Honeywell HONEYWELL INFORMATION SYSTEMS		SPEC. NO. 60149755 ~~60134093~~	SHEET 1.1 ~~1.1~~	REV. A ~~F~~

HONEYWELL INFORMATION SYSTEMS
SYSTEMS ENGINEERING - BOSTON

ENGINEERING PRODUCT SPECIFICATION (EPS - 1)

SUBSYSTEM LEVEL

TITLE: L6, ½ INCH STREAMER TAPE SUBSYSTEM

VERSION: DRAFT DATE:

PRODUCT CALENDAR REFERENCE:

FS 2000 tape spec
hand modified to apply to
FS1000 (PERTEC)

10/5/87

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INTRODUCTION

1.1 DOCUMENT DEFINITION

1.1.1 Identification and Purpose

This document is an Engineering Product Specification - Part 1 (EPS-1) for the Level 6, 1/2 inch Streamer Magnetic Tape Subsystem. It describes the functionality, performance, and configurations of a device-specific adapter which, when attached to a Medium Performance Device Controller, provides the capability of interfacing with a PE Formatter/Controller.

1.1.2 Documentation Tree Structure

NUMBER	TITLE	RESPONSIBILITY
60144409	L6 GCR Tape Subsystem	Systems Planning
	EPS-1, System Level	
60126448	New Minicomputer Line System (Part 1)	Systems Engineering
	EPS-1, Subsystem Level	
60126298	New Minicomputer Bus	Systems Engineering
60134093	L6 GCR Magnetic Tape Subsystem	Systems Engineering

NUMBER	TITLE	RESPONSIBILITY
	EPS-1, Component Level	
Purchase Specification 03850108	Streamer Tape Transport That Uses One-half Inch Media	Systems Engineering
Model #'s F880340-90-1025 and F880340-96-1525	Cipher Data Products Inc. Series F-880 Microstreamer Tape Drive	OVP Selection Engineering
Purchase Specification 03850045	GCR/PE/NRZI Tape Drives (STC)	OVP Selection Engineering
Purchase Specification 03850047	STC Formatter/Controller Unit	OVP Selection Engineering
D.002.01	PWA/PWB Testability Design	AMD&T
	Manufacturing Testability Guidelines	
MTG1	PWA Test Equipment Connection Requirements	
MTG2	Documentation Requirements for PWA Testing	AMD&T-TE
MTG3	PWA Microdiagnostic Creation	
60129949	Application Rules for Mini-computer and Terminals Products	Circuit Design
Q4.1	PWB/PWA Testability Design Rules	PAE-TEE
MG1	Component Availability	AMD&T-TE
MTG4	PWA Test Monitor/Test Box Design	AMD&T-TE

NUMBER	TITLE	RESPONSIBILITY
	Manufacturing Testability Guidelines Continued	
MTG5	PWA Quality Logic Test Creation	AMD&T-TE
MTG6	PWA Test and Verification Program Creation	AMD&T-TE
MTG7	PWA IC Socket Utilization	AMD&T-TE
MTG8	Design for Producibility, Installability, Maintainability, and Replaceability	AMD&T-YE
MPTG1	PWB/PWA Producibility Guidelines	AMD&T-TE
58035052	Worldwide Maintenance Requirements	AMD&T-TE

1.2 SCOPE

The ½ Inch Streamer Magnetic Tape Subsystem requirements for the Level 6 include a capability to read and write 1600 bpi Phase Encoded (PE), ANSI standard 9-track tapes at 25 i.p.s. & 100 i.p.s.; at 50 i.p.s. and 3200 b.p.i. the recording format is not IBM or ANSI compatible, tapes are interchangeable with other 3200 bpi cipher drives.

The Streamer Tape Controller-Adapter (STC-A), a component of the Level 6 ½ Inch Streamer Tape Subsystem, is specified herein. This adapter, when attached to the Medium Performance Device Controller (MPDC) satisfies the requirements by providing an interface to an OVP Formatter/Controller (F/C). The combination of STC-A and MPTC (MPDC with an appropriate firmware) becomes the STC-Magnetic Tape Subsystem (STC-MTS).

1.3 REFERENCE DOCUMENTS

1.3.1 Governing Documents

60131966	Level 6 Medium Performance Tape Subsystems PFS
60126448	New Minicomputer Line System EPS-1 (Part 1)
60129896	NML Maintainability EPS-1

60128217 NML Medium Performance Disk Controller Subsystem.

03850108 Purchase Specification Streamer Tape Transport That uses one-half inch media.

1.3.2 Standards

ANSI Standard (X3.40-1976) Unrecorded Magnetic Tape for Information Interchange. (9 track 200 and 800 c.p.i., NRZI and 1600 c.p.i., PE)

ANSI Standard (X3.27-1974) Magnetic Tape Labels and File Structure for Information Interchange.

ANSI Standard (X3.39-1973) Recorded Magnetic Tape for Information Interchange (1600 CPI, PE).

ANSI Standard (X3.54-1976) American National Standard for Recorded Magnetic Tape for Information Interchange (6250 CPI, Group Coded Recording).

HIS Standard B01.08, B01.10 and B01.14.

1.3.3 Related Documents

60128944 Physical I/O Interface EPS-1

60126298 Engineering Product Specification, Part 1 Level 6 Bus (Megabus) Rev. H (10-27-80)

1.4 DEFINITIONS

Block — A group of contiguous recorded characters considered and transported as a unit containing one or more logical records. Blocks are separated by interblock gaps.

BOB — Beginning Of Block on tape

BOT — Beginning Of Tape

bpi — Bits per inch

CAI — Controller Adapter Interfaces

Channel	An addressable entity on the Megabus which is visible to software
CLI-F/C	Interface between STC-A and F/C
CPI	Characters Per Inch
CRC	Cyclic Redundancy Check
DAI	Device Adapter Interface
Density	The recording density is a longitudinal measure of the nominal number of information characters which can be recorded in 9 tracks on one inch of magnetic tape. The density is stated in characters per inch (CPI).
DLI-MTU	Device Level Interface MTU
EOB	End Of Block on tape
EOT	End Of Tape
FCI	Flux Changes per Inch
F/C	Formatter/Controller (within Cypher device enclosure)
File	A collection of information consisting of one or more related blocks, the boundaries of which are identified on tape by means of tape marks
~~GCRA~~	~~Group Coded Recording Adapter~~
GCR	Group Coded Recording method
Hub End	The physical end of tape nearest the EOT marker
Interblock Gap	A dc-erased section of tape separating blocks of information
ips	Inches per second
Level 6	Level 6 Minicomputer Systems
LOS	Level Of Simultaneity
MPDC	Medium Performance Disk Controller
MPTC	Medium Performance Tape Controller (MPDC plus STC-A firmware)

MBZ	Must Be Zero
MTU	Magnetic Tape Unit
NML	New Minicomputer Line
NRZI	Non-Return-to-Zero-Inverted recording method
OEM	Original Equipment Manufacturer
Off-Line	A state in which the referenced unit may remain powered up and physically attached, but is logically inaccessable and, in general, is incapable of responding to any commands. This state is usually entered for purposes of field service intervention.
ORU	Optimum Replaceable Unit
OVP	Outside Vendor Product
OVP Tape Drives	Magnetic tape devices as specified in HIS Purchase Specification 03850108
PE	Phase-Encoded recording method
QLT	Quick Logic Test
RAW	Read After Write
RFU	Reserved for Future Use
Rim End marker	The physical beginning of tape nearest the BOT
ROS	Read Only Store
RWS	Read/Write Storage
STC – MTS	Streamer Tape Controller – Magnetic Tape Subsystem
Tape Character	A column of bits across the width of the magnetic tape. Each bit is loaded in a different tape track.
Tape Mark	A special control block recorded on magnetic tape to serve as a separator between files and file labels.
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.
TBD	To Be Determined
VRC	Vertical Redundancy Check

II

ARCHITECTURE

2.1 OVERVIEW

The STC-Magnetic Tape Subsystem (STC-MTS) provides Level 6 with the facility to store and retrieve PE formatted data from 1/2-inch magnetic tape.

A STC-MTS configuration consists of an MPTC (connected to the NML Bus) with one Streamer Tape Controller-Adapter (STC-A) controlling the Formatter/Controller (F/C) and up to four tape devices. This configuration can process simultaneously a single data transfer and one or more rewind and/or rewind and unload instructions.

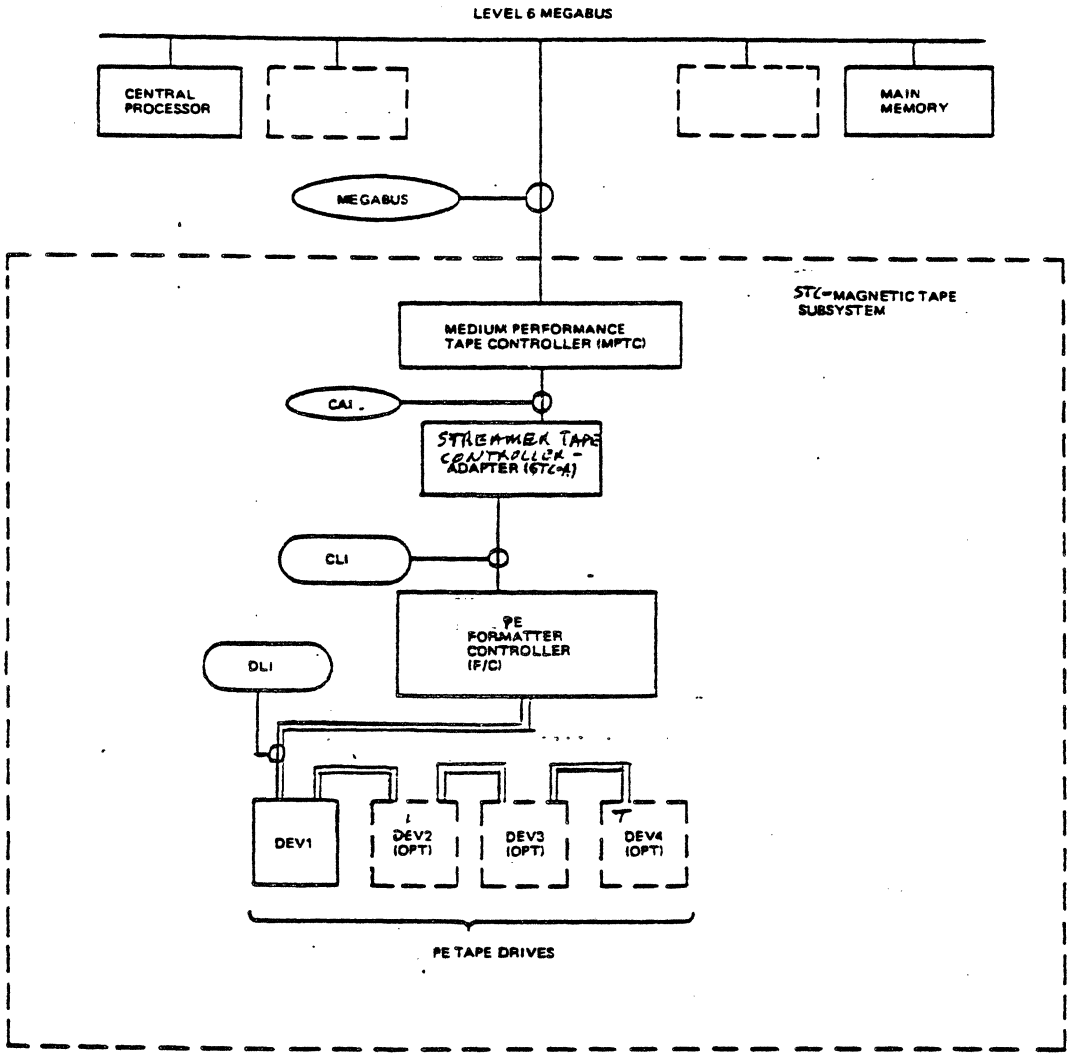
Figure 2-1 illustrates the structure of the subsystem and its relationship to the system as a whole. Detailed configurational information can be found in Section IX.

2.2 MAJOR COMPONENTS

The major components of the Level 6 STC-MTS are a Medium Performance Tape Controller (MPTC), the Streamer Tape Controller-Adapter (STC-A), and an OVP PE Formatter/Controller (F/C).

2.2.1 Medium Performance Device Controller (MPDC)

The MPDC is a microprogrammed peripheral control unit which attaches to the Level 6 Megabus (see NML Bus EPS-1) and which, via an adapter, is capable of supporting up to four devices. The microprocessor portion of the MPDC is generalized to facilitate its application as a control element for other controller/device types.



NOTE: SEE SECTION IX FOR CONFIGURATION RULES.

T = TERMINATORS

Figure 2-1 Level 6 STC Magnetic Tape Subsystem

Hardware unique to a given device/controller is localized in the device/controller adapter. The MPDC performs general purpose control functions such as:

- Execution of Level 6 bus sequences
- Command decoding
- Data transfer multiplexing between adapters
- Status and control register storage
- Direction of the general flow of command execution.

When firmware appropriate to the Streamer Tape Controller-Adapter is plugged in, the board becomes a unique Medium Performance Tape Controller (MPTC).

2.2.2 1/2-Inch Streamer Tape Controller-Adapter (STC-A)

The STC-A is implemented on a triple-size D-board which plugs onto the MPTC via two 25-pin connectors and is connected via cables to the STC-F/C . It contains the following functionality:

- Command decoding
- Data transfer multiplexing between controller/devices
- Status and control register storage
- Provides device write/read data buffers
- Provides device identification codes
- Provides controller/adapter interfaces (CAI)
- Provides adapter/tape controller interfaces (DLI)

2.2.3 PE Formatter/Controller (F/C)

The F/C is an OVP tape controller capable of generating and reading ANSI format compatible 9-track tapes at 1600 bpi PE or 3,200 b.p.i. in ANSI format. It interfaces with up to four Cypher Model F880 tape transports in a daisy bus configuration. The data format capability of each transport is 1600 bpi PE/3,200 bpi (non-compatible).

Table 2-1 shows the data byte (8-bit) transfer rate in kilobytes per second for all possible combinations of speed and density.

Table 2-1 Byte Transfer Rate

SPEED (bpi)	100 IPS	50 IPS	25 IPS
1600	160 KB	N/A	40 KB
3,200	N/A	160 KB	N/A

The F/C attaches to the STC-A adapter via the controller interface (CLI) and contains the following functionality:

- Performs device interface dialog control
- Provides device write/read data buffers
- Performs data integrity checking
- Provides controller/adapter interfaces (CLI-F/C)
- Performs error detection/correction for PE formats
- Provides the device interfaces (DLI).

For a detailed description of the F/C, refer to the Product Specification for the F880 FC (Formatter Controller).

2.2.4 1/2-Inch Magnetic Tape Unit (MTU)

The 1/2-inch magnetic tape units are OVP tape drives which meet the governing purchase specification (refer to subsection 1.3.1). The drives read and write tapes to the following summary of functionality:

- Provides for 25 ips tape speed
- Provides for 100 ips tape speed
- Provides for Read After Write (RAW)
- Provides for up to a 10-1/2-inch tape reel
- Provides for 50 i.p.s. tape speed for 3,200 bpi recording density only
- Provides for 1600 CPI PE density (9 channel)
- Provides for 3200 c.p.i. PE density (9 channel); non ANSI/IBM compatible

Models available (Cypher Data Products Inc.):

F880640-90-1025 25/100 i.p.s. 1600 PE device — Microstreamer

F-880340-96-1525 25/50/100 i.p.s. 1600/3,200 (at 50 i.p.s. only) PE device Microstreamer II.

III

FUNCTIONAL REQUIREMENTS

3.1 BASIC FUNCTIONS

3.1.1 Configuration and Simultaneity

Devices attached to the MPTC are software addressable via channel numbers. Each individual device (drive) has two channel numbers assigned, differing only in the low-order bit position (called the direction bit). When an IOLD instruction is issued to a magnetic tape device, the direction bit of the channel number specifies whether this is an input or an output data transfer. For all other commands, the direction bit is ignored by the hardware. Figure 3-1 outlines the composition of the channel number. Bits 8 through 14 are assigned at system installation and must conform to constraints defined in the NML Bus EPS-1. Software visibility of the devices attached to the MPTC is such that the devices are, in general, independent of each other. For example, operations on one tape are independent of any activity on another tape except that the MPTC initiation of a command sequence addressed to one device (channel number) may be stalled (a command sequence has been accepted but not initiated) while the MPTC is busy servicing another device. Further definition of how command sequences are handled by the subsystem can be found in the MPDC EPS-1.

The MPTC provides a single level of simultaneity (only one data transfer can be active in the subsystem) and supports the following:

- A nonbusy device must accept any command directed to it over the bus (i.e., IOLD, Configuration Words A, Range, Task Word, etc.) even though a data transfer may be active over another device. A command may be "waited" (see NML Bus

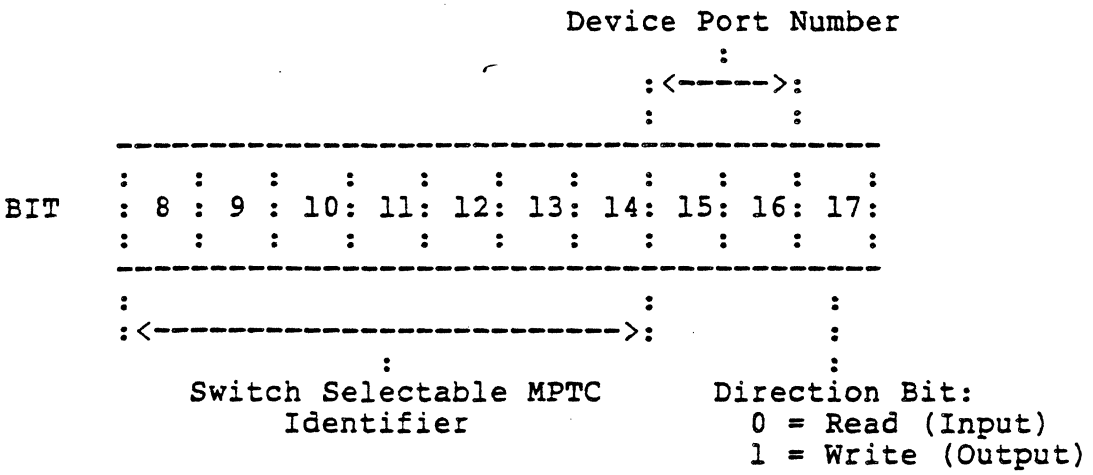


Figure 3-1 Channel Numbers

EPS-1) for a period not to exceed 12 microseconds (assuming no higher priority bus activity).

- Following completion of a data transfer operation, any rewind orders received are initiated prior to initiation of any data transfer operations.

- Channels are serviced on a rotating priority basis so that no one channel or channels can dominate adapter usage.

Note that the controller will accept a data transfer command to drive B while A is doing a data transfer but will not start the data transfer on B until A's data transfer has completed.

If a STC-A is configured with less than four devices, it only responds to channel numbers associated with the installed devices .

3.1.2 Megabus Control

3.1.2.1 Command Transfers

The MPTC recognizes a command transfer request on the Megabus when a valid channel number is decoded in bits 8 through 17 of the address bus (see NML Bus EPS-1). If the referenced device is not busy, the contents of the data and address buses are stored in the MPTC interface hardware. If the MPTC is currently executing a data transfer operation on another channel, the command transfer request may be responded to by a WAIT signal for a period not exceeding 12 microseconds (assuming no higher priority bus activity). MPTC firmware is then invoked to process the information. For the not busy case, the MPTC completes the bus cycle by issuing an ACK to

the CPU. If, however, the referenced device is busy executing a previously received command, the MPTC interface hardware completes the bus cycle by issuing a NAK (except for the Output Control Word command, see subsection 5.2.6). If the MPTC interface hardware is temporarily busy, because firmware has not had an opportunity to service a previously initiated bus cycle or because the MPTC is busy generating a read response cycle, then the MPTC interface logic completes any new bus cycle with the WAIT response (see NML Bus EPS-1). See subsection 5.2 for a description of the various commands applicable to the MPTC Tape Subsystem.

The address and data bus configurations for the various commands are detailed in subsection 5.2.

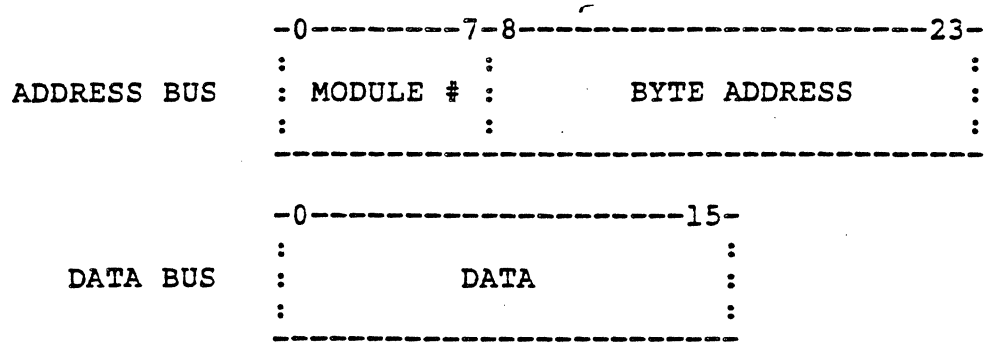
3.1.2.2 Data Transfer

All data transfers associated with the MPTC/STC-A subsystem are executed in Direct Memory Access (DMA) mode. Data transfers are normally in word mode but byte mode transfers can occur associated with the first and/or last memory cycle of a particular data transfer if the main memory buffer begins or ends on an odd byte boundary.

If a NAK response is received at the MPTC during a memory write or read request cycle on the Megabus, the data transfer continues to its normal termination with a nonexistent resource error posted in the status word (see subsection 5.2.14.14). If a WAIT response is received for a memory write or read request, the MPTC interface hardware retries the bus cycle. Retries continue until either a NAK or ACK response is received. Note that while a bus cycle is pending in the MPTC interface hardware, no bus cycles from the CPU to the MPTC are accepted (including the Output Control Word). This also applies to the interval between a memory read request and the read response (second-half read) cycle. Once the interface hardware is conditioned to do a memory transfer (either read or write,) a), other bus cycles addressed to the MPTC are completed with either NAK or WAIT (depending on channel busy status) until the memory reference is complete. Read response (second-half read) cycles from memory to MPTC are always completed with ACK (NAK and WAIT are never used for these cycles).

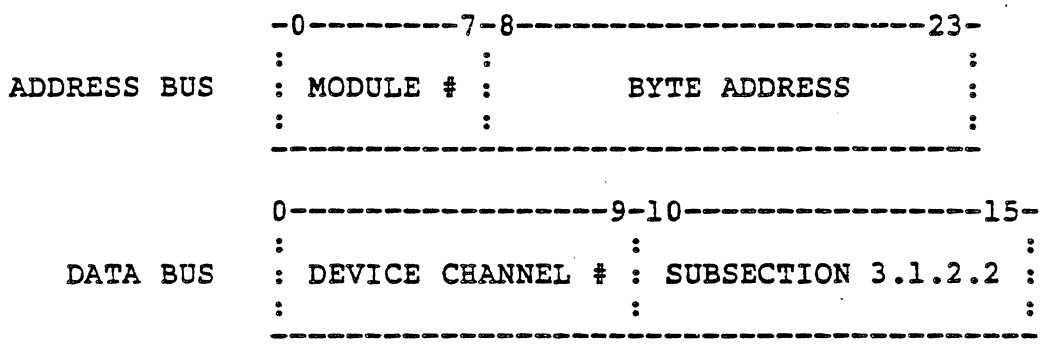
Figure 3-2 illustrates the address and data bus configurations for read and write data transfers. During the instruction cycle of memory read sequences, bits 10 through 15 of the data bus may contain the address of a register in the MPTC into which the returned data (from memory) will be delivered. In the response (second-half read) cycle, the memory places on the address bus (bits 8 through 23) the contents of the entire data bus (bits 0 through 15) as received during the instruction cycle.

MEMORY WRITE SEQUENCE



MEMORY READ SEQUENCE

INSTRUCTION CYCLE



RESPONSE CYCLE

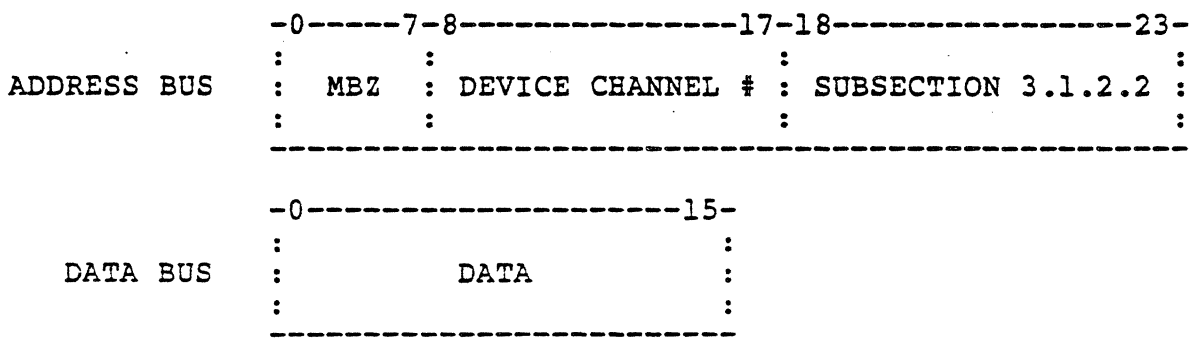


Figure 3-2 Address and Data Bus Configuration
For Read and Write Data Transfers

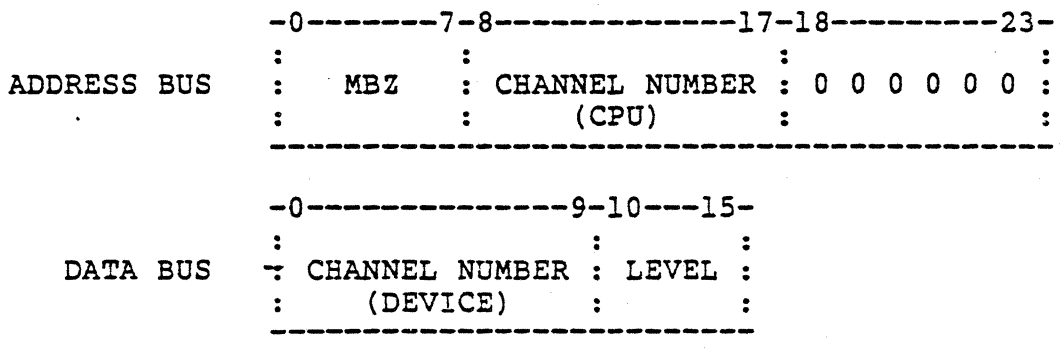
3.1.2.3 Interrupts

Whenever a channel interrupt level (see subsection 5.2.4) is nonzero and an operation initiated by an Output Task Word (see subsection 5.2.5) or Output Control Word (see subsection 5.2.6) instruction is completed or the attention bit is set in the status word (subsection 5.2.14.2), an interrupt is attempted. If a NAK response is received during an interrupt cycle, the MPTC stores the interrupt until it detects a pulse on the BSRINT (Resume Interrupts) line. The interrupt is then retried. Once an interrupt has been saved (as the result of a NAK response), the MPTC is capable of receiving commands and/or conducting data transfers on any of the other channels (subject to normal constraints). The channel with the pending interrupt, however, remains busy and the MPTC will not accept commands issued to that channel (except Output Control Word).

If the interrupt level of a channel is zero (either via an initialize process or loaded to zero), no interrupts will be attempted for that channel. If a condition or event occurs which would normally cause an interrupt, the appropriate bits in the status word are set but no interrupt is attempted or saved.

If the interrupt level is set to zero when an interrupt is pending (via Output Control Word or Master Clear), the pending interrupt is discarded.

Figure 3-3 illustrates the address and data bus configuration for interrupt sequences. The channel number supplied on the data bus during an interrupt is the channel number used in the most recent Output Address instruction for the associated device. If no previous Output Address instruction has occurred at the time of an interrupt, the low-order bit of the channel number is Zero (see subsection 3.1.1).



*See subsection 5.2.4.

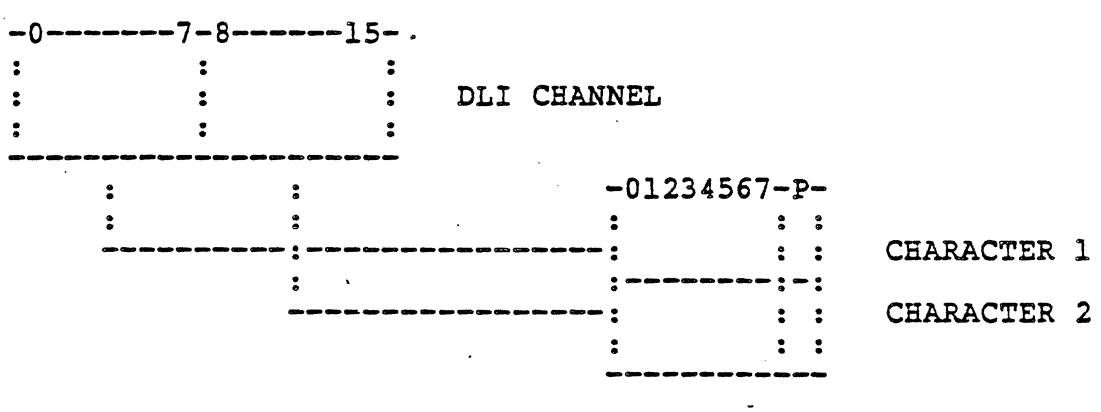
Figure 3-3 Address and Data Bus Configuration for Interrupt Sequence

3.1.3 Overview of Tape Operation

Associated with each device is a set of registers in the MPTC which are loaded by software and specify the parameters required for tape operation. In addition to range and address registers, a configuration register contains the mode of operation and a task register holds command codes. To perform a specific operation, the software first loads the configuration, address, and range registers. The task register is loaded last and specifies the operation to be performed. The MPTC begins command execution when it receives the task word.

Commands addressed to a nonbusy tape device are always accepted but execution may be delayed as described in subsection 3.1.1. All commands addressed to a busy tape device are rejected (NAK response on Megabus) except the Output Control Word (see subsection 5.2.6).

Data being written on or read from a tape is handled on a byte basis. For 9-track tapes, all 16 bits of a data word are transferred to or from the tape as follows (odd parity is written on tape and checked when read):



3.2 COMPATIBILITY

Level 6 1/2-inch Streamer Tape Subsystem provides read and write interchange with corresponding Level 6 tape subsystems and foreign tape subsystems with read and write tapes which meet ANSI standards (see subsection 1.2.3) (25 i.p.s. and 100 i.p.s., PE only)

Level 6 software drivers read and write 9-track tapes in the PE recording format on the STC-MTS.

Additional format and interchange information is given in subsection 5.1 and Section VIII.

3.3 MAIN MEMORY STORAGE

Main memory requirements for the tape driver are defined in the Magnetic Tape Driver Software Specification (TBD).

3.4 IMPLEMENTATION

The MPDC serves as a firmware-driven controller and provides the necessary bus and device/controller adapter interfaces and associated buffering and control facilities. Detailed information on MPDC implementation can be found in the Medium Performance Device Controller Product Manual (TBD).

IV

INTERFACES

4.1 USER INTERFACES

No specific user action is required to load or initialize the STC-MTS other than that required during subsystem installation for identification of subsystem configuration. Specific user actions required for the operation of tape devices can be found in the appropriate operation manual for the device.

4.2 EXTERNAL INTERFACES

4.2.1 Megabus Interface

The MPDC attaches to the Megabus as a typical I/O controller. The NML Bus EPS-1 contains the specific details for this interface (see Figure 2-1).

4.2.2 Controller/Adapter Interface (CAI)

The STC-A attaches to the MPDC as a standard MPDC adapter. The MPDC EPS-1 contains specific details for this interface.

4.2.3 Controller Level Interface for the PE Formatter/Controller (CLI-F/C)

Refer to the appropriate controller specification(s) for more detailed information than presented in this subsection. The controller specification also represents the governing document in terms of controller functionality.

The CLI-F/C interface consists of ___ signal lines between the STC-A and the ___ PE Formatter/Controller (F/C). Figure 4-1 groups these signals as input, output, and data signals as viewed from the F/C.

