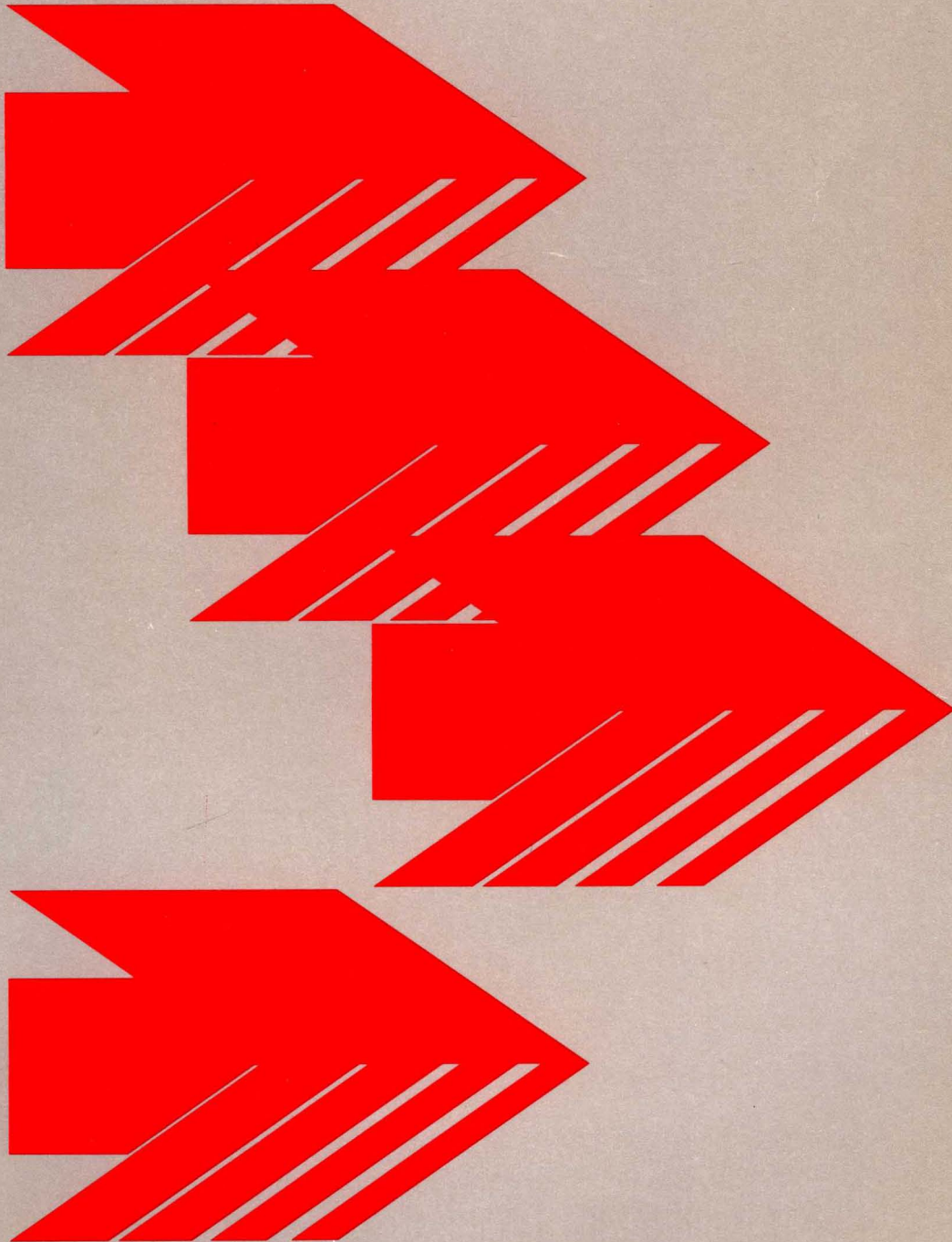




**IBM 3480 Magnetic Tape Subsystem
Reference: Channel Commands,
Status and Sense Bytes, and
Error Recovery Procedures**

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GA32-0042-4

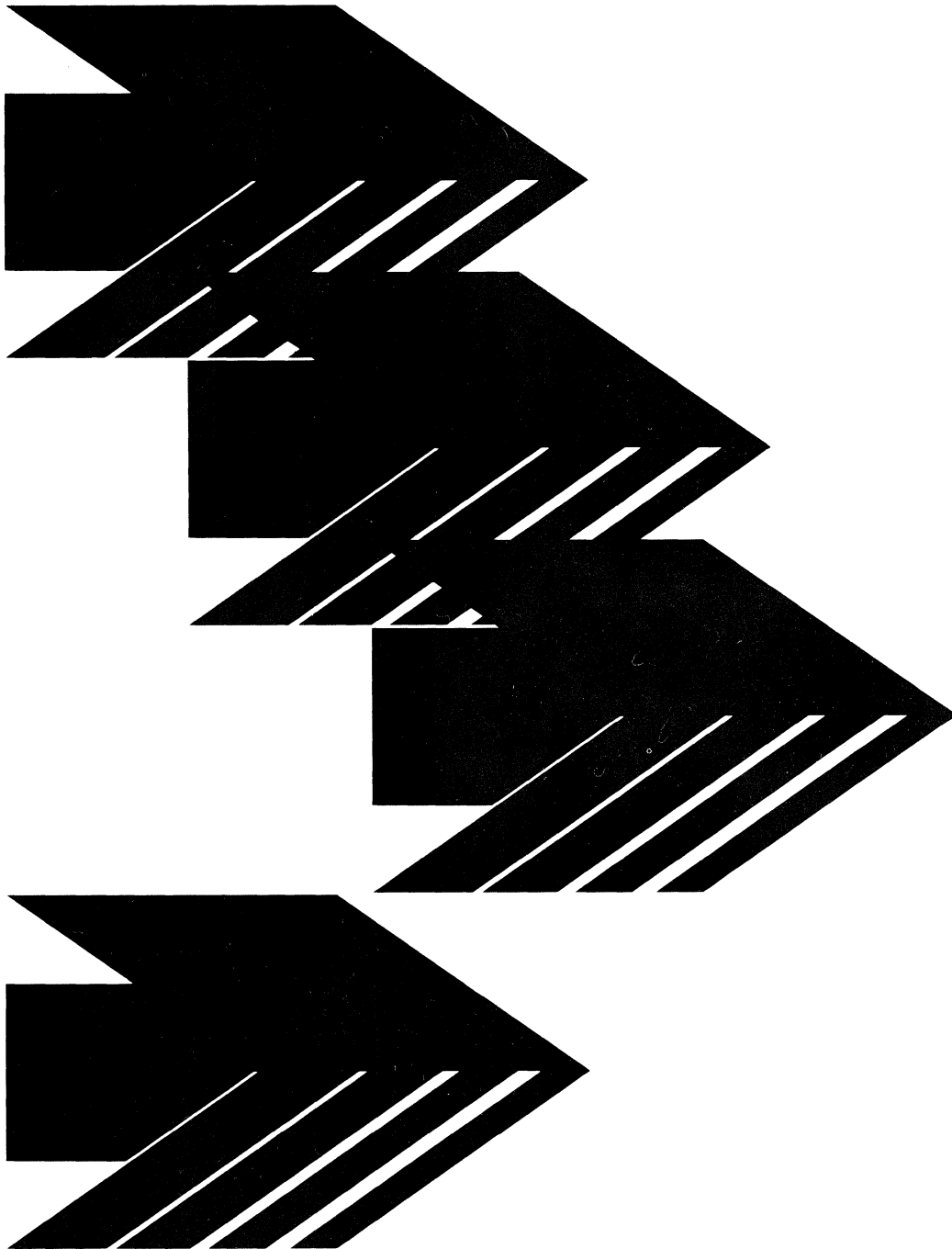




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| Fifth Edition (November 1987)

| This is a revision of and makes obsolete GA32-0042-3.

Changes or additions to the text or illustrations will be indicated by a vertical line to the left to the change.

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Preface

This book contains reference information intended for experienced system programmers, installation planners, system engineers, and IBM marketing representatives. The reader should be familiar with magnetic tape subsystems and System/370 channel programming.

The material is presented in four chapters:

- “Chapter 1. Channel Commands,” describes the channel commands that the IBM 3480 subsystem performs.
- “Chapter 2. Resets,” describes the effect of resets on the subsystem.
- “Chapter 3. Status and Sense Bytes,” describes the contents of the status byte and sense bytes generated by the subsystem.
- “Chapter 4. Problem Determination and Error Recovery,” describes the internal diagnostic programs that permit the subsystem to detect errors and to take action for recovery from such errors.

Related Publications

Although there is no prerequisite reading for using this book, additional information related to the IBM 3480 subsystem can be found in:

- *IBM Input/Output Equipment: Installation Manual—Physical Planning for System/360, System/370, and 4300 Processors*, GC22-7064
- *IBM S/370 Installation Manual: Physical Planning*, GC22-7004
- *IBM 3480 Magnetic Tape Subsystem Introduction*, GA32-0041
- *IBM 3480 Magnetic Tape Subsystem Planning and Migration Guide*, GC35-0098
- *IBM 3480 Magnetic Tape Subsystem Operator’s Guide*, GA32-0066
- *IBM 3480 Magnetic Tape Subsystem User’s Reference*, GC35-0099

- *Care and Handling of the IBM Magnetic Tape Cartridge, GA32-0047*
- *Tape and Cartridge Requirements for the IBM Magnetic Tape Cartridge Drives, GA32-0048*
- *IBM System/370 Principles of Operation, GA22-7000*
- *IBM System/370 Extended Architecture Principles of Operation, SA22-7085.*

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Summary of Amendments

IBM 3480 Magnetic Tape Subsystem Reference: Channel Commands, Status and Sense Bytes, and Error Recovery Procedures

Release GA32-0042-4, July 1987

This edition includes changes to correct errors or omissions in the previous edition.

Release GA32-0042-3, January 1987

This edition adds information on the 3480 Model A11 Control Unit and Model B11 Tape Unit.

There are also miscellaneous changes to correct errors or omissions in the previous edition.

Release GA32-0042-2, July 1986

This release reflects changes due to the addition of the Automatic Cartridge Loader feature.

There are also miscellaneous changes to correct errors or omissions in the previous edition.

Release GA32-0042-1, September 1985

This edition adds information to the description of the Load Display (9F) command.

There are also miscellaneous changes to correct errors or omissions in the previous edition.



Chapter 1. Channel Commands

The 3480 subsystem performs the channel commands listed in the channel command summary table in Figure 1 on page 2.

Command acceptance depends on validating the CCW and generating initial status. Several forms of initial status, such as command reject, chaining check, intervention required, and busy, are well known in IBM tape products of earlier design. In addition, the 3480 control unit recognizes exceptional buffer status conditions; for example:

- No buffer segment is given to the addressed tape drive for a command that requires use of the buffer.
- The buffer is empty in response to a Read or Read Backward command.
- The buffer is full in response to a Write command.
- The buffer is active on another channel path.

If these exceptional conditions occur, the control unit generates a channel command retry in initial status. The channel suspends completion of the CCW and is free to perform another channel program. When the exceptional condition is cleared, the control unit presents device end status to the channel, thereby requesting the controlling computer to issue the CCW again.

When the control unit accepts a CCW with no exceptional initial status conditions, it connects the buffer to the channel path that accepted the CCW and completes the command.

For a read operation, the control unit transfers the block of data into the buffer from the tape drive. After the data block is transferred from the buffer to the controlling computer, the control unit presents ending status to the channel and disconnects the buffer from the channel path.

For a write operation, the control unit presents the ending status to the channel after the data block is transferred to the buffer, then the control unit disconnects from the channel path.

3480 Commands

The 3480 subsystem accepts channel program commands that determine the operations that the tape drives perform.

Figure 1 shows the channel command names and hexadecimal codes for each 3480 command. A description of each command follows the figure.

Command Name	Hexadecimal Code
Assign (See Notes 1 and 3)	B7
Backspace Block	27
Backspace File	2F
Control Access (See Notes 1 and 3)	E3
Data Security Erase	97
Erase Gap	17
Forward Space Block	37
Forward Space File	3F
Load Display (See Notes 1, 3, and 4)	9F
Locate Block	4F
Mode Set (See Notes 1 and 3)	DB
No-Operation	03
Read	02
Read Backward	0C
Read Block ID (See Note 3)	22
Read Buffer (See Note 3)	12
Read Buffered Log (See Note 3)	24
Rewind	07
Rewind Unload	0F
Sense (See Note 3)	04
Sense ID (See Note 3)	E4
Sense Path Group ID (See Notes 2 and 3)	34
Set Path Group ID (See Notes 2 and 3)	AF
Set Tape-Write-Immediate (See Note 3)	C3
Suspend Multipath Reconnection (See Notes 1 and 3)	5B
Synchronize	43

Figure 1 (Part 1 of 2). 3480 Commands

Command Name	Hexadecimal Code
Unassign (See Notes 1 and 3)	C7
Write	01
Write Tape Mark	1F

Figure 1 (Part 2 of 2). 3480 Commands

Notes:

1. *The command cannot be completed, the unit check status bit and the command reject sense bit are set if the control unit previously received a Mode Set command that inhibits supervisor commands in a command chain. See the Mode Set command description in this chapter.*
2. *If this command is not the only command in the channel program, the unit check status bit and the command reject sense bit are set.*
3. *The control unit completes this command regardless of whether the addressed tape drive is ready or not ready. Except for the Assign and Load Display commands, the addressed tape drive does not have to be online in the subsystem.*
4. *The Load Display command is used in MVS operating systems only.*

Assign (B7)

The Assign command assigns the addressed tape drive to a specific channel path and replaces the physical partitioning switches that are present on IBM tape subsystems of earlier design.

Argument	The Assign command sends 11 bytes of information (called an argument) to the subsystem. These 11 bytes can contain all zeros or can contain a path group ID. If the argument contains all zeros, the addressed tape drive is assigned to the channel path group over which the command was received. If the channel path is not grouped by a Set Path Group ID command, the control unit performs as if the group consists of a unique group of one channel paths. If the argument contains a path group ID, the path must be part of a group, but the path group ID does not have to match the path group ID of the channel path over which the Assign command is issued.
Supervisor	The Assign command is a supervisor command and cannot be performed if preceded by a Mode Set command that inhibits supervisor commands.
CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end and device end along with other status, if any.
Unit Check	Caused by: <ul style="list-style-type: none">• A Mode Set command that inhibits supervisor commands precedes the Assign command in the channel program. This condition also sets the command-reject sense bit.• None of the channel-path groups for the addressed drive have the same path group ID as specified in the argument. This condition also sets the command-reject sense bit. When an Assign command with a non-zero argument is sent to a drive, that drive must have already received a Set Path Group ID command that established the group.• Fewer than 11 bytes in the argument. This condition also sets the command-reject sense bit.

- The Assign command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.
- An Assign command that is directed to a tape drive that is not installed, not operational, or is physically switched offline. ERA 46 will appear in the sense data.

