

**TL820 Automated Tape Library
for DLT Cartridges**

Software Interface Guide

**EK-TL820-IG
Revision A02**

EK-TL820-IG, Revision A02, February 8, 1995, Made in USA.

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Plug Cap	Parallel blade with ground pin (NEMA 5-15P Configuration)
Cord	Type: SJT, three 16 or 18 AWG wires
Length	Maximum 15 feet
Rating	Minimum 10 A, 125 V

ATTENTION

LIRE LA REMARQUE DANS LE MODE D'EMPLOI

REMARQUE

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Fiche	Broches paralléus avec une broche de mise à la terre (configuration NEMA 5-15P)
Cordon	Type: SJT, trifilaire 16 ou 18 AWG
Longueur	Maximum 15 pieds
Capacité	Minimum 10 A, 125 V

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LASER STATEMENT

CLASS 1 LASER PRODUCT

LASER KLASSE 1

APPAREIL À LASER DE CLASSE 1

PRODUCTO LÁSER DE CLASE 1

LUOKAN 1 LASERLAITE

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Purpose

The TL820 Automated Tape Library brings the benefits of Archival Automation™ to distributed processing and network servers. The TL820 is a 264-cartridge automated tape library subsystem for the DLT tape drives. Subsystems start with a single-drive or dual-drive unit.

An industry standard command protocol combined with either a SCSI II (Small Computer System Interface) or EIA/TIA-574 interface allows existing optical jukebox device drivers to be easily modified for use with the TL820.

This guide is for software developers who are developing application and hierarchical mass storage software which accesses the TL820. This manual describes the SCSI II and EIA/TIA-574 software interfaces, performance issues, and error handling. This manual also contains a list of error codes and possible solutions.

Conventions Used in this Guide

The following conventions are used in this guide:

- All hexadecimal numbers are succeeded by “h”.
- Error or attention conditions are represented in parenthesis, which translate as follows:

where:

SK = hexadecimal Sense Key value

ASC = hexadecimal sense Additional Sense Code

ASCQ = hexadecimal Additional Sense Code Qualifier

A definition of these values can be found in Appendix A.

References

Documentation and contacts

To obtain further information and/or copies of documentation on this product, contact:

U.S. Software Supply Business
Digital Equipment Corporation
10 Cotton Road

Nashua, New Hampshire 03063-1260

The part number of each document will be required at the time of order.

Table 1: TL820
Documentation

Document Number	Document Title	Document Description
EK-TL820-OP	TL820 Operator's Guide	This guide defines the control functions, operational procedures and end user maintenance procedures for the TL820 library.
EK-TL820-PG	TL820 Facilities Planning and Installation Guide	This guide describes facility requirements and installation procedures for the TL820 library.
EK-TL820-SV	TL820 Field Service Manual	This manual contains procedures for field isolation and replacement/repair of faulty components on a TL820 library, as well as instructions and guidelines for periodic maintenance to keep the system running at its best.
EK-TL820-SM	TL820 Diagnostic Software User's Manual	This manual describes how to install and use the TL820 Diagnostic Software Package, developed for field service personnel.

EIA/TIA Standard

The EIA/TIA-574 Standard specification is the American National Standard approved March 26, 1990 and dated September, 1990.

Copies of these documents can be obtained from:

Global Engineering Documents
2805 McGaw
Irvine, CA 92714
(800) 854-7179 or (714) 261-1455

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Introduction

The TL820 is the storage and retrieval component of an automated tape library system. A single TL820 tape library unit houses three DLT2000™ tape drives and has fully functional media changer capability as defined by the SCSI II specification.

The tape library robotics control is directed by the host computer. A serial or SCSI interface control line is used as the standard control interface for the single unit configuration.

The SCSI interface enables the robotics to be driven by the same SCSI bus as the tape drives. The MUC allows the host to control multiple tape library units from one host interface (serial or SCSI). By providing a standard control interface and supporting standard tape drives, the TL820 enables host software developers to adapt their software to drive the TL820.

The TL820 supports a serial EIA/TIA-574 interface (RS-232 for 9-pin connectors) and SCSI II interface. Only one interface is supported per tape library. With either interface, each tape library unit supports a single initiator and I/O operation at a time.

The TL820 has a minimal connection to any installed tape drives. The tape library knows the number of drives installed, but does not know the SCSI addresses for the tape drives. The tape library also does not know if the drives are on the same SCSI bus or not. All of this information is only relevant to the host computer.

Implementation Philosophy

Using the SCSI II standard, the tape library has been designed so that the host can adapt to changes in the tape library configuration. Changes in the number of tape libraries and the number of tape drives can be detected by the host.

The tape library uses the SCSI II medium-changer command set. No attempt is made to add complex commands to the tape library command set. The tape library command set is complete and includes all primitive (elemental) commands required by a host to carry out any required complex operations.

Even though the tape library relies on the host computer to issue a sequence of elemental commands in the correct order to complete complex operations, it has been designed to be forgiving of system integration errors. The tape library monitors the status of all mechanisms and does not execute operations which could result in damage to the tape library or an installed tape drive.

Medium Changer Elements

The medium changer command set accesses the address space for the set of physical locations and mechanisms within the library unit (or of the tape library for Import Export elements). The SCSI II term “element” is used throughout this document to refer to one member of the tape library address space. Each “element” is a discrete physical entity that may hold a cartridge.

The tape library is viewed as one or more library units logically connected by Import Export elements. Each element within a library unit is represented by a unique 16 bit element address. The Import Export element addresses are unique within the entire tape library. Each library unit consists of a combination of the following medium changer elements:

- Medium transport element
- Storage elements
- Data transfer elements
- Import export elements

The Mode Sense command can be issued to determine each library unit’s configuration. The first address and number of elements for each type (medium transport, storage, import export or data transfer) can also be determined using this command.

Medium Transport Element

Each library unit has a transport mechanism. This mechanism consists of the vertical and extension axes and the gripper.

The transport mechanism can hold a single tape cartridge using the gripper, and thus is considered one medium transport element. The transport mechanism is used to move media between other elements within the library unit.

Storage Elements

Each library unit contains 264 storage elements, which correspond to the bins in the tape cartridge carousel. One storage element exists per bin. Issuing a Move Medium command with a source or destination address which has been assigned to a storage element, causes the carousel to automatically rotate as required to access the bin with the transport mechanism.

Import Export Elements

The import export mechanism consists of a passthrough mechanism (PTM) and zero or one inport/outport devices (IOD).

The PTM is a conveyor which moves the cartridge to a registration position when importing or moves the cartridge out of the system when exporting. The PTM is also used to pass cartridges between tape libraries. The PTM has a single element address used by the host to move cartridges to and from the PTM registration position.

The IOD is a single cartridge inport and 12 data cartridge capacity output device. The IOD has one element address for the inport and one element address for the output.

Within the tape library each import export element is uniquely addressed. The 3 most significant bits of the high order byte represents the library unit in which the element physically resides. The low order byte of the address determines the type of import export element as follows:

- 40h left (hinge side) inport
- 41h left (hinge side) output
- 42h PTM
- 43h right (latch side) inport
- 44h right (latch side) output

The Mode Sense Data's start element address and number of elements report the import export configuration for each library unit. For example, a start address of 4040h and number of elements 3 is logical unit 2 with a PTM and a left hand IOD. This is because the upper 3 bits of the address are 010 and there are 3 inport/export elements 4040h, 4041h and 4042h.

Data Transfer Elements

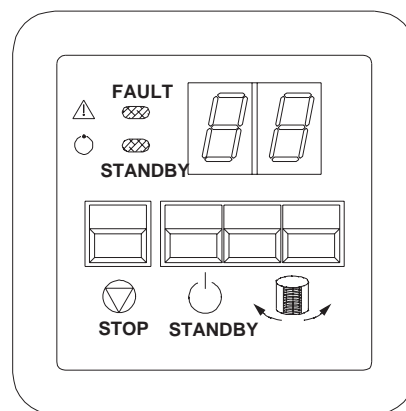
A data transfer element is associated with every tape drive installed in a library unit since each tape drive can store a single tape cartridge. The medium transfer mechanism is able to load or unload tape cartridges into or from each tape drive.

Events

Events are system conditions created by failures or operator actions such as opening the door or pressing the STOP button.

Some of these events appear as states on the control panel. For a list of event states, see Appendix B for more information. The control status panel does not queue these states.

Figure 1: Control Status Panel



Events are recorded in sense data. Depending on the interface, the host can obtain the sense data either in response to a Request Sense command or as an Unsolicited Message

For hosts using the SCSI interface, the tape library does not support asynchronous event notification. This simplifies the host/tape library interface and is acceptable since the events happen infrequently and do not require an immediate host response. The SCSI host can check for library unit events by issuing the Request Sense command to the library unit. The event sense data is transmitted in response to a Request Sense command. A tape library using the SCSI interface queues event conditions for each library unit. The host can repeatedly issue the Request Sense command to obtain each queued condition.

For hosts using the EIA/TIA-574 interface, the tape library transmits an Unsolicited Message when the event occurs (see “Unsolicited Message” on page 3-60). This Unsolicited Message contains the event sense data.

The most significant events are described in the sections that follow.

Power Cycle

When the library unit is powered on it generates a “Power On/Reset Occurred” event (SK=6 ASC=29 ASCQ=00).

Library Unit Offline/Standby

When a library unit is placed into the offline/standby state, it generates a “Logical Unit Standby Button Was Pressed” event (SK=6 ASC=80 ASCQ=09).

Library Unit Online Initialization Failure

When a library unit is placed into the online state and the online initialization fails, the library unit generates an event for the specific error condition which caused the failure. The control panel will indicate which state of the initialization failed, see Appendix B for more information).

Library Unit Door Opened

When the door of a library unit is opened, the library unit disables all actuators and generates a “Door Was Opened” event (SK=6 ASC=80 ASCQ=00).

Library Unit Stopped

When the library unit is stopped by pressing the STOP button on the control panel, the library unit disables all actuators and generates a “System Stop Button Was Pressed” event (SK=6 ASC=80 ASCQ=07).

Cartridge in Inport

When a cartridge is placed in the inport of the IOD and the inport door is closed, the library unit generates an “Import or Export Element Accessed” event (SK=6 ASC=28 ASCQ=01).

Maximum Temperature Exceeded

The library unit monitors the ambient temperature within the system. If the temperature exceeds 91°F there is a possibility for potential damage to the medium, the library unit generates a “Warning Safe Temperature Exceeded” event (SK=6 ASC=88 ASCQ=00) and continues operations. If the temperature exceeds 111°F, the library unit disables all actuators until the temperature decreases, and generates a “Maximum Temperature Exceeded” event (SK=4 ASC=88 ASCQ=01).

Operational Sequences

A description of operational sequences follow. They are listed in order of precedence. For example if the door is opened and the STOP button pressed, the door open sequence will override the system stop sequence until it is complete.

Power-On Sequence

The following actions occur when the tape library is powered on:

- The local controller for each tape library resets and initializes all the tape library hardware.
- The control panel shows “2C” to indicate the unit is powering-on.
- During this time, the tape library responds to the Inquiry, Request Sense, Log Sense, Mode Select and Mode Sense commands. Check Condition is set for all other commands, and the “Logical Unit is Not Ready” condition (SK=2 ASC=04 ASCQ=00) is set in the sense data.
- After the power-on initialization is complete, the tape library generates a “Power On/Reset Occurred” event (SK=6 ASC=29 ASCQ=00).

The system then falls into one of the following sequences depending on the condition of the system.

Door Opened Sequence

Before entering the tape library, take the unit offline. After the offline sequence is complete, press the STOP button and the doors can be opened. When the doors are opened, the tape library is no longer operational to the host. The following actions occur when the door is opened:

- The control panel changes to “2b” to indicate the door is opened.
- The tape library generates a “Door Was Opened” event (SK=6 ASC=80 ASCQ=00).
- If the door is opened without performing the offline sequence, the system halts all tape library motion. Any motion command currently in progress is aborted and Check Condition is returned to host. The “Door is Opened” condition (SK=2 ASC=80 ASCQ=00) is set in the sense data.
- While the door is opened, the tape library responds to the Inquiry, Request Sense, Log Sense, Mode Select and Mode Sense commands. Check Condition is set for all other commands issued during this time, and the “Door is Opened” condition (SK=2 ASC=80 ASCQ=00) is set in the sense data.

System Stopped Sequence

The STOP button allows the operator to stop all power to the actuators. The following actions occur when the system is stopped:

- The control panel changes to “2a” to indicate the system is stopped.
- The library unit generates a “System Stop Button Was Pressed” event (SK=6 ASC=80 ASCQ=07).
- The system halts all library unit motion. Any motion command currently in progress is aborted and Check Condition status is returned to host. The “System is Stopped” condition (SK=2 ASC=80 ASCQ=07) is set in the sense data.
- While the system is stopped, the library unit responds to the Inquiry, Request Sense, Log Sense, Mode Select and Mode Sense commands. Check Condition status is set for all other commands issued during this time, and the “System is Stopped” condition (SK=2 ASC=80 ASCQ=07) is set in the sense data.

Online Initialization Sequence

The STANDBY/ONLINE button allows the library unit to be placed online. The online initialization sequence occurs only after the doors are shut, the system is not stopped and the library unit is placed online (refer to the *TL820 Operator's Guide* to determine how the system is placed online/offline). The following actions occur during the online initialization sequence:

- The control panel changes to “2d” to indicate the unit is performing the online initialization sequence.
- The local controller for the library unit performs a test to check the operation of the library unit mechanisms.
- The mechanisms are then homed.
- During this time, the library unit responds to the Inquiry, Request Sense, Log Sense, Mode Select and Mode Sense commands. Check Condition status is set for all other commands, and the “Logical Unit in Process of Becoming Ready” condition (SK=2 ASC=04 ASCQ=01) is set in the sense data.
- When the mechanisms are tested and homed, the library unit performs an inventory of its elements. See “Library Unit Inventory Sequence” on page 2-11 for more information.
- After the initialization completes successfully, the control panel changes to “00” and the library unit is fully operational. See “Library Unit Online Initialization Failure” on page 2-8 for information on initialization failures.

Library Unit Inventory Sequence

The library unit inventories its storage elements at power-up, upon receipt of an Initialize Element Status command or after the door is closed and the library unit is placed online.

- The local controller for the library unit checks the state of the medium transport element. If it contains a tape cartridge and a PTM is available, the cartridge is placed on the PTM and the inventory is begun.
- Otherwise, the inventory cannot be performed if there is a tape cartridge in the medium transport element. In this case, if the inventory is host commanded, then Check Condition is set, and the “Transfer Full” condition (SK=5 ASC=80 ASCQ=01) is set in the sense data. Otherwise, the library unit generates a “Transfer Full” (SK=5 ASC=80 ASCQ=01) online initialization failure event (see “Library Unit Online Initialization Failure” on page 2-8).
- If the library unit contains data transfer elements (tape drives), an attempt is made to inventory them. The controller first scans for a valid barcode, if none is found, then the controller checks the status of the drive.
- If no cartridge is online in the drive, then the drive handle is opened and the gripper is extended to check for the presence of a cartridge.
- The controller uses the PTM sensors to determine whether or not a cartridge is present. If there is a cartridge on the PTM, it is centered and the controller scans it for a valid barcode.
- If this is the first inventory since power-on or if this inventory was commanded using Initialize Element Status, each face of the carousel is inventoried. If the inventory is initiated by the opening and closing of a door, only the faces exposed while the door was opened are inventoried.
- First, the face is scanned for barcodes. If the library unit has binpack sensors, then the area containing binpacks is the only area scanned. If the library unit does not have binpack sensors, the entire face is scanned; if the library unit determines that a binpack contains all invalid barcodes, it uses the gripper to sense whether or not there is a binpack present. After the face is scanned, any bins (in a present binpack) with invalid barcodes are revisited and the gripper is extended to sense whether or not a cartridge is in the bin.
- The inventory time varies, depending on the number of storage units and the number of cartridges with valid barcodes. A fully populated storage unit with valid barcodes takes much less time than a partially populated storage unit.
- Results of the inventory are returned with the Read Element Status Command.

Offline Sequence

The STANDBY button allows the library unit to be taken offline. The offline sequence can only occur when the doors are shut, the system is not stopped and the library unit is placed offline (refer to the *TL820 Operator's Guide* to determine how the system is placed online/offline). The following actions occur during the offline sequence:

When a library unit is placed offline, the following sequence is performed:

- The local controller for the library unit completes any currently processing command.
- When all commands are complete, the control panel changes to “01” to indicate the unit is offline.
- The library unit generates a “Logical Unit Standby Button Was Pressed” event (SK=6 ASC=80 ASCQ=09).
- When the library unit is offline, it responds to the Inquiry, Request Sense, Log Sense, Mode Select and Mode Sense commands. Check Condition is set for all other commands issued during this time, and the “Logical Unit is Offline” (SK=2 ASC=80 ASCQ=09) condition is set in the sense data.
- The carousel can be moved by buttons on the control status panel when the door is closed and the library unit is offline.
- Field engineer level diagnostic commands can be executed via the diagnostic port. For more information, see “Offline Diagnostics via Field Engineer Port” on page 2-19.

