CONTEMPORARY

CYBERNETICS Group

CY-8200
CARTRIDGE TAPE
SUBSYSTEM

USER'S MANUAL

DEC TU81 - B

CONTENTS

CONTEMPORARY CYBERNETICS

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CARTRIDGE TAPE
SUBSYSTEM

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1 INTRODUCTION

This publication describes the operation of the Contemporary Cybernetics Group, Inc.'s (CCG) 2 Gigabyte 5.25" SCSI tape subsystem. Information necessary for incorporation of the CY-8200 tape subsystem into any DEC Q-Bus and Unibus system is included in this publication.

1.1 GENERAL DESCRIPTION

The CY-8200 tape subsystem consists of two major components: the 8mm cartridge tape subsystem and the bus adaptor interface card.

1.1.1 CY-8200 Tape Subsystem

The CY-8200 is a high performance, high capacity 8mm cartridge tape subsystem that incorporates an integral SCSI bus interface. The subsystem utilizes advanced helical scan technology which affords a very high areal recording density and data storage capacity. It uses the industry standard 8mm tape cartridge, which is removable and rewritable. The cartridge stores more than 2 Gigabytes (2000mb) of formatted user data. The CY-8200 conforms to the dimensions of the industry standard 5.25" form factor.

Features of the CY-8200 tape drive include:

- Advanced Helical Scan Recording Technology
- Industry Standard Removable, Rewritable 8mm Tape Cartridge
- Five Tape Cartridge Sizes: 256mb to over 2GB of Formatted User Data Capacity
- Industry Standard 5.25" Form Factor
- Integrated SCSI Controller and Formatter Electronics
- Full Disconnect, Arbitration, Reconnect Support

- Powerful, Onboard Error Correction Code (ECC)
- Error Recovery Procedures Implemented in Cartridge Tape Subsystem Controller
- Read-After-Write Error Checking and Automatic Re-Write
- Non-Recoverable Error Rate of less than One Bit in 10E13 Bits Read
- High Performance SCSI Bus Data Transfer Rates of up to 1.5mb per second
- Integrated 256kb Speed-Matching Buffer
- High Performance Read/Write Access Times
- Effective Head to Tape Speed of 150" per second

1.1.2 CY-8200 Bus Adaptor Card

The CY-8200 is an intelligent SCSI host adaptor which is fully compatible with the DEC Tape Mass Storage Control Protocol (TMSCP).

The CY-8200 supports 16K bytes sector buffer, command queuing, standard SCSI bus arbitration, disconnect and reconnect, and all required SCSI commands. Up to seven SCSI target devices can be connected to CY-8200 with SCSI bus data transfer rate up to 2M bytes per second.

1.2 HARDWARE MODELS

The CY-8200 is available in two models:

1.2.1 CY-8200-Q

The CY-8200-Q is an add-on sub-system designed to be integrated into a DEC Q-Bus machine. A SCSI controller is required in order to operate the CY-8200 and is included as part of the CY-8200-Q model. The CY-8200 is mounted into an attractive stand-alone case with power supply. All cabling required to interface the CY-8200 into a Q-Bus system is provided with the CY-8200-Q.

1.2.2 CY-8200-U

The CY-8200-U is an add-on sub-system designed to be integrated into a DEC Unibus machine. A SCSI controller is required in order to operate the CY-8200 and is is included as part of the CY-8200-U model. The CY-8200 is mounted into an attractive stand-alone case with power supply. All cabling required to interface the CY-8200 into a Unibus system is provided with the CY-8200-U.

2 INSTALLATION

Chapter 2 is designed to assist with the following procedures:

- DETERMINING THE BUS ADAPTER ADDRESS
- SETTING THE BUS ADAPTER ADDRESS
- PHYSICALLY INSTALLING THE BUS ADAPTER
- INITIAL TESTING OF ADAPTER

2.1 DETERMINING BUS ADAPTER ADDRESS (VMS)

Each time a VMS system is booted, the VMS 'SYSGEN' utility is invoked to determine what physical I/O devices are present and to bring them online and attach their drivers. The CY-8200 represents a "TU81" type device to VMS. If the CY-8200 bus adapter is jumpered with the correct port address(es), VMS will automatically detect and configure it.

WARNING: On certain VMS system configurations, the addition of the CY-8200 bus adapter will require the readdressing of one or more of the previously existing cards in the bus, in order for the system to reconfigure. Please seek additional technical help if you are not certain of the ramifications of the installation of the bus adapter.

To determine the proper addresses for a CY-8200 bus adapter board in a VMS system, the user should use the SYSGEN 'CONFIGURE' utility:

1. On a running VAX/VMS system, log on as the system manager, and run the SYSGEN utility:

   $ MC SYSGEN <CR>
   SYSGEN>

2. Enter the CONFIGURE facility of SYSGEN as follows:

   SYSGEN> CONFIGURE> <CR>
   DEVICE>

3. At the DEVICE prompt, enter the list of Q-bus or Unibus options present in your VAX system. Make sure that each device count is correct and the MSCP TU81 device counts include both existing devices and the new CY-8200 bus adapter. Refer to the table below for a list of common options and their DEVICE names. (A complete list of the SYSGEN device table may be found in the VMS documentation associated with SYSGEN.)

   For example, suppose you are installing a CY-8200 Q-bus adapter in a MicroVAX system with a TK50, an RD54, a DZV11, and a DEQNA Ethernet controller. The CY-8200 bus adapter represents one one 'TU81' tape port, no matter how many drives are attached to it. Adding these to the existing devices, enter:

DEVICE> QNA	(one DEQNA)
DEVICE> DZ11	(one DZV11)
DEVICE> UDA	(one MSCP disk port)
DEVICE> TU81 2	(two MSCP tape ports)

4. When all devices have been entered, press CTRL Z to end the input session and display the results. Each device will be listed along with its port name, CSR address, interrupt vector, and driver support status. The new CY-8200 bus adapter ports will be the last TU81 device listed. For the CY-8200 Q-bus adapter QTO in the above example, SYSGEN will display:

2.2 Q-BUS

CY-8200 bus adapter model for the Q-bus appears to the Host computer as one mass-storage port, implementing DEC's Tape MSCP protocol. The port works with SCSI magnetic tapes, which appear to the Host system as 'MU' devices. Table 2-4 provides the port address options that are available.

2.2.1 Setting The Bus Adapter Address

Table 2-4 CSR Address Options (Q-Bus)

	SW4				
SWITCHES	4	3	2	1	CSR Address
	0	0	0	0	17774500
	0	0	0	1	17760404
	0	0	1	0	17760410
	0	0	1	1	17760414
	0	1	0	0	17760444
	0	1	0	1	17760450
	0	1	1	0	17760454
	0	1	1	1	17760504
	1	0	0	0	17760510
	1	0	0	1	17760514
	1	0	1	0	17760520
	1	0	1	1	17760524
	1	1	0	0	17760530
	1	1	0	1	17760534
	1	1	1	0	17760540
	1	1	1	1	17760544

The CY-8200 Bus Adapter is shipped with interrupt level 4 selected. This is the standard priority for TMSCP devices. It may be changed to level 5 as desired.