Notes:

1. *If more than 11 bytes are specified, only the first 11 bytes are sent as the argument. The incorrect length status bit is set by the channel unless the suppress length flag bit in the CCW is set to 1.*
2. *Successive Assign commands can assign a tape drive to several channel path groups. Immediately after each Assign command is completed, the assignment takes effect. However, only one Assign command need be issued for each group. The drive is assigned to all the paths in the group that is identified by the path group ID in the argument.*
3. *The control unit can perform an Assign command to a tape drive only when that tape drive is not assigned to any channel path or when the tape drive has already been assigned to the channel path over which the Assign command is issued.*
4. *The assignment of a drive is cleared by:*
 - *A Control Access command with the generalized-unassign mode of use*
 - *Power on reset*
 - *System reset on all assigned channel paths*
 - *The Unassign command*
 - *Initial microprogram load (IML)*
 - *Moving the control unit Enable/Disable switch for the channel to the Disable position*
 - *Moving the CU Online/CU Offline switch to the CU Offline position.*

Backspace Block (27)

The Backspace Block command causes the addressed tape drive to move the tape backward past one data block.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Backspace Block command is the last command in a chain, you should chain another command following the Backspace Block command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Backspace Block command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Backspace Block command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *Unit exception occurs with device end status if the backspace block operation encounters a tape mark.*
2. *Backspace Block causes a synchronize operation. See "Synchronize (43)" on page 54.*

Backspace File (2F)

The Backspace File command causes the addressed tape drive to move the tape backward past one tape file. A tape file is the data written in an area of tape between two tape marks.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Backspace File command is the last command in a chain, you should chain another command following the Backspace File command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Backspace File command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Backspace File command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: Backspace File causes a synchronize operation. See "Synchronize (43)" on page 54.

Control Access (E3)

The Control Access command permits a controlling computer to have special access to a tape drive even though the tape drive is assigned to a different controlling computer.

The special access can be used in the following ways:

- A controlling computer that already has assignment of a specific tape drive can establish a password to permit another controlling computer to access the tape drive.
- A controlling computer that does not have assignment of a specific tape drive can run a channel program on that tape drive even though the tape drive would not normally complete a channel program from a controlling computer to which it is not assigned. Only the Sense, Sense ID, Sense Path ID, Set Path ID, and Control Access commands bypass the assignment protection. The Control Access and Unassign commands can release that protection from other channel commands that follow them in the channel program.
- A controlling computer that has the password can join the channel path groups for which that is the correct password.

The Control Access command can also perform a generalized unassign operation or turn forced error logging on or off for individual drives or all the drives addressable by a control unit.

Argument

The command transfers twelve bytes of argument information from the controlling computer to the 3480 subsystem. The 12-byte argument has two parts, a mode-of-use code and an argument. Byte 0 contains the mode-of-use code and must contain hexadecimal 00, 01, 02, 40, or 80. The remaining 11 bytes contain a password and should not contain all zeros, except when mode-of-use code hexadecimal 40 ignores the contents of these bytes. The description of mode-of-use code hexadecimal 40 explains the conditions that cause these bytes to be ignored.

The mode-of-use codes are used as follows:

- **Set Password, Hexadecimal 00:** Mode-of-use code hexadecimal 00 can be used only by a controlling computer that already has assignment of the addressed tape drive. The Control Access command establishes a password for the addressed tape drive. The password cannot be zero. Then, another controlling computer can access the tape drive by specifying the correct password in a Control Access command. Once a password is established, it remains associated with the tape drive until all assignments of that tape drive are cleared.

See the descriptions of the Assign and Unassign commands for information about clearing assignments.

- **Activate Forced Error Logging, Hexadecimal 01:** Mode-of-use code hexadecimal 01 causes the control unit to enable the forced error logging mode under control of bytes 1 through 3. Forced error logging causes the control unit to report all temporary errors detected by the control unit or drives. The control unit reports the errors through the unit Check status. If the error is a temporary error (recovery is successful), the error recovery procedure action (ERPA) code in sense byte 3 is hexadecimal 48. Sense byte 7 contains hexadecimal 19.

For activate forced error logging, byte 1 of the argument must contain either hexadecimal 01 or hexadecimal 02. Bytes 2 and 3 must contain hexadecimal 0200. The rest of the argument is ignored. If byte 1 contains hexadecimal 01, forced error logging is enabled for all drives accessible by the control unit. If one control unit in a dual-control-unit subsystem receives the Control Access command with activate forced error logging, both control units enable forced error logging. If byte 1 of the argument contains hexadecimal 02, forced error logging is enabled only for the drive to which the command is addressed.

The forced error logging mode continues until a reset for it occurs. Forced error logging mode is reset by:

- A Control Access command with deactivate forced error logging
- Power on reset
- Initial microprogram load
- A check 1 (hardware error) condition
- Moving the CU Online/CU Offline switch to the CU Offline position.

- **Deactivate Forced Error Logging, Hexadecimal 02:** Mode-of-use code hexadecimal 02 causes the control unit to disable forced error logging under control of bytes 1 through 3.

For deactivate forced error logging, byte 1 must contain either hexadecimal 01 or hexadecimal 02.

Bytes 2 and 3 must contain hexadecimal 0200. If byte 1 contains hexadecimal 01, forced error logging is canceled for all drives accessible by the control unit. Any drive that was placed in forced error logging mode by activate forced error logging with byte 1 set to hexadecimal 02 is not affected. If byte 1 contains hexadecimal 02, forced error logging is canceled only for the addressed drive.

- **Generalized Unassign, Hexadecimal 40:** Mode-of-use code hexadecimal 40 clears the assignment of the addressed tape drive from all channel paths.

If no password was established by a prior Control Access command, the password in bytes 1 through 11 is ignored when mode-of-use code hexadecimal 40 is specified. If a password was established by a previous Control Access command, the password in bytes 1 through 11 must match the established password.

- **Request Temporary Unassignment, Hexadecimal 80:** Mode-of-use code hexadecimal 80 suspends the assign protection for the channel commands that follow the Control Access command in an individual channel program. The password in bytes 1 through 11 is compared to the password that was established by an earlier Control Access command using mode-of-use code hexadecimal 00. If the passwords match, the channel program can be performed.

The requested temporary unassignment remains in effect only during the channel program being performed and applies to any path in the path group over which the Control Access command was received.

Supervisor	The Control Access command is a supervisor command and cannot be performed if preceded by a Mode Set command that inhibits supervisor commands.
CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end and device end along with other status, if any.

Unit Check

Caused by:

- A Mode Set command that inhibits supervisor commands precedes the Control Access command in the channel program. This condition also sets the command-reject sense bit.
- Fewer than 12 bytes are sent in the argument. This condition also sets the command-reject sense bit.
- Byte 0 contains a value other than hexadecimal 00, 01, 02, 40, or 80, or the remaining 11 bytes of the argument contain all zeros. (Bytes 1 through 11 can contain zeros when byte 0 contains hexadecimal 40.) This condition also sets the command-reject sense bit.
- The passwords do not match. This condition also sets the command reject sense bit.
- The Control Access command that performs a generalized unassign is issued on a channel path that does not have assignment of the addressed tape drive. This condition also sets the command reject sense bit.
- For mode-of-use codes 01 and 02, byte 1 of the argument contains a value other than hexadecimal 01 or hexadecimal 02, or bytes 2 and 3 of the argument contain a value other than hexadecimal 0200. This condition also sets the command-reject sense bit.

Notes:

1. *The Control Access command is performed even if the addressed tape drive is not ready or is not online in the subsystem.*
2. *If more than 12 bytes are specified, only the first 12 bytes are sent as the argument, and the incorrect length status bit is set by the channel unless the suppress length flag bit in the CCW is set to 1.*
3. *The Assign command, which redefines the controlling computers to which the addressed tape drive is assigned, can be specified after the Control Access command with the hexadecimal mode-of-use code 80. If the redefinition includes the issuing controlling computer, the issuing controlling computer has assignment of the addressed tape drive, and no further Control Access commands are necessary.*

4. *Normal buffered log operations are not affected by the forced error logging mode.*
5. *The assignment of a drive is cleared by:*
 - *A Control Access command with the generalized-unassign mode of use*
 - *Power on reset*
 - *System reset on all assigned channel paths*
 - *The Unassign command*
 - *Initial microprogram load (IML)*
 - *Moving the control unit Enable/Disable switch for the channel to the Disable position*
 - *Moving the CU Online/CU Offline switch to the CU Offline position.*

Data Security Erase (97)

The Data Security Erase command writes a random pattern from the position of the tape when the command is issued to the physical end-of-tape. After the control unit starts the drive performing this command, it disconnects from the drive and is available for other commands to other drives.

Chaining and Special

Requirements

The Data Security Erase command must be command-chained from an Erase Gap command. Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Data Security Erase command is the last command in a chain, you should chain another command following the Data Security Erase command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Data Security Erase command.

CCR

Channel command retry can be called for error recovery only.

Initial Status

Presents channel end and disconnects from the channel.

Ending Status

Reconnects to the channel and presents device end along with other status, if any.

Unit Check

Caused by:

- The Data Security Erase command is not correctly chained. This condition also sets the command-reject sense bit.
- The addressed drive is not ready or is not online in the subsystem.
- The tape drive becomes not-ready while the command is processing, or the drive loses power. When power is restored to the drive, the control unit presents control unit end, unit check, and device end.
- The Data Security Erase command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *The Data Security Erase command does not set the unit exception status bit.*
2. *Read commands, Read Backward commands, and all space commands produce unpredictable results if they are issued while the tape is in a data security erase portion of the tape. Write commands, Erase Gap commands, and Write Tape Mark commands can be used to extend data files into tape that has been data security erased. (Write, Erase Gap, and Write Tape Mark commands that are issued in the middle of a Data Security Erase section produce unpredictable results.) After a Data Security Erase command is completed, issue a Locate Block command to move the tape to a valid data block before you issue any read or space commands.*

Erase Gap (17)

The Erase Gap command writes a unique pattern on tape. During a subsequent read operation, the control unit recognizes the pattern and skips it.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Erase Gap command is the last command in a chain, you should chain another command following the Erase Gap command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Erase Gap command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Erase Gap command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: The Erase Gap command causes a synchronize operation. See "Synchronize (43)" on page 54.

Forward Space Block (37)

The Forward Space Block command causes the addressed tape drive to move the tape forward past one data block.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Forward Space Block command is the last command in a chain, you should chain another command following the Forward Space Block command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Forward Space Block command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Forward Space Block command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *Unit exception occurs with device end status if the forward space block operation encounters a tape mark.*
2. *The Forward Space Block command causes a synchronize operation. See "Synchronize (43)" on page 54.*

Forward Space File (3F)

The Forward Space File command causes the addressed tape drive to move the tape forward past one tape file. A tape file is the data that is written in an area of tape between two tape marks.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Forward Space File command is the last command in a chain, you should chain another command following the Forward Space File command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Forward Space File command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Forward Space File command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: Forward Space File causes a synchronize operation. See "Synchronize (43)" on page 54.

Load Display (9F)

Note: This command is used in MVS operating systems only.

The Load Display command permits you to specify and control the text of messages on the message display of an addressed tape drive.

Argument The Load Display command transfers 17 bytes of data from the channel to the subsystem. The 17 bytes comprise a format control byte and two 8-byte messages.

The format control byte is the first byte of the 17 bytes transferred from the channel to the addressed tape drive. The format control byte controls the way the tape drive displays the remaining 16 bytes.

The bit definitions of the format control byte are:

Bits	Value	Description
0-2		New Message Overlay
	000	Maintain the messages in bytes 1-8 and 9-16 until the tape drive next starts tape motion, or the message is updated.
	001	Maintain the message in bytes 1-8 until the tape cartridge is physically removed from the tape drive, or until the next unload/load cycle. If the drive does not contain a cartridge when the Load Display command is received, the message is displayed momentarily. The controlling computer will not be given an indication that the message was processed but not kept.
	010	Maintain the message in bytes 1-8 until the drive is next loaded (tape tension established). If the drive is loaded when the Load Display command is received, the message is displayed momentarily. The controlling computer will not be given an indication that the message was processed but not kept. This kind of message lights the attention lights on the display.
	011	Physically access a drive without changing the message display. This option can be used to test whether a control unit can physically communicate with a drive.

Bits	Value	Description
111		Displays the messages in bytes 1–8 and 9–16. The message in bytes 1–8 will be displayed until a tape cartridge is physically removed from the tape drive, or until the drive is next loaded. The message in bytes 9–16 will be displayed until the drive is next loaded (not including the loading of the cleaning cartridge). If no cartridge is present in the drive, the first message is ignored and only the second message is displayed until the drive is next loaded (not including the loading of the cleaning cartridge). This kind of message lights the attention lights on the display.
3		Alternate Messages
	0	The tape drive displays only the message that is specified in bit 5.
	1	The tape drive displays both messages specified in bytes 1–8 and 9–16, respectively, alternating them on the message display. Each message displays for about 2 seconds with an interval of about 0.5 seconds between the messages. The sequence repeats until the message is replaced on the display. When bit 3 is set to 1, bits 4 and 5 are ignored.
4		Blink Message
	0	The message specified by the setting of bit 5 does not blink.
	1	The message specified by the setting of bit 5 displays repeatedly for about 2 seconds with an interval of about 0.5 seconds between each display. Bit 4 is ignored when bit 3 is set to 1.
5		Display Low/High Message
	0	The message specified in bytes 1–8 displays.
	1	The message specified in bytes 9–16 displays.
6	0	Reserved
7		Automatic Load Request
	0	No automatic load request is passed from the system to the Automatic Cartridge Loader. The manual load of a specific volume is assumed to be requested when the loader is in System mode.
	1	An automatic load request is passed from the system to the Automatic Cartridge Loader.

Chaining and Special

Requirements Most operating systems signal that the channel program is complete when channel end status returns for the last command in the chain. Therefore, if the Load Display command is the last command in a channel program, you should consider chaining another command after the Load Display command. (An NOP command is appropriate.) This practice ensures that any error status returns along with the device end status when the Load Display is completed.

Supervisor The Load Display command is a supervisor command and cannot be performed if preceded by a Mode Set command that inhibits supervisor commands.

CCR Channel command retry can be called for error recovery only.

Initial Status Presents a zero. The control unit remains connected to the channel.

Ending Status After the argument transfers to the subsystem, the control unit presents channel end and disconnects from the channel. When the command is completed, the control unit reconnects to the channel and presents device end along with other status, if any. If an error occurs before channel end is presented, channel end, device end, and unit check are presented together.

Unit Check Caused by:

- A Mode Set command that inhibits supervisor commands precedes a Load Display command in the channel program. This condition also sets the command-reject sense bit.
- The channel transfers fewer than 17 bytes of data. This condition also sets the command-reject sense bit.
- The channel program issues a Load Display command to the tape drive while an operator is inserting a cartridge. This condition also sets the equipment-check sense bit and sets recovery code 24 in sense byte 3.
- The drive has a check message on the display.

- The Load Display command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.
- The Automatic Cartridge Loader feature is not installed, but bit 7 of the format control byte is set to 1.

Notes:

1. *The tape drive accepts a Load Display command even if the drive is not ready.*
2. *If more than 17 bytes of data are specified, the channel transfers only the first 17 bytes as the argument and sets the incorrect length status bit unless the suppress length flag bit in the CCW is set to 1.*

Locate Block (4F)

The Locate Block command moves the tape into position on the addressed tape drive so the controlling computer can write or read a specific block on the tape. The search is performed on two levels, a high-speed search to the general vicinity of the desired record, then a search at normal reading speed to the desired record. The drive performs the high-speed search while it is disconnected from the control unit, freeing the control unit to perform other work. The control unit and the drive reconnect and work together to perform the normal-reading-speed search.

If the tape drive cannot find the specific data block or tape mark, the control unit prepares for the next command to be a Write command. In this instance, the tape drive searches for the data block or tape mark that precedes the one specified in the Locate Block command argument. The drive moves the tape to a position after the preceding block or tape mark so that the controlling computer can perform a write operation.

Argument

You must supply four bytes of data to the control unit as an argument to the Locate Block command. The bytes usually are the four bytes of the block identifier that were returned as a result of a Read Block ID command that was previously issued.

The block ID has the following format:

Bit	Meaning
0	Reserved, always 0
1-7	Physical reference value <i>see p. 35</i>
8-11	Reserved, always 0
12-31	Logical block position

The first block recorded on any tape cartridge has a block ID of hexadecimal 01000000.

