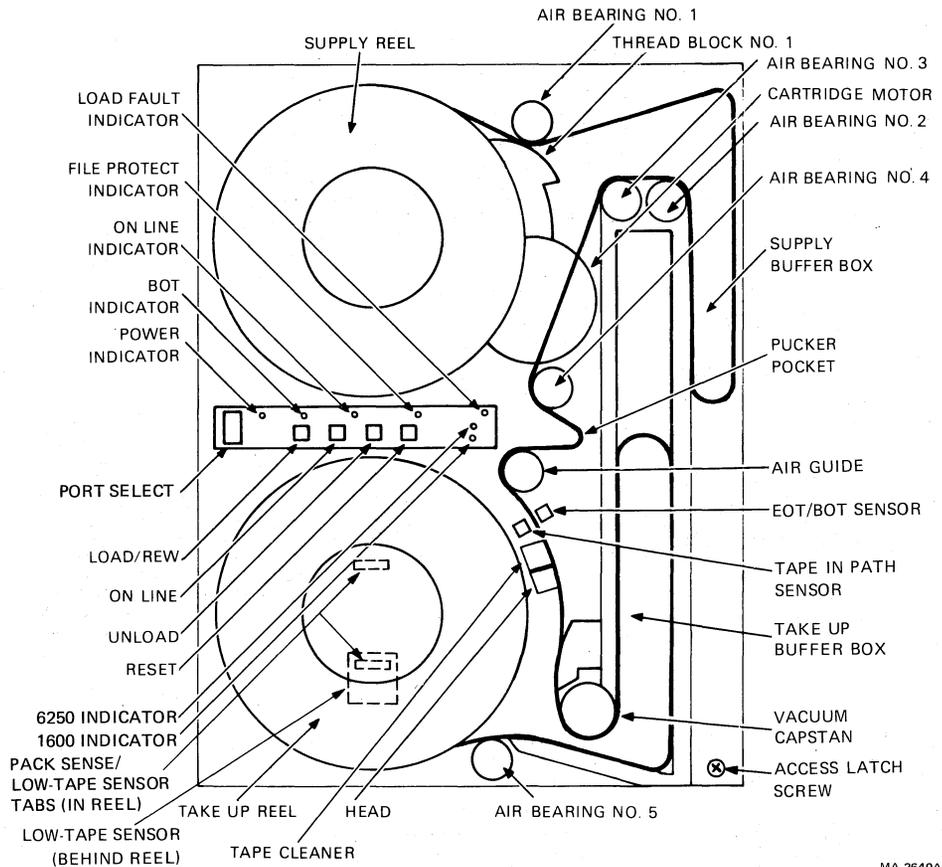


Figure 2-4 Autoload Sequence with Operator Troubleshooting



MA-2640A

Figure 2-5 Tape Path and Controls

3. Place the supply reel in position on the upper hub. Rotate until it slips easily into place, and press the reel retaining actuator. The reel should be positioned so that the tape unwinds if it is turned clockwise.
4. Manually place the tape leader between thread block 1 and air bearing 1 (Figure 2-5).

**NOTE**

**Make sure that there is no tape slack or sag between the supply reel and thread block 1.**

5. Close the transport front door.
6. Check that power is applied to the tape transport (power light is on).
7. Follow the instructions and check for the events specified in Figure 2-6. If the tape fails to load properly, the figure contains some operator troubleshooting hints that can be tried before maintenance personnel are called. Refer to Figure 2-5 to identify tape path components.

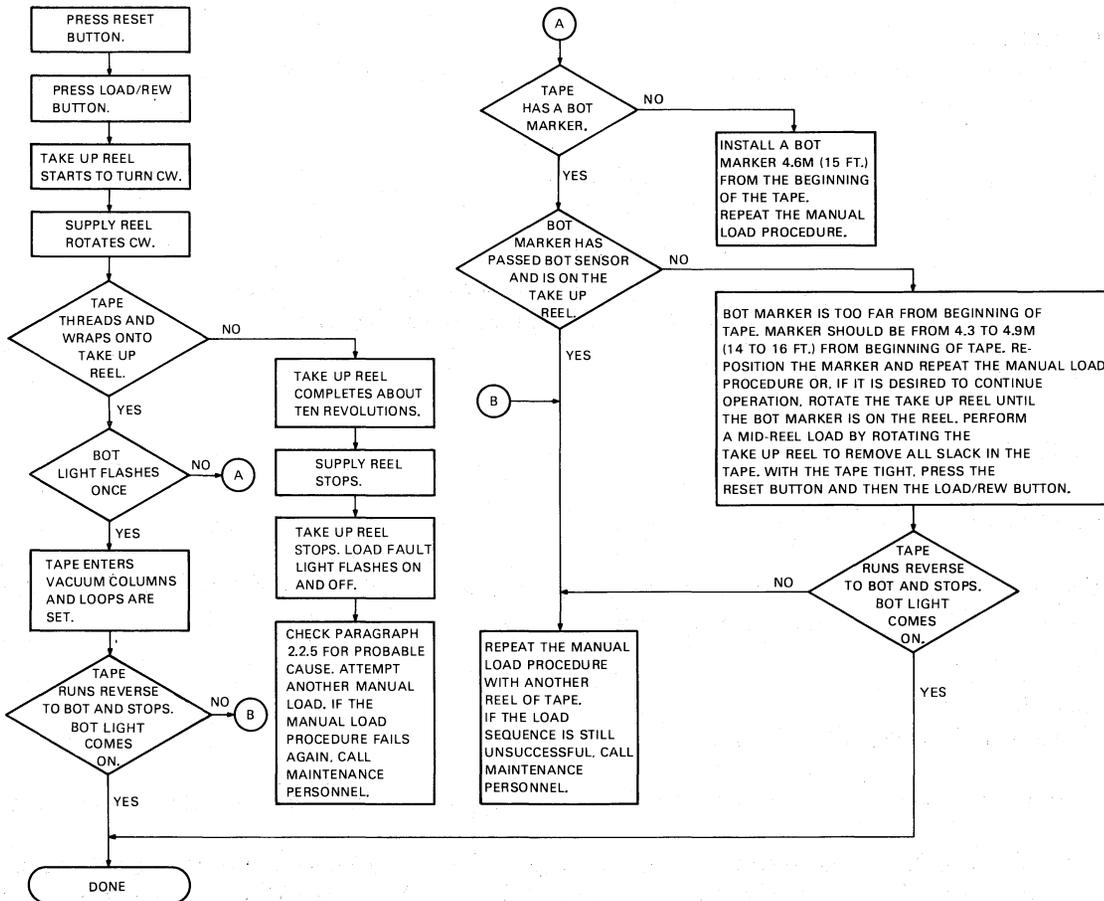


Figure 2-6 Manual Load Sequence with Operator Troubleshooting

### 2.2.5 Probable Causes of Load Failure

The following is a list of procedures for repairing load failure.

1. Check that the buffer door is closed and sealed properly.
2. Check that the front door is closed securely.
3. Check for ripped, creased, or damaged tape leader. This is especially critical if an autoload failure has occurred. If necessary crimp the end of the tape with a tape crimper.
4. Check that the write enable ring is inserted in the tape reel if a write operation is to be performed. (File protect indicator should be out.)
5. If an autoload is being performed, check the following.
  - a. A 267 mm (10.5 in) tape reel is on the supply hub
  - b. The supply reel has a full reel of tape. The tape must be between 0.64 cm and 1.59 cm (0.25 in and 0.63 in) from the outer edge of the reel.

### **2.2.6 Midreel Load**

A midreel load is usually required after a power failure or a lost interlock. Follow the steps below to perform a midreel load.

1. Rotate the take-up reel to remove all slack in the tape.

#### **CAUTION**

**Do not attempt midreel load until all slack is manually removed from the tape between the reels.**

2. Press the RESET button.
3. Close the front door.
4. Press the LOAD/REW button.

The transport loads the tape and starts a reverse operation to BOT. To stop the transport, press the RESET button. Any other command may now be given.

### **2.2.7 Unload**

Follow the steps below to unload a tape.

1. Press the RESET button to terminate any current operation and place the transport off-line.
2. Press the UNLOAD button. If the tape is at BOT, it backwinds onto the supply reel. If the tape is at midreel, it rewinds to BOT and then unloads (backwinds onto the supply reel).

### **2.2.8 Rewind**

Press the LOAD/REW button, with tape tensioned and the transport off-line, to rewind the tape to BOT. When the button is pressed with the tape at BOT, no action occurs.

### **2.2.9 On-Line/Off-Line**

Press the ON LINE button to place the transport on-line. This lights the on-line indicator. While on-line, the transport can accept external commands provided it is selected and ready. If the ON LINE button is pressed again, the transport goes off-line. The on-line indicator goes out. Also, the transport automatically goes off-line when any of the following conditions occur.

- An external rewind unload command is received
- Vacuum column interlock is broken
- AC power is lost
- RESET button is pressed
- Front door opens

## CHAPTER 3 INSTALLATION

### 3.1 SITE PLANNING

#### 3.1.1 Space Requirements

Figure 3-1 illustrates the space and service clearances required for the TU78 cabinet. There must be enough space to swing the TM78 out of the cabinet for servicing and open the front and rear doors on the TU78 tape transport.

#### 3.1.2 Power Requirements

The TU78 tape transport can be operated from 188 Vac to 256 Vac at 60 Hz, or 198 Vac to 256 Vac, at 50 Hz, with proper connections on the power chassis. Line voltage should be maintained to within  $\pm 10$  percent of the nominal value. Frequency should not vary more than  $\pm 1$  Hz.

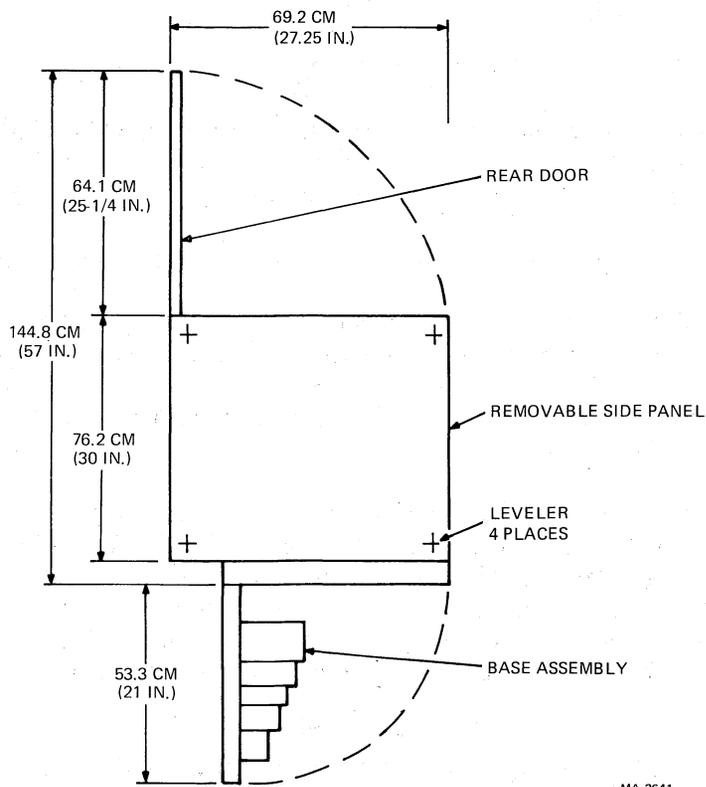


Figure 3-1 Space and Service Clearance (Top View)

### 3.1.3 Environmental Requirements

The TU78 transport should be located in an area free of excessive dust, dirt, corrosive fumes, and vapors. The bottom of the cabinet, and the air vents in the front panel and rear door of the cabinet, must not be obstructed. The operating environment should have cool, well-filtered, humidified air. A temperature range of 15° to 27° C (59° to 80° F); and relative humidity of 40 to 60 percent should be maintained.

