



**CDC® INTELLIGENT SMALL MAGNETIC
TAPE (ISMT) SUBSYSTEM**

7221-1 MAGNETIC TAPE ADAPTER

639-1 MAGNETIC TAPE TRANSPORT

**GENERAL DESCRIPTION
OPERATION
PROGRAMMING**

SUBSYSTEM REFERENCE MANUAL

REVISION RECORD

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PREFACE

This manual contains general information and external programming information for the CDC® 7221-1 Intelligent Small Magnetic Tape (ISMT) Subsystem. This manual is written for computer operators, customer engineers, and system programmers who generate or maintain peripheral processor-resident programs that drive the subsystem. Additional information on the ISMT subsystem is contained in the following manuals.

<u>Control Data Publication</u>	<u>Publication Number</u>
FA165-A Intelligent Small Magnetic Tape Adapter Hardware Maintenance Manual	60461100 (CDC)
92185 Streaming Tape Unit Hardware Reference/Maintenance Manual Volume 1	49762900 (CPI)
92185 Streaming Tape Unit Hardware Reference/Maintenance Manual Volume 2	49763000 (CPI)

CDC manuals can be ordered from Control Data Corporation, Literature and Distribution Services, 308 North Dale Street, St. Paul, Minnesota 55103 and CPI manuals from Computer Peripherals, Inc., Valley Forge Publications, 2621 Van Buren Avenue, Valley Forge Industrial Park, Norristown, Pennsylvania 19401.

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GENERAL DESCRIPTION

1

INTRODUCTION

The ISMT subsystem consists of a 7221-1 Magnetic Tape Adapter and a 639-1 Magnetic Tape Transport. The magnetic tape transport is commonly called a streaming tape unit (STU).

MB465-D Controlware converts functions from the peripheral processor (PP) into commands necessary to control the subsystem.

HARDWARE CONFIGURATION

A block diagram of the adapter is shown in figure 1-1. The adapter provides control for the STU and also contains the hardware necessary to connect CDC CYBER 180 Computer System models 810 and 830 to an industry-standard tape channel. The adapter mounts in the mainframe logic chassis.

The integrated controller interface (ICI) connects to a PP through an ICI channel.

The main processor decodes functions from the PP and issues instructions that allow the functions to be performed.

The data path processor assembles and disassembles data transmitted between the PP and STU and performs code conversion.

The industry-standard interface contains the receivers, transmitters, and control logic to drive the tape channel.

The main processor memory consists of 16K of 24-bit words in random-access memory (RAM) and 4K of 24-bit words in read-only memory (ROM). Controlware is loaded into the RAM from the PP or tape unit (device). Firmware consisting of the autoloader from PP and autoloader from tape functions and diagnostic tests is permanently coded in the ROM. The data path processor contains an additional 1K of 48-bit words in RAM.

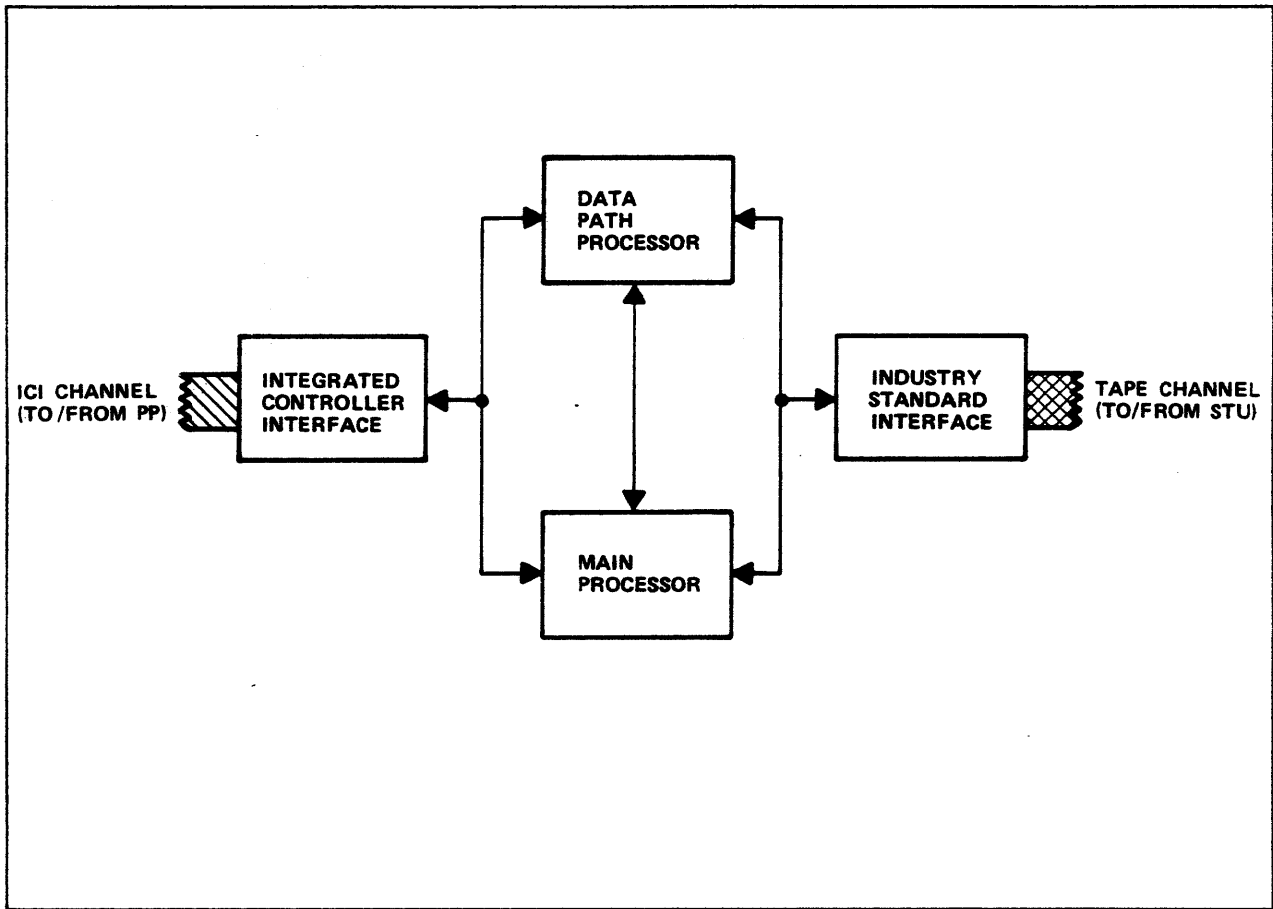


Figure 1-1. ISMT Adapter Block Diagram

SUBSYSTEM CONFIGURATION

Figure 1-2 shows the minimum ISMT subsystem configuration. A maximum configuration consists of two adapters and two STUs. Each adapter connects to its own ICI channel and STU.

FUNCTIONAL DESCRIPTION

The subsystem is driven by a PP. All communication between the PP and subsystem is initiated by 12-bit functions from the PP. Since the PP channel is 16 bits wide, the upper 4 bits must be zeros. The functions have a PP timeout limit of approximately 4 seconds to avoid hanging the channel in a full condition due to hardware logic failures. The adapter replies only to the function codes described in section 3. Some of the functions require supporting parameters or data consisting of one or more PP words. The PP activates the channel prior to input or output of parameters or data and disconnects the channel after all outputs of parameters or data. The adapter inactivates the channel after all PP inputs of parameters or data. The controlware terminates data transfer to or from the PP on data errors in which all words were not transferred. The adapter inactivates the channel with a deadman timeout within 16 seconds for any other error condition on a connected and active channel.

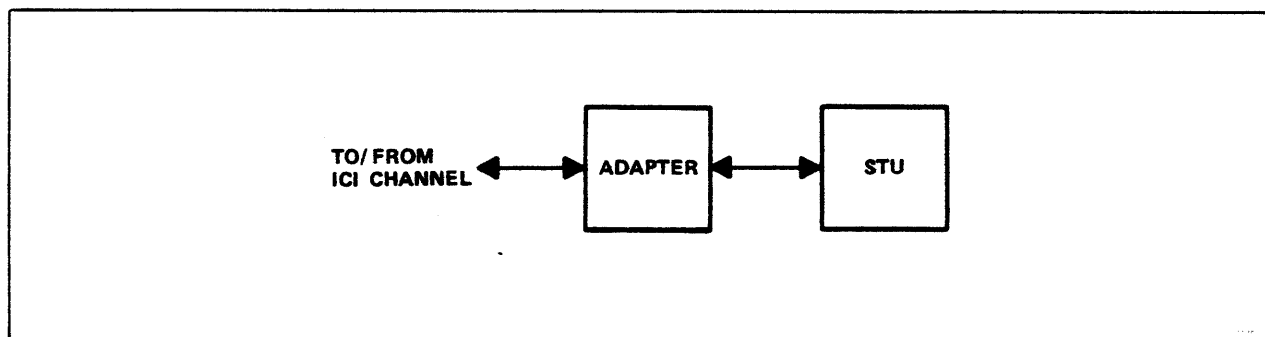


Figure 1-2. ISMT Subsystem Configuration

STREAMING TAPE UNIT RECORDING CAPABILITIES

- 9-track, 1/2-inch tape.
- Phase encoded (PE) and group coded recording (GCR) recording methods.
- 1600 character-per-inch (cpi) recording density for PE and 6250 cpi for GCR.
- 25-inch-per-second (ips) tape speed for start/stop mode in PE or GCR and 25 ips or 75 ips for streaming mode in PE or GCR.

NOTE

The tape unit automatically selects the most efficient tape speed and mode.

- 40-kilobyte/s transfer rate for 25-ips PE, 120-kilobyte/s for 75-ips PE, 156-kilobyte/s for 25-ips GCR, and 469-kilobyte/s for 75-ips GCR.

OPERATOR SWITCHES AND INDICATORS

The operator switches and indicators for the STU are shown in figure 2-1 and described in table 2-1.

OPERATING PROCEDURES

Although operator intervention is infrequent and determined by site configuration, the following paragraphs provide general guidelines for typical operator tasks.

POWER CONTROL

Power feeding of the subsystem is controlled from a single power control box. At installation time, a customer engineer performs the cable routing and switch setting required for power sequencing. Thereafter, the operator normally controls power from the power control box.

CONTROLWARE AUTOLOADING

The operator must autoloading the controlware for the subsystem into the adapter RAM before the complete function set described in section 3 can execute. Function 04XX (autoloading controlware from PP) and function 06UU (autoloading controlware from device) reside permanently in the adapter processor ROM to enable autoloading. The exact autoloading procedure depends upon site operating procedures, operating system, computer system configuration, and whether or not the computer system is running. Refer to the appropriate operating system installation handbook for Control Data recommended procedures.

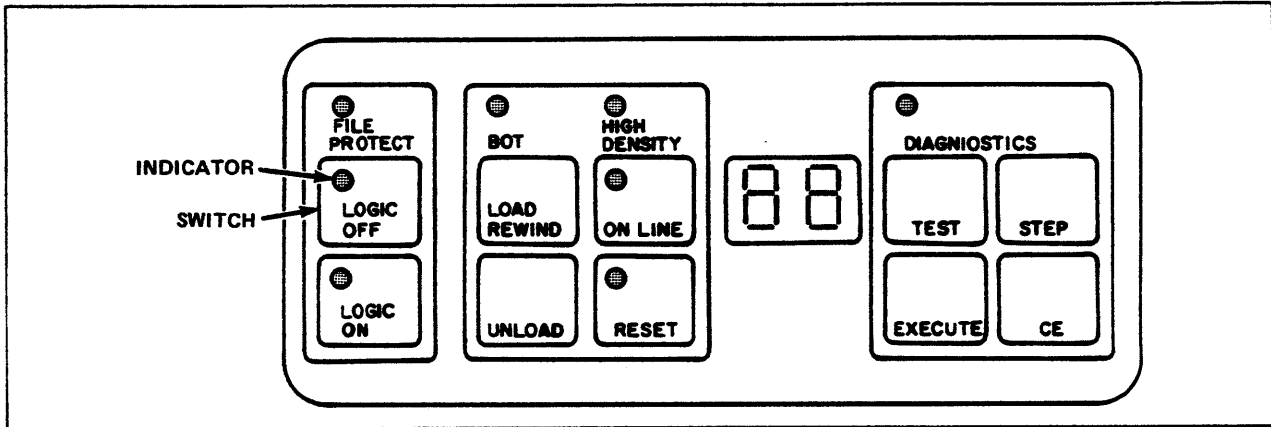


Figure 2-1. STU Operator Control Panel

Table 2-1. Operator Switch and Indicator Functions (Sheet 1 of 2)

Name	Function
FILE PROTECT indicator	Indicates absence of write enable in supply reel to inhibit write operation in STU.
LOGIC OFF switch	Removes dc power from STU.
LOGIC OFF indicator	Indicates STU is in a standby power condition.
LOGIC ON switch	Applies dc power to STU if circuit breaker is on.
LOGIC ON indicator	Indicates dc power is applied to STU.
BOT indicator	Indicates tape is positioned at beginning-of-tape marker.
LOAD/REWIND switch	Loads tape if not already loaded. If tape is loaded, it rewinds tape to beginning-of-tape marker. If STU is configured in local density select mode and tape is at beginning-of-tape marker, repeated depressions of switch alternately change density mode between PE and GCR.
UNLOAD switch	Unloads tape at normal speed from take-up reel onto supply reel if tape is loaded. Unloads tape at slow speed from take-up reel onto supply reel if tape is threaded but not loaded.
HIGH DENSITY indicator	Indicates STU is in GCR mode.

