OEM
Reference
Manual

VLS

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VLS Specification

1. Scope

This specification describes a family of magazine-oriented Autochangers for desk top or rack mount installations. The basic models described include a 4mm DAT, an 8mm, a ½'DLT, and a 3.5" Optical unit. Additional models are under development for other media types. The VLS features optional dual drive capability (except DLT drive model), standard SCSI-2 commands and rugged design for utilization with hierarchical storage management (HSM) software. All systems incorporate standard off-the-shelf drives without modification (except DLT drive model). A 2-line, 16-character front panel LCD is used to display operation information and setting, as well as diagnostics and messages.

2. Design Standards

2.1 Agency Approvals

UL 1950	Safety
CSA 950	Safety
IEC 950 (TUV)	Safety
FCC Part 15, Subpart B, Class B Certified	EMI
EN 55022, Class B, Certified	EMI

2.2 ADIC Engineering Design Standards

01-1401-01	Climatic Environment & Test
01-1401-02	Mechanical Environment & Test
01-1401-03	Power Environment & Test
01-1401-04	Acoustic Noise
01-1401-05	Product Safety Certifications
01-1401-06	EMI/RFI Emissions
01-1401-07	EMI/ESD Susceptibility
01-1401-08	Shipping Container
01-1401-09	SCSI-II (X3T9.2/86-109 Rev. 10h)

3. GENERAL REQUIREMENTS

3.1 Reliability

Reliability is expressed in both MTBF (mean time between failure) for the total number of Power On Hours and in MSBF for the total number of media swaps.

MTBF	50,000 Power On Hours
MSBF	100,000 Cartridge Swaps*

* Net of drive and/or media failures.

3.2 Application

ADICš VLS series is designed for high capacity near- and off-line storage applications such as on-line storage back up, HSM and video/design/data file libraries. It is a magazine-oriented device which allows easy transport of whole data sets. The unit is designed as a desk top device which can also be rack mounted with a simple attachment kit. Communication with the VLS is via the SCSI bus where the robotics occupy a single SCSI target ID. The standard SCSI-2 command set for Autochangers is implemented in the same way as all of ADIC's Autochangers for common application software compatibility. The large base of existing software can be directly ported to ADICš VLS series of Autochangers.

3.3 Dimensions and Weight

	DAT, 8mm, QIC	DLT	Optical
Width	17.4 inches	17.4 inches	17.4 inches
Height	8 inches	8 inches	8 inches
Depth	15.8 inches	20 inches	17.5 inches
Weight (w/o media)	30 lbs (w/2 drives)	30 lbs	30 lbs(w/2 drives)
Weight (w/o media)	27 lbs (w/1 drive)		27 lbs(w/1 drive)

3.4 Appearance and Color

Cabinet color is Cloud (ADIC P/N 14-1009-01), or special colors per OEM customer request.

3.5 Climatic and Mechanical Environment

Operating Temperature:	5 to 40 degrees C.
Storage and Shipping Temperature:	-40 to 70 degrees C.
Operating Relative Humidity:	20 to 80% RH, non-condensing
Storage and Shipping Relative Humidity:	90% maximum
Operating Shock	2 g peak for 3 ms –1/2 sine
Non-Operating Shock	20 g peak for 3 ms –1/2 sine
Operating Vibration (@5-500Hz):	0.01 & 0.25 g
Non-Operating Vibration (@5-500Hz):	0.01 & 0.5 g

3.6 AC Power Environment

AC Input Voltages:	90-254 VAC (Auto Ranging)
Frequency:	47 Hz to 63 Hz
AC Input Current:	0.6 to 0.3 A

3.7 Internal Temperature Rise

Forced air cooling is provided by a fan integral to the cabinet. The maximum internal temperature rise over room ambient air temperature is 15 degrees Celsius, with the front door in the open or closed position.

3.8 Agency Approvals

Agency approval will be sought and maintained per the design standard.

4. FUNCTIONAL REQUIREMENTS

4.1 Packaging

The main chassis of the VLS consists of a single aluminum sheet forming the base and rear panel, and supporting the cover, the internal robotic mechanism, and the front door. Design of the main chassis is such that the alignment between the carriage system, the drive mounting system and the pick arm system is preserved without the need for alignment.

4.2 Exterior Characteristics

4.2.1 Front Door

The front door hinges from the bottom and is 1" thick in order to accommodate rack mounting situations and the front magazine load orientation. The front door has a recessed window to allow visual inspection

of the operation of the VLS. The front door also contains a keyboard/display/logo area. The intent of this area is to provide a standard keyboard/display function with the ability to change the appearance by optional overlay designs. The front door is lockable with a front-access key lock.

4.2.2 Rear Surface

The rear surface contains the power entry module, fan and air filter, I/O transfer plate module, and model and system labels.

4.2.3 Bottom Surface

The unit bottom contains four 0.5" rubber feet and access plates which cover the access to the drive mounting screws of some models and allow access to the shuttle mechanism for moving the drives manually in case of mechanical failure. Because of the access plates and other protrusions, the feet must remain installed in the rack mount configuration.

4.2.4 Operational Orientation

The unit is intended for operation in the horizontal (normal) orientation only.

4.3 Interface

Both the robotics and the drives use the SCSI interface in the normal configuration.

4.4 Power

The power supply is auto-ranging consistent with the specified power requirements. The power entry module contains the power switch.

4.5 Device Compatibility

4.5.1 4mm DAT

ADIC̦s VLS Autochanger will accommodate any 3.5" DAT drive on the market with minimal modification.

4.5.2 8mm Exabyte

ADIC̦s VLS Autochanger will accommodate the Exabyte 8505 series 5.25" half-height drives.

4.5.3 3.5" Optical

ADIC̦s VLS Autochanger will accommodate the MOST, Inc. half-height 5.25" drive (for 3.5" media) and all other 3.5" magneto-optical drives.

4.5.4 QIC Mini Data Cartridge

ADICś VLS Autochanger will accommodate the Exabyte SCSI Mini Data Cartridge drive (2500 Series). Other drives of this type should be compatible with minor modification.

4.5.5 DLT Data Cartridge

ADICś VLS will accommodate the Quantum DLT2000XT, DLT4000 and DLT7000 data cartridge drives. Due to the dimensions of the DLT drive, the VLS can accommodate only a single drive.

4.5.5 AIT Data Cartridge

ADICś VLS will accommodate the Sony SDX-300C, 3.5"AIT data cartridge drive without any modification.

4.6 Standard Options

4.6.1 Drive Option

ADICś VLS Autochanger is designed to accept two drives (except for DLT drives). It may be loaded with only one drive, however, with simple front panel setup to modify the firmware as a single drive unit.

4.6.2 Differential Option

Differential SCSI is available by installing the ADIC Differential Converter board. The Changer controller board and both drives will now appear as differential.

4.6.3 Add In Boards

Add In boards such as the Peripheral Vision Library Card or the ADIC differential-to-single-ended converter board can installed in the internal area provided.

4.7 Special Features

4.7.1 Down-loadable Firmware

Firmware upgrades can be made via the SCSI bus utilizing a custom application program on a PC (from code supplied on disk or downloaded from ADIC's BBS).

4.7.2 Front Panel Option Settings

Options such as sequential mode, sequential loop back, etc., can be set from the front panel instead of using option jumpers.

4.7.3 Diagnostic and Operation Display

A 2 by 16 LCD display and appropriate buttons provide user access to special modes within the VLS. The Diagnostic Mode allows the robotics to be exercised off line. In Diagnostic Mode, the event log can be examined so that events that have occurred in the past can be viewed. In normal operation mode, status of the VLS is displayed. The display can also show activity for each drive, as well as which cartridge number is in which drive.

4.7.4 Calibration Features

Calibration factors such as Magazine Home and Arm Out are set by positioning the robotics to an indexed location and locking the setting in non-volatile memory. Screw adjustments are not required.

4.7.5 Operational lockout features

In addition to the Lock Command available to the system software, certain operation modes cannot be changed from the front panel while the front door is locked. Unlocking the door with the key enables access to all front panel activities.

4.8   Front Panel

4.8.1 Front Panel Display

The front panel display occupies the entire left side of the door assembly. Controls consist of eight buttons, two LED indicators, and a 2 *x* 16-character, back lit LCD display. The rest of the front panel display area are available for Company Logo and model name information. It is intended that the electronic hardware remain standard and that model and OEM specific "looks" be achieved using artwork on the front panel overlay.
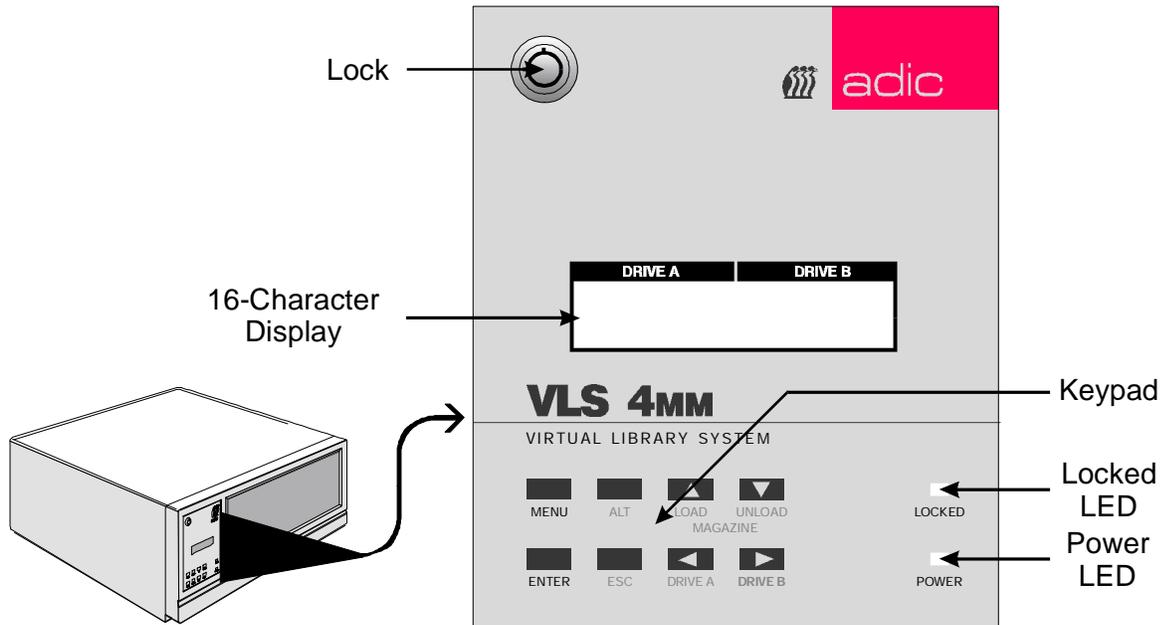
4.8.2   Operation Modes

4.8.2.1 Setup Mode

Setup Mode is used on installation of the VLS and allows the user to set the SCSI addresses of the robotics and both drives. The user may also select other parameters such as which drive(s) are active and the sequential mode options.

4.8.2.2 Diagnostic Mode

Diagnostic Mode is used to cause the VLS to perform certain diagnostic tests and report the results. Cycle Testing can be ran in this mode.

4.8.2.3 Normal Operating Mode

In Normal Operating mode, the VLS is controlled by the system software. Status information, such as drive activity, which cassette is in which drive, etc., are displayed.

VLS Diagnostics and Error Messages

If any component of the VLS is not communicating correctly, a warning message will appear on the front display.

> ### *Note*
> The error messages continue to be in a state of change. You may see error listings other than those noted below.

Boot F/W

Boot ROM checksum failure

The boot ROM contains a 2-byte checksum value of all the ROM's bytes, exclusive of the checksum value itself. This boot-ROM checksum is calculated at the time the firmware is created. When the VLS is powered up, the boot ROM re-calculates this value and compares it against the embedded value. If the two values differ, the above error is presented. This indicates that either the boot ROM is corrupted, or the board is having general problems. A **_VERY_** severe error. The controller board should be checked by a qualified service technician.

Firmware signature not found in EEPROM

The operational firmware contains a specific sequence of bytes at a specific location in the EEPROM. The boot ROM checks for this byte sequence in order to determine whether (or not) valid VLS firmware has been loaded. If the boot ROM does not find the correct byte sequence at the correct memory location, the above error is presented. This can be corrected by simply downloading the operational firmware.

EEPROM checksum failure

The operational firmware also contains a checksum similar to that of the boot ROM. If a valid firmware signature is found, the boot ROM re-calculates the operational firmware checksum and compares this value to the firmware's embedded value. If the two values do not match, the above error is presented, indicating that either the operational firmware is corrupted, or that the board is having general problems. Normally this can be corrected by downloading the firmware again. However, if the error recurs frequently, the board should be checked by a qualified service technician.

Unknown error code *xx*h

This is a catch-all for unexpected conditions. The *xx* is a 2-digit hexadecimal value. However, this error should not occur.

Operational F/W

SCSI RESET OCCURRED

Indicates that the SCSI bus has been reset, or that the VLS received a SCSI Bus Device Reset message from a host. This message is displayed for informational reasons, since a reset sets the EXCEPTION state for all changer elements (similar to opening the door).

Source location empty

Indicates that the source slot or drive is empty, or that the magazine is unloaded. This error should not occur -- except during a diagnostics menu function (where this check is skipped).

Destination location full

Indicates that the destination slot or drive is full, or that the magazine is already loaded. This error should not occur -- except during a diagnostics menu function (where this check is skipped).

Mag unload disabled by software

Indicates that the VLS has received a Prevent/Allow Medium Removal SCSI CDB with the PREVENT bit set from a host -- and has not yet received a Prevent/Allow Medium Removal CDB with the PREVENT bit cleared from that same host (i.e. software has "locked" the magazine), and that an unload magazine request has been received from the keyboard. The magazine will remain "locked" until the host sends a Prevent/Allow Medium Removal CDB with the PREVENT bit cleared, or a reset occurs (SCSI bus reset, Bus Device Reset message received, keyboard reset, or power cycled).

Can't unload, media in drive(s)

Indicates that an unload magazine request was received from the keyboard, and the VLS believes that an active drive contains media. This message can be cleared by unloading media from the drive, or by resetting the VLS.

Drive failed to eject medium

This indicates that the medium sensor beam was <u>not</u> blocked when the Unload Medium item was selected from the diagnostics menu. Either the drive did not eject the media, or it did not eject the media far enough to block the sensor beam, or the sensor has failed.

Unexpected Gripper Arm Sensor brk

Indicates that the gripper arm was blocked from moving inward from its outmost position, or the gripper arm sensor is blocked by extraneous material, or the gripper arm sensor has failed.

Unexpected Magazine Sensor break

Indicates that the magazine was blocked from moving leftward from its calibration position, or the magazine sensor is blocked by extraneous material, or the magazine sensor has failed.

Door has been opened

Indicates that the door has been opened and then closed, that the door was opened while a motor was operating (e.g. in the middle of a load magazine, position drive, unload medium, etc.), or the door sensor has failed. Close the door and retry the operation.

> ### *Note*
>
> The EXCEPTION state will be set for all changer elements, and SCSI hosts will receive a CHECK CONDITION on their next command -- other than Inquiry or Request Sense. The Sense Key will be UNIT ATTENTION (06h) with the ASC/ASCQ set to IMPORT/EXPORT ELEMENT ACCESSED (28h, 01h).

Door is open

Indicates that the door is open, that the door was already open when a request requiring a motor operation was received (e.g. at the start of a load magazine, position drive, unload medium, etc.), or that the door sensor has failed. Close the door and retry the operation.

> ### *Notes*
>
> The EXCEPTION state will be set for all changer elements, and SCSI hosts will receive a CHECK CONDITION on their next command -- other than Inquiry or Request Sense. The Sense Key will be UNIT ATTENTION (06h) with the ASC/ASCQ set to IMPORT/EXPORT ELEMENT ACCESSED (28h, 01h).
>
> If the door is open when SCSI command is received, CHECK CONDITION is returned with the Sense Key set to NOT READY (02h) and ASC/ASCQ set to MANUAL INTERVENTION REQUIRED (04h/03h).
>
> If the door is opened while a robotics motion is in progress, CHECK CONDITION is returned with the Sense Key set to ABORTED COMMAND (0Bh) and ASC/ASCQ set to MANUAL INTERVENTION REQUIRED (04h/03h).

