cipher 3000i

TECHNICAL MANUAL
3830 Series
Cipher Interface

799904-005
Revision B
February 1989

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Record of Revision

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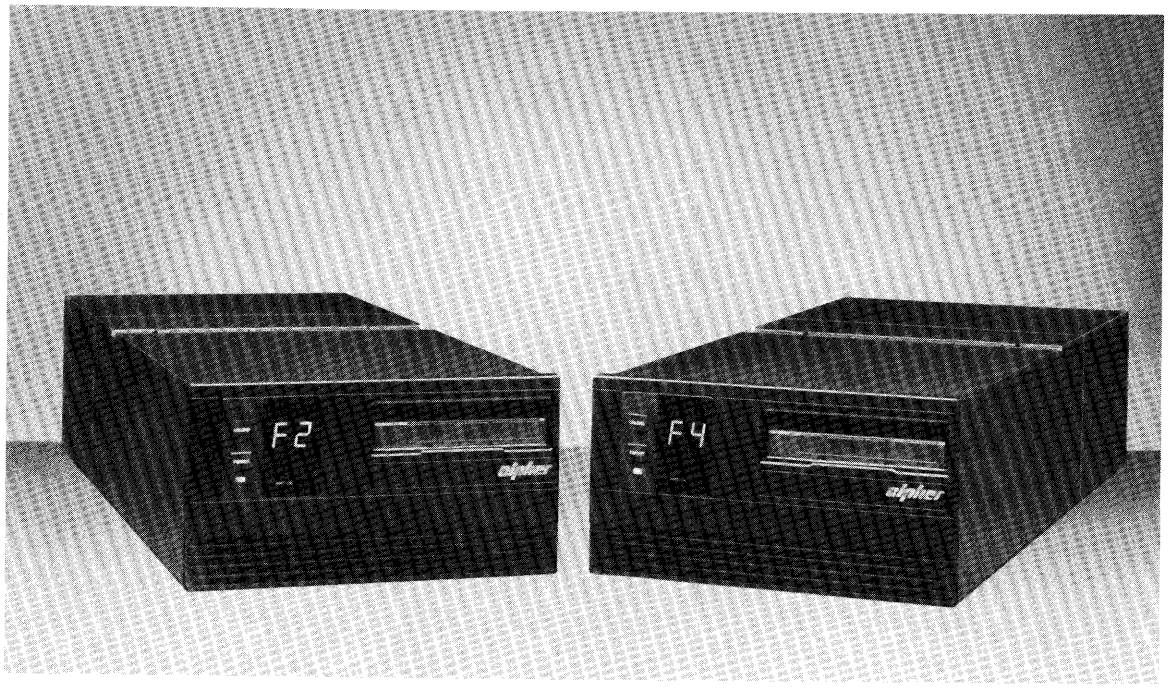
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Chapter 1 General Description



Cipher 3830 Series Cartridge Tape Drive

GENERAL DESCRIPTION

The Cipher® 3832 and 3834 Half-Inch Cartridge Tape Drives are high-capacity peripherals designed to provide both interchange and backup of high-capacity disk drives used with workstations, midrange, and small mainframe computing systems. This document, for brevity, refers to the Cipher 3832 and 3834 line of tape drives as "3830." The exact model number is provided where model-specific references are required. Detailed information on each of these models is supplied later.

The 3830 Series tape drives are manufactured to conform with the standard 203 mm (8 in.) disk form factor. The tape drives use the industry standard 3480 type half-inch tape cartridge which provides ease of operation by featuring automatic self-threading and loading of the magnetic tape. This assures ease of handling by eliminating physical contact, which protects the tape from contaminants. The nominal recording capacity of the 183 m (600 ft) tape is 320 MB.

The host computer system communicates with the 3830 through one of three available interfaces; the Small Computer Systems Interface (SCSI-1 or SCSI-2), the Intelligent Peripheral Interface (IPI), or the Cipher Interface. Available options include; power supply, rack mounting and an enclosure for operation as a table top unit.

3830 Physical Description

The standard configuration of each 3830 tape drive contains an interface, Control Unit Electronics (CUE) Board with cache memory, switches and indicators, read/write electronics, a forced air cooling fan, and the drive mechanism. The drive mechanism consists of: automatic cartridge loader/threader, motor hardware, and a head assembly.

FUNCTIONAL DESCRIPTION

The Cipher 3830 is composed of three main functional assemblies: interface, drive electronics, and the drive mechanism.

As previously mentioned, two models of the Cipher 3830 Series are available: 3832 and 3834. The 3832 contains a 2-track Read/Write Head. The 3834 contains a 4-track Read/Write Head. Both drives contain 512 KB of cache memory.

The 3834 is backward compatible, it can read and write with either two or four track formats. For example, the 3834 accepts tapes written by either a 3834 or a 3832. The 3832 accepts tapes written by either a 3832 or a 3834 set for two-track format.

Data is written and read using the Multi-track Serpentine Recording (MSR) format. As the tape emerges from the cartridge and reaches the beginning-of-tape, reading or writing begins and continues as the tape is wound onto the Take-up reel. At the end of the data track, tape direction is reversed and the Read/Write Head is repositioned. Data is written or read as the tape is wound onto the Supply reel within the cartridge. This process continues until the end of the recording area is reached. Data is recorded on the tape in a "serpentine" fashion.

Data tracks are arranged longitudinally along the tape surface. Depending on the format used by the tape drive, data is written on two (MSR-2) tracks or four (MSR-4) tracks. The term "track group" refers to the multiple number of tracks used simultaneously to read or write. The tape contains 24 data tracks. The number of track groups a tape contains is determined by the selected format. A tape recorded with the two track format contains 12 track groups. A tape recorded with the four track format contains six track groups.

Interface

The interface translates the system bus commands into tape drive executable commands, as well as translates tape drive data and status signals into the correct system bus format. The available interfaces include, Small Computer Systems Interface (SCSI-1 or SCSI-2), Intelligent Peripheral Interface (IPI), and the Cipher Interface.

Drive Electronics

The 3830 microprocessor is the Z8002 which controls all necessary logic functions relating to read/write, tape motion, cache memory, and data/command transfers between the 3830 tape drive, its interface, and the local I/O bus.

The tape drive records encoded data supplied by the interface and reads back the recorded information. The microprocessor performs these functions by interpreting the command line

signals from the I/O decode circuitry to: accelerate and decelerate the tape, position the read/write head, detect tape position, control format, and provide status.

Drive Mechanism

The drive consists of mechanical assemblies that are under microprocessor direction which precisely controls cartridge insertion and positioning, various motors that move both tape and Read/Write Head, and ejection of the cartridge.

Chapter 2 Specifications

3830 SERIES TAPE DRIVE SPECIFICATIONS

The following sections list various specifications for the Cipher 3830 tape drive, such as; power requirements, physical, and environmental. Also listed are the regulatory requirements, to which the Cipher 3830 tape drive complies.

Tape Drive Specifications

Tape Speed (Record and Rewind):	2.82 m/s (111.1 ips)
Start/Stop Time:	150 ms (max.)
Start/Stop Distance:	0.21 m (8.33 in.)
Load Time:	22 s
Unload Time:	15 s
Rewind Time (nominal):	70 s
Reposition Time (Read):	
MSR-2 (F2)	505 ms
MSR-4 (F4)	505 ms
Reposition Time (Write):	
MSR-2 (F2)	615 ms
MSR-4 (F4)	605 ms
Tape Tension:	226.8 g (8 oz)
Number of Recording Tracks:	
MSR-2 (F4)	2 (2 forward, 2 reverse)
MSR-4 (F4)	4 (4 forward, 4 reverse)
Head Step (non-cumulative):	0.4318 mm (0.017 in.)

Track Placement Accuracy:	± 0.0127 mm (± 0.0005 in.)
Recorded Azimuth Error (Static Skew):	± 0.75 minutes of arc
Flux Reversals (per track):	1063/mm (27,000 in.)
Recording Format:	Multi-track Serpentine Recording (MSR)
MTBF:	15,000 hours
MTTR:	15 minutes to FRU level

Interface Data Transfer Rates:

Cipher Interface

Cable Length	Rate
6 m (19.68 ft)	100 KB/s to 1.2 MB/s

Cache-to-Tape Transfer Rate (sustained):

MSR-2 (F2)	448 KB/s
MSR-4 (F4)	896 KB/s

Read/Write Head Transfer Rate:

MSR-2 (F2)	487 KB/s
MSR-4 (F4)	975 KB/s

Cartridge Data Capacity (nominal):

183m (600 ft)	320 MB
165m (541 ft)	290 MB

Tape Drive Power Requirements

AC Unit

The power requirements for the 3830 tape drive with the integrated ac power supply are:

Voltages:	Nominal (rms)	Operating (rms)
Low range	100V ac - 120V ac	88V ac - 140V ac
High range	200V ac - 240V ac	176V ac - 259V ac
Frequency Limits:	Nominal (Hz)	Operating (Hz)
	50 Hz-60Hz	47.5 - 63.0 Hz
Power:	150W operational	180W maximum

DC Unit

The dc power requirements for the 3830 tape drive (without the integrated ac power supply) are:

Voltages	Nominal (I)	Maximum (I)	Minimum (I)
+5V ± 5%	6.4 A	8.0 A	2.0 A
-5V ± 5%	2.4 A	3.0 A	0.0 A
+24V ± 10%	1.9 A	2.8 A	200 mA

Power:	90W operational	108W maximum

Physical Specifications

AC Unit

The physical specifications and mounting requirements for the 3830 tape drive with the integrated ac power supply are shown in Figure 2-1.

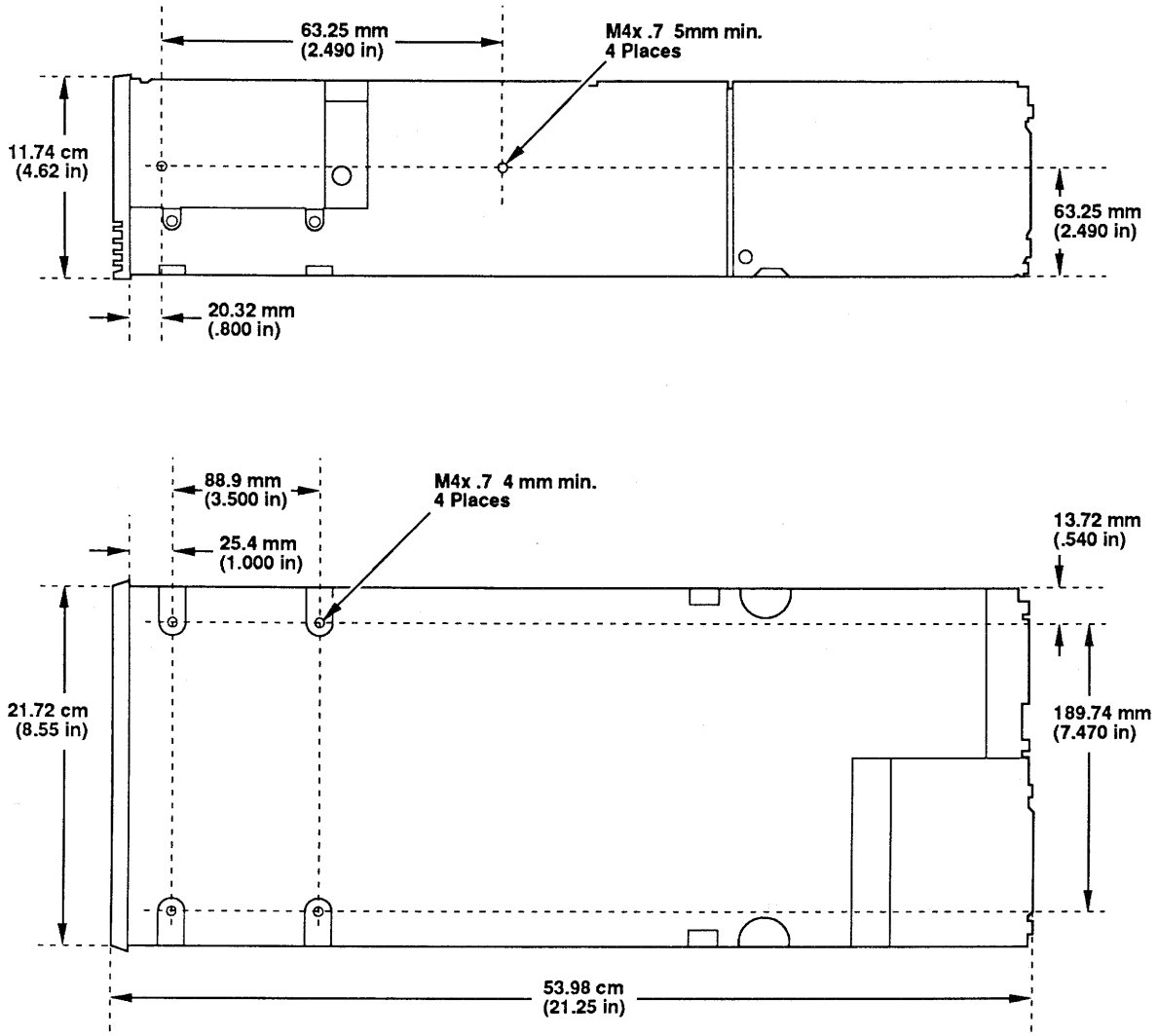


Figure 2-1. 3830 Tape Drive Dimensions With Integrated AC Supply

Shipping Weight:	66.14 kg (30 lb)
Installed Weight:	59.52 kg (27 lb)

DC Unit

The physical specifications and mounting requirements for the 3830 tape drive without the integrated ac power supply are shown in Figure 2-2.

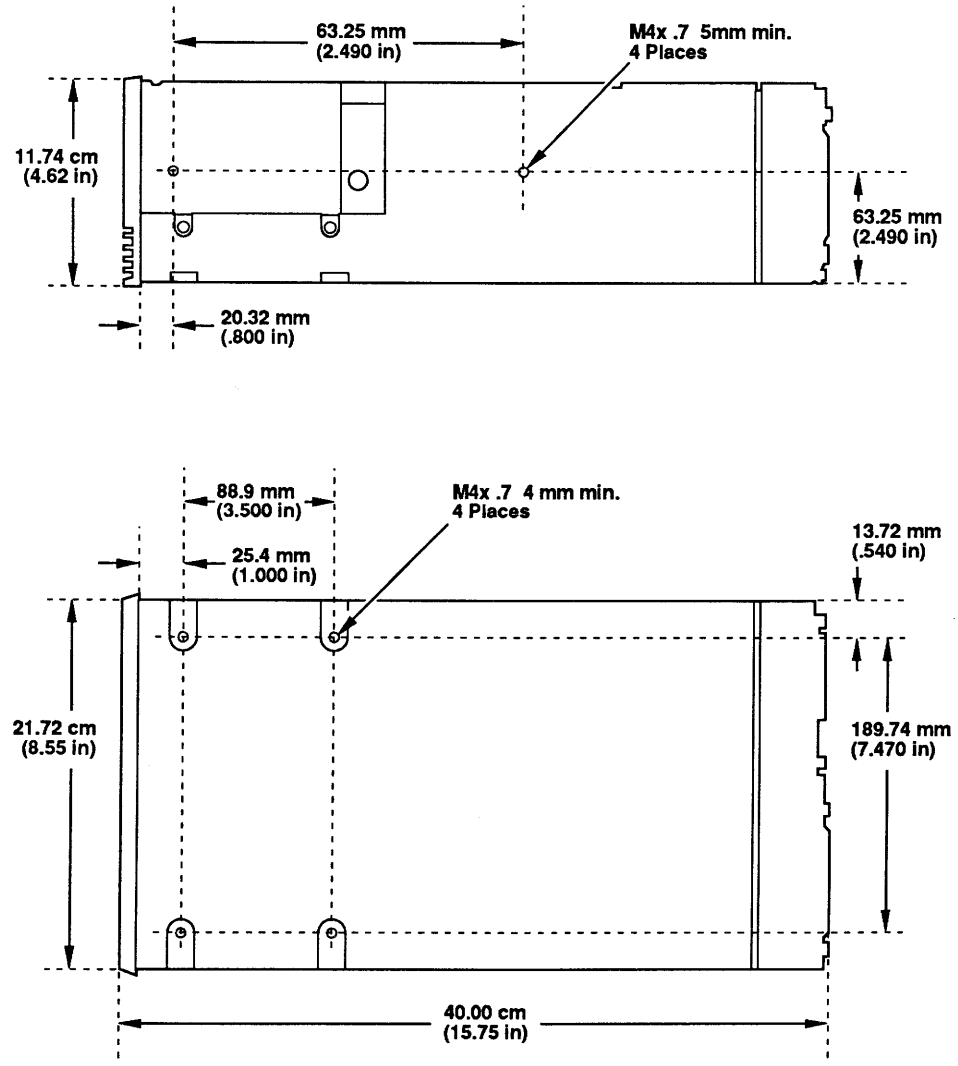


Figure 2-2. 3830 Tape Drive Dimensions

Shipping Weight:	10.35 kg (23 lb)
Installed Weight:	9.0 kg (20 lb)

Environmental Specifications

The Cipher 3830 is designed to operate over a wide range of temperature and humidity levels. This drive must not be exposed to condensation.

Operating Temperature (limited by media):	10°C to 40°C (50°F to 104°F)
Operating Humidity (limited by media):	15% to 85%, non-condensing
Maximum Wet Bulb Temperature: (limited by media)	26.0°C (78.8°F), non-condensing
Operating Altitude:	– 304.8 m to 3,048 m (– 1000 ft to 10,000 ft)
Storage Temperature:	– 40°C to 60°C (– 40°F to 140°F)
Storage Humidity:	5% to 95%, non-condensing

Regulatory Requirements

The Cipher 3830 is designed to comply with the specifications of various government and safety organizations.

Product Safety

UL recognition as a component, category 478.
CSA certification of C22.2, number 220.
IEC 380.
VDE 0806.

Electromagnetic Emissions

FCC Class A computing Devices, Part 15, Subpart J.
VDE 0871, 0875 Class B.

Cartridge

The 3830 tape drive uses the "3480-type" tape cartridge. An equivalent tape which complies with the proposed ANSI X3B5 standard may be substituted.

The magnetic tape is housed in a sturdy plastic enclosure that protects the tape from physical damage and contamination while providing ease of use and handling. The cartridge measures 10.16 cm x 12.70 cm x 2.54 cm (4 in. x 5 in. x 1 in.). Tape is available in two lengths, 165 m (541 ft) and 183 m (600 ft). The tape surface is coated with a chromium dioxide particle base.

Conventions

Throughout this manual two specific conventions are followed; the use of ANSI terms in describing system level interface commands, and the designation of logic "active low" signals.

This manual uses specific ANSI terms when referencing signals which are inherent to a particular system interface. For example, SCSI uses the terms "initiator and target," whereas IPI uses the terms "master and slave." The terms "initiator" and "master" generally refer to the host controller while "target" and "slave" generally refer to the Cipher 3830 tape drive. With the exception of the specific ANSI interface terms previously mentioned, "host" and "drive" are used respectively.

This manual designates logic signals that are defined as being "active low" with a forward slash preceding the signal mnemonic or term, such as /xxxx.

Chapter 3 Setup and Installation

UNPACKING AND REPACKING INSTRUCTIONS

Packaging

The Cipher 3830 tape drive is placed inside an anti-static bag, which is placed in a polypropylene foam shipping shell. The shell is set in a double-wall corrugated shipping carton. The foam shipping shell consists of two identical halves which use a tongue and groove method of aligning each half to the other. When the two halves are joined together, a protective shell is formed which surrounds the tape drive.

The top of the shipping shell is slightly recessed for placement of the 3830 Series Technical Manual and ac power cord. The carton and all flaps are fastened and sealed. This method of packaging minimizes the possibility of any damage during shipping.

Unpacking

Figure 3-1 shows an exploded diagram of the 3830 tape drive and the protective shipping shell. The unpacking instructions are listed as follows:

1. Place the carton right side up on either a workbench or the floor.
2. Cut the tape securing the top flaps of the box.
3. Open the top flaps.
4. Remove the 3830 Series Technical Manual and ac power cord from the top of the foam shipping shell. Note, an ac cable is included only when the integrated ac power supply is configured with the unit.
5. Remove the top half of the foam shipping shell.
6. While holding the sides, lift the tape drive from the box.

CAUTION

To prevent damage to the Front Panel, set the tape drive on a workbench with the Front Panel placed slightly over the edge.

