Alan R. Baldwin

Service Manual
November 1982
P/N 39018-2

Shugart 850/851
Flexible Disk
Storage Drive

Shugart

Shugart

475 Oakmead Parkway, Sunnyvale, CA 94086 Telephone: (408) 733-0100

PUBLICATION CHANGE NOTICE

PN: 39018-2 **Product:** SA850/851 BC **Date:** 5/24/83 **Errata: #** B

Pub. Date: 11/82 **Pub. Type:** Service

The following error has been found in paragraph 5.5.9 Track 00 Detector Assembly Adjustment (page 5-22).

Step "e" of the procedure currently instructs the user to check the adjustment by stepping the heads between tracks 00 and 02. The correct instruction is:

e. Check adjustment by stepping heads between tracks 01 and 02. Observe TP26 is low at track 02 and high at track 01. Square wave on scope indicates perfect alignment.

Please make the correction from track 00 to track 01 in ink, then insert this notice behind the front cover.

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PUBLICATION CHANGE NOTICE

PN: 39018-2 **Product:** 850/851 BC **Date:** 3/23/83 **Errata: #** A

Pub. Date: 11/82 **Pub. Type:** Service

Please make the following corrections to your manual in ink:

Page Number	Description of Change
5-13	Figure 5-9. Screw 3 is the Spring Tension Adjustment listed beneath the illustration. Write "3" next to "SPRING TENSION ADJUSTMENT (FACTORY ADJUSTMENT)."
5-27	Paragraph 5.6.12 Cartridge Guide Removal, step "a." Delete reference to paragraph 5.5.2.

After these changes are made, place this memo behind the front cover.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

LIST OF FIGURES

LIST OF FIGURES (CONT.)

LIST OF TABLES

ABBREVIATIONS/MNEMONICS

bpi	Bits Per Inch
fci	Flux Changes Per Inch
FM	Frequency Modulation
GND	Ground
HAC	Head Actuator Carriage
I/O	Input/Output
LED	Light Emitting Diode
MFM	Modified FM
MLC	Machine Level Code
NRZI	Non Return to Zero
PCB	Printed Circuit Board
POH	Power On Hours
RTN	Return
R/W	Read/Write
TP	Test Point
tpi	Tracks Per Inch
1F	Single Frequency
2F	Double Frequency

ABOUT THIS MANUAL

This manual (P/N 39018-2) supersedes all earlier manuals and incorporates Publication Change Notice A, dated 11/3/82. All earlier editions of this manual may be discarded.

While every effort has been made to ensure that the information provided herein is correct, please feel free to notify us in the event of an error or inconsistency. Direct any comments on the form at the back of this manual to:

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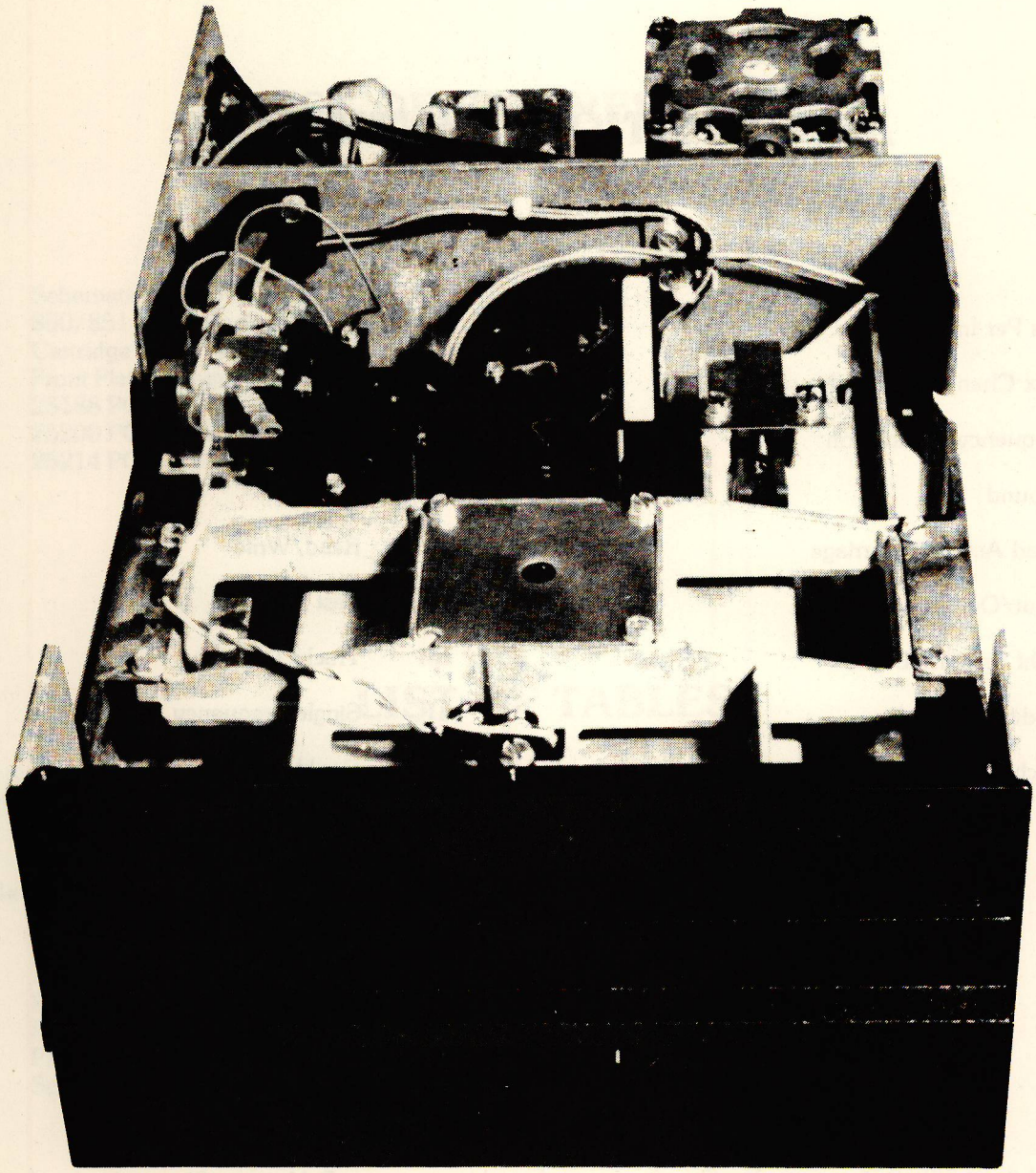


39018-50

FIGURE 1-1. SA850/851 BC DOUBLE SIDED DISKETTE DRIVE

SECTION I
INTRODUCTION

1.1 INTRODUCTION

The SA850/851 diskette storage drives are enhanced double-headed versions of the standard Shugart SA800/801 drives. SA850/851 drives provide up to four times the on-line storage capacity, faster access time, and lower heat dissipation along with improved reliability and maintainability.

SA850/851 drives read and write in single or double density on standard diskettes and on both sides of two-sided diskettes. The drives are exactly the same size as Shugart SA800/801 drives and are plug compatible. The SA850/851 drives are also media compatible with IBM 3740 and System 32 single-sided drives as well as IBM 4964 and 3600 series two-sided units.

The proprietary Fasflex™ actuator utilizes a flexible metal band for sure low friction head movement and a fast 3 ms track-to-track access time. In addition, Shugart's Bi-Compliant™ read/write head assembly provides superior compliance resulting in excellent data integrity.

Other valuable features include: programmable door lock and write protect plus dual index sensor to differentiate between single and two-sided diskettes.

The SA850/851 will prove highly cost-effective in applications such as: intelligent terminals, minicomputer/microcomputer systems, small business systems as well as word processing systems and intelligent calculators.

Key Features

a. Storage capacity of up to four times that of the SA800 and other standard floppy drives.
b. Single or double density (standard).
c. Same physical size as standard SA800/801 product family.
d. SA800/801 I/O compatibility.
e. Improved access time over standard drives - 3 ms track-to-track.
f. Proprietary Fasflex™ actuator.
g. Bi-Compliant read/write head assembly.
h. Write protect and programmable door lock are standard for improved data security.
i. Lower heat dissipation.
j. Improved ac connector.

1.2 SPECIFICATION SUMMARY

1.2.1 Performance Specifications

Capacity	Single Density	Double Density
Unformatted		
Per Disk	800 k bytes	1600 k bytes
Per Surface	400 k bytes	800 k bytes
Per Track	5.2 k bytes	10.4 k bytes
IBM Format (128 byte sectors)		
Per Disk	500 k bytes	1000 k bytes
Per Surface	250 k bytes	500 k bytes
Per Track	3.3 k bytes	6.66 k bytes

	Single Density	Double Density
Transfer Rate	250 k bits/sec	500 k bits/sec
Latency (average)	83 ms	83 ms
Access Time		
Track to Track	3 ms	3 ms
Average (including settling)	91 ms	91 ms
Settling Time	15 ms	15 ms
Head Load Time	50 ms	50 ms

1.2.2 Functional Specifications

	Single Density	Double Density
Rotational Speed	360 rpm	360 rpm
Recording Density (inside track)	3408 bpi	6816 bpi
Flux Density	6816 fci	6816 fci
Track Density	48 tpi	48 tpi
Cylinders	77	77
Tracks	154	154
Heads	2	2
Physical Sectors		
SA850/R	0	0
SA851/R	32	32
Index	1	1
Encoding Method	FM	MFM
Media Requirements		
SA850	SA150/IBM Diskette 2D	SA150/IBM Diskette 2D
SA851	SA151	SA151
Alignment Diskette	SA122	SA122

1.2.3 Physical Specifications

	Operating	Shipping	Storage
Environment Limits			
Ambient Temperature	50° to 115°F (10° to 28.3°C)	-40° to 144°F (-40° to 62.2°C)	-8° to 117°F (-22.2° to 47.2°C)
Relative Humidity	20 to 80%	1 to 95%	1 to 95%
Maximum Wet Bulb	85°F (29.1°C)	No condensation	No condensation

AC Power Requirements
50/60 ±0.5 Hz
100/115 V ac Installations = 85 to 127 V @ 0.35 A Max
200/230 V ac Installations = 170 to 253 V @ 0.25 A Max

DC Voltage Requirements
+24 V dc ± 10% 1.0 A Max
+ 5 V dc ± 5% 1.1 A Max

Mechanical Dimensions (exclusive of front panel)

	SA850R/851R	SA850/851
Height =	4.62 in. (117 mm)	4.62 in. (117 mm)
Width =	8.55 in. (217 mm)	9.50 in. (241 mm)
Depth =	14.25 in. (362 mm)	14.25 in. (362 mm)
Weight =	13 lbs (5.91 kg)	13 lbs (5.91 kg)

Heat Dissipation	Typical	Maximum
BTU/Hr	205	246
Watts	60	72

1.2.4 Reliability Specifications

Mean Time Between Failure:	5000 POH under heavy usage 8000 POH under typical usage
Preventive Maintenance:	12 months
Mean Time to Repair:	30 minutes
Component Life:	15,000 POH
Error Rates:	
Soft Read Errors:	1 per 10^9 bits read
Hard Read Errors:	1 per 10^{12} bits read
Seek Errors:	1 per 10^6 seeks
Media Life:	
Passes per Track:	3.5×10^6
Insertions:	30,000+

1.3 FUNCTIONAL CHARACTERISTICS

1.3.1 General Operation

SA850/851 Diskette Storage Drives consist of read/write and control electronics, drive mechanism, Bi-Compliant read/write heads, and a track positioning mechanism. These components perform the following functions:

a. Interpret and generate control signals.
b. Move read/write heads to the selected track.
c. Read and write data.

The Fasflex™ Head Positioning Actuator positions the read/write heads to the desired track on the diskette. The Head Load Solenoid loads the read/write heads against the diskette and data may then be recorded on or read from the diskette. See figure 1-2 for a functional diagram of the SA850/851.

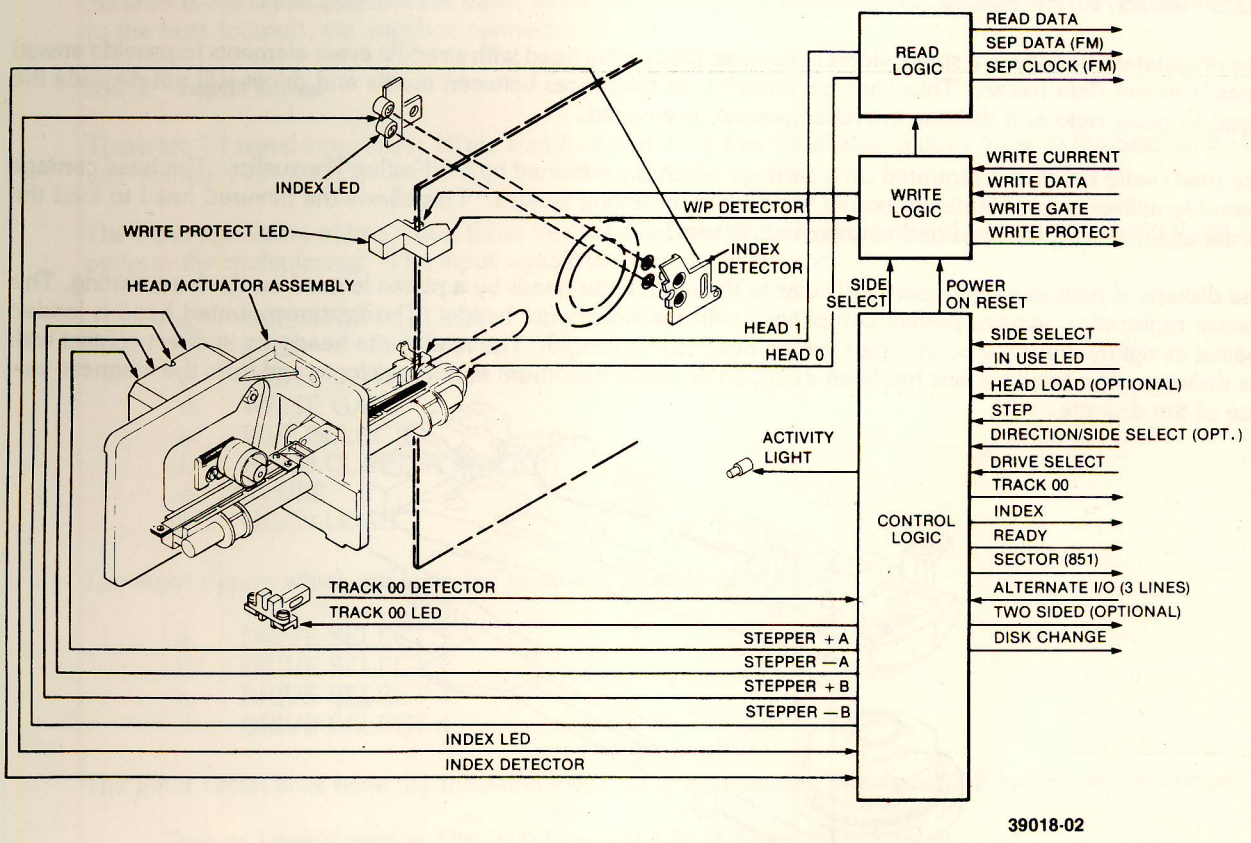


FIGURE 1-2. SA850/851 FUNCTIONAL DIAGRAM

1.3.2 Read/Write and Control Electronics

The electronics are packaged on one PCB. The PCB contains:

a. Index Detector Circuits (Sector/Index for 851).
b. Head Position Actuator Driver.
c. Head Load Solenoid Driver.
d. Read/Write Amplifier and Transition Detector (LSI Logic).
e. Data/Clock Separation Circuits (SA851 Only).
f. Write Protect Circuit.
g. Drive Ready Detector Circuit.
h. Drive Select Circuits.
i. Side Select Circuit.
j. In Use and Door Lock Circuits.
k. Write Current Switching.

1.3.3 Drive Mechanism

The diskette drive motor rotates the spindle at 360 rpm through a belt-drive system. 50 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 diskette. A clamp that moves in conjunction with the cartridge guide fixes the diskette to the registration hub.

1.3.4 Positioning Mechanism

The read/write heads are accurately positioned by the Fasflex™ metal band/stepping motor actuator system. A precision stepping motor is used to precisely position the head/carriage assembly through the use of a unique metal band/capstan concept. Each 3.6° rotation of the stepping motor moves the read/write head one track in discrete increments.

1.3.5 Read/Write Heads

The proprietary heads are a single element ceramic read/write head with straddle erase elements to provide erased areas between data tracks. Thus, normal interchange tolerances between media and drives will not degrade the signal-to-noise ratio and diskette interchangeability is ensured.

The read/write heads are mounted on a carriage which is positioned by the Fasflex™ actuator. The head carriage assembly utilizes a combination flexured/rigid head mounting system. This allows the flexured head to load the media against its rigidly mounted counterpart (figure 1-3).

The diskette is held in a plane perpendicular to the read/write heads by a platen located on the base casting. This precise registration assures perfect compliance with the read/write heads. The flexure-mounted head is loaded against its rigidly mounted counterpart via the head load solenoid. The read/write heads are in direct contact with the diskette. The head surface has been designed to obtain maximum signal transfer to and from the magnetic surface of the diskette.

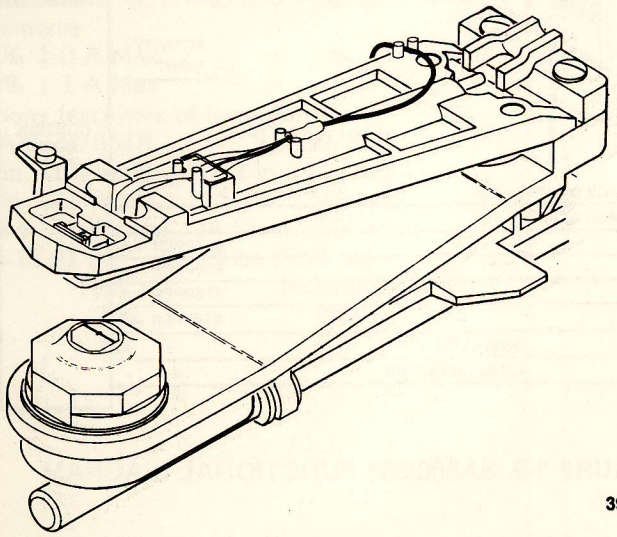


FIGURE 1-3. BI-COMPLIANT READ/WRITE HEAD

SECTION II
ELECTRICAL INTERFACE

2.1 INTRODUCTION

The interface of the SA850/851 Diskette drive can be divided into two categories:

a. Signal Interface
b. Power Interface

The following sections provide the electrical definition for each line. See figure 2-1 for all interface connections.

2.2 SIGNAL INTERFACE

The signal interface consists of two categories:

a. Control Lines
b. Data Transfer Lines

All lines in the signal interface are digital in nature and either provide signals to the drive (input), or provide signals to the host (output), via interface connector P1/J1.

2.2.1 Input Lines

There are 13 signal input lines; 10 are standard and 3 are user installable options (refer to the SA850/851 BC Service Manual P/N 39017).

The input signals are of two types, those intended to be multiplexed in a multiple drive system and those which will perform the multiplexing. The input signals to be multiplexed are:

a. DIRECTION SELECT
b. STEP
c. WRITE DATA
d. WRITE GATE
e. SIDE SELECT
f. HEAD CURRENT SWITCH
g. IN USE
h. HEAD LOAD

The input signals which are intended to do the multiplexing are:

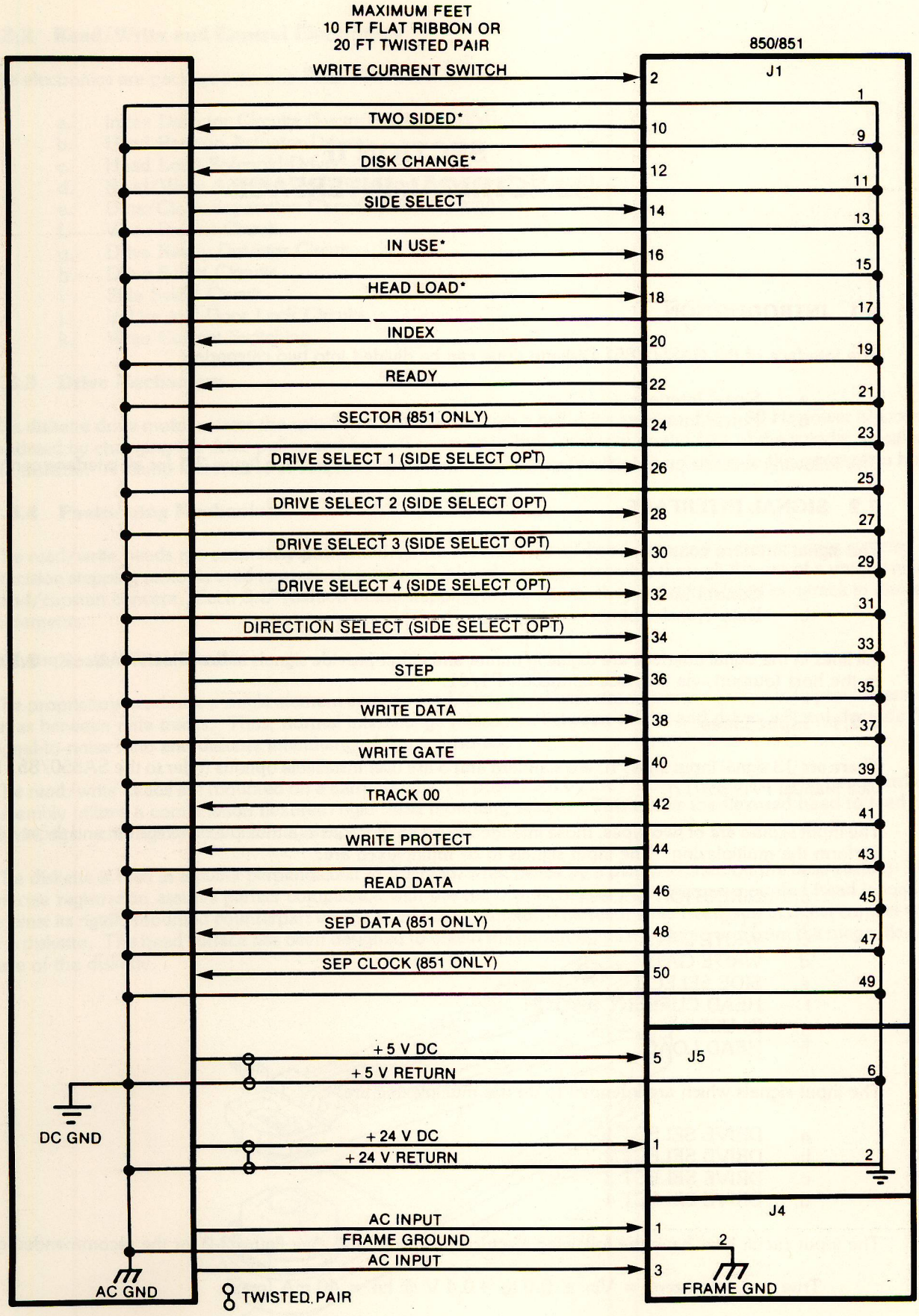
a. DRIVE SELECT 1
b. DRIVE SELECT 2
c. DRIVE SELECT 3
d. DRIVE SELECT 4

The input circuit lines have the following electrical specifications. See figure 2-2 for the recommended circuit.

True = Logical zero = Vin ± 0.0 to +0.4 V @ Iin = 40 mA (max)

False = Logical one = Vin ± 2.5 to +5.25 V @ Iin = 250 μA (open)

Input Impedance = 150 ohms



*THESE LINES ARE ALTERNATE INPUT/OUTPUT LINES AND THEY ARE ENABLED BY JUMPER PLUGS. REFER TO SA850/851 BC OEM MANUAL (P/N 39017) FOR USES OF THESE LINES. NOT SHOWN ARE PINS 4, 6, AND 8 WHICH ARE ALTERNATE I/O PINS.

39018-04

FIGURE 2-1. INTERFACE CONNECTIONS

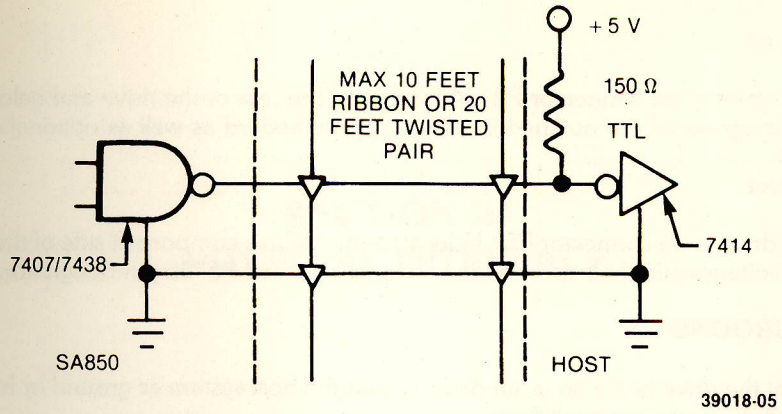


FIGURE 2-2. INTERFACE SIGNAL DRIVER/RECEIVER

2.2.2 Input Line Termination

The SA850/851 has been provided with a removable resistor pack for terminating the seven input lines that are to be multiplexed.

In order for the drive to function properly, the last drive on the interface must have these seven lines terminated. Termination of these lines can be accomplished by either of two methods.

a. As shipped from the factory, the resistor pack is installed in location 5E. These packs can be removed from all drives except the last one on the interface.

b. External termination may be used provided the terminator is beyond the last drive. Each of the five lines should be terminated by using a 150 ohm, ¼ Watt resistor, pulled up to +5 V dc.

The same removable resistor pack is also provided for terminating the optional input lines.

2.2.3 Drive Select 1–4

DRIVE SELECT, when activated to a logical zero level, activates the multiplexed I/O lines and loads the read/write head. In this mode of operation, only the drive with this line active will respond to the input lines and gate the output lines.

Four separate input lines, DRIVE SELECT 1, DRIVE SELECT 2, DRIVE SELECT 3, and DRIVE SELECT 4, are provided so that up to four drives may be multiplexed together in a system and have separate DRIVE SELECT lines. Traces "DS1," "DS2," "DS3," and "DS4" have been provided to select which DRIVE SELECT line will activate the interface signals for a unique drive. As shipped from the factory, a shorting plug is installed on "DS1." To select another DRIVE SELECT line, this plug should be moved to the appropriate "DS" pin.

2.2.4 Output Lines

There are five standard output lines from the SA850, and eight standard output lines from the SA851. Additionally, two optional output lines and eight alternate outputs are available from either the SA850 or SA851.

Output signals are driven with an open collector output stage capable of sinking a maximum of 40 mA at a logical zero level, or true state, with a maximum voltage of 0.4 V measured at the driver. When the line driver is a logical one, or false state, the driver is off and the collector current is a maximum of 250 mA.

See figure 2-2 for the recommended circuit.

2.3 POWER INTERFACE

The SA850/851 Diskette Storage Drive requires both ac and dc power for operation. The ac power is used for the spindle drive motor and the dc power is used for the electronics and the stepper motor.

2.3.1 AC Power

AC power to the drive is via connector P4/J4 located to the rear of the drive and below the ac motor capacitor. The P4/J4 pin designations are outlined in table 2-1 for standard as well as optional ac power.

2.3.2 DC Power

DC power to the drive is via connector P5/J5 located on the non-component side of the PCB near the P4 connector. The two dc voltages and their specifications, along with their P5/J5 pin designators, are outlined in table 2-2.

2.4 FRAME GROUND

It is important that the drive be frame grounded to either the host system ac ground or frame ground. Failure to do so may result in drive noise susceptibility.

TABLE 2-1. AC POWER REQUIREMENTS

P4 PIN	60 Hz		50 Hz	
	115 V (STANDARD)	208/203 V	110 V	220 V
1 2 3	85-127 V AC FRAME GND 85-127 V RTN	170-253 V AC FRAME GND 170-253 V RTN	85-127 V AC FRAME GND 85-127 V RTN	170-253 V AC FRAME GND 170-253 V RTN
MAX CURRENT	0.35 AMPS	0.25 AMPS	0.35 AMPS	0.25 AMPS
FREQ TOLERANCE	± 0.5 HZ		+ 0.5 HZ	

39018-06

TABLE 2-2. DC POWER REQUIREMENTS

P5 PIN	DC VOLTAGE	TOLERANCE	CURRENT	MAX RIPPLE (P TO P)
1	+ 24 V DC	± 2.4 V DC	1.0 A MAX* 0.85 A TYP	100 mV
2	+ 24 V RETURN			
6	+ 5 V RETURN			
5	+ 5 V DC	± 0.25 V DC	1.1 A MAX 1.0 A TYP	50 mV

*IF EITHER CUSTOMER INSTALLABLE OPTION DESCRIBED IN SECTIONS 7.1 AND 7.3 OF THE OEM MANUAL (P/N 39017) ARE USED, THE CURRENT REQUIREMENT FOR THE + 24VDC IS A MULTIPLE OF THE MAXIMUM + 24 V CURRENT TIMES THE NUMBER OF DRIVES ON THE LINE.

39018-07

SECTION III
PHYSICAL INTERFACE

3.1 INTRODUCTION

The electrical interface between the SA850/851 and the host system is via three connectors. The first connector, J1, provides the signal interface; the second connector, J5, provides the dc power; and the third connector, J4, provides the ac power and frame ground.

This section describes the physical connectors used on the drive and the recommended connectors to be used with them. See figure 3-1 for connector locations.

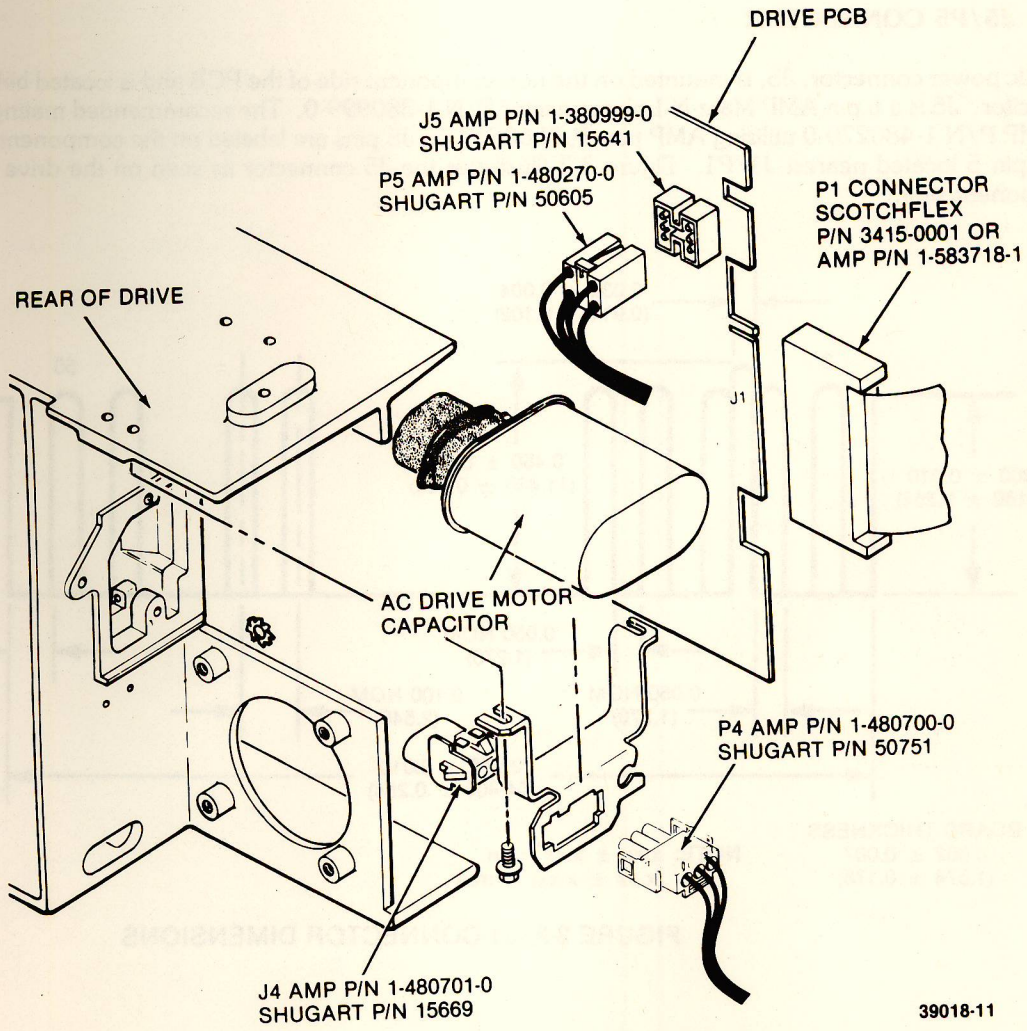


FIGURE 3-1. INTERFACE CONNECTOR - PHYSICAL LOCATION

3.2 J1/P1 CONNECTOR

Connection to J1 is through a 50 pin PCB edge card connector. The dimensions for this connector are shown in figure 3-2. The pins are numbered 1 through 50 with the even numbered pins on the component side of the PCB and the odd numbered pins on the non-component side. Pin 2 is located on the end of the PCB connector closest to the ac motor capacitor and is labeled 2. A key slot is provided between pins 4 and 6 for optional connector keying.