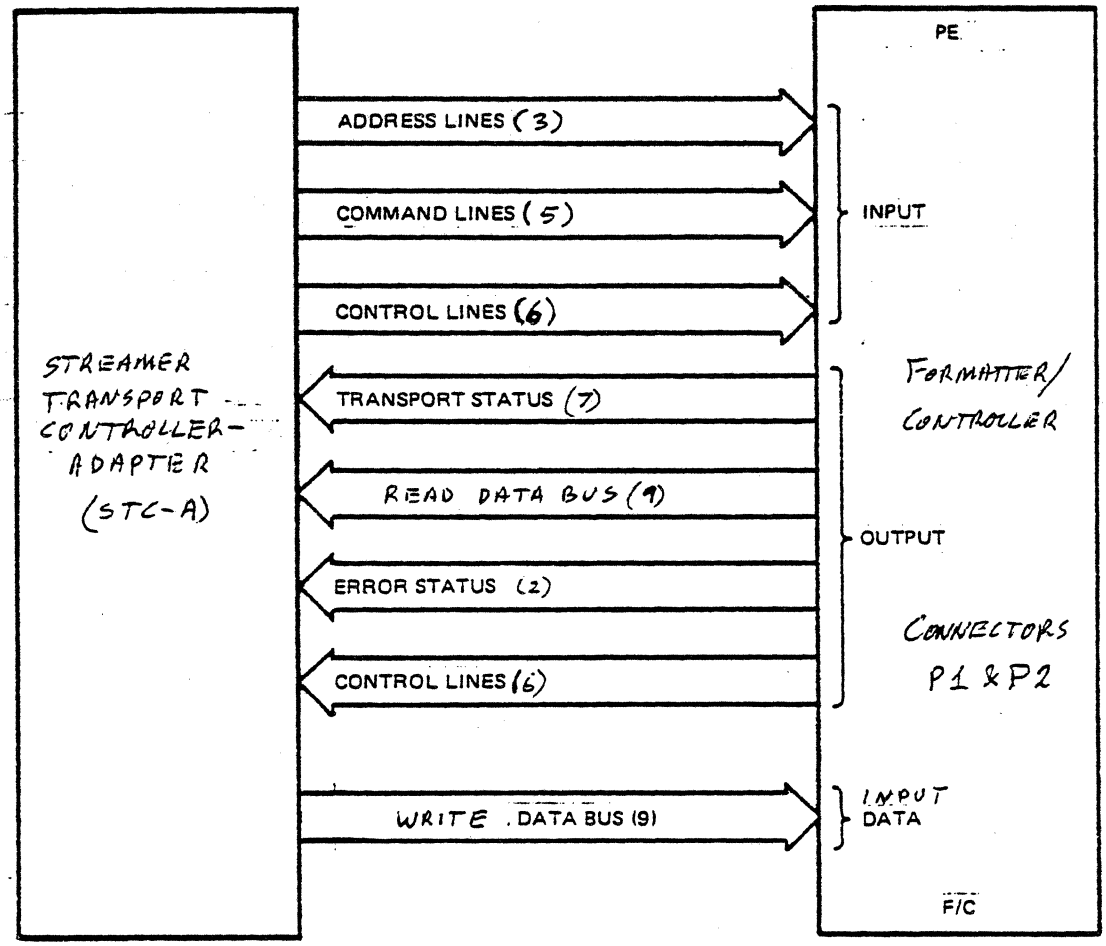


Figure 4-1 CLI-F/C Interface

Tape Transport Input lines:

Address signals:	Connector - Pin #
IFAD-	P2-48
ITADϕ-	P1-46
ITAD1-	P2-46
Command signals:	
IREV-	P1-18
IWRT-	-34
IWFM-	-42
IEDIT-	-38
IERASE-	-4ϕ
Control signals:	
IREW-	P1-2ϕ
IRWU-	P2-24
IFEN+	-17
IHISP-	-5ϕ
IGO-	P1-ϕ8
ILWD-	-ϕ4
Data signals:	
IWϕ-	P1-1ϕ
IW1-	-12
IW2-	-3ϕ
IW3-	-26
IW4-	-ϕ6
IW5-	-32
IW6-	-28
IW7-	-24
IWP-	-22

Table. 4-2 Interface signals (Sheet 1 of 2)

Tape Transport Output Lines:

Transport status:	Connector - Pin #
IRWD-	P2 - 3Φ
ION L-	- 44
ILDP-	- Φ4
IEOT-	- 22
IRDY-	- 28
IFPT-	- 32
ISPEED- (100 ips. when true)	- 4Φ
Control signals:	
IFBSY-	P1 - Φ2
IDBSY-	P2 - 38
IFMK -	- 14
IDENT-	- 16
IRSTR-	- 34
IWSTR-	- 36
Error status:	
IHER -	P2 - 12
ICER -	- 42
Data signals:	
IRΦ-	P2 - Φ2
IR 1 -	- Φ3
IR 2 -	P1 - 48
IR 3 -	- 5Φ
IR 4 -	P2 - Φ6
IR 5 -	- 2Φ
IR 6 -	- 1Φ
IR 7 -	- Φ8
IRP -	- Φ1

Table 4-2 Interface signals (Sheet 2 of 2

4.2.3.1 Input Lines (STC-A to F/C)

4.2.3.1.1 Address Lines

These lines are decoded in the F/C to select one of four transports. Tape drive addresses are preselected by switches, S1, S2, & S4 on the main drive PWB. Address decoding is as shown:

IFAD-	ITAD0-	ITAD 1-	TRANSPORT SELECTED	S1	S2	S4
ϕ	0	0	0	/	1	1
ϕ	0	1	1	/	1	ϕ
ϕ	1	0	2	/	ϕ	1
ϕ	1	1	3	/	ϕ	ϕ

Remaining codes are not valid.

going true. The address lines must remain true from the leading edge of IGO- to IFBY-

4.2.3.1.2 Command Lines

These lines are decoded in the F/C to select a unique commands. They are set at the trailing edge of the IGO- signal, and remain true for the duration of 1 microsecond minimum. The commands are coded as shown in Table 4-1. until IFBY- goes true

Table 4-1 Command Codes

IREV-	IWRT-	IWFM-	IEDIT-	IERASE-	COMMAND	DESCRIPTION
ϕ	ϕ	ϕ	1	1	NOP	No Operation
ϕ	ϕ	1	1	ϕ	DMS*	Diagnostic Mode Set
ϕ	ϕ	ϕ	ϕ	ϕ	RDF	Read Forward
ϕ	1	ϕ	ϕ	ϕ	WRT	Write
1	ϕ	1	ϕ	1	BSF	Backspace File
1	ϕ	ϕ	ϕ	1	BSB	Backspace Block
ϕ	ϕ	1	ϕ	1	FSF	Forward Space File
ϕ	ϕ	ϕ	ϕ	1	FSB	Forward Space Block
ϕ	1	1	ϕ	ϕ	WTM	Write Tape Mark
ϕ	1	1	ϕ	1	EFL	Erase Fixed length
ϕ	1	1	1	1	SER	Security Erase
1	ϕ	1	1	1	HDE*	High Density (3200 bpi)
ϕ	ϕ	1	1	1	LDE*	Low Density (1600, PE)

* Special commands, see description that follows.

Insert 23b & 23c here

insert before section 4.2.3.1.3 (after page 23a)

Diagnostic mode set (DMS).

This command redefines the interpretation of the command coding shown above. Subsequent command, if issued within 1 second, selects an internal diagnostic routine while the transport is in the "On-line" mode.

Table 4-3 Diagnostic Test Codes

IREV-	IWRT-	IWFM-	IEDIT-	IERASE-	COMMAND	DESCRIPTION
ϕ	ϕ	ϕ	ϕ	ϕ	CSE	Cycle Servos (Test 22) Command can be terminated by any other command.
1	ϕ	ϕ	ϕ	ϕ	RLM	Read Logic Margin (Test 11)
ϕ	1	ϕ	ϕ	ϕ	CMT	Circuit Margin Test 13.
1	1	ϕ	ϕ	ϕ	RMT	Reset Margin Test 12
ϕ	ϕ	1	ϕ	ϕ	EXS	Extended status

Description of diagnostic Tests XX can be found in the "Diagnostics and Service Aids" section of the Series E880 Microstreamer manual (See section 1.1.2 for reference)

Extended Status command results in an input of 256 nibbles (half-bytes) with the least significant nibble of each byte first. Interpretation of each status byte can be found in the Series E880 Microstreamer manual. Reference Table 4-3, Device Detail Status Codes

High density (HDE).

This command is available with the 50 i.p.s. option only and can be executed when the tape is at BOT only.

Low Density (LD=).

This command selects the 1600 b.p.i. density while the tape is at BOT only.

Table 4-4 Device Detail Status Codes

4.2.3.1.3 Control Lines

REWIND (IREW-).

The one microsecond (minimum) pulse initiates REWIND command in the selected, ready (IRDY- true) transport; if the tape is at load point, BOT, the command is ignored. The rewinding status line IRWD- is asserted and the transport ready IRDY- goes false. Formatter busy, IFBSY-, and data busy, IDBSY-, signals remain false. Other transports can be selected while one is in the rewinding status.

The transport becomes ready, IRDY-, and the rewinding status, IRWD-, is reset when the tape is positioned at the beginning of tape marker, ILDP-.

REWIND AND UNLOAD (IRWU-).

The one microsecond (minimum) pulse initiates REWIND command as described above with the addition of resetting the ON LINE status and initiating an unload tape procedure in the transport on sensing the BOT

COMMAND RESET (IFEN).

The two microsecond (minimum) pulse is used by the transport to reset a READ, SEARCH or WRITE command runaway when the device busy, IDBSY-, is set; the IFEN+ command is ignored if IDBSY- is false. The command is terminated within 50 milliseconds by the transport with both the IDBSY+ and IFBSY- being true.

HIGH SPEED SELECT (IHISP-).

The signal must be set true one microsecond before the trailing edge of the command strobe signal, IGO-. This 100 i.p.s. rate can be set or reset to 25 i.p.s. at any time - a delay of 1.2 microseconds must elapse before another command can be accepted by the transport.

COMMAND STROBE (IGO-).

The one microsecond (minimum) pulse trailing edge is used for latching address, command and control requests in the selected transport A B

strobed signals must be true from at least the leading edge of IGO until the formatter busy, IFBSY-, goes true.

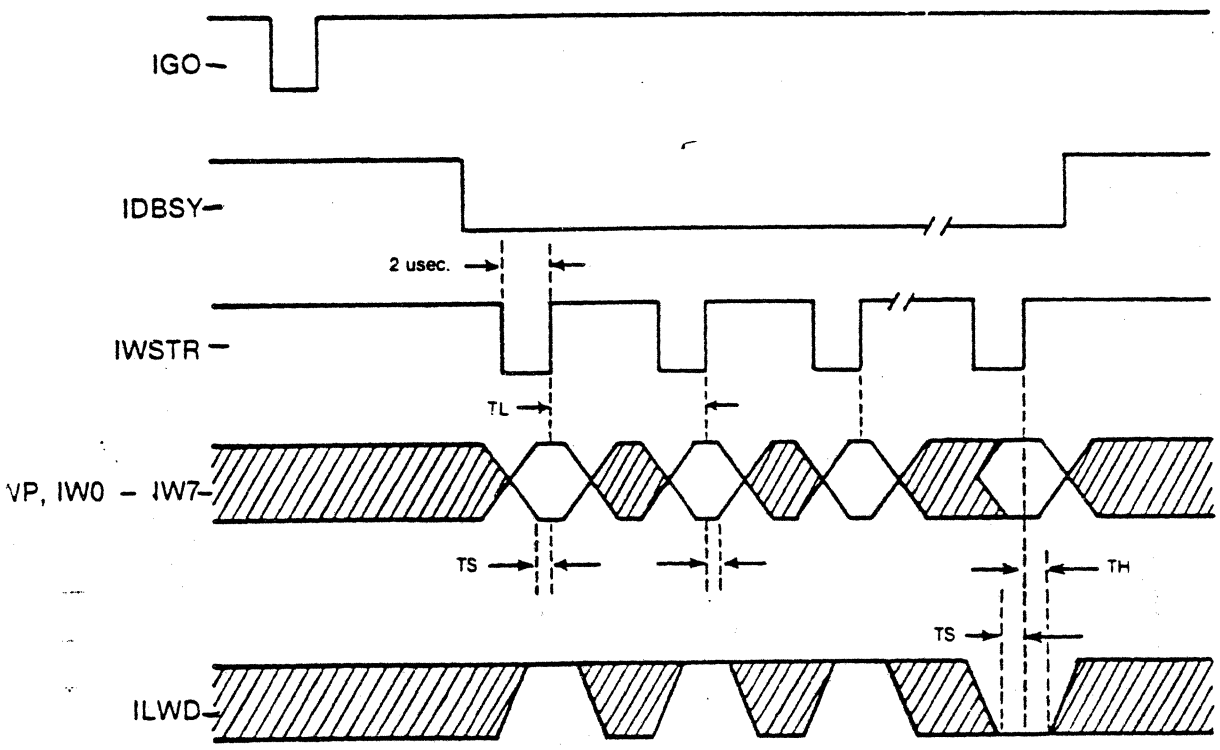
LAST WORD (ILWD) FLAG.

This flag signal is associated with the last write data character and must be true, at least, 300 nanoseconds ahead of the trailing edge of write strobe signal, IWSTR-, it terminates a WRITE command.

4.2:3.1.4 Write Data Lines.

WRITE DATA BUS (IWØ- through IW7- and IWP-).

The nine data lines, including parity, must be true, at least, 300 nanoseconds ahead of the trailing edge of write strobe signal, IWSTR- (See figure 4-2)



TS = 300 NANOSECONDS (MINIMUM)

TH = 0 NANOSECONDS (MAXIMUM)

TL = 25.00 MICROSECONDS @ 25 IPS
= 6.25 MICROSECONDS @ 100 IPS

Figure 4-1 Write Strobe Timing

4.2.3.2 Output Lines (F/C to STC- A)

4.2.3.2.1 Transport Status

REWINDING (IRWD-).

When true, this line indicates that the selected transport is in the process of rewinding to the BOT marker. IRWD- becomes false after repositioning of the BOT marker.

ON-LINE (IONL-).

When true, this line indicates that the selected transport is on line; it may or may not be IRDY- When IONL- is false IRDY- is false. IONL- is reset by the "rewind and unload" IRWU command line going true or by the control panel ON-LINE switch when the ON-LINE indicator is ON.

LOAD POINT (ILDP-).

Beginning-of-Tape status, when true, indicates that a logical or a physical beginning of tape reflective tab has been detected. Logical ILDP- indication is

If a REVERSE command is issued at ILDP – true, the command is terminated without tape motion and signals IFBSY- and IDBSY- go through a normal command sequence.

END-OF-TAPE (IEOT-).

When true, this signal indicates that the EOT marker is past the read/write head. IEOT- is reset by either a rewind command or by backing up over the EOT marker.

TAPE TRANSPORT READY (IRDY-).

When true, this signal indicates that the tape transport is not rewinding, off line, loading or unloading. When an unrecoverable hardware fault exists the tape transport goes off-line and not ready.

WRITE PERMIT RING (IFPT-).

This status command is true at all times when the tape is loaded. Write commands are prohibited and write electronics are disabled.

HIGH SPEED (ISPEED-).

When true, this signal indicates that the tape transport is in high speed - mode. This signal is latched in by the IGO- command strobe and IHISP- input line.

4.2.3.2.2 Control signals

FORMATTER BUSY (IFBSY-).

This signal is asserted one microsecond following the trailing edge of the command strobe IGO-; it goes false after command completion within the formatter (after the result of the command is transferred to the STC-A).

DATA BUSY (IDBSY-).

This signal goes true after all commands initiated by the command strobe IGO-. Commands can be sent to the F/C after the trailing edge of the IDBSY- signal before results of the previous command are available to the STC-A i.e. before the IFBSY- is false.

FILE MARK (IFMK-).

This line, when true, indicates that a file mark was detected on read-after-write or a read

operation prior to the IOBSY- going false. If the IFMK- is not detected in a file-mark write operation the tape should be backspaced and the command should be retried until successful or a predetermined try count is reached.

PE IDENTIFICATION BURST DETECTED (IDENT-).

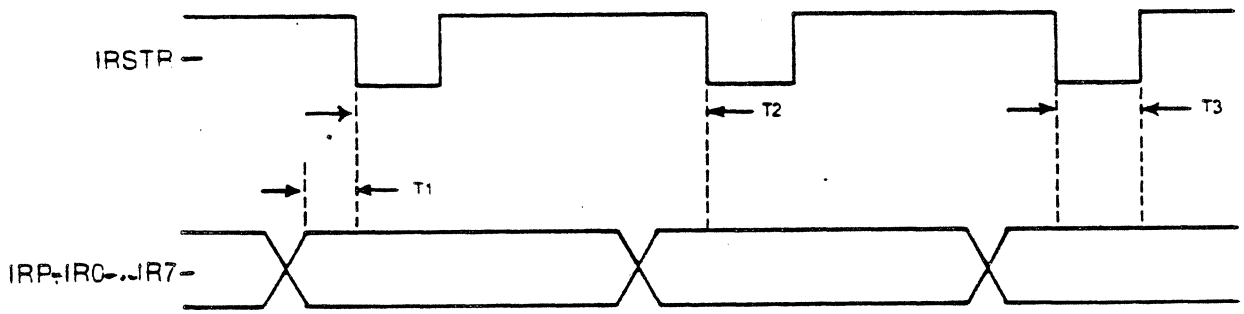
This signal is true when the F/C is reading or writing from the load point (ILOP-) and the PE identification burst is detected. IDENT- line is true after the trailing edge of ILOP-. When a write command is issued from the ILOP-, an ID burst of about 5 to 6 inches overlapping the BOT marker is generated. When a read command is issued from the ILOP-, the recorded ID burst is sampled. The ID burst consists of more than 80 character periods with only the parity channel recording ones and all other channels erased.

READ STROBE (IRSTR-).

This signal, nominally one microseconds long, is (data lines IRØ- through IR7- and IRP) used as a data strobe with data being latched on the trailing edge of the ISTRB- pulse. (Reference figure 4-

WRITE STROBE (IWSTR-).

The data presented on the IWØ through IW7 & IWP lines is strobed in on the trailing edge of the IWSTR- by the tape transport. (Reference figure 4-2)



T1 (MINIMUM) = 100 NANOSECONDS

T2 (MINIMUM) = 3.5 MICROSECONDS @ 100 IPS
= 14 MICROSECONDS @ 25 IPS

T2 (AVERAGE) = 6 MICROSECONDS @ 100 IPS
= 25 MICROSECONDS @ 25 IPS

T3 (NOMINAL) = 1 MICROSECOND

Figure 4-3 Read Strobe Timing

4.2.3.2.3 Error status lines.

HARDWARE ERROR (IHER)

When true, this signal indicates that an uncorrectable error has been detected on a write/read command before the IDBSY- goes false. Error conditions asserting this line include the following:

a. Multiple-track dropout

b. Uncorrectable parity error

c. Non-zero character in postamble

d. Excessive skew

e. Loss of data envelope after postamble detection.

CORRECTABLE ERROR (ICER-).

This signal occures when a signal/track dropout is detected and an error correction is in process before IDBSY- goes false. These signal pulses of 200 nanosecond to 10 microsecond duration have to be latched during IDBSY- to be sensed at the trailing edge of IDBSY-

4.2.3.2.4 Read Data lines

READ DATA BUS (IRØ- through IR7- and IRP-).

The nine data lines, including parity, must conform to timing constraints, see figure 4-3, relative to the read strobe IRSTR-. Parity is checked by the STC-A for all read commands.

4.2.3.3 Timing considerations

Typical examples of interface timing are shown in figures 4-4 and 4-5 for write and read operations respectively.

4.2.3.3.1 Write operation

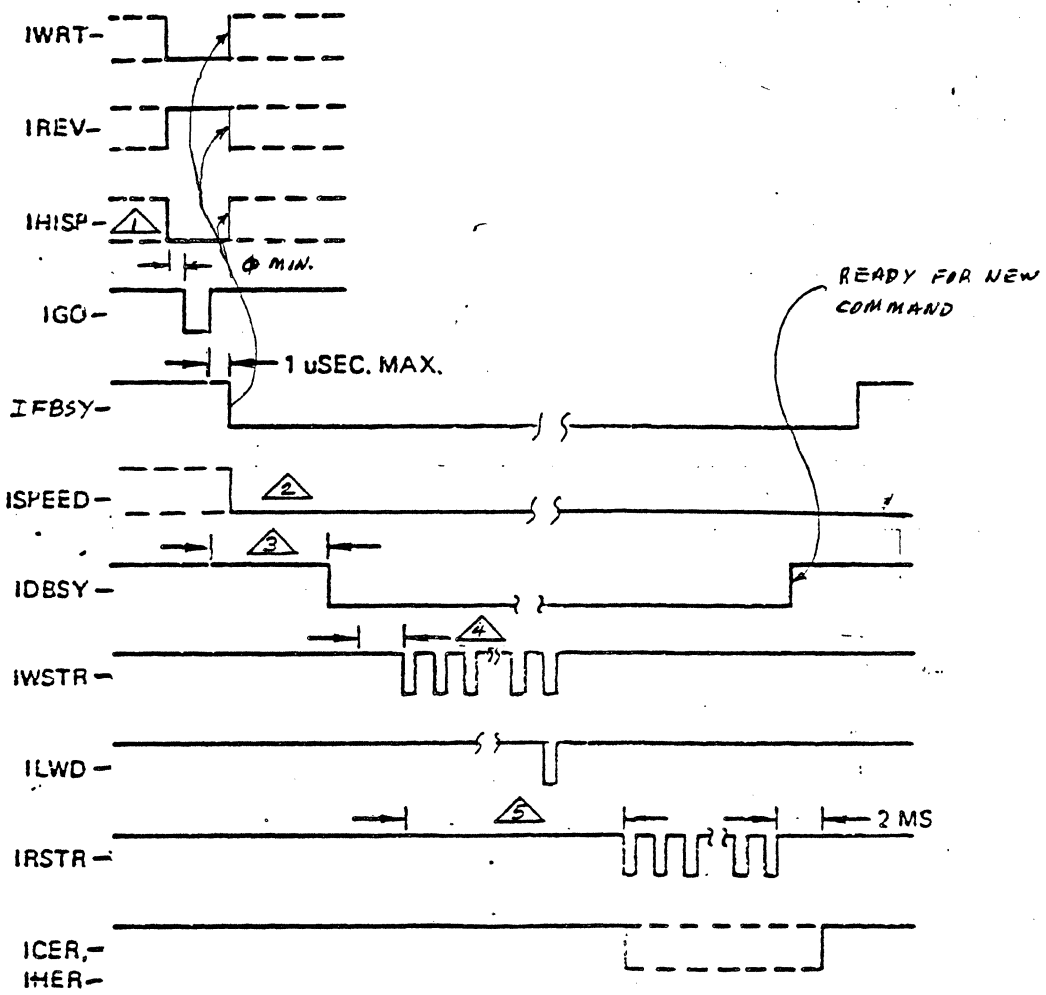
This operation is initiated by placing the tape transport address on IFAD-, ITADØ- and ITAD1- lines, the command on IREV-, IWRT-, IWFM-, IEDIT- and IERASE- lines and desired speed on IHISP- line before issuing the command strobe IGO- signal. All the above signals must remain stable until the Formatter Busy, IFBSY-, signal is asserted by the F/C indicating that the command has

been latched on the trailing edge of IGO-.

If write command is received when the tape is at BOT marker the transport writes the PE ID burst first and then asserts IDBSY-, data busy signal. The STC-A must interpret the IDBSY as a request for data in not less than 40 character intervals when the first write data strobe appears (IWSTR-). Data on the IW(X)- lines must be stable for at least 300 nanoseconds before the trailing edge of the IWSTR-. The trailing edge of the IWSTR- can also be used to trigger the next byte request in the STC-A.

The above procedure continues until the last data byte appears on the IW(X)- lines together with the last character pulse on the ILWD- line. IDBSY- becomes not true after the last character of read-after-write appears at the read head and the transport is ready to receive another command.

The STC-A ignores the read strobes (IRSTR-) and data on the IR(X)- lines during write operations.



Write Forward
Figure 4-4.

NOTES:

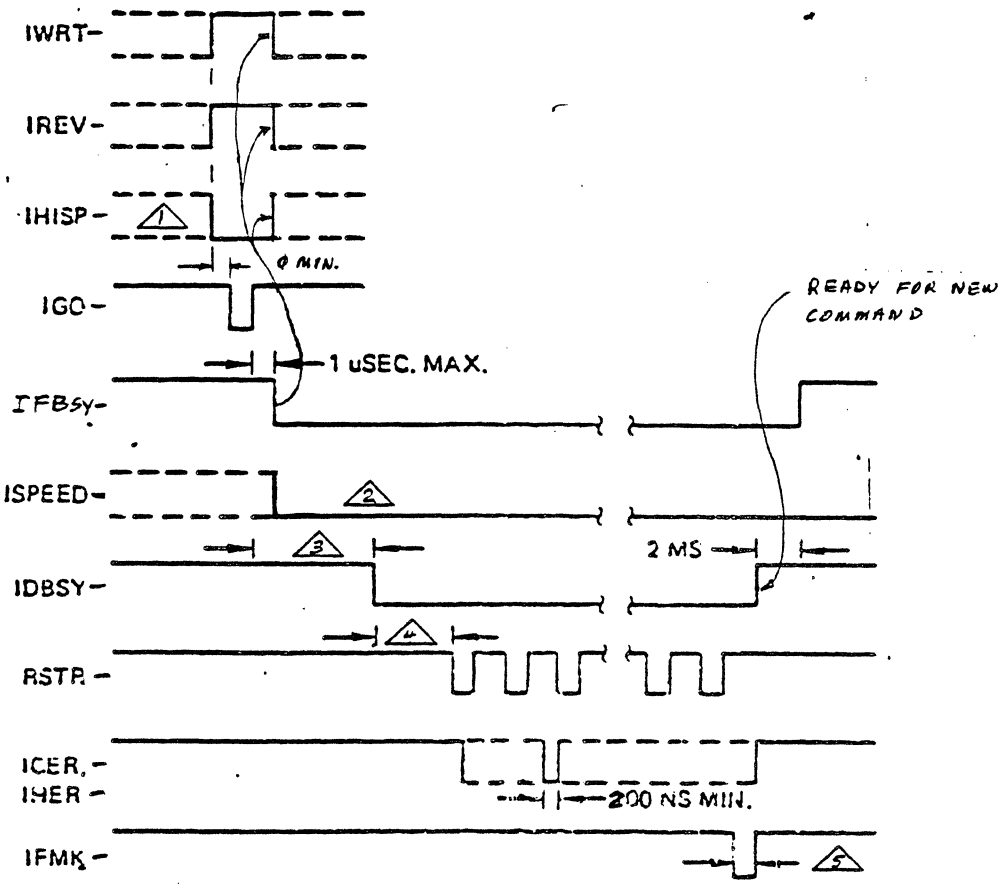
	SPEED	
	100 i.p.s.	25 i.p.s.
1	TRUE	FALSE
2	TRUE	FALSE
3	240MS	30MS
4	3 MS	2 MS
5	3 MS	12 MS

4.2.3.3.2 Read operation.

Initiation of a read command is begun by placing the address of a selected transport on IFAD-, IFAD4 and IFAD1- lines, the appropriate command on the IREV-, IWRT-, IWFM-, IEDIT- and IERASE- lines, the desired speed on the IHISP- line and then asserting the command strobe IGO- signal. The above lines must remain steady until the Formatter Busy, IFBSY-, is asserted by the F/C indicating that the command has been latched on the trailing edge of IGO-.

If a read command is received when the tape is at BOT marker the transport reads the PE ID burst first and asserts the status line, IDENT-. On receeipt of a read forward command 15 feet after the EC is detected the command is terminated by the transport.

Data busy, IDBSY-, is asserted on detection of a preamble and data strobe, IRSTR-, with data, IR(X), appears on the transport interface until a postamble



Read Forward
Figure 4-5.

NOTES:

	SPEED	
	100 i.p.s.	25 i.p.s.
1	TRUE	FALSE
2	TRUE	FALSE
3	240 MS	30 MS
4	3 MS	10 MS
5	1 MS	5 MS

is defected and IDBSY- becomes false. This indicates to the STC-A that the F/C is ready for another command.

4.2.3.3.3 Spacing operations.

Spacing operations, forward or reverse, are identical to read operations, except read strobes and error flags are not generated.

V

MEDIA AND INSTRUCTION FORMATS

5.1 MEDIA FORMAT

A detailed description of the media formats for the STC-MTS tapes is not presented here. Detailed information is available in the appropriate ANSI specification for the 1600 CPI Phase Encoded (PE), and the specification for unrecorded magnetic tape.

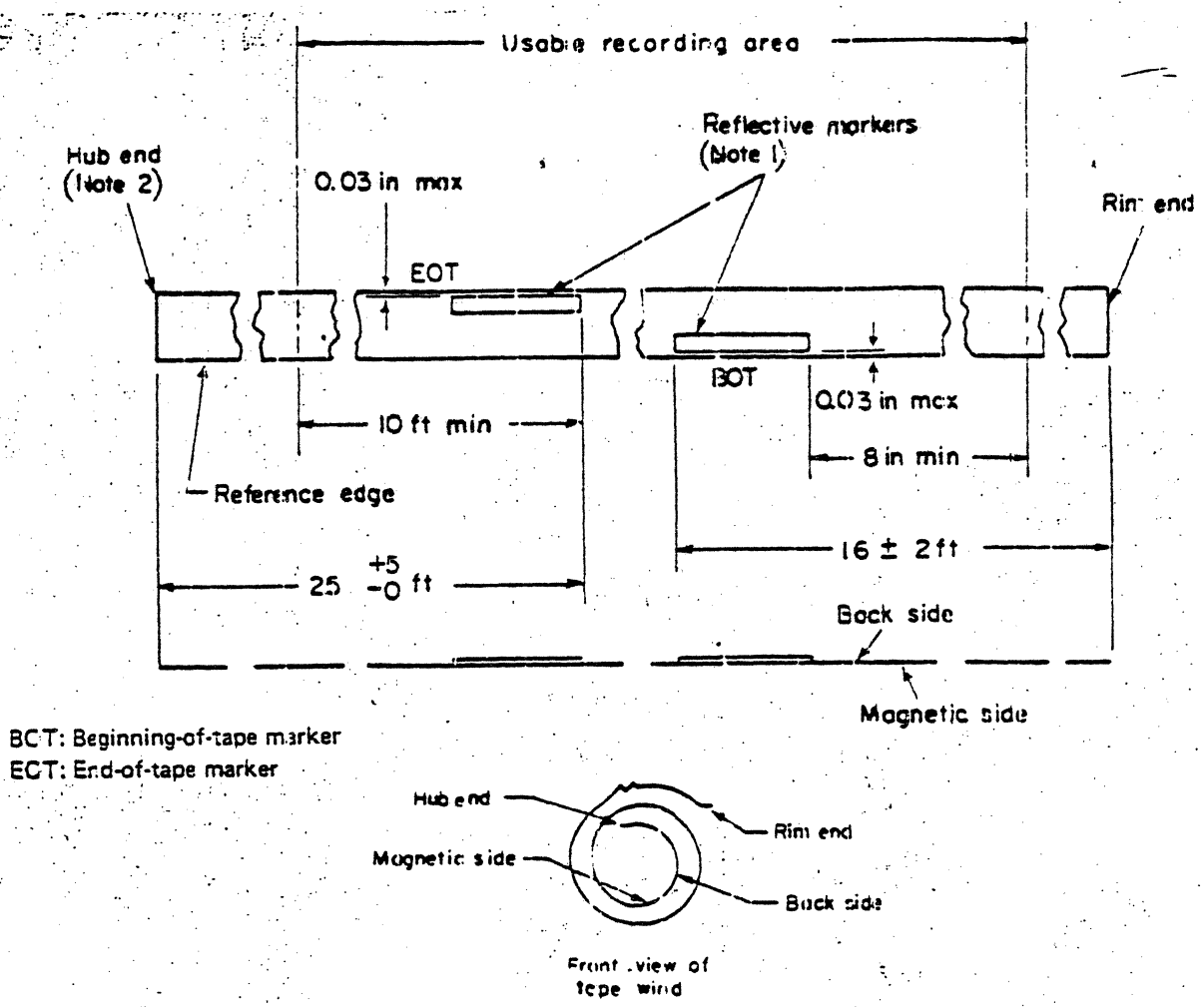
The following figures and tables illustrate the format and physical tape layout which the STC-MTS is capable of recording and reading.

5.1.1 1600 CPI Phase Encoded (PE) Recording

Figure 5-1 shows the orientation and layout of the usable recording area as defined by ANSI for 1600 CPI, PE tapes.

Figure 5-2 shows the orientation and layout of the recording format as defined by ANSI for 9-track and 1600 CPI, PE tapes.

All phase encoded data blocks contain a preamble, data, and postamble.

