799816-006
Revision AA

MODELS M890 AND M891 CACHETAPE® UNIT

VOLUME I

OPERATION AND MAINTENANCE

Cipher Data Products
10225 Willow Creek Road
San Diego, California 92131

March 1987

Federal Communications Commission (FCC) Notice

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

RECORD OF REVISIONS

Revision	Description	Date
AA	Released by ERO SD-87-0009	3/87

Serial # CM010024

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SECTION I

DESCRIPTION, UNPACKING, INSPECTION AND INSTALLATION

GENERAL

1-1. The Models M890 and M891 CacheTape® Units (CTU) are a one-half inch, nine-track magnetic tape transport manufactured by Cipher Data Products, Inc., San Diego, California. The CTU simulates the performance characteristics of traditional start/stop tape drives while using the reliable Microstreamer® tape drive mechanical components. It incorporates the industry standard interface, a dual-gap head and all control, formatting and read/write electronics on a single printed-wiring board (PWB). The CTU will operate on 100, 120, 208, 220, 230 or 240 VAC, single-phase, 50-60 Hz line power. Reels to 10.5 inches can be accommodated. Tape speed and density capabilities are:

a. Models M890-I and M891-I CTU (1600 characters per inch CPI)
   (1) 100 ips at 1600 CPI Phase-Encode (PE)

b. Models M890-II and M891-II CTU (3200 CPI)
   (1) 100 ips at 1600 CPI (PE)
   (2) 50 ips at 3200 CPI

The simulated tape speed capability is switch selected and includes (a) M890: 12.5, 25, 37.5, 45, 75 ips, and (b) M891: 45, 75, 100, 120, 140, 170, 200, and 300 (approximate) ips. (Refer to Table 1-5 for the switch settings.) Autoload capabilities for the CTU will accomodate 7, 8-1/2 and 10-1/2-inch reel sizes.

UNPACKING AND INSPECTION

1-2. The CTU is shipped in a single carton reinforced to minimize the possibility of damage during shipment. Unpack as follows:

a. With shipping container on floor or workbench, cut side and center tapes securing top of box.

b. Pull top flaps down along sides of box. Remove the upper foam blocks and place the CTU on a workbench or table. Remove the manual and installation hardware from shipping carton.

c. Check contents of shipping container against the packing slip and inspect for possible damage. **If damage exists, notify carrier.**

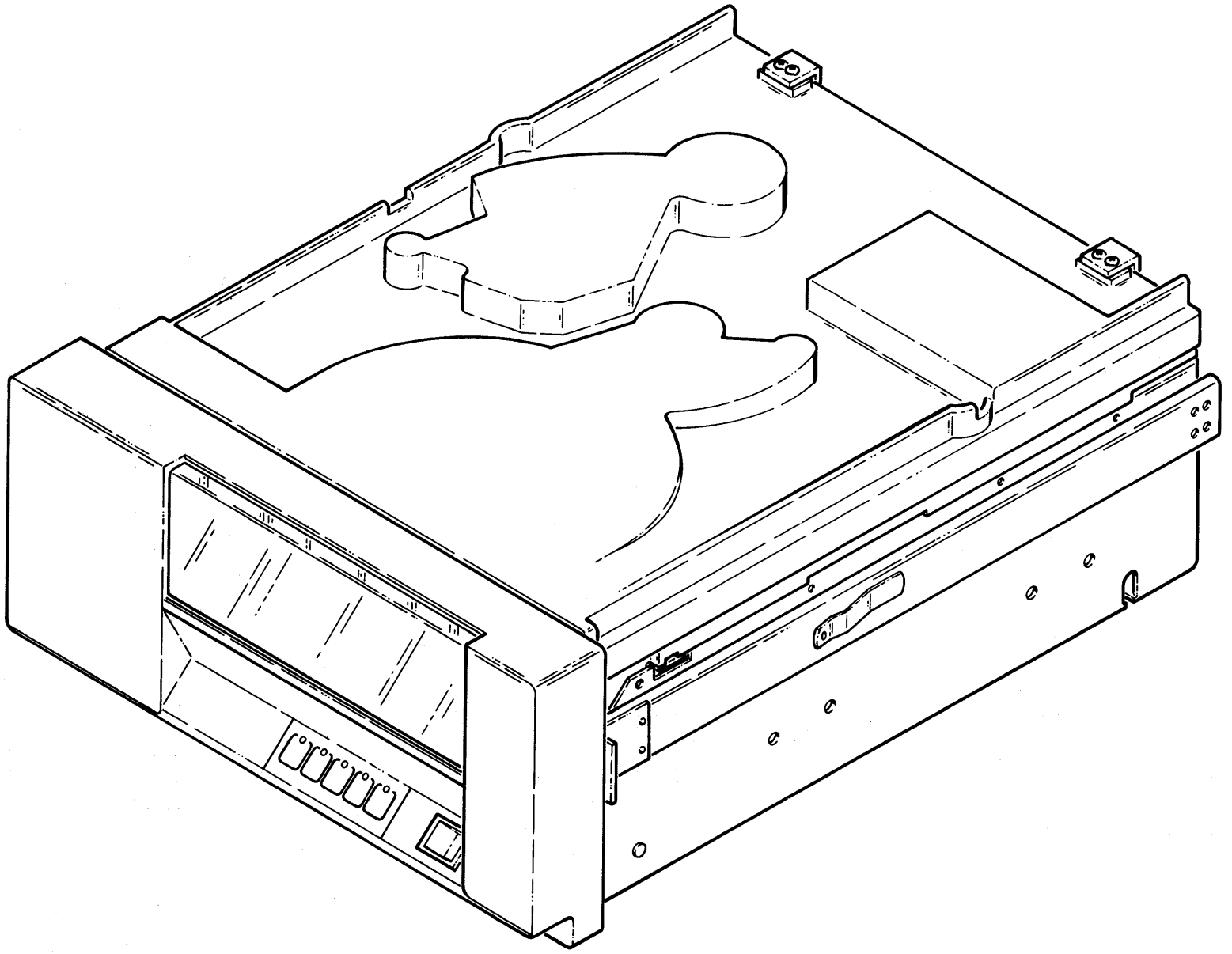


Figure 1-1. CacheTape Unit

d. Refer to the illustration taped to the front door. Remove tape holding top cover and front door in place. Open top cover by lifting sides directly behind front panel. Place cover stay (left-rear of top cover) in the slot provided. This is the maintenance access position. Pull tachometer (spring-loaded arm at left-rear of unit) away from hub and discard the foam cushion. Carefully replace tachometer assembly against hub.

e. Examine the hubs, tachometer, and other components in tape path area for foreign matter.

f. Using a screwdriver, loosen two captive screws at front sides of top plate casting. Close the top cover. Lift front panel (and top plate casting) by grasping the two lower corners of the front panel. Lift unit to its maximum upright position. Latch mechanism will automatically engage when unit is lowered approximately one inch. Insert the safety pin provided through both holes in the top plate support from outside inward (Figure 4-2). This is the service access position.

g. Remove 3 pieces of foam packing material from PWB. Check PWB and all connectors for correct installation.

h. To release latch mechanism, remove the safety pin and lift front panel before lowering it. Open top cover and tighten captive screws. Close top cover.

i. Do not replace packing tape or foam cushion materials.

j. Verify that the operating voltage indicated on the manufacturers label (rear of chassis) matches the power outlet voltage for the unit. If not, refer to paragraph 1-4 for instructions to change the operating voltage.

POWER CONNECTION

CAUTION

To prevent damage to the CTU and ensure proper operation, be sure the outlet voltage is correct before applying power to the CTU.

1-3. A power cord is supplied only for the voltage range indicated on the manufacturer's label.

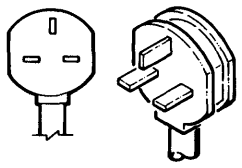
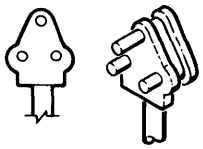
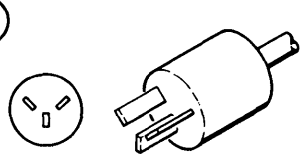
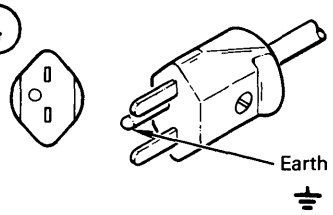
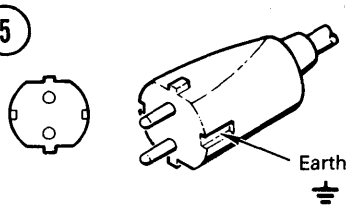
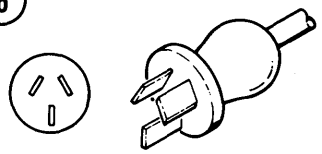
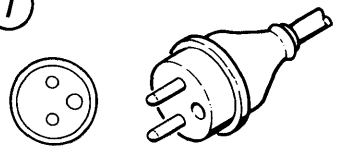
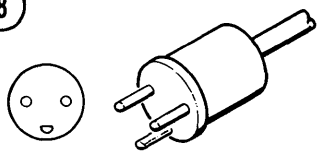
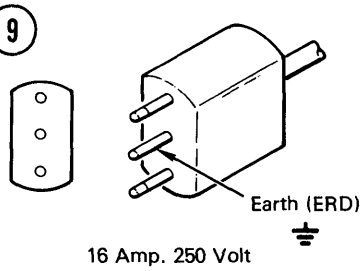
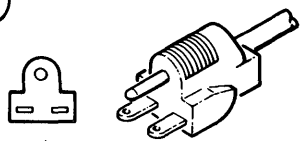
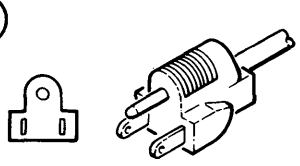
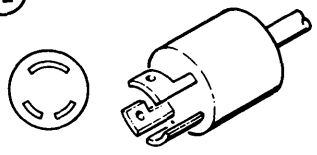
1-4. **Operating Voltage Selection.** The CTU can be operated over a wide range of line voltages by selection of the appropriate power supply voltage option. To change the power supply option, proceed as follows:

CAUTION

When CTU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of CTU in extended position could upset an inadequately mounted equipment rack.

PLUG OUTLINE:
DELINEACIONES DE CLAVIJAS (EL):

STECKER SKIZZE:
BOUCHOM DECOURANT:

1  13 Amp. 250 Volt BS 1363	2  15 Amp. 250 Volt BSI 546	3  6/16 Amp. 250 Volt (Earth Pin may be round) S.I. 32
4  10 Amp. 250 Volt (Voltage Pins may be round) SNV 24509	5  16 Amp. 250 Volt CEE7	6  10 Amp. 250 Volt Approved as C112-1964
7  16 Amp. 250 Volt CEE7	8  6/10 Amp. 250 Volt Approved AFSNIT 107	9  16 Amp. 250 Volt
10  15 Amp. 250 Volt IEC 83 UL 498	11  15 Amp. 125 Volt IEC 83 UL 498	12  15 Amp. 125 Volt

(1) United Kingdom
Ireland
Malaysia
Singapore
Argentina

(2) South Africa

(3) Israel

(4) Switzerland

(5) Germany
Austria
Bulgaria
Finland
Iceland
Indonesia
Iran
Netherlands
Norway
Poland
Portugal
Romania
Spain
Sweden
Turkey
Bolivia

(6) Australia
New Zealand
Uruguay

(7) France
Belgium
Greece
Hungary
Yugoslavia

(8) Denmark

(9) Chile
Italy

(10) United States
Canada

(11) Bahamas
Barbados
Bermuda
Brazil
Canada
Colombia
Costa Rica
Dominican Rep.
Ecuador
Guatemala
Honduras
Jamaica

(11) Mexico
Antilles
Nicaragua
Panama
Paraguay
Peru
Phillippines
Taiwan
Trinidad
Venezuela
United States

(12) Japan

a. Switch transport power OFF and remove power cord from outlet.

b. Open unit to service access position. Refer to paragraph 1-2 (f).

c. Place a shop cloth or similiar item over the PWB in the area of the power supply assembly.

WARNING

Dangerous voltages can be encountered in the next two steps if the power cord is connected to an AC source or if the unit has had power applied in the last two minutes.

d. Refer to Figure 4-24. Remove two phillips head screws securing power supply cover, noting position of chassis ground cable. Pivot cover to the right and slide forward to remove.

e. Remove voltage selection card (4, Figure 4-25) from J9 on power supply PWB. Noting position of key slot on voltage selection card, reinstall the card in J9 to correspond to the desired voltage. Refer to Table 1-1.

f. Reverse steps c and d.

g. Replace the fuse, if required, with one of the correct current rating for the voltage selected. Refer to Table 1-1. Use a slo-blo, 250V type. The fuse holder is located on the right-front of the power supply assembly. Replace the power cord if required.

h. Note in a prominent location on the unit that the "operating voltage (has been) changed to _____."

NOMINAL LINE VOLTAGE (TOLERANCE)	SELECTION CARD	FUSE (AMPS)	FREQUENCY (Hz)
100 - (85 - 110)	100	3.0	49-61
120 - (102 - 132)	120	3.0	49-61
208 - (187 - 228)	220	1.5	49-61
220 - (187 - 242)	220	1.5	49-61
230 - (204 - 253)	240	1.5	49-61
240 - (204 - 264)	240	1.5	49-61

Table 1-1. Operating Voltage Selection

INITIAL CHECKOUT

1-5. Section II contains a detailed description of all controls. To check for proper operation before installation, proceed as follows:

a. Connect power cord.

b. Clean tape path as directed in paragraphs 4-4 through 4-10.

c. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 5 seconds.) For other indications refer to paragraphs 2-6 and 2-7.

d. Ensure that tape is wound completely onto reel.

CAUTION

Both top cover and front panel door are locked during tape-loaded functions. Any attempt to open either top cover or front panel door before tape is unloaded will result in mechanical damage to the locking mechanism.

e. Open front panel door by pressing down gently on top (center) of door.

f. Insert tape into front panel of unit with write-enable ring side down.

g. Close front panel door.

h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

i. Initiate Service Aid 22 as described in paragraphs 3-11 and 3-32. Allow transport to cycle tape for a sufficient length of time to ensure proper servo operation. (It requires about 30 minutes to make a full pass on a 10.5 inch reel and complete a rewind sequence.)

j. Exit Service Aid 22. Refer to paragraph 3-11.

k. Check that LOAD indicator remains illuminated following rewind sequence.

l. Check ON-LINE switch and indicator by depressing repeatedly and observing that ON-LINE indicator is alternately illuminated and extinguished. Leave in off-line state (indicator extinguished).

m. Press UNLOAD switch. When the tape is unloaded (UNLOAD indicator illuminated) open front panel door and remove tape reel. Close front panel door.

n. Switch power off and remove power cord from outlet.

RACK MOUNTING

1-6. The CTU is designed to be mounted in a standard, 19-inch-wide, EIA equipment rack using the slides and mounting hardware provided with each unit. The tape drive unit must be mounted with no front panel obstructions. Free air supplied to the front of the unit air intake must have a pressure resistance less than 0.01 inches of water. The ambient temperature relative to the tape drive unit during operation must be 32^{o} centrigrade maximum. Refer to Figure 1-2 and drawing in Installation Hardware Package to mount the unit as follows:

a. Locate the front and rear rail holes to be used on the equipment rack (1, Figure 1-2). If they are threaded, drill them out to 0.281 inches.

b. Place the transport in service access position. Refer to paragraph 4-3.

c. Starting with either side, remove stationary section of slide (2) from transport by pulling stationary section to the front of transport.

d. Remove intermediate section of slide (3) from transport by pulling intermediate section to the rear of transport. When spring lock engages, depress to release.

e. Reassemble these sections by sliding front of intermediate section into rear of stationary section. Depress spring lock to slide completely together. Leave these sections assembled.

f. Determine, for the depth of rack, the appropriate holes to use in the mounting bracket and secure loosely to stationary section using two 10-32 X 3/8 binder head screws (4) and a nut plate (5).

g. Mount front flange of stationary section (2) to front rail by placing flange behind rack rail holes.

h. Install two 10-32 X 3/8 binder head screws (6), first through front of rail, then through stationary section flange and secure loosely with a nut plate (7).

i. Mount mounting bracket to rear of rack by placing flange in front of rack rail holes.

j. Install two 10-32 X 3/8 binder head screws (8), first through back of rack, then through mounting bracket flange and secure loosely with a nut plate (9).

k. Check alignment and correct as necessary. Tighten front, rear, and mounting bracket attachment screws.

l. Repeat steps b through j for other side.

m. Install the bottom edge of the rack latch bracket (10) on the left rail 2.13 inches below the center-line of slide using two 6-32 X 7/16 flat head screws (11), flat washers (12), split-lock washers (13) and No. 6 hex nuts (14).

n. Slide intermediate sections forward until locks engage.

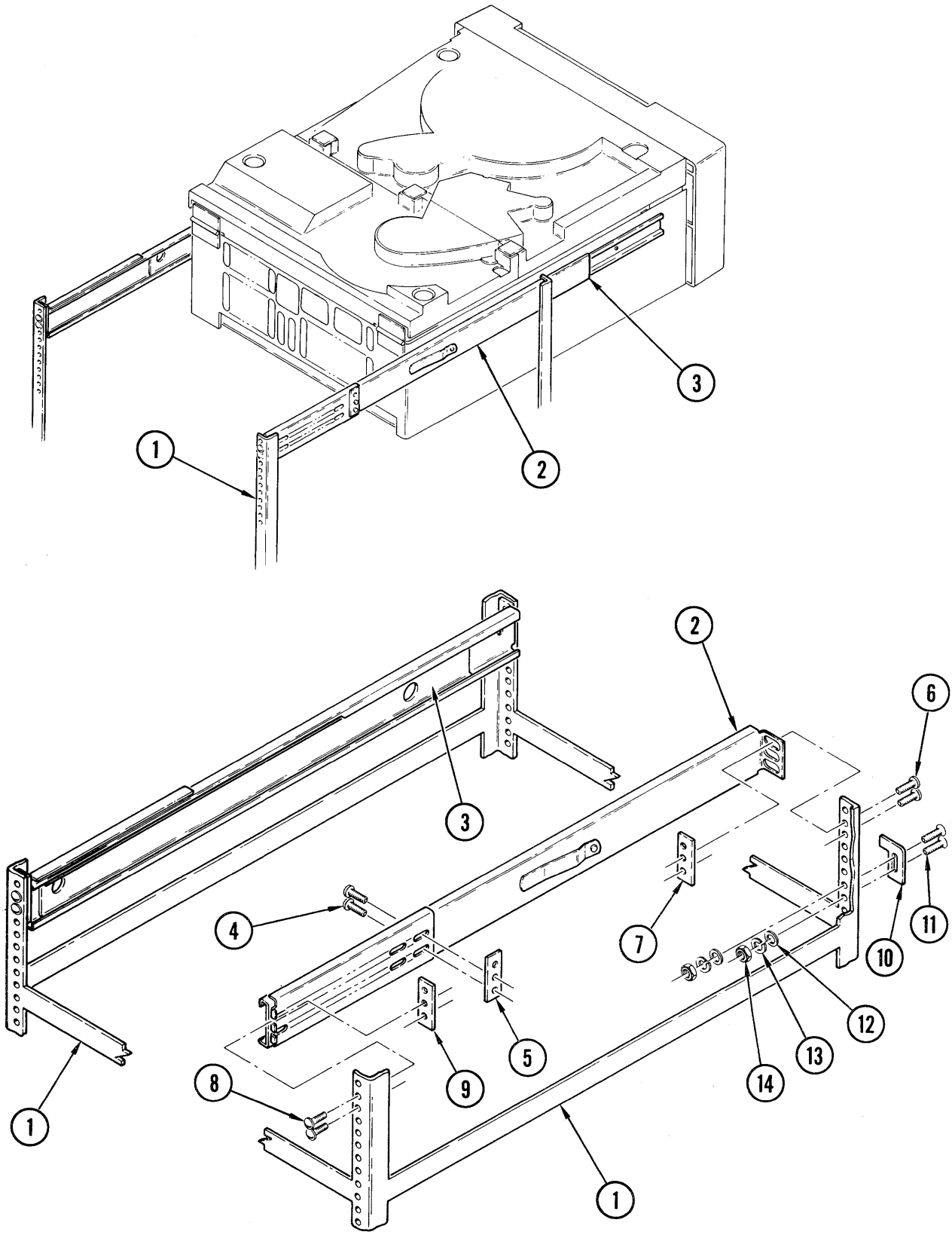


Figure 1-2. Rack Mounting

o. Carefully slide the CTU's transport-attached chassis mount sections (15) into intermediate sections while checking for binding or interference. Release locks and, before closing fully, check that the rack latch will engage securely.

p. Adjust rack latch bracket (10) or slides as required. To release, squeeze rack latch plate inside air duct opening at lower left of front panel.

q. Connect the power cord. A service loop must be provided. Ensure the cord will not chafe or interfere with other equipment.

INTERFACE CONNECTIONS

1-7. **Single-Transport Systems.** If the CTU is to be connected with the SCSI Interface unit, please refer to the SCSI Addendum, P/N 799893-001, at this time for correct interface connection. Interconnection of the CTU and system equipment should be made with a flat-ribbon cable or harness of individual twisted-pairs. To ensure reliable performance, the cables should have:

a. A maximum length of 25 feet to include service loop.

b. 28 AWG conductors for ribbon cable.

c. 22 or 24 AWG conductors with a 0.01 inch minimum insulation thickness and not less than one twist-per-inch for twisted-pair cables.

1-8. It is important that the alternate conductor in ribbon cable and the ground wires of twisted-pair be grounded at each end of the cable. The CTU will ground its end when connected. Tables 1-3 and 1-4 identify the connector pin assignments for each signal line. The signals indicated "Not Used" are properly terminated by the CTU for bus compatibility. The recommended connectors are:

a. Ribbon cable - 3M Co. Part No. 3415-0001 (or equivalent).

b. Twisted-pair cable - Viking Co. Part No. 3VT25/og JNH12 (or equivalent).

Assemble ribbon cable to connector so that it will enter the bottom of the connector when installed on the CTU.

1-9. For flat-ribbon cable, an I/O connector retainer is included with the unit. To install the connectors and retainer:

a. Open unit to service access position. Refer to paragraph 4-3.

b. Feed the interconnect cables through the opening at rear of chassis and connect to PWB. Any combination of P1/P2 may be used. See Figure 1-4 (last transport).

c. Refer to drawing in Installation Hardware Package and install connector retainer inside the chassis using two 10-32 X 1/2 pan head screws and No. 10 flat washers.

d. Select unit configuration. Refer to paragraph 1-10.

1-10. **Integration of the CTU to the System.** Refer to Tables 1-2 and 1-5 and local system installation instructions for the U3T and U5W configuration/option switch settings that establish the CTU operating parameters for block size, ramp delay, simulated speed, parity and various options.

1-11. U3T is set to match the performance capability of the CacheTape with the host system. If the configuration switch settings have not been previously established, the optimum operating configuration can be determined as follows:

CAUTION

When changing any U3T configuration switch setting, and prior to loading tape, a "Power-On Reset" must be performed by cycling the front panel power switch to its OFF position, then back to ON. This procedure will allow the CTU processor to update the new U3T switch settings into memory.

a. Select the 9K block size (U3T-3 and 4 OFF). Refer to paragraphs 1-13, 1-14, and 1-15.

b. **M891 only:** Enable the ramp delay (U3T-5 OFF).

c. Select the lowest speed -- U3T-6, 7 and 8 OFF (M890=12.5 ips, M891=45 ips).

d. Run an actual tape program or functional tape diagnostic to establish basic compatibility; e.g., measure time to back-up 10 megabytes, as reference.

NOTE

Parametric diagnostics are designed for troubleshooting a particular tape transport and are not indicative of system performance. The best tests of CTU compatibility are the live programs that use the tape sub-system. Functional diagnostics that measure tape system performance are another legitimate tool.

e. Refer to Table 1-5, set the next lower or higher block size (U3T-3 and 4), as appropriate, and repeat step d.

f. Select the next highest speed for increaced throughput (U3T-6, 7 and 8).

g. Repeat steps (d) through (f) until the data rate of the CTU exceeds the data rate capability of the system, as evidenced by data late flags in the host system, or a substantial increase in repositioning activity in the CTU (caused by write retries due to incomplete data transfers).

h. Select the next lowest speed (U3T-6, 7 and 8). Refer to paragraph 1-16.

i. Disable the ramp delays by closing switch U3T-5. If the data rate of the CTU again exceeds the system throughput rate (ref: step g), return switch U3T-5 to the OFF position (ramps enabled).

j. U3T-2 is used to select internal parity generation (U3T-2 OFF) or external parity generation (U3T-2 ON). In the external mode, the external parity is compared to the actual internal parity of the data character. If external and internal parity do not agree, a hard error is issued. The CTU does not drop tape tension for this IHER condition.

1-12. The maximum throughput can be determined by running a tape diagnostic and looking for data lates (buffer was empty when request for more data occurred) as the throughput is stepped up (increase in simulated speed). If backups only are run to intelligently integrate the unit, the top cover should be opened by accessing Diagnostic Service Aid 33 (depress TEST/HI-DEN/ON-LINE/ON-LINE/HI-DEN, in sequence). Note that each successive switch depression must be initiated within 3 seconds, or an entry reset will occur. Observe the tape motion as the throughput is stepped up to help assess if there is a cache flow problem evidenced by increased repositioning (ref: step g). Then, it drops tape after 16 repositions with Error Codes 11010 or 11001 (excessive write retries). CacheTape may also drop tape with Error Code 00011, because only partial data transmission occurred, causing a RAM parity error.

1-13. The lowest possible maximum blocksize should be set, also, so as to not unnecessarily limit throughput by limiting the cache buffer size. During read, if the maximum block size is set to 32K for a 9K actual block size, the throughput can be degraded by up to 50% compared to reading the same data at the 9K setting. Performance, although good, can be maximized by setting the configuration switches to the lowest maximum block size setting which will contain the actual recorded block size.

1-14. A performance enhancement feature is incorporated to prevent a dropped tape condition in the drive when an attempt is made to write a larger block of data than the maximum block size settings of unit configuration switches U3T-3 and U3T-4. When writing a block of data that exceeds the maximum block size setting, a hard error (IHER) flag is issued to the host and the drive automatically increments to the next higher maximum block size (from 9K to 16K or 16K to 24K, etc.).

CAUTION

IHER will be issued prior to termination of the data transfer. It is the responsibility of the host to issue a normal write retry sequence after recognizing the hard write error condition.

If, during the consequent write retry operation, the data block is still greater than the expanded block size, the drive will continue to increment to the next higher block size with each write retry generated by the host until one of the following events occur:

a. The data block is successfully written within the limits of the newly expanded maximum block size.

b. Block size expansion exceeds the 32K limit. In this event, the drive will flag IHER to the host, drop tape, and report hard error code 15 to the front panel.

1-15. The newly expanded final incrementation of maximum block size will remain fixed for the entire remainder of tape, and will reset to the selected block size only upon receiving an unload command. Therefore, to maintain optimum throughput performance it is important that the operating system maintain reasonable block sizes based on the initial switch settings of U3T-3 and U3T-4. Refer to Table 1-5 for configuration switch settings and to Figure 1-3 for switch locations.

1-16. In many cases the maximum throughput capability of the CTU is attained at one or more speed settings below the maximum attainable throughput setting. For example, the time for backing up 10.4 megabytes, in one instance, was 3 minutes at the 100, 120, 140, 170 and 200 ips setting. Consequently, the ideal setting would be 100 or 120 ips to eliminate the risk of data transfer problems at the higher speeds. This example is generally an indication of the limits of system throughput (bus activity-speed) and not controller/coupler limitations.

SPECIAL SOFTWARE COMPATIBILITY OPTIONS

1-17. **Special Software Option No. 1** (EOT LOCATION). This switch selectable feature has been incorporated to allow special EOT Location software users the ability to perform read operations in conformance with the requirements of this software. By placing unit configuration switch U3T-1 in the ON position, an EOT status is asserted at the end of the last record placed to tape. This action properly terminates subsequent read operations of a volume by sensing the EOT with the last record to be read. When writing, the drive physically senses a predicted point approximately 25 feet before the physical EOT (impending EOT pointer), locates the last block written, runs forward to EOT, repositions, reverses direction, and relocates its tape position back to the correct block location, and then proceeds with normal write operations. Cache memory capacity is reduced at this time to a maximum of 20 inches of written tape to assure that the last record accepted from the host is written prior to the physical EOT. The entire operation requires that the controller time-out be slightly greater than 20 seconds. This routine only occurs once for a full reel of tape (at impending EOT), therefore, degradation of throughput is insignificant. It is suggested that unit configuration switch U3T-1 remain OFF for users not operating under control of software that requires the physical EOT marker for orderly termination of read operations. Refer to Table 1-5 for configuration switch settings and Figure 1-3 for U3T location.

1-18. **Special Software Option No. 2** (Streaming EOT and DOUBLE FILEMARK). This switch selectable option allows the CTU to operate on a wider range of software systems. The range includes systems that support older conventional start/stop drives that require an EOT-actuated time-out to prevent these drives from writing off the end of the tape. For these systems, Option No. 2 can disable CacheTape's start/stop mode at EOT and permit streaming. This option also handles software systems that write double file marks at the end of each file or consecutive file marks during a backup operation. For these systems, the option switch can disable the normal mode of write sync on double file marks. Option No. 2 may be switch selected by placing switch U5W-4 in the ON position (refer to Figure 1-3). Otherwise, this option switch should remain in the OFF position.

NOTE

Special Software Option No. 1 and 2 selected together. Option No. 1's function is not changed but option No. 2 will only activate the double file mark function. The streaming EOT function will not activate.

1-19. **Special Software Option No. 3** (3200 BPI IDENT Status). Some software and couplers require the presence of IDENT status when operating from load point, regardless of the existence of the ID burst (as in the case of 3200 BPI operation due to a past convention). To implement this option, place switch U5W-5 in the ON position. When operating from load point, this option will cause the IDENT interface status line to be asserted when 3200 BPI density is selected (refer to Table 2-1, HI-DEN switch). As with all other switch selectable options, this switch setting should remain in the OFF position unless otherwise necessary for proper operation of the CTU. IDENT status will be asserted for 1600 BPI operation at all times (per ANSI standards).

1-20. **Parity Selection.** The user may select either internal parity generation or external parity (host provided) by the appropriate selection of unit configuration switch U3T-2. With U3T-2 in the OFF or OPEN position, parity of the IWO through IW7 data lines is determined internally by the CTU. When U3T-2 is in the ON or CLOSED position, the CTU accepts the proper parity (always odd) from the host on the parity line, IWP. If the host parity is in disagreement with the CTU's internally derived parity, a non-catastrophic hard error will be reported to the host for the specific character being written, and the correct parity will be toggled on the IRP line.

MULTIPLE-TRANSPORT OPERATION

1-21. **Daisy Chaining.** Up to eight transports may be operated from the host system (if capable) and can include combinations of CTU's, Microstreamers and embedded formatter tape transports. Transport to transport interconnect cables must meet the same criteria as for single transport operation. The total cable length from the host system to the last physical transport (or embedded formattter) must not exceed 25 feet unless active repeaters are used. See Figures 1-5 and 1-6 for daisy chain combinations.

To configure the CTU to operate on a multiple-transport system, proceed as follows:

a. Open CTU to service access position. Refer to paragraph 4-3.

b. Remove terminator resistor packs U3W and U10W (Figure 1-3) from each transport except last unit.

c. Install interconnect cables. Refer to paragraph 1-9.

d. Select unit address. Refer to paragraph 1-22.

e. Select unit configuration. Refer to paragraph 1-10.

1-22. **Unit Grounding.** The logic and the chassis grounds are tied together by a wire connecting P3 pin 9 on the formatter PWB and the unit's top plate. It is attached on the underside of the top plate at the mounting screw for the number 5 roller guide assembly. Logic and chassis ground can be separated by removing the connector from the top plate and ty-wrapping the wire back against the harness. Ensure that the tape path alignment is still correct when replacing the roller guide assembly.

1-23. **Unit Address Select.** The CTU is selected by a combination of the levels on the IFAD, ITAD0, and ITAD1 signal lines and the position of U5W switches 1, 2 and 3. Note that U5W is set for address 0 from the factory. Refer to Table 1-2 for unit address select switch settings.

SWITCH	POSITION			FUNCTION	
U5W	1 TAD0*	2 TAD1*	3 FAD*	Unit Address Select	
	ON	ON	ON	FAD0*	0
	ON	OFF	ON		1
	OFF	ON	ON		2
	OFF	OFF	ON		3
	ON	ON	OFF	FAD1*	4
	ON	OFF	OFF		5
	OFF	ON	OFF		6
	OFF	OFF	OFF		7
	4	ON		Streaming EOT and DOUBLE FILEMARK enabled	
	4	OFF		Streaming EOT and DOUBLE FILEMARK disabled	
	5	ON		3200 BPI IDENT enabled	
	5	OFF		3200 BPI IDENT disabled	
	6	ON		IRWD, IONL, ISPEED, and IFPT will not assert on the interface unless the unit is online and formatter selected (unit addressed).	
	6	OFF		IRWD, IONL, ISPEED, and IFPT will assert on the interface anytime the formatter is selected (unit addressed).	
		7-8		NOT USED	

Table 1-2. Unit Address Select/Option Switch

NOTE

CacheTape and Microstreamer drives should not be connected to conventional embedded formatter drives on the same FAD line logic level; e.g., if a CTU is set for any address between 0 and 3, the conventional drive must be set for an address between 4 and 7.

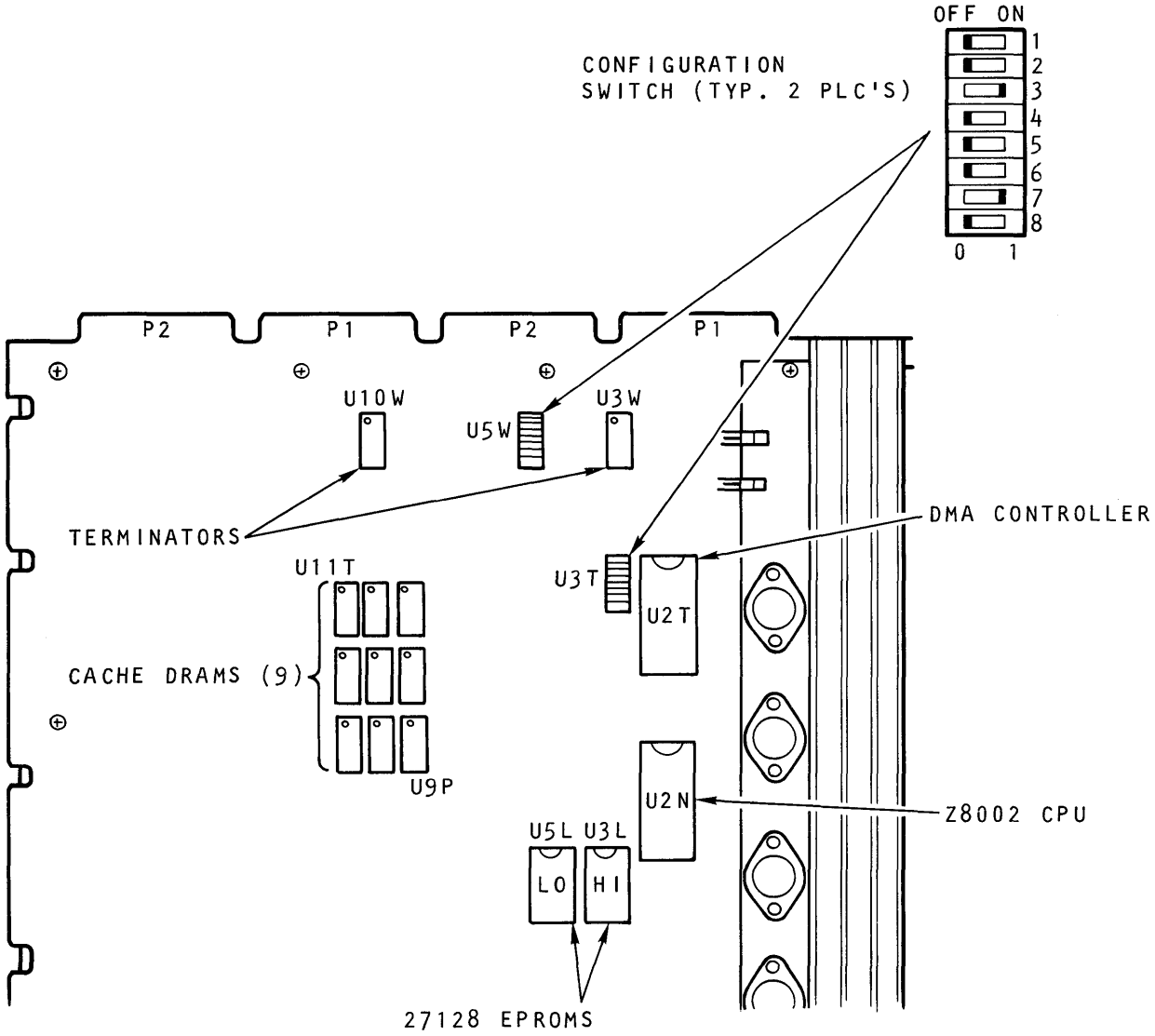


Figure 1-3. Partial PWB Layout

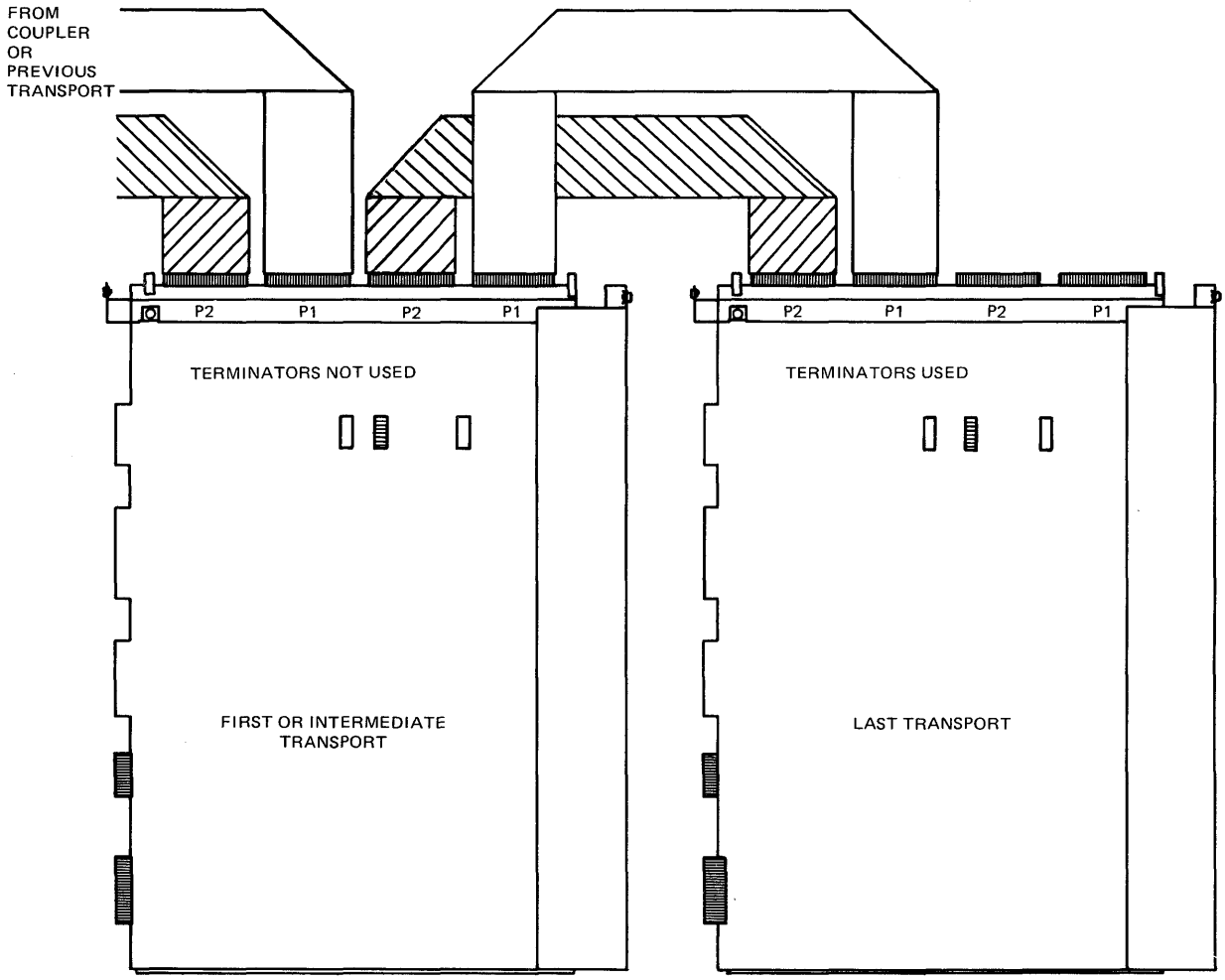


Figure 1-4. Daisy Chain Cable Configuration

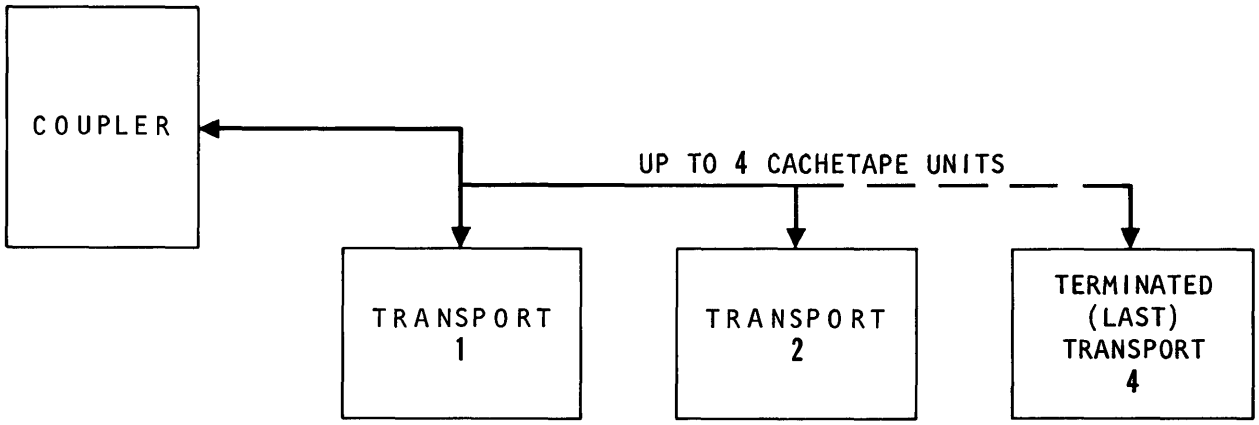


Figure 1-5. Daisy Chain Configuration

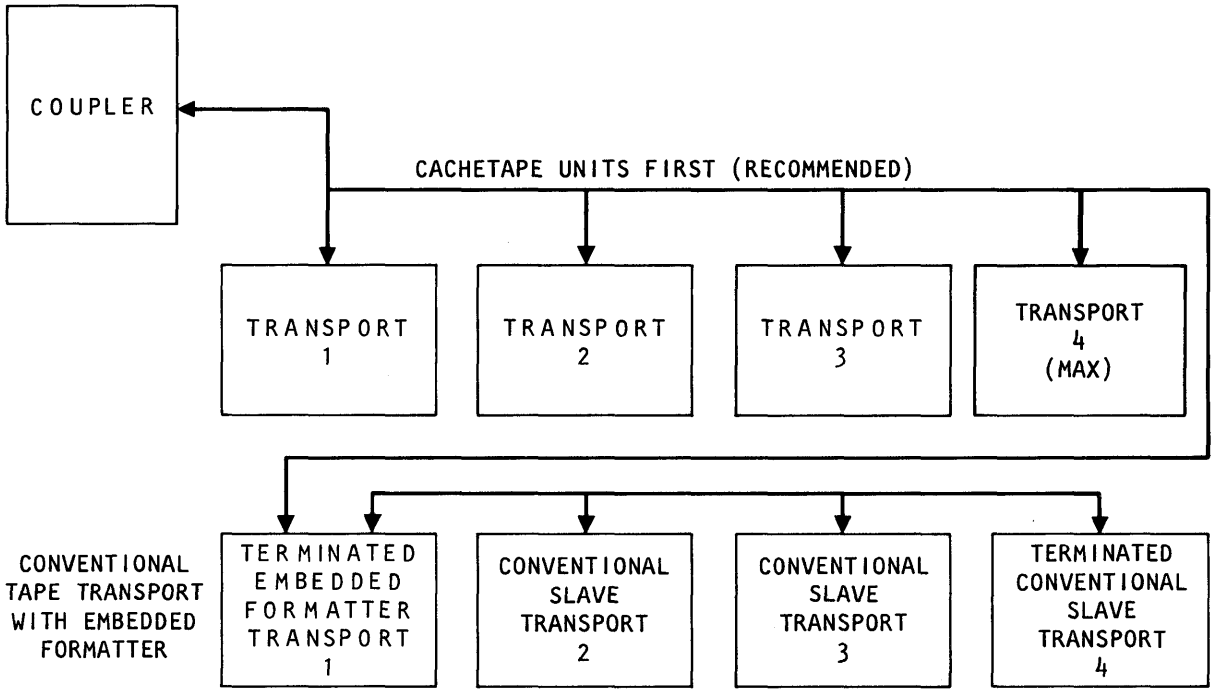


Figure 1-6. Hybrid Daisy Chain with CacheTape and Embedded Formatter Drives

PLUG NO.	LIVE PIN	GROUND PIN	SIGNAL DESCRIPTION	SIGNAL NAME
P1	4	3	Last Word	ILWD
P1	6	5	Write Data 4	IW4
P1	8	7	Initiate Command	IGO
P1	10	9	Write Data 0	IW0
P1	12	11	Write Data 1	IW1
P1	14	13	(Not Used)	(ISGL)
P1	16	15	(Not Used)	(ILOL)
P1	18	17	Reverse	IREV
P1	20	19	Rewind	IREW
P1	22	21	Write Data Parity	IWP
P1	24	23	Write Data 7	IW7
P1	26	25	Write Data 3	IW3
P1	28	27	Write Data 6	IW6
P1	30	29	Write Data 2	IW2
P1	32	31	Write Data 5	IW5
P1	34	33	Write	IWRT
P1	36	35	(Not Used)	(IRTH2)
P1	38	37	Edit	IEDIT
P1	40	39	Erase	IERASE
P1	42	41	Write File Mark	IWFM
P1	46	45	Transport Address 0	ITAD0
P2	18	17	Formatter Enable	IFEN
P2	24	23	Rewind/Unload	IRWU
P2	46	45	Transport Address 1	ITAD1
P2	48	47	Formatter Address	IFAD
P2	50	49	(Not Used)	(IHISP)

Table 1-3. Interface Signals, Controller to Transport

PLUG NO.	LIVE PIN	GROUND PIN	SIGNAL DESCRIPTION	SIGNAL NAME
P1	2	1	Formatter Busy	IFBY
P1	44	43	(Not Used)	(IRTHI)
P1	48	47	Read Data 2	IR2
P1	50	49	Read Data 3	IR3
P2	1	-	Read Data Parity	IRP
P2	2	-	Read Data 0	IR0
P2	3	-	Read Data 1	IR1
P2	4	-	Load Point	ILDP
P2	6	5	Read Data 4	IR4
P2	8	7	Read Data 7	IR7
P2	10	9	Read Data 6	IR6
P2	12	11	Hard Error	IHER
P2	14	13	File Mark	IFMK
P2	16	15	Identification	IIDENT
P2	20	19	Read Data 5	IR5
P2	22	21	End of Tape	IEOT
P2	26	25	(Not Used)	(INRZ)
P2	28	27	Ready	IRDY
P2	30	29	Rewinding	IRWD
P2	32	31	File Protect	IFPT
P2	34	33	Read Strobe	IRSTR
P2	36	35	Write Strobe	IWSTR
P2	38	37	Data Busy	IDBY
P2	40	39	(Not Used)	(ISPEED)
P2	42	41	Corrected Error	ICER
P2	44	43	On Line	IONL

Table 1-4. Interface Signals, Transport to Controller

SWITCH	POSITION			FUNCTION		
U3T	1 ON			EOT LOCATION enabled		
	1 OFF			EOT LOCATION disabled		
	2 ON			External Parity		
	2 OFF			Internal Parity		
	3		4	Select max. block size		
	OFF		OFF	9K Bytes		
	ON		OFF	16K Bytes		
	OFF		ON	24K Bytes		
	ON		ON	32K Bytes		
	5 OFF			Not Used		
	6	7	8	Selected Simulated Speed (ips)	Data Rate (KBS)	Ramp Delay (ms)
	OFF	OFF	OFF	12.5	20	30
	ON	OFF	OFF	25	40	15
	OFF	ON	OFF	37.5	60	10
	ON	ON	OFF	45	72	8.3
	OFF	OFF	ON	75	120	5.0
	ON	OFF	ON	75	120	5.0
	OFF	ON	ON	75	120	5.0
	ON	ON	ON	75	120	5.0

Table 1-5A. M890 Configuration Switches

SWITCH	POSITION			FUNCTION		
U3T	1 ON			EOT LOCATION enabled		
	1 OFF			EOT LOCATION disabled		
	2 ON			External Parity		
	2 OFF			Internal Parity		
	3		4	Select max. block size		
	OFF		OFF	9K Bytes		
	ON		OFF	16K Bytes		
	OFF		ON	24K Bytes		
	ON		ON	32K Bytes		
	5 OFF 5 ON			Enable ramp delay Disable ramp delay		
	6	7	8	Selected Simulated Speed -IPS- (Avg & Min/Max)	Data Burst Transfer Rate -KBS- (Avg & Min/Max)	Ramp Delay -msec- (Enabled)
	OFF	OFF	OFF	45	72	8.3
	ON	OFF	OFF	75	120	5.0
	OFF	ON	OFF	100	160	3.7
	ON	ON	OFF	112 (103/120)	180 (165/192)	3.0
	OFF	OFF	ON	125 (108/140)	200 (172/225)	2.6
	ON	OFF	ON	155 (138/170)	250 (220/272)	2.2
	OFF	ON	ON	185 (160/206)	295 (256/330)	1.5
	ON	ON	ON	250 (200/300)	400 (320/480)	1.0

Table 1-5B. M891 Configuration Switches

COMMANDS

1-24. The basic transport commands are derived by decoding the REVERSE, WRITE, WRITE FILE MARK, EDIT, and ERASE interface lines. When a command is issued to the transport from the controller, the transport asserts the IFBY line (true state) and performs all timing and control functions necessary for the execution of the command.

1-25. The command lines are transferred to the command registers on the trailing edge of the IGO pulse. Any errors occurring during the execution of the command are reported to the controller via the IHER or ICER interface lines. Upon completion of the command, the IDBY interface line goes false, notifying the controller that it may issue another command. All acceptable combinations of the interface lines are listed in Table 1-6. The interface lines used for command decoding are defined as follows:

a. Reverse (IREV). This is a level which, when true, specifies reverse tape motion and, when false, specifies forward tape motion.

b. Write (IWRT). This is a level which, when true, specifies the write mode of operation, and when false, specifies the read mode of operation.

c. Write File Mark (IWFM). This is a level which, when true and IWRT is also true, causes a file mark to be written on the tape.

d. Edit (IEDIT). When this level is true and IWRT is true, the transport operates in the edit mode.

e. Erase (IERASE). This is a level which, when true in conjunction with a true level on the IWRT line, causes the transport to execute an erase variable length command. The transport will be conditioned to execute a normal write command but no data will be recorded. A length of tape, as defined by ILWD, will be erased. Alternately, if IERASE, IWRT, and IWFM command lines are true, the transport is conditioned to execute a fixed length erase command. A fixed length of tape of approximately 4 inches will be erased. When command lines IWRT, IWFM, IEDIT, and IERASE are true, the transport is conditioned to execute a security erase operation. A length of tape, from the point where the command was issued to five feet beyond EOT, will be erased. The following are the commands that can be executed by the CTU. These commands are strobed by IGO.

1-26. **Read.** The CTU reads data records or file marks in either a forward or reverse direction, generating output data (eight lines plus parity) and data strobes to the controller. A read reverse to load point resets the formatter. A read forward operation will be terminated, if it occurs more than 8 feet beyond EOT. The recovery threshold is automatically lowered during a read operation in order to provide additional reliability. The write threshold is approximately 25 percent, while the read threshold drops to 10 percent. During read retry attempts, the threshold level will be lowered to 2-3 percent to optimize low amplitude signal recover.

1-27. **Space** (Forward and Reverse). This operation is identical to a standard Read, except that Read Strobe and error flags are not generated. This command will space one record either forward or reverse.

1-28. **File Search.** This signal initiates a space operation in either the forward or the reverse direction. The read data lines may be deactivated during file search operation, thereby ignoring any data that is written on the tape. The File Search command is terminated when:

a. A file mark is encountered.

b. Load point is encountered in a reverse direction.

c. The formatter is externally cleared.

d. The tape is past EOT by 15 feet or more.

1-29. **Write** (Forward only). The CTU starts tape and generates the proper delay before transferring the data character, ensuring the generation of ANSI/IBM compatible inter-record gaps and ID burst for PE. When writing in 1600 bpi mode from load point, the tape drive always generates the required PE identification burst. When IDBY goes true, it indicates that the first IWSTR (write strobe) will occur no sooner than 40 character intervals later. The write operation continues until ILWD (Last Word) is received by the transport, which indicates the last character in the data block.

1-30. True write operations (not erase) generate an automatic read verification with the signals activated as in read commands, except that signal thresholds are higher (25%). If the read-after-write verification operation detects a write error on the tape, an automatic write retry sequence is initiated. The block in error plus an additional 0.2 inches of tape are erased and the record is re-written. This procedure will be repeated up to 16 times, or until the record is successfully written without error. This process is transparent to the host. If there are 16 unsuccessful tries, a hard error (IHER) will be latched, tape motion will stop, and Error Code 11 or 19 will be displayed on the front panel. Refer to Table 3-6 and paragraph 3-36 for data recovery example.

NOTE

IHER is latched for any Write command operation that cannot be completed due to a catastrophic error.

1-31. The following are two variations of the basic write operation:

a. Edit. This signal is identical to the basic write operation, except that erase and write head currents are sequenced to overlap the record being rewritten. This operation should be preceded by a read reverse or read reverse edit command, to position the head in front of the block being edited. When editing, the new block must be exactly the same number of bytes as the old one, otherwise a hard error (IHER) will be flagged.

b. Write File Mark. This signal generates the compatible file mark and produces a (4.0 inch) IRG gap. The read file mark circuitry is activated. File mark identification is reliable, since it is recovered by means of majority gating. All required and optional tracks are written with 80 transitions (40 characters) of 0's. Channels 1, 3, and 4 are DC erased.

1-32. **Erase.** This signal produces an erase field at the head with no data flux transitions. There are three variations to this command, as follows:

a. Erase Fixed Length: Erases fixed length of tape (4 inches).
b. Erase Variable Length: Continuous erasure until terminated by the controller. Length is determined by the last character flag used in a normal write operation.
c. Security Erase: Erases forward to five feet beyond EOT. No status lines are activated; other transports may be selected after a Security Erase has started. The transport may also be commanded to rewind after completion of Security Erase by issuing a Rewind. The transport will indicate an immediate rewinding status, but will complete Security Erase and Rewind automatically.

1-33. **Write Synchronize.** This command is used to ensure that all pending writes are complete. Following issuance of this command, IDBY remains set until the entire contents of the cache are written on tape. On receipt of back-to-back Write File Mark commands, CacheTape will automatically insert a Write Sync command prior to executing the second File Mark command, unless the streaming EOT/Double Filemark option is enabled.

1-34. **3200 BPI.** This is a command (3200 CPI model only) which, when initiated while at the BOT marker, specifies the 3200 bpi mode of operation.

1-35. **1600 BPI.** This is a command which, when initiated while at the BOT marker, specifies the 1600 bpi mode of operation.

1-36. **Read Extended Drive Status.** Extended drive status is available to the host in the form of four (4) independently accessible records containing up to sixteen (16) bytes each. Extended status can only be read when the drive is ON-LINE. To access one of the 16 byte records the host must first issue the Read Extended Status command, which is "00010" = EDIT (refer to Table 1-6). The command is accompanied by the usual IGO pulse. This command places the drive in the Extended Status Mode whereby the drive will wait for a second "ACCESS" command, accompanied by IGO. This second command, or Block Access Code, selects the appropriate 16 byte block to be transferred to the host as a normal read operation on the IR0-IR7 data lines, complete with read strobes. Should more than one record be desired, the Read Extended Status command/IGO pulse may be re-issued and the appropriate block access code asserted on the five command lines, accompanied by the IGO pulse. The new status block will then be strobed to the interface.

1-37. The Error History Block may be reset to zero if the block access code is "10011." A 16 byte block will still be transferred, but the bytes currently have no meaning. A description of the information provided by the Read Extended Status command is given in Table 1-7.

1-38. **Write Edit.** This command can be used to re-write an existing data block on tape. The command is 01010 = EDIT, WRITE. The use of this command has certain restrictions. First, the user must be positioned at the start of a valid data block via a space reverse or read reverse operation. If these conditions are not met, then an illegal command 7 code will result. Next, the block size transferred to replace the old block must not exceed the original block byte count. The block size may be less if the user can assure that the post-block gap will erase any old data. If the newly written block is greater than the old block, fault code 10 will result (refer to Table 3-6).