Table 2-1. Operator Switch and Indicator Functions (Sheet 2 of 2)

Name	Function
ON LINE switch	Places STU on line and under subsystem control if tape is loaded.
ON LINE indicator	Indicates STU is on line.
RESET switch	Places STU off line, stops tape motion, and clears error status. A power on/power off sequence may be required to clear certain control faults.
RESET indicator	Indicates an STU error condition or a diagnostic test completion.
Two-digit display	<p>Lights when STU is off line and in diagnostics test mode, and displays diagnostic test sequence numbers and STU microdiagnostic or exerciser routine results.</p> <p>It also displays either a diagnostic fault code or an on-line operational failure code when RESET indicator is on.</p>
DIAGNOSTICS indicator	Indicates STU is in diagnostics test mode.
DIAGNOSTICS TEST switch	Places STU in diagnostics test mode if STU is off line.
DIAGNOSTICS STEP switch	Enters diagnostic test sequence numbers if STU is in diagnostics test mode.
DIAGNOSTICS EXECUTE switch	Executes microdiagnostic shown in two-digit display if STU is in diagnostics test mode.
DIAGNOSTICS CE switch	Executes special microdiagnostics to aid customer engineer if STU is in diagnostics test mode.

ADAPTER TAPE FIRMWARE AND CONTROLWARE INITIALIZATION

A power on, deadstart master clear, or autoloading (function 04XX or 06UU) operation enables the adapter to execute ROM diagnostics. These diagnostics are described in the autoloading adapter controlware from PP function description.

If the diagnostics execute without error and an autoloading adapter controlware from PP function is not present, a release is issued to all STUs connected to the adapter. The ROM firmware then jumps to an idle loop to wait for functions from the PP.

Controlware must be autoloading into adapter RAM with function 04XX or 06UU before most of the other PP functions can be executed. The ROM firmware executes autoloading functions 04XX and 06UU, autodump adapter memory function 05XY, and special software debugging status function 07XX. The ROM firmware also transfers existing status for functions 0012, 0112, 0212, and 0312 but will not update the status.

FUNCTION CODES

The function codes recognized by the adapter are listed in table 3-1. Each function code contains 12 bits. The upper 3 bits of the code contains the equipment number. Since the adapter is the only equipment on the channel, the upper 3 bits are zeros for all function codes. Since data transfers on the channel are 16 bits in length, the upper 4 bits must be zeros when sending functions to the adapter.

Unrecognized function codes set the alert bit in status word 1 and produce an error code of 50 in status word 3.

Bits are numbered from right to left for function codes, status codes, and other codes used in this manual. Bit 0 is in bit position 2⁰ and bit 11 is in bit position 2¹¹.

0000 - CLEAR TAPE UNIT

This function allows the PP to clear temporary error conditions in the tape unit. Tape unit modes such as ready, write, and forward are not affected by this function.

A clear pulse is sent to the connected tape unit, and an inactive signal is returned to the PP. During this time, the tape unit remains connected. If a tape unit is not connected, the function results in a no operation.

Table 3-1. ISMT Subsystem Function Codes

Function Code (Octal)	Function Name	PP Words Output	PP Words Input
0000	Clear tape unit	-	-
0001	Release connected unit	-	-
0004	Format unit	3	-
0006	Normal read clip	-	-
0106	High read clip	-	-
0010	Rewind	-	-
0110	Rewind unload	-	-
0011	Stop motion	-	-
0012	General status (words 1 through 16)	-	1 to 16
0112	Detailed status (words 3 through 16)	-	1 to 14
0212	Unit status (words 11 through 16)	-	1 to 6
0312	Packed STU sense byte status	-	20
0013	Forespace	-	-
0113	Backspace	-	-
0114	Controlled backspace	variable	-
0015	Search tapemark forward	-	-
0115	Search tapemark backward	-	-
0016	Units ready/units reset	-	-
0116	Cumulative status	-	8
0216	Comprehensive STU sense status	-	18
002U	Connect to unit OU	-	-
012U	Warmstart read unit U	-	variable
013U	Warmstart read unit U (16-bit chan mode)	-	variable
0040	Read forward	-	variable
0140	Read backward	-	variable
0047	Copy code translation read RAM	-	171
0247	Copy code translation write RAM	-	171
0050	Write	variable	-
0250	Short write	variable	-
0051	Write tapemark	-	-
0052	Erase	-	-
0252	Data security erase	-	-
0057	Load code translation read RAM	171	-
0257	Load code translation write RAM	171	-
0063	Run remote STU diagnostics	2	-
0064	ISMT diagnostic memory read	-	322
0065	ISMT diagnostic memory write	322	-
0066	ISMT diagnostic data path read	-	322
0067	ISMT diagnostic data path write	322	-
0070	Run ISMT adapter diagnostics	-	-
0175	Loop write-to-read to tape unit	variable	-
04XX	Autoload adapter controlware from PP	variable	-
05XY	Autodump adapter memory	-	variable
06UU	Autoload adapter controlware from tape	-	-
07XX	Special software debugging status	16	-

0001 - RELEASE CONNECTED UNIT

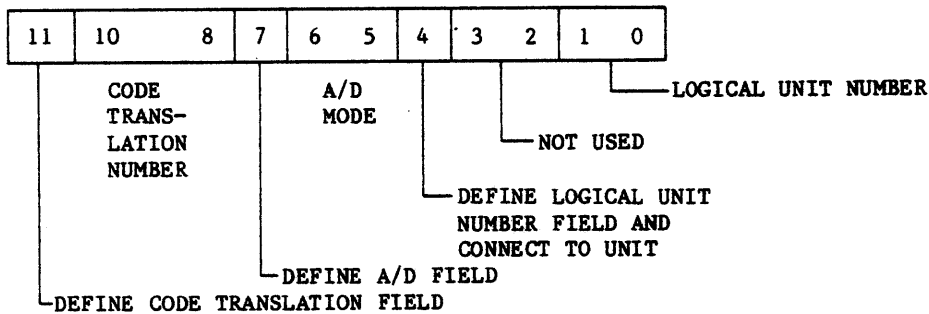
This function releases the currently connected tape unit to allow it to be available for connection to another controller. If a tape unit is not connected, the function results in a no operation.

0004 - FORMAT UNIT

This function connects the adapter to a tape unit and specifies the recording mode for the tape unit. It may also be used to modify one or more recording mode parameters without requiring all fields to be defined.

After replying to the function, the adapter waits up to 210 ms for the PP to activate the channel and send the first parameter word. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. Parameters in that word are processed before an empty signal is returned. If a connect is requested and cannot be completed, the channel is deactivated without accepting parameter word 2 or 3. If the connect field is defined, the specified tape unit is connected. Each of the other defined fields is stored, replacing the previous value. Undefined fields result in the previously defined values being retained. Parameter word 1 must always be sent. Parameter words 2 and 3 do not have to be sent if their fields are unchanged. If parameter word 3 is sent, it must be preceded by words 1 and 2. The PP must deactivate the channel after transmitting the last word.

Parameter word 1 format:



Bit 11 indicates that bits 8 through 10 contain the code translation number.

Bits 8 through 10 are coded as follows:

Bit	<u>10</u>	<u>9</u>	<u>8</u>	
	0	0	0	No translation.
	0	0	1	} Translate with code table 1 through 4 (table must be loaded with desired code set before correct translation will occur).
	0	1	0	
	0	1	1	
	1	0	0	
	1	0	1	Undefined.
	1	1	0	Undefined.
	1	1	1	Undefined.

Bit 7 defines bits 5 and 6 as an assembly/disassembly code.

Bits 5 and 6 are coded as follows:

Bit 6	5	
0	0	6-bit mode (1 12-bit channel word 2 frames).
0	1	Packed mode (2 12-bit channel words 3 frames).
1	0	16-bit mode (1 16-bit channel word 2 frames).
1	1	16-bit mode (1 16-bit channel word 2 frames).

NOTE

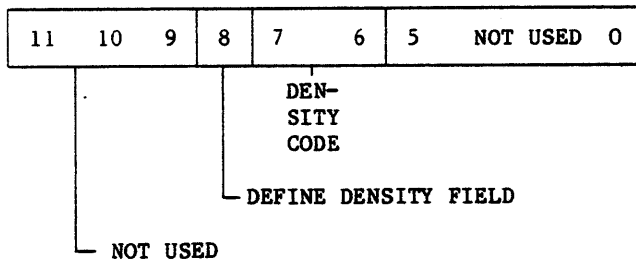
For Modes 0 and 1 the upper 4-bits of the 16-bit channel word are not used. During read operations the upper 4-bits will be zeroes and during write operations they will be ignored.

Bit 4 defines bits 0 through 3 as the code for the tape unit number and connection to that tape unit.

Bits 2 and 3 are not used.

Bits 0 and 1 are coded for tape units 0 through 3. Code 00 connects tape unit 0, and code 11 connects tape unit 3.

Parameter word 2 format:



Bits 9 through 11 are not used.

Bit 8 defines bits 6 and 7 as the density code.

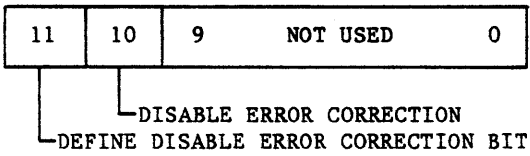
Bits 6 and 7 are coded as follows:

Bit 7	6	
0	0	1600-cpi, 9-track unit.
0	1	6250-cpi, 9-track, high-density unit.
1	0	1600-cpi, 9-track unit.
1	1	6250-cpi, 9-track, high-density unit.

The density field is effective only when writing from loadpoint.

Bits 0 through 5 are not used.

Parameter word 3 format:



Bit 11 defined bit 10 as the disable error correction bit.

Bit 10 indicates that error correction is disabled in GCR recording mode when a 1. When a 0, this bit indicates that error correction is enabled in GCR recording mode.

Bits 0 through 9 are not used.

Following a master clear function, master clear signal, or deadstart, the default values for parameter word fields are:

- Code translation = 0 (none)
- A/D mode = 0 (6-bit mode)
- Connected unit = none
- Recording mode = PE
- Disable error correction = 0 (error correction enabled)

NOTE

A connect code does not change or reset previous values. The adapter reverts to PE recording mode when a tape unit is not connected.

0006 - NORMAL READ CLIP

This function simplifies PP coding in read error recovery by allowing the clip level function to be issued even when a nominal clipping level is desired. The adapter returns an inactive signal to the PP. No other action occurs.

0106 - HIGH READ CLIP

This function specifies that the next read-type function will be done at a higher than normal clipping level. It enables the PP to raise the read clipping level during read error recovery to a level above normal. The following are considered read-type functions.

- Forespace/backspace.
- Search tapemark forward/backward.
- Read forward/backward.

The clipping level is restored to normal at the end of operation of any action function. The following are considered action functions.

- Format/connect unit.
- Rewind/rewind unload.
- Forespace/backspace.
- Search tapemark forward/backward.
- Warmstart read.
- Read forward/backward.
- Copy code translation read/write RAM.
- Write/short write.
- Write tapemark.
- Erase/data security erase.
- Load code translation read/write RAM.

0010 - REWIND

This function repositions the tape to loadpoint on a tape unit that is connected, ready, and not busy. A rewind command is sent to the tape unit and the adapter returns to the function idle loop. This allows operations to be performed on other tape units while a rewind is in progress.

0110 - REWIND UNLOAD

This function repositions the tape to loadpoint and then unloads tape on a tape unit that is connected, ready, and not busy. A rewind unload command is sent to the tape unit and the adapter returns to the function idle loop. This allows operations to be performed on other tape units while a rewind unload is in progress.