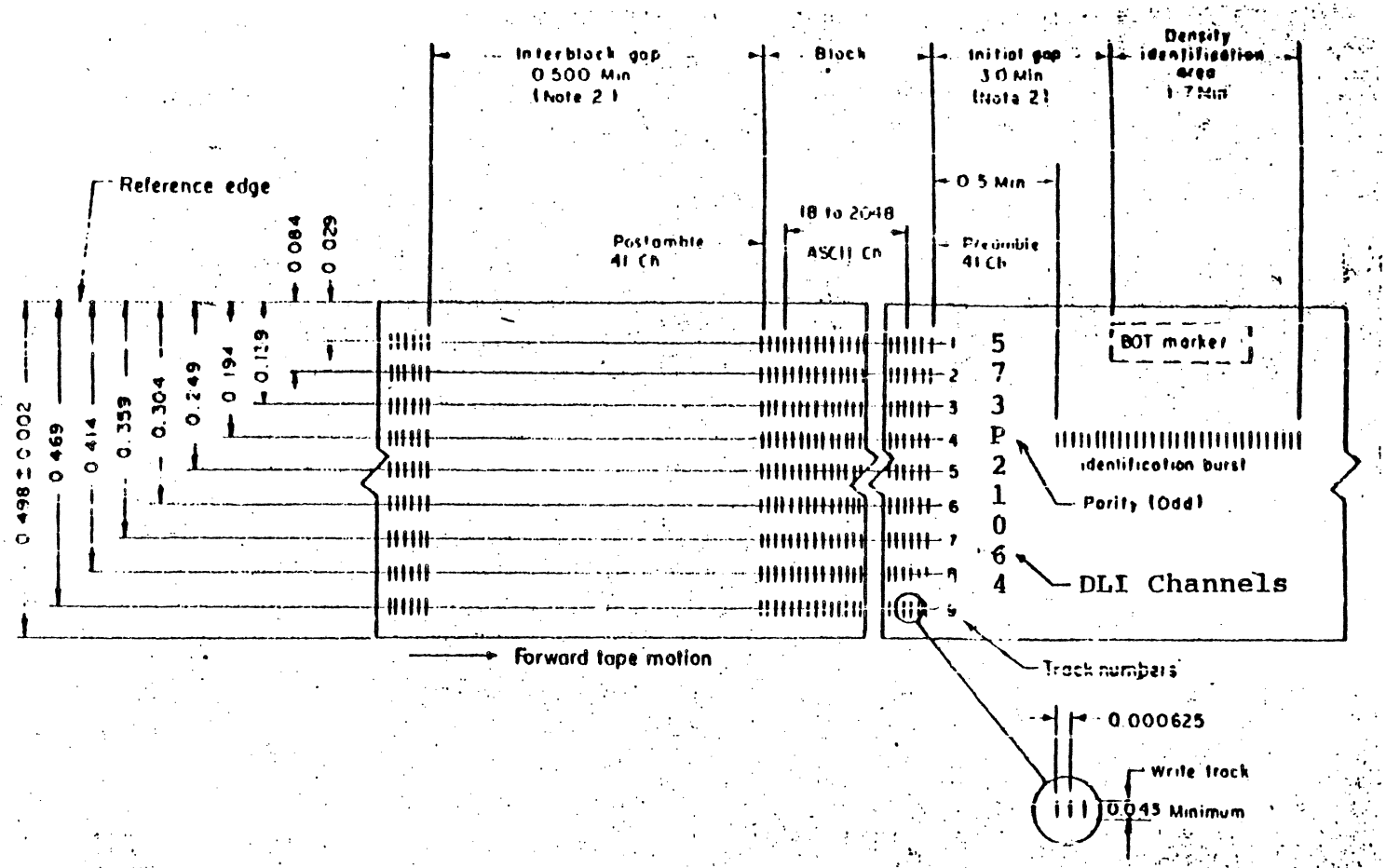


NOTES:

(1) Photoreflective markers shall not protrude beyond the edge of the tape and shall be free of wrinkles and excessive adhesive. Marker dimensions: length, 1.1 inch ± 0.2 inch; width, 0.19 inch ± 0.02 inch. thickness, 0.0008 inch maximum.

(2) Tape shall not be attached to the hub.

Figure 5-1 Usable Recording Area
(1600 CPI, PE)



Legend

BOT: Beginning of tape
Ch. Characters
CPI: Characters per inch
Min: Minimum

NOTES:

(1) Tape is shown with oxide side up, Read Write head on same side as oxide.
(2) Tape to be fully saturated in the erased direction in the interblock gap and the initial gap.
(3) The identification burst extends past the trailing edge of the BOT marker.
(4) All dimensions are given in inches.
(5) There is a track placement tolerance of ± 0.003 inch for each track.

Figure 5-2 Recording Format (1600 CPI)

Honeywell
HONEYWELL INFORMATION SYSTEMS

SPEC. NO. 60124092
SHEET 28
REV. A

5.2 INSTRUCTION FORMATS

Table 5-1 presents the instruction set which can be issued to the MPTC. The allowable forms of the Task Word instructions are given in subsection 5.2.5.

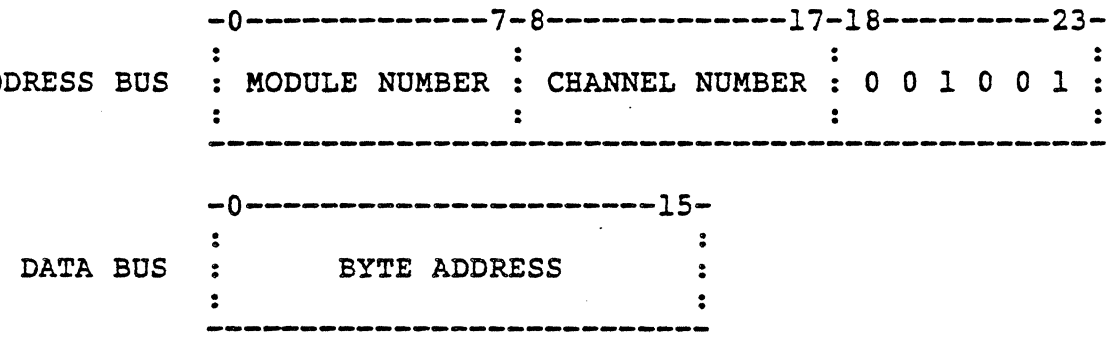
Table 5-1 Instruction Set

TYPE	FUNCTION CODE (Hex)	INSTRUCTION	SUBSECTION REFERENCE
Output	09	IOLD	5.2.1
		Address (09)	5.2.1.1
		Range (0D)	5.2.1.2
	11	Configuration Word A	5.2.2
	13	Configuration Word B	5.2.3
	03	Interrupt Control	5.2.4
	07	Task Word	5.2.5
	01	Control Word	5.2.6
Input	0C	Range	5.2.7
	08	Memory Byte Address	5.2.8
	0A	Memory Module Address/QLTI	5.2.9
	10	Configuration Word A	5.2.10
	12	Configuration Word B	5.2.11
	02	Interrupt Control	5.2.12
	26	Identification Code	5.2.13
	06	Task Word	5.2.14
	18	Status Word 1	5.2.15
	1A	Status Word 2	5.2.16
	04	Firmware Revision	5.2.17
	Any Even Code	Read RWS	5.2.18
	Any Odd Code	Write RWS	5.2.18

5.2.1 I/O Load (IOLD)

The I/O Load (IOLD) instruction is transformed by the CPU into the Output Address and Output Range instructions on the Megabus. Each IOLD instruction results in an Output Address instruction followed by an Output Range instruction.

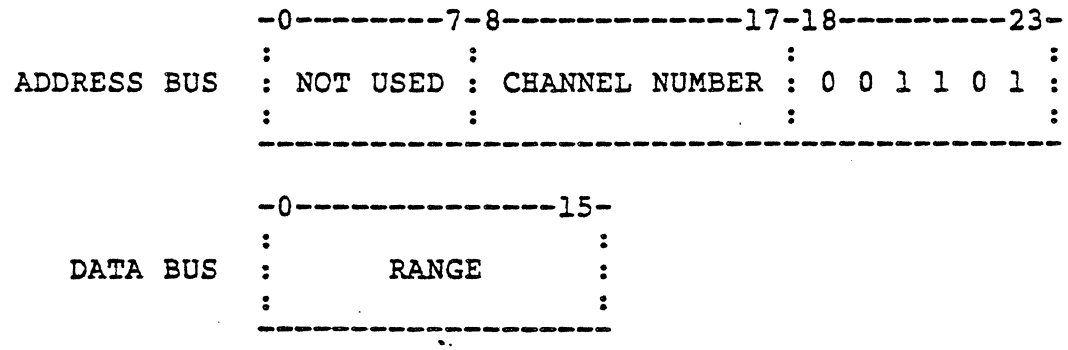
5.2.1.1 Output Address



This instruction loads a 24-bit address into the address register associated with the referenced channel (device). The address refers to the starting (byte) location in main memory where the MPTC commences input or output data transfers. Bits 0 through 7 of the address bus (module number) are the most significant bits of the address. The data bus contains the 16 least significant bits. Data transfers to or from memory are normally on a word basis but byte mode transfers can occur associated with the first and/or last memory cycle of a particular data transfer if the main memory buffer (identified by this instruction) begins or ends on an odd byte boundary.

Bit 17 of the address bus (direction bit of the channel number) determines the direction of any subsequent data transfer operation. A logical One specifies an output operation (writing on media) while a logical Zero specifies an input operation (reading from media).

5.2.1.2 Output Range

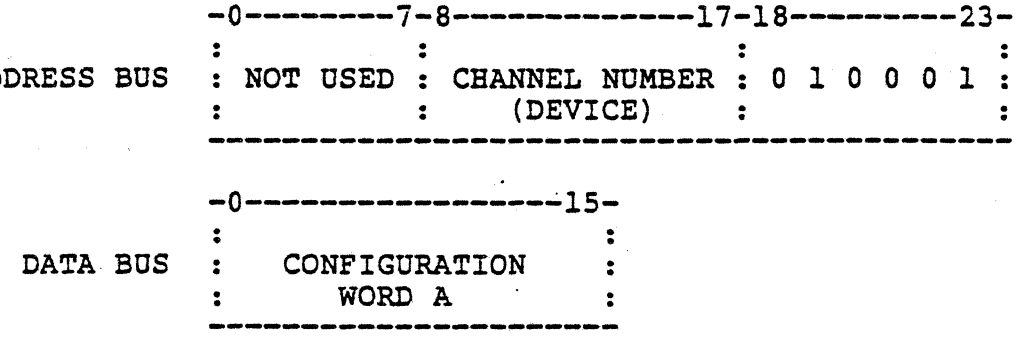


is instruction loads the range register associated with the referenced channel. The 16-bit quantity loaded (data bus) is the number of bytes to be transferred during the data transfer being set up. The number is a positive binary quantity (bit 0 must be Zero) and is decremented by the MPTC after each memory transfer.

A range of zero results in a subsequently issued read or write order setting the operation check bit of Status Word 1 (subsection 5.2.14.12), no data transfer, no tape motion initiated, and a termination of the order. Any address and range register residue is applied to the next command unless reset by another Output Range instruction.

5.2.2 Output Configuration Word A

REQUEST CYCLE



This instruction loads the Configuration Word A for the device/controller corresponding to the referenced channel. The configuration word bit significance is illustrated in Table 5-2 and defined as follows:

- Bit 0 - Recording Mode Select: Must be Zero.
- Bit 1 - 7/9 Track Select: Must Be Zero.
- Bit 2 - RFU: This bit is reserved for future use.
- Bit 3 - Parity Select: This bit selects either even or odd parity for the selected controller/device. The F/C interfaces only with 9-track tape drives; therefore, the normal setting of this bit is a Zero selecting odd parity.
- Bit 4 - Inhibit ANSI: This mode is used for diagnostic purpose only.
- Bit 5 - RFU: This bit is reserved for future use.
- Bit 6 - Normal/Diagnostic Mode Select: This bit is normally set to a Zero indicating that normal functionality is selected. The One state indicates that the controller selected is in a diagnostic mode. When this bit is set to a One for the F/C, the MPTC

preconditions the STC-A for Execute Diagnostic Command. This places the F/C in the diagnostic state for the Task Word that follows the Output Configuration Word instruction. Note that the F/C enters the diagnostic state for each Task Word issued where the diagnostic mode select bit (bit 6) of the Configuration Word is set to a One. The status information, available after execution of the Task Word in the diagnostic state, has specific meaning to the T&V software. Formatted tapes are not necessarily ANSI compatible.

- Bit 7 - RFU: Reserved for future use.
- Bit 8 - ~~Density Select~~ RFU: ~~This bit can be used to select one of two recording formats.~~ 0 - 1600 b.p.i. PE & 3,200 b.p.i. (non-compatible). 1 - 6250 b.p.i. GCR (future extension)
- Bits 9 through 15 - RFU, MBZ: These bits are reserved for future use and must be Zero for the subsystem specified.

5.2.3 Configuration Word B

REQUEST CYCLE

	0	7	8	17	18	23
ADDRESS BUS	NOT USED		CHANNEL NUMBER (DEVICE)		0 1 0 0 1 1	

	0	1	2	3	4	14	15
DATA BUS	REV	WRT	WFM	EDT	ERS	DEN	SPD

This instruction loads the Configuration Word B for the device/controller corresponding to the referenced channel. The bit significance is defined below. The command is to be used primarily for diagnostic purposes when exercising the Formatter/Controller and device Test & Diagnostic (T&D) procedure. For further information, refer to the OVP-supplied T&D procedure.

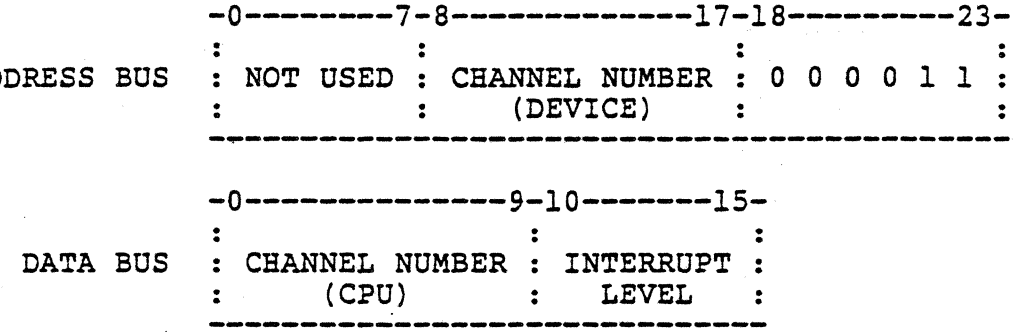
- Bits 0 through 4 define a diagnostic routine, DMS, to be performed by the tape transport as defined in section 4.2.3.1.2 in conjunction with the Execute Diagnostic Command (DMS equivalent) Task Word. Reference section 5.2.5.15.

VALID ONLY FOR WRITE RECORD AT BOT

- Bits 5 through 12 - RFU: Reserved for future use
- Bit 13 - DENSITY 0 = PE MODE; 1 = NRZI / GCR MODE
- Bit 14 - Density in PE mode only; IN NRZI / GCR MODE
  0 = NRZI (800 bpi)
  1 = GCR (6250 BPI)
  0 - 1600 b.p.i.
  1 - 3200 b.p.i.
  Selection of 3200 b.p.i. density implies a speed of 50 i.p.s.
- Bit 15 - Speed selection. 50
  0 - ~~25~~ i.p.s.
  1 - 100 i.p.s.

5.2.4 Output Interrupt Control

REQUEST CYCLE



This instruction loads, for the referenced device, the interrupt level and the channel number of the CPU to which subsequent interrupts should be sent. The level number is a 6-bit quantity positioned on the data bus as illustrated above. Bits 0 through 9 of the data bus contain the channel number of the CPU loading the interrupt level. If an interrupt level of zero is loaded, the subsystem will not generate or save interrupts for any events that occur while the interrupt level is zero. For example, if the attention bit in Status Word 1 is set to One with a stored interrupt level of zero, the subsystem will not generate an interrupt on the bus. The interrupt level is set to zero whenever the subsystem is initialized.

Table 5-~~2~~ Configuration Word A
Bit Significance

BIT	MPTC - (F/C) PE
0	0 (Must be Zero)
1	1 (Must be Zero)
2	RFU
3	Parity Select 0 = Odd Parity 1 = Even Parity
4	1 = Inhibit ANSI
5	RFU
6	Normal/Diagnostic Mode Select 0 = Normal Mode 1 = Diagnostic Mode
7	~~RFU~~ ~~Density Select 0 = 800 1 = 1600/6250~~ RFU
8	~~Density Select (Optional)~~ ~~1 = 6250 GCR 0r = 800 1600~~ ~~0 = 1600 PE & 3200 (PE non-compatible)~~ RFU
9 thru 15	RFU - Must be Zero

5.2.5 Output Task Word

REQUEST CYCLE

```
                -0--------7-8-----------17-18---------23-
                :         :              :              :
ADDRESS BUS     : NOT USED : CHANNEL NUMBER : 0 0 0 1 1 1 :
                :         :              :              :
                ----------------------------------------

                -0----------7-8---------15-
                :           :           :
DATA BUS        : COMMAND CODE : AS DEFINED :
                :           :           :
                ------------------------------
```

80	00	Rewind
C0	00	Rewind and Unload
08	NN	Forward Space Block(s)
04	NN	Back Space Block(s)
18	00	Forward Space Tape Mark
14	00	Back Space Tape Mark
09	NN	Read Forward
~~29~~	00	Security Erase to EOT
28	00	Erase Fixed Length
3A	00	Write Tape Mark
2B	00	Write
00	00	No Operation
00	9A	Loop Write-to-Read
00	9B	Execute Diagnostic Command
00	A0	Wraparound MPTC
00	A1	Adapter Wraparound

where N implies the nibble has specific meaning for the command (refer to command description).

This command outputs a Task Word to the referenced channel. The coding bits 0 through 15, illustrated above, represent the operations that are to be performed. When this command is accepted, the channel enters the busy state. All configurations, addresses, and range information must be loaded prior to execution of this command. The direction of data transfer indicated by the low-order bit of the most recent Output Address command (see subsection 5.2.1.1) must agree with the direction of transfer (read or write) specified by the command code of the Output Task Word. If it does not, operation check (Status Word 1, bit 11) is set and a normal termination of the command without data transfer and tape motion results. Commands addressed to a device not in the on-line state

result in the setting of an operation check bit (see subsection 5.2.14.12) prior to a normal termination of the order.

5.2.5.1 Rewind (8000)

This order rewinds the tape to the BOT marker. The drive remains in the busy state until the completion of the rewind operation. If the tape on the drive is at BOT when this order is issued, tape motion is not initiated and a normal termination of the order results. Note that the rewinding of a drive via the rewind button on the drive does not put the device in the busy state but activates rewinding (Status Word 2, bit 1) which affects the status of the device ready and attention bits of Status Word 1 (see subsection 5.2.14). When the manually initiated rewind is complete, the rewinding status condition is reset, device ready changes state, and the attention bit is set again.

5.2.5.2 Rewind and Unload (C000)

The rewind and unload order causes the addressed tape unit to rewind to BOT, remove the tape from the tape path, and rewind it completely onto the file reel.

If the tape on the drive is at BOT when this order is issued, only the unload sequence is initiated prior to termination of the order. The unload sequence puts the selected tape device into the off-line state and extinguishes the on-line indicator. Operator intervention is required to place the drive back in the on-line state.

5.2.5.3 Forward Space Block(s) (08NN)

This order causes the drive to space forward over the next n blocks. The order terminates when tape is positioned in the nth interblock gap. The number of blocks spaced over is a function of bits 8 through 15 of the Command Code (see subsection 5.2.5). These bits act as a counter with a range of 0 to 255_{10}. Note that a count of zero or one results in the spacing of one block.

5.2.5.4 Back Space Block(s) (04NN)

This order causes the drive to space back over the previous n blocks on tape. The order terminates when the tape is positioned in the nth previous interblock gap.

The number of blocks spaced over is a function of bits 8 through 15 of the command code (see subsection 5.2.5). These bits act as a counter with a range of 0 to 255_{10}. Note that a count of zero or one results in the spacing of one block. If this order is issued when the tape is positioned at BOT, tape motion is not initiated and the order is terminated; however, the tape's position beneath the read/write head will not be the same as that following the termination of a rewind operation. In order to place the tape

in the proper position beneath the heads following the termination of BOT of a reverse direction command (Back Space Block, Tape Mark), a Read Forward command followed by a Rewind command is necessary. This correction sequence needs to be implemented by software.

5.2.5.5 Forward Space Tape Mark (1800)

This order causes the drive to space forward over one or more blocks until a tape mark is detected. The order terminates when the tape is positioned in the interblock gap following the block containing a tape mark. If EOT is sensed while spacing, tape motion does not stop until a tape mark is detected. This results in the drive spacing off approximately 18 feet of tape beyond the EOT marker and then terminating the command - this is done to prevent the tape from running off the end of supply hub.

5.2.5.6 Back Space Tape Mark (1400)

This order causes the drive to space back over one or more blocks until a tape mark is detected. The order terminates when the tape is positioned in the interblock gap preceding the block containing the tape mark or when the tape is positioned at BOT. If this order is issued when the tape is positioned at BOT, tape motion is not initiated and a normal termination of the order follows; however, the tape's position beneath the read/write head will not be the same as that following the termination of a rewind operation. In order to place the tape in the proper position beneath the heads following the termination of BOT of a reverse direction command (Back Space Block, Back Space Tape Mark), a Read Forward command followed by a Rewind command is necessary. This correction sequence needs to be implemented by software.

5.2.5.7 Read Forward (09NN)

This order causes the drive to read forward over the next block on tape. The order terminates when the tape is positioned in the next interblock gap. The format of the data transferred from tape to memory is a function of the stored configuration word (see subsection 3.1.3). In addition to reading data, integrity checks are made (see subsections 5.2.14 and 5.2.15).

The STC-MTS also provides for the automatic retry of records where read errors occur. The retry capability is enabled when bits 8 through 15 of the command code (see subsection 5.2.5) are non-Zero. This field (bits 8 through 15) acts as a retry counter with a range of 0 to 255_{10}. Upon successful retry, Corrected Media Error (Status Word 1, bit 4) and Retry Attempted (Status Word 2, bit 9) are set in the terminating status. Retryable Media Error (Status Word 1, bit 2) is set if the retry mechanism was unsuccessful or a read error occurred and the retry counter was Zero.

5.2.5.8. Security Erase (2900)

This order causes the drive to erase tape in the forward direction from where the erase head is positioned to 5 feet beyond the EOT marker. The REWIND command can be given without waiting for Security Erase to complete. Rewind will be initiated after the Security Erase completes with proper status conditions indicated.

5.2.5.9 Erase (2800)

This order causes the drive to erase tape in the forward direction producing a 4-inch gap on the tape. The device channel remains busy for the duration of the erase order and terminates normally.

5.2.5.10 Write Tape Mark (3A00)

This order causes the addressed tape unit to move tape in the forward direction, execute an Erase, and write a tape mark identifier appropriate to the recording mode in effect at the time the command is issued. No data is transferred during the write portion of the command. The channel remains busy for the duration of the command. During the entire write operation, the read detection circuitry verifies that a complete erasure has occurred and that the tape mark written is correct. The order terminates when the tape is positioned in the gap beyond the tape mark block.

5.2.5.11 Write (2B00)

This order causes the drive to write, in the forward direction, a data block of the format specified by the configuration word (see subsection 5.2.2) most recently issued to this addressed channel.

Nondata characters used for synchronization and error checking are recorded on tape;the generation of all such characters is an F/C function. The block that is written on tape is checked for validity as it passes under the read head.

The order terminates when the tape is positioned in the gap beyond the data block written. An attempt to write a data block to a drive in write-protect (see subsection 5.2.15.3) results in no data transfer, no tape motion initiated, and the activation of the Operation Check bit of Status Word 1 (see subsection 5.2.14.12).

5.2.5.12 No Operation (0000)

This order results in no data transfer, no tape motion initiated, the normal reset of status word bits upon reception of an Output Task command, and a normal termination of the order. However, this order is NAKed if the channel is busy. It should be noted that any status information within the F/C is unaltered by this order.

5.2.5.13 Loop Write-to-Read (009A)

When issued to the F/C, the order is translated into the Loop Write-to-Read command which provides a means of checking the read/write data paths inside the F/C for proper operation. A normal write command is simulated and the F/C loops the information presented to the write bus back to the read bus and through most of the read data path. There is no tape motion. The loop write-to-read path does not include the tape drive.

All loop write-to-read operations are performed in the recording mode and data rate of the selected tape unit.

5.2.5.14 Execute Diagnostic Command (009B)

For a description of this command, refer to subsection 5.2.2. and 4.2.3.1.2 with Table 4-2 Diagnostic Test Codes. The Execute Diagnostic Command is translated by the STC-A into the Diagnostic Mode Set command to the tape transport which must be followed within one second with one of the commands described in Table 4-2 and available in the MSB of Configuration Word B. Diagnostics performed by the tape transport are described in the F880 Microstreamer Device Manual; briefly the test are:

CSE - Cycle Servos (Test 22).

During this test the drive cycles tape in both forward and reverse directions while alternating speed between 25 and 100 ips. The front panel displays the maximum tension arm motion sensed during operation.

RLM - Read Logic Margin (Test 11).

This test enables both supply and takeup servo circuits, sequencing both reel hubs clockwise and counterclockwise. Press the LOAD switch to activate the high-voltage rail drivers Q5 and Q6 (Sheet 4 of drawing 360101-314), and current limit the servos to 1 ampere. Press the UNLOAD switch to deactivate Q5 and Q6 and enable maximum current limit.

RMT - Reset Margin Test (Test 12)

This test activates and deactivates the write circuitry to allow troubleshooting of the circuit with no tape loaded on the transport. To simulate a 100-ips data rate, press the LOAD switch. Actuation of the UNLOAD switch will select the 25-ips data rate. If the ILWD interface line is grounded, a 1-character pattern is written, including preamble and postamble.

(or with tape loaded if loss of data can be tolerated)

CMT - Circuit Margin Test (Test 13)

This test performs the same functions as Test 12, except the file-mark circuits are exercised.

EXS - Extended Status

64 This order provides the capability of inputting to software ~~128 bytes of~~ detail status. The status information is stored in the starting memory location specified by the IOLD (see subsection 5.2.1). If the Range register specifies less than 128 bytes data transfer continues until the range register is zero.

If the Range register specifies more than 128 bytes, data transfers continue until the range decrements by 128 at which point the command is terminated and residual range can be read from the Range register.

128 detail status bytes are associated with the F/C. To retrieve the first status byte from the controller, the Range register should be set to read one byte.

Normal tape operations do not require the inputting of detail status since sufficient information is available in Status Words 1 and 2 (see subsections 5.2.14 and 5.2.15). Detail status information is provided primarily for diagnostic visibility.

For further information, refer to subsection 4.2.3.1.2 and Table 4-3.

CAUTION

Extended Status retrieves the state of a device after the last task. Any state changes during the status command are not indicated or retained. New status conditions are again available after initialize, another device state change or another functional task command when the Extended Status command is no longer active.

5.2.5.15 Wraparound MPTC (00A0)

The wraparound level is at the MPTC level. Functionality is as described in the following paragraphs. The direction of data transfer (read or write) is determined by the low-order bit of the channel number of the most recent Output Address command.

During a Wraparound Write command, the channel reads one to eight words from memory (at the address specified in the subsystem's memory address register) and transfer them to the MPTC FIFO buffer.

When a Wraparound Read command is received (immediately following a Wraparound Write), the bytes previously loaded into the specified FIFO buffer by the previous Wraparound Write command are returned to main memory at the address specified in the subsystem's memory address register. The bytes returned during this operation are the same as the bytes supplied by software in the preceding Wraparound Write command. The range specified for the Wraparound Write must be the same as the range for the Wraparound Read or the results are unpredictable.

A range of one to eight words must be specified for these commands. If a range of zero is selected, the command is immediately terminated (without being executed and with no status indications). If a range greater than eight words is selected, the results are unpredictable. In any case, the Wraparound Write and its associated Wraparound Read must start and end from the same memory boundary (byte or word).

A Task instruction issued to any other channel during a wraparound sequence is ignored.

5.2.5.16 Wraparound STC-A (00A1)

The wraparound level is at the STC-A level. Functionality is as described in the following paragraphs. The direction of data transfer (read or write) is determined by the low-order bit of the channel number of the most recent Output Address command.

During a Wraparound Write command, the channel reads 16 words from memory (at the address specified in the subsystem's memory address register) and transfer them to the STC-A FIFO buffer.

When a Wraparound Read command is received (immediately following a Wraparound Write), the bytes previously loaded into the specified FIFO buffer by the previous Wraparound Write command are returned to main memory at the address specified in the subsystem's memory address register. The bytes returned during this operation are the same as the bytes supplied by software in the preceding Wraparound Write command. The range specified for the Wraparound Write must be the same as the range for the Wraparound Read or the results are unpredictable.

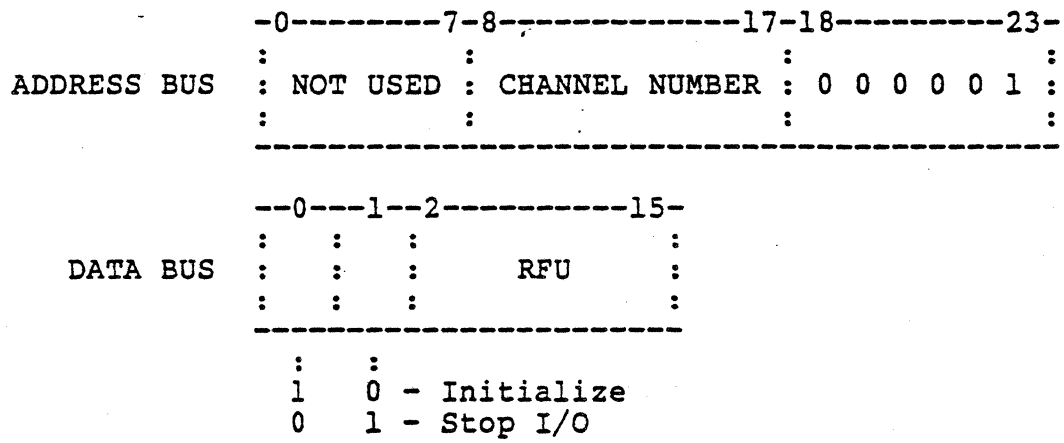
A range of 16 words must be specified for these commands. If a range of zero is selected, the command is immediately terminated (without being executed and with no status indications). If a range other than 16 words is selected, the results are unpredictable. In any case, the Wraparound Write and its associated Wraparound Read must start and end from the same memory boundary (byte or word).

A Task instruction issued to any other channel during a wraparound sequence is ignored.

5.2.5.17 Unspecified Operations

All Output Task commands issued to the MPTC/STC-A, other than those specified above, will result in unspecified operations.

5.2.6 Output Control Word



This instruction loads a control word into the referenced channel. This command is unconditionally accepted by the channel regardless of its busy status except as noted in subsection 3.1.2.

5.2.6.1 Initialize

This command causes the MPTC to reset to the same state that it enters after power up. When an Initialize command is received by the MPTC, all of its channels are initialized (regardless of which channel the command was received over).

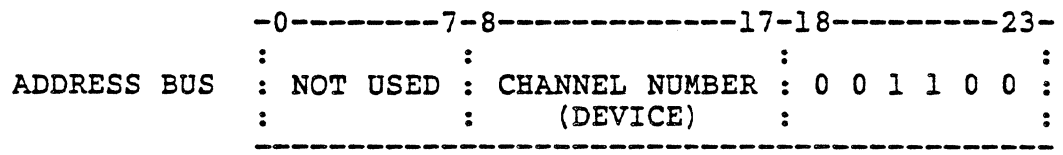
Operations in progress in the MPTC at the time of the initialization are abruptly terminated and all software addressable registers are initialized with the exception of the code conversion tables. These tables require a power-on initialize to be affected. No information about the terminated operations is retained and no interrupts for the operations are generated. The interrupt level for all channels is set to zero (interrupts blocked).

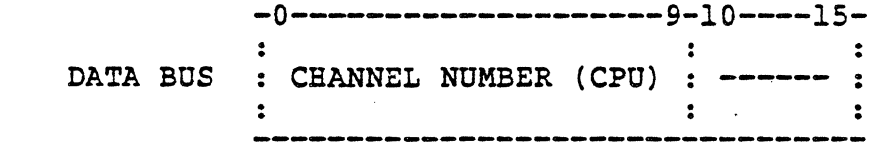
5.2.6.2 Stop I/O

This command causes any operation currently active on the specified channel to be abruptly terminated. If a data transfer operation is in progress, it is not completed nor is any error checking done. An interrupt is generated for the operation terminated by this command as if the operation had come to a normal ending point. Status, address, and range information, present in the MPTC when this command is received, are retained.

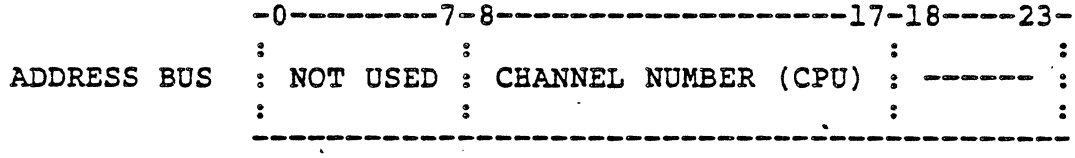
5.2.7 Input Range

REQUEST CYCLE





RESPONSE CYCLE



This instruction causes the current contents of the referenced channel's range register to be transferred to the requesting channel.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the instruction cycle. After the completion of a read operation, the contents of the range register reflects the status of that transfer with respect to the physical block read.

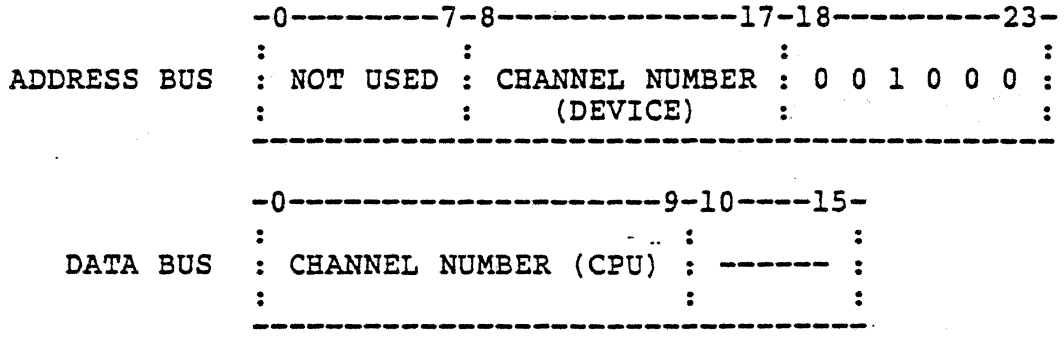
- If the contents is a positive value greater than zero and bit 8 of Status Word 1, Unequal Length Check (see subsection 5.2.14.9) is set to a logical One, the length of the physical block is less than the range.

- If the contents is zero and bit 8 of Status Word 1 is equal to One, the length of the physical block is greater than the original range.

