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Systems

IBM 3850 Mass Storage System (MSS) Principles of Operation

IBM®

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About this manual...

The audience for this manual is the customer and IBM people responsible for understanding the IBM 3850 Mass Storage System (MSS), installing it, and supporting it after installation.

This is basically a hardware manual. It describes the physical functions of each component and how these components interact to form a system capable of meeting your data processing needs. It describes the commands, orders, and response codes for each micro-programmed component.

The goal of the manual is to provide enough information about the MSS for you to understand and support it properly and get full benefit from its use. Application suggestions for the use of the system or techniques to justify its installion are not included, nor are the logical functions of data set organization and accessing explained.

The manual has two parts. Part I describes the Mass Storage System and its individual components and explains the actions and interactions of each of them.

Part II contains reference information for the MSS. This includes the Host/MSC commands and orders and MSS table and queue formats you might need for problem determination or system tuning.

General host program support for the MSS is not covered. The Bibliography at the back of this manual lists the places you can find out how OS/VS1 and OS/VS2 support the MSS as a data storage subsystem.

The microcoded programs executed in the Mass Storage Control (MSC), the Staging Adapter, and accessor control microprocessors are not covered in detail except where you need the information to know the effect of your installation variables on system operation or performance.

The MSS implements the concept of virtual online data storage. The nature and benefits of this concept are covered in the manual *Introduction to the IBM 3850 Mass Storage System, (MSS)* which you should read before attempting to use this manual.

Part I: System Description

Configuration Summary

The IBM 3850 Mass Storage System is made up of three physical components:

1. The IBM 3851 Mass Storage Facility
2. The Staging Adapter (either the IBM 3830 Model 3 or the ISC with Staging Adapter)
3. The IBM 3333 Disk Storage Control and IBM 3330 Model 1, 2, or 11 Disk Storage Units.

There are eight models of the IBM 3851 Mass Storage Facility. The following table summarizes their standard characteristics.

MSF Model	Number of DRDs	Number of DRCs	Number of MSCs	Maximum Number of Cartridges	Maximum Number of Mass Storage Volumes	Maximum Usable Capacity (10^9 Bytes)
A1	2	1	1	706	353	35.3
A2	4	2	1	2044	1022	102.2
A3	6	3	1	3382	1691	169.1
A4	8	4	1	4720	2360	236.0
B1	2	1	2	706	353	35.3
B2	4	2	2	2044	1022	102.2
B3	6	3	2	3382	1691	169.1
B4	8	4	2	4720	2360	236.0

The Mass Storage System may have one or two Mass Storage Facilities (MSF). If you have two, they must both be model A units. Two model A MSFs or one model B MSF provides two Mass Storage Controls (MSCs), only one of which can be active at any time. The second MSC is only used as an alternate to the active one and provides additional system availability.

Each MSC can have four System/370 channel connection interfaces; two are standard and two more are available as an optional feature. These are called the A, B, C, and D connections. Each of these connections can be used for a different CPU, or a single CPU can use two of them, one primary and the other as an alternate path to the MSC. Each MSC uses one control unit position on each channel to which it is attached.

In addition to the MSC, the MSF contains:

1. The dual accessor system and its controls.
2. The cartridge storage cells.
3. The Data Recording Devices (DRDs).
4. The Data Recording Control (DRC).
5. The cartridge access station, used for manually entering and removing cartridges from the Cartridge Store.

The accessor system and the storage cells make up the Cartridge Store.

The Staging Adapter for the Mass Storage System is either the IBM 3830 Model 3, or on the System 370 Models 158 and 168, the Integrated Storage Control feature with the Staging Adapter. Either of these may be used, and they may be intermixed in a single system. Each Staging Adapter must be connected to a lower port address of the MSC. The maximum number of System/370 channels to which the Staging Adapter can be attached is three for the 3830-3, or two for each path of the ISC with Staging Adapter.

Four Staging Adapters can be attached to each block multiplexor channel of a host system. The maximum number of Staging Adapters in a system with two MSFs is fourteen. This is the largest number of uniquely addressable Staging Adapter control units to which the MSC can attach.

A host system uses an address byte in the format *ddvvvvvv* in its channel commands to a Staging Adapter. *dd* is the address of the Staging Adapter (0-3), *vvvvvv* is the logical disk drive address (0-63) for that Staging Adapter.

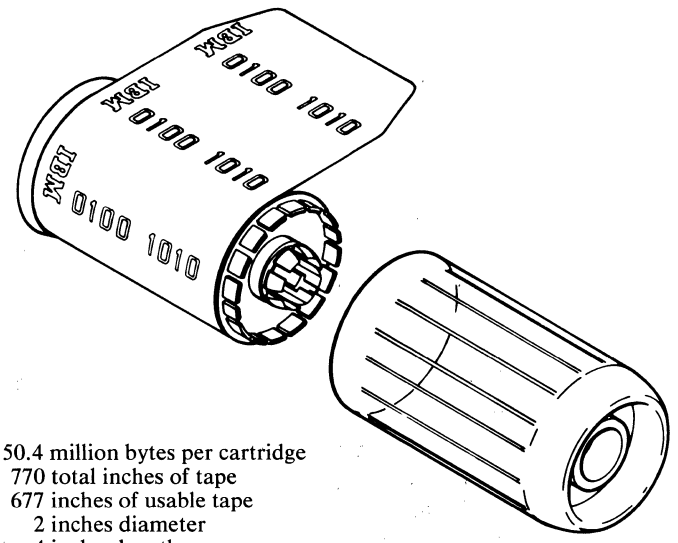
Each Staging Adapter has two control interfaces; one of these connects to a Data Recording Control (DRC) in the Mass Storage Facility, the other attaches to up to four IBM 3333 disk storage controls. Each 3333 can control up to eight 3330 disk storage drives. The total amount of 3330 DASD space that can physically attach to a Staging Adapter can exceed the amount that can be used for data staging. Each Staging Adapter can control one or two staging drive groups, each staging drive group having from one to eight logical 3330 Model 1 drives. The total staging space that can be addressed by a Staging Adapter cannot exceed 1.6×10^9 bytes. An IBM 3330-11 used for staging of data is treated like two 3330-1 units. The two disk storage models may be intermixed on one IBM 3333, but the total DASD space used for data staging cannot exceed that of eight 3330-1 units. Any drives over the maximum allowed for data staging must be designated as real drives.

The following chapter describes each part of the Mass Storage System in greater detail.

Component Descriptions

Data Cartridge

The data cartridge has a length of magnetic tape wound on a spool and enclosed in a tightly-fitting, transparent protective shell. Cartridge manufacturers assign a unique twelve-character identification number to each cartridge. This number is printed on the outer surface of the magnetic tape, and is visible through the plastic shell. Use it to identify a cartridge when it is outside the system. Do not write or put any adhesive identification labels on a cartridge because the added bulk or loose glue could cause the cartridge to bind when it is loaded into the Data Recording Device. Two data cartridges are logically connected to give a mass storage volume which is an image of an IBM 3336 model 1 disk pack.



50.4 million bytes per cartridge
770 total inches of tape
677 inches of usable tape
2 inches diameter
4 inches length

Figure 1. Data Cartridge

Data is recorded on the tape serially by bit as a series of diagonal paths called stripes. Following Figure 2, which shows the format of the stripes, is a description of the recording areas.

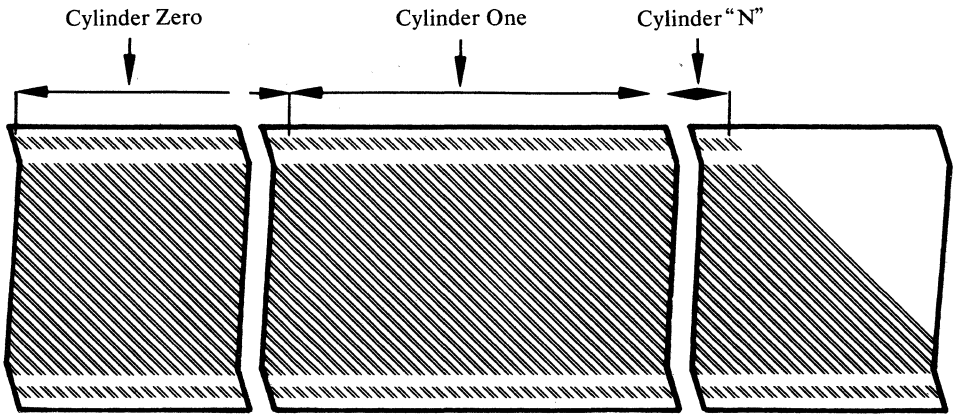


Figure 2. Stripe Format

Guard Bands

The guard bands at both ends of the stripe are blank. They allow the read/write heads time to settle over the stripe, and make tape edge damage less likely to affect the data.

Stripe Identification

The stripe ID area contains a two-byte stripe number recorded twice in consecutive two-byte fields. Stripe IDs are sequential and factory-written. The DRD cannot write in the stripe ID area. On each write operation, the system reads and compares the two IDs, and demarks the stripe (flags it as unwritable) unless they are equal. The system does not read these ID bytes during a read operation. Instead, it looks for the DRD-written ID at the beginning of the stripe data area.

Servo Area

The servo areas of the stripe are also factory-written and are used to align the read/write head along the center of the stripe.

Data Area

The data area of each stripe contains synchronization bits, the stripe identification number, 4096 bytes of data, and bytes used to detect and correct recording errors. The data area of each stripe is divided into "segments" of 208 bytes each. In normal operation, the segment is transparent to the user; however, the segment is the smallest unit of data which, in case of errors, you will have to consider in data recovery procedures.

The first 10 stripes on the cartridge tape (stripes 0-9) are the cartridge label area. Stripe 0 contains the twelve-character cartridge identification, repeatedly recorded throughout the stripe. On a cartridge that has never been loaded into a system, stripes 1-9 contain an image of stripe 0. This allows the MSC to distinguish between a new cartridge and one that has been removed from this or another Mass Storage System. The initial processing for a cartridge is writing the normal "VOL 1" header on stripe 1

of the label area. The presence of this "VOL1" header indicates that a cartridge has been entered before into this or another Mass Storage System. Stripes 2 and 3 are used for alternate stripes for stripe 1.

Stripe 5 is an image of the volume label. It is read only when the label is not readable from stripe 1, 2, or 3, and it is updated each time the volume label is updated. Stripes 6 and 7 are used as alternate label stripes for this label image. Stripes 4, 8, and 9 are reserved for system use. The format of the data cartridge label is shown later in this manual.

The remaining stripes on the cartridge are divided into 202 groups of 67 stripes each. A group corresponds to a specific cylinder of 3336 disk space. The 404 groups of stripes on two logically associated cartridges correspond to the cylinders of a 3336 Model 1 disk pack. When a cylinder of data is moved from a 3336 to a data cartridge, DASD home addresses, gaps, and error checking codes from the pack are omitted. One full cylinder of data from a 3336 pack can then be compacted and written on a maximum of 61 stripes on the data cartridge tape. With the 66th and 67th stripe reserved for system use, there is a minimum of four stripes left for alternate assignment.

Alternate stripes are assigned serially as they are needed and are not required to be at the end of the group of stripes. For example, if a write error indicates that the stripe being written (say stripe 18) is defective, the next stripe (in this case, 19) is used as the alternate, and normal data recording resumes on the following stripe (in this case, 20). If all 65 available stripes for a cylinder are used before all the data from the corresponding DASD cylinder is written, a "stripes available zero" error condition occurs. The recovery from this condition is described in the *OS/VS IBM 3850 Operations Guide.*

All cartridges used in the Mass Storage System must conform to IBM specifications.

Data Cartridge Storage Cells

Data cartridges are stored in hexagonal cells, stacked like a honeycomb, lining the front and back inside walls of the Mass Storage Facility. The front wall contains the cartridge access station; the back wall contains the data recording devices. Each storage cell has a unique physical cell address indicating which wall it is on (Z coordinate), how high it is above the bottom row of cells (Y coordinate), and how far it is to the right of the left accessor garage (X coordinate). These three coordinates determine the XYZ address of the storage cell.

The format of the two-byte XYZ address used by the Cartridge Store is shown below.

Byte 0								Byte 1							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Flag		Z	Y					X							

Flag bits:

00 Address is a storage cell

01 Address is a DRD entry station

10 Address is a DRD exit station

11 Address is the cartridge access station

The logical XYZ address (LXYZ) of a cell designates both the physical XYZ storage cell location for a data cartridge and which Mass Storage Facility of the two you may have in your system contains the cartridge. The MSF pointer replaces the flag bits in the two-byte cell address; the XYZ fields have the same meaning.

Flag bits:

00 Mass Storage Facility 0

01 Mass Storage Facility 1

This logical address is used in all the lists and tables in the Mass Storage System. The physical cell address (XYZ) is used only within a single Mass Storage Facility.

The range of valid XYZ addresses for each model of the Mass Storage Facility is shown in Figure 3.

Model	X	Y	Z
A/B 1	234-247	0-27	0-1
A/B 2	206-247	0-27	0-1
A/B 3	178-247	0-27	0-1
A/B 4	150-247	0-27	0-1

Figure 3. Valid X, Y, and Z coordinate addresses for all IBM 3851 models

XYZ Coordinates of the Cartridge Access Station and the DRDs	Z	Y	X
Cartridge access station entry	1	17	247
Cartridge access station exit	1	15	247
DRD 0 entry station	0	27	242
DRD 0 exit station	0	19	242
DRD 1 entry station	0	15	242
DRD 1 exit station	0	7	242
DRD 2 entry station	0	27	214
DRD 2 exit station	0	19	214
DRD 3 entry station	0	15	214
DRD 3 exit station	0	7	214
DRD 4 entry station	0	27	186
DRD 4 exit station	0	19	186
DRD 5 entry station	0	15	186
DRD 5 exit station	0	7	186
DRD 6 entry station	0	27	158
DRD 6 exit station	0	19	158
DRD 7 entry station	0	15	158
DRD 7 exit station	0	7	158

Figure 4. XYZ Coordinates for Cartridge Access Station and DRDs

The cells are organized logically into "cubes" of 32 storage cells, 16 cells on the back wall in a 4 x 4 array, and 16 cells directly across from them on the front wall. The volume occupied by these 32 cells is roughly that of a cube.

The Mass Storage Facility cell map, one of the MSC tables built by the Mass Storage Control Table Create program, shows the sequence, by cube, in which cartridges entered through the cartridge access station are assigned storage cell locations. Within this cell map, one bit represents each cell, to indicate whether the cell is full or empty.

Blocks of cells are removed from the cell structure to accommodate data recording devices, the cartridge access station, and physical access ports. Each of these missing storage cells is marked unusable in the cell map. The *OS/VS Mass Storage Control Table Create* manual contains more information about the cell map, including the IBM-supplied default sequence for loading cubes.

Storage cells in each accessor garage store CE data cartridges. Their cell XYZ addresses are not valid addresses for any model of the Mass Storage Facility and can be used only by the Customer Engineer.

Cartridge Access Station

The cartridge access station, shown below, is used for putting cartridges into the Mass Storage Facility and for retrieving cartridges that the system ejects. It consists of the entry cell at the bottom of the entry chute and below it the exit cell at the top of the exit chute. The entry and exit cells each have XYZ addresses in the same format as those of the storage cells.

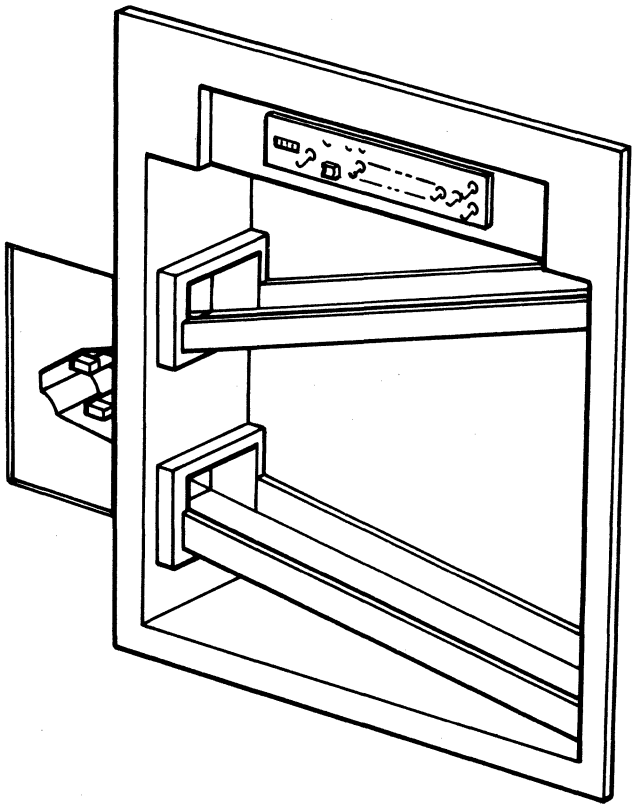


Figure 5. Cartridge Access Station

The cartridge access station is usable only when the MSC has an initiatized interface to a host System/370, and when that host is ready to receive the unsolicited messages generated by cartridge entry from the MSC.

The procedure for entering a cartridge into the Mass Storage Facility and a description of the processing done by the MSC at that time are in the Cartridge Entry section in Part II of this manual.

Accessor

The accessor moves data cartridges between cell locations, data recording devices, and the cartridge access station. Within a Mass Storage Facility, there are two accessors, each capable of reaching any cell location. The CE cartridge cell locations in the accessor garages, however, can only be reached by the accessor in whose garage they are located.

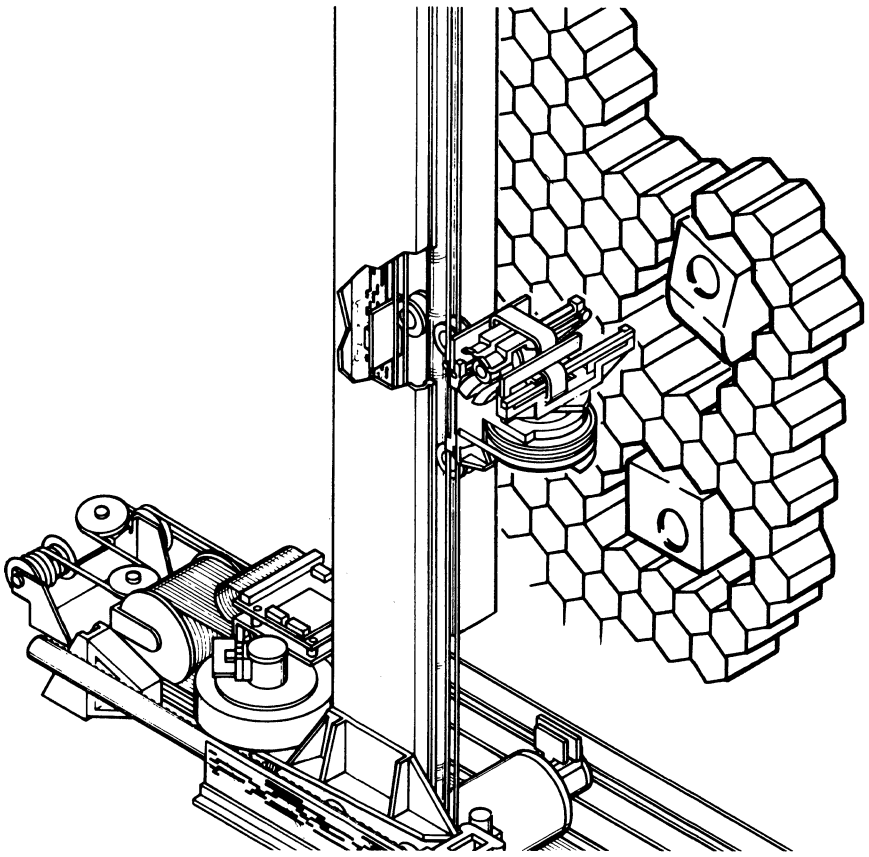


Figure 6. Accessor and Storage Cells

When an accessor moves, it is tracked by the accessor control by optically scanning coded plastic strips attached to the carriage tracks and by a tachometer attached to the drive motor. A mark on each strip at the center line of a cell confirms the alignment of the accessor.

The swivel that carries the cartridge picker has an optical sensor that indicates in which position (facing the front wall or back wall) the picker is.

The horizontal, vertical, and swivel motions of the accessor are simultaneous, making the total move time of the accessor equal to the longest of the three.

Accessor Control

The accessor control combines a microprocessor and hardware logic to control the physical motion of the two accessors in the Mass Storage Facility. Each Mass Storage Facility has two microprocessors, one in active control, the second acting as a stand-by to take control automatically if the active one fails.

The accessor control receives its move orders from the Mass Storage Control in the form of a command sequence followed by from one to eight move orders. The number of move orders sent at one time depends on the workload of the accessor control. When the accessor control is busy, the Mass Storage Control queues up move orders and sends them to the control when the control is free. The move orders are each four bytes long, the first two bytes being the "from" address, the second two bytes being the "to" address. The accessor control verifies that each address received is valid and within the physical boundaries of the Mass Storage Facility.

When more than one order is received at a time, the accessor control sequences the moves to get efficient accessor motion. If both accessors are available, the steps the control takes are:

- Sort the moves in ascending order of "from" addresses. Dispatch the moves so that both accessors are moving at the same time without interference.
- If necessary, when one accessor finishes its move, move it out of the way until the other accessor is finished, to avoid interference.
- If two moves involve the same data recording device, assign them to the same accessor.

If only one accessor is active, the move orders are scheduled sequentially, as sorted in the first step above.

Data Recording Device

The data recording device (DRD) is the tape read/write component for the Mass Storage System. It has three cartridge stations: an entry station, where the accessor delivers a cartridge to be read or written; a read/write station; and an exit station, from which the accessor retrieves the cartridge for storage back at its home cell location or to the exit cell of the cartridge access station. The entry and exit stations let the DRD load and unload cartridges without having to wait for the accessor to service it.

When the read/write station is free and a cartridge is in the entry station, the cartridge is moved to the read/write station and the spool of tape is moved out of its protective shell. The tape is threaded through the read/write transport, around a mandrel (a stationary cylinder), and onto a take-up spool. The helical path taken by the tape and the location of the read/write heads inside the mandrel are shown in Figure 7.

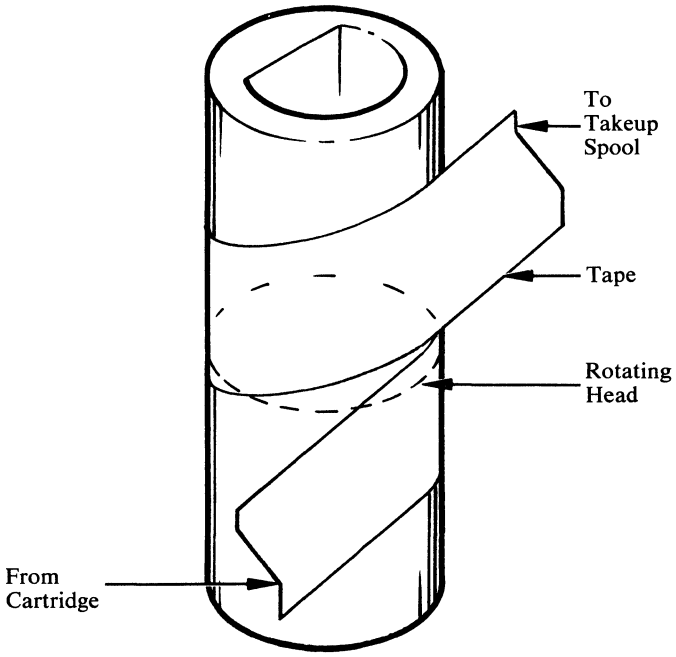


Figure 7. Mandrel and Tape Path

Dual heads write the data and do a readback check of all information written on the same revolution of the read/write head within the mandrel. The tape is held stationary while it is being read or written. When the read/write head reaches the end of a data stripe, the tape moves incrementally to the next stripe.

A high-speed (non-incremental) tape motion is used when the data recording device is scanning the tape for the stripes associated with a specific cyclinder it has to read or write.

When all the activity scheduled for the currently loaded cartridge is done, the data recording device receives an UNLOAD order from the Staging Adapter. The DRD rewinds the tape onto the supply spool, replaces the protective shell, and drops the cartridge into the exit station. From this exit station, the accessor returns the cartridge to its storage cell.

During each data cartridge unload operation, the tape head is automatically cleaned by a head cleaner built into the DRD.

Data Recording Control

The data recording control (DRC) transfers data between a data recording device and a Staging Adapter. Data formatting, serialization and deserialization of bits to bytes, error detection and correction, generation of parity bits, and generation of the error detection and correction codes are done in the data recording control. The data recording control can control a primary pair and one alternate pair of data recording devices in the same Mass Storage Facility.

The data recording control is not connected to the Mass Storage Control, but receives all its orders from the Staging Adapter. These orders are listed in Part II of this manual.

DASD Component Description

The Mass Storage System uses the 3333 control unit and the 3330 Model 1, 2, or 11 for staging data and for holding the tables it requires for its operation. These units connect to the Mass Storage Facility and to the CPU through a Staging Adapter. The several models of the 3330 may be intermixed on the Staging Adapter. Other DASD devices, such as the IBM 3340, may be used in the total computer configuration, but their data path and control cannot be through a Staging Adapter.

The 3330 disk drives can be one of the following:

- Real
- Staging
- Convertible

Real Drives

Real DASD drives are not available to the Mass Storage System for any activity. They are physically part of the system in that they use a data and control path through a Staging Adapter, but real drives are not logically connected to the Mass Storage System. Each real drive has its own Unit Control Block (UCB) in the host CPU.

Because of the data and control path through the Staging Adapter, real drives must be defined to the Mass Storage System when the MSC tables are created. When a command from the host is received by the Staging Adapter, the Staging Adapter must be able to determine if the unit addressed is a staging drive and translation of the virtual data address is required, or if it is real, in which case no address translation is needed. Real drives are allowed in the Mass Storage System configuration to provide immediate access to resident data, with no delay for staging, without forcing the user to provide additional control units or channels.

Real drives are not available to a host system through a Staging Adapter until the Mass Storage Control has completed the VERIFY portion of its IML sequence. Therefore, a host system cannot IPL from a real drive or access data on a real drive until the Mass Storage System completes its IML.

Staging Drives

Staging drives are used to hold data staged from mass storage volumes to be available for processing by the CPU, and to hold the tables used by the Mass Storage System. Staging drives are not identified by UCBs in the host CPUs, but rather by subsystem identification (SSID) numbers in the Mass Storage System. The staging drives can be varied online and offline only by the MSS form of the VARY command described in the *OS/VS IBM 3850 Mass Storage System (MSS) - Operations Guide*.

On a staging drive, the Write Inhibit switch should always be in the Read/Write position. Because data from several virtual volumes can be on the same staging pack, the write inhibit feature must be controlled by mass storage volume attributes and not by the physical switch.

Staging drives are logically divided into staging drive groups, to assist in the management of online space. Each staging drive must belong to one and only one staging drive group. There can be no more than two staging drive groups for each Staging Adapter. These are logical groups and need not be on drives attached to the same 3333 controller. The members of a staging drive group, however, must have a data path to the same Staging Adapter. Each staging drive group can have a maximum of eight logical staging drives, a logical drive being the equivalent of one IBM 3330 Model 1. One 3330 Model 11 counts as two logical staging drives.

Convertible Drives

Convertible drives can be either *real* or *staging* drives, but not both at the same time. When a drive is being used as real, it must have a real UCB varied online in the host and must have mounted on it a pack formatted for normal system use. When in use as a staging drive, the real UCB must be offline and the drive must have a pack mounted on it that is formatted for staging use and has the proper VOLID. The procedure for converting a drive from real to staging, or from staging to real, is described in the *OS/VS IBM 3850 Mass Storage System (MSS) - Operations Guide*.

Staging Packs

Staging packs are formatted by the IEHDASDR program using the new MSS operand. Staging packs have the following characteristics.

- The volume identification (VOLID) is a six-character name, the first four characters of which must be common to all staging packs used in the system. The last two characters must be the same as the last two characters of the SSID of the drive on which the pack is to be mounted.
- The volume table of contents (VTOC) for the staging pack must be on cylinder 0, track 2.
- The VTOC is initialized to show that the pack contains no free space on the whole pack. Therefore, if the pack should be inadvertently mounted on a drive available to the host control program, no space can be allocated from it.
- The VTOC indicates that the tracks available for alternate track assignment are different from those on a normal pack. Some of the cylinders normally used for alternate assignment are used to increase the space available on the pack for the staging of data.

Space on the staging pack is divided into pages of eight cylinders each, the page being the basic unit of space allocation in the Mass Storage System. Cylinder 0 is the exception, being a one-cylinder page. Cylinder 0 is not used for data staging but is reserved for the label and VTOC of the staging pack.

The Mass Storage Control tables occupy four pages (32 cylinders) on a staging pack. The remainder of the pages on a table pack are available for data staging. If you vary the drive on which a table pack is mounted offline, the drive remains online, but the data staging areas on the mounted pack become unavailable for use.

Mass Storage Control (MSC)

The Mass Storage Control is a microprogrammed processor that provides the operational control for the components of the Mass Storage System. It is physically housed in the IBM 3851 Mass Storage Facility.

The Mass Storage Control may have four System/370 channel interface positions, referred to as A, B, C, and D. A host system attaches to one of these through a control unit position of either the byte multiplex channel or a block multiplex channel operating in the burst (non-selector) mode. If an additional channel interface position is available on the MSC, a host system can increase system availability by using it as an alternate interface. An alternate interface must have a multiplex channel position independent from that of the first interface. If the Mass Storage System is used by a Multi-Processor (MP), both of the CPUs of the MP must have a channel interface to the MSC and neither may have an alternate interface.

The Mass Storage Control channel interface is used for transfer of orders, commands, control information, and status messages between the host system and the MSC. It does not carry user application data.

The Mass Storage Control exchanges control information with the accessor control and with the Staging Adapters through the MSC lower connection ports. Port 0 is standard on the MSC, port 1 is an option available as the Twin Port feature. Each port of the MSC has the ability to address eight control units, a control unit in this case being an accessor

control or a Staging Adapter. Staging Adapter 0, which controls the primary table pack of the MSC, must be attached to control unit position 0 of port 0.

To extend the storage capacity of the Mass Storage Control, the routines that handle many of the work requests from a host system are stored in the MSC/Overlay/EC table on the MSC table packs and are read into a work area of MSC main storage for execution. All control routines of the MSC are resident.

The MSC microprogram performs the following functions:

- Interprets and executes commands from a host system.
- Maintains a record of the status of all components of the Mass Storage Facility (MSF).
- Maintains the active and transient volume lists and the scratch cartridge list indicating the XYZ location of every cartridge in the Cartridge Store.
- Schedules all tasks to be performed in the MSF.
- Maintains on the MSC tables the status of all tasks being executed in the MSF for recovery purposes.
- Manages all DASD staging space and MSF component allocation.
- Maintains tables indicating the real-to-virtual address translation necessary to service host system data requests.
- Services interrupts from the cartridge access station to process cartridges into the system.
- Performs error recovery and alternate path retry for all units of the MSF. The host error recovery procedures are not used until all MSF recovery capability is exhausted.
- Maintains error statistics for subsystem components.
- Records error statistics for each cartridge on the label of the cartridge.

Alternate MSC

You may have a second MSC in your Mass Storage System for use as an alternate or back-up for the active MSC to improve system availability. More information on the alternate MSC is provided in the section of this manual describing the Power-up Sequence.

Staging Adapter Functional Description

A Staging Adapter in the Mass Storage System is either an IBM 3830 Model 3 or, on the System/370 Model 158 or 168, the Integrated Storage Control (ISC) feature with the Staging Adapter. Aside from the differences in packaging, the physical difference between these two is the number of host system channels to which they can attach and, therefore, the number of virtual drives they can address. The 3830-3 can have a maximum of four channel interfaces, the first of which must be attached to a control unit position of the Mass Storage Control port. Host systems may attach to the remaining three channel interfaces and can address 64 addresses on each interface, for a total of 192 addresses. Each half of the ISC feature with Staging Adapter can have three channel interfaces, the first of which must attach to the Mass Storage Control. The two remaining host channels can address a maximum of 128 units. There is no logical difference in the way the 3830-3 and the ISC with the Staging Adapter feature perform the Staging Adapter function and the two can be intermixed in the same Mass Storage System.

