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MTS 500
MAGNETIC TAPE SUBSYSTEM
ADDENDUM A

SERIES 6000

HARDWARE

SUBJECT:

    Additions and Changes to the MTS500 manual.

SPECIAL INSTRUCTIONS:

    This is the first addendum to DB28, Revision 0, dated August 1972. Insert the attached pages into the manual as indicated in the collating instructions on the back of this cover. Change bars in the margins indicate technical additions and changes; asterisks indicate deletions. These changes will be incorporated into the next revision of the manual.

    NOTE: This cover should be inserted following the manual cover to indicate that the document has been updated with Addendum A.

DATE:

    April 1974

ORDER NUMBER:

    DB28A, Rev. 0

COLLATING INSTRUCTIONS

To update this manual, remove old pages and insert new pages as follows:

Remove	Insert
1-1 to 1-4	1-1 to 1-4
2-5 to 2-8	2-5 to 2-8
2-13 to 2-14	2-13 to 2-14
2-23 to 2-24	2-23 to 2-24
----	3-17
A-1 to A-2	A-1 to A-2
B-1 to B-2	B-1 to B-2

Honeywell

MTS500 MAGNETIC TAPE SUBSYSTEM

SERIES 6000

SUBJECT:

General Description, Functional Description, and Operating Instructions for the MTS500 Magnetic Tape Subsystem.

PREFACE

This reference document provides hardware-oriented descriptive and instructive material for the user of the MTS500 Magnetic Tape Subsystem and for others concerned with its technical aspects, application, or use.

Divided into three sections, the manual contains a general description of the hardware used in the subsystem, including its performance specifications, capabilities, and optional features (Section I), a description of the specific functions performed by the subsystem, its interface with the External User System, data formats, instructions, and status conditions (Section II), and a description of the operator-accessible control panel switches and indicators and the operating procedures necessary to enable personnel to operate the subsystem (Section III).

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ILLUSTRATIONS

SECTION I
GENERAL DESCRIPTION

MAGNETIC TAPE SUBSYSTEM (MTS500)

The MTS500 Magnetic Tape Subsystem operates as a part of a Honeywell Series 6000 Information Processing System. This subsystem controls the writing on and reading from magnetic tape recorded in either the Non Return to Zero Invert (NRZI) or Phase-Encoded (PE) modes and accommodates either 7- or 9-track tape units or a mixture of both.

The basic subsystem consists of a Microprogrammed Peripheral Control (MPC) and one magnetic tape unit (see Figure 1-1). This basic subsystem can be expanded to include up to 16 magnetic tape units (see Figure 1-2).
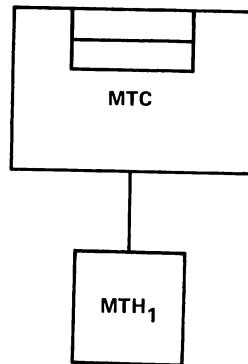
Figure 1-1. Basic MTS500 Subsystem
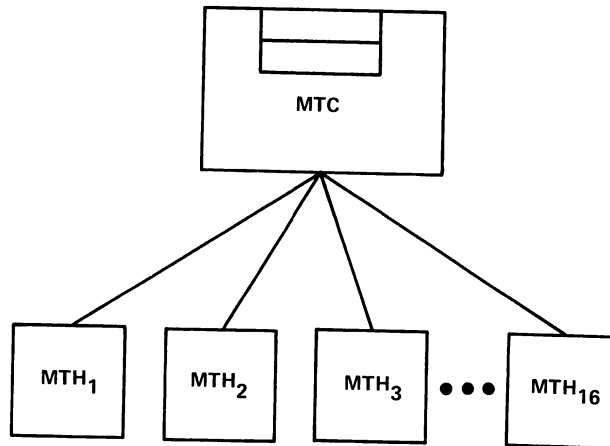
Figure 1-2. Maximum MTS500 Subsystem

Magnetic Tape Control

The MPC, a general-purpose microinstruction processor, is housed in a low-profile cabinet with an easily accessible control panel (see Figure 1-3). Modular design of the basic MPC permits expansion through the installation of optional hardware in the form of plug-in circuit boards. In addition to the control panel, the basic MPC includes:

- A maintenance panel (concealed behind the cover surrounding the control panel)
- A control store and a main memory
- A power supply and power control modules
- A forced-air cabinet cooling system

When used in an MTS500 subsystem, the MPC is configured as a Type MTC501 or MTC502.

MTC501 MAGNETIC TAPE CONTROL

The MTC501 controls up to eight Type MTH502 or MTH505 tape units. Feature MTF503, a 7-Track Tape Unit Adapter, allows one or two Type MTH501 or MTH504 7-track tape units to be used in the subsystem.

Dimensions

    51 inches (129, 5 cm) high
    55 inches (139, 7 cm) wide
    28 inches (71, 1 cm) deep

Installed Weight

    700 pounds (318 k)

Area (including door swing)

    30.5 square feet (2, 8 square meter)

Operating Environment

    Temperature: 50 - 100°F (10 - 38°C)
    Humidity: 10 - 85 percent

Power Requirements

    120/208Vac, 60 Hz
    1.83 kVA

Air Conditioning

    4600 Btu/hour
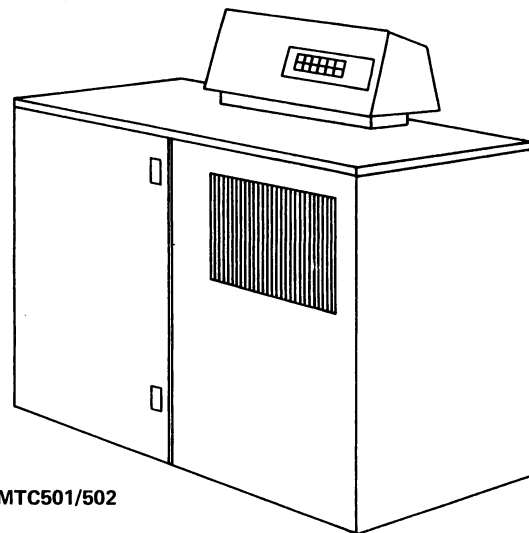
TYPE MTC501/502

Figure 1-3. Microprogrammed Peripheral Control

The Type MTC502 controls up to 16 Type MTH502 or MTH505 Magnetic Tape Units. The standard MTC502 handles one or two Type MTH501 or MTH504 7-track tape units. Feature MTF503, a 7-Track Tape Unit Adapter, adds the capability of handling two additional MTH501 or MTH504 tape units.

Magnetic Tape Units

The magnetic tape units used in MTS500 subsystem (see Figure 1-4) include both 7- and 9-track units that process data at 200, 556, 800, and 1600 bits per inch (bpi) at tape speeds of 75 and 125 inches per second (ips). Data is recorded in the NRZI mode at 200, 556, and 800 bits per inch and in the PE mode at 1600 bpi.

The tape units feature a new low-profile cabinet, single-capstan drive, automatic threading (with or without a protective canister), and a power window. Another feature is a precision tape cleaner positioned to function whenever the tape is in motion and in contact with the read/write head. Dust and other foreign matter are removed from the tape by a combination vacuum and sweeping action. The cleaning process is gentle and harmless to the tape and reduces the possibility of data errors due to magnetic tape flaws caused by the presence of foreign matter.

Information is protected from destruction by a write-enable ring that must be in place to permit recording. In a write operation, all information is immediately read and checked read-after-write dual-gap head). During normal read operations at 1600 bpi, dropped bits in any one track are automatically corrected in flight. In NRZI recording, special check characters can be used to reconstruct data.

Features and No-cost Options

The following items are available for the tape units:
- Features MTF509 and MTF519 Modification (Upgrade) Kits — convert 7-track units to 9-track units
- Feature MTF510 Cartridge Load — designed to be compatible with the IBM "Easy Load Tape Cartridge"
- Feature MTF512 (factory-installed) or MTF513 (field-installed) High Altitude Adapter — allows operation at altitudes in excess of 6000 feet above sea level
- Feature MTF514 DC Power On Meter — measures DC power on time in hours (factory-installed only)
- Feature MTF515 Tape Movement Meter — measures tape movement in hundredths of hours (factory-installed only).

Magnetic Tape

For optimum performance at 1600 bpi, only tape that meets the requirements of Honeywell Purchase Specification No. 03850027 should be used. The Honeywell 1600-bpi magnetic tape meets these specifications.

Dimensions

    30 inches (76 cm) wide
    30 inches (76 cm) deep
    65.5 inches (165,3 cm) high
    61.5 inches (155,8 cm) high (top of cabinet)

Installed Weight

    760 pounds (340 k)

Area (including door swing)

    14.8 square feet (1,4 square meters)

Operational Environment

    Temperature: 60 - 90°F (15 - 33°C)
    Humidity: 20 - 80 percent

Power Requirement

    208 Vac, 60 Hz
    1.6 kVA 501/502
    2.2 kVA 504/505

Air Conditioning Requirements

    4100 Btu/hour (MTH501, MTH502)
    6100 Btu/hour (MTH504, MTH505)
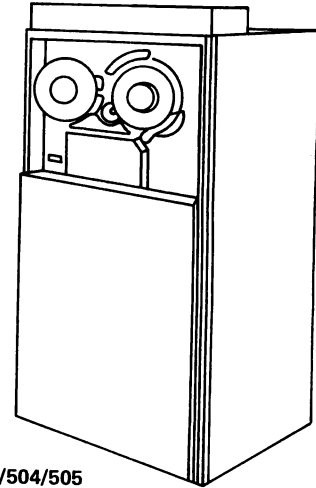
TYPE MTH501/502/504/505

Figure 1-4. Magnetic Tape Units

SECTION II
FUNCTIONAL DESCRIPTION

MAGNETIC TAPE SUBSYSTEM

The MTS500 subsystem controls the movement of, recording on, and reading from either 7- or 9-track 1/2-inch magnetic tape formatted in PE or NRZI modes. Both 75-ips and 125-ips tape speeds are available. Data can be recorded at 200, 556, 800, or 1600 (PE mode only) bpi.

Both single-channel and dual-channel (simultaneous) data transfer operations are available (see Figures 2-1 and 2-2). Single-channel controls can handle up to eight units per subsystem while dual-channel (simultaneous) controls can operate with up to 16 units. Data rates are summarized in Table 2-1.
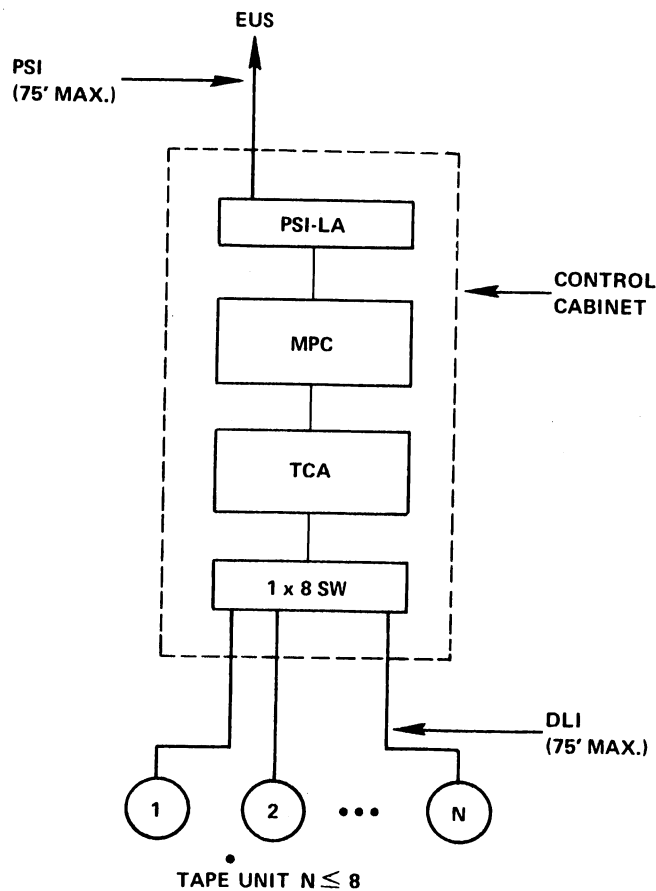
Figure 2-1. Single-Channel Subsystem
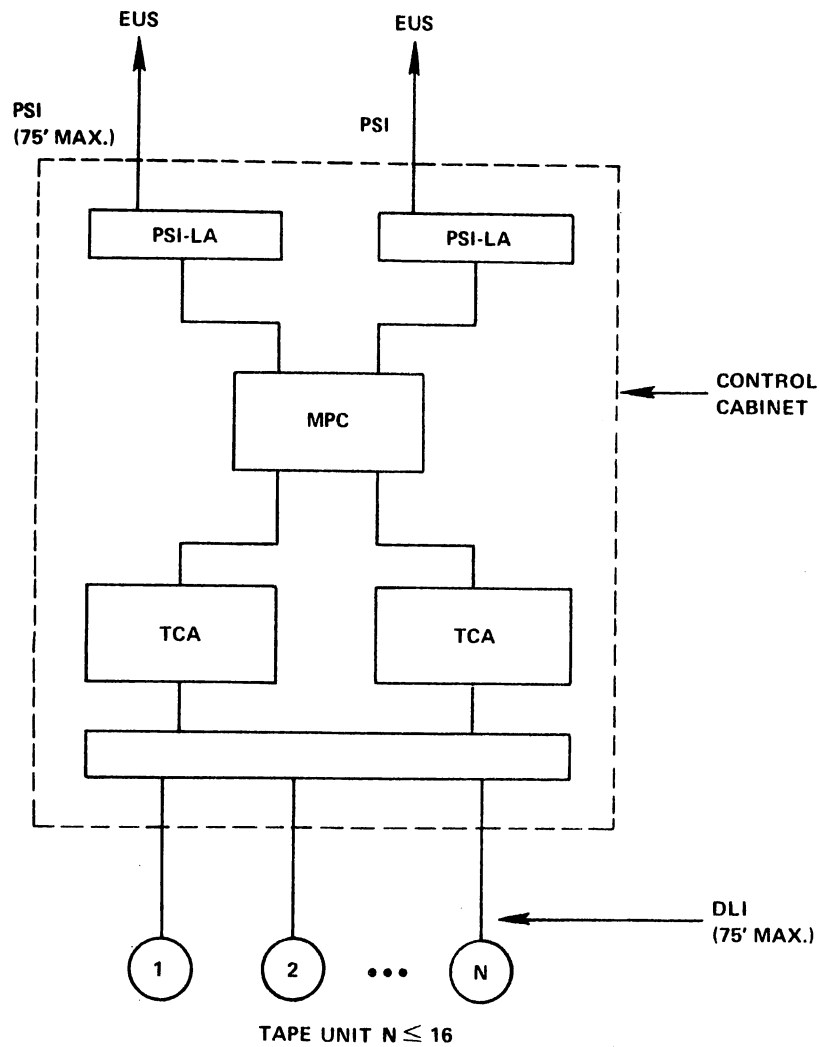
Figure 2-2. Dual-Channel Subsystem (Simultaneous)

Table 2-1. Data Rates for Various Recording Densities and Unit Speeds

Recording Density	Unit Speed[a]			
	75 ips		125 ips	
	7-Track	9-Track	7-Track	9-Track
200 bpi	11.25K (15K)	15K (20K)	18.75K (25K)	25K (33.3K)
556 bpi	31.27K (41.7K)	41.7K (55.6K)	52.125K (69.5K)	69.5K (92.6K)
800 bpi	45K (60K)	60K (80K)	75K (100K)	100K (133.3K)
1600 bpi		120K (160K)		200K (266.6K)
[a]Figure in parentheses is in thousand characters per second. Other figure is in thousand bytes per second.				

General Characteristics

The MTS500 subsystem incorporates the following features:

- Set density commands which have replaced the set density override switches on the tape units.

- Four forms of code translation (three are options):
    - BCD (Normal)
    - Six-bit to/from EBCDIC (Feature MTF505)
    - Six-bit to/from ASCII (Feature MTF504) } 9-Track Tape Units Only
    - ASCII to/from EBCDIC (Feature MTF506)

- Special Interrupt — When a special interrupt is sent to the EUS, information which defines the interrupting device and the reason for the interrupt is also sent.

- The subsystem will perform automatic retries for specified read-type command errors which have a Device Data Alert major status.

- The subsystem will maintain an error log for specified errors occurring within the subsystem.

Control Features

Table 2-2 lists the features of the Type MTC501 and MTC502.

Tape Unit Features

Table 2-3 lists the features of the available tape units.