The recommended connectors for P1 are outlined in table 3-1.

TABLE 3-1. RECOMMENDED P1 CONNECTORS

TYPE OF CABLE	MANUFACTURER	CONNECTOR P/N	CONTACT P/N
TWISTED PAIR, #18 (CRIMP OR SOLDER)	AMP	1-583718-1	583616-5 (CRIMP) 583854-3 (SOLDER)
TWISTED PAIR, #18 (SOLDER TEM.)	VIKING	3VH25/1JN-5	N/A
FLAT CABLE	3M "SCOTCHFLEX"	3415-0001	N/A

39018-08

3.3 J5/P5 CONNECTOR

The dc power connector, J5, is mounted on the non-component side of the PCB and is located below the ac motor capacitor. J5 is a 6 pin AMP Mate-N-Lok connector P/N 1-380999-0. The recommended mating connector (P5) is AMP P/N 1-480270-0 utilizing AMP pins P/N 60619-1. J5 pins are labeled on the component side of the PCB with pin 5 located nearest J1/P1. Figure 3-3 illustrates the J5 connector as seen on the drive PCB from non-component side.

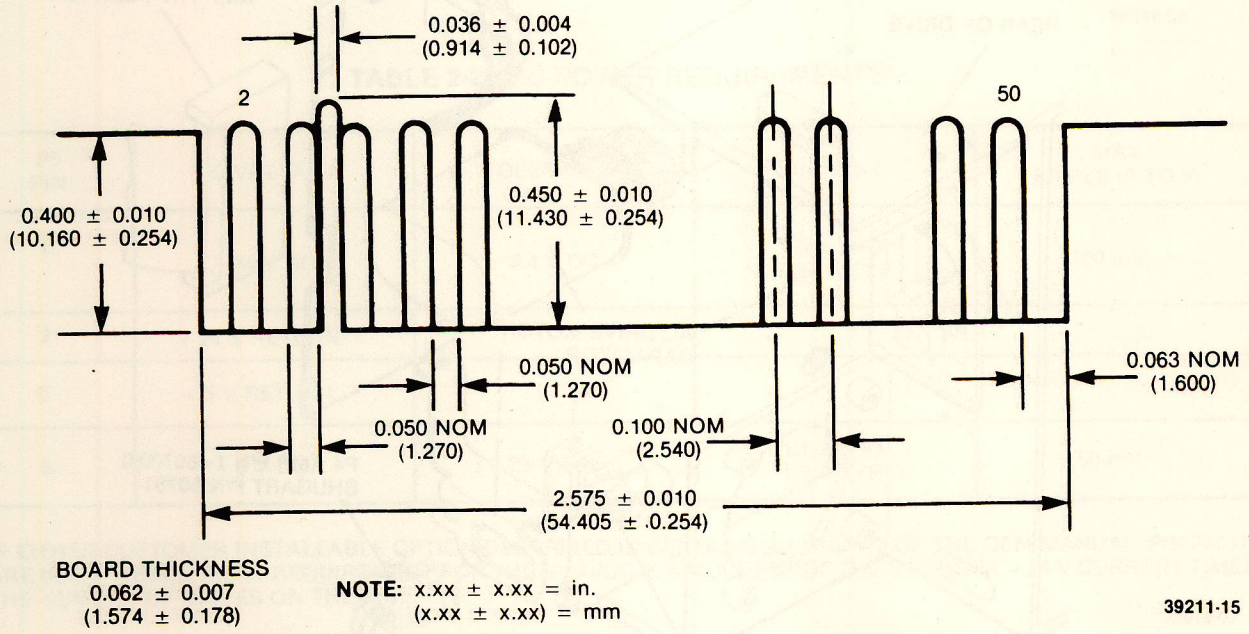


FIGURE 3-2. J1 CONNECTOR DIMENSIONS

3.4 J4/P4 CONNECTOR

The ac power connector, J4, is mounted on the ac motor capacitor bracket and is located just below the capacitor. J4 connector is a 3 pin connector AMP P/N 1-480701-0 with two 350687-1 (Shugart P/N 15665) pins and one 350654-1 (Shugart P/N 15666) pin. The recommended mating connector, P4, is AMP P/N 1-480700-0 utilizing pins 350550-1. Figure 3-4 illustrates the J4 connector as seen from the rear of the drive.

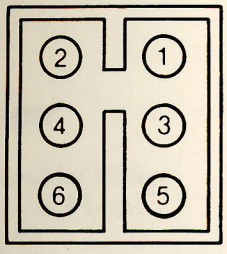


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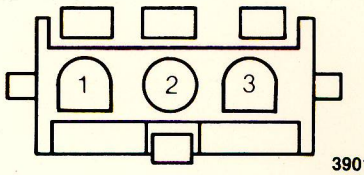
FIGURE 3-3. J5 CONNECTOR



39018-10

FIGURE 3-4. J4 CONNECTOR

SECTION IV
THEORY OF OPERATIONS

4.1 TRACK ACCESSING

a. Carriage Actuator Motor
b. Actuator Control Logic
c. Reverse Seek
d. Forward Seek
e. Track 00 Flag

Seeking the read/write heads from one track to another is accomplished by selecting the desired direction utilizing the DIRECTION SELECT interface line, loading the read/write heads, and pulsing the STEP line. Multiple track accessing is accomplished by repeated pulsing of the STEP line until the desired track has been reached. Each pulse on the STEP line will cause the read/write heads to move one track either in or out, depending on the DIRECTION SELECT line.

The Carriage Actuator Motor used on the SA850/851 is a four phase, 3.6°, permanent magnet stepper motor.

There are four stator poles with four teeth per pole extending axially the length of the rotor. The rotor contains 25 teeth per half, spaced 14.4° apart, with each being displaced on tooth pitch relative to each other. The rotor is permanently magnetized with one gear (half) being the north pole and the other the south pole. The four windings per phase are those which, when energized, will magnetize the poles causing the rotor to move one-fourth of a gear tooth pitch or one step.

4.2 ACTUATOR CONTROL LOGIC

For the following descriptions, see figure 4-1.

4.2.1 Power on Reset

The step counter (FF A and FF B) is a modified Gray Code counter that counts 0, 1, 3, and 2. At power on, the step counter is reset causing the NOT outputs to be active. When the door is closed and the heads loaded, the NOT outputs actuate the 1 and 4 drivers. With these drivers active, the position zero windings are excited causing the rotor to align as shown in figure 4-2 (depending on the previous state of the stator windings, the heads may move up to two tracks).

4.2.2 Forward Seek

a. Seek forward five tracks.

b. Assuming:
- Present position of the read/write heads to be track 00 (see figure 4-2).
- DIRECTION SELECT at a minus level (from the host system).
- WRITE GATE inactive.
- Five STEP pulses to be received (from the host system).
- Step counter reset (drivers 1 and 4 active).

—DIRECTION SELECT is inverted and becomes +DIRECTION SELECT. Since the step counter is reset (low), a high is at one input of exclusive OR A and a low at exclusive OR B. +DIRECTION SELECT is high and inverts both signals present at exclusive OR's A and B, causing the input to FFB to be high.

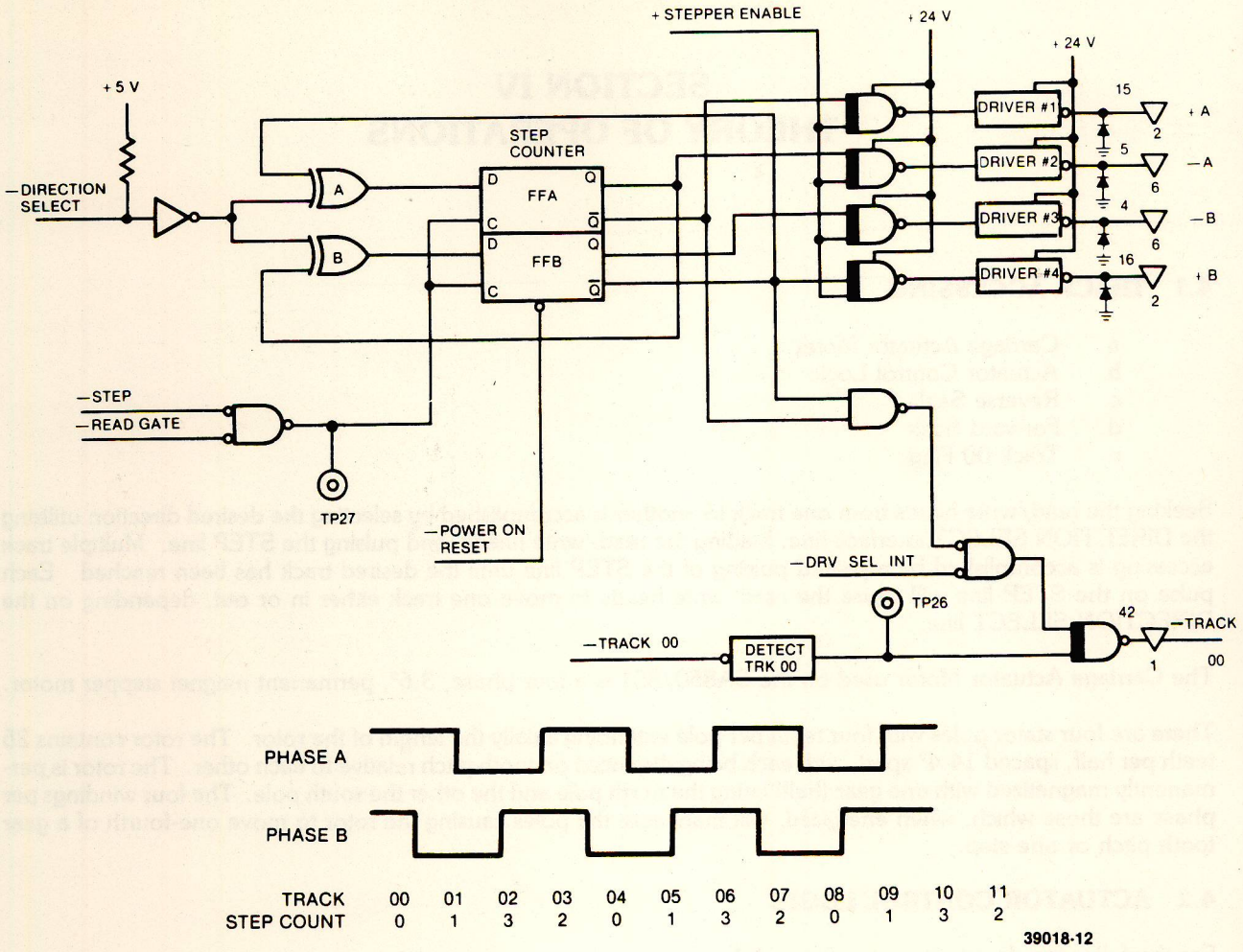


FIGURE 4-1. ACTIVATOR CONTROL LOGIC

When the first step pulse is sent to the control logic, it is ANDed with —READ GATE and then clocks FF A off and FF B on. This enables drivers 1 and 3 causing the actuator motor to move 3.6° in a clockwise direction. This in turn moves the carriage assembly one track towards the center of the diskette. See figure 4-3 (Track 01, Count 1).

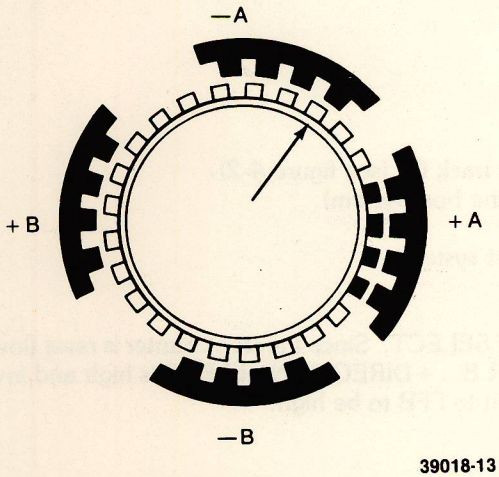


FIGURE 4-2. COUNT 0

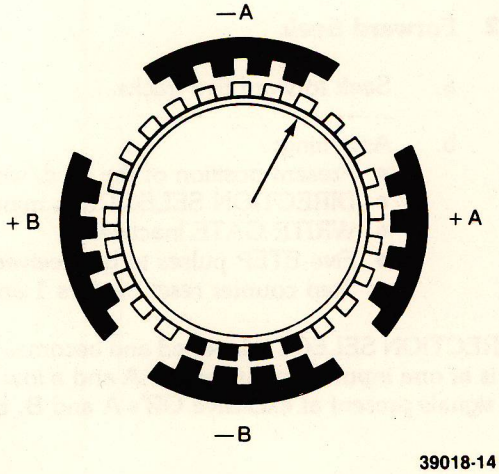


FIGURE 4-3. COUNT 1

With FF A off and FF B on, a low is presented to exclusive OR A and B allowing +DIRECTION SELECT to pass to both FF's. Upon receipt of the next step pulse, both FF's are clocked on enabling drivers 2 and 3. See figure 4-4 (Track 02, Count 3).

With both FF's on, a low is at exclusive OR A and a high at exclusive OR B which presents +DIRECTION SELECT to FF A. The next step pulse clocks FF A on and FF B off enabling drivers 2 and 4. See figure 4-5 (Track 03, Count 2).

This process is continued until the host system stops sending step pulses at track 05. At that time, FF A is off and FF B on enabling drivers 1 and 3. See figure 4-3 (Count 1).

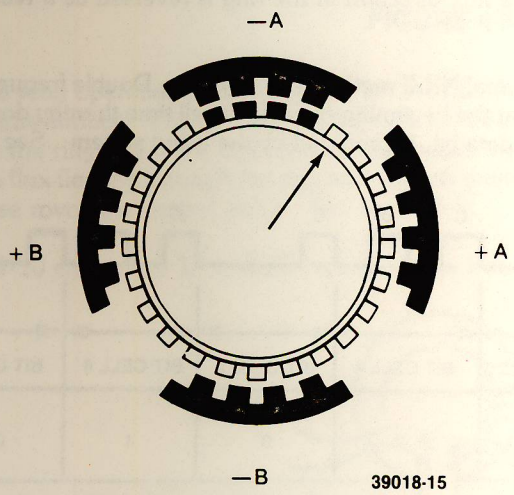


FIGURE 4-4. COUNT 3

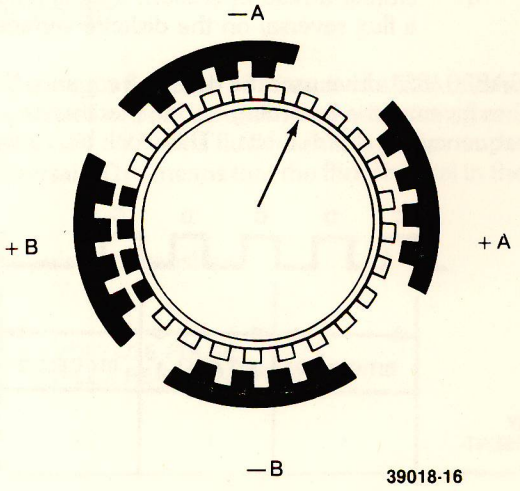


FIGURE 4-5. COUNT 2

4.2.3 Reverse Seek

a. Seek in a reverse direction five tracks.

b. Assuming:
- Present position of the read/write heads is track 05. DIRECTION SELECT at a positive level (from the host system).
- WRITE GATE inactive.
- Five step pulses to be received.
- FF A is off and FF B is on, drivers 1 and 3 are active.

+DIRECTION SELECT is inverted and becomes —DIRECTION SELECT. With FF A off and FF B on, lows are presented to exclusive OR's A and B. With the first step pulse, the FF's are clocked off enabling the 1 and 4 drivers. This causes the actuator motor to move 3.6° in a counter-clockwise direction, which moves the carriage one track towards the outside of the diskette. See figure 4-2 (Track 04, Count 0).

With both FF's off, a high is presented to exclusive OR A and a low to exclusive OR B. The next step pulse clocks FF A on and FF B off enabling drivers 2 and 4. See figure 4-5 (Track 03, Count 2).

This process continues until the fifth step pulse. With lows at exclusive OR's, FF's are clocked off enabling drivers 1 and 4. See figure 4-2 (Track 00, Count 0).

4.3 TRACK 00 INDICATOR

Track 00 Pin 42 is provided to the host system to indicate the read/write heads are at track 00. The track 00 flag on the carriage assembly is adjusted so that the flag covers the photo transistor at track 01. When FF A and B are clocked off, the actuator moves to track 00. The Q outputs and DRIVE SELECT internal are ANDed together and then ANDed with the track 00 detect to send the track 00 indication to the host system. See figure 4-1.

4.4 READ/WRITE OPERATIONS

a. SA850/851 uses the double frequency non-return to zero (NRZI) recording method.

b. The read/write heads are similar to a ring with a gap and a coil wound at some point on the ring.

c. During a write operation, a bit is recorded when the flux direction in the ring is reversed by rapidly reversing the current in the coil.

d. During a read operation, a bit is read when the flux direction in the ring is reversed as a result of a flux reversal on the diskette surface.

The SA850/851 drive uses the double-frequency (2F), horizontal NRZI method of recording. Double frequency is the term given to the recording system that inserts a clock bit at the beginning of each bit cell time thereby doubling the frequency of recorded bits. This clock bit, as well as the data bit, is provided by the using system. See figure 4-6.

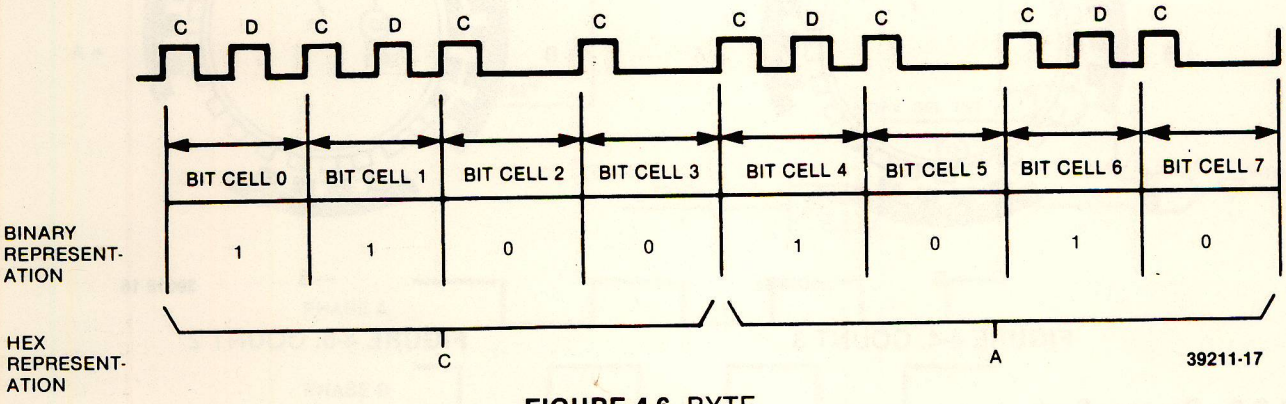


FIGURE 4-6. BYTE

The read/write heads are similar to a ring with a gap and a coil wound some point on the ring. When current flows through the coil, the flux induced in the ring fringes at the gap. As the diskette recording surface passes by the gap, the fringe flux magnetizes the surface in a horizontal direction. See figure 4-7.

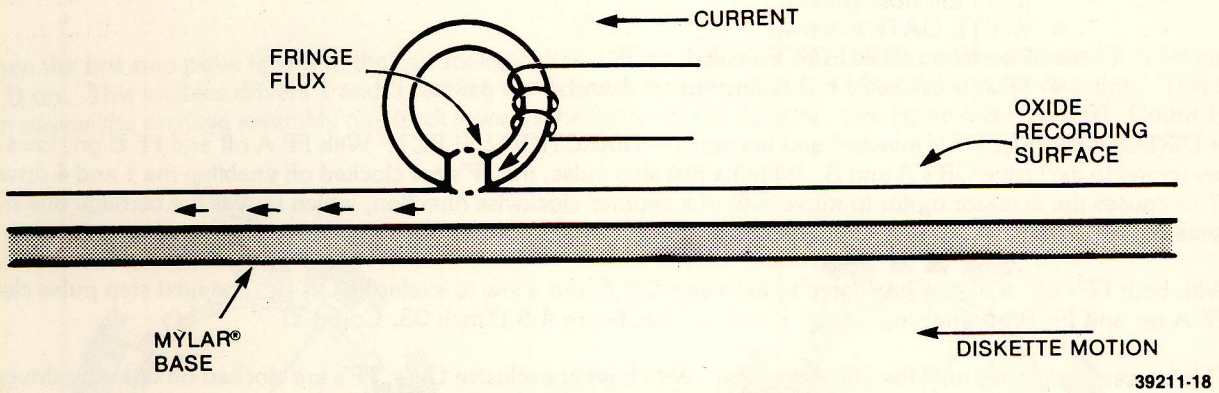


FIGURE 4-7. BASIC READ/WRITE HEAD

During a write operation, a bit is recorded when the flux direction in the ring is reversed by rapidly reversing the coil current. The fringe flux is reversed in the gap and hence the portion of the flux flowing through the oxide recording surface is reversed. If the flux reversal is instantaneous in comparison to the motion of the diskette, the portion of the diskette surface that just passed under the gap is magnetized in one direction while the portion under the gap is magnetized in the opposite direction. This flux reversal represents a bit. See figure 4-8.

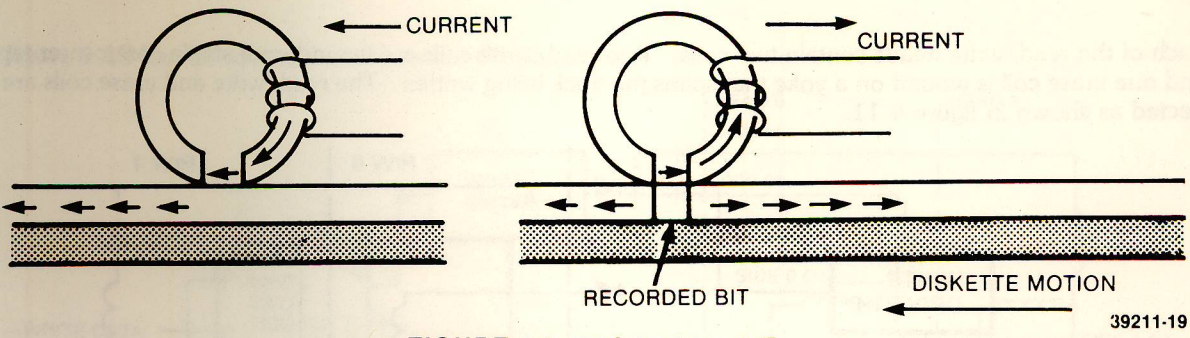


FIGURE 4-8. RECORDED BIT

During a read operation, a bit is read when the flux direction in the ring is reversed as a result of a flux reversal on the diskette surface. The gap first passes over an area that is magnetized in one direction, and a constant flux flows through the ring coil. The coil registers no output voltage at this point. When a flux transition passes under the gap, the flux flowing through the ring and coil will make a 180° reversal. This means that the flux reversal in the coil will cause a voltage output pulse. See figure 4-9.

Figure 4-10 shows the 1F and 2F recording flux transitions with pulse relationships.

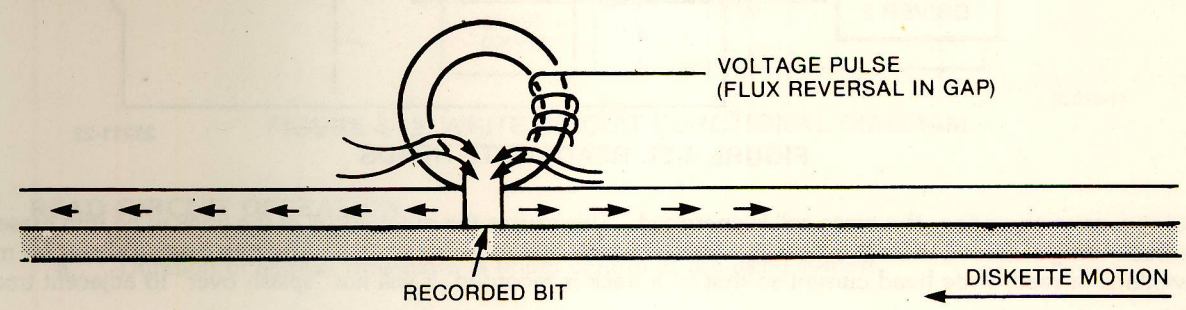


FIGURE 4-9. READING A BIT 39211-20

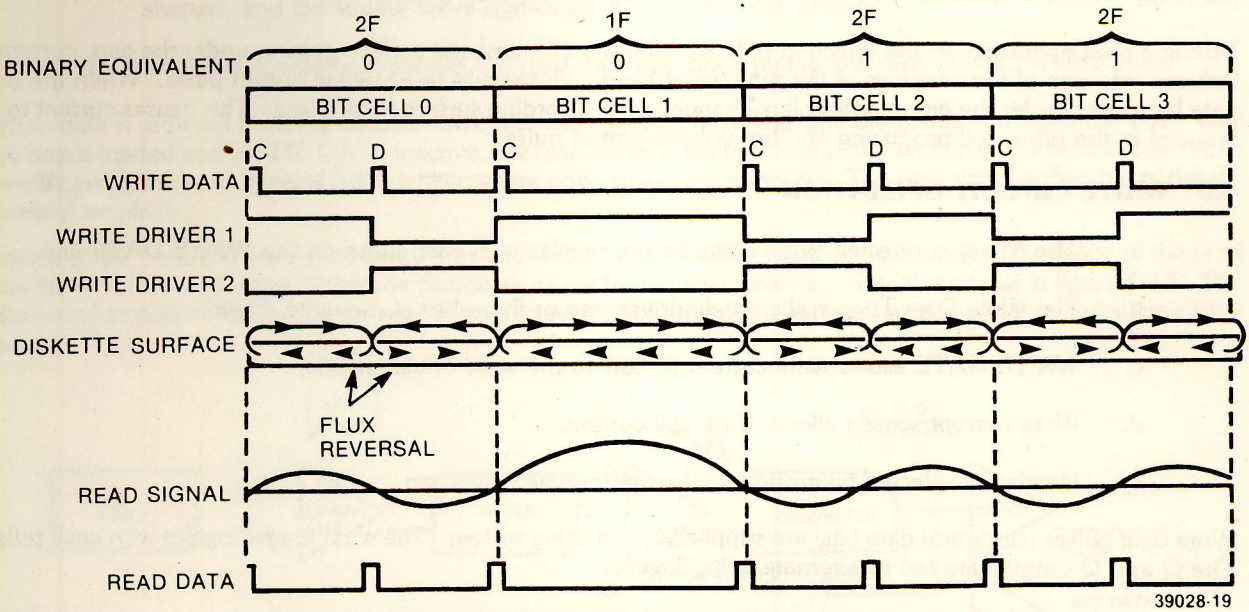


FIGURE 4-10. 1F AND 2F RECORDING FLUX AND PULSE

4.5 READ/WRITE HEAD

a. The read/write heads contain two coils each.

b. When writing, the head erases the outer edges of the track to ensure there are erased areas between adjacent tracks.

Each of the read/write heads contain two coils. Two read/write coils are wound on a single core center tapped, and one erase coil is wound on a yoke that spans the track being written. The read/write and erase coils are connected as shown in figure 4-11.

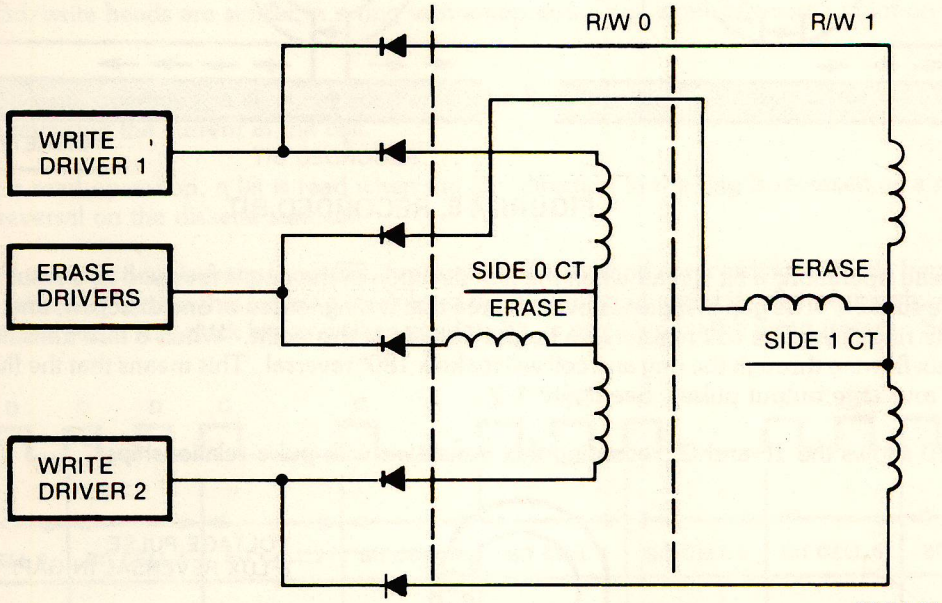


FIGURE 4-11. READ/WRITE HEADS

During a write operation, the erase coil is energized. This causes the outer edges of the track to be trim erased so the track being recorded will not exceed the 0.012 inch (0.304 mm) track width. The trim erasing allows for minor deviations in read/write head current so that as a track is recorded, it will not "splash over" to adjacent tracks.

Each bit written will be directed to alternate read/write coils, producing a change in the direction of current flow through the read/write head. This will cause a change in the flux pattern for each bit. The current through either of the read/write coils will cause the old data to be erased as new data is recorded.

During a read operation, as the direction of flux changes on the diskette surface passing under the gap, current is induced into one of the windings of the read/write head. This results in a voltage output pulse. When the next data bit passes under the gap, another flux change in the recording surface takes place. This causes current to be induced in the other coil producing another voltage output pulse.

4.6 WRITE CIRCUIT OPERATION

a. The binary connected Write Data Trigger toggles with each pulse on the WRITE DATA line.

b. The Write Data Trigger alternately drives one or the other of the write drivers.

c. WRITE GATE allows write current to flow to the write driver circuits.

d. Write current sensed allows erase coil current.

e. Heads are selected by grounding the appropriate center tap.

Write data pulses (clock and data bits) are supplied by the using system. The write trigger toggles with each pulse. The Q and $\overline{Q}$ outputs are fed to alternate write drivers.

WRITE GATE, from the using system, and NOT WRITE PROTECT are ANDed together to provide write current.

The output of one of the write drivers allows write current to flow through one-half of the read/write coil of each head. When the write data trigger toggles, the other write driver provides the write current to the other half of the read/write coils.

When write current is sensed flowing to the write drivers, a signal is generated to provide trimmed erase coil current.

See figure 4-12 for the write circuit functional diagram.

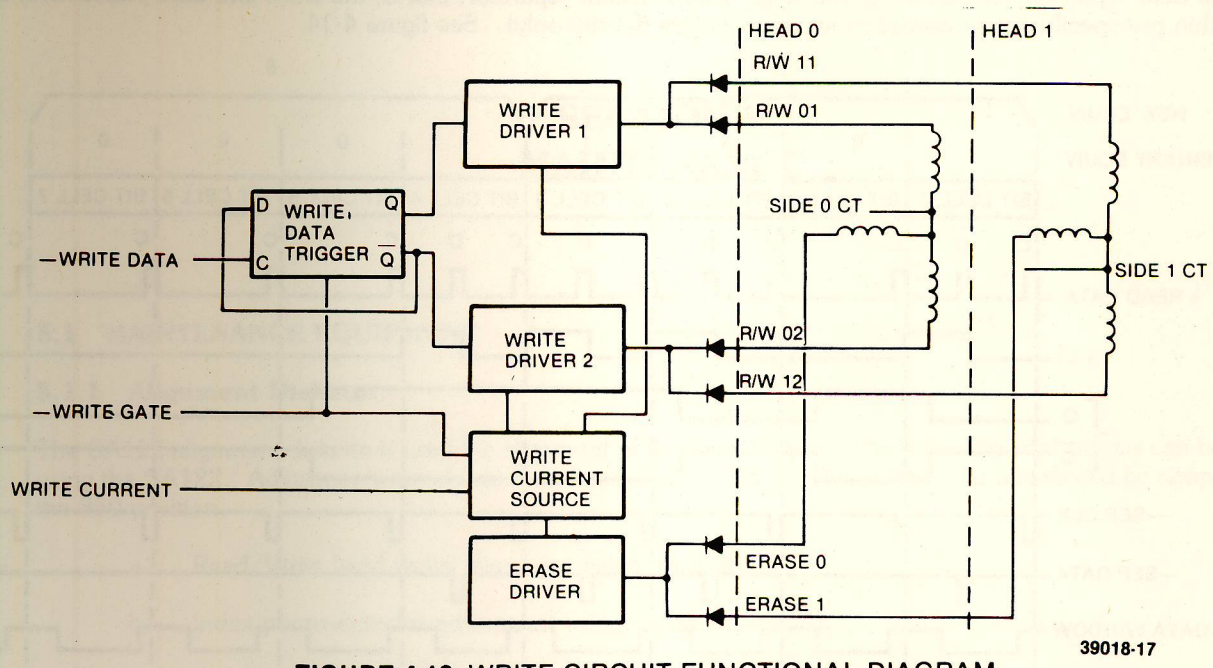


FIGURE 4-12. WRITE CIRCUIT FUNCTIONAL DIAGRAM

4.7 READ CIRCUIT OPERATION

a. Duration of all read operations is under control of the using system.

b. When the heads are loaded, the read signal amplitude becomes active and is fed to the amplifier.

c. As long as the heads are loaded and WRITE GATE is not active, the read signal is amplified and shaped, and the square wave signals are sent to the host system.

d. The data separator separates the read data into clock pulses and data pulses (SA851 only).

