75736000-A

MAGNETIC PERIPHERALS INC.

FLEXIBLE DISK DRIVE
MODEL 9404

CONTENTS

MAGNETIC PERIPHERALS INC.

a subsidiary of CONTROL DATA CORPORATION

HARDWARE REFERENCE & CUSTOMER ENGINEERING MANUAL

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or use Comment Sheet in the back of this manual.

PREFACE

This manual has been prepared for customer engineers, and other technical personnel directly involved with maintaining the Model 9404 Flexible Disk Drive unit.

MANUAL CONTENT

Maintenance information is provided in the nine sections of this manual. Section numbers and a brief description of their contents are listed below:

Section 1 - GENERAL DESCRIPTION. Describes equipment functions and operation parameters, physical description, power requirements, and other characteristics.

Section 2 - OPERATION. Describes and illustrates the location and use of all controls and indicators, power on sequencing, and operating procedures.

Section 3 - INSTALLATION AND CHECKOUT. Provides information on preparing the equipment for initial use: uncrating, power and signal cabling hook-up data, environmental considerations, and initial checkout and start-up procedures.

Section 4 - THEORY OF OPERATING. Provides general and detailed functional descriptions of equipment using aids such as overall block diagrams, sequence flow charts, and signal timing diagrams. Describes basic logic and mechanical functions.

Section 5 - DIAGRAMS. Contains all applicable logic, power, schematic, and cabling diagrams which describe the electrical connectors of components, and assemblies.

Section 6 - MAINTENANCE. Describes maintenance, troubleshooting, parts removal and replacement procedures, and repair instructions. Includes periodic maintenance requirements and cleaning procedures.

Section 7 - MAINTENANCE AIDS. Contains logic diagram symbol explanations, as well as logic block data explanations. Also includes IC element cross-reference chart, and other reference data.

Section 8 - PARTS DATA. Contains complete list of all parts which may be replaced during normal field maintenance procedures. Provides isometric exploded illustrations for each major assembly showing index number for each part. Overall isometric illustrations of unit in various assembly stages serve as Locators in finding position, name, or figure number of a particular assembly. Also includes outline of all assembly and sub-assembly names, with reference to appropriate figure for parts breakdown.

Section 9 - WIRE LISTS. Provides documentation on wiring harnesses, giving signal appearing at each terminal.

TERMINOLOGY

The following terms are used throughout the manual, and are defined here for clarification:

(A) FDD - The Model 9404 Flexible Disk Drive unit.

(B) CDC - Control Data Corporation

(C) I/O - Input/Output

(D) P/N - Part Number

APPLICABLE MANUALS

Manuals applicable to the Model 9404 Flexible Disk Drive unit are as follows:

Publication No.	Titles
75736000	Model 9404 FDD Customer Engineering Manual
75735700	Model 9400 FDD Application Note 1 (IBM 3740 Format Compatibility)
75735300	Flexible Disk Handling Procedures
83464400	Model 9404 FDD Product Specification

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SECTION 1:

GENERAL DESCRIPTION

GENERAL

The Flexible Disk Drive (FDD) is a compact, portable, random access, data storage device (Figure 1-1) that interfaces with a central processor via a control unit. Input/output data, and control signals are transmitted by means of an I/O Cable.

Data, in the form of magnetized bits, is written on, or read from the tracks of a spinning disk. The FDD uses a single, removable disk (one recording surface) enclosed in a sealed jacket. The unit is capable of hard sector or soft sector (missing clock) format operation.

The major FDD Components are the spindle, disk drive motor, read/write head, stepping motor, track indexing device, and a printed circuit board.

The standard features include integrated circuits, ceramic Read/Write head, daisy chain operation, continually monitored Unit Read interrupt, Write Fault circuitry, and write current selection to maintain high read data reliability for data interchange.

Options include unit power reduction consisting of stepper motor power reduction, low dissipation AC spindle motor, and Write Protect which uses a photo-optical sensor.

All FDD Components are mounted on a base enclosure. The front panel has a spring loaded door through which the disk is installed. The door is mechanically linked to the disk loading mechanism, and the head load interlock switch; therefore when the door is closed the read/write head is loaded on the disk in preparation for the transfer of data.

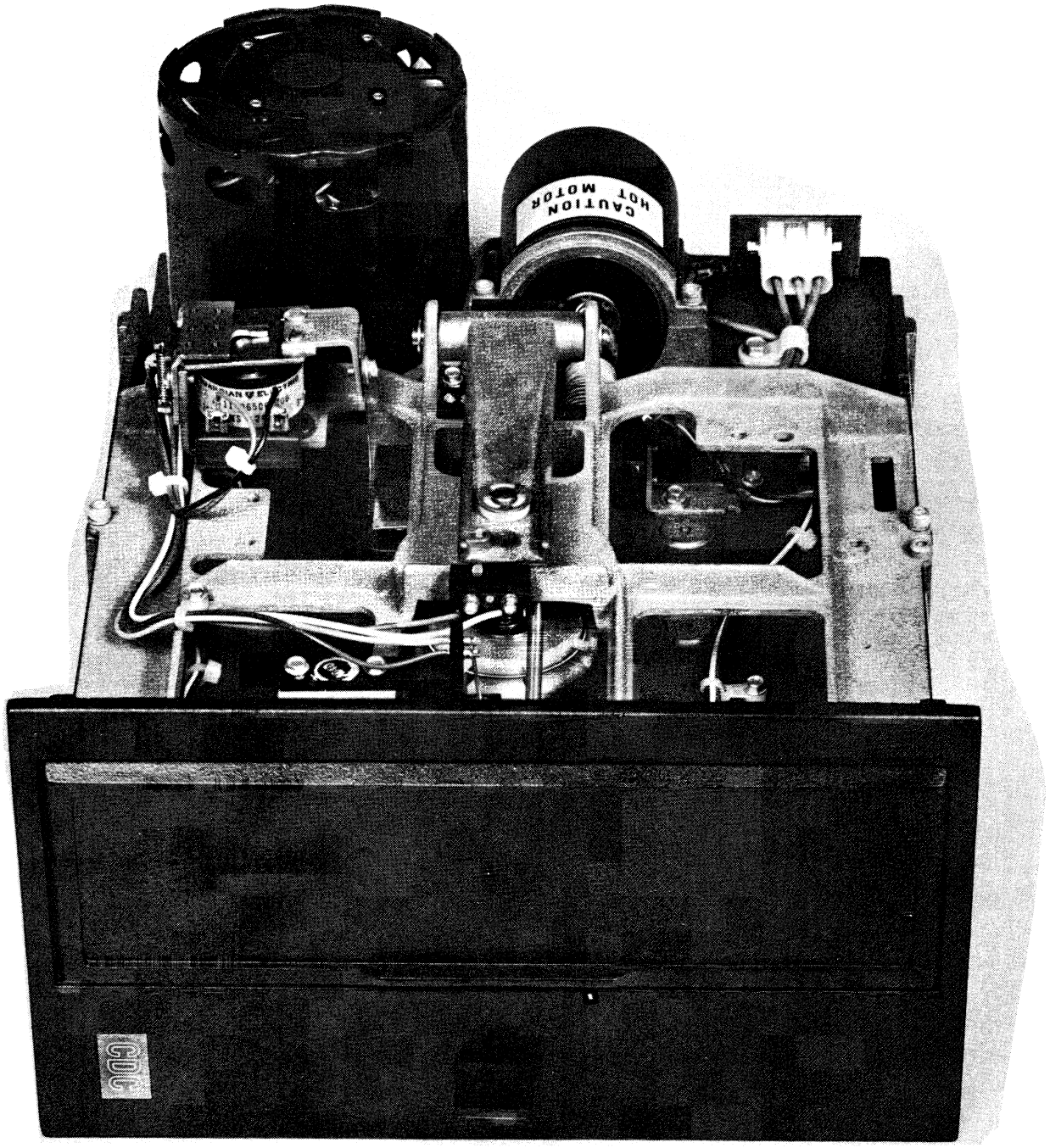


Figure 1-1. Flexible Disk Drive Unit

EQUIPMENT SPECIFICATIONS

The equipment specifications for the FDD are as follows:

ACCESSING TIME

Maximum Access Time	770 ms
Maximum One-Track Access Time	20 ms
Average Access Time	260 ms

RECORDING

Mode	Double Frequency
Density (nominal)	1836 bpi (outer track) 3268 bpi (inner track)
Bit Rate (nominal)	
Data Transfer Rate	249,984 Hz
Bits/Byte	8
Bits/Track	41,664
Tracks	77
Sectors	Format Determined

DATA CAPACITY

Bytes/Track	5,208
Bits/Track	41,664
Bits/Disk	3,208,128

FLEXIBLE DISK (Optional)	CDC 70456000; or equivalent
Disk Dimensions	8 x 8 inches (including jacket)
Useable Disk Recording Surfaces	1
Disk Surface Diameter	7.88 inches
Recording Diameters	Track 76 (inner) 2.0290 inches nominal Track 00 (outer) 3.6123 inches nominal
Disk Surface Coating	Magnetic Oxide
Disk Velocity	360 ± 3.5% rpm
Disk Storage Envelope (Optional)	CDC 70456200; or equivalent
Disk Storage Ten Pack Carton (Optional)	CDC 70455700; or equivalent

READ/WRITE HEAD

Head Unit	1
Track Width	.013 inch
Track Spacing	0.02083 inch
Erase to Read/Write Gap	.033 inch

PHYSICAL (approx.)

Height	5 inches
Width	8.78 inches
Depth	14.00 inches
Weight	12 lbs.

ELECTRICAL

Power Source (Supplied by User)

D. C

	+24-volts (±10%) @ 2.0A
	+5 -volts (±5%) @ 2.0A
	-5 -volts (±5%) @ 0.30A
	-12-volts (±5%) @ 0.30A

A. C.

BR8A2A	120 vac (±10%) single phase, 60 Hz ±2%
BR8A2B	220 vac (±10%) single phase, 50 Hz ±2%
BR8A2C	100 vac (±10%) single phase, 50/60 Hz ±2%
BR8A2D	240 vac (±10%) single phase, 50 Hz ±2%

Operating Current

BR8A2A	
Motor Start Current	0.65A
Run Current	0.40A
BR8A2B	
Motor Start Current	0.35A
Run Current	0.25A
BR8A2C	
Motor Start Current	0.90A
Run Current	0.50A
BR8A2D	
Motor Start Current	0.30A
Run Current	0.20A

SECTION 2:

OPERATION

OPERATION

INTRODUCTION

The FDD is under direct control of the input/output and power sources. No special start-up procedure is required. Operation is fully automatic and requires no operator intervention during normal operation.

OPERATING INSTRUCTIONS

NOTE

Verify that power and I/O cables are securely attached before operation.

FLEXIBLE DISK LOADING

1. Apply AC/DC power to unit.
2. Open FDD door.
3. Remove disk from storage envelope as shown in figure 2-1.
4. Carefully slide disk into FDD, as shown, into FDD until jacket is solidly against stops.
5. Carefully close unit door. Ensure that jacket is properly seated, spindle has engaged disk, and door is closed and latched.
6. Protect the empty envelope from liquids, dust, and metalic materials.

FLEXIBLE DISK REMOVAL

1. Open FDD door to stop disk rotation and disengage spindle.
2. Remove disk from FDD and put it in its storage envelope.
3. Close FDD door.

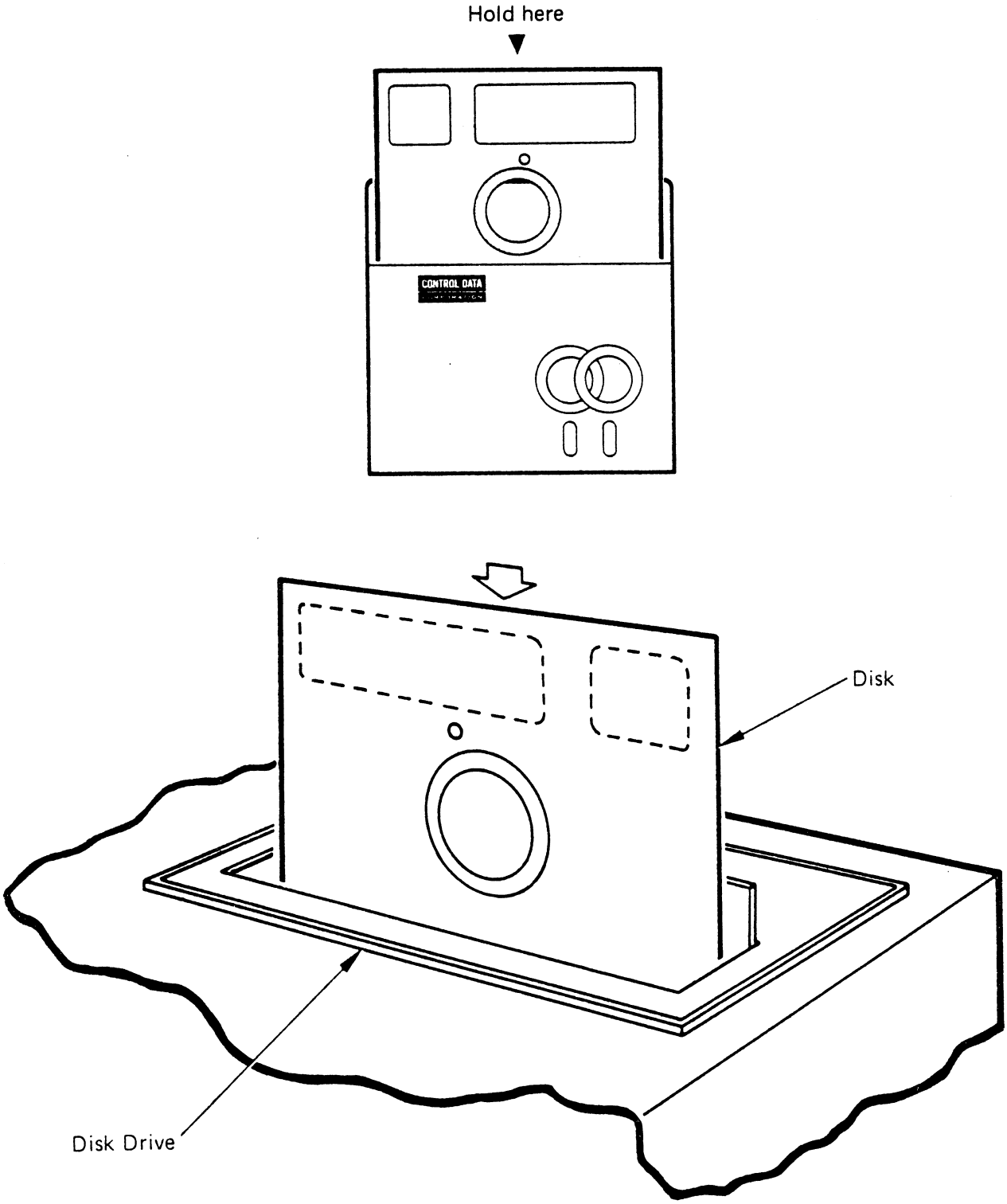


Figure 2-1. Disk Installation

ERROR RECOVERY

SEEK ERROR

Seek errors will rarely occur unless the stepping rate is significantly exceeded. In the event of a seek error, recalibration of track location can be achieved by repetitive Step Out commands until a track 00 signal is received.

WRITE ERROR

To guard against degradation from imperfections in the media, no more than 4 attempts to write a record should be used when read after write errors are encountered. In the event a record cannot be successfully written within 4 attempts, it is recommended that the sector or track be labeled defective and an alternate sector or track assigned. If more than 2 defective tracks are encountered, it is recommended that the disk be replaced.

READ ERROR

In the event of a read error up to 10 attempts should be made to recover with re-reads. If after 10 attempts the data has not been recovered, step the head several tracks away and then re-position to recover the data. Unloading the head when data transfers are not imminent will increase the data reliability and extend the disk life.

DISK HANDLING RECOMMENDATIONS

Since the recorded disk contains vital information, reasonable care should be exercised in its handling. Longer disk life and trouble free operation will result if the following recommendations are followed.

1. Do not use a writing device which deposits flakes (ie., lead or grease pencils) when writing on disk jacket label.
2. Do not fasten paper clips to disk jacket edges.
3. Do not touch disk surface exposed by jacket slot.
4. Do not clean disk in any manner.
5. Keep disk away from magnetic field and from ferromagnetic materials that may be magnetized.
6. Return disk to envelope when removed from FDD.
7. Protect disk from liquids, dust and metallic substances at all times.
8. Do not exceed following storage environmental conditions.

   Temperature: 50° to 125° F
   Relative Humidity: 8 to 80%
   Maximum Wet Bulb: 85°F (29.4°C)

9. Disks should be stored when not in use.

SECTION 3:

INSTALLATION AND CHECKOUT

INSTALLATION AND CHECKOUT

SCOPE

This section provides the information and procedures necessary to put an FDD into operation.

UNPACKING

During unpacking, care must be used so that any tools being used do not inflict damage to the unit. As a unit is unpacked, inspect it for possible shipping damage. All claims for this type of damage should be filed promptly with the transporter involved. If a claim is filed for damages, save the original packing materials . Unpack FDD as follows:

1. Cut banding and open top of corrugated carton.
2. Lift top half of styrofoam shell from carton.
3. Lift unit in polyethylene bag from bottom half of styrofoam shell and remove unit from polyethylene bag.

INSTALLATION

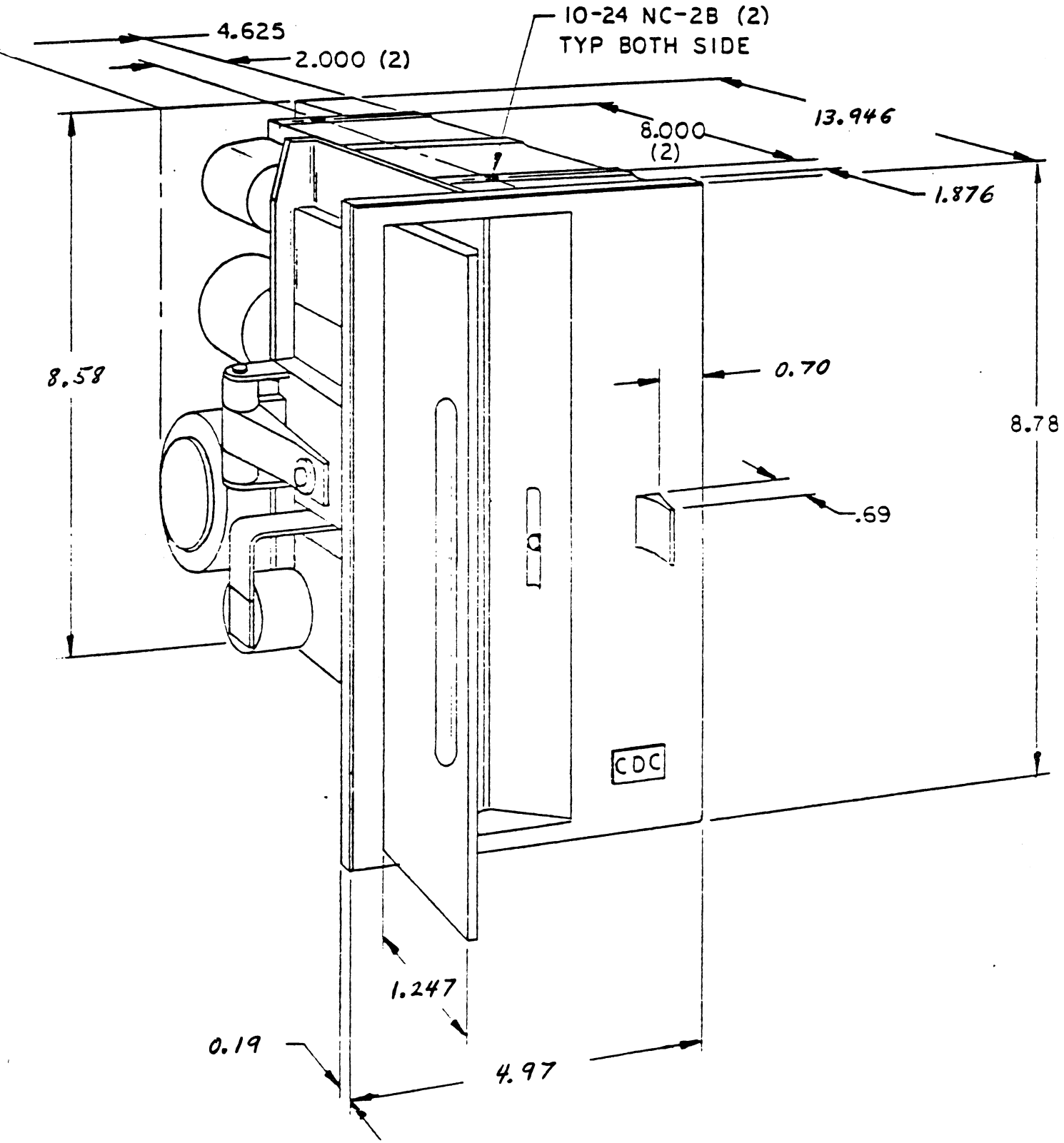
Due to the small size and light weight, the FDD can be installed or mounted in any convenient location or position. To reduce possible operator errors, mounting in a vertical position, as shown in Figure 2-1 is recommended. The FDD must be installed in a location that will prevent the I/O Cable from exceeding 25 feet in length. Refer to Figure 3-1 for dimensions and mounting provisions. Figure 3-2 provides dimentional data for FDD envelope.

