SCSI Library Commands For the Cartridge Stacker Loader (CSL)

The following SCSI Medium Changer commands for the Cartridge Stacker Loader, CSL use the same target number as the ECHO tape drive. But unlike SCSI commands to the ECHO tape drive a LUN number of 1 or 4 is accepted. The commands that commumicate with the Cartridge Stacker Loader (CSL) are Test Unit Ready, Request Sense, Reserve, Release, Inquiry, Mode select, Mode Sense, Move Medium and Read Element Status. The Cartridge Stacker Loader, CSL must be in the "Random" mode to support the the Move Medium and Read Element Status commands.

For new development the recommended commands are the Move Medium command for moving cartridges to and from magazine slots and drive(s), and the Mode Sense command using page 0x20 to get the "FULL/EMPTY" status of the magazine slots and drives.

For compatability with other drives a LUN of 0 is accepted for the Read Element Status and the Move Medium command.

The Position Loader, Select Cartridge, and Load Display SCSI commands for the Cartridge Stacker Loader, CSL use the same target number as the ECHO tape drive. These commands are described in section 9. As in SCSI commands to the ECHO tape drive a LUN number of 0 is required. The System Position and Load is used to emulate the STK-4280 POSITION LOADER command. The System Position and Load as well as the System Position Auto Load are used to emulate the Fujitsu M1016, M1017, and M2483 SELECT CARTRIDGE command. Automatic mode is for use of a CSL without using any SCSI host commands. Manual mode is used to make the CSL act like it is not there.

MODES of OPERATION

The Cartridge Stacker Loader, CSL has 5 modes of operation. The operator can choose any mode of operation through the front panel or through the Mode Select command. The default mode is AUTOMATIC.

The modes of operation are Automatic, System Position and Load, System Position Auto Load, Random and Manual. The modes are described below:

 (00)AUTOMATIC - Cartridges that are put into the magazine are automatically fed into the drive one after the other until the entire magazine is processed. Note this mode is for hosts that do not support either System mode. The operator must press the operator panel "LOAD" once to start the automatic process.

(01)AUTOMATIC CYCLE - Cartridges that are put into the magazine are automatically fed into the drive   one after the other.   After the entire magazine is processed this "cycle" is repeated. Note this mode is for hosts that do not support either System mode. The operator must press the operator panel "LOAD" once to start the automatic process.

(02)SYSTEM POSITION AND LOAD - Cartridges that are put into the magazine are fed to the drive under the host/initiator commands. The load command is done though the SCSI LOAD command, or the SCSI LOAD DISPLAY command with the MntCtl bit set to a one.

(03)SYSTEM POSITION AUTO LOAD - Cartridges that are put into the magazine are fed to the drive under the host/initiator commands. The load is automatically done after the Select Cartridge command is verified.

(04)MANUAL - Cartridges are fed to the drive loader individually by the operator. The SCSI command LOAD, LOAD DISPLAY with the MntCtl bit set, POSITION LOADER, and SELECT CARTRIDGE commands are considered illegal requests when the drive is in MANUAL mode.

8.00 TEST UNIT READY

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	LUN=1,4			0				
2	0							
3	0							
4	0							
5	Control Byte						Flag	Link

Table 6-xx: Test Unit Ready Command

The TEST UNIT READY commnad, with the LUN number 1 or 4, provides a means to check if the CSL is ready. If the CSL is ready, has at least one cartridge inserted into the magazine and the scan of the magazine by the CSL on power-up is complete the controller returns GOOD status.

NOTE, a TEST UNIT READY commnad with a LUN number of 0, returns ready if there is a cartridge loaded in the drive and the drive would accept a meduim-access commnad such as a READ without returning CHECK CONDITION.