Jumper R-S in interrupt level 5
Jumper P-R in interrupt level 4 (Standard)

The following switches should have the indicated settings:

SWITCH 1

1	2	3	4
OFF	OFF	OFF	OFF

SWITCH 4

5	6	7	8	9	10
OFF	OFF	OFF	OFF	OFF	OFF

2.2.1.1 File Search Special Consideration

Certain special applications are not compatible with high speed file searches. You may disable them by setting SW1-2 "ON".

2.2.2 Physical Installation

The following procedures suppose some familiarity with the card case and backplane on your computer. If you are not certain concerning any steps listed below, please seek additional technical help.

The Q-Bus CY-8200 bus adapter models require a single quad-wide slot in the Q-Bus backplane. Because the CY-8200 bus adapter system is fully buffered, DMA priority is not critical. The CY-8200 bus adapter supports only single-level interrupt priorities, so it should be placed AFTER any multi-level interrupting devices on the Q-Bus. There must be no unused slots between the CPU and the bus adapter.

Important Note: The old DEC RQDX1 (RX50/RD51/RD51) controller does NOT pass DMA grants. The CY-8200 bus adapter must be installed AHEAD of the RQDX1 in the backplane.

Perform the following steps to complete the installation:

1. Unpack the bus adapter board, and add the part, serial and revision numbers to the System History Label.

2. Remove the system cover to allow access to the system card cage.

3. Install the bus adapter *after* any multi-level interrupting devices and *ahead* of the RQDX1 in the backplane.

4. A 50 conductor ribbon cable that may be used to connect the CY-8200 bus adapter directly to one SCSI tape drive is supplied. Install the flat ribbon connector into 50 pin connector socket of the bus adapter board. Make sure pin 1 on the cable connector matches with pin 1 on the socket of the bus adapter card. Pin 1 is marked by an arrow.

5. Replace the system cover using the original hardware.

6. Install the other end of the cable to the DB-50 style connector on the rear of the CY-8200 subsystem chassis. Proper orientation is assured by connector design.

2.3 UNIBUS

CY-8200 bus adapter model for the Unibus appear to the Host computer as one mass-storage port, implementing DEC's Tape MSCP protocol. The port works with SCSI magnetic tapes, which appear to the Host system as 'MU' devices. Table 2-4 provides the port address options that are available.

2.3.1 Setting The Bus Adapter Address

Table 2-5 CSR Address Options (Unibus)

SWITCHES	SW4 4	3	2	1	CSR Address
	0	0	0	0	17774500
	0	0	0	1	17760404
	0	0	1	0	17760410
	0	0	1	1	17760414
	0	1	0	0	17760444
	0	1	0	1	17760450
	0	1	1	0	17760454
	0	1	1	1	17760504
	1	0	0	0	17760510
	1	0	0	1	17760514
	1	0	1	0	17760520
	1	0	1	1	17760524
	1	1	0	0	17760530
	1	1	0	1	17760534
	1	1	1	0	17760540
	1	1	1	1	17760544

The following switches should have the indicated settings:

SWITCH 1

1	2	3	4
OFF	OFF	OFF	OFF

SWITCH 4

5	6	7	8
OFF	OFF	OFF	OFF

2.3.1.1 File Search Special Considerations

Certain special applications are not compatible with high speed file searches. You may disable them by setting SW1-2 "ON".

2.3.2 Physical Installation

The following procedures suppose some familiarity with the card case and backplane on your computer. If you are not certain concerning any steps listed below, please seek additional technical help.

The Unibus CY-8200 bus adapter models require a single quad-wide SPC slot in a Small Peripheral Controller backplane. The slot must be one that can accommodate a DMA peripheral. A suitable slot would be one that has a full-height grant continuity card in it or one that has a DMA peripheral already in it.

The CY-8200 bus adapter is fully buffered, so its DMA (NPR) priority is not critical, and it may be placed anywhere in the backplane. Its BR level is fixed at Level 5, so its interrupt priority may only be altered by repositioning it in the backplane.

Perform the following steps to complete the installation:

1. Unpack the bus adapter board, and add the part, serial and revision numbers to the System History Label.

2. Remove the system cover to allow access to the system card cage.

3. Install the CY-8200 bus adapter card in a single quad-wide SPC slot in a Small Peripheral Controller backplane.

4. If the selected backplane slot has SMALL grant continuity card (G727A) in it, remove the jumper between pin CA1 and CB1 on the backplane slot selected for the CY-8200 bus adapter.

5. A 50 conductor ribbon cable is supplied that may be used to connect the CY-8200 bus adapter directly to one SCSI tape drive. Install the flat ribbon connector into 50 pin connector socket of the bus adapter board. Make sure pin 1 on cable connector matches with pin 1 on the socket of the bus adapter card. Pin 1 is marked by an arrow.

6. Replace the system cover by using the original hardware.

7. Install the other end of the cable to the DB-50 style connector on the rear of the CY-8200 subsystem chassis. Proper orientation is assured by connector design.

2.4 INITIAL SYSTEM TESTING OF BUS INTERFACE

Once the bus adapter has been installed as indicated in section 2.3, "power on" the CY-8200 subsystem. Now power on your VAX and boot up as normal.
There are three light emitting diodes (LEDs) on the CYQBA PWB. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the CYQBA executes a preliminary test at the following times:

* On power-up
* After a reset condition
* After a bus initialization
* After a write operation to the base address register

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 8031 microprocessor chip and the SCSI Processor (ESP) chip. When the CYQBA successfully completes the preliminary test, LED3 illuminates indicating that the CYQBA is waiting for TMSCP initialization.

During TMSCP initialization, by host software control, the CYQBA executes a second self-test that exercises the buffer controller chip, the Host Adapter Controller (HAC) chip and its associated circuitry, the onboard RAM, and the control memory EPROM. If the CYQBA passes this sequence of its self-test successfully, all three CYQBA LED indicators are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the LED indicators are ON (illuminated). If the CYQBA fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW1-4 or SW2-4 ON) which causes the LED indicators to display an error code.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate LSI-11 Bus activity and SCSI activity, respectively.

Once the boot has completed, you need to insure that VMS has properly auto-configured. At the system prompt, type the following command:

$ Show Device

At this time, the devices on your computer should be listed. The two devices of particular interest at this point are:

Device Name	Device Status	Error Count
PTA0:	online	
MUA0:	online	

PTA0: represents the controller. If this line is present, then VMS has found the controller at an appropriate address.

MUA0: represents the CY-8200 tape drive. If the CY-8200 is powered on and ready when VMS boots, then this device should appear. If this line is not present, then the CY-8200 is not powered on and ready, or the cable is not properly connected.

The following command will give a more complete status:

Show Device MUA0/Full

Magtape MUA0: Device type TK50 is online, file-oriented device, available to cluster, error logging is enabled.

• •
• •
• •

If both of the above devices are present, then you have successfully completed the hardware installation phase.