To direct the disconnected tape drive to search for the approximate tape position at high speed, the control unit uses the physical reference value part of the block identifier that is supplied as the argument for the Locate Block command. The drive then moves the tape to the referenced block ID. If the block cannot be found within the physical reference value range of the tape, the drive rewinds the tape and the control unit and drive search block by block for the logical block position portion of the block ID. However, permanent drive errors can result if an invalid logical block position causes the drive to move the tape to a part of the tape where no data is written.

If you do not know the physical reference value, but you do know the logical block position, the physical reference value can be set to zero. The drive rewinds the tape, and the search processes with the channel disconnected from the control unit, but the tape drive remains connected to the control unit and operates at normal recording speed.

Chaining and Special Requirements

Most operating systems signal that the channel program is complete when channel end status is returned for the last command in the chain. Therefore, if the Locate Block command is the last command chained in a channel program, you should chain another command after the Locate Block command. (An NOP command is appropriate.) This practice ensures that any error status is returned along with device end status when the Locate Block is completed.

CCR

Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status

Presents a zero. The control unit remains connected to the channel.

Ending Status

After the argument transfers to the subsystem, the control unit presents channel end and disconnects from the channel. When the command is completed, the control unit reconnects to the channel and presents device end along with other status, if any. If an error occurs before channel end is presented, channel end, device end, and unit check are presented together.

Unit Check

Caused by:

- The specified block cannot be found. Presented with device end.
- Fewer than four bytes are supplied. This condition also sets the command-reject sense bit.
- The search did not find the specified block, but positioned the tape following the block preceding the one requested. The control unit expected a write-type operation in the next tape-motion command.

The next tape-motion command specified a read-type operation. This condition also sets the locate-block-function-failed sense bit.

- The Locate Block command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *If more than four bytes are supplied, only the first four bytes are sent as the argument, and the channel sets the incorrect length status bit unless the suppress length flag bit in the CCW is set to 1.*
2. *If the Locate Block command is unsuccessful, the tape position is not known. However, you can use the Read Block ID command to determine the tape position relative to the beginning-of-tape. The first block of data that is recorded on a cartridge has a block ID of 01000000.*
3. *If a file is over-written on a longer file, two blocks with different physical reference values but identical logical block positions can be on the tape. The second identical logical block position (from the start of the tape) is a remnant of the first file.*
4. *Locate Block causes a synchronize operation. See "Synchronize (43)" on page 54.*

Mode Set (DB)

The Mode Set command transfers one byte of mode control information from main storage to the control unit. All controls specified by the Mode Set command (except tape format, bits 0 and 1) are effective only for the commands in the chain after the Mode Set command. If the subsystem does not receive a Mode Set command, default mode values are assumed.

Argument The format of the byte of mode-control information that the channel program transfers is:

Bits	Value	Description
0, 1	00	Tape Format If a combination other than 00 is specified, the command cannot be completed, and the unit check status bit and the command reject sense bit are set. The tape format bits have meaning only if the tape is positioned at the beginning-of-tape, and are effective only if the first command is a write-type command. The tape format bits for read-type commands are read from the tape.
2		Write Format
	0	Write commands perform as buffered write operations. The default value is 0.
	1	Write commands perform as tape-write-immediate operations.
3		Inhibit Supervisor Commands
	0	Any supervisor command can be performed after the Mode Set command appears in the command chain.
	1	Any supervisor command that is issued in the command chain after this Mode Set command cannot be performed, and the unit check status bit and the command reject sense bit are set.
4-6	000	Reserved If these bits are set to other than 000, the unit check status bit and the command reject sense bit are set.

Bits	Value	Description
7		Control Unit Recovery
	0	The control unit performs automatic error recovery procedures.
	1	The control unit cannot perform error recovery procedures and sends all data checks (as defined by sense byte 0, bit 4) to the controlling computer as permanent errors. Sense byte 3 is set to hexadecimal 23 or 25 while processing with the error recovery procedures inhibited.
Supervisor		The Mode Set command is a supervisor command and cannot be performed if preceded by a Mode Set command that inhibits supervisor commands.
CCR		Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.
Initial Status		Presents a zero. The control unit remains connected to the channel.
Ending Status		After the argument transfers to the subsystem, the control unit presents channel end and disconnects from the channel. When the command is completed, the control unit reconnects to the channel and presents device end along with other status, if any. If an error occurs before channel end is presented, channel end, device end, and unit check are presented together.
Unit Check		Caused by: <ul style="list-style-type: none"> • The channel program contains two Mode Set commands and the first Mode Set command has mode control bit 3 set to 1. This condition also sets the command-reject sense bit. • Bits 0, 1, 4, 5, and 6 of the argument are not all zeros. This condition also sets the command reject sense bit. • The Mode Set command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *The command is performed even if the addressed tape drive is not ready or is not online in the subsystem.*
2. *With the exception of hexadecimal C3, the 3480 subsystem performs Mode Set commands for other IBM tape drives similarly to No-Operation (NOP) commands. The hexadecimal command codes handled as NOP include: 03, 23, 2B, 33, 3B, 53, 63, 6B, 73, 7B, 93, B3, BB, A3, AB, CB, and D3. However, Mode Set commands performed like an NOP reset contingent allegiances; NOP commands do not.*
3. *When a channel program sends a Mode Set command to the control unit, all channel programs for the addressed drive are performed in the same error recovery mode until another Mode Set command is sent that changes the setting of bit 7 or until the channel program ends.*
4. *Mode Set causes a synchronize operation if the command specifies tape-write-immediate mode. See "Synchronize (43)" on page 54.*

No-Operation (NOP) (03)

The NOP command performs no operations in the tape drive.

Initial Status Presents channel end and device end.

Unit Check The addressed drive is not ready or is not online in the subsystem.

Note: The NOP command does not reset contingent allegiances. However, any other command that causes no operation does reset any contingent allegiances that exist.

Read (02)

The Read command moves data from the control unit buffer to the controlling computer main storage. When the control unit receives a Read command for a tape drive, it checks for the last command for that drive. If the last command was a Read command, the control unit transfers a block of data to the controlling computer. If the last command was not a Read command (so that the buffer is empty or contains the wrong data), the control unit disconnects from the channel and starts reading from the tape drive into the tape drive's space in the buffer. When a block of data has been read from the tape drive, the control unit reconnects to the channel and transfers the block of data to the controlling computer.

Even while the control unit is transferring the block of data to the channel, it is reading additional blocks of data from the tape drive. The control unit reads from the tape drive until the buffer space assigned to that tape drive is full. The control unit assumes that one Read command will be followed by another Read command. With the buffer kept full by reading ahead, the control unit has only to transfer data in response to following Read commands. If the tape drive reads a tape mark, the read-ahead action stops and no further data is read into the control unit buffer.

The byte count in the channel command word (CCW) may not equal the length of the data block. When the channel stops requesting data bytes, the control unit ignores any data remaining in the buffer for that data block.

All models of the 3480 control unit buffer can contain a data block size up to 102,417 bytes. Any block size larger than 102,417 bytes, may cause a control unit to transfer the data in tape synchronous mode. In tape synchronous mode, the buffer acts only as a conduit between the tape drive and the channel; the channel data rate should be as high as the tape drive data rate to prevent overrun errors.

Note: The actual size of the largest data block depends on the model of control unit and buffer.

Control Unit Model	Maximum Block Size
A11	102,417
A22 (512K buffer)	131,061
A22 (1MB buffer)	204,813

Once begun, a control unit reads or writes data from the drive in tape synchronous mode until:

- A Rewind command is performed.
- A Rewind Unload command is performed.
- A Locate Block command is performed.
- A tape mark is read.

Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.

CCR	Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end, device end and other status, if any.
Unit Check	Caused by: <ul style="list-style-type: none">• The addressed drive is not ready or is not online in the subsystem.• The Read command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.• The control unit or drive has a hardware or microprogram error. This condition also sets the equipment-check sense bit.• The data is in error. This condition also sets the data-check sense bit.• The tape drive cannot read the first data block on the tape because the recording-format identification at the beginning-of-tape is missing or is not readable. This condition also sets the not-capable sense bit.

Notes:

1. *If the tape drive reads a tape mark instead of a data block, no data is read and the control unit presents the unit exception status bit.*
2. *If a Read command follows a Write command, a Write Tape Mark command, or an Erase Gap command, the results are indeterminate.*
3. *If a data check occurs (data was read from the tape with errors), the data check is indicated by unit-check status and the data-check sense bit, but the data with the errors is transferred to the controlling computer.*
4. *Read causes a synchronize operation. See "Synchronize (43)" on page 54.*

Read Backward (0C)

Read Backward is similar to Read Forward except that the tape moves in a backward direction. The data is passed from the buffer to the channel in last-written – first-read sequence. The channel places it in the correct sequence in main storage.

When the control unit receives a Read Backward command for a tape drive, it checks for the last command for that drive. If the last command was a Read Backward command, the control unit transfers a block of data to the controlling computer. If the last command was not a Read Backward command (so that the buffer is empty or contains the wrong data), the control unit disconnects from the channel and starts reading from the tape drive into the tape drive's space in the buffer. When a block of data has been read from the tape drive, the control unit reconnects to the channel and transfers the block of data to the controlling computer.

Even while the control unit is transferring the block of data to the channel, it is reading additional blocks of data from the tape drive. The control unit reads from the tape drive until the buffer space assigned to that tape drive is full. The control unit assumes that one Read Backward command will be followed by another Read Backward command. With the buffer kept full by reading ahead, the control unit has only to transfer data in response to following Read Backward commands. If the tape drive reads a tape mark, the read-ahead action stops and no further data is read into the control unit buffer.

The byte count in the channel command word (CCW) may not equal the length of the data block. When the channel stops requesting data bytes, the control unit ignores any data remaining in the buffer for that data block.

All models of the 3480 control unit buffer can contain a data block size up to 102,417 bytes. Any block size larger than 102,417 bytes, may cause the control unit to transfer the data in tape synchronous mode. In tape synchronous mode, the buffer acts only as a conduit between the tape drive and the channel; the channel data rate should be as high as the tape drive data rate to prevent overrun errors.

Note: The actual size of the largest data block depends on the model of control unit and buffer.

Control Unit Model	Maximum Block Size
A11	102,417
A22 (512K buffer)	131,061
A22 (1MB buffer)	204,813

Once begun, a control unit reads or writes data from the drive in tape synchronous mode until:

- A Rewind command is performed.
- A Rewind Unload command is performed.
- A Locate Block command is performed.
- A tape mark is read.

Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.

CCR	Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end, device end and other status, if any.
Unit Check	Caused by: <ul style="list-style-type: none">• The addressed drive is not ready or is not online in the subsystem.• The Read Backward command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.• The control unit or drive has a hardware or microprogram error. This condition also sets the equipment-check sense bit.• The data is in error. This condition also sets the data-check sense bit.• The tape drive cannot read the first data block on the tape because the recording-format identification at the beginning-of-tape is missing or is not readable. This condition also sets the not-capable sense bit.

Notes:

- 1. If the tape drive reads a tape mark instead of a data block, no data is read and the control unit presents the unit exception status bit.*
- 2. If a data check occurs (data was read from the tape with errors), the data check is indicated by unit-check status and the data-check sense bit, but the data with the errors is transferred to the controlling computer.*
- 3. Read Backward causes a synchronize operation. See "Synchronize (43)" on page 54.*

Read Block ID (22)

The Read Block ID command transfers two 4-byte block identifiers to the controlling computer. If the controlling computer requests fewer than eight bytes, only the requested number of bytes are transferred. If the controlling computer requests more than eight bytes, the control unit transfers only eight bytes.

The bits in each 4-byte block identifier are identified from high order to low order; the higher-order bits have lower bit position numbers.

Bit Position	Description
0	Reserved, always zero
1-7	Physical reference value
8-11	Reserved, always zeros
12-31	Logical block position

The physical reference value (bits 1–7) identifies the approximate physical position of a data block or tape mark on a tape. The physical reference value of the block IDs for two successive data blocks or tape marks may or may not be the same. Do not assume this value to be a linear quantity relative to logical block position. The first data block or tape mark read after the tape cartridge is inserted has a physical reference value of hexadecimal 01.

The final 20 bits (bits 12–31) of a block ID contain the sequential count of the data block or tape mark on the tape being read. The first data block or tape mark after the load point is sequential count zero.

The block ID at any point of processing refers to the next data block or tape mark that appears to the controlling computer to be on the tape between the most recently read data block or tape mark and the physical end-of-tape. The reference provides a consistent definition of the Read Block ID command regardless of the direction of tape motion. Note that the first 4-byte group from the block ID is typically used as the argument for a Locate Block command. The Locate Block command positions the tape for the next tape motion command to operate in the forward direction.

The first block ID identifies one of the following:

- The data block that is next to be passed between the controlling computer and the subsystem in either a read or write operation
- The last data block sent to the controlling computer in a read-backward operation.

The second block ID identifies one of the following:

- The next data block that is to be written to the tape from the control unit buffer for a write operation
- The next data block that is to be read from the tape to the control unit for a read operation
- The most recent data block that was read from the tape to the control unit buffer for a read-backward operation.

If the control unit is not moving data into the buffer, the first and second block IDs are identical.

The difference between the logical block position part of the two block IDs indicates the number of data blocks in the control unit buffer after the Read Block ID command is completed. The result of subtracting the logical block position part of the second block ID from the logical block position of the first block ID indicates the direction of tape motion before the Read Block ID command was issued. If the result is negative, the control unit buffer is performing a read operation. If the result is positive, the control unit buffer is performing a write or a read-backward operation. If the logical block position parts of both block IDs are identical, the control unit is not transferring any data to or from the buffer.

Examples:

- **When Write commands precede the Read Block ID command:**
Assume the first block ID has a value of 7 and the second block ID has a value of 3. Subtracting the second block ID (3) from the first block ID (7) results in a value of 4, which is positive, and indicates the control unit is performing a write operation. The 4 represents the number of data blocks in the buffer.
- **When Read commands precede the Read Block ID command:**
Assume the first block ID has a value of 3 and the second block ID has a value of 7. Subtracting the second block ID (7) from the first block ID (3) results in a value of -4, which indicates the control unit is performing a read operation. The 4 represents the number of data blocks in the buffer.
- **When Read Backward commands precede the Read Block ID command:** The first block ID identifies the next block that the controlling computer will read in the forward direction. The second block ID identifies the most recent block that was read from the tape to the buffer. When using the same assumptions as described in Example 1 and the result is positive, there are four blocks in the buffer and the tape motion is in the backward direction.

CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end, device end and other status, if any.
Unit Check	The Read Block ID command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: The Read Block ID command is performed even if the addressed tape drive is not ready or is not online in the subsystem.

Read Buffer (12)

The Read Buffer command retrieves buffered data that the 3480 subsystem has not yet written to tape. For each Read Buffer command completed, the controlling computer retrieves one block of data in last-in, first-out sequence until the buffer for the addressed tape drive is empty. The controlling computer usually issues this command when the tape drive or subsystem malfunctions and cannot write data from the buffer to the tape.