8.10 INQURIY command 0x12h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	LUN=4			0				
2	0							
3	0							
4	Allocation length							
5	Control Byte						Flag	Link

Table 8.11 INQUIRY COMMAND

Bit Byte	7	6	5	4	3	2	1	0
0		0			8=Changer Device			
1	1		0					
2	0			0			2	
3	0	0	0	0		2		
4	Additional Length (n-4)							
5	0							
6	0							
7	0	0	1	1	0	0	0	0
8-15	8 bytes for Vendor Identification *							
16-31	16 bytes for Device Identifcation*							
32-35	4 bytes for Product Revision							

Table 8.12 INQUIRY Data Format

8.20 RESERVE/RELEASE COMMAND

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (17h/16H)							
1	LUN=1,4			3rdP	3RD Party ID			0
2	0							
3	0							
4	0							
5	Control Byte						Flag	Link

Table 8.21 Reserve/Release Command

The Reserve Unit and Release Unit READY commnad, with the LUN number 1 or 4, provides a means to reseve and relase the CSL. The commands work the same as the Reserve and Release for the Echo Tape Drive.

8.30 REQUEST SENSE Command 03h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	LUN=0,1,4			0				
2	0							
3	0							
4	Allocation length							
5	Control Byte						Flag	Link

Table 8.30 Request Sense Command

The REQUEST SENSE command with a LUN of 1 or 4 is indentical as a request sense with a LUN of 0.

8.40 *MOVE MEDIUM command 0xA5h*

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0xA5h)							
1	LUN=4 or 0			0				
2	0							
3	0							
4	0							
5	Source Address							
6	0							
7	Destination Address							
8	0							
9	0							
10	0							
11	Control Byte						Flag	Link

Table 8.41 Move Medium command

The MOVE MEDIUM command requests that the ECHO CSL move a cartridge from the source address to the destination address.

The first position in the tape magazine is 1 and the last position is 10. The drive is position 0xE (14). The second drive in a two drive CSL system is 0xF (15).

The MOVE MEDIUM command is accepted with a LUN of 0,1, or 4.

8.50 READ ELEMENT STATUS command 0xB8h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (0xB8h)							
1	LUN=4			Element type (0,1,2 or 4)				
2	0							
3	Starting Element Address (0-0xF)							
4	0							
5	Number of Elements (0-0xD)							
6	0							
7	0							
8	0							
9	Allocation Length (0-0xFF)							
10	0							
11	Control Byte						Flag	Link

Table 8.51: Read Element Status command

The READ ELEMENT STATUS command is used to obtain the status of all the internal elements (magazine slots and drives) for the Medium Changer command.

The Element Type Code:

0=All emement types reported

1=Meduim Trasnport Element (Elevator assembly) The Medium Transport Element is used only for movement of media between the Data Transfer Element (drive) and the Storage Element (magazine slot).

2= Storage Element (magazine slot) are the logical positions in the magazine.

3= Import/Export Element (Priority Cell) not supported

4 = Data Transfer Element (drive)

The READ ELEMENT STATUS first returns a summary of all the Element status data. The 8 bytes of Element status data is shown in Table x-xx.

After the Element status data, a Element status page of 8 bytes is sent before each 12 byte element descriptor.

If all the available data is requested, the ECHO returns 8 bytes of Element status data, followed by a element status page of 8 bytes for the storage elements, followed by 10 (10 magazine slots) times 12 bytes (120 bytes) of magazine slot (storage element) descriptions. This is then followed by another 8 bytes for the data transfer element (drive) status data, followed by either 12 bytes of drive descriptions for a single drive CSL or 12 times 2 (24) bytes for a dual drive CSL.

