TMB11/TS03
DECmagtape system
user's manual
(TMB11-M system)

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TMB11/TS03 DECmagtape Systems

CHAPTER 1
GENERAL INFORMATION

1.1 INTRODUCTION

The TMB11-MA/MB* DECmagtape System (TMB11/TS03)† is a magnetic tape storage system that interfaces with the PDP-11 family of processors and peripherals and provides storage for digital information. The system reads and records digital data in parallel in a 9-channel, 800 bpi, industry-compatible NRZI format.

1.2 GENERAL DESCRIPTION

1.2.1 System Configuration

The TMB11/TS03 DECmagtape System is composed of the TMB11 Controller and the TS03-M Master Tape Transport. The master tape transport is made up of a "slave" transport and an M8920 Adapter Module. A second "slave" transport (TS03-S) can be added that will interface with the adapter module contained in the master transport. Figure 1-1 is an illustration of the TMB11/TS03 system configuration.
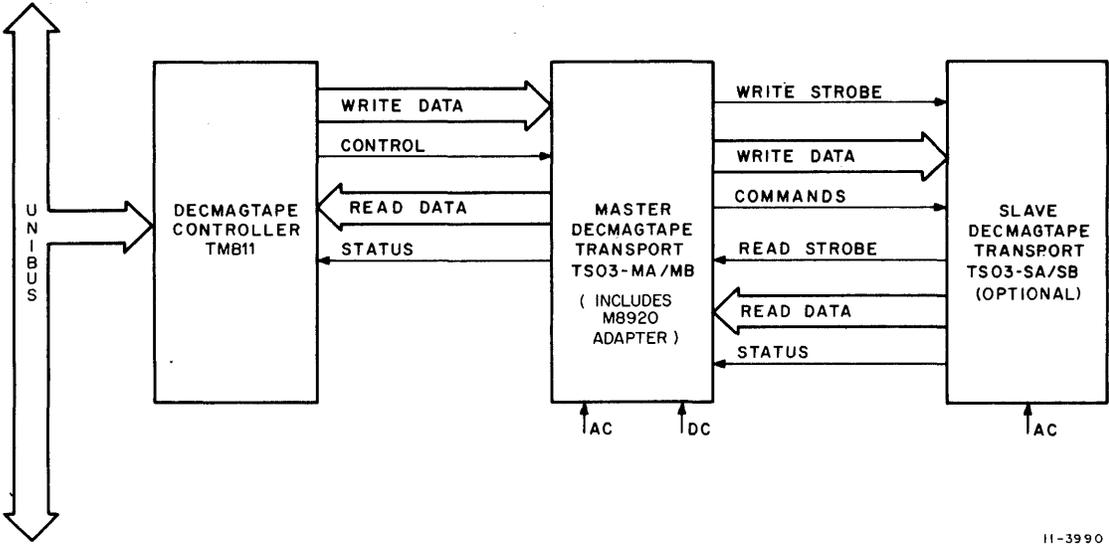
Figure 1-1   TMB11/TS03 System Configuration

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*The TMB11-MA is a 115-Vac, 60-Hz system.
 The TMB11-MB is a 230-Vac, 50-Hz system.

†The TMB11-M system is commonly referred to by its component subunits, the TMB11 and the TS03, hence the manual title *TMB11/TS03 DECmagtape System User's Manual*. Within this manual the system is referred to as the TMB11/TS03.

The TMB11 Controller interfaces the DECmagtape system to the PDP-11 Unibus. It controls data transfers, issues control commands to the TS03 master, and monitors system operation. Each TMB11 can control two TS03 transports: a master and a slave.

The TS03-M transport consists of an M8920 Adapter Module and a transport. The M8920 processes commands from the controller and issues motion and read/write commands to the master and slave transports; the M8920 also monitors status lines from the master and slave transports. Any status changes at the selected transport are reported immediately to the controller. In response to inputs from the adapter, the tape transport controls tape motion and records and reads data on magnetic tape. Two models of the master DECmagtape transport are available: the TS03-MA, which requires 115 V, 60 Hz primary power, and the TS03-MB, which requires 230 V, 50 Hz primary power. Both models also require +5 ± 5% V at 3 A and an AC LO signal.

The TS03-S transport consists of a tape transport only. In response to inputs from the master transport adapter, it controls tape motion and records and reads data on magnetic tape. The TS03-SA requires 115 V, 60 Hz primary power and the TS03-SB requires 230 V, 50 Hz primary power.

1.2.2 Physical Description
The TMB11 (Figure 1-2) consists of the following six modules:

1. M105 – Address Selector Module
2. M795 – Word Count and Bus Address Module
3. M796 – Unibus Master Control
4. M7821 – Interrupt Control Module
5. M7911 – Tape Drive Interface
6. M7912 – TMB11 Unibus Registers

The six modules are plugged into a TMB11 system unit that is mounted in an expander box. Unibus input, Unibus output, and tape transport cabling also connect to the system unit.

The tape transport (Figure 1-3) is a single, rack-mounted drawer with the M8920 Adapter Board mounted underneath on the master transports. The adapter is a hex height module; it is hinged at the front corners and swings down as shown in Figure 1-4.
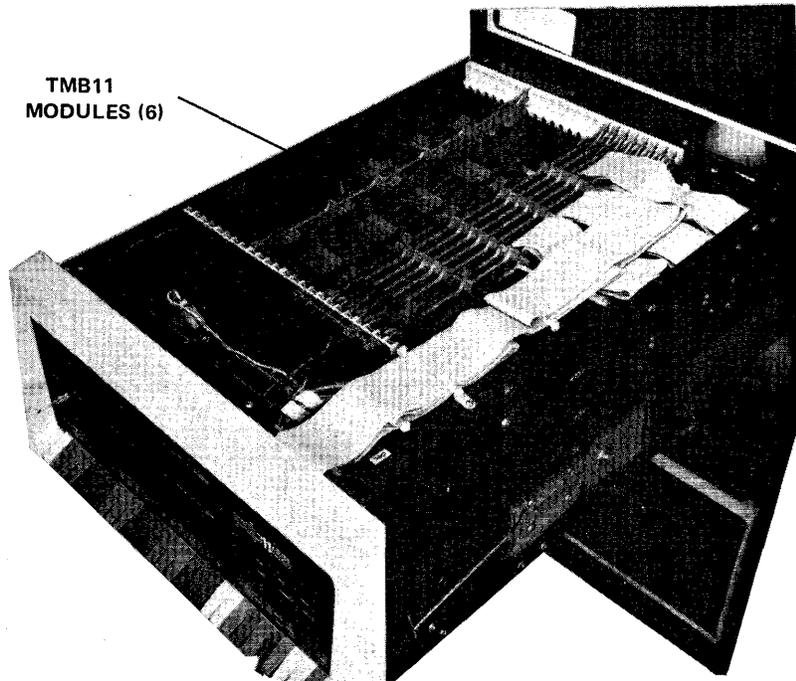
TMB11
MODULES (6)

7941-6

A.   Installed in BA11K Expander Box
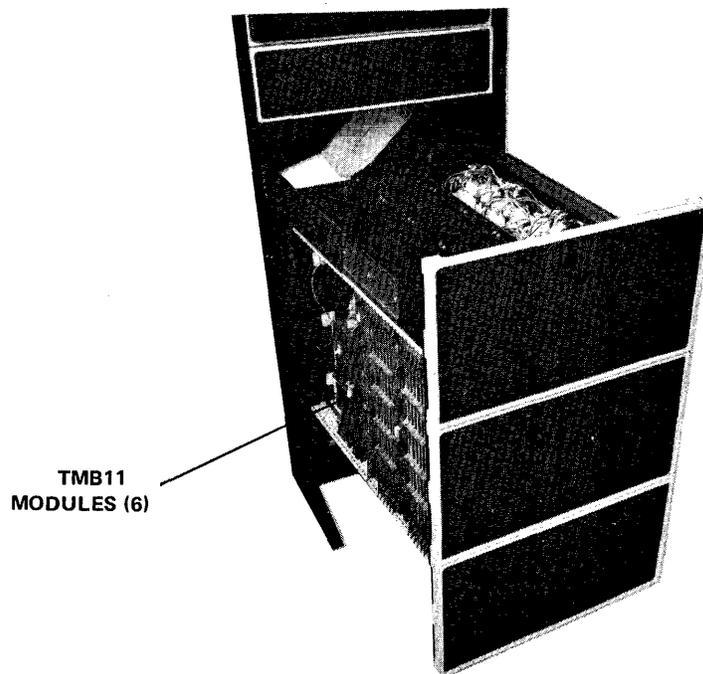
TMB11
MODULES (6)

7997-2

B.   Installed in BA11F Expander Box

Figure 1-2   TMB11 Controller
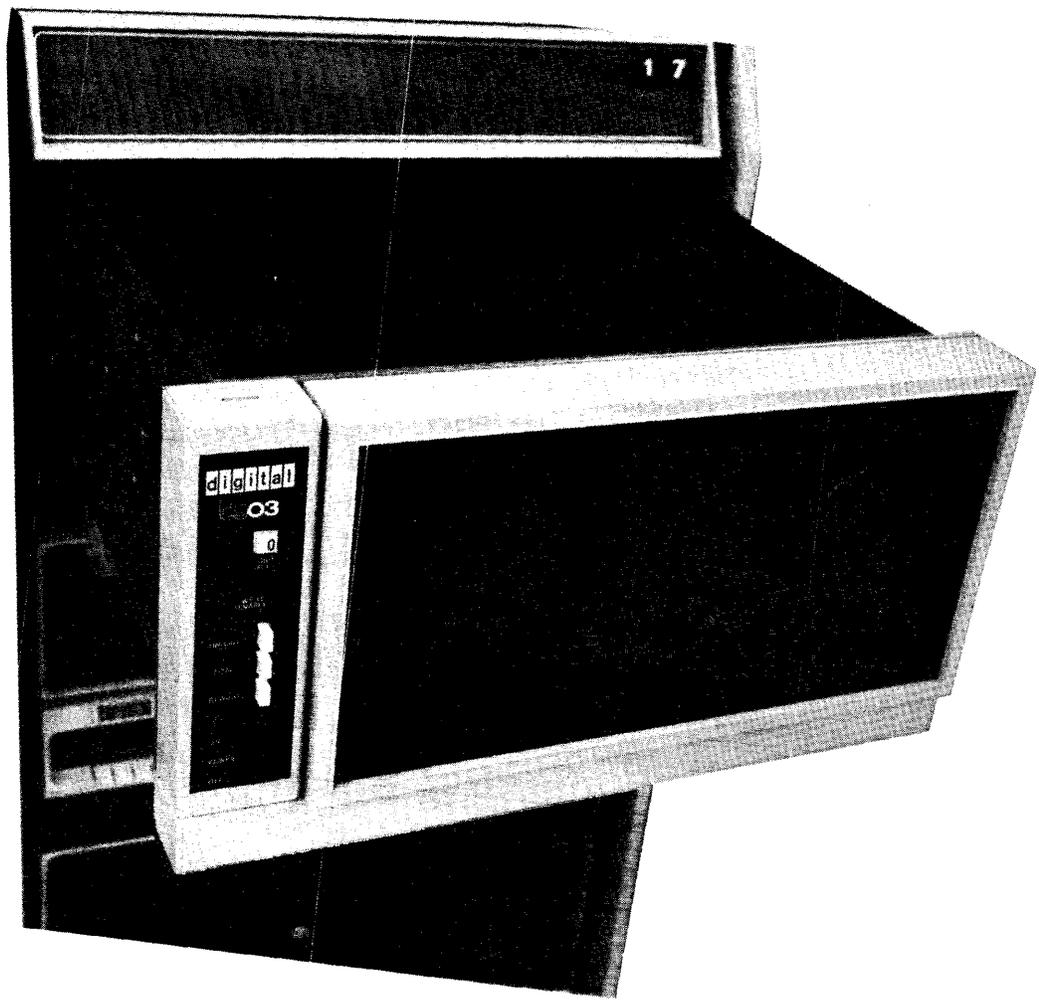
Figure 1-3   TS03 Tape Transport

7941-8

TS03
MASTER TAPE
TRANSPORT

M8920
ADAPTER
MODULE

7461-2
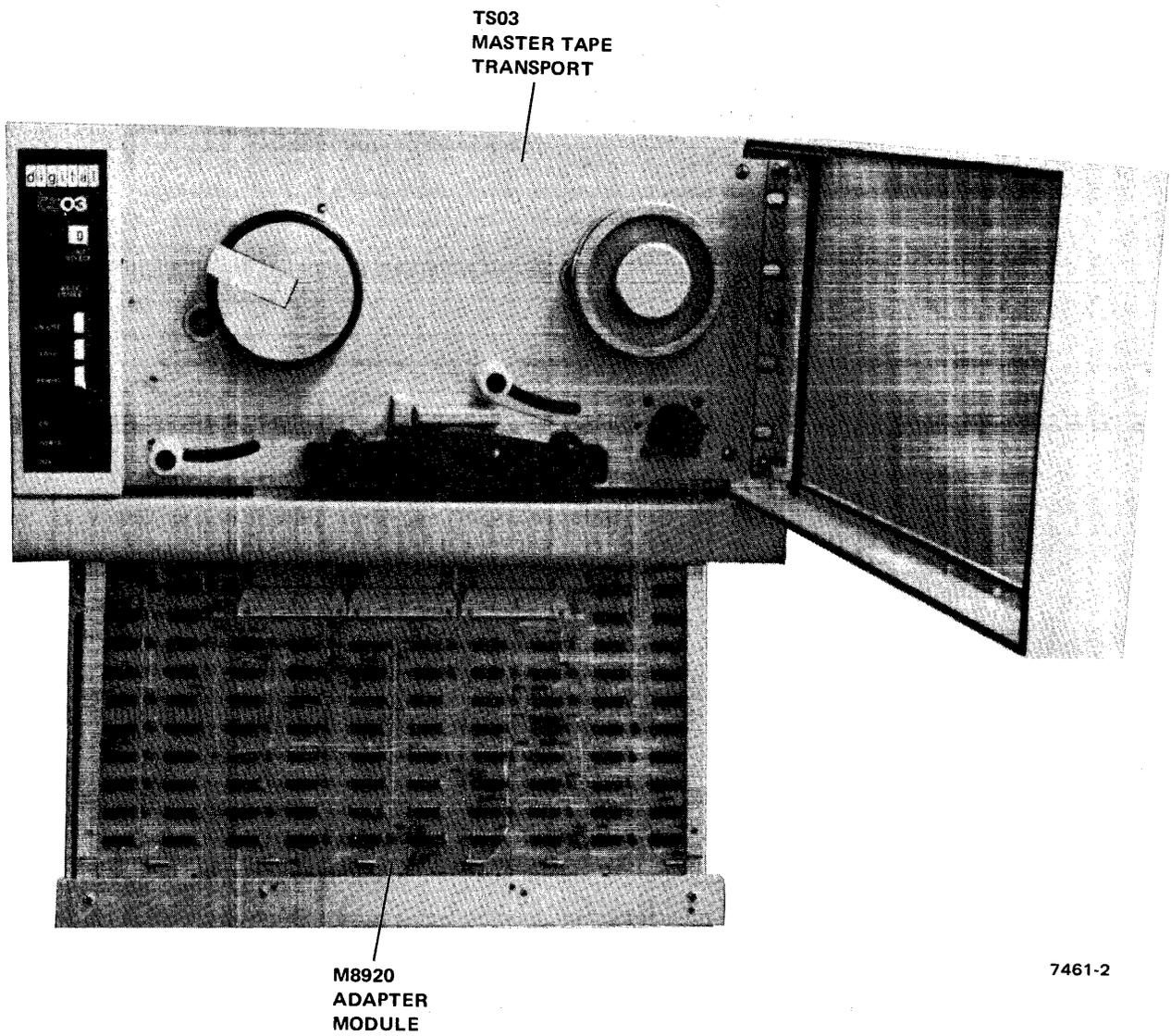
Figure 1-4   TS03-M Master Tape Transport with M8920 Adapter Module

1.3 SYSTEM FUNCTIONAL DESCRIPTION

NOTE
The TS03 tape transport operates at only one density (800 bpi) and in only one mode of operation (9 track). Consequently the system discussion that follows is restricted to these system limitations. The TMB11 is capable of other densities and can operate in the 7-track normal and 7-track core dump modes.

The basic functions performed by the controller are: off-line, read, write, write EOF, space forward, space reverse, write-with-extended-IRG, and rewind. Each of these functions is briefly described in Table 1-1.

Table 1-1 Controller Functions

Function	Description
Off-Line	The off-line function is used when it is desired to return control to the tape transport so that tape can be rewound, reels changed, etc. without using processor time.
	The off-line function places the selected tape transport in the off-line (local) mode and causes it to begin a rewind operation.
	The controller cannot write on or read from the magnetic tape when the off-line function is used.
Read	This function permits reading from the magnetic tape. During the read operation, the data portion of the record is loaded into the controller data buffer for transfer to the memory. The LRC and CRC characters are read but not transferred into memory.
Write	This function permits writing on the magnetic tape. During the write operation, data from the bus is loaded into the controller data buffer register. The controller then transfers the data to the tape transport write heads. The necessary LRC and CRC characters are generated by the master transport and written on the tape following the data. The write function advances the tape one record.
Write EOF	This function writes an end-of-file (EOF) mark on the tape. When selected, this function erases a 3-in. segment of tape prior to writing the first character. The EOF mark and the associated LRC character are considered one record. The EOF mark is an octal 23 character followed by an octal 23 LRC character.

Table 1-1 Controller Functions (Cont)

Function	Description
Space Forward	This function is used to skip over a number of records to find a specific record on the tape. When selected, the space forward function causes the tape transport to advance a specified number of records. The number of records is determined by the value in the byte record counter. This value is loaded into the byte record counter by the program. Space forward is used for tape positioning only and, therefore, does not affect information stored on the tape or in memory.
Space Reverse	This function is identical to the space forward function except the tape moves in the reverse rather than in the forward direction.
Write-with-Extended-IRG	This function is identical to the write function except that a 3-in. segment of tape is erased before writing the first character.
Rewind	This function is used for rewinding the tape on the feed reel so that the tape can either be unloaded from the transport or operation can start at the beginning of the tape. When this function is used, the tape moves in the reverse direction, at a much higher speed (75 in./sec) than for other functions, until the beginning-of-tape (BOT) marker is detected. When the BOT marker is detected, the tape slows down and comes to a complete stop at a point well beyond the BOT marker. It then moves forward again until the BOT marker is again detected, whereupon, it comes to a final stop. Rewind is used for tape positioning only and has no effect on information stored on the tape or in the memory.

Figure 1-5 is a functional block diagram of the TMB11/TS03 DECmagtape System. The processor initiates a TMB11/TS03 operation by addressing the TMB11 registers via the address decoder and loading the operation parameters* into the registers. The BUS C0–C1 bits specify an out transfer (with respect to the processor) causing SEL OUT to be asserted for the particular register addressed. As each register is selected, the processor places the appropriate data on the Unibus data lines which is then loaded into the register with the SEL OUT strobe. Thus, the command register receives the type of operation to be performed; the byte–record count register receives the number of bytes to be transferred; and the current memory address register receives the memory address of the first byte to be transferred.