CCR	Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end, device end and other status, if any.
Unit Check	The Read Buffer command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

- 1. The Read Buffer command is performed even if the tape drive is not ready or is not online in the subsystem.*
- 2. If the buffer contains no data blocks to write to the addressed drive or the last data block in the buffer was sent back to main storage in response to a previous Read Buffer command, the subsystem accepts the Read Buffer command, but no data transfers. The residual count field of the channel status word (CSW) reflects that the buffer is empty.*
- 3. The Read Buffer command can be coded to transfer less than a full block of data into main storage. In response to a Read Buffer command, the control unit erases any part of a data block that was not transferred into main storage.*
- 4. Each Read Buffer command retrieves one block of data from the buffer. The value in sense byte 31 indicates the amount of main storage needed to retrieve all the data in the buffer. Each count in sense byte 31 represents 4K bytes in the buffer. You can calculate the actual data block length that was retrieved by subtracting the residual count in the CSW from the original count in the CCW.*

5. *Use a Read Block ID command before a Read Buffer command to determine how many data blocks are in the buffer. Specify a Read Buffer command for each data block.*
6. *You should set the suppress length indication (SLI) flag on if the value of sense byte 31 is specified for the CCW count field.*
7. *When writing data in tape-write-immediate operations, a Read Buffer command cannot retrieve the data block. The block identifier that the Read Block ID command returns immediately after a write error is incomplete. Therefore, the controlling computer recovery action can only restart the Write command.*

Read Buffered Log (24)

The Read Buffered Log command transfers 32 bytes of buffered log data (sense format 21) to the controlling computer from the control unit for the addressed tape drive. See “Chapter 3. Status and Sense Bytes” on page 67 for the bit and byte descriptions of the buffered log.

CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end, device end and other status, if any.
Unit Check	The Read Buffered Log command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

- 1. The Read Buffered Log command is performed even if the addressed tape drive is not ready or is not online in the subsystem.*
- 2. The Read Buffered Log command resets all the counters in the buffered log.*

Rewind (07)

The Rewind command rewinds the tape to the beginning-of-tape.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Rewind command is the last command in a chain, you should chain another command following the Rewind command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Rewind command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Rewind command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *Presents unit exception and control unit end if the addressed drive changes from ready to not ready during a Rewind command.*
2. *Rewind causes a synchronize operation. See "Synchronize (43)" on page 54.*

Rewind Unload (0F)

The Rewind Unload command rewinds the tape into the cartridge and opens the cartridge entry door, permitting the operator to remove the cartridge from the tape drive.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Rewind Unload command is the last command in a chain, you should chain another command following the Rewind Unload command. (A Sense or Sense ID command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Rewind Unload command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- Unit check status in ending status signals the controlling computer to issue a Sense command. Sense byte 0, bit 1 (intervention required) is shown for the addressed drive, and the operator must remove the cartridge from the drive before the channel program can perform additional tape operations.
- The Rewind Unload command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: Rewind Unload causes a synchronize operation. See "Synchronize (43)" on page 54.

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Sense (04)

The Sense command transfers 32 bytes of sense information to the controlling computer. The program in the controlling computer should issue the Sense command whenever the control unit sets the unit check status bit.

The sense data usually formats in format 20. See “Chapter 3. Status and Sense Bytes” on page 67 for a description of sense data formats. The error recovery procedure action in sense byte 3 indicates the conditions for which a particular format was received and defines the steps the error recovery program in the controlling computer is to take.

The Sense command resets the control unit sense data for the addressed drive if the Sense command is issued in response to a unit check.

Until the controlling computer that received the unit check status bit issues a command other than Test I/O or NOP, the control unit maintains a contingent allegiance between the addressed tape drive and the controlling computer. Until the contingent allegiance is cleared, the addressed tape drive appears to be busy to any other controlling computer that tries to address the tape drive.

CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end and device end along with other status, if any.

Notes:

- 1. The Sense command is performed even if the addressed tape drive is not ready or is not online in the subsystem.*
- 2. The Sense command is performed for an addressed drive even if the drive is assigned to a channel path different from the one on which the Sense command was issued.*

Sense ID (E4)

The Sense ID command transfers seven bytes of information to the controlling computer. The information identifies the subsystem by model and type.

The format of the seven bytes is:

Byte	Contents
0	Hexadecimal FF
1–2	Control unit type number (3480)
3	Control unit model number (11 or 22)
4–5	Tape drive type number (3480)
6	Tape drive model number (11 or 22)
CCR	Channel command retry can be called for error recovery only.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end and device end along with other status, if any.

Note: The control unit completes this command even if:

- *The intervention required sense bit is set.*
- *The addressed tape drive is not ready (no tape cartridge is loaded).*
- *The addressed tape drive is not online in the subsystem (bytes 4, 5, and 6 are 000).*
- *The drive has been assigned (by the Assign command) to a different channel path than the Sense ID was issued upon.*

Sense Path Group ID (34)

The Sense Path Group ID command transfers 12 bytes of channel path information from the control unit to the channel. The first byte is the path-state byte, and the remaining 11 bytes contain the path-group identifier. The bit assignments of the path-state byte are:

- Bits 0 and 1 contain the grouping status.
- Bits 2 and 3 contain the assignment status.
- Bit 4 contains the channel path status.
- Bits 5 through 7 are reserved and contain all zeros.

The bits in the path-state byte are:

Bits	Value	Description
0, 1		Grouping Status
	00	Reset. No Set Path Group ID command was accepted by any tape drive attached to this subsystem on this channel path since the last system reset or power-on reset affecting this path. When bits 0 and 1 are zeros, the remaining 11 bytes must also be zeros.
	01	Reserved.
	10	Ungrouped. A valid path-group ID exists for this channel path, but the addressed drive was not instructed by a Set Path Group ID command to consider the channel paths in a grouped state; or a disband code in the function control byte of a Set Path Group ID command set this state for all the paths of a group containing this channel; or a resign from group code in the function control byte of a Set Path Group ID command set this state for this path only.
	11	Grouped. A valid Set Path Group ID command that specified the establish-group code in the function control byte was accepted on this channel path. The group can consist of this path only or it can include several paths.

Bits	Value	Description
2, 3		Assignment Status
	00	No allegiance. The drive is not assigned to any channel path and has no allegiance to any controlling computer.
	01	Allegiance to issuing controlling computer. An extended contingent allegiance exists between the drive and the issuing controlling computer (perhaps on another channel path) for another channel program.
	10	Assigned elsewhere. The drive is not assigned to the channel path that issued the Sense Group Path ID command.
	11	Assigned. The drive is assigned to the channel path that issued the Sense Group Path ID command. The drive can also be assigned to other channel paths.
4		Mode Status
	0	Single path mode.
	1	Not used, invalid for this device.
5-7	000	Reserved

Chaining and Special

Requirements Do not include the Sense Path Group ID command in a command-chain with other commands. If the Sense Path Group ID command is chained after another command, the Sense Path Group ID command cannot be performed, and the unit check status bit and the command reject sense bit are set. Furthermore, if the Sense Path Group ID command has another command chained after it, the Sense Path Group ID command is performed, but the following chained command cannot be performed, and the unit check status bit and the command reject sense bit are set.

Initial Status Presents a zero. The control unit remains connected to the channel.

Ending Status Presents channel end and device end along with other status, if any.

Set Path Group ID (AF)

The Set Path Group ID command identifies a controlling computer and specific channel path to the addressed control unit and tape drive. The Assign command also uses the path group ID as an argument. The Set Path Group ID command is especially useful when two or more controlling computers share the subsystem because a unique path group ID is assigned to each controlling computer. The subsystem identifies each controlling computer by the path group ID.

The Set Path Group ID command is set at the channel adapter level, one ID per channel. The channel program must specify the Set Path Group ID command to each tape drive of the group the controlling computer wants to use and must issue the command on each channel path to be used when accessing that drive. For example, if a tape drive can be accessed as address 181 or 281 from the same controlling computer using two channel paths, the Set Path Group ID command must be issued to that tape drive once for each channel path. A subsystem cannot recognize a path group ID until a Set Path Group ID command has been issued on each channel path the subsystem can use. If a channel path is not identified as part of a path group ID, the subsystem assumes the path to be a single, unique path group.

Argument The Set Path Group ID command sends 12 bytes of path group ID information to the subsystem.

The first byte is a function control byte, and the remaining 11 bytes contain the path group ID.

The bits in the function control byte are:

Bits	Value	Description
------	-------	-------------

0		Path Mode
----------	--	------------------

0	Indicates single-path status. I/O operations can be sent over any channel path in the path group; however, when the I/O operation is completed, a contingent allegiance is maintained for the channel path over which the I/O operation was sent.
---	---

1	Causes the subsystem to reject the command and sets the unit check status bit and the command reject sense bit.
---	---

1, 2		Group Code
-------------	--	-------------------

The group code describes to the drive how the channel paths are grouped. The contents of these bits can be coded as follows:

Bits	Value	Description
------	-------	-------------

	00	Establish Group
--	----	-----------------

The subsystem establishes groups of channel paths for the addressed tape drive. The drive compares the path group ID received to all other path group IDs it received over other paths to which it is grouped. If the path group IDs match, the tape drive forms a path group consisting of all the paths that have matching path group IDs. If no other path group ID matches, the drive assumes the path is a single-path group.

The control unit maintains the path group ID for each channel path for each tape drive. Thus, to establish groups of paths for all the tape drives that are attached to a control unit, issue a Set Path Group ID command for each of the tape drives that are attached to the control unit. Also, issue the Set Path Group ID command for each tape drive over each channel path that the controlling computer uses to access the tape drive.

The Assign command assigns exclusive use of the tape drive by all the channel paths in the channel path group. You need to issue the Assign command only once for each group of paths for each of the drives attached to the control unit. Use the Set Path Group ID command to add a new channel path to an existing group by specifying the establish group bits in the function control byte.

	01	Disband Group
--	----	---------------

The control unit disbands the group of channel paths for the addressed tape drive. However, other drives that have not received the disband group request can still be addressed over any path in the path group.

If the addressed tape drive was assigned to the path group over which the disband-group request was received, the drive is no longer assigned to all the paths in the group. The addressed tape drive remains assigned only to the path over which the disband-group request was issued. The request does not affect the assignment of the addressed tape drive to channel paths in other groups. The drive ignores the command if the path over which the disband-group request was received is not in the channel path group.

Bits	Value	Description
10		<p>Resign from Group</p> <p>The control unit removes the path over which the command is received from any path group. If the addressed tape drive was assigned to the channel path over which the command was received, the tape drive remains assigned to the other paths in the group. If there are no other paths in the group, the assignment remains with the path over which the resign-from-group request was received.</p> <p>The request does not affect the assignment of the addressed tape drive to channel paths in other groups.</p> <p>The tape drive ignores the request if the path over which the resign-from-group request was received is not in a group.</p>
11		<p>Reserved</p> <p>The Set Path Group ID command cannot be performed, and the unit check status bit and the command reject sense bit are set.</p>
3-7	00000	<p>Reserved</p>

Path Group ID Bytes:

The final 11 bytes of the Set Path Group ID command identify the path group ID. The path group ID identifies the channel paths that belong to the same controlling computer. Path group ID bytes must be the same for all devices in a control unit on a given path. The Path Group ID bytes cannot be all zeros.

Chaining and Special Requirements

Do not include the Set Path Group ID command in a command chain with other commands. If the Set Path Group ID command is chained after another command, the Set Path Group ID command cannot be performed, and the unit check status bit and the command reject sense bit are set. Furthermore, if the Set Path Group ID command has another command chained after it, the Set Path Group ID command is performed, but the following chained command cannot be completed, and the unit check status bit and the command reject sense bit are set.

Initial Status

Presents a zero. The control unit remains connected to the channel.

Ending Status

Presents channel end and device end along with other status, if any.

Unit Check

Caused by:

- Fewer than 12 bytes are sent to the control unit. This condition also sets the command-reject sense bit.
- The Set Path Group ID command is chained after another command. This condition also sets the command-reject sense bit.
- The Set Path Group ID command has another command chained after it. The Set Path Group ID command is performed, but the following chained command cannot be performed. This condition also sets the command-reject sense bit.
- Bytes 1 through 11 are set to zero.

Notes:

1. *The Set Path Group ID command is performed even if:*
 - *The addressed tape drive is not in the ready state (no tape cartridge is inserted).*
 - *The addressed tape drive is not installed in the subsystem.*
 - *The addressed tape drive is not assigned to the channel path over which the command was received.*
2. *If more than 12 bytes are specified in the command, the controlling computer sends only the first 12 bytes, and the channel sets the incorrect length status bit unless the suppress length flag bit in the CCW is set to 1.*
3. *A path is removed from a path group under the following conditions:*
 - *Power-on-reset to the control unit on which the path is set*
 - *System reset on all paths of the group*

- *A Disband command issued for that path group*
 - *Initial microprogram load (IML) on the control unit on which the path is set*
 - *Moving the control unit Enable/Disable switch to the Disable position for the channel which a path group uses*
 - *Moving the CU Online/CU Offline switch to the CU Offline position on the control unit on which the path is set.*
4. *When the last path in a path group is removed, that path group is disbanded.*

Set Tape-Write-Immediate (C3)

The Set Tape-Write-Immediate command causes all subsequent Write commands in the channel program to perform as write-immediate commands. The control unit writes any data from the buffer to the tape drive before synchronizing the tape position. After synchronizing the tape position, the control unit presents device end status to the controlling computer.

The Set Tape-Write-Immediate command has the same effect as specifying tape-write-immediate in the Mode Set command but is effective only during the channel program in which it is contained. The Set Tape-Write-Immediate command is performed even though a prior Mode Set command could have specified the inhibit supervisor commands. A Mode Set command that is performed later in the channel program resets the tape-write-immediate operation.

The Set Tape-Write-Immediate command does not transfer any data.

Chaining and Special

Requirements

You can specify the Set Tape-Write-Immediate command anywhere in a channel program, but the command performs as a no-operation if it issued after the last Write command. Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Set Tape-Write-Immediate command is the last command in a chain, you should chain another command following the Set Tape-Write-Immediate command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Set Tape-Write-Immediate command.

Initial Status

Presents channel end and disconnects from the channel.

Ending Status

Reconnects to the channel and presents device end along with other status, if any.

Unit Check

Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Set Tape-Write-Immediate command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Suspend Multipath Reconnection (5B)

The command performs as an NOP command because all controlling-computer-to-subsystem operations are done in single-path status.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Suspend Multipath Reconnection command is the last command in a chain, you should chain another command following the Suspend Multipath Reconnection command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Suspend Multipath Reconnection command.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check The Suspend Multipath Reconnection command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: The control unit performs the command even if the addressed tape drive is not ready or is not installed in the subsystem.

Synchronize (43)

The Synchronize command causes synchronization between the tape drive and the controlling computer after buffered write operations. The command ensures that, after a buffered write operation, all the buffered data is written on the tape and the tape is moved to the correct position to receive the next data block. The command is performed only after all previous write operations are completed for the addressed tape drive, and all the write data is moved from the buffer to the tape.

The System Control Program issues this command before closing a tape volume or before coordinating a checkpoint with a disk file. Usually you do not need to consider synchronization between the controlling computer, the buffer, and the addressed drive nor do you need to use the Synchronize command.

Other commands that perform a synchronize operation before they complete are:

- Write Tape Mark
- Erase Gap
- Locate Block
- Rewind
- Rewind Unload
- Any space command, such as Forward Space Block
- Any read-type command that follows a write-type command.

The Synchronize command transfers no data on the channel path. However, the Synchronize command is not used as an immediate command as defined in *IBM System/370 Principles of Operation*.

CCR	Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.
Initial Status	Presents a zero. The control unit remains connected to the channel.
Ending Status	Presents channel end and device end along with other status, if any.

Unit Check

Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Synchronize command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Note: The System/370 channel does not permit a zero-count field in a CCW. However, because no data transfers as a result of the Synchronize command and because the Synchronize command is not an immediate command, the CCW length is not zero and normally causes an incorrect-length indication in the CSW after the command is completed. Therefore, when programming the Synchronize command, set the suppress length indication bit to 1 in the CCW.

Unassign (C7)

The Unassign command discontinues an earlier assignment of the addressed tape drive to the exclusive use of a channel path or channel path group. The command must be sent over a channel path to which the addressed tape drive is assigned.

Argument The Unassign command passes 11 bytes of information (called an argument) to the subsystem. The argument can contain all zeros, which releases the addressed tape drive from the assignment to the channel path group over which the command was received. If the channel path over which the command was received was not grouped by a previous Set Path Group ID command, the control unit assumes that the group consists of a unique group of one channel paths.