The library unit remains offline until one of the other operational sequences occur.

Automatic Drive Cleaning Feature

Automatic Drive Cleaning features are only available on library unit models equipped with the necessary support electronics and hardware. At initial power-on or after a reset, the software checks to ensure that the configured model number is 6200213. If your library is configured as Model Number 6200213, you can enable the feature. (The normal state of automatic drive cleaning is “disabled”. For a detailed discussion of the automatic drive cleaning feature, see “Appendix C”.)

Multi-Unit Operation

In a multi-unit configuration, there may be up to five library units. In order to pass cartridges from one library unit to another, at least one library unit must be configured with a MUC, and all library units in the configuration must have PTMs.

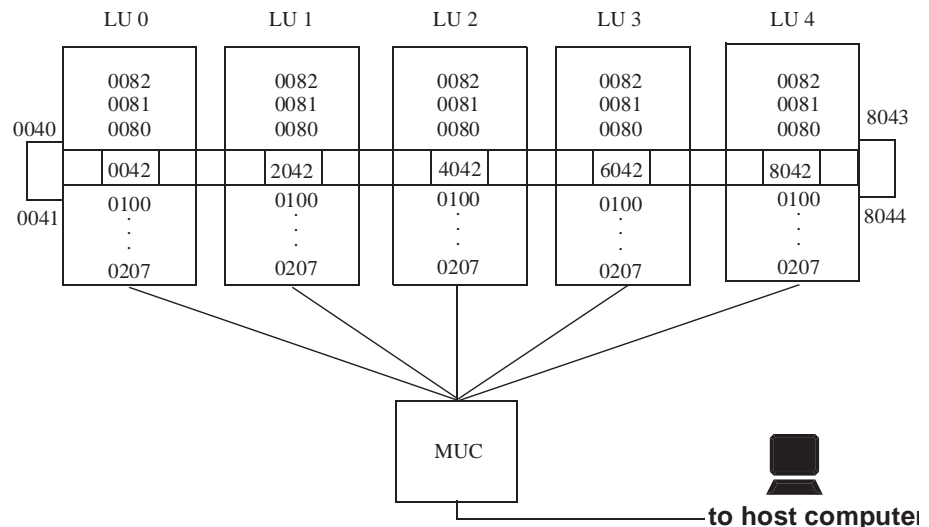
Note *Element addresses are hexadecimal and are provided for reference only. Though the addresses are accurate at the time of this publication, they are subject to change. It is recommended that the Mode Sense Data be used to determine the address configuration of each library unit.*

See Figure 2 for a logical representation of a five library unit configuration. For cabling drawings, refer to the *TL820 Facilities Planning and Installation Guide*.

A single Move Medium command can be used to move a cartridge between any import export element within the tape library and any other element in the tape library. However, two Move Medium commands are required to move a cartridge between two non-import export elements that reside within two different library units (e.g., a move from a bin to a drive in a different library unit).

After importing a cartridge from the IOD or another unit to the PTM, a storage cell or a drive, the library unit automatically scans the barcode. The barcode is not scanned by library units which are only passing the cartridge to the next unit. The barcode information can be obtained with the Read Element Status command.

Figure 2: TL820 Expansion Diagram



To import a cartridge from inport/outport device (IOD) address 0040h to storage element 0123h in library unit 3 (LU 3), the following sequence must occur:

- The host sends a Ready Inport command with an element address of 0040h.
- LU0 unlocks the inport door and turns the “ready” light on.
- The operator opens the inport door, places a cartridge into the inport device and closes the door.
- LU0 generates an Import or Export Accessed event (SK=6 ASC=28 ASCQ=01).
- The host sends a Move Medium command to the MUC with a source element address of 0040h (the inport) and a destination element address of 0123h. The LU field in the move Move Medium command contains a 3.
- The MUC reserves LU3 passthrough for importing from left to right, and LU2, LU1 and LU0 passthroughs for transporting from left to right.
- The cartridge is passed from passthrough to passthrough.
- LU0, LU1 and LU2 send a completion notice to the MUC when the cartridge is passed to the adjacent system (passthrough motors are shut down when the cartridge is passed).
- LU3 registers the cartridge against the lift gate, inventories the passthrough and sends a completion notice to the MUC.
- The MUC sends a Move Medium command to LU3 with a source element address of 6042h (the passthrough) and a destination element address of 0123h.
- LU 3 moves the cartridge from the passthrough to storage element 0123h and sends a completion notice to the MUC.
- The MUC sends command complete status to the host.

To export a cartridge from storage element 0209h in LU2 to inport/outport device address 8044h, the following sequence must occur:

- The host sends a Move Medium command to the MUC with a source element address of 0209h (the logical unit field contains a 2) and a destination element address of 8044h (the outport).
- The MUC reserves LU4 passthrough for transferring left to right to the right IOD.
- The MUC reserves LU3 passthrough for transporting from left to right.
- The MUC sends a MOVE MEDIUM command to LU2 with a source element address of 0209h and a destination element address of export right (internal address).
- LU2 reserves its passthrough, moves the cartridge from bin location 0209h to the passthrough, and starts the passthrough.
- The cartridge is passed from passthrough to passthrough.
- LU2 and LU3 send a completion notice to the MUC when the cartridge is passed to the adjacent systems (LU3 and LU4, respectively).
- LU4 sends a completion notice to the MUC when the cartridge is passed out to the IOD.
- The MUC sends command complete status to the host.

To move a cartridge from bin location 01CBh in LU1 to drive address 0081h in LU3.

- The host sends a Move Medium command to the MUC with a source element address of 01CBh (the logical unit field contains a 1) and a destination element address of 6042h (import address of LU3).
- The MUC reserves LU3 passthrough for importing left to right.
- The MUC reserves LU2 passthrough for transporting from left to right.
- The MUC sends a Move Medium command to LU1 with a source element address of 01CBh and a destination element address of the right export (internal address).
- LU1 reserves its passthrough, moves the cartridge from bin location 01CBh to the passthrough, and starts the passthrough.
- The cartridge is passed from passthrough to passthrough.
- LU1 and LU2 send a completion notice to the MUC when the cartridge is passed to the adjacent systems (LU2 and LU3, respectively).
- LU3 registers the cartridge in the passthrough and sends a completion notice to the MUC.
- The MUC sends a command complete status to the host.
- The host sends a Move Medium command to the MUC with a source element address of passthrough 6042h (the logical unit field contains a 3) and a destination element address of drive 0081h.
- LU3 moves the cartridge to the drive and sends a command complete status to the host.

Configuration Procedures

Diagnostic Port Configurable Items

A library unit can be configured using the EIA/TIA-574 diagnostic port interface. The following can be reconfigured:

- logical unit number of the library unit.
- vertical and extension positions of the data transfer elements.
- vertical and extension positions of the data storage elements.
- vertical and extension positions of the PTM.
- IOD and PTM configuration.
- model type.
- number of drives.

Setting SCSI Addresses

The MUC is switch configurable and supports any host SCSI address. Refer to Document EK-TL820-SV ("[TL820 Field Service Manual](#)") for instructions on how to configure the MUC.

Logical Unit Number

Refer to Document EK-TL820-SM ("[TL820 Diagnostic Software User's Manual](#)") for instructions how to configure the LUN.

Tape Drive Addresses

The SCSI address of a tape drive that has been installed in the tape library is set using the instructions provided by the tape drive manufacturer.

The tape library does not require the tape drive's address. The SCSI option to report tape drive addresses as part of the medium changer's configuration information is not supported by the tape library.

Error Recovery Procedures

Internal Error Recovery

If a failure occurs during a movement command, the TL820 software attempts to recover. The following are some of the retries and recovery attempted by the TL820:

- If an actuator is not in a valid starting position at the start of any movement command, the software attempts to home the actuator before starting the command. If the home is successful the command is continued. (SK=B ASC=81 ASCQ=10, SK=B ASC=83 ASCQ=10, SK=B ASC=84 ASCQ=10, SK=B ASC=86 ASCQ=10)
- If an actuator movement fails because of a current feedback, actuator timeout or mechanical position error, the actuator move is retried. If the retry is successful, the command is continued. (SK=B ASC=81 ASCQ=00-05, SK=B ASC=83 ASCQ=01/SK=4 ASC=83 ASCQ=02&03, SK=B ASC=84 ASCQ=01, SK=4 ASC=84 ASCQ=03, SK=B ASC=86 ASCQ=01, SK=B ASC=86 ASCQ=03, SK=4 ASC=86 ASCQ=07)
- If a drive does not eject the cartridge far enough for it to be fully gripped, the software will make several attempts to pull the cartridge out of the drive. It closes the gripper on the cartridge, pulls it out slightly, and then attempts again to pull the cartridge out of the drive. (SK=B ASC=81 ASCQ=51)
- If a cartridge is picked from a bin, but is not fully seated in the gripper, the cartridge is placed back in the bin and picked one more time before the error is reported. (SK=B ASC=80 ASCQ=0D)
- If the pick portion of a move command fails and the cartridge appears to be in the gripper, the command is continued and the place completed if possible. If the place fails as well, only the original pick error code is returned.
- If a place into a drive fails because of an extension axis current feedback error, the extension axis is retracted and the place is attempted one additional time before the error is reported. (SK=4 ASC=83 ASCQ=02)
- During inventory, if the initial scan of a face does not read a barcode in a bin slot, the cartridge is rescanned before extending the gripper to sense if the cartridge is there.

Operator Recovery

Refer to Document EK-TL820-OP (“[TL820 Operator’s Guide](#)”) for suggested operator recovery procedures.

System Performance

Key Performance Items

The actuator move times are the key performance items. The internal software attempts to maximize the unit's performance by allowing multiple actuators to move simultaneously. For example, the vertical axis and carousel are moved to the appropriate position at the same time when moving toward a storage element. Also, the extension and gripper actuators are moved to a ready position after the completion of a move, to prepare for the next move.

During an inventory the internal software leaves the extension axis as far out as possible, without obstructing the barcode scanner. This allows the extension to be closer to the bins. If a barcode is missing, the extension will take less time to go out and sense it.

The host can increase performance by minimizing the distance of the actuator moves. It can do this by using the time when the tape drives are busy (or when no commands are being issued) to sort the storage elements to better suit the application.

Typical Application Enhancements

The host should check for any attention or error conditions the tape library may have buffered by issuing Request Sense commands until no conditions exist.

The SCSI interface allows the host to enable the “disconnect from bus” option. This allows the target to disconnect from the bus while processing a command from the host application and reconnect when the command is complete. Disconnecting allows access to the drives or other logical units while the command is being performed.

The internal software does not support command queueing on an individual logical unit. It is up to the host application to queue commands to a unit. It may also be advantageous for the application to group queued commands to require the least amount of actuator motion.

The Position To Element command allows the application to move the robotics to a more advantageous position while the tape drives are busy. For example, if a cartridge is about to be ejected from the drive, the carousel can be moved to the face in which the cartridge is going to be placed and the robotics can be positioned in front of a drive to pick up the cartridge when ejected.

The application can also sort the most used cartridges and keep the most commonly used cartridges on one face. If the sequence of cartridges is known, while the first tape is in the drive the application can move the other cartridges all to the same face close to the top of the carousel.

System Diagnostic Support

The library unit has a layered self diagnostic capability. Each layer addresses a specific type of diagnostic need. The layers provide a basic go/no-go capability as well as complete fault isolation capability.

Host Interface Diagnostic Error Codes

The least sophisticated diagnostic capabilities are made available to the host computer using the host interface. This lowest layer consists of the tests which are performed when the library unit is placed online. These tests are designed to catch all major system failures and to give the host computer a high degree of confidence that the library unit is operational. This layer has been kept as simple as possible to minimize the amount of support software required at the host.

The next layer allows isolation of faults which occur during operation. Error definitions and recovery procedures, provided in Appendix A, are designed to be descriptive enough to quickly test failed operations and correct any conditions that would have resulted in an unnecessary service call.

Offline Diagnostics via Field Engineer Port

The top level of diagnostic commands is available using an EIA/TIA-574 diagnostic port found on each library unit. These commands are designed for use by a field service technician and are intended for use with the fault isolation procedures described in the *TL820 Field Service Manual*. They are not intended for casual use or by an untrained operator and require the use of special test equipment and parts.

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Introduction

This chapter describes the Small Computer System Interface (SCSI) and EIA/TIA-574 interfaces in relation to the TL820. SCSI II and EIA/TIA-574 specific terminology are listed below with their TL820 equivalents:

- *Logical Unit* is the library unit.
- *Initiator* is the host computer.
- *Data transfer element* is the Tape Drive.
- *Medium transport element* is the gripper/carriage.
- *Storage element* is the bin in the carousel.

SCSI Interface

The TL820 is a SCSI II medium change device. The host computer serves as the SCSI initiator and issues commands to the tape library and tape drives which act as SCSI targets.

The tape library provides only SCSI target support. It does not perform any of the initiator functions. The tape library has its own SCSI address separate from any other SCSI devices including the tape drives.

Each tape library is operated independently. SCSI queuing is not supported. Each tape library supports just one initiator and I/O operation at a time.

The tape library does not support linked commands. All element addresses must be specified absolutely, no relative addressing is permitted.

The amount of data transferred between the host and the tape library is minimal. For this reason, the tape library does not support either synchronous or wide data transfers.

The tape library is intended for use with SCSI II initiators. It cannot be used with a SCSI-I initiator.

The tape library does not support the Change Definition command, Asynchronous Event Notification, or extended contingent allegiance.

Note *The message (“Supported Messages” on page 3-5) and command (“Supported Operational Commands” on page 3-8) sections assume that you have significant knowledge of the SCSI specification.*

Reset Sequence

The tape library supports the SCSI II soft reset option. When a SCSI bus reset occurs, the tape library clears the SCSI bus as described in the SCSI II standard.

Supported Messages

This section describes the required messages and supported optional messages and their use in coordinating the host and tape library. The messages the host (a SCSI initiator) can send to the tape library (a SCSI target) are described along with the tape library response when the message is received. The messages sent by the tape library to the host are described, along with why they are sent.

These descriptions are not meant as a supplement to the information provided in the SCSI II standard. These descriptions are intended to document how these messages have been adapted for use with the tape library.

The tape library supports all messages indicated as mandatory for target support by the SCSI II specification. The mandatory messages are:

- Abort
- Bus Device Reset
- Command Complete
- Identify (initiator to target)
- Initiator Detected Error
- Message Parity Error
- Message Reject
- No Operation

The tape library also supports several messages indicated as optional for SCSI targets by the SCSI II specification. Most of the tape library operations are slow in relation to the other operations being controlled using the SCSI bus. By using these optional messages, the tape library can make the bus available for other operations while completing a tape library operation. These messages are:

- Disconnect (Direction is from target to initiator)
- Identify
- Save Data Pointer

Abort

The Abort message allows the host to clear the present operation on a specified tape library. Abort can be used as follows with the tape library:

- The initiator of an operation can abort that process by sending this message to the tape library. This stops the operation for the indicated tape library. Since only one operation is supported per tape library at a time, this message effectively stops all processing for a single library unit.
- If any other initiators send this message, the tape library accepts the message but does not abort any of the operations.

Bus Device Reset

The Bus Device Reset message from a host to the tape library causes a SCSI hard reset. The tape library responds to this message by clearing the I/O processes for all library units in a multi-unit configuration. The Unit Attention condition is set for all hosts (one per library unit is possible) to indicate that the operation they commanded has been aborted.

Command Complete

The tape library sends this message to the host after the library unit has completed the command operation and sent valid status information to the host. This message does not indicate that the operation was completed successfully. Successful completion must be determined by examining the status information.

After sending this message, the library unit is ready to accept another command.

Disconnect (From Target to Initiator)

The Identify message from the host indicates whether or not the tape library can disconnect during the execution of an operation. Whenever the tape library receives a command which cannot be immediately completed and a disconnect has been allowed, then the tape library disconnects from the host while performing the operation. This frees the SCSI bus for other uses while the operation is in progress.

The tape library disconnects from the host by sending the host the Save Data Pointer message (if necessary) just before the Disconnect message.

Given the nature of the host and tape library interface it is not expected that a data pointer will be used by the host. Only data transfers which are broken into multiple connections will end each successful connection with a Save Data Pointer and Disconnect message sequence. This conforms to SCSI II standard section 5.6.6.

The SCSI II standard also allows an optional host-to-target disconnect message. The tape library does not support this option and responds with a Message Reject if a Disconnect message is received.

Identify (Initiator to Target)

The host sends this message to the tape library to identify the tape library to which the command is being sent. This message also indicates whether the tape library disconnects during the command.

The Identify message from the host overrides the unit number in the command descriptor block. If the tape library receives an Identify message from the host, the tape library ignores the unit number in the command descriptor block. If an Identify message is not received, the tape library uses the unit number in the command descriptor block. The tape library **does not** disconnect during an operation under these circumstances.

Identify (Target to Initiator)

When the tape library uses the Disconnect message to disconnect from the host, the tape library sends an Identify message to the host after completing the operation and reselecting the host. The tape library number in this Identify message is the same as the tape library number in the Identify message the host sent to the tape library at the start of the operation.