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*Parameters include four recording density choices that are sent to the transport as DEN 5 and DEN 8 bits. The TS03 ignores these bits and operates at 800 bpi, 9-channel only.
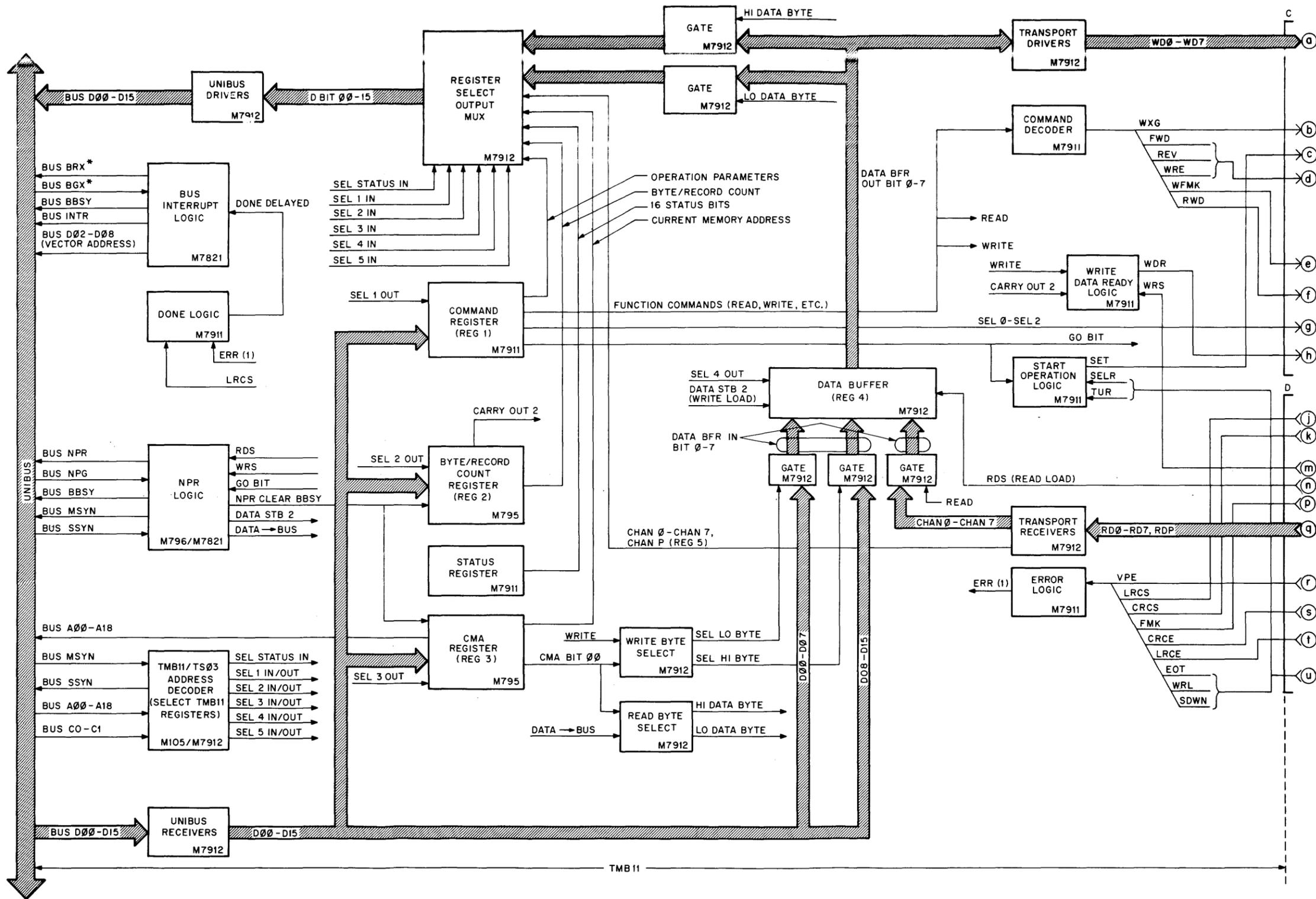
Figure 1-5 TMB11/TS03
Functional Block Diagram
(Sheet 1 of 2)
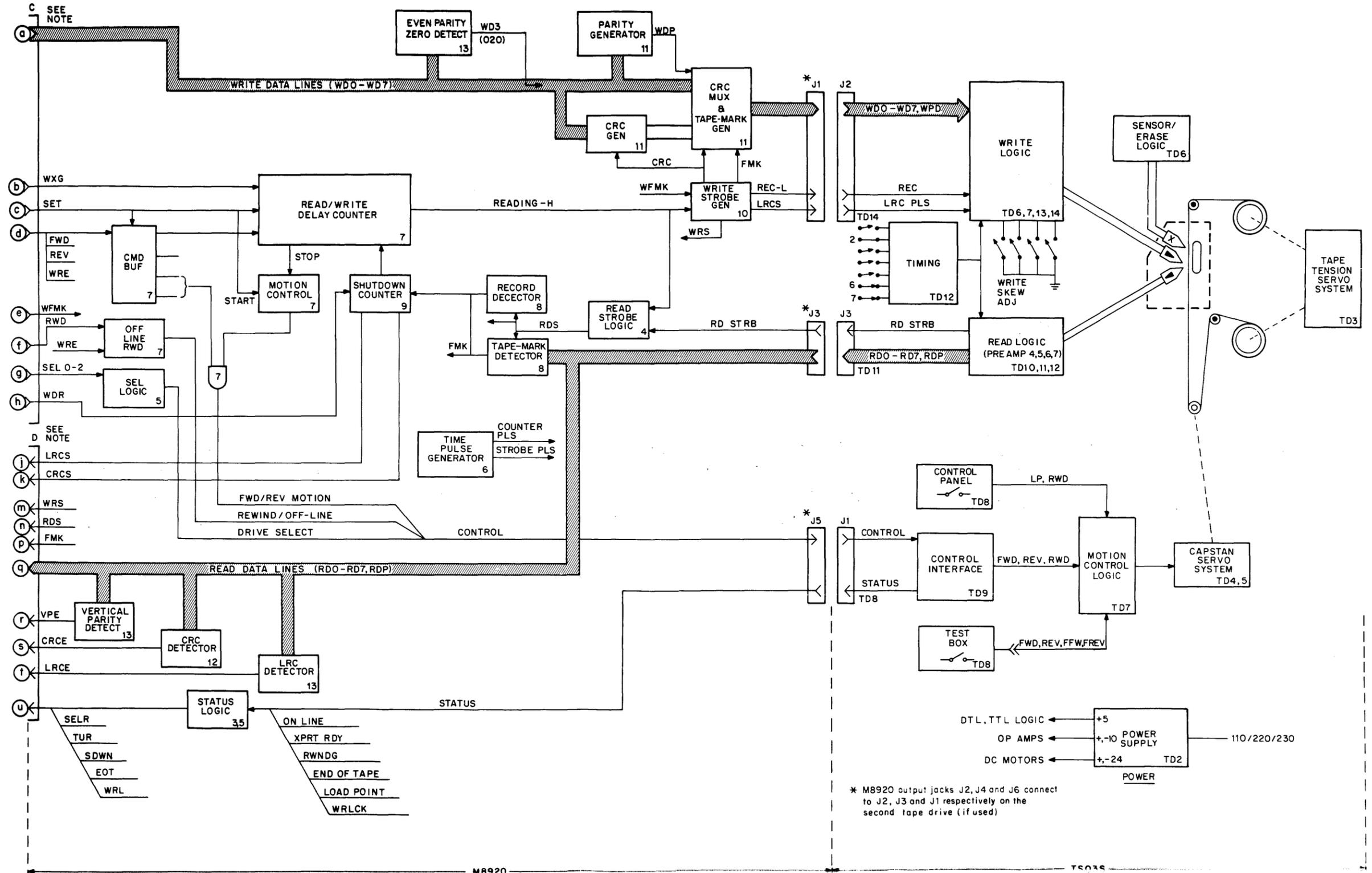
1-8

Figure 1-5   TMB11/TS03
Functional Block Diagram
(Sheet 2 of 2)

1-9

The command register selects which transport is to be involved in the transfer via the SEL 0 – SEL 2 lines, supplies the function command to the command decoder which generates the required commands for the tape transport, and asserts the GO bit to the start logic. When the start logic senses that the tape transport has been selected (SELR) and is ready (TUR), it asserts SET to the transport to start the operation.

If a read operation is commanded, the transport command buffer asserts FWD MOTION to the motion control logic which drives the capstan servo and moves the tape forward. When the tape is up to speed, the transport read logic is enabled and starts to receive data from the read heads. The read data out of the read logic (RD0–RD7, RDP) is checked for CRC, LRC, and vertical parity errors. If any such errors are detected, the TMB11 error logic is notified (CRCE, LRCE, VPE) for appropriate corrective action.

The read data is supplied to the controller along with a read strobe (RDS) which signifies the availability of read data from the transport. RD0–RD7 becomes CHAN0–CHAN7 and is gated to the data buffer register where it is loaded into the register by RDS.

RDS also requests an NPR transfer from the NPR logic. When the request is granted BUS BBSY is asserted by the logic along with DATA→BUS which gates the output of the data buffer to the Unibus data bus (BUS D00–D15) via the register select output multiplexer. DATA→BUS accomplishes this by asserting either HI DATA BYTE or LO DATA BYTE from the read byte select logic according to whether the CMA register is addressing the low byte or the high byte in memory. Thus, the data byte from the data buffer will output on either BUS D00–D07 or BUS D08–D15. The next character read will output on the alternate half of the data bus. When the NPR logic receives BUS SSYN from the memory, it asserts NPR CLEAR BBSY which increments the byte/record counter and the CMA register to prepare for the next transfer.

If a write operation is commanded by the command register, the GO BIT, in addition to enabling the start operation logic, requests an NPR transfer from the NPR logic. When the request is granted, the logic asserts BUS BBSY and BUS MSYN. The memory responds with SSYN to indicate that the first data character is on the data bus (BUS D00–D15). The NPR logic asserts DATA STB 2 which loads the data character into the data buffer, thus making it available to the transport as WD0–WD7. The data character enters the data buffer via one of two gates. In the write mode CMA BIT 00 asserts either SEL LO BYTE or SEL HI BYTE, according to whether the CMA register is addressing the low byte or the high byte in memory, thereby enabling the gate corresponding to the location of the character on the data bus.

Meanwhile, the start operation logic has asserted SET to the transport which, as in a read operation, will cause the transport command buffer to assert FWD MOTION and start the capstan servo system moving forward.

When the tape is up to speed, writing of the data characters begins. WDR (write data ready) from the controller inhibits the transport shutdown counter and enables the write strobe generator via the read/write delay counter. The write strobe generator produces REC pulses which record the data characters on tape via the write heads. A parity bit is generated for each character and a CRC character is generated for each record. Each time a character is written on tape, a WRS pulse is issued to the controller requesting the next character to be written. The WRS pulse makes an NPR request from the NPR logic and the cycle is repeated. Note that in a write operation, the GO BIT makes the first NPR request and the WRS strobes make the second and subsequent requests. After the NPR logic issues DATA STB 2 it asserts NPR CLEAR BBSY which increments the byte/record counter and the CMA register to prepare for the next transfer. When the byte/record counter senses that the desired number of bytes has been transferred (read or written), it asserts CARRY OUT 2 which negates WDR to the transport thereby inhibiting the write strobe generator and enabling the shutdown counter.

The end of a data transfer is indicated by the LRCS character at the end of each record. The LRCS strobe is applied to the done logic which then asserts DONE DELAYED to the bus interrupt logic. The interrupt logic requests a bus interrupt to notify the processor that the command operation has been completed and the TMB11/TS03 is ready for another command.

The TMB11 error logic monitors transport status including parity, CRC, and LRC errors and asserts ERR(1) to the done logic if an error condition exists. Some types of errors warrant terminating an operation before it is completed while others will wait until the end of the operation before asserting ERR(1).

The processor can read the TMB11 registers by addressing the registers and requesting an in-transfer (with respect to the processor) via the BUS C0–C1 bits. The address decoder then asserts SEL IN for the particular register selected which gates the register bits out to the data bus via the register select output multiplexer.

1.4 APPLICABLE DOCUMENTS
Table 1-2 lists PDP-11 documents that are applicable to the TMB11/TS03 DECmagtape System.

Table 1-2 Applicable Documents

Title	Description
PDP-11 Processor and Systems Manual	A series of maintenance and theory manuals that provide a detailed description of the basic PDP-11 system.
PDP-11 Processor Handbook	A general handbook that discusses system architecture, addressing modes, the instruction set, programming techniques, and software.
PDP-11 Peripherals Handbook	A handbook devoted to a discussion of the various peripherals used with PDP-11 systems. It also provides detailed theory, flow, and logic descriptions of the Unibus and external device logic; methods of interface construction; and examples of typical interfaces.
DIGITAL Logic Handbook, 1973-74 Edition	Presents functions and specifications of the M-series logic modules, accessories, and connectors used in the TMB11 Controller and the TS03 DECmagtape Transport. Includes other types of logic produced by DEC but not used with PDP-11 devices.
Paper-Tape Software Programming Handbook	Provides a detailed discussion of the PDP-11 software system used to load, dump, edit, assemble, and debug PDP-11 programs; input/output programming; and the floating-point and math package.

1.5 SPECIFICATIONS
Main Specifications

Storage medium	1/2 in. (1.27 cm) wide magnetic tape (industry compatible)
Capacity/tape reel	5 million characters
Data transfer speed	10,000 char/sec
Drives/control, maximum	2

Data Organization

Number of tracks	9
Recording density	800 bpi
Interrecord gap	0.5 in. (1.27 cm) minimum
Recording method	NRZI

Tape Motion

Read/write speed	12-1/2 in./sec
Rewind speed	75 in./sec (rewind time = 2 min. maximum)
Tape drive	Single capstan
Reel braking	Dynamic servo control
Speed variation	3% instantaneous; 1% long term
Start/stop distance	0.19 in. (0.48 cm)
Start/stop time	30 ms

Tape Characteristics

Length	600 ft (182.9 m)
Type	Mylar base, iron-oxide coated
Thickness	1.5 mils (0.038 mm)
Tension	8.0 oz (227 g)
Reel diameter	7 in. (17.8 cm)
Reel hub	3.69 in. (9.37 cm) diameter (industry standard)

Mechanical

Tape drive, mounting	Mounts on slides in a standard 19 in. (48.3 cm) cabinet
Tape drive, size	10-1/2 in. (26.7 cm) panel height, 17 in. (43 cm) deep
Tape drive, weight	37 lb (16.7 kg)
Control unit PDP-11	Mounts in a single 16-1/2 X 2-1/4 in. system unit (41.9 X 5.7 cm)

Power

Input current (TMB11)	5 A at +5 Vdc
Input current (M8920)	2 A at +5 Vdc
Input current (TS03)	1 A at 90 to 132 Vac, or 0.5 A at 180 to 264 Vac
Frequency	47 to 63 Hz, single phase
Input power	240 W at 115 Vac
	120 W at 230 Vac

Operating Environment

Temperature	15° C to 32° C
Relative humidity	20% to 80%, with maximum wet bulb 25° C and minimum dew point 2° C
Altitude	8000 ft (2438 m)

Miscellaneous

BOT, EOT detection	Photoelectric sensing of reflective strip, industry compatible
Broken tape detection	Photoelectric
Magnetic head	Dual gap, read after write, 0.15 in. (0.4 cm) gap

Interchannel Displacement

Write	150 μin. (3.8 μm) maximum
Read	150 μin. (3.8 μm) maximum
Erase head	Full width

Models

TMB11-MA	Tape drive and PDP-11 control, 115 Vac, 60 Hz
TMB11-MB	Tape drive and PDP-11 control, 230 Vac, 50 Hz
TS03-MA	Master tape drive, 115 Vac, 60 Hz
TS03-MB	Master tape drive, 230 Vac, 50 Hz
TS03-SA	Slave tape drive, 115 Vac, 60 Hz
TS03-SB	Slave tape drive, 230 Vac, 50 Hz

2.1 SITE PLANNING AND CONSIDERATIONS

2.1.1 Space Requirements

Figure 2-1 illustrates the space and service clearances required. Adequate space must be provided to slide the equipment out of the rack for servicing and to open the front door on the TS03 DECmagtape Transport. The TS03 and TMB11 may be housed in separate cabinets. If this is the case, and the cabinets are separated by long distances, consideration should be given to overhead trenching ducts for the cabling.

2.1.2 Power Requirements

The TMB11/TS03 DECmagtape System can be operated from a nominal 115 or 230 Vac, 50/60 Hz power source. Line voltage should be maintained to within 10 percent of the nominal value and the frequency should not vary more than 3 Hz.

2.1.3 Environmental Requirements

The operating environment should have cool, well-filtered, humidified air; a temperature range of 15° to 27° C; and relative humidity of 40 to 60 percent.

2.2 UNPACKING

The TMB11/TS03 may be shipped in two different configurations: with the system installed in an equipment rack or with each device packaged separately. Unpacking and installation procedures vary greatly depending on the system configuration. For example, if the user has ordered a complete PDP-11 system the TMB11/TS03 DECmagtape System is shipped installed in its appropriate rack with the interconnecting cables installed. However, if only a part of the system is shipped because the user already has a basic PDP-11 system, then the TMB11/TS03 DECmagtape System is shipped separately with the appropriate cables. Installation procedures may vary, depending on whether the unit is mounted in a DEC- or customer-supplied cabinet, the number of transports in the system, and other variable factors. Instructions are given for both cabinet and "separate device" configurations.

2.2.1 Cabinet Unpacking Instructions

To unpack the cabinet, proceed as follows:

1. Remove outer shipping container.

> **NOTE**
> **The container may be either heavy corrugated cardboard or plywood. In either case, remove all metal straps first, then remove any fasteners and cleats securing the container to the skid. If applicable, remove wood framing and supports from around the cabinet perimeter.**

SWINGING DOOR
(RH) NOTE 1

SWINGING DOOR
(LH) NOTF

REMOVABLE
END PANEL

REMOVABLE
END PANEL

CABLE ACCESS

FAN
PORTS

LEVELER
4 PLACES

CASTER SWIVEL
RADIUS 2 ¹³/₃₂"
(4) CASTERS

18 ⁷/₃₂"
(46.35 cm)

48 ⁷/₃₂"
(122.47 cm)

30"
(76.2 cm)

21 ¹¹/₁₆
(54.87 cm)

19"
(48.26 cm)

TSO3 EXTENDED
FROM CABINET

NOTES:
   1. Door may be L.H. or R.H.
      Allow space for either case.

   2. CABINET 71⁷/₁₆" (182.28 cm) high
      (floor line to cabinet top).

11-3092

Figure 2-1   Space and Service Clearance, Top View

2.   Remove the polyethylene cover from the cabinet.

3.   Unbolt cabinet(s) from the shipping skid. The bolts are located on the lower supporting side rails and are exposed by opening the access door(s). Remove the bolts.