Table 2-2. Tape Control Features

Features	MTC501	MTC502
Simultaneous Data Transfer	No	Yes
Maximum Number of Tape Units	8	16
Recording Densities		
200, 556, 800 bpi NRZI	Yes	Yes
1600 bpi PE	Yes	Yes
7-Track Tape Units	Yes	Yes
9-Track Tape Units	Yes	Yes
Code Translation		
BCD	Yes	Yes
6-bit to/from EBCDIC	Optional	Optional
6-bit to/from ASCII	Optional	Optional
ASCII to/from EBCDIC	Optional	Optional
Read Reverse Capability	No	No

Table 2-3. Magnetic Tape Unit Features

Features	MTH501	MTH502	MTH504	MTH505
No. of Tracks	7	9	7	9
Speed Forward (ips)	75	75	125	125
Rewind Speed	500	500	500	500
Reverse Speed-Backspace (ips)	75	75	125	125
Recording Density (bpi)				
200, 556, 800 NRZI	Yes	Yes	Yes	Yes
1600 PE	No	Yes	No	Yes
Automatic Load	Yes	Yes	Yes	Yes
Power Window	Yes	Yes	Yes	Yes
Options				
Canister Load (factory-installed)	Yes	Yes	Yes	Yes
High-altitude kit (factory-installed)	Yes	Yes	Yes	Yes
High-altitude kit (field-installed)	Yes	Yes	Yes	Yes
DC Power Meter	Yes	Yes	Yes	Yes
Tape Movement Meter	Yes	Yes	Yes	Yes
ANSI Compatible Recording	Yes	Yes	Yes	Yes
Modification (Upgrade) Kits	Yes	No	Yes	No

Control Description

The controls use the MPC as a central control mechanism. Included in the MPC cabinet are the following:

- The Link Adapter provides a hardware interface to the PSI channel (PSI-LA)
- Tape Control Adapter (TCA)
- Microprogrammed Peripheral Control (MPC)
- Device Switch (SW)

The TCA provides hardware control for those device-oriented functions that are not readily controlled by microprograms in the MPC. These functions include:

- LCC generation
- CCC generation
- PE data recovery and deskewing
- PE/NRZI error detection/correction
- Data buffering
- Code translation
- Pack/unpack associated with code translation
- TCA status generation
- PE preamble/postamble detection
- BOT PE identification burst generation

Major subsystem control is provided by the MPC. Its microprograms include the following functions:

- Interpretation of commands received from the EUS
- Collecting tape unit, TCA, and MPC status; formatting and transmitting to the EUS
- EOF generation/detection
- Record and file gap control
- CCC/LCC gap control
- Write-time-base control
- Blank-character time-base control
- BOT PE identification burst detection
- Preamble/postamble generation control

DEVICE ADDRESSING

The control is identified as device zero and the tape units are numbered from one through eight for a single-channel subsystem and from 1 through 16 for a dual-channel subsystem.

The device number is wired into the unit in the form of a 5-bit code when the unit is installed. A large number on the unit's operator panel corresponds to the wired-in device number. The numbers are unique within the subsystem and are not changed during the life of the unit in the subsystem.

The control maintains a table relating device codes to device switch ports. This table is dynamic in that it is updated each time a unit is added to or removed from the subsystem. Prior to initiating any activity with a particular tape unit, the control will interrogate the summary status byte containing the wired-in number to ensure that the proper device is being addressed.

ERROR INTERRUPT IMPLEMENTATION

The control has built-in logic to detect internal hardware parity errors, etc. If any of these errors is detected, the control automatically executes an error interrupt and establishes an "error interrupt in progress" state.

External User System (EUS)

The External User System for the subsystem is a Honeywell Series 6000 Information Processing System. The following documents will provide a good description of these systems:

- Series 6000 Summary Description, Order No. DA48
- Series 6000 System Startup and Operation, Order No. DA06
- Series 6000 Equipment Operator's Manual, Order No. DA33
- Series 600/6000 Macro Assembler Program (GMAP), Order No. BN86

Link Adapter (LA)

The Link Adapter connects the control to the EUS. Each LA has two ports allowing the LA to be shared by two physical interface channels for the nonsimultaneous transfer of data between the EUS and control. Channel switching is controlled by the microprograms.

Tape Control Adapter (TCA)

The tape control adapter contains device-oriented electronics and logic functions to supplement the control's capabilities. The TCA contains the data-recovery logic for phase-encoded data as well as those functions not readily controlled by the control firmware.

Magnetic Tape Unit

The magnetic tape unit provides the transport mechanism and associated read/write electronics necessary to generate and read tape. Additional functions of the tape units include:

- NRZI data recovery
- Move tape forward/reverse
- Rewind/unload/load tape in standby mode (offline to the EUS)
- Maintain status and transmit to control upon request
- Provide required control logic for tape movement
- Generate DC power for unit electronics
- Condition signals for transmission to control

Device Switch (SW)

The device switch provides the radial communications link between the TCA and the tape units. It enables switching control communications from one unit to another. The device switch allows a unit to be removed from the control without disconnecting any other unit.

Magnetic Tape

The magnetic tape provided by Honeywell Information Systems is a high-quality, clear-polyester-base tape coated with finely divided oxide particles in a flexible binder. It is furnished on 2400-ft., 10-1/2-in. reels which may be mounted in canisters (see Figure 2-3).

Media Interchangeability

Tapes generated by the tape units are compatible with tapes generated by other tape units if the other tape units comply with ANSI recording standards.

RECORDING FORMATS

In the subsystem, data can be recorded and read in NRZI mode at 200, 556, and 800 bpi on either 7- or 9-track tape or in the PE mode at 1600 bpi on 9-track tape.
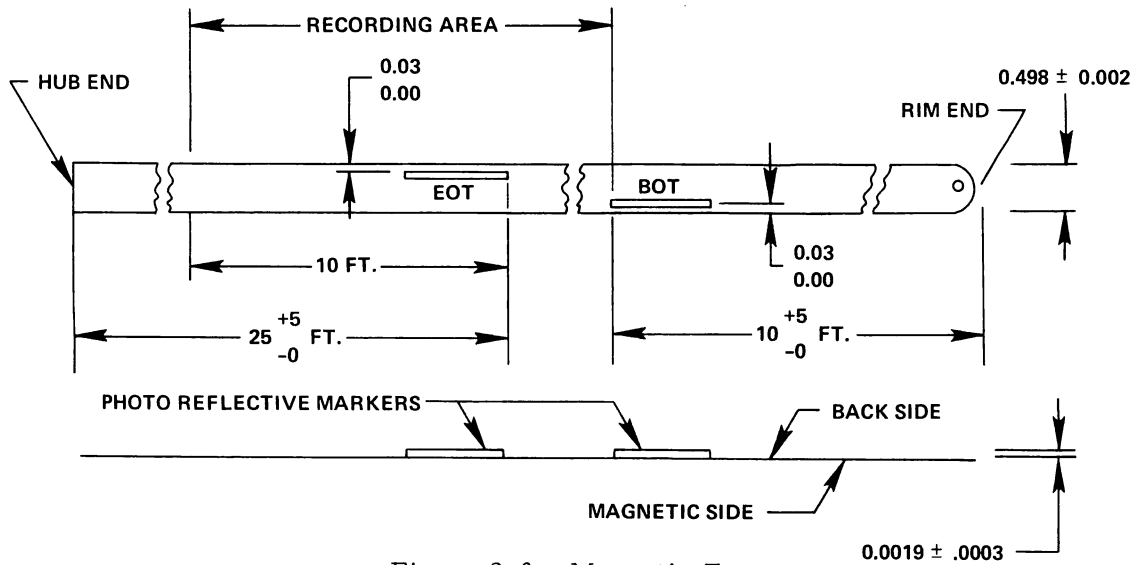
Figure 2-3. Magnetic Tape

NRZI

The NRZI or Non Return to Zero Invert (also called Non Return to Zero, Change on Ones) recording technique has a flux reversal for each 1 with no flux reversal on a 0 (see Figure 2-4).
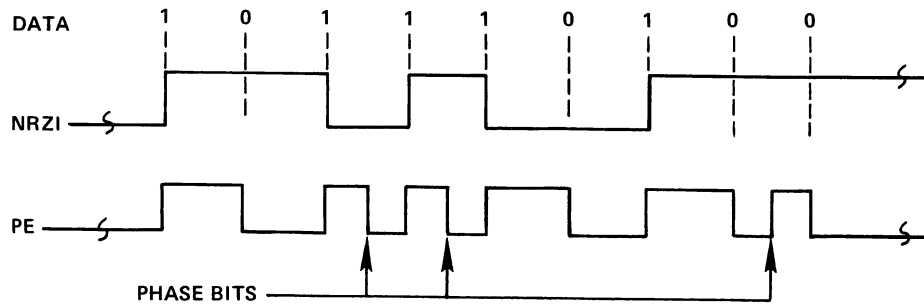
Figure 2-4. Recording Techniques

Data formats are arranged so that at least one flux reversal occurs for every frame. Thus a clock is provided without assigning a separate track.

PE

The PE or Phase-Encoded recording technique combines the clock and data to provide at least one flux reversal for each bit cell, thus achieving self-clocking (see Figure 2-4).

A 1 is a flux change to the polarity of the interrecord gap; a 0 is a flux change to the polarity opposite to the interrecord gap.

<u>Bit Weights for Tape Tracks</u>

The bit weights differ between 7- and 9-track units.

- 7-Track (NRZI only)

Track No. from Reference Edge

	7	6	5	4	3	2	1
Bit Weight	P	2^5	2^4	2^3	2^2	2^1	2^0
Control Bit 0 1	P	2	3	4	5	6	7

- 9-Track (NRZI and PE)

Track No. from Reference Edge

	9	8	7	6	5	4	3	2	1
Bit Weight	2^3	2^1	2^7	2^6	2^5	P	2^4	2^0	2^2
Control Bit	4	6	0	1	2	P	3	7	5

<u>NRZI 7-Track</u>

7-TRACK RECORD FORMAT

Figure 2-5 illustrates the record format for 7-track NRZI recording.
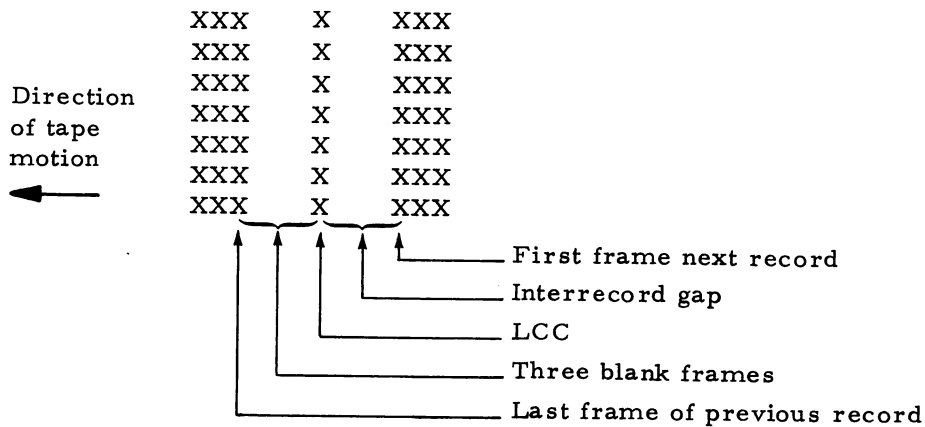
Figure 2-5. 7-Track NRZI Format

7-TRACK LATERAL PARITY

Lateral parity in BCD operation is even 1's and in binary operations is odd 1's.

7-TRACK LONGITUDINAL PARITY

The last frame of a record is followed by three blank frames. The next frame is a longitudinal parity check (LCC). Each bit of the LCC represents the even 1's parity bit for the longitudinal track in which it appears. The lateral parity of the LCC is ignored.

7-TRACK END OF FILE

Figure 2-6 shows the EOF (End of File) for 7-track NRZI recording.

```
Direction        XXX    X    X    X
of tape          XXX    X    X    X
motion           XXX    X    X    X
                 XXX    X    X    X
                 XXX    X    X    X
                 XXX    X    X    X
                 XXX    X    X    X
```

```
                                    └───── LCC for EOF frame
                              └───────── Three blank frames
                        └───────────── EOF frame
                  └───────────────── 3.75 inches nominal — EOF gap
            └───────────────────── LCC of previous record
      └───────────────────────── Three blank frames
└───────────────────────────── Last frame of previous record
```

Figure 2-6. 7-Track End of File

NRZI 9-Track (200 and 556 bpi)

NRZI 9-TRACK RECORD FORMAT

Figure 2-7 illustrates the 9-track record format for recording at 200 and 556 bpi.

```
                 XXX    X    XXX
                 XXX    X    XXX
                 XXX    X    XXX
Direction        XXX    X    XXX
of tape          XXX    X    XXX
motion           XXX    X    XXX
                 XXX    X    XXX
                 XXX    X    XXX
                 XXX    X    XXX
```

```
                              └───── First frame of next record
                        └───────── Interrecord gap
                  └───────────── LCC of current record
            └───────────────── Three blank frames
      └───────────────────── Last frame of current record
```
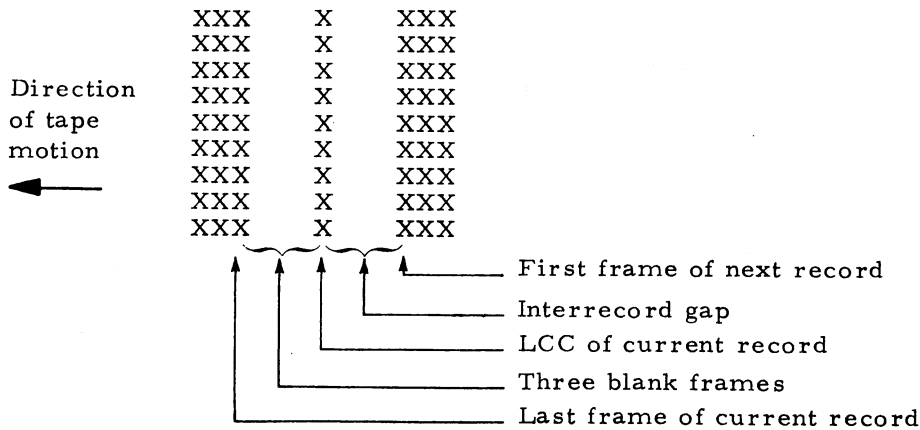
Figure 2-7. 9-Track NRZI Record Format (200 and 556 bpi)

9-TRACK LATERAL PARITY

Lateral data parity is odd 1's.

9-TRACK LONGITUDINAL PARITY

The last frame of a record is followed by three blank frames. The next frame is a longitudinal parity check (LCC). Each bit of the LCC represents the even 1's parity bit for the longitudinal track in which it appears. Lateral parity of the LCC is ignored.

9-TRACK END OF FILE
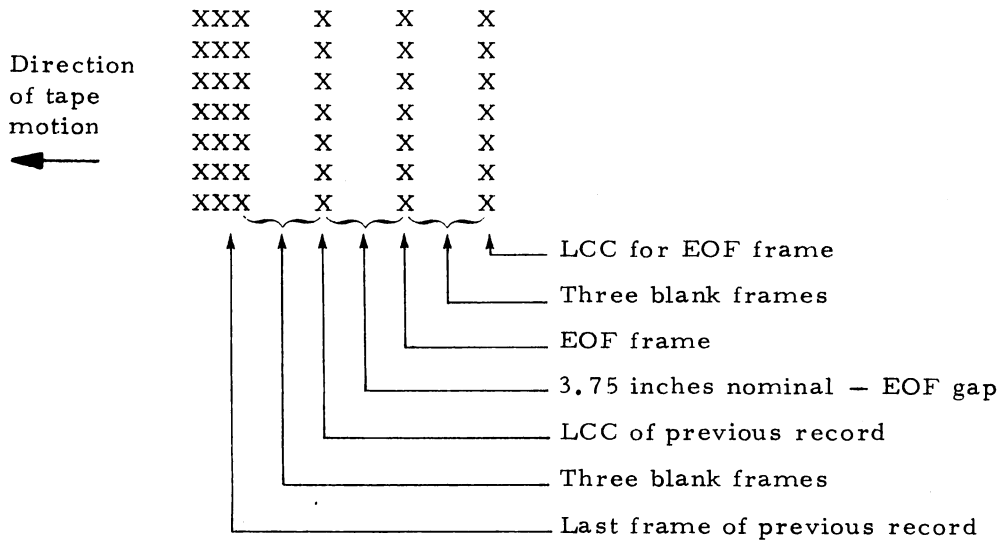
Figure 2-8 shows the EOF format for 9-track NRZI recording at 200 and 556 bpi.

