GA32-0021-1

Systems

IBM 3803 Model 2
IBM 3420 Models 4, 6, and 8
Magnetic Tape Subsystems
Subsystem Description

IBM

Preface

This manual provides reference information about the IBM 3803 Model 2 Tape Control and 3420 Models 3 - 8 Tape Units.

This manual requires no prerequisite reading; however, it is assumed the reader has a basic knowledge of stored program computers.

Second Edition (March 1974)

This is a major revision of, and obsoletes GA32-0021-0. Changes are periodically made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

All specifications in this manual are nominal unless otherwise indicated.

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Abbreviations

BCD	binary coded decimal
BOT	beginning of tape
BPI	bytes per inch
BSB	backspace block
BSF	backspace file
CCW	channel command word
CE	customer engineer
ChE	channel end
cm	centimeter
CPU	central processing unit
CSW	channel status word
CUE	control unit end
DMS	diagnostic mode set
DSE	data security erase
EBCDIC	extended binary coded decimal interchange code
EOT	end of tape
ERG	erase gap
FRU	field replaceable unit
FSB	forward space block
FSF	forward space file
hex	hexadecimal
IBG	interblock gap
ID	identification
IF	interface
I/O	input/output
ips	inches per second
Kb	kilobyte
Kd	kilodigit
LWR	loop write to read
m	meter
mm	millimeter
ms	millisecond
MS 1	Mode Set 1
MS 2	Mode Set 2
MTE	multi-track error
NOP	no operation
NRZI	non-return to zero, IBM
OS	operating system
PE	phase encoded
REW	rewind
ROS	read-only storage
RUN	rewind/unload
R/W	read/write
sec	second
SIO	start I/O instruction
Sw	switch
TCS	Two-Channel Switch
TI	tape indicate
TIE	track in error
TM	tape mark
UE	unit exception
usec	microsecond
VRC	vertical redundancy check
WTM	write tape mark

Basic Subsystem

The IBM 3803-2/3420 Magnetic Tape Subsystem consists of an IBM 3803 Model 2 Tape Control and one or more IBM 3420 Magnetic Tape Units. The 3420 Tape Units are available in six models with tape speeds of 75, 125, and 200 inches per second (190,5/317,5/508 cm/sec) for Models 3/4, 5/6, and 7/8, respectively.

The 3803 Model 2 operates at 6250 BPI and 1600 BPI densities.

A 3803 Tape Control without any switching features controls up to eight 3420 Tape Units (1 x 8 configuration).

The 3803 command set, status responses, and basic sense data are compatible with 2400-series tape subsystems. However, there are some minor programming differences. For example:

1. The number of sense bytes and contents of those bytes differs from those used by 2400-series subsystems.
2. All commands not listed in Figure 6 except Mode Set type set COMMAND REJECT (sense byte 0, bit 0).
3. A sense command must be issued after a condition is encountered which sets UNIT CHECK in the unit status byte.

In most instances, non-time dependent programs that operate successfully on 2400-series tape units will operate correctly on a 3803/3420 subsystem with the appropriate features.

3420 Tape Unit

Information presented in this section applies to all models of the tape unit.

Automatic Threading

When the operator places a file reel or a cartridge on the reel hub and presses LOAD-REWIND, the power window closes, the automatic reel latch secures the file reel to the hub, and tape is threaded, loaded into the columns, and positioned at load point without further operator action.

IBM Easy Load Cartridge

When used with a solid-flange tape reel (standard IBM 10.5 inch), the IBM Easy Load Cartridge reduces tape handling and helps prevent contamination or physical damage.

During a load operation, if the first threading sequence is unsuccessful, tape is rewound into the cartridge and another attempt is made.

Tape Transport

A single, direct-drive capstan moves tape forward or backward. Air bearings reduce friction and tape wear since the oxide (recording) tape surface contacts only the read/write head, the erase head, and the tape cleaner. Short, tapered vacuum columns greatly reduce tape inertia when starting and stopping tape. The tapered columns and single-drive capstan start and stop tape quickly and smoothly.

Read Back Checking

A two-gap read/write head allows read back checking during a write operation. Moving forward tape passes first the write gap, then the read gap.

Full-Width Erasure

An erase head applies a strong magnetic field that erases the entire width of tape during write operations. Full-width erasure prevents interchangeability problems when tape is written on one tape unit and read on another; it also reduces the chances of leaving extraneous bits in interblock gaps or skip areas.

During a write, write tape mark, or erase operation, the tape unit monitors the erase head operation. On a 3420 Model 4, 6, or 8 an erase head failure drops tape unit ready status and halts tape motion. On a 3420 Model 3, 5, or 7 an erase head failure sets UNIT CHECK, but does not drop ready status.

File Protection

A write enable ring must be present in the file reel when writing. To avoid destroying information on tape, remove the write enable ring. A reel without the ring is "file-protected." The FILE PROTECT indicator remains on when a reel without a file protect ring is mounted and no writing can occur.

Rewinding

Tape remains in the vacuum columns during rewind operations. Rewind ends when a photocell senses a beginning-of-tape (load point) reflective marker on tape.

During a rewind/unload operation, tape is rewound completely onto the file reel. The tape unit is left in unloaded status, with the tape reel latch unlocked and the window open, allowing the operator to remove the file reel.

3420 Models 4, 6, and 8

The 3420 Models 4, 6, and 8 have the following added capabilities and features:

- 6250 BPI capability.
- 0.3-inch IBG.
- Nominal data rates of 1250, 780, or 470 Kb/sec at 6250 BPI.
- Improved access times.
- Precise motion control of the media to achieve faster data access times.
- 6250 BPI or 6250/1600 BPI density features.
- Automatic read amplification.
- New tape cleaning mechanism.

3420 Models 3, 5, and 7 can be converted to 3420 Models 4, 6, and 8.

Recording Methods

6250 BPI

At 6250 BPI (246 bytes/mm), data is recorded in nine parallel tracks on tape.

6250 BPI is a basic density on the 3803 Model 2 and 3420 Models 4, 6, and 8.

1600 BPI

In 1600 BPI (63 bytes/mm) mode, 1600 bytes per inch (63 bytes/mm) are recorded in nine parallel tracks on tape. The data format uses eight of the nine bits for data, the ninth is a parity bit. Data is recorded in odd parity. The eight bits of one byte can represent an alphabetic character, zoned decimal digit, two decimal digits (packed), a special character, or eight binary bits.

1600 BPI is a basic density on the 3803 Model 2 and on 3420 Models 3, 5, and 7 and a feature on 3420 Models 4, 6, and 8.

800 BPI, Nine-Track, NRZI

Data representation is the same as for 1600 BPI PE. For nine-track NRZI operation, the dual density feature on a Model 3, 5, or 7 tape unit and the nine-track NRZI feature on a 3803 are required.

Nine-track NRZI is a feature on the 3803 Model 2 and on 3420 Models 3, 5, and 7.

Seven-Track

Data is recorded at 200, 556, or 800 BPI in seven tracks across the width of the tape. The data format uses six of the seven bits for data and the seventh bit is a parity bit. Data may be in either even or odd parity. The six bits of one character can represent a BCD character or six binary bits.

For seven-track operations, a seven-track feature on a 3420 Model 3, 5, or 7 and on a 3803 is required.

Interblock Gaps

Interblock gaps (IBGs) are as follows:

6250 BPI: 0.3 inch (7,6 mm) nominal.

800/1600 BPI Nine-track: 0.6 inch (15,2 mm) nominal; 0.5 inch (12,7 mm) minimum.

200/556/800 BPI Seven-track: 0.75 inch (19,05 mm) nominal; 0.68 inch (17,27 mm) minimum.

Magnetic Tape and Reels

Most tape volumes which operate satisfactorily on 3420 Models 3, 5, and 7 will operate with equal or better reliability for an equivalent number of bytes transferred on 3420 Models 4, 6, and 8. Tape must conform to *IBM Tape Specifications*, GA32-0006-4.

3420 Model	3	4	5	6	7	8
Tape Speed Read or Write						
(ips)	75	75	125	125	200	200
(cm/sec)	190,5	190,5	317,5	317,5	508	508
Access Times (ms)						
Read, nominal*						
6250 BPI		2.3		1.6		1.1
1600 BPI	4.0	4.0	2.9	2.6	2.0	1.65
Write, nominal*						
6250 BPI		2.1		1.5		0.95
1600 BPI	4.0	3.0	2.9	2.0	2.0	1.28
Forward Start (ms)						
Time nominal**	1.8	1.4	1.4	1.1	1.3	0.8
Data Rates						
(Kb/sec;Kd/sec)						
6250 BPI		470/940		780/1560		1250/ 2500
1600 BPI	120/240	120/240	200/400	200/400	320/640	320/640
800 BPI 9-track	60/120		100/200		160/320	
800 BPI 7-track	60		100		160	
556 BPI 7-track	41.7		69.5		111.2	
200 BPI 7-track	15.0		25.0		40.0	
Passing Times per Byte						
(usec)						
6250 BPI		2.133		1.28		0.80
1600 BPI	8.3	8.3	5.0	5.0	3.1	3.1
800 BPI	16.7		10.0		6.2	
556 BPI	24.0		14.4		9.0	
200 BPI	66.7		40.0		25.0	
Passing Times IBG (ms)						
6250 BPI		4.0		2.4		1.5
9-track PE & NRZI	8.0	8.0	4.8	4.8	3.0	3.0
7-track	10.0		6.0		3.75	
Rewind Time (sec)						
(2400-foot reel)	60	60	60	60	45	45
Rewind-Unload Time						
2400-foot reel, sec	66	66	66	66	51	51
Load Operation, approx. time to 'tape unit ready' after reel/cartridge is mounted and LOAD REWIND is pressed in						
sec.	10	10	10	10	7	7

* Read access time is the interval from initiation of a Forward Read command given to the tape control when tape is not at load point, until the first data byte is read when tape is brought up to speed from stopped status.

Write access time is the interval from the issuance of a Move command given to the tape unit when tape is not at load point, until the first data byte is written on tape when tape is brought up to speed from stopped status.

** Start time is the interval from the issuance of a Move command to the tape unit, until tape attains 90% of specified velocity.

Figure 1. Subsystem Characteristics

3803 Model 2 Tape Control

General Characteristics

The 3803 Model 2 tape control connects to the I/O interface of an IBM System/360 Model 50 and above (by RPQ only) or to an IBM System/370 Model 135 and above. The tape control consists of a CE panel, two microprogram control sections, a read section, a write section, and a channel buffer section.

Note: "I/O Interface" refers to a set of lines over which the tape control and system channel exchange control and data signals. Interface lines and operations are described in *IBM System/360 and System/370 I/O Interface, Channel to Tape Control, Original Equipment Manufacturers' Information*, GA22-6974. The 3803 may exceed an interface signal sequence of 32 microseconds, and may produce a worst case interface signal sequence of up to 50 microseconds on some instructions when in seven-track mode with the two-channel switch feature installed.

The 3803 Model 2 operates at 6250 or 1600 BPI. The 3803 Model 2 with appropriate features can process nine-track, 800 BPI NRZI and seven-track, 200/556/800 BPI NRZI tape on those 3420 Model 3, 5, and 7 tape units having the companion NRZI feature. (See Figure 2.)

All data transfers are in burst mode. The tape control executes one command on one tape unit at a time. The tape control parity checks each data byte transferred between the system and a tape unit. On write operations, bus out parity is checked and parity is corrected, if necessary, before the byte is sent to the tape unit. On read operations, parity of each byte is checked and corrected, if necessary and possible, before the byte is placed on the I/O interface. On sense operations, correct parity is supplied for each byte. Parity is also checked on command bytes.

I/O commands issued by the channel are executed with microprograms resident in two independent read-only storage (ROS) units. One ROS unit controls communication lines to the channel, while the other ROS unit controls communication lines to the tape unit.

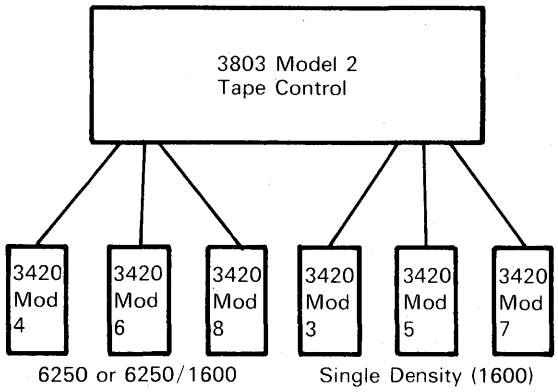
Addressing

Every tape unit has a unique device address consisting of a channel address, a tape control address, and a tape unit address. Pluggable jumpers assign the tape control address when the system is installed. The tape control contains separate device interface connectors for each tape unit address. A tape unit's address is determined by the tape control connector to which it is attached. There is no address decoding at the tape unit or device interface level.