COMMAND	(LSB) REVERSE	WRITE	WRITE FILEMARK	EDIT	(MSB) ERASE
Read Forward	0	0	0	0	0
Read Reverse	1	0	0	0	0
Read Reverse Edit	1	0	0	1	0
Write	0	1	0	0	0
Write Edit	0	1	0	1	0
Write File Mark	0	1	1	0	0
Erase Variable Length	0	1	0	0	1
Erase Fixed Length	0	1	1	0	1
Security Erase	0	1	1	1	1
Space Forward	0	0	0	0	1
Space Reverse	1	0	0	0	1
File Search Forward	0	0	1	0	0
File Search Forward (Ignore Data)	0	0	1	0	1
File Search Reverse	1	0	1	0	0
File Search Reverse (Ignore Data)	1	0	1	0	1
Write Sync	0	0	0	1	1
3200 bpi*	1	0	1	1	1
1600 bpi (PE)	0	0	1	1	1
Read Extended Status	0	0	0	1	0
Current Status	0	0	0	0	0
Configuration Status	1	0	0	0	0
Error History Status	0	0	0	1	0
Machine Status	1	0	0	1	0
Error History Reset	1	0	0	1	1

*Product Option

Table 1-6. Command Decoding

Byte No.	Bit*	Contents
		Current Status Block (Access Code = 00000)
0		**Tape Status Byte #1**
	0	IIDENT
	1	IHER
	2	ICER
	3	IFMK
	4	IRDY
	5	IONL
	6	IRWD
	7	IFPT
1		**Tape Status Byte #2**
	0	ILDP
	1	IEOT
	2	Read Retries Exceeded
	3	Write Parity Error At Interface
	4	Write Hard Error
	5	Illegal Command
	6	
	7	
2		**Error Classification**
	0	Cache Auto-Expanded Block Size: 000 - 9K; 001 = 16K; 010 = 24K; 011 = 32K; 100 = Reserved
	1	
	2	
	3	Read From Tape To Cache Overrun
	4	Write From Host To Cache Overrun
	5	
	6	
	7	
3		**Track In Error**
	0	Track 7 In Error
	1	Track 6 In Error
	2	Track 5 In Error
	3	Track 4 In Error
	4	Track 3 In Error
	5	Track 2 In Error
	6	Track 1 In Error
	7	Track 0 In Error

* Bit 0 = LSB; Bit 7 = MSB, unless otherwise specified. (1 = True/Yes, 2 = False/No)

Table 1-7. Read Extended Status

Byte No.	Bit*	Contents
		Current Status Block (Access Code = 00000)
4	0 1 Thru 7	**Track P In Error** LSB Read/Write Retry Count On Current Host Record MSB
5	0 Thru 4	**LSB** Front Panel Error Code MSB
6	 0 1 2 3 4 5 6 7	**Density Code** Density Found/Operating Density (bpi): 000 = Reserved 001 = 1600 010 = 3200 011 = Reserved Density Requested: 000 = Reserved 001 = 1600 010 = 3200 011 = Reserved Read Density Conflict Write Density Conflict
7	 0 Thru 7	**Unfixed Block Count** (includes file marks) Block Detectable Structures Remaining In Cache Fixed Block Count From BOT (includes file marks)
8 9 10		**Low Order Byte** **Mid Order Byte** **High Order Byte** Sequence Number Of Record In Hard Error
11 12 13		**Low Order Byte** **Mid Order Byte** **High Order Byte**

Table 1-7. Read Extended Status (Continued)

Byte No.	Bit*	Contents
		Configuration Status Block (Access Code = 10000)
0		**Capability**
	0	Reserved
	1	1600 bpi — 0 = Does not have capability
	2	3200 bpi — 1 = Does have capability
	3	Reserved
	4	Other
1		**Vendor Code**
2		**Model Code**
	0	000 = Other; 011 = M891-I; 110 = Reserved
	1	001 = M890-I; 100 = M891-II; 111 = Reserved
	2	010 = M890-II; 101 = Reserved
	Thru 7	
3		**Configuration State**
	0	EOT Location-- 1 = EOT Search, 0 = STD. (U3T-1)
	1	Parity-- 1 = External, 0 = Internal (U3T-2)
	2	Max. Block 00 = 9K; 10 = 24K (U3T-3)
	3	Size 01 = 16K; 11 = 32K (U3T-4)
	4	Ramp-- 1 = Disabled, 0 = Enabled (U3T-5)
	5	Simulated Speed Setting (LSB) (U3T-6)
	6	Simulated Speed Setting (U3T-7)
	7	Simulated Speed Setting (MSB) (U3T-8)
4		**Software Configuration**
	0	
	1	
	2	
	3	EOT and Double Filemark Streaming Option (U5W-4)
	4	3200 BPI IIDENT Status Option (U5W-5)
	5	
	6	
	7	

Table 1-7 Read Extended Status (Continued)

Byte No.	Bit*	Contents
		Error History Block (Access Code = 00010)
0		**Read Retry Count - Since Unload (255 max)**
1		**Write Retry Count - Since Unload (255 max)**
		Track History - Error Counts Per Track (255 max)
2		**Track 0**
3		**Track 1**
4		**Track 2**
5		**Track 3**
6		**Track 4**
7		**Track 5**
8		**Track 6**
9		**Track 7**
10		**Track P**
		Machine Status Block (Access Code = 10010)
		Head Pos'n/Tach Count In Multiples Of 1.28 Inches
0		**Low Order Byte Of Tach Count**
1		**High Order Byte Of Tach Count**
		Logical Command History
2		**Previous Host Command**
3		**2nd Previous Host Command**
4		**3rd Previous Host Command**
5		**4th Previous Host Command**
6		**5th Previous Host Command**
7		**Operating Status**
	0	Reel Size (LSB) — 00 = Unknown; 01 = 7-Inch
	1	Reel Size (MSB) — 10 = 8-1/2--Inch; 11 = 10-1/2--Inch
	2	Door Lock Status: — 0 = Unlocked; 1 = Locked
8	(LSB)	Tachometer reading
9	(MSB)	Indicating BOT location
10	(LSB)	Tachometer position
11	(MSB)	At impending EOT

Table 1-7. Read Extended Status (Continued)

SECTION II

OPERATION

GENERAL

2-1. This section describes the controls and indicators of the CTU and provides operating instructions.

CONTROLS AND INDICATORS

2-2. Control/indicator types, functions, and the conditions required for enabling the corresponding functions are given in Table 2-1. Figure 2-1 shows the controls and indicators.

LOADING TAPE

2-3. To load tape, proceed as follows:

CAUTION

Do not attempt to open either top cover or front panel door during load operation or while tape is loaded in transport. Both front panel door and top cover are locked during tape-loaded functions.

a. Apply power to unit and verify that UNLOAD indicator is illuminated. (Allow for normal delay of 5 seconds.)

b. Prepare tape-leader, if required, using Cipher tool Part No. 209990-500.

c. Verify that write-enable ring, if used, is fully seated.

d. Ensure that tape is wound completely onto reel.

e. Open front-panel door by pressing down gently on top (center) of door.

f. Insert tape into front of unit with write-enable ring side down. Tip edge of reel inside unit upward slightly to clear supply hub and place tape well inside unit. The door, when closed, should not touch the reel.

g. Close front-panel door.

h. Actuate LOAD switch. Access doors are now locked. When load sequence is completed, LOAD indicator will remain illuminated.

NOTE

During load sequence, actuation of ON LINE switch will place transport on line when BOT marker is sensed.

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
POWER	ON/OFF Rocker Switch and Indicator	Switches line power on and off.	Fuse installed. Line cord connected.
LOAD REWIND	Tactile Switch and Indicator	Loads tape to BOT marker.	Tape inserted in front panel door. Top cover and front panel door closed.
		Rewinds tape to BOT marker. Illuminates to indicate BOT tab is logically positioned at photosensor. When flashing, transport is executing a load or a rewind sequence.	Transport in off-line mode (ON-LINE indicator extinguished).
UNLOAD	Tactile Switch and Indicator	Unloads tape from any point. UNLOAD indicator flashes during unload sequence, then remains illuminated.	Transport in off-line mode. (ON-LINE indicator extinguished).

Table 2-1. Controls and Indicators

CONTROL/ INDICATOR	TYPE	FUNCTION	CONDITIONS
ON-LINE	Tactile Switch and Indicator	Switches transport to on-line mode. Illuminates to indicate transport is on line.	Tape loaded and transport in off-line mode (ON-LINE indicator extinguished).
		Second actuation switches transport off-line (must be off-line to unload). Indicator extinguished to indicate transport is off line.	Transport is in on-line mode. (ON-LINE indicator illuminated.)
TEST	Tactile Switch	Selects alternate operational mode for other switches.	Refer to paragraphs 3-6 and 3-9.
WRT EN (Write Enable)	Indicator	Illuminates to indicate write function may be performed.	Tape reel write-enable ring installed mounted on supply hub and tape loaded. Ring is removed for Write protect.
HI DEN	Tactile Switch and Indicator	First actuation (indicator illuminated): high density mode, 3200 CPI.	3200 CPI transport must be in off-line mode (ON-LINE indicator extinguished).
		Second actuation (indicator extinguished): lower density mode, 1600 CPI.	
		Indicator also reflects the density selected via the I/O command	

Table 2-1. Controls and Indicators (Continued)

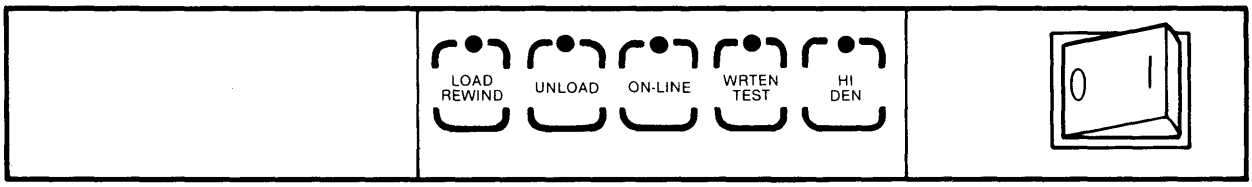


Figure 2-1. Control Panel

UNLOADING TAPE

2-4. To unload tape, proceed as follows:

a. Actuate UNLOAD switch. Transport must be in off-line mode (ON-LINE indicator extinguished).

NOTE

During the unload sequence, UNLOAD indicator will flash and access doors will remain locked. When the unload sequence is completed, UNLOAD indicator will remain illuminated and access doors will unlock.

b. Open front-panel door when UNLOAD indicator remains illuminated.

c. Carefully lift up the reel to clear the supply hub and remove.

d. Close front-panel door.

ERROR CONDITIONS

2-5. Operating failures or fault conditions are indicated by various front panel display patterns. There are two groups of fault indications: those which are normally caused by the tape or operator and can be avoided by following the proper operating procedure, and those which are machine malfunctions and require correction by an experienced service technician.

2-6. **Operator Error Codes.** These fault indications occur during normal tape loading operation. They produce error codes which will be displayed as an ON/OFF pattern of the indicators on the front panel. When the problem is corrected (i.e., closing the front panel door), actuate the LOAD switch to clear the error condition and re-enter the load sequence. If these error codes occur when proper operating procedures have been followed, a machine malfunction is indicated. Refer to Table 2-2. (These operator error codes are repeated in Table 3-7 of the manual where all of the CTU's error types, definitions, and the methods for error recovery are divided under Soft, Medium 1 and 2 and Hard errors. **(Note that error code 23 is a multi-error type.)**

2-7. **Transport Error Codes.** These faults indicate a serious deviation from the normal operating routine of the CTU. Each fault code is represented as a unique binary pattern of the front panel indicators, which flash to alert the operator. These faults inhibit the CTU and require correction by a service technician. They can be cleared only by turning the power off. Refer to Section III, Table 3-7 for these fault codes and troubleshooting instructions.

ERROR CODE*	INDICATION	CONDITIONS
17	All indicators except UNLOAD, ON-LINE and TEST flashing	The compliance arm exceeded its travel limits during normal operation. Check compliance arm operation with Service Aid 24. Check servo operation with Service Aid 11.
22	All indicators except LOAD and TEST flashing	Early EOT marker encountered. EOT marker located greater than 25 feet prior to actual EOT. Used with switch U3T-1 "ON" only. Relocate EOT marker.
23	All indicators except TEST flashing	A load operation was attempted without inserting a tape reel into the transport, the reel of tape is not properly seated, or the supply reel was not locked when attempting a manual load. Check if file protect and hub seat sensor are working properly. Attempt another LOAD operation.
25	All indicators except UNLOAD and ON-LINE flashing	An insufficient amount of tape was wrapped around the takeup hub when attempting a manual load. A minimum of five wraps is required.
26	All indicators except LOAD and ON-LINE flashing	Tape end did not peel off of reel. Remove antistatic tape/foam block if used. If caused by static charge buildup, refer to paragraph 2-8 for manual load instructions.
27	All indicators except ON-LINE flashing	A load or unload operation was attempted with the front-panel door or top cover in the open position.
28	All indicators except LOAD and UNLOAD flashing	Tape reel prevented movement of the supply reel hub. Remove and re-insert tape reel to clear. Possible bell crank solenoid failure.
29	All indicators except UNLOAD flashing	Tape reel was inserted upside-down. The bottom of the tape reel is identified by the write-enable ring groove or the write enable ring (when installed) near the inside mounting circumference.

Table 2-2. Operator Error Front Panel Indications

ERROR CODE*	INDICATION	CONDITIONS
30	All indicators except LOAD flashing	The BOT marker was not detected within the first 35 feet of tape. The leader must be a minimum of 6 feet in length.
31	All indicators flashing	After four attempts, the CTU did not successfully complete the load sequence. The tape leader should be checked for excessive damage or static charge buildup. If a second attempt at autoloading fails, refer to paragraph 2-8 for manual load instructions.

Table 2-2. Operator Error Front Panel Indications (Cont'd)

MANUAL LOAD

2-8. To load tape after a failure of the autoloading routine, proceed as follows:

a. Extend unit on its slides to clear equipment rack.

b. Place transport in operator maintenance access position by lifting top cover sides behind front panel. Place cover stay in slot provided.

c. Place reel of tape on supply hub. Ensure that reel is evenly seated on hub.

d. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply hub clockwise until supply reel is locked in place.

e. Thread tape along path shown in Figure 2-2. Carefully move tachometer assembly away from takeup hub, and, making one wrap of tape clockwise around takeup hub, gently replace tachometer assembly. Continue to wrap tape for FIVE (5) more revolutions of the takeup hub. Check that tape is seated correctly on guides and threaded properly over head assembly.

f. Close top cover, and place transport in normal operating position.

g. Depress and hold the HI DEN switch, then actuate the LOAD switch and release both. Tape should tension and advance forward until BOT tab is positioned at photosensor. LOAD indicator will illuminate, indicating that CTU is ready for use.

h. **To manually load at or beyond EOT:** There must be a minimum of 25 feet of tape beyond the EOT mark. Depress the LOAD switch and the CTU will rewind, unload, and then reload to BOT.

MANUAL UNLOAD

2-9. If for any reason the CTU cannot complete the rewind/unload sequence, the tape reel may be rewound manually as follows:

a. Place transport in operator maintenance access position. Refer to paragraph 4-2.

b. Rotate supply reel in counterclockwise direction to rewind tape onto supply reel.

c. Depress and hold the manual unlock button, located behind front-panel door on bottom left hand side of tape reel opening, and simultaneously rotate the supply reel counterclockwise until it rotates freely and can be removed from the transport.

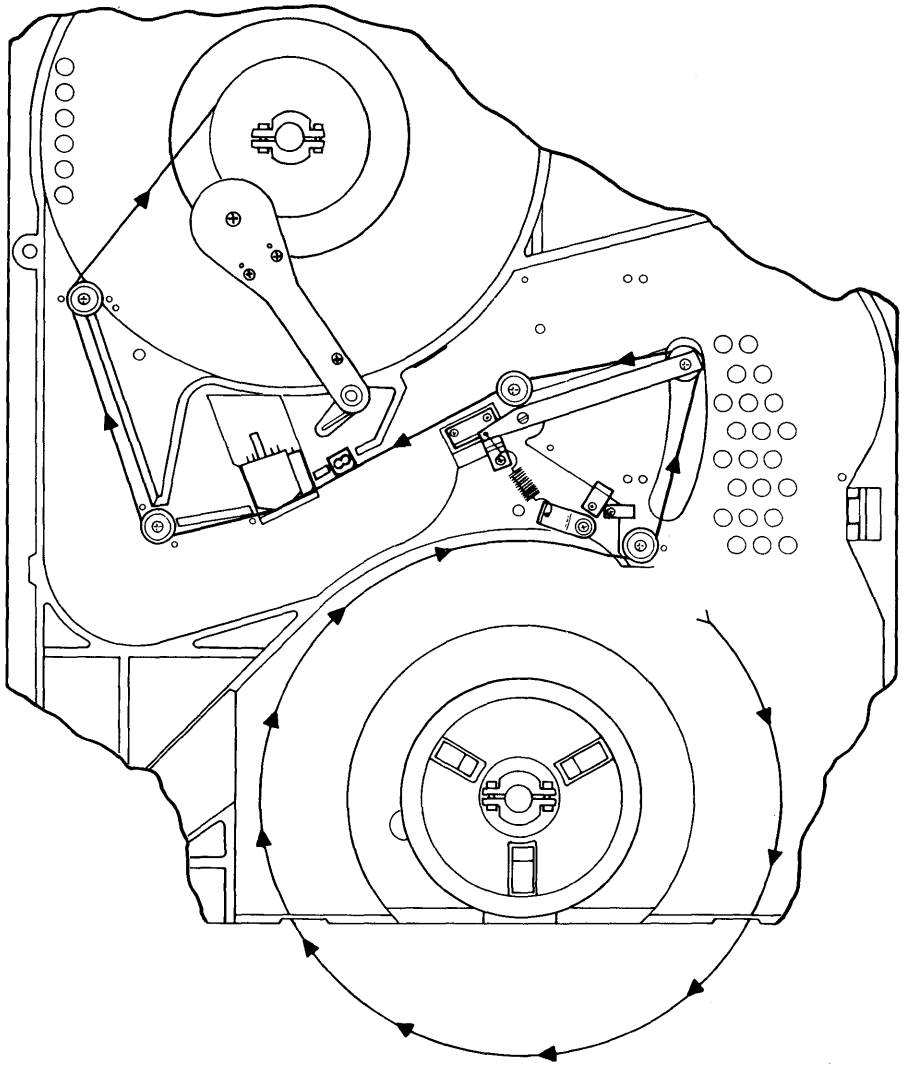


Figure 2-2. Tape Threading Path

SECTION III

TESTING AND TROUBLESHOOTING

TESTING

3-1. This section describes the two types of test capabilities available on the CTU: a series of tests that run automatically when the power is turned on, called power up self tests (PUST), and service aids, accessed by pressing the front panel switches in certain sequences that enable individual sections of the unit for testing and troubleshooting. Also, error conditions that can cause a CTU failure are listed and procedures to diagnose the failure are provided.

3-2. **Power Up Self Tests.** The PUST (Power Up Self Test) consists of a series of tests that are executed each time power is applied to the unit. These tests are designed to verify the proper operation of the unit prior to permitting tape to be loaded or, in the case of a failure, assist the technician in isolating the fault and repairing the unit. If the PUST is successful, the UNLOAD indicator is lighted continuously, and the transport is ready to be loaded. If the PUST is unsuccessful, a unique pattern will be displayed on the front panel LED's to indicate the areas of the failure. This is referred to as level 1 failure information. For certain tests, levels 2, 3, 4, and 5 failure information will be available to provide a more specific cause of the failure.

3-3. The failure display is a binary number which results from the "ON" (1) and "OFF" (0) states of the LED's with the least significant bit being the LOAD indicator on the left and the most significant bit being the HI DEN indicator on the right. See Figure 3-1. For the first six tests, the display will be the number of the test that failed and the drive will be inhibited, preventing any further interaction. Refer to Table 3-1 for PUST failure codes 1 through 6. If after power is applied to the unit, all LED's remain lighted continuously for longer than 1 second, and the LED display does not match the level 1 displays in Table 3-1, a failure of the Z8002 is indicated and no further failure information is available.

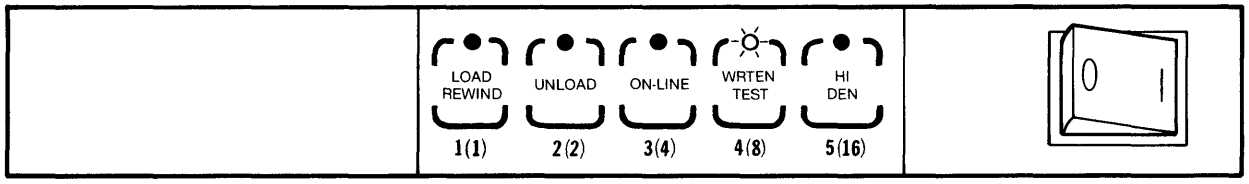


Figure 3-1. Front Panel Controls and Indicators (Diagnostic Mode)

3-4. A failure in test 7 will be indicated by LOAD, UNLOAD, and ON-LINE LED's flashing. Pressing the LOAD switch once will display the level two failure information. Levels 2 through 5 information is presented in two alternating 4-bit nybbles. The high order nybble is displayed when the HI-DEN LED is illuminated. When the HI-DEN indicator is extinguished, the low order nybble is displayed. Table 3-2 includes the levels 2 through 5 information available when the LOAD switch is pressed one through four times respectively.

3-5. A failure in tests 8-13 will be indicated initially by the front panel LED's flashing the failed test number. Referring to Table 3-3 and pressing LOAD a second time will display level two information about the failure, as described in paragraph 3-4.

3-6. When all the failure information is read, pressing the TEST switch will put the unit in the diagnostic mode. The TEST indicator will flash and the service aid access codes can then be entered. The TEST switch can be pressed (to put the unit in the diagnostic mode) any time after all front panel LED's flash. However, all failure information is then lost.

3-7. Use the procedure in Figure 3-2 and the information in Tables 3-1 through 3-3 to recognize and analyze a PUST failure.

3-8. **Service Aids.** The service aids are tests that are enabled by the technician. They are divided into two groups: those that run with no tape in the unit, and those that run after tape has been loaded.

3-9. In the case of a PUST failure of tests 8-13, pressing the TEST switch will put the unit in the diagnostic mode and the service aid codes can then be entered. Note that any failure information not read will be lost. Refer to paragraph 3-6.

3-10. For a normal power-up sequence, once the UNLOAD indicator is lighted continuously, the no-tape service aids can be accessed, or following a load sequence when the LOAD indicator is lighted continuously, the tape-loaded service aid codes can be entered.

3-11. Referring to Figure 3-1, which illustrates the controls of the CTU, the switch sequence for activating each service aid is as follows:

a. Press switches 4 and 5 in sequence to access the diagnostic mode.

b. Press switches corresponding to service aid number in sequence.

c. Execute service aid by pressing switch 5.

NOTE

Each successive switch depression must be entered within 3 seconds, or the diagnostic mode will be aborted and the switch sequence will have to be re-entered.

d. Press switch 4 to exit the service aid.

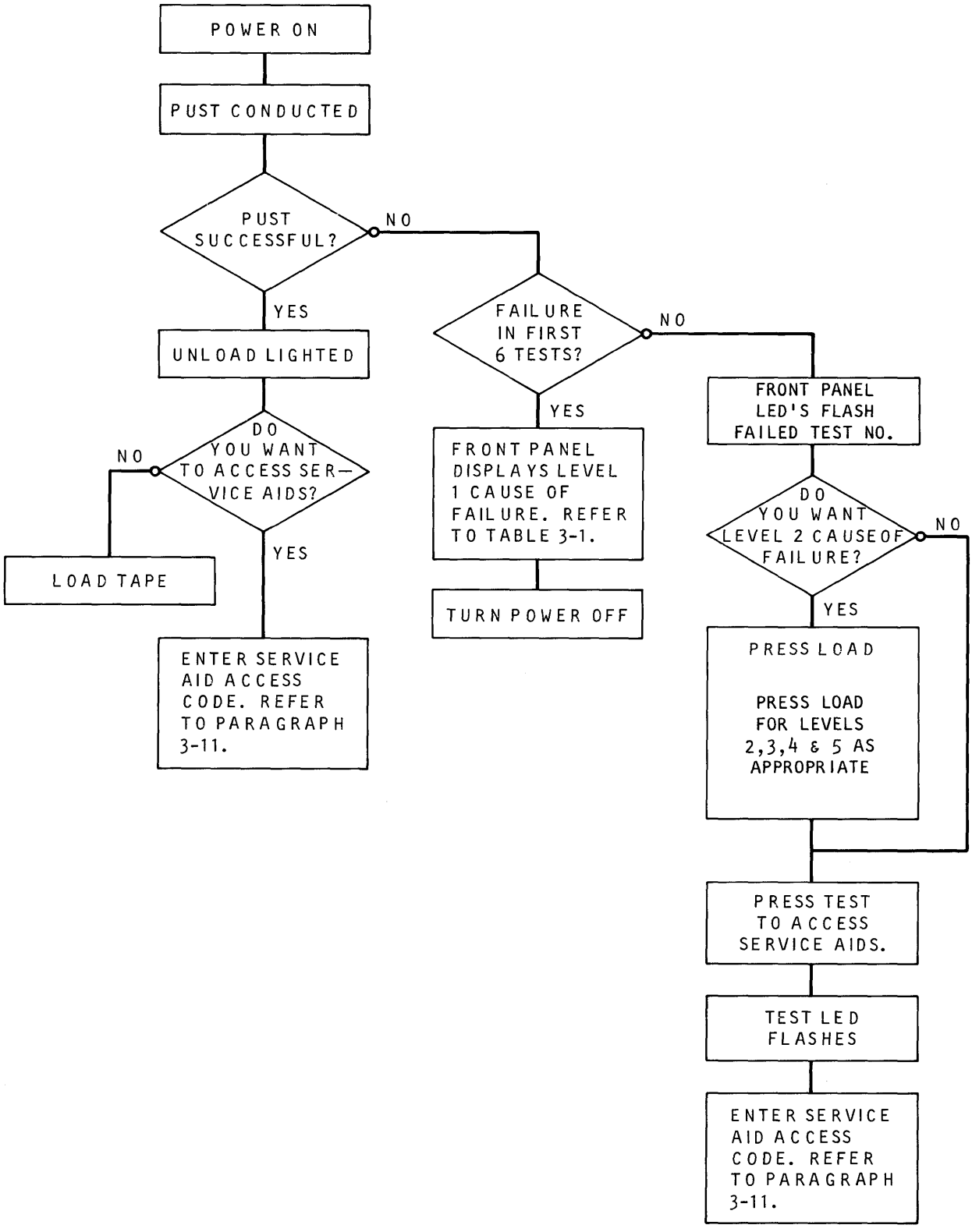


Figure 3-2. Power Up Self Test Process

PUST TEST	FAILURE	LEVEL 1 DISPLAY	LEVEL 2 DISPLAY	REMARKS
1	Low ROM (U5L)	1 0 0 0 0	---	Checksum error
2	High ROM (U3L)	0 1 0 0 0	---	Checksum error
3	Low RAM (U5N)	1 1 0 0 0	---	Data test error
4	High RAM (U3N)	0 0 1 0 0	---	Data test error
5	CIO TEST	1 0 1 0 0	---	Press LOAD
	CIO - Z1		0 0 0 1 0	IC-U9L fails
	CIO - Z2		0 0 0 0 1	IC-U11L fails
	CIO - Z3		0 0 0 1 1	IC-U13L fails
6	Early Test Exit	0 1 1 0 0		Generally indicates a failure in tests 1 thru 5, above. Tests for early PUST exit when TEST pressed and held during power up.

Table 3-1. Tests 1 through 6 PUST Failure Codes

LEVEL 1 DISPLAY	LEVEL 2 LOW HIGH	LEVEL 3 LOW HIGH	LEVEL 4 LOW HIGH	LEVEL 5 LOW HIGH	REASON
11100					DMA/Cache circuits
	10000 00001				DMA failure
		10000 00001			Base address error
		01000 00001			Word count error
		11000 00001			No count rollover
		00100 00001			Addition not 0
		10100 00001			No terminal count
	01000 00001				Cache RAM circuits
		10000 00001			Address error (low to high)
		01000 00001			Address error (high to low)
			10000 00001		RD7 - U10T
			01000 00001		RD6 - U11R
			00100 00001		RD5 - U11T
			00010 00001		RD4 - U9P
			00000 10001		RD3 - U9R
			00000 01001		RD2 - U10P
			00000 00101		RD1 - U11P
			00000 00011		RD0 - U10R
			00000 00001		RDP - U9T
				10000 00001	Read parity error (U9T)
				01000 00001	Write parity error (U9T)

Table 3-2. Test 7 PUST Failure Codes

PUST TEST	LEVEL 1 DISPLAY	LEVEL 2 BYTE LOW	LEVEL 2 BYTE HIGH	REASON
8	00010			CIO initialization failure
9	10010			DAC/ADC test failed
		10000	00001	DAC failed auto-zero
		01000	00001	Reference voltage (VIN5) error
10	01010			Servo motor test failed
		10000	00001	Unexpected drive voltage
		01000	00001	Unexpected EMF on supply motor
		11000	00001	Unexpected EMF on takeup motor
		00100	00001	Supply motor EMF out of tolerance
		10100	00001	Supply motor rotation out of tolerance
11	11010			Tachometer test failed
		10000 or 01000	00001 00001	Either of the two phases missing
		11000	00001	Both phases missing
		00100	00001	Phase separation out of tolerance
13	10110			Compliance arm voltage not in tolerance
		10000	00001	Rest voltage too low
		01000	00001	Reference voltage (VIN6) error

Table 3-3. Tests 8 through 13 PUST Failure Codes

3-12. As an example, to cycle the supply and takeup servos in the forward and reverse direction, Service Aid 11 should be used with no tape in the unit. To access Service Aid 11 proceed as follows:

a. Press switches 4 and 5 in sequence.

b. Press switch 1 two times.

c. Execute Service Aid 11 by pressing switch 5.

3-13. Each service aid will run continuously, that is repeat its basic sequence, until switch 4 is pressed to exit the service aid. Each service aid description includes any modification of the basic routine that can be enabled while the service aid is running.

3-14. During some service aids, the front panel indicators provide output data relative to the service aid being performed. This data is displayed as a binary number with the LOAD indicator as the least significant bit (LSB) and the HI DEN indicator as the most significant bit (MSB). See Figure 3-1. Each Service Aid description includes information about output data, as appropriate.

3-15. **Service Aids (No tape in unit).** Service aids with no tape in the transport are described in the following subparagraphs. Refer to paragraph 3-14 for a description of the front panel indicators.

CAUTION

If tape is in the unit for the following service aids, it may be damaged.

3-16. **Service Aid 11.** This service aid enables both supply and takeup servo circuits, sequencing both reel hubs clockwise and counterclockwise. Press the LOAD switch to activate the high voltage rail switches Q5 and Q6 and current limit the servos to 1 ampere. Press the UNLOAD switch to deactivate Q5 and Q6 and enable maximum current limit.

3-17. **Service Aid 12.** This service aid activates and deactivates the write formatter circuitry to allow troubleshooting with no tape in the transport. When enabled, the write head/erase bar are turned on and a formatted, 40-character record is generated. The write head/erase bar is turned on for the length of the record (including pre/postamble) plus approximately 15 msec, then the head is turned off for approximately 15 msec and the sequence repeats. The "data" portion of the record simulates an all zeros (3200 fci) record. Press LOAD to select a 1-character record and ONLINE to select a 256-character record. Press UNLOAD for the 40-character record.

3-18. **Service Aid 13.** This service aid operates the same as Service Aid 12 except that the file-mark circuits are exercised.

3-19. **Service Aid 21.** This service aid activates the interface output status signals for troubleshooting. Refer to Figure 3-3 for the relative sequence/timing and test points to observe the signals. If a write protected tape is used to adjust read threshold, an error "6" will result. No tape action will be allowed until a write ring is installed. **The tape will be written on.**

3-20. **Service Aid 22.** This service aid is used to display the output of the BOT sensor. The display is updated continuously so that a piece of half-inch tape with a BOT marker can be inserted in the sensor area (as a loaded tape would be) to determine the output voltage levels for blank tape and a BOT marker. Use Table 3-4 to convert the binary count of the front panel indicators to a decimal equivalent in volts. Ambient light can affect the output levels. With no tape in the sensor area, the binary count should be 14 (about 0.9 volt) or greater. With blank tape the count should be 5 (about 0.3 volt) or less. Some blank tapes may cause the output level to be a negative value which is an acceptable condition (all indicators flashing). For tape with a BOT marker, the count should be 28 (about 1.8 volts) or greater.

3-21. **Service Aid 23.** This service aid is identical to Service Aid 22 except the EOT circuit is activated. Use the same criteria for output voltage levels. There is no requirement that both sensors exhibit the same output characteristics as long as each meets the criteria described for the BOT sensor.

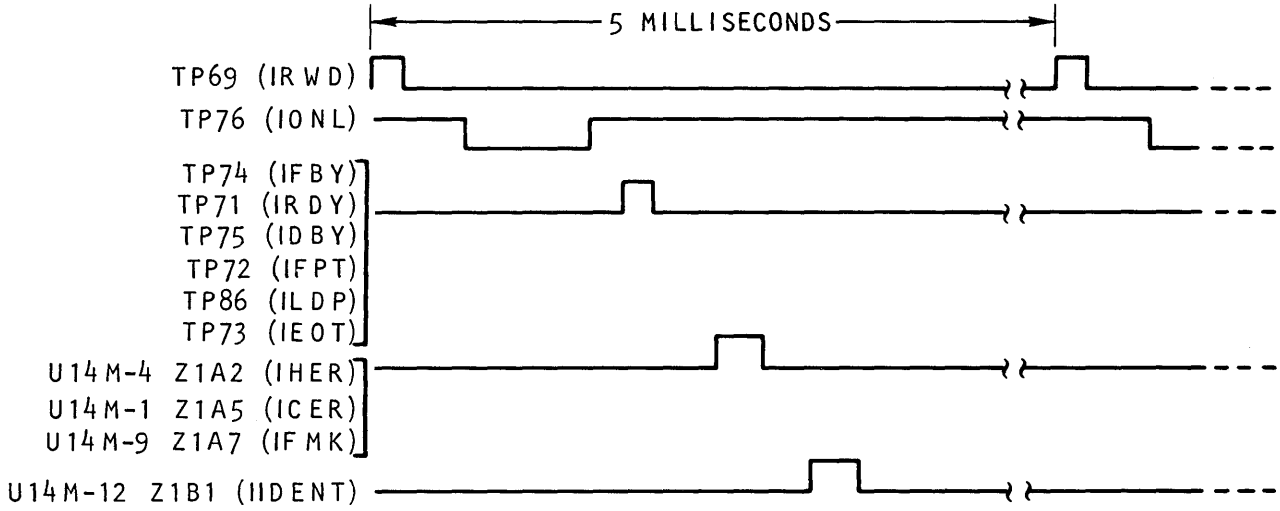


Figure 3-3. Service Aid 21 Sequence/Timing

BINARY DISPLAY	DECIMAL EQUIVALENT	OUTPUT VOLTS	BINARY DISPLAY	DECIMAL EQUIVALENT	OUTPUT VOLTS
0 0 0 0 0	0	0 or less	0 0 0 0 1	16	1.024
1 0 0 0 0	1	0.064	1 0 0 0 1	17	1.088
0 1 0 0 0	2	0.128	0 1 0 0 1	18	1.152
1 1 0 0 0	3	0.192	1 1 0 0 1	19	1.216
0 0 1 0 0	4	0.256	0 0 1 0 1	20	1.280
1 0 1 0 0	5	0.320	1 0 1 0 1	21	1.344
0 1 1 0 0	6	0.384	0 1 1 0 1	22	1.408
1 1 1 0 0	7	0.448	1 1 1 0 1	23	1.472
0 0 0 1 0	8	0.512	0 0 0 1 1	24	1.536
1 0 0 1 0	9	0.576	1 0 0 1 1	25	1.600
0 1 0 1 0	10	0.640	0 1 0 1 1	26	1.664
1 1 0 1 0	11	0.704	1 1 0 1 1	27	1.728
0 0 1 1 0	12	0.768	0 0 1 1 1	28	1.792
1 0 1 1 0	13	0.832	1 0 1 1 1	29	1.856
0 1 1 1 0	14	0.896	0 1 1 1 1	30	1.920
1 1 1 1 0	15	0.960	1 1 1 1 1	31	1.984 or greater

Table 3-4. Service Aids 22/23 Display Conversion (BOT/EOT)

BINARY DISPLAY	DECIMAL EQUIVALENT	VOLTS	BINARY DISPLAY	DECIMAL EQUIVALENT	VOLTS
0 0 0 0 0	0	0 to +0.312	0 0 0 0 1	16	0 to -0.312
1 0 0 0 0	1	+0.313	1 0 0 0 1	17	-0.313
0 1 0 0 0	2	+0.626	0 1 0 0 1	18	-0.626
1 1 0 0 0	3	+0.939	1 1 0 0 1	19	-0.939
0 0 1 0 0	4	+1.252	0 0 1 0 1	20	-1.252
1 0 1 0 0	5	+1.565	1 0 1 0 1	21	-1.565
0 1 1 0 0	6	+1.878	0 1 1 0 1	22	-1.878
1 1 1 0 0	7	+2.191	1 1 1 0 1	23	-2.191
0 0 0 1 0	8	+2.504	0 0 0 1 1	24	-2.505
1 0 0 1 0	9	+2.817	1 0 0 1 1	25	-2.817
0 1 0 1 0	10	+3.130	0 1 0 1 1	26	-3.130
1 1 0 1 0	11	+3.443	1 1 0 1 1	27	-3.443
0 0 1 1 0	12	+3.756	0 0 1 1 1	28	-3.756
1 0 1 1 0	13	+4.069	1 0 1 1 1	29	-4.069
1 1 1 1 0	15	+4.069 or greater	1 1 1 1 1	31	-4.069 or less

Table 3-5. Service Aid 24 Display Conversion (Compliance Arm)

3-23. **Service Aid 24.** This service aid is used to display the compliance arm transducer voltages on the front panel. When this service aid is initially activated, the front panel will display the actual maximum and minimum transducer voltages when the arm is at its rest position (against rear bumper) and its fully forward position, respectively. This initial voltage is displayed as a binary value on the front panel indicators. This is the mode 1 or actual arm voltage. Refer to Table 3-5 to convert the binary count to a decimal equivalent in volts. The display is continuously updated so that as the arm is moved, the binary value will change relative to the new position; e.g., when the service aid is activated and the compliance arm is in the rest position, the front panel may display a binary count of 5 (+1.565 volts). **Note that a binary count of 1 is the minimum acceptable number for proper operation.** If the arm is moved slowly toward the front bumper, the count will be observed to decrement to 0, switch to 16 (this is the sign bit, indicating a negative voltage value), and then increment to perhaps 21 (-1.565 volts). These maximum/minimum readings are the absolute limits of the arm. To determine the total voltage change (V-Delta) of the arm, place the arm in its rest position and press UNLOAD (mode 2). The front panel display will indicate a zero volt reference value at this time. Flickering of the HI DEN indicator is an acceptable condition in this position. As the arm is moved to its fully forward position, the binary count will increment to perhaps a value of 10 (+3.13 volts, from Table 3-5). The minimum value of voltage change for proper operation within the compliance arm travel limits is 2.191 volts (binary 7). To return to the mode 1 voltage condition, press the LOAD switch. Press TEST to exit this service aid.

3-23. **Service Aid 31.** This service aid is used to check the file-protect/reel-seat sensor and tape-in-path sensor. Only the supply servo is enabled. To check the file-protect/reel-seat sensor, remove the write-enable ring from a tape reel and place the reel on the supply hub. As the hub rotates counterclockwise, a double pulse of the UNLOAD indicator will occur when reel-seat reflector moves past the sensor. With a write-enable ring installed, an additional single pulse of the UNLOAD indicator should occur when the the file-protect tab rotates past the sensor. For tape-in-path testing, the LOAD indicator should be illuminated initially, indicating no tape-in-path. Insert a piece of half-inch tape so that it blocks the tape-in-path sensor and extinguishes the LOAD indicator. During this service aid, the LOAD switch controls the supply motor. Each time the LOAD switch is pressed the motor will decrease its speed. Repeated actuation of the LOAD switch will cause the motor to stop and then increase speed in the opposite direction. Without a tape reel mounted on the supply hub, no flashing indication of the UNLOAD indicator should occur.

3-24. **Service Aid 32.** This service aid activates the hub-lock and door-lock assemblies. The supply motor alternates direction to operate the supply reel locking pawls. In the counterclockwise direction, the pawls should retract (unlocked position) when the hub tab engages the bellcrank. In the clockwise direction, the pawls should extend (locked position) when the hub tab engages the bellcrank. NOTE: The supply hub may **or may not** engage the bellcrank during operation. If either the top cover or front panel door is open, the ONLINE indicator illuminates.

CAUTION

This service aid is intended for use only by a service technician during troubleshooting.

3-25. **Service Aid 33.** This service aid disables both top cover and front panel door interlocks to allow observation of the tape path during operation of tape-loaded service aids. It may be accessed either before or after an auto- or manual load sequence. This service aid is not terminated with the TEST switch and will remain enabled until the tape is unloaded or the power is turned off.

3-26. **Service Aid 34.** During this service aid, the LOAD switch controls the blower motor. When the LOAD indicator is illuminated, the blower motor should be on.

3-27. **Service Aid 42.** This service aid activates the cache memory DMA controller (channel 2), address and data lines for troubleshooting. See Figure 3-4 for the relative timing/sequence of a cache memory write operation. The data lines have a high state (1) value rotated through the byte from LSB to MSB, therefore, only one bit is high at a time. The address lines have a low state (0) value rotated through the 16 bit address word, thus, only one address line is low at a time. Power must be cycled to exit this service aid.

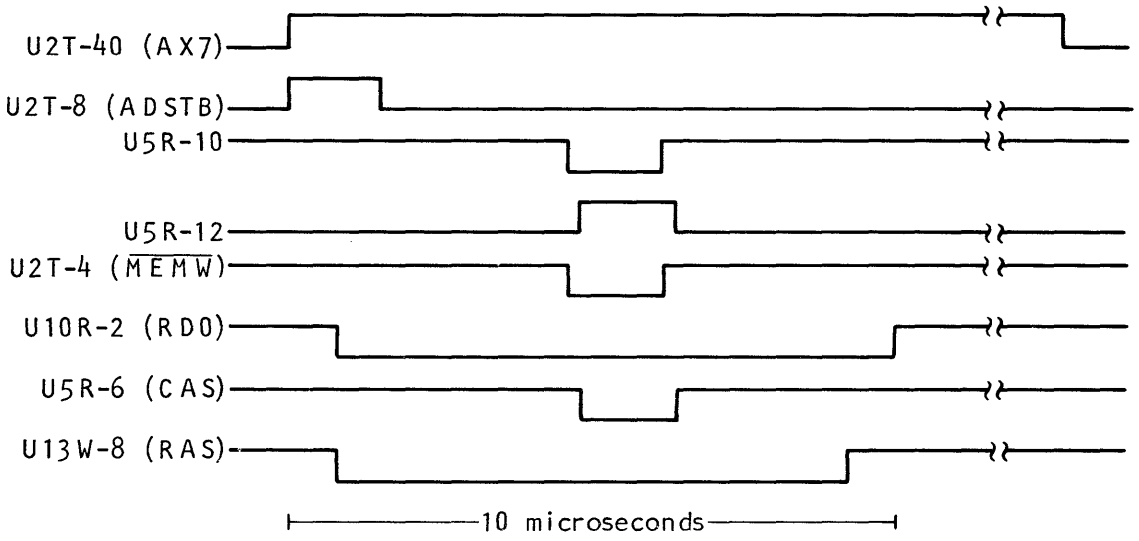


Figure 3-4. Service Aid 42 Sequence Timing

3-28. **Service Aids (Tape Loaded).** Service aids with tape in the unit are described in the following subparagraphs.

NOTE

The tape loaded service aids cannot be initiated if the tape-in-path sensor is faulty. Refer to paragraph 3-24 for detection of a faulty tape-in-path sensor.

3-29. **Service Aid 21.** This service aid is intended for adjustment of the read threshold and is usually required only when changing the head assembly or the main PWB. A good quality tape, with the write enable ring installed, should be loaded prior to entering this service aid. While observing the front panel indicators, adjust R109 until three (3) or more LED's are flashing and no LED's are ON constantly. Refer to paragraph 4-17 for detailed adjustment procedure and cautionary notes. If a write-protected tape is used, an error 6 will result. No tape action will be allowed until a write-enable ring is installed.

3-30. **Service Aid 22.** This service aid cycles the tape in both forward and reverse directions simulating the tape motion requirements of interface commands. The formatting and data circuits are not active during this service aid. Tape travel in the forward direction is always greater, and, when the tape reaches the EOT marker, the unit will rewind and repeat the sequence. When the service aid is exited, the tape will rewind if not at BOT.

3-31. **Service Aid 23.** This service aid activates the read circuits and the write circuits using the sequence described for Service Aid 12. Press LOAD, UNLOAD, or ONLINE to select 1-byte, 40-byte, or 32K-byte records, respectively. Selecting the block size initiates forward tape motion. An approximate 8 second delay will occur before forward tape motion is observed. This delay is required to sequentially load and verify all 0's into each of the nine 64K-byte cache RAMs prior to tape motion.

Press HI DEN to stop tape motion. Press HI DEN a second time for reverse tape motion. The HI DEN indicator illuminates to indicate reverse tape motion. Reverse motion inhibits the write function and read only is active. If the tape used is file protected, previously recorded data can be read in both forward and reverse directions. The EOT marker inhibits forward tape motion and BOT inhibits reverse. The 3200 CPI CTU will operate in the high density mode during this service aid (50 ips) when high density is selected (HI DEN indicator illuminated) before the service aid is entered. When the service aid is exited, the tape can be rewound to BOT by pressing LOAD/REWIND.

TRANSPORT ERROR CONDITIONS

3-32. Error conditions, other than those that would be indicated during PUST, may occur while operating the CTU. Those normally caused by the tape or operator (Operator Error Codes) are discussed in Section II, paragraph 2-6. The Transport Error Codes are machine malfunctions which indicate a serious deviation from the normal operating routine of the CTU. Each error code is represented by a unique binary pattern on the front panel indicators which flash to alert the operator. These faults inhibit the CTU and require correction by a service technician. They can be cleared only by turning the power off.

3-33. Table 3-6 is a quick descriptive list of the operator and transport errors which are explained in detail on Table 3-7. Refer to Table 3-7 for an explanation of the error conditions and some actions to take to correct the problem (1 designates a double-flashing indicator; 0 designates off). Some errors indicated during operation may, in turn, cause a PUST failure. In that case, the troubleshooting steps must begin with the PUST failure.

3-34. Data recovery example is given immediately after Table 3-7. **Data recovery must occur prior to Rewinding (IREW) or Rewinding/Unloading (IRWU).**

3-35. Table 3-8 is a list of mnemonics and their definitions.

Error	Code No.	Error Type
3	Tape length greater than 3700 feet for 1-mil tape	Med 2
4	Arm out of limits during autoload	Hard
5	Sequence error, Read forward, internal status self-check fault	Med 1
6	Write/Erase to file-protected tape	Soft
7	Illegal command on interface	Soft
8	Unexpected done status in structure; internal status self-check fault	Med 1
9	Indicates that take-up hub cleaning is necessary	Hard
10	Write Edit error, edited length greater than original length	Med 2
11	Excessive retries - Write fault	Med 2
12	Indicates that tape is still in path	Hard
13	Illegal status found in structure; internal status self-check fault	Med 1
14	18 feet past EOT	Med 2
15	Excessive block length, greater than 32 KB	Med 2
16	Sequence error, Read reverse, internal status self-check fault	Med 1
17	Operational arm fault	Hard
18	Tape speed variation greater than ±10%	Med 1
19	Vertical parity error on retries	Med 2
20	DMA failure or no start of block	Med 1
21	Write fault, excessive retries on write filemarks	Med 2
22	EOT mark location out of tolerance (switch U3T - 1 option)	Med 2
*23	Load - no tape or hub seat failure	Soft
	Unload - hub not locked, too much slack tape	Soft
	Manual load - reel seat/file-protect sensor failure	Med 1
24	Cache RAM parity error or transfer rate mismatch at the interface	Med 1
25	Not enough tape on takeup reel for manual load	Soft
26	Tape stuck on the supply reel during autoload	Soft
27	Door interlock check	Soft
28	Servo failure or hub is jammed during manual load	Soft
29	Reel upside down during load or failure to get tape into tape path during autoload	Soft
30	Undetected BOT marker within the first 35 feet of tape. Minimum leader length must be 6 feet.	Soft
31	Autoload failure after 4 retries, check tape end	Soft

Table 3-6. Error Type Description

*Error code 23 is a **multi-error** type.

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
6	01100	The CTU received a write or erase command for a file-protected tape.	1. Possible host system failure. 2. Check that write-enable ring is removed from tape reel. 3. Check file-protect circuit with Service Aid 31. 4. Check interface logic with Service Aid 21.
7	11100	An illegal or undefined command was received by the CTU.	1. Possible host system failure. 2. Check interface logic for floating or grounded inputs.
23	11101	No tape or hub seat failure during autoload.	1. Insert a tape reel into the transport. 2. Make sure tape is properly seated.
23	11101	Hub not locked, too much slack tape during autoload.	1. Insert a tape reel into the transport. 2. Make sure tape is properly seated.
25	10011	Not enough tape on take-up reel for manual load.	1. A minimum of five wraps is required.
26	01011	Tape stuck on the supply reel during autoload	1. Tape end did not peel off of reel. Remove antistatic tape/foam block if used. 2. If caused by static charge buildup, refer to MANUAL load instructions.
27	11011	Door interlock check.	1. Close front panel door or top cover.

Table 3-7A. Soft Error Definitions

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
28	00111	Servo failure or hub is jammed during manual load.	1. Remove and re-insert tape reel to clear. 2. Possible belt crank failure.
29	10111	Tape reel was inserted upside down or failure to get tape into tape path during autoload.	1. The bottom of the tape reel is identified by the write-enable ring groove or the write-enable ring (when installed) near the inside mounting circumference.
30	01111	The BOT marker was not detected within the first 35 feet of tape.	1. Check tape for BOT marker. 2. Use Service Aid 22 to check BOT sensor.
31	11111	After four attempts, the CTU did not successfully complete the load sequence. Check tape end.	1. The tape leader should be checked for excessive damage or static charge buildup. 2. If a second attempt at autoloading fails, refer to Manual load instructions.

Method for Soft Error Recovery/Action			
Interface	Result When Unit is OFF-LINE	Result When Unit is ON-LINE	Operator Action
The CTU will go off-line.	Any front panel action--LOAD, UNLOAD, ON-LINE or power off--is allowed by the CTU.	The CTU goes off-line; the interface is inactive. Any front panel action is allowed by the CTU.	Allowed to go on-line.

Table 3-7A. Soft Error Definitions (Cont'd)

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
5	10100	Sequence error: read forward internal status self-check fault.	
8	00010	Unexpected done status in structure; internal status self-check fault.	1. Note host command sequence: operating system program, version, release, etc. 2. Contact factory.
13	10110	Illegal status found in structure. Internal status self-check fault.	
16	00001	Sequence error: read reverse internal status self-check fault.	
18	01001	Tape speed variation in excess of the ANSI maximum of ±10%.	1. Check servo operation with Service Aid 11. 2. Check tachometer operation using Service Aid 11.
20	00101	DMA failure. Word count not at 0 after timeout.	1. Verify that PUST test 7 is successfully completed. 2. Check DMA and cache address/data lines using Service Aid 42.
23	11101	Reel seat/file-protect sensor failure during **manual** load.	1. Check if file-protect or hub seat sensor are working properly.
24	00011	Parity error during Cache RAM refresh cycle. Generally, host cannot sustain throughput at present speed setting.	1. Check for "soft" RAM fault: cycle power to force power-up check. 2. Check cache RAM with PUST test 7. 3. Rerun host program.

Table 3-7B. Medium 1 Error Definitions

Method for Medium I Error Recovery/Action			
Interface	Result When Unit is OFF-LINE	Result When Unit is ON-LINE	Operator Action
IHER is latched and the tape remains tensioned.	Front panel LED's are flashing; all switches are inoperative.	The flashing front panel LED's allows: rewind from host, or rewind/unload from host, read data recovery from cache prior to rewind, read extended status.	Cycle power to reset.

Table 3-7B. Medium I Error Code Definitions (Cont'd)

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
3	11000	The CTU detected more than 3700 feet of tape.	1. Try a different reel.
10	01010	Write Edit failure.	1. New block size greater than original. 2. Re-check block size.
11	10010	The number of write retries exceeded 16.	1. Try a different tape. 2. Check write circuits using Service Aids 12 (no tape in unit) or 23 (tape loaded). 3. Check read circuits using Service Aid 23 (tape loaded).
14	01110	Tape travel beyond the EOT marker exceeded 18 feet.	1. Possible host system failure. 2. Check interface logic with Service Aid 21. 3. Check EOT/BOT circuit using Service Aid 32. 4. Ensure that EOT marker on tape is properly placed.
15	11110	Data block exceeded maximum block size allowed (32 KB).	1. Possible host system failure (write operation). 2. Check ILWD interface input logic for a floating condition.
19	11001	Vertical parity error on retries.	1. Check write and read circuits using Service Aid 23 (tape loaded).

Table 3-7C. Medium 2 Error Definitions

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
21	10101	Excessive retries on write filemarks.	1. Readjust read threshold using Service Aid 21 (tape loaded). 2. Check write formatter circuits with Service Aid 13 tape unloaded, not file protected and writing 40-character blocks (press UNLOAD after test entry).
22	01101	Early EOT marker encountered (switch U3T-1 option).	1. EOT marker located greater than 25 feet prior to actual EOT. 2. Relocate EOT marker.

Method for Medium 2 Error Recovery/Action			
Interface	Result When Unit is OFF-LINE	Result When Unit is ON-LINE	Operator Action
IHER is latched and the tape remains tensioned.	Front panel LED's are flashing and all switches are inoperative.	The flashing front panel LED's allows: rewind from host, rewind/unload from host, read data recovery from cache prior to rewind, read extended status.	Cycle the power, rewind or unload.

Table 3-7C. Medium 2 Error Definitions (Cont'd)

ERROR CODE NO.	BINARY DISPLAY	CONDITIONS	ACTION
4	00100	Compliance arm circuit voltage level is out of tolerance during the autoload sequence.	1. Ensure that tape is properly wrapped around take-up hub. 2. Check compliance arm operation with Service Aid 24.
9	10010	Indicates that take-up hub cleaning is necessary.	1. Cycle power. 2. Call Technician.
12	00110	Indicates that tape is still in path.	1. Run Service Aid 21.
17	10001	Operational arm fault.	1. Cycle power. 2. Call Technician.

Method for Hard Error Recovery/Action			
Interface	Result When Unit is OFF-LINE	Result When Unit is ON-LINE	Operator Action
IHER is latched and the tape remains tensioned.	Front panel LED's are double flashing and all switches are inoperative.	The double flashing front panel LED's allows: read data recovery, read extended status before the power is cycled.	Cycle power to reset.

Table 3-7D. Hard Error Definitions

DATA RECOVERY EXAMPLE

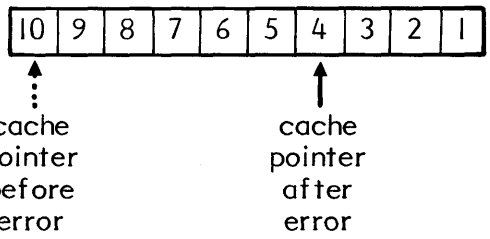
NOTE

Data recovery must occur prior to Rewinding (IREW) or Rewinding/Unloading (IRWU).

a. The host is writing records to CTU thru interface: ten (10) records are sent.

b. Error code #11 occurs while attempting to fix record #4 to tape.

c. The results are following:

From the host into cache 

d. The cache pointer is returned to the first unfixed record in cache . Any read or search command is legal. The normal recovery is by forward read, IHER resets sometime prior to IDBY going through. IHER will latch again if the unfixed records' boundary is crossed on either end.

TERM	IN/OUT	NAME	DEFINITION
Z1 - A0	I	IFEN	Formatter enable (not used)
A1	I	IGOT	Formatter command pulse detected
A2	0	IHER	Hard error
A3	0	ICER	Correctable error
A4	I	MERR	Memory parity error
A5	0	FWD/$\overline{\text{REV}}$	Formatter control
A6	I	PERR	Parity error
A7	0	IFMK	EOF detected
Z1 - B0	N/C		
B1	0	IDENT	ID burst at BOT
B2	0	IOENAB	Enable I/O at interface
B3	0	$\overline{\text{FMTRD}}$	Enable read transfer from formatter
B4	0	FIOCLK	Formatter interface clock
B5	I	$\overline{\text{POSTERR}}$	Postamble error
B6	N/C		
B7	I	$\overline{\text{POSTDET}}$	Postamble detect
Z1 - C0	O	$\overline{\text{W2XCLK}}$	Write logic 2X clock
C1	0	FRC2	Write state control 2
C2	0	FRC3	Write state control 3
C3	0	ENB 40 CNT	Enable 40 state counts (for FMK, Pre/Postamble)

Table 3-8. I/O Definitions (CIO)

TERM	IN/OUT	NAME	DEFINITION
Z2 - A0	I	$\overline{\text{RDROP 7}}$	Read after write channel drop detected
A1	I	$\overline{\text{RDROP 6}}$	"
A2	I	$\overline{\text{RDROP 5}}$	"
A3	I	$\overline{\text{RDROP 4}}$	"
A4	I	$\overline{\text{RDROP 3}}$	"
A5	I	$\overline{\text{RDROP 2}}$	"
A6	I	$\overline{\text{RDROP 1}}$	"
A7	I	$\overline{\text{RDROP 0}}$	"
Z2 - B0		$\overline{\text{RDROP P}}$	Read after write channel drop detected
B1	I	DOPEN	Door open (lid or front)
B2	I	HLOCK	Hub lock
B3	0	DLOCK	Door lock
B4	0	BLK	Block detect (read data)
B5	I	PHASE 2	Tach (pos'n interrupt)
B6	I	TIP	Tape in path
B7	0	MENAB	Motor enable (relay drive)
Z2 - C0	0	$\overline{\text{REFRESH}}$	Refresh DMA request
C1	0	$\overline{\text{PEN}}$	PE enable (read formatter)
C2	0	$\overline{\text{BLOWER}}$	Blower on
C3	I	$\overline{\text{VRCERR}}$	Vertical parity error

Table 3-8. I/O Definitions (CIO) (Cont'd)

TERM	IN/OUT	NAME	DEFINITION
Z3 - A0	I/O	LOAD	
A1	I/O	UNLOAD	
A2	I/O	ON-LINE	Front panel
A3	I/O	TEST	
A4	I/O	$\overline{\text{HIDEN}}$	
A5	0	M30	Minus 30 volt servo rail
A6	0	P30	Plus 30 volt servo rail
A7	0	$\overline{\text{MTREN}}$	Motor enable, supply & take-up
Z3 - B0	0	$\overline{\text{WHD}}$	Write head current
B1	I	TACH PULSE 0	
B2	I	$\overline{\text{EHD}}$	Erase head current
B3	I	01	Tach count enable
B4	0	HDEN	High density write select
B5	I	TACH PULSE 1	
B6	I	FPTTAB	File protect, hub seated sense
B7	I	PHASE 1	Tach count enable
Z3 - C0	0	DADR0	ADDRESS 0, D/A - A/D Converter
C1	0	DADR1	ADDRESS 1, D/A - A/D Converter
C2	0	DADR2	ADDRESS 2, D/A - A/D Converter
C3	0	$\overline{\text{DADREN}}$	D/A sample hold enable

Table 3-8. I/O Definitions (CIO) (Cont'd)

U6W PULSE No.	U6V INPUT		
0 -	AD0.....	IFBY	FORMATTER BUSY
	AD1.....	IRDY	TAPE DRIVE READY
	AD2.....	IDBY	DATA BUSY
	AD3.....	IFPT	FILE PROTECT
	AD4.....	ILDP	LOAD POINT (at BOT)
	AD5.....	IEOT	END OF TAPE
1 -	..... SET ON-LINE		
2 -	..... CLEAR REWINDING		
3 -	..... SET REWINDING		
4 -	..... CLEAR OFF-LINE		
5 -			
6 -	..... IGO TRANSITION LATCH CLEAR		
7 -	..... CLEAR DMA REQ. FOR FORMATTER READ, SET FOR WRITE		

Table 3-8. I/O Definitions (CIO) (Cont'd)

SECTION IV

MAINTENANCE

GENERAL

4-1. This section contains periodic maintenance information and adjustment procedures. Table 4-1 presents the preventive maintenance schedule.