The tape library supports one initiator at a time per library unit and does not support any target routines.

The host does an implied Resume Pointers when the Identify message is received from the tape library.

Save Data Pointer

The tape library sends this message to the host, when data transfers are broken into multiple connections, before disconnection using the Disconnect message.

Supported Operational Commands

The tape library supports all commands which the SCSI II specification indicates are required by all devices:

- Inquiry
- Request Sense
- Test Unit Ready

The tape library also supports all of the commands which the SCSI II specification indicates are required by media change devices:

- Move Medium
- Send Diagnostic

In addition, the tape library supports the following optional commands:

- Initialize Element Status
- Log Sense
- Mode Select
- Mode Sense
- Position to Element
- Read Element Status
- Rezero Unit
- Start/Stop Unit

Finally, the tape library supports the following vendor specific command:

- Ready Inport

Note *This section describes the commands, command format and data format. For the most part, these formats are taken directly from the SCSI II specification. Only the fields and values supported by the TL820 are described in this guide.*

The commands, their operation code, type, and page references are shown in Table 2.

Table 2: Supported Operational Commands

Command Name	Operation Code	Type ^a	Page
Initialize Element Status	07h	O	3-10
Inquiry	12h	M	3-11
Log Sense	4Dh	O	3-15
Mode Select	15h	O	3-20
Mode Sense	1Ah	O	3-22
Move Medium	A5h	M	3-31
Position to Element	2Bh	O	3-33
Read Element Status	B8h	O	3-35
Ready Inport	DEh	V	3-49
Request Sense	03h	M	3-50
Rezero Unit	01h	O	3-53
Send Diagnostic	1Dh	O	3-54
Start/Stop Unit	1Bh	O	3-55
Test Unit Ready	00h	M	3-56

a.

M = SCSI II command implementation is mandatory. O = SCSI II command implementation is optional. V = Vendor Unique Command.

Initialize Element Status

The Initialize Element Status command allows the host to request an inventory of the tape cartridges held in a library unit. The library unit conducts an inventory and determines whether each element contains a tape cartridge and reads the bar-code of each tape.

Inventory information is returned to the host only if requested using the Read Element Status command.

The library unit does not accept any other commands from the host during the inventory process.

The host can issue an Abort of the inventory for the library unit. If another Initialize Element Status command is then issued, the inventory process is restarted from the beginning.

If the gripper contains a tape cartridge it is placed on the passthrough, if it is available, otherwise, the inventory procedure cannot be conducted. In this case a Transfer Full error (SK=5 ASC=80 ASCQ=01) is returned. The cartridge should be moved to an available bin, and the command retried.

The format for this command data block is shown in Table 3.

Table 3: Initialize Element Status Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (07h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (00h)							
3	Reserved (00h)							
4	Reserved (00h)							
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Inquiry

The host uses the Inquiry command to determine the devices attached to the SCSI bus. Using this command, the host can request a description from each device. The description provided by each device identifies the type of device, manufacturer, and the nature of the supported SCSI interface.

The format for this command data block is shown in Table 4.

Table 4: Inquiry Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (12h)							
1	Logical Unit Number			Reserved (0h)			EVPD (0)	
2	Page Code (00h)							
3	Reserved (00h)							
4	Allocation Length							
5	Reserved (00h)							

Only the standard Inquiry data format is supported.

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

EVPD The Enable Vital Product Data (EVPD) bit should always be zero. An EVPD bit of zero specifies that the target returns the standard Inquiry data.

Allocation Length This field contains the maximum amount of data which may be returned. Anything greater than 36 returns the full 36 bytes of data.

Page Code The Vital Product Data page code. The TL820 returns only the standard Inquiry data. This field is not used and must be set to 0.

The format for the standard Inquiry data block returned by the library unit to the initiator is shown in Table 5.

Table 5: Standard Inquiry Data

Bit/Byte	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB (1)	Device-Type Modifier (00h)						
2	ISO Version (0)		ECMA Version (0)			ANSI-Approved Version (2)		
3	AENC (0)	TrmIOP (0)	Reserved (0)		Response Data Format (02h)			
4	Additional Length (1Fh)							
5	Reserved (0000h)							
6								
7	RelAdr (0)	WBus32 (0)	WBus16 (0)	Sync (0)	Linked (0)	Reserved (0)	CmdQue (0)	SftRes (0)
8- 15	(MSB) Vendor ID							(LSB)
16- 31	(MSB) Product ID							(LSB)
32- 35	(MSB) Product Revision Level							(LSB)

Peripheral Qualifier

- 0 indicates the specified library unit is currently connected.
- 1 indicates the specified library unit can be supported but is not connected.
- 3 indicates the specified library unit cannot be supported.

Peripheral Device Type

- 08h indicates medium changer device.
- 1Fh indicates unknown or no device type used in conjunction with Peripheral Qualifier 3.

RMB	A removable medium (RMB) bit of one indicates the medium is removable.
Device-Type Modifier	This field is not supported and should return a value of zero.
ISO Version and ECMA Version	A zero code value in this field indicates that the target does not claim compliance to the ISO version of SCSI (ISO IS 9316) or the ECMA version of SCSI (ECMA-111).
ANSI-Approved Version	A return of two indicates the device complies with the SCSI II Standard.
AENC	The asynchronous event notification capability bit of 0 indicates that the device does not support the asynchronous event notification capability.
TrmIOP	A terminate I/O process value of zero indicates that the device does not support the TERMINATE I/O PROCESS message.
Response Data Format	A value of two indicates that the data must be in the format specified in the SCSI II standard.
Additional Length	This field indicates the length (in bytes) of additional inquiry data available.
RelAdr	A Relative Address of zero indicates the device does not support relative addressing for this library unit.
WBus32 and WBus16	A bit of zero in these two fields indicates that the device supports 8-bit wide data transfers.
Sync	A synchronous transfer value of zero indicates the device does not support synchronous data transfer.
Linked	A linked command value of zero indicates the device does not support linked commands for this library unit.
CMDQue	A command queuing value of zero indicates the device does not support tagged command queuing for this library unit.
SftRes	A soft reset bit of zero indicates that the device responds to the RESET with a hard reset. A soft reset bit of one indicates that the device responds to the RESET condition with a soft reset. For compatibility with existing hosts, this field is set to zero even though the library performs a soft reset.
Vendor ID	This field contains the string "DEC". If communicating via a MUC and the specified library unit is not supported (Logical Units 5, 6, and 7) or not connected, then this field will contain all blanks.

Product ID	This field contains the ASCII character string “TL820....(C).DEC”.
Note	<i>Each “.” in the ASCII string above represents a “space” (20h).</i> If communicating via a MUC and the specified library unit is not supported (Logical Units 5, 6, and 7) or not connected, then this field will contain “MUC” followed by blanks.
Product Revision Level	This field contains both the MUC and the library unit firmware revision levels. The first 2 characters of the field represent the MUC firmware revision, and the last two represent the TL820 firmware revision. (E.g. “1C3H” is MUC revision 1C and TL820 revision 3H). If the revision information is not available (i.e. there is no MUC or the indicated library unit is not supported or connected) then the revision is substituted with blanks.

Log Sense Command

The Log Sense command (Table 6) provides a means to retrieve statistical information maintained by the logical unit. Data is returned from the logical unit in the Medium Changer Statistics page (see Table 8).

Table 6: Log Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (4Dh)							
1	Logical Unit Number			Reserved (0)			PPC(0)	SP(0)
2	PC (1)		Page Code					
3	Reserved (0000h)							
4								
5	(MSB)		Parameter Pointer				(LSB)	
6								
7	(MSB)		Allocation Length				(LSB)	
8								
9	Reserved (00h)							

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

PPC The parameter pointer control field is not supported and must be set to zero.

SP The save parameters field is not supported and must be set to zero.

PC The page control field defines the type of parameter values to be selected. Only cumulative values are supported, therefore this field must be set to one.

Page Codes Currently, there are only 3 supported page codes:

- 00h Supported Log Page (see Table 7 on page 3-16).
- 30h Medium Changer Statistic Page (see Table 8 on page 3-17).
- 3Fh Return all supported pages.

Parameter Pointer This field allows the host to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the target, whichever is less. See Table 10 for supported parameter codes.

Allocation Length: This field specifies how much memory the host has set aside to store the log sense information returned by the library unit.

Supported Log Page The supported log page (Table 7) returns the list of log pages supported.

Table 7: Supported Log Pages

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (00h)					
1	Reserved (00h)							
2	(MSB) Page Length (0003h) (LSB)							
3								
Supported Page List								
4	(00h)							
5	(30h)							
6	(3Fh)							

Page Length This field specifies the length in bytes of the following supported page list.

Supported Page List The supported page list field contains a list of all log page codes supported. Currently, there are only 3 pages supported. This one (00h), Medium Changer Statistics Page (30h) and (3Fh) all log pages.

Medium Changer Statistics Page This page provides a means for returning medium changer statistical data.

Table 8: Medium Changer Statistics Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Reserved (0)		Page Code (30h)					

Bit/Byte	7	6	5	4	3	2	1	0
1	Reserved (00h)							
2	(MSB) Page Length (LSB)							
3								
Log Parameter List								
4 - 11	Log Parameter (First)							
	.							
x-7 - x	Log Parameter (Last)							

Page Length

This field specifies the length in bytes of the following list of log parameters.

Log Parameter

Each Log parameter begins with a four-byte parameter header followed by four bytes of parameter value data. See Table 9 for Log Parameter format.

Table 9: Log Parameter

Bit/Byte	7	6	5	4	3	2	1	0
0	Parameter Code (MSB) (LSB)							
1								
2	DU(0)	DS(0)	TSD(0)	ETC(0)	TMC(0)		Rsv(0)	LP(0)
3	Parameter Length (04h)							
4-	Parameter Value (MSB) (LSB)							
7								

Parameter Code The parameter code field identifies which log parameter is being transferred for that log page. See Table 10 for parameter codes supported.

DU, DS, TSD, ETC, TMC and LP These parameters are not supported and must be set to zero.

Parameter Length All log parameter values supported in the Medium Changer Statistics page have a length of 4 bytes.

Parameter Value The cumulative count of parameter as described in Table 10.

Table 10: Supported Log
 Parameter Codes

Parameter Code	Description	Size (bytes)
8000	Number of seconds system has been powered on	4
8001	Number of seconds spent processing commands	4
8010	Number of attempted moves from a bin	4
8011	Number of attempted moves to a bin	4
8012	Number of attempted moves from a drive	4
8013	Number of attempted moves to a drive	4
8014	Number of attempted moves from the PTM	4
8015	Number of attempted moves to the PTM	4
8020	Number of individual carousel moves ^a	4
8021	Number of individual vertical moves*	4
8022	Number of individual extension moves*	4
8023	Number of individual gripper moves*	4
8024	Number of individual pusher extends*	4
8030	Number of carousel retries	4
8031	Number of vertical retries	4
8032	Number of extension retries	4
8033	Number of gripper retries	4
8040	Number of place into drive retries	4
8041	Number of pick from drive retries	4
8042	Number of partially gripped cartridge retries	4
8043	Number of drive load retries	4

a.

These counts are based on the individual moves of the axis. For example, to move the carousel from its current position to any other face takes three individual moves one large move close to the carousel flag, a small move to sense the edge of the flag and another small move to reach the center of the carousel flag. NOMINALLY the extension axis takes 3 moves to pick a cartridge from a bin (4 to a drive or PTM) and 5 to place a cartridge in a bin, drive or PTM; the gripper takes 2 moves to pick and 3 to place (4 to a drive, 5 to a PTM); the vertical takes one per pick or place (2 from PTM, 5 to PTM and 2 to a drive).

Mode Select Command

The Mode Select command provides a means for the host to specify parameters to the library unit. The library unit only supports changes to the Vendor Unique Page. The Vendor Unique page supports enabling or disabling of the automatic drive cleaning and drive load retry parameters.

Automatic Drive Cleaning

Automatic Drive Cleaning features are only available on library unit models equipped with the necessary support electronics and hardware. At initial power-on or after a reset, the software checks to ensure that the configured model number is 6200213. If your library is configured as Model Number 6200213, you can enable the feature. (The normal state of automatic drive cleaning is “disabled”. For a detailed discussion of the automatic drive cleaning feature, see “Appendix C”.)

Drive Load Retry

With drive load retry enabled, a retry is performed when the drive port area becomes occupied by a cartridge within 4 seconds after placing a cartridge into a drive. The load operation is attempted a maximum of 5 times. A count is kept on the number of retries the robotics has performed. Currently, this feature is not applicable to the TL820.

Table 11: Mode Select Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF (1)	Reserved (0)			SP
2	Reserved (0000h)							
3								
4	Parameter List Length (04h)							
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

SP - Save Page

When set to zero indicates perform mode select without saving. When set to one performs mode select and saves it in nonvolatile memory.

PF When set to one, the page format field indicates that the Mode Select Parameters are formatted as specified in the SCSI II Standard.

Parameter List Length Indicates the length of the following parameter list. The only page supported by the Mode Select command is the four byte Vendor Unique Page shown in Table 12. This field must be set to 4.

The format for the Mode Select Vendor Unique Page is shown in Table 12.

Table 12: Mode Select Data - Vendor Unique Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved (0)	Page Code (20h)					
1	Page Length (02h)							
2	Reserved (00h)					AC	DLR	
3	Reserved (00h)							

PS - Parameters Savable This bit is only used with the Mode Sense command (See Table 18). This bit is reserved for Mode Select command and should be set to zero.

DLR-Drive Load Retry **This feature is not applicable to the TL820.** (*Description: If bit is set to one, retries are performed. If bit is set to zero, retries are not performed.*)

AC-Auto Clean When this bit is set to one, the automatic drive cleaning feature is enabled. When it is set to zero, the automatic drive cleaning feature is disabled.

Mode Sense

The SCSI Mode Sense command provides a general method for a host to obtain the current parameter settings of a target device. The host selects the set parameters to be returned by setting the Page Code field in the command block. This code selects the page of parameter information to be returned by the target.

The TL820 tape library supports the three medium changer device parameter pages defined in the SCSI II standard and one vendor unique page:

- Element Address Assignment Page
- Transport Geometry Parameters Page

- Device Capabilities Page
- Vendor Unique Page

The host can request all pages with a single command using the Return All Pages page code as described in the standard.

The format for the Mode Sense Command block is shown in Table 13.

Table 13: Mode Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Ah)							
1	Logical Unit Number			Reserved (0)	DBD	Reserved (00)		
2	PC		Page Code					
3	Reserved (00h)							
4	Allocation Length							
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

DBD

The Disable Block Descriptors (DBD) field can be one or zero. A bit of zero indicates that the target may return zero or more block descriptors in the returned Mode Sense data at the target's discretion. A DBD bit of one specifies that the target does not return any block descriptors in the returned Mode Sense data.

PC

The page control (PC) field defines the type of parameter values to be returned.

- 0 requests the current parameter values for the specified page code for the library unit. The current values returned are the default values.
- 1 requests the target to return the changeable parameter mask for the page code specified. The page requested is returned containing information that indicates which parameters are changeable.
- 2 requests the target return the default values for the page code specified.

- 3 requests the target return saved values for the page code specified. Only the Vendor Unique Page has changeable/savable parameters. Otherwise, the current setting for each parameter is always the same as the setting that parameter had when the library unit was turned on. The library unit responds with a Check Condition status if the page control (PC) field is Saved Values, for any page codes other than 20h and 3Fh.

Page Codes

The valid page codes are:

- 1Dh Element Address Assignment Page
- 1Eh Transport Geometry Parameters Page
- 1Fh Device Capabilities Page
- 20h Vendor Unique Page
- 3Fh Return All Pages

Allocation Length

This should be set according to the number of bytes in the page that has been requested:

- 18h Element Address Assignment Page
- 08h Transport Geometry Parameters Page
- 18h Device Capabilities Page
- 08h Vendor Unique Page
- 34h Return All Pages

The parameter data returned for each Mode Sense command is preceded by a Mode Parameter Header Block. The header block is then followed by either the requested parameter page or all pages if the Return All Pages page code was used.

The format for the Mode Sense Header Block is shown in Table 14.

Table 14: Mode Sense
Data Header

Bit/Byte	7	6	5	4	3	2	1	0
0	Mode Sense Data Length							
1	Medium Type (00h)							
2	Device-Specific Parameter (00h)							
3	Block Descriptor Length (00h)							

Mode Data Length	This field is set to the amount of data following the Data Length field in bytes. This includes the last three bytes in the Header Block as well as all bytes in the parameter page or pages.
Medium Type Code	This field is reserved for medium changer devices.
Device-Specific Parameter	This field is reserved for medium changer devices.
Block Descriptor Length	This field is reserved for medium changer devices.

The format for the Element Address Assignment Page is shown in Table 15.