Code	Description
0	All element types reported (elevator, slots, drive(s))
1	Meduim transport element (elevator assembly)
2h	Storage Element (magazine slot)
4h	Data Transfer Element (drive)

Table 8.52: Element types

	7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	**0**							
1	**First Element Address Reported (1-0xA, 0xE, 0xF)**							
2	**0**							
3	**Number of Elements to be Reported (0 to 12)**							
4	**0**							
5	**0**							
6	**0**							
7	**(# of Elements Reported * 12) + (# Element status pages * 8)**							
8	**# Element status page(s) (0, 1, or 2)**							

Table 8.53: Element status data

Bit / Byte	7	6	5	4	3	2	1	0
0	Element Type Code (1, 2 or 4)							
1	0							
2	0							
3	Element Descriptor Length (12)							
4	0							
5	0							
6	0							
7	(# of Elements Descriptors * 12)							
8	# of Element Descriptors							

Table 8.54.   Element Status page

Bit Byte	7	6	5	4	3	2	1	0
0	0							
1	Element Address 1,2,...0xA							
2					Access	Except	0	Full
3	0							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	0							
7	0							
8	0							
9	0							
10	0							
11	0							

Table 8.55:   Storage Element description (magazine slot)

An access bit value of 1 indicates access to the magazine slot (storage element) is allowed. An access bit of zero indicates access to the magazine slot is denied.

An Exception bit of 0 indicates the element is in a normal state. If one, the abnormal state may be available in the addition sense code and addition sense code qualifies bytes.

A Full bit of 1 indicates the magazine slot contains a cartridge. A full bit of zero indicates the magazine slot does not contain a cartridge.

Bit Byte	7	6	5	4	3	2	1	0
0	0							
1	0							
2	0				0	0	0	0
3	0							
4	0							
5	0							
6	0							
7	0							
8	0							
9	0							
10	0							
11	0							

Table 8.56 Medium transport (elevator assembly)

Bit Byte	7	6	5	4	3	2	1	0
0	**0**							
1	**Element Address 0xE or 0xF**							
2	**0**				**1**	**0**	**0**	**Full**
3	0							
4	0							
5	0							
6	0							
7	0							
8	0							
9	0							
10	0							
11	0							

Table 8.56 Data transfer element descriptor (drive)

A Full bit of 1 indicates the drive contains a cartridge. A full bit of zero indicates the drive does not contain a cartridge.

8.60 MODE SELECT command 0x15h

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	LUN=0,1,4			PF	0			SP
2	0							
3	0							
4	Parameter List Length							
5	Control Byte						Flag	Link

Table 8.61 MODE SELECT Command

The Mode Select command is used to specify specific device parameters and options. Mode Select data consits of a header, and optionally, one or more pages of mode select data.

PF (Page Format)

0=SCSI-1 type mode select data

1=SCSI-2 type page formatted mode select data

SP (Save Parameters)

0-Mode slect data changed, but nost saved in Nonvolatile memory

1=Mode select data changed and saved in Nonvolatile memory

Bit Byte	7	6	5	4	3	2	1	0
0	0							
1	0							
2	0							
3	0							

8.62 Mode Select parameter header

8.70 MODE SENSE command 0x1Ah

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1A)							
1	LUN=0,1,4			0	DBD	0		
2	PC		Page Code					
3	0							
4	Allocation Length							
5	Control Byte						Flag	Link

Table 8.71 MODE SENSE Command

PC Field Bits

00 - Report Current Values

01- Report Changeable Values

10- Report Default Values (default and saved values are the same)

11-Report Saved Values (default and saved values are the same)

The mode sense command has the same page data as the Mode Select Command.

Bit Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code (0x20)					
1	Additional Length (0x0A)							
2	0				Mode Code			
3	P8	P7	P6	P5	P4	P3	P2	P1
4							P10	P9
5	Magazine Position							
6								
7-11								

8.73 Page Code 0x20 - device unique parameters

The mode is the mode of the ACL.

00 = AUTOMATIC

01 = AUTOMATIC CYCLE

02= SYSTEM POSITION AND LOAD

03= SYSTEM POSITION AND AUTO LOAD

04=MANUAL

The Cartridge Map is used to indicate which position in the magazine contains a cartridge. A one indicates a cartridge is present.