When data is required from the diskette drive, the using system must first load the heads and select the side. With the heads loaded and WRITE GATE inactive, the read signal is fed to the amplifier section of the read circuit. After amplification, the read signal is fed to a filter where noise spikes are removed. The read signal is then fed to the differential amplifier.

Since a pulse occurs at least once every 4 μs and data bits are present once every 2 μs, the frequency of the read data varies. The read signal amplitude decreases as the frequency increases. Note the signals in figure 4-13. The differential amplifier will amplify the read signals to even levels and make square waves out of the read signals (sine waves).

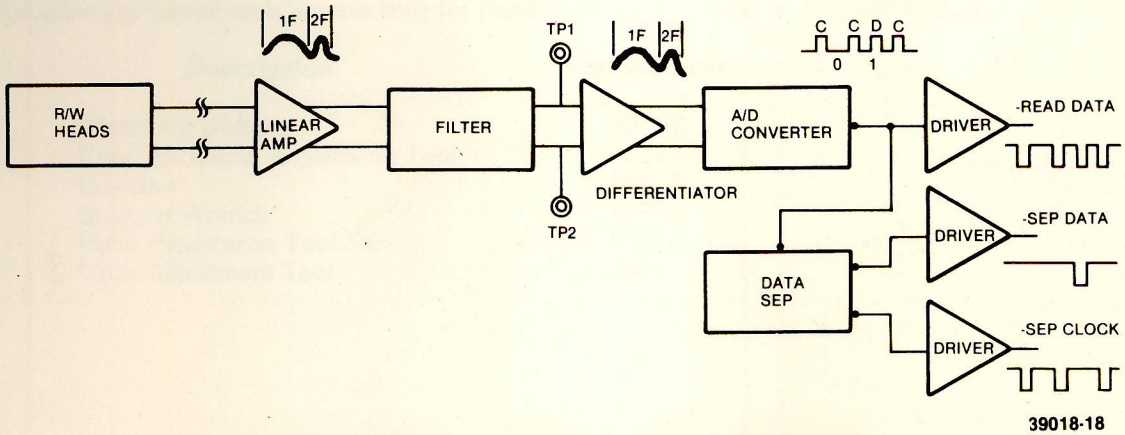


FIGURE 4-13. READ CIRCUIT FUNCTIONAL DIAGRAM

The data separator (SA851 only) is a single time constant separator, that is, the clock and data pulses must fall within pre-specified time frames or windows (single density only). See figure 4-14.

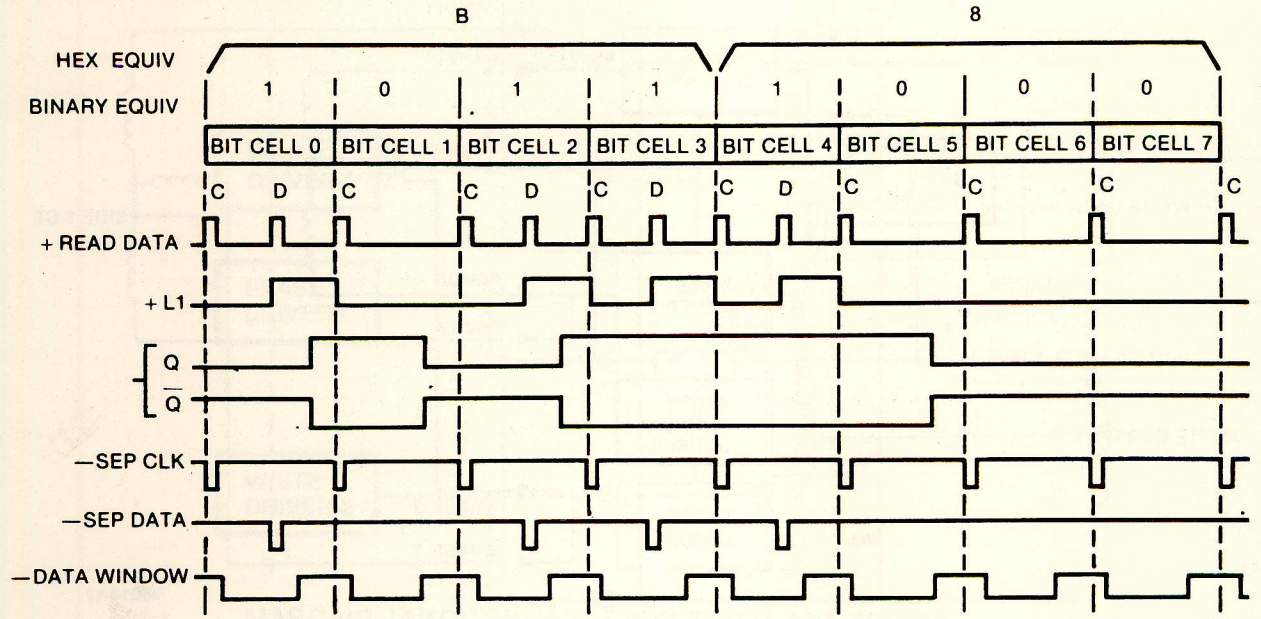


FIGURE 4-14. DATA SEPARATION TIMING DIAGRAM

SECTION V
MAINTENANCE

5.1 MAINTENANCE EQUIPMENT

5.1.1 Alignment Diskette

The SA122 alignment diskette is used for alignment of the SA850/851. The following adjustments can be made using the SA122. Adjustments are checked on head 0 and head 1. The drive under test should be jumpered to the 850 position.

a. Read/Write head radial alignment using track 38.

b. Index photo-detector adjustment using tracks 01 and 76.

c. Track 00 is recorded with standard IBM 3740 format.

d. Track 75 has 1F and 2F signals.

CAUTION

Caution should be exercised in using the SA122 alignment diskette. Tracks 00, 01, 36, 37, 38, 39, 40, 75, and 76 should **not** be written on. Doing so will destroy pre-recorded tracks.

5.1.2 SA809 Exerciser

The SA809 exerciser is built on an 8-inch by 8-inch PCB. The exerciser PCB can be used in a stand alone mode, built into a test station, or used in a tester for field service.

The exerciser is designed to enable the user to make all adjustments and check outs required on the SA850/851 drives, when used with the SA122 alignment diskette.

The exerciser has no intelligent data handling capabilities but can write both 1F and 2F frequencies. The exerciser can enable read in the drive to allow checking of read back signals.

5.1.3 Special Tools

The following special tools are available for performing maintenance on the SA850/851.

Description	Part Number
Alignment Diskette	SA122
Cartridge Guide Adjustment Tool	50377
Exerciser	50619
Spanner Wrench	50752
Head Penetration Tool Set	51218
Lifter Adjustment Tool	54687

5.2 DIAGNOSTIC TECHNIQUES

5.2.1 Introduction

Incorrect operating procedures, faulty programming, damaged diskettes, 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 diskette, then attempt to duplicate the fault on a second diskette.

5.2.2 Soft Error Detection and Correction

Soft errors are usually caused by:

a. Airborne contaminants that pass between the read/write head and the diskette. Usually these contaminants are removed by the diskette self-cleaning wiper.

b. Random electrical noise that lasts for a few microseconds.

c. Small defects in the written data and/or track not detected during the write operation that may cause a soft error during a read.

The following procedures are recommended to recover from soft errors:

a. Reread the track 10 times or until the data is recovered.

b. If data is not recovered after using step (a), access the head to the adjacent track in the same direction previously moved, then return to the desired track.

c. Repeat step (a).

d. If data is not recovered, the error is not recoverable.

5.2.3 Write Error

If an error occurs during a write operation, it will be detected on the next revolution by doing a read operation, commonly called a write check. To correct the error, another write and write check operation must be done. If the write operation is not successful after 10 attempts have been made, a read operation should be attempted on another track to determine if the media or the drive is failing. If the error still persists, the diskette should be replaced and the above procedure repeated. If the failure still exists, consider the drive defective. If the failure disappears, consider the original diskette defective and discard it.

5.2.4 Read Error

Most read errors that occur will be soft errors. In these cases, performing an error recovery procedure will recover the data.

5.2.5 Seek Error

Seek errors are due to actuator malfunction. To recover from a seek error, recalibrate to track 00 and perform another seek to the original track.

5.3 PREVENTIVE MAINTENANCE

5.3.1 Introduction

The prime objective of any preventive maintenance activity is to provide maximum availability to the user. Every preventive maintenance operation should assist in realizing this objective. Unless a preventive maintenance operation cuts machine downtime, it is unnecessary.

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, binds, and loose connections. Noticing these items during preventive maintenance may save downtime later.

Remember, do not do more than recommended preventive maintenance on equipment that is operating satisfactorily.

5.3.2 Preventive Maintenance Procedures

Details of preventive maintenance operations are listed in table 5-1. During normal preventive maintenance, perform only those operations listed on the chart for that maintenance period. Observe all safety procedures.

5.3.3 Cleanliness

Cleanliness cannot be overemphasized in maintaining the SA850/851. Do not lubricate the SA850/851. Oil will allow dust and dirt to accumulate. To prevent damage, the read/write heads should not be cleaned or touched.

5.3.4 Cautions

The heads should never touch each other. Whenever removing or installing the heads, ensure a clean piece of lens tissue is inserted between the heads to prevent them from touching.

a. Never open the cartridge guide access without first unloading the heads from the load bail (paragraph 5.6.4).

b. Ensure the upstop is in proper adjustment so the diskette will clear the heads when it is inserted.

c. Make sure the door lock is functioning properly so as not to remove a diskette while the heads are loaded.

d. The read/write heads are factory aligned with a four track offset. Loosening the head mounting screw will destroy the alignment and the actuator assembly will have to be returned to the factory for alignment.

TABLE 5-1. PREVENTIVE MAINTENANCE SCHEDULE

UNIT	FREQ MONTHS	CLEAN	OBSERVE
READ/WRITE HEADS	EVERY MONTH	USES SA111 (P/N 54612) OR EQUIV. FOLLOW PACKAGE INSTRUCTIONS.	IF CONTAMINATED.
ACTUATOR BAND, CAPSTAN AND SHAFT	12	CLEAN ALL OIL, DUST, AND DIRT ONLY IF NECESSARY.	
BELT	12		FRAYED OR WEAKENED AREAS.
BASE	12	CLEAN BASE.	INSPECT FOR LOOSE SCREWS CONNECTORS, AND SWITCHES.

39018-20

5.4 TROUBLE-SHOOTING

5.4.1 Flowcharts

Figures 5-1 through 5-6 are furnished as an aid to malfunction analysis.

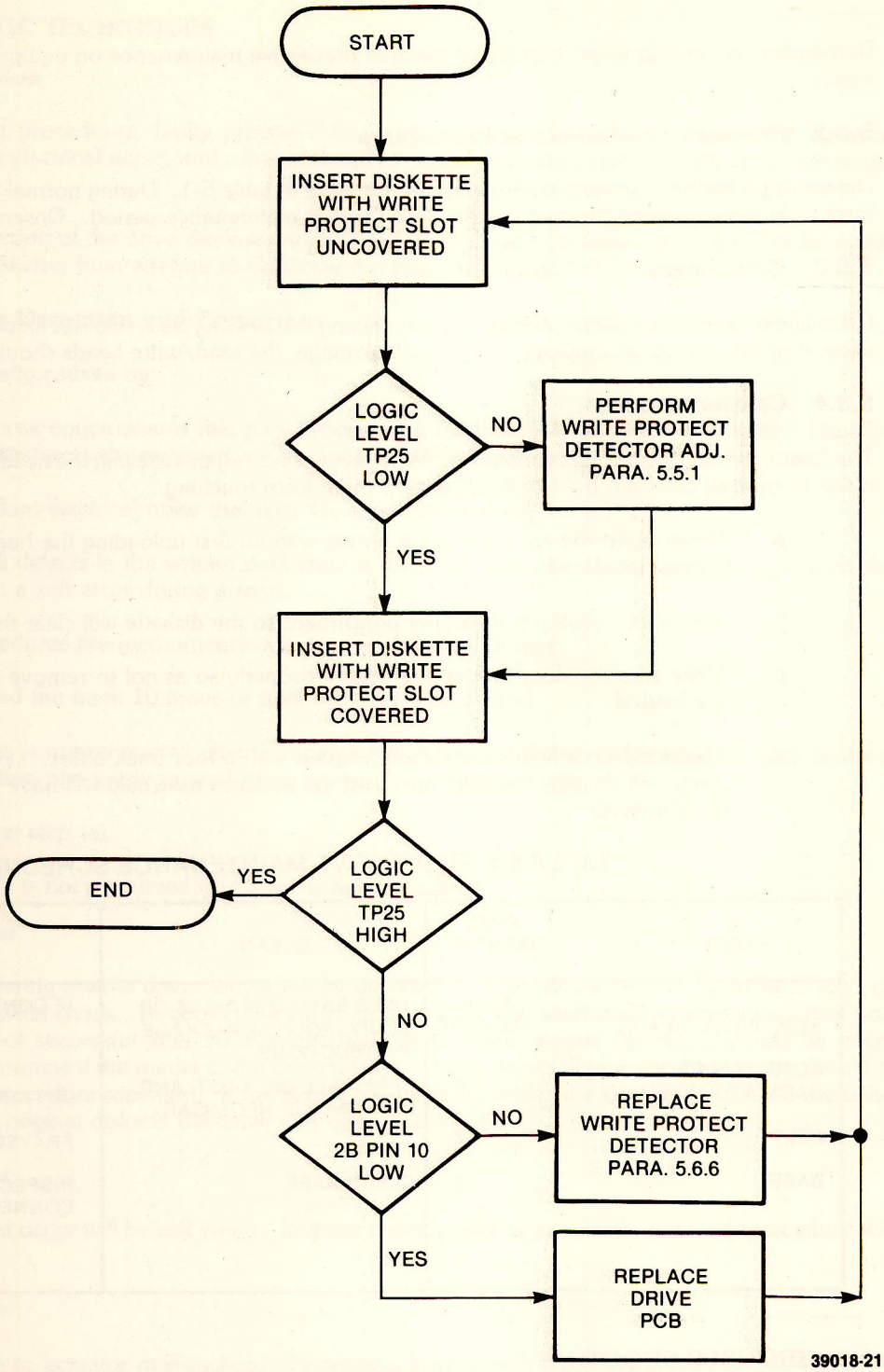


FIGURE 5-1. WRITE PROTECT INOPERATIVE

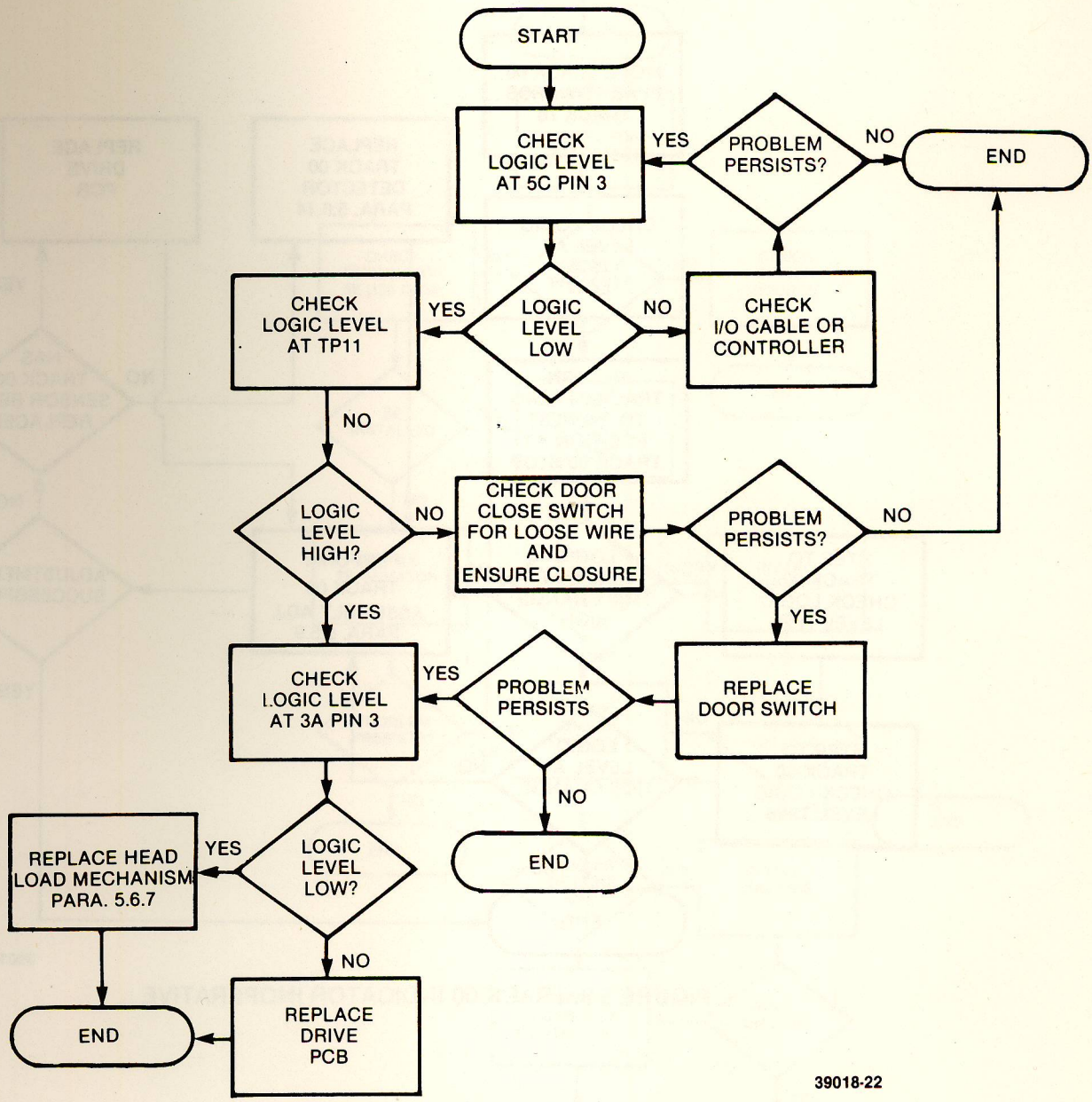


FIGURE 5-2. HEAD LOAD INOPERATIVE

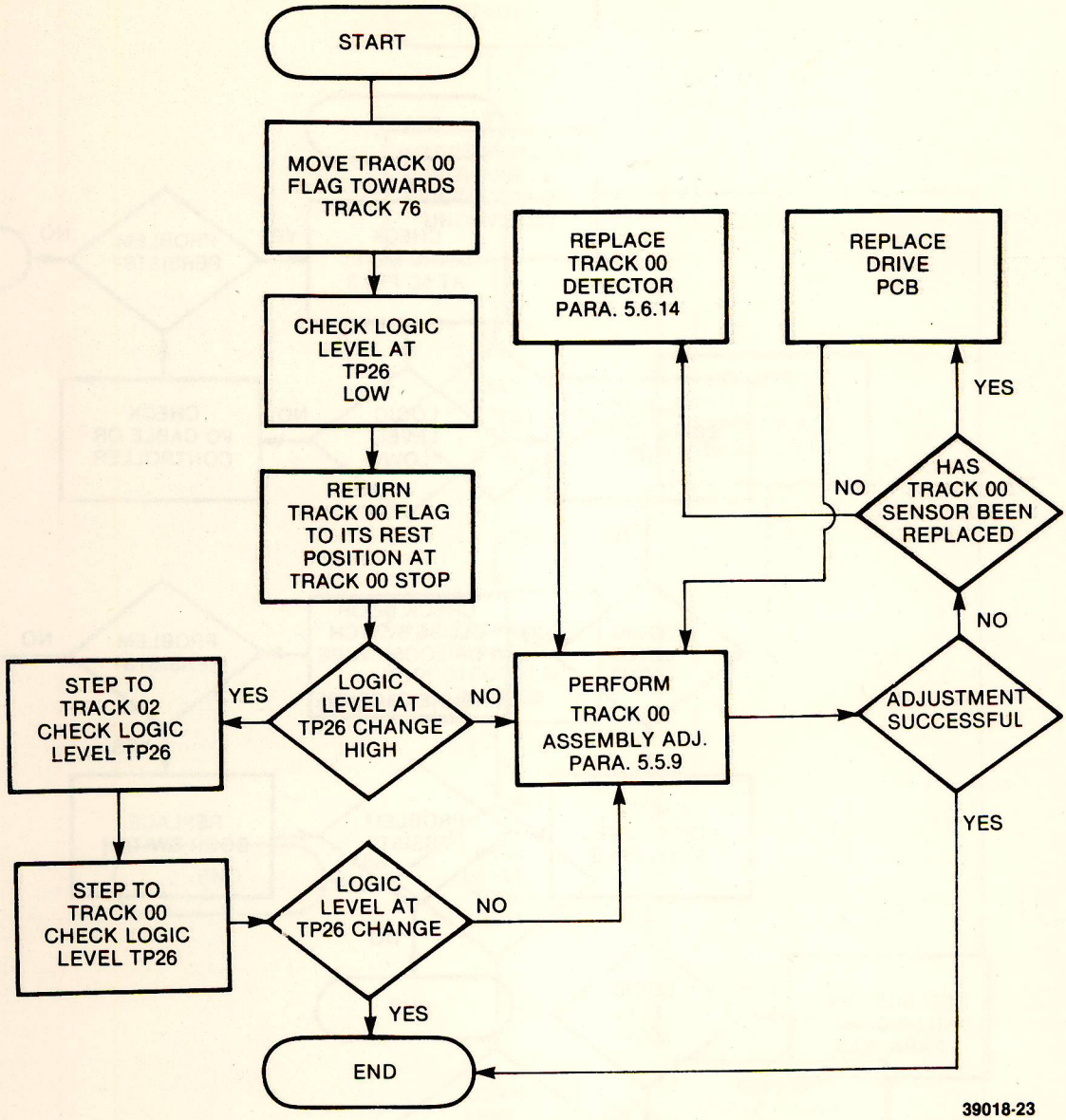


FIGURE 5-3. TRACK 00 INDICATOR INOPERATIVE

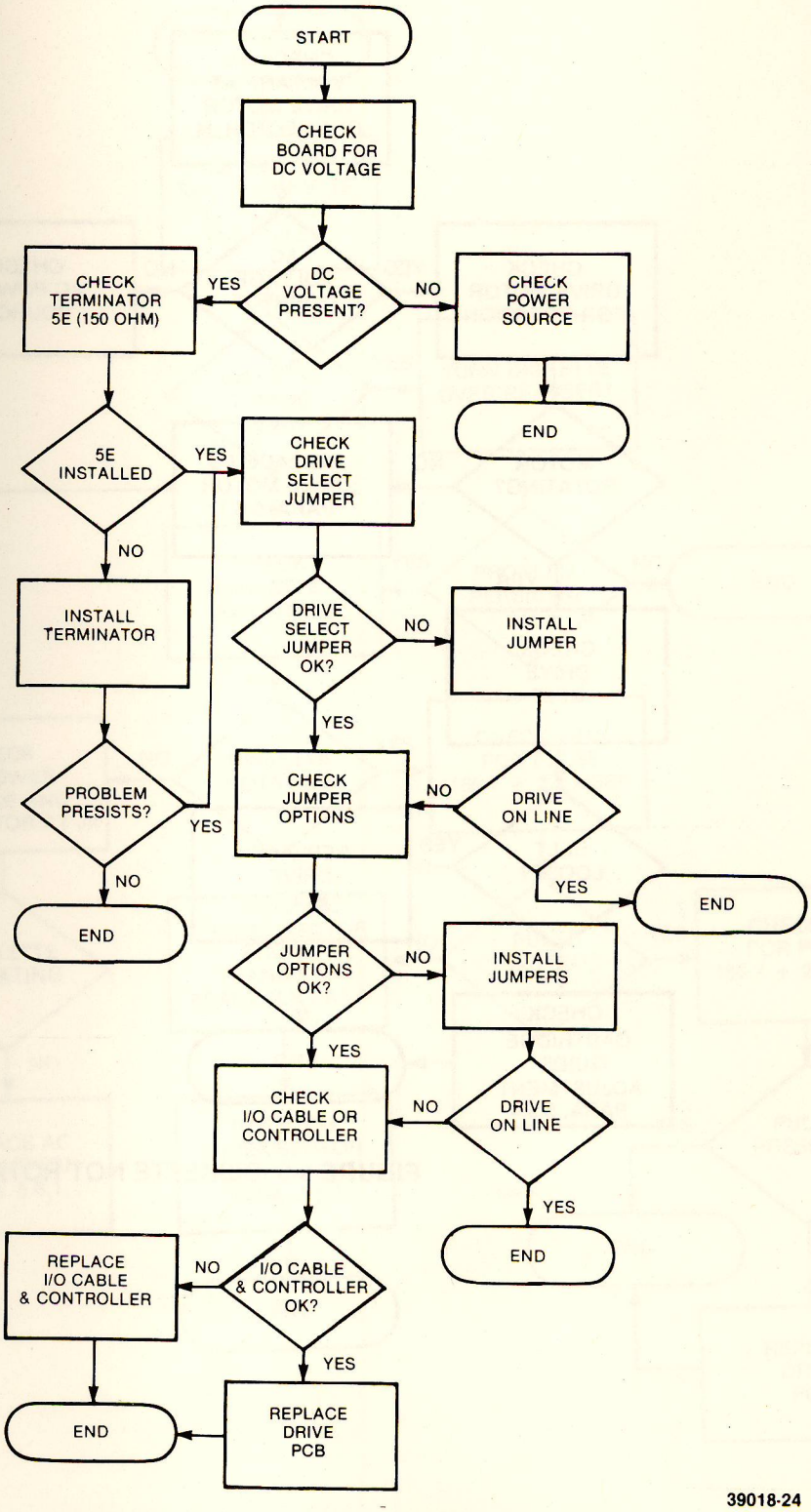


FIGURE 5-4. DRIVE NOT COMING ON LINE

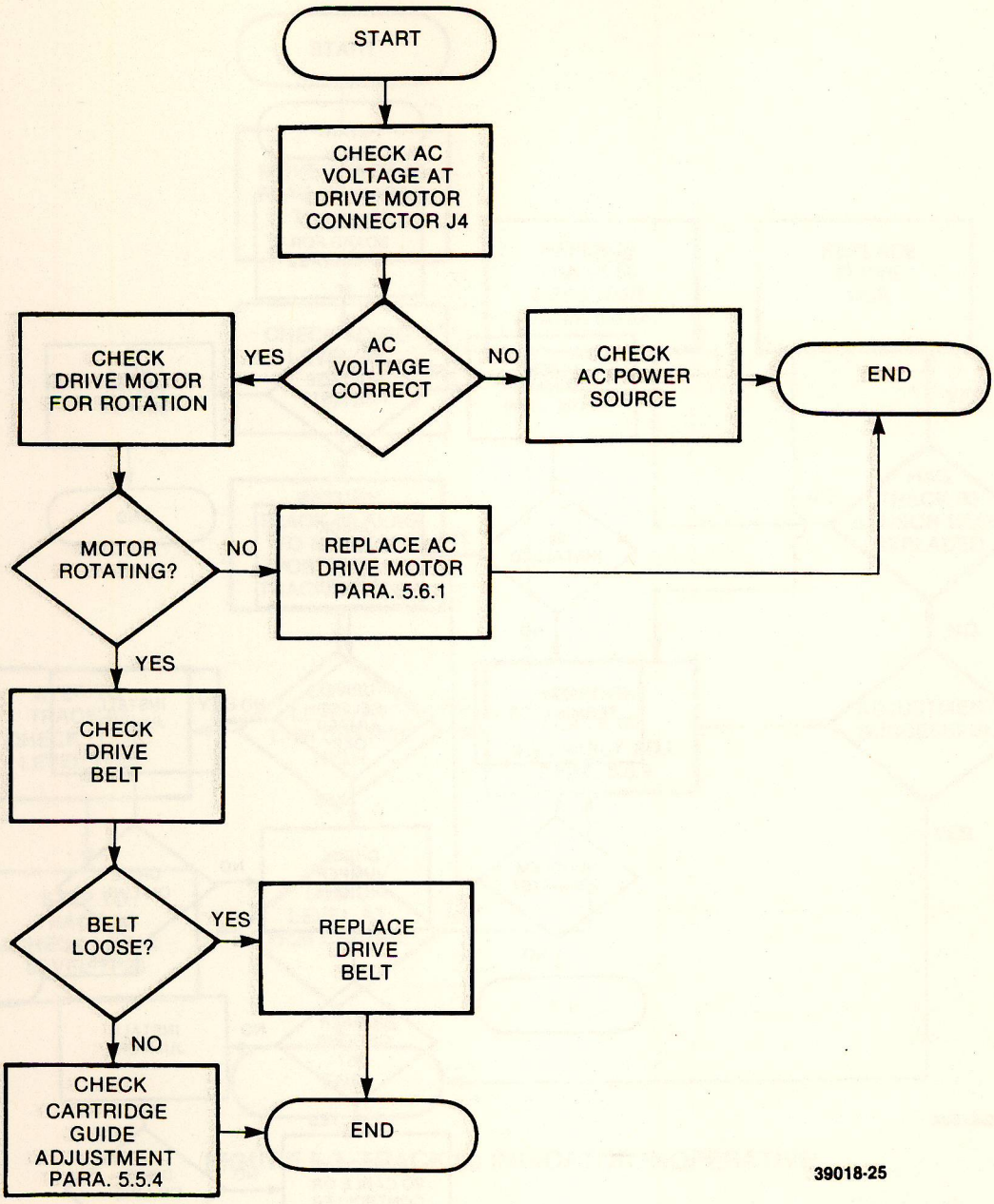


FIGURE 5-5. DISKETTE NOT ROTATING

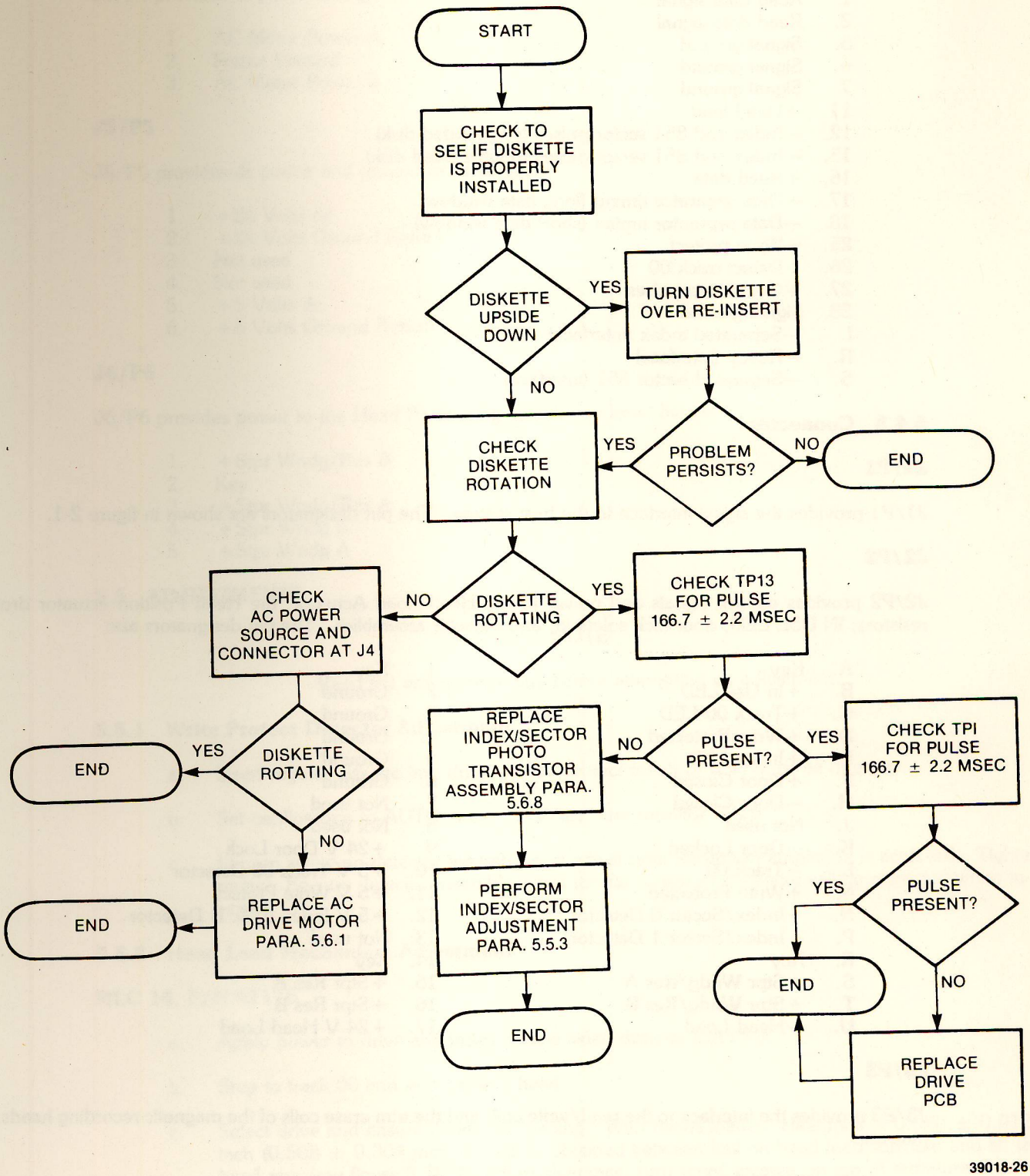


FIGURE 5-6. INDEX PULSE INOPERATIVE

5.4.2 Test Points 850/851

1. Read data signal
2. Read data signal
5. Signal ground
6. Signal ground
7. Signal ground
11. +Head load
12. —Index and 851 sector pulses (single-sided disk)
13. —Index and 851 sector pulses (double-sided disk)
16. +Read data
17. —Data separator timing (long data window)
18. —Data separator timing (short data window)
25. +Write protect
26. +Detect track 00
27. +Gated step pulses
28. Signal ground
I. —Separated index (interface)
R. —Ready (interface)
S. —Separated sector 851 (interface)

5.4.3 Connectors

J1/P1

J1/P1 provides the signal interface to the host system. The pin designators are shown in figure 2-1.