7. Remove the tape drive from the anti-static bag.

8. Remove the 3830 Series User Guide and tape cartridge from the bottom of the foam shipping shell.

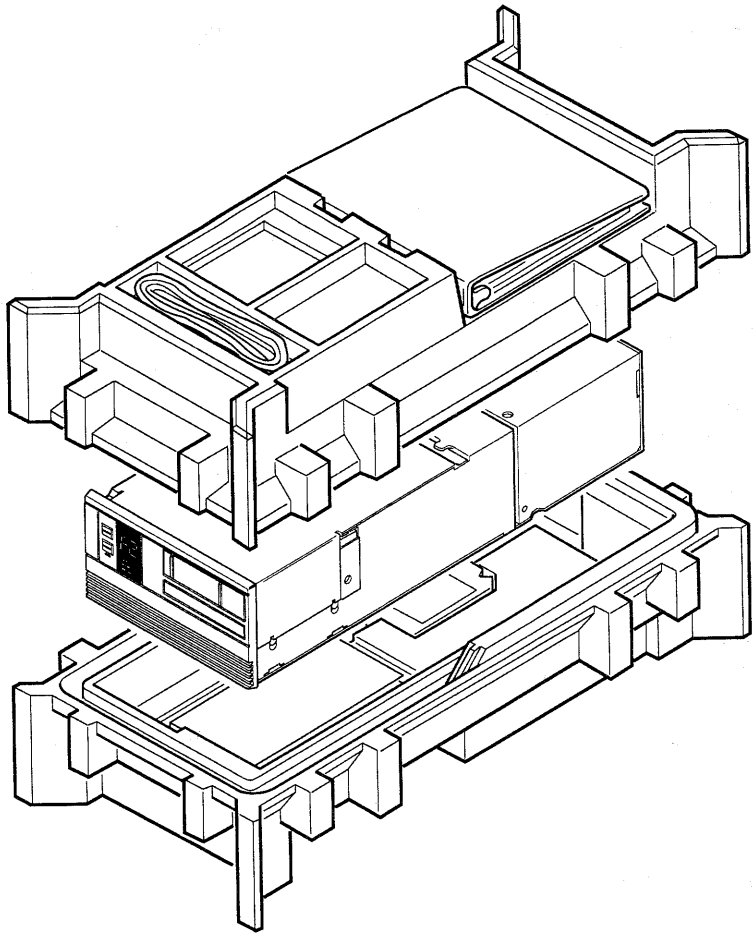


Figure 3-1. 3830 Tape Drive and Packaging

NOTE

It is recommended that all packaging material be saved for possible future shipping needs.

Repacking

Repacking the tape drive for shipment requires that the unpacking procedures be followed in a reverse order. Use an ample supply of tape to secure both the shipping shell and the carton.

CIPHER INTERFACE CONNECTION

The two 50-pin connectors (J1 and J2) provide the tape drive with the Cipher Interface communication signals from the host processor. The connector pin-outs are shown in Figure 3-2 and Figure 3-3. The physical location of the connectors are shown in Figure 3-5. The signal term definitions follow.

/IFBY	2	1	GND
/ILWD	4	3	GND
/IW4	6	5	GND
/IG0	8	7	GND
/IW0	10	9	GND
/IW1	12	11	GND
(N/C)	14	13	GND
(N/C)	16	15	GND
/IREV	18	17	GND
/IREW	20	19	GND
/IWP	22	21	GND
/IW7	24	23	GND
/IW3	26	25	GND
/IW6	28	27	GND
/IW2	30	29	GND
/IW5	32	31	GND
/IWRT	34	33	GND
(N/C)	36	35	GND
IEDIT	38	37	GND
IERASE	40	39	GND
IWFM	42	41	GND
(N/C)	44	43	GND
ITAD0	46	45	GND
IR2	48	47	GND
IR3	50	49	GND

Figure 3-2. Cipher Interface Connector J1

/IR0	2	1	/IRP
/ILDP	4	3	/IR1
/IR4	6	5	GND
/IR7	8	7	GND
/IR6	10	9	GND
/IHER	12	11	GND
/IFMK	14	13	GND
/IIDENT	16	15	GND
/IFEN	18	17	GND
/IR5	20	19	GND
/IEOT	22	21	GND
/IRWU	24	23	GND
(N/C)	26	25	GND
/IRDY	28	27	GND
/IRWD	30	29	GND
/IFPT	32	31	GND
/IRSTR	34	33	GND
/IWSTR	36	35	GND
/IDBY	38	37	GND
(N/C)	40	39	GND
/ICER	42	41	GND
/IONL	44	43	GND
/ITAD1	46	45	GND
/IFAD	48	47	GND
(N/C)	50	49	GND

Figure 3-3. Cipher Interface Connector J2

The signal term definitions for the Cipher Interface connectors are as follows:

GND (Ground)
The GND signal is logic ground.

/ICER (Interface Correctable Error)
The /ICER signal is not used. It is set logic high.

/IDBY (Interface Drive Busy)
The /IDBY signal is set active low to indicate that the drive is performing a command.

/IEDIT (Interface Edit)
The /IEDIT signal is set active low to indicate that an existing block of data on the tape is being edited.

/IEOT (End Of Tape)
The /IEOT signal is set active low when the recording head has past EOT.

/IERASE (Erase)
The /IERASE signal is set active low to indicate that a magnetic erase field is present at the write head.

/IFAD (Formatter Address)
The /IFAD signal in combination with the /TAD0 and /TAD1 signal lines select the drive address in a daisy chain configuration. For further information, refer to the /ITAD0, /ITAD1 signal definition.

/IFBY (Formatter Busy)
The /IFBY signal is set active low to indicate that the interface is performing a command.

/IFEN (Enable)
The /IFEN signal is set active low by the host to enable interface signal resets of the tape drive.

/IFMK (Interface Filemark)
The /IFMK signal is pulsed active low while the /IDBY is set active low during either a write verification, or when a read operation is performed and a Filemark is detected.

/IFPT (Interface File Protect)
The /IFPT signal is set active low to indicate that the loaded cartridge is write protected. All write commands are disabled.

/IGO (Interface Go)
The /IGO signal is pulsed active low to initiate tape motion of the selected drive. The drive must be in the ready state before tape motion can begin.

/IHER (Interface Hard Error)
The /IHER signal is pulsed active low while /IDBY is active low and a record being read or written contains an uncorrectable error.

/IIDENT (Interface Identification)
The /IIDENT signal is pulsed low when reading or writing from BOT to simulate identification burst detection.

/ILDP (Interface Load Point)
The /ILDP signal is set active low when the recording head is positioned at load point (Beginning-of-Tape).

/ILWD (Interface Last Word)
The /ILWD flag appends the last data character during write to tape operations and variable length erase operations. This flag is also used to clear the write command.

/IONL (Interface Online)
The /IONL signal is set active low to indicate that it is accessible by the host system. /IONL is cleared after an unload command is received.

/IRDY (Interface Ready)
The /IRDY signal is set active low to indicate that the tape drive is selected. The tape must also be loaded and idle.

/IREV (Interface Reverse)
The /IREV signal is set active low to initiate a reverse motion of the tape.

/IREW (Interface Rewind)
The /IREW signal is pulsed low to initiate a tape rewind. For rewind to occur, the drive must be in the ready state and the tape must not be at load point. This command is ignored if the tape is at load point.

/IR0 - /IR7, P (Interface Read Data Bus and Parity)
The read data bus is composed of eight data bits and one parity bit. Parity is odd. The drive reads data from the tape and then transfers the data to the host system on this bus. The /IR0 line is the most significant bit. When the bus carries status/sense signals, /IR7 is the most significant bit.

/IRSTR (Interface Read Strobe)
The /IRSTR signal is pulsed active low by the interface to indicate that a read character is present on the /IR0 through /IR7 bus.

/IRWD (Interface Rewind)
The /IRWD signal is set active low to indicate that the drive is rewinding to the BOT. The /IRDY signal is cleared during a rewind command.

/IRWU (Rewind/Unload)
The /IRWU signal is pulsed active low to clear the drive's online status flag, rewind and unload the tape, and then eject the cartridge.

/ITAD0, /ITAD1 (Transport Address)

The /ITAD0 and /ITAD1 signals in combination with the /IFAD signal line selects the tape drive address in a daisy chain configuration.

Drive Address	/IFAD	/ITAD0	/ITAD1
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

/IW0 - /IW7, P (Interface Write Data Bus and Parity)

The data bus is composed of eight data bits and one parity bit. Parity is odd. The host controller reads the data bus during arbitration to determine device priority. The /IW0 line is the most significant bit. When the bus carries status/sense signals, /IW7 is the most significant bit.

/IWFM (Interface Write Filemark)

The /IWFM signal is set active low to write a 101.6 mm (4.0 in.) indicator mark on the tape, prior to the writing of a file.

/IWRT (Interface Write)

The /IWRT signal is set active low to indicate that host supplied data is being written to tape.

/IWSTR (Interface Write Strobe)

The /IWSTR signal is pulsed active low by the interface to acknowledge receipt of each write character.

(N/C) (No Connection)

These lines are not used. They are terminated for compatibility.

Cable Options

Interconnection between the 3830 and the host system may be made with two 50-conductor flat ribbon cables. A characteristic impedance of 100 ohms ± 10% is recommended for unshielded flat cables. A characteristic impedance of greater than 90 ohms ± 10% is recommended for shielded cables. To assure reliable performance, the communication cables should have the following parameters:

Maximum length is 6 m (19.68 ft), service loop included. The total length includes all cable segments between the host and all tape drives.

Minimum cable conductor size is 28 AWG.

Termination Of The Cipher Interface

The tape drive configured with the Cipher Interface may be connected in a daisy-chain fashion. No more than eight drives may be connected to one controller.

The interface drivers may be internally terminated by removing resistors RP5 through RP7 (P/N 970925-011) from each tape drive, except the last drive of a daisy-chain configuration. Figure 3-4 shows the board location of the terminating resistors. Refer to the "Connectors" section of this chapter for information regarding access to the terminating resistors.

NOTE

Only the last drive in the configuration should be terminated with the appropriate terminating resistors.

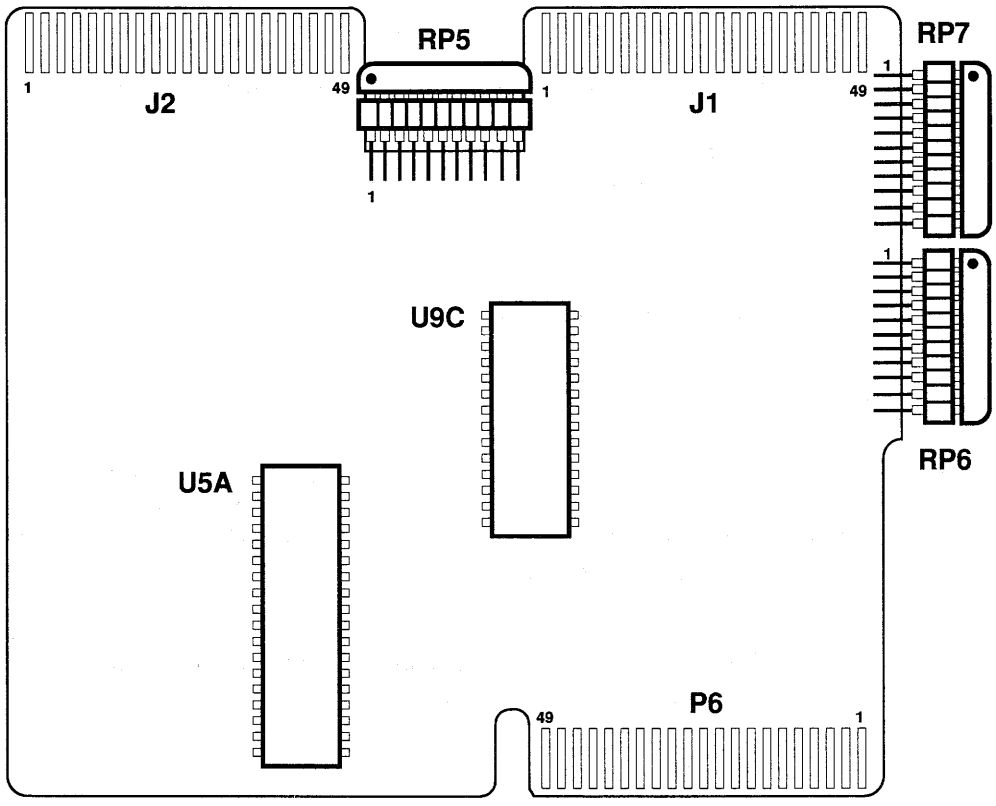


Figure 3-4. Cipher Interface Terminating Resistors

REAR PANEL

The rear panel of the 3830 tape drive contains the AC Power Switch and the interface connectors. Figure 3-5 shows the rear panel.

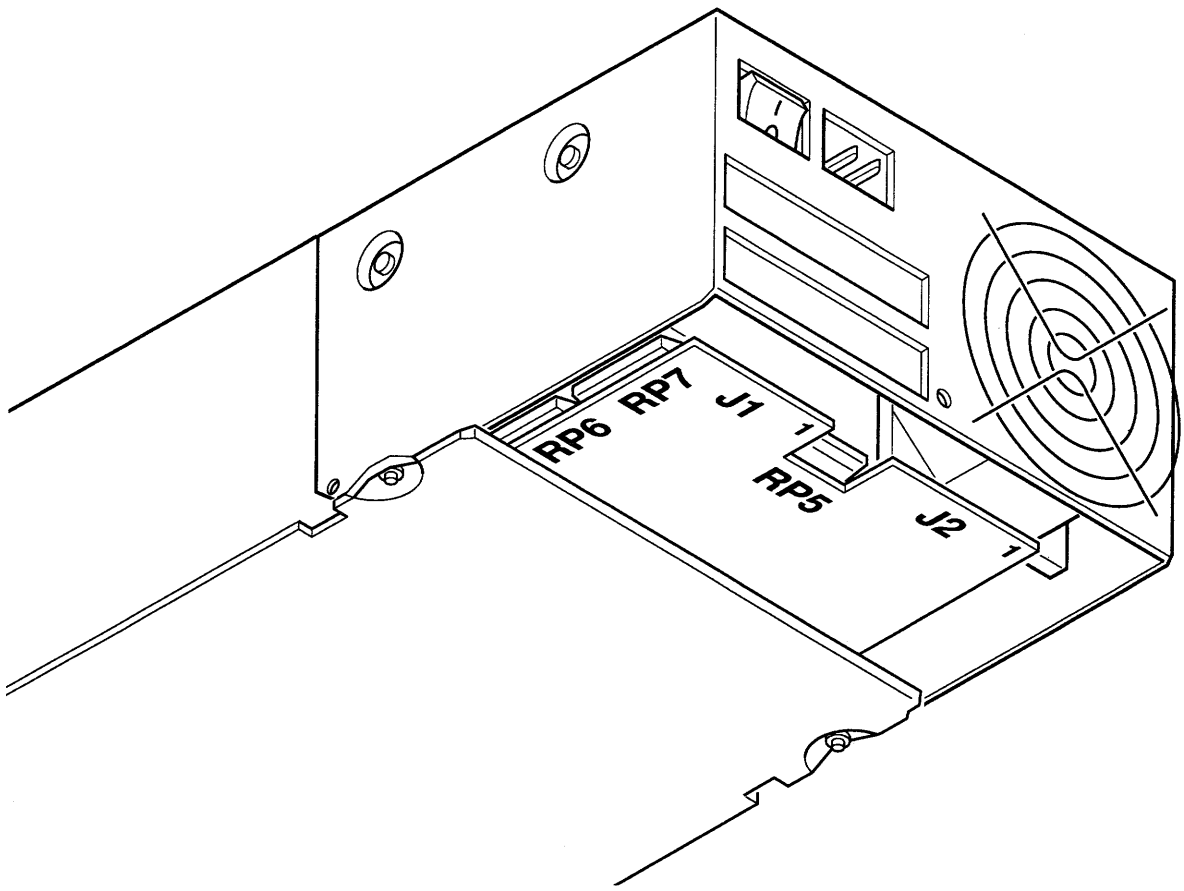


Figure 3-5. 3830 Rear Panel

Connectors

Access to the Cipher Interface Board connectors and terminating resistors is accomplished by removing both the retaining screw located at the center, bottom edge of the tape drive's rear panel and the small bottom cover plate. The physical location of the two interface connectors are shown in Figure 3-5.

AC Power Switch

The AC Power Switch is the only switch located on the rear panel of the 3830 tape drive with the integrated ac power supply. This switch controls all ac power used by the drive motors and logic. Note, some unrecoverable errors may be cleared by cycling this switch. Figure 3-5 shows the rear panel location of the AC Power Switch.

POWER REQUIREMENTS

The optional integrated ac power supply utilizes single-phase ac power. This supply provides auto-range operation in either of two voltage ranges, low (100V to 125V ac) or high (200V to 240V ac). The power supply automatically selects the appropriate voltage and frequency range without any internal or external modification.

The low voltage range features operation with the following nominal voltage levels, 100V, 110V, and 120V ac. The high voltage range features operation with the following nominal voltage levels, 200V, 208V, 220V, 230V, and 240V ac.

The power supply is capable of operating with a line frequency of 50 Hz to 60 Hz (47.5 - 63.0).

NOTE

This equipment relies on the building installation for protection of internal wiring. Maximum over current rating must not exceed 16 amperes.

POWER CABLE

The part number for the Cipher 3830 ac power cables are listed as follows. A power cord is shipped with each drive configured with the integrated ac power supply.

120V ac cable-P/N 970035-005
220V ac cable-P/N 970035-001

COOLING REQUIREMENTS

Over-temperature sense circuitry is provided within the power supply to detect internal drive temperatures that if exceeded, may lead to damage of logic components, motor amplifiers, and the power supply.When the internal drive temperature reaches 55°C ± 5°C (131°F ± 9°F) the power supply automatically switches off. Cycling the AC Power Switch restores normal operation.

Each drive is equipped with a self-contained fan to provide forced-air cooling and to assist in maintaining an internal drive temperature that is below the maximum allowable operating limit. The ambient operating temperature range for the tape drive is between 10°C and 40°C (50° - 104°F).

So that air flow is not restricted, a minimum clearance of 50.8 mm (2.0 in.) is required at the tape drive's rear panel. The Front Panel must not be covered with a facade.

CONFIGURATION PARAMETER SETTINGS

The configuration parameters of the Cipher 3830 tape drive must be correctly set for operation with a Cipher Interface host system. Table 3-1 lists the appropriate Customer Engineer Diagnostic test and the "normal operation" setting. Test procedures to access and select the various parameters are listed in the "Troubleshooting and Diagnostics" chapter of this manual.

Test	Parameter	Parameter Setting
40	Local Format Select	Enabled (Default)
43	Format Display	Enabled (Default)
50	Unit Address (Logical)	Address 0
51	Interface Parity	No Parity
52	Interface Transfer Rate	150 KB/s (Default)
53	Interface Ramp Delay	850 usec

Table 3-1. Cipher Interface Configuration Options

COMMAND SIGNALS

The Cipher Interface commands are derived by decoding the /IWRT, /IWFM, /IERASE, /IREV, and /IEDIT signal lines. The Rewind (/IREW) and Unload (/IRWU) signal lines are processed directly. If the interface receives an illegal command, the command is terminated with a Hard Error.

Table 3-2 lists the command set.

Command	/IREV	/IWRT	/IWFM	/IEDIT	/IERASE
Set Format 2	1	0	1	1	1
Set Format 4	1	1	0	0	0
Security Erase	0	1	1	1	1
Read Forward	0	0	0	0	0
Read Reverse	1	0	0	0	0
Read Extended Status	0	0	0	1	0
Current Status	0	0	0	0	0
Configuration Status	1	0	0	0	0
Error Log 1	0	0	0	1	0
Error Log 2	1	0	0	1	0
Error History Reset	1	0	0	1	1
Write	0	1	0	0	0
Write Synchronize	0	0	0	1	1
Write Filemark	0	1	1	0	0
Space Forward	0	0	0	0	1

Table 3-2. Cipher Interface Command Set (1 of 2)

Command	/IREV	/IWRT	/IWFM	/IEDIT	/IERASE
Space Reverse	1	0	0	0	1
File Search Forward	0	0	1	0	X
File Search Reverse	1	0	1	0	X
Start Diagnostic Sequence	1	1	1	1	1
Transfer Write Data	0	1	0	0	0
Transfer Read Data	0	0	0	0	0
Transfer Response	1	0	0	0	0
Select Default Partition	1	0	1	1	0
Select Data Partition 1	1	1	1	1	0

Table 3-2. Cipher Interface Command Set (2 of 2)

Set Format 2/Set Format 4

The Set Format commands allow changing the tape format of the 4-track model 3834. The model 3832 drive can only use Format 2 and returns Error Code 03 if Format 4 is requested.

The drive automatically selects the correct format if a tape has previously been written to. If a requested format is not available or the tape is not at Logical Beginning of Tape (LBOT) or Physical Beginning Of Tape (PBOT), the drive sets an Error Code.

Security Erase

This command erases the tape from the current position to the Read End Of Partition for the current partition.

Read Forward

When the Read Forward command is received, the next record is sent to the host. Initially, the drive checks cache memory to see if the requested record is present. If not, the tape is positioned and the record is transferred into cache memory. When the record is complete, the data is transferred to the host.

Read Reverse

The Read Reverse command functions the same as the Read Forward Command except the drive reads the tape in the reverse direction.

Read Extended Status

The Read Extended Status command may be used to request any of four 16-byte records or reset the Buffered Error Log (BEL). To access the status records, the host must first set the Read Extended Status command to the interface. The interface then enters the Read Extended Status Mode and notifies the host it is ready by setting Data Busy (/IDBY) and Formatter Busy (/IFBY) low.