CABLING AND CONNECTIONS

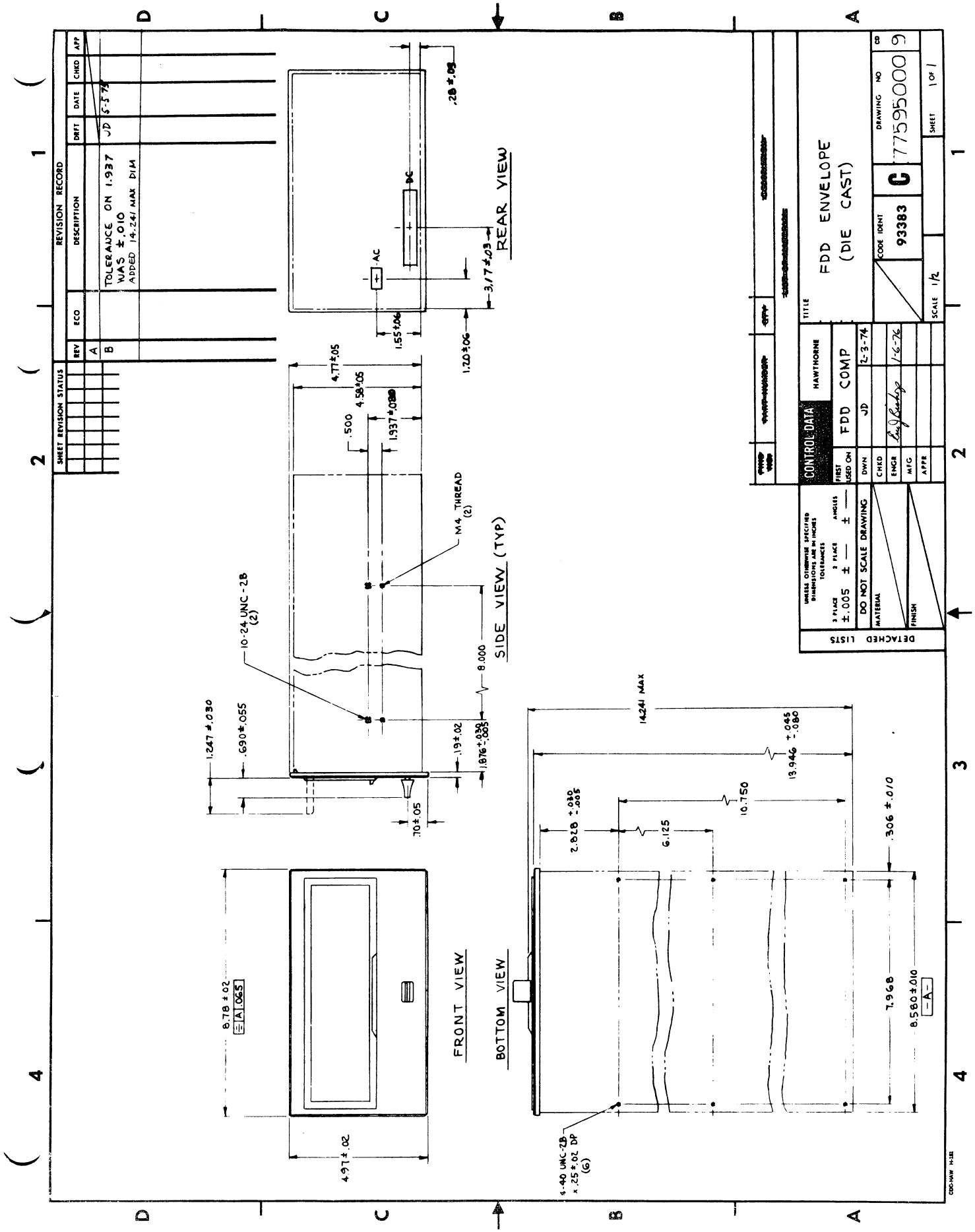
Refer to Figure 3-3 for locations of cable connector receptacles on the FDD unit.

INPUT/OUTPUT CABLE

The I/O Cable (see Figure 3-4) is required optional item supplied on order. It consists of a 50 pin 3M connector and 50 conductor 3M flat cable. An equivalent AMP connector (AMP P/N 86916-2) can also be used. Refer to Figure 3-4 for cable connector part number and attachment. The maximum cable length from connector to connector is 25 feet. All inputs and outputs require pairs, one line for function, one for ground. Characteristic impedance should be approximately 130 ohms. Power wires must be 18 AWG minimum refer to Table 3-2 for pin assignments. The I/O Cable Connector is a required optional item also. The connector consists of a self keyed connector with attaching jack-screws. Table 3-1 provides information relative to the connector pin/signal assignments for I/O Cable.



PAGE 3-2 FIGURE 3-1. DIMENSIONS AND MOUNTING PROVISIONS 75736000-A

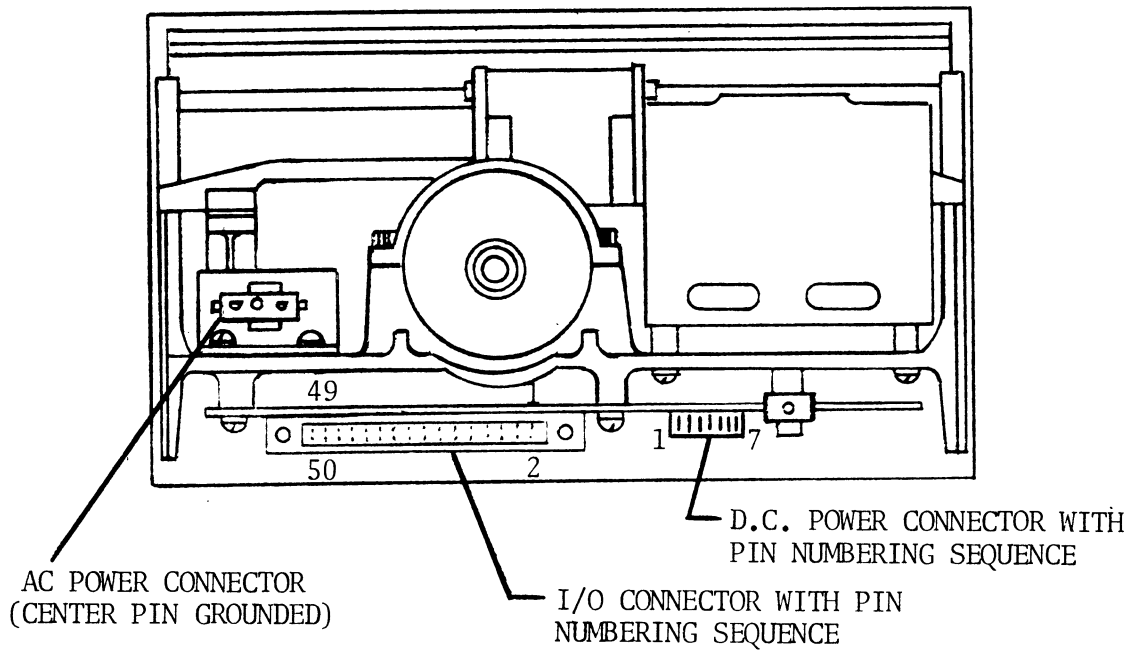


75736000-A1 Figure 3-2. FDD Envelope Dimensions Page 3-3

TABLE 3-1. INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS FOR COMPONENT BOARD ASSEMBLY 75881702

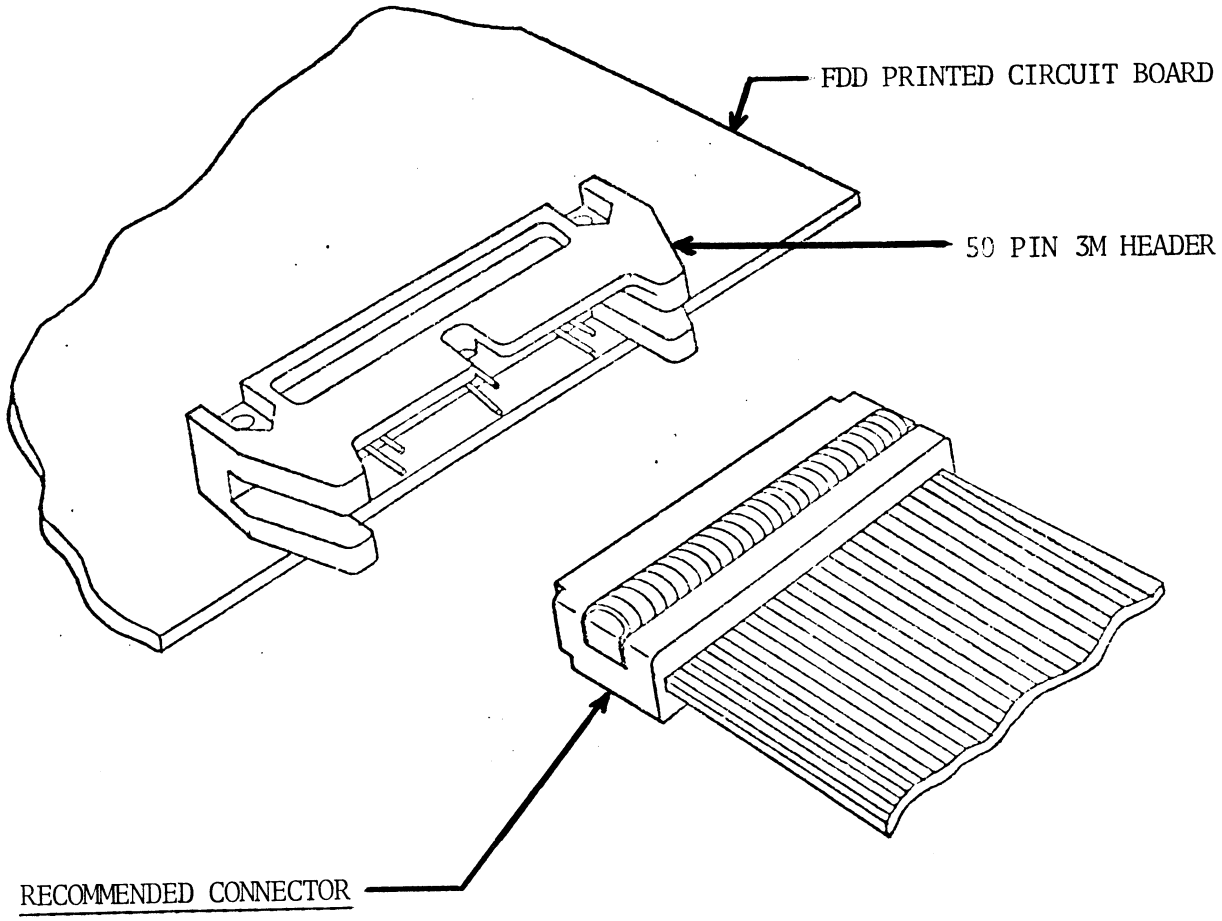
	LINE FUNCTION	PIN NUMBER* 3M	PIN NUMBER* AMP	
CONTROLLER I/O	GROUND	1	A	MODEL 9404 FDD I/O
	READ DATA/CLOCK COMPOSITE	2	B	
	GROUND	3	C	
	HEAD LOAD	4	D	
	GROUND	5	E	
	TRACK 00	6	F	
	GROUND	7	H	
	INDEX	8	J	
	GROUND	9	K	
	LOW WRITE CURRENT	10	L	
	GROUND	11	M	
	STEP	12	N	
	GROUND	13	P	
	DIRECTION	14	R	
	GROUND	15	S	
	WRITE ENABLE	16	T	
	GROUND	17	U	
	WRITE DATA	18	V	
	GROUND	19	W	
	UNIT SELECT INTERRUPT	20	X	
	GROUND	21	Y	
	UNIT SELECT INTERRUPT	22	Z	
	GROUND	23	AA	
	UNIT SELECT INTERRUPT	24	BB	
	GROUND	25	CC	
	UNIT SELECT INTERRUPT	26	DD	
	GROUND	27	EE	
	UNIT READY 1	28	FF	
	GROUND	29	HH	
	UNIT READY 2	30	JJ	
	GROUND	31	KK	
	UNIT READY 3	32	LL	
	GROUND	33	MM	
	UNIT READY 4	34	NN	
	GROUND	35	PP	
	WRITE PROTECT	36	RR	
	GROUND	37	SS	
	READ DATA SEPERATED	38	TT	
	GROUND	39	UU	
	SPARE	40	VV	
	GROUND	41	WW	
	READ CLOCK SEPERATED	42	XX	
	GROUND	43	YY	
	WRITE FAULT	44	ZZ	
	GROUND	45	AB	
	WRITE FAULT RESET	46	AC	
	GROUND	47	AD	
	SPARE	48	AE	
	GROUND	49	AF	
	SPARE	50	AH	

*Refer to Figure 3-3 for pin numbering sequence.



REAR VIEW

FIGURE 3-3. CABLE CONNECTOR RECEPTACLES FOR FDD ASSY. 75744025, 30, 31, 32

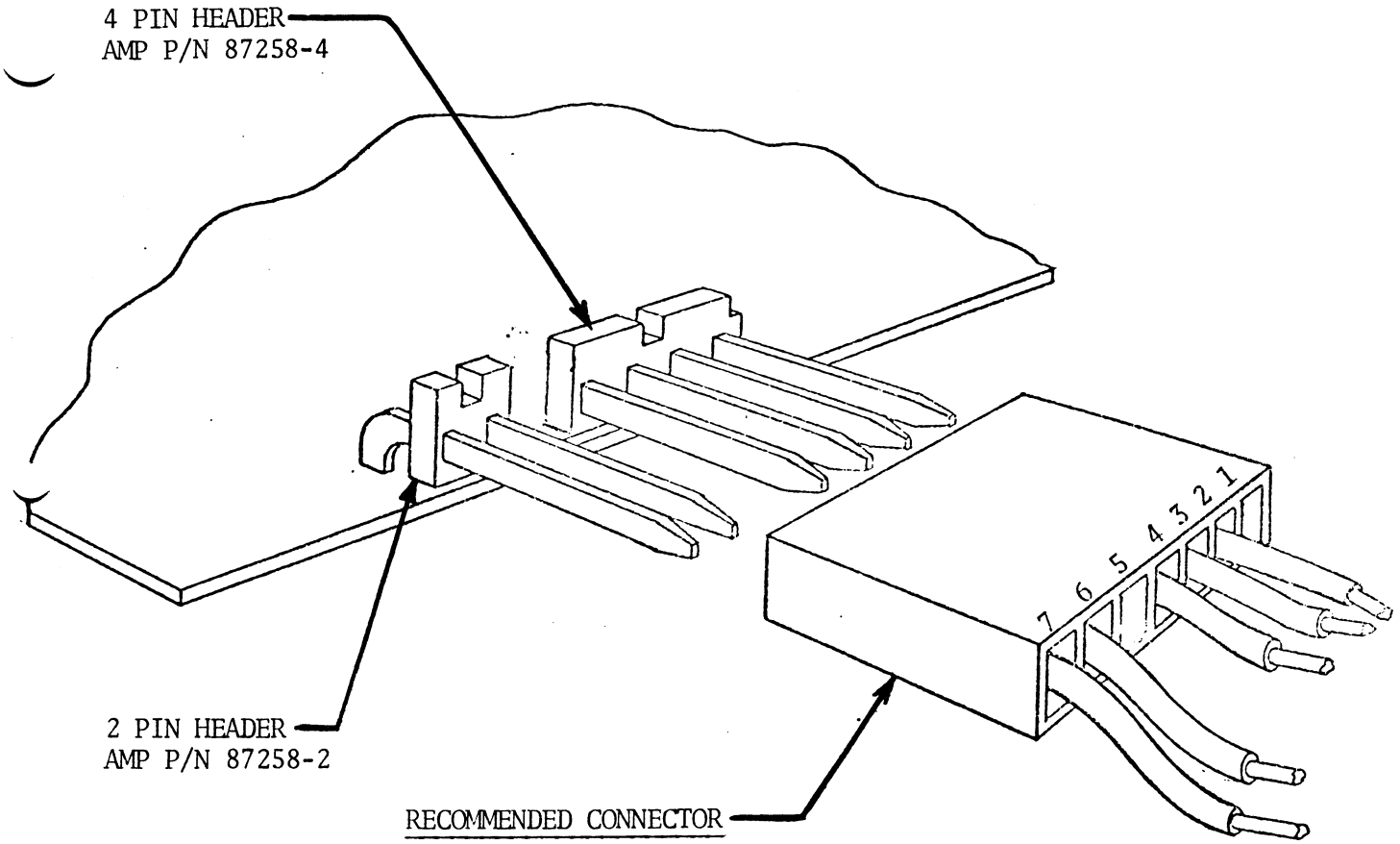


50 PIN 3M P/N 3425-0000 without strain relief
50 PIN 3M P/N 3425-3000 with strain relief

ALTERNATE CONNECTOR

50 PIN AMP P/N 86916-2

FIGURE 3-4. I/O SIGNAL CABLE CONNECTOR



RECOMMENDED CONNECTOR

AMP P/N 1-87270-1 HOUSING
AMP P/N 87278-2 CONTACTS

ALTERNATE CONNECTOR

AMP P/N 3-87025-3 HOUSING
AMP P/N 87024-3 CONTACTS
AMP P/N 87116-1 KEYING POST

FIGURE 3-5. D.C. POWER CABLE CONNECTOR

TABLE 3-2. D.C. POWER CABLE CONNECTOR PIN ASSIGNMENTS

LINE FUNCTION	PIN NUMBER*
-12 VDC (optional)	1
+5 VDC	2
GROUND	3
+24 VDC	4
NOT USED (KEYED)	5
+24 VDC RETURN	6
-5 VDC (STANDARD)	7

* Refer to Figure 3-3 for pin numbering sequence.