4.   Raise the leveling feet above the level of the roll-around casters.

5.   Use wood blocks and planks to form a ramp from the skid to the floor and carefully roll the cabinet onto the floor.

6.   Roll the system to the proper location for installation.

2.2.2   Device Unpacking Instructions
Before unpacking the equipment, check the shipping list to ensure that the correct number of packages has been received. Check the shipping list for the correct TMB11 module types. Carefully remove each device from its shipping carton. Note that the side mounts are already attached to the TS03 transport(s) and the mounting hardware is packed in a bag in each shipping carton.

2.3   INSPECTION
After removing the equipment from its container(s), inspect it and report any damage to the responsible shipper and the local DIGITAL Sales Office. Inspect as follows:

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

2.   Remove equipment covers where necessary and inspect for loose or broken modules, blower or fan damage, and loose nuts, bolts, screws, etc.

3.   Inspect wiring side of logic panels for bent pins, broken wires, loose external components, and foreign material.

4.   Check TS03 transport(s) for any foreign material that may have lodged in the tension arm, reel hubs, and other moving parts.

5.   Check TS03 power supply for proper seating of fuses and power connectors.

6.   Inspect each TMB11 module for shipping damage.

2.4   CABINET INSTALLATION – SYSTEM ALREADY INSTALLED
If the equipment is already mounted in the cabinet, proceed as follows:

1.   Lower the leveling feet so that the cabinet is resting on the floor, not on the roll-around casters.

2.   Use a spirit level to level the cabinet; ensure that all leveling feet are firmly on the floor.

3.   Remove the shipping screws that secure the equipment to the cabinet.

4.   Plug the 861 power control ac power cord into a receptacle having the correct power, voltage and frequency.

2.5 INSTALLATION OF SYSTEM COMPONENTS

The system components should be mounted in a 19 in. by 20 in. (48.3 cm by 50.8 cm) equipment bay. Figure 2-2 shows a recommended cabinet layout. The equipment should be mounted from the top down. Ensure that power is removed from the PDP-11 and the TS03(s). If the TMB11 and the TS03 are installed in more than one cabinet, ensure that the cabinets are tied to the same ground or install a ground wire between the cabinets.
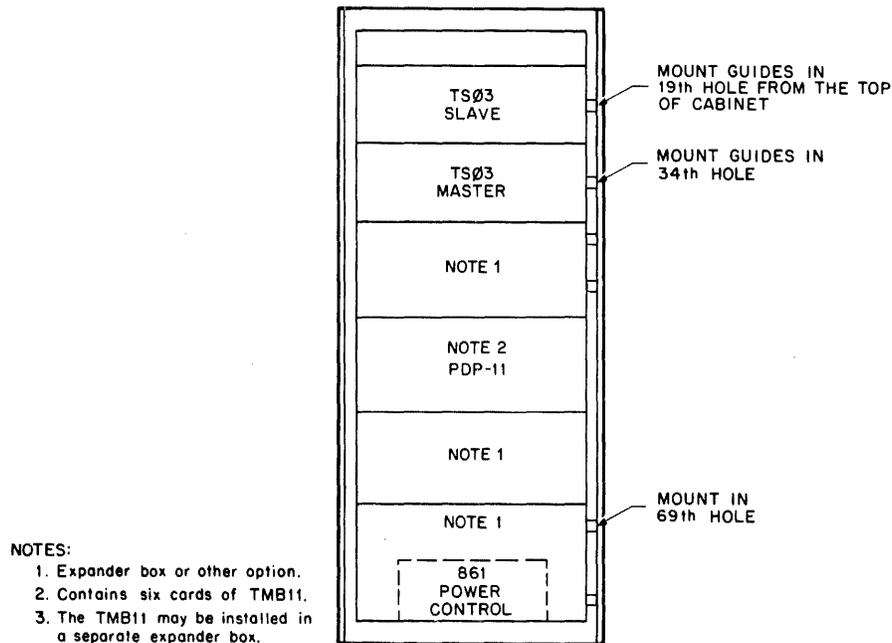
```
                          ┌──────────────┐
                          │ ┌──────────┐ │
                          │ │          │ │
                          │ ├──────────┤ │      MOUNT GUIDES IN
                          │ │          │ │  ┌── 19th HOLE FROM THE TOP
                          │ │   TSØ3   │ │      OF CABINET
                          │ │  SLAVE   │ │
                          │ ├──────────┤ │
                          │ │          │ │      MOUNT GUIDES IN
                          │ │   TSØ3   │ │  ┌── 34th HOLE
                          │ │  MASTER  │ │
                          │ ├──────────┤ │
                          │ │          │ │
                          │ │  NOTE 1  │ │
                          │ │          │ │
                          │ ├──────────┤ │
                          │ │          │ │
                          │ │  NOTE 2  │ │
                          │ │  PDP-11  │ │
                          │ ├──────────┤ │
                          │ │          │ │
                          │ │  NOTE 1  │ │
                          │ │          │ │
  NOTES:                  │ ├──────────┤ │      MOUNT IN
    1. Expander box or    │ │  NOTE 1  │ │  ┌── 69th HOLE
       other option.      │ ├──────────┤ │
    2. Contains six cards │ │┌────────┐│ │
       of TMB11.          │ ││  861   ││ │
    3. The TMB11 may be   │ ││ POWER  ││ │
       installed in       │ ││CONTROL ││ │
       a separate         │ │└────────┘│ │
       expander box.      │ └──────────┘ │
                          └──────────────┘

                                                      11-3996
```

Figure 2-2 Cabinet Installation

2.5.1 TS03 Mounting Instructions

To mount the TS03 (Figure 2-3) proceed as follows:

NOTE
If two TS03 transports (master and slave) are to be installed, the slave (the unit without the M8920 Adapter Module) is installed at the uppermost position.

1. Remove the outer portions of the guides from the TS03 chassis by actuating the slide releases and mounting the guides to the cabinet in the 19th hole from the top of the cabinet using the eight screws provided. Ensure that the guides are level and parallel to each other.

2. Lift the TS03 up and slide it carefully into the guides until the slide releases lock.

3. Carefully lift the slide releases and push the transport fully into the cabinet.

4. If a second TS03 transport is to be installed, repeat steps 1 through 3 above, but mount the guides in the 34th hole.

2-4

NOTE: DIMENSIONS FIRST SHOWN ARE IN INCHES.
DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS.

17.00
(43.18)

1.00
(2.54)

MOUNTING
SURFACE

CONTROL PANEL RETAINING
HINGE (PULL OUT LOWER
END OF PANEL FOR ACCESS
TO RACK MOUNTING SCREWS)

DUST COVER OPENS
TO APPROXIMATELY
110 DEGREES.

MOUNTING HOLES ARE FOR
ZERO NONTILT TYPE SLIDE
NO. C300-14 (NOT SUPPLIED
WITH UNIT) (DIMENSIONS
TYPICAL ON BOTH SIDES)

MOUNTING
SURFACE

8.72
(22.14)

SEE DETAIL "A"

1.75 TYP
(4.44)

2.25 TYP
(5.71)

5.75 TYP
(14.6)

1.75 TYP
(4.44)

1.48 TYP
(3.75)

.37
(.93)

.25 (.63)

.45
(1.14)

DETAIL "A"
TYPICAL SLOT
PATTERN

5.06
(12.85)

.19
(.48)

1.25
(3.18)

3.62
(9.19)

3.62
(9.19)

1.40
(3.55)

14.38
(36.53)

2.34
(5.94)

.25
(.63)

16.88
(42.88)

19.00
(48.26)

11-3046

Figure 2-3   TS03 Transport Physical Dimensions

2.5.2 TMB11 Installation/Cabling

2.5.2.1 System Unit Installation

1. Extend the expander box on its slides and remove the module access cover. (An extended BA11K and BA11F box is shown in Figure 1-2.)

2. Install a TMB11 system unit into the expander box using the two captive screws (Figure 2-4).
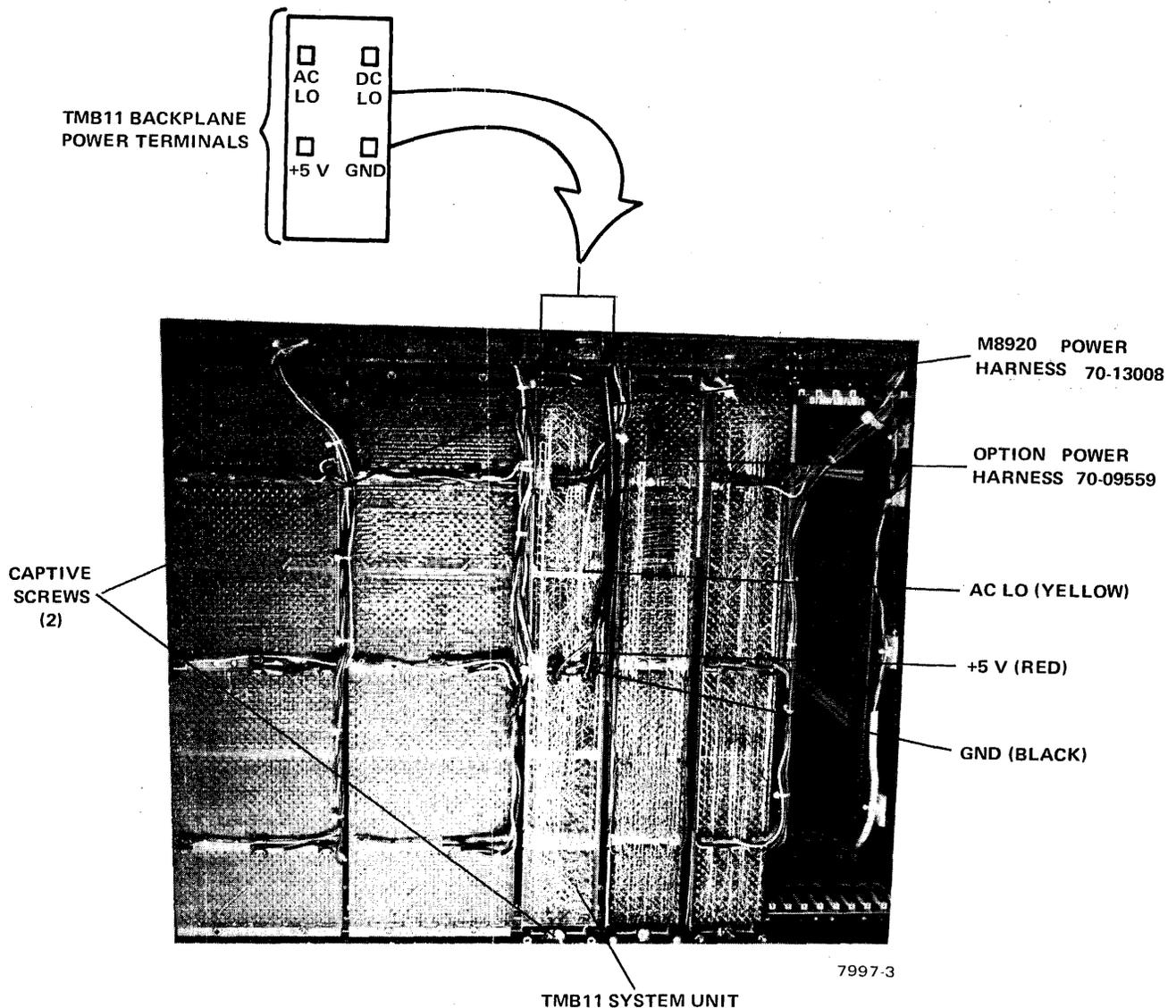
Figure 2-4 Expander Box Backplane (BA11F box shown)

3. Install the option power harness by connecting the fast-on connectors to the system unit backplane and the harness plug(s) to the expander box (Figure 2-5).

4. Install the M8920 power harness by connecting the three fast-on connectors as shown in Figure 2-4. The harness color code is:

   +5 V   red
   AC LO   yellow
   GND   black

5. Dress the M8920 power harness along the top of the BA11F expander box as shown in Figure 2-5. If a BA11K box is used dress the harness underneath the expander box.

M8920
POWER HARNESS
70-13008

OPTION POWER
HARNESS PLUGS

OPTION
POWER HARNESS
70-09559

7997-4
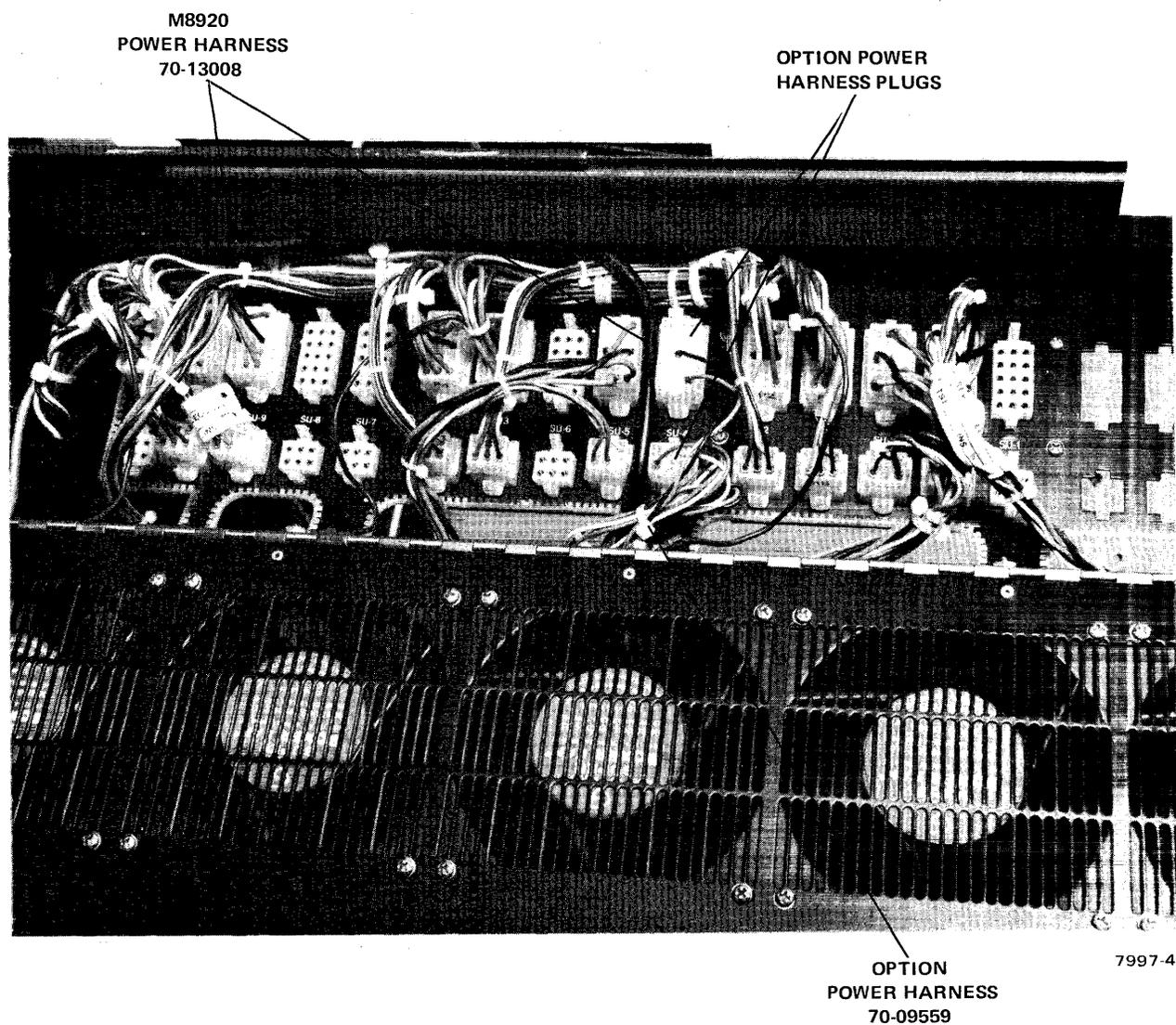
Figure 2-5   Power Cabling of TMB11 System Unit in BA11F Box

2-7

2.5.2.2 Module Installation

1. Check the jumpers on the M7821 module for a bus interrupt address of 224.

2. Check the priority jumper on the M7912 module for the correct interrupt priority level (usually BR5).

3. Check the jumpers on the M105 module for the correct address range for the TMB11 registers (772520 to 772536).

4. Plug the six TMB11 modules and a M930 terminator module into the system unit according to Figures 2-6, 2-7, and engineering drawing BD-TMB11-0-7.

2.5.2.3 Unibus Cabling – System units are connected to the Unibus in daisy-chain fashion as shown in Figure 2-8. Each unit has a Unibus in- and a Unibus out-jack. A BC11A cable connects the Unibus into the first system unit. M920 jumper modules connect the Unibus to the other system units in a given configuration. An M930 terminator module is installed in the Unibus out-jack of the last system unit in the chain. If the Unibus is to be carried onto another expander box, a BC11A Unibus cable is used to connect the Unibus from the Unibus out-connector of the last system unit in the first box to the Unibus in-connector of the first system unit in the second box. The Unibus is terminated by an M930 module installed in the out-jack of the last system unit.

Install the Unibus in-cable, Unibus out-cable, M920 jumper and/or M930 terminator according to the particular configuration. The Unibus in-connections on the TMB11 system unit are slots A1 and B1. The Unibus out-connections are slots A4 and B4 (Figure 2-9 and engineering drawing BD-TMB11-0-7). The configuration shown in Figure 2-6 utilizes a Unibus out-cable and an M920 bringing the Unibus in from the next system device. The configuration shown in Figure 2-7 uses M920 jumpers for both input and output Unibus connections.

NOTE
BC11A cable connectors will plug into the system
units either way but will not fully seat if incorrectly
installed. Make sure the connectors are fully seated
and that the notches on the connector edges are up
against the system unit slots.

2.5.2.4 Slave Bus Cabling – Connect the BC11A slave bus cable to slots E4 and F4 on the system unit (Figure 2-9). Install an M930 terminator module into slots E3 and F3 to terminate the slave bus (Figure 2-6 and engineering drawing BD-TMB11-0-7).

2.5.2.5 Securing Cables – If the installation is performed in a BA11F expander box, lift the cable trough cover and feed the BC11A cable(s) through the trough and the cable holding bracket.

