GA32-0022-0

Systems

IBM 3410/3411
Magnetic Tape Subsystems
Component Description

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Preface

This manual describes the IBM 3410/3411 Magnetic Tape Subsystem, Models 1, 2, and 3. In most instances, operational descriptions are limited to the channel and command level. Operations common to all I/O devices are described in *IBM System/360 Principles of Operation,* Form GA22-6821, and *IBM System/370 Principles of Operation,* Form GA22-7000.

Subjects covered include keys and lights, tape handling procedures, status and sense information, and error recovery procedures.

Audience

Systems programmers who are writing programs for magnetic tape.

Systems engineers who are planning installations using magnetic tape.

Sales personnel.

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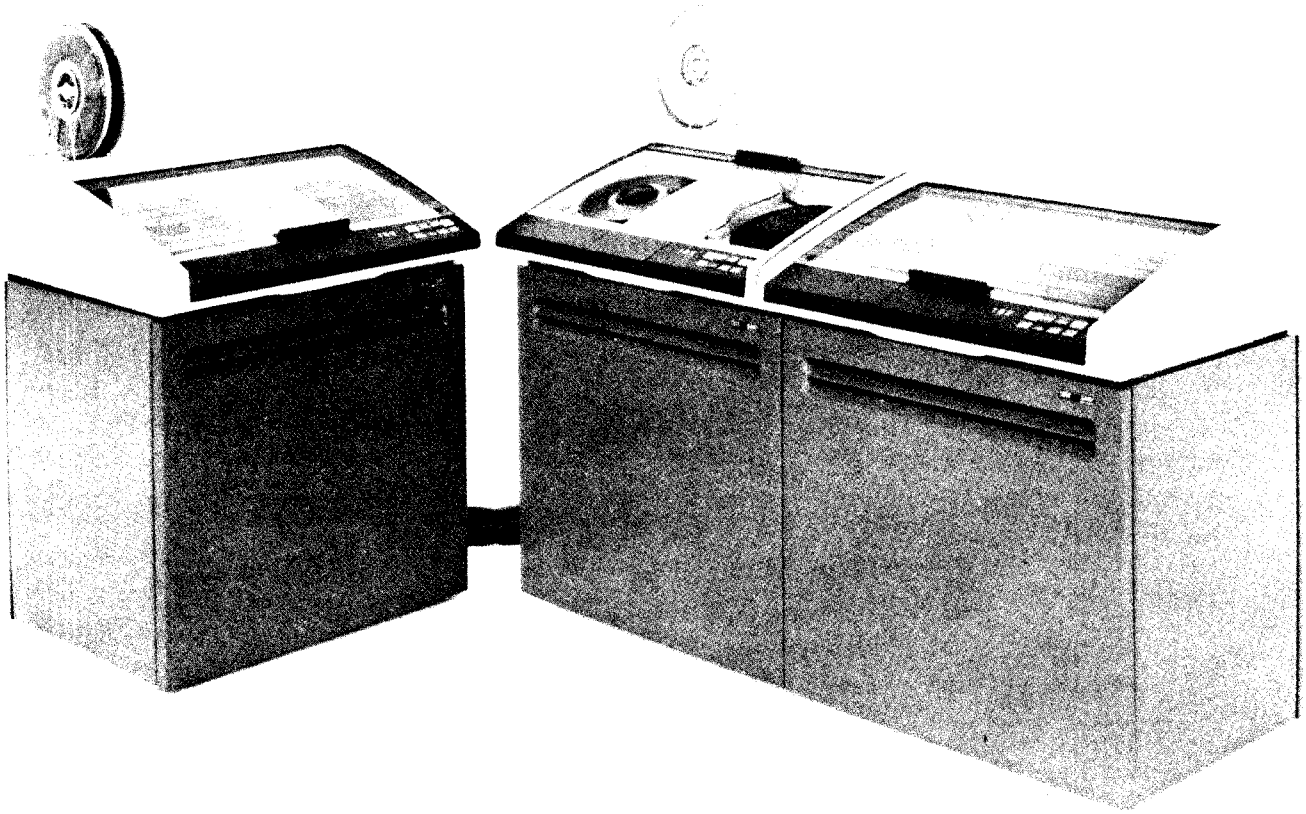

IBM 3410/3411 Magnetic Tape Subsystem

Magnetic tape is widely used as an input/output medium because it rapidly stores large amounts of information in compact, easily handled form. Tape can be used for storing intermediate results and for permanent storage of large files of data. Although the recording is permanent, any previous record is erased during the write operation. This means that tape can be used again and again with significant savings in recording costs.

A magnetic tape subsystem consists of a tape control and one or more tape units. A tape unit is an electromechanical device that transports magnetic tape past a read/write head, and either records (writes) data on the tape or senses (reads) data previously recorded on the tape. A tape control is an electronic device that controls the operation of several tape units. The tape control selects a specific tape unit, establishes the necessary conditions for an operation, provides timing signals and delays, and controls the transfer of data between the tape unit and host system. Status and sense information, which monitor the progress of an operation, are accumulated by the subsystem and sent to the host system upon request.

To write on tape, the tape control sends tape-motion control commands, write control commands, and data to the tape unit. The tape unit then moves the tape past the read/write head and writes the data on tape. To read from tape, the tape control sends tape-motion control commands and read control commands to the tape unit. The tape unit then moves the tape past the read/write head, reads the data from the tape, and sends the data to the tape control. The tape unit also rewinds, spaces tape, and unloads tape upon command from the tape control.

The IBM 3410/3411 Magnetic Tape Subsystem consists of one 3411 Magnetic Tape Unit and Control and up to five 3410 Magnetic Tape Units. The 3411 contains the tape control and power supplies for the subsystem. The 3411 completely controls the 3410s. The tape unit portion of a 3411 is identical to that in the 3410.

There are three models of the IBM 3410/3411 subsystem.

The Model 1 subsystem moves tape at 12.5 inches per second (ips) resulting in a maximum data rate of 20,000 bytes per second. A maximum of three 3410s can be included in this subsystem for a total of four tape units.

The Model 2 subsystem moves tape at 25 ips resulting in a maximum data rate of 40,000 bytes per second. A maximum of five 3410s can be included in this subsystem for a total of six tape units.

The Model 3 subsystem moves tape at 50 ips resulting in a maximum data rate of 80,000 bytes per second. A maximum of five 3410s can be included in this subsystem for a total of six tape units.

Note: Interconnected 3410s and 3411s must be the same model. Models can not be intermixed.

Tape units attach to the tape control via individual interface cables. This is called a "radial attachment," and it allows a tape unit to be disconnected from the tape control without affecting other tape units of the subsystem. Each tape unit signal connector in the tape control is associated with a unique tape unit address. When the tape control communicates with a tape unit, the interface signals are routed only to the selected tape unit.

