MEMOREX

550/552 Flexible Disc Drive
Technical Manual

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PREFACE

This manual describes typical physical and signal characteristics of the Memorex 550 (single-head) Flexible Disc Drive and the double capacity version, 552 (dual-head) Flexible Disc Drive.

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SECTION 1
GENERAL DESCRIPTION

1.1 GENERAL INFORMATION

The 550/552 Flexible Disc Drive is a low-cost magnetic recording and playback device which is capable of using the single- or the two-sided Memorex Markette® recording media or competitive equivalents (e.g., IBM). The 552 is a double-head version of the Memorex 550 single-head drive. The 552 drive can record in single- or double-density format on either side of the recording media. Media is interchangeable between IBM 4964 two-sided drives when recorded in accordance with IBM document GP21-9257-1. The 550 Flexible Disc Drive can read and write with discs that are interchangeable with other 550 Flexible Disc drives; IBM 3741, 3742, or 3540; and with the IBM System 32 when recorded in accordance with IBM OEMI Manual GA21-9190-3.

Significant features of the 550/552 are its selective AC power requirements for both domestic and international markets, the choice of black or white front bezel with or without a File Busy lamp, soft or hard sector, and the optional features of Write Protect Detection and Program-Controlled Door Lock. Also, the 552 features dual index sensors which enable detection of whether a single- or double-sided disc has been inserted.

The 550/552 is smaller and more compact than other Memorex flexible disc drives. It will fit into the standard EIA 19-inch rack in pairs if mounted horizontally or in groups of four drives if mounted vertically. See Figure 1-1 for mounting and orientation information.

Refer to Figure 1-2 for the technical description that follows. The 552 has two ceramic read/write heads mounted in a carriage that can be positioned to any one of 77 tracks. The 552 dual heads are loaded simultaneously on both sides of the diskette, and provide excellent compliance between media and read/write head with corresponding maximum media durability. The 550/552 is capable of transferring data to and from an external controller at rates of 250,000 bits per second for single-density (FM) recording or 500,000 bits per second for double-density (MFM/MMFM) recording.

The 550/552 differs from existing drives in several ways. The base is compression-molded, fiberglass-reinforced, thermosetting polyester. The head loading and disc clamping mechanisms are unique. Interlocks prevent the operator from closing the door if a flexible disc has only been partially inserted, thus eliminating possible media damage by the operator. When the door is opened, the flexible disc is partially ejected for easy removal by the operator.

The carriage positioning device consists of a three-phase, size 20, variable-reluctance stepper motor which, in conjunction with a lead screw, positions the read/write head. The stepper motor rotates the lead screw clockwise or counterclockwise in 15-degree increments, causing the heads to move from one track to another at a maximum step rate of 3 milliseconds (552) or 6 milliseconds (550). The lead screw is supported by an outboard bearing. The carriage is prohibited from rotating by a unique spring-loaded saddle bearing in the carriage. Backlash is removed by a self-lubricating, anti-backlash device which acts radially, rather than longitudinally, along the screw to reduce the offtrack effect of wear. A factory-set, permanent azimuth alignment is provided for the pole tip of each drive.

A synchronous motor is used to rotate the disc and to provide power for driving an axial flow fan. The motor speed is reduced by a belt and pulley arrangement to drive the media at 360 rpm.

The 550/552 incorporates several solid-state sensors to (1) detect Index/Sector holes, (2) locate Track 00 under the read/write head, (3) switch write current from a high write current for the outer 44 tracks to a low write current for the 33 inner tracks, and (4) determine if an inserted media has been write protected.

The Head Flexure Assembly is designed for installation into the carriage for media full life interchange with IBM Series 43 FD disc storage units. In operation, the heads record a track which is nominally 0.013-inch wide at a radial density of 48 tracks per inch. Two 0.006-inch wide erased guard bands lie on either side of the data track. This data-free band allows high reliability in media interchange. In normal operation, the 552's two heads

BLANK

gently load the recording media in such a manner that each head acts as a head-media interface force for the other, thus ensuring optimum media contact.

The 550 head loading is achieved by employing a pressure pad mounted on an arm that pivots on the carriage. Force is provided by a spring and the head is loaded by energizing a solenoid. The movement of a bail actuated by the solenoid permits the pressure pad to contact the disc and urge it gently against the head. De-energizing the solenoid moves the pressure pad away from the disc.

The 550/552 drive status, control, and read/write circuits are packaged on one printed circuit board (PCB) which can be interfaced from a 50-pin I/O connector.

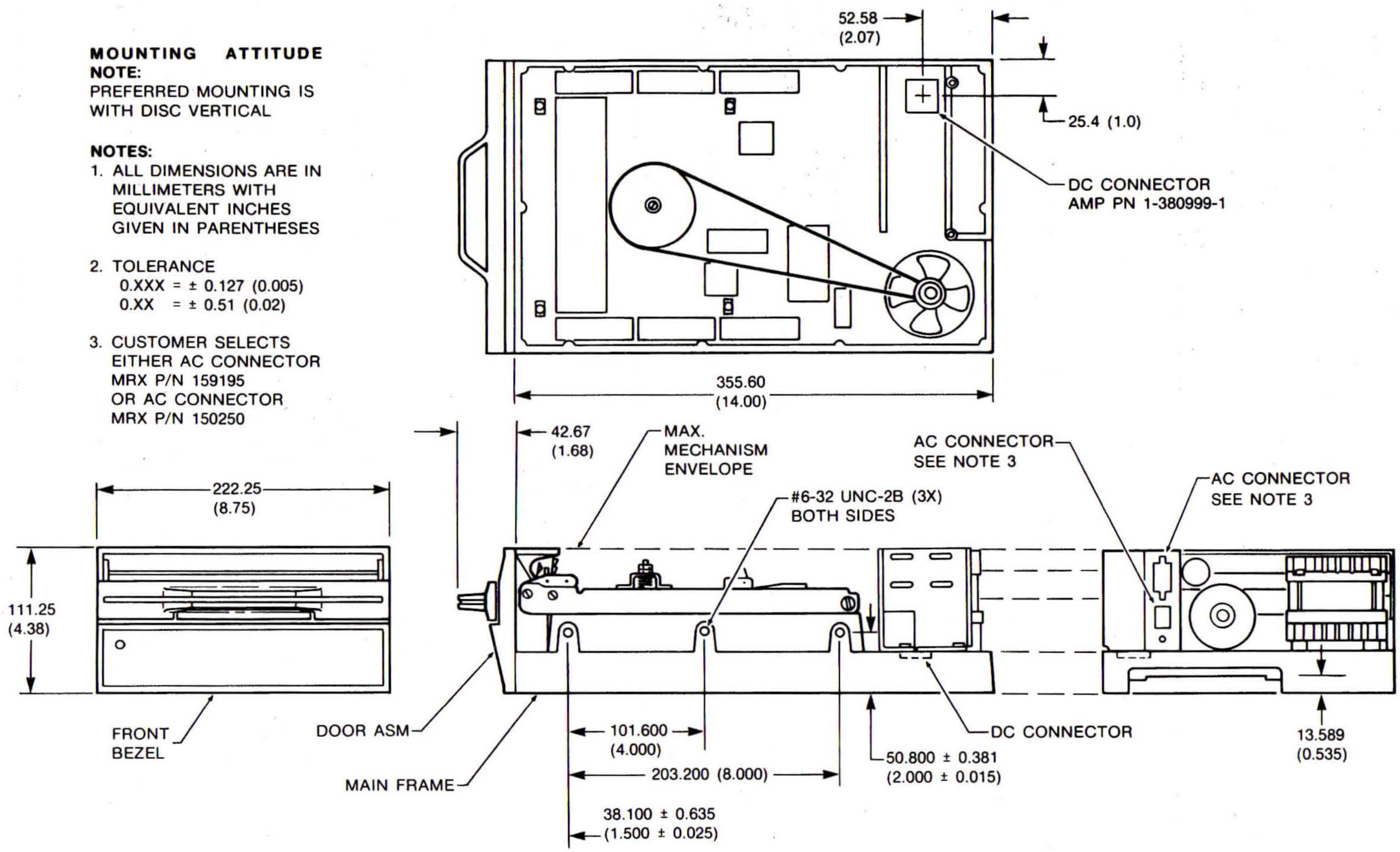


FIGURE 1-1. 550/552 FLEXIBLE DISC DRIVE MOUNTING AND AC PLUG INFORMATION

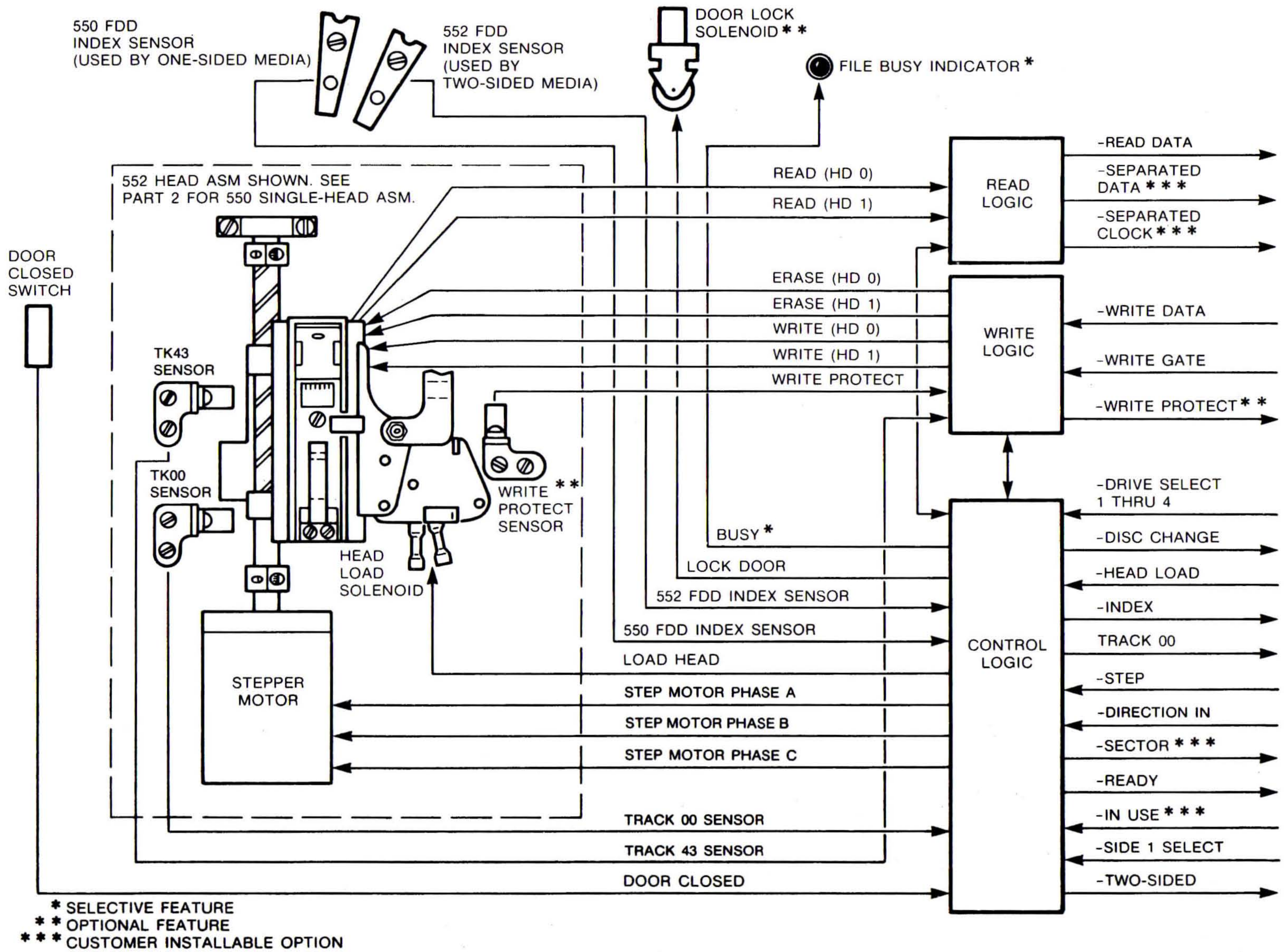


FIGURE 1-2. 550/552 FLEXIBLE DISC DRIVE FUNCTIONAL DIAGRAM (Part 1 of 2)

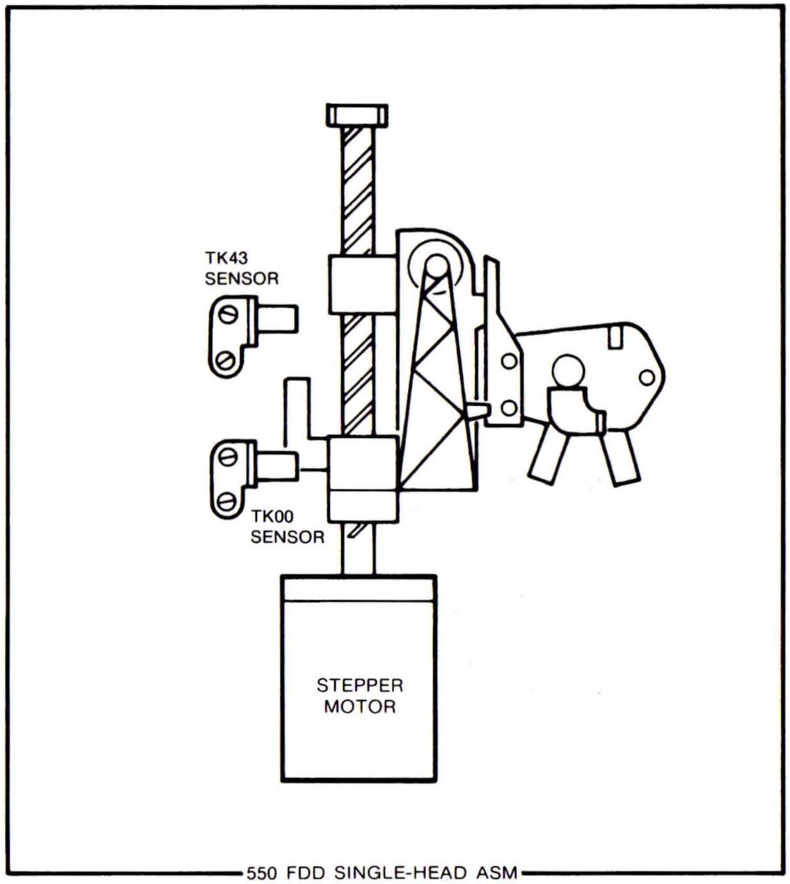


FIGURE 1-2. 550/552 FLEXIBLE DISC DRIVE FUNCTIONAL DIAGRAM (Part 2 of 2)

1.2 SUMMARY OF PERFORMANCE SPECIFICATIONS

	Single Density	Double Density
Capacity (kilobytes):		
Unformatted		
Two Sides (552 FDD)	800.0	1600.0
One Side (550 FDD)	400.0	800.0
One Track	5.2	10.4
IBM Format (128-byte sectors)		
Two Sides (552 FDD)	500.0	1000.0
One Side (550 FDD)	250.0	500.0
One Track	3.3	6.7
Transfer Rate (kilobits/second):	250	500
Latency (average, milliseconds):	83	83
Access Time (milliseconds):		
Track-to-Track (552)	3	3
Track-to-Track (550)	6	6
Average (including settle)	91	91
Settling Time	15	15
Head Load Time	35	35

1.3 SUMMARY OF FUNCTIONAL SPECIFICATIONS

	Single Density	Double Density
Rotational Speed	360 rpm	360 rpm
Recording Density Side 0, Track 76	3269.98 bpi	6539.96 bpi
Recording Density Side 1, Track 76 (552 FDD)	3410.25 bpi	6820.51 bpi
Track Density	48 tpi	48 tpi
Number of Tracks:		
550 FDD	77	77
552 FDD	154	154
Number of Heads:		
550 FDD	1	1
552 FDD	2	2
Encoding Format	FM	MFM/MMFM
Alignment Disc	Dysan 360/2	Dysan 360/2

Media Requirement

Product Family	Product Description	Part Number	Data Capacity (In Kilobytes)
Markette 1s	IBM Compatible (128 bytes/sector)	32013060	246
	IBM Compatible (128 bytes/sector) w/write protect	32013062	246
	IBM Compatible (128 bytes/sector) w/hub ring	32013064	246
	IBM Compatible Sys. 6 (512 bytes/sector)	32013066	303
	IBM Compatible (256 bytes/sector)	32013109	284
	IBM Compatible (512 bytes/sector)	32013110	303
	*32 Hard Sector	32013015	400
Markette 1d	IBM Compatible (128 bytes/sector)	32013090	246
	32 Hard Sector	32013091	800

Product Family	Product Description	Part Number	Data Capacity (In Kilobytes)
Markette 2s	Soft Sector (256 bytes/sector)	32013106	568
	Soft Sector (512 bytes/sector)	32013107	606
	*32 Hard Sector	32013108	800
Markette 2d	*Soft Sector (Unformatted)	32013102	1600
	Soft Sector (246 bytes/sector)	32013103	985
	Soft Sector (512 bytes/sector)	32013114	1098
	Soft Sector (1024 bytes/sector)	32013104	1212
	*32 Hard Sector	32013105	1600

*Unformatted

1.4 SUMMARY OF PHYSICAL SPECIFICATIONS

Environmental Limits
- Ambient Temperature = 10 to 38°C (50 to 105°F)
- Relative Humidity = 20 to 80%
- Maximum Wet Bulb = 25°C (78°F)

AC Power Requirements
- 50/60 ± 0.5 Hz
- 110/115 VAC Installations = 93 to 137 VAC at 0.35 Amps RMS typical
- 220/230 VAC Installations = 187 to 253 VAC at 0.20 Amps RMS typical

DC Power Requirements
- +24 VDC ±10% at 1.3 Amps typical
- + 5 VDC ± 5% at 0.8 Amps typical
- − 7 VDC to −16 VDC at 0.07 Amps typical
- − 5 VDC ± 5% at 0.05 Amps typical (customer-selectable option)

Mechanical Dimensions
- Height = 22.23 cm (8.75 inches)
- Width = 11.13 cm (4.38 inches)
- Depth = 35.56 cm (14.00 inches)
- Weight = 4.73 kg (10.70 pounds)
- Bezel/Door Clearance = 4.27 cm (1.68 inches)

Heat Dissipation
- 57 watts (195 BTU/hr. typical)

1.5 SUMMARY OF RELIABILITY SPECIFICATIONS

MTBF:	5000 power-on hours (heavy usage) 9000 power-on hours (typical usage)
MTTR:	30 minutes
Component Life:	15,000 power-on hours
Error Rates:	
Soft Read Error	1×10^{9} consecutive bits read
Hard Read Error	1×10^{12} consecutive bits read
Seek Errors	1×10^{6} seeks
Media Durability:	
Passes per Track	5×10^{6}
Media Insertions	30,000+
Head Loads	40,000 (distributed)

SECTION 2
FUNCTIONAL OPERATION

The 550/552 Flexible Disc Drive consists of electronic, mechanical, and transducer elements which perform the following operations:

1. AC and DC power-on sequencing
2. Drive selection
3. Track accessing
4. Side selection
5. Read operations
6. Write operations

The listed operations are detailed in the paragraphs that follow.

2.1 AC AND DC POWER-ON SEQUENCING

Before any valid read, write, or seek operations may be performed, the 550/552 must be fully powered up. Power-up is initiated when both the AC and the DC power have been switched on. The order in which the AC and the DC power are enabled is not crucial; however, both AC and DC power experience a delay between the time that they are switched on and the time that they are fully active. The delay for AC power is 2 seconds and for DC power, 90 milliseconds. Once the delay periods have been accounted for, power-up may be considered complete. Any data produced before the delay periods for AC and DC power enabling have elapsed is invalid.

2.2 DRIVE SELECTION

Drive selection occurs after AC and DC power-on sequencing has been completed; a drive is selected when one of the four jumper plug terminals has been jumpered and the corresponding drive select line becomes active. In a standard configuration, drive selection results in the following:

1. Read/Write heads are loaded.
2. I/O lines are enabled.
3. Busy LED lamp is lit (selective feature).
4. Door is locked (optional feature).

2.3 TRACK ACCESSING

When power is initially applied to the drive and the AC and DC power delays have elapsed, the first track access operation may be performed. The initial operation consists of an access to track 00 requested by the external controller. The initial access allows the controller to establish the position of the read/write head.

A read/write head moves from one track to an adjacent track as a result of the following sequence (see Figure 2-1).

1. The associated Drive Select line is activated.
2. The In/Out direction is selected.
3. The Step Input line is pulsed once for each desired track-to-track head movement. (The Write Gate line must be inactive during the course of any track access operation).

Track accessing operations are performed through a combination of logical circuitry and the 550/552 stepper motor, a 24-volt, three-phase, variable-reluctance step motor with 15-degree/step increments. The stepper motor includes twelve stator windings at 30-degree intervals and a rotor with eight teeth at 45-degree intervals. The twelve stator windings are wired in groups of four at 90-degree intervals. The three stepper motor phase inputs STEP MOTOR PHASE A, STEP MOTOR PHASE B, and STEP MOTOR PHASE C, are wired to the three groups of four stator windings. When applied to one of the phase inputs, a 24-VDC level causes the four rotor teeth closest to the energized stator windings to rotate until teeth and windings are aligned as illustrated in Figure 2-2.

The order in which the stepper motor receives the phase inputs determines the direction of the track access. If the phase windings are pulsed in sequential order (i.e., STEP MOTOR PHASE A, STEP MOTOR PHASE B, STEP MOTOR PHASE C, STEP MOTOR PHASE A, etc.), the head moves inward from the track currently accessed to the desired track. If the phase windings are pulsed in the opposite order (i.e., STEP MOTOR PHASE A, STEP MOTOR PHASE C, STEP MOTOR PHASE B, STEP MOTOR PHASE A, etc.), the head moves outward from the track currently accessed to the desired track. The phase sequence is illustrated in Figure 2-3.

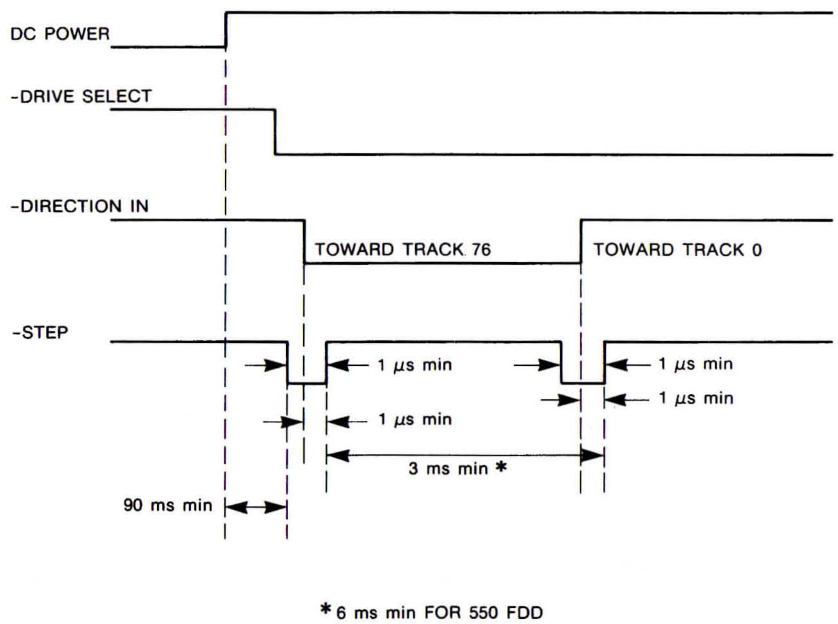


FIGURE 2-1. TRACK ACCESS TIMING

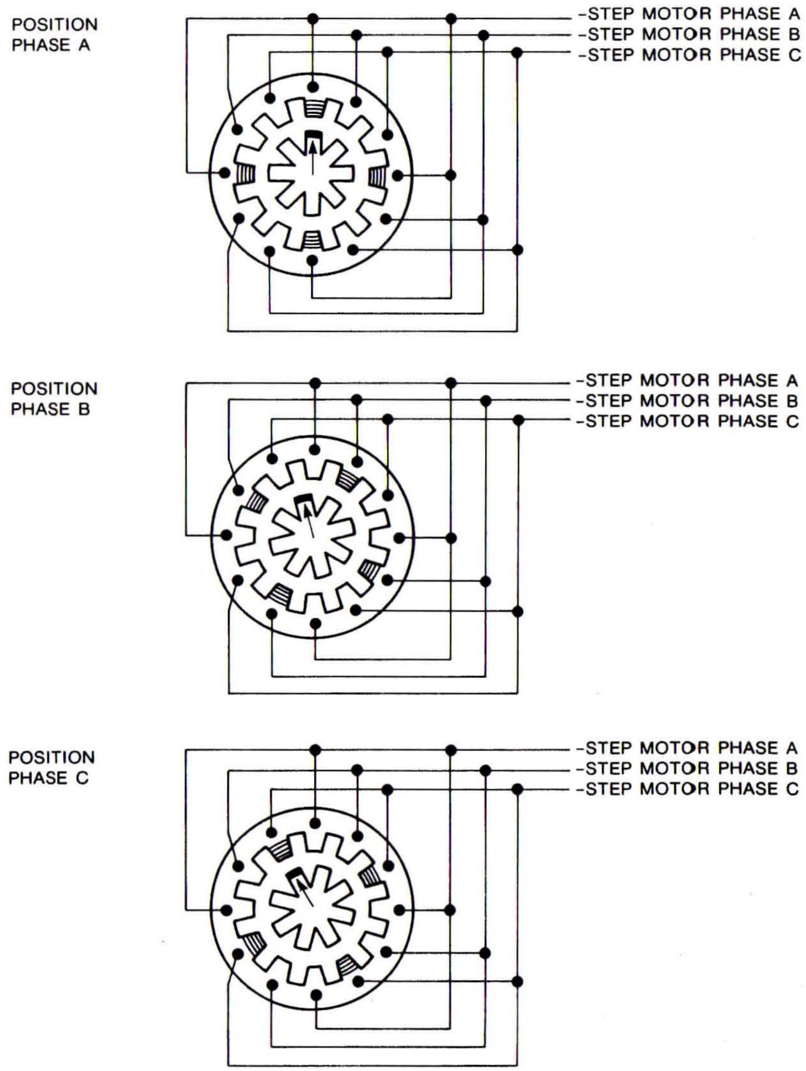


FIGURE 2-2. STEPPER MOTOR PHASE WINDINGS

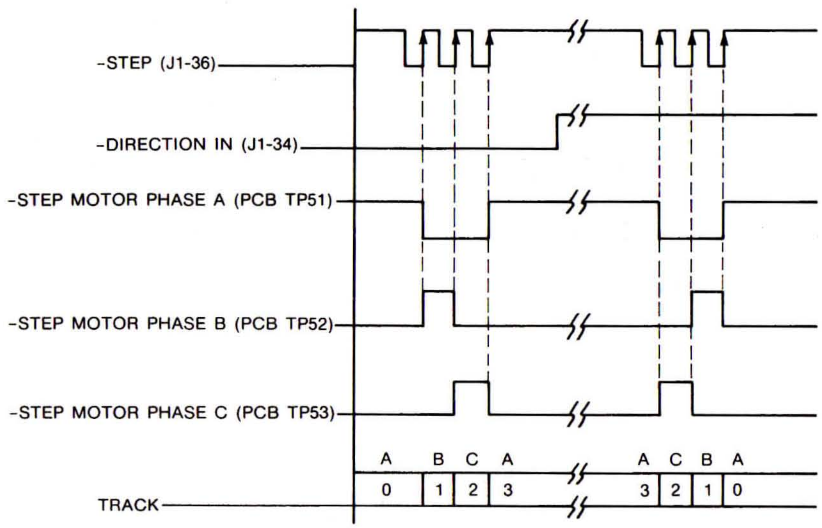


FIGURE 2-3. STEPPER MOTOR PHASE SEQUENCE

The logical circuitry that performs the track access operations consists of a group of latches activated in a specified sequence. The activation sequence is described in the following paragraphs (see Figures 2-4 and 2-5).

When power is initially applied to the PCB, the Power Up Reset latch is set for a period of at least 90 milliseconds while the DC power-up delay elapses. The Step Sync, Step Flag, Clock Active, and Direction In latches remain reset until the Power On Reset circuit is reset. In addition, the Clock Active latch, while reset, forces the one-third millisecond Clock Generator to remain reset until the first step pulse is received.

If the Drive Select latch is set and no write operation has been initiated, the first step pulse (1-microsecond pulse width minimum) causes the Step Sync latch to be asynchronously set. As a result of the Step Sync latch set state, the Clock Active latch is asynchronously set, thereby releasing the one-third millisecond Clock Generator which runs until the Clock Active latch is reset.

The first rising edge of the Clock Driver output pulses the clock input of the Step Flag latch and the Clock Active latch. The logic 1 level output from the Step Sync latch is forwarded to the Step Flag latch and the time counter, causing the counter to increase the 0 count currently stored to a 1 count. In addition, the Mode and Phase Registers are updated. As a result of the Step Flag latch set state, the Step Sync latch is asynchronously set and the set level input to the Clock Active latch is removed. The logic 1 level at the Step Flag latch D input is removed, allowing the rising edge of the next one-third millisecond Clock Driver output to forward a logical 0 to the Step Flag latch. The ROM output is consequently required to maintain a logic 1 level input to the Clock Active latch D input.

Throughout the period that the Clock Active latch D input remains at the logic 1 level, each one-third millisecond Clock Drive pulse causes the latch to remain set and the one-third millisecond Clock Generator continues the production of pulses. The one-third millisecond Clock Generator runs until the Step Flag latch ceases to be set, the Mode Register is reset (Hold Mode), and the present time binary value in the Counter is 0001. The Hold Mode (standby) is the starting and ending state of the motor drive circuitry.

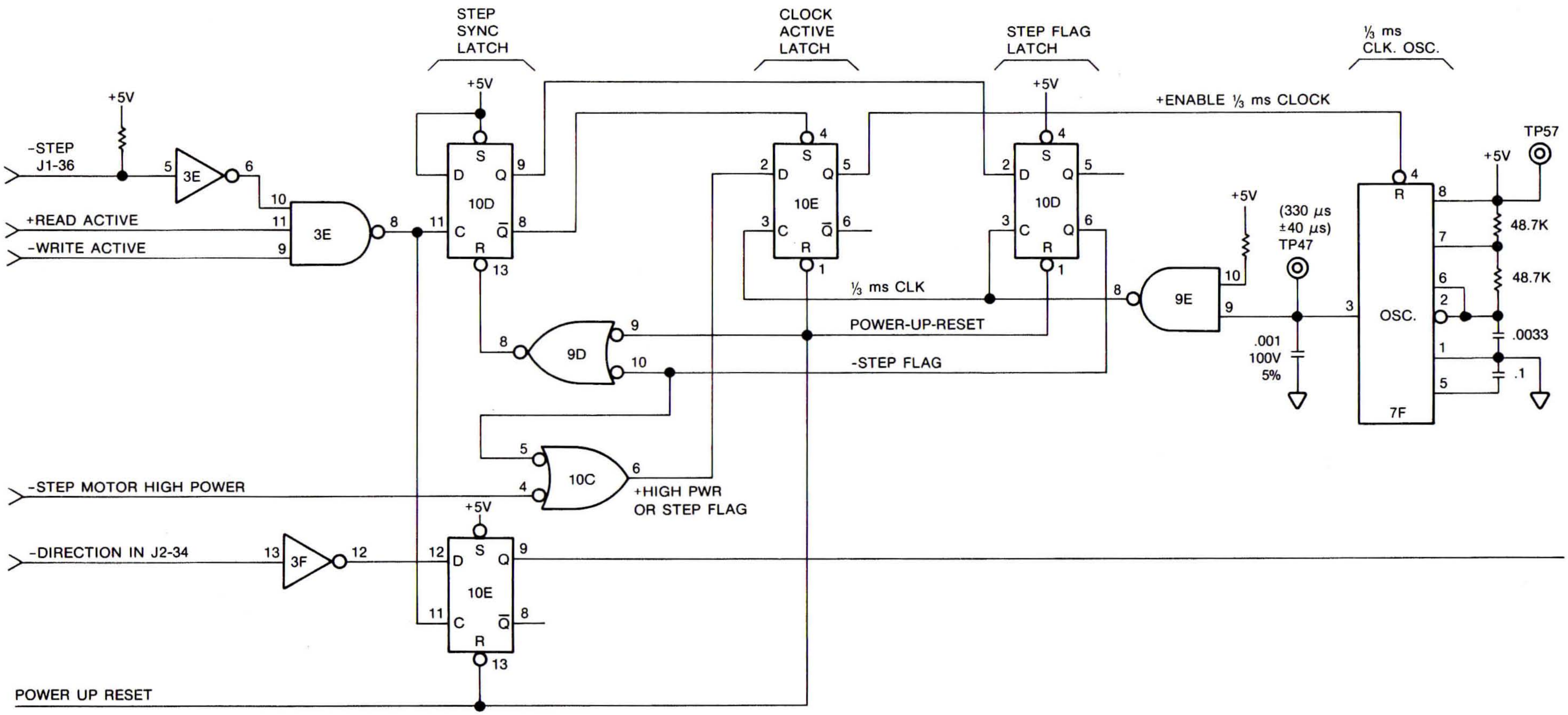


FIGURE 2-4. STEPPER MOTOR CIRCUITRY

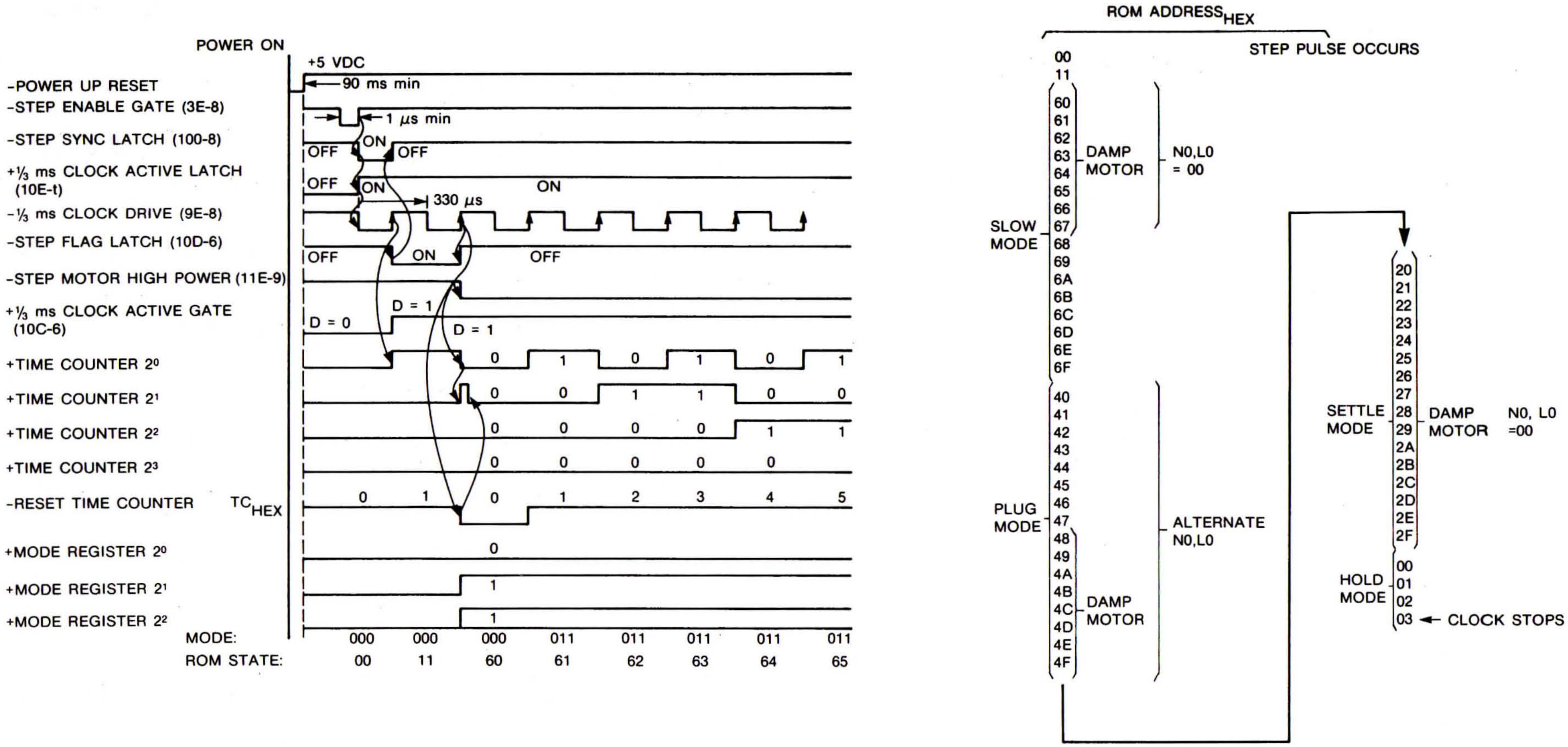


FIGURE 2-5. STEP SYNCHRONIZATION TIMING AND ONE STEP ROM SEQUENCE

2.4 SIDE SELECTION

The 552 Flexible Disc Drive has two read/write heads offset radially by 2.12 millimetres (0.0833 inch) which are selected via the Side 1 Select input line. All changes in read/write head selection preceded read or write operations by a minimum of 100 microseconds. Refer to Figure 2-6 for an illustration of the signal timing involved in side selection.