0011 - STOP MOTION

This function effects an interface disconnect operation. The tape subsystem may proceed to a normal termination by looking for an inter-record gap before stopping tape motion. The tape unit must be connected and ready in order for the function to execute.

0012 - GENERAL STATUS

This function requests status from the adapter and determines when end of operation occurs.

This status is mapped by the adapter from the tape subsystem adapter status and subsystem sense byte status.

If an end of operation has occurred, a function reply is returned to the PP within 10 μ s. After the PP activates the channel, up to sixteen 12-bit status words (beginning with status word 1) are returned to the PP. The status words are described under status words in this section. No error is reported if the PP elects to deactivate the channel before accepting the full set of status words. The adapter deactivates the channel after the last word of the set is accepted by the PP.

If an end of operation has not occurred and a read-type function (refer to 0106 description) is in progress, a function reply is sent to the PP within 50 ms but no status words are returned. After receiving a function reply, the PP activates the channel and waits 10 μ s for a full signal before deactivating the channel. The PP may continue to check for end of operation by sending the status function at selected intervals.

If a function other than a read-type function is in progress, a function reply is not sent to the PP until an end of operation occurs. A maximum delay of 4 s could occur while waiting for completion of a write tapemark or erase function at beginning of tape (BOT) in GCR mode.

0112 - DETAILED STATUS

This function is the same as the general status function, except up to fourteen 12-bit status words (beginning with status word 3) are returned to the PP.

0212 - UNIT STATUS

This function is the same as the general status function, except up to six 12-bit status words (beginning with status word 11) are returned to the PP.

0312 - PACKED STU SENSE BYTE STATUS

This function requests tape subsystem sense byte information from the adapter. The adapter returns twenty 12-bit words of packed STU sense and extended sense bytes. This information is described in the sense byte status paragraph later in this section.

0013 - FORESPACE

This function is used to position tape forward over the next physical data block without transferring data over the channel. It may be used to test validity and generate block identification (ID) status of a data block since all error checks are performed on the block. The end-of-tape (EOT) status is supplied in general status when EOT is sensed.

Tape is moved forward and data transfer is disabled, and the channel is not required to be active. Tape motion continues to the next inter-block gap (IBG). The tape unit must be connected, ready, and not busy in order for the function to execute.

0113 - BACKSPACE

This function is used to position tape backward over the next physical data block on a tape unit without transferring data over the channel.

Tape is moved backward until either loadpoint is reached or a physical record is read. Data transfer is disabled, and the channel is not required to be active. Tape motion continues to the next IBG.

The tape unit must be connected, ready, and not busy in order for the function to execute.

0114-CONTROLLED BACKSPACE

This function is used to move tape backward a distance determined solely by the number of words transmitted by the PP. The function is used during write recovery to prevent premature stopping within an erroneous data block because of a false end of record.

After replying to the function, the adapter waits for the PP to activate the channel and start sending data. Backward tape motion is then started and continued until no more data is sent. At this time, the channel should be deactivated to prevent a lost data error. Nothing is erased or written on the tape during the backspace.

Data is accepted at the same rate as during a write operation. Density and the assembly/disassembly mode currently selected affect the actual distance the tape is moved. At least one word of data must be sent by the PP.

After moving the tape the distance determined by the amount of data sent, motion is continued through use of find gap until an IBG is reached. Find gap is a procedure used by the tape unit to ensure that tape is moved to the next IBG.

The status alert bit is sent and an error code stored in status if the previous operation was not a write and if loadpoint is reached while data is still being sent or if no data was sent. The word count must be reduced by 5 to 8 percent to prevent the IBG from being missed because of a slightly fast tape speed.

The tape unit must be connected, ready, and not busy in order for the function to execute.

0015 - SEARCH TAPEMARK FORWARD

This function is used to move tape forward on a tape unit until a tapemark (filemark) is read. A series of forespace operations is performed until a tapemark is read or an error occurs (for example, unit drops ready). No data is transmitted on the channel during the search for tapemark. If a tapemark is not found, tape will be pulled off the supply reel. Status applies only to the last block read, which is normally the tapemark. Errors in previous data blocks are not reported in status. The tape unit must be connected, ready, and not busy in order for the function to execute.

0115 - SEARCH TAPEMARK BACKWARD

This function is used to move tape backward on a tape unit until a tapemark (filemark) is read. A series of backspace operations are performed until a tapemark is read or an error occurs. An example of such an error is load point encountered before finding tapemark. No data is transmitted on the channel during the search for tapemark. Status applies only to the last block read, which is normally the tapemark. Errors in previous data blocks are not reported in status. The tape unit must be connected, ready, and not busy in order for the function to execute.

0016 - UNITS READY/UNITS RESET

This function requests one word of status from the adapter to determine which tape units are ready and reset.

The adapter waits 210 ms for the channel to activate after replying to the function. If the channel fails to activate, an error code is generated and control returns to the idle loop. The status word transferred to the PP contains the following bits.

Bits 8 through 11

These bits are not used.

Bit 7

This bit indicates tape unit 3 is reset.

Bit 6

This bit indicates tape unit 2 is reset.

Bit 5

This bit indicates tape unit 1 is reset.

Bit 4

This bit indicates tape unit 0 is reset.

Bit 3

This bit indicates tape unit 3 is ready and not selected.

Bit 2

This bit indicates tape unit 2 is ready and not selected.

Bit 1

This bit indicates tape unit 1 is ready and not selected.

Bit 0

This bit indicates tape unit 0 is ready and not selected.

0116 - CUMULATIVE STATUS

This function provides a history of marginal conditions in the tape subsystem.

The cumulative status of marginal tape unit performance is stored in adapter memory for each tape unit. Execution of this function upon completion of a job transfers cumulative status from adapter memory to PP memory. The user should then transfer cumulative status from PP memory to the PP engineering file. Overflow on all error fields are indicated by all bits being set. Block counts wrap around.

The adapter waits 210 ms for the channel to activate after replying to the function. If the channel fails to activate, an error code is generated and control returns to the idle loop.

The cumulative status contains eight words. The adapter deactivates the channel if all eight words are transferred. The PP must deactivate the channel if less than eight words are transferred. The following status words are transferred to the PP.

Word 1

Bits 11 through 0 are same as those in general status word 11.

Word 2

Bits 11 and 10 are not used.

Bits 9 and 8 provide a code to indicate the tape unit selected.

Bits 7 through 0 are the upper 8 bits of a 16-bit code that indicates the number of blocks written.

Word 3

Bits 11 through 4 are the lower 8 bits of a 16-bit code that indicates the number of blocks written.

Bits 3 through 0 are the upper 4 bits of a 16-bit code that indicates the number of blocks read.

Word 4

Bits 11 through 0 are the lower 12 bits of a 16-bit code that indicates the number of blocks read.

Word 5

Bits 11 through 0 are the upper 12 bits of a 16-bit code that indicates the number of correctable single-track errors.

Word 6

Bits 11 through 8 are the lower 4 bits of a 16-bit code that indicates the number of correctable single-track errors.

Bits 7 through 0 are an 8-bit code that indicates the number of correctable double-track errors.

Word 7

Bits 11 through 4 are an 8-bit code that indicates the number of corrected memory errors in the adapter.

Bits 3 through 0 are the upper 4 bits of an 8-bit code that indicates the number of velocity errors.

Bits 7 through 0 are an 8-bit code that indicates the number of uncorrectable data errors.

0216 - COMPREHENSIVE STU SENSE STATUS

This function allows the adapter to obtain the complete set of STU sense bytes and extended sense bytes from the tape unit and return them to the PP. Two sense bytes are placed in each returned PP word. Sense bytes 0 through 7 make up the first 4 PP words and extended sense bytes 0 through 26 make up the last 14 PP words. The PP may disconnect the channel before all status words are returned. Refer to table 3-5 for bit identification of each STU sense byte.

002U - CONNECT TO UNIT OU

Bits 0 and 1 of this function are used to connect tape unit 0, 1, 2, or 3 without using the format unit function. This connects the selected tape unit to the channel and disconnects any currently connected tape unit. Motion-related hardware status such as parity error is cleared. If the specified unit is already connected, only the mentioned status clearing occurs.

If the tape unit is inoperable or does not exist, an error code is stored in status. The specified unit does not have to be ready.

The tape unit parameters, including density, selected by the last format unit function are not changed or cleared by the connect to unit function. If the default values specified in the format unit function are desired, a master clear must be accomplished before the connect to unit function is initiated.

012U - WARMSTART READ UNIT U

This function enables the system to deadstart from magnetic tape with only one function. Bits 0 and 1 of this function connect tape unit 0, 1, 2, or 3. The specified unit must be ready. A packed assembly/disassembly mode is automatically selected.

Tape is rewound, and the first data block is read. The proper density is automatically selected. Operation is identical to a read function, except the function reply is not returned to the PP until the tape unit finishes rewinding. If the tape unit is not available or an error prevents the tape unit from reaching loadpoint, a function reply is not returned to the PP. The adapter waits 210 ms for the channel to activate after replying to the function. If the channel fails to activate, an error code is generated and control returns to the idle loop.

This function must be preceded by a master clear operation to ensure that the default values (refer to 0004 description) are selected.

013U - WARMSTART READ UNIT U, HIGH DENSITY, 16-BIT CHANNEL MODE

This function is the same as function 012U, except 16-bit channel assembly/disassembly mode is automatically selected instead of packed assembly/disassembly mode.

0040 - READ FORWARD

This function is used to transfer data from a tape unit to the PP. After returning a function reply, the adapter waits up to 210 ms for the channel to activate. If the channel does not activate in 210 ms, tape motion does not start, an error is generated, and control returns to the idle loop.

When the IBG is reached and the last word has been accepted by the PP, an inactive pulse is returned by the adapter. If the PP elects to terminate data transfer before end of operation, it sends an inactive pulse to the adapter before the adapter buffer fills up without causing a lost data error. Tape motion continues until the IBG is reached. Only after the IBG is reached will the status function be accepted by the adapter. Status is then reported for the entire data block regardless of when the PP deactivates the channel. All redundancy checks are performed on the entire data block.

On-the-fly error correction occurs for both PE and GCR recording modes.

During the read forward function, tape is moved away from loadpoint. If the EOT marker is reached or passed, the EOT status bit is set. However, a limit is not placed on how far tape may be moved past the EOT marker, and it is the PP's responsibility to prevent tape from being pulled off the supply reel.

If the channel remains active after the end of data has been detected and the channel buffer is empty, the adapter deactivates the channel.

The PP must not deactivate the channel during an input operation unless the channel is full. (This requirement is not necessary if PP bit 5 is set in the deactivate channel instruction.)

The tape unit must be connected, ready, and not busy in order for the function to execute.

0140 - READ BACKWARD

This function is the same as the read forward function, except tape is moved toward loadpoint. If loadpoint is reached as tape moves backward, the BOT status bit sets and tape motion stops. An error is recorded to indicate abnormal termination. Data is assembled with the frames inverted to enable high to low order storage in memory. This function is used in PE recording mode only.

0047 - COPY CODE TRANSLATION READ RAM

This function is used to copy the contents of the read RAM table residing in the tape control unit into PP memory. The read RAM contains 256 8-bit entries. To receive the entire entry, packed assembly/disassembly mode or 16-bit mode is selected. Since the packed mode produces two 12-bit words for every three 8-bit entries, 171₁₀ 12-bit words must be read to copy the entire contents of read RAM. The lower 4 bits of word 171 contain zeros. In 16-bit mode, only 128₁₀ 16-bit words are required to read the entire RAM table. A deactivate pulse is returned to the PP if more than 171 words are read. The PP must disconnect the channel after receiving the desired number of words. The read RAM table contains an internal code set. The entries are returned to the PP in an external code set order. (Refer to 0057-Load Code Translation Read RAM function for format.) Attempting to copy code tables 0, 5, 6, or 7 results in unspecified data being returned to the PP. Before issuing this function, a format unit function must be issued specifying code table 1, 2, 3, or 4 and assembly/disassembly mode 1 or 2. Assembly/ disassembly mode 0 may be used for 6-bit internal codes.

0247 - COPY CODE TRANSLATION WRITE RAM

This function is the same as the copy code translation read RAM function, except that it copies the contents of the write RAM table. The write RAM table contains the external code set. The entries are returned to the PP in an internal code set order. (Refer to 0257-Load Code Translation Write RAM function for format.)