The 3410/3411 tape subsystem can operate in three density modes; 1600 bpi (PE) single density, 800/1600 bpi dual density (nine-track), or 200/556/800 bpi seven-track. On the 3411 tape control single density is standard. Dual density and seven-track are specified features. On the 3410 tape unit, including the tape unit portion of the 3411, all density modes are special features. One special feature must be ordered for each 3410; single density, dual density, or seven-track. The features are mutually exclusive; only one can be installed on a tape unit. Figure 1 summarizes the features available on the 3410/3411.

Subsystem Function	Feature	IBM 3411 Magnetic Tape Unit & Control	IBM 3410 Magnetic Tape Unit (Includes tape unit in 3411)
1600 BPI 9-Track only	Single Density	Standard	Feature No. 3211
1600/800 BPI NRZI 9-Track	Dual Density	Feature No. 9150	Feature No. 3211 or 3221
1600 BPI PE/ 200/556/800 BPI NRZI 7-Track	Seven-Track	Feature No. 9160	Feature No. 3211 or 6550

Figure 1. IBM 3410/3411 Feature Summary

The Single Density feature allows nine-track tape units to read or write 1600 bpi PE. No mode set command is required for the read or write operations.

The Dual Density feature allows nine-track subsystems to operate in PE mode at 1600 bpi or in nine-track NRZI mode at 800 bpi. Before initiating a write operation, the channel must first issue a Mode Set 2 command to establish the operating mode in the tape control. A Mode Set 2 command is not necessary for nine-track read operations.

The Seven-Track feature allows subsystems with a mixture of seven- and nine-track tape units to read and write in either seven-track NRZI mode or nine-track PE mode. In seven-track NRZI mode, reading and writing are done at 200, 556, or 800 bpi. Before initiating a seven-track read or write operation, the channel must first issue a Mode Set 1 command to establish the operating mode in the tape control. Tape controls with the seven-track feature also have the translator and data converter installed.

When on, the translator causes eight-bit EBCDIC (Extended Binary Coded Decimal Interchange Code) bytes from the system to be written on tape as six-bit BCD (Binary Coded Decimal) characters and six-bit BCD characters to be read from tape and translated to their eight-bit EBCDIC equivalent. Data rates are not changed when using the translator, nor is there any change in tape unit operation.

When on, the data converter causes 4 six-bit characters (24 bits) to be written on tape for every 3 eight-bit bytes received from the system. Reading seven-track tape with the data converter on reverses the process by converting the 4 six-bit tape characters to 3 eight-bit bytes. When on, the data converter reduces the data transfer rate to 75% of the operating rate with the data converter off. Data conversion can only be used when moving tape forward, that is, writing or reading forward.

Note: Both the translator and data converter are turned on or off by the Mode Set 1 command.

The subsystem is under the control of the host system which can be System/360 Models 22, 25, 30, 40, and 50 or System/370 Models 125, 135, 145, 155, and 158. The host system instructs the 3410/3411 subsystem to perform specific tasks. The tape control receives, decodes, and executes the instructions. To execute a command, the tape control instructs the selected tape unit to perform the desired operation.

A Start I/O instruction from the host system initiates a tape operation. The system also sends one of the following commands (Figure 2, Part 1 of 2) to designate the operation the subsystem is to execute:

Write

This command records data on tape. The parity of each byte is checked when it is received from the channel and again after it is written (readback check). The write command also generates an interblock gap at the end of each data block.

In PE mode, a write command issued when tape is positioned at the beginning-of-tape (BOT), generates a PE identification burst and a 3-inch (76 mm) gap before data is recorded on tape.

In NRZI mode, a write command issued when tape is at BOT, generates a 5-inch (127 mm) gap before data is recorded on tape.

Commands	Command Byte 0	1	2	3	4	5	6	7	Hex
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
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
Request Track-In-Error	0	0	0	1	1	0	1	1	1B
Mode Set 1	See Part 2 of this figure.								
Mode Set 2	See Part 2 of this figure.								

Figure 2. Command Byte Coding (Part 1 of 2)

Read Forward

This command reads data from tape as tape is moving forward. The tape unit reads data until an interblock gap is detected. The tape control checks the parity of each byte before it is sent to channel. When reading in PE mode, single-track errors are corrected before the data is sent to channel.

For dual density subsystems, the mode in which the read command operates is determined when tape is at BOT. If the PE identification burst is detected, the tape control and tape unit are set to read tape in 1600 bpi PE mode. If the PE identification burst is not detected, the tape control and tape unit are set to read tape in 800 bpi NRZI mode. The tape unit retains the mode setting until the tape is again at BOT.

For seven-track subsystems read density is determined by a Mode Set 1 command.

Read Backward

This command is similar to a read forward command except that tape moves backward.

Sense

This command transfers sense data from the subsystem to the host system. The sense bytes are stored in the tape control and tape unit. Sense Bytes 0, 1, and 2, and bits 0 to 6 of Sense Byte 3 are identical to the IBM 2400-series and 3420/3803 subsystems. The 3410/3411 subsystem uses nine sense bytes. See "Status Information and Sense Data" for further description of the status and sense bytes.

Request Track-in-Error

This command returns the track-in-error information (Sense Byte 2) from the host system to the subsystem. The tape control uses the data to correct the next data block read. This command is effective only when correcting single-track read errors during nine-track NRZI operations. It is executed but not effective during PE and seven-track operations.

Write Tape Mark

This command writes a special block on tape that is used to separate the files on tape. This special block is generated by the subsystem; no data is transferred from channel. A readback check is performed on the tape mark. If an error is detected, tape is repositioned and the tape mark is rewritten.

In PE mode with tape at BOT, a PE identification burst is written and a 3-inch (76 mm) gap is generated before the tape mark is written.

In NRZI mode with tape at BOT, only the 5-inch (127 mm) gap precedes the tape mark.

Erase Gap

This command erases tape for a predetermined distance. If tape is not at BOT, the distance erased is 3.6 inches (91 mm).

In PE mode with tape at BOT, the PE identification burst is written, then a 3-inch (76 mm) gap is erased.

In NRZI mode with tape at BOT, a 5-inch (127 mm) gap is erased.

Successive erase gap commands can be issued to generate longer gaps.

Data Security Erase

This command erases tape from the point at which it was initiated to the end-of-tape (EOT) marker. Data Security Erase is accepted by the subsystem only when chained to an Erase Gap command. To erase tape beyond the EOT marker, successive Erase Gap commands must be issued.

