SERVICE MANUAL

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HP 9875A
CARTRIDGE TAPE UNIT

Hewlett-Packard Calculator Products Division
P.O. Box 301, Loveland, Colorado 80537
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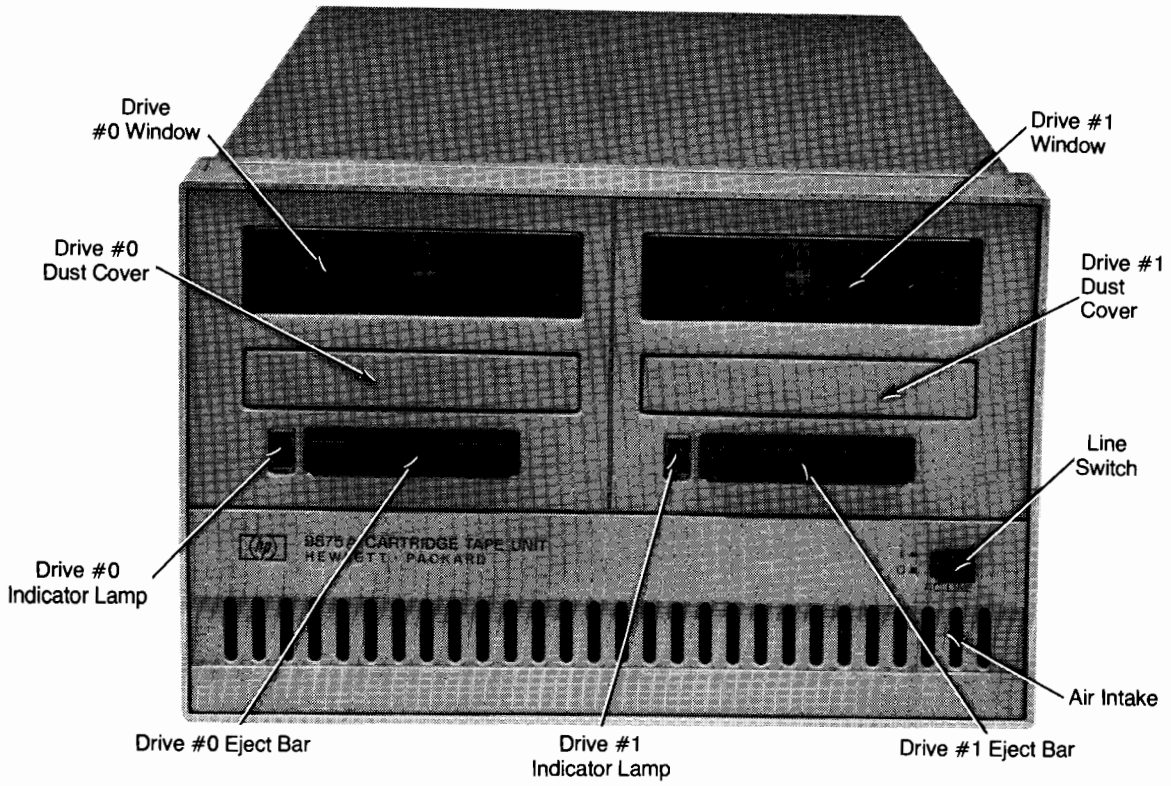
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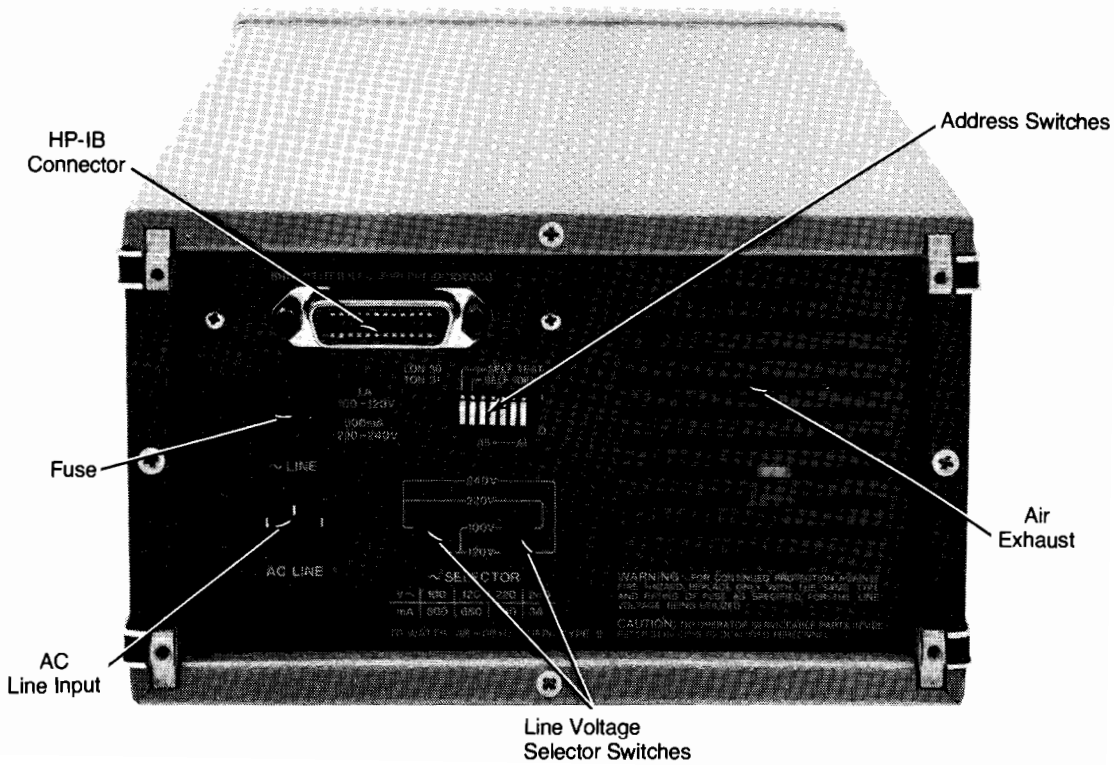
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Chapter 1
General Information

Introduction

This manual provides maintenance information for the HP 9875A Cartridge Tape Unit. The various chapters of this manual include:

1. General Information
2. Theory of Operation
3. Troubleshooting
4. Disassembly and Special Replacement Procedures
5. Parts List

Description

The HP 9875A Cartridge Tape Unit (CTU) provides data storage by writing data on and reading data off a magnetic tape. Data is transmitted to and from the CTU via the HP Interface Bus (HP-IB).

The CTU contains its own processor. This processor is responsible for processing data which is being input to and output from the CTU. The processor also interprets and executes the commands which the CTU receives via the HP-IB.

Product Support Package

The 9875A Product Support Package contains the electronics assemblies and mechanical parts necessary to service the HP 9875A.

Table 1: 9875A Product Support Package

PSP Breakdown (P/N 09875-67100)

Assembly Description	New HP Part Number	Qty.
Case with insert	09875-64501	1
Material List	09875-67120	1
Service Manual	09875-90030	1
Installation and Operating Manual	09875-90000	1
Schematic Packet	09875-90035	1
Plastic Box	1540-0015	1
Foam Insert, Plastic Box	9220-2851	1
Cable – R/W	09875-61601	1
Fuse 0.5A SB	2110-0202	2
Fuse 1A SB	2110-0007	2
Fuse 2A NB	2110-0002	2
Power switch	3101-2216	1
Cartridge, blank	9162-0061	2
IC Regulator, +12V	1826-0117	1
IC Regulator, −12V	1826-0123	1
IC Regulator, +5V	1826-0181	1
IC Regulator, +7V	1826-0423	1
IC Regulator, −6V	1826-0478	1
IC Darlington	1853-0383	2
IC Insulator	0340-0566	2
IC Insulator	0340-0583	4
PSP (Complete)	09875-67100	

Green Stripe Exchange Assemblies

Assembly Description	New HP Part Number	Rebuilt HP Part Number
Transport	5061-3002	98075-69900
Tape Control Assembly	09875-66510	09875-69510
HP-IB Assembly	09875-66515	09875-69515

Non-Repairable Assemblies

Assembly Description	New HP Part Number
I/O Assembly	09875-66540
High Voltage Assy	09875-66550

Installation Procedure

This section contains the installation and connection procedures for the HP 9875A Cartridge Tape Unit (CTU).

Cartridge Tape Unit Inspection Procedures

Carefully check the cartridge tape unit, the HP-IB cable and other items for any physical damage sustained in transit. File a claim with the carrier if any such damage has occurred.

Equipment Supplied

The following items are packaged with the HP 9875A Cartridge Tape Unit:

Table 2: Equipment Supplied

Equipment	H/P part number
Operating Manual	09875-90000
Tape Cartridge	9162-0061
Tape Head Cleaner	8500-1251
Spare Fuses	
1A	2110-0007
.5A	2110-0202

Power Cord (Appropriate cord supplied, based on origin of sale order).

Grounding Requirements

To protect operating personnel, the National Electronic Manufacturers' Association (NEMA) recommends that the cartridge tape unit be properly grounded. The cartridge tape unit is equipped with a three conductor power cable which, when connected to an appropriate power receptacle, grounds the cartridge tape unit. To preserve this protection feature, do not operate the cartridge tape unit from an AC power outlet which has no ground connection.

Power Requirements

The HP 9875A Cartridge Tape Unit has the following power requirements:

Line Voltage	100 VAC, 120 VAC, 220 VAC, 240 VAC,	+6%, −13%
Line Frequency:	48 to 66 Hertz	
Power Consumption:	100 V @ 800 mA 120 V @ 680 mA 220 V @ 380 mA 240 V @ 350 mA	

Power Cords

Power Cords supplied by HP will have polarities matched to the power input socket on the cartridge tape unit, as shown in Figure 1-1.

L − Line or Active Conductor (also called "line" or "hot")
N = Neutral or Identified Connector
E = Earth or Safety Ground

WARNING

IF IT IS NECESSARY TO REPLACE THE POWER CORD, THE REPLACEMENT CORD MUST HAVE THE SAME POLARITY AS THE ORIGINAL. OTHERWISE A SAFETY HAZARD FROM ELECTRICAL SHOCK TO PERSONNEL, WHICH COULD RESULT IN INJURY OR DEATH, MIGHT EXIST. IN ADDITION, THE EQUIPMENT COULD BE SEVERELY DAMAGED IF EVEN A RELATIVELY MINOR INTERNAL FAILURE OCCURRED.

Power cords with different plugs are available for the cartridge tape unit; the part number of each cord is shown. Each plug has a ground connector. The cord packaged with each cartridge tape unit depends upon where that cartridge tape unit is to be delivered.

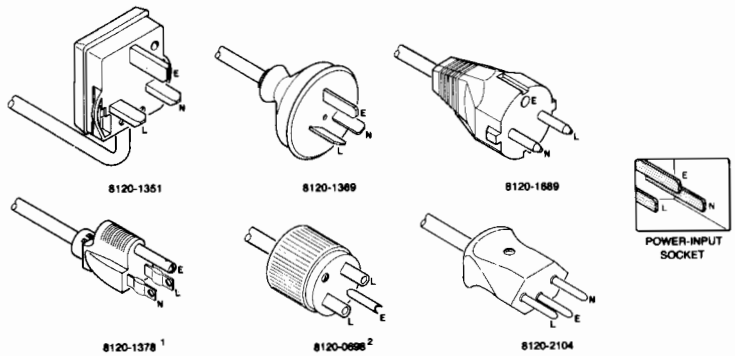

Figure 1-1: Power Cords

1 UL and CSA approved for use in the United States of America and Canada with cartridge tape units set for either 100 or 120 VAC operation.

2 UL and CSA approved for use in the United States of America and Canada with cartridge tape units set for either 220 or 240 VAC operation.

Line Voltage

The HP 9875A Cartridge Tape Unit must be set for the powerline voltage in your area. The figure below shows the correct settings for each nominal line voltage. If it is necessary to alter the setting of either switch, turn power off to the cartridge tape unit and insert the tip of a small screwdriver into the slot on the switch. Slide the switch so that the position of the slot corresponds to the desired voltage as shown in Figure 1-2.

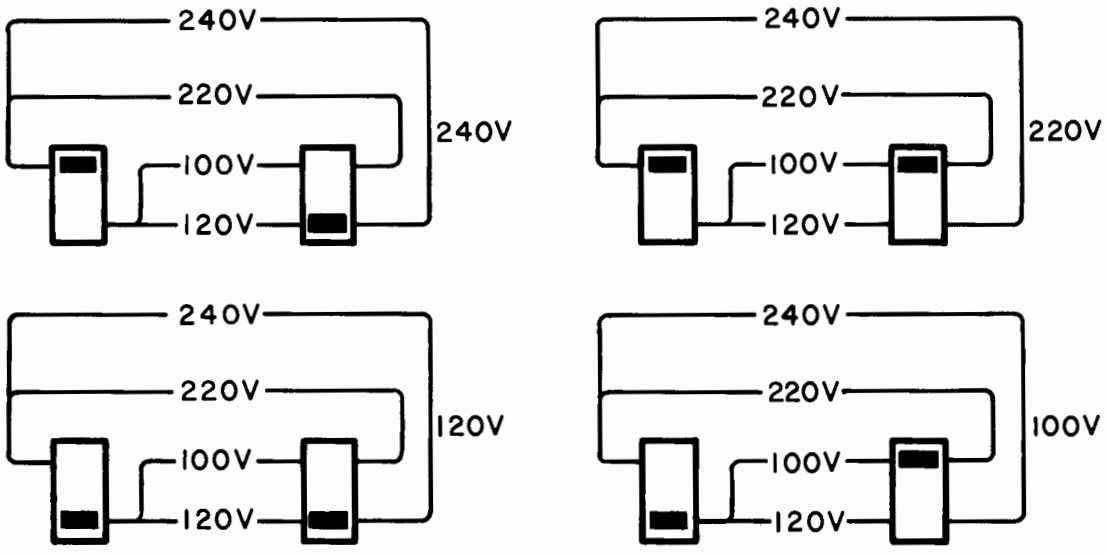

Figure 1-2: Nominal Line Voltage Settings

Fuses

The cartridge tape unit uses the following line fuses:

Line Voltage	Fuse	Part Number
100 or 120 VAC	1A	2110-0007
220 or 240 VAC	.5A	2110-0202

WARNING

TO AVOID THE POSSIBILITY OF SERIOUS INJURY, DISCONNECT THE AC POWER CORD BEFORE REMOVING OR INSTALLING A FUSE.

To change the fuse, first disconnect the power cord to the cartridge tape unit. Then remove the fuse cap by pressing inward while twisting it counterclockwise. Remove the fuse from the cap and insert the correct replacement fuse (either end) into the cap. Finally put the fuse and cap back into the holder. Press on the cap and twist it clockwise until it locks into place.

Rack Mounting

The HP 9875A Cartridge Tape Unit can be adapted for rack mounting installation. Your particular rack mounting installation may require that you select the bus address (page 1-9) before rack mounting the cartridge tape unit.

The additional parts which are required for rack mounting are:

Table 3: Rack Mounting Parts

Half-Module Rack Assembly (Option 002) (09875-80002)

Part Number	TQ	Description
2510-0193	4	Screws 8-32 x ⅜" P.H.
5020-8862	1	Rack Mounting Flange (5¼")
5061-0006	1	Half Module Rack Adapter (5¼")

Side By Side Rack Assembly[1]

Part Number	TQ	Description
0050-0515	4	Front Horizontal Lock Links
0050-0516	2	Rear Horizontal Lock Links
2510-0192	4	Screws 8-32 x ¼" F.H.
2510-0193	4	Screws 8-32 x ⅜" P.H.
2360-0360	4	Screws 6-32 x 7/16" F.H.
5020-8862	2	Rack Mounting Flange (5¼")

The rack mounting adaption is shown in Figure 1-3.

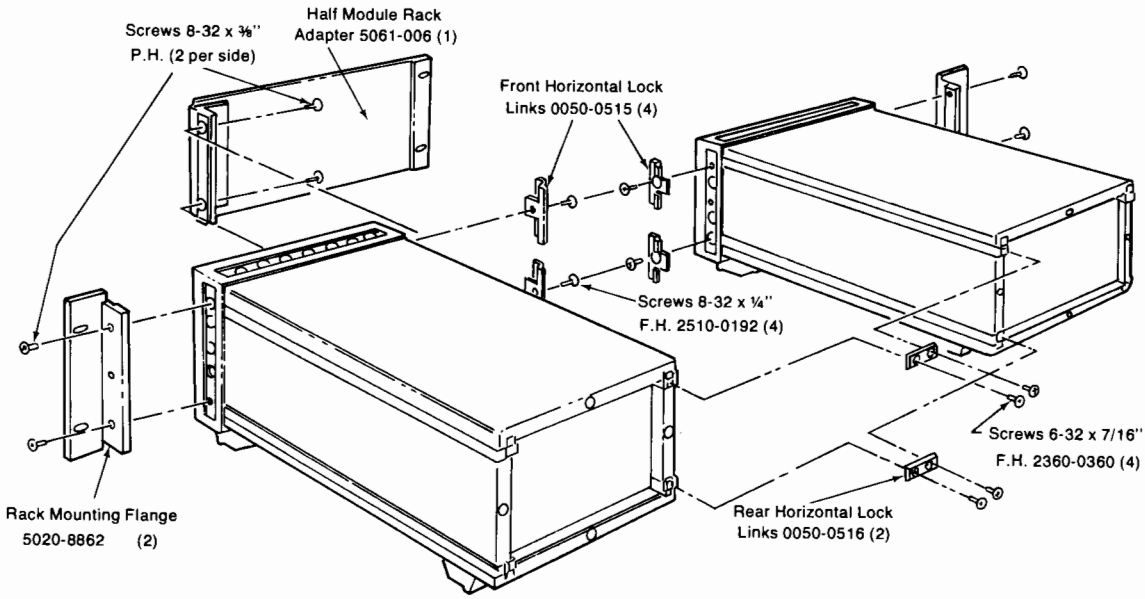

Figure 1-3: Rack Mounting Adaption

1 This configuration is possible only when mounting cabinets of equal depth together.

Interface Connection

The HP 9875A Cartridge Tape Unit is connected to the controller via the HP-IB. The following interfaces are used to connect the HP 9875A Cartridge Tape Unit to HP Desktop Computers and Controllers. The interface should be connected to the cartridge tape unit as shown in the photo (Figure 1-4).

Table 4: HP-IB Interfaces

Interface	Controller
HP 98135A	9815A
HP 98034A	9825A
HP 59405A Opt. 30	9830A, 9820A, 9821A
HP 98034A	9831A
HP 98034A	9845A

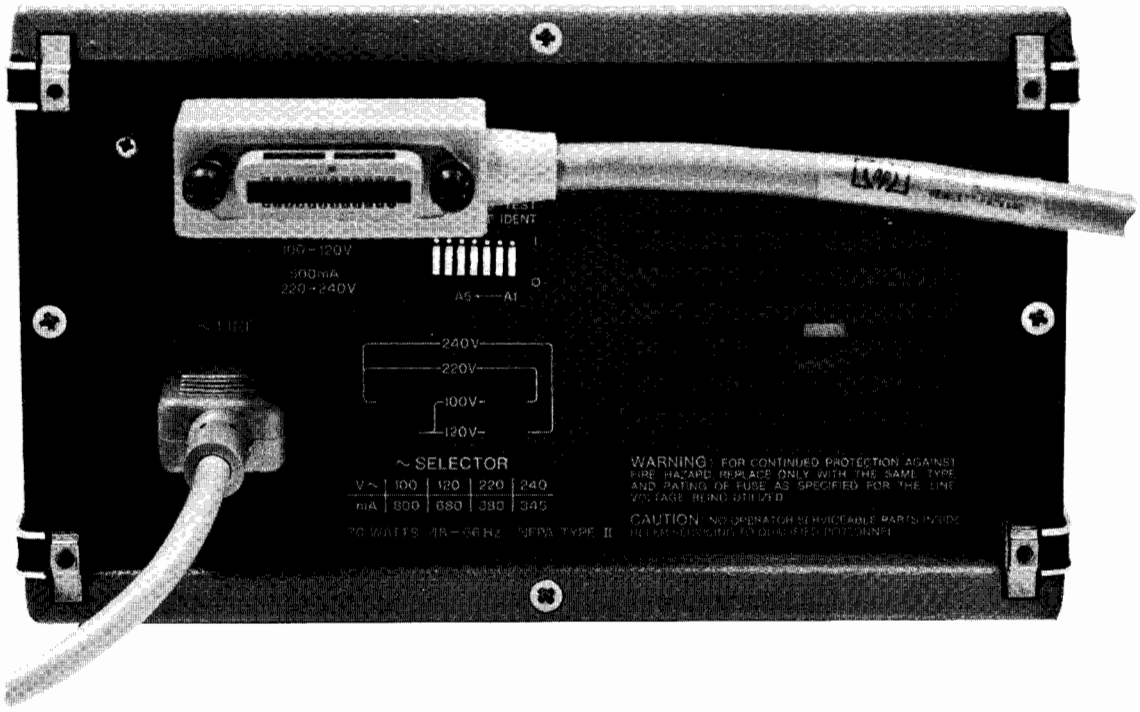

Figure 1-4: Connecting the Interface

Cartridge Tape Unit Address Code

Since each HP-IB system can have as many as 15 devices connected to it, each device must be set to a specific address code.

The cartridge tape unit can be set to any one of 30 HP-IB addresses ranging from 0 through 29. (Address 30 is reserved for Listen Only Mode; Address 31 is reserved for Talk Only Mode.) Each address can be selected by setting the switches on the cartridge tape unit rear panel. Set the switches to the appropriate binary bit positions for the particular address desired. A complete listing of available bit positions is shown in Table 5.

The cartridge tape unit is set to an address code of 4 at the factory. Check your cartridge tape unit for the proper switch positions.

Table 5: Available Bus Addresses and Codes

Address Characters		Address Switch Settings					Address Codes
Listen	Talk	(5)	(4)	(3)	(2)	(1)	decimal
SP	@	0	0	0	0	0	0
!	A	0	0	0	0	1	1
"	B	0	0	0	1	0	2
#	C	0	0	0	1	1	3
$	D	0	0	1	0	0	4 ← preset
%	E	0	0	1	0	1	5
&	F	0	0	1	1	0	6
'	G	0	0	1	1	1	7
(	H	0	1	0	0	0	8
)	I	0	1	0	0	1	9
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
-	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
0	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	^	1	1	1	1	0	30 ← listen only
?	_	1	1	1	1	1	31 ← talk only

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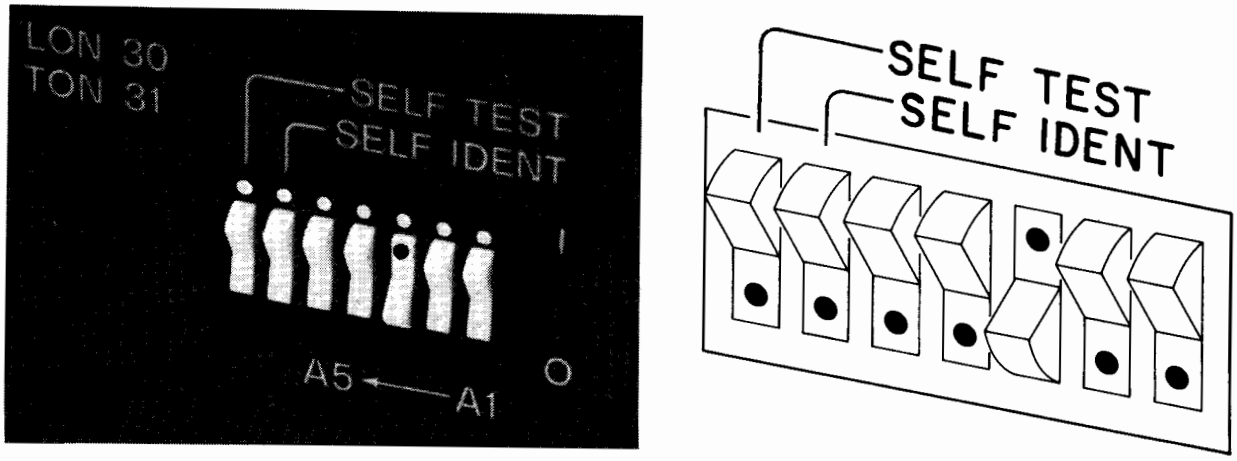

Figure 1-5: Address Switches

Power On Procedure

1. Verify that the line voltage switch settings are correct.
2. Verify that the proper fuse is installed.
3. Verify that the self-test switch is off unless you are conducting a self-test. The self-test switch is shown in Figure 1-6.
4. Verify that the power cord is connected to the CTU and the outlet.
5. Enable power by depressing the switch on the front panel (Figure 1-7).
6. Verify that one of the front panel lamps is lit. If it is flashing, refer to the Self Test in Chapter 3.

The front panel lamps are used to indicate which tape drive is selected. A flashing front panel lamp indicates that the CTU is in an error condition.