2-9

DB28

```
                 XXX   X   X   X
                 XXX   X   X   X
                 XXX   X   X   X
Direction        XXX   X   X   X
of tape          XXX   X   X   X
motion           XXX   X   X   X
                 XXX   X   X   X
                 XXX   X   X   X
                 XXX   X   X   X
```

LCC of EOF frame
Three blank frames
EOF frame
Interrecord gap
LCC of previous record
Three blank frames
Last frame of previous record

Figure 2-8. EOF Format for 9-Track NRZI Recording (200 and 556 bpi)

NRZI 9-Track (800 bpi)

NRZI 9-TRACK RECORD FORMAT (800 bpi)

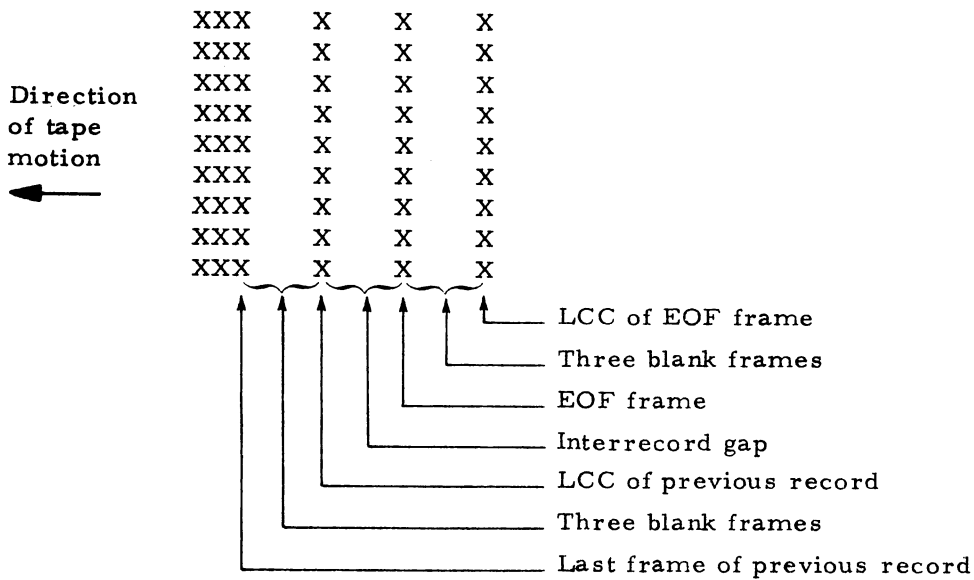Figure 2-9 illustrates the record format for 9-track recording at 800 bpi.

```
                 XXX   X   X   XXX
                 XXX   X   X   XXX
                 XXX   X   X   XXX
Direction        XXX   X   X   XXX
of tape          XXX   X   X   XXX
motion           XXX   X   X   XXX
                 XXX   X   X   XXX
                 XXX   X   X   XXX
                 XXX   X   X   XXX
```

First frame of next record
Interrecord gap
LCC for current record
Three blank frames
CCC for current record
Three blank frames
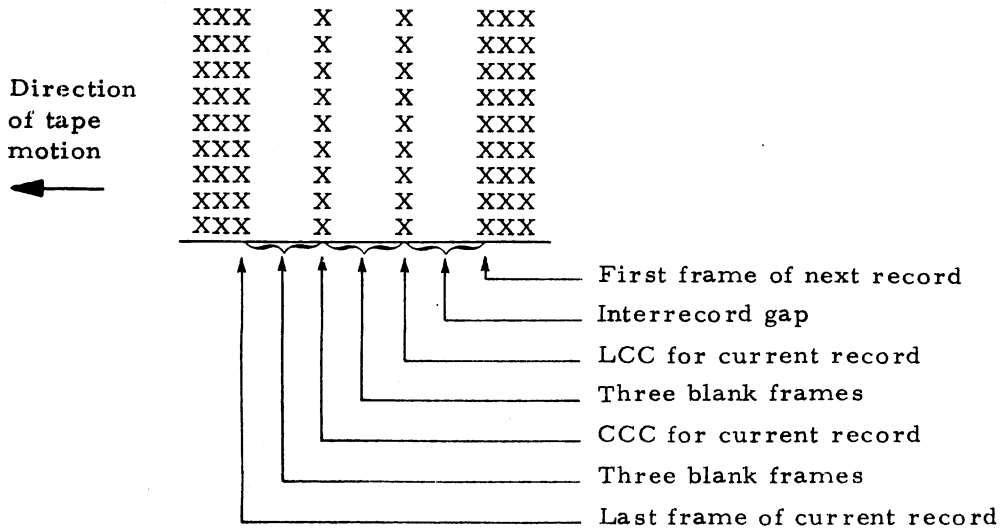Last frame of current record

Figure 2-9. 9-Track Record Format (800 bpi)

9-TRACK LATERAL PARITY

Lateral data parity is odd 1's so that each frame contains an odd number of 1's. The CCC may be either odd or even, depending on the number of data frames, while the LCC is odd.

9-TRACK LONGITUDINAL PARITY

Longitudinal parity for 9-track NRZI at 800 bpi is the same as at 200 and 556 bpi.

9-TRACK END OF FILE

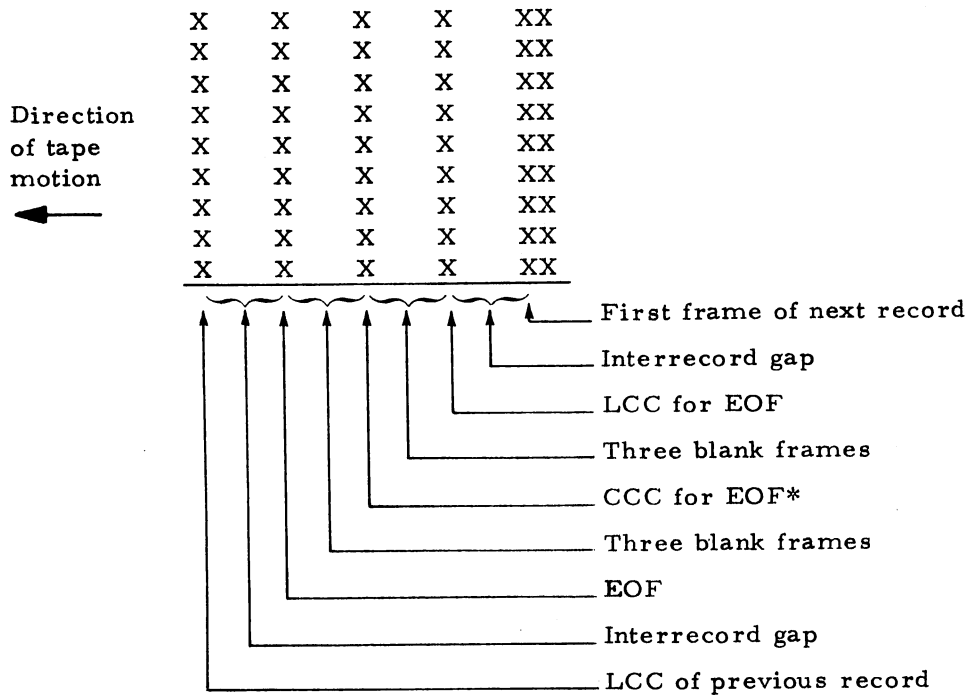Figure 2-10 shows the EOF format for 9-track NRZI recording at 800 bpi.

```
            X    X    X    X    XX
            X    X    X    X    XX
            X    X    X    X    XX
Direction   X    X    X    X    XX
of tape     X    X    X    X    XX
motion      X    X    X    X    XX
            X    X    X    X    XX
◄──         X    X    X    X    XX
            X    X    X    X    XX
```

First frame of next record

Interrecord gap

LCC for EOF

Three blank frames

CCC for EOF*

Three blank frames

EOF

Interrecord gap

LCC of previous record

Figure 2-10. EOF Format for 9-Track NRZI Recording (800 bpi)

Phase-Encoded (PE) Recording

PE TAPE FORMAT

Figure 2-11 illustrates the general tape format for PE recording at 1600 bpi.

PE IDENTIFICATION

PE recorded tapes are identified by an identification burst in track 4. This identification burst starts prior to the BOT marker and extends beyond the BOT marker. It is recorded at 1600 flux reversals per inch (fri) and is used by the control to identify PE tapes.
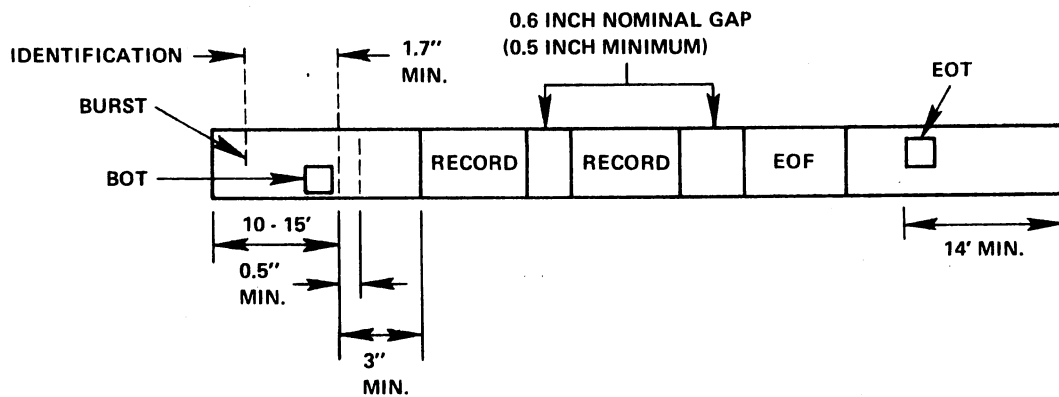
Figure 2-11. PE Tape Format

PE RECORD FORMAT

Each PE data record (see Figure 2-12) consists of three parts:

- Preamble — 41 frames, first 40 all 0's plus one all 1's
- Data
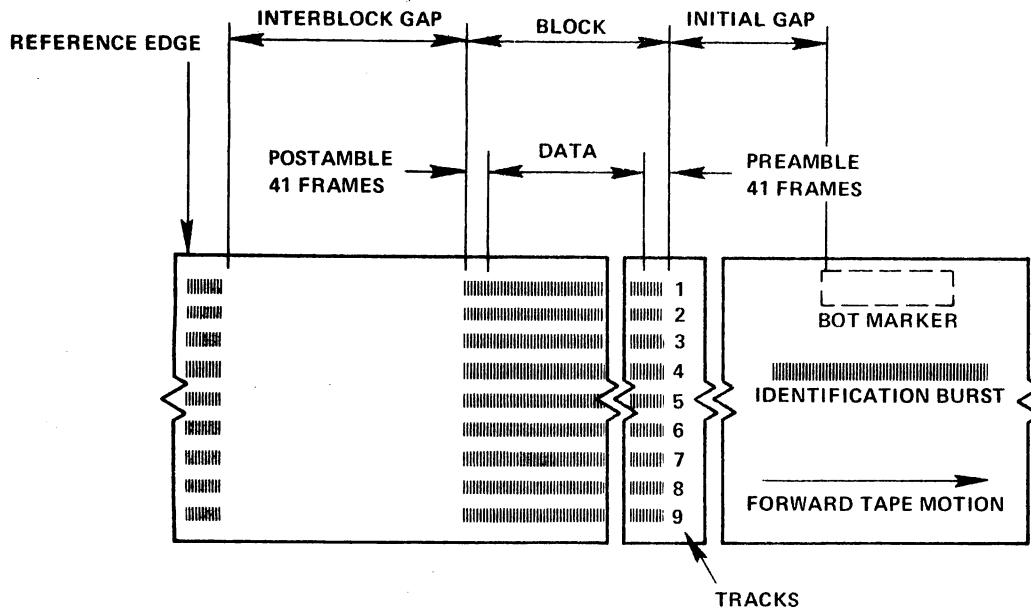- Postamble — 41 frames, one all 1's followed by 40 all 0's

Figure 2-12. PE Record Format

PE DATA PARITY

The PE data record has odd parity.

PE END OF FILE FORMAT

The PE EOF does not contain a preamble or a postamble like a normal PE record. It contains the following individual track information:

- Tracks 2, 5, and 8 — flux reversals at 3200 per inch
- Tracks 3, 6, and 9 — DC erased
- Tracks 1, 4, and 7 — See Figure 2-13

The EOF record is 240 flux reversals long divided into three segments of 80 reversals each. The bit weights are as shown in Figure 2-13.
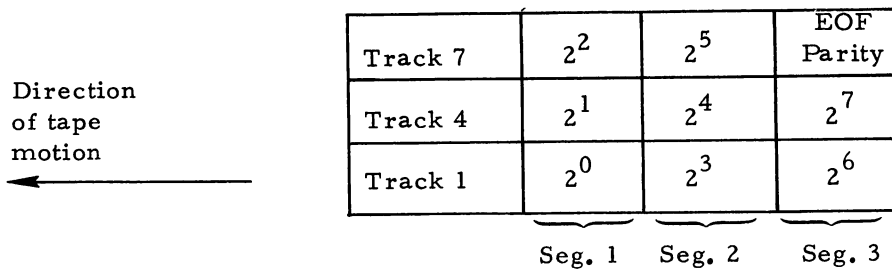
			EOF
Track 7	2^2	2^5	Parity
Track 4	2^1	2^4	2^7
Track 1	2^0	2^3	2^6

Direction
of tape
motion

Seg. 1   Seg. 2   Seg. 3

Figure 2-13. PE End of File Format

INSTRUCTION SET

Regular Instructions

The control contains microprograms that interpret instruction codes received from the EUS. These instruction codes are received via the PSI, interpreted in the control and then executed. Where device action is required, the control transmits commands and/or data to the device via the device switch.

Table 2-4 lists the regular instruction set used within the MTS500 subsystem. Table 2-5 lists the special control instructions.

- Request Status (00_8) — This instruction causes the control to transmit to the EUS the status of the last activity in the addressed device.

- Reset Status (40_8) — This instruction causes the resetting of all resettable status conditions within the addressed device.

- Request Device Status (50_8) — Extensive status information is stored in each unit. Some of this information is descriptive of the unit's physical characteristics and some descriptive of the unit's operational characteristics. The Request Device Status instruction will transfer this status to the EUS. This instruction is not legal if addressed to device zero (the control) and will be rejected.

- Reset Device Status (51_8) — This instruction provides the means for resetting the resettable status bits in the addressed tape unit. Upon receipt of this instruction, the control issues instructions to the addressed unit and the status bits are reset to 0. Successful completion of this instruction will result in Ready status being transmitted to the EUS.

- Survey Devices (57_8) — Upon receipt of this instruction, the control will interrogate each unit and assemble two bytes of information for each unit. The survey will start with unit 1 and proceed through unit 8 (single-channel control) or through unit 16 (dual-channel control).

  This instruction is legal only if addressed to device 0.

  Successful completion of this instruction will result in Ready status being sent to the EUS.

Table 2-4. Regular Instruction Set

Instruction	Op Code (Octal)	Instruction	Op Code (Octal)
Request Status	00	Erase	54
Reset Status	40	Write End-of-File Record	55
Request Device Status[a]	50	Write Tape Nine	13
Reset Device Status[a]	51	Read Tape Nine	03
Survey Devices[a]	57		
Read Control Registers[a]	26	Write Binary Record	15
Write Control Registers[a]	16	Read Binary Record	05
		Reread Binary Record	07
Set File Protect	62		
Set File Permit	63	Write BCD Record	14
Rewind	70	Read BCD Record	04
Tape Load	75	Reread BCD Record	06
Rewind/Unload	72		
		Write EBCDIC Record	34
Reserve Device[a]	66	Read EBCDIC Record	24
Release Device[a]	67		
		Write ASCII Record	37
Set 200 BPI	64	Read ASCII Record	27
Set 556 BPI	43 or 61		
Set 800 BPI	42 or 60	Write ASCII/EBCDIC Record	35
Set 1600 BPI	65	Read ASCII/EBCDIC Record	25
		Diagnostic Mode Control[a]	31
Forward Space One Record	44		
Forward Space One File	45		
Backspace One Record	46		
Backspace One File	47		
Control Store Overlay[a]	10	Main Memory Overlay	11
Load From Device[a]	05		

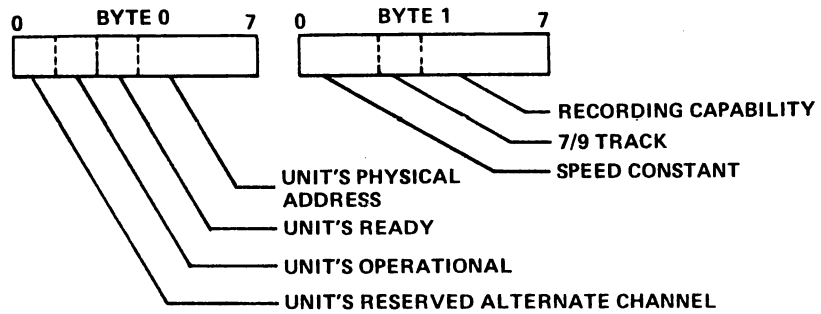[a]Master Mode Instructions; restricted to privileged users

Table 2-5. Special Control Instructions

Instruction	Op Code (Octal)
Suspend Controller[a]	00
Release Controller[a]	20
Initiate Read Data Transfer[a]	06
Initiate Write Data Transfer[a]	16
Read Controller Main Memory (ASCII)[a]	02
Write Controller Main Memory (ASCII)[a]	12
Read Lock Byte[a]	04
Write Lock Byte[a]	14
Conditional Write Lock Byte[a]	34
Write Controller Main Memory (BIN)[a]	32
Read Controller Main Memory (BIN)[a]	22

[a]Master Mode Instruction; restricted to privileged users

The bytes assembled for each tape unit contain the information in the following listing.