If the installation is performed in a BA11K expander box, perform the following:

1. Remove one screw from the center strain relief and loosen the other (Figure 2-6).

2. Swing the strain relief out and place the BC11A cable(s) up against the edge of the chassis.

3. Swing the top of the strain relief back into place.

4. Insert the removed screw and tighten both screws.
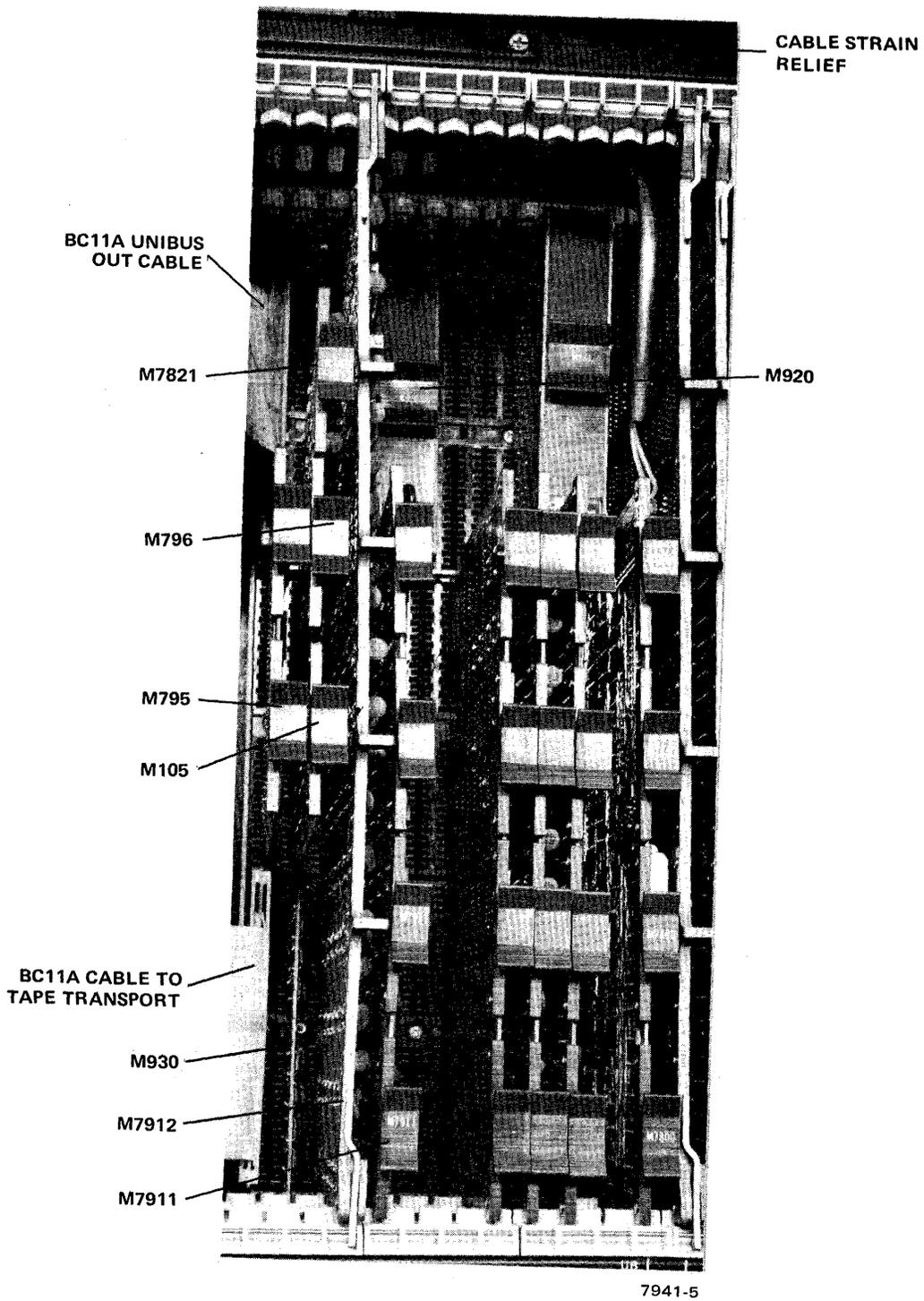
Figure 2-6 TMB11 Module Location and Cabling in BA11K Box

M920

M7821

M796

M795

M105

BC11A CABLE TO
TAPE TRANSPORT

M930 (NOT SHOWN)

M920

M7912

M7911
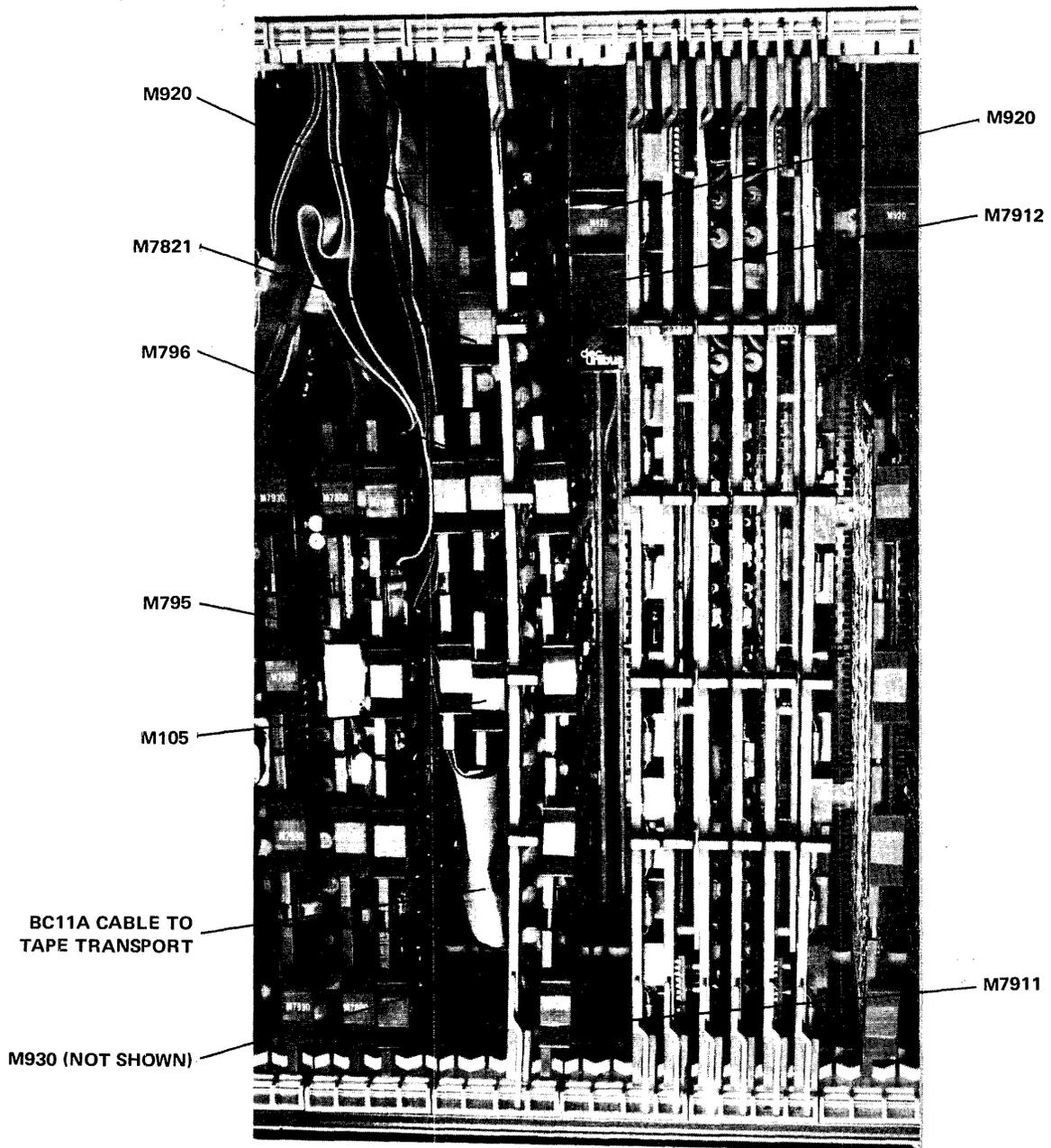
7997-1

Figure 2-7   TMB11 Module Location and Cabling in BA11F Box
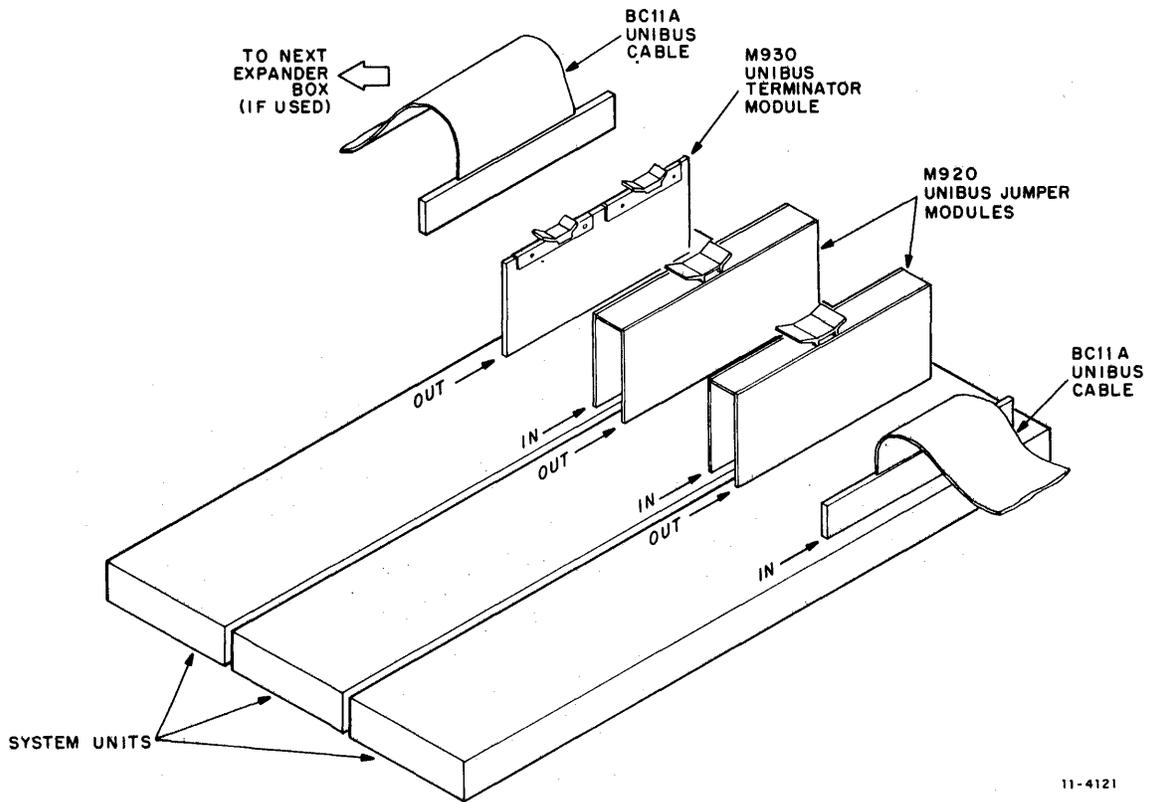
Figure 2-8 Unibus Cabling
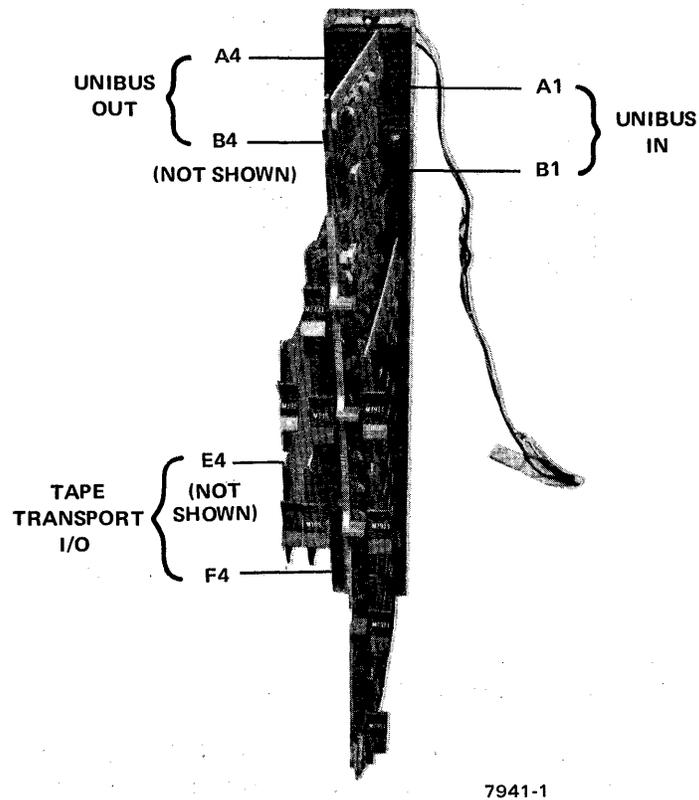
Figure 2-9 TMB11 Mounted in System Unit

2.5.3 TS03 Cabling

1. Slide out the TS03-M drawer.

2. Remove the M9820 front cover (Figure 2-10).
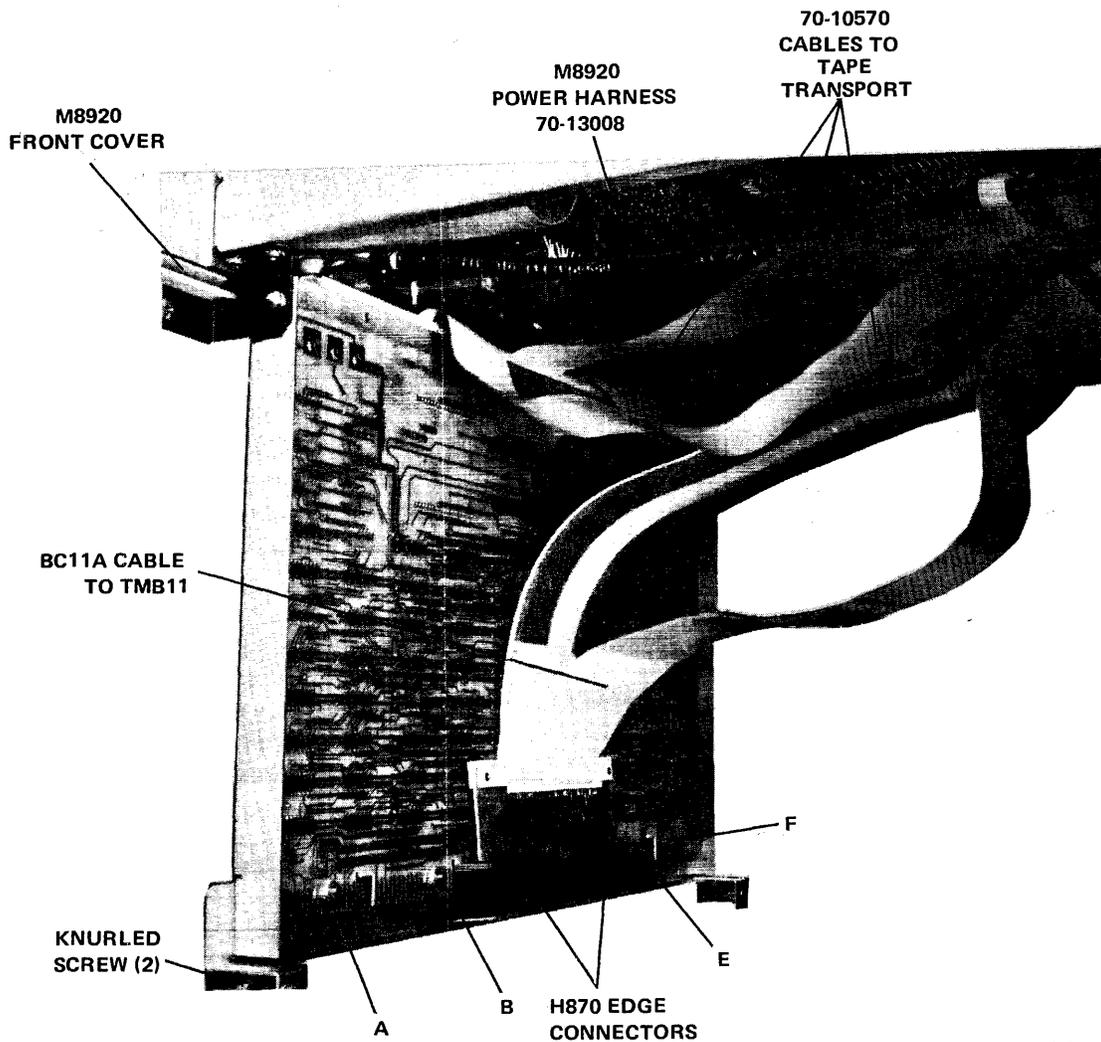
Figure 2-10   M8920 Cabling

3. Unscrew the two knurled screws holding the M8920 module and allow the module to hang down as shown in Figure 2-10.

4. Connect the BC11A cable from the TMB11 system unit to the "C" and "D" connectors on the M8920 module using two H870 edge connectors.

5. Install the 70-10570 master/slave cables between the M8920 module connectors (J1 through J6) and the TS03 master and slave transport connectors as listed in Table 2-1 and shown in Figures 2-10 and 2-11.

2-12
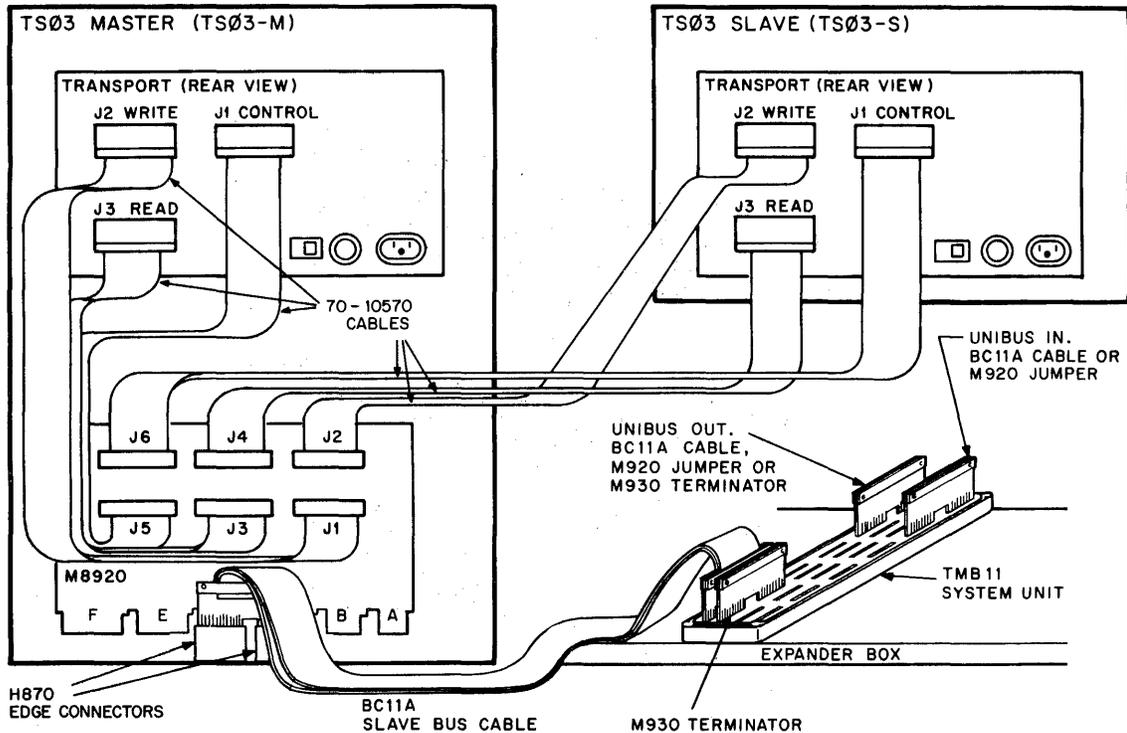
Figure 2-11   I/O Cable Connection Diagram

Table 2-1   70-10570 Cable Connections

From M8920 Adapter Board Connector	To TS03 Master Connector	TS03 Slave Connector
J1	J2	
J3	J3	
J5	J1	
J2		J2
J4		J3
J6		J1

6. Remove one screw from each of the three cable strain reliefs and loosen the other (Figure 2-12).

7. Swing the strain reliefs out and place the BC11A cables up against the edge of the chassis. Leave enough slack so that the cables are not strained when the M8920 module is swung down.