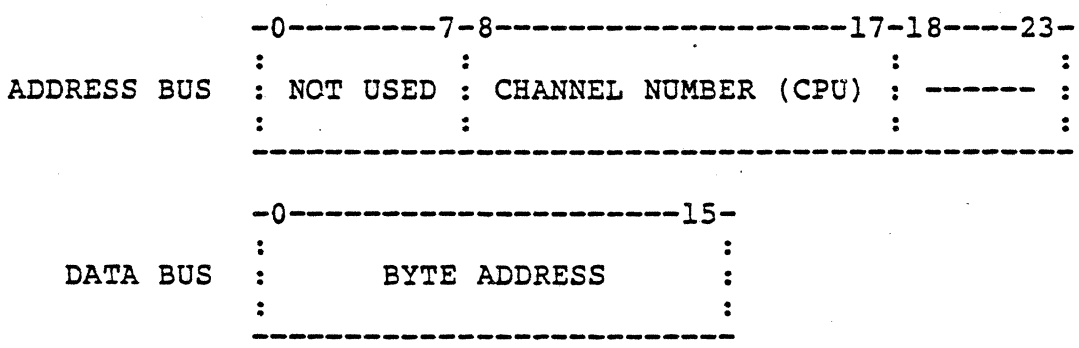
- If the contents is zero and bit 8 of Status Word 1 is equal to Zero, the length of the physical block is equal to the original range.

5.2.8 Input Memory Byte Address

REQUEST CYCLE



RESPONSE CYCLE



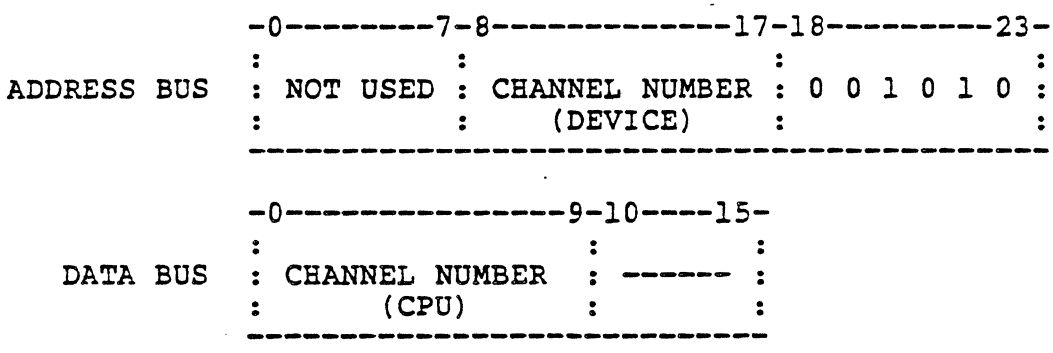
This instruction causes the current contents of the referenced channel's memory byte address to be transferred to the requesting channel.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle. The data bus contains the low-order 16 bits of the

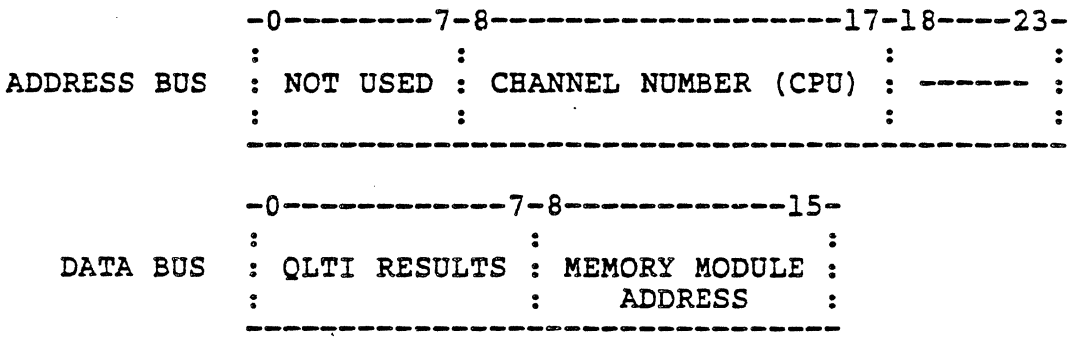
memory byte address currently stored for the specified channel in the MPTC. Note that if a Write command ended at a byte boundary (high-order 8 bits of word), the memory address reflects the next word (not the low-order 8 bits of the previous word).

5.2.9 Input Module Address/QLTI Results

REQUEST CYCLE



RESPONSE CYCLE

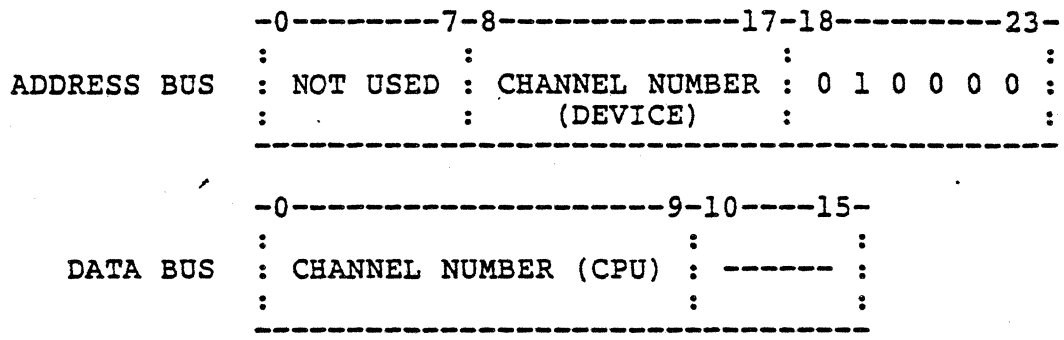


This instruction causes the current contents of the referenced channel's memory module address and QLTI register to be transferred to the requesting channel.

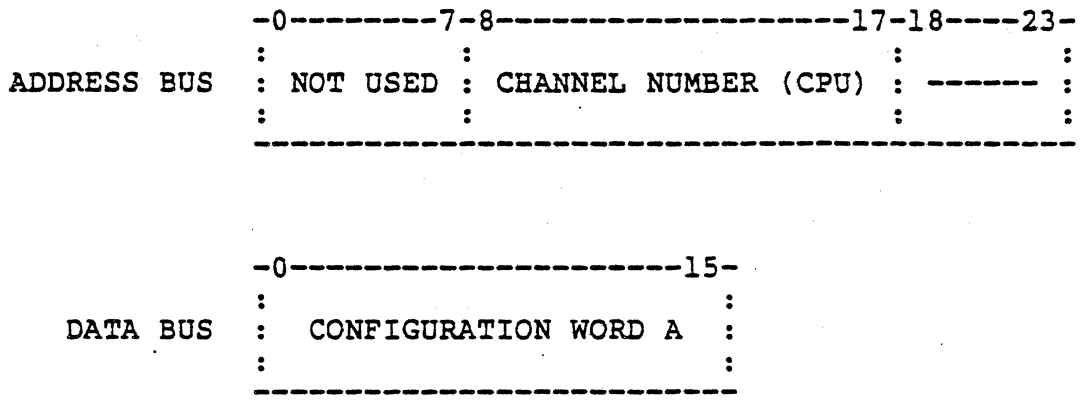
During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle. The data bus contains the high-order 8 bits of the memory word address currently stored for the specified channel in the MPTC. This command is used for diagnostic purposes only. For the QLTI explanation, refer to subsection 8.3.3, Maintainability Features.

5.2.10 Input Configuration Word A

REQUEST CYCLE



RESPONSE CYCLE



This instruction causes the current contents of the referenced channel's configuration word A register to be transferred to the requesting channel.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the instruction cycle.

5.2.11 Input Configuration Word B

REQUEST CYCLE

	0	7	8	17	18	23
ADDRESS BUS	NOT USED		CHANNEL NUMBER (DEVICE)		0 1 0 0 0 0	

	0	9	10	15
DATA BUS	CHANNEL NUMBER (CPU)		------	

RESPONSE CYCLE

	0	7	8	17	18	23
ADDRESS BUS	NOT USED		CHANNEL NUMBER (CPU)		------	

	0	1	2	3	4	5	13	14	15
DATA BUS	REV	WRT	WFM	EDT	ERS	RFU		DEN	SPD

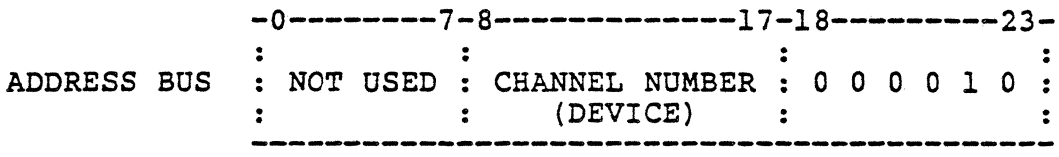
This instruction causes the current contents of the referenced channel's configuration word B register to be transferred to the requesting channel.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the instruction cycle.

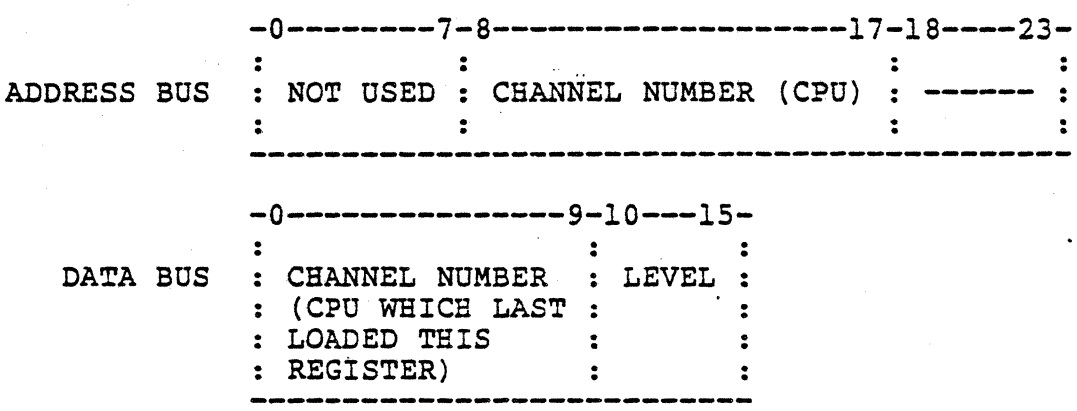
The bit significance is defined in section 5.2.3 intended for diagnostic and maintenance purposes.

5.2.12 Input Interrupt Control

REQUEST CYCLE



RESPONSE CYCLE



This instruction causes the channel's interrupt level to be transferred to the requesting channel. The level value is placed on data bus bits 10 through 15 (see above) with bit 15 as the least significant bit. This quantity is the value previously received in an Output Interrupt Control instruction or a default value of 00. The default value is the interrupt level assumed by the channel when initialized. Note that the channel number returned in bits 0 through 9 of the data bus may be different than the channel number of the CPU executing this instruction if more than one CPU is attached to the Megabus.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle.

5.2.13 Input Identification Code

REQUEST CYCLE

	0-7	8-17	18-23
ADDRESS BUS	NOT USED	CHANNEL NUMBER (DEVICE)	1 0 0 1 1 0

	0-9	10-15
DATA BUS	CHANNEL NUMBER (CPU)	------

RESPONSE CYCLE

	0-7	8-17	18-23
ADDRESS BUS	NOT USED	CHANNEL NUMBER (CPU)	------

	0-7	8-15
DATA BUS	20_{16}	WWXY YYZZ

i.e.:

2048	25/100
2049	25/50/100 } PE Streamer
2058	RFU
2059	RFU
205A	75 ips
205B	125 ips
205F	Unloaded device

This instruction causes the referenced channel to transfer its identification code to the requesting channel. The codes for each type of tape controller attached to the MPTC are:

- Bits 0-7 = 20_{16} - Identifies PE/GCR tape subsystem
- Bits 8-9 = WW - Identifies controller type attached to MPTC:
  - 00 - RFU
  - 01 - F/C (GCR/PE drives)
  - 10 - RFU
  - 11 - RFU
- Bit 10 = X - 0-(9 track) and 1-(7 track)
- Bits 11-13 = YYY - Identifies tape densities which the channel can accommodate:
  - 100 - 6250 CPI (GCR)
  - 010 - 1600/3200 (PE)
  - 001 - 800 CPI (NRZI)

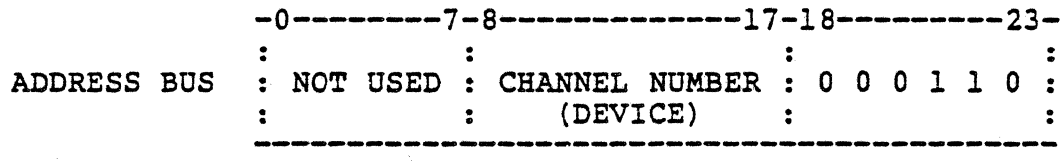
- Bits 14-15 = ZZ - Tape Speeds:

  00 - 25/100 i.p.s.
  01 - 25/50/100 i.p.s.
  10 - 75 ips
  11 - 125 ips

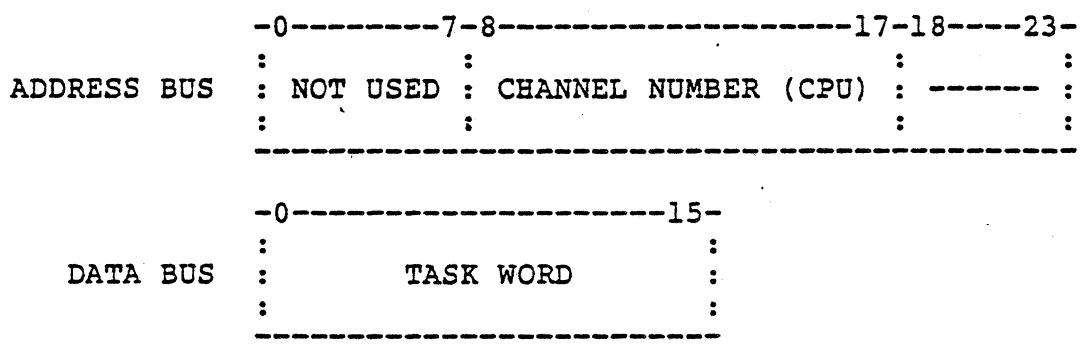
During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle.

5.2.14 Input Task Word

REQUEST CYCLE



RESPONSE CYCLE

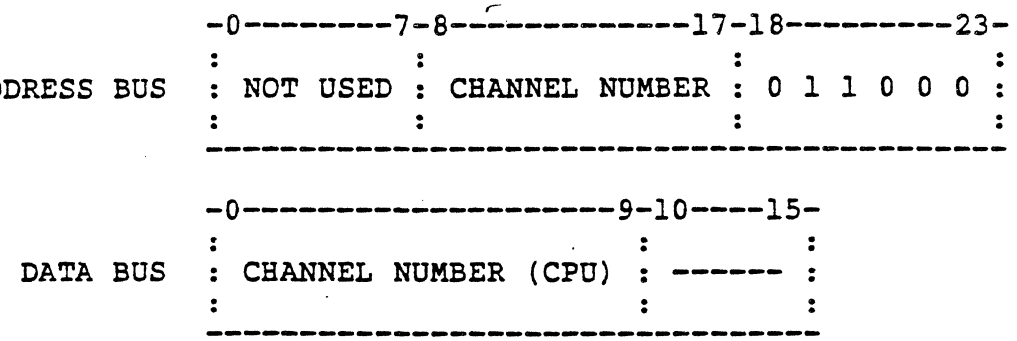


This instruction causes the task word of the referenced channel to be transferred to the requesting channel. The task word transferred contains the code for the last operation executed by the channel (unless an initialize has occurred).

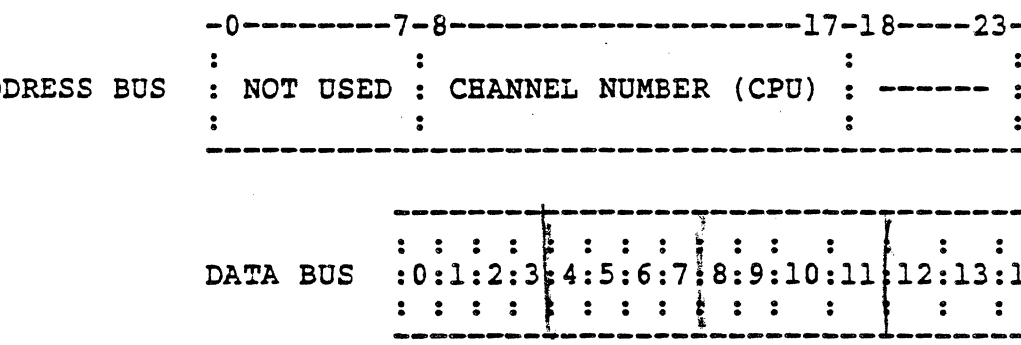
During the response cycle (second-half read) the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle.

5.2.15 Input Status Word 1

REQUEST CYCLE



RESPONSE CYCLE



0	Device Ready
1	Attention
2	Retryable Media Error
3	Subsystem Fault
4	Corrected Media Error
5	Tape Mark Detected
6	BOT
7	EOT
8	Unequal Length Check
9	Nonretryable Error
10	RFU - MBZ
11	Operation Check
12	Corrected Memory Error
13	Nonexistent Resource Error
14	Bus Parity Error
15	Uncorrected Memory Error

S+S1

S+S2

This command causes the referenced channel's Status Word 1 to be transferred to the requesting channel.

During the response cycle (second-half read), the MPTC returns in bits 8 through 23 of the address bus the same data that was received in bits 0 through 15 of the data bus during the request cycle.

5.2.15.1 Device Ready (Bit 0)

This bit indicates that the device is on-line with the medium loaded, is not rewinding, and that no further manual intervention is required to place it under program control. This bit is Zero if either Status Word 2, bit 0 is a Zero or Status Word 2, bit 1 is a One. Note that a change of state of this bit causes the attention bit (bit 1) to be set resulting in an interrupt (if the interrupt level is not zero).

5.2.15.2 Attention (Bit 1)

This bit indicates that an event has occurred at the device which requires software action. This event, moreover, was not related to a current task but, rather, was unsolicited. This bit is set whenever the device changes its ready condition as a result of a nonsoftware initiated command; that is, entering or leaving the on-line state, rewinding state, or media loaded state. Attention status may occur following a software initiated Stop I/O or Initialize command if the device was performing a Rewind or Rewind and Unload instruction.

Whenever the attention bit is set, an interrupt is attempted (if the interrupt level is not zero). If a previously initiated operation is in progress when a device state change is sensed, the resultant interrupt (with the attention bit set) serves as notification of both the end of the operation and the device state change.

This bit is reset by an Initialize (see subsection 5.2.6.1) or Input Status Word 1 command.

5.2.15.3 Retryable Media Error (Bit 2)

This bit indicates that a data error has occurred and is set whenever Status Word 2, bits 4, 5, 6 (conditional), or 7 are active.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.4 Subsystem Fault (Bit 3)

This bit indicates that the MPTC/STC-A has detected a controller type fault (F/C or MTU) which cannot be associated with a particular tape drive. Software treats this error as if the entire subsystem (that is, F/C and its attached tape drives) is down and requires maintenance action. The cause of this fault is indicated in Status Word 2, bits 12, 13, and 14.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.5 Corrected Media Error (Bit 4)

This bit indicates that an error condition was detected on the media; however, the data read is not lost. For this subsystem, the detected condition indicates that a single track error has been corrected during a PE operation.

This bit is also set when a read retry by the MPTC/STC-A was successful.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.6 Tape Mark (Bit 5)

This bit indicates that a tape mark has been detected during the execution of a Write Tape Mark, Forward Space Tape Mark or a Back Space Tape Mark order. This status bit is also active if the block encountered during execution of a forward/backspace/read block instruction is a tape mark.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.7 BOT (Beginning-of-Tape) (Bit 6)

This bit indicates that the BOT marker is positioned at the BOT sensor. A backspace or rewind order issued to a device with its tape at BOT results in no tape motion initiated and a normal termination of the order.

5.2.15.8 EOT (End-of-Tape) (Bit 7)

This bit indicates that the EOT marker is positioned at or has passed beyond the EOT sensor. This status bit remains active until the EOT marker passes back over the sensor as the result of a tape backward motion command (for example, backspace or rewind). The state of this status bit has no effect on forward motion commands.

5.2.15.9 Unequal Length Check (Bit 8)

This bit indicates that for the previous read operation, the physical block was either greater or less than the value in the range register at the beginning of the read operation. If this bit is One and there is a residue in the range register, a short block was transferred. If this bit is active and the range register contents is zero, a long block was transferred.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.10 Nonretryable Error (Bit 9)

This bit indicates that the position of tape under the read/write and erase heads is unknown. This bit is set when:

- A write order RAW failure occurs; that is, the detection of magnetic transitions on tape before the start or following the completion of a recorded data block, the failure to detect magnetic transitions in the area where a data block is being written, or the failure to detect a PE density identification area on tape when writing a PE tape, respectively (Status Word 2, bit 8 is set).
- An erase order RAW failure occurs; that is, the detection of magnetic transitions in the area on tape being erased.
- During a read order, a split block is detected (a split block is a data block in which its beginning and end positions cannot be guaranteed because of a detected unrecorded area within the block).

This status bit also becomes active when Status Word 2, bit 15 (Data Check Error) is set.

This bit is reset by an Initialize or Output Task Word command except by Sense Drive Status, NOP and Store Detail Status Tasks.

5.2.15.11 RFU-MBZ (Bit 10)

This bit is reserved for future use and must be Zero for the subsystem specified herein.

5.2.15.12 Operation Check (Bit 11)

This bit indicates that:

- A write type order (write, write tape mark, erase) was issued to a tape drive in the write protect state (see Status Word 2, bit 2).
- Upon acceptance of an output task word data transfer command, the direction of data transfer is not the same as that specified by the direction bit of the channel number issued by the previous Output Address command.
- Upon acceptance of an output task word data transfer command, the contents of the range register is Zero (write only or range is less than 18 on write if ANSI override is present).
- A command was issued to a channel on which the device is in the off-line or not ready state.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.13 Corrected Memory Error (Bit 12)

This bit indicates that during execution of the previous operation, main memory detected and corrected a memory read error. The data delivered to the MPTC/STC-A was assumed to be correct.

This bit is reset by an Initialize or Output Task Word command.

5.2.15.14 Nonexistent Resource Error (Bit 13)

This bit is set whenever the MPTC/STC-A attempts a write or read request bus cycle and receives a NAK response. Occurrence of this condition does not cause a termination of the operation in progress; however, it may result in bad data being written on the medium.

This bit is reset by an Initialize, Input Status Word 1, or Output Task Word command.

5.2.15.15 Bus Parity Error (Bit 14)

This bit is set whenever the MPTC/STC-A detects a parity error on either byte of the data bus during any output bus cycle (that is, odd function code), during a second half memory read cycle, or when a parity error is detected in bits 0 through 7 of the address bus during an Output Address command. Occurrence of this condition does not cause a termination of the operation in process; however, it may result in bad data being written on the medium.

This bit also indicates that the write/read data bus has detected an even parity data byte during a data transfer. On write operations, assertion of this line indicates that the data written on tape is incorrect; on read operations, assertion of this line indicates either an uncorrectable read error or an internal malfunction of the tape read data processing subsystem.

This bit is reset by an Initialize or (error-free) Input Status Word 1 command.

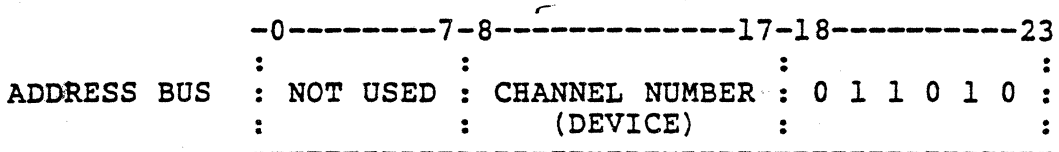
5.2.15.16 Noncorrectable Memory Error (Bit 15)

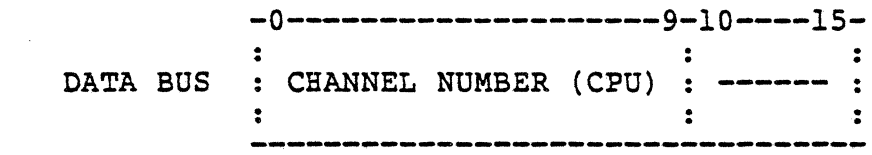
This bit indicates that during execution of the previous operation, the main memory detected a memory read error which the EDAC algorithm could not correct. The data that was delivered to the MPTC/STC-A was incorrect. Occurrence of this condition does not cause a termination of the operation in progress; however, it may result in bad data being written on the medium.

This bit is reset by an Initialize or Output Task Word command.

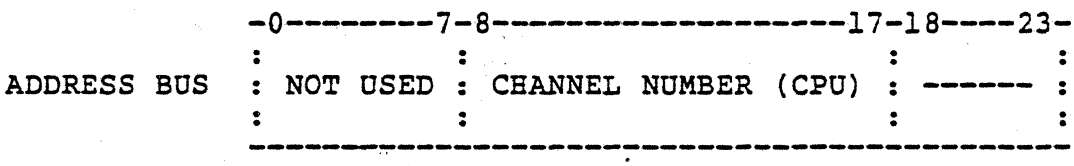
5.2.16 Input Status Word 2

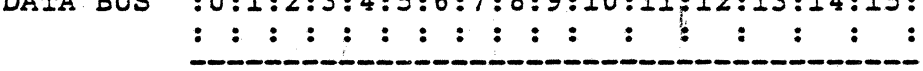
REQUEST CYCLE





RESPONSE CYCLE





0	On-line
1	Rewinding
2	File in Protect
3	RFU
4	Data Service Rate Error
5	Uncorrectable Character Error
6	Single Channel (PE)/GCR, PE, CRC Error
7	Multiple Channel (GCR/PE) Error
8	ID Burst Area Error
9	Retry Attempted
10	RFU
11	Functionality Not Available
12	Reject (F/C)
13	ROM Parity Error.(F/C)
14	CLI Parity Error
15	Data Check Error

This instruction causes the referenced channel's Status Word 2 to be transferred to the requesting channel.

During the response cycle (second half read), the MPTC returns in bits 8 through 23 of the address bus the same data received in bits 0 through 15 of the data bus during the instruction cycle. Bits 0 through 7 of the address bus and the parity bit associated with these bits are the same data as received during the instruction cycle.

5.2.16.1 On-Line (Bit 0)

This bit indicates that the device is on-line to the subsystem. The device can be put into an on-line or off-line condition via the on-line/off-line switch on the transport. The transport can also be put into off-line status via the Rewind and Unload instruction.

5.2.16.2 Rewinding (Bit 1)

This bit indicates that the device is processing a rewind operation, either via a command issued by the subsystem or by the rewind switch on the transport. This bit is not visible to software when rewinding has been initiated by a command because I/O commands issued to a busy channel are NAKed.

5.2.16.3 File in Protect (Bit 2)

This bit indicates that the device is in write protect; that is, the write permit ring is not in position on the mounted file reel.

5.2.16.4 Density Select (Bits 3 and 10)

REV.

5.2.16.5 Data Service Rate Error (Bit 4)

This bit indicates that during a read or write operation, data transfer between main memory and the device via the MPTC-C/F did not maintain the rate in demand. Either data was lost on input because of failure to keep up with device demands, or data was unavailable on output when required by the device. The detection of this error condition does not affect the execution of the operation in progress.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.6 Uncorrected Character Error (Bit 5)

This bit indicates that during a read or write operation, either a Vertical Redundancy Check (VRC) error and/or a dropped character error was detected.

- VRC Error - One or more data characters were detected with incorrect vertical parity. Data character parity is odd unless bit 3 in the stored configuration word is set (see subsection 5.2.2).

Retryable Media Error (Status Word 1, bit 2) is also set with this type error.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.7 Single Channel Error (Bit 6)

This bit indicates that during a write operation for PE, a single channel error was detected. During read operations, single channel errors are corrected by the F/C and also set Status Word 1, bit 4. During write operations, single channel errors set bit 2 of Status Word 1 (Retryable Media Error). The detection of a single channel error does not prevent the detection of a multiple channel error in the block. It also causes the setting of Status Word 1, bit 2.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.8 Multiple Channel Error (Bit 7)

This bit indicates that a multitrack error has occurred during a PE operation which was not correctable by the F/C internally.

The detection of these error conditions also sets Status Word 1, bit 2.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.9 ID Burst Area Error (Bit 8)

This bit indicates that during a read or write (RAW) operation, an error was detected in the ID burst area; that is, the ID burst cannot be read or an incompatibility exists in the ID burst area Nonretryable Error (Status Word 1, bit 9) is also set when this error occurs.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.10 Retry Attempted (Bit 9)

This bit is set whenever the MPTC/STC-A attempts a read retry (see subsection 5.2.5.7), regardless of whether or not the retry was successful.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.11 Functionality Not Available (Bit 11)

This bit indicates that for the subsystem specified herein, the Output Task Word - Read Backwards order is not available, or that an attempt was made to utilize a feature which was not available. The order terminates without tape motion.

This bit is reset by an Initialize or Output Task Word Command.

5.2.16.12 Reject (F/C) (Bit 12)

This bit indicates that the F/C has responded to a command sequence from the MPDC/STC-A with incorrect response to a given command. This indicates a serious error in the F/C and also causes the setting of Subsystem Fault (Status Word 1, bit 3).

This bit is reset by an Initialize or Output Task Word command.

5.2.16.13 ROM Parity Error (F/C) (Bit 13)

When set, this bit indicates that the control memory portion of the STC-A detected a word having incorrect parity. This line points out a serious hardware malfunction which should be repaired before attempting to use the STC-A again. Subsystem Fault (Status Word 1, bit 3) is also set when this error occurs.

This bit is reset by an Initialize or Output Task Word command.

5.2.16.14 CLI Parity Error (Bit 14)

This bit indicates that a parity error has been detected on the CLI interface (STC-A~~&~~F/C). Occurrence of this condition does not cause a termination of the operation in process; however, it may result in bad data being written on the medium. Subsystem Fault (Status Word 1, bit 3) is also set as a result of this error.

This bit is reset by an Initialize or Output Task Word command.

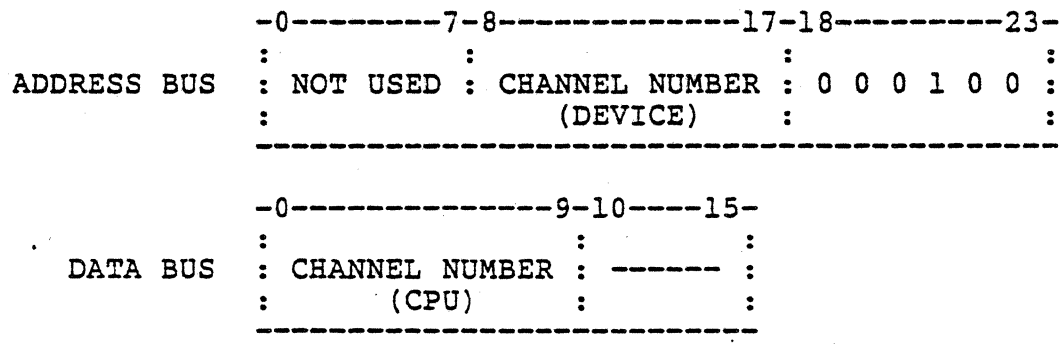
5.2.16.15 Data Check Error (Bit 15)

This line is asserted by the F/C when any of the following error conditions occur. Subsection 5.2.5.13.4 (F/C Status Word 3) describes the following errors.

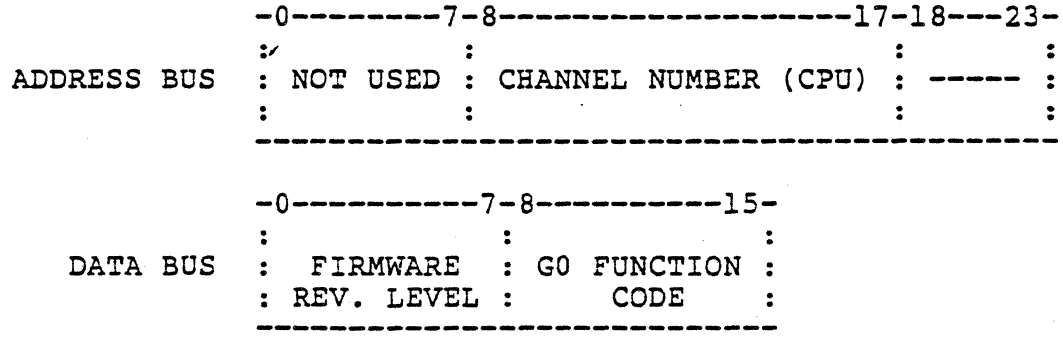
- CRC Error
- Write Tape Mark Check
- Uncorrectable Error
- Partial Record
- Multiple Track Error
- End Data Check
- Velocity Error
- BOT Reached (This error indicates that a backward command was initiated with tape positioned off BOT and BOT was reached before the end of the command. ID burst and BOTs are also set.)
- Overrun (During read/write operations, the STC-A is not able to accept/select data fast enough.)

5.2.17 Input Firmware Revision

REQUEST CYCLE



RESPONSE CYCLE



The firmware revision level is represented by a hex number; for example, 23.

The G0 function code indicates which instruction initiates a command cycle in the MPTC (refer to subsection 5.2.5).

5.2.18 Read/Write MPTC Registers

The MPTC maintains 32 registers (16 bits per register) for each device. The address of each of the various registers in the MPTC is a combination of 2 bits of the channel number and the high-order 5 bits of the function code used to write into or read from a particular register (see Figure 5-3). For example, configuration word A for MPTC device 2 is MPTC register 48 (hex).

Function Codes:

- Configuration Word A = 01000X (X = Read/Write bit)
- Device Number = 010Z (Z = Direction bit)
- Register Number = 0100 1000 = 48 (hex).