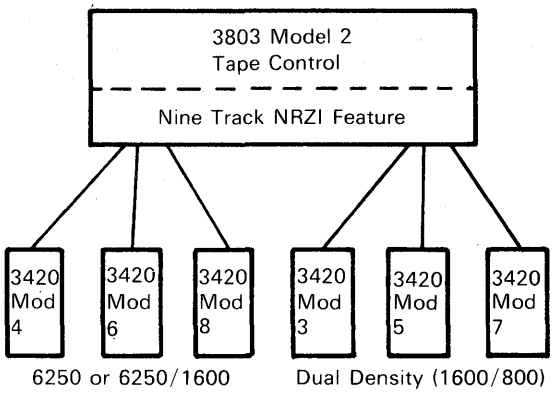
Metering

A usage meter is incorporated in the tape control and in each tape unit. The tape control's usage meter records elapsed time whenever the channel's METERING line is active and the tape control is in online status (enabled). A tape unit's usage meter records elapsed time when the tape control METERING OUT line is active, tape unit is loaded, and the tape is not at load point. METERING IN is used by the central processing unit (CPU) metering circuits; this line is active from the time a command is accepted by the tape control until Device End is generated for that command. See *IBM System/360 and System/370 I/O Interface: Channel to Tape Control OEMI*, GA22-6974.

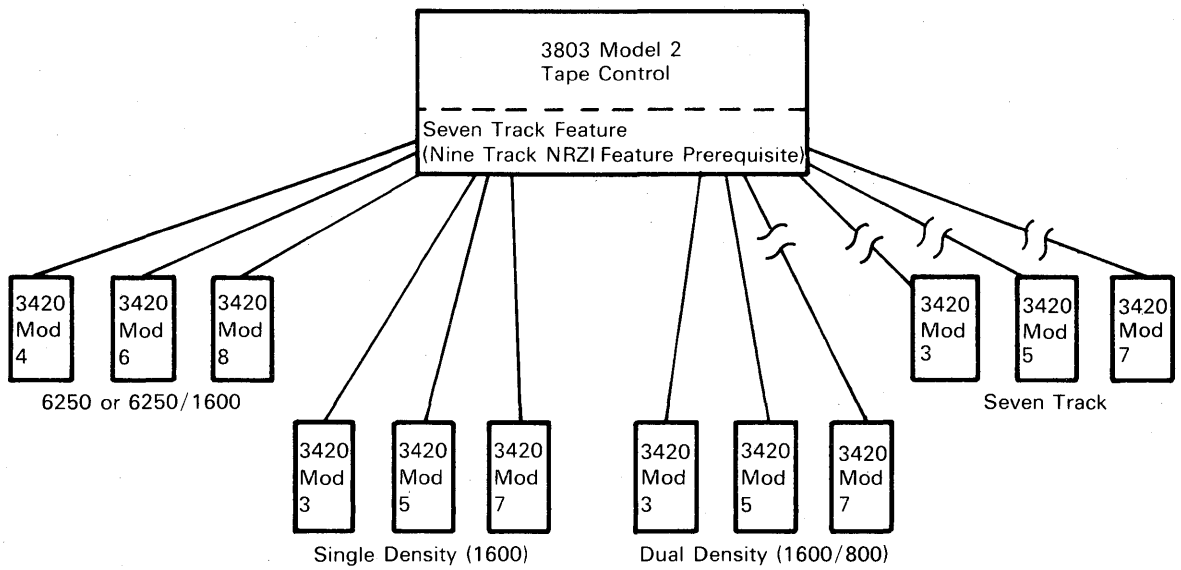
Operation with Model 4/6/8 Tape Units (6250 or 1600 BPI Mode) and Models 3/5/7 1600 BPI Tape Units



Operation with Model 4/6/8 Tape Units (6250 or 1600 BPI Mode) and Model 3/5/7 Tape Units (1600 BPI PE and 800 BPI NRZI Modes)



Operation with 3420 Model 4/6/8 Tape Units (6250 or 6250/1600 BPI Modes) and Nine and Seven Track Tape Units (Nine Track 1600 BPI PE and Nine Track 1600/800 BPI and Seven Track 200/556/800 BPI NRZI Modes)



MAXIMUM OF 8 TAPE UNITS PER TAPE CONTROL

For 3420 Model 8 Power Requirements see *IBM S/360 Physical Planning Manual*, GC22-6820.

Figure 2. 3803 Model 2 and 3420 Configurations

Enable/Disable Switch

This switch allows the tape control and tape units to be put on or taken off line so a field engineer can use the CE panel switches and indicators to diagnose errors. Whenever the tape control is in offline status (disabled), the usage meters in the tape control and all attached tape units are prevented from running. When the Two-Channel Switch feature is installed, a second Enable/Disable switch is provided on the 3803.

Power On/Off Sequencing

System power interlock circuits control normal power on/power off sequencing for the 3803/3420 tape subsystem. However, maintenance activities may necessitate dropping power in the tape control.

3803 Model 2 Features

Features available on a 3803 Model 2 are Nine-Track NRZI, Seven-Track, Two-Channel Switch, and Device Switch. See Figures 3, 4, and 5.

Nine-Track NRZI

The nine-track NRZI feature, available on the 3803 Model 2, permits operation in nine-track NRZI mode. Nine-track NRZI operation requires a 3420 Model 3, 5, or 7 tape unit with the dual density feature. Operation of this feature is similar to that of the 3803-1 with the dual density feature.

Seven-Track

The seven-track feature permits operation in seven-track NRZI mode in addition to the nine-track operation provided by the nine-track NRZI feature. Seven-track operation with a 3803 Model 2 is at 800/556/200 BPI. The seven-track feature contains both the data translator and data converter for seven-track operations. Their operation is similar to that of the 3803 Model 1 with the seven-track feature. For seven-track operation, the seven-track feature on a 3420 Model 3, 5, or 7 and on the 3803 Model 2 are required. The nine-track NRZI feature is a prerequisite for the seven-track feature on the 3803 Model 2.

Writing a tape with the translator on causes eight-bit bytes from the I/O interface to be written on tape as six-bit BCD characters; reading such a tape causes six-bit BCD characters to be translated into their EBCDIC equivalents. When using the translator, data rates are not changed and there are no changes in the tape unit's operation.

Writing a tape with the data converter on causes four tape characters (24 bits) to be written for every three storage bytes (24 bits); reading such a tape reverses the process by converting four tape characters into three storage bytes. Data conversion reduces the data transfer rate to 75% of the operating rate with data converter off.

Density (BPI) (Note 1)	3803-2 (Note 4)	3420-3/5/7 (Notes 2, 4)	3420-4/6/8 (Note 3)
6250, 9-Track	Standard	N/A	6250 Feature
1600, 9-Track	Standard	1600 Feature	6250/1600 Feature
800, 9-Track	9-Track NRZI Feature	Dual Density Feature	N/A
800, 7-Track	7-Track Feature	7-Track Feature	N/A
556, 7-Track	7-Track Feature	7-Track Feature	N/A
200, 7-Track	7-Track Feature	7-Track Feature	N/A

Notes:

1. Density must be specified for each nine-track 3420 tape unit.
2. 3420-3/5/7 can be attached to 3803-1 or 3803-2.
3. 3420-4/6/8 can be attached to 3803-2 only.
4. 9-Track NRZI feature is a prerequisite for 7-Track feature on 3803-2.

Figure 3. Density Feature Combinations

Two-Channel Switch

This feature permits the 3803 Tape Control to be accessed by a second channel. (See Figure 4.) Alternate path switching between two channels attached to the same system is under program control. The two-channel switch can also be used to share a tape control between two systems. Unless the two systems are software coupled, the tape control should be offline to one of the systems at all times. Partitioning between channels attached to two different systems is done manually.

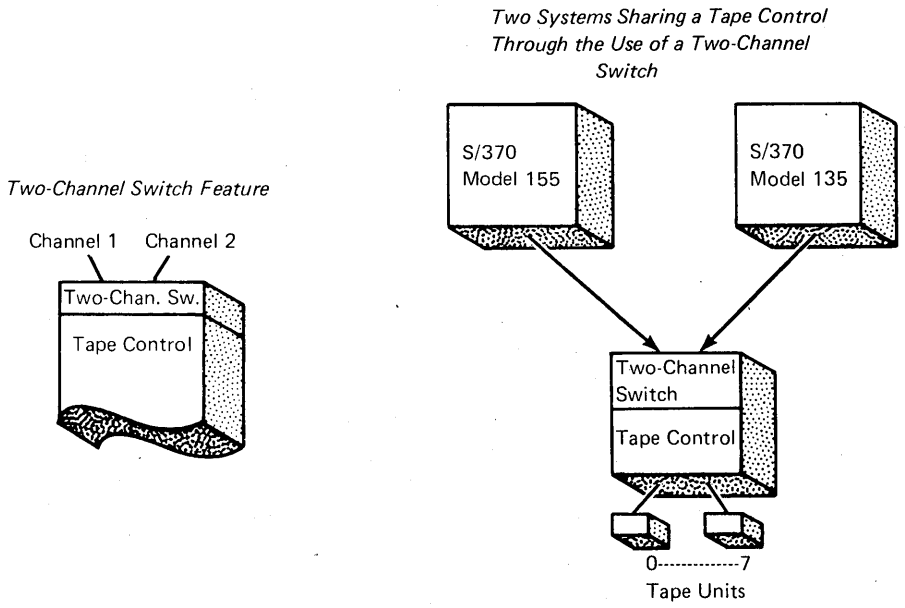


Figure 4. Two-Channel Switch

Device Switch

Tape subsystem configuration flexibility is provided by field installable switching features that allow up to 16 tape units to be switched among two to four tape controls. 3803 Models 1 and 2 can be mixed in a switching configuration; however, attempting to access a 3420 Model 4, 6, or 8 through a 3803 Model 1 is not allowed and will produce unpredictable results.

The three device switching features available with the tape subsystem are:

- 2 Control Switch (2 x 8 and 2 x 16 configurations)
- 3 Control Switch (3 x 8 and 3 x 16 configurations)
- 4 Control Switch (4 x 8 and 4 x 16 configurations)

The location of the device switches depends on the configuration desired. For example: In a 2 x 8, 3 x 8, or 4 x 8 configuration, the switching feature is required only on Tape Control 1, while in the 2 x 16, 3 x 16, or 4 x 16 configurations the switching feature is required on Tape Controls 1 and 2 (see Figure 5).

Each device switch feature requires a Communicator. A Communicator sends tape unit selection and device interface signals to one of two device switches, depending on whether tape units 0-7 or 8-F are being addressed.

The Communicator replaces the selection logic circuits and associated device interface cabling in the basic tape control with different logic circuits and cabling to the device switches.

The Communicator must be installed in all tape controls to be switched. Using a combination of the Communicator and the 2, 3, or 4 Control Switch special features, two, three, or four interconnected tape controls can address a maximum of 16 tape units. Figure 5 shows some possible switching configurations.

2 Control Switch

The 2 Control Switch is a 2 x 8 configuration of hardware switching logic. Tape Units 0-7 (attached to Tape Control 1 in part 1 of Figure 5) can be accessed by the Communicator in Tape Control 2 as well as the Communicator in Tape Control 1. A 2 x 16 configuration is obtained by installing a 2 Control Switch in Tape Controls 1 and 2, allowing the Communicators in each tape control to access its own eight 3420s as well as the 3420s of the other tape control. (See part 2 of Figure 5).