Table 15: Mode Sense
 Data - Element Address
 Assignment Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved (0)	Page Code (1Dh)					
1	Parameter Length (12h)							
2	(MSB)	First Medium Transport Element Address						(LSB)
3								
4	(MSB)	Number of Medium Transport Elements (0001h)						(LSB)
5								
6	(MSB)	First Storage Element Address						(LSB)
7								
8	(MSB)	Number of Storage Elements						(LSB)
9								
10	(MSB)	First Import Export Element Address						(LSB)
11								
12	(MSB)	Number of Import Export Elements						(LSB)
13								
14	(MSB)	First Data Transport Element Address						(LSB)
15								
16	(MSB)	Number of Data Transport Elements						(LSB)
17								
18	Reserved (0000h)							
19								

First Medium Transport Element Address

This field identifies the first medium transport element contained in the medium changer (other than the default medium transport address of zero).

Number of Medium Transport Elements

This field defines the total number of medium transport elements contained in the medium changer.

First Storage Element Address

This field identifies the first storage element contained in the medium changer.

Number of Storage Elements

This field defines the total number of storage elements contained in the medium changer.

First Import/Export Element Address

This field identifies the first import/export element contained in the medium changer.

Number of Import/Export Elements

This field defines the total number of import/export elements contained in the medium changer.

First Data Transport Element Address

The first data transfer element address field identifies the first data transfer element contained in the medium changer.

Number of Data Transport Elements

This field defines the total number of data transfer elements contained within the medium changer and accessible to the medium transport elements.

The format for the Transport Geometry Parameters Page is shown in Table 16.

Table 16: Mode Sense
 Data - Transport
 Geometry Parameters
 Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved (0)	Page Code (1Eh)					
1	Parameter Length (02h)							
(Header) TRANSPORT GEOMETRY DESCRIPTOR (Header)								
2	Reserved (00h)						Rotate (0)	
3	Member Number In Transport Element Set (00h)							

PS The parameters savable bit of zero indicates the target is not capable of saving the page in a nonvolatile vendor-specific location.

Parameter Length There are two bytes of parameter information.

Rotate A rotate bit of zero indicates that the medium transport element does not support media rotation.

Member Number In Transport Element Set

The first element in a set has a member number of zero.

The format for the Device Capabilities Page is shown in Table 17.

Table 17: Mode Sense
 Data - Device Capabilities
 Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS (0)	Reserved (0)	Page Code (1Fh)					
1	Parameter Length (12h)							
2	Reserved (0h)			StorDT ^a (0)	StorI/E (1)	StorST (1)	StorMT (1)	
3	Reserved (0h)							
4	Reserved (0h)			MT->DT (1)	MT->I/E (0)	MT->ST (1)	MT->MT (0)	
5	Reserved (0h)			ST->DT (1)	ST->I/E (0)	ST->ST (1)	ST->MT (1)	
6	Reserved (0h)			I/E->DT (0)	I/E->I/E (0)	I/E->ST (0)	I/E->MT (0)	
7	Reserved (0h)			DT->DT (1)	DT->I/E (0)	DT->ST (1)	DT->MT (1)	
8 - 11	Reserved (00000000h)							
12	Reserved (0h)			MT<->DT (0)	MT<->I/E (0)	MT<->ST (0)	MT<->MT (0)	
13	Reserved (0h)			ST<->DT (0)	ST<->I/E (0)	ST<->ST (0)	ST<->MT (0)	
14	Reserved (0h)			I/E<->DT (0)	I/E<->I/E (0)	I/E<->ST (0)	I/E<->MT (0)	
15	Reserved (0h)			DT<->DT (0)	DT<->I/E (0)	DT<->ST (0)	DT<->MT (0)	
16 - 19	Reserved (00000000h)							
a.	DT = Data Transfer Element (Tape Drive) IE = Import/Export Element (Load/Unload Mechanism) ST = Storage Element (Storage Bin) MT = Medium Transport Element (Transfer Mechanism)							

The StorDT, StorIE, StorST, and StorMT fields indicate whether an element of the indicated type (DT, IE, ST, or MT) is capable of storing a tape cartridge.

Even though a tape drive can physically store a tape cartridge, the StorDT bit indicates otherwise in this parameter page. The library unit has no control over the tape drive. For example, inventorying the contents of the tape drives (data transfer elements) is not possible by the library unit, unless the cartridge has been properly ejected. This requires coordination of the tape drives and the library unit that can only be performed by the host.

The XX->YY fields indicate whether a transfer from an element of type XX is possible to an element of type YY. A one in any of these fields indicates that all Move Medium commands where the source element is type XX and destination element is type YY are supported. A zero in these fields indicates the move may or may not be valid depending on the particular element requested. Moves to and from the IE type depend on the whether the particular element is an inport, outport or PTM. Moves from the outport or to the inport are not valid. All other IE combinations are supported.

The tape library does not support the Exchange Medium command. Bytes 12 through 15 in this parameter page contain the individual fields specifying the library unit exchange capabilities. Since the library unit has no exchange capability, all of these fields are zero.

The format of the Vendor Unique Page is shown in Table 18.

Table 18: Mode Sense
Data - Vendor Unique
Page

Bit/Byte	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code (20h)					
1	Page Length (02h)							
2	Reserved					AC	DLR	
3	Reserved							

PS-Parameters Savable This bit is always set to one indicating that this page can be saved to nonvolatile memory.

Page Code The page code value of 20h is used to indicate a vendor unique page, in page format.

Page Length The page length is fixed at a value of 2 bytes.

DLR-Drive Load Retry **This feature is not applicable to the TL820.** (*Description: If bit is set to one, retries are performed. If bit is set to zero, retries are not performed.*)

AC-Auto Clean If this bit is set to one, the current state of the automatic drive cleaning feature is “enabled”. When it is set to zero, the feature is “disabled”.

Move Medium

The host uses the Move Medium command to move a tape cartridge from one element to another within a library unit or between units. The host specifies the source element and the destination element in the command block. The library unit then moves the tape cartridge contained in the source element to the empty destination element.

The source and destination elements can be of any type: storage, medium transport, import/export or data transport element. The valid combinations of source element type and destination element type are summarized in the Mode Sense Device Capabilities Parameter Page. The library unit returns a Check Condition status and sets the sense key to Illegal Request, if an invalid combination is requested.

If a valid source element type and destination element type are specified, the command is valid but the operation may still not be possible. In this case the library unit returns Check Condition status and sets the sense key to Illegal Request.

The Additional Sense Code and Additional Sense Code Qualifier is set to indicate why the operation cannot be carried out. For example, this might occur if a source element or destination element is specified which does not contain a tape cartridge. See Appendix A, Table 1, “Sense Data Values (Hexadecimal),” for a summary of the conditions, sense key, and additional sense encoding.

The format for the Move Medium Command block is shown in Table 19.

Table 19: Move Medium Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (A5h)							
1	Logical Unit Number			Reserved (00h)				
2	(MSB) Transport Element Address (0000h) (LSB)							
3								
4	(MSB) Source Element Address (LSB)							
5								
6	(MSB) Destination Element Address (LSB)							
7								
8	Reserved (0000h)							
9								
10	Reserved (00h)						Invert (0)	
11	Reserved (00h)							

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Transport Element Address The default medium transport element address of zero or the medium transport element address specified by the Mode Sense Data can be used.

Source Element Address The source element address specifies the location from which the medium is taken.

Destination Element Address
 The destination address specifies the location to which the medium is moved.

Invert The medium changer does not support medium rotation for handling double sided media. The invert bit is set to zero.

Position To Element

The Position To Element command is used by the host to position the medium transport element in front of another element within a library unit. The host specifies the destination element in the command block. The library unit then moves the transport element in front of the destination element.

The destination element can be one of the following types: storage or data transfer. If the address is in error, the library unit returns Check Condition status and sets the sense key to Illegal Request.

The format of the Position To Element Command block is shown Table 20.

Table 20: Position To Element Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (2Bh)							
1	Logical Unit Number			Reserved (00h)				
2	(MSB) Transport Element Address (0000h) (LSB)							
3								
4	(MSB) Destination Element Address (LSB)							
5								
6	Reserved (00h)							
7								
8	Reserved (00h)						Invert (0)	
9	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Transport Element Address

The default medium transport element address of zero or the medium transport element address specified by the mode sense data can be used.

Destination Element Address

The destination address specifies the location to which the medium transport element is moved.

Invert

The medium changer does not support medium rotation for handling double sided media. The invert bit is set to zero.

Read Element Status

The host can determine the status of any of the library unit's elements by issuing a Read Element Status Command. The type of element (medium transfer, storage, import/export or data transfer) can be specified in the command as well as the starting address and number of elements for which status information is to be returned.

Each library unit automatically updates its internal element status, every time the status changes. The library unit inventory initializes the information, and it is updated with each move. Because the information is updated with each move, no action is required by the library unit other than returning the information it has stored.

A Read Element Status command must be issued to each library unit in the multi-unit configuration to receive the entire library unit element status. The individual library unit only returns information about elements specific to that unit. For example, in a multi-unit system with an IOD physically attached to library unit (logical unit) 4, the IOD (import/export element) is only reported in the Read Element Data from library unit 4.

The format for the Read Element Status Command block is shown in Table 21.

Table 21: Read Element Status Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (B8h)							
1	Logical Unit Number			VolTag	Element Type Code			
2	(MSB) Starting Element Address (LSB)							
3								
4	(MSB) Number of Elements (LSB)							
5								
6	Reserved (00h)							
7	(MSB) Allocation Length (LSB)							
8								
9								
10	Reserved (00h)							

Bit/Byte	7	6	5	4	3	2	1	0
11	Reserved (00h)							

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

VolTag The Volume Tag field (VolTag) indicates whether or not the volume tag information associated with each tape cartridge should be returned as part of the status information. The volume tag (or barcode) is updated for each tape cartridge whenever it is moved with a Move Medium command. The volume tag information for all tape cartridges can also be updated using the Initialize Element Status command. Since tape cartridges are a single sided media, only a single volume tag is supported per tape cartridge.

Element Type Code This field is used to indicate which type of element (medium transport, storage, import/export, data transfer, or all) is to be reported by this command.

- 0 indicates all element types reported.
- 1 indicates medium transport element.
- 2 indicates storage element.
- 3 indicates import/export element.
- 4 indicates data transfer elements.

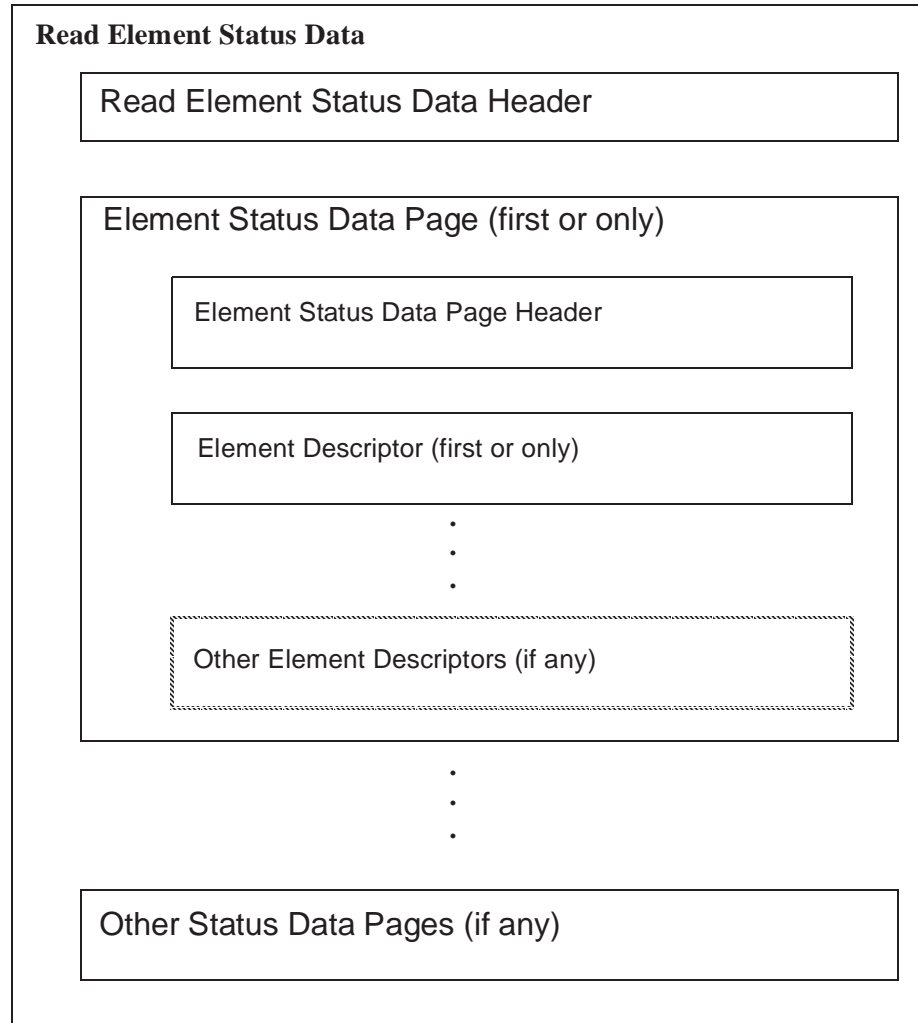
Starting Element Address and Number of Elements

These fields are used to select the range of elements to be reported. Within this range no status information will be reported for an undefined element address. Only elements matching the indicated type will be returned. No elements with an address smaller than the Starting Element Address will be reported. Beginning with the first defined element with an address greater than or equal to the Starting Element Address, all defined, type matching elements will be reported until reports for the indicated number of elements have been returned.

Allocation Length This field specifies how much memory the host has set aside to store the status information returned by the library unit. This field should be set to a number which is large enough to store the status information for the requested number of elements. If it is not, the library unit only reports the status information for the number of elements whose status information fits within the allocated space.

The returned Read Element Status Data has the following general structure:

Figure 3: Read Element
Status Data General
Structure



A single Read Element Status Data Header is returned along with one or more element status pages. The Read Element Status Data Header indicates the address of the first element reported, the number of elements reported, and the size of the report for all requested data.

The size of the report is given in bytes. The size is the total number of bytes that would be contained in the report for all requested data less seven. The Read Element Status command can be given with an Allocation Length of eight to determine how much space must be allocated to transfer all of the status data requested by the command.

The format for the Read Element Status Data is shown in Table 22.

Table 22: Element Status Data

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) First Element Address Reported (LSB)							
1								
2	(MSB) Number of Elements Reported (LSB)							
3								
4	Reserved (00h)							
5	(MSB) Byte Count of Report Available (LSB)							
6								
7								
8 - X	One or More Element Status Page(s)							

First Element Address Reported

This field indicates the element address of the element with the smallest element address found to meet the command description block request.

Number of Elements Reported

This field indicates the number of elements meeting the request in the command descriptor block. The status for these elements is returned if sufficient allocation length was specified.

Byte Count of Report Available

This field indicates the number of bytes of element status page data available for all elements meeting the request in the command descriptor block.

From one to four Element Status Pages can be returned. One page is returned for each type of element with status information. Each page contains a header and one or more element descriptors. Each element descriptor reports the status for a single library unit element.

The page header (bytes 0-7) contains information that defines the contents of the element descriptors for the elements of that type. The format of a status page is shown in Table 23.

Table 23: Element Status
 Page

Bit/Byte	7	6	5	4	3	2	1	0
0	Element Type Code							
1	PVolTag	AVolTag (0)	Reserved (00h)					
2	(MSB) Element Descriptor Length (LSB)							
3								
4	Reserved (00h)							
5	(MSB) Byte Count of Descriptor Data Available (LSB)							
6								
7								
8 - X	One or More Element Descriptors							

PVolTag A primary volume tag field value of one indicates that the primary volume tag information field is present in each of the following element descriptor blocks. A value of zero indicates that these bytes are omitted from the element descriptors that follow.

AVolTag The Alternate volume tag is not supported. This field is set to zero.

Element Descriptor Length This field indicates the number of bytes in each element descriptor.

Byte Count of Descriptor Data Available

The Byte Count of Descriptor Data Available indicates the number of bytes (minus seven) of descriptor data (excluding this header) that would be returned for the descriptors of the specified type if an adequate allocation length had been specified.

There are four different types of element descriptor blocks, one for each type of element. There are several fields which are found in more than one type of element descriptor as well as fields which are unique to an element descriptor.

The fields found in more than one type of element descriptor have been indicated by the same name in the illustrations and descriptions that follow.

The format of an element descriptor for an element of the medium transport element type is shown in Table 24.

Table 24: Medium Transport Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	Element Address (MSB) (LSB)							
1								
2	Reserved (00h)					Except	Rsvd (0)	Full
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid (0)	Invert (0)	Reserved (00h)					
10	Source Storage Element Address (0000h)							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

Element Address

This field indicates the address of the element being reported by that element descriptor.

Except The Exception field is set to one when that element is in an abnormal state. When the element is in a normal state, it is set to zero. Further information on the abnormal state is available in the Additional Sense Code and Additional Sense Code Qualifier fields.

Full The Full field is set to one whenever the element contains a tape cartridge. It is set to zero otherwise.

Additional Sense Code and Additional Sense Code Qualifier

These fields are only valid if the Exception field is set to one. Currently the only valid values for these fields indicate the “Element Contents Unknown” condition (ASC=80 ASCQ=22).

SValid, Invert, and Source Storage Element Address

The source valid, source storage element address field and the invert bit information value of zero indicates these fields are not valid.