No Gripper Arm Sensor break

Indicates that the gripper arm was blocked from moving outward to its outmost position, or that the gripper arm sensor has failed.

No Magazine Sensor break

Indicates that the magazine was blocked from moving rightward to its calibration position, or that the magazine sensor has failed.

Unexpected Medium Sensor break

Indicates that the medium sensor beam was blocked during a magazine movement operation (e.g. load magazine, position to slot, etc.). The medium sensor beam is blocked by extraneous material (e.g. a loop of tape from an improperly unloaded or damaged cassette), or the medium sensor has failed.

Unable to return medium to slot

The medium sensor beam remained continuously blocked during an unload medium operation. The medium is jammed, or the medium sensor beam is blocked by extraneous material, or the medium sensor has failed.

Unable to load medium in drive

The medium sensor beam remained continuously blocked during a load medium operation. The medium is jammed, or the medium sensor beam is blocked by extraneous material, or the medium sensor has failed.

Medium incorrectly oriented

Indicates that the medium at the currently positioned slot is incorrectly oriented for proper loading or is jamming during a load-magazine request received from the keyboard. This will occur only on VLS models which perform the orientation check, and then only for load-magazine requests received from the keyboard.

Drive positioning time-out

Indicates that the drives are blocked from shuttling, or the drive position sensor, the drive shuttle motor, or drive shuttle circuitry has failed.

Drive Operate Handle'time-out

Indicates that the OK to Operate Handle'bit from the drive was not set following a load or unload cartridge request. This will occur only on VLS DLT models.

Drive door open or close time-out

Indicates that the drive door failed to open or close. The door open or door closed sensor beam is blocked, or the door open sensor or door closed sensor has failed, or the door motor has failed. This will occur only on VLS DLT models.

Drive door not closed

Indicates that the drive door failed to stay closed. The door closed sensor has failed, or the door motor has failed. This will occur only on VLS DLT models.

Drive is busy, cant unload tape

Indicates that the drive is busy when receiving an unload tape request from the front panel. This will occur only on VLS DLT models.

Please reseat tapes in magazine

Indicates that the Cartridge Sensor is blocked during the power-up initialization. This will occur only on VLS DLT models.

Flash RAM erase failure

Indicates that Flash RAM failed to erase correctly when performing a write to Flash RAM operation.

Flash RAM write failure

Indicates that a write to the Flash RAM failed when performing a write to Flash RAM operation..

NV-RAM selection failure

Indicates that the VLS did not receive the proper response when selecting a location in NV-RAM.

NV-RAM write failure

Indicates that an NV-RAM write failure occurred.

Unknown error code *xx*h

This is a catch-all for unexpected conditions. The *xx* is a 2-digit hexadecimal value. However, this error should not occur.

> ### *Note*
>
> To recover from an error condition, press **ALT** then **ENTER**.
>
> To reset the controller, press and hold **ALT**, then press **ESC**.
>
> The Drive Status LEDs also provide "error" information. Refer to the section *Cleaning Information* for illustrations of the Drive Status LEDs as well as details on cleaning the heads.

VLS SCSI Interface Specification

1. General

The ADIC VLS connects to the host system through a SCSI interface. This interface conforms to SCSI standards specified by ANSI X3T9.2/86-109 Rev 10h.

The VLS implementation offers a standard set of features and functions which include:

- Asynchronous communication
- Single-ended configuration
- Implementation of SCSI-2 commands for Medium Changer devices

This document contains specific details on the VLS SCSI-2 interface implementation.

2. Device Model

The VLS handles physical loading and unloading of media cassettes into and out of a media drive. A removable storage magazine holds the media in the VLS while they are not loaded in the drive. The magazine can hold up to eleven media (or more, depending on the model).

Media in the VLS are selected through an Element Addressing scheme. There are four types of elements in the VLS. These elements are Import/Export, Media Transport, Data Transfer, and Storage.

The Import/Export Element addresses the <u>logical</u> function of preparing the VLS to allow the user to access the magazine of media (i.e. inserting or removing the magazine through the front door of the unit).

The Media Transport Element addresses the <u>logical</u> function of preparing the VLS for operations that perform the movement of units of media between magazine slots and media drives.

The Data Transfer Elements represent the media drives within the VLS.

The Storage Elements address the locations within the magazine where each unit of medium is stored (magazine slots).

Each element in the VLS has a unique address assigned to it and may or may not be capable of independent storage of a unit of medium. The addresses and numbers for each element type may be determined via the Element Address Assignment page of the MODE SENSE command. Determining which element types are capable of storing a unit of medium may be done via the Device Capabilities page of the MODE SENSE command.

The VLS assigns addresses to the elements as shown in the following table:

Element Type	Symbol	Address
Media Transport (magazine)	MT	00H
Import/Export	IE	01H
Data Transfer	DT	02H, or 02H & 03H
Storage 0 - max.	ST	03H, or 04H to max.

Element Address Assignment

The host controls movement of media within the VLS through the use of the MOVE MEDIUM, POSITION TO ELEMENT, or ALIGN ELEMENTS commands. When issuing one of these commands to the VLS, the host supplies a source element address and/or a destination element address.

Four combinations of source/destination element types are supported by the VLS: IE to MT, MT to IE, ST to DT and DT to ST. The permitted combinations of source and destination element types may be determined via the Device Capabilities page of the MODE SENSE command.

> **Note**
>
> Movement between either the MT or IE element and any ST element is not supported by the VLS.
>
> Moves between the IE and MT elements perform physical and logical loads and unloads of the magazine.

A MOVE MEDIUM command from IE to MT will load the magazine by moving the magazine from the import/export location and initializing the element status tables. The IE status will be set to EMPTY and the MT status will be set to FULL. The ST elements will be checked for media presence and the status tables set accordingly. This function may also be performed by pressing the LOAD button on the front panel when the LOCK indicator is off. The status tables for the various elements may be read by using the READ ELEMENT STATUS command.

A MOVE MEDIUM command from MT to IE will move the magazine to the import/export location. The IE status will be set to FULL and the MT will be set to EMPTY. The ST and DT elements will also be set to EMPTY. This function may also be performed by pressing the UNLOAD button on the front panel when the LOCK indicator is off.

Moves between ST and DT elements perform physical loads and unloads of the media into and out of a media drive from a magazine slot.

A MOVE MEDIUM command from ST to DT will physically position the appropriate drive and the magazine to the appropriate slot, then load one unit of medium from the magazine into the drive.

A MOVE MEDIUM from DT to ST will unload a unit of media which has been ejected from a drive into a magazine storage slot. Because the VLS' robotics controller has no communications access to the media drive, the host must have previously commanded the drive to eject its media. Once the media has been ejected and is sticking out of the drive, the MOVE MEDIUM command to the VLS will place the cassette into the magazine storage slot.

> ***Note***
>
> Only the element addresses for the <u>currently</u> positioned drive and slot will be accepted by the MOVE MEDIUM command when moving media from a DT element to an ST element; therefore, the desired drive and/or magazine slot should be positioned <u>before</u> commanding the drive to eject its medium. Positioning may be accomplished by sending an ALIGN ELEMENTS command or one or more POSITION TO ELEMENT commands to the VLS.

At any time, if status for an element cannot be determined by the VLS, the EXCEPTION status bit will be set for that element, indicating that the VLS does not have reliable status information for that element. When EXCEPTION is set for an element, the VLS will omit source-empty and destination-full checking prior to executing a MOVE MEDIUM command that uses that element.

Please refer to section 8 of this chapter for information on writing software for the VLS.

3. Logical Characteristics

3.1 Bus Phases

The SCSI bus has eight distinct bus phases. The SCSI bus can never be in more than one phase at any given time.

3.1.1 BUS FREE Phase

The BUS FREE phase is used to indicate that no SCSI device is actively using the bus and that it is available. In some cases, the VLS reverts to BUS FREE phase to indicate an error condition for which it has no other way to handle. This is called an Unexpected Bus Free.

3.1.2 ARBITRATION Phase

The ARBITRATION phase allows one SCSI device to gain control of the SCSI bus so that it can initiate or resume a process.

3.1.3 SELECTION Phase

The SELECTION phase allows the host system to select the VLS for the purpose of initiating some medium changer function.

If more than two SCSI ID bits are on the data bus, the VLS will not respond to selection.

As a target, the VLS will either respond to or ignore selection within 250 milliseconds.

3.1.4 RESELECTION Phase

RESELECTION is an optional phase that allows a target to reconnect to an initiator for the purpose of completing a lengthy operation for which the target had previously disconnected. Disconnection is

accomplished by notifying the host system that the target is about to release the SCSI bus, but will later reselect the host and complete the operation, by first sending a DISCONNECT message to the host, then going to the Bus Free phase; this is not an Unexpected Bus Free condition.

The VLS will disconnect from the SCSI bus when processing any type of command requiring robotics movement (e.g. MOVE MEDIUM, ALIGN ELEMENTS, etc.) or when writing data to the EEPROM via a WRITE BUFFER command, and the host system has indicated that it supports disconnect/reselect.

3.1.5 INFORMATION TRANSFER Phases

The COMMAND, DATA, STATUS, MESSAGE IN and MESSAGE OUT phases are all grouped together as the information transfer phases because they are all used to transfer data or control information via the data bus.

3.1.5.1 COMMAND Phase

The COMMAND phase is used by the host system to transfer the 6, 10, or 12 bytes of the Command Descriptor Block to the target.

3.1.5.2 DATA IN Phase

The DATA IN phase is used by the target to transfer blocks of data to the host (e.g. INQUIRY response data).

3.1.5.3 DATA OUT Phase

The DATA OUT phase is used by the host to transfer blocks of data to the target (e.g. MODE SELECT parameter data).

3.1.5.4 STATUS Phase

The STATUS phase is used by the target to send command status to the host.

The VLS supports the following status codes: GOOD (00h), CHECK CONDITION (02h), BUSY (08h), and RESERVATION CONFLICT (18h).

3.1.5.5 MESSAGE IN Phase

The MESSAGE IN phase is used by the target to send messages to the host. Please refer to section 4.0 below for more information on SCSI messages.

3.1.5.6 MESSAGE OUT Phase

The MESSAGE OUT phase is used by the host to send messages to the target. Please refer to section 4.0 below for more information on SCSI messages.

3.2   Asynchronous Conditions

The SCSI bus has two asynchronous conditions: the attention condition and the reset condition. These conditions cause the SCSI device to perform certain actions and can alter the phase sequence.

3.2.1 Attention Condition

The Attention condition allows a host to inform a target that the host has a message ready. The host creates the attention condition by asserting ATN at any time except during the ARBITRATION or BUS FREE phases. The target may get the message by performing a MESSAGE OUT phase.

The VLS will check the ATN line at selection, at any phase change and prior to release REQ for a MESSAGE IN phase. Upon detecting the attention condition, the VLS will immediately respond with the MESSAGE OUT phase.

3.2.2 Reset Condition

The Reset condition is used to immediately clear all SCSI devices from the bus. The BUS FREE phase always follows the reset condition.

The VLS will implement the hard reset alternative of SCSI-2 implying that a reset condition will be handled just as a power-on reset from a SCSI standpoint. If a reset is received while the positioning systems are in motion, the motion operation will not be affected.

The VLS will be available for selection by an initiator within 250 milliseconds following a Reset condition.

3.3   Unit Attention Conditions

The VLS generates UNIT ATTENTION conditions for two types of events. The UNIT ATTENTION condition will exist for each host until cleared by each host as specified in the SCSI specification.

POWER-ON RESET, SCSI RESET or BUS DEVICE RESET

The VLS will create a UNIT ATTENTION condition at power-on, in response to a SCSI reset or in response to a BUS DEVICE RESET message.

IMPORT/EXPORT ELEMENT ACCESSED

This condition is intended to inform the host when media within the changer may have been accessed or changed by the user. This condition also informs the host of door closure following a period during which the door was open. (Motion commands are rejected while the door is open.)

When the door is closed following an open condition, the changer will generate a UNIT ATTENTION CONDITION: IE ELEMENT ACCESSED for each host on the bus. This condition will be maintained for the host as specified by section 6.9 of the SCSI-2 specification.

If both a POWER-ON RESET and an IE ELEMENT ACCESSED UNIT ATTENTION CONDITION exist at the same time, the changer will report the POWER-ON RESET condition and will not report the IE ELEMENT ACCESSED condition.

4. Message Implementation

The message system allows communication between a host and the VLS for the purpose of physical path management.

4.1 Message Protocol

The first message sent by the host after the SELECTION should be the IDENTIFY message. This allows the establishment of the logical connection to a particular logical unit as specified by the host. Under some exceptional conditions, a host may send the ABORT message or the BUS DEVICE RESET message instead of the IDENTIFY message as the first message. Only one logical unit number should be identified for any one selection sequence; a second IDENTIFY message with a new logical unit number should not be issued before the SCSI bus has been released (BUS FREE phase).

After the RESELECTION phase, the VLS' first message will be IDENTIFY. This allows the logical connection to be re-established between the target's specified logical unit number and the host.

The VLS supports the messages listed in Figure A-3.

ABORT	06h
BUS DEVICE RESET	0Ch
COMMAND COMPLETE	00h
DISCONNECT	04h
IDENTIFY	80h - FFh
INITIATOR DETECTED ERROR	05h
MESSAGE PARITY ERROR	09h
MESSAGE REJECT	07h
NO OPERATION	08h
SAVE DATA POINTER	02h

Messages Supported by the VLS

COMMAND COMPLETE - 00h

This message is sent from the VLS to a host to indicate that the execution of a command has terminated and that valid status has been sent to the host. After successfully sending this message, the VLS will go to the BUS FREE phase by releasing BSY. The command may have been executed successfully or unsuccessfully as indicated in the status.

SAVE DATA POINTER - 02h

This message is sent from the VLS to inform the host that the VLS plans to disconnect in the middle of a DATA OUT phase, but the VLS will later RESELECT the host in order to complete the current data transfer.

This message is normally immediately followed by a DISCONNECT message.

DISCONNECT - 04h

This message is sent from the VLS to inform a host that the VLS plans to disconnect by going to the BUS FREE phase, but the VLS will later RESELECT the host in order to complete the current operation.

INITIATOR DETECTED ERROR - 05H

This message is sent from a host to inform the VLS that an error (e.g., data parity error) has occurred that does not preclude the VLS from retrying the operation.

ABORT - 06H

This message is sent from the host to the VLS to clear the present operation. If a logical unit has been identified, all pending data and status for the issuing host from the effected logical unit will be cleared, and the VLS will go to the BUS FREE phase. Pending data and status for other hosts will not be cleared. If a logical unit has not been identified, the VLS will go to the BUS FREE phase. In either case, no status or ending message will be sent for the operation.

If an ABORT message is received while the robotics systems are in motion, the motion operation will not be halted, and all affected status tables will be updated accordingly; however, no status or ending message will be sent for the operation.

MESSAGE REJECT - 07H

This message is sent from either the host or VLS to indicate that the last message it received was inappropriate or has not been implemented.

In order to indicate its intentions of sending this message, the host should assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that is to be rejected. When a VLS unit sends this message, it will change to MESSAGE IN phase and send this message prior to requesting additional message bytes from the host. This provides an interlock so that the host can determine which message is rejected.

NO OPERATION - 08H

This message is sent from a host in response to a VLS' request for a message when the host does not currently have any other valid message to send.

MESSAGE PARITY ERROR - 09H

This message is sent from the host to the VLS to indicate that one or more bytes in the last message it received had a parity error.

In order to indicate its intention of sending this message, the host should assert the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so that the VLS can determine which message has the parity error.

BUS DEVICE RESET - 0CH

This message is sent from a host to direct the VLS to clear all current commands. This message forces the VLS to an initial state with no operations pending for any host. Upon recognizing this message, the VLS will go to the BUS FREE phase.

If a BUS DEVICE RESET message is received while the robotics systems are in motion, the motion operation will not be halted, and all affected status tables will be updated accordingly; however, no status or ending message will be sent for the operation.