0050 - WRITE

This function is used to transfer data from the PP to the tape unit. After returning a function reply, the adapter waits up to 210 ms for the channel to activate and become full. If the channel does not activate in 210 ms, tape motion does not start, an error code is generated, and control returns to the idle loop.

Error checks are performed on the written data detected by the read head. A discrepancy between the number of frames written and those read is reported as an error.

The tape unit must be connected, ready, not busy, and have a write ring installed in order for the function to execute.

0250 - SHORT WRITE

This function is the same as the write function, except the final character that is transmitted is discarded. The number of characters written during 6-bit or 16-bit assembly/disassembly mode is $2N+1$, and the number is $3N+2$ during packed assembly/disassembly mode. The letter N is any integer.

0051 - WRITE TAPEMARK

This function is used to write an end of file terminating mark on the tape. A tapemark is preceded by an erase gap. A read after write check reports an error if poor erasure is detected or the tapemark is not properly detected.

The tape unit must be connected, ready, not busy, and have a write ring installed in order for the function to execute.

0052 - ERASE

This function is used to skip over a bad area of tape by including it in the IBG. Approximately 3 in of tape, excluding inter-record gap, are erased. A read after write check reports an error if poor erasure is detected. Any flux changes detected cause the erase error status bit to set.

The tape unit must be connected, ready, not busy, and have a write ring installed in order for the function to execute.

0252 - DATA SECURITY ERASE

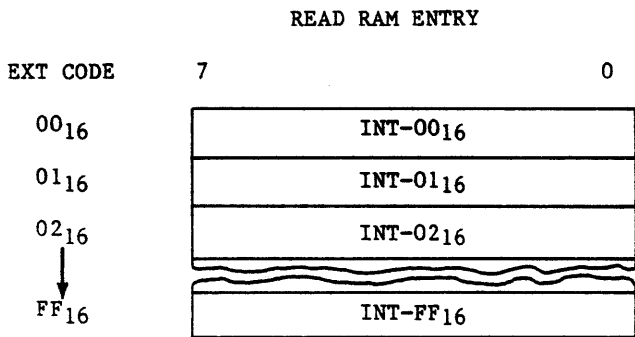
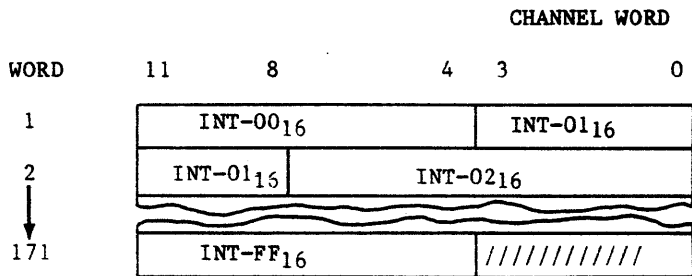
This function is used to ensure that all information following the last good block is erased to prevent unauthorized use of any data that may remain on the tape. After replying to the function, the adapter sends a data security erase (DSE) command to the tape unit and returns to its idle loop. This enables operations to be performed on other tape units while a DSE is in progress. The tape unit continues to erase tape until a position approximately 10 ft past the EOT marker is reached. The only way to stop the tape unit early is to press its reset button.

The tape unit must be connected, ready, not busy, and have a write ring installed in order for the function to execute.

0057 - LOAD CODE TRANSLATION READ RAM

This function is used to store the code set in the currently selected read RAM table 1 through 4. Attempting to load table 0, 5, 6, or 7 results in data being accepted by the adapter but not loaded. After returning a function reply, the adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop.

The read RAM holds 256 8-bit entries. The entire memory must be loaded. To load the entire entry, packed assembly/disassembly mode or 16-bit mode is selected. Since the packed mode requires two 12-bit words for every three 8-bit entries, 171₁₀ 12-bit words must be written to load the entire read RAM. With packed mode selected, the lower 4 bits of word 171 are discarded. If 16-bit mode, only 128₁₀ 16-bit words are required to load the entire RAM table. If more than 256 8-bit characters are sent, the adapter deactivates the channel. The read RAM is loaded with the desired internal code set as follows:



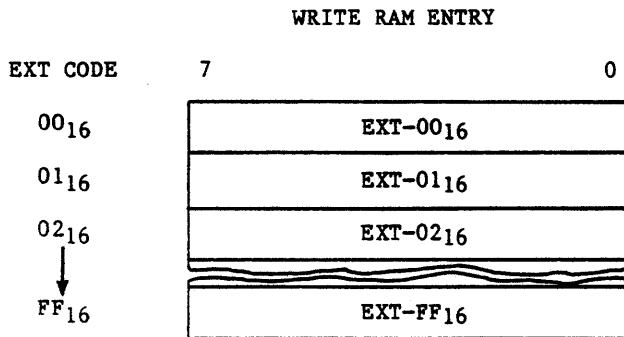
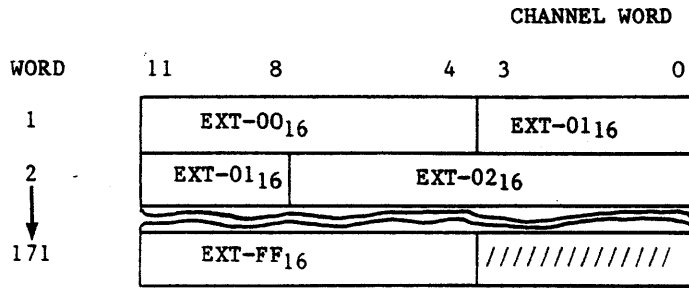
When data is read with code translation, each 8-bit external code character from the tape unit is used as an address to read its corresponding internal code character from the read RAM. This internal code character is then sent to the channel in place of the external code character.

Before issuing this function, a format unit function must be issued specifying code table 1, 2, 3, or 4 and assembly/disassembly mode 1 or 2. It is acceptable to use assembly/disassembly mode 0 when using 6-bit internal codes.

To allow detection of illegal 8-bit external code characters when translating to a 6-bit internal code, bit 6 may be set in all read RAM entries that correspond to the unacceptable external code. If bit 6 is then detected, the flag bit detected and alert status bits will set.

0257 - LOAD CODE TRANSLATION WRITE RAM

This function is the same as the load code translation read RAM function, except that it stores the code set in the write RAM table. The write RAM is loaded with the desired external code set as follows:



When data is written with code translation, each 8-bit internal code character from the channel is used as an address to read its corresponding external code character from the write RAM. This external code character is then sent to the tape unit in place of the internal code character.

0063 - RUN REMOTE STU DIAGNOSTICS

This function enables the PP to execute diagnostics that are resident within the control storage of the connected tape unit. These diagnostics test the interface, formatter, and drive hardware in the tape unit. The two parameter words that accompany the function contain a test number and test option. The length of time required to execute a test is dependent on the test selected and the length of the test tape if required. The time can be from milliseconds to minutes in duration.

This function must be followed by a general status function to check results of the diagnostics. The diagnostics completed successfully if the general status alert bit is not set. If the alert bit is set, the comprehensive STU sense status function should be set to obtain fault symptom and fault code bytes. Additional instructions are contained in the structured analysis method (SAM) tables in the STU hardware reference/maintenance manual volume 2 listed in the preface.

The tape unit must be connected and in a state required by the selected diagnostic test.

0064 - ISMT DIAGNOSTIC MEMORY READ

This maintenance function forces assembly/disassembly mode 2 and allows the PP to read 322 16-bit words from adapter memory. After returning a function reply, the adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. This function uses the same hardware path as status functions. It can be used to read the data previously written with function 0065 or 0067. If all 322 words are read, general status is set to 1000. If all 322 words are not read or an error occurs, general status is set to 5000.

The tape unit should not be connected.

0065 - ISMT DIAGNOSTIC MEMORY WRITE

This maintenance function forces assembly/disassembly mode 2 and allows the PP to write 322 16-bit words into the adapter memory. After returning a function reply, the adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. This function uses the same hardware path as functions that send parameters. General status word 1 is 5000 if there is a channel parity error or less than 322 words are received by the adapter. A general status of 1000 indicates the function completed without error.

The tape unit should not be connected.

0066 - ISMT DIAGNOSTIC DATA PATH READ

This maintenance function forces assembly/disassembly mode 2 and allows the PP to read 322 16-bit words from the adapter memory. After returning a function reply, the adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. It uses the same hardware path as a 9-track read operation in the read forward function (0040). It can be used to read the data previously written with function 0065 or 0067. If all 322 words are read, general status is set to 1000. If all 322 words are not read or an error occurs, general status is set to 5000.

The tape unit should not be connected.

0067 - ISMT DIAGNOSTIC DATA PATH WRITE

This maintenance function forces assembly/disassembly mode 2 and allows the PP to write 322 16-bit words into the adapter memory. After returning a function reply, the adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. It uses the same hardware path as a 9-track write operation in the write function (0050). A general status of 1000 indicates the function completed without error. General status word 1 is 5000 if there is an error or less than 322 words are received by the adapter.

The tape unit should not be connected.

0070 - RUN ISMT ADAPTER DIAGNOSTICS

This function allows the PP to run the same ISMT adapter diagnostics, including the full adapter loopback tests but not the memory test, that are run during a controlware autoloading from PP function (04XX). If the diagnostics run without error, general status is 1000. If not, general status is 5000, general status word 3 error code is 70, and general status word 10 contains the adapter error code (refer to appendix E) of the failing test. This function forces assembly/disassembly mode 2 (16-bit mode).

The tape unit should not be connected.

0175 - LOOP WRITE-TO-READ TO TAPE UNIT

This maintenance function is used to check the write and read paths in the adapter, tape unit cable, and tape unit interface.

The adapter sets the loop write-to-read (LWR) mode flag, replies to the function, and then returns to the RAM idle loop. Write and forward status is available to the PP until the LWR mode clears. The next function must be a write, short write, or status function. When the write or short write function is executed, the LWR data frames are sent to the tape unit at the speed and density selected in the tape unit. The data frames are then returned to the adapter and checked for errors. If an error is detected, the alert bit is set in general status. Status is available at the end of operation. The LWR mode is cleared at the end of any action function (refer to function 0106 description). The original assembly/disassembly mode and code translation selections are not changed by this function.

The tape unit must be connected, ready, and not busy.

04XX - AUTOLOAD ADAPTER CONTROLWARE FROM PP

This function master clears the adapter, executes the ROM diagnostics, and then loads controlware in the adapter RAM. If a diagnostic test does not run, the test error code is indicated in general status word 10 (appendix E). The following ROM diagnostic tests are run in sequence.

- 68000 register test.
- 68000 instruction test.
- 68000 supporting hardware test.
- Interface to ICI channel test.
- Interface to STU channel test.

A function reply is returned to the PP if all the ROM diagnostics execute without error. The adapter then waits 210 ms for the channel to activate. If the channel does not activate in 210 ms and controlware was not previously loaded, general status is 5241 and control returns to the ROM idle loop. If controlware was loaded and the channel fails to activate, general status is 1000 and control returns to the RAM controlware idle loop.

The controlware is loaded into the adapter RAM from the 12-bit PP words. The controlware is packed in RAM in the same manner as assembly/disassembly mode 1 data. In this mode, four 12-bit PP words are loaded into three 16-bit RAM words. The adapter may also load one 16-bit channel word into one 16-bit subsystem memory word if any of the four most significant bits of the first 16-bit word are set. The subsystem remains in autoloading mode until the PP disconnects the channel.

A partial autoloading of four words or less can be done to recover from channel timeout errors. Program execution is returned to the proper idle loop following the partial autoloading.

During full autoloading, the adapter firmware does a memory test. If the test is successful, the adapter firmware completes the autoloading. After the PP disconnects the channel, the adapter firmware verifies the controlware ID and calculates a checksum from the controlware data loaded into the adapter RAM. If there is a memory test error, a controlware ID error, or a checksum error, the processor returns to the ROM idle loop and general status is set to 5XXX (XXX is an error code described in appendix E). If there are no errors, adapter processor interaction tests are executed. These tests are part of the downloaded controlware. If the interaction tests fail, general status is set to 5XXX. If there are no errors, a release is issued to all tape units connected to the adapter, general status is set to 1000, and the adapter processor goes to the RAM idle loop to wait for additional functions from the PP.

05XY - AUTODUMP ADAPTER MEMORY

This function transfers the contents of adapter memory to the PP. The adapter waits 210 ms for the channel to activate. If the channel does not activate in 210 ms, an error code is generated and control returns to the idle loop. The 8-bit bytes of the 16-bit memory words are transferred to the lower 8 bits of the 12-bit PP words. The XY in 05XY defines the start point in RAM. Controlware is transferred until the channel deactivates or the adapter sends an inactive when the last word in memory is read (address 11800₁₆). This function should be issued only at the end of operation of a previous function.