The Staging Adapter has two other interfaces called control interfaces. One of these is normally connected with a Data Recording Control (DRC) of the Mass Storage Facility, the other must be connected to one or more IBM 3333 DASD controls.

The microprogrammed processor in the Staging Adapter has in addition to its main storage, 8K words which are used as a buffer for the data being staged or destaged between the DASD staging drives and the mass storage volumes of the Mass Storage Facility. The microprogram for the Staging Adapter is loaded from a diskette during its power-up sequence.

The MSC uses a set of tables to record the status of each real and virtual device it controls. When these tables are brought into the Staging Adapter during its IML, all the drives are assumed to be virtual. The action of the MSC during its VERIFY process changes the Staging Adapter tables to reflect the true real or virtual and online or offline status of each drive. Unless the MSC successfully completes the VERIFY process, the CPU cannot access data from real DASD drives connected through the Staging Adapter.

The Staging Adapter has 4 functions: (1) to transfer data between the host system and the DASD drives where the data resides for user processing, (2) to stage and destage data between the cartridges of the Mass Storage Facility and the DASD drives, (3) to intercept host system DASD commands directed at a virtual device and translate the addresses to those of the real cylinders on which the data has actually been staged, and (4) subsystem recovery.

DASD Data Transfer

There is no change in the functional operation of the existing DASD command set used by a host system. Any changes in the execution of the commands are internal to the Staging Adapter and transparent to the user.

The number of active simultaneous command chains being executed through a Staging Adapter can be more than the number of physical drives attached to it. Those chains that are not active are held in the channel retry status. A command issued to a virtual unit address whose staging drive is engaged in an activity associated with another virtual unit address must wait until the active chain is finished.

Only during a SEEK operation does the virtual-to-real address translation take place in the Staging Adapter. Since data for a virtual volume may be spread across two or more staging drives, command chains not starting with a SEEK will not necessarily find the data they are looking for. The SEEK HEAD command is executed in the Staging Adapter as a SEEK CYLINDER operation in case another virtual volume access has moved the heads.

SEEK CYLINDER operations can still be rejected due to file mask settings.

Data Staging

When a cartridge containing data to be staged has been loaded into a Data Recording Device (DRD) in the Mass Storage Facility, the Mass Storage Control sends a command to complete the staging operation to a Staging Adapter that has the necessary path to both the DRD and the host system requesting the data. The Staging Adapter initiates a search of the tape to find the proper cylinder and subsequent cylinders of data to be staged and successive stripes from that cylinder are read into the Staging Adapter buffer. Only whole stripes are read. After the stripes are read, the Staging Adapter converts the data to DASD format and unloads the buffer record by record onto real DASD space as specified in the staging order from Mass Storage Control. Any partial records are kept in the buffer until the next read of stripes from the tape. The effect is that of a circular buffer. By doing this, only full stripes are read from tape and only full records are written to DASD.

The cylinders used for the data are previously assigned to that data by an ACQUIRE order received by the Mass Storage Control from a host system. Physical DASD space is assigned by the eight-cylinder page, but data is staged by the cylinder. Only the cylinders asked for are staged.

Since the Mass Storage Control schedules data staging by virtual volume, the data staged could belong to several data sets, and the virtual volume can be spread across several drives from the same staging drive group.

When all the data required from a given cartridge has been staged, the cartridge is unloaded from the DRD and the Mass Storage Control brings the next cartridge containing data to be staged into the read position of the DRD.

During a data staging operation, the Staging Adapter is needed to initiate the data transfer from the DRD and to write the reformatted data to the staging drive. During the data transfer from the DRD to the Staging Adapter buffer, normal data transfer operations between the Staging Adapter and a host system are not interrupted.

Only one stage operation can be processed within the Staging Adapter at a time. The Staging Adapter checks for any excessively long-running execution. If a timeout occurs, the Staging Adapter presents a unit check to the Mass Storage Control along with sense data to allow error recovery procedures in the MSC to do what is necessary.

Destaging

Destaging operates in much the same way as staging but with the data path in the opposite direction. Only cylinders on which new data has been written are destaged. Data is read record by record into the Staging

Adapter buffer, compressed into tape format, and written to the data cartridge that makes up one-half of the appropriate mass storage volume. Data is written stripe by stripe to the tape.

Following the destage operation, the Staging Adapter examines the security flag associated with the data just destaged to determine if the cylinders of DASD space should be erased. If so, the erase character is written in all positions of the cylinders affected and the cylinders of data are marked invalid to prevent any attempt at reuse by a subsequent program. If the data is not erased, it remains valid and the pages can be reclaimed by a new ACQUIRE order for the data or by cylinder fault processing.

If the data is destaged, but not erased, because of a DEMOUNT order, it can be reclaimed by a subsequent MOUNT order for the same data on the same staging drive group.

Virtual Address Translation

The Staging Adapter takes the SEEK command from the command chain sent from a host system and converts the cylinder address specified in the command into the address of the real cylinder on which the data has been staged. This real address is stored in the Staging Adapter for use by the rest of the commands in the chain. The real address is recalculated with each SEEK command.

If the cylinder address translates into a cylinder that the Staging Adapter table indicates is not staged, the Staging Adapter passes a cylinder fault to the Mass Storage Control requesting the immediate scheduling of the staging of data for that cylinder.

If the host tries to access data from a virtual volume that the Staging Adapter tables indicate is not mounted, the Staging Adapter sends a unit check with intervention required to the host in the same way it does if a real volume is not ready.

If a command chain addresses a volume defined as real, the Staging Adapter does not translate the cylinder addresses.

System Reset

A system reset received by a Staging Adapter from a host system resets any interrupts pending for that host from any unit. All command chains in operation from that host are reset.

System Features

Primary Host

The primary host in the Mass Storage System is the System/370 that reads and processes the unsolicited messages and environmental sense data from the Mass Storage Control. Any one of the host CPUs in a multi-host system can be assigned as the primary; there is no preference because of size, type, or position on one of the four channel interfaces through which it connects to the MSC.

When you bring up the Mass Storage System, the first host to issue the INITIALIZE order to the MSC is the primary host. After start-up, in a multi-host system, you can make a different host the primary one by entering the ASSIGN command from its console. Issuing the ASSIGN command should be a part of the start-up procedure to be sure that the proper host is assigned as the primary one. The ASSIGN command has no effect if issued from the host that is already the primary one.

In a single host system, that one host will always be the primary since it issues the only INITIALIZE order, and there is no other host console from which to give the ASSIGN command.

In a tightly coupled MP system, both CPUs are considered to be the primary host. The attention interrupt indicating that unsolicited messages are waiting is given to both host channel interfaces. The first channel interface to respond to the interrupt is given the messages, and the attention interrupt to the other channel interface is dropped.

If the primary host should fail in a multi-host system, another host should be established as the primary as soon as possible to insure the receipt of unsolicited messages and environmental data.

If an error occurs, for example, during the reading of a data cartridge at a DRD and the MSC error recovery programs correct it, the record of the error and the recovery are passed to the primary host in the form of environmental data. The data in this message is logged by the primary host to its SYS1.LOGREC data set. Periodically, this logged data should be processed by the System Data Analyzer (SDA) program and the output scanned for possibly developing failures in subsystem devices. If, during the time when these environmental records are accumulated, there have been several primary hosts, the records are spread across SYS1.LOGREC data sets. The data from all of them should be used as input to the SDA programs to get a complete picture of the Mass Storage System operation.

An example of an unsolicited message is one containing information about cartridges entered into the Cartridge Store through the cartridge access station. After the cartridge has been processed, a record containing the cartridge serial number, VOLID (if any), and storage cell location assigned to it is sent to the primary host for logging to the system hard copy log.

If the HALT command is issued from a non-primary host, the only action taken is to deinitialize the interface between that host and the MSC. The HALT command should not be issued from the primary host until after a HALT command has been issued from all non-primary hosts.

Volume Control

Of the orders executed in the MSC, the four that are used for volume control are MOUNT, ACQUIRE, RELINQUISH, and DEMOUNT.

MOUNT

Mount messages are normally passed to an operator to instruct him to mount a specific tape reel or disk pack on a specific drive. In the Mass Storage System, when the data has been identified as being on a mass storage volume, a MOUNT order is sent to the MSC. The MOUNT order contains the VOLID of the mass storage volume on which the required data is written, the virtual unit address that the host system will use to access the data, and the identification of the host system which will use the mounted volume.

The MSC verifies that the VOLID exists and is assigned to an active, mountable volume in the Cartridge Store. Using the configuration map in the MSC tables, the MSC selects a data path from a DRD to a staging drive in the staging drive group on which the virtual unit address specified in the order is defined.

The Staging Adapter tables are updated to accept I/O instructions from the host system for this mounted volume.

The MSC allocates a page of staging space on the chosen staging drive and builds the commands necessary to stage cylinder zero of the mass storage volume. If the volume is already mounted and cylinder 0 staged, the MOUNT order does not schedule cylinder 0 for restaging. Cylinder zero is staged and remains staged throughout the time the mass storage volume is mounted unless it is destaged by the LRU processing because of its age. The MSC assumes that the VTOC of the mounted volume is on cylinder zero. If it is not, the page of staging space remains allocated to the mounted volume, but a cylinder fault results from the first access of the VTOC.

If there is no page available for the staging of cylinder 0, the MOUNT order does not schedule the staging. Rather, after the not-read-to-ready interrupt is received by the host from the Staging Adapter, the first request for access to the VTOC will cause a cylinder fault which will force the availability of a page and the staging of cylinder 0.

When the MSC finishes processing the MOUNT order, the Staging Adapter gives the same "not ready to ready" interrupt to the host system that the host would have received had an operator mounted a tape reel or disk pack and made it ready.

ACQUIRE

The ACQUIRE order is sent to the MSC at the time a data set is opened.

ACQUIRE allocates the number of cylinders specified in up to sixteen possible extents specified in the order. Staging requests are built and queued to the stage scheduler in the MSC. If the data requested in the ACQUIRE order is already staged in the same staging drive group, it will not be staged a second time but will be re-used.

The ACQUIRE order can specify that the data which is to occupy the space requested not be staged. This option is used for new data sets. If the ACQUIRE specifies that the space is to be bound (the BIND attribute), the space allocated cannot be made inactive by subsequent LRU processing. If

not enough space is available on the staging pack to meet the needs specified in the ACQUIRE order, the available space is allocated at the time the ACQUIRE is processed and the remainder is allocated, as it is needed, by page fault processing. If a delayed response is requested, the host system issuing the ACQUIRE order is notified when the staging of the data has been completed.

If a host system job step tries to access data before the staging of that data has been finished, the request could cause a cylinder fault. If so, the request is held in channel retry until the data is finally staged.

RELINQUISH

The RELINQUISH order releases acquired DASD space and indicates the disposition of staged data. The options specifiable in the order allow you to: unbind the space occupied by a bound data set or volume and let it be subject to destaging by the LRU service function; free up space without destaging of the data on it (in effect deleting the data); or destage the data that has been changed and notify the host system when the destaging is complete.

Without the RELINQUISH order, data would be destaged only by the DEMOUNT order varying the staging drive offline, or by the pages of data reaching an age sufficient to let them be scheduled for destaging by the LRU service function.

DEMOUNT

The DEMOUNT order is sent to the MSC by a host system when that host has finished with all the data sets from the specified virtual volume. This order can be initiated by an UNLOAD command or a VARY OFFLINE command. In a multi-host system, when the DEMOUNT order is processed from the last host for which the volume was mounted, the changed data for that volume is destaged.

The DEMOUNT order, unless the data is defined with the DASDERASE option, does not invalidate the data but leaves it available for later reuse. A subsequent MOUNT order for the same virtual volume makes the data usable again.

After the DEMOUNT operation, the virtual unit address is available for assignment to a new virtual volume.

Staging Pages

There are six types of pages on an in-use staging pack.

1. *Free* pages have no valid data on them. The pages may have had their data erased after their last use, they may be the pages of a newly formatted staging pack, the pages may have been invalidated because the pack was previously varied offline, or the pages may have been relinquished with destage inhibited. The free pages are the first ones used for allocation of new data.
2. *Inactive* pages contain valid data, but the space has been relinquished (or scheduled for destage) and/or the virtual volume to which the data belongs has been demounted. The pages are available for reclamation if the same data is later requested on the same staging drive group, or the page space can be reused for a subsequent space request. Inactive pages are created either by the destaging of data scheduled by the LRU service function or by the demounting of a virtual volume.

3. *Active* pages are staged with valid data. They contain the data currently in use by jobs running in the host systems.
4. *Bound* pages are active pages that have been staged with the BIND attribute. They are not available for reuse until the virtual volume they comprise is demounted or the BIND status is lifted by a RELINQUISH order with the UNBIND attribute.
5. *Unusable* pages are those on which permanent read/write errors have occurred.
6. *Table* pages are those pages reserved for the MSC tables on the primary, secondary, and alternate table packs.

Message Buffers

Message buffers are each 248 bytes long. Sixteen message buffers are reserved on the MSC tables for each initialized interface of the Mass Storage Control, with an additional 16 buffers reserved for the unsolicited messages for the primary host.

Messages vary in size up to a maximum of 65 bytes. They have the following format:

- Byte 0 - message length (including the length field)
- Byte 1 - message code
- Bytes 2-64 - variable message text

The message codes and the formats of the three message types are shown in Part 2 of this manual.

When the first message for a host is built in a message buffer, the MSC sets an attention interrupt to the appropriate host channel interface. Subsequent messages for the same host are packed into the first message buffer until it is full or until there is not enough remaining space to hold a full message. There can be more than one message in a buffer, but never a partial message. When the host system processes the buffer, the end of the messages is indicated either by all 248 bytes being used or by a zero message length field.

If a host system does not respond to the attention interrupt set for the first full buffer, a second attention interrupt is set when a message is built in the second buffer assigned to that interface. No third interrupt is set. After the eighth message buffer for a given host is filled, the MSC rejects all subsequent commands except PREPARE READ DATA, READ DATA, SENSE, TEST I/O, and NOP with a unit check. This allows buffer space for the messages being generated by work in progress, but does not allow any new work to start until the message buffers are offloaded from the MSC.

A host system responds to an attention interrupt by issuing a PREPARE READ DATA command to move the DASD message buffer to MSC main storage, and chains behind it a READ DATA command to send the buffer to the host system. One full 248-byte message buffer is sent to the host for each READ DATA command.

After a message buffer is sent to the host, it is cleared and made available for newly generated messages.

TRACE

When the MSC TRACE facility is on, the MSC writes the control blocks associated with the movement of cartridges and the staging and destaging of data to the trace areas on the MSC tables pack. Two trace areas, TRACEX and TRACEY, are each four cylinders long and are used alternately, TRACEX being used when the trace is first turned on. When a trace area is full, the MSC automatically uses the other one and notifies the operator through the primary host console of the changeover. It is the operator's responsibility to dump the full trace area before the MSC shifts back to using it when the other area is full.

When the TRACE ON order is processed, a start record is written to the TRACEX area and the accumulation of trace records begins. If the trace is already on when the order is received, the new order receives a unit check. When the TRACE OFF order is processed, a trailer record is written to the currently in-use trace area and no more trace records are written. If the trace is already off, the new command receives a unit check.

The times that the MSC writes in the trace records are:

- The time a request for staging or destaging of data was built
- The time a DRD was assigned for the data transfer
- The time the cartridge label was read at the DRD
- The time the STAGE/DESTAGE command was sent to the Staging Adapter
- The time the data staging or destaging was complete.

The time recorded in the trace record is MSC time. This time is set to zero at IML of the MSC. To relate this MSC time to real time, the host processing programs use the start record that contains the MSC time when the TRACE ON order was processed and the time and date sent from the host as part of the TRACE ON order.

TUNE

You use the TUNE order to change the LRU values for a specified staging drive group or to display the existing values for that group. You also use it to change the span of time in an LRU clock unit.

You can find directions on how to specify the TUNE command in the manual *OS/VS Mass Storage System (MSS) Services for Space Management*. You can find pointers on how the LRU values should be set in the manual *IBM 3850 Mass Storage System (MSS) Installation Guide*.

Virtual Unit Addresses

The MSS gives the user the ability to have online at any one time many virtual volumes that can be accessed by host systems. Prior to the availability of the MSS, each DASD drive could contain one pack and just the data on that pack. Now, a single staging pack can hold the data from up to 51 virtual volumes and effectively increase the use of a single drive. In order to access each virtual volume we cannot depend on the physical address of the drive but must use a virtual address. Each virtual unit address (VUA) is used by a given host to refer to a unique virtual volume. Each VUA corresponds to a virtual unit control block (VUCB) in the host system.

The minimum size of a virtual volume is one page (eight cylinders) of staging space. If your data sets are small, there might be several data sets assigned to the eight-cylinder span that makes up a single virtual volume. An ACQUIRE order for data that is physically within the space of an already mounted virtual volume results in the staging of the data set to the existing space, and the sharing of the virtual unit address. A host system can have only one SIO outstanding for any virtual unit address at one time.

Part II: Reference Material

System Operation

Power-Up Sequence

The power-up sequence for the Mass Storage System is in three stages: the application of electrical power, the Initial Microprogram Load (IML) of the Mass Storage Control and the Staging Adapter, and the execution of the VERIFY function microprogram in the Mass Storage Control.

Electrical power is applied to the Mass Storage Facility when power is applied to any host CPU to which the Mass Storage Facility is attached. When the local power supplies in the Mass Storage Facility have stabilized, the IML of the Mass Storage Control (MSC) is automatically started.

The IML text for the MSC is loaded from a floppy disk in a reader mounted in the control frame of the Mass Storage Facility. If the microprogram load of the MSC fails to finish within two minutes, a red indicator labeled "MSC1 IMPL CHECK" lights up on the panel located above the cartridge access station.

If you have a second MSC in the Mass Storage System (either a model B or a second model A MSF), it will load the same microprogram text from the floppy disk after the completion of the IML of the first MSC. If the IML of the second MSC fails, the corresponding red indicator lights up.

The VERIFY microprogram is loaded as part of the IML text. Execution of it starts in an MSC as soon as the IML process is complete, and does not depend on the successful completion of IML in the other MSC, if you have a second one in your system. The VERIFY microprogram is not re-usable and cannot be invoked by either a host CPU or by any subsequent action of the MSC. Execution of VERIFY can only follow the IML of the MSC. Until completion of the VERIFY process and initialization of the MSC interface by a host CPU, no other work can be done by the MSC.

The following are the steps of VERIFY.

1. A 67-second time delay is started, at the end of which the VERIFY function continues. This delay is to allow the completion of the IML of the Staging Adapter and to allow the 3330 disk drives that hold the table packs to come to the ready status.
2. VERIFY determines whether the MSC in which it is executing is the active or the back-up MSC by testing to see if it has control of the ports: that is, whether it controls the paths to the accessor controls and the Staging Adapters. Which MSC has control of the ports is determined by the position of an electronic switch whose initial position can be changed by the CE if the installation desires the alternate MSC to be active at IML time.

   In the back-up MSC, VERIFY processing is suspended at this point.

   In the active MSC, the VERIFY processing continues to the next step.
3. The program next verifies that the primary and secondary table packs are mounted on the proper 3330 drives and are in the ready state by checking the table pack identifier in the Verification Table. The table packs can be on the staging drives with SSIDs of 000, 002, 004, or 006. Whichever two of these drives the primary and secondary table packs

are on, the verification tables of each must point to the other to complete the test. If they are not, VERIFY terminates and the Mass Storage System is considered not available for use. You recover from this condition by restarting the power-up sequence with the two table packs properly mounted. Termination of VERIFY at this point implies that real drives attached through the Staging Adapter cannot be used for host system IML or data access.

4. In this step, VERIFY compares the Engineering Change (EC) level of the resident microprogram loaded at IML with the EC levels of the various overlay microprograms that reside on table packs. These 32-bit EC numbers must be equal. If they are not, VERIFY terminates with the appropriate code to the channel interface and the MSS will not be available for use.

   Because of the close interaction between the resident microprogram and the overlay microprograms, any changes to either will be distributed as a complete rebuild of the overlay program library on DASD and a replacement of the IML text.

5. VERIFY uses the configuration table from the primary table pack to construct a VARY order for each of the DASD units known to the Mass Storage System to restore them to the condition they were in at the time of the previous power down. During this processing by the VARY microprogram, the Staging Adapter tables that reflect the available subsystem units are built. At the conclusion of this step, a message containing a bit map reflecting the status of each subsystem unit is constructed and queued for transmission to the primary host when its interface is initialized.

   If the configuration table shows that a staging drive should be available and online but the VERIFY processing finds the wrong physical pack is mounted on the drive, the drive is marked as being in the NEUTRAL status. Unless the previous shut-down of the MSS had called for the destaging of all data, valid data will be on the missing pack. You must find the missing pack, mount it on the proper drive, and vary it online to recover the drive from the NEUTRAL status.

6. The next step of VERIFY is the task of backing out the work done by the tasks that were incomplete at the time of the last power down. The Schedule Queue Blocks that control these tasks are reconstructed in their original form and are queued for re-execution at the completion of the VERIFY processing.

   Messages to the host that were queued for transmission but were not sent prior to the last power down are reconstructed and scheduled for transmission when the host signals that it is ready to receive messages.

7. The last step in VERIFY is to add one to the sequential IML number. This number is a 16-bit field unique to the current IML. It is used as the first half of the identification field of Recovery Journal records and allows the journal recovery process to distinguish which records it should use in system reconstruction during the next IML.

   At this point, if an error has been detected a code is posted to the channel interface. When the host CPU issues its INITIALIZE command, the command is unit checked and the code is read as part of the sense data read as a result of the unit check.

Power-Down Sequence

Electrical power is physically removed from the Mass Storage Facility when power is turned off to the last host system to which the MSF is attached. In an emergency, power to the MSF can be dropped by pushing the power off button on the panel above the cartridge access station.

Before you drop power to the MSF, the system should be logically shut down to avoid excessive destage activity on restoration of power.

Failure to logically shut down the MSS, as with an unscheduled power loss, results in recovery processing by the VERIFY procedure flaging all cylinders, except those marked as read only, as written and schedules their destaging. To logically close the MSS you must issue the HALT S,LONG or HALT S,SNAP command from each host system attached to the MSF. (These commands are described fully in the *OS/VS IBM 3850 Mass Storage System (MSS) - Operations Guide*. The actions performed by the HALT command differ depending on whether you execute them from the primary host or from a non-primary host.

From a non-primary host system, the HALT S,LONG is invalid and is rejected. The HALT S,SNAP order deinitializes the channel interface to the Mass Storage Control from that host system. A HALT S,SNAP command should be issued from each non-primary host before a HALT is issued from the primary host.

From the primary host, a HALT S,SNAP command inhibits the MSC from accepting any further EXECUTE commands. All currently scheduled staging and destaging of data is completed. All cartridges are returned to their home cell locations. A message is built in the message buffer assigned to the primary host indicating the completion of the HALT processing.

A HALT S,LONG from the primary host does everything the HALT S,SNAP does and, in addition, demounts all mounted volumes. All modified, staged cylinders of data are destaged and all cartridges are returned to their home cell locations before the building of the completion message. The data, however, remains usable by a remount of the virtual volumes. The MSC tables reflect this availability. If, after a LONG halt you plan to run the IEHDASDR program on a staging pack (for example, to recover alternate tracks), you should, prior to issuing the LONG halt, vary that pack offline. This modifies the MSC tables to indicate the data is not available for reuse when the MSS is later reinitialized.

After you receive the completion message from the HALT command, you can turn off power to the MSF.

In normal operation, the SNAP option of the halt is most often used. The LONG halt should be used when you anticipate reconfiguring your system or rebuilding your tables prior to the next use of the Mass Storage System. Both the LONG halt and the SNAP halt leave data staged on the staging drives which can be reclaimed during the next power-up sequence. The LONG halt can also be used to checkpoint the Mass Storage System to give a known position from which system recovery can be effected.

Cartridge Entry

To add a cartridge to the Mass Storage Facility, put it on the entry chute with its metal base plate facing away from you. The entry cell is shaped to fit a data cartridge to prevent inserting them backwards. The cartridge rolls down the chute into the entry cell and is then ready to be picked up by an accessor. When a cartridge is in the entry cell, the bottom of the chute is blocked to keep other cartridges in the chute from stacking up on top of it and interfering with accessor operation.

When the Mass Storage Control recognizes an interrupt caused by the arrival of a cartridge in the cartridge access station entry cell, the following sequence of operations automatically starts.

1. The accessor picks up the cartridge and moves it to an available DRD.
2. The cartridge label is read and processed.
   a. If this is a new cartridge, one with the manufacturer's identification on stripe zero duplicated on stripes one through 8, stripe one is rewritten with the standard "VOL 1" header label and a Cartridge Store XYZ cell location is assigned to it stripe 5 is then rewritten with an image of stripe 1. The cartridge serial number is entered in the scratch cartridge list.
   b. If the cartridge has a valid VOLID in the cartridge label, indicating that it is part of a mass storage volume, but no XYZ location recorded, a new XYZ cell location is assigned to it and the cartridge serial number is entered in the transient volume list.
   c. If the cartridge has a "VOL 1" header on stripe one, but no valid VOLID, a XYZ cell location is assigned to the cartridge and its serial number is entered in the scratch cartridge list.
   d. If the cartridge already has an XYZ location assigned to it in the cartridge label, the MSC assumes that this cartridge has been manually removed from the Cartridge Store, does not assign a new location, and does not add the cartridge to any list.
3. The cartridge is moved to the XYZ location now recorded in its label.
4. A message indicating the action taken in the processing of the cartridge is constructed in the message buffer assigned to the primary host.

Whenever a cartridge is ejected from the Cartridge Store by a MOVE CARTRIDGE order, the MSC tables as well as the fields of the label that contain the XYZ location and Cartridge Store identification are updated to indicate that the cartridge is no longer available for processing in the system.

In some cartridge error situations, the system automatically ejects a cartridge, but normally they are ejected by an EJECTC or EJECTV or other command initiated through a host CPU. The exit chute holds up to 14 cartridges. If the system ejects a cartridge that fills the chute, the primary host console prints an "intervention required" message. All system activity stops until the chute is cleared.

Never add or remove cartridges by opening a cover and reaching into the storage cells. If you do, the cell map and other system tables will not be updated to show the true system state, reducing system integrity.
The cartridge access station cannot be used unless a primary host system has initialized its interface and is ready to receive messages from the MSC.

Least Recently Used (LRU) Service Function

This service function is called by the Space Allocation routines when there is insufficient page space available to meet the needs of a current ACQUIRE order. It schedules the destaging of active pages on the basis of which have been unreferenced for the longest time. Its purpose is to make available for space allocation within a staging drive group a number of pages no less than a number specified during Mass Storage Table creation for that staging drive group. When these pages are destaged, they become inactive pages and can be allocated. However unless the pages have been erased because of their containing secure data, the data on them remains valid and can be reclaimed until the pages are allocated to other data.

After LRU has scheduled pages for destaging but before the data is actually destaged, space allocation begins assigning space out of the inactive and free pages remaining in the group. Space allocation may have to wait for the completion of the LRU scheduled destaging if the new space request is for more pages than are actually available in the free and inactive lists.

Three values you specify at MSC table creation affect LRU and therefore the efficiency of the space allocation. They are:

- LRU clock
- Upper and lower thresholds
- Destaging groups

Following is a description of each of these and its effects.

LRU Clock

At each 65536-millisecond interval as measured by the master MSC clock, the LRU clock update routine adds into a one-byte counter the hex byte derived from the LRUCLOCK value that you specified in the CREATE command during MSC table creation. When this one-byte counter overflows, 1 is added to the LRU clock (which is a hex character kept as a table entry for each staging drive group defined to your system).

As an example, if you chose LRUCLOCK=1024, the hex value '10' is added to the one-byte counter each 65536 ms. After 16 such intervals, the counter overflows and 1 is added to each staging drive group timestamp. This gives a timestamp interval of 16 x 65536 ms, or 17.47 minutes. The timestamp can have values of hex '0' to 'F' and wraps to '0' on overflow. The time to wrap the timestamp in this example would be 16 x 17.47 minutes or about 4.6 hours.

Whenever data is read from or written to a page within a staging drive group, the current timestamp for that group is stored into the Page Status Table in the Staging Adapter for the affected page. It is this timestamp in the Page Status Table that the LRU service function uses to determine which pages have been least recently used and are to be destaged to make space available.

A fast clock (that is, a low value specified for LRUCLOCK) means that pages become old rapidly and are eligible for destaging after a relatively short period of time. This is useful in, for example, an inquiry program which requires only one access to a data set to build its response. A slow clock (that is, a high value for LRUCLOCK) is appropriate for a long-running job where you want the data around for a while. If the LRUCLOCK value is too small, the timestamp wraps too quickly, and you

can't distinguish between a recently used page and an old page that contains the same timestamp from 16 time units ago.

Since you are constrained to only one value for LRUCLOCK for your system, you must select a compromise value on the basis of your needs and refine the destaging selection for a given staging drive group through the choice of appropriate destaging groups, described later.

Upper and Lower Thresholds

The upper threshold is the largest number of pages within a staging drive group that you want to be active on non-bound, online staging drives. The lower threshold is the smallest number of pages within a staging drive group that you want to be active to hold the data needed for currently executing jobs.

You specify these thresholds in the ACTPAGE operand of the SDGxx command during MSC Table Creation. The values you give are the count of pages per staging drive in the staging drive group. These counts are stored in the Page Availability Block for that staging drive group. When a staging drive is brought online, these upper and lower threshold counts are added to upper and lower counters for that staging drive group. When a drive is taken offline, these upper and lower threshold counts are subtracted from their respective counters. When a bound volume is allocated, these upper and lower threshold counts are subtracted from their respective counters. Binding a page does not affect the counters.

When space allocation receives a request for new page space to be drawn from a staging drive group, it adds the number of currently active pages (maintained as a counter in the Page Availability Block) to the number of pages in the new request. If this total exceeds the upper threshold, LRU is called in an attempt to inactivate and schedule for destaging enough active pages from the staging drive group to bring the total of active pages plus the newly requested pages down to or below the lower threshold.

The reason for using thresholds is to maintain enough available space in a staging drive group to fulfill any new page request without delaying the new job for lack of space.

Destaging Groups

LRU destaging groups show which of the sixteen possible timestamp values for a staging drive group are to be considered equally eligible for destaging by LRU. You specify the groups in the LRUGROUP operand of the SDGxx command during MSC table generation. You can specify up to four groups. If, for example, you specify LRUGROUP=6,4,2,2, the six oldest timestamps are considered equal, the next four oldest are equal, and so on. The example shows only fourteen of the sixteen possible timestamps; pages with the two most recent timestamps are never destaged by LRU.

When the LRU function is called, it extracts from the MSC tables the timestamp values for each page in the staging drive group. These timestamps are then normalized. Normalizing the timestamps is done by subtracting from the timestamp for each page the current value of the staging drive group's LRU clock plus one. In this way, the oldest pages have a normalized timestamp of '0'. The next oldest pages have a timestamp of '1', and so on, to the most recently used pages which have a normalized timestamp of 'F'. These normalized values are compared to the group definition fields to see into which destage group they fall.

Among the pages whose normalized timestamps put them in the first group, those from the mass storage volume with the most pages allocated are scheduled for destaging first. The mass storage volume with the next highest number of pages is scheduled second, and so on. If any pages for a mass storage volume are destaged, all the eligible pages on that volume are destaged. This is done to minimize the cartridge movement time within the Cartridge Store.

If destaging all the pages in the first group doesn't bring the active page count down to the lower threshold, pages from the second are considered, then from the third, then the fourth. If there are not enough pages in all the groups to satisfy the goal of destaging to the lower threshold, then the lower threshold is not reached.