J2/P2

J2/P2 provides control signals and power to the Head Load Actuator, the Head Position actuator dropping resistors, IN USE LED, door lock solenoid, and detector assemblies. The pin designators are:

A. Key
B. +In Use LED
C. +Track 00 LED
D. +Write Protected
E. +Index LED
F. +Door Closed
H. —Door Closed
J. Not used
K. —Door Locked
L. —Track 00
M. +Write Protected
N. +Index/Sector 0 Detector
P. +Index/Sector 1 Detector
R. Key
S. +Stpr Wndg/Res A
T. +Stpr Wndg/Res B
U. —Head Load

1. Key
2. Ground
3. Ground
4. Ground
5. Ground
6. Ground
7. Not used
8. Not used
9. +24 V Door Lock
10. +5 V Track 00 Detector
11. +5 V Write Protect
12. +5 V Index (0 & 1) Detector
13. Not used
14. Key
15. +Stpr Res A
16. +Stpr Res B
17. +24 V Head Load

J3/P3

J3/P3 provides the interface to the read/write coils and the trim erase coils of the magnetic recording heads. The pins are:

1. Shield 0
2. Key
3. Read/Write 01
4. Side 0 CT
5. Read/Write 02
6. Erase 0
7. Erase 1
8. Read/Write 12
9. Side 1 CT
10. Read/Write 11
11. Key
12. Shield 1

J4/P4

J4/P4 provides ac power and ground as listed below:

1. AC Motor Power A
2. Frame Ground
3. AC Motor Power B

J5/P5

J5/P5 provides dc power and ground as listed below:

1. +24 Volts dc
2. +24 Volts Ground Return
3. Not used
4. Not used
5. +5 Volts dc
6. +5 Volts Ground Return

J6/P6

J6/P6 provides power to the Head Positioning actuator as listed below:

1. +Stpr Wndg/Res B
2. Key
3. +Stpr Wndg/Res A
4. +Stpr Wndg B
5. +Stpr Wndg A

5.5 ADJUSTMENTS

NOTE

Read the entire procedure before attempting an adjustment.

5.5.1 Write Protect Detector Adjustment

a. Insert regular diskette into drive. Write protect notch or hole must be open.

b. Set oscilloscope to AUTO sweep, 2 V/div, and monitor TP25.

c. Loosen screw on detector assembly and adjust until maximum amplitude is achieved. Tighten screw. Be sure detector assembly is not too far forward or diskette will be restricted when inserted.

5.5.2 Head Load Mechanism Adjustment

MLC 14, P/N 51176

a. Apply power to drive and insert double-sided diskette (SA150).

b. Step to track 00 and select side 1 head.

c. Select drive and ensure heads are loading. With heads loaded, clearance of 0.020 ± 0.012 inch (0.508 ± 0.304 mm) should be obtained between bail on head load solenoid and lift tab or head arm (see figure 5-7). To adjust clearance, turn screw located on top of armature (figure 5-7). Clockwise turn decreases clearance. Counter-clockwise turn increases clearance.

d. Load heads a few times to reverify 0.020 inch (0.508 mm) clearance requirement.

e. Step to track 76.

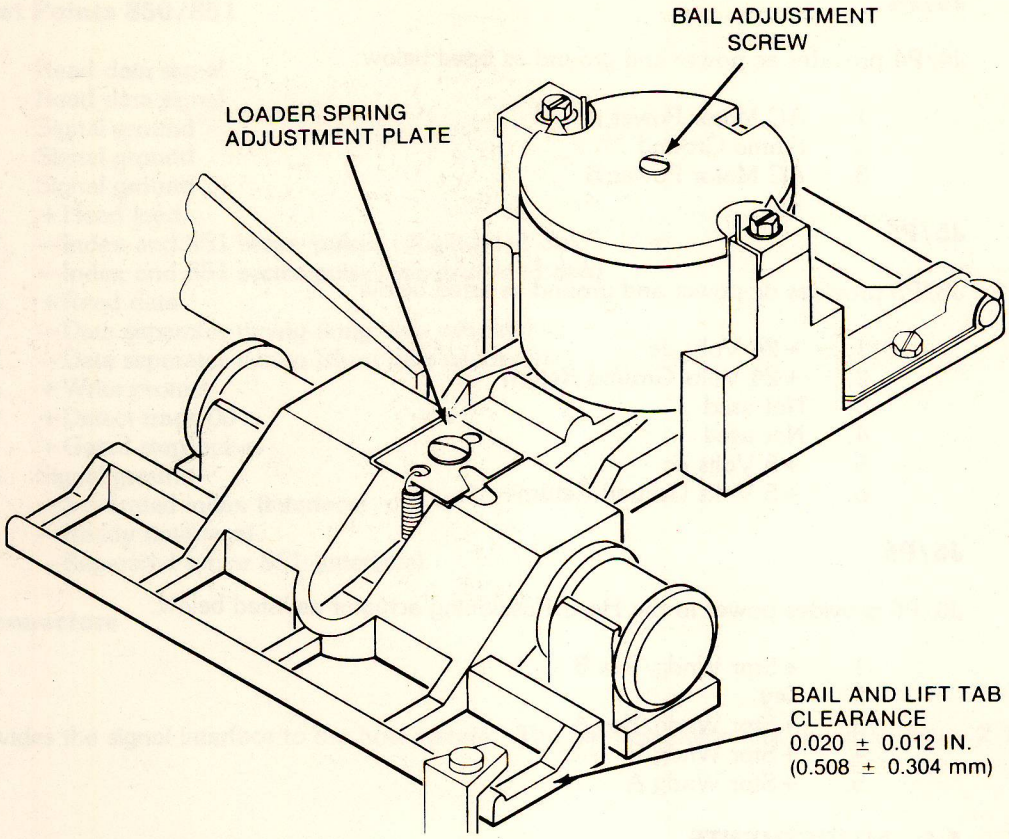


FIGURE 5-7. HEAD LOAD MECHANISM ADJUSTMENT, P/N 51176

f. Load heads. Check clearance between bail and lift tab. Lift tab **must not** be in contact with bail. Clearance must be minimum of 0.008 inch (0.203 mm) and no greater than 0.032 inch (0.813 mm).

g. Return to track 00.

h. Sync oscilloscope on TP11 (+HEAD LOAD). Set time base to 10 msec/division. Connect one probe to TP1 and other to TP2. Ground probes to TP5. Set inputs to AC couple, add and invert one input. Set vertical deflection to 200 MV/division.

i. Select side 1 head. Energize head load solenoid (do not exceed one per second) and record 2F pattern. Observe read signal on oscilloscope. Read signal should begin before 50 msec (figure 5-8).

j. If read signal begins after 50 msec, loosen screw holding loader spring adjustment plate. Slide plate away from solenoid body (figure 5-7). Select side 1 head. Energize head load solenoid (do not exceed one per second) and record 2F pattern. Observe read signal on oscilloscope. Read signal should begin before 50 msec (figure 5-8).

k. Properly adjusted head load mechanism should load with read signal settled out in 50 msec.

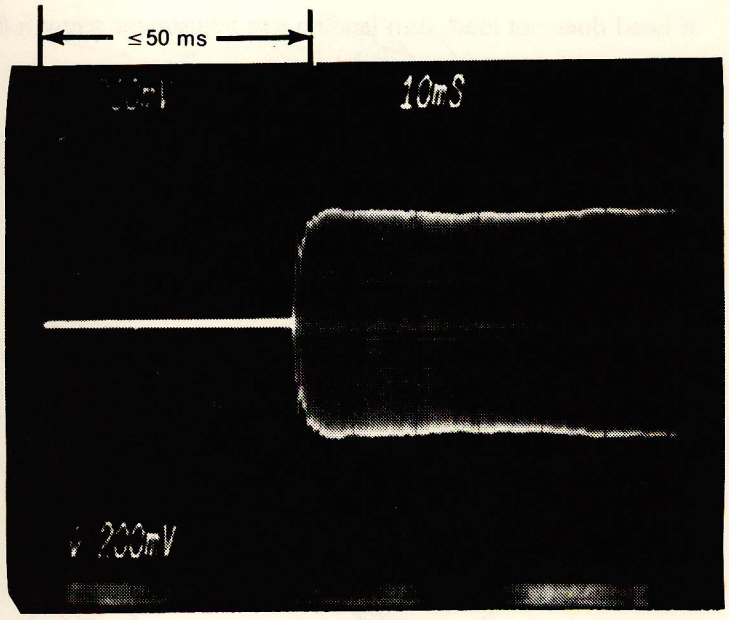
MLC 15, P/N 51460

a. Remove head cover shield (paragraph 5.6.3).

b. Apply power to drive and insert double-sided diskette.

c. With drive in horizontal position (PCB down), step to track 00.

d. Manually load bail by applying slight pressure on bail arm. Adjust lifter adjustment screw 1 (see figure 5-9) clockwise until screw contacts lifter arm. Lifter should not contact diskette.



SWEEP/CH: 10 ms/DIV
TRIGGER: TP11 EXT AC +
CHAN 1: TP1 20 mV AC
CHAN 2: TP2 20 mV AC
DISPLAY MODE: ADD

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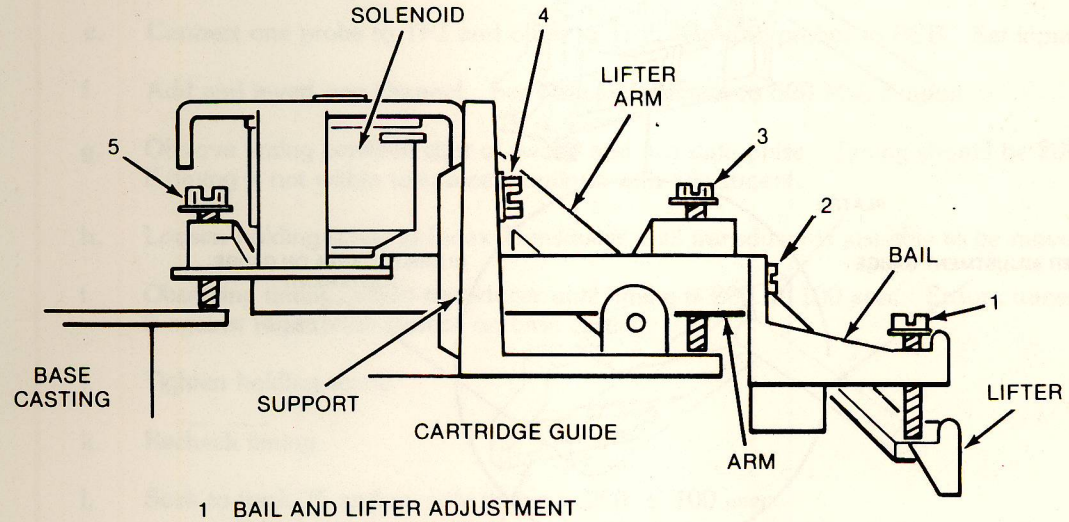
FIGURE 5-8. HEAD LOAD TIMING

e. Seek to track 76. Loosen clearance adjustment screw 4 (see figure 5-9). With head loaded, adjust clearance gap by manually moving solenoid up and down. Clearance gap specifications are 0.009 to 0.021 inch (0.229 to 0.533 mm) measured between bail and side 1 arm tab. Tighten screw 4 (see figure 5-9).

f. Seek to track 76. Check clearance gap. If not within specifications, loosen parallel adjustment screw 2 (see figure 5-9) and adjust clearance gap by moving bail arm up or down. Tighten screw 2 (figure 5-9).

g. Seek to track 00. Check clearance gap. If clearance is not within specification, repeat steps d and e.

h. Set up oscilloscope (figure 5-8). Select drive 1 and side 1. Observe head load.



1 BAIL AND LIFTER ADJUSTMENT
2 PARALLEL ADJUSTMENT
SPRING TENSION ADJUSTMENT (FACTORY ADJUSTMENT)
4 CLEARANCE ADJUSTMENT
5 LANDING GAP ADJUSTMENT

39018-46

FIGURE 5-9. HEAD LOAD MECHANISM ADJUSTMENT, P/N 51460

i. If head does not load, turn landing gap adjustment screw 5 (figure 5-9) until head loader loads.

j. Write a 2F signal on sides 1 and 0 at tracks 00 and 76.

k. Head load timing specification is less than or equal to 50 ms (figure 5-8). Adjust landing gap adjustment screw 5 (see figure 5-9) to obtain specified head load timing at tracks 00 and 76 on both sides.

l. Turn off dc power.

m. Remove diskette and close cartridge guide.

n. Return heads to track 00 by turning stepper motor shaft.

o. Turn on dc power.

p. With drive in horizontal position (PCB down) and drive selected, remove 850/851 jumper.

q. Install 851 jumper. Remove it and observe heads loading.

r. De-select drive.

s. Insert lifter adjustment gauge (P/N 54687) between bail arm and platen surface (see figure 5-10). Select drive. Place at angle toward heads with outer-top area of gauge over lifter arm. Ensure lifter adjustment gauge rests on top of ridge on lifter arm and shaft of gauge sits into corner where cartridge guide and bail arm meet. Tap very lightly on lifter arm. Lifter gauge should show movement. If no movement is present, adjust lifter adjustment screw 1 (see figure 5-9).

t. Turn lifter adjustment gauge so inner section of gauge rests on lifter arm (see figure 5-11). Tap lightly on lifter arm. No movement should be present. If there is movement, back off lifter adjustment screw 1 (see figure 5-9) one fourth of a turn and check again. After readjustment, recheck outer-top area (see figure 5-10) again to ensure there is still movement.

u. Recheck head load timing (step k). If out of specification, continue procedure.

v. Reinstall head cover shield.

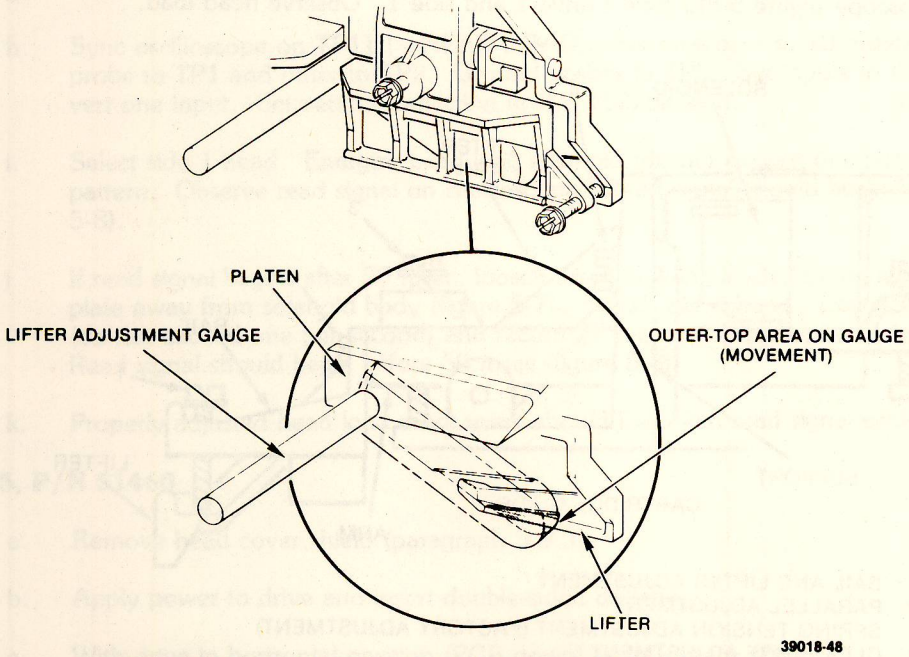


FIGURE 5-10. LIFTER ADJUSTMENT (MOVEMENT)

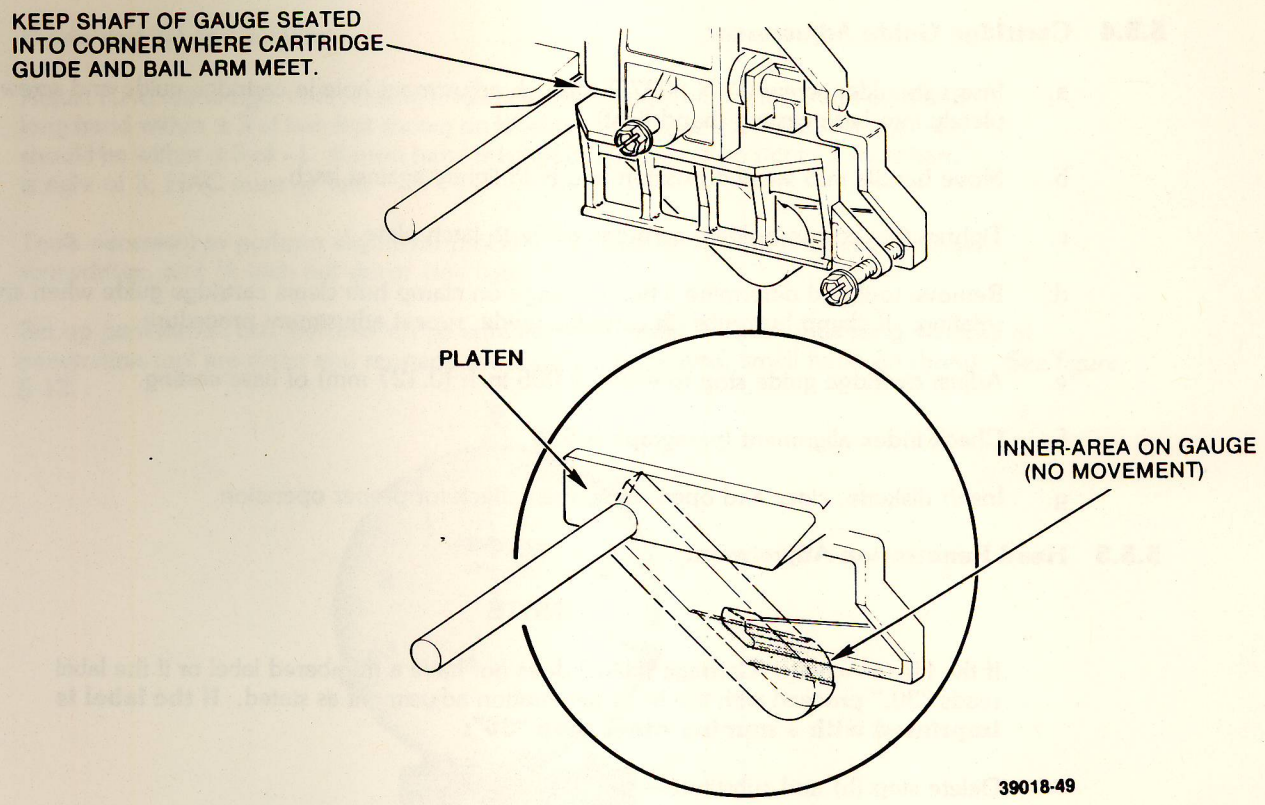


FIGURE 5-11. LIFTER ADJUSTMENT (NO MOVEMENT)

5.5.3 Index/Sector Adjustment

a. Insert SA122 alignment diskette.

b. Step carriage to track 01.

c. Sync oscilloscope, external negative, on TP13 (—INDEX).

d. Set time base to 50 μsec/division.

e. Connect one probe to TP1 and other to TP2. Ground probes to PCB. Set inputs to AC.

f. Add and invert one channel. Set vertical deflection to 500 MV/division.

g. Observe timing between start of sweep and first data pulse. Timing should be 200 ± 100 μsec. If timing is not within tolerance, continue with adjustment.

h. Loosen holding screw in Index Transducer until transducer is just able to be moved.

i. Observing timing, adjust transducer until timing is 200 ± 100 μsec. Ensure transducer assembly is against registration surface on base casting.

j. Tighten holding screw.

k. Recheck timing.

l. Seek to track 76 and reverify timing is 200 ± 100 μsec.

5.5.4 Cartridge Guide Adjustment

a. Insert shoulder screw (P/N 50377) through adjustment hole in cartridge guide and screw completely into base casting (hand tight).

b. Move handle into latched position and hold lightly against latch.

c. Tighten two screws holding cartridge guide to latch plate.

d. Remove tool and determine whether flange on clamp hub clears cartridge guide when spindle is rotating. If clamp hub rubs on cartridge guide, repeat adjustment procedure.

e. Adjust cartridge guide stop to within 0.005 inch (0.127 mm) of base casting.

f. Check index alignment (paragraph 5.5.3).

g. Insert diskette, close and open door, then check for proper operation.

5.5.5 Head Penetration Adjustment

NOTE

If the Head Actuator Carriage (HAC) does not have a numbered label or if the label reads "30," proceed with the head penetration adjustment as stated. **If the label is imprinted with a number other than "30":**

Delete step (h) and substitute—

Check dial indication for proper setting shown on label. Long hand should be within ±3 of last digit shown on label (i.e., if label reads "32," long hand should be within ±3 of +2. Short hand should point to 3. If penetration setting is out of range, continue procedure.

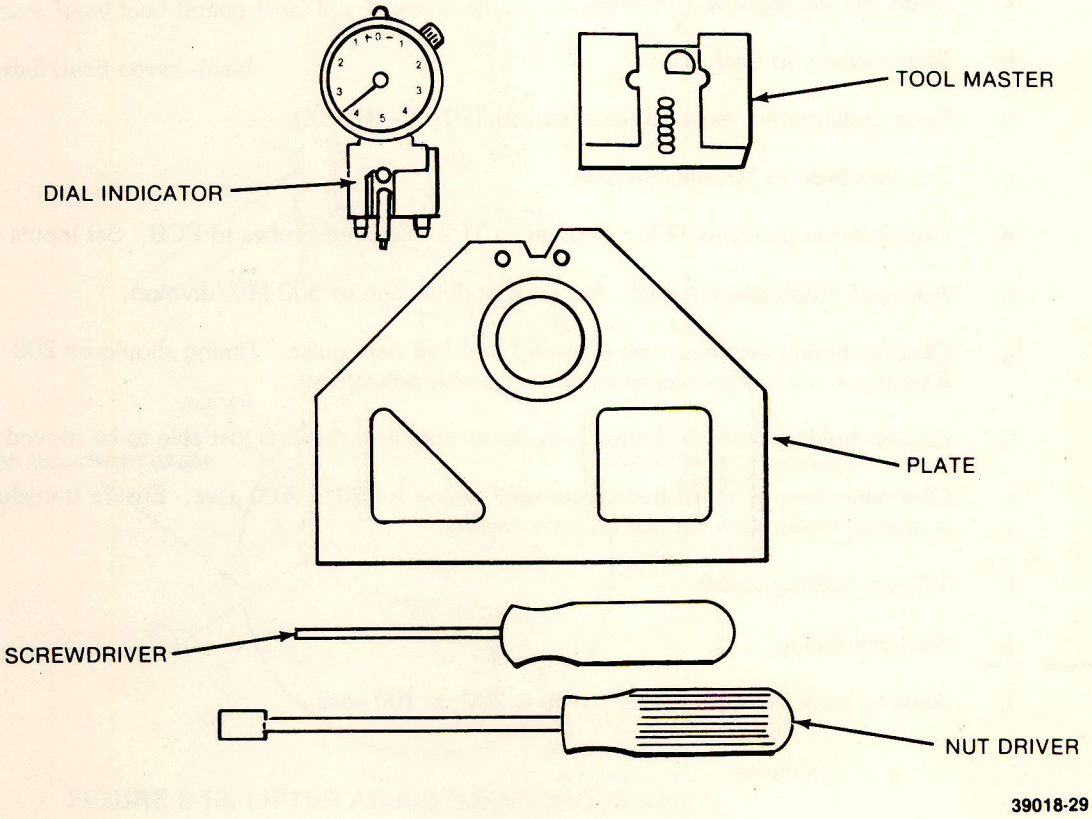


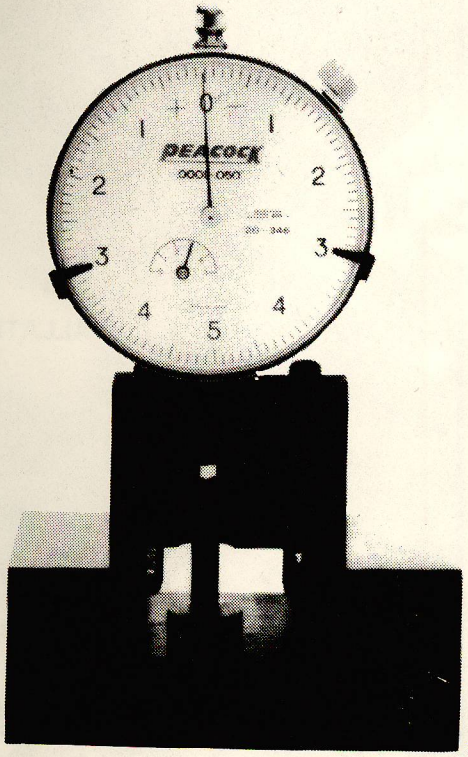
FIGURE 5-12. HEAD PENETRATION TOOLS

Delete step (k) and substitute—

Adjust HAC left to right until reading on penetration gauge reads short hand on 3 and long hand within ± 3 of last digit shown on label (i.e., if sticker shows "29," long hand should be within ± 3 of -1. If short hand is left of 3, HAC must go right. If short hand is right of 3, HAC must go left.

a. Tools necessary to perform alignment procedure consist of penetration gauge tool set, screwdriver, and 1/4-inch nut driver (see figure 5-12).

b. Set up penetration dial indicator on penetration tool master. Check indicating surfaces of penetration tool are clean and properly set (long hand on zero, small hand on three). See figure 5-13.



39018-30

FIGURE 5-13. DIAL INDICATOR

c. With drive in horizontal position, remove Head Actuator Carriage (HAC) shield and open door.

d. Slide penetration plate into drive, tapered end first, and counter bore side up

NOTE

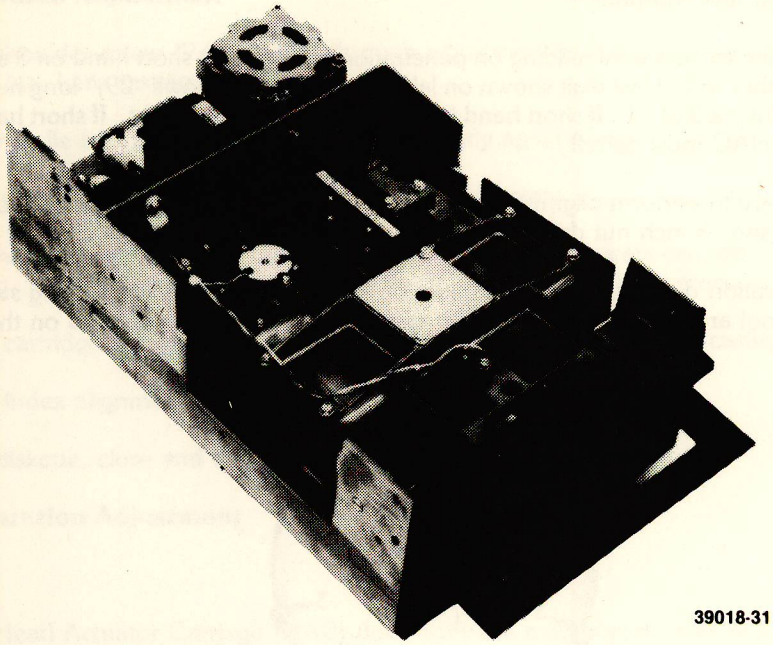
Penetration plate is made of hardened tool steel. Care should be used not to damage spindle or any other part of drive during insertion or extraction.

e. Slide plate up and over spindle until plate is squarely positioned over spindle (see figure 5-14). Close door.

NOTE

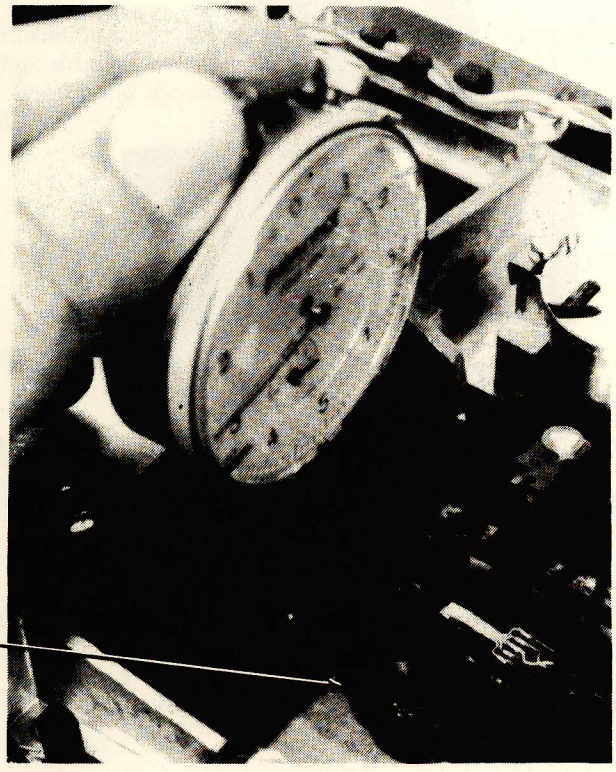
Ensure that all surfaces are clean and disk block is squarely and fully snapped onto plate. Avoid handling block by indicator.

f. Install indicator block into penetration plate until block snaps into place. See figure 5-15.



