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9885
FLEXIBLE DISK DRIVE

SERVICE MANUAL

-hp- Part No. 09885-90030
SEPT. 1976

Hewlett-Packard Calculator Products Division
P.O. Box 301, Loveland, Colorado 80537, Tel. (303) 667-5000

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Specifications

Capacity Per Disk

4,116,480 bits
514,560 – 8 bit bytes
2010 records (1 record = 256 bytes)
30 records per track
67 tracks

Rotation Speed

360 RPM

Disk Times

Head Load	40 ms
Step	8 ms/step + 8 ms settling
Latency	166.7 ms max – 83.3 ms average
Random Access	790 ms max – 297 ms average
Sequential Access	177.1 ms max – 93.7 ms average
Average Access Time	267 ms
Transfer Time	11.1 ms per record
Transfer Rate	23000 bytes/second

Command Times

The time to execute a read or write command is dependent upon the disk access time, since the time to set up the transfer is small (<200μs).

Status Command	100μs
Initialization	2 minutes
Random Read/Write (1 record)	803 ms max – 310 ms average
Sequential Read/Write (N records)	790 × N ms max – 297 × N ms ave

Line Frequency – 60 or 50 Hz ±3.5%

Power Consumption (max):

	9885M	9885S
100V	2.0A	1.8A
120V	1.6A	1.5A
220V	890 mA	820 mA
240V	800 mA	730 mA
	160 W	130 W

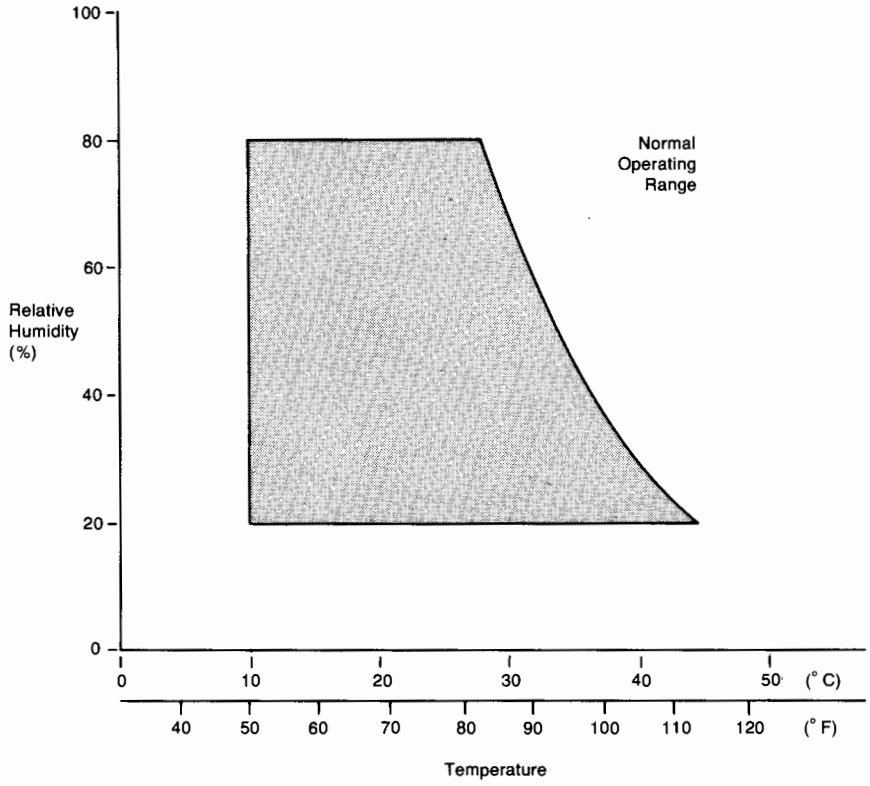
Dimensions:

Height: 133,3 mm (5.25 in.)
Width: 425,4 mm (16.75 in.)
Depth: 425,4 mm (16.75 in.)

Weight:

Net: 14,75 kg (32.5 lb)
Shipping: 21,14 kg (46.6 lb)

Temperature/Humidity Operating Range



Chapter 1
General Information

Introduction

This manual provides installation and maintenance information for the 9885 M or S Flexible Disk Drive. The various chapters in this manual include:

- General Information
- Theory of Operation
- Maintenance
- Troubleshooting
- Replaceable Parts

The 9885 can be controlled by a calculator or other mainframe. Sections of this manual specifically cover a 9825A/9885 system. These sections are identified by their title specifying 9825A/9885 information. If the 9885 is to be connected to another system, see the appropriate supplement or manual provided with your system mainframe for specific information on using the 9885 with that mainframe.

If you are not familiar with the flexible disk drive terminology, refer to the glossary in Appendix A. This chapter includes 9885 installation information.

Description

The 9885 Flexible Disk Drive provides mass storage capability by writing on and reading data from a flexible disk. One disk is used in each drive and only one side of the disk is used for data storage. The disks are interchangeable with other 9885 drives. An internal drive controller controls the read/write head positioning and the transfer of data to and from the disk.

Any particular disk system can consist of one or more drives. In multiple drive systems one drive contains a controller and is the master drive. Each master can control up to 3 other drives. Drives in the system controlled by the master do not contain the controller circuits. Each drive has its own internal power supply.

Service Kit

The 98015A Service Kit contains the electronic assemblies and mechanical parts necessary to service the 9885M/S. Included in the kit are the 9885M-9825A interface cable (P/N 98032-67913) and the 9885M-9885S interface cable (P/N 09885-61607). The 98015A Service Kit is not a functional flexible disk drive. All service kits will be shipped in a carrying case.

The kit contents are listed below:

Table 1-1. 98015A Service Kit

Green Stripe Assemblies:

Reference Designator	Description	New HP Part Number	Rebuilt HP Part Number	Quantity
A1	Power Supply	09885-66501	09885-69501	1
A2	Bit/Byte Assembly	09885-66502	09885-69502	1
A3	I/O Processor Assembly	09885-66503	09885-69503	1
A4	Data Electronics Assembly	09885-66504	09885-69504	1
A5	Drive Electronics Assembly	09885-66505	09885-69505	1
	Flexible Disk ROM	98217-67901	98217-69901	1

Other electronic assemblies:

Description	HP Part Number	Quantity
Motherboard	09885-66500	1
Track 0 Detector	0955-0088	1
Head Load Actuator	1150-1311	1
Carriage Assembly	1150-1315	1
Write Protect Detector	1150-1309	1
LED Assembly	1150-1313	1
Phototransistor Assembly	1150-1316	1

Miscellaneous parts and tools:

Description	HP Part Number	Quantity
Load Button	1535-3648	4
Alignment Disk	1150-1314	1
Cartridge Guide Adj. Tool	1150-1310	1
Load Bail Gauge	1150-1312	1
Disk Service Fixture (DSF)	98015-66501	1
Rear Housing and Cable Assembly	98032-67913	1
Carrying Case	98015-64501	1
Plastic Box	1540-0015	1
Disk System Cartridge	09885-90035	1
Initialized Disk	09885-90045	2
Green Stripe Box for A1	9211-2034	1
Green Stripe Box for A5	9211-2032	1
Green Stripe Box for A2–A4	9211-2036	3
Service Manual	09885-90030	1
Slave Interface Cable	09885-61607	1
Alignment Clamp	8170-1120	1

Extra disks for the 9885M/S are available in packs of 5 disks (P/N 09885-80004).

Options

The following options are available for the 9885 M and S.

Option 001 for 50Hz Operation

This option is installed at the factory. It enables the drive to operate properly on a 50Hz line frequency.

Option 002 Rack Mount Kit

This option allows you to mount your drive in a standard 19-inch rack mount cabinet. This option is usually installed at the factory, however a rack mount field installation kit (98024F) is available.

The rack mount brackets are not able to support the entire weight of the 9885. A shelf or other support should be provided by the equipment rack or cabinet to support the weight.

Installation Procedure

1. Replace the standard side panels with those supplied in the rack mount kit (refer to the figure below).
2. Install the rack mount brackets with the screws provided in the kit.

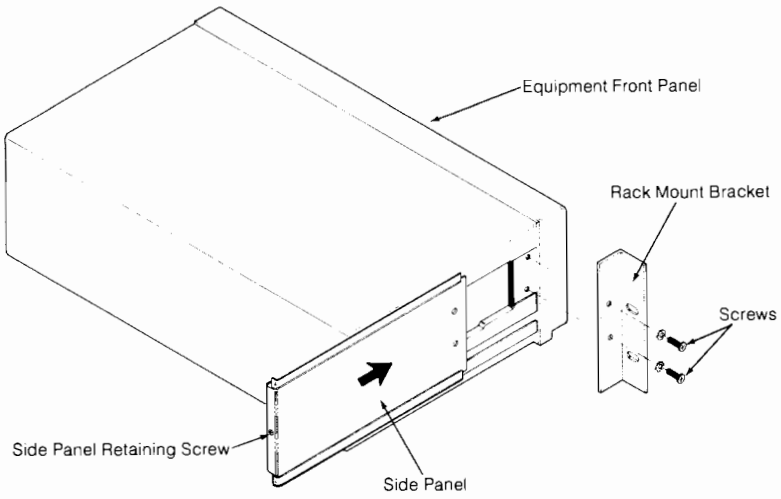


Figure 1-0. Rack Mount Installation

9825A/9885 Equipment Supplied

Table 1-2 lists the equipment supplied with the 9885M and 9885S drives (option 025) that will be used in a 9825A/9885 system. Equipment supplied with the drives for other systems should be listed in the appropriate manual for that system.

Table 1-2. 9825A/9885 Equipment Supplied

HP Part Number	Description	Quantity 9885M	9885S
98217A	Disk ROM	1	
2110-0381	Spare Fuses (3 amp SB)	2	2
2110-0544	Fuse Cap	1	1
8120-1378	Power Cord (standard USA)	1	1
09825-90010	Quick Reference Guide	2	0
09885-61607	Slave Cable		1
98032-61601	Option 085 Interface	1	
09885-87900	One Inch Notebook (includes the following)	1	1
7120-5160	Drive # Decals (0–3)	1 Pkg	1 Pkg
7120-5161	Select Code Labels (8–15)	1 Pkg	1 Pkg
7120-5255	Disk Labels	1 Pkg	1 Pkg
7120-5388	Sheet of Write Protect Tabs	1	1
9164-0074	Blank Flexible Disk	1	1
09885-90000	Disk Programming Manual	1	0
09885-90020	Disk Care Note	1	0
09885-90035	Disk System Cartridge	1	0
09885-90045	Initialized Flexible Disk	1	1

Installation

There are two versions of the 9885. The 9885M is the master drive, which contains the controller circuits. The master controls the drive in single drive systems and up to three slave drives in multiple drive systems.

The 9885S is a slave drive used in multiple drive systems. The slave drives are "chained" to the master drive. A maximum of three 9885S drives can be connected to one "M" drive.

The 09885-61607 cable is used to connect the 9885S drives in a multiple drive system.

In a 9825A/9885 system, each 98032A option 085 interface can handle up to 4 drives (one master and three slaves). Thus with the aid of an HP 9878A I/O Expander, up to 32 drives can be connected to a 9825A.

Power Requirements

The 9885M or S can operate on line voltages of 100, 120, 220, or 240 Vac (+5%, −10%). The line frequency must be within ±3.5% of 50 or 60Hz. The voltage selector switches on the rear panel must be set to the nominal ac line voltage in your area. Figure 1-1 shows the setting of the voltage selector switches for the various line voltages.

NOTE
Option 001 must be installed in the 9885 when operating on a line frequency of 50 Hz.

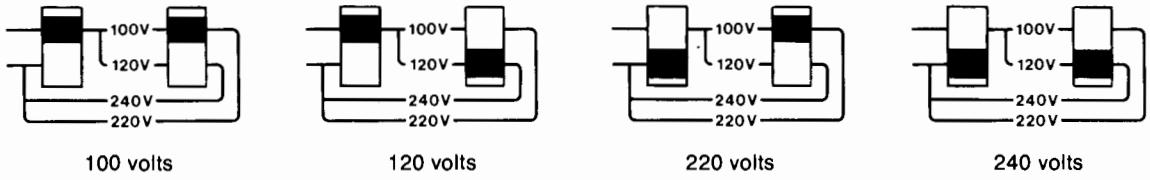


Figure 1-1. Line Voltage Selector Switches

Fuses

A different fuse is required for each of the two voltage ranges of 100-120 Vac and 220-240 Vac. See Table 1-3 for the correct fuse selection.

Table 1-3. Fuses

Voltage Setting	Fuse Rating	HP Part Number
100, 120	3 amp (SB)	2110-0381
220, 240	2 amp (SB)	2110-0002

9825A/9885 System Installation Procedure

To install a 9885M or S follow this procedure:

1. After unpacking the 9885, remove the foam shipping piece from the disk door.
2. Set the voltage selector switches on the rear panel (see Figure 1-1) for the line voltage in your area.
3. Ensure that the fuse on the rear panel is the proper type and rating (see Table 1-3).
4. Set the drive select switch (see Figure 1-2) to the desired drive number (0-3). Each drive connected to a particular 98032A option 085 interface must have a different drive number. A maximum of four drives can be connected to one interface.

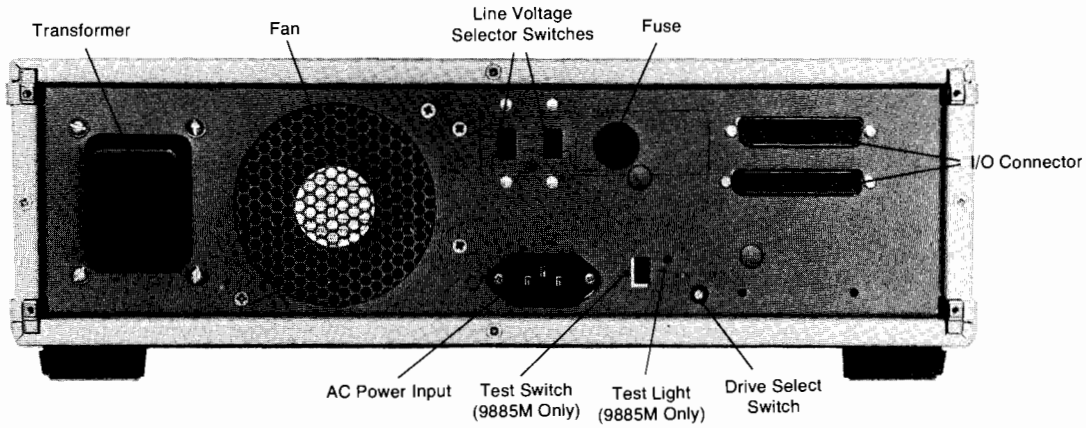


Figure 1-2. 9885 Rear Panel

5. For a single drive system, connect the 9885M to the calculator via the 98032A option 085 interface. Connect the drive end of the interface cable to the top I/O connector on the back of the 9885M (Figure 1-2).
6. For multiple drive systems, connect the 9885M as per step 5. Then connect the 9885S drives in series to the master drive using the 09885-61607 cable between drives (see Figure 1-3).

> **NOTE**
> A 9885S cannot be connected directly to a 9825A Calculator, it must be connected to a 9885M.

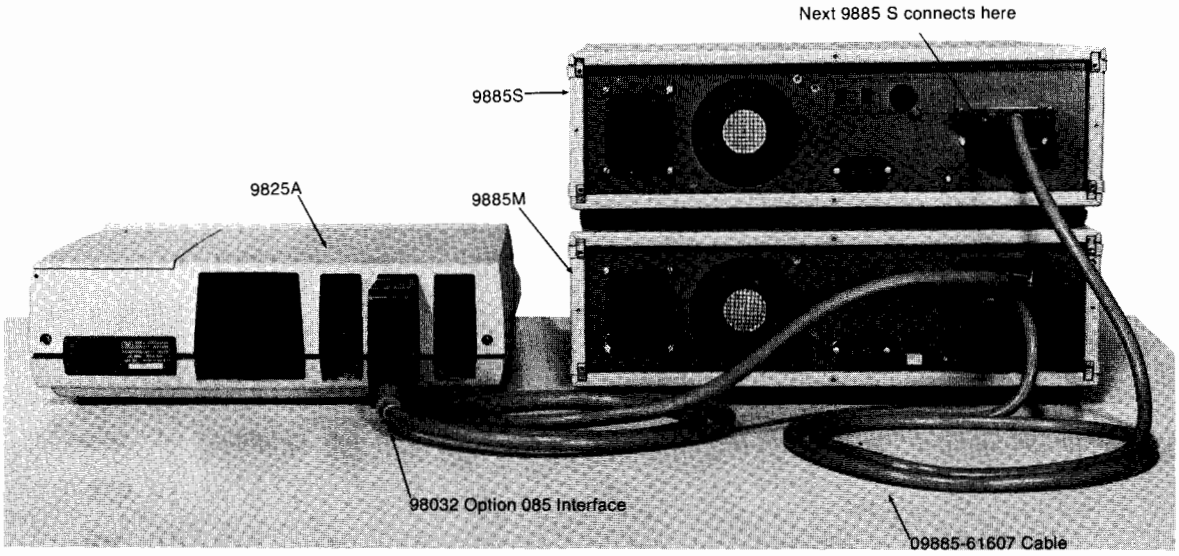


Figure 1-3. Connecting the 9885S Drives

7. Set the 98032A option 085 interface select code to the desired select code. The select code can be in the range of 8 to 15.
8. Connect the ac power cord to the power input connector on the back of the drive (Figure 1-2) and to an appropriate ac power source.

9. Switch the calculator off and install the Disk ROM; then switch the calculator on.
10. Switch the drive(s) on. The power switch is on the right front panel. All drives in a system must have power applied before the system can be operated.

> **CAUTION**
> Use only flexible disks approved by HP. Permanent damage to the read/write head in the drive mechanism can result from using other disks.

11. Install the disk system cartridge in the calculator.
12. To verify system operation, install the preinitialized disk (09885-90045) in one of the drives in the system and close the doors of all the drives (see Disk Loading and Handling, Page 1-7).
13. Load the exerciser (`ldb 3`).
14. Select the drive (using the drive statement) in which the preinitialized disk is loaded.
15. Checkread the entire disk by executing `ckrd`.
16. Repeat steps 14 and 15 on each drive in the system to verify the operation of each drive.
17. Disks can now be initialized on the drives.

Self Test

After installation you may wish to check the electrical performance of the drive. The drive can be checked with or without a disk installed. The disk door must be closed before the self test can be performed, even if a disk is not installed.

> **CAUTION**
> Performing self test with a disk installed will destroy data on the disk. Use a blank disk for the self test. Do not use the preinitialized disk.

To perform the self test, first disconnect the interface cable between the 9885M and the calculator. Then close the doors on all the drives in the system. Insert the blade of a screwdriver into the slot of the test switch on the rear panel of the 9885M (see Figure 1-2) and press the switch down; then release it.

Without the disk installed, self test will:

- Check the nanoprocessor and program memory.
- Check the drive control and drive status circuits.
- Check the I/O functions.

With the disk installed, self test will:

- Check the nanoprocessor and program memory.
- Check the drive control and drive status circuits.
- Check the I/O functions.
- Check the read/write electronics.
- Check the head positioning circuits.

Although the self test does not check all of the drive electronic functions, it does give a high confidence level that the drive is working when trying to isolate problems in a system, or following installation. The test takes less than one minute to complete. When the test is complete, the self test light by the self test switch will go out.

When the test fails, the light will remain on. If the light stays on longer than 1 minute, the test has failed. To repeat the test press the self test switch again. If the test fails again, see Chapter 4, Troubleshooting.

Disk Loading and Handling

The flexible disk is enclosed in a sealed plastic jacket. The interior of the jacket is lined with a wiping material to clean the disk of foreign material. To load the disk, first open the disk door on the front of the drive by pressing in on the door latch (see Figure 1-4). Insert the disk with the label facing up and out; then close the door by pressing it down. The disk can be loaded or unloaded with power on and drive spindle rotating. When the disk is removed from the drive, it should be stored in its envelope to protect it.

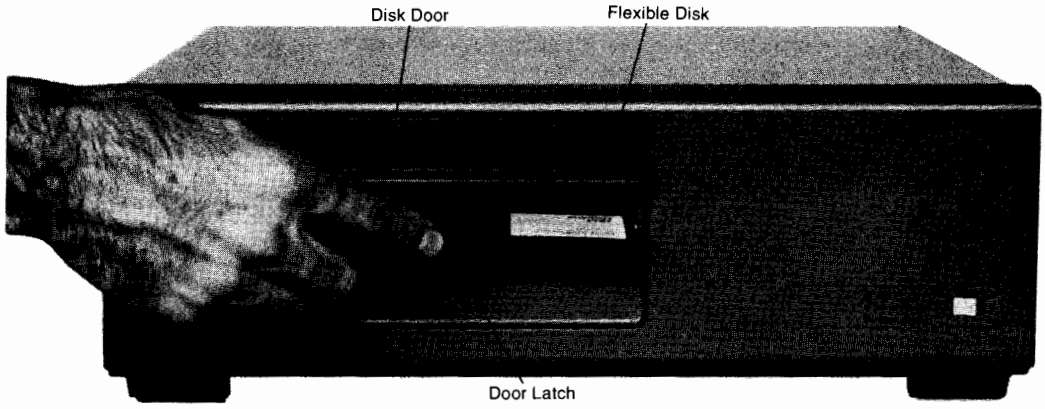


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Figure 1-4. Loading the Disk

To ensure error free disk operation, follow the care and handling precautions below.

- Use only HP approved disks, since the use of others can result in damage to the drive mechanism, high maintenance costs and data loss. HP warranty does not cover damage caused by the use of disks not approved by HP.
- Return the disk to its storage envelope whenever it is removed from the drive.
- Keep disks away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on the disk.
- Storage envelopes are designed to protect the disk. Replace envelopes when they become worn, cracked or distorted.
- Do not write on the plastic jacket with a lead pencil or ballpoint pen. Use a felt tip pen, and write only on the label area.
- Heat and contamination from a carelessly dropped ash can damage the disk.
- Do not expose the disk to extreme temperature or humidity (see Specifications).
- Do not touch or attempt to clean the disk surface. Abrasions or fingerprints may cause loss of stored data.

Write Protect

The disk can be write protected, that is, writing on the disk can be inhibited. The write protect feature is enabled (disk protected) when the write protect hole (see Figure 1-5) is open. When the hole is covered, writing is allowed on the disk. The hole is covered by placing a write tab over the top of the hole and folding the tab over covering the bottom of the hole.

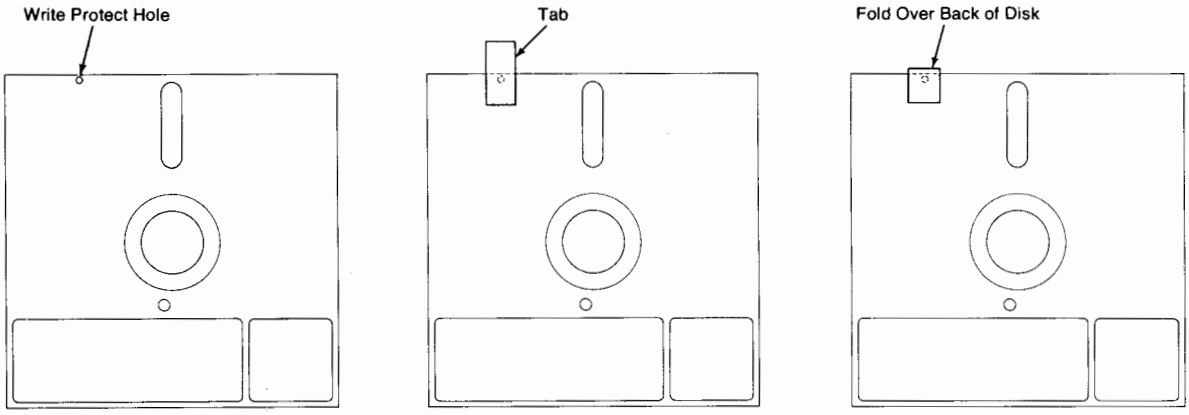


Figure 1-5. Write Protect Feature

Other types of disks may not have a write protect hole. To write protect one of these disks, a hole must be made as specified in Figure 1-6.

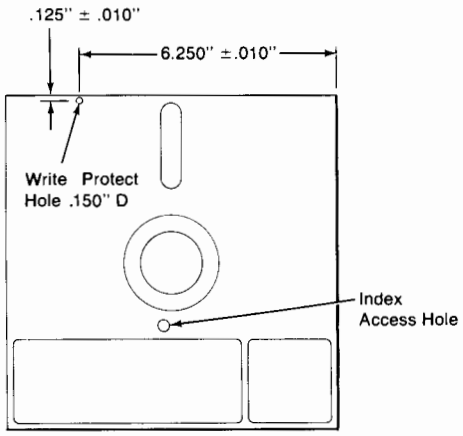


Figure 1-6. The Write Protect Hole

Chapter 2
Theory of Operation

Introduction

This chapter contains the 9885 theory of operation and block diagrams. The 9885 can be broken down into drive and controller sections. The mechanical drive with the drive electronics assembly (A5) is described first. The controller presentation includes the remaining circuit assemblies (A1-A4).

Drive Theory of Operation

The drive portion of the 9885M or S consists of the drive electronics assembly (A5) attached to the bottom of the drive, the drive mechanism, the read/write head, the head positioning mechanism and the removable disk. These components perform the following functions:

- Interpret disk commands
- Generate disk status signals
- Move the read/write head to the selected track
- Read and write data

Refer to Figure 2-1 and the A5 Schematic Diagram (Figure 4-7) during the following presentation.

Drive Electronics Assembly (A5)

The drive electronics assembly interfaces the controller to the mechanical drive.

Here is a description of the major A5 assembly circuits and their functions.

Index Detector

The index detector transfers the index pulse from the drive to the controller. The index pulse is generated once each revolution of the disk (every 166.7 ms) to indicate the beginning of track 0. Normally this signal is high and makes a transition to a low for 1.7 ms once each revolution.

Track 0 Detector

The track 0 detector senses the track 0 flag on the carriage. The signal from the track 0 detector is "anded" with the phase 1 signal of the stepper motor by U5A. This signal becomes the Track 0 signal.

Head Position Actuator Driver

Step and direction signals (STEP, DRCT) from the controller are decoded into drive signals which are applied to three transistor drivers (Q1 thru Q6). Each driver output is applied to the head position actuator (stepper motor) to move the head forward or back a specified number of tracks. The stepper motor rotates a lead screw clockwise or counterclockwise in 15 ° increments. A 15 ° rotation of the lead screw moves the read/write head one track position.

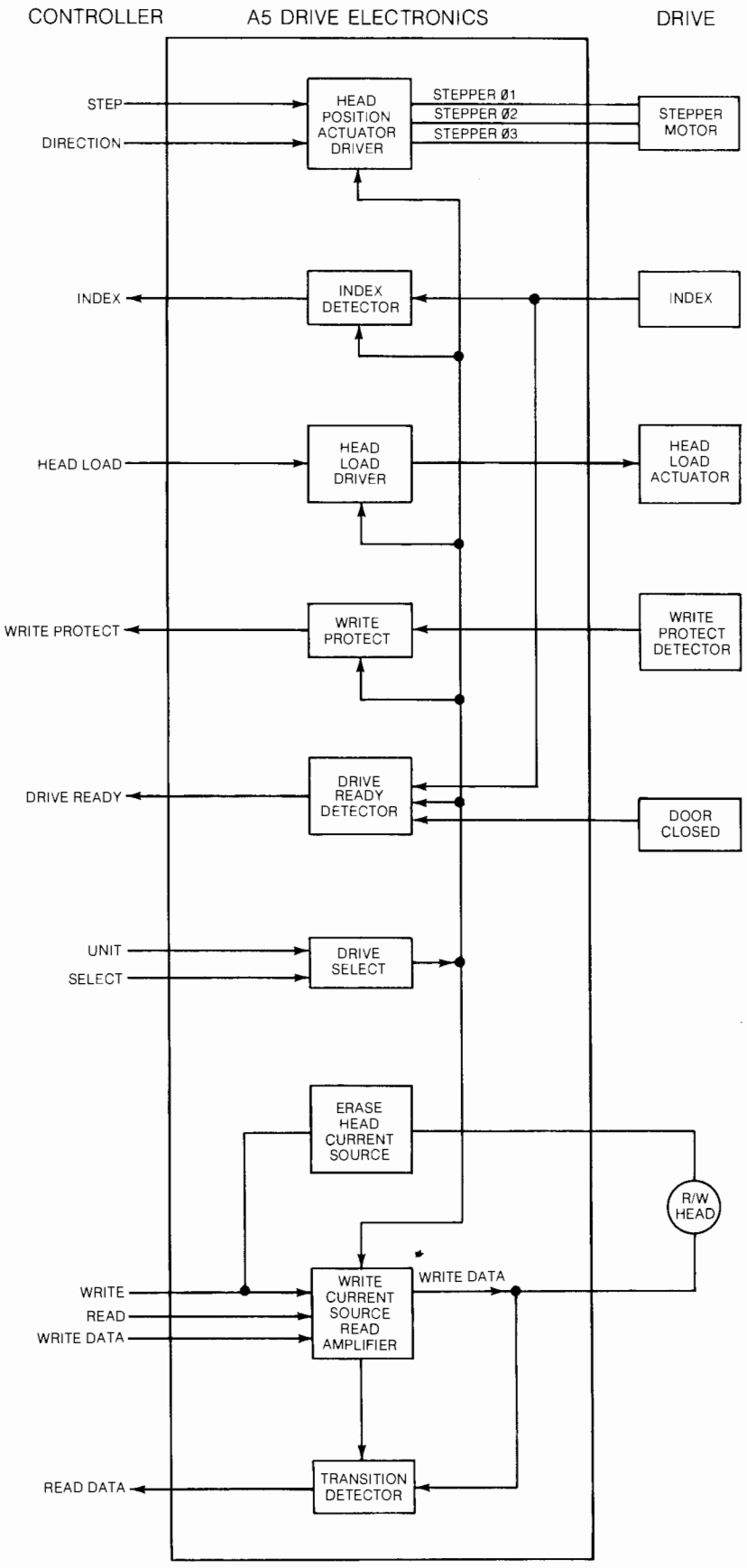


Figure 2-1. Drive Block Diagram

Head Load Actuator Driver

A head load signal (HDLD) from the controller enables the head load actuator driver (Q7). The driver energizes an actuator which positions the head load pad against the disk. A head down (HDDW) status signal is delayed for 35 ms to allow for head settling. If a second head load signal is not received within 300 ms, the head will unload.

Read/Write Amplifier and Transition Detector

The encoded write signal (WTRN) from the controller along with a write enable signal (WREN) is applied to a write current source. The output of the current source (U28) drives the read/write head, writing the data on the disk.

When data is read from the disk, a read amplifier (U24) amplifies the data. The output of the amplifier is shaped and sent through a transition detector (U16) to further form the data into a digital signal. The data is then sent to the controller for decoding (RTRN).

Erase Head Current Source

When data is written on a disk, the write enable signal from the controller also enables the erase head current source (U28). When writing, the erase head erases the outer edges of the track to ensure that the data being recorded will not exceed the .012 inch track width.

Write Protect

When a write protected disk is installed, the write protect signal (WPRO) is sent from the drive to the controller. The signal is low when the disk is protected. Write protect inhibits writing on the disk.

Drive Ready Detector

The ready detector (U1) monitors several drive conditions and sends a ready signal (DRDY) to the controller if all the conditions are met. The drive is ready when all the following conditions occur:

- A disk is installed.
- The door is closed.
- Two index holes have been sensed after the door is closed.

Drive Select and Drive Number

The drive number, set on the rear panel, is sent to the A5 assembly on the SEL lines. The processor assembly addresses the drive on the UNT lines. If the SEL and UNT codes compare, subsequent commands will be accepted by that drive.

When SEL and UNT compare, the following A5 circuits are enabled:

- Head load
- Head positioning
- Read/write

Drive Status

Drive status signals are sent to the processor assembly by U2 and U6. The status signals are:

DRDY	– Drive Ready	WPRO	– Write Protect
DOPN	– Door Open	HDDW	– Head Down
INDX	– Index Pulse	PWR	– Power Applied
TRK0	– Track 0 Detected		

Drive Mechanism

A drive motor rotates the disk spindle at 360 rpm through a belt drive. 50 Hz or 60 Hz power is accommodated by changing the drive pulley and belt. A registration hub, centered on the face of the spindle, positions the disk in the drive. A clamp presses the disk to the registration hub when the door is closed.

Read/Write Head

The head is a single element ceramic read/write head with straddle erase elements to provide erased areas between data tracks.

Controller Theory of Operation

Refer to the 9885M Block Diagram, Figure 2-2, during the following presentation. The controller consists of three circuit assemblies: the processor and I/O assembly (A3), the bit/byte converter assembly (A2) and the data electronics assembly (A4). You may also wish to refer to the schematic diagrams of these assemblies (Figures 4-4, 4-5, 4-6). The circuit component references refer to these schematics.

Processor and I/O (A3)

The A3 assembly is the main sequencer and regulator for all disk operations. Other circuits in the controller are capable of performing a sequence of operations from a single A3 nanoprocessor command.

The A3 assembly interfaces the 9885M to the calculator and contains the following circuits:

- The system clocks
- Nanoprocessor
- ROM
- I/O buffers
- Drive control latches
- Status buffers
- Self test

The A3 assembly's I/O interface between the controller and the calculator's interface consists of the following:

- A 16-bit bi-directional data bus (DIO0-DIO15)
- A two line handshake (PCTL and PFLG)
- A status line (PSTS)
- An initialization line (PRESET)
- An external interrupt line (EIR)
- An extended control line (CTL0)

Commands to the controller, status words from the controller, data to be written on the disk and data read from the disk are all transferred on the 16-bit data bus under control of the two handshake lines.

Data from the calculator is input to the controller on the 16 DI/O lines. The input data is received by multiplexers (U18, U23) where the 16-bit data word is gated onto the D-lines as two 8-bit bytes.

Data is sent to the calculator through latches U1, U2, U3, and U10. The controller outputs two successive 8-bit bytes to the D-lines to provide a 16-bit word for the DI/O lines. The lower 8 bits of a 16-bit word are latched into U3 and U10. The upper 8 bits are latched into U1 and U2. The 16-bit word is then sent to the calculator's interface on the DI/O lines.