CTU POSITIONS FOR SERVICING

CAUTION

When CTU is to be extended on slides from equipment rack, ensure that rack is mounted securely. Weight of CTU in extended position could upset an inadequately anchored equipment rack.

4-2. **Operator Maintenance Access (See Figure 4-1).** To gain access to the tape path area for routine cleaning, proceed as follows:

a. Switch CTU power off.

b. Withdraw drive on its slides until locks engage.

c. Open top cover by lifting sides directly behind front panel. Place cover stay in slot provided.

d. Perform required maintenance.

e. To return drive to operating position, close top cover.

f. Release slide locks and push unit back into equipment rack.

g. Switch CTU power on.

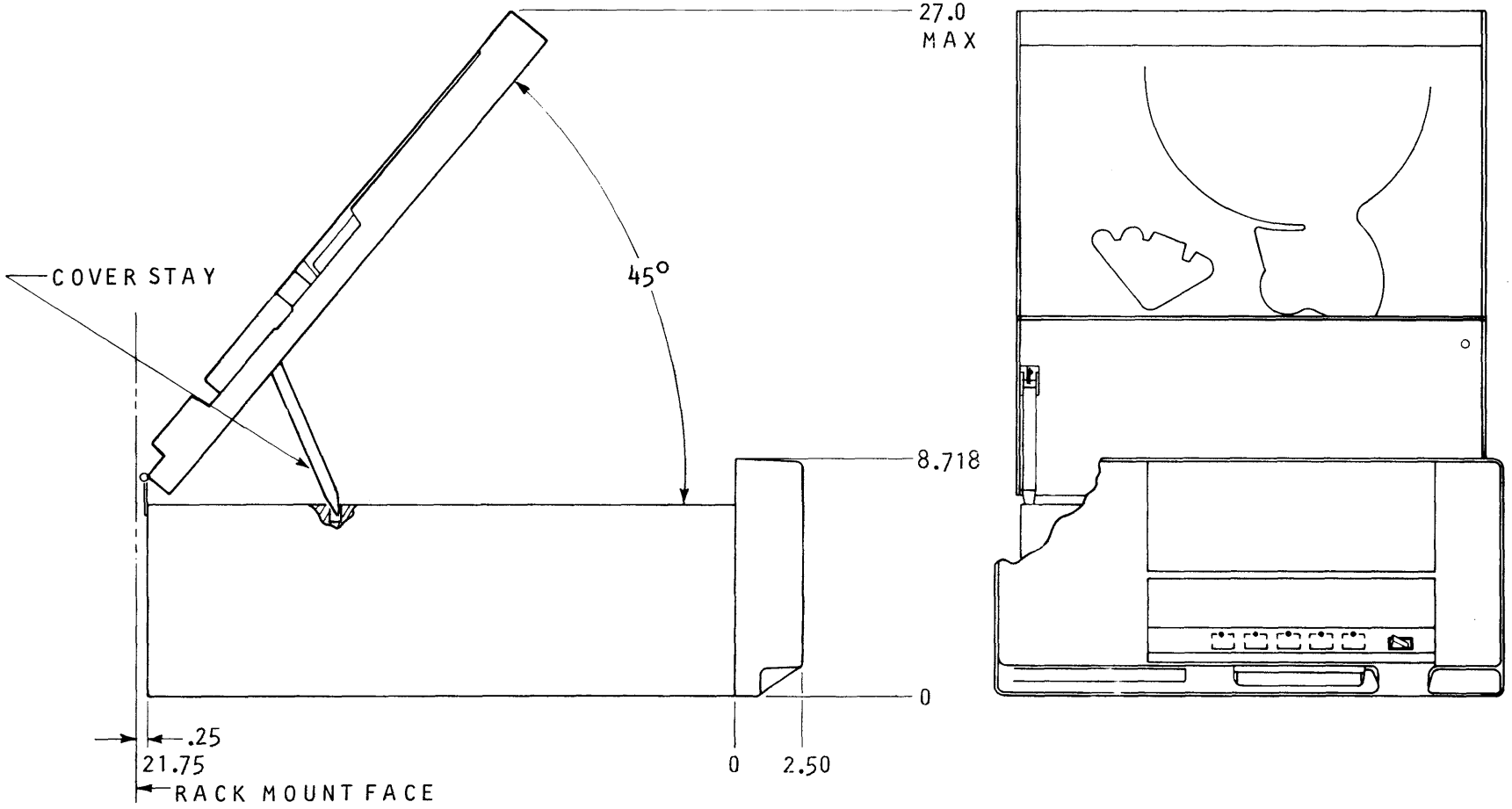


Figure 4-1. Operator Maintenance Access Position

4-3. **Service Access (See Figure 4-2).** To gain access to the main PWB and other internal components, proceed as follows:

a. Switch CTU power off.

b. Place drive in operator maintenance access position. (Refer to paragraph 4-2.)

c. Using a screwdriver, loosen two captive screws located at front sides of top plate casting.

d. Close top cover.

e. Grasping two lower corners of front panel, lift front panel to its maximum upright position. Lower slowly (about one inch) until the top plate support latch engages.

f. Insert the safety pin provided through both holes in the top plate support.

g. Perform required maintenance.

h. To return drive to operating position, remove the safety pin.

i. Lift front panel to its maximum upright position and lower smoothly to horizontal position.

j. Reverse steps a through d.

OPERATOR PREVENTIVE MAINTENANCE

4-4. For routine cleaning, place the CTU in the operator maintenance access position. Figure 4-3 identifies by number the locations of items that require routine cleaning. The recommended cleaning materials are:

a. Lint-free, Non-abrasive Cloths

b. Solvent Resistant Swabs

c. Tape Drive Cleaner (Freon TF)

NOTE

Items a through c are available as Cipher Part No. 960855-001, Tape Drive Cleaning Kit. Do not use alcohol as cleaning agent.

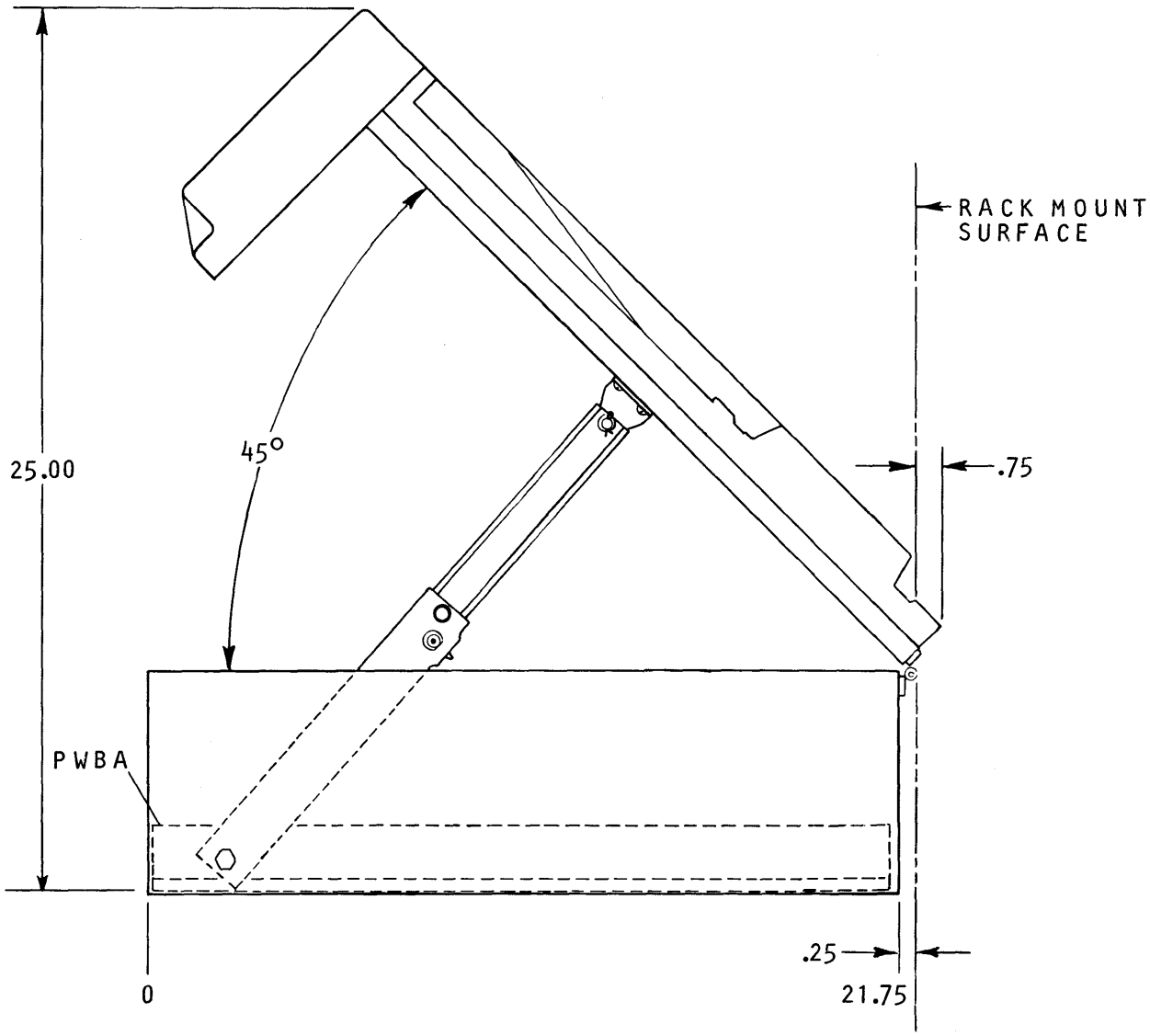


Figure 4-2. Service Access Position

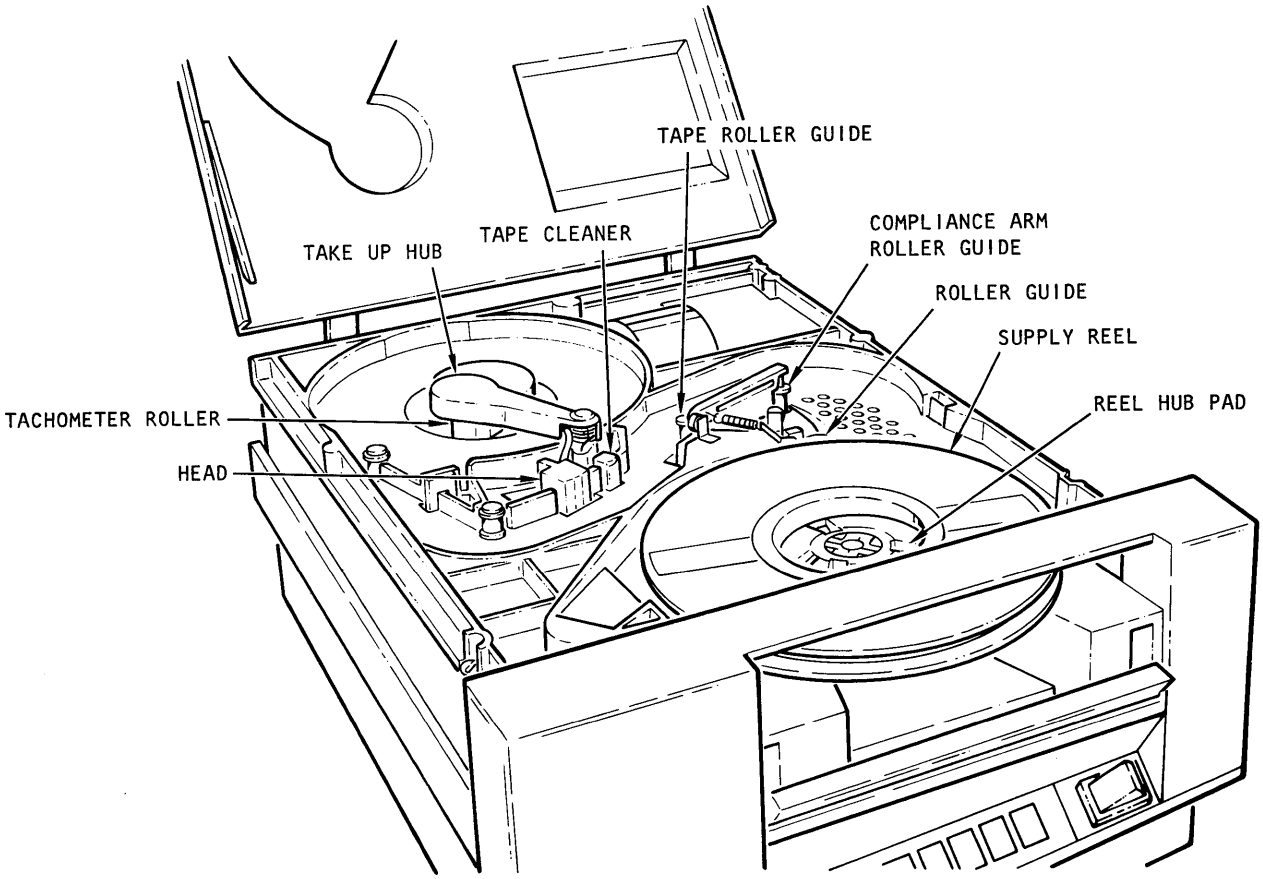


Figure 4-3. Tape Path and Related Parts

MAINTENANCE OPERATION	FREQUENCY (HOURS)	QUANTITY TO MAINTAIN	PROCEDURE PARAGRAPH
Operator			
Tachometer Roller	40*	1	4-5
Take Up Hub	40*	1	4-6
Roller Guides	40*	5	4-7
Reel Hub Pads	40*	3	4-8
Head	20*	1	4-9
Tape Cleaner	40*	1	4-10
Front Panel and Door	As Required	1	4-11
Top Plate Casting	As Required	1	4-12
Filter	1000	1	4-13
Service Technician			
Replace Reel Motors	5000	2	4-40 4-44

*The above frequency schedule should be observed or performed weekly, whichever is sooner.

Table 4-1. Preventive Maintenance Schedule

CAUTION

Do not apply a cleaner directly from the container to the surface to be cleaned, even though instructions on the container may indicate to do so. Always apply the cleaner to a swab or wipe first, carefully removing any excess. The tachometer roller and roller guides contain precision bearings. Solvents allowed to run into the bearings will break down the lubricant.

4-5. **Tachometer Roller (Figure 4-3).** Use a swab moistened with tape path cleaner. Gently wipe the entire roller surface. The roller can be rotated by manually turning the take-up hub slowly.

4-6. **Take-Up Hub (Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Rotate the hub manually while gently wiping the tape wrapping surface.

4-7. **Roller Guides (Figure 4-3).** Use a swab moistened with tape path cleaner. Rotate each roller and gently wipe the tape contact surface and flanges or washers.

4-8. **Reel Hub Pads (Figure 4-3).** Use a swab or wipe moistened with tape path cleaner. Wipe the contact surface of each pad and remove any debris around the pad.

4-9. **Head (Figure 4-3).** Use a swab or wipe moistened with head cleaner. Wipe the entire face of the head and attached erase bar, paying particular attention to the recessed areas.

CAUTION

Rough or abrasive materials can scratch sensitive surfaces of the head resulting in permanent damage. Other cleaners, such as alcohol based types, can cause read/write errors.

4-10. **Tape Cleaner (Figure 4-3).** Use a swab moistened with head cleaner. Wipe each blade along its length. Remove accumulated oxides from the recessed area between the blades.

CAUTION

Exercise care to avoid damage to sharp edges of tape cleaner blades.

4-11. **Front Panel and Door.** Use a wipe moistened with plastic cleaner.

4-12. **Top Plate Casting.** Use a wipe moistened with plastic cleaner. Referring to Figure 4-3, wipe away the oxide dust in the tape path area. Be careful not to get dirt on the head, rollers, etc. Avoid disturbing the sensors.

4-13. **Filter.** Locate and remove the filter from inside the air duct opening at the lower left of the front panel. See Figure 4-4. Clean the filter with low pressure compressed air, or vacuum, in the opposite direction of airflow and reinstall.

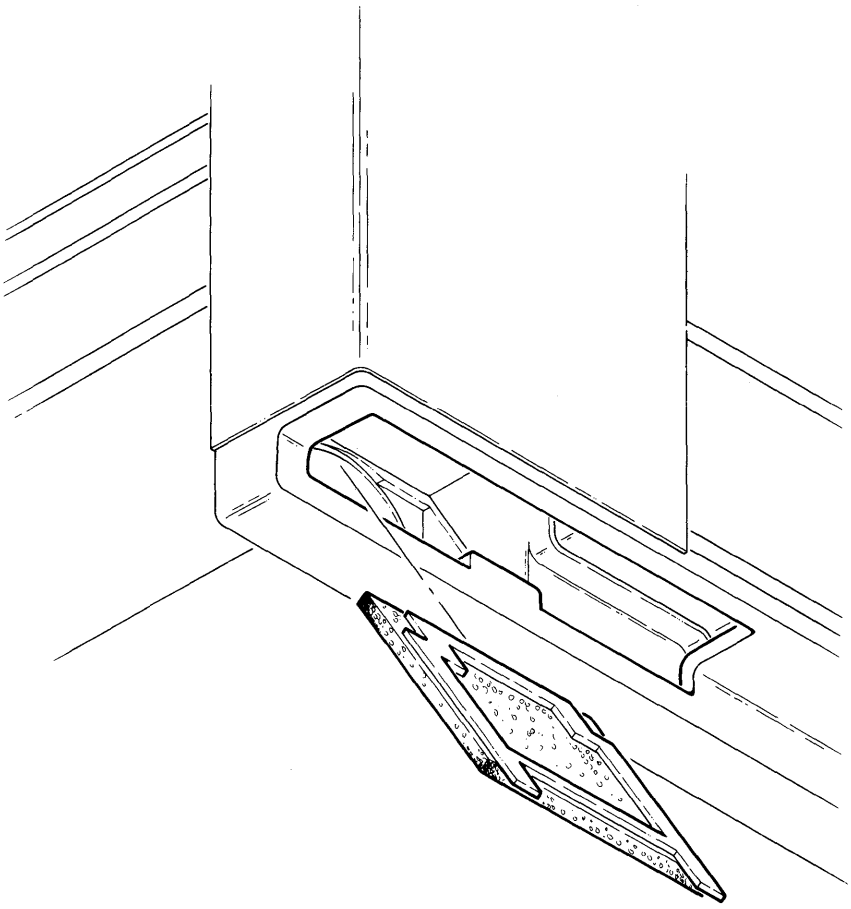


Figure 4-4. Air Filter Removal

SERVICE TECHNICIAN PREVENTIVE MAINTENANCE

4-14. **Reel Motors.** Replace both reel motors after 5000 hours of unit operation. Refer to paragraphs 4-40 and 4-44 for removal/replacement instructions.

CORRECTIVE MAINTENANCE

4-15. **Fuse Removal and Replacement.** To replace the fuse, proceed as follows:

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

a. Remove power cord from outlet.

b. Place the drive in service access position. Refer to paragrpah 4-3.

c. Locate fuse cap on power supply housing. Push and twist cap to remove.

d. For 100-120 volt operation, use a 3-ampere, slo-blo, 250V type fuse.

e. For 208-240 volt operation, use a 1-1/2 ampere, slo-blo, 250V type fuse.

f. Reverse steps a through c.

4-16. **Voltage Regulator Adjustment.** A minor adjustment of the +5V voltage regulator circuit may be required following repair of the power supply or main PWB's or replacement of a major assembly on the unit. To adjust the +5V regulator circuit, proceed as follows:

a. Place the drive in service access position. Refer to paragraph 4-3.

b. Switch power on and allow unit to warm-up.

c. Connect a voltmeter to TP81 and ground.

d. Adjust R312 for +5.25, +0.15/-0.05V.

e. Reverse steps a through c.

4-17. **Read Threshold Adjustment.** Adjustment of the read threshold level is required only when the head or main PWB is changed. Adjust read threshold as follows:

a. Place drive in service access position. Refer to paragraph 4-3.

b. Apply power to unit.

c. Load tape (write-enable ring must be installed).

NOTE

Use a National Bureau of Standards Reference Level Tape, or a certified tape that produces comparable read levels when compared with a National Bureau of Standards tape for this adjustment.

CAUTION

Do not use a library or removed tape for this adjustment because the tape used will be written on by the CTU.

d. Activate Service Aid 21. Refer to paragraphs 3-8 and 3-20.

e. Shield the LED indicators on the front panel from ambient light so that an accurate indication of ON, OFF or FLASHING can be observed.

f. Note the indication of the front panel LED's before attempting any adjustment.

g. If any three or more indicators are FLASHING with no indicator(s) ON steadily, NO ADJUSTMENT IS REQUIRED. Refer to step i.

h. If less than three indicators are FLASHING or any indicator(s) are ON steadily, adjust R109 for the indication in step g. R109 may require several turns (in either direction to find the correction adjustment point. If the correct adjustment point cannot be found, a fault in (a) making the adjustment, (b) the head assembly, or (c) main PWB is indicated.

i. Exit Service Aid 21 by pressing TEST.

NOTE

This adjustment is based on the amplitude characteristics of the tape used for the adjustment. Other tapes whose amplitude characteristics are different may not provide the same indication after the adjustment. This fact simply reflects the difference in tapes and is not a fault condition. The tolerance range of the adjustment takes into account the inherent differences between tapes that otherwise meet the ANSI X 3.40-1976 criteria.

j. Reverse steps a through c.

REPAIR AND REPLACEMENT OF PARTS AND COMPONENTS

4-18. The CTU is designed to operate over long periods of time without requiring corrective maintenance of any kind. Spare parts are available for replacement of parts and subassemblies which may have become damaged or worn through extremely long and/or hard usage. This section presents instructions for removal of defective parts and subassemblies from the transport and replacement with the parts available, as well as disassembly, assembly, and adjustment instructions where applicable, and a list of tools and special parts, Table 4-2.

Except as noted, subassemblies and parts which can be removed from above the top plate are indexed in Figure 4-5, while those which can be removed from beneath the top plate are indexed in Figure 4-6. Refer to the respective key lists of these figures for the names of the subassemblies and parts indexed on each. These lists also contain the figure numbers of the detail drawings, presented in this section, in which removal and/or disassembly of these subassemblies and parts are illustrated.

WARNING

To prevent severe electrical shock, remove power plug from power source before performing any servicing operation on transport.

ITEM	DESCRIPTION	CIPHER P/N
1	Hub height adjustment tool	760105-545
2	Skew monitor (IC clip assy.)	960067-001
3	Spring scale (for tension arm) 0-36 oz spring scale John Chatillon & Sons 83-30 Kew Gardens Rd. Kew Gardens, NY 11415	 Chatillon P/N LP36
4	Tape end cutter/crimper	209990-500
5	Vibratight (for adjustment screws)	209990-075
6	Torque seal (for screw heads)	209994-025
7	Loctite -222- adhesive	209990-072
8	Loctite 242	209990-074
9	Loctite -601- fast retaining compound	209990-076
10	Permabond - sealer (air duct)	209990-107
11	Lubriplate - bearing lubricant	210444
12	Master Skew tape (IBM)	799019-401
13	Tracking tape Pericomp Corp. 14 Huron Dr. Natick, MA 01760 (617) 237-4052	 970039-001

Table 4-2. Repair and Maintenance Tool/Parts List

The torque values for screws are below on Table 4-3.

Screw Size	Range (in/lbs)
4-10	3.7-5.2
6-32	5.5-7.5
10-32	17-19
For PWB's	2-3

Table 4-3. Torque Values for Screws

FRONT PANEL ASSEMBLY (1, Figure 4-5).

4-19. **Power Switch Replacement.** To replace the power switch (1, Figure 4-7), proceed as follows:

a. Remove power cord from outlet.

b. Position transport in service access position in accordance with instructions in paragraph 4-3.

c. Remove wire connectors from terminals of power switch in back of front panel, identifying each terminal as to the switch terminal from which it was removed.

d. Bend in tabs holding switch to panel, and push out of panel from back.

e. Place replacement switch in front panel, bend tabs in back of switch as necessary to fit tightly in panel, and reconnect wires as identified in step c.

f. Restore transport to operating position.

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-5	MODEL CTU TAPE TRANSPORT (Top View).....	REF	
-1	FRONT PANEL ASSEMBLY	4-7	4-21
-2	SUPPLY HUB ASSEMBLY	4-8	4-23
-3	HEAD ASSEMBLY.....	4-10	4-24
-4	ROLLER GUIDE ASSEMBLY.....	4-11	4-25
-5	EOT/BOT SENSOR ASSEMBLY.....	4-12	4-26
-6	TACHOMETER ASSEMBLY.....	4-13	4-27
-7	COVER ASSEMBLY	4-14	4-28
-8	TAKEUP HUB ASSEMBLY.....	4-15	4-29
-9	COMPLIANCE ARM ASSEMBLY	4-17	4-30
-10	TAPE-IN-PATH SENSOR, TRANSMITTER	4-18	4-32
-11	TAPE-IN-PATH SENSOR, RECEIVER	4-19	4-33
-12	COMPLIANCE ARM BUMPER ASSEMBLY.....	4-20	4-34
-13	ROLLER TAPE GUIDE ASSEMBLY (Solid).....	4-21	4-35
-14	FILE-PROTECT SENSOR.....	4-22	4-36

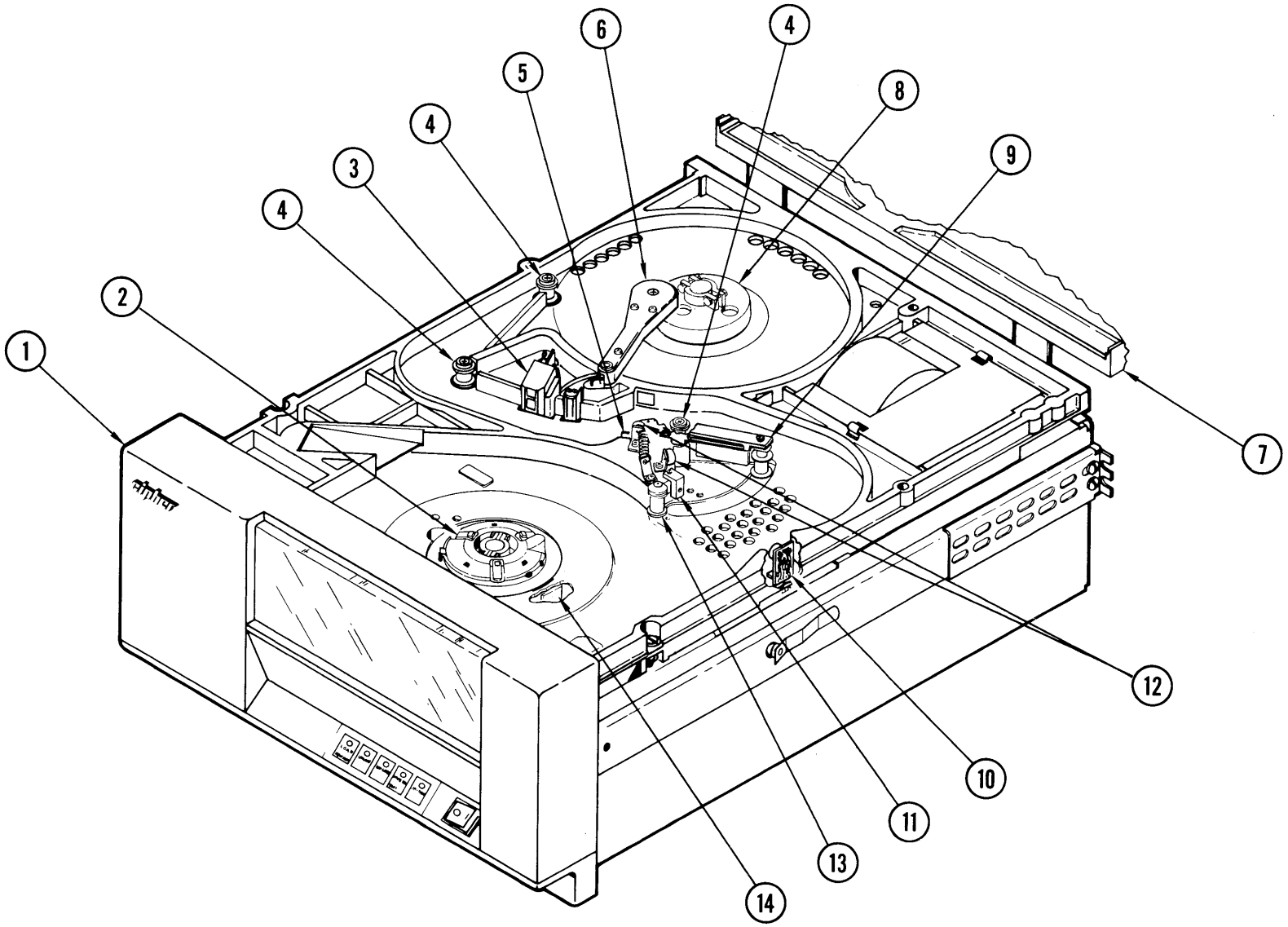


Figure 4-5. Model CTU Tape Transport (Top View)

FIGURE & INDEX NO.	DESCRIPTION	DETAIL FIGURE NO.	PROCEDURE PARAGRAPH NO.
4-6	MODEL CTU TAPE TRANSPORT (Bottom View) .	REF	
-1	DRIVE MAIN PWB ASSEMBLY	4-23	4-37
-2	POWER SUPPLY ASSEMBLY	4-24	4-38
-3	POWER SUPPLY PWB	4-25	4-39
-4	TAKEUP MOTOR ASSEMBLY.....	4-26	4-40
-5	AIR DUCT, top-plate	4-27	4-41
-6	AIR DUCT, front panel	4-27	4-42
-7	TUBE, air intake	4-27	4-41
-8	SUPPLY MOTOR ASSEMBLY	4-28	4-44
-9	AIR CAPACITOR ASSEMBLY.....	4-17	4-30
-10	HUB LOCK ASSEMBLY	4-29	4-45
-11	DOOR LOCK ASSEMBLY	4-30	4-48
-12	TRANSFORMER ASSEMBLY	4-31	4-49

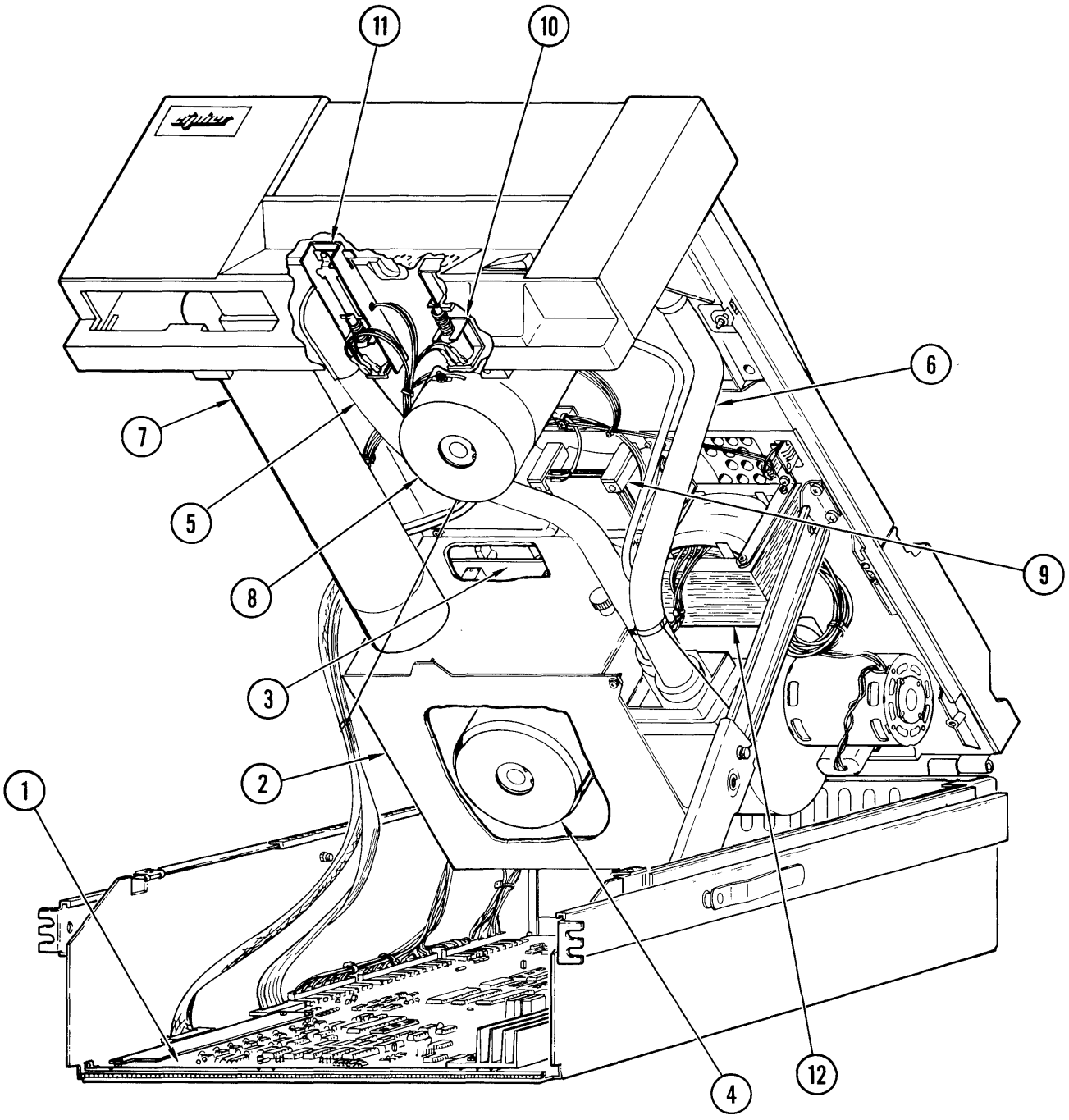


Figure 4-6. Model CTU Tape Transport (Bottom View)

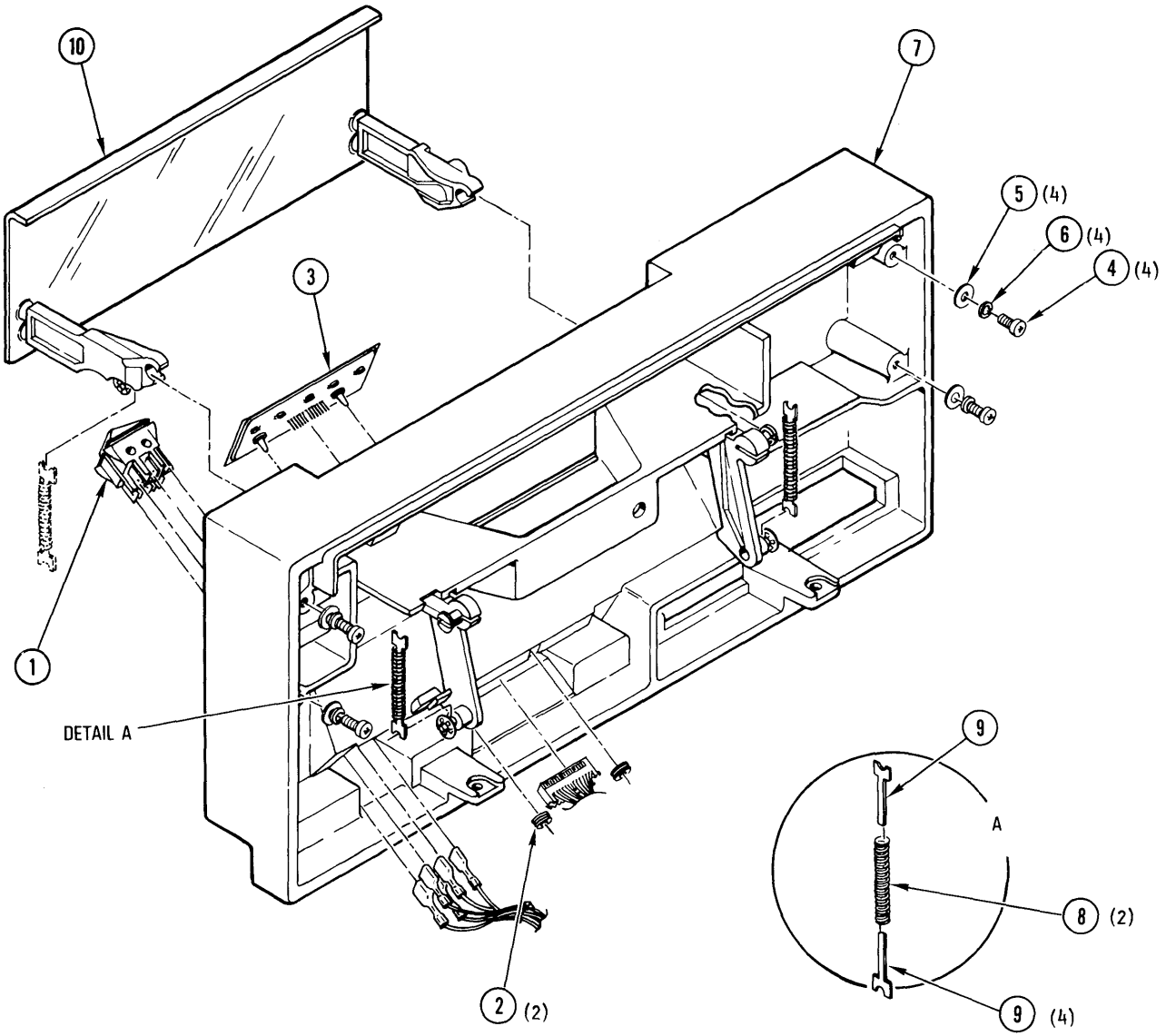


Figure 4-7. Front Panel Assembly

4-20. **Touch Switch Replacement.** To replace the touch switch (3, Figure 4-7), proceed as follows:

a. Position transport in service access position (paragraph 4-3).

b. Remove connector from switch in back of front panel, noting position of connector.

c. Remove grommets (2) from attachment posts of switch (3) and lift switch out of front panel.

d. Insert replacement switch in front panel, place grommets (2) on attachment posts, pressing down tightly against panel, and secure using Permabond.

e. Attach switch connector at back in same position as removed in step b (brown wire nearest power switch).

f. Restore transport to operating position.

4-21. **Front Panel Subassembly Replacement.** To replace the front-panel subassembly (7, Figure 4-7), proceed as follows:

NOTE

For purposes of this procedure, it is assumed that power switch (1), touch switch (3), and door assembly (10) are to be removed from discarded front panel subassembly and reused in replacement. If one or more of these items is also to be replaced, disregard instructions for removal of such items in this paragraph.

a. Position transport in service access position (paragraph 4-3).

b. Open front-panel door (10).

c. Remove four screws (4), lockwashers (5), and flat washers (6). Remove switch wire terminals and connectors attached to switches (1 and 3), noting position of each. Lift off entire front panel assembly.

NOTE

If air intake tube comes off with front panel, remove from front panel and set aside for reassembly.

d. Remove following parts and subassemblies from discarded front-panel subassembly (7) and replace in replacement front panel subassembly as follows:

(1) Power switch: refer to paragraph 4-19.

(2) Touch switch: refer to paragraph 4-20.

(3) Door assembly: refer to paragraph 4-22.

e. If air intake tube came off with front panel replace in front panel.

f. Attach complete front panel assembly to top plate with screws, washers, and lockwashers removed in step c. Ensure that gooseneck of front panel air duct is properly positioned (paragraph 4-42, step f).

g. Reconnect wires and connectors as identified in step c.

h. Restore transport to operating position.

i. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

4-22. **Removal And Replacement of Door Assembly.** To replace the door assembly (10, Figure 4-7), proceed as follows:

a. Remove front panel assembly from top plate in accordance with paragraph 4-21, steps a, b, and c.

b. Remove two springs (8) and four guides (9), and push door off the hinge points, using finger pressure on front of door at the arm. Remove the door through the front panel opening.

c. Install door assembly in front panel subassembly by snapping arms onto plastic studs of front panel assembly, as indicated in Figure 4-7.

d. Assemble guides (9) with springs (8), with flat surfaces of guides in contact with each other.

e. Reinstall assembled front panel assembly on top plate in accordance with paragraph 4-21, steps e-i.

f. Use Service Aid 32 to test door lock adjustment. Refer to paragraph 4-48, step j for adjustment procedure.

SUPPLY HUB ASSEMBLY (2, Figure 4-5).

4-23. **Removal, Replacement and Adjustment (Figure 4-8).** Place transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

a. Rotate hub assembly (1, Figure 4-8) so that socket-head screws face front panel door.

b. Open front-panel door and loosen socket-head screws (2).

c. Remove supply hub from reel motor shaft.

d. Install replacement hub on shaft, and position hub height gauge, Cipher Part No. 760105-545, as shown in Figure 4-9 so that it contacts the raised machined surface of the top plate. Raise the supply hub until the reference surface contacts the hub-height tool.

e. Ensuring that hub-height tool is in contact with both the top plate and reel hub, tighten socket-head screws (2).

f. Remove tool, restore transport to operating position, and load tape.

g. Run tape forward and reverse using Service Aid 23, noting tape position on reel for which replacement hub was installed. If tape is centered between sides of reel, adjustment is correct. If not, loosen socket-head screws and repeat steps d through g until positioning is correct.

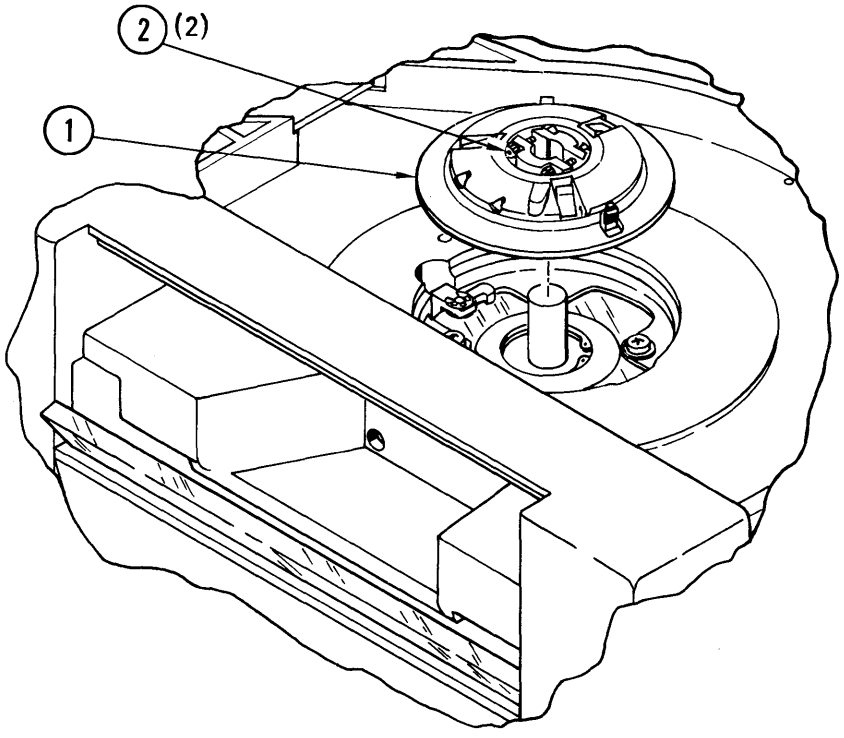


Figure 4-8. Supply Hub Assembly

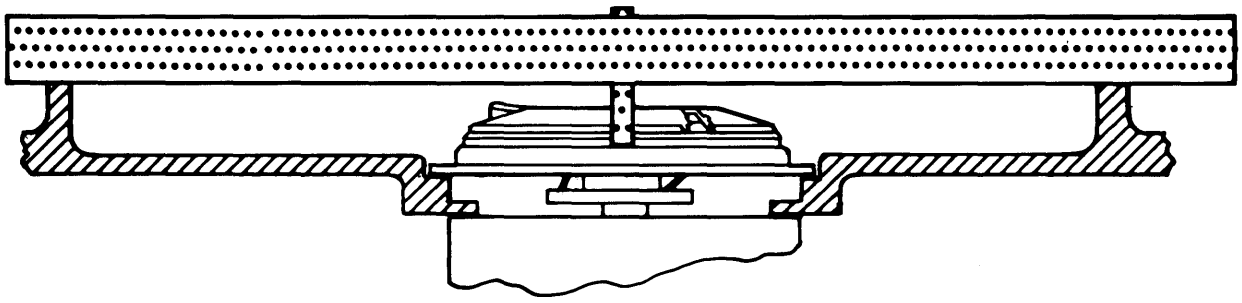


Figure 4-9. Supply Hub Adjustment

HEAD ASSEMBLY (3, Figure 4-5).

4-24. **Removal and Replacement of Assembly and Parts (Figure 4-10).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

NOTE

It is not necessary to remove complete assembly from top plate in order to remove tape scraper (13, Figure 4-10). Refer to this paragraph, step f. If head is defective and in need of replacement, entire head assembly (8), including tape scraper (13) must be replaced.

a. Remove head connectors from P6/P7 on main PWB and remove from cable retractor.

b. Working from under side of top plate, remove center adjustment screw (1), flat washer (2), four screws (3), and lockwashers (4), three flat washers (5), one flat washer (6), and cable clamp (7) supporting assembly (8) with one hand as last screw is removed. Identify wire terminal and cable clamp as to position from which removed, and save attaching parts for reinstallation.

c. Pull assembly (8) and wire harness carefully down through hole in top plate and cables over air intake tube.

d. Install replacement assembly in reverse order of sequence in steps b and c, carefully pushing head and connectors through hole in top plate and attaching wire terminal and cable clamp in positions from which removed. Do not tighten center adjustment screw (1) at this time.

e. Feed head connectors and cables through cable retractor and over air intake tube and install on J6/J7 on main PWB.

f. If tape scraper (13) only is to be replaced. remove two socket-head screws (12), nuts (9), lockwashers (10), and flat washers (11). Save attaching parts for reassembly, and install replacement scraper in reverse order of removal.

g. Adjust tape scraper (13) as follows:

(1) Insert and load a tape.

(2) Loosen socket-head screws (12) and move tape scraper away from tape.

(3) Slowly move tape scraper toward tape until it contacts tape.

(4) Rotate tape scraper until both scraper blades are touching the tape. producing two vertical creases in the tape at the points of contact.

(5) Verify that tape is touching erase bar. Check for vertical crease in tape at the point of contact.

(6) Tighten socket-head screws (12) and reverify that tape is in contact with both blades of tape scraper and the erase bar.

h. Perform tape alignment procedure, paragraph 4-50.

i. Place transport in operating position.

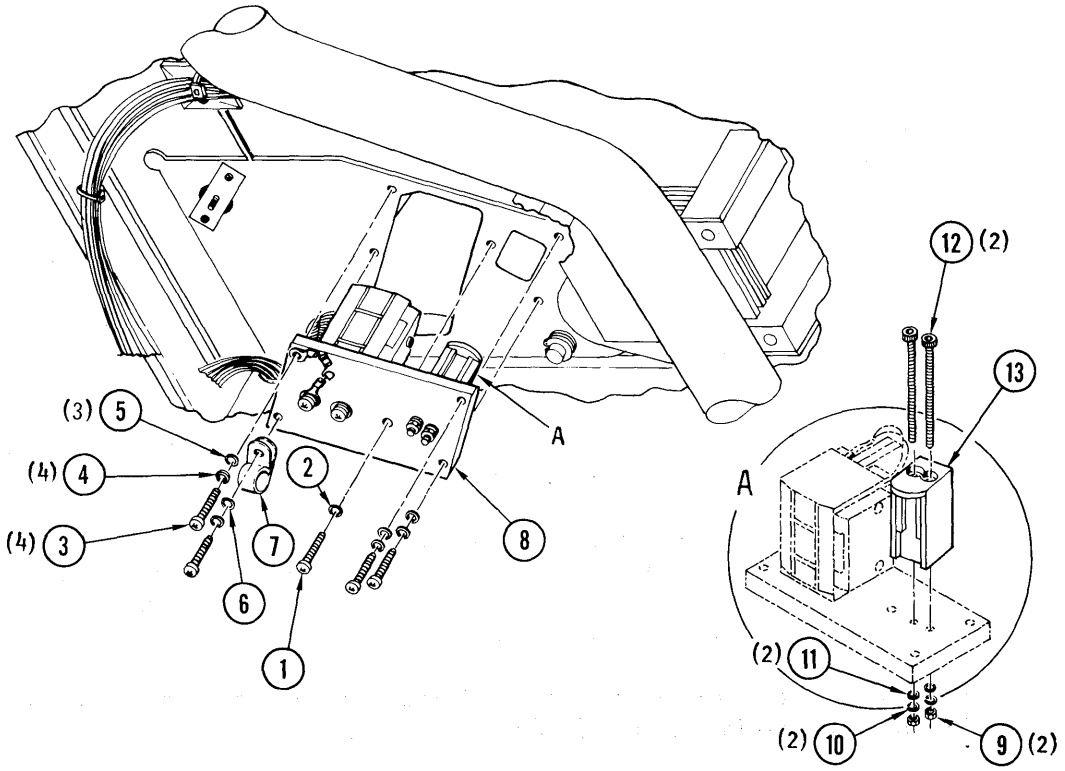


Figure 4-10. Head Assembly

ROLLER GUIDE ASSEMBLY (4, Figure 4-5).

4-25. **Removal and Replacement of Assembly (Figure 4-11).** Place the transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

a. Remove attaching screw (1, Figure 4-11), leaving shims (4) and spring (3) in place, remove roller guide assembly through top of top plate, saving attaching parts for reassembly.

b. Install replacement roller guide (2), using original attaching parts.

c. Perform tape alignment procedure, paragraph 4-50.

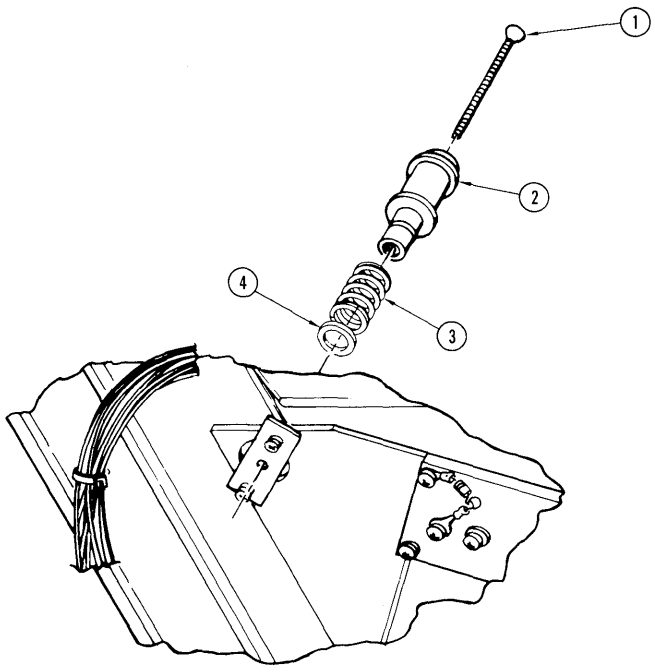


Figure 4-11. Roller Guide Assembly

EOT/BOT SENSOR ASSEMBLY (5, Figure 4-5).

4-26. **Removal and Replacement (Figure 4-12).** Place transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

a. Holding compliance arm aside to provide access to mounting screws, remove two screws (1, Figure 4-12) and lock washers (2) and retain for reassembly.

b. Remove EOT/BOT assembly (3), carefully pulling wires and connector (4) through hole in top plate assembly.

c. Unplug EOT/BOT assembly.

CAUTION

To prevent misalignment, avoid contact with sensors mounted on replacement EOT/BOT PWB. Sensors are factory-aligned for optimum output.

d. Attach plug removed in step c.

e. Feed wires and connector (4) carefully through hole in top plate assembly (refer to step b).

f. Attach EOT/BOT assembly loosely with screws (1) and lockwashers (2), position assembly as close to tape as mounting bracket will allow, with PWB parallel to casting wall directly behind it, and tighten screws.

g. Place transport in operating position.

h. Use Service Aids 22 and 23 to test EOT/BOT assembly.

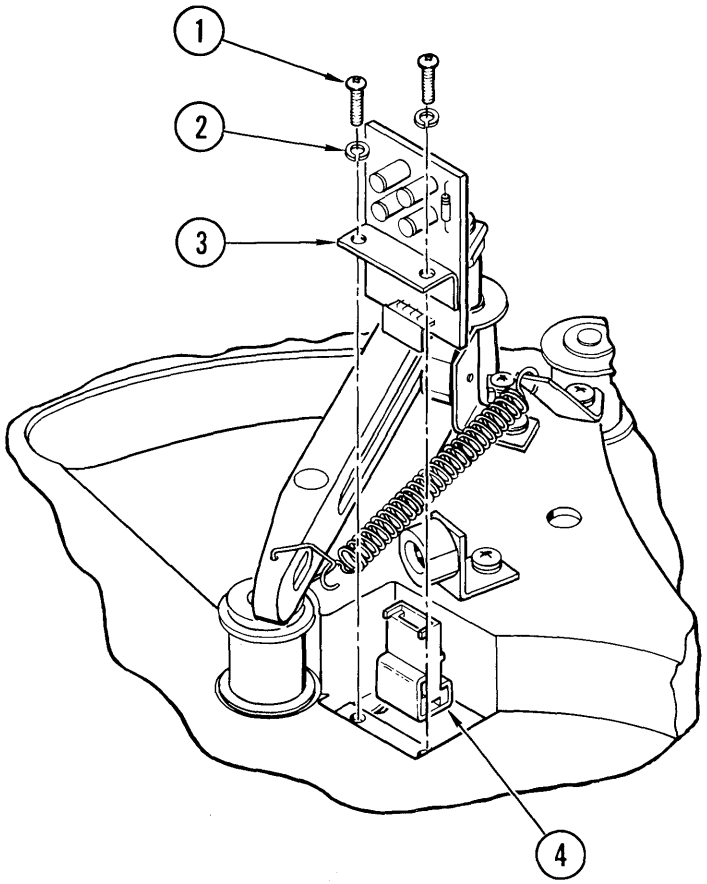


Figure 4-12. EOT/BOT Assembly

TACHOMETER ASSEMBLY (6, Figure 4-5).

4-27. **Removal and Replacement (Figure 4-13).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Disconnect tachometer wiring harness connector from mating connector beneath top plate.

b. Remove grip ring (1, Figure 4-13), wavespring washer (2), and shim(s) (3) from tachometer post beneath top plate and save for reassembly.

c. Remove tachometer assembly (6) from top plate, pulling wire harness and connector carefully through hole.

d. If lower bearing (4) or upper bearing (5) was removed, apply Loctite 601 sparingly to outside surface of replacement bearing before installing.

e. Install replacement tachometer assembly through upper bearing (5) and lower bearing (4), seating end of spring in adjacent small hole in top plate.

f. Install shim(s) (3), wavespring washer (2), and grip ring (1). If necessary, install additional shims (3) to compress wavespring half of its height when grip ring is installed.

g. Push connector and wire harness through top plate hole, and connect beneath top plate.

h. Place transport in operating position.

i. Use Service Aid 11 to test tachometer operation.

COVER ASSEMBLY (7, Figure 4-5).

4-28. **Removal and Replacement of Assembly and/or Parts (Figure 4-14).** Place the transport in operator maintenance access position (paragraph 4-2). Remove damaged cover assembly, subassemblies, and/or parts as necessary in the sequence of index numbers (Figure 4-14) assigned to the item and its attaching parts, saving attaching parts for use during reassembly if necessary, and install the replacement item in reverse sequence of removal. Observe the following special instructions:

a. When replacing catch (10) tighten screws just enough to hold and then try closing cover. If catch is too far forward and prevents cover from closing or is too far back to engage latch on front panel assembly, loosen attaching screws (8) and move catch forward or backward so that the cover closes and catch latches securely on front panel.

b. Restore transport to operating position.