Primary Volume Tag Information

If the Volume Tag information was requested in the command block, the Primary Volume Tag Information field will be included in the element descriptor. This field contains the information read from the barcode affixed to each tape cartridge; its format is shown in Table 25.

Table 25: Primary
Volume Tag Information
Format

Bit/Byte	7	6	5	4	3	2	1	0
12 - 43	Volume Identification Field							
44	Reserved (0000h)							
45								
46	Volume Sequence Number (0000h)							
47								

Volume Identification Field

This field is a left justified sequence of ASCII characters representing the barcode scanned from the cartridge followed by blanks.

Note *The SCSI specification indicates that this field should be followed by zeros. Therefore, this feature is subject to change.*

Volume Sequence Number This field is reserved and set to zero.

The format of an element descriptor for an element of the storage element type is shown in Table 26.

Table 26: Storage Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address (LSB)							
1								
2	Reserved (0h)			Access	Except	Reserved (0)	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

Element Address

This field indicates the address of the element being reported by that element descriptor.

- Access** An access bit value of one indicates that access to the element by a medium transport element is allowed. If the corresponding binpack is not present, the bit is set to zero. If the binpack is present, the bit is set to one.
- Except** The Exception field is set to one when that element is in an abnormal state. When the element is in a normal state, it is set to zero. Further information on the abnormal state will be available in the Additional Sense Code and Additional Sense Code Qualifier fields in that element descriptor. See the Request Sense Command for the meaning of the codes contained in the two Sense Code fields.
- Full** The Full field is set to one whenever the element contains a tape cartridge. It is set to zero otherwise.

Additional Sense Code and Additional Sense Code Qualifier

These fields are only valid if the Exception field is set to one. Currently, the only valid values for these fields indicate either the “Element Contents Unknown” condition (ASC=80 ASCQ=22), “Bin Pac Missing” (ASC=80 ASCQ=02), “Cleaning Cartridge Installed” (ASC=30 ASCQ=03) or “Operator Medium Removal Requested” (ASC=5A ASCQ=01).

- SValid** The SValid bit is set to one if the information in the Source Storage Element Address field is valid. If the information is unknown (due to a door open or power on condition) the SValid bit is set to zero.
- Invert** The invert field is not supported and is set to zero.

Source Storage Element Address

The Source Storage Element Address represents the address of the last storage element which held the cartridge. The SValid field indicates whether or not this information is valid.

Primary Volume Tag Information

If the Volume Tag information was requested in the command block, the Primary Volume Tag Information field will be included in the element descriptor. See Table 25 for format.

The layout of an element descriptor for an element of the import export element type is illustrated in Table 27.

Table 27: Import Export Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address (LSB)							
1								
2	Reserved (0)	Import Enable	Export Enable	Access	Except	Import Export	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

Import Element

The Import Enable field indicates whether the element can import a tape cartridge into the library unit. It is set to one if imports are possible through that element and zero otherwise. This field is always set to one for the 'import elements', zero for 'outport elements' and one for 'passthrough elements.'

Export Enable	The Export Enable field indicates whether the element can export a tape cartridge from the library unit. It is set to one if exports are possible through that element and zero otherwise. This field is always set to one for 'outport and passthrough elements' and zero for 'inport elements'.
Access	An access bit value of one indicates access to the element by a medium transport element is allowed. This field is zero for 'inport and outport elements' and one for 'passthrough elements'.
Except	The Exception field is set to one when that element is in an abnormal state. When the element is in a normal state, it is set to zero. Further information on the abnormal state will be available in the Additional Sense Code and Additional Sense Code Qualifier fields in that element descriptor. See Appendix A for the meaning of the codes contained in the two Sense Code fields.
Import Export	The Import Export field of one indicates the unit of media in the element was placed there by an operator. It is set to zero if the tape cartridge contained in the element was placed there by the transfer mechanism. This field is only set to one for 'inport elements' which contain a cartridge. Otherwise, it is set to zero.
Full	The Full field is set to zero whenever the element does not contain a tape cartridge or in the case of an 'outport element' whenever it is not full. It is set to zero otherwise.

Additional Sense Code and Additional Sense Code Qualifier

These fields are only valid if the Exception field is set to one. Currently the only valid values for these fields indicate the "Element Contents Unknown" condition (ASC=80 ASCQ=22).

SValid	The SValid bit is set to one if the information in the Source Storage Element Address field is valid. If the information is unknown the SValid bit is set to zero.
Invert	The invert field is not supported and is set to zero.

Source Storage Element Address

The Source Storage Element Address represents the address of the last storage element which held the cartridge. The SValid field indicates whether or not this information is valid.

The format of an element descriptor for an element of the data transfer element type is shown in Table 28.

Table 28: Data Transfer Element Descriptor

Bit/Byte	7	6	5	4	3	2	1	0
0	(MSB) Element Address (LSB)							
1								
2	Reserved (0h)			Access (1)	Except	Rsvd (0)	Full	
3	Reserved (00h)							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Reserved (000000h)							
7								
8								
9	SValid	Invert (0)	Reserved (00h)					
10	Source Storage Element Address							
11								
12 - 47	Primary Volume Tag Information (if present)							
48 - 51	Reserved (00000000h)							
52	Vendor Unique (0000h)							
53								

Element Address

This field indicates the address of the element being reported by that element descriptor.

Access

An access bit value of one indicates access to the element by a medium transport element is allowed.

- Except** The Exception field is set to one when that element is in an abnormal state. When the element is in a normal state, it is set to zero. Further information on the abnormal state will be available in the Additional Sense Code and Additional Sense Code Qualifier fields in that element descriptor. See the Request Sense Command for the meaning of the codes contained in the two Sense Code fields.
- Full** The Full field is set to one whenever the element contains a tape cartridge. It is set to zero otherwise.

Additional Sense Code and Additional Sense Code Qualifier

These fields are only valid if the Exception field is set to one. Currently the only valid values for these fields indicate the “Element Contents Unknown” condition (ASC=80 ASCQ=22) and “Cleaning Cartridge Installed” (ASC=30 ASCQ=03).

- SValid** The SValid bit is set to one if the information in the Source Storage Element Address field is valid. If the information is unknown (due to a door open or power on condition) the SValid bit is set to zero.
- Invert** The invert field is not supported and is set to zero.

Source Storage Element Address

The Source Storage Element Address represents the address of the last storage element which held the cartridge. The SValid field indicates whether or not this information is valid.

Primary Volume Tag Information

If the Volume Tag information was requested in the command block, the Primary Volume Tag Information field is included in the element descriptor. See Table 25 for format.

Ready Inport

The vendor specific Ready Inport command allows the host to unlock the IOD inport door. After this command has been issued, the Inport Door light goes on to indicate that the operator has access. The operator then has up to one minute to open the IOD inport door and place a cartridge inside. When the operator closes the inport door the library unit generates a Unit Attention “Import or Export Element Accessed” (SK=6 ASC=28 ASCQ=01). If the operator does not place a cartridge in the inport within one minute, the IOD light will go out and another Ready Inport is required to unlock the inport door.

Table 29: Ready Inport Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (DEh)							
1	Logical Unit Number			Reserved (00h)				
2	Element Address (MSB) (LSB)							
3								
4	Reserved (00h)							
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Element Address

Address of inport to ready.

Request Sense

The Request Sense command allows the host to receive sense data from the tape library.

The tape library supports the reporting of current and deferred errors only. A current error (error code 70h) is returned when the error was generated during the execution of the command indicating the Check Condition. A deferred error (error code 71h) is returned when the error was generated prior to the execution of the command indicating Check Condition.

The tape library supports unit attention condition queuing as described in 6.9 in the SCSI II standard.

Other details of processing for this command are consistent with those described in 7.2.14 of the SCSI II standard.

The format of the Request Sense command is shown in Table 30.

Table 30: Request Sense Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (03h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (0000h)							
3								
4	Allocation Length							
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Allocation Length

This field contains the maximum amount of data which may be returned to the host. Anything greater than 15 returns the full 15 bytes of data.

The format of the Request Sense data is shown in Table 31.

Table 31: Request Sense Data

Bit/Byte	7	6	5	4	3	2	1	0
0	Valid (0)	Error Code (70h or 71h)						
1	Segment Number (00h)							
2	Filemark (0)	EOM (0)	ILI (0)	Reserved (0)	Sense Key			
3	(MSB)							
4	Information (00000000h)							
5								
6	(LSB)							
7	Additional Sense Length (07h)							
8	(MSB)							
9	Command-Specific Information (00000000h)							
10								
11	(LSB)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	Field Replaceable Unit Code (00h)							

Valid This field is set to zero indicating the information field is not being used.

Segment Number, Filemark, EOM, and ILI

These fields are not supported and are set to zero.

Error Code

The following error values are supported:

- 70h current error
- 71h deferred error

Sense Key

The following Sense Key values are supported:

0h	NO SENSE
1h	RECOVERED ERROR
2h	NOT READY
4h	HARDWARE ERROR
5h	ILLEGAL REQUEST
6h	UNIT ATTENTION
9h	VENDOR SPECIFIC
Bh	ABORTED COMMAND

Information

This field is not supported and is set to zero.

Additional Sense Length, Additional Sense Code, and Additional Sense Code Qualifier

See Appendix A for a list of possible sense information returned from the tape library.

Command-Specific Information and Field Replaceable Unit Code

These fields are not supported and are set to zero.

Rezero Unit

The Rezero Unit command allows the host to home all library unit mechanisms.

The format of the Rezero Unit command is shown in Table 32.

Table 32: Rezero Unit Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (01h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (000000h)							
3								
4								
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Send Diagnostic

The library unit includes a built-in self test. This test is automatically performed when the library unit is turned on. It can also be performed by issuing the Send Diagnostic command to the library unit. This test verifies all major library unit subsystems are working.

The format of the Send Diagnostic command is shown in Table 33.

Table 33: Send Diagnostic Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Dh)							
1	Logical Unit Number			PF (1)	Reserved (0)	Self Test (1)	Dev-OfL (0)	Unit-OfL (0)
2	Reserved (00h)							
3	(MSB) Parameter List Length (00) (LSB)							
4								
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

PF

A page format bit of one specifies that the Send Diagnostic parameters conform to the page structure as specified in the SCSI II standard. This bit must be set to one.

Self Test

A self test bit of one directs the target to complete its default self test. If the self-test passes, a Good status is returned. If the self-test fails, a Check Condition status is returned and the sense key is set to Hardware Error. The Additional Sense fields identify the type of failure. The description of the Request Sense command tells how to get the Sense data from the tape library and how to interpret the Sense data fields.

DevOfL and UnitOfL

These bits are not used and must be set to zero.

Parameter List Length

A parameter length of zero indicates that no data is transferred.

Start/Stop Unit Command

The host can enable or disable a library unit from accepting medium access commands by sending the Start/Stop Unit command.

The format for the Start/Stop Unit Command Descriptor Block is shown in Table 34.

Table 34: Start/Stop Unit Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (1Bh)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (0000h)							
3								
4	Reserved (00h)						Start	
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Start

A start bit of one enables the library unit; zero disables the library unit.

Test Unit Ready

The host uses the Test Unit Ready command to determine if a library unit is ready.

The library unit responds in one of the following ways, depending upon the state of the library unit:

- Returns a Good status:
Whenever the library unit is ready to accept a medium access command without returning a Check Condition status it returns this status in response to a Test Unit Ready command.
- Returns a Check Condition status:
When the library unit receives a Test Unit Ready command but is not ready to accept a medium access command, it sets the Additional Sense fields and returns this status. The meaning of the values in the Additional Sense fields are described along with the Request Sense command.

The format for the Test Unit Ready Command Descriptor Block is shown in Table 35.

Table 35: Test Unit Ready Command

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (00h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (000000h)							
3								
4								
5	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the message should be sent to.

EIA/TIA-574 Interface

The tape library has been designed to support the EIA/TIA-574 and SCSI interfaces. An attempt was made at keeping the EIA/TIA-574 and SCSI interfaces consistent. Because SCSI has strict interface guidelines, the EIA/TIA-574 interface has been designed to support the SCSI command set and format. In addition to the command set, a set of message commands have been added to emulate the SCSI messages. Only the messages which pertain to an EIA/TIA-574 interface are emulated. Messages such as Disconnect, which have no meaning with this interface, are not included.

Another layer has also been added to the command set. This layer supports a wrapper around all transmitted data and software handshaking. The wrapper consists of a header and trailer which keep track of the start and end of data, length and checksum of the transmission packet. The software handshaking involves acknowledging transmitted data packets. (This acknowledgment is negative if error is detected by wrapper or hardware.)

Messages

The tape library supports all of the operational commands supported by the SCSI interface. In addition, the tape library supports operational message commands which emulate the SCSI messages.

These messages are listed in Table 36.

Table 36: Supported Messages

Message Name	Operation Code	Sender	Page
Abort	F6h	Host	3-58
Command Complete	F0h	LU	3-59
Unsolicited Message	EFh	LU	3-60

Abort

The host uses the Abort command to abort a command currently being executed by the logical unit. This message emulates the SCSI Abort message described in “Abort” on page 3-5.

The format for the Abort message is shown in Table 37.

Table 37: Abort Message

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (F6h)							
1	Logical Unit Number			Reserved (00h)				
2	Reserved (00h)							
3	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the message should be sent to.

Command Complete

The tape library sends the Command Complete message to the host when a library unit has completed a command. This command emulates the SCSI STATUS phase and the Command complete message seen in the previous chapter. In addition, when an error condition is detected the sense data is included as part of this message (a SCSI host must issue a separate Request Sense command to obtain this data).

The format for the Command Complete message is shown in Table 38.

Table 38: Command Complete Message

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (F0h)							
1	Logical Unit Number			Reserved (00h)				
2	Completed Command Operation Code							
3	Status							
4 - 18	Sense Data (if Status is 02h) only							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the message should be sent to.

Status

The following are valid for the Status field:

00 GOOD	The command completed successfully.
02 CHECK CONDITION	The command encountered a warning or error.
04 BUSY	The command was rejected because the library unit was busy.

Sense Data

The Sense data field is only present if the status is Check Condition. This field is the format of the Request Sense Data as described in “Request Sense” on page 3-50. This differs from the SCSI philosophy of returning Sense Data only upon request.

Unsolicited Message

The tape library sends this message to the host when an unsolicited event occurs.

The format for the Unsolicited Message is shown in Table 39.

Table 39: Unsolicited Message

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (EFh)							
1	Logical Unit Number			Reserved (00h)				
2	Status (02h-CHECK CONDITION)							
SENSE DATA								
3	Valid (0)	Error Code (70h or 71h)						
4	Segment Number (00h)							
5	Filemark (0)	EOM (0)	ILI (0)	Reserved (0)	Sense Key			
6	(MSB)							
7	Information (00000000h)							
8								
9	(LSB)							
10	Additional Sense Length (07h)							
11	(MSB)							
12	Command-Specific Information (00000000h)							
13								
14	(LSB)							
15	Additional Sense Code							
16	Additional Sense Code Qualifier							
17	Field Replaceable Unit Code (00h)							

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the message should be sent to.

Status Always 02h for Check Condition.

Valid This field is set to zero indicating the information field is not being used.

Segment Number, Filemark, EOM, and ILI

These fields are not supported and are set to zero.

Error Code The following error values are supported:

70h current error
71h deferred error

Sense Key The following Sense Key values are supported:

0h NO SENSE
1h RECOVERED ERROR
2h NOT READY
4h HARDWARE ERROR
5h ILLEGAL REQUEST
6h UNIT ATTENTION
9h VENDOR SPECIFIC
Bh ABORTED COMMAND

Information This field is not supported and is set to zero.

Additional Sense Length, Additional Sense Code, and Additional Sense Code Qualifier

See “Appendix A: Sense Data Values” for a list of possible sense information returned from the tape library.

Command-Specific Information and Field Replaceable Unit Code

These fields are not supported and are set to zero.

Supported Operational Commands

The tape library supports all of the operational commands supported by the SCSI interface. All supported commands are listed in Table 40. The format of the commands are described in “SCSI Interface” on page 3-4.

Table 40: Supported Operational Commands

Message/Command Name	Operation Code	Sender	Page
Initialize Element Status	07h	Host	3-10
Inquiry	12h	Host	3-11
Log Sense	4Dh	Host	3-15
Mode Select	15h	Host	3-20,3-64
Mode Sense	1Ah	Host	3-22
Move Medium	A5h	Host	3-31
Position To Element	2Bh	Host	3-33
Read Element Status	B8h	Host	3-35
Ready Inport	DEh	Host	3-49
Request Sense	03h	Host	3-50
Rezero Unit	01h	Host	3-53
Send Diagnostic	1Dh	Host	3-54
Start/Stop Unit	1Bh	Host	3-55
Test Unit Ready	00h	Host	3-56

The EIA/TIA-574 command and response data differ from the SCSI Interface commands in that all independent data is sent to the host with an Intermediate Data Header. (This does not include data that is part of the “Command Complete” or “Unsolicited Messages”. See “Intermediate Data Header” on page 3-63.) All data from the host is appended to the end of the command. (See “EIA/TIA-574 Mode Select Command Format” on page 3-64.)