8. Swing the top of the strain reliefs back into place.

9. Insert the removed screws and tighten all screws.

STRAIN RELIEFS (3)
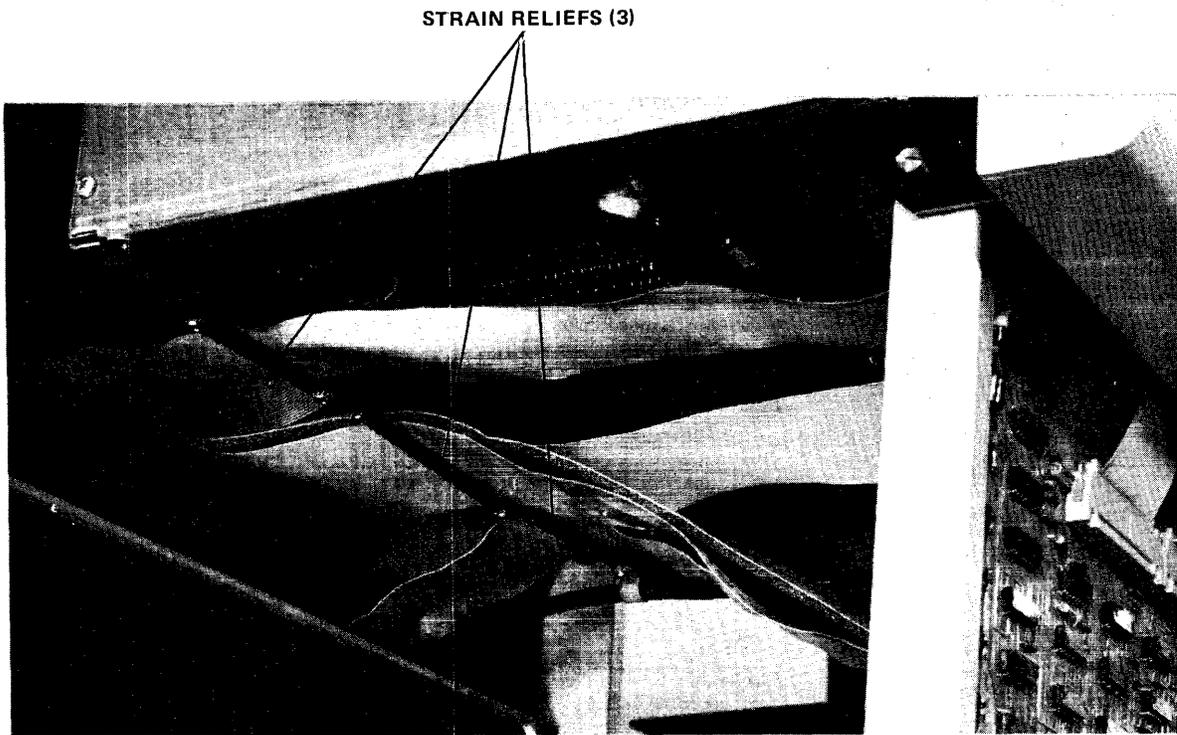
7941-3

Figure 2-12   Securing TMB11/TS03 Cables

10. Feed the M8920 power harness over the hinged edge of the M8920 module.

11. Connect the harness to the fast-on connectors on the M8920. The color code for the connections is:

    +5 V   red
    AC LO   yellow
    GND   black

12. Neatly dress all cables. Leave service loops so TS03 transports can be extended from the cabinet and the M8920 adapter can be swung down on its hinges.

13. Swing the M8920 module up into position and secure it with the two knurled screws.

14. Replce the M8920 front cover. Slide in the TS03 drawer.

15. Plug the TS03 master and slave transport ac power cords into the 861 power control switched receptacle as shown in Figure 2-13.

2-14

TS03 MASTER (TS03-M)
TRANSPORT (REAR VIEW)
M8920 ADAPTER
GND AC LO +5V
SWITCHED AC POWER
POWER HARNESS
(70-13008)
TMB11 SYSTEM UNIT
TS03 SLAVE (TS03-S)
TRANSPORT (REAR VIEW)
861 POWER CONTROL
PRIMARY AC POWER
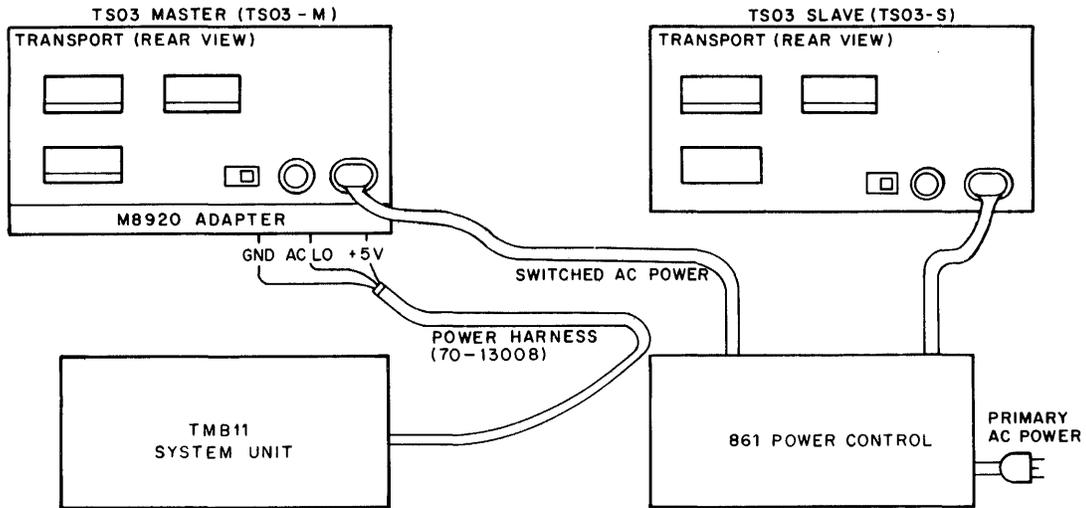
11-3998

Figure 2-13 Power Connection Diagram

2.6 ACCEPTANCE TESTING

Perform the operating instructions contained in Chapter 3. Refer to Paragraph 5.6 of the *TMB11/TS03 Maintenance Manual* (corrective maintenance) if any failures occur. Run the diagnostics as described in Paragraph 5.6.1. If the TMB11/TS03 system operates normally and the diagnostics show satisfactory results, then the system has been properly installed and system operation is up to specification.

2-15

CHAPTER 3
SYSTEM OPERATING INSTRUCTIONS

3.1 CONTROL AND INDICATORS
Figure 3-2 describes the controls and indicators.

3.2 OPERATING PROCEDURES

3.2.1 Tape Threading
To thread the tape on the transport, proceed as follows:

1. Raise the latch of the quick-release hub and place the tape file reel to be used on the supply hub (Figure 3-1) with the write enable ring side next to the transport deck.

2. Hold the reel flush against the hub flange and secure it by pressing the hub latch down.

3. Thread the tape along the path as shown in the threading diagram (Figure 3-1).

4. Holding the end of the tape with a finger, wrap a few turns counterclockwise around the takeup hub.
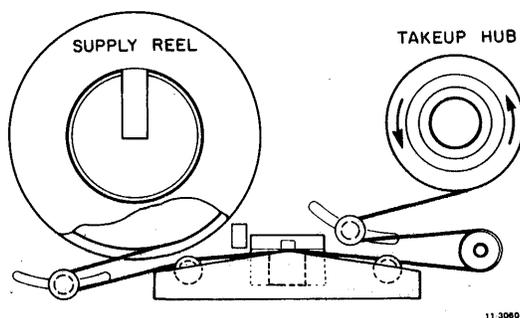
Figure 3-1   Tape Threading Diagram

3.2.2 Power Up
Press the POWER ON/OFF switch to ON to apply ac power to the transport.
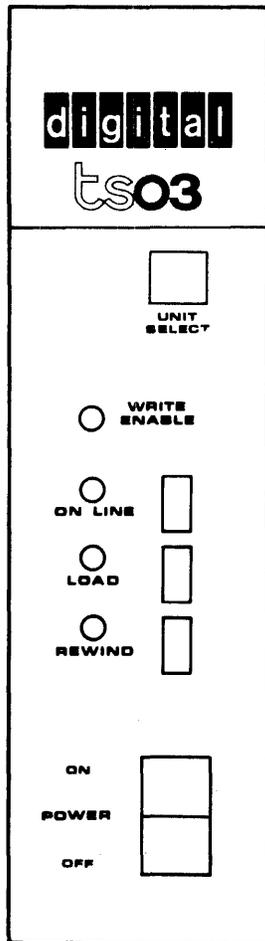
11-3045

UNIT SELECT Plug – One of two plugs can be inserted, des-
ignating unit as 0 or 1.

NOTE
In a single drive sytem, the drive is always
designated as drive 0. In a dual drive system,
either drive can be designated as drive 0.

WRITE ENABLE Indicator – Illuminated whenever a reel
with a write enable ring is mounted on the supply hub.

ON LINE Pushbutton/Indicator – A momentary pushbutton,
which functions as alternate action. When first activated, the
tape unit is placed in an on-line condition; when the tape
unit is on-line, it can be remotely selected and will be ready
if tape is loaded to or past the load point. When activated
again it takes the unit off-line. The indicator is illuminated in
the on-line condition. The load function must be performed
before the unit will go on-line.

LOAD Pushbutton/Indicator – The momentary pushbutton
activates the reel servos (tensions tape) and starts the load
sequence. The indicator is illuminated when the reel servos
are activated and tape is tensioned.

REWIND Pushbutton/Indicator – The momentary pushbut-
ton activates a rewind operation. This control is enabled only
when tape is tensioned and the unit is off-line. The indicator
is illuminated during either a local or a remote rewind
operation.

POWER Switch – The ON/OFF switch applies ac power to
the tape transport.

Figure 3-2   Controls and Indicators

3.2.3   Tape Loading
Pressing the LOAD pushbutton energizes the reel servos and initiates a load sequence. Tape advances
to the load point marker and stops. If for some reason the load point marker is already past the sensor
(as, for example, in restoring power after a shutdown), tape will continue to move. Under these condi-
tions, press LOAD and then REWIND and the tape will rewind to the load point. Once pressed, the
LOAD switch is illuminated and is inactive until power has been turned off or tape is removed from
the machine.

3.2.4   Placing Tape Unit On-Line
After the tape is properly threaded and has been loaded and brought to the load point, press the ON
LINE pushbutton and check that the ON LINE indicator illuminates. (The REWIND pushbutton is
disabled when the tape unit is on-line.) On-line status enables the tape unit to be remotely selected and
to perform all normal operations under remote control.

3.2.5 Tape Rewind and Unloading

Provision is made in the TS03 transport for rewinding a tape to the load point under remote control. However, this operation may also be performed manually as follows:

1. If the ON LINE indicator is illuminated, press the ON LINE pushbutton. Check that the indicator extinguishes when pressure is removed.

2. Press the REWIND pushbutton. The tape will now rewind to the load point marker.

3. After the tape has been positioned at the load point under remote or local control, it can be unloaded by pressing the REWIND pushbutton to rewind the tape past the load point to the physical beginning of the tape.

NOTE
The rewind sequence cannot be stopped until the tape has rewound either to the load point or until tension is lost at the physical beginning of the tape.

3.2.6 Power Shutdown

Press the POWER ON/OFF switch to OFF to remove ac power from the transport. A tape transport should not be turned off when tape is loaded and is past the load point marker. The TS03 transport is designed to prevent physical damage to the tape in the event of power failure, and to minimize operator error that could destroy recorded data. In the event of power failure during tape unit operation, manually wind the tape forward several feet before restoring power. When power has been restored, press the LOAD pushbutton, then the REWIND pushbutton. This will rewind the tape to the load point. If desired, the tape can then be advanced to the data block nearest the point at which the power failure occurred by initiating the appropriate control commands.

CAUTION
In dual drive systems, when one drive is on-line and running, *do not* turn power off at the unused drive, i.e., do not set the TS03 POWER ON–OFF switch to OFF. To do so may result in data errors on the drive that is running.

CHAPTER 4
CUSTOMER CARE AND
PREVENTIVE MAINTENANCE

4.1 CUSTOMER RESPONSIBILITIES
The customer is directly responsible for:

1. Obtaining operating supplies, including disk cartridges, disk packs and filters, magnetic tape, DECtape, paper tape, cassettes, printer paper, printer ribbons, plotter paper, etc.

2. Supplying accessories, including disk storage racks, DECtape storage racks, carrying cases for disk cartridges and DECtape, cabinetry, tables, and chairs.

NOTE
Users of Digital Equipment Corporation equipment may obtain the proper operating supplies and accessories by contacting:

Digital Equipment Corporation
DEC Supplies Order Processing
146 Main Street
Maynard, Massachusetts 01754
Phone: (617) 897-5111, Ext. 5218, 5907
Boston Area: (617) 890-0330
TWX: 710-347-0212
Cable: Digital Mayn
Telex: 94-8457

3. Maintaining the required logs and report files consistently and accurately.

4. Making the necessary documentation available in a location convenient to the system.

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

6. Turning off the teletypewriter and/or line printer when these devices are not in use.

7. Ensuring that ac plugs are securely plugged in each time equipment is used.

8. Performing the specific equipment care operations described in Paragraphs 4.2 and 4.3 at the suggested frequencies or more often if usage and environment warrant.

4.2 CARE OF 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 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 will spread 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 on top of the tape transport, or in any other location where it might be affected by hot air.

4.3 CUSTOMER PREVENTIVE MAINTENANCE OF TS03 TAPE TRANSPORT

4.3.1 General
Digital Equipment Corporation tape transports are highly reliable precision instruments that will 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 will assist the customer in caring for his equipment and ensure the highest level of performance and reliability.

4.3.2 Preventive Maintenance
To ensure trouble-free operation, a preventive maintenance schedule should be kept. Preventive maintenance consists of cleaning only a few items, but the cleanliness of these items is very important to proper tape transport operation. The frequency of performance will vary somewhat with the environment and degree of use of the transport. Therefore, a rigid schedule applying to all machines is difficult to define. The recommended periods apply to units in constant operation in ordinary environments. They should be modified if experience shows other periods are more suitable. Table 4-1 contains the cleaning instructions.

Before performing any cleaning operation, remove the supply reel and store it properly. All items in the tape path must be cleaned on a per-shift basis. In cleaning, it is important to be thorough yet gentle and to avoid certain dangerous practices. It should be remembered that the tape cleaner is a strong cleaning agent and should not come in contact with painted surfaces or plastic.

Refer to Appendix C for additional magnetic tape drive cleaning instructions.

CAUTION
Do not use acetone or lacquer thinner, aerosol spray cans, rubbing alcohol, or excessive cleaner. Be extremely careful not to allow the cleaner to penetrate ball bearings, tension rollers, and motors.

4.3.3 Materials Required

1. DECmagtape system and magtape cleaning kit
2. Lint-free wipers.

Table 4-1 Customer Care Operations

Frequency	Operation
Once per Shift	Using cotton-tipped wooden swabs moistened with head cleaner inspect and clean the following (Figure 4-1); then remove any residue with a clean, dry swab. Head and head shield — Tape cleaner Load point/end-of-tape sensor — Tape tension roller (not shown) Missing tape sensor — Capstan (not shown) Both tape guides
Weekly	1. Using a lint-free cloth or wipe, dust the inside and outside of the plexiglass door. If dirt and dust have accumulated, a mild soap and water solution or antistatic cleaner may be used. Ensure that the door is dry before returning the tape transport to service. 2. Using a lint-free cloth or wipe moistened with alcohol (at least 91%), remove all built-up material on the reel hub surfaces, especially around the O-ring. Remove any residue with a clean, dry wipe.
Monthly	Dust and vacuum the exterior of the outer door and top of the cabinet.
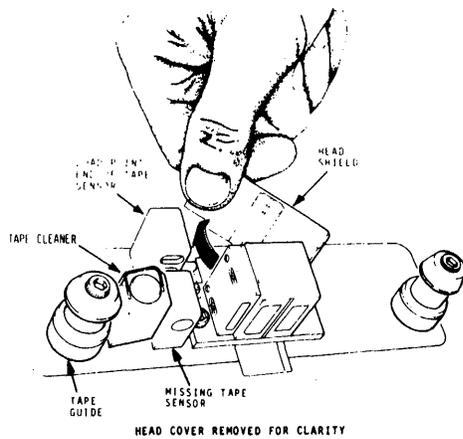
11-3051

Figure 4-1 Opening Head Shield

4-3

A.1 MAGNETIC TAPE FUNDAMENTALS – DEFINITIONS

1. Reference Edge – The edge of the tape as defined by Figure A-1. For tape loaded on a tape transport, the reference edge is toward the observer.

REFERENCE EDGE

TAPE
LEADER

OXIDE
SURFACE

SUPPLY
REEL

10-1265
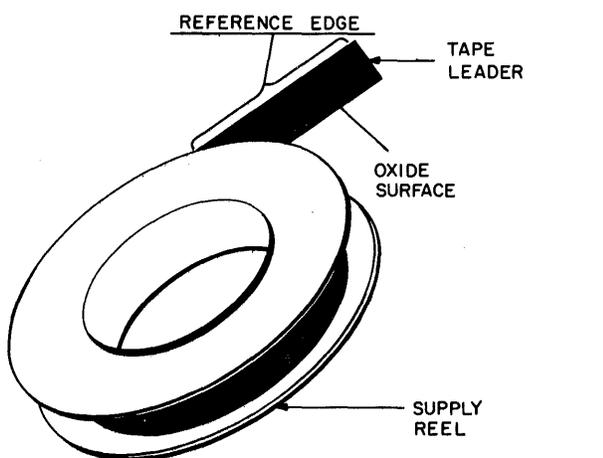
Figure A-1   Reference Edge of Tape

2. BOT (Beginning-of-Tape) Marker – A reflective strip placed on the nonoxide side of the tape, against the reference edge, 15 ft, ±1 ft (457 cm, ±30.5 cm) from the beginning of the tape.

3. EOT (End-of-Tape) Marker – A reflective strip placed on the nonoxide side of the tape, against the nonreference edge, 25 to 30 ft (762 to 914 cm) from the trailing edge of the tape.