3 Control Switch

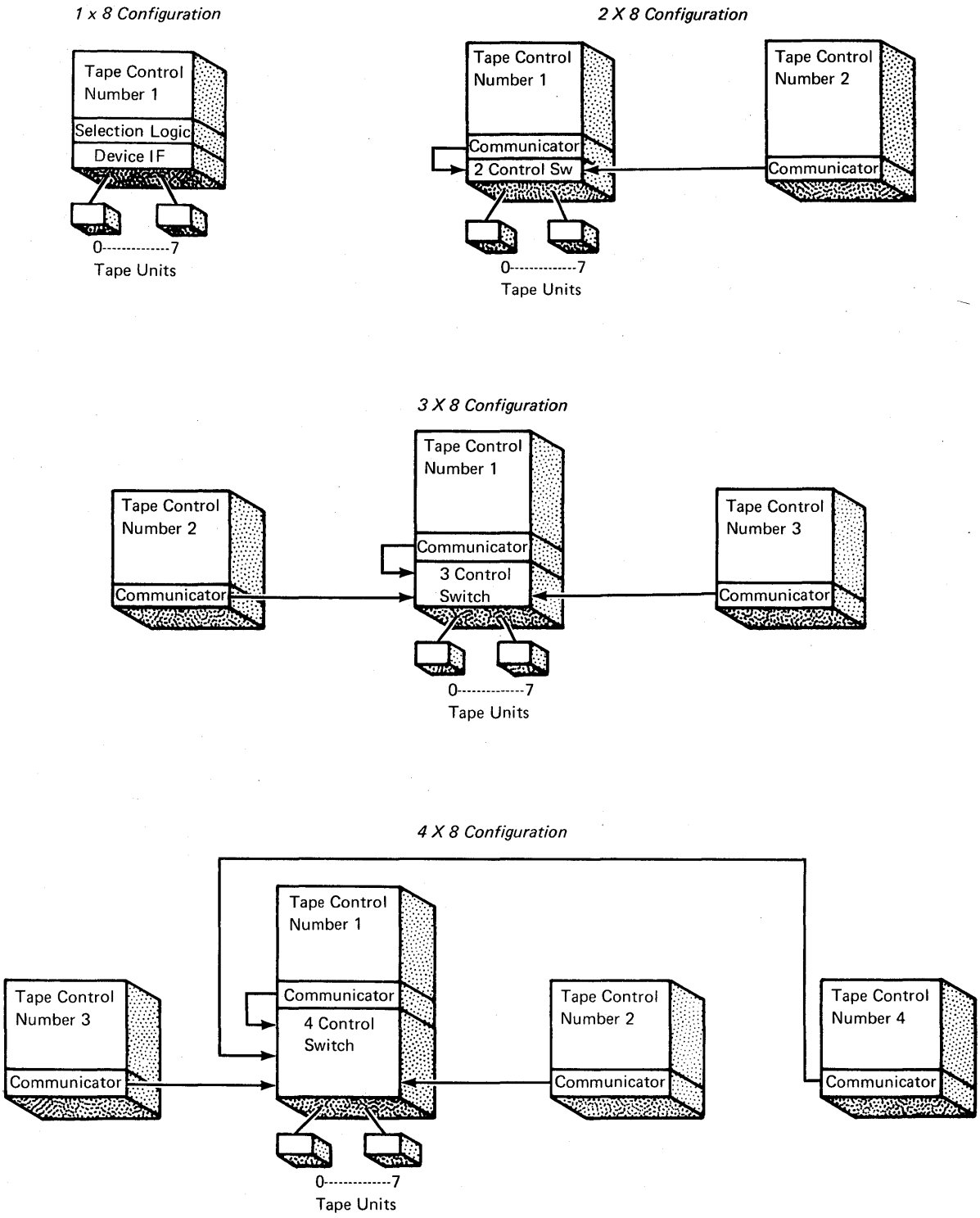
A 3 x 16 configuration is obtained by installing a 3 Control Switch in Tape Controls 1 and 2. A third tape control must be added to the configuration. Tape Control 3 does not contain any switch hardware or attach any tape units, but does contain a Communicator (see part 2 of Figure 5).

4 Control Switch

A 4 x 16 configuration is obtained by installing a 4 Control Switch in Tape Controls 1 and 2. Two more tape controls must be added to the configuration. Tape Controls 3 and 4 do not contain any switch hardware or attach any tape units, but each contains a Communicator (see part 2 of Figure 5).

The 3 Control Switch and the 4 Control Switch are expansions of the 2 Control Switch. They allow access to the eight attached tape units by the additional Communicators.

In all of the configurations, the device switch is logically invisible except for a 'busy' response to initial selection when the addressed tape unit is being used by another tape control. All device switch features contain priority logic to systematically allocate a tape unit in the event of conflicting tape control requests.

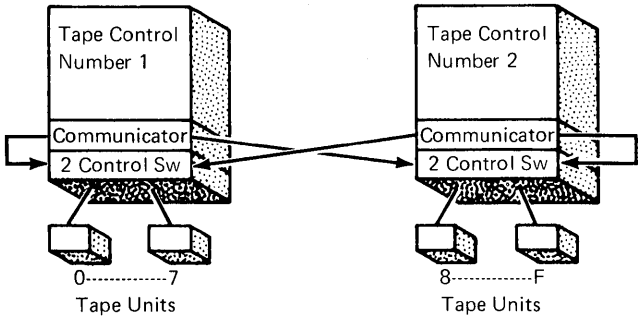


Notes:

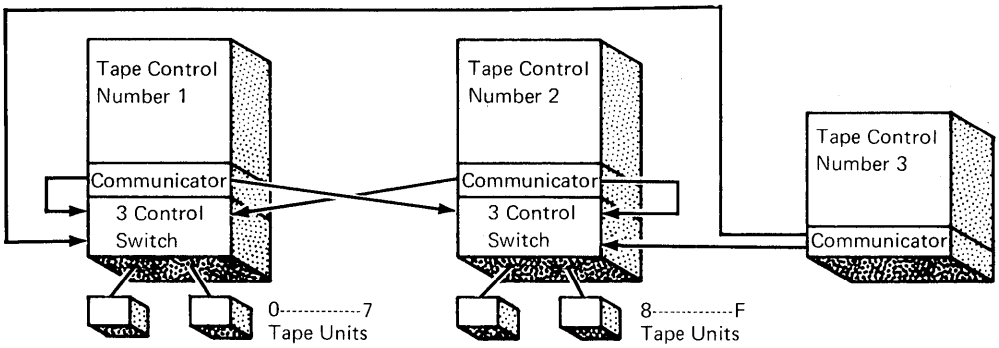
- A maximum of 8 tape units and 4 tape controls.
- Tape units attach only to tape controls with switch features.
- Any or all tape controls may have a two-channel switch feature.

Figure 5. Switching Configurations (Part 1 of 2)

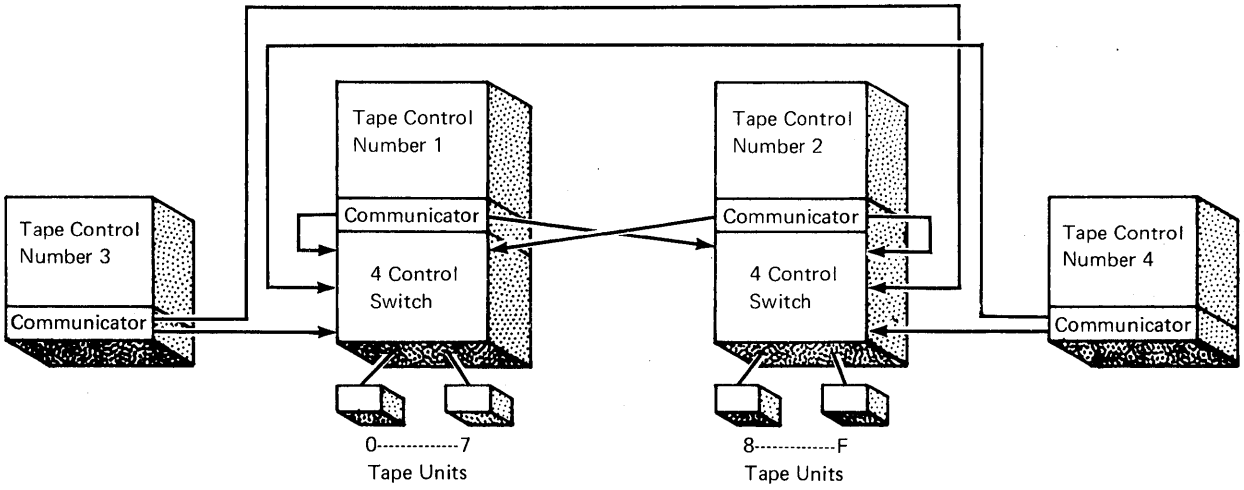
2 x 16 Configuration



3 x 16 Configuration



4 x 16 Configuration



Notes:

- A maximum of 16 tape units and 4 tape controls.
- Tape units attach only to tape controls with switch features.
- Any or all tape controls may have a two-channel switch feature.

Figure 5. Switching Configurations (Part 2 of 2)

Commands

Commands executed by this subsystem fall into one of the following categories:

1. Burst Commands
2. Motion Control Commands
3. Non-Motion Control Commands

Figure 6 lists the subsystem command codes.

Programming Note: The 3803/3420 subsystem has no interlocking to prevent the execution of improper sequences of write- and read-type operations that may result in writing extraneous bits or leaving partial blocks on tape. Avoiding these improper sequences is a program responsibility.

Avoid the following two basic sequences:

1. A write-type operation after a forward read-type operation except:
   a. When the block or Tape Mark (TM) read is known to be followed by a TM.
   b. When the block or TM read is known to have been followed by ERG when written or known to have been the last block written before a backward operation.

   For example: R R W* avoid.
   W B R W* allowed.

2. A read forward-type operation following write-type operations.

   For example: R B W R* avoid.
   W B R R* avoid.

W indicates a write-type operation: Write, Write TM, or Erase Gap (ERG).

R indicates a forward read-type operation: Read Forward, Forward Space Block, or Forward Space File.

B indicates a backward read-type operation: Read Backward, Backspace Block, or Backspace File.

* indicates the logical record on which problems may occur.

Because it may be difficult or impossible to ensure the above safe situations, the use of a write after read forward sequence should be used only in applications where strict control of format and command sequence exists.

Write is allowable following a backspace. Assume the following tape format with labels where * is used to denote a TM: VOL HDR * DATA SET * EOF * HDR * DATA SET * EOF * *. A rewrite of the last data set involves the following safe and proper sequence. After processing the next to last EOF and TM, read forward to verify the HDR label of the last data set, backspace, write a new HDR, and rewrite the data set. If a new data set is being added, the read forward verifies the second consecutive TM, and thus, the true end of a data set on this tape. A backspace, write new HDR, etc., completes the sequence.

	Command Byte								
	0	1	2	3	4	5	6	7	Hex
Burst Commands									
Write	0	0	0	0	0	0	0	1	01
Read Forward	0	0	0	0	0	0	1	0	02
Read Backward	0	0	0	0	1	1	0	0	0C
Sense	0	0	0	0	0	1	0	0	04
Sense Reserve	1	1	1	1	0	1	0	0	F4
Sense Release	1	1	0	1	0	1	0	0	D4
Request Track-In-Error	0	0	0	1	1	0	1	1	1B
Loop Write-To-Read	1	0	0	0	1	0	1	1	8B
Set Diagnose	0	1	0	0	1	0	1	1	4B
Motion Control Commands									
Rewind	0	0	0	0	0	1	1	1	07
Rewind Unload	0	0	0	0	1	1	1	1	0F
Erase Gap	0	0	0	1	0	1	1	1	17
Write Tape Mark	0	0	0	1	1	1	1	1	1F
Backspace Block	0	0	1	0	0	1	1	1	27
Backspace File	0	0	1	0	1	1	1	1	2F
Forward Space Block	0	0	1	1	0	1	1	1	37
Forward Space File	0	0	1	1	1	1	1	1	3F
Data Security Erase	1	0	0	1	0	1	1	1	97
Non-Motion Control Commands									
No-Operation	0	0	0	0	0	0	1	1	03
Diagnostic Mode Set	0	0	0	0	1	0	1	1	0B
Mode Set 1	See Below.								
Mode Set 2	See Below.								