The second command must be one of the five codes - Current Status, Configuration Status, Error Log 1, Error Log 2, or Error History Reset - for the desired status or log. The 16-byte record is then transferred to the host as a normal read operation on the read data (/IR0 - /IR7) lines. The Buffered Error Log (BEL) is unaltered unless the Error History Reset is used. If the command for Error History Reset is used, the 16 bytes for Error Log 2 are transferred, and the BEL is cleared and reset.

Current Status

The Current Status command returns the information in Table 3-3 to the host system.

Byte	Bit	Description
0		Tape Status
	7	/IFPT
	6	/IRWD
	5	/IONL
	4	/IRDY
	3	/IFMK
	2	0
	1	/IHER
	0	0
1		Tape Status
	7-2	0
	5	Illegal Command
	4	0
	3	Write Parity Error at Interface
	2	0
	1	/IEOT
	0	/ILDP
2		Cache Size 08h = 512K
3		Fault Code. Refer to Table 3-4.
4-5		0
6		Format Code
	7-6	0
	5-3	Current Format (010 = MSR-2; 011 = MSR-4)
	2-0	Last Format Requested (010 = MSR-2; 011 = MSR-4)
7		0
8-10		Current Block Position
11-15		0

Table 3-3. Current Status Response

FAULT CODES

Cipher Interface Fault Codes are reported to the host system in byte 3 of the Current Status response packet. These hex codes are reported to the host and are not displayed on the tape drive's front panel display. Note, these fault codes are not the same as the Fault Symptom Codes as listed in the "Troubleshooting and Diagnostic" chapter of this manual.

Fault Code	Description
01	Cipher Interface received an illegal command.
02	Device not ready.
03	Format requested by the Set Format command is not available.
04	Format command was received while tape is not positioned at BOT.
0F	Diagnostic command is terminated.
40	Set format command failed to obtain the device's "Operating Modes" data.
41	Machine Exception, Byte 3 is not zero.
42	Machine Exception, physical interface check.
43	Machine Exception, uncorrectable data check.
44	Machine Exception, equipment check.
45	Machine Exception, hardware write protected.
46	Command Exception parameter received.
47	Command Aborted parameter received.
48	Incomplete, BOT detected.
49	Incomplete, EOT detected.
4A	Incomplete, Filemark detected.
4B	Incomplete, Block Length Exception.
4C	Incomplete, blank tape.
4D	Incomplete, no record found.
4E	Invalid Command parameter received.
4F	Missing Parameter parameter received.
80	Response extent not equal to zero after Write Filemark, Space or Search command.
81	Device Slave Response parity error on information transfer.
82	Parity Error on data written to the FIFO during information transfer.
83	No data transferred by data transfer command.

Table 3-4. Fault Codes From Byte 3 of Current Status (1 of 2)

Fault Code	Description
C1	Attempt to send command packet failed.
C2	Failed to select the facility.
C3	Data transfer response from device timed out.
C4	Command response from device timed out.

Table 3-4. Fault Codes From Byte 3 of Current Status (2 of 2)

Configuration Status

The Configuration Status command returns the information described in Table 3-5 to the host system.

Byte	Bit	Description
0		Capability
	7-4	0
	3	1 = MSR-4 Enabled
	2	1 = MSR-2 Enabled
	1-0	0
1		Vendor Code
2		Model Code
	7-5	0
	4	1
	3	0 = 3832 1 = 3834
	2-1	1
	0	0
3		Configuration
	7-5	0
	4	0 = Ramp Enabled 1 = Ramp Disabled
	3-2	11b = Maximum Block Size (64K)
	1	0 = Internal Parity 1 = External Parity
	0	0
4-15		0

Table 3-5. Configuration Status Responses

Error Log 1

The Error Log 1 command returns the first 16-bytes of the Buffered Error Log (BEL) to the host system. The status information is described in Table 3-6.

Byte	Description/Contents
0	Reserved.
1	Reserved.
2	20
3	2B
4 - 6	Block ID. The logical block position of a data block or tape mark that would be next written or read in a forward direction. The high bits are in byte 4, the middle bits are in byte 5, The low bits are in byte 6. The range is 000000 through FFFFF.
7	21
8	Read Forward Data Checks, contains the number of read data checks that required Error Recovery Procedure Action (ERPA) intervention. Only the first error is logged. Errors that occur during error recovery are recorded in byte 14 of Error Log 2.
9	Read Backward Data Checks, contains the number of read backward data checks that required Error Recovery Procedure Action (ERPA) intervention. Only the first error is logged. Errors that occur during error recovery are recorded in byte 14 of Error Log 2.
10	Write Data Checks, contains the number of temporary data checks that required Error Recovery Procedure Action (ERPA) intervention. Only the first error is logged. Errors that occur during error recovery are recorded in byte 8 of Error Log 2.
11, 12	Reserved.
13	00
14, 15	Read Bytes Processed, contains the number of data sectors read from the CUE Board to the read channel of the Read/Write Board. Each count is equal to 8320 bytes. The maximum value is 65535.

Table 3-6. Error Log 1

Error Log 2

The Error Log 2 command returns the second 16-bytes of the Buffered Error Log (BEL) to the host system. The status information is described in Table 3-7.

Byte	Description/Contents
0, 1	Write Bytes Processed, contains the number of data sectors written from the write channel to the CUE Board. Each count is equal to 8320 bytes. The maximum value is 65535.
2	00
3 - 7	Reserved.
8	Write Skip Recovery Count, contains the number of times sectors have been skipped and rewritten during error recovery.
9 - 13	Reserved.
14	Read Recovery Retry Counts, contains the total number of read errors encountered during device error read recovery for the cartridge. Bytes 8 and 9 of Error Log 1 count initial events.
15	00

Table 3-7. Error Log 2

Error History Reset

The Error History Reset transfers the same data as Error Log 2 except for one condition. After data transfer is complete, Error Logs 1 and 2 are cleared. Note, individually accessing either Error Log 1 or 2 leaves the Error Logs intact and unaltered.

Write

When the Write command is sent to the Cipher Interface, the next block of data transferred on the write data (/IW0 - /IW7) lines is stored in cache for subsequent recording to tape.

The host sets the Last Word (/ILWD) signal line true when the last character is placed on the data lines to signal termination of the record.

Write Synchronize

When the Write Synchronize command is sent to the Cipher Interface, all data in the cache is written to the tape.

The Write Synchronize command is used to purge the cache before other tape handling is initiated. When received, all pending writes in cache are completed.

Write Filemark

The Write Filemark command causes a Filemark to be written at the current tape position.

Space Forward/Space Reverse

The Space Forward and Space Reverse commands cause the drive to skip the next record on the tape. Read strobes (/IRSTR) are not sent during the skip.

File Search Forward/Reverse Command

The File Search Forward and File Search Reverse commands allow positioning the tape at the end of a Filemark. Execution of the command causes the drive to skip records until one of the following conditions occurs:

Condition	Status Line Set
File mark detected	/IFMK
LEOT is reached	/IEOT
LBOT is reached	/ILDP
Blank tape detected	/IRDY

Read strobes (/IRSTR) are not sent during the skips. When one of the four conditions is encountered the drive stops the tape and sets the appropriate status lines to the host.

Start Diagnostic Sequence

The Start Diagnostic Sequence command allows more direct access to the drive. The following four types of information transfer are available by sending a sequence of three commands to the Cipher Interface.

Command Packet transfer
Write Data transfer
Read Data transfer
Response Packet transfer

The host sends the command to initiate a diagnostic data transfer. The command codes are sent as a Command Packet, similar to a Write command.

If the command sent to the drive requires a Read Data transfer, the second command must be a Read Forward Command. If the command requires a Write Data transfer, the second command must be a Write Command.

The data transfer is then accomplished the same way as a normal Read or Write command. When the transfer is completed, the Cipher Interface terminates the command and waits for a third command.

If a data transfer is not required or has been completed, the third command must be a Read Reverse command. This causes the Cipher Interface to transfer the Response packet to the host and resume normal operation.

All commands sent during the diagnostic sequence are terminated with Hard Error set.

NOTE

Care should be taken when using this command. The Cipher Interface and the tape drive controller do not update the tape status and the drive must be instructed to reposition the tape at the end of any Diagnostic Sequence commands.

Select Default Partition

At power-up and cartridge insertion the tape is positioned at the beginning of the default partition, Partition 0.

Select Data Partition 1

This command positions the tape at the beginning of Partition 1.

Chapter 4 Operator Information

INTRODUCTION

This chapter provides the end user with the necessary information to perform normal operating procedures. The following topics are covered in this chapter:

Switches and Indicators
Cartridge Handling
Loading and Unloading the Tape Cartridge
Operating Commands
Diagnostics

Switches and Indicators

The following sections provide the location of the front panel switches and indicators. Front panel switches and indicators are the same for both models (3832 and 3834). Figure 4-1 shows the front panel switches and indicators. Rear panel switches are discussed in the "Setup and Installation" chapter of this manual.

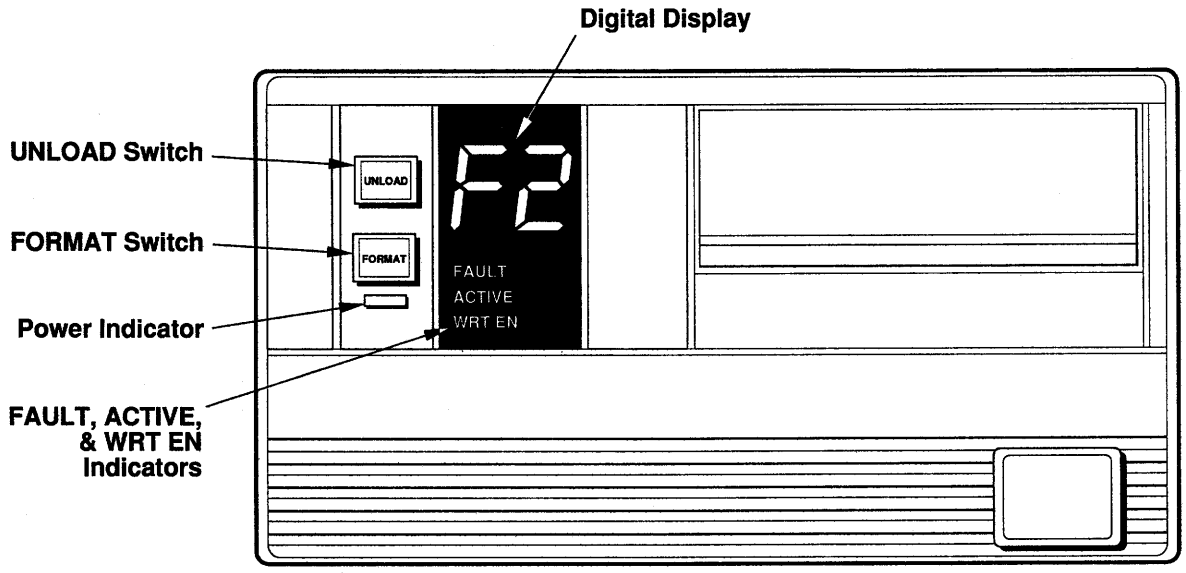


Figure 4-1. Front Panel Switches and Indicators

FORMAT Switch

The FORMAT Switch allows for selection of the MSR format to be used for drive operations, two-track (F2) or four-track (F4). The drive's format is displayed on the Digital Display. For further information, refer to the "Operating Commands" section.

The FORMAT Switch also performs various diagnostic functions which are described in the "Troubleshooting and Diagnostics" chapter.

UNLOAD Switch

Pressing the UNLOAD Switch causes the tape drive to initiate the tape unload process. The tape is rewound into the cartridge, and when unloading is complete the drive ejects the cartridge approximately 25.4 mm (1 in.).

The UNLOAD Switch also performs various diagnostic functions which are described in the "Troubleshooting and Diagnostics" chapter. Note, this switch is disabled during a head clean operation.

Power Indicator

The Power Indicator is located beneath the FORMAT Switch. This indicator is lit whenever power is supplied to the drive. If the integrated ac power supply is installed, ac power must be present and the AC Power Switch must be set to the ON position.

ACTIVE Indicator

The ACTIVE Indicator is lit during execution of host commands such as; reading and writing, and during diagnostic testing. This indicator remains lit until all drive commands have been completed and tape motion is halted.

During cartridge loading and unloading, the ACTIVE Indicator flashes with a 25% duty cycle.

Write Enable Indicator (WRT EN)

The WRT EN Indicator is lit when the inserted data cartridge is not write protected. The indicator remains lit until the cartridge is unloaded.

When a write-to-tape operation is performed and the write protect switch is enabled, previously recorded data may be lost. With the switch in the write protect setting, data cannot be written to tape. Refer to Figure 4-2 for the location of the cartridge write protect switch.

FAULT Indicator

The FAULT Indicator is lit when the drive contains an unrecoverable fault. A Fault Symptom Code (FSC) is sent to the host system and the code for the failed Field Replaceable Unit (FRU) is saved in the non-volatile RAM (NVRAM) memory for repair center reference. NVRAM data may be retrieved through system commands. The FSC is also displayed on the front panel's Digital Display.

NOTE

The FAULT Indicator also signals an "Ignore Request" message. Depending on the state of the drive, the attempted operator command was either undefined or considered illegal. Therefore, the Fault Indicator flashes twice to signify that the command was ignored.

Digital Display

The two-digit hexadecimal LED display indicates the drive format (F2 or F4), Fault Symptom Codes (FSC), and diagnostic test codes.

CARTRIDGE HANDLING

The magnetic tape is housed in a sturdy plastic enclosure that protects the tape from physical damage and contamination while providing ease of use and handling. An added feature of the cartridge is that the user does not need to touch the tape, this increases data integrity.

CAUTION

Care must be taken so that the cartridge is not exposed to either extreme temperatures or strong magnetic fields. The operator should also observe all instructions provided by the media manufacturer.

Tape cartridges differ from reel tape in that, there are no reflective markers or leaders on the tape. Therefore, the beginning-of-tape and end-of-tape positions are defined as specific length relationships between the Take-up and Supply spools.

The cartridge contains three recessed areas for external labeling of the volume name or serial number: one on the front edge of the spine, one on the top, and another on the side. Labels placed on the front edge of the spine are visible while the cartridge is loaded in the drive.

Write protection is accomplished with an integrated write protect switch located on the rear of the cartridge. Figure 4-2 shows the write protect switch.

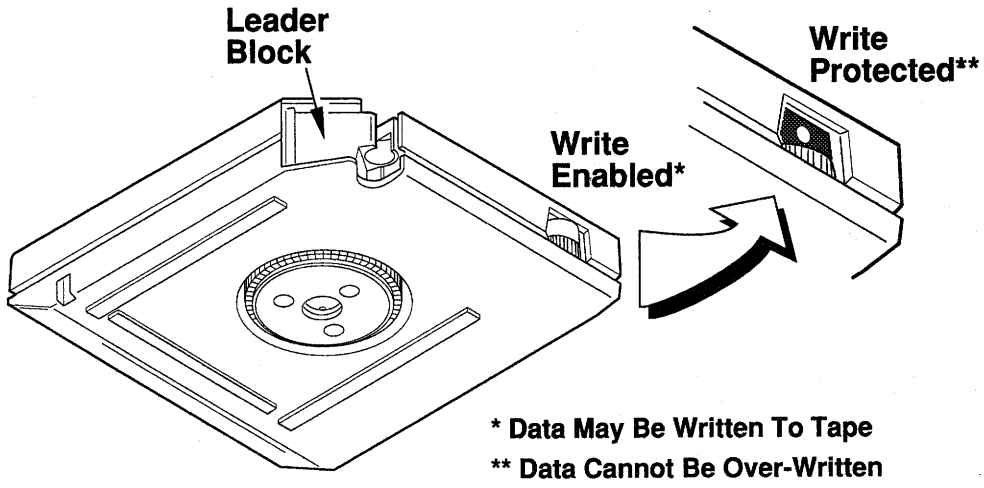


Figure 4-2. Tape Cartridge Write Protect Switch

LOADING THE TAPE CARTRIDGE

The tape is automatically loaded after the cartridge is inserted. The drive's Threader Arm attaches to the leader block that is connected to the beginning of the tape and threads the tape past two roller guides, the Head Assembly, two more roller guides, and then onto the Take-up reel.

Use the following procedures to load the tape.

1. If required, set the AC Power Switch to the ON position. Power-on Diagnostics are performed; test run time is approximately 10 seconds. For further information, refer to the "Troubleshooting and Diagnostics" chapter of this manual.

   The device indicates successful completion of Power-on Diagnostics by turning off the FAULT Indicator and displaying either the default format or blanking the display, depending on whether the Format Display Selection (Test 43) is enabled or disabled.

2. The tape drive is now ready to accept the cartridge. Be sure that the cartridge write protect switch is set to the correct position. Note, the operator must also ensure that the leader block is inserted in the cartridge before loading. Insert the cartridge into the loading slot with the leader block on the right side, and the hub facing down. The drive will not accept the cartridge in any other position. Figure 4-3 shows the correct position for inserting the cartridge.

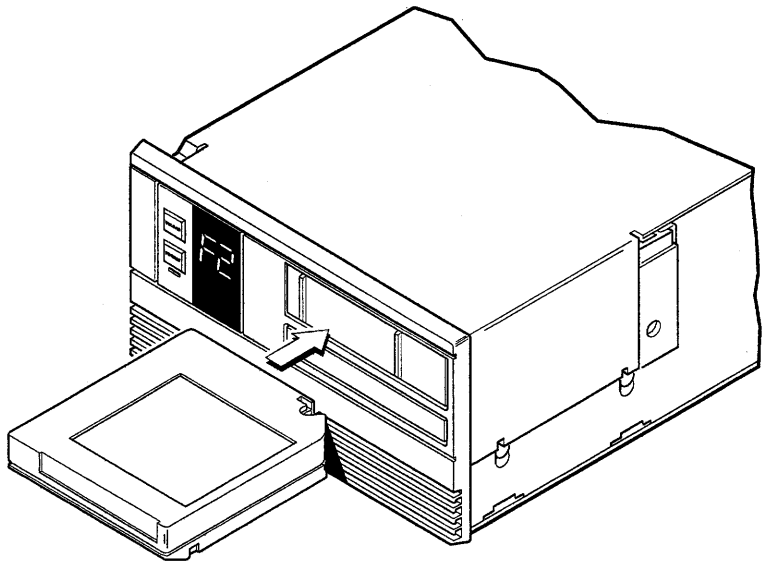


Figure 4-3. Inserting the Tape Cartridge

3. Gently, push the cartridge until it reaches a physical stop. This engages the drive mechanism to automatically load the cartridge. The ACTIVE Indicator flashes during the load process.

4. Be sure that the appropriate tape format has been selected, two-track "F2" or four-track "F4".

   When a cartridge is loaded, the drive's default format is displayed. If the cartridge is blank, the user must select the desired format at the load point (BOT). Otherwise, the format of a previously recorded cartridge cannot be changed unless writing is started from the beginning-of-tape.

   When prerecorded cartridges are loaded, the drive attempts to recognize and default to the tape's recorded format. If the drive is capable of processing the format, all read operations default to this format.

5. The tape cartridge is now loaded and "online." Since the drive is under the control of the host computing system, no further user intervention is required until the host system completes the operating functions, or the tape is full.

6. To unload the tape cartridge, press the UNLOAD Switch. Refer to the "Unloading the Tape Cartridge" section in this chapter.

UNLOADING THE TAPE CARTRIDGE

Pressing the UNLOAD Switch places the drive in the "not ready" state. All requested drive commands are completed. The tape is rewound and the Threader Arm inserts the leader block into the cartridge. The cartridge is then ejected from the drive.

Use the following procedures to unload the tape.

1. Press the UNLOAD Switch. The drive is taken offline and placed in the "not ready" state. All previously buffered commands are synchronized. Synchronization is a command which writes all cache-resident data to tape before processing the next command.

   If the user is prevented from unloading a "locked" cartridge due to a system interface command. The drive ignores the unload request and signals the "Ignore Request" message by flashing the FAULT Indicator twice. The user may override the lock by pressing and holding the UNLOAD Switch for five seconds. Normal unload procedures are then initiated. For further information, refer to the "Operating Commands" section of this chapter.

2. The tape is rewound onto the Supply reel within the cartridge and the leader block is inserted into cartridge.

3. The cartridge is ejected from the drive approximately 25.4 mm (1 in.).

4. The cartridge may now be removed from the drive.

CAUTION

If the cartridge is not ejected and characters appear on the front panel display, the drive cannot complete the unload process. Any attempt to forcibly remove the captured cartridge may result in damaged tape and lost data. Procedures to manually recover a trapped cartridge are described in the "Maintenance" chapter of this manual.

OPERATING COMMANDS

The user needs to be familiar with several commands to successfully operate the Cipher 3830 tape drive. The commands are: Format, Load Abort, Unload Reject, and Unload Reject Override. These commands are described in the following sections.

Format

The FORMAT Switch allows for selection of the format that is to be used for drive read/write operations. Format determines the cache to tape transfer rate and the number of data tracks (track groups) that are written concurrently to tape. The format of the drive is displayed on the Digital Display.

For example, the MSR format of a Cipher 3834 drive may be set to operate with either four-tracks or two-tracks. The Cipher 3832 may only be set to operate with an MSR format of two-tracks. The four-track MSR format is displayed as "F4." The two-track MSR format is displayed as "F2."