2.5 READ OPERATION

The 550/552 Flexible Disc Drive reads data via the following sequence of operations.

1. The desired drive is selected. When the drive is selected, the heads are loaded. A 35-millisecond delay necessary to account for head load settle time occurs before read procedures may be initiated.

2. The desired read/write head is selected.

3. The Write Gate line is inactive during the ensuing track access operation.

4. The head accesses to the desired track position. The time delay for a track access operation may be calculated by multiplying the number of tracks crossed during the course of the access by 3 milliseconds for 552 FFD (6 milliseconds for 550 FDD) to determine the minimum track-to-track positioning time. A 15-millisecond delay for head settle time is added to the minimum track-to-track positioning time to yield the total access time.

Once gathered, the read data is forwarded to the external controller that requested the read operation. The external controller separates the data and clock information, then decodes the data. Refer to Figure 2-7 for the signal timing of the read operation.

If the data to be read is formatted for single density (FM), the customer may utilize the data and clock separator provided in the 550/552 Drive circuitry. To activate this option, PCB terminal posts FS must be jumper plugged when the FM format has no missing clock pulses in the address mark field; PCB terminal posts TS must be jumper plugged when the FM format has three missing clock pulses in the address mark field (for example, IBM format).

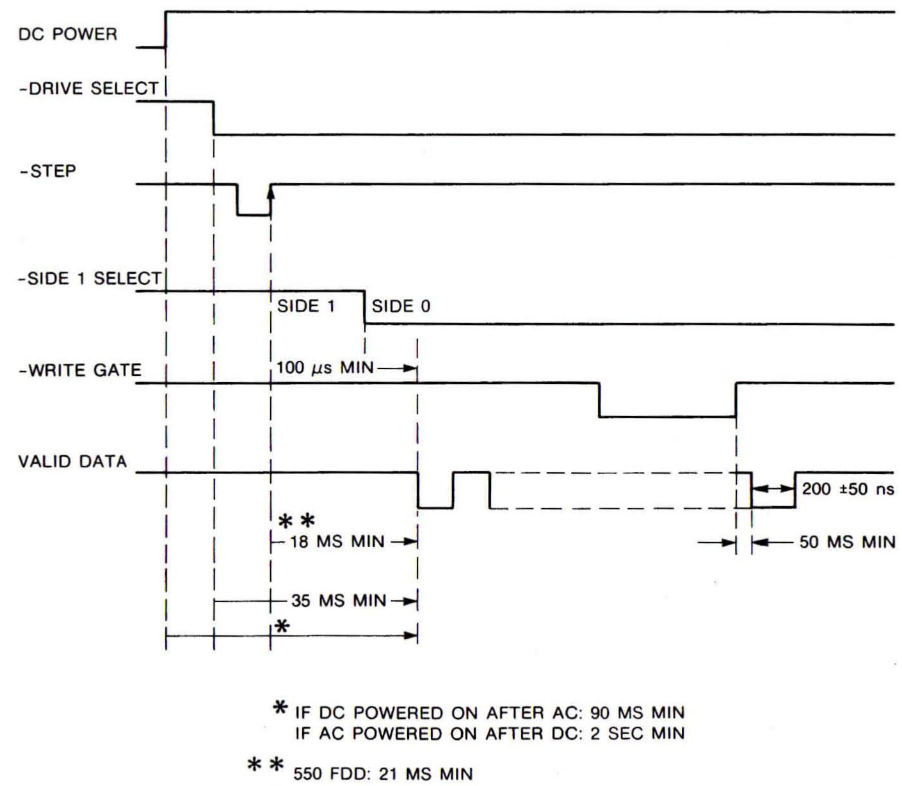
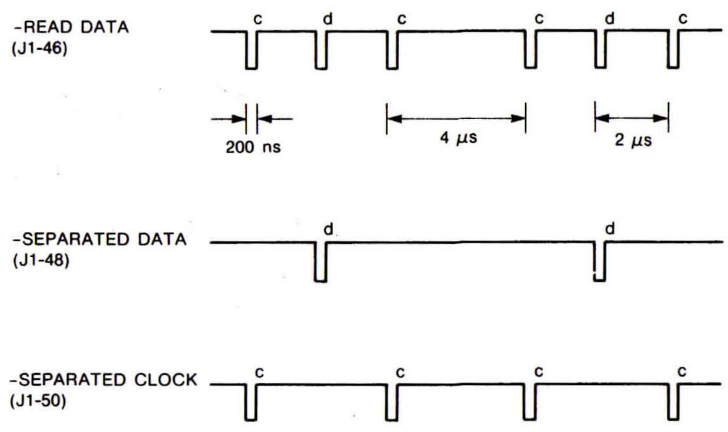


FIGURE 2-6. 552 FLEXIBLE DISC DRIVE SIDE SELECT TIMING



P.W. = 200 ±50 NS
R.T. = 100 NS MAXIMUM (10% to 90% points)
F.T. = 60 NS MAXIMUM (90% to 10% points)

BIT JITTER (DATA) = ± 200 NS MAX
BIT JITTER (CLOCK) = ± 400 NS MAX

(BIT JITTER: TESTED AT TRACKS 0, 43, 44 AND 76
WITH TEST PATTERNS ALL 1's, ALL 0's, AND $E5_{hex}$.)

FIGURE 2-7. READ DATA TIMING

2.6 WRITE OPERATION

A valid write operation is performed via the following sequence of operations.

1. The desired drive is selected. When the drive is selected, the heads are loaded. A 35-millisecond delay necessary to account for head load settle time occurs before the write operation may be initiated.

2. The desired read/write head is selected at least 100 microseconds before the Write Gate line is activated.

3. The Write Gate is inactive during the ensuing track access operation.

4. The head accesses to the desired track position. The time delay for a track access operation may be calculated by multiplying the number of tracks crossed during the access by 3 milliseconds for the 552 (6 milliseconds for the 550) to determine the minimum track-to-track positioning time. A 15-millisecond delay for head settle time is added to the minimum track-to-track positioning time to yield the total access time.

5. The Write Gate line is activated. Within a maximum of 4 microseconds following the activation of the Write Gate line, the Write Data line must be pulsed.

The 550/552 Flexible Disc Drive can record data using either a single-density format (FM) or one of two double-density formats (MFM/MMFM). If either of the double-density formats is chosen, the write data requires time precompensation at the controller level to minimize the bit shift observable when the data is subsequently read. The amount of time and the direction of the bit pulse precompensation required is determined by the bit pattern nearest the bit being written. Refer to Table 2-1 for a detailed definition of the direction and the amount of time required for bit pulse precompensation at the controller level. In addition, the controller must contain a Phase Locked Oscillator (PLO) circuit to monitor and control clock synchronization.

TABLE 2-1. PRECOMPENSATION

Recommended precompensation at the controller level for MFM double-density recording formats:

	Precompensation
0 0 X 1 X 0 0 *	without
0 0 X 1 X 0 1 *	125 ns late
0 0 X 1 X 1 0 *	250 ns late
0 0 X 1 X 1 1	without
0 1 X 1 X 0 0 *	250 ns early
0 1 X 1 X 0 1 *	125 ns early
0 1 X 1 X 1 0 *	without
0 1 X 1 X 1 1	without
1 0 X 1 X 0 0 *	125 ns early
1 0 X 1 X 0 1 *	without
1 0 X 1 X 1 0 *	125 ns late
1 0 X 1 X 1 1	without
1 1 X 1 X 0 0	without
1 1 X 1 X 0 1	without
1 1 X 1 X 1 0	without
1 1 X 1 X 1 1	without

*Indicates a valid MFM half bit sequence.

Later Half Bits to be Written

Half Bit to be Written with or without Precompensation

Earlier Written Half Bits

Note:

1 = flux transition
0 = no flux transition

The single-density recording format (FM) is encoded at the controller level by combining the clock and the data bits such that the data bits occur between the clock bits at half-bit-cell intervals.

The double-density recording formats (MFM/MMFM) differ from the single-density recording format (FM) in that the clock bit is not written consistently unless the data bits are all zeroes (i.e., no data bits are to be written). The conditions under which the MFM format may be encoded are as follows:

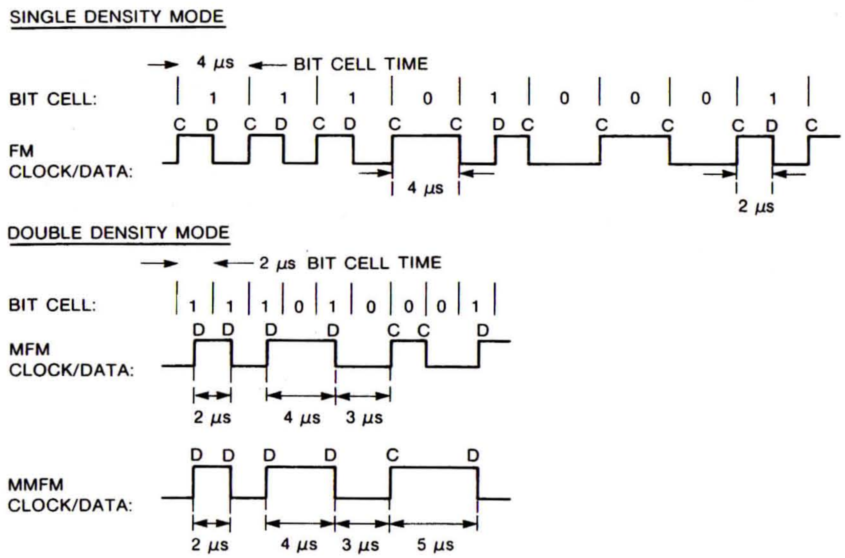
1. All data bits must be written at half-bit-cell intervals.
2. A clock bit is written at the beginning of a bit cell only if that bit cell and the previous bit cell do not contain data bits.

The conditions under which the MMFM format may be encoded are as follows.

1. All data bits must be written at half-bit-cell intervals.
2. A clock bit is written at the beginning of a bit cell only if that bit cell does not contain a data bit and the previous bit cell does not contain either a clock or a data bit.

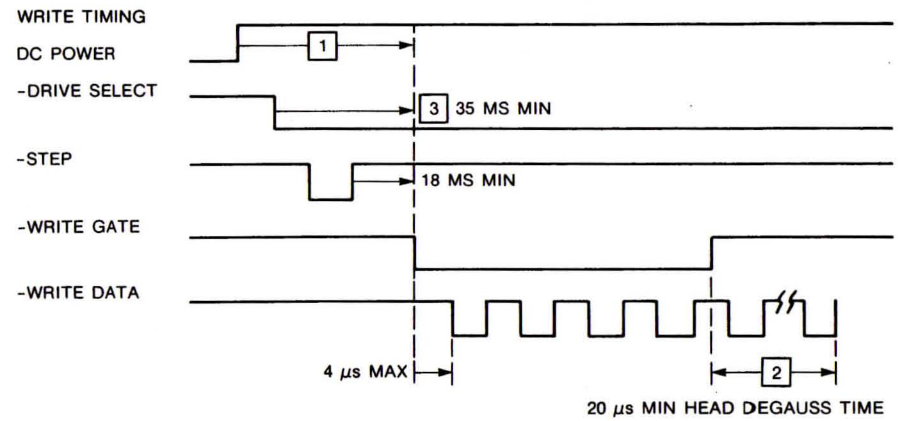
Examples of FM, MFM, and MMFM bit spacing are shown in Figure 2-8.

Figures 2-9 and 2-10 illustrate write data timing. Figure 2-11 provides information on index/sector timing and power on reset timing.



PULSE SEPARATION FORMAT
FM: 1F, 2F (I.E., 4 μs, RESPECTIVELY)
MFM: 1F, 3/2F, 2F (I.E., 4 μs, 3 μs, 2 μs, RESPECTIVELY)
MMFM: 4/5F, 1F, 3/2F, 2F (I.E., 5 μs, 4 μs, 3 μs, 2 μs, RESPECTIVELY)

FIGURE 2-8. DATA PULSE SEPARATION



NOTES:

1. THE CONTROLLER, INDEPENDENT OF THE DRIVE, DELAYS THE START OF THE WRITE OPERATION FOR AT LEAST 90 MS IF THE AC POWER IS FULLY POWERED UP BEFORE THE DC POWER IS TURNED ON, OR TWO SECONDS IF THE AC AND DC POWER ARE TURNED ON AT THE SAME TIME.
2. THE R/W HEAD REQUIRES AN ELAPSED TIME PERIOD AT THE END OF A WRITE OPERATION IN ORDER TO ALLOW THE RESIDUAL HEAD MAGNETISM TO DECAY.
3. WHEN THE R/W HEADS ARE LOADED, A MINIMUM OF 35 MS MUST HAVE ELAPSED BEFORE THE START OF A WRITE OPERATION.

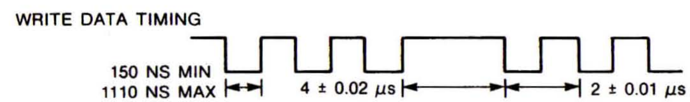
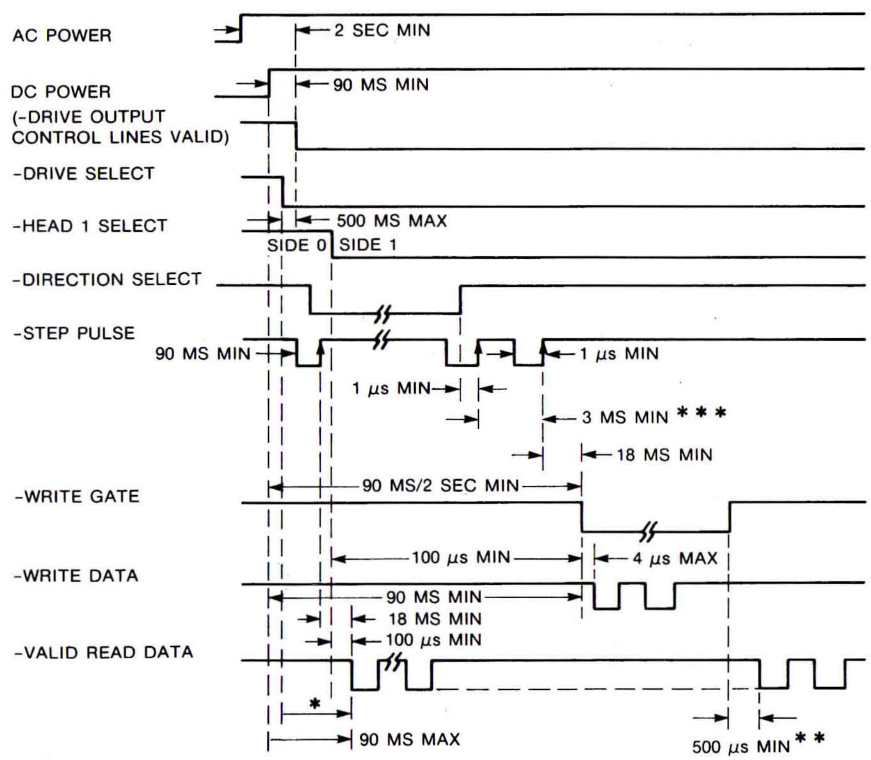


FIGURE 2-9. WRITE TIMING/WRITE DATA TIMING (FM)



* 35 MS MIN ELAPSE FROM HEAD LOAD START; OR, OPTIONALLY, A MINIMUM OF 15 MS ELAPSES IF STEPPER MOTOR POWER IS SWITCHED FROM LOWER POWER (+5 VDC) TO HIGH POWER (+24 VDC) INDEPENDENT OF HEAD LOAD.

* * THE 500 µs IS DUE TO ERASE DELAY.

* * * 6 MS MIN FOR 550 FDD.

FIGURE 2-10. CONTROL AND DATA TIMING

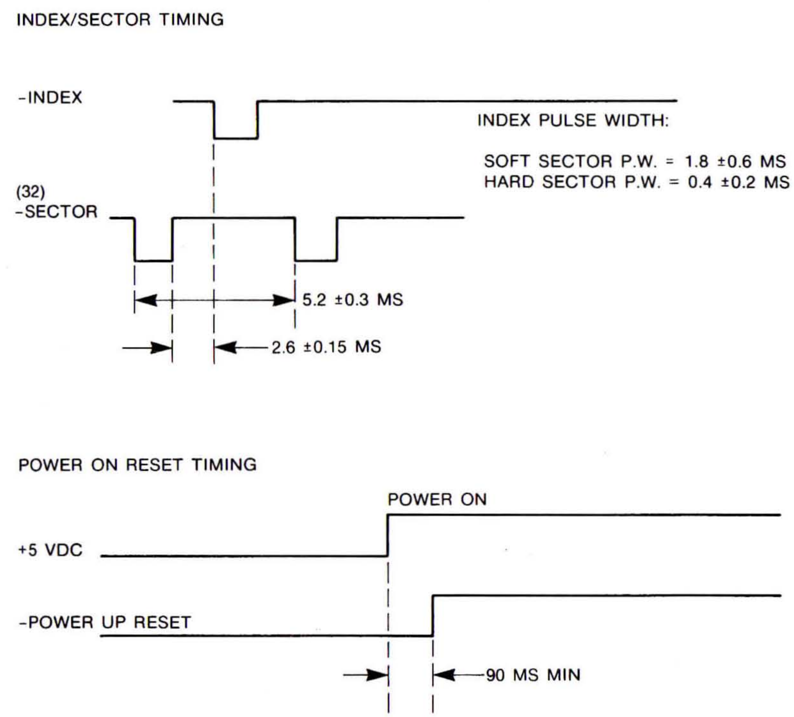


FIGURE 2-11. INDEX/SECTOR TIMING AND POWER UP RESET TIMING

SECTION 3
INTERFACE DEFINITION

3.1 GENERAL INFORMATION

The electrical interface between the drive(s) PCB and the controller is accomplished by the drive I/O connector (J1) and the DC power (i.e. +5 VDC, +24 VDC, and -7 to -16 FDC unregulated, or optionally the minus voltage may be -5 VDC regulated) via the J4 connector.

The J1 connector is a 50-pin connection with odd numbered pins common ground on the noncomponent side of the PCB (see paragraph 3-2). The contact pads are 100 mil centers and have a two key slot between contact pads 10, 12, and 14. The key slots are 0.036 ±0.004-inch wide and 0.450 ±0.010-inch in length as shown in Figure 3-1.

The two read/write head cables connect internally to the PCB by way of a pair of six pin connectors which have one pin clipped off to accommodate a keyed connector (i.e., J3 is for head 0 and J6 is for head 1). Their location on the PCB is on the component side as shown in Figure 3-4 (paragraph 3.4.3), and pin identification is specified in Table 3-1.

The PCB connection to internal circuits is accomplished by a 36-pin connector, J2. (See Figure 3-1 and Table 3-2.)

The controller provides power to the drive(s) via an AC connector (JA). Memorex offers the user a choice between the AC connector types. The first of these is a VDE compatible connector and is designated as Memorex P/N 159195 (AMP P/N 1-480701-0). The mating plug associated with this connector is defined as AMP P/N 1-480700-0. The second AC connector is designated as Memorex P/N 150250 (AMP P/N 1-480305-0) with an associated mating plug designated as AMP P/N 1-480303-0. The AC connectors are illustrated in Figure 3-1.

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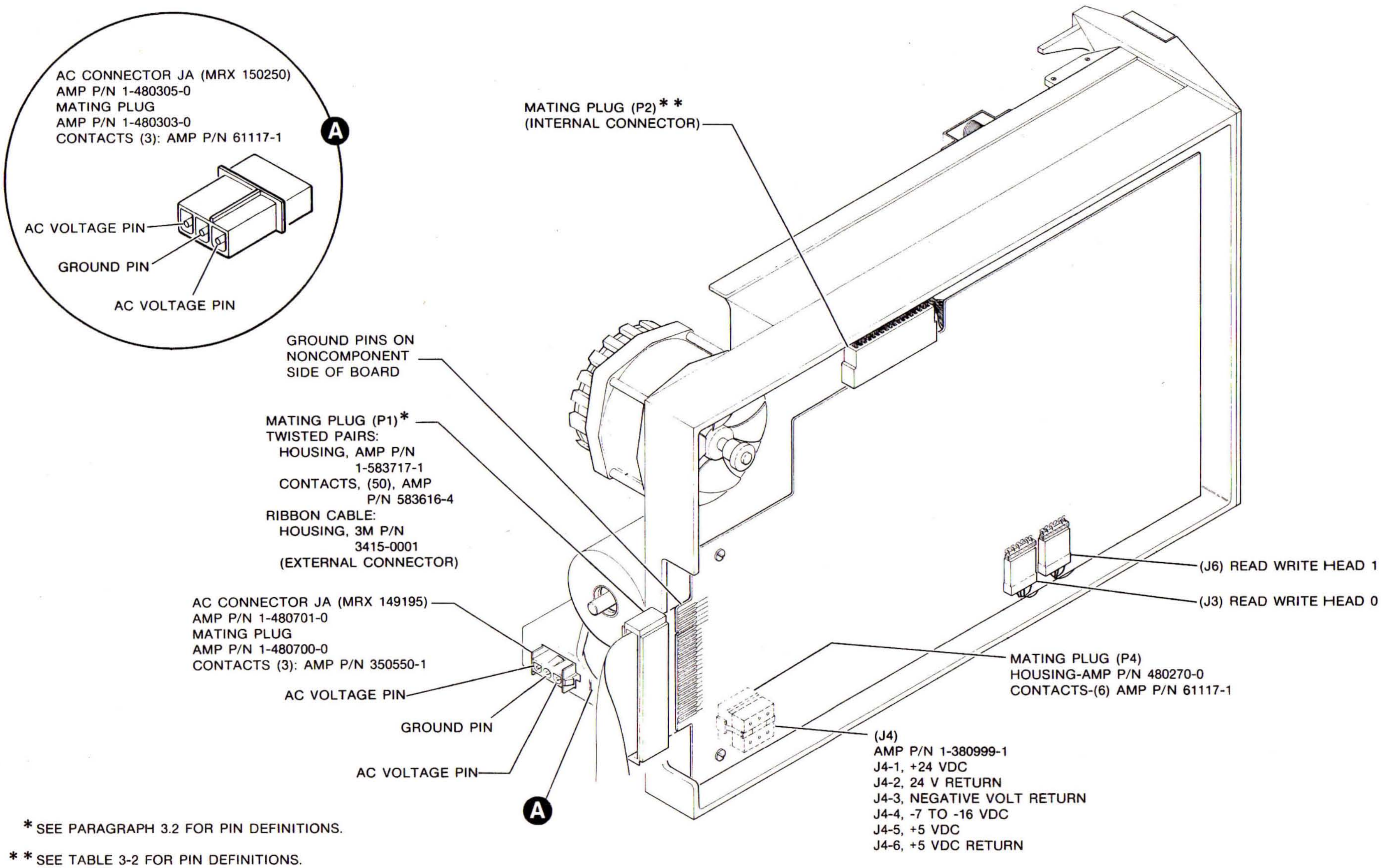


* SEE PARAGRAPH 3.2 FOR PIN DEFINITIONS.

** SEE TABLE 3-2 FOR PIN DEFINITIONS.

FIGURE 3-1. INTERFACE CONNECTORS—PHYSICAL LOCATION DIAGRAM

TABLE 3-1. READ/WRITE HEAD CABLE CONNECTOR

Side 0 (J3)	
J3-1	HEAD 0 READ/WRITE POSITIVE
J3-2	HEAD 0 READ/WRITE RETURN
J3-3	HEAD 0 READ/WRITE NEGATIVE
J3-4	(Key)
J3-5	HEAD 0 ERASE POSITIVE
J3-6	HEAD 0 ERASE NEGATIVE (Not Used)
Side 1 (J6)	
J6-1	HEAD 1 READ/WRITE POSITIVE
J6-2	HEAD 1 READ/WRITE RETURN
J6-3	HEAD 1 READ/WRITE NEGATIVE
J6-4	(Key)
J6-5	HEAD 1 ERASE POSITIVE
J6-6	HEAD 1 ERASE NEGATIVE (Not Used)

TABLE 3-2. INTERNAL INTERFACE (J2)

J2-A	INDEX 2 EMITTER ANODE	J2-L	+BUSY LAMP ANODE
J2-1	INDEX 2 EMITTER CATHODE	J2-10	BUSY LAMP CATHODE
J2-B	INDEX 1 EMITTER ANODE	J1-M	+STEP MOTOR DRIVE
J2-2	INDEX 1 EMITTER CATHODE	J2-11	----
J2-C	-INDEX 2 DETECTOR	J2-N	-STEP MOTOR PHASE C
J2-3	INDEX 2 DETECTOR RETURN	J2-12	----
J2-D	-INDEX 1 DETECTOR	J2-P	-STEP MOTOR PHASE B
J2-4	INDEX 1 DETECTOR RETURN	J2-13	----
J2-E	WRITE INHIBIT EMITTER ANODE	J2-R	-STEP MOTOR PHASE A
J2-5	----	J2-14	----
J2-F	-WRITE INHIBIT	J2-S	-DOOR CLOSED SWITCH
J2-6	WRITE INHIBIT RETURN	J2-15	DOOR CLOSED SWITCH RETURN
J2-H	----	J2-T	+>TRACK 43 DETECTOR
J2-7	----	J2-16	>TRACK 43 RETURN
J2-J	-DOOR LOCK SOLENOID	J2-U	TRACK 00 EMITTER ANODE
J2-8	DOOR LOCK SOLENOID +24 V	J2-17	>TRACK 43 EMITTER ANODE
J2-K	-HEAD LOAD SOLENOID	J2-V	+TRACK 00 DETECTOR
J-9	HEAD LOAD SOLENOID +24 V	J2-18	TRACK 00 RETURN

3.2 INPUT/OUTPUT SIGNALS

This section provides a definition for each of the input and output signals at the 550/552 Flexible Disc Drive to external controller interface connector (J1). The entire set of I/O signals is digital and is logically defined below.

Drive-to-Controller Interface (J1)

J1-2 J1-4 J1-6 J1-8	SPARE I/O PINS
J1-10 -TWO-SIDED J1-12 -DISC CHANGE	OUTPUT: DRIVE STATUS
J1-14 -SIDE 1 SELECT J1-16 -IN USE J1-18 -HEAD LOAD	INPUT: DRIVE CONTROL
J1-20 -INDEX J1-22 -READY J1-24 -SECTOR	OUTPUT: DRIVE STATUS
J1-26 -DRIVE SELECT 1 J1-28 -DRIVE SELECT 2 J1-30 -DRIVE SELECT 3 J1-32 -DRIVE SELECT 4	INPUT: DRIVE ENABLE
J1-34 -DIRECTION IN J1-36 -STEP	INPUT: DRIVE CONTROL
J1-38 -WRITE DATA J1-40 -WRITE GATE	INPUT: DATA AND ENABLE
J1-42 -TRACK 00 J1-44 -WRITE PROTECT	OUTPUT: DRIVE STATUS
J1-46 -READ DATA J1-48 -SEPARATED DATA J1-50 -SEPARATED CLOCK	OUTPUT: DRIVE DATA

Input Signal Line Definitions (J1):

Logic 0 = 0.0 to 0.4 VDC at 40 mA maximum
Logic 1 = 2.5 to 5.25 VDC at 0.0 mA
Z_{in} = 150 Ohms

The following five input signals may be multiplexed, providing the customer with a multidrive system: -SIDE 1 SELECT, -DIRECTION IN, -STEP, -WRITE DATA, and -WRITE GATE. These inputs may be multiplexed by the -DRIVE SELECT 1 through 4 input signal lines. The five input signals are terminated at the drive by a resistor IC (0.25-watt, 150-ohm) at the 2F location. The resistor IC should be removed from all but the farthest drive for a multidrive system.

Output Signal Line Definitions (J1):

All output signals are open collector drives capable of sinking 40 mA at low logic level. At a high logic level, the leakage current will not exceed 0.25 mA. The following is a recommended circuit and interface cable. (See Figure 3-2).

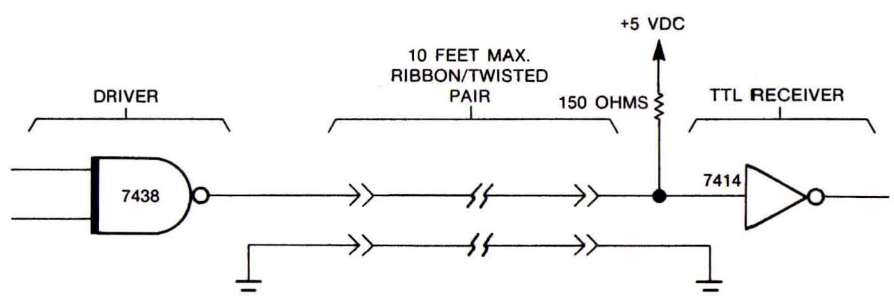


FIGURE 3-2. I/O LINE DRIVER/RECEIVER

3.3 DRIVE-TO-CONTROLLER INTERFACE (J1)

3.3.1 -Two-Sided (Customer-Installable Option) (J1-10)

This output signal will change from a high to a low logic level indicating that a two-sided diskette has been inserted if the 2S terminal posts have a jumper plug inserted. (This output pin can be alternately used as a spare I/O pin.)

3.3.2 -Disc Change (Customer-Installable Option) (J1-12)

The -DISC CHANGE output signal is enabled by installing a jumper plug at the DC location. If the drive is deselected, this signal will activate when the drive is next selected if the door has been opened in the interim. The signal is deactivated when the drive is next deselected. See Figure 3-3 and paragraph 3.4.3.10.

3.3.3 -Side 1 Select (J1-14)

A high logic level at this input will cause the side 0 read/write head to be selected. A low logic level at this input will cause the side 1 read/write head to be selected. A minimum of 100 microseconds must elapse between changes from one read/write head to another before a read or write operation can commence.