Set Density			Parity		Data Converter		Translator									
200	556	800	Odd	Even	On	Off	On	Off								
Mode Set 1 (Seven-Track)																
X			X		X			X	0	0	0	1	0	0	1	1	13
X				X		X		X	0	0	1	0	0	0	1	1	23
X				X		X	X		0	0	1	0	1	0	1	1	2B
X			X			X		X	0	0	1	1	0	0	1	1	33
X			X			X	X		0	0	1	1	1	0	1	1	3B
	X		X		X			X	0	1	0	1	0	0	1	1	53
	X			X		X		X	0	1	1	0	0	0	1	1	63
	X			X		X	X		0	1	1	0	1	0	1	1	6B
	X		X			X		X	0	1	1	1	0	0	1	1	73
	X		X			X	X		0	1	1	1	1	0	1	1	7B
		X	X		X			X	1	0	0	1	0	0	1	1	93
		X		X		X		X	1	0	1	0	0	0	1	1	A3
		X		X		X	X		1	0	1	0	1	0	1	1	AB
		X	X			X		X	1	0	1	1	0	0	1	1	B3
		X	X			X	X		1	0	1	1	1	0	1	1	BB
Mode Set 2 (Nine-Track)																
800	1600	6250														
		X							1	1	0	1	0	0	1	1	D3
	X								1	1	0	0	0	0	1	1	C3
X									1	1	0	0	1	0	1	1	CB

Note: Seven-track Mode Set 1 commands are treated as 'no-op reset sense' when issued to a tape control without the seven-track NRZI feature.

Figure 6. 3803-2/3420 Commands

Burst Commands

Burst commands transfer data across the channel/tape control interface. Channel End and Device End are signaled when the operation is complete (ending status).

The burst commands are:

Write
Read Forward
Read Backward
Sense
Sense Reserve
Sense Release
Request Track-In-Error
Loop Write-To-Read (maintenance aid*)
Set Diagnose (maintenance aid*)

* Diagnostic programs issue maintenance aid commands via SIOs (op-codes in the CCW).

Write

Records data on tape as it moves forward and creates an interblock gap (IBG) at the end of each block. The tape control checks the parity of each data byte received from the I/O Interface.

Read Forward

Sets the tape unit to forward read status. As the tape moves, data is read until the read head detects the next IBG. The tape control checks and, if necessary and possible, corrects the bits in each byte transferred to the I/O Interface. Sensing a tape mark sets Unit Exception with Channel End and Device End in the Unit Status Byte.

Read Backward

Sets the tape unit to backward read status. Read backward operation is similar to read forward, except that the 7-track NRZI data converter mode cannot be used. Data flow and controls are the same as in Read Forward. A read backward given at load point or into load point sets Unit Check. The tape unit remains in backward status at the end of a read backward command.

Sense

The sense bytes are transferred to the channel. There are 24 bytes of sense data available. The CCW specifies the number of sense bytes to be transferred and the starting storage address. The information transferred includes unusual conditions associated with the last operation and provides details about the current conditions present in the tape control and the tape unit. A sense command addressed to a not ready tape unit will be executed.

Sense Reserve

Reserves the addressed tape control to the channel issuing this command. The tape control will remain reserved to the channel until either:

- A Sense Release command is issued by the reserving channel, or
- A system reset occurs.

Attempting to select a tape control that is reserved by another channel results in a Tape Control Busy indication. The Sense Reserve command should only be issued by the Control Program.

Sense Release

This command releases the reserved tape control. A Sense Release command is honored only when issued by the channel which had reserved that tape control. The Sense Release command should only be issued by the Control Program.

Programming Note: Sense Reserve and Sense Release commands can only be used on subsystems having the two-channel switch feature. If these commands are issued to a tape control without this feature, Command Reject results. When using these commands, they must be the first command in a chain or Command Reject will result.

The Sense Reserve and Sense Release commands are not supported by IBM's Operating Systems.

Request Track-In-Error (Request TIE)

Request TIE returns to the tape control a data byte containing track-in-error information for nine-track tape units and sensing level information for seven-track tape units. This information was transmitted to the channel in Sense Byte 2 following a Read, Read Backward, Write, or Loop-Write-To-Read command.

When issued following a 6250 or PE operation, Request TIE is treated as No-op Reset Sense.

When issued following a nine-track NRZI read operation, a Request TIE conditions the tape control for a corrective read.

When issued following a seven-track read operation, the request TIE byte controls the read clipping level. See Sense Byte 2 for details.

Loop Write-To-Read (LWR)

This is a write command that checks the tape control and tape unit data and control paths but does not move tape. In 6250 or 1600 BPI mode, LWR writes and error checks the record. In NRZI mode, LWR writes the record but error checks only Write Trigger VRC and the Channel Buffer Check.

On nine-track 3420 tape units, a LWR command issued at BOT is executed in 1600 BPI mode. Elsewhere on tape, LWR is executed in the current operating mode of the tape unit.

LWR does not require the tape unit to be in write status, but the tape unit must be 'ready.' Execution of an LWR does not change the status of the tape unit. A LWR performed from the CPU uses the same data path as a Write command.

Set Diagnose

This command is used to summon microdiagnostic routines. Four bytes are transferred from channel to the tape control to modify the operation of succeeding commands in the chain.

Motion Control Commands

Motion control commands move tape but do not transfer data across the channel/tape control interface.

All motion control commands operate as follows:

1. Channel End is signaled when the command is accepted (initial status).
2. Device End is signaled when the operation, except for Rewind Unload (see below), is completed (ending status).

3. The tape control responds with 'busy' if the tape control is addressed while executing the command.

Note: For Rewind/Unload, Channel End is signaled in initial status, and Device End, Control Unit End, and Unit Check are signaled in an interrupt status cycle after the command becomes effective at the tape unit. Device End is signaled again when the operator reloads tape, presses START, and the tape unit goes from 'not ready' to 'ready' providing the tape control has not been offline in the interim.

Motion control commands are:

Rewind
Rewind/Unload
Erase Gap
Write Tape Mark
Backspace Block
Backspace File
Forward Space Block
Forward Space File
Data Security Erase

Rewind (REW)

The selected tape unit rewinds tape to load point.

Rewind/Unload (RUN)

The selected tape unit rewinds tape to load point, unloads the tape from the columns, closes the cartridge (if used), and opens the window.

Erase Gap (ERG)

The selected tape unit moves tape forward and erases tape for a distance as shown below:

	Single ERG	Successive ERGs
(6250 BPI)	3.75 in.(95,3mm)	3.45 in.(87,6mm)
(1600 BPI and 800 BPI 9-track)	4.2 in.(106,7mm)	3.6 in.(91,4mm)
(seven-track)	4.5 in.(114,3mm)	3.75 in.(95,3mm)

Write Tape Mark (WTM)

The selected tape unit moves tape forward and writes a tape mark block. A "tape mark" is a special block used to separate files.

At 6250 and 1600 BPI, a WTM command causes the subsystem to write a tape mark preceded by an Erase Gap. Attempting to write a tape mark on a file-protected tape unit sets Command Reject.

Backspace Block (BSB)

Tape moves backward to the next interblock gap or to load point, whichever comes first. No data bytes are transferred. Channel End is signaled when the command is accepted. Device End is signaled at the next interblock gap or load point. Sensing a tape mark sets Unit Exception, with Device End in the status byte. Backspacing into or at load point sets Unit Check with Device End in the status byte. The tape unit remains in backward status.

Backspace File (BSF)

The selected tape unit moves tape backward to the interblock gap on the load point side of a tape mark, or to load point, whichever comes first. No data bytes are transferred. Unit Exception is not set when tape mark is sensed.

Forward Space Block (FSB)

The selected tape unit moves tape forward to the next interblock gap. Initial status contains Channel End. Sensing a tape mark sets Unit Exception, with Device End in the status byte.

Forward Space File (FSF)

The selected tape unit moves tape forward to the interblock gap beyond the next tape mark. No data bytes are transferred. Initial status contains Channel End. Device End is signaled at the completion of the operation. Sensing the tape mark does not set the Unit Exception bit.

Programming Note: The tape control responds with a Tape Control Busy sequence while performing an ERG, WTM, BSB, BSF, FSB, or FSF operation.

Data Security Erase (DSE)

The selected tape unit erases tape from the point at which the operation is initiated until the end-of-tape marker is sensed.

The DSE command is accepted by the tape control only when chained immediately following an Erase Gap command. Receipt of this command under any other conditions results in Command Reject. Channel End occurs in initial status if the command is accepted and Device End is signaled when the operation is complete. An attempt to erase a file-protected tape sets Command Reject. Unit exception never occurs as a result of this command. Data Security Erase at TI causes an immediate ending sequence. The control unit does not remain busy after initial selection. An attempt to select the tape unit during DSE execution will result in Busy Status.

During DSE execution, the tape unit monitors erase head current to ensure that the tape is erased. If erase head failure is detected, the operation is terminated by dropping tape unit 'ready.' Device End is issued as a result of the 'ready' drop. The Unit Check bit is set in tape unit status and may be sensed. At the completion of a DSE, the tape control presents device end to channel.

Programming Note: If the tape unit drops 'ready' or fails logically during DSE, the ending status contains Device End and sense bit 4 of byte 7 is set.

Device End is signaled at the detection of TI during a normal DSE completion. However, a Sense command should be performed to assure EOT was reached. Upon completion of the DSE, the Operating Program must issue sufficient erase gap commands to erase any data which may have been written beyond TI. Erasure of four feet of tape, or the issuance of 14 erase gap commands is generally sufficient to erase any data. The channel must be enabled for interrupts to detect a unit check condition due to manual intervention. When device end is signaled, a Sense command should be performed to assure the tape unit reached EOT.

The Data Security Erase command is not currently supported by IBM's Operating Systems. DOS supports DSE via a Magnetic Tape Command (MTC).

Non-Motion Control Commands

Non-motion control commands do not move tape and do not transfer data across the channel/tape control interface.

Channel End and Device End are signaled when non-motion control commands are accepted (initial status). Non-motion control commands are:

No-Operation
Mode Set 1
Mode Set 2
Diagnostic Mode Set (maintenance aid*)

* Diagnostic programs issue maintenance aid commands via SIOs (op-codes in the CCW).

No-Operation (NOP)

NOP performs no function in the tape control or tape unit, and does not transmit data or move tape. No-Operation does not reset tape control sense data.

Programming Note: Placing a NOP command at the end of a series of chained commands delays channel disconnect from the tape control until the NOP is executed. Channel operation will be more efficient if this programming convention is not used.

Mode Set 1 (MS 1)

Mode Set 1 commands sent to tape controls with the seven-track NRZI feature establish tape unit operating mode for succeeding seven-track NRZI operations. Bits 0 and 1 control density and bits 2, 3, and 4 control parity (odd or even), data converter (on or off), and translator (on or off) circuits in the tape control. See Figure 6.

A Mode Set 1 command affects operation of all seven-track tape units attached to the tape control. Unless reset, the tape control retains its mode setting until it receives another Mode Set 1 command.

Mode Set 2 (MS 2)

Mode Set 2 commands sent to a 3803 Model 2 with the nine-track NRZI feature set operating mode (6250 BPI, 1600 BPI PE, or 800 BPI nine-track NRZI) for succeeding write-type operations.

Unless reset, the tape control retains its mode setting until it receives another Mode Set 2 command.

Diagnostic Mode Set (DMS)

DMS causes an artificial signal-loss condition that checks read and write error detection circuits.

- In 6250 BPI Write track P is made all zeros and the program supplies the error correcting code as part of the data. In 6250 mode Diagnostic Read inhibits single and double track error correction and sends check characters to channel with data.
- In PE mode, whenever write data contains successive one bits in any track, writing in that track is inhibited until the last one bit is reached.
- In nine-track NRZI mode, no bits are written in track P.
- In seven-track NRZI mode, no bits are written in track C.

A Diagnostic Mode Set command affects only operations for the command chain in which it is issued.

I/O Instructions

In addition to initiating one of the I/O operations by means of the Start I/O instruction, the program can cause certain actions at the tape control by using the Test I/O and Halt I/O instructions.

Test I/O

This instruction performed by the Central Processing Unit (CPU), causes the status byte for the selected tape unit to be sent to the channel for analysis. No actual operation is performed.

Note: A Test I/O command issued to a not ready tape unit results in a contingent connection on tape controls with the Two-Channel Switch.

Halt I/O

This instruction causes data transfer to stop. The tape control disconnects from the channel and proceeds independently to the completion of the operation. When the operation is completed, the tape control tries to re-establish connection with the channel to transfer ending status. If addressed while completing the operation, the tape control returns a 'busy' signal.

If a Halt I/O instruction is executed after 'status in' and before tape motion is started during a Write or Read, the operation is canceled, and Channel End, Device End, and Unit Check are generated.

Inserting Tape Reel In Cartridge

1. Open cartridge toggle.
2. Holding cartridge vertical, insert reel as shown. Be sure tape end hangs free. If necessary, expand cartridge to accept reel.
3. Close cartridge toggle.