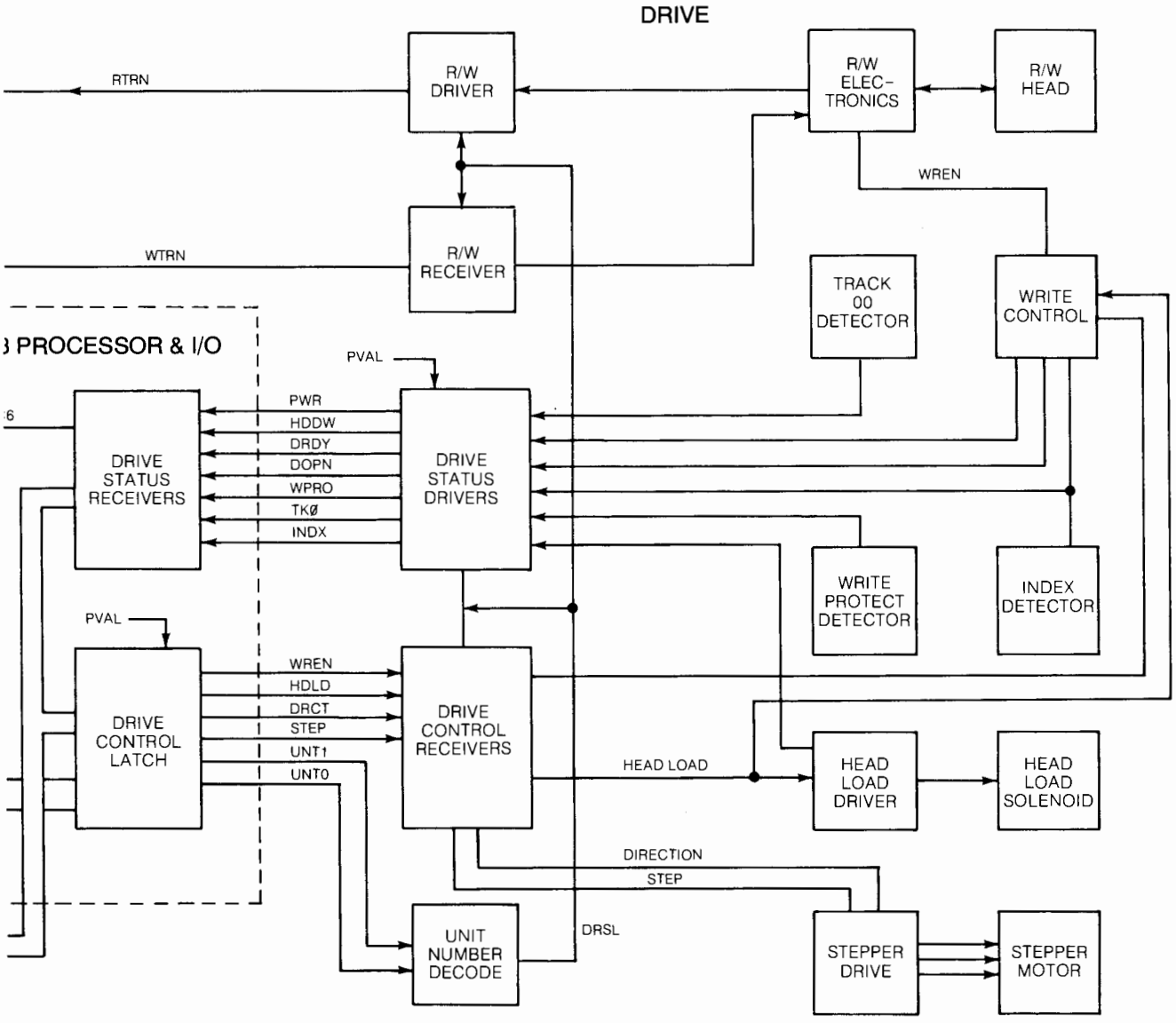
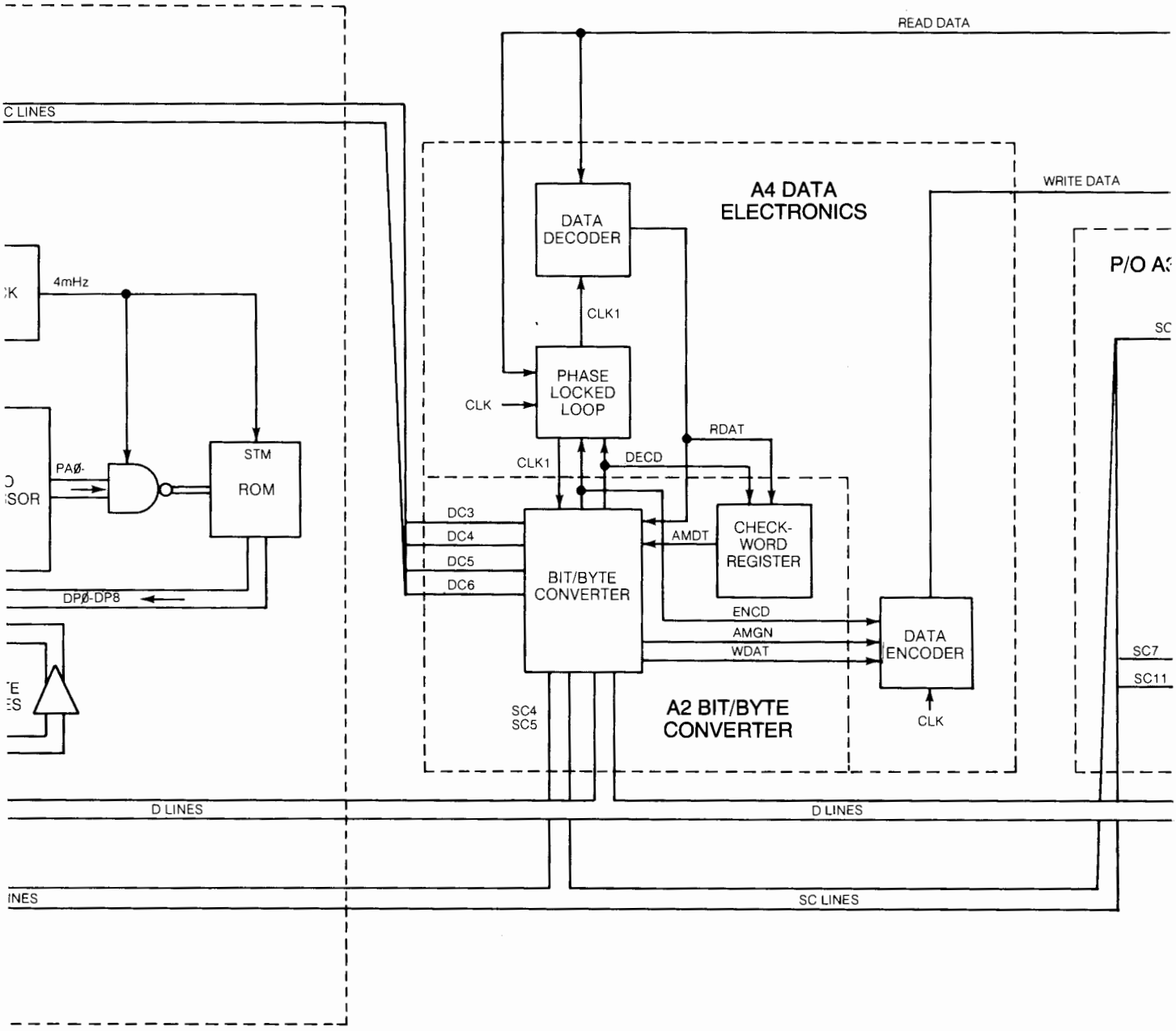
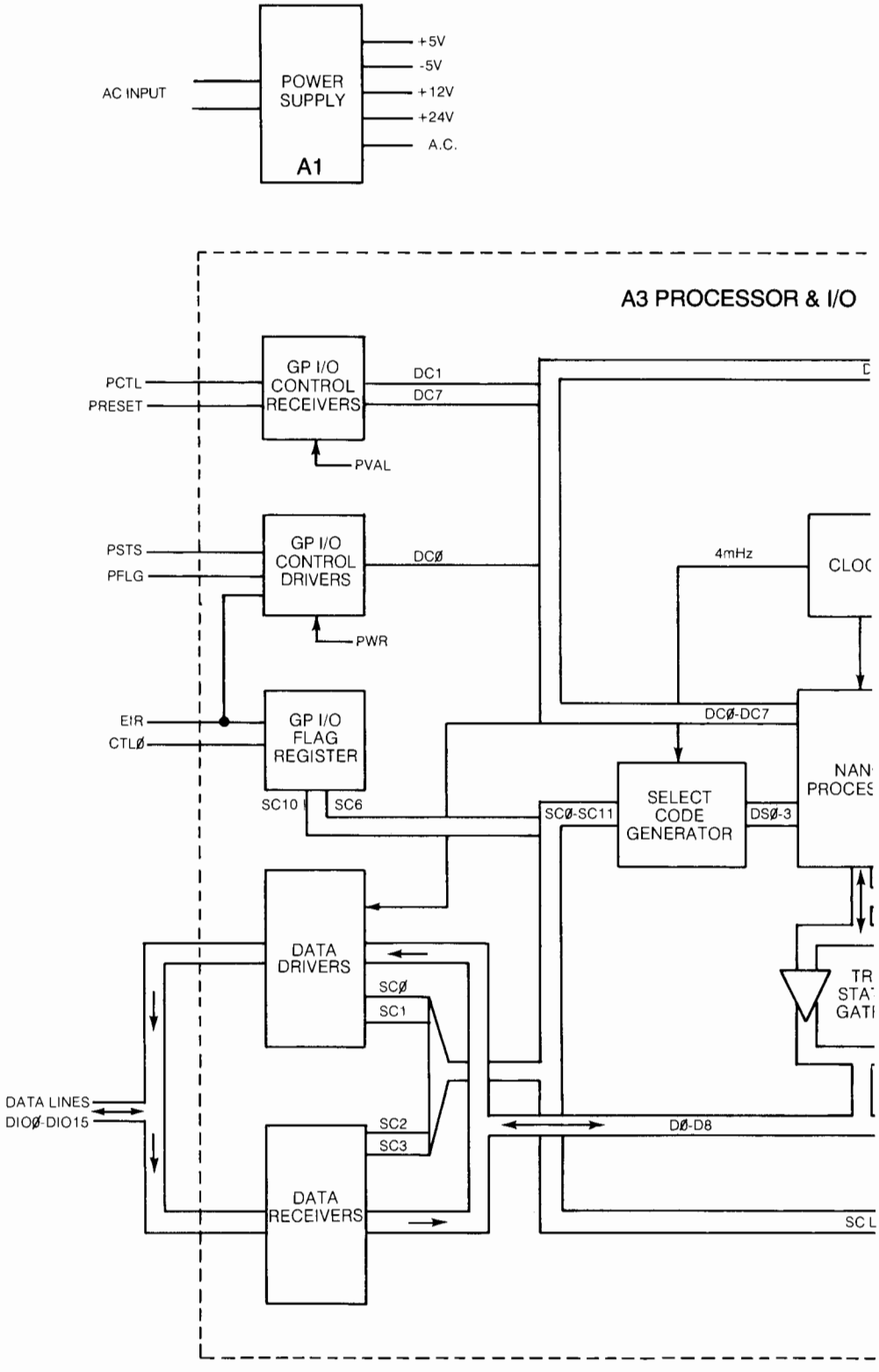


Figure 2-2. 9885M Block Diagram


READ DATA
C LINES
A4 DATA
ELECTRONICS
WRITE DATA
DATA
DECODER
P/O A3
CLK1
4mHz
PHASE
LOCKED
LOOP
CLK
RDAT
CLK1
DECD
STM
ROM
PAØ-
DC3
DC4
DC5
DC6
AMDT
CHECK-
WORD
REGISTER
BIT/BYTE
CONVERTER
DPØ-DP8
ENCD
AMGN
WDAT
DATA
ENCODER
SC7
SC11
SC4
SC5
A2 BIT/BYTE
CONVERTER
CLK
D LINES
D LINES
SC LINES


AC INPUT
POWER SUPPLY
A1
+5V
-5V
+12V
+24V
A.C.
A3 PROCESSOR & I/O
PCTL
PRESET
GP I/O CONTROL RECEIVERS
DC1
DC7
PVAL
PSTS
PFLG
GP I/O CONTROL DRIVERS
DCØ
PWR
4mHz
CLOC
EIR
CTLØ
GP I/O FLAG REGISTER
DCØ-DC7
NAN
PROCES
SC10
SC6
SCØ-SC11
SELECT CODE GENERATOR
DSØ-3
DATA DRIVERS
SCØ
SC1
TR
STA
GATI
DATA LINES
DIOØ-DIO15
SC2
SC3
DØ-D8
DATA RECEIVERS
SC L

Data to be written on the disk is sent on the D lines to the bit/byte converter assembly (A2). The operation of the bit/byte converter is controlled via the DC5 and DC6 lines.

Status from the drive(s) is received through U11 and U17. The nanoprocessor sends status information to the calculator.

The heart of the controller is the 8-bit nanoprocessor and associated 16K ROM. The nanoprocessor operation is sequenced by the clock. The clock also sequences the fetching of instructions from the ROM. ROM addresses are sent from the nanoprocessor to the ROM on the PA lines (PA0 – PA10). Before the ROM can output instructions to the nanoprocessor, a start memory pulse (STM) is needed. Information to or from the nanoprocessor is sent on the D lines and the DC lines. If data is to be sent to or from the nanoprocessor on the D lines, the device select lines (DS0 – DS3) determine which section of the A3 assembly has access to the D lines. The DS lines are decoded by U21 and U26. The output of these decoders enable the different sections of A3. Here is a list of the different A3 sections enabled by the DS lines.

- The data input multiplexer (U18, U23)
- The 16-bit data output latch (U1, U2, U3, U10)
- The drive status gates (U11, U17)
- The drive command latch (U25)
- The drive select latch (U24)
- The marginal test and self test flag latch (U17)
- The error indicator latch (U20)
- The reset self test latch (U20)

The basic system clock is an 8 Mhz oscillator. This basic clock is changed to a two-phase 4 Mhz clock by U5 and U6 to synchronize operation of the nanoprocessor and ROM. In addition, 8 Mhz, 1 Mhz and 500 Khz clocks are provided for the other controller assemblys.

When the self test switch is pressed on the rear panel, the STST line will cause the controller to be initialized and then execute the self test routine.

The nanoprocessor will execute an initialization routine when any of the following occur:

- Power is applied to the 9885M.
- Preset is sent from the interface.
- Self test switch is pressed.

Bit/Byte Converter (A2)

The bit/byte converter interfaces data between the processor assembly (A3) and the data electronics assembly (A4).

Data to be written on the disk is sent to the bit/byte converter assembly on the D lines. The data is latched into U24 and U25 and then into U17 and U18. After an 8-bit byte is in U17 and U18, a shift is initiated which shifts the byte out of U18 to the data encoder on A4. At the same time, the data byte is input to the checkword register (U7, U14, U21, U28). At the end of a record (256 bytes), the contents of the checkword register are shifted out (OCRC = low) to the encoder to be written at the end of the record. Thus during a write operation, the A2 assembly converts 8-bit bytes from the A3 assembly into serial data for the data encoder on the A4 assembly.

Data read from the disk is first sent to the decoder on the A4 assembly, then it is input serially to U17 and U18. When an 8-bit byte is shifted into U17 and U18, it is transferred to U19 and U20, and gated (8-bit parallel) to the processor assembly through U26 and U27. Data being read is also sent to the checkword register (U7, U14, U21, U28). At the end of the record, the checkword that was previously written on the disk is shifted into the checkword register. If the two checkwords are the same, the checkword register contains all 1's and no errors have occured. If the checkwords do not compare, a checkword error (from U12) is sent to the A3 assembly. Thus, during a read operation, serial data from the decoder on the A4 assembly is converted to 8-bit bytes and sent to the A3 assembly.

The operation of the A2 assembly is sequenced by a state register (U10 and U11). The address mark detect line (AMDT) and the DC5 and DC6 lines determine the states of U10 and U11. In addition to sequencing the A2 operation, the state register also sends encode or decode commands to the data electronics assembly (A4).

Data Electronics Assembly (A4)

The data electronics assembly can be divided into three sections; the encoder, the decoder and the phase locked loop.

Encoder

The encoder combines the data to be written on the disk from the A2 assembly with clock pulses to form a series of bits (ones and zeros) which will be recorded on the disk. The recording technique used is "double density recording". Using double density it is possible to store twice as many bits in a given area on the disk without changing the transition density. This means that each data bit is written in the center of a bit cell (see Figure 2-3). Clock bits are written at the leading edge of a bit cell if no data or clock bit was written in the previous cell, and no data bit is to be written in the present cell. Here are some examples of double density recording.

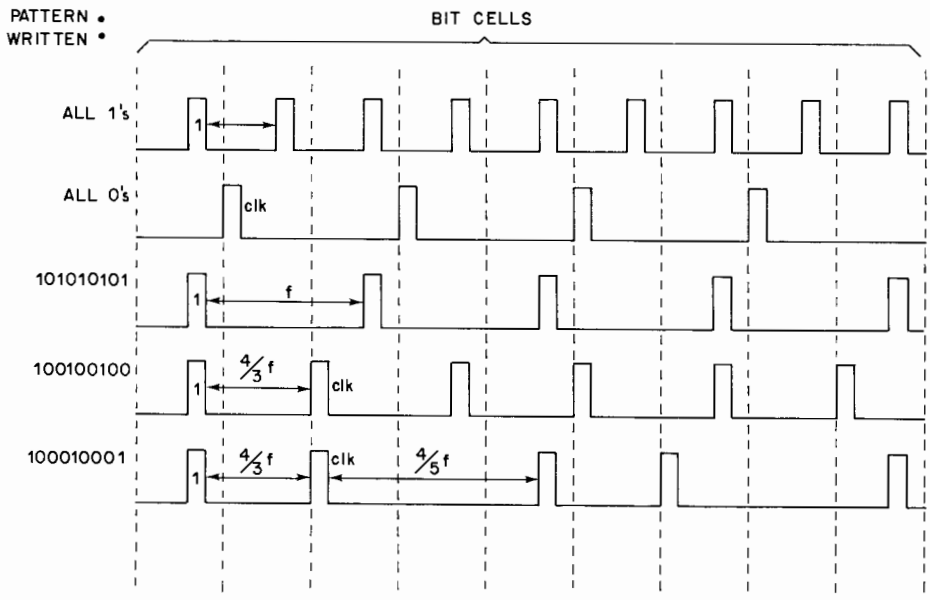


Figure 2-3. Double Density Recording Technique

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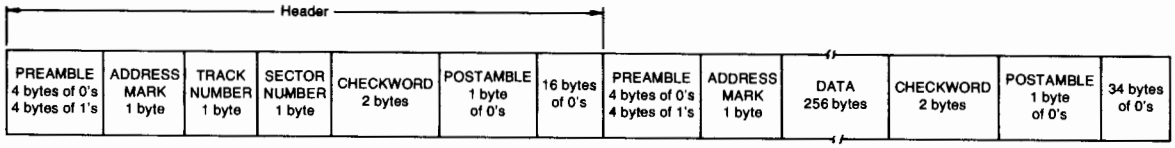
Figure 2-4 shows the format of each record on the disk.



Note: The header is written on the disk only during initialization.

Figure 2-4. Record Format

The encoding operation is controlled by the state machine comprised of a programmed logic array (U26) and a 3-bit state register (U27 and U30). Encoding is enabled by an encode command signal (ENCD) which is sent from the A2 assembly.

U22 is a serial-in, parallel-out shift register. U16 is a 1 of 7 decoder. U16, 22 and U27 form a network to provide precompensation for pulse crowding.

Decoder

The decoder translates the transition patterns read from the disk into a sequence of bits. The bits are then sent to the bit/byte converter (A2). A decode command (DECD) from the A2 assembly starts the decoding process. The inputs to the decoder are the read transitions (RTRN) , the 500 kHz clock and the phase locked loop clock. U19, U23 and U24 control the decoding process.

U8 and U9 are a data/clock separator. U3 and U17 act as a detector which senses an address mark (a unique bit pattern) and outputs an address mark detected signal (AMDT) when the address mark occurs.

Read data (RDAT) is the actual series of bits that is sent to the bit/byte assembly.

U10, U11, U12 and U19 form a marginal transition detector. If a data transition is not properly positioned, it is considered marginal and is indicated by setting MTST high.

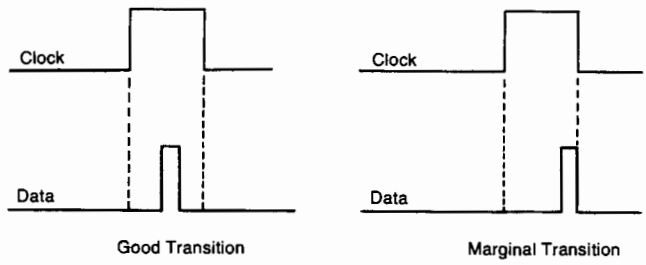


Figure 2-5. Transition Detection

Phase Locked Loop

The purpose of the phase locked loop (PLL) is to generate clock pulses that are synchronized in phase and frequency with the transitions read from the disk. The PLL clock (U15 and U14) is actually a variable frequency oscillator and is used by the decoder to separate the data and clock pulses. The clamp signal is used to synchronize the PLL clock in phase with pulses read from the disk prior to the "locking up" of the PLL.

A filter comprised of C33, C37, R43 controls the response time of the PLL to changes in the Sample signal. It is desirable to read the preamble of a record with a very quick response time to enable the PLL to lock easily. When reading the address or data, it is better to dampen the response time to reduce sensitivity to noise and transient pulses; the Fast Lock signal controls this. Fast Lock is true when reading the preamble and false at other times.

U21 is a detector which compares the PLL clock and the Sample signal from the decoder (see Figure 2-6).

The detector generates an error signal which is used by the PLL to compensate for frequency variations in pulses read from the disk. If the Sample pulse occurs as the PLL clock crosses zero, there is no error. Error magnitude varies with the time between the PLL clock zero crossing and the center of the sample pulse.

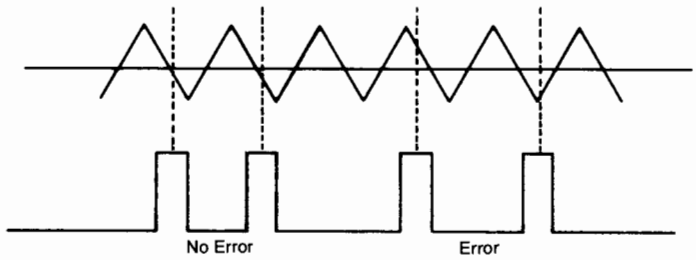


Figure 2-6. Detector Signal Comparison

Power Supply (A1)

The power supply schematic diagram is Figure 4-3 . The power supply assembly provides ±5V, +12V, and +24 dc to the 9885 circuits. ±5V and +12V are used to power the logic circuits. +24V is used to power the head position stepper motor and the head load solenoid. Ac from the transformer secondary winding is used to power the drive motor which turns the disk.

9825A/9885 System

A 9825A/9885 system consists of the following items:

- A 9825A Calculator.
- A 9885 Disk ROM.
- A Disk System Cartridge.
- A 98032A Option 085 Interface.
- A 9885M and one or more optional 9885S drives.

The disk ROM is installed in the calculator. The ROM "steals" an area of 1140 bytes in the calculator's read/write memory.This stolen area is used for a bootstrap execution buffer and two, 256-byte data buffers.

Besides stealing memory, the disk ROM:

- Recognizes all disk commands.
- Executes the basic disk commands which reside in the ROM.
- Recognizes and fetches commands stored on the bootstrap area.
- Transfers files between the disk system cartridge and the disk.

The disk system cartridge contains the binary bootstrap programs. These programs are loaded onto the disk when the disk is initialized. The disk system cartridge also contains:

- An initialization routine
- A data recovery routine
- Exercisers

To any one 98032A option 085 interface, one 9885M and up to three 9885S drives may be connected.

9825A/9885 Disk Organization

Each disk has 67 tracks, 30 records/track, 256 bytes/record and 8 bits/byte. Data can be recorded on one side only.

System Area

Track 0 is the systems track. The systems track consists of:

- Systems table (1 record)
- Directory (22 records)
- Availability table (6 records)
- One unused record

Systems Table

When a disk is initialized, the number of defective tracks is recorded in the systems table. If more than 6 tracks are defective, the disk is rejected (by software). An entry in the systems table indicates the number of defective tracks. The physical location of the tracks will not be known to software. This results in a contiguous set of logical tracks with no intervening defective tracks. For example, if there are 2 defective tracks on a disk, the usable tracks will be numbered 0 to 64.

Directory

The directory can contain up to 352 possible entries. Each entry has 8 words. One entry is in the directory for each file written on the disk.

Each entry has the following information:

Word	Information
0	File name (first 2 characters)
1	File name (next 2 characters)
2	File name (last 2 characters)
3	File start address (bits 0–11 = record number)
4	File size in records
5	Current file size in records (words for program files)
6	File type
7	Used for memory files only

The file type (word 6) is defined as follows:

	Type
000	Not used
001	Data file
010	Program file
011	Key file
100	Program and key file
101	Memory file
110	Binary program file
111	Not used

Availability Table

The availability table monitors the amount of space left on the disk. Each table entry is 2 words. Word 0 is the address of the first available record. Word 1 is the number of available records. A maximum of 256 entries is permitted in this table. The table is automatically updated after each "KILL" statement to combine contiguous available space.

Bootstraps

Tracks 1 through 4 are used for the bootstrap programs. The bootstraps are loaded from the disk system cartridge when the disk is initialized. The bootstraps are statements and routines used by the system that are not contained in the ROM.

Backup Track

Track 5 contains the same system information as track 0. The information on track 5 will be used if track 0 should become defective.

User's Area

Tracks 6 through 66 are used for recording user files and programs. The tables in the systems area are updated whenever new information is added to or deleted from the disk and whenever the disk is reorganized.

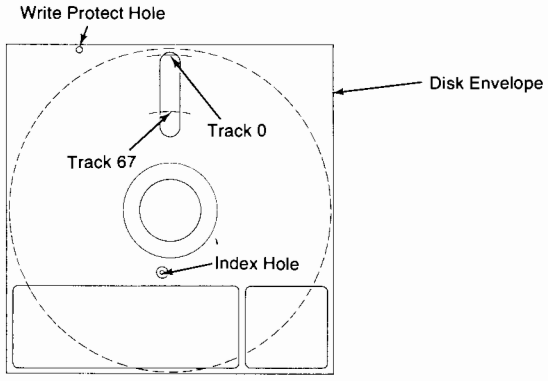


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Figure 2-7. The Disk

Alignment Disk

The alignment disk is a prerecorded disk used in drive alignment.

Track 0 is recorded with a standard format which is used for aligning the head.

Track 38 is recorded with a "cats eye" pattern used for aligning the head.

Tracks 1 and 76 are used in the index adjustment.

Track 75 is used in the load button adjustment.

> **NOTE**
> Do not write on the alignment disk; writing can destroy the prerecorded tracks.

9825A/9885 Disk System Cartridge Programs

The Disk System Cartridge contains the following programs.

Track 0

File	
0	Initialize routine
1	Soft error recovery (binary)
2	Soft error recovery (user language)
3	Exerciser (binary)
4–9	Unused
10–69	Bootstrap routines

These programs are repeated on track 0 in files 100 through 169, i.e.,

Track 0

File	
100	Initialize routine
101	Soft error recovery (binary)
102	Soft error recovery (user language)
103	Exerciser (binary)
104–109	Unused
110–169	Bootstrap routines

Track 1 is identical to track 0, thus four copies of the programs are available. See the 9825/9885 Disk Programming Manual for details on the Disk System Cartridge programs except the exerciser programs which are described below.

9825A/9885 Exercisers

The exerciser on file 3 of the disk system cartridge consists of a checkread routine and a pattern test. Flow charts and an explanation of the exercisers are given below.

The exerciser can be used with or without the 9825/9885 ROM installed. Without the ROM, the exerciser assumes a select code of 8 and a drive number of 0. With the ROM installed, any allowable select code and drive number may be specified.

Checkread syntax – `ckrd` n, s, e

Pattern test syntax – `ptrn tst` n, s, e

n = the number of test cycles. If n = 0 the test will run continuously. The cycle number is displayed after each pass.

s = starting track

e = ending track

Entering non-existant tracks or entering an ending track number less than the starting track number will result in an error.

Both statements are programmable once the binary program has been loaded.

The ckrd is non-destructive. All the ckrd parameters are optional. (e.g., ckrd = checkread the entire disk, ckrd 1,3 = check track 3 once). "ckrd passed" is printed when the test passes.

The ptrn tst is destructive. All ptrn test parameters are optional. It will run only on a disk with no files in use. If ptrn tst is attempted on a disk containing files, an error message is printed. If a system area (trk 0, boots, trk 5) is tested by ptrn tst, zeros are written in the area and a message is printed that information has been destroyed. The 5 octal patterns used by ptrn tst are:

143306
066154
155555
133333
000000

If a compare fail occurs during the ptrn tst, a compare fail message is printed listing the track, record and the failing pattern. "ptrn tst passed" is printed when the test passes.

An error message listing the track, record and type of error is printed for each read or write error during ckrd or ptrn tst. There are no rereads or rewrites if an error occurs. ptrn tst reads with a tight margin, ckrd does not.

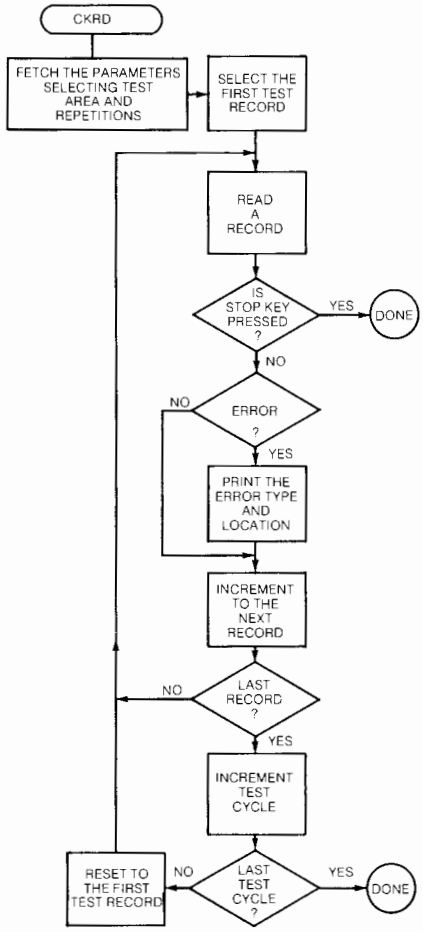


Figure 2-8. Exerciser Flowchart

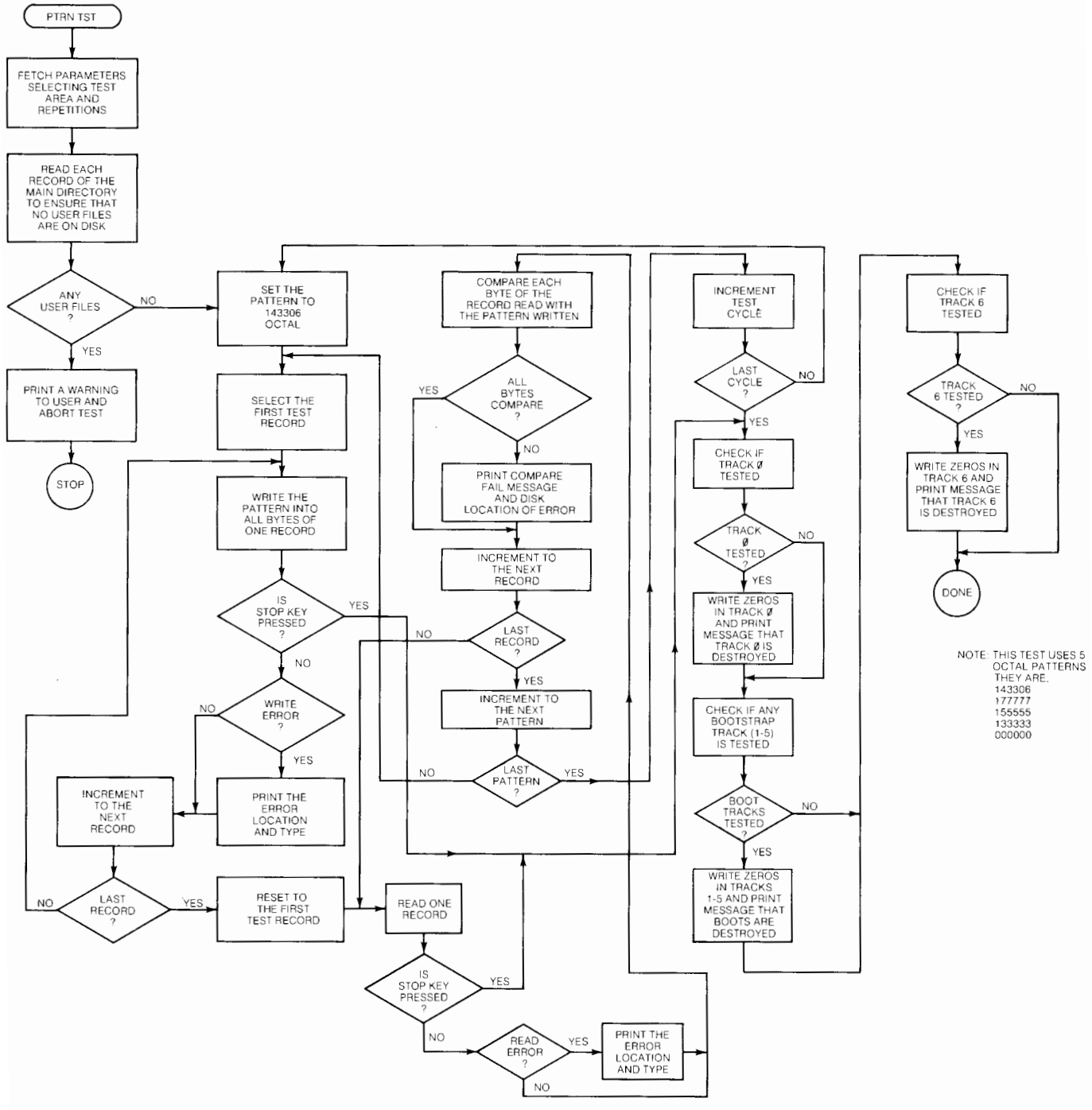


Figure 2-8. Exerciser Flowchart (Cont.)

Disk Service Fixture

The Disk Service Fixture (DSF) allows you to service and align the 9885 disconnected from the system. To use the DSF, first remove the A3 and A4 assemblies from the 9885 and set the drive select switch to 3. Then plug the DSF onto the lower I/O connector on the back of the drive. Connect the wire coming from the DSF to +5V (e.g., pin 14 of a 14-pin IC).

The fixture's switches are shown in Figure 2-9.

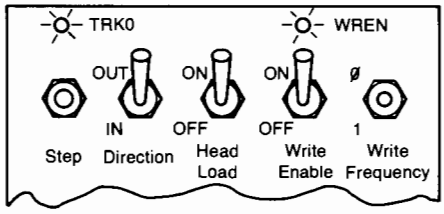


Figure 2-9. DSF Switches

Pressing the step button will step the carriage in or out (depending on the direction switch setting) one track position. If the button is held down, the carriage will continuously step in the specified direction until track 77 or −1 is reached.

The direction switch controls the direction of carriage movement. If the switch is up (towards the "TRACK 0" indicator) the carriage will move towards track 0 when the step button is pressed. If the switch is down (IN position), the carriage will move towards track 77 when the step button is pressed.

The TRACK 0 indicator will light when the track 0 flag is detected and the stepper motor phase 1 winding is energized.

The head load switch loads and unloads the read/write head. The head must be loaded to read from or write on the disk.

The write enable switch enables you to write on the disk. If the switch is up (towards the write indicator), write is enabled. If the switch is down, read is enabled. The write indicator is lit when write is enabled.

When the write is enabled, 0's or 1's can be written on the disk. Position the write switch to the 1 or 0 position for the appropriate pattern. The center position of the write switch is the off position.

Chapter 3
Maintenance

Introduction

This chapter provides the 9885 assembly access information and the 9885 mechanical and electrical adjustments. A recommended preventive maintenance schedule is given below.