Rewind

This command rewinds tape to BOT. If tape is at BOT when the command is issued, the operation is terminated immediately without error.

Rewind Unload

This command rewinds tape to BOT and then unloads tape. If tape is already at BOT, tape is unloaded to complete the operation.

Forward Space Block

This command moves tape forward to the next interblock gap.

Forward Space File

This command moves tape forward to the interblock gap beyond the first tape mark encountered.

Backspace Block

This command moves tape backward to the next interblock gap or to BOT, whichever occurs first.

Backspace File

This command moves tape backward to the interblock gap beyond the first tape mark encountered or to BOT, whichever occurs first.

Mode Set 1 (Seven-Track Feature)

This command establishes operating conditions in the tape control for subsequent seven-track read or write operations. The Mode Set 1 command determines the density, turns the data converter and translator on or off, and sets subsystem operations to odd or even parity. The subsystem retains its mode setting until reset or until it receives another mode set command. See Figure 2, Part 2 of 2.

200	556	800	1600	Odd Parity	Even Parity	DC On	DC Off	Translate On	Translate Off	Command Byte 0	1	2	3	4	5	6	7	Hex
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)																		
			x							1	1	0	0	0	0	1	1	C3
		x								1	1	0	0	1	0	1	1	CB

Note 1: Seven-track Mode Set 1 commands are treated as NOP-reset sense bytes when issued to a tape control without the seven-track NRZI feature.
Note 2: Nine-track Mode Set 2 commands are treated as NOP-reset sense bytes when issued to a tape control without the nine-track NRZI feature.

Figure 2. Command Byte Coding (Part 2 of 2)

Mode Set 2 (Dual Density)

This command establishes the operating conditions (1600 bpi or 800 bpi) in the tape control and tape unit for subsequent nine-track write operations. The command is accepted by the tape unit only when the tape unit is at BOT on a write-type command. During read operations, the mode is automatically set when tape is at BOT. (See "Read Forward.")

Characteristics	Model 1	Model 2	Model 3
Tape Speed (ips)	12.5	25	50
Write Access Time*	15 ms	12 ms	6 ms
Read Access Time*	15 ms	12 ms	6 ms
Data Rate:			
1600 bpi	20 kb/sec	40 kb/sec	80 kb/sec
800 bpi	10 kb/sec	20 kb/sec	40 kb/sec
556 bpi	6.95 kb/sec	13.9 kb/sec	27.8 kb/sec
200 bpi	2.5 kb/sec	5.0 kb/sec	10.0 kb/sec
Time Per Byte:			
1600 bpi	50 usec	25 usec	12.5 usec
800 bpi	100 usec	50 usec	25 usec
556 bpi	144 usec	72 usec	36 usec
200 bpi	400 usec	200 usec	100 usec
Interblock Gap (IBG):			
Length/Time			
Nine-Track	0.6 in/48 ms	0.6 in/24 ms	0.6 in/12 ms
Seven-Track	0.75 in/60 ms	0.75 in/30 ms	0.75 in/15 ms
Rewind Time (±10%) (2400 feet)	3 minutes	3 minutes	2 minutes
Tape Threading	Manual	Manual	Manual
Reel Sizes (inch)	10.5, 8.5, 7, or 6 (for all models)		

Tape Requirements

The following half-inch tapes can be used: IBM Series/500, IBM Heavy Duty, IBM Dynexcel®, or competitive formulations which meet the tape and reel criteria in *Tape Specifications*, Form GA32-0006.

Note: IBM tapes other than those named above do not provide adequate reliability and should not be used.

* **Read Access Time** is the interval from issuance of a Read Forward 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 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.

Machine Environment

Relative Humidity: 20 to 80%

Temperatures:

Operating: 60 to 90° F (15.6 to 32.2° C)

Non-Operating: 50 to 110° F (10 to 43.3° C)

Maximum Wet Bulb: 78° F (25.6° C)

Metric equivalents:

1600 bpi	= 63 bytes per mm	0.6 inches	= 15,2 mm
800 bpi	= 31,5 bytes per mm	0.75 inches	= 19 mm
556 bpi	= 21,9 bytes per mm	6 inches	= 152,4 mm
200 bpi	= 7,9 bytes per mm	7 inches	= 177,8 mm
50 ips	= 1270 mm per second	8.5 inches	= 216 mm
25 ips	= 635 mm per second	10.5 inches	= 266,7 mm
12.5 ips	= 317,5 mm per second	2400 feet	= 732 meters

Figure 3. IBM 3410/3411 Magnetic Tape Subsystem Specifications

This section contains procedures for handling and storing tape, turning power on and off, and recovering from errors. Also included are descriptions of the Operator's Panel and of the status and sense bytes. Refer to the *IBM 3410/3411 Operator's Guide,* Form G232-0004, for additional operating procedures.

Tape Handling and Storage

Tape Handling

A tape reel that is not in use on a tape unit should always be stored in its container. Establish procedures to protect magnetic tape from contamination which causes degraded tape unit performance. Some common rules are:

1. Never leave tape reels or containers exposed. Tape may be damaged, or dust accumulating on the tape or in the container can contaminate the tape.
2. Erasing a tape reel identification label is a cause of contamination. Use new labels when changing reel identification. Select a label with an adhesive backing that does not leave a residue and that can be applied and removed easily.
3. Never allow a loose end of tape to trail on the floor; dirt picked up in this manner can reach the tape transport and be passed on to other sections of the tape.
4. Do not allow smoking in areas where tape is in use. Ashes contaminate tape. Live ashes can permanently damage the tape surface.
5. Don't touch the tape edges through the reel openings or press on the reel flanges. Such pressure will compress the tape and damage its edges.
6. Be very careful when removing the write-enable ring. Always unload tape before removing the write-enable ring; never remove the ring while tape is loaded on the tape unit.

Tape Storage

To prevent tape contamination and damage during storage, follow these procedures:

1. Before a tape is stored, secure the loose end of tape with a tape end retainer to prevent the tape from unwinding in the container.
2. Always store tape in an upright position. Never store tapes flat or in stacks; accidental damage or reel warpage may result.
3. Store tapes in a cabinet or shelf elevated from the floor and away from sources of paper and dust. Dust can be transferred from the outside of the container to the reel during load and unload operations.