The X in 05XY partly defines the memory starting addresses as follows:

050Y	Start at hexadecimal address 0Y00
051Y	Start at hexadecimal address 2Y00
052Y	Start at hexadecimal address 4Y00
053Y	Start at hexadecimal address 6Y00
054Y	Start at hexadecimal address 8Y00
055Y	Start at hexadecimal address AY00
056Y	Start at hexadecimal address CY00
057Y	Start at hexadecimal address EY00

The Y in 05XY further defines the memory starting address as follows:

0500	Start at hexadecimal address 0000
0501	Start at hexadecimal address 0400
0502	Start at hexadecimal address 0800
0503	Start at hexadecimal address 0C00
0504	Start at hexadecimal address 1000
0505	Start at hexadecimal address 1400
0506	Start at hexadecimal address 1800
0507	Start at hexadecimal address 1C00

The adapter memory hexadecimal address ranges are as follows:

0000	1FFF ROM firmware
2000	3FFF not used
4000	BFFF ROM controlware
C000	FFFF not used
10000	107FF data path processor writeable control store (WCS)

06UU - AUTOLOAD ADAPTER CONTROLWARE FROM TAPE

NOTE

Controlware must have previously been written on tape beginning at loadpoint. The tape record format is 9-track PE.

This function autoloads controlware into the adapter from tape unit UU (0 through 3). It starts the adapter processor executing firmware microcode in the ROM idle loop. All instructions necessary to execute this function are in the adapter ROM. If there is a function parity error, a function reply is not returned to the PP. Prior to loading controlware from the tape unit, the following ROM diagnostics are run in sequence.

- 68000 register test.
- 68000 instruction test.
- 68000 supporting hardware test.

- Interface to ICI channel test.
- Interface to STU channel test.
- RAM and writeable control store memory test.

If any of the preceding tests detects a failure, a function reply is not returned to the PP and general status is set to 5XXX (XXX is an error code described in appendix E).

If the tests run successfully, the adapter attempts to connect to the selected tape unit, rewind tape, locate the controlware record, and load controlware. After the controlware is loaded into the adapter RAM, the adapter firmware verifies the controlware ID, calculates a checksum and compares it with the correct value, and runs the RAM controlware interaction tests. If any of the preceding events fail, a function reply is returned to the PP, tape is not rewound, general status is set to 5XXX, and control returns to the ROM idle loop. If all the preceding events execute correctly, a function reply is returned to the PP, tape is rewound, general status is set to 1000, and control goes to the RAM idle loop.

07XX - SPECIAL SOFTWARE DEBUGGING STATUS

This function is used as a debugging aid for operating system software. After replying to the function, the adapter waits up to 210 ms for the channel to activate. The adapter then accepts 1 to 16 words of simulated general status from the PP as specified by XX in this function. These simulated status words are returned to the PP only once at the time the XX count is satisfied. If the channel is not activated in 210 ms, the previously loaded simulated status is again used on the count of XX. Also, if not all 16 simulated status words are sent to the adapter, the previously selected word count is retained. The contents of the simulated status words are not checked by the adapter, and they do not change the operation of any other functions. Function 0700 must be issued to disable a previous count of XX that was not satisfied.

This function should only be issued at the end of operation of a previously issued function.

STATUS WORDS

The adapter returns status information to the PP in response to general (0012), detailed (0112), and unit (0212) status functions. This status information is required by the operating system to interpret tape subsystem operation and to provide necessary information for error recovery algorithms. For general status, up to sixteen 12-bit status words are returned to the PP. For detailed status, the first two words are skipped and words 3 through 16 are returned to the PP. For unit status, the first 10 words are skipped and words 11 through 16 are returned to the PP. Table 3-2 identifies each bit of the 16 status words.

In the following status word descriptions, a logical 1 (set bit) implies that the event happened or the condition is true.

Table 3-2. Status Bit Assignments

	11	10	9	8	7	6	5	4	3	2	1	0
GENERAL STATUS ORIGIN →												
WD 1	ALERT	0	TU CONNECT	0	WRITE RING	9 TRACK	CHARACTER FILL	FILE MARK	EOT	BOT	UNIT BUSY	UNIT READY
WD 2	CRC BLOCK ID									0	0	0
DETAILED STATUS ORIGIN →												
WD 3	LOST DATA	UNIT CHECK	TAPE PARITY ERROR	CHANNEL PARITY ERROR	ADAPTER PARITY ERROR	ERROR CODE						
WD 4	0	DOUBLE TRACK CORRECTION	SINGLE TRACK CORRECTION	0	0	0	0	0	0	0	0	0
WD 5	0	0	CRC DETECTED ERROR	AUX CRC DETECTED ERROR	0	0	0	VELOCITY ERROR	0	FLAG BIT DETECTED	VARIABLE GAP SELECTED	EXCESSIVE SKEW ERROR
WD 6	0	DATA PATH PE	0	0	0	0	0	0	0	0	BAD RESYNC BURST	0
WD 7	0	0	0	TRACK IN ERROR								
WD 8	0	CODE TRANSLATION	A/D MODE	LAST DIRECTION REVERSE	LAST OPERATION WRITE	ERROR CORRECTION DISABLED	16 BIT MODE	0	0	0	0	0
WD 9	0	NOISE BYPASSED	0	0	0	0	ERASE ERROR	0	0	0	0	0
WD 10	0	0	0	ADAPTER ERROR CODE								
UNIT STATUS ORIGIN →												
WD 11	GCR CAPABILITY	NRZI CAPABILITY	0	0	0	0	DUAL DENSITY	DENSITY	SPEED			
WD 12	0	0	0	0	0	0	0	RESET KEY	DSE	0	0	0
WD 13	0	0	0	0	0	0	PARKED	0	0	0	0	0
WD 14	0	0	0	0	0	0	0	0	0	0	0	0
WD 15	0	0	0	0	AGC FAULT	0	0	0	0	0	VARIABLE LONG GAP	VARIABLE SHORT GAP
WD 16	HARD ERROR	CORRECTED ERROR	ID BURST DETECTED	FILE MARK DETECTED	FILE PROTECT	GCR MODE	HIGH SPEED	READY	END OF TAPE	LOAD- POINT	REWIND	ON LINE

WORD 1 - GENERAL STATUS

Bit 11 - Alert

This bit indicates that an abnormal condition is reported in various status words.

The following status word bits cause the alert bit to set.

<u>Status Word</u>	<u>Bit</u>	<u>Description</u>
3	11	Lost data
3	10	Unit check
3	9	Tape parity error
3	8	Channel parity error
3	7	Adapter parity error
3	0 through 6	Error code (excluding zero)
5	9	CRC detected error
5	8	AUX CRC detected error
5	4	Velocity error (if write)
5	2	Flag bit detected
5	0	Excessive skew error
6	10	Data path PE
6	1	Bad resync burst
9	10	Noise bypassed
9	5	Erase error
10	0 through 8	Adapter error code (excluding zero)

Bit 10 - Not Used

This bit is not used.

Bit 9 - Tape Unit Not Connected

When this bit is a 0, it indicates that a tape unit is connected.

Bit 8 - Not Used

This bit is not used.

Bit 7 - Write Ring

This bit indicates that the tape reel has a write ring and therefore is not file-protected.

Bit 6 - 9 Track

This bit indicates that a 9-track tape unit is logically connected.

Bit 5 - Character Fill

This bit indicates that the lower 6 or 8 bits of the final data word returned to the PP contain fill bits. This gives the character an undefined value. If only the lower 4 bits of the final data word are fill bits, the character fill bit does not set.

Bit 4 - Filemark

This bit indicates that the last data block read or written was identified as a filemark or tapemark.

Bit 3 - End of Tape (EOT)

This bit indicates that tape is positioned at or beyond the EOT marker. Less than 10 usable feet of tape remain on the reel. The status bit is cleared when the EOT marker passes the sensor in the reverse direction.

Bit 2 - Beginning of Tape (BOT)

This bit indicates that tape is positioned at the BOT marker (loadpoint).

Bit 1 - Unit Busy

This bit indicates that the tape unit is performing a rewind or a data security erase function.

Forward or reverse tape motion for all other functions is reported by bit 5 (parked) in status word 13.

Bit 0 - Unit Ready

This bit indicates that tape is loaded and the start switch was the last switch pressed on the tape unit. This bit is a 1 during rewind and data security erase functions and a 0 during a rewind unload function.

WORD 2 - CRC BLOCK IDENTIFICATION

Bits 11 through 3 - Block Identification Code

This is a 9-bit cyclic redundancy code that is generated from the last data block that was read or written. Its purpose is to help the PP locate the last good data block during read or write recovery. The code is invalid if a parity error status bit is set.

The block identification code is not generated during a backspace function.

Bits 2 through 0 - Not Used

These bits are not used.

WORD 3 - DETAILED STATUS

Bit 11 - Lost Data

This bit indicates that the PP failed to deactivate the channel soon enough after stopping the transfer of data or failed to keep up to the tape unit transfer rate.

Bit 10 - Unit Check

This bit indicates that an abnormal condition is reported in status word 12.

The reset key bit (status word 12, bit 4) causes the unit check bit to set. The unit check bit, in turn, sets the alert bit.

Bit 9 - Tape Parity Error

This bit indicates that an error was detected and reported in status word 5 or 9 in the last data block. This condition requires error recovery by the PP.

The following status word bits cause the tape parity error bit to set. The tape parity error bit, in turn, sets the alert bit.

<u>Status Word</u>	<u>Bit</u>	
5	9	CRC detected error
5	8	AUX CRC detected error
5	4	Velocity error (write mode)
5	0	Excessive skew error
9	5	Erase error

Bit 8 - Channel Parity Error

This bit indicates that incorrect parity was detected in the data just written. Incorrect channel parity in a function code is indicated by no response from any equipment on the channel and an error code if the next function is a status request.

Bit 7 - Adapter Parity Error

This bit indicates that an internal adapter error was detected.

Bits 6 through 0 - Error Code

If this code has a value other than zero, it indicates that the requested operation was not performed. All possible coded errors are listed in table 3-3.

Table 3-3. Status Word 3 Error Codes (Sheet 1 of 2)

Error Code (Octal)	Description	Action
01	Connect rejected because tape unit off line, powered off, or not cabled to adapter.	Report error condition.
04	Function rejected because tape unit not ready.	Report tape position uncertain and log error.
05	Tape unit declared not ready during last operation because of unit check status or an interrupt.	Report tape position uncertain and log error.
06	Write not executed because write ring missing.	Request write ring.
07	Tape unit not capable of reading tape's density.	Discontinue effort to read tape and log error.
10	Over 7.6 m (25 ft) of blank tape in PE mode or 4.6 m (15 ft) in GCR mode.	Report error condition.
12	Unable to write from loadpoint because of bad tape (ID burst not detected immediately after being written).	Request different reel and log error.
16	Unable to properly set tape unit automatic gain control (AGC) on this tape in GCR mode.	Clean tape unit and retry function. If error persists, discontinue effort to read tape and log error.
30	Backward motion attempted at loadpoint.	Report error condition.
31	Tape unit 4 through 17 requested (only numbers 0 through 3 supported).	Log condition and report to operating system.

Table 3-3. Status Word 3 Error Codes (Sheet 2 of 2)

Error Code (Octal)	Description	Action
32	Tape unit busy rewinding or doing a data security erase.	Wait until unit is not busy.
33	Reverse read attempted in GCR mode.	Report error condition.
34	A controlled backspace function was attempted when the previous operation was not a write.	Suspect system error.
41	Tape unit failed to reach operating speed.	Logically remove tape unit from system and log error.
50	Function code not recognized.	Suspect system error if error persists.
51	Tape unit not connected.	Suspect system error.
52	Function parameters not sent.	Reissue function and parameters one more time. Suspect system error if error persists.
55	Channel parity error during function or parameter transmission.	Perform actions in appendix C.
61	Data not received in time for a PP output operation.	Report error and retry operation.
62	PP not ready to receive data for a PP input operation.	Report error and retry operation.
70	ISMT subsystem detected a catastrophic failure during operation or while running internal diagnostics.	Refer to general status word 10 for adapter error code.

WORD 4 - ERROR CORRECTION INDICATION

Bit 11 - Not Used

This bit is not used.

Bit 10 - Double-Track Correction

This bit indicates double-track error correction is performed in mode.

Bit 9 - Single-Track Correction

This bit indicates single-track error correction is performed in PE or GCR mode.

Bits 8 through 0 - Not Used

These bits are not used.