Complete software visibility to the MPTC registers is provided for diagnostic purposes. An output bus sequence addressed to one of the devices causes the information on the data bus (16 bits) to be loaded into the device-specific register specified by the device port number and the high-order 5 bits of the function code.

The Output Address command is a special case. When an Output Address command is executed (on part 0, for example) MPTC register 08 (hex) is loaded with the low-order 16 bits of the address. The high-order 8 bits of MPTC register 0B are loaded with the high-order 8 bits of the address.

Any input bus sequence addressed to a device causes the register specified by the port number and the high-order 5 bits of the function code to be returned to the register via the data bus (during the second half read cycle). A detailed register map for each device type is available in the MPTC/STC-A manuals.

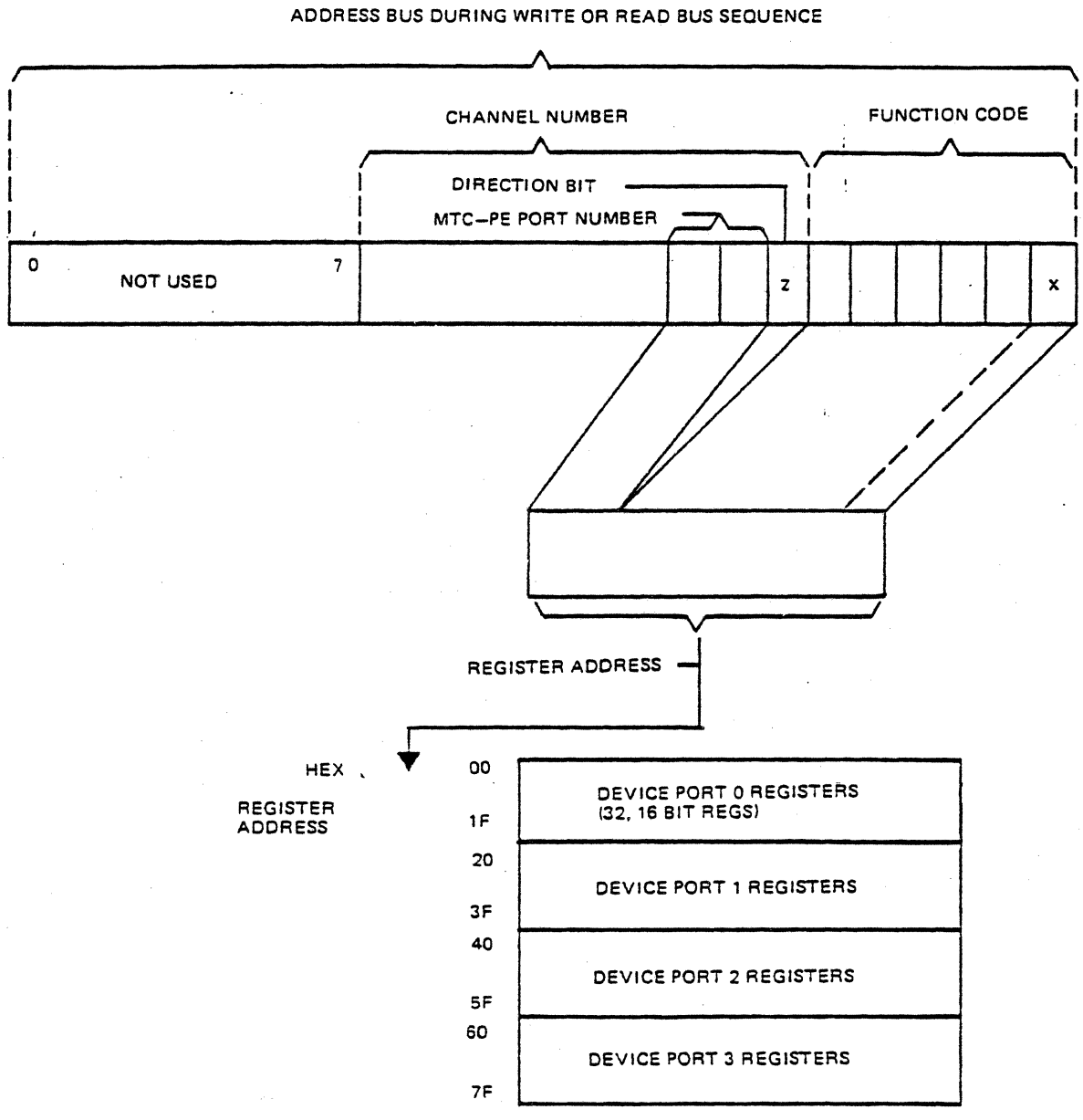


Figure 5-3 MPDC Device Specfic Registers and Addressing

VI

PHYSICAL AND LOGICAL STRUCTURE

6.1 PHYSICAL STRUCTURE

The ½ Inch Streamer Tape Subsystem consists of the MPTC (MPDC plus STC tape firmware) M-board, the Streamer Tape Controller-Adapter (STC-A), a 3/4-size D-board, and a 1/4-size ROS memory D-board. Also included are the OVP formatter/controller for [illegible]PE formatted tapes and up to four tape devices.

6.1.1 Physical Specifications - MPTC

6.1.1.1 Mechanical

- Dimensions: 15 in. wide by 16 in. long by .062 in. thick (M-board)
- Weight: Approximately 28 oz
- Cabling: None
- Cooling: Forced unfiltered air at 125°F maximum temperature ambient at 110 CFM

6.1.1.2 Environment

- Per HIS Standard B01.08 - Class 3 (contamination requirements are waived)
- Meet all U.L. requirements.

6.1.1.3 Electrical

- Primary Power B01.08, Groups I, II, III
- Power module to share a common chassis with the printed circuit boards
- NML Power Specification (60131103).

6.1.2 Physical Specifications - Streamer Tape Controller/Adapter (STC-A and ROS Daughter Boards)

6.1.2.1 Mechanical

- Dimensions: (combined) 14.3 in. (36.33 cm) wide by 12 in. (30.48 cm) long by 0.062 in. (0.157 cm) thick
- Weight: Approximately 16 oz (0.454 kg)
- Cabling: Four 25-pin connectors to connect between M-board and D-boards. Two signal cables between the D-board and the OVP formatter/controller (F/C) with a maximum distance of 20 feet (to the last transport).
- Cooling: Forced, unfiltered air at 125°F (51.7°C) maximum ambient temperature at 110 CFM (51.9 liters/sec).

6.1.2.2 Environment

Same as 6.1.1.2.

6.1.2.3 Electrical

Same as 6.1.1.3.

6.1.3 Physical Specifications - OVP Formatter/Controller (F/C) with ½-Inch Tape Drive

6.1.3.1 Mechanical - Formatter/Controller. Integral part of the first tape transport.

- Cabling: Each tape drive is connected to the F/C with two OVP supplied cables having a maximum length of 20 feet.

- Cooling: Forced air cooling to satisfy operational temperature requirements.

6.1.3.2 Environment*

The F/C shall withstand the following environmental extremes without adverse affects (reference HIS Standards B01.08 and B01.100. shown in brackets if different)

- Operational Temperature: 13°C (10°C) to 40°C
- Storage Temperature: -40°C to 50°C
- Operating Humidity: 20% (10%) to 85% (95%) (non condensing)
- Storage Humidity: 90% max. (noncondensing)
- Operating Temperature Gradient: 12°C per hour
-
- Meet all UL requirements

6.1.3.3 Electrical*

- Adequate storage unit protection to be provided

- Primary AC power: 120 Vac (+10%, -15%), single phase, 60 Hz (+0.5, -0.5)

  220 Vac (+10%, -15%), single phase, 50 Hz (+0.5, -0.5)

  240 Vac (+6%, -15%), single phase, 50 Hz (+0.5, -0.5)

- Power dissipation: 270 watts

6.1.3.4 Physical Specifications - OVP PE 1/2-Inch Tape Drive

Mechanical

- Dimensions: 17.00 in. width
  22.00 in. depth
  8.75 in. height

- Weight: 80 lb (without rack or cables)

- Cabling: Two signal cables connect the tape drive to the F/C

- Cooling: Forced air cooling to satisfy operational temperature requirements.

*Pending negotiations with vendor.

6.1.4.2 Environment*

The tape device shall withstand the following environmental extremes without adverse affects (reference HIS Standards B01.08 and B01.10).

- Operational Temperature: 50°F to 100°F
- Storage Temperature: -31°F to 149°F
- Operating Humidity: 10% to 90% RH (noncondensing)
- Storage Humidity: 5% to 89% RH (noncondensing)
- Operating Temperature Gradient: 19.8°F per hour
- Storage Temperature Gradient: 77°F per hour

6.1.4.3 Electrical*

- Adequate storage unit protection be provided
- Primary AC power: 120 Vac (+10%, -15%), single phase, 60 Hz (+0.5, -0.5)

  220 Vac (+10%, -15%), single phase, 50 Hz (+0.5, -0.5)

  240 Vac (+6%, -15%), single phase, 50 Hz (+0.5, -0.5)

There will be isolation of dc ground and frame ground in the tape drive. The two grounds will be brought out to the I/O connector separately for external connection at a system level tie point.

6.1.4 Physical Specifications - 1/2-Inch Magnetic Tape and Reels

6.1.4.1 Mechanical

The magnetic tape device provides for the front loading of tape media and reels which meet ANSI X3.40 1973. The tape handler will accept up to 10-1/2-inch diameter supply and takeup reels with a tape media capacity of up to 2400 feet; automatic cartridge loading and tape threading are accomplished through a power window.

6.1.4.2 Environment

The tape media shall withstand the following environmental extremes without adverse affects:

*Pending negotiations with vendor.

- B01.08 Environment: Operating
- B01.10 Environment: Manufacturing, Transportation and Installation
- B01.14 Data System Standard Unrecorded 1/2-Inch Magnetic Tape.

6.2 LOGICAL STRUCTURE

Figure 6-1 is a preliminary block diagram of the STC-A. Major functional units and interfaces are illustrated in the figure. For additional detail of the logical structure of the STC-A, refer to the MPTC/STC-A Product Manual (TBD).

6.3 TESTABILITY/PRODUCIBILITY

The product should conform to the manufacturing Testability and Producibility Design Rules outlined in the reference documents in subsection 1.1.2.

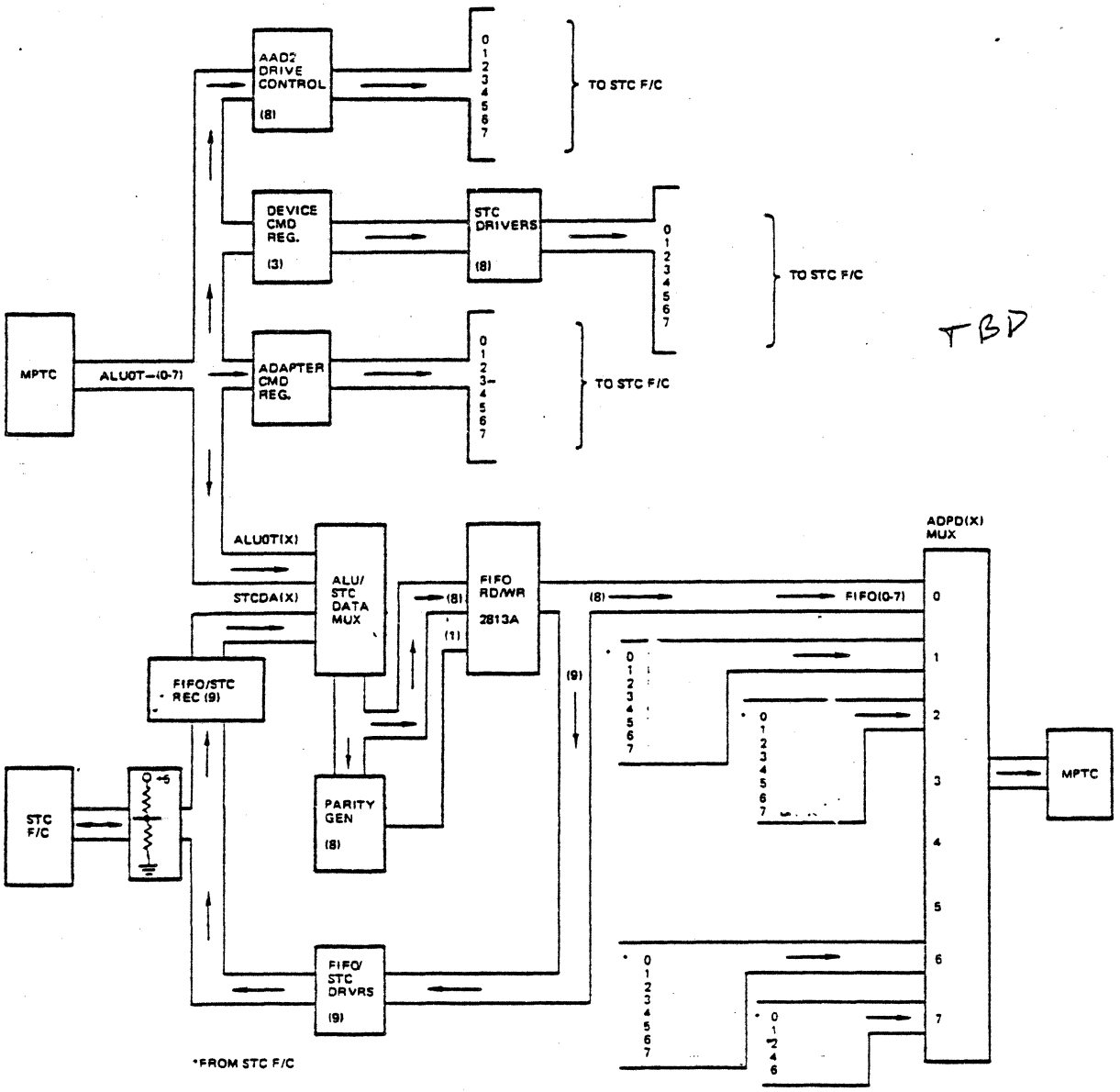


Figure 6-1 STC-A Functional Block Diagram

VII

PERFORMANCE

The performance of the ½ Streamer Tape Subsystem is expressed in terms of its maximum throughput requirements and the performance characteristics of the devices that can be configured to the subsystem. Performance characteristics are given in Table 7-1.

The nominal data throughput of 160,000 bytes per second is experienced when reading or writing PE-formatted tape at a tape speed of 100 ips, and 40,000 bytes per second at 25 ips (refer to Table 2-1).

The MPTC/STC-A, a single LOS subsystem, will accept up to four device-specific command sequences, one for each available device. Multiple tape rewind operations may be processed concurrently with a single data transfer operation if the power distribution system allows.

Level 6 1/2-Inch Streaming Tape Adapter Subsystems handle related tape which satisfy ANSI Standard X3.40-1973, Unrecorded Magnetic Tape for Information Exchange. The tape, having a nominal width of 1/2 inch and a thickness 1-1/2 millimeters, is normally stored on reels in lengths of 2400, 1200, 600, and 300 feet. Reels are capable of accepting a write-enable ring which, when removed from the reel, prevents the recording system from writing on media contained on the reel.

The Level 6 1/2-Inch Streaming Tape Subsystem specified herein is capable of recording/reading tape employing the PE (Phase Encoding) techniques at both the 1600 b.p.i. and 3200 b.p.i. densities although at the higher density it is not ANSI compatible.

Table 7-1 1/2-Inch Streaming Tape
Subsystem Performance Characteristics

Recording format	Microstreamer I		Microstreamer II		
Method	Phase Encode		Phase Encode		
Data Tracks	8		8		
Parity Track	1		1		
Density	1600 bpi		1600/3200 bpi		
Operation Speeds	25 ips	100 ips	25.	50.	100 ips
Data Access Time (ms)	40	260	40	120	260
Reposition Time (ms)	120	780	120	350	780
Reinstruct Time (ms)					
Read	15	4	15	8	4
Write	12	3	12	6	3
Character Rate (character per second) @					
1600 bpi	40.000	160.000	40.000	N/A	160.000
3200 bpi	N/A	N/A	N/A	160.000	N/A

Recording Format

Compatible with ANSI Standards X3.54-1976 and X3.39-1973 for Recorded Magnetic Tape for Information Interchange (see subsection 5.1) at 1600 b.p.i. only.

Recording Capability

Write PE tapes conform to ANSI standards. Resultant recorded PE tapes are to be readable on Level 6 PE tape subsystems and foreign PE tape subsystems that have the capability to read ANSI standard PE tape media.

Reading Capability

Read PE tapes in conformance with ANSI standards (tapes) which have been recorded on Level 6 PE tape subsystems, Series 700 PE tape subsystems, and/or Level 6 PE tape subsystems. PE tapes which are not in conformance with ANSI standards and are readable on HIS or foreign PE tape subsystems may or may not be able to be read by the Level 6 PE tape subsystem specified herein.

Backup Times

The total time required for the operator to complete the task of backup for a given disk capacity is given in Tables 7-2 and 7-3. These calculations are based on a write speed of 100 ips and a rewind speed of 200 ips. Additionally, 1 minute is added for each tape load function.

DISK SIZE MBYTES	BLOCK SIZE IN BYTES					
	8192	4096	2048	1024	512	256
20	3.9	4.4	5.3	7.4	10.7	18.0
40	8.0	9.0	10.7	13.9	21.3	36.0
60	12.3	13.1	16.4	21.3	31.9	54.1
80	15.6	18.0	21.3	28.7	43.5	72.2
100	19.7	22.1	27.1	36.0	54.1	89.4
160	32.0	35.3	42.6	56.6	86.1	144.3
200	40.2	44.3	53.3	71.3	108.2	179.5

Table 7-2 Time in Minutes for Various Capacity and Block Size at 1600 bpi

DISK SIZE MBYTES	BLOCK SIZE IN BYTES					
	8192	4096	2048	1024	512	256
20	2.5	2.5	3.3	4.9	9.0	16.6
40	4.1	4.9	7.4	10.7	17.2	31.2
60	6.6	8.2	10.7	15.6	25.4	46.7
80	8.2	10.7	13.9	20.5	34.4	62.3
100	11.5	13.3	18.0	26.2	43.5	77.9
160	18.0	21.3	28.7	41.8	69.7	124.6
200	22.1	26.2	35.2	53.3	86.1	155.8

Table 7-3 Time in Minutes for Various Capacity and Block Size at 3200 bpi

Number of tape reels per disk.

Tables 7-4 and 7-5 show the number of 10.5-inch reels of 1.5-mil (standard 2400-foot) tape required to back up a specific disk size. The figures shown include all formatting characters and record gaps.

DISK SIZE MBYTES	BLOCK SIZE IN BYTES					
	8192	4096	2048	1024	512	256
20	0.48	0.54	0.65	0.9	1.3	2.2
40	0.97	1.1	1.30	1.7	2.6	4.4
60	1.50	1.6	2.00	2.6	3.9	6.6
80	1.90	2.2	2.60	3.5	5.3	8.8
100	2.40	2.7	3.30	4.4	6.6	10.9
160	3.90	4.3	5.20	6.9	10.5	17.6
200	4.90	5.4	6.50	8.7	13.2	21.9

Table 7-4 Number of Reels of Tape for Various Capacity and Block Size at 1600 bpi (2400' Reel)

DISK SIZE MBYTES	BLOCK SIZE IN BYTES					
	8192	4096	2048	1024	512	256
20	0.3	0.3	0.4	0.6	1.1	1.9
40	0.5	0.6	0.9	1.3	2.1	3.8
60	0.8	1.0	1.3	1.9	3.1	5.7
80	1.0	1.3	1.7	2.5	4.2	7.6
100	1.4	1.6	2.2	3.2	5.3	9.5
160	2.2	2.6	3.5	5.1	8.5	15.2
200	2.7	3.2	4.3	6.5	10.5	19.0

Table 7-5 Number of Reels of Tape for Various Capacity and Block Size at 3200 bpi (2400' Reel)

Tape Capacity

The total number of bytes to be stored in a single reel of tape varies with the block size.

Figure 7-1 will give an idea of the capacity achievable for various block lengths. The chart allows for a standard gap size of 0.6 inch and takes into account the preamble and postamble characters required for each block of data recorded in PE format.

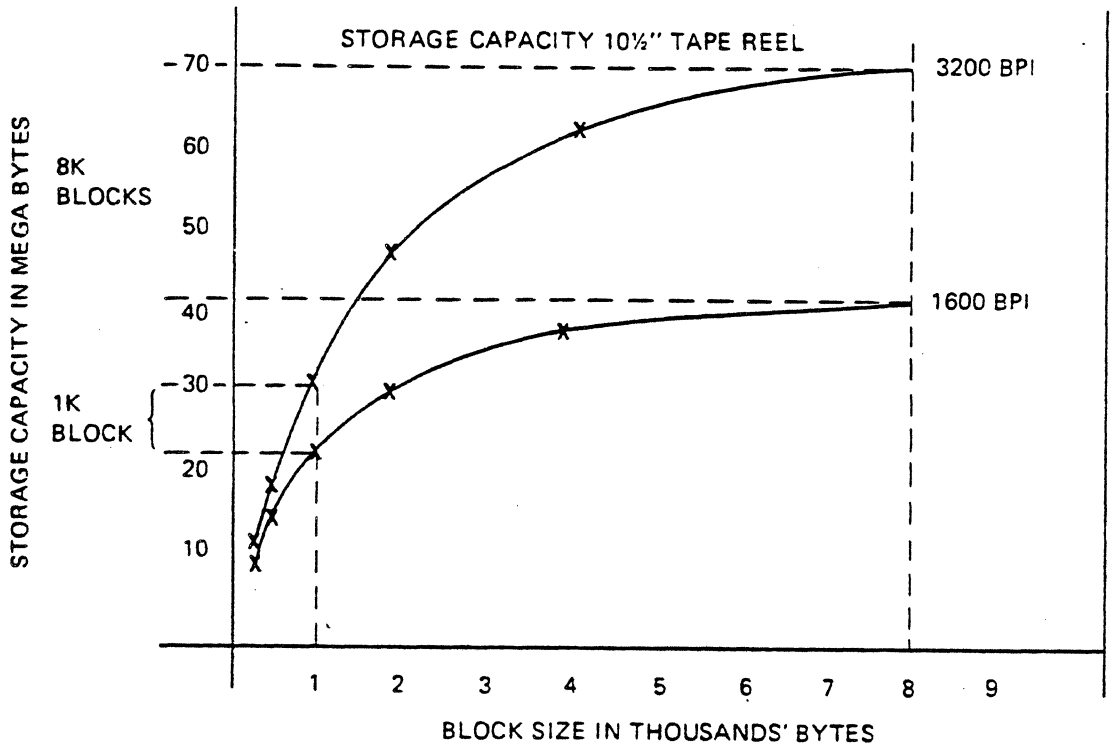


Figure 7-1 Storage Capacity vs Block Size

VIII

AVAILABILITY

8.1 INTEGRITY

Integrity facilities in the STC -MTS subsystem assure that data can be accurately written and retrieved from media. Data integrity is established via error detection facilities built into the data formats described in subsection 5.1. All data characters written on tape media have a parity bit appended such that when the data is subsequently read, the accuracy of the recovered data is guaranteed within the limits specified in subsection 8.4.1.4.

Error conditions detected at the device adapter subsystem (MPTC/STC-A) level are held in status registers of the MPTC (see subsections 5.2.14 and 5.2.15) for subsequent inquiry by a higher level processor. Hardware/firmware integrity is checked upon initialization of the MPTC/STC-A subsystem via test routines which determine if the subsystem can respond properly to basic input/output commands.

8.2 SECURITY

Protection of data on media from being destroyed by unauthorized writing over or erasing is provided at the device level. Means for activation of this security, inhibiting any writing to a tape device, is by the removal of a write permit ring from a tape reel.

The detection of a write command issued to a protected device is reported in Status Word 1, bit 11 (see subsection 5.2.14.12).

8.3 MAINTAINABILITY

8.3.1 Maintainability Requirements

The following design goals, measured in hours, are specified as a minimum to be achieved during the first year after initial ship and during the third year after unlimited production is authorized.

8.3.1.1 Mean Time to Repair (MTTR)

MTTR represents the average repair time for a service engineer to diagnose, isolate, repair or replace, and verify the fix. MTTR does not include response time, travel time, or idle time at the site waiting for the system or needed spare parts. These MTTR times are given for each Optimum Replaceable Unit (ORU) that comprises the MPTS-GCR subsystem.

ORU	First Year	Third Year
Medium Performance Tape Controller	1.0 hr	0.75 hr
Streamer Tape Controller – Adapter	1.0 hr	0.75 hr
OVP Formatter/Controller & Tape Drive	0.75 hr	0.50 hr

8.3.1.2 Maximum Time to Repair (XTTR)

This represents the time in which 90% of all repairs are made. XTTR is given for each ORU that makes up the GCR-MTS subsystem.

ORU First Year	Third Year	
Medium Performance Tape Controller	2.0 hr	1.5 hr
Streamer Tape Controller – Adapter	2.0 hr	1.5 hr
OVP Formatter/Controller & Tape Drive	1.5 hr	1.0 hr

8.3.1.3 Diagnostic Facility Localization Effectiveness (DFLE)

This represents the probability that a hard failure will be localized to an ORU. The DFLE given takes into consideration the comprehensiveness, the resolution, and the accuracy of the diagnostic facility provided.

ORU First Year	Third Year	
Medium Performance Tape Controller	80%	90%
Streamer Tape Controller-Adapter	80%	90%
OVP Formatter/Controller & Tape Drive	75%	90%

8.3.1.4 Mean Time Between Preventive Maintenance (MTBPM)

This goal, the period between required or recommended preventive maintenance (PM), is given for each ORU.

ORU	MTBPM
Medium Performance Tape Controller	No PM
Streamer Tape Controller — Adapter	No PM
OVP Formatter/Controller	No PM
Run Diagnostics	Monthly
Check Fans and dc Voltages	Quarterly
OVP Magnetic Tape Device	Every 8 hours for principal tape path cleaning; weekly for remaining tape path cleaning

8.3.1.5 Mean Time to Perform Preventive Maintenance (MTTPM)

This goal applies to the OVP tape drives and is not more than four hours per year per device.

8.3.2 Maintenance Strategy

The maintenance strategy for the STC -MTS subsystem is in accord with the governing EPS-1 specification on the Level 6 System. The subsystem shall be partitioned into ORUs which can be effectively diagnosed for a faulty condition via a combination of firmware controlled tests, software tests, and visual indicators. Available diagnostic aids to be provided are to be executable by the customer as well as a service engineer. Simple repairs, such as the replacement of a defective ORU with an operational one, should be carried out by trained customer personnel or a service engineer.

8.3.3 Maintainability Features

The Optimum Replaceable Units (ORUs) for the subsystem are:

- MPTC
- Streamer Tape Controller-Adapter (STC-A)
- OVP Formatter/Controller (F/C) subassembl with Magnetic Tape Unit.

Isolation of a failure to an ORU is achieved via a two-step procedure. The first step is a hardware verification routine called a Quick Logic Test (QLT). This test supplies a go, no-go visual identification of an MPTC hardware failure. Its purpose is to verify basic data paths such that appropriate ORU test and verification routines can be loaded and run. The QLT is restricted to verifing the MPTC board and the associated adapter. Successful completion of the QLT does not imply that the MPTC is free of faults but indicates that the subsystem can be responsive to commands issued to it.

The QLT is invoked in the MPTC in response to a Master Clear on the Megabus or an Initialize command (Output Control Word).

Results of the QLT appear as a visual indication on the control panel and on the front edge of the MPTC board. The indicator lights during execution of the QLT and goes off only if the QLT completes successfully.

Some specific function codes useful in troubleshooting hardware and firmware failures are as follows.

- Function code 04 (addressed to any active port) returns:

```
-0-----------7-8---------------15-
:             :                 :
: FIRMWARE REV : GO FUNCTION CODE :   EXAMPLE:  23.XX
:             :                 :
-------------------------------
```

- Function code 0A (addressed to any active port) returns:

```
-0-----------7-8---------------15-
:             :                 :
:     QLTI    :    REF. 5.2.9   :   EXAMPLE:  FF.XX
:             :                 :
-------------------------------
```

where QLTI = Quick Logic Test Indicators

During the initialization sequence, the QLTI location is used as follows:

- Set to FF on initialize.
- Set to 00 if any basic MPTC subtest fails.
- Set to FF if all basic MPTC subtests pass.
- Bits 4 through 7 are reset as a block if the Megabus QLT, executed prior to completion of an (first) input function code, fails.

- Bits 0 through 3 are selectively reset by CAI-Adapter QLT sequences when tests fail. Bit numbers correspond to port numbers.

If at the end of both QLTs (MPTC and STC-A) the QLTI register is FF, the indicator light on the front edge of the MPTC board is turned off. Conversely, if the QLTI register is other than FF, the light remains on.

Examples of some QLTI contents and their interpretations are:

- FF = All QLTs were successful
- 00 = Basic MPTC (ALU, SPM, etc.) QLT failed
- F0 = Megabus QLT failed in one or more ports
- AF = Failure detected in ports 1 and 3

Software isolation test routines verify all the MPTC, STC-A operational aspects of the MPTC and isolate failures to the attached tape controller, F/C, or device. Operator interface with these routines is via the CPU control panel or a TTY compatible console. These routines cannot share the system with other programs. Diagnostic functionality has been included in the subsystem to support software diagnostic routines (see subsection 5.2.2).

The designated STC-A and MPTC are easily removable and replaceable; only a screwdriver is required. System power must be off to remove an MPTC or STC-A. Removal and replacement philosophy for the attached tape controller (F/C) and the tape devices are defined by FED. T&V's can be used as an aid in identifying failed ORUs in the F/C or in the tape devices. Power for the F/C and the tape units is independent of system power, thus enabling powering down and replacement of failed devices without affecting system operation except where the specific devices in question are involved.

A test procedure for isolating faults to the MPTC, STC-A, or controller/device is supplied to support the QLT and the STC-A T&V routines. This test procedure is for execution by nontechnical, trained, customer personnel or field engineering personnel.

Note that T&V programs have access to all device diagnostic features and data. The instructions available to do this are not necessarily available for normal programming use.

8.4 RELIABILITY

8.4.1 Reliability Requirements

8.4.1.1 Product Life

Product life is defined as the period of time within which the equipment performs within established reliability goals.

ORU	Product Life
Medium Performance Tape Controller	10 years
Group Coded Recording Adapter	10 years
OVP Formatter/Controller with Magnetic Tape Device	5 years*

8.4.1.2 Unit Power-On

For purposes of specifying reliability goals, the unit power-on is specified to be 500 hours per month. The unit power-on time of a component is also expressed in usage hours of the component (see subsection 8.4.1.6).

8.4.1.3 Duty Factor

The duty factor of the MPTC/STC-A subsystem electronics is 100% of the power-on time. The duty factor of the mechanical hardware (that is, moving parts) of the transport is approximately 25% of the power-on time.

8.4.1.4 Data Error Rate Requirements

The error rate goals for the following three categories are:

Category of Error	
Detected write error	1×10^{8}
Detected recoverable read error	1×10^{9}
Detected unrecoverable read error	1×10^{10}

A detected unrecoverable read error condition is an error which remains after ten attempts to read the record in which the error is located.

8.4.1.5 Mean Time Between Failures (MTBF)

MTBF is expressed in power-on hours of the component or ORU and is concerned only with hardware failures. It is a minimum to be achieved.

ORU	First Year	Third Year
Medium Performance Tape Controller	50,000 hr	60,000 hr
Streamer Tape Controller – Adapter	90,000 hr	120,000 hr
OVP Formatter/Controller with Magnetic Tape Device	5,000 hr	5,500 hr

*Three more years after refurbishment.

8.4.1.6 Mean Time Between Calls (MTBC)

MTBC is expressed in usage hours of the component or ORU between unscheduled or scheduled demand or emergency calls caused by hardware, operator, or media malfunctions which cannot be corrected by the operator or required installation of FCOs (Field Change Orders). A "call" is a visit to the customer site by a field engineer. MTBC does not include calls for preventive maintenance.

ORU	First Year	Third Year
Medium Performance Tape Controller	40,000 hr	50,000 hr
Group Coded Recording Adapter	70,000 hr	90,000 hr
OVP Formatter/Controller with Magnetic Tape Device	2,500 hr	2,500 hr

IX

CONFIGURABILITY

9.1 GENERAL

Configurability requirements, restrictions, options, etc. for a PE tape subsystem are described in this section. Figure 9-1 identifies the basic configurational units of the subsystem and their interfaces. The following paragraphs specify configurational characteristics of relevant units. Performance parameters, instructions, and interfaces are described in earlier sections.

9.2 MPTC (MPDC Plus Streamer Firmware)

Specific configurational limitations of the MPDC can be found in the MPDC EPS-1. In general, the following points are pertinent to an STC-MTS Subsystem:

- The MPTC functions at any NML Bus position. However, because of the burst transfer mode of operation of the MPTC and its data buffering, the MPTC is normally placed at the lower priority end of the bus but with a higher priority than the CP.
- Multiple MPTCs may be configured for a particular NML system (but may be limited by system throughput capabilities).
- No modifications to the basic MPDC are necessary for the support of an STC-A. However, a new firmware load makes the MPDC into an MPTC.
- The MPTC can support one adapter. Refer to the MPDC EPS-1 for descriptions of attachable adapters.

- The high-order seven bits of the subsystem channel numbers are assigned at system installation by the setting of switches on the MPTC (refer to subsection 3.1).

The following configuration rules apply:

- The maximum number of drives in the tape subsystem is four.
- The Formatter/Controller (F/C) can handle up to four Cipher Microstreamer I & II drives.