39018-31

FIGURE 5-14. PENETRATION PLATE INSTALLATION

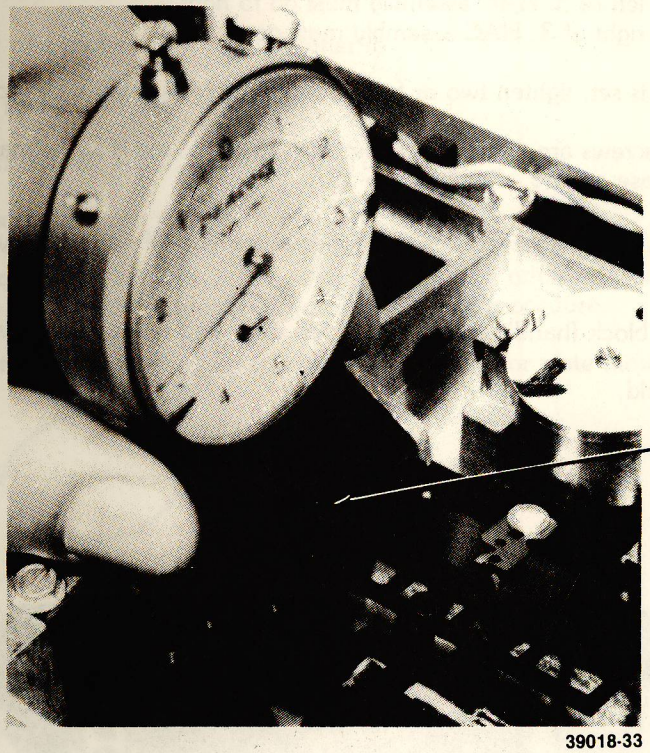


39018-32

FIGURE 5-15. DIAL INDICATOR INSTALLATION

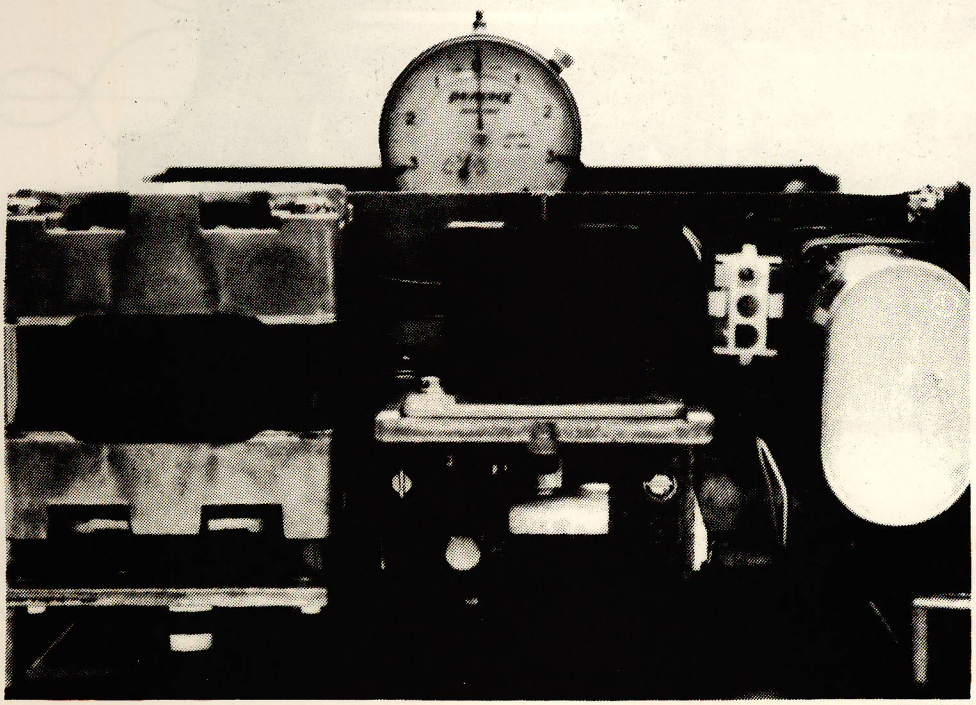
g. Shaft extending from stepper motor can be used to move head up far enough so gauge point indicates off tab on side 0 head as shown in figure 5-16.

h. Check dial indicator for proper setting. Long hand should be between ±3. Short hand should point to 3. If penetration setting is out of range, continue with procedure. See figure 5-17.



39018-33

FIGURE 5-16. INSTALLATION CHECK



38018-34

FIGURE 5-17. CORRECT PENETRATION

i. With penetration gauge installed, set drive in vertical position, ac motor closest to bench.

j. Loosen two or four mounting screws using 1/4-inch nut driver.

k. Adjust HAC assembly left to right until reading on penetration gauge reads short hand on 3 and long hand on 0 ±0.003.

- If short hand is left of 3, HAC assembly must go to right.
- If short hand is right of 3, HAC assembly must go to left.

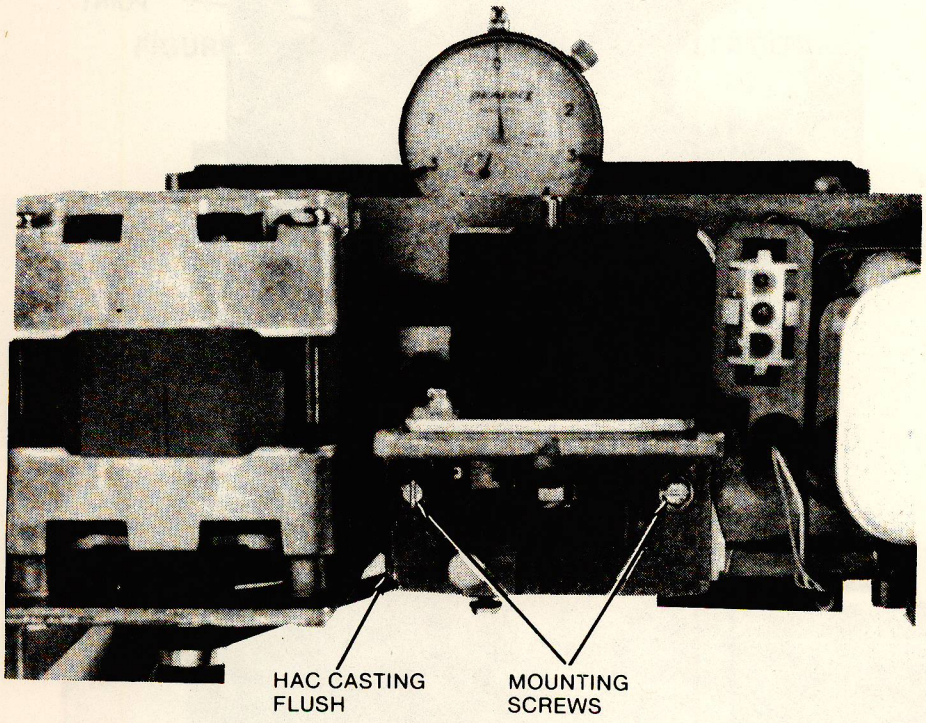
l. When penetration is set, tighten two or four mounting screws using a 1/4-inch nut driver.

m. As two mounting screws are tightened, make sure HAC casting is flush (making contact) with machined lip on base casting. See figure 5-18.

n. Check penetration gauge again to ensure proper alignment. If not properly aligned, return to step (i).

o. Remove indicator block (handle carefully). Open door and remove penetration gauge.

p. Replace HAC shield.



39018-37

FIGURE 5-18. PENETRATION ADJUSTMENT

5.5.6 Head Radial Alignment

NOTE

Actuator assembly is aligned at factory and adjustment is not normally required after replacing head and actuator assembly. If, after checking, lobes are within 70% of each other, alignment is **not** recommended.

Alignment diskette in following procedure should be at room conditions for at least 1 hour prior to alignment and check.

a. Insert SA122 alignment diskette.

b. Step heads to track 38.

c. Sync oscilloscope, external negative, on TP12 (—INDEX). Set time base to 20 Msec per division. Scope will display over one revolution.

d. Connect one probe to TP1 and another to TP2.

e. Ground probes to PCB.

f. Set inputs to AC, ADD, and invert one channel.

g. Set vertical deflection to 100 MV/division.

h. Amplitude of two lobes must be within 70% of each other on sides 0 and 1 (see figure 5-19). If lobes do not fall within specification, continue with procedure.

i. Loosen two or four mounting screws which hold motor plate mounting screws. See figure 5-19.

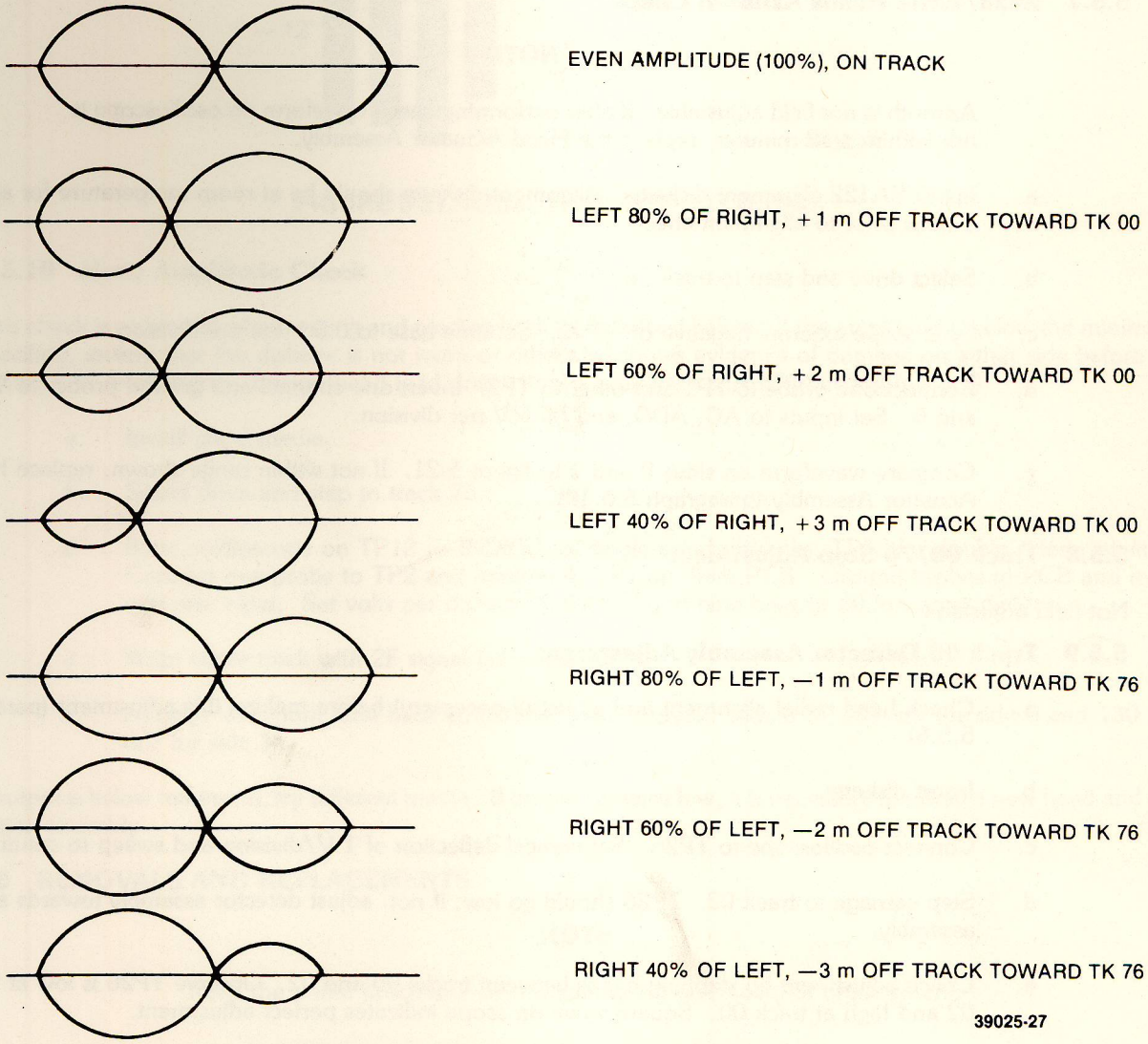


FIGURE 5-19. HEAD RADIAL ALIGNMENT

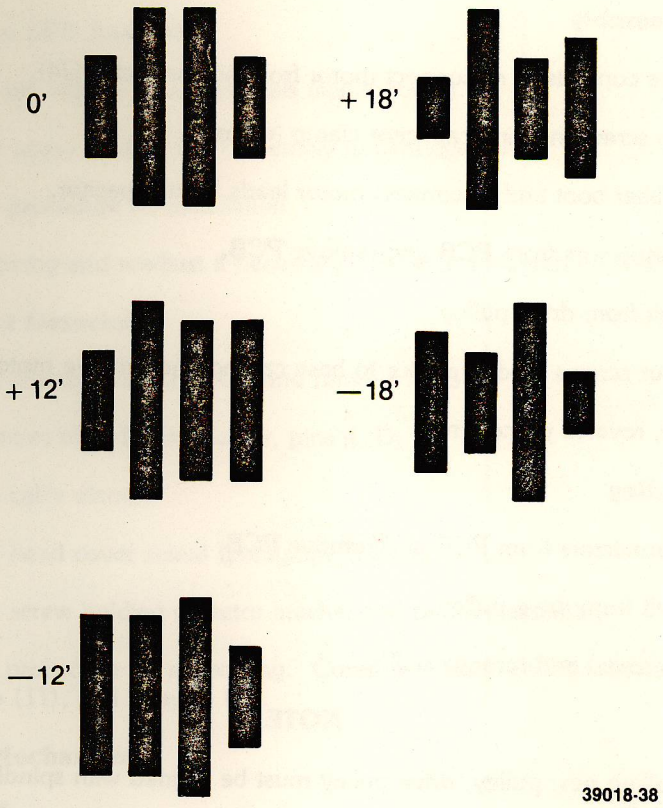


FIGURE 5-21. AZIMUTH BURST PATTERNS

5.5.10 Head Amplitude Check

This check is only valid when writing and reading back as described below. If the amplitude is below the minimum specified, ensure that the diskette is not worn or otherwise shows evidence of damage on either side before re-writing and re-checking. Ensure head load down stop is properly adjusted (paragraph 5.5.2).

a. Install good media.

b. Select drive and step to track 76.

c. Sync oscilloscope on TP12 (—INDEX) for single sided diskettes, TP13 for double sided diskettes. Connect one probe to TP2 and another to TP1 on drive PCB. Ground probes to PCB and invert one input. Set volts per division to 50 mV and time base to 20 Msec per division.

d. Write entire track with 2F signal (all ones).

e. Average minimum read back amplitude, peak-to-peak, should be 130 mV for side 0 and 130 mV for side 1.

If output is below minimum, try different media. If output remains low, it is necessary to install a new head and actuator assembly.

5.6 REMOVALS AND REPLACEMENTS

NOTE

Read the entire procedure before attempting a removal or replacement.

5.6.1 Drive Motor Assembly

a. Extract three contacts to disconnect motor from ac connector (J4).

b. Loosen two screws holding capacitor clamp to base.

c. Remove rubber boot and disconnect motor leads from capacitor.

d. Remove connectors from PCB and remove PCB.

e. Remove belt from drive pulley.

f. Remove four screws holding motor to base casting and remove motor.

g. To reinstall, reverse procedure.

5.6.2 Motor Drive Pulley

a. Remove connectors from PCB and remove PCB.

b. Remove belt from drive pulley.

c. Loosen set screw and remove pulley.

NOTE

When installing new pulley, drive pulley must be aligned with spindle pulley so belt tracks correctly.

d. To reinstall, reverse procedure.

5.6.3 Head Cover Shield Removal

a. Loosen two screws holding cover to guide opening assembly.

b. Slide cover back toward drive and remove cover.

c. To reinstall, reverse procedure.

5.6.4 Cartridge Guide Access

a. Remove head cover shield (paragraph 5.6.3).

b. Turn actuator shaft to position head at approximately track 00.

c. Open cartridge guide by pressing pushbar on front of drive.

d. Insert clean piece of lens tissue between heads to prevent them from touching each other. Gently lower moveable head arm assembly.

CAUTION

Ensure head load arm is off load bail before performing following step.

e. Loosen two screws holding cartridge to door latch plate.

f. Release safety catch on guide open assembly by pressing it toward back of drive.

g. Swing cartridge guide out.

h. To restore cartridge guide to normal position, reverse procedure and adjust as per paragraph 5.5.4

5.6.5 Index/Sector LED Assembly

a. Disconnect wires to LED terminals (solder joints).

b. Remove screw holding LED assembly to cartridge guide.

c. Reverse procedure for installation.

d. Check timing and readjust if necessary. Refer to paragraph 5.5.3.

5.6.6 Write Protect Detector

a. Remove connectors from PCB and remove PCB.

b. Extract wires from P2 connector, pins 4, D, 11, and M.

c. Remove cable clamps.

d. Remove head cover shield (paragraph 5.6.3).

e. Remove screw holding detector bracket and remove assembly.

f. Reverse procedure for reinstalling. Connect wires to P2 by following: Red to (4), Black to (D), White to (11), and Gray to (M).

5.6.7 Head Load Mechanism

MLC 14, P/N 51176

a. Install diskette.

b. Remove head cover shield (paragraph 5.6.3).

c. Extract wires from P2 connector pins 17 and U.

d. Unfasten four mounting screws and remove actuator assembly.

NOTE

When installing, make sure fasteners for mounting solenoid body do not interfere with armature.

e. To reinstall, reverse procedure. Refer to paragraph 5.5.2 for Head Load Mechanism adjustment procedure.

MLC 15, P/N 51460

a. Install data diskette.

b. Remove head cover shield (paragraph 5.6.3).

c. Remove blue and purple wires from head load solenoid.

d. Remove two mounting screws.

e. Remove actuator assembly.

f. To reinstall, reverse above procedure. Refer to paragraph 5.5.2 for Head Load Mechanism adjustment procedure.

5.6.8 Index/Sector Photo Transistor Assembly

a. Disconnect P2 connector from PCB.

b. Remove wires from Door Closed switch: Orange - Common, Grey - N/C, and Red - N/O. Extract wires from P2 connector pins 12-black, N-green, P-brown, 6-orange, F-grey, and H-red.

c. Remove cable clamp holding wires for detector.

d. Remove screw holding detector to base plate and remove assembly.

e. To reinstall, reverse procedure.

5.6.9 Spindle Assembly

a. Remove head cover shield (paragraph 5.6.3).

b. Switch out cartridge guide (paragraph 5.6.4).

c. Remove drive belt.

CAUTION

Pre-loaded rear bearing may fly out when spindle pulley is removed.

d. Remove nut and two spring washers holding spindle pulley. Spanner wrench (P/N 50752) must be used to hold spindle.

e. Withdraw spindle hub from opposite side of baseplate.

f. Reverse procedure for installation.

g. Tighten nut to 20 in./lbs, ensuring that spring washers are compressed. Add drop of LOCTITE #290 to threads.

5.6.10 Head Actuator Assembly

a. Remove connectors and PCB.

b. Remove cable clamp holding read/write head cable on PCB side of drive.

c. Remove grommet from cable bracket on head side.

d. Unload heads (refer to paragraph 5.6.4, steps d and e).

e. Remove two or four screws holding actuator assembly to base casting.

f. Carefully remove heads and actuator assembly from drive. Take care not to snag heads, load arms, or read/write head cable on casting.

g. To reinstall:

(1) Hold assembly at slight angle towards you when installing (approximately 15° counter-clockwise viewed from rear).

(2) Rotate actuator into position against ledge while simultaneously lifting arm tab with bail so heads are separated and protective tissue between heads falls free.

(3) Position actuator casting firmly and squarely against ledge on base casting. Secure with two or four screws and washers (install locating screw nearest ledge first).

5.6.11 Clamp Hub Removal

a. Remove hub clamp plate.

b. Remove hub clamp and spring.

c. To reinstall, reverse procedure. No adjustment is necessary.

5.6.12 Cartridge Guide Removal

a. Perform all steps of following paragraphs:

- 5.6.4
- 5.6.5
- 5.6.6
- 5.5.2
- 5.6.7

b. Loosen cartridge guide stop.

c. Remove E-ring from pivot shaft.

d. Remove pivot shaft.

e. Tilt cartridge guide slightly and remove from upper pivot.

f. To reinstall cartridge guide, reverse procedure.

g. Perform write protect adjustment (paragraph 5.5.1) and head load mechanism adjustment (paragraph 5.5.2).

5.6.13 Door Lock Solenoid and In Use LED Assembly

a. Remove track 00 detector (paragraph 5.6.14).

b. Remove door lock assembly.

c. Reverse procedure to install new assembly.

d. Adjustment of door lock should not be necessary. If gap between armature tab and latch is not 0.015 ± 0.010 inch (0.309 ± 0.254 mm), adjustment must be made by loosening two screws on armature.

5.6.14 Track 00 Detector

a. Remove head cover shield (paragraph 5.6.3).

b. Swing cartridge guide open (paragraph 5.6.4).

c. Manually rotate stepper shaft and move carriage to track 77.

d. Remove screw holding bracket to base casting.

e. Remove bracket and detector.

f. Extract cable from P2 connector: Pins 3-brown, C-black, 10-orange, and L-red.

g. Remove cable clamps and remove detector assembly.

h. To reinstall, reverse procedure.

5.6.15 Front Plate Assembly Removal

a. Insert cartridge guide adjustment tool (P/N 50377) through adjustment hole in cartridge guide. Screw completely into base casting (hand tight).

b. Remove door lock wires from P2, Pin 2-black, B-brown, 9-violet, K-blue.

c. Remove cable clamp holding door lock wires.

d. Remove two allen head screws holding handle to front plate. Remove handle.

e. Remove four screws holding front plate to base casting.

f. Remove two screws holding door lock assembly to front plate.

g. Remove two allen head screws holding In Use LED to door lock assembly.

h. Grasp both ends of push button and bow outwards to remove LED.

i. Reverse procedure to reinstall.

j. Check index adjustment (paragraph 5.5.3).

5.7 SA850/851 RECOMMENDED INCOMING RECEIVING AND INSPECTION

5.7.1 Test Equipment

All SA850/851 drives are 100% adjusted and tested before leaving the factory. It is only necessary to inspect for shipping damage on receipt of the drives.

Inspection should be simple and test equipment kept to a minimum. Shugart recommends the following equipment:

a. SA850/851 BC Service Manual
b. SA809 Exerciser
c. Exerciser Instruction Manual
d. Power Supply for Exerciser (±5 V, +24 V; −5 V not required on drives with an MLC 10 and above).
e. Oscilloscope
f. SA122 Alignment Diskette
g. SA150/151 Diskette

5.7.2 Inspection Procedure

a. Unpack drive.

b. If drive is SA850-4, attach PCB.

c. Visually inspect for physical damage.

d. Ensure all power is off. Attach Exerciser cables to appropriate drive connectors and ac cord to P4 connector.

e. Power up.

f. Insert SA150/151 diskette.

g. Set track addresses of 00 and 76 into exerciser.

h. Load head and let drive seek automatically for 5 minutes. After 5 minutes, move address 76 to 00. Seeking should stop and track 00 indicator should be on.

i. Push door open button while drive is seeking. Door must not open.

j. Using SA850 Service Manual, SA122 alignment diskette, and Exerciser Instruction Manual as guides, perform following checks:

(1) Head Load Actuator Timing (paragraph 5.5.2).
(2) Index/Sector Adjustment (paragraph 5.5.3).
(3) Head Radial Alignment (paragraph 5.5.6).

k. Remove SA122 alignment disk and insert SA150/151 diskette.

l. Seek to track 76. Write 2F on both sides. Minimum read back signal from each head should be 130 mV.

m. Connect scope to TP13 and verify index timing is 166.7 ± 2.2 msec.

n. Power off.

o. Remove connectors. If drive is SA850-4, remove PCB.

p. Repack drive.

5.7.3 Conclusion

This inspection procedure verifies that the critical functions of the drive are working properly (i.e., the file reads and writes, the drive accesses, the disk rotates at the proper speed, and critical adjustments are within specifications).

5.8 PHYSICAL LOCATIONS

Figure 5-22 illustrates the physical locations of the major components of the SA850/851.

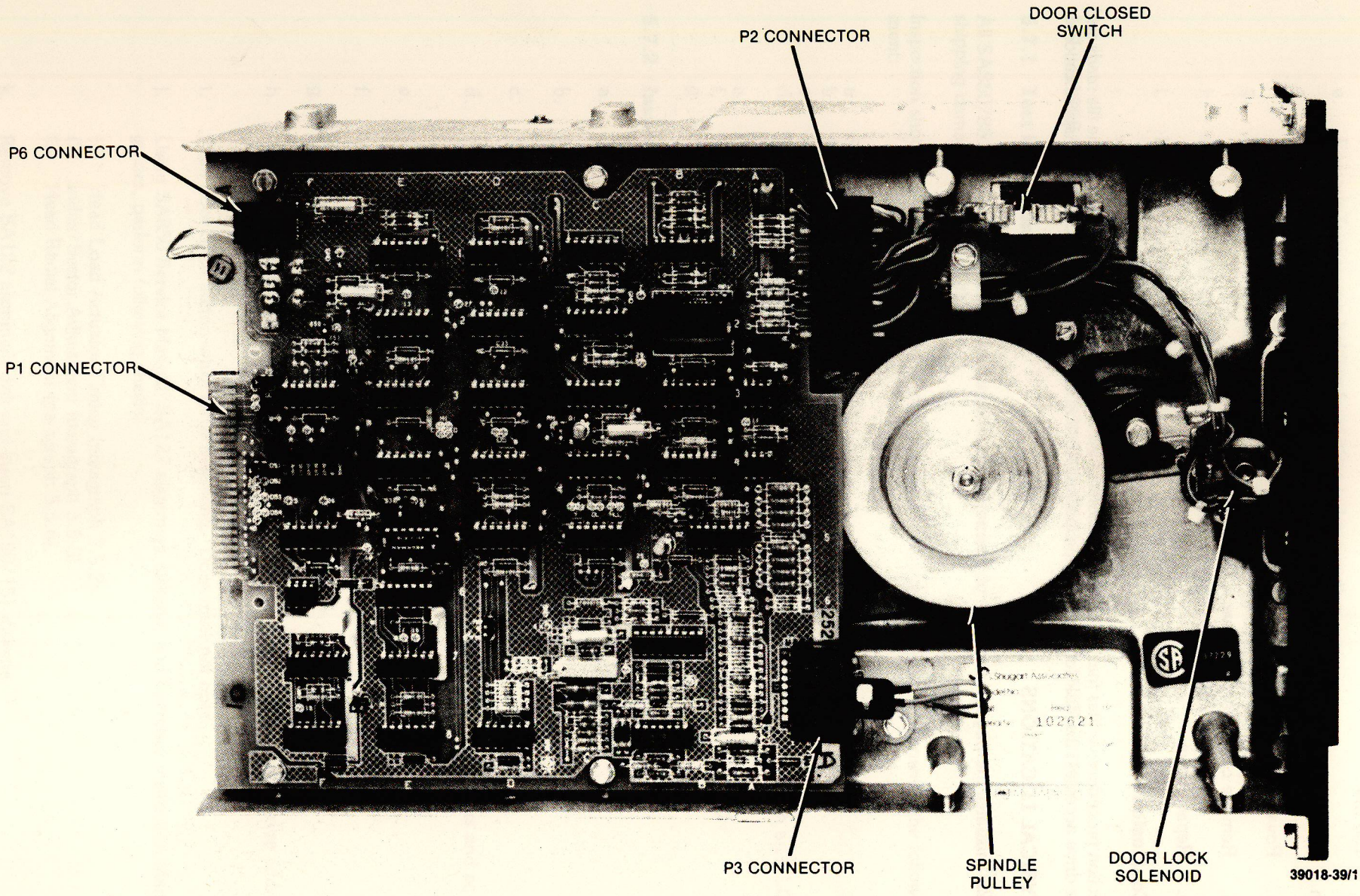


FIGURE 5-22. PHYSICAL LOCATIONS (SHEET 1 OF 4)

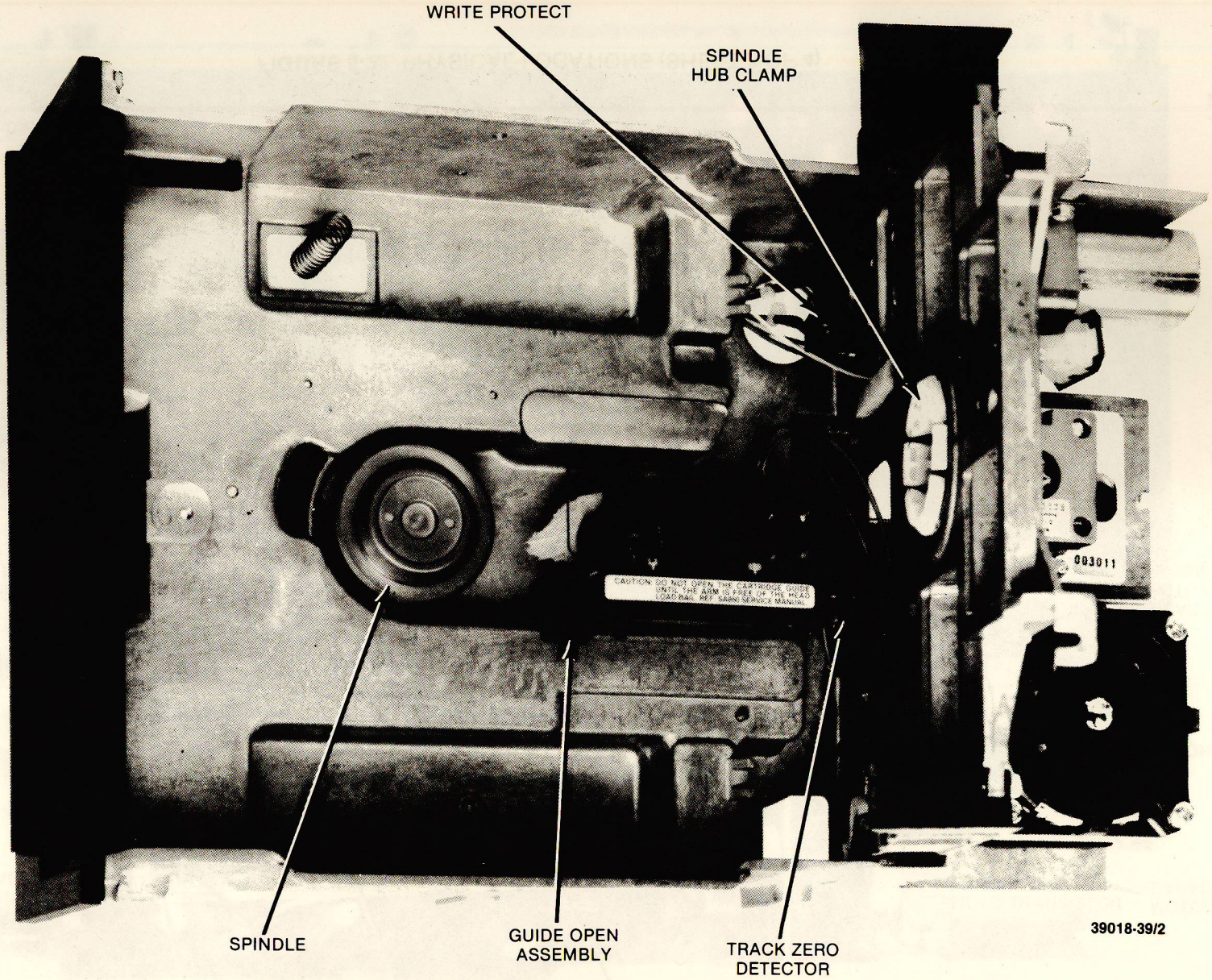


FIGURE 5-22. PHYSICAL LOCATIONS (SHEET 2 OF 4)

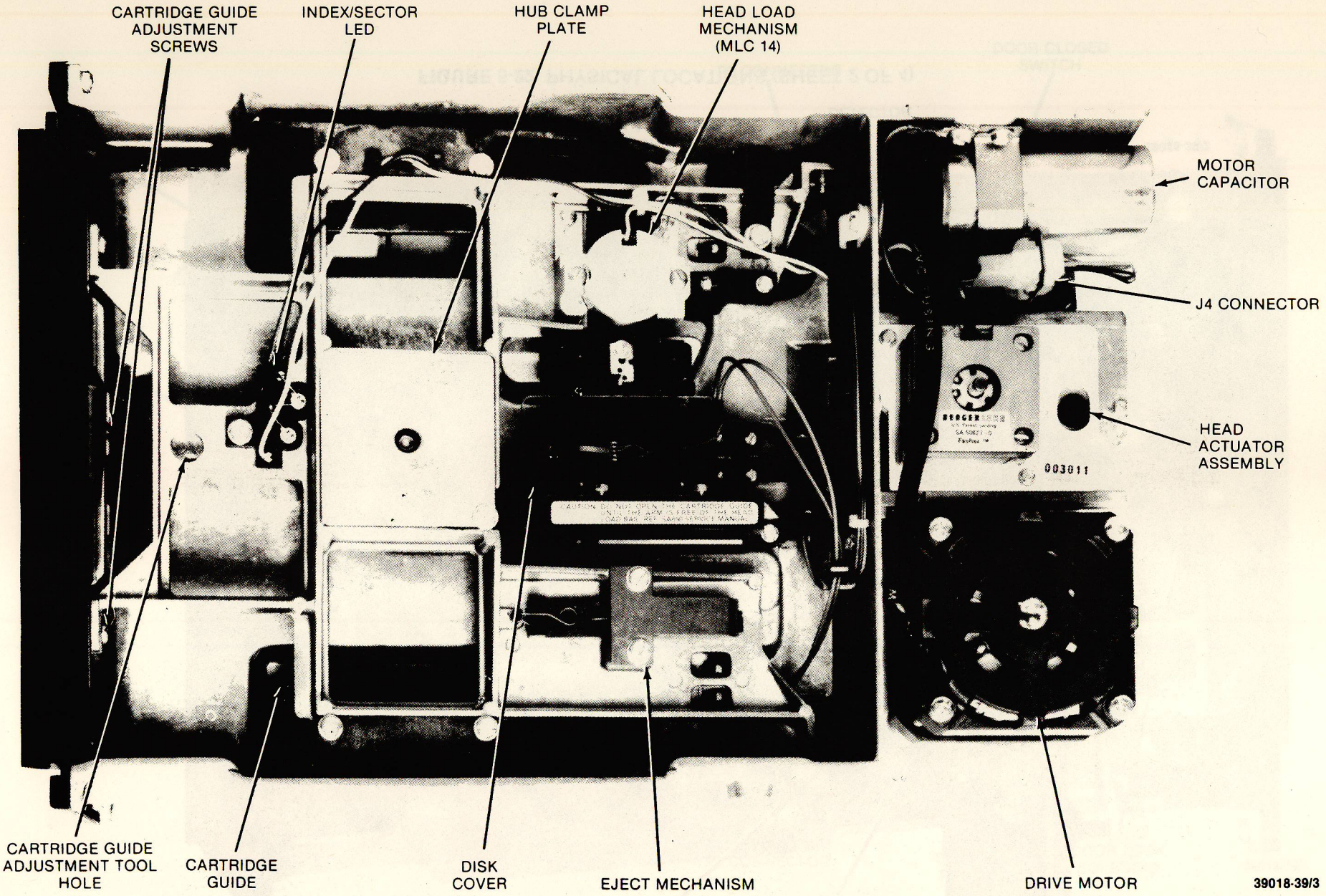


FIGURE 5-22. PHYSICAL LOCATIONS (SHEET 3 OF 4)