Preventive Maintenance

A good preventive maintenance schedule will result in greater system reliability. Visual inspection of the drive should be the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, binding and loose connections. Cleanliness cannot be overemphasized in maintaining the disk drive. Do not lubricate the drive. Oil will allow dust and dirt to accumulate. Table 3-1 details the recommended preventive maintenance operations.

Table 3-1. Annual PM Schedule

Item	Observe	Action
Read/Write Head	Oxide build up	Clean Read/Write head ONLY IF NECESSARY
	Check for proper alignment	Perform head alignment if necessary
R/W Head Load Button	Excessive wear	Replace
Stepper motor and lead screw	Inspect for nicks or burrs	Clean off all oil, dust and dirt
Belt	Frayed or weakened areas	Replace if necessary
Chassis	Inspect for loose screws, connectors and switches	Clean chassis
Read Amplifier Balance	Correct Waveform	Adjust

Tools Required

Table 3-2 lists the tools required to disassemble and assemble the 9885.

Table 3-2. Tools Required

Flatblade screwdriver
Pozidrive screwdriver
Right Angle Pozidrive screwdriver
1/4" wrench
11/32" wrench
Set of allen wrenches
Needlenose pliers
Pin extractor or paper clip

Extracting Pins

Some of the assembly access procedures require that pins be extracted from the A5 P5 connector. To extract pins from this connector, insert the end of a paper clip between the pin and the connector wall from the front of the connector (see Figure 3-1). Pull the wire and pin from the back of the connector. When connecting P5 the numbered pins should face the component side of A5.

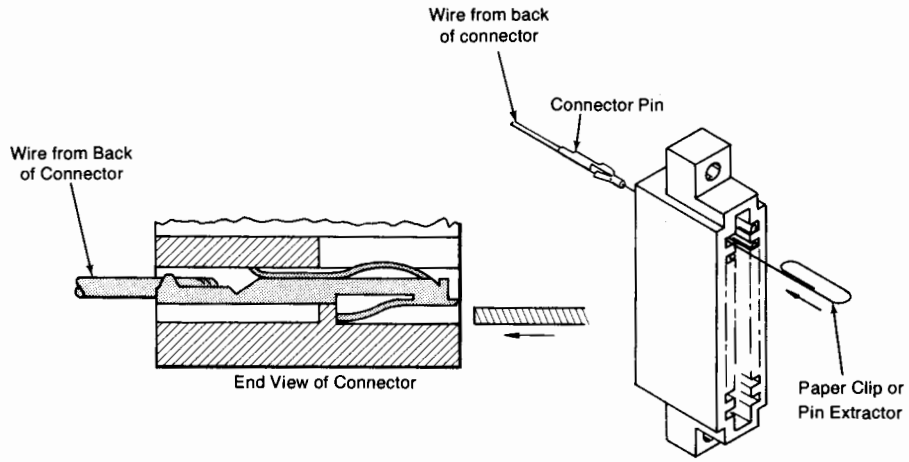


Figure 3-1. Extracting Pins from P5

Assembly Access

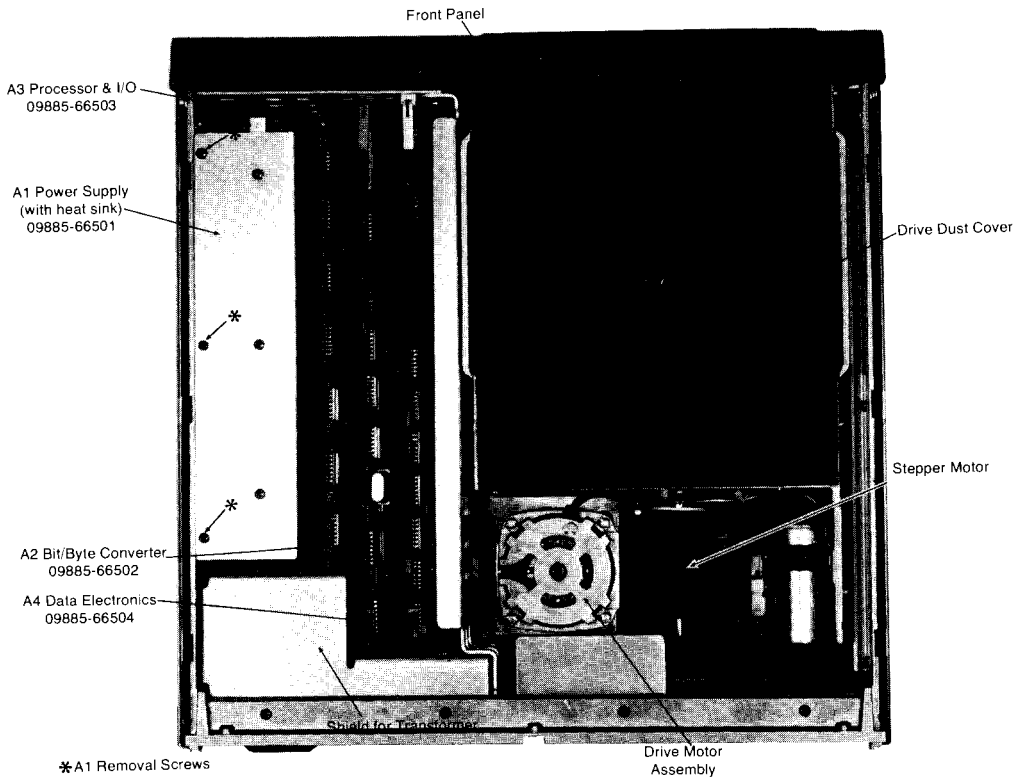
All the 9885 assemblies can be accessed by removing either the top or bottom cover. See Figure 3-2 for the assemblies found under each cover. Under the top cover is a plastic dust cover over the drive that must be removed to access the upper drive assemblies. This dust cover simply lifts off the drive.

To remove either the top or bottom cover, loosen the screw at the back center of the cover, slide the cover back and remove it. In a like manner, the side covers can be removed.

NOTE

When installing the covers, ensure that the front edge of the cover fits in the slot in the front panel.

A



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B

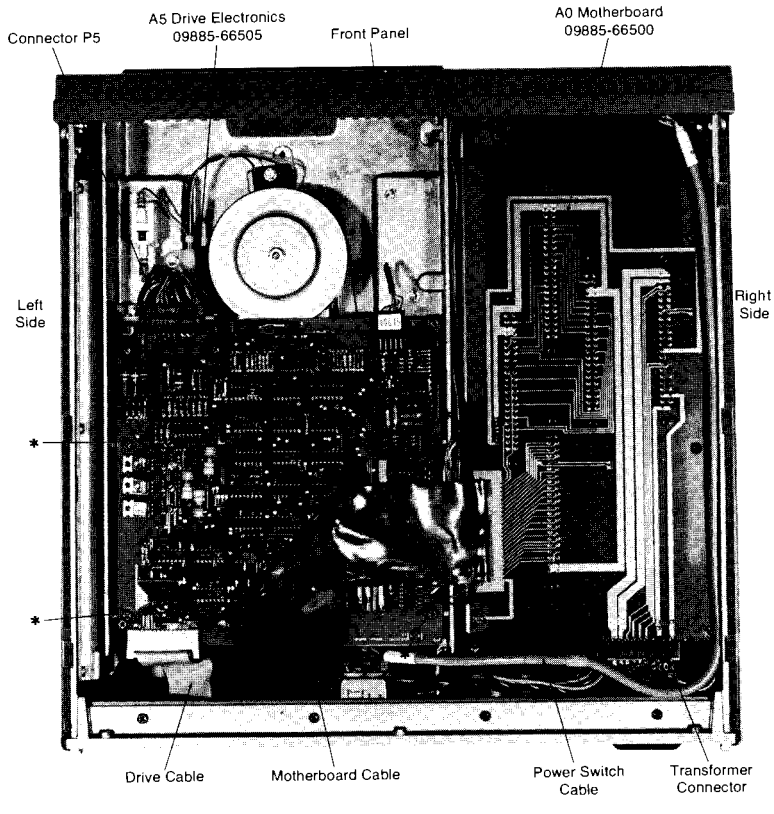


Figure 3-2. 9885 Top & Bottom Assemblies

Figures 3-3 and 3-4 show the components on the top and bottom of the drive assembly.

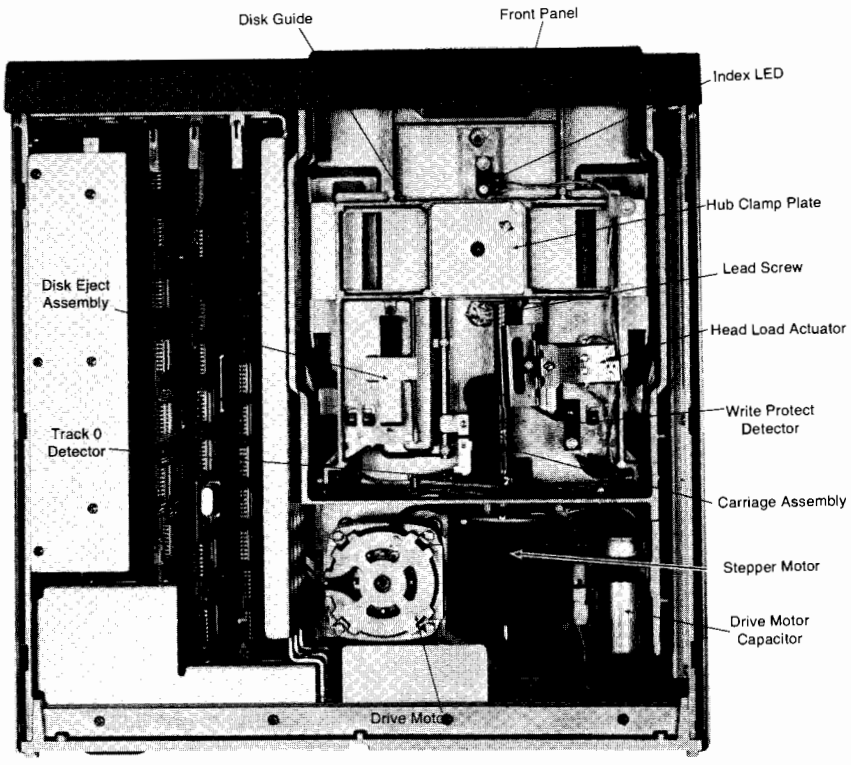


Figure 3-3. Drive Top

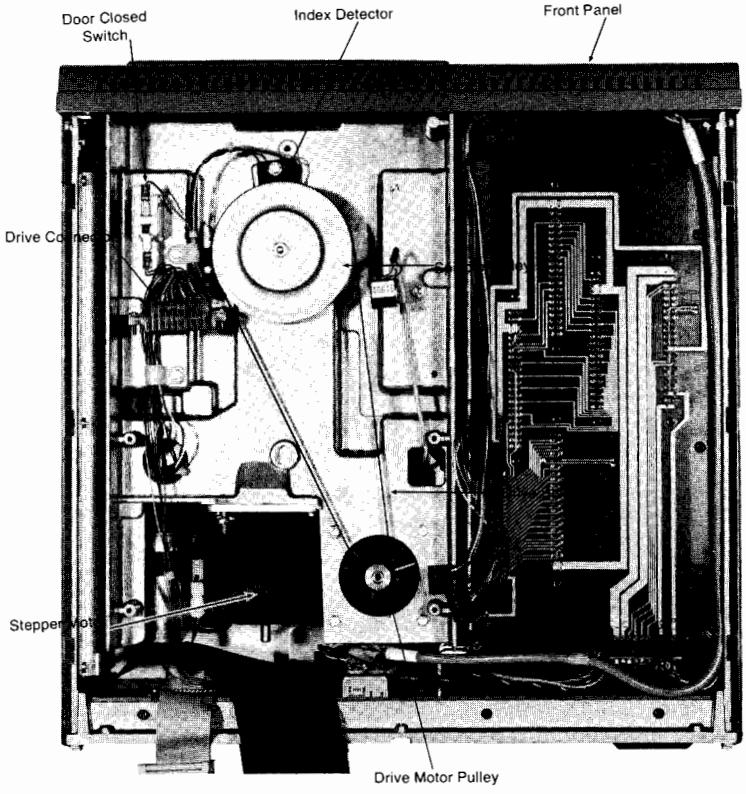


Figure 3-4. Drive Bottom

CAUTION
REMOVE ALL AC POWER BEFORE REMOVING ANY 9885 ASSEMBLY.

Assembly Removal

The following procedures will help you disassemble the 9885. Unless otherwise noted, the assemblies are assembled by reversing the given procedure. When moving or replacing assemblies, always perform any necessary adjustments.

Controller Removal

A1 – Remove the 3 screws holding the heat sink to the side casting. Pull the assembly up and out of the 9885.

A2, A3, A4 – Press outwards on the colored extractors; then lift the assembly up and out of the 9885.

Rear Panel Removal

Remove the top, bottom and side covers. Remove A1 through A4. Remove the 6 screws in Figure 3-5A on the right side panel and remove the 4 screws in Figure 3-5B on the left side panel holding the rear panel to the side frames. Then remove the three screws shown in Figure 3-5C and remove the panel. Pull the back panel to the rear and off the chassis. Disconnect the various cables connecting the rear panel to the 9885. The rear panel assemblies are shown in Figure 3-6. When replacing the rear panel, be careful not to pinch any wires.

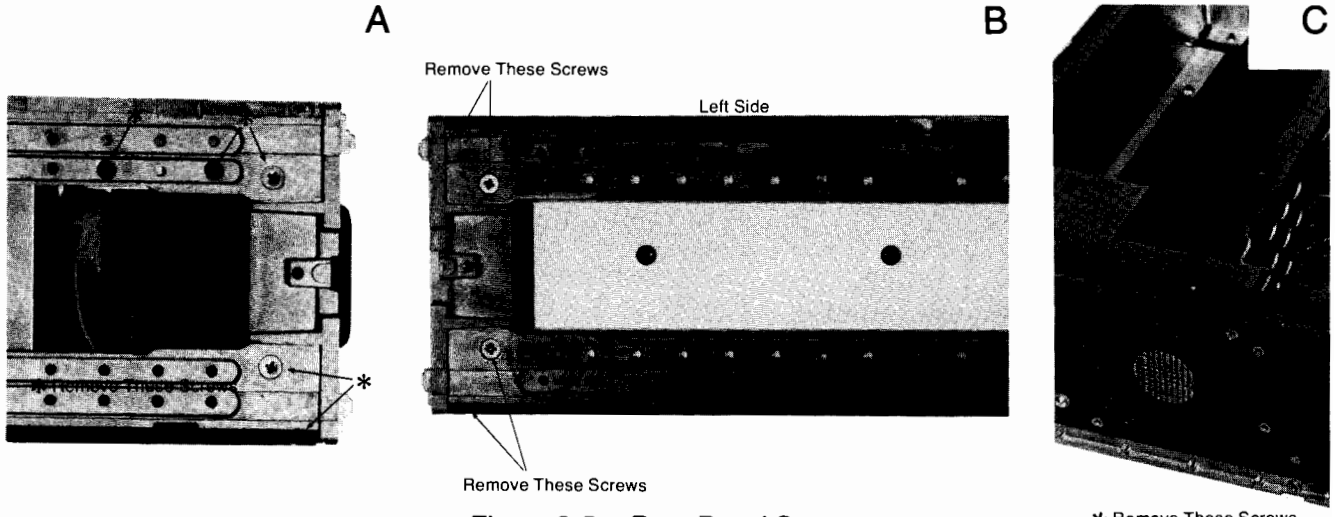


Figure 3-5. Rear Panel Screws

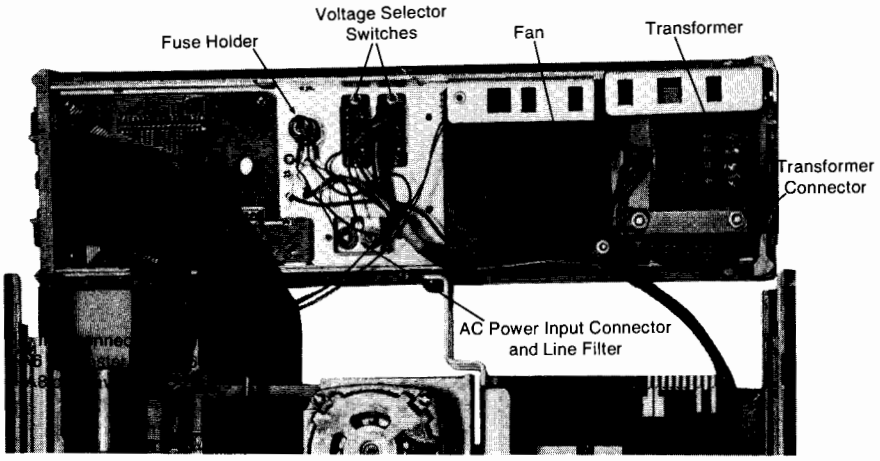
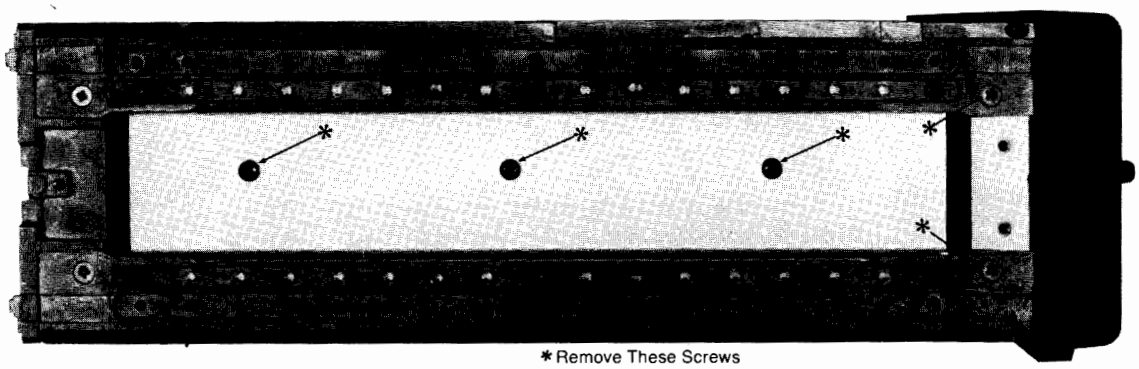


Figure 3-6. Rear Panel Assemblies

Drive and Front Panel Removal

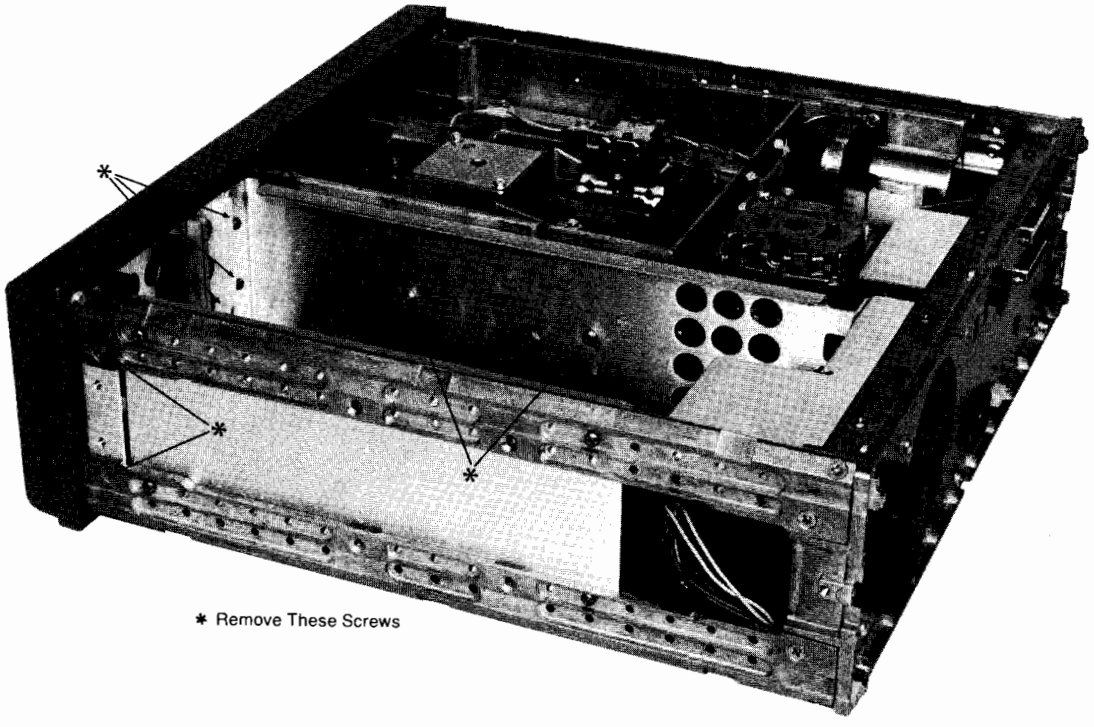
1. Remove the drive motor cable.
2. Remove the 2 screws on each side of the 9885 that hold the front panel to the side frames (see Figure 3-7A).
3. Remove 3 screws holding the drive casting to the left side frame.
4. Remove A1 through A4.
5. Remove 2 screws holding the drive casting to the center bracket (Figure 3-7B).
6. Remove 3 screws holding the center bracket to the front panel.
7. Remove the front 2 screws on the A0 mother board (Figure 3-7C).
8. Remove the drive/front panel assembly and disconnect the various cables that connect to it.
9. Remove the left front bracket (Figure 3-7D).
10. Remove 4 screws holding the drive to the front panel (Figure 3-7D).
11. Loosen the 2 screws holding the door to the disk guide and remove the front panel from the drive.
12. Remove the cable from the A7 indicator assembly.

A

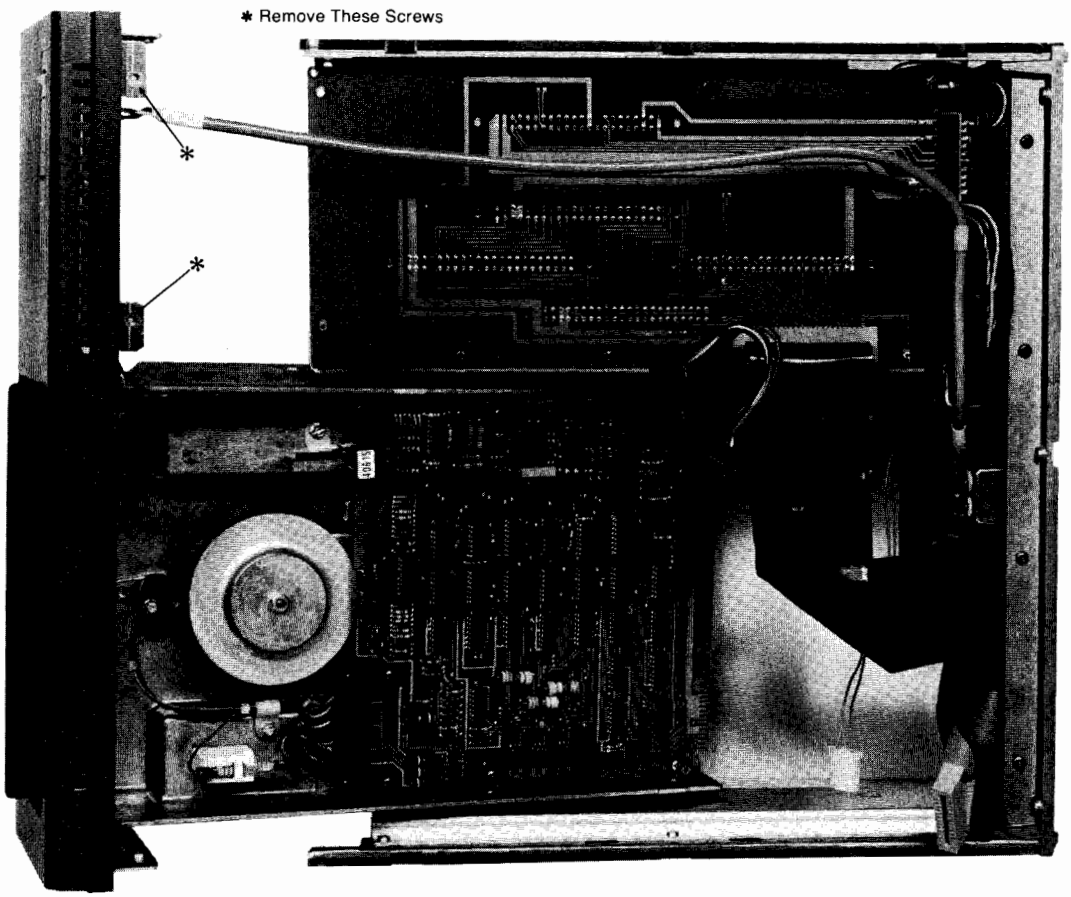


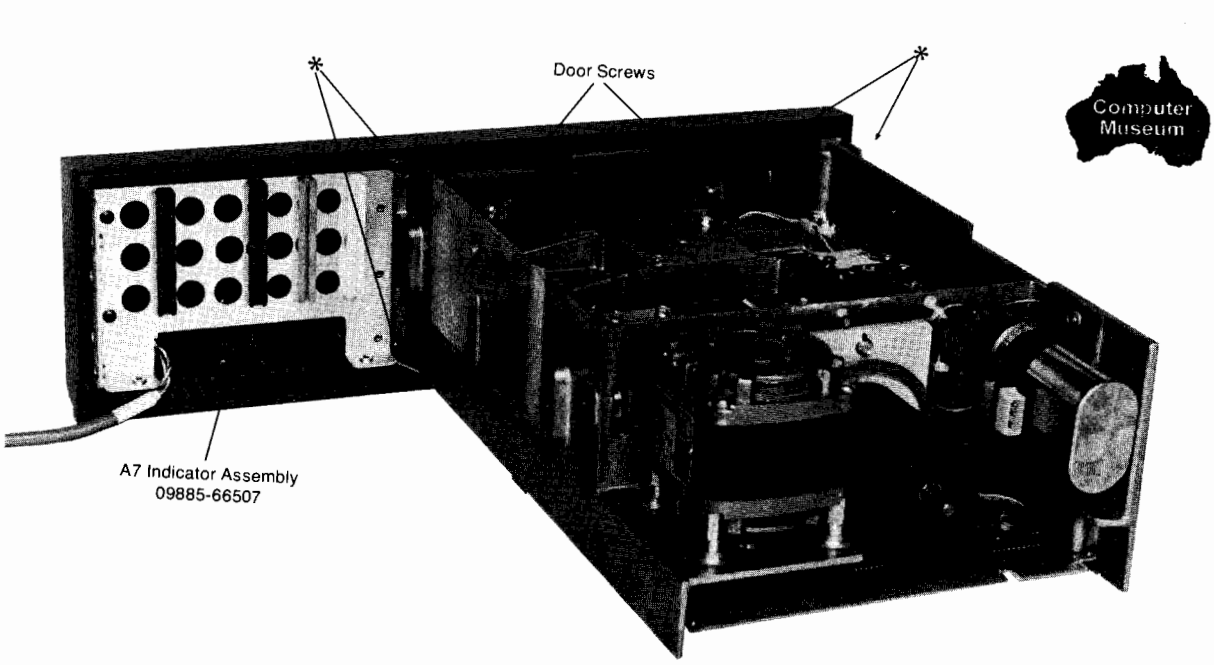
* Remove These Screws

B



* Remove These Screws





* Front Panel Screws

Figure 3-7. Drive/Front Panel Removal

A5 Removal

1. Remove the connectors that connect to the A5 assembly.
2. Remove the 4 screws holding the A5 assembly to the drive (see Figure 3-2B).

Drive Assembly Removal

Drive Motor Assembly Removal

The drive motor and capacitor are one assembly (see Figure 3-3).

1. Remove the A5 assembly.
2. Remove the two screws holding the capacitor clamp to the drive casting.
3. Remove the belt from the drive pulley.
4. Remove the four screws (on the bottom of the drive casting) holding the motor to the drive casting and remove the motor.
5. Disconnect the drive motor connector.
6. When installing the motor assembly ensure that the ground lead is installed between the capacitor clamp and the drive casting.

Disk Guide Removal

1. Using a rubber band or tape restrain the head load arm to prevent damage to the head and load arm.
2. Loosen the 2 door screws to free the guide from the door (Figure 3-7D).

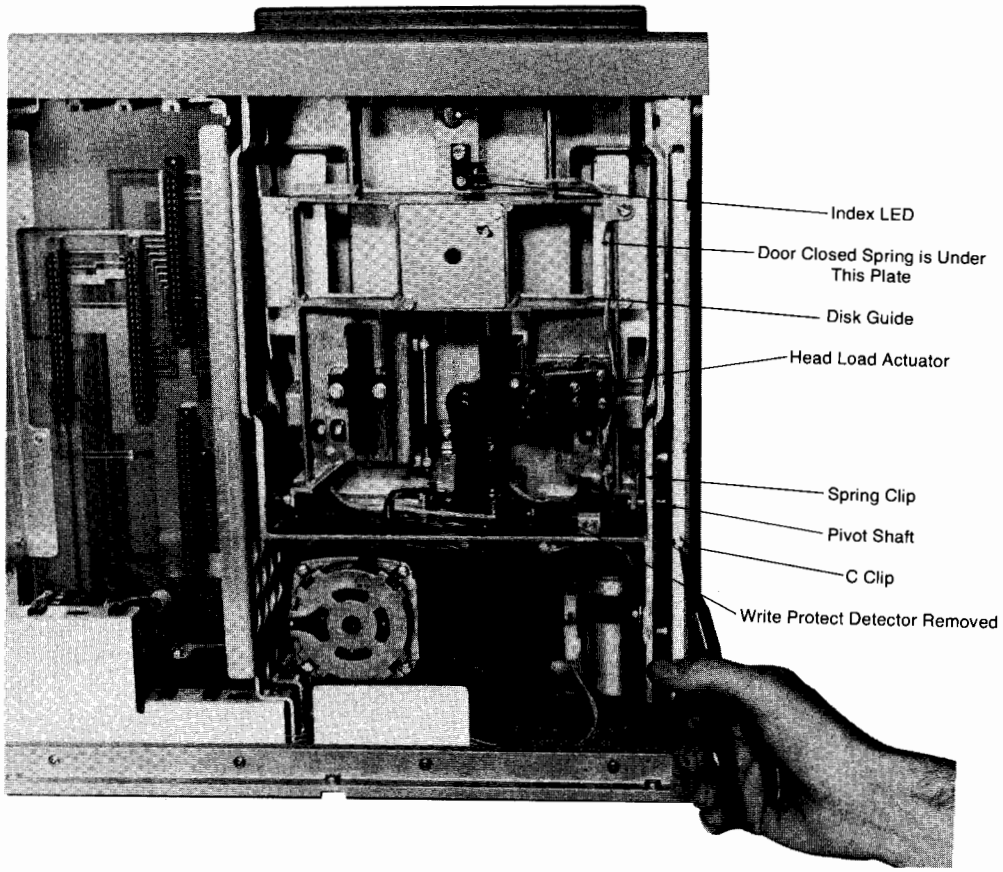


Figure 3-8. Removing the Disk Guide

3. Remove the write protect detector.
4. Using needlenose pliers remove the C-clip from the pivot shaft and remove the shaft (see Figure 3-8).
5. Remove the disk guide and the spring clip.
6. When exchanging the disk guide it is also necessary to remove the index LED and the head load actuator.
7. Perform the disk guide adjustment when installing the guide. Ensure that the spring on the door closed switch is properly installed when replacing the guide.
8. Perform the write protect adjustment.

Drive Motor Pulley Removal

1. Remove the A5 assembly.
2. Loosen the set screw and remove the pulley.

Write Protect Detector Removal

1. Remove the A5 assembly.
2. Remove pins 3, 4, E and J from A5 P5.
3. Remove the cable clamp which the wires go through.
4. Remove the screw holding the detector bracket and remove the detector (see Figure 3-3).
5. To reinstall, connect the wires as follows:

   Red – pin 3
   Gray – pin 4
   Black – pin E
   White – pin J
6. Perform the write protect adjustment.

Head Load Actuator Removal

1. Unsolder the two wires on the actuator terminals.
2. Remove the disk guide.
3. Remove the screw that holds the actuator to the guide.
4. Perform the disk guide alignment and the head load adjustments.

Index Detector Removal

1. Disconnect P5 from the A5 assembly.
2. Remove the wires from the door closed switch (see Figure 3-9).
3. Extract pins 6, 9, B and H from P5.
4. Remove the cable clamp holding the detector wires.
5. Remove the screw holding the detector to the drive casting and remove the detector.
6. To reinstall connect the wires as follows:

   Orange – pin B
   Brown – pin H
   Red – pin 6
   Black – pin 9
7. Perform the Index adjustments when reinstalling.

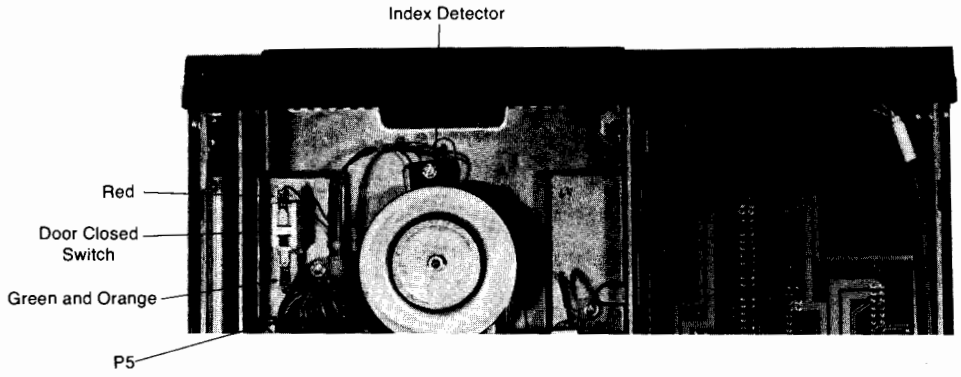


Figure 3-9. Removing the Index Detector

Index LED Removal

1. Unsolder the two wires connecting to the index LED.
2. Remove the screw holding the index LED assembly and remove the assembly.

Spindle Assembly Removal

1. Remove the disk guide and the drive belt.
2. Remove the nut and washer holding the spindle pulley.

> **CAUTION**
> THE PRE-LOADED REAR BEARING MAY FLY OUT WHEN THE SPINDLE PULLEY IS REMOVED.