3.3.4 -In Use (Customer-Installable Option) (J1-16)

If jumper plug D is installed, a low logic level on the In Use input line illuminates the BUSY LED (Light Emitting Diode) and energizes the door lock solenoid. Thus, the media can be inserted or removed whenever -IN USE is inactive. If jumper plug DL is installed in conjunction with jumper plug D, a low logic level on the -In Use input line is latched when the drive is selected, energizing the door lock solenoid and activating the BUSY LED. The latch is reset only after the drive is deselected and subsequently reselected, and -IN USE is deactivated. Thus, if jumper plug DL is installed, the following sequence of actions occurs between the time that the media is inserted and the time that the media can be removed: -IN USE is activated; the drive is selected; -IN USE is deactivated; the drive is deselected; the drive is reselected.

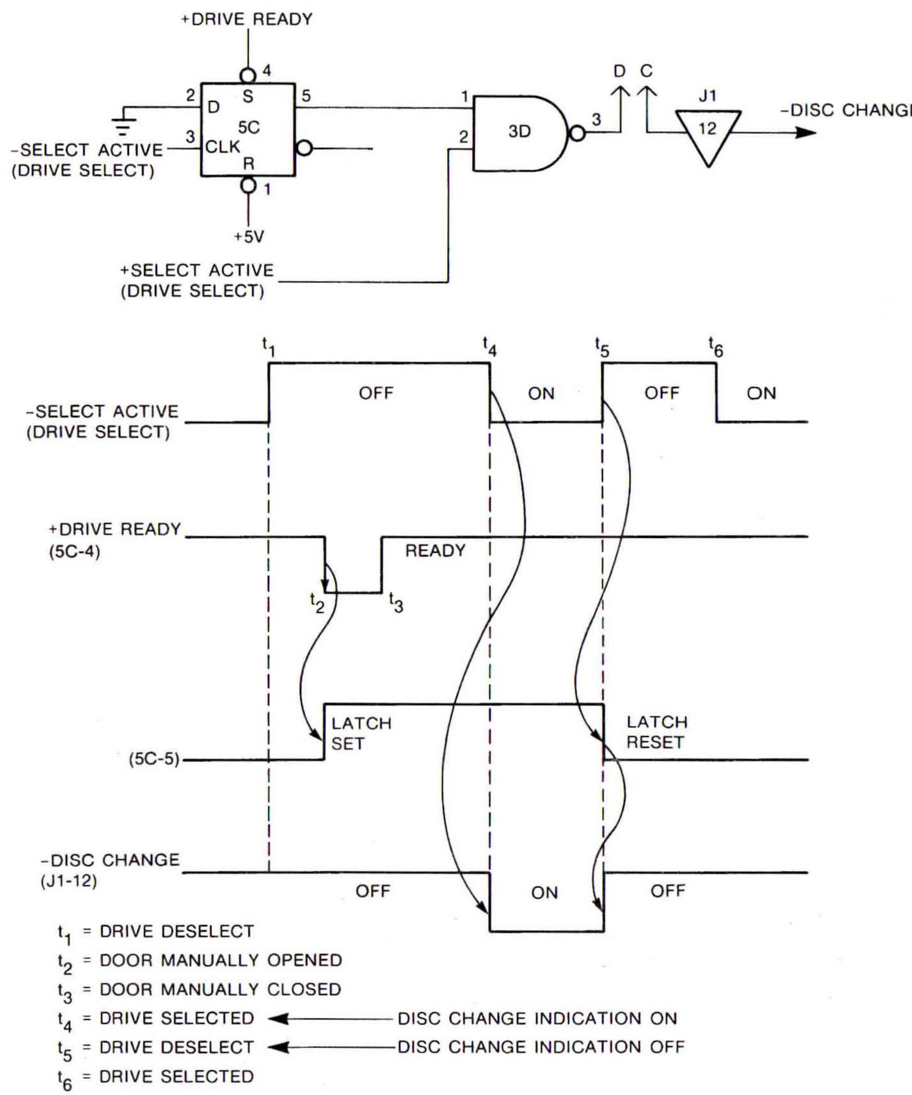


FIGURE 3-3. -DISC CHANGE OUTPUT

3.3.5 -Head Load (Customer-Installable Option) (J1-18)

If jumper plug C is installed and jumper plug X is removed, a low logic level at the -HEAD LOAD input activates the head load solenoid and the door lock solenoid when the drive is selected and ready.

3.3.6 -Index (J1-20)

An output pulse is provided for each revolution. The pulse width is 1.8 ± 0.6 milliseconds for soft sector format, or 0.4 ± .0.2 milliseconds for hard sector formats. The period for this pulse train is 166.66 ± 3.33 milliseconds.

An index pulse leading edge in the 32-hard-sector format (customer-installable option), shall be between 2.545 and 2.75 milliseconds from the most previous sector pulse leading edge. (See Figure 3-4).

3.3.7 -Ready (J1-22)

When the diskette has been inserted and the door closed, a low logic level will signify that the AC and DC powers are on and at least two index pulses have been counted.

NOTE

If a single-sided diskette is installed, the READY signal will switch to a low logic level when side 0 is selected, or to a high voltage level (not ready) if side 1 is selected. If a two-sided diskette (552 FDD application) is installed, the READY signal will go low when either read/write head (side) is selected.

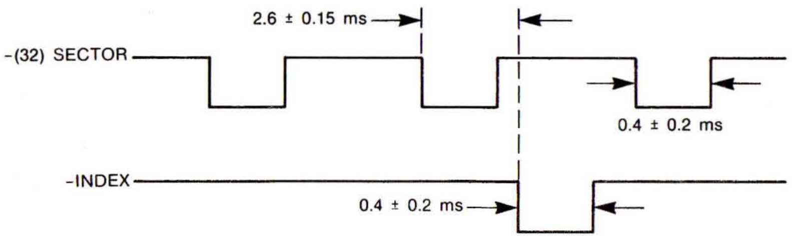


FIGURE 3-4. INDEX/SECTOR TIMING

3.3.8 -Sector (Customer-Installable Option) (J1-24)

An output pulse is provided for each hard sector hole detected in the media. The number of pulses per revolution may be 32, 16, or 8 depending on the option selected. The pulse width is the same as the hard sector index pulse width (0.4 ± 0.2 milliseconds).

3.3.9 -Drive Select 1 through 4 (J1-26, 28, 30, and 32)

In the standard PCB configuration, a separate single line is used for each drive selection by customer use of jumper plugs (DS1 through DS4).

3.3.10 -Direction In (J1-34)

The trailing edge of a step pulse will cause the stepper motor to move 0.0208-inch radially in toward the center of the diskette when this input has been at a low logic level for at least 1 microsecond, or radially outward from the center if this signal has been at a high logic level for at least 1 microsecond.

3.3.11 -Step (J1-36)

The trailing edge of the step pulse (i.e., a low to a high logic level transition) will cause the read/write head to be repositioned over an adjacent track, depending on the level of the -DIRECTION IN input signal. The pulse width of this input signal must be at least 1 microsecond and the minimum time between pulses cannot be less than 3 milliseconds for the 552 FDD or 6 milliseconds for the 550 FDD. A write or read operation can follow a step operation any time after a minimum of 15 milliseconds has elapsed.

3.3.12 -Write Data (J1-38)

Each transition from a high to a low logic level will cause a magnetic flux reversal to occur at the read/write head gap, thereby writing a data bit (or clock bit) onto the recording media (diskette). When writing data/clock in the FM encoded format, the pulse width can be between 0.15 and 1.10 microseconds and the period between pulses for an all data bit zeroes (i.e., clock pulses only) is 3.98 to 4.02 microseconds. The write data pulse train period for an all ones (one data pulse interleaved between pairs of clock pulses) is 1.99 to 2.01 microseconds.

3.3.13 -Write Gate (J1-40)

A low logic level on this input will enable the write data circuits and disable the read data output circuits. A high logic level on this input will enable the read data circuits and outputs; i.e., -READ DATA, -SEPARATED DATA, and -SEPARATED CLOCK.

3.3.14 -Track 0 (J1-42)

A low logic level at this output occurs when Track 0 is located under the read/write head, and the -STEP MOTOR PHASE A signal to the stepper motor is the only phase signal active.

3.3.15 -Write Protect (Optional Feature) (J1-44)

If Optional Feature 312376 is selected, this output signal will remain low when a write-protected disc is inserted. The media is write-protected when the diskette write-protect notch is open; thus, the write operation is disabled. A write operation involving a write-protected diskette can be performed by placing a tab over the diskette write-protect notch.

NOTE

IBM does not have write-protected notched diskettes.

3.3.16 -Read Data (J1-46)

This output line provides the composite data and clock pulse train during a read operation and switches from a high to a low logic level when a recorded data or clock bit is read.

The pulse width of the read data/clock pulse is 0.2 ±0.05 microseconds. The allowable bit shift (pulse jitter) of a read data pulse or a read clock pulse at this output is ±0.2 microseconds and ±0.4 microseconds, respectively.

3.3.17 -Separated Data (Customer-Installable Option) (J1-48)

This output line provides the separated data from the composite FM read data and clock signal, and except for the removed clock pulses has the same timing characteristics as the READ DATA output signal; i.e., a pulse width equal to 0.2 ±0.05 microseconds with ±0.2 microseconds pulse jitter allowable.

3.3.18 -Separated Clock (Customer-Installable Option) (J1-50)

This output line is a synchronous clock derived from the composite FM READ DATA AND CLOCK signal, and except for the removed data pulses, has the same timing characteristics as the READ DATA output signal; i.e., pulse width equal to 0.2 ±0.05 microseconds and ±0.4 microseconds pulse jitter allowable.

3.4 SYSTEM CONFIGURATION

3.4.1 General

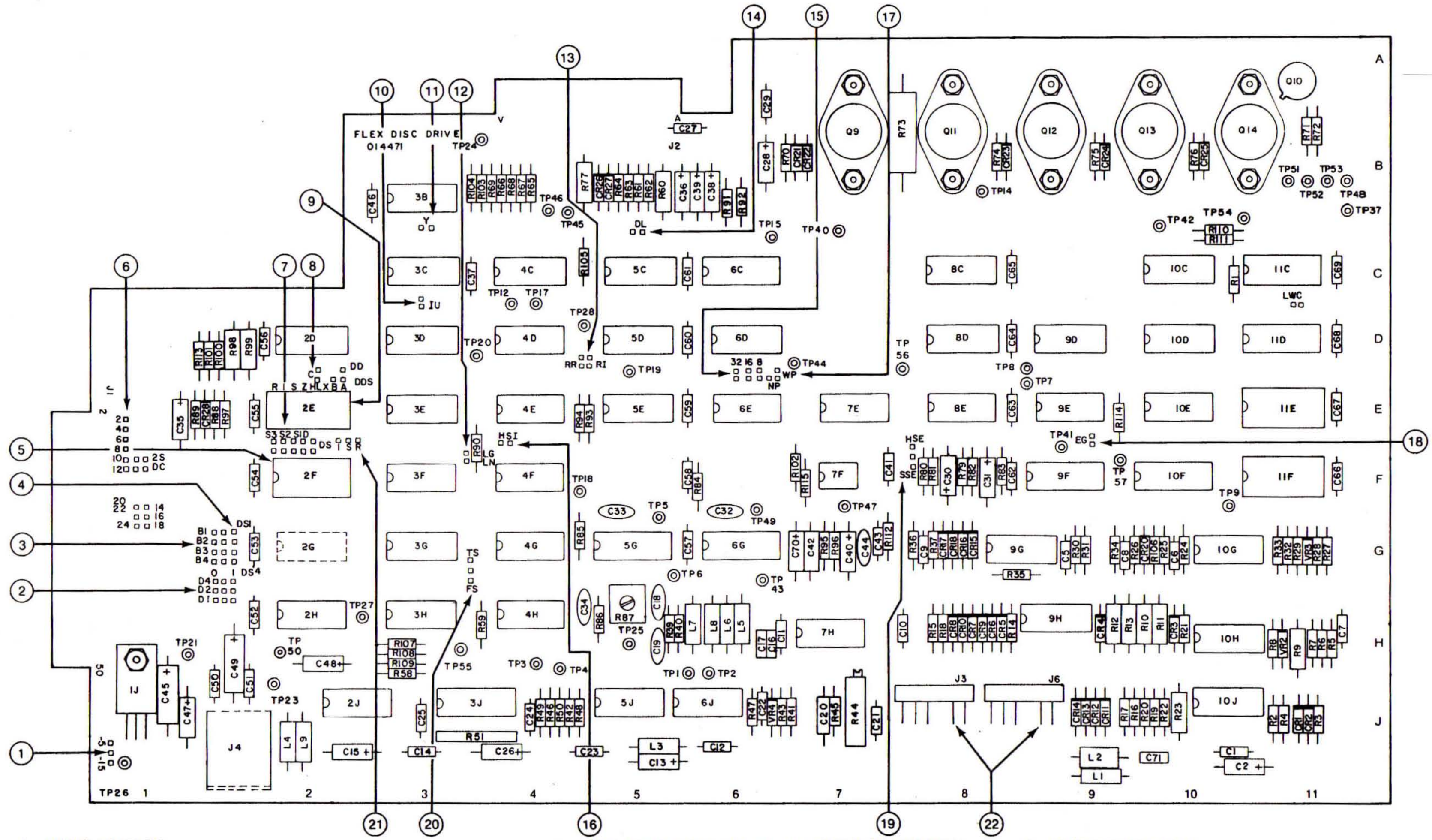
The 550/552 Flexible Disc Drive is powered and controlled externally from the customer's system. The power requirements are for a single-phase AC source to drive the AC motor. The DC requirements are for three voltages: +5 VDC, +24 VDC, and -7 to -16 VDC; or, as a customer installed option, regulated -5 VDC. See paragraph 1-4, Summary of Physical Specifications, for AC and DC power requirements and frequency tolerances.

3.4.2 Serial Cable System

The 550/552 may be installed in a system with up to eight drives by encoding the addresses.

3.4.3 Implementation of Customer-Installable Options

The following paragraphs describe the implementation of customer-installable options in the 550/552 and define the standard configuration as shipped from Memorex. Refer to Figure 3-5 and Table 3-3 for locations and designations of all components described in the procedures. Table 3-4 lists the PCB test points for the user's convenience.



1. MINUS VOLTAGE
2. DRIVE SELECT: ENCODED 1 OF 8 TERMINAL POSTS AND COMPARATOR
3. SIDE 1 SELECTION VIA ONE OF DRIVE SELECT INPUTS OPTION
4. DRIVE SELECT; 1 OF 4 TERMINAL POSTS
5. 150 OHM IC
6. SPARE I/O PINS (J1-2, 4, 6 AND 8)
7. SIDE SELECT
8. HEAD LOAD; DRIVE SELECT ENCODED/NON ENCODED
9. JUMPER PLUG SHUNT
10. IN USE TRACE
11. BUSY LAMP OPTION
12. SPARE SCHMIDT TRIGGER RECEIVER
13. RADIAL READY AND RADIAL INDEX
14. DOOR LOCK
15. HARD SECTOR 32, 16 OR 8
16. HARD SECTOR INDEX
17. WRITE PROTECT
18. ERASE GATE
19. SOFT/HARD SECTOR ERASE TIMING
20. DATA/CLOCK SEPARATOR RESYNC ON ⅓ MISSING CLOCK BITS
21. RADIAL INDEX, SECTOR AND READY
22. R/W HEAD CONNECTORS J3 (HD0) AND J6 (HD1)

FIGURE 3-5. PCB COMPONENT LOCATION

TABLE 3-3. STANDARD CONFIGURATION AS SHIPPED FROM MEMOREX

Designator/Description	PCB Coordinates	Schematic Locator	Open	Short
-15	1J	E41,E42		X
-5	1J	E42,E43	X	
Terminators, 14-Pin DIP, 150-ohm	2F	2F		Installed
DS1	1G-2G	E2,E3		X
DS2	1G-2G	E5,E6	X	
DS3	1G-2G	E8,E9	X	
DS4	1G-2G	E11,E12	X	
B1	1G-2G	E1,E2	X	
B2	1G-2G	E4,E5	X	
B3	1G-2G	E7,E8	X	
B4	1G-2G	E10,E11	X	
Comparator, 74LS85	2G	2G	IC Not Installed	
RR	4D-5D	E57,E58		X
RI	4D-5D	E55,E56		X
R Shunt (DIP)	2E	2E-1,16		X
I Shunt (DIP)	2E	2E-2,15		X
S Shunt (DIP)	2E	2E-3,14		X
Z Shunt (DIP)	2E	2E-4,13		X
HL Shunt (DIP)	2E	2E-5,12		X
X Shunt (DIP)	2E	2E-6,11		X
B Shunt (DIP)	2E	2E-7,10		X
A Shunt (DIP)	2E	2E-8,9		X
2S	1F	E61,E62	X	

Designator/Description	PCB Coordinates	Schematic Locator	Open	Short
DL (If door lock solenoid option selected)	5C	E39,E40		X
D (If door lock solenoid option selected)	2E-2F	E35,E36		X
DD	2D-2E	E13,E14		X
DDS	2D-2E	E14,E15	X	
DC	1F	E59,E60	X	
HSI (If Hard Sector Format feature installed)	4E-4F	E44,E45		X
32	6D-6E	E46,E47		X
16	6D-6E	E48,E49	X	
8	6D-6E	E51,E50	X	
WP	6D-6E	E66,E67		X
NP	6D-6E	E65,E66	X	
Y	3B-3C	E29,E30	X	
C	2D-2E	E28,E27	X	
DS	2E-2F	E31,E32	X	
HSE (If Hard Sector Format feature installed)	7F-8F	E69,E70		X
SSE (If Soft Sector Format feature installed)	7F-8F	E68,E69		X
TS (For IBM compatibility)	3G-4G	E88,E89		X
FS	3G-4G	E88,E87	X	
S1	2E-2F	E75,E76	X	
S2	2E-2F	E77,E78		X
S3	2E-2F	E79,E80	X	

TABLE 3-4. PCB TEST POINTS

TP 1	Filtered Read Preamp. Pos.	TP 29	(Not Used)
TP 2	Filtered Read Preamp. Neg.	TP 30	(Not Used)
TP 3	Read Differentiator Neg.	TP 31	(Not Used)
TP 4	Read Differentiator Pos.	TP 32	(Not Used)
TP 5	Read Data Deglitcher (t_2 = 0.2 ±0.02 μs)	TP 33	(Not Used)
		TP 34	(Not Used)
TP 6	Data/Clock Separator Window (t = 2.8 ± 0.28 μs)	TP 35	(Not Used)
		TP 36	(Not Used)
TP 7	-WRITE DATA NEGATIVE TRANSITION	TP 37	Logic Ground (+5 and minus volt.)
TP 8	-WRITE DATA POSITIVE TRANSITION	TP 38	(Not Used)
TP 9	-ERASE ACTIVE	TP 39	(Not Used)
TP 10	(Not Used)	TP 40	-> TRACK 43
TP 11	(Not Used)	TP 41	+WRITE ACTIVE
TP 12	-TRACK 00 DETECTOR, Track 1/Track 0	TP 42	+SIDE SELECT ENABLE
TP 13	(Not Used)	TP 43	+READ DATA DEGLITCHER (t = 1 ±0.1 μs)
TP 14	-STEP MOTOR HIGH POWER	TP 44	Logic Ground
TP 15	+WRITE INHIBIT DETECTOR	TP 45	-INDEX 1 DETECTOR (550 FDD)
TP 16	(Not Used)	TP 46	-INDEX 2 DETECTOR (552 FDD)
TP 17	+Index/Sector Separator Timer	TP 47	+STEP CLOCK (Period = 330 ±40 μs)
TP 18	+INDEX	TP 48	+DAMPENING
TP 19	+SECTOR	TP 49	+DRIVE SELECT ACTIVE
TP 20	+DOOR CLOSED SWITCH	TP 50	-VDC, after Regulator
TP 21	+24 VDC	TP 51	+STEP MOTOR PHASE A
TP 22	(Not Used)	TP 52	+STEP MOTOR PHASE B
TP 23	+5 VDC	TP 53	+STEP MOTOR PHASE C
TP 24	Transducer Ground	TP 54	+SIDE 1 SELECTED
TP 25	Read Preamp. Ground	TP 55	±READ DATA TRANSITIONS
TP 26	-VDC Before Regulator	TP 56	+READ ACTIVE
TP 27	DC Ground	TP 57	+STEP CLOCK ENABLE
TP 28	+READY		

3.4.3.1 Negative Voltage

Normal input voltage is -7 to -16 VDC through a voltage regulator. The regulator can be bypassed by removing the jumper plug at -15 PCB terminal pair location and installing the jumper plug at the -5 terminal pair location. See Figure 3-6.

This will allow the customer to input an externally regulated -5 VDC supply to the drive.

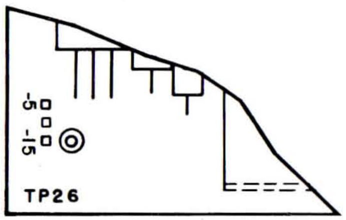


FIGURE 3-6. -7 VDC TO -16 VDC OR -5 VDC TERMINAL POST

3.4.3.2 Termination of Multiplexed Input Lines

The terminators for the multiplexed input lines are packaged in a DIP at PCB location 2F. See Figure 3-7.

NOTE

In a multidrive system, the terminator DIPs must be removed from all drives except the drive furthest from the controller.

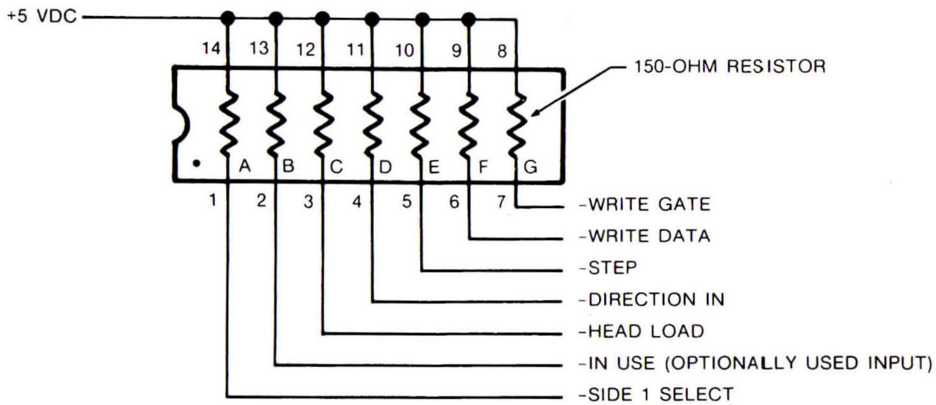


FIGURE 3-7. 150-OHM DIP

3.4.3.3 Drive Select

In the standard configuration as shipped from Memorex, the unit drive is selected by placing a low voltage level at I/O connector J1 pin 26. If there are multiple drives in the customer's system (up to four), the jumper plug at DS1 may be moved to one of the other terminal pairs (DS2, DS3, or DS4). Each drive is internally terminated by a 150-ohm resistor from the input line to the +5 VDC.

Four options are available to increase drive select versatility beyond that offered by the standard configuration: (1) nonencoded drive select without head(s) loaded, (2) nonencoded head load with drive(s) selected, (3) nonencoded drive select and rezero without head(s) loaded, and (4) encoded select 1 of 8 drives.

Select Drive Without Heads Loaded

To extend media life, this option allows the drive control signals to be monitored by the controller while the heads are unloaded and the drive has been selected.

The heads are loaded when the signal line -Head Load (J1-18) goes active. A subsequent write or read operation must wait a minimum of 35 milliseconds.

Procedure:

1. Cut X shunt of DIP located at 2E (pins 6 to 11). See Figures 3-8 and 3-9.
2. Install plug at terminal post C.

Load Heads Without Selecting Drive

Each drive may have its own head load line (radial configuration). Thus, when doing a copy operation from one drive to another drive, the heads may be kept loaded on all drives even though not selected, thereby eliminating the 35-millisecond head load settle time.

Procedure:

1. Cut B shunt of DIP located at 2E (pins 7 to 10).
2. Jumper plug DS terminal posts. See Figure 3-16.
3. Cut HL shunt of DIP located at 2E (pins 5 to 12).
4. Jumper plug C terminal posts located between DIPs at 2D and 2E. See Figure 3-9.
5. Cut the trace that connects E25 and E26. Connect a jumper wire from E26 to one of the Spare I/O Pads.

NOTE

When the subsystem is configured radially, the line terminator DIP at 2F location must not be removed from any drive.

Select Drive and Perform Initial Rezero Without Loading Heads

This option will allow the controller to restore to track zero even though the heads are not loaded (also, the door may be open).

Procedure:

1. Cut B shunt of DIP located at 2E (pins 7 to 10).
2. Jumper plug DS terminal posts. See Figure 3-16.
3. Cut HL shunt of DIP located at 2E (pins 5 to 12).
4. Jumper plug C terminal posts located between DIPs at 2D and 2E. See Figure 3-9.

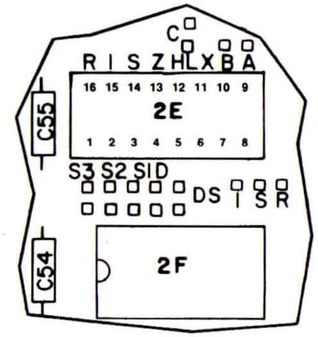


FIGURE 3-8. SIDE SELECT TERMINAL POSTS

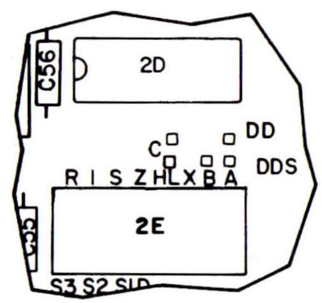


FIGURE 3-9. DRIVE SELECT OPTION

Select 1-to-8 Drives (Encoded)

The customer may alternately install the following circuits to implement the necessary decoding for 1-to-8 drive selection, as encoded at the controller and connected via the three I/O lines at J1 pins 28, 30, and 32. Refer to Figure 3-10 for a schematic representation of the circuits discussed in the following paragraphs.

Description	Memorex Part Number	Manufacturer's Part Number	Quantity
Comparator IC at 2G	157924	TI 74LS85	1
Jumper Plugs	159301	Berg 65474-004	6
Terminal Posts	159163	Berg 75491-004	9

Procedure:

1. Remove any jumper plugs installed at DS1, DS2, DS3, DS4, B1, B2, B3, and B4 terminals. See Figure 3-11.

2. Cut the trace at DD and jumper wire DDS. See Figure 3-12.

3. Install nine terminal posts (Memorex PN 159163) at the D1, D2, D4, 0, and 1 matrix. See Figure 3-13.

4. Install three jumper plugs on D1, D2, D4, 0, and 1 matrix as desired from the following table:

Decimal Address	A0	A1	A2	A3	B0*	B1*	B2*	B3*
				74LS85 Inputs				
0	0	1	1	1	0	1	1	1
1	0	0	1	1	0	0	1	1
2	0	1	0	1	0	1	0	1
3	0	0	0	1	0	0	0	1
4	0	1	1	0	0	1	1	0
5	0	0	1	0	0	0	1	0
6	0	1	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0

Where: 1 = High Voltage
0 = Low Voltage

* 74LS85 inputs, B0, B1, B2, and B3 correspond, respectively, to J1 connector pins 26, 28, 30, and 32.

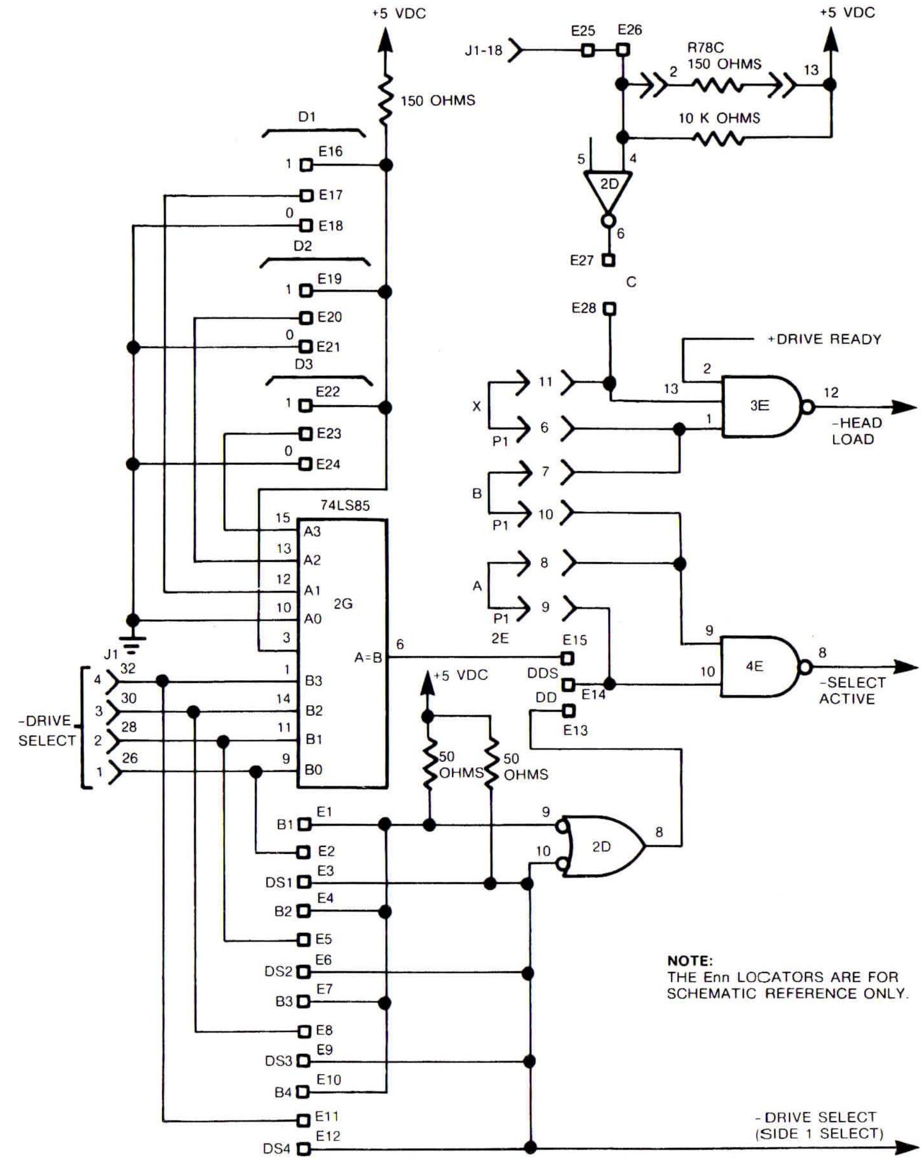


FIGURE 3-10. DRIVE SELECTION (ENCODED) CIRCUITRY

5. Install IC 74LS85 at PCB location 2G.

6. Install a jumper plug at DS2, DS3, and DS4 on each of the three drives located physically farthest away from the controller. See Figure 3-14. This will provide the three encoded select line terminations (150-ohm resistor pull-up to +5 VDC).

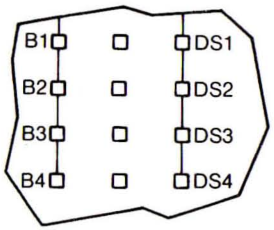


FIGURE 3-11. DRIVE SELECT TERMINAL POSTS

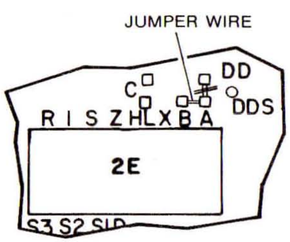


FIGURE 3-12. JUMPER PLUG SHUNT

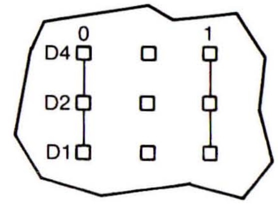


FIGURE 3-13. DRIVE SELECT DECODE

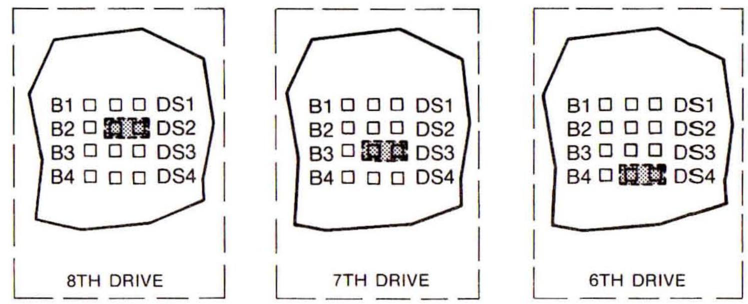


FIGURE 3-14. DRIVE SELECT DECODE JUMPER PLUGS

3.4.3.4 Door Lock

If the Door Lock Solenoid feature is installed, the door is locked each time that the R/W head(s) on the selected drive is loaded. If the -In Use option is installed in conjunction with the Door Lock Solenoid feature, the -IN USE input signal energizes and latches the door lock solenoid upon receipt of a low logic level. The latch that engages the door lock solenoid is reset only when the drive is deselected and subsequently reselected (see paragraph 3.3.4). The circuitry involved in the operation of the door lock is illustrated in Figure 3-15.

Two modes of door lock operation are possible: door lock—simultaneous or door lock—radial.

Door Lock—Simultaneous

The doors of all the drives are locked when the controller activates the IN USE input signal.