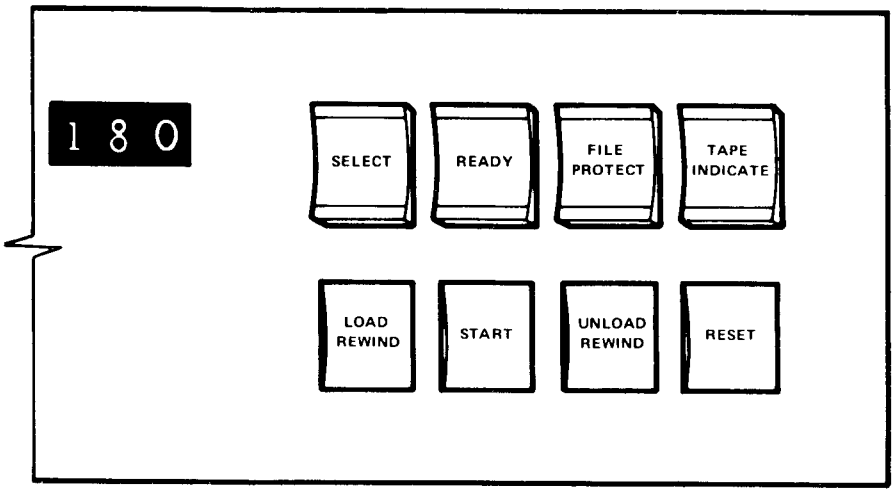

Figure 4. Operator's Panel

SELECT

This lamp is turned on when the tape unit is being operated by the tape control. The tape unit must be ready before it can execute commands from the tape control.

READY

This lamp indicates that the tape unit is capable of executing commands from the tape control.

To turn on the READY lamp, the tape unit must be loaded, the cover closed, the START key must be pressed, and tape must not be in motion (as in a load or rewind operation for example). Pressing the START key while tape is loading or rewinding, causes the READY lamp to turn on after the operation is complete and tape motion stops.

FILE PROTECT

This lamp indicates that the tape unit is not capable of executing a write or erase command.

The FILE PROTECT lamp is turned on when the tape unit is not ready, or when a file-protected tape reel is mounted. A file-protected reel is one from which the write-enable ring has been removed. The write-enable ring should be removed from the back of the tape reel to protect information on the tape from accidental erasure or rewrite.

TAPE INDICATE

This lamp is turned on when the end-of-tape (EOT) reflective marker is sensed with tape moving in a forward direction. Sensing EOT in write status sets unit exception. The lamp is turned off when the EOT marker is sensed with tape moving in a backward direction.

RESET

Pressing this pushbutton removes the tape unit from ready status, turns off the READY lamp, stops tape motion, and prevents the tape unit from responding to commands from the tape control.

UNLOAD REWIND

This pushbutton causes the tape unit to rewind tape to load point and then unload. If the tape is at load point when UNLOAD REWIND is pressed, the tape unit unloads immediately. The UNLOAD REWIND pushbutton is disabled when the tape unit is ready.

START

If the tape unit is loaded, pressing this pushbutton allows the tape unit to respond to commands from the tape control, turns on the READY lamp, and disables all other pushbuttons except RESET.

If the tape unit is ready or not loaded, the START pushbutton has no effect.

LOAD REWIND

If the tape unit is not loaded, pressing this pushbutton causes the tape to load into the vacuum columns and to be moved forward to load point (the load point reflective marker is sensed at the photosense block). The BOT reflective marker must be positioned to the left of the vacuum columns.

If the tape unit is loaded, not ready, and tape is not positioned at load point, pressing this pushbutton causes tape to move backward (rewind) to load point.

If the tape unit is ready or if tape is already positioned at load point, pressing LOAD REWIND has no effect.

ENABLE/DISABLE

This switch allows the subsystem to be taken off-line for maintenance. Operation of this switch (located on the 3411) is interlocked with the system program. The switch setting can be changed at any time, but the subsystem changes status only when the system is in a Halt or Wait state. The switch must be set to the ENABLE position to put the subsystem on-line. The switch must be set to the DISABLE position to take the subsystem off-line.

A disabled subsystem is nonexistent to the system program.

Note: When the switch is set to DISABLE, the subsystem does not go off-line until all pending status information (except a device end resulting from selecting a not ready tape unit) is accepted by the program.

When the subsystem is to be disabled (or enabled), proceed as follows:

1. Turn the ENABLE/DISABLE switch to the ENABLE (or DISABLE) position.
2. Press STOP and then START at the system console. The subsystem is now on-line (or off-line).

Usage Meter

A time meter on the 3411 records the elasped time that the tape control is in use. The meter runs whenever the subsystem is enabled (on-line) with the ENABLE/DISABLE switch, and the host system is operational.

A time meter on each 3410 records only the time that the tape unit is in use. The meter runs whenever the subsystem is enabled, tape is away from load point, and the host system is operational.

Power On/Off Procedures

Normal power on/off sequencing for the subsystem is controlled by the system power interlock circuits. Maintenance activities (such as taking a tape unit off-line) may necessitate dropping power in the tape control.

Voltage transients caused by dropping or bringing up tape control power during system operation can cause erroneous system interrupts. To avoid this, use the following procedures when dropping or bringing up tape control power:

Power Off Procedure

The channel to which the tape control is attached must have completed all operations and have no pending interrupts.

1. Vary the subsystem off-line (refer to your operating system guide).
2. Set the ENABLE/DISABLE switch to DISABLE. This allows the subsystem to go off-line when the system reaches a 'wait state.'

   Optional: To force the system into a wait state, press STOP then START at the system console.
3. Turn power off at the tape control after the tape control goes off-line.

Power On Procedure

1. Set ENABLE/DISABLE switch to DISABLE.
2. Turn power on at the tape control.
3. Set the ENABLE/DISABLE switch to ENABLE. This allows the subsystem to go on-line when the system reaches a 'wait state.'

   Optional: To force the system into a wait state, press STOP then START at the system console.

Status Information And Sense Data

Unit Status Byte

The unit status byte contains eight bits of status information pertaining to the selected tape unit and tape control. Unit status information is retained by the tape control or channel until it is incorporated in the channel status word (CSW), or until another operation is accepted. Unit status information is updated at the beginning of each tape operation (except Test I/O) to indicate initial status. It is also updated during a tape operation to provide ending status at termination of the I/O operation. This information is set in the status portion of the channel status word by an I/O interruption or, under certain conditions, by a Start I/O, Test I/O or Halt I/O instruction. Bits 32-39 of the CSW, which indicate tape unit and tape control status, are described in this section. Bits 40-47 of the CSW, which indicate channel status, are described in *IBM System/360 Principles of Operation*, Form GA22-6821.

Notes:

1. Only one channel end and device end are generated for each I/O operation.
2. Channel end and device end are not generated when programming errors or equipment malfunctions are detected during initiation of an operation prior to tape control returning its status.
3. When command chaining takes place, only the channel end and device end of the last operation are made available to the program.
4. The channel may or may not present channel end to the operating system even though channel end was present in the subsystem ending status when a control unit end or device end prematurely terminated a chain of commands, or during the initiation of a chained command.
5. If an unusual condition is detected during *initiation* of a chained command, the chain is terminated without the device end indication.