Note: If you have a "TU81" device, in addition to the CY-8200, and the CY-8200 is the second device for auto-configure, then you should see:

Device Name	Device Status
PTA0:	
PTB0:	online
MUB0:	online

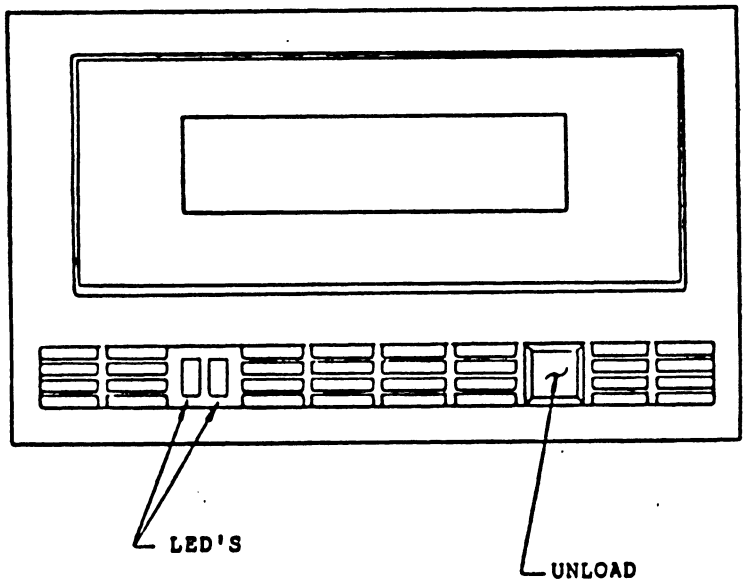
Where PTB0: represents the CY-8200 bus adapter and MUB0: represents the CY-8200 drive

3 OPERATING PROCEDURES

3.1 CY-8200 TAPE DRIVE CONTROLS AND INDICATORS

Drive specific operator controls and indicators are located on the front panel of the unit as shown in Figure 3-1:

Figure 3-1 Front Panel Controls and Indicators



3.1.1 Unload Switch

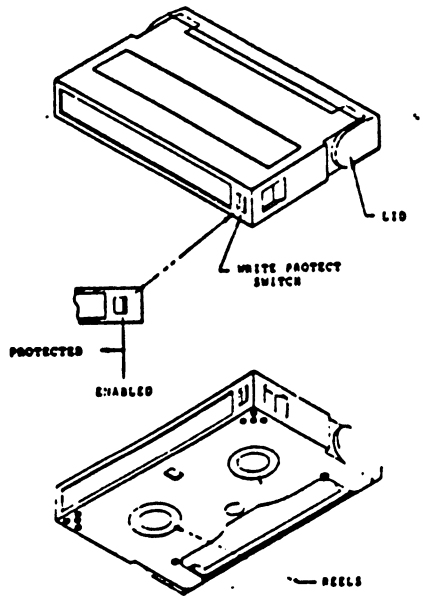
The Unload Switch is a push-button switch on the front of the unit, used by the operator to initiate a rewind, unload, and eject of the data cartridge.

3.1.2 Write Protect Tab

The 8mm data cartridge is equipped with a Write Protect Tab to prevent unintentional writing of the tape. To set the write protect tab, the tape cartridge must be removed from the tape transport. A ball-point pen or other suitable instrument can be used to move the position of the write protect tab.

To write protect the data cartridge, move the write protect tab to the desired position as shown in Figure 3-2. If the red tab in the recessed area at the bottom of the cartridge is visible, the data cartridge is write protected and can not be written to or erased. Conversely, if the red tab is not visible, the data cartridge is write enabled and can be written to or erased.

Figure 3-2 8MM Data Cartridge



3.1.3 Power-up Initialization Indicators

During Power-up Initialization, the RED and GREEN LEDs are both turned on indicating the CY-8200 is performing power-on self-test diagnostics. The time required to complete self-test diagnostics and initialization routines is 120 seconds maximum. When the diagnostics are complete, both LEDs are turned off. If the self-test fails, both the GREEN and RED LEDs will flash.

3.1.4 Power-on Indicator

Upon completion of the self-test diagnostics, the GREEN LED indicates the status of the unit. When the GREEN LED is on, this indicates that a data cartridge is loaded and the CY-8200 is loaded and ready.

3.1.5 SCSI Interface Activity Indicator

Variable blinking of the RED LED when the CY-8200 is ready indicates activity on the SCSI interface between the initiator and the unit. Interface activity can occur at any time after the unit is in a ready state.

3.2 CARTRIDGE TAPE LOAD PROCEDURE

To LOAD the data cartridge into the drive:

1. Ensure the Write Protect tab on the data cartridge has been set correctly for the desired operation.

2. If the tape access door is closed, press the UNLOAD switch to open the drive door. See Figure 3-1 for UNLOAD Switch location.

3. Insert the data cartridge label side up, cartridge lid facing towards the drive.

4. Gently close the drive door. The data cartridge will automatically load.

3.3 CARTRIDGE TAPE UNLOAD PROCEDURE

To UNLOAD the data cartridge from the drive:

1. Press the UNLOAD switch located on the front panel of the drive. The green indicator is turned OFF at the beginning of this operation.

2. The Unit will rewind the tape, unload and eject the cartridge unless one of the following conditions exist:

   - The unit is not powered up.
   - The unit is not in an idle state.
   - There is a contingent connection to/from the host.
   - The PREVENT MEDIUM REMOVAL command has been issued by the host to the unit. In this case the tape will be rewound and unloaded, but the tape will not be ejected.

4 APPLICATIONS SOFTWARE PROCEDURES

The CY-8200 utilizes the Standard VMS Backup system. In general the CY-8200 can be treated as any other tape system with the following special considerations.

4.1 MOUNTING AND DISMOUNTING A DRIVE

The CY-8200 must be mounted as a foreign device before it can be read from or written to. It should be dismounted before removing a tape cartridge.

- To mount the CY-8200

  $MOUNT MUAO:/FOREIGN

- To dismount the CY-8200

  $DISMOUNT MUAO:/NOUNLOAD

4.2 INITIALIZING A TAPE

Initializing a tape writes a volume label and a logical end of tape mark (two file marks) at the beginning of the tape. A tape should be initialized:

1. When writing data to a brand new tape for the first time.

2. When a previously written tape is to be returned to service as a blank tape. Any data on a tape cartridge is irretrievably lost when the tape is initialized.

4.2.1 To Initialize A Tape

Dismount the CY-8200 drive, as described above, and type:

$ INITIALIZE/OVERRIDE=(ACCESS,EXPIR,OWNER) MUAO:/label

where "label" is whatever label you wish to assign to that tape cartridge.

Before the VMS INITIALIZE utility actually writes the new tape header, it attempts to read the existing tape's header record to test the accessability, expiration date, and ownership of the tape. If VMS decides that the tape should not be initialized, the command will be aborted, usually with the message

MEDIUM NOT ONLINE

Under some circumstances, this will happen with a blank tape (one that has never been INITIALIZEd, and hence has no tape header). This problem is prevented by setting the OVERRIDE switches, as shown above.