Procedure:

1. Remove the jumper plug DL located near PCB location 5C. See Figure 3-5.

2. Install jumper plug at D terminal posts. See Figure 3-16.

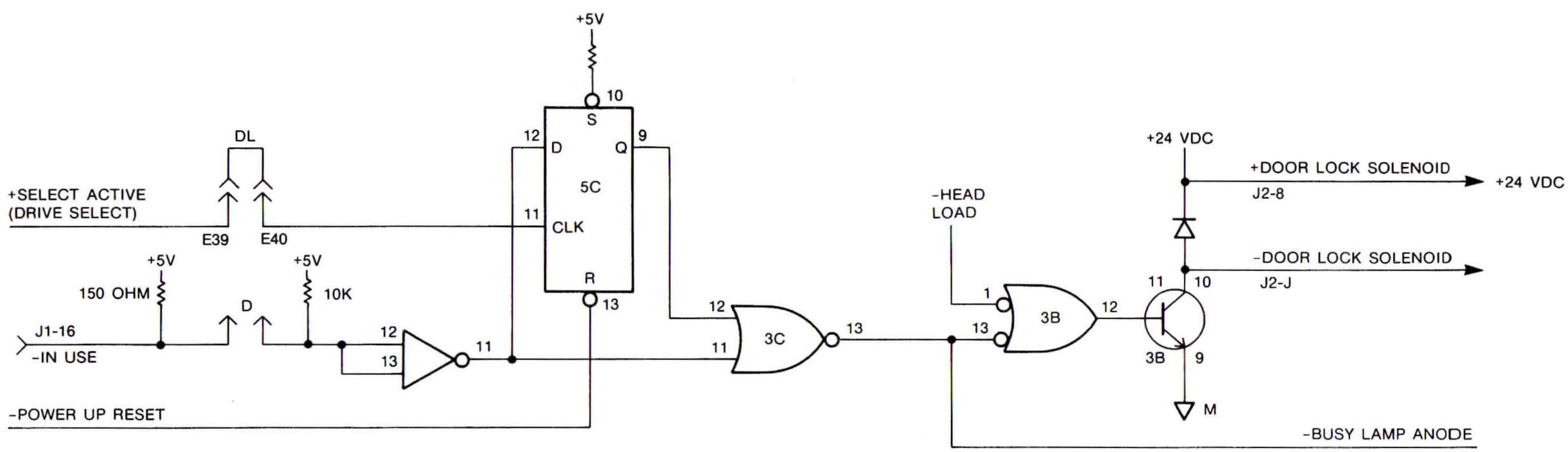


FIGURE 3-15. DOOR LOCK CIRCUIT

Door Lock—Radial

Each drive utilizes a separate input line from the controller to energize and de-energize only its door lock solenoid.

Procedure:

1. Remove DL jumper plugs and install a jumper plug at D. See Figures 3-5 and 3-16.

2. Cut the trace at the two J1-16 pads and jumper the wire from pad 16 to a spare I/O pin at J1. See Figure 3-4.

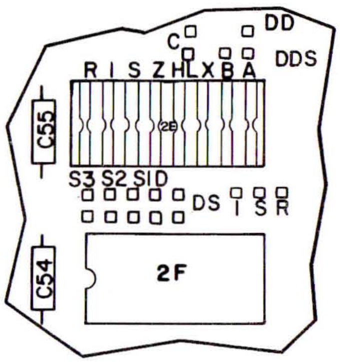


FIGURE 3-16. JUMPER PLUG SHUNT AND TERMINAL POSTS

3.4.3.5 Busy Lamp

If this optional feature is installed, the LED mounted on the front bezel will be lit when the drive is selected. The following customer-installable option will light the LED whenever the head is loaded.

Procedure:

1. Cut away shunt Z at 2E between pins 4 and 13. See Figure 3-16.
2. Install jumper plug at Y terminal posts near PCB location 3B. See Figure 3-5.

NOTE

If the -IN USE D jumper is installed, the BUSY LED will also illuminate when -IN USE or the In Use latch is active.

3.4.3.6 Side Select

The input at J1-14 (-SIDE 1 SELECT) is normally used to select which side of the 552 read/write head is to be used via a jumper plug installed at the S2 terminal posts. Two options are available: side select-direction in or side select-drive select.

Side Select-Direction In

This option allows the direction of the head motion during a step operation and subsequently the media side (or read/write head) to be selected during a read or write operation by a single input line. The -SIDE 1 SELECT signal is time multiplexed with the input signal -DIRECTION IN, J1-34, from the controller.

Procedure:

1. Remove any jumper plugs at S3 and S2 terminal posts. See Figure 3-8.
2. Install a jumper plug at S1 terminal posts.

Side Select-Drive Select

For a system with a maximum of two drives, this option will provide for the media side (i.e., read/write head) to be chosen from one of three unused drive select lines. Therefore, the four bussed drive select lines can be used—two lines for drive select and side select of one drive, and the other two lines for the other drive.

Procedure:

1. Remove jumper plugs at S1 and S2 terminal posts on both drives.
2. Install jumper plug at S3 terminal posts on both drives.
3. Choose the appropriate terminal post at DS1, DS2, DS3, or DS4 for the drive select function and install a jumper plug.
4. Of the three remaining DSn locations, choose the appropriate terminal post at B1, B2, B3, or B4 and install a jumper plug for the media side select. See Figure 3-17 and the following example.

Example:

I/O Line	When Active	When Not Active
-Drive Select 1	Selects the first drive	—
-Drive Select 2	Selects side 1 of the first drive	Selects side 0 of the first drive
-Drive Select 3	Selects the second drive	—
-Drive Select 4	Selects side 1 of the second drive	Selects side 0 of the second drive

NOTE

No more than one Drive Select line should be active at the same time.

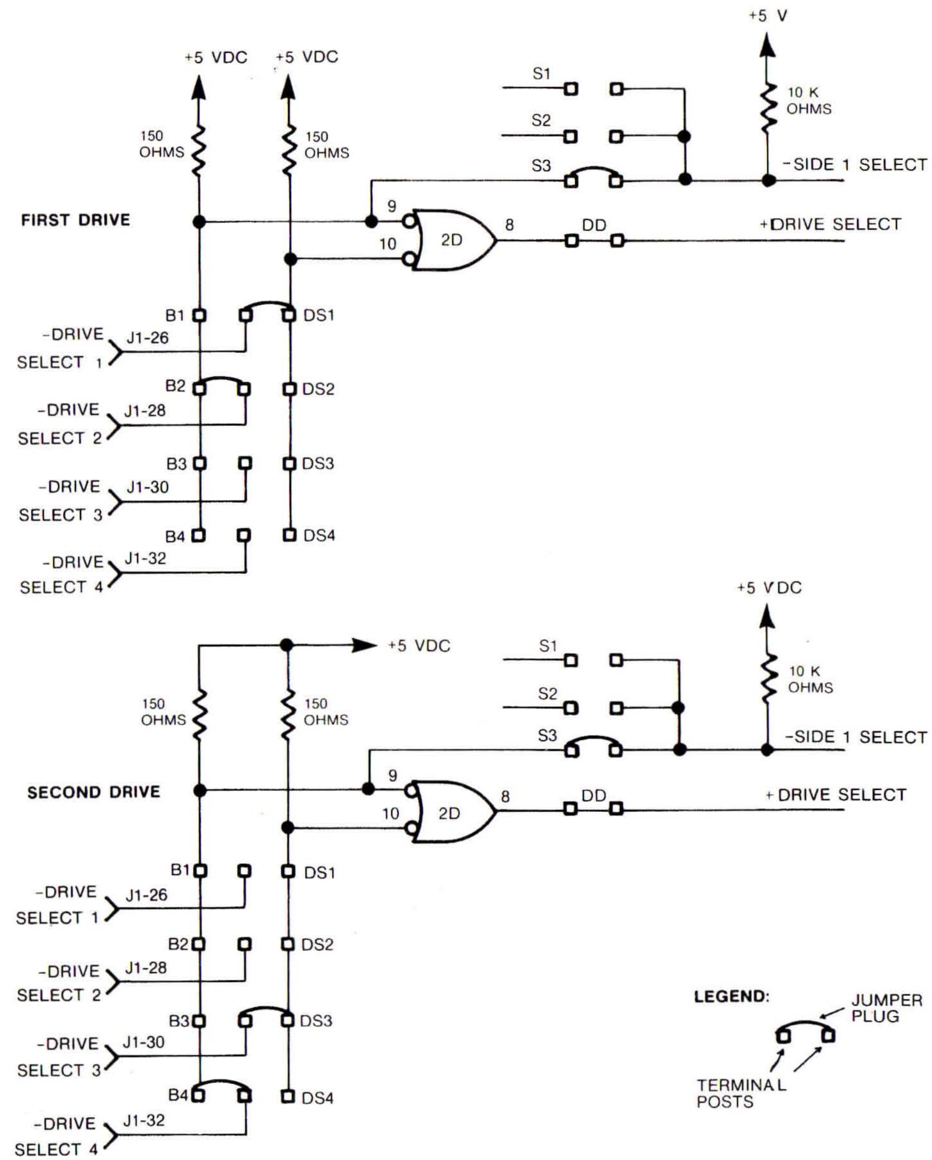


FIGURE 3-17. SIDE SELECTION USING DRIVE SELECT LINES

3.4.3.7 Index

The normal mode provides one Index pulse per disc revolution for soft sectoring (no sector holes). Two options are possible: hard sector index, and radial index and sector monitoring.

Hard Sector Index

This output may be optionally installed to provide the necessary change to adjust to a recording media with hard sector holes.

Procedure:

Install jumper plug at HSI located between PCB locations 4E and 4F.

Radial Index and Sector Monitoring

This option enables the customer to monitor the Index and Sector output lines even though the drive has not been selected. In this way, access time could be reduced in a multidrive system by waiting until the Index pulse, or Sector pulse (hard sector option), is nearer.

Procedure:

1. Cut away the trace at RI located near 5D and 4D. See Figure 3-18.
2. Cut away shunt I at 2E between pins 2 and 15. See Figure 3-16. (If Hard Sector selective feature has been installed, also cut away shunt S at 2E between pins 3 and 14.)
3. Add a jumper wire from pad I to one of the unused spare I/O pins (e.g., J1-2, 4, 6, or 8) pads. See Figure 3-16.
4. If the Hard Sector selective feature option has been installed, also jumper wire from the pad at S to one of the unused spare I/O pin pads (e.g., J1-2, 4, 6, or 8). See Figure 3-5.

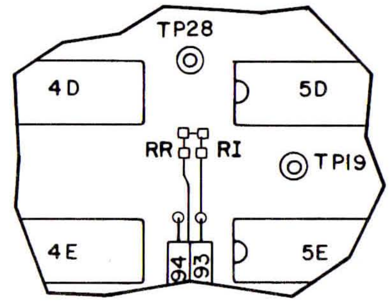


FIGURE 3-18. RADIAL TRACES

3.4.3.8 Hard Sector

This output is used for the Hard Sector selective feature option. To prepare any drive PCB for Hard Sector, simply install a jumper plug at HSI located near 4E and 4F and move the jumper plug at SSE to HSE. The sector rate will be 32 pulses per revolution unless changed by the customer to either 8 or 16 pulses per revolution as described in the following paragraphs.

Eight Sector Pulses

Procedure:

1. Cut away trace 32 located between 6D and 6E. See Figure 3-19.
2. Add jumper wire between 8 pads.

Sixteen Sector Pulses

Procedure:

1. Cut away trace 32 located between 6D and 6E. See Figure 3-19.
2. Add jumper wire between 16 pads.

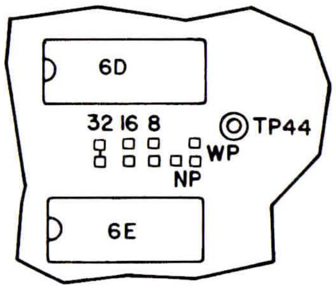


FIGURE 3-19. SECTOR AND WRITE PROTECT

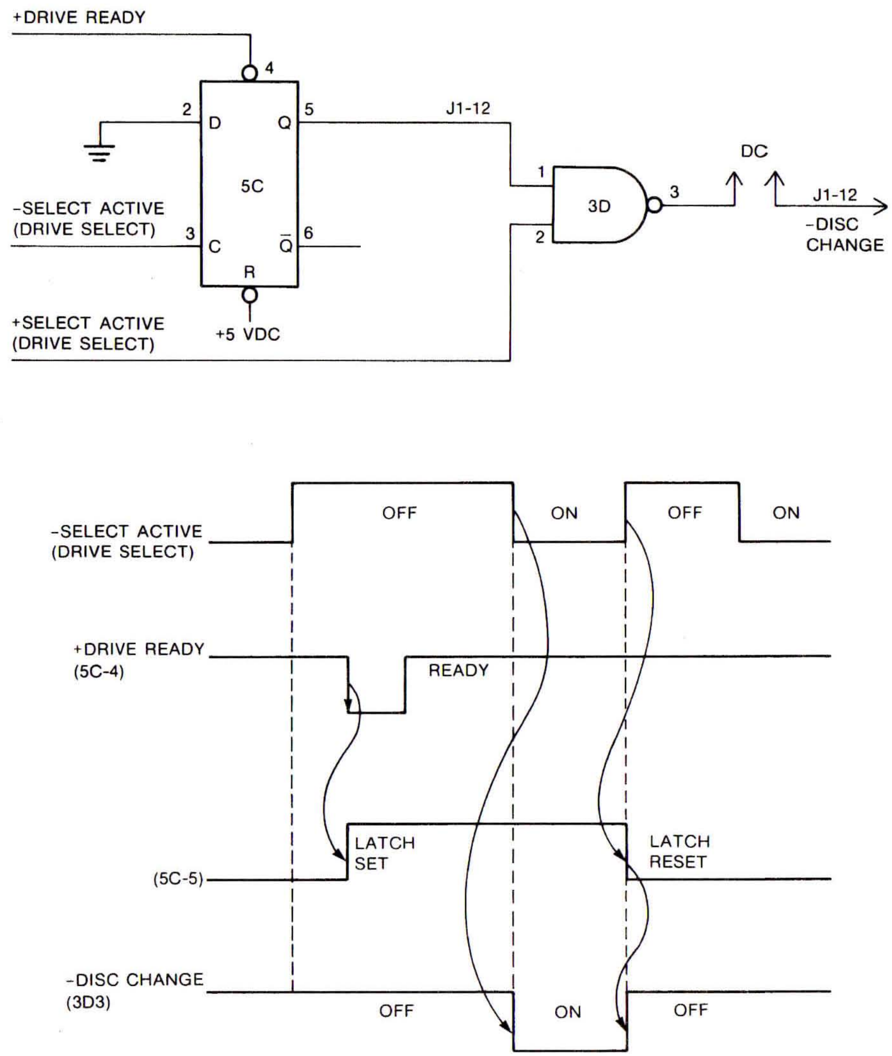


FIGURE 3-20. DISC CHANGE LATCH

3.4.3.9 Ready (Radial)

This output can be optionally converted to a radial output; i.e., the output can be monitored independent of whether the drive is selected.

Procedure:

1. Cut away trace RR located near 4D and 5D. See Figure 3-18.
2. If the system contains more than one flexible disc drive, add a jumper wire from pad R to one of the unused spare I/O pin pads.

3.4.3.10 Disc Change

This customer-installable option output is enabled by installing a jumper plug at the DC terminal posts located near the J1-12 pad.

This output is inactive until the door is opened and +DRIVE READY is deactivated. Once activated, this output will remain at a low logic level throughout the period of selection even if the door is subsequently closed. The -DISC CHANGE signal is only deactivated when all of the following conditions are met: the door is closed, the +READY signal is at a high logic level, the drive is deselected, and then reselected. See Figures 3-3 and 3-20.

3.4.3.11 Data/Clock Separator (FM Format Only)

For FM formats with 3 missing clock pulses (for example, IBM format), the TS jumper plug is normally installed. The presence of the TS jumper plug allows clock resynchronization only after 3 missing clock pulses. If resyschronization after any single clock bit is desired, the FS jumper plug may be optionally installed. See Figure 3-21.

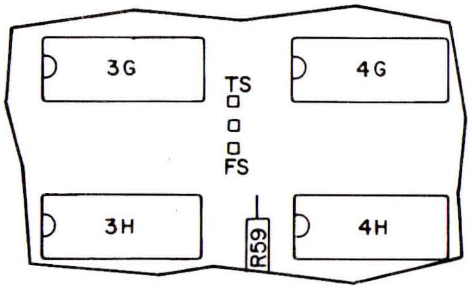


FIGURE 3-21. INTERNAL SEPARATOR SYNC

3.4.3.12 Write Protect Bypass

The Write Protect optional feature causes any write operation to be inhibited and the controller notified that a disc has been installed with a write protect notch. This protect feature can be bypassed to allow the drive to write on a disc which has an open write protect notch. The write protect line driver will continue to provide the controller with an indication of the state of the write inhibit detector.

Procedure:

1. Cut away trace WP located near 6D. See Figure 3-19.
2. Add jumper wire at NP pads.

3.4.3.13 In Use

This input is normally not enabled. It may be optionally enabled to light the BUSY LED and/or lock the drive door when either or both optional features are installed. A second option is to use an alternate input signal to provide the same function as the In Use signal.

In Use—In Use Signal

Procedure:

Install a jumper plug at D terminal posts located between 2E and 2F. See Figure 3-8.

In Use—Alternate Input Signal

Procedure:

1. Cut trace 16 located near J1-18. See Figure 3-5.
2. Add jumper wire from 16 pad, farthest away from J1-16 contact, to any unused spare I/O pin.

3.4.3.14 Erase Current Delay Time

The erase current turn-on and turn-off times are referenced to the write gate signal, and are different for soft and hard sector. See Figure 3-22.

Procedure:

1. Jumper plug SSE terminal posts for soft sector formats.
2. Jumper plug HSE terminal posts for the hard sector format selective feature option.

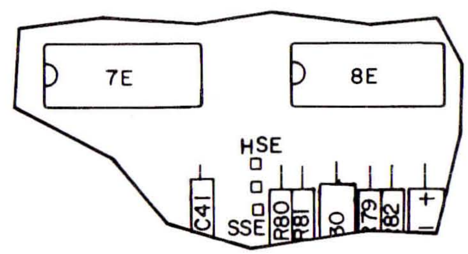


FIGURE 3-22. CURRENT DELAY

3.4.3.15 Erase Gate

The erase delay times are normally controlled internally by the drive, but can be controlled optionally by the Erase Gate input from the controller.

Procedure:

1. Cut away trace EG located between 9E and 9F.
2. Add jumper wire from EG pad to LG pad as shown in Figure 3-23.
3. Add a jumper wire from LN pad to any of the spare I/O pin pads near J1.
4. Add a 150-ohm pull-up resistor from pad LN to +5 VDC.

NOTE

A low logic level at the I/O input to LN activates the erase gate.

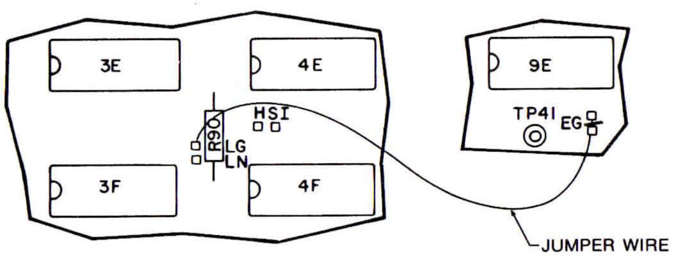


FIGURE 3-23. ERASE GATE

3.4.3.16 Write Current

The write current is normally controlled internally to switch to a lower write current value when at the 33 inner track positions. The write current may be controlled optionally by an external controller.

Procedure:

1. Cut trace LWC located between 11C and 11D.
2. Add jumper wire from LWC pad as shown in Figure 3-24 to one of the unused spare I/O pin pads.
3. Install a 150 ohm line terminator resistor to +5VDC.

NOTE

A high logic level at the write current input pin causes the Write Current line to be activated.

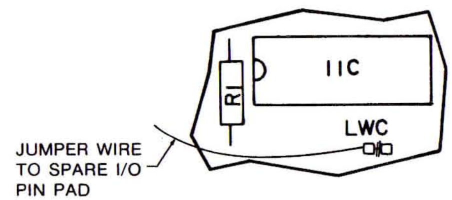


FIGURE 3-24. WRITE CURRENT

SECTION 4
MAINTENANCE PROCEDURES

This section provides complete, step-by-step instructions for 550/552 drive removal/replacement and alignment/adjustment techniques.

Before performing any of the following maintenance procedures, the operator or field service technician should check the following when answering a maintenance call.

Check to ensure that the operator is attempting an operation that is valid and the proper procedure is being employed. It is always a good idea to contact the person placing the call and attempt to have him identify the problem, whenever possible.

Check for obvious problems, i.e., input power fluctuations, loose cables to the PCB, dirty head, loose drive belt, cartridge inserted upside down or backwards, etc.

WARNING

Power should be removed from the 550/552 Disc Drive before attempting any maintenance procedures which do not require power to be on.

A few minutes spent checking the basics may save hours of maintenance and troubleshooting time.

4.1 TOOLS REQUIRED

The tools required in order to properly perform the various maintenance procedures listed in paragraphs 4.3 and 4.4 are:

TOOL	REQUIRED FOR
Screwdriver (0.19" × 0.04" blade)	Most maintenance procedures
¼" open end wrenches (2 required)	Clamp adjustment
Small nose pliers	Spindle spring removal
#1/16 AF Allen wrench	Drive pulley
#5/64 AF Allen wrench	Carriage end stop
Feeler gauge set	Various adjustments and clearances
Oscilloscope	Most alignments and adjustments
9/16" 0 punch	Spindle bearing removal
552 alignment disc (P/N 312391)	Head and track alignment
Gram gauge-pull type, 0-20 gm	To check load on head load arm (550-FDD)
AMP 465195-1	To remove pins from P2 connector

4.2 PREVENTIVE MAINTENANCE (PM)

The 550/552 Flexible Disc Drive is designed to operate with a minimum of preventive maintenance. The annual cleaning and inspection listed below is the only PM required. The PM procedure can be performed by an operator in a few minutes time.

4.2.1 Materials Required For PM

1. Isopropyl alcohol.
2. Cotton swabs.

4.2.2 550/552 Drive Cleaning

The following cleaning procedure is recommended by Memorex. It should be performed at least once each year.

1. Clean the head assembly using a cotton swab moistened in isopropyl alcohol (95% type is recommended). Wipe the head carefully to remove all accumulated dirt and oxide.

2. With the drive belt removed, clean the belt and the belt surfaces on the drive and driven pulley using a cotton swab moistened in isopropyl alcohol. Remove all accumulated dirt.

4.2.3 550/552 Drive Inspecting

The following inspection is recommended by Memorex. It should be performed at least once each year.

1. Inspect the drive belt for frayed edges or loose (stretched) belt. Change belt if required.

2. Inspect the Head Load Pad (on the 550 only) for worn or dirty pad. Change the pad using the following procedure, if required.

4.2.3.1 550 Head Load Pad Replacement

1. Locate pop-out pad assembly, refer to Figure 4-1. This assembly fits into the tip of the head load arm.

2. Remove worn pad assembly by squeezing retaining lugs and pushing the pad assembly out, as shown below.

3. Install new pad assembly.

NOTE

Some early production models will not have this pop-out pad, in which case the worn pad must be removed from the load arm, residual adhesive and foreign matter must be removed from the cavity and a new pad must be installed.

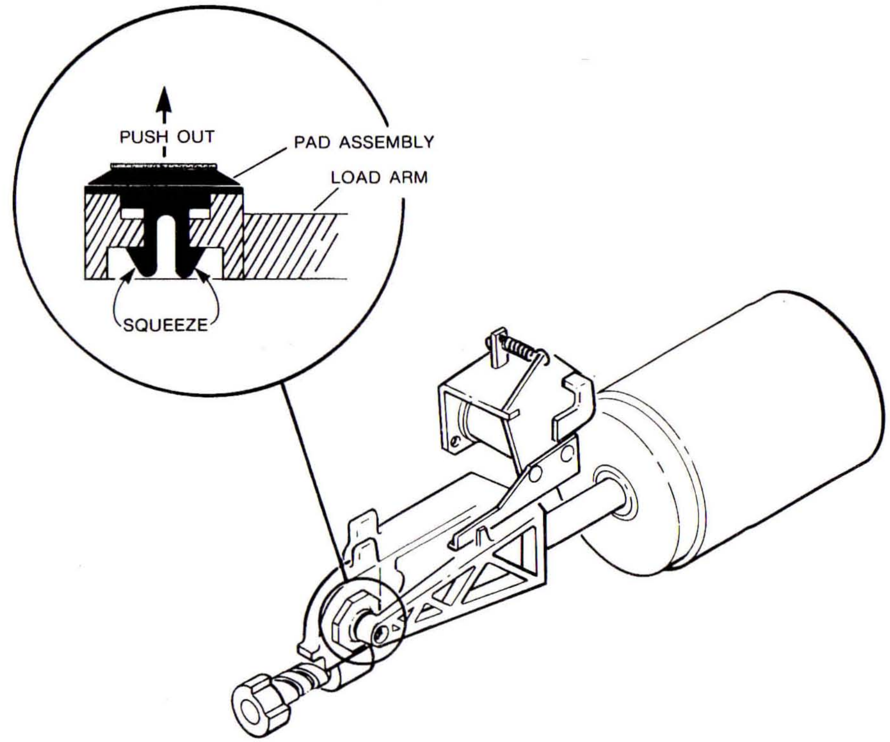


FIGURE 4-1. POP-OUT LOAD PAD REMOVAL (550)

4.3 MECHANICAL REMOVAL AND REPLACEMENT

4.3.1 Printed Circuit Board (PCB)

All drive electronics are mounted on a single printed circuit board. The PCB (shown in Figure 4-2) is mounted on the 550/552 drive with the component side out. The PCB is connected to the drive's base by two screws and four latch type standoffs. Four cable plugs are connected to the PCB, I/O, DC power, and internal circuits for the 550 drive. Five cable plugs are connected to the PCB, I/O, DC power, and internal circuits for the 552 drive. See Figure 3-1.

4.3.1.1 Removal

Prerequisite: None

1. Disconnect connectors J1, J3 (and J6 for the 552 FDD), and J4.
2. Remove two corner screws [A].
3. Disengage four latch type standoffs [B] by squeezing latches and sliding board off.
4. Disconnect connector J2.
5. Remove PCB.

4.3.1.2 Replacement

1. Reconnect J2.

CAUTION

Ensure cabling to internal circuits connector (J2) is free and does not cause warping of the PCB.

2. Reconnect connectors J1, J3 (and J6 for the 552 FDD), and J4.
3. Position PCB, and engage four latch type standoffs [B].
4. Install two corner screws [A].

4.3.2 Drive Belt

A drive belt is installed on the 550/552 drive under the PCB. The belt provides spindle rotation by connecting the driven pulley, installed on the spindle, to a drive pulley, installed on the drive motor shaft. The drive belt [C] is shown in Figure 4-2.

4.3.2.1 Removal

Prerequisite: PCB removal (see paragraph 4.3.1).

Remove the belt [C] by sliding it off the driven pulley [D].

4.3.2.2 Replacement

1. Install the belt [C] over the drive pulley [E] and then over the driven pulley [D].
2. Apply AC power to motor to ensure belt is tracking properly before reinstalling PCB.

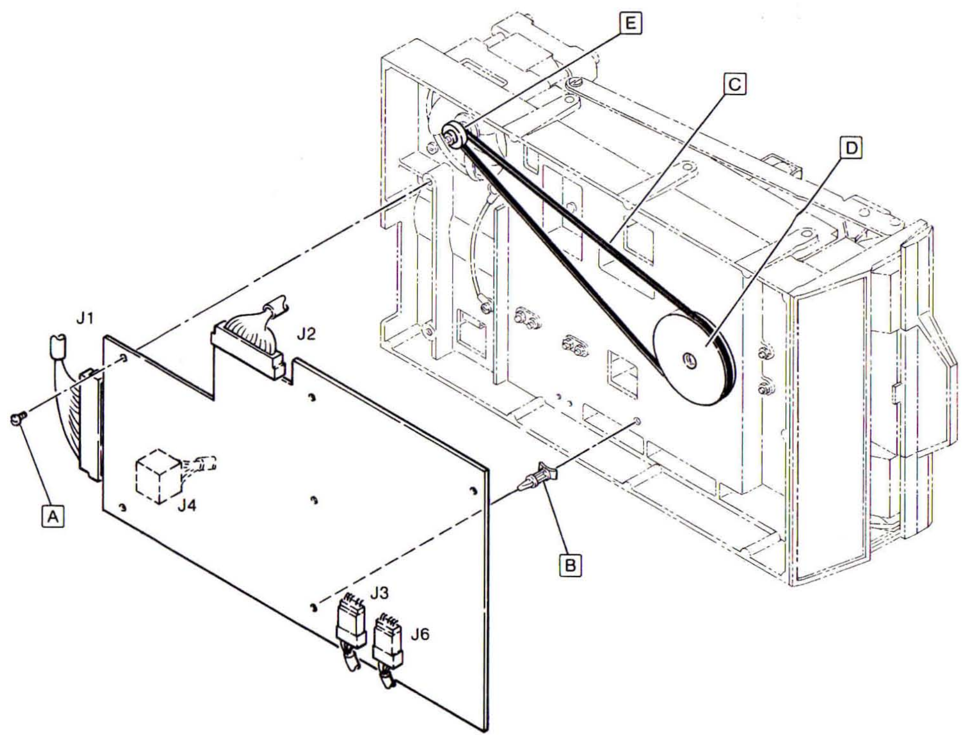


FIGURE 4-2. PRINTED CIRCUIT BOARD (PCB) AND DRIVE BELT REMOVAL AND REPLACEMENT

4.3.3 Head Load Solenoid Assembly

The 550/552 Head Load Solenoid Assembly consists of a solenoid assembly with an armature extention that operates a spring-loaded bail. The purpose of the assembly is to control the action of the 550 load arm, which is spring-loaded to press the disc in the cartridge against the head mounted on the carriage assembly. In the case of the 552 FDD, the purpose of the head load solenoid assembly bail is to initiate the spring-loaded fork action that allows the two heads to come in contact with the revolving media.

The Head Load Solenoid Assembly is mounted on the 550 drive as shown in Figure 4-3. The Solenoid Assembly is attached to the drive base by two screws on the bottom of the assembly.

4.3.3.1 Removal

Prerequisites: PCB removal (see paragraph 4.3.1).

1. Disconnect the solenoid leads and wires [A] . All connections are of the slip-on type.
2. Remove the two solenoid attaching screws [B].
3. Remove head load solenoid assembly [C].

4.3.3.2 Replacement

1. Position the head load solenoid assembly [C] in place and install two attaching screws [B].
2. Connect the slip-on leads and wires [A] removed in the disassembly process.
3. Perform Bail Clearance Verification to complete replacement procedure (refer to paragraph 4.4.9).
4. Install PCB.

4.3.4 Sensor Assemblies

There are three separate Sensor Assemblies to provide track 00, track 43, and write protect (optional) information to the PCB via the J2 connector. These Sensor Assemblies (shown in Figure 4-3) are mounted on the base by two holding screws each.

The track 00 sensor indicates to the electronics that the head is positioned at track 00 or the adjacent track on either side of track 00.

The track 43 sensor indicates to the electronics that the head is positioned at track 44 through 76 inclusive. This information is used by the electronics to switch to low write current for the 33 innermost tracks. The signal to the electronics remains active for all tracks above 43.

The Write Protect Sensor indicates to the electronics that a disc cartridge with a Write Inhibit notch is presently inserted in the drive. The electronics will inhibit the write and erase circuitry as long as this disc is used. The Write Protect Sensor is an option on the 550/552 drive.

4.3.4.1 Removal

Prerequisite: PCB removal (see paragraph 4.3.1)

1. Disconnect slip-on wires on the sensor assembly.
2. Remove two screws [D] holding the sensor assembly to the base. (Retain or retrieve socketed nuts [E] on opposite side of base and head cable clamp [F] secured by screws.)
3. Remove sensor(s).

4.3.4.2 Replacement

1. Position sensor(s) in place.
2. Install two holding screws in each sensor: the holding screws for the track 43 sensor should be accompanied by the head cable clamp.
3. Reconnect wires previously removed.
4. Follow adjustment procedure detailed in paragraphs 4.4.4, 4.4.6, and 4.4.12 (track 00, >track 43, Write Protect Adjustment, respectively) of this manual.