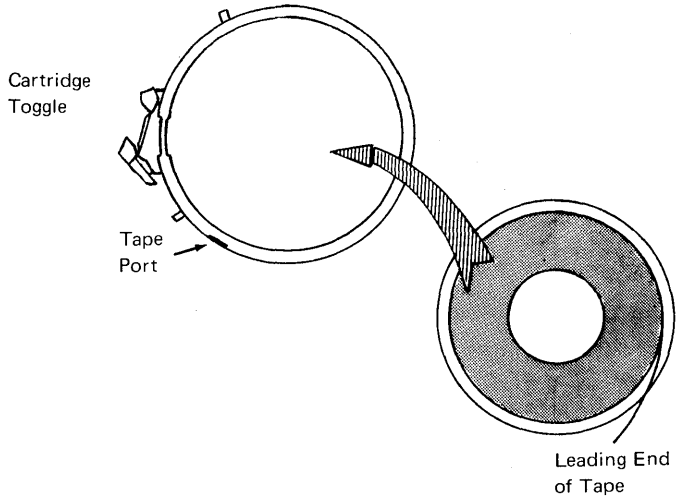


Figure 7. Inserting Tape Reel in Cartridge

Load Procedure

1. Place reel against hub flange.

   When mounting reel, rotate reel to position leading end of tape in center of threading chute.

   When mounting cartridge, seat opening pin in cartridge toggle.

2. Press LOAD/REWIND and START.

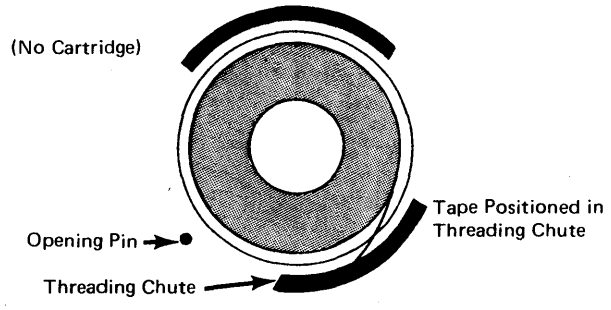


Figure 8. Load Procedure

Unload Procedure

1. Press RESET and REWIND/UNLOAD.
2. After window opens, remove reel or cartridge by pulling forward over latch detents.
3. If not using cartridge, attach tape end retainer and return tape to container.

Operating Procedures After Failure

Tape Fails to Thread (With Cartridge)

1. Remove reel and cartridge.
2. Ensure tape end is undamaged and hangs freely in the cartridge (if necessary, trim end with cutter, part 2512063).
3. Check that unlatching the cartridge toggle opens the tape port.
4. Remount reel and cartridge and try load procedure again.
5. If failure recurs, remove reel from cartridge and try load procedure without cartridge.

Tape Fails to Thread (Without Cartridge)

1. Ensure tape end is undamaged and positioned in threading chute (if necessary, trim end with cutter, part 2512063).
2. Open doors and clear any obstructions from tape path.
3. Close doors and try load procedure again. If unit still fails, notify CE.

End of Tape Comes Off Machine Reel Hub as Tape Loads in Columns

Check leader length (distance from tape end to BOT marker). Tape with less than 10-foot (3 m) leader may not load reliably. To recover information from a tape with a short leader, attach additional temporary leader with clear cellophane tape.

Note: After information is recovered (reproduced on another tape reel), recondition source reel by cutting off old leader and BOT marker. Trim end with cutter, and apply new BOT marker about 15 feet (4,6 m) from leading end. Have marker parallel to and about 1/32 inch (0,8 mm) from front edge of tape. Marker must not be wrinkled or extend beyond tape edge.

Tape Unit Fails to Sense EOT Marker (Tape End Comes Off Reel)

Verify presence of EOT marker approximately 25 feet (7,6 m) from end of tape. If marker is present, malfunction could be a program error or machine failure - notify CE.

1. Rewind Procedure - With Cartridge:
   a. Open front door and manually wind remaining tape on machine reel. Close front door and press RESET and UNLOAD. When cartridge closes, remove cartridge and reel and mount an empty reel on machine.
   b. Open door, manually thread tape from machine reel through tape path, and wind approximately ten turns of tape on file reel. Close door and press LOAD/REWIND.
   c. Unload tape unit and return reel to cartridge when rewinding is complete.

2. Rewind Procedure - Without Cartridge:

   Do (b) of step 1. Unload tape unit when rewinding is complete.

Tape Threads Successfully, But Fails to Load in Columns

Check for missing BOT marker, or incorrect leader length. Tapes with more than 30-foot (9 m) leaders may not load reliably. If BOT marker is present and leader length is correct and tape fails to load in columns, notify CE.

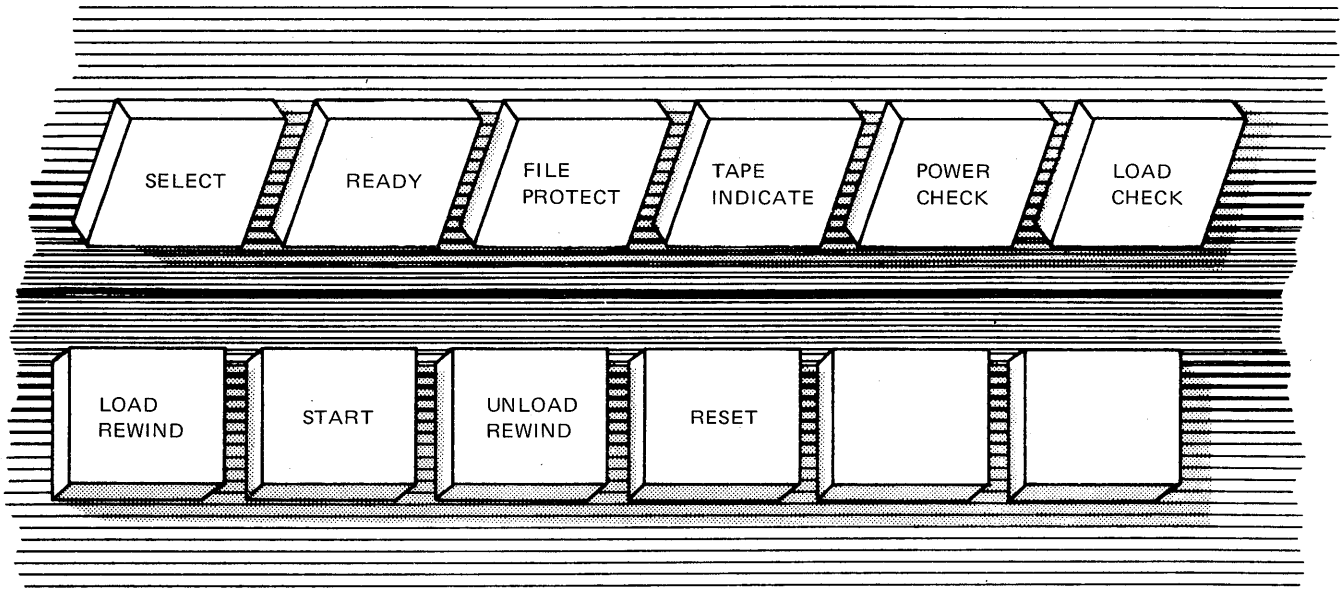
Window Fails to Open After Unload Operation

1. Open access door and manually wind remaining tape onto file reel.
2. Close front door and press RESET and UNLOAD.
3. Notify CE.

Channel Fails To Select Tape Unit (Device Switching or Two-Channel Switch Feature Installed)

Check that toggle switches on the appropriate 3803 operator's panel (Figure 10) are set to enable selection of the desired tape control and tape unit. (Refer to "3803 Operator's Panel, Toggle Switches.")

3420 Indicators and Pushbuttons



Indicator	Condition Indicated When On
Select	Tape control is selecting this unit.
Ready	Tape unit is ready for operation with tape control. (Columns loaded, access door and window closed, and START pressed.)
File Protect	Tape is protected from erasing or writing. (Write enable ring is removed or tape is rewinding or unloaded.)
Tape Indicate	EOT marker was sensed or tape is broken.
Power Check	Open fuse, loss of air, or voltage malfunction. Call CE.
Load Check	Threading failure.

Pushbutton	Status of Tape Unit When Used and Resulting Action
Load/Rewind	Unloaded - Power window closes, reel latch closes, and cartridge opens (if present). Tape threads, loads into columns, rewinds to BOT, and stops.
	Loaded and Not Ready - Tape rewinds to BOT and stops. If power is lost, manually wind file reel until tape slack is removed between reels. After power is restored, press LOAD/REWIND to load tape in columns. The unit rewinds at slow speed to BOT, and stops.
Unload/Rewind	Loaded and Not Ready - Tape is rewound to BOT, tape unit unloads, cartridge closes (if present), reel latch opens, and power window opens.
	After Load Check with Cartridge - Press RESET to remove LOAD CHECK. Be sure tape end is inside cartridge, then press REWIND/UNLOAD to close cartridge.
Start	Columns Loaded - Places tape unit in ready status (if door and window are closed).
Reset	Columns Loaded and Ready - Turns off READY to enable manual operation.
	High Speed Rewinding - Changes rewind from high to slow speed.
	Slow Speed Rewinding - Stops rewind (stops tape motion).
	Load Check - Resets LOAD CHECK.

Figure 9. 3420 Indicators and Pushbuttons

Toggle Switches

The Switching features include sets of toggle switches to make the tape units individually available to each of the tape controls in the switching configuration. Switches are arranged in groups of eight on the operator panels of Tape Controls 1 and 2. See Figure 10. Switches in each of the groups on Tape Control 1 correspond to Tape Units 0 - 7 and switches in each group on Tape Control 2 correspond to Tape Units 9 - F.

A switch in the ON position makes the corresponding tape unit available to the tape control for that group of switches. When the switch is OFF, the tape unit is not available. An attempted selection with the switch OFF results in a 'Non-existent' status for that address.

Switches are arranged on Tape Controls 1 and 2 in tape switching configurations as follows:

Configuration	Switches on Tape Control 1	Switches on Tape Control 2
1 x 8	None	None
2 x 8	16	None
3 x 8	24	None
4 x 8	32	None
2 x 16	16	16
3 x 16	24	24
4 x 16	32	32

Switches for a 4 x 16 configuration are as follows:

Switches on Tape Control 1

Tape Control 1 to Tape Units 0-7	Tape Control 3 to Tape Units 0-7
Tape Control 2 to Tape Units 0-7	Tape Control 4 to Tape Units 0-7

Switches on Tape Control 2

Tape Control 1 to Tape Units 9-F	Tape Control 3 to Tape Units 9-F
Tape Control 2 to Tape Units 9-F	Tape Control 4 to Tape Units 9-F

Note: Before turning a tape unit switch OFF, permission should be obtained from the operating system. All outstanding operations or pending status should be completed.

After receiving permission from the system operator, placing the switch in the OFF position will disable that path when CLOCK OUT becomes inactive. On some operating systems, it may be necessary to stop the system to deactivate CLOCK OUT. If there is no tape unit physically attached to a particular address, all paths to that address must be disabled. Results of addressing a tape unit that is not connected (switch in ON position and no tape unit attached) to a particular address are unpredictable.

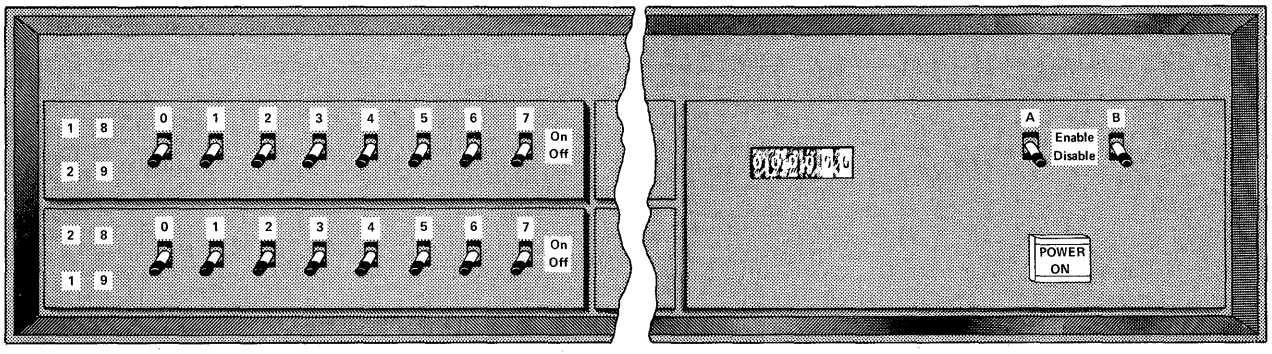


Figure 10. 3803 Operator's Panel

Enable/Disable Switch(es)

Set switch to ENABLE to place the tape control and attached tape units online. To take the tape control and tape units offline, set switch to DISABLE. Switch operation is interlocked with the CPU program. The switch setting can be changed at any time, but the tape control changes status only when the CPU is in a halt or wait state.