## 3.2 UNPACKING AND INSPECTION

### 3.2.1 Unpacking

The TU78 cabinet(H9500)comes mounted to a shock absorbing wooden shipping skid that measures approximately 76 cm (30 in) wide, 107 cm (42 in) long, and 15 cm (5.75 in) high. The cabinet comes packed in an extra strong corrugated cardboard container that measures approximately 76 cm (30 in) wide, 89 cm (35 in) long, and 147 cm (58 in) high. (Units shipped outside the continental United States have an additional wooden container around the cardboard carton. The side panels of the container are bolted together.) Also mounted to the shipping skid are two wooden ramps which are repositioned during the unpacking procedure so that the cabinet may be rolled off the skid.

To unpack the TU78 from its shipping container, and remove the shipping skid, perform the following procedure. (Refer to Figure 3-2).

1. Cut and remove the plastic bands around the cardboard container. Remove the angle boards.
2. Cut the tape on the top and sides of the container.
3. Remove and dispose of the container. (It is not reusable.)
4. Remove the plastic bag from the cabinet.
5. Two hex head bolts hold the wooden ramps to the shipping skid. Unfasten the ramps by removing the bolts and associated washers. Both ramps are positioned between the TU78 cabinet and the shipping skid, and are visible from the front of the cabinet.
6. Slide the ramps out from under the cabinet and set them aside for assembly (step 9).
7. Unbolt the cabinet from the shipping skid. Remove four hex bolts that hold the cabinet frame to the skid deck (Figure 3-3). Discard the bolts, washers, and nuts.
8. Remove and discard the three wooden block spacers located between the cabinet frame and the skid deck. (Figure 3-3).
9. Attach the two wooden ramps to the skid deck. Four tee nuts have been driven into the top of the skid deck on the left side for this purpose. (Refer to the exploded view of Figure 3-2 showing mounting details). Position the aluminum bracket of one mounting ramp underneath the skid deck so that the holes in the bracket are lined up with the tee nuts. Fasten the bracket to the skid deck with two 1/4-20 × 3/4 hex bolts. (The bolts are shipped in the accessory package.) Attach the second ramp to the skid deck in the same manner.

### CAUTION

**The following step requires two people to roll the TU78 down the wooden ramps. The majority of the weight of the TU78 is situated in the upper half of the cabinet, making it top-heavy. Do not attempt this procedure with only one person.**

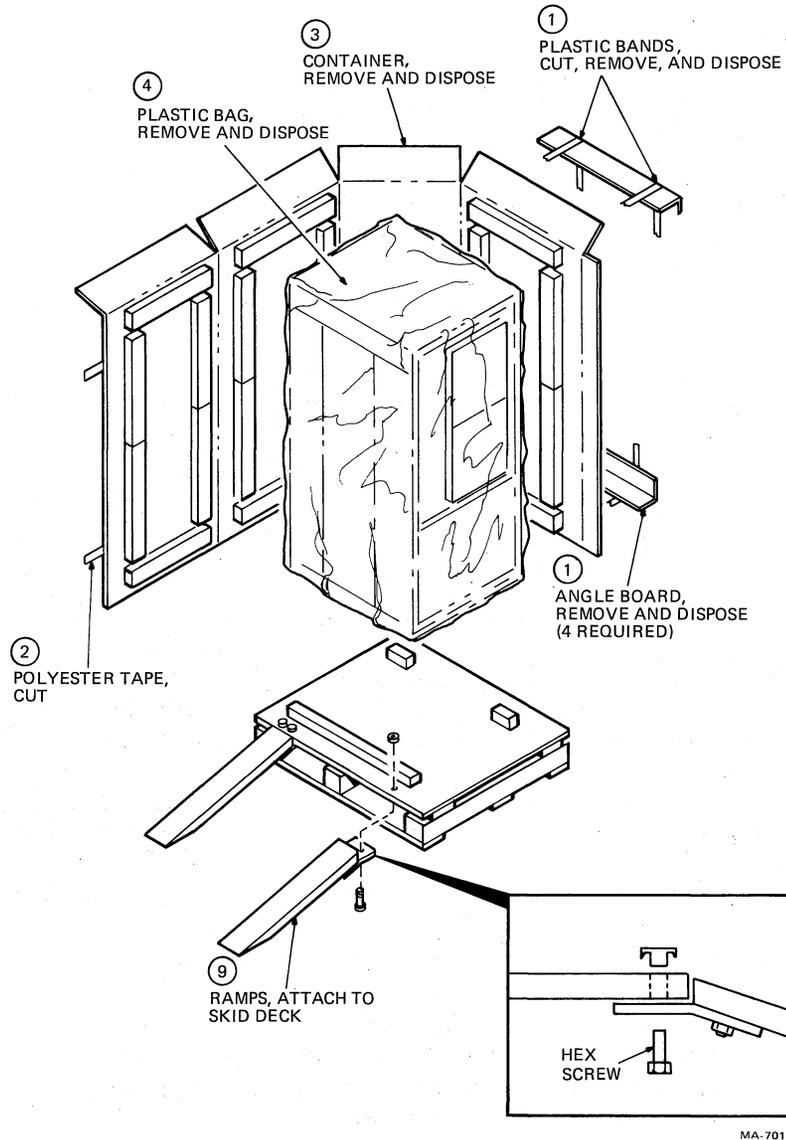


Figure 3-2 Unpacking the TU78

10. Roll the TU78 toward the left side of the side deck by pushing gently on the right side of the cabinet. With one person bracing a shoulder against the left front and the other person bracing a shoulder against the left rear of the cabinet, allow it to roll off the skid deck, down the wooden ramps and onto the floor.
11. Unfasten the wooden ramps. Discard them and the shipping skid.

### 3.2.2 Inspection

After unpacking the TU78 transport, inspect it and report any damage to the responsible shipper and the local DIGITAL sales office. Perform the inspection according to the following steps.

1. Inspect all switches, indicators, and panels for damage.

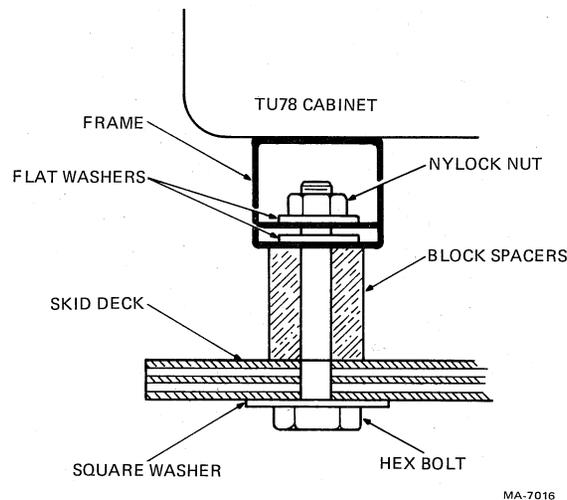


Figure 3-3 TU78 Mounting for Shipment

2. Open TU78 front door. Fully depress the upper and lower release buttons and open the buffer box door. Check that the buffer box door is tightly secured to the cabinet. Inspect for foreign material, loose or damaged components, and for glass damage.
3. Check the transport for any foreign material that may have lodged in the take-up reel or other moving parts.
4. Rotate the supply hub and take-up reel. Check for binding and physical damage.
5. Rotate the capstan. Check for binding and physical damage.

#### CAUTION

**The capstan is fragile. Do not touch the capstan rubber surface and do not apply pressure to the capstan which might cause it to deform.**

6. Check tape path for any sharp edges.
7. Close the buffer box door by pressing the two release buttons using moderate pressure. (The buttons will not catch if pressed too hard.)
8. Close the TU78 front door.

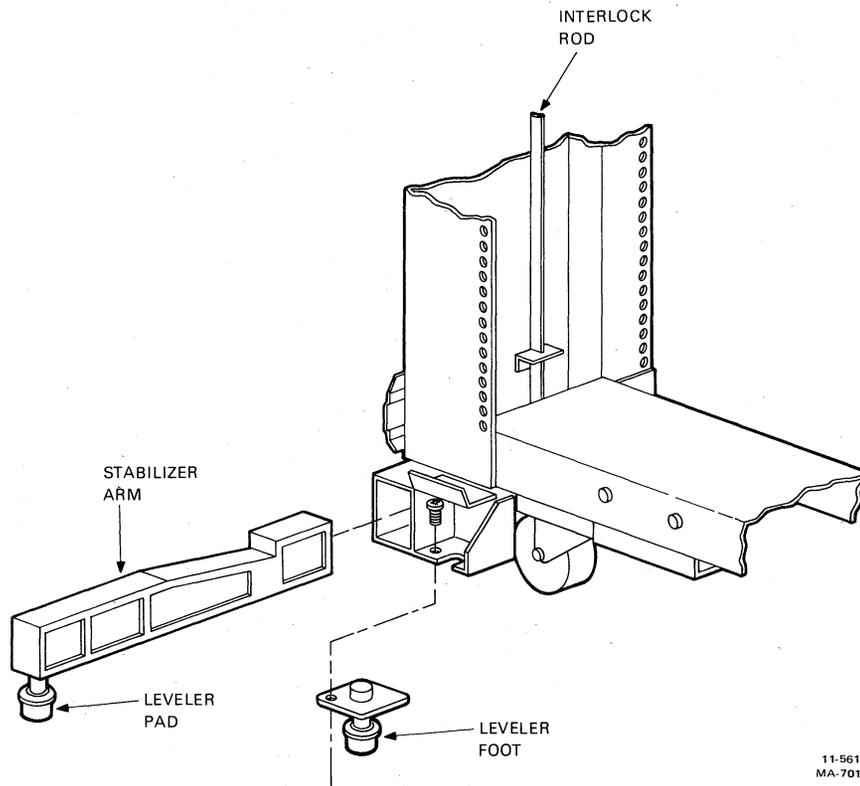
### 3.3 SINGLE TRANSPORT INSTALLATION

#### 3.3.1 Mechanical Installation

After the shipping container and skid have been removed and visual inspection has been performed, roll the transport cabinet into position and proceed as follows.