4. 9-Channel Recording – Eight tracks of data plus one track of vertical parity. Figure A-2 shows the relationship between track and bit weight for a 9-channel transport.*

---

*When the track vs bit channel standard was adopted, the outer tracks were more susceptible to bit dropping errors. Consequently, channels containing the least 1s were assigned the outer locations on the tape.
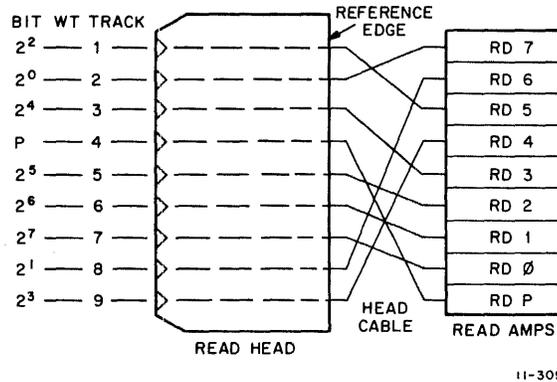
Figure A-2 Track-Bit Weight Relationship for 9-Channel Transport

5. Tape Character – A bit recorded in each of the nine channels.

6. Record – A series of consecutive tape characters.

7. File – An undefined number of records (minimum = zero, no maximum).

8. Interrecord Gap (IRG) – A length of erased tape used to separate records [0.5 in. (1.27 cm) minimum for 9-track; maximum IRG is 25 ft (762 cm)].

9. Extended IRG – A length of erased tape [3 in. (7.62 cm) minimum] optionally used to separate records. It must be used between BOT and the first record.

10. Tape Speed – The speed at which tape moves past the read/write heads; normally stated in inches per second.

11. Tape Density – The density of sequential characters on the tape. It is normally specified in bytes per inch (bpi), which is equivalent to characters per inch.

12. Write Enable Ring – A rubber ring that must be inserted on the supply reel to allow the transport to write on the particular tape. This safety feature helps prevent accidental destruction of previously recorded data.

13. Tape Mark (TM) – A record written on the tape to designate the end of a file; sometimes referred to as a file mark (FMK).

A.2 RECORDING METHODS AND DECmagtape FORMATS
The DECmagtape system is an on-line mass storage system for programs or data. Data is recorded on tape in vertical rows called characters. Each character consists of eight data bits and one vertical parity bit. The vertical parity bit is program-selected as even or odd. The odd parity bit guarantees that each character records at least one 1 bit.

The parity bit is generated according to the rule that the number of 1s in a character (parity bit included) is odd or even. For example, if odd parity is used and the character contains an even number of 1 bits, the parity bit is generated as a 1 bit and an odd number of 1 bits are recorded; then, if an even number of bits are read back from tape, a vertical parity error is generated to notify the program that the data is in error.

A-2

The data characters are recorded in blocks of characters termed records (Figure A-3). Each record contains a specified number of characters determined by the word count. The minimum record length is 3 characters; the minimum word count is the 2's complement of 3 or 7775_8.
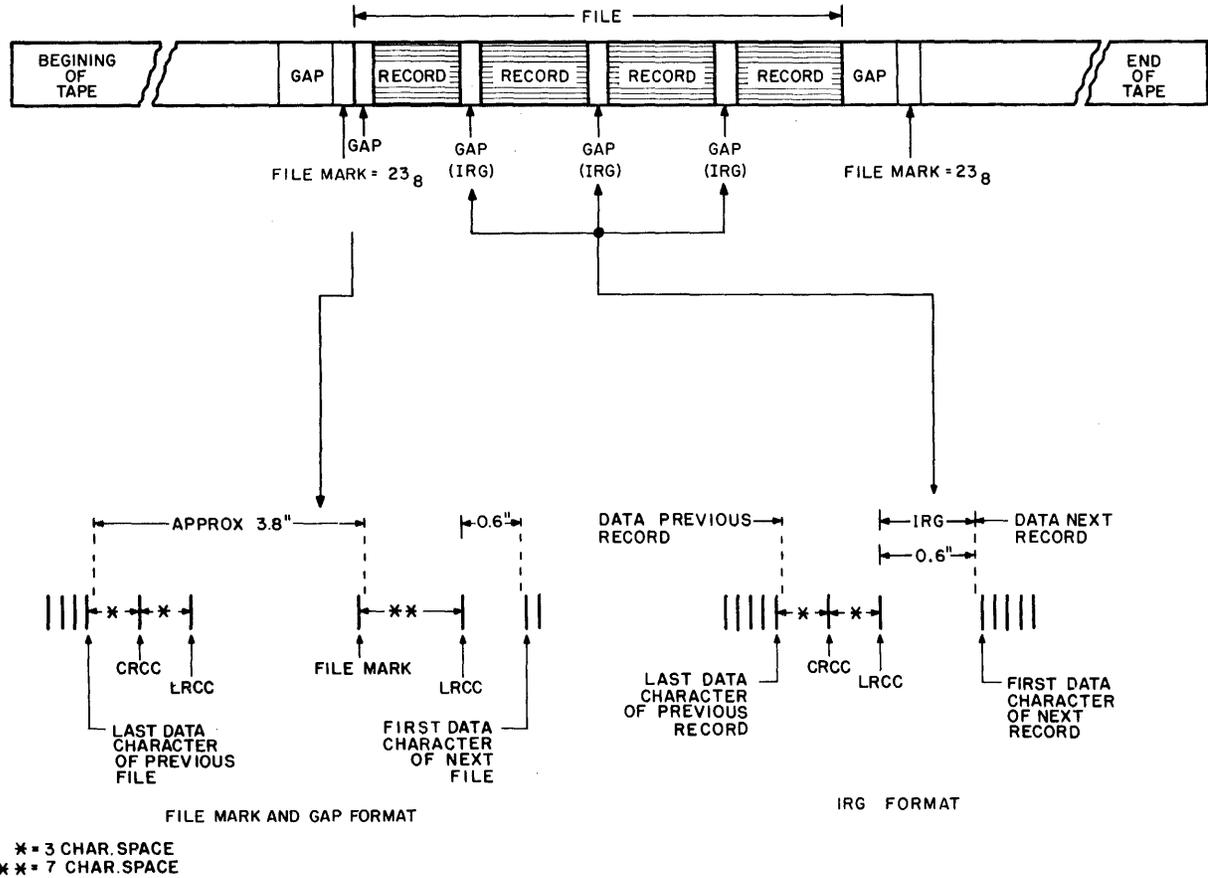
Figure A-3   Data Recording Scheme

Records are separated by interrecord gaps (IRGs). The IRG is 0.5 in. (1.27 cm) minimum [approximately 0.6 in. (1.5 cm) in normal operation], but may be extended to 3 in. (7.62 cm) by performing an extended gap operation. Tape IRGs (unrecorded areas) provide areas on the tape for the transport to start or stop and also separate data records.

A.2.1   NRZI Recording Method (non-return-to-zero change on one)
In the NRZI recording method, a 1 bit is represented by a reversal in the direction of tape magnetization on a track; a 0 bit is represented by no change in tape magnetization.

A.2.2 9-Channel Tape Format

The format (Figure A-4) is composed of from 18* to 2048 nine-bit characters spaced 1/800 in. (3 mm) apart, followed by 3 character spaces, a CRC character, 3 more spaces and an LRC character. This unit of data is called a record. At 800 characters per inch, the record is between 1/32 in. (79 mm) minimum and 5 in. (12.7 cm) maximum. Between each record is a gap of at least 1/2 in.† The tape structure consists of a number of records followed by a file mark (Figure A-3). Since data is recorded and read at high speed, IRGs are used to provide space for starting and stopping a tape transport. A transport accelerates from standstill to full speed in approximately 0.2 in. (0.5 cm) of tape and decelerates from full speed to standstill in 0.2 in. (0.5 cm) of tape; thus, the minimum IRG of 0.5 in. (1.27 cm) provides adequate space for starting and stopping the tape transport.

8E-0500
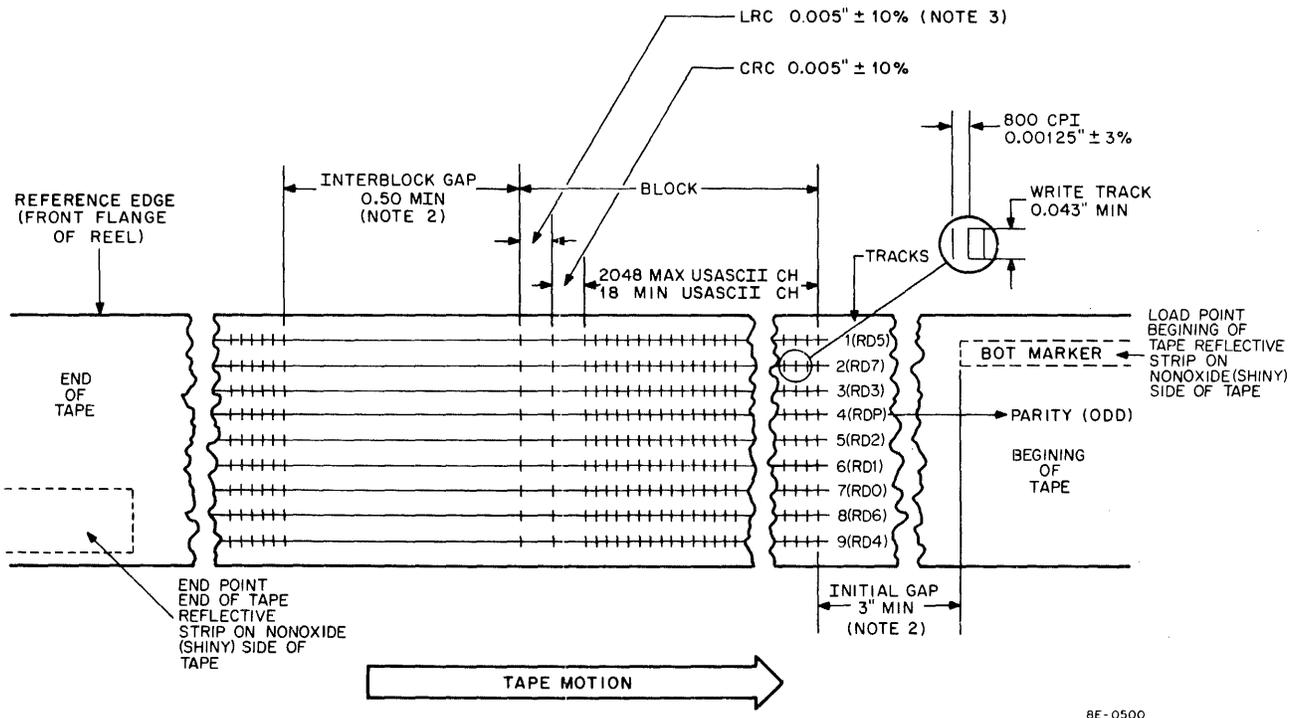
LEGEND:

BPI	Tape Bits per Inch
BOT	Beginning of Tape
LRC	Longitudinal Redundancy Check
CRC	Cyclic Redundancy Check

NOTES:

1. Tape is shown with oxide side up, read/write head on same side as oxide. Tape is shown representing 1 bits in all NRZI recording; 1 bit produced by reversal of flux polarity, tape fully saturated in each direction.

2. Tape to be fully saturated in the erased direction in the interrecord gap and the initial gap.

3. An LRC bit is written in any track if the longitudinal count in that track is odd. Character parity is ignored in the LRC character.

4. CRC – Parity of CRC character is odd if an even number of data characters are written, and even if an odd number of characters are written.

Figure A-4   Tape Recording Format

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*USASCII program standards, not a hardware limit.
†0.5 in. (1.27 cm) minimum; 0.6 in. (1.5 cm) nominal.

The CRC character is generated during a write operation and written at the end of a record. The check character performs the same function to a record as the parity bit does to a character.

The LRC character is the final character in the record and is generated so that for each track the sum of 1 bits (CRC character included) is even. The LRC character is written on tape by clearing the write buffer in the tape transport after the CRC character is written. The LRC strobe resets the write buffer, causing a 1 to be written on each track containing an odd number of 1s; a 0 is written on each track containing an even number of 1s.

A.2.3 7-Channel Tape Format

Each character frame in a 7-channel tape (Figure A-5) consists of six character bits (B, A, 8, 4, 2, 1) in descending order of significance. The parity bit, or check bit (C), is the seventh bit and is set or cleared by the transport write head. One byte of a data word corresponds to one tape character. However, because one byte contains eight bits and a tape character contains only six data bits, two bits within each byte are not used. During a read operation, the extra bits are forced to 0; during a write operation, the bits remain unchanged. During the core dump mode of operation, one byte corresponds to two tape characters. Thus, all bits within the byte are used; however, the two most significant bits on the tape are not used.
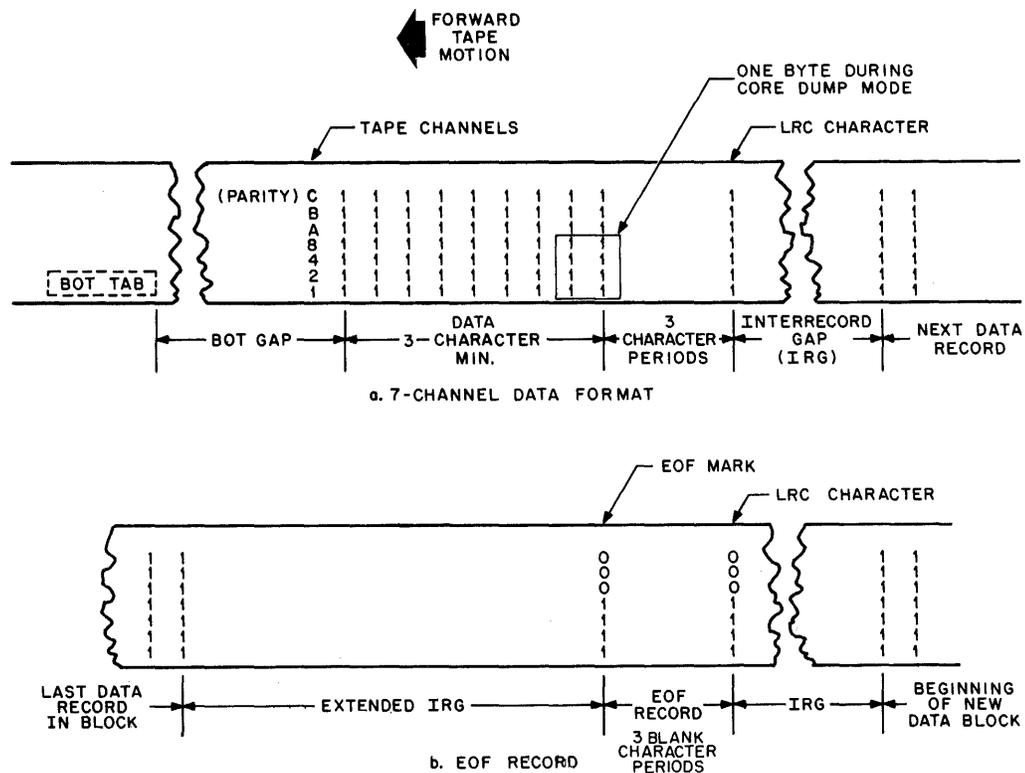

Figure A-5   7-Channel Tape Format

A-5

The magnetic tape is divided into data records, each record separated by an interrecord gap (IRG). A record for 7-channel tape may be any length from a minimum of 24 characters to a maximum of 4008 characters. In a block format, a number of records are written together with an IRG before the first record and after the last record. In either case, the IRG is an unused portion of tape preceding and following the record or the block.

The longitudinal redundancy check (LRC) character is written after the data and is separated from the data by three character spaces. Each bit in the LRC is such that the total number of bits in any specific channel is even.

The end of a block of records is indicated by an end-of-file mark character. The end-of-file (EOF) mark is separated from the data by an extended IRG. The extended IRG is a 3-in. strip of blank tape compared to the standard 3/4-in. IRG for 7-channel tape and the 1/2-in. IRG for 9-channel tape. The EOF mark and associated LRC character are considered to be one complete record.

The 9-channel tape format (Figure A-6) is similar to the 7-channel format; however, because each character consists of eight data bits and one parity bit, a byte corresponds to a tape character. Therefore, there is no need for a core dump mode, because information can be transferred from the system to the tape on a one-to-one ratio. A record for 9-channel tape may be any length from 18 characters to 2048 characters. In addition, the 9-channel format includes a cyclic redundancy check (CRC) character. Data is followed by three blank character periods, the CRC character, three more blank character periods, and the LRC character. The LRC character is followed by an IRG as before.
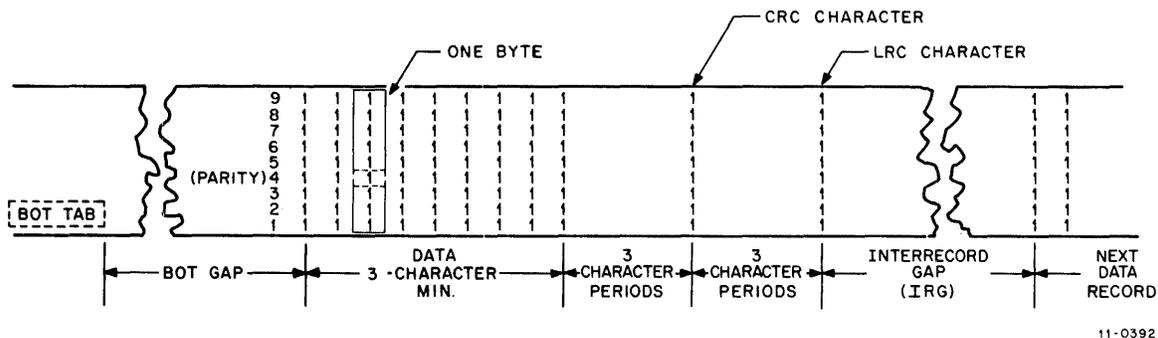
Figure A-6   9-Channel Tape Format

A.3   CYCLIC REDUNDANCY CHECK (CRC) CHARACTERS

The CRC character provides a method of error detection and correction on magtape transports. The code has nine check bits that form a check character at the end of each record. To perform a correction, a record in which an error has been detected must be reread into memory with the LRC and CRC characters for program evaluation. Errors involving more than one track can be detected but not corrected.

The CRC character is generated as follows:

1.   The CRC register is cleared at the beginning of each record. As each data bit is written on tape, it is exclusively ORed with its corresponding bit in the CRC register.

2.   The CRC register is shifted one position to the right after the exclusive OR operation has taken place.

3. The bits entering CRC 2, CRC 3, CRC 4, and CRC 5 of the CRC register are inverted if the bit entering CRCP is a 1. Data is shown in Table A-1; the resultant CRC character is shown in Table A-2.