An argument that does not contain all zeros is interpreted as a channel path group ID as established by the Set Path Group ID command. The contents of the 11-byte argument are compared to the channel path group ID previously assigned and the drive is released from those channel paths that have the same path group ID. The Unassign command does not have to contain an argument that matches the channel path group ID for the channel path over which the Unassign command was sent.

Supervisor The Unassign command is a supervisor command and cannot be performed if preceded by a Mode Set command that inhibits supervisor commands.

CCR Channel command retry can be called for error recovery only.

Initial Status Presents a zero. The control unit remains connected to the channel.

Ending Status Presents channel end and device end along with other status, if any.

Unit Check

Caused by:

- The Unassign command is sent over a channel path to which the addressed tape drive was not assigned. This condition also sets the command-reject sense bit.
- The addressed tape drive was not assigned to a channel path group ID that matches the one specified in the Unassign argument. This condition also sets the command-reject sense bit.
- A Mode Set command that inhibits supervisor commands precedes the Unassign command. This condition also sets the command-reject sense bit.

Notes:

1. *The Unassign command is performed even if the tape drive is not ready or is offline.*
2. *The Unassign command can be sent from any controlling computer along any channel path to which the drive is assigned and can release the addressed tape drive from any correctly specified channel path, even if those channel paths belong to a different controlling computer.*
3. *The assignment of a drive is cleared by:*
 - *A Control Access command with the generalized-unassign mode of use*
 - *Power on reset*
 - *System reset on all assigned channel paths*
 - *The Unassign command*
 - *Initial microprogram load (IML)*
 - *Moving the control unit Enable/Disable switch for the channel to the Disable position*
 - *Moving the CU Online/CU Offline switch to the CU Offline position.*

Write (01)

The Write command writes data blocks from the controlling computer to the control unit buffer. The control unit then transfers the data to the tape drive independently of what is happening on the channel.

All models of the 3480 control unit buffer can contain a data block size up to 102,417 bytes. Any block size larger than 102,417 bytes, may cause the control unit to transfer the data in tape synchronous mode. In tape synchronous mode, the buffer acts only as a conduit between the tape drive and the channel; the channel data rate should be as high as the tape drive data rate to prevent overrun errors.

Note: The actual size of the largest data block depends on the model of control unit and buffer. Please notice that the largest block size that can be written is larger than the largest block size that can be read. This can create a problem if control unit independence is required, or if the channel has insufficient data transfer capability.

Control Unit Model	Maximum Block Size
A11	102,426
A22 (512K buffer)	131,066
A22 (1MB buffer)	204,826

Once begun, a control unit reads and writes data from the drive in tape synchronous mode until:

- A Rewind command is performed.
- A Rewind Update command is performed.
- A Locate Block command is performed.
- A tape mark is written.

Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.

Chaining and Special

Requirements

Some operating systems signal that the channel program is complete when channel end status returns for the last command in the chain. The write command can present channel end and device end separately as described under “Initial Status” and “Ending Status.”

For those operating systems, if the Write command is the last command chained in a chained program, you should chain another command (NOP is appropriate) after the Write command so that any error status is returned with device end when the Write command is completed.

Note that the MVS operating system does not signal that the channel program is complete if channel end is presented to a Write command without device end.

CCR

Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status

Presents a zero. The control unit remains connected to the channel.

Ending Status

Presents channel end and device end together along with other status, if any, except in two situations: 1) when transferring data in tape-write-immediate and 2) when the tape has moved past the logical end-of-tape. In these two situations, the control unit presents channel end and disconnects from the channel. When the command is completed, the control unit reconnects to the channel and presents device end and other status, if any.

Unit Check

Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Write command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit. *Byte 0 bit 7*

Note: Unit exception and control unit end are presented when a Write command is issued after the tape has moved past the logical end-of-tape.

Write Tape Mark (1F)

The Write Tape Mark command writes a unique pattern on the tape. One tape mark indicates file separation.

Chaining and Special

Requirements Most operating systems signal that a channel program is complete when channel end status returns for the final command in the chain. If a Write Tape Mark command is the last command in a chain, you should chain another command following the Write Tape Mark command. (An NOP command is appropriate.) This practice ensures that any error status that results from the program returns with the device end status for the Write Tape Mark command.

CCR Channel command retry can be called to hold the command until subsystem resources are available or until a previous buffer operation is completed.

Initial Status Presents channel end and disconnects from the channel.

Ending Status Reconnects to the channel and presents device end along with other status, if any.

Unit Check Caused by:

- The addressed drive is not ready or is not online in the subsystem.
- The Write Tape Mark command is issued to an addressed drive that is not assigned to the issuing path but is assigned to another path. This condition also sets the assigned-elsewhere sense bit.

Notes:

1. *Unit exception and control unit end are presented when a Write Tape Mark command is issued after the tape has moved past the logical end-of-tape.*
2. *Write Tape Mark causes a synchronize operation. See "Synchronize (43)" on page 54.*

Test I/O (00)

The Test I/O (TIO) controlling computer instruction causes the Test I/O command to be sent to the control unit. An all-zero command code used in the channel program is an invalid command and results in a channel program check.

The Test I/O command causes the status byte to be transmitted to the controlling computer during the initial selection sequence. No drive operation is performed.

Initial Status Presents channel end and device end along with other status, if any.

Unit Check The addressed drive is not ready, and no status is stacked or pending.

Chapter 2. Resets

The 3480 subsystem responds to reset and disconnect signals on the channel as described below.

System Reset

A system reset resets:

- The channel path on which the system reset is issued and removes the path from all path groups that were previously established for any drive on that path
- The path group ID for the path
- An I/O operation in progress on the resetting channel path
- All tape drive assignments to the resetting channel path
- A password established by a prior Control Access command (if any) if the tape drive is assigned only to the resetting channel path
- All sense data that is not for a deferred unit check
- Any contingent allegiances for the resetting channel path except for some queued deferred unit checks.

If system reset is issued when the buffer contains data that is to be written to tape for a channel path group and the resetting channel path is the last remaining path in the group or is ungrouped, the 3480 control unit attempts to write the buffered data before the reset is completed. If a permanent error occurs during a write operation after a system reset, a deferred unit check is queued and is presented to the controlling computer during the next I/O operation for the addressed tape drive.

Deferred unit checks caused by permanent write errors remain in effect complete with their associated sense data until the controlling computer accepts the deferred unit check or a power-on reset occurs.

Deferred unit checks caused by permanent write errors are sent to the controlling computer regardless of the paths that issue system reset within a channel path group.

If the system reset is issued on the last available path of a group, the deferred unit check is queued and is presented along an ungrouped path. The deferred unit check is presented only when the specific drive is addressed again.

If the resetting path is the last path in the group, the subsystem does not reset the following items until all the buffer write data associated with this path group is written to tape or a deferred unit check is queued for the failing write operation.

- Any prior grouping status
- Assignment protection
- Passwords established by the Control Access command
- Mode set values in effect when the system reset was received.

These items remain in effect until all necessary buffered-data/tape drive synchronization is completed successfully or a deferred unit check is queued. See “Synchronize (43)” on page 54 for an description of synchronization. Even after a system reset is received on a channel path, later operations on another channel path can proceed as if the system reset is not complete (Assign or Unassign status for example).

Note: If an initial program load (IPL) of the controlling computer is causing the system reset, deferred unit check can still be queued in the control unit. Therefore, the initialization program must be prepared to receive deferred unit check during the first I/O operation to the tape drives.

If the first I/O operation to an addressed tape drive is the IPL Read command but a deferred unit check is pending for that tape drive on the associated channel path, the controlling computer cannot complete the IPL process because the deferred unit check is presented in the status of the Read command. A subsequent request to perform an IPL to the controlling computer from the addressed tape drive should cause no interruption.

For more information about system reset, see *IBM System/370 Principles of Operation*, or *IBM System/370 Extended Architecture Principles of Operation*.

Selective Reset

Selective reset affects only the device address with Operational In active. All tags and buses to the channel are reset. Except when deferred unit checks are queued before or during a selective reset, all pending status and sense bits are reset for the tape drive being reset. A selective reset clears contingent allegiance between the drive and the controlling computer over the affected channel. Buffered log data is not reset. An implicit synchronize operation is performed when a tape drive receives a selective reset. Selective reset does not affect channel path groups and assignments.

For more information about selective reset, see *IBM System/370 Principles of Operation* or *IBM System/370 Extended Architecture Principles of Operation*.

Power-On Reset

A power-on reset in the control unit resets all path group IDs, all drive assignments to exclusive channel paths, and all contingent allegiances to the drive. Also, a control-unit power-on reset resets all sense data and buffered logs and requires that an initial microprogram load (IML) be performed.

A drive can complete an individual power-on reset, which does not affect the subsystem. A power-on reset in the drive causes the drive microprocessor and associated logic to be reset. When the power-on reset is completed, the control unit supplies microcode updates when the drive requests them.

Interface Disconnect

When the controlling computer performs a Halt I/O, Halt Device, or Halt Subchannel instruction, the interface disconnect sequence causes the addressed tape drive to stop all activity at the next normal ending point. All data transfer on the channel path stops.

If the tape drive is moving the tape into position or is performing a Rewind, Rewind Unload, or Data Security Erase command, the operation is completed.

Because the data is buffered by the control unit, if an interface disconnect sequence occurs when the control unit is completing a Write command at the channel, the count value stored in the CSW may not accurately indicate how much data was written on the tape. For more information about interface disconnect, see *IBM System/370 Principles of Operation*, or *IBM System/370 Extended Architecture Principles of Operation*.

Chapter 3. Status and Sense Bytes

The 3480 subsystem monitors all subsystem operations for errors. If possible, subsystem errors are corrected by the subsystem error recovery procedures (ERPs). A count of these temporary errors is recorded in the buffered log data for later analysis and can be retrieved by issuing a Read Buffered Log or (format 21) Sense command. Errors or abnormal conditions that subsystem ERPs cannot correct cause a unit check to be presented to the controlling computer. A subsequent Sense command from the controlling computer brings in the sense data to aid in finding the problem and defining possible additional recovery action.

The status byte contains eight bits that provide response information regarding the current CCW. Bits 32 through 39 of the System/370 channel status word (CSW) contain the status byte information. The CSW formatted by the I/O Supervisor components of MVS-Extended Architecture supplies the same information.

Sense data is presented in three formats: 19, 20 and 21. Thirty-two bytes of sense information in each format for each tape drive is stored in the control unit. Sense bytes 0 through 6 are common to sense data formats 19, 20 and 21. The format of sense bytes 8 through 31 is determined by the contents of sense byte 7.

- Sense byte 7 = hexadecimal 19 (format 19)

The sense bytes are presented when the subsystem is in forced logging mode and are used by the service representative.

- Sense byte 7 = hexadecimal 20 (format 20)

The sense bytes contain tape drive and control unit error information.

- Sense byte 7 = hexadecimal 21 (format 21)

The sense bytes contain buffered log data.

Format 20 sense data is given when a Sense command is performed except when:

- The Sense command is issued in response to the unit check status bit that occurs after a Rewind Unload command is completed.
- The Sense command is issued in response to a deferred unit check caused when statistical counters in the buffered log data overflow.

Format 21 sense data is buffered log data and is given in response to a Read Buffered Log command. Format 21 is also given when:

- A Sense command is performed and one or more of the statistical counters has reached a predetermined value or overflows
- A Rewind Unload command is performed.

Sense data (formats 19 and 20) is reset after:

- System reset (excluding deferred unit checks)
- Selective reset
- Power-on reset
- Acceptance of an I/O instruction other than Test I/O or NOP following a contingent allegiance
- A Sense command, format 19 or 20, is performed.

Buffered log data (format 21) is reset after:

- System reset
- Power-on reset
- A Sense command (format 21) is performed
- A Read Buffered Log command is performed.

The need to present buffered log data never takes precedence over the indication of format 20 sense data. If both format 20 and format 21 sense data occur at the same time, the format 20 sense data is given in response to a unit check status bit. The control unit keeps a contingent allegiance to the selected tape drive on the same channel path as the unit check was received. Later, by way of a deferred unit check on the next I/O operation other than Test I/O or NOP, the format 21 data is given in response to the Sense command.

Detailed descriptions of the status and sense bytes follow the summaries. In the following descriptions, the term *set* means the sense bit being described has a value of 1. If a bit is not set or is reset, it has a value of 0.

Status Byte

Figure 2 is a summary of the status byte. See the beginning of this chapter for a brief description of the status byte.

Bit							
0	1	2	3	4	5	6	7
Attention	Status Modifier	Control Unit End	Busy	Channel End	Device End	Unit Check	Unit Exception

Figure 2. Status Byte Summary

Bit 0, Attention

The attention bit is set along with the device end status bit and the unit exception status bit when the drive is changed from not-ready to ready state. The change of state is caused by:

- Inserting a cartridge in a drive that has the Ready/Not Ready switch in the Ready position.
- Placing the Ready/Not Ready switch to the Ready position on a drive that has a cartridge inserted. The drive must have been primed while in the not-ready state. See the device end status bit for a description of primed.

Bit 1, Status Modifier

The status modifier bit is set along with the busy bit when the control unit is busy. The bit is also set along with the channel end status bit and the unit check status bit to place the channel in retry status. When an immediate attempt to retry is requested, the device end status bit is set along with the channel end status bit and the unit check status bit. If the attempt to retry is not immediate, the device end status bit is set when the control unit is ready to retry the command.

Bit 2, Control Unit End

If the control unit was busy during initial selection, the control unit end bit is set when the control unit is no longer busy and can accept a command. The bit is set along with the busy and status modifier bits when the control unit is busy for only a short time.

The bit is always set along with the device end status bit if the channel end status bit was set earlier and the unit check status bit or the unit exception status bit is set along with the device end status bit.

Bit 3, Busy

The busy bit is set when the drive is busy. The bit is set along with the status modifier bit when the control unit is busy. The bit is always set along with status modifier and control unit end bits when the control unit is busy for only a short time. The busy bit is set in initial status with other status bits to indicate that the status was previously stacked or pending.

Bit 4, Channel End

The channel end status bit is set when the data transfer portion of an I/O operation is complete or when control information between the channel and the control unit or tape drive is complete and the channel is no longer needed to perform the current command.

Bit 5, Device End

The device end status bit is set when an I/O command has been completed or when the controlling computer issues an I/O request and the busy bit is returned. In the latter instance, the control unit sets this bit to indicate that the drive-busy condition has been cleared.

The bit is set along with the attention and the unit exception status bits when a tape drive is changed from the not-ready to the ready state and has been primed.

A tape drive is primed when a Rewind/Unload command is completed or when an I/O command is issued and the tape drive is in the not-ready state.

Bit 6, Unit Check *status bit*

The unit check status bit is set when one of the following conditions is sensed in the subsystem:

- The tape drive is in a not-ready state and a motion-type command is issued to it.
- An error condition prevents successful completion of an operation.
- A Read Backward, Backspace Block, or Backspace File command is issued to a tape drive that is positioned at the beginning-of-tape.
- The tape drive has accepted a Rewind Unload command.
- A deferred unit check occurs. *see next page*
- A command or command sequence is invalid.
- Chaining occurs to or from a Set Path Group ID command or a Sense Path Group ID command.
- A write-type command is issued to a file-protected tape.

- The tape drive that the channel requested is assigned to exclusive use by another channel path group.
- The buffered log has overflowed.
- A forward-motion command is issued to a tape drive that is positioned at the physical end-of-tape.

Note: The tape must be moved backward to at least the logical end-of-tape before any forward motion command can be performed.