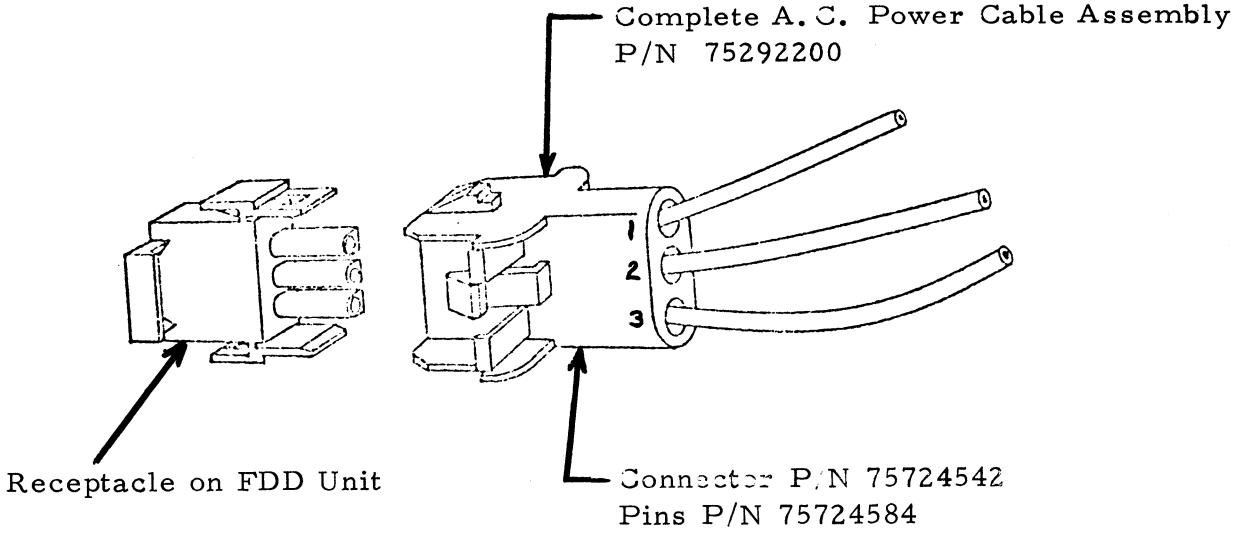


Figure 3-6. A.C. Power Cable Connector

D. C. POWER CABLE AND CONNECTOR

The Model 9404 FDD receives DC power through a power cable attached to a seven position AMP connector, which plugs into two right angled headers mounted on the printed circuit board. A two pin header (AMP P/N 87258-2) and a four pin header (AMP P/N 87258-4) are used. These two headers are mounted such that they form a composit seven pin header, with the fifth position missing (see Figure 3-5). The connector pin for each signal assignment is tabulated in Table 3-2.

The Model 9404 FDD uses -5 VDC (from pin seven) as standard, but can accept -12 VDC (from pin one) as an option.

The DC power can be supplied with a single cable in a daisy chain manner for up to four Model 9404 FDD units in a subsystem. The plug-in connector consists of a locking clip housing (AMP P/N 1-87270-1) with the 5th position molded shut for keying. The housing uses AMP P/N 87278-2 locking clips contacts, attached with AMP P/N 90308 crimping tool. If locking clip contacts are not desired, a different housing (AMP P/N 3-87025-3), which utilizes high pressure contacts (AMP P/N 87024-3), and a nylon keying post which plugs into the 5th position (AMP P/N 87116-1) can be used.

A. C. POWER CABLE

The AC Power Cable (CDC P/N 75292200 or equivalent - see Figure 3-6) is an optional item supplied on order. All wires are stranded wire, 18 AWG minimum with center pin connection utilized as frame ground. Refer to Figure 3-6 for connector part numbers and attachment.

ENVIRONMENT

Operating and storage environments of the FDD are as follows:

Operating status	50 to 100° F (12° f/hr maximum fluctuation) 20 to 80% relative humidity (providing there is no condensation).
Non-operating status	-30 to +150° F 5 to 95% relative humidity (providing there is no condensation). Max. Wet Bulb 80° F

INITIAL CHECKOUT

This procedure should be used to determine that FDD is operational. The procedure assumes that unit is installed and I/O and power cables are connected.

1. Remove top cover.
2. Apply ac power to unit and visually check that spindle rotates.
3. Apply dc power to unit.
4. Close one of the Unit Select switches (Switch 1-1, 1-3, 1-5, or 1-7).
5. Close one of the Ready switches (Switch 1-2, 1-4, 1-6, or 1-8).
6. Insert diskette (see Figure 2-1).
7. Apply a head load command signal to unit and close access door. Check that head load solenoid actuates, and door close microswitch is actuated.
8. Apply a stepping command signal to unit and check that actuator steps head as commanded.
9. Remove command signals and ac power from unit.

SECTION 4:

THEORY OF OPERATION

SECTION 4:

THEORY OF OPERATION

SCOPE

The theory of operation for the FDD is divided into two parts. The first part gives a general theory of operation. The second part gives a detail functional description of all major components both electronic and mechanical and describes all signals exchanged between the FDD and the controller.

GENERAL

The basic function of the FDD is to indicate to the controller when it is ready to operate, and respond to the commands of the controller to (1) receive and generate control signals (2) position the read/write head to selected tracks and (3) write or read data on the diskette when selected.

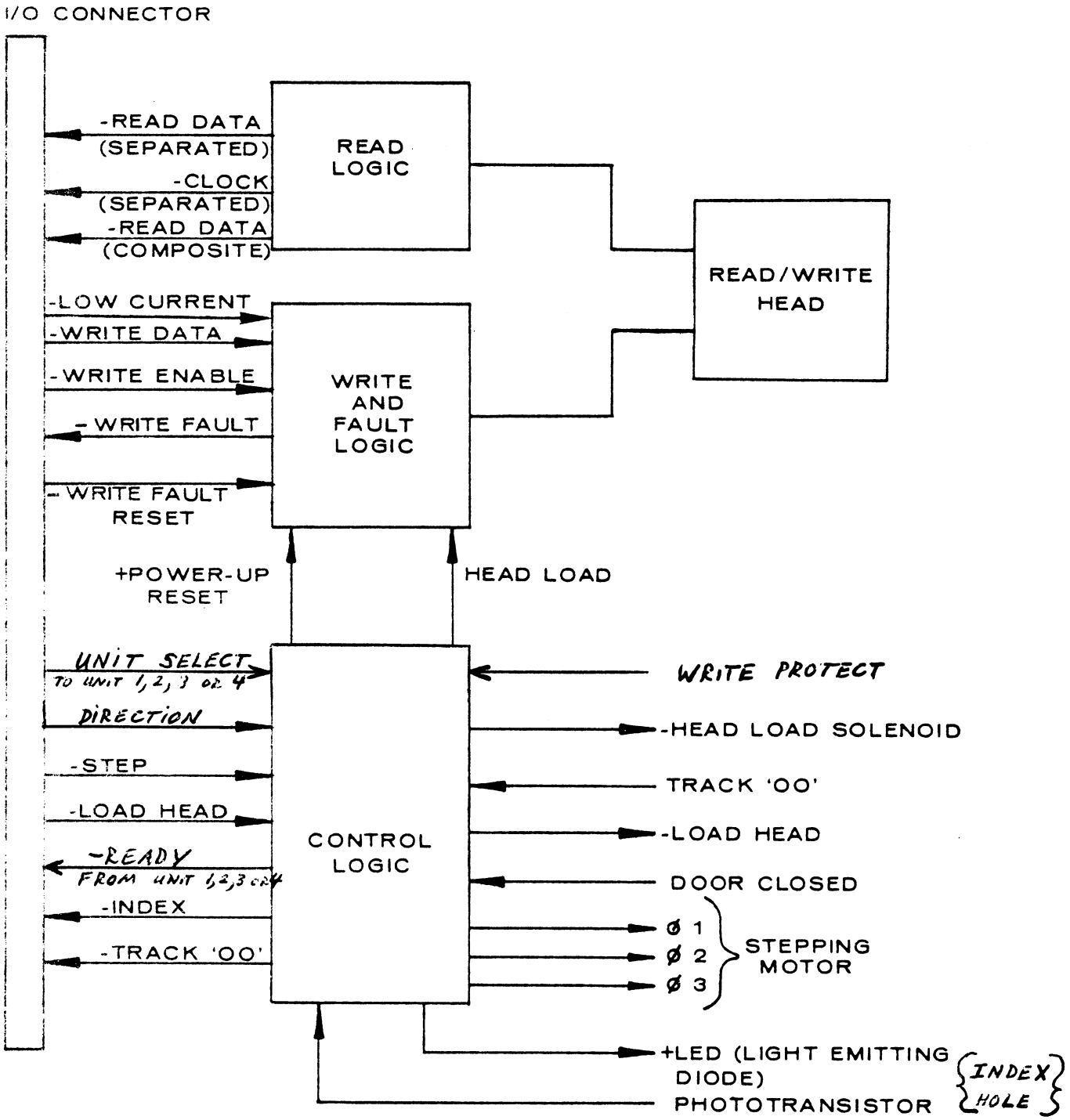


Figure 4-1. Functional Block Diagram

Signals received and transmitted by the FDD are shown in Figure 4-1, and explained in Table 4-1. All signals received by the FDD are gated with Unit Select so that no stepping, reading, or writing can be performed on an unselected FDD. Also, all signals generated within the FDD, except the Ready signal, are gated with Unit Select so that no signals can be transmitted from an unselected FDD.

During the write operation, the selected FDD receives Write Enable, Head Load, Write Data, and Low Current (Track 41 or greater) signals. If a Write Fault occurs, it will be transmitted to the controller. During Read operation, the selected FDD will receive a Load Head command. The Write Enable line remaining high implies a Read operation. Under these conditions, the FDD will transmit Separated Data, Separated Clock, and Read Data (Composite) signals to the controller. Controller commands Step and Direction are received during a track seek operation on a selected FDD. The FDD transmits Index pulses as long as it is selected. Also, the selected FDD transmits a Track 00 signal to the controller whenever the read/write head is at Track 00.

Positioning of the read/write head is accomplished by a lead screw driven by a stepper motor. The read/write head is mounted on a carriage which is attached to the lead screw. Each Step and Direction command from the user system increments the stepper motor which, in turn, rotates the lead screw 15°. Each 15° rotation of the lead screw moves the read/write head one track position.

The Model 9404 FDD has an internal control circuit which reduces the stepper motor power 20 milliseconds after the last Step command. This is accomplished through the retriggerable one shot multivibrator U-3 at pin 7. The time out of this one shot is approximately 22 milliseconds. Step Commands which occur at a repetition rate of 10 milliseconds will hold U-3 pin 7 high. This has the effect of holding the transistor Q 24 on, and clamping the voltage source to the center tap of the stepping motor at +24 Volts. When the last Step Command is received, the one shot U-3 pin 7 will time out and go low. This turns Q 24 off, and leaves the center tap of the stepping motor floating. The inductive reaction of the stepping motor winding in use at that instant of time will force the voltage at the center tap toward a negative voltage. However, the +5 Volt clamp through CR 20 will prevent the voltage from dropping lower than approximately 4.3 Volts. The stepping motor voltage will then remain at this level until the next Step Command is received, which will force Q 24 to the On state again.

Reading or writing operation begins by placing the read/write head in contact with the disk at the desired track. To write data on the disk, Write Data is sent by the controller to condition the write logic, then current pulses, corresponding to the input data, are applied to the write head, causing bits on the disk track to be correspondingly magnetized. Erasure of previously recorded data is simultaneously accomplished during writing operation.

To read from the disk, magnetized bits in the format of the pre-recorded data are sensed by the read/write head. This signal is amplified, separated into clock and

data information, and transmitted to the user system.

FUNCTIONAL DESCRIPTION

Refer to Figures 4-1, 5-1, and Schematic 75772202 for the following discussion.

The FDD is divided into the following major functional areas:

1. Control Logic
2. Write and Write Fault Logic
3. Read Logic
4. Disk Drive
5. Read/Write Head

Control Logic

The functions of the control logic are to generate the signals that (1) establish the ready status of the FDD, (2) step the read/write head in, or out, upon selection and command of the controller, (3) load the head on the disk for read/write operations, (4) protect the disk from writing if the write protect hole is present, (5) indicate when the read/write head is at Track 00, and (6) generate the index pulses when the diskette is rotating and the FDD is selected.

At initial voltage application, the two flip flops of U14 are set in the high state through the action of Q4 and Q5. At the instant the +5V appears, Q5 will be turned on, forcing pins 1 and 13 of U14 low, and setting the output of pins 5 and 9 of U14 high. As the capacitor C10 is charged, Q4 will turn on and force Q5 off. This will cause the clearing signal to go high and remain high as long as the +5 volts remains present.

Each Step command received sequentially energizes one of the three phases of the stepper motor. The logic level of the Direction command determines whether the phase sequence is ØA, ØB, ØC, ØA. . . or ØA, ØC, ØB, and ØA.

Movement of the read/write head is initiated by the Step and Direction commands from the controller. The head is stepped one track, either toward the spindle (In) or away from the spindle (Out), with each Step command. The direction is regulated by the status of the Direction line. A low level of the Direction line causes the read/write head to step toward the spindle, and a high level causes the read/write head to step away from the spindle.

The phase sequence through which the stepper motor is driven is controlled by the Direction command, by being gates with ØA (NAND gate U10 Pin 6) to control the logic level of the CD inputs to the two flip flops of U14 pins 2 and 12. The Step function triggers a 3 microsecond one shot multivibrator, U9 pin 7, to provide a clock to cause the two flip flops of U14 to change state at each Step command. The control functions controlling the stepper motor drivers Q8, Q10, and Q12 are generated by AND-ing the true and compliment outputs of the two flip flops of U14 pins 5, 6, 9, and 8. The Step command is gates with Write Enable to prevent stepping while the write heads are activated, U13 pin 6. Both the Step and Direction commands are gated with the Unit Select command at U16 pin 6, and U16 pin 3, respectively. The flip flops of U14 are clocked by the trailing edge of the 3 microsecond one shot U9.

The read/write head of a selected FDD can be loaded when the disk is fully installed and the front panel door is closed. Closing the front panel door actuates the door interlock switch which completes the circuit to the head load solenoid. When the controller sends a Head Load, the head load solenoid is energized causing the armature bail to actuate, placing the disk against the read/write head.

Track 00 signal is generated when the carriage assembly closes the Track 00 switch. Closing this switch sets the latch formed by the two gates of U10 pin 8 and U10 pin 11. The output of this latch (pin 8) is gated with ØA and Unit Select to provide the Track 00 signal that is transmitted to the controller from U5 pin 6.

The beginning of each disk track is indicated by an Index pulse. The disk rotates between a light source (LED) and a sensor (photo-transistor). When the index hole in the disk passes over the light source, light is detected by the sensor. The sensor output is amplified and transmitted to the controller as the Index pulse when the FDD is selected.

The Ready signal is generated when the disk comes up to proper operating speed. The index pulses are used to re-trigger the multivibrator (U9 pin 10). The output of this element will remain high on a continuous basis when repetition rate of the index pulses is shorter than the time out of U9 pin 10. This logic function is used to control the R/S flip flop (U7) to generate the Read signal. The switches (1-2, 1-4, 1-6, and 1-8) allow selection of the relative position of each FDD within the Daisy Chain Configuration. The position of these switches has been chosen so that they are interlaced with their common Unit Select switches of 1-1, 1-3, 1-5, and 1-7 (see Figure 5-1).

The Write Protect is accomplished through use of a LED (light-emitting diode) and a photo-transistor. These are mounted such that the presence of a write protect hole in the diskette will cause U13 pin 1 to be driven low. This signal is gated with Unit Select, and subsequently with Write Enable, to inhibit writing on any diskette possessing a write protect hole.

Write and Fault Logic

A write operation begins in a selected FDD with a Write Enable command from the controller. This command simultaneously enables the write data switching drivers (U23), and write data gates (U22), blocks the input to the read circuit by reverse biasing diodes CR13 through CR16, and after a 400 microsecond delay, energizes the erase windings. Data applied to the Write Data input alternately switches a constant write current through the write drivers to the head winding. Low Current operation, used when writing on track 43 or greater, is selected by switching a series resistor (R71) into the write current source (Q18).

A Write Fault signal is generated if Write Enable is commanded and the head is not loaded (head load solenoid not energized) or Write Enable is commanded and no data is applied, or Write Enable is command but Write Data is applied at the wrong rate. Either one or both of the conditions sets the write fault latch (U26). Commanding a Write Fault Reset clears the Write Fault signal by resetting the write fault latch (U26).

Read Logic

Read operation is enabled when the read/write head is loaded on the disk and Write Enable is not commanded. With Write Enable not commanded, the data blocking diodes (CR13 through CR16) are forward biased, and data sensed by the read/write head is fed to the read data circuit. The read signal from the disk is in the form of a sine wave (see Figure 5-1). This analog signal is amplified, filtered, differentiated (reference U1, Q1, Q2, and Q3), and coupled to a combination differential voltage comparator and one multivibrator which develops a 250 nanosecond pulse for each transition of the input signal. The read data logic (U5, U7, U8, U27, and U28) separates the composite signal and simultaneously transmits Separated Clock, Separated Data, and Composite Data outputs to the controller when the FDD is selected. (This data separation has been designed for double frequency recording without missing clock format).

Disk Drive

Disk Drive is accomplished by clamping the disk between the cone assembly (item 17, figure 8-3) and a belt driven spindle (item 2, figure 8-3). The spindle is rotated at 360 rpm by the disk drive motor (item 102, figure 8-1).

Read/Write Head

The read/write head is in direct contact with the disk during read or write operation. Since the head is rigidly mounted on the carriage assembly, head load is achieved by a solenoid actuated bail (item 21, figure 8-3) allowing the head load arm to force the disk against the read/write head. The head surface is designed for maximum signal transfer to and from the magnetic surface of the disk with minimum head/disk wear. Tunnel erase DC erases the intertrack area to reduce off-track signal-to-noise rate and permits disk interchangeability between units.

CONTROL AND DATA LINE CHARACTERISTICS (Signals)

Figure 4-2 depicts the control and data line transmission system used on the FDD. All signal lines must be termined at the receiver with an impedance of 130 ohms accomplished through a 3M flat cable. All communication between controller and FDD is with a maximum line length of 25 feet. Figure 5-1 shows the timing of typical operations.

Logic Levels

The following definitions will be used throughout this manual:

Logic 1 (Active State)	Refers to the low-voltage condition of 0-volts (+0.5V, -0.0V)
Logic 0 (Inactive State)	Refers to the high-voltage condition of +5.0 volts (+0.5V, -0.5V).

Transmitter Characteristics

The FDD uses the TTL 7438 (quad 2- input buffer or driver) to transmit all control and data signals. This transmitter is capable of sinking a current of 48 ma with an output voltage of 0.5 volts (maximum).

Line Receiver Characteristics

The FDD uses SN75154 quad line receiver. The input of each receiver is termined in 130 ohms, as shown in Figure 4-2.