The Magazine position is the location of the next cartridge to be loaded.

Bit Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code (0x1D)					
1	**Additional Length (0x12)**							
2-3	Medium Transport Element Address (0x0000)							
4-5	Number of Medium Transport Elements (0x0001)							
6-7	First Storage Element Address (0x0001)							
8-9	Number of Storage Elements (0x000A)							
10-11	First Import/Export Elements (0x000)							
12-13	Number of Import/Export Elements (0x000)							
14-15	First Data Transfer Elements (0x0001/2)							
16-17	Number of Data Transfer Elements (0x0001/2)							
18-19	Reserved (0x0000)							

8.75 ACL page code 1D, element address assignments

Bit Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code (0x1E)					
1	Additional Length (0x02)							
2	0							
3	0							

8. 66 ACL page code 1E, element address assignments

Bit Byte	7	6	5	4	3	2	1	0
0	PS	0	Page Code (0x1F)					
1	Additional Length (0x0E)							
2	0				1	0	1	0
3	0							
4	0				0	0	0	0
5	0				1	0	1	0
6	0				0	0	0	0
7	0				1	0	1	0
8-11	0							
12	0				0	0	0	0
13	0				0	0	0	0
14	0				0	0	0	0
15	0				0	0	0	0

8.77 ACL page code 1D, element address assignments

BYTE 2 = STORAGE FIELD

    3 Store in Data Transfer (DT or drive)   = 1 (yes)

    2 Store in Import/Export   (I/E or priority cell)   = 0 (no)

    1 Store in Storage Element (ST or magazine slot)   =1 (yes)

    0 Store in Medium Transport (EL or elevator assembly)   = 0 (no)

BYTE 4 = Move from EL (elevator assembly) to DT,I/E, ST, and EL

    3 Can move from EL (elevator) to DT (drive)   = 0 (no)

    2 Can move from EL (elevator) to I/E (priority cell)   = 0 (no)

    1 Can move from EL (elevator) to ST(magazine slot) = 0 (no)

    0 Can move from EL (elevator) to EL (elevator)   = 0 (no)

BYTE 5 = Move from ST (magazine slot) to DT,I/E, ST, and EL

    3 Can move from ST (magazine slot) to DT (drive)   = 1 (yes)

    2 Can move from ST (magazine slot) to I/E (priority cell)   = 0 (no)

    1 Can move from ST (magazine slot) to ST(magazine slot) = 1 (yes)

    0 Can move from ST (magazine slot) to EL (elevator) = 0 (no)

BYTE 6 = Move from I/E (priority cell) to DT,I/E, ST, and EL

    3 Can move from I/E (priority cell) to DT (drive)   = 0 (no)

    2 Can move from I/E (priority cell) to I/E (priority cell)   = 0 (no)

    1 Can move from I/E (priority cell) to ST(magazine slot)   = 0 (no)

    0 Can move from I/E (priority cell) to EL (elevator) = 0 (no)

BYTE 7 = Move from DT (drive) to DT,I/E, ST, and EL

    3 Can move from DT (drive) to DT (drive)   = 1 (yes)

    2 Can move from DT (drive) to I/E (priority cell)   = 0 (no)

    1 Can move from DT (drive) to ST(magazine slot) = 1 (yes)

    0 Can move from DT (drive) to EL (elevator)   = 0 (no)

BYTE 12 = Move from EL (elevator assembly) to DT,I/E, ST, and EL

    3 Can exchange from EL (elevator) to DT (drive)   = 0 (no)

    2 Can exchange from EL (elevator) to I/E (priority cell)   = 0 (no)

    1 Can exchange from EL (elevator) to ST(magazine slot)   = 0 (no)

    0 Can exchange from EL (elevator) to EL (elevator)   = 0 (no)

BYTE 13 = Exchange from ST (magazine slot) to DT,I/E, ST, and EL

    3 Can exchange from ST (magazine slot) to DT (drive)   = 0 (no)

    2 Can exchange from ST (magazine slot) to I/E (priority cell) = 0 (no)

    1 Can exchange from ST (magazine slot) to ST(magazine slot) = 0 (no)

    0 Can exchange from ST (magazine slot) to EL (elevator)   = 0 (no)