Intermediate Data Header

The data sent to the host in response to a command is formatted as shown in Table 41.

Table 41: Intermediate Data Header

Bit/Byte	7	6	5	4	3	2	1	0
0	Intermediate Data Operation Code (FFh)							
1	Logical Unit Number			Reserved (00h)				
2	Command Operation Code							
3	Reserved (00h)							
4 - x	Data							

Logical Unit Number The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

Command Operator Code This field indicates which data type is being returned.

03h	Request Sense Data
12h	Inquiry Data
1Ah	Mode Sense Data
4Dh	Log Sense Data
B8h	Read Element Status Data

Data This field contains data corresponding with the specified Command Operator Code.

The format for this data is defined as follows.

Request Sense Data*	Table 31
Inquiry Data	Table 5
Mode Sense Data	Table 14-Table 18
Log Sense Data	Table 7-Table 10
Read Element Status Data	Table 22-Table 28

* Request Sense Data is only returned in this format when the sense key is “No Sense Data”. Otherwise, it is appended to the command for the Request Sense command.

EIA/TIA-574 Mode Select Command Format

Currently, the only data sent from the host is with the Mode Select command.

The EIA/TIA-574 interface combines the Mode Select command Table 11 on page 3-20 and the Mode Select Vendor specific page into one data block as shown in Table 42.

Table 42: EIA/TIA Mode Select Command Format

Bit/Byte	7	6	5	4	3	2	1	0
0	Operation Code (15h)							
1	Logical Unit Number			PF (1)	Reserved (0)			SP
2	Reserved (0000h)							
3								
4	Parameter List Length							
5	Reserved (00h)							
6	PS (0)	Reserved (0)	Page Code (20h)					
7	Page Length (02h)							
8	Reserved (00h)					AC	DLR	
9	Reserved (00h)							

Logical Unit Number

The Logical Unit Number can range from 0-4. This field indicates which logical unit the command should be sent to.

SP - Save Page

When set to zero indicates perform mode select without saving. When set to one performs mode select and saves it in nonvolatile memory.

PF

When set to one, the page format field indicates that the Mode Select Parameters are formatted as specified in the SCSI II Standard.

Parameter List Length

Indicates the length of the following parameter list. The only page supported by the Mode Select command is the four byte Vendor Unique Page shown in Table 12 on page 3-21. This field must be set to 4. (If the 4 byte Mode Page Header is included, this field must be set to 8.)

PS - Parameters Savable	This bit is only used with the Mode Sense command (See Table 18 on page 3-29). This bit is reserved for Mode Select command and should be set to zero.
DLR-Drive Load Retry	When this bit is set to one, retries will be performed. When this bit is set to zero, retry will not be performed.
AC-Auto Clean	When this bit is set to one, the automatic drive cleaning feature is enabled. When it is set to zero, the automatic drive cleaning feature is disabled.

Command/Message/Status Packaging

All commands, messages and status data supported by the EIA/ TIA-574 interface are repackaged into a packet(s) to ensure accurate transmission. Each packet can transmit 128 bytes of data, so each command or message is transmitted as a single packet. Status data may exceed 128 bytes (e.g. Read Element Status data), so it is broken up into multiple packets. Each packet consists of a header, data, and a trailer, where data is either a command, message or status data.

For all fields listed below that have more than one byte, the first byte is the most significant byte. The format for the packet is shown in Table 43.

Table 43: EIA/TIA-574
 Interface Packet

Byte	Description	Values
0	Start of Packet character (delimiter)	“[“
1	Packet Type	'a' - Acknowledge Packet 'n' - Negative Acknowledge Packet 'd' - Data Packet
2-3	Message Number. Incremental counter updated after transmission of all packets in a message.	0h - valid for NAKs only 1h-FFFFh
4	Packet Number. Number of current packet within message.	0h - valid for NAKs only 1h-FFh - should not exceed total number of packets.
5	Total Number of Packets. X of N packets within message.	0h - valid for NAKs only 1h-FFh
6	Data Length. (n) Number of byte of data in packet.	0h - valid for ACK/NAKs only 1h-FFFFh
7		
8	Start of Data character (delimiter)	“<“
- n+8	Data	This field does not exist if n is 0.
n+9	End of Data character (delimiter)	“>”
n+10	Checksum	Sum of all packet bytes up to and including End of Data character
n+11		
n+12	End of Packet character (delimiter)	0Ah

The Packet Type field determines whether or not a message is data or protocol (ACK/NAK). Protocol messages (ACKs and NAKs) do not contain data and always has a data length of 0. Their message and packet number fields indicate which packet is being acknowledged. A NAK message only fills in these fields if they can be determined from the received packet.

For data type messages, the message, packet and total packet number fields are generated by the transmitter. The format of the data is the same as described in previous sections of this manual, except that the data can be divided over multiple packets.

Software Handshake

Three types of packets can be transmitted over the EIA/TIA-574 interface. One is used to transmit data and the other two are protocol packets which are used for software handshaking. These protocol packets are transmitted by a receiver to acknowledge that a data packet was received (with or without error - NAK or ACK).

If the transmitter receives an ACK then the message transmitted without error, and can continue transmitting the next packet. If a NAK or nothing is received, then the transmitter should re-transmit the packet. The number of retries is driver dependent.

Notes on Creating a Device Driver

The data is transmitted as binary, not ASCII. The driver must be written with this in mind. The device driver should not assume that every character which matches a delimiter is a delimiter. The delimiters should be used only to verify that it is parsing the packet correctly. Data length, delimiters, checksum and a timeout can be used to verify the packet is received correctly.

This protocol allows multiple packets to be sent before waiting for an acknowledgment. The transmitting driver does not have to use this, but the receiving portion of the driver must support it.

All data packets must be acknowledged within 400 ms, or the tape library resends the data packet.

Note *If communicating directly to a library unit (not via a MUC), the library unit queues unsolicited messages until they have been acknowledged.*

The library unit sends the unsolicited message, if it is not acknowledged within 400ms (after several retries), it queues the unsolicited message. The library unit does not resend the message until a command is received from the host. Note that commands will not be processed by the library unit until the unsolicited messages have been acknowledged.

Configuration

The EIA/TIA-574 serial communications interface is configured as follows:

- BAUD Rate 9600
- Data Bits 8
- Parity None
- Stop Bits 1

Appendix A: Sense Data Values

Table 1 lists message information that can be sent from the TL820 library unit to the host computer. In addition to definition, recovery suggestions where possible, and the host interface receiving the message, the table lists the following information.

- Sense Key
- Additional Sense Code (ASC),
- Additional Sense Code Qualifier (ASCQ), and
- Additional Sense Length (ASL) fields of the sense data block.

Valid host interfaces are listed below. If the interface is abbreviated in the table, the abbreviation is shown in parentheses.

- SCSI
- EIA/TIA-574 (TIA/EIA)
- Diagnostic (Diag)
- All

The messages and recovery/explanations use abbreviations. These abbreviations are spelled out below:

LU	Logical Unit/Library Unit
REQ'D	Required
DEV	Device
Diag	Diagnostics
NVRAM	Nonvolatile RAM
A/D	Analog-to-Digital

Table A-1: Sense Data Values (Hexadecimal)

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
0	00	00	00	NO ADDITIONAL SENSE INFORMATION No recovery necessary.	All
2	04	00	07	LU IS NOT READY, CAUSE NOT REPORTABLE Check library unit power. Retry command.	All
2	04	01	07	LOGICAL UNIT IN PROCESS OF BECOMING READY Wait for library unit to complete initialization.	All
2	04	03	07	LU IS NOT READY, MANUAL INTERVENTION REQ'D Initialization failed. Determine failure type by checking any previous error code returned to host. Correct the cause of the failure and toggle ONLINE/STANDBY switch.	All
2	08	00	07	LOGICAL UNIT COMMUNICATION FAILURE Check cables. Ensure library unit is powered on. Retry command.	SCSI
B	08	01	07	LOGICAL UNIT COMMUNICATION TIME-OUT Check cables. Ensure library unit is powered on. Retry command.	SCSI EIA/TIA
5	1A	00	07	PARAMETER LIST LENGTH ERROR Invalid parameter list length specified by Mode Select command.	SCSI EIA/TIA
5	20	00	07	INVALID COMMAND OPERATION CODE Verify host command format using the TL820 Software Interface Guide.	SCSI EIA/TIA
5	21	01	07	INVALID ELEMENT ADDRESS Check Mode Sense data for correct element addresses.	SCSI EIA/TIA
5	24	00	07	INVALID FIELD IN COMMAND DATA BLOCK Ensure all reserve fields are set to zero.	SCSI EIA/TIA
5	25	00	07	LOGICAL UNIT IS NOT SUPPORTED Verify the logical unit field specified in the command contains a legitimate logical unit number. Check cabling to logical unit(s).	SCSI EIA/TIA
5	26	00	07	INVALID FIELD IN PARAMETER LIST Verify Mode Select page fields. Verify that fields comply with the command format described in the TL820 Software Interface Guide.	SCSI EIA/TIA

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
5	26	02	07	PARAMETER VALUE INVALID Verify Mode Select page fields. Verify that fields comply with the command format described in the TL820 Software Interface Guide.	All
6	28	01	07	IMPORT OR EXPORT ELEMENT ACCESSED IOD door has been closed	All
6	29	00	07	POWER-ON, RESET OR BUS DEV. RESET OCCURRED Informational message. No action is necessary.	All
-none- <u>OR</u> 5	30 30	03 03	07 07	CLEANING CARTRIDGE INSTALLED Indicates that the element contains a cleaning cartridge that is not “used-up”. <u>OR</u> CLEANING CARTRIDGE INSTALLED <ul style="list-style-type: none"> • A cleaning cartridge cannot be removed from a drive because it is being used in a cleaning operation. • A cartridge cannot be placed into the drive because the drive is being cleaned. • A cartridge cannot be placed into an empty storage element because it is reserved for a cleaning cartridge that is currently in use in a drive cleaning operation. 	SCSI EIA/TIA SCSI EIA/TIA
5	39	00	07	SAVING PARAMETERS NOT SUPPORTED Verify Save Parameter field in the Mode Sense command complies with the command format described in the TL820 Software Interface Guide.	SCSI EIA/TIA
5	3A	00	07	MEDIUM NOT PRESENT The inventory indicated that a cartridge was in this bin but no cartridge was sensed by the gripper when it attempted to pick it. Retry the command. Check for proper seating of the cartridge. It may also indicate that the tape is not ready to be picked from the drive because the tape is not fully unloaded. Retry the command. If the problem persists, check the function of the tape drive handle assembly. Manually unload the tape.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
5	3B	0D	07	MEDIUM DESTINATION ELEMENT FULL Destination element address already contains a cartridge. Issue a Read Element Status command and retry move command. If the problem repeats, issue an Initialize Element Status command followed by a Read Element Status command and retry move command.	All
5	3B	0E	07	MEDIUM SOURCE ELEMENT EMPTY Source element address does not contain a cartridge. Issue a Read Element Status command and retry move command. If problem repeats issue an Initialize Element Status command followed by a Read Element Status command and retry the move command.	All
B	45	00	07	SELECT OR RE-SELECT FAILURE TL820 timed out trying to reselect host. Make sure host is running.	SCSI
4	47	00	07	SCSI PARITY ERROR Check cable connections and cable length.	SCSI
B	49	00	07	INVALID MESSAGE ERROR Received invalid message from logical unit. Check cable connections and cable length.	SCSI
5	4E	00	07	OVERLAPPED COMMANDS ATTEMPTED Second command was sent to logical unit, when previous was executing.	EIA/TIA
5	53	02	07	MEDIUM REMOVAL PREVENTED Prevent Medium Removal command was executed and command was received to export cartridge. Execute Allow Medium Removal command and retry move medium command.	SCSI EIA/TIA
6	54	00	07	SCSI TO HOST SYSTEM INTERFACE FAILURE Possible SCSI bus time-out or premature disconnect. Check cable connections and cable length.	SCSI
-none-	5A	01	07	OPERATOR MEDIUM REMOVAL REQUEST Indicates that the element contains a cleaning cartridge that is "used-up" and the system is unable to export the cleaning cartridge.	SCSI EIA/TIA
2	80	00	07	DOOR IS OPENED INVENTORY MAY HAVE BEEN CORRUPTED Close door and retry command. If the system is ONLINE, it executes its initialization procedure.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
6	80	00	07	DOOR WAS OPENED INVENTORY MAY HAVE BEEN CORRUPTED Close door and retry command.	All
5	80	01	07	TRANSFER FULL - COMMAND CAN NOT BE EXECUTED Gripper has cartridge in it. Move cartridge to empty storage element using Move Medium command. Retry command.	All
5	80	02	07	BIN PAC MISSING If applicable, install the missing bin pac. Retry the command. If the problem persists, notify Field Service.	All
5	80	06	07	TRANSFER EMPTY - COMMAND CANNOT BE EXECUTED Gripper does not contain cartridge at beginning of place portion of Move Medium command.	All
B	80	06	07	TRANSFER EMPTY - COMMAND ABORTED Gripper does not contain cartridge at end of pick portion of Move Medium command.	All
2	80	07	07	SYSTEM IS EMERGENCY STOPPED (BUTTON IS CURRENTLY PUSHED) The STOP button on the status panel is in the on position. Press the STOP button to the off position.	All
6	80	07	07	SYSTEM STOP BUTTON WAS PRESSED (MAY CURRENTLY BE PRESSED) Check the STOP button. Retry command.	All
2	80	09	07	LOGICAL UNIT IS TURNED OFFLINE The ONLINE/STANDBY button on the status panel is in the STANDBY position. Press the ONLINE/STANDBY button to the ONLINE position.	SCSI EIA/TIA
6	80	09	07	LOGICAL UNIT STANDBY BUTTON WAS PRESSED Retry command.	SCSI EIA/TIA
B	80	10	07	LOAD RETRY FAILED TL820 was unable to successfully load the drive, even after retries. Check drive alignment. If problem continues, drive may need servicing	All
4	80	0A	07	NVRAM CHECKSUM FAILURE Nonvolatile RAM contents are corrupted. Ensure nonvolatile RAM ICs are seated correctly. Use the Diagnostic host to initialize nonvolatile RAM and calibrate system.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
B	80	0B	07	COMMAND ABORTED BY USER Informational message. No action is necessary.	All
5	80	0C	07	UNIT DISABLED Issue Start Unit command.	SCSI EIA/TIA
B	80	0D	07	CARTRIDGE IS ONLY PARTIALLY GRIPPED (ONLY SEEN IN THE FRONT SENSOR). Issue a Move Medium command to move the cartridge from the transfer element to an empty storage element.	All
4	80	0F	07	LOW POWER ERROR Check power connections.	All
B	80	21	07	INVENTORY TIMEOUT Scanning of a carousel face using the barcode scanner did not complete within acceptable time limits. Issue an Initialize Element Status command.	All
5	80	22	07	ELEMENT CONTENTS UNKNOWN The contents of an element address are unknown. Issue a Read Element Status for the element address. If contents are still unknown issue an Initialize Element Status command.	All
4	80	23	07	BARCODE DECODER COMMUNICATION FAILURE Unable to initialize decoder. Verify that the decoder is powered on. Cycle power and/or check cable connections.	All
B	80	80	07	LIGHT CURTAIN BLOCKED Visually inspect system for obstructions. If obstruction exists remove source of obstruction. If obstruction does not exist check light curtain sensor.	All
4	80	81	07	LIGHT CURTAIN TEST FAILURE Start initialization again, and verify extension axis is moving out far enough to break the light curtain. If it is, then the Field Engineer should inspect the light curtain sensors.	SCSI EIA/TIA
B	81	00	07	GRIPPER FAILURE Gripper not on sensors at end of move. Issue a Rezero Unit command.	All
B	81	01	07	GRIPPER TIMEOUT Gripper did not reach desired position. Issue a Rezero Unit command.	All
B	81	02	07	GRIPPER EXTEND PUSHER FAILURE Gripper did not reach pusher extended position. Issue a Rezero Unit command.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
B	81	03	07	GRIPPER OPEN FAILED ON EXTEND PUSHER Gripper did not reach open position. Issue a Rezero Unit command.	All
B	81	04	07	GRIPPER OPEN FAILURE Gripper did not reach open position. Issue a Rezero Unit command.	All
B	81	05	07	GRIPPER CLOSE FAILURE Gripper did not reach close position. Issue a Rezero Unit command.	All
B	81	10	07	GRIPPER INVALID STARTING POSITION Gripper position is unknown. Issue a Rezero Unit command.	All
4	81	20	07	GRIPPER SENSORS TEST FAILED Cartridge-in-Gripper sensors were not blocked by pusher during gripper self-test. Use Diagnostic interface to test pusher and Cartridge-in-Gripper sensors.	All
4	81	50	07	REAR CASSETTE IN GRIPPER SENSOR IS BLOCKED, BUT FRONT SENSOR IS CLEAR. Either the pusher is extended and blocking the sensor or possibly a cartridge is in the gripper, but the front sensor is not working. Issue a Rezero Unit command. If condition repeats, check for a cartridge in the gripper and issue a Move Medium to an empty storage element.	All
B	81	51	07	UNABLE TO PICK CARTRIDGE Cartridge was sensed in front gripper sensor, but was unable to seat cartridge in the rear gripper sensor. Check that gripper sensors are working and/or that tape was ejected far enough.	All
B	83	01	07	EXTENSION TIMEOUT Extension axis did not reach desired position. Retry command. If failure repeats use Diagnostic host to run extension self-test.	All
4	83	02	07	EXTENSION CURRENT FEEDBACK FAILURE Extension axis collided with obstruction. Determine cause of obstruction. Align and calibrate the system.	All
4	83	03	07	EXTENSION MECHANICAL POSITION ERROR Extension axis was unable to move to commanded position. Retry command. If failure repeats, use the Diagnostic host to run extension self-test.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
B	83	10	07	EXTENSION INVALID ACTUATOR START POSITION Extension axis position is unknown. Issue a Rezero Unit command.	All
4	83	21	07	EXTENSION ACTUATOR CURRENT FEEDBACK TEST FAILURE Unable to detect current feedback during self-test. Restart unit. If failure repeats, use Diagnostic host to run extension self-test.	All
4	83	22	07	EXTENSION ACTUATOR ENCODER (OR MOTOR) TEST FAILURE The value of the extension encoder did not change during self-test. Restart unit. If failure repeats, use Diagnostic host to run extension self-test.	All
4	83	81	07	EXTENSION A/D SELF-TEST FAILURE The analog to digital converter failed during self-test. Restart unit. If failure repeats, use Diagnostic host to run extension self-test.	All
4	83	83	07	EXTENSION DIGITAL SELF-TEST FAILURE Unable to toggle test bit during self-test. Restart unit. If failure repeats, use Diagnostic host to run extension self-test.	All
B	84	01	07	VERTICAL TIMEOUT Vertical axis did not reach desired position within the time limits. Retry command. If failure repeats, use the Diagnostic host to run vertical self-test.	All
4	84	02	07	VERTICAL CURRENT FEEDBACK FAILURE Vertical axis collided with obstruction. Determine and remove the cause of obstruction.	All
4	84	03	07	VERTICAL MECHANICAL POSITION ERROR Vertical axis did not reach desired position. Retry command. If failure repeats, use the Diagnostic host to run vertical self-test.	All
B	84	10	07	VERTICAL INVALID ACTUATOR START POSITION Position of vertical axis is unknown. Issue a Rezero Unit command.	All
4	84	21	07	VERTICAL ACTUATOR CURRENT FEEDBACK TEST FAILURE Unable to detect current feedback during self-test. Restart unit. If failure repeats, use Diagnostic host to run vertical self-test.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
4	84	22	07	VERTICAL ACTUATOR ENCODER (OR MOTOR) TEST FAILURE The value of the vertical encoder did not change during self-test. Restart unit. If failure repeats use Diagnostic host to run vertical self-test.	All
B	86	01	07	CAROUSEL TIMEOUT Carousel axis did not reach desired position. Retry command. If failure repeats use Diagnostic host to run carousel self-test.	All
B	86	02	07	CAROUSEL NOT ON FACE FLAG At the end of a carousel move, the carousel was not on a face flag. Issue a Rezero Unit command.	All
B	86	03	07	CAROUSEL MECHANICAL POSITION ERROR Carousel axis did not reach desired position. Retry command. If failure repeats, use the Diagnostic host to run vertical self-test.	All
B	86	04	07	CAROUSEL UNDEFINED POSITION Position of carousel axis is unknown. Issue a Rezero Unit command.	All
4	86	05	07	CAROUSEL IS MISSING FACE OR HOME FLAG Did not detect eight face flags during carousel homing or unable to find home flag.	All
B	86	06	07	CAROUSEL CORRECTION FAILURE Size of correction exceeded maximum correction size. Issue a Rezero Unit command.	All
4	86	07	07	CAROUSEL CURRENT FEEDBACK FAILURE Carousel axis collided with obstruction. Determine and remove the cause of obstruction.	All
B	86	08	07	CAROUSEL NOT ON HOME FLAG At the end of carousel homing, the carousel did not position itself on the home flag. Issue a Rezero Unit command.	All
B	86	10	07	CAROUSEL INVALID ACTUATOR START POSITION Position of carousel axis is unknown. Issue a Rezero Unit command.	All
4	86	21	07	CAROUSEL ACTUATOR CURRENT FEEDBACK TEST FAILURE Unable to detect current feedback during self-test. Restart unit. If failure repeats, use the Diagnostic host to run carousel self-test.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
4	86	22	07	CAROUSEL ACTUATOR ENCODER (OR MOTOR) TEST FAILURE The value of the carousel encoder did not change during self-test. Restart unit. If failure repeats, use the Diagnostic host to run carousel self-test.	All
4	86	81	07	CAROUSEL A/D SELF-TEST FAILURE The analog to digital converter failed during self-test. Restart unit. If failure repeats, use Diagnostic host to run carousel self-test.	All
4	86	83	07	CAROUSEL DIGITAL SELF-TEST FAILURE Unable to toggle test bit during self-test. Restart unit. If failure repeats, use the Diagnostic host to run carousel self-test.	All
6	88	00	07	WARNING SAFE TEMPERATURE EXCEEDED This is only a warning that the temperature in the system exceeds the normal operational temperature (91°F). This feature is not available on those units whose top assembly number is 6101280.	All
4	88	01	07	MAXIMUM TEMPERATURE EXCEEDED System will shutdown and remains shutdown until temperature is down to an acceptable level (below 111°F). This feature is not available on those units whose top assembly number is 6101280.	All
B	8A	00	07	MISSING CALIBRATION TOOL Calibration was started without the calibration tool inserted in the gripper. Insert calibration tool in gripper.	Diag
B	8A	01	07	MISSING CALIBRATION FLAG A calibration flag was not detected during calibration. Insert all required calibration cartridges.	Diag
5	8A	02	07	UNCALIBRATED POSITION System requires calibration.	All
5	8A	03	07	INVALID CALIBRATION PARAMETER A parameter entered during calibration was incorrect.	All
B	8B	00	07	PASS THROUGH BUSY An attempt was made to use a pass through that was already in use. Wait for busy pass through to complete. Retry command.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
B	8B	01	07	PASS THROUGH TIMEOUT The pass through failed to move the cartridge to the desired location within a time-out period.	All
4	8B	02	07	PASS THROUGH GATE FAILURE Unable to raise pass through gate.	All
B	8B	03	07	PASS THROUGH FULL An attempt was made to use a pass through that is occupied. Move cartridge from pass through and retry command.	All
B	8B	04	07	PASS THROUGH EMPTY An attempt was made to move a cartridge from an empty pass through. Place the desired cartridge on the pass through. Retry command.	All
4	8B	05	07	PASS THROUGH CURRENT FEEDBACK FAILURE The pass through is jammed. Determine and remove the cause of obstruction.	All
B	8B	07	07	NO CARTRIDGE ON PASS THROUGH No cartridge was detected on pass through during self test. Place a cartridge on the pass through. Retry command.	Diag
B	8B	08	07	CALIBRATE PASS THROUGH SENSORS The registration sensor on the pass through did not detect the cartridge correctly.	All
4	8B	30	07	PASS THROUGH MOTOR OR SENSOR FAILURE During PTM self test (vis diagnostic port only), a cartridge is passed between sensors on the PTM. This error is returned if any of the PTM sensors do not transition. This could occur due to a faulty sensor or motor.	Diag
B	8C	01	07	IOD TIMEOUT The Inport/Outport Device failed to move the cartridge from the INPORT within a time-out period.	All
B	8C	02	07	IOD OUTPORT FULL The cartridge OUTPORT is full. Open the outport door and remove the cartridges. Retry command.	All
B	8C	03	07	IOD INPORT FULL A cartridge is present in the INPORT at selftest start-up. Remove the cartridge. Retry command.	Diag
B	8C	04	07	IOD INPORT EMPTY An attempt was made to move a cartridge from an empty INPORT. Place the desired cartridge in the INPORT. Retry command.	All