Whenever LRU destages any pages from a staging drive group, 1 is added to the LRU clock for that staging drive group. This artificially makes those pages already timestamped seem older than they really are, but it makes available a supply of pages that are old enough to destage the next time LRU must free space on this staging drive group.

Subsystem Identification (SSID)

Subsystem identification is a set of three-hex-digit numbers identifying the physical components of the Mass Storage System. These digits are displayed on the operator console in error or information messages, are used by the operator in VARY orders, appear on fault analysis reports, and appear on reports prepared from the system log as part of the service aids.

The SSID of each staging drive should be marked on the address plug for that drive to assist in matching the drive to the staging pack formatted for that drive.

The following chart shows how the SSID is constructed for the various physical units of the Mass Storage System.

	SSID number		
	1st hex digit	2nd hex digit	3rd hex digit
Unit Type	4 5 6 7	0 1 2 3	4 5 6 7
DASD	0	Staging Drive group (0-27)	Logical device address
Cartridge Store	1	Cartridge Store No. (0-1)	0 = both Accessor Controls 1 = Accessor Control 1 2 = Accessor Control 2
DRD	2	Mass Storage Facility No. (0-1)	DRD (0-7)
DRC	4	Mass Storage Facility No. (0-1)	DRC (0-3)
Staging Adapter	8	Staging Adapter (0-13)	0
MSS	F	F	F

For example, 110 refers to both of the microprocessors that control accessor motion in the Mass Storage Facility you designated as number 1. FFF is the SSID associated with the MSS as a whole, and appears in messages about data cartridges and other components that do not have their own specific SSID. 019 is the SSID of DASD drive number 1 in staging drive group 3.

Tape Data Cartridge Label

The format of the standard cartridge label is:

Bytes	Definition
0-3	'VOL 1' - Standard label header
4-9	Volume identification (VOLID)
10	Volume security
11-36	Reserved and must be blank
37-50	Owner ID
51-78	Reserved and must be blank
79	'T'

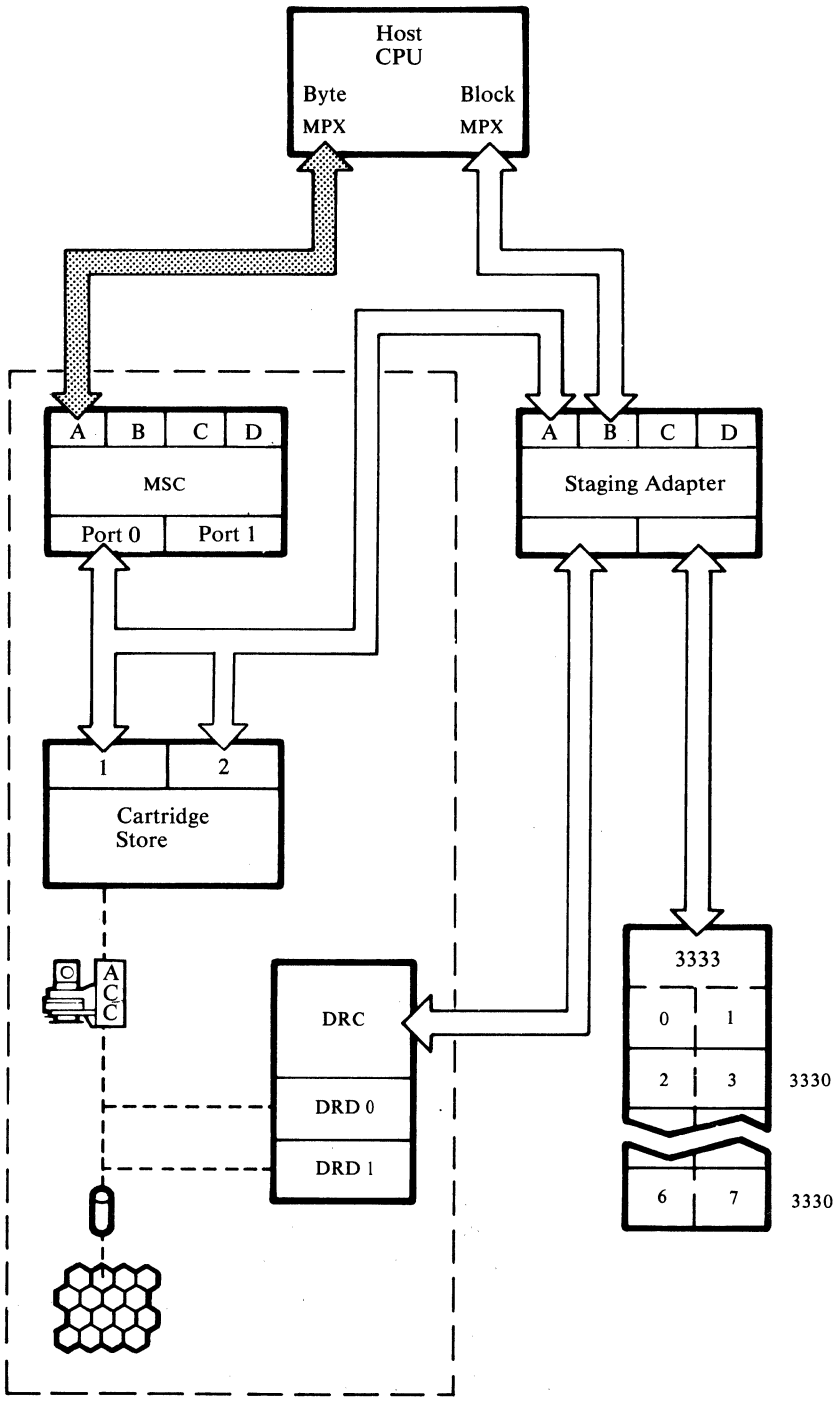
The 176 bytes following the standard label portion contain usage and error statistics for the cartridge

Bytes	Definition
80-81	Cylinders per volume
82-83	Tracks per cylinder
84-85	Bytes per track
86-87	Reserved and must be zero
88-89	Cartridge cell address for this cartridge (LXYZ)
90-91	Reserved and must be zero
92	Volume flags bit 0 - CE cartridge bit 1 - Reserved volume bit 2 - Secure volume bit 3 - Exclusive volume bit 4 - Scratch cartridge bit 5 - BIND volume bit 6 - Write inhibit bit 7 - Reserved
93-94	Reserved and must be zero
95	Volume sequence number (1 or 2)
96-99	Count of stripes read DRD0
100-103	Count of stripes written DRD0
104-105	Recovered read checks for DRD 0
106-107	Recovered write checks for DRD 0

Bytes	Definition
108-109	Cartridge loads on DRD 0
110-111	Load errors for DRD 0
112-127	Same as 96-111 for DRD 1
128-143	Same as 96-111 for DRD 2
144-159	Same as 96-111 for DRD 3
160-175	Same as 96-111 for DRD 4
176-191	Same as 96-111 for DRD 5
192-207	Same as 96-111 for DRD 6
208-223	Same as 96-111 for DRD 7
224-235	Cartridge serial number for this cartridge
236-247	Cartridge serial number for other cartridge of the pair
248-255	Reserved and must be zero

Host/MSC Commands and Orders

The schematic diagram below shows the components of the Mass Storage System with broad arrows indicating the control and data paths between them. The host/MSC connection, shown by the shaded arrow, is used for the commands and orders described in the following section and summarized in the table on the following page. The commands and orders for the other paths are shown summarized in tables after the following section.



Type	Command/Order Name	Hex Code	
		Command	Order
Sense	Test I/O	00	
	Sense	04	
	Switch	44	
	Sense I/O	E4	
Read	Read Data	06	
	Prepare Read Data	26	
Buffered Log	Read Buffered Log	A4	
Diagnostic	Diagnostic Write	41	
	Diagnostic Read	42	
	Diagnostic Control	43	
Misc	HIO/HDV		
	NOP	03	
	Modified NOP	A3	
Execute	Acquire	87	02
	Assign Primary Host	87	12
	Associate CPU ID	87	2C
	Copy Cartridge	87	28
	Copy Tables	87	16
	Copy Volume	87	2A
	Define Volume	87	18
	Demount	87	06
	Host Ready for Messages	87	20
	Initialize	87	10
	Mount	87	08
	Move Cartridge	87	0E
	NOP	87	1E
	Prepare and Reset Buffer Log	87	26
	Purge	87	14
	Relinquish	87	04
	Suspend Processing	87	22
	Trace	87	24
	Tune	87	1C
	Vary Off	87	0C
	Vary On	87	0A

TEST I/O - Command Code '00'

This immediate command determines the status of the MSC. It causes one byte of status to be sent to the channel in the initial selection sequence. TEST I/O normally presents an all-zero status byte, but a unit check might be presented if one is pending from a previous operation.

SENSE - Command Code '04'

This command causes the MSC to transfer 32 bytes of sense information to the channel. The host system issues this command, after receiving a unit check from the MSC to identify the specific nature of the error or unusual condition that caused the check. The SENSE command must be the first command issued by the host to the MSC following the unit check. If any command other than the SENSE, TEST I/O, READ BUFFERED LOG, or NOP, is issued to the MSC after a unit check, the sense information for the unit check is lost. No command should be chained to the SENSE command. If one is, it is not accepted by the MSC. The format of the 32 bytes is shown in the Sense Data Appendix of this manual.

If the SENSE command is received and there is no sense information to transfer, byte 1 of the 32 bytes sent contains the host channel interface identification and all other bytes are zero.

For a tightly-coupled MP system, the SENSE command must be sent over the same channel interface that received the unit check.

After data transfer is complete, channel end and device end are presented to the channel and the sense data is reset.

SWITCH - Command Code '44'

This command is sent to the alternate MSC in the Mass Storage System by the host Error Recovery Programs to make the alternate MSC active and take the currently active MSC offline. After switching the ports to make them available to the alternate MSC, the command triggers the completion of the IML verification of the MSC. (For more on this, look in the Power-up Sequence portion of this manual.)

This command must follow a SUSPEND PROCESSING order from the primary host that prepares the MSC for the SWITCH command.

After completion of the verification by the MSC, the host sends the INITIALIZE and HOST READY FOR MESSAGES execute orders. The alternate MSC is now the active processor in the Mass Storage System.

All orders and commands to the previously active MSC result in a unit check. A new IML of the switched-from MSC is automatically started to restore it to alternate status.

SENSE I/O - Command Code 'E4'

This command is issued by a host system to identify a control unit at a given channel address. The SENSE I/O command returns seven bytes to the host, the format of which is:

- Byte 0 = 'FF'
- Bytes 1-2 = control unit type number (3851)
- Byte 3 = control unit model number (00)
- Bytes 4-6 = binary zeros

READ DATA - Command Code '06'

This command transfers data from the MSC message buffer to the channel interface of that host. It must be preceded by a PREPARE READ DATA command. The host issues this command sequence as a result of receiving an attention interrupt from the MSC. 248 bytes, the size of the message buffer, are transmitted.

For a tightly-coupled MP system, the attention interrupt indicating that there are messages to be sent is given to both CPUs. The first host to issue the READ DATA command sequence gets the contents of the message buffer and the attention interrupt to the other CPU is dropped.

At the completion of the data transfer, channel end and device end are presented to the host channel. If fewer than 248 bytes are transmitted, unit check is also given.

PREPARE READ DATA - Command Code '26'

This command must precede a chained READ DATA command. Its purpose is to transfer the next DASD message buffer associated with the host issuing the command to MSC main storage so that it can be read into the host by the READ DATA command.

READ BUFFERED LOG - Command Code 'A4'

This command causes the 32 bytes of buffered log sense data to be sent to the channel. This command must be chained behind a PREPARE BUFFERED LOG execute order or behind another READ BUFFERED LOG command.

Channel end and device end are presented to the channel after the transfer of data. If a unit check is required because not all 32 bytes are transferred, it is given as the initial status of the following command.

DIAGNOSTIC COMMANDS - Command Codes '41', '42', and '43'

These commands provide the necessary control for diagnostic test programs. The commands are built around a 512-byte diagnostic buffer in the MSC. You are encouraged not to use these commands.

- Diagnostic write - code X'41'
  512 bytes of data are sent from the host to the MSC.
- Diagnostic read - code X'42'
  512 bytes of data are read from the MSC.
- Diagnostic control - code X'43'
  8 bytes of information are sent to the MSC for control and analysis by an executing diagnostic program.

HALT I/O-HALT DEVICE (HIO/HDV)

These commands are used to terminate the execution of a channel program. They do not send a command byte. The MSC is disconnected from the channel.

NO OPERATION (NOP) - Command Code '03'

This command causes the MSC to present channel end and device end together to the channel. A status byte of zero is also presented.

MODIFIED NOP - Command Code 'A3'

This command terminates an interface suspend sequence. The data length of the command must not be zero and the SLI bit must be on. Channel end is presented with no data transferred. Device end is sent when the order that was suspended completes execution. A unit check is sent to the channel with channel end and device end if there was no order suspended in the channel.

If any order or command is issued to a suspended channel except TEST I/O, NOP, or SENSE prior to the issuing of the MODIFIED NOP, the channel remains suspended and a unit check is sent to the channel together with channel end and device end.

EXECUTE - Command Code '87'

This command, followed by one order code and its associated data, is sent to the MSC where the order is executed by the MSC microprogram. The following pages describe the various orders and their actions in the MSC.

ACQUIRE - Order Code '02'

The ACQUIRE order is used to cause the allocation of DASD space for the staging of virtual volume data and to schedule the staging of that data. Optionally, the order can specify that the allocated space be bound or that the data should not be scheduled for staging at this time.

The required space is allocated from the unbound space on the staging drive group. The order is rejected if the space is not available and the attribute byte specifies that the space is to be bound or the attribute byte specifies a delayed response. The space allocation routine may call the LRU service function to force space to be made available in the staging drive group to be used for the data from this VOLID.

Channel end is returned to the host after receipt of the order by the MSC. Device end is returned after the space has been allocated and the data scheduled for staging. If there is a request for delayed response, the host is notified by an attention interrupt with a message text including the MSGID specified in the order after the completion of the staging of the data.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	02	00	Attributes	Count
04	VOLID			
08				
0C	MSGID			
10	CPUID			
14		00	00	00
18	EXTENT 1			
• • •	• • •			
54	Up to 16 Extents			

Attributes

Bit 0: If set indicates the space acquired is to be bound. Reallocation of the space does not occur until the volume is demounted, or the space is relinquished with the unbind attribute.

Bit 1: If set indicates a delayed response request; an attention interrupt is to be sent to the host system after space is allocated and the requested data is staged.

Bit 2: If set indicates the space requested is to be allocated, but no data is to be staged.

Count

The binary count of the number of extents (1 - 16) specified in the extent fields below.

VOLID

The six-character name of the mass storage volume on which the data to be staged is recorded.

MSGID

The six-byte identification contained in the message returned to the host if a delayed response was requested in the attribute byte. The message identification is used to relate the completion of the acquire activity with the original request for the activity.

CPUID

The five-byte (10-digit) manufacturer's identification of the CPU for which this data is to be made available.

Extent

This field specifies the beginning virtual cylinder (two bytes), and the ending virtual cylinder (two bytes) of an extent. This information is provided for up to a maximum of sixteen extents.

ASSIGN PRIMARY HOST - Order Code '12'

This order is generated by the host system in response to the operator entry "ASSIGN." The CPU that issues this order is assigned by the MSC to be the primary host to receive all messages not associated with a specific host system order. These messages include those generated as a result of cartridges being inserted at the cartridge access station and environmental data records to be written to SYS1.LOGREC.

There is no restriction as to which host may or should be the primary one, but there must be a primary host at all times. Device end is returned at the completion of processing of the order.

When the Mass Storage System is initialized, the first host system to send the INITIALIZE order is designated the primary host by the MSC.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	12	00	00	00

ASSOCIATE CPUs - Order Code '2C'

The ASSOCIATE CPUs order is used to modify entries in the configuration table relating CPUs of tightly-coupled MP systems using MSS. Device end is returned at the completion of processing.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	2C	00	Attributes	00
04	CPUID			
08		00	00	00

Attributes

Bit 0: If set, means associate the CPUID specified in the order with the other CPU specified in the association table bit-map as tightly-coupled MP CPUs. If CPU 0 and CPU 1 are to be associated and CPU 0 is specified in the order, all volumes for CPU 1 are demounted. All volumes mounted for CPU 0 are mounted for CPU 1. Any volumes mounted for both remain mounted for both. If one of the CPUs is the primary host, both become the primary host. If the two CPUs are already associated, no action is taken.

Bit 1: If set, means disassociate the two CPUs designated as tightly-coupled in the association table bit-map. If the two were the primary host, the CPU specified in the CPUID field of the order becomes the only primary host. If the CPUs are already disassociated, no action is taken.

Bits 2-4: are reserved and must be zero.

Bit 5: If set, means disassociate the two tightly-coupled CPUs (same as bit 1 above). Also deinitialize the interface of the other CPU, that is, the one of the formerly tightly-coupled pair that did not issue this order.

Bit 6: If set, means associate the two CPUs (as described for bit 0), but demount all volumes for both CPUs. The volumes are demounted even if the two CPUs are already associated.

CPUID

The five-byte (10-digit) manufacturer's identification of the CPU issuing this order.

COPY CARTRIDGE - Order Code '28'

The COPY CARTRIDGE order is used by a host-system error recovery program if the error recovery program in the MSC cannot destage data because of too many unusable stripes in a cylinder area of tape. It can also be used to copy data from a cartridge that is aging to the point where errors are likely to occur. The volume involved in the copy operation cannot be already mounted unless destage errors are preventing its demount.

Only one cartridge of the volume pair can be copied with this order. To copy both cartridges, use the COPY VOLUME order.

The label of the old cartridge is not used to build the new label. In that way, a cartridge with an unreadable label can be copied. To get the proper information into the new cartridge label, a DEFINE VOLUME order must be run.

The COPY CARTRIDGE order causes the data not already staged from the cartridge to be staged to DASD. This is followed by a destage to the new cartridge.

Device end is returned to the host when the staging has been completed and the destaging to the new cartridge has been scheduled. At the end of the copy operation, the MSGID is delivered in a message text to the host system that requested the copy.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	28	00	Attributes	00
04	VOLID			
08				
0C	MSGID			
10 14 18	CSN			

Attributes

Bit 0: If set, indicates cartridge 1 of the pair making up the VOLID is to be copied.

Bit 1: If set, indicates cartridge 2 of the pair making up the VOLID is to be copied.

Bits 2-7: Are reserved and must be zero.

VOLID

The six-character volume name of the volume, one of whose cartridges is to be copied.

MSGID

The six-byte identification contained in the message to be returned to the host at the completion of the copy cartridge operation. This order has an implicit delayed response.

CSN

If a specific cartridge from the scratch cartridge list is to receive the copied data, it must be specified here. If this field is binary zeros, the next cartridge in the scratch list is used.

COPY TABLES - Order Code '16'

The COPY TABLES order copies either the entire MSC table area or only the Trace tables, according to the setting of the attribute bytes. The volume to which they are copied must be mounted prior to the execution of the COPY TABLES order, and space for the copy operation must be acquired with the BIND attribute. The copy is made by destaging the tables to the cartridge specified in the VOLID followed by a staging of the data to DASD space acquired with the BIND attribute. This is necessary because, as a general rule, the tables and the DASD space to which they are copied are not on the same Staging Adapter. Device end is returned after the destage of the tables to the mass storage volume and the scheduling of the staging of the tables to the staging drive space acquired.

Because one purpose for copying the tables is to make them available for listing, the location of each table is given to the user in a message text at the end of the copy MSC table operation.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	16	00	Attributes	
04	EXTENT			
08	VOLID			
0C				
10	MSGID			

Attributes

Bit 0: If set, means this is a MSC table copy.

Bits 1-7: are reserved and must be zero.

Bit 8: If set, means this is a copy of Trace table X.

Bit 9: If set, means this is a copy of Trace table Y.

If both bit 8 and 9 are set, Trace tables X and Y are both copied.

Bit 10: If set, means copy the active Trace table whichever one it is.

Bit 11: If set, means copy the inactive Trace table.

Bits 12-15: are reserved and must be zero.

Bits 0-7 and bits 8-15 are mutually exclusive.

Extents

This is a four-byte field which contains the beginning cylinder (two bytes) and the ending cylinder (two bytes) of the extent of the virtual volume to which the tables are to be copied. There must be sufficient space to hold the pages containing the MSC tables. The tables are not necessarily page aligned and the whole pages on which they are written must be copied.

VOLID

The six-character name of the volume to receive the tables. This volume must be mounted before the copy operation starts.

MSGID

The six-byte identification contained in the message text sent to the host system at the end of the copy operation. This order has an implied delayed response.

COPY VOLUME - Order Code '2A'

The COPY VOLUME order is used to copy a volume into or out of the Mass Storage System and to copy an active volume to a transient volume within the system. For a copy operation within the system, the active and the transient volume need not be in the same Mass Storage Facility.

Device end is returned to the host that requested the action after the order has been enqueued to the stage scheduler. A delayed response is implicit in this order and the completion of the copy operation is indicated by an attention interrupt to the host with a message containing the MSGID text.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	2A	00	Attributes	00
04	VOLID			
08				
0C	MSGID			
10	CSN			
14				
18				
1C	RUA		00	

Attributes

Bit 0: If set, means transfer data from the pack mounted at the specified real unit address (RUA) to the cartridges specified by the VOLID.

Bit 1: If set, means transfer the data from the cartridges specified by the VOLID to the pack on the specified real unit address (RUA).

Bit 2: If set, means transfer the data from the VOLID specified to the transient volume whose first cartridge is identified by the CSN field of the order.

Bit 3: If set, means transfer the data from the transient volume whose first cartridge has the CSN shown in the order to the VOLID shown.

Bits 4-7: Reserved and must be zero.

VOLID

The six-character name of the mass storage volume to be used in the copy operation. This volume must not be mounted.

MSGID

The six-byte code contained in the message returned to the host at the completion of the copy operation.

CSN

The cartridge serial number of the first cartridge of a transient volume pair that is to be copied to or from.

RUA

The address from the host UCB on which the 3336-1 pack is mounted for the copy operation. This drive must be defined as a convertible drive to the Mass Storage System to ensure that it has a path to a Staging Adapter. The specified drive must be varied online as a real drive. In the case of an MP system, both CPUs must be able to reach the same drive with the same RUA.

DEFINE VOLUME - Order Code '18'

The DEFINE VOLUME order is used to create a volume from scratch cartridges, to eliminate a volume and return its cartridges to the scratch cartridge list, to move a virtual volume between the active volume inventory and the transient volume list, or to modify the name, label contents, or volume flag of a an existing volume.

Device end and the completion message for this order are returned to the host after all activity associated with the order ends. This activity includes the updating of the label of the volume, updating the MSC tables, and restoring the updated cartridges to their storage cells.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	18	00	Attributes	CSID
04	VOLID			
08			Volume Flag	00
0C	NVOLID			
10			00	00
14 18 1C	CSN1 (12 bytes)			
20 24 28	CSN2 (12 bytes)			
2C	00	00		
30	MSGID			
34	00	00		
• • • 78	USER DATA (70 bytes)			

Attributes

Bit 0: If set, means a new volume is created. If cartridges are specified in the order, they are used to create the volume; otherwise, the first two cartridges from the scratch list are selected. The cartridge labels are updated and the volume name is put into the transient volume list.

Bit 1: If set, means the volume identified in the VOLID field of the order is eliminated from the volume inventory and the cartridges are returned to the scratch cartridge list. The cartridge labels are updated to show their scratch status.

Bit 2: If set, means the active volume that is currently identified by the name in the VOLID field of the order is renamed with the name in the NVOLID field. Volume flags are replaced by those specified in the volume flag field of the order unless the flag field is X'FF', in which case the flags remain unchanged.

Bytes 10-79 of the cartridge label are modified by the corresponding bytes of the USER DATA field of this order that are not binary zero. The volume inventory entry for the old VOLID is deleted and the new VOLID is placed in the transient volume list.

Bit 3: If set, means the volume flags in this order will replace those in the volume specified in the VOLID field.

Bit 4: If set, means the volume in the transient volume list whose first cartridge is the one whose serial number is specified in the CSN1 field of the order is deleted, and the two cartridges are returned to the scratch cartridge list.

Bit 5: If set, means the volume in the transient volume list whose first cartridge is the one whose serial number is in the CSN1 field of the order will be renamed to the name shown in the NVOLID field. The volume flags are replaced by the flags in the order's volume flag field unless that field is X'FF', in which case the volume flags are unchanged. Bytes 10-79 of the cartridge label are modified by the corresponding bytes of the USER DATA field of this order that are not binary zero.

Bit 6: If set, means the volume in the transient list whose first cartridge is the one whose serial number is in the CSN1 field of this order is deleted from the transient volume list and added to the volume inventory.

Bit 7: If set, means the volume named in the VOLID field of the order is deleted from the volume inventory and added to the transient volume list.

Attribute bits 0-7 are mutually exclusive. One and only one of them must be set to 1 in a valid DEFINE VOLUME order.

CSID

Bits 0-5: Reserved and must be zero.

Bits 6-7: The logical number of the Cartridge Store in which the volume to be processed by this order is located.

VOLID

The six-character name of the volume to be processed by this order.

Volume Flags

Bit 0: CE cartridge

Bit 1: Reserved and must be zero.

Bit 2: Secure volume (DASDERASE)

Bit 3: Exclusive volume

Bit 4: Scratch cartridge (Cannot be set by the user)

Bit 5: Bind attribute for the volume

Bit 6: Write inhibit

Bit 7: Reserved and must be zero

NVOLID

The new six-byte identification for a renamed volume.

CSN1 - CSN2

Two twelve-byte fields used to explicitly identify the scratch cartridges to be used in creating a new volume.

The CSN1 field is also used to identify volumes in the transient volume list. If either field is unused, it must be set to binary zeros.

MSGID

The six-byte identification contained in the message returned to the host at the completion of the define volume operation. A delayed response is implicit in this order.

USER DATA

This field is used only with the volume create and rename options of this order. When creating a volume, all 70 bytes of this field are placed in positions 10-79 of the cartridge label. On rename options, those bytes of this field that are not binary zero replace the corresponding bytes of the cartridge label's user data field.

DEMOUNT - Order Code '06'

The DEMOUNT order is issued to make a virtual volume unavailable for use on DASD by the specified host system. If there are no other host systems using the volume, DEMOUNT causes all the written cylinders from that volume to be scheduled for destaging. Any bound data is unbound whether it was bound by an ACQUIRE or by a volume attribute. Device end is returned after the destaging of all space has been enqueued to the stage scheduler.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	06	00	Attributes	00
04	VOLID			
08				
0C	MSGID			
10	CPUID			
14		00	00	00

Attributes

Bit 0: Reserved and must be zero.

Bit 1: Delayed response request—If set, indicates a delayed response request; an attention interrupt is to be sent to the host at the completion of the demount activity.

Bits 2-7: Reserved and must be zero.

VOLID

The six-character name of the volume to be demounted.

MSGID

The six-byte identification contained in the message returned to the host if delayed response was requested in the attribute byte. The message identification is used to relate the completion of the demount activity with the original request for the action.

CPUID

The five-byte manufacturer's identification of the CPU to which the demounted volume is no longer to be available.

HOST READY FOR MESSAGES - Order Code '20'

The HOST READY FOR MESSAGES order is issued by a host system during system initialization or during MSC recovery to indicate the host is ready to receive attention interrupts from the MSC. The attention interrupts indicate that one or more messages are pending for that host. Until the HOST READY FOR MESSAGES order is received, the MSC withholds all attention interrupts for that host.

For an MP system, a HOST READY FOR MESSAGES order from either CPU indicates that both CPUs are ready to receive attention interrupts.

When the four bytes of this order are received by the MSC, channel end and device end are sent to the host as ending status.

The HOST READY FOR MESSAGES indication in the MSC is reset either when the MSC receives a new Initial Microprogram Load, or when the specific host system is reset.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	20	00	00	00

INITIALIZE - Order Code '10'

The INITIALIZE order is sent to the Mass Storage Control by the host system initialization procedure (or by the host error recovery program) to identify and activate a host channel interface which intends to use the Mass Storage System, or to request a current configuration bit map over an already initialized interface.

Device end is returned to the host system when the processing of the order is finished.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	10	00	Attributes	00

Attributes

Bit 0: If set, this order requests a configuration bit map (message code 92) be sent to the requesting host. The interface must already be initialized.

Bit 1: If set, means this order comes from one CPU of an MP pair. Both CPU interfaces are to be initialized. If not set, the order initializes only the interface to the requesting host.

Bits 2-7: Reserved and must be zero.

Note: The INITIALIZE order is unit checked if bit 0 is on and the interface is not already initialized, or if bit 0 is off and the interface is initialized.

MOUNT - Order Code '08'

A host system issues a MOUNT order to make a mass storage volume available for access by a specified host. The VUA specified in the order is defined in the Mass Storage System Configuration Map as belonging to a single staging drive group. Since only one copy of any data is staged at one time, more than one host can mount the same volume only if they do so on VUAs that belong to the same staging drive group and if the assigned VUAs are designated as sharable when the MSC tables are created.

If the MOUNT order causes the remounting of a demounted volume on a staging drive group other than the one on which it was previously mounted, all the previously staged data on the old staging drive group is marked invalid and the mount operation continues on the new staging drive group. If a bound volume is remounted on the same staging drive group, all data still staged is marked invalid.

If a MOUNT is received for a virtual volume already mounted by the same CPU on the same VUA, the MOUNT is accepted without a unit check, and no not-ready-to-ready interrupt is given.

The MOUNT order for a non-bound mass storage volume causes one page of real DASD space to be allocated and schedules cylinder 0 of the volume to be staged if it has not been staged as a result of a previous MOUNT order. If the mount request is for a bound volume, space for the entire volume is allocated before cylinder 0 is scheduled for staging.

Channel end is returned to the host by the MSC after the order is received. Device end is returned by the MSC after it has scheduled cylinder 0 to be staged but before the actual staging is complete. When the staging is complete, the not-ready-to-ready interrupt is sent to the host by the Staging Adapter.

<table>
<tr><th>Offset</th><th>Byte 0</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th></tr>
<tr><td>00</td><td>08</td><td>00</td><td>Attributes</td><td>00</td></tr>
<tr><td>04</td><td colspan="3">VOLID</td><td rowspan="2">VUA</td></tr>
<tr><td>08</td><td colspan="3"></td></tr>
<tr><td>0C</td><td colspan="4">CPUID</td></tr>
<tr><td>10</td><td></td><td colspan="3"></td></tr>
</table>

Attributes

Bits 0-3: Reserved for use by the host control program; ignored by the MSC.

Bits 4-7: Reserved and must be zero.

VOLID

The six-character name of the volume to be mounted.

VUA

The virtual unit address on which the volume is to be mounted.

CPUID

The five-byte (10-digit) manufacturer's identification of the CPU for whose use this volume is to be mounted.

MOVE CARTRIDGE (Host System Generated) - Order Code '0E'

The MOVE CARTRIDGE order is used to eject a cartridge or transient volume from a Cartridge Store. In the process of the eject operation, the cartridge label is updated and the system tables are modified to show that the cartridge is not being kept physically in the system.

The cartridges to be moved must not belong to a mounted volume, and must not be scheduled for staging. If these conditions are not met, the order is rejected.

Device end and the completion message returned to the host after all activity making up the move operation is completed.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	0E	00	Attributes	CSID
04 08 0C 10	00 (16 bytes)			
14 18 1C	CSN			
20	00	00		
24	MSGID			

Attributes

Bits 0-1: Reserved and must be zero.

Bit 2: If set, means the cartridges to be moved make up a transient volume. The volume is identified by the CSN field of the order. That cartridge is the first of the pair that make up the transient volume. If only one cartridge of the transient volume is found in the system, that one is moved and the order is valid.

Bit 3: If set, means the cartridge to be moved is a member of the scratch cartridge list. If no CSN is specified in the order (the CSN field is binary zeros), the first cartridge on the scratch list is moved.