Byte:Bits	Description

0:0   Reserved Alternate Channel

A logical 1 in this bit position indicates that the unit is reserved for use by an alternate channel as the result of a Reserve Device command previously issued from another channel. If this bit is a logical 1, all other bits in the byte pair for that unit are invalid.

0:1   Operational

A logical 1 indicates that the unit is capable of communication with the external user system; logical 0 means the unit is incapable of communication with EUS.

0:2   Ready

A logical 0 in this position indicates that (a) the unit is in the process of executing a rewind-type operation or the Tape Load command, (b) the device is in the standby state, or (c) the unit is in a fail state.

0:3 — 0:7   Unit's Address

This is the 5-bit number which is wired into the unit at subsystem installation. The low-order bit is in position 0:7.

1:0 — 1:2   Speed Constant

This field specifies the forward speed capability of the handler.

```
                              1:0
                     1:2
  0  0  0                      Invalid Speed Code
  0  0  1                      75 ips
  0  1  0                      125 ips
```

1:3   7/9 Track

Logical 1 = 9-track tape unit.

1:4 — 1:7   Recording Capability

This field describes the PE and NRZI recording capability of the handler.

```
                           1:4
                   1:7
  0  0  0  0a               1600 bpi
  0  0  0  1                200, 556, 800 bpi
  0  1  0  0a              {1600 bpi
                           {200, 556, 800 bpi
```

[a] These codes are not legal if 7- or 9-track bit is logical 0.

- Read Control Register (26_8) — This instruction allows the EUS to obtain the contents of error logs maintained in the control for each tape unit and is legal only if addressed to a unit. This instruction causes the contents of the counters related to the addressed unit to be sent to the EUS.

  The control registers contain the following information:
  - Number of Read Records
  - Number of Write Records
  - Number of Records with Write Error
  - Number of Records with Read Error
  - Number of Transfer Timing Errors on Read
  - Number of Transfer Timing Errors on Write
  - Number of PE Records with Single Track Correction

- Write Control Register (16_8) — This instruction allows the EUS to load particular data in the unit error logs in the control and is invalid if addressed to device 0.

- Set File Protect (62_8) — This instruction will unconditionally inhibit write operations on the selected unit even with the Write Permit ring in the tape reel. The unit will remain in the Set File Protect mode until a new reel is loaded or until the Set File Permit instruction is issued to the unit.

- Set File Permit (63_8) — This instruction allows write operations on a unit which has been protected by a previous Set File Protect instruction if the Write Permit ring is in place. The instruction will be rejected if the Write Permit ring is not in place.

- Rewind (70_8) — This instruction causes the tape on the selected unit to be positioned on the BOT marker. The control is free to accept commands directed to other tape units during the execution of this instruction. When this instruction has been executed, a special interrupt is sent to the EUS by the control.

- Tape Load (75_8) — This instruction causes the selected unit to load and position the tape at the BOT marker. The control is free to accept instructions directed to other units during the Load operation. This instruction is valid only if the unit is in the Standby-Unloaded state.

  If the tape is at the BOT when this instruction is received, the control will send the initiate status-Peripheral Subsystem Ready-Positioned at BOT to the EUS.

- Rewind-Unload (72_8) — This instruction causes the tape on the selected unit to be run back onto the supply reel. The tape will stop so that the tape reel can be readily dismounted.

- Reserve Device (66_8) — This instruction allows an EUS to reserve an unreserved device for its exclusive use. The device is reserved to the Link Adapter port through which the instruction was received. The Reserved mode may be erased by a Release Device instruction through the same Link Adapter port which received the Reserve Device instruction.

- Release Device (67_8) — This instruction releases a device from the reserved condition when the instruction is received through the same Link Adapter port that received the Reserve Device instruction.

- Set 200 bpi (64_8) — This instruction causes the addressed unit to be set to 200 bpi if currently in the NRZI mode or if at the BOT marker and capable of this density. The unit will remain at 200 bpi until modified by another density instruction.

- Set 556 bpi (43_8 or 61_8) — This instruction causes the addressed unit to be set to 556 bpi if currently in the NRZI mode or if at the BOT marker and capable of this density. The unit will remain at 556 bpi until modified by another instruction.

- Set 800 bpi (42_8 or 60_8) — This instruction causes the addressed unit to be set to 800 bpi, if currently in the NRZI mode, or, if at the BOT marker and capable of this density. The unit will remain at 800 bpi until modified by another density instruction.

- Set 1600 bpi (65_8) — This instruction causes the addressed unit to be set to 1600 bpi if at the BOT marker and capable of 1600 bpi. The unit will remain at 1600 bpi until modified by another density instruction. The tape must be at the BOT marker when the new Set Density instruction is received or this next Set Density command will be rejected.

- Forward Space One Record (44_8) — This instruction causes the tape mounted on the addressed unit to be moved forward over the number of records specified in the Instruction Data Control Word (IDCW) and positioned to read or write the next sequential record. No data is transferred to the EUS during the execution of this instruction and tape parity is not checked.

  The tape subsystem remains busy during the execution of this instruction. After executing this instruction, the terminate status is sent to the EUS. If the record spaced over was an End-of-File record, the EOF Status will be sent to the EUS, the operation will terminate and the residue will reflect the unfulfilled record tally.

- Forward Space One File (45_8) — This instruction results in the tape on the addressed unit moving forward until an EOF record is detected. The tape is positioned to read or write over the record following the EOF record. No data is transferred to the EUS during the execution of this instruction and data parity is not checked. The subsystem remains busy while this instruction is executed. After the instruction is executed, the EOF terminate status is sent to the EUS.

- Backspace One Record (46_8) — This instruction causes the tape on the addressed unit to be moved backward over the number of records specified in the tally field of the IDCW and positioned to read or write the record just passed over. No data is transferred to the EUS during the execution of this instruction and data parity is not checked. The tape subsystem will remain busy during the execution of this instruction. After the instruction is executed the appropriate terminate status will be sent to the EUS. If the tape is at the BOT marker when this instruction is received the Command Reject-Positioned at BOT status will be sent to the EUS.

- Backspace One File (47_8) — This instruction causes the tape on the addressed unit to be moved backward until an EOF record is detected. The tape is positioned to read or write over the EOF record just spaced over. No data is transferred to the EUS and data parity is not checked during execution of this instruction.

  The tape subsystem remains busy during execution of this instruction. The EOF terminate status is sent to the EUS when the instruction has been executed. If the tape is at the BOT marker when the instruction is received the Command Reject-Positioned at BOT status will be sent to the EUS.

  If an EOF record is not detected before the BOT marker is reached, the tape will be positioned at the BOT marker and the Peripheral Subsystem Ready-Positioned at BOT status sent to the EUS.

- Control Store Overlay (10_8) — This instruction loads microprograms into the tape control's Control Store.

- Load From Device (05_8)[1] — This instruction is sent only immediately following a control initialize resulting from activation of the IOM BOOTLOAD pushbutton or in response to software.

---

[1] Same code as Read Binary Record

- Erase (54$_8$) — This instruction causes the tape on the addressed unit to be erased in the forward direction for 8.5 inches. The 8.5 inches is measured from the tape position at the time the instruction is received. The magnetic polarity is the same as gap polarity.

  The tape subsystem can be busy during this instruction and the appropriate terminate status will be sent after execution is complete.

  A read check is made during execution of this instruction. If a bit is detected in the erased tape, the status Device Data Alert — Bit Detected During Erase Operation will be sent to the EUS.

- Write End of File (55$_8$) — This instruction causes an EOF Record to be written. No data transfer will be made during execution of this instruction.

- Write Tape Nine (13$_8$) — This instruction causes the control-IOM combination to convert 9-bit bytes from memory to 8-bit frames to be written on tape. This instruction is valid only for 9-track tape units.

- Read Tape Nine (03$_8$) — This instruction causes the converting of 8-bit frames to 9-bit bytes imbedded in the 36-bit Series 6000 word. This instruction is valid only for 9-track tape units.

- Write Binary Record (15$_8$) — This instruction results in the writing of one record in the binary mode of operation.

- Read Binary Record (05$_8$) — This instruction results in the reading of one record in the binary mode of operation.

- Reread Binary Record (07$_8$) — This instruction is the same as Read Binary Record except that the control sets the tape unit in the low-threshold state prior to starting the tape motion.

- Write BCD Record (14$_8$) — This instruction results in the writing of one record by translating the data received from the EUS and writing it as BCD.

- Read BCD Record (04$_8$) — This instruction results in the reading of one record and translating the data from tape to BCD.

- Reread BCD Record (06$_8$) — The execution of this instruction is the same as Read BCD except that the control will set the tape unit in the low-threshold state before starting the tape.

- Write EBCDIC Record (34$_8$) — This instruction results in the writing of one EBCDIC record with translation from the Series 6000 6-bit characters to EBCDIC characters.

- Read EBCDIC Record (24$_8$) — This instruction results in the reading of one EBCDIC record with translation from EBCDIC characters to Series 6000 6-bit characters.

- Read ASCII Record (27$_8$) — This instruction results in the reading of one ASCII record with translation to 6-bit characters.

- Write ASCII/EBCDIC Record (35$_8$)[1] — This instruction results in the writing of one record with translation from ASCII characters to EBCDIC characters.

- Read ASCII/EBCDIC Record (25$_8$)[1] — This instruction results in the reading of EBCDIC data on tape and translation to ASCII characters.

- Diagnostic Mode Control (31$_8$) — This instruction is used to transfer DLI instructions directly to the addressed tape unit from the EUS.

- Main Memory Overlay (11$_8$) — This instruction results in loading microprograms in the control main memory during control bootload operations.

---

[1] See Appendix B

Special Control Instructions

These special control instructions must be addressed to device 0 and cannot be mixed with normal instructions.

- Suspend Controller (00_8) — This instruction allows an EUS to seize the control when it is physically connected to more than one EUS via two or more PSI's. The control will take the following actions:

  - Complete any channel programs which were initiated prior to receiving this instruction.

  - Ignore all new program requests except from the channel issuing the suspend instruction.

  - Execute the actions defined in the IDCW containing the Suspend Controller instruction.

- Release Controller (20_8) — This instruction resets the suspend state setup by a previously issued Suspend Controller instruction. This instruction must be received from the EUS issuing the Suspend Controller instruction.

- Initiate Read Data Transfer (06_8) — This instruction tells the control that a data transfer is about to start. It is used in conjunction with the following special instructions:

  - Read Controller Main Memory (Binary)

  - Read Controller Main Memory (ASCII)

  - Read Lock Byte

- Initiate Write Data Transfer (16_8) — This instruction tells the control that the data transfer is about to start. It is used in conjunction with the following special instructions:

  - Write Controller Main Memory (Binary)

  - Write Controller Main Memory (ASCII)

  - Write Control Store

- Read Controller Main Memory (ASCII) (02_8) — This instruction is used to transfer information from the control main memory to the EUS.

- Write Controller Main Memory (ASCII) (12_8) — This instruction is used to write data into the control main memory from the EUS.

- Read Lock Byte (04_8) — This instruction transfers the address of a lock byte to the control.

- Write Lock Byte (14_8) — This instruction is used to transfer information to a specific lock byte in the control main memory.

- Conditional Write Lock Byte (34_8) — This instruction is used to transfer information to a specific lock byte in the control main memory on a conditional basis. The information is written into the lock byte only if the lock byte is all 0's.

- Write Controller Main Memory (Binary) (32_8) — This instruction is used to write data from the EUS into the control main memory when the data is formatted in the EUS core as binary information.

- Read Controller Main Memory (Binary) (22_8) — This instruction is the same as Read Controller Main Memory (ASCII) except that data is in binary form.

STATUS

There are two classes of status which the control can send to the PSIA; initiate/terminate status, and special status. The control supplies status in a definite format for each class. The status is returned to the EUS after the completion of every instruction.

Terminate — Major Status and Substatus

The priority scheme for major status conditions is shown in Table 2-6. The priority system prevents attempting to reflect two unique major status conditions at the same time. Substatus codes not listed in Table 2-6 are illegal. An X in the substatus field means that the bit may be either a 0 or a 1.

- Peripheral Subsystem Ready (0000) — This major status informs the EUS that the subsystem is ready to accept a command. At the time this major status is sent to the EUS, substatus will be encoded and sent to the EUS. The following substatuses are legal with this major status:

  - Ready (000000) — The device last addressed is ready to accept an instruction.

  - Write Protected (xx0xx1) — Last unit addressed by the EUS is write-protected.

  - Positioned at BOT (000x1x) — The tape reel mounted on the last unit addressed by the EUS is positioned at the BOT.

  - 9-Track Unit (xxx1xx) — Last unit addressed by the EUS is a 9-track unit.

  - 2-Bit Fill (01xx0x) — The final byte transmitted to the EUS for a 7-track read operation contains two low-order 0's padded to final character. This substatus may also occur with 9-track read operations (Read EBCDIC Record or Read ASCII Record).

  - 4-Bit Fill (10xx0x) — The final byte transmitted to the EUS for a 7-track read operation contains four low-order 0's padded to the final character read from tape. This substatus may also occur with 9-track read operations (Read EBCDIC Record or Read ASCII Record).

  - 6-Bit Fill (11xx0x) — The final byte transmitted to the EUS for a 7-track read operation contained six low-order 0's padded to final character read from tape. Also possible with 9-track read operations (Read EBCDIC Record or Read ASCII Record).

  - ASCII Alert (001x00) — Valid only during Write ASCII/EBCDIC command execution. Indicates that the ASCII data being written contained an illegal character.

- Device Busy (0001) — This major status indicates that the addressed tape unit is either rewinding, loading, or under control of another channel. The following substatus conditions are legal with this major status:

  - In Rewind (000001) — The addressed tape unit is currently executing a rewind operation.

  - Device Reserved (100000) — The addressed tape unit is currently reserved to an alternate channel as a result of a Reserve Device instruction.

Table 2-6. Major Status and Substatus

Major Status/Substatus	Code	Priority
Command Reject/	0101	Highest
Invalid Op Code	000xx1[a]	
Invalid Device Code	000x1x	
Invalid IDCW Parity	0001xx	
Positioned at BOT	001000	
Forward Read After Write	010000	
9-Track Error	100000	
MPC Command Reject/	1101	
Illegal Procedure	000001	
Illegal LC Number	000010	
Illegal Suspended LC Number	000011	
Continue Bit Not Set	000100	
End of File/	0100	
End of File Mark (7-Track)	001111	
End of File Mark (9-Track)	010011	
Data Alert Condition	111111	
Single Character Record	xxxxxx	
Device Data Alert/	0011	
Transfer Timing Alert	000001	
Blank Tape on Read	000010	
Bit Detected During Erase Operation	xxxx11	
Transmission Parity Alert	xxx1xx	
Lateral Tape Parity Alert	xx1xxx	
Longitudinal Tape Parity Alert	x1xxxx	
End of Tape Mark	1xxxxx	
MPC Device Data Alert/	1011	
Transmission Alert	000001	
Inconsistent Command	000010	
Sum Check Error	000011	
Byte Locked Out	000100	
PE-Burst Write Error	001000	
Preamble Error	001001	
T&D Error	001010	
Multitrack Error	010000	
Skew Error	010001	
Postamble Error	010010	
NRZI CCC Error	010011	
Code Alert	010100	
Device Attention/	0010	
Write Protected	00xx01	
No Such Handler	000010	
Handler in Standby	0xx10x	
Handler Check	0x1x0x	
Blank Tape on Write	01x100	
MPC Device Attention/	1010	
Configuration Switch Error	000001	
Multiple Devices	000010	
Illegal Device I.D. Number	000011	
Incompatible Mode	001000	
TCA Malfunction	0011xx	
MTH Malfunction	010000	
Multiple BOT	010001	
Device Busy/	0001	
In Rewind	000001	
Device Reserved	100000	
Alternate Channel in Control	000010	
Device Loading	000100	
Peripheral Subsystem Ready/	0000	Lowest
Ready	000000	
Write Protected	xx0xx1	
Positioned at BOT	000x1x	
9-Track Handler	xxx1xx	
2-Bit Fill	01xx0x	
4-Bit Fill	10xx0x	
6-Bit Fill	11xx0x	
ASCII Alert	001x00	

[a] x = bit may be 0 or 1

- Alternate Channel in Control (000010) — The addressed tape unit is currently busy with an I/O operation on the alternate channel. The unit is not reserved with a Reserve Device instruction.