A disabled tape control is nonexistent to the CPU program since the tape control does not return 'operational in' in response to a 'select out' from the channel.

Programming Note: All outstanding or pending status information should be accepted by the program (that is, cleared from the tape control) before the switch is set to DISABLE. For example, a program may be delayed if the tape control is disabled while a tape unit is executing a Rewind command previously given via that tape control. The Device End, normally presented when the tape unit reaches load point, will not be presented while the tape control is disabled. In addition, if power is dropped on the tape control, this Device End and any other status will be lost.

To restart I/O when the tape control is disabled:

1. After system indicates a nonoperational device, turn the Enable/Disable switch to ENABLE.
2. Press STOP and then START at the CPU.
3. Attempt the I/O operation again.

Power On/Off Procedures

Power Off

1. Ensure that the channel attached to the tape control has completed all operations and has no pending interrupts.
2. Set Enable/Disable Switch(es) to DISABLE.
3. When the green (Panel Enabled) light turns on, dc and then ac power may be turned off. (See CAUTION below.)
4. If green light fails to turn on, it may be necessary to stop CPU.

Power On

1. Turn on ac power switch.
2. Turn on dc power switch.
3. Restore the Enable/Disable Switch(es) to ENABLE. (See CAUTION below).

CAUTION
Power On/Off at the tape control or tape unit should only be done by trained service personnel. For the steps to be taken, refer to the 3803-2/3420 Maintenance Library Manual, Section 12-010.

Status Byte

The status byte contains a parity bit and 8 other bits which indicate the current status of the tape control and the selected tape unit. The tape control sends this byte to the channel interface during initial selection and again at the end of each operation. Designations of the 8 bits and the conditions that they represent are:

Bit	Designation	Interpretation
0	Attention	Not used.
1	Status Modifier	Used along with status bit 3 to indicate control unit busy.
2	Control Unit End	Control Unit End indicates that the tape control has become available for use in another operation. Control Unit End is set: 1. Upon completion (at tape control level) of every operation during which a Control Unit Busy was signaled. 2. Upon completion of a control operation which had Channel End in the initial status and during which a Unit Check or Unit Exception was detected.
3	Busy	Busy indicates that the tape unit or tape control cannot execute a command for one of the following reasons: 1. If any command (including test I/O) is recognized, no status is stacked, and the selected tape unit is rewinding or switched. 2. If any command, other than test I/O, is recognized and status is stacked. 3. If any command, other than test I/O, is recognized and the tape control has a Control Unit End, or the addressed tape unit has a Device End or Unit Check interrupt condition outstanding (not yet accepted by the channel).
4	Channel End	Channel End indicates that the channel interface is no longer required for the operation. It is set when a Read, Read Backward, Write, Sense command has been completed, or a control command has been accepted.
5	Device End	Device End is set: 1. When the tape reaches load point during a rewind or tape indicate during Data Security Erase. 2. When a Rewind/Unload operation is completed at the tape control level. 3. When a control command is completed at the tape unit level.

Bit	Designation	Interpretation
		4. With Channel End, at the completion of other commands. 5. If a tape unit performing an operation becomes not ready (for example, power off, manual reset). 6. When a tape unit becomes not busy after selection was attempted while it was busy. 7. On the first initial selection after the tape unit becomes ready if the tape control has not been armed.
6	Unit Check	Unit Check indicates the tape unit or tape control has encountered an unusual condition. The cause of a Unit Check is stored as sense data which is available to the program in response to a Sense command. Unit Check is set when any of the following occur: 1. Any Sense Byte 0 error indicator is set. 2. A Read Backward, Backspace Block, or Backspace File is initiated into or at load point. 3. A Rewind/Unload is completed at the tape control level. 4. Bit 7 of Sense Byte 1 (Not Capable) is set. 5. Tape Unit is not Ready. 6. Bit 3 of Sense Byte 5 (ID Burst Check) is set. 7. Bit 4 of Sense Byte 8 (SAGC Check) is set.
7	Unit Exception	Unit Exception is set when the tape control detects a condition that usually does not occur, and does not necessarily indicate an error. Unit Exception is set: 1. If Tape Indicate is on during a Write, Write Tape Mark, or Erase Gap. 2. If a tape mark is sensed during a Read, Read Backward, Forward Space Block, or Backward Space Block. **Notes:** a. The tape unit sets Tape Indicate when it senses the trailing edge of the end-of-tape (EOT) reflective marker while tape is moving forward. b. A subsequent Write, Write Tape Mark, or Erase Gap command causes Unit Exception to be set again with Device End if Tape Indicate has not been reset. c. A command which moves tape backward so that the tape unit again senses the trailing edge of the EOT marker resets Tape Indicate, hence, Unit Exception may not occur again. d. Rewinding or unloading tape also resets Tape Indicate. e. In read and space block operations, Unit Exception is not set again, therefore, it is important to handle a Unit Exception when it is recognized.

Sense Bytes

Sense data supplements the information contained in the status byte. There are 24 bytes of sense data, stored in the tape control and tape units, containing information on error conditions, TU status, TC status, and maintenance aids. A sense command causes the bytes to be transferred to the channel.

All sense information (except MP hardware errors, sense byte 4, bit 0, and sense bytes 11 and 12) is reset upon acceptance of any command other than Sense, Test I/O, or No-Op. MP hardware error sense bytes are reset by a Sense command. All sense information is reset by General Reset.

Programming Note: When comparing sense data from a 2803/2420 subsystem to sense data from a 3803/3420 subsystem, the sense data must be checked in proper priority sequence. See ERPs.

Example: A command to a non-existing tape unit results in Intervention Required (sense byte 0, bit 1) in both cases. The remainder of the first six sense bytes may not match.

The following charts define the 24 sense bytes.

Sense Byte 0 (Unit Check)

Bit	Designation	Interpretation
0	Command Reject	Command reject is set: 1. When a Write, Loop Write to Read, Write Tape Mark, or Erase is issued to a file-protected tape unit. 2. When an unidentified command code is received by the 3803 tape control. 3. If a DSE command is issued that is not command chained to an Erase command. 4. If Reserve or Release command is issued: a. to a tape control that does not have the Two-Channel Switch Feature, or b. other than as the first command in a chain sequence.
1	Intervention Required	Intervention Required is set whenever the addressed tape unit is 'not ready' or nonexistent. **Note:** Dropping 'ready' while performing a command causes Unit Check along with any other ending status.
2	Bus Out Check	Bus Out Check is set: 1. Whenever Bus Out has incorrect (even) parity during command or data byte transfer. 2. When a ROS hardware error has occurred (any bit is on in sense byte 11 or 12) and there are no other bits on in sense byte 0.
3	Equipment Check	Equipment check is set on a control unit connected operation when: 1. Bit 0 or 1 of sense byte 4 is set. 2. Bit 3 or 4 of sense byte 8 is set. (See sense byte 8.) 3. Bit 0, 2, 3, 4, 5, or 7 of sense byte 10 is set. 4. Bit 0, 1, 2, 3, 4, 5, or 7 of sense byte 12 is set. (Set if error occurred between presentation of initial and ending status and the command involved tape motion.)

Bit	Designation	Interpretation
4	Data Check	Data Check is set when: 1. End-of-block is sensed before any data bytes are detected during a 6250 BPI or PE (1600 BPI) read or read backward operation. Bit 0 of sense byte 1 is set (Noise). 2. Bit 0, 1, 2, 3, 4, or 7 of sense byte 3 is set. 3. Bit 3 in sense byte 4 is set. 4. Bit 2, 4, 5, or 6 in sense byte 5 is set. 5. Bits 0, 3, 5, or 6 in sense byte 8 is set. 6. Bit 1 of sense byte 9 is set.
5	Overrun	Overrun is set when channel cannot supply data to the tape control fast enough on a write operation or take data fast enough from the tape control on a read or read backward operation. If data check is on, overrun is suppressed.
6	Word Count Zero	Word Count Zero is set: 1. When COMMAND OUT responds to the first SERVICE IN of a Write operation. 2. When Halt I/O is received after receipt of a Write or Read command but before tape motion is initiated. **Note:** When Word Count Zero is set, no tape motion has occurred.
7	Data Converter Check	When operating in data converter mode for a read operation, Data Converter Check (DCC) is set to indicate that the last byte (or only byte) sent to the channel was padded with zeros. The following conditions will cause a DCC error to occur on records which are not an even multiple of four characters: 1. If one character is read from tape, and the byte sent to the channel had bits 6 and 7 padded with zeros. 2. If two characters are read from tape, and two bytes are sent to the channel with the second byte padded with zeros in bits 4, 5, 6, and 7. 3. If three characters are read from tape, and three bytes are sent to the channel with the third byte padded with zeros in bits 2, 3, 4, 5, 6, and 7. **Note:** Data Converter Check cannot occur in a read backward operation.

Sense Byte 1

Bit	Designation	Interpretation
0	Noise	Noise is set when: 1. A Data Check occurs during a 6250 BPI or 1600 BPI read or read backward operation. 2. No data is transferred on a read or read backward operation. 3. Data is detected on an erase operation. 4. Data is detected during the erase portion of a write tape mark operation.
1	TU Status A	TU status A is set when an addressed tape unit is selected, ready, and not busy.

Bit	Designation	Interpretation
2	TU Status B	TU status B is set when an addressed tape unit is not ready. Assuming no outstanding device end status, bits 1 and 2 determine response to initial selection as follows:

TU Status A#	TU Status B#	TU Status	Response to Initial Selection*
Off	Off	Non-existent	Unit Check**
Off	On	Not ready, arm For Device End	Unit Check**
On	Off	Ready and not rewinding	Clean status

* If the stack flag is off and no Device End is outstanding.

** Unit Check is not signaled for a sense operation. Following a Unit Check (due to Non-existent or Not ready) or Busy indication, Device End is signaled when the tape unit becomes ready and not rewinding or switched.

\# In the 2400-series, TU status A and TU status B are lines from the tape unit. They do not exist on the 3803/3420 subsystem and are logically constructed by the tape control from the tape unit responses.

3	Seven Track	Seven Track is set when the selected tape unit has the seven-track feature.
4	Load Point	Load Point is set when the selected tape unit is at the beginning of a tape.
5	Write Status	Write Status is set when the selected tape unit is in write status.
6	File Protect	File Protect is set when the selected tape unit is in file protect status.
7	Not Capable	Not Capable is set when: 1. Leaving load point and a Read or Forward Space command scanning the load point area for a format burst finds that the tape unit feature, tape control feature, and tape format do not agree. Tape motion is halted. Channel End, Device End, and Unit Check are signaled in the status byte for Read operations, and Control Unit End, Device End, and Unit Check are set for Forward Space operations. **Note:** Following a Read Not Capable, tape is positioned away from load point with the read head located between the identification burst area and the first data block on tape. 2. On a Write operation if the density retained in the tape unit does not match the capability of the tape control.

Sense Byte 2 (Track In Error)

This sense byte contains the track-in-error (TIE) indicator bits that are set at the end of a Read, Read Backward, Write, or Loop-Write-To-Read (LWR) command.

For nine-track NRZI operations:

Write or LWR has bits 6 and 7 on.

In read or read backward operations:

1. A single bit and data check indicate the track in error.
2. Bits 6 and 7 with Data Check indicate an uncorrectable error pattern.
3. Bits 6 and 7 without Data Check indicate normal operation.

For seven-track NRZI operation:

During seven-track read or read backward operations, the track-in-error byte is used for tape unit sense level control. The values are:

	TIE
Normal - no read VRC error	00
1st read VRC error	80
2nd read VRC error	40
3rd error will return to normal and continue to cycle as shown above.	