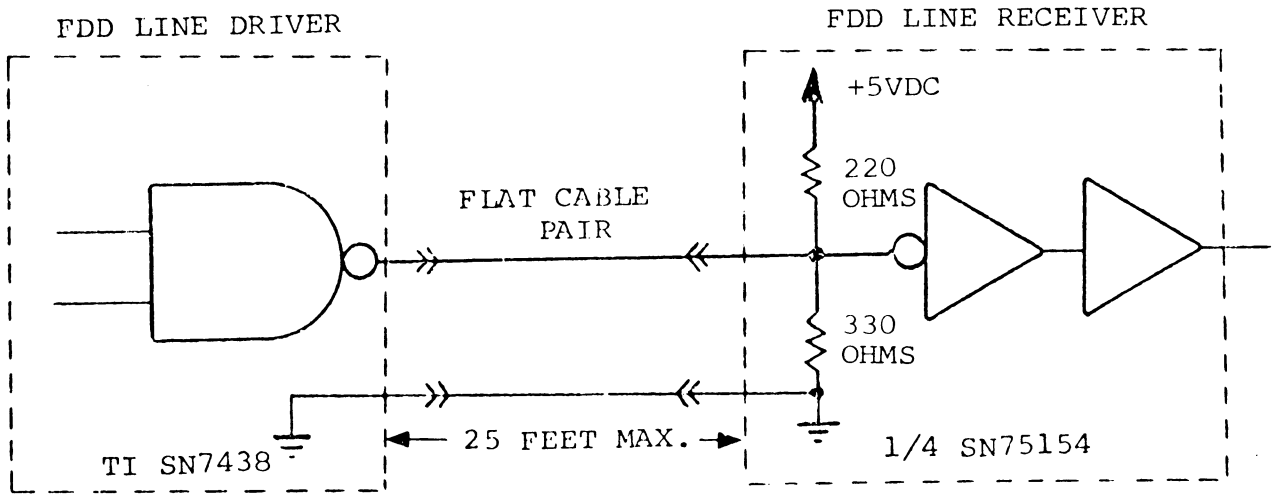


Figure 4-2.
Control and Data Line Transmission System

Control and Data Line Functions (Refer to Figure 4-1)

The signals that are exchanged are described in Table 4-1 and are shown relative to a point of origin in Figure 4-1.

TABLE 4-1. INPUT/OUTPUT LINES

SIGNAL	FUNCTION
Input Lines	
-Unit Select (4 Lines)	A unique signal used to enable all control and status communication, except Ready status, between the drive and the controller. A low level on this line selects the FDD. A high level on this line decouples the FDD from the controller. Four switch positions are provided within the drive to allow selection of relative position within the chain.
-Step	A 10 microsecond (minimum) logic 1 level pulse on this line causes the head to move one track inward toward the center of the disk.
-Direction	The level of this line controls the direction the head will be stepped. A logic 1 (0.5V) causes heads to step toward the spindle. A logic 0 (5V) causes the heads to step away from the spindle.
-Head Load	A logic 1 level on this line loads the disk against the head through the use of a pressure pad on the opposing side of the disk. The logic 1 level must be initiated 60 milliseconds prior to initiating a read or write operation to allow for head load settling time. For increased head and media life, this signal must be at a logic 0 whenever a data transfer operation is not is process or pending.
-Write Enable	To enable the FDD write driver, this line is held at a logic 1. To disable the FDD write driver and enable the FDD read circuitry, this line is held at logic 0.

TABLE 4-1. INPUT/OUTPUT LINES (Cont'd)

SIGNAL	FUNCTION
-Write Fault Reset	A logic 1 level on this line clears the Write Fault Latch.
-Write Data	This line contains the composite double frequency coded Write Clock and Data information to the FDD. The Write Clock and Data pulses must be 250 nanoseconds ±20% in length and are true at the logic 1 level. Information to be recorded on the disk is derived from the trailing edge of each pulse (i.e., at the logic 1 to logic 0 transition point).
-Low Current	This line reduces Write Current for tracks 43 or greater. A low level reduces Write Current.
Output Lines	
Ready (4 Lines)	A low level on this line indicates to the controller that the diskette has been inserted correctly, the door is closed, and the diskette is at speed. This line is not gated by Unit Select within the drive. The output driver of the Ready line is an open collector gate. A pull up resistor to +5V must be provided at the controller for this line. Four switch positions are provided within the drive to allow selection of the relative position within the Daisy Chain. These switches have been interlaced with the Unit Select switch positions (see Figure 5-1).
-Index	This line gives an indication of the relative position of the disk by outputting a logic 1 pulse for every sector hole of the disk. The 1.5 ± 0.6 milliseconds pulse is generated by sensing the index hole in the disk using a photo-optical technique.
-Write Fault	A logic 1 level indicates one or more of the following fault conditions: -Write enable without head load.

TABLE 4-1. INPUT/OUTPUT LINES (Cont'd)

SIGNAL	FUNCTION
-Write Fault (Cont'd)	-Write enable without write data. Incorrect write data rate.
- Write Fault Reset	A Write Fault can be cleared by a logic 1 on the Write Fault Reset line.
-Track 00	A logic 1 level indicates that the head is positioned over track 00.
-Write Protect	A logic 1 level indicates that hole on diskette is uncovered.
-Read Data (Separated)*	This line contains the separated data information. A logic 1 level pulse of 250 nanoseconds ± 20% corresponds to a data 1 bit read from the disk.
-Clock (Separated)*	This line contains the separated clock information. A logic 1 level pulse of 250 nanoseconds ± 20% corresponds to a clock bit read from the disk.
-Read Data (Composite)	This line contains the unseparated data and clock information. A logic 1 level pulse of 250 nanoseconds ± 20% corresponds to data or clock pulses read from the disk.

* These signals are valid only when double frequency recording without missing clock is used.

POSITIONING CHARACTERISTICS

The time for a single track move is 20ms including settling time. This is defined as the time to move between any pair of adjacent tracks. Multiple track moves can be made at 10ms per step plus 10ms settling time after the last step.

The random average positioning time is 260ms. This is defined as the summation of the move times for all possible moves divided by the number of possible moves.

The maximum positioning time is 770ms. This is defined as the time to move the head from track 00 to track 75, or from 75 to 00, and includes settling time.

SECTION 5:

DIAGRAMS

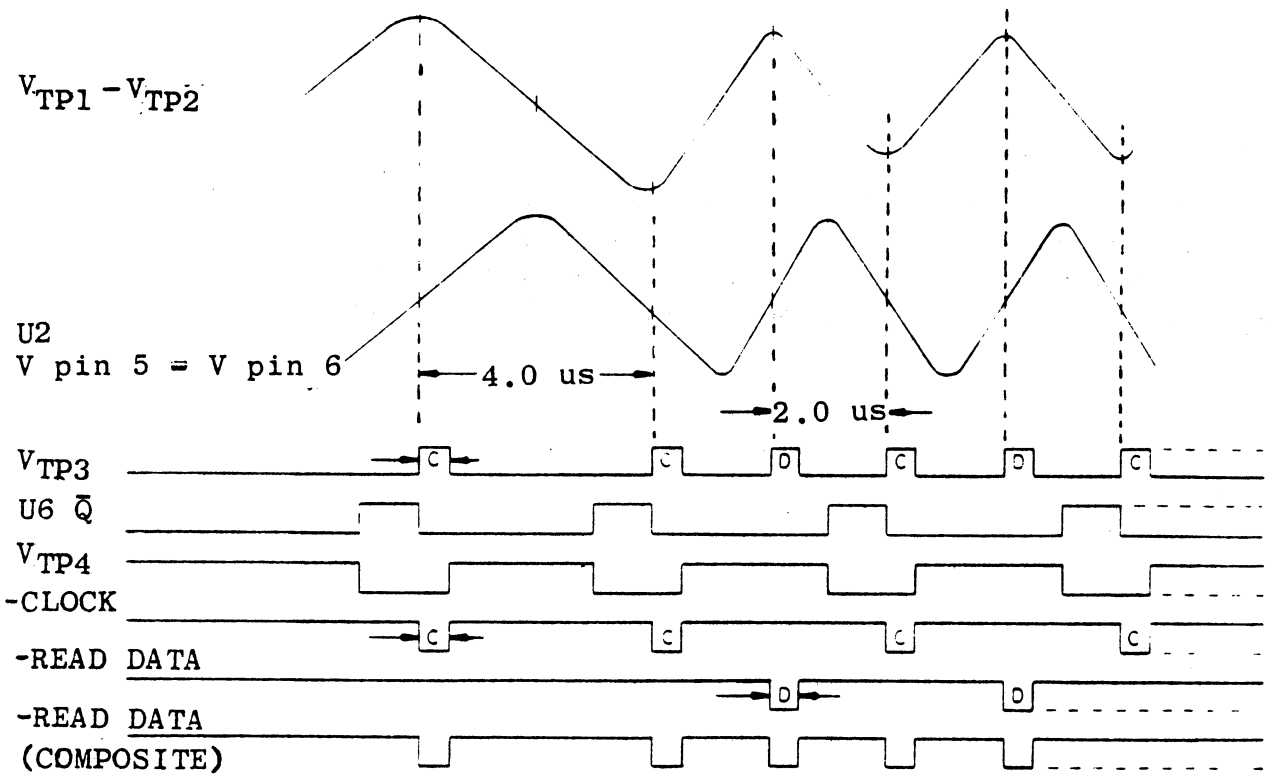
SECTION 5:

DIAGRAMS

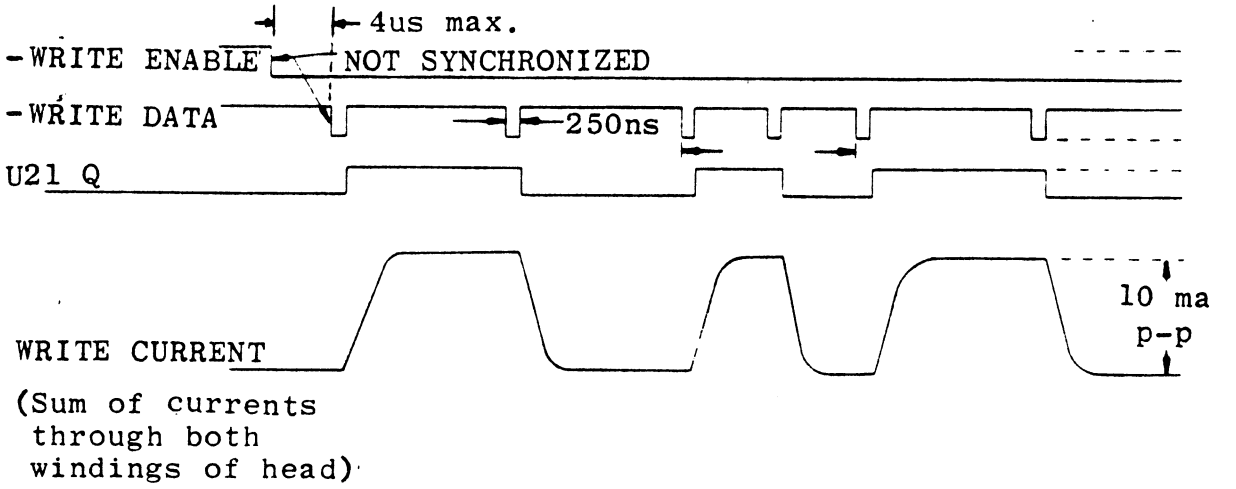
INTRODUCTION

This section contains diagrams that describe the Flexible Disk Drive in terms of the functions it performs. Figure 5-1 shows timing diagrams which illustrate signal time relationships during read, write, step-in, and step-out operations. Schematics of the FDD printed circuit board follow timing diagrams.

READ



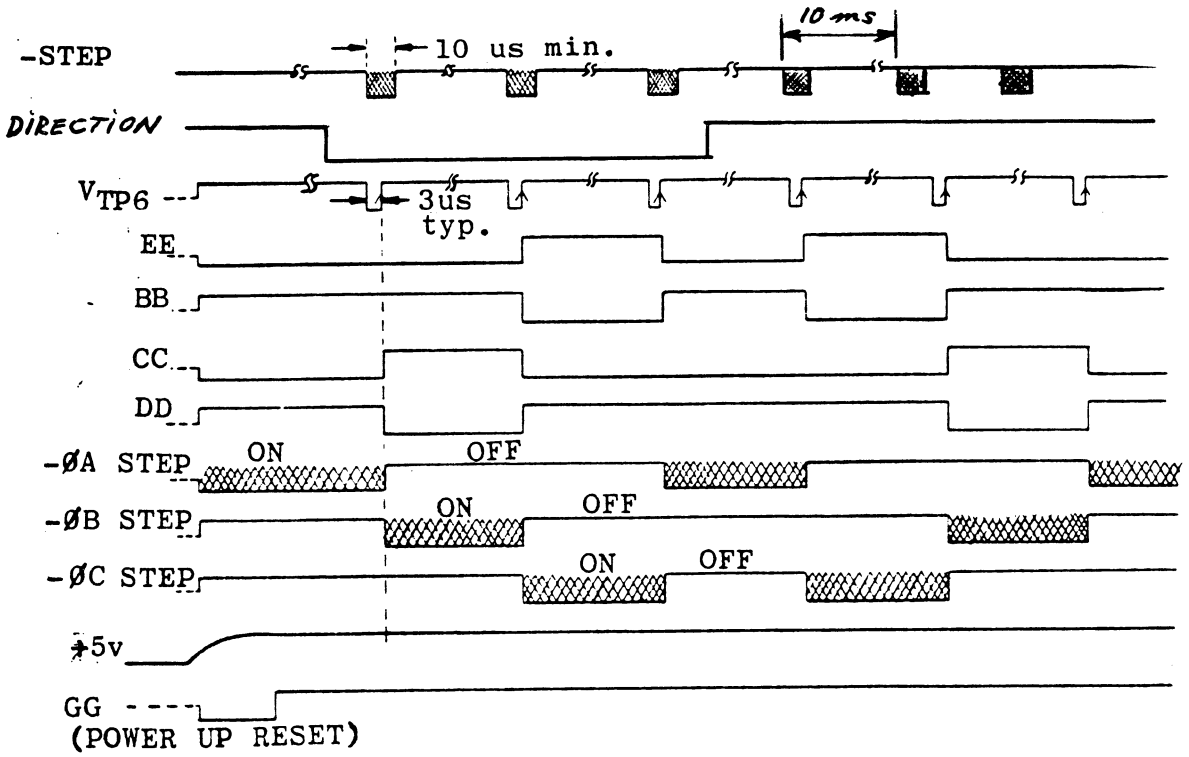
WRITE



FDD 007-1-A

Figure 5-1. Timing Diagrams (Sheet 1)