#### NOTE

**If the TU78 is placed next to another system cabinet, do not remove the adjoining side panels and bolt the cabinets together. Rather, leave the side panels**



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Figure 3-4 Location of Stabilizer Arm and Leveler Feet

**on and position the TU78 side panel tight against the other cabinet's side panel. This maintains proper air flow in both cabinets.**

1. An array of vertical slots constitutes the venting in the cabinet front panel. A quick release latch is located approximately 2.54 cm (1 in) behind each end of this array. Insert a thin-bladed tool (such as a small steel rule) into one of the end slots, and push on the latch while simultaneously pulling forward to release one corner of the front panel. In the same manner, while continuing to pull forward, release the latch at the other end of the array to free the front panel. Remove the front panel and set it aside. Do not disconnect the ground strap from the panel.
2. Remove the two leveler pads and four leveler feet that are blister wrapped wrap and taped to the inside of the front panel.
3. Raise the interlock rods on each side of the cabinet. Remove the two stabilizer arms from the stabilizer sleeve assemblies (Figure 3-4).
4. Screw the leveler pads into the stabilizer arms.
5. Raise the interlock rods. Reinsert the stabilizer arms into the stabilizer sleeve assemblies.
6. Install the leveler feet in the lower corners of the cabinet frame (Figure 3-4).

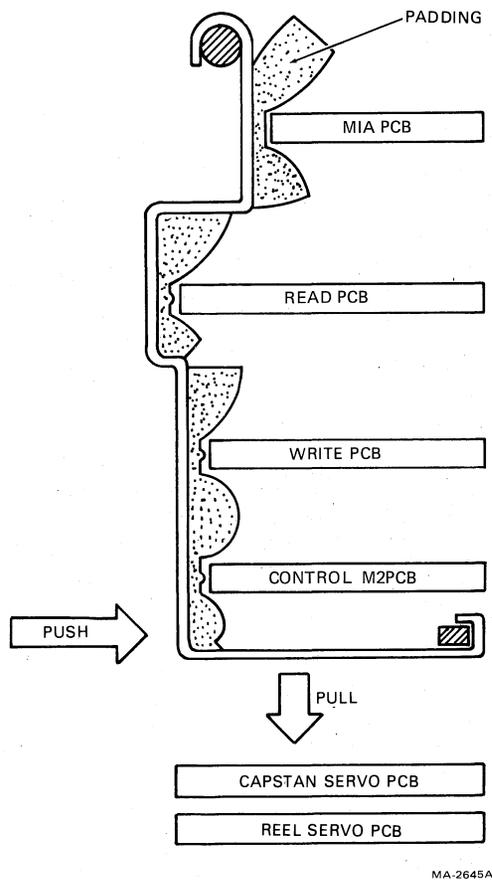


Figure 3-5 PCB Shipping Bracket (Side View)

7. Using a 9/16-inch wrench, lower the leveling feet until they make contact with the floor stabilizing the cabinet.
8. Using a level, adjust the feet until the cabinet is level.
9. Extend the two stabilizer arms and lower the leveler pads until they just touch the floor yet can easily slide along the floor. Do not place any weight on the leveler pads.
10. Insert a 5/32-inch Allen wrench into the rear door latch, and turn one-quarter turn in a counterclockwise direction. Open the door.
11. Open the transport front door and the buffer box door. Using a screwdriver, release the service lock located in the lower right corner of the base assembly. Swing the base assembly open.

**NOTE**

**The base assembly does not swing open unless the stabilizer arms are extended (step 9).**

12. Remove the PCB shipping bracket by pushing in on the lower front and pulling down from underneath (Figure 3-5).

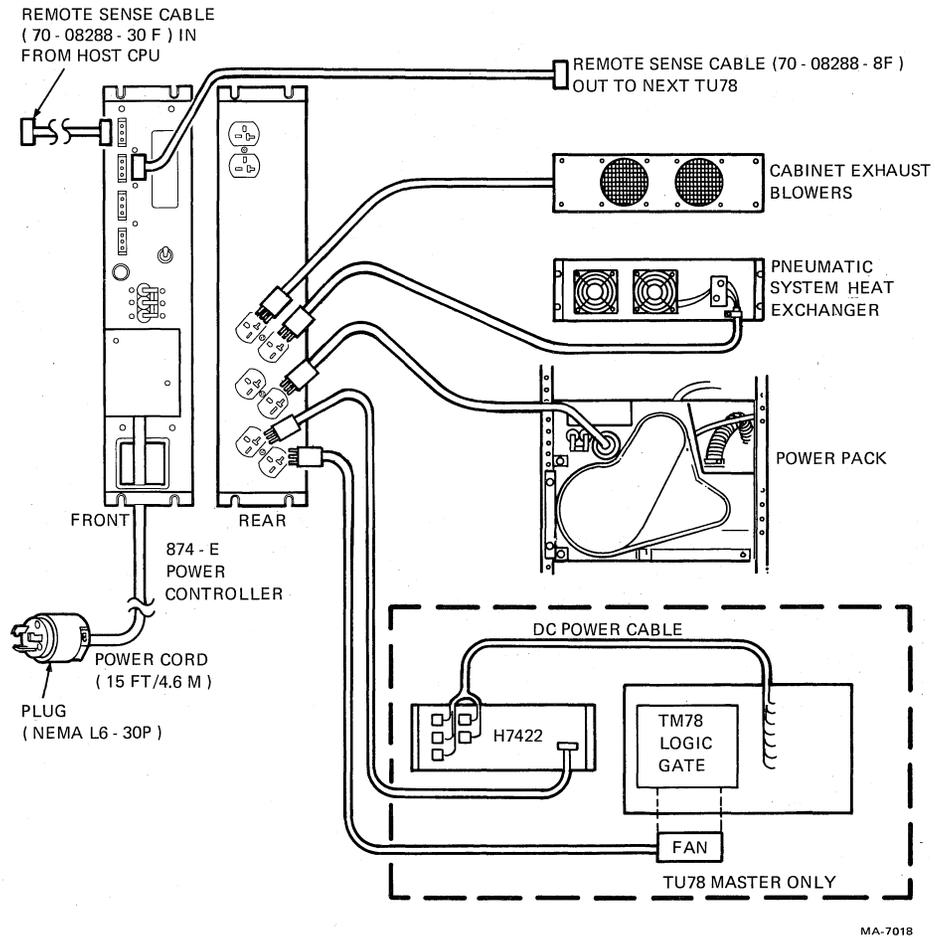


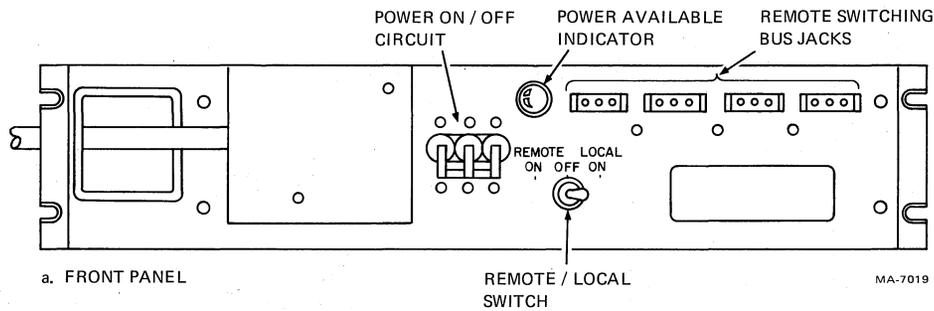
Figure 3-6 TU78 Power Distribution

13. Check seating of PCBs in their sockets.
14. Replace the PCB shipping bracket.

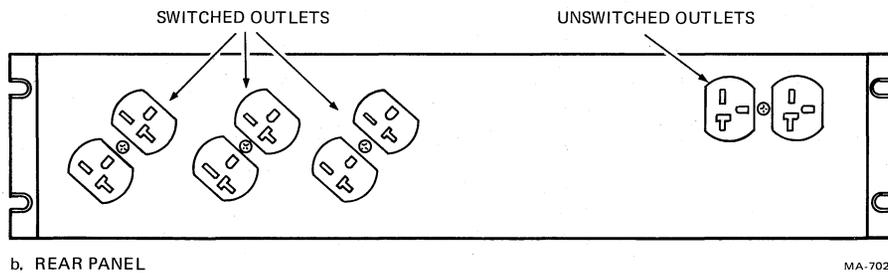
### 3.3.2 Power and Cabling

Figure 3-6 shows the TU78 ac power distribution system. Refer to this figure while making the following checks.

1. Check the following internal power cabling connections.
  - a. Power cable from 874-E power controller switched outlet to transport power pack (Figure 3-6).
  - b. Power cable from 874-E switched outlet to cabinet exhaust blowers.
  - c. Power cable from 874-E switched outlet to pneumatic system heat exchanger blowers.
  - d. Power cable from 874-E switched outlet to H7422 power supply (master TU78 only).



a. Front Panel



b. Rear Panel

Figure 3-7 874-E Power Controller

- e. Power cable from 874-E switched outlet to TM78 logic cage blower.
  - f. DC power cable harness from H7422 power supply to TM78 logic gate (master TU78 only).
2. Check that the power on/off circuit breaker on the 874-E is on and the remote/local switch is set to remote. (Figure 3-7).
  3. Check fuses on power pack fuse panel (Figure 1-5). It is necessary to swing the TM78 logic gate out on its hinge. The fuses can be seen from the front of the cabinet.
  4. Remove the cover from the power transformer terminal strip (Figure 3-8). (The ac input plug on power pack must also be removed.) Check that the blue, brown, and white/red wires are connected to the lower terminals (Table 3-1). The terminals are numbered 1 through 9, from left to right. Replace the cover and connect the power pack connector.
  5. Check that the circuit breaker on the rear of the power pack is in the on (up) position.
  6. Remove the pulley cover from the rear of the transport power pack (Figure 3-8). Spin the ac motor pulley by hand and check that the blower and compressor belts are tight and track properly.