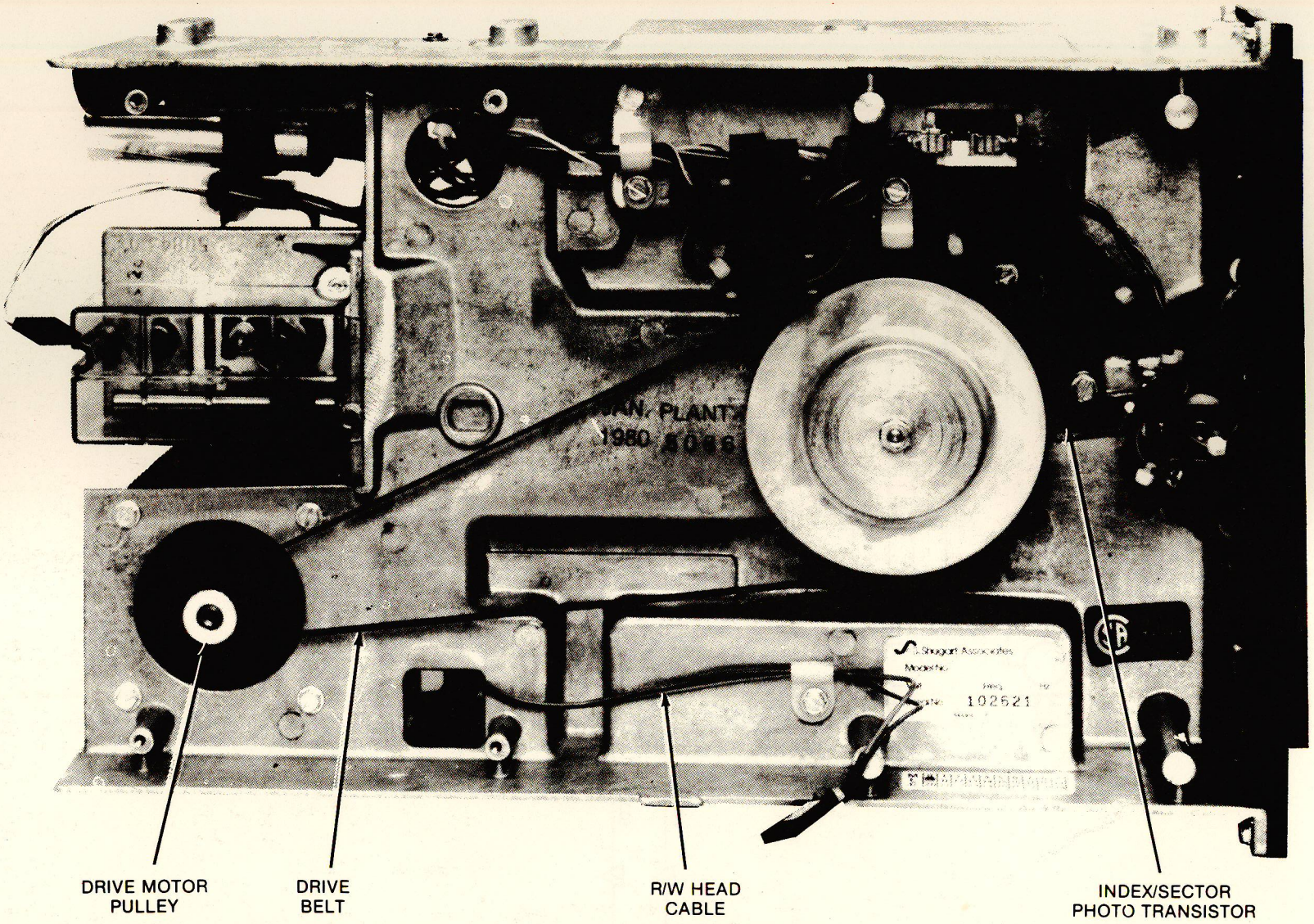
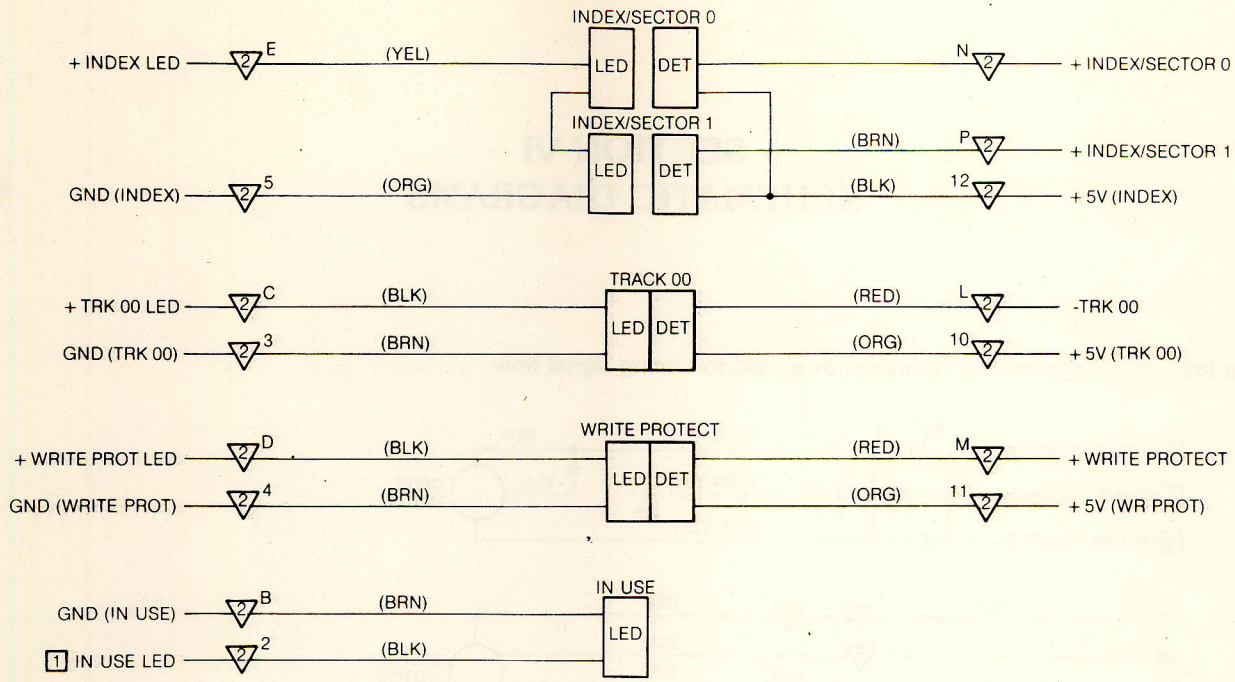


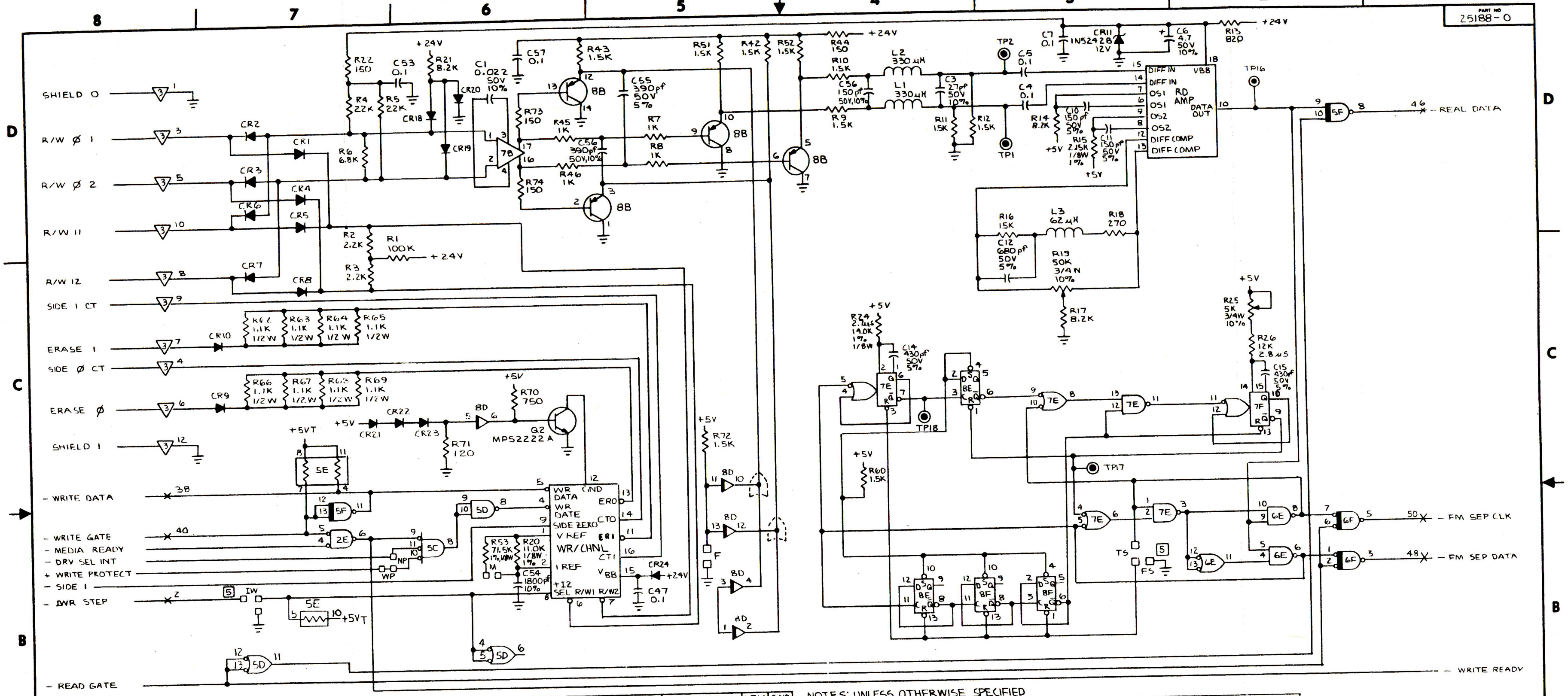
FIGURE 5-22. PHYSICAL LOCATIONS (SHEET 4 OF 4)

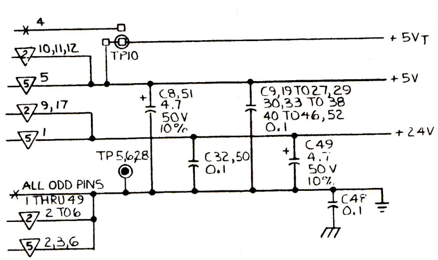


NOTES:
1. GROUND WHEN INACTIVE AND + 1.5 V DC WHEN ACTIVE.

39018-41

FIGURE 6-2. LOGIC DIAGRAMS





TYPE	POSITION	UNUSED ELEMENTS	+5V (PIN)	GND (PIN)
7400	2D,4D,5D,6E,7E	6E1	14	7
7402	3C		14	7
7404	3B,4C	3B1,2,4,6	14	7
7407	8D		14	7
7427	5C		14	7
7432	2E		14	7
7438	3F,5F		14	7
7474	4B,1D,3D,3E,8E,8F		14	7
7486	1E		14	7
74LS14	4E		14	7
96LS02	2C,7F		16	8
75453B	6F		8	4
75462	3A,4A		8	4
16270-1	5A		10	3
16278-0	7B		11	5
LM339	2B		3	12
RPK 150Ω	5E		—	—
SHUNT	4F		—	—
TPQ3906	8B		—	—
ULN2074B	1B		—	4,5,12,13
UHP407	1C		14	7

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITORS ARE IN MICROFARADS, 50V,+80,-20%.
2. ALL DIODES ARE IN4148.
3. ALL INDUCTORS ARE IN MICROHENRYS, ±10%.
4. ALL RESISTORS ARE IN OHMS, 1/4W, ± 5%.
5. [5] SHORTING PLUGS INSTALLED.
6. CONNECTOR SYMBOL REFERENCE: ✱ = J1, ▽2 = J2, ▽3 = J3, ▽4 = J4, ▽5 = J5 & ▽6 = J6.
7. —□—□— INDICATES CUT-TRACE OPTION.
8. —□ □— INDICATES JUMPER OPTION
9. —□—□— INDICATES SHUNT JUMP/ CUT-TRACE OPTION.
10.
11. —/\/\/\— INDICATES RESISTOR PACK
12. [12] JUMPER OPTION "850/851" IS AS FOLLOWS:
ASSEMBLY 25189-2 - 850
ASSEMBLY 25190-2 - 851

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C57	C13
CR28	
L3	
Q2	
R74	R23, 49
TP29	TP 3,4,7,8,9 14,15,19 TO 24

USED ON ASSEMBLY
25189 - 2
25190 - 2

MUST CONFORM TO ENGINEERING SPEC. ES 30000-0

MATERIAL — TOLERANCE UNLESS OTHERWISE NOTED — LINEAR ±.XX ±.XXX — ANGULAR±

USED ON 850

CASE DEPTH / HARDNESS / SURFACE TREATMENT ES

CORNERS EDGES BROKEN: OUTSIDE MAX, INSIDE MAX

EC HISTORY: DATE / NO. — FIELD 509A — FIELD 509A

TITLE: SCHEMATIC DIAGRAM

DWN J. SLACK 9-80 — RELEASED FOR ASSEMBLY

CHK / APR

SIZE D — SCALE — — DOC CODE SC — SHEET 1 OF 2 — PART NO 25188-0 — REV/EC 509

PART NO 25188-0

5112 (12/79)

FIGURE 6-3. SCHEMATIC DIAGRAM, 25188 (SHEET 1 OF 2)

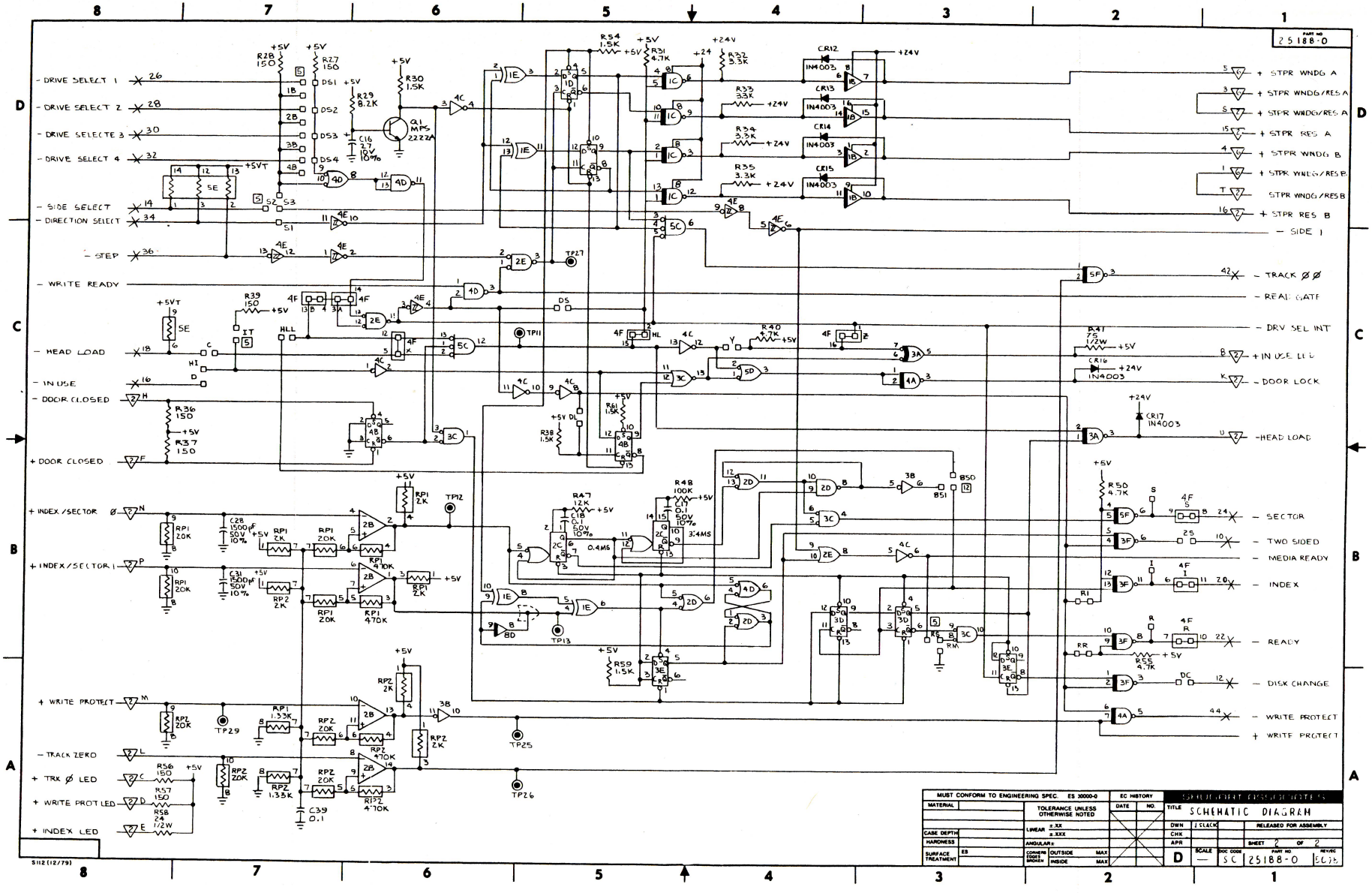
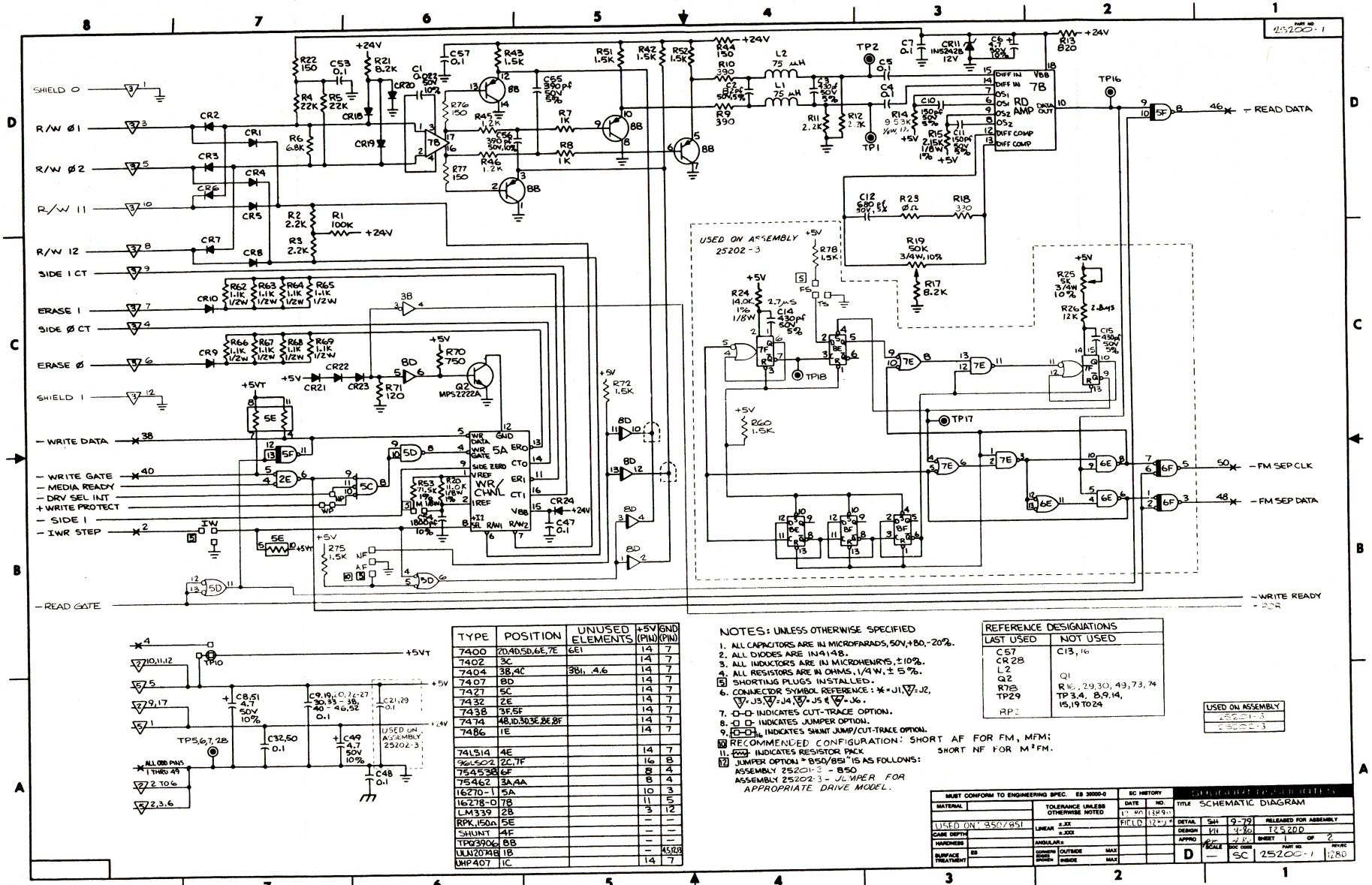


FIGURE 6-3. SCHEMATIC DIAGRAM, 25188 (SHEET 2 OF 2)



TYPE	POSITION	UNUSED ELEMENTS	+5V (PIN)	GND (PIN)
7400	2D,4D,5D,6E,7E	6E1	14	7
7402	3C		14	7
7404	3B,4C	3B1, ,4,6	14	7
7407	8D		14	7
7427	5C		14	7
7432	2E		14	7
7438	3F,5F		14	7
7474	4B,1D,3D,3E,8E,8F		14	7
7486	1E		14	7
74LS14	4E		14	7
96LS02	2C,7F		16	8
75453B	6F		8	4
75462	3A,4A		8	4
16270-1	5A		10	3
16278-0	7B		11	5
LM339	2B		3	12
RPK,150A	5E		—	—
SHUNT	4F		—	—
TPQ3906	8B		—	—
ULN2074B	1B		—	4,5,7,8
UHP407	1C		14	7

FIGURE 6-4. SCHEMATIC DIAGRAM, 25200 (SHEET 1 C

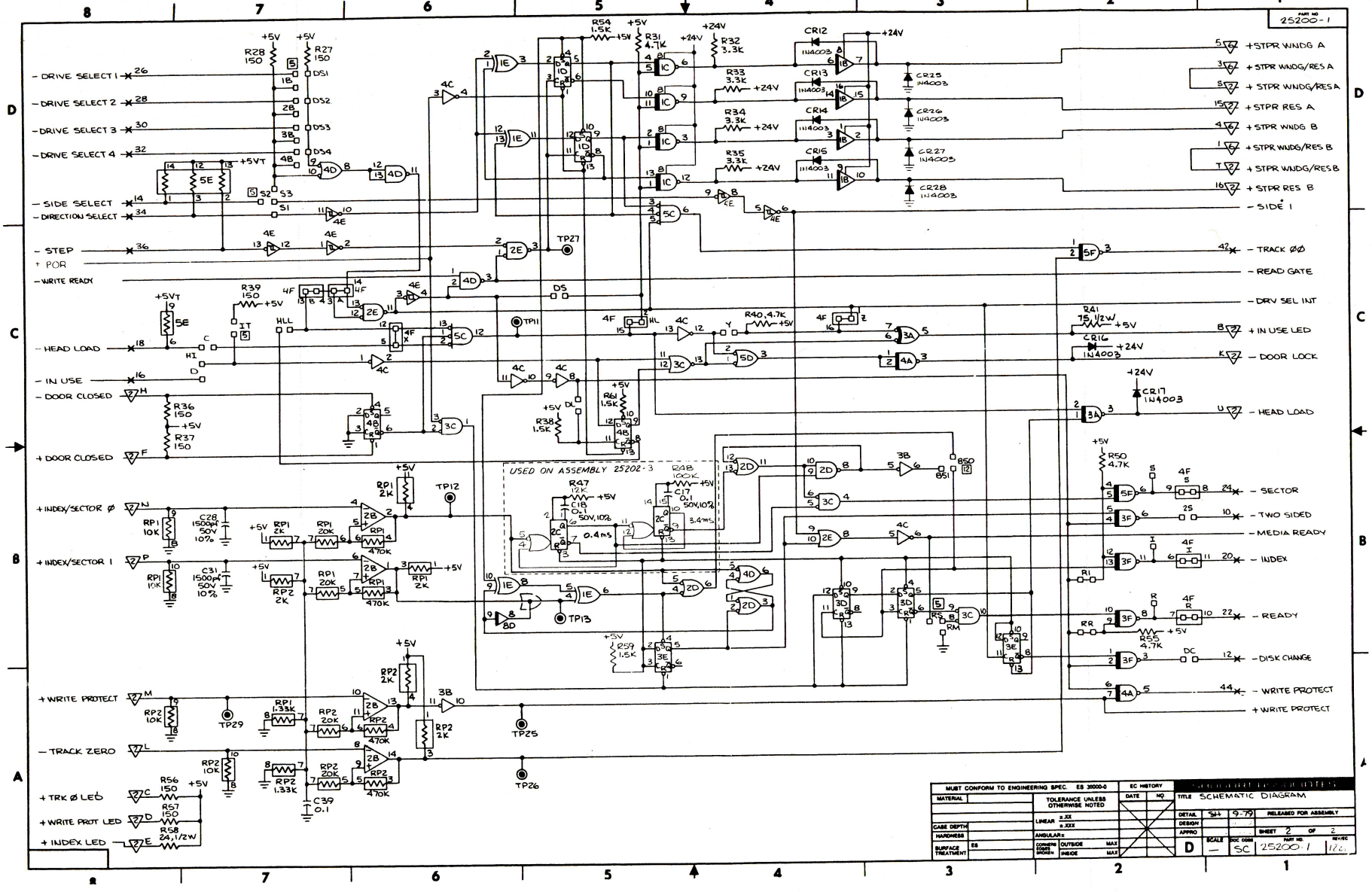
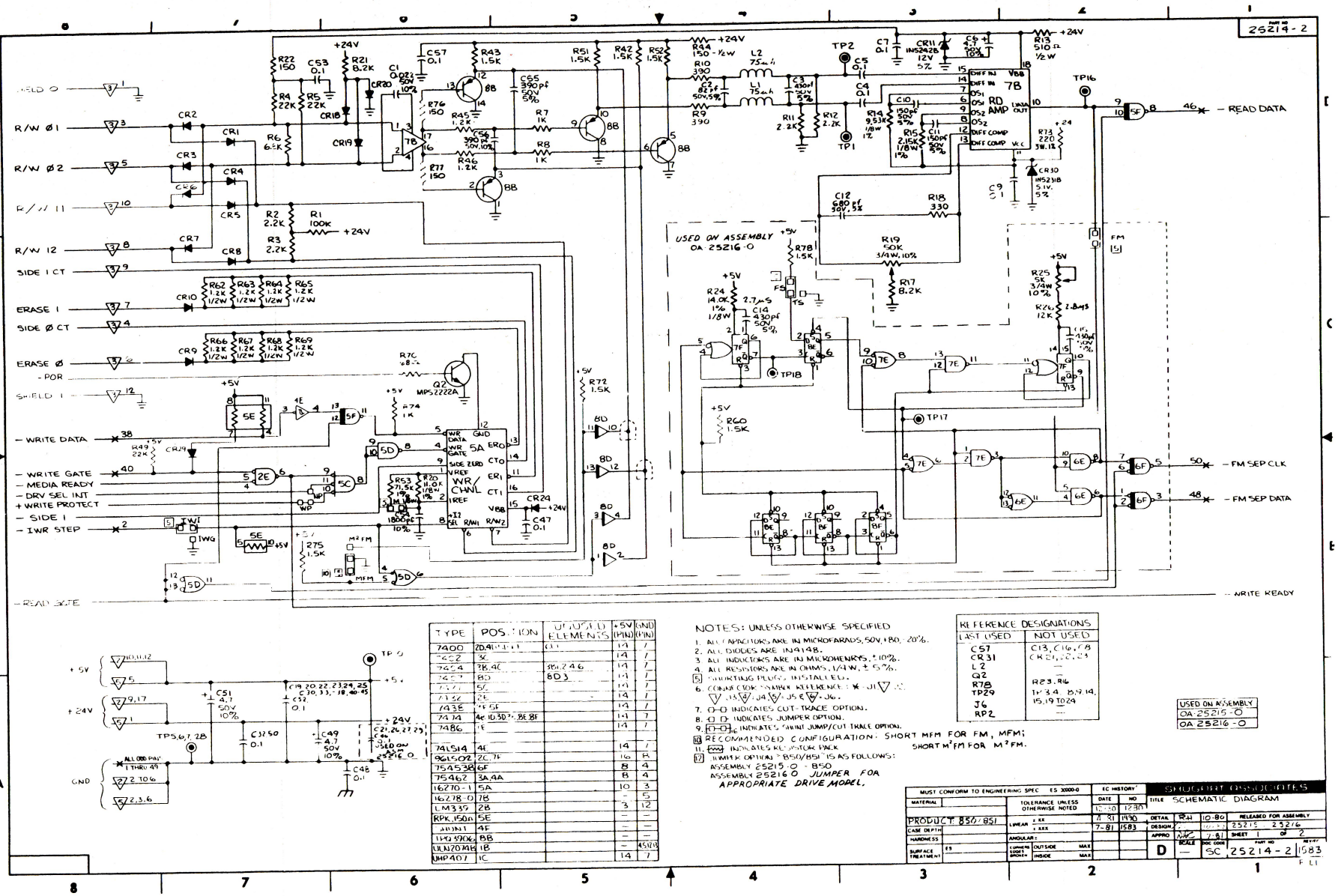


FIGURE 6-4. SCHEMATIC DIAGRAM, 25200 (SHEET 2 OF 2)



TYPE	POSITION	UTILIZED ELEMENTS	+5V (PIN)	GND (PIN)
7400	2B,4B,4F,5B	C11	14	7
7402	5C		14	7
7404	7B,8C	3B,4,2,6	14	7
7407	8D	8D3	14	7
7414	5C		14	7
7432	2E		14	7
7438	4F,5F		14	7
7474	4C,10,3D2*,8E,8F		14	7
7486	1E		14	7
74LS14	4E		14	7
96LS02	2C,7E		16	8
75453B	6F		8	4
75462	3A,4A		8	4
16270-1	5A		10	3
16278-0	7B		-	5
LM339	2B		3	12
RPK150Ω	5E		-	-
3N211	4F		-	-
1N4906	8B		-	-
ULN2074A	1B		-	45V/0
UHP907	1C		14	7

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL CAPACITORS ARE IN MICROFARADS, 50V, ±80, -20%.
2. ALL DIODES ARE IN4148.
3. ALL INDUCTORS ARE IN MICROHENRYS, ±10%.
4. ALL RESISTORS ARE IN OHMS, 1/4W, ±5%.
5. MOUNTING HOLES, INSTALLED.
6. CIRCUIT CONNECTOR NUMBER REFERENCE: ▽ J1 ▽ J3 ▽ J4 ▽ J5 & ▽ J6.
7. ⊏⊐ INDICATES CUT-TRACE OPTION.
8. ⊏⊐ INDICATES JUMPER OPTION.
9. ⊏⊐ INDICATES "SHUNT JUMP/CUT TRACE OPTION.
10. RECOMMENDED CONFIGURATION: SHORT MFM FOR FM, MFM; SHORT MFM FOR MFM.
11. RPK INDICATES RESISTOR PACK
12. JUMPER OPTION "850/851" IS AS FOLLOWS:
    ASSEMBLY 25215-0 - 850
    ASSEMBLY 25216-0 JUMPER FOR APPROPRIATE DRIVE MODEL.