Bits 4-7: Reserved and must be zero.

Bits 2 and 3 are mutually exclusive. One and only one attribute bit must be specified.

CSID

Bits 0-5: Reserved and must be zero.

Bits 6-7: These two bits specify the logical Cartridge Store which contains the cartridge or cartridges to be moved.

CSN

This field contains the twelve-byte cartridge serial number of the scratch cartridge that is to be moved, or the first cartridge of the transient volume that is to be moved. The field must be zero if the cartridge to be moved is the first one from the scratch cartridge list.

MSGID

The six-byte identification contained in the message that is returned to the host system at the completion of the processing of this order. The order has an implicit delayed response.

NOP - Order Code '1E'

This order presents device end and unit check to the requesting host. When it is chained to the SUSPEND PROCESSING order to complete the required sequence when preparing to switch MSCs, the sense data associated with the unit check indicates the status of the MSC switch. Without the SUSPEND PROCESSING order, the NOP order results in sense data that can be used to determine the active or alternate status of an MSC.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	1E	00	00	00

PREPARE AND RESET BUFFERED LOG - Order Code '26'

The PREPARE AND RESET BUFFERED LOG order must be followed immediately in the CCW chain from the host by a READ BUFFERED LOG command. If it is not, the data in the buffered log area of the MSC may be invalid. Device end is returned after the buffered log data has been constructed in the MSC and is ready to be read.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	26	00	Attributes	00
04	SSID		00	00

Attributes

Bit 0: If set to 1, indicates that the SSID specified in this order is to have its buffered log data prepared to be read. This attribute bit can be used by any host system. If the unit SSID specifies a component not in the system, the log data is binary zeros and the SSID is passed back to the host as X'FFF'.

If set to 0, indicates that the SSID passed with the order is to be changed to the next higher available subsystem component and the buffered log data for this component prepared to be read. This order can be used to gather all buffered log data for every component of the system without explicitly specifying the SSIDs of each system component. To do so, the host must send FFF as the SSID in the first PRBL order. When the MSC receives an SSID that is equal to or higher than the last existing available subsystem component, the MSC will respond to the next chained READ BUFFERED LOG command with zeros for the log data and an SSID of FFF.

Bits 1-15: Reserved and must be zero.

PURGE - Order Code '14'

The PURGE order causes all volumes mounted by the system specified in the CPUID field of the order to be demounted. A host system cannot purge itself if it has an interface to the MSC initialized and ready to receive messages. A host may only purge itself during its IPL by entering PURGE as a system parameter. The purging is done prior to the initialization of the interface.

Device end is returned to the host system issuing the PURGE order after all the demounts are processed. Not all of the staging scheduled during these demounts is complete at this time.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	14	00	Attributes	00
04	CPUID			
08				

Attributes

Bit 0: If set, indicates the purge operation is for one or both of the CPUs of an MP pair. If the CPUs are currently associated, change the CPUID in the order to the other one of the pair and purge both CPUs. If the CPUs are not currently associated, purge only the other one of the pair. If bit 0 is not set, the single host specified by the CPUID is to be purged.

Bits 1-7: Reserved and must be zero.

CPUID

The five-byte manufacturer's identification of the CPU to be purged.

RELINQUISH - Order Code '04'

The RELINQUISH order is used to cause the release of DASD space with or without the destaging of the data in that space. If the RELINQUISH order is used without inhibiting destaging (bit 2 of the attribute byte set), the data on the relinquished space can be reused by a later job if the space has not been reallocated.

Channel end is sent to the host after receipt of the order. Device end is sent after the updated data has been scheduled for destaging and the space has been made available for future allocation pending the successful destaging of the updated cylinders. If a delayed response was requested, the host is notified by an attention interrupt and a message containing the order's MSGID at the completion of the destaging of the data.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	00	Attributes	Count
04	VOLID			
08				
0C	MSGID			
10	CPUID			
14		00	00	00
18	EXTENT			
• • •	• • •			
54	Up to 16 Extents			

Attributes

Bit 0: If set, means the BIND attribute of the VOLID set in a previous ACQUIRE operation is reset.

Bit 1: If set, indicates a delayed response request; an attention interrupt is sent to the host system after the changed data specified in the extents has been destaged and the pages of space made inactive.

Bit 2: If set, means no destaging of the data written in the relinquished space is scheduled even if the data has been modified. The data is marked as invalid and must be restaged if needed later.

Bits 3-7: Reserved and must be zero.

If no attributes are specified this order causes no action.

Count

The binary count of the number of extents specified below.

VOLID

The six-character name of the volume on which the data set is recorded.

MSGID

The six-byte identification contained in the message returned to the host if a delayed response was requested in the attribute byte. The message identification is used to relate the completion of the relinquish activity with the original request for that activity.

CPUID

The five-byte (10-digit) manufacturer's identification of the CPU requesting the relinquish activity.

Extent

This field specifies the beginning virtual cylinder (two bytes) and the ending virtual cylinder (two bytes) of a data extent whose space is to be relinquished. This information is provided for up to a maximum of sixteen extents.

SUSPEND PROCESSING - Order Code '22'

The SUSPEND PROCESSING order is issued by a host system in preparation for a power down, to deinitialize the host/MSC channel interface of the requesting host, or to prepare for a switch from the active to the alternate MSC.

For a non-primary host, if the SUSPEND PROCESSING order is issued with the reconfiguration attribute, it is rejected by the MSC. If the non-primary host or the primary host issues SUSPEND PROCESSING order with the immediate attribute, the interface between it and the MSC is disabled. All stage and destage activity already scheduled for that CPU is completed.

Only a primary host can issue the reconfiguration SUSPEND PROCESSING order. The primary host must be the only host system with an initialized interface to the MSC at the time the order is issued. At that time, all currently scheduled stage and destage operations are completed. All data that is staged and has been modified is scheduled for destaging and that destaging is completed. All cartridges are returned to their home cell locations and all messages pending for any host are dropped. The Recovery Journal is reset.

Only the primary host can issue the SUSPEND PROCESSING order to prepare the MSC for a switch to the backup MSC. Other host interfaces may be initialized and will remain so after execution of this order. This order must be chained to a NOP order to complete the process of preparing for the MSC switch. All stage/destage activity in process when this order is received is allowed to finish and all cartridges are returned to their storage cells. Trace, if active, is ended.

Device end is presented to the host issuing the SUSPEND PROCESSING order when all the scheduled activity caused by the order is complete.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	22	00	Attributes	00

Attributes

Bit 0: If set, indicates this is an order for an immediate shutdown.

Bit 1: If set, indicates this is a request for a reconfiguration shutdown.

Bit 2: If set, indicates this order is to prepare the MSC for a switch to the alternate MSC.

Bits 3-7: Reserved and must be zero.

TRACE - Order Code '24'

The TRACE order is used to start or stop the writing of trace records to the trace areas of the MSC tables.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	24	00	Attributes	00
04 08	T/D			

Attributes

Bit 0: If set, means start the MSC trace.

Bit 1: If set, means stop the MSC trace.

Bits 2-7: Reserved and must be zero. Either bit 0 or bit 1 must be set.

T/D

This field contains the CPU time and date at the time the order was constructed.

TUNE - Order Code '1C'

This order allows a host system to order a change to the LRU values associated with a given staging drive group. The order can also be used to display existing LRU values for the specified staging drive group.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	1C	00	Attributes	
04	SDG	00		
08	MSGID			
0C	DATA			

Attributes

Bit 0: If set to 0, means display the LRU values for the staging drive group specified in the order.

If set to 1, means modify the LRU values for the staging drive group, using the data contained in the order.

Bits 1-7: Reserved and must be zero.

Bit 8: If set, means display or modify the LRU thresholds.

Bit 9: If set, means display or modify the LRU slice range values.

Bit 10: If set, means display or modify the LRU clock resolution.

Bits 11-15: Reserved and must be zero.

SDG

The staging drive group number whose values are to be displayed or modified. This field should be binary zero if attribute bit 10 is on.

MSGID

The six-byte code that identifies the data associated with the display option of this order when it is sent back to the host.

DATA

If LRU values are to be changed, this field contains the new values to be substituted for the old ones in the MSC and the Staging Adapter. If thresholds are being modified:

- Byte 0 contains the new upper threshold delta
- Byte 1 contains the new lower threshold delta
- Bytes 2 and 3 are reserved and must be zero

If LRU slice ranges are being modified,

- Bytes 0-3 contain the new slice range values.

If the LRU clock resolution is being changed:

- Byte 0 contains the new clock resolution value.
- Bytes 1-3 are reserved and must be zero.

VARY OFF - Order Code '0C'

The VARY OFF order notifies the Mass Storage Control to stop using the device specified by the SSID of the order. The SSID can be that of a DASD drive, a DRD, a Staging Adapter, a Mass Storage Facility, Cartridge Store, or an accessor control microprocessor. If the specified device is already offline, or if the DASD drive is not in the state specified by the attribute byte, the MSC returns device end with unit check to the host system. Normal device end is returned when the vary off processing is complete.

In the case of varying offline a staging drive with valid data on it, the scheduled destage of the data is completed before the MSGID specified in the order is returned to the host. The MSC tables cannot be varied offline. A VARY order for the table pack will, however, make the remainder of the table pack unusable for data staging.

If a DRD is varied offline, all work in progress for that device is finished, no new work is scheduled for it. The last DRD of a Mass Storage Facility cannot be varied offline. An attempt to do so results in a unit check and a termination code of 79. The last DRD may be varied offline only by varying offline the Mass Storage Facility itself. The last DRC can also be varied offline only by varying off the MSF.

If a Mass Storage Facility is varied offline, all work in progress within it is allowed to finished. No new work is accepted.

The last accessor control in a Cartridge Store can be varied offline only by varying the Cartridge Store offline. Device end is returned after all processing is complete. If the device is already offline, device end and unit check are returned.

<table>
<tr><th>Offset</th><th>Byte 0</th><th>Byte 1</th><th>Byte 2</th><th>Byte 3</th></tr>
<tr><td>00</td><td>0C</td><td>00</td><td>Attributes</td><td>00</td></tr>
<tr><td>04</td><td colspan="2">SSID</td><td colspan="2">RUA</td></tr>
<tr><td>08</td><td colspan="4" rowspan="2">CPUID</td></tr>
<tr><td>0C</td><td>00</td><td colspan="2"></td></tr>
<tr><td>10</td><td colspan="4">MSGID</td></tr>
</table>

Attributes

Bit 0: If set, means the unit varied offline is a DASD drive previously varied online for use as a staging drive. All valid, updated data on the drive is scheduled for destaging. Use of this attribute requires that you specify an MSGID that will be sent as a message to the host system when all the data has been destaged.

Bit 1: If set, means the unit varied offline is a DASD drive previously varied online as a real drive.

Bit 2: If set, the DASD staging drive referred to by the SSID becomes unavailable to the MSC after the current stage/destage activity against it is complete. The data is not destaged as with a normal VARY OFF order and the Staging Adapter tables are not modified. The drive specified by the SSID assumes the NEUTRAL status. VARY ON with the staging attribute returns the drive to normal staging use.

Bit 3: If set, the DASD staging drive referred to by the SSID is set to the NEUTRAL status described in bit 2 above, and the real DASD unit specified in the RUA of the order is made available for real use by CE test programs (OLTEP). A staging drive varied offline this way is in the TEST status.

Bits 4–7: Reserved and must be zero.

The attribute bits are used only when varying DASD devices offline. One and only one bit must be specified.

SSID

The subsystem identification of the Mass Storage System device that is to be varied offline.

RUA

The Real Unit Address of the DASD drive to be set to the real status when it is varied offline for TEST.

CPUID

The manufacturer's identification of the CPU that has the real unit address of the DASD drive being put in the TEST status.

MSGID

The six-byte identification contained in the message to be sent to the host system upon completion of the destage activity (if any) scheduled by the VARY OFF operation. This message is used to relate the completion of the activity with the host request.

VARY ON - Order Code '0A'

The VARY ON order is used to tell the Mass Storage System that a device specified by the SSID of the order can be used. The device specified can be a DASD drive, a DRD, a DRC, a Staging Adapter, the entire Cartridge Store, or one accessor control of the Cartridge Store. If the device is already online, the MSC returns device end and unit check to the host system.

When a Staging Adapter is varied online, the MSC determines if the Staging Adapter tables are invalid and need to be rebuilt. All staged data is marked as written so that it will eventually be destaged. Device end is returned after all processing is complete. If the device is already online, device end and unit check are returned.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	0A	00	Attribute	00
04	SSID		00	00

Attributes

Bit 0: If set, means the device to be varied online is a staging drive. The VOLID of the pack mounted on the DASD drive with the SSID shown in the order is read and verified to ensure it is a proper staging pack and is mounted on the proper drive.

Bit 1: If set, means the DASD drive is to be varied online as real; that is, it can be treated as a drive that does not belong to the Mass Storage System.

Bits 2-7: Reserved and must be zero.

The attribute bits are used only when varying DASD devices online. One and only one bit must be specified.

SSID

The subsystem identification of the device to be varied online.

Message Formats

A message sent from the MSC to a host system via the message buffer can have one of three formats, (or it may be environmental or sense data). The formats of the three types of data messages are shown here. The format of the environmental and sense data is shown in the Appendix of this manual.

In each message, the first byte is message length, the second byte is message code.

Type 1 - Delayed Response with MSGID and Posting Code

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	0C	70	MSGID	
04				
08	Posting Code	00	SSID	

Posting code:

X'71' an error occurred during the stage/destage process

X'7E' a pack was varied offline, but IEHDASDR must be run on the pack before it can be used again.

X'7F' successful completion

SSID: This field is only valid for a VARY offline order with a delayed response. Indicates the drive varied offline.

Type 2 - Solicited Messages with MSGID

The following are the type 2 messages, showing the format and the order which generates each one. All type 2 messages have a message code less than '70'.

MOVE CARTRIDGE - Eject A Scratch Cartridge

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	24	01	MSGID	
04				
08 0C 10 14	00			
18 1C 20	CSN			

MOVE CARTRIDGE - Eject Transient Volume

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	03	MSGID	
04				
08	VOLID			
0C			Volume Flags	
10	00			
14				N
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

N is either 1 or 2 and is the count of the number of cartridges of this transient volume that are in the cartridge store.

DEFINE VOLUME - Create Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	04	MSGID	
04				
08	VOLID			
0C			Volume Flags	
10 14	00			
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

DEFINE VOLUME - Eliminate Active Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	05	MSGID	
04				
08	VOLID			
0C				
10 14	00			
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

DEFINE VOLUME - Rename Active Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	06	MSGID	
04				
08	Old VOLID			
0C			Volume Flags	00
10	New VOLID			
14			00	00
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

DEFINE VOLUME - Replace Volume Flags Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	10	07	MSGID	
04				
08	VOLID			
0C			New Volume Flags	00

DEFINE VOLUME - Eliminate Transient Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	08	MSGID	
04				
08	VOLID			
0C				
10 14	00			
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

DEFINE VOLUME - Rename Transient Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	18	09	MSGID	
04				
08	Old VOLID			
0C			Volume Flags	00
10	New VOLID			
14			00	00

DEFINE VOLUME - Activate Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	10	0A	MSGID	
04				
08	VOLID			
0C			Volume Flags	

DEFINE VOLUME - Deactivate Volume Option

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	30	0B	MSGID	
04				
08	VOLID			
0C			Volume Flags	
10 14	00			
18 1C 20	CSN of First Cartridge of Volume			
24 28 2C	CSN of Second Cartridge of Volume			

TUNE

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	0C	0C	MSGID	
04				
08	Display Data			

The tune order can request the display of the upper and lower threshold deltas, destage slice ranges, or LRU clock resolution. The data displayed reflects the request in the order generating the message.

Thresholds

Offset	Byte 0	Byte 1	Byte 2	Byte 3
08	Upper Delta	Lower Delta	00	00

Slice Ranges

Offset	Byte 0	Byte 1	Byte 2	Byte 3
08	Range 0	Range 1	Range 2	Range 3

LRU Clock Resolution

Offset	Byte 0	Byte 1	Byte 2	Byte 3
08	Time Delta	00	00	00

COPY CARTRIDGE

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	2C	0D	MSGID	
04				
08	VOLID			
0C				
10 14	00			
18 1C	New CSN			
20 24 28	Old CSN			

COPY Tables

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	40	0E	MSGID	
04				
08	CHR - Real Drive Table			
0C	CHR - Mounted Volume Table			
10	CHR - Scratch Cartridge Table			
14	CHR - Volume Inventory Table			
18	CHR - Transient Volume Table			
1C	CHR - VVA/VOLID Table			
20	CHR - Configuration Table			
24	CHR - Page Status Table			
28	CHR - Cell Map			
2C	CHR - VVA Table			
30	CHR - Journal			
34	CHR - Schedule Queue Table			
38	CHR - Overlay Table			
3C	CHR - Message Blocks			

Eradicate Volume

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	1C	0F	MSGID	
04				
08	VOLID			
0C			Volume Flags	00
10 14 18	CSN of First Cartridge of Volume			

Type 3 - Unsolicited Messages With No MSGID

The following messages result from the orders as shown. All type 3 messages have a message code equal to or greater than '80'.

MOVE CARTRIDGE - Enter Cartridge With Valid LXYZ Address Already Assigned

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	80	LXYZ	

MOVE CARTRIDGE - Enter Scratch Cartridge

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	10	81	LXYZ	
04 08 0C	CSN			

MOVE CARTRIDGE - Enter CE Volume

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	24	82	LXYZ	
04 08 0C	CSN			
10 14 18	00			
1C	VOLID			
20			00	00

MOVE CARTRIDGE - Enter Transient Volume

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	24	83	LXYZ	
04 08 0C	CSN of Cartridge Entered			
10 14 18	CSN of other cartridge of pair making up volume			
1C	VOLID			
20			S	N

S - the volume sequence number (1 or 2)

N - number of cartridges in Cartridge Store that belong to this volume (1 or 2)

TRACE On

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	84	00	00

TRACE Switch - MSC Switch to Alternate Area

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	85	C	00

C - X means TRACEX now in use

C - Y means TRACEY now in use

TRACE Ended

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	86	C	00

C - X means TRACEX last area used

C - Y means TRACEY last area used

Volume Available

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	08	8F	VOLID	
04				

Verify

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	7C	90	Pri	Alt
04 • • • 78	Configuration Bit Map			

PRI - last two hex digits of SSID of primary table pack.

ALT - last two hex digits of SSID of alternate table pack.

The format of the configuration bit map is in the MSC tables section of this manual.

INITIALIZE

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	7C	92	Pri	Alt
04 • • • 78	Configuration Bit Map			

PRI - last two hex digits of SSID of primary table pack.

ALT - last two hex digits of SSID of alternate table pack.

The format of the configuration bit map is in the MSC tables section of this manual.

Pack Change Interrupt

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	04	93	SSID	CC

SSID - last two hex digits of the drive from which the pack change interrupt was received.

CC - condition code (error code).

Destage With Error - Destage Not Forced

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	10	95	SSID	
04	LUA	VP	RP	CYL
08	VOLID			
0C			00	00

LUA - logical unit address

VP - virtual page number

RP - real page number

CYL - cylinder on which error noted

If destage is forced, the message code (byte 01 of the message) is 96.

Reconfigure (Pack Change Interrupt)

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	08	97	From RUA	To RUA
04	From SSID		To SSID	

RUA - real unit address

REMOUNT

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	00	48	VOLID	
04				
08	VUA	From SDG	To SDG	00

VUA - Virtual Unit Address

Host ERP Priorities

Priority	CSW Status Bit	Sense		Condition	Modifier	Outboard Recording	Host Action
		Byte	Bit				
00				SIO Condition Code 3		Yes	8
01		0 3 11	0 0 -	Command Reject and Format 0, Message 02		No	9
02		0 3 11	0 0 -	Command Reject and Format 0, Message 0B		No	10
03		0 3 11	0 0 -	Command Reject and Format 0, Message 0A		No	8
04		0 3 11 12	0 0 - -	Command Reject and Format 0, Message 0 and Termination code 80		No	8
05		0	0	Command Reject, not Format 0		Yes	1
06		0	3	Equipment Check on the execution of Sense command X'04'		Yes	6
07		0	5	Host Retry		Yes	2
08	45			Channel Control Check		Perm	CCH
09	46			Interface Control Check		Perm	CCH
10		0	1	Intervention Required		Yes	4
11		0	7	Environmental Data	A/B	yes	5
12				Equipment Check	A/B	yes	3
13				Bus Out Check		perm	3
14	44			Channel Data Check		perm	3
15	47			Chaining Check		perm	3
16	42			Program Check		No	1
17	43			Protection Check		No	1
18	41			Incorrect Length		No	1
19				No Previous Error		Yes	6
0A		1	0	CE Message		Yes	7
0B		1	1	Subsystem Unit Usable		Yes	7

Modifiers: CE Message and Subsystem Unit Unusable cannot occur by themselves. They are modifiers to Equipment Check and Environmental Data.

CCH (Channel Check Handler) means all recovery action is handled by the host CPU.

Outboard Recording: means a recording is made on SYS1.LOGREC only if the error is permanent after retry.

Note: Any error on the SWITCH command sequence will be posted as a permanent error.

ERP Host Actions

Action 1:

Exit to the operating system with permanent error indication.

Action 2:

1. Record on SYS1.LOGREC.
2. Repeat the failing CCW(s).

Action 3:

1. If a modifier bit is on, print a message to the operator and record on SYS1.LOGREC.
2. Repeat the failing CCW(s).
3. If the error condition is not corrected in five retries; and if Equipment Check or Bus Out Check, do action 8. Otherwise do action 6.

Action 4:

Print an error message to the operator and do action 5.

Action 5:

1. Record on SYS1.LOGREC.
2. If the error did not put the channel in "suspend" status, restart the operation at the failing CCW.
3. If the channel is in "suspend" status and command chaining is in effect, restart the operation with a modified NOP (command code 'A3') CCW chained to the failing CCW+8.
4. If the channel is in "suspend" status and command chaining is not in effect, issue a modified NOP (command code 'A3') chained to a NOP CCW.

Action 6:

1. Print an error message to the operator and record on SYS1.LOGREC.
2. Exit to the operating system with permanent error indication.

Action 7:

1. Print an error message to the operator and record on SYS1.LOGREC.
2. Continue processing the error condition that the modifier was associated with.

Action 8:

1. Print an error message to the operator and record on SYS1.LOGREC.
2. If an alternate MSC is not available, set the failing MSC offline and exit to the operating system with a permanent error indication.
3. Print a message to the operator indicating 'MSC switch started.' Switch device UCB's and set failing MSC offline. Issue switch CCWs to the available MSC.
4. If the commands to switch MSCs are successful, print a message to the operator indicating 'switch successful' and restart the failing user CCWs with error counters zeroed; otherwise,
5. Print a message to the operator indicating 'switch failed.' Set the failing MSC offline and exit to the operating system with a permanent error indication.

Action 9:

1. Print an error message to the operator and record on SYS1.LOGREC.
2. Issue 'Initialize' and 'Host Ready For Messages' CCWs to the primary MSC.
3. If the CCWs fail, exit to the operating system with permanent error indication.
4. If the CCWs are successful, restart the user's failing CCWs.

Action 10:

1. Print an error message to the operator and record on SYS1.LOGREC.
2. If the error occurred on the user's CCWs (ERP not in control), restart the operation with a modified NOP (command code 'A3') CCW chained to the failing CCW.
3. If the error occurred during the ERP, restart the operation with a modified NOP (command code 'A3') CCW chained to the failing CCW +8.

Mass Storage Control (MSC) Tables

The MSC microprogram requires the use of and maintains tables that reside on DASD to locate Virtual Volume data, verify MSS configuration, account for all cartridges and volumes, and recover from media or system failures. Two table packs are used; the primary table pack which controls all functions, and the alternate table pack which is used for table recovery. The table data on each pack is identical. Other formatted space is also reserved on a DASD drive for a copy area and is used for table recovery.

The tables are:

- Verification
- Staging Drive Group
- Mounted Volume
- Scratch Cartridge
- Volume Inventory
- Transient Volume
- VVA/VOLID Cross-Reference
- Configuration
- PST Image
- Cell Map
- Virtual Volume Address
- Recovery Journals
- Schedule Queue
- Diagnostic/EC/Overlay

Verification Tables

These tables are used during MSS initialization and verification and contain miscellaneous data, non-DASD unit control blocks, a configuration bit map, mount equalization records, and a suspend long confirmation record.

Miscellaneous Data

Offset	Data Area Name
00 04	Table Pack Identifier
08	IML/Sequence Number
10	Table CHRs
50	Staging Drive Group ID Table
90	DASD UCB
98	Journal UCB
A0	Reserved
C0	Reserved
DC	Trace CHRs
EC	LRU Control Word
F0	Real To Virtual Page Cross Reference
F4 F8	Reserved
FC	VOLID Prefix

The miscellaneous areas shown are described in detail below.

Table Pack Identifier

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	E0	0E	60	0F
04	E0	0E	60	0F

IML/Sequence Number

Built with all zeros, bytes 0 and 1 are used as a counter and are increased by 1 at each IML.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
08	XX	XX	00	00

Table Cylinder-Head-Records (CHRs)

DASD location (Cylinder-Head-Record) of the start of MSC tables. This is virtual CHR data. The format and table identifier is as follows:

Offset	Byte 0	Logical Cylinder Byte 1	Head Byte 2	Record Byte 3	Table Name	Table ID
'10'	00	09	0B	13	MVT Data Block	00
'14'	00	08	00	01	Staging Drive Group	10
'18'	00	08	0B	01	Mounted Volume	20
'1C'	00	13	02	01	Scratch Cartridge	30
'20'	00	15	10	01	Volume Inventory	40
'24'	00	18	10	01	Transient Volume	50
'28'	00	1A	08	01	VVA–VOLID Cross-Reference	60
'2C'	00	1A	0A	01	Configuration	70
'30'	00	1A	0C	01	PST Image	80
'34'	00	1B	01	01	Cell Map	90
'38'	00	1B	02	01	VVA	A0
'3C'	Last cylinder in journal	1B	0B	01	Journal	B0
'40'	00	1C	00	01	Schedule Queue	C0
'44'	00	1C	08	01	Diag/EC Overlay/ Table	D0
'48'	00	1B	03	01	Message Buffer	E0
'4C'	00	Reserved	Reserved	Reserved	Reserved	

Staging Drive Group ID Table with Current LRU Values

Each word describes, by Staging Adapter (0-D), the staging drive group numbers for logical 3333 zero and one and the current LRU values for the staging drive group. Twenty-eight staging drive group numbers from '00' to '1B' are valid. The format is as follows:

Offset	Bit Position	Significance
'50'	0 0 0 X X X X X	Staging Drive Group 0 for SA0
'51'	0 0 0 X X X X X	Staging Drive Group 1 for SA0
'52'	0 0 0 0 0 0 0 0	LRU value for SA0, Staging Drive Group 0
'53'	0 0 0 0 0 0 0 0	LRU value for SA0, Staging Drive Group 1
'54'- '84'	Same as 50-53 describing Staging Adapters 1-D.	

DASD UCB/Refresh Journal UCB

DASD unit control block for the volume containing the MSC tables. The format is as follows:

Offset	Bit Position	Significance
'90'	0...	Valid indicator for primary address
	.0..	Online indicator for primary address
	..0.	Ready indicator for primary address
	...0	Busy indicator for primary address
	.... 0...	Valid indicator for secondary address
	.... .0..	Online indicator for secondary address
	.... ..0.	Ready indicator for secondary address
	0	Busy indicator for secondary address
'91'	0000 0000	Work bits (initialized to zeros)
'92'	0000 0000	Active bits (initialized to zeros)
'93'	0000 0000	Post bits (initialized to zeros)
'94' - '95'		The primary address (hex) used by the MSC to access the table pack.
'96' - '97'		The secondary (alternate) address (hex) used by the MSC to access the table pack. Valid data if bits 4-6 in byte 90 are 1's.
'98' - '9F'		The alternate table unit control block. The format of this control block is the same as '90' - '97'.
'A0' - 'CF'		Reserved and must be zero.

Trace CHRs

Trace facility CHR pointers. This is virtual CHR data. The format is as follows:

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Table Name
'DC'	'00'	Cylinder Number	Head Number	Record Number	End of Trace X
'E0'	'00'	Cylinder Number	Head Number	Record Number	End of Trace Y
'E4'	'C0'	Cylinder Number	Head Number	Record Number	Start of Trace X
'E8'	'80'	Cylinder Number	Head Number	Record Number	Start of Trace Y

LRU Control Word

The format is as follows:

Offset	Bit Position	Significance
'EC'	0 0 0 0 0 0 0 0	LRU initial clock value set to zero.
'ED'	X X X X X X X X	LRU time value. Indicates variation in LRU update frequency.
'EE'- 'EF'	0 0 0 0 0 0 0 0	LRU to IOS interface.

Real To Virtual Page Cross-Reference

The format is as follows:

Offset	Significance
'F0'	Hex real page number that contains virtual cylinders '08'-'0F' of the MSC tables.
'F1'	Same as 'F0' for cylinders '10'-'17'.
'F2'	Same as 'F0' for cylinders '18'-'1F'.
'F3'	Same as 'F0' for cylinders '20'-'27'.
'F4' - 'FB'	Reserved.

VOLID Prefix

Offset	Significance
'FC' - 'FF'	EBCDIC VOLID prefix assigned to each volume used as staging space. Last two bytes of each VOLID contain the SSID.

Non-DASD UCB Data

Each record contains non-DASD unit control block data in the following format:

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	Count	Reserved		
04 ⋮ FC	Unit control block data			

COUNT

The number (in hex) of words of valid data that follow.

Configuration Bit Map

The first half of the table (offset '48' - '6C') is a list of all units generated in the configuration.

The second half (offset '70' - '94') indicates which of these units were online at the last power down of the MSS. This half of the table is used by 'VERIFY' to restore the MSS to the state it was in at the last power down.

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'48'	DRDs on CS0	DRDs on CS1	00	00
'4C'	Staging Adapter		DRCs	
'50' • • •	240 Staging Drive Group Drives			
'6C'			00	Cartridge Store
'70'	DRDs on CS0	DRDs on CS1	00	00
'74'	Staging Adapter		DRCs	
'78' • • •	240 Staging Drive Group Drives			
'94'			00	Cartridge Store

DRDs

Each bit set to 1 indicates the DRD is generated in the configuration. Bit 0 is for DRD 0, bit 1 is for DRD 1, etc.

Staging Adapters

Each bit set to 1 indicates the Staging Adapter is generated in the configuration. Byte 0 bit 0 is for Staging Adapter 0, byte 0 bit 1 is for Staging Adapter 1, etc. Byte 1 bit 0 is for Staging Adapter 8, byte 1 bit 1 is for Staging Adapter 9, etc.

DRCs

Each bit set to 1 indicates the DRC is generated in this configuration. Byte 0 bit 0 is for DRC 0, etc.

Staging Drive Group Drives

Each byte represents a staging drive group. Byte 0 is for staging drive group 0, byte 1 is for staging drive group 1, etc. Each bit within the bytes indicates a drive that is generated in the configuration. Bit 0 is for drive 0, bit 1 is for drive 1, etc.

Cartridge Store

Bits 0-1 = 00 Cartridge Store 00
01 Cartridge Store 01

Bits 2-7 = Reserved

Mount Equalization Records

Mount equalization records are used by a host to distribute mount requests across staging drive groups and have the following format:

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Staging Drive Group
'00'	Flags	Varied	Mounted Volumes		0
'04'	Flags	Varied	Mounted Volumes		1
⋮					⋮
'68'	Flags	Varied	Mounted Volumes		27
⋮	Unused				
'80'	LRU	Drive	Unit Address		1
'84'	LRU	Drive	Unit Address		2
⋮					⋮
'E8'	LRU	Drive	Unit Address		27

Flags

Used only by the MSC, they are zeros when received from the host.