Table A-1   Five-Character Record

	Characters				
Bit	**Data Character 0**	**Data Character 2**	**Data Character 3**	**Data Character 4**	**Data Character 5**
P	0	0	1	0	1
0	1	0	0	1	0
1	0	1	0	1	0
2	0	1	0	1	1
3	1	0	1	1	0
4	0	1	1	0	1
5	0	1	1	0	1
6	1	0	1	0	1
7	0	1	0	1	0

Table A-2   CRC Character in Register When Writing

CRC Bits	**CRC Register**						**CRC Character On Tape**
	Cleared	**Character 1**	**Character 2**	**Character 3**	**Character 4**	**Final**	
CRCP	0	0	0	0	1	1	0
CRC0	0	0	0	1	0	0	1
CRC1	0	1	0	0	0	0	1
CRC2	0	0	0	0	0	1	1
CRC3	0	0	1	0	0	0	1
CRC4	0	1	0	0	0	1	1
CRC5	0	0	0	1	1	0	1
CRC6	0	0	1	1	1	0	1
CRC7	0	1	0	0	1	0	1

4. Steps 1 – 3 are repeated for each data character of record.

5. At CRC time, all positions of the CRC register, except CRC2 and CRC4, are complemented and the resultant CRC character is written on tape.

6. The CRC register is cleared for the next record.

A.4 LONGITUDINAL REDUNDANCY CHECK (LRC) CHARACTER

The LRC character is written three spaces after the CRC character. The vertical parity bit is always written on the LRC character; the vertical parity of LRC is never checked. The LRC character makes the longitudinal parity even for the entire record, including the CRC. The LRC is generated by the LRC register in the following manner:

1. The LRC register is cleared at the beginning of a record.

2. As characters are written on tape, corresponding 1 bits complement the LRC register at the time data is written on tape.

3. At LRC time, the LRC strobe clears the write buffer and 1s are written on tape in only those channels for which the write buffer is set prior to clearing.

4. Following this method, the LRC character forces an even number of bits to be recorded on each track of the tape. The CRC character is included in determining the LRC character.

A.5 DATA FILES

As previously stated, a record is a group of characters preceded by an IRG and terminated by three spaces, a CRC character, three more spaces, and an LRC character. A file is a group of records separated by IRGs and terminated by a 3 in. (7.62 cm) gap followed by a file mark. The file mark is a record consisting of a single data character [the end-of-file (EOF) character] followed by seven blank characters and an LRC character. The CRC character is not written on an EOF record. The LRC character with a file mark is a duplicate of the EOF character (23_8).

A.6 TRACK ASSIGNMENTS

The track assignments for read, write, and parity bits are shown in Table A-3.

Table A-3 Track Assignments for Data and Parity

Transport Track Number	Write Data Bits	Read Data Bits	Binary Weight
1 furthest from transport	WD5	RD5	2^2
2	WD7	RD7	2^0
3	WD3	RD3	2^4
4	WDP	RDP	–
5	WD2	RD2	2^5
6	WD1	RD1	2^6
7	WD0	RD0	2^7
8	WD6	RD6	2^1
9 closest to transport	WD4	RD4	2^3

B.1 TS03 PARTS

Figures B-1 through B-3 and Tables B-1 through B-3 show the location and identifying parts comprising the TS03 DECmagtape Transport. Tables B-4, B-5, and B-6 list replaceable/spare parts. Table B-7 relates the TS03 DEC part numbers to the vendor part numbers.

NOTE
See the engineering drawing set for parts information on the M8920 adapter module.
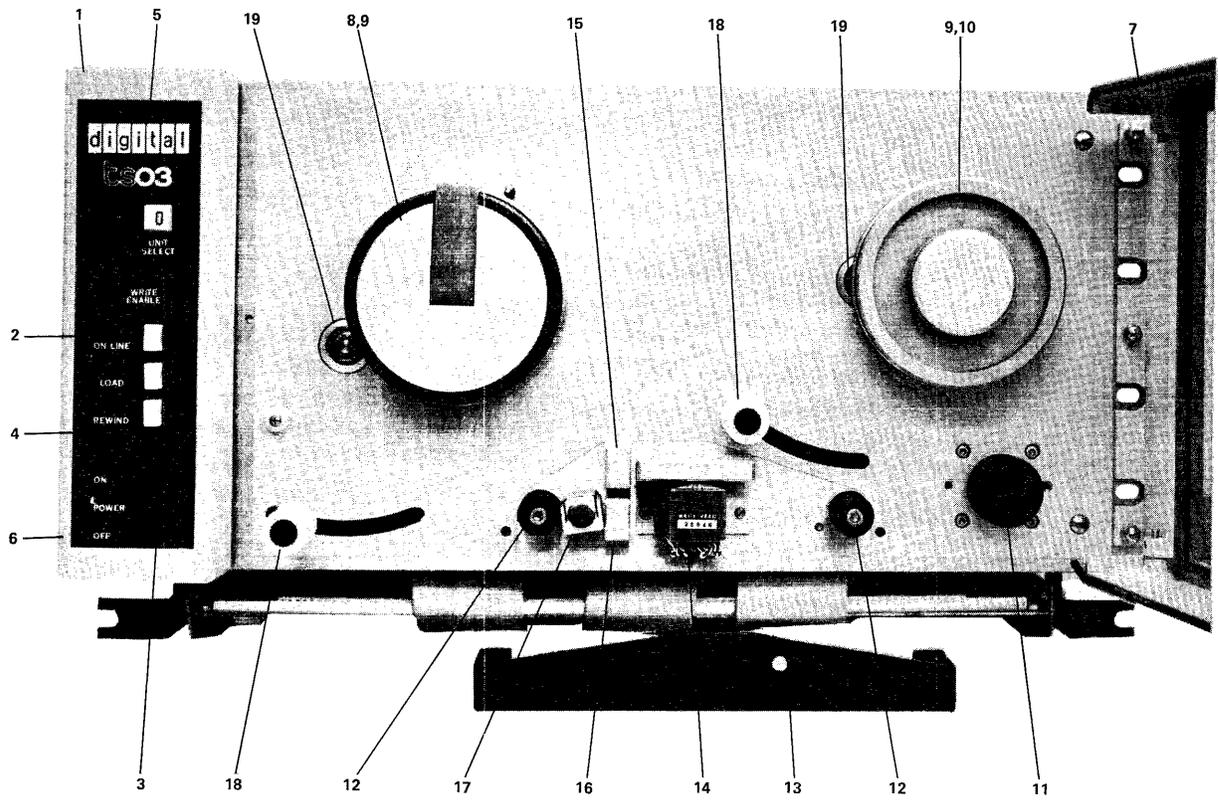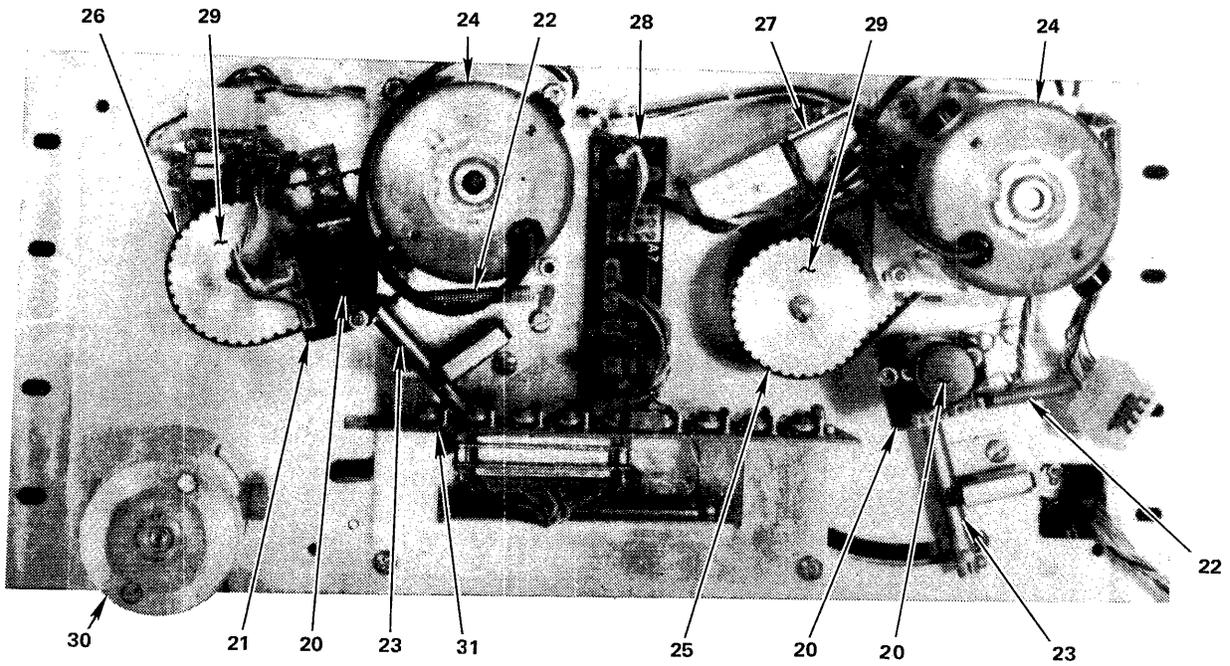
Figure B-1 Front Panel Parts Identification

M-0598

Table B-1 Illustrated Parts Breakdown for Figure B-1

Item	Part No.	Description
1	*	Control Panel Assembly (Note 1)
2	151-0057-001	Pushbutton Switch Assembly
3	151-0038-001	Power Switch
4	190-4448-001	LED Display, PC Board Assembly
5	291-3922-xxx	Switch Cover (Note 1)
6	391-4440-xxx	Control Panel (Note 1)
7	*	Dust Cover Assembly
8	190-2744-001	Hub, Quick Release (Note 2)
9	198-0011-001	Hub Bearing Assembly
10	190-2772-001	Takeup Hub
11	*	Capstan Wheel
12	*	Tape Guide Assembly
13	291-1509-001	Head Cover (Note 1)
14	*	Head Assembly
15	*	Photosensor Assembly, Load Point, EOT
16	*	Photosensor Assembly, Broken Tape
17	*	Tape Cleaner
18	*	Tension Roller Guide Assembly
19	190-4554-001	Tension Arm Bearing Assembly
20	*	Magpot Tension Sensor Assembly
21	*	Magpot Circuit Module
22	*	Spring, Tension
23	*	Tension Arm Assembly
24	*	Reel Motor Assembly
25	*	Belt, Supply Drive
26	*	Belt, Takeup Drive
27	*	File Protect Switch Assembly
28	190-4013-001	Connector PC Board Assembly
29	191-0805-001	Pulley, Reel Drive
30	*	Capstan Motor/Tachometer Assembly
31	*	Read Preamplifier PC Board Assembly

NOTES
1. Specify logo and paint color if different from standard.
2. Order repair kit 198-0100-001 as spare (Table B-6).

*Indicates replaceable part. For part number, see Replaceable Parts List (Table B-4).
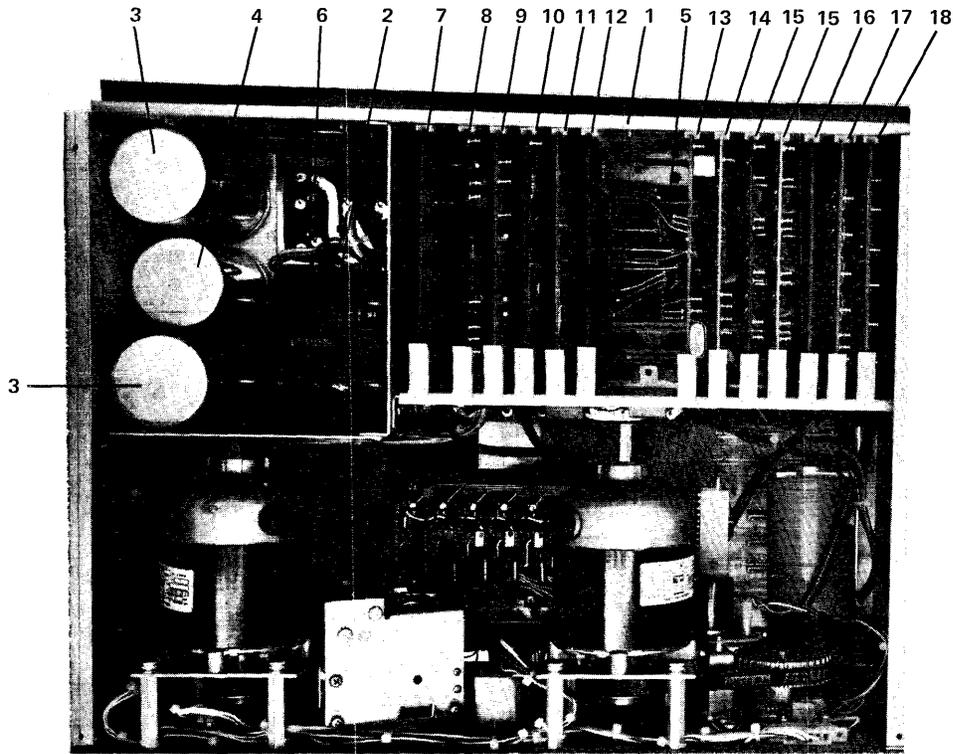
7856-9B

Figure B-2   Tape Transport Parts Identification (Top View)

Table B-2   Illustrated Parts Breakdown for Figure B-2

Item	Part No.	Description
1	190-4442-001	Power Supply/Card Cage Assembly
2	*	Transformer Assembly
3	*	Capacitor, 18,000 mF/25 V
4	*	Capacitor, 39,000 mF/10 V
5	190-4206-001	Motherboard Assembly
6	*	Rectifier
7	*	Servo Preamplifier Module
8	*	Sensor Amplifier/Driver Module
9	*	Ramp Generator Module
10	*	Pushbutton Control Module
11	*	Control Interface Module
12	190-3841-001	Control Terminator Module
13	*	Delay Timing Module
14	*	Read Amplifier/Clipping Control Module
15	*	Quad Read Amplifier Module
16	190-3860-001	Data Terminator Module
17	*	Four-Channel Write Amplifier Module
18	*	Five-Channel Write Amplifier Module

*Indicates replaceable part. For part number, see Table B-5.
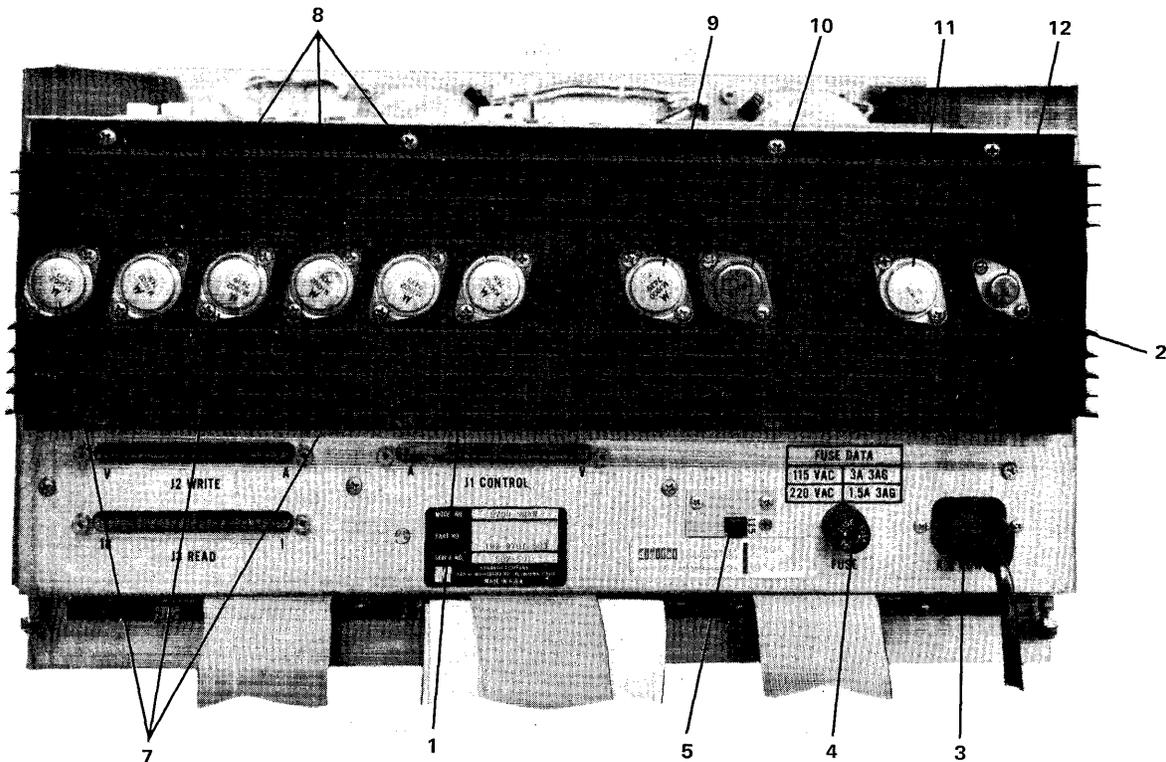
7856-4A

Figure B-3   Tape Transport Parts Identification (Rear View)

Table B-3   Illustrated Parts Breakdown for Figure B-3

Item	Part No.	Description
1	*	Voltage Regulator/Servo Power Assembly
2	190-4352-001	Voltage Regulator PC Board Assembly (Note 1)
3	127-0003-001	Power Receptacle
4	*	Fuseholder
4	*	Fuse, 3AG, 3 A (115 V operation)
4	*	Fuse, 3AG, 1.5 A (220/230 V operation)
5	*	Switch, 115/220 V
6	*	Power Cord (not shown)
7	148-0122-001	Power Transistor Type MJ802 Motorola (Note 1)
8	148-0121-001	Power Transistor Type MJ4502 Motorola (Note 1)
9	148-0102-003	Power Transistor Type MJ900 Motorola (Note 1)
10	148-0102-004	Power Transistor Type MJ1000 Motorola (Note 1)
11	148-0053-001	Power Transistor Type 2N3055 (Note 1)
12	148-0075-001	Power Transistor Type 2N4910 (Note 1)

NOTES

1.   Normally voltage regulator/servo power assembly is replaced as a module. These
     parts are listed for reference purposes.

*Indicates replaceable part. For part number, see Table B-6.

B-5

Table B-4   Replaceable/Spare Parts for Figure B-1

Item	Part No.	Description	Qty Spare	Note
1	198-4439-001	Control Panel Assembly	1	1
7	198-2771-xxx	Dust Cover Assembly		1
11	198-2605-001	Capstan Wheel	1	
12	198-1509-001	Tape Guide Assembly	2	
14	198-2399-010	Head Assembly, Nine-Track	1	2
14	198-2399-003	Head Assembly, Seven-Track	1	2
15	198-1138-001	Photosensor Assembly, Load Point/EOT	1	
16	198-1139-001	Photosensor Assembly, Broken Tape	1	
17	198-2747-001	Tape Cleaner Assembly	1	
18	198-2647-002	Roller Guide Assembly	1	
20	198-0013-001	Magpot Tension Sensor Assembly (includes Magpot Circuit Module)	1	
22	198-0017-002	Spring, Tension (package of 2)	1	
23	198-2827-001	Tension Arm Assembly		
24	198-4438-001	Reel Motor Assembly	1	
25/ 26	198-0101-001	Belt Kit (1 each supply/takeup)		
27	198-2641-001	File Protect Switch Assembly		
30	198-2484-001	Capstan Motor Assembly	1	3
31	198-3631-xxx	Read Preamplifier Printed Circuit Board Assembly	1	3

NOTES

1. Unless specified, control panels, and dust covers will be shipped with standard paint colors. If special paint or logo is required, please specify.