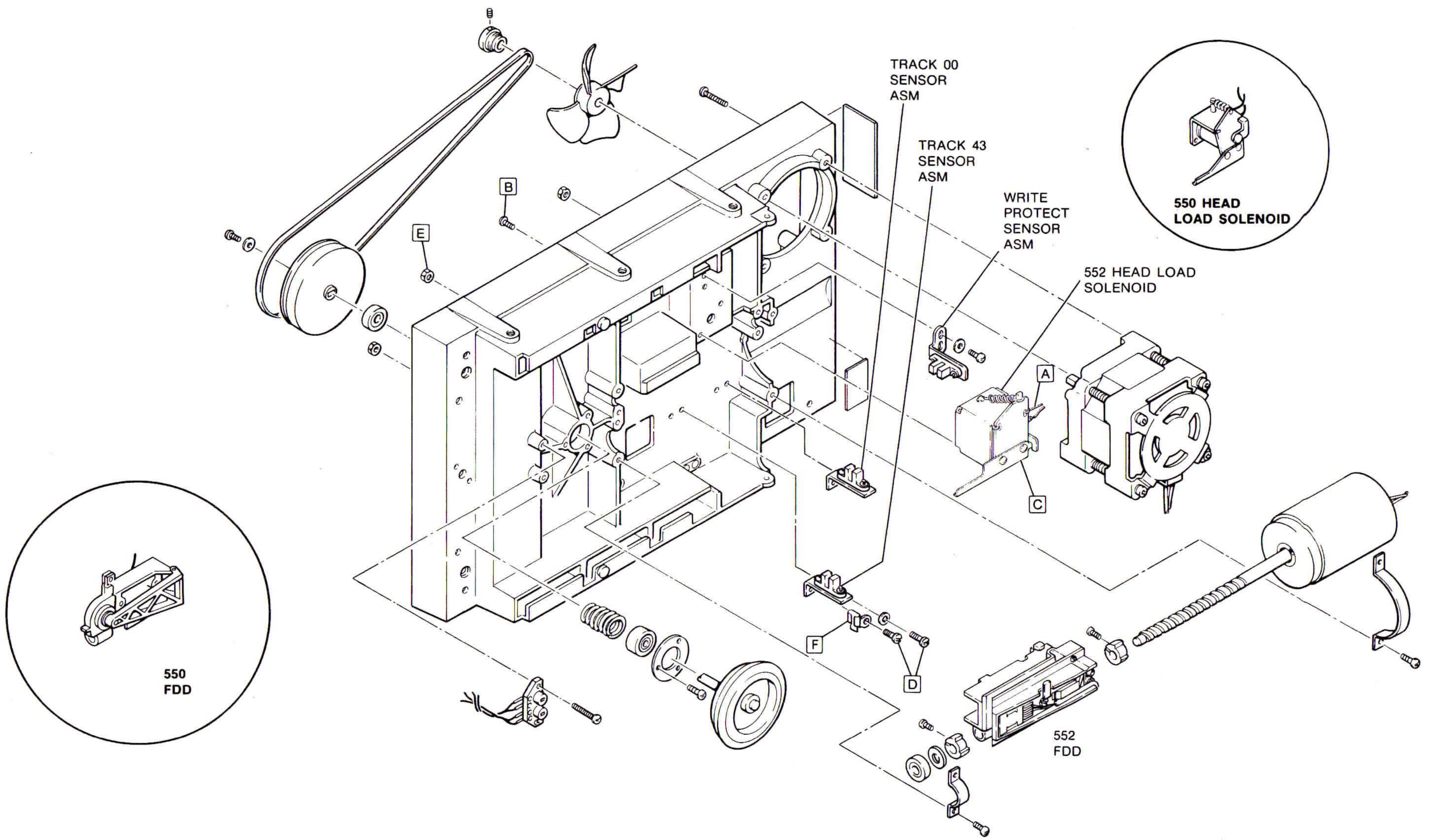


FIGURE 4-3. HEAD LOAD SOLENOID AND SENSOR ASSEMBLY REMOVAL AND REPLACEMENT

4.3.5 Door Closed Switch

The Door Closed Switch is located on the main frame (shown in Figure 4-4) and secured to the assembly by two screws. The switch prevents the drive from becoming READY unless the door is properly latched. The head cannot be loaded unless the switch makes contact.

NOTE

In earlier production models, the Door Closed Switch is mounted on the top of the carrier assembly.

4.3.5.1 Removal

Prerequisite: None

1. Remove two wires (slip-off type) [D] from switch [B].
2. Remove the two screws [A], washer, and nut plate that hold the door switch [B] to the main frame.
3. Remove the switch.

4.3.5.2 Replacement

1. Install the two screws [A], washer, and nut plate after positioning the door switch [B] under its mounting holes.
2. Reconnect wires [D].
3. Close the door and adjust the position of the door switch [B] by pressing it against the main frame as tightly as possible. Tighten the two screws [A]. Verify that the switch makes and breaks contact.

4.3.6 Index/Sector Detector

The Index/Sector Detector is mounted on the carrier assembly of the 550 FDD and the 552 FDD as shown in Figure 4-4. The detector is used to detect the presence of the index hole on the flexible disc. When using hard sectored discs, the index detector is used to detect both index and sector holes as the disc rotates. The relative position of the detector on the carrier assembly mounting slot determines the timing alignment. Light from the LED falls on the detector when a disc index or disc sector hole passes between the two. The light turns on the detector and a threshold detector circuit generates the timing pulse.

4.3.6.1 Removal

Prerequisite: None

1. Remove two wires [E] connected to the detector assembly [F].
2. Remove one holding screw and washer [G].
3. Remove the detector assembly [F].

4.3.6.2 Replacement

1. Position the detector over the mounting holes.
2. Install the holding screw and washer [G].
3. Reconnect the two wires previously removed [E].
4. Refer to paragraph 4.4.5 of this manual for the Index Sector Alignment Procedure.

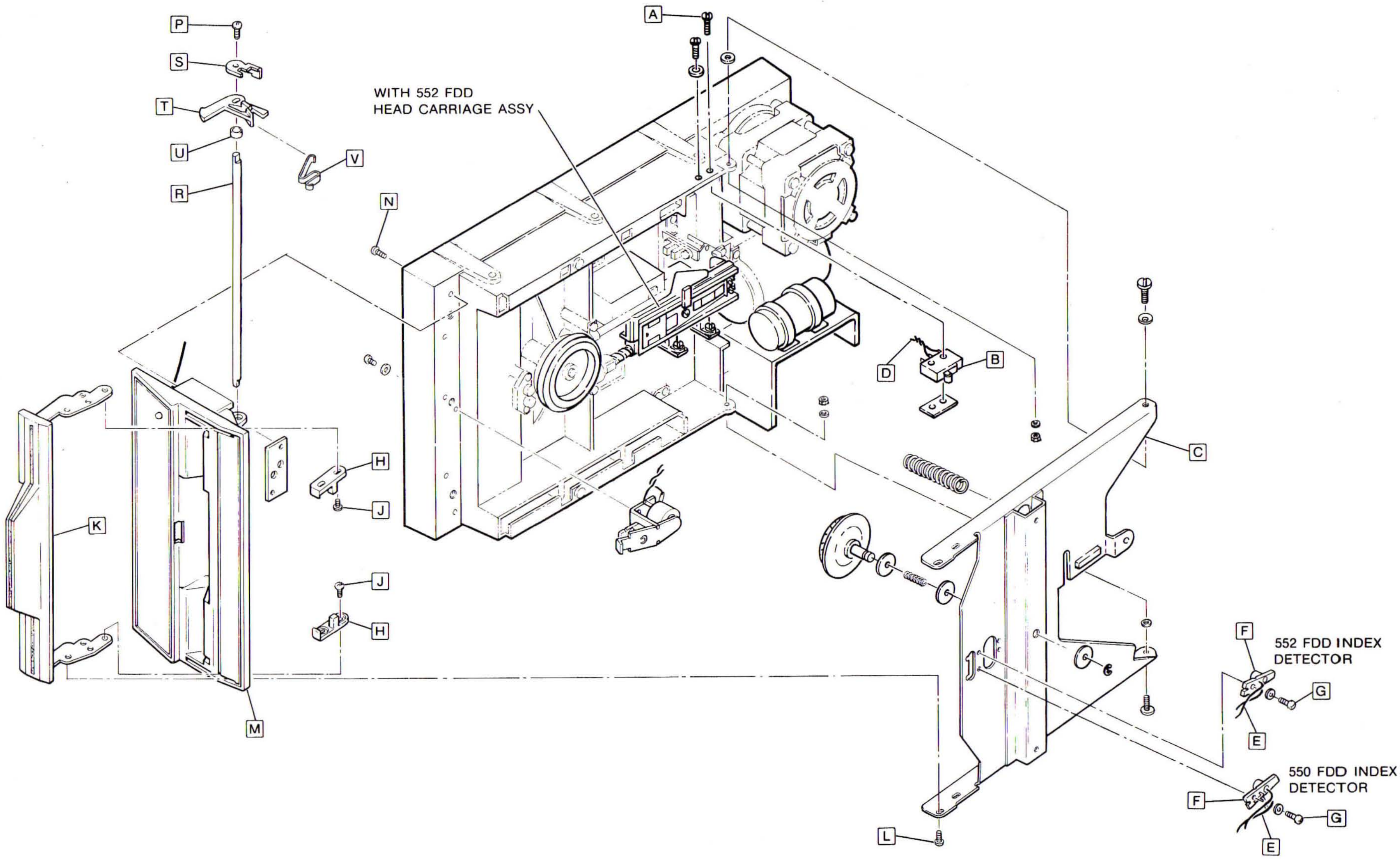


FIGURE 4-4. DOOR CLOSED SWITCH, INDEX SECTOR DETECTOR, DOOR, BEZEL AND INTERLOCKING LATCH ASSEMBLY REMOVAL AND REPLACEMENT

4.3.7 Door Assembly

The Door Assembly is mounted to the carrier assembly via two brackets as shown in Figure 4-4. Two interlock actuators are also attached to these brackets. The door is made of a molded, glass-filled thermoplastic. 550/552 operations are inhibited unless the door is properly closed and latched. The door is attached to the carrier which contains the disc clamping mechanism. Closing the door clamps the disc to the spindle and holds the cartridge against the platen.

4.3.7.1 Removal

Prerequisite: None

1. Remove two interlock actuators [H] (one on each door bracket) by removing two screws [J] in each actuator.
2. Disconnect Door Assembly [K] from carrier [C] by removing four screws [L] (two on each side).
3. Pull Door Assembly [K] out through bezel [M].

4.3.7.2 Replacement

1. Push Door Assembly [K] into position through bezel [M].
2. Reconnect Door Assembly to carrier assembly [C] by installing four screws [L] . (Two on each side.)
3. Reconnect two interlock actuators (one on each side of door) by installing two screws in each actuator.
4. Refer to paragraphs 4.4.11 and 4.4.13 of this manual for proper adjustments to be performed after replacement.

4.3.8 Bezel and Interlocking Latch

The bezel is the front panel of the flexible disc drive. An optional bezel with a red file busy indicator may be installed to inform the operator when the unit is reading or recording. It warns the operator that interrupting the operation in progress may affect data integrity.

The two interlocking latches are attached to the bezel via an interlock shaft. The latches lock the flexible disc cartridge in place after proper insertion. Operating in conjunction with the interlock actuators, the latches prevent the door from closing if a disc is improperly seated. The bezel and interlocking latches are shown in Figure 4-4.

4.3.8.1 Removal

Prerequisite: Removal of PCB (paragraph 4.3.1) and door assembly (paragraph 4.3.7) for bezel removal only. No prerequisites are required for the removal of the interlocking latches.

1. Loosen the four bezel mounting screws [N].

NOTE

On some early production models the bezel screws must be removed.

2. Remove bezel [M] by sliding it out of the drive frame.
3. Remove two screws [P] one at each end, on the interlock shaft [R].
4. Remove latch stops [S].
5. Slide interlocking latches [T] off ends of shaft.
6. Remove bushings [U].
7. Remove latch springs [V].
8. Remove interlock shaft [R] .

4.3.8.2 Replacement

1. Insert interlock shaft [R] into bezel [M].
2. Install latch springs [V].
3. Install bushings [U].
4. Install interlocking latches [T] on ends of interlock shaft.

CAUTION

Ensure that latches are fully engaged with flats on shaft before starting screws. Ensure that latches are properly installed under springs.

5. Install one screw [P] at each end of shaft to the interlocking latch with latch stops [S] under screw heads.
6. Install bezel [M] by sliding it on to the drive base as far as it will go.
7. Tighten the four mounting screws [N] making sure bezel is centrally positioned and tight against base for full length.
8. Refer to paragraphs 4.4.11 and 4.4.13 for appropriate adjustment procedure.

4.3.9 Program Controlled Door Lock

The Program-Controlled Door Lock is an optional solenoid-operated device to prevent the opening of the drive door. When the solenoid is energized, the locking ear blocks the door latch, thus protecting the drive from being interrupted. The lock is mounted internally, on the base; Figure 4-5 shows the location of the door lock assembly.

4.3.9.1 Removal

Prerequisite: Bezel and door removal (paragraphs 4.3.7 and 4.3.8, respectively).

1. Disconnect cable [A].
2. Remove two mounting screws and washers [B].
3. Remove lock assembly [C] .

4.3.9.2 Replacement

1. Position lock assembly [C] in place.
2. Install two mounting screws [B].
3. Reconnect cable [A].

CAUTION

When reinstalling bezel ensure that locking ear lies on top of stop on bezel.

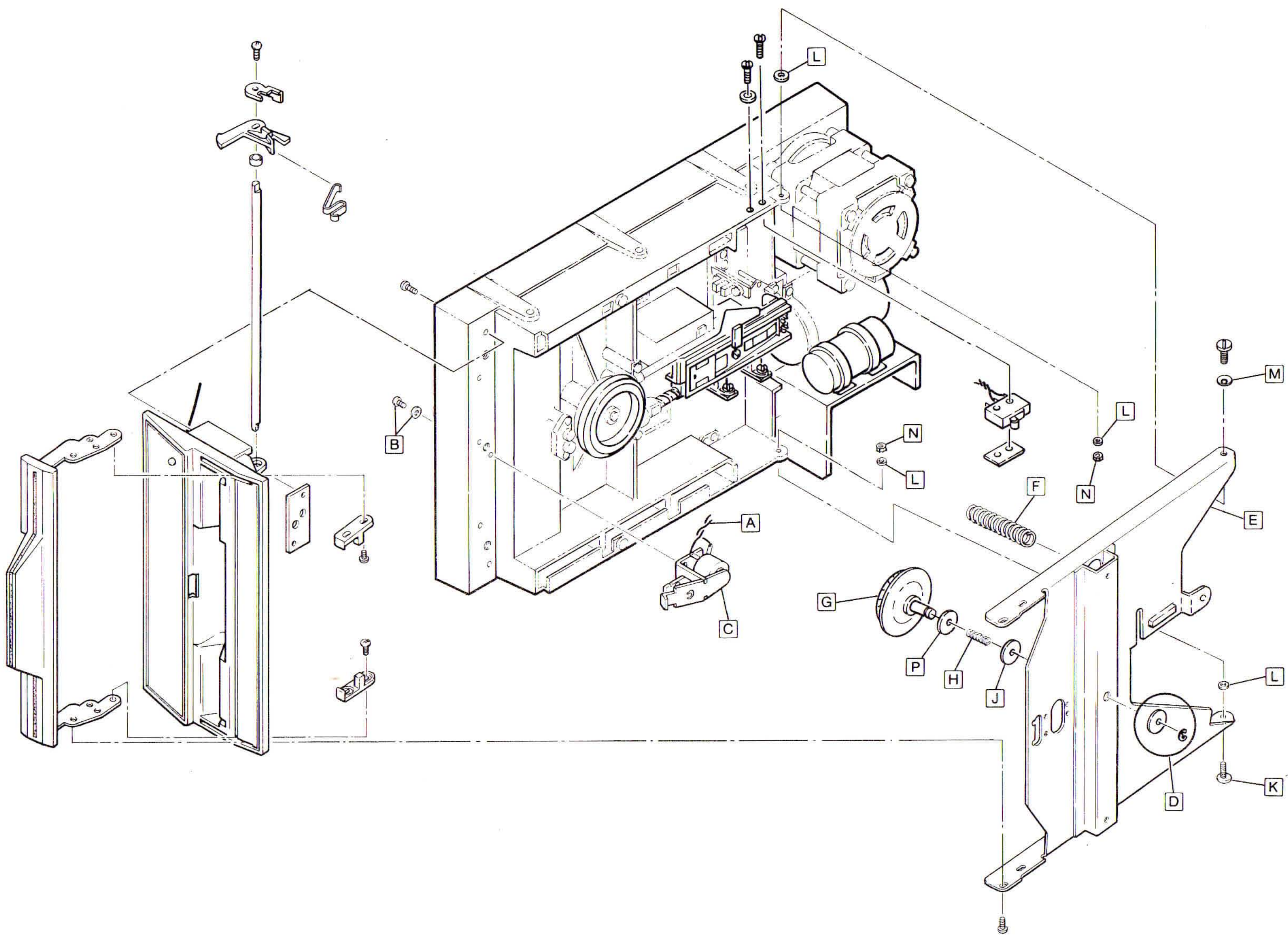


FIGURE 4-5. PROGRAM CONTROLLED DOOR LOCK, CLAMP, AND CARRIER ASSEMBLY REMOVAL AND REPLACEMENT

4.3.10 Disc Clamp

The Disc Clamp is used to center the disc on the spindle and clamp the disc to the spindle. It is mounted on the carrier and performs its function when the door is closed and latched. The Clamp is secured by a retaining ring and requires no vertical adjustment. The Clamp Assembly is shown in Figure 4-5.

NOTE

In earlier production models, the clamp contains an adjustable nut for vertical positioning.

4.3.10.1 Removal

Prerequisite: Door assembly removal (paragraph 4.3.7).

1. Remove retaining ring and washer [D] that hold clamp to carrier [E].
2. Swing open carrier assembly and remove carrier springs [F].

CAUTION

Open carrier carefully. Do not force past stops. Do not allow carrier to slam shut.

3. Remove clamp [G], spring [H], washer [P], and washer [J] from carrier.

4.3.10.2 Replacement

1. Assemble steel washer [P], spring [H], and plastic washer [J] on clamp [G].
2. Place clamp and screw in spindle cavity.
3. Close carrier carefully, allowing screw to protrude through hole.
4. Install washer, and retaining ring [D] on outer side of carrier to secure clamp.

CAUTION

Ensure carrier springs [F] are reinstalled before replacing door assembly.

5. Refer to paragraph 4.4.11 for alignments and adjustments.

4.3.11 Carrier Assembly

The main function of the Clamp Carrier Assembly is to hold and actuate the disc clamp. It also provides mounting means for the Door Closed Switch, index detectors, and cartridge pressure pad. The Carrier is mounted to the base by two pivot screws. The Carrier is shown in Figure 4-5.

NOTE

In earlier production models, the Door Closed Switch is mounted on the top of the Carrier Assembly.

4.3.11.1 Removal

Prerequisite: Door assembly removal (paragraph 4.3.7.1, Step 2 only).

1. Disconnect two wires to door switch assembly if the switch is mounted on the carrier assembly.
2. Disconnect wires to index detector(s) assembly.
3. Remove cables.
4. Remove two Carrier pivot screws [K].
5. Retain four washers [L], one spring washer [M], and two kep nuts [N].
6. Remove Carrier [E]; retain two Carrier springs [F].

4.3.11.2 Replacement

1. Position carrier [E] in place; with two Carrier springs [F] not yet inserted.
2. Install pivot screws [K] ensuring that spring washer [M] is directly under head of pivot screw closest to drive motor and outer washers [L] are next to the main frame.
3. Place inner washers [L] and kep nuts [N] on pivot screws [K].
4. Install the two Carrier springs [F].
5. Install cables.
6. Reconnect wires to index detector(s) assembly.
7. Reconnect two wires to door switch assembly if the switch is mounted on the carrier assembly.
8. Perform the adjustments listed in paragraphs 4.4.5 (Index Alignment) and 4.4.11 (Carrier Adjustment) to complete the replacement procedure.

4.3.12 Spindle, Bearings, and Driven Pulley

The Spindle Assembly consisting of the spindle and press fitted hub is mounted in bearings on the base as shown in Figure 4-6. The Driven Pulley is mounted on the spindle on the opposite end of the hub. The pulley is driven by the drive motor and belt to provide disc rotation.

4.3.12.1 Removal

Prerequisite: PCB (paragraph 4.3.1), belt (paragraph 4.3.2), and Carrier Assembly (paragraph 4.3.11) removals.

1. Remove pulley mounting screw and washer [A].
2. Remove driven pulley [B].
3. Remove lower spindle bearing (bearing under driven pulley) [C].
4. Turn drive over.
5. Remove spindle assembly [D].
6. Remove three mounting screws [E] and keeper plate [F].
7. Invert drive again; press-out upper spindle bearing [G] and bearing load spring [H]. (This requires a $^9/_{16}$ inch diameter punch.)

4.3.12.2 Replacement

1. Insert bearing load spring [H] and carefully press upper spindle bearing [G] in hole until seated.

NOTE

Shielded end of bearings should be out.

2. Install keeper plate [F] with three mounting screws [E].
3. Insert spindle assembly [D].
4. Invert drive.
5. Install lower spindle bearing [C].
6. Install driven pulley [B].

CAUTION

On reassembly be extremely careful when putting driven pulley on shaft. Use moderate hand pressure to hold pulley in keyed position while tightening screw. Bearing load spring will push pulley out of key if proper pressure is not applied. It may be necessary to hold the hub during this operation.

7. Install screw and washer [A] on bottom side of spindle.

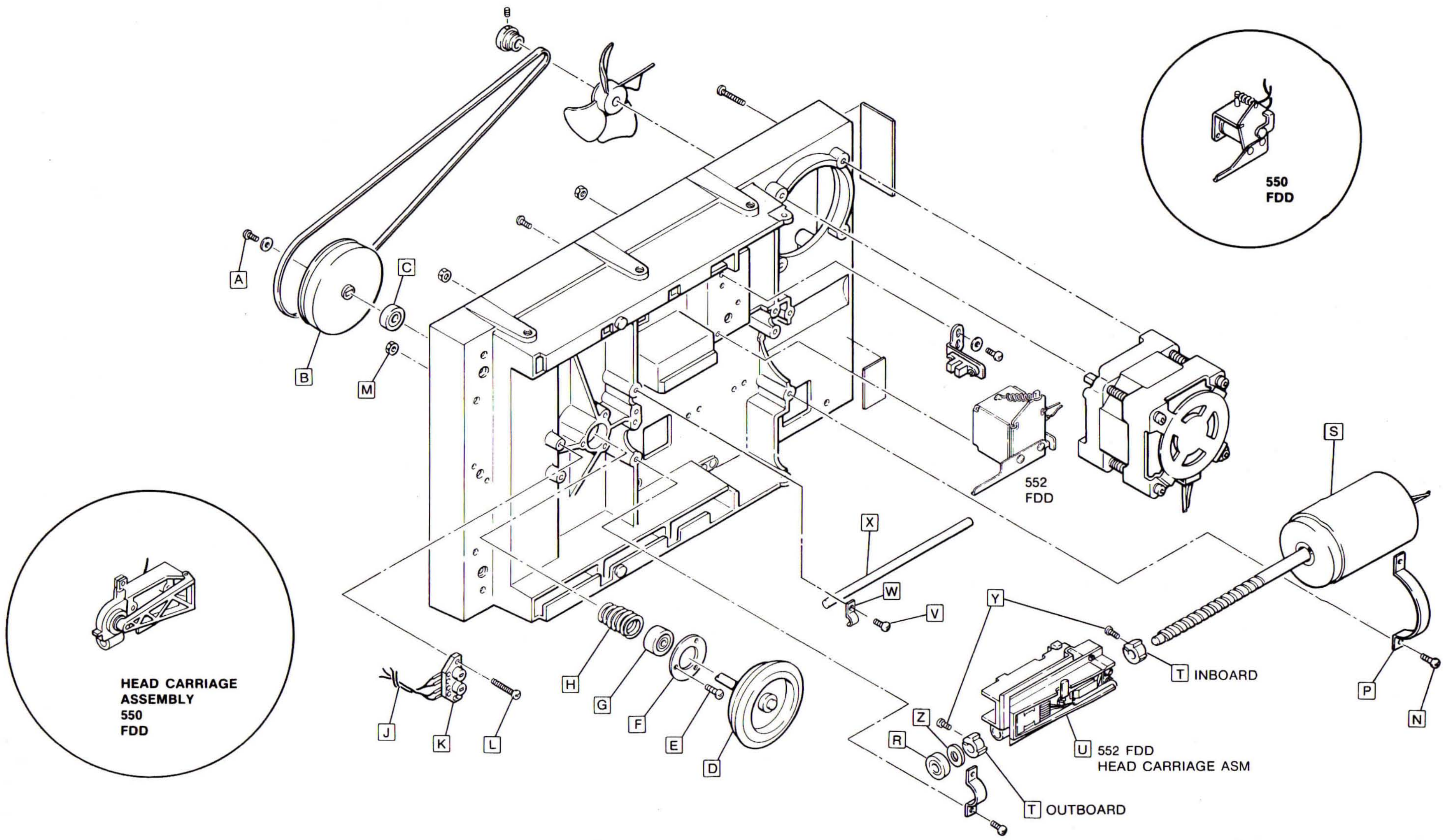


FIGURE 4-6. SPINDLE, BEARINGS, DRIVEN PULLEY, INDEX/SECTOR EMITTERS, STEPPER AND CARRIAGE ASSEMBLY REMOVAL AND REPLACEMENT

4.3.13 Index/Sector Emitter (LED) Assembly

The Emitter Assembly is mounted on the base in front of the spindle assembly; it is secured by two mounting screws. The assembly normally includes two LEDs (Light Emitting Diodes) which emit invisible infrared light directed at the Index/Sector Detector Assemblies whenever DC power is applied to the drive. The assembly can include a second LED for alternate side operation. The Index/Sector Emitter Assembly is shown in Figure 4-6.

4.3.13.1 Removal

Prerequisites: PCB (paragraph 4.3.1) and door assembly removal (paragraph 4.3.7).

1. Swing open carrier.
2. Disconnect the cable(s) [J] to the Emitter Assembly [K].
3. Remove two screws [L] and nuts [M] holding Emitter Assembly to base.
4. Remove Emitter Assembly [K] .

4.3.13.2 Replacement

1. Position Emitter Assembly [K] over its mounting holes on base.
2. Install two screws [L] and nuts [M] to secure Emitter Assembly to base.
3. Reconnect the cable(s) [J] previously removed.
4. Refer to paragraph 4.4.5 for the Index alignment procedure, and paragraph 4.4.11 for door alignment procedure.

4.3.14 Stepper and Carriage Assembly

The Stepper motor is used to position the carriage at the track address determined by the drive electronics. The Stepper [S] and Carriage [U] Assembly are shown in Figure 4-6.

The recording head is mounted on a carriage that travels parallel to a radius of the recording disc. The carriage is driven toward or away from the disc center by a rotating screw on which the carriage is mounted. The screw is rotated in either direction by the Stepper motor. The Stepper motor rotates the screw in 15-degree increments. The linear head travel resulting from one rotational increment is equal to the center-to-center distance between two adjacent tracks on the disc and is approximately 0.053 centimetre (approximately 0.021 inch). Accessing depends upon the initial alignment of the carriage on the screw so that the head is radially positioned over a track centerline. Carriage stops are mounted on both ends of the screw to prevent inadvertent carriage overtravel. The stops must be correctly positioned after the head radial alignment is complete.

4.3.14.1 Removal

Prerequisite: PCB removal (paragraph 4.3.1). If Stepper removal is being performed, start with step A; if Carriage is being removed, start with step B.

Step A. Remove cable ties and disconnect wires from positions M, N, P, and R of PC connector J2 (See Figure 4-2).

Step B. Loosen screw [Y] in outboard carriage end stop.

1. Remove cable clamp [F] (see Figure 4-3) from track 43 switch assembly.
2. Remove two Stepper clamp screws [N] and remove clamp [P].
3. Ensure that track sensor flag is free of sensors.
4. Withdraw Stepper motor until end of shaft is free from bearing [R].
5. Remove Stepper motor [S] and Carriage assembly by swinging carriage clear of way shaft [X] and lifting off of base.
6. Remove outboard carriage end stop [T] and o-ring [Z].
7. Unscrew Carriage assembly [U] from Stepper motor shaft.
8. Carriage is now free.
9. Loosen screw [Y] of inboard carriage end stop.
10. Remove or loosen inboard carriage end stop [T].

4.3.14.2 Replacement

1. Install inboard carriage end stop (do not tighten screw $\boxed{Y}$), and screw the Carriage assembly $\boxed{U}$ on to the Stepper motor $\boxed{S}$ shaft.

2. Install outboard carriage end stop $\boxed{T}$ (do not tighten screw $\boxed{Y}$), and o-ring $\boxed{Z}$.

3. Install Stepper motor and Carriage assembly on base by sliding Stepper motor shaft into bearing $\boxed{R}$, and allow Stepper motor to seat in its saddle with the motor axially indexed against the frame.

CAUTION

Ensure ear on load arm overlays the bail on head load solenoid. Ensure that carriage guide properly engages the way shaft and that the sensor flag clears the sensors.

4. Install Stepper clamp $\boxed{P}$ using two Stepper clamp screws $\boxed{N}$.

5. Install cable clamp and screw on base of track 43 switch assembly.

NOTE

Ensure that the clamped cable is long enough to allow the Head Carriage assembly to access all carriage positions without restraint. The clamped cable should not contact adjacent components at any access position.

6. Reconnect wires from M, N, P, and R positions of P2 connector (if required).

7. Install cable ties (if required).

8. Refer to the following adjustments in this manual to complete replacement procedure.

Adjustment	Paragraph
Radial	4.4.2
Track 00	4.4.4
Track 43	4.4.6
End stops	4.4.7
Bearing/shoulder clearance	4.4.8
Bail Clearance Verification	4.4.9
Carrier/door/ disc clamp	4.4.11

4.3.15 Way Shaft

The Way Shaft provides carriage torsional constraint for the lead screw. The Way Shaft is shown in Figure 4-6 as [X].

4.3.15.1 Removal

Prerequisite: Door assembly removal (paragraph 4.3.7).

1. Swing open carrier.
2. Loosen screw [V] on clamp [W] closest to spindle.
3. Remove other clamp by removing screw.
4. Slide out Way Shaft [X] .

4.3.15.2 Replacement

1. Slide Way Shaft [X] into place.
2. Install clamp previously removed.
3. Tighten screw [V] on clamp closest to spindle [W] .
4. Close carrier assembly.
5. Perform Carrier Assembly and Disc Clamp adjustments (see paragraphs 4.3.10 and 4.3.11, respectively).

4.3.16 Drive Motor and Capacitor Assembly

The Drive Motor and Capacitor Assembly provides power to rotate the disc spindle. Speed is reduced from synchronous speed to 360 rpm by means of a belt and pulley system. The Motor is provided with an axial-flow fan for cooling. The Motor is mounted on the top side of the base. The Capacitor is also mounted on the top side of the base at the adjacent corner. Mounting is shown in Figure 4-7.

4.3.16.1 Removal

Prerequisite: PCB and drive belt removals (paragraphs 4.3.1 and 4.3.2).

1. Remove the grounding wire [A] on the PCB side of the Drive. One motor mounting screw [B] and one screw [C] on capacitor mounting bracket hold the ground wire to the base.
2. Remove the remaining Capacitor bracket screw.
3. Remove the remaining three Motor mounting screws and lock washers.
4. Remove Motor [D] and Capacitor assembly [E] from base.

4.3.16.2 Replacement

1. Install Motor [D] and Capacitor assembly [E] over respective positioning holes on the base.
2. On the PCB side, install three Motor mounting screws [B] and washers [F] leaving the hole closest to the Capacitor bracket empty.
3. Install Capacitor bracket screw in the far end (hole closest to outer edge of unit); align with other hole in base and tighten screw.
4. Reconnect the ground wire [A] using the two remaining screws and lock washers in the remaining holes on the Motor and Capacitor mounting bracket.

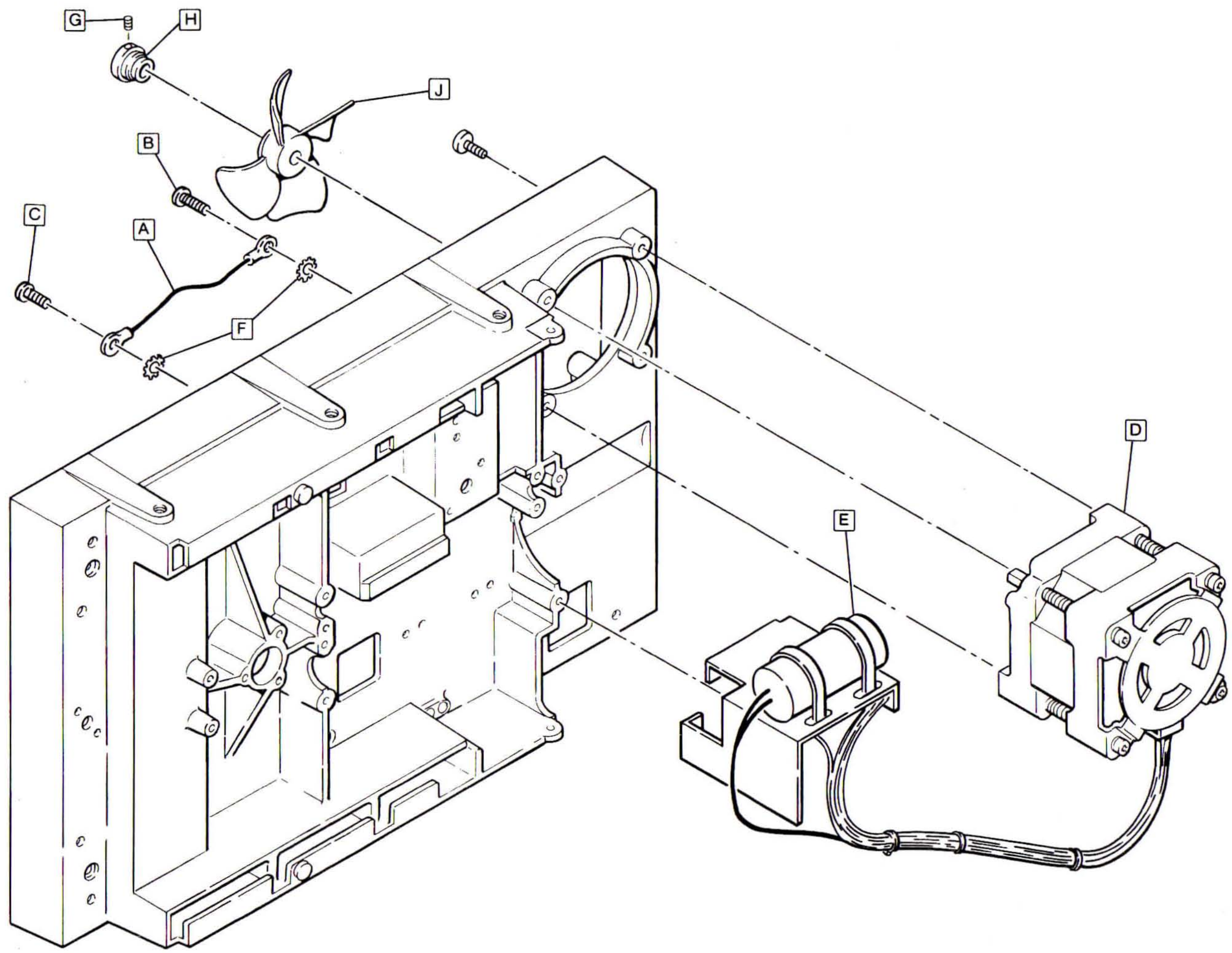


FIGURE 4-7. DRIVE MOTOR CAPACITOR, DRIVE PULLEY AND FAN ASSEMBLY REMOVAL AND REPLACEMENT

4.3.17 Drive Pulley

The Drive Pulley is mounted on the end of the drive motor shaft located on the PCB side of the drive. The Drive Pulley drives the driven pulley on the spindle via a linking drive belt. Figure 4-7 shows the Drive Pulley location.