3. Pull the spindle hub out from the top of the drive.
4. When installing, tighten the nut to 20 in-lbs.

Hub Clamp Removal

1. Remove the 2 screws holding the hub clamp plate.
2. Remove the hub clamp and spring.

Stepper/Carriage Assembly Removal

Removal

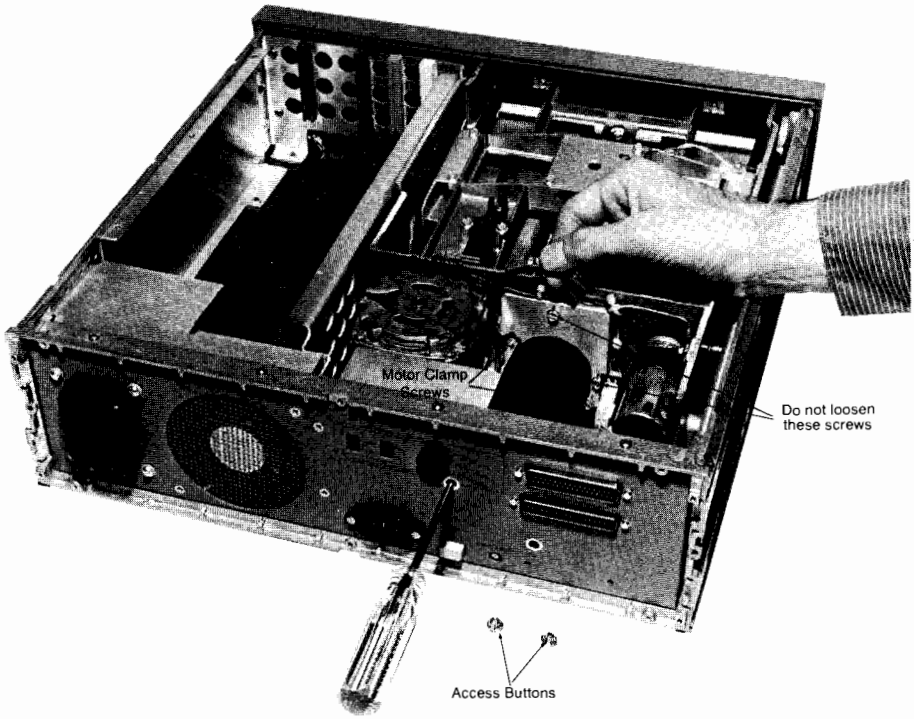
1. Remove the A5 assembly. Remove the clamp holding the read/write head cable (blue) to the bottom of the drive.
2. If the stepper motor is to be replaced, remove the stepper motor cable pins on A5 P5. Extract pins 2 – red, 5 – brown, 8 – orange and 10 – black. Remove the cable clamp.
3. Remove the 2 access buttons on the rear panel.
4. Loosen the two motor clamp screws and swing the clamp away from the motor (see Figure 3-10).

> **CAUTION**
> THE STEPPER MOTOR MOUNTING PLATE IS ALIGNED AT THE FACTORY. DO NOT LOOSEN THE THREE FACTORY SEALED SCREWS.

5. Remove the rubber grommet on the read/write head cable from its slot on the casting.

6. Turn the stepper motor until the carriage runs off the end of the lead screw. Remove the motor through the bottom of the drive.

A



B

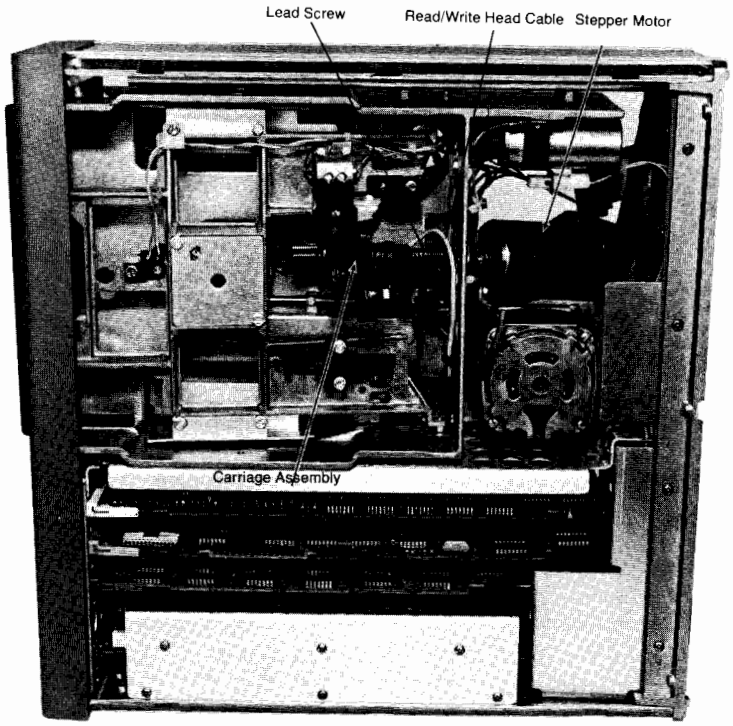


Figure 3-10. Stepper/Carriage Removal

Installation

7. If installing a new carriage, set the pre-load nut in notch 3 (see Figure 3-11).
8. When threading the lead screw into the carriage, press the pre-load nut slightly against the spring before engaging the lead screw in the threaded portion of the carriage. The gap between the pre-load nut and the rear of the carriage can vary depending on how the lead screw is threaded into the carriage. The gap should be approximately 1/16". After assembling, ensure that there is a gap between the pre-load nut and the rear of the carriage.
9. Perform the carriage adjustment.
10. Perform the head radial adjustment.
11. Perform the track 0 stop adjustment.
12. Perform the track 0 flag adjustment.
13. Perform the index adjustment.

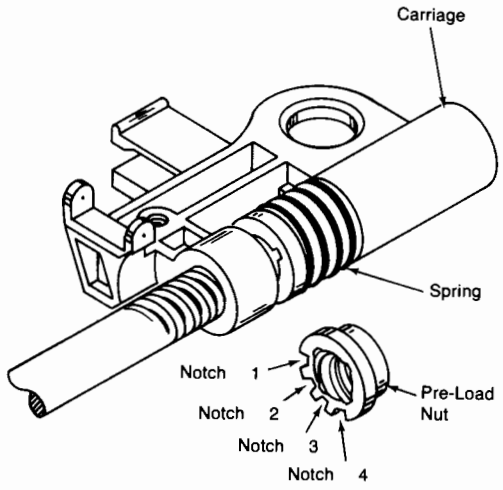


Figure 3-11. Setting the Pre-Load Nut

Head Load Button Removal

1. Hold the head load arm out away from the head.
2. To remove the button, squeeze the locking tabs together with a pair of needlenose pliers and press forward.
3. To install a button, press the button into the arm from the head side until it snaps into place.
4. Perform the head load button adjustment.

> **NOTE**
> When making adjustments ground the oscilloscope probes to the A5 PC assembly. Chassis is not ground for logic signals.

Mechanical Adjustments

Mechanical adjustments usually have to be made after an associated mechanical part has been replaced or removed for maintenance. All adjustments are made with the 9885 disconnected from the system and the Disk Service Fixture installed. See the Disk Service Fixture description in Chapter 2 to become familiar with the fixture.
Table 3-3 lists the various mechanical adjustments and when each should be performed.

Table 3-3. Mechanical Adjustments

Adjustment	Perform
Write Protect	After replacing or moving the write protect detector or the write protect LED.
Head Load Actuator Head Load Timing	After replacing the head load actuator (new).
Index	After replacing or moving the index detector or the index LED.
Disk Guide	After moving the disk guide or replacing it.
Carriage	After carriage replacement.
Head Alignment	After installing the stepper motor or carriage.
Head Load Button	After installing new load button.
Track 0 stop and flag	After installing the carriage or the track 0 detector.

Equipment Required

In addition to the tools required for assembly access, the following equipment is required to make the adjustments.

Table 3-4. Equipment Required

Voltmeter:
DC volts 1% accuracy
Oscilloscope:
horiz – 50 μsec/cm
vert – dual trace amplifier (50 mv/cm)
Disk Service Fixture

Alignment Disk

Disk Guide Alignment Tool

Head Load Alignment Tool

Three Scope Probes (10:1)

Write Protect Adjustment

This adjustment ensures that the write protect signal is at its maximum value when a protected disk is inserted in the drive.

1. Insert a disk into the drive. The write protect hole must be open.
2. Connect channel A of the oscilloscope to U23 pin 6 on A5. Set up the scope as follows:

   horizontal time base – 100 μsec/cm
   vertical amplifier –.2V/cm
   input – DC
   sync – INT
   display – A
3. Loosen the screw on the write protect detector and move the detector until maximum amplitude is seen on the scope.
4. Tighten the screw.

Head Load Actuator Adjustment

This adjustment ensures the proper mechanical clearances are met when the head load actuator is energized (head loaded) and deenergized (head unloaded).

1. Remove the disk and close the door. Energize the head load coil.
2. Place the head load tool on the drive casting (see Figure 3-12).
3. Adjust the down stop so that the top of the head load bail is flush with the top of the tool (±.005").
4. Step the carriage to track 38 and de-energize the head load coil (turn drive off).
5. Place the adjustment tool onto the read/write head and place the load button in the cup of the tool.
6. Adjust the up stop on the actuator so that the bail just touches the head load arm (±.005").
7. Energize the head load coil and manually step the carriage from track 0 through track 76. Ensure that there is at least .01" clearance between the head load bail and the head load arm.

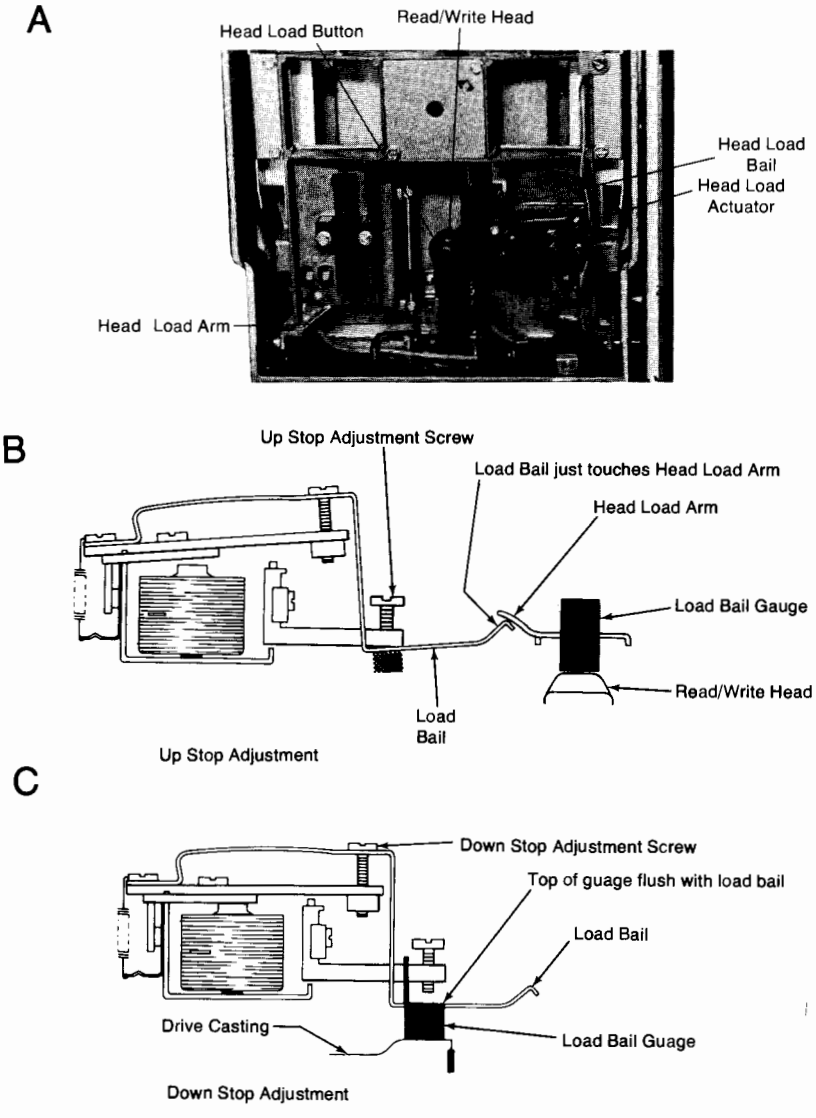


Figure 3-12. Head Load Stop Adjustments

Head Load Timing

This adjustment ensures that the head is loaded and full read amplitude is present within 35 milliseconds after the head load signal is sent.

1. Insert the alignment disk.
2. Step the carriage to track 0.
3. Set up the oscilloscope as follows:

   horizontal time base – 5 msec/cm
   vertical amplifier – .5Vcm
   input – AC
   sync – EXT+
   display – A+B, INVERT B

Computer Museum

4. Connect the scope probes as follows:

   Channel A – A5TP10 } (read preamplifier)
   Channel B – A5TP11 }
   sync – head load actuator (blue wire)

5. Energize the head load coil and observe the read signal (see Figure 3-13). The signal must be at full amplitude within 35 milliseconds. If not, proceed with step 6.
6. Check the head load actuator adjustments. If the adjustments are correct, adjust the down stop screw clockwise until the timing is within specs.

> **NOTE**
> Do not exceed 1/4 turn.

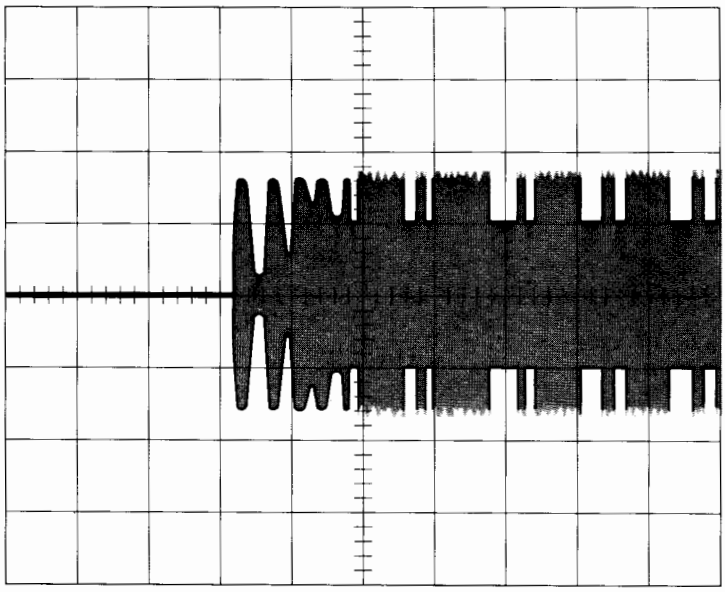


Figure 3-13. Head Load Timing Waveform

Index Adjustment

This adjustment ensures that the index pulse occurs before the start of the sector 0 data.

1. Insert the alignment disk.
2. With an oscilloscope, monitor A5TP4 (Index). Set the scope as follows:

   horizontal time base – .5msec/cm
   vertical amplifier – .2V/cm
   input – DC
   sync – INT
   display – A
3. Adjust the index potentiometer on the index phototransistor to obtain a 1.7 msec pulse ±.5 msec (see Figure 3-14).
4. Step the carriage to track 1.
5. Set the oscilloscope as follows:

   horizontal time base – 50μsec/cm
   vertical amplifier – 100mv/cm
   input – AC
   sync – EXT+, DC or ACF
   display – A+B, B inverted
6. Connect the sync probe to A5TP4 (Index).
   Connect channel A to A5TP10 } (read preamplifier)
   Connect channel B to A5TP11 }
7. The timing between the start of the sweep and the first data pulse should be 200 ± 100 μsec (see Figure 3-15). If the timing is not in tolerance, continue with this procedure.
8. Loosen the screw holding the index phototransistor assembly.
9. Move the assembly until the timing in step 7 is met; then tighten the screw.
10. Step the carriage to track 76 and verify that the timing is 200 ± 50 μsec.

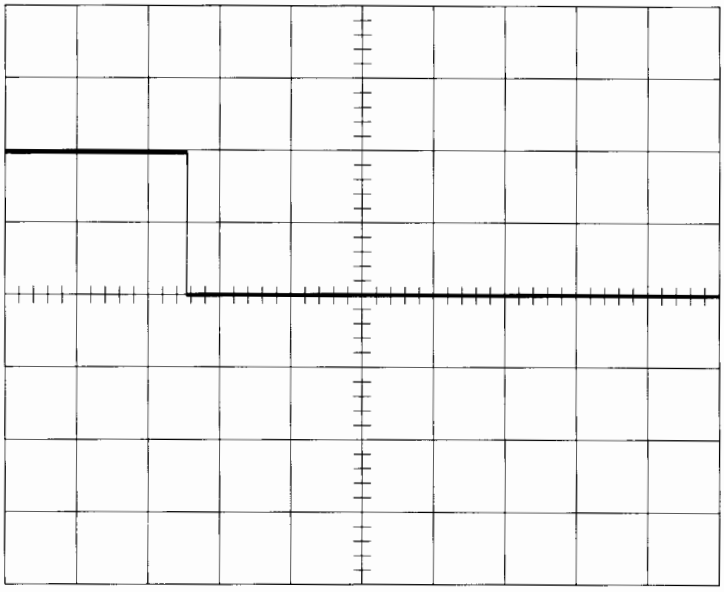


Figure 3-14. Index Pulse Waveform

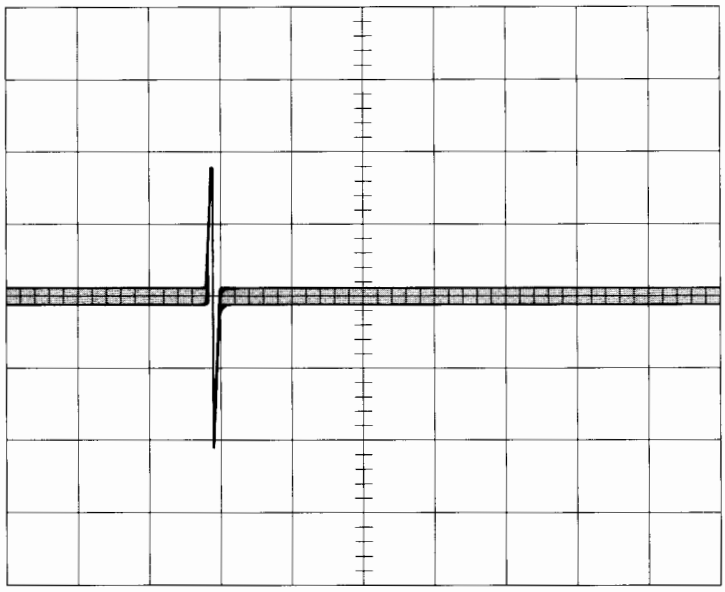


Figure 3-15. Index Timing Waveform

Disk Guide Adjustment

This adjustment ensures that there is enough clearance between the disk guide and the flexible disk when the disk is installed.

1. Insert the disk guide alignment tool through the adjustment hole in the disk guide (see Figure 3-16) and screw it into the base casting (hand tighten).
2. Move the door to the latched position and hold it up against the latch.
3. Tighten the two screws to hold the disk guide to the door. Check to see that the door is straight.
4. Remove the tool and ensure that the hub clamp does not rub on the disk guide when the spindle is rotating.
5. If the hub clamp rubs, repeat the procedure.
6. Check the index alignment.
7. Insert a disk; close and open the door and check for proper operation.

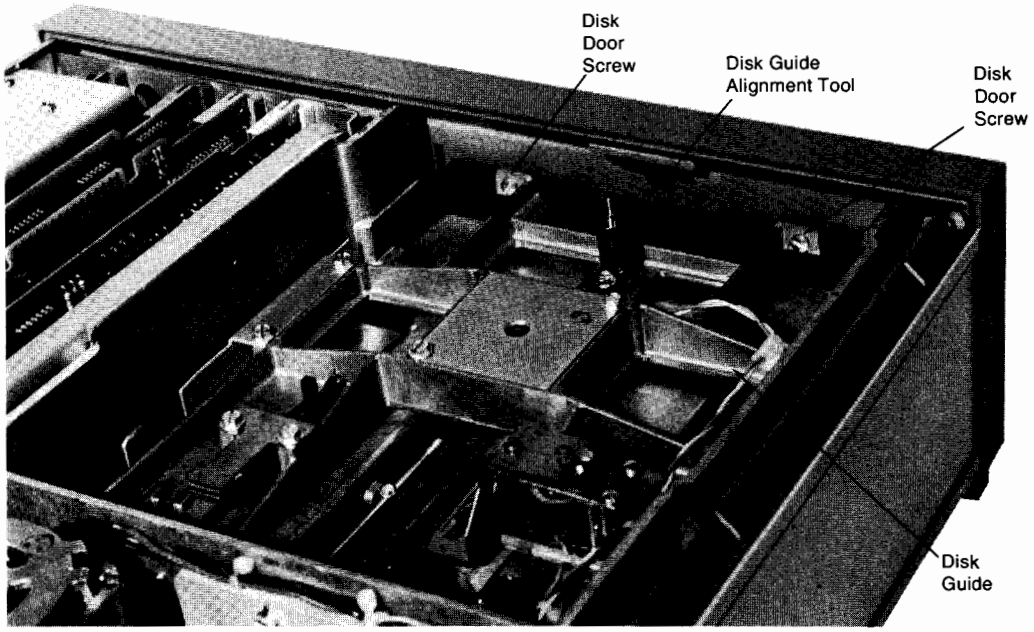


Figure 3-16. Disk Guide Adjustment

Carriage Adjustment

This is a rough adjustment which is done when the carriage assembly is replaced. This adjustment is in preparation for the head radial alignment.

1. Loosen the stop collar lock screw and manually rotate the lead screw to move the carriage towards the stepper motor, until the head load arm tab is near the end of the load bail and the back of the load arm is flush with the casting. Tighten the collar set screw.
2. Position the track 0 tab approximately in the center of its slot in the track 0 detector and tighten the screw (see Figure 3-17).

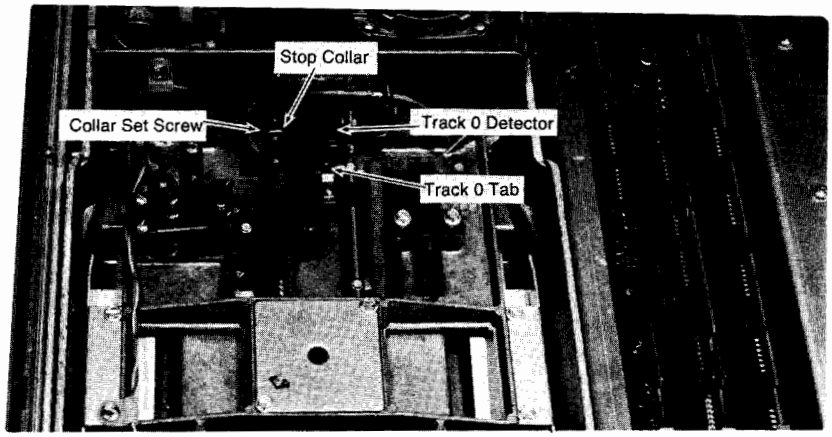


Figure 3-17. Carriage Adjustment

3. Move the carriage out towards the spindle until the tab is clear of the track 0 detector.
4. Set the oscilloscope as follows:

   horizontal time base – 5msec/cm
   vertical amplifier –.1V/cm

input – AC
sync – EXT.+, DC
display A+B, B inverted

5. Insert the alignment disk and load the head.
6. Step the carriage back until the track 0 lamp on the DSF lights.
7. Connect the sync probe to A5TP4 (Index).
   Connect channel A to A5TP10 } (read preamplifier)
   Connect channel B to A5TP11 }
8. Loosen the 2 stepper motor mounting screws and rotate the stepper motor case until the track 0 data appears on the scope (see Figure 3-18). Rotate until maximum amplitude is obtained and tighten the mounting screws. This is only a rough adjustment.

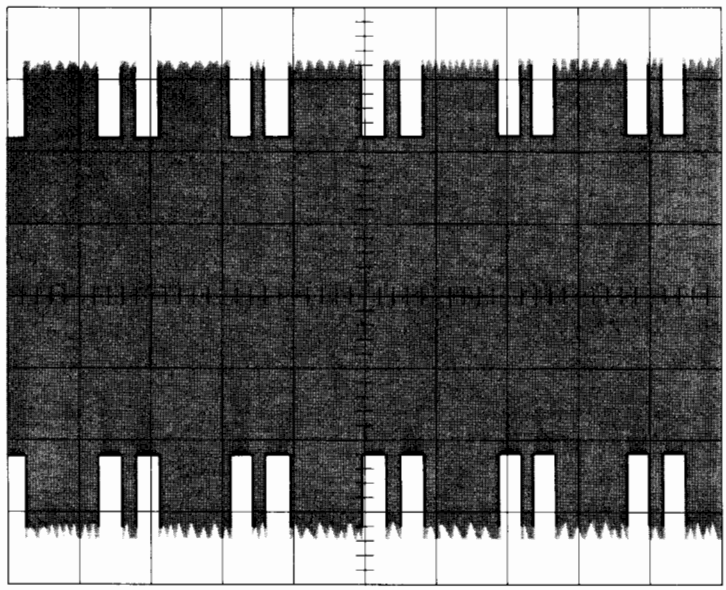


Figure 3-18. Track 0 Data Pattern

CAUTION
DO NOT LOOSEN THE THREE FACTORY SEALED SCREWS.

Head Radial Alignment

This adjustment ensures that the read/write head is aligned to read the center of a desired track. When this adjustment is done properly, the drive will be compatible with other drives.

NOTE
This alignment should be checked before adjusting index, track 0 flag and track 0 stop.

1. Load the alignment disk. The disk should be at room temperature for at least twenty minutes before alignment.
2. Step the carriage to track 38.

3. Set up the oscilloscope as follows:

   horizontal time base – 20 msec/cm
   vertical amplifier – 50 mv/cm
   input – AC
   sync – EXT+, DC
   display – A+B, B inverted

4. Connect the sync probe to A5TP4 (Index).
   Connect channel A to A5TP10 } (read preamplifier)
   Connect channel B to A5TP11 }

5. The lobes on the waveform shown on the oscilloscope should be within 90% amplitude of each other (see Figure 3-19). If the amplitude is not proper, continue with this procedure.
6. Loosen the two stepper motor mounting screws.

CAUTION
DO NOT LOOSEN THE THREE FACTORY SEALED SCREWS.

7. Rotate the stepper motor until the amplitude of the lobes is the same. Tighten the motor screws.
8. Check the alignment by stepping from track 38 and then returning to it. Do this from both directions, re-adjust the stepper motor if necessary. The waveform may be slightly different; this is acceptable as long as the lobes are within 90%.
9. Perform the track 0 flag and stop adjustments.

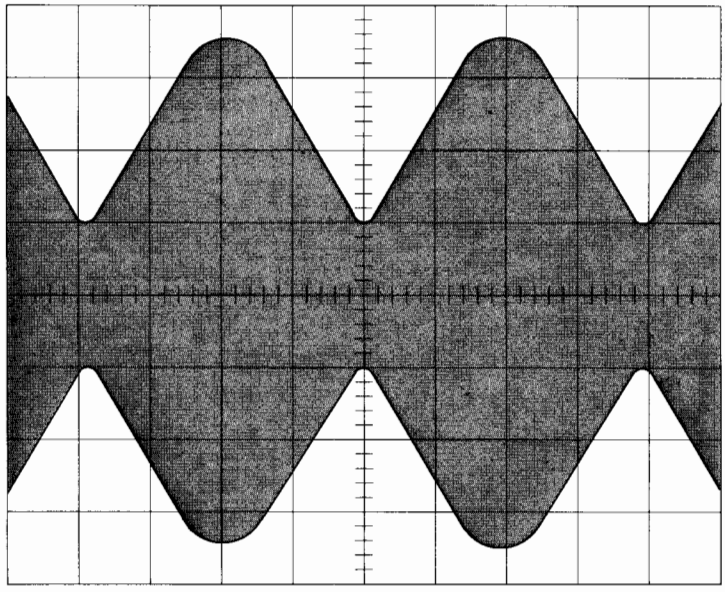


Figure 3-19. Head Alignment Waveform

Track 0 Flag Adjustment

This adjustment ensures that the track 0 signal is high (true) on tracks 0 and 1, and low (false) on other tracks.

1. Check the Head Radial Adjustment before making this adjustment.

2. Set the oscilloscope as follows:

   horizontal time base – 20 msec/cm
   vertical amplifier – .1 V/cm
   input – DC
   sweep – auto
   display – A

3. Step the carriage to track 1; the voltage on A5TP3 should be high (+5 volts).
4. If not high, loosen the track 0 tab screw and move the tab towards the stepper until A5TP3 just goes high. Tighten the screw.
5. Check the adjustment by stepping the carriage between tracks 0 and 2. TP3 should be high at tracks 0 and 1, and low at track 2.

Track 0 Stop Adjustment

The track 0 stop adjustment sets a mechanical stop for the carriage assembly to prevent damage to the assembly. The head radial alignment should be correct before performing this adjustment.

1. Step carriage to track 0.
2. The distance between the back of the carriage and the stop collar should be .040" ± .020" (see Figure 3-20). Loosen the collar set screw and slide the collar until the distance is met. Tighten the set screw.
3. Switch the drive off and manually rotate the lead screw clockwise until the carriage stops. In this position, the distance between the carriage and collar should be .020" ± .010".
4. If clearances in steps 2 and 3 are not met, proceed with this procedure.
5. Loosen the stop collar.
6. Step the carriage to track –1.
7. Position the stop collar so there is .020" ± .010" between the carriage and the stop collar.
8. Rotate the collar until the stop contacts the carriage stop surface. Tighten the screw.
9. Set the oscilloscope as follows:

   horizontal time base – 20msec/cm
   vertical amplifier – 50 mv/cm
   input – AC
   sync – EXT+
   display A+B, B inverted

10. Connect the sync probe to A5TP4 (Index).
    Connect channel A to A5TP10 } (read preamplifier)
    Connect channel B to A5TP11 }
11. Step the carriage to track 0. Check the track 0 data pattern with the scope.
12. Step the carriage between track 0 and 76. Check for binding and head cable interference.

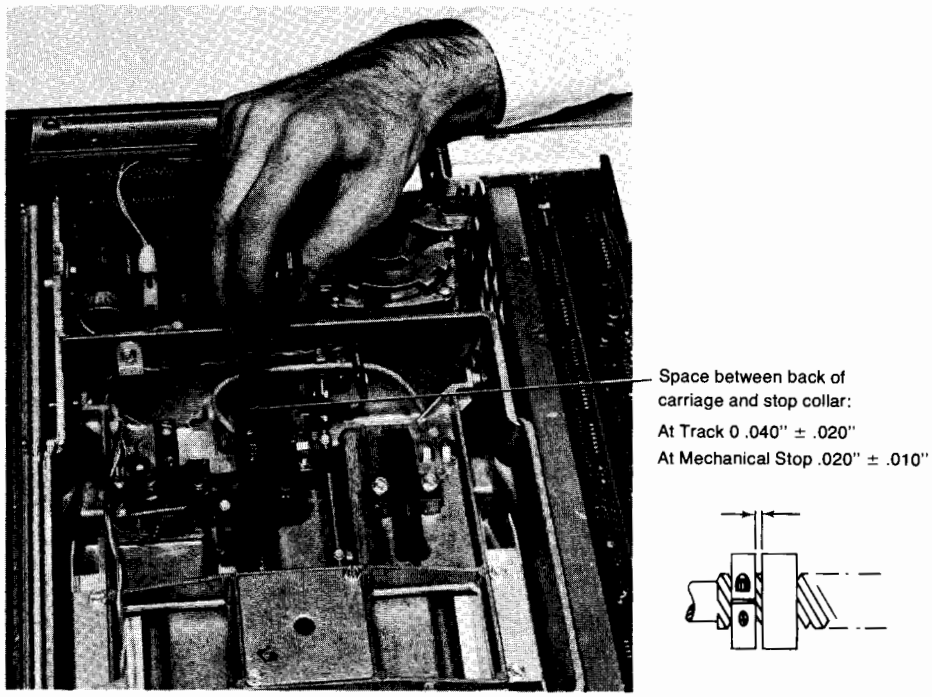


Figure 3-20. Track 0 Stop Adjustment

Head Load Button Adjustment

This adjustment ensures that the head load button is positioned so that maximum amplitude is obtained from the read/write head.

1. Insert alignment disk.
2. Set up the oscilloscope as follows:

   horizontal time base – 20 msec/cm
   vertical amplifier – 50 mv/cm
   input – AC
   sync – EXT+
   display – A+B, B inverted

3. Connect the sync probe to A5TP4 (Index).
   Connect channel A to A5TP10 } (read preamplifier)
   Connect channel B to A5TP11 }
4. Step to track 75.
5. Rotate the load button 10 ° at a time until maximum amplitude is obtained.

Adjustment – When to do it

Here is a summary of the adjustments to perform when replacing some of the more common drive assemblies.

Replace track 0 detector – 0955-0088

- Check head radial alignment
- Adjust track 0 flag
- Adjust track 0 stop

Replace index LED – 1150-1313, index phototransistor – 1150-1316

- Adjust index potentiometer
- Adjust index timing

Replace head load actuator (disk guide removed) – 1150-1311

- Adjust disk guide
- Adjust head load actuator
- Adjust head load timing
- Adjust write protect

Replace head load button – 1535-3648

- Adjust load button
- Check head amplitude

Replace carriage – 1150-1315, stepper assembly – 3140-0582

- Adjust carriage
- Head Radial Alignment
- Adjust load button
- Adjust track 0 flag
- Adjust track 0 stop
- Adjust index
- Check head amplitude

Electrical Checks and Adjustments

Power Supply Voltages

The various voltages in the 9885 should be checked for proper values. Table 3-5 lists the power supply voltages and the voltage tolerance of each supply.

Figure 3-21 shows the test points used to check each voltage.

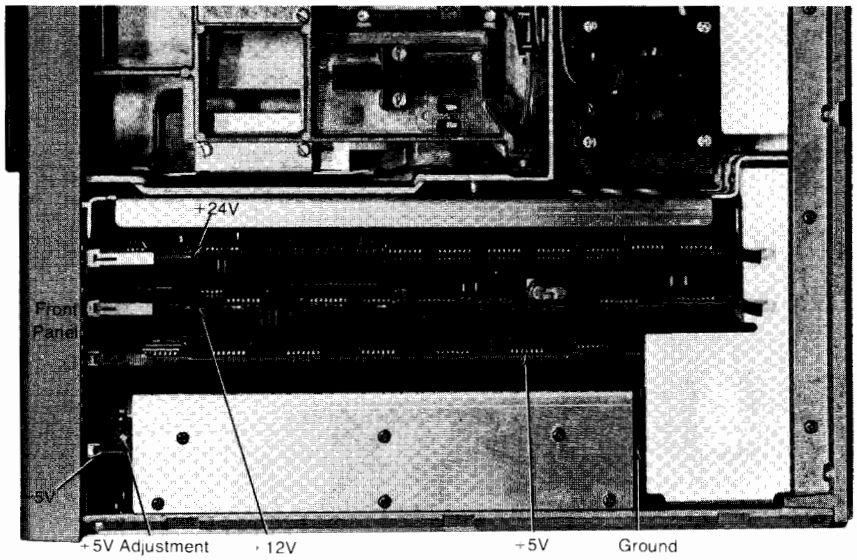


Figure 3-21. Power Supply Test Points

The +5V supply is the only adjustable supply. The adjustable potentiometer is shown in Figure 3-21.

Table 3-5.

Power Supply	Tolerance
+5V	±2%
−5V	±5%
+12V	±2%
+24V	±2%

Head Amplitude Check

The head amplitude check verifies that the read signal amplitude is sufficient to avoid read errors.