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
4	8C	05	07	IOD CURRENT FEEDBACK FAILURE The IOD INPORT is jammed. Determine and remove the cause of obstruction.	All
B	8C	06	07	IOD INPORT DOOR IS OPEN The INPORT door on the IOD is open. Close INPORT door. Retry command.	All
B	8C	07	07	IOD INPORT REGISTRATION A cartridge is detected in the INPORT but it is improperly registered. Reseat the cartridge. Retry command.	All
B	8D	01	07	STEPPER MOTOR TPU TIMEOUT CPU failure. Retry command. If failure repeats, power cycle unit. Use diagnostic host to self test stepper.	All
B	8D	02	07	STEPPER MOTOR MOVE TIMEOUT CPU failure. Retry command. If failure repeats, power cycle unit. Use diagnostic host to self test stepper.	All
4	8D	05	07	STEPPER MOTOR HARDWARE ERROR Stepper was unable to reach destination (open or close). Retry command. If failure repeats use diagnostic host to self test stepper.	All
4	8D	03	07	STEPPER MOTOR TPU RAM ERROR CPU failure. Retry command. If failure repeats, power cycle unit. Use diagnostic host to self test stepper.	All
4	8D	04	07	STEPPER MOTOR TPU REGISTER ERROR CPU failure. Retry command. If failure repeats, power cycle unit. Use diagnostic host to self test stepper.	All
4	8D	06	07	STEPPER MOTOR CURRENT FEEDBACK TEST FAILURE Unable to sense current feedback from stepper motor controller. Use diagnostic host to self test stepper.	All
4	8E	01	07	FLASH MEMORY UNABLE TO IDENTIFY Replace flash memory on CPU.	Diag
4	8E	02	07	FLASH MEMORY UNABLE TO ERASE Replace flash memory on CPU.	Diag
4	8E	03	07	FLASH MEMORY UNABLE TO PROGRAM Replace flash memory on CPU.	Diag
B	8F	00	07	LIBRARY UNIT COMMAND TIMED OUT Verify communications to Library Unit still exist by issuing another command	SCSI EIA/TIA

Sense Key	ASC	ASCQ	ASL	Description Recovery/Explanation	Host Interface
B	8B	80	07	PTM DOOR OPEN ERROR The PTM cannot complete an operation because a unit door is open. Close all doors. Retry operation.	SCSI EIA/TIA
B	8B	81	07	PTM DOOR STOPPED ERROR The PTM cannot complete an operation because another unit has stopped operating. Retry operation.	SCSI EIA/TIA
B	8B	82	07	PTM LIGHT CURTAIN ERROR The PTM cannot complete an operation because a light is broken. Visually inspect system for obstructions. If obstruction exists remove source of obstruction. If obstruction does not exist check light curtain sensor. Retry operation.	SCSI EIA/TIA
B	8B	83	07	PTM UNIT OFFLINE ERROR The PTM cannot complete an operation because a unit is off-line. Check the STOP button. Retry command. Check the ONLINE/STANDBY button on the status panel. Press the ONLINE/STANDBY button to the ONLINE position. Retry operation.	SCSI EIA/TIA
B	8B	84	07	PTM LIGHT CURTAIN ERROR The PTM cannot complete an operation because of an over-temperature condition. Visually inspect system. If an over-temperature condition exists, power-down the library and notify Field Service. If over-temperature condition does not exist, check sensors. Retry operation.	SCSI EIA/TIA
B	8B	85	07	PTM CONCURRENT The PTM cannot complete an operation because another PTM is operating. Retry operation.	SCSI EIA/TIA

Appendix B:

Control Panel Status Codes

The Control Panel communicates error and status information using display codes. The display codes and their descriptions are listed in Table B-1.

Table B-1: Control Panel
Status Codes

Code	Code Description
00	System online and ready to accept host commands.
01	System offline and ready to accept diagnostic commands.
2a	STOP button depressed.
2b	Door open (front or back).
2C	System performing power-up sequence.
2d	System is initializing actuators and taking inventory.
2f	Low Power Error
3a	Error occurred during initialization of actuator prior to coming online.
3b	Error occurred during actuator self-test prior to coming online.
3C	Inventory failed.
4a	Extension home failed.
4b	Extension test failed.
4C	Carriage A/D failed.
4d	Carriage diagnostic test failed.
5a	Vertical home failed.
5b	Vertical test failed.
6a	Carousel home failed.
6b	Carousel test failed.
6C	Carousel A/D test failed.

Code	Code Description
6d	Carousel digital test failed.
7a	Gripper home failed.
7b	Gripper test failed.
8b	Light curtain test failed.
8C	Light curtain broken.
d0-dF	Downloading (one digit increments every sixteen S-Records received).
E0	Downloader ready.
E1	Downloader complete.
EA	Can't identify flash memory.
Eb	Can't erase flash memory.
EC	Can't program flash memory.
F0-F7	Carousel is on face indicated (0-7).
FF	MPU firmware at location U3 & U4 missing or defective

Appendix C:

Automatic Drive Cleaning

Specification

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Purpose and Scope

This appendix presents a specification for the implementation of the Automatic Drive Cleaning features on mid-range DLT tape libraries.

Availability of Automatic Drive Cleaning Features

Automatic Drive Cleaning features are only available on library unit models equipped with the necessary support electronics and hardware. The software checks to ensure that the configured model number is 6200213. With the model number verified, the software enables the Automatic Drive Cleaning features.

Drive Cleaning Modes

Two modes of drive cleaning support are provided on mid-range DLT libraries: Host Initiated Cleaning Mode and Fully Automatic Cleaning Mode.

Host Initiated Cleaning Mode

Drive cleaning in host initiated cleaning mode is initiated by the host. Although the library unit will internally track cleaning cartridge movement and use, the library unit provides no cleaning support in host initiated cleaning mode. The host is responsible for all cleaning functions such as detecting when a drive requires cleaning, tracking and selecting cleaning cartridges, initiating media movement of the cleaning cartridge to the drive and determining when a cleaning cartridge has been “used up”.

Fully Automatic Cleaning Mode

Drive cleaning in fully automatic cleaning mode is initiated by the library unit when it determines that a drive requires cleaning. The library unit will monitor each drive’s status to determine when a drive requires cleaning (see section , “Monitoring Drives”, on page 9). When the library unit determines that cleaning for a drive is required, the library unit selects an available cleaning cartridge, handles media movement of the cleaning cartridge to and from the drive, and supervises the cleaning operation in the drive (see section , “Drive Cleaning/Cleaning Cartridge Export Operations”, on page 10). The library unit will track cleaning cartridges within the library, monitor cleaning cartridge use and determine when a cleaning cartridge has been “used up”, and export “used up” cleaning cartridges from the library (see section , “Cleaning Cartridges”, on page 6).

Selection of Cleaning Mode

The cleaning mode will be selectable by using either the diagnostic software interface, or through a host initiated Mode Select command. A host initiated Mode Select command is the only way to permanently change the cleaning mode in the library unit's nonvolatile memory. The default cleaning mode will be host initiated cleaning mode, which essentially disables all library unit support for drive cleaning. The cleaning mode, if saved in the library unit's nonvolatile memory, will be retained when the library unit power is cycled.

Selection Using the Diagnostic Software Interface

The cleaning mode will be selectable using the diagnostic software interface. The cleaning mode selected using the diagnostic software interface will be retained only until the library unit is power cycled. The diagnostic software interface can not permanently change the cleaning mode in the library unit's nonvolatile memory.

To enable fully automatic cleaning mode, the command "AUTO CLEAN ENABLE" must be issued to the diagnostic interface either directly or by using the diagnostic software. To enable host initiated cleaning mode, the command "AUTO CLEAN DISABLE" must be issued to the diagnostic interface either directly or by using the diagnostic software.

Selection Using a Host Initiated Mode Select Command

The cleaning mode will be selectable using a host initiated Mode Select command. The cleaning mode may be set in the vendor unique page, which can be permanently saved to the library unit's nonvolatile memory by the host using the Save Page bit. A host initiated Mode Select command is the only method that can permanently change the cleaning mode in the library unit's nonvolatile memory. Note that a SCSI bus reset will not change the cleaning mode.

To enable fully automatic cleaning mode, the host must set bit number 1 in the first parameter byte following the Page Length byte in the vendor unique page. To enable host initiated cleaning mode, the host must clear bit number 1 in the first parameter byte following the Page Length byte in the vendor unique page. The cleaning mode can be permanently saved to the library unit's nonvolatile memory by the host using the Save Page bit.

Reporting of Cleaning Mode

Reporting of the current cleaning mode may be obtained by using either the diagnostic software interface, or through a host initiated Mode Sense command.

Reporting Using the Diagnostic Software Interface

The diagnostic software interface can be used to obtain a report of the current cleaning mode. To obtain a report of the current cleaning mode, the command “AUTO CLEAN REPORT” must be issued to the diagnostic interface either directly or by using the diagnostic software. In response, the current cleaning mode will be shown, as well as the cleaning required status of each drive, and the bar code label, number of uses, and storage element location for each cleaning cartridge in the library unit.