4.3.17.1 Removal

Prerequisite: PCB and drive belt removal (paragraphs 4.3.1 and 4.3.2).

1. Loosen set screw G in drive pulley H with a $1/16$ AF socket head key.
2. Remove pulley.

4.3.17.2 Replacement

1. Install pulley and tighten set screw.

CAUTION

Ensure set screw is installed on flat side of shaft.

2. Adjust installation of pulley to conform to the specifications shown in Figure 4-8.

4.3.18 Fan Assembly

The Fan Assembly is part of the drive motor assembly, used for cooling the motor. Mounting location is shown in Figure 4-7.

4.3.18.1 Removal

Prerequisite: PCB, Drive Belt and Drive Pulley removals (paragraphs 4.3.1, 4.3.2, and 4.3.12, respectively).

Carefully pry fan J up and off of motor shaft, working against inner hub. Avoid forcing outer hub or fan blades.

4.3.18.2 Replacement

Press fan onto drive motor shaft per specifications shown in Figure 4-8. Apply force at inner hub only.

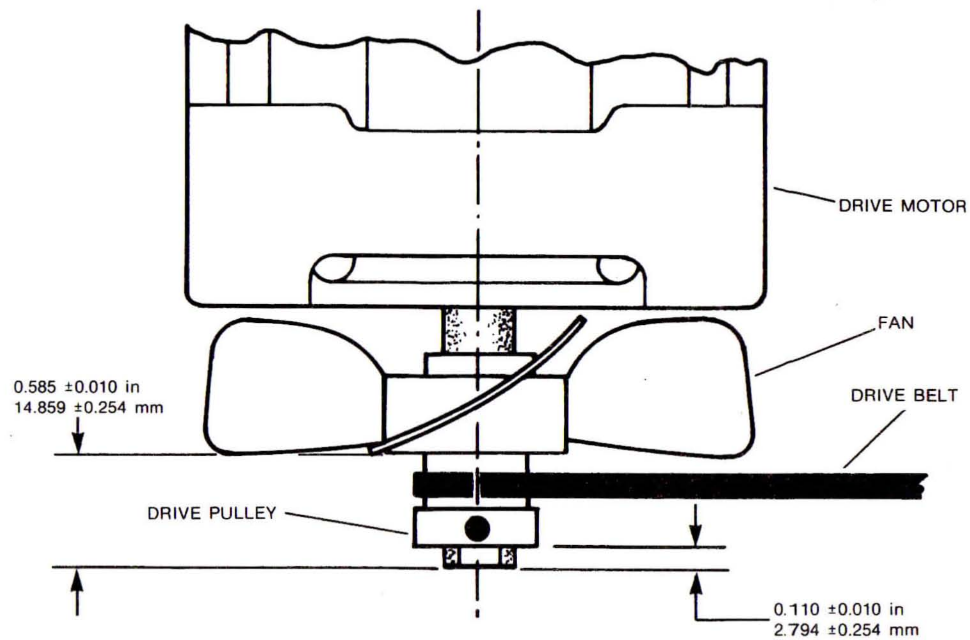


FIGURE 4-8. DRIVE PULLEY AND FAN INSTALLATION SPECIFICATIONS

4.3.19 Eject Springs

The Eject Springs are responsible for pushing the cartridge partially out of the drive for easy removal. This action occurs when the interlocking latches release the cartridge. The Eject Springs are mounted under the carrier, one on each side. Figure 4-9 shows the Eject Springs and mounting positions.

4.3.19.1 Removal

Prerequisite: PCB removal (paragraph 4.3.1).

1. From the PCB side remove two screws [A] attaching each spring [B] to the base.

2. Remove springs, retain socketed nuts [C] .

4.3.19.2 Replacement

1. Install springs.

CAUTION

Ensure that ends of springs are resting against end of cartridge guide ears on base.

2. Install four securing screws.

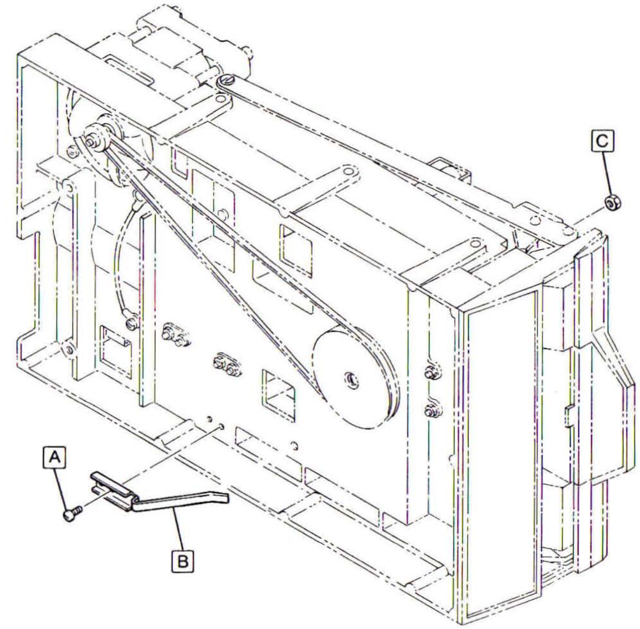


FIGURE 4-9. EJECT SPRINGS REMOVAL AND REPLACEMENT

4.4 ELECTRICAL REPLACEMENT, ALIGNMENT AND ADJUSTMENT

4.4.1 Printed Circuit Board (PCB)

The Printed Circuit Board (PCB) Assembly contains the necessary electronic circuitry for the 550/552 drive. All operations internal to the 550/552 (i.e., reading, recording, status, and controlling) are controlled by a single PCB. The block diagram in Figure 4-10 shows the major functional sections of the PCB. For detailed logic drawings, refer to the 550/552 Logic Manual.

The PCB Assembly is a replaceable unit. Once it is determined that a PCB problem exists, the board should be removed and replaced per the instructions in paragraph 4.3.1.

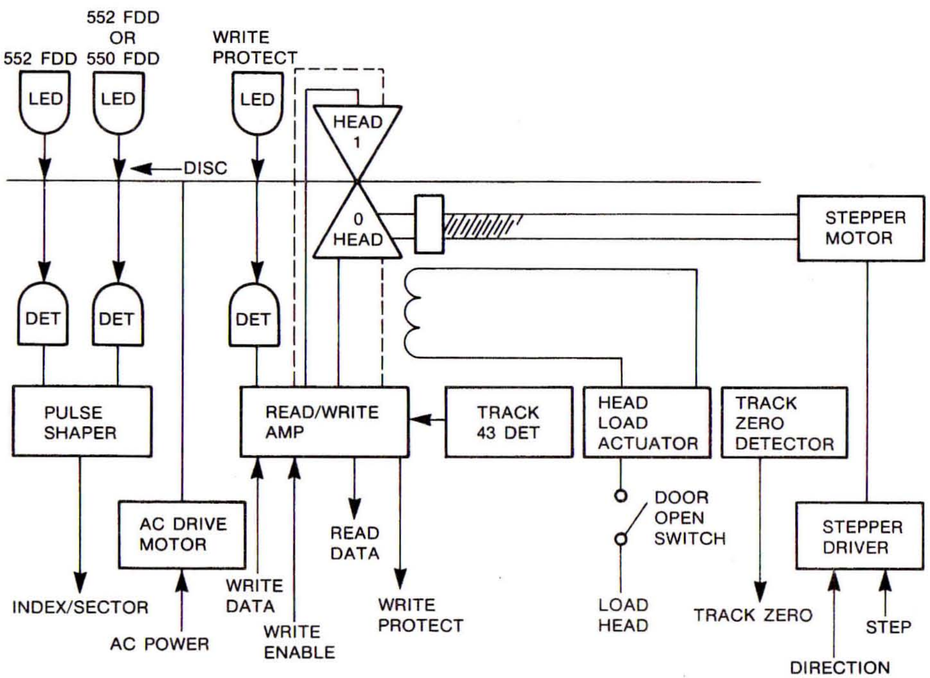


FIGURE 4-10. PCB FUNCTIONAL BLOCK DIAGRAM

4.4.2 Radial Head Check

Prerequisite: Warm-up period of one-half hour.

1. Insert field service alignment cartridge into drive.

2. Access track 38.

3. Ensure that the output at T51 is at a high logic level.

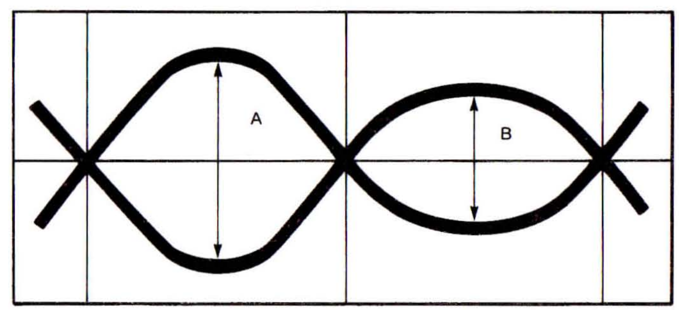
4. Set up oscilloscope as follows:

Vertical	0.2V per division
Horizontal	20 msec per division
Input	Add differentially
Sync	Index (TP 18)

   Place test probes on PCB TP 1 and TP 2 (head signal test points).

5. Observe waveform. The lobes ratio should be as specified in Figure 4-11. This specification applies to both heads on 552 drives.

6. If waveform is within specification, Radial Head check is completed. If waveform is not within specification, refer to Radial Head Alignment Procedure, paragraph 4.4.3.



$1.50 > \frac{A}{B} > 0.67$

FIGURE 4-11. RADIAL HEAD CHECK

4.4.3 Radial Head Alignment Procedure

Prerequisite: Warm-up period of one-half hour with alignment disc inserted is required for temperature stability before doing any alignment in this section.

1. Insert field service alignment cartridge into drive.
2. Access track 38.
3. Ensure that the output at T51 is at a high logic level.
4. Connect oscilloscope to test point TP 1 and TP 2; set scope as follows:

Vertical	0.2V per division
Horizontal	20 msec per division
Input	Add differentially
Sync	On index (TP 18)

5. Load head.
6. Ground test point TP 14, thus applying 24 VDC to motor phase winding.
7. Loosen two screws $\boxed{N}$ on Stepper motor clamp $\boxed{P}$ to permit Stepper rotation (Figure 4-6).
8. Observe waveform; it should be distinct lobe patterns; refer to Figure 4-11.
9. Adjust (rotate) stepper housing with front of housing indexed against base until both adjacent lobes meet the lobe ratio specified in Figure 4-11.
10. Tighten clamp screws without disturbing alignment.,

Verify radial head alignment as follows:

1. Remove ground from TP14.
2. Access track 37, then return to track 38.
3. Observe waveform; the lobe ratio must meet the following requirement: 1.5 > A/B > 0.8.
4. Access any track less than track 36, then return to track 38.
5. Observe waveform; the lobe ratio must meet the requirement specified in Step 3.
6. Access track 39, then return to track 38.
7. Observe waveform; the lobe ratio must meet the requirement specified in Step 3.
8. Access any track greater than track 40, then return to track 38.
9. Observe waveform; the lobe ratio must meet the requirement specified in Step 3.
10. Remove test probes.

4.4.4 Track 00 Alignment Procedure

Prerequisite: Perform the Radial Head Alignment Procedure (paragraph 4.4.3) if the Radial Head Check (paragraph 4.4.2) indicates that the heads are out of alignment.

1. Insert the alignment disc (Dysan 360/2 or equivalent) into the drive.
2. Access track 01 and load the head(s). Track 01 can be verified by observing the index alignment data burst that occurs when scoping test points TP 1 and TP 2 on the PCB.
3. Ground one of the transistor Q12 case mounting screws to TP 37 with a jumper wire. This procedure activates the STEP MOTOR PHASE C signal.
4. Ground TP 14 (-High Power) to TP 44 with a jumper wire. This procedure causes the Stepper motor voltage to increase from the standby voltage of +5 VDC to +24 VDC.
5. Check Q12 and Q13 case at a low logic level; check Q14 case at +24 VDC.
6. Loosen the two screws on the track detector (see Figure 4-3) and position it so that the voltage measured at the IC 4C Pin 1 is at 1.26 ±0.2 VDC.

NOTE

With the input to the Schmitt trigger (4C Pin 1) at 1.26 ±0.2 VDC, the output (TP 12) will be indeterminate. Thus, TP 12 should not be used in this step.

7. Remove the two jumper wires.
8. Verify that -TRACK 00 (TP 12) is at a low logic level when track 00 or track 01 is accessed and is at a high logic level when track 02 or higher is accessed.

4.4.5 Index Detector Alignment

4.4.5.1 550 FDD

1. Insert the alignment disc (Dysan 360/2, or equivalent) into the drive.

2. Access track 01.

3. Scope: Channel A 0.2/0.5V/div. (TP 1 or TP 2)
   Sync +Index 550 FDD: TP 18
   +Index 552 FDD: TP 18
   Sweep 50 μs/div.

4. Observe the waveform. The time period should be 200 microseconds ±50 microseconds until the first data pulse as shown in Figure 4-12. If it is not, adjust the appropriate index detector (see Figure 4-4).

5. Set the scope sweep time to 500 microseconds/div., and scope IC 4H Pin 8 (+INDEX) to verify the pulse width is between 1.3 and 2.2 milliseconds. If not, replace the index detector and/or emitter to obtain proper pulse width.

NOTE

Do **not** try to force the physical parts into a position to obtain the proper pulse width.

6. Set the scope sweep time to 50 microseconds and access track 76.

7. Observe waveform. It should be within ±30 microseconds of the time period observed or adjusted for track 01 in Step 4 (see Figure 4-12). If the waveform time period is not within this specification, the deviation may be caused by misaligned track position actuator, broken carriage, or damaged Field Service Alignment disc.

4.4.5.2 552 FDD

1. Remove one of the quick disconnect leads from the 500 FDD Index Detector (see Figure 4-4).

2. Perform Steps 1 through 7 of paragraph 4.4.5.1 to align the 552 FDD Index Detector.

3. Reconnect the 550 FDD Index Detector lead and remove one of the quick disconnect leads from the 552 FDD Index Detector.

4. Perform Steps 1 through 7 of paragraph 4.4.5.1 to align the 550 FDD Index Detector.

5. Reconnect the 552 FDD Index Detector.

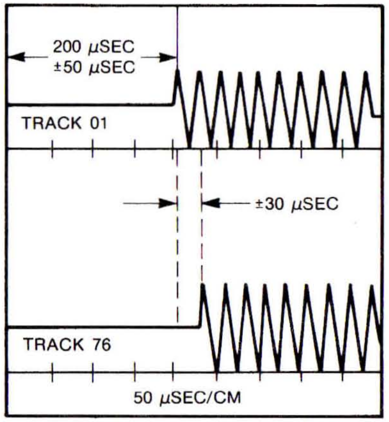


FIGURE 4-12. INDEX SENSING ALIGNMENT WAVEFORM

4.4.6 Track 43 Alignment Procedure

Prerequisite: Radial Head alignment and Track 00 alignment performed.

1. Access track 00; then, move forward 43 tracks.
2. Verify that the output at TP52 is at a high logic level.
3. Place test probe on TP 40.
4. Loosen two screws which hold track 43 sensor. (Refer to Figure 4-3.)

NOTE

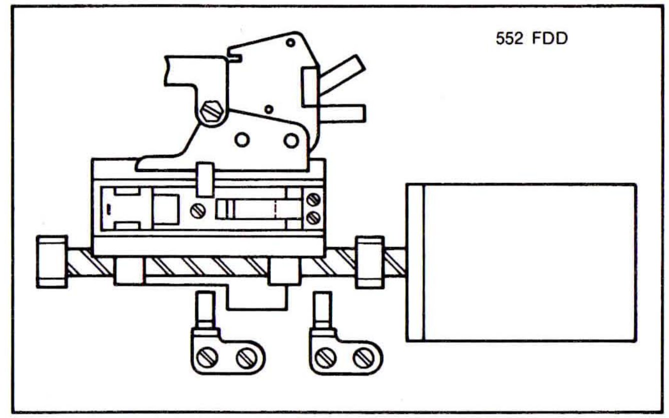
One sensor screw also holds cable clamp.

5. Adjust sensor position until observed logic level goes high (greater than +4V).
6. Tighten two securing screws, being careful not to disturb adjustment.
7. Access track 44 and verify that the logic level goes low.

4.4.7 End Stops Adjustment Procedure

Prerequisite: Radial Head alignment.

1. Access track 00; move forward 77 steps to track 77.
2. Position end stop so that the inboard end stop contacts the carriage lug with 0.38 ±0.25 millimetre (0.015 ±0.010 inch) between the edge of the stop and the carriage frame.
3. Tighten screw [Y] on the inboard carriage end stop (see Figure 4-6).
4. Move the head reverse 78 steps; this positions head on track -01.
5. Position outboard end stop so that it contacts carriage lug with 0.38 ±0.25 millimetre (0.015 ±0.010 inch) between the edge of the stop and carriage lug. (Refer to Figure 4-13).
6. Tighten screw [Y] on outboard carriage end stop (see Figure 4-6).



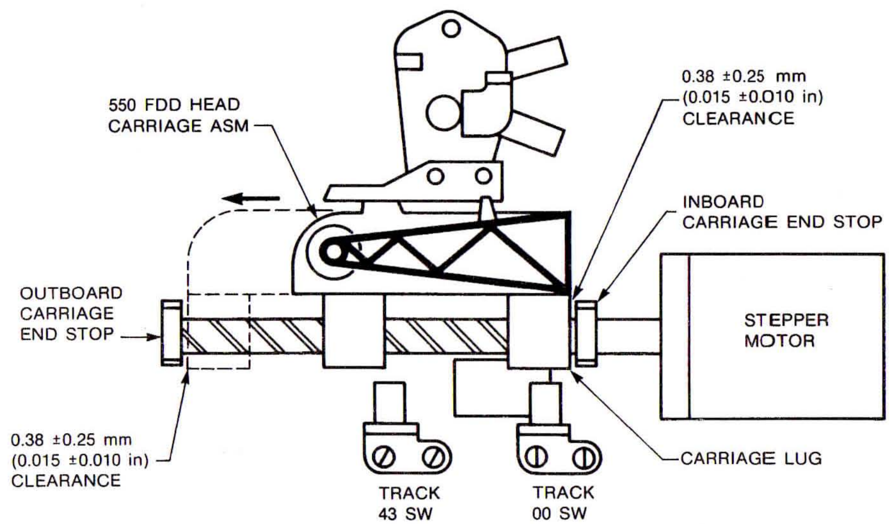


FIGURE 4-13. END STOP CLEARANCE

4.4.8 Bearing/Shoulder Clearance (Verification Only)

This check is performed after a Stepper motor is reinstalled or replaced, or the outboard bearing clamp is loosened.

With shoulder of the Stepper motor in contact with the forward edge of the shallow Stepper motor relief in the base, verify a clearance of 0.76 ±0.25 millimetre (0.030 ±0.010 inch) between shoulder on shaft and edge of outboard bearing. (Refer to Figure 4-14.)

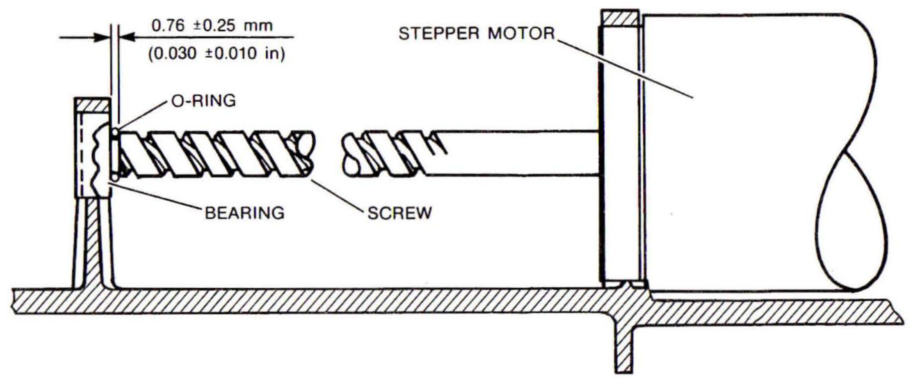


FIGURE 4-14. BEARING/SHOULDER CLEARANCE

4.4.9 Bail Clearance

This check is performed after a Stepper motor, Carriage, or Head Load Solenoid assembly is reinstalled or replaced (media not inserted).

4.4.9.1 550 FDD

Verify a minimum clearance of 0.25 millimetre (0.010 inch) between the armature bail and load arm ear for all positions of the carriage when the load arm solenoid is energized. (Refer to Figure 4-15.)

4.4.9.2 552 FDD

Verify that the clearance between the bail and the load arm ear is 0.25 millimetre (0.010 inch) for all carriage positions when the head load solenoid is energized. (Refer to Figure 4-15.)

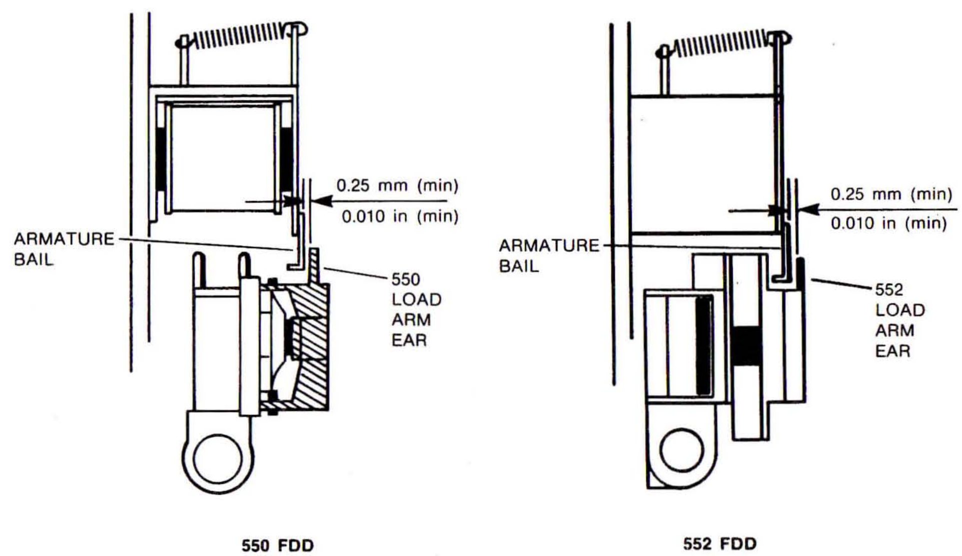


FIGURE 4-15. BAIL AND LOAD ARM CLEARANCE

4.4.10 Load Pad Clearance Check

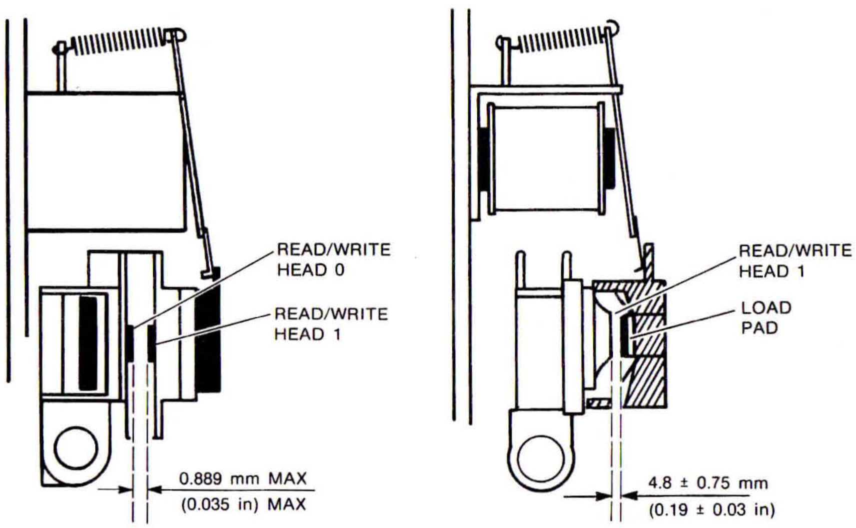
This check is performed after a Head Load Solenoid replacement.

4.4.10.1 550 FDD

With the load arm solenoid deenergized, verify a 4.8 ±0.75 millmetre (0.19 ±0.03 inch) clearance exists between the read/write and the load pad. (Refer to Figure 4-16.)

4.4.10.2 552 FDD

With the head load solenoid deenergized, verify that the sliders protrude from their respective frames less than 0.389 mm (0.035 in). (Refer to Figure 4-16.)



552 FDD

550 FDD

FIGURE 4-16. READ/WRITE HEAD AND LOAD PAD CLEARANCE

4.4.11 Carrier/Door/Disc Clamp Check

This adjustment is performed after a Carrier/Door or bezel replacement. With the door latch seated on the bezel latch surface, the door shall be fastened to the clamp carrier per the specifications shown in Figure 4-17.

4.4.11.1 Early Production Models

With the door latched closed, the disc clamp nut shall be adjusted per the specifications shown in Figure 4-17.

4.4.11.2 Current Production Models

With the door latched closed, verify that a 1.27 ±0.76 millimetre (0.05 ±0.03 in) clearance exists between the retainer ring and the washer as shown in Figure 4-17.

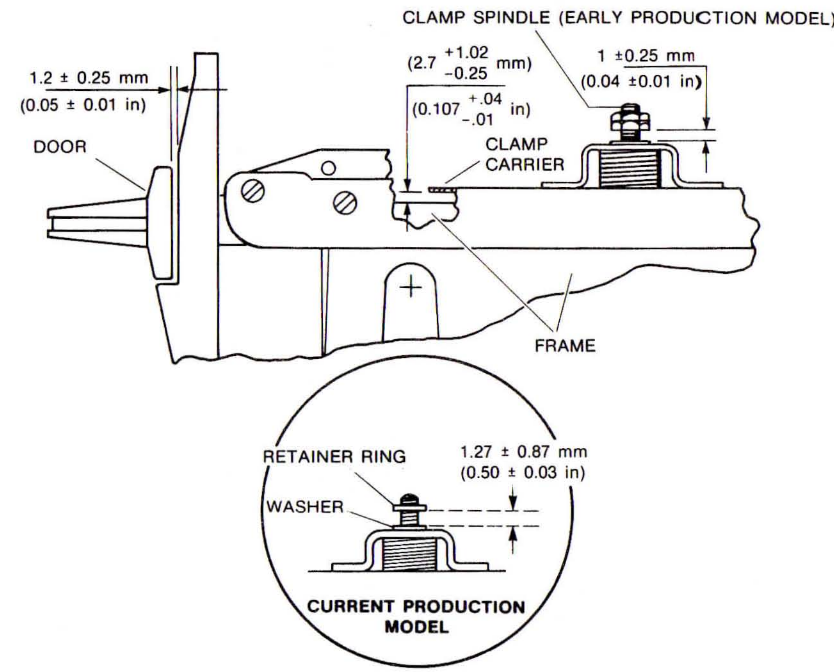


FIGURE 4-17. DOOR AND DISC CLAMP POSITIONS

4.4.12 Write Protect Adjustment Procedure

Adjust the Write Protect Sensor so that a cartridge with a Write Protect notch, meeting ANSI standards, activates it, and a cartridge without the notch does not activate it.

1. Loosen two screws in Write Protect Sensor; refer to Figure 4-3.
2. Move sensor until the Write Protect Sensor performs as described. Using an oscilloscope, look at TP 15; write protect activated = low, not activated = high.
3. Tighten screws.

4.4.13 Interlocking Latch Actuators Adjustment Procedure

To adjust the Interlocking Latch Actuator, perform the following procedure.

1. Open the door fully and measure the dimensional clearance specified in part A of Figure 4-18. If the actual clearance does not equal the specified clearance, adjust the Actuator by loosening the two holding screws, reposition the actuator so that the specification is met, and tighten the two holding screws.
2. Close the door partially and measure the dimensional clearance specified in part B of Figure 4-18. If the actual clearance does not equal the specified clearance, adjust the actuator as described in step 1.

Operating conditions:

The dimensional clearances illustrated in Figure 4-18 are nominal and may need to be varied to ensure the proper operation of the Interlocking Latch Actuators. The following text describes the prerequisites for correct operations of the mechanism.

1. When a disc cartridge is either absent or fully inserted, the operator must be able to move the door from a fully open to a fully closed position without obvious restriction or overstroke beyond the latched position.
2. While the door is opening, the interlocking latches must release the cartridge as soon as the door latch has cleared the path of the cartridge.
3. When a disc cartridge is partially inserted, the interlocking latches must effectively block door closure at both actuators.
4. When a disc cartridge is released, attempted reclosures before the door has fully opened must be prevented by the secondary blocking surfaces of the interlocking latches.

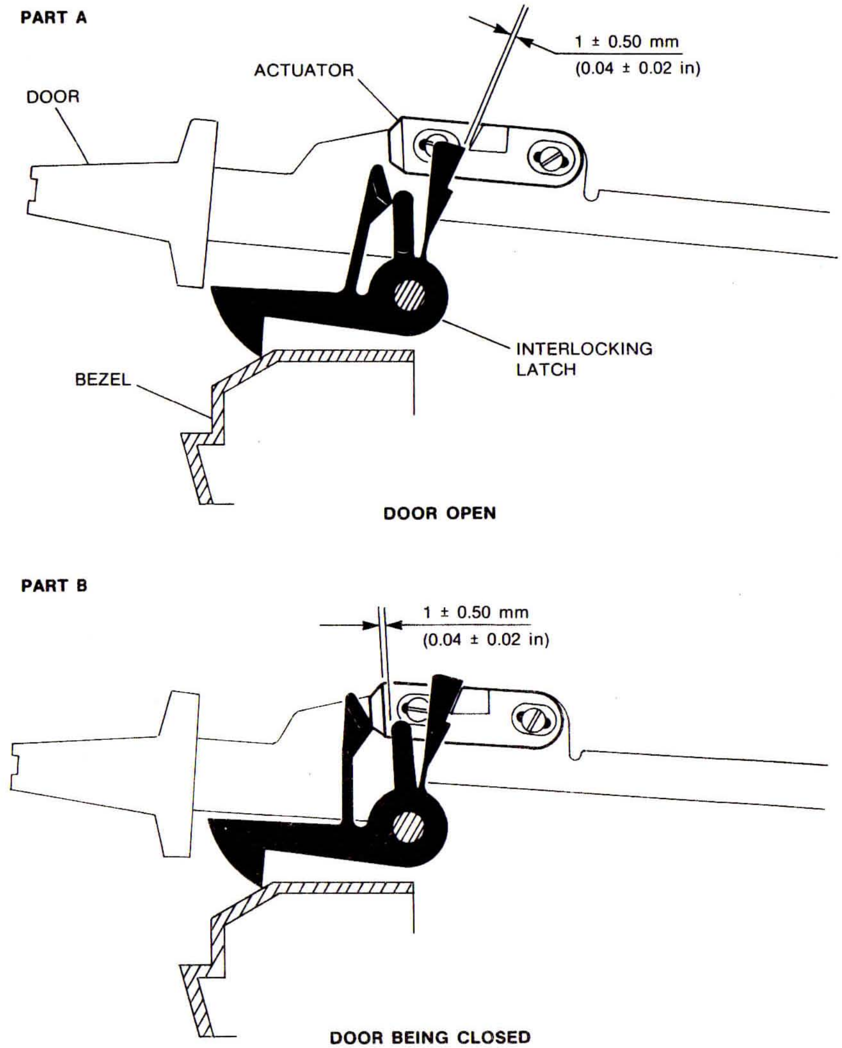


FIGURE 4-18. INTERLOCKING LATCH AND ACTUATOR

4.4.14 Read Channel Zero Crossing Detector Symmetry Alignment

Two methods of performing the alignment are possible—the first method is performed using an alignment disc and the second method is performed using a read/write disc.

Alignment Disc:

1. Insert an alignment disc (Dysan 360/2, or equivalent) into the drive.
2. Access the unmodulated 250 kHz signal at track 75 with the two digital voltmeter probes at IC 2J Pins 2 and 4 of the PCB.
3. Verify that the differential voltage between the two pins is 0.0 ±25 mV; adjust R44 potentiometer, if needed.

Read/Write Disc:

1. With a read/write disc installed, access track 76 and write a series of ones (2F pattern).
2. Scope TP 55 to verify that the signal pattern is identical to the pattern shown in Figure 4-19. If the signal pattern is not identical, adjust R44 potentiometer.