In response to a unit check status bit, the controlling computer must issue a Sense command to retrieve the information necessary to record the error. The control unit maintains a contingent allegiance between the controlling computer and the tape drive when the unit check status bit occurs. Until the controlling computer issues a command other than Test I/O or No Operation, the addressed tape drive is busy to I/O requests on other channel paths to ensure that the controlling computer can retrieve the sense information.

The subsystem can signal a unit check status that belongs to an earlier error condition. The signal of an earlier error is called *deferred unit check*. Therefore, the error may not be associated with the command or channel program that received the unit check.

The subsystem cannot send a deferred unit check for the following channel commands:

- Assign
- Control Access
- Load Display
- Mode Set*
- Read Buffered Log
- Sense
- Sense ID*
- Sense Path Group ID
- Set Path Group ID.
- Set Tape Write Immediate*

* Except for unit checks caused by buffered log overflow.

All other channel commands can receive a deferred unit check. The controlling computer examines the state of sense byte 0, bit 6, to determine whether the unit check belongs to the channel command that was processing when the unit check was signalled or to another condition.

Some conditions that cause a deferred unit check are:

- A cartridge was manually removed from the addressed drive.
- A hardware failure error occurred that must be signalled to the controlling computer when the next I/O operation is performed (although the next channel program is not the cause).

Bit 7, Unit Exception

The unit exception status bit is set if the logical end-of-tape is reached during processing of a Write, Write Tape Mark, or Erase Gap command. Any data in the buffer is written on the tape and the buffered data and the tape position are synchronized.

Unit exception is also set if a tape mark is sensed while processing a Read, Read Backward, Forward Space Block, or Backward Space Block command.

The unit exception bit is set along with the attention bit and the device end status bit when a tape drive is changed from the not-ready to the ready state.

Sense Bytes 0 through 7

Figure 3 is a summary of sense bytes 0 through 7. For more information about the relationship of these sense bytes to sense bytes 8 through 31, see the beginning of this chapter.

Sense Byte	Bit							
	0	1	2	3	4	5	6	7
0	Command Reject	Intervention Required	Bus Out Check	Equipment Check	Data Check	Overrun	Unit Check Timing	Assigned Elsewhere
1	Locate Block Function Failed	Drive Online to Control Unit	Not used	Out of Sequence Record	Beginning of Tape	Write Status	File Protect	Not Capable
2	Channel Adapter Code			Channel Adapter Location	Detecting Control Unit	Cartridge Availability in the Automatic Cartridge Loader	Drive in Synchronous Data Transfer Mode	Block ID Positioning Indicator
3	Error Recovery Procedure Action (ERPA)							
4	Not used				High-Order Block ID			
5	Low-Order Block ID							
6	Low-Order Block ID							
7	Format Code							

Figure 3. Sense Bytes 0 through 7 Summary

Sense Byte 0

Bit 0, Command Reject

The command reject sense bit is set when:

- A Write, Write Tape Mark, Erase Gap, or Data Security Erase command is sent to a tape that is file protected.
- The control unit receives an invalid command.

- A Data Security Erase command is issued that is not command-chained to an Erase Gap command.
- The subsystem receives an inhibited supervisor channel command.
- The subsystem senses an invalid channel program sequence.
- An invalid argument is specified in a command.
- A block to be written does not fit into the data buffer.

Bit 1, Intervention Required

The intervention required bit is set when the addressed tape drive is not ready or does not exist. *Also in Record Unload. See p. 42*

Note: The status of this bit is real-time dependent. If a not-ready drive becomes ready before the sense is presented to the controlling computer, the bit is off.

Bit 2, Bus Out Check

The bus out check bit is set if the data bus from the channel has the wrong parity when a command or data byte is transferred.

Bit 3, Equipment Check

The equipment check bit is set:

- For a control unit hardware or microprogram failure; ERPA codes 2C, 47, 4A, and 4B
- For a drive equipment check or control-unit-to-drive adapter error; ERPA codes 22, 35, and 36
- For certain operational errors; ERPA codes 24, 2D, and 38.

Bit 4, Data Check

The data check bit is set when an error is detected while performing read- or write-type operations between the control unit and the drive. ERPA codes that set data check status are 23, 25, 26, 28, 31, and 41.

Data checks can be caused by:

- Hardware failures (control unit or drive or the cabling between them)
- Damaged or defective tape
- Improper operating procedures or conditions, including programming.

The ERPA code is not intended to identify the specific cause.

Bit 5, Overrun

The overrun bit can be set when reading or writing a single block of data that is too large to fit in the buffer. In this condition, both the channel and the drive are accessing the buffer at the same time. If the buffer is full when a byte is to be placed in it or is empty when a byte is requested, an overrun occurs. This condition is likely, if the channel data rate is less than three megabytes per second. The subsystem attempts error recovery procedures before this bit is set. Data overrun is the only type of overrun that can occur on the subsystem.

Bit 6, Unit Check Timing

The unit check timing bit is set when the unit check that caused the sense data is a deferred unit check. For example, the data check is relevant to a previous command. The bit is set to 0 when the unit check status bit applies to a condition that relates to the channel command that is processing now. If the controlling computer requests a Sense command that is not related to a unit check and for which there is no contingent allegiance, the content of this bit may be invalid.

Bit 7, Assigned Elsewhere

The assigned elsewhere bit is set when the tape drive receives a command over a channel path to which the tape drive is not assigned, but the drive is assigned to a different channel path.

Sense Byte 1

Bit 0, Locate Block Function Failed

The locate block function failed bit is set when the Locate Block command cannot find the data block or tape mark that was requested.

Bit 1, Drive Online to Control Unit

The drive online to control unit bit is set when the control unit has established communication with the addressed tape drive.

Bit 2, Reserved

The bit must be a zero.

Bit 3, Out of Sequence Record

The out of sequence record bit is set when the block ID shows that the block being read is out of sequence.

Bit 4, Beginning of Tape

The beginning-of-tape bit is set when the tape on the addressed tape drive is at the beginning-of-tape position.

Bit 5, Write Status

The write status bit is set when a write-type command was the most recent command sent to the addressed tape drive. The bit is reset when a read-type command was the most recent command sent to the addressed tape drive.

Bit 6, File Protect

The file protect bit is set when a tape cartridge that is protected against write operations is inserted in the addressed tape drive. The bit is valid only when sense byte 1 bit 1 (drive online to control unit) is set.

Bit 7, Not Capable (Read)

The not capable bit is set when the tape drive cannot read the first data block on a tape because the recording-format identification at the beginning-of-tape is missing or is not readable. *see p. 53*

Sense Byte 2

Bits 0–2, Channel Adapter

The channel adapter bits identify the channel adapter that the subsystem is using now.

Code	Interpretation
001	Channel adapter A
010	Channel adapter B
011	Channel adapter C
100	Channel adapter D

Bit 3, Channel Adapter Location

The channel adapter location bit is not set if the channel adapter being used now is in control unit 0 or if there is only one control unit in the subsystem. The bit is set if the channel adapter being used now is in control unit 1.

Bit 4, Detecting Control Unit

The detecting control unit bit is not set if the condition causing the sense was detected by control unit 0. The bit is set if the condition causing the sense was detected by control unit 1.

Bit 5, Cartridge Availability in the Automatic Cartridge Loader

The cartridge-availability-in-the-Automatic-Cartridge-Loader bit is set (active) if:

- The loader is installed and operational.
- The loader is in system mode.
- There are cartridges loaded in the input stack, and the output stack has room to receive indexed cartridges.

This bit is set each time the drive presents status to the control unit for a 3480 drive with the loader feature attached. The bit is not set (inactive) when any of the above conditions do not apply.

Bit 6, Drive in Synchronous Data Transfer Mode

The drive-in-synchronous-data-transfer-mode bit is set when the control unit places the drive in tape synchronous mode. The control unit does no error recovery procedures for check conditions for the drive while the drive is in tape synchronous mode. The positioning of the tape for error recovery procedure actions (ERPA) 23 and 25 is the same as for buffered data transfers. See "Error Recovery Procedure Codes" on page 89 for the error recovery procedure actions.

If you provide a SYNAD or ESTAE routine and a write operation is involved, you can use a Forward Space Block command or a Read command to check the condition of the written block. The Forward Space Block command will fail if a partial block is written or the block ID is not correct. The Read command will fail if the block contains a data check, if a partial block is written, or if the block ID is not correct.

Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.

Bit 7, Block ID Positioning Indicator

The block ID positioning indicator bit has meaning only when a positioning error has occurred and a contingent allegiance has been established. See "Error Handling" on page 101 for more information about positioning.

Sense Byte 3

Byte 3 contains the 3480 error recovery procedure action (ERPA) code. It describes the action that the controlling computer should take to recover from an error within the subsystem. See “Error Recovery Procedure Codes” on page 89 for a description of the errors indicated by sense byte 3 and the controlling computer recovery action.

Sense Byte 4

Bits 0–3, Not Used

These bits must be zeros.

Bits 4–7, Logical Block Position

The logical block position bits identify the high-order bits of the logical-block-position part of the block identifier for the next data block or tape mark that would be read or written in a forward direction. See “Error Handling” on page 101 for information about how the block ID is used during error recovery.

Sense Bytes 5 and 6

Bytes 5 and 6 identify the last 16 bits of the logical block position part of the block identifier for the next data block or tape mark to be read or written in a forward direction. See “Error Handling” on page 101 for information about how the block ID is used during error recovery.

Sense Byte 7

Byte 7 identifies the format of sense bytes 8 through 31.

- If byte 7 contains hexadecimal 20, the format represents error sense data (format 20).
- If byte 7 contains hexadecimal 21, the format represents buffered log data (format 21).
- If byte 7 contains hexadecimal 19, the format represents forced logging operation (format 19). The definitions of sense bytes in format 19 are the same as those for format 20.

Format 19 sense is issued after the subsystem successfully recovers from a temporary error condition. The service representative places the subsystem in forced logging mode to get format 19 sense, which gives him analytic information about temporary errors. Normally, a subsystem is not in forced logging mode, and temporary errors are counted only in the subsystem. Format 21 sense supplies the content of these counters. Forced logging mode does not affect format 20 sense or the reasons that cause unit checks for format 20 sense.

Format 21 sense contains a set of counters for usage and errors. An overflow of any counter causes a unit check to be issued, and the resulting sense command transfers the content of all format 21 counters to the controlling computer for logging. All counters are reset on a format 21 sense operation. The controlling computer can also use the Read Buffered Log command to get the contents of format 21 counters.

Sense Bytes 8 through 31

Figure 4 on page 79 is a summary of sense bytes 8 through 31 for both format 20 and format 21. Format 19 sense is defined the same as format 20.

n=20

Sense Byte	Format	Bit							
		0	1	2	3	4	5	6	7
8	20	Drive Error Recovery Procedure (ERP) Code							
	21	Count of Temporary Read Data Checks							
9	20	Control Unit Service Information							
	21	Count of Temporary Read Backward Data Checks							
10	20	Control Unit Service Information							
	21	Count of Temporary Write Data Checks							
11	20	Control Unit Service Information							
	21	Count of Read Blocks Corrected							
12	20	Control Unit Service Information							
	21	Count of Write Blocks Corrected							
13	20	Control Unit Service Information							
	21	Count of Temporary Control Unit Errors							
14	20	Control Unit Service Information							
	21	Count of Read Bytes Processed (byte 1)							
15	20	Control Unit Service Information							
	21	Count of Read Bytes Processed (byte 2)							
16	20	Control Unit Service Information							
	21	Count of Write Bytes Processed (byte 1)							
17	20	Control Unit Service Information							
	21	Count of Write Bytes Processed (byte 2)							
18	20	Drive Service Information							
	21	Count of Read Blocks Processed <i>continued in byte 26</i>							
19	20	Reserved				Drive Model Number			
	21	Count of Write Blocks Processed <i>continued in byte 26</i>							
20	20	Drive Command							
	21	Write Transient Conditions							
21	20	Drive Service Information							
	21	Read Transient Conditions							
22	20	Drive Service Information							
	21	Count of Temporary Write Data Checks without Hardware Indicator (see sense byte 10)							
23	20	Drive Service Information							
	21	Count of Temporary Read Data Checks without Hardware Indicator (see sense bytes 8 and 9)							
24	20	Channel Adapter A	Channel Adapter B	Channel Adapter C	Channel Adapter D	Not used	Channel Type		
	21	Erase Gap Counts							
25	20	Dual Control Unit Communication Coupler	Not used				Automatic Cartridge Loader		
	21	Temporary Drive Errors							
26	20	Control Unit EC Level							
	21	Low Order Position of Read Block Counter				Low Order Position of Write Block Counter			
27	20	Control Unit EC Level	Drive Model Supported	Control Unit EC Level Control unit serial number (high-order)					
	21	Control Unit EC Level	Drive Model Supported	Control unit serial number (high-order)					
28	20	Control Unit Serial Number (low-order)							
	21	Control Unit Serial Number (low-order)							
29	20	Control Unit Serial Number (low-order)							
	21	Control Unit Serial Number (low-order)							
30	20	Logical Drive Address				Physical Drive Address			
	21	Read Recovery Retry Count							
31	20	Data Byte Count (in 4K-byte blocks)							
	21	Logical Drive Address				Physical Drive Address			

Figure 4. Sense Bytes 8 through 31 Summary

Sense Byte 8

Format 20: The byte contains an internal subsystem ERP code when a tape drive has asked for action from the control unit error recovery procedures.

Format 21: The byte contains a count of the read forward errors that were corrected by internal subsystem ERP action.

Sense Byte 9

Format 20: The byte contains information for the service representative about control unit logic/hardware conditions.

Format 21: The byte contains a count of the read backward errors that were corrected by internal subsystem ERP action.

Sense Byte 10

Format 20: The byte contains information for the service representative about control unit logic/hardware conditions.

Format 21: The byte contains a count of the write blocks that were corrected by internal subsystem ERP action.

Sense Byte 11

Format 20: The byte contains information for the service representative about control unit logic/hardware conditions.

Format 21: The byte contains a count of the read blocks that were corrected by the data error correction logic without needing ERP action.

Sense Byte 12

Format 20: The byte contains information for the service representative about control unit logic/hardware conditions.

Format 21: The byte contains a count of the write blocks corrected by the data error correction logic without needing ERP action.

Sense Byte 13

Format 20: The byte contains information for the service representative about control unit logic/hardware conditions.

Format 21: The byte contains a count of the control unit errors that were recovered by the internal subsystem ERP action.

Sense Bytes 14 and 15

Format 20: The bytes contain information for the service representative about control unit logic/hardware conditions.

Format 21: The bytes contain a count of the bytes read from the drive to the channel. Each count has a value of 4K bytes and is rounded to the nearest 4K-byte value.

Sense Bytes 16 and 17

Format 20: The bytes contain information for the service representative about control unit logic/hardware conditions.

Format 21: The bytes contain a count of the bytes written from the channel to the drive. Each count is equal to 4K bytes and is rounded to the nearest 4K-byte value.

Sense Byte 18

Format 20: The byte contains information for the service representative about drive logic/hardware conditions. See sense bytes 20 and 21, format 20.

Format 21: This byte combined with the high-order four bits of sense byte 26 form a 12-bit binary counter of read blocks processed. Byte 18 is the high-order eight bits of the 12-bit counter. Each count in sense byte 18 represents 256 blocks. The maximum value of the total counter is 65,520 blocks.

Sense Byte 19

Format 20: This byte identifies the drive model number.

Bit	Meaning
0–3	Reserved (will be zero)
4–5	Zero
6	Drive Model B22
7	Drive Model B11

Format 21: The byte combined with the low-order four bits of sense byte 26 form a 12-bit binary counter of write blocks processed. Byte 19 is the high-order eight bits of the 12-bit counter. Each count in sense byte 19 represents 256 blocks. The maximum value of the total counter is 65,520 blocks.