WORD 5 - ERROR INDICATORS

Bits 11 and 10 - Not Used

These bits are not used.

Bit 9 - CRC Detected Error

This bit indicates that the cyclic redundancy check detected an error.

Bit 8 - AUX CRC Detected Error

This bit indicates that the auxiliary cyclic redundancy check detected an error.

Bits 7 through 5 - Not Used

These bits are not used.

Bit 4 - Velocity Error

This bit indicates that the tape failed to reach speed in time for operation.

Bit 3 - Not Used

This bit is not used.

Bit 2 - Flag Bit Detected

This bit indicates that bit 6 of the read code translation table entry was detected in the set state. This must occur when reading with code translation and the assembly/disassembly mode equal to zero (6-bit mode).

Bit 1 - Variable Gap Selected

This bit indicates that the IBG is a variable length.

Bit 0 - Excessive Skew Error

This bit indicates that one or more tracks had more than the permitted amount of skew.

WORD 6

Bit 11 - Not Used

This bit is not used.

Bit 10 - Data Path Parity Error

This bit indicates that a parity error was detected in the data path circuits.

Bits 9 through 2 - Not Used

These bits are not used.

Bit 1 - Bad Resync Burst

This bit indicates that a bad resync burst was detected in one or more tracks during a GCR read-after-write check.

Bit 0 - Not Used

This bit is not used.

WORD 7

Bits 11 through 9 - Not Used

These bits are not used.

Bits 8 through 0 - Track in Error

These bits indicate pointer errors to the tracks as follows:

<u>Bit</u>	<u>Track in Error</u>
8	9 (data bit 23)
7	8 (data bit 21)
6	7 (data bit 27)
5	6 (data bit 26)
4	5 (data bit 25)
3	4 (parity bit)
2	3 (data bit 24)
1	2 (data bit 20)
0	1 (data bit 22)

WORD 8 - SUBSYSTEM MODE

Bit 11 - Not Used

This bit is not used.

Bit 10 - Code Translation

This bit indicates that code translation has been specified in the format unit function (0004).

Bit 9 - Assembly/Disassembly Mode

When a 1, this bit indicates that the packed assembly/disassembly mode has been specified in the format unit function (0004). When a 0, it indicates that the 6-bit assembly/disassembly mode is specified in the format unit function.

Bit 8 - Last Direction Reverse

This bit indicates that the last direction command issued to the tape unit requested that it move backward toward loadpoint.

Bit 7 - Last Operation Write

This bit indicates that the last tape unit operation was a write, write filemark, or erase because current is present in the write and erase heads.

Bit 6 - Error Correction Disabled

This bit indicates that no error correction will be performed by the adapter. This applies to all modes of recording.

Bit 5 - 16-Bit Mode

When a 1, this bit overrides bit 9 and indicates that the 16-bit assembly/disassembly mode has been specified in the format unit function (0004). When a 0, it indicates that the packed assembly/disassembly mode has been specified in the format unit function.

Bits 4 through 0 - Not Used

These bits are not used.

WORD 9 - FLAG BIT REGISTER

Bit 11 - Not Used

This bit is not used.

Bit 10 - Noise Bypassed

This bit indicates that one or more noise-length blocks were skipped over before reading a legitimate block or filemark.

Bits 9 through 6 - Not Used

These bits are not used.

Bit 5 - Erase Error

This bit indicates that unerased flux changes were detected at a low read clip level while forming the IBG or during an erase function.

Bits 4 through 2 - Not Used

These bits are not used.

Bits 1 and 0 - Read Clip Level

These bits provide a code that indicates one of the following clip levels at which the next read operation will be performed.

<u>Bit 1</u>	<u>Bit 0</u>	<u>Clip Level</u>
0	0	Normal
0	1	High

WORD 10 - ADAPTER ERROR CODE

Bits 11 through 9 - Not Used

These bits are not used.

Bits 8 through 0 - Adapter Error Code

If this code has a value other than zero, it indicates the adapter detected an error and cannot continue with the operation. The adapter error codes are listed in appendix E.

WORD 11 - HARDWARE CAPABILITY AND TAPE UNIT STATUS

Bit 11 - GCR Capability

This bit indicates that the tape unit contains the GCR option.

Bit 10 - Not NRZI Capability

This bit is always a 1. It indicates that the tape subsystem does not contain the nonreturn to zero, invert on ones (NRZI) recording capability.

Bits 9 through 6 - Not Used

These bits are not used.

Bit 5 - Dual Density

This bit indicates that the connected tape unit is 9-track.

Bits 4 and 3 - Density

These bits provide a code that indicates one of the following densities.

<u>Bit 4</u>	<u>Bit 3</u>	<u>Density</u>
0	0	1600 cpi, PE, single-density unit
0	1	1600 cpi, PE, double-density unit
1	0	Illegal
1	1	6250 cpi, GCR

Bits 2 through 0 - Speed Capability of Tape Unit

These bits form a code that indicates one of the following tape speeds.

<u>Bit 2</u>	<u>Bit 1</u>	<u>Bit 0</u>	<u>Tape Speed</u>
0	0	0	No tape unit connected
0	0	1	Illegal
0	1	0	100 ips
0	1	1	75 ips
1	0	0	125 ips
1	0	1	200 ips
1	1	0	150 ips
1	1	1	25 ips

WORD 12

Bits 11 through 5 - Not Used

These bits are not used.

Bit 4 - Reset Key

This bit indicates that the reset switch on the tape unit has been pressed. It clears upon receipt of a clear tape unit function or any tape motion function.

Bit 3 - Data Security Erase

This bit indicates that the tape unit is performing a data security erase.

Bits 2 through 0 - Not Used

These bits are not used.

WORD 13 (OPTIONAL)

Bits 11 through 6 - Not Used

These bits are not used.

Bit 5 - Parked

This bit indicates that tape has stopped moving in the tape unit.

Bits 4 through 0 - Not Used

These bits are not used.

WORD 14

Bits 11 through 0 - Not Used

These bits are not used.

WORD 15 (OPTIONAL)

Bits 11 through 8 - Not Used

These bits are not used.

Bit 7 - AGC Fault

This bit is used in GCR mode only to indicate that one or more tracks have maximum gain setting.

Bits 6 through 2 - Not Used

These bits are not used.

Bit 1 - Variable Long Gap

This bit indicates that the variable long gap mode is selected in the tape unit.

Bit 0 - Variable Short Gap

This bit indicates that the variable short gap mode is selected in the tape unit.

WORD 16 - STU INTERFACE STATUS AT END OF LAST OPERATION

Bit 11 - Hard Error

This bit indicates one of the following errors occurred in the tape unit.

- Vertical parity error without associated dropout
- Single-track correction on write command
- False preamble detection
- False postamble detection
- Excess skew
- Multi-track error
- Parity error on channel interface
- Identification error on read-after-write operation
- Noise error
- Equipment check
- Read timeout
- Device sense error
- Loop write-to-read error
- Illegal command
- Reverse into load point
- Density conflict

Bit 10 - Corrected Error

This bit indicates that single-track error correction is performed in PE and GCR modes and double-track error correction in GCR mode in the tape unit.

Bit 9 - ID Burst Detected

This bit indicates that an ID burst is detected on tape during a read or read-after-write operation from loadpoint.

Bit 8 - File Mark Detected

This bit indicates that a file mark is detected on tape during a read-type or write-type operation.

Bit 7 - File Protect

This bit indicates that the tape reel mounted on the tape unit does not have a write enable ring.

Bit 6 - GCR Mode

This bit indicates that GCR mode is selected in the tape unit.

Bit 5 - High Speed

This bit indicates that the tape unit is in 75-ips streaming mode.

Bit 4 - Ready

This bit indicates that the tape unit is loaded and ready to accept on line or sense commands.

Bit 3 - End of Tape

This bit indicates that the EOT marker is detected on tape during forward motion.

Bit 2 - Load Point

This bit indicates that tape is at logical BOT although the BOT marker is not under the sensor.

Bit 1 - Rewind

This bit indicates that the tape unit is off line or performing a rewind operation.

Bit 0 - On Line

This bit indicates that the tape unit is loaded and on line.

SENSE BYTE STATUS

The adapter returns twenty 12-bit words of tape subsystem sense byte status (thirty 8-bit sense bytes) to the PP in response to function 0312. The STU sense bytes are only valid if the alert is set in General Status word 1 after an operation has completed and a tape unit is connected. Table 3-4 identifies the sense bytes in the twenty 12-bit words. Sense bytes 0 through 7 are required while the remaining ones are extended (optional). Table 3-5 identifies the status bits in each sense byte.

Table 3-4. Tape Subsystem Sense Byte Status Information

	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	Sense Byte 0						Sense					
Word 2	Byte 1			Sense Byte 2								
Word 3	Sense Byte 3						Sense					
Word 4	Byte 4			Sense Byte 5								
Word 5	Sense Byte 6						Sense					
Word 6	Byte 7			Extended Sense Byte 3								
Word 7	Extended Sense Byte 4						Extended Sense					
Word 8	Byte 5			Extended Sense Byte 6								
Word 9	Extended Sense Byte 7						Extended Sense					
Word 10	Byte 8			Extended Sense Byte 9								
Word 11	Extended Sense Byte 10						Extended Sense					
Word 12	Byte 12			Extended Sense Byte 13								
Word 13	Extended Sense Byte 14						Extended Sense					
Word 14	Byte 15			Extended Sense Byte 16								
Word 15	Extended Sense Byte 18						Extended Sense					
Word 16	Byte 19			Extended Sense Byte 20								
Word 17	Extended Sense Byte 21						Extended Sense					
Word 18	Byte 22			Extended Sense Byte 23								
Word 19	Extended Sense Byte 24						Extended Sense					
Word 20	Byte 25			Extended Sense Byte 26								

The sense byte status bits are described in the paragraphs following table 3-5.

Table 3-5. Sense Byte Status Bits Identification (Sheet 1 of 3)

Sense Byte	*MSB Bit **LSB							
	0	1	2	3	4	5	6	7
0	Command Reject	Interv Required	Drive Type	Equip Check	Data Check	Command Overrun	Unit Check	Unit Except
1	Reverse	Write	Edit	Wrt File Mark	Erase	High Sp Select	Threshold	Long Gap
2	Ready	On Line	Rewind	File Protect	Not Used	High Speed	BOT	EOT
3	File Mark	Illegal Command	Density Conflict	Device Response Check	Position Check	Channel in PE	Wrt Hdw Check	Gap Control
4	Read Timeout	Noise	ID Check	Uncorrect Data	Postamble Error	Multidrop	No Trk Pointer	TIE 4
5	TIE 7	TIE 6	TIE 5	TIE 3	TIE 9	TIE 1	TIE 8	TIE 2
6	Fault Symptom Code							
7	Marginal Device Indication							
Ext 0	Not Used							
Ext 1	Not Used							
Ext 2	Not Used							
Ext 3	Host Command Reject	Write PE	Read PE	Rd Bfr Overflow/ Underflow	Remote Density Select	I/F Unit Check	Format Response Check	Not Used
Ext 4	Illegal Interface Command	Device Command Check	Density Conflict	File Protected	Reset Key	Not Used	Device Not Ready	Device Off Line
Ext 5	Interface PE	Interface Response Check	Read Hardware Check	Write Hardware Check	Device Response Check	Device Hardware Check	Velocity Check	Device Interrupt

*Most significant bit. **Least significant bit.

Table 3-5. Sense Byte Status Bits Identification (Sheet 2 of 3)

Sense Byte	*MSB							Bit							**LSB	
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Ext 6	AGC Check	Not Used	Rd Data Check	ID Fault	Not Used	Unrecv Error	BOT Error	Tape Motion								
Ext 7	Formatter Command															
Ext 8	GCR Mode	High Speed Mode	Adaptive Velocity	File Mark Detected	Diag Mode	Start/Stop Mode	Gap Mode									
Ext 9	Diagnostic Fault Code															
Ext 10	Diagnostic Subfault Code															
Ext 11	Not Used															
Ext 12	Write Transfer Check	Residual Byte Ct Check	Write CRC PE	4/5 PE	Not Used	Write AUX CRC	Not Used	Not Used								
Ext 13	Residual Char Check	Read CRC Check	Read AUX CRC Check	Resync Error	ECC 3	Uncorrect Data	No Trk Pointer	Excessive Pointers								
Ext 14	Noise Check	Postamble Error	Skew Error	Read Timeout	Wrt Tape Mark Chk	ID Check	ARA Burst Check	ARA ID Check								
Ext 15	EC Hardware Check	Read Buffer in PE	Read Transfer Check	Read Data PE	End Mark Check	Double Track Correction	Single Track Correction	Tie 4								
Ext 16	TIE 7	TIE 6	TIE 5	TIE 3	TIE 9	TIE 1	TIE 8	TIE 2								
Ext 17	Not Used															
Ext 18	Reverse	Write	Data Security Erase	GCR	Variable Long Gap	Start/Stop	Not Used	Not Used								
Ext 19	Remote Diag Inhibit	Remote Diag	LWR I/F	LWR PE	LWR GCR	Not Used	Not Used	GCR Density Selected								

*Most significant bit. **Least significant bit.