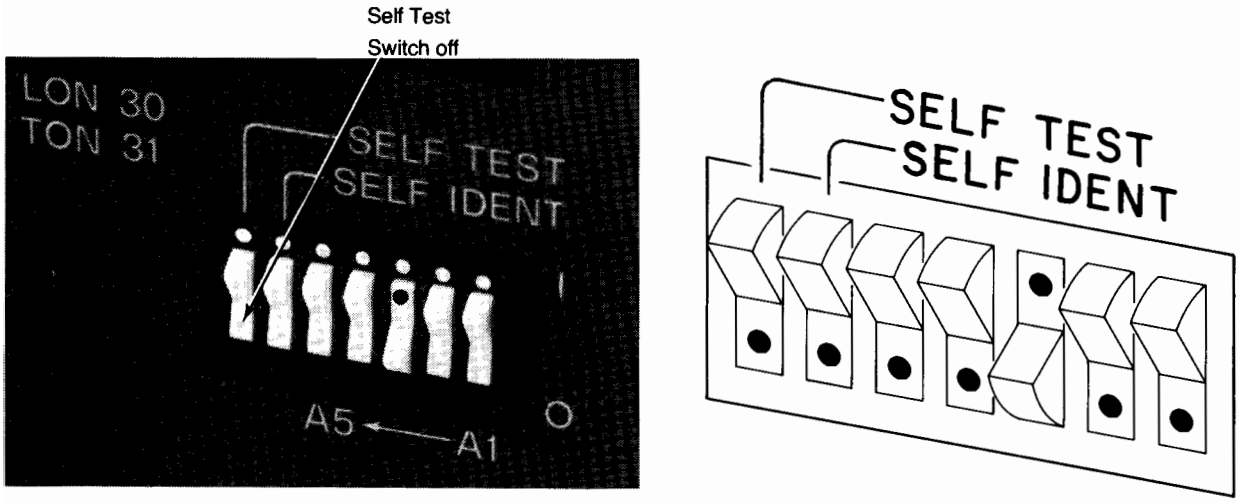

Figure 1-6: Self Test Switch OFF

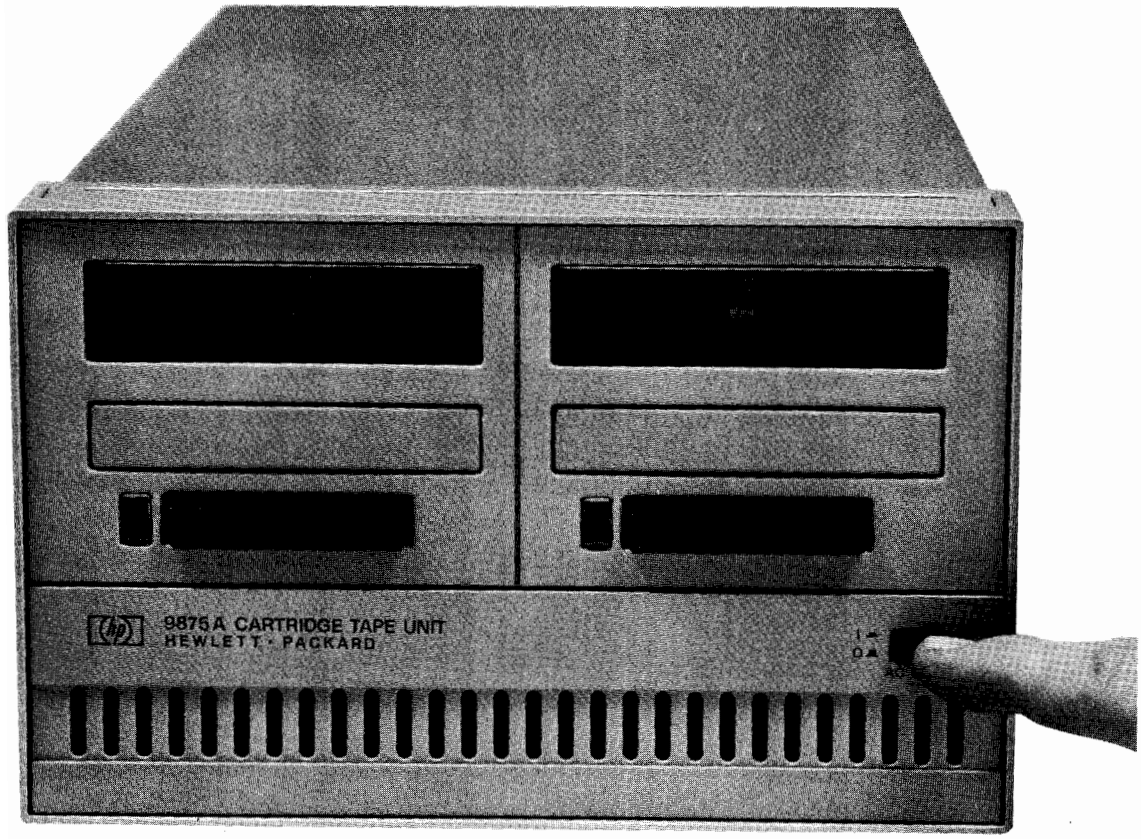

Figure 1-7: Enabling Power to the CTU

Cartridge Tape Unit Care

The HP 9875A Cartridge Tape Unit should be periodically cleaned.

Dirt and dust are by far the greatest cause of cartridge related errors. Several basic precautions can reduce such problems substantially.

Magnetic Tape Head

To ensure the reliability of tape operation, it is recommended that the tape head be cleaned after every eight hours of tape operations. It's a good idea to clean the tape head before making important recordings.

The tape head is cleaned as follows:

1. Remove the tape cartridge if installed.
2. Clean the tape head with a cotton swab that has been dampened with head cleaning solution (HP P/N 8500-1251). Wipe the top of the head a few times with the cotton swab. Remove any other dust that has accumulated in the vicinity of the tape head.

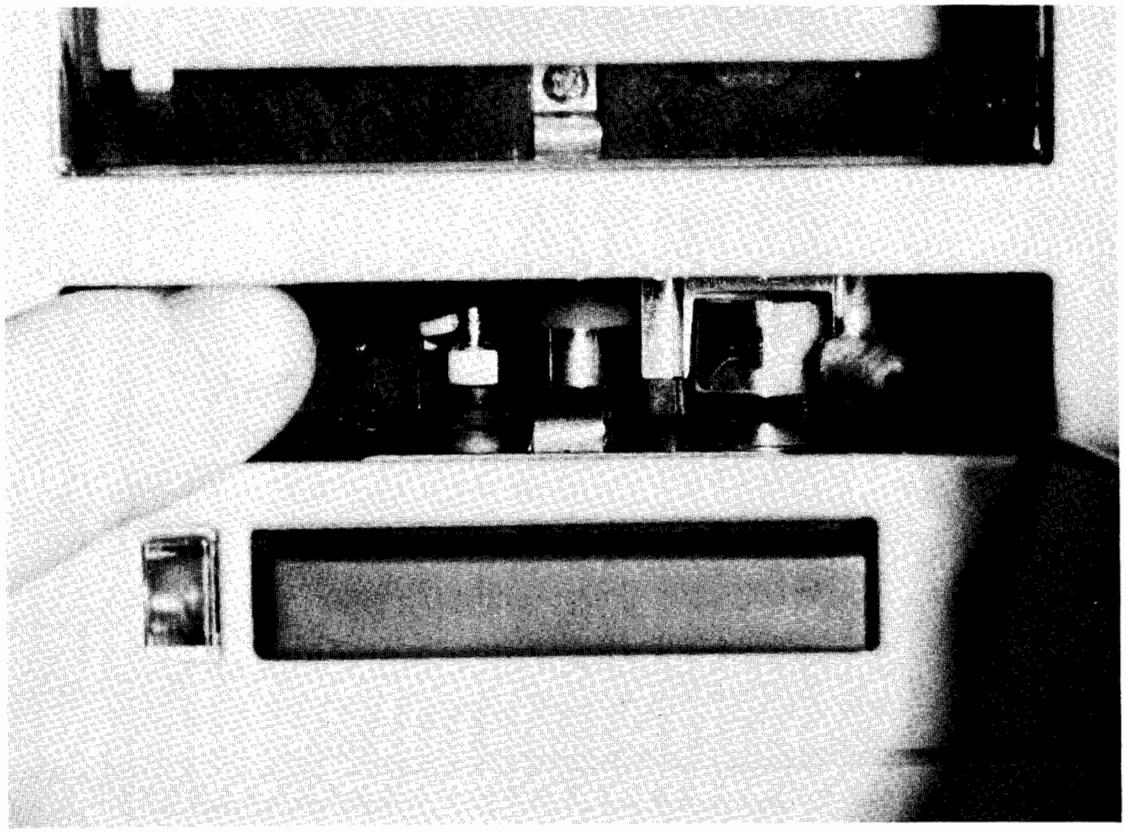

Figure 1-8: Cleaning the Read/Write Head

Tape Care

Tape Cartridge

1. Rewind the cartridge after each use
2. Keep the tape transport door clean.
3. Keep the cartridge in the plastic container supplied with it.

Two other factors can affect the reliability of the tape cartridge. Strong magnetic fields can erase data and programs stored on the cartridge. Physical damage to the tape, such as wrinkled or folded tape can also cause write and read problems. Since loss of data can be an inconvenience at best, and a disaster at worst, you should always maintain a back-up copy for critical programs or data on a separate tape cartridge.

Conditioning the Tape

Repeated operations over a short length of tape (usually less that 4000 bytes or 1.5m (5 ft.)) can cause slack (extreme changes in temperature can also cause this). The outer layer of tape can slip and rub on the cartridge, causing damage to the tape. If tape drive operation continues, the tape may jam and be ruined.

NOTE

This problem is most likely to occur if exclusive use is made of one file or two adjacent files near the beginning or end of tape.

If a particular application requires such operation, this slack can be prevented by conditioning the tape periodically. Conditioning the tape can be done by executing a FE instruction, followed by a RW instruction. The FE and RW instructions are explained in Chapter 5 of the Operating Manual.

Respooling the Tape

If the tape unwinds completely from one of the reels, refer to Figure 1-9 using the following procedure to rethread the tape.

1. Remove the 4 screws holding the cartridge cover and remove the cover.
2. Thread the tape around the guides as shown in the figure.
3. With the tape extended almost to the drive belt, moisten the end of the tape so that it will stick to the take-up reel.

   Use a pencil (or other sharp instrument) to guide the tape between the drive belt and the take-up reel. Keeping the tape taut, wind the tape onto the take-up reel using the pencil.

   As you wind the tape onto the reel, ensure that there is no slack in the tape. If the tape is not tight, repeat the operation. Be sure the tape follows the hub around for the first turn.

   Wind at least 20 turns of tape onto the reel by turning the drive roller. If any rollers creep up away from the plate, press them back again.

   Reassemble the cartridge.

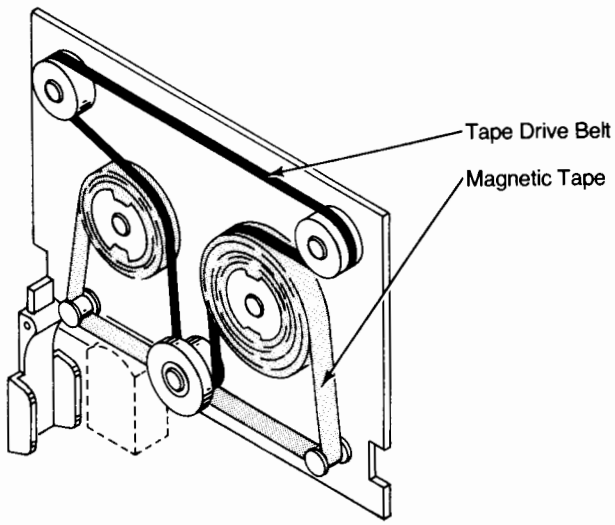

Figure 1-9: Tape Cartridge

Self Test

The Self Test is used to verify proper operation of the CTU. Whenever power is applied to the CTU, the CTU automatically conducts a test of the internal electronic circuitry.

The read/write tape circuitry can only be tested by inserting a tape cartridge into the CTU. A dual-drive CTU requires that a tape cartridge be inserted in each tape drive.

NOTE

The self test records test data on the tape cartridge. All data which was previously recorded on the tape is erased when the test data is recorded.

Self Test Procedure

1. Turn power off to the CTU.
2. Insert a tape cartridge (preferrably blank) into each tape drive of the CTU. The record protect tab must be positioned so that data can be recorded on the tape (tab slid in the direction of the arrow). The Self Test records data on the tape. Therefore you should use a tape which does not contain any important data.
3. Set the Self Test switch on the rear panel of the CTU on, as shown in the photo.

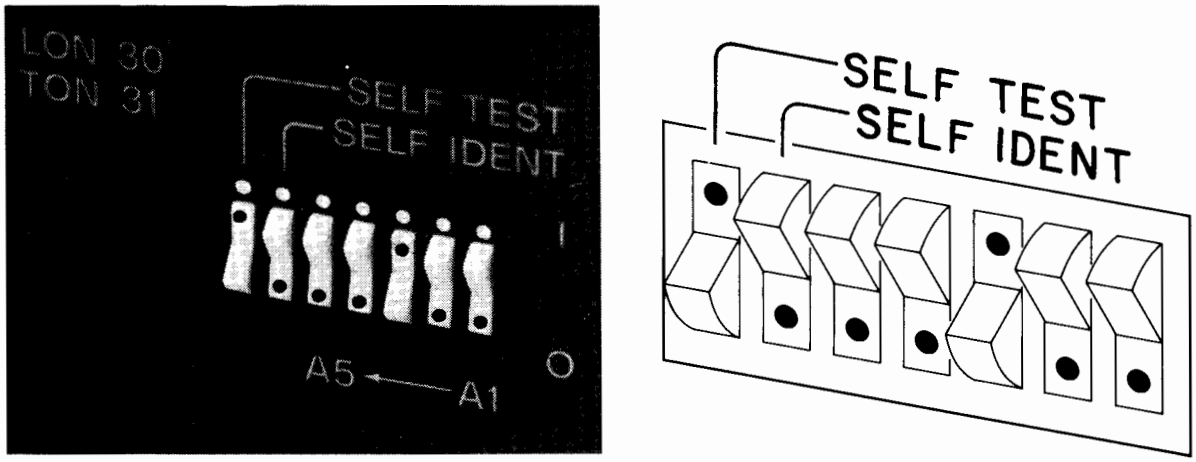

Figure 1-10: Self Test Switch On

4. Turn power on to the CTU.

The test results are displayed by the lamps on the front panel of the CTU. If the CTU has failed the Self Test, a front panel lamp flashes.

A common error during the Self Test occurs when the cartridge is write protected, or is not installed in the CTU while the CTU is running the Self Test. If either of these two conditions exist, correct them and re-run the Self Test.

Another source of Self Test failure is a defective tape. Re-running the test with a new tape may be all that is required to verify the operation of the CTU.

A more comprehensive testing of your system (controller and interface) can be accomplished by using your controller to output the Self Test and Output Error instruction. The Self Test instruction is explained in Chapter 5, of the Operating Manual.

A detailed listing of the Self Test results is found in Chapter 3, under the Self Test Results section.

NOTE

The self test switch must be switched off for normal operation of the CTU.

Chapter 2
Theory of Operation

This chapter contains the HP 9875A theory of operation and block diagrams. The HP 9875A can be broken down into four sections:

Processor
Tape Electronics and Servo Control
Interface Control
Power Supply

The complete diagram of the 9875A is shown in Figure 2-15. Figure 2-15 is the foldout at the end of this chapter.

PROCESSOR SECTION

The following explanation is a general functional description of the components which comprise the Processor Section. The processor section block diagram is shown in Figure 2-1.

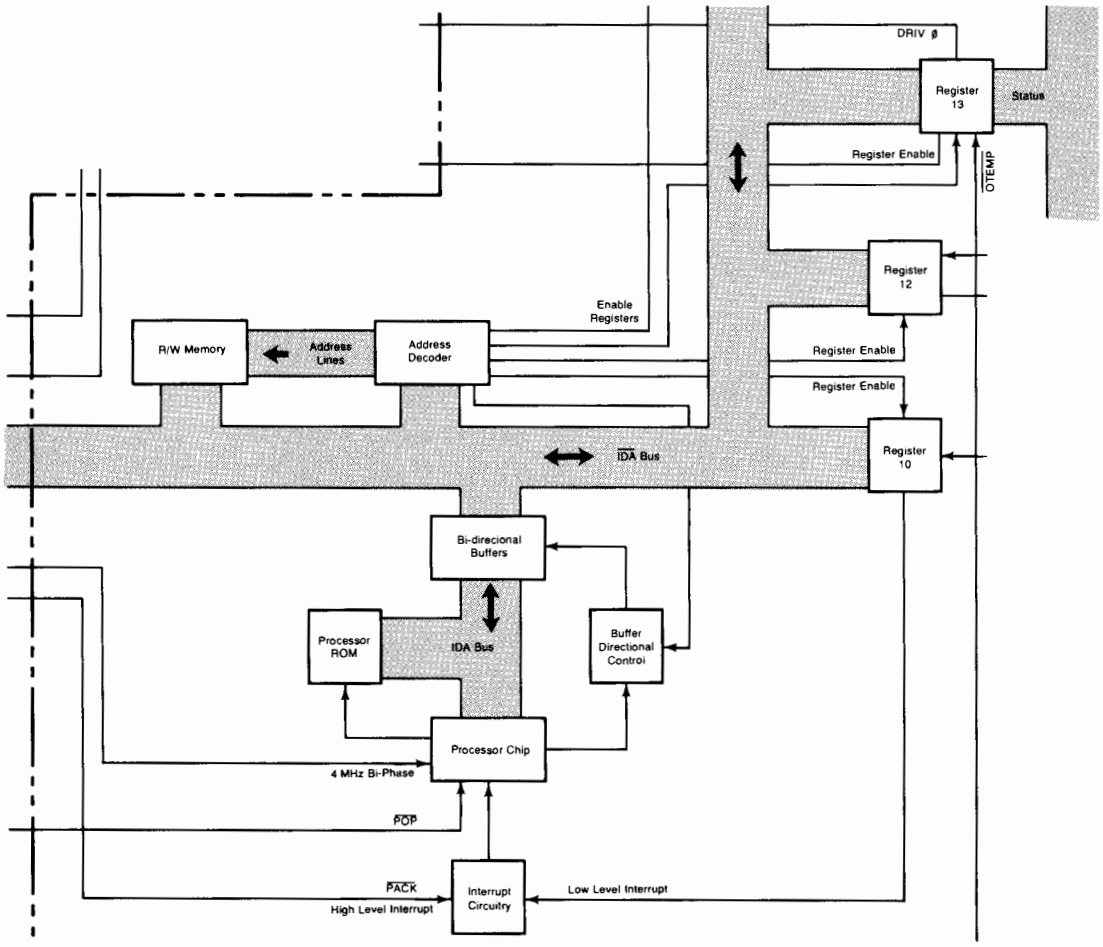

Figure 2-1: Processor Section

Processor Chip

The Processor Chip controls all operations within the cartridge tape unit. The instruction set for the Processor Chip is contained in the Processor ROM. The Processor handles 16 bit words.

The Processor Chip operates by performing memory cycles to the ROM, RAM, and Register sections of the CTU.

The ROM memory cycle enables the processor to obtain its operating instruction from the processor ROM.

The RAM memory cycle allows the processor to read/write data from/to the R/W memory. This is done during operations involving normal buffering of data, or operations on temporary variables in the processor's scratch pad memory.

The Register memory cycle is used by the processor for general control and data transfer within the CTU. During a Register memory cycle, the processor executes instructions such as, enabling the handshake with the Interface Control Chip, services interrupts from the Interrupt Circuitry, and prepares the CTU to receive instructions from the HP-IB

Processor ROM

The Processor ROM contains the 4k words operating software for the processor.

Bi-directional Buffers

The Bi-directional buffers allow two-way transmission of signals between the IDA bus and the $\overline{\text{IDA}}$ bus. The Bi-directional buffers also condition the signals so they are compatible with the MOS bus (IDA) and the TTL bus ($\overline{\text{IDA}}$).

U2 is responsible for lines 0 through 7 on both the IDA and $\overline{\text{IDA}}$ bus. U5 is responsible for lines 8 through 15 on both the IDA and $\overline{\text{IDA}}$ bus.

Bus Direction Control

U14 is used to control the direction of flow along the buses.

IDA and $\overline{\text{IDA}}$ Buses

The IDA and $\overline{\text{IDA}}$ buses are used to transmit 16 bit instructions, data and addresses to the internal sections of the cartridge tape unit. The IDA bus is a positive true logic, MOS bus. The $\overline{\text{IDA}}$ bus is a negative true logic, TTL bus. The required signal inversion between these buses is provided by the bi-directional buffers.

Read/Write Memory

The Read/Write memory provides storage for 512, sixteen bit words. 256 words of this RAM memory are used as the base page scratch pad R/W memory. The remaining 256 words are used as a double-buffered 128 word memory section (Two-256 eight bit buffers). Any data passed to/from the tape is sent to the R/W memory.

Address Decoder

The Address Decoder is used to select the specified location for R/W operations. This location can be either the R/W memory, register 10, 11, 12 or 13 as needed.

Register 10

Register 10 is the interrupt priority encoder. Register 10 is used in conjuction with the Interrupt Circuitry for handling both low and high level interrupts.

Register 12

Register 12 is a control register, used to perform the handshake with the Interface Control Chip. Other functions of Register 12 include handling request service ($\overline{\text{SRQ}}$), response to a parallel poll, and the status of the rear panel "Self-Test" switch.

Register 13

Register 13 is used to:

- monitor the listen only/talk only switch positions on the rear panel.
- monitor the over temperature signal ($\overline{\text{OTEMP}}$) in the CTU.
- select the appropriate tape drive for operation.
- indicate an error condition
- output the status byte (U29)

Interrupt Circuitry

The Interrupt circuitry is a state machine which, when enabled, indicates to the processor that an interrupt has occurred.

While an interrupt is being serviced by the processor, the interrupt circuit keeps the processor from being re-interrupted (or nesting interrupts) by storing the interrupts until the pending interrupt is serviced. At the completion of servicing the interrupt, the stored interrupt priorities are serviced in priority order.

The high level interrupt is serviced before the low level interrupts. The interrupt priorities (listed in order of decreasing priority) are:

	Priority #	
High Level Interrupt	7	Poll Acknowledge ($\overline{\text{PACK}}$) from tape control.
	6	Device Clear ($\overline{\text{DC}}$)
Low Level Interrupts	5	Serial Poll Transmit Enable ($\overline{\text{SPXE}}$)
	4	Secondary Talk on Bus ($\overline{\text{STOB}}$)
	3	Not Used
	2	Not Used
	1	Not Used
	0	Not Used

Signals

$\overline{\text{PACK}}$

Poll Acknowledge Tape Control Chip is ready to receive/send another byte of data.

$\overline{\text{POP}}$

Power On Preset. Initializes the CTU.

Tape Electronics and the Servo Control Section

The following explanation is a general functional description of the components which comprise the Tape Electronics and the Servo Control Section. The Tape Electronics section block diagram is shown in Figure 2-2.

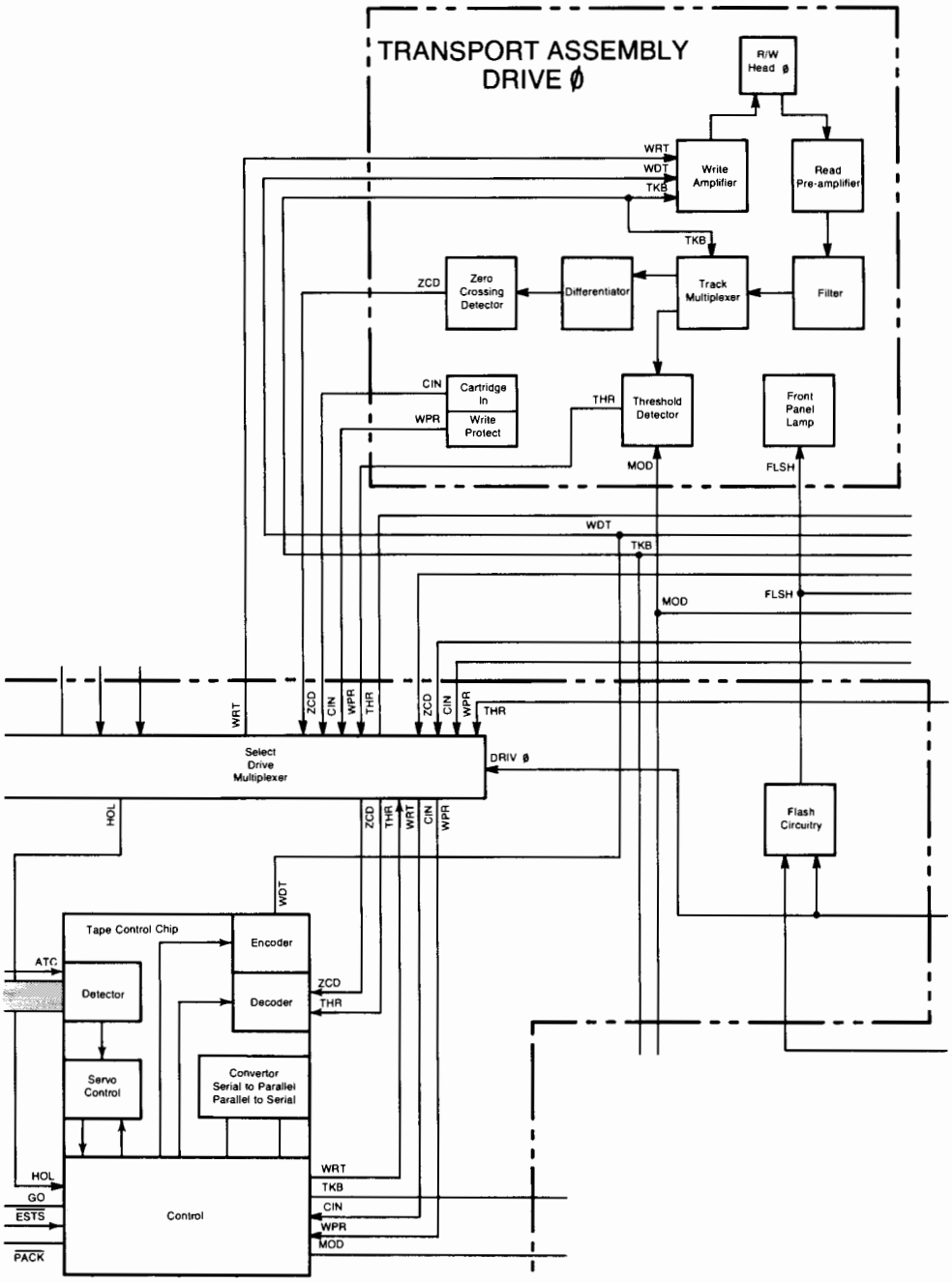

Figure 2-2: Tape Electronics Section

NOTE

The Tape Control Chip and the Select Drive Multiplexer are listed twice; once in the tape electronics section and once in the servo control section. There is only one Tape Control Chip and one Select Drive Multiplexer in a 9875A.

Tape Control Chip

The Tape Control Chip is used for controlling the operation of the Tape Electronics section. Among the functions of the Tape Control Chip are:

Conversion from bit-parallel on the $\overline{\text{IDA}}$ bus to the bit-serial format required by the tape format.

Sending the write enable signal (WRT). Sending the track select signal (TKB). Decoding the data read from the tape utilizing the zero-crossing detector signal (ZCD) and the threshold level signal (THR).