   NOTE: The control will not hold instructions waiting for an addressed unit to come Ready.

- Device Loading (000100) — The addressed tape unit is executing a Load instruction.

● Device Attention (0010) — This major status indicates a condition requiring manual intervention has occurred within the addressed unit. At the time this status is sent, substatus will be transmitted as follows:

- Write Protected (0xxx01) — The addressed unit was issued a Write instruction but the Write-Permit ring is not in place or the unit is write-protected by a Set File Protect instruction.

- No Such Unit (000010) — The addressed unit does not exist or is off-line.

- Unit Standby (0xx10x) — The addressed unit is in the standby state.

- Unit Check (0x1x0x) — The addressed unit is unable to operate properly. The detection of the Unit Check condition during the processing of a command will cause the unit to be set to the Unit Standby state. Both substatus conditions will be reflected to the EUS under the Device Attention major status.

- Blank Tape on Write (01x100) — This substatus indicates that the tape unit receiving the last Write command did not write properly as no bits were detected by the echo read operation.

● Device Data Alert (0011) — This major status indicates some type of alert condition occurred during the last instruction execution within the subsystem. Substatus is transmitted as follows:

- Transfer Timing Alert (000001) — This alert indicates that the EUS or the control did not transfer data at a rate compatible with the data transfer rate of the tape. If this condition is detected during a Read instruction, the data transfer to the EUS will be completed.

- Blank Tape on Read (000010) — This alert indicates that no bits were detected during a read operation for a nominal distance of 25 feet. This condition will cause the unit to be stopped.

- Transmission Parity Alert (xxx1xx) — This alert indicates that a parity error was detected by the LA on the write data from the EUS. The write operation will proceed to its normal termination.

- Lateral Tape Parity Alert (xx1xxx) — This alert indicates that incorrect parity across the tape was detected on data transferred.

- Longitudinal Tape Parity Alert (x1xxxx) — This alert indicates that incorrect parity along the length of the tape was detected on data transferred.

- End of Tape Mark (1xxxxx) — This alert occurs only during a write or erase operation. The operation will proceed to its normal termination.

- Bit Detected During Erase Operation (xxxx11) — This alert will not cause termination of the erase operation.

● End of File (0100) — This major status is sent to the EUS at the termination of any one of the following instructions:

- Read, where the record read was an EOF record.

- Backspace or Forward Space Record, where the record spaced over was an EOF record.

- Backspace File, unless no End of File is detected before the tape moves to the loadpoint.

- Forward Space File, unless no End of File is detected before tape is pulled off the supply reel.

The EOF major status is always accompanied by a substatus character.

● Command Reject (0101) — This major status condition indicates an unacceptable instruction was received and rejected by the subsystem. Substatus is transmitted as follows:

- Invalid Operation Code (000xx1) — This substatus indicates that an unacceptable operation code was received by the subsystem.

- Invalid Device Code (000x1x) — This substatus indicates that an illegal device code was received by the subsystem.

- Invalid IDCW Parity (0001xx) — This substatus indicates that the parity of an IDCW byte was even.

- Positioned at BOT (001000) — This substatus indicates that a backspace type instruction was issued to a unit with tape positioned at the BOT marker.

- Forward Read After Write (010000) — This status is sent to the EUS to indicate that a read instruction was rejected due to the previously addressed unit being in the write mode and that records following the record written should be considered invalid by the EUS.

- 9-Track Error (100000) — This substatus indicates that a 9-track instruction was issued to a 7-track tape unit.

● MPC Device Attention (1010) — This major status indicates a condition requiring manual intervention has occurred within the addressed device. Substatus is transmitted to the EUS as follows:

- Configuration Switch Error (000001) — This substatus indicates that the application firmware loaded into the control does not agree with the configuration switches on the maintenance panel.

- Multiple Devices (000010) — This substatus indicates that the control has detected at least two devices with the same identification number.

- Illegal Device ID Number (001000) — This substatus indicates that at least one device has an ID number outside the legal range of numbers.

- Incompatible Mode (001000) — This substatus indicates that the tape unit mode (PE or NRZI) and the tape mode do not agree.

- TCA Malfunction (0011xx) — This substatus indicates that a fault has been detected within one of the TCA's connected as a part of the control. The two low-order bits indicate the IAI port to which the TCA is connected as follows:

Port	Substatus
0	001100
1	001101
2	001110
3	001111

- MTH Malfunction (010000) — This substatus indicates that the control has detected an apparent malfunction with the tape unit and the unit did not indicate a malfunction to the control.

- Multiple BOT (010001) — This substatus indicates that additional BOT marker(s) have been detected on the tape.

- MPC Device Data Alert (1011) — This major status indicates to the EUS that some type of alert condition occurred during the last instruction execution. Substatus is transmitted as follows:

- Transmission Parity Error (000001) — This substatus indicates that a transmission parity error was detected during the execution of a special control instruction.

- Inconsistent Command (000010) — This substatus is the result of one of the following conditions occurring during the execution of a Special Controller instruction:

  1. Word count for Read Controller Main Memory, Write Controller Main Memory and Write Control Store Instructions is 0.

  2. Execution of Read Controller Main Memory or Write Control Main Memory instructions requires access to non-existent memory.

  3. Lock Byte number specified is illegal.

  4. The continue bit in the IDCW for the Special Control instruction is 0.

- Sum Check Error (000011) — This substatus is the result of an error in the sum check-out used by the Write Control Store instruction.

- Byte Locked Out (000100) — The Lock Byte referenced by the conditional Write Lock Byte instruction is non-zero.

- PE-Burst Write Error (001000) — This substatus indicates that the control was not able to properly write the PE-Burst on tape.

- Preamble Error (001001) — This substatus indicates that an error was detected either with the preamble or with an apparent lack of data following the preamble. Valid only in PE mode.

- T&D Error (001010) — This substatus is used with the Device Wrap-around instruction to indicate that the byte in error and byte count have been stored in main memory.

  NOTE: The next five substatus codes are related in that they may occur simultaneously within either the PE or NRZI mode. They are listed in order of priority.

- Multitrack Error (01000) — This substatus indicates that a data record contained errors in more than one track. Valid for either PE mode or the NRZI mode (CCC on 800 bpi 9-track).

- Skew Error (010001) — This substatus indicates that excessive skew was detected during a read or write in PE mode or during a write in NRZI mode.

- Postamble Error (010010) — This substatus indicates that the postamble of the PE record read may have been in error.

- NRZI CCC Error (010011) — This substatus indicates that the record just read contained correctable errors and may be reread. The control will perform error correction on the data during the next forward read issue to the tape unit.

- Code Alert (010100) — This substatus indicates that a character has been detected that is not in the code translation tables.

- MPC Command Reject (1101) — This major status indicates that an unacceptable command was received and rejected by the subsystem. Substatuses associated with this major status are as follows:

  - Illegal Procedure (000001) — This substatus indicates that the channel program is in error due to one of the following conditions:

    1. The control was not in the suspend state when a special control instruction requiring that state was received.

    2. A special control instruction did not precede the Initiate Write Data Transfer instruction or the Initiate Read Data Transfer instruction.

  - Illegal LC Number (000010) — This substatus indicates that the logical channel number preceding the IDCW is not valid.

  - Illegal Suspended LC Number (000011) — The control was in the suspend state and an IDCW was addressed to a logical channel other than the one over which the suspend instruction was received.

  - Continue Bit Not Set (000100) — The first IDCW of a two IDCW Special Control instruction did not have the Continue Bit set.

Special Status

The special status is used to transmit information identifying which device is causing the interrupt and the reason for the interrupt. Special status can be used in either normal or test mode.

SPECIAL STATUS — NORMAL MODE

This special status mode is used by the tape units to notify the EUS of special events that have occurred. There are six tape unit interrupts and three control interrupts. The unit interrupts are:

- Termination of Rewind Instruction
- Termination of Rewind/Unload Instruction
- Termination of Tape Load Instruction
- MTH brought to Ready state manually
- MTH has malfunctioned
- MTH released

The three control events are:

- Controller suspended
- Controller released
- ITR's overlaid

SPECIAL STATUS – TEST MODE

This mode may be used to relay particular information from the control to the EUS. The information is set into the configuration switches and transmitted to the EUS by activation of the Operator Interrupt Switch.

ERROR DETECTION AND CORRECTION

The MTS500 subsystem utilizes several error detection/correction modes. These include:

- Read-after-write checks during all write-type instructions.
- Lateral parity on each data frame written on tape.
- Longitudinal parity on each NRZI record.
- CCC is generated and checked for each 9-track 800 bpi NRZI record.
- In-flight error correction for single track read error in PE mode.
- Automatic retry on data-dependent read errors.
- Verification of instruction, device number, IDCW format and device type.
- Parity generation and check on byte transfer across PSI.
- Parity check within tape unit for instruction codes received from the control.
- Significant points within the drive mechanism monitored by unit and control notified when a malfunction is detected.

Some of these functions are performed by the tape unit and the balance by the control.

The MTS500 subsystem has the ability to retry when certain type errors are detected within the subsystem, as well as when certain type errors are detected on the PSI.

Each of these conditions will result in the control attempting the current operation 64 times. If the operation is successful within 64 tries, the status is reported to the EUS as a normal successful execution. If the operation is not successful within 64 tries, the operation will be terminated with a status indicating the unsuccessful execution and the reason.

ERROR LOGGING IN THE CONTROL

The control maintains counts of specific errors which occur within the subsystem and to a limited extent for errors which occur on the PSI. The accumulation of error counts is performed by the control. The EUS can interrogate the control to determine the count for any period of time.

Errors Logged on Control Basis

The control maintains 11 counters in its main memory. The contents are available to the EUS through the Read Controller Main Memory instruction. In addition, the EUS can load the counters with the Write Controller Main Memory instruction.

PSI PARITY ERROR COUNTER

The control maintains four 1-byte counters for recording the number of activities containing a parity error while transferring information across the PSI. There is one counter for each possible PSI.

OPI/PSI COUNTER

These four 1-byte counters record the number of times the OPI line on the PSI is dropped as a result of unsuccessful communication of the LA with the PSIA.

OPI/IAI COUNTER

These two 1-byte counters record the number of times the OPI line is dropped due to IAI faults.

ERROR INTERRUPT COUNTER

This 1-byte counter records the number of times the control executes an error interrupt.

Errors Logged on a Tape Unit Basis

The control maintains seven counters for each tape unit. The counters contain counts of error records and counts of records transferred to/from the tape units.

NUMBER OF RECORDS READ

This 2-byte counter records the number of physical records which the tape unit has read in response to read instructions.

NUMBER OF WRITE RECORDS

This 2-byte counter records the number of physical records which have been written by the tape unit in response to write instructions.

NUMBER OF RECORDS WITH WRITE ERROR

This 2-byte counter records the number of physical records which contained an error during the write process.

NUMBER OF RECORDS WITH READ ERROR

This 2-byte counter records the number of physical records which contained an error during a read process.

NUMBER OF TRANSFER TIMING ERRORS ON READ

This 2-byte counter records the number of transfer-timing errors detected during the read mode.

NUMBER OF TRANSFER TIMING ERRORS ON WRITE

This 2-byte counter records the number of transfer timing errors detected during the write mode.

NUMBER OF PE RECORDS WITH SINGLE-TRACK CORRECTION

This 2-byte counter records the number of PE records which were successfully read and which required that the in-flight single-track correction be performed.

SECTION III
OPERATING INSTRUCTIONS

SUBSYSTEM CONSIDERATIONS

The MTS500 Magnetic Tape Subsystem is designed for ease of operation as well as for efficient storage and retrieval of data. The tape units feature automatic threading to minimize manual handling of the tape, to reduce setup time, and to reduce the possibility of tape damage due to operator mishandling. The tape unit also incorporates precision tape cleaners which function whenever the tape is in motion and in contact with the read/write head. The tape cleaners remove dust and foreign matter to reduce the possibility of data errors caused by foreign matter.

CONTROLS AND INDICATORS

Subsystem controls and indicators consist of operating, configuration, and maintenance switches and operational status displays. Operating controls and indicators, used during normal daily operations, are easily accessible and readily visible to operating personnel. The configuration switches are set during installation and normally are changed only if the subsystem is reconfigured. The configuration switches are not readily accessible to prevent inadvertently changing the setting. The maintenance switches and indicators are for the use of Honeywell Information Systems Field Engineers for off-line maintenance.

Control Operating Controls and Indicators

The Operator Control Panel, located on top of the control, contains the switches and indicators required for normal operation of the control (see Figure 3-1). The color-coded indicators provide an obvious display of the control's operating status.

AC BREAKER ON

This indicator glows red when the control cabinet circuit breaker is ON and AC power is available from the main distribution panel.

NOTE: The control cabinet circuit breaker is located behind the right front door at the bottom right of the cabinet on panel CKP (see Figure 3-2).

(RED) (YELLOW) (GREEN) (GREEN)/(YELLOW) (GREEN)/(RED) (RED)/(WHITE)

| AC BREAKER ON | POWER ON | POWER OFF | NORMAL / TEST | READY / TROUBLE | OVER TEMP / ALARM RESET | F E E D |
| START | AUTOMATIC / MANUAL | INT EXT / CONT STORE | OPERATOR INTERRUPT | HALTED | INITIALIZE | |

(WHITE) (GREEN)/(BLUE) (RED) (RED)/(RED) (WHITE) (BLUE) (WHITE) (ADDRESS/SIMULATE)
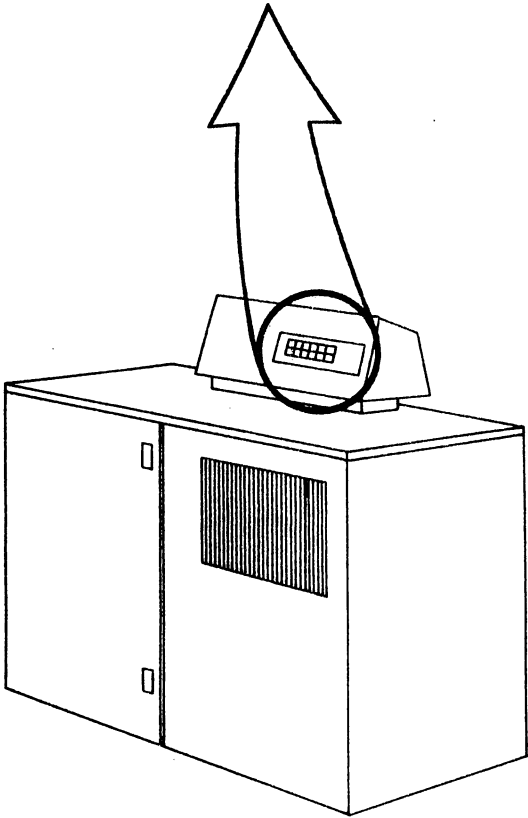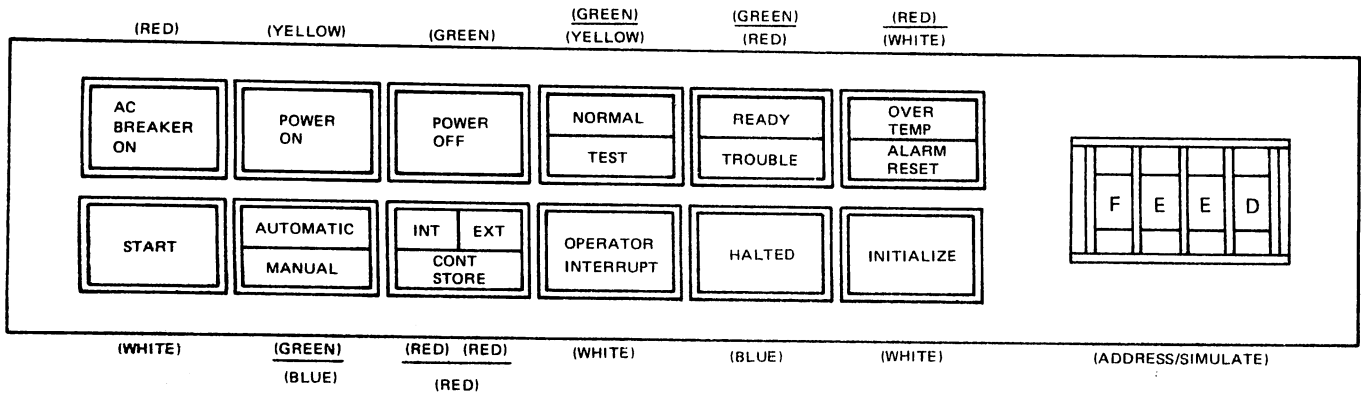
Figure 3-1. Control Operator Panel

POWER ON

When the POWER ON push button/indicator is pushed, AC power is applied to the cabinet power supply. The indicator glows yellow when power is applied to the cabinet power supply. After DC power comes up in the cabinet, the POWER OFF indicator is extinguished.