STEPPING MOTOR



INDEX

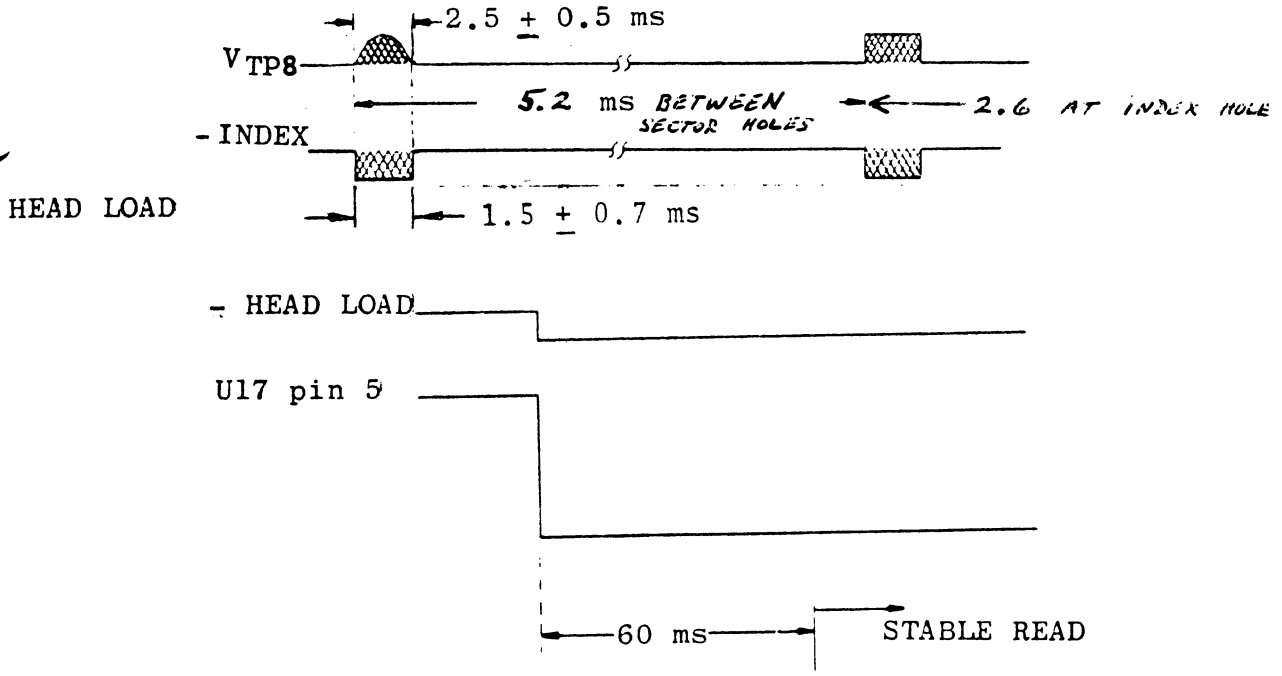
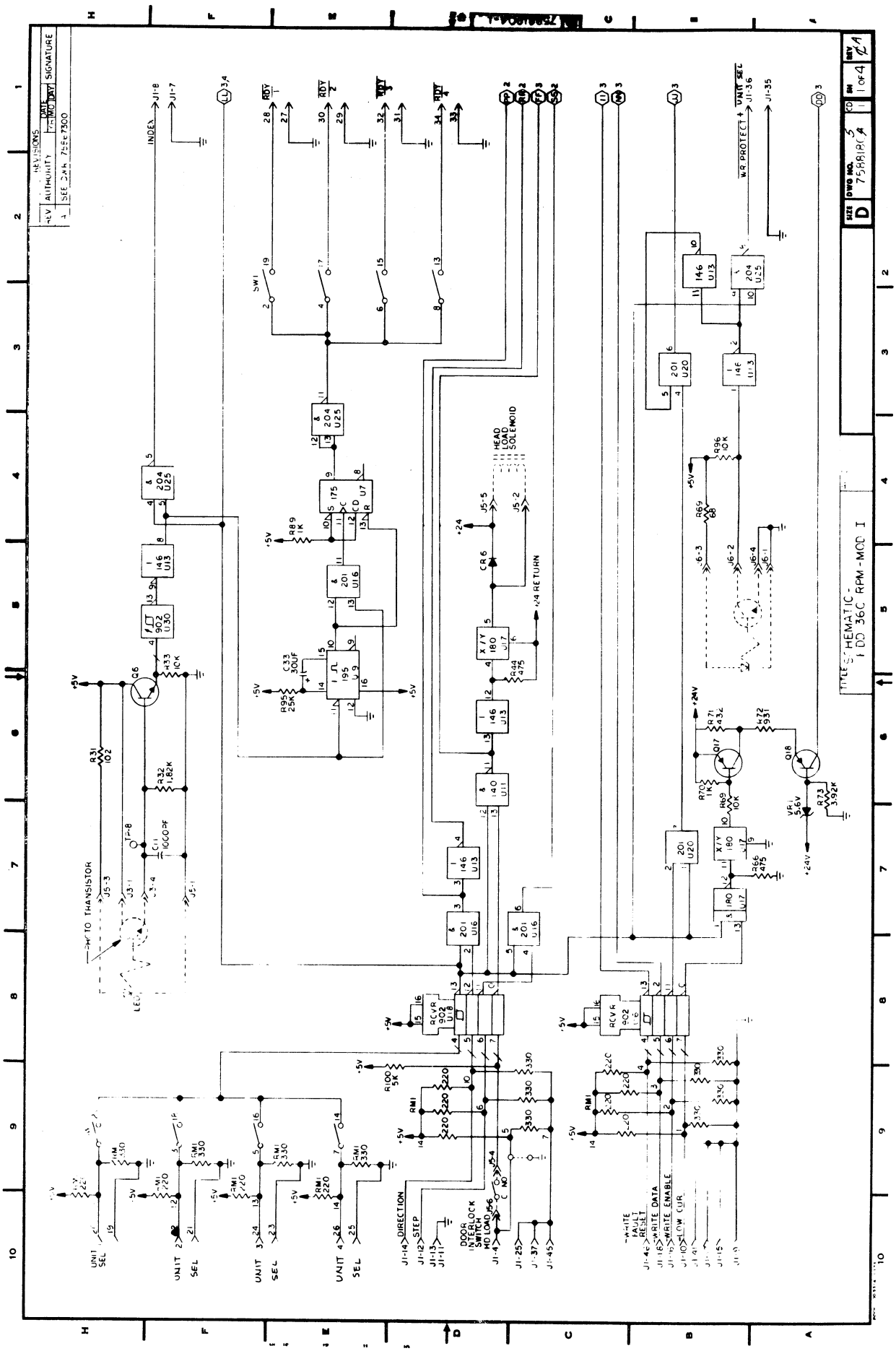
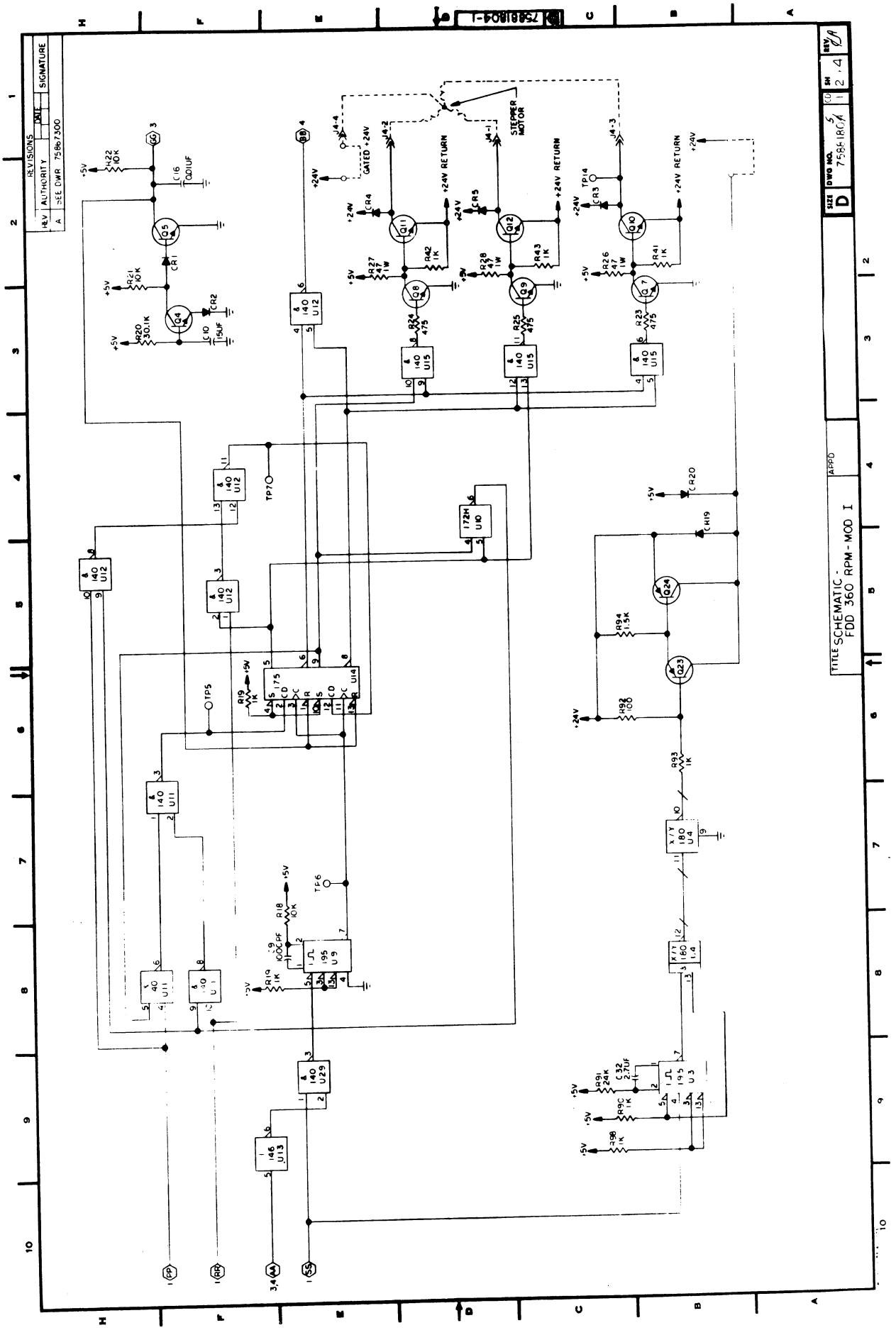
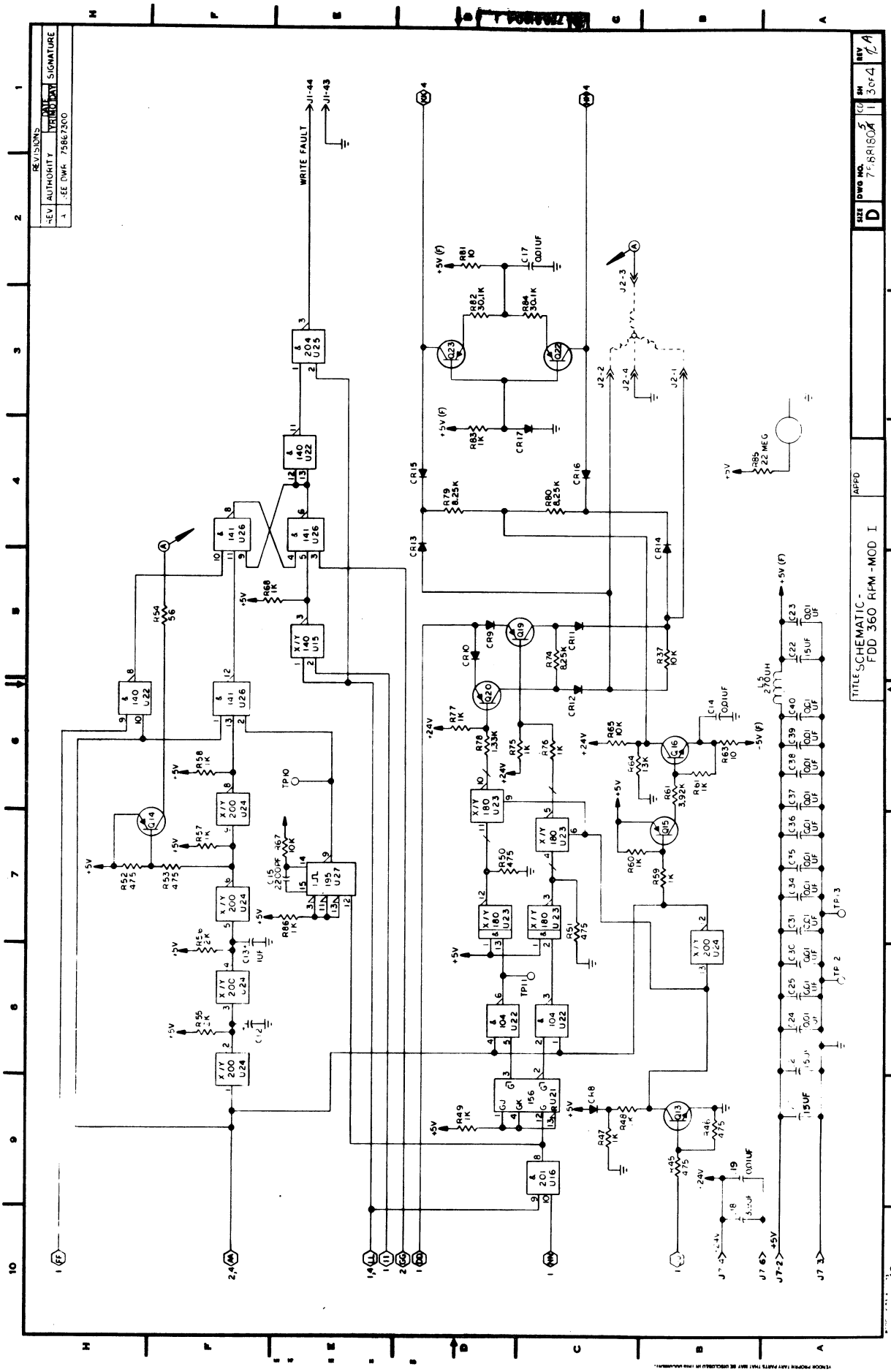
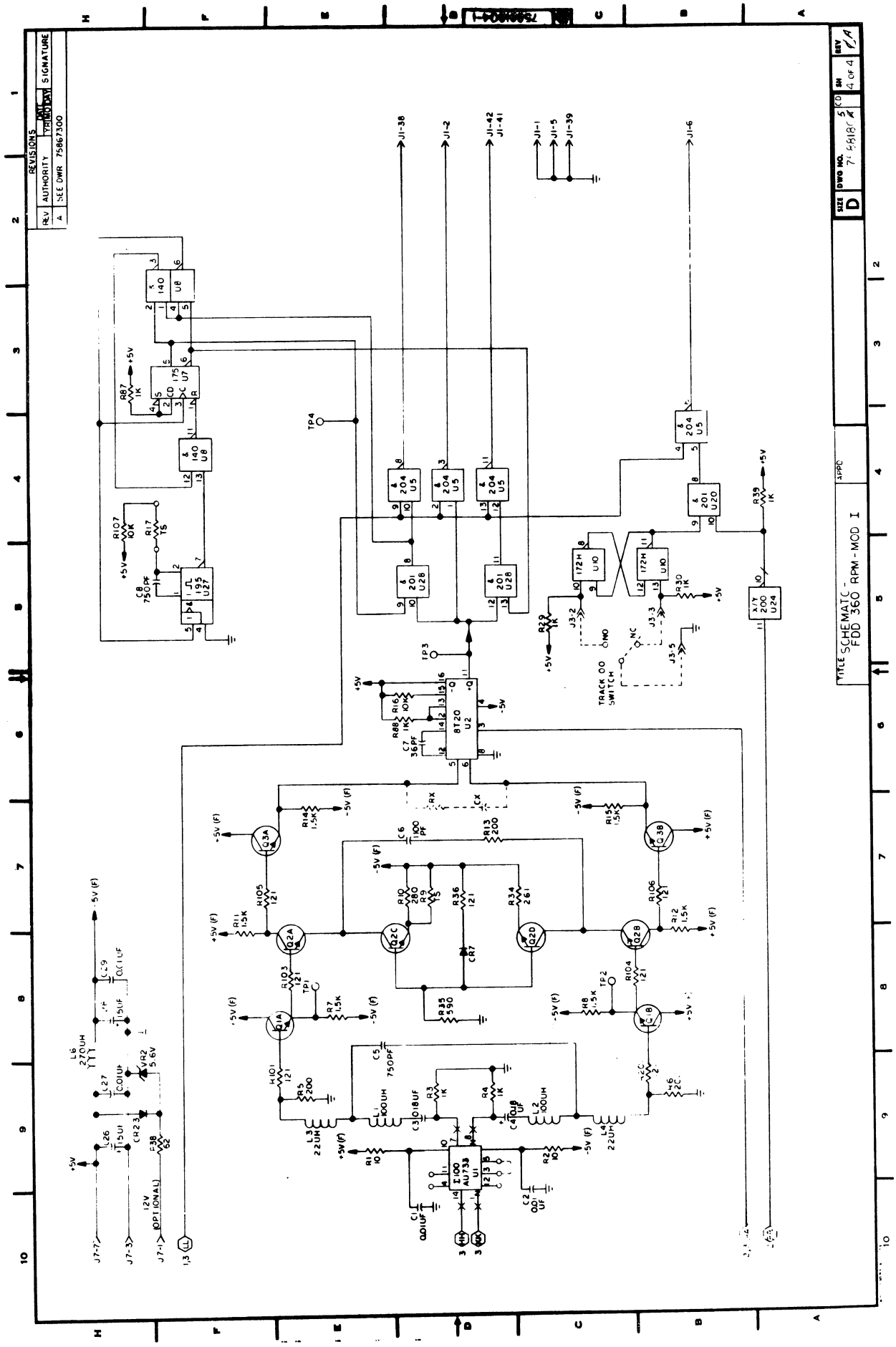


Figure 5-1. Timing Diagrams (Sheet 2)


SCHEMATIC
100 36C RPM-MOD I
INDEX
HEAD LOAD SOLENOID
+24 RETURN
WR PROTECT
UNIT SEL
DIRECTION
STEP
DOOR INTERLOCK SWITCH
MOTOR ON
WRITE FAULT RESET
WRITE DATA
WRITE ENABLE
SLOW CUR


REVISIONS
REV AUTHORITY DATE SIGNATURE
A SEE DWR 75867300
SIZE D DWG NO. 75536804 REV B
SCH 1 2 4
TITLE SCHEMATIC - FDD 360 RPM - MOD I
APPD
STEPPER MOTOR
GATED +24V
+24V RETURN
+5V
+24V


REVISIONS
REV | AUTHORITY | DATE | SIGNATURE
A | SEE DWG 75867300
WRITE FAULT
SCHEMATIC - FDD 360 RPM - MOD I
SIZE D
DWG NO. 75891804
REV A
SH 3 of 4


REVISIONS
REV
AUTHORITY
DATE
SIGNATURE
A
SEE DWR 75867300
SIZE
D
DWG NO.
75736000-1
REV
A
SHT
4 OF 4
TITLE
SCHEMATIC -
FDD 360 RPM - MOD I
J1-38
J1-2
J1-42
J1-41
J1-1
J1-5
J1-39
J1-6
TP4
TP3
TP2
TP1
U1
AU733
U2
8T20
TRACK 00
SWITCH
+5V
-5V
+5V (F)
-5V (F)
12V
(OPTIONAL)

SECTION 6:

MAINTENANCE

SECTION 6:

MAINTENANCE

This section contains the instructions required to maintain the FDD. The information is provided in the form of preventive maintenance, troubleshooting, and corrective maintenance.

Maintenance Tools

The special tools (or equivalent) required to maintain an FDD are listed below:

Description	CDC Part Number
Actuator Alignment Tool	75292000
Outer Stop Gauge	83401300
Inner Stop Gauge	83401400

The standard tools required to maintain the FDD are listed below:

Socket Wrenches
Sizes: 5/16", 1/4", 3/16", 11/32"

Allen Wrenches
Sizes: .050", 1/16", 5/64", 7/64"

PREVENTITIVE MAINTENANCE

The FDD is designed to require no preventitive matinenance.

HEAD CLEANING

On occasions the read/write head may require cleaning. If this situation occurs, clean head as follows:

CAUTION

Do not smoke while cleaning. Do not touch head face with fingers. Do not leave residue or lint on the head faces. Trapped residual particles can result in the loss of a head and/or a scored disk.

a. Use lint-free gauze to lightly drybuff head face. Cleaning is completed if deposits are removed.

b. If oxide deposits were not removed in Step (a), use dry gauze to lightly buff head face, dampen (do not soak) gauze with head cleaning solution (91% isopropyl alcohol) and wipe head face.

TROUBLESHOOTING

An improperly adjusted FDD may exhibit symptoms of one that has a malfunction; therefore the adjustment procedures should be performed before assuming that the unit has failed. If the malfunction still exists after the performance of the adjustment procedures, consult Table 6-1: Troubleshooting Chart, for the symptoms observed, checks to be made, and action to be taken. Refer to Figure 6-1 for test points and Figure 6-2 for waveforms mentioned in the troubleshooting chart. Before troubleshooting is started, check all dc supply voltages.

DC VOLTAGE CHECK

+5V ± 5% at TP9, J7-2

-5V ± 5% at J7-7

+24V ± 10% at J7-4 and J1-14 (+24V RETURN at J1-11 and J1-13)

-12V ± 5% at J7-1

TABLE 6-1. TROUBLESHOOTING CHART

SYMPTOM	CHECK	RESULTS	ACTION
1. Disk not rotating	a. AC voltage at drive motor connector	AC voltage not present	Check AC power source
		AC voltage OK	Proceed to check (b)
	b. Drive motor for rotation	Motor not rotating	Replace drive motor
		Motor rotating	Proceed to check (c)
	c. Drive belt for looseness	Belt loose	Replace belt
		Belt OK	Proceed to check (d)
	d. Spindle and cone assembly for proper alignment	Spindle and cone out of alignment	Loosen support (item 42, figure 8-2, and position so that cone (item 14, figure 8-2) fits into spindle (item 43, figure 8-2). (Position by pushing down on spindle cone shaft vertically with ball point pen-pen will slip off if any side force is exerted.)
		Alignment OK	Perform push rod travel adjustment procedure (page 6-17). If problem persists, proceed to check (e).
	e. Disk clamping area for excessive wear or damage.	Excessive wear	Replace disk
		Disk OK	Proceed to check (f)
	f. Gap between bail pad (item 27, figure 8-2) and disk load stop (item 87, figure 8-2) with head load solenoid actuated.	Gap less than .015	Loosen bail mounting screw (item 23, figure 8-2) and adjust bail for a gap of .015 when solenoid is actuated.