Sense Data

Sense data provides detailed information about the selected tape unit and about the last operation performed by the tape control. Information transferred by the sense command is more detailed than that supplied by the unit status byte, and may be used to determine the cause of a unit check indication. Figure 5 summarizes the status and sense information.

Unit Status and Sense Byte Summary

Bit / Byte	0	1	2	3	4	5	6	7
Unit Status	Attention (Not Used)	Status Modifier	Control Unit End	Busy	Channel End	Device End	Unit Check	Unit Exception
Sense Byte								
0	Command Reject *	Intervention Required *	Bus Out Check *	Equipment Check *	Data Check *	Overrun *	Word Count Zero *	Data Converter Check *
1	Noise †	Tape Unit Status A	Tape Unit Status B	Seven-Track Tape Unit	Load Point	Write Status	File Protected	Not Capable *
2	Track-in-Error							
3	Read/Write VRC †	Multiple Track Error or LRC Error †	Skew Error †	End Data Check or CRC †	Envelope Check †	1600 BPI Set in Tape Unit	Backward	Not Used
4	Tape Unit Positioning Check #	Tape Unit Reject #	Tape Indicate	Not Used	Not Used	Diagnostic Track Check †	Tape Unit Check	Not Used
5	New Subsystem	New Subsystem	Write Tape Mark Check #	PE ID Burst Check *	Parity Compare †	Tach Check #	False End Mark †	Reserved for RPQ
6	Seven-Track Tape Unit	Short Gap Mode	Dual Density	Alternate Density	Tape Unit Model Identification			
7	Lamp Check ¤	Left Column Check ¤	Right Column Check ¤	Ready Reset ¤	Data Security Erase	Not Used	Not Used	Not Used
8	Not Used	Feedthrough Check	Not Used	End Velocity Check †	Readback Data not Detected #	Start Velocity Check †	Not Used	Not Used

† Sets Data Check
# Sets Equipment Check
* Sets Unit Check
¤ Sets Tape Unit Check

Figure 5. Unit Status and Sense Byte Summary

STATUS BYTE

Bit	Designation	Interpretation
0	Attention	Not Used
1	Status Modifier	Used with bit 3 (Busy): bits 1 and 3 ON indicate the tape control is busy or has an interrupt pending for a tape unit other than the one addressed.
2	Control Unit End	Control unit end indicates the tape control has become available for another operation. Control unit end is set: 1. At completion of every tape control operation during which control unit busy was signaled. 2. At completion of a control command (which presented channel end in initial status) in which a unit check or unit exception is detected.
3	Busy	Busy indicates the tape unit or tape control cannot execute a command or instruction because one of them is executing a previously initiated operation or has a pending interrupt condition. Bit 3 (Busy) ON and bit 1 (Status Modifier) OFF indicates: 1. That any command (including Test I/O) is recognized, no interrupt is pending, and the selected tape unit is rewinding or performing a data security erase. 2. That any command other than Test I/O is recognized and: a. The tape control has a control unit end interrupt pending. b. The addressed tape unit has a device end or unit check interrupt pending.
4	Channel End	Channel end indicates completion of the portion of an I/O operation involving transfer of data or control information between the tape control and channel. Channel end means that the channel is available for another operation. Channel end is set when a read, read backward, write, or sense command has been completed, or when a control command has been accepted by the tape control.
5	Device End	Device end indicates completion of an I/O operation at the tape unit, or when the tape unit is made ready manually. Device end indicates that the tape unit is available for another operation. Also see Sense Byte 1, Bits 1 and 2 (Tape Unit Status A and B). Device end is set: 1. When a load operation has been completed and the START key is pressed (tape unit goes from not ready to ready status). 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.
4. Along with channel end at the completion of other commands.
5. Along with unit check when a tape unit that is performing any operation except rewind unload or rewind becomes not ready (that is power off, manual reset, etc).
6. When a tape unit becomes not busy after selection was attempted while the tape unit was busy.

6 Unit Check

Unit check indicates the tape unit or tape control has encountered an unusual condition. Cause of a unit check is stored as sense data that is available to the program in response to a sense command. Unit check is set when any of the following occur:

1. Any bit in Sense Byte 0 is set.
2. A read backward, backspace block, or backspace file operation is initiated into or at load point.
3. A rewind unload operation becomes effective at the tape unit level (interrupt status cycle).
4. Sense Byte 1, Bit 7 (not capable) is set.
5. Sense Byte 5, Bit 3 (PE identification burst) is set.
6. A failure occurred which prevents completion of a data security erase command.
7. An error occurred during a space operation after channel end was presented.

7 Unit Exception

Unit exception indicates the tape control detected a condition that usually does not occur, but is not necessarily an error. Unit exception is set:

1. If tape indicate is on during a write, write tape mark, or erase gap operation.
   a. Tape indicate is turned on when the tape unit senses the end-of-tape (EOT) reflective marker while tape is moving forward.
   b. Subsequent write, write tape mark, or erase gap instructions result in additional unit exception indications if tape indicate is not reset.
   c. Tape indicate is turned off when the tape unit senses the EOT reflective marker while tape is moving backward, or when tape is unloaded.
   d. Sensing the EOT reflective marker during a data security erase operation does not set unit exception. The data security erase operation is completed when tape reaches the EOT reflective marker.

2. If a tape mark block is detected during a read, read backward, forward space block, or backspace block operation.

   Note: A 'service out' response to 'status in' clears unit exception. Because read and space-block operations do not set unit exception again, it is important to handle a unit exception when it is recognized.

SENSE BYTE 0

Bit	Designation	Interpretation
0	Command Reject	Present: 1. If a write, write tape mark, or erase gap command is issued to a file-protected tape unit. 2. If an illegal command is decoded. 3. If a data security erase command is issued without chaining it to an erase gap command.
1	Intervention Required	Present if the addressed tape unit is not ready or is nonexistent.
2	Bus Out Check	Present if channel bus out has incorrect (even) parity during a command byte or data transfer.
3	Equipment Check	Present if any of the following are set: Sense Byte 4, Bits 0 or 1 Sense Byte 5, Bits 5 or 2 Sense Byte 8, Bit 4
4	Data Check	Present if any of the following are set: Sense Byte 1, Bit 0 Sense Byte 3, Bits 0, 1, 2, 3, or 4 Sense Byte 4, Bit 5 Sense Byte 5, Bits 4 or 6 Sense Byte 8, Bits 3 or 5
5	Overrun	Present when service is requested but data cannot be transferred during a read, read backward or write operation. Data transfer stops when overrun is detected.
6	Word Count Zero	Present: If channel responds with command out to the first service request during a write data, request TIE, or set diagnose operation. If a Halt I/O is received after initial status is accepted, but before the first service request is made in the above operations.
7	Data Converter Check	Present if each data block read in seven-track data convert mode does not contain a multiple of four bytes.