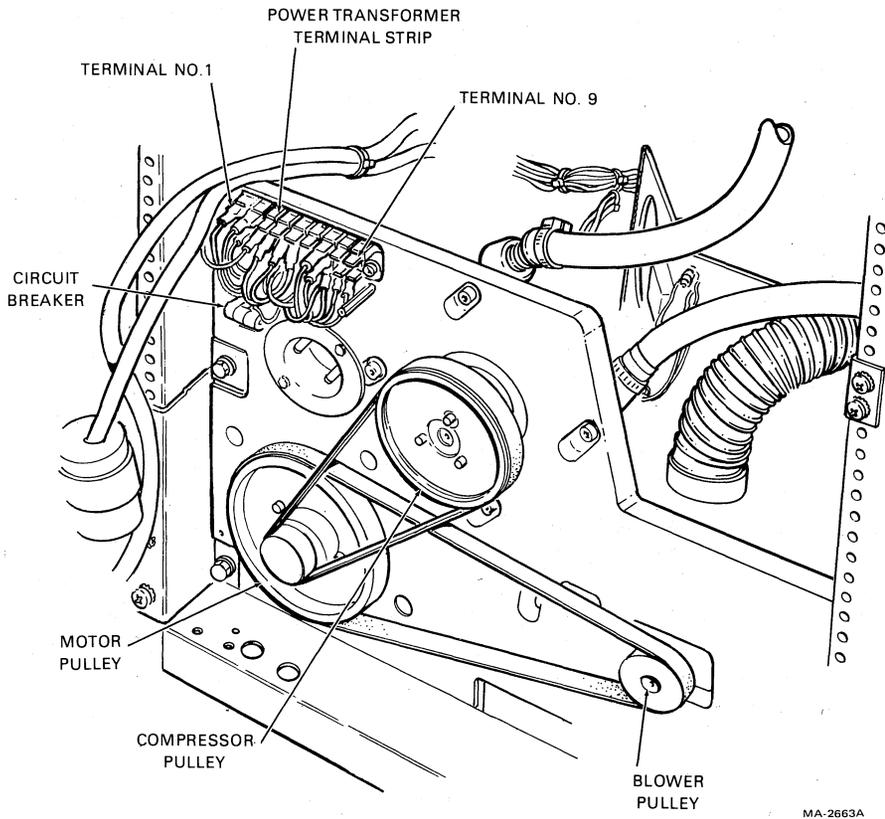


Figure 3-8 Rear of Power Pack with Pulley Cover Removed

Table 3-1 Primary Power Connections

Input Voltage	Blue wire	Brown Wire and White/Red Wire
198 – 205	TB1-4	TB1-7
206 – 215	TB1-3	TB1-7
216 – 225	TB1-4	TB1-8
226 – 235	TB1-3	TB1-8
236 – 245	TB1-4	TB1-9
246 – 255	TB1-3	TB1-9

**NOTE**

All TU78 transports are manufactured to operate in the 0 to 610 m (0 to 2000 ft) range. If the transport you are installing is to operate at higher elevations, you must install one of the optional high altitude kits listed below. If not, replace the pulley cover.

The following optional high altitude kits are available.

- |                   |       |                              |
|-------------------|-------|------------------------------|
| 610 to 1220 m     | 60 Hz | (PN A2W-0476-10 or 29-23985) |
| (2000 to 4000 ft) | 50 Hz | (PN A2W-0476-11 or 29-23982) |



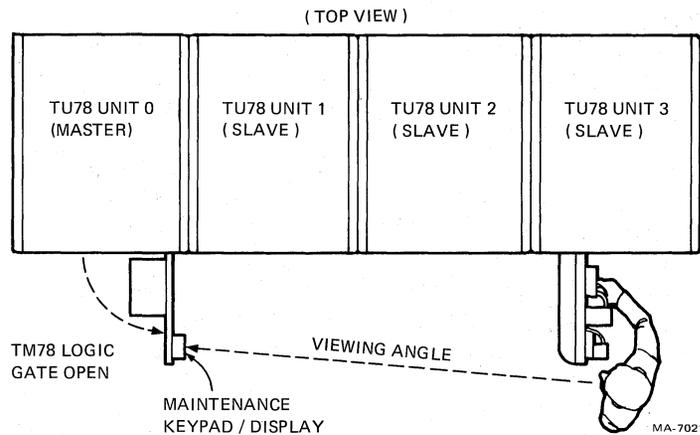


Figure 3-9 Cabinet Placement for Maintenance Display Visibility

- f. Check that both belts track completely on the pulleys. If not, some shift of the motor pulleys may be necessary.
- g. Replace the belt guard and the power cord.
- h. Package the old belts and pulleys in a marked container, and leave it in the base of the transport. It is possible that the transport may be moved to a lower altitude in the future.

**NOTE**

**For the following two steps, refer to the procedures found in the installation section (Chapter 3) of the TM78 User Guide or Technical Manual.**

7. Connect the BC06S round MASSBUS cable to the input port connector.
8. Connect a MASSBUS terminator to the output port connector.
9. Connect the remote switching control bus from the CPU to one of the front jacks on the 874-E.
10. Using the green/yellow ground cable provided, ground the TU78 cabinet frame to the CPU cabinet frame. The grounding studs for the TU78 are located on the lower side frame members (Figure 3-11).
11. Replace the front panel. Close the rear door.
12. Check that system power is off at the CPU. Connect the ac power cable from the 874-E to the power source.
13. Perform acceptance testing (Paragraph 3.5).

### 3.4 MULTIPLE TRANSPORT INSTALLATION

#### 3.4.1 Mechanical Installation

When an installation requires more than one transport, only the master transport is shipped with the side panels. During installation, remove one of the side panels, and bolt the master and slave transport(s) together. Then mount the removed side panel onto the end slave transport.

After removing the shipping containers and skids, perform the visual inspection of the transports. Then roll the transport cabinets into their approximate positions. Place the master transport to the left (facing front) of all other transports. This allows the TM78 keypad/display to be seen from the other transports in the line when the logic gate is swung out (Figure 3-9).

**NOTE**

**If the TU78 on either end is placed next to another system cabinet, do not remove the adjoining side panels and bolt the cabinets together. Rather, leave the side panels on and position the TU78 side panel tight against the other cabinet's side panel. This maintains proper air flow in both cabinets.**

Unless otherwise specified, perform the installation of each cabinet as follows.

1. An array of vertical slots constitutes the venting in the cabinet front panel. A quick release latch is located approximately 2.54 cm (1 in) behind each end of this array. Insert a thin-bladed tool (such as a small steel rule) into one of the end slots, and push on the latch while simultaneously pulling forward to release one corner of the front panel. In the same manner, while continuing to pull forward, release the latch at the other end of the array to free the front panel. Remove the front panel and set it aside. Do not disconnect the ground strap from the front panel.
2. Remove the two leveler pads and four leveler feet that are blister wrapped and taped to the inside of the front panel.
3. Raise the interlock rods on each side of the cabinet. Remove the two stabilizer arms from the stabilizer sleeve assemblies (Figure 3-4).
4. Screw the leveler pads into the stabilizer arms.
5. Raise the interlock rods. Reinsert the stabilizer arms into the stabilizer sleeve assemblies.
6. Install the leveler feet in the lower corners of the cabinet frame (Figure 3-4).
7. Extend the two stabilizer arms from each cabinet and lower the leveler pads until they just touch the floor. Do not place any weight on the leveler pads.
8. Open the master transport front door. Using a screwdriver, release the service lock located in the lower right corner of the base assembly. Swing the base assembly open.

**NOTE**

**The base assembly will not swing open unless the stabilizer arms are extended (step 7).**

9. Locate the fastener attached to the underside of the master transport top cover (Figure 3-10). Release the top cover by turning the fastener one-quarter turn in a counterclockwise direction. When it is released, the fastener hangs by a wire from the top cover. Pull the top cover forward approximately 1.27 cm (0.5 in) and lift it off. Rest the cover on top of the cabinet, leaving the ground wire connected.
10. Remove the end panel on the right side by grasping it on both sides and lifting it off the four mounting bolts. If the side panel does not lift off, it may be necessary to loosen the mounting bolts. In this case, remove the front panel trim to gain access to the upper front mounting bolt. To remove the trim, lift it up and out (Figure 3-11).

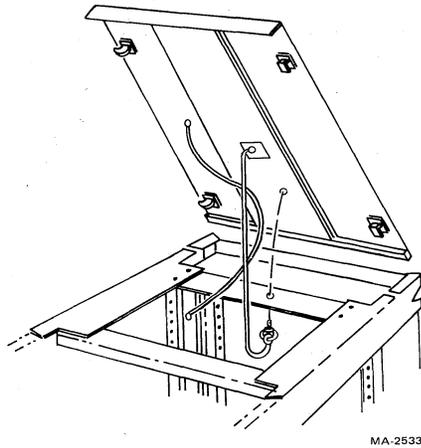


Figure 3-10 Top Cover Fastener

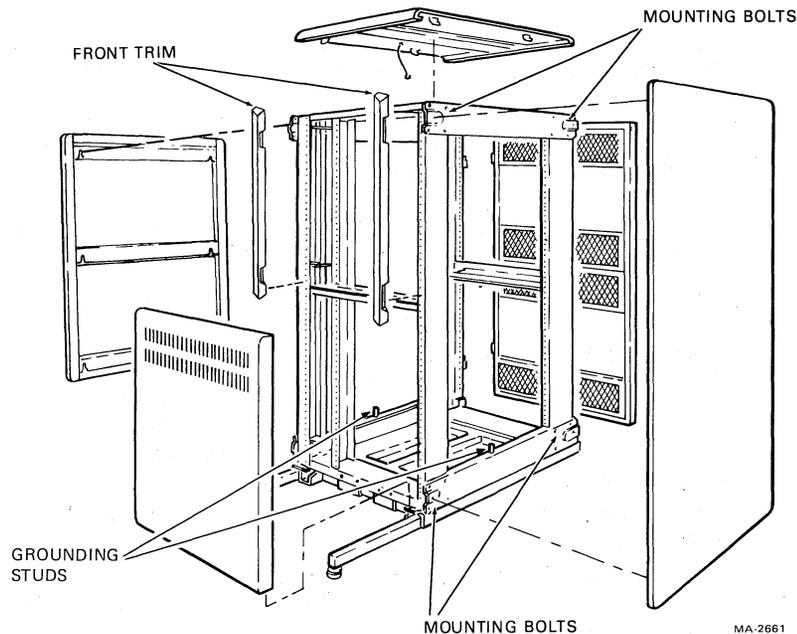


Figure 3-11 Cabinet with Side Panels and Top Cover Removed

11. Disconnect the side panel ground strap from the cabinet frame and set the panel aside.
12. Remove the four exposed mounting bolts from the master transport.
13. Push the cabinets together so they are in adjoining positions with the mounting bolt plates side by side.
14. Using the short ground strap included with the slave transports, ground the master and slave cabinets together.
15. Using the green/yellow ground cable provided with the master, ground the master TU78 cabinet frame to the CPU cabinet frame.