BYTE 14 = Exchange from I/E (priority cell) to DT,I/E, ST, and EL

    3 Can exchange from I/E (priority cell) to DT (drive) = 0 (no)

    2 Can exchange from I/E (priority cell) to I/E (priority cell)= 0 (no)

    1 Can exchange from I/E (priority cell) to ST(magazine slot) = 0 (no)

    0 Can exchange from I/E (priority cell) to EL (elevator)   = 0 (no)

BYTE 15 = Exchange from DT (drive) to DT,I/E, ST, and EL

    3 Can exchange from DT (drive) to DT (drive)   = 0 (no)

    2 Can exchange from DT (drive) to I/E (priority cell) = 0 (no)

    1 Can exchange from DT (drive) to ST(magazine slot)   = 0 (no)

    0 Can exchange from DT (drive) to EL (elevator)   = 0 (no)

9.00 OTHER SCSI COMMANDS FOR THE CSL

9.10 POSITION LOADER COMMAND

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (02h)							
1	LUN							Imm
2	0							
3	0							
4	0					CSL Position #		
5	Control Byte						Flag	Link

Table 9.11: POSITION LOADER Command

If an automatic cartridge loader is present, the POSITION LOADER Command will select (save) the CSL location for the next load command. If a tape was loaded in the drive when this command is issued the tape will be unloaded to the last position loader location. The new location will be stored and after a SCSI LOAD command is issued, the tape will be loaded from the CSL position number stored from this command.

The first position in the tape magazine is 1 and the last position is 10.

The automatic cartridge loader must be in System Position and Load mode. System Position and Load mode is selected by the front panel.

9.20 SELECT CARTRIDGE Command DBh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (DBh)							
1	LUN						WAIT	Imm
2	0							
3	0							
4	0							
5	0							
6	0							
7	0							
8	Magazine Position							
9	Control Byte						Flag	Link

Table 9.21 SELECT CARTRIDGE Command

The SELECT CARTRIDGE command causes the magazine position to be remembered and optionally load the cartridge specified in the Magazine Position. If a cartridge was already loaded in the drive, it is unloaded to the last select cartridge command "Magazine Position."

Magazine Positions from 1 to 10 (0xA) are valid.

The SELECT CARTRIDGE command works in System Position and Load or System Position Auto Load mode. If in System Position and Auto Load mode, the selected cartridge is moved to the loading position and loaded. If System Position and Load mode is currently selected from the front panel, the Magazine position is only remembered. The cartridge is loaded after a load command or a LOAD DISPLAY command with the MntCtl bit set to a one.

The WAIT bit is valid in System Position and Load mode only. If :

WAIT = 1 and Imm = 0, command complete occurs after a cartridge is loaded

WAIT = 0 and Imm = 0, command complete occurs after the load is started

WAIT = 0 and Imm = 1, command complete occurs after the CDB is verified

WAIT = 1 and Imm = 1; is an illegal request.

In System Position and Load the WAIT bit equal to 1 causes and illegal request. In System Position and Load mode if the immediate bit is 0 or 1, command complete occurs after the CDB is validated.

9.30 SENSE CARTRIDGE command 0xCAh

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (CAh)							
1	LUN							
2	0							
3	0							
4	0							
5	0							
6	0							
7	0							
8	Transfer length (0x06h)							
9	Control Byte						Flag	Link

Table 9.31: SENSE CARTRIDGE command

The SENSE CARTRIDGE command transfers information on the state of the cartridge stacker loader.