POWER OFF

The POWER OFF push button/indicator removes power from the cabinet power supply when pushed. The indicator glows green. When the POWER OFF push button/indicator is pushed, the POWER ON indicator is extinguished.

NORMAL/TEST

The NORMAL/TEST indicator is a split-field indicator which reflects the state of the MAINT PANEL MODE switch. The upper field will glow green if the MAINT PANEL MODE switch is in the NORMAL position or the bottom field will glow yellow if in the TEST position. The switch must be in the NORMAL position for normal control operation.

The MAINT PANEL MODE switch is located behind the cover surrounding the control panel. If the switch is inadvertently left in the TEST position by the Field Engineer, the operator may open the cover and reset it to NORMAL.
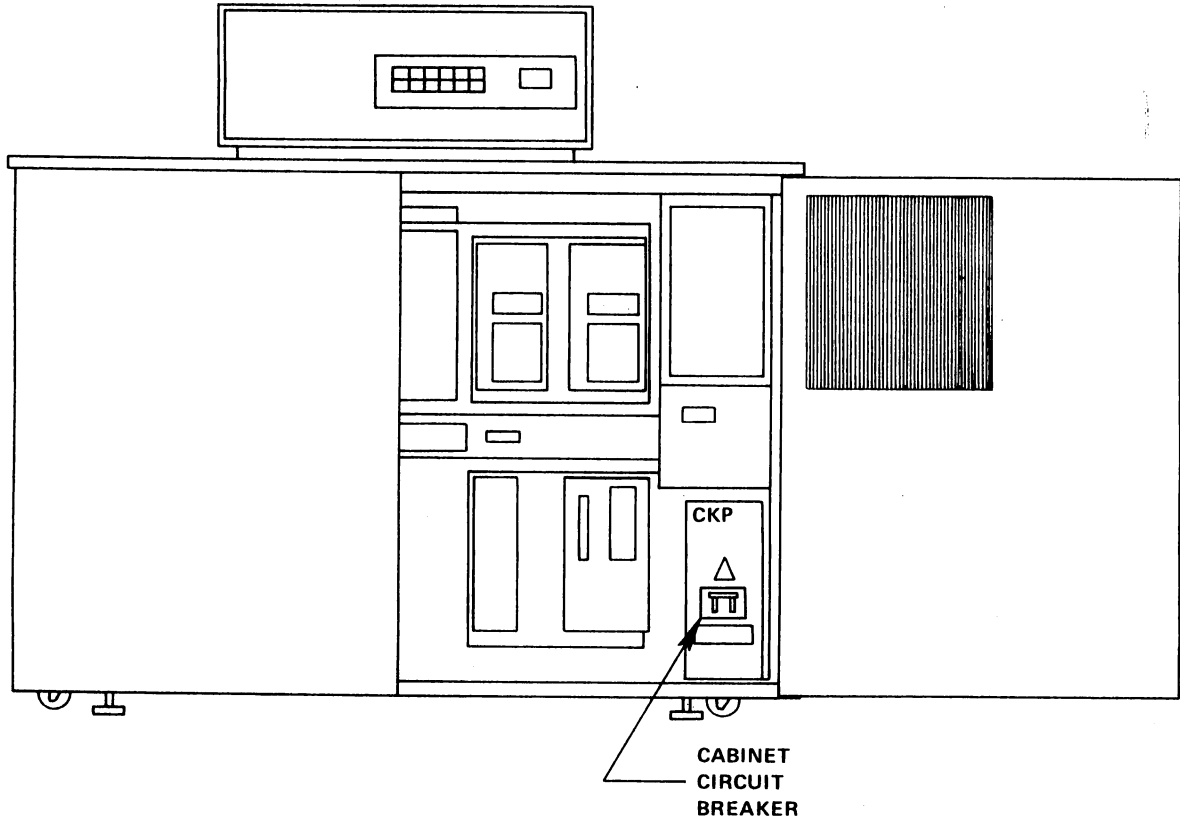
Figure 3-2. Control Cabinet Circuit Breaker Location

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READY/TROUBLE

The split-field READY/TROUBLE indicator reflects the operational state of the control: green — READY, red — TROUBLE. The TROUBLE indicator will be lit when the HALTED indicator is on, when the OPERATIONAL MODE switch is in the OFF LINE position, or when there is a problem within the subsystem.

If the HALTED indicator is on, the operator may attempt to put the control in the READY state by pressing the START push button/indicator. If the control does not leave the halt state, the operator may open the maintenance panel cover and reset the OPERATIONAL MODE switch to the ON LINE position.

If the trouble persists or if the OPERATIONAL MODE switch was already in the ON LINE position, the operator should notify the Honeywell Field Engineer.

OVER TEMP/ALARM RESET

The split-field OVER TEMP/ALARM RESET push button/indicator glows red in the OVER TEMP field and white in the ALARM RESET field and the control audible alarm sounds to indicate a temperature above 60°C within the control cabinet. The audible alarm and the ALARM RESET field can be turned off by pressing the push button/indicator. The OVER TEMP field will remain lit until the temperature condition dissipates.

If the temperature condition persists, press the POWER OFF push button to remove power from the subsystem and notify the Honeywell Field Engineer.

START

The START push button/indicator is used to reset the control from the TROUBLE to the READY state when the HALTED indicator is lit.

AUTOMATIC/MANUAL

This alternate action push button/indicator reflects the operational mode of the control: green — AUTOMATIC, blue — MANUAL. The push button allows operator control of the execution of the initialize and halt options of the microprogram. These options are inhibited when in the AUTOMATIC mode. The state of the control is changed to the alternate state each time the push button is activated.

INT/EXT/STORE

This three-way split-field push button/indicator glows red in the individual field when an error is detected. Pressing the push button, or execution of the error option of the microprogram,

should reset the error and turn off the indicator field. If the error persists, the Honeywell Field Engineer should be notified.

The categories of error conditions are as follows:

- EXT — error detected during a Device Adapter interface or main memory operation.
- INT — error detected internal to the processing structure of the control (internal buses, etc.).
- STORE — error detected during the access of a microprogram from control store.

OPERATOR INTERRUPT

The **OPERATOR INTERRUPT** switch is used to initiate execution of the information set in the ADDRESS/SIMULATE thumbwheel switches. The indicator glows white when activated and will go out when the OPERATOR INTERRUPT state is reset by the microprogram.

HALTED

This indicator glows blue when the control goes into the halt state.

INITIALIZE

The INITIALIZE push button/indicator resets the control to the initialized state and lights the HALTED indicator. The INITIALIZE indicator glows white when activated.

ADDRESS/SIMULATE

These four thumbwheel switches are used in conjunction with the OPERATOR INTERRUPT push button to permit the operator to address various functions of the control. An error can result if the switches are changed while being sensed by the microprogram.

Maintenance Panel

The maintenance panel is located behind the cover surrounding the control panel (see Figure 3-3). Only the following maintenance panel switches are of interest to the operator; the remainder of the switches are for the use of the Honeywell Field Engineer.

MAINT PANEL MODE

This two position toggle switch controls the TEST/NORMAL status of the control. When the switch is in the TEST position, the maintenance panel is activated so the Honeywell Field Engineer can perform manual test routines.

The switch must be in the NORMAL position for normal operations. The state of the switch will be indicated by the NORMAL/TEST indicator on the control panel. If the TEST field is illuminated when operations are initiated, open the cover and reset to NORMAL.
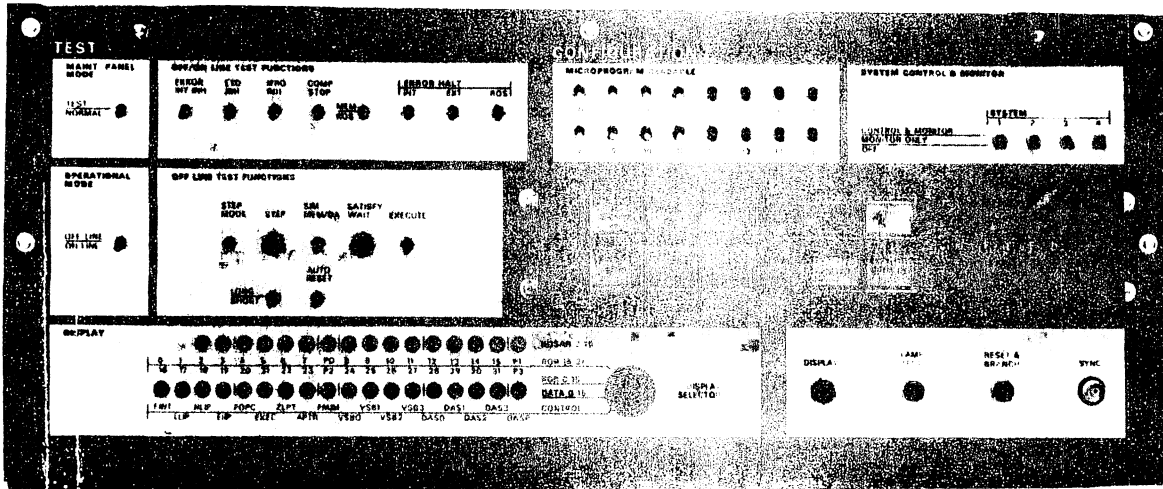
Figure 3-3. Control Maintenance Panel

OPERATIONAL MODE

This 2-position toggle switch is used to place the subsystem offline for testing. If the HALTED indicator is lit, lift the cover and check the state of this switch. It must be in the ON LINE position for normal subsystem operation.

LAMP TEST

This push-button switch is used to test the lamps on the panel. All logic-controlled lamps will be illuminated when the LAMP TEST button is pressed.

CONFIGURATION SWITCHES

The 16 CONFIGURATION switches are readable by microprogram control and provide configuration control and operational information. The functions and settings of the CONFIG-URATION switches are as shown in Table 3-1.

Table 3-1. CONFIGURATION Switches

Switch	Function	Setting Normal	Other	
0	Bypass Basic Logic Test (BLT)	↓	↑	BLT Bypass
1	BLT Loop Control	↓	↑	Loop on BLT
2	LA (for Boot) (Port 2)	↓	↑	LA Port 3
3	No. of LAs in Subsystem	↓	↑	Two LAs
4	Inhibit Interval Timer Runout (ITRO) Detection	↓	↑	Inhibit INTRO (Ports 2 & 3)
5,6,7	Unit Identification (for Boot Device)	5 6 7		Device No.
		↓ ↓ ↓		8
		↓ ↓ ↑		1
		↓ ↑ ↓		2
		↓ ↑ ↑		3
		↑ ↓ ↓		4
		↑ ↓ ↑		5
		↑ ↑ ↓		6
		↑ ↑ ↑		7
8, 9, 10	Control Configuration	8 9 10		
		↓ ↑ ↓		Single Channel
		↓ ↑ ↑		Dual Channel
11	Tape Density (556 bpi)	↓	↑	800 bpi
12	Number of Tracks 7-Track	↓	↑	9-Track
13	Main Memory Size 4K	↑	↓	2K
14	Bypass Error Interrupt	↓	↑	ITR Test
15	Not Applicable			

Tape Unit Operating Controls and Indicators

The tape unit's Operator Control Panel is located on top of the tape unit and is of the "Dead Front" type, i.e., the indicators are visible only when illuminated (see Figure 3-4).

INDICATORS

READY Indicator

The READY indicator is illuminated and visible whenever the unit is ready to execute read/write commands from the control. It will be illuminated after the unit has successfully

completed a load operation and the READY push button has been pressed, or at the successful completion of a load tape command. It will not be illuminated while rewinding or unloading.
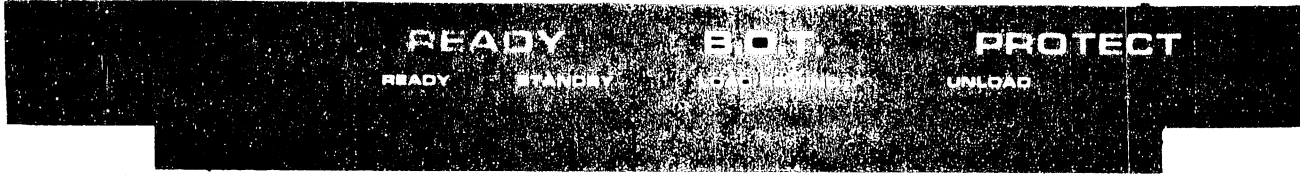
Figure 3-4. Tape Unit's Operator Control Panel

PROTECT Indicator

The PROTECT indicator is illuminated when one of the following conditions exists:

- No file reel is mounted on the unit
- The file reel does not have the write permit ring in place
- A load or rewind operation is in process
- A Write protect command has been received and executed.

B.O.T. Indicator

The B.O.T. indicator is illuminated when the BOT reflective marker is being sensed.

SWITCHES

READY Switch

When the READY push button switch is pressed, the loaded tape unit will be put into the READY state at the successful completion of either a load operation or a manually initiated rewind operation.

STANDBY Switch

The STANDBY push button switch has two functions:

- To remove the unit from the READY state
- To raise the power window.

Pressing the STANDBY switch while the unit is in the READY state will turn off the READY indicator and place the unit in the STANDBY state. Pressing the STANDBY switch while the unit is unloaded will raise the power window.

LOAD/REWIND Switch

The LOAD/REWIND push button switch has three functions:

- To initiate a load operation
- To initiate a rewind operation
- To engage the automatic file reel hub.

A load operation will be initiated if the unit is not loaded when the LOAD/REWIND switch is pressed. If the unit is loaded when the LOAD/REWIND switch is pressed, a rewind operation will be initiated. The tape will rewind onto the file reel until the BOT marker is detected.

If the SEMI/AUTO switch is in the SEMI position when the LOAD/REWIND switch is pressed, the automatic file reel hub will be engaged.

The LOAD/REWIND switch is inoperative while the tape unit is in the READY state.

UNLOAD Switch

The UNLOAD push button switch has three functions:

- To initiate an unload operation
- To lower the power window
- To disengage the automation file reel hub.

If the unit is loaded and in the not ready state when the UNLOAD switch is pressed, an unload operation will be initiated and all tape will be wound on to the file reel.

If the unit is not loaded when the UNLOAD switch is pressed, the power window will be lowered.

If the SEMI/AUTO switch is in the SEMI position and the LOAD/REWIND switch has been closed when the UNLOAD switch is pressed, the automatic file reel hub will be disengaged.

Unit Identifier

The unit identifier slips into the left end of the operator panel. It must agree with the device code wired into the unit at installation. The unit identifier can easily be changed if it is necessary to change the identity of the unit.

SEMI/AUTO Switch

The SEMI/AUTO toggle switch is located in the upper right corner of the tape compartment behind the power window. When the switch is in the AUTO position, the unit will perform a fully automatic load when the LOAD/REWIND switch is pressed.

When the SEMI/AUTO switch is in the SEMI position and the LOAD/REWIND switch is pressed, the file reel hub is engaged. This allows the operator to manually thread tape through the mechanism and wind it onto the machine reel. The SEMI/AUTO switch is put into the AUTO position and the load operation is completed.

This feature permits the use of reels with bad leaders until the operator has the time to repair the leader. It also allows the unit to be used when the automatic load is not operative.

SUBSYSTEM OPERATION

The subsystem operates in the EUS environment with the IOM and/or the DATANET 355 Front-End Network Processor. For operation of the subsystem in conjunction with the EUS, refer to the following Series 6000 manuals:

- System Startup and Operation Manual, Order No. DA06
- Macro Assembler Program (GMAP), Order No. BN86
- Equipment Operator's Manual, Order No. DA33

Since operation of the subsystem is under control of the EUS, the main concerns of the subsystem operator are:

- Turning the subsystem on at the start of operations.
- Turning the subsystem off at the end of operations.
- Loading and unloading tape reels as requested by the EUS.
- Monitoring for and resolving minor alert conditions.
- Notifying the Honeywell Field Engineer when alerts or malfunctions cannot be readily resolved.
- Keeping the equipment and area clean.
- Storing and retrieving file reels as required.