1. Install a known good disk.
2. Step to track 76.
3. Set the oscilloscope as follows:

   horizontal time base – 20 msec/cm
   vertical amplifier – 50 mv/cm
   input – AC
   sync – EXT+
   display – A+B, B inverted

4. Connect the sync probe to A5TP4 (Index).
   Connect channel A to A5TP10 } (read preamplifier)
   Connect channel B to A5TP11 }

5. Write all ones on track 76.
6. The average minimum read back amplitude peak to peak should be 120 millivolts (see Figure 3-22). If this amplitude is below the minimum specified, the load pad should be replaced and the head should be cleaned if necessary before rewriting and rechecking. If the output is still low, it will be necessary to install a new head and carriage assembly.
7. Write all zeros on track 76.
8. The ratio of the amplitude with zeros to the amplitude with ones should be less than 3.

   i.e., $\frac{\text{Zero Amplitude}}{\text{One Amplitude}} < 3$

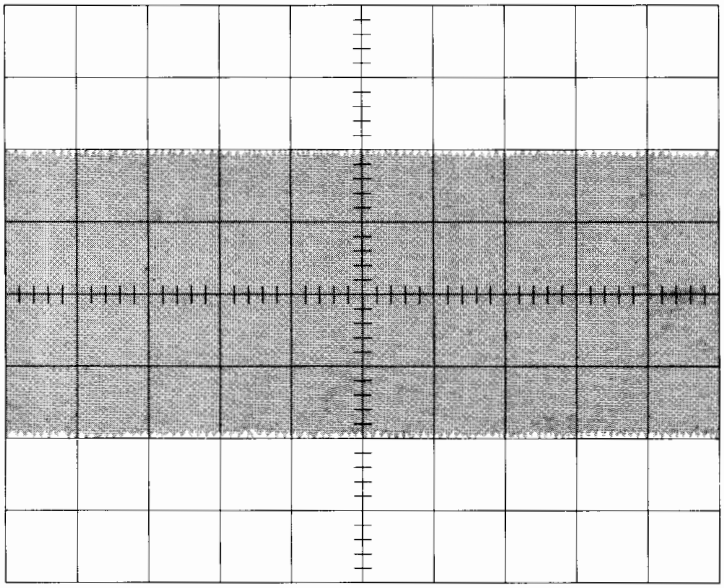


Figure 3-22. Head Amplitude Waveform

Read Amplifier Balance

This adjustment ensures that the read amplifier is properly balanced. This adjustment should be checked when the A5 assembly or read/write head is changed, and during a normal PM procedure.

1. Install a known good disk.
2. Step to track 66.
3. Set the oscilloscope as follows:

   horizontal time base – .5 μsec/cm
   vertical amplifier – 20 mv/cm
   input – DC
   sync – internal –
   display – A
4. Connect channel A to the digital read signal, TP2 on A5.
5. Write all 1's on track 66.
6. Read track 66. Adjust R17 so the center pulse is converged to one pulse (see Figure 3-23).

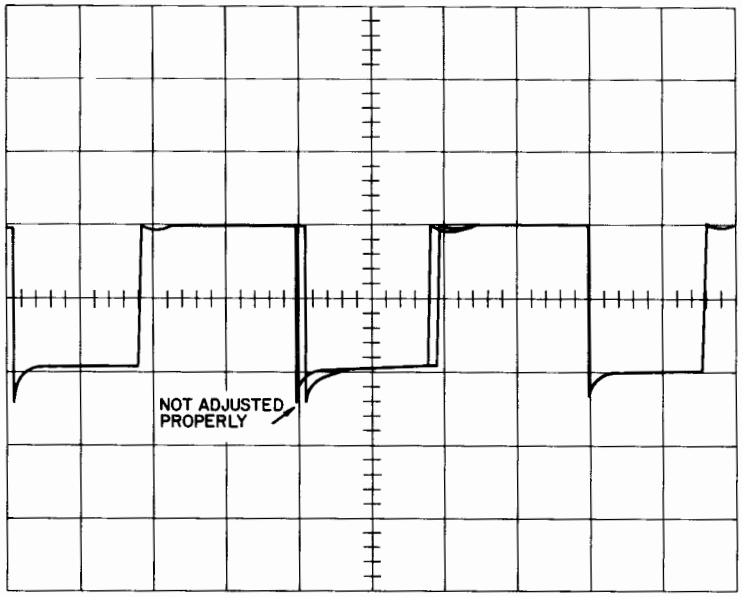


Figure 3-23. Read Amplifier Balance

Chapter 4
Troubleshooting

Introduction

The information in this chapter and the theory of operation (Chapter 2) will help you troubleshoot and repair the 9885.

Isolating the Problem

Incorrect operating procedures, faulty programming, damaged disks, and "soft errors" created by airborne contaminants, random electrical noise, and other external causes can produce errors falsely attributed to drive failure or misadjustment.

Unless visual inspection of the drive discloses an obvious misalignment or broken part, attempt to repeat the fault with the original disk, then attempt to duplicate the fault on a second disk.

Soft Errors

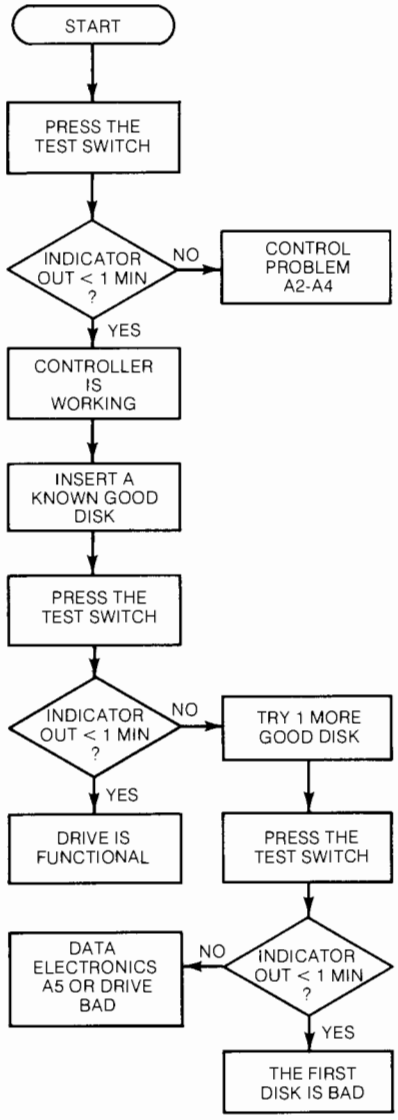
Soft errors are usually caused by:

1. Airborne contaminants that pass between the read/write head and the disk. Usually these contaminants can be removed by the cartridge self-cleaning wiper on the inside of the envelope.
2. Random electrical noise that usually lasts for a few microseconds.
3. Small defect in the written data and/or track that may cause a soft error during a read.
4. Worn or defective load pad.

Troubleshooting with Self Test

To isolate a problem using self test, first disconnect the 9885M from the calculator interface cable. All the drives in the system should be switched on with the disk doors closed. At this time disks should not be installed in the drives. With these initial conditions set, use the self test troubleshooting trees below.

SINGLE DRIVE SYSTEM



MULTIPLE DRIVE SYSTEM

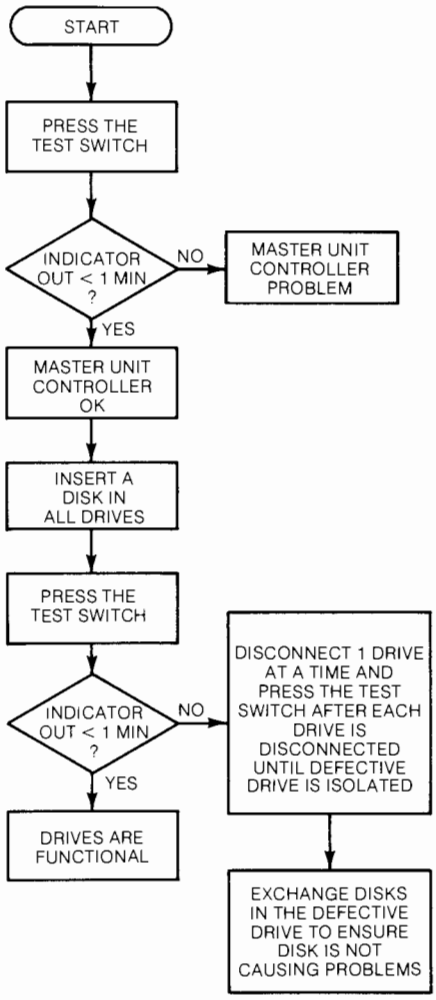


Figure 4-1. Self Test Troubleshooting Trees

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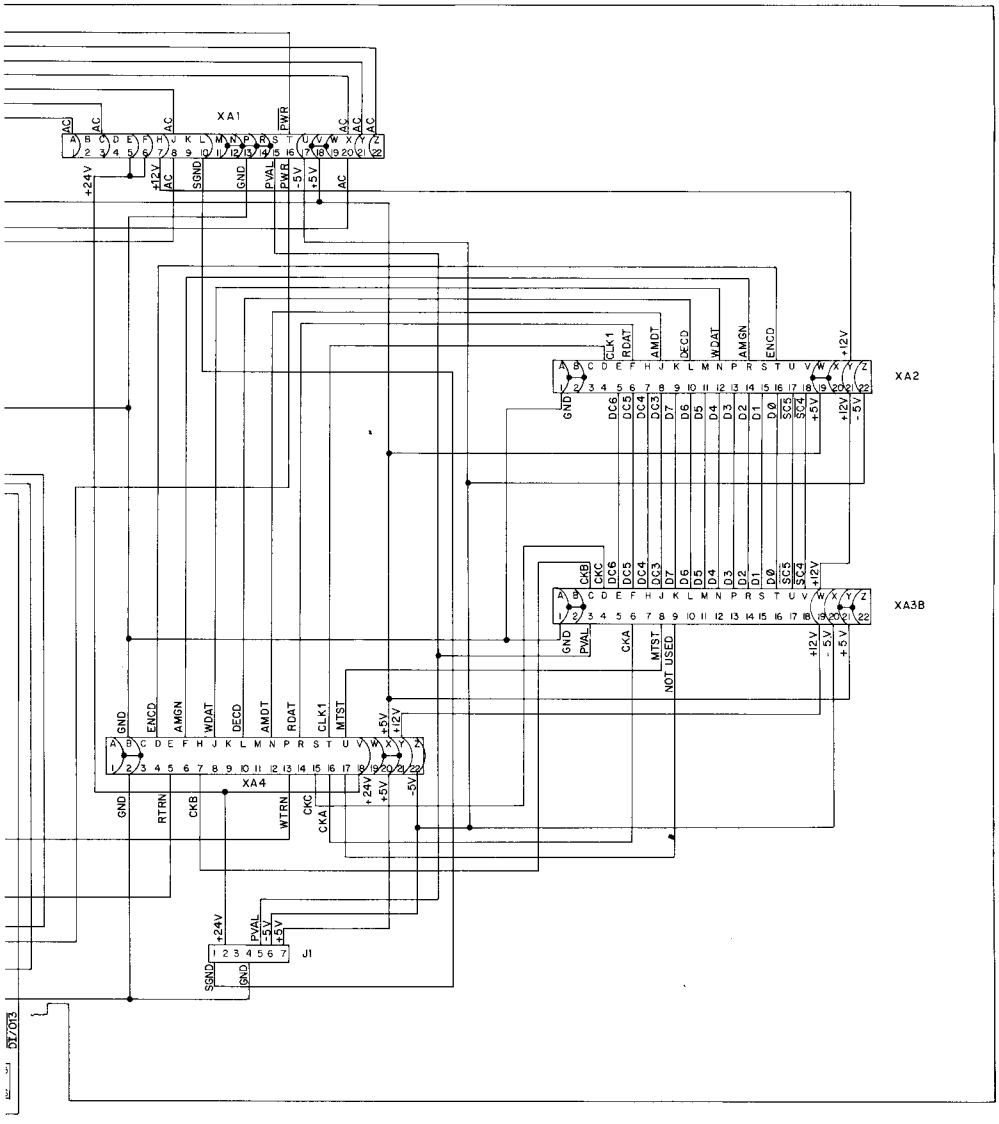
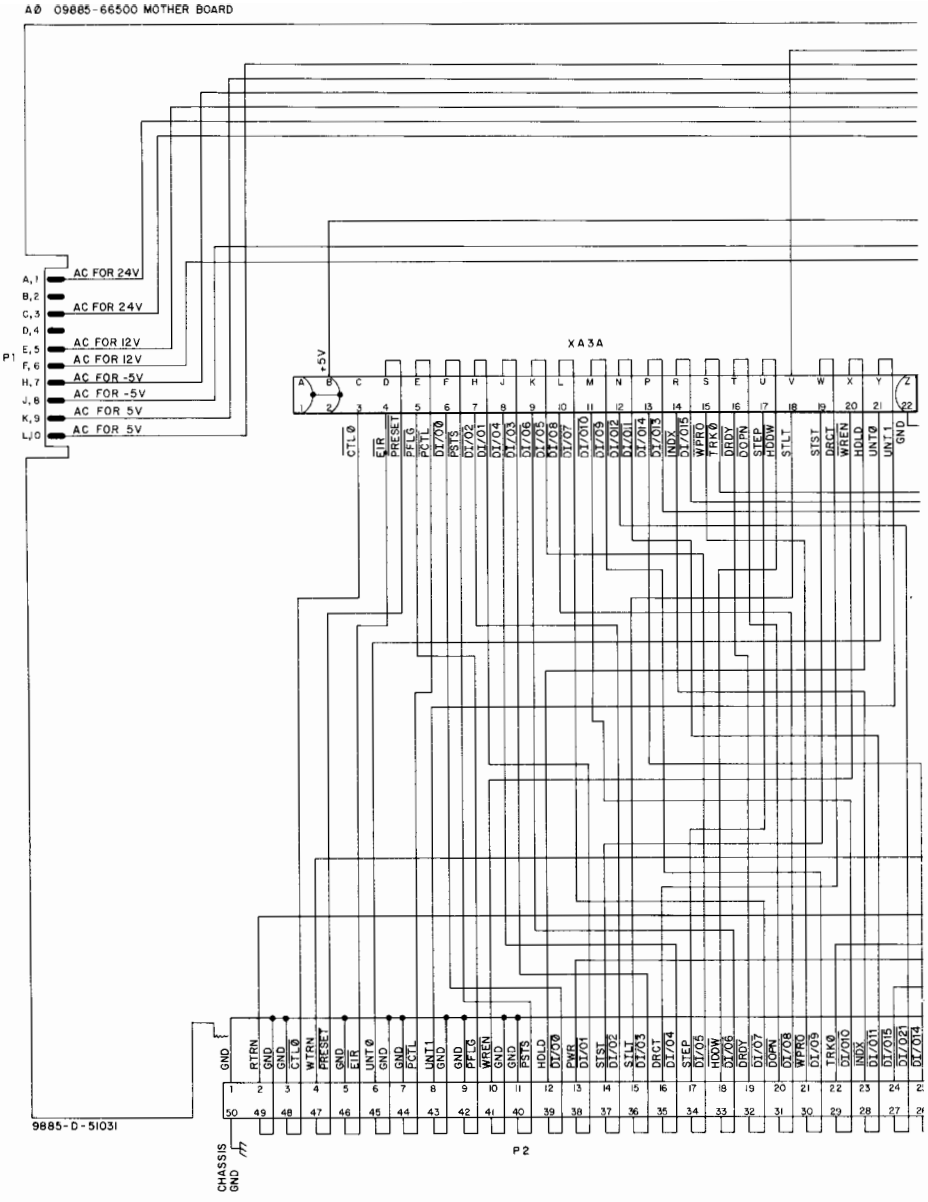
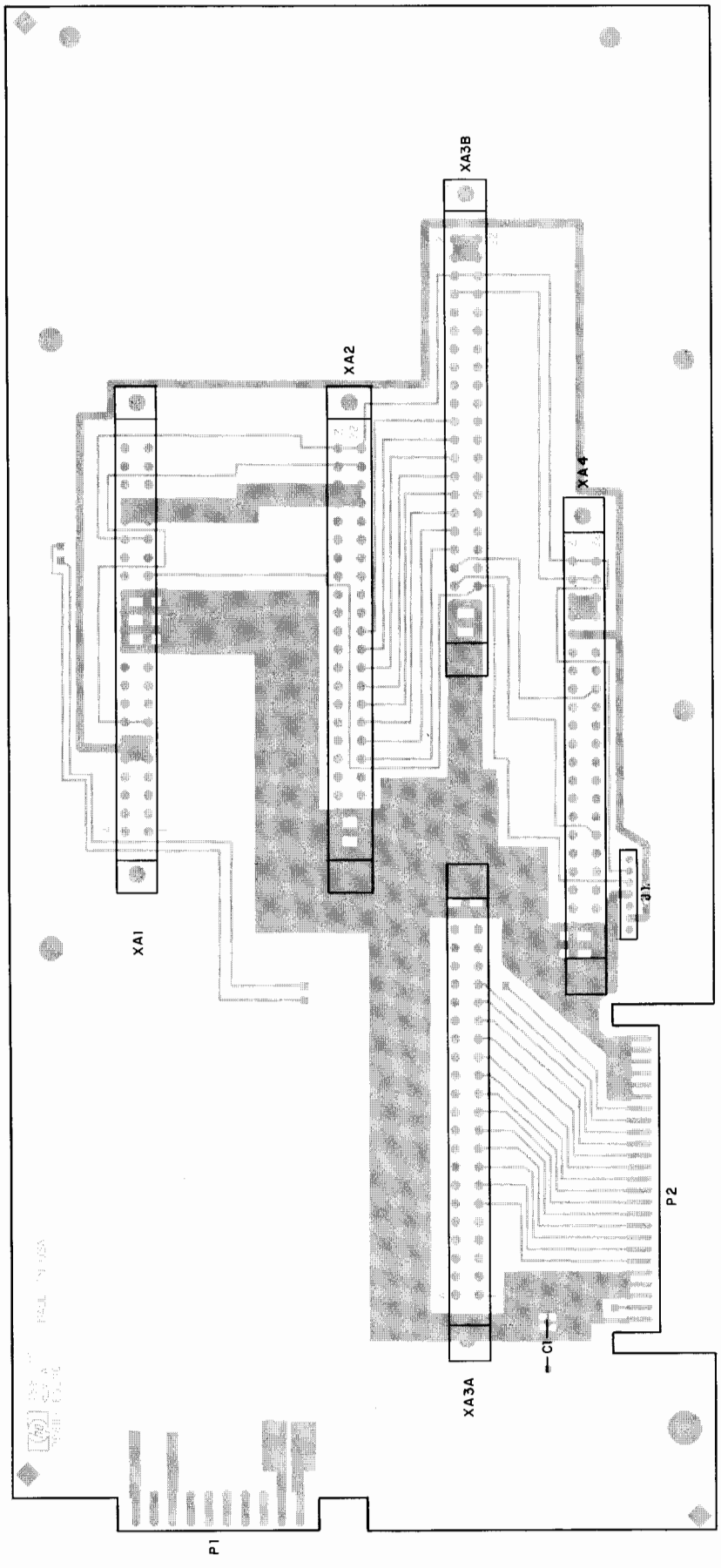


Figure 4-2. A0 Motherboard Assembly Schematic Diagram


A0 09885-66500 MOTHER BOARD
P1
A,1 AC FOR 24V
B,2
C,3 AC FOR 24V
D,4
E,5 AC FOR 12V
F,6 AC FOR 12V
H,7 AC FOR -5V
J,8 AC FOR -5V
K,9 AC FOR 5V
L,0 AC FOR 5V
XA3A
+5V
CTL0
EIR
PRESET
PFLG
PCTL
DI/00
PSTS
DI/02
DI/01
DI/04
DI/03
DI/06
DI/05
DI/08
DI/07
DI/010
DI/09
DI/012
DI/011
DI/014
DI/013
INDX
DI/015
WPRO
TRK0
DRDY
DOPN
STEP
HDOW
STLT
STST
DRCT
WREN
HOLD
UNT0
UNT1
GND
9885-D-51031
P2
CHASSIS GND
GND
RTRN
GND
GND
CTL0
WTRN
PRESET
GND
EIR
UNT0
GND
GND
PCTL
UNT1
GND
GND
PFLG
WREN
GND
GND
PSTS
HOLD
DI/00
PWR
DI/01
STST
DI/02
STLT
DRCT
DI/04
STEP
DI/05
HDOW
DI/06
DRDY
DI/07
DOPN
DI/08
WPRO
DI/09
TRK0
DI/010
INDX
DI/011
DI/015
DI/021
DI/014



COMPONENT SIDE

A0

-hp- Part No. 09885-66500 Rev A

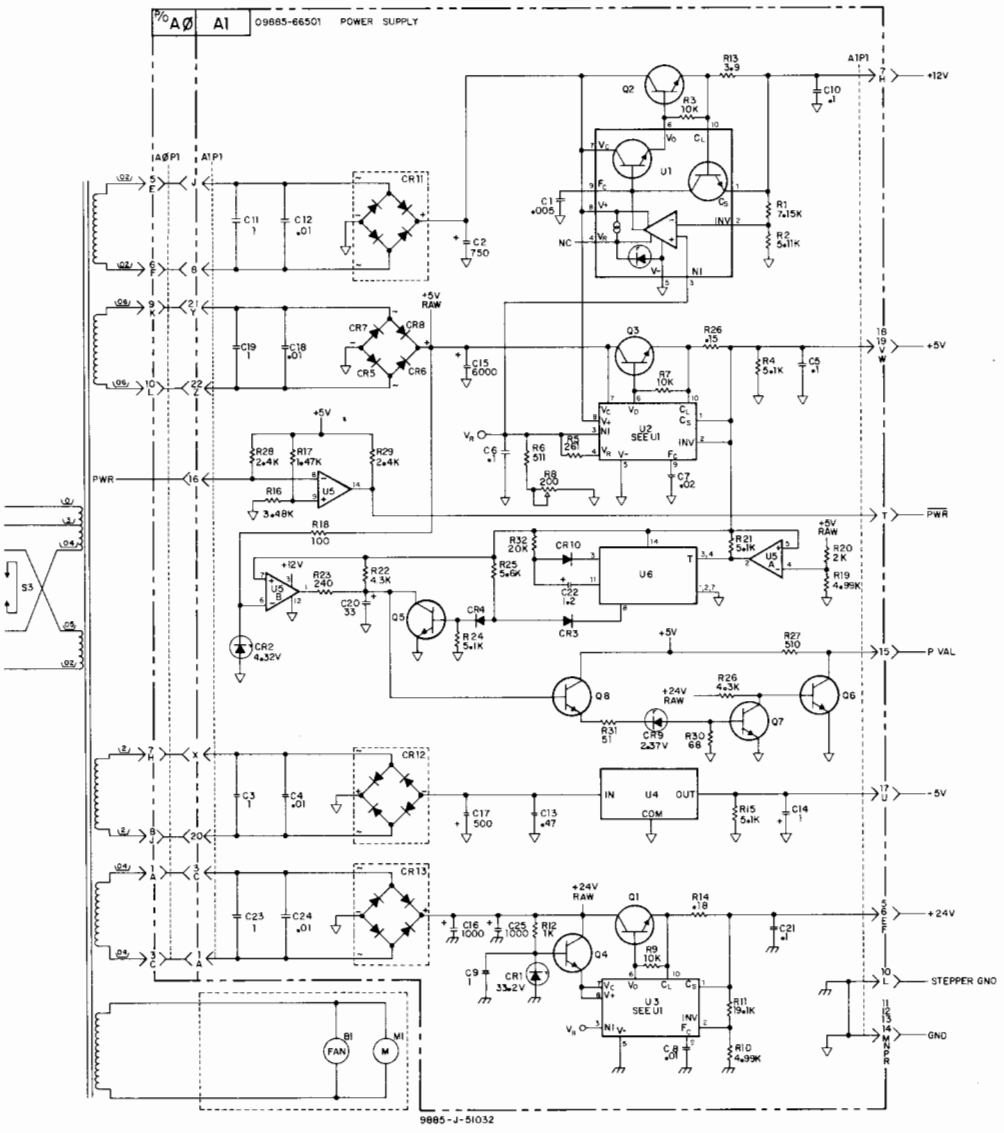
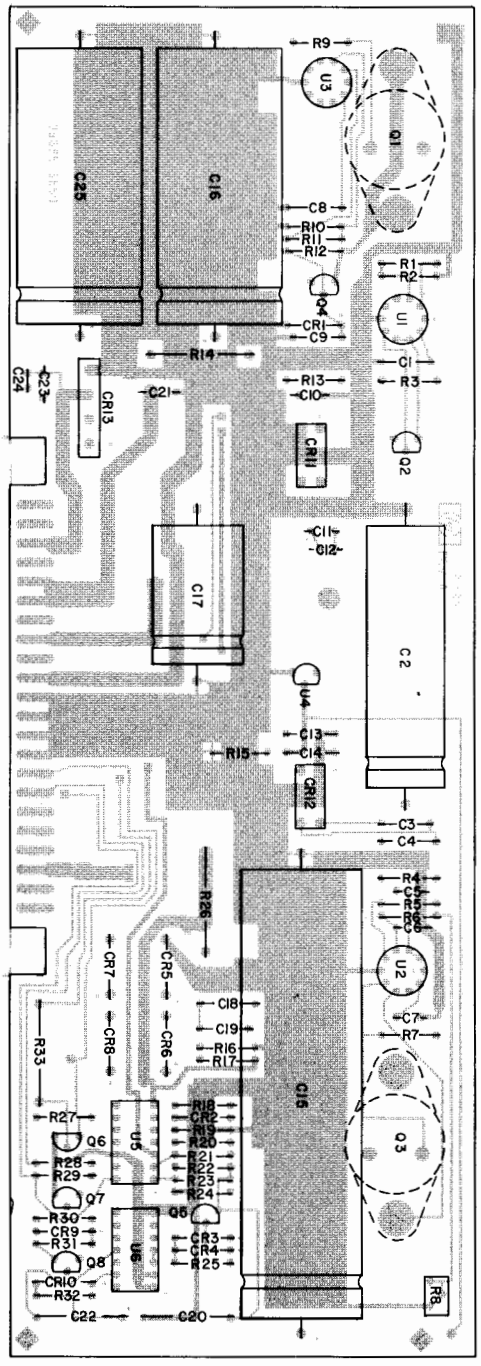
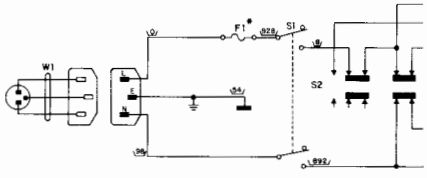


Figure 4-3. A1 Power Supply Assembly Schematic Diagram

A1P1





* F1 IS 3A FOR 110/120 VAC OPERATION
F1 IS 2A FOR 220/240 VAC OPERATION

COMPONENT SIDE

A1

-hp- Part No. 09885-66501 Rev A

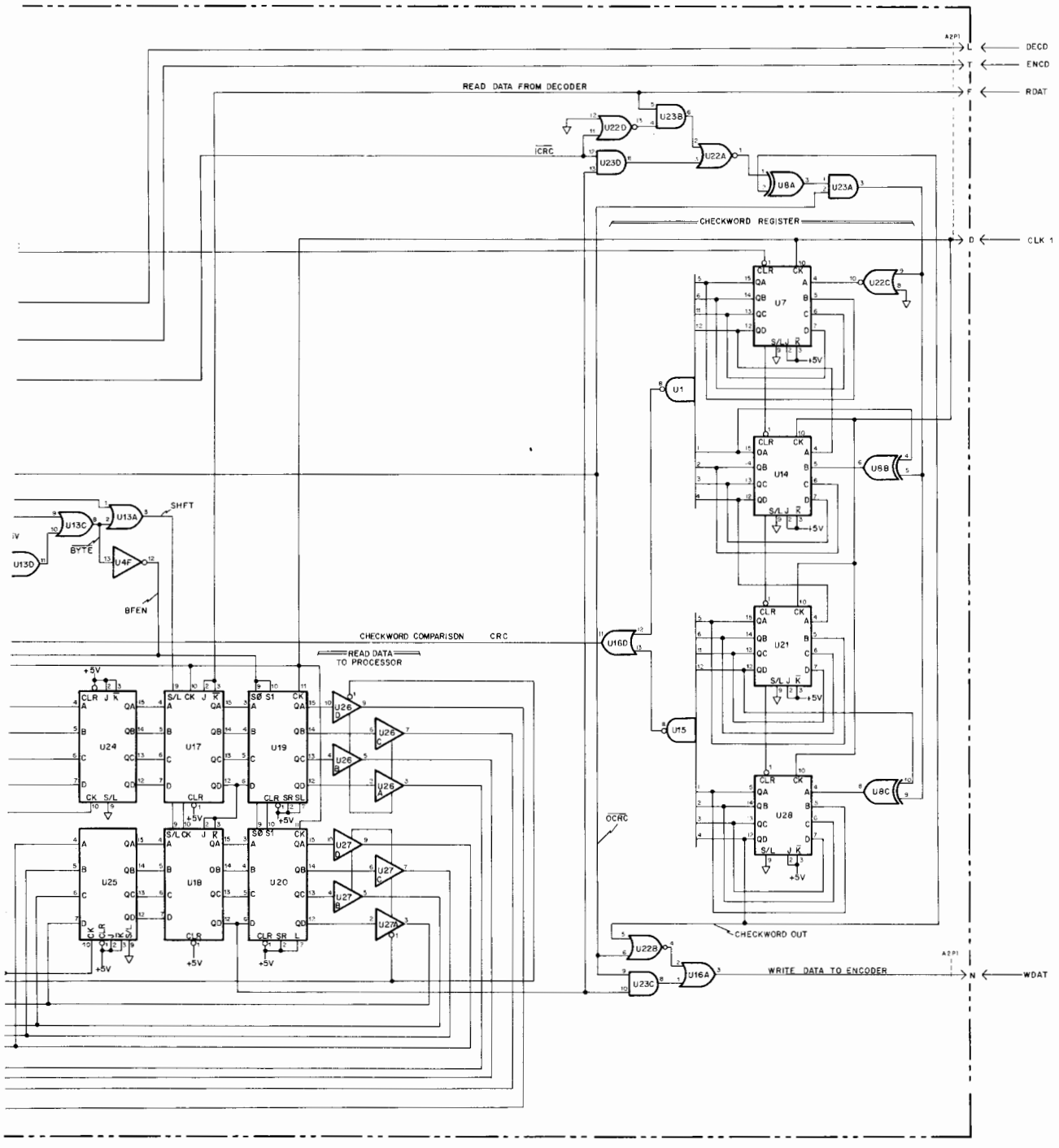
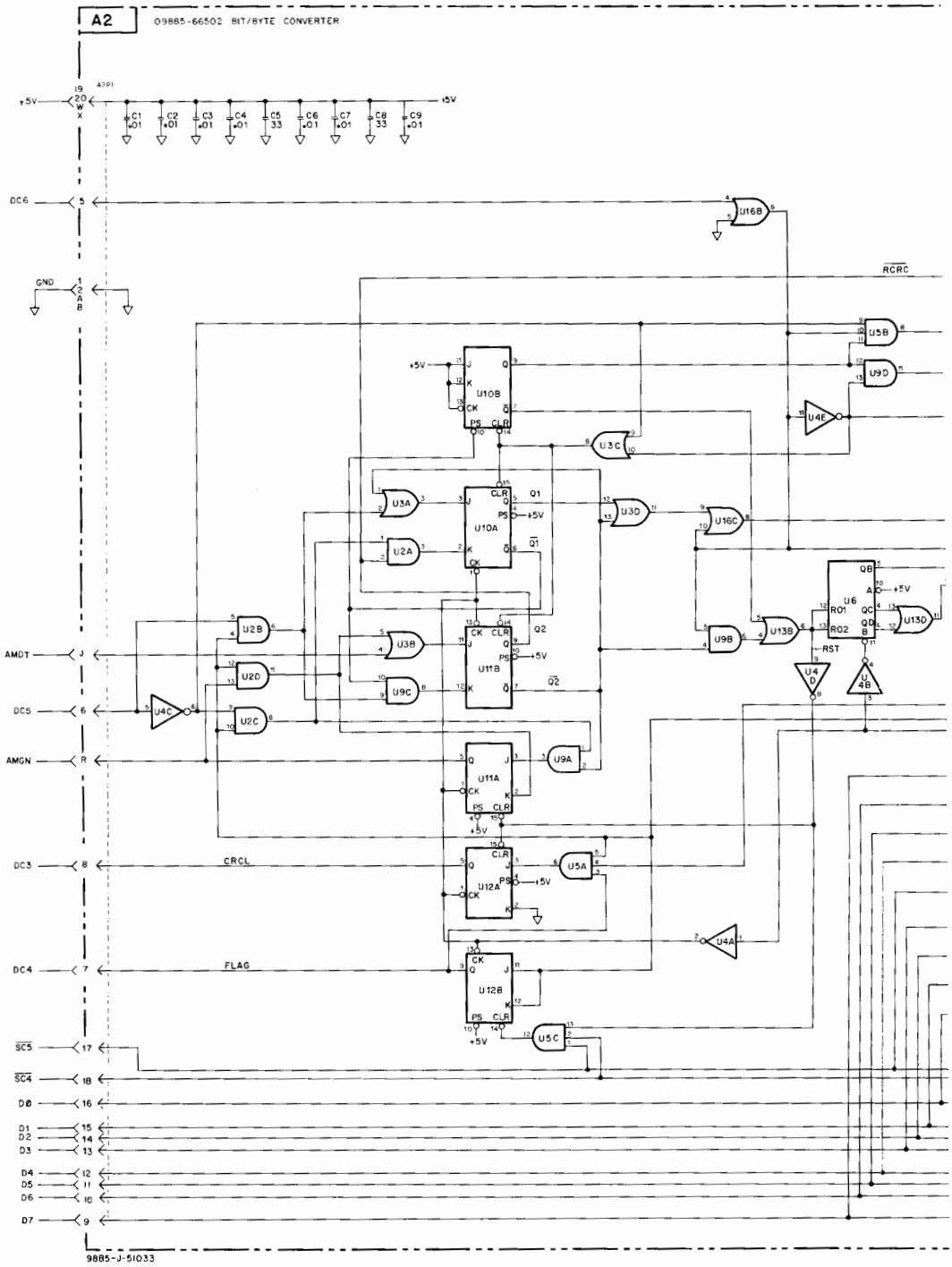
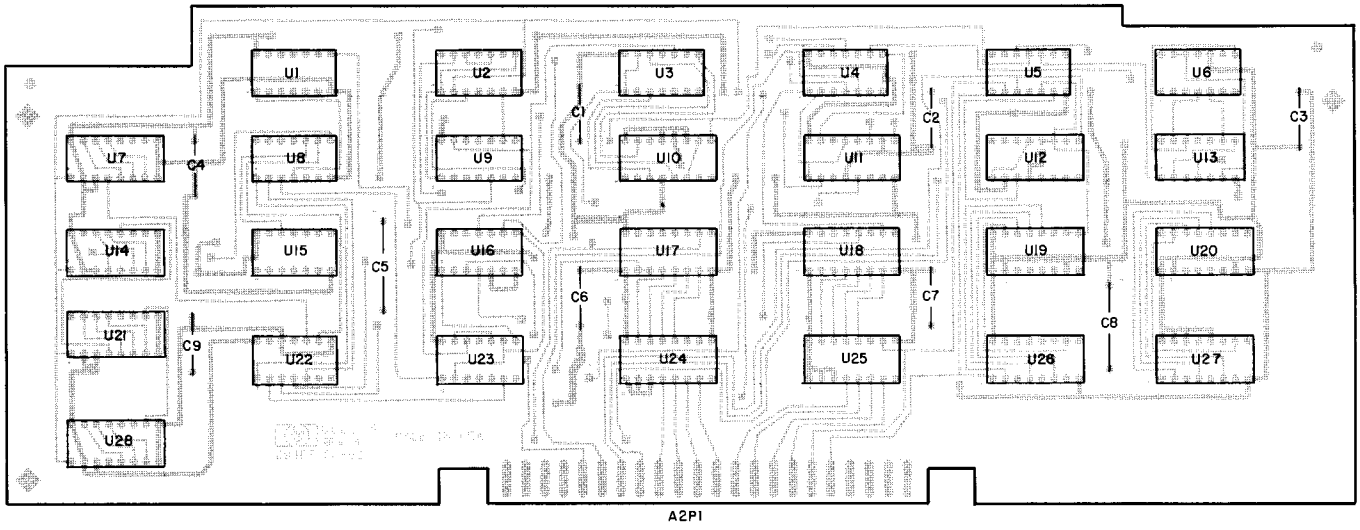