SENSE BYTE 1

Bit	Designation	Interpretation
0	Noise	Present: In PE mode, if a condition which causes a data check occurs during a read or read backward operation. In NRZI mode, if data is detected after the disconnect sequence has started. Also sets data check. In NRZI or PE mode, if any read back signal is detected during an erase gap operation. Also sets data check.
1	Tape Unit Status A	Present if the tape unit is selected, ready, and not busy.
2	Tape Unit Status B	Present if the selected tape unit's START pushbutton has not been pressed, or if the selected tape unit's START pushbutton has been pressed but the tape unit is executing a rewind or data security erase.
3	Seven-Track Tape Unit	Present if the selected tape unit has the seven-track feature.
4	Load Point	Present if the selected tape unit is loaded, ready, and is at beginning-of-tape (BOT).
5	Write Status	Present if the selected tape unit is in Write Status or is not ready. When not present, the tape unit is in Read Status.
6	File Protected	Present if the tape reel on the selected tape unit does not have a write-enable ring installed and the tape unit is ready. Also set if the tape unit is not ready.
7	Not Capable	Present when a subsystem without the NRZI capability attempts to read a NRZI tape. Attempting to read a NRZI tape results in tape stopping away from load point so that the IBG (interblock gap) preceding the first data block is over the read head.

Tape Unit Status A	Tape Unit Status B	
0	0	tape unit is nonexistent
0	1	tape unit is not ready
1	0	tape unit is ready and not busy
1	1	tape unit is ready and busy

SENSE BYTE 2 (TRACK-IN-ERROR)

During a PE read or write operation, this byte indicates the dead tracks or tracks with a phase error. If no dead track is found, bits 6 and 7 are set on.

During a NRZI read operation, this byte contains the track-in-error (TIE) byte. If no track is found, bits 6 and 7 are set on.

During a NRZI write operation, this byte is not used and bits 6 and 7 are set on.

SENSE BYTE 3

Bit	Designation	Interpretation
0	Vertical Redundancy Check	Present in PE or NRZI if a parity error which cannot be corrected occurs while reading data forward or backward, or if any parity error occurs during a read-back check of a write operation. Also sets data check.
1	Multi-track Error	Present in PE operations if a weak signal is found in two or more tracks and/or a phase error is found in the same block. Also sets data check.
	Longitudinal Redundancy Check (LRC)	LRC is set in NRZI write operations if the generated LRC byte has incorrect parity. This bit is also set in NRZI read or read backward operations if the LRC register does not contain all zeros or has incorrect parity after reading a complete data block. Also sets data check.
2	Skew	Present when excessive bit misalignment is detected during PE read or read backward operations or during NRZI write operations. Also sets data check.
3	End Data Check	Present in PE read or write operations if a preamble and at least one byte of data is sensed but no postamble is detected before reaching the IBG. Also sets data check.
	Cyclic Redundancy Check (CRC)	Present during a NRZI read or read backward operation if the CRC byte read from tape does not match the CRC pattern generated while the data block was being read. Also present during NRZI write operations if the CRC byte parity is incorrect during the read-back check, or if the CRC pattern read back from tape differs from the pattern that was written. Also sets data check.
4	Envelope Check (PE Only)	Present in PE operations if, during a read, read backward, or write, the signal amplitude is too low or if a phase error occurs. Data check is set if the error is uncorrectable and occurs during a read or read backward. Data check is always set if an envelope check occurs during a write operation.
5	1600 bpi	Present when the selected tape unit is in 1600 bpi (PE) mode. If not set, the selected tape unit is in NRZI mode.
6	Backward	Present when the tape unit is in backward status.
7	Not Used	

SENSE BYTE 4

Bit	Designation	Interpretation
0	Tape Unit Positioning Check	Present if the tape is expected to be stopped but the positioning line between tape unit and tape control is still active. This can happen when the tape control attempts to set a command in the tape unit. Also sets equipment check.
1	Tape Unit Reject	Present if the tape unit fails to set a command properly, or if ready drops while tape is in motion. Also sets equipment check.
2	Tape Indicate	Present whenever the end-of-tape (EOT) marker is sensed during a forward tape operation.
3	Not Used	
4	Not Used	
5	Diagnostic Track Check	Present if a diagnostic operation detects a dead track or phase error condition. Also sets data check.
6	Tape Unit Check	This bit is set by bits 0, 1, 2, or 3 of Sense Byte 7.
7	Not Used	

SENSE BYTE 5

Bit	Designation	Interpretation
0	New Subsystem	Always zero, and is used with bit one of this sense byte to identify sense information pertaining to the 3410/3411 subsystem.
1	New Subsystem	Always one, and is used with bit zero of this sense byte to identify sense information pertaining to the 3410/3411 subsystem.
2	Write Tape Mark (WTM) Check	Present if the tape mark is not written correctly. The subsystem automatically repositions tape and retries the write tape mark operation 15 times. If the WTM operation is successful, no error is set. If the tape mark cannot be written correctly, equipment check is set.
3	PE Identification Burst	Present during PE write operations initiated from load point if the PE identification burst is not written correctly, or a start velocity error occurs from loadpoint in either PE or NRZI write operations. **Note:** This bit can be set only if the PE identification burst jumper is installed on the tape control. This jumper is installed at the factory, but may be moved by maintenance personnel if certain problems exist when using system programs prior to OS release level 21 or DOS release level 27.
4	Parity Compare	Present during read data operations if the parity of a data byte being sent to the channel differs with the parity of that byte when received from the microprogram portion of the tape control. Also sets data check.
5	Tachometer Check	Present if capstan motion is not detected after tape has been set in motion. If no tachometer pulses are detected, the capstan is apparently not in motion. Also sets equipment check.
6	False End Mark	Present: 1. In PE write data operations if the all ones byte of the postamble is followed by less than 37 bytes of all zeros. 2. In PE read data operations if the all ones byte of the postamble is followed by less than 15 bytes of all zeros. Also sets data check.
7	Reserved for RPQ	When present, the subsystem contains an RPQ feature.