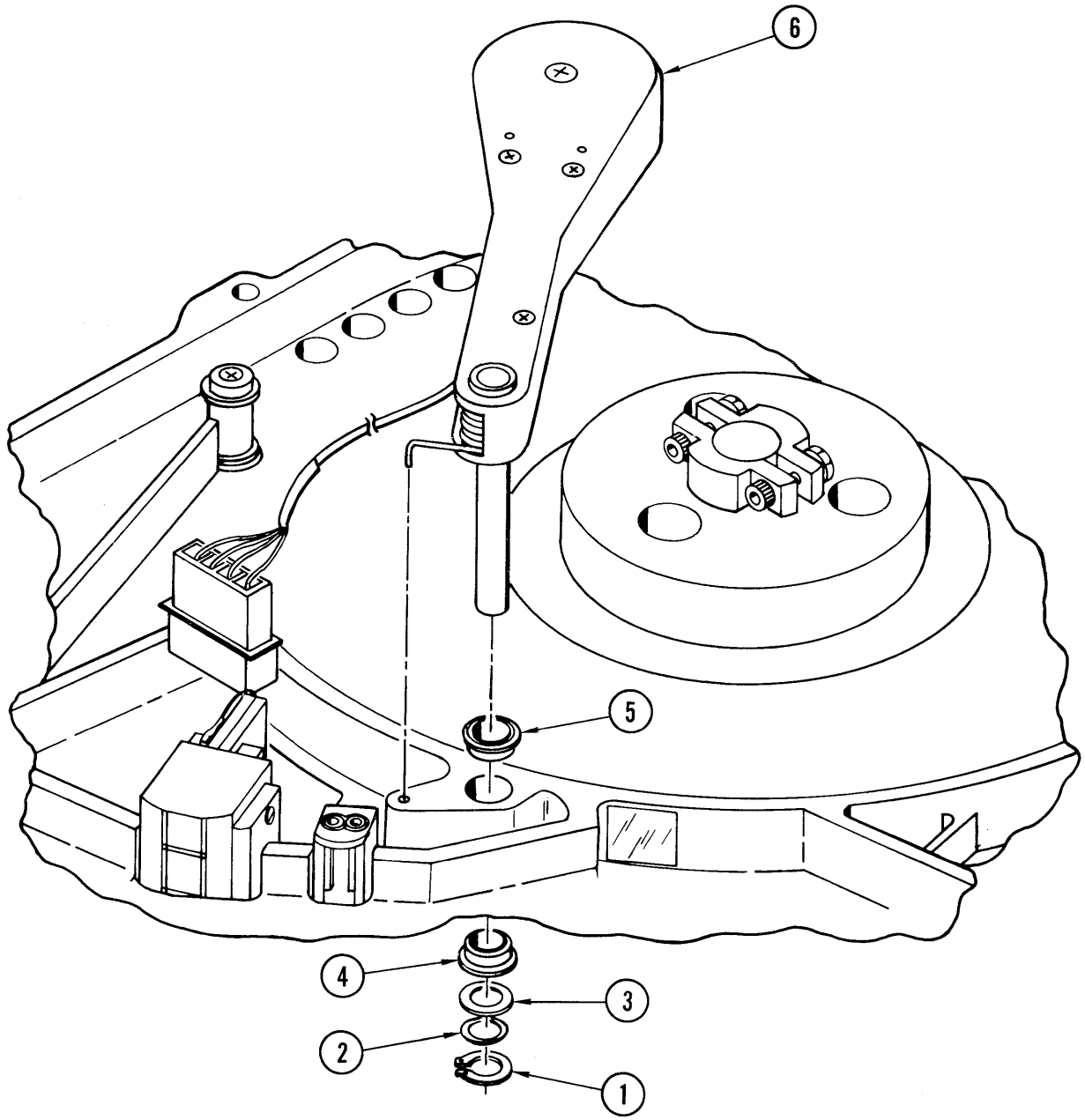


Figure 4-13. Tachometer Assembly

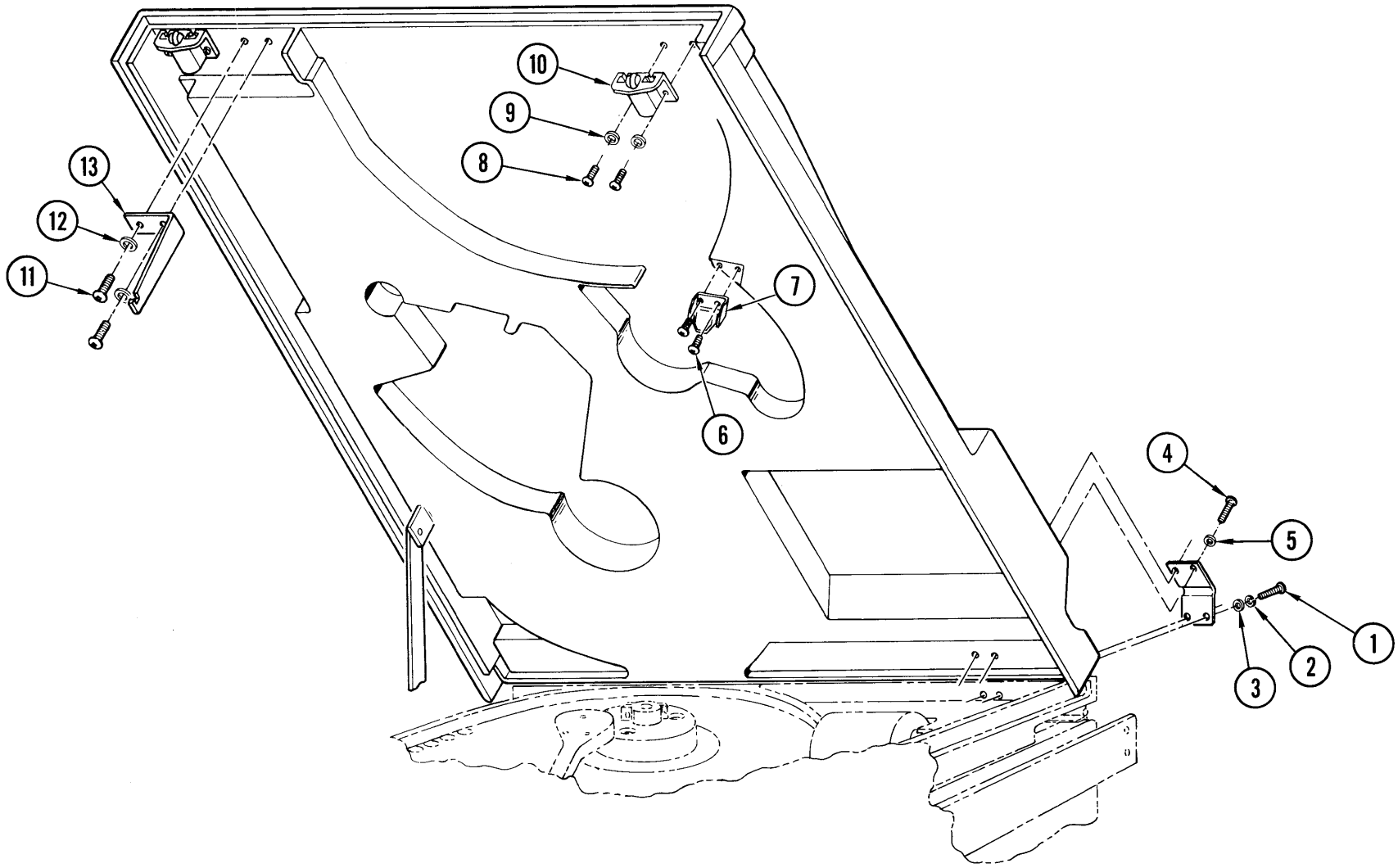


Figure 4-14. Top Cover Assembly

TAKEUP HUB ASSEMBLY (8, Figure 4-5).

4-29. **Removal, Replacement, and Adjustment (Figure 4-15).** Place the transport in operator maintenance access position (paragraph 4-2) and proceed as follows:

a. Secure tachometer assembly (1) away from the takeup hub.

b. Loosen socket-head screws (2, Figure 4-15) and remove hub (3).

c. Install replacement hub on shaft and position hub height gauge, Cipher part No. 760105-545, as shown in Figure 4-16.

d. Position hub on shaft so that hub height gauge is in contact with both the raised machined area of the top plate and takeup hub, and tighten socket-head screws (2).

e. Remove tool, carefully replace tachometer assembly against hub, restore transport to operating position, and load tape.

f. Run tape forward and reverse using Service Aid 23, noting tape position on replacement hub. If tape is centered on hub, adjustment is correct. If not, loosen socket-head screws (2) and repeat steps b through e.

g. Place transport in operating position.

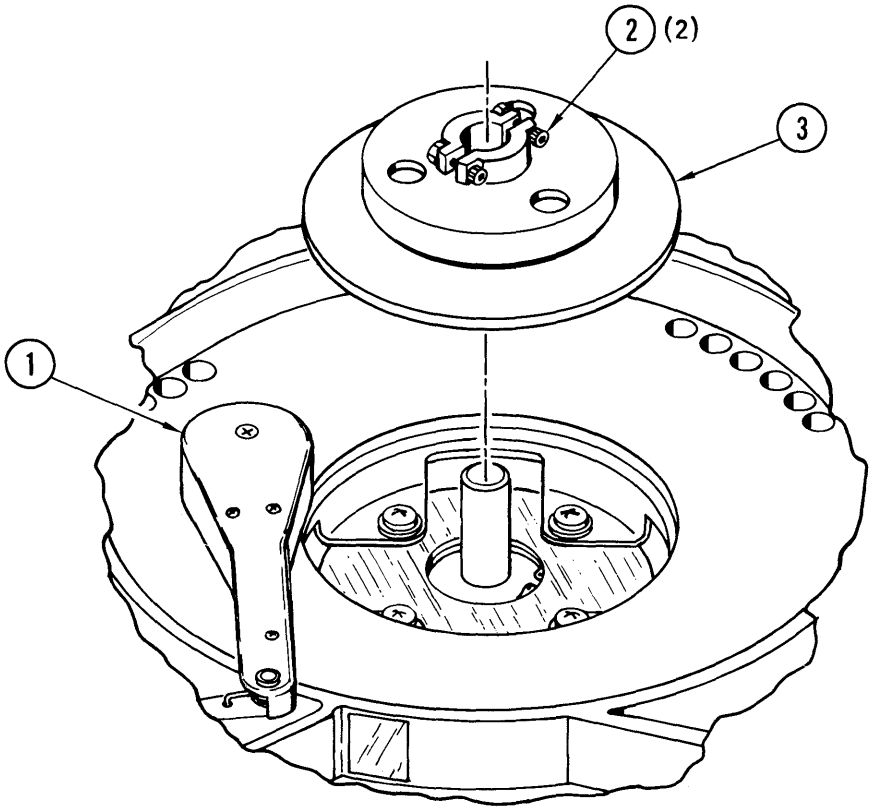


Figure 4-15. Takeup Hub

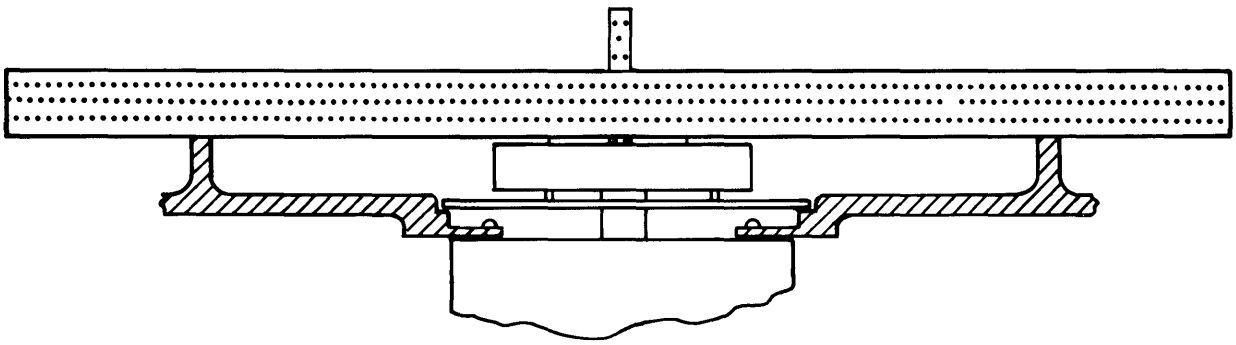


Figure 4-16. Takeup Hub Adjustment

COMPLIANCE ARM ASSEMBLY (9 Figure 4-5), AIR CAPACITOR ASSEMBLY (9, Figure 4-6).

NOTE

To facilitate removal of the compliance arm assembly, this procedure combines the removal, disassembly, assembly and installation of the compliance arm assembly with that of the air capacitor.

4-30. **Removal and Disassembly (Figure 4-17).** Place the transport in service access position (paragraph 4-3). Proceed as follows:

NOTE

Save all attaching parts for use in reassembly.

a. Remove the top plate air duct (paragraph 4-41). Do not remove Ty-rap.

b. Remove two screws (1), and flat washers (2) attaching air capacitor shutter blade (3) to hub (4), and remove blade (3) from air capacitor stator (7).

c. Remove wire terminals clipped to air capacitor stator (7) plates and identify for reassembly.

d. Remove two allen-head screws (5) and one allen-head screw (6), and remove air capacitor stator (7) from top plate.

e. Loosen socket head screw (8) and remove shutter hub (4) from end of compliance arm shaft.

f. From top side of plate, remove spring (9) from bracket (10).

g. From bottom side of top plate, remove retaining ring (11), wavespring washer (12), and shim (13). Lift compliance arm assembly from top plate. Remove lower bearing (14) or upper bearing (15) only if it requires inspection and/or replacement. These bearings are attached to top plate with Loctite 601.

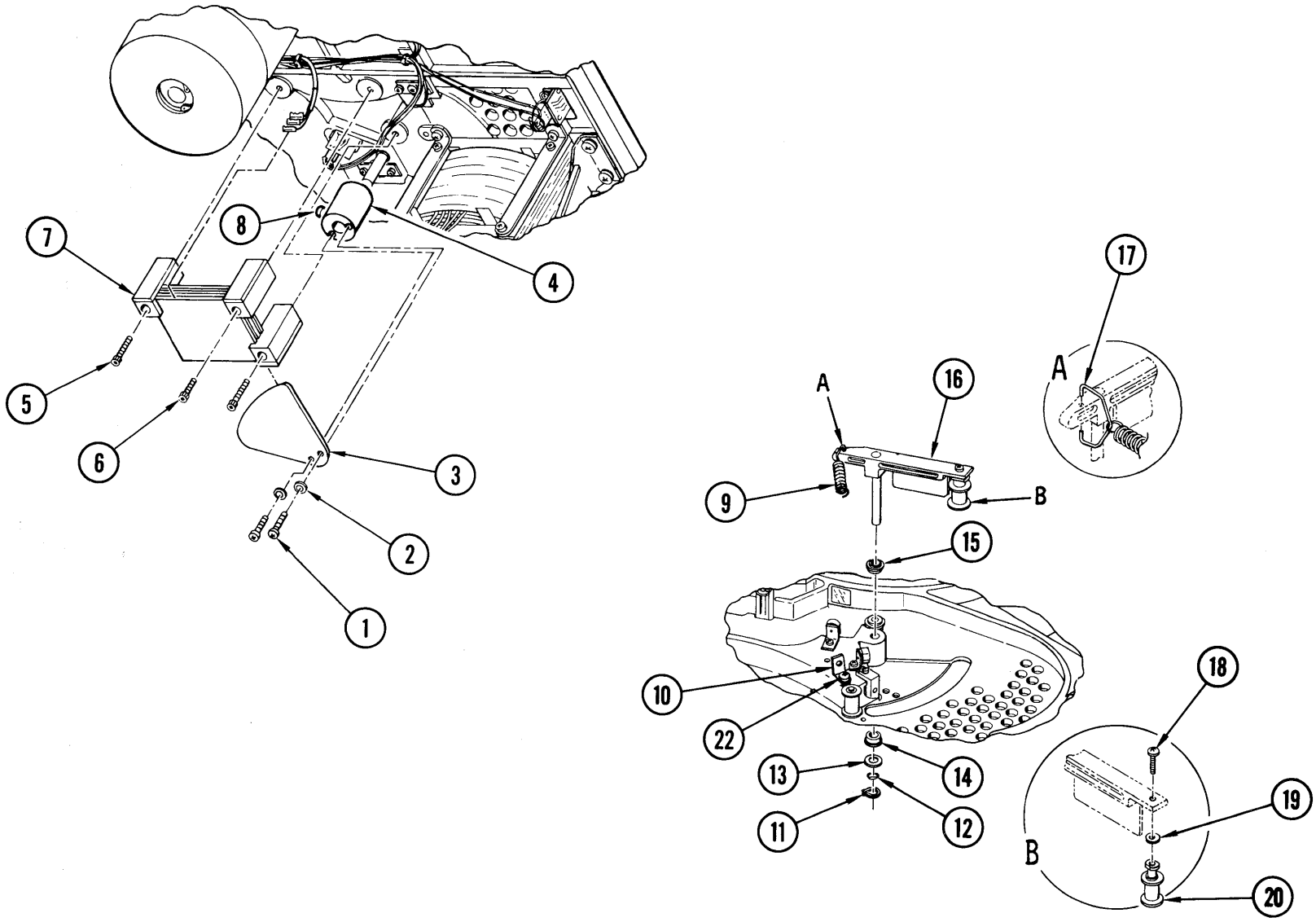


Figure 4-17. Compliance Arm and Air Capacitor Assemblies

h. Remove clip (17) from arm (16) by spreading ends out of hole in arm.

i. To remove tape guide (20), remove screw (18), and shim (19), saving shim for reassembly.

4-31. **Reassembly, Installation, and Adjustment.** Reassemble and install the compliance arm and air capacitor assemblies as follows:

a. Replace defective parts and reassemble compliance arm assembly as shown in Figure 4-17, in reverse order of steps g through i, paragraph 4-30, observing the following special instructions.

(1) Use attaching parts and shims saved from removal and disassembly as necessary.

(2) Apply Lubriplate to bearing surfaces between clip (17) and arm (16).

b. If bearing (14) or (15) was removed, apply small amount of Loctite 601 around outside of bearing and replace.

c. Install shaft carefully through bearings in top plate.

d. Install shim (13), wavespring washer (12), and retaining ring (11) on bottom of shaft. Check wavespring washer (12) to see that it is compressed half of its height. If not, add shims (13) as necessary, checking compliance arm for freedom of movement.

e. Slip hub (4) of capacitor shutter over end of compliance arm shaft, tightening socket head screw (8) just enough to hold hub on shaft.

f. Mount air capacitor stator (7) to under side of top plate with one screw (1/2 - inch) (6), and two screws (5/8-inch) (5), applying Loctite 242 to screws before insertion.

g. Slip blade (3) of capacitor shutter between two upper plates of capacitor stator (7), and attach to hub (loosen hub if required) with two screws (1), and flatwashers (2).

h. Rotate compliance arm assembly to front bumper and secure with Ty-rap.

i. Loosen hub socket head screw (8) slightly, rotate capacitor shutter blade (3) to within 0.1 inch of power supply housing, and adjust height of hub so that rotor blade does not bind on either plate of capacitor stator (7).

j. Tighten hub socket head screw (8).

k. Remove Ty-rap securing compliance arm assembly to front bumper and allow compliance arm to rotate to rear bumper (under its own weight). If compliance arm does not swing freely, readjust height of capacitor shutter, steps i and j, until compliance arm swings freely.

l. Attach compliance arm spring (9) to bracket (10).

m. Clip wire terminals to air capacitor stator (7) plates at points from which removed in step b, paragraph 4-30.

n. Place transport in operator maintenance access position (paragraph 4-2).

CAUTION

To prevent data reliability problems due to improper tape tensioning, the position of the compliance arm spring bracket (10) is factory aligned and should not be changed unless necessary.

o. If spring bracket position was changed, adjust for proper spring tension as follows:

(1) Attach 0 to 36 oz. spring scale, available from John Chatillon & Sons, 83-30 Kew Gardens Rd., Kew Gardens, New York 11415, Part No. LP36, to compliance arm by inserting hook end of scale into notch provided on top of compliance arm near the pivot point.

(2) Loosen screw (22) attaching bracket (10) and position bracket so that screw (22) is in the center of its slotted adjustment range.

(3) Pull spring scale toward front panel of transport until compliance arm roller is positioned between 4th and 5th row (from front panel) of holes in top plate. Scale must be held perpendicular to compliance arm.

(4) With compliance arm positioned between 4th and 5th holes in top plate, spring scale should indicate 23.5 ± 4.25 ounces. Adjust spring bracket to obtain this reading by moving bracket to stretch or shorten spring. Any deviation from zero reading should be added or subtracted from spring scale reading.

(5) Verify that minimum spring tension required to move arm from rest position is 10 ounces.

(6) If readjustment is required in either substep (4) or (5), reverify both readings.

p. Use Service Aid 24 to test compliance arm and air capacitor assemblies.

TAPE-IN-PATH SENSOR, TRANSMITTER (10, Figure 4-5).

4-32. **Removal and Replacement (Figure 4-18).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove connector at back of top plate from tape-in-path sensor transmitter.

b. Remove two screws (1, Figure 4-18) and lockwashers (2) and pull transmitter (3) carefully through hole from back of top plate.

c. Position replacement sensor transmitter carefully in place through hole from back of top plate and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, transmitter.

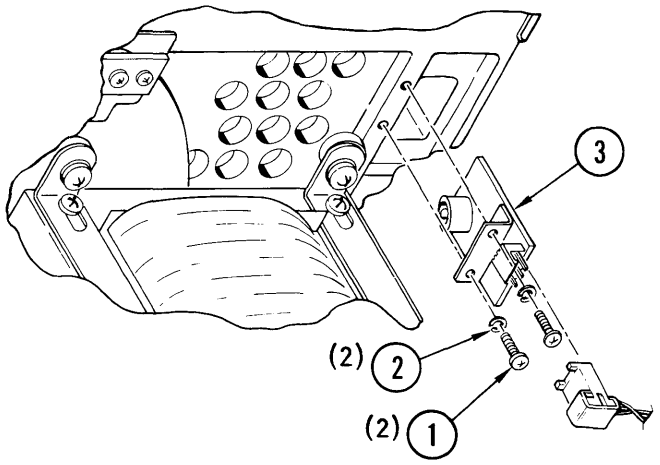


Figure 4-18. Tape-in-Path Sensor, Transmitter

TAPE-IN-PATH SENSOR, RECEIVER (11, Figure 4-5).

4-33. **Removal and Replacement (Figure 4-19).** Place the transport in service access position (paragraph 4-2) and proceed as follows:

a. Remove connector at back of top plate.

b. Remove attaching screw (1, Figure 4-18), lockwasher (2), and flatwasher (3) and remove tape-in-path sensor receiver (4). Save attaching parts for reassembly.

c. Install replacement receiver using screw (1), lockwashers (2) and flatwasher (3).

d. Reinstall connector.

e. Place transport in operating position.

f. Use Service Aid 31 to test tape-in-path sensor, receiver.

COMPLIANCE ARM BUMPER ASSEMBLY (12, Figure 4-5).

4-34. **Removal and Replacement (Figure 4-20).** With the transport in operator maintenance position (paragraph 4-2), proceed as follows:

a. Remove screw (1, Figure 4-20), lockwasher (2), and bumper assembly (3).

b. Reinstall in reverse order of removal, and adjust to contact compliance arm squarely. Ensure spring (4) does not touch bumper in the compliance arm's full arc of travel. Reposition bumper to clear spring if required.

c. Place transport in operating position.

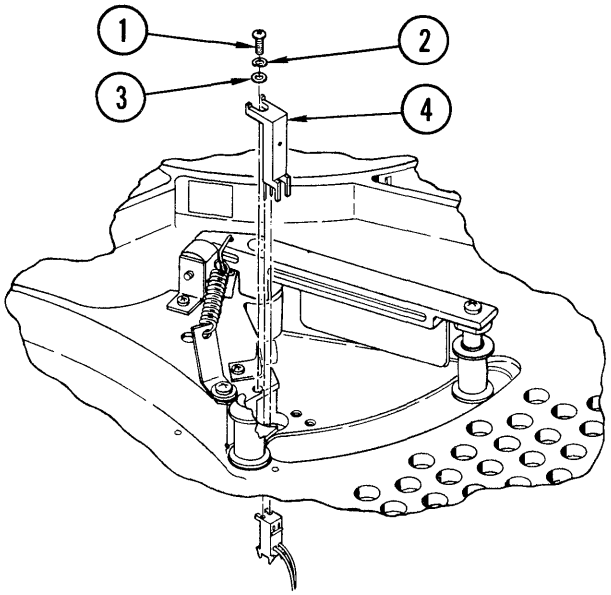


Figure 4-19. Tape-in-Path Sensor, Receiver

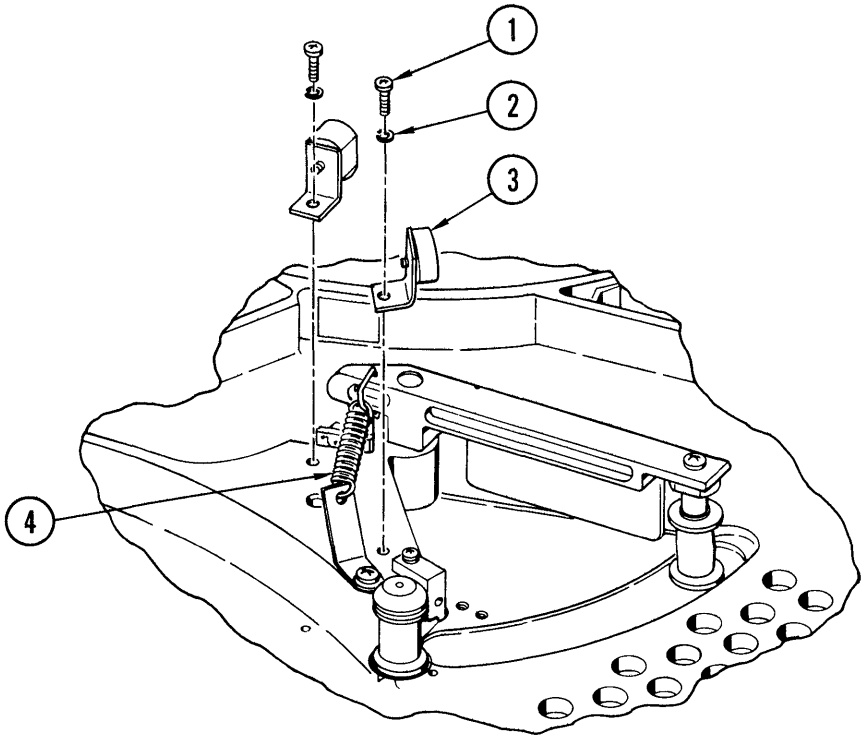


Figure 4-20. Compliance Arm Bumper Assembly

ROLLER TAPE GUIDE ASSEMBLY (SOLID) (13, Figure 4-5).

4-35. **Removal and Replacement (Figure 4-21).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove attaching screw (1, Figure 4-21) and lockwasher (2), and leaving shims in place remove tape guide assembly (solid) from top of top plate. Save attaching parts for reinstallation.

b. Reinstall tape guide assembly (solid) (3) in reverse order of step a.

c. Perform tape alignment procedure in accordance with instructions in paragraph 4-50.

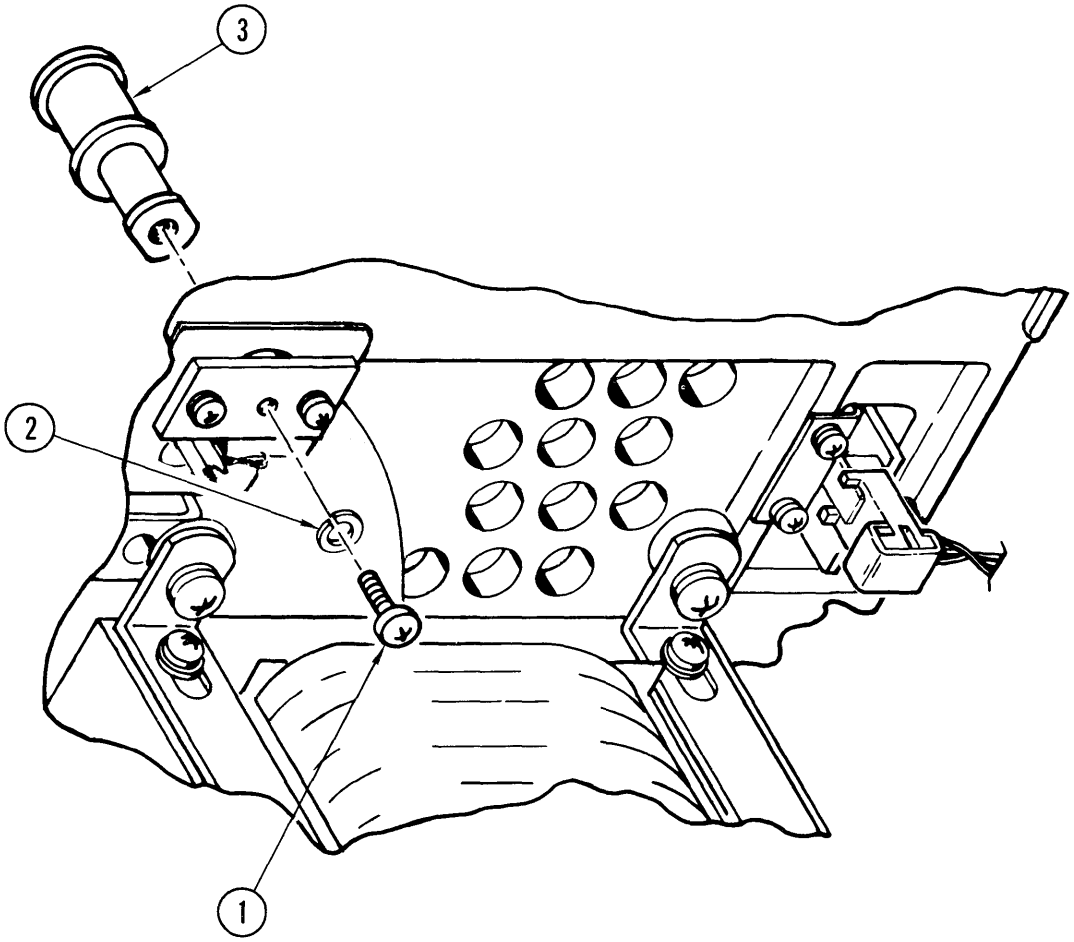


Figure 4-21. Tape Guide Assembly (Solid)

FILE-PROTECT SENSOR (14, Figure 4-5).

4-36. **Removal and Replacement (Figure 4-22).** Place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove connector (back of top plate) from file-protect sensor (3, Figure 4-22).

b. Remove two screws (1) and lockwashers (2) and pull sensor (3) carefully through hole of top plate. Save attaching parts for reassembly.

c. Position replacement sensor carefully through hole and secure with screws (1) and lockwashers (2).

d. Attach connector removed in step a.

e. Place transport in operating position.

f. Use Service Aid 31 to test file-protect sensor.

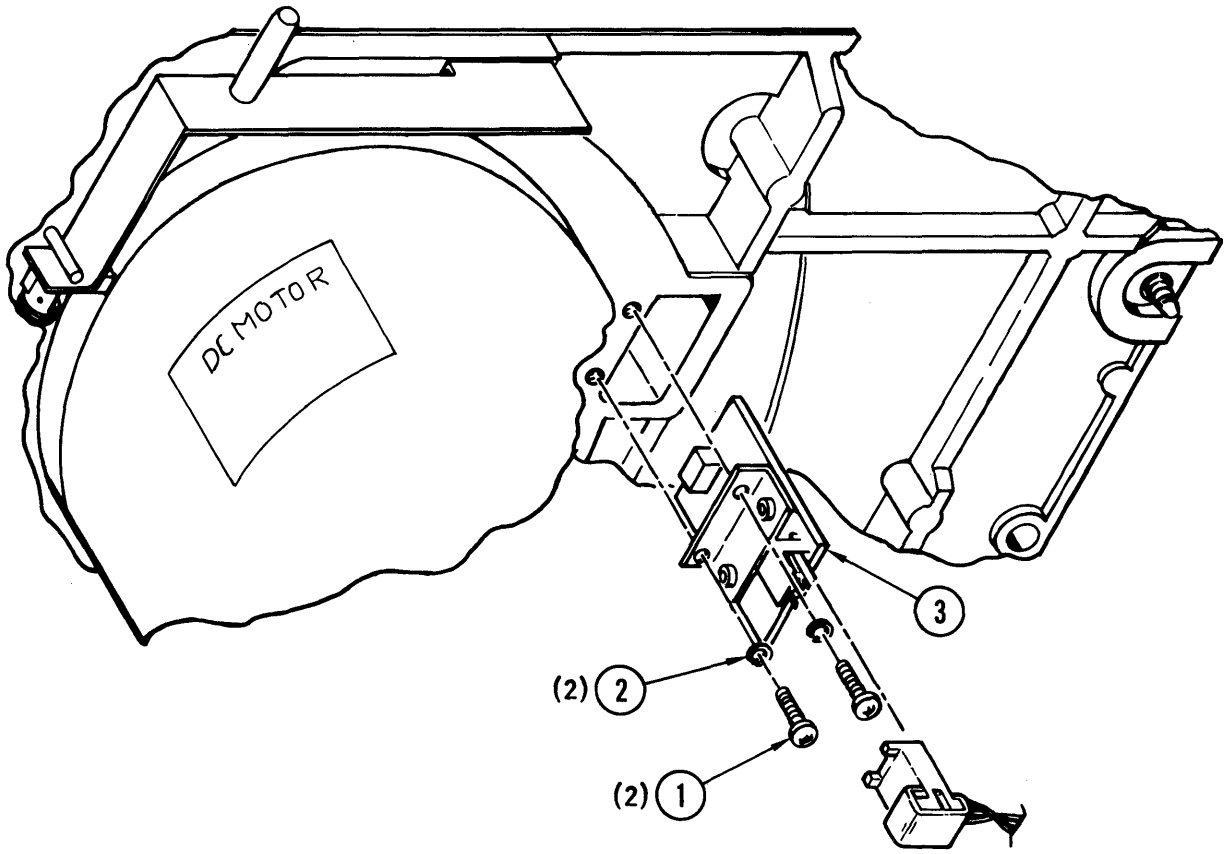


Figure 4-22. File-Protect Sensor

DRIVE MAIN PRINTED WIRING BOARD (PWB) ASSEMBLY (1, Figure 4-6).

4-37. **Removal and Replacement (Figure 4-23).** Place the drive in service access position (paragraph 4-3) and proceed as follows:

a. Remove power cord from outlet.

b. Remove screw (1), lockwasher (2), and flat washer (3) from front center of board.

c. Remove all connectors.

d. Lift front of board over lip on chassis, slide forward and remove I/O connectors.

e. Remove board from chassis.

f. Position replacement board and install I/O connectors.

g. Reconnect all connectors.

h. Secure board with screw (1), lockwasher (2), and flat washer (3).

i. Adjust read threshold per paragraph 4-17.

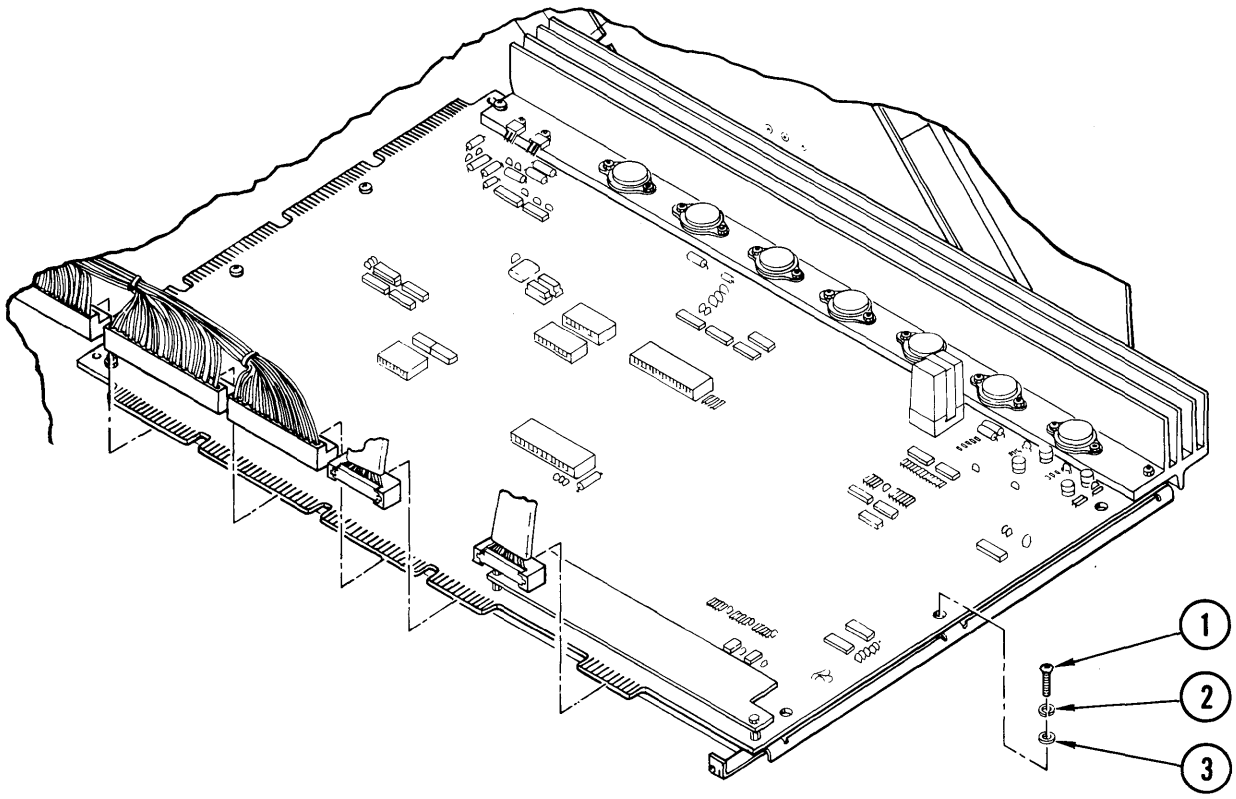


Figure 4-23. Drive Main Printed-Wiring Board

POWER SUPPLY ASSEMBLY (2, Figure 4-6).

4-38. **Removal and Replacement (Figure 4-24).** Place the drive in service access position (paragraph 4-3) and proceed as follows:

a. Turn power off and remove power cord from rear of power supply chassis.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

NOTE

Although not required, the following steps are simplified by removal of the top plate air duct (paragraph 4-41), front panel air duct (paragraph 4-42) and air intake tube (paragraph 4-43).

c. Remove screws (1, Figure 4-24), lockwashers (2), and flatwashers (3) securing power supply cover (4).

d. Remove wiring harness from clip cord (5) securing wiring harness to outside of power supply chassis, and disconnect wiring harness connector from power supply PWB.

e. Remove screws (6), lockwashers (7), and flatwashers (8) securing power supply chassis to top plate.

f. Remove screws (9), lockwashers (10), and flatwashers (11) securing chassis to rear bracket.

g. Disconnect air pump wires (13) and terminals from EMI filter (12) noting position from which removed.

h. If air pump assembly (15) is to be replaced, remove nuts (14), securing air pump to chassis.

i. Install replacement assembly in reverse order of removal ensuring transformer and power switch wire bundles are routed through the housing opening near the top plate.

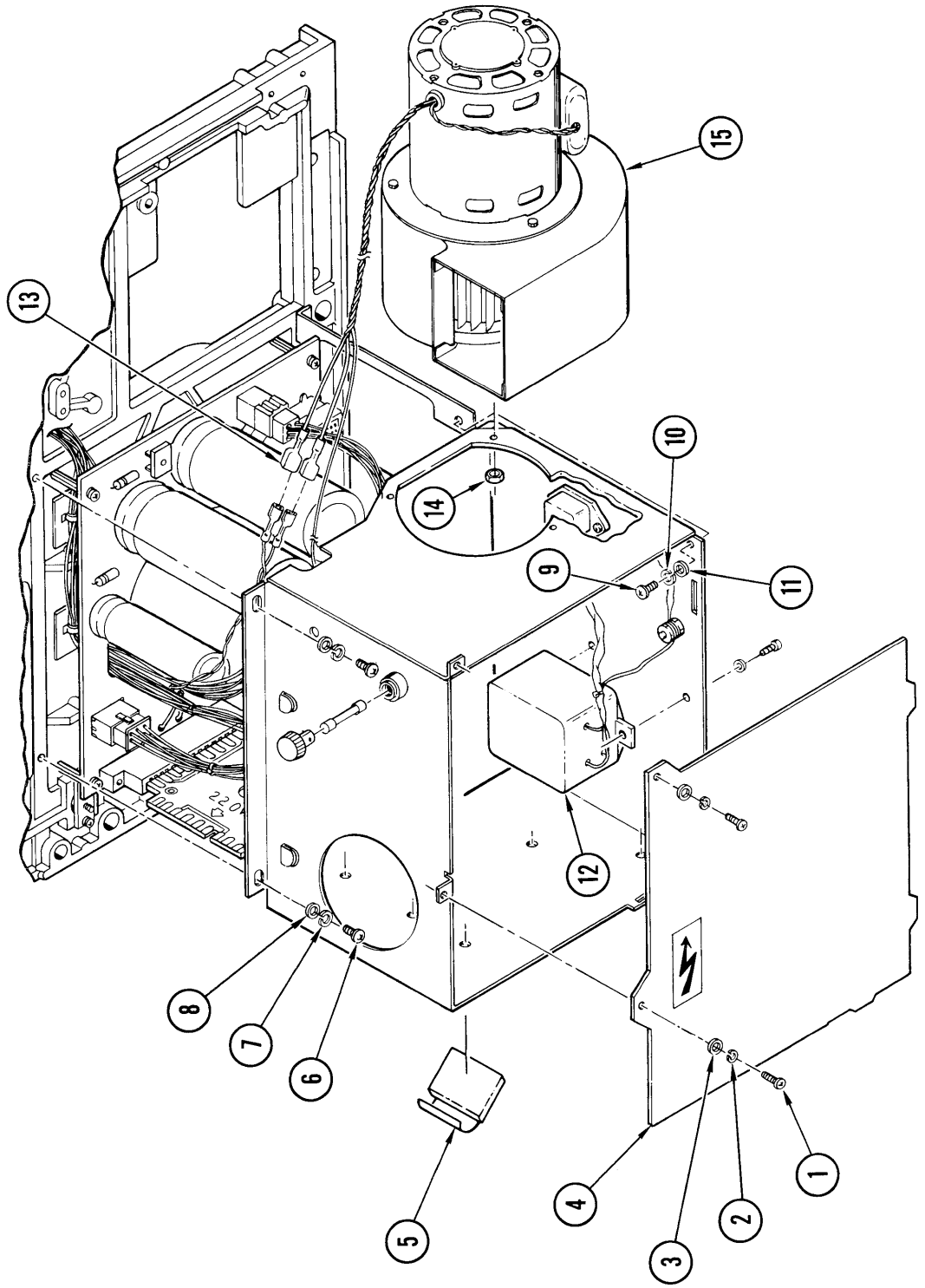


Figure 4-24. Power Supply Assembly

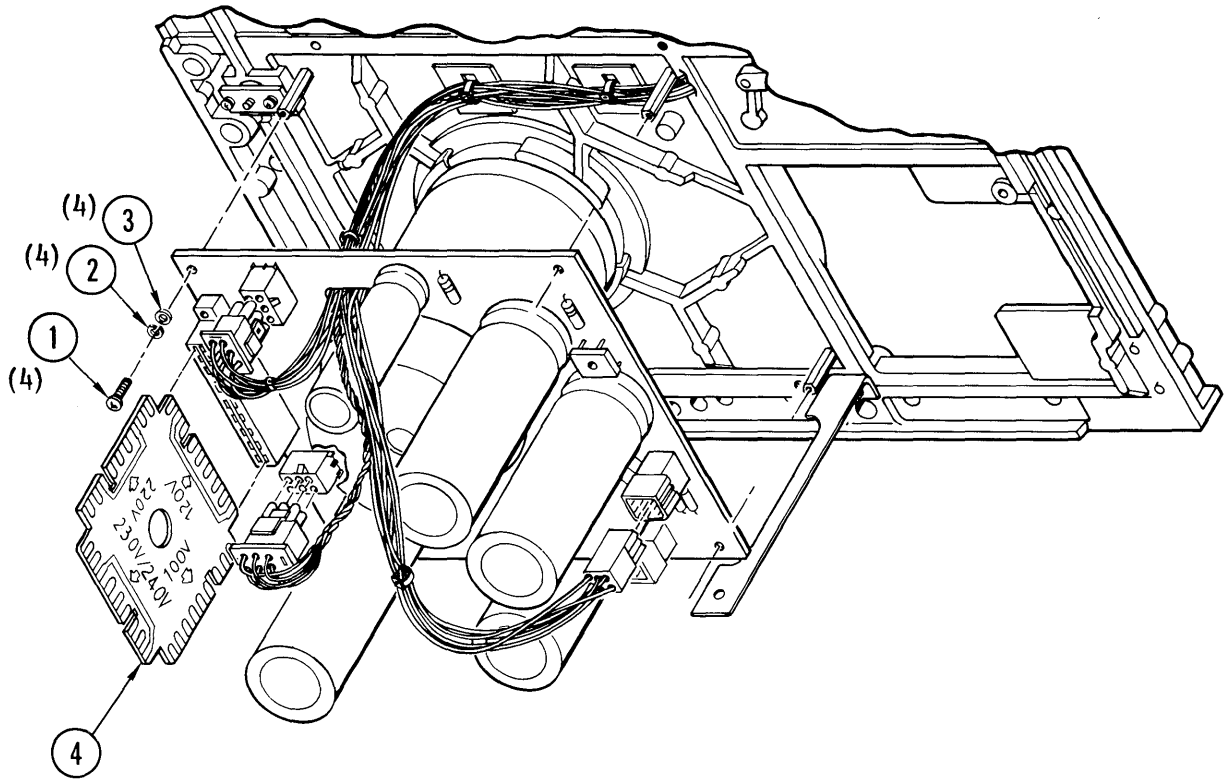


Figure 4-25. Power Supply PWB

POWER SUPPLY PWB (3, Figure 4-6).

4-39. **Removal and Replacement (Figure 4-25).** Place the drive in service access position (paragraph 4-3) and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove power supply assembly in accordance with instructions in paragraph 4-38.

d. Disconnect all wiring harness connectors from power supply PWB.

e. Remove screws (1), lockwashers (2), and flatwashers (3), and carefully lower power supply PWB while feeding cables through board opening. Remove voltage selection card (4).

f. Reconnect all connectors to replacement PWB and replace voltage selection card (4).

g. Hold PWB in place and secure with screws (1), lockwashers (2), and flatwasher (3).

h. Replace power supply chassis in reverse order of instructions in paragraph 4-38.

i. Place drive in operating position.

TAKEUP MOTOR ASSEMBLY (4, Figure 4-6).

4-40. **Removal, Replacement and Adjustment (Figure 4-26).** Place the transport in service access position (paragraph 4-3) and remove and replace the takeup motor assembly in accordance with the following procedure:

a. Remove power cord from outlet.

b. Remove drive main PWB in accordance with instructions in paragraph 4-37.

c. Remove takeup hub in accordance with paragraph 4-29.

d. Remove power supply assembly cover in accordance with instructions in paragraph 4-38.

e. Disconnect motor wire terminals identifying as necessary for reinstallation.

f. Remove four screws (1, Figure 4-26), lockwashers (2), flatwashers (3), shoulder washers (4), and takeup motor (6) out of drive, noting orientation of motor. Save attaching parts, including insulator (5), for use in assembly.

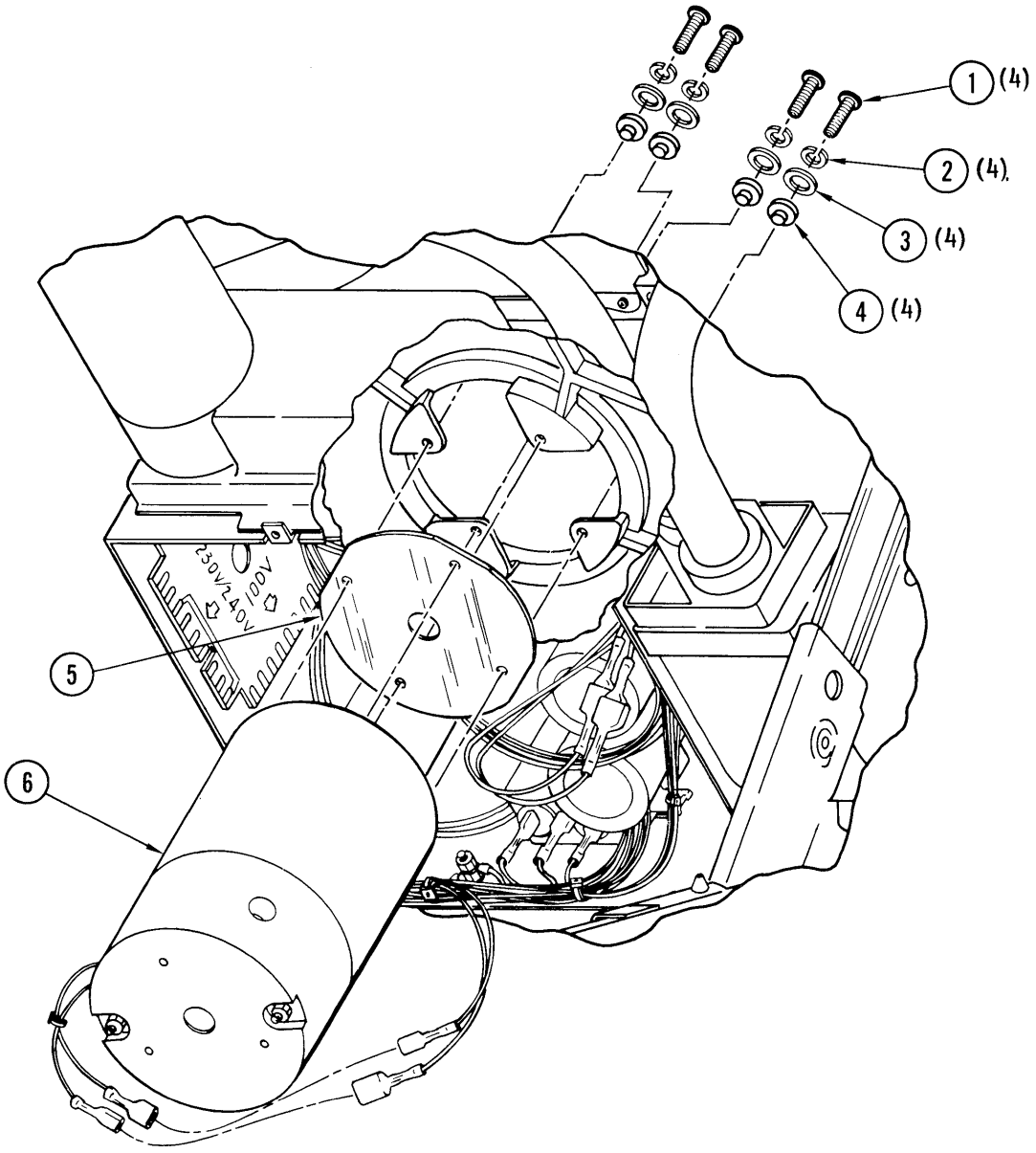


Figure 4-26. Takeup Motor Assembly

g. Install replacement motor in same orientation as motor removed in step f, in reverse order of steps e and f.

h. Reinstall power supply cover in accordance with instructions in paragraph 4-38.

i. Reinstall and adjust takeup hub in accordance with paragraph 4-29.

j. Reinstall main PWB in accordance with instructions in paragraph 4-37.

k. Use Service Aid 11 to test motor operation.

AIR DUCT, TOP PLATE (5, Figure 4-6), AIR DUCT, FRONT PANEL (6), TUBE, AIR INTAKE (7).

4-41. **Removal and Replacement (Figure 4-27).** Place the transport in service access position (paragraph 4-3). To replace the top-plate air duct, proceed as follows:

a. Remove head connectors J6/J7 from main PWB and cable retractor (5). At top-plate end of top-plate air duct (4), remove screw (1), lockwasher (2), and flatwasher (3).

b. Pull other end from blower adapter (6), and remove air duct.

c. Remove cable retractor (5) from old duct and secure with Ty-rap on replacement duct.

d. Install replacement duct by slipping flared end over blower adapter (6) and reinstalling screw, lockwasher and flat washer.

e. Place transport into operating position.

4-42. **Front Panel Air Duct (Figure 4-27).** Replace the front panel air duct as follows:

a. Note positions of power switch harness and safety pin retractor Ty-raps on duct and remove.

b. Remove front panel in accordance with instructions in paragraph 4-21, steps a, b, and c, but do not remove switch wire terminals and connectors.

c. Pull front panel just far enough away from transport to remove gooseneck end of front-panel air duct (7), noting position from which removed with reference to air deflector on front, right-hand edge of top plate.

d. Pull other end of duct off blower adapter (6).

e. To install replacement front-panel air duct (7), place flared end of duct on blower adapter.

f. Position gooseneck end of duct so that it opens into air deflector and holding end of duct in place, replace front-panel assembly, squeezing positioning block of front-panel over gooseneck, ensuring that air intake tube (8) is in place in front-panel adapter (9) and power supply.

g. Reinstall front panel assembly in accordance with paragraph 4-21, step f.

h. Fasten power switch wiring harness and safety pin retractor to duct with Ty-raps according to step a.

i. Place transport in operating position.

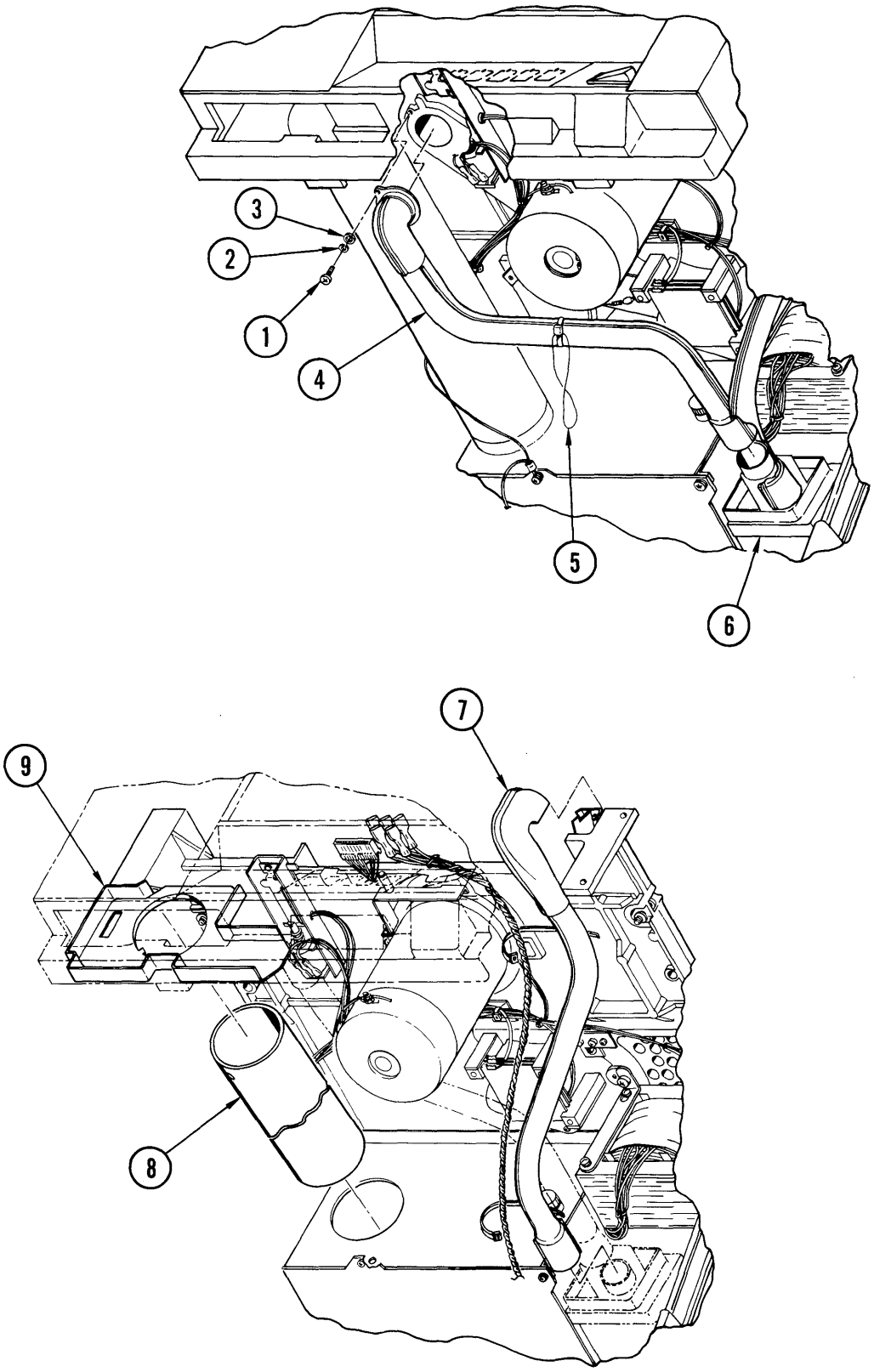


Figure 4-27. Top Plate Air Duct,
Front Panel Air Duct, Air Intake Tube

4-43. **Air Intake Tube. (Figure 4-27).** Replace the air intake tube as follows:

a. Remove the filter. Refer to paragraph 4-13.

b. Place unit in service access position.

c. Remove air intake tube (8) from power supply case by depressing tube slightly at hole (bottom of tube) to disengage tooth and slide forward into front panel adapter (9).

d. Remove front panel as in paragraph 4-42, but do not remove Ty-raps, etc.

e. Slide air intake tube out of front panel adapter.

f. Install replacement tube in reverse order of removal.

g. Place transport in operating position.

SUPPLY MOTOR ASSEMBLY (8, Figure 4-6).