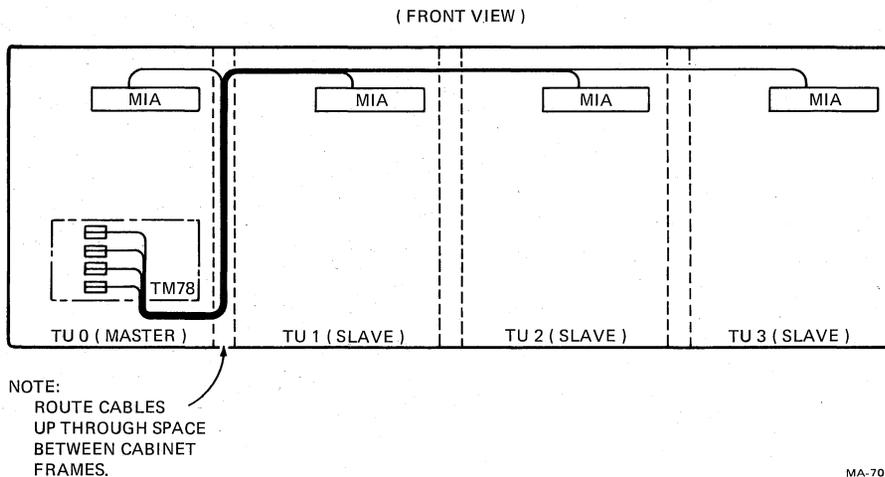


Figure 3-12 TU Bus Cable Routing for a Multiple Transport Configuration

16. Using a 9/16-inch wrench, lower the leveling feet of the highest cabinet until they make contact with the floor stabilizing the cabinet.
17. Using a level, adjust the feet until the cabinet is level.
18. Level and adjust the adjoining cabinet(s) so that the bolting (middle) holes on the four corner bolting plates are aligned.

**NOTE**

**Before performing the next step, the TU bus cables for all slave transports must be laid in loosely between the master and first slave (Figure 3-12). There are two 4.6 m (15 ft) cables (PN 70-17382-15) for each slave. Orient the cables so that the red stripe on the side faces the rear of the cabinet. Do not tape the cables together since this would inhibit the replacement of a single cable in the event of failure.**

19. Insert 1/4-inch bolts into the holes and secure them with kep nuts. Bolting the cabinets in this manner provides good horizontal alignment.
20. Readjust the leveler pads on the stabilizer arms until each pad touches, yet easily slides along the floor. Do not place any weight on the leveler pads.
21. Install the four mounting bolts from the master cabinet into the mounting bolt plates of the end slave transport. Remove front panel trim if necessary.
22. Open the base assembly of the end slave transport. Release the top cover fastener, remove the cover, and rest it on top of the cabinet, off to one side. Do not disconnect the cover ground strap.
23. Set the side panel from the master transport next to the slave transport. Connect the panel ground strap to the cabinet frame. Mount the panel onto the side of the slave transport.

24. Replace the top cover and secure the cover fastener.
25. Insert a 5/32-inch Allen wrench into the rear door latch. Turn it one-quarter turn in a counterclockwise direction and open the door.
26. Open the base assembly of each transport. Remove the PCB shipping bracket by pushing in on the lower front and pulling down from underneath (Figure 3-5). Check seating of PCBs in their sockets. Replace the PCB shipping bracket.

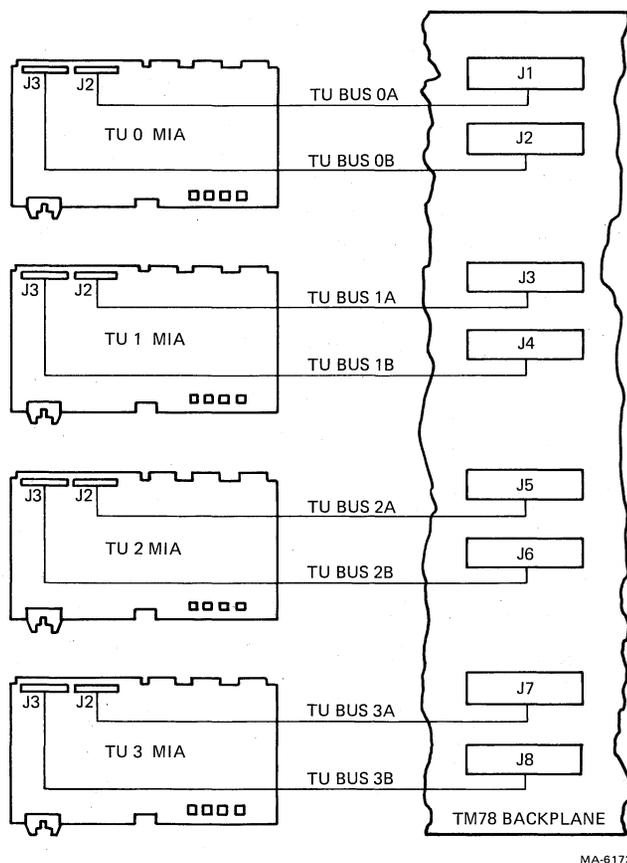
### 3.4.2 Power and Cabling

Figure 3-6 shows the TU78 ac power distribution system. Refer to this figure while making the following checks.

1. Check the following internal power cabling connections for all the transports.
  - a. Power cable from 874-E power controller switched outlet to transport power pack (Figure 3-6).
  - b. Power cable from 874-E switched outlet to cabinet exhaust blowers.
  - c. Power cable from 874-E switched outlet to pneumatic system heat exchanger blowers.
  - d. Power cable from 874-E switched outlet to H7422 power supply (master TU78 only).
  - e. Power cable from 874-E switched outlet to TM78 logic cage blower (master TU78 only).
  - f. DC power cable harness from H7422 power supply to TM78 logic gate (master TU78 only).
2. Check that the power on/off circuit breaker on the 874-E is on and the remote/local switch is set to remote (Figure 3-7).
3. Check fuses on power pack fuse panel (Figure 1-5). The fuses can be seen from the front of the cabinet. (On the master transport, it is necessary to swing the TM78 logic gate out on its hinge.) A closer view can be obtained from the rear of the cabinet by looking over and down onto the fuse panel.
4. Remove the cover from the power transformer terminal strip (Figure 3-8). (The ac input plug on the power pack must also be removed.) Check that the blue, brown, and white/red wires are connected to the lower terminals (Table 3-1). The terminals are numbered 1 through 9, from left to right. Replace the cover and connect the power pack connector.
5. Check that the circuit breaker on the rear of the power pack is in the on (up) position.
6. Remove the pulley cover from the rear of the transport power pack (Figure 3-8).

#### NOTE

**All TU78 transports are manufactured to operate in the 0 to 610 m (0 to 2000 ft) range. If the transport you are installing is to operate at higher elevations, you must install a high altitude belt and pulley kit. Refer to Paragraph 3.3.2, step 6 for instructions.**



MA-6172

Figure 3-13 Radial TU Bus Connections

Spin the ac motor pulley by hand and check that the blower and compressor belts are tight and track properly. Replace the pulley cover.

**NOTE**

**For the following two steps, refer to the procedures found in the installation section (Chapter 3) of the TM78 User Guide or Technical Manual.**

7. Connect the BC06S round MASSBUS cable to the input port connector.
8. Connect a MASSBUS terminator to the output port connector.
9. Install the TU bus cables between the TM78 in the master transport and the slave transport(s). Figure 3-12 shows the positioning of the cables relative to the cabinet frames. The TU bus for the master transport is prewired at the factory. Figure 3-13 shows the electrical connection for each TU bus cable. Start at the TM78 end of the cable and work toward the MIA (multiple interface adapter) end.

**NOTE**

**The procedure for connecting the cable to the TM78 is found in the installation section (Chapter 3) of the TM78 User Guide or Technical Manual.**

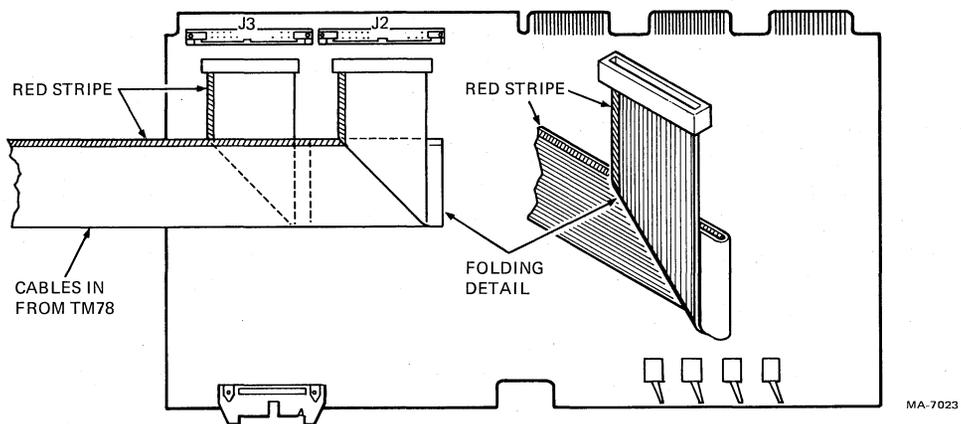


Figure 3-14 Cable Orientation on TU78 MIA PCBA (Slave Only)

10. The TU bus cables should exit up through the space between the frame members of the master and first slave transports. (Refer to note after Step 18, Paragraph 3.4.1). Fold all cables over and thread them through the space between the cabinet frame and the transport card cage side panels. The cables should lie flat over the MIA PCBs.
11. Dress and bend the cables as shown in Figure 3-14. Note the orientation of the red stripe. Plug the appropriate cables into the two MIA jacks (J2 and J3). Any slack in the cables should be taken up, folded, and tie-wrapped.
12. Repeat this procedure for each set of cables going to each slave transport. The cables for each succeeding transport should be layed over the preceding transports MIA card (Figure 3-12).
13. Daisy chain the remote switching control bus by connecting the bus from the CPU to one of the jacks on the front of the master transport's 874-E power controller. Using another cable, connect the bus from one of the other jacks on the 874-E to the 874-E in the next transport. Continue the daisy chain until all the TU78s are connected to the remote switching control bus.
14. Check that system power is off at the CPU. Connect the ac power cable from each 874-E to a power source.
15. Install cabinet front panels, and close and secure all base assemblies.
16. Perform acceptance testing (Paragraph 3.5).

### 3.5 ACCEPTANCE TESTING

This section describes all the acceptance tests required for the TU78 transport and the TM78 tape formatter. If they are performed satisfactorily, then the units have been installed and are operating properly.

Acceptance testing is divided into three categories: turn-on and loading checkout, subsystem quick check, and system level diagnostics. The turn-on and loading checkout verifies only basic functions of the transport and formatter. The subsystem quick check involves calling certain microcoded test routines from the TM78 maintenance panel. The system level diagnostics treat the formatter and transport as a subsystem, and exercise them to the fullest extent.