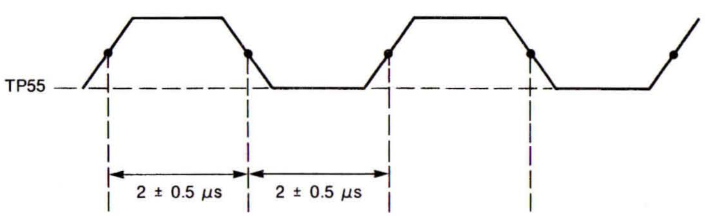


FIGURE 4-19. READ DATA TRANSITION

4.4.15 Data/Clock Separator Window Adjustment

1. Insert an alignment disc (Dysan 360/2, or equivalent) into the drive.
2. Access the drive to track 00 (IBM-compatible FM format data).
3. Connect a scope probe to TP 6 (data/clock separator window) and adjust scope:

Vertical gain:	2 to 5V/div.
Sweep time:	0.5 μs/div.
Sync:	On leading edge of signal

4. Verify that the time from the positive going leading edge to the negative going trailing edge is 2.875 ± 0.125 microseconds; adjust R87 potentiometer, if needed. See Figure 4-20.

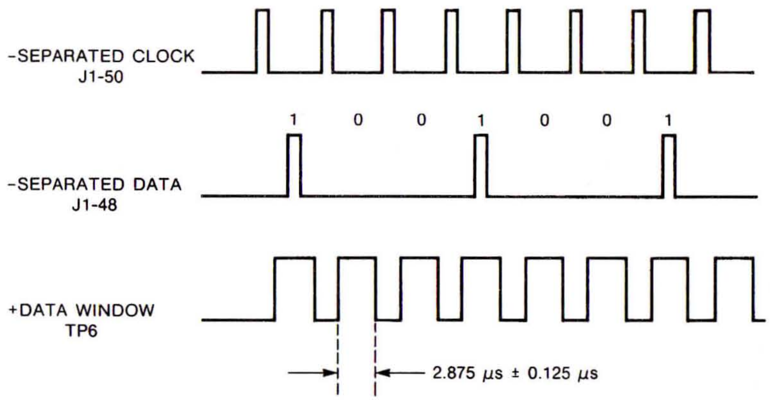


FIGURE 4-20. TP6 OUTPUT (+DATA WINDOW)

BLANK

4.5 TROUBLESHOOTING FLOWCHARTS

The flowcharts listed in this section are provided to help the service technician in locating a faulty assembly within the 550/552 Flexible Disc Drive. The flow charts are generated under the assumption that the malfunction causing the error is related to the 550/552 Flexible Disc Drive only, and **not** to the controller involved. All flowcharts in this section allow the service technician to isolate faults to the subassembly level (for example, PCB, Head, etc.). Methods for isolation of individual, erring components are not provided.

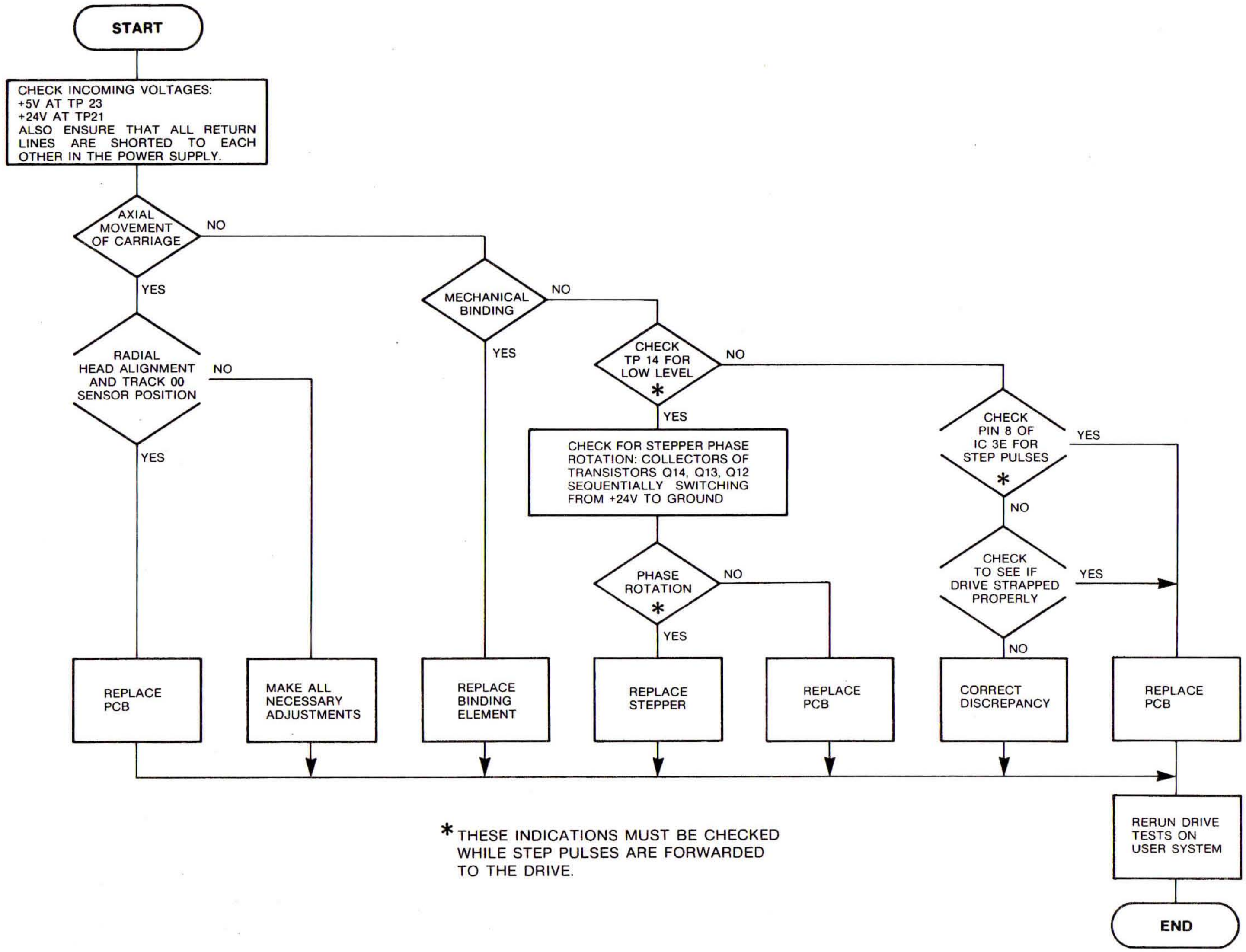


FIGURE 4-21. HEAD POSITION ACTUATOR DIAGNOSTIC FLOWCHART

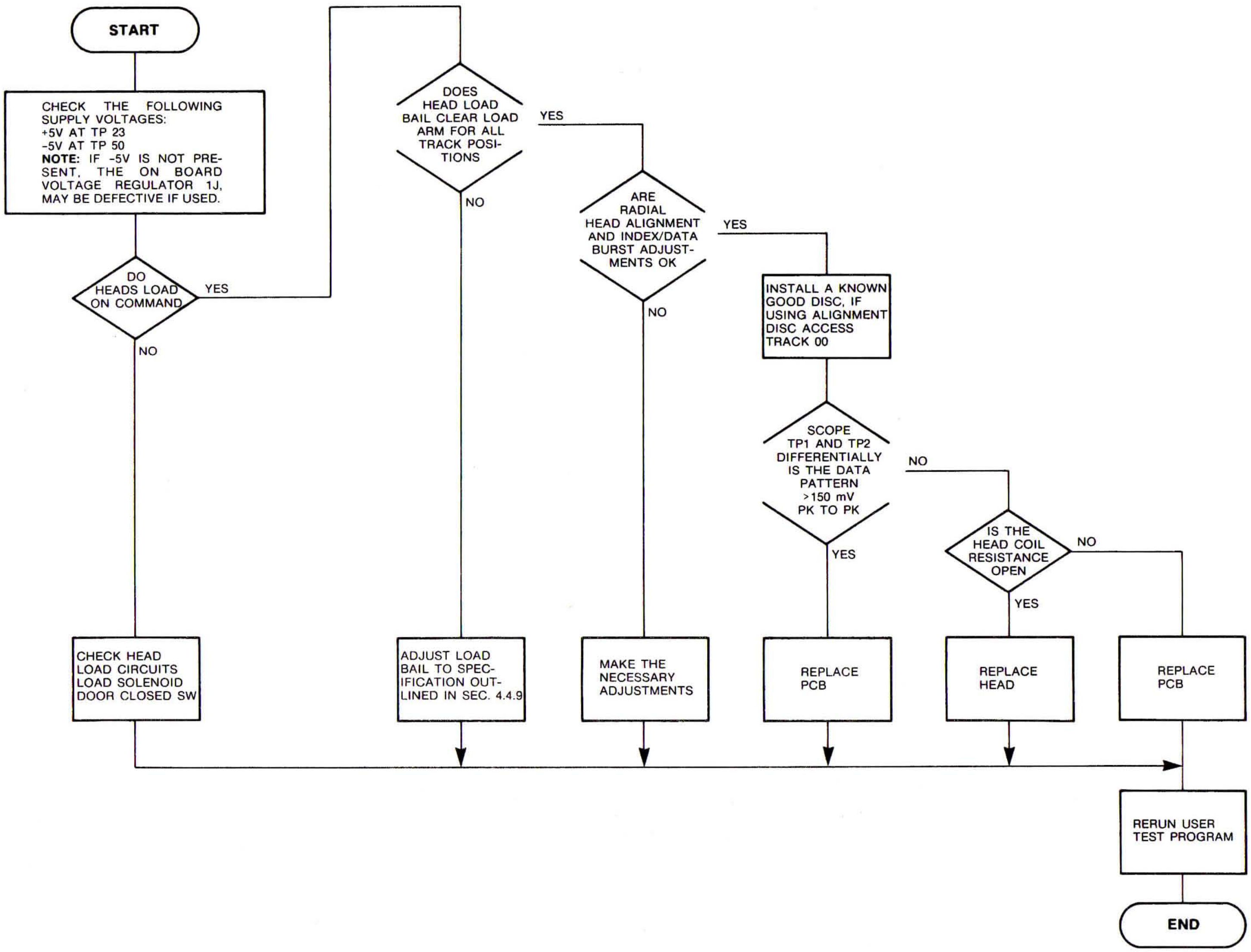


FIGURE 4-22. READ CIRCUIT DIAGNOSTIC FLOWCHART

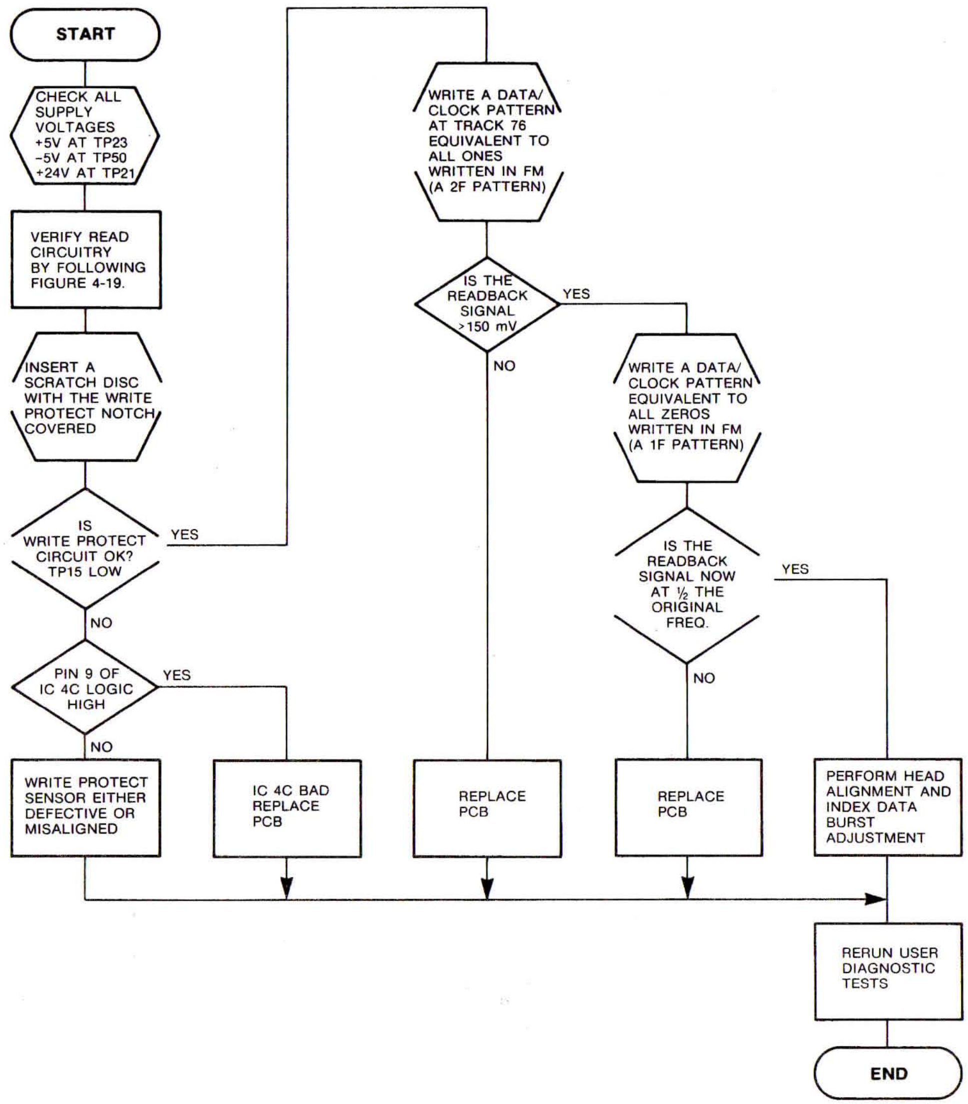
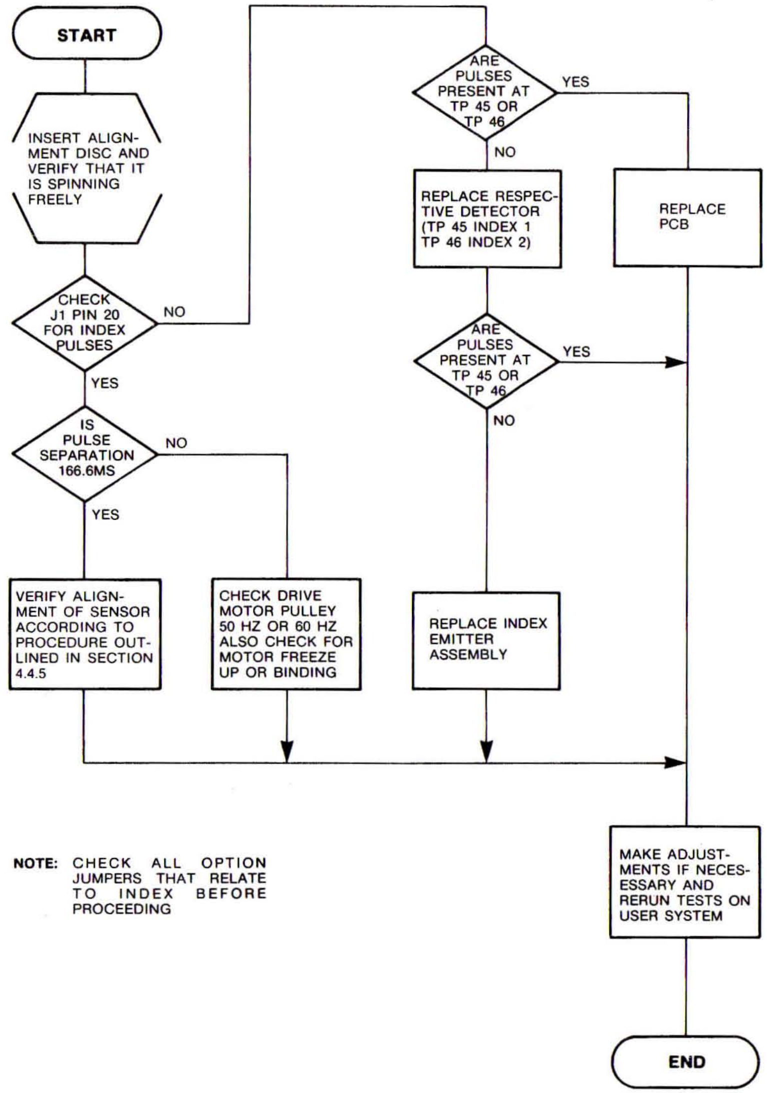


FIGURE 4-23. WRITE CIRCUIT DIAGNOSTIC FLOWCHART



NOTE: CHECK ALL OPTION JUMPERS THAT RELATE TO INDEX BEFORE PROCEEDING

FIGURE 4-24. INDEX PROBLEM DIAGNOSTIC FLOWCHART

SECTION 5
RECORDING CHARACTERISTICS

5.1 RECORDING MODES

Data may be recorded onto the media by the 550/552 Flexible Disc Drive in one of two modes—single-density mode (FM) or double-density mode (MFM or MMFM). The encoding algorithm performed external to the drive by the controller is defined below with illustrations (Figure 5-1) for both FM and MFM/MMFM.

FM—A clock bit occurs at the leading edge of every bit cell time.

Any data bit occurs at the bit cell time half-bit position.

MFM—Any data bit occurs at the bit cell time half-bit position.

A clock bit occurs at the leading edge of a current bit cell only if:

1. there is no data bit to be written in the current bit cell time, and
2. there was no data bit written in the previous bit cell time.

MMFM—Any data bit occurs at the bit cell time half-bit position.

A clock bit occurs at the leading edge of a current bit cell time only if:

1. there is no data bit to be written in the current nor previous bit cell time, and
2. there was no clock bit written in the previous bit cell time.

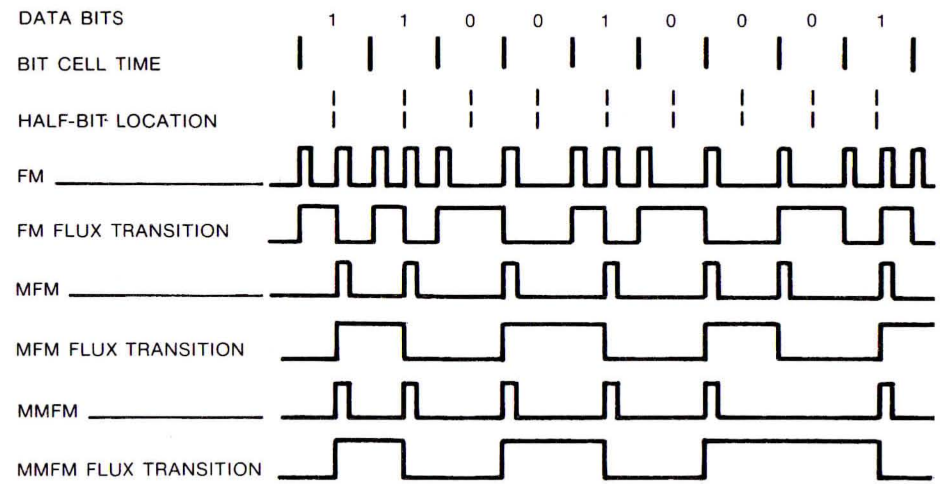


FIGURE 5-1. COMPARISON OF FM, MFM, AND MMFM RECORDING

5.2 MEDIA

The 550 and 552 recording media recommended by Memorex are listed in the Summary of Functional Specifications (paragraph 1.3). Data can be written onto or read from either side 0 or side 1 (550, side 0 only) as the disc turns freely within the jacket. During read or write operations, the head(s) is in contact with the rotating disc. The media used for the 550 is identical to the media used for the 552 with the exception of the index sector hole position (see Figure 5-2).

The 552 has been designed to operate on any disc cartridge used for single-sided or two-sided operation and that meets the requirements set forth in *The IBM Diskette General Information Manual,* IBM Publication GA21-9182. Assuming compatible data format records, any two-sided disc is interchangeable between any two-sided disc drives.

5.3 DISC FORMATTING CONSIDERATIONS

Several drive and controller parameters must be considered when selecting a disc format. These include instantaneous revolution tolerance, physical index hole detection tolerance, read preamplifier recovery time, and the distance between the read/write gap and the erase core at the drive level; and write oscillator tolerance at the controller level.

An example of a two-sided recording media preinitialized to the industry standard for double-density application is shown below in Figure 5-3 and Table 5-1 with IBM's Diskette 2D, PN 1766872, 26 sectors of 256-byte records (reference IBM Document GA21-9257-1). Side 0, track 0 is initialized in single-density (FM) whereas the remaining 76 tracks on side 0 and the 77 tracks on side 1 are initialized in double-density (MFM).

In soft sector formatting, the index hole in the recording media is the physical indication that the start of a revolution has occurred. Immediately upon detection of the index pulse, the controller writes a series of bytes (GAP4A) to allow for variations in the physical index hole detection, rotational speed, and tolerances between medias and disc drives (interchangeability). Following this gap, a series of sync (00) bytes is written which allows sufficient time during a subsequent read operation for the data/clock separator to become synchronized. (See "Double Density Guide" Application Note for further discussion of data/clock separation.) Following the sync bytes, a series of unique bytes are written which serve as index address mark and identification.

The index field is separated from the first sector sync bytes of the ID field by a series of bytes forming GAP1. The first sector follows the GAP1 series of bytes with a series of sync bytes to allow time for the data/clock separator synchronization just prior to the data ID field address mark. The address mark is a series of unique bytes which identify the data ID field. Track number, side 0/1, sector number, single-/double-density information precede two bytes of cyclic redundancy check (CRC) bits for the previous eight bytes. (See the 26th sector of Figure 5-3 for locations of these fields.)

The data ID field is separated from the sector data field by a series of bytes (GAP2) which allows for speed and oscillator variations, and erase core clearance of the ID field CRC bytes prior to a write gate turn-on for a write operation.

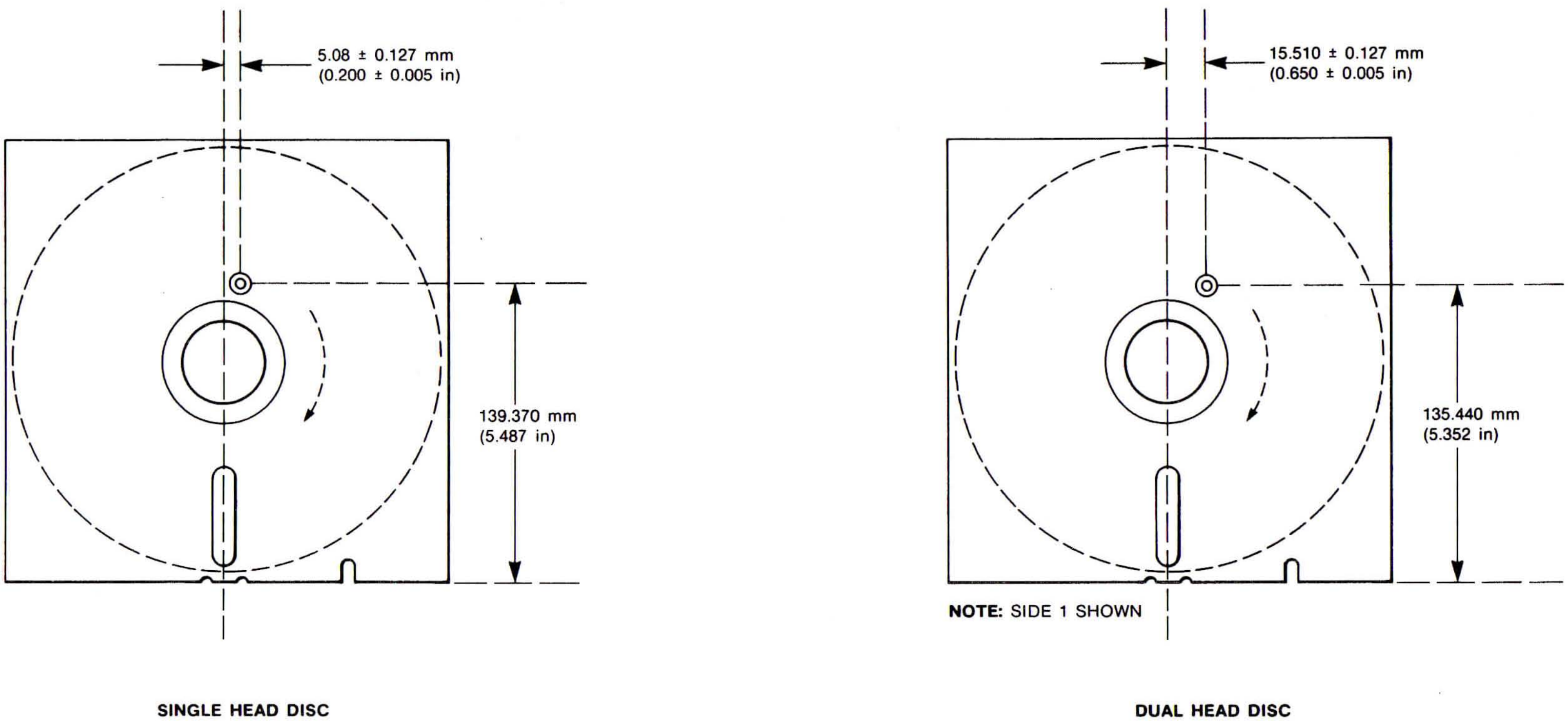


FIGURE 5-2. INDEX SECTOR HOLE POSITION

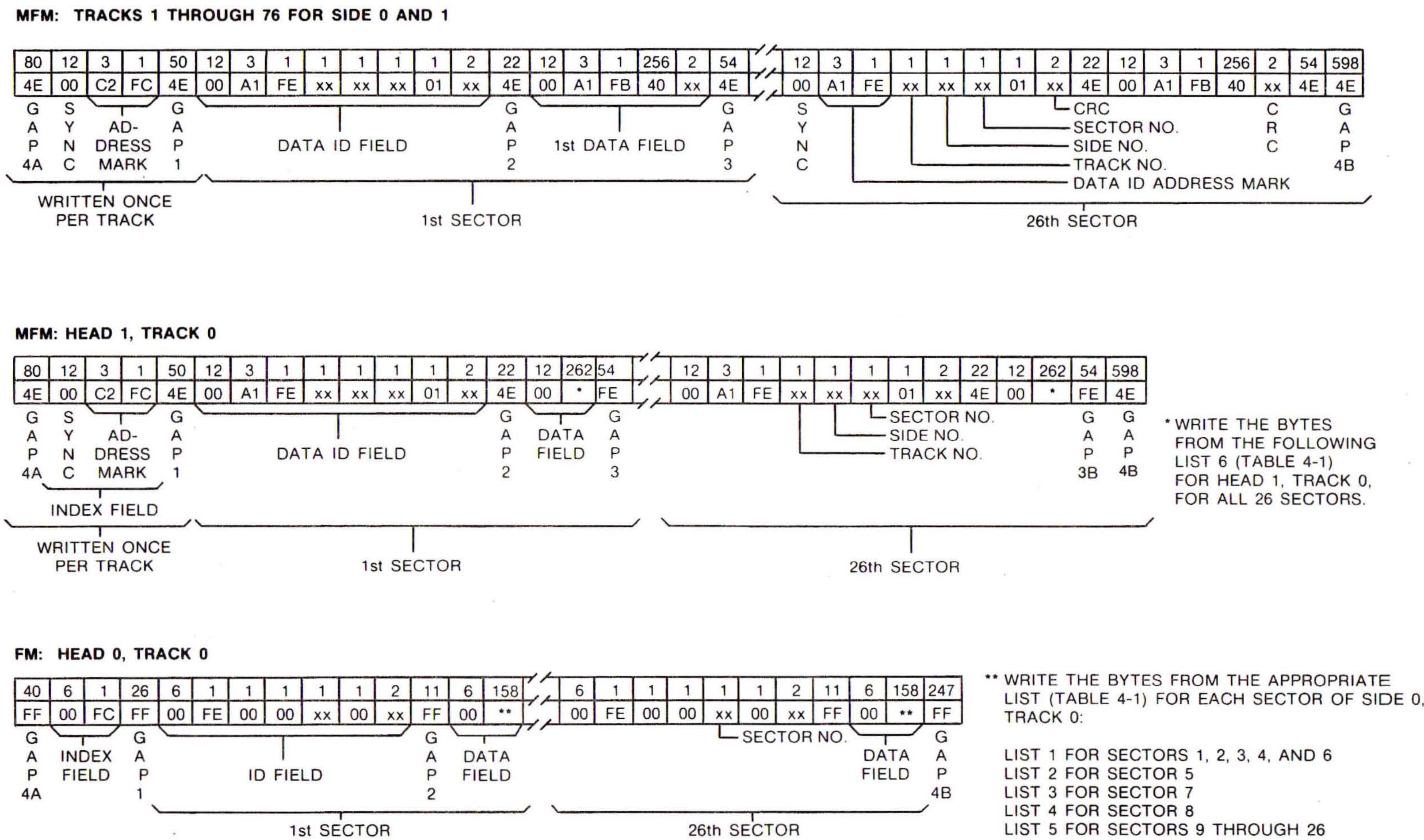


FIGURE 5-3. IBM TWO-SIDED, 26-SECTOR (256-BYTE RECORD) FORMAT

TABLE 5-1. DATA FIELDS FOR RECORDING DUAL-HEAD MEDIA INITIALIZATION

Number of Bytes	Hexa-decimal Value	Number of Bytes	Hexa-decimal Value	Number of Bytes	Hexa-decimal Value
List 1		**List 4**		**List 5**	
1	FB(Note 1)	1	FB(Note 1)	1	F8 (Note 1)
80	40	1	C8	1	C4
48	00	1	C4	1	C4
2	xx (Note 2)	1	D9	1	D9
27	FF	1	F1	1	F1
		1	40	1	40
List 2		1	C4	1	C4
1	FB(Note 1)	1	C1	1	C1
1	C5	1	E3	1	E3
1	D9	1	C1	1	C1
1	D4	13	40	2	xx (Note 3)
1	C1	2	40	11	40
1	D7	1	F2	2	40
123	40	1	F5	1	F2
2	xx (Note 2)	1	F6	1	F5
27	FF	1	40	1	F6
List 3		1	F0	1	40
1	FB(Note 1)	1	F1	1	F7
1	E5	2	F0	1	F5
1	D6	1	F1	2	F0
1	D3	1	F1	1	F1
1	F1	1	F7	1	F1
1	C9	1	F4	1	F7
1	C2	1	F1	1	F4
1	D4	1	F2	1	F1
1	C9	1	F6	1	F2
1	D9	4	40	1	F6
1	C4	1	C8	4	40
61	40	30	40	1	C8
1	D4	1	F0	30	40
3	40	1	F1	1	F7
1	F1	2	F0	1	F5
3	f0	1	F1	2	F0
1	E6	49	40	1	F1
48	40	2	xx (Note 2)	49	40
2	xx (Note 2)			2	xx (Note 2)
27	FF			27	FF

Note 1: Three missing clock pulses at bit 2, 3, and 4 positions.
Note 2: CRC for previous 129 bytes.
Note 3: First sector 07_{hex}, increment for each sector written to 26_{hex}.

TABLE 5-1. DATA FIELDS FOR RECORDING DUAL-HEAD MEDIA INITIALIZATION (Continued)

Number of Bytes	Hexa-decimal Value	Number of Bytes	Hexa-decimal Value	Number of Bytes	Hexa-decimal Value
List 6		1	F4	1	F2
3	A1	1	F1	1	F5
1	F8	1	F2	1	F6
1	C4	1	F6	1	40
1	C4	4	40	1	F7
1	D9	1	C8	1	F5
1	F1	30	40	2	F0
1	40	1	F7	1	F1
1	C4	1	F5	1	F1
1	C1	2	F0	1	F7
1	E3	1	F1	1	F4
1	C1	49	40	1	F1
2	xx (Note 4)	1	C4	1	F2
13	40	1	C4	1	F6
1	F2	1	D9	4	40
1	F5	1	F1	1	C8
1	F6	1	40	30	40
1	40	1	C4	1	F7
1	F7	1	C1	1	F5
1	F5	1	E3	2	F0
2	F0	1	C1	1	F1
1	F1	2	xx (Note 5)	49	40
1	F1	11	40	2	xx (Note 6)
1	F7	2	40	54	4E

Note 4: For first sector, write 27; increment by two decimally for successive sectors.
Note 5: For first sector, write 28_{10}, then increment by two for each successive sector.
Note 6: CRC for the previous 260 bytes.