Select Drive Multiplexer

The multiplexer is used to select the proper drive for the commands.

Write Amplifier

The Write Amplifier provides a gated current source so the encoded data signal (WDT) can be recorded on the tape by the R/W head. The Write Amplifier controls the direction of current flow through the R/W head.

Read/Write Head

The Read/Write (R/W) Head is used to record and read the flux reversal signals onto and from the tape.

Read Pre-Amplifier

The Read Pre-Amplifier amplifies the flux reversal signals detected from the tape.

Filter

The Filter is used to remove noise from the signal.

Track Multiplexer

The Track Multiplexer is used to route the signals, from either track A or B, to the Zero Crossing Detector and the Threshold Detector.

Differentiator	The Differentiator is used to provide a differentiated wavetrain for the Zero Crossing Detector to process.
Zero Crossing Detector	The Zero Crossing is used to determine when the signal from the R/W head has reached a peak.
Threshold Detector	The Threshold Detector is used to determine when a flux transition has sufficient amplitude to be considered an intentional flux reversal.

Signals

CIN (Cartridge In)	The cartridge is present in the transport.
DRIV0 ($\overline{\text{DRIVE 0}}$)	Select Drive 0 or Drive 1 ($\overline{\text{DRIV0}}$)
FR (Flux Reversal)	The same signal as ZCD.
MOD (Mode)	The threshold level is set for normal operation or at a higher level for verification and search operations.
THR (Threshold)	The Threshold Detector Signal.
TKB (Track B)	Select the B track for R/W operations.
WDT (Write Data)	The encoded data to be written.
WPR (Write Protect)	The cartridge is write protected.
WRT (Write Enable)	The write amplifier is to process the WDT signal.
ZCD (Zero Crossing)	The Zero Crossing Detector signal.

Servo Control Section

The Servo Control Section maintains the proper speed during the operations. The Servo Control Section block diagram is shown in Figure 2-3.

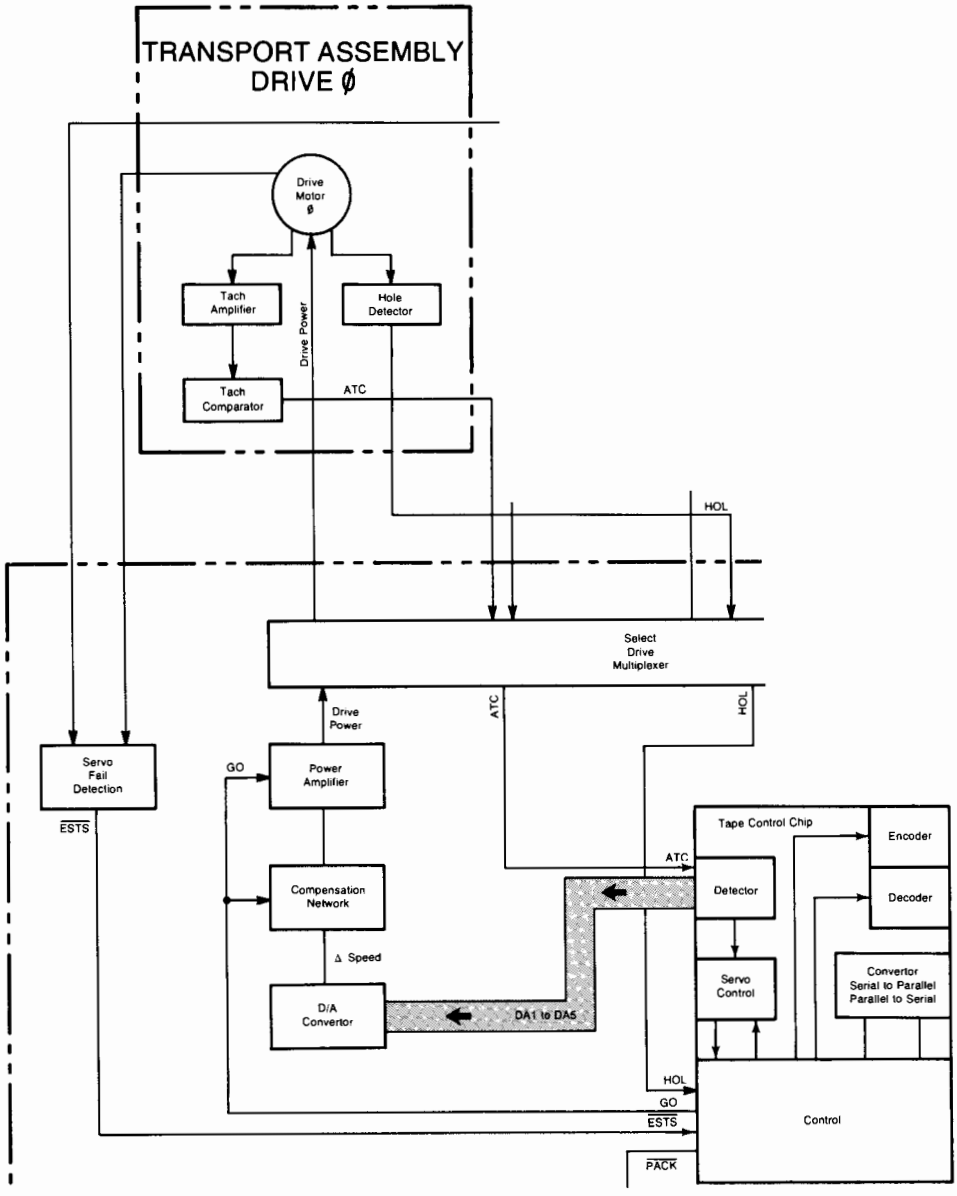

Figure 2-3: Servo Control Section

Tape Control Chip

The Tape Control Chip controls the acceleration and deceleration of the drive motor during R/W and search operations by comparing the output of the Tach Comparator Amplifier to the required tach pulse rate which is needed for the operation of the drive and by generating the encoded error signal (DA1 to DA5) for the Digital/Analog Convertor. The Tape Control Chip also shuts down the transport in the event of over-voltage or over-current indications ($\overline{ESTS}$).

The Tape Control Chip sends the $\overline{PACK}$ signal to the processor chip via the interrupt circuitry, to signify that a word of data has been recorded/read and that the Tape Control Chip is ready for its next word of data or instruction.

Digital/Analog Convertor

The Digital/Analog Convertor is used to decode the five bit error signal (DA1 to DA5) and generate the appropriate analog voltage level. The error signal is an incremental change (faster/slower). The analog voltage level is used to alter the speed of the drive motor.

Compensation Network

The Compensation Network is used to control the operating characteristics of the servo system.

Power Amplifier

The Power Amplifier is used to amplify the voltage output from the filter compensation network. This signal is the drive power for the transport.

Select Drive Multiplexer

The Select Drive Multiplexer enables the correct tape drive to operate, depending on the selected drive from register 13 (DRIV 0)

Drive Motor

The Drive Motor is used to move the tape via the capstan.

Tach Amplifier and Comparator

The Tach Amplifier and Comparator optically senses the rotational velocity of the drive motor. This signal is then sent to the Tape Control Chip for processing.

Servo Fail Detection

The Servo Fail Detection circuitry protects the tape drives against over-current and over-voltage conditions. The output of Servo Fail Detection circuitry is the $\overline{\text{ESTS}}$ signal which is sent to the Tape Control Chip.

Hole Detector

The Hole Detector circuitry is used to spot the end-of-tape holes.

Signals

ATC (Tach Pulses)

This is the output of the Tach Comparator.

$\overline{\text{ESTS}}$ (Emergency Stop)

The over-current or over-voltage levels have been reached.

GO

This initializes the Filter and Power Amplifier circuits.

HOL

This indicates that an End-of-Tape hole has been encountered.

The following circuitry is also used by both the Tape Electronics and the Servo Control Sections.

Error Detection and Flash Circuitry

The Error Detection and Flash Circuitry is used to Flash the front panel lamp when an error occurs (FLSH signal).

Clock

The Clock is used to provide a 4 MHz clock rate for the Tape Control Chip and the Processor Chip. The Processor Chip uses a Bi-phase clock pulse.

Interface Control Section

The following explanation is a general functional description of the components which comprise the Interface Control Section. The Interface Control Section block diagram is shown in Figure 2-4.

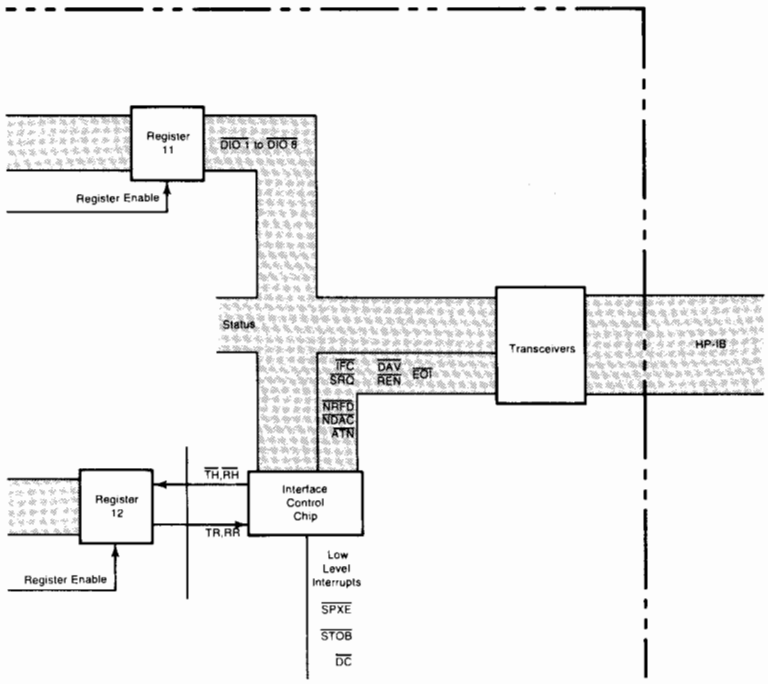

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Figure 2-4: Interface Control Section

Transceivers

The Transceivers are tri-state, negative true logic devices used to connect the CTU with the interface. The data is transmitted along the interface in accordance with IEEE specification 488-1975.

Interface Control Chip

The Interface Control Chip coordinates the data transfer between the interface and the CTU. The Interface Control Chip also handshakes with the CTU's Processor Chip (through Register 12) so data can be written/read to/from the Input/Output Port (Register 11).

Register 11

Register 11 is the Input/Output Port (I/O). All tape commands and data to/from the interface pass through the I/O Port.

Register 12

Register 12 coordinates the handshake between the Processor Chip and the Interface Control Chip. Data is handshaked out when TR and $\overline{TH}$ are valid. Data is handshaked in when RR and $\overline{RH}$ are valid.

Register 13

Register 13 contains the Status Byte information for the CTU.

Signals

$\overline{TH}$ (Transmit Handshake)

Data is sent from register 12 to the Interface Control Chip.

TR (Transmit Ready)

Data is present at register 12.

$\overline{RH}$ (Receive Handshake)

Data is sent from the Interface Control Chip to register 12.

RR (Receive Ready)

Data is expected at register 12.

Power Supply Section

The following explanation is a general functional description of the components which comprise the Power Supply Section. The Power Supply Section block diagram is shown in Figure 2-5.

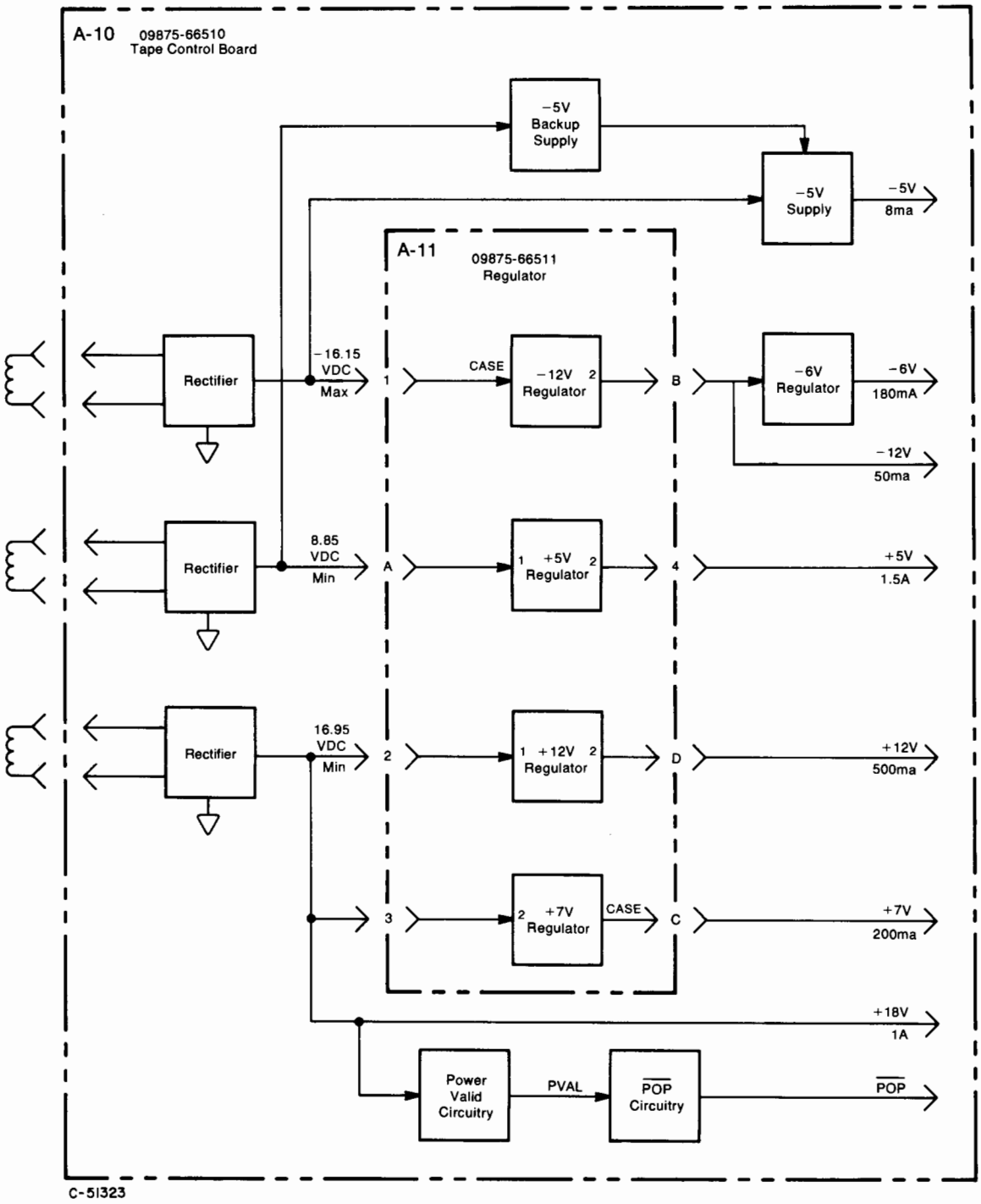


Figure 2-5: Power Supply Section

The power supplies in the CTU produce six regulated voltages and one unregulated voltage. The power supply voltages are shown in Table 6.

	Component	Voltage	Current	Use	Location
	C28,CR19,CR23,R69	−5V	8mA	IC Backgate	Tape Control Board
	U1	+5V	1.5 A	IC Power	Regulator Board
	U18	−6V	180 mA	IC Power	Tape Control Board
Regulated	U2	+7V	200 mA	IC Power	Regulator Board
	U3	−12V	50 mA	IC Power	Regulator Board
	U4	+12V	500 mA	IC Power	Regulator Board
Unregulated		+18V	1.74 A	Transport	
				Motors	Tape Control Board
				& +7, +12	
				regulators	

Table 6: Power Supply Voltages

The chassis mounted transformer reduces the line voltage to the appropriate levels for the three diode bridge circuits.

The −5V circuit (C39, CR28, CR29, R92) must be the first power supply within tolerance and the last power supply to shut off. The −5V supply is the backgate supply for all MOS devices in the CTU. There is a back-up −5V power supply (C41, CR26, CR27, L1, Q11, R74, R76) for use when the −5V voltage fails.

CAUTION

ATTEMPTING TO OPERATE THE CTU WITH THE −5V SUPPLY INOPERATIVE MAY CAUSE PERMANENT DAMAGE TO THE PROCESSOR CHIP, PROCESSOR ROM AND THE TAPE CONTROL CHIP.

The Power Valid Circuitry generates the PVAL signal. The PVAL signal signifies that the power supplies are at the proper voltage levels to begin the tape operations. This triggers the $\overline{\text{POP}}$ circuitry which initializes the CTU to a known state.

Internal Operation of the CTU

The processor chip (U-3) co-ordinates all transfers of instructions, data and addresses throughout the CTU. To understand this operation, a general description of the processor chip operations is given for both a read and a write memory cycle.

Read Memory Cycle

The processor chip originates a Read Memory Cycle by putting an address on the IDA bus, and by setting the RDW line high and the $\overline{\text{STM}}$ line low.

The bi-directional buffers transfer the address from the IDA bus to the $\overline{\text{IDA}}$ bus. The decoder then identifies the section (either registers or R/W memory) containing the object location of the Read Memory Cycle.

The decoder enables the addressed register to place the data onto the $\overline{\text{IDA}}$ bus and sets the $\overline{\text{UMC}}$ line to a low level. The data remains on the bus until after the $\overline{\text{SMC}}$ line goes high.

The data is latched into the processor chip through the bi-directional buffers when the $\overline{\text{SMC}}$ line goes high. The typical time for a Read Memory Cycle is 1125 nanoseconds.

The $\overline{\text{PDR}}$ line is low level whenever the processor chip is driving the bus.

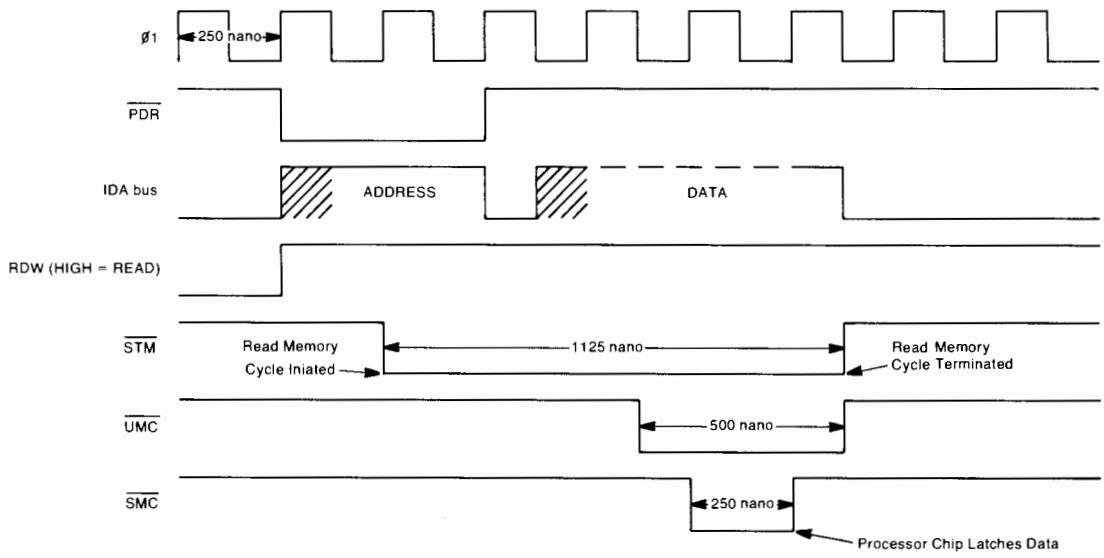


Figure 2-6: Simplified Read Memory Cycle

* all times are typical.

** address and data maybe either high or low level.

Write Memory Cycle

The processor chip originates a Write Memory Cycle by putting an address on the IDA bus, and by setting the RDW low and the $\overline{\text{STM}}$ line low.

The bi-directional buffers transfer the adress from the IDA bus to the $\overline{\text{IDA}}$ bus. The decoder then identifies the section (either registers or R/W memory) containing the object location of the Write Memory Cycle.

The processor chip places and holds the data onto the bus until the decoder acknowledges by setting the $\overline{\text{UMC}}$ low.

When the $\overline{\text{UMC}}$ line is set low, the processor chip then cycles the $\overline{\text{SMC}}$ line through a low/high cycle. When the $\overline{\text{SMC}}$ line goes high, the object location of the Write Memory Cycle accepts the data.

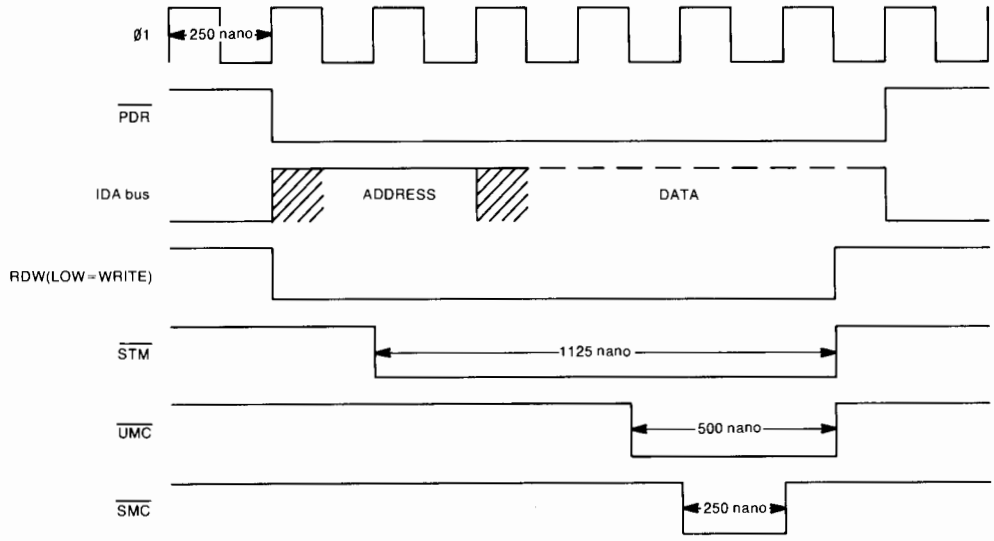


Figure 2-7: Simplified Write Memory Cycle

* all times are typical.

** addresses and data may be either high or low level.

The following timing diagrams are shown for the other data transfer handshakes in the CTU.

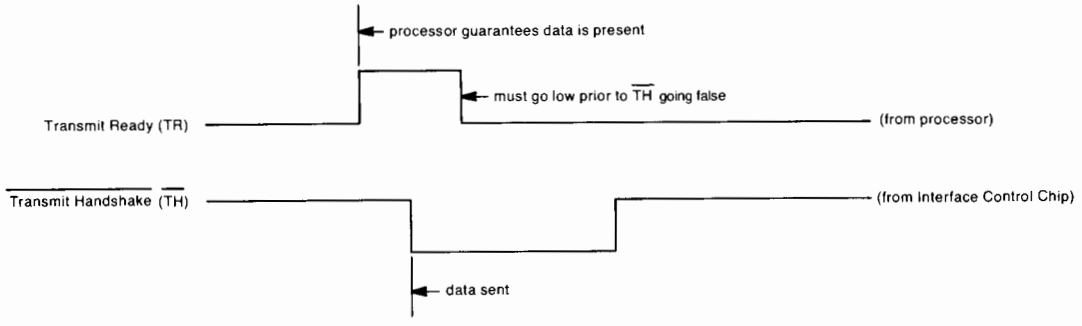


Figure 2-8: Handshake Data From Processor Chip To Interface Control Chip

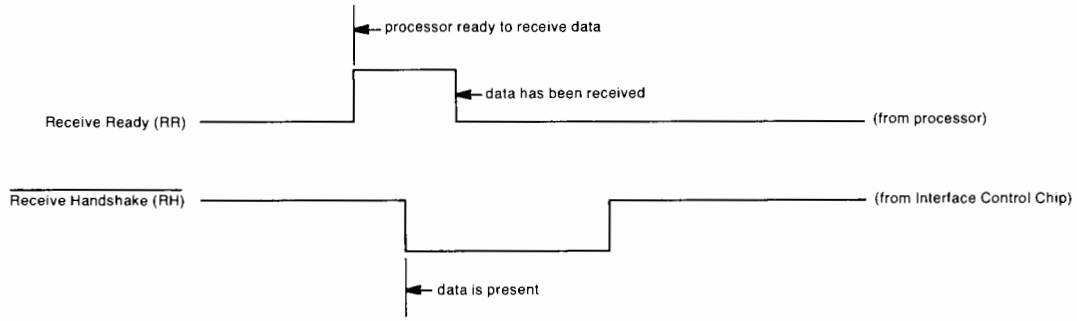


Figure 2-9: Handshake Data From Interface Control Chip To Processor Chip

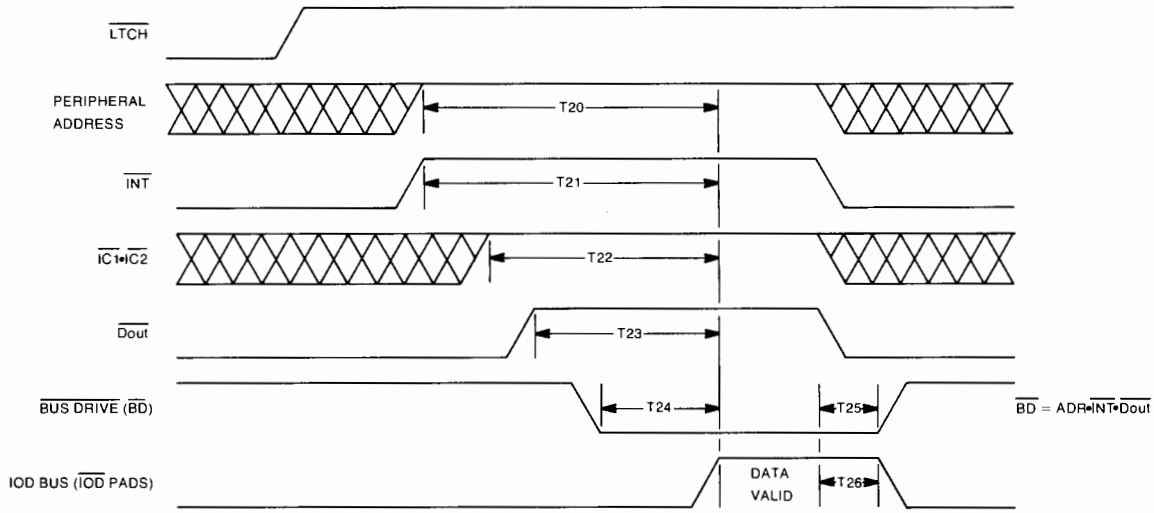


Figure 2-10: Tape Control Chip Read Cycle

Symbol	Parameter	Ref. Point	Min	Max	Units
T20	Peripheral Address Valid ($\overline{PA}$)	Data Valid	300		Nsec
T21	Int. False	Data Valid	300		Nsec
T22	Leading Edge of Reg. Code True ($\overline{IC1}$-$\overline{IC2}$)	Data Valid	300		Nsec
T23	$\overline{DOUT}$ False	Data Valid	50		Nsec
T24	$\overline{Bus\ Drive}$ True	Data Valid	0		Nsec
T25	$\overline{Bus\ Drive}$ True	$\overline{DOUT}$ True	10	75	Nsec
T26	Data Not Valid	$\overline{DOUT}$ True	10	75	Nsec