Bit 0 = 1 increase the Varied On count by 1
Bit 1 = 1 decrease the Varied On count by 1
Bit 2 = 1 increase the Varied On count by 2
Bit 3 = 1 decrease the Varied On count by 2
Bit 4 = 1 increase the Mounted Volumes count by 1
Bit 5 = 1 decrease the Mounted Volumes count by 1
Bit 6 = 1 increase the Mounted Volumes count by 2
Bit 7 = 1 decrease the Mounted Volumes count by 2

Varied

A count of the number of logical drives that are varied online for staging and do not contain a bound volume.

Mounted Volumes

A count of the number of volumes mounted on this staging drive group, including bound volumes.

LRU

A count of the number of times the LRU service function has been invoked for this staging drive group since the last MSC IML. The counter wraps from 255 to 0.

Drive

The number of logical drives that exist for the staging drive group.

Unit Address

The number of UCBs that have been SYSGENed for the staging drive group for all host systems attached to the MSC.

Suspend Long Confirmation Record

Indicates that the reconfigure shutdown issued by the "Suspend Processing" order has been completed successfully. The 4-byte table entry is set to all 0's at IML. If all interfaces are suspended, this 4-byte entry contains AA AA AA AA.

Staging Drive Group Table

The staging drive group table contains a list of all staging drive groups attached to the Mass Storage System and a description of the information on each page within them. There is one entry in the table for each of the 28 possible staging drive groups. Each of the 28 staging drive group table entries contains 11 blocks of information in this format:

Block No.	Description
0	Real Page Map Device 0
1	Real Page Map Device 1
2	Real Page Map Device 2
3	Real Page Map Device 3
4	Real Page Map Device 4
5	Real Page Map Device 5
6	Real Page Map Device 6
7	Real Page Map Device 7
8	Page Availability Block
9	Demounted Volume Block
10	LRU Pages Block

Real Page Map

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Real Page
'00'	Flag	Virtual Page	Mounted Volume Table Pointer		0
'04'	Flag	Virtual Page	Mounted Volume Table Pointer		1
'08'	Flag	Virtual Page	Mounted Volume Table Pointer		2
'0C'	Flag	Virtual Page	Mounted Volume Table Pointer		3
⋮					⋮
'CC'	Flag	Virtual Page	Mounted Volume Table Pointer		51

Flag

00 = Page is free
Bit 0 = Page Active
Bit 1 = Page Inactive
Bit 2 = Page Bound
Bit 3 = Volume Bound
Bit 4 = Page in error
Bit 6 = Page Contains MSC Tables
Bit 7 = Page not available.

Virtual Page

The virtual page allocated to this real page.

Mounted Volume Table Pointer

Block displacement of MVT entry.

Page Availability Block

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Free Total		Active Total	
'04'	Inactive Total		Bound Total	
'08'	'33'	Upper Delta	Upper Threshold	
'0C'		Lower Delta	Lower Threshold	
'10'	SA1	SA2		
'14'	W	X	Y	Z
⋮				
'20'	Free Count Device 0	Active Count Device 0	Inactive Count Device 0	Bound Count Device 0
⋮				
'3C'	Free Count Device 7	Active Count Device 7	Inactive Count Device 7	Bound Count Device 7
'40' '44'	Free Page Bit Map Device 0			
⋮				
'78' '7C'	Free Page Bit Map Device 7			
'80' '84'	Active Page Bit Map Device 0			
⋮				
'B8' 'BC'	Active Page Bit Map Device 7			
'C0'	Flags - Device 0	Real Interface - Device 0	Original RUA Device 0	Real Unit Address - Device 0
. . .				
'DC'	Flags - Device 7	Real Interface - Device 7	Original RUA Device 7	Real Unit Address - Device 7

FREE, ACTIVE, INACTIVE, and BOUND Totals

A total of the pages in each of the specified categories for all available devices.

Upper and Lower Delta

Total number of pages on each device that the customer specifies to be available at any time. These totals are added to the thresholds when devices are varied on, and subtracted when devices are varied off.

Upper and Lower Thresholds

Count of active and bound page space. Used by the Least Recently Used service function to allocate space for staging new pages. (Active plus bound totals equal to, or exceeding, the upper threshold invoke LRU.)

SA1, SA2

Contains the Staging Adapter IDs to which this staging drive group is connected.

Bit 0 = Valid
Bit 3 = 0 for logical 3333 0, 1 for logical 3333 1.
Bits 4-7 = Staging Adapter ID

W, X, Y and Z (Destage Slice Ranges)

These bytes are used by the LRU Routine. The 4 high-order bits are used as time slices and are compared with the LRU clock in the Staging Adapter.

Free, Active, Inactive, and Bound Counts (By Device Number)

Contain a count of the pages in each of the specified categories for each device.

Free Page Bit Map

One bit to indicate free status for each page for each device. The bit on means the page is free.

Active Page Bit Map

One bit is set on to indicate active status for each page for each device.

Flags (By Device Number)

Bit 0 = Drive exists.
Bit 1 = Varied on virtual.
Bit 2 = Varied on real.
Bit 3 = 3330 Model 11.
Bit 4 = Drive contains MSC tables.
Bit 5 = Volume bound.
Bit 6 = Varied offline neutral.
Bit 7 = Second half of 3330 Model 11 pack.

Original RUA - VXXCCDDD

V = Validity

XX = Must be 0

CC = 3333 address

DDD = Device Address

Real Interface (By Device Number)

Staging Adapter and channel connection for this device.

Bit 0 = 0
Bit 1 = Channel B of SA1
Bit 2 = Channel C of SA1
Bit 3 = Channel D of SA1
Bit 5 = Channel B of SA2
Bit 6 = Channel C of SA2
Bit 7 = Channel D of SA2

Real Unit Address (RUA) — AABCCDDD

AA = Interface made real by Vary Off test
B = 0 for Staging Adapter 1, 1 for Staging Adapter 2
CC = 3333 address
DDD = Device address

Demounted Volume Block

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Next Available Entry Pointer	Current Pointer		
'04'	Mounted Volume Table Pointer		Mounted Volume Table Pointer	
⋮				
'FC'	Mounted Volume Table Pointer		Mounted Volume Table Pointer	

Next Available Entry Pointer

Offset to next available entry.

Current Pointer

Offset to entry currently being used for allocation.

Mounted Volume Table Pointer

Points to MVT entry for volume with inactive pages.

MVT Pointer Format:

AA X BBBBB BBBBBBBB

AA = Cartridge Store Identifier

X = Reserved and must be zero

BBBBB BBBBBBBB = Block displacement to MVT entry

LRU *Pages Block*

Same format as Demounted Volume Block.

Mounted Volume Table (MVT)

The Mounted Volume Table contains a list of all mounted volumes. Demounted volumes are retained as part of the MVT until all pages of the volume are allocated to other volumes. There is one entry in the MVT for each VOLID that is mounted, or demounted but not reallocated, on any staging drive group. A control field is used with the table to define it.

Control Field Format

4 Control Blocks
442 Index Blocks
Overflow Blocks
MVT Entries

Control Blocks

Each Control Block is a bit map of 2048 MVT entries. The block location of each bit that is set to 0 identifies an MVT entry that is currently in use or not available.

Index Blocks

Index blocks are used to locate the start of the MVT entry for each VOLID and have the following format:

Byte 0	Byte 1	Byte 2	Byte 3
Flags	Entry Length '08'	'1F'	Entries in Block Up to 31
Up to 31 MVT Entries			
VOLID			
		Displacement	

Flags

Bit 0 = 1 Overflow out.
Bit 1 = 1 Overflow block.
Bit 2 = 1 Last block in index (last block in overflow area only)
Bits 3-7 = zeros

Displacement

The number of MVT entries from the start to the one to which this VOLID refers.

MVT Entry Format

Offset	Byte 0	Byte 1	Byte 2	Byte 3	
'00'	VOLID				
'04'			Volume Attribute		
'08'	LXYZ 1		LXYZ 2		
'0C'	Mount Flag	Inactive Count	Reserve/ Release	Staging Drive Group Index	
'10'	Logical 3333 Address	Volume Available Message	00	00	
'14'	SA1	CPUID (B)	CPUID (C)	CPUID (D)	
'18'	VVA1	VUA (B)	VUA (C)	VUA (D)	
'1C'	SA2	CPUID (B)	CPUID (C)	CPUID (D)	
'20'	VVA2	VUA (B)	VUA (C)	VUA (D)	
					⋮
'34'	Flag/Dev.	Bound Count	Real Page	Cylinder Map	VP0
'38'	Flag/Dev.	Bound Count	Real Page	Cylinder Map	VP1
					⋮
'FC'	Flag/Dev.	Bound Count	Real Page	Cylinder Map	VP50

Volume Attribute

Bit 0 = CE Cartridge
Bit 1 = Reserved
Bit 2 = Secure Volume
Bit 3 = Exclusive Volume
Bit 4 = Scratch Cartridge
Bit 5 = Bound Volume
Bit 6 = Write Inhibit
Bit 7 = Reserved

LXYZ 1

Physical cartridge store location of the first half of the VOLIDs data.

LXYZ 2

Physical cartridge store location of the second half of the VOLIDs data.

Mount Flag

Bit 0 = Volume Mounted
Bit 1 = Mounted Exclusive
Bit 2 = Volume Bound
Bits 3-7 = Must be 0

Inactive Count

Total number of inactive pages.

Reserve/Release

Bit 4 = 0 for Staging Adapter 1
Bit 4 = 1 for Staging Adapter 2
Bits 6-7 = Staging Adapter Port Reserving Volume

Staging Drive Group Index

The number of the staging drive group (0-27).

Logical 3333 Address

Bits 0-3 = Reserved

Bit 4 = 0, logical address 0. 1, logical address 1.

Bits 3-7 = Reserved
The logical address of the 3333 that has this volume mounted.

Volume Available Message

One bit for each host interface indicating a volume available message (code 8F) is required when this VOLID is no longer mounted by any host.

Bit 0 = 1 Interface A
Bit 1 = 1 Interface B
Bit 2 = 1 Interface C
Bit 3 = 1 Interface D
Bits 4-7 = Must be 0

Staging Adapter 1 and 2

Bit 0 = Staging Adapter is Valid
Bit 1 = Interface B Active
Bit 2 = Interface C Active
Bit 3 = Interface D Active
Bits 4-7 = Staging Adapter Address

CPU ID

Bit 0 = 1, Interface is an alternate path.
Bits 4-7 = CPU for which volume is mounted (0-15).

VVA 1 and 2

Virtual Volume Address assigned for the Staging Adapter. (40-FF)

VUA

Bits 0,1 = Staging Adapter interface

01 = Interface B
10 = Interface C
11 = Interface D (on 3830-3)

Bits 2-7 = Virtual Unit Address used by host system. (00-3F)

Flag/Device

Bit 0 = Page is inactive. The Staging Adapter PST is not valid for the page. The MVT pointer is in the demounted volume block or LRU'd pages block.
Bit 1 = Cylinder(s) written within a page are scheduled for destage/erase. (Cartridge 1)
Bit 2 = Cylinder(s) written within a page are scheduled for destage/erase. (Cartridge 2)
Bits 3,4 = Reserved for space allocation/deallocation/demark page in error.
Bits 5-7 = Logical device on which page has been allocated.

Bound Count

Count of the number of ACQUIRES with BIND active in this page (decreased by RELINQUISH with UNBIND).

Real Page

Real page on DASD to which this virtual page is allocated (if Real Page=0, page is not allocated).

Cylinder Map

Bit-significant map of the cylinders in a page indicating which cylinders are staged or scheduled for stage. If the page is not allocated, this map indicates the cylinders that were previously acquired or cylinder faulted for this volume.

Scratch Cartridge Table

The Scratch Cartridge Table is a list of the cartridge serial numbers and the location of all cartridges within each Cartridge Store that do not have a VOLID assigned. A control field is used with this list to define it.

Control Field Format

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	Flags	Entry Length	Entry Limit	Use Count
04	00	CHR		

Byte 0 Bit 0 = Last Table Block
Bit 1 = Last Active Block
Bit 2 = End of Track Block
Bit 3 = Last Track in Table
Bits 4-7 = Compare length: 12 for cartridge serial number.

Byte 1 Each entry in the list has a length of 20.

Byte 2 Maximum number of entries for the block is 12.

Byte 3 Use count of entries in the block.

Bytes 5-7 Cylinder, head, and record number of the next track. (Not valid if Byte 0 bit 3=1)

Scratch Cartridge Table Entry

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Reserved			
'04' '08' '0C'	Cartridge Serial Number			
'10'	LXYZ		Reserved	

LXYZ

Cartridge Store location of this cartridge.

Volume Inventory Table

The Volume Inventory Table records information pertaining to virtual volumes in each Cartridge Store.

Each VOLID entry describes the attributes of the volume and the Cartridge Store LXYZ location assigned to each cartridge.

The VOLID table consists of three areas, each containing 442 blocks of data plus an overflow area. A control field is used with each block to define it. The format for each block is as follows:

Control Field Format

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	Flags	Entry Length '0C'	'14'	Entries in Block Up to 20
04	Overflow Track Pointer			

Flags

Bit 0 = 1 Last block of table.
Bit 1 = 1 Last active block on track
Bit 2 = 1 End of track
Bit 3 = 1 Last track of table or area
Bit 4 = 1 Block has been used
Bits 5-6 = 01 Area 1
10 Area 2
11 Area 3
Bit 7 = 1 Overflow Block

Overflow Track Pointer

The pointer to the next track in the overflow area. (Valid only in overflow area.)

Volume Inventory Table Entries

Offset	Byte 0	Byte 1	Byte 2	Byte 3	
'00'	VOLID				
'04'			Volume Flags	Copy Flags	Entry 1
'08'	LXYZ 1		LXYZ2		
⋮					⋮
'F4'	VOLID				
'F8'			Volume Flags	Copy Flags	Entry 20
'FC'	LXYZ 1		LXYZ 2		

Volume Flags

Bit 0 = CE Cartridge
Bit 1 = Reserved
Bit 2 = Secure Volume
Bit 3 = Exclusive Volume
Bit 4 = Scratch Cartridge
Bit 5 = Bound Volume
Bit 6 = Write Inhibit
Bit 7 = Reserved

COPY Flags

Bit 0 = Copy in progress for cartridge 1
Bit 1 = Copy in progress for cartridge 2

LXYZ 1

Cartridge Store address for cartridge 1 of volume.

LXYZ 2

Cartridge Store address for cartridge 2 of volume.

Transient Volume Table

The Transient Volume Table is a list of volume identifiers of volumes that have been deactivated, or of volumes entered into the cartridge access station but not as yet activated. A control field preceding each block is used with this list to define it.

Control Field Format

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	Flags	Entry Length	Entry Limit	Use Count
04	00	CHR		

Byte 0 Bit 0 = Last Table Block
Bit 1 = Last Active Block
Bit 2 = End of Track Block
Bit 3 = Last Track in Table
Bits 4-7 = Compare length: 12 for cartridge serial number. 6 for VOLID.

Byte 1 Each entry in the list has a length of 24.

Byte 2 Maximum number of entries for the block is 10.

Byte 3 Use count of entries in the block.

Bytes 5-7 Cylinder, head, and record number of the next track.

Transient Volume Table Entry

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	LXYZ 1		LXYZ 2	
'04' '08' '0C'	Cartridge Serial Number			
'10' '14'	VOLID			
			Volume Flags	Reserved

LXYZ 1, LXYZ 2

Cartridge Store locations of the pair of cartridges assigned to this VOLID.

Volume Flags

Bit 0 = CE Cartridge
Bit 1 = Reserved
Bit 2 = Secure Volume
Bit 3 = Exclusive Volume
Bit 4 = Scratch Cartridge
Bit 5 = Bound Volume
Bit 6 = Write Inhibit
Bit 7 = Reserved

VVA/VOLID Cross-Reference Table

This table contains a list of all possible Virtual Volume Addresses and relates them to the VOLID assigned to that address. This table is used to index into the Mounted Volume Table for a particular VOLID instead of scanning the whole Mounted Volume Table. There are 192 possible VVA entries for each Staging Adapter. The format is as follows:

	40 . . . VVAs . . . FF
SA0	192 entries
SA1	192 entries
⋮	
SAF	192 entries

Each entry is 4 bytes long and contains the following information.

VVA/VOLID Cross-Reference Table Entry

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	Flag	00	Mounted Volume Table Pointer	
04	Flag	00	Mounted Volume Table Pointer	

Flag

Bit 0 = If set, entry is valid; the MVT Pointer is correct.
Bits 1-7 = must be 0.

Mounted Volume Table Pointer

Bytes 2 and 3 contain the block offset from the start of the Mounted Volume Table data blocks to the Mounted Volume Table entry for this Virtual Volume Address.

Configuration Table

This table is used to determine the relationship between the host system, channel connections, Staging Adapters, and alternate paths defined for each virtual unit mounted by the host system. The table consists of a configuration index, configuration data blocks, Staging Adapter real device table, and an uninitialized cartridge image. The configuration index contains one block of information (XX00-XXFF) and has two parts: the index and the conversion table.

Configuration Index

Offset	Byte 0	Byte 1	Staging Adapter Channel B		Staging Adapter Channel C		Staging Adapter Channel D		Staging Adapter
			Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
'00'	Cartridge Store Connection		CPU ID	CU/ CHL	CPU ID	CU/ CHL	CPU ID	CU/ CHL	0
'08'									1
'10'									2
'18'									3
'20'									4
⋮									
'78'									F

Cartridge Store Connection

Bit 0 = 0 –Staging Adapter to Cartridge Store connections defined in Bits 4-5.

= 1 –Cartridge Store. (Bits 4-7 zeros.)

Bit 4 = Cartridge Store 0

Bit 5 = Cartridge Store 1

Bits 6 and 7 = Reserved and must be 0

CPU ID

One-byte CPU ID (00-0F) that represents the five-byte manufacturer's ID. (Identical to Manufacturer's ID Conversion Table entry)

Control Unit/Channel Address

One-byte control unit and channel address the host system uses to address this interface. It has this format:

Bits 0-1 = Control Unit (CU)
Bits 2-3 = Must be 00
Bits 4-7 = Channel Address (CHL)

Each of the CPU-CU/CHL entries in the index is used to reference a configuration data block. There are a total of 64 configuration data blocks in the data area of this table. The physical position of the CPU-CU/CHL entry in the index determines which configuration data block is associated with it.

Manufacturer's ID Conversion Table

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 8	CPU ID
'80' '88' '90' '98' 'A0' 'A8' . . . 'F8'	5 Bytes of Manufacturer's ID					Pointer	Flag 1	Flag 2	00 01 02 03 04 05 . . . 0F

Manufacturer's ID

The unique five bytes of the CPU identification number and model number.

The physical location of the Manufacturer's ID within this table determines the one-byte CPU ID to be inserted into the configuration index byte for each Virtual Unit Address that is mounted.

Pointer

The CPU ID of the other CPU in a Multiprocessor pair.

Flag 1

Bit 0 = Must be 0.
Bit 1 = This CPU is part of a potential Multiprocessor connection. (It may not be currently associated.)
Bit 2 = This CPU has an alternate path.
Bits 3-5 = Must be 0.
Bits 6 and 7 = CPU interface connection. (00, 01, 10, or 11 for A, B, C, or D)

Flag 2

Bit 0 = This entry in the table is valid.
Bit 1 = This CPU is currently associated as part of an Multiprocessor pair.
Bit 2 = The message buffer for this Multiprocessor interface or alternate path is the common message buffer. (Valid when bit 1=1)
Bits 3-5 = Must be 0.
Bits 6 and 7 = CPU alternate path interface connection (flag 1 bit 2 must=1 for these bits to be valid). (00, 01, 10, or 11 for A, B, C, or D)

Configuration Data Block

Offset	Virtual Unit Address	Byte 0	Byte 1	Byte 2	Byte 3
'00'	00	Configuration	Alternate Path	Alternate Path	Alternate Path
'04'	01				
'08'	02				
'0C'	03				
'10'	04				
'14'	05				
.	. . .				
'FC'	3F				

Configuration Bits

Bit 0 = 0 – Sharable
= 1 – Device not shared
Bit 1 = VUA addressed is in use
Bit 2 = 0 – Logical 3333 0,
1 – Logical 3333 1.
Bits 3-7 = Staging Drive Group (0-27)

Alternate Path

Bits 0 and 1 = 00 - No alternate path
01 - Staging Adapter Channel B
10 - Staging Adapter Channel C
11 - Staging Adapter Channel D
Bits 2 and 3 = Are set to 00.
Bits 4-7 = Staging Adapter Number (0-D).

Uninitialized Cartridge Image

The uninitialized cartridge image contains the following data for a cartridge CTOC that has not been initialized:

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	E5	D6	D3	F1
'04' ⋮ '4C'	Blanks			
'50'	01	94	00	13
'54'	32	E6	00	00
'58'	00	00	00	00
'5C'	08	00	00	F1
'60' ⋮ 'FC'	Zeros			

Staging Adapter Real Device Table

The Staging Adapter Real Device Table is a bit map of all devices attached to all Staging Adapters that are considered "real" at IML time. During IML, the MSC updates the Staging Adapter tables to reflect this condition. The format is as follows:

	3333 00	3333 01	3333 10	3333 11	
Offset	**Byte 0**	**Byte 1**	**Byte 2**	**Byte 3**	**Staging Adapter**
'00'	Alternate Staging Adapter	Alternate Staging Adapter	Alternate Staging Adapter	Alternate Staging Adapter	0
'04'	Interface B Devices	Interface B Devices	Interface B Devices	Interface B Devices	
'08'	Interface C Devices	Interface C Devices	Interface C Devices	Interface C Devices	
'0C'	Interface D Devices	Interface D Devices	Interface D Devices	Interface D Devices	
'10'	Same as Staging Adapter 0				1
⋮					⋮
'FC'	Same as Staging Adapter 0				F

Alternate Staging Adapter

An alternate Staging Adapter that is connected to this 3333. ('FF' indicates that this 3333 is not shared by another Staging Adapter.)

Interface B, C, D, Devices

Eight bits that represent all eight possible devices that can be addressed as real by the host system on the specified Staging Adapter interface and 3333. Each bit represents a logical drive. Bit 0=1 means that logical drive 0 is real, bit 4=1 means that logical drive 4 is real.

Page Status Table Image

The Page Status Table Image is a table containing 16 blocks of information for each Staging Adapter. Each block contains 52 page entries for one logical staging drive. The format is as follows:

Device 0	1	...	F	SA0 Pages
.				00
.				01
.				02
.				03
.				04
. . .				. . .
.				
Not Used Validity				51

Each entry is 4 bytes long in the following format:

Offset	Byte 0	Byte 1	Byte 2	Byte 3
00	VVA	VP	Cylinders Valid	Cylinders Written

The last word of the 'F' block is the validity indication. This word contains 'CC CC CC CC' if the table is currently valid.

Cell Map Table

This table contains a list of each LXYZ location in the Cartridge Store, showing the empty or full condition of the location. The Cell Map Table contains one block (XX00 through XXFF) of information for controls, and four other blocks for locations: one for X addresses 150-181, one for X addresses 182-213, one for X addresses 214-245 and one for X addresses 246-247. Cube pointers within the table are used to control the address and sequence for new cartridges loaded at the cartridge access station. The cube pointers are in the control block. Each of the four address blocks have this format:

Cell Map Block

	X Locations																
	Byte 0				Byte 1				Byte 2				Byte 3				
Y Locations	**01**	**23**	**45**	**67**	**01**	**23**	**45**	**67**	**01**	**23**	**45**	**67**	**01**	**23**	**45**	**67**	**Offset**
0-3																	'00'
4-7																	'04'
8-11	150	151	152	153	150	151	152	153	150	151	152	153	150	151	152	153	'08'
12-15																	'0C'
16-19																	'10'
20-23																	'14'
24-27																	'18'
	Not Used																'1C'
0-3																	'20'
4-7																	'24'
8-11	154	155	156	157	154	155	156	157	154	155	156	157	154	155	156	157	'28'
12-15																	'2C'
16-19																	'30'
20-23																	'34'
24-27																	'38'
	Not Used																'3C'
⋮																	⋮
0-3																	'E0'
4-7																	'E4'
8-11	178	179	180	181	178	179	180	181	178	179	180	181	178	179	180	181	'E8'
12-15																	'EC'
16-19																	'F0'
20-23																	'F4'
24-27																	'F8'
	Not Used																'FC'

A cube is represented by 4 bytes and each of the 32 bits represents one cell. Each cube contains 4 X locations times 4 Y locations times 2 Z locations. The four X locations repeat themselves in each byte of the cube according to this format:

X Locations	Byte 0				Byte 1				Byte 2				Byte 3			
0-3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3

Each of the four bytes contains one Y location, four X locations and eight Z locations according to this format:

Y Location							
X Location 0		X Location 1		X Location 2		X Location 3	
Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7

The even numbered bits represent the back Z location for this XY location the odd numbered bits represent the front Z location for this XY location.

The contents of the bits represent the empty or full condition of the Cartridge Store location identified by the position of the bit in the table.

0 = cell full

1 = cell empty

A total of 175 cubes are required to identify all cells in the Cartridge Store. A control block is used to indicate which cubes are available and to determine the loading sequence. The control block format is as follows:

Offset	Control Block			
	Byte 0	**Byte 1**	**Byte 2**	**Byte 3**
'00' '04' '08' '0C' '10' '14'	175 One-Bit Cube Flags			
'18' '1C' 'C0' ⋮ 'C4'	175 One-Byte Cube Pointers			
'C8' 'CC' 'F8' 'FC'	Filler			

The one-bit cube flag corresponds to the one-byte cube pointer at the same displacement within the table and has the following meaning:

0 = Cube full

1 = Cube has at least one free cell.

The one-byte pointer has the following meaning:

AA BB BBBB

AA = The number of the block which contains the desired cube. (0-3)

BBBBBB = The sequential number of the 4 byte word within the block. (All words are counted in the block)

The filler bytes are FF.

Virtual Volume Address Table

This table indicates which Virtual Volume Addresses are currently in use by the Staging Adapter. The table contains two blocks of information. There are eight Staging Adapters for each block.

Offset	Byte 0	Byte 1	Byte 2	Byte 3	Staging Adapter
'00' . . . '14'	192 Virtual Volume Address usage bits				0
'18-1C'	Unused				
'20' . . . '34'	192 Virtual Volume Address usage bits				1
'38-3C'	Unused				
. . .					
'E0' . . . 'F4'	192 Virtual Volume Address usage bits				7
'FB-FC'	Unused				

Each bit represents one of the VVAs from 40 through 4F. The table location of each bit that is set to 1 specifies which VVA is currently specified in a Mounted Volume Table entry. (Example: Byte 1, bit 4 indicates VVA 4C.)

MSC Recovery Journals

A sequential journal is maintained on DASD to record changes to MSC tables. A Recovery Journal, containing copies of table records prior to updating, is used to recover from system failures. A copy of the tables is also maintained on a backup table pack.

Schedule Queue Table

This table consists of 64 blocks of information for each Cartridge Store. The information is used to control stage and destage activities within the Mass Storage System. One block is used for one operation. The block contains a block header and as many mini-headers as are required to accomplish the operation. The format of a Schedule Queue Block is as follows:

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Block Flag	Current Mini-header Pointer	Block Flag 1/Cartridge Store ID	Block Flag 2/Staging Drive Group Index
'04'	Staging Adapter 1	Staging Adapter 2	VVA1	VVA 2
'08'	QCB 0	QCB 1	QCB 2	QCB 3
'0C'	QCB 4	QCB 5	DRD Address	QCB Pointer
'10'	VOLID			
'14'			LXYZ	
'18'	Trace T2		Trace T3	
'1C'	ST Save	BR Save	Joblist Chain Pointer	Spare
'20' '24' ⋮ 'FC'	Mini-Headers as required			

Block Flag

Bits 0-1 = 00 Null
01 Ready for delete or reread.
10 Valid, not started.
11 Valid and active in Active Stage Queue.
Bit 2 = Current entry is non-staging adapter type.
Bit 3 = Staging Adapter 2 valid.
Bit 4 = DRD allocation not required for this block.
Bit 5 = DRD assigned via Staging Adapter 2.
Bit 6 = Reserved for Alternate Path Retry X.
Bit 7 = Reserved for Alternate Path Retry Y.

Current Mini-Header Pointer

This byte is the sector offset of the mini-header currently in use.

Block Flag 1/Cartridge Store ID

Bit 0 = Must be 0 when block is used as Schedule Queue. Used internally by the Stage Scheduler as a re-read/wait indicator. Used also as Trace start/end indicator.
Bit 1 = LXYZ mismatch detected for this block.
Bit 2 = Message Buffer overflowed for this block.
Bit 3 = This block is in error waiting for a joblist.
Bit 4 = Stage Scheduler issued CARTRIDGE UNLOAD command.
Bit 5 = Inhibit CTOC read flag for IOS.
Bits 6-7 = Cartridge Store ID (0-1).

Block Flag 2/Staging Drive Group Index

Bit 0 = Read CTOC from stripe 5.
Bit 1 = Reserved.
Bit 2 = Reserved.
Bit 3-7 = Staging Drive Group (0-27).

Staging Adapter 1, Staging Adapter 2

These bytes are used to identify the Staging Adapters that can be used for accessing the DRD that has been allocated.

VVA1, VVA2

These bytes are the virtual Volume Addresses used by Staging Adapter 1 or Staging Adapter 2.

QCB 0 through 5

These bytes are an image of the queue control block that is associated with this schedule queue block.

DRD Address

This byte is the DRD address that has been allocated for use by this schedule queue block.

QCB Pointer

This byte is used to indicate which word in the QCB sector is associated with this schedule queue block. Bits 6 and 7 are used to determine which QCB sector is in use, and bits 0 through 5 are used to address the word within the sector.

VOLID

These six bytes contain the alphanumeric EBCDIC notation of the volume identifier being used by this schedule queue block.

LXYZ

These two bytes are the Cartridge Store address of the cartridge 1 of the VOLID being used by this schedule queue block.

Trace T2, Trace T3

Trace T2 is the time that the schedule queue performed the DRD allocation. Trace T3 is the return from DRD allocation and CTOC read.

ST Save, BR Save

The contents of the ST and BR Registers are saved at this location when this schedule queue block becomes active.

Joblist Chain Pointer

This byte is valid only when the block flag indicates valid and active. It contains a pointer to the next active schedule queue block that is waiting for a joblist. 00 indicates no other block is waiting for a joblist.

Mini-Headers

There are three types of mini-headers used in schedule queue blocks: Staging Adapter type, non-Staging Adapter type, and I/O Request Block (IORB) type. The Staging Adapter type is used to perform stage/destage activity. The non-Staging Adapter type is used to perform message activity. The IORB type is used to perform activity that does not require staging/destaging such as LRU activity. The format of each type follows.

Staging Adapter Type

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Sequence Byte	Mini-Flag	Unused	Next Mini-Header
'04'	Trace T1			
'08'	Trace T4		Trace T5	
'0C'	Order ID	CPU ID	Unused	
'10'	Staging Adapter Flag	Count	VUA	VVA
'14'	LUA	VP	RP	CYL
⋮				
Variable	LUA	VP	RP	CYL

Page list - zero or more pages

Sequence Byte

Bit 0 = Verify XYZ
Bit 1 = Move Data (Stage/Destage)
Bit 2 = Checkpoint the block
Bit 3 = Reserved
Bit 4 = Update first Staging Adapter tables
Bit 5 = Update second Staging Adapter tables
Bit 6 = Reserved
Bit 7 = Reserved

Note: The sequence bits are turned off as the Stage Scheduler performs the requested function.

Mini-Flag

Bits 0 and 1 = 00 Destage, Staging Adapter type.
01 Non-Staging Adapter type.
10 Stage, Staging Adapter type.
11 Non-Staging Adapter type.
Bit 3 = Secondary mini-header pointer valid. (valid only if bit 1=1)
Bit 4 = NOP (valid only if bit 1=1)
Bit 5 = IORB Type.
Bit 6 = IORB Staging Adapter 2 update requested (in addition to Staging Adapter 1 request)
Bit 7 = Reserved.