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C57	C13, C16, C18
CR31	CR21, 22, 23
L2	—
Q2	—
R78	R23, R16
TP29	TP3,4, 15,17, 15,19 TO 24
J6	—
RP2	—

USED ON ASSEMBLY
0A-25215-0
0A-25216-0

MUST CONFORM TO ENGINEERING SPEC ES 30000-0	EC HISTORY	SHUGART ASSOCIATES
MATERIAL	DATE / NO	TITLE SCHEMATIC DIAGRAM
PRODUCT 850/851	12-80 / 1230	
CASE DEPTH	4-81 / 1490	DETAIL RH 10-80 RELEASED FOR ASSEMBLY
HARDNESS	7-81 / 1583	DESIGN SHEET 1 OF 2
SURFACE TREATMENT ES		APPRO SIZE D DOC CODE SC PART NO 25214-2 REV 1583

TOLERANCE UNLESS OTHERWISE NOTED: LINEAR ± .XX, ± .XXX; ANGULAR ±; FLUSHING AND BROKEN EDGES OUTSIDE MAX, INSIDE MAX

FIGURE 6-5. SCHEMATIC DIAGRAM, 25214 (SHEET 1 OF 2)

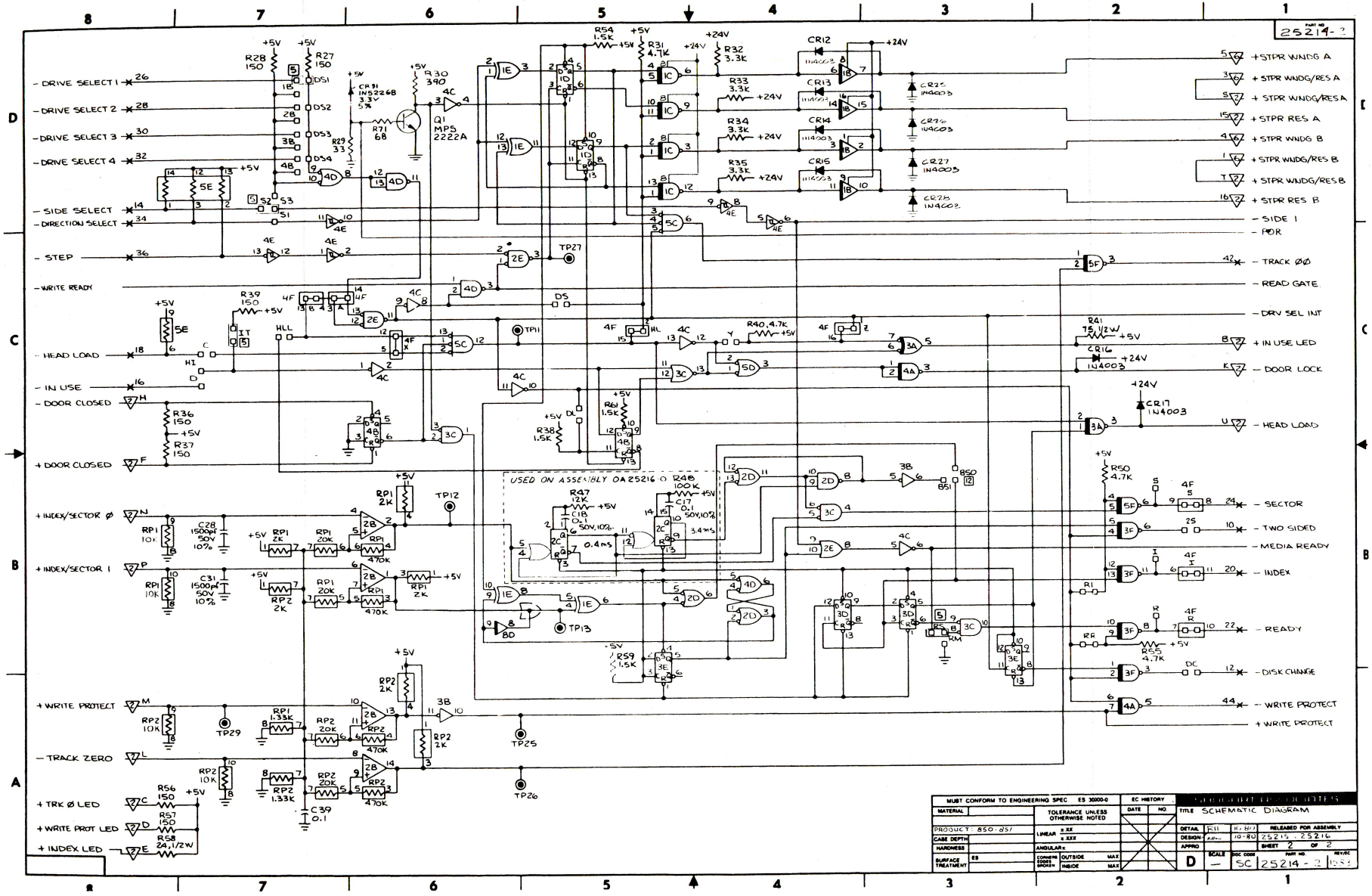


FIGURE 6-5. SCHEMATIC DIAGRAM, 25214 (SHEET 2 OF 2)

SECTION VII
ILLUSTRATED PARTS CATALOG

7.1 DESCRIPTION

The Illustrated Parts Catalog is arranged so that the figure will always precede the parts listing and, when possible, will appear directly above the parts list or on the left hand page immediately preceding it.

The first number in the list will always refer to the figure number. The second number will refer to the reference number of the part within the figure.

Part numbers enclosed in parentheses refer to parts belonging to a Next Higher Assembly (NHA) and are of importance only to those customers with alternate assemblies. Following the descriptions of these parts, the designation NHA P/N _____ gives the part number of the assembly to which they pertain. When applicable to the customer's assembly, these alternate parts will be used in lieu of the standard part listed directly above them. Assume that the quantity per assembly for these alternate parts is the same unless otherwise listed.

When an assembly is referred to within a figure and a further breakdown is shown on another figure, then the referenced figure will be called out.

7.2 INDENTED LEVEL

The parts list is indented to show the levels of assembly within a figure. The major assembly will never be indented. All parts or assemblies that attach to the assembly will be indented one space. Parts within those assemblies will be indented two spaces and so on.

7.3 QUANTITY PER ASSEMBLY

The quantity listed is the quantity used on the major assembly. Major assemblies themselves will never have a quantity listed.

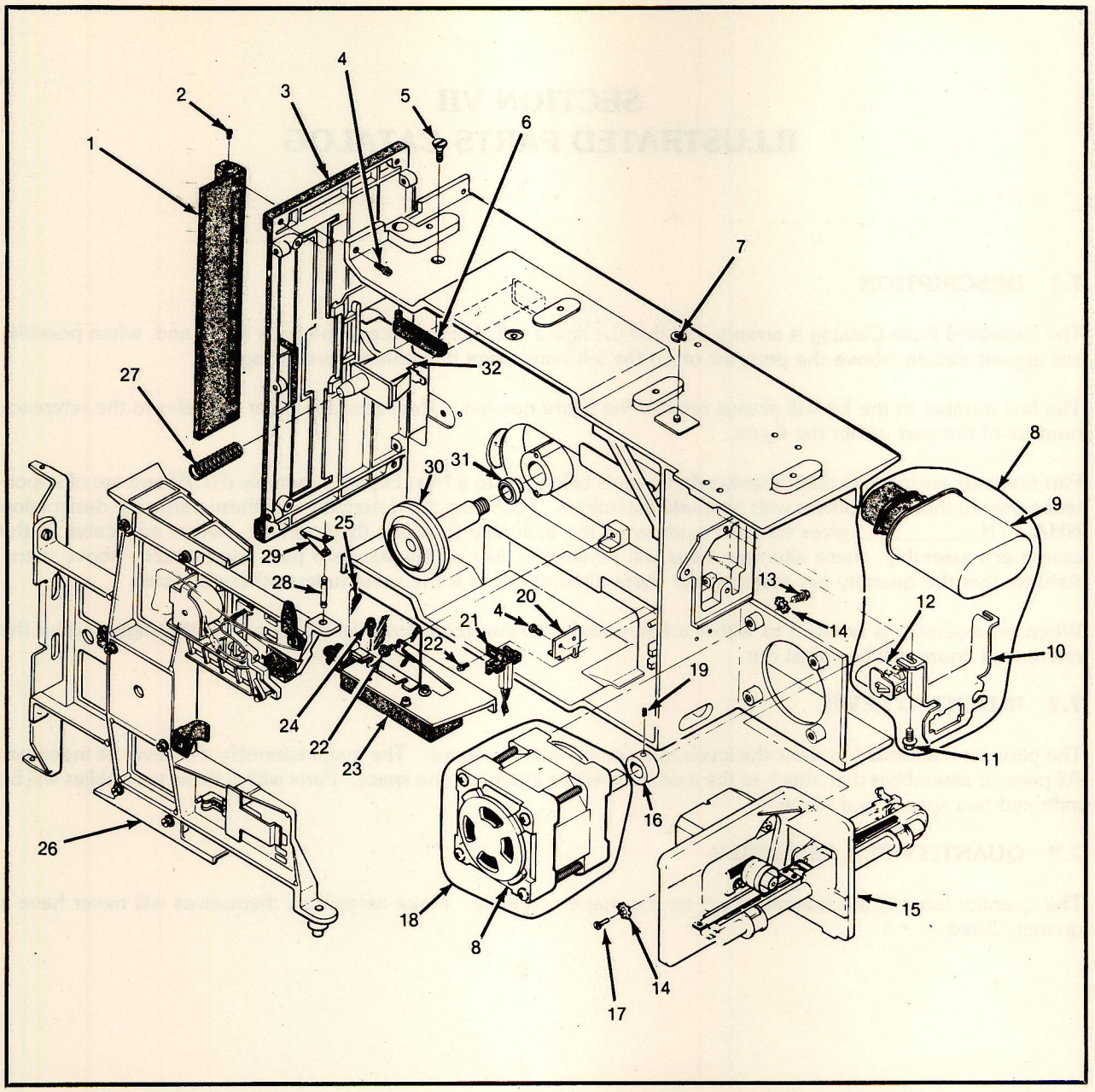
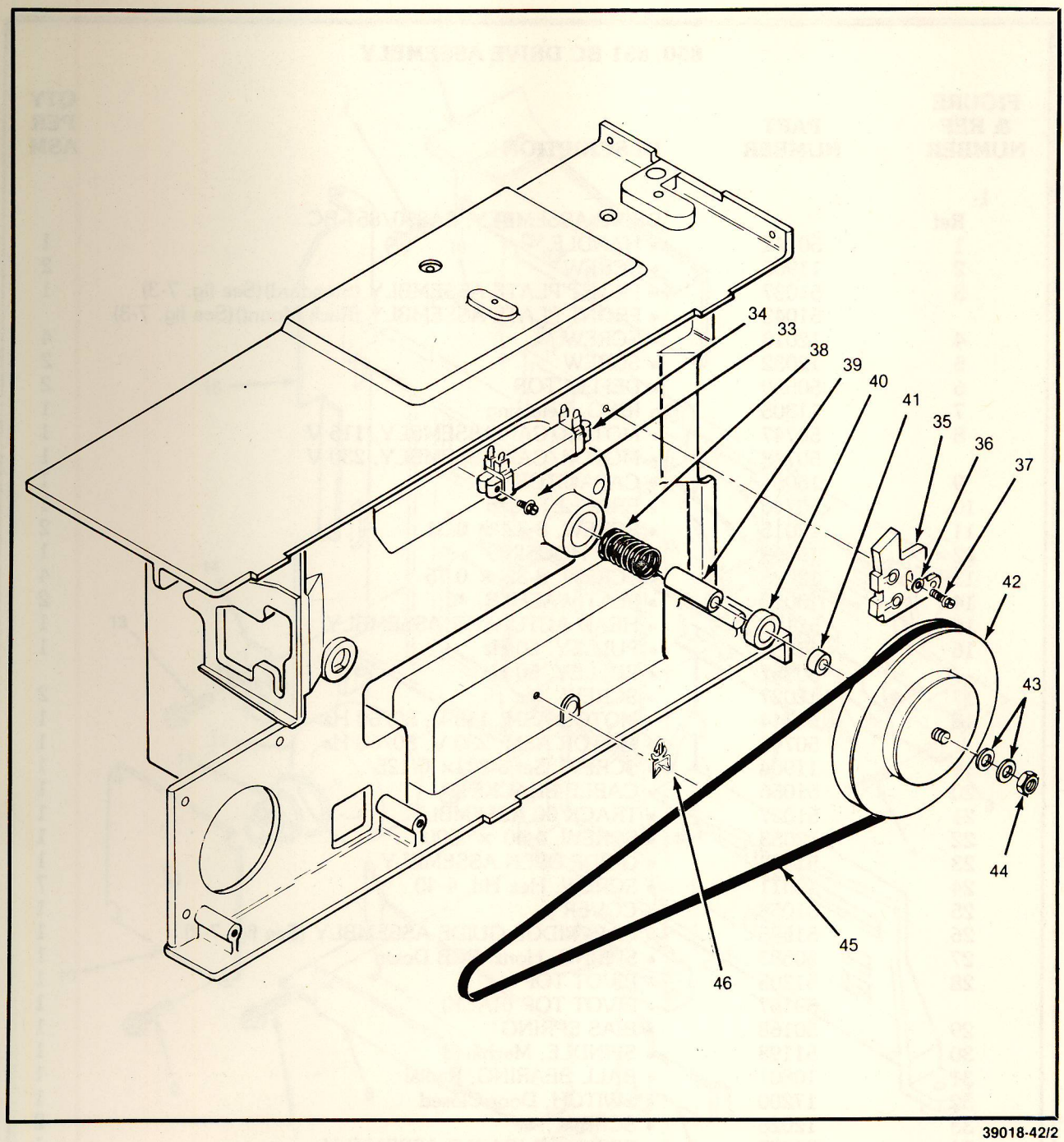


FIGURE 7-1. 850/851 BC DRIVE ASSEMBLY (SHEET 1 OF 2)

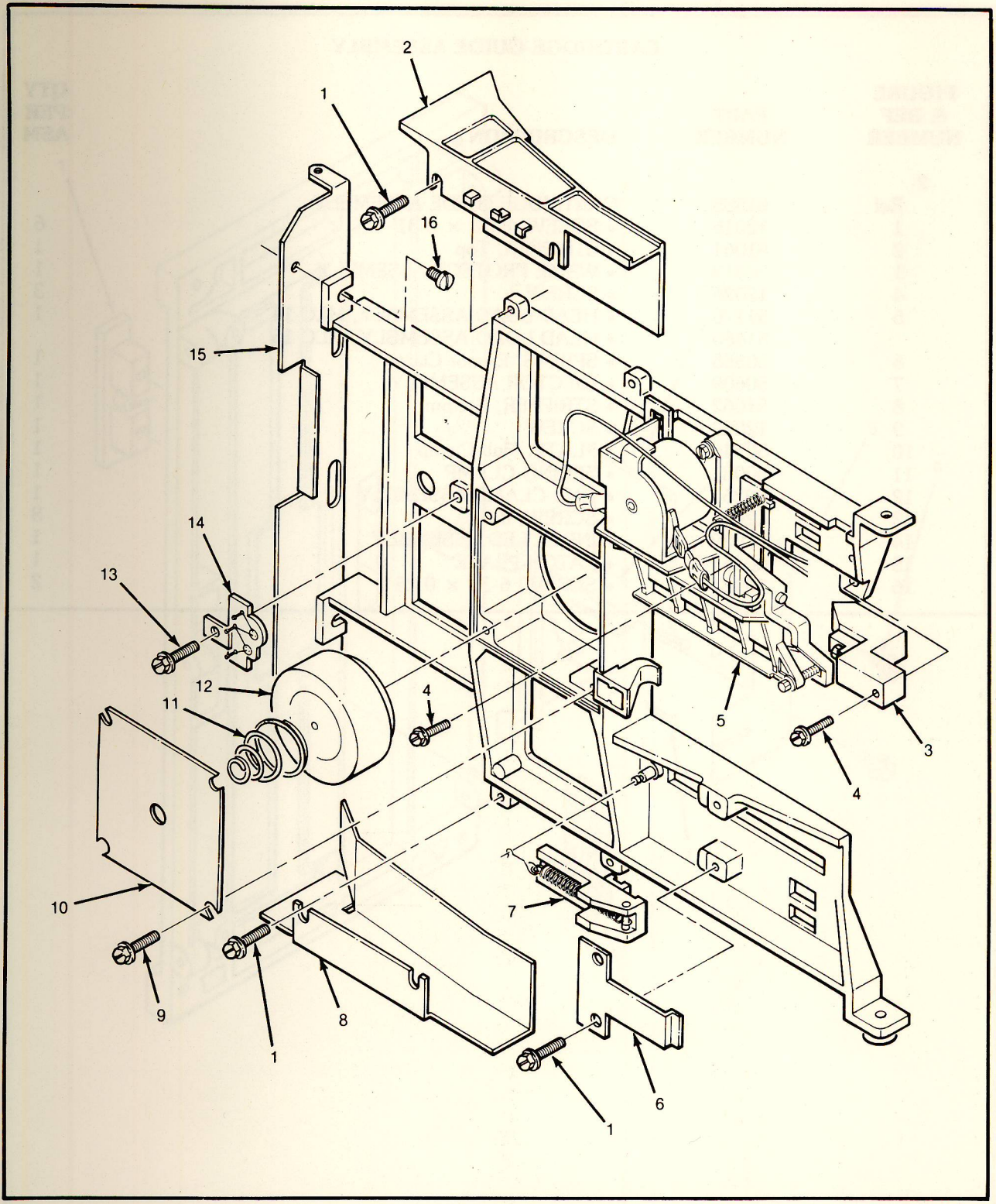


39018-42/2

FIGURE 7-1. 850/851 BC DRIVE ASSEMBLY (SHEET 2 OF 2)

850/851 BC DRIVE ASSEMBLY

FIGURE & REF NUMBER	PART NUMBER	DESCRIPTION	QTY PER ASM
1-			
Ref		DRIVE ASSEMBLY, SA850/851 BC	
1	50142	• HANDLE	1
2	11905	• SCREW	2
3	51037	• FRONT PLATE ASSEMBLY (Standard) (See fig. 7-3)	1
	51043	• FRONT PLATE ASSEMBLY (Rack Mount) (See fig. 7-3)	
4	12013	• SCREW	4
5	12032	• SCREW	2
6	50559	• DEFLECTOR	2
7	11305	• RING, Retaining	1
8	50747	• MOTOR/CAP ASSEMBLY, 115 V	1
	50748	• MOTOR/CAP ASSEMBLY, 230 V	1
9	15004	• CAPACITOR	1
10	50746	• BRACKET, Cap	1
11	12015	• SCREW, 8-32 × 0.31	2
12	15669	• CAP HOUSING	1
13	12028	• SCREW, 8-32 × 0.75	4
14	10013	• FLAT WASHER, #6	2
15	51127	• HEAD ACTUATOR ASSEMBLY	1
16	50358	• PULLEY, 60 Hz	1
	50357	• PULLEY, 50 Hz	
17	12027	• SCREW	2
18	50744	• MOTOR ASM, 115 V, 50/60 Hz	1
	50745	• MOTOR ASM, 230 V, 50/60 Hz	1
19	11904	• SCREW, Set 6-32 × 0.125	1
20	51056	• CABLE BRACKET	1
21	51027	• TRACK 00 ASSEMBLY	1
22	12053	• SCREW, 4-40 × .500	1
23	51203	• GUIDE OPEN ASSEMBLY	1
24	12011	• SCREW, Hex Hd, 4-40	7
25	51058	• COVER	1
26	51585	• CARTRIDGE GUIDE ASSEMBLY (See fig. 7-2)	1
27	50583	• SPRING, Horiz. PCB Down	1
28	51205	• PIVOT TOP	1
	50167	• PIVOT TOP (RACK)	1
29	50168	• BIAS SPRING	1
30	51198	• SPINDLE, Machined	1
31	10801	• BALL BEARING, Radial	1
32	17200	• SWITCH, Door Closed	1
33	12026	• SCREW	2
34	51028	• RESISTOR/CABLE ASSEMBLY	1
35	51046	• PHOTO DETECTOR ASSEMBLY	1
36	10014	• WASHER, #8	1
37	12036	• SCREW, Slotted Hex Washer	1
38	50166	• SPRING, Spindle	1
39	51231	• SPACER, Spindle, Long	1
40	10800	• BALL BEARING, Radial	1
41	50019	• SPACER, Spindle, Short	1
42	50016	• PULLEY SPINDLE, Machined	1
43	12509	• WASHER, Spring, #8	2
44	10025	• NUT, 8-32	1
45	50356	• BELT, 60 Hz	1
	50355	• BELT, 50 Hz	1
46	10426	• CABLE CLAMP	3



39018-43

FIGURE 7-2. CARTRIDGE GUIDE ASSEMBLY

CARTRIDGE GUIDE ASSEMBLY

FIGURE & REF NUMBER	PART NUMBER	DESCRIPTION	QTY PER ASM
2-			
Ref	51585	CARTRIDGE GUIDE ASSEMBLY	
1	12015	• SCREW, 8-32 × 0.31	6
2	51061	• STRIPPER, Top	1
3	50313	• WRITE PROTECT ASSEMBLY	1
4	12026	• SCREW	3
5	51176	• HEAD LOAD ASSEMBLY, MLC 14	1
	51460	• HEAD LOAD ASSEMBLY, MLC 15	
6	50555	• SPRING, Ejector Clamp	1
7	50609	• EJECTOR ASSEMBLY	1
8	51062	• STRIPPER, Bottom	1
9	12020	• SCREW	1
10	50546	• PLATE, Hub Clamp	1
11	50031	• SPRING CLAMP	1
12	50254	• HUB CLAMP ASSEMBLY	1
13	12016	• SCREW, 8-32	8
14	51029	• INDEX LED ASSEMBLY	1
15	50151	• LATCH PLATE	1
16	10187	• SCREW, 6-32 × 0.25	2

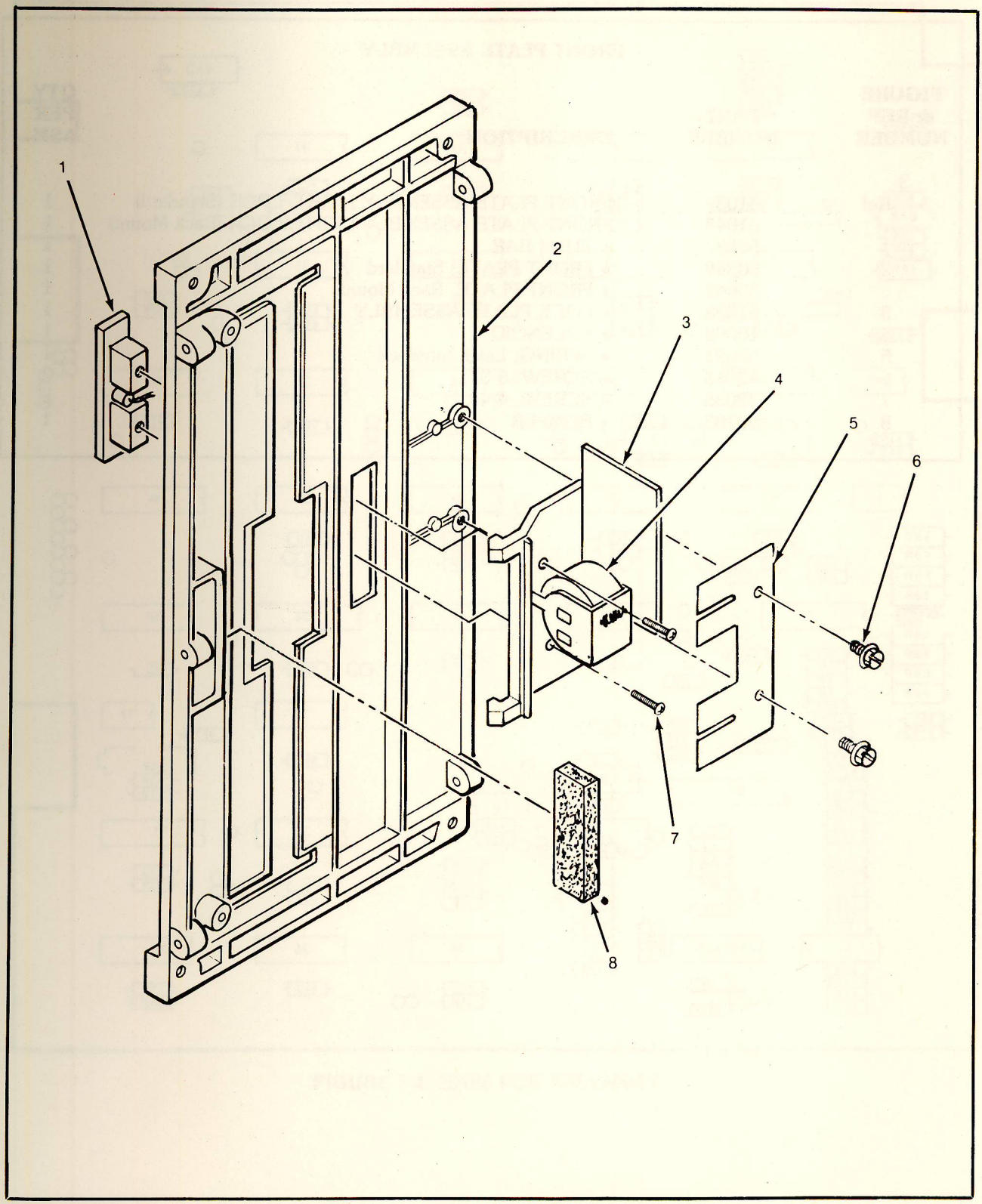


FIGURE 7-3. FRONT PLATE ASSEMBLY LIGHT/LOCK

FRONT PLATE ASSEMBLY

FIGURE & REF NUMBER	PART NUMBER	DESCRIPTION	QTY PER ASM
3-			
Ref	51037	FRONT PLATE ASSEMBLY LIGHT/LOCK (Standard)	1
	51043	FRONT PLATE ASSEMBLY LIGHT/LOCK (Rack Mount)	1
1	50587	• PUSH BAR	1
2	50349	• FRONT PLATE, Standard	1
	50667	• FRONT PLATE, Rack Mount	1
3	51038	• LOCK PLATE ASSEMBLY	1
4	10002	• SOLENOID	1
5	50691	• SPRING, Latch Interlock	1
6	12013	• SCREW, 6-32	2
7	12035	• SCREW, 4-40	2
8	50183	• BUMPER	1

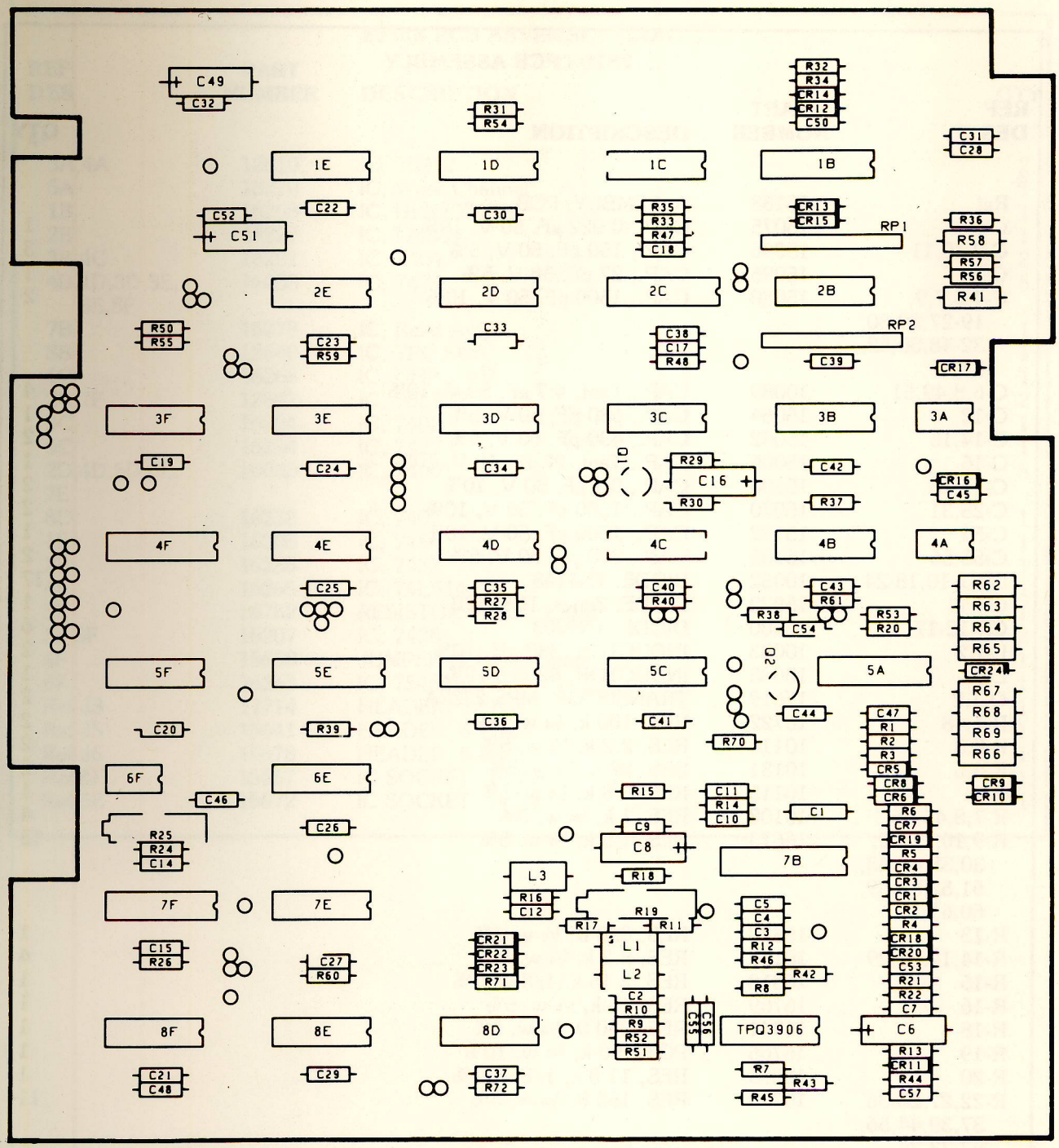


FIGURE 7-4. 25188 PCB ASSEMBLY

25188 PCB ASSEMBLY

REF DES	PART NUMBER	DESCRIPTION	QTY
4-			
Ref	25188	ASSEMBLY, PCB	
C-1	15075	CAP., 0.022 μF, 50 V, 10%	1
C-2,10,11	15096	CAP., 150 pF, 50 V, 5%	3
C-3	15095	CAP., 27 pF, 50 V, 5%	1
C-4,5,7,9, 19-27,29,30, 32-48,50,52, 53,57	15080	CAP., 1500 pF, 50 V, 10%	2
C-6,8,49,51	10089	CAP., Tant, 4.7 μF, 50 V, 10%	4
C-12	15064	CAP., 680 pF, 50 V, 5%	1
C-14,15	15062	CAP., 430 pF, 50 V, 5%	2
C-16	15006	CAP., Tant, 27 μF, 10 V, 10%	1
C-17,18	15106	CAP., 0.1 μF, 50 V, 10%	2
C-28,31	15070	CAP., 1500 pF, 50 V, 10%	2
C-54	15102	CAP., 1800 pF, 50 V, 10%	1
C-55,56	15105	CAP., 390 pF, 50 V, 5%	2
CR-1-10,18-24	10062	DIODE, 1N4148	17
CR-11	15922	DIODE, Zener, 1N5242B	1
CR-12-17	15900	DIODE, 1N4003	6
L-1,2	10083	INDUCTOR, 330 μH, 10%	2
L-3	10085	INDUCTOR, 62 μH, 10%	1
Q-1,2	17619	TRANSISTOR, MPS 2222A	2
R-1,48	16722	RES, 100 k, ¼ w, 5%	2
R-2,3	10118	RES, 2.2 k, ¼ w, 5%	2
R-4,5	10131	RES, 22 k, ¼ w, 5%	2
R-6	10115	RES, 6.8 k, ¼ w, 5%	1
R-7,8,45,46	10108	RES, 1 k, ¼ w, 5%	4
R-9,10,11,12, 30,38,42,43, 51,52,54,59, 60,61,72	16673	RES, 1.5 k, ¼ w, 5%	15
R-13	16878	RES, 820 Ω, ¼ w, 5%	1
R-14,17,21,29	10112	RES, 8.2 k, ¼ w, 5%	4
R-15	16818	RES, 2.15 k, 1/8 w, 1%	1
R-16	16769	RES, 15 k, ¼ w, 5%	1
R-18	16741	RES, 270 Ω, ¼ w, 5%	1
R-19	16766	POT., 50 k, ¾ w, 10%	1
R-20	16895	RES, 11.0 k, 1/8 w, 1%	1
R-22,27,28,36, 37,39,44,56, 57,73,74	16773	RES, 150 Ω, ¼ w, 5%	11
R-24	16896	RES, 14.0 k, 1/8 w, 1%	1
R-25	16729	POT, 5 k, ¾ w, 10%	1
R-26,47	16714	RES, 12 k, ¼ w, 5%	2
R-31,40,50,55	10111	RES, 4.7 k, ¼ w, 5%	4
R-32,33,34,35	16779	RES, 3.3 k, ¼ w, 5%	4
R-41	10126	RES, 75 Ω, ½ w, 5%	1
R-53	16897	RES, 71.5 k, 1/8 w, 1%	1
R-58	16819	RES, 24 Ω, ½ w, 5%	1
R-62-69	16880	RES, 1.1 k, ½ w, 5%	8
R-70	16755	RES, 750 Ω, ¼ w, 5%	1
R-71	16843	RES, 120 Ω, ¼ w, 5%	1
RP1,2	16810	RES, SIP, Custom	2