If unfamiliar with interlocks and other conditions affecting autoload/manual load selection, refer to Paragraph 2.2.2.

### 3.5.1 Turn-On and Loading Checkout

The turn-on and loading checkout applies power to the subsystem in order to observe the state in which the formatter comes up running and the transport comes up idle. This test also loads the transport under various conditions in order to check for the proper responses. The checkout utilizes flowcharts to show the proper sequence of events for each loading operations. The flowcharts include minor troubleshooting aids to help locate simple problems caused by bad tape or improper loading procedures. Perform the following operations in order.

#### 3.5.1.1 Power On – Follow the instructions and check for the events specified.

1. Remove the lower front panel of the master transport to gain access to the TM78 formatter.
2. Turn both TM78 MASSBUS ports off-line by flipping TM78 backplane DIP switches 1 and 5 to the right (0) position.
3. Turn on power. This may be done remotely by turning on the host CPU, or locally by flipping the REMOTE/LOCAL switch located on the 874-E to LOCAL ON.
4. Check for the following.
  - a. All fans in subsystem turn on.
  - b. The following indicators on the TU78 control panel light: Power, File Protect, 6250. All other lights on the TU78 control panel remain unlit.
  - c. The internal microcomputer exercises the TM78 maintenance panel display. This exercise consists of rotating the following characters through all six LEDs in the display: **0, 1, 2, 3, 4, 5, 6, 7, -, H, E, L, P**. The rotating display allows you to check that each LED can produce each available character. It also indicates that the internal microcomputer is running.

If the display does not rotate the characters, press and release the TM78 master reset button, located on the backplane just to the right of the DIP switches. If the display still does not rotate the characters, this indicates that there is a TM78 logic or power supply malfunction (assuming that the TM78 is off-line). Refer to the troubleshooting procedures found in chapter 5 of the *TM78 Technical Manual*.

5. Perform the TM78 maintenance keypad tests. Press each key (except ENA) independently in order to produce its keypad matrix location in the display. The second LED digit indicates the column number and the fifth LED indicates the row number. The other LEDs display hyphens. Figure 3-15 illustrates the keypad with the assigned column and row numbers. When no key is pressed, the display reverts to the rotating character test.

Now press the ENA (enable) key firmly for one second. This stops the microcomputer from running the maintenance display/keypad tests and display **HELLO** in the LEDs. Now the keypad is enabled and the microcomputer is waiting for a command. Press ENA again and the microcomputer disables the keypad and the display goes blank.

#### 3.5.1.2 Load Sequence Without Tape – With no tape reel mounted on the supply hub and the front door closed, follow the instructions and check for the events specified in Figure 3-16.

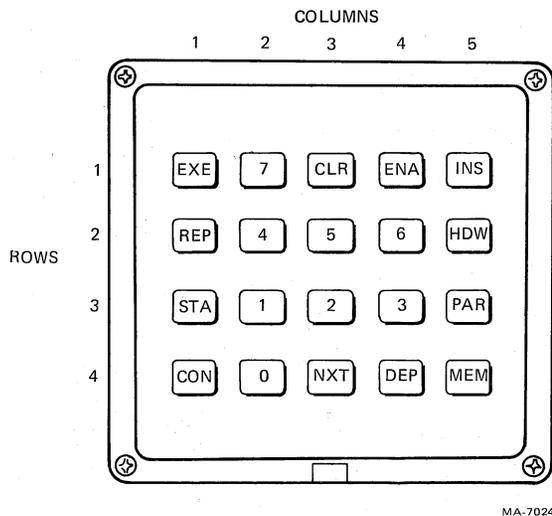


Figure 3-15 TM78 Maintenance Keypad

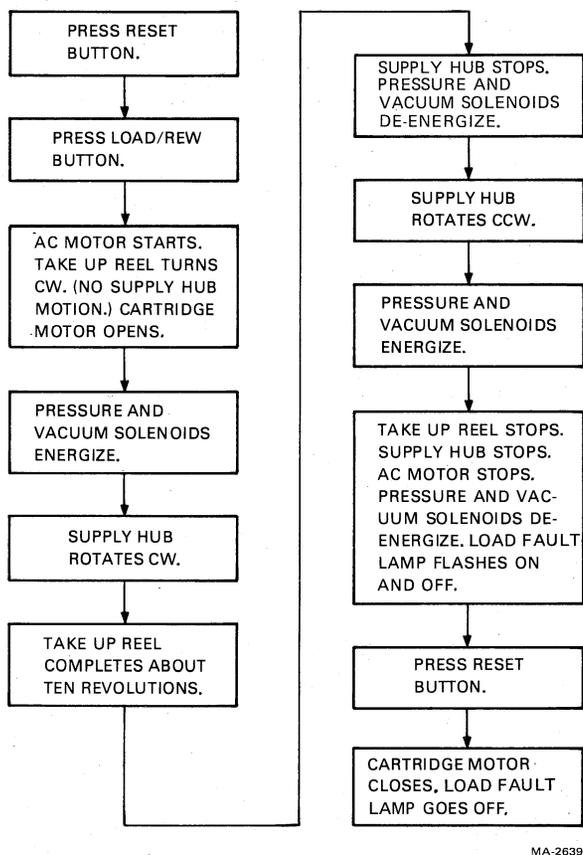


Figure 3-16 Load Sequence Without Tape



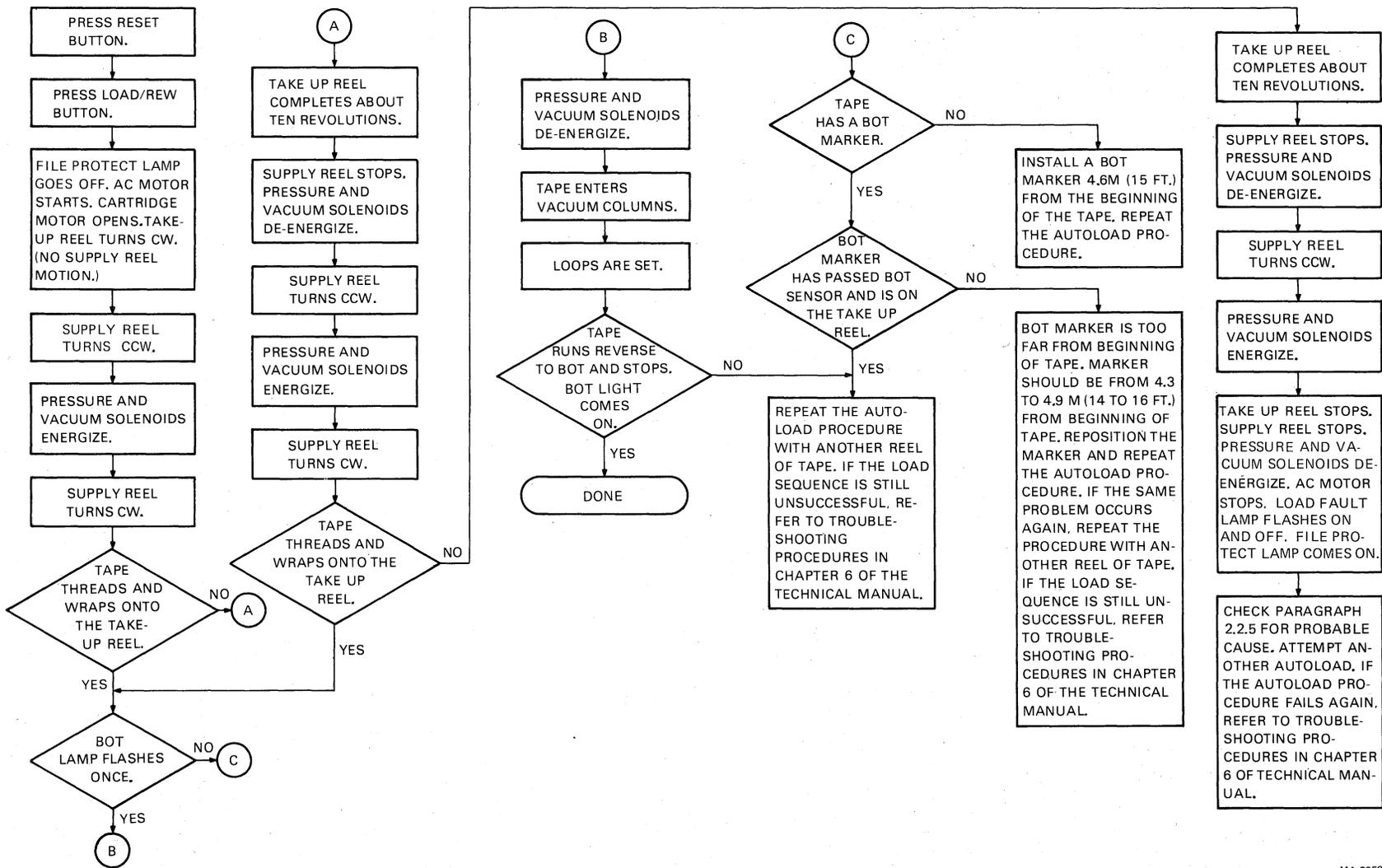
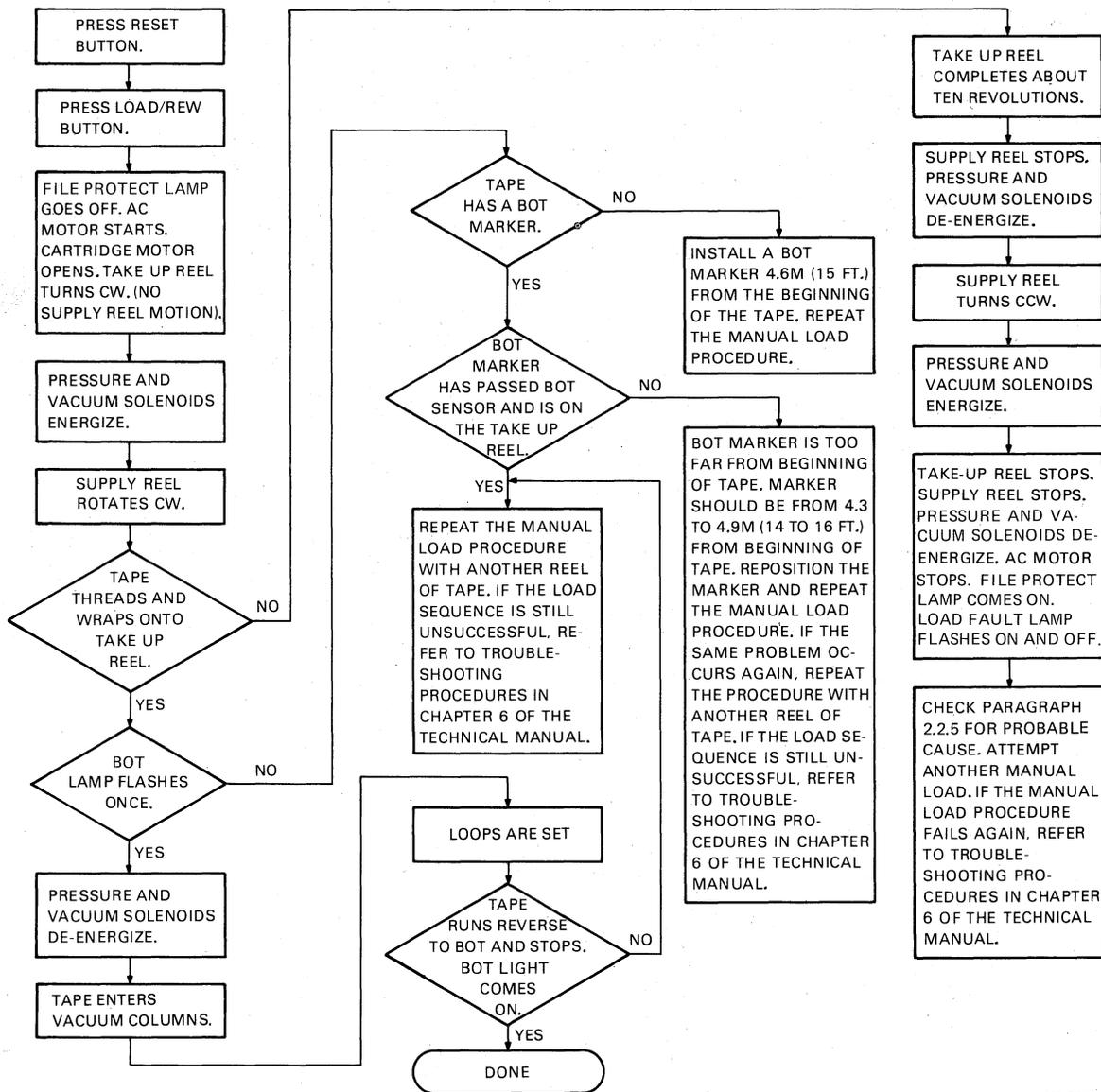