Next Mini-Header

This byte is used as the low-order address byte of the next mini-header. The schedule queue sector is the high-order address byte. The last mini-header has 00 in this byte.

Trace T1

Trace T1 is the time that this mini-header was put into the schedule queue block.

Trace T4

Trace T4 is the time that the stage/destage operation was requested by this mini-header.

Trace T5

Trace T5 is the time the stage/destage operation was completed for this mini-header.

Order ID

This byte is the order or function this mini-header is to perform.

CPU ID

This byte identifies the CPU that caused this schedule queue block to be set up.

Staging Adapter Flag

A one byte field describing the current activity of the Staging Adapter.

Count

This byte contains a count of the number of pages in the page list at the end of this mini-header.

VUA

This byte contains the virtual unit address for the unit required by this mini-header.

VVA

This byte is inserted by the Stage Scheduler depending on which Staging Adapter is used. The VVA contains the virtual volume address for this schedule queue block when it is valid and active.

LUA, VP, RP, CYL. (Page List)

These words (one or more) are the page lists of the pages required by this mini-header.

Non-Staging Adapter Type

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	CPU Interface	Mini-Flag	Secondary Pointer	Next Mini-Address
'01'	Message Length	Host Code		
⋮ End	Message Data			

CPU Interface

This byte is a binary representation of the CPU interface this mini-header controls. The format is as follows:

Bit(s) 0, 1, 2, and 3 = 0000 Interface A
0001 Interface B
0010 Interface C
0011 Interface D

Mini-Flags

Bits 0 and 1 = 00 Destage, Staging Adapter type.
01 Non-Staging Adapter type.
10 Stage, Staging Adapter type.
11 Non-Staging Adapter type.
Bit 2 = System Reset, ignore message
Bit 3 = Secondary mini-header pointer valid (valid only if bit 1=1)
Bit 4 = NOP (valid only if bit 1=1)
Bit 5 = IORB type
Bit 6 = IORB Staging Adapter 2 update requested (in addition to Staging Adapter 1 request)
Bit 7 = Reserved.

Next Mini-Address

This byte is used as the low-order address byte of the next mini-header. The schedule queue sector is the high-order address byte.

Message Length

This byte is a count in hex of the number of data bytes in the message data area.

Host Code

This byte is an error code sent to the host for posting.

IORB Type

Offset	Byte 0	Byte 1	Byte 2	Byte 3
'00'	Re-served	Mini- flag 1	00	Next Mini-Header
'04'	Staging Adapter Flag	Count	VUA	VVA
'08'	LUA	VP	RP	CYL
⋮				
Vari-able	LUA	VP	RP	CYL

Page list zero or more pages.

Mini-Flag 1

Bit 0 = 0
Bit 1 = 1
Bit 2 = 0
Bit 3 = 0
Bit 4 = 0
Bit 5 = IORB Type
Bit 6 = Staging Adapter 1 valid and should be updated
Bit 7 = Staging Adapter 2 valid and should be updated

The other areas of this mini-header have the same meanings as in the Staging Adapter type.

Diagnostic/EC/Overlay Table

The Diagnostic/EC/Overlay Table contains Cartridge Store, Staging Adapter, and Mass Storage Control EC patches; Cartridge Store and Staging Adapter diagnostic routines; and Mass Storage Control overlay areas.

Track					
	0	CS0 Patches	00	CS1 Patches	00
	1	00	00	00	00
	2	SA0 Patches	SA1 Patches	SA2 Patches	SA3 Patches
	3	SA4 Patches	SA5 Patches	SA6 Patches	SA7 Patches
	4	SA8 Patches	SA9 Patches	SAA Patches	SAB Patches
	5	SAC Patches	SAD Patches	00	00
⋮	6	Cartridge Store Diagnostic Routines			
	13				
⋮	14	DRD Diagnostic Routines			
	21				
	22	MSC Patches			
	23	00			
⋮	24	MSC Overlay			
	39				

The patch areas are used to modify the functional code of the specified units to an updated EC level. The diagnostic areas contain a mirror image of the 23FD CE Diagnostic disk. The CE can use either the 23FD disk or this table to exercise diagnostic routines.

Appendix A - Sense Data

The following pages show the format and meaning of the 32-byte sense records. These records are read by a SENSE command (code '04') issued by a host system in response to a unit check from the MSC, or are sent to the primary host as unsolicited environmental data records.

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 00 (BYTE 11)
NO MESSAGE (DECODE BYTES 0-3)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10*		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	0	0	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

*If the SSID in bytes 1 and 2 indicates a DRC (04XX), byte 10 contains the DRD number of the path which the MSC APR indicates unusable.

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 01 (BYTE 11)
INVALID COMMAND CODE

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	0	0	1
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 02 (BYTE 11)
INTERFACE NOT INITIALIZED

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	0	1	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 03 (BYTE 11)
INCORRECT CCW LENGTH

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	0	1	1
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 04 (BYTE 11)
INCORRECT DATA VALUE

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	1	0	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 5, DR ENVIRONMENTAL DATA PRESENT (BYTE 11)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	0	1	0	1
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16 Read Usage Ctr MSS 17 Read Usage Ctr MSS 18 Read Usage Ctr		16M counter, overflows at 8M. Bits 0-7 unused, bit 8 off = overflow, bits 9-31 are counter.							
MSS 20 Write Usage Ctr MSS 21 Write Usage Ctr MSS 22 Write Usage Ctr MSS 23 Write Usage Ctr		16M counter, overflows at 8M. Bits 0-7 unused, bit 8 off = overflow, bits 9-31 are counter.							
MSS 24 Soft Read Checks MSS 25 Soft Read Checks		64K counter, overflows at 32K. Bit 0 off = overflow, bits 1-15 are counter.							
MSS 26 Soft Write Chks MSS 27 Soft Write Chks		64K counter, overflows at 32K. Bit 0 off = overflow, bits 1-15 are counter.							
MSS 28 No of DRD Loads MSS 29 No of DRD Loads		64K counter, overflows at 32K. Bit 0 off = overflow, bits 1-15 are counter.							
MSS 30 No of DRD Load Errors MSS 31 No of DRD Load Errors		64K counter, overflows at 32K. Bit 0 off = overflow, bits 1-15 are counter.							

Note: Buffered log counters are from the MSC and apply to the DRD indicated in the SSID. SSID =FFF

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 6 (ABNORMAL TERMINATION OF MSC FUNCTION)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		VOLID if termination code = C2. CHR if termination code = CB, CD or CC. SSID if termination code = C9.							
MSS 5		VOLID if termination code = C2. CHR if termination code = CB, CD or CC. SSID if termination code = C9.							
MSS 6		VOLID if termination code = C2. CHR if termination code = CB, CD or CC.							
MSS 7		VOLID if termination code = C2. CHR if termination code = CB, CD, or CC.							
MSS 8		VOLID if termination code = C2.							
MSS 9		VOLID if termination code = C2.							
MSS 10		Table ID if termination code = C4 or C0. Pointer if termination code = C7 or C8. VUA if termination code = C3.							
MSS 11 Message Code		0	0	0	0	0	1	1	0
MSS 12 Termination Code		Termination Codes are on the next pages.							
MSS 13		0	0	0	0	0	0	0	0
MSS 14		Cell Address if termination code = C1.							
MSS 15		Cell Address if termination code = C1.							
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

SSID=FFF

BYTE 12 FOR FORMAT 0, MESSAGE 6

The following table summarizes the known errors generated by external order functions and internal service functions.

Termination Code	Meaning
01	The VUA is not defined by any Staging Adapter table entry.
02	The VUA specifies a Staging Adapter which has no Cartridge Store connections.
03	The VUA is already in use.
04	The number of volumes mounted exceeds the system capacity.
05	The specified VUA is non-sharable, but the volume is already mounted and sharable.
06	The requested volume is currently mounted exclusively.
07	The requested volume is not in the volume inventory.
08	The requested volume resides in a Cartridge Store which is inaccessible with this VUA.
09	The configuration table indicates more than two Staging Adapters connect to one 3333.
0A	The VUA specifies a Staging Adapter on which the specified VUA is invalid.
0B	The VUA specifies a staging drive group which has no drives containing pages that can be bound.
0C	Some pages on the requested volume are marked unavailable.
0D	Not used
0E	Not used
0F	The configuration table indicates this CPU is part of a tightly coupled system, but the identity of the associated CPU is not known.
10	The specified volume is currently in use by a staging drive group which is inaccessible with the VUA.
11	The mounted volume table indicates the specified volume is currently in use by this CPU.
12	The specified volume is being destaged from a staging drive group which is inaccessible with this VUA.
13	The VUA specifies a Staging Adapter which currently has no virtual addresses available.
14	Requested volume is varied off.
15	Not used
16	Not used
17	Manufacturer's ID cannot be converted to a logical CPU ID.
18	Cartridge Store is offline or unusable.
19	No valid Staging Adapters.
1A	Mounted Volume not enqueued.
1B	Staging Adapter was not found for table update.
1C	Not used
1D	Not used
1E	The specified volume is not from SDG 0.

Termination Code	Meaning
20	Invalid operation - cannot eliminate CE Volume.
21	Cartridge Store full - no free cells.
22	Volume mounted.
23	Cartridge serial number not found.
24	No scratch cartridges remain in the Cartridge Store. The wrong Cartridge Store may have been requested.
25	Invalid information in the label.
26	Sequence #1 cartridge of requested volume is not in Cartridge Store.
27	Invalid options in the attribute byte.
28	Serial numbers are missing or not identical on this a CE volume create operation.
29	The VOLID already exists on another volume.
2A	Sequence #2 cartridge of requested volume is not in Cartridge Store.
2B	Destaging in progress on specified volume.
2C	Not used
2D	Not used
2E	Staging drive group table indicates mounted but mounted entry not found.
2F	Copy Cartridge failed due to equipment error. Cartridge has been ejected.
30	Illegal Order - the order contains syntax errors.
31	Invalid SSID - invalid type code or unit not in the Mass Storage System.
32	No attributes were specified on a Vary On/Off of a DASD.
33	A Vary On/Off request with the real attribute has been issued to a DASD volume in staging status.
34	A Vary On/Off request with the staging attribute, or a Vary Off request with the neutral or test attribute has been issued to a DASD volume in real status.
35	A Vary Off request with the neutral attribute has been issued to a DASD volume that is not in staging or neutral status.
36	A Vary Off request with the test attribute has been issued, but the RUA specified is invalid.
37	A request has been issued to Vary Off the last microprocessor of a Cartridge Store without the Cartridge Store being offline.
38	A request has been issued to Vary Off the last Data Recording Controller without the Cartridge Store being offline.
3A	A Vary On request with the real attribute has been issued to a DASD volume that has no real interfaces defined.
3B	A Vary On/Off request with the real attribute has been issued to a DASD volume in neutral status.

Termination Code	Meaning
3C	A Vary Off request with the staging attribute has been issued to a DASD volume in neutral status.
3D	A Vary On/Off request has been issued to a DASD volume marked for real use only.
3E	The required attribute bits are not zero.
3F	A table journal error was previously reported (error code = 60). No additional functions are allowed to start.
40	Order terminated because of I/O error.
41	CC 1 on TIO (intervention required in the sense data).
42	Unit check on TIO (no intervention required in the sense data).
43	CC 3 on TIO (control unit).
44	Not used
45	No DASD space available for staging.
46	Virtual page not acquired and bound.
47	Volume not mounted for table transfer.
48	Journal is full.
49	Insufficient space requested for table copy.
4A	Reserved.
4C	I/O Error - only the sequence #1 cartridge has been successfully ejected.
4D	Interface specified to be purged is both initialized and ready.
4E	Incorrect attributes, the job list does not meet requirements for these functions.
4F	Order for disassociate and deinitialize attribute.
50	No path available for Read/Write access to MSC tables.
51	Initialize order issued but MSC already initialized.
52	Incorrect attributes.
53	Could not locate journal end.
54	Cannot locate Mass Storage System table module cartridge containing Refresh Journal for table update.
55	Cartridge Store Cell is empty on selection.
56	Not used
57	Volume not mounted or already demounted.
58	Not used
59	Manufacturer's CPU ID not correct - tightly coupled CPU indicated but never found.
5A	DASD IORB - DASD tables unusable.
5B	Sequence failure, or illegal action requested.

Termination Code	Meaning
5C	Cartridge Store unusable or Cartridge Store not valid in subsystem configuration.
5D	Test I/O - path to unit not available within the Mass Storage System configuration.
5E	Resources unavailable for DRD allocation.
5F	An expected A3 order not received on interface suspend sequence.
60	Table recovery incomplete - because table pack is not active.
61	Tape recovery journal full.
62	Not used
63	Not used
64	Not used
65	No Staging Adapter available for Destage operation.
66	Not used
67	Not used
68	Cube pointer not found in block header for the Cartridge Store.
69	No path available to last address used to access MSC tables.
6A	Table pack key not found on device at address previously containing the MSC tables.
6B	Messages have been lost during Unsolicited Device End Processing operation because the message buffer was full.
6C	Micro code not valid in MSC receiving a Lower Interface Select (LIS) command.
6D	Following a lower interface select sequence (and 8 retries), the lower interface remains inactive.
6E	Not used
70	Alternate Staging Adapter never found during a reserve request.
71	Not used
72	Volume not mounted.
73	Not used
74	Not used
75	A Vary On request with the staging attribute has been issued to a DASD that has not been initialized for the Mass Storage System.
76	A Vary On request with the staging attribute has been issued to a DASD volume that is already in staging or neutral status, but whose VOLID is different.
77	A Vary On request with the staging or real attribute has been issued to a DASD volume that is not completely offline. A delayed response for the preceding Vary Off is still outstanding.

BYTE 12 FOR FORMAT 0, MESSAGE 6 (Cont'd)

Termination Code	Meaning
78	Device already varied on/off.
79	Request to vary off last DRD for a MSF. MSF must be varied off.
7A	Not used
7B	Invalid QCB linkage.
7C	Given VOLID is not mounted.
7D	VOLID not mounted by this CPU.
7E	Specified attribute bits are not zero.
7F	Trace already recording or not active.
80	No lower interface and diagnostic control is not in the Writable Control Storage
81	Illegal order - invalid attributes.
82	23FD not up to speed.
83	23FD seek check.
84	Invalid compare when applying MSC patch or updating a table block.
85	DRD not offline.
86	VOLID not in volume inventory or CSN not in scratch cartridge list.
87	An attempt was made to use the lower interface on the backup MSC.
88	No active DRC found on attempt to write ECs to control store.
89	Cartridge does not belong to the Cartridge Store.
8C	Not used
8D	Error during write of configuration bit map.
8E	I/O error accessing MSC tables.
8F	Overlay and WCS code level do not match.
90	Illegal order - invalid attributes.
91	Shutdown request issued by primary host without other interfaces shut down.
92	Either reconfigure, immediate, or prepare for MSC switch was not issued by the primary host.
93	Not used
94	Stage/Destage impossible due to prior error.
9A	Unit is not available: (a) not part of the subsystem configuration or (b) due to an error condition.
9B	Attributes instructed function to increment to the next unit, but issuing host is not the primary host.
9C	SSID was invalid.
9D	There are no more units available in the subsystem configuration.

The Following codes supply additional sense data as shown below.

Termination Code	Meaning
A0	Not used
A1	DRD allocation impossible - path does not exist.
A2	Read of CTOC indicates lost cartridge.
A6	Not used
A7	Not used
A8	DVB/LPB table is full and mounted entries cannot be freed.
A9	May not copy CE cartridge.
AA	Cannot communicate from spindle to Cartridge Store(s).
AB	Unsuccessful staging.
AD	Associate request but CPUID not configured for possible MP.
AE	Association table entry not valid.
AF	Configuration table Staging Adapter port incorrect.
B1	QCB is wrong length.
B4	Message buffer is full and a read data command is needed to relieve the situation.
B5	Invalid Staging Drive Group number and/or incorrect attribute bytes.
B6	Not used
B7	Not used
BC	Not used
BD	No inactive pages exist for mounted volume record which has a non-zero inactive count.
BE	Not used
BF	Error in Staging Drive Group. Free count for device is non-zero, but free page bit map for device indicates no free pages.

Term Code	Meaning	Generation Function	Sense Information
C0	No space in table	Move/Define	Table ID
C1	Cartridge does not belong to cartridge store	Move	LZYX
C2	Requested volume is bound	Clear volume	VOLID
C3	Input VUA from SA does not match MVT	Reserve/Release	VUA
C4	Volume not in table	Move/Define	Table ID
C7	Ending cylinder of an extent is greater than the highest cylinder on the volume. (Sense shows displacement)	Move/Define	Pointer to failing extent
C8	Starting cylinder of an extent is greater than the ending	Acquire/Relinquish	Pointer to failing extent
C9	Record 1 of MSC tables has invalid ID	Verify	SSID
CA	Reserved		
CB	MSC UCB record on DASD has invalid word count	Verify	CHR in error
CC	MSC UCB record too large	Verify	CHR in error
CD	Table ID miscompare	Table Module	CHR in error

Termination Code (Hex)	Sense Byte Number												
	4	5	6	7	8	9	10	11	12	13	14	15	16-27
C0							Table ID	Msg = 06	Term Code				
C1											LZYX		
C2	VOLID												
C3							VUA						
C4, C0							Table ID						
C7-C8							Pointer*						
C9	SSID												
CB-CD	CHR												

Error codes generated by the verify function are presented via a unit check of initialize.

Note: Table ID's given below.

Table ID	Table
10	Staging Drive Group
20	Mounted Volume
30	Scratch Cartridge
40	Volume Inventory
50	Transient Volume
60	VVA/VOLID Reference
70	Configuration
80	PST image
90	Cell Map
A0	VVA
B0	Journal
C0	DASD Queue
D0	Diag/EC table/overlay code
E0	Message Buffer

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 7 (BYTE 11)
APR SEQUENCE TERMINATOR

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	MSC	VOLID if available							
MSS 5	MSC	VOLID if available							
MSS 6	MSC	VOLID if available							
MSS 7	MSC	VOLID if available							
MSS 8	MSC	VOLID if available							
MSS 9	MSC	VOLID if available							
MSS 10		Port Logical Unit Address of the successful path.							
MSS 11 Message Code		0	0	0	0	0	1	1	1
MSS 12 Termination Code		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		LZYX, if available **							
MSS 15		LZYX, if available **							
MSS 16		Cartridge Serial Number, Char 0, if available							
MSS 17		Cartridge Serial Number, Char 1, if available							
MSS 18		Cartridge Serial Number, Char 2, if available							
MSS 19		Cartridge Serial Number, Char 3, if available							
MSS 20		Cartridge Serial Number, Char 4, if available							
MSS 21		Cartridge Serial Number, Char 5, if available							
MSS 22		Cartridge Serial Number, Char 6, if available							
MSS 23		Cartridge Serial Number, Char 7, if available							
MSS 24		Cartridge Serial Number, Char 8, if available							
MSS 25		Cartridge Serial Number, Char 9, if available							
MSS 26		Cartridge Serial Number, Char 10, if available							
MSS 27		Cartridge Serial Number, Char 11, if available							
MSS 28		First cylinder in error when stage with error occurred (otherwise 0).							
MSS 29		First cylinder in error when stage with error occurred (otherwise 0).							
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Termination Code:

00 A DRC or DRD marked unusable or suspect
01 Media error or media in use during APR.
02 Stripes Available = 0
03 Load Failure
04 Stage with error performed

Information Supplied

Active Volumes (Stage, Schedule, Redefine, etc)	Non Active Volume	Cartridge Entering Cartridge Access Station
VOLID, LZYX	CSN, LZYX	**<(CSID) Bits 0 and 1 of byte 14

SSID=FFF

Byte 3, bits 6, 7

6 7
0 1 APR successful
1 0 APR unsuccessful
1 1 Unsuccessful completion code due to ERP action MSC to SA

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 9 (BYTE 11)
MISPLACED CARTRIDGE

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	MSC	VOLID if available							
MSS 5	MSC	VOLID if available							
MSS 6	MSC	VOLID if available							
MSS 7	MSC	VOLID if available							
MSS 8	MSC	VOLID if available							
MSS 9	MSC	VOLID if available							
MSS 10	MSC	TABLE ID if available							
MSS 11 Message Code		0	0	0	0	1	0	0	1
MSS 12 Case Number		See Note 1							
MSS 13		0	0	0	0	0	0	0	0
MSS 14		LZYX if available							
MSS 15		LZYX if available							
MSS 16		CSN if available							
MSS 17		CSN if available							
MSS 18		CSN if available							
MSS 19		CSN if available							
MSS 20		CSN if available							
MSS 21		CSN if available							
MSS 22		CSN if available							
MSS 23		CSN if available							
MSS 24		CSN if available							
MSS 25		CSN if available							
MSS 26		CSN if available							
MSS 27		CSN if available							
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Note 1 - Byte 12 Detail
Bits 0-3 = 0000 Cases 1, 3, 4, 5, 6, 7, 8, 9
= 1010 Case 2 with no pending DE
= 1100 Case 2 with pending DE (move/define)
Bits 4-7 = 0001-1001 Cases 1-9

Cases
1 Expect full cell and find empty cell on any move operation.
2 Cartridge label not as expected.
3 Expect empty cell and find full cell on any move operation.
4 Cartridge stuck in picker during move request.
5 Cartridge stuck in picker on power up or initialization.
6 Invalid cell address given to Cartridge Store.
7 Permanent error at unload (second cartridge may be at preload station).
8 Cartridge in picker at initialization.
9 Cartridge in DRD during power failure.

Summary of Addresses

Case #	Meaning of LZYX	Position of Cartridge After Error
1	Home Address	Possible for Cartridge to be at post load
2	Home Address	Home Address
3	'To' Address	Reserve Cell (1 of 2)
4	Home Address	In Picker
5	NA	In Picker
6	Invalid 'to' address Invalid 'from' address	Reserve CS Cell Home Address
7	Home Address	At DRD
8	Reserve Cell Address	Reserve Cell
9	Home Address	At DRD

SSID = FFF

MSS FORMAT 0 (BYTES 3, BIT 0)
MESSAGE CODE 0A (BYTE 11)
COMMAND NOT ALLOWED ON BACK—UP MSC

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	1	0	1	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 0B (BYTE 11)
A3 COMMAND REQUIRED

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	1	0	1	1
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 0C (BYTE 11)
UNUSUAL CONDITION

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	1	1	0	0
MSS 12 Subcodes		See Subcodes Below							
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Subcodes in Byte 12

00 Configuration error. MSC IDS got an unexpected interrupt from an unknown address (no UCB). SSID = FFF.
01 Initial status has no meaning. SSID = FFF.
02 The Cartridge Access Station is full. Intervention is required.
03 Device End timer overflow. A command issued by the MSC has exceeded a predetermined time to complete.

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 0D (BYTE 11)
MESSAGE BUFFER NOT VALID

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11		0	0	0	1	1	0	0	1
Message Code									
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 0E EXPECTED SENSE
(04) NOT RECEIVED

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	1	1	1	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 0 (BYTE 3, BIT 0)
MESSAGE CODE 0F (BYTE 11)
MESSAGE BUFFER THRESHOLD EXCEEDED

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11 Message Code		0	0	0	0	1	1	1	1
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 1 (BYTE 3, BIT 1)
MSC EQUIPMENT/CONTROL CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11		0	0	0	0	0	0	0	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15	Control Check NA Register	Host Channel Buffer Parity Check	Host Channel A or C Check	Host Channel B or D Check	Host Data Transfer Check	Port Channel Ctrl/Interface Check (See Byte 20)	0	Microprog Detected Error (See Byte 23)	Multi-Connect Channel C or D Check
MSS 16	TA Register	Port Bus Out, TA Register							
MSS 17	MA Register	Port Bus In, MA Register							
MSS 18	Tag, TD Register	Gate Port 1 On	Hold Out	Select Out	Address Out	Suppress Out	Command Out	Service Out	Not Op Out
MSS 19	Host Channel TC Register	00 Not Used 01 Host Channel Read Ctrl 10 Host Channel Write Ctrl 11 Freeze		Last Byte Request	Host Op In	Host Address In	Host Status In	00 Not Used 10 MSC Channel Write 01 MSC Channel Read 11 Not Used	
MSS 20	Port Check 1 NC Register	Tag Error (See Byte 21)	0	Sp Op 19/20 Error	0	MSC Buffer Parity Check	MSC Channel Bus Out Parity Check	Port Transfer Check	Timeout (not an error condition)
MSS 21	Port Check 2 ND Register	Status In and (Service or Data In)	Address In and (Service or Data In)	Status In and Address In	Op In Glitch	Op In Drop with Tag Up	Op In Select Out Seq Error	0	0
MSS 22	Port Tag In NE Register	Address In	Status In	Disconnect In	Data In	Service In	Mark In 0, Port 0	Mark In 0, Port 1	Port 1 Selected

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 23		Code showing error found by I/O Channel microprogram (Byte 15, Bit 6 On)							
MSS 24		Code showing cause of I/O Channel error number one (Byte 23, Code 01)							
MSS 25		0	0	0	Selective Reset Issued	Halt I/O or Selective Reset Successful	Halt I/O Issued	Intf Ctl Check w/o Selective Reset	Disconnect In on Interface
MSS 26		Fault Symptom Code (Generated by SDA)							
MSS 27		Fault Symptom Code (Generated by SDA)							
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Byte 23

Code	Meaning
'01'	Interface timeout (Forces entry by hardware address 0080, see Byte 24)
'02'	Incorrect length from lower interface
'03'	Address In and Address Out do not compare
'04'	Op In and Select In both active
'05'	Poll with CU busy on selection
'06'	CU Busy not in status during CU Busy sequence
'07'	CU Busy but with Op In active
'08'	Check 2 detected
'09'	Select In active on chained reselection
'0A'	CU Busy during Sense I/O
'0B'	Select In active on Start I/O
'0C'	Select In active before selection
'0D'	Op In active before selection
'0E'	Select In and Op In both active before selection
'0F'	CU Busy on chained reselection
'10'	Unit Checks on Sense (04)

Byte 24

Code	Meaning
'04'	Timeout while waiting for Status In, Op In, Address In, or Select In
'08'	Timeout while waiting for Address In to become inactive after Command Out is activated
'0C'	Timeout while waiting for Status In to become active (Initial status)
'10'	Timeout while waiting for data transfer to start
'14'	Timeout while waiting for Op In to become inactive if initial status is ending status
'18'	Timeout while waiting for Status In to become inactive during CU Busy sequence
'1C'	Timeout while waiting for Status In to become inactive after Initial Status
'20'	Timeout while in read data transfer
'24'	Timeout while in write data transfer
'28'	Timeout after data transfer while waiting for ending Status In to become active
'2C'	Timeout after ending status, while waiting for status to become inactive
'30'	Timeout while waiting for Op In to become inactive

MSS FORMAT 2 (BYTE 3, BIT 2)
MSC SELECTIVE RESET

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4		0	0	0	0	0	0	0	0
MSS 5		0	0	0	0	0	0	0	0
MSS 6		0	0	0	0	0	0	0	0
MSS 7		0	0	0	0	0	0	0	0
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11		0	0	0	0	0	0	0	0
MSS 12		High-order Failing Address from Backup Register							
MSS 13		Low-order Failing Address from Backup Register							
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		TC Register after an unsolicited Selective Reset has occurred							
TC Reg CHL Ctl									
MSS 18		TG Register after an unsolicited Selective Reset has occurred							
TG Register Host Request In									
MSS 19		0	0	0	0	0	0	0	0

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 20		Associated with read error 0/2 or 1/3 from address in bytes 12 and 13							
Storage									
MSS 21		Associated with read error 0/2 or 1/3 from address in bytes 12 and 13							
Storage									
MSS 22		Associated with read error 0/2 or 1/3 from address in bytes 12 and 13							
Storage									
MSS 23		Associated with read error 0/2 or 1/3 from address in bytes 12 and 13							
Storage									
MSS 24		1	Clock	CA Decode Even	CA Decode Odd	CB Decode Even	CB Decode Odd	Branch or Status	Special Op
Chk-1 if Bit 0=1									
MSS 24		0	Clock	CS Decode	0	A Register	B Register	ALU	23FD Parity
Chk-1 if Bit 0=0									
MSS 25		0	Read Error 0/2	Read Error 1/3	0	Cycle Control	CD Decode	0	0
Check-1 if Byte 24, Bit 0=1									
MSS 25		SAB 0-7	SAB 8-15	SWB Byte 0/2	SWB Byte 1/3	CS Address Bus Check	AMR Error	23FD Not Ready	0
Check-1 if Byte 24, bit 0=0									
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 3 (BYTE 3, BIT 3)
CARTRIDGE STORE ERROR SENSE (NOT BUFFERED LOG)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4 Recovery	CS 0	Command Reject	Number of mave bytes divisible by four	Bus Out Check MSC to CS	Equipment Check	Data Check	Number of move bytes not divisible by four.	Permanent Error	Environment Data
MSS 5 Recovery Mode	CS 1	CE Message	Reconfigured	Queue Check	Cartridge In Picker	Processor Check	Program Check	Selective Reset	Buffered Log Data
MSS 6 Move In Progress	CS 2	Binary number of move-in-progress by right accessor				Binary number of move-in-progress by left accessor			
MSS 7 Queue Execute Status	CS 3	Moves executed from queue							
MSS 8 Move Check Right Acc	CS 4	X Tach Check Right Acc	Y Tach Check Right Acc	Invalid X Address Right Acc	Invalid Y Address Right Acc	X Address Check Right Acc	Y Address Check Right Acc	X Strip Check Right Acc	Y Strip Check Right Acc
MSS 9 Right Acc Immediate Fault	CS 5	36v Off Right Acc	Gap Error Right Acc	Interference Check Right Acc	Swivel Check Right Acc	Circuit Protector Open, UV/OV on 36v, or 36v off Right Acc	Shift Register Data Check Right Acc	0	Wire Rope Break Right Acc
MSS 10 Picker Check Right Acc	CS 6	Cartridge In Picker Right Acc	Sel/Restore Timeout Right Acc	Cell Full or Empty Right Acc	Sel/Restore Check Right Acc	Select Right Acc	Restore Right Acc	Sel/Restore Seq Check Right Acc	Gap Blocked Right Acc
MSS 11 Right Acc Shift Register and Move	CS 7	Order Sequence Check Right Acc	Shift Reg Sync or Parity Check Right Acc	Stopped Timeout Right Acc	Shift Register Check Right Acc	X Move Not Complete Right Acc	Y Move Not Complete Right Acc	Swivel Not Complete Right Acc	Move Complete Timeout Right Acc
MSS 12 Move Check Left Acc	CS 8	X Tach Check Left Acc	Y Tach Check Left Acc	Invalid Address Left Acc	Invalid Address Left Acc	X Address Check Left Acc	Y Address Check Left Acc	X Strip Check Left Acc	Y Strip Check Left Acc
MSS 13 Left Acc Immediate Fault	CS 9	Reserved	Gap Error Left Acc	Interference Check Left Acc	Swivel Check Left Acc	Circuit Protector Open, UV/OV on 36V, or 36V off Left Acc	Shift Register Data Check Left Acc	0	Wire Rope Break Left Acc

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 14	CS 10	Cartridge In Picker Left Acc	Sel/Restore Timeout Left Acc	Cell Full/Empty Left Acc	Sel/Restore Failure Left Acc	Select Left Acc	Restore Left Acc	Sel/Restore Seq Check Left Acc	Gap Blocked Left Acc
MSS 15	CS 11	Order Sequence Check Left Acc	Shift Register Sync or Parity Check Left Acc	Stopped Timeout Left Acc	Shift Register Check Left Acc	X Move Not Complete Left Acc	Y Move Not Complete Left Acc	Swivel Not Complete Left Acc	Move Complete Timeout Left Acc
MSS 16	CS 12	I/O Parity	I/O Invalid	Storage Parity	Invalid Op Code	Buffer Parity	0	Cartridge Reserve Cell 2	Cartridge Reserve Cell 1
MSS 17	CS 13	Adapter Address				0	Last Interrupt Level		
MSS 18	CS 14	High Order PSW Instruction Counter							
MSS 19	CS 15	Low order PSW Instruction Counter							
MSS 20	CS 16	0	0	Z From Address	Y From Address - Right Accessor				
MSS 21	CS 17	X From Address for Right Accessor							
MSS 22	CS 18	0	0	Z To Address	Y To Cell Address - Right Accessor				
MSS 23	CS 19	X To Address - Right Accessor							
MSS 24	CS 20	0	0	Z From Address	Y From Address - Left Accessor				
MSS 25	CS 21	X From Address for Left - Accessor							
MSS 26	CS 22	0	0	Z To Address	Y To Address - Left Accessor				
MSS 27	CS 23	X "To" Cell Address - Left Accessor							
MSS 28	CS 24	0	0	0	0	0	Error Logging Count		
MSS 29	CS 25	0	0	0	0	0	0	0	0
MSS 30	CS 26	0	0	0	0	0	0	0	0
MSS 31	CS 27	0	0	0	0	0	0	0	0