Figure 4-4. A2 Bit Byte Converter Assembly Schematic Diagram


A2
09885-66502 BIT/BYTE CONVERTER
A2P1
+5V
GND
DC6
DC5
DC3
DC4
AMDT
AMGN
CRCL
FLAG
RCRC
RST
SC5
SC4
D0
D1
D2
D3
D4
D5
D6
D7
C1 .01
C2 .01
C3 .01
C4 .01
C5 33
C6 .01
C7 .01
C8 33
C9 .01
U10B
U10A
U11B
U11A
U12A
U12B
U2A
U2B
U2C
U2D
U3A
U3B
U3C
U3D
U4A
U4B
U4C
U4D
U4E
U5A
U5B
U5C
U6
U9A
U9B
U9C
U9D
U13B
U13D
U16B
U16C
9885-J-51033



COMPONENT SIDE

A2

-hp- Part No. 09885-66502 Rev A

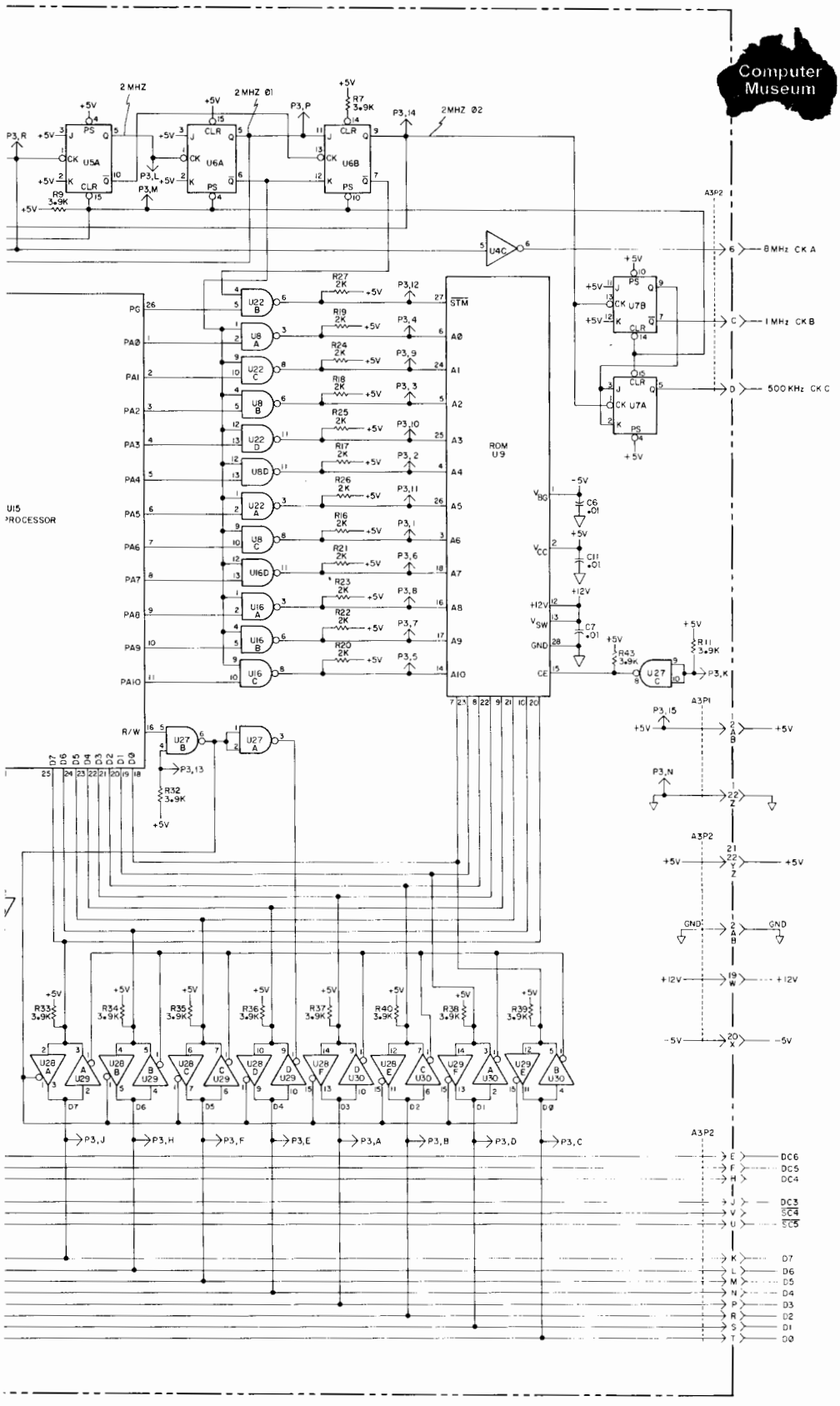
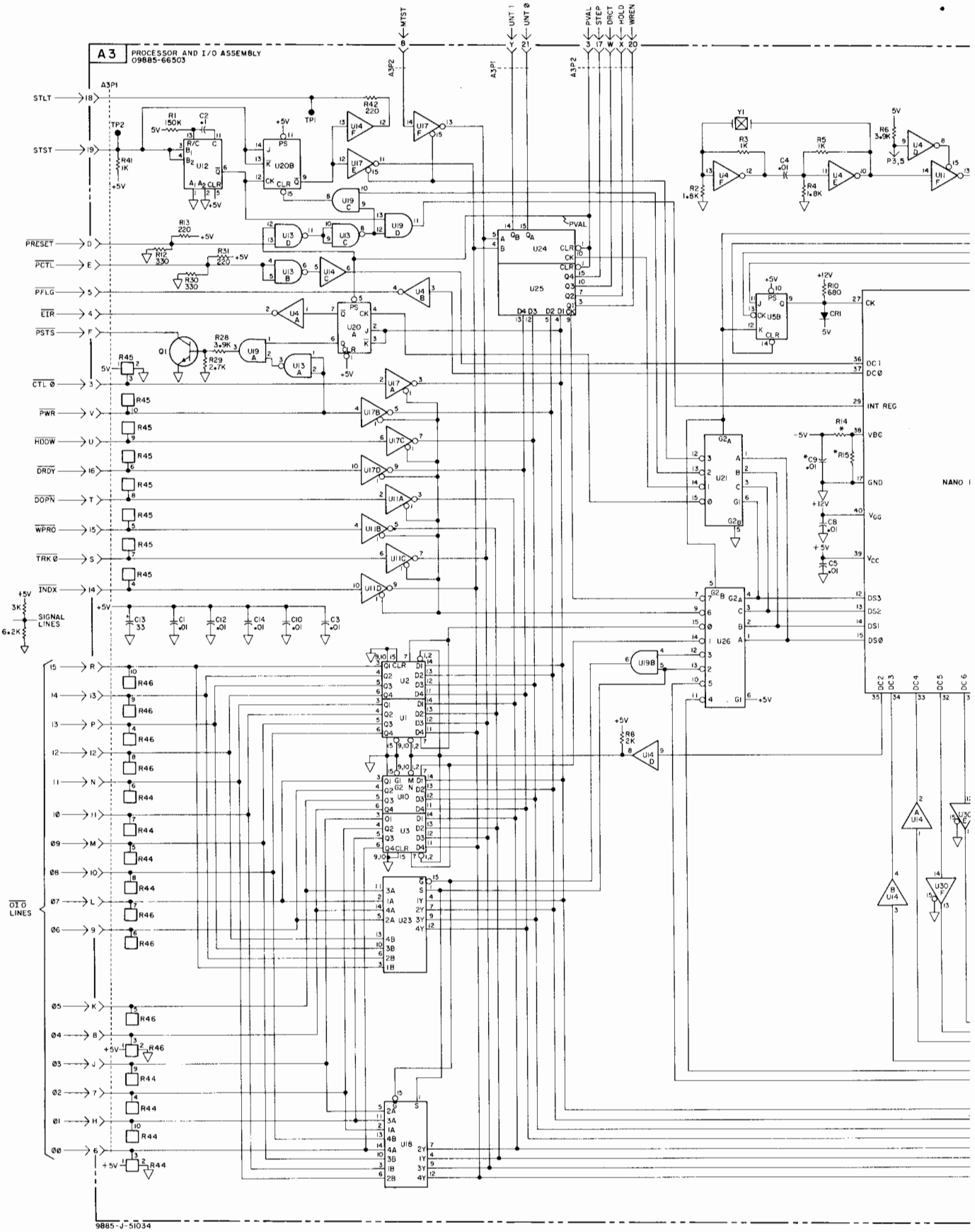
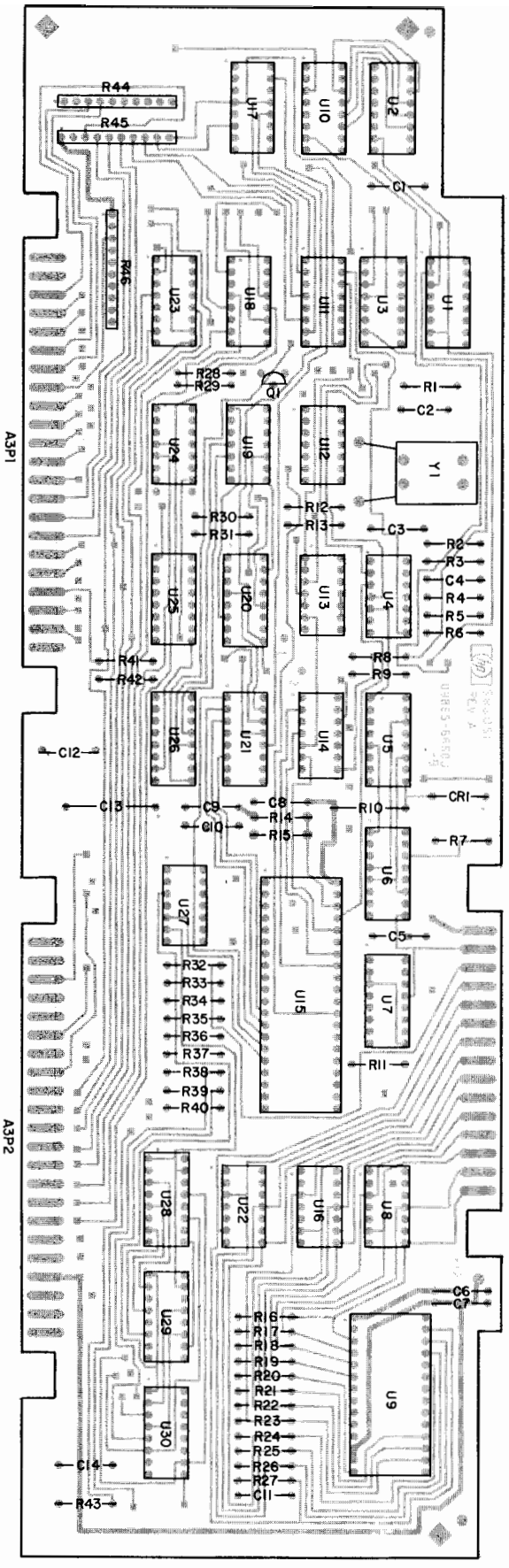
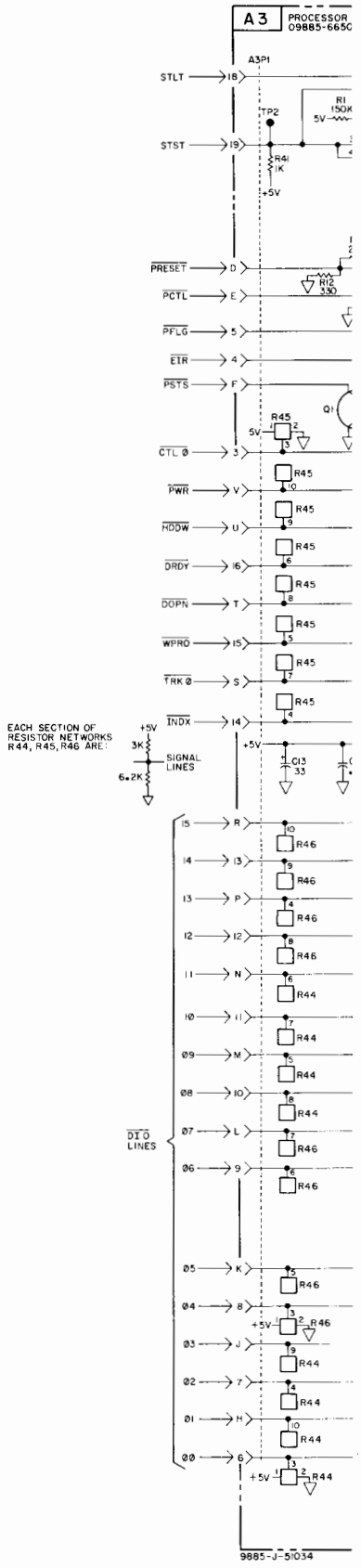


Figure 4-5. A3 Processor and I/O Assembly Schematic Diagram


A3 PROCESSOR AND I/O ASSEMBLY
09885-66503
A3P1
A3P2
MTST
UNT 1
UNT 0
PVAL
STEP
DRCT
HOLD
WREN
STLT
STST
PRESET
PCTL
PFLG
EIR
PSTS
CTL Ø
PWR
HDDW
DRDY
DOPN
WPRO
TRK Ø
INDX
EACH SECTION OF RESISTOR NETWORKS R44, R45, R46 ARE:
3K
6.2K
SIGNAL LINES
DI O LINES
INT REG
VBG
GND
VGG
VCC
DS3
DS2
DS1
DSØ
DC1
DCØ
DC2
DC3
DC4
DC5
DC 6
NANO I
9885-J-51034



(For Factory Use Only)
A3P3



COMPONENT SIDE

A3

-hp- Part No. 09885-66503 Rev A

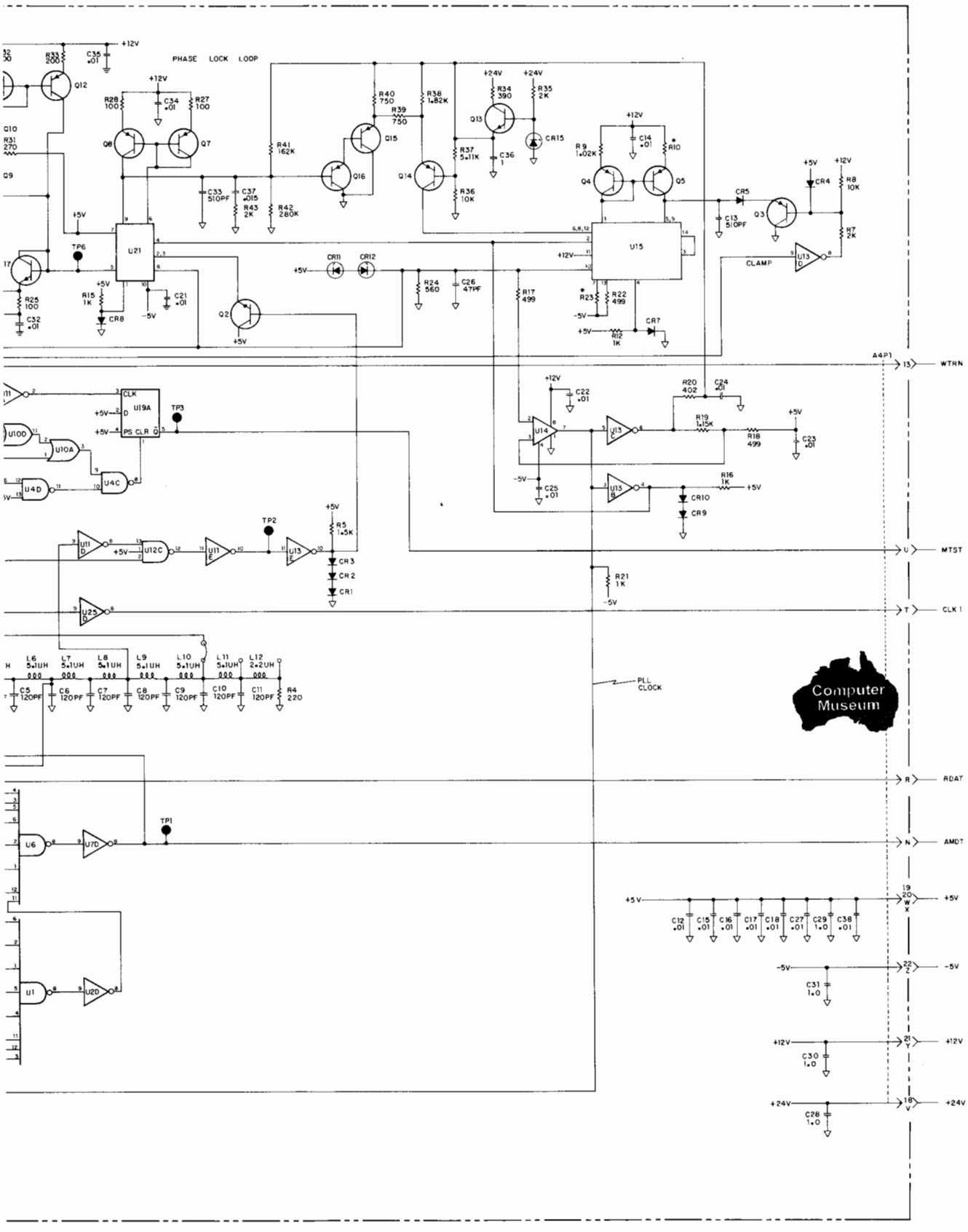
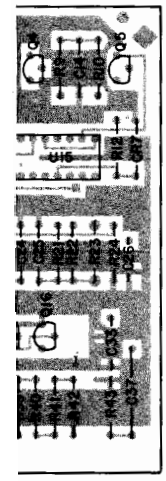


Figure 4-6. A4 Data Electronics Assembly Schematic Diagram



A4 09885-66504 DATA ELECTRONICS

DATA ENCODER

DATA DECODER

ENCO

CLK 1MHZ

AMGN

CLK 500KHZ

WDAT

CLK 8MHZ

OECD

RTRN

CLAMP

TP4

TP5

U26 PLA

U16

U23

U17

U3

Q1

Q6

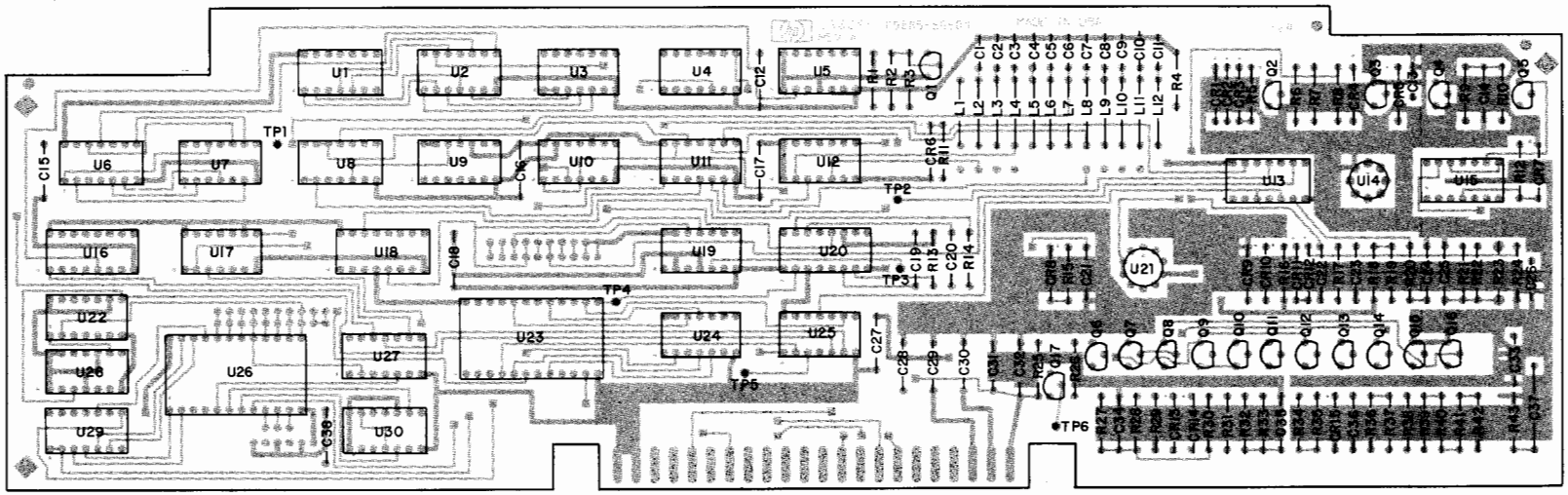
Q9

Q10

Q11

Q17

09885-J-51035

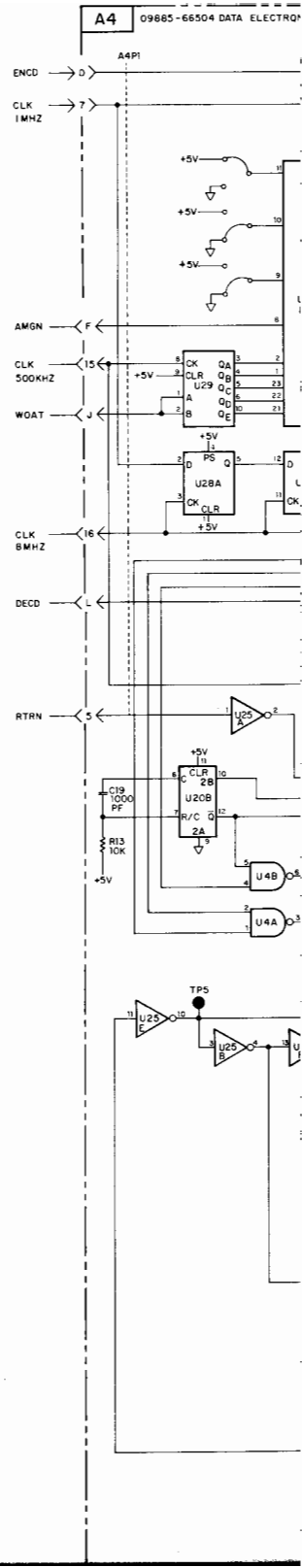


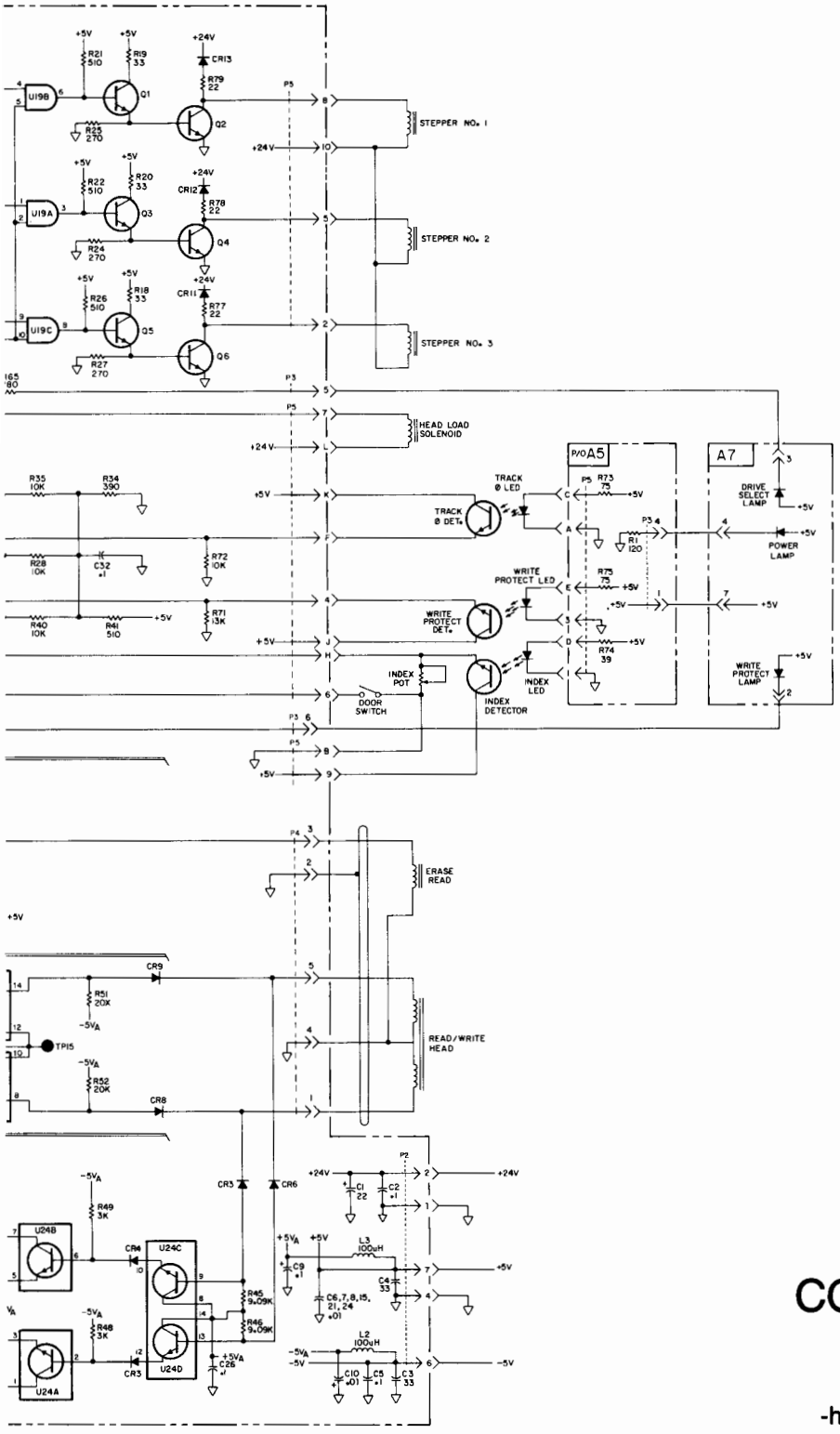
A4P1

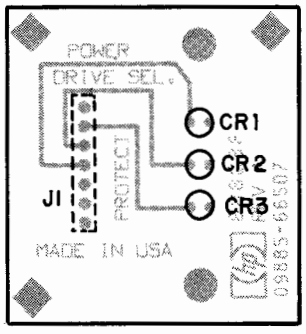
COMPONENT SIDE

A4

-hp- Part No. 09885-66504 Rev A





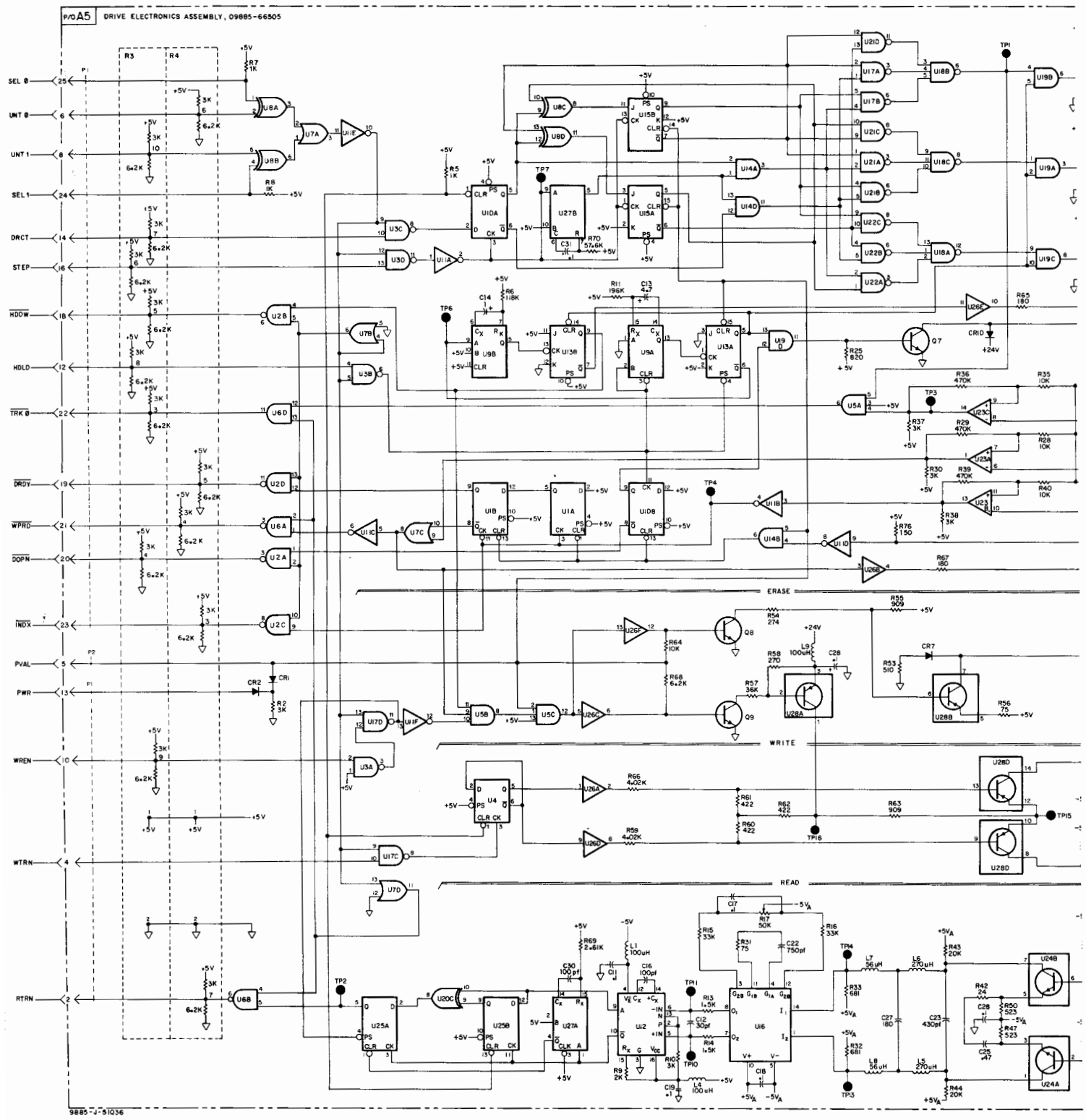


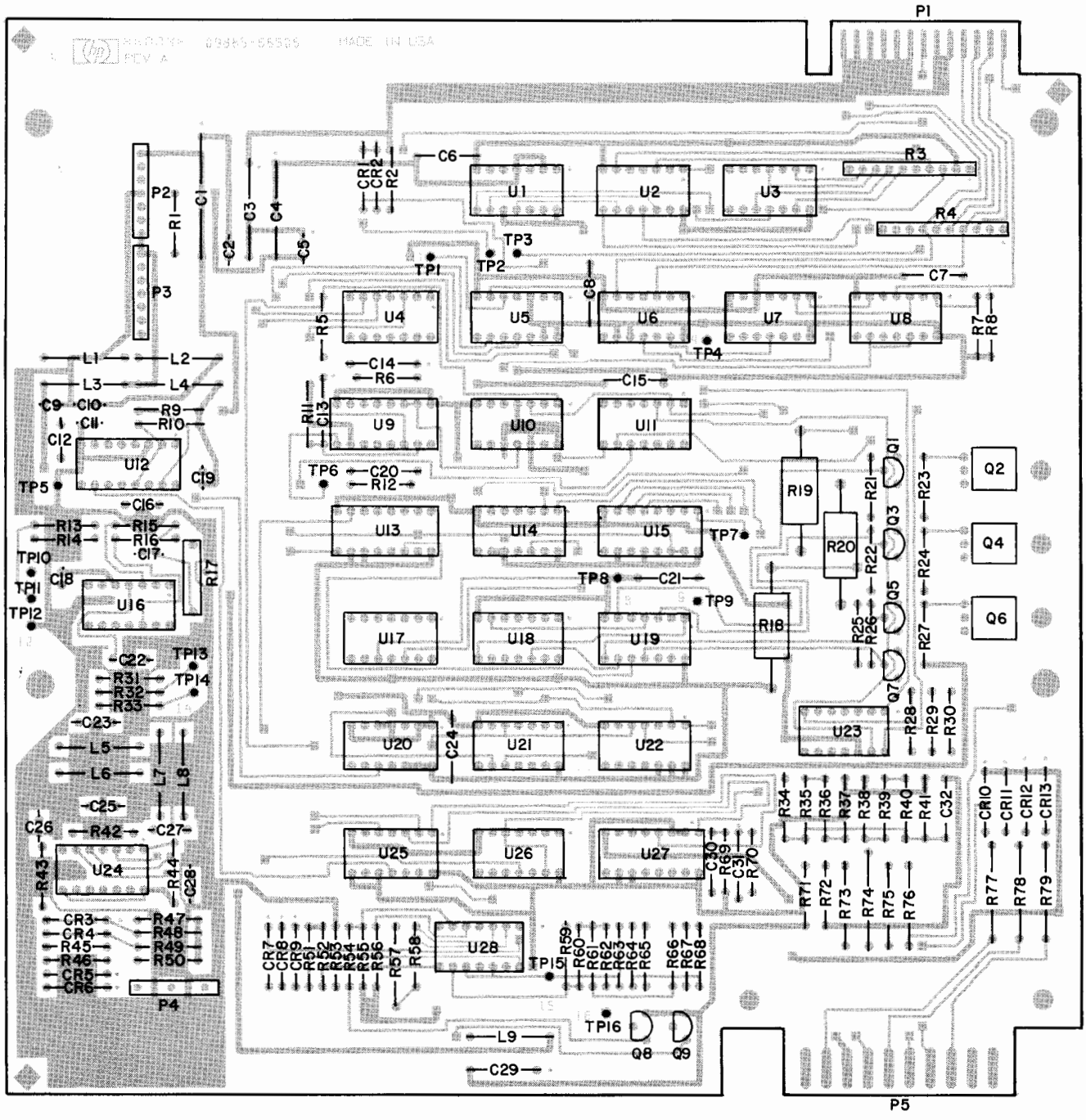
COMPONENT SIDE

A7

-hp- Part No. 09885-66507 Rev A

Figure 4-7. A5 Drive Electronics Assembly Schematic Diagram (includes A7)


P/O A5 DRIVE ELECTRONICS ASSEMBLY, 09885-66505
SEL 0
UNT 0
UNT 1
SEL 1
DRCT
STEP
HDDW
HDLD
TRK 0
DRDY
WPRO
DOPN
INDX
PVAL
PWR
WREN
WTRN
RTRN
ERASE
WRITE
READ
9885-J-51036



COMPONENT SIDE

A5

-hp- Part No. 09885-66505 Rev A

ne 9885S.