4-44. **Removal and Replacement (Figure 4-28).** Place transport in service access position (paragraph 4-3) and remove and replace the supply motor assembly as follows:

a. Remove power cord from outlet.

b. Remove supply hub in accordance with paragraph 4-23.

c. Disconnect motor wire terminals from wire leads, identifying each as necessary for reinstallation.

d. Remove bell crank retaining ring (5, Figure 4-28).

e. Remove screw (1) lockwasher (2), flatwasher (3), shoulderwasher (4), and insulator (6), holding motor (7) as last screw is being removed.

f. Lower motor (7) from top plate, simultaneously slipping bellcrank off post on top of motor.

g. Install replacement motor with bellcrank post nearest bellcrank, slipping bellcrank onto post, in reverse order of removal.

h. Install retaining ring on bellcrank post (paragraph 4-45).

i. Connect motor wire terminals as identified in step c.

j. Reinstall and adjust supply hub in accordance with instructions in paragraph 4-23.

k. Use Service Aid 11 to test motor operation.

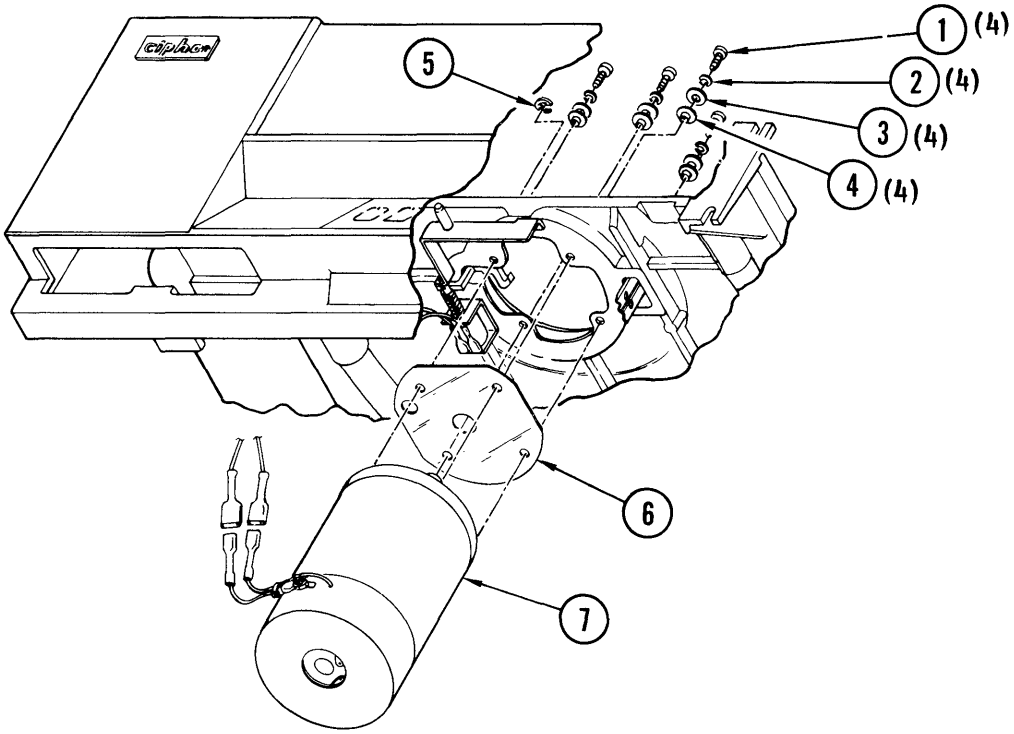


Figure 4-28. Supply Motor Assembly

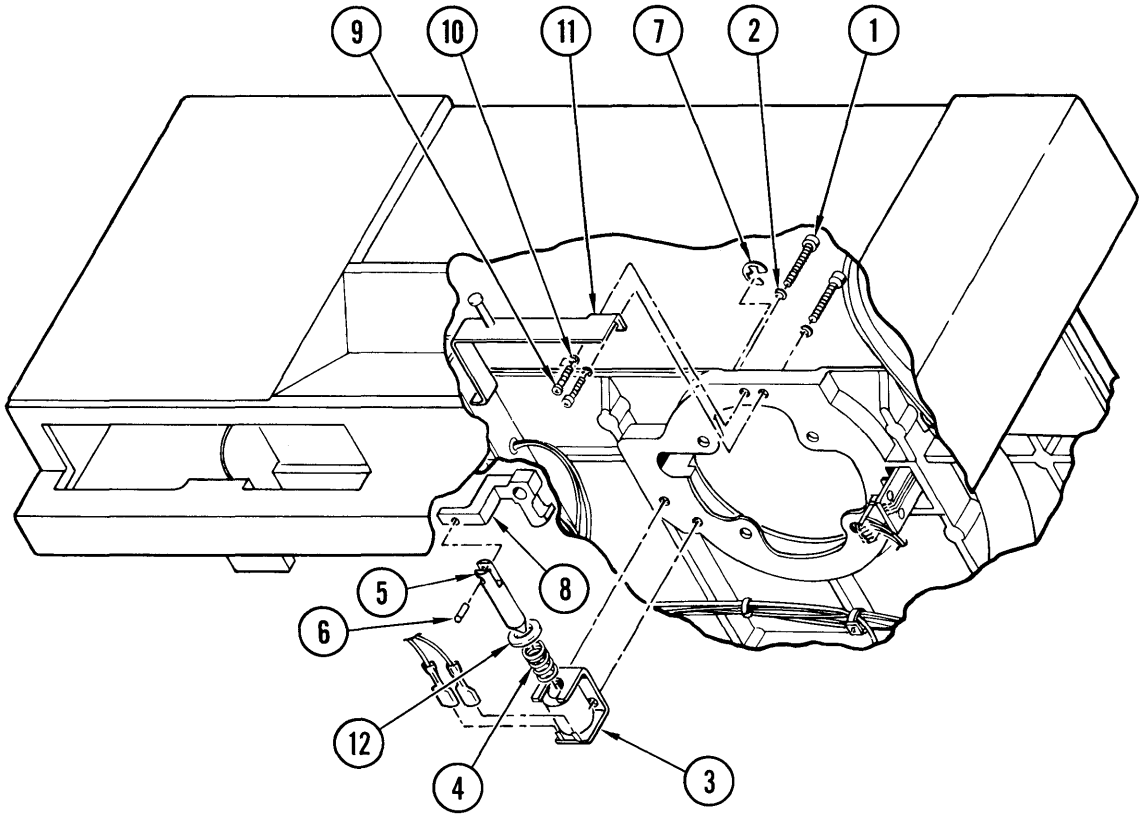


Figure 4-29. Hub Lock Assembly

HUB LOCK ASSEMBLY (10, Figure 4-6).

4-45. **Disassembly, Removal and Replacement (Figure 4-29).** To disassemble hub lock assembly and remove parts from top plate and supply motor, proceed as follows:

a. Remove power cord from outlet.

b. Place transport in service access position (paragraph 4-3).

c. Remove wire terminals from solenoid (3, Figure 4-29) and identify for reassembly.

d. Remove two screws (1), and lockwashers (2), and remove solenoid (3) from top plate and spring (4) and washer (16) from solenoid plunger (5).

e. If plunger (5) or bellcrank (8) must be replaced, remove supply motor in accordance with instructions in paragraph 4-44. Remove retaining ring (7) and bellcrank (8) from motor, and press out pin (6), releasing plunger (5).

4-46. **Reassembly and Installation.** Replace defective parts, and reassemble and install the hub lock assembly as follows:

a. Install bellcrank (8) on supply motor with retaining ring (7). Reinstall motor on top plate in accordance with instructions in paragraph 4-44.

b. Complete reassembly and reinstall solenoid (3) on top plate in reverse sequence of steps c and d, paragraph 4-45.

c. Place transport in operating position.

d. Use Service Aid 32 to test hub lock assembly operation.

4-47. **Manual Unlock Assembly (Hub Lock) (Figure 4-29).** To replace the manual unlock assembly or one of its parts, proceed as follows:

a. Place transport in service access position (paragraph 4-3).

b. Remove manual unlock assembly (11) from top plate by removing two screws (9, Figure 4-29) and lockwashers (10).

c. Reinstall in reverse order of step b.

d. Ensure that the hub lock solenoid spring will return the manual unlock assembly fully against the stop pin. Reposition the manual unlock assembly if required.

e. Place transport in operating position.

DOOR LOCK ASSEMBLY (11, Figure 4-6).

4-48. **Removal and Disassembly (Figure 4-30).** Place the transport in service access position (paragraph 4-3). Remove the door lock assembly from the top plate and disassemble as necessary to replace defective parts as follows:

a. Remove power cord from outlet.

b. Remove wire terminals from solenoid noting positions for reassembly.

c. Remove door lock assembly from top plate by removing two screws (1, Figure 4-30) and lockwashers (2).

d. Remove slip-on connectors from microswitch noting positions for reassembly and feed through grommet.

e. Remove two screws (3), and lockwashers (4), and remove solenoid (5) from assembly. Remove spring (6) and spacer (7).

f. Remove switch (13), by removing two nuts (8), lockwashers (9), flat washers (10), screws (11) and flat washers (12). Switch may then be removed by sliding out solenoid end of bracket.

g. No further disassembly is recommended.

h. Replace defective parts, and reassemble door lock assembly in reverse sequence of disassembly, steps c and d.

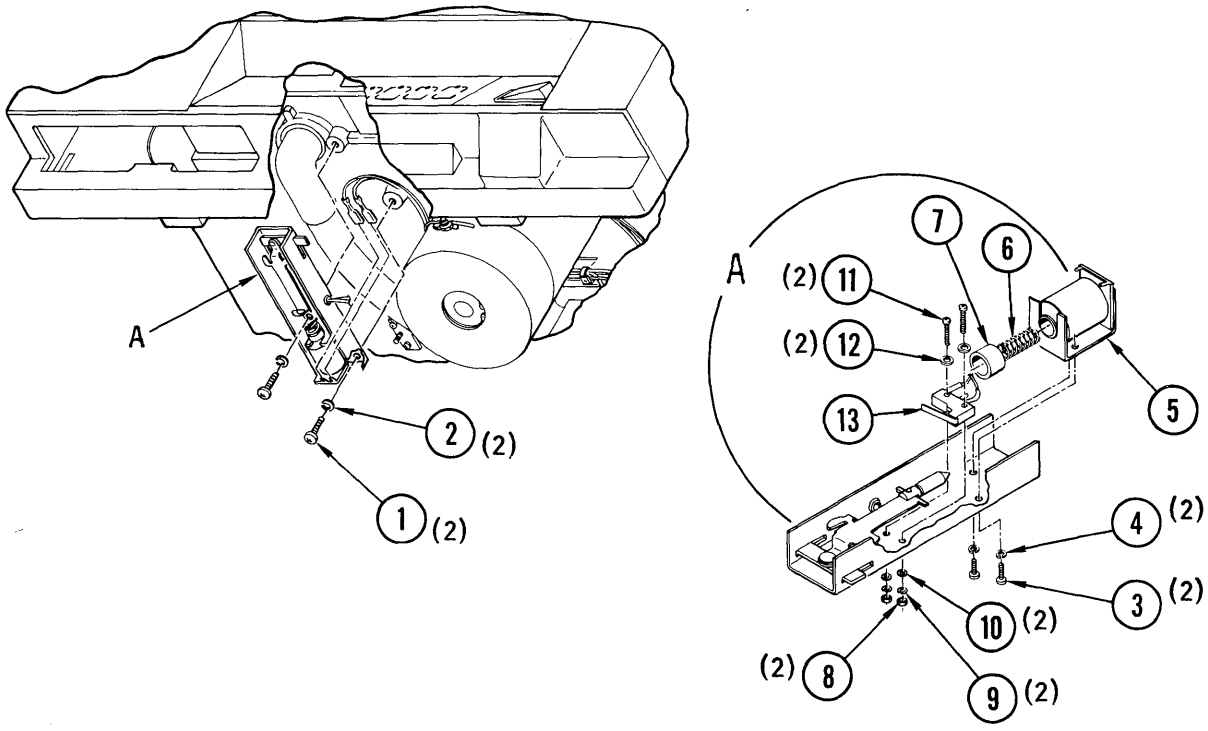


Figure 4-30. Door Lock Assembly

i. Install door lock assembly on top plate with attaching parts removed in step b. Do not tighten screws.

j. Adjust position of door lock assembly as follows:

(1) Close top cover of transport. Position door lock assembly so that the plate is approximately 1/8-inch in front of latching arm of cover lock tab (6, Figure 4-14), and tighten screws.

(2) Applying very light pressure, attempt to close transport door. If door will not close completely, loosen screws (1), push door lock assembly forward until door will close, and retighten screws (1).

(3) Place drive in operating position and connect to power source.

(4) Actuate POWER switch and LOAD touch switch. If only LOAD and POWER indicators illuminate, door lock assembly is properly positioned and adjustment is complete.

(5) If all indicators except ON-LINE are flashing upon execution of step (4), place drive in service access position, loosen screws (1), and pull door lock assembly slightly toward rear of unit.

(6) Repeat steps (3), (4), and (5) until both top cover and door open with POWER switch off and only LOAD and POWER indicators illuminate when these switches are actuated.

k. Place transport in operating position.

TRANSFORMER ASSEMBLY (12, Figure 4-6).

4-49. **Removal and Replacement (Figure 4-31).** To replace the transformer assembly, place the transport in service access position (paragraph 4-3) and proceed as follows:

a. Remove power cord from outlet.

b. Remove drive main PWB from transport (paragraph 4-37).

c. Remove power supply assembly and power supply PWB in accordance with paragraphs 4-38 and 4-39.

d. Unplug primary and secondary transfomer connectors from power supply PWB, and cut all Ty-raps securing transformer wire bundles to power supply components and other parts of drive, noting position of Ty-raps before removing.

e. Support transformer (4, Figure 4-31) and remove four screws four (1), four lockwashers (2), and four flatwashers (3), and remove from drive.

f. Install replacement transformer in reverse sequence of step e.

g. Replace Ty-raps removed in step c.

h. Reinstall power supply PWB in accordance with paragraph 4-39, ensuring that transformer wire bundles are properly secured with Ty-raps.

i. Plug in transformer primary and secondary connectors to power supply.

j. Reinstall power supply assembly in accordance with paragraph 4-38, and reinstall drive main PWB in accordance with paragraph 4-37.

k. Place drive in operating position.

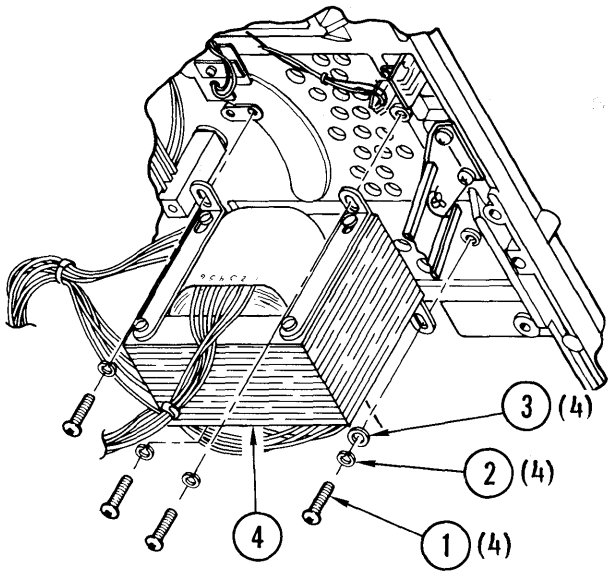


Figure 4-31. Transformer Assembly

TAPE ALIGNMENT

4-50. All tape guides must be checked for proper tape path alignment following replacement of any part in the tape path. Proceed as follows:

a. Actuate power switch to ON.

b. Insert and load a new tape.

NOTE

A used tape may have damaged or weak edges which would adversely affect its tape-path tracking characteristics.

c. Use Service Aid 33 to disable door and top cover lock. Place drive in operator maintenance access position.

d. Ensure that supply reel is properly seated on supply hub.

e. Referring to paragraph 3-33, operate drive in Service Aid 23.

f. If tape is not centered between sides of reel, unload tape and adjust hub height as necessary.

g. Observe position of tape on roller guide (2, Figure 4-32).

h. If tape is not centered on guide, turn power switch to OFF, and remove guide (2) from compliance arm in accordance with paragraph 4-30 step i and Figure 4-17.

i. Add or reduce thickness of shims (19) as required to compensate for off-center position of tape and reinstall guide on compliance arm. Repeat as necessary to obtain correct centering of tape on guide (2).

j. Run tape forward and check for edge curl on guide (3). If curl is present on lower washer, turn power switch to OFF and increase shims under roller guide (1). If curl is present on upper washer of guides (3), decrease shim thickness under roller guide (1). Resume forward tape motion and recheck tape position. Repeat this step until tape tracks smoothly around guide (3).

k. Depress lower washer on guide (3) and check for optimum movement of tape away from top washer of 0.005 inch. If necessary, reshim guide (2) to maintain proper tape centering.

l. Run tape in forward direction and check for edge curl on guide (4). If curl is present, turn transport power to OFF and add or remove shims on guide (5). Do not alter guide (5) more than ±0.005 inch from factory setting.

NOTE

Curl on guide (4) can be caused by improper alignment on any other guide in the tape path. If tracking has been verified on guide (3), tape curl on guide (4) is probably caused by misalignment of guide (5). Normally, improper alignment of guides (1) and (2) will show up as tracking problems on guide (3).

m. Run tape in reverse direction (Service Aid 23) and check for tape curl on all edges.

n. Depress lower washer on guides (3), (4), and (5) and check for optimum tape movement, away from top washer, of 0.005 inch.

o. Add or delete shims on guides (1), (2) and (5) as required to eliminate edge curl on all rollers and reverify forward tape path alignment by checking for maximum tape shift on guide (2) of ±0.015 inch.

p. Check head azimuth and read skew. Refer to paragraph 4-51.

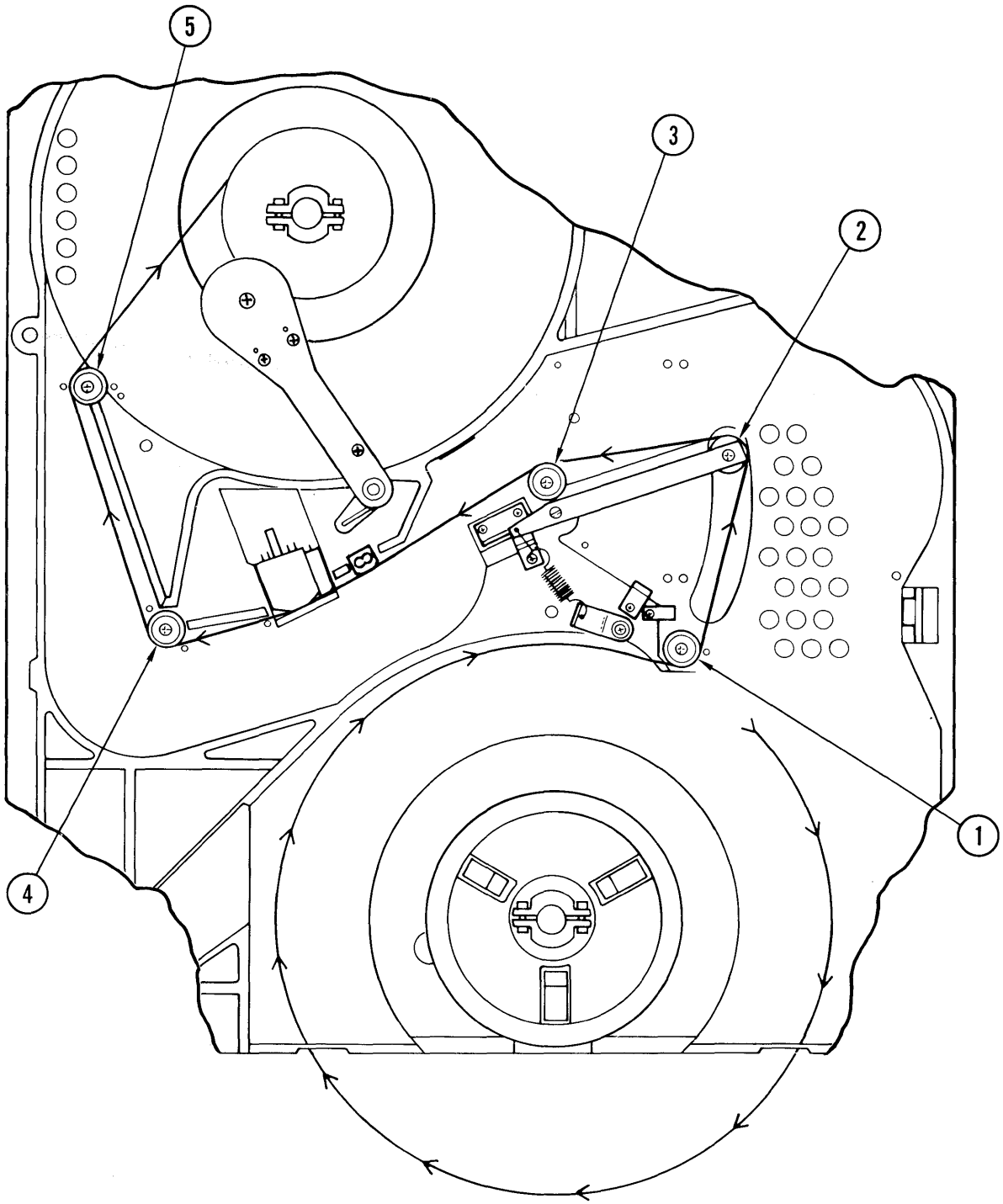


Figure 4-32. Tape Path Adjustment

4-51. **Head Azimuth Adjustment.** Adjust head azimuth as follows:

a. Place drive in service access position.

b. Turn transport power off and attach skew monitor, Cipher Part No. 960067-001 to U14A, U14D, and U14G.

(1) A skew monitor may be constructed using three 14-pin IC clips and nine 47K ohm resistors.

(2) Attach one end of a resistor to pins 9, 11, and 13 on each IC clip.

(3) Connect the other end of all nine resistors together to form a summing junction.

c. Actuate transport power switch to ON and load master skew tape, Cipher Part No. 799019-401.

d. Connect oscilloscope to test point on skew monitor and ground test point.

e. Loosen center adjustment screw (1, Figure 4-10).

f. Referring to paragraph 3-33, operate drive in Service Aid 23.

g. Adjust azimuth screw (1, Figure 4-10) so that outputs of all tracks, as monitored at test point on skew monitor, fall within 24% or less of the byte-to-byte period. (See Figure 4-33)

h. Run tape in reverse direction, using Service Aid 23, and verify reverse skew is within 24% or less of the byte-to-byte period.

i. Alternate tape direction between forward and reverse and optimize skew adjustment by minimizing width of skew pulse.

j. Apply torque seal, Cipher Part No. 209994-025, to head of adjustment screw.

k. Remove skew tape from transport and load a Pericomp tracking tape, available from Pericomp Corporation, Natick, Massachusetts 01760.

l. Connect oscilloscope to TP10 and ground.

m. Run tape in forward direction (Service Aid 23) and compare P1 and P2 on oscilloscope trace. See Figure 4-34.

n. Calculate difference in amplitude (positive peak) between P1 and P2 and refer to Table 4-4 for conversion of volts to inches. If P1 is greater than P2, subtract calculated figure from 0.007 inch. If P2 is greater than P1, add figure to 0.007 inch. Reference edge must be 0.007 ± 0.003 inch.

o. Remove skew monitor and place drive in normal operating position.

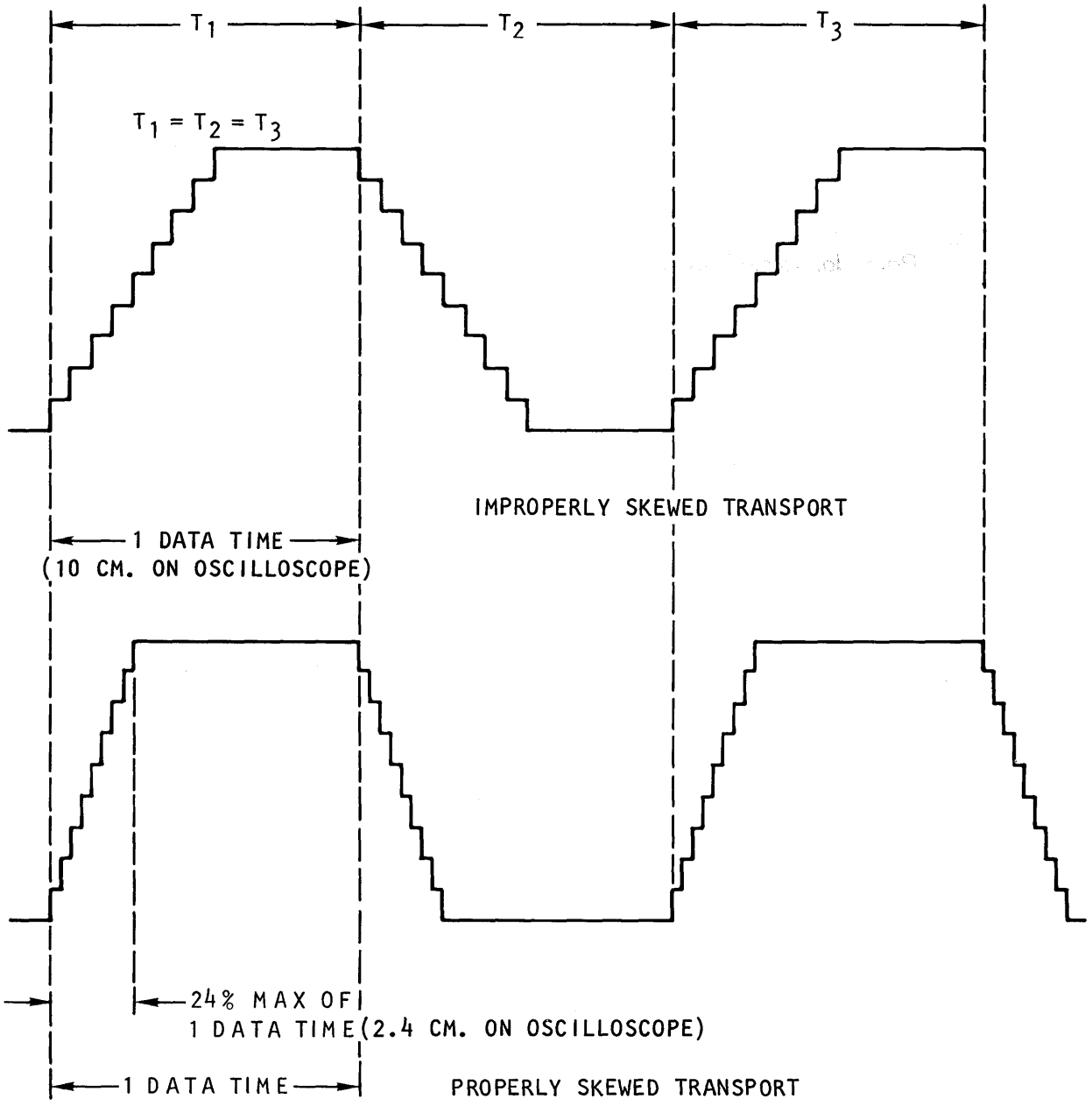


Figure 4-33. Skew Adjustment Waveform

VOLTS	INCHES
0.000 TO 0.024	0.000
0.025 TO 0.049	0.001
0.050 TO 0.074	0.002
0.075 TO 0.100	0.003

Table 4-4. Reference Edge Distrance

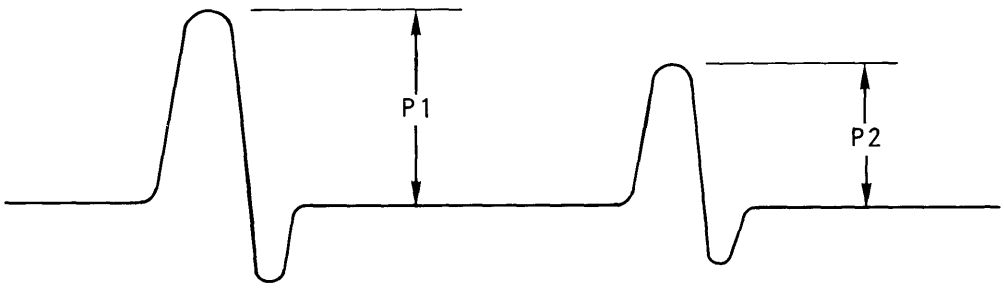


Figure 4-34. Reference Edge Measurement Waveform (TP10)
Using Pericomp Tracking Tape

SECTION V

ILLUSTRATED PARTS BREAKDOWN

INTRODUCTION

5-1. The illustrated parts breakdown divides the CacheTape Unit into assemblies. subassemblies, and component parts. Component parts are properly indented to show their relationship to the next higher assembly. Attaching parts are listed immediately following the item they attach, and preceding the components of that item.

5-2. Exploded view illustrations serve as a visual aid for identification of component parts of each assembly. Index numbers are used to identify the exploded parts shown. In the case of electronic components (capacitors, resistors, diodes, etc.) on a printed wiring board, a reference designation number is assigned to each, consisting of a capital letter (C for capacitor, R for resistor, etc.) and a sequential number, beginning with the numeral 1 for each capital letter. (Printed wiring boards are not exploded.) When used in conjunction with the schematic diagram and the DESCRIPTION column of the parts list, the reference designation numbers provide data required to troubleshoot, repair, or replace any components.

5-3. Figure 5-1 is an overall view of the magnetic tape transport for use in identifying major assemblies. Figures 5-2 through 5-12 represent both an exploded view of these major assemblies and their relationships to the overall assembly.

5-4. Abbreviations used in this section are defined below.

ABBREVIATION	DEFINITION
A or amp	ampere
al	aluminum
cap	capacitor
dia	diameter
ft	feet (or foot)
hex	hexagon
Hz	Hertz

ABBREVIATION	DEFINITION
ID	inner diameter
in.	inch (or inches)
kV	kilovolt
lg	long
meg	megohm
No. or Nos.	number or numbers
NPN	negative-positive-negative (transistors)
OD	outer diameter
	ohm
PNP	positive-negative-positive (transistors)
pF	picofarad
R	resistor
subs	subsequent
thk	thick
uF	microfarad
v	volt (or voltage)
VDC	volts direct current
VAC	volts alternating current
W	Watt
w/	with
x	by (or names)

EXPLANATION OF THE PARTS LIST

5-5. **FIG. & INDEX NO. Column.** Illustrations are numbered sequentially. The item numbers on each illustration are keyed to the same number appearing in the parts list. If a part number is shown for an item, but no index number is shown, the assembly is immediately broken out below the part number and each item in the assembly is given its own index number. If parts are interchangeable, only one index number will be assigned to the item.

5-6. **PART NUMBER Column.** The number that appears in this column will be the Cipher Data part number. In the case of an electronic component (capacitor, resistor, transistor, etc.), its location in an illustration is determined by the grid system, e.g., transistor U11F will be found by reading down the sides of the illustration to row number 11, then across the top of the illustration from right to left until the letter F row is reached. Each electronic component assigned a circuit symbol (i.e., reference designation) will have that designation listed in the Figure & Index No. in alphanumeric sequence. Where the sequence is broken due to the removal, revision, or change of a component, the notation "NOT USED" will appear in the DESCRIPTION column opposite the designation that has been removed.

5-7. **DESCRIPTION Column.** Descriptive data as to type, size, color, etc. is provided to fully identify the part when ordering or replacing. Blueprint titles are normally given first, with the basic noun name in capital letters, followed by additional descriptive terms. Acceptable abbreviations are contained in the abbreviation table above.

5-8. **QTY Column.** This column indicates the quantity of each part required for the assembly or subassembly. This quantity is not necessarily the total quantity used for the complete assembly.

NOTE

The same parts may be used in various subassemblies; or in the case of multiple components with attaching hardware, only the quantity of hardware used to attach one item is given.

5-9. **USABLE ON CODE Column.** This column lists the code letter assigned to the current models of the CacheTape Unit for identification purposes.

CODE	MODEL
A	Model M890 (1600 bpi)
B	Model M890 (3200 bpi)
C	Model M891 (1600 bpi)
D	Model M891 (3200 bpi)
E	CacheTape Unit (VDE)

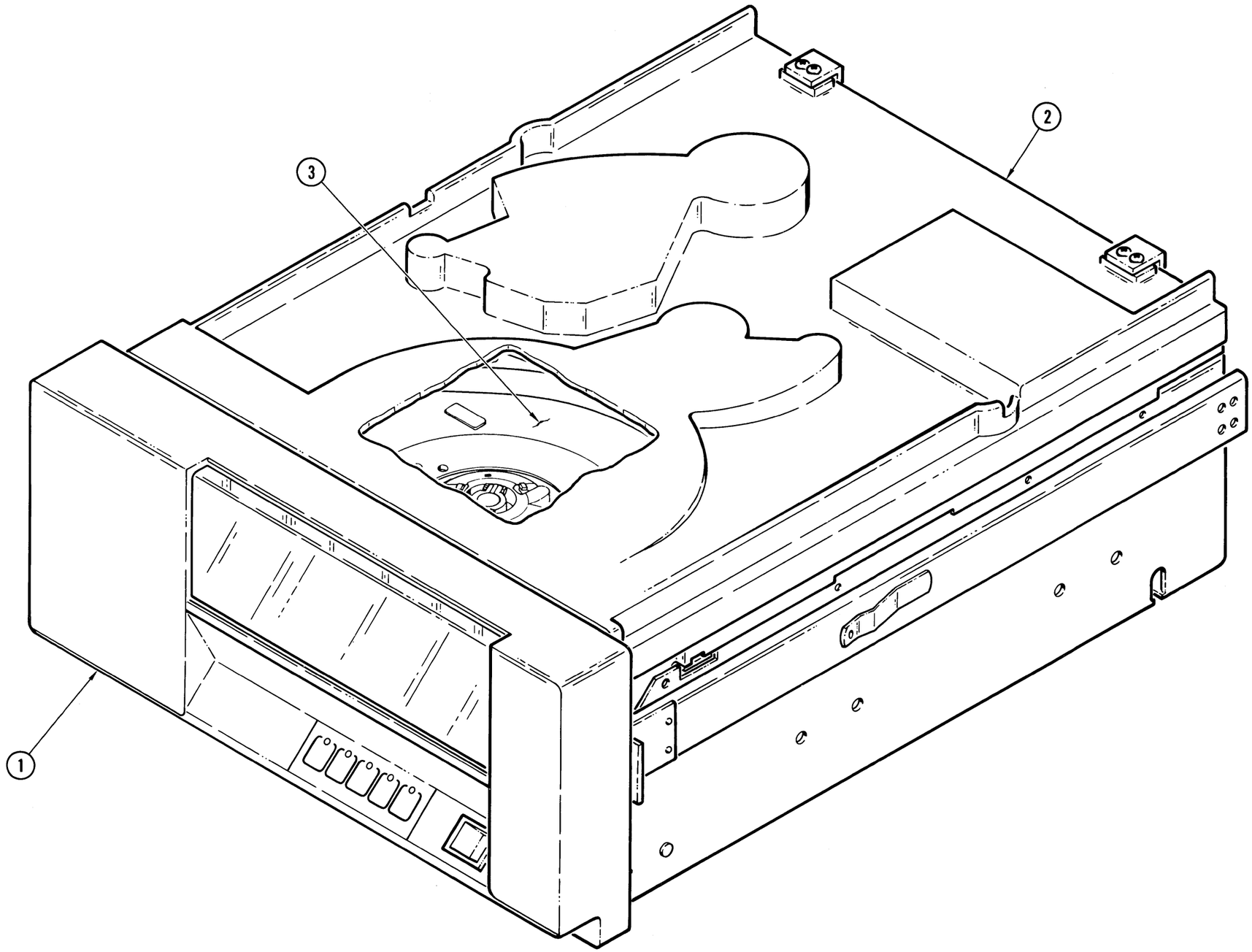


Figure 5-1. CacheTape Unit (Assembled View)

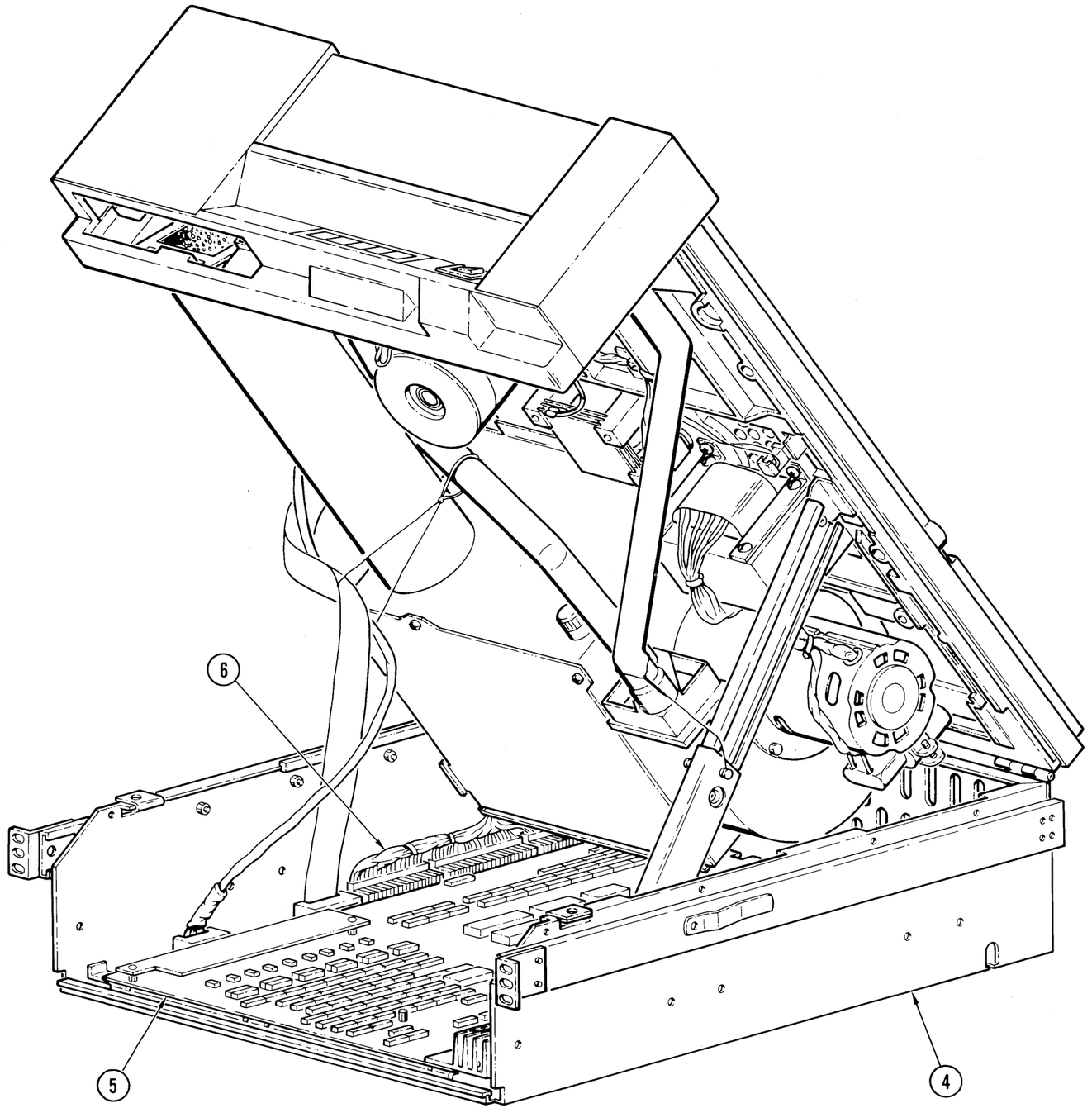


Figure 5-1. CacheTape Unit (Assembled View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-1	960652-004 960654-004 960666-004 960668-004	MAGNETIC TAPE TRANSPORT, ... (See Figure 5-2)	REF	A B C D
-1	960359-001	. FRONT PANEL ASSEMBLY ..... (See Figure 5-3)	1	
-2	960057-001	. TOP COVER ASSEMBLY	1	
-3	960567-001	. BASIC DRIVE ASSEMBLY ..... (See Figure 5-4)	1	
-4	960566-013	. CHASSIS ASSEMBLY ..... (See Figure 5-5)	1	
-5	962235-001 962234-001 962233-001 964360-001 962236-001 964361-001	. PRINTED WIRING BOARD ASSEMBLY, ...	1 1 1 1 1 1	A B C D
-6	960629-001	. HARNESS ASSEMBLY	1	

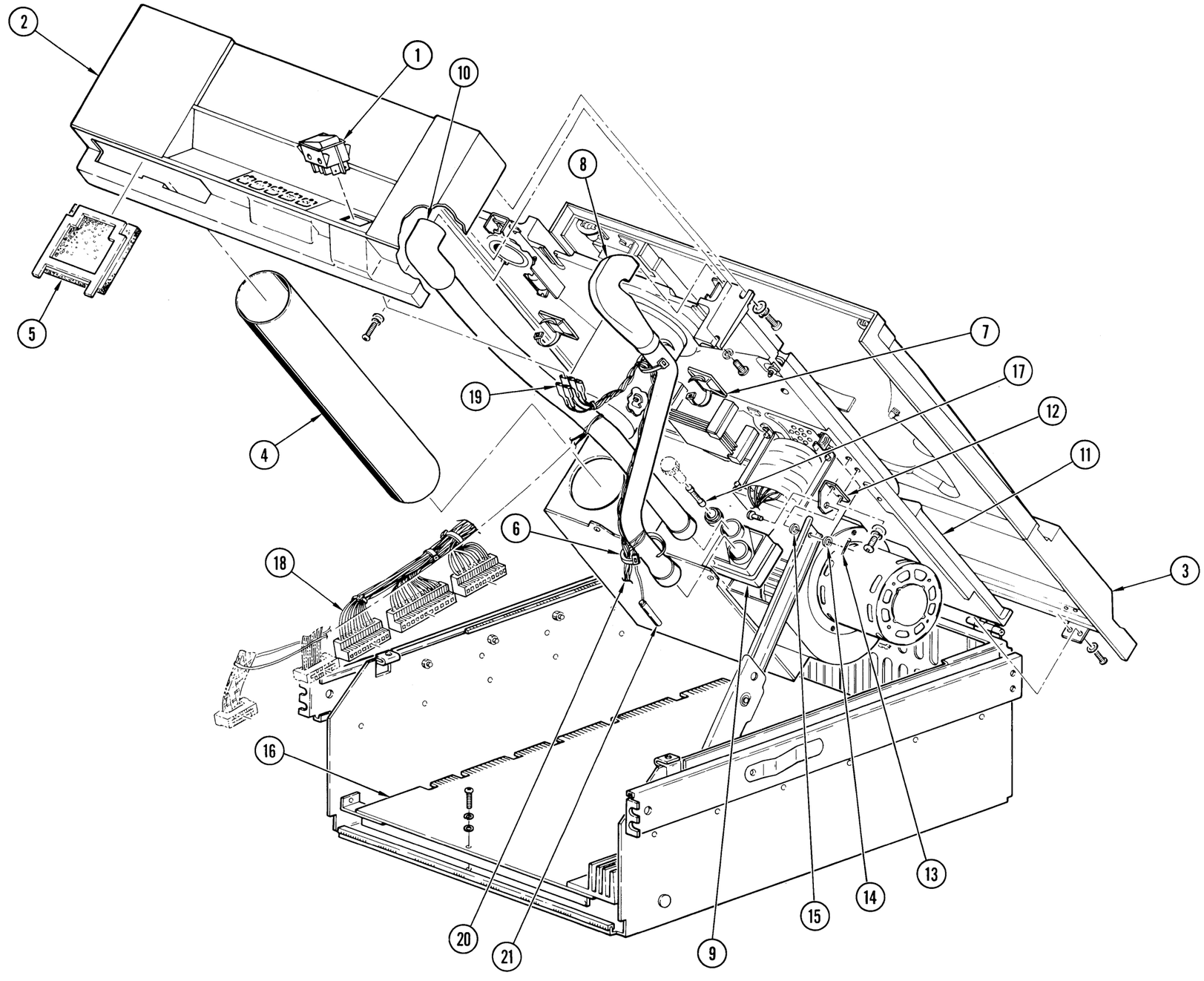


Figure 5-2. CacheTape Unit (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2	960652-004	MAGNETIC TAPE TRANSPORT, Model ..... M890, 75 ips, 1600 bpi	REF	A
	960654-004	MAGNETIC TAPE TRANSPORT, Model M890, ... 75 ips, 3200 bpi	REF	B
	960666-004	MAGNETIC TAPE TRANSPORT, Model ..... M891, 125 ips, 1600 bpi	REF	C
	960688-004	MAGENTIC TAPE TRANSPORT, Model ..... M891, 125 ips, 3200 bpi	REF	D
-1	760105-570	. SWITCH, Power, ...	1	A,B,C,D
	960180-001	. SWITCH, Power, TUV	1	E
-2	960359-001	. FRONT PANEL ASSEMBLY ..... (See Figure 5-3 for breakdown)	1	
-3	960057-001	. TOP COVER ASSEMBLY	1	
-4	760101-795	. . AIR DUCT (Tube)	1	
-5	960027-001	. FILTER, Air	1	
-6	210229-516	. TY-RAP, 8 in	2	
-7	970457-001	. CABLE CLAMP, adhesive backed	3	
-8	160107-478	. DUCT, Air, front panel	1	
-9	760101-609	. NOZZLE, Blower	1	
-10	760106-554	. DUCT, Air, top plate	1	
-11	960567-001	. BASIC DRIVE ASSEMBLY ..... (See Figure 5-4 for breakdown)	1	
-12	760101-660	. BRACKET, Support, top plate assembly	1	
-13	205042-509	. PIN, Cotter, 1/16 x 1/2 in. lg	1	
-14	207104-021	. WASHER, Flat, No. 10	1	
-15	961084-001	. SPACER	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-2				
-16	962235-001	. PRINTED WIRING BOARD ASSEMBLY, ...	1	A
	962234-001	Drive/Formatter	1	B
	962233-001		1	C
	964360-001		1	
	962236-001		1	D
	964361-001		1	
-17	211151-330	. FUSE, 3AG, slo-blo, 3 amp	1	
-18	960629-001	. HARNESS ASSEMBLY	1	
-19	160105-453	. HARNESS ASSEMBLY, Power switch	1	
-20	970134-001	. LANYARD, Elastic	1	
-21	760105-519	. PIN, Safety	1	

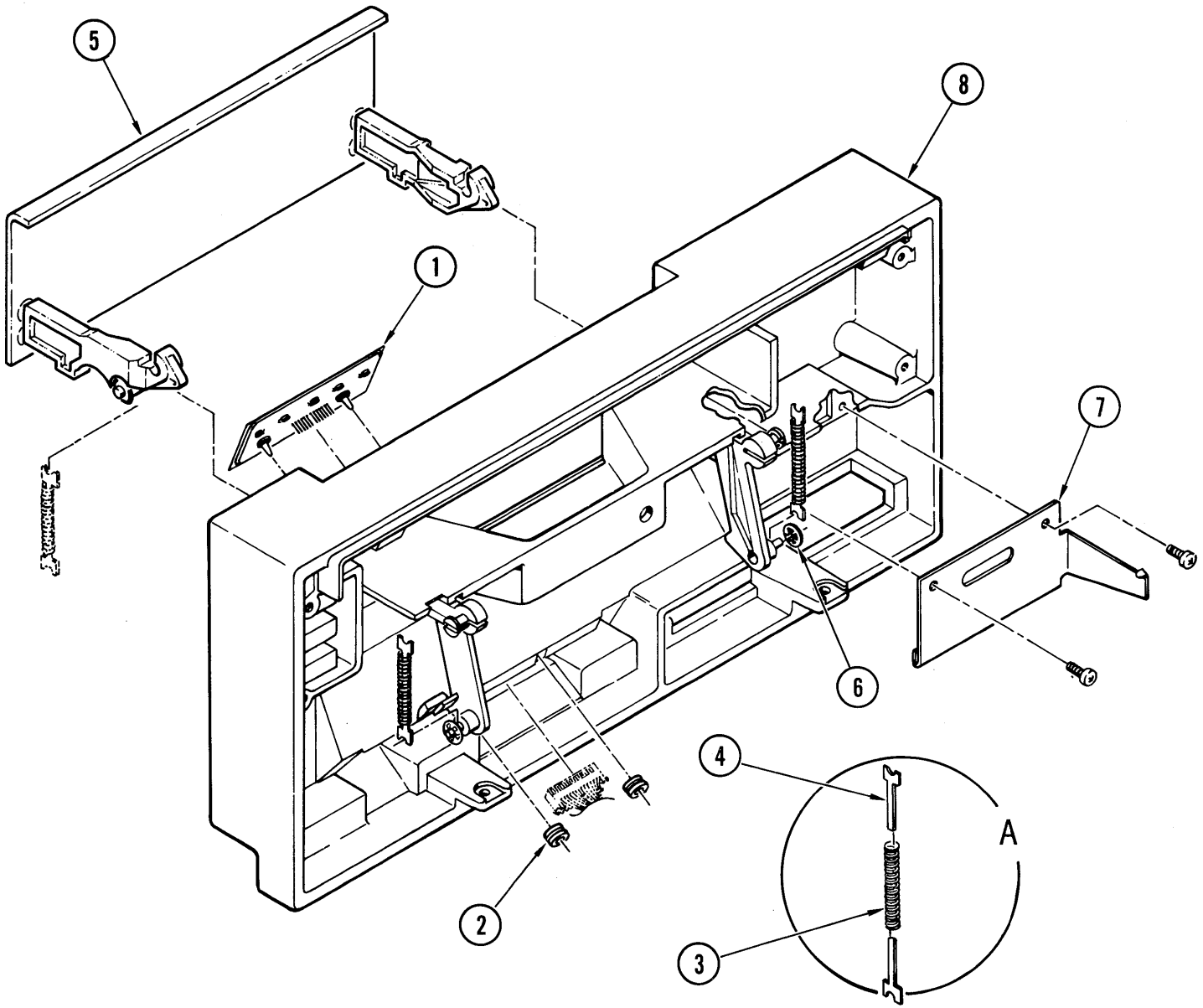
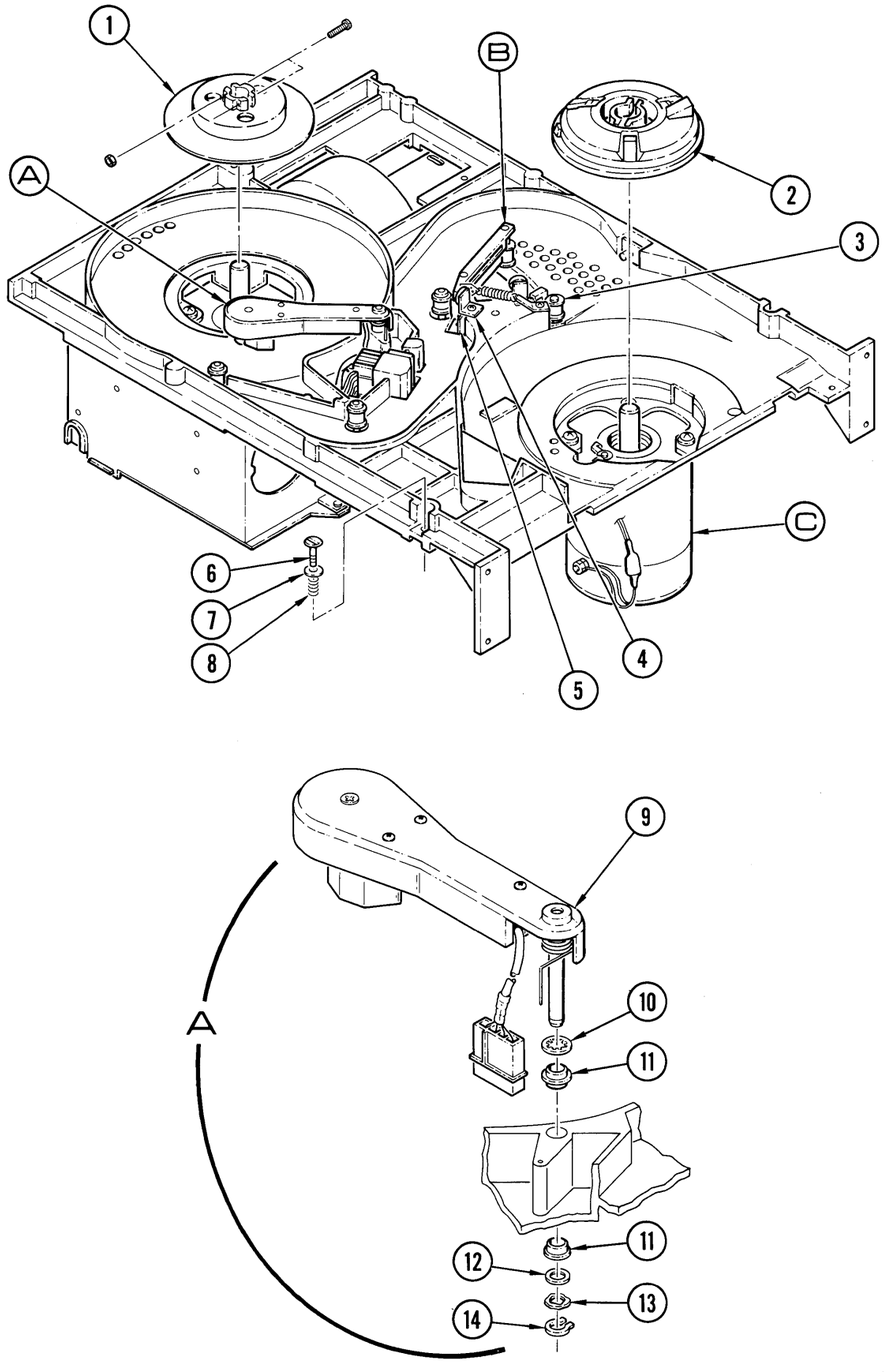


Figure 5-3. Front Panel Assembly (Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-3	960359-001	FRONT PANEL ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	961414-003	. TOUCH SWITCH, Tactile response.....	1	
-2	205287-006	. RUBBER GROMMET	2	
-3	210001-013	. SPRING, Compression, 5-lb.....	2	
-4	760101-591	. GUIDE, Spring	4	
-5	964032-002	. DOOR ASSEMBLY	1	
-6	210200-016	. RING, Retaining, push-on	2	
-7	760101-531	. LATCH, Rack	1	
-8	760102-662	. FRONT PANEL, Painted	1	



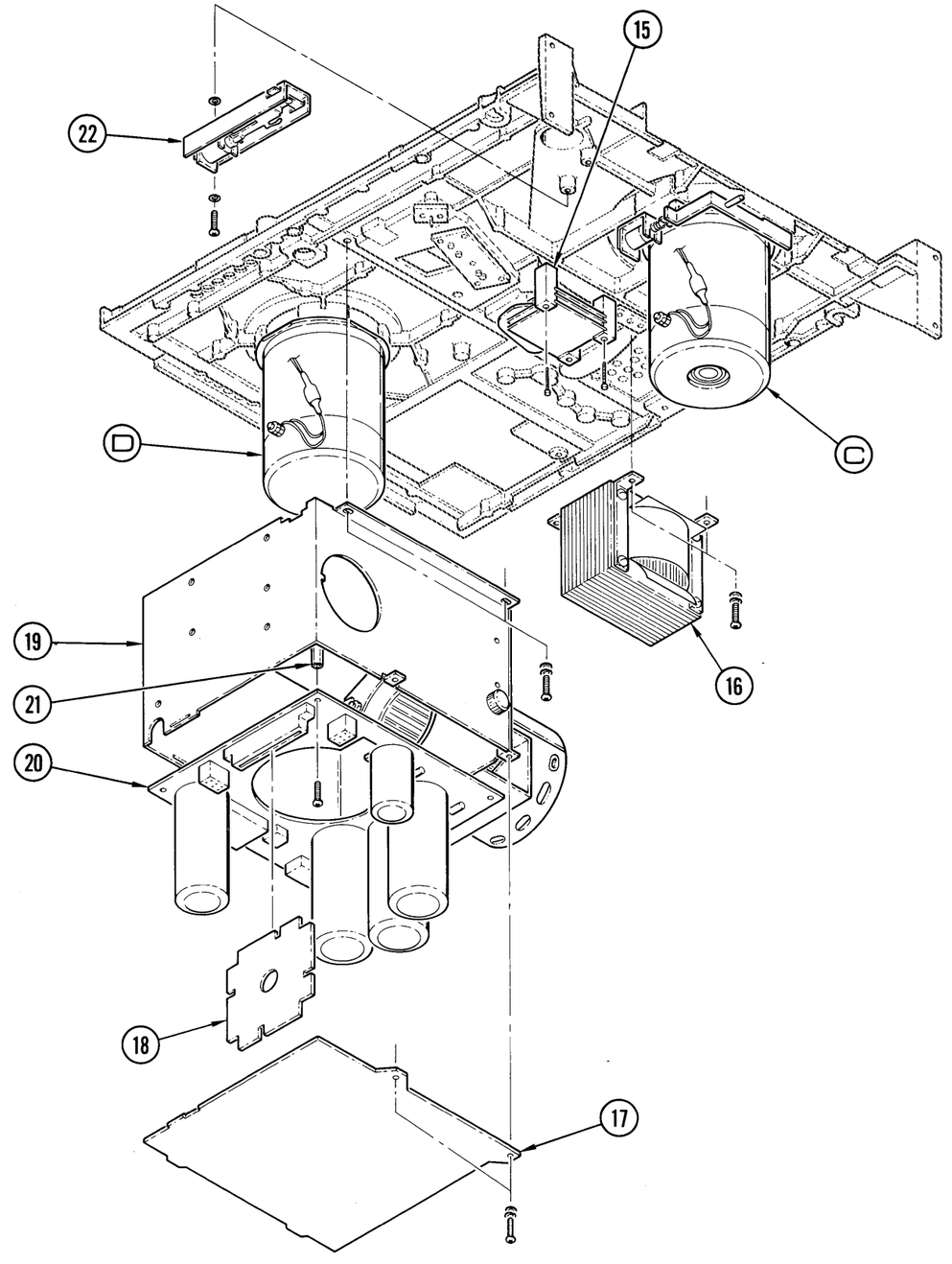


Figure 5-4. Basic Drive Assembly (Exploded View)