Sense Byte 20

Format 20: The byte contains the code for the internal subsystem drive command that was processing when an error condition was detected. See sense byte 21, format 20.

Format 21: Write transient conditions.

Sense Byte 21

Format 20: The byte contains information for the service representative about the drive logic/hardware conditions.

Format 21: Read transient conditions.

Sense Byte 22

Format 20: The byte contains the code for the internal subsystem drive command that was processing when an error condition was detected.

Format 21: The byte contains a count of write blocks that were corrected by the internal subsystem ERP actions where no hardware indicators were present. The count is a subset of and is included in the count in sense byte 10.

Sense Byte 23

Format 20: The byte contains information for the service representative about the drive logic/hardware conditions.

Format 21: The byte contains a count of read blocks that were corrected by the internal subsystem ERP actions where no hardware indicators were present. The count is a subset of and is included in the count in sense bytes 8 and 9.

Sense Byte 24

Format 20: The byte indicates the channel adapters installed and active on the control unit and the channel type to which the active channel adapter is set on the control unit panel.

Bit	Meaning
0	Channel adapter A installed
1	Channel adapter B installed
2	Channel adapter C installed
3	Channel adapter D installed
4–7	Channel type
	0001 = Interlock 1.5-megabyte per second, (non-data-streaming)
	0101 = 2-megabyte per second data-streaming
	0110 = 3-megabyte per second data-streaming

Format 21: The byte contains a count of the times a block is erased and written again during the internal subsystem ERP actions for the addressed tape drive.

Sense Byte 25

Format 20: The byte indicates the features installed on the control unit. If a bit is on, the feature it represents is installed.

Bit	Meaning
0	Dual Control Unit Communications Coupler feature
1–6	Not used
7	Automatic Cartridge Loader feature

Format 21: The byte contains a count of drive errors recovered by internal subsystem ERP actions.

Sense Byte 26

Format 20: The byte represents the design level of the microprogram used on the subsystem.

Bit	Meaning
0-4	Composite level
5-7	EC Level

Format 21: The byte forms the four low-order positions of the read and write block counters. The four high-order positions of this byte are the four low-order positions of the read block counter, sense byte 18. The four low-order positions of this byte are the four low-order positions of the write block counter, sense byte 19. Each count in the two counters in this byte represents 16 blocks. Each count is rounded to the nearest 16-block value.

Sense Byte 27

Formats 20 and 21: The byte is set by switches under the cover of the control unit that are changed only by the service representative or at the factory.

Bit	Meaning
0-1	Control unit hardware EC level
2	Control unit hardware supports drive Model: 0 = B11 1 = B22
3	Control unit hardware EC level
4-7	High-order digit of the control unit serial number, 0-9

Sense Bytes 28 and 29

Formats 20 and 21: These bytes contain the four low-order digits of the control unit serial number and are changed only by the service representative or at the factory.

Sense Byte 30

Format 20:

Bit	Meaning
0–3	Logical drive address
4–7	Physical drive address

Format 21: The byte contains a count of the times the control unit tried consecutive read recovery actions for the same block.

Sense Byte 31

Format 20: The byte contains a count of the 4,096-byte blocks of data in the buffer. The count is specified as the number of 4K-byte blocks. The count is rounded up to the next 4K-byte increment for blocks of less than 4K bytes. For example, a 3,456-byte block of data is given as a count of '01', and a 5,678-byte block of data is given as a count of '02'.

Format 21:

Bit	Meaning
0–3	Logical drive address
4–7	Physical drive address

Chapter 4. Problem Determination and Error Recovery

The 3480 subsystem depends on controlling computer facilities for the correct handling of error conditions that cannot be resolved within the subsystem and for the recording of error data reported by the subsystem.

The 3480 has sense data format and error recovery procedures (ERPs) for errors that occur during tape processing.

When errors occur in the subsystem, the subsystem's error recovery procedures are used first in an attempt to recover. If the subsystem recovers successfully, the error is counted in the buffered log. If the subsystem cannot recover from an error by using its ERP, it uses the unit check status bit and sense byte 3 to inform the controlling computer that an error occurred and the action that should be taken. The code in sense byte 3 can indicate specific retry or recovery actions that the controlling computer should perform, or the code can indicate that the error should be logged for historical purposes only.

Operating system console messages that indicate permanent subsystem hardware failures and that contain information such as status and sense are flagged to alert the operator. The operator should report this information to the service representative for use in fault isolation. Messages requiring operator intervention remain active until appropriate action is taken by the operator. For more information on errors that require operator intervention, see "What to Do if You Have a Problem," Chapter 5 of *IBM 3480 Magnetic Tape Subsystem Operator's Guide*.

Error Recovery Procedures (ERP)

The subsystem has error recovery procedures (ERPs) for errors that occur during write and read operations.

Write Operations

If a write-type operation cannot be completed because of an error, the subsystem ERPs attempt to correct the error by retrying the operation to the drive or by writing erase gaps and then retrying the operation to the drive.

Buffered Write Operations

If the subsystem ERPs cannot recover from an error, the unit check status bit (status bit 6) is sent to the controlling computer. The unit check status bit can be sent during the current channel command or during a later I/O operation that is sent to the drive that had the error. If the unit check status bit is sent during the current channel command, the error may have occurred earlier in the channel program chain or for a record in a previous chain because of buffering. For a more detailed description of deferred unit check, see “Bit 6, Unit Check” on page 70.

When the controlling computer receives the unit check status bit, it issues a Sense command to the tape drive that sent the unit check status bit and starts its own error recovery procedures. Sense byte 3 indicates the precise action that the controlling computer should take. See “Error Recovery Procedure Codes” on page 89 for a description of the error recovery procedure actions.

Tape-Write-Immediate Operations

Error recovery in tape-write-immediate is similar to error recovery in buffered write except that the unit check status is presented in the same status as the device end for the Write command that encountered the error. The subsystem is able to retry failing commands as needed using the Channel Command Retry, and the controlling computer does not have to reissue the command. See “Write (01)” on page 58 for a description of the types of operations available for writing data.

Read Operations

Buffered Read Operations

To recover from errors or failures, the subsystem attempts to retry the read-type or space-type command. In a dual-control-unit subsystem, some failures are retried through all control unit and path combinations. If the attempts to retry the command are unsuccessful, the subsystem then attempts to perform the command by moving the tape in the opposite direction. For example, if the subsystem is trying to recover from an error or failure that occurred during a read operation and the attempts to retry the command were unsuccessful, the subsystem will move the tape in a backward direction. If the subsystem recovery from tape is successful, the data is read from tape into the buffer in a backward direction, that is, from the last byte to the first byte in the data block. Therefore, the subsystem directs the controlling computer to issue a Read Backward command to get the data from the buffer in the correct sequence. The controlling computer reads and stores the block of data from the first byte to the last byte. If the subsystem error recovery during a read-type operation is not successful, a permanent read error signal is sent to the controlling computer.

Error Recovery Procedure Codes

Sense byte 3 identifies the error recovery procedure action (ERPA) code. The following figure describes the code, the error, and the action taken by the controlling computer to recover from the error.

ERPA Code	Description of Error	Host Recovery Action
00	Non-Error Sense: The ERPA code 00 is sent in response to a Sense command when no contingent allegiance occurred after a unit check.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message NON-ERROR SENSE. 3. Enter a permanent OBR record.
01-20	Reserved	Not used
21	<p>Data Streaming Not Operational: After repeated attempts to transfer data to or from the controlling computer in streaming mode, as set on the control unit operator panel, the control unit has switched the data transfer mode to interlock. Interlock mode is used until the control unit detects a system reset or until the current volume is demounted.</p> <p>Prior to Release 24 of the microprogram, the 3480 subsystem does not support this ERPA.</p>	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DATA STREAMING ERROR. 3. Enter a permanent record in the OBR. 4. Resume processing.
22	<p>Path Equipment Check: The following errors cause this error code:</p> <ul style="list-style-type: none"> • Drive adapter error occurred. • Could not recover from a buffer error on the lower interface. • Could not use internal path (sense byte 2 identifies the path in error). • Could not recover from an error detected during a cartridge index/load cycle on the Automatic Cartridge Loader. The cartridge is manually retrievable by the operator. 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message EQUIPMENT CHECK. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).

Figure 5 (Part 1 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
23	<p>Read Data Check: A permanent read error has occurred, or a temporary read error occurred with one of the following conditions:</p> <ul style="list-style-type: none"> • The controlling computer had inhibited control-unit error recovery with Mode Set bit 7. • Tape synchronous mode was in effect. <p>Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.</p> <p>When a permanent error is indicated for ERPA 23, the data read from the tape and sent to the controlling computer may not be correct.</p>	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DATA CHECK. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR) (see note in DDR description).
24	<p>Load Display Check: A Load Display command is received by a drive while a cartridge is being loaded.</p>	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message LOAD DISPLAY CHECK. 3. No OBR record is entered. 4. No DDR.

Figure 5 (Part 2 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
25	<p>Write Data Check:</p> <ul style="list-style-type: none"> • Buffered data could not be written on the tape successfully. ERP has tried erase gaps and rewrites but was unable to complete the write operation successfully. • A permanent error occurred when trying to write data, an IBG, or a tape mark on the tape. All attempts to retry the operation have been completed, but unsuccessfully. • A temporary write error occurred with one of the following conditions: <ul style="list-style-type: none"> – The controlling computer had inhibited control-unit error recovery by Mode Set bit 7. – Tape synchronous mode was in effect. <p>Prior to Release 24 of the microprogram, the 3480 subsystem does not support tape synchronous mode.</p> 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DATA CHECK. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).

Figure 5 (Part 3 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
26	<p>Data Check (Read Opposite): A read recovery is in progress, and a Read command (in the opposite direction) must be issued to the subsystem before the data can be recovered.</p> <p>If the command at CCW address pointer -8 is hexadecimal 02 (Read), issue a hexadecimal 0C (Read Backward) chained to a hexadecimal 37 (Forward Space Block).</p> <p>If the command at CCW address pointer -8 is hexadecimal 0C (Read Backward), issue a hexadecimal 02 (Read) chained to a hexadecimal 27 (Backspace Block).</p> <p><i>Note: If the controlling computer cannot issue a command to the subsystem to read the block in the opposite direction, a permanent OBR record is entered. If the subsystem cannot complete the command to read the record in the opposite direction, a unit check is issued and the associated sense information contains the ERPA code.</i></p>	<ol style="list-style-type: none"> 1. Move the tape to the correct position, if necessary. 2. Issue a read command in the opposite direction. 3. Resume processing (CCW address pointer +8). 4. Enter permanent OBR record and write a console message, DATA CHECK, if the read opposite recovery fails. See the note in the description.
27	<p>Command Reject: Refer to the description in Chapter 9 for the conditions that can cause Command Reject.</p>	<ul style="list-style-type: none"> • Signal a permanent error. • Write a console message COMMAND REJECT. • No OBR record is entered. • No DDR.
28	<p>Write ID Mark Check: The ID mark could not be written successfully at the BOT. Any data to be written to the drive is still in the buffer.</p>	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message WRITE ID CHECK. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).
29	Reserved	Not used

Figure 5 (Part 4 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
2A	Buffered Log Data Present: A statistical or error counter in the buffered log has overflowed. <i>(p. 20)</i>	<ol style="list-style-type: none"> 1. Enter a miscellaneous data record (MDR) (format 21). 2. Reissue the command. 3. Resume processing.
2B	Buffered Log Data Present: A rewind unload occurred, or a Read Buffered Log command was issued. <i>(p. 20)</i>	<ol style="list-style-type: none"> 1. Enter a miscellaneous data record (MDR) if SIO count $\neq 0$. 2. Resume processing (CCW address register +8).
2C	Permanent Equipment Check: <ul style="list-style-type: none"> • The control unit cannot recover because an error occurred in the subsystem hardware or microprogram. • The control unit recovery action was unsuccessful. 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message EQUIPMENT CHECK. 3. Enter a permanent record in the OBR. 4. No DDR.
2D	Data Security Erase Command Failure: The drive became not-ready after the command was issued, or an error occurred while the command was processing.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DSE FAILURE. 3. Enter a permanent record in the OBR. 4. No DDR.
2E	Not Capable (BOT Error): <ul style="list-style-type: none"> • A density mark could not be read correctly because: <ul style="list-style-type: none"> – A void occurred at the beginning-of-tape. – A timeout occurred before the density separator was detected. – The density mark could not be read. • The block ID read by the control unit is invalid. Bit 0 or bits 8–11 are nonzero. 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message NOT CAPABLE. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).
2F	Reserved	Not used

*Sense byte 1
bit 7
(p. 75)*

Figure 5 (Part 5 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
30	File Protected: A write type operation was attempted on a tape cartridge that is file protected.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message FILE PROTECTED. 3. Operator intervention: verify that the file protection is correct and, if correct, cancel the job. If the file protection is not correct, restart the job. 4. No record is entered in the OBR. 5. No DDR.
31	Tape Void: No patterns or data were found on the tape during a read operation. The tape could be positioned after the last data block or tape mark that was written on the tape.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message TAPE VOID. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).
32	Load Assistance: An error caused the drive to lose tape tension.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message TENSION LOSS. 3. Enter a permanent record in the OBR. 4. No DDR.
33	Load Failure: The cartridge is not inserted correctly or the tape is not threaded correctly.	<ol style="list-style-type: none"> 1. Write a console message INTERVENTION REQUIRED. 2. Write a second console message RELOAD CARTRIDGE. 3. Enter a temporary record in the OBR (first occurrence of the error only). 4. Issue the command again.

Figure 5 (Part 6 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
34	<p>Manual Unload: The drive cannot maintain tape tension and control tape movement during an unload operation.</p>	<ol style="list-style-type: none"> 1. Write a console message INTERVENTION REQUIRED. 2. Write a second message UNLOAD CARTRIDGE. 3. Enter a temporary record in the OBR (first occurrence of the error only). 4. Issue the command again.
35	<p>Drive Equipment Check: One of the following conditions occurred:</p> <ul style="list-style-type: none"> • The control unit cannot recover from a drive detected error. • A check code message is displayed on the drive message display and a Load Display command is issued (drive display is busy). • The Automatic Cartridge Loader does not respond across the interconnection to the tape drive. • The Automatic Cartridge Loader does not respond to an initial microprogram load (IML) correctly. • A failure occurred during an index/load or unload cycle. The tape cartridge is not manually retrievable by the operator. 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message EQUIPMENT CHECK. 3. Enter a permanent record in the OBR. 4. No DDR.
36	<p>Drive Patch Load Failure: The control unit cannot load microprogram patches to the drive.</p>	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message EQUIPMENT CHECK. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).