TABLE 6-1. TROUBLESHOOTING CHART (Cont'd)

	SYMPTOM	CHECK	RESULTS	ACTION
2.	Index pulse missing	a. Disk properly installed (see Figure 2-1)	Disk upside down	Install disk as shown in Figure 2-1
			Disk installation OK	Proceed to check (b)
		b. Disk rotation	Disk not rotating	Perform checks-for symptom 1 (Disk not rotating)
			Disk rotating	Proceed to check (c)
		c. TP8 for pulse shown in Figure 6-2 . Pulse occurs every 5.2ms ± 3%.	No pulse	Replace phototransistor (item 79, figure 8-2). If problem persists, replace LED (item 39, figure 8-2)
			Pulse present	Proceed to check (d)
		d. J1-8 for pulse shown in Figure 6-2g.	No pulse	Replace PC Board
3.	Head not loading	a. J1-4 for HEAD LOAD signal (Figure 6-2h)	Signal not present	Check I/O cable or controller
			Signal present	Proceed to check (b)
		b. J5-4 for HEAD LOAD signal (figure 6-2h) with door closed.	Signal not present	Adjust door interlock switch set screw (item 19, figure 8-2) to insure switch closure. If problem persists replace interlock switch (item 40, Figure 8-2)
			Signal present	Proceed to Check (c)

TABLE 6-1. TROUBLESHOOTING CHART

SYMPTOM	CHECK	RESULTS	ACTION
3. (Continued)	c. J5-2 for HEAD LOAD signal (Figure 6-2h)	Signal not present	Replace PC Board
		Signal present	Replace head solenoid
4. Read/Write head cannot be stepped in or out	a. J1-12 for STEP signal (figure 6-2j). J1-14 for Direction signal (Figure 6-2I & J)	Signal not present	Check I/O Cable or controller
		Signal present	Proceed to Check (b)
	b. STEP signal occurs as shown in Figure 6-2I at J4-3, -2, & -1. Direction signal occurs as shown in Figure 6-2I and J at J4-3, -2 & -1. (Signal "on" condition is a negative-going pulse)	Signal not present	Check resistance across each stepper motor winding. If any winding is open, replace motor. If not, replace PC Board
		Incorrect signal sequence	Replace PC Board
		Signal present and correct sequence	Proceed to Check (c)
	c. Resistance across each stepper motor winding	Less than 19 ohms	Replace stepper motor

TABLE 6-1. TROUBLESHOOTING CHART (Cont'd)

	SYMPTOM	CHECK	RESULTS	ACTION
5.	No TRACK 00 indication	a. TRACK 00 indication (ground)	No TRACK 00 indication (+5V)	Check for closure of track 00 switch (item 84, Figure 8-2) using the volt-ohmeter. If switch is defective replace switch. If switch is OK, verify that carriage is stepping out far enough to actuate switch. If not perform steps 17-20 of actuator alignment procedure (page 6-17).
			Track 00 indication OK at J3-2.	Replace PC Board
6.	Read errors (1 in 10^9 bits) or unable to read any data	a. Read/Write head for corosion of dirt	Head dirty	Clean heads according to procedure on page 6-3.
			Head clean	Proceed to Check (b)
		b. Check for proper disk loading	Disk not loading properly	Perform Checks outlined for Symptom #3.
			Disk loading properly	Proceed to Check (c)
		c. Condition of disk	Condition questionable	Replace with known good disk
			Disk condition good	Proceed to Check (d)
		d. Data at TP1 & TP2, using oscilloscope differential plug-in. Verify waveform amplitude and shape as shown in Figures 6-2 a & b.	Waveform amplitude or shape not as shown	Replace PC Board. If problem persists replace read/write head

TABLE 6-1. TROUBLESHOOTING CHART

SYMPTOM	CHECK	RESULTS	ACTION
7. Write Errors	a. Presence of WRITE FAULT indication	Fault indication	Reset WRITE FAULT. If fault indication persists, check for one or more of the following: (1). Absence of WRITE ENABLE signal (Figure 6-2F) at J1-16. (2). Absence of WRITE DATA signal (Figure 6-2F) at J1-18. (3). Incorrect data rate measured at J1-18. (4). Door interlock open. If one or more of these conditions exist, check controller.
		No fault indication	Proceed to Check (b)
	b. TP11 for presence of write flip-flop signal (Figure 6-2E)	Signal not present	Replace PC Board
		Signal present	Proceed to Check (c)
	c. J2-1 & J2-2 for current pulse (Figure 6-2E), Use oscilloscope current probe to check waveform.	Current pulse present	Replace read/write head (actuator assembly).
		Current pulse not present.	Replace PC Board.

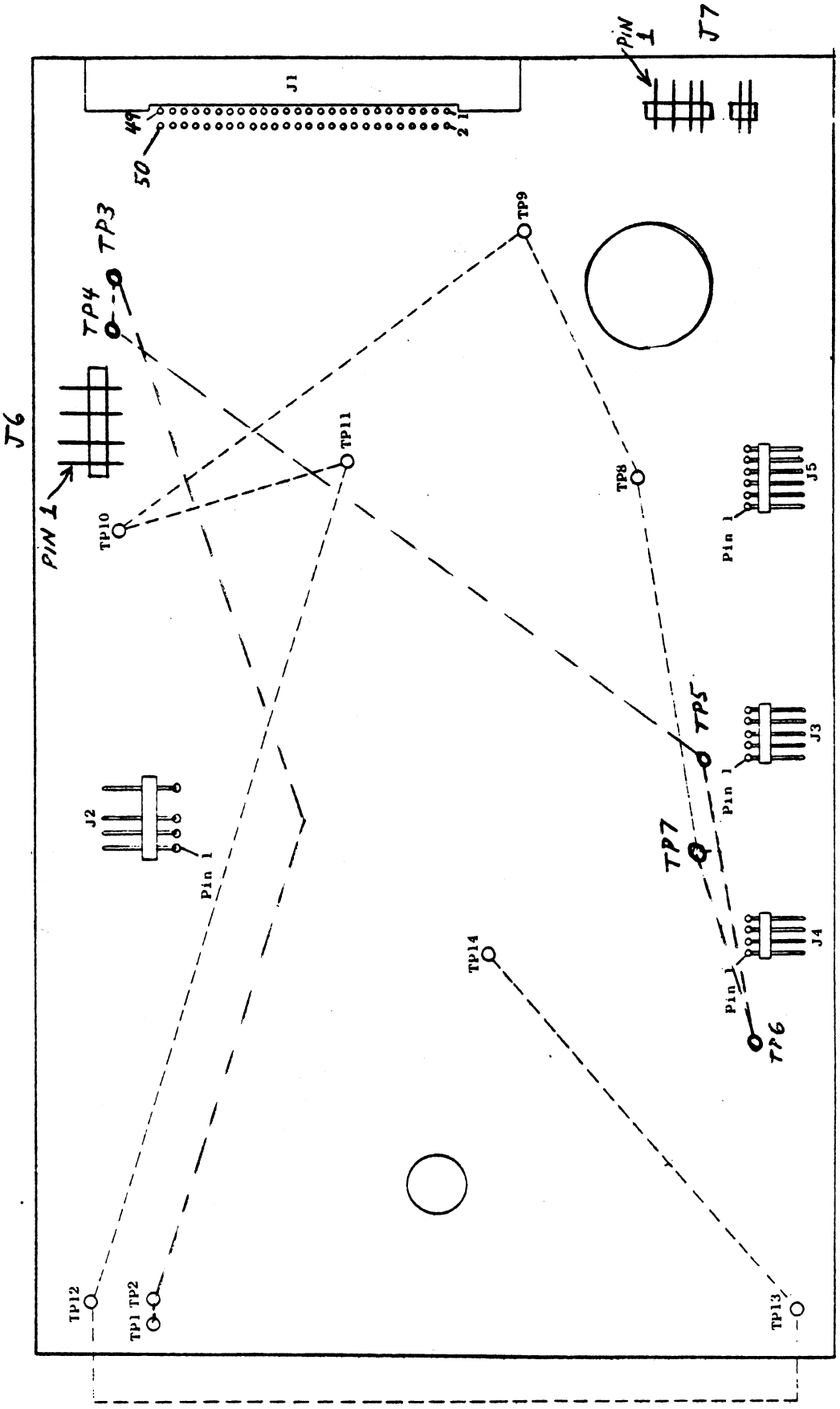
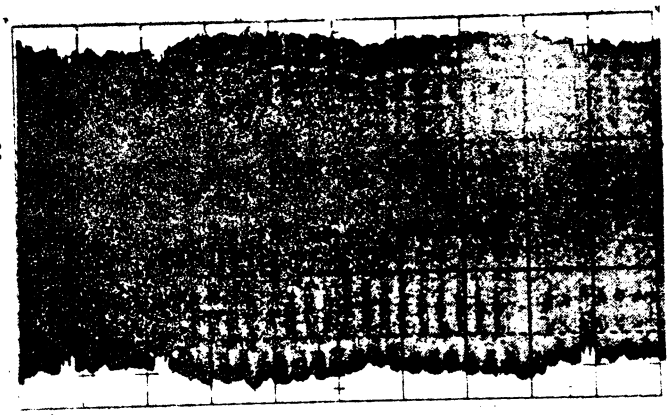


Figure 6-1. Test Point And Connector Locations (Model 9404)

SCOPE SETTINGS:
200 mv/cm
20 ms/cm



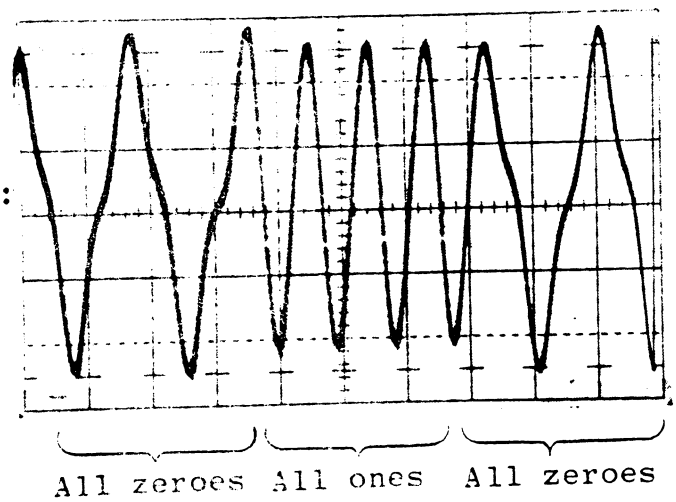
TP1&2
Approx. Amplitude Range
500mv-2000mv*
300mv-1800mv**

*All zeroes
*All ones

(a)

TP1&2 DIFFERENTIAL READ SIGNAL FOR ENTIRE TRACK

SCOPE SETTINGS:
200 mv/cm
10 us/cm

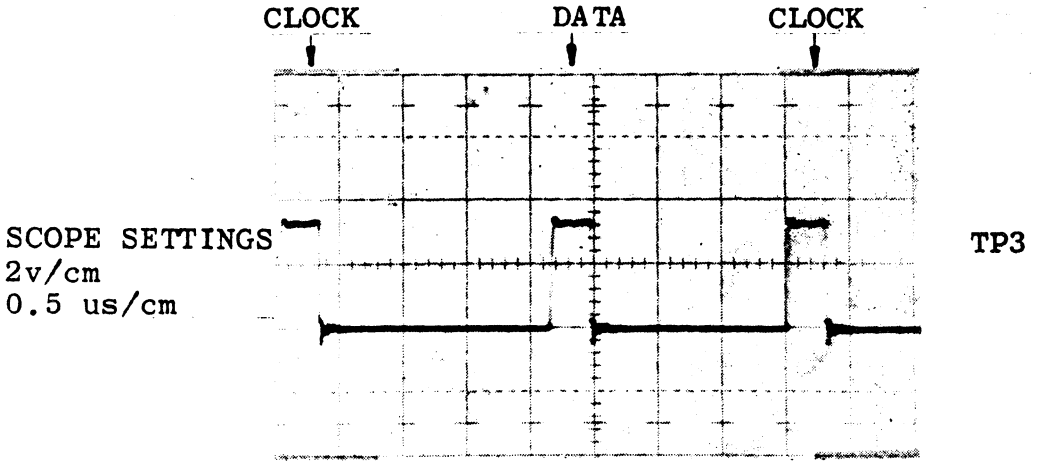


TP1&2

(b)

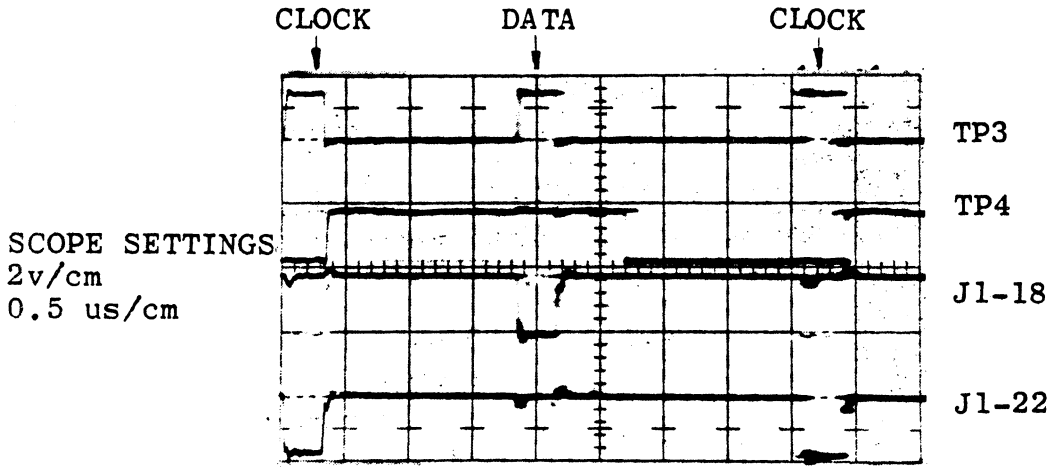
TP1&2 DIFFERENTIAL READ SIGNAL FOR PORTION OF TRACK

Figure 6-2. Waveforms (Sheet 1)



(c)

TP3 + READ DATA (COMPOSITE)



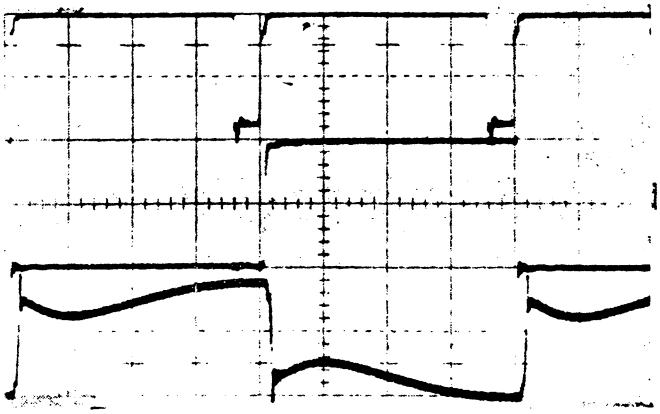
(d)

TP3 +READ DATA (COMPOSITE)
TP4
J1-18 -READ DATA (SEPARATED)
J1-22 -CLOCK (SEPARATED)

FDD 008-2-A

Figure 6-2. Waveforms (Sheet 2)

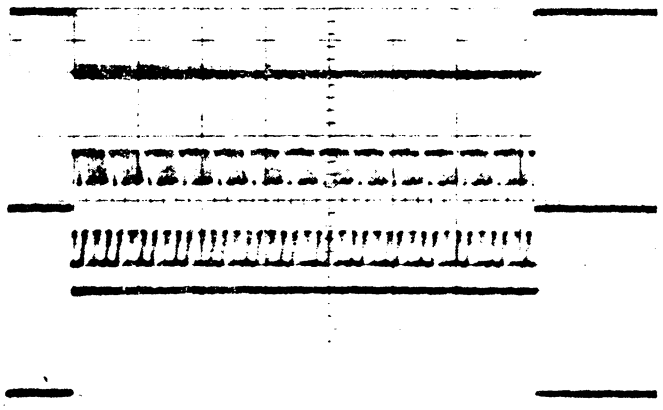
SCOPE SETTINGS:
2v/cm
5 ma/cm (Write Current)
0.5 us/cm



(e)

J1-50 - WRITE DATA
TP11 WRITE F/F OUTPUT
J2-1, J2-2 HEAD WRITE CURRENT

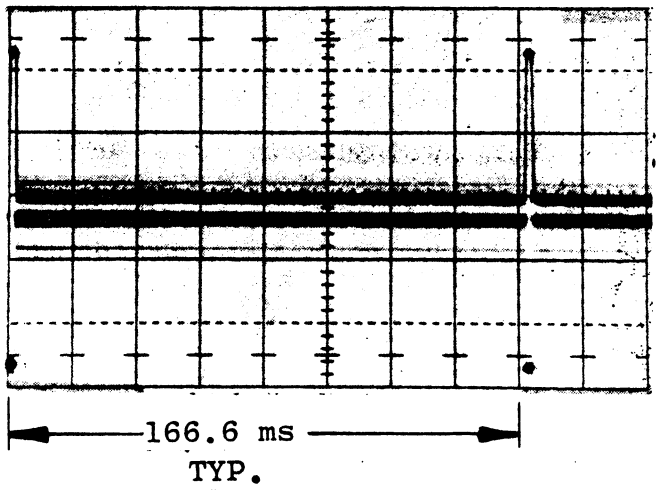
SCOPE SETTINGS:
5v/cm
5 ma/cm (Write Current)
50 ma/cm (Erase Current)
20 ms/cm



(f)

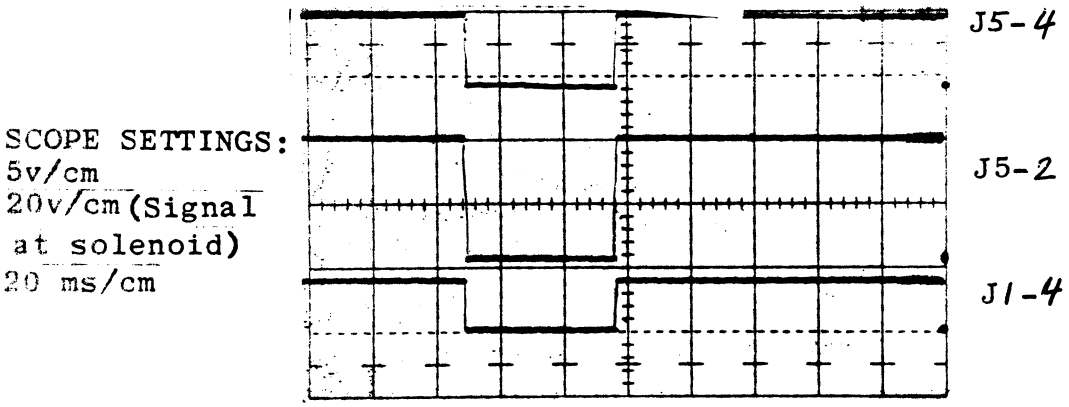
J1-48 WRITE ENABLE
J2-1, J2-2 WRITE CURRENT (THROUGH HEAD)
J2-3 ERASE CURRENT (THROUGH HEAD)

FDD 008-3-A



(g)

TP8 PHOTOTRANSISTOR OUTPUT
J1-32 -INDEX SIGNAL



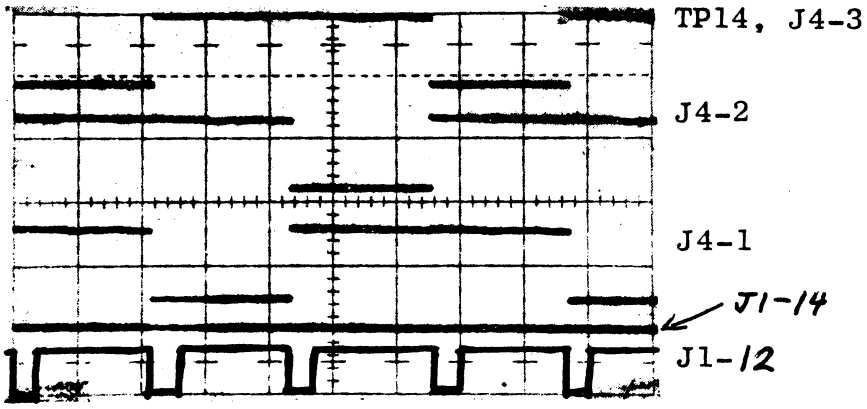
(h)

J1-26 -HEAD LOAD SIGNAL
J5-4 DOOR CLOSED SIGNAL
J5-2 SIGNAL AT HEAD LOAD SOLENOID

FDD-008-4-A

Figure 6-2. Waveforms (Sheet 4)

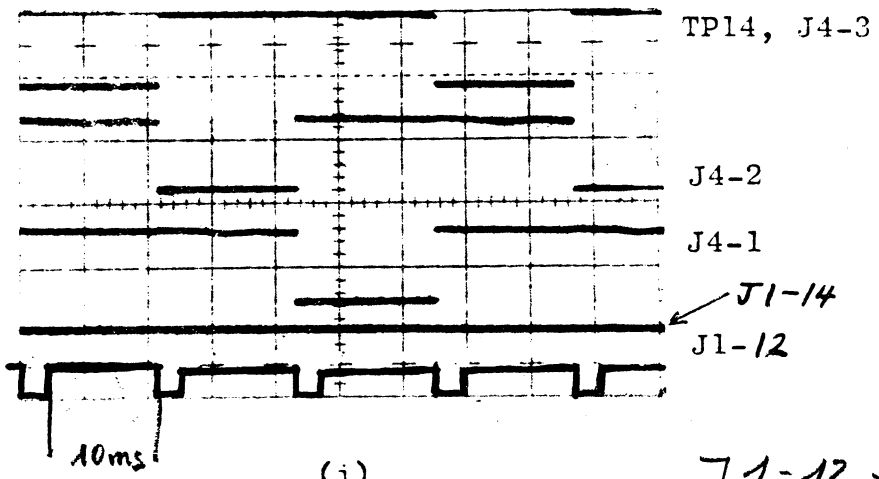
SCOPE:SETTINGS:
20v/cm
5v/cm (STEP OUT signal)
5 ms/cm



(i)

TP14, J4-3 MOTOR ØA SIGNAL
J4-2 MOTOR ØB SIGNAL
J4-1 MOTOR ØC SIGNAL
J1-44 -STEP IN SIGNAL
J1-12 DIRECTION STEP (HIGH LEVEL)

SCOPE SETTINGS:
20v/cm
5v/cm (STEP IN signal)
5 ms/cm



(j)

J1-12 Step
J1-14 Dir

TP14, J4-3 MOTOR ØA SIGNAL
J4-2 MOTOR ØB SIGNAL
J4-2 MOTOR ØC SIGNAL
J1-46 -STEP IN SIGNAL
J1-12 DIRECTION STEP (LOW LEVEL)

FDD 008-5-A

9400 Step 44
Step 46

Figure 6-2. Waveforms (Sheet 5)

CORRECTIVE MAINTENANCE

Detailed alignment procedures and removal and replacement procedures are provided under corrective maintenance.