4.3 VMS TAPE BACKUP COMMAND SWITCHES

4.3.1 Image

Produces a functionally equivalent copy of the input volume on the on the output volume. Copies all the files on the input volume...no file selection qualifiers are permitted. Output volume must be mounted /FOREIGN.

4.3.2 Physical

Copies the entire input volume onto the output volume on a block-by-block basis, ignoring any file structure. Output volume must be mounted /FOREIGN. Note that this command copies the entire disk capacity regardless of how much of the disk is used.

4.3.3 Buffer count=n

Specifies the number of I/O buffers to be used in the backup operation. The default is 3. A maximum of 5 may be specified. Use of more buffers than the default may improve operation.

4.4 OUTPUT QUALIFIERS

4.4.1 Nocrc

Inhibits the calculation and storing of Cyclic Redundancy Check records on the output medium. The creation of these records requires considerable CPU overhead as well as tape overhead, and unnecessarily duplicates the error detection mechanisms of the CY-8200.

4.4.2 Group size=n

BACKUP calculates and appends one error correction record to every group of 'n' data records, allowing it to correct one 'uncorrectable' read error in each group. The default is 10. A value of n=0 inhibits the entire process.

4.4.3 Block size=n

Specifies the output record size in bytes. The default for tape devices is 8192 (8 Kbytes). The allowable range is 2048 to 65024 bytes. Larger block sizes may improve the performance, but may also cause problems at End-of-Tape if the controller's logical EOT occurs less than the specified block size before physical EOT.

For example:

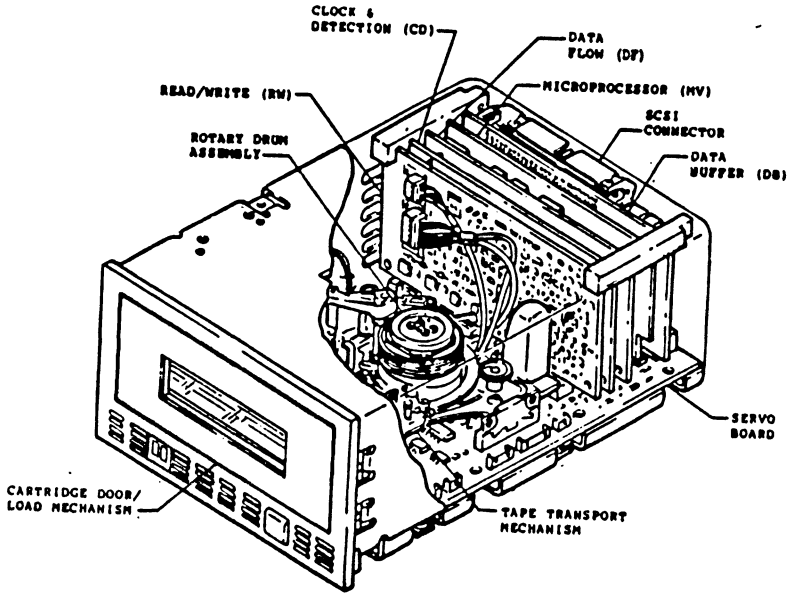
$ BACKUP /IMAGE /BUFFER COUNT=5 DUA0: MUB0:name.bck-/NOCRC /GROUP SIZE=0 /BLOCK SIZE=32768

This example produces an image backup with no CRC records, no error correction records, and a block size of 32 KB. This set of command switches will produce the most efficient image backup in terms of time required, but at the expense of BACKUP's normal error correction capabilities. For detailed information on the VMS Backup Utilities, please reference your VMS documentation.

5 PRODUCT DESCRIPTION

The tape unit of the CY-8200 shown in Figure 5-1, consists of an 8mm tape transport mechanism and recording channel, servo, formatter, controller, interface electronics, software, and package parts. The subsystem is a true digital data storage device, derived from 8mm video recording technology, with performance improvements and many additional functions necessary for data processing purposes.

Figure 5-1 CY-8200 Cartridge Tape Subsystem



5.1 HELICAL SCAN RECORDING

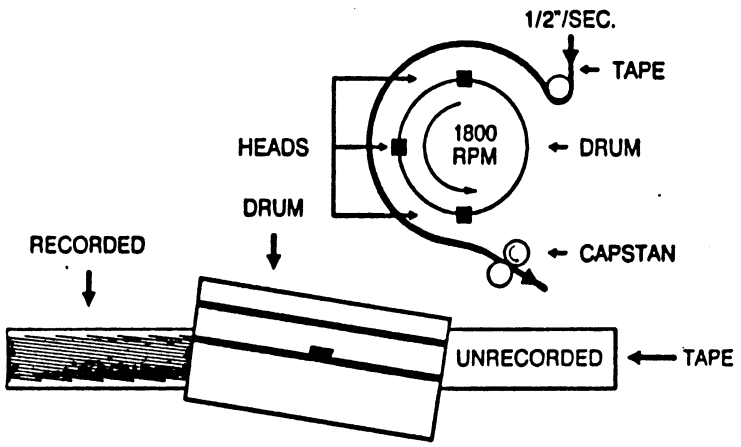
Helical scan recorders write very narrow tracks at an acute angle to the edge of tape in a diagonal pattern on the tape. In this way a track length is created which is several times longer than the width of the tape. Tracks can be accurately positioned by the geometry of the tape path to very precise minimal tolerances thus facilitating very high tracks per inch (TPI). When combined with a high linear flux density, very high areal density is the result.

Read, Write and Servo heads are mounted on a drum which rotates constantly at 1800 RPM, resulting in an effective head-to-tape speed of approximately 150 inches per second. Actual tape movement is less than .5 inches per second. These and other forces acting upon the tape and various component mechanisms are correspondingly low, resulting in long life for both media and tape transport.

The combination of the helical wrap of the tape around the drum, rotational motion of the head/drum assembly and linear motion of the tape causes the heads to trace a path (or track) across the tape, 3.037 inches long, at an acute angle of approximately 5 degrees with reference to the bottom edge of tape. See Figure 5-2.

Figure 5-2 Helical Scan Recording

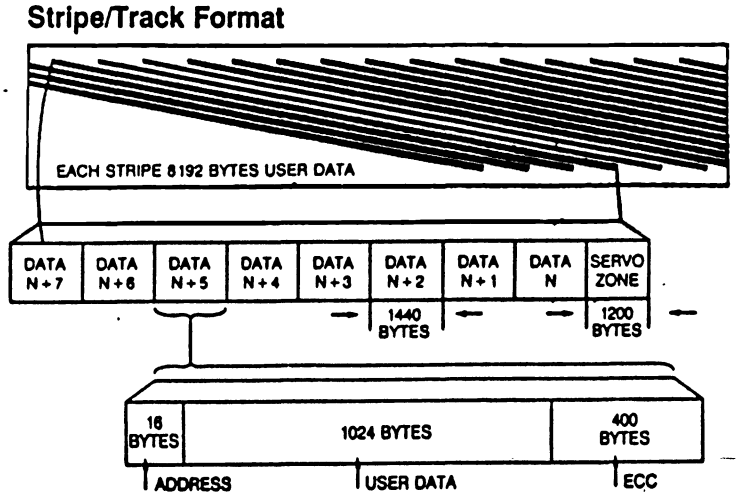
Helical Scan Recording



5.2 RECORDED TRACK FORMAT

The recorded track format consists of 8 fixed length data blocks and a servo zone. Each data block contains up to 1,024 bytes of user data; additional bytes are appended to the block by the formatter which consist of address and ECC information. The recorded track format and configuration relative to 8mm tape are illustrated in Figure 5-3.