NOTES

When a blank tape is loaded, the operator must select the appropriate format. Otherwise, the tape is written with the drive's default format.

The format of a previously recorded cartridge cannot be changed unless writing is started from the beginning-of-tape.

When prerecorded cartridges are loaded, the drive attempts to recognize and default to the tape's recorded format. If the drive is capable of processing the format, all read operations default to this format.

Load Abort

The Load Abort function allows a cartridge load that is in progress to be exited. Pressing the UNLOAD Switch while a cartridge is being loaded forces the tape to be unloaded and ejected after the beginning of tape has been reached.

Unload Reject (SCSI only)

Unload Reject prevents the user from unloading a cartridge that has been "locked" by a system interface command. The drive ignores the unload request and signals the "Ignore Request" message by flashing the FAULT Indicator.

Unload Reject Override (SCSI only)

When a "locked" cartridge is loaded, the user may override the lock by pressing and holding the UNLOAD Switch for five seconds. Normal unload procedures are then initiated.

DIAGNOSTICS

Several levels of operator diagnostics are available for the Cipher 3830 tape drive. Diagnostic levels include; Power-on, Idle Time, User, and Customer Engineer. Due to the nature of diagnostics, only Power-on Diagnostics is discussed in this section. For further information regarding the various diagnostic levels, refer to the "Troubleshooting and Diagnostics" chapter of this manual.

Power-on Diagnostics

The Power-on Diagnostic tests are ROM-resident routines that are performed when the drive is powered-on. Approximate test run time is 10 seconds.

1. Power-on Diagnostics begins by illuminating all front panel indicators. The Minimum System Configuration Tests are performed.

2. If an error is detected during this phase of the Power-on Diagnostics, all front panel indicators remain lit and microprocessor activities halt.

3. After successful completion of the Minimum System Configuration Tests, the ACTIVE Indicator is turned off. The Data Hardware Verification Tests are performed next.

4. If an error is detected during this phase of Power-on Diagnostics, the FAULT, WRT EN, and Power Indicators remain lit and a Fault Symptom Code (FSC) is logged in the NVRAM and displayed on the Digital Display.

5. After successful completion of the Data Hardware Verification Tests, the FAULT Indicator is turned off. The Power-on Diagnostic Tests are complete.

Chapter 5 Maintenance

CLEANING THE TAPE PATH

Since the Cipher 3830 tape drive is microprocessor based, the internal firmware is able to maintain a greater level of control accuracy over the servo mechanism and associated logic functions. Therefore, preventive maintenance is limited to cleaning the tape path which includes the Read/Write Head and tape roller guides. Cleaning should be performed after every eight eight hours of use.

Use a high-quality half-inch cleaning cartridge. Cleaning instructions are as follows:

NOTE

No special operator precautions are required for performing a cleaning cycle. Internal sensors detect the difference between cleaning and data cartridges.

1. Insert the cleaning cartridge into the tape drive. Head cleaning begins automatically.

2. When the cleaning cycle is complete, the cleaning cartridge is automatically ejected. Cleaning time is approximately 1 minute.

FUSES

The integrated power supply of the Cipher 3830 tape drive contains two fuses to protect against excessive power levels. These fuses are neither customer accessible nor customer replaceable.

MANUAL RECOVERY OF THE TAPE CARTRIDGE

A failed drive that cannot complete the unloading process must be partially disassembled for manual recovery of the tape cartridge.

CAUTION

Whenever performing removal and replacement of any FRU, assure that all interconnecting cables, including power, have been disconnected.

Before proceeding any further, make certain that you are properly grounded to prevent any electro-static damage to the boards during disassembly and reassembly.

1. Switch OFF the power to the unit.
2. Disconnect the ac power cord and all interface cables.
3. Remove the unit from its mounting and place on an insulated pad on a work bench.
4. Remove the three screws which secure the Top Cover to the Deck Plate.
5. Pull the right side away from the side of the Deck Plate and lift up. Pull towards the front of the drive to clear the top tabs at the back of the cover.
6. Remove the Top Cover and set it aside.
7. Carefully turn the unit on its side.
8. Remove the six screws and washers which secure the Bottom Cover to the Deck Plate.
9. Carefully remove the Bottom Cover from the Deck Plate and Rear Panel/Power Supply chassis by lifting the front up and pulling forward to clear the front tabs.
10. Insert a 5/64 in. Allen driver into the Supply Motor spindle and wind in a counter-clockwise direction until all tape has been removed from the Take-up Hub. Do not attempt to force the Threader Arm Assembly to the home position by rewinding. Refer to Figure 5-1.

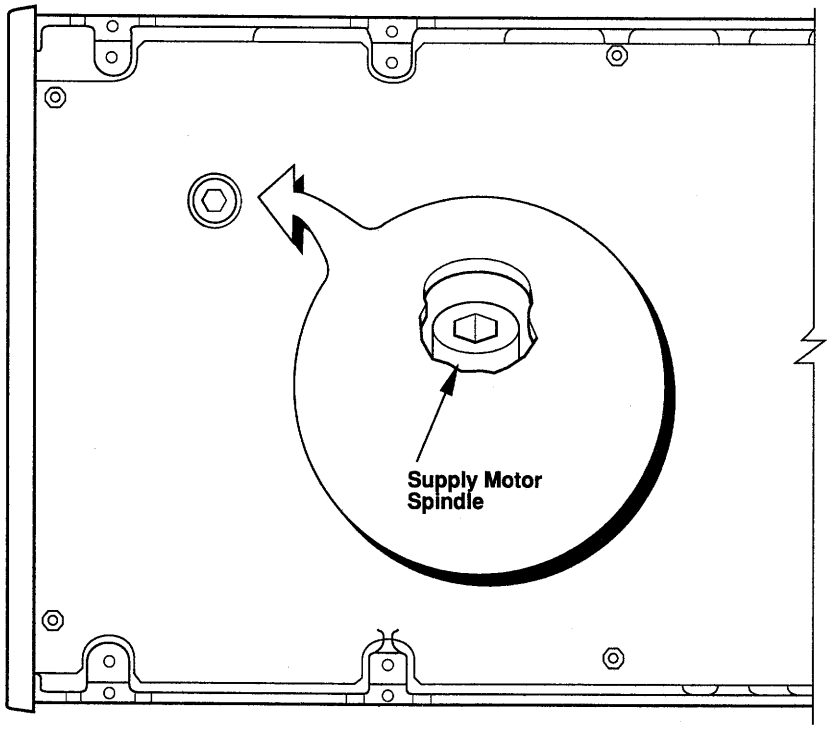


Figure 5-1. Manual Tape Rewind

11. Gently move Threader Arm and tape leader block back to the home position while continuing to wind the tape. Refer to Figure 5-2. The Threader Arm Assembly should release the tape leader block.

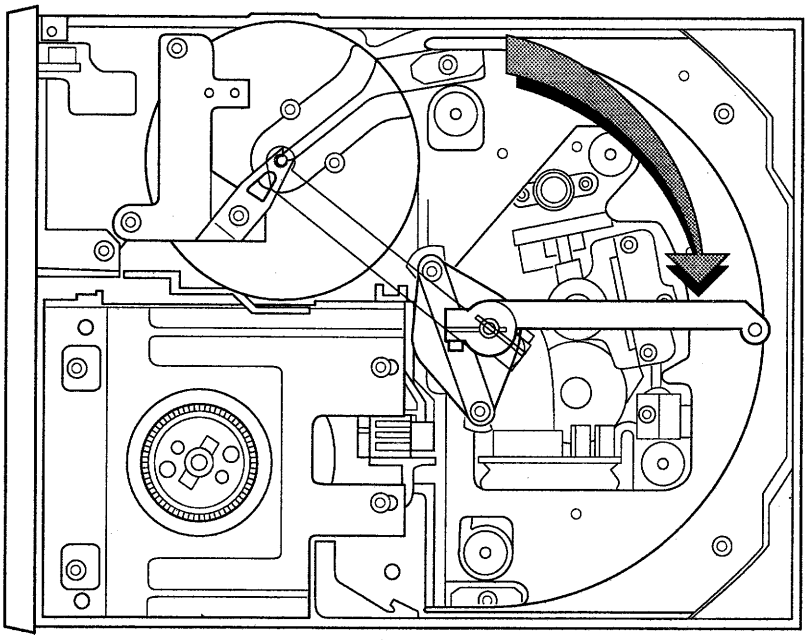


Figure 5-2. Return Threader Arm to Home Position

12. Manually insert the leader block into the cartridge. Do not attempt to force the leader block into the cartridge by rewinding.

13. Using a flat blade screw driver, raise the Cartridge Slide Tray by turning the screw counter-clockwise. Refer to Figure 5-3. As the screw is turned, the tray rises. Continue turning the screw to eject the tape cartridge.

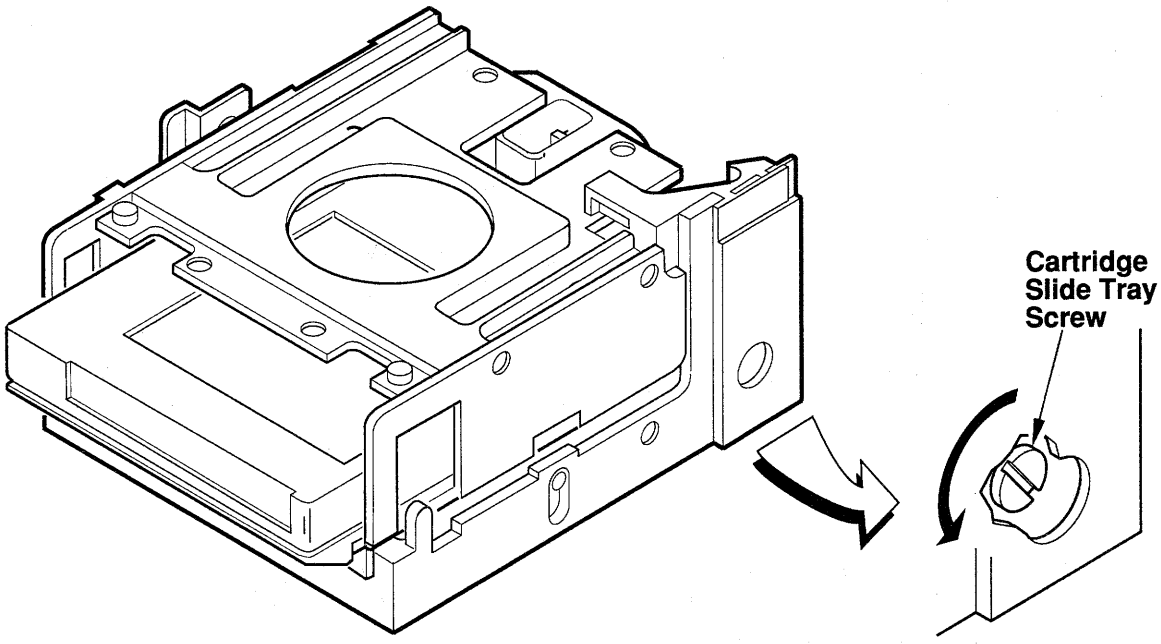


Figure 5-3. Raising the Cartridge Slide Tray

14. Reassemble the drive. Replace Bottom and Top Covers, and install all screws.

Chapter 6 Troubleshooting and Diagnostics

FAULT CONDITIONS

Fault conditions are divided into two categories, those that cause the FAULT Indicator to flash and those that do not.

If during operation the drive detects an unrecoverable fault, the FAULT Indicator is lit. The appropriate Fault Symptom Code (FSC) code is stored in the unit's non-volatile RAM (NVRAM) memory. If a fault is detected yet does not light the drive's FAULT Indicator, an error code is sent to the host. The host logs an error message and halts the operation.

TROUBLESHOOTING

A checklist is provided as a troubleshooting aid to assist with fault isolation and functional validation after the repair. The step-by-step checklist details sound troubleshooting techniques that reduce tape drive down-time to a minimum.

1. Read the FSC from the front panel display.
2. Visually check for abnormalities, check all electrical connections for good contacts.
3. Refer to the "Diagnostics Codes" section of this chapter for the definition of the FSC.
4. Perform the appropriate diagnostic tests on the tape drive to verify the fault condition or problem.
5. Read which FRUs may cause the problem.
6. Replace suspected bad FRUs and re-test the drive. Procedures to remove and replace the FRU assemblies are located in the "FRU Removal and Replacement" chapter of this manual.
7. If test fails, repeat steps 5 and 6 until unit passes.
8. If unit passes, it is now ready to be placed back in operation.

DIAGNOSTICS

Diagnostics allow for review and selection of various configurable parameters. Diagnostic tests are available to assist the service representative as efficient troubleshooting tools that help to reduce tape drive down-time.

These tests insure that data can be transferred through the drive; written, read, and transferred back to the host system. Four levels of diagnostic tests are available. The levels of diagnostics are as follows:

Power-on Diagnostics:

These tests are performed when the drive is powered-on. Power-on tests reside in ROM memory, which is located on the Control Unit Electronics (CUE) Board.

Idle Time Diagnostics:

The integrity of data accuracy is of prime importance to the Cipher 3830 tape drive. The Idle Time tests are dynamic, in that these tests are performed when; an interface command is not being processed, there is no pending read/write activity, or when more than 500 ms has lapsed since the last read/write function.

User Diagnostics:

The User Diagnostic tests provide the operator with the ability to perform basic read/write confidence tests by exercising the internal hardware and firmware of the 3830 tape drive.

Customer Engineer Diagnostics:

Customer Engineer Diagnostic tests provide the service representative with the ability to review or set the user configurable parameters. These diagnostic tests may be performed to test internal hardware, firmware, and tape drive functions to assist in the servicing of the 3830 tape drive.

Power-on Diagnostics

Power-on Diagnostics are performed when the drive is powered-on. These tests reside in the ROM memory located on the drive's CUE Board.

Power-on Diagnostics begin by illuminating all front panel indicators and display segments for two seconds. The following Minimum System Configuration Tests are performed:

Microprocessor
Scratch RAM
Counters/Timers (CIO)
Input/Output modules
Non-Volatile RAM (NVRAM)
+5V dc
ROM checksum

If an error is detected during this phase of the Power-on Diagnostics, all front panel indicators remain lit and all microprocessor activities halt. Note, the defective FRU may be either the power supply or the CUE Board.

After successful completion of the Minimum System Configuration Tests, the ACTIVE Indicator is turned off. The following Data Hardware Verification Tests are then performed:

Watchdog Timer (Power/microprocessor fail)
Direct Memory Access
Cache Data Compare
FIFO Buffer Data Compare
High speed cache
CRC generators/checkers
Interface
Power supply tests
Read/Write Board
Data path integrity test (CRC and parity)

If an error is detected during this phase of the Power-on Diagnostics, the FAULT, WRT EN, and Power Indicators remain lit and, a Fault Symptom Code (FSC) is logged in the NVRAM and displayed.

After successful completion of the tests, the FAULT Indicator is turned off. Only the Power Indicator remains lit. The Power-on Diagnostic tests are complete. Approximate test run time is 10 seconds.

Idle Time Diagnostics

The integrity of data accuracy is of prime importance to the Cipher 3830 tape drive. Therefore, a set of tests have been installed in the drive's firmware which are automatically performed during periods of drive inactivity.

The Idle Time Diagnostics are performed when; an interface command is not being processed, there is no pending read/write activity, or when more than 500 ms has lapsed since the last read/write cycle. While a test is in progress, the interface command register is polled at least every 100 ms to determine whether a host command has been received. If a host command has been received, the current Idle Time Diagnostic test is suspended while the drive performs the requested read/write operation. The tests are resumed when conditions for the Idle Time Diagnostics are met. The Idle Time Diagnostic tests are as follows:

Microprocessor
ROM Checksum
Data cache
DMA (at least three channels)
FIFO cache
High speed cache
CRC generators/checkers
Read/Write Board

If an error condition is detected, the FSC log in NVRAM is updated. An error message is sent to the host processor, and depending upon the severity of the error, the FAULT Indicator is lit.

User Diagnostics

User Diagnostic tests provide the operator with the ability to perform basic read/write confidence by testing the internal hardware and firmware of the 3830 tape drive. The tests may be performed prior to backup operations to assure a greater level of file transfer accuracy.

User Diagnostics can only be performed on a device which is in the unloaded state. User Diagnostic tests are accessed by the following steps:

1. Unload and remove the data cartridge.
2. Press and hold the UNLOAD Switch.
3. With the UNLOAD Switch pressed, press and release the FORMAT Switch.
4. Release the UNLOAD Switch. The digital display shows the code "00."
5. The drive is now in the User Diagnostic test mode.

Diagnostic Test Selection

The front panel display serves as an indicator for both test selection and status results. Test selection is determined by pressing and releasing the FORMAT Switch, this increments the test selection menu. Pressing and holding the FORMAT Switch increments the test number at an increasing rate, up to a maximum of 5 Hz.

Several methods are available for exiting a selected test or a test that is in progress. These methods are listed as follows:

Abort Diagnostic Mode:
To abort diagnostics, press and hold the UNLOAD Switch for at least two seconds.

Abort Test In Progress:
To abort a test in progress and exit diagnostics, press the UNLOAD Switch. If required, the drive unloads and ejects the cartridge.

Executing Reserved Test Numbers:
If a reserved or unused test is selected, diagnostics are terminated.

The User Diagnostic tests are as follows. Reserved and unused test numbers are not listed.

NOTE

Before performing either Read/Write Test, make sure the cartridge is not write protected.

01 - Short Read/Write Test

The Short Read/Write Test writes 1000 blocks of data on an odd track group in the forward direction. Tape direction is reversed. The test writes 1000 blocks of data on an even track group. The 1000 blocks of data within the two track groups are then read forward and reverse. Note, the Customer Engineer may need to change the MSR format by enabling the Local Format Select prior to performing this test. Test procedures are as follows:

1. Select test "01."

2. Press and release the UNLOAD Switch.

3. The display flashes the test number. The operator must insert a write enabled scratch cartridge before a five second timer expires. If not, the test must be reselected. The test begins as soon as the tape is loaded.

4. Approximate test run time is 1.5 minutes. Test run time is also dependent upon the quality of the tape. After completion of the test, the cartridge is unloaded and an FSC is displayed if a failure has been detected.

5. After successful completion of the test, the format (F2 or F4) is displayed and diagnostics are terminated.

02 - Long Read/Write Test

The Long Read/Write Test writes a forward track group from the tape load point to the end-of-tape. Tape direction is reversed and a track group is written from the end-of-tape position to the tape load point position. Each of the two track groups are read, both forward and reverse. Note, the Customer Engineer may need to change the MSR format by enabling the Local Format Select prior to performing this test. Test procedures are as follows:

1. Select test "02."

2. Press and release the UNLOAD Switch.

3. The display flashes the test number. The operator must insert a write enabled scratch cartridge before a five second timer expires. If not, the test must be reselected. The test begins as soon as the tape is loaded.

4. This test is performed continuously. The UNLOAD Switch must be pressed to exit the test. After completion of the test, the cartridge is unloaded and an FSC is displayed if a failure has been detected.

5. After successful completion of the test, the format (F2 or F4) is displayed and diagnostics are terminated.

03 - Lamp Test

The Lamp Test provides the operator with the ability to test all segments of the Digital Display. Procedures are as follows:

1. Select test "03."
2. Press and release the UNLOAD Switch.
3. The Digital Display displays "88" for two seconds.
4. After successful completion of the test, the MSR format (F2 or F4) is displayed and diagnostics are terminated.

Terminating User Diagnostics

User Diagnostics are terminated by pressing and holding the UNLOAD Switch for at least two seconds.

test 4 riser Firmwarelevel

Customer Engineer Diagnostics

Customer Engineer Diagnostic tests provide the service representative with the ability to set the user configurable parameters and to perform (specialized) tests on internal hardware and firmware. These tests also provide the service representative with an efficient troubleshooting tool that helps to reduce tape drive down-time.

Customer Engineer Diagnostics can only be entered on a device which is in the unloaded state. Access the tests by the following steps:

1. Unload and remove the data cartridge.
2. Press and hold the UNLOAD Switch.
3. With the UNLOAD Switch pressed, press and release the FORMAT Switch.
4. Release the UNLOAD Switch. The digital display shows the code "00." The drive is now in the User Diagnostic mode.
5. Select test "09" from the User Diagnostic test level. If the operator attempts to access test "09" from User Diagnostics, the Ignore Request response is signaled.
6. Press and hold the UNLOAD Switch.
7. With the UNLOAD Switch pressed, press and release the FORMAT Switch. Note, the FORMAT Switch must be pressed within two seconds of pressing and holding the UNLOAD Switch.
8. Release the UNLOAD Switch. The digital display shows the code "10." The drive is now in the Customer Engineer Diagnostic test mode.

Diagnostic Test Selection

The front panel display serves as an indicator for both test selection and status result. Test selection is determined by pressing and releasing the FORMAT Switch which increments the test selection. Pressing and holding the FORMAT Switch increments through the test menu at an increasing rate, up to a maximum of 20 Hz.