The data field is preceded by a series of bytes to provide time for the data/clock separator to synchronize. A series of address mark bytes follows which may not conform to the double-density encoding rules (i.e., missing clock bits within the address marks), as may the index, ID, and data address marks. See Figure 5-4 for examples of encoding address marks. A series of user data bytes precedes two bytes of CRC. The sector ID and data field is then separated from the next sector, or the final track gap, by a series of bytes called GAP3. GAP3 provides time to allow the write gate turn-off after an update write, and allows time for the erase core to clear the data field

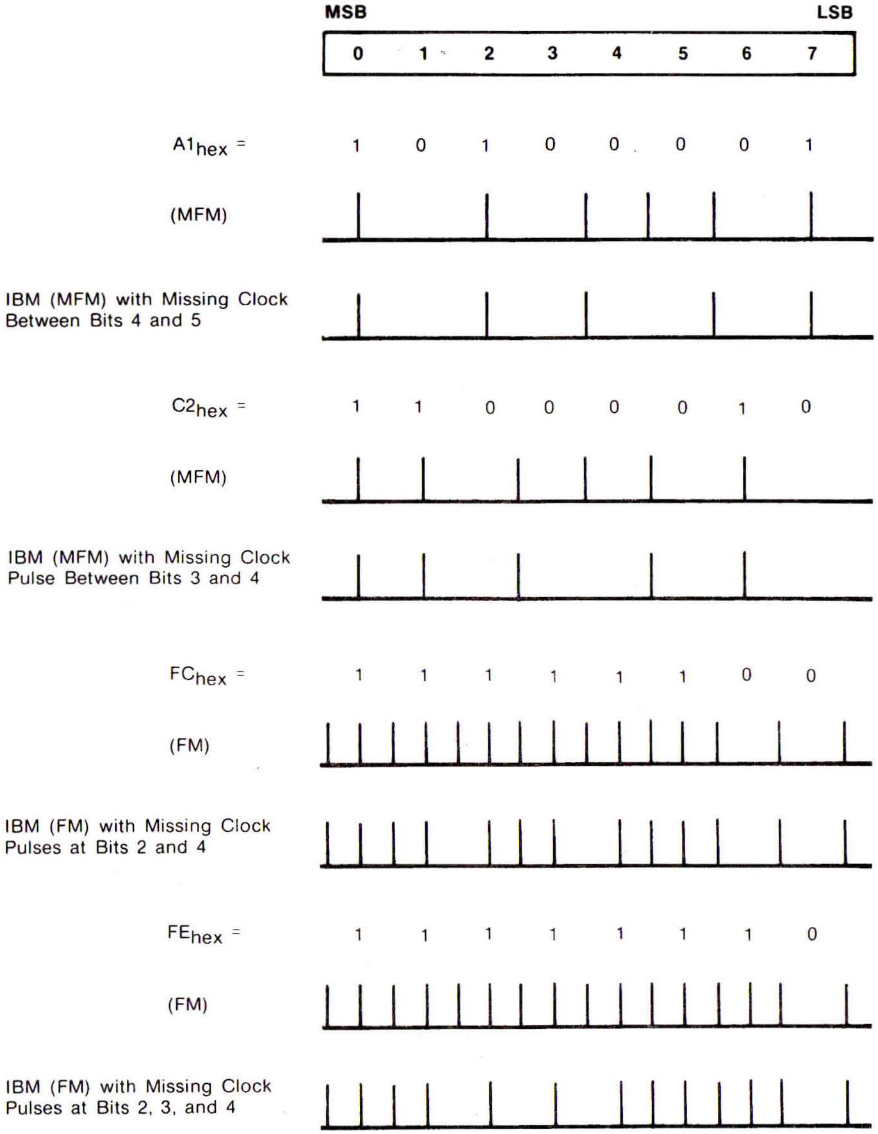
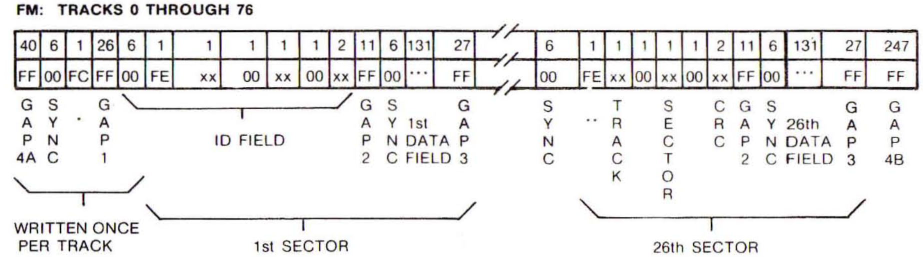


FIGURE 5-4. TWO-SIDED UNIQUE ADDRESS MARKS

CRC bytes. GAP3 also allows for variations in speed, the write oscillator, the read preamplifier recovery time, and system turnaround time to read the following ID field.

GAP4B is the last gap prior to the physical index. This gap allows for speed and write oscillator variations during a format write and variations in the physical index hole detection, and therefore, may vary in the number of bytes.

An example of a one-sided disc preinitialized to an FM format, as described in IBM's one-sided diskette OEMI manual (GA21-9190-3), is shown in Figures 5-5 and 5-6, and Table 5-2. The initialization of a blank disc prepares it for the customer's use by recording data addresses on tracks 1 through 76 and by recording identifying information about data on track 0, the index track. The initialization data as read for IBM-compatible 26 sector, 128-byte records (IBM PN 2305830) is as follows:



· INDEX ID ADDRESS MARK
·· DATA ADDRESS MARK
··· WRITE THE BYTES FROM THE APPROPRIATE LIST FOR EACH SECTOR AS FOLLOWS (SEE TABLE 4-2):

LIST 1 FOR TRACK 0, SECTORS 1, 2, 3, 4, AND 6
LIST 2 FOR TRACK 0, SECTOR 5
LIST 3 FOR TRACK 0, SECTOR 7
LIST 4 FOR TRACK 0, SECTOR 8
LIST 5 FOR TRACK 0, SECTORS 9 THROUGH 26
LIST 6 FOR TRACKS 1 THROUGH 76, SECTORS 1 THROUGH 26

FIGURE 5-5. IBM ONE-SIDED, 26-SECTOR (128-BYTE RECORD) FORMAT

TABLE 5-2. DATA FIELDS FOR RECORDING SINGLE-SIDED DISC INITIALIZATION

Number of Bytes	Hexadecimal Value
List 1	
1	FB(Note 4)
80	40
48	00
2	xx (Note 2)
27	FF
List 2	
1	FB(Note 4)
1	C5
1	D9
1	D4
1	C1
1	D7
75	40
48	00
2	xx (Note 2)
27	FF
List 3	
1	FB(Note 4)
1	E5
1	D6
1	D3
1	F1
1	C9
1	C2
1	D4
1	C9
1	D9
1	C4
69	40
1	E6
48	00
2	xx (Note 2)
27	FF

Number of Bytes	Hexadecimal Value
List 4	
1	FB(Note 4)
1	C8
1	C4
1	D9
1	F1
1	40
1	C4
1	C1
1	E3
1	C1
15	40
1	F0
1	F8
1	F0
1	40
1	F0
1	F1
2	F0
1	F1
1	40
1	F7
1	F3
1	F0
1	F2
1	F6
35	40
1	F0
1	F1
2	F0
1	F1
1	40
48	00
2	xx (Note 2)
27	FF

Number of Bytes	Hexadecimal Value	
List 5		
1	F8	(Note 4)
2	C4	
1	D9	
1	F1	
1	40	
1	C4	
1	C1	
1	E3	
1	C1	
2	xx	(Note 3)
13	40	
1	F0	
1	F8	
1	F0	
1	40	
1	F7	
1	F4	
2	F0	
1	F1	
1	40	
1	F7	
1	F3	
1	F0	
1	F2	
1	F6	
35	40	
1	F7	
1	F4	
2	F0	
1	F1	
1	40	
48	00	
2	xx	(Note 2)
27	FF	
List 6		
1	FB	(Note 4)
128	E5	
2	xx	(Note 2)
27	FF	

Note 1: IBM-Compatible CRC for the five previous bytes. The polynomial is:

$$G(X) = 1 + X^5 + X^{12} + X^{16}$$

with the accumulating register set to all ones prior to transfer.

Note 2: Same as Note 1 except for prior 129 bytes.

Note 3: These two bytes will be EBCDIC '09' (i.e., hex F0F9) the first time written, EBCDIC '10' (i.e., hex F1F0) the second time written, etc., and EBCDIC '26' (i.e., hex F2F6) the last time written on each track.

Note 4: The missing clock bit pattern for this byte is hex C7.

FIGURE 5-6. SINGLE-HEAD UNIQUE ADDRESS MARKS

5.4 READ ERROR DETECTION AND CORRECTION

While the design and the functional parameters of the controller are the customer's prerogative, Memorex recommends a series of guidelines for the construction of read error detection and correction procedures.

5.4.1 Write Operation

The recommended controller write operation is as follows:

1. The controller instructs the drive to write the data record(s) for a period of one revolution, then perform a read-to-verify operation for the period of the next revolution.

2. If a read-to-verify error occurs, the controller instructs the drive to repeat the write operation followed by the read-to-verify operation a maximum of ten times on the same track. This procedure ends before the drive reaches the limit of ten retries if a successful read-to-verify operation is completed on an earlier pass. If the drive is unable to perform a valid read-to-verify operation after ten passes, the write operation and the read-to-verify operation will be attempted on another track. The successful performance of the operations on the new track indicates that the original track was defective. In this case, either the media should be replaced or the defective track should be logically avoided. If the operations are not successfully performed on the new track, the malfunction may be due to a drive error and further testing should be performed to determine the source of the error.

5.4.2 Read Operation

The recommended controller read operation is as follows:

1. Most read errors are soft in nature; a soft read error is defined as a data bit which, if in error during the first read attempt, may be recovered on retry. Memorex suggests that read operations be retried until successful to a maximum of ten retries.

2. If the drive has retried a read operation ten times with no success, the controller instructs the drive to move the heads to an adjacent track in the direction of the most recent track access. The controller then instructs the drive to move back to the original track position and perform the read operation until successful to a maximum of ten retries. If the read operation cannot be performed successfully after the second set of retries, the error is considered hard, or unrecoverable.

SECTION 6
550/552 TROUBLESHOOTING AIDS

The signal flowcharts in this section are provided to help the customer while troubleshooting the drive. The figures represent functional areas and identify test points, indicating level of voltage when the function is active.

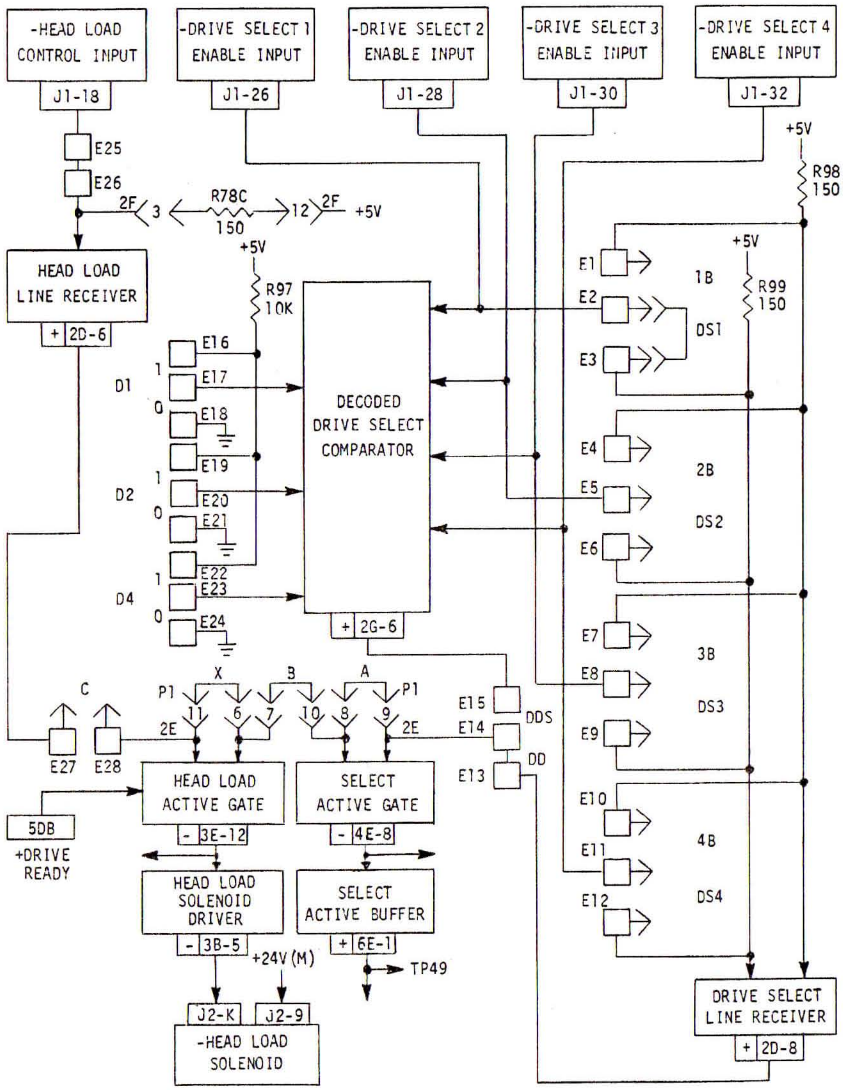


FIGURE 6-1. HEAD LOAD AND DRIVE SELECT FUNCTIONS

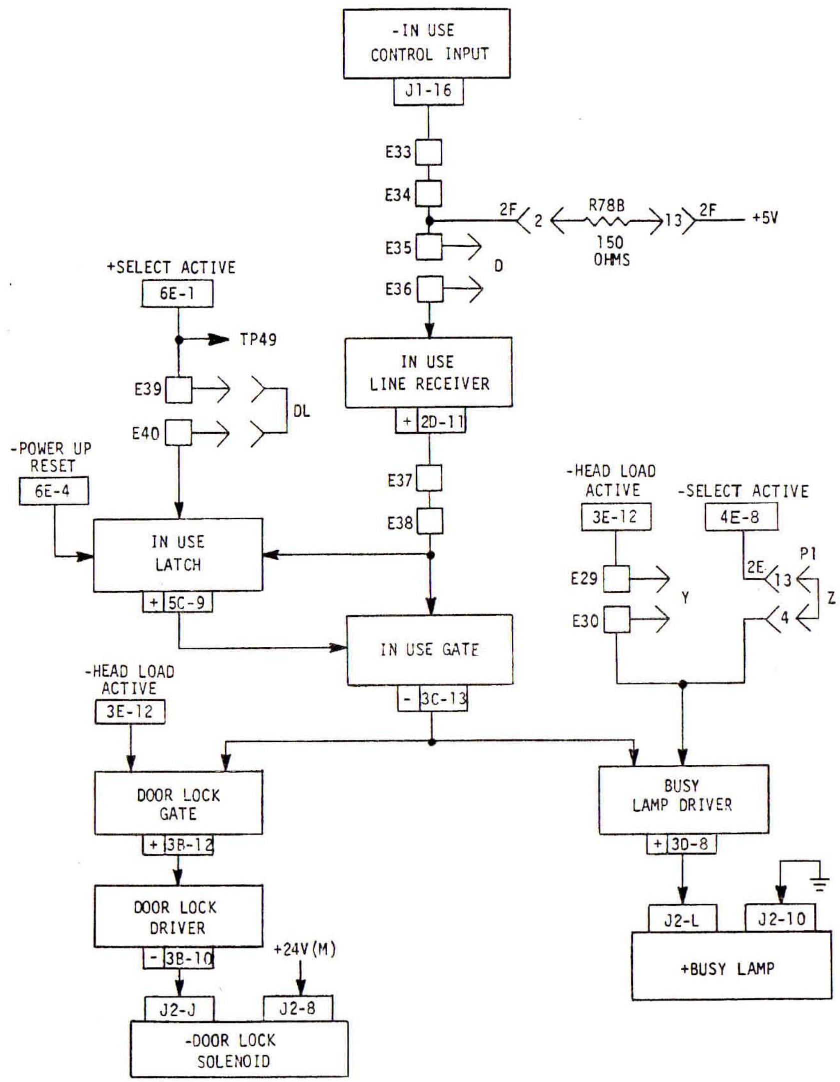


FIGURE 6-2. IN USE, DOOR LOCK AND BUSY LAMP FUNCTIONS

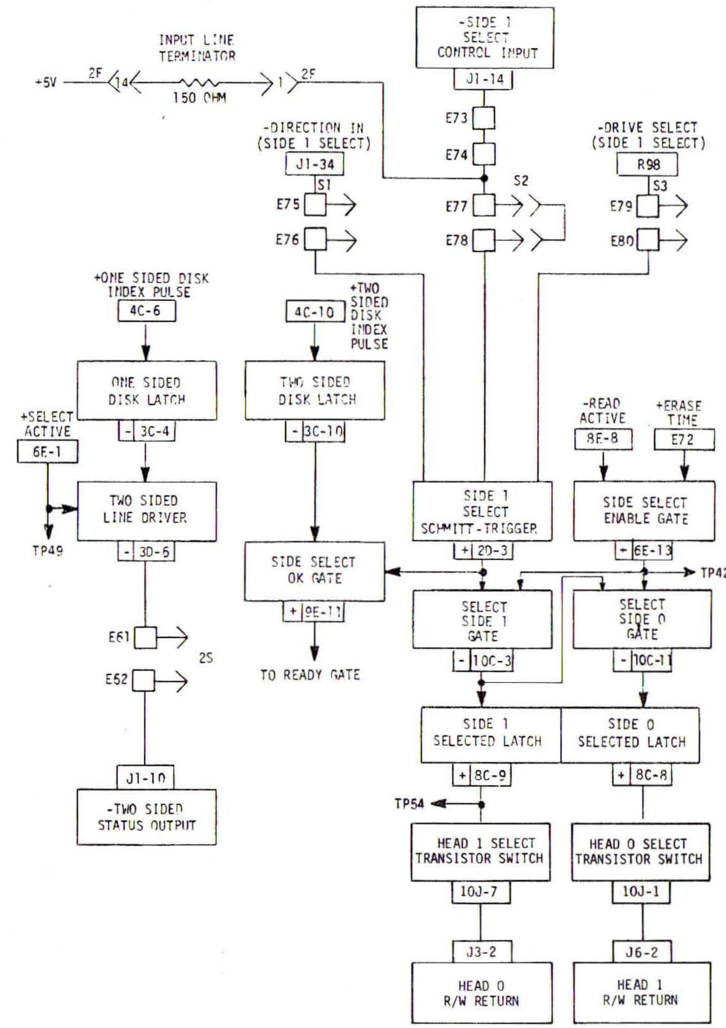


FIGURE 6-3. DISC TYPE AND SIDE SELECT FUNCTIONS

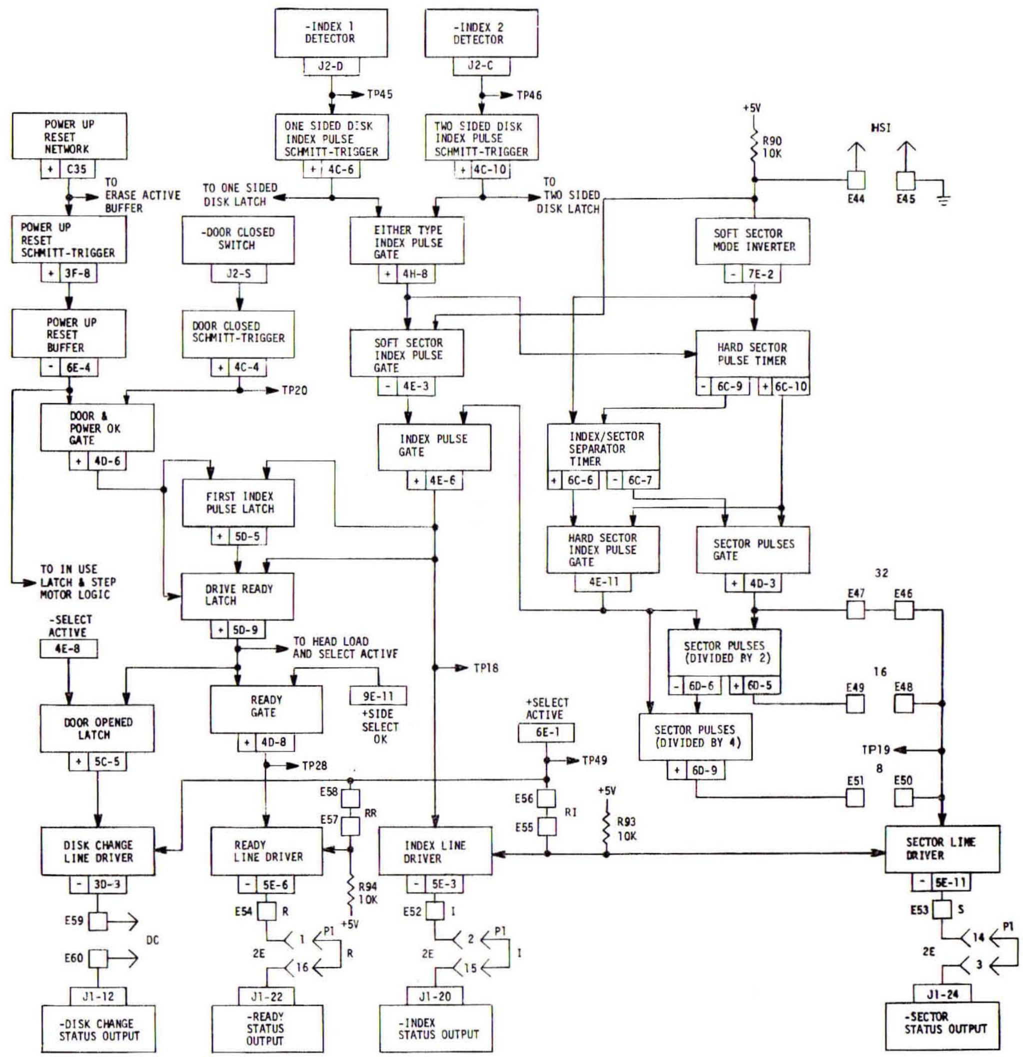


FIGURE 6-4. DISC CHANGE, READY, INDEX AND SECTOR FUNCTIONS

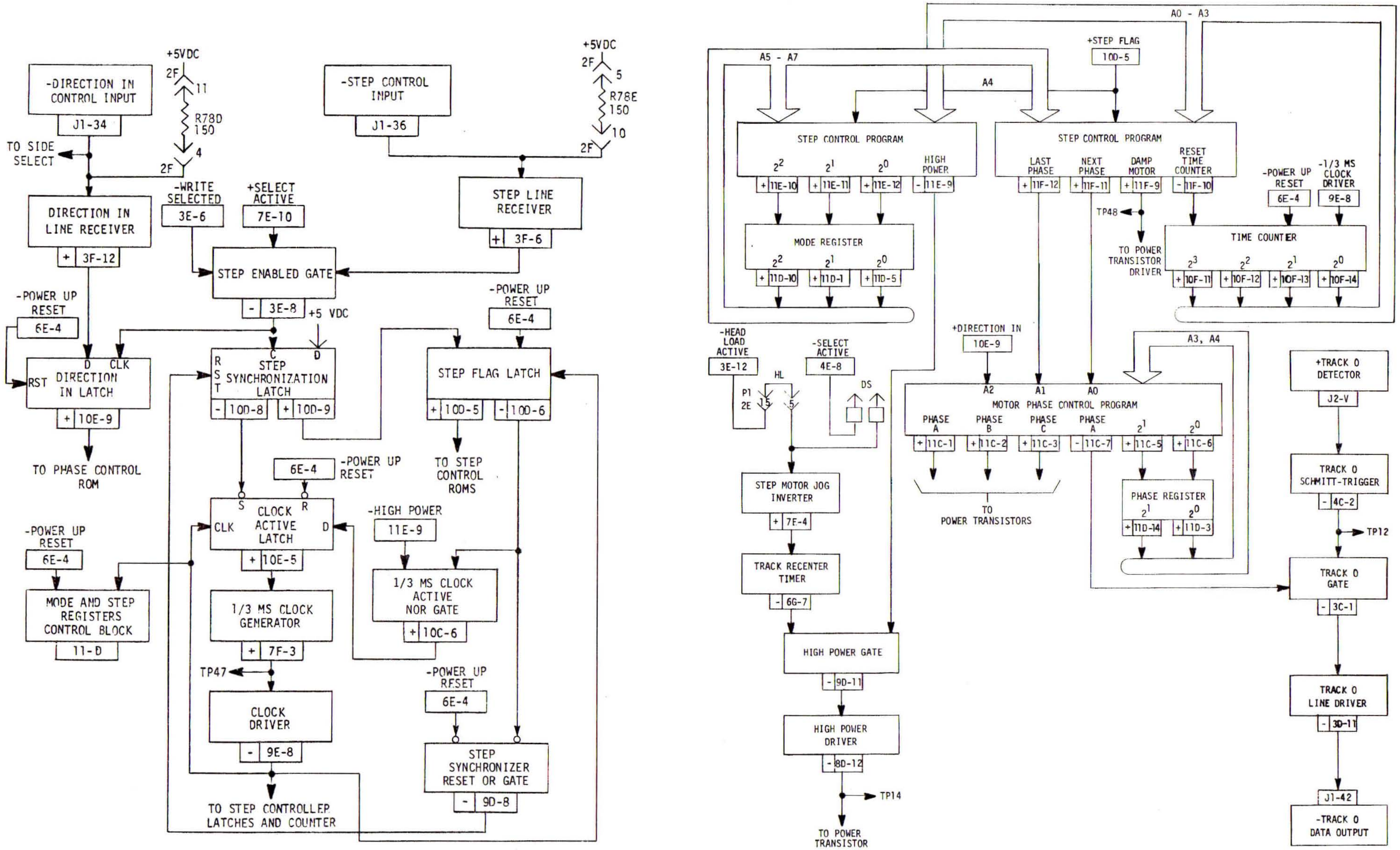


FIGURE 6-5. STEP MOTOR CONTROLLER

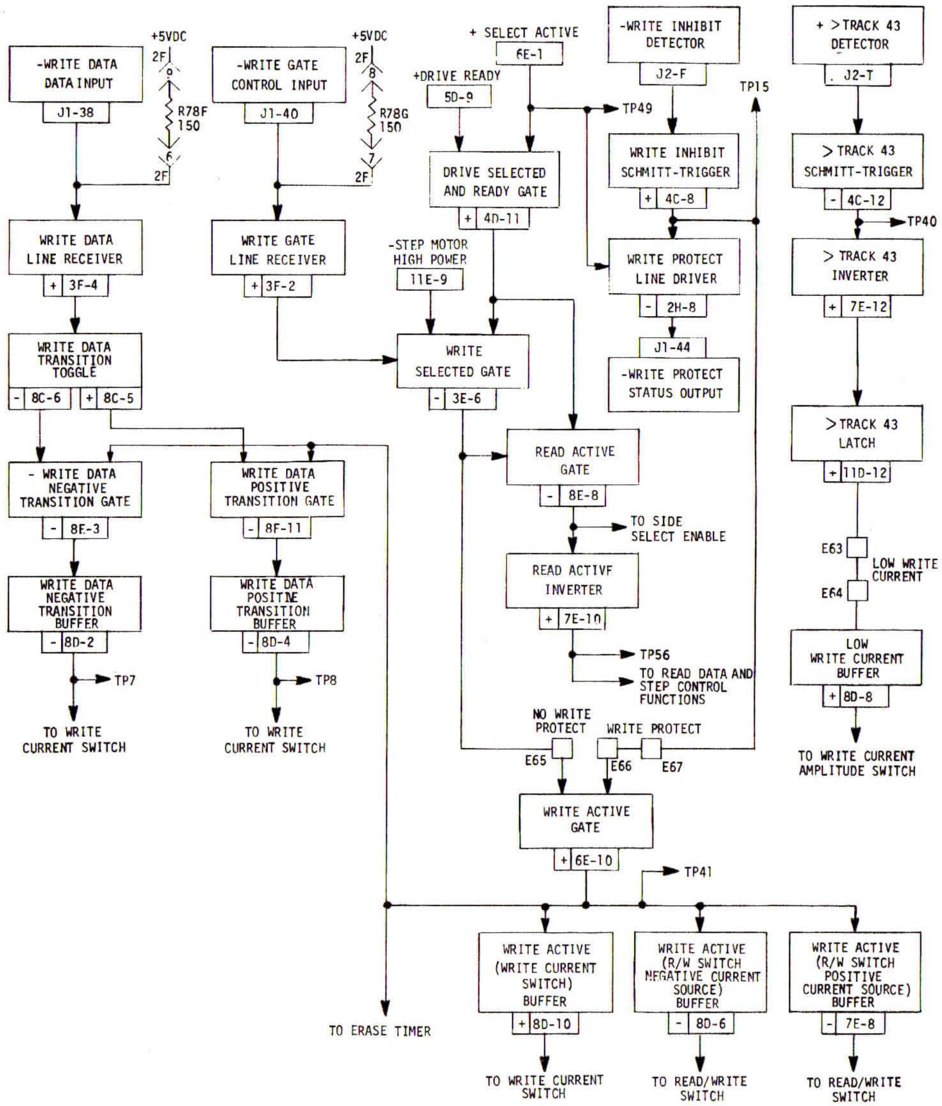


FIGURE 6-6. WRITE DATA CONTROL FUNCTION

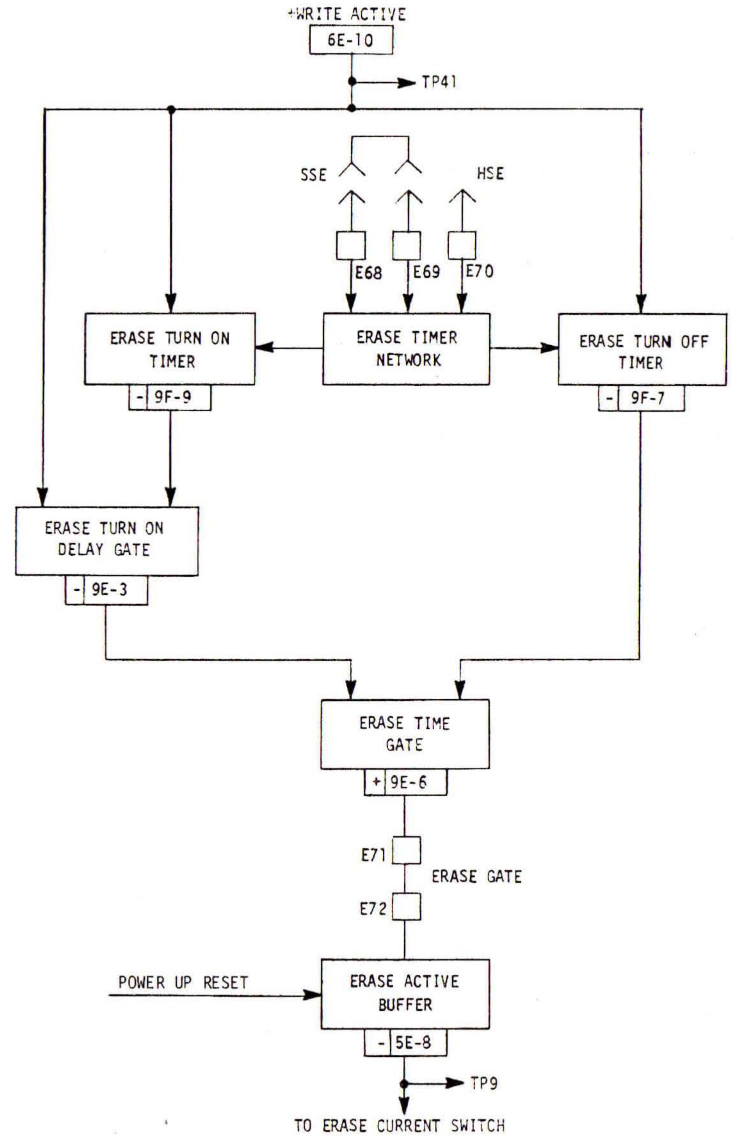


FIGURE 6-7. ERASE DELAY FUNCTION

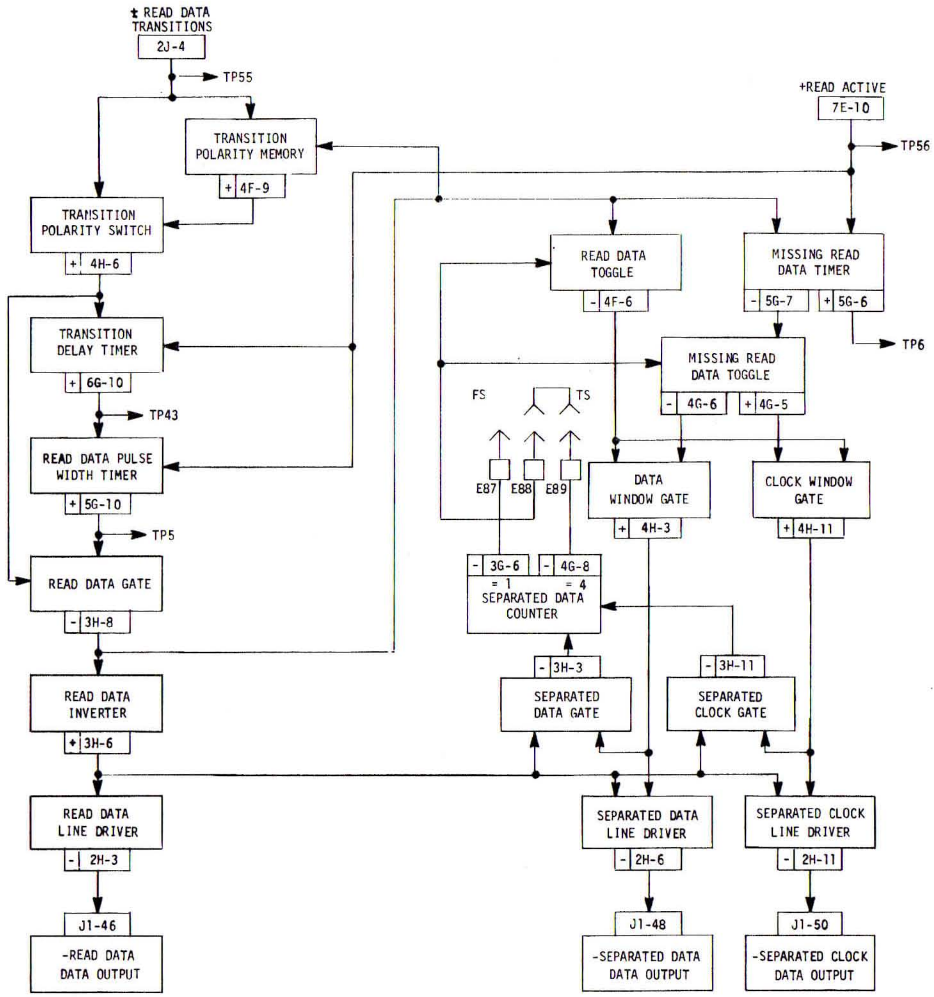


FIGURE 6-8. READ DATA OUTPUT FUNCTION

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