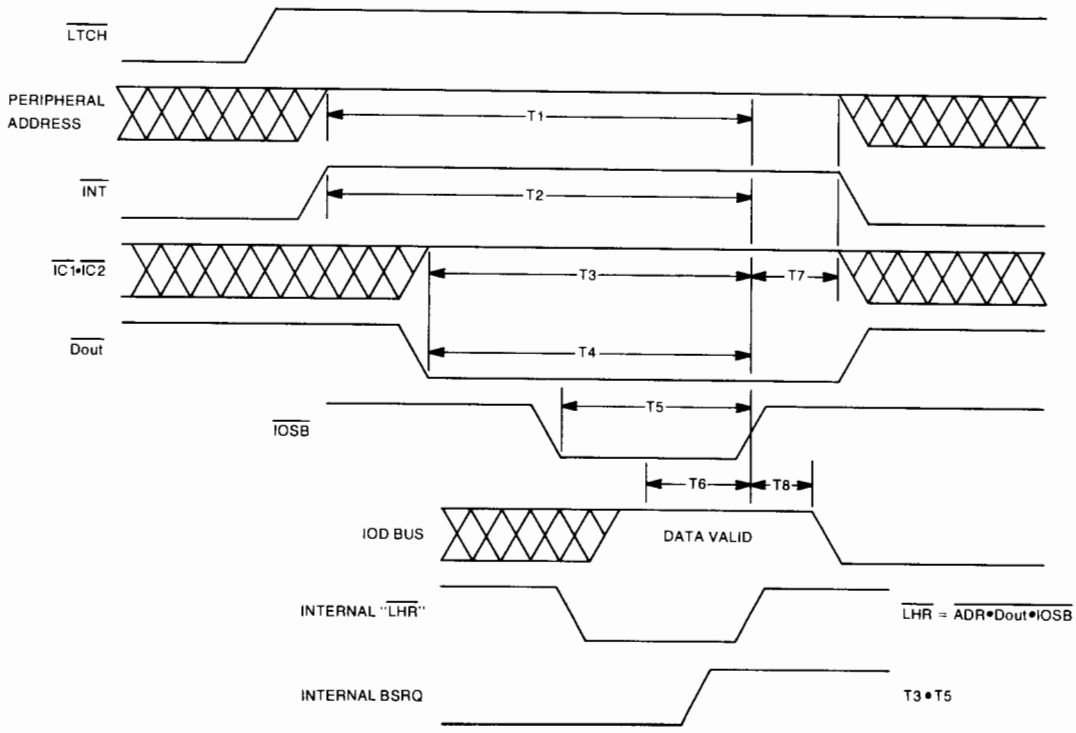


Figure 2-11: Tape Control Chip Write Cycle

Symbol	Parameter	Ref. Point	Min	Max	Units
T1	Peripheral Address Valid	$\overline{IOSB}$ going false	400		NS
T2	$\overline{INT}$ false	false	400		NS
T3	Leading Edge of Reg. Code true ($\overline{IC1}$-$\overline{IC2}$)	false	250		NS
T4	$\overline{DOUT}$ True	false	200		NS
T5	$\overline{IOSB}$ Pulse Width		200		
T6	Leading Edge of $\overline{IOD}$ Data true	$\overline{IOSB}$ going false	50		NS
T7	Trailing Edge of per. add., $\overline{INT}$. and Reg. code true.	$\overline{IOSB}$ going false	50		NS
T8	Trailing Edge of $\overline{IOD}$ Data true	false	80		NS

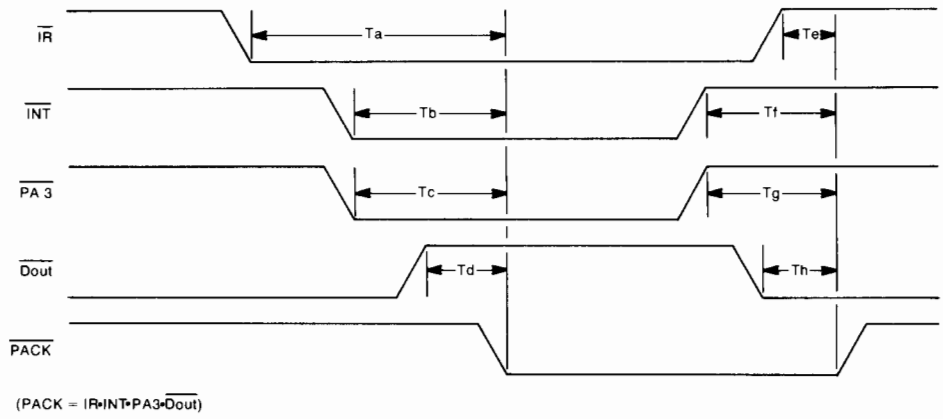


Figure 2-12: Tape Control Chip Interrupt Poll Timing

Symbol	Parameter	Ref. Point	Min	Max	Units
Ta	IR True	PACK True	85		Nsec.
Tb	INT true	PACK True	75		Nsec.
Tc	PA3 true	PACK True	75		Nsec.
Td	DOUT False	PACK True	40		Nsec.
Te	IR false	PACK Release	20	50	Nsec.
Tf	INT False	PACK Release	20	50	Nsec.
Tg	PA3 False	PACK Release	20	50	Nsec.
Th	DOUT True	PACK Release	10	25	Nsec.

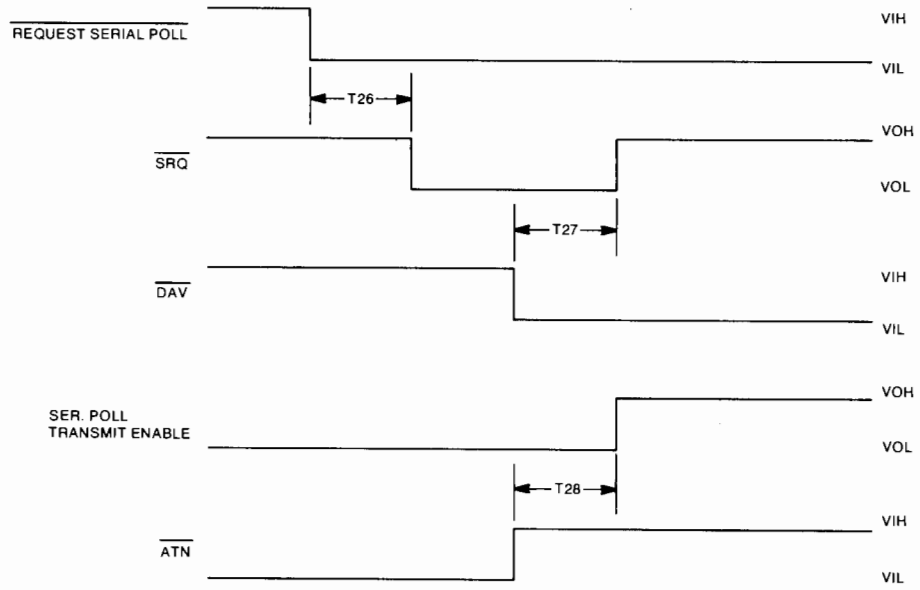


Figure 2-13: Service Request

Symbol	Conditions	Max.	Units
T26	Req. Serv. (SRQ)	150	NS
T27		200	NS
T28	Addressed to talk and serial poll mode	175	NS

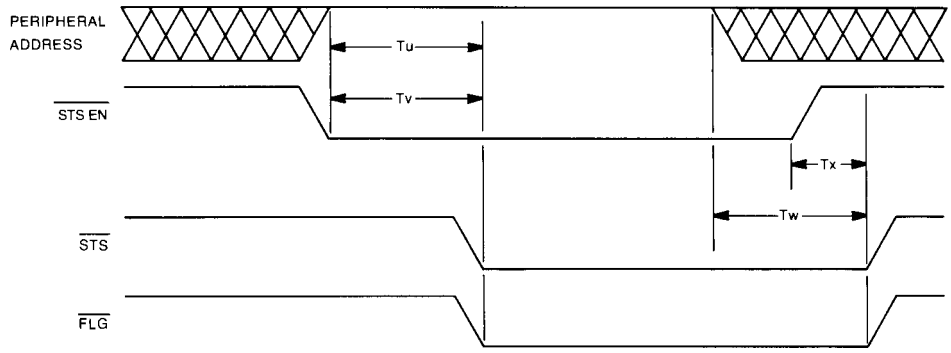
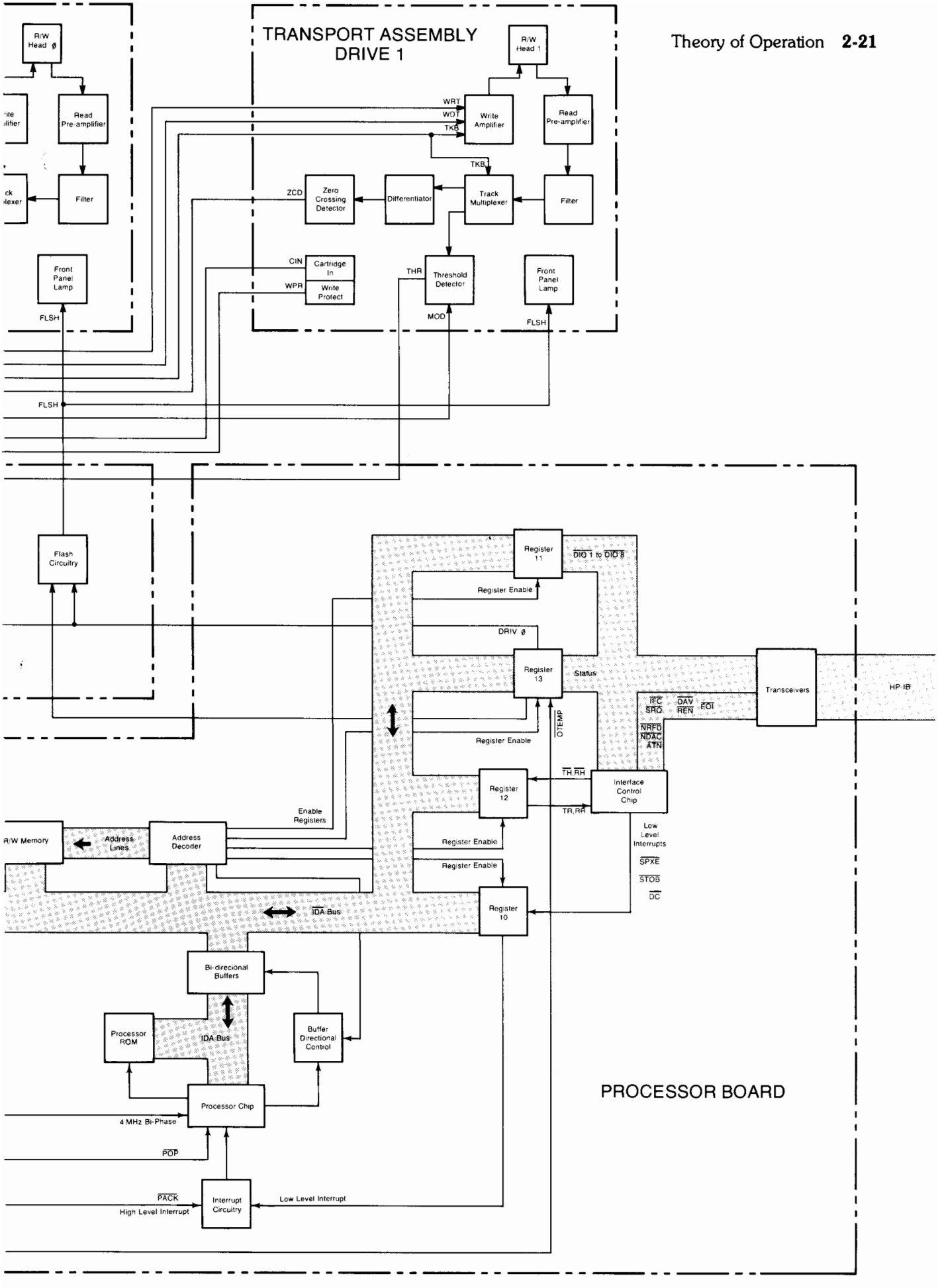
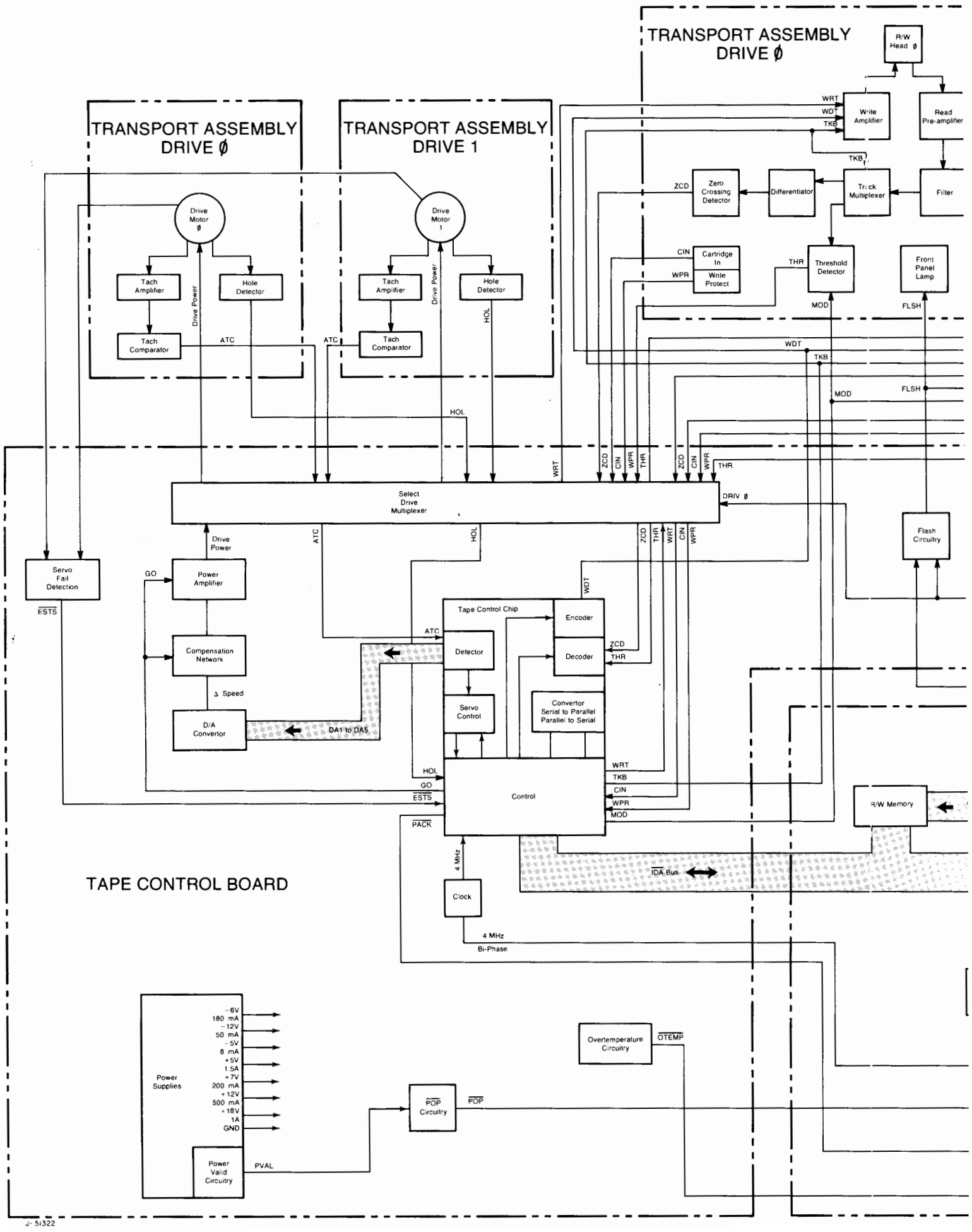


Figure 2-14: Tape Control Chip $\overline{FLG}$ and $\overline{STS}$ Timing

Symbol	Parameter	Ref. Point	Min	Max	Units
Tu	Peripheral add true ($\overline{PA}$)	$\overline{STS}$ or $\overline{FLG}$ true	200		Nsec.
Tv	Status enable true ($\overline{STS\ EN}$)	$\overline{STS}$ or $\overline{FLG}$ true	100		Nsec.
Tw	Peripheral add false	$\overline{STS}$ or $\overline{FLG}$ release		200	Nsec.
Tx	Status enable false	$\overline{STS}$ or $\overline{FLG}$ release		100	Nsec.



9875A Block Diagram


TRANSPORT ASSEMBLY DRIVE Ø
TRANSPORT ASSEMBLY DRIVE Ø
TRANSPORT ASSEMBLY DRIVE 1
R/W Head Ø
Write Amplifier
Read Pre-amplifier
Zero Crossing Detector
Differentiator
Track Multiplexer
Filter
Drive Motor Ø
Drive Motor 1
Tach Amplifier
Hole Detector
Tach Comparator
Drive Power
ATC
HOL
Cartridge In
Write Protect
Threshold Detector
Front Panel Lamp
Select Drive Multiplexer
Flash Circuitry
Servo Fail Detection
Power Amplifier
Compensation Network
D/A Convertor
Tape Control Chip
Encoder
Detector
Decoder
Servo Control
Convertor Serial to Parallel Parallel to Serial
Control
R/W Memory
Clock
4 MHz
Bi-Phase
IDA Bus
TAPE CONTROL BOARD
Power Supplies
Power Valid Circuitry
Overtemperature Circuitry
Power Circuitry

Chapter 3
Troubleshooting

There are two types of problems which necessitate troubleshooting the Cartridge Tape Unit:

- "Hard" errors
- "Intermittent" errors

"Hard" errors are typically caused by a fuse blowing, or a defective I.C. chip. These errors can be traced to a specific cause.

"Intermittent" errors are errors which typically occur without any apparent reason. They are nearly impossible to duplicate.

In view of this, it is recommended that your initial check should include:

- The Operating Environment of the Cartridge Tape Unit
- The Age and Condition of the Tape
- Determining if the Problem Applies to Only One of Two-Transports
- The Program Software to verify that the Program is Correct.

Checking these items first may save you from unnecessary troubleshooting of an otherwise operational Cartridge Tape Unit.

How To Fix It

Power On Problems

If the Cartridge Tape Unit does not respond to enabling power, you should check:

- The Line Voltage Selector Switch Settings
- The Line Voltage
- The Power Cord
- The Line Fuse
- The Power Supply Voltage

The Power Supply Test Points are located on the bottom of the Tape Control and Power Supply Board (A-10), as shown in Figure 3-1. The Power Supply Voltages should be within the tolerances shown in Table 7.

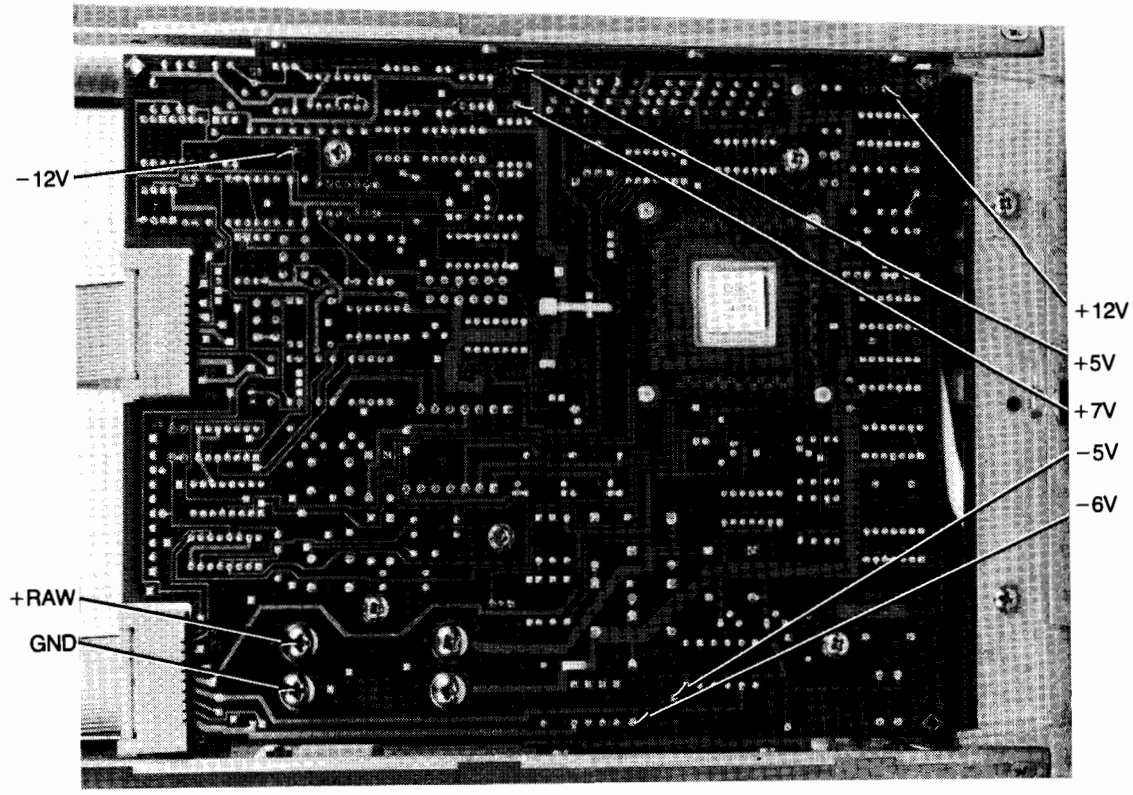


Figure 3-1: Power Supply Test Points

Table 7: Power Supply Voltage Tolerances

Power Supply	MIN	MAX	Typical Current
−5	−5.5 VDC	−4.5 VDC	8 mA
+5	+4.75 VDC	+5.25 VDC	1.5 A
−6	−6.25 VDC	−5.75 VDC	180 mA
+7	+6.7 VDC	+7.3 VDC	200 mA
−12	−12.6 VDC	−11.4 VDC	50 mA
+12	+11.4 VDC	+12.6 VDC	500 mA
+18 (+RAW)	+16.95 VDC	+18.3 VDC	1.74 A

Self Test

The next procedure in troubleshooting would be the Self Test. This can be done as stated in Chapter 1.

The Self Test consists of the following steps, in their indicated order.

Step	Operation
1. RAM test	A read/write routine verifies that each bit in R/W memory can handle a 0 and a 1.
2. ROM test	A checksum test which verifies the ROM bit pattern.
3. Tape Control test	a). The registers in the tape control chip are verified. b). The status line, flag line, and associated flip-flops are verified.
4. Register 13 test	The Select Drive FF is verified.
5. Register 10 test	All flip-flops in Register 10 are verified.

6. Tape test

If a write enabled tape cartridge is inserted in the tape drive, the following occurs:

a). set track A
b). set auto verify mode
c). rewind the tape
d). mark file "MF1,0"
e). write 256 bytes of data using "WR".
f). select track B
g). rewind the tape
h). mark file "MF1,0"
i). write 256 bytes of data using "WR"

If a tape drive 1 has a write enabled tape inserted in it, the tape test is also executed for drive 1.

This completes the Self Test.

Table 8: Summary of the Self Test

	No or Write Protected cartridge inserted.	Write Enabled cartridge inserted.
Normal Power On	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Self Test Switch On,[1] followed by Power On	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6
Self Test Command received	1, 2, 3, 4, 5	1, 2, 3, 4, 5, 6

1 The indicator lamp can not flash until the Self Test Switch is turned off.

It is recommended that the Self Test be performed in three stages.

1. Self Test Switch ON without the cartridge...to test the electronics.
2. Self Test Switch ON with the cartridge...to test the R/W operation.
3. ST command followed by an OE command with the cartridge...to test the controller and I/O sections.

Exerciser Flowchart

The following general purpose exerciser may be used to test the operation of the Cartridge Tape Unit. Before conducting the exerciser, the following procedures must be performed.

1. The Self-Test switch must be off.
2. Good tapes must be used for each transport. Each tape used is marked over nearly all of its length, therefore, do not use a tape which contains important data.
3. CTU must be connected to a controller.

This exerciser is similar to the exerciser performed by the 9825A with the CTU.