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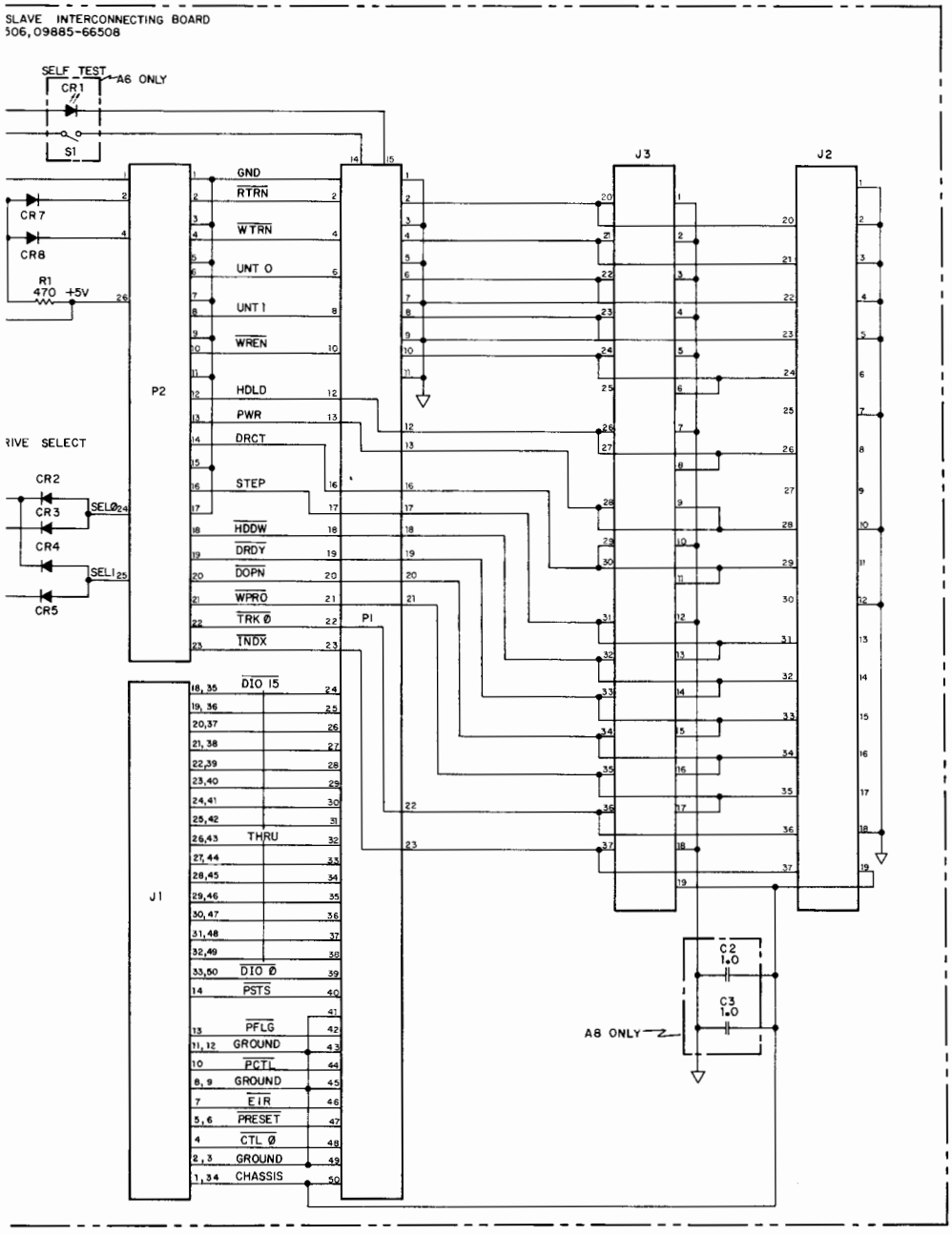


Figure 4-8. A6/A8 Interconnect Assembly Schematic Diagram

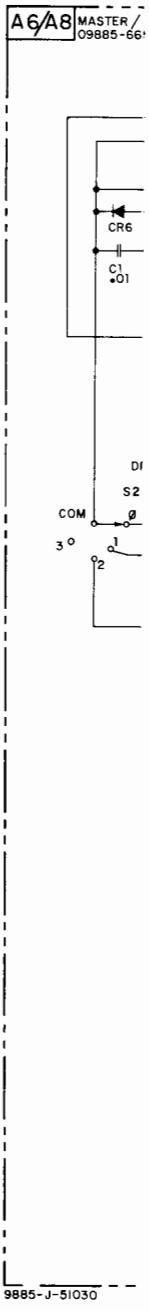
J1 – Interface from calculator connects here. This connector is not present on tl

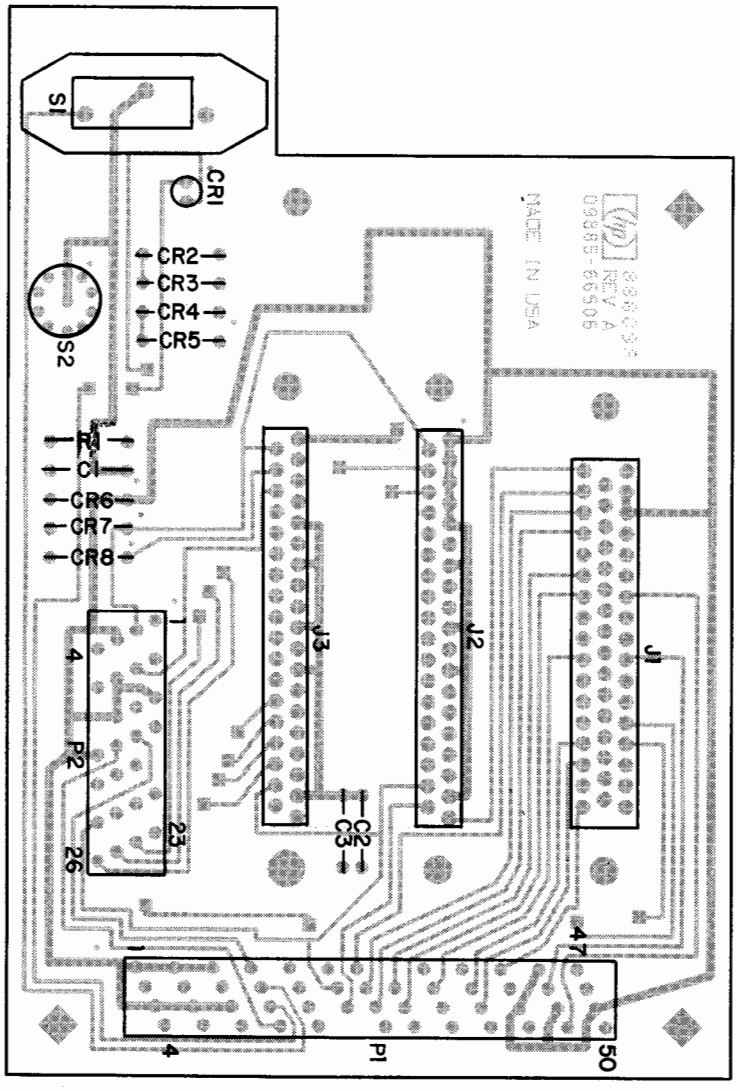
J2 – 9885M lower connector, 9885S top connector. Slave cable connects here.

J3 – Lower connector on 9885S, not present on 9885M.

P1 – Large ribbon cable which connects to A0.

P2 – Small ribbon cable which connects to A5.





COMPONENT SIDE

A6-A8

-hp- Part No. 09885-66506 Rev A

-hp- Part No. 09885-66508 Rev A

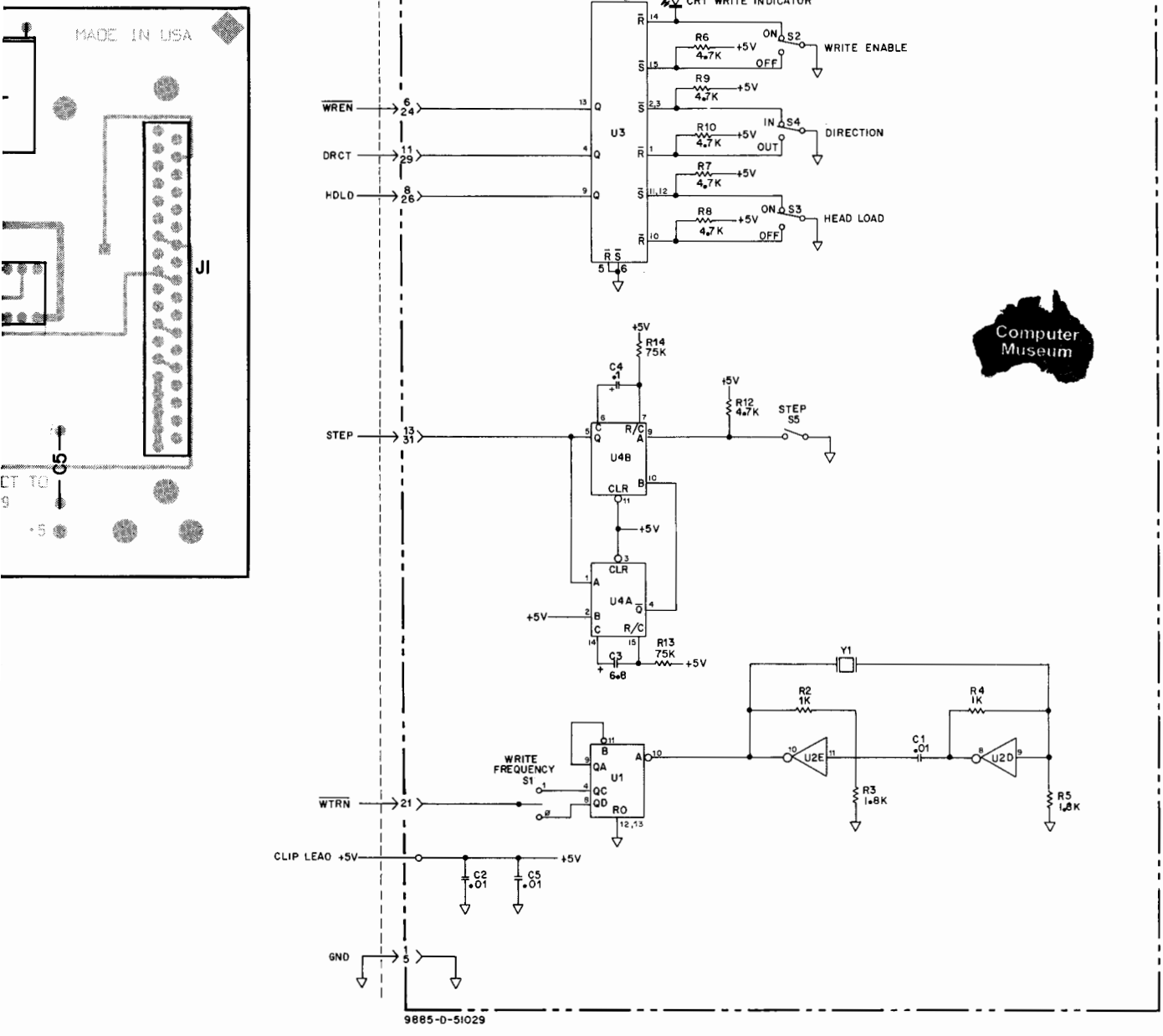


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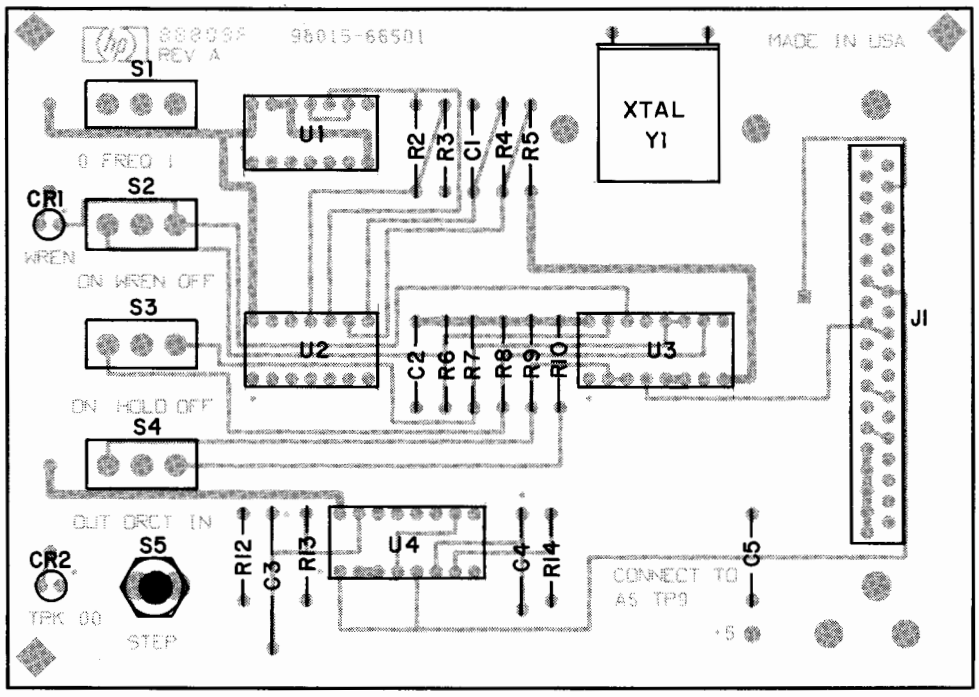
Figure 4-9. Disk Service Fixture Schematic Diagram


08809F
REV A
96015-66501
MADE IN USA
S1
U1
R2
R3
C1
R4
R5
XTAL
Y1
0 FREQ 1
CR1
S2
WREN
ON WREN OFF
S3
U2
C2
R6
R7
R8
R9
R10
U3
J1
ON HOLD OFF
S4
OUT DRCT IN
R12
C3
R13
U4
C4
R14
C5
CONNECT TO
AS TP9
+5
CR2
S5
TPK 00
STEP

Chapter 5
Replaceable Parts

Introduction

This chapter provides ordering information for the 9885 electrical and mechanical parts.

The electrical components on a particular printed circuit are listed in the order of their component designators. The mechanical drive parts in Table 5-1 are listed with reference numbers. These reference numbers correspond to the numbered parts illustrations in Figures 5-1 through 5-3. The numbers in the quantity column indicate the total quantity of a part used on a particular assembly. The quantity is given only the first time the part number is listed. All manufacturer's part numbers listed for the drive mechanical parts are numbers of Shugart Associates, Sunnyvale, California, 94086.

Table 5-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
AØ	**09885-66500**		**Motherboard Assembly**
C1	0160-0128	1	C-F: 2.2UF 25V
	1251-1887	5	Connector – PC 44 pin
	1251-4498	1	Connector – 7 pin
A1	**09885-66501**		**Power Supply Assembly**
C1	0150-0014	1	C-F: 5000PF 20%
C2	0180-0578	1	C-F: 750UF 40V
C3	0160-0127	4	C-F: 1UF 25V
C4	0160-3847	3	C-F: .01UF 25V
C5,C6	0160-3622	4	C-F: .1UF 50V
C7	0160-2605	1	C-F: .02UF 25V
C8	0160-3847		C-F: .01UF 25V
C9	0160-0127		C-F: 1UF 25V
C10	0160-3622		C-F: .1UF 50V
C11	0160-3508	1	C-F: 1UF
C12	0160-3879	2	C-F: .01UF 100V
C13	0160-0174	1	C-F: .47UF 25V
C14	0160-0127		C-F: 1UF 25V
C15	0160-0583	1	C-F: 6000UF 30V
C16	0180-2666	2	C-F: 1000UF 60V
C17	0180-0237	1	C-F: 500UF 25V
C18	0160-3847		C-F: .01UF 25V
C19	0160-0127		C-F: 1UF 25V
C20	0180-0229	1	C-F: 33UF 10V
C21	0160-3622		C-F: .1UF 50V
C22	0180-0348	1	C-F: 1.2UF 35V
C23	0160-4005	1	C-F: 1UF 100V
C24	0160-3879		C-F: .01UF 100V
C25	0180-2666		C-F: 1000UF 60V
CR1	1902-0654	1	DIO: ZNR 33.2V
CR2	1902-3073	1	DIO: ZNR 4.32V
CR3,CR4	1901-0040	3	DIO: SI .05A 30V
CR5 thru CR8	1901-0662	4	DIO: Power Rectifier
CR9	1902-3002	1	DIO: ZNR 2.37V
CR10	1901-0040		DIO: SI .05A 30V
CR11,CR12	1901-0364	2	Diode Assembly
CR13	1901-0638	1	Diode Assembly
Q1	1854-0063	2	XSTR: 2N3055
Q2	1854-0039	2	XSTR: 2N3053
Q3	1854-0063		XSTR: 2N3055
Q4	1854-0039		XSTR: 2N3053
Q5	1854-0087	1	XSTR: SI NPN
Q6,Q7	1854-0215	2	XSTR: 2N3904
Q8	1854-0071	1	XSTR: SPS5103
R1	0698-4471	1	R-F: 7.15K 1%
R2	0757-0438	2	R-F: 5.11K 1%
R3	0683-1035	3	R-F: 10K 5%
R4	0683-5125	5	R-F: 5.1K 5%
R5	0698-3132	1	R-F: 261 1%
R6	0757-0416	1	R-F: 511 1%
R7	0683-1035		R-F: 10K 5%
R8	2100-3350	1	R-Variable 200 10%
R9	0683-1035		R-F: 10K 5%
R10	0757-0438		R-F: 5.11K 1%
R11	0698-4484	1	R-F: 19.1K 1%

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
R12	0683-1025	1	R-F: 1K 5%
R13	0683-0395	1	R-F: 3.9 5%
R14	0811-2654	1	R-F: .18 10%
R15	0683-5125		R-F: 5.1K 5%
R16	0698-3152	1	R-F: 3.48K 5%
R17	0757-1094	1	R-F: 1.47K 1%
R18	0683-1015	1	R-F: 100 5%
R19	0698-3279		R-F: 4.99K 1%
R20	0757-0283	1	R-F: 2K 1%
R21	0683-5125		R-F: 5.1K 5%
R22	0683-4325	1	R-F: 4.3K 5%
R23	0683-2415	1	R-F: 240 5%
R24	0683-5125	1	R-F: 5.1K 5%
R25	0683-5625	1	R-F: 5.6K 5%
R26	0812-0045	1	R-F: .15 3%
R27	0683-5115	1	R-F: 510 5%
R28,R29	0683-2425	2	R-F: 2.4K 5%
R30	0683-6805	1	R-F: 68 5%
R31	0683-5105	1	R-F: 51 5%
R32	0683-2035	1	R-F: 20K 5%
R33	0686-4325	1	R-F: 4.3K 5%
U1 thru U3	1820-0196	3	IC: U5R7723393
U4	1826-0220	1	IC: LM320H
U5	1826-0174	1	IC: MC3302
U6	1820-0207	1	IC: V1A960159X
	09885-04101	1	Head Sink Cover
	1200-0043	2	Transistor Insulators
	1205-0011	2	Transistor Heat Sink
	1400-0493	3	Cable Strap
A2	**09885-66502**	1	**Bit/Byte Converter Assembly**
C1 thru C4	0160-3847	7	C-F: .01UF 25V
C5	0180-0229	2	C-F: 33UF 10V
C6,C7	0160-3847		C-F: .01UF 25V
C8	0180-0229		C-F: 33UF 10V
C9	0160-3847		C-F: .01UF 25V
U1	1820-1207	2	C-F: 74LS30
U2	1820-1201	3	IC: 74LS08
U3	1820-1208	3	IC: 74LS32
U4	1820-1199	1	IC: 74LS04
U5	1820-1203	1	IC: 74LS11
U6	1820-1443	1	IC: 74LS293
U7	1820-1300	8	IC: 74LS195
U8	1820-1211	1	IC: 74LS86
U9	1820-1201		IC: 74LS08
U10 thru U12	1820-1212	3	IC: 74LS112
U13	1820-1208		IC: 74LS32
U14	1820-1300		IC: 74LS195
U15	1820-1207		IC: 74LS30
U16	1820-1208		IC: 74LS32
U17,U18	1820-1300		IC: 74LS195
U19,U20	1820-1276	2	IC: 74LS194
U21	1820-1300		IC: 74LS195
U22	1820-1144	1	IC: 74LS02
U23	1820-1201		IC: 74LS06
U24,U25	1820-1300		IC: 74LS195

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Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
U26,U27	1820-1491	2	IC: 74LS367
U28	1820-1300		IC: 74LS195
A3	**09885-66503**		**Processor, I/O Assembly**
C1	0160-3847	12	C-F: .01UF 25V
C2	0150-0121	1	C-F: .1UF 50V
C3 thru C12	0160-3847		C-F: .01UF 25V
C13	0180-0229	1	C-F: 33UF 10V
C14	0160-3847		C-F: .01UF 25V
CR1	1901-0040	1	DIO: Si .05A 30V
Q1	1854-0071	1	XSTR: NPN SPS5103
R1	0683-1545	1	R-F: 150K ¼w
R2	0683-1825	2	R-F: 1.8K 5%
R3	0683-1025	3	R-F: 1K 5%
R4	0683-1825		R-F: 1.8K 5%
R5	0683-1025		R-F: 1K 5%
R6,R7	0683-3925	15	R-F: 3.9K 5%
R8	0683-2025	12	R-F: 2K 5%
R9	0683-3925		R-F: 3.9K 5%
R10	0686-6815	1	R-F: 680 5% ½w
R11	0683-3925		R-F: 3.9K 5%
R12	0683-3315	2	R-F: 330 5%
R13	0683-2215	3	R-F: 220 5%
R14			See Padding List
	0757-0418		R-F: 619 (−2.0V)
	0698-3447		R-F: 422 (−2.5V)
	0698-3447		R-F: 422 (−3.0V)
	0698-3443		R-F: 287 (−3.5V)
	0698-3440		R-F: 196 (−4.0V)
	0757-0401		R-F: 100 (−4.5V)
	0757-0346		R-F: 10 (−5.0V)
R15			See Padding List
	0698-3447		R-F: 422 (−2.0V)
	0698-3447		R-F: 422 (−2.5V)
	0757-0418		R-F: 619 (−3.0V)
	0757-0419		R-F: 681 (−3.5V)
	0757-0421		R-F: 825 (−4.0V)
	0757-0422		R-F: 909 (−4.5V)
	0757-0280		R-F: 1000 (−5.0V)
R16 thru R26	0683-2025		R-F: 2K 5%
R27	0683-4715	1	R-F: 470 5%
R28	0683-3925		R-F: 3.9K 5%
R29	0683-2725	1	R-F: 2.7K 5%
R30	0683-3315		R-F: 330 5%
R31	0683-2215		R-F: 220 5%
R32 thru R40	0683-3925		R-F: 3.9K 5%
R41	0683-1025		R-F: 1K 5%
R42	0683-2215		R-F: 220 5%
R43	0683-3925		R-F: 3.9K 5%
R44 thru R46	1810-0136	3	R-Network 216C
U1 thru U3	1820-0574	4	IC: DM8551N
U4	1820-0683	1	IC: 74S04N
U5,U6	1820-0269	2	IC: 74S112N
U7	1820-1212	1	IC: 74LS112N

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
U8	1820-0269	3	IC: 7403N
U9	1818-2643	1	IC: ROM
U10	1820-0574		IC: DM8551N
U11	1820-1492	2	IC: 74LS368N
U12	1820-1422	1	IC: 74LS122
U13	1820-1425	1	IC: 74LS132
U14	1820-0668	1	IC: 7407
U15	1820-1692	1	IC: Nanoprocessor
U16	1820-0269		IC: 7403N
U17	1820-1492		IC: 74LS368N
U18	1820-1438	2	IC: 74LS257
U19	1820-1201	1	IC: 74LS08
U20	1820-1282	1	IC: 74LS109
U21	1820-1216	2	IC: 74LS138
U22	1820-0269		IC: 7403N
U23	1820-1438		IC: 74LS257
U24	1820-1300	1	IC: 74LS195N
U25	1820-1195	1	IC: 74LS175
U26	1820-1216		IC: 74LS138
U27	1820-1197	1	IC: 74LS00N
U28 thru U30	1820-1491	3	IC: 74LS367N
Y1	0410-0443	1	Crystal: 8MHz
	1200-0552	1	Socket: IC-40 pm
	1200-0553	1	Socket: IC
	1200-0770	1	Socket: Crystal
	0403-0189		PC Extractor, Black
	4040-0751		PC Extractor, Orange
A4	**09885-66504**		**Data Electronics Assembly**
C1 thru C11	0160-2205	11	C-F: 120PF 300V
C12	0160-3847	16	C-F: .01UF 25V
C13	0160-0362	2	C-F: 510PF 300V
C14 thru C18	0160-3847		C-F: .01UF 25V
C19	0160-0938	1	C-F: 1000PF 100V
C20	0140-0199	1	C-F: 240PF 300V
C21 thru C25	0160-3847		C-F: .01UF 25V
C26	0160-2307	1	C-F: 47PF 300V
C27	0160-3847		C-F: .01UF 25V
C28 thru 31	0160-0127	5	C-F: 1UF 25V
C32	0160-3847		C-F: .01UF 25V
C33	0160-0362		C-F: 510PF 300V
C34,C35	0160-3847		C-F: .01UF 25V
C36	0160-0127		C-F: 1UF 25V
C37	0160-0194	1	C-F: .015UF 200V
C38	0160-3847		C-F: .01UF 25V
CR1 thru CR10	1901-0040	12	DIO: SI .05A 30V
CR11,CR12	1902-3002	2	DIO: ZNR 2.37V
CR13,CR14	1901-0040		DIO: SI .05A 30V
CR15	1902-3182	1	DIO: ZNR 12.1V
L1	9140-0098	2	L-F: 2.2UH
L2 thru L11	9100-3559	10	L-F: 5.1UH
L12	9140-0098		L-F: 2.2UH
Q1	1853-0089	13	XSTR: 2N4917
Q2	1854-0092	4	XSTR: 2N3563

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
Q3 thru Q9	1853-0089		XSTR: 2N4917
Q10	1854-0092		XSTR: 2N3563
Q11,Q12	1853-0089		XSTR: 2N4917
Q13	1854-0092		XSTR: 2N3563
Q14 thru Q16	1853-0089		XSTR: 2N4917
Q17	1854-0092		XSTR: 2N3563
R1	0683-7515	1	R-F: 750 5%
R2,R3	0683-1025	7	R-F: 1K 5%
R4	0683-2015	4	R-F: 200 5%
R5	0683-1525	2	R-F: 1.5K 5%
R6	0683-1025		R-F: 1K 5%
R7	0683-2025	3	R-F: 2K 5%
R8	0683-1035	4	R-F: 10K 5%
R9	0698-4195	1	R-F: 1.02K 1%
R10			See Padding List
	0698-4422		1270 1%
	0757-0426		1300 1%
	0757-0317		1330 1%
	0698-4423		1370 1%
	0698-4424		1400 1%
	0698-3225		1430 1%
	0757-1094		1470 1%
	0757-0427		1500 1%
	0698-4425		1540 1%
	0698-4426		1580 1%
	0757-0428		1620 1%
R11	0683-2015		R-F: 200 5%
R12	0683-1025		R-F: 1K 5%
R13	0683-1035		R-F: 10K 5%
R14	0683-3925	1	R-F: 3.9K 5%
R15,R16	0683-1025		R-F: 1K 5%
R17,R18	0698-4123	3	R-F: 499 1%
R19	0698-4469	1	R-F: 1.15K 1%
R20	0698-4453	1	R-F: 402 1%
R21	0683-1025		R-F: 1K 5%
R22	0698-4123		R-F: 499 1%
R23			See Padding List
	0698-3122		R-F: 412 1%
	0698-3447		R-F: 422 1%
	0757-0414		R-F: 432 1%
	0698-3488		R-F: 442 1%
	0698-3510		R-F: 453 1%
	0698-0082		R-F: 464 1%
	0757-0415		R-F: 475 1%
	0698-3178		R-F: 487 1%
	0698-4123		R-F: 499 1%
	0757-0416		R-F: 511 1%
	0698-4454		R-F: 523 1%
	0698-4455		R-F: 536 1%
	0698-4456		R-F: 549 1%
	0757-0417		R-F: 562 1%
	0698-4457		R-F: 576 1%
	0698-4458		R-F: 590 1%
	0757-0161		R-F: 604 1%
	0757-0418		R-F: 619 1%
	0698-4459		R-F: 634 1%
	0698-4460		R-F: 649 1%
	0698-3511		R-F: 665 1%

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
R24	0683-5615	1	R-F: 560 5%
R25	0683-1015	3	R-F: 100 5%
R26	0683-6805	1	R-F: 68 5%
R27,R28	0683-1015		R-F: 100 5%
R29,R30	0683-1035		R-F: 10K 5%
R31	0683-2715		R-F: 270 5%
R32,R33	0683-2015		R-F: 200 5%
R34	0683-3915	1	R-F: 390 5%
R35	0683-2025		R-F: 2K 5%
R36	0757-0442	1	R-F: 10K 1%
R37	0757-0438	1	R-F: 5.11K 1%
R38	0757-0429	1	R-F: 1.82K 1%
R39,R40	0757-0420	2	R-F: 750 1%
R41	0757-0470	1	R-F: 162K 1%
R42	0698-4532	1	R-F: 280K 1%
R43	0683-2025		R-F: 2K 5%
R44	0683-1525		R-F: 1.5K 5%
U1	1820-1207	2	IC: 74LS30
U2	1820-1199	3	IC: 74LS04
U3	1820-1433	4	IC: 74LS164
U4	1820-1197	1	IC: 74LS00
U5	1820-0621	1	IC: 7438
U6	1820-1207		IC: 74LS30
U7	1820-1199		IC: 74LS04
U8,U9	1820-1112	7	IC: 74LS74
U10	1820-1211	1	IC: 74LS86
U11	1820-1199		IC: 74LS04
U12	1820-1202	1	IC: 74LS10
U13	1820-0471	1	IC: 7406
U14	1820-0321	1	IC: Comparator 710
U15	1821-0001	1	IC: CA3046
U16	1820-1217	1	IC: 74LS151
U17	1820-1433		IC: 74LS164
U18	1820-1194	1	IC: 74LS193
U19	1820-1112		IC: 74LS74
U20	1820-0579	1	IC: 74123
U21	1820-0427	1	IC: MC1496
U22	1820-1433		IC: 74LS164
U23	1820-1820	1	IC: PLA-BUM DM 8575
U24	1820-1112		IC: 74LS74
U25	1820-1416	1	IC: 74LS14
U26	1820-1819	1	IC: PLA-BUL DM 8575
U27,U28	1820-1112		IC: 74LS74
U29	1820-1433		IC: 74LS164
U30	1820-1112		IC: 74LS74
A5	**09885-66505**		**Drive Electronics Assembly**
C1	0180-1794	1	C-F: 22UF 35V
C2	0160-0576	11	C-F: .1UF 50V
C3,C4	0180-0229	2	C-F: 33UF 10V
C5	0160-0576		C-F: .1UF 50V
C6 thru C8	0160-3847	6	C-F: .01UF 25V
C9 thru C11	0160-0576		C-F: .1UF 50V
C12	0160-2199	1	C-F: 30PF 300V
C13	0180-0309	1	C-F: 4.7UF 10V
C14	0180-0291	1	C-F: 1UF 35V
C15	0160-3847		C-F: .01UF 25V

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
C16	0160-2204	2	C-F: 100PF 300V
C17 thru C19	0160-0576		C-F: .1UF 50V
C21	0160-3847		C-F: .01UF 25V
C22	0160-2035	1	C-F: 750PF 300V
C23	0160-0939	1	C-F: 430PF 300V
C24	0160-3847		C-F: .01UF 25V
C25	0160-4441	1	C-F: .47UF 50V
C26	0160-0576		C-F: .1UF 50V
C27	0140-0197	1	C-F: 180PF 300V
C28	0160-0576		C-F: .1UF 50V
C29	0180-0291		C-F: 1UF 35V
C30	0160-2204		C-F: 100PF 300V
C31	0180-1743	1	C-F: .1UF 35V
C32	0160-0576		C-F: .1UF 50V
CR1,CR2	1901-0028	6	DIO: SI .75A 400V
CR3 thru CR9	1901-0050	7	DIO: SI
CR10 thru CR13	1901-0028		DIO: SI .75A 400V
L1 thru L4	9100-2562	5	L-F: 100UH
L5,L6	9100-1642	2	L-F: 270UH
L7,L8	9100-1631	2	L-F: 56UH
L9	9100-2562		L-F: 100UH
P2,P3	1251-4498	2	7-Pin Connector
P4	1251-4499	1	5-Pin Connector
Q1	1854-0354	3	XSTR: NPN SS2077
Q2	1854-0456	3	XSTR: NPN SI
Q3	1854-0354		XSTR: NPN SS2077
Q4	1854-0456		XSTR: NPN SI
Q5	1854-0354		XSTR: NPN SS2077
Q6	1854-0456		XSTR: NPN SI
Q7 thru Q9	1854-0071	3	XSTR: NPN SPS5103
R1	0683-1215	1	R-F: 120 5%
R2	0683-3025	7	R-F: 3K 5%
R3,R4	1810-0136	2	R-Network 216C
R5	0683-1025	3	R-F: 1K 5%
R6	0698-3265	1	R-F: 118K 1%
R7,R8	0683-1025		R-F: 1K 5%
R9	0683-1235	1	R-F: 12K 5%
R10	0683-3025		R-F: 3K 5%
R11	0698-3453	1	R-F: 196K 1%
R13,R14	0683-1525	2	R-F: 1.5K 5%
R15,R16	0683-3335	2	R-F: 33K 5%
R17	2100-3054	1	R-Variable 50K 10%
R18 thru R20	0764-0033	3	R-F: 33 5%
R21,R22	0683-5115	5	R-F: 510 5%
R23,R24	0683-2715	4	R-F: 270 5%
R25	0683-8215	1	R-F: 820 5%
R26	0683-5115		R-F: 510 5%
R27	0683-2715		R-F: 270 5%
R28	0683-1035	5	R-F: 10K 5%
R29	0683-4745	3	R-F: 470K 5%
R30	0683-3025		R-F: 3K 5%
R31	0757-0398	2	R-F: 75 1%
R32,R33	0757-0419	2	R-F: 681 1%
R34	0683-3915	1	R-F: 390 5%
R35	0683-1035		R-F: 10K 5%

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
R36	0683-4745		R-F: 470K 5%
R37,R38	0683-3025		R-F: 3K 5%
R39	0683-4745		R-F: 470K 5%
R40	0683-1035		R-F: 10K 5%
R41	0683-5115		R-F: 510 5%
R42	0683-2405	1	R-F: 24 5%
R43,R44	0683-2035	4	R-F: 20K 5%
R45,R46	0757-0288	2	R-F: 9.09K 1%
R47	0698-4454	2	R-F: 523 1%
R48,R49	0683-3025		R-F: 3K 5%
R50	0698-4454		R-F: 523 1%
R51,R52	0683-2035		R-F: 20K 5%
R53	0683-5115		R-F: 510 5%
R54	0757-0409	1	R-F: 274 1%
R55	0757-0422	2	R-F: 909 1%
R56	0757-0398		R-F: 75 1%
R57	0686-3625	1	R-F: 3.6K 5%
R58	0683-2715		R-F: 270 5%
R59	0683-3558	1	R-F: 4.02K 1%
R60 thru R62	0698-3447	3	R-F: 422 1%
R63	0757-0422		R-F: 909 1%
R64	0683-1035		R-F: 10K 5%
R65	0683-1815	2	R-F: 180 5%
R66	0698-3558		R-F: 4.02K 1%
R67	0683-1815		R-F: 180 5%
R68	0683-6225	1	R-F: 6.2K 5%
R69	0698-0085	1	R-F: 2.61K 1%
R70	0698-4500	1	R-F: 57.6K 1%
R71	0683-1335	1	R-F: 13K 5%
R72	0683-1035		R-F: 10K 5%
R73	0686-7505	2	R-F: 75 5%
R74	0698-5083	1	R-F: 39
R75	0686-7505		R-F: 75 5%
R76	0686-1515	1	R-F: 150 5%
R77 thru R79	0689-2205	3	R-F: 22
U1	1820-1112	4	IC: 74LS74
U2	1820-0269	1	IC: 7403
U3	1820-1425	2	IC: 74LS132
U4	1820-1112		IC: 74LS74
U5	1820-1203	1	IC: 74LS11
U6	1820-0621	1	IC: 7438
U7	1820-1208	1	IC: 74LS32
U8	1820-1211	2	IC: 74LS86
U9	1820-1423	1	IC: 74LS123
U10	1820-1112		IC: 74LS74
U11	1820-1199	1	IC: 74LS04
U12	1820-1048	1	IC: MU8T20
U13	1820-1212	2	IC: 74LS112
U14	1820-1201	1	IC: 74LS08
U15	1820-1212		IC: 74LS112
U16	1820-0194	1	IC: NE592
U17	1820-1307		IC: 74S132
U18	1820-1202	1	IC: 74LS10
U19	1820-0513	1	IC: 7409
U20	1820-1211		IC: 74LS86