Figure 5-3 CY-8200 Recorded Track Format



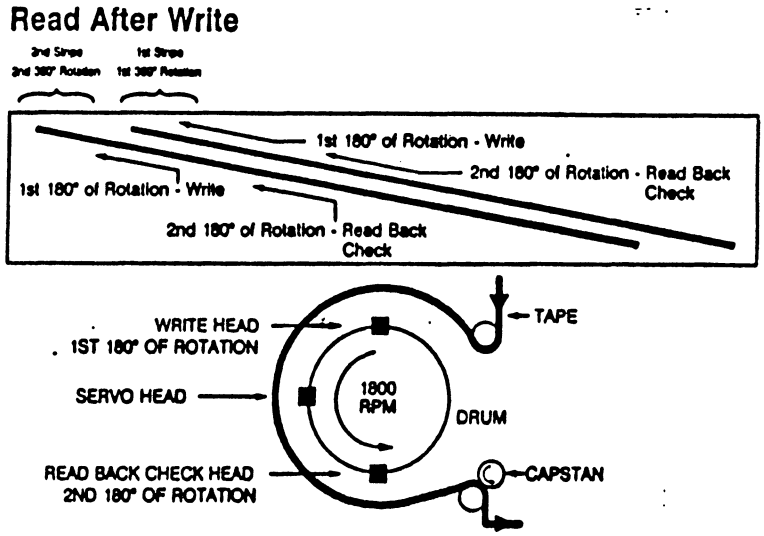
5.3 TAPE FORMATTING

No preformatting or other media conditioning procedures are required for 8mm data cartridges. During WRITE operations the CY-8200 records information and formatted user data blocks.

5.4 READ-AFTER-WRITE

During WRITE operations, the CY-8200 records servo information and formatted user data blocks on the same track and performs a read-afterwrite check for a WRITE error condition. Error recovery procedures are performed without host intervention and without the need to reposition the tape. This automatic certification of the written data eliminates the need for separate certification of the tape. See Figure 5-4.

Figure 5-4 CY-8200 Read-After-Write



5.5 ERROR CORRECTION CODE

The CY-8200 employs a powerful Error Correction Code (ECC) to ensure data reliability. The ECC can correct a burst as long as 264 bytes in error and as many as 80 additional random error in each data block. The ECC is capable of multiple burst and random error corrections. It has been designed to be extremely effective against the kinds of error patterns characteristic of cartridge tape subsystems.

5.6 READ INTERCHANGE

Read Interchange of recorded 8mm cartridges is accomplished through use of a proprietary, track-following servo technique which ensures proper head-to-track alignment. During READ operations, a signal is developed by sampling the servo information recorded in each track. This signal is used to control linear tape velocity resulting in accurate positioning of the track under the READ data head.

5.7 SYSTEM INTERFACE AND CONTROL

User access to the CY-8200 is via the SCSI Interface. The CY-8200 is operated as a sequential access device. In general, the CY-8200 is capable of most commands and sequences customary to devices operated as 9-track tape systems. Error recovery procedures are controlled by the CY-8200 in a manner that is transparent to the host system; complete error statistics are retained for all operations and are available via the SENSE REQUEST command.

5.8 DATA FORMATTER

The Data Formatter is composed of the 256Kb data buffer, and the data flow electronics. The data buffer consists of 256Kb of DRAM which is organized as a 9-bit wide, dual-port, circular memory. Data transfers for the SCSI interface and the data flow electronics take place to and from the data buffer asynchronously. Logical user data blocks are formatted into physical blocks in the data buffer for recording on tape. Tag and address information are appended to each data block in the data buffer electronics. Initiation of data buffer transfer operations and management of buffer storage space is performed in firmware. The data flow electronics consist of the WRITE encoder and the READ decoder functions.

The WRITE encoder receives data blocks from the data buffer, appends ECC information, inserts synchronization markers, and performs interleave sequencing of bytes through the modulation encoder and bit serializer to the WRITE driver circuit.

The READ decoder receives a serial data bit stream and clock from the clocking and detection circuit, detects synchronization markers and determines alignment to data, demodulates data bytes, and assembles and corrects data blocks.

5.9 READ/WRITE/ERASE ELECTRONICS

The WRITE Electronics consist of a write compensation circuit and the write head driver circuit. The READ Electronics consist of preamplifier and equalization circuits for the Read and Servo channels and circuits for data detection and recovery and alignment of the data clock. The ERASE Electronics consist of a frequency generator and current driver for the Erase head.

5.10 MOTION CONTROL SYSTEM

The Motion Control SYstem consists of the drum and capstan servos, circuits to drive the reel motor, the load motor, the mode change motor, and the control solenoid. Also included are sensor interface circuits for the drum, capstan and reel tachometers, load and mode states, EOT/BOT, tape length and type, write protect, and door closed. The motion control system is operated by firmware through a dedicated microprocessor.

5.11 TAPE TRANSPORT

The Tape Transport mechanism is manufactured to allow operation of the device as a digital cartridge tape system. Video recording channel or servo electronics are not included in the unit. The tape transport mechanism is compatible with standard 8mm cartridges in all respects. No mechanical alterations are made to the design other than in the case of the rotary drum assembly and erase head.

5.12 START/STOP AND STREAMING OPERATIONS

The CY-8200 operates as either a streaming tape device or as a start/stop tape device. The mode of operations is dependent upon the ability of the INITIATOR to transfer data to the CY-8200 at a high enough rate to sustain operation in the streaming mode. If the INITIATOR cannot maintain the necessary transfer rate, starting and stopping will occur automatically when the data buffer is empty.

To sustain operations of the CY-8200 in the streaming mode, the INITIATOR must be capable of transferring data to the CY-8200 at a minimum of 246kb per second without padding.

6 RECORDING FORMAT

The Recording Format defines the arrangement of information including user data, file marks, and EOT/BOT indicators as recorded on the tape media. This definition takes two forms:

1. A logical format which is relative to the user's perspective and certain functions of the CY-8200 controller and data path.

2. A physical format which is relative to functions of the CY-8200 data path, recording channel, and motion control system.

6.1 RECORDING PARAMETERS

The Recording Parameters used by the CY-8200 are shown in Table 6-1.