For proper operation of the exerciser, it is recommended that the following set-up information be included in the program:

- HP-IB interface select code
- CTU address code
- # of transports in the CTU

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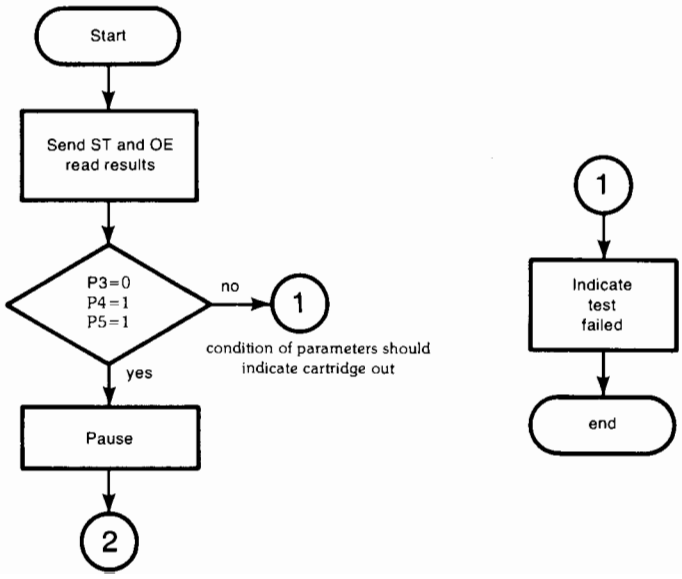
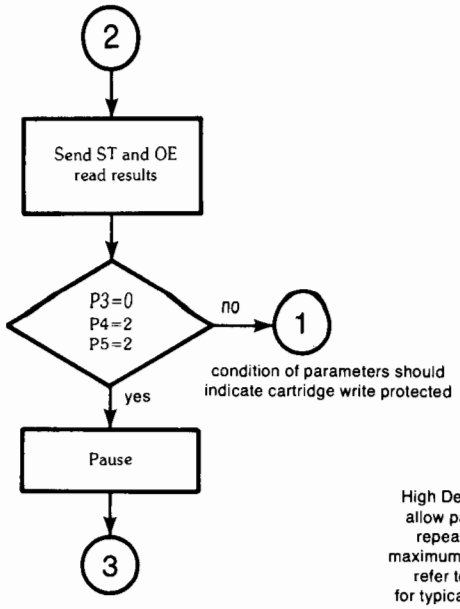
Exerciser

Phase 1 is conducted without tapes in the CTU.



Phase 2 requires that WRITE PROTECTED tapes be inserted into the CTU.



Phase 3 requires that WRITE ENABLED tapes be inserted into the CTU.

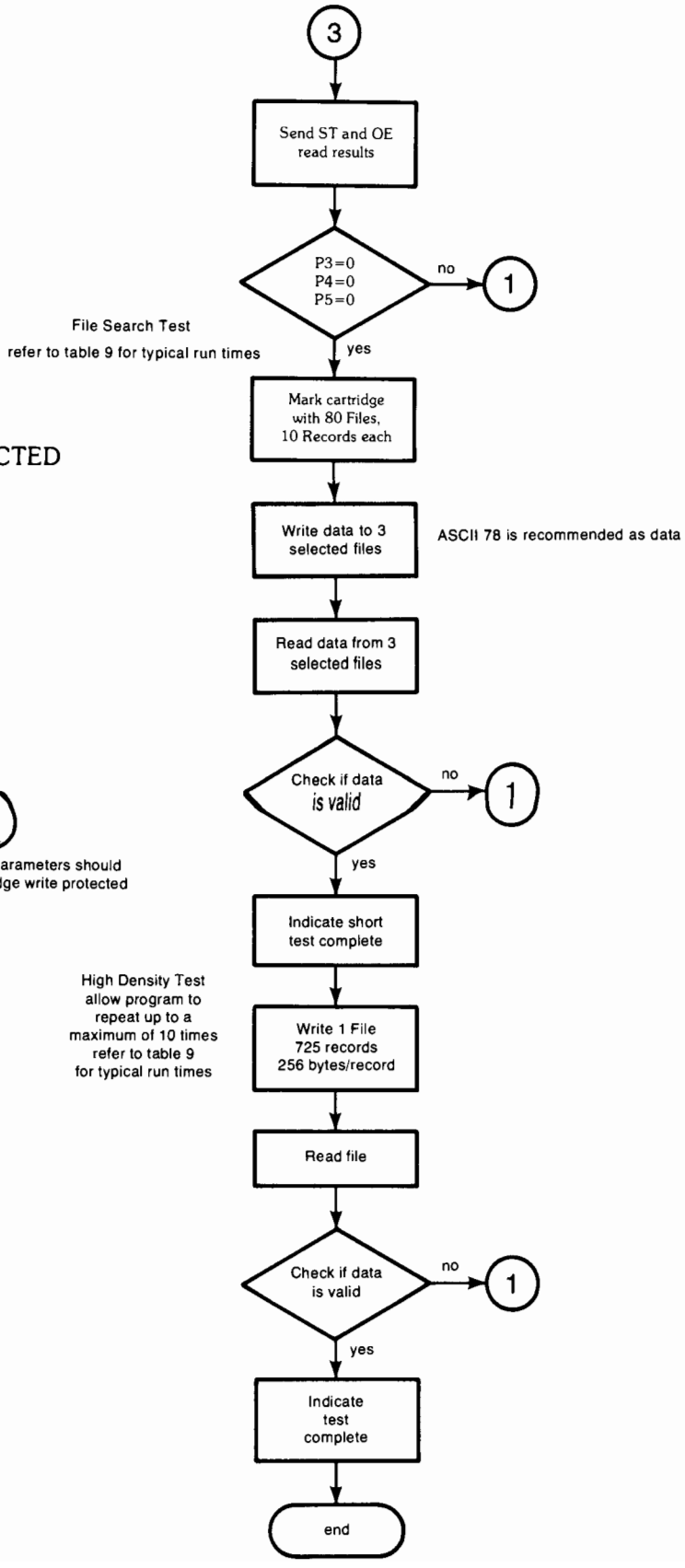


Table 9: Typical Exerciser Run Times

	One Drive	Two Drive
File Search Test	6 min	12 min
High Density Test		
AV off	16.5 min per repetition	33 min. per repetition
AV on	21.25 min per repetition	42.25 min per repetition

Self Test Results

The Self-Test results are returned by the CTU when an Output Error (OE) command is received by the CTU.

The OE command returns five parameters from the CTU. The five parameters are:

Error Code #1 (First Parameter Returned)

0. No error or test passed
1. Cartridge out or file not found.
2. Cartridge is write protected or record not found.
4. Drive not present or internal cartridge temperature is too high.
8. Verify failed or unknown or illegal tape position.
16. File/record overflow or attempt to read an empty file/record.
32. Body checksum error or attempt to store, write or mark a non-updateable record.
64. Header checksum error or end of tape.
128. Servo or hardware failure.

Error Code #2 (Second Parameter Returned)

0. No error.
1. Unexpected byte received.
2. Unexpected byte requested.
4. Illegal character in parameter list.
8. Mandatory parameter is not specified.
16. Too many parameters specified.
32. Parameter is out of limits.
64. Syntax error.

Electronics Test (Third Parameter Returned)

		Probable Failure (Assembly)
16	Register 13 failure (Select Drive FF)	A-15
36	$\overline{\text{STOB}}$ Failure (secondary talk on bus)	A-15
37	$\overline{\text{SPXE}}$ Failure (serial poll transmit enable)	A-15
40	DC Device Clear Failure	A-15
41	$\overline{\text{PACK}}$ Failure (poll acknowledge between Tape Control Chip and Processor Chip).	A-15
64	Tape Control Chip (Flag Failure)	A-10/A-15
65	Tape Control Chip (Status Failure)	A-10/A-15
66	Tape Control Chip (Internal Register Failure)	A-10
128	Processor ROM Failure	A-15
129	R/W Memory Failure (U-23)	A-15
130	R/W Memory Failure (U-30)	A-15
131	R/W Memory Failure (U-18)	A-15
132	R/W Memory Failure (U-12)	A-15

Tape Drive 0 Test (Fourth Parameter Returned)

The test results are the same as Parameter 1 (Error Code 1)

Tape Drive 1 Test (Fifth Parameter Returned)

The test results are the same as Parameter 1 (Error Code 1).

NOTE

The Fifth Parameter returned is always 0 on a single drive 9875A.

NOTE

A flashing front panel lamp immediately after power on indicates a probable failure in the R/W memory (A-15). (Either U-31, U-24, U-17, or U-11.)

Other Problems

Software Errors

Since there is no ROM for controllers to use with the CTU, a common cause of error is the software for the customers program. To assist you in troubleshooting, the following state diagram is provided in Figure 3-3.

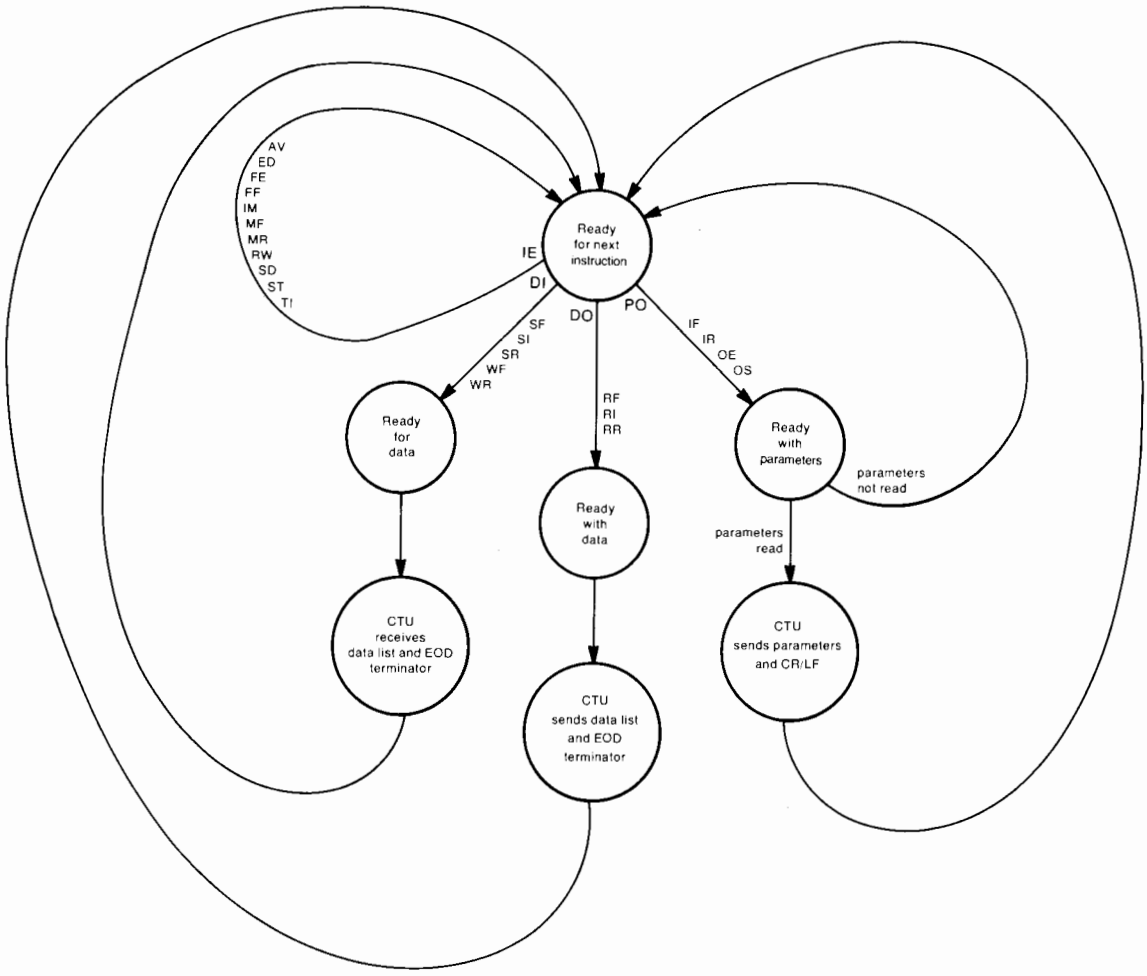


Figure 3-3: Software State Diagram

The state diagram shows that the four types of instructions (IE, DI, DO and PO) cause the CTU to leave the ready for next instruction state while executing an instruction. The state diagram shows the next expected action to avoid an error. Any other action which does not follow the state diagram generates an error (I.E. receiving an SF instruction after a RF instruction generates an error).

Common causes of errors are:

1. Failure to terminate a data list sent to the CTU with an EOD character.
2. Failure to read the EOD character on a data list sent from the CTU.

The CTU can be cleared from an error condition by sending the OS or OE instruction.

NOTE

The CTU must always be in the ready for next instruction state when it receives a instruction, or an error is generated.

Table 10: Troubleshooting

Problem \ Probable Cause	Transport Assembly	Tape Control Board (A-10)	Processor Board (A-15)	Power Supply Section (A-10)	Drive Transistors	Voltage Switchboard (A-50)	Select Code Switchboard (A-40)	Regulator Board (A-11)	Tape Cartridge	I/O Cable	Program Software	Line Fuse
No Response at Power On				2								1
Line Fuse Blows				2		1						
Fuse OK CTU Inoperative			2								1	
Incorrect Power Supply Voltages				1				2				
Transport Assembly Inoperative	1	2	3									
No Tape Movement			3	2	4					1		
Unidirectional Tape Movement	2	3			1							
Data Not Recorded	1	2	3									
Data Not Read	1	2	3									
Autoverify Failed	2	3							1			
Invalid Error Indication		2	1									
Tape Control Chip Inoperative		1										
Cartridge Failure	2	3							1			
I/O Problems			3				2			1		

Chapter 4
Disassembly and Special Replacement Procedures

This chapter contains the disassembly and special replacement procedures for the Cartridge Tape Unit (CTU).

WARNING

THE CTU SHOULD BE DISCONNECTED FROM THE POWER SOURCE BEFORE ATTEMPTING TO DISASSEMBLE THE UNIT.

Front Panel Assembly

The front panel removal requires you to remove the plastic insert which covers the retaining screws. The front panel can be removed by removing the two (2) top and two (2) bottom retaining screws, as shown in Figure 4-1.

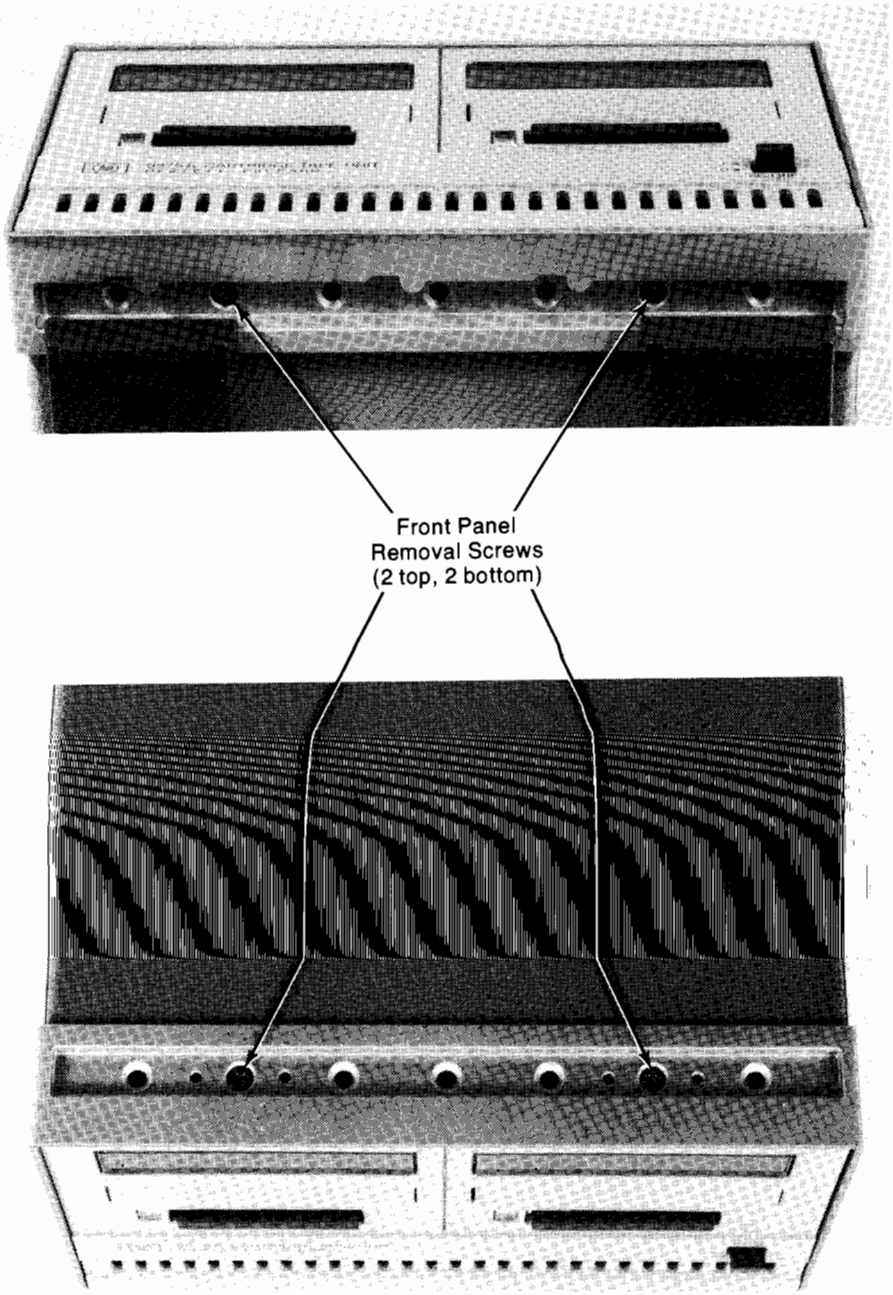


Figure 4-1: Front Panel Assembly Removal

Top, Bottom and Side Panel Assemblies

The top, bottom and side panels are each retained by a single screw, as shown in the photo. The panels are removed by unscrewing the screw and sliding the panel off the CTU (Figure 4-2).

CAUTION

DO NOT LAY THE CARTRIDGE TAPE UNIT SO THAT THE FRONT PANEL IS LAYING ON A FLAT SURFACE. THIS CAN DAMAGE THE ON/OFF SWITCH OR THE TAPE CARTRIDGE EJECTORS.

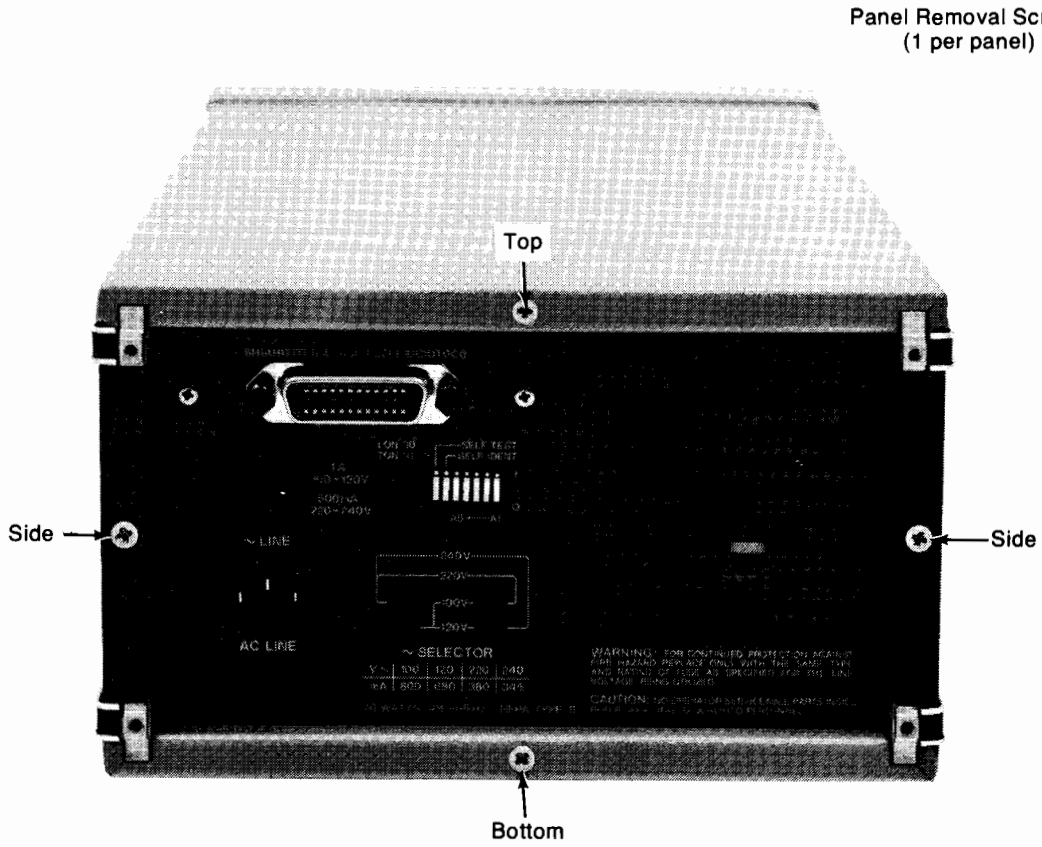


Figure 4-2: Top, Bottom and Side Panel Assembly Removal

Rear Panel Assembly

The rear panel can be removed by removing the top and bottom panels and four (4) retaining screws as shown in Figure 4-3. The terminals must be disconnected from the voltage switchboard.

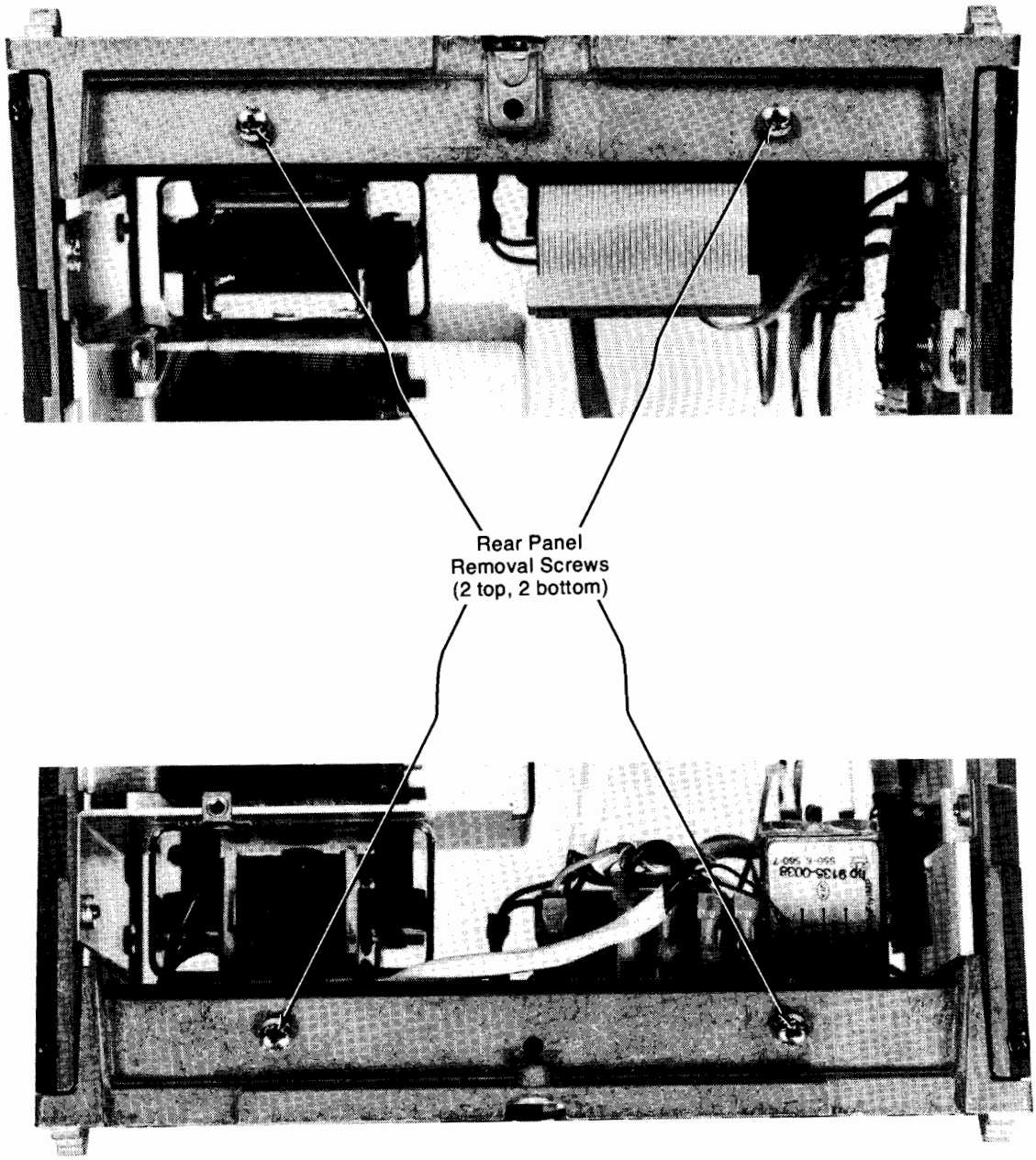


Figure 4-3: Rear Panel Assembly Removal

Select Code Switchboard

The select code switchboard (A-40) can be removed by removing the two (2) retaining screws and by disconnecting the ribbon cable from the processor board as shown in Figure 4-4.

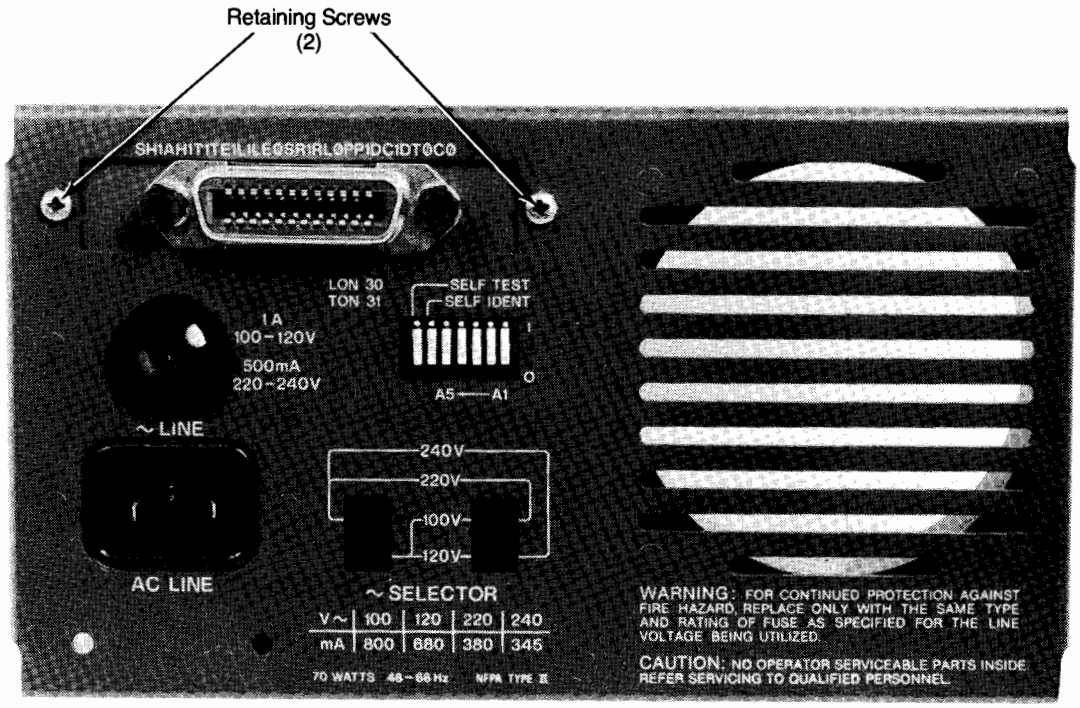


Figure 4-4: Select Code Switchboard Removal

Tape Control and Power Supply Board

The tape control and power supply board can be removed by removing the four retaining screws as shown in Figure 4-5. Disconnect the ribbon cables from the processor board and the transport assembly. The two (2) molex connectors must be disconnected from the transformer and the motor drive.