Table 3-5. Sense Byte Status Bits Identification (Sheet 3 of 3)

Sense Byte	Bit								
	*MSB	0	1	2	3	4	5	6	**LSB
Ext 20	Command Reject	Device Fault	Diag Request	Local Density Change	AGC Check	Reset Key	Reverse in BOT	Marginal Condition	
Ext 21	Last Rejected Command Code								
Ext 22	HSPD Up Ramp Timeout	LSPD Up Ramp Timeout	HSPD Down Ramp Timeout	LSPD Down Ramp Timeout	HSPD Speed	LSPD Speed	LSPD AGC	HSPD AGC	
Ext 23	Fault Code/Test Completion Code								
Ext 24	Subfault Code/Test Completion Code								
Ext 25	RFU								
Ext 26	Microcode Revision Level								

*Most significant bit. ** Least significant bit.

WORD 1 - SENSE BYTE 0 AND FIRST 4 BITS OF SENSE BYTE 1

Bit 11 - Command Reject

This bit indicates that the tape unit received an illegal command.

Bit 10 - Intervention Required

This bit indicates that the tape unit is not ready.

Bit 9 - Drive Type

This bit is set when a PE/GCR tape unit is connected and reset when a PE tape unit is connected.

Bit 8 - Equipment Check

This bit indicates one of the following conditions.

- Internal hardware malfunction is detected.
- Data parity error is detected on the channel.
- Gap control is not detected within the defined window.
- Positioning is not detected within the defined window.

Bit 7 - Data Check

This bit indicates that error recovery must be performed due to one of the following conditions.

- Postamble error is detected.
- Excessive skew is detected.
- ID burst is not currently recorded when writing from BOT.
- ID burst is not detected when reading from BOT.
- Noise is detected during read after write check on erase command.
- Multidrop is detected.
- No data is detected (read timeout error).
- Readback data does not occur when expected during write tape mark command or tape mark is not written.
- Uncorrectable data errors are detected.
- One track in error during PE write operation.
- More than one track in error during GCR write operation.
- A recoverable hardware failure occurs.
- Density conflict is detected.

Bit 6 - Command Overrun

This bit indicates that a command is received when tape unit is busy. This bit also sets bit 11 of this word.

Bit 5 - Unit Check

This bit is set when bit 7, 8, 9, 10, or 11 of this word is set.

Bit 4 - Unit Exception

This bit indicates that error correction is performed during a PE read operation, single-track correction is performed during a GCR write operation, or double-track correction is performed during a GCR write operation, or double-track correction is performed during a GCR read operation.

Bit 3 - Reverse

This bit indicates that a reverse command was the last command issued.

Bit 2 - Write

This bit indicates that a write command was the last command issued.

Bit 1 - Edit

This bit indicates that an edit command was the last command issued.

Bit 0 - Write File Mark

This bit indicates that a write file mark command was the last command issued.

WORD 2 - LAST 4 BITS OF SENSE BYTE 1 AND SENSE BYTE 2

Bit 11 - Erase

This bit indicates that an erase command was the last command issued.

Bit 10 - High-Speed Select

This bit indicates that a high-speed select command was the last command issued.

Bit 9 - Threshold

This bit indicates that a threshold command was the last command issued.

Bit 8 - Long Gap

This bit indicates that a long gap command was the last command issued.

Bit 7 - Ready

This bit indicates a ready tape status.

Bit 6 - On Line

This bit indicates an on line tape status.

Bit 5 - Rewinding

This bit indicates a rewinding tape status.

Bit 4 - File Protected

This bit indicates a file protected tape status.

Bit 3 - Not Used

Bit 2 - High Speed

This bit indicates a high-speed tape status.

Bit 1 - BOT

This bit indicates a BOT tape status.

Bit 0 - EOT

This bit indicates an EOT tape status.

WORD 3 - SENSE BYTE 3 AND FIRST 4 BITS OF SENSE BYTE 4

Bit 11 - File Mark

This bit indicates that a tape mark is detected during a read or space command.

Bit 10 - Illegal Command

This bit indicates an illegal command sequence is detected. For example, a read reverse command is decoded with tape unit at BOT or both write and reverse bits are set when a command is decoded. This bit also sets bit 8 of word 1.

Bit 9 - Density Conflict

This bit indicates that the selected tape density is incorrect.

Bit 8 - Device Response Check

This bit indicates that a communications error is detected between the tape unit and formatter.

Bit 7 - Position Check

This bit indicates that a hardware failure is detected. This bit also sets bit 8 of word 1.

Bit 6 - Channel in PE

This bit indicates that a parity error is detected on data received from the channel. This bit also sets bit 8 of word 1.

Bit 5 - Write Hardware Check

This bit indicates that a hardware failure is detected. This bit also sets bit 8 of word 1.

Bit 4 - Gap Control

This bit indicates that a hardware failure is detected. This bit also sets bit 8 of word 1.

Bit 3 - Read Timeout

This bit indicates that no data is detected within 7.6 m (25 ft) of tape in PE mode or 4.6 m (15 ft) in GCR mode. This bit also sets bit 7 of word 1.

Bit 2 - Noise

This bit indicates that noise is detected during a read-after-write check on an erase command or an IBG is not detected at end of record. This bit also sets bit 7 of word 1.

Bit 1 - ID Check

This bit indicates that the ID is not correctly recorded while writing from BOT or is not detected while reading from BOT. This bit also sets bit 7 of word 1.

Bit 0 - Uncorrectable Data

This bit indicates that a data error cannot be corrected.

WORD 4 - LAST 4 BITS OF SENSE BYTE 4 AND SENSE BYTE 5

Bit 11 - Postamble Error

This bit indicates that a postamble error is detected. This bit also sets bit 7 of word 1.

Bit 10 - Multidrop

This bit indicates that more than one pointer in PE mode or more than two pointers in GCR mode is detected. This bit also sets bit 7 of word 1.

Bit 9 - No Track Pointer

This bit indicates that a parity error is detected in PE mode while a pointer is not detected. This bit also sets bit 7 of word 1.

Bit 8 - TIE 4

This bit indicates that track 4 (parity bit) is in error.

Bit 7- TIE 7

This bit indicates that track 7 (data bit 0) is in error.

Bit 6 - TIE 6

This bit indicates that track 6 (data bit 1) is in error.

Bit 5 - TIE 5

This bit indicates that track 5 (data bit 2) is in error.

Bit 4 - TIE 3

This bit indicates that track 3 (data bit 3) is in error.

Bit 3 - TIE 9

This bit indicates that track 9 (data bit 4) is in error.

Bit 2 - TIE 1

This bit indicates that track 1 (data bit 5) is in error.

Bit 1 - TIE 8

This bit indicates that track 8 (data bit 6) is in error.

Bit 0 - TIE 2

This bit indicates that track 2 (data bit 7) is in error.

WORD 5 - SENSE BYTE 6 AND FIRST 4 BITS OF SENSE BYTE 7

Bits 11 through 4 - Fault Symptom Code

These bits provide fault code representation for internally detected failure mode. Refer to the STU reference/maintenance manual listed in the preface.

Bits 3 through 0 - Marginal Device Indication

These bits and bits 11 through 8 of word 6 provide an indication of marginal tape unit performance. Refer to the STU reference/maintenance manual listed in the preface.

WORD 6 - LAST 4 BITS OF SENSE BYTE 7 AND EXTENDED SENSE BYTE 3

Bits 11 through 8 - Marginal Device Indication

Bit 7 - Host Command Reject

Bit 6 - Write Parity Error

Bit 5 - Read Parity Error

Bit 4 - Read FIFO Overflow/Underflow

Bit 3 - Remote Density Select

Bit 2 - F/I Unit Check

Bit 1 - Formatter Response Check

Bit 0 - Not Used

WORD 7 - EXTENDED SENSE BYTE 4 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 5

Bit 11 - Illegal Interface Command

This bit indicates an illegal operation code from the I/O board. A command was issued specifying wrong direction, such as, a reverse command from BOT.

Bit 10 - Device Command Check

This bit indicates that a read reverse or backspace command was issued at BOT.

Bit 9 - Density Conflict

This bit indicates that the selected tape density is incorrect.

Bit 8 - File Protected

This bit indicates that a write command was issued to a tape unit with no write ring.

Bit 7 - Reset Key

This bit indicates that the reset switch on the tape unit has been activated.

Bit 6 - Not Used

Bit 5 - Device Not Ready

This bit indicates that the tape unit is not ready when a device command is received.

Bit 4 - Device Off Line

This bit indicates that the tape unit is off line when a device command is received.

Bit 3 - Interface Parity Error

This bit indicates that the formatter detects a parity error from the adapter.

Bit 2 - Interface Response Check

This bit indicates that the adapter does not respond to the formatter.

Bit 1 - Read Hardware Check

This bit indicates that a hardware malfunction occurred in the formatter read circuit.

Bit 0 - Write Hardware Check

This bit indicates that a hardware malfunction occurred in the formatter write circuit.

WORD 8 - LAST 4 BITS OF EXTENDED SENSE BYTE 5 AND EXTENDED SENSE BYTE 6

Bit 11 - Device Response Check

This bit indicates that the formatter received incorrect status from the tape unit.

Bit 10 - Device Hardware Check

This bit indicates that a hardware malfunction occurred in the tape unit.

Bit 9 - Velocity Check

This bit indicates that the tape unit did not come up to speed in the required time.

Bit 8 - Device Interrupt

This bit indicates that a tape unit interrupt occurred during operation.

Bit 7 - AGC Check

This bit indicates that the automatic gain control could not be properly set in GCR mode during an automatic read amplification (ARA) burst.

Bit 6 - Not Used

Bit 5 - Read Data Check

This bit indicates that an error is detected by the formatter read logic.

Bit 4 - ID Fault

This bit indicates that a bad ID field on tape is detected by the formatter or the AGC check bit is set.

Bit 3 - Not Used

Bit 2 - Unrecoverable Error

This bit indicates that data is unrecoverable.

Bit 1 - BOT Error

This bit indicates that an error occurred at BOT.

Bit 0 - Tape Motion

This bit indicates that tape motion occurred during the last operation.

WORD 9 - EXTENDED SENSE BYTE 7 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 8

Bits 11 through 4 - Formatter Command

These bits provide the binary code of the formatter command that was executed.

Bit 3 - GCR Mode

This bit indicates that the formatter was in GCR mode during the last operation.

Bit 2 - High-Speed Mode

This bit indicates that the formatter was in high-speed mode during the last operation.

Bit 1 - Adaptive Velocity

This bit indicates that the speed will be automatically selected by the subsystem to provide optimal throughput.

Bit 0 - File Mark Detected

This bit indicates that a file mark was detected during the last operation.

WORD 10 - LAST 4 BITS OF EXTENDED SENSE BYTE 8 AND EXTENDED SENSE BYTE 9

Bit 11 - Diagnostic Mode

This bit indicates that the formatter was in diagnostic mode during the last operation.

Bit 10 - Start/Stop Mode

This bit indicates that the formatter is in start/stop mode.

Bits 9 and 8 - Gap Mode

These bits indicate which gap mode is selected by the jumper options and the tape unit FLGAP I/O signal during a write operation. These bits are coded as follows:

Bit 9	8	
0	0	Fixed gap mode
0	1	Variable short gap mode
1	0	Variable long gap mode
1	1	Extended gap mode

Bits 7 through 0 - Diagnostic Fault Code

These bits provide the fault code used by the customer engineer to isolate a probable failing field replaceable module. Refer to the STU hardware reference/maintenance manual volume 2 listed in the preface for SAM tables and fault code definitions.

WORD 11 - EXTENDED SENSE BYTE 10 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 12

Bits 11 through 4 - Diagnostic Subfault Code

These bits provide the subfault code that is used with the SAM tables to isolate a hardware element that failed during a diagnostic test.

Bit 3 - Write Transfer Check

This bit indicates that the write strobe generator contains a malfunction.

Bit 2 - Residual Byte Count Check

This bit indicates that the formatter latency buffer contains a malfunction that results in the wrong number of residual bytes at the end of operation.