IDENTIFY - 80H to FFH

These messages are sent by either the host or the VLS to establish the logical connection between a host and the VLS for a particular logical unit, and also allow a host to indicate its support of disconnect/reselect. The bit values for IDENTIFY messages are defined as follows:

Bit 7	This bit is always set to 1 to distinguish these messages as IDENTIFY messages.
Bit 6	This bit is only set to 1 by the host. When set to 1, it indicates that the host has the ability to accommodate disconnection and reselection.
Bits 5-3	Reserved.
Bits 2-0	These bits specify the logical unit number to which a logical connection is requested.

Bit Values for IDENTIFY Messages

Only one logical unit number should be identified for any one selection sequence; a second IDENTIFY message with a new logical unit number should not be issued before the bus has been released (BUS FREE phase).

5.   Command Implementation

A command is communicated by sending a Command Descriptor Block (CDB) to the VLS. All Commands consist of six-, ten- or twelve-byte CDBs. The CDB always has an operation code as its first byte and a control byte as its last byte.

Reserved bits, fields, bytes and code values are set aside for future standardization. A reserved bit, field or byte should be set to zero (0). If the VLS receives a reserved bit, field or byte that is not set to zero, the sense key will be set to ILLEGAL REQUEST, the additional sense code and qualifier will be set to INVALID FIELD IN CDB and a CHECK CONDITION status will be returned (refer to the REQUEST SENSE command description for more information on sense keys, additional sense codes, and additional sense code qualifiers).

The format for Command Descriptor Blocks is as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Group Code			Command Code				
1	LUN			CDB-specific Fields				
2	CDB-specific Fields							
3	CDB-specific Fields							
4	CDB-specific Fields							
5	CDB-specific Fields or Control							
6	CDB-specific Fields							
7	CDB-specific fields							
8	CDB-specific Fields							
9	CDB-specific Fields or Control							
10	CDB-specific Fields							
11	Control							

CDB Format

The operation code of the CDB has a group code field and a command code field. The three-bit group code field provides for eight groups of command codes. The group code definitions are shown in Figure A.

Group Code	Operation Codes	CDB Length
0	00h - 1Fh	Six bytes
1	20h - 3Fh	Ten bytes
2	40h - 5Fh	Ten bytes
3	60h - 7Fh	Reserved
4	80h - 9Fh	Reserved
5	A0h - BFh	Twelve bytes
6	C0h - DFh	Vendor-specific
7	E0h - FFh	Vendor-specific

CDB Group Codes

The LUN field is contained in bits 5-7 of the second byte of every CDB. The LUN field of the CDB is supported strictly for compatibility with SCSI-1 devices; host software should specify the LUN in the IDENTIFY message since this field may be changed by the SCSI-3 specification.

The VLS only supports a LUN value of zero (0). If the VLS receives a LUN value other than zero, the sense key will be set to ILLEGAL REQUEST, the additional sense code and qualifier will be set to LUN NOT SUPPORTED, and a CHECK CONDITION status will be returned.

The Control byte is the last byte of every CDB. The VLS views the control byte as a reserved byte.

5.1 Command Support

The VLS will support the commands listed below. These include all mandatory and some optional and vendor-specific commands for SCSI-2 Medium Changer devices.

COMMAND	OPERATION CODE
ALIGN ELEMENTS	E5h
INITIALIZE ELEMENT STATUS	07h
INQUIRY	12h
LOG SENSE	4Dh
MODE SELECT	15h
MODE SENSE	1Ah
MOVE MEDIUM	A5h
POSITION TO ELEMENT	2Bh
PREVENT/ALLOW MEDIUM REMOVAL	1Eh
READ BUFFER	3Ch
READ CAPACITY	25h
READ ELEMENT STATUS	B8h
RELEASE	17h
REQUEST SENSE	03h
RESERVE	16h
REZERO UNIT	01h
SEND DIAGNOSTIC	1Dh
TEST UNIT READY	00h
WRITE BUFFER	3Bh

Supported Commands

It is possible that the list of supported commands may change as the VLS' operating firmware is updated; however, the exact list of supported commands for any version of the VLS' firmware may be determined via the Implemented SCSI-2 Commands and the Implemented Vendor-specific Commands Vital Product Data pages of the INQUIRY command. Please refer to the INQUIRY command description for more information on these Vital Product Data pages.

Please refer to section 8 of this chapter for information on writing software for the VLS.

5.2   ALIGN ELEMENTS (E5h, Vendor Specific)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (E5h)							
1	LUN			Reserved (0)				
2 : 3	(MSB) Medium Transport Element Address (0)							(LSB)
4 : 5	(MSB) Data Transfer Element Address							(LSB)
6 : 7	(MSB) Storage Element Address							(LSB)
8	Reserved (0)							
9	Reserved (0)							
10	Reserved (0)							Inv (0)
11	Control (0)							

ALIGN ELEMENTS Command

The ALIGN ELEMENTS command aligns both the DT element specified in the Data Transfer Element Address field and the ST element specified in the Storage Element Address field with the gripper arm. This vendor-specific command allows the host to simultaneously position both the DT and ST elements without the need for two separate POSITION TO ELEMENT commands. The Element Address Assignment page of the MODE SENSE command may be examined prior to issuing this command in order to determine the allowable range of values for the Data Transfer Element Address and Storage Element Address fields. Please note, however, that this SCSI command is specific to the ADIC VLS family. Also note that the structure of the ALIGN ELEMENTS CDB is identical to that for the MOVE MEDIUM CDB, except for the command code field. This is to facilitate the use of the ALIGN ELEMENTS and MOVE MEDIUM commands when requesting a VLS Unload Medium operation.

If the Storage Element Address represents an ST element which is FULL and the Data Transfer Element Address represents a DT element which is also FULL, or if the element address in the Data Transfer Element Address field is not a valid DT address, or if the element address in the Storage Element Address field is not a valid ST element address, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS, and return CHECK CONDITION status.

> ***Note***
>
> Because the VLS' robotics controller has no communications access to the media drive, the host must have previously commanded the drive to eject its media. Once the media has been ejected and is sticking out of the drive, a MOVE MEDIUM command to the VLS will place the cassette into the magazine storage slot; however, the desired drive and/or magazine slot should be positioned <u>before</u> commanding the drive to eject its medium. Positioning may be accomplished by sending an ALIGN ELEMENTS command or one or more POSITION TO ELEMENT commands to the VLS.

5.3   INITIALIZE ELEMENT STATUS (07h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	LUN			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

INITIALIZE ELEMENT STATUS Command

When an INITIALIZE ELEMENT STATUS command is received, all slots will be checked for media presence and the corresponding ST element status set accordingly. After successfully checking all slots, the IE element status will be set to EMPTY and the MT element status will be set to FULL. The status for the DT elements are unaffected.

The REZERO UNIT command functions identically to the INITIALIZE ELEMENT STATUS command.

5.4   INQUIRY (12h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN			Reserved (0)				EVPD
2	Page Code							
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

INQUIRY Command

The INQUIRY command requests that information regarding parameters of the VLS be sent to the initiator.

An Enable Vital Product Data (EVPD) bit of zero specifies that the VLS return the standard INQUIRY data. In this case, if the Page Code field is not zero the VLS will set the Sense Key to ILLEGAL REQUEST and set the Additional Sense Code/Additional Sense Code Qualifier to INVALID FIELD IN CDB, and return a CHECK CONDITION status.

An EPVD bit of one specifies that the VLS return the Vital Product Data page specified by the Page Code field. The page code field specifies which page of Vital Product Data the target should return.

The INQUIRY command will return CHECK CONDITION status only when the VLS cannot return the requested data.

If an INQUIRY command is received from an initiator with a pending Unit Attention condition, the VLS will perform the INQUIRY command but will not clear the Unit Attention condition.

5.4.1 Standard Inquiry Data

Bit Byte	7	6	5	4	3	2	1	0
0	Periph. Qual. (0)				Peripheral Device Type (08h)			
1	RMB (1)	Device Type Modifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI Version (2)		
3	AENC (0)	TrmIOP (0)	Reserved (0)		Response Data Format (2)			
4	Additional Length (n-4)							
5	Reserved (0)							
6	Reserved (0)							
7	RelAdr (0)	W32 (0)	W16 (0)	Sync (0)	Linked (0)	Rsv (0)	Que (0)	SftRe (0)
8 : 15	(MSB) Vendor Identification ("ADIC ") (LSB)							
16 : 31	(MSB) Product Identification ("VLS 8mm ")* (LSB)							
32 : 35	(MSB) Product Revision Level (LSB)							
36 : 55	(MSB) Vendor-specific 1 (LSB)							
56 : 95	(MSB) Reserved (0) (LSB)							
96 : n	(MSB) Vendor-specific 2 (LSB)							

Standard Inquiry Data

*	(VLS 8mm ") = VLS 8mm model
	("VLS 4mm ") = VLS 4mm model
	("VLS 4mm ") = VLS SDX model
	("VLS DLT ") = VLS DLT model, if Product Sign-On, 8MM = N
	("VLS 8mm ") = VLS DLT model, if Product Sign-On, 8MM = Y

The VLS will set the peripheral qualifier field to 0, indicating that the specified peripheral device type is currently connected to this logical unit. The peripheral device-type field will be set to 08h, indicating a Medium Changer device.

The VLS will indicate that the medium is removable by setting the Removable Medium Bit (RMB) to a one.

The Device-Type Modifier field will be set to zero.

The ISO Version and ECMA Version fields will be set to zero. The ANSI Version field will be set to 02h indicating compliance with SCSI-2.

The Asynchronous Event Notification Capability (AENC) is reserved for all SCSI devices other than Processor devices and will be set to zero by the VLS.

The Terminate I/O Process bit (TrmIOP) will be set to zero indicating that the VLS does not support use of the Terminate I/O Process message.

The Response Data Format field will be set to 02H indicating a INQUIRY data format compatible with SCSI-2.

The Additional Length field provides the total number of remaining bytes <u>available</u> to be transferred. If the Allocation Length specified in the CDB is too small to transfer all of the data, the Additional Length field will not be adjusted to reflect the truncation, but only the number of bytes specified in the CDB will be transferred. If the Allocation Length specified in the CDB is larger than the number of bytes available, then only the total number of data bytes available will be transferred, and this shall not be considered an error condition.

The Relative Addressing bit (RelAdr) will be set to zero, indicating that the VLS does not support relative addressing.

The Wide-32 and Wide-16 bits (W32 and W16) will be set to zero, indicating that the device does not support 16- or 32-bit transfers.

The Synchronous Transfer bit (Sync) will be set to zero indicating that the device does not support synchronous transfers.

The Linked Commands bit (Linked) will be set to zero, indicating that the device does not support linked commands.

The Command Queuing bit (Que) will be set to zero indicating that command queuing is not supported.

The Soft Reset bit (SftRe) will be set to zero, indicating that the device responds to the RESET condition with the Hard Reset alternative.

The Vendor Identification field contains eight-bytes of left-justified, space-padded ASCII data identifying the vendor.

The Product Identification field contains sixteen bytes of left-justified, space-padded ASCII data identifying the product.

The Product Revision Level field contains four bytes of left-justified, space-padded ASCII data identifying the product revision level.

The Vendor-specific 1 field contains from 0 up to 20 bytes of vendor-specified data. This field will only be returned if it contains one or more bytes of data, or if the Vendor-specific 2 field is returned.

The Vendor-specific 2 field contains from 0 up to 64 bytes of vendor-specified data. This field will only be returned if it contains one or more bytes of data.

5.4.2 Vital Product Data

The Vital Product Data pages of the INQUIRY command allow the host to request additional information about the VLS. The VLS supports the following Vital Product Data pages:

Page Code	Description
00h	Supported Vital Product Data Pages Page
80h	Product Serial Number Page
C0h	Firmware Revision Page
E0h	Implemented SCSI-2 Commands Page
E1h	Implemented Vendor-specific Commands Page

Vital Product Data Pages

5.4.2.1 Firmware Revision Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (C0h)							
2	Reserved (0)							
3	Page Length (3Eh)							
4 : 25	(MSB) Revision (LSB)							
26 : 44	(MSB) Build Date (LSB)							
45 : 58	(MSB) Checksum (LSB)							

Firmware Revision Page

The Firmware Revision page provides information identifying the current operating firmware version. Please note, however, that this Vital Product Data page is specific to the ADIC VLS family.

The Revision field contains 22 bytes of ASCII data in the form "Firmware Revision=*vvvv*" where *vvvv* is identical to the data returned in the Product Revision Level field of the standard INQUIRY data.

The Build Date field contains 19 bytes of ASCII data in the form "Build Date=*mm/dd/yy*" where *mm/dd/yy* is the date the operating firmware was compiled.

The Checksum field contains 14 bytes of ASCII data in the form "Checksum=*cccc*h" where *cccc* is the ASCII-hexadecimal representation of the 16-bit checksum value for the operating firmware.

5.4.2.2 Implemented SCSI-2 Commands Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (E0h)							
2	Reserved (0)							
3	Page Length (12h)							
4	TEST UNIT READY Operation Code (00h)							
5	REZERO UNIT Operation Code (01h)							
6	REQUEST SENSE Operation Code (03h)							
7	INITIALIZE ELEMENT STATUS Operation Code (07h)							
8	INQUIRY Operation Code (12h)							
9	MODE SELECT Operation Code (15h)							
10	RESERVE Operation Code (16h)							
11	RELEASE Operation Code (17h)							
12	MODE SENSE Operation Code (1Ah)							
13	SEND DIAGNOSTIC Operation Code (1Dh)							
14	PREVENT/ALLOW MEDIUM REMOVAL Operation Code (1Eh)							
15	READ CAPACITY Operation Code (25h)							
16	POSITION TO ELEMENT Operation Code (2Bh)							
17	WRITE BUFFER Operation Code (3Bh)							
18	READ BUFFER Operation Code (3Ch)							
19	LOG SENSE (40h)							
20	MOVE MEDIUM Operation Code (A5h)							
21	READ ELEMENT STATUS Operation Code (B8h)							

Implemented SCSI-2 Commands Page

The Implemented SCSI-2 Commands page lists the command codes for all standard SCSI-2 commands supported by the VLS. This page may be examined in order to determine which standard SCSI-2 commands are supported. Please note, however, that this Vital Product Data page is specific to the ADIC VLS family.

Since the number and codes of the supported SCSI-2 commands may change as the VLS' operating firmware is updated, this page should be examined in order to determine which standard SCSI-2 commands are supported by the current firmware.

5.4.2.3 Implemented Vendor-specific Commands Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (E1h)							
2	Reserved (0)							
3	Page Length (01h)							
4	ALIGN ELEMENTS Operation Code (E5h)							

Implemented Vendor-specific Commands Page

The Implemented Vendor-specific Commands page lists the command codes for all SCSI commands specific to the ADIC VLS. This page may be examined in order to determine which vendor-specific SCSI commands are implemented. Please note, however, that this Vital Product Data page is specific to the ADIC VLS family.

Since the number and codes of the supported vendor-specific SCSI commands may change as the VLS' operating firmware is updated, this page should be examined in order to determine which vendor-specific SCSI commands are supported by the current firmware.

5.4.2.4 Product Serial Number Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (80h)							
2	Reserved (0)							
3	Page Length (n - 3)							
4 : n	(MSB) Product Serial Number (LSB)							

Product Serial Number Page

The Product Serial Number page contains from 0 to 40 bytes of ASCII data representing the VLS' serial number.

5.4.2.5 Supported Vital Product Data Pages Page

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)				Peripheral Device Type (08h)			
1	Page Code (00h)							
2	Reserved (0)							
3	Page Length (05h)							
4	Supported Vital Product Data Pages Page Code (00h)							
5	Unit Serial Number Page Code (80h)							
6	Firmware Revision Page Code (C0h)							
7	Implemented SCSI-2 Commands Page Code (E0h)							
8	Implemented Vendor-specific Commands Page Code (E1h)							

Supported Vital Product Data Pages Page

The Supported Vital Product Data Pages page lists the page codes for all supported Vital Product Data pages.

Since the number and codes of the supported Vital Product Data pages may change as the VLS' operating firmware is updated, this page should be examined in order to determine which other Vital Product Data pages are supported by the current firmware.

5.5   LOG SENSE (4Dh)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	LUN (0)			Reserved (0)			PPC (0)	SP (0)
2	PC (01b)		Page Code					
3	Reserved (0)							
4	Reserved (0)							
5 : 6	(MSB) Parameter Pointer (LSB)							
7 : 8	(MSB) Allocation Length (LSB)							
9	Control (0)							

LOG SENSE Command

The LOG SENSE command provides a means for the VLS to report statistical information to the host system.