Error Condition For UC Status and Equip Check Sense (CS)

Move Timeout
Select/Restore Error (Timeout or Failure)
Magnetic Field
Shift Register Error (Command Sequence, Sync/Parity, Stopped Timeout)
MC/PC Check
Address Check
Processor Check
Shift Register Data Check (LWR)

Error Condition For UC Status and Data Check Sense

Invalid Address
Cell Full/Empty

MSS FORMAT 3 (BYTE 3, BIT 3)
CARTRIDGE STORE BUFFERED LOG OVERFLOW (BYTE 5, BIT 7 ON)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4 Sense	CS 0	Command Reject	0	Bus Out Parity Check	Equipment Check	Data Check	Number of move bytes not divisible by four.	Permanent Error	Environment Data
MSS 5 Sense	CS 1	CE Message	Reconfigured	Queue Check	Cartridge In Picker	Processor Check	Program Check	Selective Reset	Buffered Log Data
MSS 6	CS 2	0	0	Error Overflow EitherAccessor	Usage Count Overflow - Right Accessor				
					4096	2048	1024	512	256
MSS 7	CS 3	Usage Count Overflow - Right Accessor							
		128	64	32	16	8	4	2	1
MSS 8	CS 4	Select/Restore Timeout Count - Right Accessor				Select/Restore Check Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 9	CS 5	X Move Not Complete Count - Right Accessor				Y Move Not Complete Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 10	CS 6	X Address Check Count - Right Accessor				Y Address Check Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 11	CS 7	X Tach Check Count - Right Accessor				Y Tach Check Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 12	CS 8	Gap Error Count - Right Accessor				Gap Error Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 13	CS 9	Select/Restore Sequence Check Count - Right Accessor				Swivel Move Timeout Check Count - Right Accessor			
		8	4	2	1	8	4	2	1
MSS 14	CS 10	X Strip Check Count - Right Accessor				Y Strip Check Count - Right Accessor			
		2048	1024	512	256	2048	1024	512	256

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 15	CS 11	X Strip Check Count - Right Accessor							
		128	64	32	16	8	4	2	1
MSS 16	CS 12	Y Strip Check Count - Right Accessor							
		128	64	32	16	8	4	2	1
MSS 17	CS 13	0	0	0	Usage Count Overflow - Left Accessor				
					4096	2048	1024	512	256
MSS 18	CS 14	Usage Count Overflow - Left Accessor							
		128	64	32	16	8	4	2	1
MSS 19	CS 15	Select/Restore Timeout Count - Left Accessor				Select/Restore Check Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 20	CS 16	X Move Not Complete Count - Left Accessor				Y Move Not Complete Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 21	CS 17	X Address Check Count - Left Accessor				Y Address Check Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 22	CS 18	X Tach Check Count - Left Accessor				Y Tach Check Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 23	CS 19	Gap Error Count - Left Accessor				Gap Error Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 24	CS 20	Select/Restore Sequence Check Count - Left Accessor				Swivel Check Count - Left Accessor			
		8	4	2	1	8	4	2	1
MSS 25	CS 21	X Strip Check Count - Left Accessor				Y Strip Check Count - Left Accessor			
		2048	1024	512	256	2048	1024	512	256
MSS 26	CS 22	X Strip Check Count - Left Accessor							
		128	64	32	16	8	4	2	1
MSS 27	CS 23	Y Strip Check Count - Left Accessor							
		128	64	32	16	8	4	2	1
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT 9 (BYTE 11, BITS 0-3)
DRD ERROR

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environment Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	0	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 12	DR 8	0	0	8192	4096	2048	1024	512	256
Stripe ID Reg High									
MSS 13	DR 9	128	64	32	16	8	4	2	1
Stripe ID Reg Low									
MSS 14	DR 12	0	0	8192	4096	2048	1024	512	256
Stripe ID CTR High									
MSS 15	DR 12	128	64	32	16	8	4	2	1
Stripe ID CTR Low									
MSS 16	DRC 14	Assign Latches 0-A	Assign Latches 1-A	Assign Latches 2-A	Assign Latches 3-A	Assign Latches 0-B	Assign Latches 1-B	Assign Latches 2-B	Assign Latches 3-B
MSS 17	DRD 0	On Line	Interface Check	Unloaded	Device Check	Rotor Ready	Device Busy	Loaded (Ready)	Move Complete
MSS 18	DRD 1	Timeout Error	Servo Check	Cable Check	Write Disabled	OV/UV Check	Vacuum Check	Pneumatic Check	Write Driver Check
MSS 19	DRD 2	Cartridge Entry Timeout	Cartridge Exit Timeout	Move Timeout	Indexer Check	Thread/Load Check	Unload Timeout	Bus Out Parity Check	Tag Bus Parity Check

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 20	DRD 3	Spool Tach Check	Spool Overcurrent	Spool Runaway/ Tach Check	DGC Check	Rotor Check	IHC/ Lifter Check	Capstan Overcurrent/ Tach Check	Capstan Runaway
MSS 21	DRD 4	Indexer Drive Forward	Indexer Drive Backward	LWR	Interrupt Pending	DGC Register 8	DGC Register 4	DGC Register 2	DGC Register 1
MSS 22	DRD 5	Index Program 16	Index Program 8	Index Program 4	Index Program 2	Index Program 1	Write Disable 1	Write Disable 3	Write Disable 4
DRD Byte 0, Bit 6 = 0									
DRD Byte 0, Bit 6 = 1		Servo Sign	Servo Bit 4	Servo Bit 3	Servo Bit 2	Servo Bit 1	0	0	0
MSS 23	DRD 6	Search Register 128	Search Register 64	Search Register 32	Search Register 16	Search Register 8	Search Register 4	Search Register 2	Search Register 1
MSS 24	DRD 7	0 = Search Mode 1 = Step Mode	0 = Forward 1 = Backward	Search Register 8192	Search Register 4096	Search Register 2048	Search Register 1024	Search Register 512	Search Register 256
MSS 25		0	0	0	0	0	0	0	0
MSS 26	SA 21	FSC							
MSS 27	SA 22	FSC							
MSS 28	DRD 8	S1 Input Ready	S2 Cartridge Preload	S4 Cartridge Postload	S8 Spool Tach	S9 Spool Clear	S10 Tape End	S11 Index Position	0
MSS 29	DRD 9	S15 Capstan Tach	S16 Rotor Tach	S18 Column Vacuum	S20 Mandrel Pressure	Guide Lifter Input	Guide Lifter Sense	Column Valve Drive	Column Valve Sense
MSS 30	DRD 10	EC Level 16	EC Level 8	EC Level 4	EC Level 2	EC Level 1	Feat Level 4	Feat Level 2	Feat Level 1
MSS 31	DRD 11	Thread Program 16	Thread Program 8	Thread Program 4	Thread Program 2	Thread Program 1	0	Servo Dead	Stripe Skew Excessive

Messages Format 9 (Byte 11, bits 4-7)

0 No message.
1 Interrupt timer expired waiting for an interrupt.
2 Recycle ERP invoked.
3 No response to select device command.
4 Device status not '8B' at initial selection or recycle time.
5 Device or interface check on TIO.
6 Device 'Online' bit is Off.
7 Device check on Erase.
8 Device or Inf Ck during Head Offset ERP.
9 Can't read ID - tape still moving (no move complete).
A Cylinder restarted 8 times during destage due to servo check or ID mismatch and end of cylinder.
B Timeout or unload with cartridge already at exit support.
C Unload ERPs invoked (3 unloads plus 1 forced unload).
D Unable to issue forced unload.
E Unable to continue unload ERPs (DVC byte 2-1, cart exit TO.
F Reserved.

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT A (BYTE 11, BITS 0-3)
SA (CTL-I ADT) ERROR

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environ-mental Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	0	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 12 Control Check	SA 8	Buffer Parity Check	Interface Check Channel A/C	Interface Check Channel B/D	Channel Transfer Check	CTL-I Check	CTL-I Load S Registers* Check	Compare Assist Check	Intf Check Chan C/D or Multi Conn
MSS 13 Control Interface	SA 9	CTL-I Controller Check	CTL-I Select Active Check	CTL-I Buffer Parity Check	CTL-I Unexpected End Check	CTL-I Tag Bus Check	CTL-I Bus Out Parity Check	CTL-I Transfer Check	Any ADT Check Byte 14
MSS 14 ADT-1 Check	SA 10	ADT Controller Check	ADT Select Active Check	CTL-I ADT Bus In Check	ADT Unexpected End Check	ADT Byte Counter Check	CTL-I ADT Bus Out Check	ADT Sync In Check	Any ADT Group 2 Check
MSS 15 ADT-2 Check	SA 11	ADT Address Register Check	DBS Write Bus Check	CCU/DBS Read Bus Check	0	ADT Transfer Check	DBS Address Bus Check	ADT/DBS Read Bus Parity Check	0
MSS 16	SA 12	TA Register CTL-I Bus Out							

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 17	SA 13	Tag Bus Bit 0	CTL-I Control Lines to ND	0	0	Tag Bus Bit 4	Tag Bus Bit 5	Tag Bus Bit 6	Tag Bus Bit 7
TD Register									
MSS 18	SA 14	MA Register CTL-I Bus In							
MSS 19	SA 15	CTL-I Select Hold	CTL-I Tag Gate	CTL-I Error Alert Gate	Allow Busy Channel A/B	Enable CUE D	Enable CUE C	Enable CUE B/Disable A	Allow NA Load
TB Register									
MSS 20	SA 16	0	0	0	0	0	0	0	0
ME Register									
MSS 21	SA 17	Byte Counter Bit 15 (ADT)	Byte Counter Bit 14 (ADT)	Byte Counter Bit 13 (ADT)	Byte Counter Bit 12 (ADT)	Byte Counter Bit 11 (ADT)	Byte Counter Bit 10 (ADT)	Byte Counter Bit 9 (ADT)	Byte Counter Bit 8 (ADT)
MB Register									
MSS 22	SA 18	Byte Counter Bit 7 (ADT)	Byte Counter Bit 6 (ADT)	Byte Counter Bit 5 (ADT)	Byte Counter Bit 4 (ADT)	Byte Counter Bit 3 (ADT)	Byte Counter Bit 2 (ADT)	Byte Counter Bit 1 (ADT)	Byte Counter Bit 0 (ADT)
MC Register									
MSS 23	SA 19	CTL-I Select Alert 1	CTL-I Select Active	CTL-I Sync In	Index	CTL-I Normal End	CTL-I Check End	CTL-I Tag Valid	0
ND Register									
MSS 24	DRC 2	Tag Bus Parity Error CTL-I ADT In	Bus Out Parity Error CTL-I ADT In	1 of 4 Check or Address Check	DEV-I Bus In Parity Check	0	Tag Bus Parity Error DEV-I	Bus Out Parity Error DEV-I	0
MSS 25	DRC E	Assign Latches 0-A	Assign Latches 1-A	Assign Latches 2-A	Assign Latches 3-A	Assign Latches 0-B	Assign Latches 1-B	Assign Latches 2-B	Assign Latches 3-B
MSS 26	SA 21	Fault Symptom Code							
MSS 27	SA 22	Fault Symptom Code							
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Messages Format A (Byte 11, bits 4-7)

0 No messages.
1 Check 2 error.
2 Channel transfer error or BOPAR.
F Reserved

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT B (BYTE 11, BITS 0-3)
DATA HANDLING ERROR (SEE NOTE)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environ-mental Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	0	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 28 ERP Flag Byte	SA 24	0000 Gain Nominal, Offset Nominal 0001 Gain Up 0010 Gain Down 0011 First Offset Forward 0100 Second Offset Forward 0101 1st Offset Backward 0110 2nd Offset Backward 0111 Skew Forward 1000 Skew Backward 1001 All retries failed				0-8 Counter for Retries of Operations in Bits 0-4			
MSS 13 Check End	DRC CE	0	Demark Check	Erased Stripe	Read/Write Data Check	Read/Write Overrun	Device Check	Stripe Format Check	Stripes Available Zero
MSS 14	DRC 1	Write CRC Check	CRC Not Zero	Uncorrectable Data	Amplitude Sensor Check	Syndrome Check	Multi-Section Check	Erase Check	Write Status
MSS 15 Format Error	DRC 4	ID Check in ID Field	ID Check in Data Field	Mark Check in ID Field	Read ID Index Check	Mark Check in Data Field	No Data Found in Data Field	Data Gate Check	No ID Found
MSS 16 (See Synd Chk)	DRC 5	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8
MSS 17 (See Synd Chk)	DRC 6	Seg 9	Seg 10	Seg 11	Seg 12	Seg 13	Seg 14	Seg 15	Seg 16
MSS 18 (See Synd Chk)	DRC 7	Seg 17	Seg 18	Seg 19	Seg 20	0	0	0	0

Note: Byte 4, bit 7 is 0 for unrecoverable data handling errors; Byte 4, bit 7 = 1 represents error logging mode (DR data).

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 19 (Stripe ID Reg)	DRC 8	0	0	8192	4096	2048	1024	512	256
MSS 20 (Stripe ID Reg)	DRC 9	128	64	32	16	8	4	2	1
MSS 21 (Stripes Available Counter)	DRC A	128	64	32	16	8	4	2	1
MSS 22 (Stripes Counter)	DRC B	128	64	32	16	8	4	2	1
MSS 23 (Stripe ID Counter)	DRC C	0	0	8192	4096	2048	1024	512	256
MSS 24 (Stripe ID Counter)	DRC D	128	64	32	16	8	4	2	1
MSS 25	DRD 4	Indexer Drive Forward	Indexer Drive Backward	LWR	Interrupt Active	DGC Register 8	DGC Register 4	DGC Register 2	DGC Register 1
MSS 26	SA 22	Fault Symptom Code							
MSS 12	SA 8	0	0	0	0	0	0	0	0
MSS 27	SA 23	Fault Symptom Code							
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Messages Format B (Byte 11, bits 4-7)

0 No message.
1 Check End on Demark.
2 Overrun or Stripe Available 0 on Stage/Destage.
3 Invalid data on R0 stripe.
4 Stripe available 0 on CTOC.
5 Timeout on during data transfer.
6 Invalid data in buffer during stage operation.
7 Erase Failure.
8 Failure to seek to N-1.
9 No ID found (seek only).
A ID miscompare (seek only).
F Reserved.

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT C (BYTE 11, BITS 0-3)
COMMAND REJECT

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environ-mental Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	Spare	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	0	0	0	0

Messages Format C (Byte 11, bits 4-7)

0 No message.
1 Invalid command.
3 CCW count less than required.
4 Data value not as required.
5 Reserved for diagnostics.
6 DSM error - device busy.
7 LTR Table invalid for given LUA.
8 DASD device specified is connected to Chan A.
B Timeout due to DASD unavailability.

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT D (BYTE 11, BITS 0-3)
DRD BUFFERED LOG

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environ-mental Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	0	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 12 / MSS 13 / DRD Buffered Log	SA / SA	Read Usage Counter 64K counter overflows at 32K Bit 0 on = overflow, bits 1-15 are Counter							
MSS 14 / MSS 15 / DRD Buffered Log	SA / SA	Error Logging Mode	Load Check	Soft Read Check Counter. 16K Counter overflow at 8K. Bit 2 on = overflow. Bits 3-15 are counter position.					
MSS 16 / MSS 17 / DRD Buffered Log	SA / SA	Write Usage Counter 64K counter overflows at 32K Bit 0 on = overflow, bits 1-15 are Counter							
MSS 18 / MSS 19 / DRD Buffered Log	SA / SA	Soft Write Check Counter 16K counter overflows at 8K Bits 0-1 Unused, bit 2 on = overflow, bits 2-15 are Counter							
MSS 20	SA	0	0	0	0	0	0	0	0
MSS 21	MSC	Cartridge Serial Number, Char 0							
MSS 22	MSC	Cartridge Serial Number, Char 1							
MSS 23	MSC	Cartridge Serial Number, Char 2							
MSS 24	MSC	Cartridge Serial Number, Char 4							
MSS 25	MSC	Cartridge Serial Number, Char 5							
MSS 26	MSC	Cartridge Serial Number, Char 6							
MSS 27	MSC	Cartridge Serial Number, Char 7							
MSS 28	MSC	Cartridge Serial Number, Char 8							
MSS 29	MSC	Cartridge Serial Number, Char 9							
MSS 30	MSC	Cartridge Serial Number, Char 10							
MSS 31	MSC	Cartridge Serial Number, Char 11							

Characters 0, 1, and 2 are the manufacturers ID; characters 4-11 are the cartridge serial numbers. Character 3 is omitted to produce a blank.

MSS FORMAT 4 (BYTE 3, BIT 4)
SA FORMAT E (BYTE 11, BITS 0-3)
DRC ERROR

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	0	0	Environ-mental Data
MSS 5	SA 1	CE Message	Media Failure	Read	Sense ID	0	ADT Status	CTL-I ADT (TE 4)	Buffered Log Data
MSS 6	SA 2	0	0	0	0	0	0	0	0
MSS 7	SA 3	0	0	0	0	0	0	0	0
MSS 8	SA 4	Command In Error							
MSS 9	SA 5	Retry Same Unit	Retry Alt DRC	Retry Alt DRD	Retry Alt SA	0	0	First Alt Path	Port 1
MSS 10	SA 6	Port Logical Unit Address							
MSS 11	SA 7	Format				Message			
MSS 12 Control Check	SA 8	Buffer Parity Check	Interface Chk Channel A	Interface Chk Channel B	Chan Transfer Check	CTL-I Check	CTL-I LD S Regs Check	Compare Assist Check	0
MSS 13 Control Information	SA 9	CTL-I Control Check	CTL-I Select Active Check	CTL-I Buffer Parity Check	CTL-I Unexpected End Check	CTL-I Tag Bus Check	CTL-I Bus Out Parity Check	CTL-I Transfer Check	Any ADT Check
MSS 14 ADT-I Check	SA 10	ADT Controller Check	ADT Select Active Check	CTL-I ADT Bus In Check	Unexpected End Check	ADT Byte Counter Check	CTL-I ADT Bus Out Check	ADT Sync In Check	ADT Group 2 Check
MSS 15	SA 12	TA Register CTL-I Bus Out							
MSS 16 TD Register	SA 13	Tag Bus Bit 0	CTL-I Control Lines to ND	0	0	Tag Bus Bit 4	Tag Bus Bit 5	Tag Bus Bit 6	Tag Bus Bit 7
MSS 17	SA 14	MA Register CTL-I Bus In							

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 18	SA 15	CTL-I Select Hold	CTL-I Tag Gate	CTL-I Error Alert Gate	Allow Busy Channel A/B	Enable CUE D	Enable CUE C	Enable CUE B Disable A	Allow NA Load
TB Register									
MSS 19	SA 16	0	0	0	0	0	0	0	0
ME Reg									
MSS 20	DRC 2	CTL-I TAG BUS ADT Parity Check	CTL-I BUS OUT ADT Parity Check	Address Check (1 of 4 Check)	DEV-I BUS IN Parity Check	0	DEV-I TAG BUS Parity Check	DEV-I BUS OUT Parity Check	0
MSS 21	DRC 3	Bus Out Parity Check (Write)	Write Register Parity Check	E/GCR Check	0	Buffer Parity Check	Read Bit Counter Check	0	0
MSS 22	DRC 4	ID Check in ID Field	ID Check in Data Field	Mark Check in ID Field	Read ID Index Check	Mark Check in Data Field	No Data Found in Data Field	Data Gate Check	No ID Found
MSS 23	DRC E	Assign Latches 0-A	Assign Latches 1-A	Assign Latches 2-A	Assign Latches 3-A	Assign Latches 0-B	Assign Latches 1-B	Assign Latches 2-B	Assign Latches 3-B
Assign Latches									
MSS 24	DRD 0	On Line	Interface Check	Unloaded	Device Check	Rotor Ready	Device Busy	Ready (Loaded)	Move Complete
MSS 25		0	0	0	0	0	0	0	0
MSS 26	SA 21	Fault Symptom Code							
MSS 27	SA 22	Fault Symptom Code							
MSS 28	DRC 8	0	0	8192	4096	2048	1024	512	256
Stripe ID Reg High									
MSS 29	DRC 9	128	64	32	16	8	4	2	1
Stripe ID Reg Low									
MSS 30	DRC 12	0	0	8192	4096	2048	1024	512	256
Stripe ID CTR High									
MSS 31	DRC 13	128	64	32	16	8	4	2	1
Stripe ID CTR Low									

** Check End Status

Messages Format E (Byte 11, bits 4-7)

0 No messages.
1 Hot lines present on Bus In of DCIA.
3 Controller returned wring address on select device.
5 Time out during DCIA tag sequence.
A No stripe format error on dummy write during seek.
B No Stripe format error following seek read.
F Reserved.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 0 (BYTE 11, BITS 0-3)
PROGRAM OR SYSTEM CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Channel Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 7 Restart Command If Byte 5, Bit 7 is on	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message			
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		0	0	0	0	0	0	0	0
MSS 28		0	0	0	0	0	0	0	0
MSS 29		0	0	0	0	0	0	0	0
MSS 30		0	0	0	0	0	0	0	0
MSS 31		0	0	0	0	SA Number (0-F)			

Messages Format 0 (Byte 11, bits 4-7)

0 No messages.
1 Invalid command.
2 Invalid sequence.
3 CCW count less than required.
4 Data value not as required.
5 Diagnostic write not permitted by file mark.
6 Channel discontinued retry operation.
7 Channel returned with incorrect retry CCW.
8 23FD not ready.
9 23FD permanent seek check.
A 23FD permanent read check.
B Improper alternate/defective track pointer.
C Invalid virtual volume.
D Index detected in gap of record.
E Unstageable data.
F Reserved.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 1 (BYTE 11, BITS 0-3)
DEVICE EQUIPMENT CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Channel Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record found	File Protected	Write Inhibit	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Envir Data	0	0	0	0
MSS 7 Restart Command If Byte 5, Bit 7 Is On	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message			
MSS 12 File Status	SA 8	Index Error	Offset Active	Seek Incomplete	Seek Complete	Online	Attention	Busy	Record Ready
MSS 13 Monitor Code	SA 9	0	Diagnostic 4	Diagnostic 2	Diagnostic 1	0	Mode 4	Mode 2	Mode 1
MSS 14 Monitor State	SA 10	State 8	State 7	State 6	State 5	State 4	State 3	State 2	State 1
MSS 15 Check Status	SA 11	CE Program Stop	0	0	0	DEV-I Bus Out Parity	Monitor Check	0	Drive Cmd Reject
MSS 16 Safety	SA 12	Data Safety	Servo Safety	0	Pad Safety Mod 11	Power On Reset	Power on Reset Raw	Head Not Loaded	Even Latch
MSS 17 TA Reg/Expctd	SA 13	Expected data for messages 1, 6, 7, 8, 9 (contents of Bus Out). TA Register contents for Message Code 3 and C.							
MSS 18 MA Reg/Rcvd	SA 14	Drive Status for Message 9. Contents of MA Register (Bus In) for codes 1, 3, 6, 7, and 8.							
MSS 19 Tag Bus/TD Reg	SA 15	Contents of TD Register (Tag Bus) for codes 1, 3, 6, 7, 8, and 9.							

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 20	SA 16	PLO Error	Write Parity Error	Read Parity Error	Bit Ring Error	Write Compare Chk	Data Transfer Check	Missing PLO Pulses	VFO Phase Error
Ctlr Chk 1 Byte									
MSS 21	SA 17	ECC No Input Data Found	ECC PO or Write Error	ECC P2 or P3 Error	ECC P1 Error	Sync Out Check	PLO Counter Check	Gap Counter Check	Gap Control Check
Ctlr Chk 2 Byte									
MSS 22	SA 18	Select Alert 1	Select Active Check	CTL-I Bus In Check	Reserved	Message Codes			
Ctlr Chk 3 Byte									
MSS 23	SA 19	Drive Select Error	CTL-I Tag Bus Check	Device Check	CTL-I Bus Out Check	Write Sense Check	Write/Read Valid Check	Device Bus Out Reg Chk	Ctlr Bus In Assem Chk
Ctlr Chk 4 Byte									
MSS 24	SA 20	0	0	0	0	0	0	0	0
MSS 25	SA 21	0	0	0	0	0	0	0	0
MSS 26	SA 22	Fault Symptom Code							
MSS 27	SA 23	Fault Symptom Code							
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31		0	0	0	0	SA Number (0-F)			

Messages Format 1 (Byte 11, bits 4-7)

0 No messages.
1 Set target error.
2 Microprogram detected error (see Byte 22).
3 No write gate at drive.
4 No write current sense.
5 String switch error in setting primed interrupt.
6 Transmit cylinder error.
7 Transmit head error.
8 Transmit difference error.
9 File status not as expected.
A Seek error.
B Seek incomplete on retry.
C No interrupt from drive.
D Compare failure ECC P2 or P3.
E Compare failure ECC P1.
F Retry byte count/sector value incorrect.

Messages Format 1 (Byte 22, bits 4-7)

0 Reserved.
1 TAG VALID missing (CTL-I).
2 NORMAL END/CHECK END missing (CTL-I).
3 NORMAL END missing (CTL-I).
4 No index after 40 ms or solid index indication.
5 Unexpected status with CHECK END.
6 3330 selection address check.
7 Pre-selection check.
8 Zero pattern alignment error.
9 Repetitive command overrun indication.
A Drive interrupt during busy.
B Drive status not as expected after seek or set sector.
C-E Reserved.
F Always active (hot) bus in bit.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 2 (BYTE 11, BITS 0-3)
DASD CONTROLLER EQUIPMENT CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Channel Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Envir Data	0	0	0	0
MSS 7 Restart Cmd if Byte 5, Bit 7 On	SA 3	0	0	0	0	0	1	0 if Write 1 if Read	0 if Read 1 if Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message			
MSS 12	SA 8	0	0	0	0	0	0	0	0
MSS 13	SA 9	0	0	0	0	0	0	0	0
MSS 14	SA 10	0	0	0	0	0	0	0	0
MSS 15 Control Check	SA 11	Channel Buffer Parity Check	Interface Check Channel A/C	Interface Check Channel B/D	Data Transfer Check	CTL-I Check defined by Byte 24	Load S Register	Compare Assist	Multi connect Channel C or D Check

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 16	SA 12	0 0 0				0 0			0
MSS 17	SA 13	Contents of TA Register (valid only if Sense Byte 11='24')							
CTL-I Bus Out									
MSS 18	SA 14	Contents of MA Register (valid only if Sense Byte 11='24')							
CTL-I Bus In									
MSS 19	SA 15	Contents of TD Register (valid only if Sense Byte 11='24')							
CTL-I Tag Bus									
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 24 CTL-I Check	SA 20	Controller Check	Select Active Check	CTL-I Bus In Check	Unexpected End Check	Tag Bus Parity Check	Bus Out Parity Check	CTL-I Transfer Error	Any ADT Check
MSS 25	SA 21	0	0	0	0	0	0	0	0
MSS 26	SA 22	0	0	0	0	0	0	0	0
MSS 27	SA 23	0	0	0	0	0	0	0	0
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31	SA 27	0	0	0	0	SA Number (0-F)			

Messages Format 2 (Byte 11, bits 4-7)

0 No messages.
1 Unused.
2 Unused.
3 S Register load check.
4 CTL-I Register valid. (Bytes 17-19)
5-F Unused.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 3 (BYTE 11, BITS 0-3)
DASD CONTROLLER CONTROL CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Req	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 7 Restart Cmd if Byte 5, Bit 7 On	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message			
MSS 12 BAR	SA 8	Address of Control Storage Word when error was detected							
MSS 13 BAR	SA 9	Address of Control Storage Word when error was detected							
MSS 14 Chk 1 Reg (Early)	SA 10	1=Early	Clock Error	CA Decode Even	CA Decode Odd	CB Decode Even	CB Decode Odd	Branch/ Status	Special Operations
MSS 14 Chk 1 Reg (Late)	SA 10	0=Late	Clock Error	CS Decode or Status Set	0	A Register	B Register	ALU	23FD Parity
MSS 15 Check 1 Register (Early) if Byte 14, bit 0 = 1	SA 11	0	Storage Read Byte 0/1	Storage Read Byte 2/3	0	Cycle Control	CD Decode	0	0
MSS 15 Check 1 Register (Late) if Byte 14, bit 0 = 0	SA 11	Storage Address Bus 0-7	Storage Address Bus 8-15	Storage Write Byte 0/2	Storage Write Byte 1/3	Control Store Address Check	AMR Error	23FD Not Ready	0

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 16	SA 12	Storage Error Pattern Register							
MSS 17	SA 13	Contents of TC Register							
MSS 18	SA 14	Contents of TG Register							
MSS 19	SA 15	0	0	0	0	0	0	0	0
MSS 20	SA 16	Storage SA Register							
MSS 21	SA 17	Storage SB Register							
MSS 22	SA 18	Storage SC Register							
MSS 23	SA 19	Storage SD Register							
MSS 24	SA 20	0	0	0	0	0	0	0	0
MSS 25	SA 21	0	0	0	0	0	0	0	0
MSS 26	SA 22	0	0	0	0	0	0	0	0
MSS 27	SA 23	0	0	0	0	0	0	0	0
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31	SA 27	0	0	0	0	SA Number (0-F)			

Messages Format 3 (Byte 11, bits 4-7)

No messages defined.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 4 (BYTE 11, BITS 0-3)
DATA CHECKS WITHOUT ERROR DISPLACEMENT AND PATTERN (ECC UNCORRECTABLE)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 7 Restart Cmd if Byte 5, Bit 7 On	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message*			
MSS 12 Cylinder	SA 8	High-order cylinder byte of last seek address							
MSS 13 Cylinder	SA 9	Low-order cylinder byte of last seek address							
MSS 14 Head	SA 10	High-order head byte of last seek address							
MSS 15 Head	SA 11	Low-order head byte of last seek address							
MSS 16 Record	SA 12	Record number of error record							
MSS 17 Sector	SA 13	Sector number of error record							

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 18 Offset	SA 14	Amount of offset used to recover from error							
MSS 19 Retries	SA 15	Number of retries required to recover from error							
MSS 20 Source Drive ID	SA 16	Storage Control	Storage Control	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 21	SA 17	0	0	0	0	0	0	0	0
MSS 22	SA 18	0	0	0	0	0	0	0	0
MSS 23	SA 19	0	0	0	0	0	0	0	0
MSS 24	SA 20	0	0	0	0	0	0	0	0
MSS 25	SA 21	0	0	0	0	0	0	0	0
MSS 26	SA 22	Fault Symptom Code							
MSS 27	SA 23	Fault Symptom Code							
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31	SA 27	0	0	0	0	SA Number (0-F)			

* Contents of Bytes 12-16 are unreliable if Byte 11 Messages Format 4 are is 0, 1, 4, 5, or 9.