Table 6-1 Recording Parameters

Parameter	Metric Units	Non-Metric Units
Linear recording density		
Flux Bit	2126 FR/mm 1701 bits/mm	54,000 FR/inch 43,200 bits/inch
Track width	.025 mm	.00098 inch
Track pitch	.031 mm	.00122 inch
Track density	32.26 tracks/mm	819.35 tracks/inch
Areal recording density		
Flux Bit	68.6 KFR/sqmm 54.9 Kbits/sqmm	44.2 MFR/sqi 34.4 Mbits/sqi
Track angle	4.9 degrees	
Wrap angle	221 degrees	
Edge guard band	1.0025 mm	.039 inch
Track length	71.411 mm	2.811 inches

6.2 PHYSICAL FORMAT

6.2.1 Physical Beginning of Tape (PBOT)

The Physical Beginning of Tape (PBOT) is located on the tape at the point where the translucent leader material is attached to the media, with the tape rewound. This position is detected by an optical sensor in the tape transport mechanism and reported by the controller to the host.

6.2.2 Physical End of Tape (PEOT)

The Physical End of Tape (PEOT) is located on the tape at the point where the translucent leader material is attached to the media, with all the tape on the take-up reel. This position is detected by an optical sensor in the tape transport mechanism and reported by the controller to the host.

6.2.3 Track Following Servo

A data track contains information which is detected and used by Track Following Servo electronics to optimize tracking and insure data interchange between users.

6.2.4 Analog Tape Mark (ATM)

The Analog Tape Mark (ATM) contains servo data like that of a data track and a tone frequency.

6.2.5 Data Zone

The Data Zone of a track, other than an ATM track, consists of a preamble, data segments, and a postamble. Composition of the data zone is the same, regardless of the type(s) of blocks recorded in the track.

A preamble is a string of bits of all 1's. The data segments of a track consist of encoded data, ECC, and ID information. The postamble is a string of bits of all 1's.

6.3 LOGICAL FORMAT

6.3.1 Data Block

The CY-8200 records fixed length Data Blocks. Each block consists of 14 bytes of header information, 400 bytes of error correcting code information, two bytes of CRC, and up to 1024 bytes of user data. A track can contain eight data blocks for a total capacity of 8192 user data bytes; note that a track may contain fewer data bytes if one or more data blocks are replaced by gap blocks.

6.3.2 Gap Block

Gap Blocks are unknown to the user and cannot be accessed by a WRITE or READ or any other operation available to the user. The Gap blocks are recorded only at the discretion of the controller. Gap blocks are inserted by the controller to complete a track when less than eight data blocks are available at the time the recording of the tape is initiated.

6.3.3 Gap Track

A Gap Track (or gap strip) consisting of eight gap blocks is recorded during WRITE operations, after the last track containing data blocks, when there are no more data blocks available to be written on the track. The controller will then reposition the tape and, assuming the WRITE operation is continued and more data blocks become available, will record the data on the next track adjacent to the gap track.

6.3.4 File Mark

A File Mark (or tape mark) is a composite of an erased length of tape followed by a series of unique ATM tracks. The information contained in the tracks is defined by the controller. The user cannot alter nor access the data content.

6.3.5 Logical Beginning of Tape (LBOT)

Logical Beginning of Tape (LBOT) is recorded on the tape by a WRITE operation at a point approximately 18" from PBOT. A LBOT is a composite of an erased length of tape, followed by a series of tracks which are used to locate LBOT and to perform initial automatic calibration of the servo system. The first track containing data blocks is recorded directly after the last track containing the LBOT information. The information contained in the LBOT tracks is defined by the controller. The user cannot alter nor access the data.

6.3.6 Logical End of Tape (LEOT)

Logical End of Tape (LEOT) is determined by the controller based on the number of tracks recorded on the tape beyond the LBOT. For this purpose, the lengths of erased segments are converted to an equivalent number of tracks. The number of blocks which determine the LEOT is listed for each of the different length tapes in Table 6-2.

Table 6-2 Logical End of Tape Physical Track

Cartridge Size	LEOT Track Count
P6-30mp; 512	523320
P6-60mp; 1024	1,046,640
P6-90mp; 1536	1,569,960
P6-120mp; 2048	2,093,280

7 PERFORMANCE SPECIFICATIONS

7.1 INTERFACE PARAMETERS

7.1.1 Write Access Time

The Write Access Time is defined as the time elapsed from the receipt, by the CY-8200, of the last byte of the command data block (CDB), until the presentation of REQ to transfer the first data byte across the SCSI interface. The Write Access Time is a maximum of 950 microseconds.

7.1.2 Read Access Time

The Read Access Time is defined as the time elapsed from the receipt, by the CY-8200, of the last byte of the command data block (CDB), until the presentation of REQ to transfer the first data byte across the SCSI interface. When Read data resides in the data buffer at the time the Read command is received, the Read Access Time is a maximum of 900 microseconds.

7.2 SERVO PARAMETERS

7.2.1 Nominal Tape Speed

The Nominal Tape Speed at which data may be recorded and read is 10.89 mm/second. Short term speed variation is limited to plus or minus 3% of nominal over any 66.6 millisecond period synchronized to drum rotation. Long term speed variation is plus or minus .5%.

7.2.2 Rewind Tape Speed

Rewind Tape Speed averages 75 times nominal tape speed or 816.7 mm/sec (32.2"/sec).

7.2.3 Reposition Time

Reposition Time for the CY-8200 is defined as the time elapsed from issuance of the stop command to the motion control system, until the tape is repositioned, at nominal speed, such that the next byte of data may be transferred (independent of any interface delays incurred). Reposition time ranges from 1082 milliseconds to 1115 milliseconds.

7.2.4 Drum Rotation Period

The Drum Rotation Period is 33.3 Milliseconds plus or minus .1%. The nominal effective head to tape speed (due to drum rotation) is 148.4" per second.

7.3 DATA TRANSFER RATE

The maximum burst data transfer rate is limited by performance of the SCSI Host Adapter and the CY-8200 buffer control hardware. The maximum burst data transfer rate will not exceed 1.5Mb per second. Maximum sustained performance is expected to be approximately 1.2Mb per second. This level of performance has been measured when operating the CY-8200 attached to an Adaptec SCSI development system.

8 RELIABILITY SPECIFICATIONS

The CY-8200 has been designed to exceed a useful Service Life of five years, during which time all performance and reliability specifications are applicable.

8.1 DATA RELIABILITY

Conditions under which specifications for data reliability apply are:

1. 8mm tape cartridges must conform to the industry standard for this type of tape.

2. Cartridges must have been written on a CY-8200 unit in good operating condition.

3. Cartridges must be read on a CY-8200 unit in good operating condition.

4. Errors caused by a failure of the unit will not be included in determining data reliability.

5. Errors caused by faulty or damaged cartridges or media will not be included in determining data reliability.

6. Errors that are corrected by the CY-8200 error correcting code will not be included in determining data reliability.

7. Environmental conditions for the CY-8200 and 8mm cartridges must be maintained as specified in Chapter 10.

8. Errors caused by failure to comply with input power and grounding requirements, interference from external sources, and incorrect system operation or failure will not be included in determining data reliability.

9. Errors that occur in blocks other than blocks containing USER data bytes will not be included in determining data reliability.