25188 PCB ASSEMBLY (CONT.)

REF DES	PART NUMBER	DESCRIPTION	QTY
4-			
3A,4A	12610	IC, 75462	2
5A	16270	IC, Write Channel	1
1B	16268	IC, ULN2074B	1
2B	16227	IC, LM339	1
3B,4C	16201	IC, 7404	2
4B,1D,3D,3E, 8E,8F	16203	IC, 7474	6
7B	16278	IC, Read Amp	1
8B	12640	IC, TPQ3906	1
1C	16268	IC, UHP - 407	1
2C,7F	12642	IC, 96LS02	2
3C	16204	IC, 7402	1
5C	16234	IC, 7427	1
2D,4D,5D,6E, 7E	10050	IC, 7400	5
8D	16232	IC, 7407	1
1E	16205	IC, 7486	1
2E	16235	IC, 7432	1
4E	16265	IC, 74LS14	1
5E	16752	RESISTOR PACK, 150 Ω	1
3F,5F	16207	IC, 7438	2
4F	15658	JUMPER BLOCK, Shunt	1
6F	16263	IC, 75453B	1
Ref-J3	17714	HEADER, 12 Pos.	1
Ref-J5	15641	HEADER, 6 Pos.	1
Ref-J6	15678	HEADER, 5 Pos.	1
Ref-4F	15657	IC SOCKET, 16 Pin	1
Ref-5E	15672	IC SOCKET, 14 Pin	1

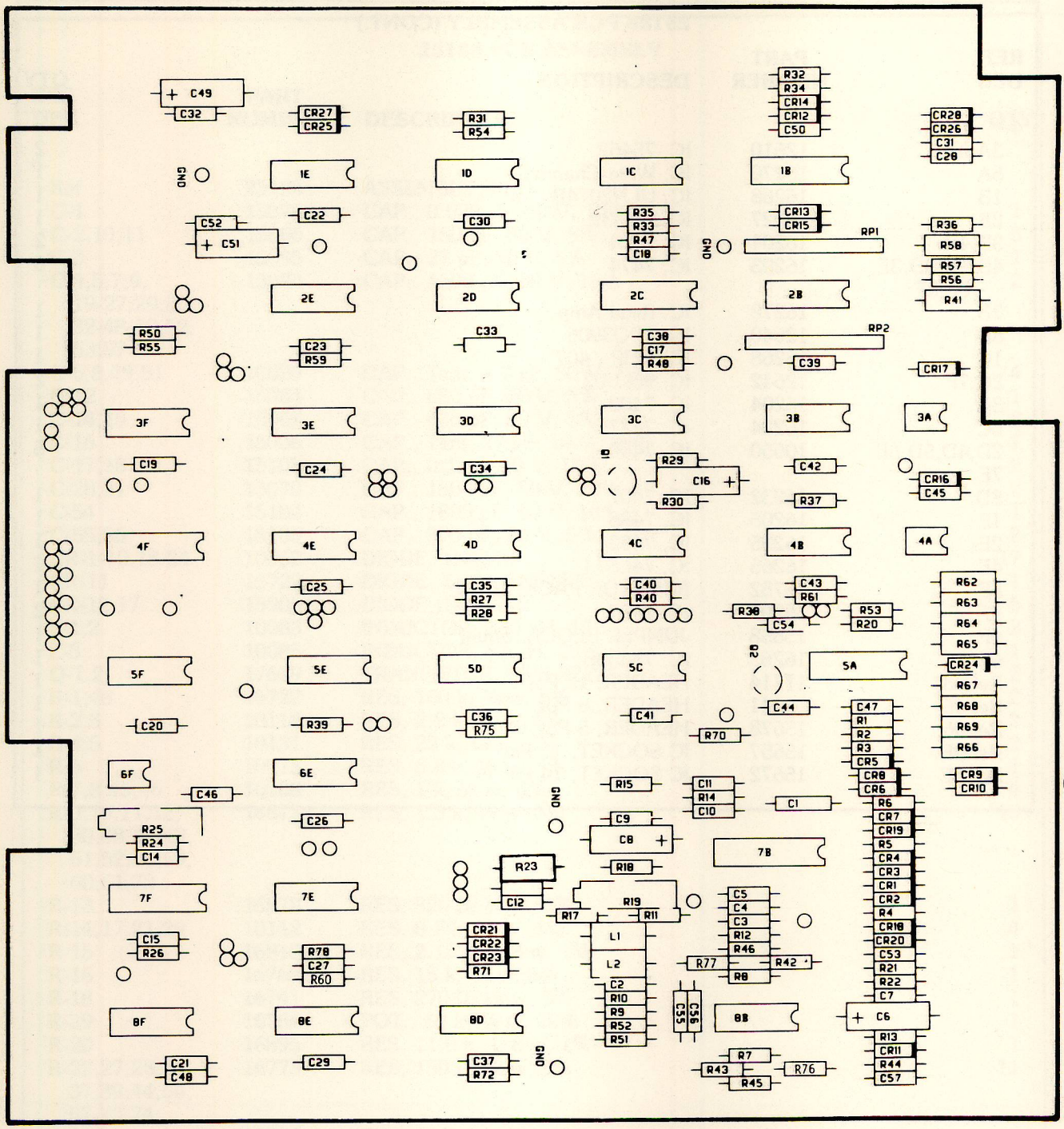


FIGURE 7-5. 25200 PCB ASSEMBLY

25200 PCB ASSEMBLY

REF DES	PART NUMBER	DESCRIPTION	QTY
5-			
Ref	25200	ASSEMBLY, PCB	
C-1	15075	CAP., 0.022 μF, 50 V, 10%	1
C-2	15115	CAP., 82 pF, 50 V, 5%	1
C-3,14,15	15062	CAP., 430 pF, 50 V, 5%	3
C-4,5,7,9, 19-27,29,30, 32-48,50,52, 53,57	15080	CAP., 0.1 μF, 50 V, +80-20%	36
C-6,8,49,51	10089	CAP., Tant, 4.7 μF, 50 V, 10%	4
C-10,11	15096	CAP., 150 pF, 50 V, 5%	2
C-12	15064	CAP., 680 pF, 50 V, 5%	1
C-17,18	15106	CAP., 0.1 μF, 50 V, 10%	2
C-28,31	15070	CAP., 1500 pF, 50 V, 10%	2
C-54	15102	CAP., 1800 pF, 50 V, 10%	1
C-55,56	15105	CAP., 390 pF, 50 V, 10%	2
C-1-10,18-24	10062	DIODE, 1N4148	17
CR-11	15922	DIODE, Zener, 1N5242B	1
CR-12-17,25-28	15900	DIODE, 1N4003	10
L-1,2	16312	INDUCTOR, 75 μH, 10%	2
Q-2	17619	TRANSISTOR, MPS 2222A	1
R-1,48	16722	RES, 100 k, ¼ w, 5%	2
R-2,3,11,12	10118	RES, 2.2 k, ¼ w, 5%	4
R-4,5	10131	RES, 22 k, ¼ w, 5%	2
R-6	10115	RES, 6.8 k, ¼ w, 5%	1
R-7,8	10108	RES, 1 k, ¼ w, 5%	2
R-9,10	16749	RES, 390 Ω, ¼ w, 5%	2
R-13	16878	RES, 820 Ω, ¼ w, 5%	1
R-14	16915	RES, 9.53 k, 1/8 w, 1%	1
R-15	16818	RES, 2.15 k, 1/8 w, 1%	1
R-17,21	10112	RES, 8.2 k, ¼ w, 5%	2
R-18	16838	RES, 330 Ω, ¼ w, 5%	1
R-19	16766	POT., 50 k, ¾ w, 10%	1
R-20	16895	RES, 11.0 k, 1/8 w, 1%	1
R-22,27,28,36, 37,39,44,56, 57,76,77	16777	RES, 150 Ω, ¼ w, 5%	11
R-23	16887	RES, 0 Ω	1
R-24	16896	RES, 14.0 k, 1/8 w, 1%	1
R-25	16729	POT, 5 k, ¾ w, 10%	1
R-26,47	16714	RES, 12 k, ¼ w, 5%	2
R-31,40,50,55	10111	RES, 4.7 k, ¼ w, 5%	4
R-32-35	16779	RES, 3.3 k, ¼ w, 5%	4
R-38,42,43,51, 52,54,59,60, 61,72,75,78	16773	RES, 1.5 k, ¼ w, 5%	12
R-41	10126	RES, 75 Ω, ½ w, 5%	1
R-45,46	16756	RES, 1.2 k, ¼ w, 5%	2
R-53	16897	RES, 71.5 k, 1/8 w, 1%	1
R-58	16819	RES, 24 Ω, ½ w, 5%	1
R-62-69	16880	RES, 1.1 k, ½ w, 5%	8
R-70	16755	RES, 750 Ω, ¼ w, 5%	1
R-71	16843	RES, 120 Ω, ¼ w, 5%	1
RP1,2	16920	RES, SIP, Custom, 10 Pin	2

25200 PCB ASSEMBLY (CONT.)

REF DES	PART NUMBER	DESCRIPTION	QTY
5-			
3A,4A	12610	IC, Peripheral Driver, 75462	2
5A	16270	IC, Write Channel	1
1B	16267	IC, ULN-2074B	1
2B	16227	IC, LM339	1
3B,4C	16201	IC, 7404	2
4B,1D,3D,3E, 8E,8F	16203	IC, 7474	6
7B	16278	IC, Read Amp	1
8B	12640	IC, TPQ-3906	1
1C	16268	IC, UHP-407	1
2C,7F	12642	IC, 96LS02	2
3C	16204	IC, 7402	1
5C	16234	IC, 7427	1
2D,4D,5D,6E, 7E	10050	IC, 7400	5
8D	16232	IC, 7407	1
1E	16205	IC, 7486	1
2E	16235	IC, 7432	1
4E	16265	IC, 74LS14	1
5E	16752	NETWORK, RES, 14 Pin, 150 Ω	1
3F,5F	16207	IC, 7438	2
4F	15658	SHUNT, Jumper Block	1
6F	16263	IC, 75453B	1
Ref-4F	15657	IC SOCKET, 16 Pin	1
Ref-5E	15672	IC SOCKET, 14 Pin	1
Ref-J3	17714	HEADER, 12 Pos.	1
Ref-J5	15641	HEADER, 6 Pos.	1
Ref-J6	15678	HEADER, 5 Pos.	1

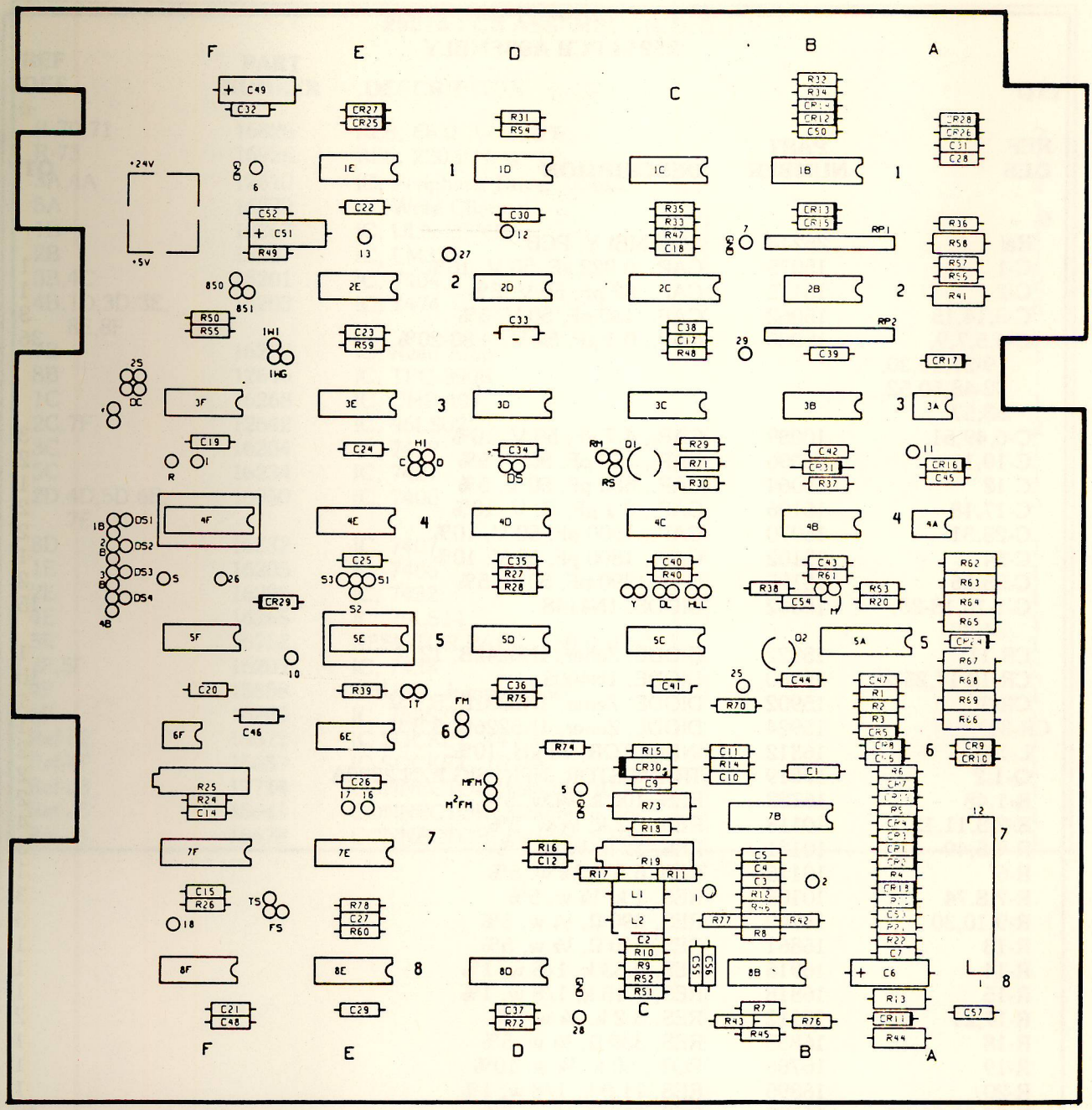


FIGURE 7-6. 25214 PCB ASSEMBLY

25214 PCB ASSEMBLY

REF DES	PART NUMBER	DESCRIPTION	QTY
6-			
Ref	25214	ASSEMBLY, PCB	
C-1	15075	CAP., 0.022 μF, 50 V, 10%	1
C-2	15115	CAP., 82 pF, 50 V, 5%	1
C-3,14,15	15062	CAP., 430 pF, 50 V, 5%	3
C-4,5,7,9, 19-27,29,30, 32-48,50,52, 53,57	15080	CAP., 0.1 μF, 50 V, +80-20%	36
C-6,49,51	10089	CAP., 4.7 μF, 50 V, 10%	3
C-10,11	15096	CAP., 150 pF, 50 V, 5%	2
C-12	15064	CAP., 680 pF, 50 V, 5%	1
C-17,18	15106	CAP., 0.1 μF, 50 V, 10%	2
C-28,31	15070	CAP., 1500 pF, 50 V, 10%	2
C-54	15102	CAP., 1800 pF, 50 V, 10%	1
C-55,56	15105	CAP., 390 pF, 50 V, 5%	2
C-1-10,18-20, 24,29	10062	DIODE, 1N4148	15
CR-11	15922	DIODE, Zener, 1N5242B, 12 V	1
CR-12-17,25-28	15900	DIODE, 1N4003	10
CR-30	15902	DIODE, Zener, 1N5231B, 5.1 V	1
CR-31	15924	DIODE, Zener, 1N5226B, 3.3 V	1
L-1,2	16312	INDUCTOR, 75 μH, 10%	2
Q-1,2	17619	TRANSISTOR, NPN, SIG P/N 2222A	2
R-1,48	16722	RES, 100 k, ¼ w, 5%	2
R-2,3,11,12	10118	RES, 2.2 k, ¼ w, 5%	4
R-4,5,49	10131	RES, 22 k, ¼ w, 5%	3
R-6	10115	RES, 6.8 k, ¼ w, 5%	1
R-7,8,74	10108	RES, 1 k, ¼ w, 5%	3
R-9,10,30	16749	RES, 390 Ω, ¼ w, 5%	3
R-13	16861	RES, 510 Ω, ½ w, 5%	1
R-14	16915	RES, 9.53 k, 1/8 w, 1%	1
R-15	16818	RES, 2.15 k, 1/8 w, 1%	1
R-17,21	10112	RES, 8.2 k, ¼ w, 5%	2
R-18	16838	RES, 330 Ω, ¼ w, 5%	1
R-19	16766	POT., 50 k, ¾ w, 10%	1
R-20	16895	RES, 11.0 k, 1/8 w, 1%	1
R-22,27,28,36, 37,39,56,57, 76,77	16777	RES, 150 Ω, ¼ w, 5%	10
R-24	16896	RES, 14.0 k, 1/8 w, 1%	1
R-25	16729	POT, 5 k, ¾ w, 10%	1
R-26,47	16714	RES, 12 k, ¼ w, 5%	2
R-29	16925	RES, 33 Ω, ¼ w, 5%	1
R-31,40,50,55	10111	RES, 4.7 k, ¼ w, 5%	4
R-32-35	16779	RES, 3.3 k, ¼ w, 5%	4
R-38,42,43,51, 52,54,59,60, 61,72,75,78	16773	RES, 1.5 k, ¼ w, 5%	12
R-41	10126	RES, 75 Ω, ¼ w, 5%	1
R-44	10130	RES, 150 Ω, ½ w, 5%	1
R-45,46	16756	RES, 1.2 k, ¼ w, 5%	2
R-53	16897	RES, 71.5 k, 1/8 w, 1%	1
R-58	16819	RES, 24 Ω, ½ w, 5%	1
R-62-69	16919	RES, 1.2 k, ½ w, 5%	8

25214 PCB ASSEMBLY (CONT.)

REF DES	PART NUMBER	DESCRIPTION	QTY
6-			
R-70,71	16826	RES, 68 Ω, ¼ w, 5%	2
R-73	16926	RES, 220 Ω, 3 w, 1%	1
3A,4A	12610	IC, Peripheral Driver, 75462	2
5A	16270	IC, Write Channel	1
1B	16267	IC, ULN-2074B	1
2B	16227	IC, LM339	1
3B,4C	16201	IC, 7404	2
4B,1D,3D,3E, 8E,8F	16203	IC, 7474	6
7B	16278	IC, Read Amp	1
8B	12640	IC, TPQ-3906	1
1C	16268	IC, UHP-407	1
2C,7F	12642	IC, 96LS02	2
3C	16204	IC, 7402	1
5C	16234	IC, 7427	1
2D,4D,5D,6E, 7E	10050	IC, 7400	5
8D	16232	IC, 7407	1
1E	16205	IC, 7486	1
2E	16235	IC, 7432	1
4E	16265	IC, 74LS14	1
5E	16752	RESISTOR PACK, 150 Ω (Dip)	1
3F,5F	16207	IC, 7438	2
4F	15658	SHUNT, Jumper Block	1
6F	16263	IC, 75453B	1
Ref-5E	15672	IC SOCKET, 14 Pin	1
Ref-4F	15657	IC SOCKET, 16 Pin	1
Ref-J3	17714	CONNECTOR, Header, 10 Post	1
Ref-J5	15641	CONNECTOR, Header, 6 Pos.	1
Ref-J6	15678	CONNECTOR, Header, 5 Pos.	1

TABLE 7-1. PART NUMBER TO FIGURE REFERENCE CROSS REFERENCE

Part Number	Fig. Ref.
10002	3-4
10050	4-8D
	5-2D
10013	1-14
10014	1-36
10025	1-44
10050	6-2D
10062	4-CR1
	5-CR1
	6-CR1
10083	4-L1
10085	4-L3
10089	4-C6
	5-C6
	6-C6
10108	4-R7
	5-R7
	6-R7
10111	4-R31
	5-R31
	6-R31
10112	4-R14
	5-R17
	6-R17
10115	4-R6
	5-R6
	6-R6
10118	4-R2
	5-R2
	6-R2
10126	4-R41
	5-R41
	6-R41
10130	6-R44
10131	4-R4
	5-R4
	6-R4
10187	2-16
10426	1-46
10801	1-31
10800	1-40
11305	1-7
11904	1-19
11905	1-2
12011	1-24
12013	1-4
	3-6
12015	1-11
	2-1
12016	2-13
12020	2-9
12026	1-33
	2-4
12027	1-17
12028	1-13
12032	1-5
12035	3-7
12036	1-37

Part Number	Fig. Ref.
12053	1-22
12509	1-43
12610	4-3A
	5-3A
	6-3A
12640	4-8B
	5-8B
12642	4-2C
	5-2C
	6-2C
15004	1-9
15006	4-C16
15062	4-C14
	5-C3
	6-C3
15064	4-C12
	5-C12
	6-C12
15070	4-C28
	5-C28
	6-C17
15075	4-C1
	5-C1
	6-C1
15080	4-C4
	5-C4
	6-C4
15095	4-C3
15096	4-C10
	5-C10
	6-C2
15102	4-C54
	5-C54
	6-C54
15105	4-C55
	5-C55
	6-C55
15106	4-C17
	5-C17
	6-12
15115	5-C2
	6-C2
15641	4-Ref J5
	5-Ref J5
	6-Ref J5
15657	4-Ref 4F
	5-Ref 4F
	6-Ref 4F
15658	4-4F
	5-4F
	6-4F
15669	1-12
15672	4-Ref 5E
	5-Ref 5E
	6-Ref 5E
15678	4-Ref J6
	5-Ref J6
	6-Ref J6

Part Number	Fig. Ref.
15900	4-CR12
	5-CR12
	6-CR12
15902	6-CR30
15924	6-CR31
15992	4-CR11
	5-CR11
	6-CR11
16201	4-3B
	5-3B
	6-3B
16203	4-4B
	5-4B
	6-4B
16204	4-3C
	5-3C
	6-3C
16205	4-1E
	5-1E
	6-1E
16207	4-3F
	5-3F
	6-3F
16227	4-2B
	5-2B
	6-2B
16232	4-8D
	5-8D
	6-8D
16234	4-5C
	5-5C
	6-5C
16235	4-2E
	5-2E
	6-2E
16240	6-8B
16263	4-6F
	5-6F
	6-6F
16265	4-4E
	5-4E
	6-4E
16267	4-1B
	5-1B
	6-1B
16268	4-1C
	5-1C
	6-1C
16270	4-5A
	5-5A
	6-5A
16278	4-7B
	5-7B
	6-7B
16312	5-L1
	6-L1

TABLE 7-1. PART NUMBER TO FIGURE REFERENCE CROSS REFERENCE (CONT.)

Part Number	Fig. Ref.
16714	4-R26
	5-R26
16722	4-R1
	5-R1
	6-R1
16729	4-R25
	5-R25
	6-R25
16741	4-R18
16749	5-R9
	6-R9
16752	4-5E
	5-5E
	6-5E
16755	4-R70
	5-R70
16756	5-R45
	6-R45
16766	5-R19
	6-R19
16769	4-R16
16773	4-R9
	5-R38
	6-R38
16766	4-R19
16777	5-R22
	6-R22
16779	4-R32
	5-R32
	6-R32
16810	4-RP1
16818	4-R15
	5-R15
	6-R15
16819	4-R58
	5-R58
	6-R19
16826	6-R70
16838	5-R18
	6-R18
16843	4-R71
	5-R71
16861	6-R13
16878	4-R13
	5-R13
16880	4-R62
	5-R62
16887	5-R23
16895	4-R20
	5-R20
16896	4-R24
	5-R24
	6-R24
16897	4-R53
	5-R53
	6-R53
16915	5-R14
	6-R14
16919	6-R62
16920	5-RP1
16926	6-R73
17200	1-32
17619	4-Q1
	5-Q2
	6-Q1
25188	4-Ref
25200	5-Ref
25216	6-Ref
17714	4-Ref J3
	5-Ref J3
	6-Ref J3
50016	1-42
50019	1-41
50031	1-11
50138	3-3
50142	1-1
50151	2-15
50166	1-38
50167	1-29
50168	1-29
50183	3-8
50254	2-12
50313	2-3
50349	3-2
50355	1-45
50356	1-45
50357	1-16
50358	1-16
50546	2-10
50555	2-6
50559	1-6
50583	1-27
50587	3-1
50609	2-7
50667	3-2
50691	3-5
50744	1-18
50745	1-18
50746	1-10
50747	1-8
50748	1-9
51027	1-21
51028	1-34
51029	2-14
51037	3-Ref
51043	3-Ref
51061	2-2
51046	1-35
51062	2-8
51127	1-15
51134	1-26
	2-Ref
51176	2-5
51194	1-25
51198	1-30
51203	1-23
51205	1-28
51231	1-39

39018-47

7.4 RECOMMENDED SPARE PARTS STOCKING GUIDE

The spare parts stocking guide is broken down into three levels. These levels are Site or Field Support Engineer (level 1), Branch Office (level 2), and Depot or Headquarters (level 3). The quantities assume that Site is replenished by the Branch immediately, and Branch replenished by the Depot within 30 days.

The inventories that the levels can maintain are:

Site	1 to 20 machines
Branch	1 to 100 machines
Depot	
Depot only parts	Unlimited
Branch replenishment	Same as Branch ratio

Table 7-2 shows the spare parts required to support the 850/851 BC diskette drive in the field.

TABLE 7-2. SPARE PARTS STOCKING GUIDE

PART NUMBER	DESCRIPTION	QUANTITY PER LEVEL		
		SITE	BRANCH	DEPOT**
10800	BEARING, Spindle	1	3	3
10801	BEARING, Flanged Spindle	1	3	3
15004	CAPACITOR, Motor		1	1
17200	SWITCH, Door Closed	1	1	1
25189*	PCB, 850	1	4	4
25190*	PCB, 851	1	4	4
25201*	PCB, 850	1	4	4
25202*	PCB, 851	1	4	4
25215*	PCB, 850	1	4	4
25216*	PCB, 851	1	4	4
50016	PULLEY, Spindle			1
50019	SPACER, Spindle Short			1
50142	HANDLE		1	1
50151	LATCH PLATE			1
50166	SPRING, Spindle			2
50254	HUB CLAMP ASM		2	2
50313	WRITE PROTECT ASM	1	2	2
50349	FRONT PLATE (STANDARD)			1
50355*	BELT (50 HZ)	1	3	3
50356*	BELT (60 HZ)	1	3	3
50357*	PULLEY MOTOR (50 HZ)			1
50358*	PULLEY MOTOR (60 HZ)			1
50555	SPRING, Ejector Clamp		1	1
50609	EJECTOR ASM		1	1
50667	FRONT PLATE (Rack)			1
50691	SPRING, Latch Interlock		2	2
50747*	MOTOR (115 V), With Capacitor		1	1
50748*	MOTOR (208/220/230 V, 50/60 Hz), With Capacitor		1	1
50746	BRACKET, Cap			1
51027	TK00 DETECTOR ASM	1	1	1
51029	LED ASM		2	2
51038	LATCH ASM		1	1
51046	PHOTO DET ASM	1	2	2
51061	STRIPPER, Top			1
51062	STRIPPER, Bottom			1
51127	HEAD/ACTUATOR ASM		2	2
51176	HEAD LOAD ASM		1	1
51198	SPINDLE, Machined			1
51203	GUIDE OPEN ASM		1	1
51231	SPACER, Spindle Long			1

*Stock item which reflects the machine installed.

**Depot parts listed are only unique to the depot. Stocking levels to back up Branch stocks should be added.

39018-45

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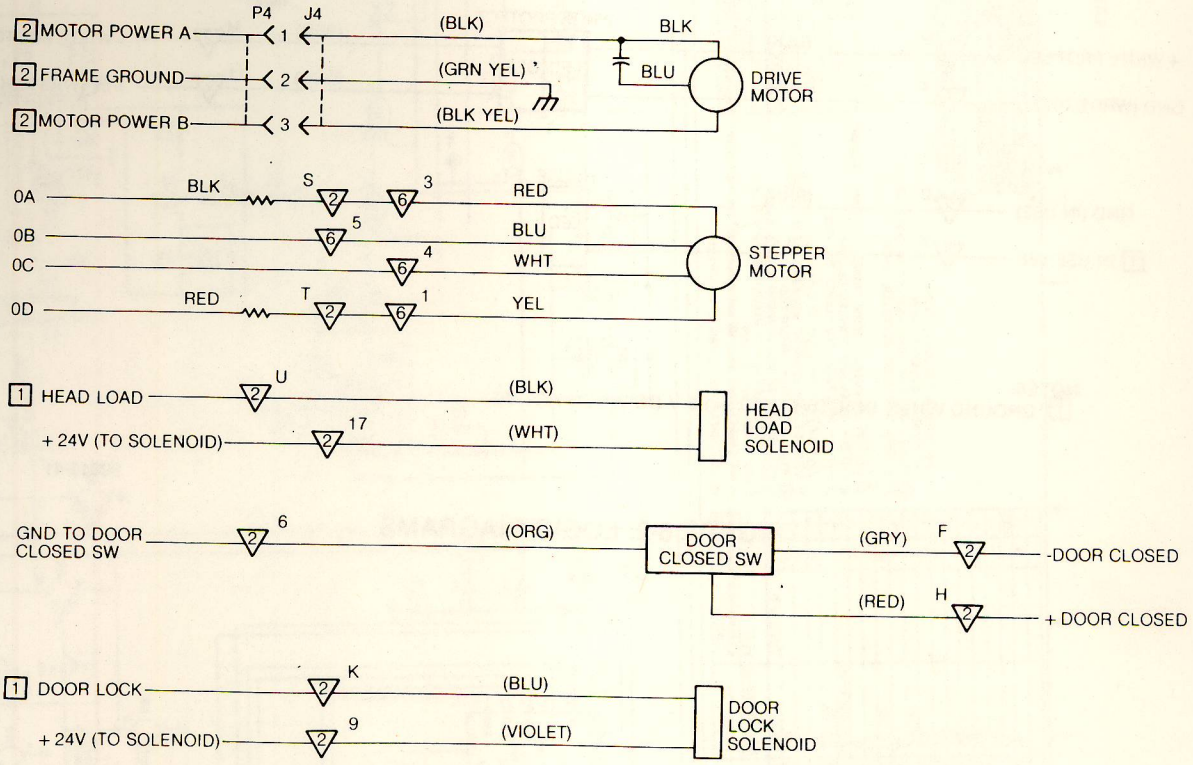
SECTION VI
SCHEMATIC DIAGRAMS

The following diagrams are furnished as an aid to tracing signal flow.



NOTES:
[1] GROUND WHEN ACTIVE AND + 24 WHEN INACTIVE.
[2] 115 OR 230 V AC.

39018-40

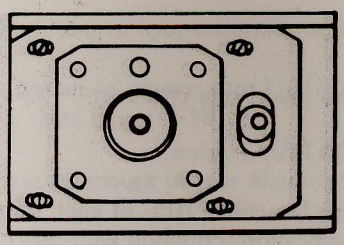
FIGURE 6-1. LOGIC DIAGRAMS

j. Move plate by rotating eccentric adjusting nut.

k. When lobes are of equal amplitude, tighten motor plate mounting screws (see figure 5-20).

l. Check adjustment by stepping off track and returning. Check in both directions and readjust as required.

m. Whenever head radial alignment is adjusted, track 00 alignment must be checked (paragraph 5.5.9).



39018-36

FIGURE 5-20. MOTOR PLATE

5.5.7 Read/Write Heads Azimuth Check

NOTE

Azimuth is not field adjustable. If after performing check waveform on oscilloscope is not within ± 18 minutes, replace the Head Actuator Assembly.

a. Install SA122 alignment diskette. Alignment diskette should be at room temperature for at least 1 hour prior to alignment check.

b. Select drive and step to track 76.

c. Sync scope external negative on TP12. Set time base to 0.5 Msec per division.

d. Connect one probe to TP1 and other to TP2. Invert one channel and ground probes to TP5 and 6. Set inputs to AC, ADD, and 50 MV per division.

e. Compare waveform on sides 0 and 1 to figure 5-21. If not within range shown, replace Head Actuator Assembly (paragraph 5.6.10).

5.5.8 Track 00/76 Stop Adjustment

Not field adjustable.

5.5.9 Track 00 Detector Assembly Adjustment

a. Check head radial alignment and adjust (if necessary) before making this adjustment (paragraph 5.5.6).

b. Insert diskette.

c. Connect oscilloscope to TP26. Set vertical deflection of 1 V/division and sweep to continuous.

d. Step carriage to track 02. TP26 should go low; if not, adjust detector assembly towards actuator assembly.

e. Check adjustment by stepping heads between tracks 00 and 02. Observe TP26 is low at track 02 and high at track 00. Square wave on scope indicates perfect adjustment.