Messages Format 4 (Byte 11, bits 4-7)

0 HA field ECC uncorrectable.
1 Count field ECC uncorrectable.
2 Key field ECC uncorrectable.
3 Data field ECC uncorrectable.
4 No sync byte found in HA field.
5 No sync byte found in count field.
6 No sync byte found in key field.
7 No sync byte found in data field.
8 Unused.
9 AM detection failure on retry.
A-F Unused.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 5 (BYTE 11, BITS 0-3)
ECC CORRECTABLE DATA CHECK
WITH DISPLACEMENT AND PATTERN

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 7 Restart Cmd If Byte 4, Bit 7 On	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G,H	Drive ID on for E, D, F,H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message*			
MSS 12 Cylinder	SA 8	High-order cylinder byte of last seek address							
MSS 13 Cylinder	SA 9	Low-order cylinder byte of last seek address							
MSS 14 Head	SA 10	High-order head byte of last seek address							
MSS 15 Head	SA 11	Low-order head byte of last seek address							
MSS 16 Record	SA 12	Record number of error record							
MSS 17 Sector	SA 13	Sector number of error record							
MSS 18 Offset	SA 14	Amount of offset used to recover from error							

* Contents of Bytes 12-16 are unreliable if Byte 11 Messages Format 5 are 0, 1, 4, 5, or 9.

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 19	SA 15	Number of bytes processed by Storage Control to end of data field in error (Restart Displacement)							
Restart Displacement									
MSS 20	SA 16	Number of bytes processed by Storage Control to end of data field in error (Restart Displacement)							
Restart Displacement									
MSS 21	SA 17	Number of bytes processed by Storage Control to end of data field in error (Restart Displacement)							
Restart Displacement									
MSS 22	SA 18	Displacement of first byte in error relative to end of the failing data field (High order)							
Error Displacement									
MSS 23	SA 19	Displacement of first byte in error relative to end of the failing data field (Low order)							
Error Displacement									
MSS 24	SA 20	Pattern to be exclusive ORed with erroneous data in main storage (High order)							
Error Pattern									
MSS 25	SA 21	Pattern to be exclusive ORed with erroneous data in main storage (Middle order)							
Error Pattern									
MSS 26	SA 22	Pattern to be exclusive ORed with erroneous data in main storage (Low order)							
Error Pattern									
MSS 27	SA 23	0	0	0	0	0	0	0	Channel Truncated
Channel Truncated									
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31		0	0	0	0	SA Number (0-F)			

Messages Format 5 (Byte 11, bits 4-7)

0 HA field correctable.
1 Count field correctable.
2 Key field correctable.
3 Data field correctable.
4-F Reserved.

MSS FORMAT 5 (BYTE 3, BIT 5)
SA FORMAT 6 (BYTE 11, BITS 0-3)
USAGE/ERROR STATISTICS (DASD)

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	MSS 0	Command Reject	Intervention Required	Bus Out Parity	MSC or SS Equip Check	0	Host Retry	0	Environ-mental Data
MSS 1	MSS 1	CE Message	Unit Unusable	Host Channel ID	Host Channel ID	SSID Char 0			
MSS 2	MSS 2	SSID Char 1				SSID Char 2			
MSS 3	MSS 3	MSC Prog/ Sys Envir Check Format 0	MSC Equipment/ Control Check Format 1	MSC Selective Reset Format 2	CS Equipment/ Control Check Format 3	SA-DR Path Format 4	SA-DASD Equipment/ Control Check Format 5	Any Unsuccessful Retry	Any Successful Retry
MSS 4	SA 0	Command Reject	Intervention Required	Channel Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 5	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 6	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 7 Restart Cmd if Byte 5, Bit 7 On	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 8 Control/Drive ID	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 9	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 10	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 11 Format/Message	SA 7	Format				Message			
MSS 12 Byte Count	SA 8	Number of bytes read or searched in key and data fields (not including retry operations)							
MSS 13 Byte Count	SA 9	Number of bytes read or searched in key and data fields (not including retry operations)							
MSS 14 Byte Count	SA 10	Number of bytes read or searched in key and data fields (not including retry operations)							
MSS 15 Byte Count	SA 11	Number of bytes read or searched in key and data fields (not including retry operations)							

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 16	SA 12	Number of ECC correctable data checks that have been recorded by the storage control							
Correctable Data Checks									
MSS 17	SA 13	Number of ECC correctable data checks that have been recorded by the storage control							
Correctable Data Checks									
MSS 18	SA 14	Number of ECC uncorrectable data checks retried by the storage control							
Retry Data Chks									
MSS 19	SA 15	Number of ECC uncorrectable data checks retried by the storage control							
Retry Data Chks									
MSS 20	SA 16	Number of access motions initiated by the channel							
Seeks									
MSS 21	SA 17	Number of access motions initiated by the channel							
Seeks									
MSS 22	SA 18	0 = A and B 1 = C and D	0	0	0	0	0	0	0
Channel Selected									
MSS 23	SA 19	Number of seek errors successfully retried by the storage control							
Seek Errors									
MSS 24	SA 20	Command overrun Channel A or C (retried by Storage Control)							
Cmd Overruns									
MSS 25	SA 21	Data overrun Channel A or C (retried by Storage Control)							
Data Overruns									
MSS 26	SA 22	Command overrun Channel B or D (retried by Storage Control)							
Cmd Overruns									
MSS 27	SA 23	Data overrun Channel B or D (retried by Storage Control)							
Data Overruns									
MSS 28	SA 24	Real Unit Address							
MSS 29	SA 25	Real Cylinder							
MSS 30	SA 26	Real Cylinder							
MSS 31		0	0	0	0	SA Number (0-F)			

Messages Format 6 (Byte 11, bits 4-7)

No messages defined.

SA FORMAT 0 (BYTE 7, BITS 0-3) PROGRAM/SYSTEM CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd if Byte 1, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder Address (low order) from most recent seek from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8		0	0	0	0	0	0	0	0
MSS 9		0	0	0	0	0	0	0	0
MSS 10		0	0	0	0	0	0	0	0
MSS 11		0	0	0	0	0	0	0	0
MSS 12		0	0	0	0	0	0	0	0
MSS 13		0	0	0	0	0	0	0	0
MSS 14		0	0	0	0	0	0	0	0
MSS 15		0	0	0	0	0	0	0	0
MSS 16		0	0	0	0	0	0	0	0
MSS 17		0	0	0	0	0	0	0	0
MSS 18		0	0	0	0	0	0	0	0
MSS 19		0	0	0	0	0	0	0	0
MSS 20		0	0	0	0	0	0	0	0
MSS 21		0	0	0	0	0	0	0	0
MSS 22		0	0	0	0	0	0	0	0
MSS 23		0	0	0	0	0	0	0	0
MSS 24		0	0	0	0	0	0	0	0
MSS 25		0	0	0	0	0	0	0	0
MSS 26		0	0	0	0	0	0	0	0
MSS 27		Drive SSID Char 1				Drive SSID Char 2			

Messages Format 0 (Byte 7, bits 4-7)

0 No messages.
1 Invalid command.
2 Invalid sequence.
3 CCW count less than required.
4 Data value not as required.
5 Diagnostic write not permitted by file mark.
6 Channel discontinued retry operation.
7 Channel returned incorrect retry CCW.
8 23FD not ready.
9 23FD permanent seek check.
A 23FD permanent read check.
B Improper alternate/defective track pointer.
C Invalid virtual volume.
D Index detected in gap of record.
E Unstageable data.
F Unused.

SA FORMAT 1 (BYTE 7, BITS 0-3)
DEVICE EQUIPMENT CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd if Byte 5, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder address (low order) from most recent seek argument from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8	SA 8	Index Error	Offset Active	Seek Incomplete	Seek Complete	Online	Attention	Busy	Record Ready
File Status									
MSS 9	SA 9	0	Diagnostic 4	Diagnostic 2	Diagnostic 1	0	Mode 4	Mode 2	Mode 1
Monitor Code									
MSS 10	SA 10	State 8	State 7	State 6	State 5	State 4	State 3	State 2	State 1
Monitor State									
MSS 11	SA 11	CE Program Stop	0	0	0	DEV-I Bus Out Parity	Monitor Check	0	Drive Cmd Reject
Check Status									
MSS 12	SA 12	Data Safety	Servo Safety	0	Pad Safety Mod 11	Power On Reset	Power On Reset Raw	Head Not Loaded	Even Latched
Safety									
MSS 13	SA 13	Expected data for messages 1, 6, 7, 8, 9 (contents of Bus Out). TA register for message code 3 and C.							
TA Reg/Expected									
MSS 14	SA 14	Drive status for message 9. Contents of MA Reg (Bus In) for message codes 1, 3, 6, 7, and 8.							
MA Reg/Received									
MSS 15	SA 15	Contents of TD Register Tag Bus for codes 1, 3, 6, 7, 8, and 9							
Tag Bus/TD Reg									
MSS 16	SA 16	PLO Error	Write Parity Error	Read Parity Error	Bit Ring Error	Write Compare Chk	Data Transfer Control Check	Missing PLO Pulses	VFO Phase Error
Ctlr Chk 1 Byte									
MSS 17	SA 17	ECC No Input Error	ECC P0 or Write Error	ECC P2 or P3 Error	ECC P1 Error	Sync Out Check	No Reorient Counter Check	Gap Counter Check	Gap Control Check
Ctlr Chk 2 Byte									
MSS 18	SA 18	Select Alert 1	Select Active Check	CTL-I Bus In Check	Reserved	Message Code			
Ctlr Chk 3 Byte									
MSS 19	SA 19	Drive Selection Error	CTL-I Tag Bus Check	Device Check	CTL-I Bus Out Check	Write Sense Check	Write Valid Check	Device Bus Out Check	Controller Bus In Check
Ctlr Chk 4 Byte									

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 20	SA 20	0	0	0	0	0	0	0	0
MSS 21	SA 21	0	0	0	0	0	0	0	0
MSS 22	SA 22	Fault Symptom Code							
MSS 23	SA 23	Fault Symptom Code							
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Messages Format 1 (Byte 7, bits 4-7)

0 No messages.
1 Set target error.
2 Microprogram detected error (see Byte 18).
3 No write gate at drive.
4 No write current sense.
5 String switch error in resetting primed interrupt.
6 Transmit cylinder error.
7 Transmit head error.
8 Transmit difference error.
9 File status not as expected.
A Seek error.
B Seek incomplete on retry.
C No interrupt from drive.
D Compare failure ECC P2 or P3.
E Compare failure ECC P1.
F Retry byte count/sector value incorrect.

Messages Format 1 (Byte 18, bits 4-7)

0 Unused.
1 TAG VALID missing (CTL-I).
2 NORMAL END/CHECK END missing (CTL-I).
3 NORMAL END missing (CTL-I).
4 No index after 40 ms or solid index indication.
5 Unexpected status with CHECK END.
6 3330 selection address check.
7 Pre-selection check.
8 Zero pattern alignment error.
9 Repetitive command overrun indication.
A Device interrupt during busy.
B Device status not as expected after seek or set sector.
C-E Reserved.
F Always active (hot) bus in bit.

SA FORMAT 2 (BYTE 7, BITS 0-3)
DASD CONTROLLER EQUIPMENT CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd if Byte 1, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder address (low order) from most recent seek argument from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8	SA 8	0	0	0	0	0	0	0	0
MSS 9	SA 9	0	0	0	0	0	0	0	0
MSS 10	SA 10	0	0	0	0	0	0	0	0
MSS 11	SA 11	Channel Buffer Parity Check	Interface Check Channel A/C	Interface Check Channel B/D	Data Transfer Check	CTL-I Check defined by Byte 20	Load S Registers	Compare Assist	Multi Connect Channel C or D Check
Control Check									
MSS 12	SA 12	0	0	0	0	0	0	0	0
MSS 13	SA 13	Contents of TA Register (valid only if sense byte 7='24')							
CTL-I Bus Out									
MSS 14	SA 14	Contents of MA Register (valid only if sense byte 7='24')							
CTL-I Bus In									
MSS 15	SA 15	Contents of TD Register (valid only if sense byte 7='24')							
CTL-I Tag Bus									
MSS 16	SA 16	0	0	0	0	0	0	0	0
MSS 17	SA 17	0	0	0	0	0	0	0	0
MSS 18	SA 18	0	0	0	0	0	0	0	0
MSS 19	SA 19	0	0	0	0	0	0	0	0
MSS 20	SA 20	Controller Check	Select Active Check	CTL-I Buffer Check	Unexpected End Check	Tag Bus Parity Check	Bus Out Parity Check	CTL-I Transfer Error	Any ADT Check 2
CTL-I Check									
MSS 21	SA 21	0	0	0	0	0	0	0	0
MSS 22	SA 22	0	0	0	0	0	0	0	0
MSS 23	SA 23	0	0	0	0	0	0	0	0
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Messages Format 2 (Byte 7, bits 4-7)

0 No messages.
1 ECC P1 or P3 compare failure.
2 ECC P2 compare failure.
3 S Register Load Check.
4 CTL-I Register Valid. (Bytes 13-15)
5-F Unused.

SA FORMAT 3 (BYTE 7, BITS 0-3)
STORAGE CONTROL CHECK

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Required	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd if Byte 1, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E,	Drive ID on for E, F, G, H	Drive ID on for C, D, G,	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder address (low order) from most recent seek argument from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8	SA 8	Address of control storage word when error was detected							
BAR									
MSS 9	SA 9	Address of control storage word when error was detected							
BAR									
MSS 10	SA 10	1 = early	Clock Error	CA Decode Even	CA Decode Odd	CB Decode Even	CB Decode Odd	Branch/ Status	Special Operations
Chk 1 Reg (Early)									
MSS 10	SA 10	0 = late	Clock Error	CS Decode or Status Set	0	A Register	B Register	ALU	23FD Parity
Chk 1 Reg (Late)									
MSS 11	SA 11	0	Storage Read Byte 0/2	Storage Read Byte 1/3	0	Cycle Control	CD Decode	0	0
Check 1 Register (Early) if Byte 10, Bit 0 = 1									
MSS 11	SA 11	Storage Address Bus 0-7	Storage Address Bus 8-15	Storage Write Byte 0/2	Storage Write Byte 1/3	Control Store Address Check	AMR Error	23FD Not Ready	0
Check 1 Register (Late) if Byte 10, Bit 0 = 0									
MSS 12	SA 12	Storage Error Pattern Register							
MSS 13	SA 13	Contents of TC Register							
MSS 14	SA 14	Contents of TG Register							
MSS 15	SA 15	0	0	0	0	0	0	0	0
MSS 16	SA 16	Storage SA Register							
MSS 17	SA 17	Storage SB Register							
MSS 18	SA 18	Storage SC Register							
MSS 19	SA 19	Storage SD Register							
MSS 20	SA 20	0	0	0	0	0	0	0	0
MSS 21	SA 21	0	0	0	0	0	0	0	0
MSS 22	SA 22	0	0	0	0	0	0	0	0
MSS 23	SA 23	0	0	0	0	0	0	0	0
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Messages Format 3 (Byte 7, bits 4-7)
No messages defined.

SA FORMAT 4 (BYTE 7, BITS 0-3)
DATA CHECKS WITHOUT ERROR DISPLACEMENT AND PATTERN

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Req	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd if Byte 1, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8	SA 8	High order cylinder byte of last seek address							
Cylinder									
MSS 9	SA 9	Low order cylinder byte of last seek address							
Cylinder									
MSS 10	SA 10	High order head byte of last seek address							
Head									
MSS 11	SA 11	Low order head byte of last seek address							
Head									
MSS 12	SA 12	Record number of error record							
Record									
MSS 13	SA 13	Sector of error record							
Sector									
MSS 14	SA 14	Amount of offset used to recover from error							
Offset									
MSS 15	SA 15	Number of retries required to recover from error							
Retries									
MSS 16	SA 16	Storage Control	Storage Control	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Source Drive ID									
MSS 17	SA 17	0	0	0	0	0	0	0	0
MSS 18	SA 18	0	0	0	0	0	0	0	0
MSS 19	SA 19	0	0	0	0	0	0	0	0
MSS 20	SA 20	0	0	0	0	0	0	0	0
MSS 21	SA 21	0	0	0	0	0	0	0	0
MSS 22	SA 22	Fault Symptom Code							
MSS 23	SA 23	Fault Symptom Code							
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Contents of bytes 8-12 are unreliable if byte 7 message code is 0, 1, 4, 5, or 9

Messages Format 4 (Byte 7, bits 4-7)

0 HA field ECC uncorrectable.
1 Count field ECC uncorrectable.
2 Key field ECC uncorrectable.
3 Data field ECC uncorrectable.
4 No sync byte found in HA field.
5 No sync byte found in count field.
6 No sync byte found in key field.
7 No sync byte found in data field.
8 Reserved.
9 AM detection failure on retry.
A-F Reserved.

SA FORMAT 5 (BYTE 7, BITS 0-3)
DATA CHECK WITH ERROR DISPLACEMENT AND PATTERN

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Req	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3 Restart Cmd if Byte 1, Bit 7 On	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
MSS 4	SA 4 Control/Drive ID	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
MSS 5	SA 5	Cylinder Address (low order) from most recent Seek Argument from the Channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7 Format/Message	Format				Message			
MSS 8	SA 8 Cylinder	Cylinder of last seek							
MSS 9	SA 9 Cylinder	Cylinder of last seek							
MSS 10	SA 10 Cylinder	Head of last seek							
MSS 11	SA 11 Head	Head of last seek							
MSS 12	SA 12 Record	Record number of error record							
MSS 13	SA 13 Sector	Sector of error record							
MSS 14	SA 14 Offset	Amount of offset used to recover from error							
MSS 15	SA 15 Restart Displmnt	Number of bytes processed by storage control to end of data field in error (Restart displacement)							
MSS 16	SA 16 Restart Displmnt	Number of bytes processed by storage control to end of data field in error (Restart displacement)							
MSS 17	SA 17 Restart Displmnt	Number of bytes processed by storage control to end of data field in error (Restart displacement)							
MSS 18	SA 18 Error Displmnt	Displacement of first byte in error relative to end of the failing data field (High order)							
MSS 19	SA 19 Error Displmnt	Displacement of first byte in error relative to end of the failing data field (Low order)							
MSS 20	SA 20 Error Pattern	Pattern to be exclusive ORed with erroneous data in main storage (High order)							
MSS 21	SA 21 Error Pattern	Pattern to be exclusive ORed with erroneous data in main storage (Middle order)							
MSS 22	SA 22 Error Pattern	Pattern to be exclusive ORed with erroneous data in main storage (Low order)							
MSS 23	SA 23	0	0	0	0	0	0	0	Channel Truncated
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Contents of bytes 8-12 are unreliable if byte 7 message code is 0, 1, 4, 5, or 9

Messages Format 5 (Byte 7, bits 4-7)

0 HA field correctable.
1 Count field correctable.
2 Key field correctable.
3 Data field correctable.
4-F Reserved.

SA FORMAT 6
USAGE/ERROR STATISTICS

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 0	SA 0	Command Reject	Intervention Req	Bus Out Parity	Equipment Check	Data Check	Overrun	0	0
MSS 1	SA 1	Permanent Error	Invalid Track Format	End of Cylinder	0	No Record Found	File Protected	Write Inhibited	Operation Incomplete
MSS 2	SA 2	Stage Error	Correctable	Destage Error	Environ-mental Data	0	0	0	0
MSS 3	SA 3	0	0	0	0	0	1	0 If Write 1 If Read	0 If Read 1 If Write
Restart Cmd If Byte 1, Bit 7 On									
MSS 4	SA 4	DASD Controller ID	DASD Controller ID	Drive ID on for A, B, C, D	Drive ID on for A, B, E, F	Drive ID on for A, C, E, G	Drive ID on for E, F, G, H	Drive ID on for C, D, G, H	Drive ID on for B, D, F, H
Control/Drive ID									
MSS 5	SA 5	Cylinder Address (low order) from most recent seek argument from the channel							
MSS 6	SA 6	0	Mod 1, 2 (CAR=256), Mod 11 (CAR=512)	Mod 1, 2 (CAR=0), Mod 11 (CAR=256)	Head address of last seek (excluding retry seeks)				
MSS 7	SA 7	Format				Message			
Format/Message									
MSS 8	SA 8	Number of bytes read or searched in key and data fields (not including retry operations)							
Byte Count									
MSS 9	SA 9	Number of bytes read or searched in key and data fields (not including retry operations)							
Byte Count									
MSS 10	SA 10	Number of bytes read or searched in key and data fields (not including retry operations)							
Byte Count									
MSS 11	SA 11	Number of bytes read or searched in key and data fields (not including retry operations)							
Byte Count									
MSS 12	SA 12	Number of ECC correctable data checks detected by the storage control							
Correctable Data Checks									
MSS 13	SA 23	Number of ECC correctable data checks detected by the storage control							
Correctable Data Checks									

MSS Sense Byte	Unit Sense Byte	0	1	2	3	4	5	6	7
MSS 14	SA 14	Number of ECC uncorrectable data checks successfully retried by the storage control							
Retry Data Checks									
MSS 15		Number of ECC uncorrectable data checks successfully retried by the storage control							
Retry Data Checks									
MSS 16	SA 16	Number of access motions initiated by the channel							
Seeks									
MSS 17	SA 17	Number of access motions initiated by the channel							
Seeks									
MSS 18	SA 18	0 = A and B 1 = C and D	0	0	0	0	0	0	0
Channel Select for Bytes 20-23									
MSS 19	SA 19	Number of seek errors successfully retried by the storage control							
Seek Errors									
MSS 20	SA 20	Interface A or C (No. retried by storage control)							
Cmd Overruns									
MSS 21	SA 21	Interface A or C (No. retried by storage control)							
Data Overruns									
MSS 22	SA 22	Interface B or D (No. retried by storage control)							
Cmd Overruns									
MSS 23	SA 23	Interface B or D (No. retried by storage control)							
Data Overruns									
MSS 24	SA 24	Real Unit Address							
MSS 25	SA 25	Real Cylinder							
MSS 26	SA 26	Real Cylinder							
MSS 27	SA 27	Drive SSID Char 1				Drive SSID Char 2			

Messages Format 6 (Byte 7, bits 4-7)

No messages defined.

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Glossary

The following terms are used throughout this book.

accessor: The component in the Mass Storage Facility that transports cartridges between the cells, the data recording devices, and the cartridge access station.

accessor control: The component in the Mass Storage Facility that decodes and sequences messages from the Mass Storage Control and directs the motion of the accessor.

acquire: To allocate space on a staging drive and to stage data from a cartridge to the staging drive.

active mass storage volume: See active volume.

active volume: A mass storage volume residing within the Mass Storage Facility and available for mounting by the operating system.

attention interrupt: A signal from the Mass Storage Control to the CPU that a message is waiting for the CPU.

base mass storage volume: See base volume.

base volume: A mass storage volume that can have copies or duplicates.

BIND: (1) An attribute of a data set that keeps the data set on one or more staging drives until the data set is released by the user regardless of the length of time or the demands for space. (2) An attribute of a mass storage volume that reserves an entire staging pack for the mass storage volume whenever the volume is mounted.

cartridge: The storage medium of the Mass Storage System, consisting of a container with magnetic tape wound around a spool inside it.

Cartridge Access Station: An opening on the Mass Storage Facility where cartridges are manually loaded or retrieved.

cartridge label: An area on the magnetic storage tape that contains the cartridge identification and other information about the cartridge.

cartridge serial number: A unique number that identifies a cartridge; recorded magnetically and visibly on the tape.

Cartridge Store: The part of the Mass Storage Facility that consists of the cells, the accessors, and the accessor controls.

cell: A hexagonal compartment within the Mass Storage Facility where a cartridge is stored.

cell cube: A block of 32 cells, four X addresses by four Y addresses, by two Z addresses.

copy mass storage volume: See copy volume.

copy volume: An inactive mass storage volume that is an exact reproduction of another mass storage volume. Both volumes have the same volume identification.

convertible drive: A drive that can be designated to be either a staging drive or a real drive.

cylinder fault: A condition that occurs when the operating system requires data that has not been staged. The cylinder fault causes a cylinder of data to be staged.

data cartridge: See cartridge.

DASDERASE: An attribute of a mass storage volume that causes binary zeros to be written on the staging drive after data from the mass storage volume has been destaged.

data recording control: The component of the Mass Storage Facility that starts and stops data recording devices, encodes and decodes, and assists with error recovery. The abbreviation is DRC.

data recording device: The unit in the Mass Storage Facility that reads and writes data on the cartridge media. The abbreviation is DRD.

default mass storage volume group: The collection of mass storage volumes that do belong to a mass storage volume group defined by the Mass Storage System Communicator. The name of the group is always SYSGROUP.

delayed response: An indication from the Mass Storage Control that a Mass Storage Control I/O is finished.

destage: To move data from a staging drive to a mass storage volume.

DRC: See data recording control.

DRD: See data recording device.

duplicate mass storage volume: See duplicate volume.

duplicate volume: An inactive mass storage volume that has the same identification as another mass storage volume and is not a copy.

eject: To move a cartridge from the Mass Storage Facility to the cartridge access station.

EXCLUSIVE: An attribute of a mass storage volume that allows only one CPU at a time to access the mass storage volume.

Extended Group Coded Recording: The technique is used to encode the data on the tape in a data cartridge. This technique includes error correction code. The abbreviation is E/GCR.

E/GCR: See Extended Group Coded Recording.

general-use mass storage volume: See general-use volume.

general-use volume: A mass storage volume that is assigned to a mass storage volume group and can be used for nonspecific requests for a mass storage volume.

group: See mass storage volume group or staging drive group.

IML: See Initial Microprogram Load.

inactive mass storage volume: See inactive volume.

inactive volume: A mass storage volume that is not available for mounting by the operating system.

Initial Microprogram Load: The action of loading a microprogram. The abbreviation is IML.

Integrated Storage Control: A feature on the Model 158 or 168 processors that control the 3330 Disk Storage. With the addition of the Staging Adapter, the Integrated Storage Control can control staging drives. See also Staging Adapter.

Inventory data set: See Mass Storage Volume Inventory data set.

Journal data set: See Mass Storage Volume Control Journal data set.

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

Least Recently Used: An algorithm that determines the order in which active staged pages must be destaged. The algorithm ensures the staging drive group will always have the amount of allocatable space defined by the space manager.

loading pattern: The order in which cells are filled with cartridges that are entered in the Mass Storage Facility through the cartridge access station.

loosely-coupled: A connection of more than one CPU such that the CPUs share only channels.

Mass Storage Control: A microprogrammed portion of the Mass Storage Facility that passes information to the accessor control, and controls data and space on staging drives. The Mass Storage Control is abbreviated MSC.

Mass Storage Control Table Create: A program that builds the Mass Storage Control tables. The abbreviation is MSCTC.

Mass Storage Control tables packs: A direct access storage pack that contains Mass Storage Control tables.

Mass Storage Control twin port: A feature of a Mass Storage Control that allows the Mass Storage Control to address a total of 16 of the following: Mass Storage Facilities, 3850 Model 3 Storage Controls, or Integrated Storage Controls that have the addition of the Staging Adapter.

Mass Storage Facility: The component of a Mass Storage System that contains the storage media and the facilities for accessing the media. The abbreviation is MSF.

Mass Storage System: The name for the entire storage system, consisting of the Mass Storage Facility and all devices that are defined to the Mass Storage Control. The abbreviation is MSS.

Mass Storage System Communicator: A program that handles communication between system control programs and the Mass Storage Control. The Mass Storage Volume Control functions are an integral part of the Mass Storage System Communicator. The abbreviation is MSSC.

mass storage volume: A direct access storage volume residing on two associated cartridges.

Mass Storage Volume Control functions: A collection of functions that reside in the Mass Storage System Communicator and are designed to assist the space manager in managing mass storage volumes and mass storage volume groups. The abbreviation is MSVC.

Mass Storage Volume Control Inventory data set: Same as Mass Storage Volume Inventory data set.

Mass Storage Volume Control Journal data set: A data set that contains messages to the space manager and information used to rebuild the Mass Storage Volume Inventory data set.

mass storage volume group: A collection of mass storage volumes. The space manager can define a group, and the Mass Storage System Communicator defines a default mass storage volume group. The name of the parameter used in job control language for a group is MSVGP.

Mass Storage Volume Inventory data set: A data set that describes mass storage volumes and mass storage volume groups. The abbreviation is MSVI.

MSC: See Mass Storage Control.

MSCTC: See Mass Storage Control Table Create.

MSF: See Mass Storage Facility.

MSS: See Mass Storage System.

MSSC: See Mass Storage System Communicator.

MSVC: See Mass Storage Volume Control.

MSVI: See Mass Storage Volume Inventory data set.

nonstaging drive: Same as real drive.

page: The unit of space that is allocated on a staging drive. The page consists of 8 cylinders.

path: A hardware connection known to the operating system that permits the movement of data within the hardware.

primary CPU: The CPU in a multi-CPU system configuration that has the responsibility of processing unsolicited messages from the Mass Storage Control.

real drive: A drive that is attached to a storage control (3830 Model 3) or an Integrated Storage Control with a Staging Adapter and has the pack formatted as a nonstaging (or real) pack. No staging is performed on this drive.

relinquish: To free space on a staging drive. It can cause data to be destaged.

restricted-use mass storage volume: See restricted-use volume.

restricted-use volume: A mass storage volume assigned to a mass storage volume group and used only by requests specifing the mass storage volume identification.

scratch: To remove the information about a mass storage volume from the Mass Storage Volume Inventory data set and put the identification of both cartridges on a list of scratch cartridges.

scratch cartridge: A cartridge that is not part of a mass storage volume.

scratch data cartridge: See scratch cartridge.

SHARED: An attribute of a mass storage volume that allows more than one CPU at a time to access the mass storage volume.

solicited message: A message from the Mass Storage Control to the CPU that is expected by the CPU.

space manager: The person who is responsible for managing space on mass storage volumes.

stage: To move data from a cartridge to a staging drive.

Staging Adapter: (1) An addition to a System/370 Model 158 or 168 Intergrated Storage Control (ISC) feature that enables the ISC to operate in a Mass Storage System. (2) A 3830 Model 2 Storage Control that has been modified to operate in a Mass Storage System. The modification changes the designation of the storage control to a 3830 Model 3 Storage Control.

staging drive: A 3330 Model 1, 2, or 11 that is designated by the Mass Storage Control Table Create program to receive data from a Mass Storage Facility.

staging drive group: A collection of staging drives for space management and recovery. It is created by the user with the Mass Storage Control Table Create program.

staging effective data rate: An amount of data transferred between the data recording devices and the staging drives in one second. The amount of data is normally averaged over an hour.

staging pack: A 3336 Disk Pack that has been initialized to receive data from a Mass Storage Facility.

Storage Control: The 3830 Model 3, the direct access storage device control unit in the Mass Storage System that controls the transfer of data during staging and destaging operations. Also see Staging Adapter.

stripe: The portion of the cartridge tape that is accessible to a given head position.

subsystem identification: An identification on each device in the Mass Storage System. The devices include staging adapters, staging drives, Mass Storage Facility, data recording devices, and data recording controls. The abbreviation is SSID.

System Data Analyzer: A program that analyzes collected data about hardware errors in the Mass Storage System.

system effective data rate: An amount of data transferred between the staging drives and the CPU in one second. The amount of data is normally averaged over an hour.

tables pack: See Mass Storage Control tables pack.

tightly-coupled: A connection of more than one CPU such that the CPUs share main storage and communicate directly with one another.

trace: A monitor in the Mass Storage Control that records data about Mass Storage System activity and staging and destaging. The data describes completed Mass Storage System functions from the activity schedule queues plus time stamps.

twin port: See Mass Storage Control twin port.

unsolicited message: A message from the Mass Storage Control to the primary CPU that is not requested or expected by the primary CPU.

virtual drive: A direct access storage device that does not physically exist. It exists logically on one or more staging drives.

virtual unit address: An address for a virtual drive that consists of the channel address, the Staging Adapter address and the device address. The virtual unit address can be assigned to any staging drive group. Each staging drive can have more than one virtual unit address, but only one real unit address.

virtual unit control block: A unit control block that contains a virtual unit address.

virtual volume: The data from a mass storage volume while it is located on a staging drive.

volume: See mass storage volume or virtual volume.

volume group: See mass storage volume group or default mass storage volume group.

WRITEINHIBIT: An attribute of a mass storage volume that prevents writing on the mass storage volume. It means the same as read-only.

Index

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