ADJUSTMENT PROCEDURES

Actuator Alignment

The FDD must be connected to the user system or to a test set to perform this procedure.

1. Remove chassis support (Item 14, figure 8-3) by removing four (4) socket head screws (item 51, figure 8-3).

2. Move carriage assembly (reference figure 6-4) to the rearmost position by turning outer stop in a counter-clockwise direction.

3. Apply dc voltage to the FDD.

NOTE

Step 3 ensures that read/write head is aligned on approximately track 00 and step motor 0A is energized.

4. Place alignment tool, CDC 75292000, on spindle assembly as shown in figure 6-3. Ensure that alignment tool contacts carriage at contact point B (see figure 6-3).

5. If there is a gap between the edge of the alignment tool and carriage at the contact point B, it will be necessary to loosen the photo-transistor mount screws and move the mount so that contact at point B is possible.

6. Now check to see if a gap exists between the end of the tool and the carriage assembly (Gap A in figure 6-3). If so, slightly loosen the right stepper motor clamp screw (see figure 6-3).

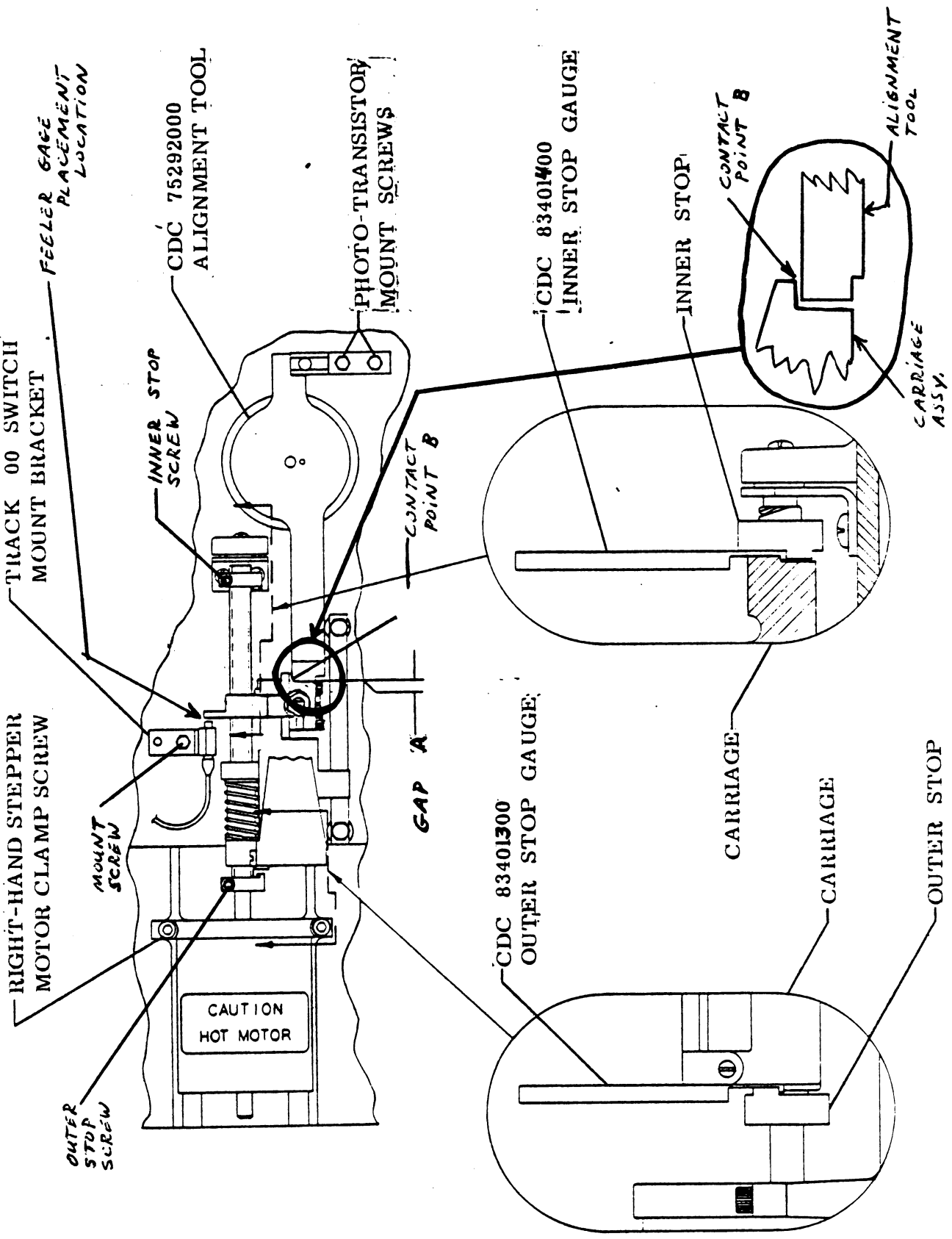
7. Rotate stepper motor in direction required to eliminate gap.

8. Tighten stepper motor clamp screw and check gap again. Repeat steps 6 through 8, as required, to eliminate gap.

9. Loosen photo-transistor mount screws (see figure 6-3) and move mount until it contacts alignment tool, as shown in Figure 6-3. Tighten transistor mount screws.

NOTE

Make sure that the opposite end of alignment tool is still in contact with carriage at contact point B after completion of step 9.



75736000-A Figure 6-3. Alignment Tool Installation 6-15

10. Remove alignment tool.

11. Place outer stop gauge (CDC P/N 83401300) against carriage as shown in figure 6-3.

12. Loosen outer stop screw (see figure 6-3) and move outer stop until tooth contacts stop gauge as shown in figure 6-3. Tighten stop screw and remove gauge.

13. Step read/write head in to track 76.

14. Place inner stop gauge (CDC P/N 83401400) against carriage as shown in figure 6-3.

15. Loosen inner stop screw (see figure 6-3) and move inner stop until it contacts stop gauge as shown in figure 6-3. Tighten stop screw and remove gauge.

16. Step read/write head out to track 01.

17. Place a .010 feeler gauge between carriage assembly and track 00 switch, as shown in figure 6-3.

18. Verify that track 00 switch closes by observing TRACK 00 signal at terminal J1-28 on Component Board Assembly 75772109, terminal J3-2 on Component Board Assembly 75865206, and terminal J1-30 on Component Board Assembly 75867205.

19. If TRACK 00 signal does not occur, loosen track 00 switch bracket mount screw and rotate switch bracket forward until TRACK 00 signal occurs.

20. Recheck all adjustments made in this procedure and repeat all steps having out-of-tolerance indications.

Push Rod Travel Adjustment

This procedure must be performed whenever chassis support (item 14, figure 8-3) is removed and replaced.

1. With front panel door closed, verify that retaining ring (item 10, figure 8-2) and disk load bushing (item 11, figure 8-2) will rotate when turned by hand. If not, perform step 2.

2. Adjust disk load arm set screw (item 19, figure 8-2) clockwise until retaining ring and bushing can be rotated by hand.

Door Interlock Switch Adjustment

1. Verify that interlock switch closes, when closing the door, prior to the door latching. If not, perform step 2.

2. With door closed, rotate switch adjusting screw (item 19, figure 8-2) clockwise until switch closes. Continue to rotate screw another half-turn.

REMOVAL AND REPLACEMENT PROCEDURES

The following procedures give the proper sequence for removal and replacement of major assemblies. To avoid damage to parts, the procedure must be performed in sequence. All item numbers referred to in these procedures are located in figures 8-1 and 8-2.

Printed Circuit Board

1. Disconnect I/O Cable from J1.

2. Disconnect harnesses from J2, J3, J4, J5, J6, and J7 (figure 6-1) on printed circuit board.

3. Remove connector J1.

4. Unlatch four (4) push-in clips and remove printed circuit board.

5. To replace printed circuit board, perform steps 1 through 4 in reverse order.

Actuator Assembly

1. Open front panel door (item 1, figure 8-1).

2. Disconnect harness from J2 and J4 on printed circuit board.

3. Remove four (4) socket head screws (item 8, figure 8-2) securing chassis support (item 42, figure 8-2).

4. Slide chassis support back far enough to clear push rod (item 22, figure 8-2) of front panel and lift support clear of chassis.

5. Remove two (2) screws (item 50, figure 8-2) securing bearing retainer (item 54, figure 8-2) next to inner stop.

6. Remove stepper motor clamp (item 47, figure 8-2) by removing two socket head screws (item 46, figure 8-2). Remove Cable Clamp (item 49).

7. Carefully slide actuator assembly (stepper motor, actuator, and bearings at the end of stepper shaft) straight out toward the rear of the FDD until bearings (items 51 and 53, figure 8-2) are clear of the casting.

8. Before replacing actuator assembly, apply Molycote (P/N 95016100) to stepper motor shaft. This should be applied sparingly.

9. To replace actuator assembly, perform steps 5 through 7 in reverse order.

10. Perform actuator alignment procedure on page 6-15.

11. Perform 1 through 3 in reverse order.

12. Perform chassis support adjustment on page 6-3.

13. Perform push-rod travel adjustment procedure on page 6-16.

Drive Motor Assembly

1. Perform removal procedure for printed circuit board.

2. Perform removal for actuator assembly.

3. Remove screw (item 63, figure 8-2) from capacitor bracket (item 66, figure 8-2). Remove Bracket.

4. Remove screws securing drive motor cable clamps (item 63, figure 8-2).

5. Remove ac connector (item 70, figure 8-2) from bracket (item 64, figure 8-2).

6. Remove spindle drive belt (item 3, figure 8-2).

7. Remove three (3) nuts (item 67, figure 8-2) securing drive motor (item 77, figure 8-2).

8. Remove drive motor assembly (drive motor, capacitor, and AC Connector).

9. To replace drive motor assembly, perform steps 1 through 7 in reverse order.

Head Load Pad Replacement

1. Remove power from the unit

2. Move the carriage assembly to its rear most position (toward the stepper motor) by turning the aft part of the stepper motor shaft (see figure 6-3). This will provide clearance for lifting the head load arm.

3. Lift the head load arm until the head load pad is visible (see figure 6-3). Remove the used pad with a sharp tool, if necessary, and discard. Be sure to remove all of the old pad.

4. Remove the protective backing from the new head load pad and place pad in center of recess in head load arm. Press pad firmly to insure adhesion after assuring pad lies wholely within recess.

5. Lower arm gently onto head.

Spindle and Cone Alignment

This procedure must be followed whenever the chassis support casting has been loosened.

1. Position support so that cone fits into spindle.
2. Install four cap screws loosely.
3. With the point of a ball point pen or similar tool which will slip if side force is exerted, push down the spindle cone and center in the spindle socket.
4. While continuing to push down on the spindle cone, tighten the four mounting screws securely.

Head Load Bail

Perform this procedure whenever the head load solenoid or polyested foam pad are replaced.

1. Loosen bail mounting screw.
2. Manually depress solenoid armature.
3. Insert a .015" shim between bail and cast support avoiding foam strip.
4. Insure that bail is parallel to support and tighten mounting screw.

Track "00" Switch Adjustment

Perform this procedure when track "00" switch has been replaced or the device fails to give corrent track "00" indication.

1. With a ohmmeter, check for switch contact closure at track "00". Replace switch if defective.
2. If switch is OK, verify that carriage is stepping out far enough to actuate switch. If not perform steps 17-20 of the actuator alignment procedure.

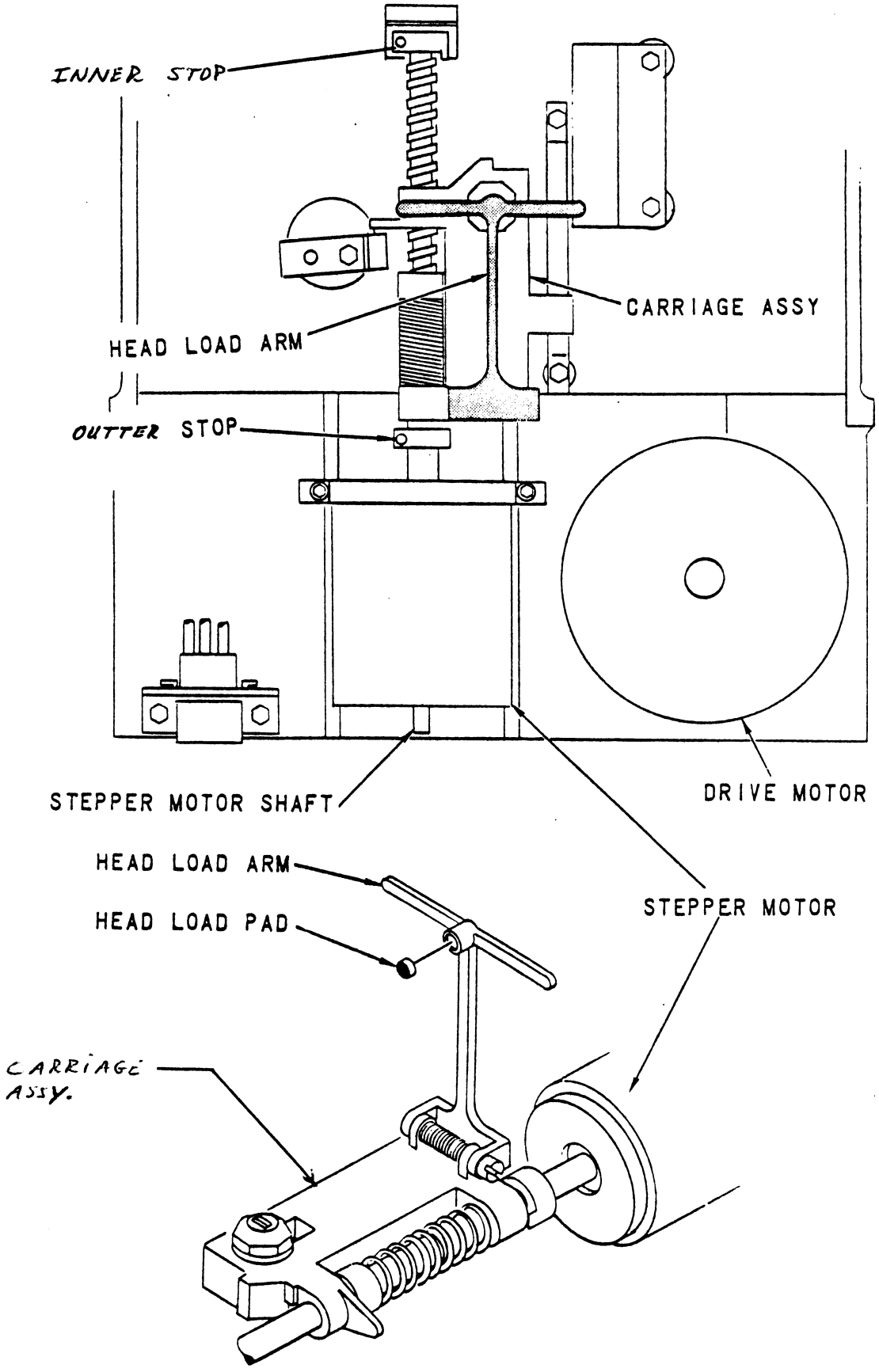


Figure 6-4. Head Load Pad Replacement Illustration

SECTION 7:

MAINTENANCE AIDS

SECTION 7:

MAINTENANCE AIDS

GENERAL

This section contains detailed information on the logic circuits used in the FDD. The logic consists of two types of circuits: discrete component and integrated circuits (IC). Integrated circuits are contained within a single chip and discrete component circuits contain individually identifiable resistors, capacitors, transistors, etc.

PHYSICAL DESCRIPTION (LOGIC)

All components are mounted on one side of the printed circuit board. The board is 8 x 11 inches and contains both IC and discrete component circuits.

USE OF RELATIVE LEVEL INDICATORS

The relative level indicator is a small triangle located at the input or output to a logic block. The presence or absence of this indicator indicates the conditions that are necessary to satisfy the function of the logic block. The presence of the triangle indicates a 0 logic level on that line is needed to satisfy the function. The absence of the triangle indicates a logical 1 is needed to satisfy the function.

The relative level indicator depicts the occurrence of inversion. Figure 7-1 shows some representative examples of the relative level indicator being used in this manner.

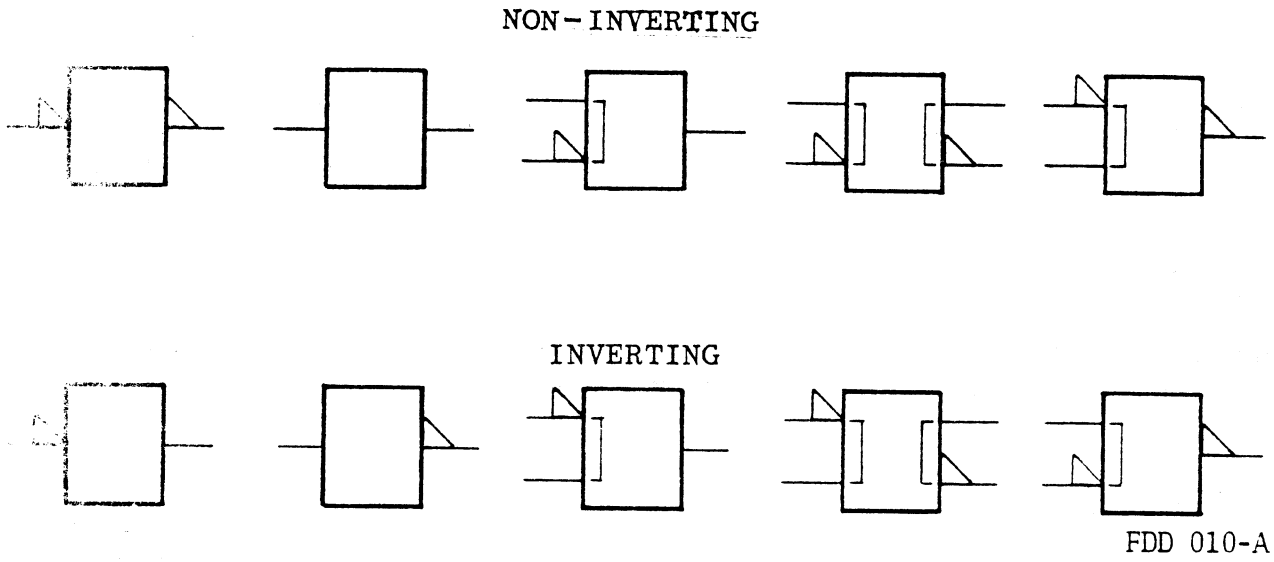


Figure 7-1. Inversion Conventions

INTEGRATED CIRCUITS

Figure 7-2 shows an example of a schematic block and the information that it contains. The first line gives the function symbol which identifies the logic function that the block performs. Refer to figure 7-3 for a summary of function symbols. The second line gives the CDC element number. Refer to Table 7-2 for a cross-reference between the CDC element number and the manufacturer's type. The third line on the schematic block gives the circuit reference designation.