Customer Engineer Diagnostics not only allows the service representative to step through the tests at a faster pace, as compared to User Diagnostics, the service representative also has the ability to decrement through the test selection menu. The procedure to decrement through the test menu is as follows. Press and hold the UNLOAD Switch, then within two seconds, press the FORMAT Switch. While the FORMAT Switch is pressed, the test menu "backs up" at an increasing rate, up to a maximum of 20 Hz.

After selecting the desired test, press and release (within two seconds) the UNLOAD Switch. The test begins on release of the switch.

For tests not requiring use of the display, the test number is displayed during test execution. On completion of the test, "00" is displayed indicating successful completion. If a failure occurs, the FAULT Indicator is lit and an FCS code is displayed. The methods of exiting a selected test or a test that is in progress include:

Abort Diagnostic Mode:

To abort diagnostics, press and hold the UNLOAD Switch for at least two seconds.

Abort Test In Progress:

To abort a test in progress and return to the diagnostic menu, press the UNLOAD Switch. If required, the drive unloads and ejects the cartridge. The code "00" is displayed to indicate that the service representative may select another test. Press the FORMAT Switch to return to the test selection menu.

Executing Reserved Test Numbers:

If a reserved or unused test is selected, the "Ignore Request" signal is indicated. The Ignore Request signal is indicated by the FAULT Indicator flashing twice. The diagnostic session is terminated.

Customer Engineer Diagnostic tests are as follows. Reserved and unused test numbers are not listed.

13 - Servo Test

The Servo Test continuously cycles tape between BOT and EOT. Tape direction may be manually reversed by pressing and releasing the FORMAT Switch. Test procedures are as follows:

1. Select test "13."
2. Press and release the UNLOAD Switch.
3. The display flashes the test number. The operator must insert a write enabled scratch cartridge before a five second timer expires. If not, the test must be reselected. The test begins as soon as the tape is loaded.

4. User may unload the tape anytime by pressing the UNLOAD Switch. After successful completion of the test, the cartridge is unloaded and "00" is displayed. An FSC is displayed only if a failure is detected.

30 - Default Configuration Setup

This test initializes the NVRAM parameters. If the NVRAM is not programmed, all user configurable parameters are set to the default values. The tape drive re-calculates the torque constants for the Take-up (TU) and Supply (SU) Motors. All default values, including interface specific parameters, are listed as follows:

Local Format Select	Enabled
Format Display	Enabled
Unit Address (Logical)	Address 0
Interface Parity	No Parity
Interface Transfer Rate	150 KB/s
Interface Ramp Delay	850 usec

NOTE

This test must be performed prior to loading tape. If tape has been loaded, power must be cycled before selecting this test.

Test procedures are as follows:

1. Select test "30."
2. Press and release the UNLOAD Switch. Test run time is approximately one minute.
3. Parameters are set to the default values, motor torque values are calculated and stored in the NVRAM.
4. Successful completion is indicated by the display flashing the test number "02." The Long Read/Write Test may be performed by inserting a write enabled scratch cartridge before a five second timer expires. The test begins as soon as the tape is loaded.
5. To return to the test selection menu, press and release the UNLOAD Switch to display "00." Then, press the FORMAT Switch. Note, the power must be cycled to store the values in NVRAM.

40 - Local Format Selection

This test allows the operator to change the Local Format Selection parameter. Test procedures are as follows:

1. Select test "40."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5 seconds. The current parameter is displayed. The parameters are:

   01 - Local Format Selection Enabled (Default)
   02 - Local Format Selection Disabled

   01

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

43 - Format Display Selection

This test allows the operator to change the Format Display Selection parameter. Test procedures are as follows:

1. Select test "43."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5. The current parameter is displayed. The parameters are as follows:

   01 - Format Display Selection Enabled (Default)
   02 - Format Display Selection Disabled (Model 3832 only)

   01

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

44 - ? = 02

50 - Unit Address Selection

This test allows the operator to change the logical Unit Address Selection parameter. Test procedures are as follows:

1. Select test "50."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5 seconds. The current parameter is displayed. The parameters are as follows:

   00 - Address 0 (Default)
   01 - Address 1
   02 - Address 2
   03 - Address 3
   04 - Address 4
   05 - Address 5
   06 - Address 6
   07 - Address 7

   00

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

51 - Parity Selection

This test allows the operator to change the Parity Selection parameter. Test procedures are as follows:

1. Select test "51."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5 seconds. The current parameter is displayed. The parameters are:

   01 - Parity
   02 - No Parity (Default)

   01

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

52 - Transfer Rate Selection Test

This test allows the operator to change the Transfer Rate Selection parameter. Test procedures are as follows:

1. Select test "52."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5 seconds. The current parameter is displayed. The parameters are as follows:

   01 - 150 KB/s (Default)
   02 - 187 KB/s
   03 - 250 KB/s
   04 - 375 KB/s
   05 - 480 KB/s
   06 - 600 KB/s
   07 - 800 KB/s
   08 - 1200 KB/s

   08 på nogle
   skal den være 04
   prøv med TCH-test

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

53 - Ramp Delay Selection

This test allows the operator to change the Ramp Delay Selection parameter. Test procedures are as follows:

1. Select test "53."

2. To view the current parameter, press and release the UNLOAD Switch. The display blanks for 0.5. The current parameter is displayed. The parameters are:

   01 - 100 usec
   02 - 850 usec (Default)

   01

   If the current setting is correct, press and release the UNLOAD Switch to exit the test.

3. To change the displayed parameter setting press the FORMAT Switch.

4. After selection is made, press the UNLOAD Switch to store the value in NVRAM.

5. The code "00" is displayed. Press the FORMAT Switch to return to the test selection menu.

70 - Motor Torque Calculations Test

This test calculates the SU and TU Motor Torque constants and stores the values in NVRAM. The present constants are not displayed during the test. Test procedures are as follows:

NOTE

This test must be performed prior to loading tape. If tape has been loaded, power must be cycled before selecting this test.

1. Select test "70."
2. Press and release the UNLOAD Switch. Test run time is approximately one minute.
3. Successful completion is indicated by "00". Press the FORMAT Switch to return to the test selection menu. Note, the power must be cycled to store the values in NVRAM.

Terminating Customer Engineer Diagnostics

Customer Engineer Diagnostics are terminated by pressing and holding the UNLOAD Switch for at least two seconds.

DIAGNOSTIC CODES

The firmware not only supplies the instruction code for normal operation, it is also responsible for detecting failure of drive components. After an unrecoverable error has been detected, the firmware generates a Fault Symptom Code (FSC) which is stored in the NVRAM and displayed on the front panel display. A pointer in the NVRAM is incremented after each FSC is logged. When the FSC buffer is full, the pointer is set to the beginning of the FSC memory area. Up to 36 FSCs can be stored in the NVRAM.

NOTE

The hex alpha characters are displayed in upper case, except "b" and "d" which are displayed in lower case.

The displayed FSC identifies a unique set of FRUs for fault isolation. FRU failures are identified in the following manner:

For 98% of all device errors, the FSC determines the correct FRU group.
For 80% of all device errors, the FSC points to the correct FRU group of three or less.
For all device detected errors, the failing assembly is identified first 70% of the time.

Table 6-1 is a directory of the FSCs, their description, and a listing of the possible Field Replaceable Units that may have failed.

Fault Symptom Code	Field Replaceable Unit	Description
10	1. CUE Board	Verification of the Z8002 CPU internal registers failed.
11	1. CUE Board	ROM checksum error.
12	1. CUE Board	Scratch RAM address error.
13	1. CUE Board	Z8002 Scratch RAM Parity Check/Generator failed.
14	1. CUE Board	Write/Read test for the CIO programming registers failed.
15	1. CUE Board	Z8036 Counter/Timer Interrupt failed.
16	1. CUE Board	DMA SRAM cannot be accessed properly or data errors occur during read/write.
17	1. CUE Board	Write/read test of the DMA registers failed.
19	1. CUE Board	IFC ULA chip cannot be programmed correctly.
1A	1. CUE Board	High Speed Buffer cannot be addressed properly or a data error occurred during write/read.
1B	1. CUE Board	High Speed Buffer parity check failed. A parity error is not flagged due to incorrect parity data in the HSB.
1C	1. CUE Board	Either the cache data buffer cannot be addressed properly or a data error occurred during write/read.
1D	1. CUE Board	A CRC error occurred during data transfer through the CRC ULA chip.
1E	1. CUE Board	Data error occurred during data transfer from High Speed Buffer to cache or, from cache to the High Speed Buffer.
1F	1. CUE Board 2. R/W Board	Error with Channel 0 of the Cache Data Manager to read/write interface during data transfer from cache to the CDM Channel 0 while in FIFO loopback mode.
20	1. CUE Board	CUE Board NVRAM is not initialized. Note, before changing FRU, attempt to initialize NVRAM by performing Customer Engineering Test "30."
21	1. R/W Board 2. CUE Board	R/W Board failed self test of the read/write status registers.

Table 6-1. Fault Symptom Code Directory (1 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
22	1. R/W Board 2. CUE Board 3. Cable Assy. CUE-R/W	Write/Read error. CUE board cannot communicate with either status or command registers.
23	1. R/W Board 2. CUE Board	Forced Error test failed to produce a read/write error in the loopback mode.
24	1. R/W Board 2. CUE Board 3. Cable Assy CUE-R/W	Read/Write Board failed the loopback test.
25	1. CUE Board	Forced parity error on the DMA SRAM failed to generate an error.
26	1. R/W Board 2. CUE Board	Read/Write Board failed to generate WIRQ or RIRQ interrupts within 30 ms of a reset.
27	1. CUE Board	DMA failed to auto-program correctly.
28	1. Servo Board 2. Supply Motor Assy. 3. CUE Board 4. Harness Assy-Signal/Servo	Supply Reel Tachometer cannot achieve phasing polarity. Either the Supply Motor or Supply Tachometer is malfunctioning.
34	1. Head Plate Assy. 2. R/W Board 3. CUE Board	The A/D tension sensor reference voltage exceeded tolerance.
39	1. CUE Board 2. Power Supply 3. Harness Assy-Signal/Servo	Either the "ac fail" signal was generated by the power supply or the Watchdog timer expired.

Table 6-1. Fault Symptom Code Directory (2 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
44	1. Cartridge 2. Loader Assy. 3. Servo Board 4. CUE Board 5. Threader Arm	Supply reel is spinning freely. The cartridge may have either a detached leader block or the tape is broken.
46	1. Servo Board 2. CUE Board	Supply Motor spins freely during threading.
48	1. Threader Arm Assy. 2. Take-up Motor Assy. 3. Servo Board	During unthreading, the Threader Arm stopped in the tape path. After three retry attempts, servo motion is halted and a manual unload is required.
4A	1. Take-up Motor Assy. 2. Servo Board 3. Harness Assy.-Signal/Servo	Take-up Motor failed to move to the "lock" position. Threader Arm could not insert leader block into the Take-up Spool.
4B	1. Take-up 2. Motor Assy. 3. CUE Board 4. Threader Arm Assy. 5. Harness Assy.-Signal/Servo	During threading, the Threader Arm was unable to spool tape to the Take-up reel. The cartridge is ejected.
4C	1. Cartridge 2. Supply motor Assy. 3. CUE Board	The normal cartridge radius was determined to exceed the tolerance range.
4E	1. Servo Board 2. Supply Motor Assy. 3 Take-up Motor Assy.	Ramp up time is too slow. A manual tape unload is required.
4F	1. Servo Board 2. Supply Motor Assy. 3. Take-up Motor Assy.	Ramp up time is too fast. A manual tape unload is required.

Table 6-1. Fault Symptom Code Directory (3 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
50	1. Servo Board 2. Supply Motor Assy. 3. Take-up Motor Assy.	Ramp down time is too slow. A manual tape unload is required.
51	1. Servo Board 2. Supply Motor Assy. 3. Take-up Motor Assy.	Ramp down time is too fast. A manual tape unload is required.
52	1. Head Plate Assy. 2. Servo Board 3. CUE Board	Insufficient tension is detected. The cartridge is unloaded and ejected.
54	1. CUE Board 2. R/W Board 3. Supply Motor Assy.	Tape was moved past the end of track position.
55	1. Supply Motor Assy. 2. Take-up Motor Assy. 3. Servo Board 4. CUE Board	Servo reels spun in opposite direction. Tape may be loose or severed. Manual unload may be required.
56	1. Supply Motor Assy. 2. Take-up Motor Assy. 3. Servo Board 4. CUE Board	Motor torque constant calculations exceed tolerance.
57 - 5A	1. Servo Board 2. Supply Motor Assy. 3. CUE Board 4. Take-up Motor Assy.	Tape speed was not in tolerance range while tape was streaming. A manual tape unload is required.

Table 6-1. Fault Symptom Code Directory (4 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
5C	1. Cartridge 2. Threader Arm Assy. 3. Loader-Motorized Assy.	During threading, the Threader Arm moved from the home position with out the leader block. No motion was detected in the Supply reel servo. The cartridge is unloaded.
5D	1. Cartridge 2. Threader Arm Assy. 3. Loader-Motorized Assy.	Leader block is separated from the Threader Arm during threading. Threader Arm is returned to the home position and the cartridge is ejected.
60	1. CUE Board	"Reels" module was called with invalid parameters. A mid tape load is required to remove the cartridge.
61 - 66	1. CUE Board	An illegal firmware statement was detected during tape motion. A mid tape load is required to remove the cartridge.
68	1. Servo Board 2. CUE Board	Servo diagnostic firmware was called with an invalid mode parameter.
69	1. CUE Board	Servo Motor currents exceeded tolerance. A mid tape load (Diagnostic Test "20") is required to remove the cartridge.
6B	1. Servo Board 2. CUE Board 3. Take-up Motor Assy. 4. Supply Motor Assy.	Drive cannot spool tape to Take-up reel during a mid-tape load.
6F	1. Head Plate Assy. 2. Servo Board 3. Harness Assy.-Signal/Servo 4. CUE Board	Head stepper failed to move within the specified time period.
72	1. CUE Board	Unable to record correct motor torque (KT) values in CUE board NVRAM.
73	1. CUE Board	Checksum error was detected on the KT/DAC values in NVRAM. Note, before changing FRU, attempt to initialize NVRAM by performing Customer Engineering Test "70."

Table 6-1. Fault Symptom Code Directory (5 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
74	1. Servo Board 2. CUE Board	Drive is unable to null control DACs for reel motors.
77	1. Take-up Motor Assy. 2. Supply Motor Assy. 3. Threader Arm Assy.	Take-up reel did not reach load point within the 60 s time out period of the unload cycle.
79	1. Cartridge 2. Switch Assy.	Cartridge is write protected.
7F	1. R/W Board 2. CUE Board	Before logging an error, the loop back test failed.
80	1. R/W Board 2. CUE Board 3. Cartridge	At the end of a write sequence, not all WIRQ, RIRQ, and GAPOUT interrupts were received within the 100 ms time out period.
81	1. R/W Board 2. CUE Board 3. Cartridge 4. Supply Motor Assy.	An intersector gap error occurred while positioning the tape for a write.
82	1. R/W Board 2. CUE Board 3. Cartridge 4. Supply Motor Assy.	An intersector gap error occurred while positioning the tape for a write read reverse.
83	1. R/W Board 2. CUE Board	Time out occurred during DMA data transfer to the Read/Write Board.
84	1. CUE Board 2. R/W Board 3. Power Supply Assy.	The Read/Write Board issued a WIRQ with a regulator error status in the STATUS1 register.
85	1. R/W Board 2. CUE Board	The GAPOUT interrupt occurred out of sequence.
86	1. R/W Board 2. CUE Board	Timing for RIRQ interrupt was out of bounds. Either DMA timed out (1.2 s) with out special sector functions being issued after EOD, or, an RIRQ was issued within 4 ms of a previous RIRQ.
87	1. R/W Board 2. CUE Board	The duration of the WIRQ interrupt signal was outside of its specific range.

Table 6-1. Fault Symptom Code Directory (6 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
88	1. CUE Board	Fatal RIRQ interrupt error. Decoding bits in STATUS3 register indicate an invalid command, sector data lost, or status lost fault.
89	1. CUE Board	An RIRQ interrupt was issued within 4 ms of a previous RIRQ.
8A	1. R/W Board 2. CUE Board	Bad read status. (ISG error with GAPOUT or no ISG error and no GAPOUT.)
8B	1. R/W Board 2. CUE Board 3. Cartridge	RIRQ interrupt was received outside of its specific range.
8C	1. Cartridge 2. Head Plate Assy. 3. R/W Board	Write skip retries exceeded.
8D	1. Cartridge 2. Head Plate Assy. 3. R/W Board	Read end-of-tape (REOT) position was reached prior to the detection of an EOT sector.
8E	1. Cartridge 2. Head Plate Assy. 3. R/W Board	The end-of-partition position was reached before the end-of-data sector was detected.
8F	1. R/W Board 2. CUE Board 3. Cartridge	RIRQ interrupt was received outside of its specific range.
90	1. Cartridge 2. Head Plate Assy. 3. R/W Board 4. CUE Board	Beginning of partition reached while reading in reverse direction, EOT sectors were not detected.
91	1. CUE Board	Read Reverse went beyond beginning of partition.
92	1. R/W Board 2. CUE Board	During Read Reverse, the ADMA timed out, no data was received for 1.2 s.
93	1. R/W Board 2. CUE Board	Non read/write error was detected during read.
94	1. R/W Board 2. CUE Board	RIRQ interrupt was received before resolving the previous RIRQ.

Table 6-1. Fault Symptom Code Directory (7 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
95	1. Cartridge 2. Head Plate Assy. 3. R/W Board	Write skip history is beyond recovery. This is due to too many consecutive sectors containing bad RIRQ statuses.
96	1. Cartridge 2. Head Plate Assy. 3. R/W Board	Read retries exceeded. The drive attempted 50 read retries in order to recover the data. All attempts failed.
97	1. Cartridge 2. R/W Board 3. CUE Board	During a write append reposition operation, a GAPOUT was not received. A sector without a GAPOUT cannot be appended.
98	1. Cartridge 2. R/W Board 3. CUE Board	During a write append reposition operation, an RIRQ occurred in a sector containing an ISG error.
99	1. Cartridge 2. R/W Board 3. CUE Board	During a write append reposition operation, an RIRQ interrupt was not received.
9A	1. Cartridge 2. R/W Board 3. CUE Board	During a write append reposition operation, a GAPOUT interrupt was received outside its specified range.
9B	1. CUE Board	Data Security Erase command was received while the tape was not in a defined position.
9C	1. R/W Board 2. Head Plate Assy. 3. CUE Board	Write error reported by the Read/Write Board during Data Security Erase command.
9D	1. CUE Board 2. R/W Board	Invalid mode selection. This is generally a firmware error.
9E	1. CUE Board	Invalid track request. This is generally a firmware error.
A0	1. CUE Board 2. Head Plate Assy.	Model contention exists between the Head FRU EEPROM and the Read/Write Board.
A1	1. CUE Board	No free data structures available for read retry.

Table 6-1. Fault Symptom Code Directory (8 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
A3	1. Cartridge 2. CUE Board 3. R/W Board	Too many GAPOUT interrupts were received.
A4	1. Cartridge 2. CUE Board 3. R/W Board	Too many RIRQ interrupts were received.
A5	1. Cartridge 2. CUE Board 3. R/W Board	Too many WIRQ interrupts were received.
A6	1. CUE Board	Write skip sequence used the wrong sectors.
A7	1. R/W Board 2. CUE Board	Read/Write Board "read input port" timed out due to the Read Input Port Full (RIPT) flag being set.
A8	1. R/W Board 2. CUE Board	Read/Write Board "write input port" timed out due to the Write Input Port Full (WIPT) flag being set.
A9	1. CUE Board 2. R/W Board	During writing, a fatal WIRQ interrupt was caused by either a status lost, data lost, or an invalid command.
AA	1. CUE Board 2. R/W Board	A CRC error was detected by the Read/Write Board during a write operation.
AB	1. R/W Board 2. CUE Board 3. Cartridge	Write non data sector error. Two of five "phantom" sectors were not validated.
AC	1. CUE Board 2. R/W Board	At the start of a read or write operation, the DMA halted while in an inactive state.
AD	1. R/W Board 2. Cartridge 3. CUE Board	A fatal WIRQ write driver error was logged by the Read/Write Board.
AF	1. Cartridge 2. Head Plate Assy. 3. R/W Board 4. CUE Board	Write skip retries exceeded. The write skip was initiated by a fatal RIRQ status.
B0	1. CUE Board	Data write to an illegal sector was attempted. This is generally a firmware error.