9.3 Streamer Tape Controller – ADAPTER (STC-A)

The following points are pertinent to the attachment of the Streamer Tape Controller-Adapter:

- The STC-A attaches to the MPTC via the Controller Adapter Interface. This interface is described in the MPDC EPS-1.
- The STC-A supports up to four tape controllers.
- The STC-A supports any of the configurations described with no hardware or firmware modifications.
- Device numbers (bits 7 and 8 of the channel number, see Figure 3-1) are assigned based on the position of the device on the DLI.

9.3.1 PE Formatter/Controller (F/C) with Magnetic Tape Drive

- The F/C attaches to the STC-A via the CLI-F/C interface defined in Section IV
- Up to four PE tape drives may be attached to the STC-A.

~~9.3.2 Magnetic Tape Device~~

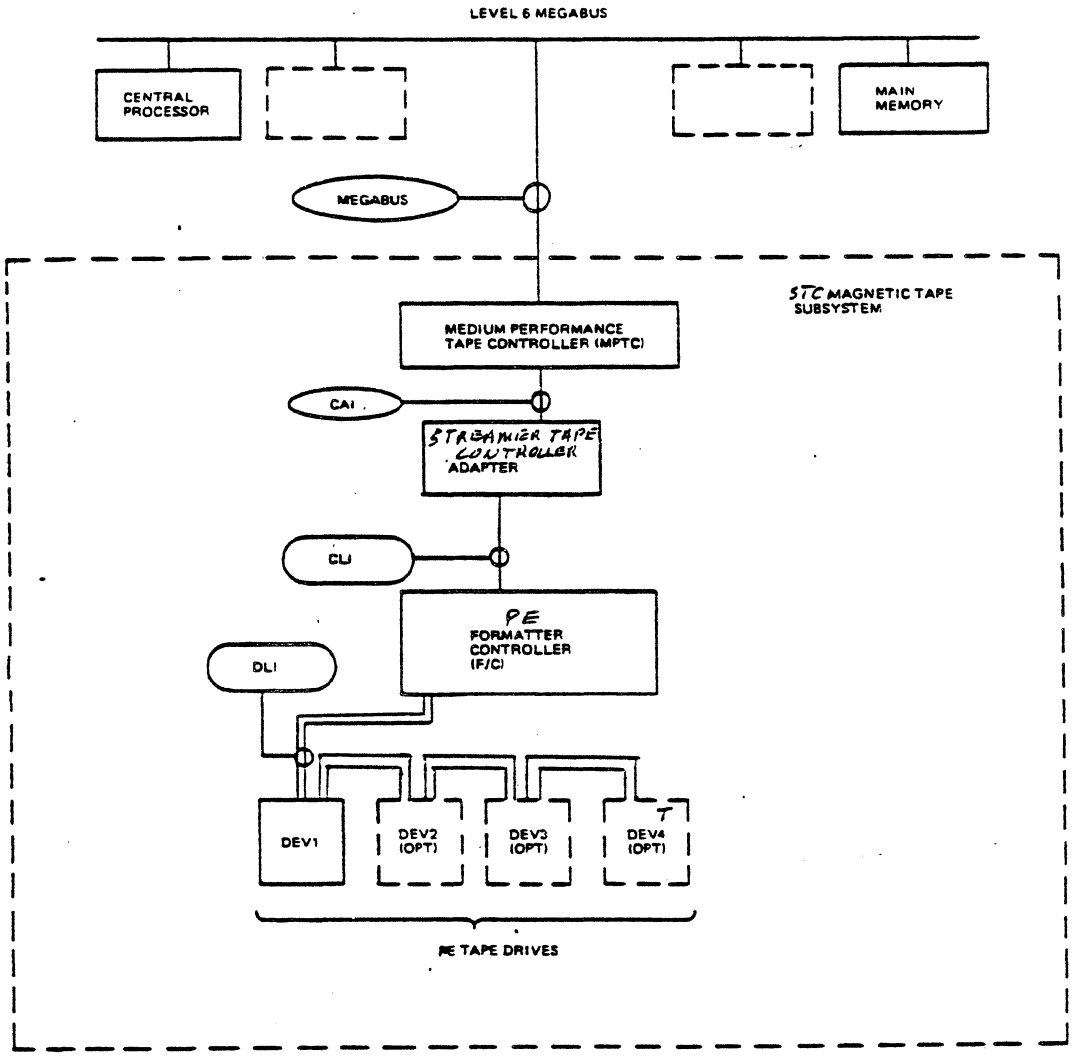
- ~~MTUs connect to the F/C via the Unit Level Interface as defined in Section IV~~
- ~~From one to four drives may be attached to the F/C (see Configuration Rules) in a radial fashion.~~

9.4 OTHER CONFIGURATION CONSIDERATIONS

Availability parameters identified in Section VIII assume support by a Level 6 Operating System.

9.5 SAMPLE CONFIGURATIONS

Figure 9-1 shows a typical Level 6 application with up to four PE tape drives attached.



NOTE: SEE SECTION IX FOR CONFIGURATION RULES.

T- TERMINATOR

Figure 9-1 STC Magnetic Tape Subsystem Configurational Units

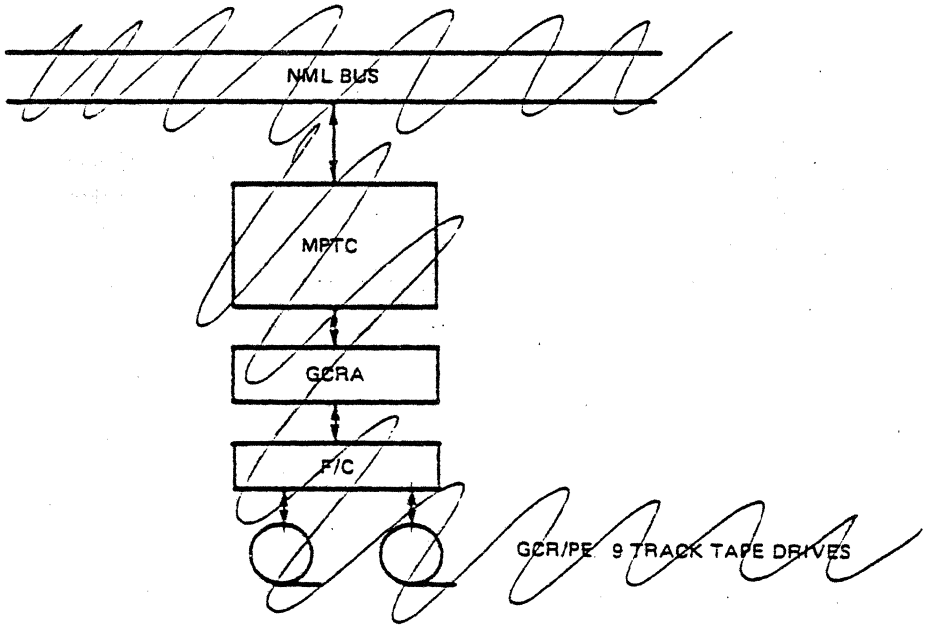


Figure 9-2 L6 Application With Two GCR/PE Tape Units

DPS-6 PERTEC FS1000 ADAPTER STATUS BIT DEFINITIONS

STATUS WORD 1

BIT	NAME	DEFINITION
0	DEVICE READY	-Formatter Interface signal IRDY
1	ATTENTION	-Tape Drive went from ONLINE to OFFLINE or visa versa
		-Unsolicited Hard Error (IHER)
2	RETRYABLE MEDIA ERROR	-Rate Error (overrun/underrun)
		-Range > 16 on Wraparound Commands
		-Corrected Error (ICER) on Forward Write
3	SUBSYSTEM FAULT	-Failure in Adapter Clear Logic
		-Adapter Parity Error
		-Formatter Interface signal ISGL
		-Timeout (no response from Formatter after command sent)
		-Formatter still busy after Clear Command
		-Formatter still in Rewind State after Clear
		-Formatter not ready (IRDY) after Clear Command
4	CORRECTED MEDIA ERROR	-Corrected Error (ICER) on Read Command
5	TAPE MARK DETECTED	-Formatter Interface signal IFMK
6	BOT	-Formatter Interface signal ILDP
7	EOT	-Formatter Interface signal IEOT
8	UNEQUAL LENGTH CHECK	-No File Mark found for a zero range Read Cmd
		-A File Mark or Hard Error terminated Read Cmd
		-Range given in L6 IOLD cmd is less than actual amount read from tape drive
9	NONRETRYABLE ERROR	-Blank Tape
		-Reverse Command given at BOT
		-Backspace Command given at BOT
10	RFU - MBZ	-Reserved for Future Use
11	OPERATION CHECK	-Formatter Interface signal ISGL
		-Corrected Error (ICER) and Adapter Parity Err
		-Command other than Device Clear or Load given while Tape Drive is OFFLINE
		-Write Command given with File Protect (IFPT)
		-Write Command given with ANSI-INHIBIT bit of Configuration Word A set
		-Write Command given with zero range
		-Write Command given with no previous IOLD
		-Formatter does not go busy after command sent
		-Adapter does not pass data read from Formatter
		-Write cmd terminated by Formatter before last word written by adapter
		-Premature termination of cmd by Formatter
		-Variable Erase Command sent with zero range
		-Var Erase Command sent with no previous IOLD
12	CORRECTED MEMORY ERROR	-Megabus Yellow Indicator
13	NONEXIST RESOURCE ERR	-Megabus Cycle was NAK'd
14	BUS PARITY ERROR	-Megabus Parity Error
15	UNCORRECTED MEMORY ERR	-Megabus Red Indicator

DPS-6 PERTEC FS1000 ADAPTER STATUS BIT DEFINITIONS

STATUS WORD 2

BIT	NAME	DEFINITION
0	ON-LINE	-Formatter Interface signal IONL
1	REWINDING	-Formatter Interface signal IRWD
2	FILE IN PROTECT	-Formatter Interface signal IFPT
3	HIGH SPEED	-Formatter Interface signal ISPEED
4	DATA SERVICE RATE ERR	-Rate Error (Overrun/Underrun)
5	UNCORRECTABLE CHAR ERR	-Unused
6	SINGLE CHANNEL ERROR	-Formatter Interface signal ICER
7	MULTIPLE CHANNEL ERROR	-Formatter Interface signal IHER
8	ID BURST AREA ERROR	-Unused
9	RETRY ATTEMPTED	-At least one retry was attempted
10	NO DATA TIMEOUT	-Blank Tape
		-Reverse Command given at BOT
		-Backspace Command given at BOT
11	FUNCTIONALTY NOT AVAIL	-Unused
12	REJECT	-Failure in Adapter Clear Logic
		-Timeout (no response from Formatter after command sent)
		-Formatter still busy after Clear Command
		-Formatter still in Rewind State after Clear
		-Formatter not ready (IRDY) after Clear Command
13	ROM PARITY ERROR	-Unused
14	CLI PARITY ERROR	-Adapter Parity Error
15	DATA CHECK ERROR	-Unused

FORMATTER INTERFACE SIGNAL DEFINITIONS

IRDY - This is a level which is true only when the unit is ready to receive commands through the interface lines.

IFMK - This signal is low when a file mark is read from tape.

ILDP - This level goes true when the unit is ready and tape is positioned at BOT. This signal goes false after the BOT marker moves forward passing the BOT detector.

IEOT - This signal is set low when the EOT marker is detected during a forward motion and reset when the EOT marker is detected during a reverse motion.

ISGL - This signal is used to report that the selected drive is malfunctioning.

ICER - This signal is set low by a single track dropout during a read or read-after-write operation. ICER in a read-after-write operation indicates that the record should be rewritten.

IHER - The IHER signal is set low if a read error is detected by the formatter. All error information is reported to the controller before IDBY goes false. IHER is set by one of the following:

(1) More than one channel dropout.
(2) Parity error without any channel dropout indication.
(3) A false postamble is detected.
(4) Attempting to read an NRZI or GCR tape.
(5) Attempting to read a blank tape.

IFPT - This level goes true when the write enable ring is removed from the supply reel of the selected drive and remains true until tape is unloaded.

ONL - This is a level which is low when the unit is in the On-line mode.

IRWD - This is a level which is true when the drive is engaged in any rewind operation. A true IRWD causes IRDY to go false.

ISPEED - This signal indicates operating tape speeds of the selected drive. When true, the signal indicates operation in the high speed mode (2.54 m/s [100 ips] if 63 cpmm [1600 cpi] is selected, 1.27 m/s [50 ips] if 126 cpmm [3200 cpi] is selected); when false, the signal indicates operation in the low speed mode (0.635 m/s [25 ips] if 63 cpmm [1600 cpi] is selected.

Signal definitions are from "FS1000 Series Formatted Tape Drive Product Specification" , copywrite 1984 Pertec Peripherals Corporation.

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PERTEC
PERIPHERALS
CORPORATION

from Steve Mycher
Pertec
Boxborough MA

FS1000 SERIES
FORMATTED TAPE DRIVE
PRODUCT SPECIFICATION

Document No. 81607 (8/84)

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1.0 INTRODUCTION

This specification provides a physical description, functional description, and specifications for the Pertec Peripherals Corporation (PPC™) Model FS1000 Series Formatted Magnetic Tape Drives.

The FS1000 is a formatted tape drive designed to record data on and read data from 12.7 mm (0.5 inch) magnetic tape in both a streaming mode of operation (not stopping between data blocks), and in the standard incremental mode (fast start and fast stop between data blocks). The unit is horizontally slide mounted with front panel access to the tape, and features automatic loading of standard 177.8 mm (7 inch), 215.9 mm (8.5 inch), and 266.7 mm (10.5 inch) diameter reels.

NOTE

PPC reserves the right to make changes to this document without notice and all parameters specified in the document are subject to change.

2.0 APPLICABLE DOCUMENTS

ANSI X3.39-1973 — Recorded Magnetic Tape for Information Interchange (1600 cpi, Phase Encoded)

ANSI X3.40-1976 — Unrecorded Magnetic Tape for Information Interchange (9-track, 200 and 800 cpi, NRZI, 1600 cpi, Phase Encoded)

3.0 PHYSICAL DESCRIPTION OF EQUIPMENT

The FS1000 is designed for slide mounting in a standard EIA rack with the tape reels in a horizontal position. The front bezel contains a covered opening for insertion of the tape reel. All operator controls and indicators are located on the front panel. An air inlet is at the front of the unit. Two doors in the top of the unit provide access to the tape area. Interface cable connections and air exhaust are via the rear panel. All access doors on the drive are equipped with interlocks that prevent tape motion when the doors are open. The interlocks can be defeated, when necessary, to service the equipment.

3.1 PHYSICAL DIMENSIONS

The FS1000 drive dimensions are shown in Figure 3-1. The unit mounts in a standard EIA equipment rack, 482.6 mm (19 inches) wide, using the mounting hole pattern illustrated in Figure 3-2. A standard vertical panel opening of 222.25 mm (8.75 inches) is required. A Cipher-compatible mounting bracket, available as an option, is shown in Figure 3-3. Access to the drive is shown in Figure 3-4.

3.2 WEIGHT

- 50 kg (110 lbs) maximum

3.3 COLORS

Standard front bezel component colors are as follows:

- Bezel — Black/White
- Front Door — Smoked Bronze
- Control Panel — Black background with white lettering

3.4 LOGO PROVISION

The front bezel contains an area for installation of a logo. The FS1000 front bezel is provided in two versions. One contains a standard PPC logo in this space, the other version has the space blank for installation of a private label.

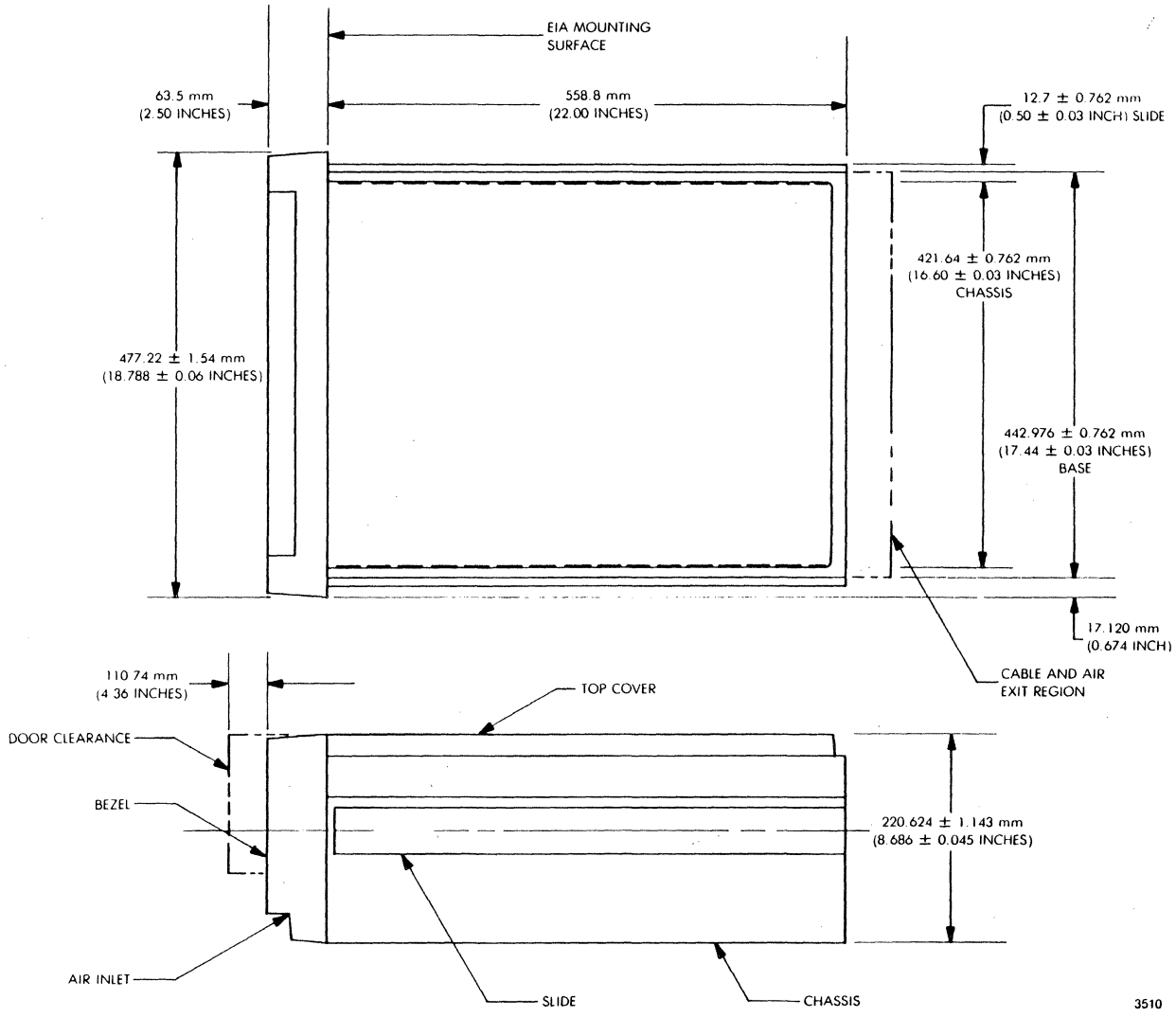


Figure 3-1. Physical Dimensions

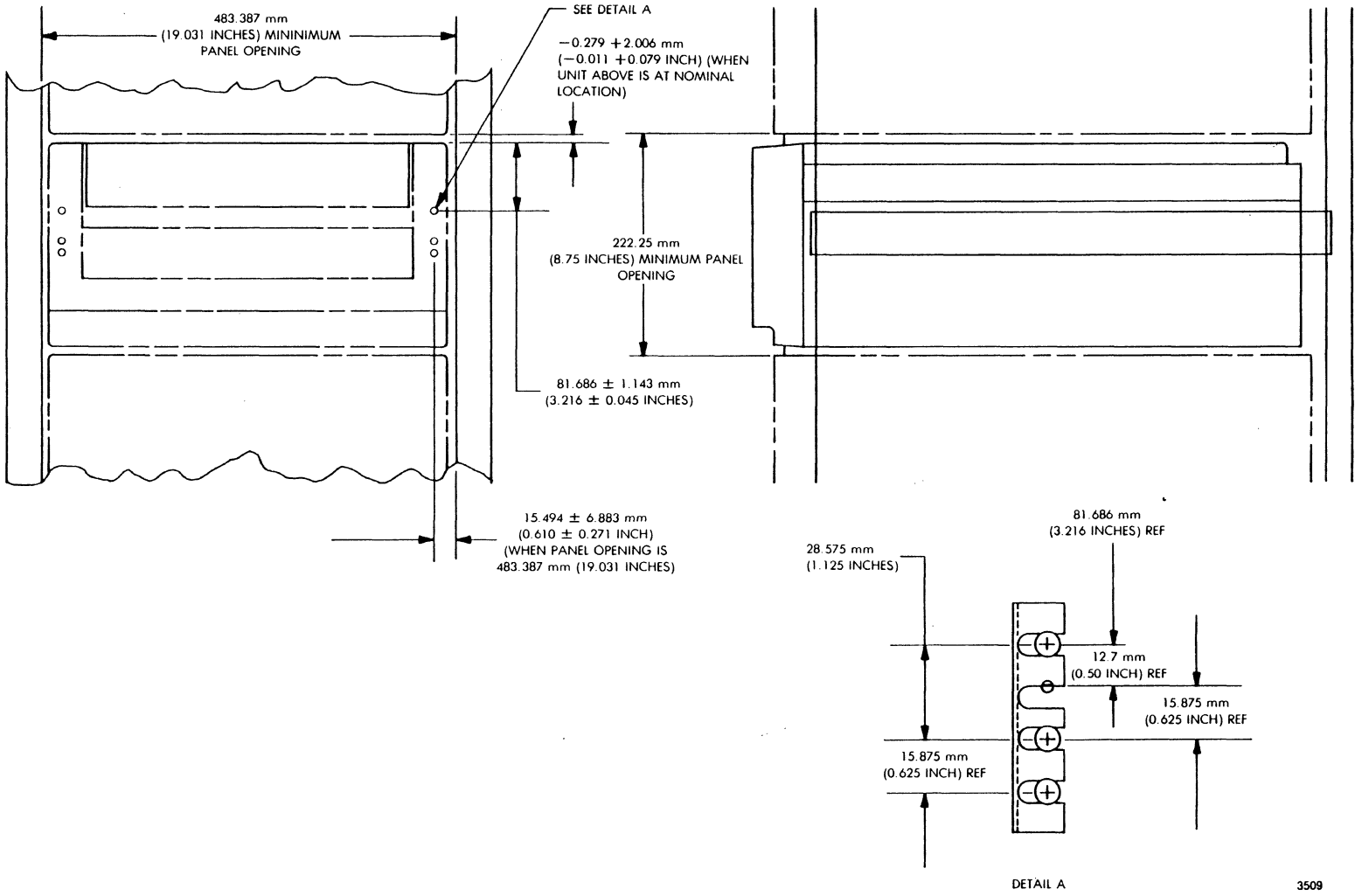
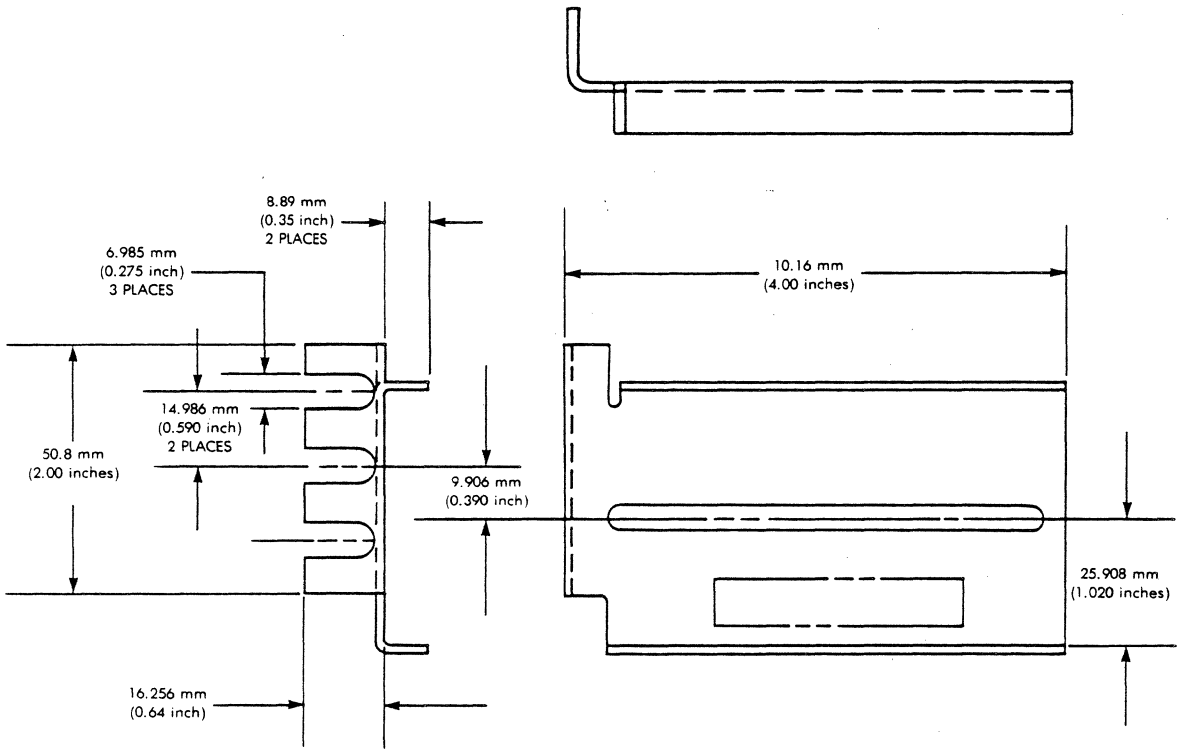


Figure 3-2. EIA Mounting Holes



NOTE:
1. THESE BRACKETS ARE USED ONLY IF DIRECT COMPATIBILITY WITH CIPHER MOUNTING IS REQUIRED.

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Figure 3-3. Cipher-Compatible Mounting Adapter Bracket

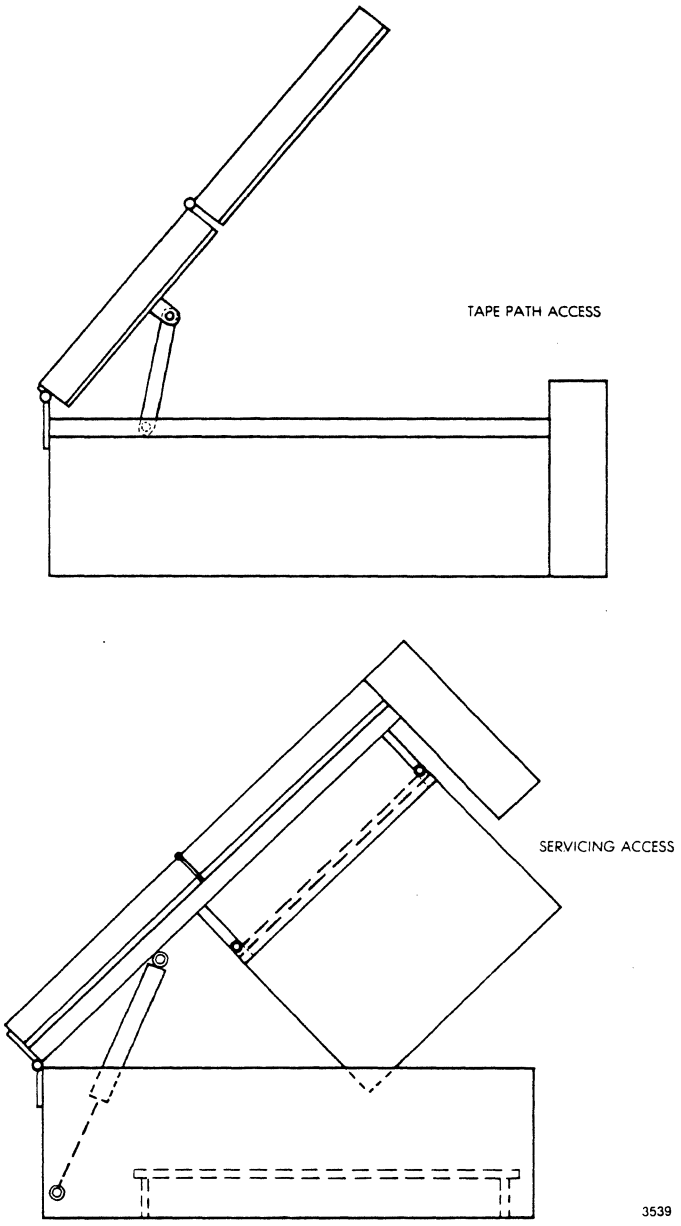


Figure 3-4. Access to Tape Drive

4.0 FUNCTIONAL CHARACTERISTICS

The FS1000 formatted tape drive has operating speeds of 0.63 m/s (25 ips), 1.27 m/s (50 ips), and 2.54 m/s (100 ips) and accelerates to and decelerates from these speeds at linear ramp times sufficient to achieve the specified access times. Upon stopping, the FS1000 reverses its direction and positions the tape such that, when commanded, the tape can be accelerated in the forward direction and still develop an ANSI minimum Interblock Gap (IBG). To eliminate a loss of time required to reposition the tape, the unit accepts commands within the IBG during a specified re-instruct time. Commands received after the re-instruct time must wait for completion of the repositioning cycle and a forward acceleration before the command can be executed. Tape motion continues at normal velocity if commands are received during the re-instruct time.

If a command is not received before the unit completes the repositioning operation, the unit will remain stopped until the next command is received. When a command is received while the unit is stopped, the unit accelerates to attain normal tape velocity and the command is executed.

Figure 4-1 illustrates the command re-instruct time and the acceleration and deceleration of the tape. Size of the IBG is selectable via the FUNCTION SELECT switch on the control panel, or the controller interface.

4.1 MECHANICAL AND ELECTRICAL SPECIFICATIONS

Mechanical and electrical specifications are listed in Table 4-1.

4.2 ELECTRICAL SAFETY

4.2.1 INTERLOCKS

The front and top doors are equipped with interlocks that stop tape motion when the doors are opened. The interlocks can be overridden by function code when necessary, to allow service access with the equipment in operation.

4.2.2 FAULT SENSING

The unit incorporates a set of power-up diagnostic subroutines that monitor power supply outputs and the condition of other critical circuits. Detected fault conditions are displayed on the operator panel. Refer to Paragraphs 5.5 and 6.0 for additional details.

4.2.3 POWER FAILURE PROTECTION

The unit is designed to prevent electrical damage when power is removed. All electrical input lines, except safety ground, are opened when the power switch is in the off state.

4.3 POWER SOURCE DISTURBANCES

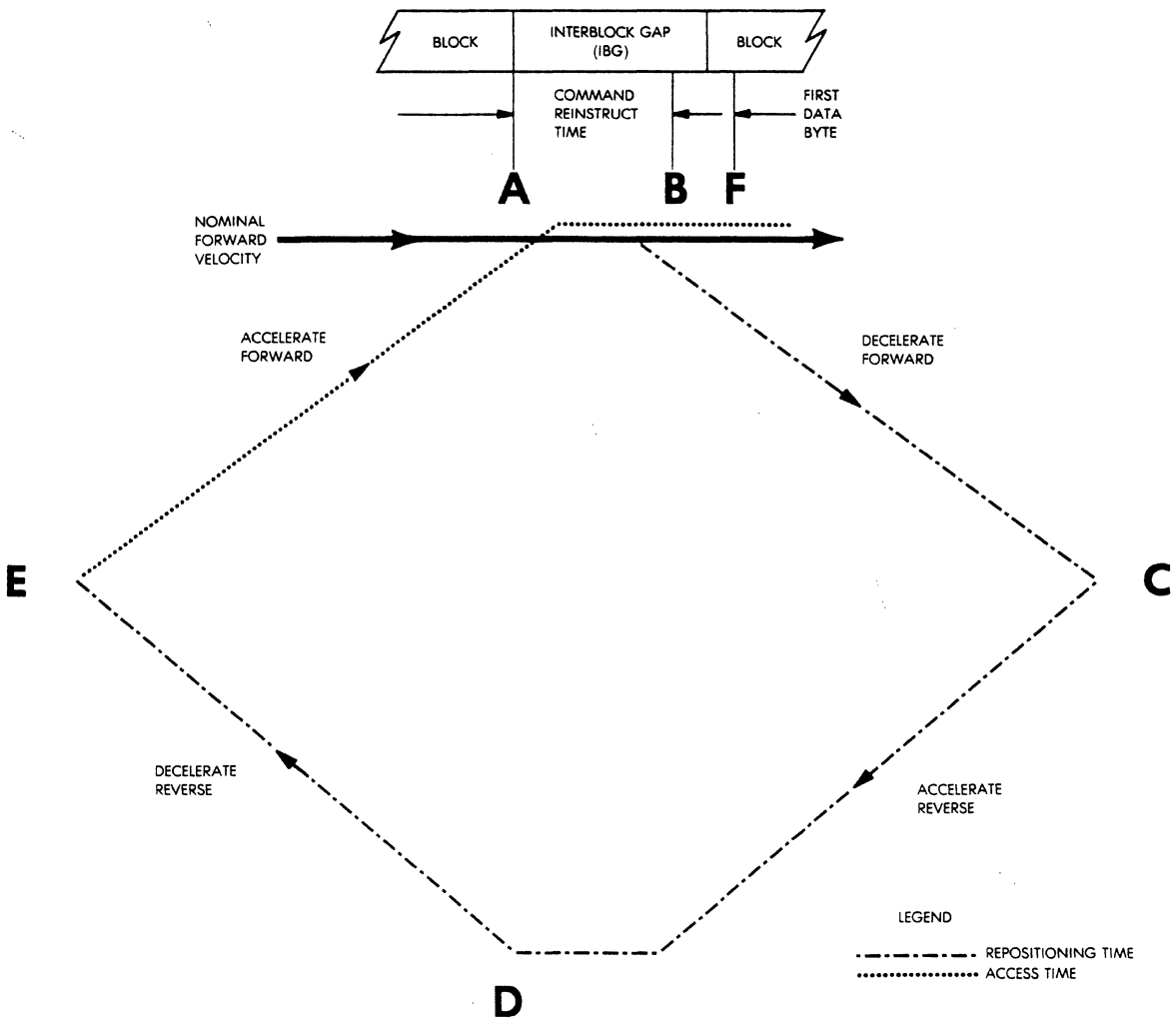
The tape drive is designed to withstand the following power source disturbances without damage.