2. Head is supplied on mounting plate and with face shield and connector. Specify number of tracks. All heads are read after write with side mounted erase. Deskew chart is furnished with each head.

3. Capstan motor/tachometer assembly is supplied with capstan wheel in case of damage to capstan in removal.

Table B-5 Replaceable/Spare Parts for Figure B-2

Item	Part No.	Description	Qty Spare	Note
2	198-4474-601	Transformer Assembly		
3	198-3625-199	Capacitor, Electrolytic, 18,000 mF, 25 V min		
4	198-3610-449	Capacitor, Electrolytic, 39,000 mF, 10 V min		
6	198-0108-001	Rectifier, MR751, Motorola (package of 6)		
7	198-4306-xxx	Servo Preamplifier Module	1	1
8	198-3844-001	Sensor Amplifier/Driver Module	1	
9	198-3194-xxx	Ramp Generator Module	1	1
10	198-3843-001	Pushbutton Control Module	1	
11	198-3842-001	Control Interface Module	1	
13	198-4845-xxx	Delay Timing Module (9-track, special)	1	1, 2
14	198-4179-xxx	Read Amplifier/Clipping Level Module	1	1
15	198-4178-xxx	Quad Read Amplifier Module	1	1
17	198-3848-001	Four-Channel Write Amplifier Module	1	
18	198-3849-001	Five-Channel Write Amplifier Module	1	

NOTES
1. Assembly varies with speed of machine. Please specify when ordering.

2. Delay timing module version varies with machine specifications. Consult card identification strip or schematic section for module type required.

Table B-6 Replaceable/Spare Parts for Figure B-3

Item	Part No.	Description	Qty Spare	Note
1	198-4441-001	Voltage Regulator/Servo Power Assembly	1	1
4	198-0802-001	Fuse Holder		
	198-0133-030	Fuse 3AG, 3 A (115 V) (box of 5)	1	
	198-0133-015	Fuse 3AG, 1.5 A (230 V) (box of 5)	1	
5	198-5001-103	Switch, 115/220 V		
6	198-0068-001	Power Cord		
	198-0100-001	Hub Repair Kit	1	2
	198-0102-001	Brush Replacement Kit, Reel Motor (4 brushes)	1	
	198-0103-001	Brush Replacement Kit, Capstan Motor (2 brushes)	1	

NOTES
1. Heat sink assembly includes regulation module 190-4352-001. This module is not readily replaceable without replacing heat sink.
2. Repair kit contains those items subject to wear.

Table B-7 DEC/Vendor TS03 Transport Part Numbers

Vendor Number	DEC Number	Description
154-0035-001	29-21904	Tape Path Alignment Tool
190-1509-001	29-21905	Tape Guide
190-2399-010	29-21906	Head Assembly
190-2641-001	29-21907	File Protect Assembly
190-2747-001	29-21908	Tape Cleaner Assembly
190-3631-005	29-21909	Read Preamplifier Module
190-3645-002	29-21910	Ramp Generator Module
190-3841-001	29-22269	Control Terminator Module
190-3842-001	29-21911	Interface Control Module
190-3843-001	29-21912	Tape Motion Control
190-3844-001	29-21913	Sense Amplifier/Driver Module
190-3848-001	29-21914	Write Amplifier (4-Channel) Module
190-3849-001	29-21915	Write Amplifier (5-Channel) Module
190-3860-001	29-22268	Data Terminator Module
190-4178-004	29-21916	Quad Read Amplifier Module
190-4179-004	29-21917	Read Amplifier/Clip Control Module
190-4220-001	29-21918	Mag Pot PLB
190-4306-001	29-21919	Servo Preamplifier Module
190-4352-001	29-21920	Voltage Regulator PCB
190-4845-001	29-21921	Timing Delay Module
192-9900-001	29-21922	Test Panel
190-4448-001	29-21923	LED Display
190-4441-001	29-21924	Voltage Regulator/Servo Power Amplifier
190-3468-001	29-21925	Module Extender
190-2647-002	29-21926	Tension Roller
190-2484-001	29-21927	Capstan Motor
128-0091-001	29-21928	Spring
125-0030-006	29-21929	O-Ring
190-4218-001	29-21930	Mag Pot
190-4438-001	29-21931	Reel Motor
151-0057-001	29-21932	Switch
190-1139-001	29-21933	Broken Tape Sensor
190-1138-001	29-21934	Tape Photo Sensor
151-0038-001	29-21935	Switch
125-0006-001	29-21936	Reel Drive Belt (Supply)
125-0015-001	29-21937	Reel Drive Belt (Take-Up)
125-0008-103	29-21938	Bearing
125-0040-001	29-21939	Bearing
154-0001-001	29-21940	Capstan Puller

Table B-7 DEC/Vendor TS03 Transport Part Numbers (Cont)

Vendor Number	DEC Number	Description
190-4474-601	29-21941	Transformer
148-0114-001	29-21942	LED Fairchild FLV-102
148-0108-001	29-21943	Diode MR751
148-0122-001	29-21944	Power Transistor MJ802
151-0802-002	29-21945	Fuse Holder
115-3625-199	29-21946	Capacitor (18K MFD or larger)
115-3610-449	29-21947	Capacitor (40K MFD or larger)
198-0100-001	29-21964	Hub Repair Kit
148-0121-001	29-10334	Power Transistor MJ4502
148-0075-001	29-19037	Transistor 2N4910
148-0053-001	15-10008	Transistor 2N3055A
148-0102-003	15-10712	Transistor MJ-900
148-0102-004	15-10853	Transistor MJ-1000
198-0133-030	90-07217	Fuse 3 A—3 AG (115 V)
198-0133-015	90-08388	Fuse 1.5 A—3 AG (230 V)

B.2 TMB11 PARTS

Table B-8 lists spare parts with part numbers for the TMB11 controller.

Table B-8 TMB11 Replaceable/Spare Parts

Item	Part No.
Tape Drive Interface Module	M7911
TMB11 Unibus Registers Module	M7912
Address Selector Module	M105
WC and CMA Module	M795
Unibus Master Control Module	M796
Interrupt Control Module	M7821
Unibus Jumper Module	M920
Unibus Terminator Module	M930
Unibus Cable	BC11A-X*
Wired Assembly (TMB11)	70-12678
Captive Screws (2)	90-08157
Option Harness RK11-D (BA11F Box)	70-09559
Option Harness RK11-D (BA11K Box)	70-10117
Option Harness RK11-D (BA11D Box)	70-08992
Power Harness (M8920)	70-13008

*X = length of cable in feet.
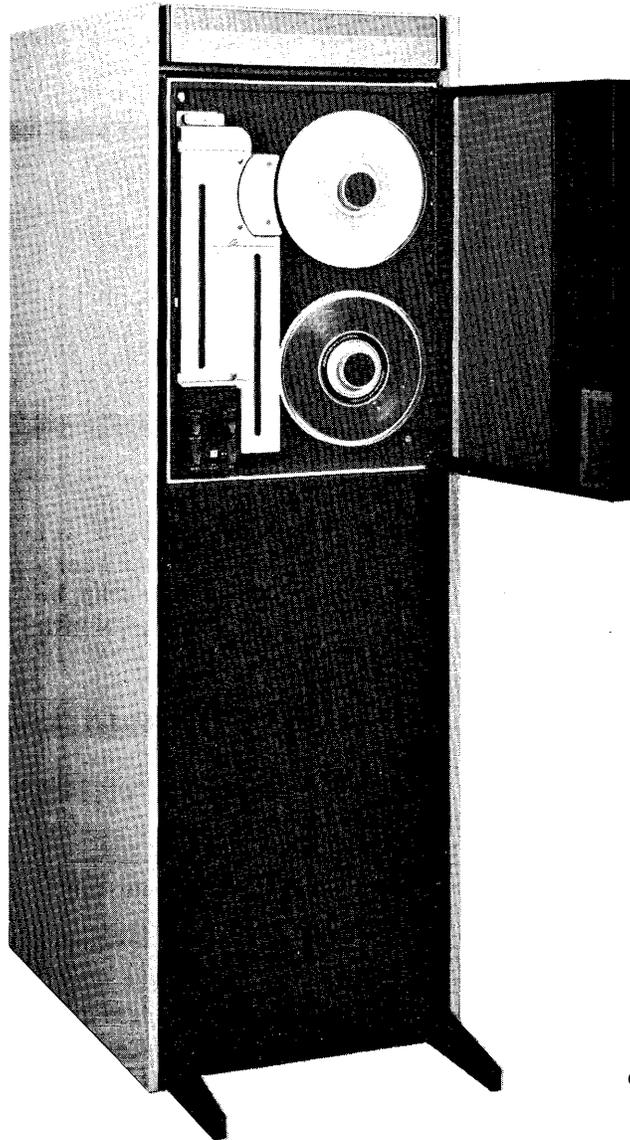
6999-2

C.1 DIGITAL'S MAGNETIC TAPE DRIVE CLEANING KIT

This DIGITAL Magnetic Tape Cleaning Kit has been carefully configured to provide you with cleaning materials that will not harm your tape equipment and will not leave any residue behind to interfere with data reliability.

The hints contained in the following few paragraphs will, if heeded, ensure that you get the very best results possible from this kit.

The FREON TF113 cleaning fluid in this kit is one of the safest and best degreasing agents available. It will not adversely affect any part of DIGITAL's tape equipment. To ready the can of fluid for service, 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, when using TF113, avoid excessive skin contact, do not allow TF113 to come in contact with the eyes, and do not swallow it. Use TF113 only in a well-ventilated area.

When cleaning tape equipment, never dip a contaminated cleaning swab or wipe into the can. To transfer fluid onto the swab, pour a little out into the screw cap and dip the swab into the cap. Discard the remaining fluid when the cleaning operation is complete.

Always keep the can of fluid tightly closed when not in use, because FREON TF113 evaporates rapidly when exposed to air.

Use only the cleaning materials contained in this kit to clean tape heads, guides, reels – in general, any part of the drive where a dirty residue could ultimately come in contact with tape. To clean other parts of the drive, such as the exterior surfaces of doors or the friction pads of brakes, use any reasonably clean, lint-free material with or without cleaning fluid.

NOTE
Should you encounter 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.

C.2 THE CARE AND CLEANING OF DIGITAL'S MAGNETIC TAPE DRIVES

C.2.1 Cleaning the TU16 and TU10 DECmagtape Drives

1. First, dismount the tape from the unit.

2. Clean the following components of these drives using a foam-tipped swab soaked in cleaning fluid (Figure C-1).

   a. Read/write head (Location A)
   b. Erase head (Location B)
   c. Tape cleaner (Location C)
   d. Upper roller guide (Location D)
   e. Lower roller guide (Location E)

NOTE
Be careful to keep cleaning fluid only on the tape-bearing surface of roller guides to prevent degreasing the roller guide bearings.
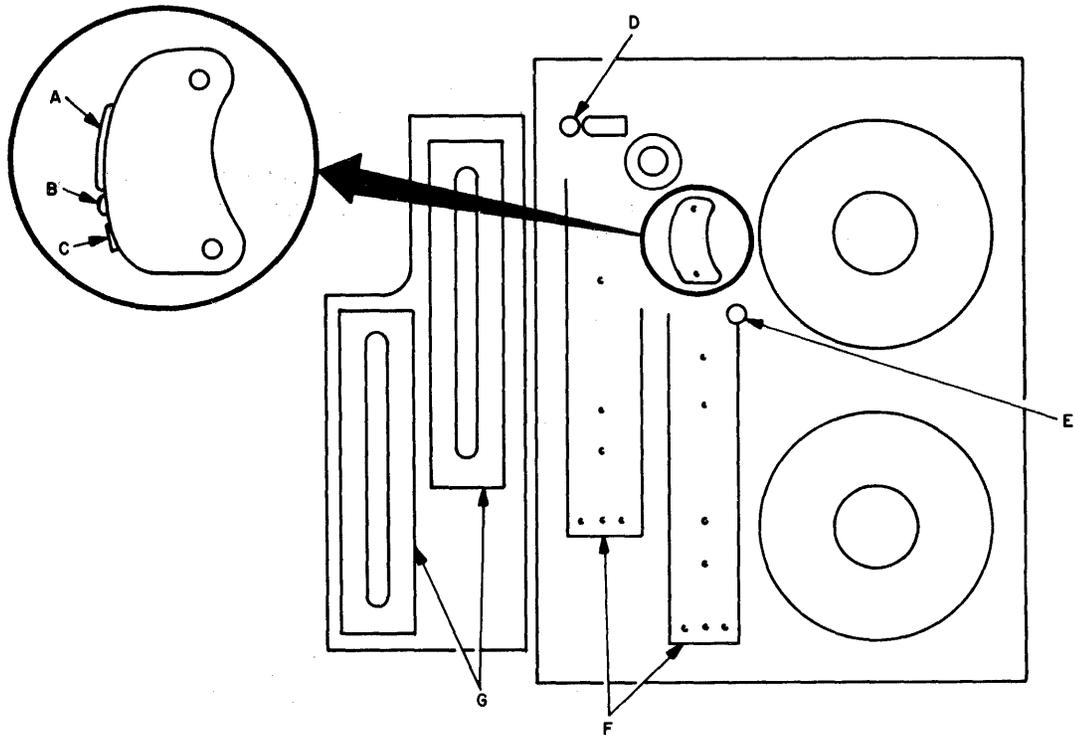
11 - 3357

Figure C-1   Location of Read/Write and Erase Heads and Tape Cleaner

3.   When cleaning the head area, avoid the spring-loaded ceramic washers on the tape drive
     assemblies. If it appears necessary to run the swab over the tape bearing surface of these
     guides to remove oxide deposits, do so; however, when cleaning is completed, be sure that
     the washer is pressed snugly up against the tape guide surface and not "hung up" on its shaft
     (Figure C-2).

4.   Next, clean the vacuum pockets (F) and the inner surface of the vacuum door (G) using a
     lint-free wipe and cleaning fluid. Pass another lint-free wipe over the head using a polishing
   action to remove any remaining deposits.
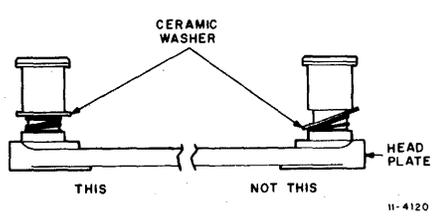
Figure C-2   Proper Ceramic Washer Positioning

C-3

C.2.2 Cleaning the TS03 DECmagtape Drive

1. Remove the tape from the transport.

2. Remove the head cover by pulling it gently toward you.

3. Pop up the head shield by exerting a light-to-medium upward force on the left side of the shield. (Refer to Figure C-3.) The shield opens up to about a 45° angle. Do not force it past this point or serious damage may result.


LOAD POINT/
END OF TAPE
SENSOR

HEAD
SHIELD

TAPE CLEANER

TAPE
GUIDE

MISSING TAPE
SENSOR

HEAD COVER REMOVED FOR CLARITY   11-3051
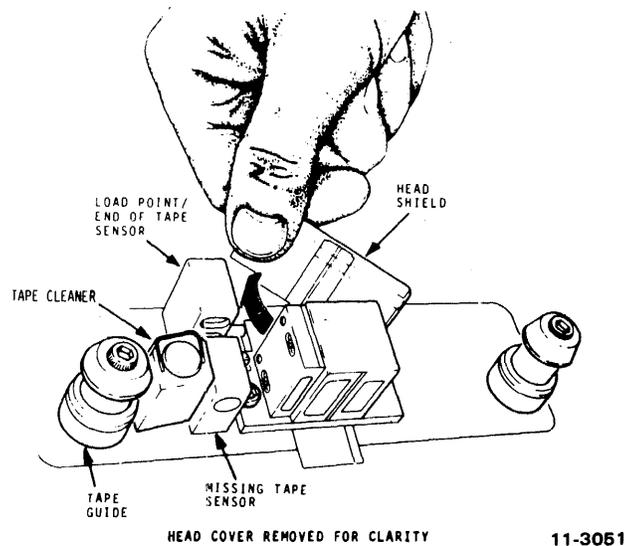
Figure C-3   TS03 Tape Head Assembly

4. Using a lint-free cloth and cleaning fluid clean:

   a.   Head and head shield
   b.   Load point and end-of-tape sensor
   c.   Missing tape sensor
   d.   Tape guides
   e.   Tape cleaner
   f.   Tape roller guides (two, not shown)
   g.   Capstan (not shown)

If any oxide deposits have built up on the head or tape guides, scrub them away using a swab and cleaning fluid. Follow this scrubbing with another pass with the lint-free wipe.

NOTE
**When cleaning roller guides, be careful to keep the
cleaning fluid on the tape-bearing surface of the
guides to prevent degreasing their bearings.**

5.	Next, use a lint-free wipe and cleaning fluid to remove all dust and dirt from the inside of the plexiglass door.

6.	Finally, push down the head shield until it pops into position, replace the head cover, and restore the drive to operation.

C.2.3   Cleaning the TU60 DECcassette Drive

1.	First, remove the cassettes from the drives.

2.	Pull open the lower door to expose the recording head, tape guides, and leader sensor.

3.	Using a swab and cleaning fluid, clean the recording head and tape guides on both drives.

4.	Pass a lint-free wipe over the head and guides, and gently dust the sensor and bulb and lens on both drives.

5.	Close the lower door and restore the drive to service.

C.2.4   Cleaning the TU56 DECtape Drive

1.	Dismount all tapes.

2.	Using a lint-free wipe, give the front of the unit a general cleaning to remove all lint, dust, and loose oxide that may have accumulated.

3.	Moisten one of the swabs and scrub away the oxide that has built up on the edges of the guiding paths. A pointed wooden dowel that has been soaked in cleaning solvent is often very helpful to remove very old, hard deposits which have become lodged in these areas.

4.	Wet a lint-free wipe with the solvent and scrub the tape guiding path and the top of the tape head. Follow this treatment with a dry lint-free wipe to pick up any residual solvent.

C.2.5   Cleaning other DIGITAL Tape Units

Cleaning instructions for tape units not mentioned here can be found in the maintenance manuals for those units.

Reader's Comments

Your comments and suggestions will help us in our continuous effort to improve the quality and usefulness of our publications.

What is your general reaction to this manual? In your judgment is it complete, accurate, well organized, well written, etc.? Is it easy to use? _____

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What features are most useful? _____

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What faults do you find with the manual? _____

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Does this manual satisfy the need you think it was intended to satisfy? _____

Does it satisfy *your* needs? _____ Why? _____

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Would you please indicate any factual errors you have found. _____

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Please describe your position. _____

Name _____ Organization _____

Street _____ Department _____

City _____ State _____ Zip or Country _____

- - - - - - - - - - - - **Fold Here** - - - - - - - - - - - - -

- - - - - - - - Do Not Tear - Fold Here and Staple - - - - - - - - -