Table 6-1. Fault Symptom Code Directory (9 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
B1	1. CUE Board	A write was attempted without saving the positioning information.
B2	1. CUE Board	The write skip sequence of data structures in cache are out of order.
B3	1. CUE Board	Cache pointer does not decrement.
B4	1. Cartridge 2. R/W Board 3. Head Plate Assy.	Tape format not recognized. Tape is either blank, or was written in a non-recognizable format (density).
B5	1. CUE Board	Read command attempted beyond EOD sectors. This is generally a firmware error.
B6	1. CUE Board	Cache pointer does not increment.
B7	1. CUE Board	Cache was not cleared before read operation was initiated.
B8	1. Cartridge 2. Head Plate Assy. 3. R/W Board 4. CUE Board	Less than two good EOT sectors were available during track turnaround.
B9, BA	1. CUE Board	Cache pointers overlapped.
BB	1. Cartridge 2. Head Plate Assy. 3. R/W Board 4. CUE Board	EOT sectors were not found between sectors of different tracks.
BC	1. R/W Board 2. CUE Board	CRC mismatch caused by excessive write skip retries.
BD	1. R/W Board 2. Cartridge	Fatal RIRQ interrupt caused by a "GAPIN" error, or an error occurred during a "status in" write operation.
BE	1. Cartridge 2. Head Plate Assy. 3. R/W Board	Through buffered log counts, the Kino Statistical Analysis and Reporting System (KSARS) has determined that the cartridge is defective and that drive servicing is required.
BF	1. CUE Board	KSARS firmware error.

Table 6-1. Fault Symptom Code Directory (10 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
C0	1. CUE Board	Drive firmware is in an invalid state.
C1	1. Cartridge 2. CUE Board 3. R/W Board	During a data buffer read, the first sector read after the "start of block indication" was not the first sector of the block.
C3	1. Cartridge 2. CUE Board 3. Head Plate Assy.	During a data buffer read, and the "end of block" is indicated, the last sector read was not the last sector in the block.
C4	1. Cartridge 2. R/W Board 3. Head Plate Assy.	During a data buffer read, a file mark was detected before any blocks were read from the tape.
C5	1. Cartridge 2. CUE Board	Sector ID numbers of data read from the buffer are not sequential.
C6	1. Cartridge 2. CUE Board	Block ID numbers of data read from the buffer are not sequential.
C7	1. Cartridge 2. CUE Board 3. Head Plate Assy.	Data read from the buffer contained too many sequential EOT sectors.
C8	1. Cartridge 2. CUE Board 3. Head Plate Assy.	During a data buffer read, too many non-user sequential sectors were read.
C9	1. Rear Panel 2. CUE Board 3. Host Interface/Cable	Bus parity error detected by host.
CA	1. CUE Board 2. Power Supply 3. Host Interface/Cable	Interface Controller error. The number of bytes requested was not equal to the number of bytes received.
CB	1. CUE Board 2. Rear Panel 3. Host Interface/Cable	Interface Controller detected a parity error on data received from the host.
CC	1. CUE Board 2. Rear Panel 3. Host Interface/Cable	Interface Controller detected an internal invalid state.

Table 6-1. Fault Symptom Code Directory (11 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
CD	1. CUE Board	Parity error detected during data transfer from High Speed Buffer to cache.
CE	1. CUE Board 2. Rear Panel 3. Host Interface/Cable	Parity error detected during data transfer from host interface bus to the High Speed Buffer.
CF	1. CUE Board	NVRAM contains an invalid address. Note, before changing FRU, attempt to initialize NVRAM by performing Customer Engineering Test "50".
D0	1. CUE Board	CRC error detected during data transfer from cache to the High Speed Buffer.
D1	1. CUE Board	Interface Controller detected a counter wrap error.
D2	1. CUE Board	Synchronization error between LTAPE and PTAPE.
D3	1. CUE Board	Fatal parity error was detected in either RAM or DMA SRAM.
D4	1. Cartridge	KSARS determined, through buffered log counts, that the cartridge is defective.
D5	1. Head Plate Assy. 2. R/W Board	KSARS determined, through buffered log counts, that drive servicing is required. The error is not reported to the host.
D6	1. CUE Board	Synchronization error between LTAPE and PTAPE.
D7	1. CUE Board	Invalid Interface Controller interrupt was issued.
D8	1. Cartridge 2. Head Plate Assy. 3. CUE Board	Neither file mark nor block mark were detected.
D9	1. CUE Board	During write skip, write sectors are out of sequence.

Table 6-1. Fault Symptom Code Directory (12 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
DA	1. CUE Board	Write sectors are out of sequence.
DF	1. CUE Board 2. Servo Board 3. Supply Motor Assy. 4. Take-up Motor Assy.	Motor runaway, ramp up or down. A manual tape unload is required.
E0	1. Loader Motorized Assy. 2. Threader Arm Assy. 3. CUE Board 4. Harness Assy.-Signal/Servo	During initiation of a load sequence, the Cartridge-Inserted sensor was not in the correct state.
E2	1. Cipher I/F Board 2. CUE Board	Cipher Interface Board failed to power-up.
E5	1. Loader Motorized Assy. 2. Harness Assy. 3. CUE Board	Cartridge-Inserted sensor was active after eject.
E6	1. Head Plate Assy. 2. Servo Board 3. CUE Board	Head FRU failed to indicate correct calibration at either the head bar or the head index sensor.
E7	1. Head Plate Assy. 2. Servo Board 3. CUE Board 4. Harness Assy.-Signal/Servo	Head motion sense failure. Head FRU failed to indicate motion at the slot detector.
E9	1. Head Plate Assy. 2. Servo Board 3. CUE Board	Illegal head position request.
EA	1. Head Plate Assy. 2. Servo Board 3. CUE Board 4. Harness Assy.-Signal/Servo	Head Positioner EEPROM cannot be accessed.

Table 6-1. Fault Symptom Code Directory (13 of 14)

Fault Symptom Code	Field Replaceable Unit	Description
EC	1. CUE Board	Tachometer ULA failure.
ED	1. Servo Board 2. CUE Board	Supply Motor spins freely before the tape is loaded.
EE	1. CUE Board 2. Servo Board 3. Take-up Motor Assy.	Take-up Motor failed the power-up test.
F0, F1		Reserved
F2	N/A	Read/Write format. This is not a Fault Symptom Code.
F3		Reserved
F4	N/A	Read/Write format. This is not a Fault Symptom Code.
F5-FF		Reserved

Table 6-1. Fault Symptom Code Directory (14 of 14)

Chapter 7 FRU Removal and Replacement

INTRODUCTION

This chapter describes the procedure and order in which the FRUs (Field Replaceable Units) are removed and replaced. Most of the FRUs are easily-located by cast-in or machined-in features. The steps are divided into two categories, FRUs that are accessible from the top side and those from the bottom side. The Field Replaceable Units and their part numbers are listed in Table 7-1. All 3834 FRU part numbers not listed are the same as the corresponding 3832 FRU.

Field Replaceable Units	3834	3832
Front Panel Assembly	(same)	965290-001
Threader Arm Assembly	(same)	965255-001
Loader Assembly	(same)	964910-001
Cipher Interface Board	(same)	965175-001
Control Unit Electronics (CUE) Board	(same)	965156-001
Servo/Control Board	(same)	964249-001
Read/Write Board	963891-004	963891-002
Rear Panel/Power Supply Assembly	(same)	964921-001
Head Positioner Assembly	964533-001	964533-002
Supply Motor	(same)	964636-001
Take-Up Motor	(same)	963887-004

Table 7-1. 3830 FRU Assembly Part Numbers

The FRUs are listed in order of progression from the outermost to the innermost, and must be removed in the correct sequence. An example follows. For removal of the Servo/Control Board, first remove the Bottom Cover, then remove the CUE Board, and finally remove the Servo/Control Board. Reassembly is just the reverse of this procedure.

CAUTION

Before proceeding any further, make certain that you are properly grounded to prevent any electro-static damage to the boards during disassembly and reassembly.

Whenever performing removal and replacement of a FRU, assure that all interconnecting cables, including power, have been disconnected.

The following steps apply to the removal and replacement of all FRUs.

1. Set the drive in the offline mode by unloading and removing the cartridge from the drive.
2. Switch OFF the power to the unit.
3. Disconnect the ac power cord and the interface cables.
4. Remove the unit from its mounting and place on an insulated pad on a work bench.

Tools

This section lists the various tools needed to perform removal and replacement of the 3830 tape drive FRUs. The following tools are required:

T8 TORX® driver
T10 TORX® driver
T20 TORX® driver
5/64 in. Allen wrench
flat blade screwdriver
small adjustable wrench
Precision Dowel Pin Cipher P/N - 971399-001

TORX® is a trademark of Camcar Division of Textron Inc.

TABLE TOP CABINET (OPTIONAL)

Removal

1. At the rear of the cabinet, remove the two screws which secure the top cover to the bottom cover.

2. Slide the top cover (approximately 1.27 cm [0.5 in.]) toward the rear of the drive to clear the locking tabs. Remove the top cover by lifting straight up.

3. Remove the Top Cover and set it aside.

4. Lift the 3830 tape drive from the bottom cover and set it aside.

Replacement

1. To replace the tape drive within the table top cabinet, reverse the removal procedure steps.

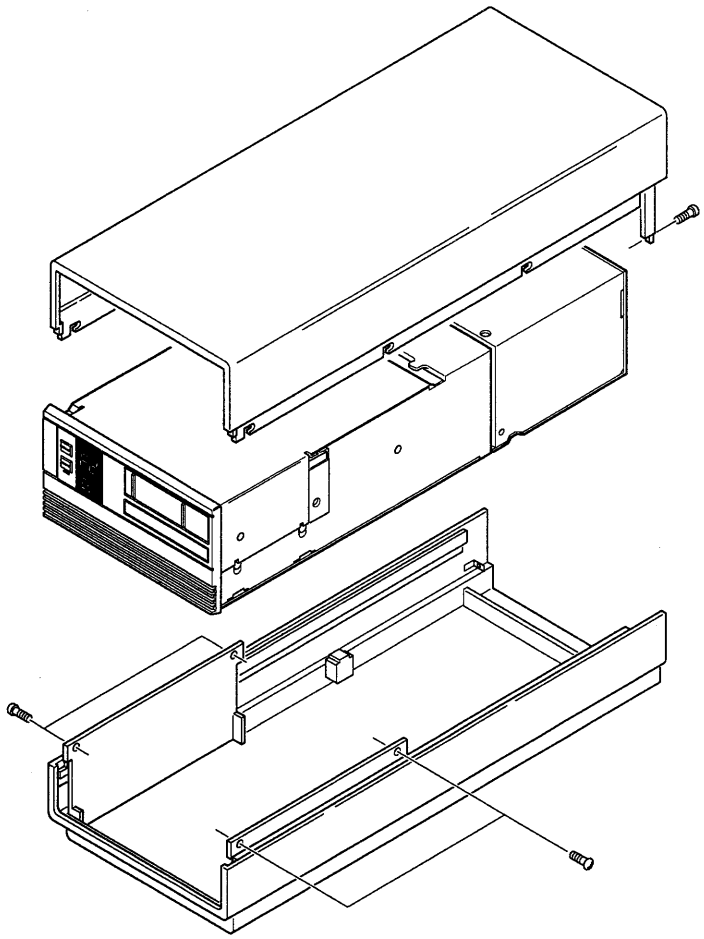


Figure 7-1. Table Top Cabinet

TOP COVER

Removal

1. Remove the three screws which secure the Top Cover to the Deck Plate.

2. Pull the right side away from the side of the Deck Plate and lift up. Pull towards the front of the drive to clear the top tabs at the back of the cover.

3. Remove the Top Cover and set it aside.

Replacement

1. To replace the Top Cover, reverse the removal procedure steps.

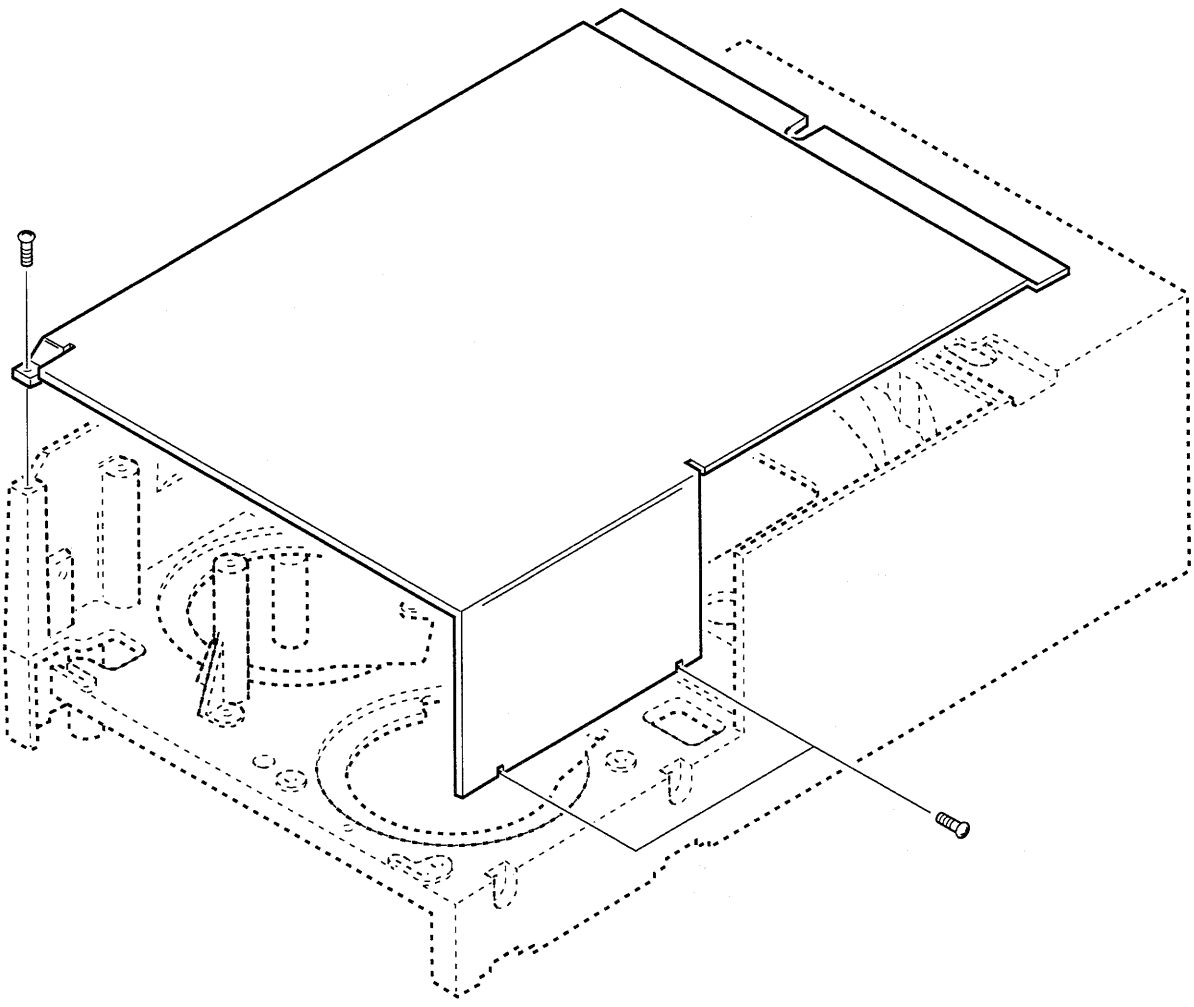


Figure 7-2. Top Cover

FRONT PANEL ASSEMBLY

Removal

1. Remove Top Cover.
2. Loosen the inside retaining screw.
3. Lift the Front Panel assembly straight up from its slots in the Deck Plate.
4. Carefully remove the Front Panel Assembly from the drive.
5. Disconnect the Front Panel Connector from the CUE Board.

Replacement

1. To replace the Front Panel Assembly, carefully orient it to the Deck Plate and reverse the removal procedure steps.

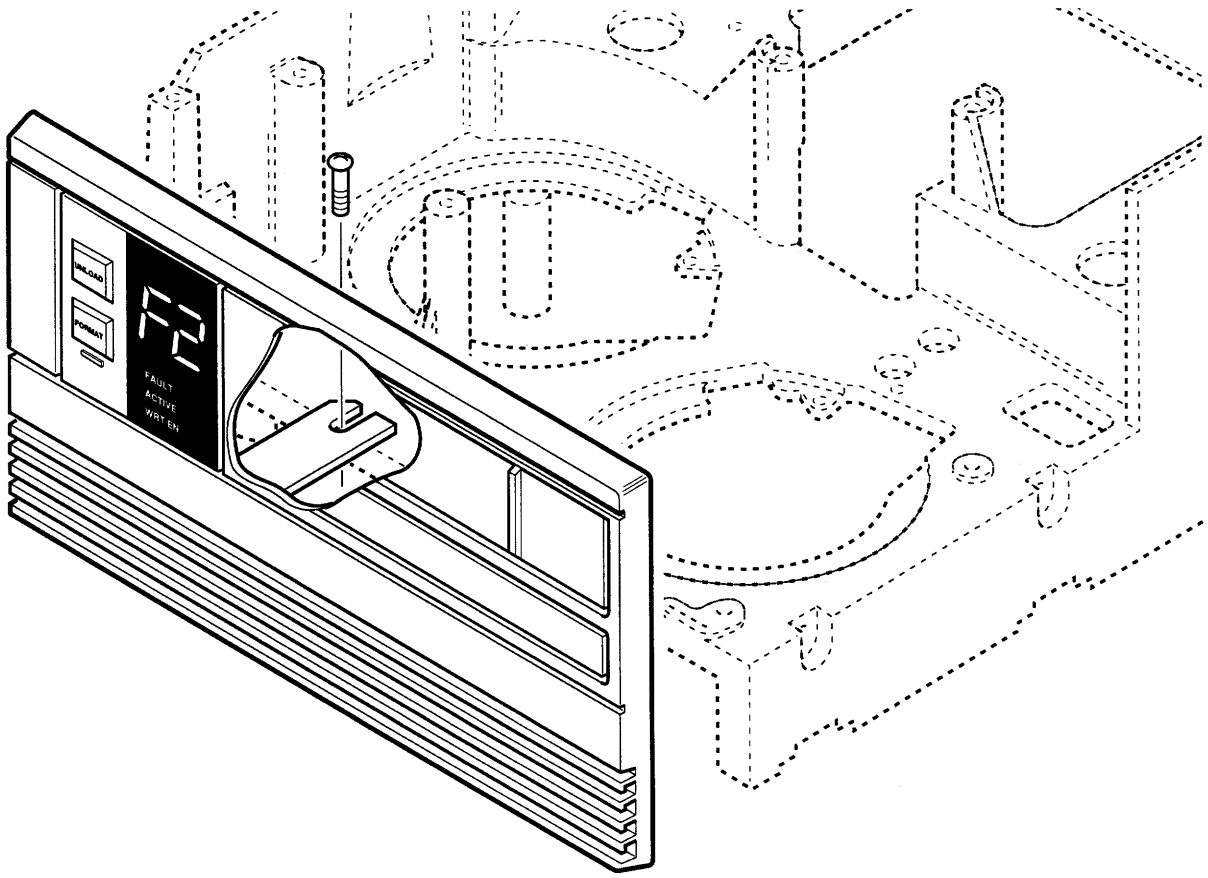


Figure 7-3. Front Panel Assembly

THREADER ARM ASSEMBLY

Removal

1. Remove Top Cover.

2. Remove the four mounting screws which secure the Threader Arm Assembly to the Deck Plate.

3. While carefully removing the Threader Arm Assembly from the Deck Plate, disconnect the cable and set it aside.

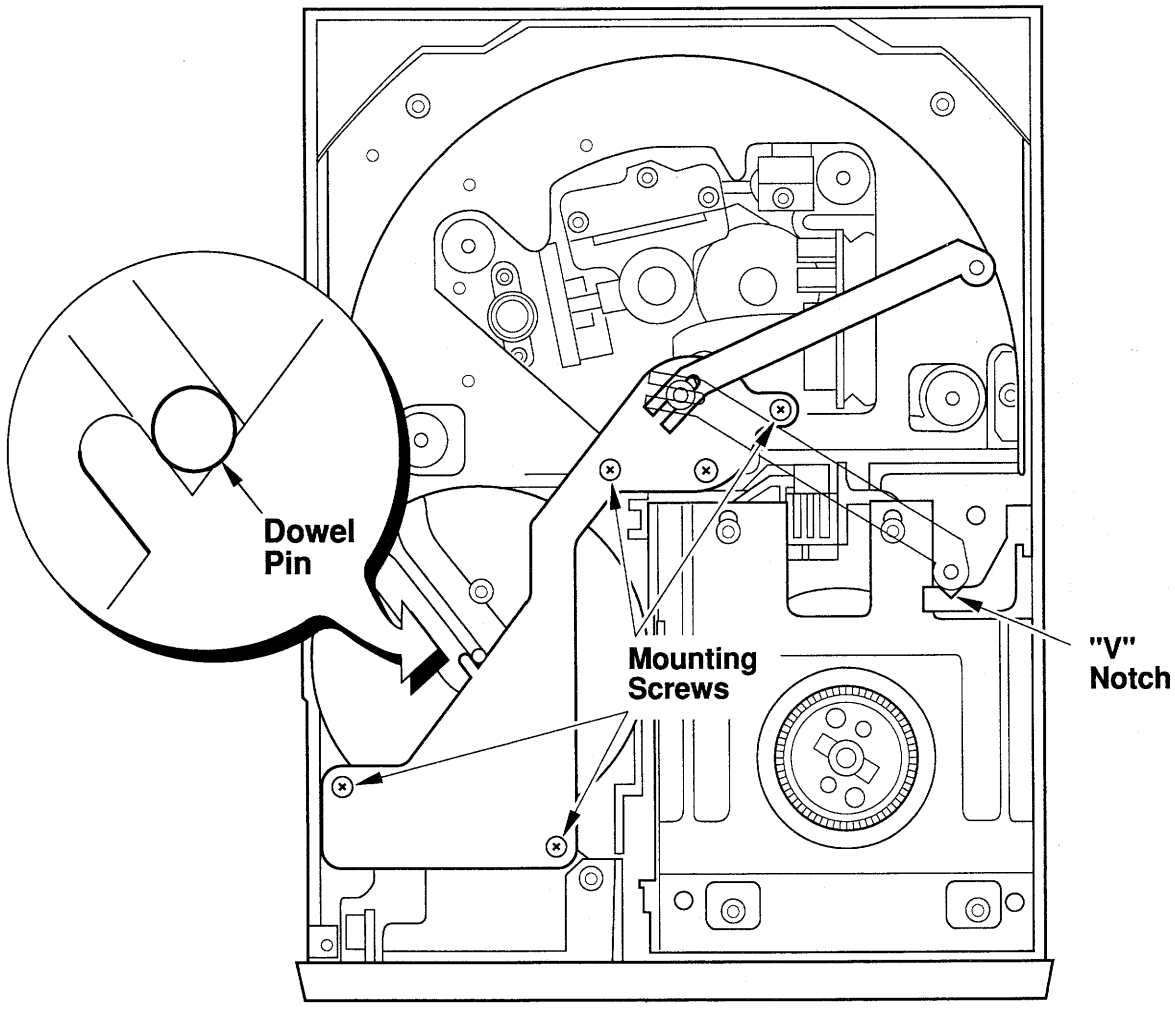


Figure 7-4. Threader Arm Assembly

Replacement

1. To replace Threader Arm Assembly, connect the cable and carefully place the Threader Arm Assembly in position.

2. Loosely insert the four mounting screws which secure the Threader Arm Assembly to the Deck Plate. Be sure that the nylon bushings are located between the Threader Arm Assembly and the Deck Plate.