4.3.1 VOLTAGE SURGE

A maximum of 150 percent above the nominal RMS voltage, recovering to 30 percent in 11 milliseconds, 20 percent in 50 milliseconds, and 10 percent in 3 seconds.

4.3.2 VOLTAGE SAG

A maximum of 100 percent below the nominal RMS voltage, recovering to 50 percent in 11 milliseconds, 30 percent in 50 milliseconds, and 10 percent in 0.5 second.



NOTES:

1. COMMAND REINSTRUCT TIME (A TO B): TAPE MOTION CONTINUES AT THE NOMINAL VELOCITY IF A COMMAND IS RECEIVED BETWEEN A AND B. IF A COMMAND ARRIVES AFTER THE END OF THE REINSTRUCT TIME (B), THERE IS A COMMAND OVERRUN, AND THE TAPE UNIT AUTOMATICALLY GOES THROUGH A REPOSITIONING CYCLE.
2. REPOSITIONING TIME (B TO C TO D TO E): IF A COMMAND HAS NOT BEEN RECEIVED BY THE TIME THE TAPE UNIT REACHES THE STOPPED STATE (E), THE TAPE REMAINS STOPPED AND AWAITS THE NEXT COMMAND.
3. ACCESS TIME (E TO A TO F): WHEN A COMMAND IS RECEIVED WHILE THE TAPE UNIT IS IN THE STOPPED STATE, IT ACCELERATES FORWARD FROM E TO ATTAIN NOMINAL VELOCITY AND EXECUTES THE COMMAND. (ACCESS TIME IS THE TIME BETWEEN THE STOPPED STATE AND THE POINT AT WHICH IDBY IS SET TRUE (LOW).

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Figure 4-1. Reinstruct, Positioning and Repositioning

Table 4-1
Mechanical and Electrical Specifications

Tape Tension	2.502N ±0.278N (9 ounces ± 1 ounce)		
Tape (computer grade) Width Thickness	Conforming to ANSI X3.40-1976 12.6492 ±0.0508 mm (0.498 ±0.002 inch) 0.0381 mm (1.5 mil) (nominal). 0.0254 mm (1.0 mil) tape (Memorex MRX XL3600 or equivalent) may be used.		
Reel Sizes	177.8, 215.9, 266.7 mm (7, 8.5, 10.5 inches)		
Autothread Reliability	95% including retries (Tape leader to be free of creases or folds and tape to be from media vendors approved by PPC)		
Rewind Time, 731.52 m (2400 feet) of tape	3 minutes (nominal)		
Tape Speed (nominal)	**Low Speed** 0.635 m/s (25 ips)	**High Speed** 1.27 m/s (50 ips)	 2.54 m/s (100 ips)
Record Density	63 c/mm (1600 cpi)	126 c/mm (3200 cpi)	63 c/mm (1600 cpi)
Access Time (nominal) Read, with 15.24 mm (0.6 inch) IBG Write, with 15.24 mm (0.6 inch) IBG	 55 ms 67 ms	 105 ms 111 ms	 225 ms 228 ms
Command Reinstruct Time (nominal) with 15.24 mm (0.6 inch) IBG Between write block commands Between read block commands	 10 ms 16 ms	 5 ms 8 ms	 2.5 ms 4 ms
Repositioning Time (nominal)	150 ms	290 ms	675 ms
Recording Characteristics	Records and reads data consistent with ANSI X3.39-1973		
Power (worst case) Start/Stop Mode	350 watts (averaged over a 10-second interval)		
Input Voltages	100v, 120v, 220v, or 240v (+10, −15%)		
Line Frequency	48—62 Hz		
Mechanical Shock Operating — rack mounted Non-Operating — rack mounted Packaged	 Shock machine or hammer — 1G for 10 ms Free-fall drop — 0.25 inch Hammer — 2G for 10 ms Free-fall drop — 0.5 inch Hammer — 25G for 15 ms Free-fall drop — 2 inches		
Vibration Operating Non-Operating Packaged	 5—14 Hz — 0.002 inch peak-to-peak displacement 14—16 Hz — 0.02 Gpk 16—51 Hz — 0.0015 inch peak-to-peak displacement 52—320 Hz — 0.2 Gpk 5—9 Hz — 0.05 inch peak-to-peak displacement 9—350 Hz — 0.2 Gpk 5—63 Hz — 0.01 inch peak-to-peak displacement 63—500 Hz — 2 Gpk		
Temperature Operating Non-Operating Shipping	 4.4°C to 40°C (40°F to 104°F) −28.9°C to 71°C (−20°F to 160°F) −28.9°C to 71°C (−20°F to 160°F)		
Humidity Operating Non-Operating	 15%—95% relative humidity without condensation 5%—95% without condensation		
Altitude Operating Non-Operating Shipping	 0 to 2,438 m (0 to 8,000 feet) 0 to 15,240 m (0 to 50,000 feet) 0 to 15,240 m (0 to 50,000 feet)		

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4.3.3 POWER OUTAGE

The drive will withstand a power outage of up to 11 milliseconds with no degradation in performance.

4.4 INRUSH CURRENT

The drive is designed to withstand initial inrush current under worst case combination of line voltage, load, and temperature, without equipment damage, blown fuses, or tripped circuit breakers. Inrush current levels shall not exceed the following limits operating at 100 or 120 volts.

- 60 amperes during the first half cycle
- 15 amperes after 300 milliseconds.

If the unit is operating at 220 or 240 volts, inrush current limits are as follows:

- 30 amperes during the first half cycle
- 7.5 amperes after 300 milliseconds.

5.0 CONTROLS AND INDICATORS

5.1 CONTROL PANEL

Figure 5-1 shows control and indicator positions on the control panel. The control panel contains six switches, two 7-segment displays, and nine indicator lamps.

5.2 CONTROL SWITCHES

5.2.1 POWER SWITCH

The two-position toggle type POWER switch controls application of ac power to the FS1000 Tape Drive. Power-up diagnostics are also initiated with the POWER switch.

5.2.2 LOAD/ON LINE SWITCH

When the LOAD/ON LINE switch is depressed once, with tape not tensioned, auto load begins. The switch is depressed a second time to place the drive On-line.

In the On-line mode, the drive will respond only to commands sent via the host interface (front panel switches, except LOAD/ON LINE will be ignored). All host interface command, data, and status lines are active in the On-line mode. In the Off-line mode, all host interface command lines (except Load-On-Line) are disabled. Data and status lines are not disabled but do not present any data to the interface in the Off-line mode.

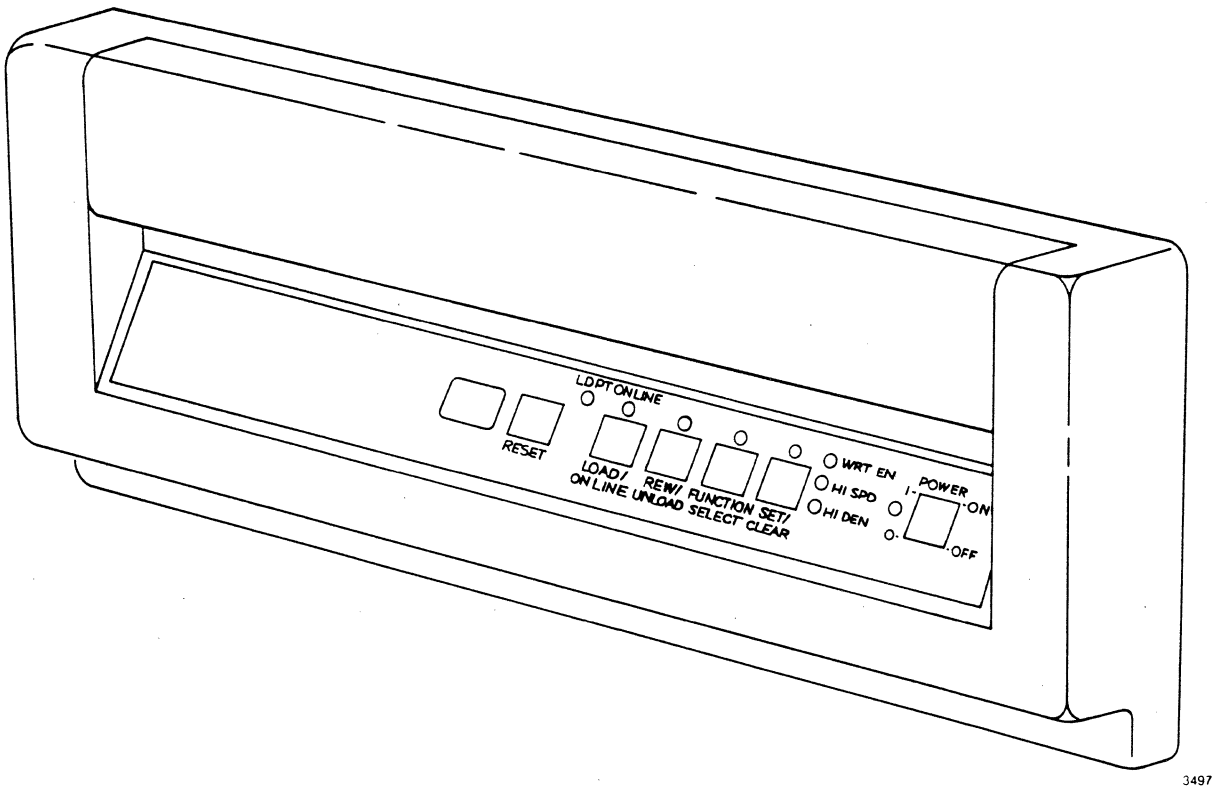

Figure 5-1. Control Switches and Indicators

If the front panel Load/On Line function selection option is cleared, two consecutive depressions of the switch result in the unit automatically going On-line when load point is reached. Subsequent depressions of the switch will cause the drive to toggle between the On-line and Off-line states. The unit is never allowed On-line prior to the tape reaching load point.

5.2.3 REW/UNLOAD SWITCH

When the REW/UNLOAD switch is depressed once, with the unit Off-line and beyond load point, a rewind to load point is initiated. When load point is reached, the switch is depressed a second time to unload the tape. Two consecutive depressions of the switch with the unit Off-line and beyond load point, will result in the tape automatically being unloaded at the end of the rewind operation.

5.2.4 FUNCTION SELECT SWITCH

When the FUNCTION SELECT switch is depressed and held for at least 3 seconds, with the drive Off-line and tape not in motion, the 7-segment displays will step through the function codes (listed in Table 5-1). While the switch is held, the displays will continue to step through the codes at the rate of one per second. The LOAD/ON LINE and REW/UNLOAD switches are disabled when mode selection is in process. The RESET switch is used to end the function selection operation. Detailed instructions for using the Function Select mode are contained in manual numbers 110831 and 111311.

5.2.5 SET/CLEAR SWITCH

When the function selection operation is in process, depressing the SET/CLEAR switch sets the function code currently on the 7-segment display to true or clears it to false. Subsequent depressions of the switch, without changing the displayed function code, will result in the selected code being toggled between the true and false states. If the function code displayed is one of a multiple choice group, setting one code within the group will clear the previous choice for that group. If one of the diagnostic codes has already been set, the functions of the front panel switches and indicators are modified. Refer to the description of the appropriate diagnostic code for switch functions.

5.2.6 RESET SWITCH

Depressing the RESET switch with the unit Off-line, terminates the last command in process, clears a load fault and terminates the mode selection operation. Depressing the switch again has no effect.

5.3 INDICATORS

5.3.1 POWER INDICATOR

This indicator is illuminated when secondary ac power is present.

5.3.2 LD PT (LOAD POINT) INDICATOR

This indicator flashes during a load operation and is steadily illuminated when the tape is at load point.

5.3.3 ON LINE INDICATOR

When the LOAD/ON LINE switch has been depressed twice and mode 31 (refer to Table 5-1) is true, the indicator flashes during a load operation, and lights continuously when load point is reached. If mode 31 is false, the indicator remains off until load point is reached and the LOAD/ON LINE switch is depressed for the second time. The indicator then lights continuously.

Table 5-1
Function Selection Codes

Code	Operational Codes		Notes
	Code Set (LED On)	Code Cleared (LED Off)	
–0	Unit address 0 selected	Unit address 0 deselected	
–1	Unit address 1 selected	Unit address 1 deselected	
–2	Unit address 2 selected	Unit address 2 deselected	
–3	Unit address 3 selected	Unit address 3 deselected	
–4	Unit address 4 selected	Unit address 4 deselected	1
–5	Unit address 5 selected	Unit address 5 deselected	
–6	Unit address 6 selected	Unit address 6 deselected	
–7	Unit address 7 selected	Unit address 7 deselected	
10	Local speed select. Function codes 11, 12, and 13 enabled.	Speed selection accomplished via interface. Function codes 11, 12, and 13 disabled.	
11	Speed = 0.635 m/s (25 ips) Density = 63 c/mm (1600 cpi) selected	Deselected	1
12	Speed = 1.27 m/s (50 ips) Density = 126 c/mm (3200 cpi) selected	Deselected	
13	Speed = 2.54 m/s (100 ips) Density = 63 c/mm (1600 cpi) selected	Deselected	
20	Start/stop mode selected. Unit will function as a start/stop drive while writing at 0.635 m/s (25 ips). Unit will reposition for all other commands and speeds.	Streaming mode selected. Unit will reposition if next command not received during reinstruct period.	
21	Gap length selected by codes 22—29. Extended gap command from I/O (IRTH1) is ignored.	If extended gap is not selected via I/O (IRTH1 high), default to 0.6 inch gap. If extended gap is selected via I/O (IRTH1 low), gap length is as indicated by codes 22—29.	
22	0.6 inch gap selected	Deselected	1
23	0.9 inch gap selected	Deselected	
24	1.2 inch gap selected	Deselected	
25	2.4 inch gap selected	Deselected	
26	4.8 inch gap selected	Deselected	
27	6.0 inch gap selected	Deselected	
28	8.0 inch gap selected	Deselected	
29	10.0 inch gap selected	Deselected	
30	Tape is automatically tensioned and brought to BOT, and (if unit was previously on line) unit is placed on line. If unit was not previously on line, tape is tensioned and brought to BOT, unit then idles. Occurs when tape is in path immediately after primary power is applied.	No autoload function; if tape is in path, it will sit idle.	3
31	Tape is loaded and brought to BOT with single depression of LOAD/ON LINE switch. Second switch depression after tape reaches BOT is required to place drive on line.	Tape is loaded and brought to BOT with single depression of LOAD/ON LINE switch. Second switch depression prior to tape reaching BOT causes drive to automatically go on line when tape reaches BOT.	

NOTES:
1. Only one code within this group can be set at a time. Setting a code clears the previously set code within the group. The individual codes within the group cannot be cleared independently.
2. Diagnostic use only.
3. Autoload function (code 30) must be set before tape is tensioned.
4. If RESET switch is pressed, unit will return to Function Select mode with code 50 displayed. To return to normal operation, set mode 50 and depress RESET.

Continued

Table 5-1
Function Selection Codes

Code	Operational Codes		Notes
	Code Set (LED On)	Code Cleared (LED Off)	
32	External write data parity bit is selected — controller generates odd parity	Return to normal operation — internal parity generation	
	Diagnostic Codes		
50	Normal operation selected — default code for diagnostic routines.	Diagnostic routine selected	1
51	Manual control of tape motion functions is provided by front panel controls. Refer to Paragraph 5.5.	Diagnostic mode 51 deselected	4
52	Manual control of tape shuttle function is provided by front panel controls. Refer to Paragraph 5.5.	Diagnostic mode 52 deselected	4
53	Provides front panel monitoring of tension and velocity encoders and various sensors. Refer to Paragraph 5.5.	Diagnostic mode 53 deselected	4
54	Provides front panel control of self-adjustment diagnostics. Refer to Paragraph 5.5.	Diagnostic mode 54 deselected	4
55	Provides front panel examination and display of various data from the Control Write PCBA. Refer to Paragraph 5.5.	Diagnostic mode 55 deselected	4
60	Provides manual override of various safety interlocks. Refer to Paragraph 5.5. ***WARNING*** ***THIS CODE IS INTENDED FOR USE DURING SERVICING BY QUALIFIED TECHNICIANS ONLY. IMPROPER USE CAN RESULT IN INJURY TO PERSONNEL AND EQUIPMENT DAMAGE.***	Diagnostic mode 60 deselected	4
61	Provides manual override of various motion control corrections. Refer to Paragraph 5.5. *CAUTION* *THIS CODE IS INTENDED FOR USE DURING SERVICING BY QUALIFIED TECHNICIANS ONLY. IMPROPER USE CAN RESULT IN EQUIPMENT DAMAGE.*	Diagnostic mode 61 deselected	4

NOTES:
1. Only one code within this group can be set at a time. Setting a code clears the previously set code within the group. The individual codes within the group cannot be cleared independently.
2. Diagnostic use only.
3. Autoload function (code 30) must be set before tape is tensioned.
4. If RESET switch is pressed, unit will return to Function Select mode with code 50 displayed. To return to normal operation, set code 50 and depress RESET.

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5.3.4 REW/UNLOAD INDICATOR

When the REW/UNLOAD switch is depressed twice while the unit is Off-line and loaded, the indicator will flash as tape is rewound and unloaded. If the switch is depressed once, the indicator is illuminated during rewind and extinguishes when tape stops at BOT. When the switch is depressed again, the indicator will flash as tape is unloaded.

5.3.5 FUNCTION SELECT INDICATOR

This indicator is illuminated when the unit is in the Function Select state. Depressing the RESET switch causes the indicator to go off.

5.3.6 SET/CLEAR INDICATOR

This indicator is illuminated when the unit is in the Function Select state, and the displayed function code is true.

5.3.7 WRT EN INDICATOR

Indicates that a reel of tape with a write enable ring is loaded on the drive.

5.3.8 HI SPD INDICATOR

Indicates that one of the drive's higher operating speeds (1.27 m/s [50 ips] or 2.54 m/s [100 ips]) has been selected.

5.3.9 HI DEN INDICATOR

Indicates that the drive's high recording density has been selected.

5.4 SEVEN SEGMENT DISPLAYS

Two 7-segment displays are located on the front panel as illustrated in Figure 5-1. These displays indicate the unit address, function select codes when the drive is in the function select condition, and diagnostic codes.

A continually illuminated code indicates that diagnostic checks are in process. If a fault is identified, the displays flash the fault code until power is switched off or RESET is depressed.

5.5 DIAGNOSTIC

Selection of the diagnostic codes listed in Table 5-1 changes the functions of the front panel controls and indicators. The purpose of each of these codes and the resultant switch and indicator functions are given in the following paragraphs.

5.5.1 CODE 51

When code 51 is set and a tape is loaded, the functions of the front panel controls and indicators are changed to provide manual control of tape motion. Functions available are Forward, Reverse, Stop, Load, and EOT/BOT Cycle. Tape motion will be at the speed preselected by the operator using Function Select codes 11, 12, and 13. Functions of the front panel controls and indicators with code 51 set, are shown in Figure 5-2.

The Forward, Reverse, and Stop functions are self-explanatory. Depressing the Load/Cycle switch with a tape reel in place on the supply hub but tape not threaded will initiate an autoload operation. Tape will thread, tension, advance to load point, and stop. Depressing the Load/Cycle switch with tape loaded will initiate the EOT/BOT Cycle function. The EOT/BOT Cycle function interacts with Forward and Reverse. With EOT/BOT Cycle off, the drive will move tape in the selected direction and stop when either the EOT or BOT marker is detected.

With EOT/BOT Cycle on, tape motion will automatically reverse when either marker is detected, and tape will cycle continuously until stopped by the operator. Depressing the RESET switch will cause the drive to exit code 51 and revert to Function Select mode with code 50 displayed.

5.5.2 CODE 52

Selection of code 52 provides a shuttle function at the speed preselected by the operator using Function Select codes 11, 12, and 13. Functions of the front panel controls and indicators, with code 52 set, are shown in Figure 5-3.

The forward or reverse shuttle length is displayed by pressing and releasing the appropriate switch. Depressing the Load/Decrement Length switch with a tape reel in place on the supply hub but tape not threaded will initiate an autoload operation. Tape will thread, tension, advance to load point, and stop. To change the shuttle length, press and hold the Forward or Reverse Length display switch, and simultaneously press and hold the Increment Length or Decrement Length switch until the desired shuttle length is displayed. Length is displayed in hexadecimal tach lines after ramp-up, most significant byte first (for 1 second), then the least significant byte. When incrementing or decrementing, each time the LSB goes to 0, the MSB will be displayed for 1 second. Shuttling is started and stopped by depressing the Shuttle/Stop switch. If EOT is detected during forward motion, the tape will rewind to BOT and shuttling will restart. Depressing the RESET switch will cause the drive to exit code 52 and revert to Function Select mode with code 50 displayed.

5.5.3 CODE 53

Selection of code 53 provides front panel monitoring of the tension or velocity encoder. The front panel indicators allow monitoring of the unit sensors. Functions of the front panel controls and indicators, with code 53 set, are shown in Figure 5-4.

When Tension Look is depressed, the tension encoder count is shown on the 7-segment display, and the sensor functions shown over the indicators (Figure 5-4) are displayed on the indicators. When (Velocity Look) is depressed, the velocity encoder count is shown on the 7-segment display, and the sensor functions shown under the indicators (in parentheses) are displayed on the indicators. Depressing the RESET switch will cause the drive to exit code 53 and revert to Function Select mode with code 50 displayed.

5.5.4 CODE 54

Selection of code 54 provides front panel access to four adjustment diagnostic routines; SU/TU DAC MID Self Adjustment, SU Load Pulse Self Adjustment, SU/TU Load Speed Self Adjustment, and Motor Torque Factor Self Adjustment. Performance of the SU Load Pulse Self Adjustment and SU/TU Load Speed Self Adjustment requires a 10.5 inch reel of tape to be locked on the supply hub but not threaded. The Motor Self Adjust requires the use of an 8.5 inch reel of tape. Functions of the front panel controls and indicators, with code 54 set, are shown in Figure 5-5. Depressing the RESET switch will cause the drive to exit code 54 and revert to Function Select mode with code 50 displayed.

5.5.5 CODE 55

Selection of code 55 provides front panel access to and display of data stored in memory that may be required during maintenance operations. Functions of the front panel controls and indicators with code 55 set are shown in Figure 5-6.

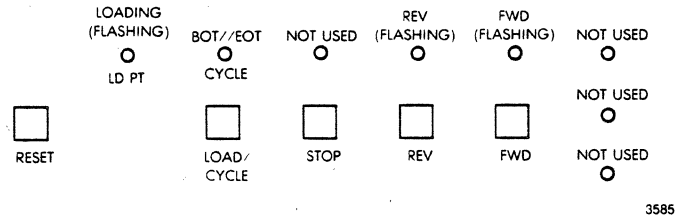

Figure 5-2. Code 51 Control/Indicator Functions

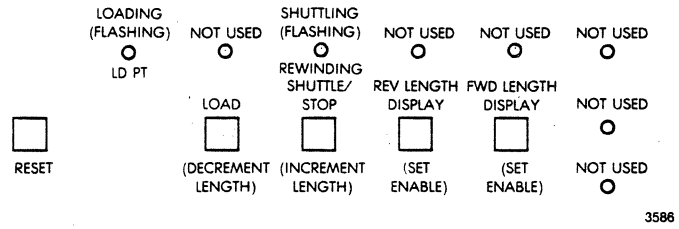

Figure 5-3. Code 52 Control/Indicator Functions

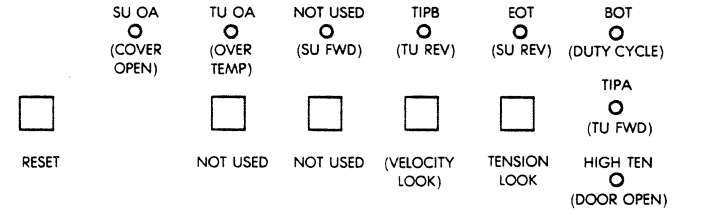

Figure 5-4. Code 53 Control/Indicator Functions

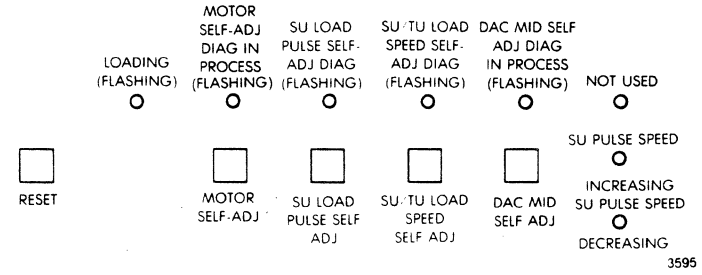

Figure 5-5. Code 54 Control/Indicator Functions

When the Prom Version Examine/Display switch is depressed, the associated indicator will flash and the PROM 0 version will be shown on the 7-segment display. The version number will be shown as four sequential bytes (e.g., first byte, 11; second byte 22; third byte, 50; fourth byte, 01: equals PROM 0 version 112250-01). Given a PROM 0 version of 112250-01, PROMs 1—3 would be 112251-01, 112252-01, and 112253-01, respectively. PROM 1—3 version numbers are not displayed.

Depressing the NOVRAM Motor Factor Examine/Display switch causes the associated indicator to flash while the contents of the NOVRAM motor factor table are shown on the 7-segment display. The table consists of 20 bytes which are presented sequentially. The factors displayed and their byte numbers are given in the following list. Takeup reel tension (TU TENSION), bytes 1 and 2; takeup motor drag (TU MDRAG), bytes 3 and 4; takeup motor acceleration (TU ACCEL), bytes 5 and 6; head drag (HDRAG), bytes 7 and 8; supply reel tension (SU TENSION), bytes 9 and 10; supply motor drag (SU MDRAG), bytes 11 and 12; supply motor acceleration (SU ACCEL), bytes 13 and 14; takeup reel load speed (TU LD SPD), byte 15; supply reel load speed (SU LD SPD), byte 16; supply reel load pulse, reverse (SU LD PULSE REV), byte 17; supply reel load pulse, forward (SU LD PULSE FWD), byte 18; byte 19 not used; takeup/supply digital analog converter mid value (TU/SU DACMID), byte 20. The most significant (left) nibble when added to $1F8_{16}$ will equal the TU DACMID. The least significant (right) nibble when added to $1F8_{16}$ will equal the SU DACMID.

Depressing the Unit Configuration Examine/Display switch causes the associated indicator to flash while the Unit Configuration is shown on the 7-segment display. The configuration will be shown as CX, where C stands for Configuration and X represents a hexadecimal (Base 16) number from 0 to F. Depressing the RESET switch will cause the drive to exit code 55 and revert to Function Select mode with code 50 displayed.

5.5.6 CODE 60

Selection of code 60 provides manual override, via the front panel controls, of four safety interlocks designed into the drive. The front panel indicators flash to provide a display of the interlock features that have been defeated. Functions of the front panel controls and indicators, with code 60 set, are shown in Figure 5-7. Depressing the RESET switch will cause the drive to exit code 60 and revert to Function Select mode with code 50 displayed.

WARNING

CODE 60 OVERRIDES SAFETY FEATURES BUILT INTO THE DRIVE TO PROTECT THE OPERATOR FROM INJURY AND THE EQUIPMENT FROM DAMAGE. IT IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE TECHNICIANS.

5.5.7 CODE 61

Selection of code 61 provides manual override, via the front panel controls, of four motion control correction functions designed into the drive. The front panel indicators flash to provide a display of the correction functions that have been defeated. Functions of the front panel controls and indicators with code 61 set, are shown in Figure 5-8. Depressing the RESET switch will cause the drive to exit code 60 and revert to Function Select mode with code 50 displayed.

CAUTION

CODE 61 DISABLES CRITICAL CORRECTION FEATURES BUILT INTO THE DRIVE THAT ARE REQUIRED FOR NORMAL, SAFE OPERATION. IF MISUSED, DAMAGE TO THE EQUIPMENT CAN OCCUR. CODE 61 IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE TECHNICIANS.

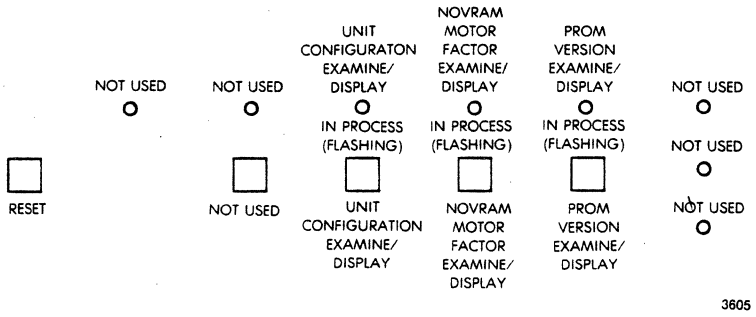

Figure 5-6. Code 55 Control/Indicator Functions

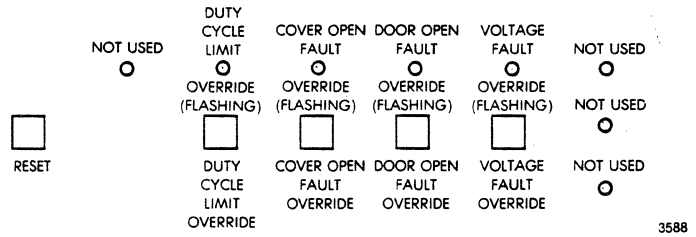

Figure 5-7. Code 60 Control/Indicator Functions

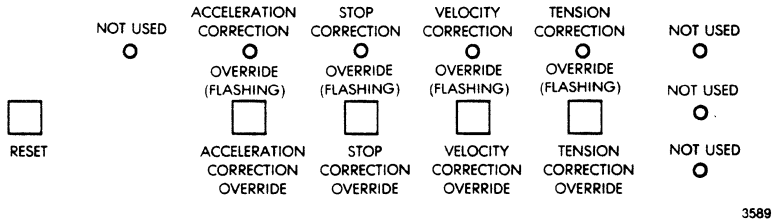

Figure 5-8. Code 61 Control/Indicator Functions

6.0 DIAGNOSTICS AND TEST

6.1 DIAGNOSTIC LEVELS

Three levels of diagnostics are provided to monitor tape drive operation. If a fault condition is detected, test execution stops and a fault code is flashed on the operator panel displays. The display continues flashing until power is switched off or RESET is depressed. Depressing the RESET switch initiates the remaining portions of the diagnostics provided no tape or drive damage will result. Diagnostic codes isolate faults to PCBAs and subassemblies. Diagnostic firmware is contained in socket-mounted ROMs for routine flexibility.

6.2 POWER-UP DIAGNOSTICS

This diagnostic set runs automatically whenever power is applied and a tape reel is not loaded. The following functions are checked.

(1) Power supply voltage output, except +5v

(2) Control microprocessor operation

(3) Formatter write sequencer*

(4) Formatter read data electronics*

(5) Formatter file mark and ID generation and detection circuits*

(6) Microprocessor communications bus (PMS bus)*

6.3 OPERATOR INITIATED DIAGNOSTICS

This set of diagnostics is initiated by the operator, using the FUNCTION SELECT switch. A reel of pre-recorded tape must be loaded. The following functions are checked.

(1) Power supply voltage output, except +5v

(2) Supply and takeup reel motors, servo power amplifiers, and motion functions

(3) Read and write circuits using a work tape

6.4 CONTINUOUS DIAGNOSTICS

When tape is loaded and in motion, this set of diagnostics continuously checks the following.

(1) Power supply voltage outputs

(2) Blower operation

(3) Supply and takeup reel motors, servo power amplifiers, and motion functions.

6.5 TEST

A test mode is available to exercise the drive Off-line with a tape loaded. This mode is selected using the FUNCTION SELECT switch. It permits a technician to make adjustments without intervention by the host system connected to the host interface.

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* Fault conditions detected cause line ISGL to go true (low).

7.0 INTERFACE DESCRIPTION

7.1 BASIC INTERFACE CHARACTERISTICS

Two 50-lead flat cables are used for the formatter-to-controller interface. Interface lines to and from the formatter are TTL compatible, single-ended. Pulsewidths are 200 nanoseconds or greater, unless otherwise noted. See Figure 7-1 for the interface configuration.

Formatter-to-controller drivers have a current sinking capability of 24 mA maximum (74LS240 or equivalent). Terminator circuits on the formatter consist of a 220-ohm resistor to + 5v and a 330-ohm resistor to ground as shown in Figure 7-1. Receivers are 74LS240.

A low level on the interface line is a logical true condition. A disconnected interface line is interpreted as a logical false signal by the formatter logic.