The Parameter Pointer Control (PPC) field controls the type of information returned by the VLS. The VLS only supports a value of zero for the Parameter Pointer Control field.

The Save Parameters (SP) field indicates whether the VLS should save all savable Log Parameters to vendor-specific, non-volatile memory locations upon execution of this command. Since the VLS does not support the saving Log Parameters function, this value must be zero.

The Page Control (PC) field indicates the type of Log Parameter values to be returned. Since the VLS does not support threshold values or default cumulative values, this field must be 01b, indicating that the VLS will return the current cumulative values.

The Page Code field identifies which page of Log Parameters the VLS will return. Only a single Log Page will be returned. The VLS supports the following Log Pages:

Page Code	Description
00h	Supported Log Pages Page
30h	VLS Counters Page
32h	Operation Log Page

Page Code Usage

The Parameter Pointer field allows the host to control the first Log Parameter to be returned. Data will be returned starting with the specified Log Parameter code through the maximum Log Parameter code for the specified page, or the number of bytes specified in the Allocation Length field, whichever is less. A value of zero indicates that all Log Parameters for the specified page will be returned. If the Log Parameter code in the Parameter Pointer field is larger than the maximum Log Parameter code for the specified page, or the Log Parameter code is not supported in the specified page, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID FIELD IN CDB, and return CHECK CONDITION status.

> **Note**
>
> When requesting the Supported Log Pages Page, the Parameter Pointer field of the LOG SENSE CDB must be zero.

5.5.1 LOG SENSE Data

LOG SENSE data returned from the VLS to the host contains a header, followed by zero or more variable-length Log Parameters.

Byte	Item
0 - 3	Log Page Header
4 - n	Log Parameter(s)

LOG SENSE Data

5.5.1.1 Log Page Header

The Log Page Header consists of a four-byte block that contains the following information :

Bit Byte	7	6	5	4	3	2	1	0
0				Page Code				
1				Reserved (0)				
2 : 3	(MSB)			Page Length				(LSB)

Log Page Header

The Page Code field identifies which Log Page is being returned.

The Page Length field indicates the number of bytes of Log Parameter data <u>available</u> for all Log Parameters meeting the requirements of the command. This value will not be truncated to match the value of the Allocation Length field of the LOG SENSE CDB.

5.5.1.1 Log Parameter

Except for Log Parameters in the Supported Log Pages page, all Log Parameters consists of a four-byte header followed by a variable number of bytes of Log Parameter data:

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)			Parameter Code				(LSB)
2	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (0)		Rsv (0)	LP
3				Parameter Length (n - 3)				
4 : n	(MSB)			Parameter Data				(LSB)

Log Parameter

The Parameter Code field identifies which Log Parameter is being returned.

The Disable Update (DU) field

The Disable Save (DS) field

The Target Save Disable (TSD) field

The Enable Threshold Comparison (ETC) field

The Threshold Met Criteria (TMC) field

The Parameter Length field indicates the length in bytes of the Parameter Data field.

For the Supported Log Pages Page, Log Parameters consist of a single byte which is the Page Code of a supported Log Parameter Page.

> ### *Note*
>
> When requesting the Supported Log Pages Page, the Parameter Pointer field of the LOG SENSE CDB must be zero.

5.5.2   Log Pages

The VLS supports several Log Parameter pages. These pages are described in the sections that follow.

5.5.2.1 Supported Log Pages Page

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (00h)							
1	Reserved (0)							
2 : 3	(MSB) Page Length (0003h) (LSB)							
4	Supported Log Pages Page Code (00h)							
5	VLS Counters Page Code (30h)							
6	Operation Log Page Code (32h)							

Supported Log Pages Page

5.5.2.2 VLS Counters Page

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (30h)							
1	Reserved (0)							
2 : 3	(MSB) Page Length (3 - n) (LSB)							
4 : n	(MSB) Log Parameters (LSB)							

VLS Counters Page

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)			Parameter Code				(LSB)
2	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (0)		Rsv (0)	LP (0)
3	Parameter Length (2)							
4 : 5	(MSB)			Counter Value				(LSB)

VLS Counters Parameters

PARAMETER CODE	MEANING
0	Count of "Source Empty" errors
1	Count of "Destination Full" errors
2	"Removal Prevented"
3	"Unexpected Arm Sensor Break"
4	"Unexpected Magazine Sensor Break"
5	"No Arm Sensor"
6	"No Magazine Sensor"
7	"No Medium Sensor"
8	"Shuttle Position Time-out
9	"Other Error"
10	"No Media"
11	"Door Is Open"
12	"Door Was Opened"
13	"Lost Cass"
14	"Load Fail"
15	"Reversed Cass"
16	"Door opened while physically locked"
17	"Door opened while PREVENT MEDIUM REMOVAL in effect"

Error Counters

PARAMETER CODE	MEANING
100	"Load Magazine"
101	"Unload Magazine"
102	"Recalibrate"
103	"Position To Slot"
104	"Position To Drive"
105	"Load Medium"
106	"Unload Medium"

Operation Counters

PARAMETER CODE	MEANING
200	"Load Magazine" retries
201	"Unload Magazine" retries
202	"Recalibrate" retries
203	"Position To Slot" retries
204	"Position To Drive" retries
205	"Load Medium" retries
206	"Unload Medium" retries

Operation Retry Counters

5.5.2.3 Operation Log Page

The VLS may support an Operation Log page depending on hardware revision. This page is described as follows.

Bit Byte	7	6	5	4	3	2	1	0
0	Page Code (32h)							
1	Reserved (0)							
2 : 3	(MSB) Page Length (3 - n)							(LSB)
4 : n	(MSB) Log Parameters							(LSB)

Operation Log Page

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)	Parameter Code (0000h)						(LSB)
2	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (0)		Rsv (0)	LP (0)
3	Parameter Length (1)							
4	Count of Logged Events (N)							

Operation Log Parameter 0

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)	Parameter Code (1 - N)						(LSB)
2	DU (0)	DS (1)	TSD (0)	ETC (0)	TMC (0)		Rsv (0)	LP (1)
3	Parameter Length (28h)							
4 : 43	(MSB)	Event Descriptive Text						(LSB)

Operation Log Parameters 1 - N

The following is a partial list of the descriptive text of Operation Log Page events. You may see other events than those noted below.

Power on or user reset

Unit online due to user request

Unit off-line due to user request

Cmd: 03 00 00 00 20 00 (cmd is from SCSI host adapter)

SCSI selection by SCSI ID N (N = SCSI ID of host adapter)

SCSI reselection of SCSI ID N

SCSI disconnect from SCSI ID N

SCSI status = 00h (status request from SCSI host adapter)

Load magazine

Unload magazine

Door opened

Door closed

Position drive d (d = Drive A or B)

Position magazine to slot ss (ss = 01- *max. for model*)

Load from slot ss to drive d

Unload from d to slot ss

ERROR: Can't unload, media in drive(s)

ERROR: Source location empty

ERROR: Unexpected Gripper Arm Sensor brk

Retrying operation

5.6   MODE SELECT (15h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	LUN (0)			PF (1)	Reserved (0)			SavPgs
2	Reserved (0)							
3	Reserved (0)							
4	Parameter List Length							
5	Control (0)							

MODE SELECT Command

The MODE SELECT command provides a means for a host to specify certain operating parameters to the VLS. This command should be used in conjunction with the MODE SENSE command.

The Page Format (PF) field indicates the format of the Parameter List data which follows the Parameter List header and any Block Descriptors. A value of zero indicates that the data is formatted according the SCSI-1 specification (i.e. the format for all data following the header and Block Descriptors is vendor-specific). A value of one indicates that the data is formatted according to the SCSI-2 specification. Since the VLS only accepts data in the SCSI-2 format, this value must be one.

If bit set, we return CHECK CONDITION with additional sense set to "Saving pages not supported."

The Save Pages (SavPgs) field indicates whether or not to save parameters for use after a power-up or reset. A value of zero indicates that the current parameters will not be saved, while a value of one indicates that the current values of all savable pages (including any values updated by this MODE SELECT command) will be saved after the successful completion of the MODE SELECT command.

The Parameter List Length field specifies the total length in bytes of all parameter data that will be transferred to the VLS. A value of zero in this field indicates that no data will be transferred and will not be considered as an error. If the value in this field causes the truncation of the Parameter List Header, any Block Descriptor, or any Mode Parameter Page, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to PARAMETER LIST LENGTH ERROR, and return CHECK CONDITION status.

> ### *Note*
>
> The host system should issue a MODE SENSE command with the Page Control field set to Changeable Values (01b) and the Page Code field set to All Supported Pages (3Fh) before issuing the MODE SELECT command so that it may determine the codes for all supported pages, the lengths of the pages, and which parameters within the pages are changeable.

5.6.1 MODE SELECT Parameter List Data

MODE SELECT Parameter List data sent to the VLS from the host contains a header, followed by zero or one block descriptors, followed by zero or more variable-length Mode Parameter Pages.

Byte	Item
0 - 3	Parameter List Header
4 - y	Block Descriptor(s)
y + 1 - n	Mode Parameter Page(s)

MODE SELECT Parameter List Data

5.6.1.1 Parameter List Header

The Parameter List Header consists of a four-byte block that contains the following information :

Bit Byte	7	6	5	4	3	2	1	0
0				Mode Data Length (0)				
1				Medium Type (0)				
2				Device-specific Parameter (0)				
3				Block Descriptors Length				

Parameter List Header

The Mode Data Length field is reserved in the MODE SELECT command and must be zero.

The Medium Type and Device-specific Parameter fields are reserved for all medium-changer devices and must contain zeroes.

The Block Descriptors Length field contains the total length of all Block Descriptors which are to be sent to the VLS. The VLS only supports a single Block Descriptor in the Parameter List data; therefore, the only acceptable values for this field are either zero or eight.

5.6.1.2 Block Descriptors

A Block Descriptor consists of an eight-byte block that contains the following data.

Bit Byte	7	6	5	4	3	2	1	0
0	Density Code (0)							
1 : 3	(MSB) Number of Blocks (0) (LSB)							
4	Reserved (0)							
5 : 7	(MSB) Block Length (0) (LSB)							

Block Descriptor Fields

The Density Code field is reserved for all media-changer devices and must be set to zero. All other fields are considered as reserved by the VLS and must be set to zero.

5.6.2 Mode Pages

The VLS supports several Mode Parameter pages. These pages are described in the sections that follow.

Note

Only those parameters within a Mode Page which are reported as changeable by the MODE SENSE command may be changed with the MODE SELECT command. If any non-changeable parameter within a page is set to a value other than that reported as the current value by the MODE SENSE command, the VLS will set the Sense Key to ILLEGAL REQUEST, the Additional Sense to INVALID FIELD IN PARAMETER LIST, and return CHECK CONDITION status.

5.6.2.1 Element Address Assignment Page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)			Page Code (1Dh)				
1	Page Length (12h)							
2 : 3	(MSB) First Medium Transport Element Address (0) (LSB)							
4 : 5	(MSB) Number of Medium Transport Elements (1) (LSB)							
6 : 7	(MSB) First Storage Element Address (LSB)							
8 : 9	(MSB) Number of Storage Elements (LSB)							
10 : 11	(MSB) First Import/Export Element Address (1) (LSB)							
12 : 13	(MSB) Number of Import/Export Elements (1) (LSB)							
14 : 15	(MSB) First Data Transfer Element Address (2) (LSB)							
16 : 17	(MSB) Number of Data Transfer Elements (LSB)							
18 : 19	(MSB) Reserved (0) (LSB)							

Element Address Assignment Page

The Element Address Assignment page defines the addresses assigned to the elements of the VLS. This page also defines the number of each type of element that is present.

Note

No parameters of this Mode Page may be changed with the MODE SELECT command. If this page is sent to the VLS as part of the Parameter List data and any parameter within this page is set to a value other than that reported as the current value by the MODE SENSE command, the VLS will set the Sense Key to ILLEGAL REQUEST, the Additional Sense to INVALID FIELD IN PARAMETER LIST, and return CHECK CONDITION status.

5.6.2.2 Device Capabilities Page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)				Page Code (1Fh)			
1	Page Length (0Eh)							
2	Reserved (0)				StorDT (1)	StorIE (0)	StorST (1)	StorMT (0)
3	Reserved (0)							
4	Reserved (0)				MT→DT (0)	MT→IE (1)	MT→ST (0)	MT→MT (0)
5	Reserved (0)				ST→DT (1)	ST→IE (0)	ST→ST (0)	ST→MT (0)
6	Reserved (0)				IE→DT (0)	IE→IE (0)	IE→ST (0)	IE→MT (1)
7	Reserved (0)				DT→DT (0)	DT→IE (0)	DT→ST (1)	DT→MT (0)
8 : 11	(MSB) Reserved (0) (LSB)							
12	Reserved (0)				MT↔DT (0)	MT↔IE (0)	MT↔ST (0)	MT↔MT (0)
13	Reserved (0)				ST↔DT (0)	ST↔IE (0)	ST↔ST (0)	ST↔MT (0)
14	Reserved (0)				IE↔DT (0)	IE↔IE (0)	IE↔ST (0)	IE↔MT (0)
15	Reserved (0)				DT↔DT (0)	DT↔IE (0)	DT↔ST (0)	DT↔MT (0)

Device Capabilities Page

The Device Capabilities page defines characteristics of the element types on the VLS.

Note

No parameters of this Mode Page may be changed with the MODE SELECT command. If this page is sent to the VLS as part of the Parameter List data and any parameter within this page is set to a value other than that reported as the current value by the MODE SENSE command, the VLS will set the Sense Key to ILLEGAL REQUEST, the Additional Sense to INVALID FIELD IN PARAMETER LIST, and return CHECK CONDITION status.

5.6.2.3 LCD Page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)			Page Code (22h)				
1	Page Length (52h)							
2	Reserved (0)				DspLn 1	DspLn 2	Rsv (0)	Rsv (0)
3	Reserved (0)							
4 : 43	(MSB) LCD Line 1 User Text (LSB)							
44 : 83	(MSB) LCD Line 2 User Text (LSB)							

LCD Page

The LCD page provides the host with a method of displaying text on the VLS' front-panel LCD.

A value of 22h in the Page Code field indicates that parameters for the LCD page follow.

The Page Length field specifies the length in bytes of parameter data which follows. This field must be set to 52h for the LCD page.

The DspLn 1 field indicates the source for the text displayed on the first line of the front-panel LCD. A value of 0 indicates that the LCD will display text as directed by the VLS' firmware. A value of 1 indicates that the LCD will display the text specified in the LCD Line 1 User Text field when the VLS is in the On-Line mode.

The DspLn 2 field indicates the source for the text displayed on the second line of the front-panel LCD. A value of 0 indicates that the LCD will display text as directed by the VLS' firmware. A value of 1 indicates that the LCD will display the text specified in the LCD Line 2 User Text field when the VLS is in the On-Line mode.

The LCD Line 1 User Text field contains up to forty characters of text which will be displayed on the first line of the front-panel LCD if the DispLn 1 field is set to 1. If less than forty characters are to be displayed, the byte following the last character to be displayed should be set to zero.

The LCD Line 2 User Text field contains up to forty characters of text which will be displayed on the second line of the front-panel LCD if the DispLn 2 field is set to 1. If less than forty characters are to be displayed, the byte following the last character to be displayed should be set to zero.

The available character codes and the characters they represent are shown in the following table:

	0x	1x	2x	3x	4x	5x	6x	7x	8x	9x	Ax	Bx	Cx	Dx	Ex	Fx
x0	ND			0	@	P	`	p								
x1			!	1	A	Q	a	q								
x2			"	2	B	R	b	r								
x3			#	3	C	S	c	s								
x4			$	4	D	T	d	t								
x5			%	5	E	U	e	u								
x6			&	6	F	V	f	v								
x7			'	7	G	W	g	w								
x8			(	8	H	X	h	x								
x9			)	9	I	Y	i	y								
xA			*	:	J	Z	j	z								
xB			+	;	K	[	k	{								
xC			,	<	L	¥	l	|								
xD			-	=	M	]	m	}								
xE			.	>	N	^	n	→								
xF			/	?	O	_	o	←								

LCD Character Codes

5.6.2.4 Vendor-specific Page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (00h)					
1	Page Length (2Ah)							
2 : 33	(MSB)			Copyright				(LSB)
34 : 41	(MSB)			Firmware Build Date				(LSB)
42 : 43	(MSB)			Checksum				(LSB)

Vendor-specific Mode Page

The Vendor-specific page provides vendor-specified information in a vendor-specified format.