10. Blocks containing user data bytes that comply with the criteria for read-back check (the criteria may allow some minimal error level) will not be counted as write errors.

The CY-8200 physically writes and reads fixed length blocks 1024 data bytes. Data reliability is specified as a block error rate (BLKER) in units of 1 error per total number of blocks transferred to the host. A bit error rate (BER) is also listed as a convenience based on an assumption of 1024 user bytes per block.

8.1.1 Write Reliability

A WRITE error occurs when a read-back check indicates that a data block was not correctly written. These errors are counted by the controller and are reported as part of the WRITE command completion status. If the data block can be correctly written by a subsequent retry, then the error is a temporary write error. If a data block cannot be correctly written after a maximum of 12 retry attempts, then the error is a permanent write error.

CY-8200 Accumulated Production Units

	1 to 4999	5000 to 10000	more than 10000
Permanent WRITE Errors			
BLKER	4.1×10^{-8}	1.6×10^{-8}	8.2×10^{-9}
BER	5.0×10^{-12}	2.0×10^{-12}	1.0×10^{-12}

8.1.2 Read Reliability

A READ error occurs during a READ operation when a data block that was correctly written cannot be read. These errors are counted by the controller and are reported as part of the READ command completion status. If the data block can be correctly read by a subsequent retry, then the error is a temporary read error. If a data block cannot be correctly read after a maximum of 8 retry attempts, then the error is a permanent read error.

CY-8200 Accumulated Production Units

	1 to 4999	5000 to 10000	more than 10000
Permanent READ Errors			
BLKER	4.1×10^{-9}	1.6×10^{-9}	8.2×10^{-10}
BER	5.0×10^{-13}	2.0×10^{-13}	1.0×10^{-13}

8.2 MACHINE RELIABILITY

Mean Time Between Failure (MTBF) is defined as:

$$\text{MTBF} = \frac{\text{Total Power-On Hours}}{\text{Number of Relevant Equipment Failures}}$$

CY-8200 is drawing current from the input power supply system. Relevant Equipment Failures are defined exclusively as those failures which cannot be corrected by the operating personnel and require the intervention of maintenance personnel. Types of excluded failures are:

- Failures arising from incorrect operating procedures.

- Cable failures, power supply failures, or other failures not caused by equipment.
- Failures caused by incorrect grounding procedures or by interference from external sources.
- Media failures, or any failures or degraded performance caused by use of faulty or damaged media.
- New failures which arise from continued use of a failed, misaligned, or damaged CY-8200 unit.
- Failures caused by incorrect maintenance procedures, and all failures which occur within 40 POH of any maintenance activity that includes the modification, adjustment, or replacement of any CY-8200 assembly.

Conditions under which specifications of machine reliability apply are:

- 8mm tape cartridges used must conform to the industry standards for this type of tape.
- Environmental conditions for the CY-8200 and 8mm cartridges must be maintained as specified in Chapter 10.

8.2.1 MTBF

The MTBF specified below is subject to the following limitations:

- Minimum conditions for evaluating MTBF are 32 units installed to 5,000 hours each.
- MTBF is specified for a maximum duty cycle of 10%. Duty Cycle is defined as:

$$\text{Duty Cycle} = \frac{\text{Total Hours of Mechanical Operation} \times 100\%}{\text{Total Power-On Hours}}$$

Mean Time Between Failure (in hours):

CY-8200 Accumulated Production Units

	1 to 4999	5000 to 10000	more than 10000
MTBF	12000	16000	20000

9 POWER SPECIFICATIONS

9.1 VOLTAGES

The CY-8200 operates from the standard DC supply voltages, +5 volts and +12 volts, as specified below. All specified voltages are DC; no AC power is used. The CY-8200 does not provide any overvoltage or overcurrent protection.

+5 Volt Input

Nominal Tolerance:	+/- 4%
Regulation:	+/-.8%, over load range
Ripple and Noise (60Hz to 20 Mhz)	80 mVpp, maximum
Load Currents:	4 amp, maximum

+12 Volt Input

Nominal Tolerance:	+/- 4%
Regulation:	+/-.8%, over load range
Ripple and Noise (60Hz to 20 Mhz)	80 mVpp, maximum
Load Currents:	1.2 amp, maximum

9.2 SAFETY AGENCY CONSIDERATIONS

Safety agency certification requires that the supplied voltages be from:

- A Safety Extra Low Voltage source (per IEC380).
- A Class 2 transformer rated at 30 volts rms sinusiodal or less.

- An insolating transformer (or a power supply that includes an insolating transformer) with open-circuit potential or no-load output of no more than 42.4 volts peak, and the energy available is limited so the current under any condition of load, including short circuit, is not more than eight amperes after one minute of operation.

9.3 POWER CONNECTOR

The Power Connector used in the CY-8200 is compatible with the power connector used by standard 5.25" devices. The drive unit's P1 Power Connector (Molex 8981 series) has the pin assignments as shown in Table 9-1.

Table 9-1 P1 DC Power Pin Assignment

P1 Pin No.	Usage
1	+12V
2	Ground
3	Ground
4	+5V

9.4 POWER DISSIPATION

The maximum average power dissipation (+/- 1 w) is specified as follows:

	CY-8200 Accumulated Production Units	
	1 to 4999	more than 10000
POWER	20 Watts	15 Watts

10 PHYSICAL DESCRIPTION

The CY-8200 drive envelope dimensions are shown in Figure 10-1.

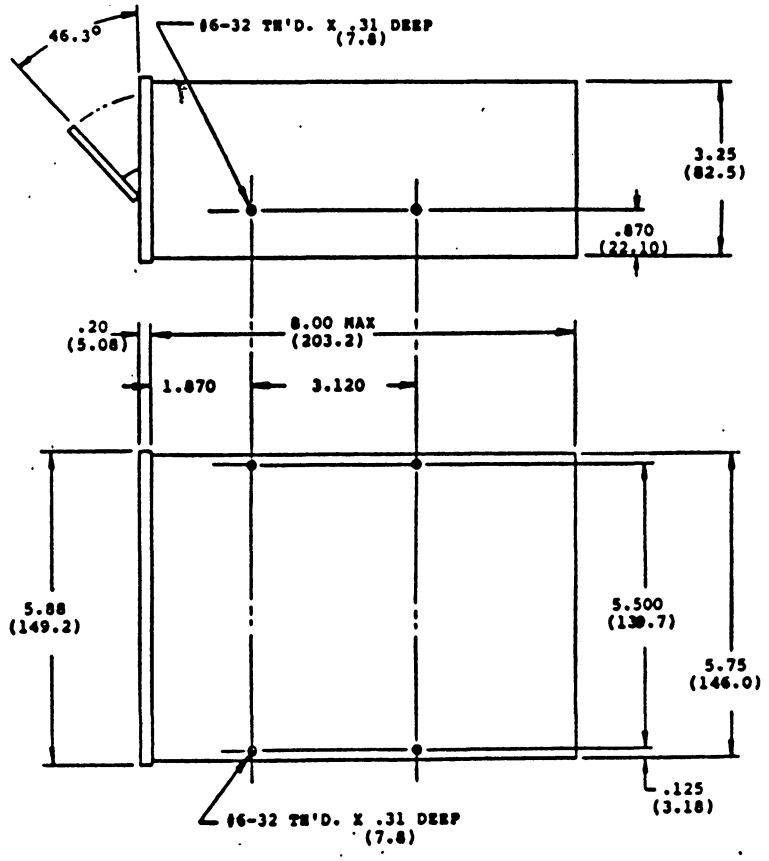
10.1 MOUNTING

The CY-8200 may be purchased as an add-on subsystem for any Unibus or Q-Bus equipped DEC computer. The unit may be mounted in a single unit stand-alone case or a standard 19" rack with a four drive capacity. A single unit can be mounted internally in the Microvax 3000 series (BA123 cabinets) with the addition of a plastic mounting plate.