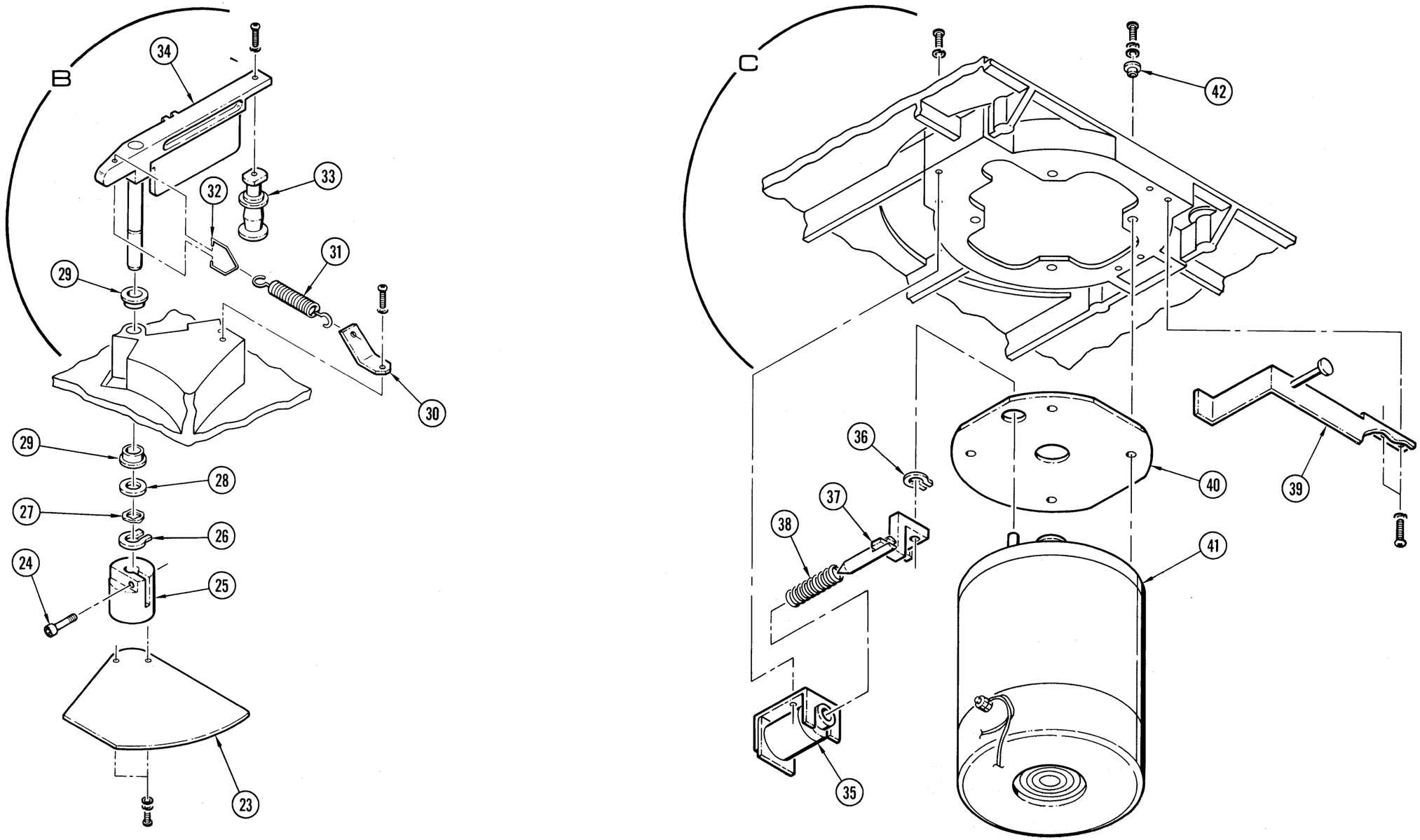
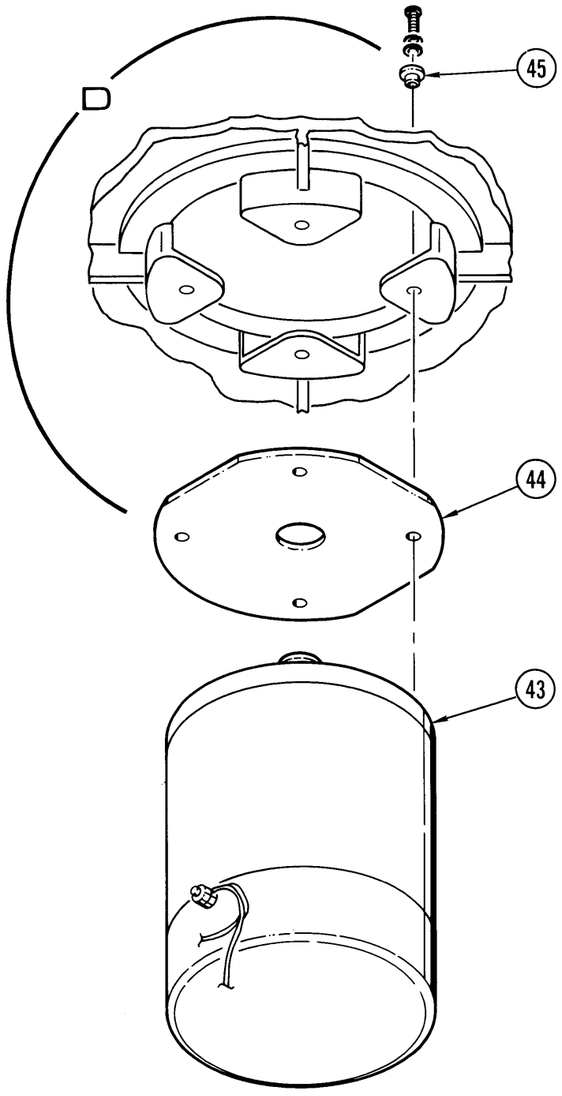


Figure 5-4. Basic Drive Assembly
(Exploded View)



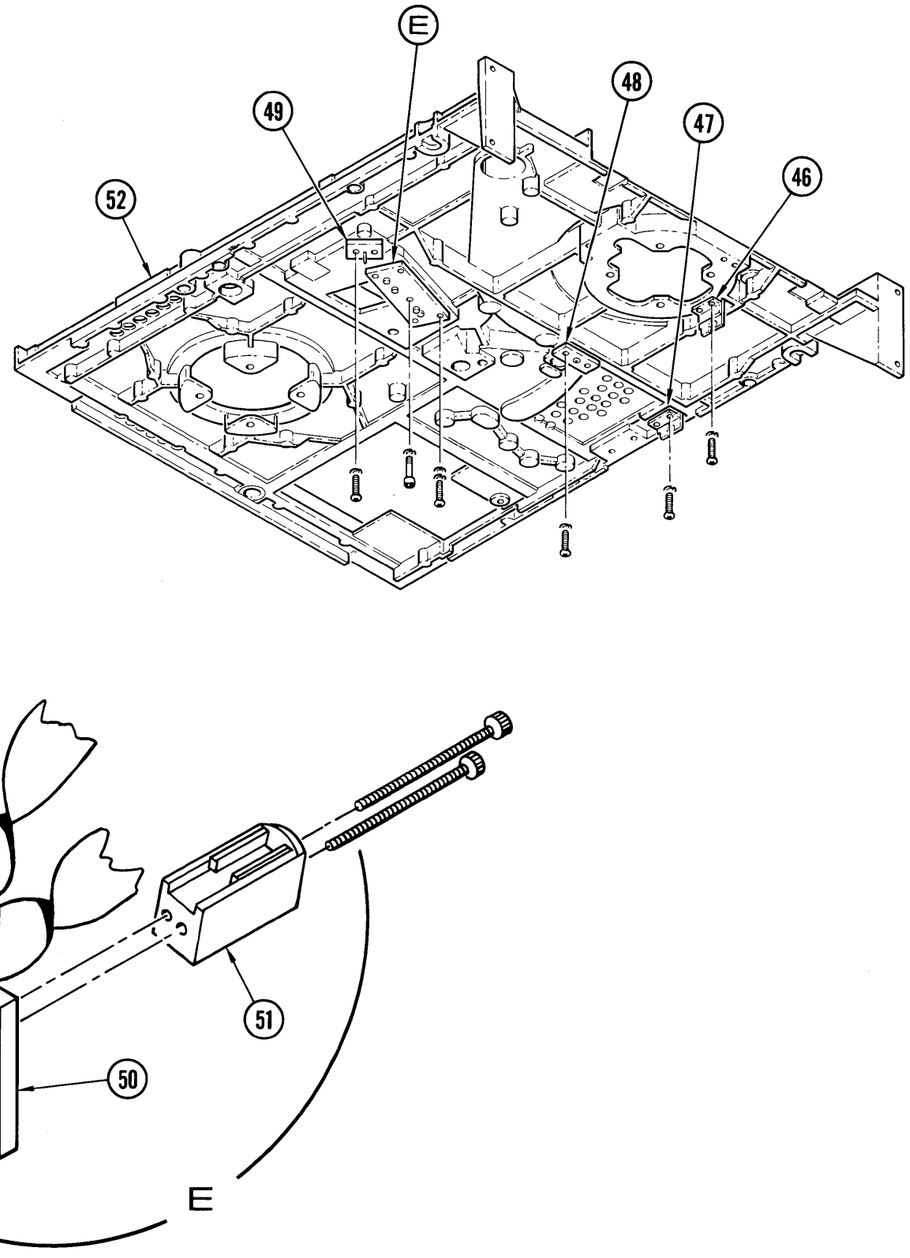


Figure 5-4. Basic Drive Assembly
(Exploded View)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4				
	960567-001	BASIC DRIVE ASSEMBLY ..... (See Figure 5-2 for next higher assembly)	REF	
-1	760106-567	. HUB, Takeup	1	
-2	160101-406	. SUPPLY HUB ASSEMBLY	1	
-3	160103-433	. TAPE SENSOR ASSEMBLY, Molded.....	1	
-4	160106-478	. BUMPER ASSEMLBY	1	
	160106-479	. BUMPER ASSEMBLY	1	
-5	160101-009	. PRINTED WIRING BOARD ASSEMBLY.....	1	
		Reflective Sensor, EOT/BOT.....	1	
-6	962197-001	. SCREW, Captive, quick opening	2	
-7		. DELETED	0	
-8	962653-001	. SPRING, Compression, fastener	2	
-9	160105-433	. TACHOMETER ASSEMBLY.....	1	
-10	210200-037	. RING, Retaining, Push-On	1	
-11	210067-001	. BEARING, 1/4 x 3/8 in.	2	
-12	731911-102	. SHIM, .005 in. thick, 1/4 in. ID	AR	
-13	210008	. WASHER, Wave spring	1	
-14	205226-050	. RING, Grip, 1/4 in. ID	1	
-15	160101-471	. CAPACITOR PLATE ASSEMBLY.....	1	
-16	160106-402	. TRANSFORMER ASSEMBLY	1	A,B,C,D
	960199-002	. TRANSFORMER ASSEMBLY	1	E
-17	960015-001	. COVER ASSEMBLY, Power supply housing	1	
-18	760102-102	. PWB VOLTAGE SELECT	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4				
-19	960292-001	. POWER SUPPLY HOUSING ASSEMBLY ..... (See Figure 5-6 for breakdown)	1	A,B,C,D
	960292-002	. POWER SUPPLY HOUSING ASSEMBLY ..... (See Figure 5-6 for breakdown)	1	E
-20	960415-001	. PWB ASSEMBLY, Power Supply ..... (See Figure 5-11 for breakdown)	1	
-21	210030-250	. STANDOFF, 1/4 Hex, 1, 6-32	4	
-22	160101-418	. DOOR LOCK ASSEMBLY	2	
	160103-499	. COMPLIANCE ARM ASSEMBLY	1	
-23	760102-575	. SHUTTER, Molded	1	
-24	970938-405	. SCREW, Torx	1	
-25	963430-001	. HUB, Capacitor shutter	1	
-26	210200-032	. RING, Retaining, external, 1/4 in.	1	
-27	210008	. WASHER, Wave spring	1	
-28	731911-102	. SHIM, 0.005 in. thick x 1/4 in. ID	1	
-29	210067-001	. BEARING, 1/4 x 3/8 in.	2	
-30	760101-565	. . BRACKET, Spring, compliance arm	1	
-31	210006-010	. . SPRING, Extension	1	
-32	760101-554	. . CLIP, Spring	1	
-33	760104-500	. . TAPE GUIDE, Crowned roller, short	1	
-34	160104-492	. . ARM AND SHAFT ASSEMBLY	1	
-35	760101-840	. SOLENOID, 24VDC continuous	1	
-36	210200-001	. RING, Retaining	1	
-37	960745-001	. BELLCRANK, Assembly	1	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-4				
-38	760101-704	. SPRING, Compression	1	
-39	960930-001	. BRACKET, Hub, Unlock.....	1	
-40	760101-756	. INSULATOR, Motor	1	
-41	760101-527	. MOTOR, Permanent magnet, 4 in. ..... diameter, supply	1	
-43	799031-201	. MOTOR, Permanent magnet, ... 4 in. dia, takeup	1	
-42	760101-768	. WASHER, Shoulder, insulating	4	
-44	760101-756	. INSULATOR, Motor	1	
-45	760101-768	. WASHER, Shoulder, insulating	4	
-46	160101-005	. PRINTED WIRING BOARD ASSEMBLY, ... File protect	1	
-47	160104-401	. ROLLER GUIDE ASSEMBLY.....	1	
-48	160101-010	. PRINTED WIRING BOARD ASSEMBLY, ... Reflective sensor, Tape-In-Path	1	
-49	961139-001	. HEAD ASSEMBLY.....	1	
-50	131047-001	. . TAPE SCRAPER ASSEMBLY	1	
-51	160104-400	. ROLLER GUIDE ASSEMBLY.....	3	
-52	760106-547	. TOP PLATE	1	

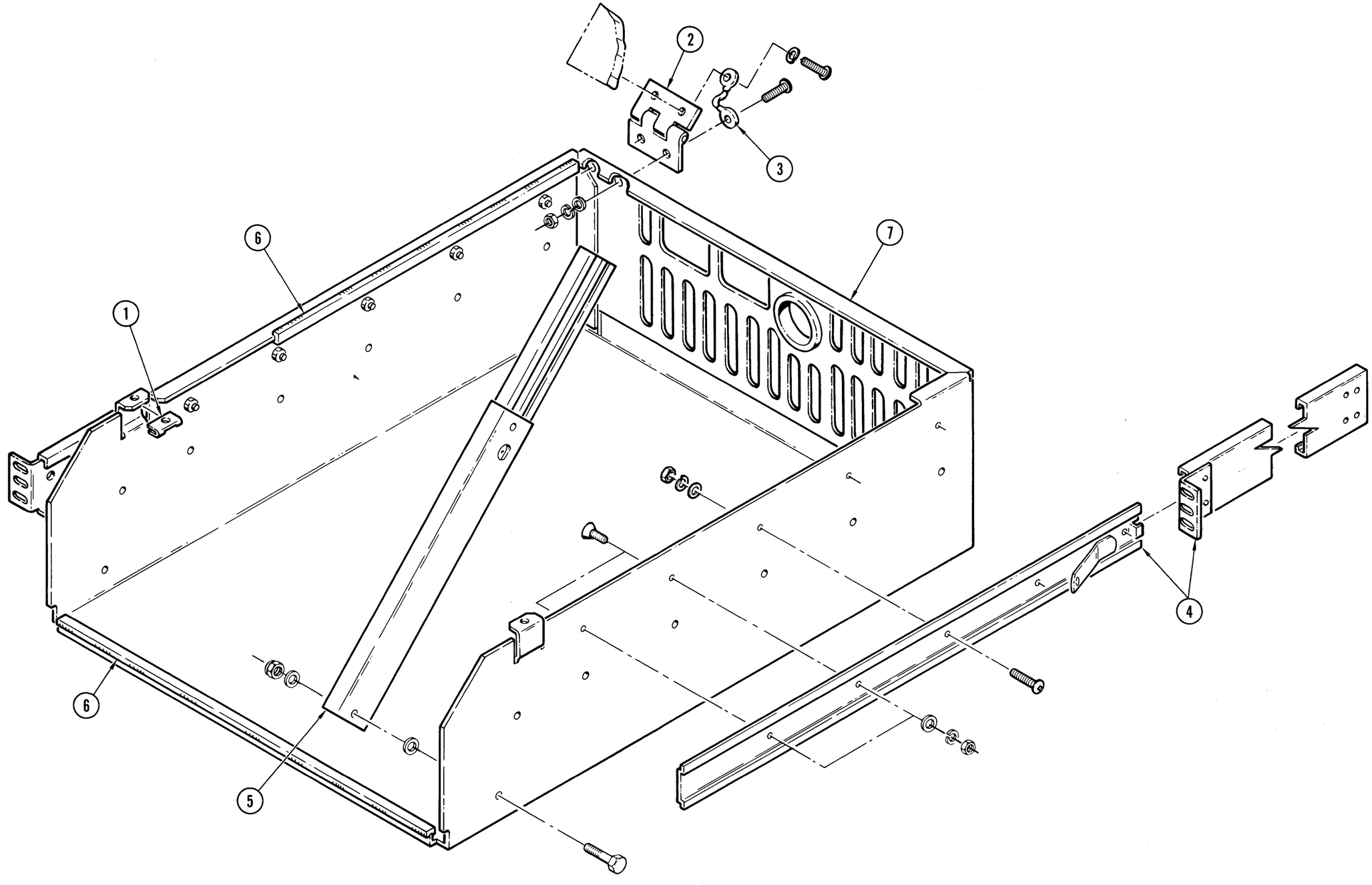


Figure 5-5. Chassis Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-5				
	960566-013	CHASSIS ASSEMBLY ..... (See Figure 5-1 for next higher assembly)	REF	
-1	210116-027	. FASTENER, Clip-on	2	
-2	760103-535	. HINGE.....	2	
-3	960032-001	. GROUND STRAP, Chassis	1	
-4	960274-001	. SLIDE ASSEMBLY, Modified	2	
-5	160106-408	. SUPPORT ASSEMBLY, Top plate	1	
-6	205288-200	. GROMMET, Strip	2.5	
-7	960073-001	. CHASSIS, Narrow, modified	1	

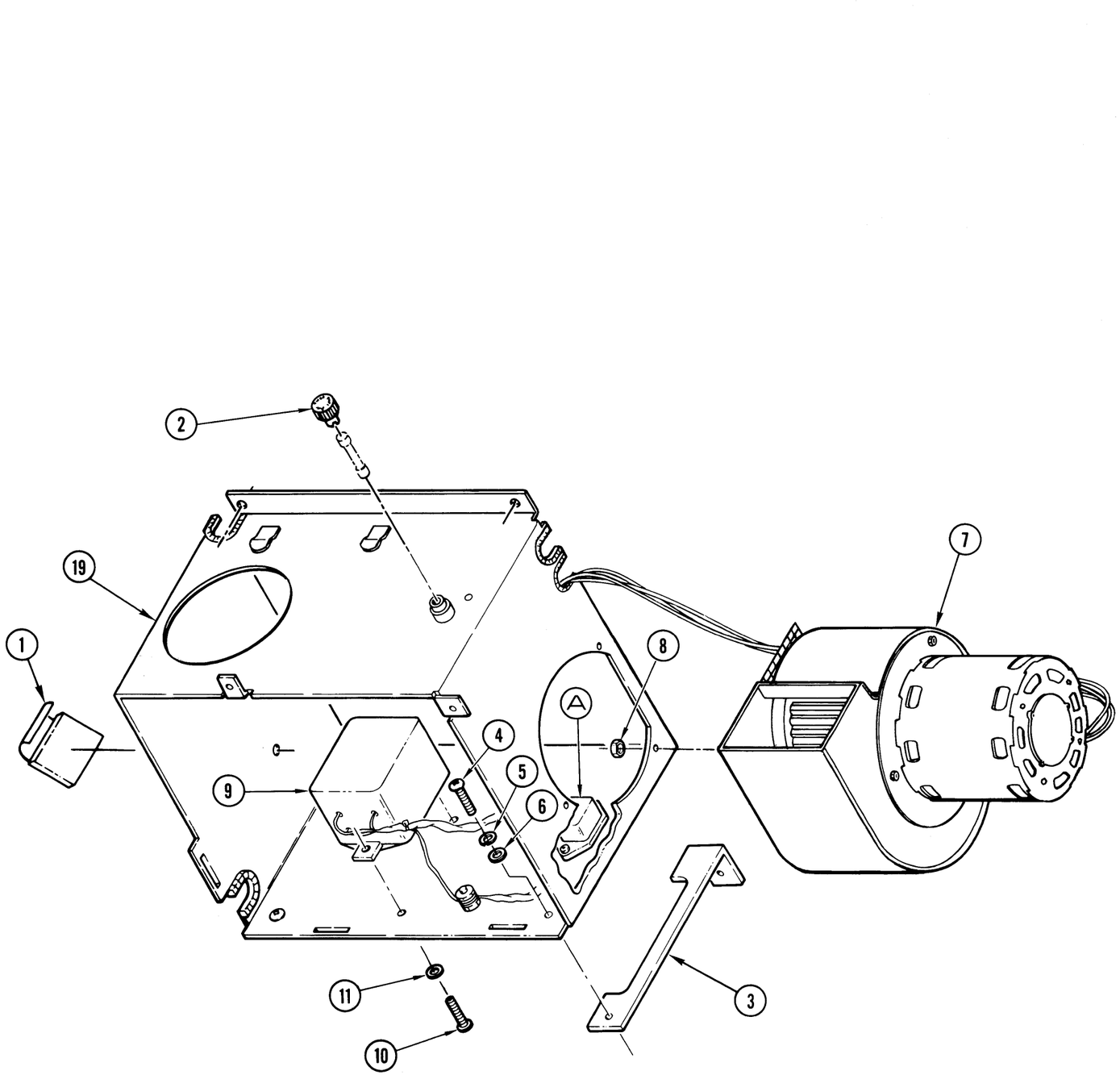


Figure 5-6. Power Supply Housing Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-6	960292-001	HOUSING ASSEMBLY, Power Supply Assembly ..... (See Figure 5-4 for next higher assembly)	REF	A,B,C,D
	960292-002	HOUSING ASSEMBLY, Power Supply Assembly ..... (See Figure 5-4 for next higher assembly)	REF	E
-1	970457-001	. CABLE CLAMP, Adhesive backed	1	
-2	970511-001	. FUSEHOLDER, Panel	1	
-3	760106-540	. BRACKET	2	
		(ATTACHING PARTS)		
-4	213092-106	. SCREW, Socket head cap ..... 10-32 x 3/8 in lg, black only	2	
-5	207102-011	. WASHER, Split lock, No. 10	2	
-6	207104-021	. WASHER, Flat, No. 10	2	
-7	160105-439	. AIR PUMP ASSEMBLY.....	1	A,B,C,D
	960488-001	. AIR PUMP ASSEMBLY.....	1	E
		(ATTACHING PARTS)		
-8	970219-012	. NUT, Hex, No. 8-32, Locking	3	
		-- -- -- * -- -- --		
-9	960294-001	. FILTER, ASSEMBLY, IEC	1	
		(ATTACHING PARTS)		
-10	213271-606	. SCREW, Pan head, phillips, ... 6-32 x 3/8 in lg, cadmium, black or zinc	2	
-11	207605-021	. WASHER, Flat, No. 6	2	
		-- -- -- * -- -- --		
-12	210555-027	. TERMINAL, Ring ..... 22-16 AWG, No. 8	3	
-13	207801-021	. WASHER, Flat, No. 8	2	
-14	207802-011	. WASHER, Split lock, No. 8	2	

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY	USABLE ON CODE
5-6				
-15	207803-051	. NUT, Hex, No. 8, 8-32	2	
		-- -- -- * -- -- --		
-16	960412-001	. RECEPTACLE ASSEMBLY	1	
		(ATTACHING PARTS)		
-17	970099-001	. RIVET, Pop, 1/8 inch dia	2	
-18	970035-005	. POWER CORD, AC Line	1	
-19	960293-001	. HOUSING, Power Supply	1	

SECTION VI

GLOSSARY OF TERMS

AD0-AD15	Multiplexed address/data lines used to provide addresses and route data between the microprocessor and certain memory devices.
A/D	Analog-to-digital converter.
ADSTB	DMA address strobe output used to strobe the upper address byte into the cache address latch.
AL0-AL15	Latched address lines used by the microprocessor to address and enable control circuit memory devices and I/O devices.
$\overline{AS}$	Microprocessor address strobe. When active, indicates that the signals on the address lines are valid addresses.
AX0-AX7	DMA address lines. The four least significant bits (AX0-AX3) are bidirectional; the four most significant bits are outputs and are enabled only during DMA service.
BITCLK	Bit Clock. Used to generate PECLK when both channel two and channel one are dropped.
Block	Term identifying a data record. Block sizes of 9K, 16K, 24K, or 32K bytes are selectable via configuration switch U3T.
BOT	Beginning of Tape. Indicated by a reflective marker placed on the tape that is detected by an optical sensor.
BPI	Bits per inch. Specifies the packing density of data on the tape (1600 bpi standard, 3200 bpi optional).
B/$\overline{W}$	Byte/Word. A microprocessor output that defines the type of memory reference on the address/data bus.
CAS	Column Address Strobe. Used in cache memory addressing to enable columns of data in the cache RAM's.
CDATAX	Corrected Data Multiplexed. Data byte that is sent to the cache bus register in serial form.

CHANP, 0-7	Write data transmitted to the write head via drivers U17J and U17K.
CHDROP P, 0-7	Channel Drop Multiplexed. This signal represents the multiplexed channel drop signals.
CIO	Counter/timer and parallel I/O unit. Devices used to generate timing signals and provide I/O parts for the microprocessor.
CLK4	A 3.84-MHz clock signal used as a peripheral clock (PCLK) by the CIO's, and by the DMA logic and cache memory addressing circuit.
CLK5	A 3.84-MHz clock signal used to clock the analog-to-digital converter.
Command Reinstruct Time	During streaming operation, a period of time after reading or writing the last character of a data block in which the system must instruct the tape drive either to continue or enter a repositioning cycle.
CTU	Short form for the Models M890 and M891 CacheTape Unit.
DAC	Digital-to-analog converter device.
$\overline{\text{DACK0}}$-$\overline{\text{DACK3}}$	Data acknowledge signals from the DMA. Used to acknowledge the receipt of Data Request signals (DREQ0-DREQ3) from the microprocessor.
DATA0X	Data Zeroes Multiplexed. This signal represents the serialized data bits input into the skew buffer.
DATA P, 0-7	Data. Refers to the data lines from the read logic to the formatter.
DAVL P, 0-7	Data Available. Term identifying data that is positioned at the read head and is ready to be clocked into the formatter.
DAVLX	Data Available Multiplexed. This signal is used to input the serialized data into the skew buffer.
$\overline{\text{DCLK}}$	Data Clock. Generated in read skew buffer circuit; used in the cache bus interface logic to latch data bits to the read data lines.
DCLK1	Data Clock 1. Alternate input to the formatter read clock circuitry. Used in the event of data dropout in Read Channel 2.
DCLK2	Data Clock 2. Primary input to the formatter read clock circuitry. Synchronizes PE clock to the data rate.
$\overline{\text{DINLOW}}$	Data in Low. Enables write data to be clocked into the write formatter circuit from the write formatting control circuit.
DMA	Direct Memory Access controller. Provides control of cache memory operations independent of direct microprocessor control.

DMAIO — DMA Input/Output. Generated in the DMA control logic by signals from the microprocessor; used as a chip select signal to enable the DMA controller.

DOUT — Data Out. This signal is used to enable the output from the skew buffer.

DREQ0 — DMA Request 0. Request for DMA service to transfer data between cache memory and physical tape. (Highest priority DMA request.)

DREQ1 — DMA Request 1. Request for DMA service to transfer data between cache memory and host interface.

DREQ2 — DMA Request 2. Request for DMA service to perform microprocessor/cache memory communications via DMA.

DREQ3 — DMA Request 3. Request for DMA service to refresh cache memory. (Lowest priorty DMA request.)

$\overline{DS}$ — Data Strobe. This signal is initiated by the microprocessor and is used to strobe data in and out of the CPU.

DX0-DX7 — DMA data bus lines. Bidirectional three-state signals used to transfer data between the cache memory and the DMA.

EEVEN — Generated by the parity generator and used during a memory read function to notify the microprocessor that a parity error (even parity) has been detected.

$\overline{EOP}$ — End of Process. Generated by the DMA to indicate the completion of the current DMA service operation.

EOT — End of Tape. Indicated by a reflective marker placed on the tape that is detected by an optical sensor.

FBY — Formatter Busy. Generated by the transport status registers to signal the host interface on the IFBY line that tape motion is occurring.

File Mark — A special control block consisting of 80 flux reversals (40 characters) at 3200 frpi in channels P, 0, 2, 5, 6, and 7 with channels 1, 3, and 4 dc erased.

FRC1,2,3 — Flux Reversal Control Lines. These lines determine the write formatter mode of operation. They are used as follows:

	FRC1	FRC2	FRC3
Write ID Burst	1	0	0
Write File Mark	1	0	1
Write Data	1	1	1

frpi	Flux reversals per inch. The number of changes of polarity, or flux changes, that occur during each one-inch segment of tape.
FSEL	Formatter Select. This signal indicates drive is selected by comparing the unit number of the drive to the IFAD and ITAD lines. FSEL enables drive status information (IONL, IRDY, etc.) to be sent to the controller.
FWD	Forward. This signal indicates forward tape motion to the read discriminator circuit.
$\overline{\text{GAP}}$	Gap Detected. Generated by the block/gap detection logic when no channel activity is occurring to notify the microprocessor that a gap has been detected.
GO	Initiated by IGO from the interface. Indicates that the CTU is on-line and selected, and that a tape motion command has been initiated.
HLDA	Hold Acknowledge. Signals the DMA that the microprocessor has relinquished control of the cache bus.
HLDR	Hold Request. Sent from the DMA to the microprocessor to request control of the cache bus.
IBG	Interblock Gap. A 0.6-inch gap between blocks of data recorded on the tape.
ICER	Correctable Error. Interface output signal. During a read/write opration, indicates the occurrence of a correctable error.
ID Burst	Identification Burst. A burst at the beginning of the tape of 1600 frpi in the P channel and erasure in all other channels to indicate a PE tape.
IDBY	Data Busy. Interface output signal. Goes true after simulated ramp delay and remains true during execution of all channels initiated by IGO.
IDENT	Identification. Interface output signal. Pulsed when read head passes BOT marker to identify a 1600 bpi (PE) tape.
IEDIT	Edit. Interface input signal. With IWRT true, causes CTU to operate in the edit mode.
IEOT	End of Tape. Interface output signal indicating that the EOT marker has been detected.
IERASE	Erase. Interface input signal specifying the erase mode of operation.
IFAD	Formatter Address. Interface input signal used in combination with ITAD0 and ITAD1 and switches S1, S2, and S3 to select the CTU.

IFBY	Formatter Busy. Interface output signal indicating that tape motion is occurring.
IFEN	Formatter Enable. Interface input signal. Enables the CTU.
IFMK	File Mark. Interface output signal. Indicates that the CTU has detected a file mark.
IFPT	File Protect. Interface output signal indicating that a reel of tape without a file protect ring is mounted on a selected CTU.
IGO	Initiate Command. Interface input signal used to latch the command specified on the command lines into the selected CTU.
IHER	Hard Error. Interface output signal used to indicate that an uncorrectable error has been detected by the CTU.
ILDP	Load Point. Interface output signal used to indicate that the BOT marker is positioned in front of the photosensor.
ILWD	Last Word. Interface input signal used during a write operation to indicate that the character to be strobed into the formatter is the last character of the record.
$\overline{\text{INTA}}$	Interrupt Acknowledge. Generated in the microprocessor logic and sent to the CIO's to indicate that an interrupt acknowledge cycle is in progress.
Interblock Gap	See IBG.
INTERDEN	Interface Device Enabled. Generated by PULSE2, FSEL, and ONL; when true, indicates that the device is not rewinding, is selected, and is on-line.
I/$\overline{\text{O}}$	Input/Output. Generated in microprocessor section to specify that an input/output operation is taking place.
IONL	On-Line. Interface output signal. Indicates that selected CTU is accessible to the host controller.
$\overline{\text{IOR}}$	I/O Read. Control signal used to access data from host controller when writing data in cache memory.
$\overline{\text{IOW}}$	Input/Output Write. Used in conjunction with $\overline{\text{DACK0}}$ to generate WLATCH when transferring data under DMA control from cache memory to the write formatter.
ips	Inches per second. The speed at which tape is moved through the physical transport.
IRDY	Ready. Interface output signal. Indicates that CTU is on-line, not rewinding, and ready to accept a remote command.

IREV	Reverse. Interface input signal. With CTU ready and on-line, causes tape to move in the reverse direction when true and in the forward direction when false.
IREW	Rewind. Interface input signal. With CTU ready, on-line, and not at BOT, causes tape to rewind in reverse direction.
IRP, IR0-IR7	Read Data. Interface output signals that carry read data from the CTU to the host controller.
IRSTR	Read Strobe. Interface output signal. Pulses to indicate that a character is present on the controller interface.
IRWD	Rewinding. Interface output signal that indicates the tape is rewinding to beginning of tape.
IRWU	Rewind/Unload. Interface input signal. With CTU on-line, causes selected unit to go off-line, rewind to BOT marker, and then unload the tape.
ISU	Supply reel servo current. The drive signal from the DAC to the supply servo circuit.
ITAD0, ITAD1	Transport Address 0 and 1. Interface input signal used with IFAD and switches S1, S2, and S3 to select the CTU.
ITHR	Read Threshold. Generated by the DAC and used in the read circuits to set the level at which a read signal is detected.
ITU	Takeup reel servo current. The drive signal from the DAC to the takeup servo circuit.
IWFM	Write File Mark. Interface input signal. With IWRT true, causes a file mark to be written on the tape.
IWP, IW0-IW7	Write Data. Interface input signals that carry write data from the host controller to the CTU.
IWRT	Write. Interface input signal. When true, specifies the write mode, and when false, specifies the read mode.
IWSTR	Write Strobe. Interface output signal. Indicates that the character on the data lines has been recorded and the next character is needed.
KBS	Kilobytes per Second. Density of the data recorded on tape with respect to tape speed.
$\overline{\text{LASTW}}$	Last Word. This signal indicates the last data character to be written is present on the interface.
$\overline{\text{MEMR}}$	Memory Read. Three-state DMA signal used to access data from cache memory during a DMA read operation.

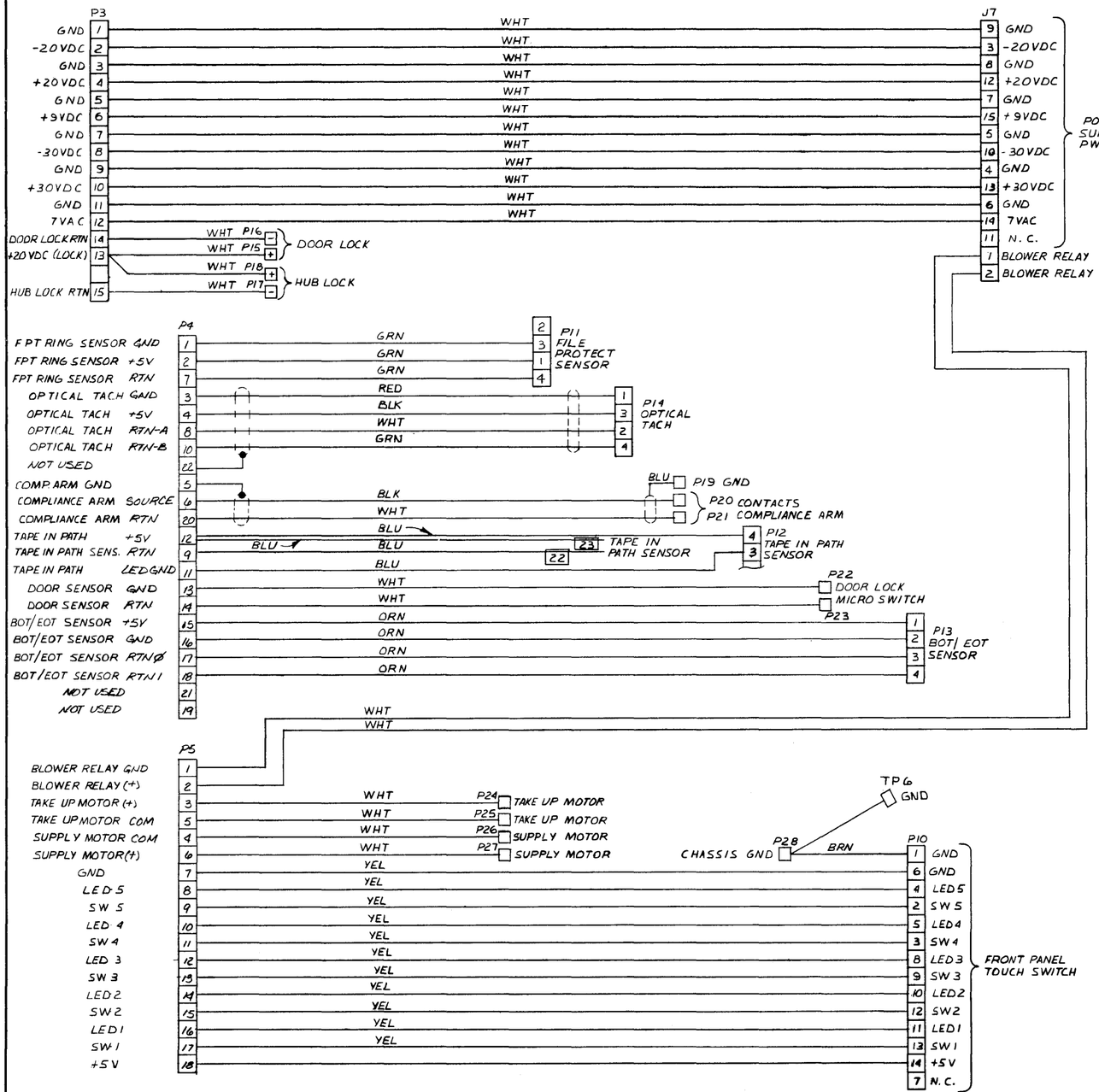
$\overline{\text{MEMW}}$	Memory Write. Three-state DMA signal used to enable the cache memory write function during a DMA write operation.
$\overline{\text{MREQ}}$	Memory Request. Tri-state output active low signal which indicates that the address bus holds a valid address for a memory read or write operation.
$\overline{\text{NVI}}$	Non-Vectored Interrupt. Generated by the analog-to-digital converter and sent to the microprocessor to request a non-vectored interrupt.
ONL	On-Line. Set by the microprocessor via the PULSE1 signal to indicate that the CTU is ready to accept commands from the host controller.
OUTLATCH0	Generated by the output status register to initiate the Formatter Busy (FBY) status signal.
PCLK	Peripheral Clock. The CPU clock signal used to clock the CIO's.
PE	Phase-Encode. The data recording format used by the CTU.
PECLK	Phase Encode Clock. Clock (22 times the data rate) that is used to synchronize the data in the formatter.
$\overline{\text{PENAB}}$	Phase Encode Enable. This signal enables formatter to send read strobes and data information.
Postamble	One all-ones byte and 40 all-zero bytes following a data block.
$\overline{\text{POSTERR}}$	Postamble Error. This signal is true when an error has been detected in the postamble.
Preamble	40 all-zero bytes followed by an all-ones byte preceding a data block.
PSEL	Parity Select. This signal gates parity channel from the read logic to the formatter.
PULSE 0	Pulse 0. This signal clocks the I/O Control register.
PULSE 1	Pulse 1. This signal sets the on-line flip-flop.
PULSE 2	Pulse 2. This signal resets the rewind flip-flop.
PULSE 3	Pulse 3. This signal sets the rewind flip-flop.
PULSE 4	Pulse 4. This signal resets the on-line flip-flop.
PULSE 6	Pulse 6. This signal resets the IGO flip-flop and the parity error flip-flop in the write data circuit after an error has been detected.
PULSE 7	Pulse 7. This signal is the dynamic RAM enable signal and is used to clock the DREQ0 flip-flop in the DMA control logic.

RAS	Row Address Strobe. Used in cache memory addressing to enable rows of data in the cache RAM's.
RDATA P, 0-7	Read Data. These signals are the nine data lines being read off tape.
$\overline{\text{RDCMD}}$	Read Command. Enables the outputs of the input motion commands latch, routing the motion commands to the microprocessor on the AD0-AD5 lines.
$\overline{\text{RDIN}}$	Read In. Generated in the microprocessor section during a CPU I/O read cycle; indicates that the CPU requests read data from the input motion commands logic, the DMA, or the analog-to-digital converter.
RDLD	Read Load. Enables the output of the read data latch in the cache read circuit.
$\overline{\text{RDROP P, 0-7}}$	Read Drop. This signal indicates the loss of data for a minimum of four character times. Used for block, file mark, and ID Burst detection.
Repositioning	In certain command sequences during streaming tape operation, places the tape in the correct position with respect to the record head when record velocity is attained during a subsequent command.
$\overline{\text{RES}}$	Reset. Input to the microprocessor. Active low signal that forces program counter to zero and initializes the CPU.
RESET	Generated in the $\overline{\text{RES}}$ logic and sent to the DMA to clear the command, status, request, and temporary registers. DMA is in the idle state following RESET.
RLATCH	Read Latch. Generated in the DMA control logic; clocks read data into the data latches in the cache read circuit.
RDP, RD0-RD7	Read data from the cache memory RAM's.
R/W, R/$\overline{\text{W}}$	Read/Write. Specifies the read/write status of the CPU.
RWD	Rewind. Set by the rewind latch in the motion commands circuit to specify a rewind operation.
SCAN P, 0-7	This signal selects which data channel will be multiplexed into the formatter.
SMDH	Supply Motor Drive High. This signal is used for the supply motor drive voltage.
SMDL	Supply Motor Drive Low. This signal is used for the supply motor return and current sense.

SODD	Summation Odd. This signal indicates the parity (odd or even) of the read data.
STRBX	This signal enables read strobes and read data from the formatter. Used to disable read strobes when the postamble has been detected.
SUMH	Supply Motor High. This signal is the supply motor drive signal that directly drives the motor.
SUML	Supply Motor Low. This is the return signal from the supply motor.
TMDH	Takeup Motor Drive High. This signal is used for the takeup motor drive voltage.
TMDL	Takeup Motor Drive Low. This signal is used for the takeup motor return and current sense.
TUMH	Takeup Motor High. This signal is the takeup motor drive signal that directly drives the motor.
TUML	Takeup Motor Low. This is the return signal from the takeup motor.
V9P	Voltage 9 Positive. This signal is the positive 9-vdc signal from the power supply that is used to generate the +5-vdc signal.
V20M	Voltage 20 Minus. Negative 20-vdc drive voltage for the reel servo circuits (clockwise rotation).
V30M	Voltage 30 Minus. Negative 30-vdc drive voltage for the reel servo circuits (counterclockwise rotation).
V30P	Voltage 30 Positive. Positive 30-vdc drive voltage for the reel servo circuits (clockwise rotation).
$\overline{\text{VHMON}}$	Voltage High Minus On. This signal enables -30 volts to the takeup and supply motors.
$\overline{\text{VI}}$	Vectored Interrupt. Used by the CIO when requesting a CPU interrupt.
VIN0	Voltage Input Zero. This signal is input voltage from the EOT sensor.
VIN1	Voltage Input One. This signal is input voltage from the BOT sensor.
VIN2	Voltage Input Two. This signal is input voltage from the compliance arm transducer logic.
VIN3	Voltage Input Three. This signal is used to determine supply servo EMF and voltage.

VIN4	Voltage Input Four. This signal is used to determine takeup servo EMF and voltage.
VIN6	Voltage Input Six. This signal is used to indicate the speed at which the compliance arm changes position.
VIN7	Voltage Input Seven. This signal is used to indicate the DAC servo offset voltage.
$\overline{\text{VRCERR}}$	Parity Error. This signal is true when a read parity error has been detected.
W2XCLK	Write 2 Times Clock. This signal clocks the data to the write head.
$\overline{\text{WAIT}}$	When active (low), this signal causes the CPU to go into the wait state.
WDCLK	Word Clock. This signal is used during a cache memory write operation to clock data from the host controller onto the cache bus.
WLATCH	Write Latch. This signal is used during a physical tape write operation to clock write data from the cache bus into the write formatter.
W/$\overline{\text{R}}$	Generated by R/$\overline{\text{W}}$ from the CPU; specifies the read/write status of the CPU.
$\overline{\text{WROUT}}$	Write Out. Generated in the microprocessor section during a CPU I/O write cycle; indicates that the CPU wants to input commands to the motion commands logic, the DMA, and the DAC.
WSTROBE	This signal is a clock that latches the write data into the formatter.
Z1A0-Z1A7, Z1B0-Z1B7, Z1C0-Z1C3, Z2A0-Z2A7, Z2B0-Z2B7, Z2C1, Z2C2, Z3A5-Z3A7, Z3B0-Z3B7, Z3C0-Z3C3	Input/output signals to/from the CIO's; used to interface with the CPU on the AD0-AD7 lines. (See Table 3-8 for additional information.)

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENG'R. RELEASE	LL	4/23/80	MT	4/25/80
B	INCORP ECO 7851	RL	7/20/80	MS	7/21/80
C	INCORP ECO 8028	LJ	8-13-80	MS	8-14-80



360101-320
REV C

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX ± ± .XXX ± ± ANGLES ±	APPROVALS	DATE
	DWN L. LIPTAK	4-23-80
	CHK	4/24/80
	MECH ENG	6-25-80
	ELEC ENG	6/24/80
	APPD ENG	6-25-80
	QC	6-25-80
DO NOT SCALE DRAWING	DOC CHK	6/26/80

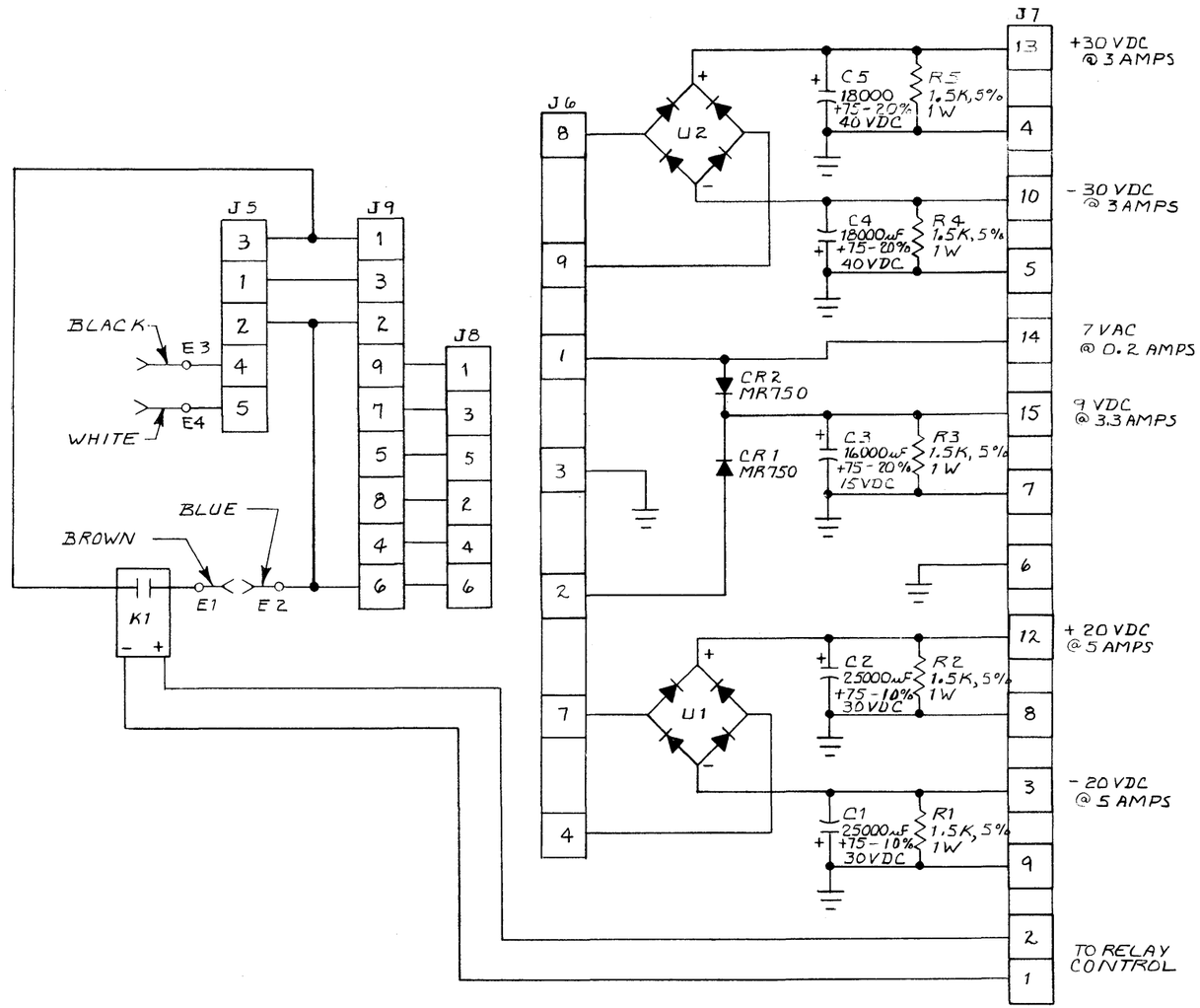
Cipher Data Products SAN DIEGO CALIF.

TITLE: SCHEM - HARNESS

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	360101-320	C

SCALE NONE SHEET 1 OF 1

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	[illegible]	EC	11/3/82	CK	11/4/82
B	INCORP ECO 15542	EC	3/29/83	CK	3/30/83



960026-001

REV B

D & D MGR	
ME MGR	4/10/82
DOC MGR	
UL/CSA	11/5/82

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE
	MECH	
	ELEC.	
	MFG	
	MATL	
	QA	
	MKT	
	ISSUED	

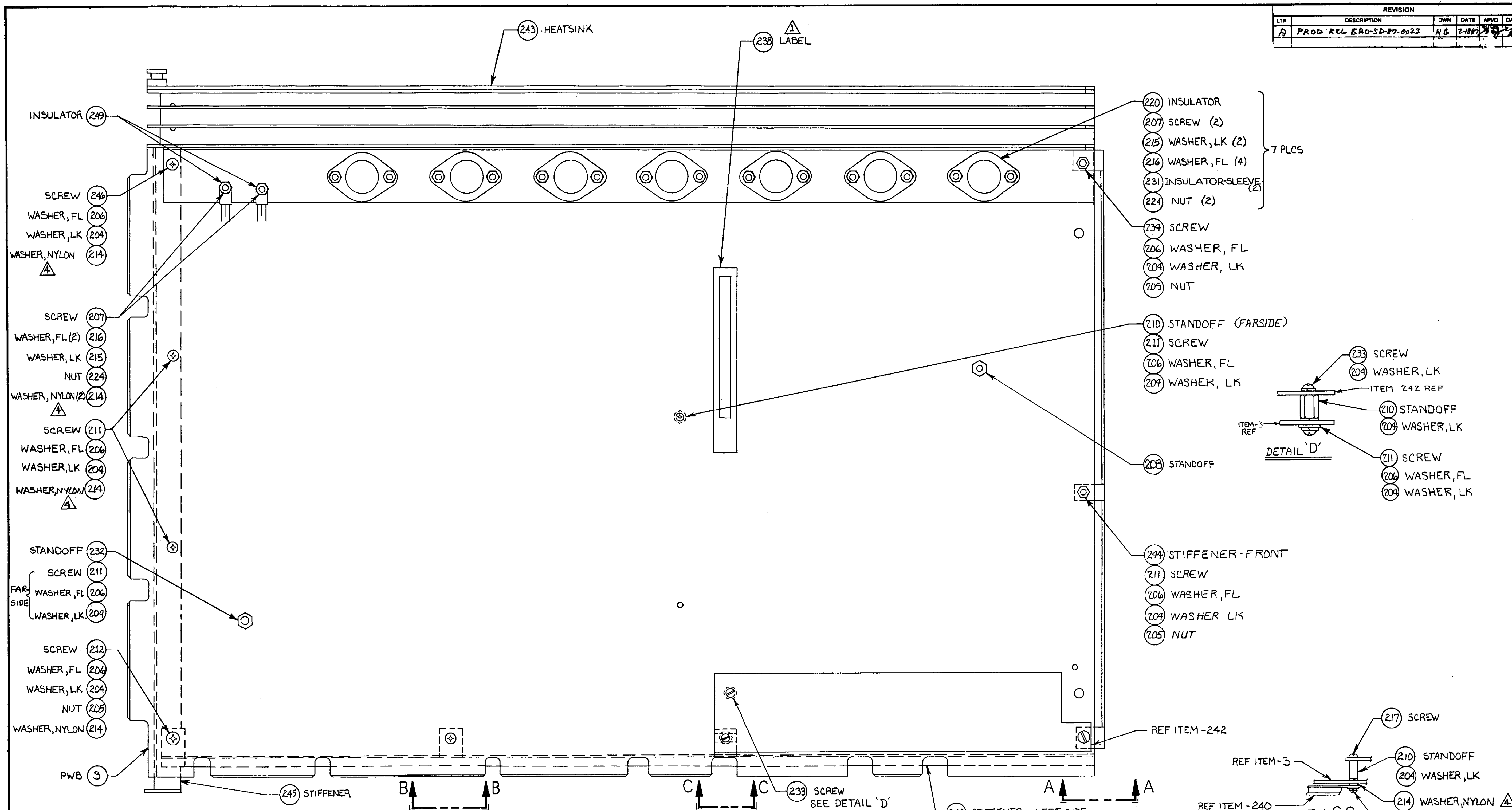
DWN B. Camargo 11/3/82
CHK M. Gambolt 11/5/82

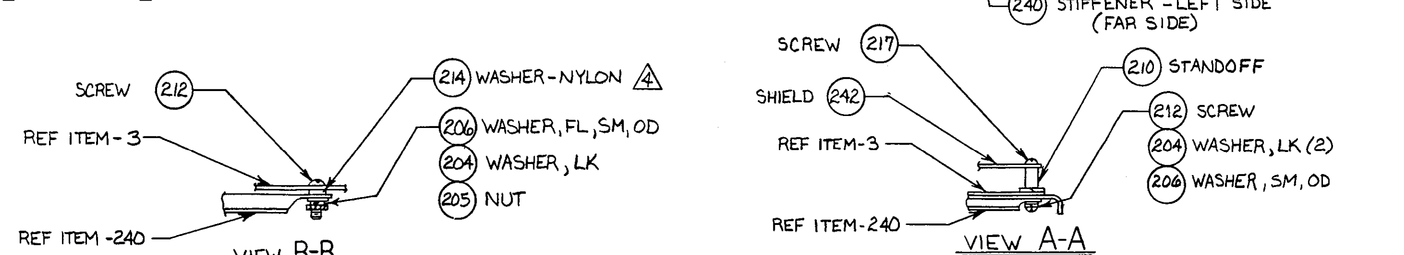
cipher data products, inc. SAN DIEGO CALIF.

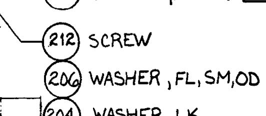
TITLE
SCHEM- PWB, POWER SUPPLY

CODE IDENT	SIZE	DWG NO	REV
32274	C	960026-001	B

SCALE NONE | MOD | SH 1 OF 1







7. COMPONENTS AT LOCATIONS R312, R307, R327, R328, L2 & L3 ARE NOT BEING USED.

6. RECTANGLE PAD ON I.C.'S DENOTES PIN-1.

5. ALL COMPONENTS WITH THE EXCEPTION OF Q17, Q21, Q19 and K1 ARE TO HAVE A MAX HEIGHT ABOVE THE PWB OF .43.

△4 INSTALL ITEM-214 BETWEEN STIFFENER AND BOARD, 6-PLACES.

3. ITEM-77 AND ITEM-84 TO BE INSTALLED AWAY FROM PWB THE THICKNESS OF THE COMPONENT.

2. FOR SCHEMATIC SEE 961658-300.

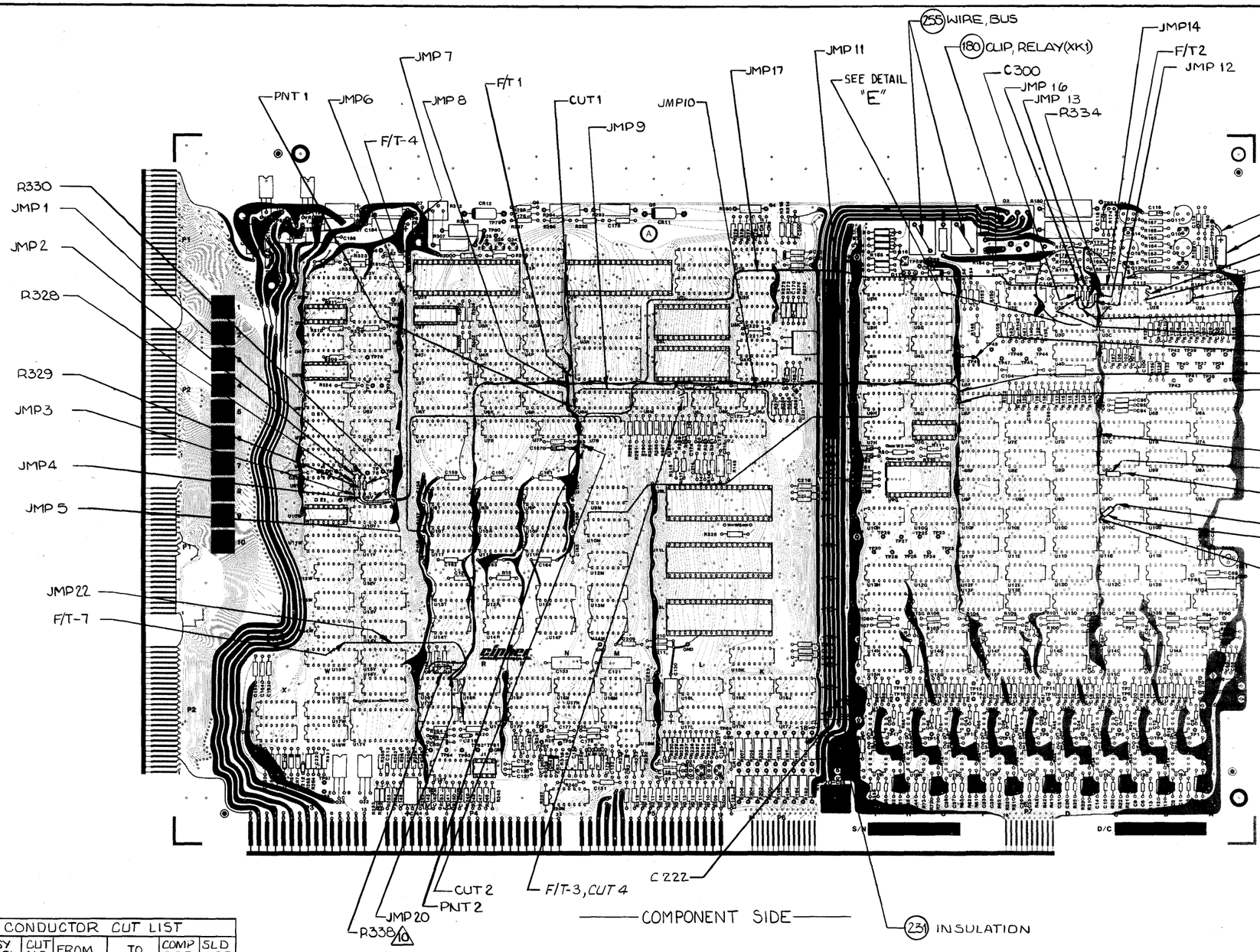
△1 MARK PART NUMBER AND REVISION LETTER ON LABEL (ITEM-238) USING A PERMANENT AND LEGIBLE MARKING METHOD.