> ***Note***
>
> No parameters of this Mode Page may be changed with the MODE SELECT command. If this page is sent to the VLS as part of the Parameter List data and any parameter within this page is set to a value other than that reported as the current value by the MODE SENSE command, the VLS will set the Sense Key to ILLEGAL REQUEST, the Additional Sense to INVALID FIELD IN PARAMETER LIST, and return CHECK CONDITION status.

5.7   MODE SENSE (1Ah)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	LUN (0)			Rsv (0)	DBD	Reserved (0)		
2	PC		Page Code					
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

MODE SENSE Command

The MODE SENSE command provides a means for the VLS to report parameters to a host.

The Disable Block Descriptors (DBD) field controls whether or not the VLS returns Block Descriptors to the host. A value of one indicates that the VLS will <u>not</u> return Block Descriptors. A value of zero indicates that the VLS may, at its option, return Block Descriptors. If this value is zero, the VLS will return a single Block Descriptor to the host.

The Page Control (PC) field defines the type of parameter values to be returned. The Page Control field values are defined as follows:

Bit 7	Bit 6	Type of Parameter Values
0	0	Current Values
0	1	Changeable Values
1	0	Default Values
1	1	Saved Values

Page Control Field Values

CURRENT VALUES - 00b

A PC field value of 00b requests the target to return the current parameter values for the specified Page Code for the VLS.

CHANGEABLE VALUES - 01b

A PC field value of 01b requests the VLS to return the changeable parameter mask for the Page Code specified. The page requested shall be returned containing information that indicates which parameters are changeable. All bits of parameters that are changeable shall be set to one. All bits of parameters that are not changeable by a host shall be set to zero.

DEFAULT VALUES - 10b

A PC field of 10b requests the VLS to return the default values for the Page Code specified. The page requested shall be returned with each supported parameter set to its default value. Parameters not supported by the VLS are set to zero.

SAVED VALUES - 11b

A PC field of 11b requests the target to return the saved values for the Page Code specified. If a particular page is not savable (indicated by the PS bit set to zero in the returned data for that page), or the page has never been saved, the default values for that page will be returned.

The Page Code field specifies which Mode page or pages the VLS should return. Page Code usage is defined as follows:

Page Code	Description
00h	Vendor-specific Page
1Dh	Element Address Assignment Page
1Fh	Device Capabilities Page
22h	LCD Page
3Fh	All Supported Pages

Page Code Usage

A host may request any one or all of the supported pages of the VLS. If a host attempts a MODE SENSE command with a Page Code value that is not implemented by the VLS, the VLS will return CHECK CONDITION status and set the Sense Key to ILLEGAL REQUEST and the Additional Sense to INVALID FIELD IN CDB.

A Page Code field of 3Fh indicates that all pages implemented by the VLS shall be returned to the host. The pages will be returned in numeric order, with the exception of the Vendor-specific page; this page will be returned <u>last</u>.

5.7.1 MODE SENSE Data

MODE SENSE data returned from the VLS to the host contains a header, followed by zero or one block descriptors, followed by zero or more variable-length Mode Pages.

Byte	Item
0 - 3	Mode Parameter Header
4 - y	Block Descriptor(s)
y + 1 - n	Mode Page(s)

Mode Sense Data

5.7.1.1 Mode Parameter Header

The Mode Parameter Header consists of a four-byte block that contains the following information:

Bit / Byte	7	6	5	4	3	2	1	0
0	Mode Data Length							
1	Medium Type (0)							
2	Device-specific Parameter (0)							
3	Block Descriptors Length							

Mode Parameter Header

The Mode Data Length field contains a length count of all data available for transfer as specified in the Page Code field of the MODE SENSE CDB. This consists of a sum of the Mode Parameter Header length (excluding the Mode Data Length byte itself), the value in the Block Descriptors Length field, and the total lengths of all Mode pages specified in the Page Code field.

The Medium Type and Device-specific Parameter fields are reserved for all medium-changer devices and will contain zeroes.

The Block Descriptors Length field contains the total length of all Block Descriptors which are available to be returned, depending on the setting of the DBD field of the MODE SENSE CDB. If the DBD field was set to one, the VLS will not return any Block Descriptors and this field will be set to zero. If the DBD field was set to zero, the VLS will return a single Block Descriptor, and this field will be set to eight.

ADIC strongly recommends that host software always check this value in order to determine the correct offset to the Mode pages.

5.7.1.2 Block Descriptors

A Block Descriptor consists of an eight-byte block that contains the following data.

Bit / Byte	7	6	5	4	3	2	1	0
0	Density Code (0)							
1 : 3	(MSB) Number of Blocks (0)							(LSB)
4	Reserved (0)							
5 : 7	(MSB) Block Length (0)							(LSB)

Block Descriptor Fields

The Density Code field is reserved for all media-changer devices and will be set to zero. All other fields are considered as reserved by the VLS and will be set to zero.

5.7.2 Mode Pages

The VLS is capable of returning several types of Mode pages. These pages are described in the sections that follow.

5.7.2.1 Element Address Assignment Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv (0)	Page Code (1Dh)					
1	Page Length (12h)							
2 : 3	(MSB) First Medium Transport Element Address (0) (LSB)							
4 : 5	(MSB) Number of Medium Transport Elements (1) (LSB)							
6 : 7	(MSB) First Storage Element Address (LSB)							
8 : 9	(MSB) Number of Storage Elements (LSB)							
10 : 11	(MSB) First Import/Export Element Address (1) (LSB)							
12 : 13	(MSB) Number of Import/Export Elements (1) (LSB)							
14 : 15	(MSB) First Data Transfer Element Address (2) (LSB)							
16 : 17	(MSB) Number of Data Transfer Elements (LSB)							
18 : 19	(MSB) Reserved (0) (LSB)							

Element Address Assignment Page

The Element Address Assignment page is used to report the addresses assigned to the elements of the VLS. This page also reports the number of each type of element that is present.

> ### *Note*
>
> Since the VLS family varies widely in the number of magazine storage slots available, and since most VLS models can be user-configured for either one or two media drives, ADIC strongly recommends that host software examine the Element Address Assignment page in order to determine the addresses and numbers of the available Storage and Data Transfer Elements.

A PS bit of one indicates that a target is capable of saving the page in a non-volatile vendor-specific location. Because the VLS does not support saving of the Element Address Assignment page, the PS bit value will be zero.

The First Medium Transport Element Address field identifies the address of the first Medium Transport element contained the VLS.

The Number of Medium Transport Elements field defines the total number of Medium Transport elements contained in the VLS.

The First Storage Element Address field identifies the first medium Storage Element defined in the VLS.

The Number of Storage Elements field defines the total number of medium Storage Elements contained in the VLS. This number represents the number of slots in the magazine.

The First Import/Export Element Address field identifies the first medium portal that is accessible by both the medium transport devices and also by an operator from outside the medium changer. The VLS assigns this field a value of 01h.

The Number of Import/Export Elements field contains the total number of Import/Export elements contained in the VLS.

The First Data Transfer Element Address field identifies the first Data Transfer element contained in the VLS.

The Number of Data Transfer Elements field defines the total number of Data Transfer elements for which the VLS is currently configured.

5.7.2.2 Device Capabilities Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv (0)	Page Code (1Fh)					
1	Page Length (0Eh)							
2	Reserved (0)				StorDT (1)	StorIE (0)	StorST (1)	StorMT (0)
3	Reserved (0)							
4	Reserved (0)				MT→DT (0)	MT→IE (1)	MT→ST (0)	MT→MT (0)
5	Reserved (0)				ST→DT (1)	ST→IE (0)	ST→ST (0)	ST→MT (0)
6	Reserved (0)				IE→DT (0)	IE→IE (0)	IE→ST (0)	IE→MT (1)
7	Reserved (0)				DT→DT (0)	DT→IE (0)	DT→ST (1)	DT→MT (0)
8 : 11	(MSB) Reserved (0) (LSB)							
12	Reserved (0)				MT↔DT (0)	MT↔IE (0)	MT↔ST (0)	MT↔MT (0)
13	Reserved (0)				ST↔DT (0)	ST↔IE (0)	ST↔ST (0)	ST↔MT (0)
14	Reserved (0)				IE↔DT (0)	IE↔IE (0)	IE↔ST (0)	IE↔MT (0)
15	Reserved (0)				DT↔DT (0)	DT↔IE (0)	DT↔ST (0)	DT↔MT (0)

Device Capabilities Page

The Device Capabilities page defines characteristics of the element types on the VLS. This information may be used by the host to determine functions permitted by the MOVE MEDIUM and EXCHANGE MEDIUM commands.

A PS bit of one indicates that a target is capable of saving the page in a non-volatile vendor-specific location. Because the VLS does not support saving of the Device Capabilities page, the PS bit value will be zero.

In the field names on this page, the following element type abbreviations are used:

  MT - a Medium Transport element

  ST - a Storage element

  IE - an Import/Export element

  DT - a Data Transfer element

In the descriptions, *XX* and *YY* are any of the above element type abbreviations.

A Stor*XX* bit value of one indicates that the elements of type *XX* may provide independent storage for a unit of media. A value of zero indicates that elements of type *XX* provide virtual sources or destinations, that the location of the unit of media is provided by an element of some other type. The value of StorST is one by the definition of that element type. The VLS provides independent storage of media only for Storage and Data Transfer elements. Consequently, only the StorDT and StorST bit values will contain a one.

An *XX→YY* bit value of one indicates that the medium-changer device supports MOVE MEDIUM commands where the source address is of element type *XX* and the destination address is of element type *YY*.

An *XX→YY* value of zero indicates that these MOVE MEDIUM commands will be rejected with ILLEGAL REQUEST.

The VLS supports MOVE MEDIUM commands only for the source/destination combinations defined below:

> IE→MT - Load Magazine
>
> MT→IE - Unload Magazine
>
> ST→DT - Load Medium
>
> DT→ST - Unload Medium

An *XX↔YY* bit value of one indicates that the medium-changer device supports EXCHANGE MEDIUM commands where the source address is of element type *XX*, the first destination address is of type *YY*, and the second destination address is of the same element type as the source element.

An *XX↔YY* bit value of zero indicates that these EXCHANGE MEDIUM commands will be rejected with ILLEGAL REQUEST.

Since the VLS does not support the EXCHANGE MEDIUM command, these bits will be zero for all of the element type combinations.

5.7.2.3 LCD Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv (0)	Page Code (22h)					
1	Page Length (52h)							
2	Reserved (0)				DspLn 1	DspLn 2	Rsv (0)	Rsv (0)
3	Reserved (0)							
4 : 43	(MSB) LCD Line 1 User Text (LSB)							
44 : 83	(MSB) LCD Line 2 User Text (LSB)							

LCD Page

The LCD page provides information about text the host may be displaying on the VLS' front-panel LCD.

A PS bit of one indicates that a target is capable of saving the page in a non-volatile vendor-specific location. Because the VLS supports saving of the LCD page, the PS bit value will be one.

The DspLn 1 field indicates the source for the text displayed on the first line of the front-panel LCD. A value of 0 indicates that the LCD is displaying text provided by the VLS' firmware. A value of 1 indicates that the LCD will display the text in the LCD Line 1 User Text field when in the On-Line mode.

The DspLn 2 field indicates the source for the text displayed on the second line of the front-panel LCD. A value of 0 indicates that the LCD is displaying text provided by the VLS' firmware. A value of 1 indicates that the LCD will display the text in the LCD Line 2 User Text field when in the On-Line mode.

The LCD Line 1 User Text field contains the text which will be displayed on the first line of the front-panel LCD if the DispLn 1 field is set to 1.

The LCD Line 2 User Text field contains the text which will be displayed on the second line of the front-panel LCD if the DispLn 2 field is set to 1.

5.7.2.4 Vendor-specific Page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv (0)	Page Code (00h)					
1	Page Length (2Ah)							
2 : 33	(MSB) Copyright (LSB)							
34 : 41	(MSB) Firmware Build Date (LSB)							
42 : 43	(MSB) Checksum (LSB)							

Vendor-specific Mode Page

The Vendor-specific page provides vendor-specified information in a vendor-specified format and is implemented to provide compatibility with the SCSI-1 MODE SENSE command.

The Copyright field contains 32 bytes of left-justified, space padded ASCII data displaying the firmware copyright notice.

The Firmware Build Date field contains 8 bytes of ASCII data in the form "*mm/dd/yy*" where *mm/dd/yy* is the date the operating firmware was compiled.

The Checksum field contains the 16-bit checksum value for the operating firmware.

5.8　MOVE MEDIUM (A5h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	LUN (0)			Reserved (0)				
2 : 3	(MSB) Medium Transport Element Address (0) (LSB)							
4 : 5	(MSB) Source Element Address (LSB)							
6 : 7	(MSB) Destination Element Address (LSB)							
8	Reserved (0)							
9	Reserved (0)							
10	Reserved (0)							Inv (0)
11	Control (0)							

MOVE MEDIUM Command

The MOVE MEDIUM command requests that the VLS move a unit of medium from a source element to a destination element.

The Transport Element Address field specifies the Medium Transport element that is to be used in executing this command. The default Medium Transport element address of zero should be used. If a non-zero address is specified, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS and return CHECK CONDITION status.

The source address and the destination address may represent a Storage element, an Import/Export element, a Data Transfer element or a Medium Transport element. If the address specified has not been assigned to a specific element of the VLS or the source/destination element type combination is not supported, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS and return CHECK CONDITION status.

The VLS supports MOVE MEDIUM commands only for the source/destination combinations defined below:

　　　　IE→MT - Load Magazine

　　　　MT→IE - Unload Magazine

　　　　ST→DT - Load Medium

　　　　DT→ST - Unload Medium

If this command is received and the source element status is EMPTY with the EXCEPTION bit cleared, or the destination element status is FULL with the EXCEPTION bit cleared, the VLS will set the Sense

Key to ILLEGAL REQUEST, set the Additional Sense to either SOURCE ELEMENT EMPTY or DESTINATION ELEMENT FULL, and return CHECK CONDITION status.

> ### *Note*
>
> If the element status for an element has the EXCEPTION bit set, the VLS will not check for EMPTY or FULL status, but will simply assume the element is in the correct state for the requested operation. Therefore, the host software should first check the source and destination elements' status and, if an EXCEPTION bit is set, perform any appropriate inquiries and/or initializations prior to performing a MOVE MEDIUM operation.

An Invert bit (Inv) of one specifies that the medium should be inverted or rotated prior to depositing the medium into the destination element. The VLS does not support medium rotation.

If an Unload Medium operation (DT→ST) is requested, and the destination address is for a Storage element other than the magazine slot currently aligned with the gripper arm, or the source address is for a Data Transfer element other than the drive currently aligned with the gripper arm, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS, and return CHECK CONDITION status.

> ### *Note*
>
> Because the VLS' robotics controller has no communications access to the media drive, the host must have previously commanded the drive to eject its media. Once the media has been ejected and is sticking out of the drive, a MOVE MEDIUM command to the VLS will place the cassette into the magazine storage slot; however, the desired drive and/or magazine slot should be positioned before commanding the drive to eject its medium. Positioning may be accomplished by sending an ALIGN ELEMENTS command or one or more POSITION TO ELEMENT commands to the VLS.

5.9 POSITION TO ELEMENT (2Bh)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	LUN (0)			Reserved (0)				
2 : 3	(MSB) Medium Transport Element Address (0) (LSB)							
4 : 5	(MSB) Destination Element Address (LSB)							
6	Reserved (0)							
7	Reserved (0)							
8	Reserved (0)							Inv (0)
9	Control (0)							

Position to Element Command

The POSITION TO ELEMENT command is used to align either a magazine slot or medium drive with the VLS' gripper arm.

The Transport Element Address field specifies the Medium Transport element that is to be used in executing this command. The default Medium Transport element address of zero should be used. If a non-zero address is specified, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS, and return CHECK CONDITION status.