3. Insert Precision Dowel Pin (P/N-971399-001) into the spindle hole of the Take-up reel hub.

4. Rotate the Threader Arm so that it touches the "V" notch at the Home Position.

5. Rotate the Threader Arm Assembly until the tab contacts the alignment pin.

6. While holding the Threader Arm Assembly stationary, tighten the mounting screws.

7. Remove the Precision Dowel Pin.

LOADER ASSEMBLY

Removal

1. Remove Top Cover.
2. Disconnect the Loader Assembly cable at the connector.
3. Disconnect the switch carriage Back Plane Connector.
4. Remove the three screws and washers which secure the Loader Assembly to the Deck Plate.
5. Disconnect the Loader Motor Connector.
6. Carefully remove the Loader Assembly and set it aside.

Replacement

1. To replace the Loader Assembly, carefully orient it and reverse the removal steps.

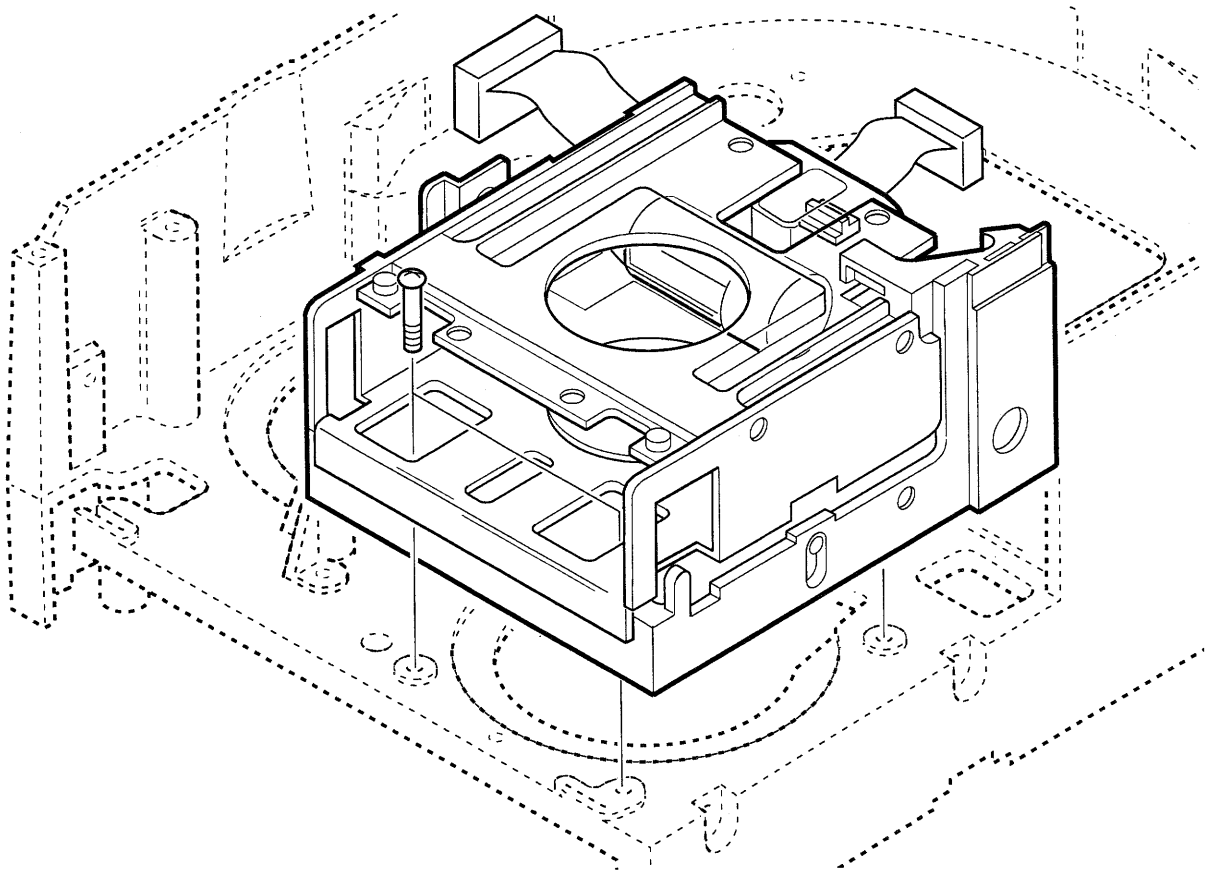


Figure 7-5. Loader Assembly

BOTTOM COVER

Removal

1. Carefully turn unit upside down.

2. Remove the six screws and washers which secure the Bottom Cover to the Deck Plate.

3. Carefully remove the Bottom Cover from the Deck Plate and Rear Panel/Power Supply chassis by lifting the front up and pulling forward to clear the front tabs.

Replacement

1. To replace Bottom Cover, reverse the removal procedure steps.

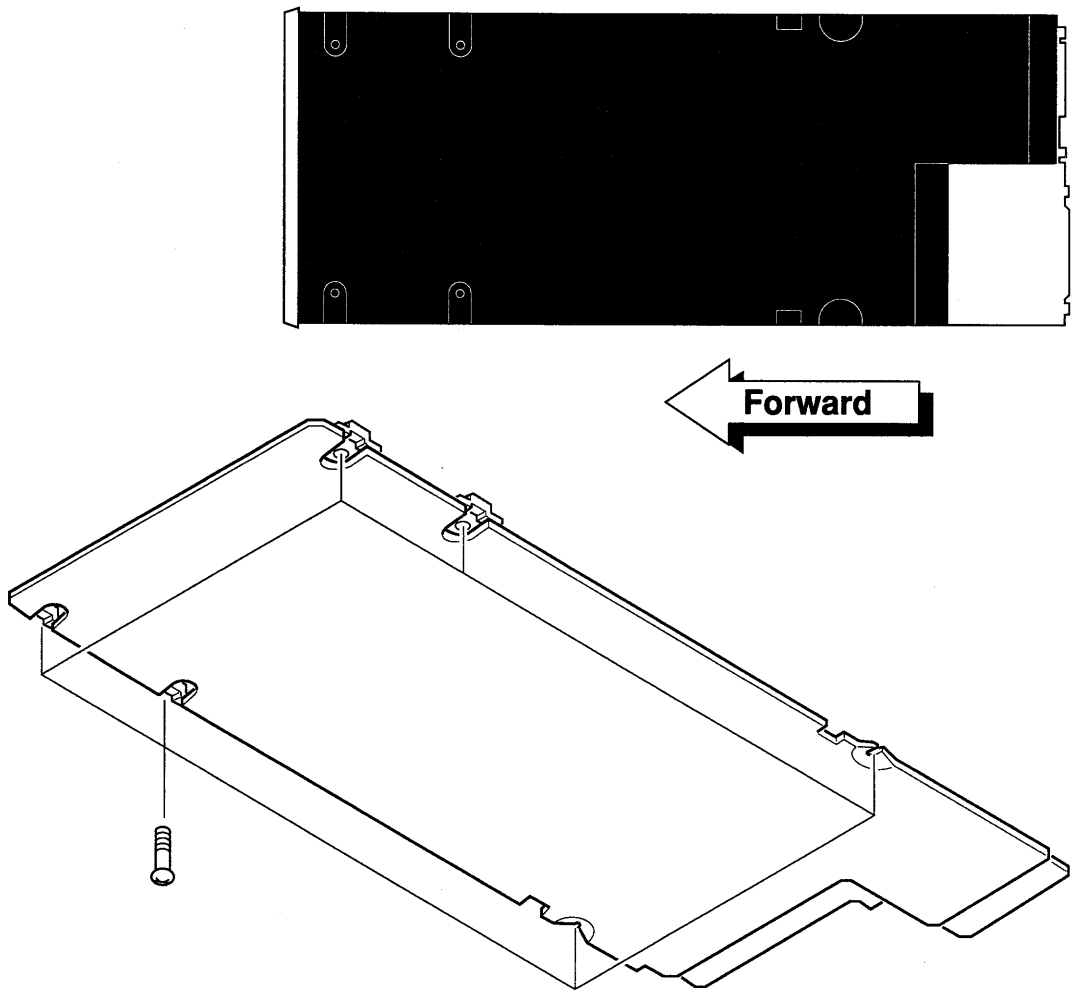


Figure 7-6. Bottom Cover

CIPHER INTERFACE AND CUE BOARDs

Removal

1. Perform procedures to remove the Bottom Cover.
2. Remove the screw which holds the Cipher Interface Board to its standoff.
3. Remove the six screws and washers which hold the CUE Board on its stand-offs.
4. Rotate the unit onto its left side, with the Take-up reel down.
5. Disconnect the CUE Board's J6 connector, lay the board out flat and disconnect J1 through J5.
6. Carefully remove the Cipher Interface Board from the CUE Board's J6 edge connector.

Replacement

1. To replace the Cipher Interface and CUE Boards, reverse the removal procedure steps.

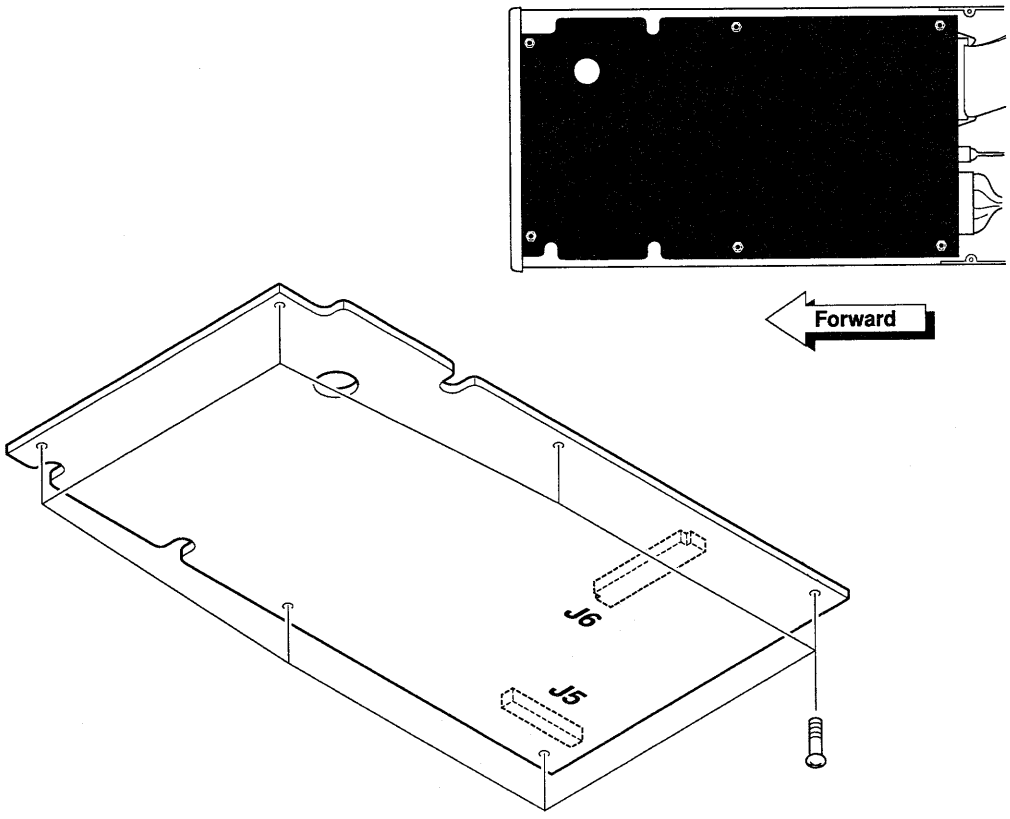


Figure 7-7. Cipher Interface and CUE Boards

Replacing the Firmware

The EPROM Memory ICs (U11A and U13A) contain the firmware to operate the CUE Board's Z8002 microprocessor. Refer to Figure 7-8 for the location of ICs U11A and U13A. IC U13A contains the LOW ROM firmware, Cipher P/N 965622-001. IC U11A contains the HIGH ROM firmware, Cipher P/N 965623-001. The ICs are socketed in order to accommodate future upgrades to the tape drive's firmware capabilities. Firmware replacement procedures are as follows:

Removal

1. Follow the CUE Board removal instructions.
2. Gently remove ICs U11A and U13A from their sockets.
3. Insert the new EPROM ICs into their respective sockets.

NOTE

Examine both ICs to determine that all pins are correctly seated.

Replacement

1. To replace the CUE Board, reverse the removal procedure steps.

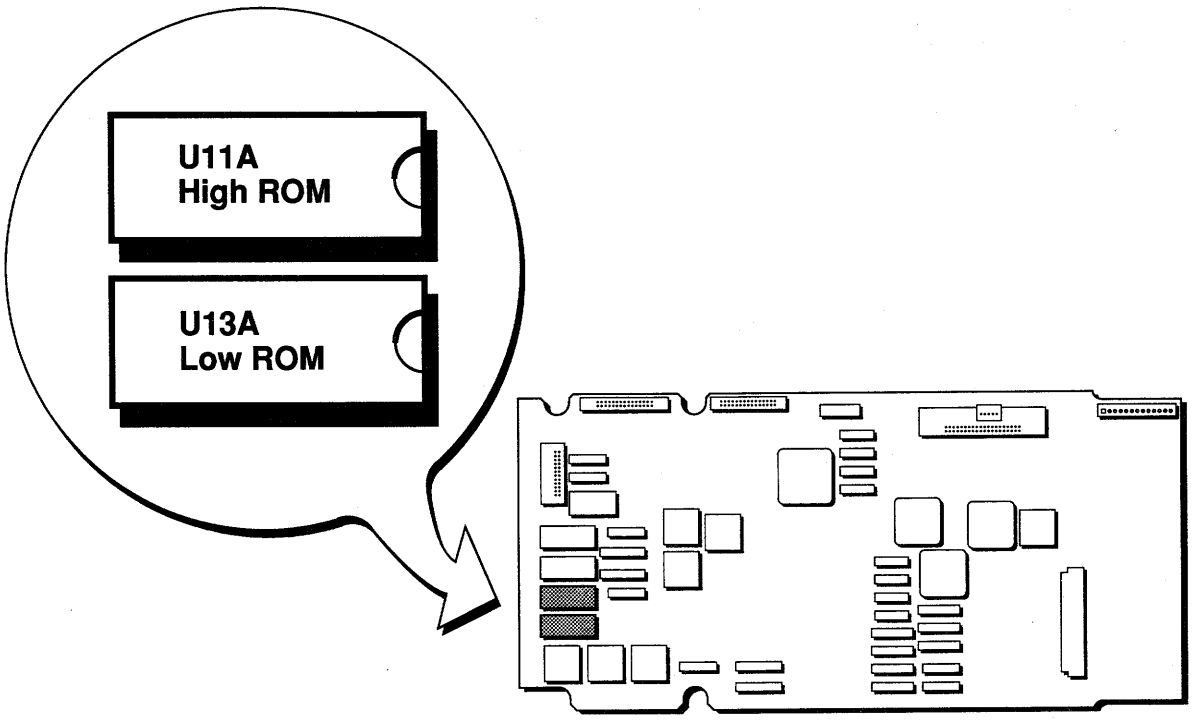


Figure 7-8. Location of Firmware EPROMs

SERVO/CONTROL BOARD

Removal

1. Perform procedures to remove Bottom Cover and CUE Board.

2. Remove the two screws at the rear and the two standoffs in front which secure the Servo/Control Board to its stand-offs.

3. Disconnect the Servo/Control Board connectors J1 through J4 and carefully remove it and set it aside.

Replacement

1. To replace Servo/Control Board, carefully orient it and reverse the removal procedure steps.

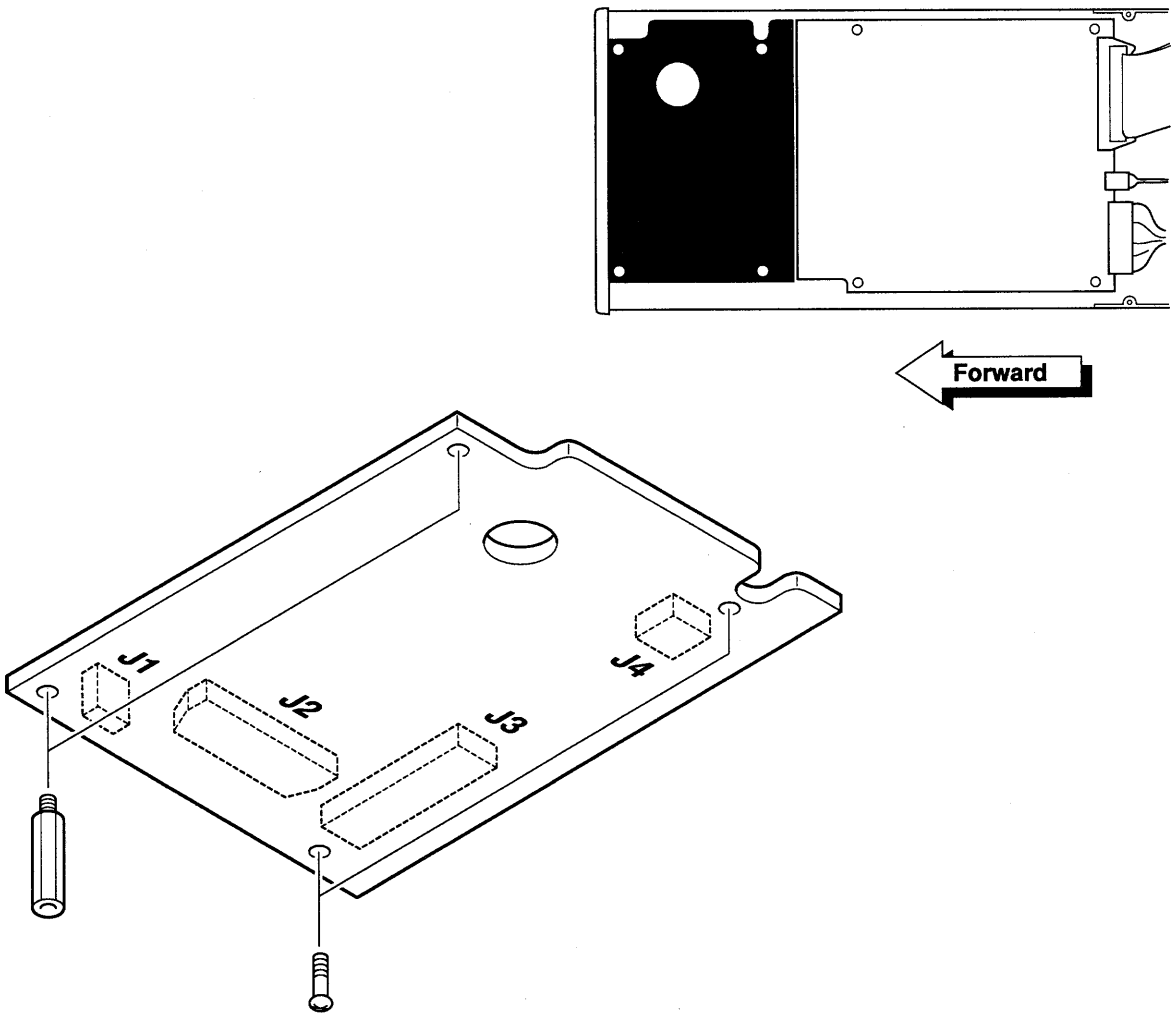


Figure 7-9. Servo/Control Board

READ/WRITE BOARD

Removal

1. Perform procedure step to remove Bottom Cover and CUE Board.
2. Remove the four stand-offs which secure the Read/Write Board to its stand-offs.
3. Separate the Read/Write Board from the head cable connector by lifting it straight up.
4. Disconnect the Read/Write Board electrical connector cable and carefully remove the Board and set it aside.