Figure 5 (Part 7 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
37	Tape Length Error: The tape length in the cartridge is too short. The error could occur when the leader block was replaced (the length of tape ahead of the BOT has been trimmed).	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message TAPE LENGTH CHECK. 3. Enter a permanent record in the OBR. 4. No DDR.
38	Physical End-of-Tape: A read or write operation was processing when the physical end-of-tape pattern was reached. The drive does not pull the tape out of the cartridge.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message PHYSICAL END OF TAPE. 3. No OBR record is entered. 4. No DDR.
39	Backward at BOT: While moving the tape backwards, the beginning-of-tape pattern was reached.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. If the block ID is not zero, enter a permanent record in the OBR. 3. If the block ID is zero, do not enter an OBR record and do not do DDR.
3A	Drive Reset by Operator: The drive Reset switch was operated, and the drive is not ready.	<p>If a command is issued to the drive:</p> <ol style="list-style-type: none"> 1. Write a console message INTERVENTION REQUIRED. 2. Write a second console message MAKE DRIVE X READY. 3. Try the command again.
3B	Volume Removed by Operator: The Rewind Unload switch on the drive has been pressed and the cartridge is unloaded.	<p>If a command is issued to the drive:</p> <ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message UNLOAD ERROR. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).
3C-3F	Reserved	Not used

Figure 5 (Part 8 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
40	Overrun: A data overrun between the channel and the control unit buffer occurred while processing a large block that does not fit in the buffer.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message OVERRUN. 3. Enter a permanent record in the OBR and do dynamic device reconfiguration (DDR). 4. If a 1.5 or 2.0 megabyte-per-second channel is being used, switch to an alternate 3 megabyte-per-second channel if the configuration allows it.
41	Block ID Sequence Error: The control unit detected an incorrect block ID sequence.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message SEQUENCE. 3. Enter a permanent record in the OBR. 4. No DDR.
42	Degraded Mode: A condition that can cause degraded subsystem performance was detected within the subsystem.	<ol style="list-style-type: none"> 1. Write a console message SUBSYSTEM IN DEGRADED MODE. 2. Enter a permanent record in the OBR. 3. Issue the command again.
43	Intervention Required: A Start I/O or Start Subchannel instruction was received by a drive that is not ready.	<ol style="list-style-type: none"> 1. Write a console message INTERVENTION REQUIRED. 2. Write a second console message MAKE DRIVE X READY. 3. Issue the command again.
44	Locate Block Unsuccessful: The control unit is unable to find the block preceding the desired block.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message RECORD NOT FOUND. 3. No OBR record is entered. 4. No DDR.

Figure 5 (Part 9 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
45	Drive Assigned Elsewhere: The drive is not assigned to the channel path on which the command was issued. It is assigned to a different channel path.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DRIVE ASSIGNED ELSEWHERE. 3. No OBR record is entered. 4. No DDR.
46	Drive Not Online: A command was issued to a drive that is not online. <ul style="list-style-type: none"> • The drive may be switched offline. • The drive power may be switched off. • The drive address may not be set correctly. 	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message DRIVE OFFLINE. 3. No OBR record is entered. 4. No DDR.
47	Control Unit Error: The control unit developed an error that caused it to initialize itself again and continue.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message CU. CHECK ONE ERROR. 3. Enter a permanent record in the OBR. 4. No DDR.
48	Log Sense Data and Retry Request	<ol style="list-style-type: none"> 1. Enter a temporary record in the OBR. 2. Issue the command again.
49	Bus Out Parity: The bus out parity error was detected on the command or parameter transfer.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message BUS OUT PARITY. 3. Enter a permanent record in the OBR. 4. Do dynamic device reconfiguration (DDR).
4A	Control Unit ERP Failed: The control unit was unsuccessful in an attempt to recover from a data handling failure.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message CONTROL UNIT ERP FAILED. 3. Enter a permanent record in the OBR. 4. No DDR.

Figure 5 (Part 10 of 11). Error Recovery Codes

ERPA Code	Description of Error	Host Recovery Action
4B	Control Unit and Drive Incompatible: The drive requested microprogram patches, but none is available.	<ol style="list-style-type: none"> 1. Write a console message NO PATCHES AVAILABLE. 2. Enter a permanent record in the OBR. 3. Do dynamic device reconfiguration (DDR).
4C	Recovered Check-One Failure: The control unit developed a hardware error but was able to recover.	<ol style="list-style-type: none"> 1. Signal a permanent error. 2. Write a console message CU. CHECK ONE ERROR. 3. Enter a permanent record in the OBR. 4. Resume processing.

Figure 5 (Part 11 of 11). Error Recovery Codes

Dynamic Device Reconfiguration (DDR)

Dynamic device reconfiguration allows the operator to move a tape cartridge from a failing tape drive to another tape drive without restarting the job. If DDR is not available, a permanent error indication is sent to the access method or user program.

If available in your controlling computer control program, DDR should be used to move the cartridge to a different tape drive. DDR action presumes the tape drive that indicated the error is suspect. To correctly save the data that may be in the control unit buffer, DDR must:

1. Save the CSW that indicated the original unit check status bit for use in Step 6. The CSW shows where to resume the user's channel program.
2. Issue a succession of Read Buffer commands to recover write data from the buffer to the controlling computer main storage if the user's program was writing data when the error occurred.
3. Issue a Read Block ID command to identify the current tape position. If the error occurred while the tape was moving forward, the tape is positioned immediately ahead of the failing block. If the error occurred while the tape was moving backward, the tape is positioned immediately ahead of the failing block.
4. Issue a Locate Block command to position the tape correctly after the operator has moved the tape to a different tape drive.
5. Use the tape-write-immediate operation to write the data that was read in Step 2 on the tape cartridge that has been inserted in a different tape drive.
6. Continue with the user's channel program. If the program was being performed in buffered write, the user can continue with that type of operation. The address field of the CSW that was saved in Step 1 points to the place where the user's program can be resumed (plus eight). Data chaining may have to be taken into account when determining the actual location to restart the user's I/O command chain.

Permanent Error

The controlling computer builds an outboard record (OBR) for logging and sends an appropriate operator message to the console.

Operator Intervention

The operator must perform some manual action, such as moving a tape, to resume processing on the subsystem.

Resume Processing

The channel program resumes processing at the point of interruption after the system control program has performed any required action. No error signal is sent to the user, or the channel program resumes processing at the command following the command that was in error. In this instance, the channel status word (CSW) address field contains the address of the next command if command chaining was specified in the command in error and data chaining was not specified.

Note: The controlling computer program analyzes the CCWs when the program is to resume processing at a command beyond the failing CCW. Data-chained CCWs must be taken into consideration when determining the actual location for the program to resume processing.

When a read recovery is in progress and a read-opposite command must be issued to the subsystem before the data can be recovered, the command at CCW address pointer minus 8 shows the direction of the original command.

If the command is hexadecimal 02, issue a Read Backward (0C) command-chained to a Forward Space Block command.

If the command is hexadecimal 0C, issue a Read Forward (02) command-chained to a Backspace Block command.

If the read-opposite recovery is not successful, the tape stays at the position pointed to by the CCW address when the original error occurred—not the CCW address minus 8.

Error Handling

The more extensive error checking in the 3480 subsystem permits better detection of and recovery from various types of errors. The value of sense byte 2 bit 7 should be saved until the controlling computer finishes its error recovery procedure actions.

Errors can occur in either read or write operations and either before or after data blocks are read and written. During error recovery, the controlling computer must be able to identify the exact physical position of the tape relative to the read/write head. The Block ID Positioning Indicator is saved immediately after a unit check. The controlling computer determines whether the value in the block ID argument of the Locate Block command should be altered before performing a Backspace Block, Locate Block ID, or other command in response to recoverable errors that usually lead to DDR. The block ID is given in the sense data or in the result of a Read Block ID command. The operation that was being tried affects the interpretation of the value of sense byte 2 bit 7.

Generally, when sense byte 2 bit 7 is set to 0, the block ID in the sense data (or obtained in response to a Read Block ID command) can be used to move the tape into position by performing a Locate Block command. When sense byte 2 bit 7 is set to 1, the block ID is offset by plus or minus 1.

The offset of the block ID aids the controlling computer error recovery procedures; that is, the controlling computer uses the dynamic device reconfiguration (DDR) action to move the tape cartridge to another drive. The controlling computer issues a Locate Block ID command to the tape drive after the cartridge has been moved. The Block ID Positioning Indicator (sense byte 2 bit 7) permits the controlling computer to adjust the argument in the Locate Block ID command. Therefore, the user's channel command does not have to be changed, nor must the controlling computer issue any channel commands (Forward Space Block, Backspace File, and so forth) to move the tape into position before resuming the user's channel program.

Buffered Read Forward Operations

When an error occurs during a read forward operation (sense byte 2 bit 7 is 0), the block ID in sense bytes 4 through 6 (or the block ID in sense bytes 0 through 3 obtained by performing a Read Block ID command) identifies the data block or file mark that the controlling computer was trying to read. The block ID, when used as an argument in a Locate Block ID command issued after the cartridge is moved, causes the tape to be positioned correctly for again issuing the channel command that could not be performed. When sense byte 2 bit 7 is 1, the block ID identified is one higher than the data block or file mark that the controlling computer was trying to read. Therefore, the value of 1 should be subtracted from the block ID in sense bytes 4 through 6 or sense bytes 0 through 3. The value remaining after subtracting 1 from the block ID is the value that should be used as the argument in a Locate Block ID command issued after the cartridge is moved.

Buffered Read Backward Operations

When the error occurred during a read backward operation (sense byte 2 bit 7 is 0), the block ID in sense bytes 4 through 6 or sense bytes 0 through 3 identifies the data block or file mark that the controlling computer was going to read backward next. The block ID is used as the argument in a Locate Block ID command issued after the cartridge is moved to move the tape to the correct position for issuing the Read Backward channel command again.

Buffered Write Operations

During buffered write operations, sense byte 2 bit 7 is not set. The block ID identifies the area on tape where the data block or file mark should have been written. When the control unit determines that the data cannot be written on the tape, the controlling computer performs a Read Buffer command to retrieve the buffered data. After the cartridge is moved as a dynamic device reconfiguration (DDR) action, the controlling computer issues a Read Block ID command using the block ID as the argument to move the tape to the correct position to perform the reissued write channel command.

Tape-Write-Immediate Mode Operations

When sense byte 2 bit 7 is 0, the block ID identifies the area of tape where the data block or file mark should have been written. When sense byte 2 bit 7 is 1, part of the data was written on the tape, and the tape moved to a position beyond the beginning of the block ID. The value remaining after subtracting 1 from the block ID is the value that should be used as the argument in a Locate Block ID command issued after the cartridge is moved. Therefore, a 1 should be subtracted from the block ID and the remaining value used as the argument in a Locate Block ID command issued after the cartridge has been moved to move the tape to the correct position.

Glossary

This glossary defines the special terms, abbreviations, and acronyms that are used in this publication. It does not include all terms previously established for the IBM System/370 or its operating systems; therefore, if you do not find the term you are looking for, refer to the index or to the *Vocabulary for Data Processing, Telecommunications, and Office Systems*, GC20-1699.

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access method. A technique for moving data between processor storage and input/output devices.

archiving application. The retention of records, in machine-readable form, for historical purposes.

argument. (1) * (ISO) The value of an independent variable.

backup-and-recovery application. The short-term retention of records to be used for

restoring essential business and system files when vital data has been lost because of program or system errors or malfunctions.

automatic cartridge loader. A feature for the 3480 tape drive. This feature attaches to the front of the drive and allows both the automatic loading of premounted tape cartridges, and the manual loading of single tape cartridges.

beginning-of-tape. * (ISO) The location on a magnetic tape that indicates the beginning of the permissible recording area.

block. * A collection of contiguous records recorded as a unit. Blocks are separated by interblock gaps (IBG) and each block may contain one or more records.

BOT. Beginning of tape.

buffer. * A routine or storage used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another.

capacity. See media capacity.

CCR. Channel command retry.

CCW. Channel command word

channel. See data channel

channel command. An instruction that directs a data channel, control unit, or device to perform an operation or set of operations.

channel command word. A doubleword at the location in main storage specified by the channel address word. One or more CCWs make up the channel program that directs data channel operations.

channel path. A communication path along which signals can be sent between a controlling computer and I/O devices.

channel path group. A group of identified channel paths over which the controlling computer and an I/O device can communicate.

channel status word (CSW). An area in storage that provides information about the termination of input/output operations.

command. See channel command.

contingent allegiance. A condition in which a device owes a response to a specific channel path because of a unit check.

conversion. The process of changing from one method of data processing to another or from one data processing system to another.

CSW. Channel status word.

data. * Any representations such as characters or analog quantities to which meaning is, or might be, assigned.

data base. (TC97) A set of data that is sufficient for a given purpose or for a given data processing system.

data channel. A device that connects a processor and main storage with I/O control units.

data control block. A control block used by access method routines in storing and retrieving data.

data set. The major unit of data storage and retrieval, consisting of a collection of data in one of several prescribed arrangements and described by control information to which the system has access.

DDR. Dynamic device reconfiguration.

deferred unit check. A condition in which a device returns a unit check indication for the controlling computer, which pertains to an event that occurred asynchronously with the channel commands. The deferred unit check may not refer to the command that receives the indication.

disband group. To remove the grouping of a channel path group.

drive loaded. A condition of a tape drive in which a tape reel or cartridge has been inserted in the drive and the tape has been threaded to the beginning-of-tape position.

dump. (ISO) To write the contents of storage, or of a part of storage, usually from an internal storage to an external medium, for a specific purpose such as

to allow other use of storage, as a safeguard against faults or errors, or in connection with debugging.

dynamic device reconfiguration. A facility that allows a demountable volume to be moved, and repositioned if necessary, without abnormally terminating the job or repeating the initial program load procedure.

effective recording density. The number of user bytes per unit of length of the recording medium.

ERP. See error recovery procedures.

ERPA. See error recovery procedure action.

error recovery procedure action. Actions taken to recover from errors that occur during channel program processing.

error recovery procedures (ERP). Procedures designed to help isolate and, where possible, to recover from errors in equipment. The procedures are often used in conjunction with programs that record the statistics of machine malfunctions.

extended contingent allegiance. A condition caused by a permanent buffered-write error in which the drive responds only to the channel path group from which the write command was received. The extended contingent allegiance continues until a controlling computer in the channel path group retrieves the unwritten data from the buffer or issues a tape motion command.

field replaceable unit. An assembly that is replaced in its entirety when any one of its components fails. In some cases a field replaceable unit may contain other field replaceable units; for example, a brush and a brush block that can be replaced individually or as a single unit.

file. * (ISO) A set of related records, treated as a unit, for example, in stock control, a file could consist of a set of invoices.

format. * (ISO) The arrangement or layout of data on a data medium.

FRU. See field replaceable unit.

interchange application. The preparation of tapes for use on other systems or devices, either local or remote, or the use of tape data prepared by another system.

JCL (job control language). * A problem-oriented language designed to express statements in a job that are used to identify the job or describe its requirements to an operating system.

journalizing. Recording transactions against a data set so that the data set can be reconstructed by applying transactions in the journal against a previous version of the data set.

loader. See automatic cartridge loader

load point. The beginning of the recording area on magnetic tape.

logical end-of-tape. A point on the tape where written data normally ends.

magnetic recording. * (ISO) A technique of storing data by selectively magnetizing portions of a magnetizable material.

magnetic tape. (TC97) A tape with a magnetizable surface layer on which data can be stored by magnetic recording.

magnetic tape drive. (ISO) A mechanism for moving magnetic tape and controlling its movement.

media capacity. The amount of data that can be contained on a storage medium, such as tape, expressed in bytes of data.

migration. See conversion.

OBR. Outboard recorder.

outboard recorder. A feature that records pertinent data on the system recorder file when an unrecoverable I/O error occurs.

physical end-of-tape. A point on the tape beyond which the tape is not permitted to move.

primed. Pertaining to a condition of a tape drive when the controlling computer has addressed the drive but the drive was not in a ready state.

processing application. The completion of a systematic sequence of operations performed on data to accomplish a specific purpose.

record. * (ISO) A collection of related data or words, treated as a unit; for example, in stock control, each invoice could constitute one record.

synchronization. The process of coordinating the activities of the controlling computer and the 3480 subsystem to obtain the condition in which the buffer is empty and the tape is in the correct position for the next operation.

tape cartridge. A container holding magnetic tape that can be processed without separating it from the container.

volume. (1)(ISO) A certain portion of data, together with its data carrier, that can be handled conveniently as a unit. (2)(ISO) A data carrier that is mounted and demounted as a unit, for example, a reel of magnetic tape, a disk pack.

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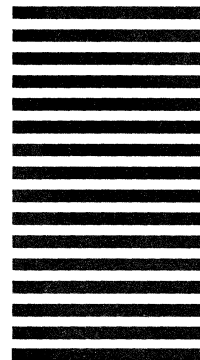
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