NOTES:

REV			
SHEET	1	2	3

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	APPROVAL	DATE	DWN R. LOVEJOY 2/18/87	cipher data products, inc. SAN DIEGO CALIF
TOLERANCES ARE DECIMALS .X± .XX± .XXX± ANGLES±	DES ENG	2/18/87	CHK 2/18/87	
	SAFETY	2/19/87	TITLE PICTORIAL - PWB ASSY, DRIVE/FORMATTER	
	DES MGR	2-19-87		
	MFG ENG	2/19/87		
	QA B. Daras	2/19/87	CODE IDENT 32274	SIZE D · DWG NO 964283-000 · REV A
DO NOT SCALE DRAWING	MKT			
	ISSUED	2-1987	SCALE FULL	MOD · SH 1 OF 3

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE



12

JUMPER LIST

ASSY LEVEL	JMP NO	FROM	TO	COMP SIDE	SOLD SIDE	WIRE GA.	WIRE ITEM
9	1	U9V-13	U9V-12	X		30	253
	2	U9V-14	U9V-13	X			
	3	U9V-1	U7N-11	X			
	4	U9V-2	U7N-10	X			
	5	U9V-3	U7N-9	X			
	6	C157-B	F/T-4	X		26	254
	7	R306 LOCATION		X			
	8	C109-B	F/T-1	X		30	253
	9	U6N-20	C224-L	X			
	10	C224-L	R270-B	X			
	11	L10M-1	U6H-3	X		26	254
	12	U2D-6	F/T-2	X		30	253
	13	U2D-8	U2D-9	X			
	14	U2D-8	U2B-16	X			
	15	U2B-8	U2B-9	X			
963459-001 REV A	16	U2D-9	U2D-10	X			
	17	U7N-16	U2D-10	X			
	18	U2D-5	U2D-7	X			
963459 -002 REV A	19	U5F-11	R338	X		30	258
	20	R338	U16T-9	X		30	
	21	C148-B	F/T-6	X			
	22	U16-8	F/T-7	X			

11

12

COMPONENT TABLE

ASSY LEVEL	REF DES.	FROM	TO
9	R329	U9V-2	U9V-13
	R328	U9V-1	U9V-14
	R330	U9V-3	U9V-12
	R336	U2D-6	U2D-9
	R334	U2D-7	U2D-8
	C222	C53-T	C222-R
963459-001 REV. A	C300	U2D-5	U2D-10
	C301	C117-R	TP50
963459 -002 REV A	R338	U16T-9	C148-B
	C302	F/T-9	F/T-8 10
	C303	F/T-10	F/T-11

CONDUCTOR CUT LIST

ASSY LEVEL	CUT NO.	FROM	TO	COMP SIDE	SLD SIDE
9	1	U7N-16	PNT-1	X	
	2	U7N-16	PNT-2	X	
	3	U2B-16	F/T-5	X	
	4	C224-L	F/T-3	X	
963459-002 REV. A	5	FROM U13H-12			X
	6	FROM F/T-7			X

12 FOR EXTENSION OF REWORK TABLES SEE SHEET 3.

11 JUMPER 19 & 20 ARE TO BE TWISTED TOGETHER (MINIMUM 1 TURN PER INCH) PRIOR TO SOLDERING IN PLACE.

10 SECURE COMPONENTS BODY AND LEAD IN PLACE USING ADHESIVE ITEM 260, INSULATE BOTH ENDS WITH ITEM 248 OR 259 AS REQUIRED.

9 ASSY 963459-001 REV A CAN BE MADE FROM 961658-001 REV D.

8 ALL JUMPERS ARE TO BE TACK IN PLACE EVERY 1.5" USING ITEM 260 OR EQUIVALENT ADHESIVE AS IT REQUIRED.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ±
.XX ±
.XXX ±
ANGLES ±
DO NOT SCALE DRAWING

REV STATUS	REV
OF SHEETS	SH 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

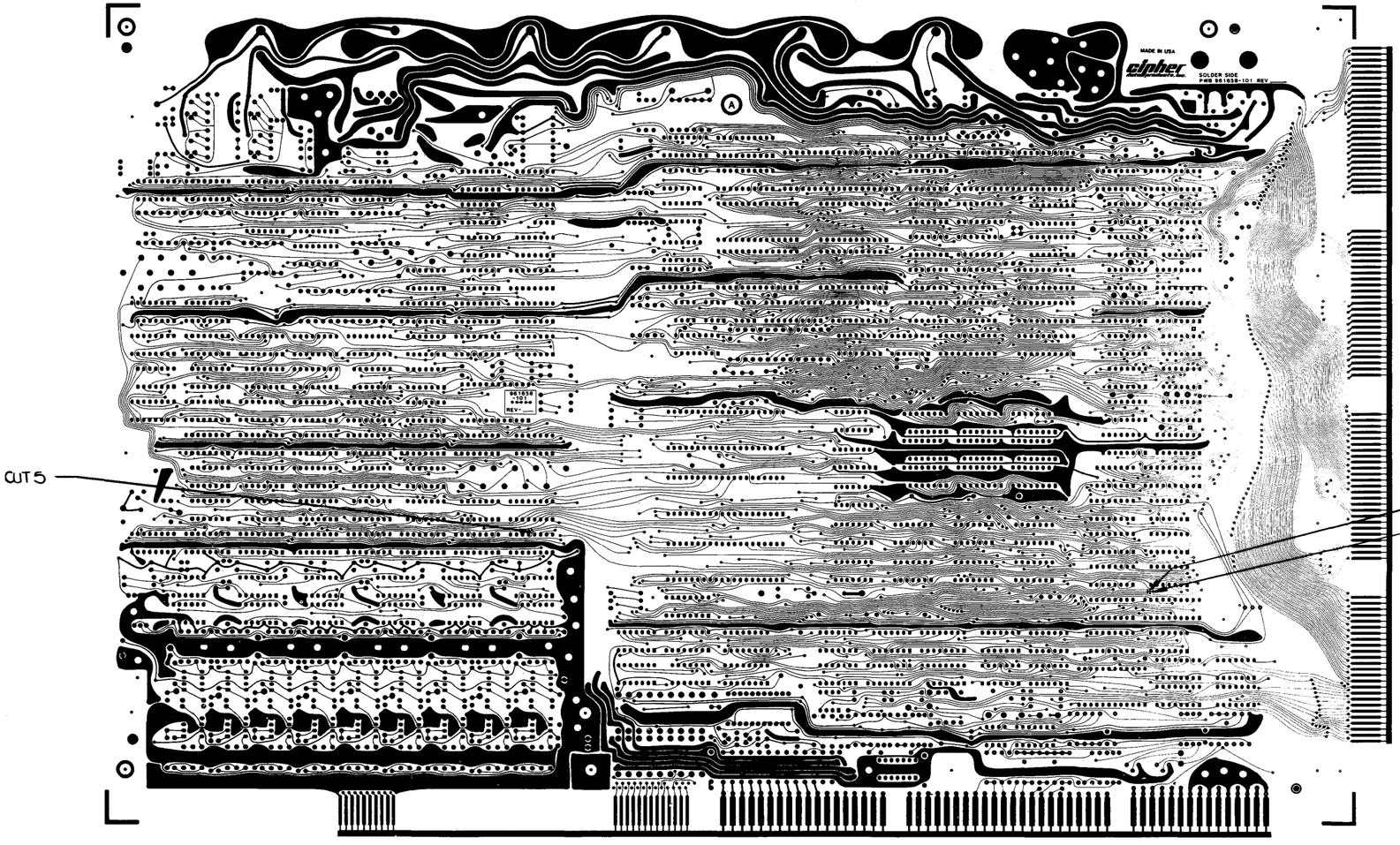
APPROVAL	DATE
OWN	
CHK	
DES ENG	
SAFETY	
DES MGR	
MFG ENG	
ISSUED	

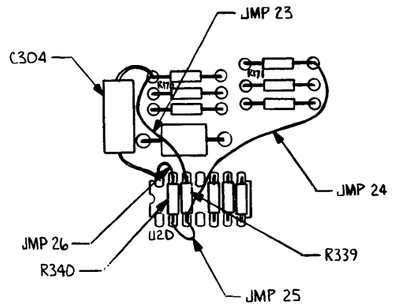
cipher SAN DIEGO CALIF

TITLE: PICTORIAL - PWB ASSY, DRIVE/FORMATTER

CODE IDENT	SIZE	DWG NO	REV
32274	D	964283-000	A

SCALE FULL MOD SH 2 OF 3





DETAIL "E" 8 10

8

JUMPER LIST

ASSY LEVEL	JMP NO.	FROM	TO	COMP SIDE	SOLD SIDE	WIRE AWG	WIRE ITEM
963459-003	23	U2D-12	R178(L)	X		30	253
	24	U2D-3	R171(R)	X		30	253
	25	U2D-2	U2D-3	X		30	253
	26	U2D-13	U2D-14	X		30	253

10

COMPONENT TABLE

ASSY LEVEL	REF DES	FROM	TO
963459-003	R339	U2D-3	U2D-12
	R340	U2D-2	U2D-13
	C304	U2D-14	R178(L)

COMPONENT DELETE

ASSY	
963459--003	C102, R159, C115

CODE IDENT	SIZE	DWG NO.	REV.
32274	D	964283-000	A
SCALE	MOD	SH 3 OF 3	

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	PROD REL ECO 30-87-0023	RL	2-17-87		2-19-87

5. SWITCHES – U3T: OPERATIONS OPTION SWITCH.
U5W: FMTR ADDRESS SELECT.

6. JUMPERS W1, W3, W4, W5 FOR FUTURE USE.

7. ⏚ DENOTES +5R GROUND

NOTES:

1. RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
2. CAPACITOR VALUES ARE IN MICROFARADS.
3. IC Vcc & GND PINS UNUSED PORTIONS:

a. +5 R & +5V DEVICES:

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
74LS00	U2G, U3V, U5V, U8V, U11B, U11C, U11E, U11F, U12E, U17T		14	7	U2G-A U17T-B,D
74LS04	U4G, U4H, U8A, U8B, U8C, U16T		14	7	U4H-B,C,E,F U16T-D
74LS08	U1P, U4P, U7H, U7V, U14R, U16W		14	7	U1P-C,D, U7H-C U14R-A,B
74LS10	U16R		14	7	U16R-B,C
74LS11	U3G, U4V		14	7	U3G-C
74LS14	U3P, U14A, U14D, U14G, U5R, U2V		14	7	U5R-D
74LS32	U2H, U2P, U5K, U6R, U9M, U12M, U13M		14	7	U13M-B
74LS42	U1K		16	8	–
74LS74	U5P, U13R, U13W, U14P, U14T, U17R		14	7	–
74LS86	U4W, U12B, U12C, U12D, U12F, U12G, U16M, U16N, U17M		14	7	U4W-B U12F-C,D U17M-A
74LS109	U3D, U5H, U6A, U6B, U7A, U7B, U13B, U13C, U13E, U13F, U13H		16	8	U3D-A U5H-A
74LS125	U13P		14	7	–
74LS132	U7P		14	7	U7P-B,C
74LS138	U6W, U8D		16	8	–
74LS151	U7C, U10F, U10G		16	8	–
74LS153	U7E, U15K		16	8	–
74LS157	U9E		16	8	–
74LS163	U4D, U7D, U9A, U9B, U9C, U9D, U10B, U10C, U10D, U10E, U11D, U17W, U18W		16	8	–
74LS164	U7F, U8E, U8F, U9F, U14W		14	7	–
74LS174	U6F, U6G, U6V, U13A, U13D, U13G, U13V, U15V, U16K, U16P, U16V		16	8	–
74LS175	U10M, U12V, U14V, U17L, U17N		16	8	–
74LS195	U3K		14	7	–
74LS240	U11W		20	10	–
74LS244	U5T		20	10	–
74LS245	U7R, U7T		20	10	–
74LS280	U11V		14	7	–
74LS367	U3R, U4R		16	8	–
74LS368	U16L		16	8	–
74LS373	U1L, U2L, U6T		20	10	–
74LS374	U2W, U15W		20	10	–
74LS365	U10V		16	8	
74S10	U5F		14	7	U5F-B
74S140	U2E		14	7	U2E-B
82S129	U7G		16	8	
339	U6H, U19T		3	12	U6H-A,C
2128	U3N, U5N		24	12	
2764	U3L, U5L		28	14	
4864	U9P, U9R, U9T, U10P, U10R, U10T, U11P, U11R, U11T *CORRECT PINOUT		* 8	* 16	
6305	U12H		16	8	
6336-1	U9G, U17V		24	12	

IC TYPE	REFERENCE DESIGNATOR	+5R	+5V	GND	UNUSED
7404	U2K		14	7	
7406	U16J, U17X, U18X		14	7	U17X-B,C,D
7407	U6P, U10H, U17J, U17K		14	7	U10H-C,D U6P-A,B,C,E
7414	U17P	14		7	U17P-D,E,F
7438	U7W, U8W, U9W, U14M		14	7	–
74121	U13T, U4K		14	7	–
8237A-4	U2T		31	20	–
ADC1001	U6N		20	10	–
					–
MC4024	U3C		14	7	–
MC4044	U5G		14	7	–
Z8002	U2N		10	31	–
Z8036	U9L, U11L, U13L		23	7	–
RES PACK	U3W, U10W		16	8	–
RES PACK	U4T		1-8		–

b. -6V +5V DEVICES

IC TYPE	REFERENCE DESIGNATOR	-6V	+5V	GND	UNUSED
4051	U7J, U7N	7	16	8	–
4053	U2B	7	16	8	–

C. -12V +15V DEVICES

IC TYPE	REFERENCE DESIGNATOR	-12V	+15V	GND	UNUSED
319	U14C, U14F, U14H, U15A, U15C, U15D, U15F, U15G, U15H	6	11		–
709P	U19A, U19B, U19C, U19D, U19E, U19F, U19G, U19H, U19I	4	7		–
4136	U2A, U2C, U20N	7	11		–
TL082	U6J, U6K, U6L, U18A, U18B, U18C, U18D, U18E, U18F, U18G, U18H, U18I, U18M	4	8		U18M-A
DAC1006	U6M		20	10	

d. MISC DEVICES

IC TYPE	REFERENCE DESIGNATOR		UN REG 20V	GND	UNUSED
393	U3H		8	4	–

4. LAST USED REFERENCE DESIGNATOR

C	304	R	340	W	6
CR	13	S		E	2
DS		TP	90		
J	1	U			
K	1	VR	2		
P	7	Y	1		
Q	26	L	3		

REV	REV	A	A	A	A	A	A	A	A	A	A	A	A
STATUS	SH	1	2	3	4	5	6	7	8	9	10	11	12

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ±
.XX ±
.XXX ±
ANGLES ±
DO NOT SCALE DRAWING

	APPROVAL	DATE
SAFETY	Ken Venturi	2/19/87
MECH		
ELECT	[illegible]	2/19/87
MFG	[illegible]	2/19/87
MATL		
QA	[illegible]	2/19/87
PROJ		
ISSUED	[illegible]	2/19/87

DWN RL 2/17/87
CHK [illegible] 2/19/87
TITLE SCHEM-
DRIVE/FORMATTER
CODE IDENT 32274
SIZE D
DWG NO 964283-300
REV A
SCALE
MOD
SH 1 OF 12

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REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

U2N Z8002

U3K LS197 — U11K LS42 — U4H LS04 — U2K 7404 — U2L LS373 — U1L LS373 — U9L 8036 — U11L 8036 — U13L 8036 — U5H LS32 — U6H LS08 — U1P LS08 — U16L LS368 — U7P LS132 — U3P LS14

Y1 7.68 MHZ

R278 1K; R277 4.7K; R282 4.7K; R276 4.7K; R283 4.7K; R279 680; R280 510; R272 680; R273 680; R219 100K; R231 100K; R230 100K; R229 100K; R208 100K; R210 220(5); R209 1.2K(5); R212; R211; R214; R213; R216; R215; R218; R217; R313 750; R281 750; C170 1000PF; C173 1500 PF; C167 1500 PF

CR9 1N4148; CR10 1N4148

P5

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE
	DWN	
	MECH	
	CHK	
	ELEC	
	MFG	
	MATL	
	QA	
	MKT	
	ISSUED	

cipher data products, inc. SAN DIEGO CALIF

TITLE · SCHEM - DRIVE/FORMATTER

CODE IDENT	SIZE	DWG NO	PFV
32274	D	964283-300	A
SCALE —	MOD		SH 2 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

P1

U3W 220/330Ω DIP TERM PACK — IREV, IWRT, IWFM, IEDIT, IERASE, RESERVED A, RESERVED B, IGO, UNUSED A, UNUSED B, UNUSED C, IREW, ITADO, IRWU

U10W 220/330Ω DIP TERM PACK — ILWD, IWP, IW0, IW1, IW2, IW3, IW4, IW5, IW6, IW7, IH SP, IFAD, ITADI, IFEN

+5V

IREV 18 — IWRT 34 — IWFM 42 — IEDIT 38 — IERASE 40 — RESERVED A 14 — RESERVED B 16 — IW7 24 — UNUSED A 29 — UNUSED B 36 — ILWD 4 — IWP 22 — IW0 10 — IW1 12 — IW2 30 — IW3 26 — IW4 6 — IW5 32 — IW6 28 — UNUSED C 44 — IGO 8 — 23 — 25 — 27 — 31 — 33 — 35 — 37 — 39 — 41 — 43 — 45 — 49 — IREW 20 — ITADO 46

P2

IH SP 50 — IFAD 48 — ITADI 46 — IFEN 18 — IRWU 24

U2W LS374 — D inputs 3, 4, 7, 8, 13, 14, 17, 18; CLK 11; Q outputs 2, 5, 6, 9, 12, 15, 16, 19 — AD0, AD1, AD2, AD3, AD4, AD5, AD6, AD7 (2,10,11,12); pin 1; pin 10

IW7 (6) — ILWD (10) — IWP — IW0 — IW1 — IW2 — IW3 — IW4 — IW5 — IW6 (6)

U2V LS14 — pins 13, 12 — W6 — R325 4.7K — +5V — DEN(10)

U5W — pins 14, 16, 15, 12, 13, 11

R311 10K — +5V

R322 10K — R309 10K — R310 10K — R323, 10K — R324 10K

U2V LS14 — pins 5, 6

U4W — pins 12, 13, 11; 10, 9, 8; 2, 1, 3

U4V LS11 — pins 10, 11, 9

LS86(3)

U3V LS00 — pins 4, 5, 6 — Z1A0(2)

U2V LS14 — pins 1, 2

U3V LS00 — pins 2, 1, 3

U2V LS14 — pins 11, 10

U3V LS00 — pins 9, 10, 8

U14P LS74 — D pin 12, Q pin 9, CLK pin 11, pin 13, pin 10 — +5V

Z1A1(2)

U13M LS32 — pins 2, 1, 3 — FBY — OUTLATCH

LS138 — A, B, C — (2) AL0, AL1, AL2 — G2A, G2B, G1 — (2) WROUT, (2) AL12 — Y0–Y7 — PULSE0, PULSE1, PULSE2, PULSE3, PULSE4, PULSE 5 (N/C), PULSE 6(6), PULSE 7 (10)

U6W

RDCMD

U12M LS32 — pins 1, 2, 3 — (2) AL15, (2,10,11) RDIN

U13P LS125(3) — pins 12, 11, 13 — AD8 (2,10,11,12)

U13P — pins 5, 6, 4 — AD9 (2,10,11,12)

U13P — pins 9, 8, 10 — AD10 (2,10,11,12)

GO — FSEL

U7V LS08 — pins 9, 10, 8

U8V — pins 2, 1, 3; 4, 5, 6; 10, 9, 8; 12, 13, 11

LS00(4)

U5V LS00 — pins 1, 2, 3; 10, 9, 8

U7V LS08 — pins 1, 2, 3

U8V — pins 12, 13, 11

U4V LS11 — pins 5, 4, 6

U5W — pins 8, 9

ONL

R326 10K — +5V

TP76

RWD

U7V LS08 — pins 4, 5, 6

TP69

U2V LS14 — pins 8, 9

TP77

LS174 — CK pin 9; D pins 11, 6, 14, 13, 4, 3; Q pins 10, 7, 15, 12, 5, 2; CLR pin 1 — (2) AD0, AD1, AD2, AD3, AD4, AD5 — (2,5,6) RES — U6V

TP74

TP73

TP70

TP71

TP75

TP72

TP78

TP86

7438(10) — U8W — pins 9, 10, 8

U9W — pins 4, 5, 6

U8W — pins 4, 5, 6

U9W — pins 12, 13, 11

U7W — pins 4, 5, 6

U9W — pins 1, 2, 3

U8W — pins 1, 2, 3

U7W — pins 9, 10, 8

U8W — pins 12, 13, 11

U9W — pins 10, 9, 8

7438(4) — U14M — pins 4, 5, 6

U14M — pins 1, 2, 3

U14M — pins 9, 10, 8

U14M — pins 12, 13, 11

IFBY P1 2

P2

IRDY 28 — IDBSY 38 — IFPT 32 — ILDP 4 — IEOT 22 — ISPEED 40 — IRP (6) — IONL 44 — IRWD 30 — IHER 12 — ICER 42 — IFMK 14 — IDENT 16

E2 — E1

(2) Z1A2 — (2) Z1A3 — (2) Z1A7 — (6,10) INTERDEN — (2) Z1B1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ±
.XX ±
.XXX ±
ANGLES ±
DO NOT SCALE DRAWING

	APPROVAL	DATE
MECH		
ELEC		
MFG		
MATL		
QA		
MKT		
ISSUED		

DWN | CHK

cipher data products, inc. SAN DIEGO CALIF

TITLE SCHEM - DRIVE/FORMATTER

CODE IDENT	SIZE	DWG NO	REV
32274	D	964283-300	A

SCALE — | MOD | SH 3 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

+15V
R336 30.1K 1%
+6V
UN7-16
C300 .047µF 50V
R334 20K 1%
(5) V30P
R298 270
Q6 2N-6050
C186 4.7 50V
R294 1.5K,1W
C176 .01
Q26 2N4401
R297 1K
(2) Z3A6
(5) V20P
MR820 CR11
TP50
-6V
Q14 2N4401
R172 18K
R173 4.3K
R174 390
Q15 2N-3494
C301 4.7 50V
R171 4.3K
R340 4.3K
C304 .33
R339 200K
Q3 SJ5804
Q12 2N4403
Q4 SJ5803
C118 200pF
R168 18K
Q13 2N2243
C114 1000
R169 4.3K
R160 68
R170 390
V30M
U2B 4053
+15V
TP35
U2A 4136
R131 20K
C105 .047
R136 15K
R129 180K
-12V
(11) ISU
R188 3.92K 1% 1/8W
R130 4.75K 1% 1/8W
IS
+5V
R143 20K
(2) Z3A7
V30P
R166 4.3K
R167 390
Q10 2N4401
R165 18K
Q11 2N-3494
R164 4.3K
Q1 SJ5804
Q8 2N4403
Q2 SJ5803
C116 200pF
R161 18K
Q9 2N2243
1000 C113
R156 2.2K
C117 .68 50V
R158 68
R162 4.3K
R163 390
V30M
U2B 4053
TP41
U2A 4136
R133 20K
C106 .0015
R134 15K
R135 180K
(11) ITU
R189 4.75K 1%, 1/8W
R137 4.75K 1% 1/8W
IT
TP52
SMDH(5)
TP45
VIN 3(11)
VS
+15V
U2C 4136
R178 30.1K,1%
R182 30.1K,1%
C119 .15 50V
R181 9.09K,1%
-12V
R128 14K 1%
U2A 4136
R157 4.02K 1%
R132 4.02K,1%
R183 1K,1%
R176 1K 1%
R180 .25 6.5W, 5%
R124 10K,1%
U2C 4136
TP46
R126 10K,1%
SMDL(5)
VIN 7 (11)
TP51
TMDH(5)
TP47
VIN 4 (11)
VT
U2C 4136
R177 30.1K,1%
R191 30.1K,1%
C120 .15 50V
R190 9.09K 1%
R114 21.5K 1%
U2A 4136
R125 4.02K 1%
R142 4.02K 1%
R184 1K,1%
R175 1K 1%
R179 .25 6.5W,5%
R123 10K,1%
U2C 4136
TP44
R127 10K,1%
C103 .01
TMDL(5)
TP79
(5) V20M
CR12 MR820
C175 .01
VHMON
R293 1.5K,1W
Q5 2N6057
+5V
R299 220
Q25. 2N4403
R296 270
(2) Z3A5
R295 1K
Q24 2N4401
(5) V30M
C190 4.7 50V

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE	DWN		cipher data products, inc. SAN DIEGO CALIF.
	MECH		CHK		
	ELEC		TITLE	SCHEM - DRIVE / FORMATTER	
	MFG				
	MATL				
	QA		CODE IDENT 32274	SIZE D	DWG NO 9642 83-300 REV A
	MKT				
	ISSUED		SCALE	MOD	SH 4 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

+20VDC
-20VDC
+9VDC
VDC
VDC
RTN'S
NC
TAPE IN PATH SENSOR
FPT RING SENSOR
OPTICAL TACH
BOT EOT SENSORS
DOOR SENSE
P3
P4
P5
P6
J1
V20P(4)
V20M(4)
V9P
V30M(4)
V30P(4)
+15V
+5V
+5R
-12V
-6V
TP84
TP83
TP80
TP82
TP81
TP3,21,31,33,54, 60,68,87-90
C193 .1 uF 63V,20%
C191 4.7 50V
C198 .1 100V,10%
C194 10 50V
C222 22UF 20V
C226 6.8 35V
.01 C6,18,30,42,56, 59,88,90,95, 111,128,138,146,151,154 183,203,207,211,218
C223 22UF 20V
VR2 7815
Q16 78L05
C123 .1 16V
C189 .1uF 63V,20%
C188 4.7 50V
C228 .1 uF 100V,10%
C187 10 50V
C200 .1,16V
C107 .1,16V
C54 6.8 35V
C227 68 35V
.01 C7,19,31,43, 55,60,87, 89,96,110, 127,139,147 153,150 202,181, 208,210, 217
VR1 7912
R315 1K
R314 4.1K
C180 .1uF 63V,20%
C184 10 50V
Q7 LM323
C185 10 50V
.01 C57,86,91,94,112, 129,137,148,152, 155,182,229 204,206,209, 216
R186 200
R187 22K
R185 2.2K
C124 .1
C108 .1
R146 5.1M
R154 1K
R153 4.7K
U3H 393
R155 4.3K
LS04
U4H
TP49
RES (2,3,5,6)
RESET (10)
(2) Z2B7
R150 1K
TP53
CR13 1N4001
K1 24V 10A
Q17 2N6037
C149 .01
CR8 1N4001
CR7 1N4001
TP66 DOOR LOCK
TP67 HUB LOCK
(2)Z2B3
(2)Z2B2
R265 470
R269 470
Q23 2N6037
Q22 2N6037
LOCK 2D
DOOR LOCK
HUB LOCK
TMDL(4)
TMDH(4)
SMDL(4)
SMDH(4)
TUML
TUMH
SUML
SUMH
TUM.H
SUM.H
+15V
R232 1K
U17P 7414
R220 15
R233 15
CR2 1N4148
(2) Z2C2
TO SSR BLOWER CONTROL
R251 10K
R249 150
C141 .1
R252 4.7K
R255 150
C143 3900PF
R253 430
R250 430
C142 3300pf
C140 3300pf
R245 1.3K
R241 1.3K
R246 150
R247 10K
C144 47 6V
R254 5.6Ω
C145 .01
Z2B1(2)
VIN1 (11)
VIN0 (11)
+5V
R260 12K
R320 1M
C219 33PF
R261 10K
R262 10K
R263 10K
R259 10K
R256 43K
R258 43K
R248 430
C213 33PF
C212 33PF
U19T 339
TP61
TP65
TP64
TP63
TP62
Z3B6(2)
Z2B6(2)
Ø1(2)
Ø2(2)
7407(4)
U10H
R227 2.2K
R225 4.7K
R224 3.3K
R223 1K
R228 10K
R222 240
R221 33
Q20 2N3702
Q21 2N6034
Q19 2N6034
Q18 2N3702
C126 .0015
C125 .1
C130 10 20V
CR1 IN4733A
WHEADCT
ERASERET
ERASEDRV
P6
-12 V
R318 24K
R319 1.2K
R240 4.7M
R257 1K
R242 22K
R264-1 22K
CR4 1N4148
R239 1M 1%
C135 3.3PF
CR6 1N4148
CR5 1N4148
CR3 1N4148
C134 .0047
R238 4.7M
U20N 4136
TP59
TP57
VIN 2(11)
C121 .047
R35 200K
C177 100PF
R25 1M
U18M 7L082
C179 .01
C178 .01
TP56
VIN 6(11)
C131 1,000 PF
C136 .1
R243 1K
R234 10K 1%
R237 100K
C133 .047
C132 .1
R235 4.7K
R236 4.7K
Z18Ø(2)
7414 U17P

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE
	MECH	
	ELEC	
	MFG	
	MATL	
	QA	
	MKT	
	ISSUED	

DWN
CHK
cipher data products, inc. SAN DIEGO CALIF
TITLE: SCHEM - DRIVE/FORMATTER
CODE IDENT 32274 | SIZE D | DWG NO 964283-300 | REV A
SCALE | MOD | SH 5 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

+5V
Z3B4(2,5)
Z1C3(2)
U15K LS153
E1G E2G GND 1C2 2C0 2C1 2C3 1C0 1C1 1C3 2C2
U11W LS240 (SH-3) IW0 IW1 IW2 IW3 IW4 IW5 IW6 IW7
U13V LS174 RD7 RD5 RD3 RD1 RDP
U16P LS174 EOP (10)
U12V LS175 RD6 RD4 RD2 RD0 (10,12)
U17N LS175 WLATCH (10)
U16M 7406(6)
U16K LS174
U17L LS175
LS86G(9)
U17J U16J 7406(6) R203 R205 R195 R197 R194 R199 R201 R196 R198 R207 R190 R191 CHAN P CHAN O CHAN 1 CHAN 2 CHAN 3 CHAN 4 7407(6)
U17K R202 R204 R192 R193 R200 R206 560 CHAN 5 CHAN 6 CHAN 7 7407(6) 1/2W(9) 470(9) 1/2W
P6 TO WRITE HEAD
OINLOW
RES (2,3,5)
+5V
(10) SODD
(3) IWP
U16H LS86
U17R LS74 CLK
Z1A6(2)
PULSE 6(3)
(10) IOR
(10) DACK 1
U12M LS32
U16T LS04
U17W 7438
IWSTR
WDCLK(10)
(3,6,10) INTERDEN
WSTROBE (10)
P2
(9) CDATAX
U14W LS164
U15W LS374
RDLD (10)
(10) DREQ Ø
(9) PECLK
R338 240
U15V LS174
U14V LS175
U18X
U17X
IR7 IR6 IR5 IR4 IR3 IR2 IR1 IRØ IRP
P1
INTERDEN (3,6,10)
7406(9)
IRP(3)
5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,45,47,49
RLATCH (10)
U18W LS163 LOAD
U17W LS163
U17R LS74 PRE
FRC1 FRC2 FRC3
Z1C2 (2)
Z1C1 (2)
LS08
U16V LS174
U17V 6336-1
DO1 DO2 DO3 DO4 DO5 DO6 DO7 DO8
W1 W2 W4
U16R LS10
U17T LS00
W2XCLK
Z1C0(2)
BITCLK(9)
U16T LS04

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
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ANGLES±
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MECH	
ELEC	
MFG	
MATL	
QA	
MKT	
ISSUED	

DWN | CHK

cipher data products, inc. SAN DIEGO CALIF.

TITLE SCHEM - DRIVE/FORMATTER

CODE IDENT	SIZE	DWG NO	REV
32274	D	964283-300	A

SCALE | MOD | SH 6 OF 12

IC VOLTAGES - TYP 9 PLACES

+15V 709P 7 4 -12V

+15V TL082 8 4 C53 .01 C58 .01 -12V

+15V 319 11 6 C72 .01 -12V C73 .01 C65 .01

CHANNEL P

961658-300 REV

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

CHANNEL Φ

CHANNEL 1

CHANNEL 2

CHANNEL 3

CHANNEL 4

CHANNEL 5

CHANNEL 6

CHANNEL 7

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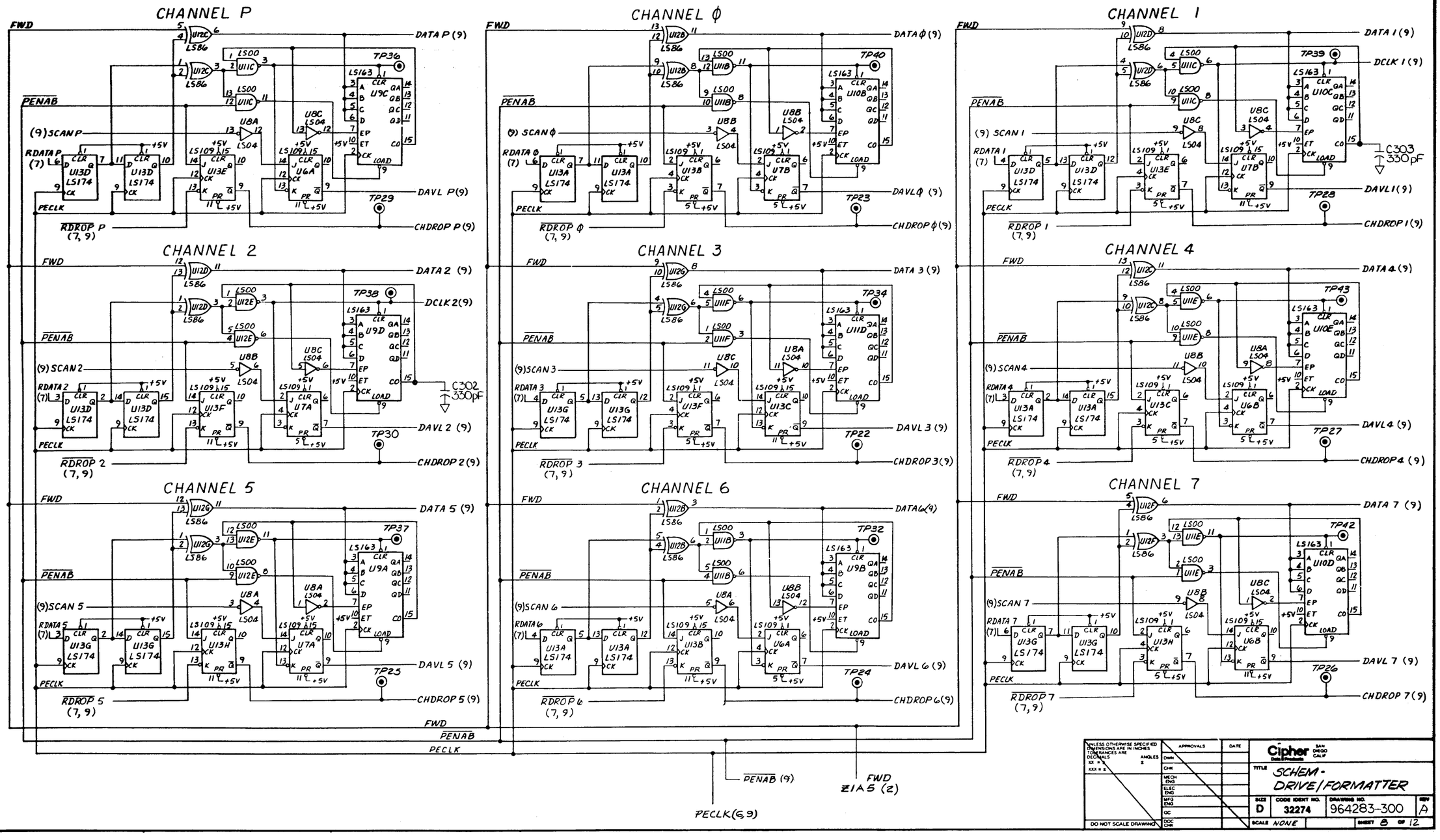
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS XX ± .1 XXX ± .03 ANGLES ±	APPROVALS	DATE	Cipher Data Products SAN DIEGO CALIF.
DO NOT SCALE DRAWING	DWN		TITLE SCHEM-DRIVE/FORMATTER
	CHK		
	MECH ENG		
	ELEC ENG		
	MFG ENG		SIZE D · CODE IDENT NO. 32274 · DRAWING NO. 964283-300 · REV 1A
	QC		SCALE NONE · SHEET 7 OF 12
	DOC CTRL		

961658-300 REV B

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS XX ± XXX ± ANGLES ±	APPROVALS	DATE	Cipher Data Products SAN DIEGO CALIF.
DO NOT SCALE DRAWING	DWN		TITLE SCHEM- DRIVE/FORMATTER
	CHK		
	MECH ENG		
	ELEC ENG		
	MFG ENG		
	QC		
	DOC CTRL		

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	32274	964283-300	A

SCALE NONE SHEET 8 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

(8) DCLK 2
(8) DCLK 1
(6) BITCLK
U7E LS153
R119 100
C99 330pf
MC4044 U5G
R120 1.5K
R118 1.5K
C98 .01
+5V
R115 1K
C104 .22
R117 1K
C101 47pf
U3C MC4024
C100 .1
R138 82
L1 .47µhy
U2E 743140
TP48
R139 150
C97 180pf
(9) PEN
U4G LS04
PENAB (8)
PECLK (6,8,9)
U9F LS164
U8F LS164
U8E LS164
U7F LS164
R5 10K
U6F LS174
W1 W3
U7G 6336-1
825129
U6G LS174
U6F LS174
U6G LS174
U4D LS163
U3D LS109
U7D LS163
U2G LS00
SCANP (8)
U8D LS138
SCAN0
SCAN1
SCAN2
SCAN3
SCAN4
SCAN5
SCAN6
SCAN7
(8)
U7H LS08
U2H LS32
U5F S10
Z1B7 (2)
DCLK (10)
C DATA X (6)
STRBX (10)
DAVLX
DATAOX
CHDROPX
GAP
U2H LS32
U1IF LS00
U3G LS11
U4G LS04
U2G LS00
(SH6) PECLK
U7C LS151
U10F LS151
U10G LS151
U9E LS157
(8) DAVL 0
DAVL 1
DAVL 2
DAVL 3
DAVL 4
DAVL 5
DAVL 6
DAVL 7
(8) DATA 0
DATA 1
DATA 2
DATA 3
DATA 4
DATA 5
DATA 6
DATA 7
(8) CHDROP P
CHDROP 0
CHDROP 1
CHDROP 2
CHDROP 3
CHDROP 4
CHDROP 5
CHDROP 6
CHDROP 7
STROBE
(8) DATA P
(8) DAVL P
U12H 6305
RDROP P
RDROP 0
RDROP 1
RDROP 2
RDROP 3
RDROP 4
RDROP 5
RDROP 6
RDROP 7
(7,8)
R110 220K
R111 220K
R122 3.92K 1% 1/8W
R121 3.01K 1% 1/8W
U6H 339
R113 10K
R116 10K
C92 470 pf
C93 470 pf
U5H LS109
Z2B4 (2)
POSTERR
VRCERR
U10M LS175
(2) Z2C1
Z1B5 (2)
Z2C3 (2)
PEN (9)
+5

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE
	MECH	
	ELEC	
	MFG	
	MATL	
	QA	
	MKT	
	ISSUED	

DWN		
CHK		
TITLE	SCHEM- DRIVE / FORMATTER	
CODE IDENT 32274	SIZE D	DWG NO 964283-300 REV A
SCALE —	MOD	SH 9 OF 12

cipher data products, inc. SAN DIEGO CALIF

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

(2,3,10,11)$\overline{RDIN}$ — U10V LS365 — (2,10,11)AL13 — AD$\emptyset$ (2,11,12)

(3) ILWD — U16T LS04 — U14T LS74 — (6,10) WDCLK — (2) Z1B2 — U14R LS08 — $\overline{DACK}$ 1 (10)

(3) DEN — U14T LS74 — DREQ 1 (10) — (2) Z1B4 — Z1B6 (2)

(2) Z1B3 — U9M LS32 — (9) $\overline{DCLK}$ — U9M LS32 — U16W LS08 — (6) WSTROBE

(9) STR8X — U9M LS32

U13W F74 — (N/C) — (3) PULSE 7 — U16T LS04 — DREQ$\emptyset$ (6,10) — (10) $\overline{DACK}$ Q

U9M LS32 — WLATCH (6) — RDLD (6)

(2) AL1 — U3R — AX0 (10)

(2) AL2 — U3R — AX1 (10) — 15 LS367

(2) AL3 — U4R — AX2 (10)

(2) AL4 — U4R — AX3 (10) — 15 LS367

(12)$\overline{DMAIO}$ — (2,3,11) $\overline{WROUT}$ — U6R LS32 — U6P 7407

(2,3,10,11) $\overline{RDIN}$ — R301 330 — C174 150PF — U6R LS32 — U6P 7407 — $\overline{OPT}$ (12)

U14P LS74 — DREQ3 (10) — (2) Z2C$\emptyset$ — (10) $\overline{DACK}$ 3

(10) $\overline{DACK}$ 1 — U12M LS32 — U16T LS04 — R321 220 — (6,10) WDCLK — C220 470PF — (3,6) INTERDEN

RLATCH (6) — C122 100PF — R15 8.2K — +5V

U13T 74121 — U7W 7438 — IRSTR — P2 34

U3P LS04 — U5V LS00

(10) DREQ2 — U13M LS32 — U4P LS08 — U5P LS74 — (2) CLK4 — $\overline{WAIT}$ (2)

(2) IO — U7V LS08 — U4P LS08 — U5P LS74 — (2) CLK4

U7H LS08 — U12M LS32

(10) $\overline{DACK}$ 2 — W/$\overline{R}$ (2)

(2,10,11) AL13 — U2H LS32 — (2) $\overline{IO}$ — (2) ALØ — U13R LS74 — (2) $\overline{AS}$ — DREQ2 (10)

AEN (12)

+5V — R305 3.3K — R304 3.3K — R300 4.7K — (6) $\overline{IOR}$ — $\overline{IOW}$ — $\overline{EOP}$ (6)

U7T LS245 — AD15 AD14 AD13 AD12 AD11 AD10 AD9 AD8 — (2,12)

U11V LS280 — RD$\emptyset$ RD1 RD2 RD3 RD4 RD5 RD6 RD7 — (6,12) — SODD (6)

U16W LS08 — U11P LS125 — RDP (6,12)

U13R LS74 — Z1A4 (2) — $\overline{MEMR}$ (10)

(12) (10) (12) — READY HLDR — $\overline{MEMR}$ — $\overline{MEMW}$ — HLDA — CS — AEN — $\overline{EOP}$ — $\overline{IOW}$ — $\overline{IOR}$ — DREQ$\emptyset$ DREQ1 DREQ2 DREQ3 $\overline{DACK\emptyset}$ $\overline{DACK1}$ $\overline{DACK2}$ $\overline{DACK3}$ — (6) (10) (6)

(5) RESET — RESET — U2T 8237A-4 — CLK — CLK 4 (2)

AX7 AX6 AX5 AX4 AX3 AX2 AX1 AX0 — DX7 DX6 DX5 DX4 ADSTB DX3 DX2 DX1 DX0 — (10) (12)

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ±
.XX ±
.XXX ±
ANGLES ±
DO NOT SCALE DRAWING

APPROVAL	DATE
MECH	
ELEC	
MFG	
MATL	
QA	
MKT	
ISSUED	

DWN | CHK

cipher data products, inc. SAN DIEGO CALIF

TITLE: SCHEM — DRIVE / FORMATTER

CODE IDENT	SIZE	DWG NO	REV
32274	D	964283-300	A

SCALE — MOD — SH 10 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

(2) AD15 AD14 AD13 AD12 AD11 AD10 AD9 AD8 AD7 AD6

+5V

R271 1

C168 4.7

DAC1006 U6M

D10 D19 VR RF IOUT1 IOUT2 CS WR XFER BYTE1

(2) AL15

R268 4.99K 1/8W

R275 4.99K 1/8W

R274 330

R267 2.49K

U6L TL082

-12V

R147 2.2K

C214 150pf

U7J 4051

XIN Y0 Y1 Y2 Y3 INHIBIT A B C

+5V -6V

(2) Z3C0 (2) Z3C1 (2) Z3C3 (2) Z3C2

U6J TL082 ISU (4)

U6J TL082 ITU (4)

U6H TL082 R149 220 ITHR(7)

C201 .01 C171 .01 C172 .01 C215 .01

R148 330K

R316 1K R317 10K +5V

R290 1K(7) R291 R292 R289 R284 R286 R285 R287 10K

(5)VIN0 (5)VIN1 (5)VIN2 (4)VIN3 (4)VIN4 (4)VIN6 (4)VIN7

U7N 4051

R288 1K

U6K TL082

C169 330PF

+6V -6V

R270 511 R269 511

C224 4.7µF

U6N ADC1001

CLK5 AL14 RDIN (2,3,10) WROUT (2,10,11) INTR NVI AD8 AD9 AD10 AD11 AD12 AD13 AD14 AD15

R330 20K R331 20K R332 20K

C221 100PF 5% R329 4.99K 1%

(2) WROUT +5V

U4K 74121

U5L Z7128 U3L Z7128 U3N Z128 U5N Z128

AL1 AL2 AL3 AL4 AL5 AL6 AL7 AL8 AL9 AL10 AL11 AL12 AL13 AL14

A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12

AD0 AD1 AD2 AD3 AD4 AD5 AD6 AD7 AD8 AD9 AD10 AD11 AD12 AD13 AD14 AD15

(10,12) (10) (11) (2)

U3P LS04 U2P LS32 U4P LS08

(2) AL15 (2) DS (2) MREQ (2) W/R (2) R/W (2) B/W (2) AL0

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ±
.XX ±
.XXX ±
ANGLES ±
DO NOT SCALE DRAWING

APPROVAL	DATE
MECH	
ELEC	
MFG	
MATL	
QA	
MKT	
ISSUED	

DWN
CHK

cipher data products, inc. SAN DIEGO CALIF

TITLE: SCHEM - DRIVE / FORMATTER

CODE IDENT	SIZE	DWG NO	RFV
32274	D	964283-300	A

SCALE — MOD — SH 11 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE

(10) MEMR
(10) MEMW
(10) AEN
+5V +5V
R302 3.3K
R303 3.3K
U5V LS00
U5R LS14
C109 .01
U13W F74
CLK4 (2,10)
(10)
AX7 AX6 AX5 AX4 AX3 AX2 AX1 AX0 DX7 DX6 DX5 DX4 ADSTB DX3 DX2 DX1 DX0
(12) DX0 DX1 DX2 DX3
(12) DX4 DX5 DX6 DX7
U6T GEN
U5T
LS373
LS244
A0 A1 A2 A3 A4 A5 A6 A7
U10R 4164
U11P 4164
U10P 4164
U9R 4164
U9P 4164
U11T 4164
U11R 4164
U10T 4164
U9T 4164
RAS W CAS
C103 .01
C164 .01
C161 .01
C159 .01
C160 .01
C165 .01
C158 .01
C162 .01
C157 .01
C156 .01
RD0 (6,10)
RD1 (6,10)
RD2 (6,10)
RD3 (6,10)
RD4 (6,10)
RD5 (6,10)
RD6 (6,10)
RD7 (6,10)
RDP (6,10)
C166 .01
U4T 10K
1 THRU 8 +5V
OPT (10)
U3R
U4R
AD8 AD9 AD10 AD11 AD12 AD13 AD14 AD15
(2,10,11)
LS367 (8)
U3T
(2,3,11) AD0 AD1 AD2 AD3 AD4 AD5 AD6 AD7
(2) W/R
U7R LS245
DX0 DX1 DX2 DX3 DX4 DX5 DX6 DX7
12
(10) DMAIO
(2) AS
U13M LS32

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING	APPROVAL	DATE
	DWN	
	CHK	
	MECH	
	ELEC	
	MFG	
	MATL	
	QA	
	MKT	
	ISSUED	

cipher data products, inc. SAN DIEGO CALIF

TITLE SCHEM - DRIVE/FORMATTER

CODE IDENT	SIZE	DWG NO	REV
32274	D	964283-300	A

SCALE 4 | MOD | SH 12 OF 12

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	PROD REL ERO SD-0281	CL	4-14-84	[illegible]	4-18-84
B	INCORP ECO 17622	DMD	[illegible]	[illegible]	4-24-84
C	INCORP ECO 17761	PB	8/9/84	[illegible]	8-15-84
D	INCORP ECO 18022	LS	5/7/85	[illegible]	5-9-85
E	INCORP ECO 18127	ME	6/19/85	[illegible]	6-21-85

W1 W2 W3

PS1-E4
PS1-E3
5 4 FILTER PS2FL1 (FL1) 2 3 1
PS2FL1-5,W — E4
PS2FL1-4,BK — E3
AC SUPPLY TERMINALS
PS2 XF1-B,BK
PS2 L1-N,BL
G/Y

VOLTAGE SELECT CARD
E1 E2 VOLTAGE SELECT TERMINALS
B1-2,BR
B1-3,BL
PS1J4 (J5) W4P1 (P5)
A2S1-2,BR
A2S1-5,Y
A2S1-6,R
A2S1-1,BK
A2S1-4,O

PS1J1 (J8) W5P1 (P8) 1 2 3 4 5 6
T1-6,BL
T1-5,O
T1-3,V
T1-2,R
T1-4,Y
T1-1,BR

B1-1,G/Y
PS2J1-E,G/Y
PS2E1, CHASSIS GND (E15)

M1 TAKE-UP MOTOR (P25) (P24)
W1P3-5,WK
W1P3-3,WK

PS2XF1 FUSEHOLDER
PS2FL1-1,BK
PS2J1-L,BK

W4 W7 W8 W9

PS1J3 (J7) W1P4 (J7)
W1P3-1,W 1
W1P3-2,W 2
W1P1-2,W 3
W1P1-7,W 4
5 6
W1P1-5,W 7
W1P1-3,W 8
W1P1-1,W 9
W1P1-8,W 10
11
W1P1-4,W 12
W1P1-10,W 13
W1P1-12,W 14
W1P1-6,W 15

PS1J2 (J6) W6P1 (P6)
T1-12,R
T1-11,BR
T1-13,O
T1-9,W
T1-10,BK
T1-8,GY
T1-7,BL

AC INPUT
PS2J1 (P1)
E GND,G/Y
N PS2FL1-3,BL
L PS2XF1-A,BK

PS1 POWER SUPPLY PWB
PS2 POWER SUPPLY HOUSING

W6

PU1 HEAD ASSY
WRITE READ
W2P2-1 … W2P2-20 W2P1
W3P2-1,BR
SHLD
W3P2-3,R
-4,W
-5,O
-6,W
-7,Y
-8,W
-9,G
-10,W
-11,BL
-12,W
-13,V
-14,W
-15,GY
-16,W
17,BR/W
18,W
-19,BK
W3P2-20,W
W3P1
W2P2-21 1
W2P2-22 2
PU2 ERASE BAR

SHLD 4
WIP2-4,R
WIP2-10,W
WIP2-3,BK
WIP2-8,G
1 2 3 4 WIP5 (P14) A5J1
A5 OPTICAL TACH

L1 DOOR LOCK SOLENOID
WIP2-13,W 1 (P22)
WIP2-14,W 2 (P23)
WIP1,14,W 3 (P16)
WIP1,13,W 4 (P15)
L2-1,W

L2 HUB LOCK SOLENOID
L1-4,W +1 (P18)
WIP1-15,W -2 (P17)

A7J1 WIP8 (P13)
WIP2-18,O
WIP2-17,O
WIP2-16,O
WIP2-15,O
A7 EOT/BOT SENSOR

PS2E2 (P28) CHASSIS GND.
WIP1-9,BR
Ssplice, WIP10-1,BR

(P19) 1 SHLD-WIP2-5
(P20) 2 WIP2-20,CLR
(P21) 3 WIP2-6,BK
A9 CAPACITOR PLATE ASSY

(P26) (P27) SUPPLY MOTOR M2

WIP2-7,Y
WIP2-1,Y
WIP2-2,Y
1 2 4 WIP9 (P11) A6J1
A6 FILE PROTECT SENSOR

A4J1 WIP8 (P29)
WIP2-9,BL
WIP2-12,BL
A4 TAPE-IN-PATH SENSOR

W4

W5

B1 AIR PUMP
B1C1 1 Y 2 Y
1 PS2E1,G/Y
2 PS1-E1,BR
3 PS1-E2,BL
4
5

W6P1-9,BL 7
W6P1-8,GY 8
W6P1-4,W 9
W6P1-7,BK 10
W6P1-2,BR 11
W6P1-1,R 12
W6P1-3,O 13
T1 TRANSFORMER
1 W5P1-6,BR
2 W5P1-4,R
3 W5P1-2-O
4 W5P1-5,Y
5 W5P1-3,V
6 W5P1-1,BL
A3 TOP PLATE ASSY

WIP2-11,BL
WIP2-12,BL
1 2 3 4 (P12) WIP7 A8J1
A8 TAPE-IN-PATH EMITTER

PS2E2,BR SPLICE
A2S2 WIP10 (P10)
1 SPLICE,BR
2 WIP3-9,Y
3 WIP3-11,Y
4 WIP3-8,Y
5 WIP3-10,Y
6 WIP3-7,Y
7
8 WIP3-12,Y
9 WIP3-13,Y
10 WIP3-14,Y
11 WIP3-16,Y
12 WIP3-15,Y
13 WIP3-17,Y
14 WIP3-18,Y
TOUCH SWITCH

A2S1
1 W4P1-4,BK
2 W4P1-1,BR
3
4 W4P1-5,O
5 W4P1-2,Y
6 W4P1-3,R
POWER SWITCH
A2 FRONT PANEL ASSY

960587-001 REV. E

A1 WIP1 (P3) A1J1
WIP4-9,W 1
WIP4-3,W 2
WIP4-8,W 3
WIP4-12,W 4
WIP4-11,BK
WIP4-7,W 5
WIP4-15,W 6
WIP4-1,W 7
WIP4-10,W 8
PS2E2,BR 9
WIP4-13,W 10
WIP1-4,BK 11
WIP4-14,W 12
L1-4,W 13
L1-3,W 14
L2-2,W 15

WIP2 (P4) A1J2
WIP9-2,Y 1
WIP9-4,Y 2
WIP5-3,BK 3
WIP5-1,R 4
SHLD A9-1 5
A9-3,BK 6
WIP5-1,Y 7
WIP5-4,BR 8
WIP8-1,BL 9
WIP5-2,O 10
WIP7-3,BL 11
WIP8-2,BL 12
WIP7-4,BL
L1-1,W 13
L1-2,W 14
WIP6-4,O 15
WIP6-3,O 16
WIP6-2,O 17
WIP6-1,O 18
19
A9-2 CLR 20
21
SHLD 22

WIP3 (P5) A1J3
WIP4-1,W 1
WIP4-2,W 2
M1-2,W 3
M2-1,W 4
M1-1,W 5
M2-2,W 6
WIP10-6,Y 7
WIP10-4,Y 8
WIP10-2,Y 9
WIP10-5,Y 10
WIP10-3,Y 11
WIP10-8,Y 12
WIP10-9,Y 13
WIP10-10,Y 14
WIP10-12,Y 15
WIP10-11,Y 16
WIP10-13,Y 17
WIP10-14,Y 18

W2P2 (P6) A1J4
W2P1-1 1
W2P1-2 2
W2P1-3 3
-4
THRU
-19
W2P1-20 20
W2P1-21 21
W2P1-22 22

W5P2 (P7) A1J5
W3P1-1,BR 1
SHLD,BK 2
W3P1-3,R 3
-4,W 4
-5,O 5
-6,W 6
-7,Y 7
-8,W 8
-9,G 9
-10,W 10
-11,BL 11
-12,W 12
-13,V 13
-14,W 14
-15,GY 15
-16,W 16
-17,BR/W 17
W3P1-18,W 18
SHLD,BK 19
W3P1-20,W 20

A1 PWB FORMATTER

NOTES

1. A REFERENCE DESIGNATION SHOWN IN PARENTHESIS, E.G.; "(P6)", REFERS TO THE CORRESPONDING DESIGNATION FOR THAT ITEM ON ASSOCIATED DRAWINGS & PARTS LISTS.
2. INTERPRET DRAWING PER ANSI Y14.15a-1971
3. THIS CONNECTION IS OPTIONAL; REFER TO APPROPRIATE PARTS LIST.
4. SHIELD OF OPTICAL TACH CABLE IS GROUNDED AT WIP2-22.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE DECIMALS .X ± .XX ± .XXX ± ANGLES ± DO NOT SCALE DRAWING

REV STATUS	REV
OF SHEETS	SH 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

	APPROVAL	DATE
DWN	[illegible]	4/16/84
CHK	[illegible]	4-18-84
DES ENG	[illegible]	9/7/84
SAFETY	[illegible]	9/18/84
DES MGR	—	
MFG ENG	[illegible]	11/19/84
ISSUED	[illegible]	11-27-84

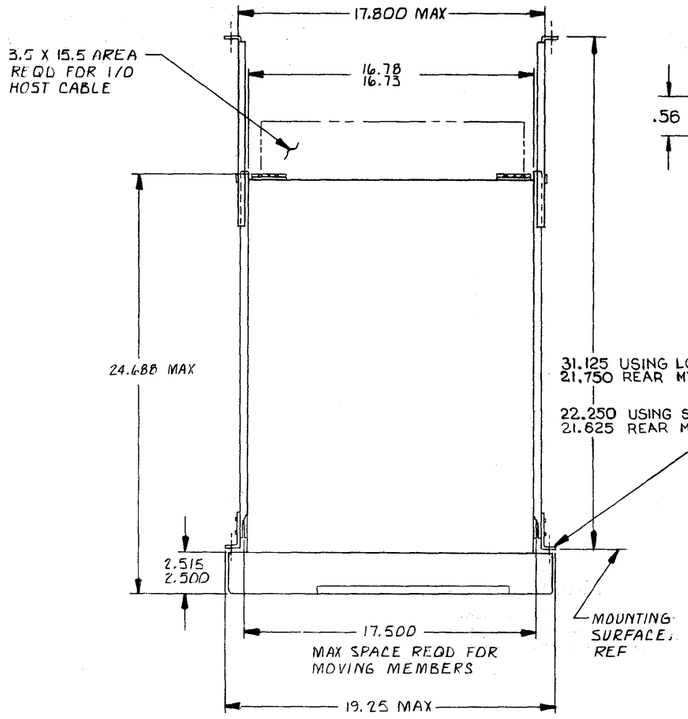
cipher SAN DIEGO CALIF

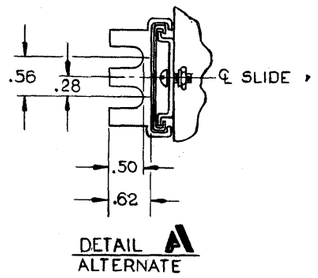
TITLE: WIRING DIAGRAM- MTSU

CODE IDENT 32374 | SIZE D | TYPE NO. 960587-001 | REV. E

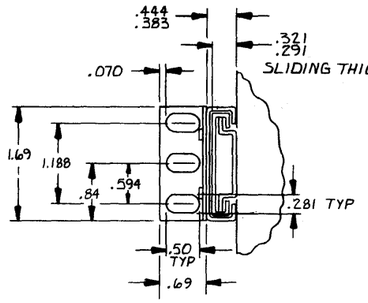
SCALE NONE | SH 1 OF 1

REVISION					
LTR	DESCRIPTION	DWN	DATE	APVD	DATE
A	ENG REL	LS	3/16/83	GK	3/16/83
B	INCORP ECO 16701	MK	9-1-83	[illegible]	11-7-83
C	INCORP ECO 17463	MK	5-10-84	[illegible]	5-18-84
D	INCORP ECO 17622	DMD	6/7/84	[illegible]	6-20-84

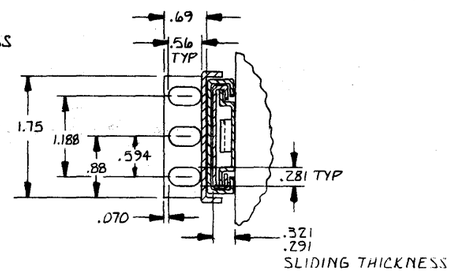




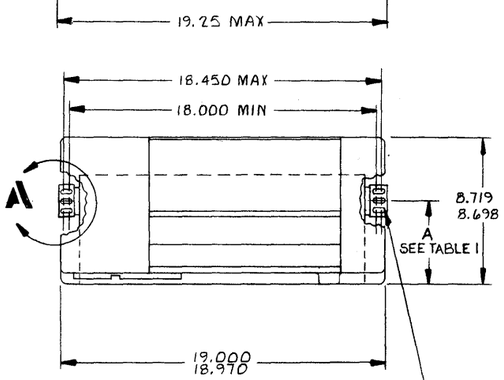
DETAIL A
ALTERNATE

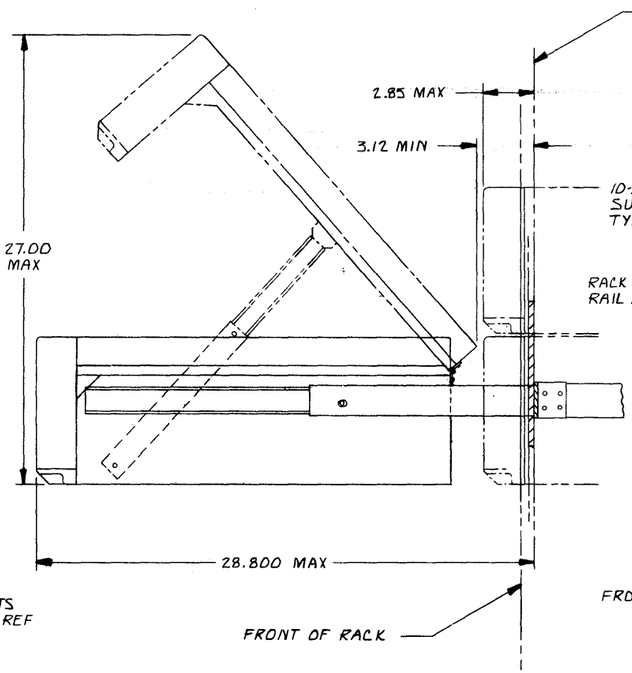


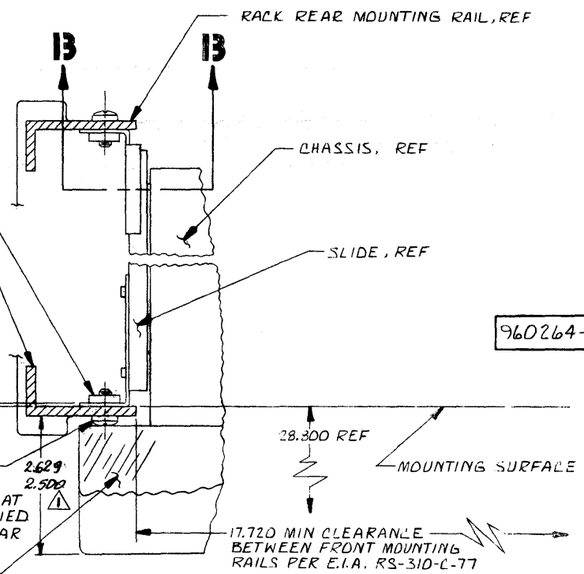
DETAIL A
(SEE ALT DETAIL A)



SECTION B-B
SCREWS & BAR NUT OMITTED FOR CLARITY







TYPICAL INSTALLATION
THE F880 WITH SLIDES MOUNTED IS DESIGNED TO FIT INTO A STANDARD E.I.A. RS-310-C-77 RACK

NOTE:
⚠1 MOUNTING DIMENSIONS WILL VARY FROM 2.629 WITH A BINDER HEAD SCREW TO 2.500 WITH A FLUSH HEAD SCREW.