Reporting Using a Host Initiated Mode Select Command

A host initiated Mode Sense command can be used to obtain a report of the current cleaning mode as well as if the cleaning mode is changeable, the default cleaning mode, and the cleaning mode permanently saved to the library unit’s nonvolatile memory. The type of report requested is determined by the Page Control field of the Mode Sense command, and the data is located in bit number 1 in the first parameter byte following the Page Length byte in the vendor unique page. A bit value of 1 indicates fully automatic cleaning mode is enabled, or that the mode is changeable, as appropriate. A bit value of 0 indicates that host initiated cleaning mode is enabled, or that the mode is not changeable, as appropriate.

Cleaning Cartridges

In host initiated cleaning mode, the host is fully responsible for identifying, tracking, and monitoring cleaning cartridges. Although the library unit will internally track cleaning cartridge locations and use, this information is not available to the host in host initiated cleaning mode. In fully automatic cleaning mode, the library unit will track cleaning cartridge locations, monitor cleaning cartridge use to determine when a cleaning cartridge has been “used up”, and export used cleaning cartridges from the library.

Cleaning Cartridge Capacity

A maximum of ten cleaning cartridges may be present in the library unit at any given time. If an attempt is made to import additional cleaning cartridges, the library unit will export the additional cleaning cartridges.

Identification of Cleaning Cartridges

Cleaning cartridges will be identified with a uniquely identifiable bar code. A bar code for a cleaning cartridge must begin with the prefix “CLN”, for example “CLN001”.

Storage and Tracking of Cleaning Cartridges

A cleaning cartridge will be tracked by the library unit from the time it is imported into the library until the time it is exported from the library. Once a cleaning cartridge with a particular bar code is exported from the library, the library unit will no longer retain knowledge of that cleaning cartridge. If a cleaning cartridge with the same bar code is subsequently imported into the library, it will be considered a different cleaning cartridge for all tracking and monitoring purposes.

A cleaning cartridge is imported by the host to an available storage element or directly to a drive. The library unit will begin tracking the cleaning cartridge and monitoring its use following a successful identification of it using the bar code scanner.

There may only be one cleaning cartridge with a given bar code stored in the library. If an attempt is made to import a cleaning cartridge with a bar code identical to one which is currently stored in the library, the library unit will export the new cleaning cartridge.

As the library unit determines that drives require cleaning and cleaning cartridges are used to clean the drives, the library unit will track the movement of the cleaning cartridges and their current location within the library. When a cleaning cartridge has been “used up”, the cleaning cartridge will be exported from the library.

The library unit will track cleaning cartridges that are moved by a host initiated Move Medium command or by a movement command initiated from the diagnostic interface.

The library unit will attempt to adjust for cleaning cartridges that are manually moved within the library while the library unit is off line. When an inventory is performed when a library unit is powered up or brought back on line, the library unit will scan the library for cleaning cartridges. For each cleaning cartridge, it will first check if previous records show that a cleaning cartridge with the same bar code was in the same location. If so, the library unit assumes that it is the same cleaning cartridge and retains all cleaning cartridge information, such as the use count, etc. If previous records do not show a cleaning cartridge with the same bar code at the current location, the library unit will then check if a cleaning cartridge with the same bar code label was previously located at another location (and is not currently at that other location). If so, the library unit assumes that it is the same cleaning cartridge that was manually moved, and retains all cleaning cartridge information, such as the use count, etc. If the library unit can not locate a previous record for the cleaning cartridge, it will assume the cleaning cartridge is new and create a new record for it.

Monitoring Cleaning Cartridge Use

The library unit will maintain a usage history for each cleaning cartridge currently contained within the library unit. The usage history will consist of a count of the number of times that the cleaning cartridge was used to clean a drive and a indicator which indicates that the cleaning cartridge has been “used up.”

When a cleaning cartridge has been successfully identified and imported to the library, the usage history for that cleaning cartridge will be initialized so that the use count is 0 and the “used up” indicator is false.

Each time a cleaning cartridge is removed from a drive via the robotics (which is assumed to imply that a drive cleaning operation has completed, either successfully or unsuccessfully), the use count for the cleaning cartridge used in the drive cleaning operation will be incremented. If the use count has then reached the maximum allowable number of uses of 20, the “used up” indicator will be set to true, and in fully automatic cleaning mode the cleaning cartridge will be exported from the library. Note that a library unit will update use counts for cleaning cartridges that are used in host initiated cleaning operations (regardless of the cleaning mode), as well as those used in library initiated cleaning operations.

Some error conditions (such as described in section , “Supervising the Drive Cleaning Operation”, on page 11) may result in the cleaning cartridge’s “used up” indicator being set to true before its use count has reached the maximum allowable number of uses. In these cases, the cleaning cartridge will be exported from the library with its use count less than the maximum.

When a cleaning cartridge has been exported from the library, all record of that cleaning cartridge will be deleted and all monitoring of that cleaning cartridge will cease.

Element Status Information

The presence of cleaning cartridges will result in the reporting of additional status information in response to host initiated Read Element Status commands. This additional information will only be present in fully automatic cleaning mode, and will be suppressed in host initiated cleaning mode. The additional information may consist of the Except bit being set and the Additional Sense Code and Additional Sense Code Qualifier values being filled in, as well as possible changes to the Access bit, as described below.

A storage element that contains a cleaning cartridge that is not used up will have the Access bit set to 1, the Except bit set to 1, and the status set to Cleaning Cartridge Installed (ASC=30 ASCQ=03). A storage element that contains a cleaning cartridge that has been used up will have the Access bit set to 1, the Except bit set to 1, and the status set to Operator Medium Removal Request (ASC=5A ASCQ=01). A storage element that is empty but is the home location for a cleaning cartridge that is currently being used in a cleaning operation will have the Access bit set to 0, the Except bit set to 1, and the status set to Cleaning Cartridge Installed (ASC=30 ASCQ=03).

A data transfer element that is currently being cleaned as part of a fully automatic cleaning operation will have the Access bit set to 0, the Except bit set to 1, and the status set to Cleaning Cartridge Installed (ASC=30 ASCQ=03).

A data transfer element that contains a cleaning cartridge placed there by the host will have the Access bit set to 1, the Except bit set to 0 and the status set to Cleaning Cartridge Installed (ASC=30 ASCQ=03).

Monitoring Drives

In host initiated cleaning mode, the host is fully responsible for monitoring the drives to determine when a drive indicates that cleaning is required. In fully automatic cleaning mode, the library unit will monitor the drives to determine when a drive indicates that cleaning is required.

Drive Interface

The library will examine the drive flag “CLEANING_REQUIRED”. When this flag is set, it will indicate that the drive requires cleaning.

Drive Monitoring

All installed drives will be checked following the completion of a system inventory, and all drives meeting the conditions detailed in section , “Drive Interface”, on page 9, will be noted as requiring cleaning. The library unit will select only one drive for cleaning per check. A drive which is currently being cleaned will not be selected. If a drive is the latest drive cleaned, it will not be selected unless it is the only drive that requires cleaning. On the completion of a Move Medium command from any drive, only that drive will be checked, and if it meets the conditions detailed in section , “Drive Interface”, on page 9, it will be noted as requiring cleaning.

Initiating Drive Cleaning Operations

In host initiated cleaning mode, the host is fully responsible for initiating drive cleaning operations. In fully automatic cleaning mode, the library unit will initiate drive cleaning operations. The host may choose to initiate a drive cleaning operation while in fully automatic cleaning mode. In these cases, the library unit will update the cleaning cartridge’s use count, but will not perform any other support functions for the cleaning operation.

In fully automatic cleaning mode, the library unit will initiate a cleaning operation for a drive immediately after it has been determined that it requires cleaning. If more than one drive requires cleaning simultaneously, the cleaning operation for the lowest numbered drive only will be initiated. The remaining drives that require cleaning will be serviced the next time they are checked.

Drive Cleaning/Cleaning Cartridge Export Operations

In host initiated cleaning mode, the host is fully responsible for all drive cleaning operations, such as selecting an available cleaning cartridge, handling the media movement of the cleaning cartridge to and from the drive, and supervising the cleaning operation in the drive, and for all cleaning cartridge export operations. In fully automatic cleaning mode, the library unit will handle all drive cleaning operations, such as selecting an available cleaning cartridge, handling the media movement of the cleaning cartridge to and from the drive, and supervising the cleaning operation in the drive, and all cleaning cartridge export operations.

Selection of Cleaning Cartridges

When a drive cleaning operation is initiated, the library unit will select an available cleaning cartridge to use. Cleaning cartridges with their “used up” indicator set to true will not be considered for use.

If no available cleaning cartridge can be found, the drive cleaning operation will not proceed (since the drive will still indicate that it needs cleaning, a new drive cleaning operation will be attempted the next time the drive is checked).

Media Movement to the Drive

When a cleaning cartridge has been successfully selected, the library unit will attempt to move the cleaning cartridge to the drive requiring cleaning. If the movement operation can not be successfully completed due to unrecoverable errors, the drive cleaning operation will not proceed (since the drive will still indicate that it needs cleaning, a new drive cleaning operation will be attempted the next time the drive is checked). Wherever possible, the library unit will attempt to return the cleaning cartridge back to its storage element. If an unrecoverable error occurs during the movement of a cleaning cartridge that prevents a subsequent host initiated command from successfully completing, the subsequent host initiated command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return the appropriate error (such as transfer element full).

The host may issue a command requiring the transport while the library initiated cleaning cartridge movement is in progress. If this occurs, the host initiated command will be held until the library initiated movement command has completed. If an error occurs with the library initiated movement command, the host initiated command will be processed following the error, but will likely encounter an error condition resulting from the previous library initiated command. If so, the subsequent host initiated command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return the appropriate error (such as transfer element full).

If the host attempts to move another cartridge to the cleaning cartridge’s original location while the cleaning cartridge is being used in a cleaning operation, the host’s attempted Move Medium command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return a Cleaning Cartridge Installed status (SK=5 ASC=30 ASCQ=03). The cleaning cartridge’s original location will not become available until either the library unit determines that the cleaning cartridge’s location has been emptied (with an Initialize Element Status), the cleaning cartridge is moved to a different storage element, or the cleaning cartridge is exported from the library.

Supervising the Drive Cleaning Operation

When a cleaning cartridge has been successfully placed into the drive requiring cleaning, the drive will automatically load the cartridge and initiate the cleaning operation. The library unit will be available to service host initiated commands during the drive cleaning operation.

If the host attempts to move a cartridge into the drive that is being cleaned, the command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return a Cleaning Cartridge Installed status (SK=5 ASC=30 ASCQ=03).

Upon successful completion of the cleaning operation, the drive will automatically rewind the cleaning cartridge to be at bottom, and unload the cleaning cartridge. Unsuccessful drive cleaning operations may not rewind and unload the cartridge, especially if it is a regular data cartridge incorrectly labeled as a cleaning cartridge. If a drive does not automatically unload a cleaning cartridge following a drive cleaning operation, then the library unit will force an unload of the cartridge.

The library unit will monitor the drive flag "HANDLE_OK" to determine when the cleaning cartridge has been unloaded by the drive.

When the cleaning cartridge has been unloaded, the cleaning operation will be considered completed. The library unit will only attempt to clean the drive once each time it is checked, and if the cleaning operation was not successful the drive will not be serviced again until the next time the drive is checked as described in section , "Drive Monitoring", on page 9.

The library unit will monitor the total time taken for the cleaning operation. If the cleaning operation has not completed within the maximum time limit of 5 minutes, the library unit will force an unload of the cleaning cartridge from the drive, and the library unit will set the cleaning cartridge's "used up" indicator to true, causing the cleaning cartridge to be exported from the library (see section , "Monitoring Cleaning Cartridge Use", on page 8). The drive will again be serviced the next time the drive is checked as described in section , "Drive Monitoring", on page 9.

Media Movement from the Drive

When the cleaning operation has been successfully or unsuccessfully completed, the library unit will increment the cleaning cartridge's use count and attempt to move the cleaning cartridge from the drive to either a storage or export element.

If upon completion of the cleaning operation the cleaning cartridge has not been marked as "used up", the library unit will attempt to move the cleaning cartridge to the storage element that the cleaning cartridge originally occupied prior to the cleaning operation. If that storage element is occupied, the library unit will attempt to export the cleaning cartridge from the library.

If upon completion of the cleaning operation the cleaning cartridge has been marked as "used up", the library unit will attempt to export the cleaning cartridge from the library. If the export element is not available (the export is full, the pass through element is occupied, or on a multi-unit library with no export element), the cleaning cartridge will be returned to its previous storage location.

If an export or movement operation can not be successfully completed due to unrecoverable errors, the library unit will wherever possible attempt to return the cleaning cartridge back to its original storage element and clear the transport element. If an unrecoverable error occurs during the movement of a cleaning cartridge that prevents a subsequent host initiated command from successfully completing, the subsequent host initiated command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return the appropriate error (such as transfer element full).

Exporting Cleaning Cartridges

Each time a cleaning operation is successfully or unsuccessfully completed, the library unit will attempt to export all cleaning cartridges that have been marked as “used up.”

If the cleaning cartridge for the just completed cleaning operation has been “used up”, it will be exported first.

If the cleaning cartridge for the just completed cleaning operation has not been “used up”, it will be moved to its original storage element, and the library unit will then search for other “used up” cleaning cartridges.

After each successful export of a “used up” cleaning cartridge, the library unit will search for other cleaning cartridges that have been marked as “used up.” The library unit will continue attempting to export “used up” cleaning cartridges until either there are no more “used up” cleaning cartridges, or an export operation fails to successfully complete.

If an export operation for a cleaning cartridge can not be successfully completed because the export elements are full, the library unit will attempt to return the cleaning cartridge to its original storage element (it will continue to be marked as “used up”), and no further attempts will be made to export cleaning cartridges until the next cleaning operation completes.

If an export or movement operation can not be successfully completed due to unrecoverable errors, the library unit will wherever possible attempt to return the cleaning cartridge back to its original storage element and clear the transport element. If an unrecoverable error occurs during the movement of a cleaning cartridge that prevents a subsequent host initiated command from successfully completing, the subsequent host initiated command will fail, Check Condition will be set in the returned status byte, and a subsequent Request Sense will return the appropriate error (such as transfer element full).

Glossary

actuator	Refers to one of the four motored assemblies in the TL820: gripper, extension, vertical and carousel.
alignment	In the context of this manual, alignment refers to the mechanical adjustments required for successful operation of the TL820 library.
alignment cartridge	An alignment aid in the general form of a DLT cartridge. There are two types of alignment cartridges: a tape drive alignment cartridge which has flanges to keep it from being stuck in a drive, and a bin pack alignment cartridge which fits into a bin pack.
alignment tool	An alignment aid which seats in the gripper and is used in conjunction with the alignment cartridges.
asynchronous event notification	Optional, unsolicited event protocol specified in SCSI II standard.
Automated Cartridge Library	A robotic storage and retrieval system for tape cartridges.
auto-clean	This term refers to the Automatic Drive Cleaning feature. Two modes of drive cleaning support are available on library units with a Model Number of 6200213: Host Initiated and Fully Automatic. (See “Appendix C” for a detailed discussion.)
barcode	In the context of this manual, the machine-readable label on DLT cartridges.
carousel	The eight-sided rotating cylinder in the center of the library unit which holds bin packs with DLT cartridges.
carousel face	One side of the eight-sided carousel.
control panel	The panel containing the display, fault light, and control buttons on the front door of the TL820 library unit.
data transfer element	The tape drive installed in a library unit.
EIA/TIA-574	Serial communications cabling and protocol standard for 9-pin connectors, sometimes called RS232.
element	An addressable physical component of the TL820 that can serve as the location of a unit of media.
host	See host computer.
host computer	The computer which issues high-level pick and place commands to control the TL820 library.
import export element	Refers to the PTM, the inport or the outport of the TL820
initiator	In this manual, SCSI II terminology for the host computer.

inport	Refers to the portion of the IOD which allows the operator to import a cartridge into tape library.
IOD	Inport/Outport device.
LED	Light Emitting Diode.
library unit	A single TL820 cabinet and the robotics therein.
logical unit	The number used to reference an individual library unit.
medium changer device	SCSI terminology referring to devices which mechanize the movement of media to and from primary devices (such as tape drives).
medium transport element	A component of the TL820 that is used to move units of media. Also known as the transport mechanism.
MUC	Multi-Unit Controller. A component of the TL820 library unit which permits the TL820 library to communicate to a host computer using a SCSI interface and which directs the control signals from the host computer to each of the units in the library.
on-line	Ready for communication with a host computer.
operation	Refers to entire SCSI operation from initiation by host to completion of command by target.
output	Refers to the portion of the IOD which holds cartridges exported from the tape library.
pick	The act of removing a cartridge from one location in preparation for placing it in another location.
place	The act of placing a cartridge in a location after it has been picked from another location.
PTM	Passthrough Mechanism
SCSI	Small Computer System Interface (SCSI) communications standard for attaching peripheral equipment to computers. In the context of this manual it always refers to the SCSI II standard.
storage elements	Elements correspond to the bins in the tape cartridge carousel. One storage element exists per bin.
tape drive	The mechanism which reads and writes data to and from a tape.
target	In this manual, SCSI II terminology for the TL820 device.
transport mechanism	This mechanism consists of the vertical and extension axes and the gripper. It is used to move media between any of the storage and/or data transfer elements.

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