The Destination Element Address field may specify either a Storage element or a Data Transfer element. If the destination address represents a Storage element which is FULL and the Data Transfer element currently aligned with the gripper arm is also FULL, or the destination address represents a Data Transfer element which is FULL and the Storage element currently aligned with the gripper arm is also FULL, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID ELEMENT ADDRESS, and return CHECK CONDITION status.

Note

If the element status for an element has the EXCEPTION bit set, the VLS will not check for EMPTY or FULL status, but will simply assume the element is in the correct state for the requested operation.

An Invert bit (Inv) value of one requests that the transport element be inverted or rotated before positioning in front of the destination element. The VLS does not support media rotation and the Invert bit must, consequently, contain a value of zero.

Because the VLS' robotics controller has no communications access to the media drive, the host must have previously commanded the drive to eject its media. Once the media has been ejected and is sticking out of the drive, a MOVE MEDIUM command to the VLS will place the cassette into the magazine storage slot; however, the desired drive and/or magazine slot should be positioned <u>before</u> commanding the drive to eject its medium. Positioning may be accomplished by sending an ALIGN ELEMENTS command or one or more POSITION TO ELEMENT commands to the VLS.

5.10   PREVENT/ALLOW MEDIUM REMOVAL (1Eh)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Eh)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							Prv (0)
5	Control (0)							

PREVENT/ALLOW MEDIUM REMOVAL Command

The PREVENT/ALLOW MEDIUM REMOVAL command requests that the VLS enable or disable the removal of the media magazine from the VLS (Unload Magazine operation).

The Prv field indicates whether a PREVENT or ALLOW operation is being issued. A value of one in the Prv field indicates that the VLS should prevent magazine removal while a value of zero indicates that magazine removal should be allowed.

5.11 READ BUFFER (3Ch)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	LUN (0)		Reserved (0)			Mode		
2	Buffer ID							
3 : 5	(MSB) Buffer Offset (0) (LSB)							
6 : 8	(MSB) Allocation Length (LSB)							
9	Control (0)							

READ BUFFER Command

The READ BUFFER command is used in conjunction with the WRITE BUFFER command to read and write specific areas of the VLS' EEPROM.

The function of this command and the meaning of the other fields within this CDB depend on the contents of the Mode field. The possible values for the Mode field are as follows:

Mode	Description
1h	Reserved
2h	Data
3h	Descriptor
4h - 7h	Reserved

READ BUFFER Modes

The Buffer Offset field is considered as reserved by the VLS in all modes.

5.11.1 Data Mode

In this mode, the VLS returns buffer data to the host. The Buffer ID field identifies the specific buffer from which to return data. The buffers are defined as follows as follows:

Buffer ID	Length	Description
0h	24	INQUIRY Vendor and Product fields
1h	4	INQUIRY Version field
2h	≤ 21	INQUIRY Vendor Specific field 1 (length preceded)
3h	≤ 65	INQUIRY Vendor Specific field 2 (length preceded)
4h	≤ 41	OEM Serial Number (length preceded)

READ BUFFER Buffer IDs

For buffers 2, 3, and 4, the first byte of data returned is the length of the remaining valid data in the buffer.

5.11.2 Descriptor Mode

In this mode, a four-byte Buffer Descriptor is returned. The Buffer ID field identifies the buffer whose Descriptor is to be returned. The Buffer Descriptor is defined as follows:

Bit Byte	7	6	5	4	3	2	1	0
0	Offset Boundary (0)							
1 : 3	(MSB)			Buffer Capacity				(LSB)

Buffer Descriptor

The Offset Boundary field defines the byte-alignment for the buffer. The VLS only supports byte-alignment, so this value will be zero.

The Buffer Capacity field returns the size of the buffer in bytes. Please note that for buffers 2, 3, and 4, this is the <u>maximum</u> capacity of the buffer, including the length byte. The READ BUFFER command must be used in the Data mode in order to obtain the length of valid data for these buffers.

5.12　READ ELEMENT STATUS (B8h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	LUN (0)			Rsv (0)	Element Type Code			
2 : 3	(MSB) Starting Element Address (LSB)							
4 : 5	(MSB) Number of Elements (LSB)							
6	Reserved (0)							
7 : 9	(MSB) Allocation Length (LSB)							
10	Reserved (0)							
11	Control (0)							

READ ELEMENT STATUS Command

The READ ELEMENT STATUS command requests the VLS to return the status tables of its elements to the initiator.

The Element Type Code field specifies the particular element type(s) selected for reporting by this command. A value of zero specifies that status for all element types should be reported. The element type codes are defined as follows:

Code	Description
0h	All element types (valid in CDB only)
1h	Medium Transport Element
2h	Storage Element
3h	Import/Export Element
4h	Data Transfer Element
5h-Fh	Reserved

Element Type Codes

The Starting Element Address field specifies the minimum element address to report. Only elements with an element type code permitted by the Element Type Code specification and an element address greater than or equal to the Starting Element Address will be reported.

The Number of Elements field specifies the maximum number of Element Descriptors to be returned by the VLS for this command. The value specified by this field is not the range of element addresses to be considered for reporting but rather the number of defined elements to report.

The Allocation Length field specifies the maximum number of bytes of data to return. If the Allocation Length is not sufficient to transfer all of the Element Descriptors, the VLS will transfer all those descriptors that can be <u>completely</u> transferred, and this will not be considered an error.

5.12.1 READ ELEMENT STATUS Data

The data returned by the READ ELEMENT STATUS command will consist of an eight-byte Element Status Data header followed by one to four Element Status pages. Each status page consists of an eight-byte Element Status Page Header followed by one or more Element Descriptors.

A sample configuration of the full Element Status Data is shown below. Note that there is only one Status Data Header. There are up to four Element Status pages which each include only one Element Status Page Header and any number of Element Descriptors.

Element Status Data Header
MT Element Status Page Header
MT Element Descriptor
IE Element Status Page Header
IE Element Descriptor
DT Element Status Page Header
DT #0 Element Descriptor
DT #1 Element Descriptor
ST Element Status Page Header
ST #0 Element Descriptor
...
ST #*n* Element Descriptor

Full Element Status Data Structure

5.12.1.1 Element Status Data Header

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB) First Element Address Reported							(LSB)
2 : 3	(MSB) Number of Elements Reported							(LSB)
4	Reserved (0)							
5 : 7	(MSB) Byte Count of Report Available							(LSB)

Element Status Data Header

The First Element Address Reported field indicates the element address of the element with the smallest element address found to meet the command request.

The Number of Elements field indicates the number of elements meeting the request in the command. The status for all these elements is returned only if sufficient allocation length was specified.

The Byte Count of Report Available indicates the number of bytes of element status page data <u>available</u> for all elements meeting the request in the command. This value shall not be truncated to match the allocation length.

5.12.2 Element Status Pages

Each Element Status page consists of an eight-byte Element Status Page Header followed by one or more twelve-byte Element Descriptors.

The element status page header includes the Element Type Code of the elements being reported, the length of each descriptor block and the total number of bytes of Element Descriptor information which follow the header for this element type.

Each Element Descriptor contains the element address and the element status table for a specific element of the VLS. The exact format of the element status table is dependent upon the element type.

5.12.2.1 Element Status Page Header

Bit Byte	7	6	5	4	3	2	1	0
0	Element Type Code							
1	Pvt (0)	Avt (0)	Reserved (0)					
2 : 3	(MSB) Element Descriptor Length (0Ch) 							(LSB)
4	Reserved (0)							
5 : 7	(MSB) Byte Count of Descriptor Data Available 							(LSB)

Element Status Page Header

The Element Type Code field indicates the element type reported by this Element Status page.

The Element Descriptor Length field indicates the number of bytes in each Element Descriptor.

The Byte Count of Descriptor Data Available field indicates the total number of bytes of Element Descriptor data available for elements of this element type meeting the request in the command. This value shall not be truncated to match the allocation length.

5.12.2.2 Medium Transport Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB) Element Address 							(LSB)
2	Reserved (0)					Exc	Rsv (0)	Full
3	Reserved (0)							
4	Additional Sense Code (0)							
5	Additional Sense Code Qualifier (0)							
6 : 8	(MSB) Reserved (0) 							(LSB)
9	SVal (0)	Inv (0)	Reserved (0)					
10 : 11	(MSB) Source Storage Element Address (0) 							(LSB)

Medium Transport Element Descriptor

The Element Address field gives the address of the VLS' Medium Transport element.

An Exception (Exc) bit of one indicates the element is in an abnormal state (EXCEPTION state), and the settings of the other status fields may not accurately the element's true status. An Exception bit of zero indicates the element is in a normal state, and the settings of the other status fields may be used to determine the element's current status.

> ### *Note*
>
> The occurrence of an EXCEPTION state for an element does not imply that the VLS cannot process motion commands for that element. It simply means that the true status of that element is unknown. If the changer receives a motion command that affects an element in an EXCEPTION state, the changer will assume the element is in the correct state for that command and will attempt to determine the true status of the element in carrying out the command. If the EXCEPTION bit is not set, the changer will rely on the other status flags within the status tables in accepting and carrying out or rejecting the motion command received. In this manner, the host can choose to attempt corrective operations or allow the changer to make these attempts itself.
>
> When the door of the VLS is opened, it is possible that the user is moving media or mechanisms within the unit, bypassing the VLS' robotics mechanisms; consequently, the VLS will place <u>all</u> elements in an EXCEPTION state.

A Full bit value of one indicates that the VLS has successfully completed mapping the media magazine by testing for the presence of a unit of medium in each magazine storage slot (i.e. the magazine is considered to be in the *loaded* state). A value of zero indicates that the magazine has been moved to the position for removal from or insertion into the VLS (i.e. the magazine is in the *unloaded* state).

The Additional Sense Code and Additional Sense Code Qualifier fields may provide specific information on an abnormal element state. The values in these fields are as defined for the Additional Sense Code and Additional Sense Code Qualifier of the REQUEST SENSE data.

A Source Valid (SVal) bit value of one indicates that the data in the Source Storage Element Address field is valid. A value of zero indicates that the value in this field is not valid.

An Invert (Inv) bit value of one indicates that the media in the Medium Transport element was inverted by a MOVE MEDIUM or EXCHANGE MEDIUM command since it was last in a Storage element. Since the VLS does not support medium rotation, this value will be zero.

The Source Storage Element Address field provides the address of the last Storage element from which a unit of media was moved into the Medium Transport element. This field is valid only if the SValid bit is one.

Since the VLS does not support movement of media between the Medium Transport element and any Storage element, both the Source Valid and Source Storage Element Address fields will be zero.

5.12.2.3 Storage Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)			Element Address				(LSB)
2	Reserved (0)				Acc	Exc	Rsv (0)	Full
3	Reserved (0)							
4	Additional Sense Code (0)							
5	Additional Sense Code Qualifier (0)							
6 : 8	(MSB)			Reserved (0)				(LSB)
9	SVal (0)	Inv (0)	Reserved (0)					
10 : 11	(MSB)			Source Storage Element Address (0)				(LSB)

Storage Element Descriptor

An Access bit (Acc) value of one indicates access to the element by a medium transport element is allowed. An Access bit of zero indicates access to the element by the medium transport element is denied.

The Source Storage Element Address field provides the address of the last storage element this unit of media was moved from. This element address value may or may not be the same as this element. This field is valid only if the Source Valid bit is one.

Since the VLS does not support the direct movement of media between Storage elements, both the Source Valid and Source Storage Element Address fields will be zero.

5.12.2.4 Import/Export Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)			Element Address				(LSB)
2	Reserved (0)		ImEnab (1)	ExEnab (1)	Acc	Exc	ImpExp	Full
3	Reserved (0)							
4	Additional Sense Code (0)							
5	Additional Sense Code Qualifier (0)							
6 : 8	(MSB)			Reserved (0)				(LSB)
9	SVal (0)	Inv (0)	Reserved (0)					
10 : 11	(MSB)		Source Storage Element Address (0)					(LSB)

Import/Export Element Descriptor

An Import Enable (ImEn) bit of one indicates that this Import/Export element supports movement of media into the scope of the medium changer device. An ImEn bit of zero indicates that this element does not support import actions.

An Export Enable (ExEn) bit of one indicates that this Import/Export element supports movement of media out of the scope of the medium changer device. An ExEn bit of zero indicates that this element does not support export actions.

An Access (Acc) bit of one indicates that access to the Import/Export element by a Medium Transport element is allowed. An access bit of zero indicates access to the Import/Export element by Medium Transport elements is denied.

An Import/Export (ImpExp) bit of one indicates the media magazine in the Import/Export element was placed there by an operator. An ImpExp bit of zero indicates the media magazine in the Import/Export element was placed there by the VLS robotics.

5.12.2.5 Data Transfer Element Descriptor

Bit Byte	7	6	5	4	3	2	1	0
0 : 1	(MSB)			Element Address				(LSB)
2	Reserved (0)				Acc	Exc	Rsv (0)	Full
3	Reserved (0)							
4	Additional Sense Code (0)							
5	Additional Sense Code Qualifier (0)							
6	NBus (0)	Rsv (0)	IDVal (1)	LUNVal (0)	Rsv (0)	LUN (0)		
7	SCSI Bus Address							
8	Reserved (0)							
9	SVal	Inv (0)	Reserved (0)					
10 : 11	(MSB)			Source Storage Element Address				(LSB)

Data Transfer Element Descriptor

An Access (Acc) bit value of one indicates access to the Data Transfer element by the Medium Transport element is allowed. A value of zero indicates access to the Data Transfer element by a Medium Transport element is denied.

A Not This Bus (NBus) bit value of one indicates that the SCSI Bus Address and LUN values are not valid for the same SCSI bus used to communicate with the VLS. A Not This Bus bit value of zero indicates that the SCSI Address and LUN values, if valid, are on the same SCSI bus as the VLS.

An ID Valid (IDVal) bit value of one indicates that the SCSI Bus Address field contains valid information.

An LUN Valid (LUNVal) bit value of one indicates that the LUN field contains valid information.

The LUN field, if valid, provides the logical unit number within the SCSI bus device of the medium drive served by the VLS at this element address. This field is valid only if the LUN Valid bit is one.

The SCSI Bus Address field, if valid, provides the SCSI address (binary representation) of the medium drive served by the VLS at this element address. This field is valid only if the ID Valid bit is one.

The Source Storage Element Address field provides the address of the last storage element this unit of media was moved from. This field is valid only if the Source Valid bit is one.

5.13 RELEASE (17h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

RELEASE Command

The RELEASE command is used to release previously reserved units. It is not an error for a host to attempt to release a reservation that is not currently active. In this case, the VLS shall return GOOD status without altering any other reservations.

This command will cause the VLS to terminate a unit reservation that is active from the host to the specified logical unit.

5.14   REQUEST SENSE (03h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

REQUEST SENSE Command

The REQUEST SENSE command requests that the VLS transfer sense data to the host.

The VLS will be capable of returning nineteen bytes of data in response to a REQUEST SENSE command. If the allocation length is eighteen or greater, the VLS will return nineteen bytes of data. If the allocation length is less than eighteen, the data transfer size will equal the allocation length. The additional sense length field of the sense data will not be adjusted to reflect truncation if the allocation length is less than the sense data available.

5.14.1 Standard Sense Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Val (0)	Error Code (70h)						
1	Segment Number (0)							
2	FM (0)	EOM (0)	ILI (0)	Rsv (0)	Sense Key			
3 : 6	(MSB) Information (0) (LSB)							
7	Additional Sense Length							
8 : 11	(MSB) Command-specific Information (0) (LSB)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code							
15 : 17	SKSV (0)	(MSB) Sense Key Specific (0) (LSB)						
18	Door	GripCl	DrvVal	Arm	DrvB	Beam	DrvA	Mag
19	Reserved (0)						KbdMd	Lock
20	Menu	Alt	Up	Right	Enter	Esc	Down	Left
21	Magazine Position							

Standard Sense Data

The Segment Number, Information, Command-specific Information, Sense Key Specific Valid (SKSV), and Sense Key Specific fields are not supported by the VLS and will contain zeros.

The FM, EOM, and ILI fields are reserved for all medium changer devices and will be zero.