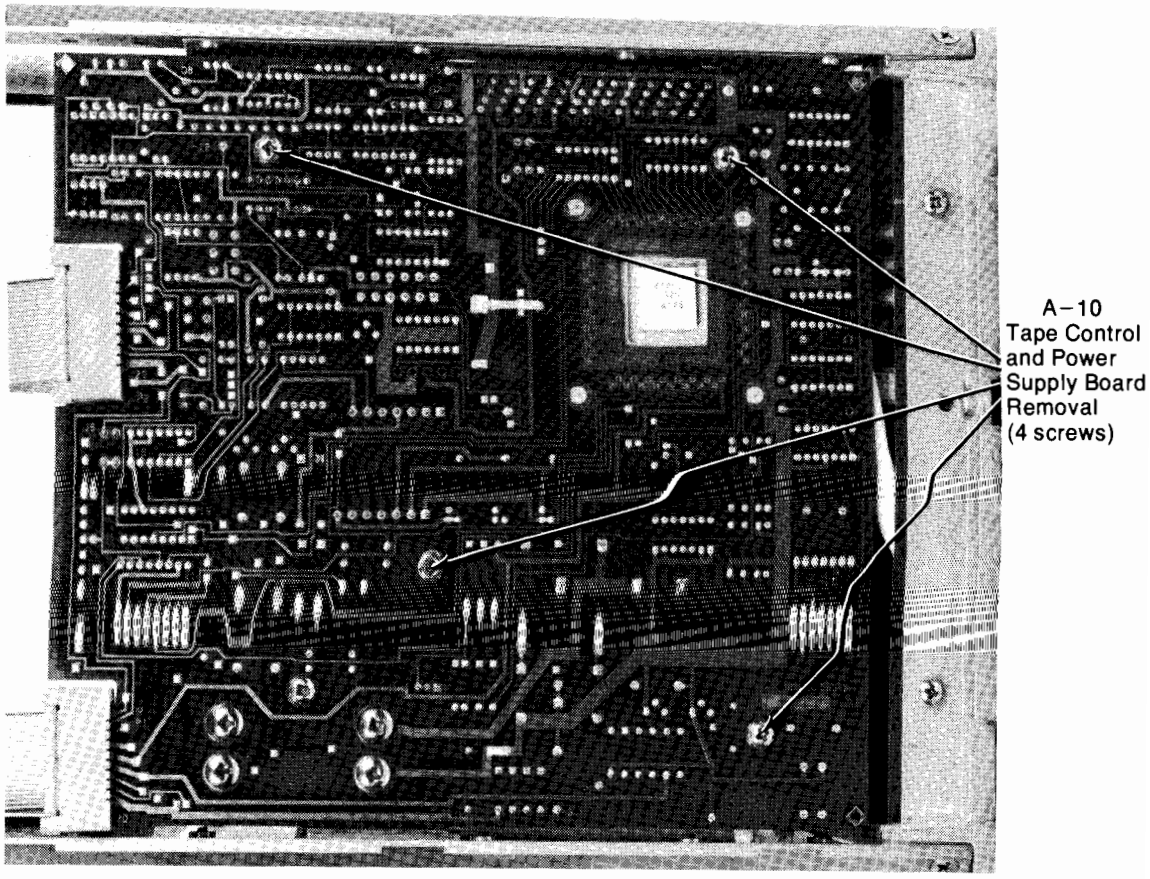


Figure 4-5: Tape Control and Power Supply Board Removal

Processor Board

The processor board (A-15) can be removed by removing the four (4) retaining screws as shown in Figure 4-6.

CAUTION

WHEN REMOVING THE PROCESSOR BOARD (A-15), AVOID IMPACTING THE BOARD INTO THE HEAD DRIVER BOARD AND THE ASSOCIATED CABLING.

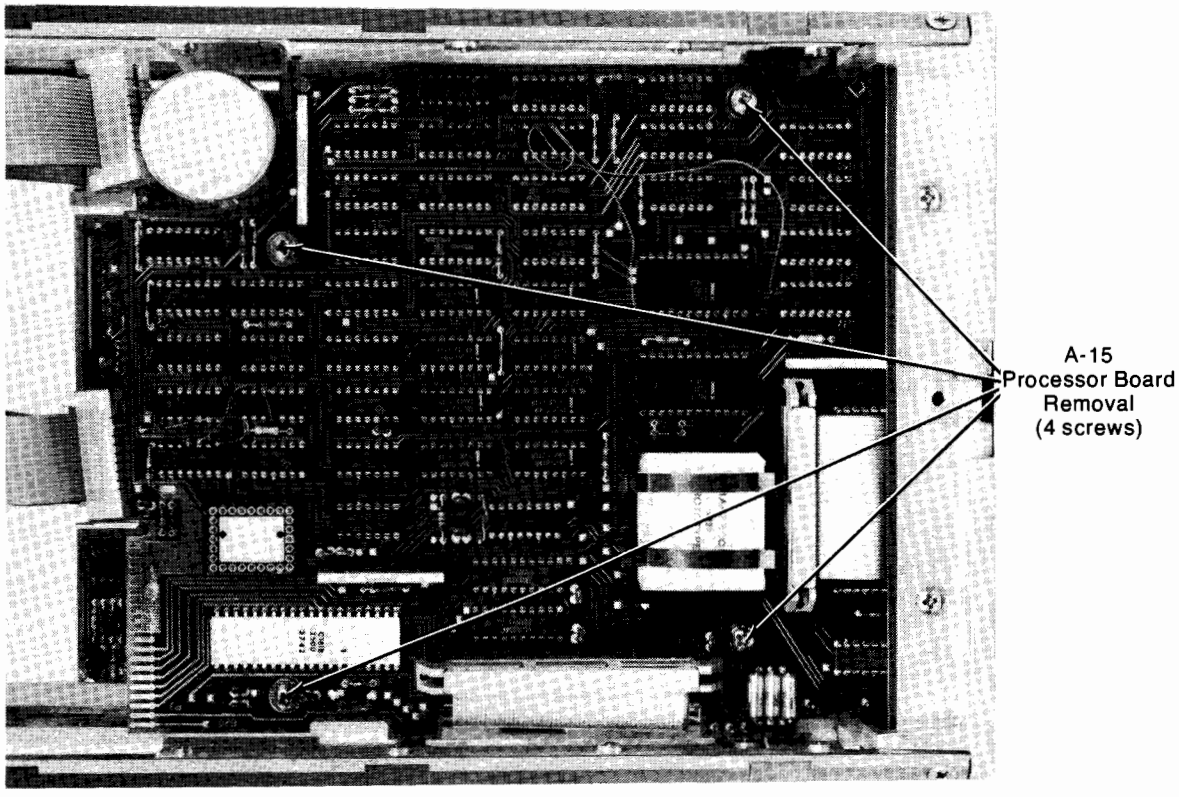


Figure 4-6: Processor Board Removal

Motor Drivers

The motor driver transistors can be removed by removing the two (2) mounting screws for each transistor and by disconnecting the transistor from the socket. When replacing a motor driver transistor, remember to replace the sil-pad insulator under each transistor (Figure 4-7).

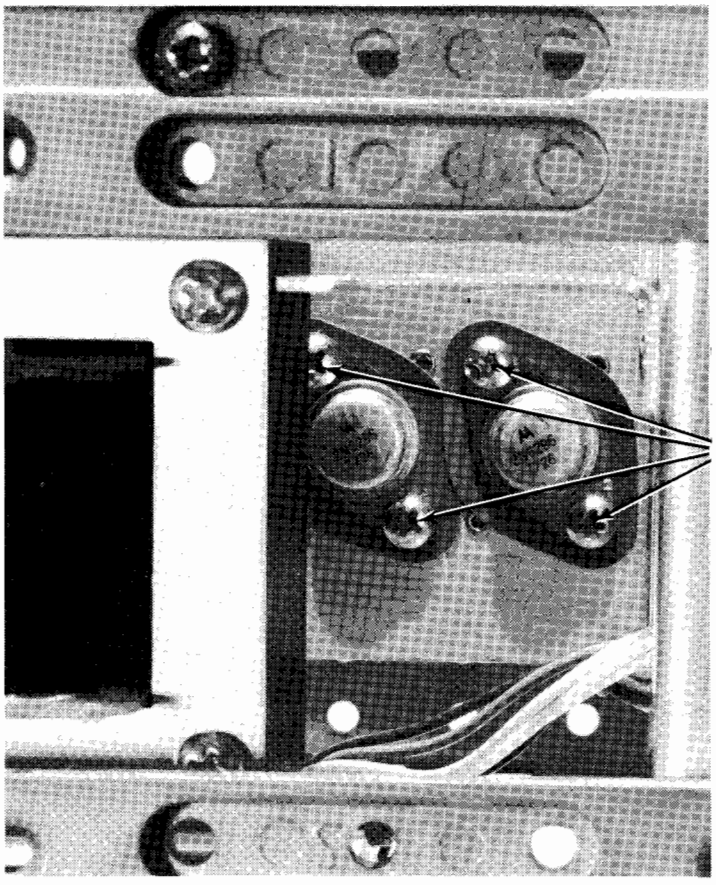


Figure 4-7: Motor Drive Transistors Removal

Voltage Regulators

The voltage regulators can be removed by removing the U-bracket and the six (6) retaining screws as shown in Figure 4-8. The regulators must be desoldered from the regulator board.

NOTE

The insulators must be reinstalled when replacing the individual regulators.

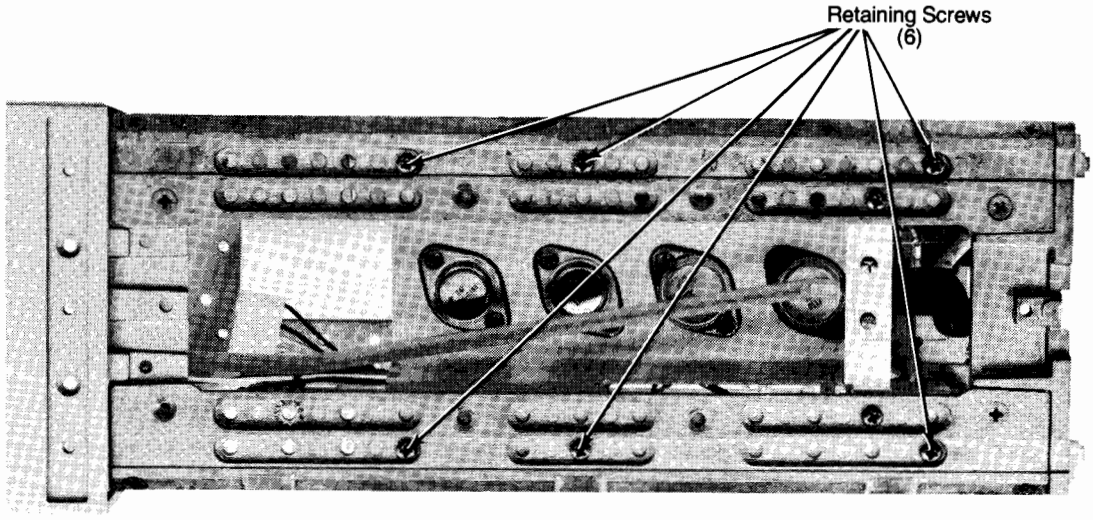


Figure 4-8: Voltage Regulator Removal

Transport Assembly

The transport assembly can be removed by first removing the four (4) retaining screws as shown in Figure 4-9.

NOTE

The transport and the head board are not to be separated. Both pieces are to be removed interconnected. The sheet metal bracket is not an exchange part.

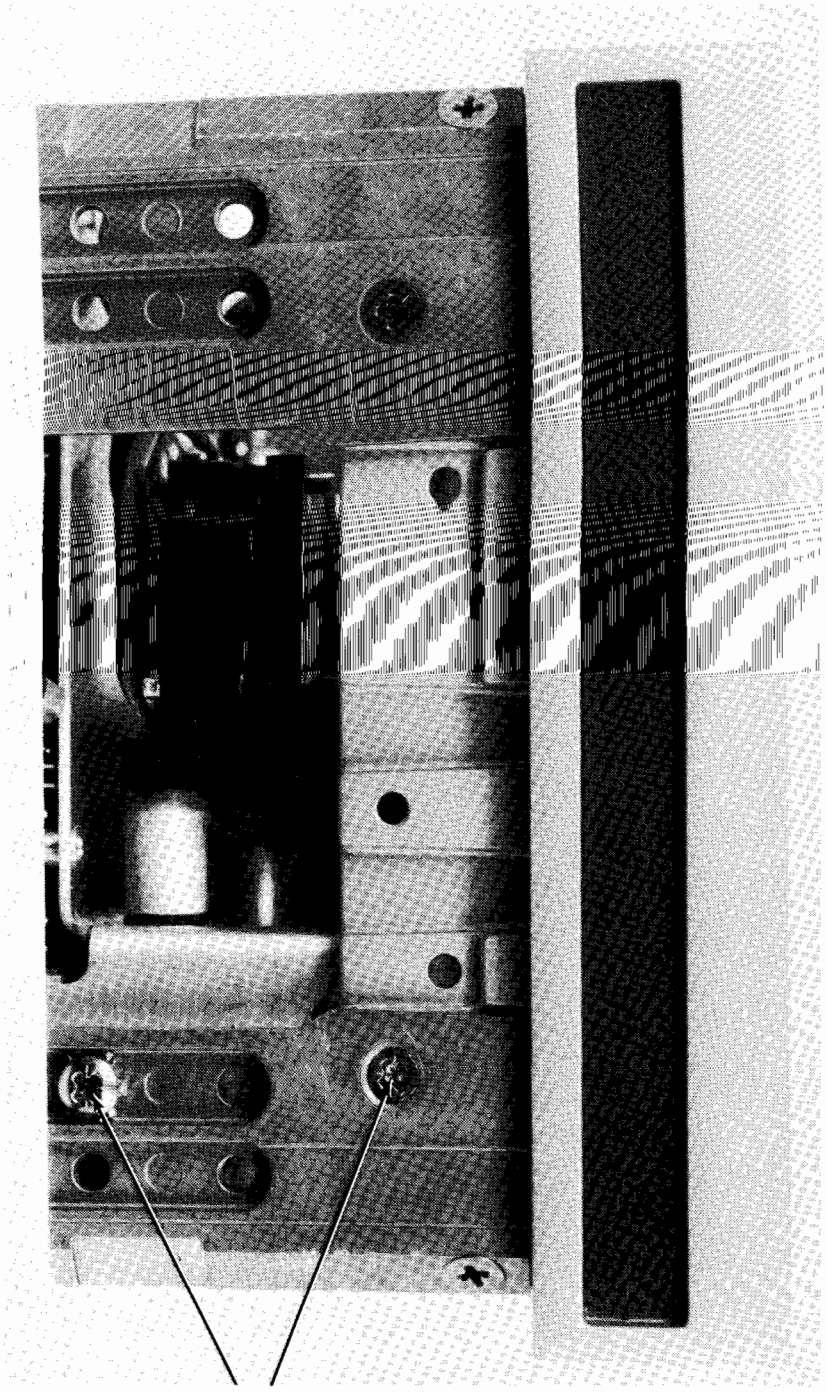


Figure 4-9: Transport Assembly Removal

To remove the transport drive, it is necessary to remove the four (4) retaining screws as shown in the photo. It is also necessary to remove the two (2) screws which hold the head driver borad in place. Not shown in the photo is the grounding strap for each motor, which must also be removed.

NOTE

The cable is not returned with the transport assembly during board exchange.

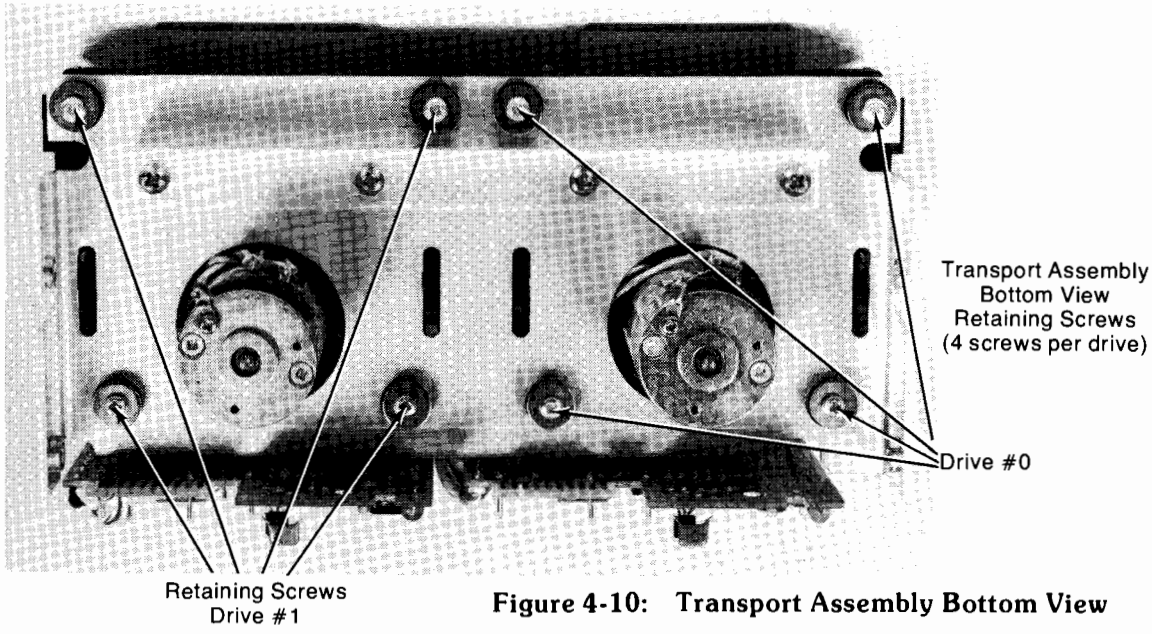


Figure 4-10: Transport Assembly Bottom View

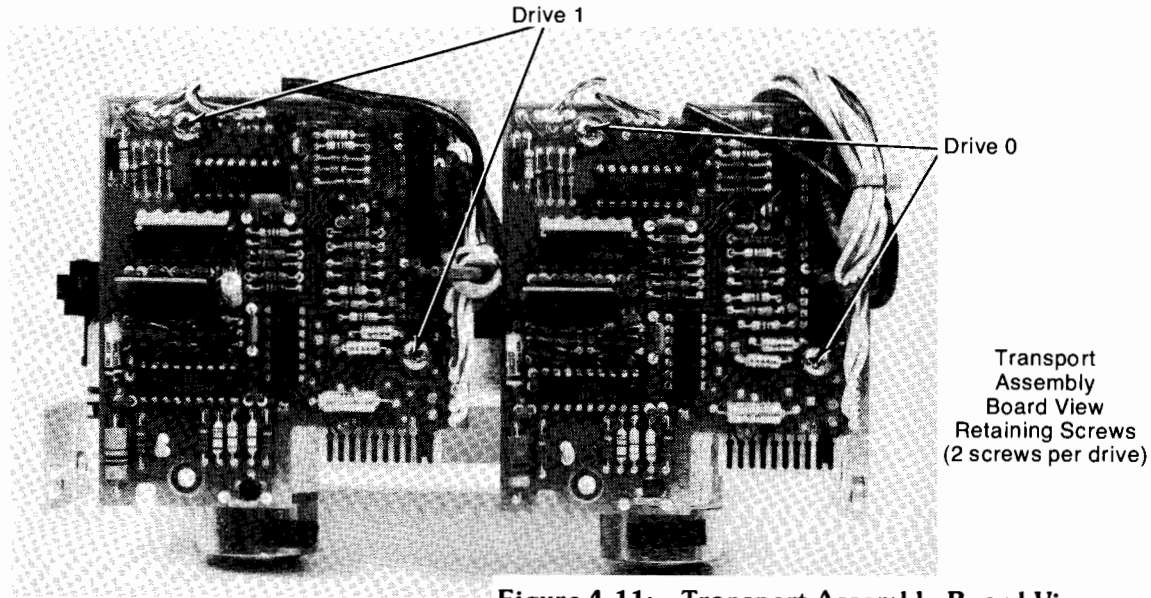


Figure 4-11: Transport Assembly Board View

Transformer and Fan

The transformer can be removed by removing the four (4) retaining screws as shown in Figure 4-12, and the one (1) screw which secures the ground lug.

NOTE

When re-assembling the cartridge tape unit, the transformer should be mounted with the ground connector pointing to the bottom panel.

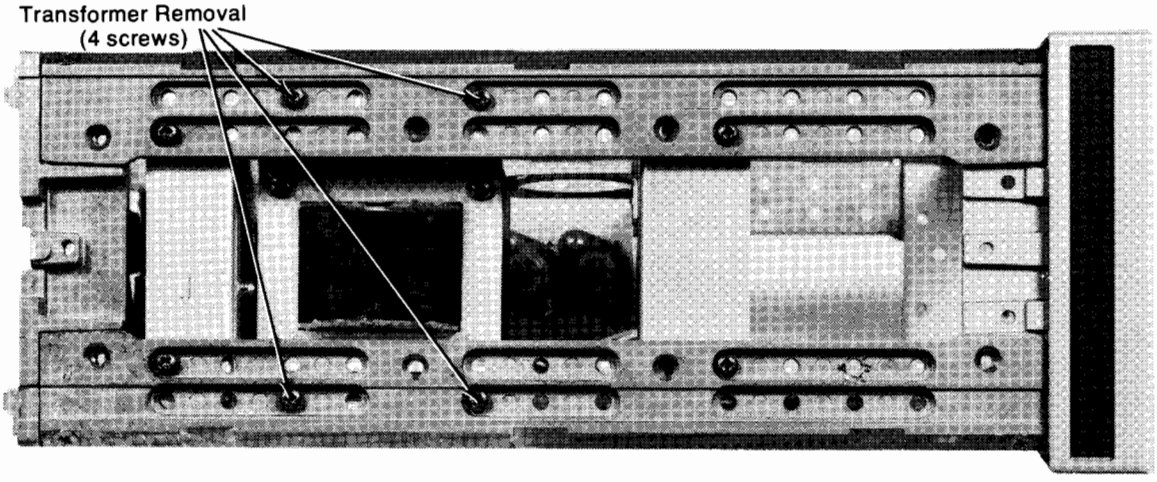


Figure 4-12: Transformer Removal

The fan can be removed by removing the two (2) retaining screws as shown in Figure 4-13.

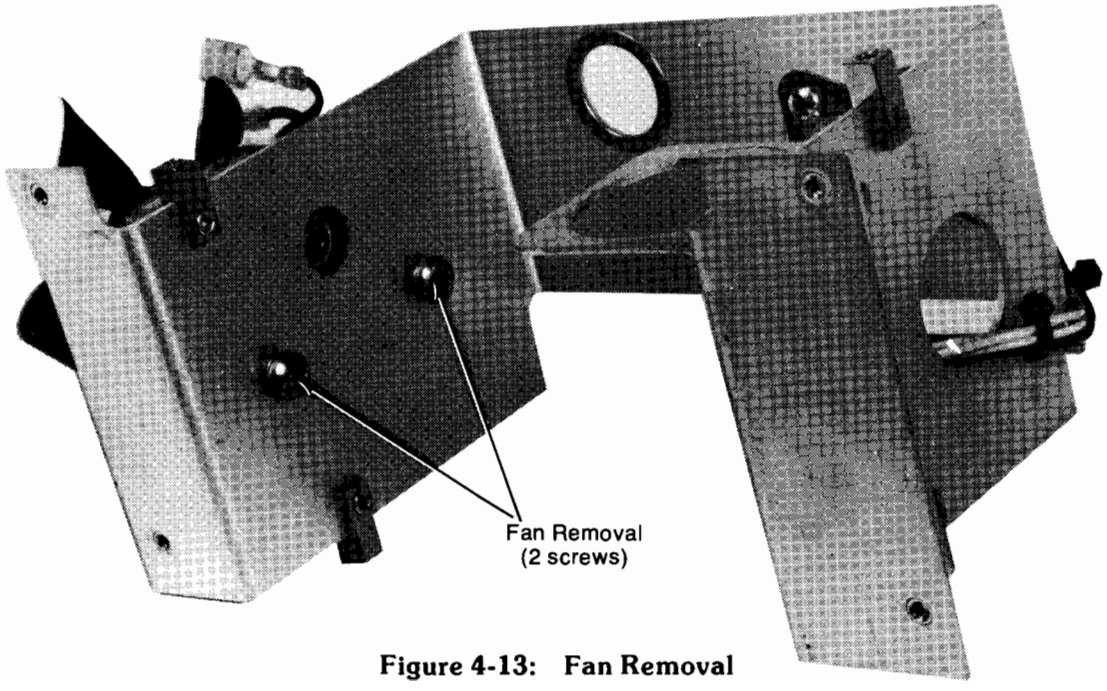


Figure 4-13: Fan Removal

Voltage Switchboard

The Voltage Switchboard can be removed from the rear panel assembly by removing the three (3) retaining screws as shown in Figure 4-14.