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
U21,U22	1820-1197	2	IC: 74LS00
U23	1826-0174	1	IC: MC3302
U24	1858-0053	1	IC: XSTR-Q2T2222
U25	1820-1112		IC: 74LS74
U26	1820-0668	1	IC: 7407
U27	1820-1437	1	IC: 74LS221
U28	1858-0052	1	IC: XSTR-Q2T2905
A6	**09885-66506**		**Interconnect Assembly (Master)**
C1	0160-3847	1	C-F: .01UF 25V
CR1	1990-0487	1	LED
CR2 thru CR8	1901-0040	7	DIO: SI .05A 30V
R1	0683-4715	1	R-F: 470 5%
P1	0360-1706	1	Connector - 3m 3426
P2	0362-0390	1	Connector
	0380-0565	4	Standoff Bushing
	09885-61601	1	Drive Assembly Cable
	09885-61602	1	Mother Assembly Cable
J2	1251-4464	1	37 pin Connector
J1	1251-4465	1	50 pin Connector
S1	3100-2117	1	Self Test Switch
S2	3100-3388	1	Drive Number Switch
A7	**09885-66507**		**Indicator Assembly**
	1251-4498	1	7-pin Connector
CR2,CR3	1990-0485	2	LED
CR1	0990-0487	1	LED
A8	**09885-66508**		**Interconnect Assembly (Slave)**
C1	0160-3847	1	C-F: .01UF 25V
C2,C3	0160-0127	2	C-F: 1UF 25V
CR2 thru CR8	1901-0040	7	DIO: SI .05A 30V
P1	0360-1706	1	Connector - 3m 3426
P2	0362-0390	1	Connector
R1	0683-4715	1	R-F: 470 5%
S2	3100-3388	1	Drive Number Switch
	0380-0565	4	Standoff Bushing
	09885-61601	1	Drive Assembly Cable
	1251-4464	2	37-pin Connector
	7120-5345	1	Decal
	09885-64401		**Chassis Assembly**
	09885-01201	1	Center Bracket
	09885-01204	1	Drive Mounting Bracket
	09885-01205	1	Rear Bracket
	09885-01206	1	Heatsink Bracket
	09885-64402	1	Top Cover
	09885-64403	1	Bottom Cover
	2510-0205	5	Machine Screw 8-32
	5020-8836	4	Corner Strut
	5040-7201	4	Foot

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
	09885-67901		**Rear Panel Assembly (Master)**
	09885-67903		Rear Panel Assembly (Slave)
	0390-0006	4	Nylon Spacer
	09885-00201	1	Rear Panel (Master)
	09885-00202	1	Rear Panel (Slave)
	3101-2042	2	Voltage Selector Switch
Z1	9100-3875	1	Line Filter
	09885-61605	1	Power Cable (internal)
	3101-2080	1	Power Switch
	5040-8076	1	Rocker for power switch
	09885-64405	2	Hole Cover
	09885-64601	1	Fan Screen
	1251-2262	1	PC Assembly Connector (transformer)
	1251-4342	2	Pins for motor connector
	1251-4466	1	Motor connector housing
	2110-0543	1	Fuse Holder
	2110-0545	1	Fuse Holder Cap
	2190-0575	1	Washer
	3050-0835	1	Washer
	3160-0288	1	Fan
	5020-8804	1	Rear Casting
	9100-3498	1	Power Transformer
	09885-67902		**Front Panel Assembly**
	0510-0578	1	Restraining Patch
	09885-01202	1	Left Front Bracket
	09885-01203	1	Right Front Bracket
	09885-60201	1	Front Panel
	5040-8059	1	Eject Button
			Miscellaneous
F1	2110-0002	1	Fuse
	5040-8060	1	Disk Door
	7120-5129	1	Information Label
	7120-5254	1	Serial Plate
	7120-5350	1	Warning Label
	09885-00601	1	Voltage Shield
	09885-31002	2	Side Cover
	09885-61603	1	Indicator Assembly Cable (to A7)
	09885-61604	1	DC Power Cable
	09885-61607	1	Slave Cable
Option 001	**09885-30001**		**50Hz Option Assemblies**
	1535-3649	1	50Hz Drive Belt
	1535-3650	1	50Hz Pulley
	7120-5387	1	Option 001 Label
Option 002	**09885-30002**		**Rack Mount Option Asemblies**
	09885-21202	2	Rack Mount Bracket
	09885-24101	2	Rack Mount Side Cover
	7120-5357	1	Option 002 Label
	2190-0010	4	Screw
	2510-0107	4	Screw

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION
	09885-80000		**Miscellaneous Materials Kit**
	09885-87900	1	Note Book Assembly
	09885-90000	1	9825A/9885 Operating Manual
	09885-90020	1	Disk Care Note
	09885-90035	1	Disk System Cartridge
	09885-90045	1	Initialized Disk
	7120-5160	1	Drive Number Labels (0-3)
	7120-5161	1	Select Code Labels (8-15)
	7120-5255	1	Disk Labels
	7120-5330	1	Customer Information Label
	7120-5388	1	Write Protect Label
	9164-0074	1	Blank Disk
	9230-0420	1	Disk Envelope
	9282-0576	1	Vinyl Bag
	9282-0580	1	Notebook
	09885-90010	1	Reference Guide
	2110-0381	2	Fuse - 3 amp SB
	2110-0545	1	Fuse Holder Cap
	8120-1378	1	AC Power Cable
	98032-61601		**Option 085 Interface Cable**
	1251-2058	1	Connector Lock Assembly
	1251-3399	50	Connector Contact
	1251-4147	1	PCB Edge Connector
	1251-4475	1	Hood R & P Connector
	1251-4480	1	Connector-50 Pin
A1	**98015-66501**		**Disk Service Fixture**
C1,C2	0160-3847	3	C-F: .01UF
C3	0180-0116	1	C-F: 6.8UF
C4	0180-1743	1	C-F: .1F
C5	0160-3847	1	C-F: .01UF
CR1	1990-0486	1	LED, Red
CR2	1990-0485	1	ED, Green
R1	0683-2215	2	R-F: 220
R2	0683-1025	2	R-F: 1K
R3	0683-1825	2	R-F: 1.8K
R4	0683-1025		R-F: 1K
R5	0683-1825		R-F: 1.8K
R6 thru R10	0683-4725	6	R-F: 4.7K
R11	0683-2215		R-F: 220
R12	0683-4725		RF: 4.7K
R13,R14	0683-7535	2	R-F: 75K
S1	3101-0936	1	Switch SPDT
S2 thru S4	3101-1258	3	Switch SPDT
S5	3101-0063	1	Switch Pushbutton
U1	1820-1443	1	IC: 74LS293
U2	1820-0174	1	IC:7404
U3	1820-1440	1	IC: 74LS279
U4	1820-1437	1	C: 74LS221
Y1	0410-0465	1	XTAL: 4 MHz
	0380-0565	2	Standoff
	1251-1029	1	Connector Lock
		1	Connector AMP P/N 205713-1

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR. PART NO.
1		3	Flat Washer, #6	10013
2		1	Flat Washer, #8	10014
3		1	Nut, 8-32	10025
4		1	Drive Motor Capacitor (110V)	10095
		1	Drive Motor Capacitor (220V)	15004
5		1	Connector Block	10140
6		1	Rubber Boot	10148
7		1	3 Pin Connector Housing	10150
8		1	Screw 4-40 × .250"	10172
9		2	Screw 4-40 × .500"	10176
10		2	Screw 6-32 × .250"	10187
11		2	Cable Clamp 1/8"	10262
12		1	Cable Clamp 3/8"	10264
13		2	Cable Clamp 3/16"	10375
14		1	Spindle Bearing	10800
15		1	Flanged Spindle Bearing	10801
16		2	Clip	11305
17		1	Screw 2-56 × .250"	11903
18		1	Screw 6-32 × .125"	11904
19		2	Screw, B.V.	11905
20		2	Screw, 4-40 × .250"	12011
21		2	Screw, 4-40 × .375"	12012
22		12	Screw, 6-32 × .312"	12013
23		13	Screw, 8-32 × .312"	12015
24		3	Screw, 8-32 × .375"	12016
25		2	Screw, 8-32 × .500"	12020
26		1	Screw, 4-40 × .625"	12026
27		3	Screw, 6-32 × .500"	12027
28		4	Screw, 8-32 × .750"	12028
29		2	Lock Washer, #8	12500
30		2	Spring Washer	12509
31	1553-3652	1	Door Open Switch	17200
32		1	Spindle Pulley Assembly	50016
33		1	Long Spindle Spacer	50018
34		1	Short Spindle Spacer	50019
35	50031-SHU	1	Hub Clamp Spring	50031
36		1	Nut	50087
37		1	Pre-Load Spring	50088
38		1	Bracket	50098
39		1	Stepper Motor Plate	50112
40	0955-0088	1	Track 0 Detector Assembly	50121
41	3140-0581	1	110V Motor	50123
42	1150-1316	1	Phototransistor Assembly – Index	50128
43	3140-0582	1	Stepper Motor Assembly	50130
44		1	Spindle Spring	50166
45		1	Cartridge Guide Pivot	50167
46		1	Bias Spring	50168
47		1	Lead Screw Limit Stop	50245
48	50254-SHU	1	Hub Clamp Assembly	50254
49	1150-1309	1	Write Protect Detector Assembly	50313
50	1535-3649	1	50 Hz Belt	50355
	1535-3651	1	60 Hz Belt	50356
51	1535-3650	1	50 Hz Pulley	50357
	50358-SHU	1	60 Hz Pulley	50358
52		1	Plate Spring	50362

Table 5-1. Replaceable Parts (Cont.)

REFERENCE DESIGNATOR	-hp- PART NO.	TQ	DESCRIPTION	MFR.	MFR. PART NO.
53		1	Dust Cover		50440
54		1	Disk Guide Spring		50522
55		1	Track 0 Flag		50529
56	1535-3648	1	Load Button		50542
57		1	Disk Guide		50544
58		1	Hub Clamp Plate		50546
59		1	Bottom Stripper		50547
60		1	Top Stripper		50548
61		1	Disk Guide Assembly		50550
62		1	Ejector Clamp Spring		50555
63	50556-SHU	1	Spring Hook		50556
64	1150-1313	1	Index LED Assembly		50557
65	1150-1311	1	Head Load Actuator Assembly		50558
66		1	Spindle Hub Assembly		50561
67	1150-1315	1	Carriage Assembly		50562
68		1	Grommet		50578
69		1	Latch Plate		50579
70	50583-SHU	1	Door Open Spring		50583
71		1	Mounting Clamp		50584
72		4	Spacer		50602
73	50609-SHU	1	Ejector Assembly		50609
74		2	Deflector		50559

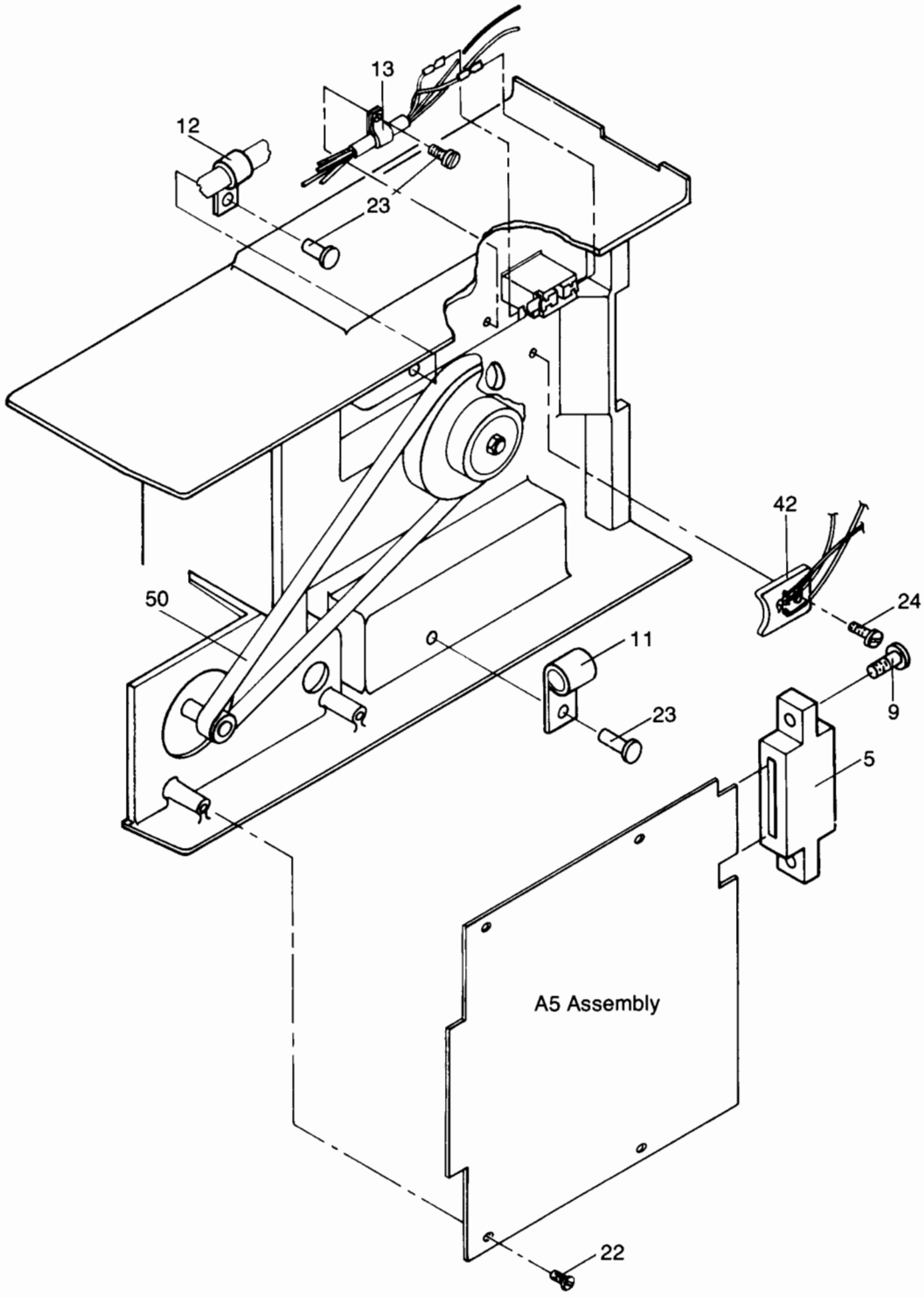

Figure 5-1. Bottom Drive Chassis

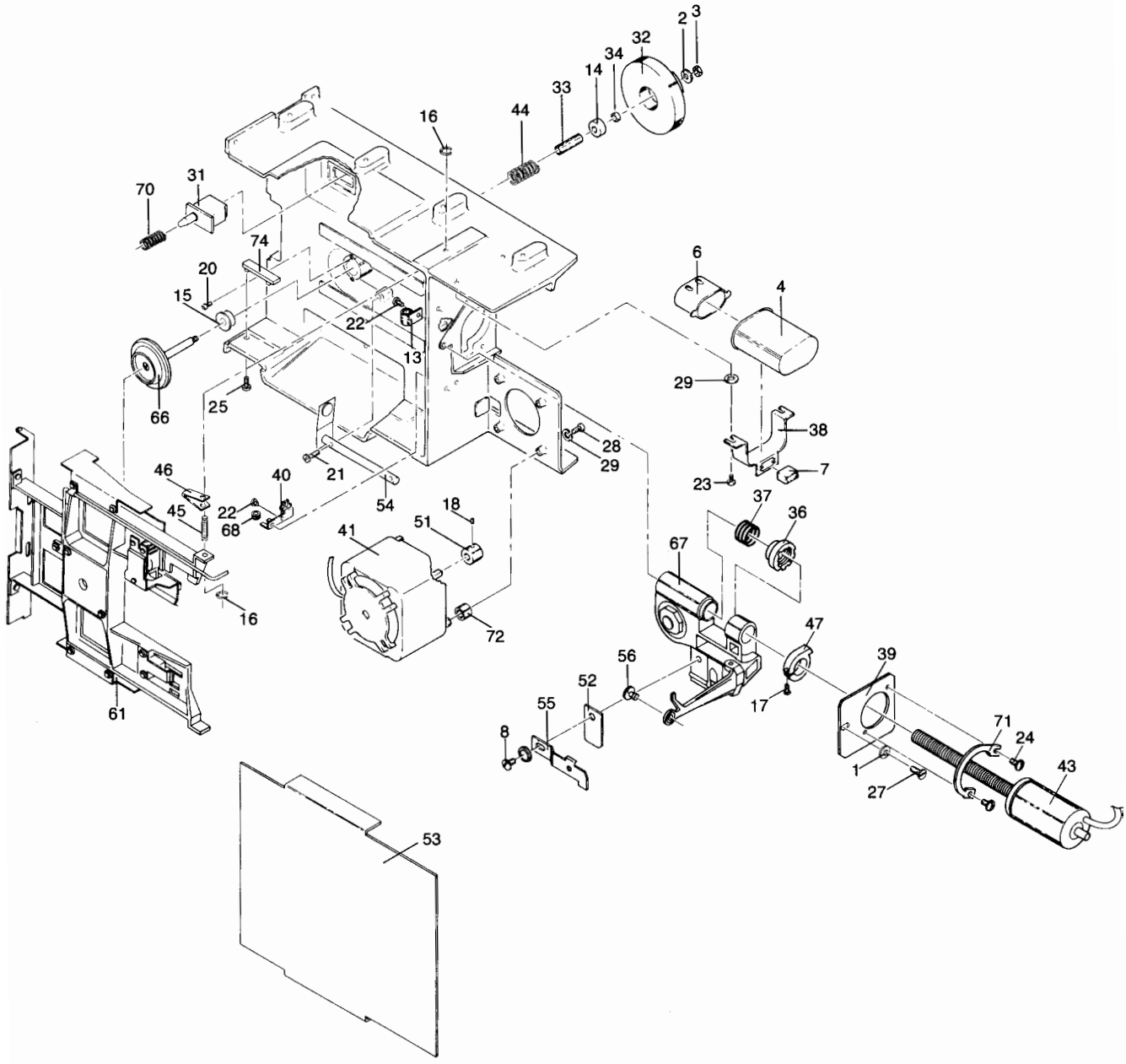

Figure 5-2. Top Drive Chassis

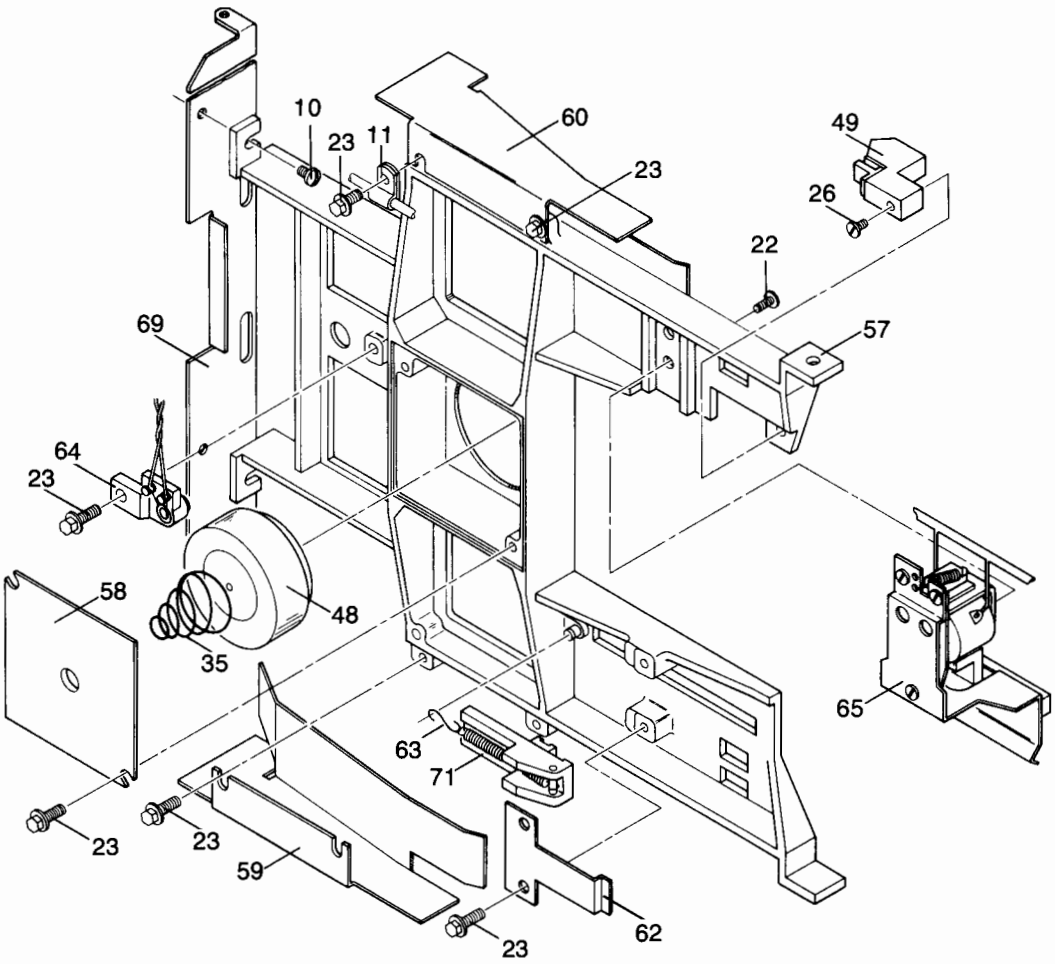

Figure 5-3. Disk Guide

Computer Museum

Appendix A

Glossary of Disk Terms

address mark – A unique bit pattern used to identify the start of a header or a record. The header address mark is different from a record address mark. All header address marks are the same and all record address marks are the same.

backup track – Track 6 of an initialized disk contains the same information as track 0; the systems table, the directory and the availability table.

bootstraps – Binary programs loaded from the Disk System Cartridge onto the disk during initialization. These programs are part of the system software, and consist of disk commands and routines. These programs are utilized by the system during operation.

checkword – A 16 bit word written on the disk at the end of each record. This word is generated by the controller during a write operation. Each record has its own unique checkword (CRC). The checkword is compared during a read operation as a check for data validity.

checkword error – When a record is read, the data is gated to the checkword register. At the end of the record the checkword is read from the disk and compared to the contents of the checkword register. If the checkword does not compare, a checkword error (d7) is generated indicating an error in reading.

controller – The controller is a group of printed circuit assemblies (A2–A4) in the 9885M drive. The controller monitors and controls all drive functions. The 9885S drive does not contain these assemblies.

defective track – A track on the disk where the reading and writing of data is not possible. This condition is usually caused by a scratch, dirt, or lack of magnetic oxide on the surface of the disk. The number of defective tracks is identified during initialization and is recorded in the systems table on tracks 0 and 6.

disk – The disk is the storage medium for the 9885. Data is written on a thin magnetic oxide film. The disk is enclosed in a plastic jacket to protect it.

drive – The 9885M and S are referred to as drives.

drive number – The drive number (0–3) is selected by the drive select switch on the rear panel of the drive.

double density – The type of recording technique used by the 9885, giving increased storage capacity and high bit density.

end or record marker – A marker written in the first word of each record when a file is opened. This marker is also written at the end of the data in a file.

error recovery routines – Binary programs allowing the user to read a file ignoring header and checksum errors.

file – A file is one or more user records written on the disk.

flexible disk – The disk is sometimes referred to as a flexible disk.

flexible disk drive – The 9885M and S drives are referred to as flexible disk drives.

head – The read/write head contains the read, write and erase elements. The elements (coils) are encased in ceramic. When the head is loaded, it is in contact with the disk surface.

header – A bit pattern written during the initialization procedure. A header is at the beginning of each record.

index – An index pulse is generated each revolution of the disk. The index pulse indicates the start of a track.

hard error – Results usually from a hardware failure. A hard error is usually non-recoverable, however the software error recovery routines can be used in an attempt to recover from the error.

initialize – When a disk is initialized, addresses are written on it and the systems tracks (bootstraps and tables) are set up.

master – The 9885M is the master drive. It contains the controller assemblies (A2–A4).

phase lock loop – When reading, the phase lock loop synchronizes the clock and data from the disk before it goes to the decoder.

preamble – A group of one bits at the beginning of a record and a header.

record – A pattern of bits written on the disk following the header.

seek – The movement of the carriage from one track to another track.

slave – The 9885S is referred to as the slave. It does not contain the controller assemblies as the 9885M does.

soft error – Soft errors are recoverable errors and non-repeatable errors usually caused by dirt in the air or on the disk, random electrical noise, small defects in data or the disk, or a defective load pad.

select code – In a 9825/9885 system, each 98032A Option 085 Interface must be set to a different select code. The allowable flexible disk system select codes are from 8 to 15.

systems area – The systems area consists of track 0 thru 5 on the disk. This area contains the systems tables, bootstraps and backup track.

track – Any one of 67 concentric circles on the surface of the disk. The tracks are numbered from 0 (toward the outer edge) to 66 (inner most track). Tracks are spaced .012 inches center to center.

track 0 – Track 0 is the track closest to the outer edge of the disk. The carriage is at its "home" position when it is at track 0.

transition – A flux reversal on the disk will produce an electrical transition during a read. These transitions are decoded into bits in the decoder. Writing data on the disk produces the flux reversals on the disk.

tight margin – Restricting the normal time during a read that transitions can be interpreted as bits.

verify error – Generated when reading under a tight margin (d9) or during the pattern test. It indicates that the record was read correctly but transitions were marginal for reading and they might not be read correctly on the next attempt.

write protect – Writing on the disk is not allowed when the write protect hole is open.

98032A Option 085 Cable Assembly

The 98032A Option 085 interface cable connects the 9885M to the 9825A Calculator. Refer to the 98032A Installation and Service Manual for troubleshooting and service information on the 98032A printed circuit assemblies.

Option 085 Cable Wiring

Here is a diagram of the 98032A Option 085 cable.

Interface Connector			9885M Connector	
Line	Pin	Wire Color	Pin	Line
GND	A1	905	2	GND
DO15	A2	948	18	DIO15
DO14	A3	947	19	DIO14
DO13	A4	946	20	DIO13
DO12	A5	945	21	DIO12
DO11	A6	937	22	DIO11
DO10	A7	936	23	DIO10
DO9	A8	935	24	DIO9
DO8	A9	934	25	DIO8
DO7	A10	97	26	DIO7
DO6	A11	96	27	DIO6
DO5	A12	95	28	DIO5
DO4	A13	94	29	DIO4
DO3	A14	93	30	DIO3
DO2	A15	92	31	DIO2
DO1	A16	91	32	DIO1
DO0	A17	90	33	DIO0
GND	A18	9	8	GND
PCTL	A19	98	10	PCTL
I/O	A20	901	15	N/C
PRESET	A21	902	5	PRESET
CTL0	A22	927	4	CTL0
CTL1	A23	928	6	CTL1
GND	A24	903	11	GND
Shield	A25	Shield	1	Chassis GND
GND	B1	906	3	GND
DI15	B2	926	35	DIO15
DI14	B3	925	36	DIO14
DI13	B4	924	37	DIO13
DI12	B5	923	38	DIO12
DI11	B6	915	39	DIO11
DI10	B7	914	40	DIO10
DI9	B8	913	41	DIO9
DI8	B9	912	42	DIO8
DI7	B10	7	43	DIO7
DI6	B11	6	44	DIO6
DI5	B12	5	45	DIO5
DI4	B13	4	46	DIO4
DI3	B14	3	47	DIO3
DI2	B15	2	48	DIO2
DI1	B16	1	49	DIO1
DI0	B17	0	50	DIO0
GND	B18	Inner Drain	9	GND
PFLG	B19	8	13	PFLG
PSTS	B20	908	14	PSTS
EIR	B21	918	7	EIR
STI0	B22	916	16	N/C
STI1	B23	917	17	N/C
GND	B24	904	12	GND
Shield	B25	Shield	34	Chassis GND

Option 085 Configuration Board Jumpers

The configuration board is located in the rear housing of the interface case. Jumpers for the option 085 cable are installed in positions 2, 5, 7, B, E and F .

9825A/9885 Error Messages

Hardware Errors

error d0 Firmware/driver out of synchronization. More than six defective tracks in a row. (Press RESET)

error d1 All drives in system not powered.

error d2 Door opened while disk is being accessed.

error d3 Disk not in drive or no such drive number.

error d4 Write not allowed to protected disk. Bad hardware.

error d5 Record header error. (Use Error Recovery Routine)

error d6 Track not found. (Use Error Recovery Routine)

error d7 Data Checkword error. (Use Error Recovery Routine)

error d8 Hardware failure. (Press RESET)

error d9 Verify error due to drive problem. Marginal data. (Reprint data)

Software Errors

error D0 Improper argument.

error D1 Argument out of range.

error D2 Improper file size (negative, 0 or >32767).

error D3 Invalid file name.

error D4 File not found.

error D5 Duplicate file name.

error D6 Wrong file type.

error D7 Directory overflow.

error D8 Insufficient storage space on disk.

error D9 Verify error due to cable, calculator or drive problem. Bad data (Reprint data.)

error F0 File overflow when read or print executed.

error F1 Bootstraps not found. (Reload bootstraps)

error F2 String read but wrong data type encountered.

error F3 Attempt to read data item but type doesn't match.

error F4 Availability table overflow. (Repack)

error F5 Attempt on end branch from other than running program.

error F6 Unassigned data file pointer.

error F7 Disk is down so line cannot be reconstructed.

error F8 Disk is down and STOP pressed.

error F9 System error. (Save files individually and reinitialize)

These mainframe errors take on additional meaning when the Disk ROM is installed.

error 03 Mnemonic not found because disk may be down.

error 29 Line can't be executed because ROM (usually String) is missing.

error 31 Line not found.

error 50 Get or chain should be last statement in a line.

error 51 ROM now installed which wasn't when savem was executed.

error 52 ROM now missing which wasn't when savem was executed.

error 63 Disk load operation would overlay gsb return address so load not executed.

error 64 get, chain or getk not allowed from live keyboard mode or during an ent statement.

These errors may result during the binary Initialization and Error Recovery Routines.

error B0 Wrong syntax, argument out of range or variable not properly dimensioned.

error B1 More than six defective tracks on the disk.

error B2 Verify error. Boots on the disk not identical to boots on the cartridge.

error B3 dtrk or tinit not allowed because error information lost or error not d5.

error B4 Attempt to access record for error correction which isn't part of data file.

error B5 Improper string length (inconsistent with length given in header).

error B6 Not enough space in calculator buffer for data item.

error B7 Missing disk or String ROM.

error B8 Track still bad after tinit.

Mnemonic	Definition	Remarks
AMDT	Address Mark Detect	Output by A4 whenever an address mark is read.
AMGN	Address Mark Generate	Generated by A2 when address mark is needed.
BFEN	Buffer Enable	Loads the A2 read buffer (when high) with the contents of the shift register.
BYTE	Byte Sync	High when 8 bits have been loaded into the A2 shift register.
CRCL	CRC Latch (DC3)	High indicates checkword error.
CTL0	Extended Control Line	Control line used by interface when addressing the A3 assembly.
DC0–DC6	Direct Control Lines	Used by nanoprocessor as input, output or flag lines.
DECD	Decode Enable	Set high by A2 assembly whenever the A4 assembly must decode data on a read.
DIO0–DIO15	16-bit I/O Data Bus	16-bit bidirectional I/O Bus.
D0–D7	Internal 8-bit Data Bus	8-bit bidirectional data/instruction bus for the nanoprocessor.
DOPN	Door Open	Low when disk door is open.
DRCT	Direction	Head moves toward track 0 when high and step line is pulsed.
DRDY	Drive Ready	Low when drive is selected and ready for access.
DS0–DS3	Device Select Lines	Used by nanoprocessor to select internal input or output devices.
EIR	External Interrupt Request (Abort DMA Transfer from Calculator)	Used only to abort a Direct Memory Access operation.
ENCD	Encode Enable	Set high by A2 when A4 must encode data for a write.
FLAG	Byte Transfer Flag (DCU)	High when A2 shift register has shifted a byte in or out.
HDDW	Head Down (loaded)	Set low by A5 when the head is loaded.
HDLD	Head Load	Set high by A3 when head should be loaded.
ICRC	CRC Input Select	When low, data is input to the checkword register for checkword generation.
INDX	Index	Low once per revolution of the disk when index hole is detected by index detector.
MTST	Marginal Transition	High when a marginal transition has occurred.
OCRC	Output CRC	Low when a checkword is to be sent from checkword register to the A4 assembly.
PA0–PA10	Program Address Lines	Used by nanoprocessor to select next program address.
PCTL	Peripheral Control	Set low by calculator to indicate new data ready for write or data can be accepted for read.
PFLG	Peripheral Flag	Used with PCTL to provide handshake.
PRESET	Preset line from the calculator used to initialize the controller	Set low by calculator to initialize controller.
PSTS	Peripheral Status	Low if 9885 hardware not functioning properly.
PVAL	Power Valid from Power Supply	Set high by A1 whenever power is applied.
PWR	Power applied to drive	Set high by A5 when power is applied.
RCRC	CRC Reset	A low resets the checkword register to all zeros.
RDAT	Read Data	Serial data sent from the A4 assembly to the A2 assembly.
RTRN	Read Transition	Clock and data pulses read from the disk.
SC lines	Select Code Lines SC4 = enable read buffer SC5 = enable write buffer	Lines decoded from the DS0 – DS3 lines.
SEL0 SEL1	Drive Select Lines	Determines the drive number. Set by the drive number switch on rear panel.
SHFT	Shift/Load Select	Sent to A2 shift register when shifting data in or out.
STEP	Step (carriage)	A change from low to high rotates stepper motor one step.
STLT	Self test light	High lights the self test light.
STST	START self test	High when self test switch is pushed.
STM	START Memory	Sends next ROM instruction to nanoprocessor when low.
TRK 0	Track 0	Low when head is at track 0.
UNT0 UNT1	Unit (drive number) Lines	Used by A3 assembly to select which drive will be addressed for disk operations.
WDAT	Write Data	Serial data output from the A2 shift register to the A4 assembly.
WPRO	Write Protect	Low when a write protected disk is inserted.
WREN	Write Enable	High when a write operation is to be done.
WTRN	Write Transition	Data and clock pulses from the A4 assembly to be written on the disk.

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