Control Operation

The control imposes few duties on the operator. These generally consist of:

- Turning cabinet power on or off as required.
- Monitoring the various indicators for the operational status and correcting any temporary error or malfunction halts.
- Initializing the control.
- Generating special interrupts as required.

POWER UP SEQUENCE

The following procedure should be followed when powering up the control at the start of operations:

- Check distribution panel circuit breaker; turn on if not already on.

- Turn on cabinet power by turning on cabinet power circuit breaker. The cabinet power circuit breaker is located inside the right front door of the controls (see Figure 3-2).

- Press POWER ON push button indicator on operator control panel. This will bring up DC power and turn off the POWER OFF indicator.

- If the control is to be manually initialized, press the INITIALIZE push button on the operator control panel. This will reset the control to a known state and allow the control to be bootloaded.

POWER OFF SEQUENCE

To turn the control off at the end of a shift, follow the following procedure:

- Press POWER OFF push button/indicator.

- Turn off cabinet power circuit breaker.

- Turn off subsystem primary power at the main distribution panel, if required by local operating procedures.

Tape Unit Operation

Operation of the tape unit consists of turning power on and off as required, correcting temporary alert conditions and loading and/or unloading tape reels as required.

POWER UP SEQUENCE

The following procedure should be followed when applying power to the tape unit:

- Turn on breakers supplying power to the unit.

- Turn on cabinet power by setting the cabinet circuit breaker to the ON position. The cabinet circuit breaker is located on the back of the unit in the lower left corner. (See Figure 3-5.) The amber lights adjacent to the circuit breaker light when the circuit breaker is ON.

LOAD TAPE

With Canister

Use the following procedure when loading tape canisters on the tape unit:

- Lower the power window by pressing the UNLOAD switch, if glass is up.

- Place the closed canister onto file reel hub. The index tabs on the canister must fit into the corresponding receptacles on the tape unit.

- Press LOAD/REWIND switch. The unit will automatically open the canister, remove the leader from the canister, load tape into the vacuum columns, wind the tape on the machine reel, and stop on the BOT marker.

If the unit fails to load the tape onto the machine reel, it will rewind the tape and make two additional tries to load. At the end of the third try the unit will rewind the tape into the canister and lower the window.

3-11   DB28
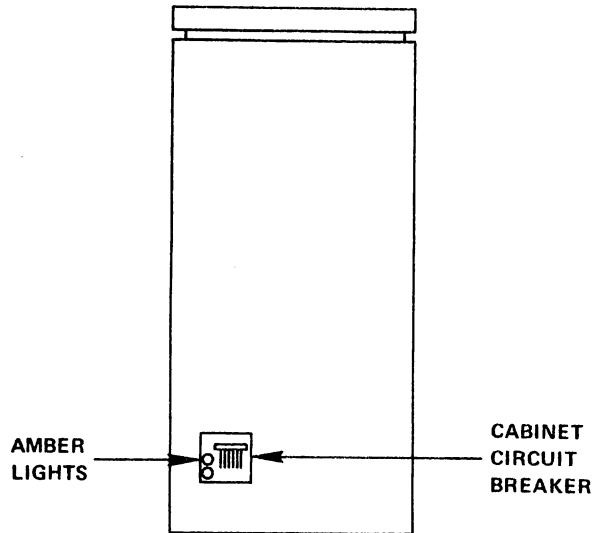
Figure 3-5. Rear View of Tape Unit

If the tape unit fails to load tape automatically, follow the Manual Load procedure.

Without Canister

The following procedure should be used when loading the tape unit without using a canister:

- Press the UNLOAD switch to lower the window, if the power window is up.
- Place the reel of tape onto the file reel hub.
- Press the LOAD/REWIND switch. The unit will automatically load and stop on the BOT marker.

If the unit fails to wind the tape on the machine reel it will make three tries to load the tape. After the third try it will rewind the tape onto the file reel and lower the window.

> NOTE: Good tape leaders are necessary to assure successful automatic loading. The leaders must either be cut square with a scissors or cut with the crimping tool (C60202399-001).

Static conditions may cause the leader to cling to the reel of tape and not separate during the reverse tape motion at the start of the load tape operation. To assure successful tape loads under these conditions, two operator techniques may be used:

- After setting the reel on the file reel hub, preposition the leader into the ramp so that the leader is at the extreme left end of the ramp covering the oval slot (see Figure 3-6). Press the LOAD/REWIND switch. The tape should load automatically.
- Follow Manual Load procedure.

Alert Condition	Recovery Procedure
b. Tape motion failure	Check that main circuit breaker is set to ON. Check front door; it must be completely closed. Try to cycle unit up again. If failure recurs, notify the Field Engineer.
c. Unit will not set ready	Notify Field Engineer.
d. Excessive data error rate	Clean unit in accordance with maintenance procedures. If failures continue, notify Field Engineer.
e. Amber light at cabinet circuit breaker not lit. (See Figure 3-5)	Notify Field Engineer.
f. Unit fails to cycle up	Notify Field Engineer.
g. File reel hub fails to open	Set SEMI/AUTO switch to SEMI, press LOAD/REWIND switch, and then the UNLOAD switch. If hub continues to fail to open, notify Field Engineer.

Handling of Magnetic Tape

The magnetic oxide on the tape is capable of retaining a recorded signal indefinitely unless altered by an external magnetic field. Therefore, in handling and storing magnetic tapes, care must be taken to physically protect the tape so that it will always be possible to recover the stored information accurately. The following is a list of minimum precautionary measures to be taken to prevent physical damage from destroying the information stored on tape:

- Always close tape storage container after removing tape. This will prevent entry of dirt and other contaminates into the storage container.

- Never squeeze tape flanges together when picking up, handling, or mounting a reel of tape. Apply pressure only to the hub area. Forcing the reel flanges against the tape can damage the edges of the tape.

- Keep hands off the tape. Body oils and salts can contaminate the tape.

- Keep all liquids away from tape.

- Store tape reels upright in the tape-storage container. Tape edge damage can result from stacking tape in stacks.

- Keep the tape unit mechanism clean. Use only approved solvents.

- Keep all magnetic materials away from the tapes during handling and storage.

- Store tapes in areas free of magnetic fields such as AC bus bars, welding generators, etc.

- Store tapes in an environment as close as possible to the computer room environment.

- If tapes have been subjected to temperature extremes, allow sufficient time for the entire reel to reach room temperature before using. As a rule of thumb, tapes should be conditioned for the same length of time as they were subjected to the temperature extreme. Normally no more than one day should be required even for extended periods out of the proper environment.

- Avoid smoking in the immediate vicinity of the tape.

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The MTH should be cleaned every day before starting operation, using the following procedure:

- Remove tape from MTH

- Turn main circuit breaker (see Figure 3-5) OFF. Open front door.

- Open upper cover to expose Read/Write head.

- Soak brush (HIS FED Part No. 71002005-001) with Freon, and clean rubber surface of capstan. Rotate capstan slowly by gripping nut on motor shaft and continue to brush surface of capstan with Freon until all apparent residue and oxide have been removed.

- Dampen a lint-free cloth in Freon and clean the following:

  - Tape guide located on left side just below capstan

  - The two tape idler rollers located on outside edges at top of vacuum column

  - Tape guides located above and below Read/Write head

  - All exposed surfaces of Read/Write head

    ```
    CAUTION

    Wipe Read/Write head in direction of tape
    motion to prevent damage to head lamina-
    tions.

    Heads are easily damaged.  Keep metallic
    objects away from heads
    ```

  - Inside surface of upper cover

  - Porous surface of load ramp between slot and left end

- Open bin glass to expose vacuum columns. Clean all tape marks from bin glass with a lint-free cloth and glass cleaner.

- Clean inside of vacuum columns using a Freon-soaked lint-free cloth. Use cotton swabs and Freon to clean surfaces of emitter and detector blocks located in side walls of vacuum columns.

- Close bin glass, upper cover, and front door. Turn main circuit breaker ON.

OPEN AND CLOSE FILE REEL HUB

The file reel hub engages a reel of tape in position during a load operation and disengages to allow removal of the reel of tape after an unload operation.

If the operator needs to engage the file reel hub without loading the tape unit, set the SEMI/AUTO switch to SEMI and press the LOAD/REWIND switch. This will engage the hub. If the operator then wants to cycle the unit down, open the front door, set the SEMI/AUTO switch to AUTO, and close the front door.

If the tape unit cycles down without disengaging the file reel hub, the file reel hub can be disengaged by setting the SEMI/AUTO switch to SEMI, pressing the LOAD/REWIND switch, and then pressing the UNLOAD switch. The hub will then disengage.

WRITE-PERMIT RING

The write-permit ring on the file reel and write-permit assembly on the unit operate to permit or inhibit writing on a particular reel of tape.

The write-permit ring is installed in a groove on the back of the file reel (see Figure 3-8). When the ring is in position, new information can be written onto the tape.
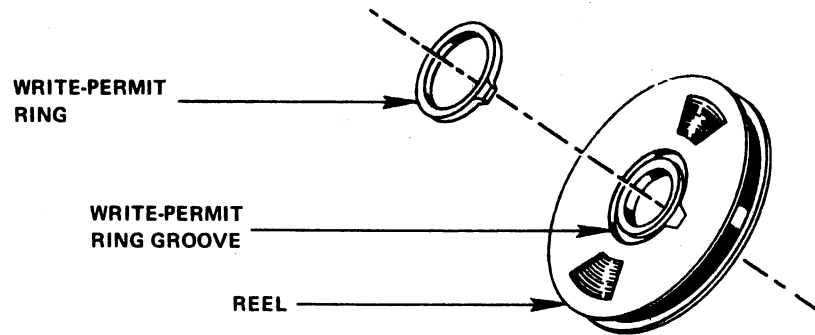
Figure 3-8. Write-Permit Ring

Alert Conditions and Recovery Procedures

The following is a list of Alert Conditions and the corresponding Recovery Procedures:

Alert Condition	Recovery Procedure
a. Tape thread failure	Damaged leaders are the usual cause of failure to thread. Remove all folds and creases in leader and cut square with scissors or leader crimp tool. For satisfactory canister operation the leader should be prepared with the crimp tool and the reel should have 2000 to 2400 feet of tape. If this procedure fails, thread the unit manually and notify the Field Engineer.

Alert Condition		Recovery Procedure
b.	Tape motion failure	Check that main circuit breaker is set to ON. Check front door; it must be completely closed. Try to cycle unit up again. If failure recurs, notify the Field Engineer.
c.	Unit will not set ready	Notify Field Engineer.
d.	Excessive data error rate	Clean unit in accordance with maintenance procedures. If failures continue, notify Field Engineer.
e.	Amber light at cabinet circuit breaker not lit. (See Figure 3-5)	Notify Field Engineer.
f.	Unit fails to cycle up	Notify Field Engineer.
g.	File reel hub fails to open	Set SEMI/AUTO switch to SEMI, press LOAD/REWIND switch, and then the UNLOAD switch. If hub continues to fail to open, notify Field Engineer.

Handling of Magnetic Tape

The magnetic oxide on the tape is capable of retaining a recorded signal indefinitely unless altered by an external magnetic field. Therefore, in handling and storing magnetic tapes, care must be taken to physically protect the tape so that it will always be possible to recover the stored information accurately. The following is a list of minimum precautionary measures to be taken to prevent physical damage from destroying the information stored on tape:

● Always close tape storage container after removing tape. This will prevent entry of dirt and other contaminates into the storage container.

● Never squeeze tape flanges together when picking up, handling, or mounting a reel of tape. Apply pressure only to the hub area. Forcing the reel flanges against the tape can damage the edges of the tape.

● Keep hands off the tape. Body oils and salts can contaminate the tape.

● Keep all liquids away from tape.

● Store tape reels upright in the tape-storage container. Tape edge damage can result from stacking tape in stacks.

● Keep the tape unit mechanism clean. Use only approved solvents.

● Keep all magnetic materials away from the tapes during handling and storage.

● Store tapes in areas free of magnetic fields such as AC bus bars, welding generators, etc.

● Store tapes in an environment as close as possible to the computer room environment.

● If tapes have been subjected to temperature extremes, allow sufficient time for the entire reel to reach room temperature before using. As a rule of thumb, tapes should be conditioned for the same length of time as they were subjected to the temperature extreme. Normally no more than one day should be required even for extended periods out of the proper environment.

● Avoid smoking in the immediate vicinity of the tape.

APPENDIX A

PHASE-ENCODED IN-FLIGHT ERROR CORRECTION

This is a general description of in-flight error correction as employed by the subsystem while reading phase-encoded (PE) data records. Both the read and read-after-write processes are described, with some attention given to related items. In addition, a brief summary of PE data records is provided.

PE DATA RECORDS

Each phase-encoded data record contains three parts: (1) preamble, (2) data, (3) post-amble. The preamble is written as 41 frames, where 40 frames contain all 0's including the parity position, followed by one frame which contains all 1's. The data is written next with odd parity. Following the data is the postamble, which is a mirror image of the preamble.
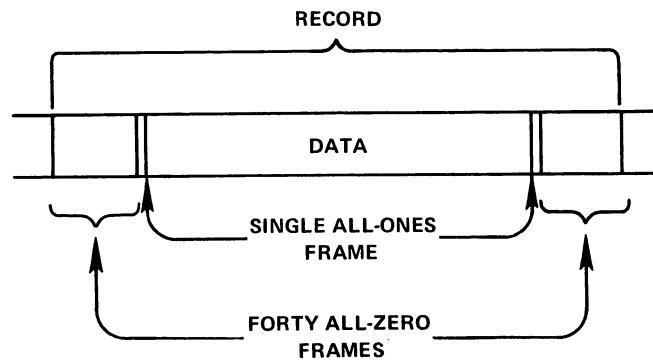
In recording the 0's and 1's in phase encoding, both bits result in a flux change on tape. The 0 bit has a defined polarity, with the 1 bit having the opposite polarity. Since both 0 and 1 bits result in flux changes on the media, successive 0 bits and successive 1 bits require a flux reversal intermediate between successive, like bits. This added flux reversal is termed the phase bit. The data-bit and phase-bit flux transitions for a given track are illustrated in the following sketch.

DATA	1 0 1 1 1 0 0 1 0
TAPE FLUX	
DATA BITS	
PHASE BITS	
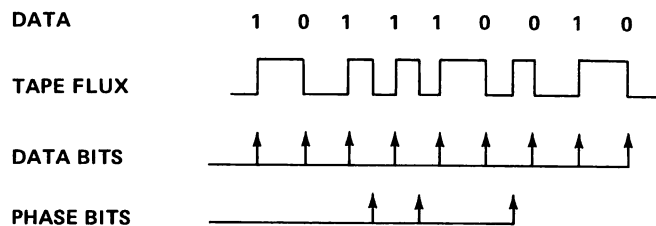
READ MODE

The reading of PE records is a carefully controlled process aimed at ensuring reliable recovery of data from the media. Since the data was verified as correct when it was written (as described below under Write Mode), the read process must capture this "good" data.

In the PE read process, each track is treated independently of other tracks until the character is formed at the output of the deskew register. The signal in each track is threshold-detected, digitized, and the timing of this signal verified. Each change of state of this digitized signal corresponds to a flux reversal on tape. The digitized signal then enters the deskew buffer, where the characters are assembled for transmission to the external user.

At this point, three checks are made on the assembled character. The first check determines if excessive skew has occurred, and the second check determines if the parity of the assembled character is correct. If either of these checks fails, the external user is notified via a terminate error status.

The third check — a timing check — determines if a bit is in error in one or more tracks in the assembled character. (Recall that in PE recording both 0 and 1 bits have a corresponding flux reversal on tape.) If two or more tracks are in error simultaneously, a multi-track terminate error status is returned to the external user. However, if any single track is in error, the control may insert the required bit based on the other data and parity bit of the assembled character, thus correcting the character for transmission to the external user.

There are two forms of data correction, resulting from missing data bits or those with incorrect timing. If the missing data bits do not exceed two consecutive characters, the control will insert the correct bit and transfer the data to the external user. With short errors of this type it is possible for the missing bits to move from one track to another, with the control inserting the correct bits. This is possible as long as the errors do not occur simultaneously in two or more tracks. This form of in-flight error correction is illustrated on the following page.

In those cases where an error occurs which requires a retry of the read command (i. e. , an error prohibiting in-flight error correction), the record will be reread using modified margins, such as a lowered read threshold. The balance of the reading process is as described above.