Figure 3-18 Autoload Sequence



MA-2655A

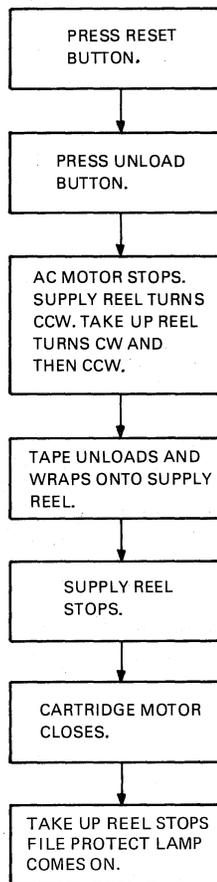
Figure 3-19 Manual Load Sequence

**3.5.1.5 Manual Load Sequence** – Install a write enable ring on a 216 mm or 178 mm (8.5 in or 7 in) tape reel. Mount the reel onto the supply hub. Check that the leader has no creases or rips. If necessary, crimp the end of the tape with the tape crimper. Insert 8 cm to 10 cm (3 in to 4 in) of tape into the threadblock column. Close the transport front door. Follow the instructions and check for the events specified in Figure 3-19.

**3.5.1.6 Unload Sequence** – Follow the instructions and check for the events specified in Figure 3-20.

**3.5.1.7 Manual Load Repeatability** – Perform the following steps.

1. Mount a 216 mm or 178 mm (8.5 in or 7 in) tape reel onto the supply hub.



MA-2652

Figure 3-20 Unload Sequence

2. Check that the leader has no creases or rips. If necessary, crimp the end of the tape with the tape crimper.
3. Insert 8 cm to 10 cm (3 in to 4 in) of tape into the threadblock column.
4. Close the transport front door.
5. Initiate a manual load by pressing and releasing the LOAD/REW button.
6. If the tape loads successfully, press the UNLOAD button to unload the tape.
7. Repeat steps 3, 4, 5, and 6 eight times. If a failure occurs within the 8 tests, continue manual loading up to 20 tests. There should be no more than 3 failures among 20 successive tests.

After completing the manual load repeatability test, check the tape for damage caused by the tape transport. The tape should not show damage sufficient to cause a load failure or data errors.

### 3.5.1.8 Autoload Repeatability – Perform the following steps.

1. Mount a 267 mm (10.5 in) tape reel onto the supply hub.
2. Check that the leader has no creases or rips. If necessary, crimp the end of the tape with the tape crimper.
3. Close the transport door.
4. Initiate an autoload by pressing and releasing the LOAD/REW button.
5. If the tape loads successfully, press the UNLOAD button to unload the tape.
6. If autoload fails, the tape automatically tries to load a second time. If the second attempt fails, the load fault lamp flashes. This is counted as one failure.
7. Repeat steps 4, 5, and 6 nine times. If a failure occurs within the 9 tests, continue autoloading up to 20 tests. There should be no more than 2 failures among the 20 successive tests.
8. After completing the autoload repeatability test, check the tape for damage caused by the tape transport. The tape should not show damage sufficient to cause a load failure or data errors.

### 3.5.2 Subsystem Quick Check

Perform this test using the TM78 formatter for each TU78 transport, one at a time.

1. Load a write enabled scratch tape on the desired transport. Place the transport on-line.
2. Place the transport port select switch in the number 3 position (maintenance mode).
3. Enable the TM78 maintenance keypad by pressing the ENA key. The display should respond with **HELLO**.
4. Select the transport as follows.
  - Press **0** (parameter item #0).
  - Press **PAR**. (The display should flash parameter item 0, then display its contents.)
  - Enter the TU number to be exercised by pressing **0, 1, 2, or 3**.
  - Press **DEP**. (The display should flash the new contents of parameter item 0).
5. Issue a Write GCR command to the transport.
  - Enter **63**. (The display should show **63**).
  - Press **EXE**.

The subsystem executes the write GCR command, puts the results in the display, and waits for the next command. The results are in the format **II–FF**, where **II** is the interrupt code and **FF** is the failure code. The only two acceptable results are **01–00** (done with no errors), or **01–01** (done with a correctable error). Any other results are not acceptable, indicating a problem somewhere in the subsystem. Refer to the interrupt code/failure code cross-reference and troubleshooting sections of the *TM78 Technical Manual*.

- The write GCR command may be executed again by pressing **EXE**, or repeatedly by pressing **REP**. To halt a repeated operation, press **CLR**.
6. Repeat the quick check (steps 1, 2, 4, and 5) for each transport in the subsystem.
  7. Disable the keypad by pressing the **ENA** key. The display should go blank.
  8. Turn both TM78 MASSBUS ports on-line, by flipping TM78 backplane DIP switches 1 and 5 to the left 1 position.
  9. Verify each TU78 vacuum and pressure setting by performing the procedures in Paragraph 6.5.4 of the *TU78 Technical Manual, Volume 2*. This is especially important if a high altitude belt/pulley kit has just been installed. Adjust any setting that is out of tolerance.

### 3.5.3 TM78/TU78 System Level Diagnostics

Mount and load a write enabled 267 mm (10.5 in) tape reel. Place the transport on-line and check that the on-line indicator lights. Set the transport port select switch to 0 or 1, depending upon the MASSBUS port being driven. If exercising a single port subsystem, set the switch to 0.

Table 3-3 lists the TM78/TU78 diagnostics for DECsystem 10/20 and VAX-11/780 systems. Load and run the appropriate diagnostics. Refer to the instructions in the diagnostic documentation and use the parameters specified in the following paragraphs.

**Table 3-3 TM78/TU78 Diagnostics for Acceptance Testing**

Title	DECSYSTEM-20	VAX	Description
Control Logic Test	DFTUI	EVMAE	Tests MASSBUS controller and TM78 formatter logic. Also tests subsystem basic command functions while checking for proper tape motion timing. Must be run from each CPU separately, through both MASSBUS ports (if dual port option present). Provides error information to user via console or line printer.
Data Reliability	DFTUJ	EVMAA	Tests TM78 circuitry and TU78 circuitry by writing and reading predetermined data patterns and recording modes. Provides error information to user via console or line printer. May be run in dual port mode (from dual CPUs) driving two or more transports.

### 3.5.3.1 DECsystem 10/20 Diagnostics

#### DFTUI (Basic/Control Logic Supervisor)

1. Run one pass of test "accept" (TM78 acceptance) with all manual intervention tests enabled.  
Allow one pass with no errors.
2. Run "accept" for five passes with manual intervention tests disabled.  
Allow five passes with no errors.

#### DFTUJ (Data Reliability)

1. Allow one pass in default mode with the error criteria listed in Table 3-4.

### 3.5.3.2 VAX 11/780 Diagnostics

#### Standalone Mode (Level 3)

1. Control Logic Test (EVMAE) - Boot the diagnostic supervisor (ESSAA) and configure system (select drives, RHs, etc.) to run TM78/TU78.

Run the control logic test (EVMAE) for one pass with all manual intervention tests enabled. After loading the diagnostic supervisor, in order to print the subtest header information, type in SET TRACE.

Proceed as follows after the supervisor prompt.

```
DS>SET TRACE  
DS>RUN EVMAE/SEC:MANUAL
```

Allow one pass with no errors.

Run the control logic test again for five passes without the manual intervention tests as follows.

```
DS>START/PASS:5
```

Allow five passes with no errors.

2. Data Reliability (EVMAA) – Run the data reliability exerciser (EVMAA) for one pass. A pass comprises two complete tape passes (to EOT), once for PE format and once for GCR format.

Proceed as follows after the supervisor prompt.

```
DS>RUN EVMAA
```

or in conversation mode

```
DS>ST/SEC:CONVER
```

Allow one pass with the error criteria in Table 3-4.

### On-Line Mode Under VMS (level 2)

1. Boot the VMS operating system and load the diagnostic supervisor (ESSAA). Run the data reliability test (EVMAA) for one pass, preferably with other users (jobs) running simultaneously.

Allow one pass with the error criteria in Table 3-4. Make sure that the TU78 tape subsystem does not degrade total system performance in the on-line mode.

**Table 3-4 Maximum Error Rate Per Pass**

Error Type	Write	Read	Read Reverse
Status Errors	0	0	0
Non-recoverable	0	0	0
Media	20	—	—
Double track corrections	—	1	1
Single track corrections	—	5	5
Data compare	—	0	0
Others	10	5	5

#### NOTES

One pass consists of writing and reading from BOT to EOT twice, once in each density mode.

If the TU78 does not meet these specifications, further passes are necessary to determine the validity of errors.