The Sense Key field contains information about the current status of the most recent operations. This field may contain any of the values as follows:

Sense Key	Definition
00h	NO SENSE
02h	NOT READY
04h	HARDWARE ERROR
05h	ILLEGAL REQUEST
06h	UNIT ATTENTION
07h	DATA PROTECT
0Bh	ABORTED COMMAND

Sense Keys

The Additional Sense Length field will contain a value representing the amount of data available in the sense data following the Additional Sense Length field.

The Additional Sense Code and Additional Sense Code Qualifier fields will contain information relevant to the status of the unit. These two fields together are frequently referred to as the Additional Sense. The possible values for these fields are as follows:

ASC	ASCQ	Definition
00	00	No Additional Sense
04	01	Becoming Ready
04	03	Manual Intervention Required
06	00	No Reference Position Found
06	80	Drive Door Open*
06	81	Drive Door Open/Close Time-out*
06	82	Drive Door Blocked*
15	01	Mechanical Positioning Error
1A	00	Parameter List Length Error
20	00	Invalid Command Code
21	01	Invalid Element Address
24	00	Invalid CDB Field
25	00	Logical Unit Not Supported
26	00	Invalid Field In Parameter List
28	01	Import/Export Element Accessed
29	00	POR or BDR Occurred
3A	00	Media Not Present
3A	00	Drive Not Ready*
3B	0D	Destination Element Full
3B	0E	Source Element Empty
3D	00	Invalid Bits in Identify Message
48	00	Initiator Detected Error Received
53	00	Media Load/Eject Failure
53	02	Removal Prevented
5A	00	Operator Request or State Change Input (Unspecified)

Additional Sense Values

* VLS DLT model only.

The Door bit indicates the current status of the VLS' door. A value of one in this field represents a door open condition while a zero indicates the door is closed.

The Gripper Closed Flag (GripCl) indicates the current status of the media gripper. When this bit is one, it indicates that the gripper is closed or in the process of closing; when it is zero, it indicates that the gripper is open or in the process of opening.

The Drive Alignment Data Valid (DrvVal) bit indicates the current status of the two Drive Aligned bits. When this bit is one, it indicates that the drives are not in the process of changing position and the information provided in the DrvA and DrvB bits is valid; when DrvVal is zero, it indicates that the drives are in the process of changing position and the information in the DrvA and DrvB bits is <u>not</u> valid.

The Arm bit indicates the current status of the VLS' gripper arm sensor. A value of one in this field indicates that the sensor is blocked, implying that the arm is currently in the maximum out position.

The Drive B Aligned (DrvB) bit, along with the Drive Alignment Data Valid bit, indicates the current position status of drive B. When this bit is zero and the DrvVal bit is one, it indicates that drive B is currently aligned with the gripper arm; when both this bit and the DrvVal bit are one, it indicates that drive B is not aligned and its media slot or door is blocked.

The Beam bit represents the status of the sensor beam that monitors the front of the currently positioned medium drive. A value of one in this field represents beam breakage by either a unit of medium or the gripper arm.

The Drive A Aligned (DrvA) bit, along with the Drive Alignment Data Valid bit, indicates the current position status of drive A. When this bit is zero and the DrvVal bit is one, it indicates that drive A is currently aligned with the gripper arm; when both this bit and the DrvVal bit are one, it indicates that drive A is not aligned and its media slot or door is blocked.

The Magazine Positioning Sensor (Mag) bit represents the status of the VLS' media magazine position-reference sensor. A value of one in this field indicates that the sensor is blocked, while a value of zero indicates that the sensor is clear.

The Lock Sensor (Lock) bit represents the status of the VLS' door lock sensor. A value of one in this field indicates that the sensor is clear, indicating that the VLS' door is locked.

The Keyboard Mode (KbdMd) bit represents the operating mode of the front-panel keyboard. A value of zero in this field indicates that the keyboard is in the normal operating mode. A value of one in this field indicates that the keyboard has been manually placed in the Keyboard Pass-through mode and the VLS will not respond to any key presses except MENU (return to normal keyboard operating mode), LEFT (scroll display left), RIGHT (scroll display right), and the ALT+ESC combination (reset VLS).

The Menu, Alt, Up, Right, Enter, Esc, Down, and Left bits indicate the most recent key or keys to be pressed. A value of one in these fields indicates that the corresponding key was pressed. Please note that it is possible to have multiple bits set if multiple keys have been pressed simultaneously (e.g. pressing the ALT and DOWN keys simultaneously would cause both those bits to be set). A value of zero in all the fields indicates that no key has been pressed since the VLS was last powered on or reset via the keyboard.

The Magazine Position field contains the value of the magazine slot currently aligned with the gripper arm. Please note that this value is zero-based (i.e. a value of zero represents slot one, a value of one represents slot two, etc.). A value of FEh indicates that the magazine is in the Import/Export location (i.e. the magazine carrier is positioned for removal or insertion of a magazine). A value of FFh indicates that the magazine position is unknown and will be recalibrated at the next magazine movement operation, or that the magazine is in the process of changing position.

5.15 RESERVE (16h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

RESERVE Command

The RESERVE command is used to reserve units for the use of the host. The RESERVE and RELEASE commands provide the basic mechanism for contention resolution in multiple-host systems.

This command requests that the entire unit be reserved for the exclusive use of the host until the reservation is superseded by another valid RESERVE command from the same host that made the reservation or until released by a RELEASE command from the same host that made the reservation, or by a BUS DEVICE RESET message from any host, by a hard SCSI bus RESET condition, or by a power off/on cycle. A unit reservation will not be granted if the VLS is reserved by another host.

If, after honoring the reservation, any other host then subsequently attempts to perform any command on the VLS other than an INQUIRY command, a REQUEST SENSE command, a RESERVE command, or a RELEASE command (which will be ignored), the command will be rejected with RESERVATION CONFLICT status.

Element reservation is not supported by the VLS.

5.16   REZERO UNIT (01h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

REZERO UNIT Command

The REZERO UNIT command functions identically to the INITIALIZE ELEMENT STATUS command. Refer to section 5.3 for a description of the operation of the REZERO UNIT command.

5.17   SEND DIAGNOSTIC (1Dh)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	LUN (0)			PF (0)	Rsv (0)	SlfT (1)	DOfl (0)	UOfl (0)
2	Reserved (0)							
3 : 4	(MSB) Parameter List Length (0) (LSB)							
5	Control (0)							

SEND DIAGNOSTIC Command

The SEND DIAGNOSTIC command requests the VLS to perform diagnostic operations on itself, on the specified logical unit, or on both. The only mandatory implementation of this command is the self-test feature with the parameter list length of zero.

The VLS only implements the self-test function of the SEND DIAGNOSTIC command. All normal power-on self-test functions will be performed.

5.18   TEST UNIT READY (00h)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

TEST UNIT READY Command

The TEST UNIT READY command provides a means to check if the VLS is ready to accept other commands. This is not a request for a self-test. If the VLS would accept an appropriate medium-access command without returning CHECK CONDITION status, this command will return a GOOD status.

If a TEST UNIT READY command is received while the door is open, the unit will respond with CHECK CONDITION and the sense data will be set to NOT READY, MANUAL INTERVENTION REQUIRED.

5.19   WRITE BUFFER (3Bh)

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	LUN (0)			Reserved (0)		Mode		
2	Buffer ID							
3 : 5	(MSB) Buffer Offset (0) (LSB)							
6 : 8	(MSB) Parameter List Length (LSB)							
9	Control (0)							

WRITE BUFFER Command

The WRITE BUFFER command is used in conjunction with the READ BUFFER command to read and write specific areas of the VLS' EEPROM.

The function of this command and the meaning of the other fields within this CDB depend on the contents of the Mode field. The possible values for the Mode field are as follows:

MODE	DESCRIPTION
1h	Reserved
2h	Data
3h - 4h	Reserved
5h	Download Firmware and Save
6h - 7h	Reserved

WRITE BUFFER Modes

The Buffer Offset field is considered as reserved by the VLS in all modes.

> ***Note***
>
> Starting with version 2.08 of the operating firmware, the user must place the VLS in a special Write EEPROM mode from the front panel before any WRITE BUFFER operations will be permitted. If the VLS is <u>not</u> in the Write EEPROM mode, the VLS will set the Sense Key to DATA PROTECT, set the Additional Sense to LOGICAL UNIT NOT READY, MANUAL INTERVENTION REQUIRED, and return CHECK CONDITION status.

5.19.1 Data Mode

In this mode, the VLS obtains buffer data from the host and writes it to the specified buffer area of the EEPROM. The Buffer ID field identifies the specific buffer to which data is to be written. The buffers are defined as follows:

Buffer ID	LENGTH	DESCRIPTION
0h	24	INQUIRY Vendor and Product fields
1h	4	INQUIRY Version field
2h	≤ 21	INQUIRY Vendor Specific field 1 (length preceded)
3h	≤ 65	INQUIRY Vendor Specific field 2 (length preceded)
4h	≤ 41	OEM Serial Number (length preceded)

WRITE BUFFER Buffer IDs

For buffers 2, 3, and 4, the first byte of data written is the length of the remaining valid data to be written to the buffer.

5.19.2 Download Firmware and Save Mode

In this mode, the VLS starts writing data starting at the lowest address of the EEPROM and continues until the number of bytes specified in the Allocation Length field have been transferred. In this mode, the Buffer ID field is reserved. Please note that if the Allocation Length is larger that 64,512 (00FC00h) bytes, the VLS will set the Sense Key to ILLEGAL REQUEST, set the Additional Sense to INVALID FIELD IN CDB, and return CHECK CONDITION status.

> **Note**
>
> The firmware download is actually performed by the boot ROM.
> Control of the VLS is returned to the boot ROM for the duration of the
> download; the operating firmware does not resume control until after
> the VLS successfully resets itself upon completion of the download.

Please refer to the section on downloading new firmware for more information on this mode.

6.   Boot ROM SCSI Command Implementation

This section briefly describes the SCSI command specification of the VLS' boot ROM. Please refer to the appropriate command description in section 5 for descriptions of the fields in each command.

6.1   INQUIRY (12h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN			Reserved (0)				EVPD
2	Page Code							
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

INQUIRY Command

6.1.1 Standard Inquiry Data

Bit Byte	7	6	5	4	3	2	1	0
0	Periph. Qual. (0)			Peripheral Device Type (08h)				
1	RMB (1)	Device Type Modifier (0)						
2	ISO Version (0)		ECMA Version (0)			ANSI Version (2)		
3	AENC (0)	TrmIOP (0)	Reserved (0)		Response Data Format (2)			
4	Additional Length (n-4)							
5	Reserved (0)							
6	Reserved (0)							
7	RelAdr (0)	W32 (0)	W16 (0)	Sync (0)	Linked (0)	Rsv (0)	Que (0)	SftRe (0)
8 : 15	(MSB) Vendor Identification ("ADIC ") (LSB)							
16 : 31	(MSB) Product Identification ("VLS Boot ") (LSB)							
32 : 35	(MSB) Product Revision Level (LSB)							

Standard Inquiry Data

6.1.2 Vital Product Data

Page Code	Description
00h	Supported Vital Product Data Pages Page
C0h	Firmware Revision Page
E0h	Implemented SCSI-2 Commands Page
E1h	Implemented Vendor-specific Commands Page

Vital Product Data Pages

6.1.3 Firmware Revision Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (C0h)							
2	Reserved (0)							
3	Page Length (3Eh)							
4 : 25	(MSB) Revision (LSB)							
26 : 44	(MSB) Build Date (LSB)							
45 : 58	(MSB) Checksum (LSB)							

Firmware Revision Page

6.1.4 Implemented SCSI-2 Commands Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (E0h)							
2	Reserved (0)							
3	Page Length (09h)							
4	TEST UNIT READY Operation Code (00h)							
5	REQUEST SENSE Operation Code (03h)							
6	INQUIRY Operation Code (12h)							
7	RESERVE Operation Code (16h)							
8	RELEASE Operation Code (17h)							
9	MODE SENSE Operation Code (1Ah)							
10	SEND DIAGNOSTIC Operation Code (1Dh)							
11	WRITE BUFFER Operation Code (3Bh)							
12	READ BUFFER Operation Code (3Ch)							

Implemented SCSI-2 Commands Page

6.1.5 Implemented Vendor-specific Commands Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (E1h)							
2	Reserved (0)							
3	Page Length (00h)							

Implemented Vendor-specific Commands Page

6.1.6 Supported Vital Product Data Pages Page

Bit Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier (0)			Peripheral Device Type (08h)				
1	Page Code (00h)							
2	Reserved (0)							
3	Page Length (04h)							
4	Supported Vital Product Data Pages Page Code (00h)							
5	Firmware Revision Page Code (C0h)							
6	Implemented SCSI-2 Commands Page Code (E0h)							
7	Implemented Vendor-specific Commands Page Code (E1h)							

Supported Vital Product Data Pages Page

6.2 MODE SENSE (1Ah)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	LUN (0)			Rsv (0)	DBD	Reserved (0)		
2	PC		Page Code					
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

MODE SENSE Command

6.2.1 Page Code Usage

Page Code	Description
00h	Vendor-specific Page
3Fh	All Supported Pages

Page Code Usage

6.2.2 Vendor-specific Page

Bit Byte	7	6	5	4	3	2	1	0
0	PS (0)	Rsv (0)	Page Code (00h)					
1	Page Length (2Ah)							
2 : 33	(MSB)			Copyright				(LSB)
34 : 41	(MSB)			Firmware Build Date				(LSB)
42 : 43	(MSB)			Checksum				(LSB)

Vendor-specific Mode Page

6.3   READ BUFFER (3Ch)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Ch)							
1	LUN (0)			Reserved (0)		Mode		
2	Buffer ID							
3 : 5	(MSB)			Buffer Offset (0)				(LSB)
6 : 8	(MSB)			Allocation Length				(LSB)
9	Control (0)							

READ BUFFER Command

6.3.1 READ BUFFER Modes

Mode	Description
1h	Reserved
2h	Reserved
3h	Reserved
4h - 7h	Reserved

READ BUFFER Modes

6.4   REQUEST SENSE (03h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Allocation Length							
5	Control (0)							

REQUEST SENSE Command

6.4.1   Standard Sense Data Format

Bit Byte	7	6	5	4	3	2	1	0
0	Val (0)	Error Code (70h)						
1	Segment Number (0)							
2	FM (0)	EOM (0)	ILI (0)	Rsv (0)	Sense Key			
3 : 6	(MSB)	Information (0)						(LSB)
7	Additional Sense Length							
8 : 11	(MSB)	Command-specific Information (0)						(LSB)
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code							
15 : 17	SKSV (0)	(MSB) Sense Key Specific (0)						(LSB)

Standard Sense Data

6.4.2   Sense Keys

Sense Key	Definition
00h	NO SENSE
02h	NOT READY
04h	HARDWARE ERROR
05h	ILLEGAL REQUEST
06h	UNIT ATTENTION
0Bh	ABORTED COMMAND

Sense Keys

6.4.3 Additional Sense Values

ASC	ASCQ	Definition
00	00	No Additional Sense
20	00	Invalid Command Code
24	00	Invalid CDB Field
25	00	Logical Unit Not Supported
29	00	POR or BDR Occurred
3D	00	Invalid Bits in Identify Message
48	00	Initiator Detected Error Received

Additional Sense Values

6.5 RESERVE (16h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (16h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

RESERVE Command

6.6 SEND DIAGNOSTIC (1Dh)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	LUN (0)			PF (0)	Rsv (0)	SlfT (1)	DOfl (0)	UOfl (0)
2	Reserved (0)							
3 : 4	(MSB) Parameter List Length (0) (LSB)							
5	Control (0)							

SEND DIAGNOSTIC Command

6.7 TEST UNIT READY (00h)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	LUN (0)			Reserved (0)				
2	Reserved (0)							
3	Reserved (0)							
4	Reserved (0)							
5	Control (0)							

TEST UNIT READY Command

6.8 WRITE BUFFER (3Bh)

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (3Bh)							
1	LUN (0)			Reserved (0)			Mode	
2	Buffer ID							
3 : 5	(MSB) Buffer Offset (LSB)							
6 : 8	(MSB) Parameter List Length (LSB)							
9	Control (0)							

WRITE BUFFER Command

6.8.1 WRITE BUFFER Modes

MODE	DESCRIPTION
1h	Reserved
2h	Reserved
3h - 4h	Reserved
5h	Download Firmware and Save
6h - 7h	Reserved

WRITE BUFFER Modes

7.   VLS SCSI Sense Codes

This section lists the Sense Key plus Additional Sense Code/Additional Sense Code Qualifier combinations that are supported by the VLS, and also describes the conditions under which they will be generated. In the following descriptions, SK is the Sense Key value found at byte offset 2 in the sense data returned by the Request Sense command, while ASC is the Additional Sense Code and Additional Sense Code Qualifier values found at byte offsets 12 and 13.