Sense Byte 3 (Data and Equipment Checks)

Bit	Designation	Interpretation
0	Read/Write Vertical Redundancy Check	R/W VRC is set: 6250 When in error correction mode and the track(s) in error cannot be found. 1600 When there is a VRC error without a dead track or phase error. NRZI When a VRC occurred during a read or read backward operation or a missing byte is detected. Also set on a seven-track write operation if a missing byte is detected.
1	Multiple Track Error/Longitudinal Redundancy Check	6250/1600 When multiple tracks in error are detected. NRZI Present when a Longitudinal Redundancy Check occurred during a read, read backward, write, or write tape mark operation.
2	Skew Error	Present when excessive skew was detected on a 6250 BPI or 1600 BPI write, read, or read backward operation or a NRZI write operation. Set in 6250/1600 BPI mode if a track fails to start.
3	End Data Check/Cyclic Redundancy Check	1600 BPI read operations if the ending marker is not detected, or if the postamble has less than six or more than 50 bytes. All write operations when a CRC error occurs. 6250 or 800 BPI nine-track read operations when a CRC error occurs.
4	Envelope/Error Correction Check	ENV/ECC is set: 6250 When any track signal falls below the threshold on a read or write operation. This does not set Data Check. 1600 When there is a phase error or any track falls below the threshold on a read or write operation. This sets Data Check on write only. NRZI When a byte with incorrect parity is detected during a write or write tape mark operation.
5	1600 BPI set in TU	Set when the selected tape unit is in phase-encoded mode.
6	Backward	Backward is set when the selected tape unit is in backward status.

Bit	Designation	Interpretation
7	C/P Compare	Set in 6250 BPI when hardware logic detects an internal parity error. Set in seven-track NRZI if correct parity (odd or even) is not maintained by the tape control as follows: a. With translator and data converter both off if parity within a byte changes within the tape control during read or write. b. With data converter on and translator off on read operations if the parity of a group of four BCD characters changes within the tape control. c. With data converter on and translator off during write operations if the parity of a group of three EBCDIC bytes changes within the tape control. **Notes:** 1. Bus Out Parity Error or MTE can cause a C Compare error. 2. Data Converter Check blocks C Compare if DCC occurs first.

Sense Byte 4

Bit	Designation	Interpretation
0	MP Hardware Error	MP Hardware Error is set whenever an MP 1 or MP 2 Hardware Error occurs as defined in sense bytes 11 and 12.
1	Reject Tape Unit	Reject Tape Unit is set if the selected tape unit dropped 'ready' during execution of a tape motion command.
2	Tape Indicate	Tape Indicate is set whenever the end-of-tape marker is sensed during a forward tape operation.
3	Write Trigger VRC	Write Trigger VRC is set if the byte written by the write triggers has incorrect parity.
4	Spare	
5	Loop-Write-To-Read	Present when the last command was a Loop-Write-To-Read.
6	Tape Unit Check	Present when Unit Check is present in the tape unit sense.
7	Reserved for RPQ	

Sense Byte 5

Bit	Designation	Interpretation
0	New Subsystem	Always zero on 3803-2/3420 subsystem.
1	New Subsystem	Always present on 3803-2/3420 subsystem.
2	Write Tape Mark Check	Present when a tape mark is not written properly.
3	ID Burst Check	Present if the 6250 BPI or PE identification burst is not written correctly off load point. May be on if byte 8, bit 4 is on.
4	Start Read Check	Present when beginning of data is not recognized.
5	Partial Record	Present when IBG appears before end of data is recognized.
6	Postamble Error	Present when a postamble error is detected.
7	Reserved for RPQ	

Sense Byte 6 (Tape Unit)

Bit	Designation	Interpretation
0	Seven-Track Tape Unit	Present when the selected tape unit is a seven-track unit. This bit is never active for Models 4, 6, and 8.
1	Write Current Failure	Indicates that one or more write drivers have been turned on or write bias current is flowing while the tape unit is in read status.
2	Dual Density	Present when the selected 3420 Model 3, 5, or 7 is capable of 1600 and 800 BPI operation or the selected 3420 Model 4, 6, or 8 is capable of 6250 and 1600 BPI operation.
3	3420 Not Set to 1600 BPI	This bit indicates the mode of the tape unit in the following manner: Bit 3 On: Models — Mode 3, 5, 7 — 800 BPI, 9-track NRZI 4, 6, 8 — 6250 BPI Bit 3 Off: 3, 5, 7 — 1600 BPI 4, 6, 8 — 1600 BPI Bit 3 is always on for 7 track tape units.
4-7	Tape Unit Model Identification	Model 3: Bit 4 = 0, Bit 5 = 0, Bit 6 = 1, Bit 7 = 1 Model 4: Bit 4 = 1, Bit 5 = 0, Bit 6 = 1, Bit 7 = 1 Model 5: Bit 4 = 0, Bit 5 = 1, Bit 6 = 0, Bit 7 = 0 Model 6: Bit 4 = 1, Bit 5 = 1, Bit 6 = 0, Bit 7 = 0 Model 7: Bit 4 = 0, Bit 5 = 1, Bit 6 = 0, Bit 7 = 1 Model 8: Bit 4 = 1, Bit 5 = 1, Bit 6 = 0, Bit 7 = 1

Sense Byte 7 (Tape Unit READY-Drop Source)

Bit	Designation	Interpretation
0	Lamp Failure	Indicates that the fiber optics lamp has failed.
1	Tape Bottom Left	Indicates that the tape bottomed in the left column.
2	Tape Bottom Right	Indicates that the tape bottomed in the right column.
3	Reset Key	Tape unit not ready because RESET was pressed, or the door interlock was opened, after the unit had been in a start condition. **Note:** The tape unit conditions this line only if a read or write command is executed before the RESET pushbutton is pressed.
4	Data Security Erase	Indicates that a DSE is in process or was being performed. **Notes:** 1. Does not cause "ready" to drop. 2. Will not be on at normal completion of DSE (tape unit reached TI).
5	Erase Head Failure	No erase head current or write head bias current is flowing in write status or erase head current is flowing while in read status.
6	Air Bearing Pressure	The air bearing and/or the machine reel hub pressure has dropped below a critical level.
7	Load Failure	The tape unit failed to load properly.

Sense Byte 8 (Microprogram Detected Errors)

Bit	Designation	Interpretation
0	IBG Detected	Present if, when writing 6250 or 1600 BPI, if IBG is detected while writing the data portion, or BOR is not detected within a specified time after one track in each zone is detected.
1	Spare	
2	Spare	
3	Early Begin Read Back Check	Present if BOB becomes active too soon on a write or write tape mark operation. This bit sets Data Check (1600 BPI) or Equipment Check (6250 BPI).
4	Control Burst Check	Present if the control burst cannot adjust the gain of the individual tracks. May or may not cause an equipment check.
5	Slow Begin Read Back Check	Present only if Start Read Check (byte 5, bit 4) is on and is used as a modifier for FRU finding.
6	Slow End Read Back Check	Present on write operations if end of data is not detected.
7	Velocity Retry/Restart	Present when: 1. Another attempt was necessary on initial Velocity Check on write operation. 2. When a single byte of noise occurred during a NRZI read delay. **Note:** This bit is not an error.

Sense Byte 9

Bit	Designation	Interpretation
0	6250 BPI Correction	Set for information only when 1- or 2-track correction was necessary and does not indicate an error.
1	Velocity Change During Write	Present when an excessive velocity change is detected during a write operation.
2	Channel Buffer Check	Present when data into the channel buffer does not match data out of the channel buffer.
3	CRC III	Present when a CRC error is detected.
4	6250 BPI Tape Control	Present when the tape control has capability to read and write 6250 BPI code.
5	Spare	
6	Spare	
7	Tape Control Unit Reserved	Present when the tape control is in reserved status.

Sense Byte 10

Bit	Designation	Interpretation
0	Command Status Reject	Present when tape unit fails to return the proper command status.
1	Spare	
2	Control Status Reject	Present when tape unit fails to return the proper control status.
3	Write TM or Record Not Detected Block Read Back Check	Present when the record or tape mark written cannot be spaced over.
4	Dynamic Reversal Check	Present when the tape control loses control of tape position during dynamic reversal on write.
5	Tach Start Failure	Present when no change is detected in the tachometer status within a specified length of time during start delay.
6	Spare	
7	Velocity Check	Present when the tape unit does not attain and/or maintain proper velocity during write delay.

Sense Byte 11 (MAL 1 ROS/MP Errors)

Bit	Designation	Interpretation
0	'B' Bus Parity Error MP 1	Present when 'B' bus parity is incorrect on a transfer of an LSR contents to any external register (except to the 'A' register).
1	Spare	
2	Low ROS Parity/Low IC Parity on Branch Instruction (BU or BOC)	Present when: 1. Bad parity is detected in ROS Register bits 8 through 15. 2. Bad parity is detected in the instruction counter (bits 8 through 15) during a branch operation (BU or BOC).
3	Hi IC/BR Cond/Hi ROS Register Parity	Present if: 1. ROS register bits 0 through 7 have bad parity. 2. Page register bits 4 through 7 have bad parity. 3. An even number of the total branch conditions of MP 1 is met during execution of a BOC instruction.
4	Microprogram Detected Hardware Error	Present when the microprogram detects a malfunction in MP 1. Example: Incorrect branch condition during MP 1 checkout.
5	'D' Bus Parity MP 1	Present when even parity is detected on the "D" bus.
6	Spare	
7	Br Cond Error MP 1	Present if an even number of branch conditions is detected during test of one half of the branch conditions. **Note:** The branch conditions tested for this error are also tested along with all others, and bit 3 of this sense byte is set if an even number is detected.

Sense Byte 12 (MAL 2 ROS/MP Errors)

Bit	Designation	Interpretation
0	'B' Bus Parity Error MP 2	Present when 'B' bus parity is bad on a transfer of an LSR contents to any external register (except to the 'A' register).
1	Spare	
2	Low ROS Parity/Low IC Parity on Branch Instruction (BU or BOC)	Present When: 1. Bad parity is detected in ROS register bits 8 through 15. 2. Bad parity is detected in the instruction counter bits 8 through 15 during a branch operation (BU or BOC).
3	Hi IC/Br Cond Err/Hi ROS Register Parity	Present if: 1. ROS Register bits 0 through 7 have bad parity. 2. Page register bits 4 through 7 have bad parity. 3. An even number of the total branch conditions of MP 2 is met during execution of a BOC instruction.
4	Microprogram Detected Hardware Error	Present when the microprogram detects a malfunction in MP 2. Example: Incorrect branch condition during MP 2 checkout.
5	'D' Bus Parity MP 2	Present when the 'D' bus has even parity.
6	Spare	
7	BR Cond Error MP 2	Present if more than one branch condition is detected during test of one half of the branch conditions. **Note:** The branch conditions tested for this error are also tested along with all others, and bit 3 of this sense byte is set if an even number is detected.

Sense Byte 13

Bit	Designation	Interpretation
0-1	Tape Control Features	00 None of the following 01 7-Track NRZI 10 9-Track NRZI 11 Spare

Sense Byte 13, Bits 2-7 and Sense Byte 14 (Tape Control Identification - Serial Number)

Sense Bytes 15 and 16 (Tape Unit Identification - Serial Number)

Sense Byte 17 (Tape Control Features)

Bit	Designation	Interpretation
0	Tape Control Feature	Two-Channel Switch
1-3	Tape Control Features 000 Select Logic 001 2 x 8 Device Switch Low (Addresses 0-7)* 010 3 x 8 Device Switch Low (Addresses 0-7)* 011 4 x 8 Device Switch Low (Addresses 0-7)* 100 Communicator Only 101 2 x 8 Device Switch High (Addresses 8-F)* 110 3 x 8 Device Switch High (Addresses 8-F)* 111 4 x 8 Device Switch High (Addresses 8-F)*	
4-7	Engineering Change Level of Tape Control	

* The device addresses of tape units physically attached to this 3803.