The following data bytes are returned by the Sense Cartridge command:

Bit Byte	7	6	5	4	3	2	1	0
0					Mode Code			
1					Magazine Position			
2					Magazine Size (0x0A)			
3	Special Mode (for expansion)							
4	P8	P7	P6	P5	P4	P3	P2	P1
5							P10	P9

Table 6-xx: POSITION LOADER Command

If Cart Drv0 "cartridge in drive 0" is set to one a cartridge is loaded in tape drive 0.

If Cart Drv1 "cartridge in drive 1" is set to one a cartridge is loaded in tape drive 1. This is the "other" drive in a 2 drive, one CSL system.

The Mode Code is the Automatic, System Position and Load, System Position and Auto Load, or Manual mode of operation selected from the front panel.

00 = No autoloader or Manual Mode or Special Mode (T.B.D.)

01 = Automatic mode

10 - System Position and Load

11 - System Position and Auto Load

The Magazine Position is the last position selected by a SELECT CARTRIDGE or POSITION LOADER command. If only a LOAD from the panel or the SCSI host has occurred, the Magazine Position is the position of the cartridge loaded. If no loads or Position commands have been issued the Magazine Position is 0.

The Magazine Size is 0x0A or 10.

The bits P1-P10 indicates if a cartridge is present within a magazine. A bit value of 1 indicates the presence of a cartridge at the corresponding position in the magazine. A bit vale of 0 indicates the absence of a cartridge.

6.3 LOAD DISPLAY Command

Bit / Byte	7	6	5	4	3	2	1	0
0	Operation Code (0xCF)							
1	LUN			0				
2	0							
3	0							
4	0							
5	0							
6	0							
7	0							
8	Transfer Length (11h)							
9	Control Byte						Flag	Link

Table 6-5: LOAD DISPLAY Command

The Load Display Command is used to allow 16 bytes of text to be displayed on the Operator Control Panel LCD Display. The message will be alternated with the normal ECHO message until a load or unload command is received. The messge will also be deleted if the opreator sets the Echo into the OFFLINE state. The LOAD DISPLAY command transfers 17 bytes of data from the host to the target.

Transfer Length - Must be 17d (l1h).

The 17 bytes of data are formatted as follows:

Bit / Byte	7	6	5	4	3	2	1	0
0	0			0	0	0	0	LOAD
1 - 16	ASCII Message 16 bytes long							

Table 6-6 Load Display Data Format

6.4 LOAD / UNLOAD Command

Bit Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	LUN			0				Immed
2	0							
3	0							
4	0							Load
5	Control Byte						Flag	Link

Table 6-7: LOAD UNLOAD Command

The LOAD/ UNLOAD command requests the cartridge to be loaded or unloaded. Prior to performing the load or unload operation, the target shall ensure that all buffered data, filemarks, and setmarks have been transferred to the medium.

Immed

An immediate bit of zero indicates that the target shall not return status until the load or unload operation has completed. An Immed bit of one indicates that the target shall return status as soon as all buffered commands have completed execution and the command descriptor block of the LOAD UNLOAD command has been validated. If CHECK CONDITION status is returned for a LOAD UNLOAD command with an Immed bit of one, the load or unload operation shall not be performed.

Load

The load bit is enabled only for logical units having a loader option installed. If the load bit is set to one, the cartridge currently positioned in the autoloader shall be loaded and positioned to the beginning-of-tape. The autoloader is positioned from the front panel, or by issuing the POSITION LOADER command.

If the load bit is zero, the cartridge in the logical unit shall be rewound and unloaded. If an autoloader is installed, the logical unit will return the cartridge to the magazine position it originally came from. Following successful completion of an unload operation, the logical unit shall return CHECK CONDITION status with the sense key set to NOT READY for all subsequent medium-access commands until a new volume is mounted or a load operation is successfully completed.

When operating in buffered mode, the target shall discard any unwritten buffered data after the LOAD UNLOAD command is validated if the previous command was terminated with CHECK CONDITION status and the device is unable to continue successfully writing.