WRITE MODE

To ensure that the data is written correctly, each character written on tape is read and returned to the control immediately after being written. This process is called read-after-write.

During this read-after-write action, the threshold is raised and the deskew criteria tightened. In addition, the three checks mentioned above are performed on the output of the deskew register to verify valid data at that point. No in-flight error correction occurs during this read-after-write process since the only requirement is to verify that the data was written correctly.

```
3
1
7        XX
6        |
5        |                      XX
P        |            XX        |
4        |            |         |
0        |            |         |
2        |            |         |         / END OF RECORD
^        |            |         |
|        |_____|_____|_____ CORRECTED BITS
|_____
         BIT WEIGHT
```
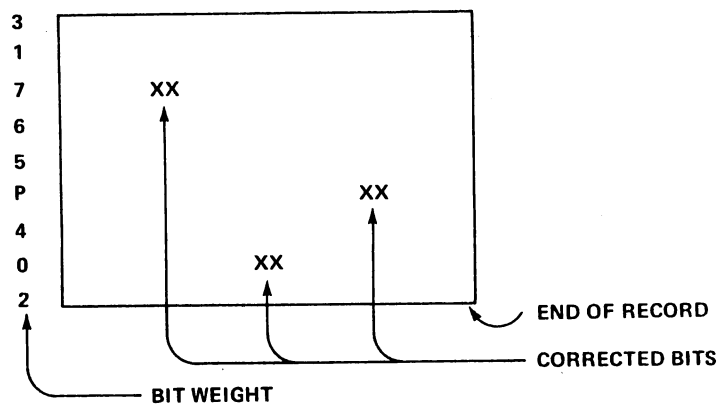
The second form of the third check, also leading to in-flight error correction while reading phase-encoded data records, will accommodate the case where a single track has a loss of flux reversals for more than two characters. In this case, the control will turn off the bad track (dead track) and continue reading and inserting the corrected bit for the missing bit. The bad track is turned off for the balance of the record. This form of in-flight error correction is recorded in error logs maintained by the control. These logs may be interrogated by the external user.

```
3
1
7
6          XXXXXXXXXXXXX
5
P   P
    4
    0
    2                            ┐╭ END OF RECORD
         ┆----------------┆
                  ↑
                 ─── DEAD TRACKING
      ↑
      └──── BIT WEIGHT
```
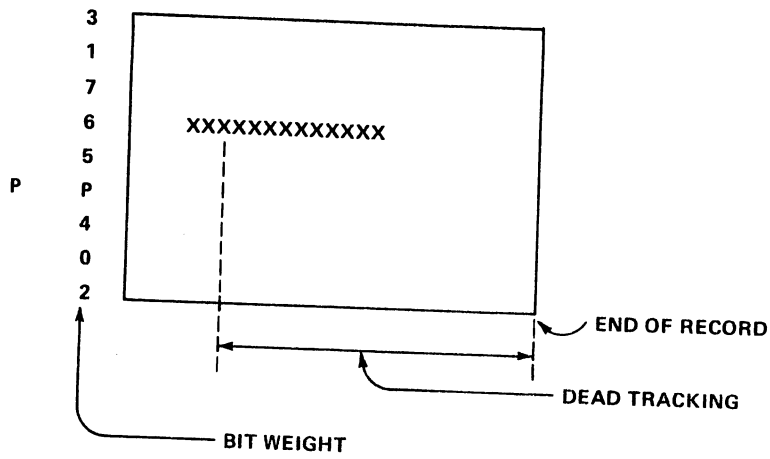
If, while bit correction is occurring during dead tracking, a second track has a loss of flux reversals, the control will detect this condition and indicate a multi-track error as terminate status to the external user.

APPENDIX B
USER INTERFACE TO OPTIONAL CODE TRANSLATORS

The optional code translation capabilities may be utilized by initiating the appropriate read and write commands at the General Macro Assembly Program (GMAP) level. Each of these translation options has a unique command which directs the control to perform the desired translation. (They are valid only with 9-track tape units.)

To translate from the 6-bit code of the 6000 system to/from a tape containing EBCDIC information, the user must use the commands Write EBCDIC Record and Read EBCDIC Record. When performing the 6-bit to/from EBCDIC translations, there is a one-to-one corresponder. e between codes for the numerics, between uppercase alphabetic letters, and between all graphics appearing in common for the 6-bit and EBCDIC code sets. When reading an EBCDIC tape, the lowercase alphabetic letters are converted to uppercase letters. For those cases where a one-to-one correspondence does not exist in the graphics, the conversions of Figure B-1 are made by the control.

When an EBCDIC character other than those included in the characters of Figure B-1 is detected on tape when reading, it will be converted to an octal 77 in 6-bit code (the ! character), and status returned to the user that the data record just read contained a code alert condition. Since the translation is performed on each tape frame, every frame in the record must contain an EBCDIC character. Otherwise, the translations will be invalid.

6-BIT (6000)		EBCDIC (ON TAPE)	
↑	←——→	¬	
←	←——→	—	
!	←——	FF	
¦	←——	|	
[	←——→	{	*
]	←——→	}	*
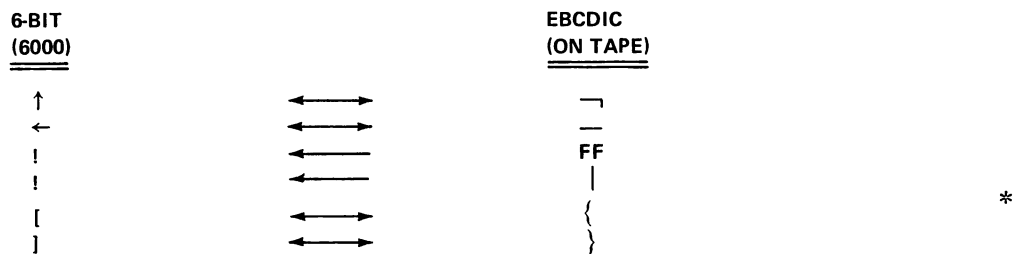
Figure B-1. 6-Bit/EBCDIC Conversions

To translate from the 6000 6-bit code to/from 9-track tape containing ASCII characters, the user should use the Write ASCII Record and Read ASCII Record commands. When reading a tape containing ASCII characters, all lower-case alphabetic letters are converted to upper-case letters in the 6-bit code of the 6000 system. For the numerics, upper-case letters, and all graphics defined on a one-to-one basis, the translation is character-for-character when reading or writing. For those cases where a one-to-one definition of characters does not exist between ASCII and the 6-bit code of the 6000, the conversions of Figure B-2 are made by the control.

6-BIT (6000)		ASCII (ON TAPE)
↑	←——→	∧
←	←——→	_
[	←——	{
]	←——	}
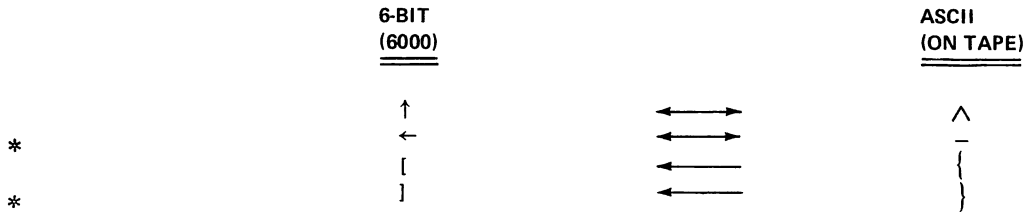
Figure B-2. 6-Bit/ASCII Conversions

In addition to these translations, if an ASCII character which is not included in Figure B-2 is detected on tape during a read command, the invalid character is converted to an octal 77 in the 6-bit code (the ! character). The status is then returned to the user to indicate that the record just read contained a code alert condition. All frames in the record must contain valid ASCII characters as defined in Figure B-2.

The third translation enables the user to translate ASCII characters into 6000 and EBCDIC characters on 9-track tape. To use this translation feature, the user must use the commands Write ASCII/EBCDIC Record and Read ASCII/EBCDIC Record. These translations will map all numerics and alphabetic characters (upper and lower case) to the corresponding character. Also, all graphics defined on a one-to-one basis will be mapped directly to the graphic of the other code set. For those cases where a one-to-one correspondence does not exist between ASCII and EBCDIC graphics, the conversions of Figure B-3 are performed by the control.

Further, any character to be written which is not in the ASCII code set of Figure B-3 will be written on tape as the EBCDIC character EO. When reading an EBCDIC tape for translation to the ASCII code set, all frames in the record are assumed to contain EBCDIC characters defined in Figure B-3. If a character not included in Figure B-3 is read from tape, it is converted to the ASCII character EO, and the status is returned to the user to indicate that the record just read contained a code alert condition.

```
ASCII                                          EBCDIC
(6000)                                         (ON TAPE)

  ^          ←──────                          ┐
  !          ←──────                          │
  [          ──────→                          (
  ]          ──────→                          )
  EO*        ←──────                          ¢
```
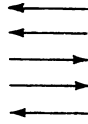
Figure B-3. Conversions

APPENDIX C
GLOSSARY OF TERMS

ASCII Mode	— A PSIA mode in which the eight-bit bytes have a ZERO bit between them in core.
Binary Mode	— A PSIA mode in which the eight-bit bytes are packed contiguously in core.
Block (also Record)	— A group of physically contiguous characters which are recorded on and read from magnetic tape as a unit. A block may consist of one or more complete records. Blocks are separated on the tape by Interblock Gaps produced automatically at the end of a block during writing. Therefore, a tape block is marked or defined by an Interblock Gap before and after the block.
BLT	— Basic Logic Test.
BOT	— Beginning of Tape is a point near the physical beginning of the tape which is denoted by a reflective marker on the uncoated side of the tape. Also an indicator on the tape unit's Operator's Panel which is illuminated to indicate that the BOT marker is being sensed.
BOT Marker	— A reflective strip placed on the uncoated side of the tape to denote the BOT.
bpi	— Bits per inch. Data recording density when considered longitudinally along tape on one track.
Byte	— A group of eight bits which are considered as a unit. Bit 0 is the most significant bit and bit 7 is the least significant bit.
CCC	— Cyclic Check Character.
Channel	— Information is written on magnetic tape by magnetizing small discrete areas in parallel tracks or channels. The channel number indicates the logical position of the bits on the tape (see Figure 2-3).
Control	— The MTC501 or MTC502 Tape Controls.
DLI	— Magnetic Tape Unit Device Level Interface.
EOT	— End of Tape is a point near the physical end of the tape which is denoted by a reflective marker on the uncoated side of the tape.
EOT Marker	— A photo reflective strip on the tape denoting the EOT. The EOT Marker indicates the beginning of the end of tape area and causes the control to notify the EUS to terminate write operations in an orderly fashion.
EUS	— External User System is the central system using the magnetic tape subsystem.
File	— A collection of information, consisting of related records and blocks. The boundaries of a file are indicated by file marks.
File Mark	— A unique pattern recorded on the tape to indicate the boundary between files.
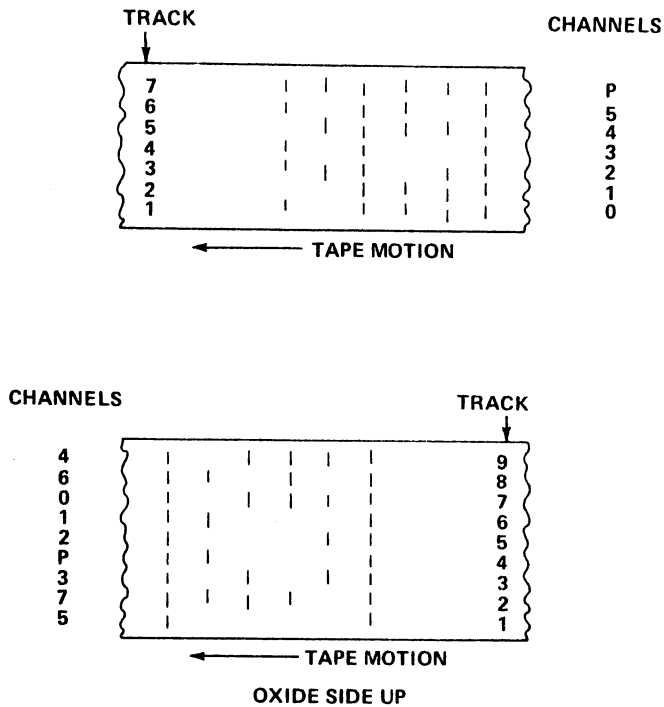
Figure C-1. 7- and 9-Track Tape Layouts

Frame (also Tape Frame)	— A column of bits running laterally across the tape. Each bit is located in a different tape channel (track). A 7-track tape frame has up to seven bits, a 9-track frame has up to nine bits.
fri	— Flux reversals per inch.
IAI	— Internal Adapter Interface.
IOM	— Input/Output Multiplexer.
Inaccessible State (also Off-line)	— A machine state in which the referenced device is not recognized as existing. This state exists when a device has been powered down or when the cable has been disconnected.
Interblock Gap also Interrecord Gap	— The physical, longitudinal, non-data area generated on magnetic tape between two consecutive physical blocks.
ips	— Inches per second
ITR	— Integrated Test Routine
LA	— Link Adaptor
Label	— A block at the beginning or end of a volume or a file which serves to identify and/or delimit that volume or file.
LCC	— Longitudinal Check Character
Load Point	— Same as BOT
MPC	— Microprogrammed Peripheral Control
NRZI	— Non Return to Zero, Invert. A recording technique wherein a flux reversal in either direction is used to represent a ONE bit. When NRZI tape is read, the absence of a flux reversal is interpreted as a ZERO bit.

NRZI write skew error	— An error condition in which the time interval between the first and last bits of a frame is not within allowable limits. This condition is monitored to prevent misalignment of the tape information caused by tape with snaky edges and ensures interchangeability with tape recorded on other manufacturer's tape transports.
Offline	— A device state in which the referenced device may remain powered up and physically attached to the control but it is logically inaccessible to the control and is incapable of responding to a command.
One	— A logic state corresponding to:

- a 1 recorded on tape
- a 1 on any interface line
- a 1 in a buffer or a memory.

PE (Phase-Encoded)	— A recording technique in which flux reversals are written for both 1's and 0's. PE recording is done only on 9-track tapes. PE 1's and 0's on tape are defined as follows:

- A PE 1 data bit is defined as a flux reversal (occurring at data time) to the polarity of the interblock gap when reading tape in the forward direction. This will be a high to low transition on the DLI.

- A PE 0 data bit is defined as a flux reversal (occurring at data time) to the polarity opposite to that of the interblock gap, when reading tape in the forward direction. This will be a low to high transition on the DLI.

- A flux reversal shall be written at the nominal midpoint between successive ONE bits or between successive 0 bits to establish proper polarity. This flux reversal shall be called a phase flux reversal.

Postamble	— A unique pattern written on tape immediately following the last data frame in a block when using PE recording. The postamble consists of a single all-1's frame followed by 40 all-0's frames. It is never transferred to or from main memory.
Preamble	— A unique pattern written on tape immediately preceding the first data frame in a block when using PE recording. The preamble consists of 40 all-0's frames followed by a single all-1's frame. It is used to synchronize the read detection circuitry prior to reading the data portion of a block. It is never transferred to or from main memory.
PSI	— Peripheral Subsystem Interface
PSIA	— Peripheral Subsystem Interface Adapter
Ready	— A device state in which the device is currently executing a command or is capable of executing any command defined for the device.
Record	— A collection of related data items which is treated by software as a single unit of information. One or more records normally constitute a block.
Recording Density	— The longitudinal measure of the number of information bits in a single channel in one-inch of tape. It is stated in bpi.
Seized and Reserved	— A device state in which a device has been seized by an access path and the device is reserved to that same access path.
Standby-loaded	— A tape unit mode in which the tape is loaded and operator intervention is required to bring the unit to the Ready state.
Standby-unloaded	— A tape unit mode in which the tape is unloaded but the unit is capable of responding to a Load Tape command.

Tape Mark	— Same as file mark
Tape Track	— Longitudinal rows, along the length of the magnetic tape, where bits of information are placed. The track number indicates the physical position on the tape.
TCA	— Tape Control Adapter.
Volume	— A physical unit of storage media. For magnetic tape, a volume is synonymous with "a reel of magnetic tape."
ZERO	— A logic state which corresponds to:

- A 0 recorded on tape
- A 0 on an interface line
- A 0 in a buffer or a memory.

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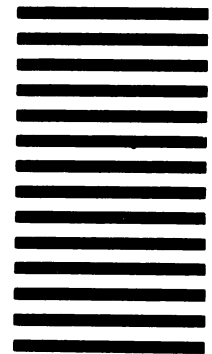NOTE: U. S. Postal Service will not deliver stapled forms

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