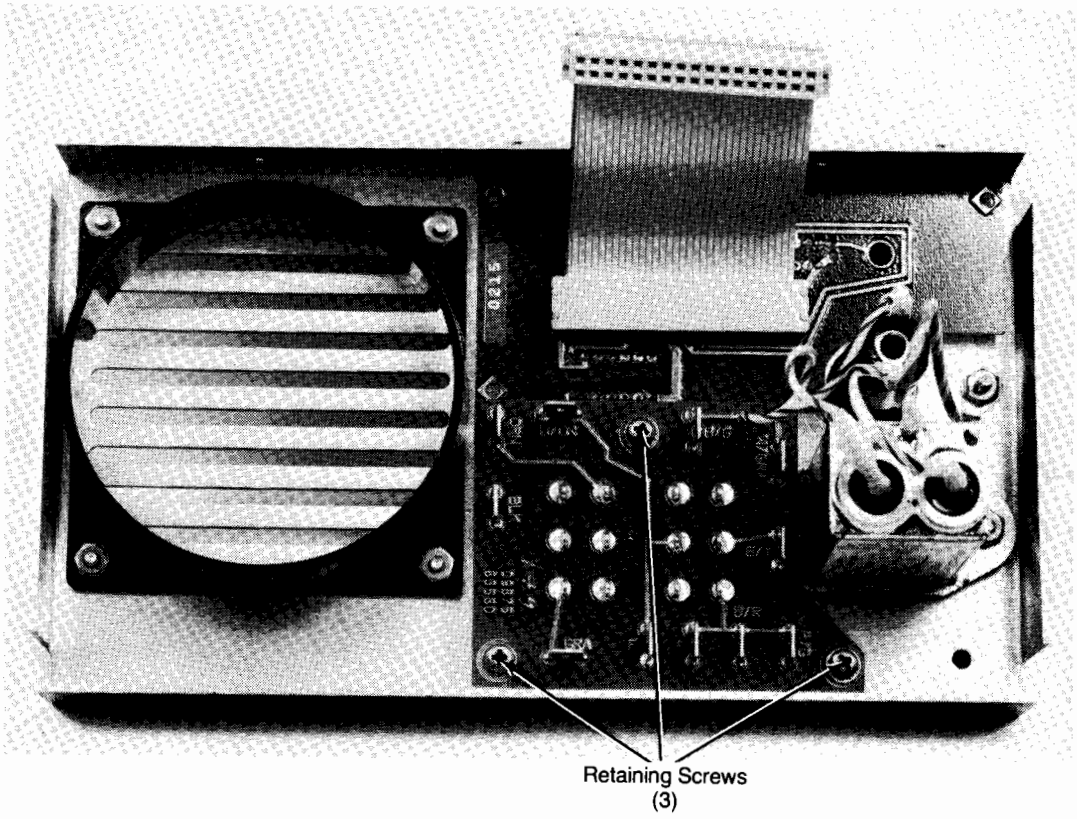


Figure 4-14: Voltage Switchboard Removal

Special Replacement Procedures

Replacement of the Tape Control Chip.

1. Remove the four retaining nuts and heat sink, shown in Figure 4-15.

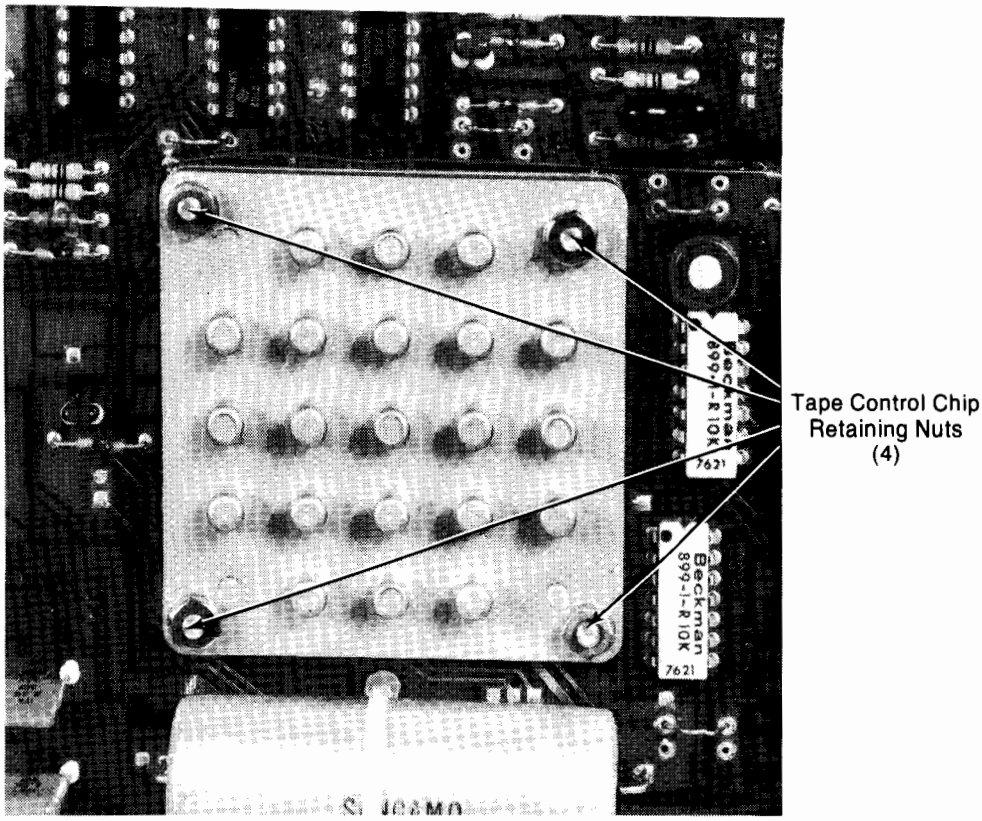


Figure 4-15: Tape Control Chip

2. Remove the Tape Control Chip and the connection gasket.
3. Check the power supply voltages. Failure of the −5V supply is a primary cause of the Tape Control Chip failure.

NOTE

Avoid touching the contacts on the tape control chip, the P.C. board, and the connection gasket.

---

4. Clean the contacts on the P.C. board. The use of isopropyl alcohol and a cotton swab for cleaning is recommended.

5. Install the connection gasket as shown in Figure 4-16. The shiny side of the gasket should be next to the P.C. board.

NOTE

A connection gasket should only be used once. The connection gasket should be handled by the paper border.

CAUTION

FLEXING THE CONNECTION GASKET MAY RESULT IN ITS DAMAGE.

Computer Museum

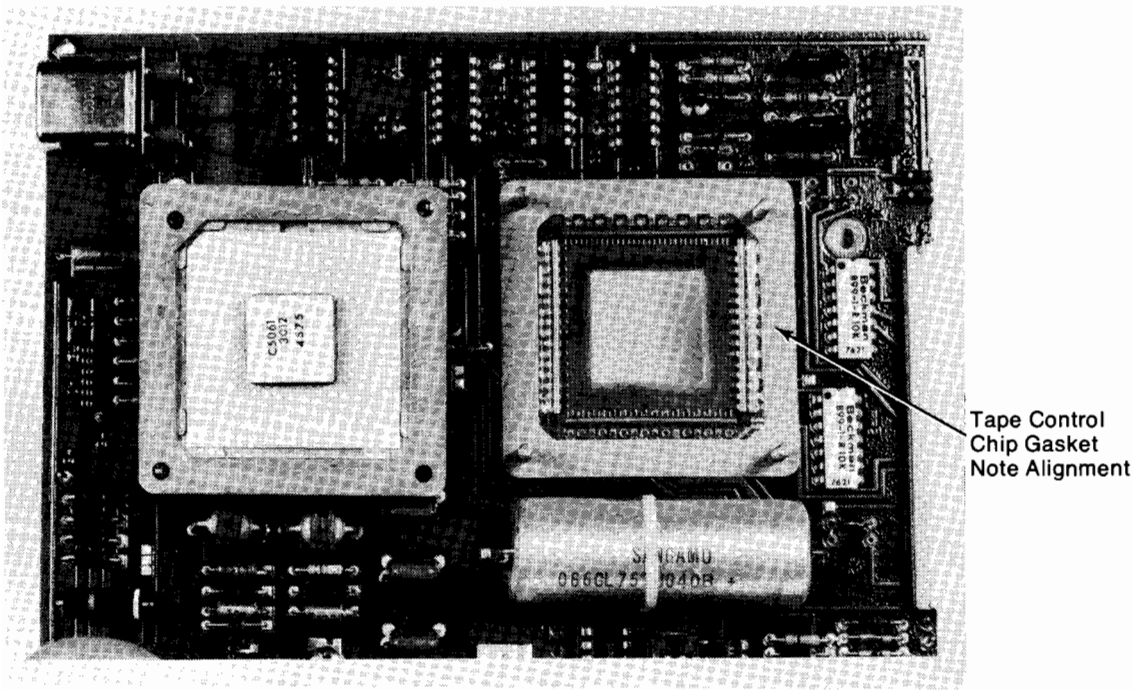


Figure 4-16: Tape Control Chip Gasket Alignment

6. Clean the contacts on the Tape Control Chip. The use of isopropyl alcohol and a cotton swab for cleaning is recommended.

7. Install the Tape Control Chip, as shown in Figure 4-17.

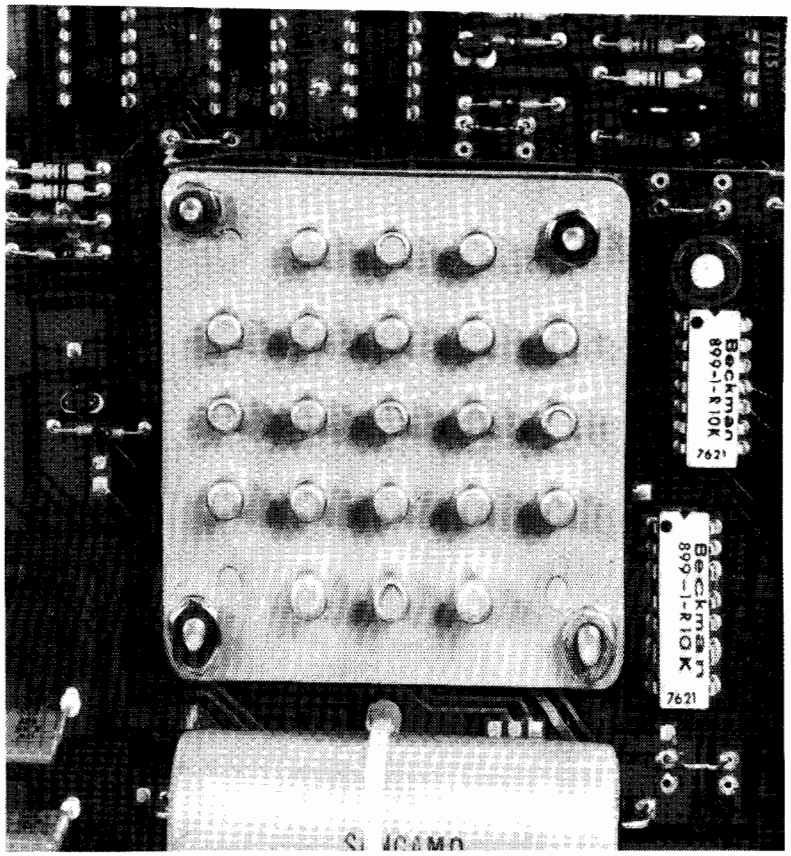


Figure 4-17: Tape Control Chip Completed Installation

8. Install the heat sink. Tighten the retaining nuts until they are snug. Do not over-tighten.

Replacement of the Processor ROM

1. Grasp the processor ROM by the edges and carefully pull the ROM straight up from its mounting pins (Figure 4-18).
2. Align the ROM to be installed with the mounting pins on the p.c. board. Verify that the square alignment socket on the ROM is aligned with the square mounting pin on the p.c. board. The gold-plated side of the ROM must face away from the p.c. board.
3. Carefully press the ROM down onto its mounting pins.

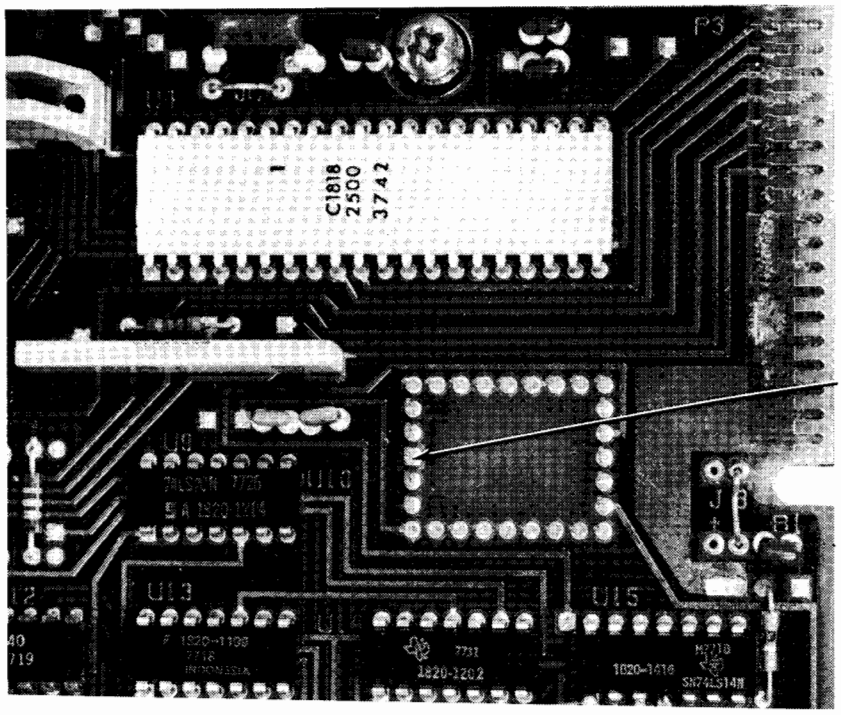


Figure 4-18: Processor ROM Alignment Point

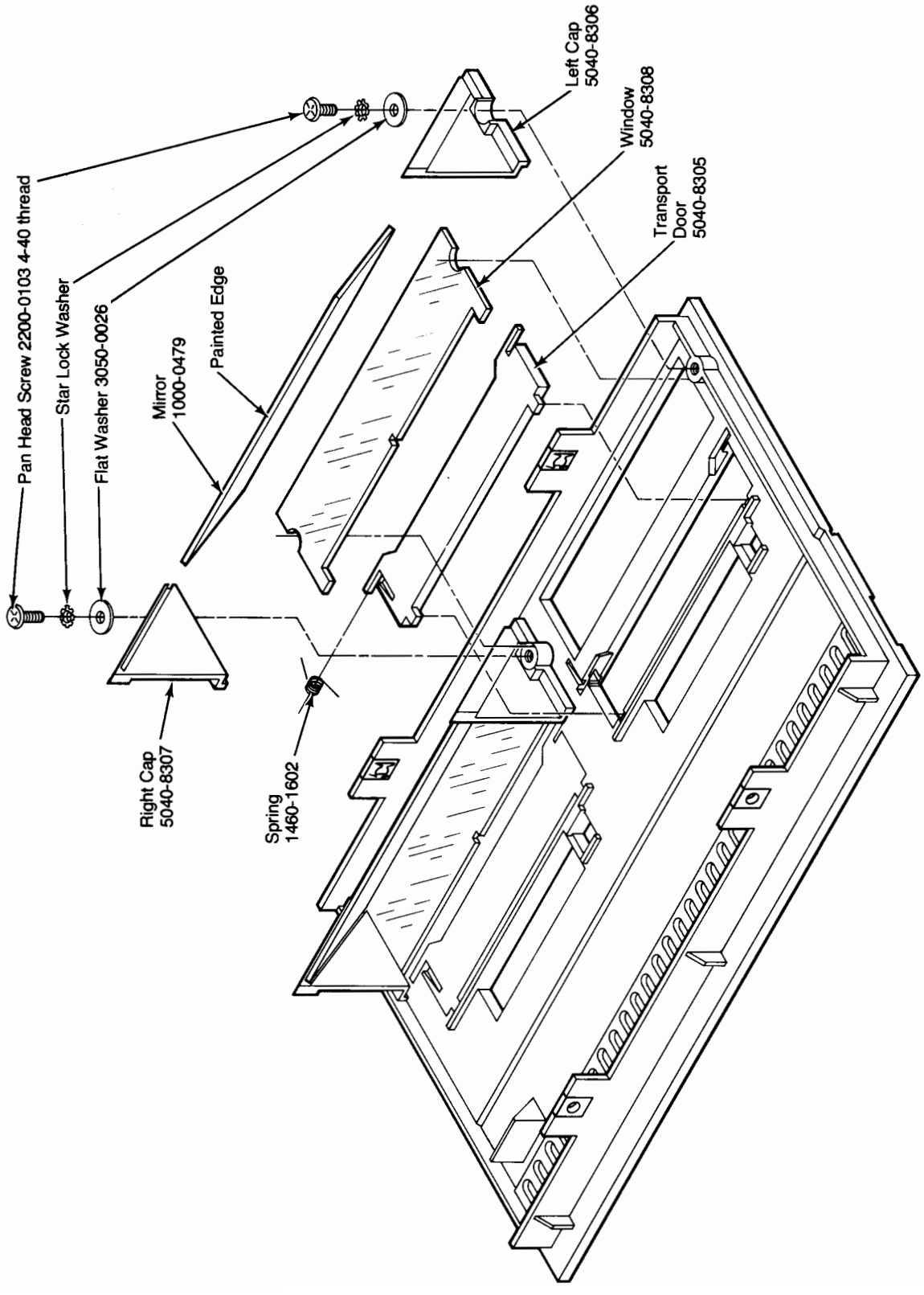


Figure 4-19: Front Panel Exploded View

Chapter 5
Replaceable Parts

Introduction

This chapter contains the 9875A replaceable parts list. Each part listed is given a level number in the first column. The levels indicate which items are a part of a particular sub-assembly and which sub-assemblies are part of major assemblies.

A "1" level item is a major assembly. The major assembly may have sub-assemblies and other parts listed as "2" and "3" levels after the "1" level part number. This gives you a choice as to which level of assembly you wish to order and also tells you what you get with a major assembly. Remember, all parts listed after a "1" level are associated with that "1" level part until the next "1" level part appears. The "2" and "3" level parts are similarly referenced.

An * by a part-number indicates that hardware is required for the installation of that part. The hardware required can be found at the end of the assembly's parts list.

The total quantity of a part is listed only the first time it is used on a particular assembly. The electrical/electronic components on a particular pc assembly are listed in the order of their component designators.

The component locators and schematics for the 9875A can be found in the schematic packet (HP P/N 09875-90035).

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
1					**Frame Assembly**
1		0340-0566		2	Transistor Insulator
1		0370-2580		1	Power Key
1		0400-0193		4	Shock Grommet
1		0515-0008		2	Machine Screw
1		0624-0405		2	Tapping Screw
1		09845-24701		2	Spacer 3.81 mm (.15 in. long)
2		7205-0006		1	Aluminum Round 11.13 mm (.483 in. dia.)
1		09845-24702		2	Spacer 16.51 mm (.65 in long)
2		7205-0006		1	Aluminum Round 11.13 mm (.438 in. dia.)
1		09875-00602		1	Switch Shield
2		4114-0399		1	Plastic Sheet 1.02 mm (.04 in. thick)
1		*09875-01201		1	Transport Bracket
2		7204-0005		1	Aluminum Sheet 1.60 mm (.063 in. thick)
1		09875-01205		1	Stiffener
2		7204-0098		1	Aluminum Sheet 2.03 mm (.08 in thick)
1		*09875-01206		1	Switch Bracket
2		7204-0016		1	Aluminum Sheet 1.27 mm (.05 in. thick)
1		*09875-01210		1	Side Bracket
2		09875-01209		1	C-F Bracket
3		7204-0005		1	Aluminum Sheet 1.60 mm (.063 in thick)
2		1200-0168		2	Transistor Socket
2		1530-1098		4	Fastener
2		7204-0005		1	Aluminum Sheet 1.60 mm (.063 in. thick)
1		09875-61601		1	Read/Write Cable
2		1251-2867		2	Keyed Connector
2		1251-4030		2	PC Edge Connector
2		8120-1779		1	Unshielded Cable 28AWG
1		*09875-61605		1	Motor Drive Cable
2		1251-0627		1	Keyed Connector
2		1251-4358		1	7 Pin Connector F
1		*09875-61606		1	Power Switch Assembly
2		0890-0101		1	Tubing .06 m (.197 ft. length)
2		1251-4823		4	Crimp-on Contact
2		3101-2216		1	Power Switch
					Hardware Required For 09875-01201
		0380-0741		4	Standoff 6-32 thread 4.75 mm (.187 in. length)
		0510-0002		8	Fastener 6-32 thread
		0510-0004		4	Fastener 8-32 thread
					Hardware Required For 09875-01210
		0510-0001		2	Fastener 6-32 thread
					Hardware Required For 09875-01210
		0361-0015		1	
		0361-0230		2	
		0361-0235		4	
		0361-0245		4	
		0510-0002		4	Fastener 6-32 thread
					Hardware Required For 09875-61605
		1251-3073		6	
		1400-0249		3	
		8150-0007		1	.22 m (.738 feet)
		8150-0022		1	.22 m (.738 feet)
		8150-0027		1	.21 m (.705 feet)
		8150-0033		1	.43 m (1.411 feet)
		8150-0038		1	.21 m (.705 feet)

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
					Hardware Required For 09875-61606
		0890-0765		1	.06 m (.197 feet)
		8150-0027		1	.43 m (.41 feet)
		8150-0144		1	.47 m(.541 feet)
		8150-0159		1	.47 m (.541 feet)
		8150-0164		1	.43 m (.41 feet)
					Tape Control and Power Board
1	A-10	09875-66510		1	PC Assembly Tape Control and Power Board
2	C1	0160-3847		17	C-F: .01uF 50V
2	C2	0160-0127		3	C-F: 1uF 25V
2	C3,C4	0160-3847			C-F: .01uF 50V
2	C5	0160-0205		1	C-F: 10pF 500V
2	C6 thru C9	0160-3847			C-F: .01uF 50V
2	C10,C11	0140-0200		2	C-F: 390pF 300V
2	C12	0140-0190		1	C-F: 39pF 300V
2	C13	0160-0576		8	C-F: .1uF 50V
2	C14	0160-3847			C-F: .01uF 50V
2	C15	0180-1746		1	C-F: 15uF 20V
2	C16	0160-0170		3	C-F: .22uF 25V
2	C17	0160-0174		1	C-F: .47uF 50V
2	C18	0160-3847			C-F: .01uF 50V
2	C19	0180-0578		1	C-F: 750uF 40V
2	C20,C21	0160-3847			C-F: .01uF 50V
2	C22	0160-0576			C-F: .1uF 50V
2	C23	0160-3847			C-F: .01uF 50V
2	C24	0160-0128		3	C-F: 2.2uF 50V
2	C25	0160-0576			C-F: .1uF 50V
2	C26	0160-0128			C-F: 2.2uF 50V
2	C27	0160-0576			C-F: .1uF 50V
2	C28	0160-0128			C-F: 2.2uF 50V
2	C29	0160-0576			C-F: .1uF 50V
2	C30	0160-0363		2	C-F: 620pF 300V
2	C31,C32	0160-0170			C-F: .22uF 25V
2	C33	0160-0363			C-F: 620pF 300V
2	C34,C35	0160-3847			C-F: .01uF 50V
2	C36	0180-0291		2	C-F: 1uF 35V
2	C37,C38	0160-3847			C-F: .01uF 50V
2	C39	0180-0291			C-F: 1uF 35V
2	C40	0180-0197		2	C-F: 2.2uF 20V
2	C41	0160-0938		1	C-F: 1000pF 100V
2	C42	0180-0197			C-F: 2.2uF 20V
2	C43	0180-0376		1	C-F: .47uF 35V
2	C44	0160-0576			C-F: .1uF 50V
2	C45	0160-3879		1	C-F: .01uF 100V
2	C47	0160-0128			C-F: 2.2uF 50V
2	C48	0180-1861		1	C-F: 27uF 10v
2	C49	0180-2392		1	C-F: 5500uF 30V
2	C50	0180-2523		1	C-F: 6600uF 30V
2	C51	0160-0576			C-F: .1uF 50V
2	CR1,CR2	1901-0040		9	DIO: Si .05A 30V
2	CR3	1910-0016		1	DIO: GE60V
2	CR4	1902-0041		2	DIO: Breakdown 5.11V
2	CR5	1901-0028		5	DIO: Si .75A 400V
2	CR6	1902-3205		1	DIO: Breakdown 15V
2	CR7 thru CR10	1901-0040			DIO: Si .05A 30V
2	CR11,CR12	1902-3036		2	DIO: Breakdown 3.16V
2	CR13 thru CR16	1901-0673		4	DIO: Power Rectifier
2	CR17 thru CR24	1901-0662		8	DIO: Power Rectifer
2	CR25	1902-3107		1	DIO: Zener 5.76V