## **CHAPTER 4 CUSTOMER CARE AND PREVENTIVE MAINTENANCE**

### **4.1 CUSTOMER RESPONSIBILITIES**

The following is a list of maintenance procedure for which the customer is responsible.

1. Obtain operating supplies, including magnetic tape and cleaning supplies.
2. Supply accessories, including cabinetry, tables, and chairs.
3. Maintain the required logs and report files consistently and accurately.
4. Make the necessary documentation available in a location convenient to the system.
5. Keep the exterior of the system and the surrounding area clean.
6. Make sure that ac plugs are securely plugged in each time equipment is used.
7. Perform specific equipment care operations described in Paragraph 4.2 and 4.3 at the suggested frequencies, or more often if usage and environment warrant.

### **4.2 MAGNETIC TAPE CARE**

The following is a list of steps necessary for properly maintaining magnetic tape.

1. Do not expose magnetic tape to excessive heat or dust. Most tape read errors are caused by dust or dirt on the read head; it is imperative that the tape be kept clean.
2. Always store tape reels inside containers when they are not in use. Keep the empty containers tightly closed to keep out dust and dirt.
3. Never touch the portion of tape between the BOT and EOT markers. Oil from fingers attracts dust and dirt.
4. Never use a contaminated reel of tape. This spreads dirt to clean tape reels and could have an adverse affect on tape transport reliability.
5. Always handle tape reels by the hub hole. Squeezing the reel flanges could lead to tape edge damage in winding or unwinding tapes.
6. Do not smoke near the tape transport or storage area. Tobacco smoke and ash are especially damaging to tapes.

7. Do not place magnetic tape near any line printer or other device that produces paper dust.
8. Do not place magnetic tape in any location where it might be affected by hot air.
9. Do not store magnetic tape in the vicinity of electric motors.

### 4.3 PREVENTIVE MAINTENANCE

#### 4.3.1 General

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

#### 4.3.2 Preventive Maintenance

To ensure trouble-free operation, a preventive maintenance schedule should be kept. This involves cleaning only a few items, but the cleanliness of these items is very important to proper tape transport operation. The frequency of the cleaning varies with the environment and degree of use of the transport. Therefore, it is difficult to define a general schedule for all machines. Daily cleaning is recommended for TU78 units in constant operation in ordinary environments. This schedule should be modified if experience shows other periods are more suitable. Paragraph 4.3.4 contains the cleaning instructions.

Before performing any cleaning operation, remove the file reel and store it properly. All items in the tape path should be cleaned on a daily basis. It is important to be thorough yet gentle and to avoid certain dangerous practices. Some tape cleaners are strong cleaning agents and should not come in contact with painted surfaces or plastic.

#### CAUTION

**Do not use acetone or lacquer thinner, rubbing alcohol, or excessive cleaner. Be extremely careful not to allow the cleaner to penetrate ball bearings and motors.**

#### 4.3.3 Magnetic Tape Transport Cleaning Kit

A magnetic tape transport cleaning kit (TUC01) has been provided. Its materials do not harm tape equipment and do not leave any residue behind to interfere with data reliability. The following paragraphs contain hints to make sure that the very best results are obtained.

The Freon TF113<sup>TM</sup> cleaning fluid in this kit is one of the safest and best degreasing agents available. It does not adversely affect any part of DIGITAL's tape equipment. To ready the can, unscrew the top and punch a small hole in the metal seal covering the pour spout.

#### WARNING

**TF113 is a non-restricted, non-hazardous substance. However, avoid excessive skin contact. Do not allow it to come in contact with the eyes, and do not swallow it. Use only in a well-ventilated area.**

---

<sup>TM</sup>Trademark of Dow Chemical Company

Never dip a contaminated cleaning swab or wipe into the can. To transfer fluid onto the swab, pour a little into the cap and dip the swab into the cap. Discard the fluid remaining in the cap when the cleaning operation is complete.

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

Use the cleaning materials contained in the kit to clean tape heads, air bearings, tape guide blocks, the tape cleaner, capstan, reel hubs, and any part of the transport where a dirty residue might contact the tape. To clean other parts of the transport (such as the exterior surfaces of doors) use any reasonably clean, lint-free material, with or without cleaning fluid.

#### NOTE

**For an unusually stubborn dirt deposit that appears to resist TF113, try a mild soap and water solution to dislodge it. After using soap, be sure to wash down the affected area thoroughly with TF113 to remove soapy residues.**

#### 4.3.4 TU78 Tape Transport

Perform the following steps to clean the TU78 tape transport.

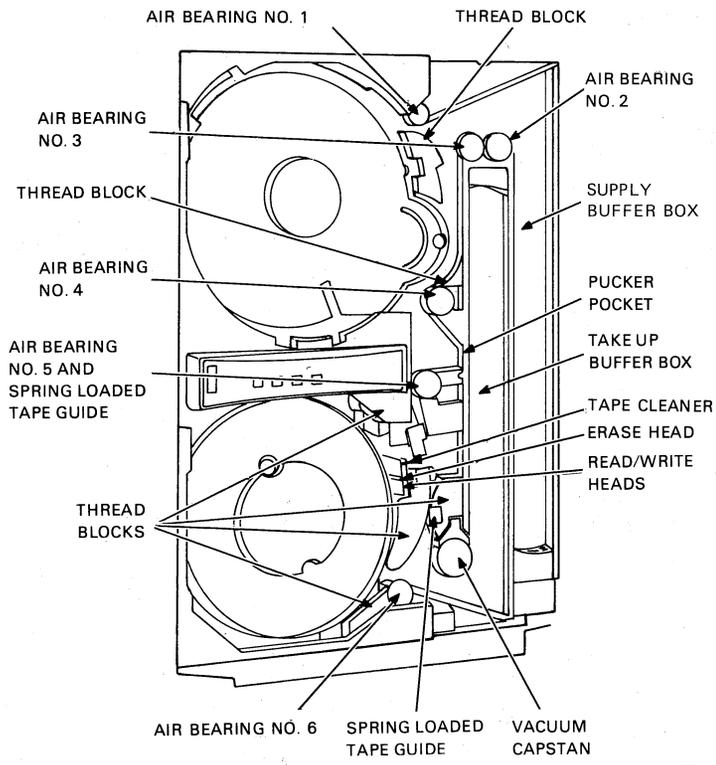
1. Dismount the tape from the unit.
2. Clean the following components of the transport using a foam-tipped swab soaked in cleaning fluid (Figure 4-1).

Read/write head  
Erase head  
Tape cleaner  
Air bearings (6)  
Spring-loaded ceramic tape guides (2)  
Thread blocks (6)  
Capstan  
Buffer boxes (2)  
Pucker pocket  
Buffer box glass, pocket glass, door overlay

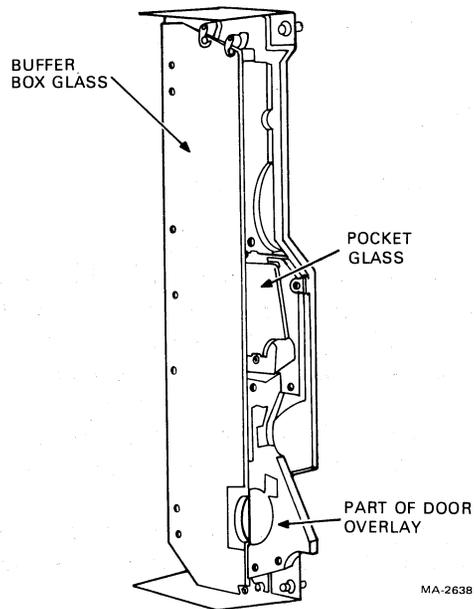
#### NOTE

**Only use the foam-tipped swabs. Do not touch any part of the tape path since oil from fingers attracts dust and dirt. Also, excessive physical pressure on the capstan could affect its alignment.**

3. When cleaning the thread blocks, be sure to clean the air guide ports. Every thread block has air guide ports except the metal block containing the spring-loaded tape guide.
4. When cleaning the spring-loaded ceramic guides, be sure that the washer is pressed firmly against the tape guide surface and not hung up on its shaft.
5. When cleaning the inner surface of the vacuum door, use a lint-free wipe and cleaning fluid. Pass another lint-free wipe over the head using a polishing action to remove any remaining deposits.



a. Tape Path Items



b. Buffer Box Door

Figure 4-1 Transport Items for Daily Cleaning

#### 4.4 ORDERING SUPPLIES, ACCESSORIES AND DOCUMENTATION

For information about supplies, accessories, and additional documentation for your TU78 tape transport (or for any DIGITAL equipment), contact your local sales office or call DIGITAL Direct Catalog Sales.

Continental US, 8:30 am to 6 pm (EST), call 800-258-1710  
New Hampshire, 8:30 am to 6 pm (EST), call 603-884-6660  
Chicago, 8:15 am to 6 pm (CT), call 312-640-5612  
San Francisco, Alaska, and Hawaii, 8:15 am to 6 pm (PT),  
call 408-734-4915.

Terms and conditions include net 30 days and F.O.B. DIGITAL plant. Freight charges are prepaid by DIGITAL and added to the invoice. Minimum order is \$100.00. (Minimum does not apply when full payment is submitted with an order). Checks and money orders should be made out to Digital Equipment Corporation.

Purchase orders for supplies, accessories, and documentation should be sent to the following address.

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

Purchase orders must show shipping and billing addresses and state whether a partial shipment will be accepted.

In addition to the hardware documentation listed in Table 1-1, the following accessories and supplies may be purchased to support the TU78 tape transport.

Item	Part No	Description
Magnetic Tape	TUM24-A	732 M (2400 ft) magnetic tape in autoloader belt
Magnetic Tape	TUM24-AL	10 TUM24-A tapes
Magnetic Tape	TUM24-AM	50 TUM24-A tapes
Autoloader Belts	TUM24-AX	10 autoloader belts for 26.7 cm (10.5 in) diameter tape reels
Cleaning Kit	TUC01	Magnetic tape transport cleaning kit containing fluid, swabs, wipes, and cleaning instructions
Markers	90-09177-00	Magnetic tape foil sensing markers for re-creating EOT/BOT points



## APPENDIX A GLOSSARY

ACRC	Auxiliary cyclic redundancy check
AMTIE	Amplitude track in error
ANSI	American National Standards Institute
BOT	Beginning of tape
CPU	Central processor unit
CRC	Cyclic redundancy check
DIP	Dual in-line package
ECC	Error correcting code
EOT	End of tape
FCPI	Flux changes per inch
GCR	Group code recording
IRWU	Interface rewind unload
MIA	Multiple interface adaptor
PCB	Printed circuit board
PE	Phase-encoded
REW	Rewind
TIP	Tape in path
TU BUS	Tape unit bus
WLO	Write lockout



**TU78 MAGNETIC TAPE TRANSPORT  
USER'S GUIDE  
EK-0TU78-UG-002**

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