Bit 1 - Write CRC Parity Error

This bit indicates that the write cyclic redundancy check (CRC) generator contains a malfunction.

Bit 0 - 4/5 Parity Error

This bit indicates that the GCR write 4 to 5 conversion logic contains a malfunction.

WORD 12 - LAST 4 BITS OF EXTENDED SENSE BYTE 12 AND EXTENDED SENSE BYTE 13

Bit 11 - Not Used

Bit 10 - Write AUX CRC Parity Error

This bit indicates that the AUX CRC generator contains a malfunction.

Bits 9 and 8 - Not Used

Bit 7 - Residual Character Check

This bit indicates that the GCR residual character is incorrect.

Bit 6 - Read CRC Check

This bit indicates that the GCR CRC character is incorrect.

Bit 5 - Read AUX CRC Check

This bit indicates that the GCR auxiliary character is incorrect.

Bit 4 - Resync Error

This bit indicates that the GCR resync group is incorrect.

Bit 3 - ECC 3

This bit indicates that an error is detected in corrected data.

Bit 2 - Uncorrectable Data

This bit indicates that an uncorrectable error is detected in the data.

Bit 1 - No Track Pointer

This bit indicates that an error was detected in PE mode and no track pointer was specified. This bit also sets bit 2 of this word.

Bit 0 - Excessive Pointers

This bit indicates that an error was detected in GCR mode and more than two track pointers were specified. This bit also sets bit 2 of this word.

WORD 13 - EXTENDED SENSE BYTE 14 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 15

Bit 11 - Noise Check

This bit indicates that the erase operation is incomplete or marginal.

Bit 10 - Postamble Error

This bit indicates that an error was detected in the postamble.

Bit 9 - Skew Error

This bit indicates that excessive skew was detected.

Bit 8 - Read Timeout

This bit indicates that no data is detected within 7.6 m (25 ft) of tape in PE mode or 4.6 m (15 ft) in GCR mode.

Bit 7 - Write Tape Mark Check

This bit indicates that a read-after-write error is detected while writing a tape mark.

Bit 6 - ID Check

This bit indicates that an error is detected in the ID burst in PE or GCR mode.

Bit 5 - ARA Burst Check

This bit indicates that an error is detected during the automatic read amplitude burst in GCR mode.

Bit 4 - ARA ID Check

This bit indicates that an error is detected in the ARA ID during GCR mode.

Bit 3 - EC Hardware Check

This bit indicates that the error correction hardware contains a malfunction.

Bit 2 - Read Buffer in Parity Error

The bit indicates that a parity error occurred on read data into the latency buffer.

Bit 1 - Read Transfer Check

This bit indicates that the read strobe generator contains a malfunction.

Bit 0 - Read Data Parity Error

This bit indicates that a parity error is detected while read data is transferred to the read output buffer during a diagnostic test.

WORD 14 - LAST 4 BITS OF EXTENDED SENSE BYTE 15 AND EXTENDED SENSE BYTE 16

Bit 11 - End Mark Check

This bit indicates that an end mark is missing in GCR mode.

Bit 10 - Double-Track Correction

This bit indicates that double-track correction occurred in GCR mode.

Bit 9 - Single-Track Correction

This bit indicates that single-track correction occurred in PE or GCR mode.

Bit 8 - TIE 4

This bit indicates that the parity track is in error.

Bits 7 through 0

These bits indicate which track is in error.

WORD 15 - EXTENDED SENSE BYTE 18 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 19

Bit 11 - Reverse

This bit indicates reverse status in the tape unit during the last command.

Bit 10 - Write

This bit indicates write status in the tape unit during the last command.

Bit 9 - Data Security Erase

This bit indicates data security erase status in the tape unit during the last command.

Bit 8 - GCR

This bit indicates GCR mode status in the tape unit during the last command.

Bit 7 - Variable Long Gap

This bit indicates variable long gap status in the tape unit during the last command.

Bit 6 - Start/Stop

This bit indicates start/stop status in the tape unit during the last command.

Bits 5 and 4 - Not Used

Bit 3 - Remote Diagnostics Inhibit

This bit indicates that a diagnostic test is being executed from the tape unit control panel which inhibits execution of remote diagnostics.

Bit 2 - Remote Diagnostics

This bit indicates that a diagnostic test is being executed from the system console.

Bit 1 - LWR I/F

This bit indicates that a loop write-to-read diagnostic test is being executed on the tape unit/formatter interface.

Bit 0 - LWR PE

This bit indicates that a loop write-to-read diagnostic test is being executed in PE mode through the tape unit's read/write hardware.

WORD 16 - LAST 4 BITS OF EXTENDED SENSE BYTE 19 AND EXTENDED SENSE BYTE 20

Bit 11 - LWR GCR

This bit indicates that a loop write-to-read diagnostic test is being executed in GCR mode through the tape unit's read/write hardware.

Bit 10 - Not Used

Bit 9 - Not Used

Bit 8 - GCR Density Selected

This bit indicates that the last density selected by the operator before going on line was GCR density.

Bit 7 - Command Reject

This bit indicates that an invalid command was received from the adapter. A breakdown of this condition can be derived from bits 3 through 0 of word 3.

Bit 6 - Device Fault

This bit indicates a hardware malfunction in the tape unit. A breakdown of this condition can be derived from the remaining sense bytes.

Bit 5 - Diagnostic Request

This bit indicates that the tape unit requested the formatter to execute a diagnostic test.

Bit 4 - Local Density Change Request

This bit indicates that the tape unit requested the formatter to execute a density change.

Bit 3 - AGC Check

This bit indicates that the automatic gain control is not correctly set in GCR mode.

Bit 2 - Reset Key

This bit indicates that the reset switch on the tape unit control panel was activated.

Bit 1 - Reverse in BOT

This bit indicates that the BOT was detected while tape was moving in reverse.

Bit 0 - Marginal Condition

WORD 17 - EXTENDED SENSE BYTE 21 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 22

Bits 11 through 4 - Last Rejected Command Code

These bits define the last rejected command code of the tape unit. If bit 11 of word 18 is set, these bits define bits in error for the AGC check.

Bit 3 - HSPD Up Ramp Timeout of Marginal Limits

Bit 2 - LSPD Up Ramp Timeout of Marginal Limits

Bit 1 - HSPD Down Ramp Timeout of Marginal Limits

Bit 0 - LSPD Down Ramp Timeout of Marginal Limits

WORD 18 - LAST 4 BITS OF EXTENDED SENSE BYTE 22 AND EXTENDED SENSE BYTE 23

Bit 11 - HSPD Speed

Bit 10 - LSPD Speed

Bit 9 - LSPD AGC

Bit 8 - HSPD AGC

Bits 7 through 0 - Fault Code/Test Completion Code

WORD 19 - EXTENDED SENSE BYTE 24 AND FIRST 4 BITS OF EXTENDED SENSE BYTE 25

Bits 11 through 4 - Subfault Code/Test Completion Code

These bits contain the subfault code for an internally detected failure mode during a hard error. During remote diagnostics, it contains a test subcompletion code.

Bits 3 through 0 - Reserved for Future Use (RFU)

WORD 20 - LAST 4 BITS OF EXTENDED SENSE BYTE 25 AND EXTENDED SENSE BYTE 26

Bits 11 through 8 - Reserved for Future Use (RFU)

Bits 7 through 0 - Microcode Revision Level

GLOSSARY

A

Adapter

The equipment that provides a hardware connection between a streaming tape unit (STU) and a CYBER 180 series computer system. It converts CYBER 180 functions to the command set of the tape unit.

Controlware

A program that executes within the adapter and determines the functional characteristics of the adapter. It resides in adapter RAM.

Deadman Timer

An adapter circuit that deactivates the connected channel when the channel is active but has not transferred a word for 16 seconds.

Device

A tape unit. Also called a drive.

Firmware

A program that resides in the adapter ROM. It provides internal adapter tests and autoloads the controlware into adapter RAM.

Function

A 12-bit code issued by a PP to the adapter to initiate adapter or subsystem activity.

Operation

An adapter or subsystem task controlled by one or more PP functions.

Parameter

One or more 12-bit words issued after a function to provide the adapter with information relative to the function.

Processor

A microprocessor within the adapter.

Random-Access Memory

This is a portion of the processor memory that is used for controlware storage. It is abbreviated RAM.

Read-Only Memory

A portion of the processor memory that contains brief internal adapter tests and code for processing autoloading functions. It is abbreviated ROM.

DEADMAN TIMER

B

The adapter uses a deadman timer for functions that transfer data, parameters, or status between the adapter and PP. The timer monitors the PP channel for a hung condition. Each time a full or empty signal is transferred across the channel, the timer is disabled. If a word is not transferred in 16 seconds, the timer deactivates the channel and resets to zero.

CHANNEL PARITY ERROR ON FUNCTION FROM PP

The adapter does not reply to a function having a parity error. The PP times out the function to avoid hanging the channel. After the time-out, the PP disconnects the channel and resends the function to the adapter. The operation must be aborted if parity errors continue.

PARITY ERROR ON PP WRITE

The PP completes the write operation normally after detection of the parity error. The PP then sends a general status function (0012) to the adapter. The adapter controlware prepares the status words in its memory. A general status of 5000 in word 1 is returned to the PP. The PP then sends a detailed status function (0112) to the adapter and bit 8 of detailed status word 3 is set to indicate a write parity error. The PP resends the write function and parameters or data to recover from the parity error. The operation must be aborted if parity errors continue.

NOTE

If parity errors occur during general or detailed status functions, refer to parity error on function from PP and parity error on PP read paragraphs.

PARITY ERROR ON PP READ

The PP tests the appropriate bit in the status and control register after the data block input. This is done prior to sending the next function. The adapter controlware does not detect a parity error on a PP read, and only general status indicates an adapter error. The PP must take one of the following actions after detecting the parity error.

- Resend the function and reread the parameters or data.
- Abort the operation if parity errors continue.

CONTROLWARE IDENTIFICATION

D

The controlware binary contains the following identification information when controlware is loaded into adapter memory.

<u>Adapter Memory Address (Hexadecimal)</u>	<u>Value (Hexadecimal)</u>	<u>Description</u>
4600	B465	Last four digits of controlware part number MB465.
4614	ODOX	Controlware revision number.

ADAPTER ERROR CODES

E

These error codes define the problem encountered during controlware initialization or when diagnostics detect a failure. During controlware initialization, the error codes are returned as the last 9 bits of general status word 1 (5XXX). During internal background diagnostics or following a run ISMT diagnostics function (0070), the failure is reported with the alert bit set in status word 1, error code 70 recorded in status word 3, and the adapter error code recorded in status word 10.

<u>Error Code</u>	<u>Description</u>
000	No error
<u>CYBER ICI ERROR CODES (001-077)</u>	
001	Special function logic error
003	Control out register error
004	Data loopback parity error
077	Undefined error
<u>DATA PATH ERROR CODES (100-177)</u>	
100	Control sequencer error
101	Writeable control store error
102	Pipeline register parity error
103	Arithmetic logic unit (ALU) index register error
104	First in/first out (FIFO) logic error
105	ALU error
106	ALU status register error
107	ALU condition code MUX error
110	FIFO to data path parity error
177	Undefined error
<u>68000 MICROPROCESSOR ERROR CODES (200-277)</u>	
200	Internal error
201	Instruction test error
203	Data path test error
204	Block ID test error

206 Status register test error
 207 Parity test error
 210 Interface to STU test error
 211 CYBER ICI channel test error
 220 Controlware ID error
 221 Controlware checksum error
 222 Controlware initialization error
 223 Controlware diagnostic error
 224 Controlware exception error
 225 Controlware interrupt error
 226 06XX function cannot find the controlware on tape
 227 06XX function unrecoverable tape error
 230 Interrupt controller logic error
 231 Counter timer logic error
 232 Single-error correction/double-error detection (SECDED) logic error
 233 Lower ROM error
 235 Lower RAM error
 236 Upper RAM error
 237 Parity error register error
 240 Data loopback error
 241 Channel was not activated in time for an autoloading function
 242 CYBER channel or adapter parity error during 04XX, 06XX function or data
 243 06XX function cannot connect to STU.
 244 06XX function cannot rewind the STU.
 277 Undefined error

STU INTERFACE ERROR CODES (300-377)

301 Data loopback data error
 302 Data loopback parity error
 304 STU formatter diagnostic test error
 377 Undefined error

COMMENT SHEET

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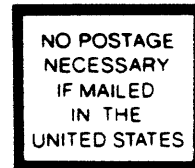
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