SENSE BYTE 6

Bit	Designation	Interpretation
0	Seven-Track Tape Unit	Present if the selected tape unit has the seven-track feature.
1	Short Gap Mode	Present when the tape positioning circuits are set to stop tape quicker after the tape unit detects an IBG. When active, these circuits position the read head closer to the last block read. The tape control sets the tape unit to short gap mode whenever data is detected prematurely at the beginning of a read operation. Reading a data block prematurely indicates that the IBG is less than 0.5-inches (12.7 mm) long. This bit is used only as a maintenance aid and does not signal an error. Short gap mode is turned off only with a write, rewind, or rewind unload command.
2	Dual Density	Present if the selected tape unit has the Dual Density Feature installed.
3	Alternate Density	Present if the selected tape unit is set for NRZI mode. If not present, the selected tape unit is set for PE mode.
4-7	Tape Unit Model	These bits indicate the tape unit model:

	Bits			
	4	5	6	7
Model 1	0	0	0	0
Model 2	0	0	0	1
Model 3	0	0	1	0

SENSE BYTE 7

Bit	Designation	Interpretation
0	Lamp Check	Present if the EOT, BOT, or tachometer photosensing lamp in the tape unit fails. Also sets tape unit check.
1	Left Column Check	Present if a loss of vacuum occurs in the left vacuum column after tape is loaded. Also sets tape unit check.
2	Right Column Check	Present if a loss of vacuum occurs in the right vacuum column after tape is loaded. Also sets tape unit check.
3	Ready Reset	Present if the RESET pushbutton is pressed, if the door interlock has opened after the START pushbutton had been pressed, or on a rewind unload command. Also sets tape unit check.
4	Data Security Erase	Present if the tape unit is performing a data security erase. This bit is reset when the EOT reflective marker is detected or when the tape unit becomes ready after a tape unit check while executing a data security erase command.
5	Not Used	
6	Not Used	
7	Not Used	

SENSE BYTE 8

Bit	Designation	Interpretation
0	Not used	
1	Feedthrough	Present if data is detected at the read head while writing the preamble. This bit is used as a maintenance aid and does not signal an error.
2	Not Used	
3	End Velocity Check	Present during a write data operation if the capstan velocity is not within specifications after writing the data block. Also sets data check.
4	Readback Data Not Detected	Present during a write data operation if the written data is not sensed by the read head before the tape has moved a specified distance. Also sets equipment check.
5	Start Velocity Check	Present during a write data operation if the capstan velocity is not within specifications before writing the data block. Also sets data check.
6	Not Used	
7	Not Used	

Error Recovery Procedures (ERP)

This section describes error conditions that can occur when operating 3410/3411 Models 1, 2, or 3 subsystems, and prescribes minimum recovery actions that must be implemented to achieve acceptable performance and read/write reliability. These ERPs provide uniform recovery actions independent of operating systems or system model, and apply to DOS (System/370) and OS (System/360 and System/370). Other operating systems support these subsystems using their current level of half-inch tape ERP support. DOS support on System/360 attachment is supported by the level of DOS currently available for 2400-Series Tape Subsystems.

Extended volume error statistics requirements are supported by OS release level 21 and DOS release level 27.

Messages

An operator message issued for these procedures must contain the following minimum information:

- A message code*
- Channel, subsystem, and device address.
- The command in progress when the error occurred.
- The error condition which caused the message.
- Complete status and sense information.

* Clear, meaningful messages are encouraged and are especially important for Terminal Action Ia.

Minimum Block Length

Minimum block lengths were established to distinguish between noise and data blocks in NRZI operations. Minimum block lengths are 12 bytes for a read operation and 18 bytes for a write operation (plus LRC and CRC bytes). There is no minimum block length for PE operation.

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 (BOT) is reached in "n" backspaces during a tape cleaner sequence, reposition for a forward read with "n minus 2" forward spaces. Reposition for a backward read with "n" forward spaces.

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

Operation of Error Recovery Procedures

An I/O error causes an interrupt condition. If unit check (CSW bit 38) is present in the CSW, a sense command must be performed before any other operation in the subsystem to obtain further information about the error interrupt. Figure 6 lists the sequence in which Status and Sense Bits must be checked, and it also indicates what action is required.

Pri-ority	Status byte	Sense byte/bit	Condition	Applicable to Read	Write	Control	Action
1	38		Unit Check	X	X	X	II
2		0 3	Equipment Check	X	X	X	X
3		0 2	Bus Out Check	X	X	X	IV
4		0 1	Intervention Required	X	X	X	III
5		0 0	Command Reject	X	X	X	XIII
6		0 5	Overrun	X	X		VII
7		1 4	Load Point	X		X	XII
8		0 4	Data Check	X			V
8		0 4	Data Check		X		VI
8		0 4	Data Check			X	VIII
9		7 4	Data Sec 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			IX
13		5 3	PE ID Burst Ck		X	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 6. Status and Sense Indicator (Bits) Checking Sequence

Action Requirements of Error Recovery Procedures

Action I

Terminal Action Ia (With Operator Option)

Note: The decision process by which the choice between Actions Ia and Ib is resolved need not necessarily reside within the ERP module. The location of this decision process is a system design responsibility.

An operating system may provide either or both of the following facilities at this point.

- Operator control interface.
- Additional programmed recovery interface.

If both are defined, exit to the operator control interface first.

Some of the operator control interface options which may be defined are:

- Retry the recovery procedure.
- Continue to the additional programmed recovery interface.

Terminal Action Ib (Without Operator Option)

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

Action II (Unit Check)

Perform a SENSE command (unless already performed) and continue checking as shown in Figure 6. (The CSW information must be moved to a work area prior to this command.)

Action III (Intervention Required)

No Device End In Unit Status

Test for Tape Unit Status B (Sense Byte 1, Bit 2). If Tape Unit Status B is off, the tape unit is nonexistent. Provide operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

If Tape Unit Status B is on, provide an operator intervention required message and reissue the command when the tape unit is made ready.

Device End In Unit Status

If the command was Rewind Unload, continue processing. Otherwise, ignore the intervention required condition and continue checking as indicated in Figure 6.

Action IV (Bus-Out Check)

No Device End In Unit Status

Reissue the command.

Device End In Unit Status

If this condition occurs during a write command, reposition the tape and reissue the command. For all other commands, reissue the command.

Repeat this procedure until five retries have been attempted. If the error persists, provide operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

Action V (Data Check On Read Or Read Backward)

Recovery action must determine if the block is a noise block; if not, retry 40 times in the same direction (as original CCW) and 40 times in the opposite direction, with tape cleaner sequences after every fourth retry. The steps are as follows:

Step 1

Determine if the block should be classified as a noise block (noise bit off and the block length is less than 12 bytes). If the noise bit (Sense Byte 1, Bit 0) is on, or if the block length meets or exceeds the minimum length requirements, the read operation should be retried, using steps 1 through 19.