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
2	CR26,CR27	1901-0040			DIO: Si .05A 30V
2	CR28	1902-0041			DIO: Breakdown 5.11V
2	CR29	1901-0040			DIO: Si .05A 30V
2	CR30	1902-3190		1	DIO: Breakdown 13V
2	CR31 thru CR34	1901-0028			DIO: Si .75A 400V
2	CR35	1901-0364		1	DIO: Assembly Si
2	F1,F2	2110-0002		2	Fuse: 2.0 A NB
2	L1	9140-0210		1	L-F: 100uH
2	Q1	1855-0082		2	Pchan JFET: SS3723
2	Q2	1853-0234		1	Transistor: PNP Si
2	Q3,Q4	1854-0558		4	Transistor: NPN Si Darlington
2	Q5	1853-0089		1	Transistor: 2N4917
2	Q6	1855-0082			Pchan JFET: SS3723
2	Q7,Q8	1854-0558			Transistor: NPN Si Darlington
2	Q9,Q10	1854-0215		2	Transistor: 2N3904
2	Q11	1854-0071		2	Transistor: NPN SPS5103
2	Q12	1854-0094		1	Transistor: 2N3646
2	Q13	1854-0071			Transistor: NPN SPS5103
2	R1,R2	0698-5842		2	R-F: 16 .05
2	R3,R4	0683-1035		9	R-F: 10K .05 ¼W
2	R5	0683-1025		14	R-F: 1K .05
2	R6,R7	0757-0283		4	R-F: 2K .01
2	R8,R9	0683-3045		2	R-F: 300K .05 ¼
2	R10	0757-0453		3	R-F: 30.1K .01
2	R11	0683-1035			R-F: 10K .05 ¼w
2	R12	0757-0453			R-F: 30.1K .01
2	R13	0698-3492		1	R-F: 2.67K .01
2	R14	0683-1025			R-F: 1K .05
2	R15	0683-1035			R-F: 10K .05 ¼w
2	R16	0683-1025			R-F: 1K .05
2	R17	0683-1045		3	R-F: 100K .05 ¼w
2	R18,R19	0757-0283			R-F: 2K .01
2	R20	0757-0453			R-F: 30.1K .01
2	R21 thru R24	0683-1025			R-F: 1K .05
2	R25	0683-3315		1	R-F: 330 .05
2	R26,R27	0698-4435		2	R-F: 2.49K .01
2	R28	0683-2725		3	R-F: 2.7K .05
2	R29	0757-0424		1	R-F: 1.1K .01
2	R30	0683-1025			R-F: 1K .05
2	R31,R32	0683-3325		5	R-F: 3.3K .05
2	R33	0683-1225		1	R-F: 1.2K.05
2	R34	0683-2435		1	R-F: 24K .05 ¼w
2	R35,R36	0683-3615		2	R-F: 360 .05
2	R37	0698-0064		1	R-F: 9.31K .01
2	R38	0683-1045			R-F: 100K .05 ¼w
2	R39	0757-0439		1	R-F: 6.81K .01
2	R40	0683-6225		2	R-F: 6.2K .05
2	R41	0683-3625		1	R-F: 3.6K .05
2	R42	0811-1553		4	RES: .68 .05 2w
2	R43 thru R45	0683-8215		6	R-F: 820 .05
2	R46	0811-1553			RES: .68 .05
2	R47	0757-1094		1	R-F: 1.47K .01
2	R48	0757-0444		1	R-F: 12.1K .01

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
2	R49	0698-3152		1	R-F: 3.48K .01
2	R50,R51	0683-5615		4	R-F: 560 .05
2	R52	0683-8215			R-F: 820 .05
2	R53,R54	0683-5615			R-F: 560 .05
2	R55,R56	0683-8215			R-F: 820 .05
2	R57,R58	0683-1025			R-F: 1K .05
2	R59,R60	0683-1825		6	R-F: 1.8K .05
2	R61	0683-1245		2	R-F: 120K .05
2	R62	0683-4715		3	R-F: 470 .05
2	R63	0683-1825			R-F: 1.8K .05
2	R64	0683-4715			R-F: 470 .05
2	R65	0683-1825			R-F: 1.8K .05
2	R66	0683-1245			R-F: 120K .05
2	R67	0683-1825			R-F: 1.8K .05
2	R68	0683-1025			R-F: 1K .05
2	R69	0683-1825			R-F: 1.8K .05
2	R70	0683-1025			R-F: 1K .05
2	R71,R72	0683-1035			R-F: 10K .05 ¼w
2	R73	0683-4715			R-F: 470 .05
2	R74	0683-1025			R-F: 1K .05
2	R75	0683-6225			R-F: 6.2K .05
2	R76	0686-1615		1	R-F: 160 .05
2	R77 thru R79	0683-1035			R-F: 10K .05 ¼w
2	R80	0683-2225		1	R-F: 2.2K .05
2	R81	0683-1555		1	R-F: 1.5M .05 ¼w
2	R82	0683-6245		1	R-F: 620K .05
2	R83,R84	0683-3325			R-F: 3.3K .05
2	R85,R86	0683-4725		2	R-F: 4.7K .05
2	R87	0683-1045			R-F: 100K .05 ¼w
2	R88	0683-3325			R-F: 3.3K .05
2	R89	0683-1025			R-F: 1K .05
2	R90,R91	0811-1553			RES: .68 .05 2w
2	R92	0689-3315		1	R-F: 330 .05
2	RP1,RP2	1810-0126		2	RES: DIP Network
2	RP3,RP4	1810-0055		2	RES: Network
2	R97			1	R-F: 2K
2	R98	0683-2025			RF: 2K .05
2	T1	0837-0050		1	Thermistor: 1K .1
2	U1	1820-1288		1	IC: MMH0026CL
2	U2	1826-0139		2	OpAmp: MC1458P1
2	U3	1820-0981		1	IC: DGTL 4016
2	U4	1820-0471		1	IC: SN7406N
2	U5	1826-0065		3	IC: SGTL LM311N
2	U6	1826-0174		1	Comparator: MC3302P
2	U7	1826-0139			OpAmp: MC1458P1
2	U8	1826-0188		1	D-A Convertor: MC1408L-8
2	U9	1820-0174		1	IC: SN7404
2	U10	1820-1204		1	IC: SN74LS20N
2	U11	1820-1272		1	IC: SN74LS33N
2	U12	1820-0054		1	IC: SN7400
2	U13,U14	1826-0065			IC: SGTL LM311N
2	U15	1820-0281		1	IC: SN74107N
2	U16,U17	1820-1470		2	IC: SN74LS157
2	U18	1826-0478		1	IC: LM7906T
2	U19	1820-0269		1	IC: SN7403
2	U20	1820-0514		1	IC: SN7426N
2	U21	1826-0180		1	IC: 555
2	U22	5061-3012		1	IC: Tape Control Chip

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
2	Y1	0410-0443		1	Crystal: 8MHz
2		09875-61603		1	Cable: A10-A15
2		1200-0770		1	Crystal Socket
2		1205-0349		1	Heat Sink
2		1251-2501		14	Connector,Single Cont
2		1251-4882		2	Connector 09-65-1071
2		09845-67904		1	Gasket Assembly Connector
2		*2110-0269		4	Fuse Clip
2		98032-01301		4	Jumper
2		0360-0679		4	PC Board Stud
					Hardware Required For 2110-0269
		1400-0778		1	
		2190-003		6	Split Lock Washer
		2190-0011		4	Star Lock Washer
		2200-0141		2	Pan Head Screws 4-40
		2260-0001		6	Nut 4-40 thread
		2680-0128		4	Screw 10-32 thread
					Regulator Board
1	A-11	09875-66511		1	PC Assembly Regulator Board
2	C1	0180-0291		3	C-F: 1uF 35V
2	C2	0180-1743		3	C-F: .1uF 35V
2	C3	0180-0291			C-F: 1uF 35V
2	C4	0180-0376		1	C-F: .47uF 35V
2	C5	0180-1743			C-F: .1uF 35V
2	C6	0180-0291			C-F: 1uF 35V
2	C7	0180-1846		1	C-F: 2.2uF 35V
2	C8	0180-0376			C-F: .1uF 35V
2	R1	0683-1625		1	R-F: 1.6K .05
2	U1	1826-0181		1	Voltage Regulator LM323K
2	U2	*1826-0423		1	IC: LM317K
2	U3	1826-0123		1	Voltage Regulator LM320K-12
2	U4	1826-0117		1	IC: Linear
2		*09875-01101		1	Heat Sink
3		0380-0164		2	Standoff
3		7204-0098		1	Sht Al 2.03 mm thick (.08in)
					Hardware Required For1826-0423
		0360-0016		1	
		2360-0119		8	Pan Head Screw 6-32 thread 11.3 mm (.438 in. length)
		8150-2167		1	.17 m (.55 ft.)
					Hardware Required For 09875-01101
		0360-1610		1	
		0361-0229		1	
		0380-0111		2	Standoff 6-32 thread 6.35 mm (.25 in. length)
		0510-0002		6	Fastener 6-32 thread
2		0340-0503		4	Transistor Insulator
2		0340-0583		4	Transistor Mounting Insulator
2		0590-0970		8	Retained Nut 6-32 thread
					Processor Board
1	A-15	09875-66515		1	PC Assembly Processor Board
2	C1 thru C3	0180-0374		3	C-F: 10uF 20V
2	C4	0160-0170		1	C-F: .22uF 25V
2	C5 thru C10	0160-0576		15	C-F: .1uF 50V 20%
2	C11	0160-3847		15	C-F: .01uF 50V

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
2	C12 thru C19	0160-0576			C-F: .1uF 50V 20%
2	C20	0160-3847			C-F: .01uF 50V
2	C21	0160-0576			C-F: .1uF 50V 20%
2	C22 thru C32	0160-3847			C-F: .01uF 50V
2	C33	0160-3878		1	C-F: 1000pF .20
2	C34,C35	0160-3847			C-F: .01uF 50V
2	R1	0683-2225		1	R-F: 2.2K .05
2	R2	0683-1335		1	R-F: 13K .05 ¼w
2	R3	0683-1035		7	R-F: 10K .05 ¼w
2	R4	0683-4725		1	R-F: 4.7K .05
2	R5 thru R10	0683-1035			R-F: 10K .05 ¼w
2	RP1	1810-0041		1	Resistor Network
2	RP2	1810-0080		1	Resistor Network
2	RP3	1810-0055		1	Resistor Network SIP
2	U1	1820-1972		2	IC: MC3448
2	U2	1820-1584		2	IC: Binary Buffer
2	U3	1818-2500		1	IC: Binary Processor Chip
2	U4	1820-1972			IC: MC3448
2	U5	1820-1584			IC: Binary Buffer
2	U6	1820-1972			IC: MC3448
2	U7	1AA7-6001		1	IC: Interface Control Chip
2	U8	1820-1491		3	IC: SN74LS367N
2	U9	1820-1204		1	IC: SN74LS20N
2	U10	1818-2814		1	IC: ROM 64K
2	U11,U12	1818-0140		8	IC: RAM(256*4)
2	U13	1820-1199		2	IC: TTL INV 74LS04N
2	U14	1820-1202		2	IC: 74LS10N
2	U15	1820-1416		1	IC: TTL 74LS14
2	U16	1820-1972			IC: MC3448
2	U17,U18	1818-0140			IC: RAM(256*4)
2	U19	1820-1202			IC: 74LS10N
2	U20	1820-1197		2	IC: 74LS00N
2	U21	1820-1144		2	IC: SN74LS02N
2	U22	1820-2108		1	IC: Signetics 8T31
2	U23,U24	1818-0140			IC: RAM (256*4)
2	U25	1820-1196		2	IC: SN74LS174N
2	U26,U27	1820-1112		6	IC: 74LS74
2	U28	1820-1492		2	IC: SN74LS368N
2	U29	1820-2077		1	IC: Intel 8212
2	U30,U31	1818-0140			IC: RAM(256*4)
2	U32	1820-1196			IC: SN74LS174N
2	U33	1820-1212		4	IC: SN74LS112N
2	U34	1820-1144			IC: 74LS02N
2	U35	1820-1491			IC: SN74LS367N
2	U36	1820-1112			IC: 74LS74
2	U37	1820-1492			IC: SN74LS368N
2	U38	1820-1199			IC: 74LS04N
2	U39	1820-1212			IC: SN74LS112N
2	U40,U41	1820-1112			IC: 74LS74
2	U42	1820-1216		1	IC: SN74LS138
2	U43	1820-2121		1	IC: SN74LS348
2	U44	1820-1203		1	IC: SN74LS11N
2	U45	1820-1491			IC: SN74LS367N
2	U46	1820-1198		1	IC: 74LS175

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
2	U47	1820-1197			IC: 74LS00N
2	U48	1820-1212			IC: SN74LS112N
2	U49	1820-1198		1	IC: SN74LS03N
2	U50	1820-1112			IC: 74LS74
2	U51	1820-1212			IC: SN74LS112N
2		1251-3090		1	Connector 50 pin M
2		1251-3379		1	Connector 25 pin
2		98032-01301		3	Jumper
2		1251-3025		1	Header
2		1200-0650		1	Interface Control Chip Socket
2		1200-0651		1	Socket Lid
2		T-29078		1	Heat Sink
					Select Code Switchboard
1	A-40	*09875-66540		1	PC Assembly Select Code Switchboard
2	S1	3101-2162		1	Switch
2		09875-61604		1	I/O Cable
3	C1	0160-0574		1	C-F: .022uF
3		1251-4040		1	Connector: 24 pin F
2		*09875-04101		1	I/O Plate
3		7204-0005		1	Sheet Alum. 1.60 mm thick (.063 in.)
2		0380-0643		1	Stud Mounting Standoff
					Hardware Required For 09875-66540
		0510-0137		2	Fastener 4-40 thread
					Hardware Required For 09875-04101
		0380-0342		2	Standoff 6.35 mm (.125 in. length)
					Voltage Switchboard
2	A-50	09875-66550		1	PC Assembly Voltage Switchboard
3		1251-5153		11	Terminals
3		*3101-2042		2	Slide Switch
2		2110-0007		1	Fuse: 1A 250V
2		2110-0543		1	Fuse Holder
2		2110-0545		1	Fuse Holder-Cap
2		5040-8304		1	Fan Shroud
2		*9135-0038		1	Line Filter
					Hardware Required For 3101-2042
		8150-0144		1	.09 m (.295 ft.)
		8150-0159		1	.08 m (.262 ft.)
					Hardware Required For 9135-0038
		0360-0016		1	
		2190-0003		4	Lock Washer
		2190-0005		2	Star Lock Washer
		2200-0103		3	Pan Head Screws 4-40 thread 6.35 mm (.25 in. length)
		2260-0001		8	Nut 4-40 thread
		3050-0716		4	Flat Washer 3.25 mm (.128 in. id)
		8150-1273		1	.06 m(.197 ft.)
		8150-2167		1	.07 m (.230 ft.)
					Transformer Assembly
1		09875-67903		1	Transformer Assembly
2		*9100-4072		1	Power Transformer
2		0390-0006		4	Nylon Spacer
2		0890-0101		1	Tubing .09 m (.295 ft.)
2		*09875-01204		1	Transformer Bracket

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
3		7204-0005		1	Sheet Alum. 1.60 mm thick (.063 in.)
2		09875-61602		1	Secondary Cable
3		1251-0627		1	PLZG Key-Connector
3		*1251-4358		1	Connector 7 pin F
2		1251-4823		5	Crimp-on Contact
2		*2510-0135		4	Machine Screw
					Hardware Required For 9100-4072
		0460-0042			
		8150-0005			
		8150-0017			
		8150-0297			
					Hardware Required For 09875-01204
		0360-1610		1	
		0361-0229		1	
		0510-0002		4	Fastener 6-32 thread
					Hardware Required For 1251-4358
		1251-0670		2	
		1251-3073		4	
		1400-0249		3	
		8150-0007		1	.48 m (1.575 ft.)
		8150-0038		1	.46 m (1.509 ft.)
		8150-0408		1	.44 m (1.444 ft.)
					Hardware Required For 2510-0135
		0390-0006		4	
		0890-0103		1	.15 m (.492 ft.)
		2580-0004		4	Nut 8-32 thread
		3050-0017		4	Flat Washer 6.60 mm (.26 in. id)
					Miscellaneous Kit
1		09875-8100		1	Standard Miscellaneous Kit
2		09875-87900		1	Miscellaneous Parts
3		9211-0046		1	Carton
3		2110-0007		1	Fuse: 1A 250V
3		2110-0202		2	Fuse: .5A SB
3				1	AC Power Cable (as required)
3		8120-1834		1	Piggyback Cable
3		8500-1251		1	Magnetic Tape Head Cleaner
3		9162-0061		1	Magnetic Tape Cartridge
3		09875-90000		1	Installation and Operating Manual
					Miscellaneous Kit Options
3		98135-90011		1	Operating Note (Option 015 only)
3		09825-90075		1	Operating Note (Option 025 only)
3		09831-90075		1	Programming Techniques (Option 031 only)
3		09845-90675		1	Programming Techniques (Option 045 only)
					Front Panel Assembly
1		09875-81001		1	Standard Front Panel Assembly
2		09875-67901		1	Front Panel Assembly
3		09875-64401		1	Front Panel
3		1000-0479		1	Mirror
3		*1460-1602		1	Spring
3		5040-8305		1	Transport Door
3		5040-8306		1	Left Cap
3		5040-8307		1	Right Cap
3		5040-8308		1	Window
3		5040-8345		1	Lens

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	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
					Hardware Required For 1460-1602
		0510-0162		4	Fastener 6-32 thread
		2200-0103		2	Pan Head Screw 4-40 thread 6.35 mm (.25 in. length)
		3050-0026		2	Flat Washer 3.18 mm (.125 in. id)
					Rear Panel Assembly
1		*09875-67902		1	Rear Panel Assembly
2		0890-0101		1	Tubing
2		09875-00201		1	Rear Panel
					Hardware Required For 09875-67902
		0510-0153		4	Fastener 6-32 thread
1		1853-0383		2	Transistor: Darlington 2N6296
1		2360-0322		2	Machine Screw
1		3140-0604		1	Fan Motor
1		3160-0307		1	Fan Blade
1		5001-0439		2	Side Trim
1		5020-8815		1	Front Frame
1		5020-8816		1	Rear Frame
1		5020-8835		4	Corner Strut
1		5040-7201		4	Foot
1		5040-7203		1	Top Trim
1		5040-8303		1	Switch Rod
1		5040-8320		1	Eject Button
1		5060-9829		1	Top Cover
1		5060-9841		1	Bottom Cover
1		*5060-9855		2	Cover
					Hardware Required For 5060-9855
		0360-0016		1	
		0361-1040		2	
		0400-0018		1	.05 m (.16 ft.)
		0510-0162		4	Fastener 6-32 thread
		0624-0045		4	Tapping Screw 6-20 thread 9.53 mm (.375 in. length)
		0624-0329		2	Tapping Screw 4-20 thread 19.05 mm (.75 in. length)
		0890-0765		1	.10 m (.33 ft.)
		2150-0192		14	
		2190-0010		2	Star Lock Washer 4.27 mm (.168 in. id)
		2190-0034		2	Split Lock Washer 4.93 mm (.194 in. id)
		2190-0824		2	Star Lock Washer 2.59 mm (.102 in. id)
		2200-0103		3	Pan Head Screw 4-40 thread
		2360-0113		10	Pan Head Screw 6-32 thread 6.35 mm (.25 in. length)
		2360-0115		20	Pan Head Screw 6-32 thread 7.92 mm (.312 in. length)
		2360-0322		6	Screw 6-32 thread 9.53 mm (.375 in. length)
		2510-0103		2	Pan Head Screw 8-32 thread
		2680-0099		2	
		3050-0026		6	Flat Washer 3.18 mm (.125 in. id)
		3050-0098		2	Flat Washer 2.39 mm (.094 in. id)
		8150-2167		1	.18 m (.58 ft.)

	REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION
					Option 001 Assembly
1		09875-80001		1	Option 001 Assembly
2		0400-0193		4	Shock Grommet
2		09845-24701		2	Spacer 3.81 mm (.15 in.)
3		7205-0006		1	Aluminum Round 11.13 mm dia. (.438 in.)
2		09845-24702		2	Spacer 16.51 mm (.65 in.)
3		7205-0006		1	Aluminum Round 11.13 mm dia. (.438 in.)
2		09875-61601		1	Read/Write Cable
3		1251-2867		2	PLZG Key Connector
3		1251-4030		2	PC Edge Connector
3		8120-1779		1	Unshielded Cable 28AWG .12 m (.4 ft.)
2		09875-67911		1	Front Panel Assembly (Dual Transport)
3		09875-64402		1	Front Panel (Dual Transport)
3		1000-0479		2	Mirror
3		*1460-1602		2	Spring
3		5040-8305		2	Transport Door
3		5040-8306		2	Left Cap
3		5040-8307		2	Right Cap
3		5040-8308		2	Window
3		5040-8345		2	Lens
3		5040-8320		2	Eject Button
					Hardware Required For 1460-1602
		2200-0101		3	Pan Head Screws 4-40 thread
		3050-0026		3	Flat Washer 3.18 mm (.125 in. id)
					Option 002 (Rack Mounting Adaption)
1		09875-80002		1	Rack Mounting Assembly
2		5061-0057		1	Rack Adapter Kit

Appendix A
Acronyms

The following Acronyms are used in this manual and on the schematic diagrams. A bar over the top of an Acronym indicates that the signal is valid at a negative true logic assertion level.

ADD 16 thru ADD 19	Addressing lines for the Processor ROM
ATC	Output from the Tach Comparator Circuit
$\overline{\text{ATN}}$	Attention line (IEEE 488-1975)
$\overline{\text{BD}}$	Bus Drive. Tape Control Chip driving the $\overline{\text{IDA}}$ bus
Bit 0 thru Bit 15	Output lines from the Processor Chip
CIN	Cartridge in transport
CLK	Clock Signal (4 MHz 5V sq. wave or 12V sq. wave)
DA0 thru DA4	D/A convertor input lines for Servo Control Section
$\overline{\text{DAV}}$	Data Valid line (IEEE 488-1975)
$\overline{\text{DC}}$	Device Clear
DEV Add 1 thru DEV Add 5	Select Code address for the CTU
$\overline{\text{DIO1}}$ thru $\overline{\text{DIO8}}$	Data Input/Output Lines 1 thru 8 (IEEE 488-1975)
$\overline{\text{DOUT}}$	Data Out. Directional indicator for Tape Control Chip
DRIVO	Drive 0 selected
$\overline{\text{DRIV1}}$	Drive 1 selected
$\overline{\text{EOI}}$	End of Instruction (IEEE 488-1975)
$\overline{\text{ESTS}}$	Emergency Stop for over-current or over-voltage
FF	Frequency Feedback. Tach pulse input to the Tape Control Chip
$\overline{\text{FLG}}$	Flag line for the Tape Control Chip
FLSH	Flash panel lamp signal

FR	Flux Reversal detected by the Read head
FST	Fast. Sets a high threshold for FR detection at high speed
FWD	Forward. Direction of the drive motor
$\overline{\text{FWD}}$	Reverse. Direction of the drive motor
GND	Ground
GO	Go signal to enable tape drive motor to operate
HOL	Hole. Hole encountered on the tape
$\overline{\text{IC1}}$	Internal register address for Tape Control Chip
$\overline{\text{IC2}}$	Internal register address for Tape Control Chip
IDA 0 thru IDA 15	Instructions, Data and Address bus lines (MOS)
$\overline{\text{IDA 0}}$ thru $\overline{\text{IDA 15}}$	Instructions, Data and Address bus lines (TTL)
$\overline{\text{IFC}}$	Interface Clear (IEEE 488-1975)
$\overline{\text{INIT}}$	Initializes the Tape Control Chip until power supplies are valid
$\overline{\text{INT}}$	Interrupt poll in progress
$\overline{\text{IOD 0}}$ thru $\overline{\text{IOD 15}}$	Data from the Tape Control Chip onto the $\overline{\text{IDA}}$ bus
$\overline{\text{ISOB}}$	Input/Output Strobe. Tape Control Chip latches data on rising edge
$\overline{\text{IR}}$	Interrupt Requested of the Processor Chip
$\overline{\text{IRHEN}}$	High Priority Interrupt
$\overline{\text{IRLEN}}$	Low Priority Interrupt
$\overline{\text{LTCH}}$	Latch. Latches $\overline{\text{PA0}}$ thru $\overline{\text{PA3}}$ and $\overline{\text{IC1}}$, $\overline{\text{IC2}}$
LTN Only	Listen Only mode of operation
MOD	Mode. Sets threshold level
MTH 0	Motor high, drive 0
MTH 1	Motor high, drive 1
MTL 0	Motor low, drive 0
MTL 1	Motor low, drive 1
MVG 0	Moving drive 0
MVG 1	Moving drive 1
$\overline{\text{NDAC}}$	Not Data Accepted (IEEE 488-1975)
$\overline{\text{NRFD}}$	Not Ready for Data (IEEE 488-1975)

ODD	Output Data Drive. ROM is driving the IDA bus
$\overline{\text{OTEMP}}$	Internal CTU temperature exceeds 40° C
$\overline{\text{PA 0}}$ thru $\overline{\text{PA 3}}$	Peripheral Addresses 0 thru 3. Tape Control Chip is addressed when all are low
$\overline{\text{PACK}}$	Poll Acknowledge from the Tape Control Chip
$\overline{\text{PDR}}$	Processor driving the $\overline{\text{IDA}}$ bus
$\overline{\text{POP}}$	Power on Preset. Initializes the CTU
PVAL	Power supplies valid
RAL	Register Address Line. High when going to/from a register
RAW	Unregulated voltage (+18 VDC)
$\overline{\text{REN}}$	Remote Enable (IEEE 488-1975)
RESP to $\overline{\text{PPOLL}}$	Response to Parallel Poll
$\overline{\text{RH}}$	Receive Handshake. Data valid in Interface Control Chip
RR	Receive Ready. Data being sent to Register 12
SIGN	Sign of error voltage given to motor control circuitry
$\overline{\text{SLOB}}$	Secondary Listen on bus
$\overline{\text{SMC}}$	Synchronous Memory Complete. Device has received data
$\overline{\text{SRQ}}$	Service Request (IEEE 488-1975)
$\overline{\text{STM}}$	Start Memory Cycle
$\overline{\text{STOB}}$	Secondary Talk on bus
$\overline{\text{STS}}$	Status
$\overline{\text{STSEN}}$	Status Enable
SYNC	Synchronization line
Talk Only	CTU is in the Talk Only mode
TE 1	Transmit Enable 1. Transmit code for Interface Control Chip
TE 2	Transmit Enable 2. Transmit code for Interface Control Chip
$\overline{\text{TH}}$	Transmit Handshake. Data sent to Interface Control Chip
THR	Threshold signal
TKB	Track B selected on tape

TR	Transmit Ready. Data valid to Interface Control Chip
TRB	Track B selected on the R/W head
$\overline{\text{UMC}}$	Unsynchronous Memory Complete
VBG	Backgate Voltage (−5V)
WDT	Write Data. Selects direction of current flow through R/W head
WPR	Write Protected Cartridge in transport
WRT	Write Enable. Sends write current to the R/W head
ZCD	Zero Crossing Detected
01,02	12V clock pulse for Processor Chip and Tape Control Chip
01*,02*	5V clock pulse for TTL components

The following Acronyms also appear on the schematic diagrams. They were used during development of the CTU with special purpose test equipment.

$\overline{\text{BG}}$	Bus Grant
$\overline{\text{BR}}$	Bus Request
$\overline{\text{EBG}}$	Extended Bus Grant
$\overline{\text{ERA}}$	Extended Register Address
$\overline{\text{MBC}}$	Monitor Bus Control
$\overline{\text{MSTM}}$	Monitor $\overline{\text{STM}}$
$\overline{\text{RESET}}$	Reset

Appendix B
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