10.2 WEIGHT

The CY-8200 weight is 19 pounds (2.045 kg).

Figure 10-1 Envelope and Mounting Hole Dimensions



11 ENVIRONMENTAL SPECIFICATIONS

11.1 OPERATING CONDITIONS

The following information defines the environmental conditions for normal operation of the CY-8200:

11.1.1 Temperature Range

+5 to +40 degrees Celsius
+41 to +104 degrees Fahrenheit

When operated within the temperature range specified above, the CY-8200 does not require forced air cooling.

11.1.2 Maximum Temperature Variation

Less than 1 degree Celsius per minute, not more than 10 degrees Celsius per hour.

Less than 2 degrees Fahrenheit per minute, not more than 18 degrees Fahrenheit per hour.

11.1.3 Relative Humidity

20% to 80%; non-condensing

11.1.4 Altitude

-300 to +3,000 meters
-984.3 to +9,843 feet

11.1.5 Electrostatic Discharge (ESD) Immunity

The CY-8200 when properly installed will withstand discharges up to 10,000 volts applied to those points which are accessible during normal use without effecting the permanent read error rate or requiring operator intervention.

11.1.6 Vibration

The CY-8200 is capable of reading and writing while being subjected to a .3 grms random vibration spectrum as defined below.

Frequency (Hz)	Slope (dB/Oct)	PSD(g2/Hz)
5-350	0	.0002
350-500	-6	--
500	--	.0001

11.1.7 Shock

The CY-8200 is capable of reading and writing while being subjected to the following three kinds of shock:

1) 3 g for 5 ms
2) 2 g for 11 ms
3) 1 g for 20 ms

11.1.8 Acoustic Noise

The CY-8200 noise criteria (NC) level should not exceed NC-50 at 3' under all conditions.

11.1.9 Particulate Contamination

The maximum allowable limits for particulate contamination in the CY-8200 and 8mm tape cartridge environments are as shown below:

Particulate Contamination

Particle Size (microns)	Particle Count/Cubic Meter
< 1.0	4×10^7
1.0 to 1.5	4×10^6
1.5 to 5.0	4×10^5
5.0 to 10.0	4×10^4
10.0	4×10^3

11.2 STORAGE CONDITIONS

The following information defines the environmental conditions for storage of the CY-8200.

1. The CY-8200 has not been unpacked.
2. The storage period does not exceed 3 years.
3. 8mm data cartridges are not packaged with the unit.

11.2.1 Temperature Range

-20 to +60 degrees Celsius
-4 to +140 degrees Fahrenheit

11.2.2 Maximum Temperature Variation

Less than 1 degree Celsius per minute, not more than 10 degrees Celsius per 30 minutes.

Less than 2 degrees Fahrenheit per minute, not more than 18 degrees Fahrenheit per 30 minutes.

11.2.3 Relative Humidity

10% to 90%; non-condensing

11.2.4 Altitude

-300 to +12,200 meters
-984.3 to +40,026 feet

11.3 TRANSPORTATION CONDITIONS

The following information defines the environmental conditions for transportation of the CY-8200:

1. The CY-8200 has not been unpacked.
2. The storage period does not exceed 3 years.
3. 8mm data cartridges are not packaged with the unit.

11.3.1 Temperature Range

-20 to +60 degrees Celsius
-4 to +140 degrees Fahrenheit

11.3.2 Maximum Temperature Variation

Less than 1 degree Celsius per minute, not more than 10 degrees Celsius per 30 minutes.

Less than 2 degrees Fahrenheit per minute, not more than 18 degrees Fahrenheit per 30 minutes.

11.3.3 Relative Humidity

10% to 90%; non-condensing

11.3.4 Altitude

-300 to +12,200 meters
-984.3 to +40,026 feet

11.3.5 Vibration (Non-operating)

The CY-8200 is capable of surviving a 2.41 g rms random vibration spectrum as defined below:

Frequency (Hz)	Slope (dB/Oct)	PSD(g2/Hz)
5-100	0	.020
100-137	-6	--
137-350	0	.0107
350-500	-6	--
500	--	.0052

11.3.6 Shock (Non-operating)

The CY-8200 is capable of surviving the following two kinds of shocks when the unit is not operating:

1) 40 g for 11 ms

2) 30 g for 30 ms

12 MAINTENANCE PROCEDURES

12.1 PREVENTATIVE MAINTENANCE

The CY-8200 should be cleaned with the appropriate cleaning kit every 30 Gigabytes of data or once a month, whichever occurs first.

12.2 OPERATOR MAINTENENCE

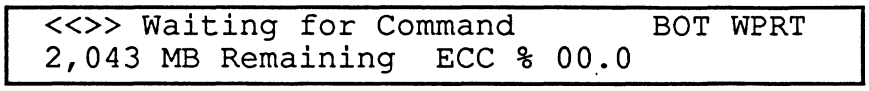
If under normal operating conditions, the CY-8200 8mm cartridge tape drive experiences high error rates with known good tapes, then cleaning with the appropriate cleaning kit is recommended. If performance has not improved after cleaning, the CCG technical support staff should be contacted.

A APPENDIX

A. 1 CY-8200 LIQUID CRYSTAL DISPLAY (Optional)

A example of information displayed on the LCD is shown in Figure A-1.

Figure A-1 Liquid Crystal display



A . 1 . 1 Tape Motion Indicator (<<>>)

This field indicates the direction of tape motion: forward(">") or reverse ("<"). Double arrows indicate high speed tape motion during skip to file mark and rewind operations.

A . 1 . 2 End of Tape Indicator

This field indicates that the drive heads are positioned at the begining ("BOT") or end ("EOT") of tape. This field will be blank whenever the heads are positioned between the beginning and the end of tape.

A . 1 . 3 Write Protect Indicator

This field will display "WPRT" if the tape cartridge is write protected.

A . 1 . 4 Current Action

This field displays the task currently being performed by the drive/interface. When the unit is idle the default display is "Waiting for Command ...".

A.1.5 Tape Remaining Indicator

This field displays the amount of tape that remains in megabytes. Default display is "0 mb"

A.1.6 Error Rate Indicator

This field displays a percentage of blocks requiring error recovery during a read or requiring re-writing during a write. (Labels are "ECC" and "Rewrt" respectively.)