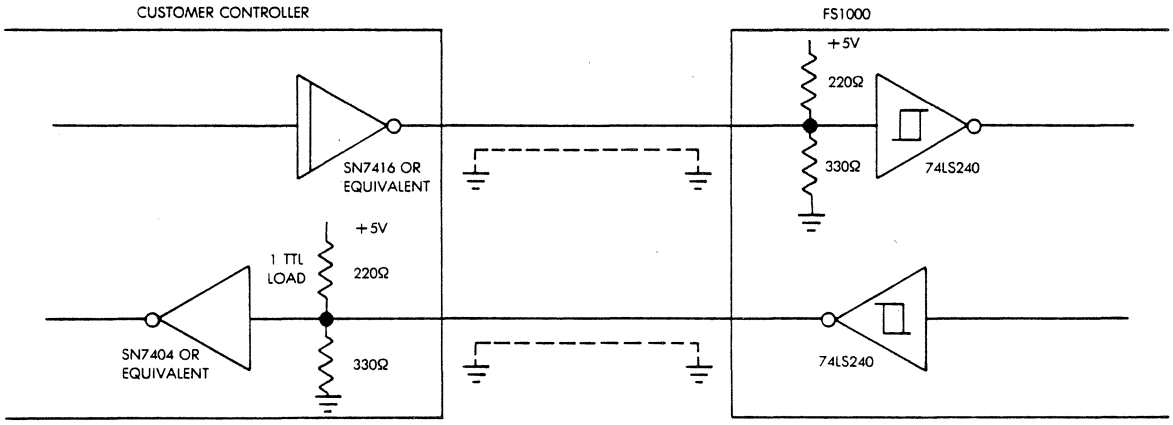
7.1.1 CABLE SPECIFICATIONS

7.1.1.1 50-Lead Flat Cable

The following cable length specifications apply to 50-lead flat cable, 28 AWG (3M 3365-50 or equivalent). Two cables are used at the controller interface to the drive.

(1) For a cable connecting a controller to a single drive, the length of the cable is limited to 6.1 metres (20 feet). Longer cable lengths are possible with the use of active repeaters.

(2) For a cable connecting two or more drives in a daisy-chain configuration to a controller, the total cable length is limited to 6.1 metres (20 feet). Longer cable lengths are possible with the use of active repeaters.



NOTES: 1. NO MORE THAN 1 TTL LOAD SHOULD BE DRIVEN BY INTERFACE SIGNALS FROM THE CONTROLLER.
2. IMPROVED NOISE MARGIN WILL BE ACHIEVED IF THE RECEIVER IN THE CUSTOMER CONTROLLER SHOWN ABOVE IS REPLACED WITH A SN74LS14 OR EQUIVALENT DEVICE HAVING SCHMITT TRIGGER INPUT CHARACTERISTICS. THIS IMPROVEMENT IN SIGNAL-TO-NOISE RATIO BECOMES MORE SIGNIFICANT AS CABLE LENGTHS INCREASE TO THE MAXIMUM ALLOWABLE SIZE.

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Figure 7-1. Interface Configuration

7.2 INTERFACE SIGNALS

All formatter interface signals are designated by the prefix "I" on all interface schematic drawings. The active level on the interface corresponds to a logic low so any disconnected line results in a logic high.

- Logic Low = 0.05v to 0.5v = True
- Logic High = 2.5v to 5.0v = False

Refer to Figure 7-2 for interface connections.

7.3 CONTROLLER-TO-FORMATTER INTERFACE LINES

7.3.1 FORMATTER ADDRESS (IFAD) AND TRANSPORT ADDRESS (ITAD0, ITAD1)

These three lines in combination, allow the controller to select one of several drives connected to the controller. The maximum number of drives that may be connected in a daisy-chain configuration is as follows:

(1) Eight FS1000 drives

or

(2) Four FS1000 drives and one standard formatted start/stop drive. The standard formatted start/stop drive may, in turn, have up to three unformatted start/stop drives connected in the standard daisy-chain configuration as shown in Figure 7-3. Only the final unit in the chain requires the installation of terminating resistors.

Signal levels and the resulting address selection are listed in Table 7-1.

7.3.2 INITIATE COMMAND (IGO)

This pulse initiates the commands listed in Table 7-2. The trailing edge of IGO strobes the signals described in Paragraphs 7.3.3—7.3.8 into the formatter. At the same time, the Formatter Busy signal (IFBY) is set low.

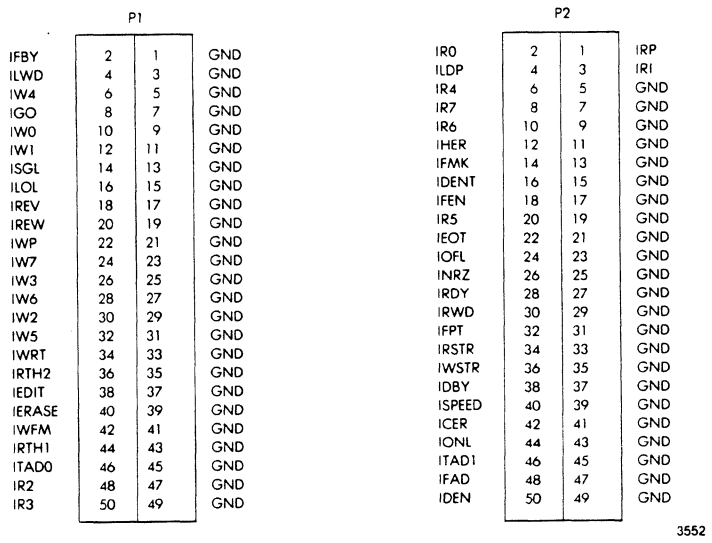

Figure 7-2. Formatter/Controller Interface Connector

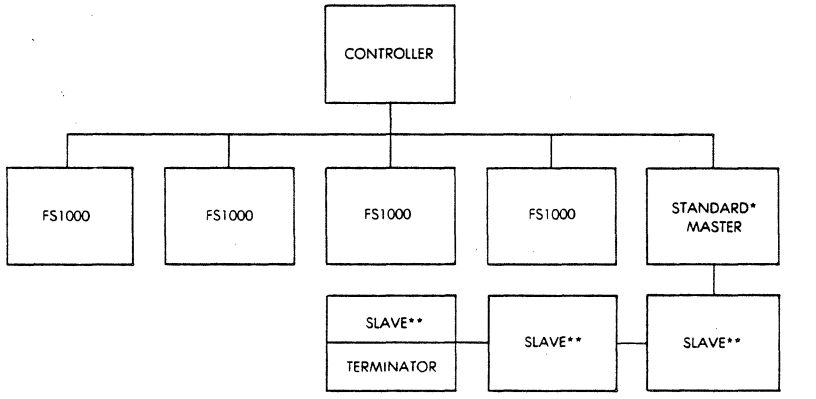

Figure 7-3. Mixed Daisy-Chain Configuration

Table 7-1
Transport Address Selection

Address	IFAD	ITAD0	ITAD1
0	H	H	H
1	H	H	L
2	H	L	H
3	H	L	L
4	L	H	H
5	L	H	L
6	L	L	H
7	L	L	L

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Table 7-2
Formatter Commands Initiated by IGO Pulse

Command	IREV	IWRT	IWFM	IEDIT	IERASE
Read Forward	H	H	H	H	H
Read Reverse (Normal)	L	H	H	H	H
Read Reverse (Edit)	L	H	H	L	H
Write	H	L	H	H	H
Write File Mark	H	L	L	H	H
Edit	H	L	H	L	H
Variable Length Erase	H	L	H	H	L
Fixed Length Erase	H	L	L	H	L
Space Forward	H	H	H	H	L
Space Reverse	L	H	H	H	L
File Mark Search Forward — with data	H	H	L	H	H
File Mark Search Reverse — with data	L	H	L	H	H
File Mark Search Forward — without data	H	H	L	H	L
File Mark Search Reverse — without data	L	H	L	H	L
Diagnostic	H	H	L	L	H
Data Security Erase	H	L	L	L	L
Select 126 c/mm (3200 cpi)/1.27 m/s (50 ips)	L	H	L	L	L

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7.3.3 REVERSE/FORWARD (IREV)

This signal specifies forward or reverse tape motion. It is used in combination with other signals to form the formatter commands listed in Table 7-2.

Low = Reverse

High = Forward

7.3.4 WRITE/READ (IWRT)

This signal specifies the operating mode of the system. It is used in combination with other signals to form the formatter commands listed in Table 7-2.

Low = Write

High = Read

7.3.5 WRITE FILE MARK (IWFM)

This signal causes a Write File Mark to be written on the tape, if IWRT is also low during this time. It is used in combination with other signals to form the formatter commands listed in Table 7-2.

7.3.6 EDIT (IEDIT)

This is an additional command line used in conjunction with IREV, IWRT, IWFM, and IERASE to edit a record on tape, initiate diagnostics or data security erase, and select the high density mode. Command signal combinations are listed in Table 7-2.

7.3.7 ERASE (IERASE)

This is an additional command line used during erase and file mark search operations. It is used in combination with other signals to form the formatter commands listed in Table 7-2.

7.3.8 DENSITY SELECT (IRTH2)

The IRTH2 signal specifies the data density during a write command. Selection is accomplished at BOT during a write operation.

- Low = 126 c/mm (3200 cpi) (PE)
- High = 63 c/mm (1600 cpi) (PE)

7.3.9 SPEED SELECT (IDEN)

IDEN is used to select tape speed.

- High = 0.635 m/s (25 ips)
- Low = 2.54 m/s (100 ips)

This line inactive if 1.27 m/s (50 ips) 126 c/mm (3200 cpi) selected.

7.3.10 REWIND (IREW)

IREW is a pulse (200 nanoseconds minimum) that causes the drive to rewind to Load Point, providing the unit is Ready and On-line. The pulse does not cause the formatter to become busy.

7.3.11 OFF-LINE (IOFL)

This pulse (200 nanoseconds minimum) causes the drive to be placed in the Off-line mode of operation and to perform a rewind/unload operation. IOFL does not cause the formatter to become busy.

7.3.12 LOAD-ON-LINE COMMAND (ILOL)

This pulse (200 nanoseconds minimum) causes the unit to be placed On-line and to rewind to BOT if tape was loaded. If tape was not loaded, it will be loaded, rewound to BOT (if necessary) and the drive placed On-line.

7.3.13 FORMATTER ENABLE (IFEN)

This is a level which, when low, enables the formatter interface. A high level, disables the interface, resets all status on the interface, and stops tape motion in the FS1000 after completion of the operation in process.

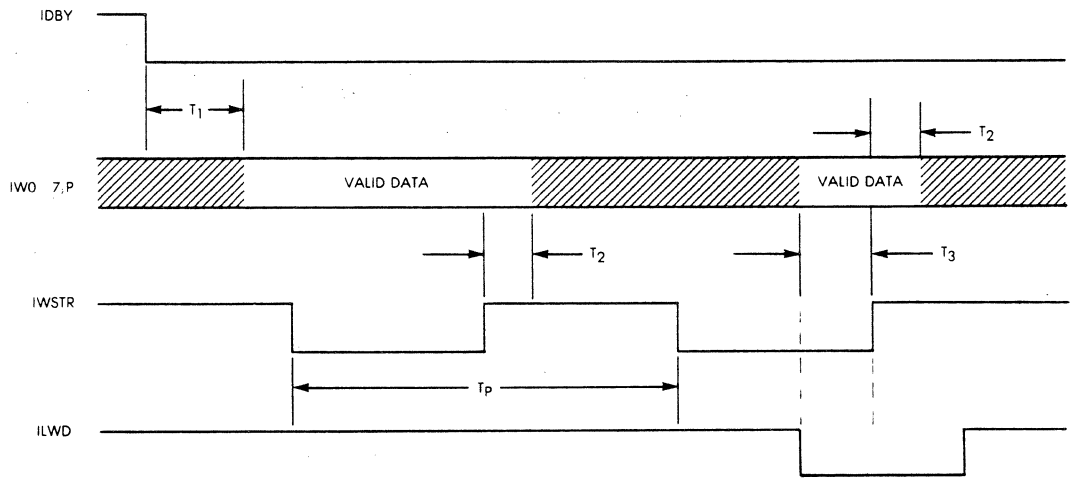
7.3.14 WRITE DATA LINES (IW0—IW7)

These eight lines transmit write data from the controller to the formatter. The eight data bits on the Write Data lines are written onto the corresponding tracks on tape. IW7 corresponds to the least significant bit of the character.

The first character of the data record should be available on these lines within forty character periods after Data Busy goes true and should remain true until after the trailing edge of the first Write Strobe pulse issued by the formatter. See Figure 7-4 for timing relationships. The next character must then be set up a minimum of 100 nanoseconds before the next trailing edge (low to high) of IWSTR. Subsequent characters will be processed in this way until Last Word is set low, indicating that the last character is being transferred. Table 7-3 identifies the Write Data lines with regard to interface identification, ANSI track number and binary weight.

7.3.15 WRITE DATA PARITY (IWP)

This line is used only when external parity generation is selected via the front panel function codes. External parity generation requires the customer to generate odd parity on the Write Data lines and apply this parity bit to IWP. Setup timing requirements for this line are consistent with requirements for IW0—IW7.



NOTES:
$T_1 \leq$ 40 CHARACTER TIMES
$T_2 \geq$ 0 NANOSECONDS
$T_3 \geq$ 50 NANOSECONDS
T_P = 1 CHARACTER TIME
25 µS @ 0.635 M/S (25 IPS)
6.25 µS @ 1.27 M/S (50 IPS)

Figure 7-4. Write Data Timing

Table 7-3
Data Binary Weight Identification

Write Line	Binary Weight	Pertec Interface Channel	ANSI Track
IW7	0	7	2
IW6	1	6	8
IW5	2	5	1
IW4	3	4	9
IW3	4	3	3
IW2	5	2	5
IW1	6	1	6
IW0	7	0	7
IWP	P	P	4

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7.3.16 LAST WORD (ILWD)

During the execution of a Write command or an Erase (Variable Length) command, this pulse is used to indicate that the next character to be strobed into the formatter is the last character of the record. The line will be set low by the controller a minimum of 50 nanoseconds before the next trailing edge (low to high) of IWSTR.

7.3.17 GAP LENGTH (IRTH1)

The Gap Length (IRTH1) signal is used to control the length of the interblock gap written at the end of a write command. IRTH1 is tested during the time that the IGO signal goes low to transfer a write command to the FS1000. If IRTH1 is high at this time, the length of the interblock gap will be 15.24 mm (0.6 inch). If IRTH1 is low, the interblock gap will be determined by function select codes.

7.3.18 EXTENDED GAP SELECTION

Extended gap selection is accomplished using front panel function select modes 21—29. Operation of these modes is defined as follows:

NOTE

Mode 21 can either be set or reset. Only one of modes 22—29 can be set at a time.

Mode 21 Reset — If extended gap is not selected via the interface, unit defaults to 0.6 inch gap. If extended gap is selected via the interface, gap length is as specified by modes 22—29 (Table 5-1).

Mode 21 Set — Gap length is as specified by modes 22—29. Extended gap command from interface is ignored.

7.4 FORMATTER-TO-CONTROLLER INTERFACE LINES

7.4.1 FORMATTER BUSY (IFBY)

When a command is issued to the formatter, IFBY goes low at the trailing edge of IGO and remains low until the command is executed and the drive is repositioning.

7.4.2 DATA BUSY (IDBY)

The IDBY signal is set low in the following modes.

(1) Write: Tape has reached operating speed and traversed the defined IBG.

(2) Read: Tape has reached operating speed.

IDBY is reset when the read head has just read the record. For on-the-fly operation, a new command must be given right after IDBY is reset and must occur before IFBY is reset. This signal should be used by the controller to inhibit further commands.

7.4.3 IDENTIFICATION (IDENT)

The signal is low when a PE ID burst is read from tape in 63 c/mm (1600 cpi) data density.

7.4.4 HARD ERROR (IHER)

The IHER signal is set low if a read error is detected by the formatter. All error information is reported to the controller before IDBY goes false.

IHER is set by one of the following.

(1) More than one channel dropout.

(2) Parity error without any channel dropout indication.

(3) A false postamble is detected.

(4) Attempting to read an NRZI or GCR tape.

7.4.5 CORRECTED ERROR (ICER)

This signal is set low by a single track dropout during a read or read-after-write operation. ICER in a read-after-write operation indicates that the record should be rewritten.

7.4.6 FILE MARK (IFMK)

This signal is low when a file mark is read from tape.

7.4.7 DRIVE STATUS AND CONFIGURATION LINES

The listed lines are used to indicate the status and configuration of the selected drive and are defined in the following paragraphs.

- Status: IRDY, IONL, IRWD, IFPT, ILDP, IEOT
- Configuration: ISPEED

7.4.7.1 Ready (IRDY)

This is a level which is true only when the unit is ready to receive commands through the interface lines.

7.4.7.2 On-Line (IONL)

This is a level which is low when the unit is in the On-line mode

7.4.7.3 Rewinding (IRWD)

This is a level which is true when the drive is engaged in any rewind operation. A true IRWD causes IRDY to go false.

7.4.7.4 File Protect (IFPT)

This level goes true when the write enable ring is removed from the supply reel of the selected drive and remains true until tape is unloaded.

7.4.7.5 Load Point (ILDP)

This level goes true when the unit is ready and tape is positioned at BOT. The signal goes false after the BOT marker moves forward passing the BOT detector.

7.4.7.6 End Of Tape (IEOT)

This signal is set low when the EOT marker is detected during a forward motion and reset when the EOT marker is detected during a reverse motion.

7.4.7.7 Tape Speed (ISPEED)

This signal indicates operating tape speeds of the selected drive. When true, the signal indicates operation in the high speed mode (2.54 m/s [100 ips] if 63 cpmm [1600 cpi] is selected, 1.27 m/s [50 ips] if 126 cpmm [3200 cpi] is selected); when false, the signal indicates operation in the low speed mode (0.635 m/s [25 ips] if 63 cpmm [1600 cpi] is selected.

7.4.8 WRITE STROBE (IWSTR)

The positive going edge of this signal is used to strobe write data from the controller to the formatter. See Figure 7-4 for timing data.

7.4.9 READ STROBE (IRSTR)

This signal is used to strobe read data to the controller (pulsewidth 200 nanoseconds minimum).

7.4.10 READ DATA (IR0—IR7,P)

These nine lines transmit read data from the formatter to the controller. The eight data bits on the Read Data lines are read from the corresponding track on the tape. The parity bit (IRP) is generated to provide odd parity based on the values of the eight data bits. IR7 corresponds to the least significant bit. Binary weight of the Read Data lines is the same for the corresponding number Write Data line given in Table 7-3 (i.e., IR5 and IW5 both have a binary weight of 2).

7.4.11 UNIT CHECK (ISGL)

This signal is used to report that the selected drive is malfunctioning.

7.4.12 DIAGNOSTIC ACKNOWLEDGE (INRZ)

This level, when true, indicates that the formatter is executing the diagnostic command.

8.0 BASIC FS1000 CHARACTERISTICS

8.1 BASIC FS1000 COMMANDS

The formatter commands and resultant modes of operation are described in the following paragraphs. All commands, with the exception of Rewind (IREW), Off-line (IOFL) and Load/ On-Line (ILOL), are initiated by a low-to-high transition on the IGO interface line. This transition samples the logic states of the interface lines given in Table 7-2. IREW, IOFL AND ILOL commands are initiated in direct response to a true level on the appropriate interface lines. Refer to Table 7-2 in conjunction with the following command descriptions.

8.1.1 READ FORWARD

The Read Forward command causes tape to be accelerated to operating speed. The drive reads the first record encountered. The electronics in the unit generate the delays necessary for proper tape positioning under the read head. The next record on tape can be read by supplying a new Read Forward command to the drive during the reinstruct time delay, thereby improving the access time to the next record. This is referred to as on-the-fly operation. (Refer to repositioning characteristics in Paragraph 4.1.) If the next command is not issued within the reinstruct time delay period, the FS1000 will go through the repositioning sequence.

8.1.2 READ REVERSE (NORMAL AND EDIT)

The Read Reverse command is similar to a Read Forward command except that tape motion is in reverse. Records may also be read in reverse on-the-fly. During any reverse operation, the formatter always resets to the quiescent state when the BOT is detected.

A Read Reverse command may be modified to properly position tape for a subsequent write edit operation. The change in position is done by the formatter in response to an Edit command. Details of the Edit command are contained in Paragraph 8.1.4.

8.1.3 WRITE

When executing a Write command, the FS1000 accelerates tape to operating speed and, after the appropriate pre-record delay time, begins to transfer data from the controller to the drive. The process continues until a Last Word (ILWD) command is received from the controller. The tape will continue to move forward until the record has been read by the read head, then tape will go through the reinstruct time delay. Consecutive records may be written on-the-fly, by issuing commands during the reinstruct time. If the next command is not issued within the reinstruct time delay period, the FS1000 will go through the repositioning sequence. Reinstruct time can be extended when using the extended IBG feature.

8.1.4 EDIT

Edit operations are similar to Write operations except the write current is switched off slowly at the end of an edit sequence to minimize the possibility of recording a *glitch*. For proper head positioning, and Edit command should be preceded by a Read Reverse (Edit) command.

8.1.5 WRITE FILE MARK

The Write File Mark command causes a file mark to be written on tape; Paragraph 8.3.6 provides details of the Write File Mark command for PE format.

8.1.6 ERASE (VARIABLE LENGTH)

The Erase (Variable Length) command causes tape to be moved in the forward direction with erase current on. An ILWD signal from the controller terminates the erase operation. Note that in the PE mode, the ID burst will not be erased when an Erase command is given from BOT.

8.1.7 ERASE (FIXED LENGTH)

The Erase (Fixed Length) command causes a length of approximately 102 mm (4 inches) of tape to be erased. This command is always executed while moving tape in the forward direction.

8.1.8 SPACE FORWARD

The Space Forward command is similar to a Read Forward command except that no Read Strobe (IRSTR) signals are supplied to the controller. Although error checking is not performed, a test is made to determine if the record spaced over was a File Mark.

8.1.9 SPACE REVERSE

The Space Reverse command is similar to a Read Reverse command except that no IRSTR signals are supplied to the controller. Although error checking is not performed, a test is made to determine if the record spaced over was a File Mark.

8.1.10 FILE MARK SEARCH FORWARD

A File Mark Search Forward command causes the drive to execute a series of Read Forward commands while on-the-fly at the speed and density previously selected. This series is terminated when either a File Mark character or the EOT marker is located. Tape is stopped when the File Mark is read as in a normal Read operation. If the EOT marker is detected during a File Mark Search, the operation is terminated and tape is stopped at the end of the record currently being processed. The File Mark Search Forward command inhibits presentation of IRSTR, ICER and IHER signals at the formatter-to-controller interface.

8.1.11 FILE MARK SEARCH REVERSE

A File Mark Search Reverse command causes the drive to execute a series of Read Reverse commands while on-the-fly at the speed and density previously selected. This series is terminated when either a File Mark character or the BOT marker is located. Tape is stopped when the File Mark is read as in a normal Read operation. If the BOT tab is detected during a File Mark Search, the operation is terminated. The File Mark Search Reverse command inhibits presentation of IRSTR, ICER and IHER signals at the formatter-to-controller interface.

8.1.12 FILE MARK SEARCH FORWARD WITH DATA

This command is the same as the File Mark Search Forward command (Paragraph 8.1.10) except the data circuitry is enabled and presentation of IRSTR, ICER, and IHER is not inhibited.

8.1.13 FILE MARK SEARCH REVERSE WITH DATA

This command is the same as the File Mark Search Reverse command (Paragraph 8.1.11) except the data circuitry is enabled and presentation of IRSTR, ICER, and IHER is not inhibited.

8.1.14 DIAGNOSTIC

Various diagnostic codes can be selected using the Function Select mode and the front panel controls. Refer to Paragraph 5.5 for a description of each of these codes.

8.1.15 DATA SECURITY ERASE

This command causes tape to be erased from its present position to a point 0.91 to 1.52 metres (3 to 5 feet) after EOT. Tape is then rewound to BOT.

8.1.16 SELECT 126 C/MM (3200 CPI)/1.27 M/S (50 IPS)

This command causes the drive to operate at a tape speed of 1.27 m/s (50 ips) and a data density of 126 c/mm (3200 cpi). (This is an alternative to use of the IRTH2 and IDEN lines for speed and density selection.)

8.1.17 REWIND

The rewind command causes the tape to rewind to BOT. In systems with multiple formatted drives in a daisy-chained configuration, one or more of the units may be rewinding while the controller is transferring data to or from another formatted drive in the chain.

8.1.18 OFF-LINE

The Off-Line command places the drive under local control. Only the selected unit is placed Off-line in daisy-chained systems (this command causes the tape drive to perform a Rewind/Unload operation).

8.1.19 LOAD-ON-LINE

The Load-On-Line command enables a remote load sequence if this feature is selected using the FUNCTION SELECT switch.

8.2 GAP GENERATION

8.2.1 INTERBLOCK GAP GENERATION

The drive provides timing to generate the necessary 15.24 mm (0.6 inch) gap between records. Longer gaps can be generated using the Extended Gap feature or by using the Erase command.

Extended gaps can be selected locally by first setting Function Select code 21 (Table 5-1), and then selecting the required gap length represented by codes 22—29. With code 21 reset, the extended gap feature is enabled over the interface by the IRTH1 signal. Gap length is selected by codes 22—29.

8.2.2 FILE MARK GAP

A File Mark is preceded by a gap of approximately 102 mm (4 inches) of blank tape and is followed by a normal IBG.

8.3 PHASE ENCODED FORMAT

This equipment records data on tape in accordance with ANSI Specification No. X3.39-1973 for 1600 cpi PE recording. The same format is used for 3200 cpi recording with the exceptions that are identified in Paragraphs 8.3.1 through 8.3.11. The following paragraphs describe the features of this recording format.

8.3.1 DATA

Phase Encoded (PE) data are characterized as follows.

(1) A 0 bit corresponds to a transition in the middle of the bit cell away from the erase direction of magnetization.

(2) A 1 bit corresponds to a transition in the middle of the bit cell toward the erase direction of magnetization.

(3) In the case of successive 0 bits or successive 1 bits, an additional transition is required at the cell boundary. This transition is referred to as the *phase transition* and is in the opposite direction from that of the *data transition.*

8.3.2 PREAMBLE

The Preamble is a burst of forty 0 bits followed by a 1 bit (in all tracks) at the beginning of each record. When reading, the formatter tracking circuit uses this burst to synchronize the decoding circuits. The detection of the 1 bit indicates the beginning of the data field.

8.3.3 DATA FIELD

The Data Field is written with data and phase transitions as defined in Paragraph 8.3.1. The formatter is capable of writing and reading records of a minimum of three characters. There is no hardware limitation to the maximum number of data characters that may be included in a single data record.

8.3.4 POSTAMBLE

The Postamble is comprised of a single 1 bit followed by a burst of forty 0 bits (in all tracks) at the end of the record. The postamble provides a means of synchronization when reading tape in reverse.

8.3.5 PARITY

When writing, the data in the Parity (P) data track are generated by the formatter in such a way as to provide odd parity for all characters in the data field. As an option, parity may be supplied by the IWP interface signal.

8.3.6 FILE MARK

8.3.6.1 63 c/mm (1600 cpi)

When a Write File Mark command is executed, the formatter generates the file mark gap and then generates a File Mark consisting of 80 flux reversals at 126 fr/mm (3200 frpi) in Channels P, 0, 2, 5, 6, and 7. Channels 1, 3, and 4 are dc-erased.

When reading, the formatter will recognize a File Mark if there are flux reversals in Channels 7, 2, and 6, with Channels 1, 3, and 4 dc-erased. Channels P, 5, and 0 are ignored for this test.

8.3.6.2 126 c/mm (3200 cpi)

File mark is the same as for 63 c/mm (1600 cpi) except the 80 flux reversals are at 252 fr/mm (6400 frpi).

8.3.7 IDENTIFICATION BURST

8.3.7.1 63 c/mm (1600 cpi)

When performing a Write command from BOT, the formatter writes an ANSI and IBM compatible ID burst consisting of a sequence of flux reversals at 63 fr/mm (1600 frpi) in Channel P, with all other tracks dc-erased.

During a read, or read-after-write operation, the formatter samples the output of Channel P as the BOT marker traverses the read head. If an ID burst is detected, the IDENT interface line is activated.

8.3.7.2 126 c/mm (3200 cpi)

When performing a write command from BOT at a recording density of 126 c/mm (3200 cpi), the formatter writes a sequence of flux reversals at 126 fr/mm (3200 frpi) in Channels P and 2, with all other tracks dc erased. During a read, or read-after-write operation, the formatter samples the output of Channels P and 2 as the BOT marker traverses the read head.

8.3.8 DROPOUT AND ERROR CORRECTION

A dropout is detected by the formatter for a particular track if no data are present on that track for more than 1.5 bit cell times or a data bit is not detected in any bit cell. This test is made after approximately twenty-four 0 bits of the preamble have been read in each track. If only one of the nine tracks has a dropout detected in the formatter, the formatter will correct this track by using the odd parity nature of the data in conjunction with the single track dropout indication.

8.3.9 DESKEW OF READ DATA

As data are read from tape, the data transitions corresponding to bits of a specific character may arrive at the formatter at different times due to the skewed relationship of the nine data tracks. Data may be skewed as much as eight characters and still be deskewed properly.

8.3.10 ERROR DETECTION

For an explanation of errors detected by the FS1000 while reading tape, refer to Paragraphs 7.4.4 and 7.4.5.

8.3.11 VARIABLE FREQUENCY OSCILLATOR

A variable frequency oscillator (VFO) is used to decode data. This VFO follows the long- and short-term speed variation of the data being read.

9.0 RELIABILITY AND MAINTAINABILITY

9.1 ADJUSTMENTS

The FS1000 tape drive does not require adjustment over its anticipated life unless components are replaced. Electrical adjustments that may be required following component replacement are the read amplifier outputs, write current, EOT/BOT amplifier, supply reel amplifier offset, and the regulated voltages. Mechanical adjustments consist of head azimuth, mid-tension flag, tension arm, and tape path adjustments.

9.2 ERROR RATES

The error rate limits of this specification apply using tape that meets ANSI X3.40-1973 Unrecorded Magnetic Tape Standard, or equivalent, over an operating ambient temperature of 15.6°C to 32.2°C (60°F to 90°F) and a relative humidity level of 30 to 80 percent non-condensing. Errors caused by damaged tape oxide or foreign particles shall not be counted.

9.2.1 READ ERROR

The recoverable read error rate will not exceed one error in 10^9 bytes.

9.2.2 WRITE ERROR

The recoverable read-after-write error rate will not exceed one error in 10^8 bytes (media faults excluded).

9.2.3 IRRECOVERABLE ERRORS

An irrecoverable error is defined as an error that exists after five retries and after errors due to damaged oxide or foreign particles have been eliminated. The irrecoverable error rate will not exceed one error in 10^{10} bytes when reading a tape that was recorded on an identical tape drive.

9.3 SERVICE LIFE

The unit is designed and constructed to provide a service (useful) life of 6 years or 24,000 power-on hours, whichever occurs first. Repair or replacement of major parts will be permitted during useful life.

9.4 MEAN-TIME-BETWEEN-FAILURE (MTBF)

Following an initial break-in period of 100 hours, the drive MTBF will exceed 5,000 hours (not including failures of the read/write head). The following formula defines MTBF.

$$\text{MTBF} = \text{Operating Hours} \div \text{Number of Equipment Failures}$$

Operating hours are the total power-on hours less any maintenance time; equipment failure is defined as those failures which necessitate repairs, adjustments, or replacements on an unscheduled basis. Equipment failure means that emergency maintenance is required because of hardware failure or substandard performance. This excludes stoppages or substandard performance caused by operator error, adverse environment, power failure, or other failure not caused by the equipment.

9.5 MEAN-TIME-TO-REPAIR (MTTR)

The MTTR will not exceed 0.25 hour excluding adjustments. MTTR is defined as the mean time for an adequately trained and equipped serviceman to diagnose and correct malfunction while following service procedures contained in the service manual. Servicing

will be limited to replacing major subassemblies, including PCBAs. To establish a meaningful MTTR, operating time must exceed 100 hours and include all sites where the FS1000 is used.

9.6 PREVENTIVE MAINTENANCE REQUIREMENTS

In a normal environment, scheduled preventive maintenance is necessary for the anticipated life of the FS1000 Tape Transport. Maintenance requirements are specified in Table 9-1. Procedures for performing the required maintenance operations are given in the FS1000 Tape Drive Operating and Service Manual (PPC Document No. 111311).

9.7 SERVICEABILITY

Access is provided to all areas of the tape drive to facilitate replacement of defective subassemblies.

Table 9-1

Preventive Maintenance Schedule

Interval*	Item
Daily	Clean Head Clean Fixed Guides (2) and Tape Cleaner Cean Tachometer Roller Clean Fixed Roller Clean Tension Transducer Roller Clean Supply Reel Friction Ring Clean Supply Hub Write Protect Ring Reflective Surface
2500 Hours or 6 Months	Clean Air Filter Check Tape Path Alignment Check Skew
*More frequent servicing may be required if operating in an abnormally dirty environment.	

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10.0 REGULATORY AGENCY REQUIREMENTS

The FS1000 Tape Drive is designed to comply with the requirements of the following agencies.

(1) UNDERWRITERS LABORATORIES (UL)
UL recognized as a component under the UL Electronic Data Processing Units and Systems Classification (UL 478).

(2) CANADIAN STANDARDS ASSOCIATION (CSA)
CSA certified under CSA C22.2 Number 154.

(3) VERBAND DEUTSCHER ELECTRONIKER (VDE)
0804/5.72 Regulations for Telecommunication Apparatuses including Information Processing Equipment.

(4) INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
435, Safety of Data Processing Equipment.