TABLE I - REF	
CHASSIS ASSY	DIM A
960566-001, -009 & -010	5.000 4.900
960566-002	3.972 3.872
960566-004	4.320 4.220

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
DECIMALS
.X ± .1
.XX ± .03
.XXX ± .010
ANGLES ±
DO NOT SCALE DRAWING

APPROVAL	DATE
MECH	3/11/83
ELEC	3/11/83
MFG	3/6/83
TEST	
QA	
MKT	
ISSUED	3/11/83

DWN 3-11-83 CHK 3-11-83

cipher SAN DIEGO CALIF

TITLE
MTSU-RACK MOUNT, INTERFACE

CODE IDENT	SIZE	DWG NO	REV
32274	D	960264-000	D

SCALE NONE MOD SH 1 OF 1

960264-000 REV D

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

962233-001 OPCODE: 1 REV: K PWB ASSY-DRIVE/FMTR,125IPS, *
MODEL:
ECO NO: 19761
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0	ECO#19644	2/23/87	99/99/99
962622-011	S/W-CACHE,ASSY HI ROM,125,1600	0	A	4	1.000	1.000	EA	F	Y	N	1.000	0	0	U3L ECO#19761	4/13/87	99/99/99
962622-012	S/W-CACHE,ASSY LOW,ROM,125,	0	A	5	1.000	1.000	EA	F	Y	N	1.000	0	0	U5L ECO#19761	4/13/87	99/99/99
731006-800	LABEL-ASSY	1	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

962234-001 OPCODE: 1 REV: L PWB ASSY-DRIVE/FMTR,75IPS, *
MODEL:
ECO NO: 19797
DATE OF LAST ECO: 4/25/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0	ECO#19644	2/23/87	99/99/99
962602-011	S/W-CACHE,ASSY HI ROM,75,1600/	0	A	4	1.000	1.000	EA	F	Y	N	1.000	0	0	U3L ECO#19797	4/24/87	99/99/99
962602-012	S/W-CACHE,ASSY LOW ROM,75,1600	0	A	5	1.000	1.000	EA	F	Y	N	1.000	0	0	U5L ECO#19797	4/24/87	99/99/99
731006-800	LABEL-ASSY	3	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

962235-001 OPCODE: 1 REV: K PWB ASSY-DRIVE/FMTR 75,1600BPI
MODEL:
ECO NO: 19761
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0	ECO#19644	2/23/87	99/99/99
962610-011	S/W-CACHE ASSY HI ROM,75,1600	0	A	4	1.000	1.000	EA	F	Y	N	1.000	0	0	U3L ECO#19761	4/13/87	99/99/99
962610-012	S/W-CACHE ASSY LOW ROM,75,1600	0	A	5	1.000	1.000	EA	F	Y	N	1.000	0	0	U5L ECO#19761	4/13/87	99/99/99
731006-800	LABEL-ASSY	1	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

962236-001 OPCODE: 1 REV: L PWB ASSY-DRIVE/FMTR,125IPS, *
MODEL:
ECO NO: 19797
DATE OF LAST ECO: 4/25/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0	ECO#19644	2/23/87	99/99/99
962618-011	S/W-CACHE ASSY HI ROM,125,1600	0	A	4	1.000	1.000	EA	X	Y	N	1.000	0	0	U3L ECO#19797	4/24/87	99/99/99
962618-012	S/W-CACHE ASSY LOW ROM,125,	0	A	5	1.000	1.000	EA	X	Y	N	1.000	0	0	U5L ECO#19797	4/24/87	99/99/99
731006-800	LABEL-ASSY	3	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		5/15/85	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
964283-000	PICT-PWB ASSY DRIVE/FMTR	0	A	1	.000	1.000	EA	F	Y	N	.000	0	0		2/18/87	99/99/99
964283-300	SCHEM-DRIVE FMTR	0	A	2	.000	1.000	EA	F	Y	N	.000	0	0		2/18/87	99/99/99
961658-101	PWB-DRIVE/FORMATTER	1	C	3	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
160102-445	SOFTWARE ASSY-PE CONT	1	A	4	1.000	1.000	EA	X	N	N	1.000	0	0	U7G	00/00/00	99/99/99
160101-461	SOFTWARE ASSY-DATA DROP	1	D	5	1.000	1.000	EA	X	N	N	1.000	0	0	U12H	00/00/00	99/99/99
960422-001	SOFTWARE ASSY-WRITE	1	A	6	1.000	1.000	EA	X	N	N	1.000	0	0	U17V	00/00/00	99/99/99
160101-447	SOFTWARE ASSY-READ DESKEW	1	D	7	1.000	1.000	EA	X	N	N	1.000	0	0	U9G	00/00/00	99/99/99
200013-100	RES-1.00 KOHM 1/8W 1% FF	3	P	8	4.000	1.000	EA	F	N	N	4.000	0	0	R183,184,175,176	00/00/00	99/99/99
200013-249	RES-2.49 KOHM 1/8W 1% FF	3	P	9	2.000	1.000	EA	F	Y	N	2.000	0	0	R185,267 ECO#19706	4/13/87	99/99/99
200013-392	RES-3.92 KOHM 1/8W 1%	3	P	10	2.000	1.000	EA	F	N	N	2.000	0	0	R122,188	00/00/00	99/99/99
200013-475	RES-4.75 KOHM 1/8W 1% FF	3	P	11	3.000	1.000	EA	F	N	N	3.000	0	0	R130,137,189	00/00/00	99/99/99
200013-499	RES-4.99 KOHM 1/8W 1% FF	3	P	12	3.000	1.000	EA	F	Y	N	3.000	0	0	R268,275,3	00/00/00	99/99/99
200014-100	RES-10.0 KOHM 1/8W 1% FF	3	P	13	5.000	1.000	EA	F	N	N	5.000	0	0	R123,124,126,127,234	00/00/00	99/99/99
200014-301	RES-30.1 KOHM 1/8W 1% FF	3	P	14	5.000	1.000	EA	F	Y	N	6.000	0	0	R141,177,178,182,336	00/00/00	99/99/99
200749-250	RES-0.25 OHM 6.5W 10%	3	E	15	2.000	1.000	EA	B	N	N	2.000	0	0	R179,180	00/00/00	99/99/99
200016-100	RES-1.00 MOHM 1/8W 1% FF	3	P	16	1.000	1.000	EA	F	N	N	1.000	0	0	R239	00/00/00	99/99/99
200063-750	RES-7.5 KOHM 1/8W 5% FC	3	J	17	9.000	1.000	EA	F	N	N	9.000	0	0	R3,13,23,33,43,53,63,73,83	00/00/00	99/99/99
200013-909	RES-9.09 KOHM 1/8W 1% FF	3	P	18	2.000	1.000	EA	B	N	N	2.000	0	0	R140,181	00/00/00	99/99/99
200013-402	RES-4.02 KOHM 1/8W 1% FF	3	P	19	4.000	1.000	EA	B	N	N	4.000	0	0	R125,132,142,157	00/00/00	99/99/99
200072-390	RES-390 OHM 1/4W 5% CF	3	Z	20	4.000	1.000	EA	F	N	N	4.000	0	0	R163,167,170,174	00/00/00	99/99/99
200520-100	RES-1.0 OHM 1/4W 5% FC	3	D	21	1.000	1.000	EA	F	N	N	1.000	0	0	R271	00/00/00	99/99/99
200070-560	RES-5.6 OHM 1/4W 5% CF	3	Z	22	1.000	1.000	EA	F	N	N	1.000	0	0	R254	00/00/00	99/99/99
200071-150	RES-15 OHM 1/4W 5% CF	3	Z	23	2.000	1.000	EA	F	N	N	2.000	0	0	R220,233	00/00/00	99/99/99
200071-330	RES-33 OHM 1/4W 5% CF	3	Z	25	1.000	1.000	EA	F	N	N	1.000	0	0	R221	00/00/00	99/99/99
200071-820	RES-82 OHM 1/4W 5% CF	3	Z	26	1.000	1.000	EA	F	N	N	1.000	0	0	R138	00/00/00	99/99/99
200072-100	RES-100 OHM 1/4W 5% CF	3	Z	27	2.000	1.000	EA	F	N	N	2.000	0	0	R119,249	00/00/00	99/99/99
200072-150	RES-150 OHM 1/4W 5% CF	3	Z	28	3.000	1.000	EA	F	N	N	3.000	0	0	R139,246,255	00/00/00	99/99/99
200072-360	RES-360 OHM 1/4W 5% CF	3	Z	29	1.000	1.000	EA	F	Y	N	1.000	0	0	R186 ECO#19706	4/13/87	99/99/99
200072-220	RES-220 OHM 1/4W 5% CF	3	Z	30	8.000	1.000	EA	F	N	N	8.000	0	0	R149,210,212,214,216	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200072-220	RES-220 OHM 1/4W 5% CF	3	Z	30	8.000	1.000	EA	F	N	N	8.000	0	0	,218,299,321	00/00/00	99/99/99
200072-240	RES-240 OHM 1/4W 5% CF	3	Z	31	2.000	1.000	EA	F	N	N	2.000	0	0	R222,338	00/00/00	99/99/99
200072-270	RES-270 OHM 1/4W 5% CF	3	Z	32	2.000	1.000	EA	F	N	N	2.000	0	0	R296,298	00/00/00	99/99/99
200072-330	RES-330 OHM 1/4W 5% CF	3	Z	33	2.000	1.000	EA	F	N	N	2.000	0	0	R274,301	00/00/00	99/99/99
200072-430	RES-430 OHM 1/4W 5% CF	3	Z	34	3.000	1.000	EA	F	N	N	3.000	0	0	R248,250,253	00/00/00	99/99/99
200072-470	RES-470 OHM 1/4W 5% CF	3	Z	35	2.000	1.000	EA	F	N	N	2.000	0	0	R264,265	00/00/00	99/99/99
200082-510	RES-510 OHM 1/2W 5% CF	3	J	36	1.000	1.000	EA	F	N	N	1.000	0	0	R280	00/00/00	99/99/99
200072-680	RES-680 OHM 1/4W 5% CF	3	Z	37	3.000	1.000	EA	F	N	N	3.000	0	0	R272,273,279	00/00/00	99/99/99
200072-750	RES-750 OHM 1/4W 5% CF	3	Z	38	2.000	1.000	EA	F	N	N	2.000	0	0	R281,313	00/00/00	99/99/99
200071-680	RES-68 OHM 1/4W 5% CF	3	Z	39	11.000	1.000	EA	F	N	N	11.000	0	0	R1,11,21,31,41,51,61,71,81,158,160	00/00/00	99/99/99
200073-100	RES-1.0 KOHM 1/4W 5% CF	3	Z	40	21.000	1.000	EA	F	Y	N	21.000	0	0	R115,117,150,154,223,232,243,257,278,284-286,288-292,295,297315,316	2/16/87	99/99/99
200073-120	RES-1.2 KOHM 1/4W 5% CF	3	Z	41	6.000	1.000	EA	F	N	N	6.000	0	0	R209,211,213,215,217,319	00/00/00	99/99/99
200073-130	RES-1.3 KOHM 1/4W 5% CF	3	Z	42	2.000	1.000	EA	F	N	N	2.000	0	0	R241,245	00/00/00	99/99/99
200073-150	RES-1.5 KOHM 1/4W 5% CF	3	Z	43	3.000	1.000	EA	F	N	N	3.000	0	0	R118,120,226	00/00/00	99/99/99
200073-240	RES-2.4 KOHM 1/4W 5% CF	3	Z	45	1.000	1.000	EA	F	N	N	1.000	0	0	R318	00/00/00	99/99/99
200073-220	RES-2.2 KOHM 1/4W 5% CF	3	Z	46	3.000	1.000	EA	F	Y	N	3.000	0	0	R147,156,227 ECO#19706	4/13/87	99/99/99
200073-110	RES-1.1 KOHM 1/4W 5% CF	3	Z	47	1.000	1.000	EA	F	N	N	1.000	0	0	R314	00/00/00	99/99/99
200014-140	RES-14.0 KOHM 1/8W 1% FF	3	P	48	1.000	1.000	EA	B	N	N	1.000	0	0	R128	00/00/00	99/99/99
200014-215	RES-21.5 KOHM 1/8W 1% FF	3	P	49	1.000	1.000	EA	F	N	N	1.000	0	0	R114	00/00/00	99/99/99
200023-301	RES-3.01 KOHM 1/4W 1% FF	3	C	50	1.000	1.000	EA	F	N	N	1.000	0	0	R121	00/00/00	99/99/99
200073-330	RES-3.3 KOHM 1/4W 5% CF	3	Z	51	23.000	1.000	EA	F	N	N	23.000	0	0	R2,7,12,17,22,27,32,37,42,47,52,57,62,67	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200073-330	RES-3.3 KOHM 1/4W 5% CF	3	Z	51	23.000	1.000	EA	F	N	N	23.000	0	0	,72,77,82,87,224,302,303-305	00/00/00	99/99/99
200073-430	RES-4.3 KOHM 1/4W 5% CF	3	Z	52	8.000	1.000	EA	F	N	N	8.000	0	0	R155,162,164,166,169,171,173340	00/00/00	99/99/99
200073-470	RES-4.7 KOHM 1/4W 5% CF	3	Z	53	38.000	1.000	EA	F	N	N	38.000	0	0	R10,20,30,40,50,60,70,80,90-108,153,225,235,236,252,300,276,277,282,283,325	00/00/00	99/99/99
200074-180	RES-18 KOHM 1/4W 5% CF	3	Z	54	4.000	1.000	EA	F	N	N	4.000	0	0	R161,165,168,172	00/00/00	99/99/99
200074-100	RES-10 KOHM 1/4W 5% CF	3	Z	55	47.000	1.000	EA	F	Y	N	47.000	0	0	R4,5,8,9,14,18,19,24,28,29,34,38,39,44,48,49,54,58,59,64,68,69,74,78,79,84,88,89,112,113,116,228,247,251,259,261-263,287,309-311,317,322-324,326	2/16/87	99/99/99
200074-120	RES-12 KOHM 1/4W 5% CF	3	Z	56	1.000	1.000	EA	F	N	N	1.000	0	0	R260	00/00/00	99/99/99
200074-150	RES-15 KOHM 1/4W 5% CF	3	Z	57	11.000	1.000	EA	F	N	N	11.000	0	0	R6,16,26,36,46,56,66,76,86,134,136	00/00/00	99/99/99
200074-200	RES-20 KOHM 1/4W 5% CF	3	Z	58	6.000	1.000	EA	F	Y	N	6.000	0	0	R131,133,143,330,331,332	00/00/00	99/99/99
200074-220	RES-22 KOHM 1/4W 5% CF	3	Z	59	3.000	1.000	EA	F	N	N	3.000	0	0	R187,242,2	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
200074-220	RES-22 KOHM 1/4W 5% CF	3	Z	59	3.000	1.000	EA	F	N	N	3.000	0	0	64	00/00/00	99/99/99
200073-820	RES-8.2 KOHM 1/4W 5% CF	3	Z	60	1.000	1.000	EA	F	N	N	1.000	0	0	R15	00/00/00	99/99/99
200074-430	RES-43 KOHM 1/4W 5% CF	3	Z	61	2.000	1.000	EA	F	N	N	2.000	0	0	R256,258	00/00/00	99/99/99
200014-200	RES-20.0 KOHM 1/8W 1% FF	3	P	62	1.000	1.000	EA	F	Y	N	2.000	0	0	R334	00/00/00	99/99/99
200075-100	RES-100 KOHM 1/4W 5% CF	3	Z	65	6.000	1.000	EA	F	N	N	6.000	0	0	R208,219,229,230,231,237	00/00/00	99/99/99
200075-180	RES-180 KOHM 1/4W 5% CF	3	Z	66	2.000	1.000	EA	F	N	N	2.000	0	0	R129,135	00/00/00	99/99/99
200075-200	RES-200 KOHM 1/4W 5% CF	3	Z	67	2.000	1.000	EA	F	N	N	2.000	0	0	R35,339	00/00/00	99/99/99
200075-220	RES-220 KOHM 1/4W 5% CF	3	Z	68	2.000	1.000	EA	F	N	N	2.000	0	0	R110,111	00/00/00	99/99/99
200075-330	RES-330 KOHM 1/4W 5% CF	3	Z	69	1.000	1.000	EA	F	N	N	1.000	0	0	R148	00/00/00	99/99/99
200076-100	RES-1.0 MOHM 1/4W 5% CF	3	Z	70	2.000	1.000	EA	F	N	N	2.000	0	0	R25,320	00/00/00	99/99/99
200022-511	RES-511 OHM 1/4W 1% FF	3	C	71	2.000	1.000	EA	F	Y	N	2.000	0	0	R269,270	00/00/00	99/99/99
200076-470	RES-4.7 MOHM 1/4W 5% CF	3	Z	72	2.000	1.000	EA	F	N	N	2.000	0	0	R238,240	00/00/00	99/99/99
200074-470	RES-47 KOHM 1/4W 5% CF	3	Z	73	1.000	1.000	EA	F	Y	N	1.000	0	0	R146 ECO#19706	4/13/87	99/99/99
200082-560	RES-560 OHM 1/2W 5% CF	3	J	75	9.000	1.000	EA	F	N	N	9.000	0	0	R191,192,196,197,199,200,202,205,207	00/00/00	99/99/99
200082-470	RES-470 OHM 1/2W 5% CF	3	J	76	9.000	1.000	EA	F	N	N	9.000	0	0	R190,193,194,195,198,201,203,204,206	00/00/00	99/99/99
200093-150	RES-1.5 KOHM 1W 5% CF	3	D	77	2.000	1.000	EA	F	N	N	2.000	0	0	R293,294	00/00/00	99/99/99
200209-202	RES,POT-2 KOHM 1/2W CRMT	3	C	78	1.000	1.000	EA	B	N	N	1.000	0	0	R109	00/00/00	99/99/99
205255-500	RES,NET-220/330 OHM 5% 1.5	3	E	79	2.000	1.000	EA	B	N	N	2.000	0	0	U3W,10W	00/00/00	99/99/99
205257-101	RES,NET-10 KOHM 16 PIN	3	B	81	1.000	1.000	EA	B	N	N	1.000	0	0	U4T	00/00/00	99/99/99
970984-001	CAP-ELEC-4.7MF 50V NON POLAR	3	A	84	5.000	1.000	EA	B	Y	N	5.000	0	0	C186,188,190,191,301	1/21/87	99/99/99
201148-150	CAP-PC,.15MF,50V,5%	3	J	85	2.000	1.000	EA	B	N	N	2.000	0	0	C119,120	00/00/00	99/99/99
201204-331	CAP-CER,3.3PF,50V,5%,NPO	3	L	86	10.000	1.000	EA	B	Y	N	10.000	0	0	C3,10,15,22,27,34,39,46,50,135	00/00/00	99/99/99
201123-100	CAP-DM,1000PF,500V,5%	3	F	87	1.000	1.000	EA	B	N	N	1.000	0	0	C131	00/00/00	99/99/99
201111-330	CAP-CER,33PF,200V,10%	3	E	88	3.000	1.000	EA	B	N	N	3.000	0	0	C212,213,219	00/00/00	99/99/99
201204-472	CAP-CER,47PF,50V,5%,NPO	3	L	89	10.000	1.000	EA	B	Y	N	10.000	0	0	C4,11,16,23,28,35,40,47,51,101	00/00/00	99/99/99
201204-272	CAP-CER,27PF,50V,5%,NPO	3	L	90	9.000	1.000	EA	B	N	N	9.000	0	0	C2,9,14,21	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

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REQ: Y=PART REQUIRED
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PF: Y=PART PRINTS ON SALES ORDER
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201204-272	CAP-CER,27PF,50V,5%,NPO	3	L	90	9.000	1.000	EA	B	N	N	9.000	0	0	,26,33,38,45,49 201111-270	00/00/00	99/99/99
201204-103	CAP-CER,100PF,50V,5%,NPO	3	L	91	12.000	1.000	EA	B	Y	N	12.000	0	0	C64,66,68,69,74,75,77,80,81,122,177,221	00/00/00	99/99/99
201204-203	CAP-CER,200PF,50V,5%,NPO	3	L	92	2.000	1.000	EA	B	Y	N	2.000	0	0	C116,118	00/00/00	99/99/99
201204-333	CAP-CER,330PF,50V,5%,NPO	3	L	93	4.000	1.000	EA	B	N	N	4.000	0	0	C99,169,302,303	00/00/00	99/99/99
201114-104	CAP-CER,1000PF,50V,10%,X7R	3	F	94	3.000	1.000	EA	B	Y	N	3.000	0	0	C113,114,170	00/00/00	99/99/99
201114-154	CAP-CER,1500PF,50V,10%,X7R	3	F	95	4.000	1.000	EA	B	N	N	4.000	0	0	C106,126,167,173 201113-150	00/00/00	99/99/99
201113-390	CAP-CER,3900PF,50V,10%	3	L	96	1.000	1.000	EA	B	N	N	1.000	0	0	C143	00/00/00	99/99/99
201114-474	CAP-CER,4700PF,50V,10%,X7R	3	F	97	1.000	1.000	EA	B	N	N	1.000	0	0	C134 201113-470	00/00/00	99/99/99
201103-820	CAP-CER,8200PF,50V,10%	3	E	98	9.000	1.000	EA	B	N	N	9.000	0	0	C1,8,13,20,25,32,37,44,225	00/00/00	99/99/99
201114-334	CAP-CER,3300PF,50V,10%,X7R	3	F	99	2.000	1.000	EA	B	N	N	2.000	0	0	C140,142	00/00/00	99/99/99
201114-105	CAP-CER,10000PF,50V,10%,X7R	3	F	100	109.000	1.000	EA	B	N	N	109.000	0	0	C6,7,18,19,30,31,42,43,53,55-62,63,67,70,71,76,78,79,82,85-91,94-96,98 103,109-112,127-129,137-139,145-149,150-166,171,172,175,176,178,179,181-183,201-204,206-211,215-218,229,5,12,17,24,	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
201114-105	CAP-CER,10000PF,50V,10%,X7R	3	F	100	109.000	1.000	EA	B	N	N	109.000	0	0	29,36,41,48,52,65,72,73 201114-100	00/00/00	99/99/99
201114-470	CAP-CER,.047MF,50V,10%	3	F	101	3.000	1.000	EA	B	Y	N	3.000	0	0	C84,121,133	10/24/86	99/99/99
201114-106	CAP-CER,100000PF,50V,10%,X7R	3	F	102	8.000	1.000	EA	B	Y	N	8.000	0	0	C100,107,123,125,132,136,141,200 17	1/21/87	99/99/99
970575-001	CAP-CER,.047MF@50VDC AXIAL Z5U	3	A	103	1.000	1.000	EA	B	Y	N	1.000	0	0	C300	10/24/86	99/99/99
201112-470	CAP-CER,470PF,50V,10%	3	J	104	1.000	1.000	EA	B	Y	N	1.000	0	0	C220	00/00/00	99/99/99
201171-100	CAP-ELEC,10MF,50V,	3	K	105	5.000	1.000	EA	B	Y	N	5.000	0	0	C130,184,185,187,194	1/21/87	99/99/99
201160-680	CAP-TANT,6.8MF,35V,10%	3	F	106	3.000	1.000	EA	B	N	N	3.000	0	0	C54,226,227	00/00/00	99/99/99
970205-001	CAP-CER,.1MF,100V,10%,RADIAL	3	D	107	2.000	1.000	EA	B	Y	N	2.000	0	0	C192,228	00/00/00	99/99/99
201191-006	CAP-ELEC,47MF,6V, ,ALUM	3	H	108	1.000	1.000	EA	B	N	N	1.000	0	0	C144	00/00/00	99/99/99
970478-001	CAP-MYLAR,.1U,63V,20%,RADIAL	3	A	109	3.000	1.000	EA	B	N	N	3.000	0	0	C180,189,193	00/00/00	99/99/99
201204-153	CAP-CER,150PF,50V,5%,NPO	3	L	110	2.000	1.000	EA	B	N	N	2.000	0	0	C174,214	00/00/00	99/99/99
201204-183	CAP-CER,180PF,50V,5%,NPO	3	L	111	1.000	1.000	EA	B	N	N	1.000	0	0	C97	00/00/00	99/99/99
201224-684	CAP-MYLAR,.68MF,50V,10%	3	B	112	1.000	1.000	EA	B	N	N	1.000	0	0	C117	00/00/00	99/99/99
201160-475	CAP-TANT,4.7MF,10V,20%,MINI	3	A	113	2.000	1.000	EA	B	Y	N	2.000	0	0	C168,224	00/00/00	99/99/99
201204-473	CAP-CER,470PF,50V,5%,NPO	3	L	114	2.000	1.000	EA	B	N	N	2.000	0	0	C92,93	00/00/00	99/99/99
201161-226	CAP-TANT,22MF,20V,20%	3	C	115	2.000	1.000	EA	B	N	N	2.000	0	0	222,223	00/00/00	99/99/99
202009-999	DIODE RECTIFIER,1 AMP	3	C	116	3.000	1.000	EA	B	N	N	3.000	0	0	CR7,8,13	00/00/00	99/99/99
202018-100	DIODE,SWITCHING,1N4148	3	D	117	7.000	1.000	EA	B	N	N	7.000	0	0	CR2-6,9,10	00/00/00	99/99/99
202028	DIODE-ZENER	3	B	118	1.000	1.000	EA	B	N	N	1.000	0	0	CR1	00/00/00	99/99/99
202034-999	DIODE-RECT FAST RECOVERY	3	B	119	2.000	1.000	EA	B	N	N	2.000	0	0	CR11,12	00/00/00	99/99/99
209991-004	INDUCTOR-.47UHY,20%	3	B	120	1.000	1.000	EA	B	N	N	1.000	0	0	L1	00/00/00	99/99/99
201224-224	CAP-MYLAR,.22MF,50V,10%	3	B	121	1.000	1.000	EA	B	N	N	1.000	0	0	C104	00/00/00	99/99/99
203554-001	IC-8237 DMA 8BIT 4MHZ	3	D	123	1.000	1.000	EA	B	N	N	1.000	0	0	U2T	00/00/00	99/99/99
203564-123	IC-4164 MEM MOS RAM 64KX1	3	J	124	9.000	1.000	EA	B	N	N	9.000	0	0	U9P,9R,9T,10P,10R,10T,11P,11R,11T 203564-124	00/00/00	99/99/99
201148-100	CAP-PC,.1MF,50V,	3	J	125	2.000	1.000	EA	B	Y	N	2.000	0	0	C108,124	1/21/87	99/99/99
203075-002	IC-2128 RAM 2KX8	3	F	126	2.000	1.000	EA	B	N	N	2.000	0	0	U3N,5N	00/00/00	99/99/99

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963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
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203575-110	IC-8002 CPU 16BIT 4MHZ	3	B	127	1.000	1.000	EA	B	N	N	1.000	0	0	U2N	00/00/00	99/99/99
203555-110	IC-8036 CIO 16BIT 4MHZ	3	C	128	3.000	1.000	EA	B	N	N	3.000	0	0	U9L,11L,13L	00/00/00	99/99/99
201114-470	CAP-CER,.047MF,50V,10%	3	F	129	1.000	1.000	EA	B	Y	N	1.000	0	0	C103	2/18/87	99/99/99
203550-001	IC-1006 CONV D-A 10BIT 500NS	3	B	130	1.000	1.000	EA	B	N	N	1.000	0	0	U6M	00/00/00	99/99/99
203550-501	IC-1001 CONV A-D 10BIT 170NS	3	E	131	1.000	1.000	EA	B	N	N	1.000	0	0	U6N	00/00/00	99/99/99
203007-393	IC-393 COMP DUAL LOW OFFSET	3	H	132	1.000	1.000	EA	B	N	N	1.000	0	0	U3H	00/00/00	99/99/99
203007-350	IC-319 VOLT COMP/BFR DUAL	3	F	133	9.000	1.000	EA	B	N	N	9.000	0	0	U15A,15D,15F,15G,15H,14C,14F,14H,15C	00/00/00	99/99/99
203007-500	IC-323 REG 3A,5V,POS REG,TO-3*	3	H	134	1.000	1.000	EA	B	N	N	1.000	0	0	Q7	00/00/00	99/99/99
203007-700	IC-339 VOLT COMP QUAD	3	J	135	2.000	1.000	EA	B	N	N	2.000	0	0	U6H,19T	00/00/00	99/99/99
203012-999	IC-4044 DET PHASE FREQ	3	C	136	1.000	1.000	EA	B	N	N	1.000	0	0	U5G	00/00/00	99/99/99
203012-136	IC-4136 OP AMP QUAD	3	H	137	3.000	1.000	EA	B	N	N	3.000	0	0	U2A,2C,20N	00/00/00	99/99/99
203013-320	IC-7815 VOLT REG	3	D	138	1.000	1.000	EA	B	N	N	1.000	0	0	VR2	00/00/00	99/99/99
203013-300	IC-7912 VOLT REG,12V,1.5AMPS	3	L	139	1.000	1.000	EA	B	N	N	1.000	0	0	VR1	00/00/00	99/99/99
203013-317	IC-78L05 VOLT REG +5V 5%	3	E	140	1.000	1.000	EA	B	N	N	1.000	0	0	Q16	00/00/00	99/99/99
203043-500	IC-709 OP AMP HI-PERFORM	3	G	141	9.000	1.000	EA	B	N	N	9.000	0	0	U19A,19B,19C,19D,19E,19F,19G,19H,19I	00/00/00	99/99/99
970325-001	IC-74F74 FF D DUAL	3	D	142	1.000	1.000	EA	B	N	N	1.000	0	0	13W	00/00/00	99/99/99
201148-330	CAP-PC,.33MF,50V,5%	3	J	143	1.000	1.000	EA	B	Y	N	1.000	0	0	C304	2/18/87	99/99/99
203130-999	IC-082 OP AMP JFET IN	3	E	144	13.000	1.000	EA	B	N	N	13.000	0	0	U6L,6J,6K,18A,18B,18C,18D,18E,18F,18G,18H,18I,18M	00/00/00	99/99/99
203052-051	IC-4051 MUX 8 CH	3	C	145	2.000	1.000	EA	B	N	N	2.000	0	0	U7J,7N	00/00/00	99/99/99
203052-053	IC-4053 MUX 2CH TRIP	3	C	146	1.000	1.000	EA	B	N	N	1.000	0	0	U2B	00/00/00	99/99/99
203071-999	IC-4024 MLTV V-CTRL DUAL	3	A	147	1.000	1.000	EA	B	N	N	1.000	0	0	U3C	00/00/00	99/99/99
203026-999	IC-7404 INV HEX	3	A	149	1.000	1.000	EA	B	N	N	1.000	0	0	U2K	00/00/00	99/99/99
970221-001	IC-74LS00 NAND 2IN POS QUAD	3	E	150	10.000	1.000	EA	B	N	N	10.000	0	0	U2G,3V,5V,8V,11B,11C,11E,11F,12E,17T	00/00/00	99/99/99
970011-001	IC-74LS04 INV HEX	3	D	151	6.000	1.000	EA	B	N	N	6.000	0	0	8A,8B,8C,4G,4H,16T	00/00/00	99/99/99
203026-500	IC-7406 INV BFR/DRV HEX	3	G	152	3.000	1.000	EA	B	N	N	3.000	0	0	U16J,17X,18X	00/00/00	99/99/99

BILL OF MATERIAL
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MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

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970010-001	IC-74LS08 AND 2IN QUAD	3	B	153	6.000	1.000	EA	B	N	N	6.000	0	0	U7H,7V,4P,1P,16W,14R	00/00/00	99/99/99
203029-002	IC-74LS10 NAND 3IN TRIP	3	J	154	1.000	1.000	EA	B	N	N	1.000	0	0	U16R	00/00/00	99/99/99
203029-003	IC-74LS11 AND 3IN TRIP	3	F	155	2.000	1.000	EA	B	N	N	2.000	0	0	U3G,4V	00/00/00	99/99/99
203029-010	IC-74S10 NAND 3IN TRIP	3	B	156	1.000	1.000	EA	B	N	N	1.000	0	0	U5F	00/00/00	99/99/99
203030-367	IC-74LS367 DRVR BUS HEX	3	J	157	2.000	1.000	EA	B	N	N	2.000	0	0	U3R,4R	00/00/00	99/99/99
203031-050	IC-74S140 NAND 4IN POS DUAL	3	E	158	1.000	1.000	EA	B	N	N	1.000	0	0	U2E	00/00/00	99/99/99
203035-032	IC-74LS32 OR 2IN QUAD	3	J	159	7.000	1.000	EA	B	N	N	7.000	0	0	U2H,2P,6R,5K,9M,12M,13M	00/00/00	99/99/99
203036	IC-7438 NAND 2IN BUF QUAD	3	E	160	4.000	1.000	EA	B	N	N	4.000	0	0	U7W,8W,9W,14M	00/00/00	99/99/99
203039-001	IC-74LS74 FF D DUAL	3	M	161	5.000	1.000	EA	B	N	N	5.000	0	0	U5P,17R,13R,14P,14T	00/00/00	99/99/99
203042-001	IC-74LS86 XOR QUAD	3	K	162	9.000	1.000	EA	B	N	N	9.000	0	0	U4W,16N,16M,17M,12B,12C,12D,12F,12G	00/00/00	99/99/99
203042-510	IC-74LS197 CNTR/LATCH BIN	3	G	163	1.000	1.000	EA	B	N	N	1.000	0	0	U3K	00/00/00	99/99/99
203046-132	IC-74LS132 2IN QUAD	3	J	165	1.000	1.000	EA	B	N	N	1.000	0	0	U7P	00/00/00	99/99/99
203046-148	IC-74LS138 DCDR 3-8 LINE	3	K	166	2.000	1.000	EA	B	N	N	2.000	0	0	U6W,8D	00/00/00	99/99/99
203046-150	IC-74LS42 DCDR BCD-DEC	3	C	167	1.000	1.000	EA	B	N	N	1.000	0	0	U1K	00/00/00	99/99/99
203046-151	IC-74LS151 SEL 1-8 DATA	3	K	168	3.000	1.000	EA	B	N	N	3.000	0	0	U7C,10F,10G	00/00/00	99/99/99
203046-153	IC-74LS153 SEL/MLTP 4-1 LINE	3	G	169	2.000	1.000	EA	B	N	N	2.000	0	0	U7E,15K	00/00/00	99/99/99
203047-157	IC-74LS157 MUX 2-1 LINE QUAD	3	G	170	1.000	1.000	EA	B	N	N	1.000	0	0	U9E	00/00/00	99/99/99
203048-150	IC-74LS163 CNTR 4BIT SYNC	3	K	171	13.000	1.000	EA	B	N	N	13.000	0	0	U4D,7D,17W,18W,9A,9B,9C,9D,10B,10C,10D,10E,11D	00/00/00	99/99/99
203049-164	IC-74LS164 8BIT PARALLEL OUT	3	L	172	5.000	1.000	EA	B	N	N	5.000	0	0	U7F,8E,8F,9F,14W	00/00/00	99/99/99
203051-100	IC-74LS175 FF D QUAD	3	G	173	5.000	1.000	EA	B	N	N	5.000	0	0	U12V,14V,17N,17L,10M	00/00/00	99/99/99
203051-174	IC-74LS174 FF D HEX	3	K	174	11.000	1.000	EA	B	N	N	11.000	0	0	U6V,13A,13D,13G,13V,15V,16P,16V,16K,6F,6G	00/00/00	99/99/99
203052-244	IC-74LS244 BFR OCT 3S	3	K	175	1.000	1.000	EA	B	N	N	1.000	0	0	U5T	00/00/00	99/99/99

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203061-280	IC-74LS280 PARITY TREE 9IN	3	C	176	1.000	1.000	EA	B	N	N	1.000	0	0	U11V	00/00/00	99/99/99
970451-001	IC-74LS365 DRVR BUS HEX	3	B	177	1.000	1.000	EA	B	N	N	1.000	0	0	U10V	00/00/00	99/99/99
203082-500	IC-7407N BUF DRV HEX	3	E	178	4.000	1.000	EA	B	N	N	4.000	0	0	U6P,10H,17J,17K	00/00/00	99/99/99
203085-001	IC-74LS14 INV SCHMITT HEX	3	J	179	6.000	1.000	EA	B	N	N	6.000	0	0	R14A,14D,14G,3P,5R,2V	00/00/00	99/99/99
203029-500	IC-7414 INV HEX SCHMITT TRIP	3	B	180	1.000	1.000	EA	B	N	N	1.000	0	0	U17P	00/00/00	99/99/99
203094-500	IC-74LS109 FF JK POS EDGE	3	J	181	11.000	1.000	EA	B	Y	N	11.000	0	0	U3D,5H,6A,6B,7A,7B,13B,13C,13E,13F,13H	00/00/00	99/99/99
203102-245	IC-74LS245 TRANSCEIVR BUS OCT	3	E	182	2.000	1.000	EA	B	N	N	2.000	0	0	U7R,7T	00/00/00	99/99/99
203102-373	IC-74LS373 LATCH D OCT	3	G	183	3.000	1.000	EA	B	N	N	3.000	0	0	U1L,2L,6T	00/00/00	99/99/99
203102-375	IC-74LS374 FF D OCT	3	F	184	2.000	1.000	EA	B	N	N	2.000	0	0	U15W,2W	00/00/00	99/99/99
203122-368	IC-74LS368 HEX BUS DRIVER	3	L	185	1.000	1.000	EA	B	N	N	1.000	0	0	U16L	00/00/00	99/99/99
203036-039	IC-74LS125 BUS BUF QUAD	3	F	186	1.000	1.000	EA	B	N	N	1.000	0	0	U13P	00/00/00	99/99/99
204007-700	TRANSISTOR-POWER,NPN	3	K	187	2.000	1.000	EA	B	N	N	2.000	0	0	Q9,13	00/00/00	99/99/99
204010-533	TRANSISTOR-NPN,SILICON	3	F	188	4.000	1.000	EA	B	N	N	4.000	0	0	Q10,14,24,26	00/00/00	99/99/99
204010-535	TRANSISTOR-PNP SILICON	3	J	189	3.000	1.000	EA	B	N	N	3.000	0	0	Q8,12,25	00/00/00	99/99/99
204010-700	TRANSISTOR-POWER,PNP	3	J	190	2.000	1.000	EA	B	N	N	2.000	0	0	Q11,15	00/00/00	99/99/99
204012-999	TRANSISTOR,PNP SILICON	3	C	191	2.000	1.000	EA	B	N	N	2.000	0	0	Q18,20	00/00/00	99/99/99
960081-001	TRANS PNP DARL	1	B	192	2.000	1.000	EA	B	N	N	2.000	0	0	Q2,4	00/00/00	99/99/99
960082-001	TRANS NPN DARL	1	B	193	2.000	1.000	EA	B	N	N	2.000	0	0	Q1,3	00/00/00	99/99/99
204026-050	TRANSISTOR-PNP,DARLINGTON	3	D	194	1.000	1.000	EA	B	N	N	1.000	0	0	Q6	00/00/00	99/99/99
204026-057	TRANSISTOR-NPN,DARLINGTON	3	F	195	1.000	1.000	EA	B	N	N	1.000	0	0	Q5	00/00/00	99/99/99
204027-034	TRANSISTOR P-N-P SILICON	3	E	196	2.000	1.000	EA	B	N	N	2.000	0	0	Q19,21	00/00/00	99/99/99
204027-037	TRANSISTOR N-P-N SILICON	3	E	197	3.000	1.000	EA	B	N	N	3.000	0	0	Q17,22,23	00/00/00	99/99/99
203030-202	IC-74LS240 DRVR BUS OCT	3	B	199	1.000	1.000	EA	B	N	N	1.000	0	0	U11W	00/00/00	99/99/99
970267-001	PIN-TEST,.040SQ X .360LG	3	A	200	87.000	1.000	EA	F	Y	N	87.000	0	0	TP1-19,21-54,56,57,59-90 205026-999	00/00/00	99/99/99
203044	IC-74121 MLTV MNST	3	B	201	2.000	1.000	EA	B	N	N	2.000	0	0	U13T,U4K	00/00/00	99/99/99
207602-011	WASHER,SPLIT LOCK #6	3	B	204	13.000	1.000	EA	F	Y	N	13.000	0	0		00/00/00	99/99/99
207604-081	NUT-HEX RADIO PATTERN	3	B	205	3.000	1.000	EA	F	N	N	3.000	0	0		00/00/00	99/99/99
207608-021	WASHER,FLAT,SMALL OD #6	3	B	206	2.000	1.000	EA	F	Y	N	2.000	0	0		00/00/00	99/99/99
213271-409	SCREW-PHP,ZINC,4-40X 9/16	3	G	207	16.000	1.000	EA	F	N	N	16.000	0	0		00/00/00	99/99/99
970667-001	STANDOFF-PWB,INSUL	3	D	208	1.000	1.000	EA	B	Y	N	1.000	0	0		00/00/00	99/99/99
210111-768	CRYSTAL-7.680MHZ,HC-18/U,	3	F	209	1.000	1.000	EA	B	N	N	1.000	0	0	Y1	00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
210030-632	STDOFF-1/4 HES,A/F,3/8,6-32	3	A	210	3.000	1.000	EA	B	Y	N	3.000	0	0		00/00/00	99/99/99
213271-606	SCREW-PHP,ZINC,6-32X3/8	3	G	211	5.000	1.000	EA	F	Y	N	5.000	0	0		00/00/00	99/99/99
213271-607	SCREW-PHP,ZINC,6-32X7/16	3	G	212	4.000	1.000	EA	F	Y	N	4.000	0	0		00/00/00	99/99/99
213700-609	WASHER-FLAT,NYLON,SM PAT	3	B	214	10.000	1.000	EA	F	N	N	10.000	0	0		00/00/00	99/99/99
207403-011	WASHER,SPLIT LOCK #4	3	C	215	16.000	1.000	EA	F	N	N	16.000	0	0		00/00/00	99/99/99
207402-021	WASHER,FLAT #4	3	B	216	32.000	1.000	EA	F	N	N	32.000	0	0		00/00/00	99/99/99
210016-006	SCREW-6-32X1/4 BDR HD SLT	3	A	217	2.000	1.000	EA	F	N	N	2.000	0	0		00/00/00	99/99/99
210197-200	RELAY-2PDT 10AMP 24VOLT	3	D	218	1.000	1.000	EA	B	N	N	1.000	0	0	K1	00/00/00	99/99/99
205025-516	SOCKET-DIP, 16 CONTACTS	3	E	219	1.000	1.000	EA	B	N	N	1.000	0	0	XU16K	00/00/00	99/99/99
970862-001	INSULATOR-THERMALLY COND,TO-3*	3	A	220	7.000	1.000	EA	B	Y	N	7.000	0	0	(Q1-7)	10/17/86	99/99/99
211011-008	SOCKET,8 PIN LOW PROFILE	3	A	222	1.000	1.000	EA	B	N	N	1.000	0	0	XJ1	00/00/00	99/99/99
211011-016	SOCKET,16 PIN LOW PROFILE	3	D	223	3.000	1.000	EA	B	N	N	3.000	0	0	XU7G,3W,10W	00/00/00	99/99/99
207405-051	NUT,HEX #4	3	C	224	16.000	1.000	EA	F	N	N	16.000	0	0		00/00/00	99/99/99
211011-024	SOCKET,24 PIN LOW PROFILE	3	E	225	1.000	1.000	EA	B	N	N	1.000	0	0	XU9G	00/00/00	99/99/99
211011-028	SOCKET,28 PIN LOW PROFILE	3	F	226	2.000	1.000	EA	B	N	N	2.000	0	0	XU3L,XU5L	00/00/00	99/99/99
211011-040	SOCKET,40 PIN LOW PROFILE	3	E	227	5.000	1.000	EA	B	N	N	5.000	0	0	XU2T,2N,9L,11L,13L	00/00/00	99/99/99
211015-003	SWITCH-DIP,8POS,SEALED	3	K	228	2.000	1.000	EA	B	N	N	2.000	0	0	U3T,5W	00/00/00	99/99/99
211077-999	CLIP-RELAY	3	B	229	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
211078-999	SOCKET RELAY	3	A	230	1.000	1.000	EA	B	N	N	1.000	0	0	XUK1	00/00/00	99/99/99
961328-001	INSULATOR-SLEEVE,	1	B	231	14.000	1.000	EA	B	N	N	14.000	0	0		00/00/00	99/99/99
210030-141	STDOFF-1/4 HEX,7/16,6-32	3	A	232	2.000	1.000	EA	B	N	N	2.000	0	0		00/00/00	99/99/99
213271-604	SCREW-PHP,ZINC,6-32X1/4	3	G	233	1.000	1.000	EA	F	N	N	1.000	0	0		00/00/00	99/99/99
213271-607	SCREW-PHP,ZINC,6-32X7/16	3	G	234	5.000	1.000	EA	F	N	N	5.000	0	0		00/00/00	99/99/99
731006-800	LABEL-ASSY	1	B	238	1.000	1.000	EA	F	N	N	1.000	0	0		00/00/00	99/99/99
760101-695	STIFFENER-LEFT SIDE	1	D	240	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
760101-803	SHIELDED-READ AMP	1	C	242	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
760101-827	HEATSINK-DIECAST	1	G	243	1.000	1.000	EA	B	Y	N	1.000	0	0		10/06/86	99/99/99
760102-543	STIFFENER-FRONT WITH TAB	1	B	244	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
760101-693	STIFFENER-REAR	1	E	245	1.000	1.000	EA	B	N	N	1.000	0	0		00/00/00	99/99/99
213271-609	SCREW-PHP,ZINC,6-32X9/16	3	G	246	1.000	1.000	EA	F	N	N	1.000	0	0		00/00/00	99/99/99
209100-552	TUBING TFL 22 GA	3	B	248	.000	1.000	EA	F	N	N	.200	0	0		00/00/00	99/99/99
210875-501	INSULATOR-THERMALLY	3	B	249	2.000	1.000	EA	B	N	N	2.000	0	0	(VR1,2)	00/00/00	99/99/99
211116	TRANSIPAD TO-5	3	A	252	4.000	1.000	EA	B	N	N	4.000	0	0	XQ9,11,13,15	00/00/00	99/99/99
208430-999	WIRE-30AWG,BLUE KYNAR,	3	A	253	.000	1.000	FT	F	Y	N	.500	0	0		00/00/00	99/99/99
208425-998	WIRE-26AWG,KYNAR,ROLL*	3	A	254	.000	1.000	FT	F	N	N	.001	0	0		00/00/00	99/99/99
208500-297	WIRE BUS TND COPPER 20AWG	3	B	255	.000	1.000	EA	F	N	N	.001	0	0		00/00/00	99/99/99
100383-930	WIRE-SLD INSUL,BACK PNL,WHT,30	0	B	258	.001	1.000	FT	F	Y	N	.001	0	0		00/00/00	99/99/99
970259-001	TUBING-PVC,105DEG,CLEAR,24	0	A	259	.001	1.000	FT	P	Y	N	.001	0	0		00/00/00	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

963459-003 OPCODE: 4 REV: B PWB ASSY-BASIC
MODEL:
ECO NO: 19706
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
209998-060	LOCTITE TAK PAK	3	B	260	.001	1.000	EA	F	Y	N	.001	0	0		00/00/00	99/99/99
970965-106	CAP-10UF,16VDC,+-10%	0	A	261	1.000	1.000	EA	P	Y	N	1.000	0	0	C108 ECO#1 9706	4/13/87	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

964360-001 OPCODE: 3 REV: C PWB ASSY-DRIVE/FMTR,125 IPS
MODEL:
ECO NO: 19761
DATE OF LAST ECO: 4/13/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
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PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0		2/23/87	99/99/99
962622-011	S/W-CACHE,ASSY HI ROM,125,1600	0	A	4	1.000	1.000	EA	F	Y	N	1.000	0	0	U3L ECO#19761	4/13/87	99/99/99
962622-012	S/W-CACHE,ASSY LOW,ROM,125,	0	A	5	1.000	1.000	EA	F	Y	N	1.000	0	0	U5L ECO#19761	4/13/87	99/99/99
731006-800	LABEL-ASSY	1	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		00/00/00	99/99/99
970934-006	TERM-RING,#6INSL GRIP,22-18AWG	3	A	7	1.000	1.000	EA	F	Y	N	1.000	0	0		3/02/87	99/99/99
208415-111	WIRE-STRD,22AWG,IRPVC,WHT	3	C	8	.200	1.000	FT	F	Y	N	.200	0	0		3/02/87	99/99/99
209998-060	LOCTITE TAK PAK	3	B	9	.000	1.000	EA	F	Y	N	.000	0	0		3/02/87	99/99/99

BILL OF MATERIAL

AS OF 12/31/93

CLASS CODE: 3300
MICRO "I-P" PURCHASED ASSY'S

964361-001 OPCODE: 3 REV: D PWB ASSY-DRIVE/FMTR,125 IPS
MODEL:
ECO NO: 19797
DATE OF LAST ECO: 4/25/87

OP: ORDER POLICY CODE
REQ: Y=PART REQUIRED
N=PART OPTIONAL
PF: Y=PART PRINTS ON SALES ORDER
N=PART DOES NOT PRINT ON SO

PART NUMBER	DESCRIPTION	OP	RV	ITEM NO.	QTY PER ASSEMBLY	YIELD FACTR	UM	SC	REQ	PF	DEFAULT QUANTITY	DAYS OFF SET	SEQ	REFERENCE DESIGNATOR	EFFECTIV DATE	OBSOLETE DATE
963459-003	PWB ASSY-BASIC	4	B	1	1.000	1.000	EA	S	Y	N	1.000	0	0		2/23/87	99/99/99
962618-011	S/W-CACHE ASSY HI ROM,125,1600	0	A	4	1.000	1.000	EA	X	Y	N	1.000	0	0	U3L ECO#19797	4/24/87	99/99/99
962618-012	S/W-CACHE ASSY LOW ROM,125,	0	A	5	1.000	1.000	EA	X	Y	N	1.000	0	0	U5L ECO#19797	4/24/87	99/99/99
731006-800	LABEL-ASSY	3	B	6	1.000	1.000	EA	F	Y	N	1.000	0	0		5/15/85	99/99/99
970934-006	TERM-RING,#6INSL GRIP,22-18AWG	3	A	7	1.000	1.000	EA	F	Y	N	1.000	0	0		3/02/87	99/99/99
208415-111	WIRE-STRD,22AWG,IRPVC,WHT	3	C	8	.200	1.000	FT	F	Y	N	.200	0	0		3/02/87	99/99/99
209998-060	LOCTITE TAK PAK	3	B	9	.000	1.000	EA	F	Y	N	.000	0	0		3/02/87	99/99/99

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