Block length can be determined as follows:

1. If not data chaining, the CCW count less the CSW residual count must meet or exceed 12.
2. If data chaining, independent of the count in the first CCW, and the chain broke after the first CCW, assume block length requirements have been met.
3. If data chaining, the count in the first CCW is less than 12, and the chain broke before the second CCW, block length does not meet or exceed 12.
4. If data chaining, the count in the first CCW is equal to or greater than 12, and the chain broke before the second CCW, the first CCW count less the CSW residual count must be equal to or greater than 12.

Step 2

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

Step 3

Set the correct mode (if seven-track), or send the track-in-error information (Sense Byte 2) to the subsystem with a request TIE command (if nine-track NRZI).

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

Step 4

Reissue the Read or Read Backward Command.

Note: TIC (Transfer in Channel) is the only command that may be executed between Steps 3 and 4, because commands to the subsystem may destroy the track-in-error information. Correction of a block should be attempted using only the track-in-error information from that block (if PE or nine-track NRZI).

Step 5

Repeat Steps 1 through 4 until the block is read successfully or a minimum of 40 retries (41 reads) have been attempted.

After every fourth reread (Step 4), the block in error should be passed by the tape cleaner blade.

Note: Tape cleaner positioning for a forward read is five backspaces followed by four forward spaces. For a backward read, it is four backspaces followed by five forward spaces. If load point is reached in "n backspaces" during tape cleaner positioning, reposition for read forward with "n minus 2" forward spaces, and reposition for read backward with "n" forward spaces. If a tape mark is encountered during tape cleaner positioning, the unit exception indication should be ignored, and the tape mark should be treated as a normal block.

Step 6

Note: This is the minimum read opposite recovery procedure. However, this procedure does not exclude other methods which may prove suitable for a particular operating system.

Should the error persist, determine if:

a. Data Chaining is being performed.

Note: This specification does not prohibit read opposite recovery from this case. It is, however, judged an allowable exclusion based on the amount of additional ERP code required for read opposite recovery in this situation.

b. Data converter mode set is being used and if the seven-track tape unit bit is set in Sense Byte 1.

c. Suppress Data Transfer bit is set in the failing read CCW.

If any of these conditions are met, provide an operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia." If neither is met, proceed to Step 9.

Step 7

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

Step 8

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

Step 9

Set the correct mode (if seven-track), or send the track-in-error information (Sense Byte 2) to the tape control with a request TIE command (if PE or nine-track NRZI).

Step 10

Issue a read command in the direction opposite (read opposite CCW) with the Suppress Data Transfer bit on. See Note after Step 4.

Step 11

Repeat Steps 7 through 10 until the block is read successfully or a minimum of 40 retries have been attempted. If the block is read successfully, note the remainder of the 40 retries and go to Step 12. If, after attempting 40 retries the read opposite CCW is still unsuccessful, go to Step 19.

After every fourth reread (Step 10), the block in error should be passed by the tape cleaner blade. See Note after Step 5.

Step 12

If the actual block count is greater than the failing original read CCW count, proceed to Step 19.

Note: This procedure does not prohibit read opposite recovery. It is, however, judged an allowable exclusion based on the amount of additional ERP code required for read opposite recovery in this situation.

If the actual block count is equal to or less than the failing read CCW count, compute the correct data address and count for read opposite CCW and proceed to Step 13.

Step 13

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

Step 14

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

Step 15

Set the correct mode (if seven-track), or send the track-in-error information (Sense Byte 2) to the tape control with a request TIE command (if PE or nine-track NRZI).

Step 16

Issue the read opposite CCW with the computed address count, and the Suppress Data Transfer bit off. See Note after Step 4.

Step 17

Repeat Steps 13 through 16 until the block is read successfully or the remainder of the 40 retries have been attempted. If the block is read successfully, go to Step 18. If, after attempting 40 retries, the read opposite CCW is still unsuccessful, go to Step 19.

After every fourth reread (Step 16), the block in error should be passed by the tape cleaner blade. See Note after Step 5.

Step 18

Set the correct mode (if seven-track), and reposition the tape over the error block. If command chaining, complete the balance of the chain. Post completion without error condition and continue with normal processing.

Step 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 operating system. See "Terminal Action Ia."

Action VI (Data Check On Write)

Reposition the tape, issue an erase gap (ERG), issue a mode set (if seven-track), and reissue the command. Repeat this procedure until 14 retries have been attempted.

If the error persists through 14 retries:

Step 1

Change the failing write CCW to loop-write-to-read CCW to obtain data for error recording.

The write 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 destroy previously written data blocks.

The failing write CCW is issued to complete the 15th retry, and the resulting data is recorded if an error occurs. If an error does not occur, the previous sense data is recorded.

Step 2

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

Note: This action is designed for the maximum length of 64,000 bytes at 800 bpi.

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

For a read or write operation, reposition the tape and reissue the command. For a control command, reissue the command. Repeat this procedure until five retries have been attempted. If the error persists, provide an operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

Action VIII (Data Check On Control)

A data check cannot occur during a write tape mark. The tape subsystem automatically retries the WTM command 15 times. If the tape mark cannot be written correctly, equipment check is set. If a data check occurs during an erase gap (ERG) command, reissue the command. Repeat this procedure until three retries have been attempted. If the error persists, provide an operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

Action IX (Not Capable)

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

Note: Retries may be made at user option; otherwise it is recommended that an alternate reel be mounted and processed.

Action X (Equipment Check)

Tape position is indeterminate; provide an operator message, post completion with error condition, and exit to operating system. See "Terminal Action Ia."

Action XI (Data Security Erase Failure)

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

Action XII

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

Action XIII

Provide an operator message, post completion with check condition, and exit to operating system. See "Terminal Action Ib."

Action XIV (PE Identification Burst Check On Write, Write Tape Mark, and Erase Gap)

Use a rewind or backspace block command to reposition tape (if a backspace block is used to backspace into load point, ignore the resulting unit check), and reissue the command.

For a write command, repeat this procedure until successful or until 14 retries have been attempted. If the error persists through 14 retries, go to Step 1.

For a write tape mark or erase gap command, repeat this procedure until successful, or until 15 retries have been attempted. If the error persists through 15 retries, go to Step 2.

Step 1

Change the failing write CCW to loop-write-to-read CCW to obtain data for error recording.

The write 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 destroy previously written data blocks.

Data is recorded after the loop-write-to-read is completed. The failing write CCW is issued to complete the 15th retry, and the resulting data is recorded if an error occurs. If an error does not occur, the previous sense data is recorded.

Step 2

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

The entries in this index are shown as they appear in the text, that is, capitalized words are capitalized in text, lowercase words are lowercase in text, etc.

A

B

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