Replacement

1. To replace the Read/Write Board, carefully orient it and reverse the removal procedure steps.

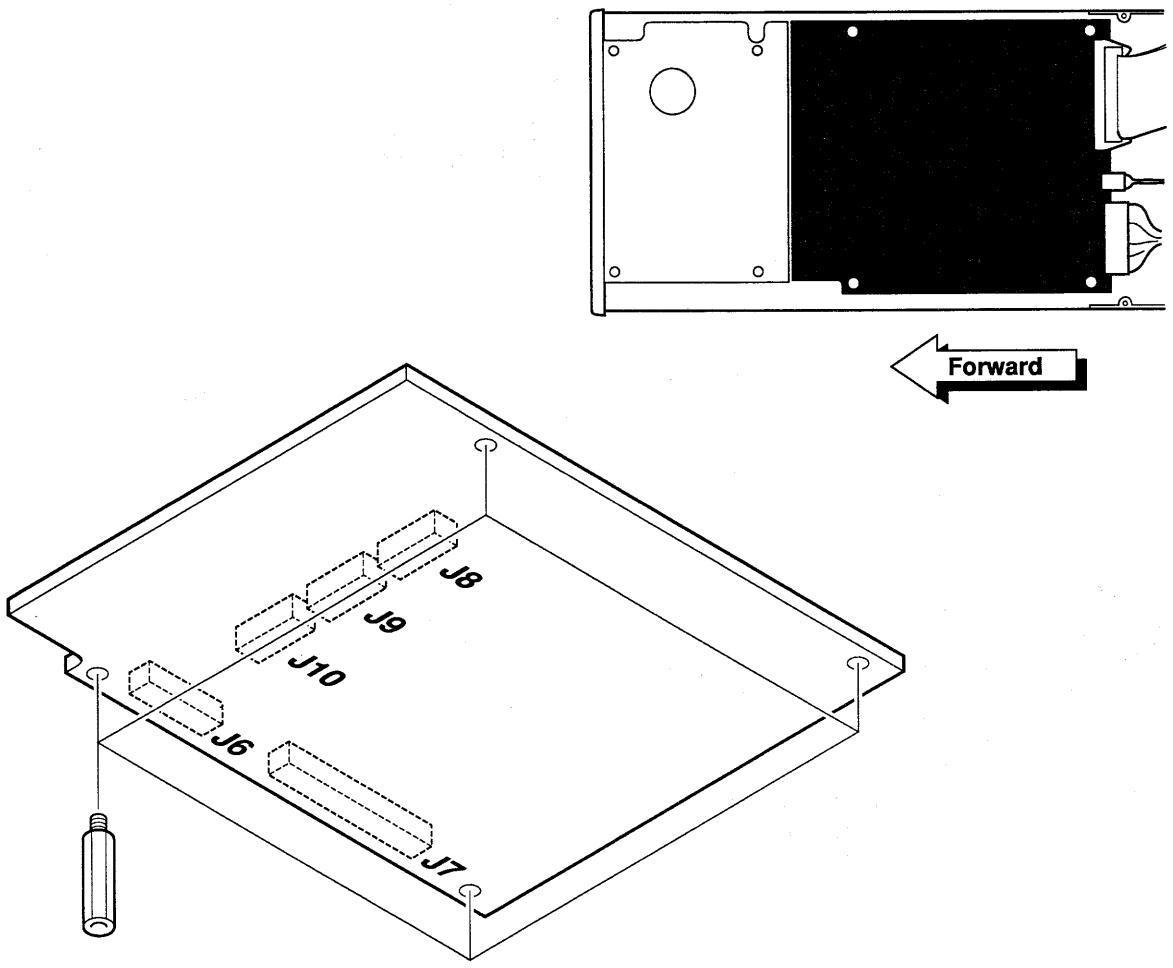


Figure 7-10. Read/Write Board

REAR PANEL / POWER SUPPLY ASSEMBLY

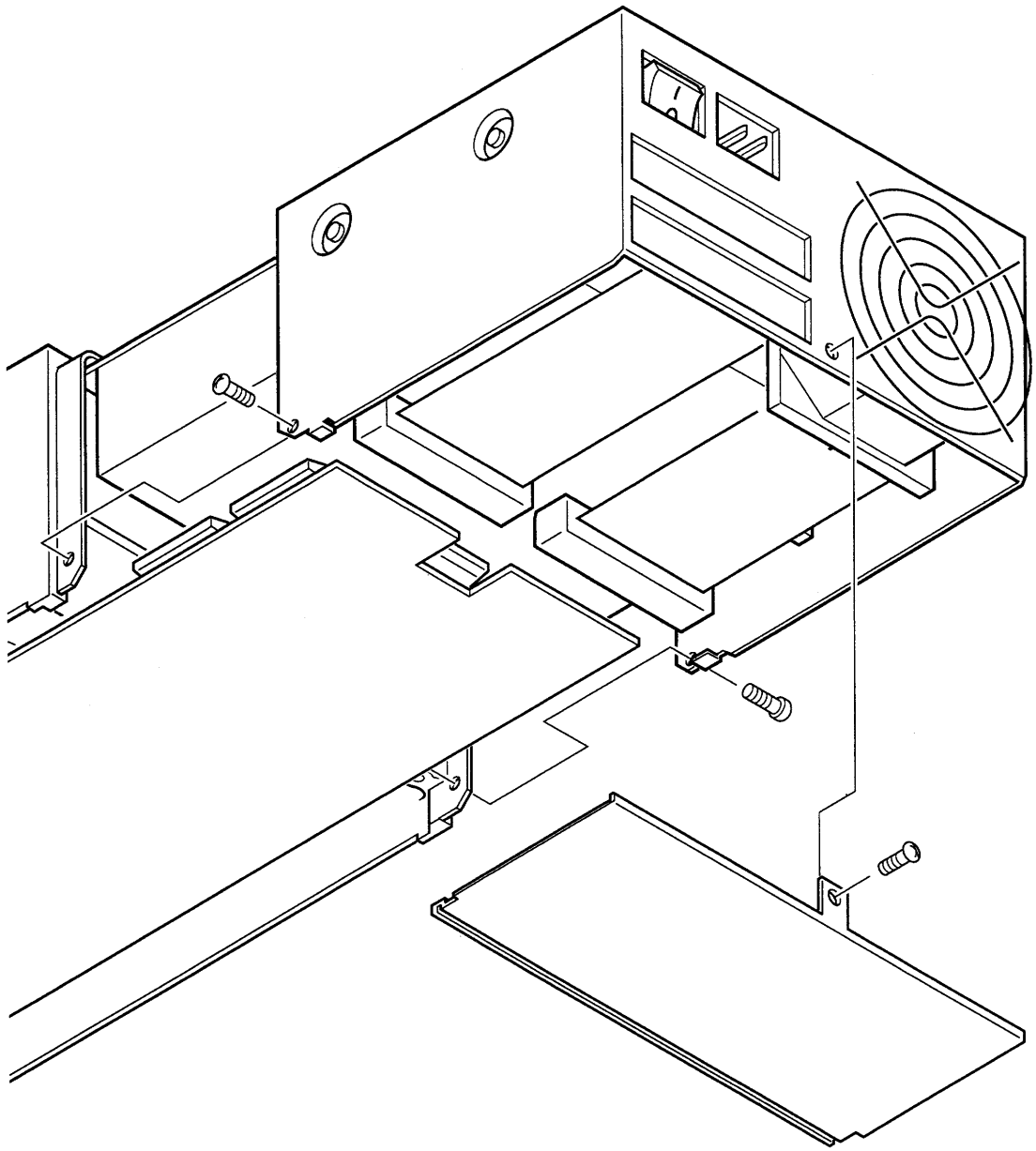


Figure 7-11. Rear Panel/Power Supply Assembly

Removal

1. Perform procedure steps to remove Bottom Cover, CUE Board and Read/Write Board.

2. Remove the four screws which hold the Rear Panel/Power Supply to the Deck Plate.

3. Disconnect any electrical connectors attached between the drive and the Rear Panel/Power Supply.

4. Remove Rear Panel/Power Supply from the Deck Plate by pulling it back to clear the tabs and then lift it straight up and out.

Replacement

1. To replace the Rear Panel/Power Supply Assembly, reverse the removal procedure steps.

HEAD POSITIONER ASSEMBLY

Removal

1. Perform procedure steps to remove Bottom Cover, CUE Board, Servo/Control Board, and the Read/Write Board.

2. From the top side, disconnect the electrical connector to the Head Positioner Assembly.

3. From the bottom side, remove the three screws which secure the Head Positioner Assembly to the Deck Plate.

4. From the bottom side, carefully, so as not to bang the Head Positioner and Rollers, remove the Head Positioner Assembly and set it aside.

CAUTION

While working with the Head Positioner Assembly, the head should be covered to protect it from damage.

Replacement

1. To replace the Head Positioner Assembly, carefully orient it to the Deck Plate and reverse the removal procedure steps.

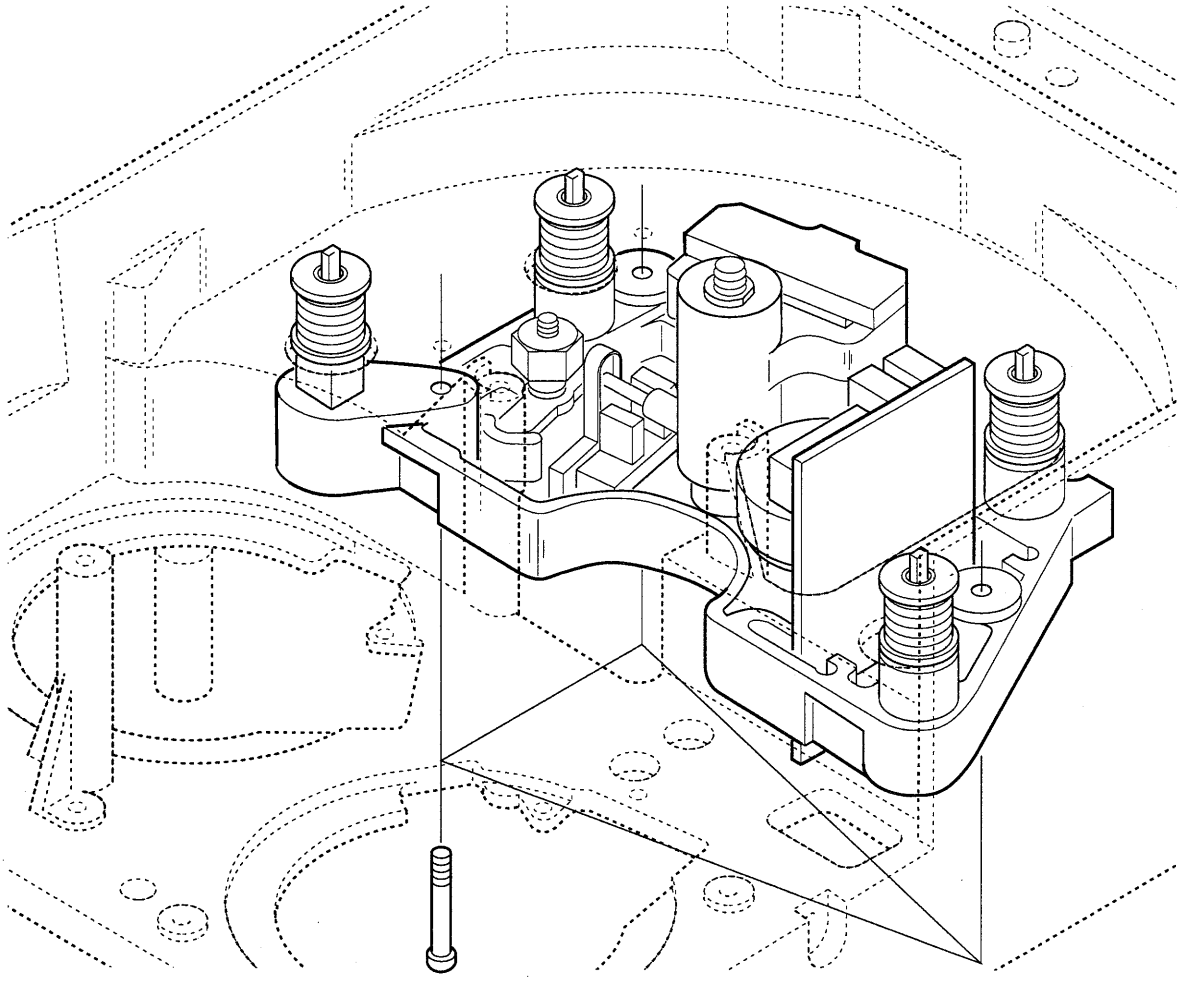


Figure 7-12. Head Positioner Assembly

SUPPLY MOTOR

Removal

1. Perform the procedures to remove the Bottom Cover, CUE Board, Servo/Control Board, Top Cover, and the Loader Assembly.

2. From the bottom side of the motor, disconnect the two electrical connectors.

3. From the top side, remove the three screws and lift the motor straight up and out.

Replacement

1. To replace the Supply Motor, reverse the removal procedure steps.

2. Perform CE Diagnostic Test "70" to recalculate the motor torque constants.

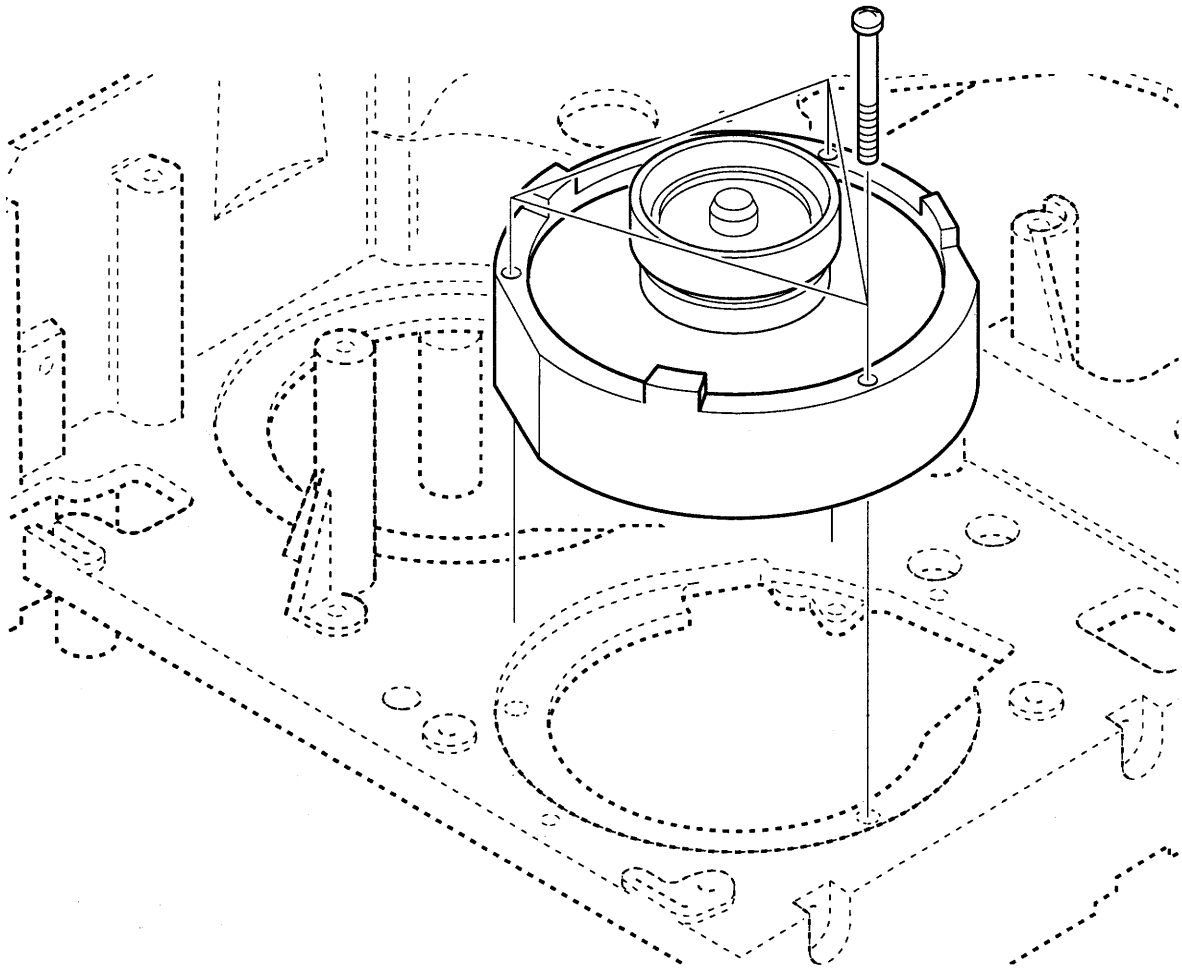


Figure 7-13. Supply Motor

TAKE-UP MOTOR

Removal

1. Perform the procedures to remove the Bottom Cover, CUE Board, Servo/Control Board, Top Cover, and Threader Arm Assembly.

2. From the bottom side of the motor, disconnect the two electrical connectors.

3. From the top side, rotate the Take-up spool to locate and remove the three motor retaining screws. Lift the motor straight up and out.

Replacement

1. To replace the Take-up Motor, reverse the removal procedure steps.

2. Perform CE Diagnostic Test "70" to recalculate the motor torque constants.

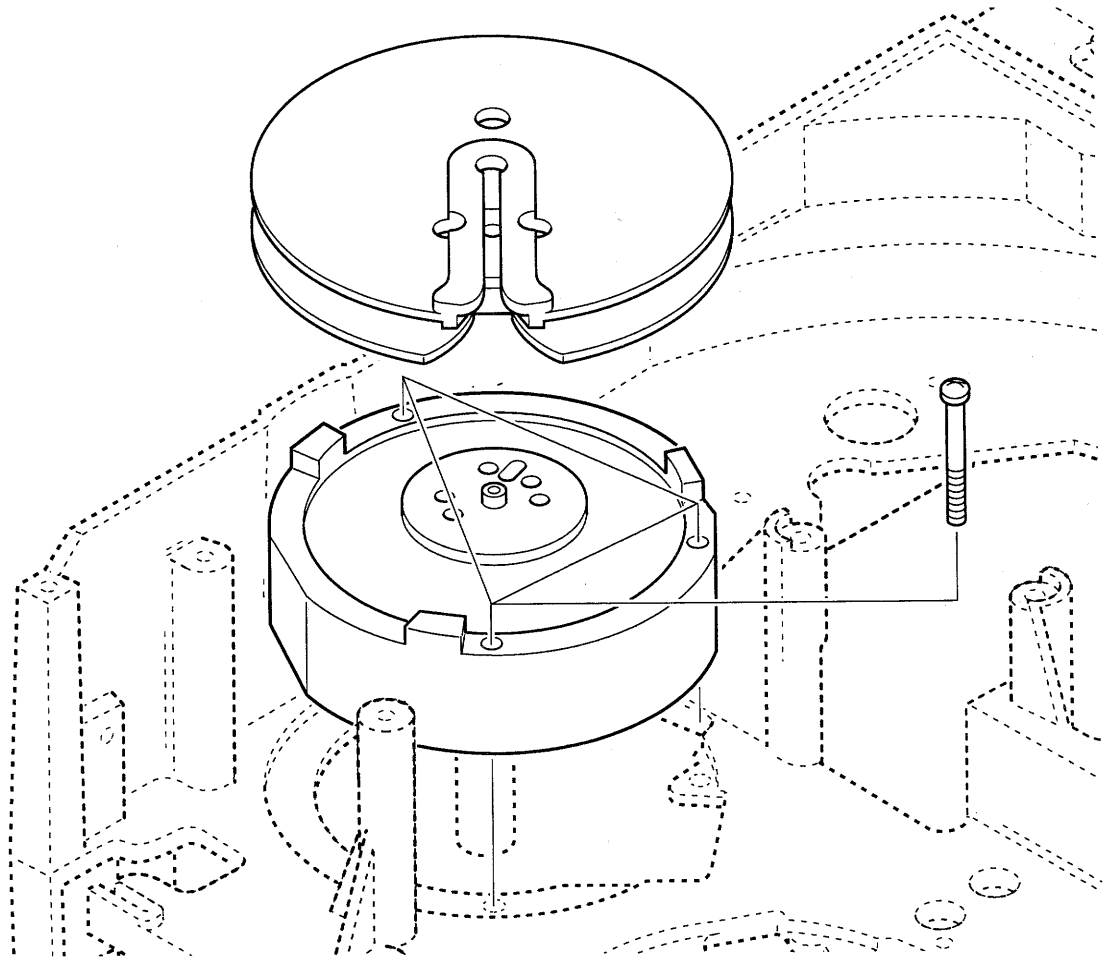


Figure 7-14. Take-Up Motor