SK=00h, ASC/ASCQ=00h, 00h
(No Sense - No Additional Sense)

> The previous command completed successfully; no sense information is available.

SK=02h, ASC/ASCQ=04h, 01h
(Not Ready - In Process of Becoming Ready)

> The VLS is in the process of initializing.

SK=02h, ASC/ASCQ=04h, 03h
(Not Ready - Logical Unit Not Ready, Manual Intervention Required)

> The front door was open when the SCSI command was received.

SK=02h, ASC/ASCQ=3Ah, 00h
(Not Ready - Medium Not Present)

> The cassette beam sensor was not interrupted when an unload cassette operation was requested (the drive did not fully eject the cassette).

SK=04h, ASC/ASCQ=06h, 00h
(Hardware Error - No Reference Position Found)

> The gripper arm or magazine failed to interrupt its respective sensor beam while attempting to calibrate its position during a load magazine, unload magazine, recalibrate, position, load cassette, or unload cassette operation.

SK=04h, ASC/ASCQ=06h, 81h
(Hardware Error - Drive Door Open)

> The drive door was open when the VLS started to perform, or was performing a magazine move. This will occur only on VLS DLT models.

SK=04h, ASC/ASCQ=06h, 82h
(Hardware Error - Drive Door Open/Close Time-out)

> The drive door did not open or close within a specified time-out period. This will occur only on VLS DLT models.

SK=04h, ASC/ASCQ=06h, 83h
(Hardware Error - Drive Door Blocked)

> The cartridge sensor was blocked when a close door command was received. This will occur only on VLS DLT models.

SK=04h, ASC/ASCQ=15h, 01h
(Hardware Error - Mechanical Positioning Error)

> The cassette beam sensor remained blocked during an unload cassette operation, the cassette beam sensor was interrupted during the magazine movement portion of a load magazine, unload

magazine, recalibrate, position, or load cassette operation, the gripper arm position sensor was unexpectedly blocked during a load magazine, unload magazine, recalibrate, load cassette, or unload cassette operation, or the magazine position sensor remained blocked while trying to calibrate its position during a load magazine or recalibrate operation.

SK=04h, ASC/ASCQ=53h, 00h (VLS DLT only)
(Hardware Error - Drive not logically unloaded)

The OK to Operate Handle'was not set when move media from drive command was received. This will occur only on VLS DLT models.

SK=04h, ASC/ASCQ=53h, 00h
(Hardware Error - Media Load or Eject Failed)

The cassette beam sensor was continuously interrupted during a load cassette operation (the drive did not initiate a mechanical load of the cassette).

SK=05h, ASC/ASCQ=1Ah, 00h
(Illegal Request - Parameter List Length Error)

The value in the Parameter List Length field of the MODE SELECT command caused the truncation of the Parameter List header, a Block Descriptor, or a Mode Page.

SK=05h, ASC/ASCQ=20h, 00h
(Illegal Request - Invalid Command Operation Code)

The operation code in the CDB is not supported by the VLS.

SK=05h, ASC/ASCQ=21h, 01h
(Illegal Request - Invalid Element Address)

An element address field in the CDB contains a value larger than the total number of elements supported, the MT element address field is non-zero in a Move Medium or Position To Element CDB, the destination element type is not ST in a Position To Element CDB, or the source/destination element type pairing is not supported in a Move Medium CDB.

SK=05h, ASC/ASCQ=24h, 00h
(Illegal Request - Invalid Field in CDB)

A reserved field in the CDB contained a non-zero value, or a CDB field contains an illegal or unsupported parameter value.

SK=05h, ASC/ASCQ=25h, 00h
(Illegal Request - Logical Unit Not Supported)

The LUN field in the CDB or Identify message contained a non-zero value.

SK=05h, ASC/ASCQ=26h, 00h
(Illegal Request - Invalid Field In Parameter List)

A reserved field contained a non-zero value or a non-changeable field contained a value other than the reported current one in the Parameter List data of the MODE SELECT command.

SK=05h, ASC/ASCQ=3Bh, 0Dh
(Illegal Request - Medium Destination Element Full)

An unload magazine was requested while the magazine is unloaded (IE element status=FULL and IE EXCEPT bit is cleared), a load magazine was requested while the magazine is loaded (MT element status=FULL and MT EXCEPT bit is cleared), a position operation to a non-empty slot was requested with the drive full (STn element status=FULL and DT element status=FULL), or a load cassette or unload cassette was requested with the destination element full (DT element status=FULL or STn element status=FULL, respectively).

SK=05h, ASC/ASCQ=3Bh, 0Eh
(Illegal Request - Medium Source Element Empty)

> An unload magazine was requested while the magazine is unloaded (MT element status=EMPTY and MT EXCEPT bit is cleared), a load magazine was requested while the magazine is loaded (IE element status=EMPTY and IE EXCEPT bit cleared), a position operation or cassette load or unload was requested with the magazine unloaded (MT element status=EMPTY), or a load cassette or unload cassette was requested with the source element empty (STn element status=EMPTY or DT element status=EMPTY, respectively).

SK=05h, ASC/ASCQ=3Dh, 00h
(Illegal Request - Invalid Bits in Identify Message)

> A reserved bit in an Identify message was set.

SK=05h, ASC/ASCQ=53h, 02h
(Illegal Request - Medium Removal Prevented)

> An unload magazine operation was requested with the drive full (DT element status=FULL).

SK=05h, ASC/ASCQ=5Ah, 00h
(Illegal Request - Operator Request Or State Change Input)

> A command other than INQUIRY, READ BUFFER, RELEASE, REQUEST SENSE, RESERVE, TEST UNIT READY, or WRITE BUFFER was received while the VLS was in Write EEPROM mode.

SK=06h, ASC/ASCQ=28h, 01h
(Unit Attention - Import or Export Element Accessed)

> The front door was opened and then closed again before the SCSI command was received.

SK=06h, ASC/ASCQ=29h, 00h
(Unit Attention - Power On, Reset, or Bus Device Reset Occurred)

> A power-on reset or SCSI bus reset occurred, or a Bus Device Reset message was received.

SK=07h, ASC/ASCQ=04h, 03h
(Data Protect - Logical Unit Not Ready, Manual Intervention Required)

> A WRITE BUFFER command was received when the VLS was <u>not</u> in Write EEPROM mode.

SK=0Bh, ASC/ASCQ=04h, 03h
(Aborted Command - Logical Unit Not Ready, Manual Intervention Required)

> The front door was opened during the execution of a load magazine, unload magazine, recalibrate, position, load cassette, or unload cassette operation, or an incorrectly oriented cassette was detected during a load magazine operation.

SK=0Bh, ASC/ASCQ=48h, 00h
(Aborted Command - Initiator Detected Error Message Received)

> Current CDB was not processed because an Initiator Detected Error message was received by the VLS.

8.0   ADIC Media Changer Software Programming Notes

This section provides some guidelines and suggestions for the programmer writing software to support any of the ADIC media changers.

8.1   SCSI Addresses

The ADIC 4mm DAT Autochanger (1200 Series) normally automatically assigns its own SCSI bus address at an offset of three from the address assigned to the tape drive by the rotary switch in the rear of the unit. For example, if the tape drive SCSI address switch is set to 3, the Autochanger would configure itself to respond at SCSI address 6. However, newer revisions of the Autochanger have added the capability to individually configure the SCSI addresses of the tape drive and the Autochanger via a second rotary switch. This addressing scheme is called "split addressing" and is the normal mode of operation for the VLS family of media changers.

Consequently, it is not always possible for the software to determine the SCSI address of the media changer simply by identifying the SCSI address of a media drive, nor can the SCSI address of a media drive used in the media changer be reliably inferred from the SCSI address of the media changer. However, ADIC media changers do always know the SCSI addresses of any installed media drives, and makes this information available in the SCSI Bus Address field of the Data Transfer Element Descriptor of the READ ELEMENT STATUS command. Therefore, it is recommended that the software examine this field in order to determine the SCSI addresses of any media drives installed in the media changer. The following is a pseudo-code example for determining the SCSI addresses of all media changers and their associated media drives on a single SCSI channel.

```
FOR each valid SCSI address
    Send INQUIRY command
    IF device == ADIC Autochanger
        This changer address = SCSI address
        Send MODE SENSE command, page code = Element Address Assignment page,
            Number of media drives = value from number of data transfer elements field,
            First DT element address = value from first DT element address field

        Send READ ELEMENT STATUS command, element type code = DT, starting
            element address = first DT element address, number of elements = number of
            media drives
        FOR each DT element address
            IF IDVal == 1
                Media drive SCSI ID for this changer = value from SCSI bus address field
            END (IF IDVal == 1)
        END (FOR each DT element address)

    END (IF device == ADIC Autochanger)
END (FOR each valid SCSI address)
```

8.2 MODE SENSE and Block Descriptors

Versions of the ADIC 4mm DAT Autochanger firmware prior to v3.51 did not provide any block descriptors in the data returned in response to a MODE SENSE command. In order to provide compatibility with certain driver software, versions 3.51 and later, and all firmware versions for the ADIC VLS family, will return a single block descriptor, unless overridden by the Disable Block Descriptors bit in the MODE SENSE CDB, as described in the section on the MODE SENSE command.

Due to the differences in firmware behavior described above, and also because of vendor implementation differences permitted under both the SCSI-1 and SCSI-2 specifications, ADIC strongly recommends that software should <u>always</u> use the value in the Block Descriptor Length field of the returned Mode Parameter Header in order to determine the correct offset to any returned Mode Pages or vendor-specific information for <u>any</u> SCSI device which supports the MODE SENSE command. Please refer to the appropriate sections of both the SCSI-1 and SCSI-2 specifications for further information on Block Descriptors and the MODE SENSE command.

8.3 Element Addresses

The ADIC VLS family consists of standard SCSI-2 media changers supporting a wide range of removable media types. The number of media slots supported depends upon the media type. Also, for each media type, media changers are available in single-drive only, upgradable single-drive, and dual-drive models.

ADIC strongly recommends that the software examine the Element Address Assignment page of the MODE SENSE command in order to determine the number and addresses of the Storage elements and Data Transfer elements supported by a particular media changer.

8.4 Element Status Hierarchy

ADIC media changers support two basic forms of logical media movement operations: magazine load or unload (IE→MT or MT→IE), and medium load or unload (ST→DT or DT→ST). Since individual units of media are moved to or from slots within a removable magazine, the status of those media changer elements relating to the magazine (the IE and MT elements) takes precedence over the status of those elements relating to individual media units (the ST and DT elements). For example, if the status of the IE element is FULL or the status of the MT element is EMPTY, the media changer will assume that the source element is EMPTY for a medium load or unload operation, even if the status of the source element is FULL.

Similarly, since an EXCEPTION status indicates that the element is in an abnormal state, this status takes precedence over a FULL or EMPTY status for an element. For error-recovery purposes, any element which has an EXCEPTION status will not have its FULL or EMPTY status checked when performing a load, unload, or position operation.

The software should treat an EXCEPTION status for an element as an error condition for that element, and should not rely on the element's FULL or EMPTY status. Furthermore, the software should treat an EXCEPTION status for the IE or MT elements as an error condition for all ST and DT elements as well, regardless of whether or not an individual ST or DT element also has an EXCEPTION status.

8.5 Drive Logical-Load Failure

Some media drives (usually tape drives) will occasionally accept a media cartridge from the media changer during a Load Medium operation, and then, at some later point in time, determine that the media cartridge is not usable, and eject it. This is referred to as a "logical-load failure." Since the drive had

accepted the media cartridge and held it for some period of time before ejecting it again, the ADIC media changer considers the Load Medium operation to have been successful and cannot distinguish the ejection of the media cartridge due to a logical-load failure from an ejection of the media cartridge due to normal operation of the drive. However, in many cases the drive will never have reported any change in state when queried by the software (typically using the TEST UNIT READY command). Since the media changer reports that it successfully performed the Load Medium operation, but the drive never even reports that any medium was present, error detection and implementation of subsequent corrective procedures or user notification becomes difficult, if not impossible, if the software only queries either the media changer or the drive.

Fortunately, by querying both the drive and the ADIC media changer, it is possible for the software to detect the logical-load error condition. After the media changer has reported successful completion of a Load Medium operation, a logical-load failure exists if the following two conditions are true:

a) The Medium Sensor Beam is blocked (as indicated by the BM bit returned in response to a REQUEST SENSE command sent to the ADIC media changer).

b) The drive had not reported a READY status prior to the sensor beam blockage (as indicated by the status returned in response to a TEST UNIT READY command sent to the drive).

Please refer to the section on the REQUEST SENSE command for further information on obtaining the status of the Medium Sensor Beam.

The following is a pseudo-code example illustrating the recommended sequence of events for loading a unit of media from a magazine slot into the drive.

```
IF desired DT == EMPTY and desired ST == FULL
    SCSI address = Autochanger SCSI address
    Send MOVE MEDIUM command, source = desired ST address, destination = desired DT
        address
    IF MOVE MEDIUM == successful
        WHILE not timed-out
            SCSI address = media drive SCSI address
            Send TEST UNIT READY command
            IF TEST UNIT READY == ready
                Drive status = Load OK
                BREAK (WHILE not timed-out loop)
            ELSE
                SCSI address = Autochanger SCSI address
                Send REQUEST SENSE command
                IF BM bit == 1
                    Drive status = Logical Load Failure
                    BREAK (WHILE not timed-out loop)
                END (IF BM bit == 1)
            END (IF TEST UNIT READY == ready)
        END (WHILE not timed-out)
        Drive status = Load Time-Out
    END (IF MOVE MEDIUM == successful)
END (IF desired DT == EMPTY and desired ST == FULL)
```

8.6　　　Media Changer Unload Medium Operation

Since ADIC media changers cannot control when a LOAD/UNLOAD command is sent to a media drive, and since it is also not possible for the media changer to position either the magazine or the drive once the Medium Sensor Beam is blocked, restrictions are placed on the MOVE MEDIUM, POSITION TO ELEMENT, and ALIGN ELEMENTS commands when the associated drive contains media; this is done in order to reduce the possibility of the media changer attempting to move media from the drive into a magazine slot which is already full. Please refer to the sections on these commands for further information on these restrictions.

The software should use either the POSITION TO ELEMENT or ALIGN ELEMENTS command <u>prior</u> to requesting that the drive eject its media and subsequently requesting the media changer to perform an Unload Medium operation. The software may use the READ ELEMENT STATUS command in order to determine whether or not a DT or ST element contains media.

The following is a pseudo-code example illustrating the recommended sequence of events for ejecting a unit of media from the drive and moving it to a magazine slot.

```
IF desired DT == FULL and desired ST == EMPTY
    SCSI address = Autochanger SCSI address
    Send ALIGN ELEMENTS command, DT address = desired DT address, ST address =
        desired ST address
    IF ALIGN ELEMENTS == successful
        SCSI address = media drive SCSI address
        Send LOAD/UNLOAD command, mode = unload (or equivalent command,
            depending upon device type and vendor implementation)
        IF LOAD/UNLOAD == successful
            SCSI address = Autochanger SCSI address
            Send MOVE MEDIUM command, source = desired DT address, destination =
                desired ST address
        END (IF LOAD/UNLOAD successful)
    END (IF ALIGN ELEMENTS successful)
END (IF desired DT == FULL and desired ST == EMPTY)
```

In the preceding pseudo-code example, the ALIGN ELEMENTS command can be replaced with two invocations of the POSITION TO ELEMENT command; once to position the magazine, if necessary, and the second time to position the drive, if necessary. Please note, however, that in this instance ADIC strongly recommends that the magazine be positioned <u>first</u> to avoid possible mechanical jamming in the event that a media drive has already ejected its medium.