Sense Byte 18

Bit	Designation	Interpretation
0	Power Check/Airflow	Voltage out of range or cooling air failure (causes READY to drop).
1-3	(Tape Unit Identification - Serial Number - high order, coded)	
4-7	EC Level of Tape Unit	

Sense Byte 19

Bit	Designation
0	Primed for Device End Tape Unit 7
1	Primed for Device End Tape Unit 6
2	Primed for Device End Tape Unit 5
3	Primed for Device End Tape Unit 4
4	Primed for Device End Tape Unit 3
5	Primed for Device End Tape Unit 2
6	Primed for Device End Tape Unit 1
7	Primed for Device End Tape Unit 0

Sense Byte 20

Bit	Designation
0	Primed for Device End Tape Unit F
1	Primed for Device End Tape Unit E
2	Primed for Device End Tape Unit D
3	Primed for Device End Tape Unit C
4	Primed for Device End Tape Unit B
5	Primed for Device End Tape Unit A
6	Primed for Device End Tape Unit 9
7	Primed for Device End Tape Unit 8

Sense Byte 21 (Thread and Load Diagnostics)

Bit	Designation
0	LOAD Button Depressed
1	Left Reel Turning
2	Right Reel Turning
3	Tape Present
4	Reels Loaded
5	Load/Rewind
6	Load Complete
7	Load Check

Sense Byte 22 (Field Replaceable Unit Identification)

Sense Byte 23 (Field Replaceable Unit Identification)

The 3803/3420 error recovery procedures (ERPs) provide uniform minimum recovery actions independent of operating systems or equipment and describe additional recovery options.

An I/O error causes an interrupt and sets an error indicator in the channel status word. If Interface Control Check (bit 46) or Channel Control Check (bit 45) is indicated in the CSW, perform "Terminal Action Ib." If Unit Check (bit 38) is indicated in the CSW, execute a Sense command to further define the error before selecting the tape control. Figure 11 shows checking sequence ("priority") for status and sense bits, and indicates the actions required.

Priority	Status Bit	Sense Byte		Bit Condition	Applicable To:			
		Byte	Bit		Read	Write	Control	Action
01	38			Unit Check	X	X	X	II
02		0	3	Equipment Check	X	X	X	X
03		0	2	Bus Out Check	X	X	X	IV
04		0	1	Intervention Required	X	X	X	III
05		0	0	Command Reject	X	X	X	XIII
06		0	5	Overrun	X	X		VII
07		1	4	Load Point	X		X	XII
08		0	4	Data Check	X			V
08		0	4	Data Check		X		VI
08		0	4	Data Check			X	VIII
09		7	4	Data Security Erase			X	XI
10	44			Channel Data Check	X	X	X	VII
11		0	7	Data Converter Check	X			XIII
12		1	7	Not Capable	X	X	X	IX
13		5	3	ID Burst Check		X		XIV
14				No Previous Sense Bits On	X	X	X	X
15	47			Chaining Check	X			VII
16	42			Program Check	X	X		XII
17	43			Protection Check	X	X		XII
18	41			Incorrect Length	X	X		XII

Figure 11. Status and Sense Indicator (Bits) Checking Sequence

Tape Cleaner Sequence

A tape cleaner sequence moves tape back and forth past the tape cleaner blade to dislodge any contaminants that may be causing read errors. The tape cleaner sequence for a forward read operation is five backspaces, then four forward spaces. For a backward read operation, the sequence is four backspaces, then five forward spaces.

Beginning of Tape: If the beginning of tape (load point) is reached in "n" backspaces during a tape cleaner sequence, reposition tape for a Forward Read with "n minus 2" Forward Spaces. Reposition tape for a Backward Read with "n" Forward Spaces.

Tape Mark Block: If a tape mark is read during a tape cleaner sequence, ignore the unit exception indication and process the tape mark as a normal block.

Operator Messages

An operator message must include:

1. Message code.
2. Channel, tape control, and device addresses.
3. Command in progress when error occurred.
4. Error condition causing the message.
5. All status and sense bits.

Action Requirements

Terminal Action Ia (With Operator Option)

An operating system may provide operator-control options and/or additional programmed error recovery.

If both are defined:

1. Again attempt the recovery procedure.
2. Continue to the additional programmed error recovery.

Terminal Action Ib (Without Operator Option)

If the additional programmed error recovery is defined, exit to it.

Action II (Unit Check)

Move CSW information to a work area, issue a sense command (unless already performed), and continue checking as in Figure 11.

Action III (Intervention Required)

No Device End in Unit Status: Test for TU Status B (sense byte 1, bit 2). If TU Status B is off, device is "nonexistent." Provide operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

If TU Status B is on, the device is 'not ready.' Provide "operator intervention required" message, and reissue the command when the tape unit has been made ready.

Device End in Unit Status: If the command was Rewind/Unload, continue processing. Otherwise, ignore an intervention required condition, and continue checking as indicated in Figure 11.

Action IV (Bus Out Check)

No Device End in Unit Status: Reissue the command.

Device End in Unit Status: If error occurs while writing, reposition tape and reissue command. For all other commands, reissue the command. If error persists after six attempts, provide operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia" and "Supplementary Information."

Action V (Data Check On Read or Read Backward)

1. Determine if the block should be classified as a noise block (noise block is less than the minimum block length of 12 bytes). If the block is valid data (noise bit on [sense byte 1, bit 0] or block length meets or exceeds minimum length requirements), attempt another read operation. If the block is a noise record, go to step 4.

   To determine block validity:

   a. When not data chaining, assume block is valid data if the CCW count less the CSW residual count is 12 or greater.

   b. When data chaining, assume block is a noise record if the count in the first CCW is less than 12 and the chain broke before the second CCW.

   c. When data chaining, assume the block is valid data if the sum of the CCW counts (up to and including the failing CCW) minus the CSW residual count is 12 or greater.

2. Set the correct mode (if seven-track), and reposition tape.

3. Set the correct mode (if seven-track), and send the track-in-error information (sense byte 2) to the tape control with a TIE command.

   Note: For program simplicity, the mode set and TIE commands may be issued whether required or not.

4. Reissue the read or read backward command.

   Note: Transfer in Channel (TIC) is the only command that may be executed between steps 3 and 4, as other commands to the tape control may destroy the track-in-error and mode set information. When attempting to correct a nine-track block, use only the track-in-error information from that block.

5. Repeat steps 1 through 4 until the block is read successfully or at least 41 attempts are made. Perform a tape cleaner sequence after every fourth attempt.

6. If the error persists, determine whether Read Opposite Recovery (ROR) is possible. Read Opposite Recovery is not possible if:

   a. Data chaining is being performed.

   b. Operating in seven-track, data-convert mode (sense byte 1, bit 3 on).

   c. Suppress data transfer bit is set in the failing read CCW.

   If ROR is not possible, provide an operator message, post completion with error condition, and exit to the operating system. If ROR is possible, proceed to step 9 (tape is correctly positioned for first ROR attempt). See "Terminal Action Ia" and "Supplementary Information."

7. Determine if the block should be classified as a noise block. See Action V, step 1.

8. Set the correct mode (if seven-track), and reposition tape.

9. Set the correct mode (if seven-track), and send the track-in-error information (sense byte 2) to the tape control with a TIE command.
10. Issue a read command in the opposite direction (Read Opposite CCW) with the suppress data transfer bit on.
11. Repeat steps 7 through 10 until the block is read successfully or at least 41 attempts have been made. If the block is read successfully, determine the number of attempts left and go to step 12. If, after 41 attempts, the Read Opposite CCW is still unsuccessful, go to step 19.

    Note: After every fourth try, perform a tape cleaner sequence.
12. If the actual block count is greater than the failing original Read CCW count, go to step 19.

    If the actual block count is equal to or less than the failing Read CCW count, compute the correct data address and count for the Read Opposite CCW. Proceed to step 13.
13. Determine if the block should be classified as a noise block. See Action V, step 1.
14. Set the correct mode (if seven-track), and reposition tape.
15. Set the correct mode (if seven-track), and send the track-in-error information (sense byte 2) to the tape control with a TIE command (if nine-track).
16. Issue the Read Opposite CCW with the computed address, the count, and the suppress data transfer bit off.
17. Repeat steps 13 through 16 until the block is read successfully or the remainder of the 41 attempts have been performed. If the block is read successfully, go to step 18. If after attempting 41 tries, the Read Opposite CCW is still unsuccessful, go to step 19.

    Note: After every fourth try, perform a tape cleaner sequence.
18. Set the correct mode (if seven-track). Space over the error block, post completion without error condition, and continue with normal processing.
19. Set the correct mode (if seven-track), and reissue the read or read backward command.

    If the error persists, provide an operator message, post completion with error condition, and exit to the operating system. See "Terminal Action Ia" and "Supplementary Information."

Action VI (Data Check On Write and Write Tape Mark)

Reposition the tape, issue an Erase Gap (ERG), issue a Mode Set (if seven-track), and reissue the command. For a Write, repeat this procedure until successful or until 15 attempts have been made. If the error persists through 14 retries, go to Step 1.

For a Write Tape Mark, repeat this procedure until successful or until 16 attempts have been made. If the error persists through 16 tries, go to Step 2.

Step 1:
Change the failing Write CCW to a Loop-Write-To-Read CCW to obtain data for error recording.

The Loop-Write-To-Read CCW must not be command chained or data chained from or to any of the CCWs in the original failing CCW chain. (Such a chain could cause tape movement and destruction of previously written tape records.)

After the Loop-Write-To-Read has been completed, the error data will be stored in the tape control sense data. The failing Write CCW will be issued to complete the 16th attempt and, if an error occurs, the resulting error data will be recorded.
Step 2:
Provide an operator message, post completion with error condition, and exit to the operating system. See "Terminal Action Ia."

Note: This action is designed for the maximum length of 32,768 bytes at 800 BPI.

Action VII (Overrun, Channel Data Check, Chaining Check)

For a Read Forward, Read Backward, or Write command, reposition tape and reissue the command. If the error persists after six attempts, provide operator message, post completion with error condition, and exit to the operating system. See "Terminal Action Ia" and "Supplementary Information."

Action VIII (Data Check On Control)

For a Write Tape Mark, execute Action VI. For an Erase Gap, reissue the command.

If the error persists after four attempts, provide operator message, post completion with error condition, and exit to the operating system. See "Terminal Action-Ia."

Action IX (Not Capable)

Provide operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

Action X (Equipment Check)

Equipment Check is valid only if associated with Device End in the CSW. If tape position is indeterminate, provide an operator message, post completion with the error condition, and exit to the operating system. See "Terminal Action Ia."

Action XI (Data Security Erase)

Provide operator message, post completion with error condition, and exit to the operating system. See "Terminal Action Ia."

Action XII (Load Point, Program Check, Protection Check, Incorrect Length)

Post completion with check condition, and exit to the operating system. See "Terminal Action Ib" and "Supplementary Information."

Action XIII (Command Reject, Data Converter Check)

Provide operator message, post completion with error condition, and exit to the operating system. See "Terminal Action Ib" and "Supplementary Information."

Action XIV (ID Burst Check on Write, Write Tape Mark, and Erase Gap)

Use a Rewind command to reposition the tape and reissue the command.

For a Write, repeat this procedure until successful or until 15 attempts have been made. If the error persists through 15 tries, go to step 1.

For a Write Tape Mark or Erase Gap, repeat this procedure until successful, or until 16 attempts have been made. If the error persists through 16 tries, go to step 2.

Step 1:
Change the failing Write CCW to a Loop-Write-To-Read CCW to obtain data for error recording.

The Loop-Write-To-Read CCW must not be command chained or data chained from or to any of the CCWs in the original failing CCW chain. (Such a chain could cause tape movement and destruction of previously written tape records.)

After the Loop-Write-To-Read has been completed, the error data will be recorded. The failing Write CCW will be issued to complete the 16 attempts and, if an error occurs, the resulting error data will be recorded.

Step 2:
Provide an operator message, post completion with error condition, and exit to the operating system. The operator message should indicate that the probable cause of the permanent error is a bad spot on the tape media in the area where the ID Burst must be written.

Supplementary Information

Bus Out, Overrun, Data Check on Read or Write, Channel Data Check, and Chaining Check: Additional programmed recovery might include alternate path retry.

Command Reject, Program Check, Protection Check, Incorrect Length: If additional programmed recovery allows the task to abnormally terminate, provide suitable comment regarding the source of the termination.

Load Point: Normally, load point is used as a data set delimiter and, thus, is provided for in the additional programmed recovery. If load point is an unexpected condition and the task is allowed to abnormally terminate, provide suitable comment regarding the source of the termination.

Data Converter Check: This check occurs on binary tapes not generated by the data converter feature and is used to adjust the final bytes of the block. Normally, the additional programmed recovery provides for this condition.

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Reader's Comment Form

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IBM 3420 Models 4, 6, and 8
Magnetic Tape Subsystems
Subsystem Description

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