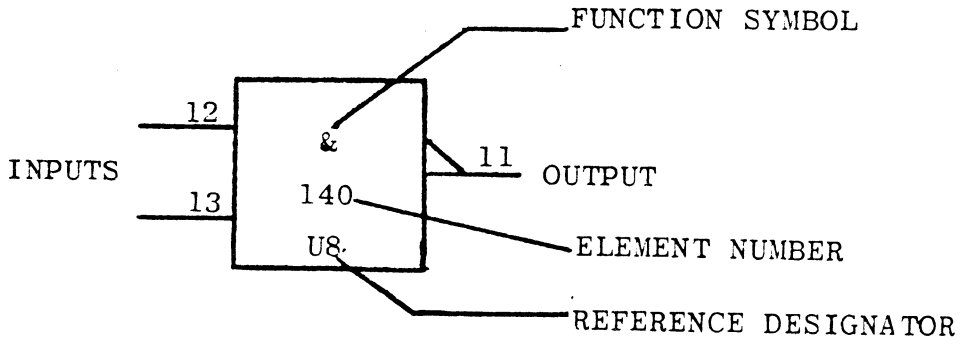
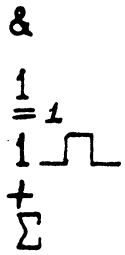


Figure 7-2. Integrated Circuit Symbols

TABLE 7-1. CDC ELEMENT NUMBER CROSS REFERENCE

CDC Designation		Mfg. Designation	
Element	Part No.	Type	Function
140	51651900	7400 or 9002	Quad 2-input NAND
141	50250700	7410 or 9003	Triple 3-input NAND
143	51639900	7440 or 9009	Dual 4-input buffer
160	50251000	7472	J/K MS Flip-Flop
161	51718600	9601 or 74122	Retriggerable multivibrator
172H	50251600	3002	Quad 2-input NOR
175	50251500	3060 or 74H74	Dual type D Flip-Flop
180	51768200	75450	Dual peripheral driver
200	50254200	7406	Hex inverter
302	15126900	733	Operational amplifier
902	50254500	75154	Quad receiver
8T20	1512700	8T20	Bidirectional one-shot

FUNCTION SYMBOLS



AND GATE or INVERTER

OR GATE or INVERTER
EXCLUSIVE OR

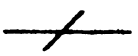
ONE SHOT
INHIBITING INPUT

SUMMING CIRCUIT. Number following (example:"100") indicates gain of 100.

LEVEL CONVERSION -Transmission line to Logic Level, Switch State to Logic Level, or Logic Level to Power Output.

SCHMITT TRIGGER (Lower trip point adjustable).

GENERAL SYMBOLS



Indicates non-standard logic level

Indicates analog signal

Test Points

Figure 7-3. Schematic Symbols

LOGIC DIAGRAM INPUT/OUTPUT INFORMATION

Figure 7-4 shows examples and gives the explanation of input/output (source/destination) information contained on the logic diagrams.

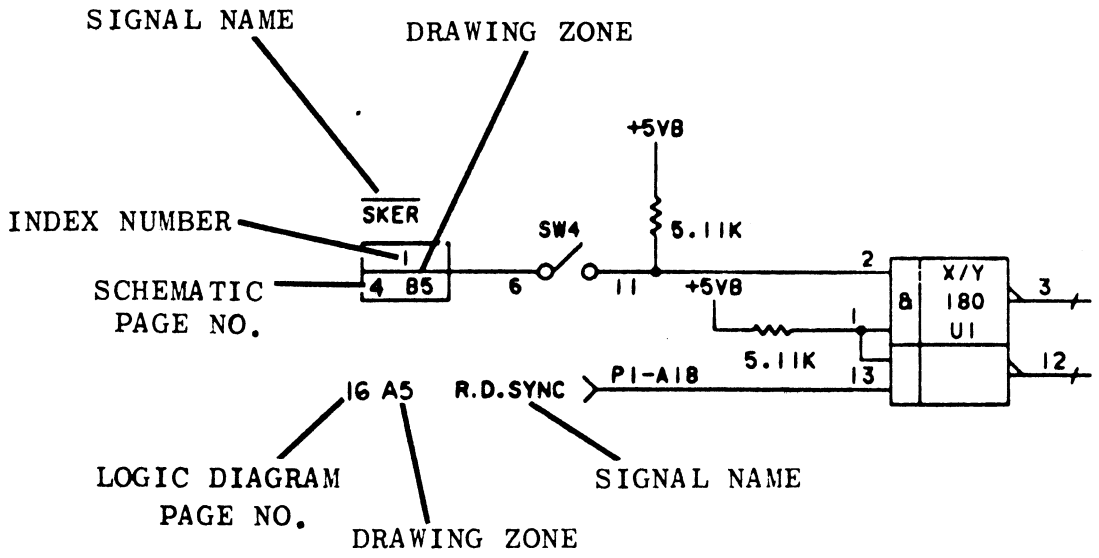


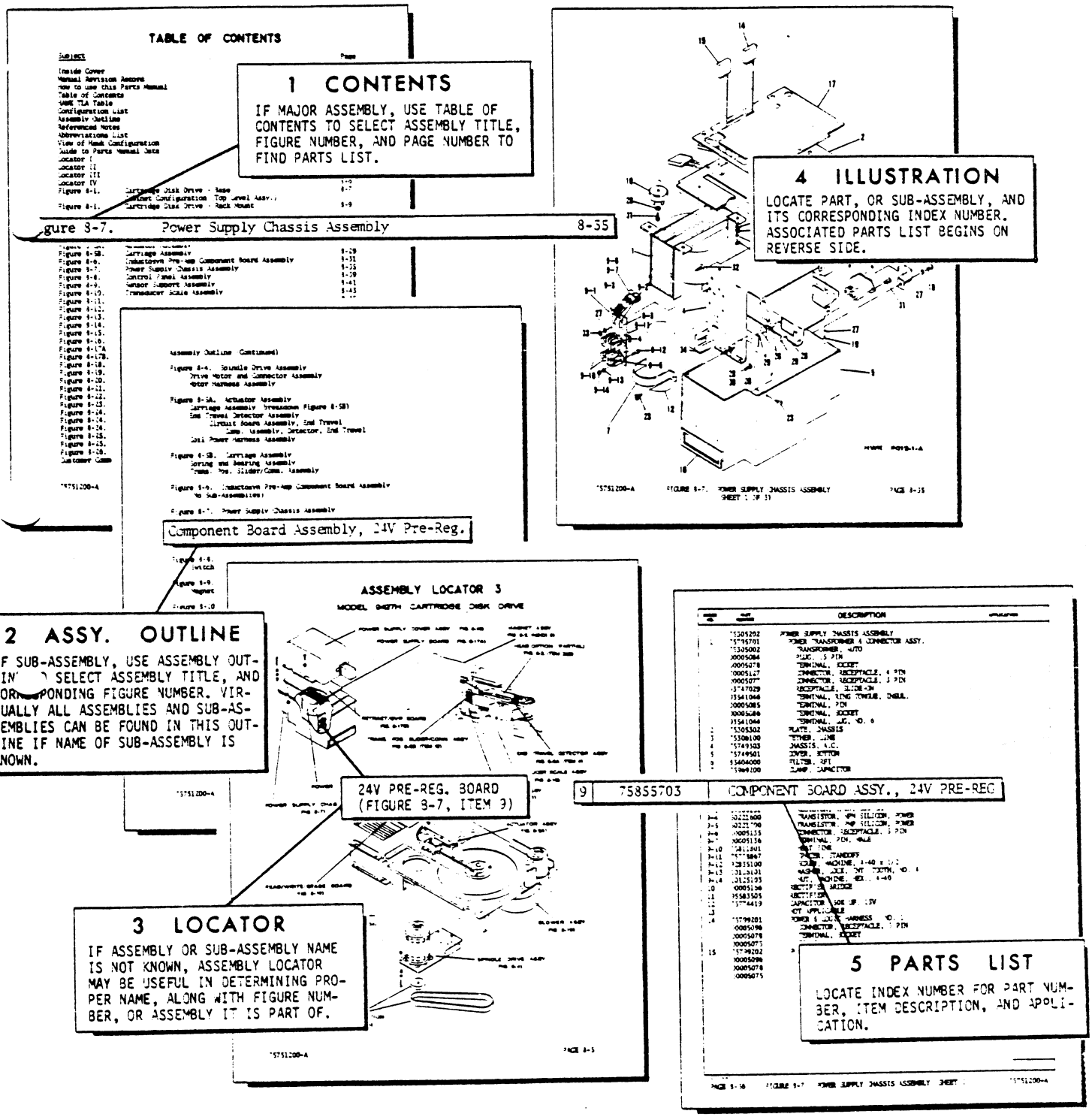
Figure 7-4. Logic Diagram Input/Output Information

SECTION 8:

PARTS DATA

GUIDE TO PARTS MANUAL DATA

MODEL 9400 CARTRIDGE DISK DRIVE



HWK P002-1-A

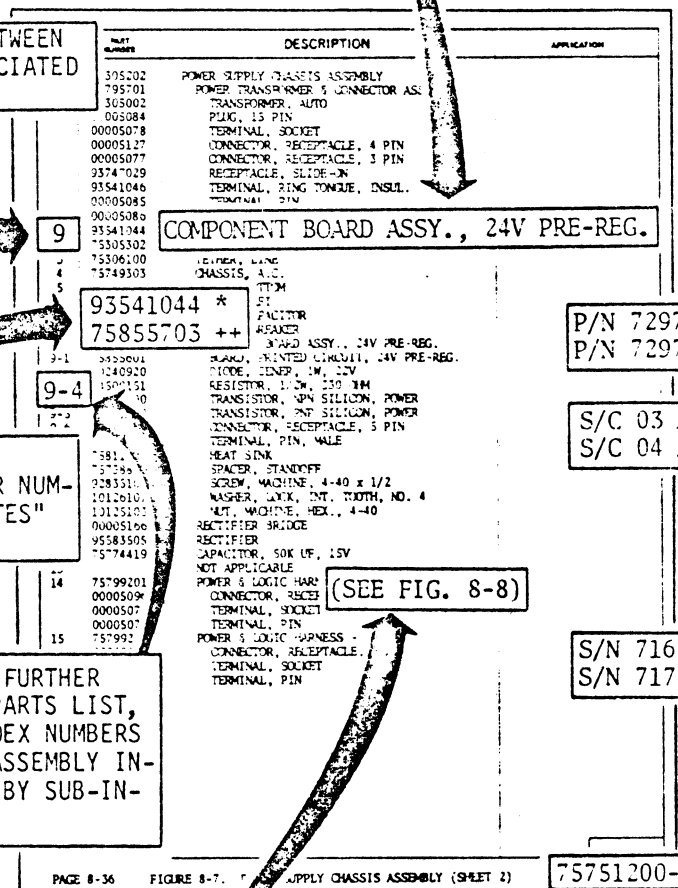
GUIDE TO PARTS MANUAL DATA

MODEL 9400 CARTRIDGE DISK DRIVE

CONTAINS NOMENCLATURE OF PARTS. ALSO SHOWS THE RELATIONSHIP OF PARTS TO ASSEMBLIES BY MEANS OF INDENTATION. AN INDENTED ITEM IS PART OF THE FIRST PREVIOUS ASSEMBLY WHICH IS INDENTED TO A LESSOR DEGREE.

THE APPLICATION OF AN ASSEMBLY, SUB-ASSEMBLY, OR PIECE PART IS REFLECTED IN APPLICATION COLUMN. S/C = SERIES CODE. S/N = SERIAL NUMBER. P/N = PART NUMBER.

PROVIDES CROSS REFERENCE BETWEEN THE PARTS LIST AND THE ASSOCIATED FIGURE.



P/N 72974201, 02
P/N 72974203

S/C 03 AND BELOW
S/C 04 AND ABOVE

S/N 716 AND BELOW
S/N 717 AND ABOVE

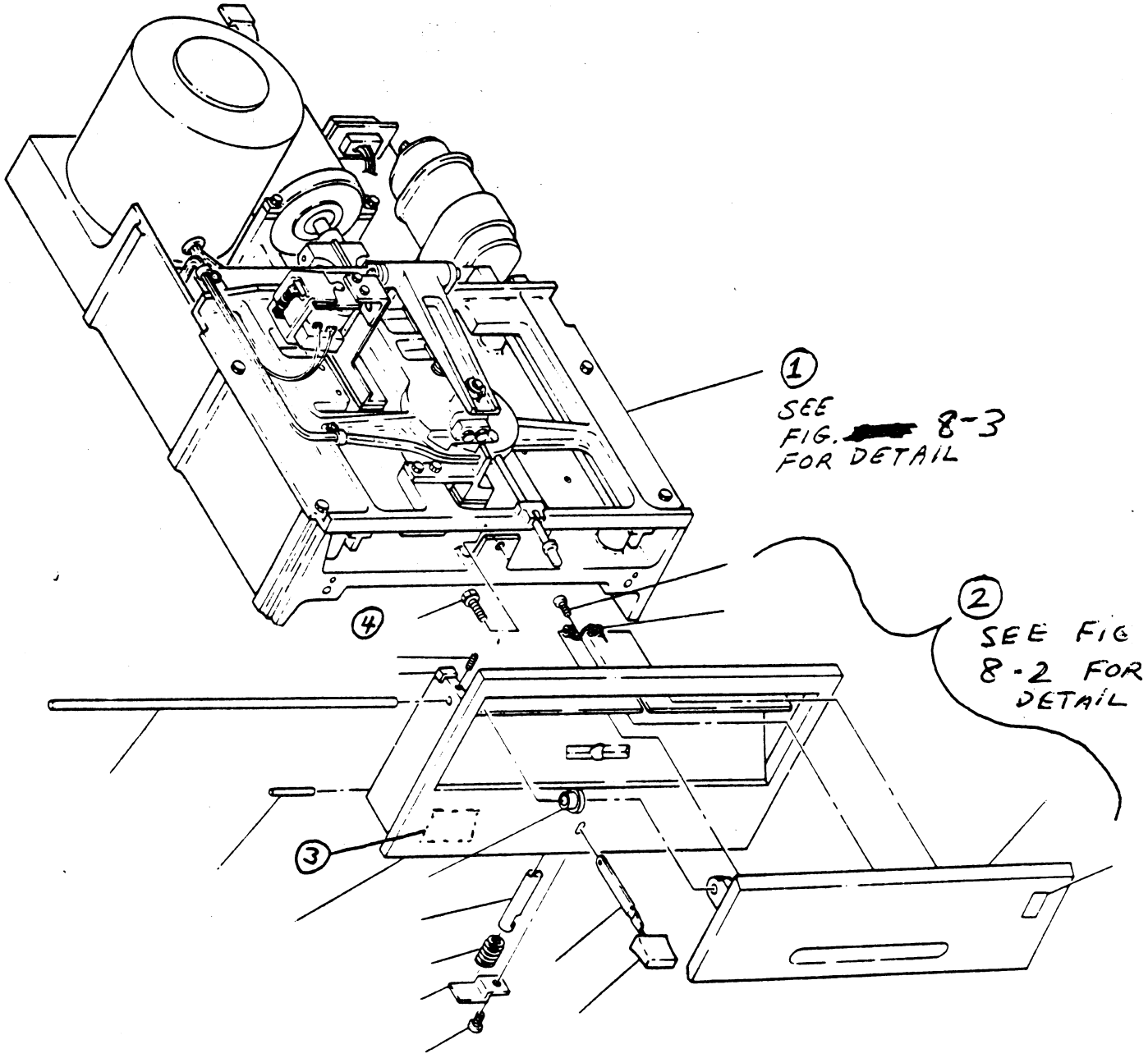
PART NUMBER OF LISTED PART. ASTERISKS OR PLUS SIGNS AFTER NUMBER REFERS TO "REFERENCED NOTES" LISTED AT FRONT OF MANUAL.

A SUB-ASSEMBLY WHICH IS FURTHER BROKEN DOWN WITHIN THE PARTS LIST, AND ILLUSTRATION, HAS INDEX NUMBERS FOR COMPONENTS SHOWING ASSEMBLY INDEX NUMBER (9) FOLLOWED BY SUB-INDEX NUMBER (4).

IF AN ASSEMBLY IS NOT BROKEN DOWN IMMEDIATELY AFTER BEING LISTED, A REFERENCE WILL BE MADE TO THE FIGURE NUMBER WHERE THE BREAKDOWN IS MADE.

PUBLICATION NUMBER AND REVISION DATA. THE NUMBER 75751200 REPRESENTS THE PUBLICATION NUMBER OF MANUAL THE PAGE IS PART OF. LETTER A REPRESENTS REVISION LEVEL OF MANUAL, AND NUMBER 3 REPRESENTS REVISION LEVEL OF PARTICULAR PAGE.

HWK P002-



75736000-A Figure 8-1. FDD Top Assembly (Model 9404)

INDEX NO.	PART NUMBER	DESCRIPTION	APPLICATION
	75744025	FDD Top Assembly, 60Hz, 120V, BR8A2A	
	75744030	FDD Top Assembly, 50Hz, 220V, BR8A2B	
	75744031	FDD Top Assembly, 50/60Hz, 100V, BR8A2C	
	75744032	FDD Top Assembly, 50Hz, 240V, BR8A2D	
101	83458201	Common Parts Assembly	
102	75291911	Drive Motor Assy., 60Hz, 120V	75744025
102	75291912	Drive Motor Assy., 50Hz, 220V	75744030
102	75291915	Drive Motor Assy., 50/60Hz, 100V	75744031
102	75291916	Drive Motor Assy., 50Hz, 240V	75744032
103	83403700	Bracket, Connector, Amp	
104	75881702	Component Board Assembly	
105	83401801	Front Panel Assembly	
106	15010304	Emblem, CDC	
107		Not Applicable	
108		Not Applicable	
109	83427802	Write Protect Assembly	
109-1	83427700	Mount, Write Protect	
109-2	83453601	Optical Switch	
109-3	75293954	Housing, Connector	
109-4	94245602	Contact, Crimp, Socket Insert	
109-5	10125762	Screw, Flat Hd., 82° x .625	
109-6	10125602	Washer, Plain, No. 2	
109-7	10125800	Washer, Spring Lock, No. 2	
109-8	10125102	Nut, Mach., Hex., No. 2	
109-9	93592164	Screw, Hex Hd., Self-tap, 6-32 x 1/2	
110		Not Applicable	
111	15002000	Label, CSA	75744025

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Figure 8-1. FDD Top Assembly (Model 9404)

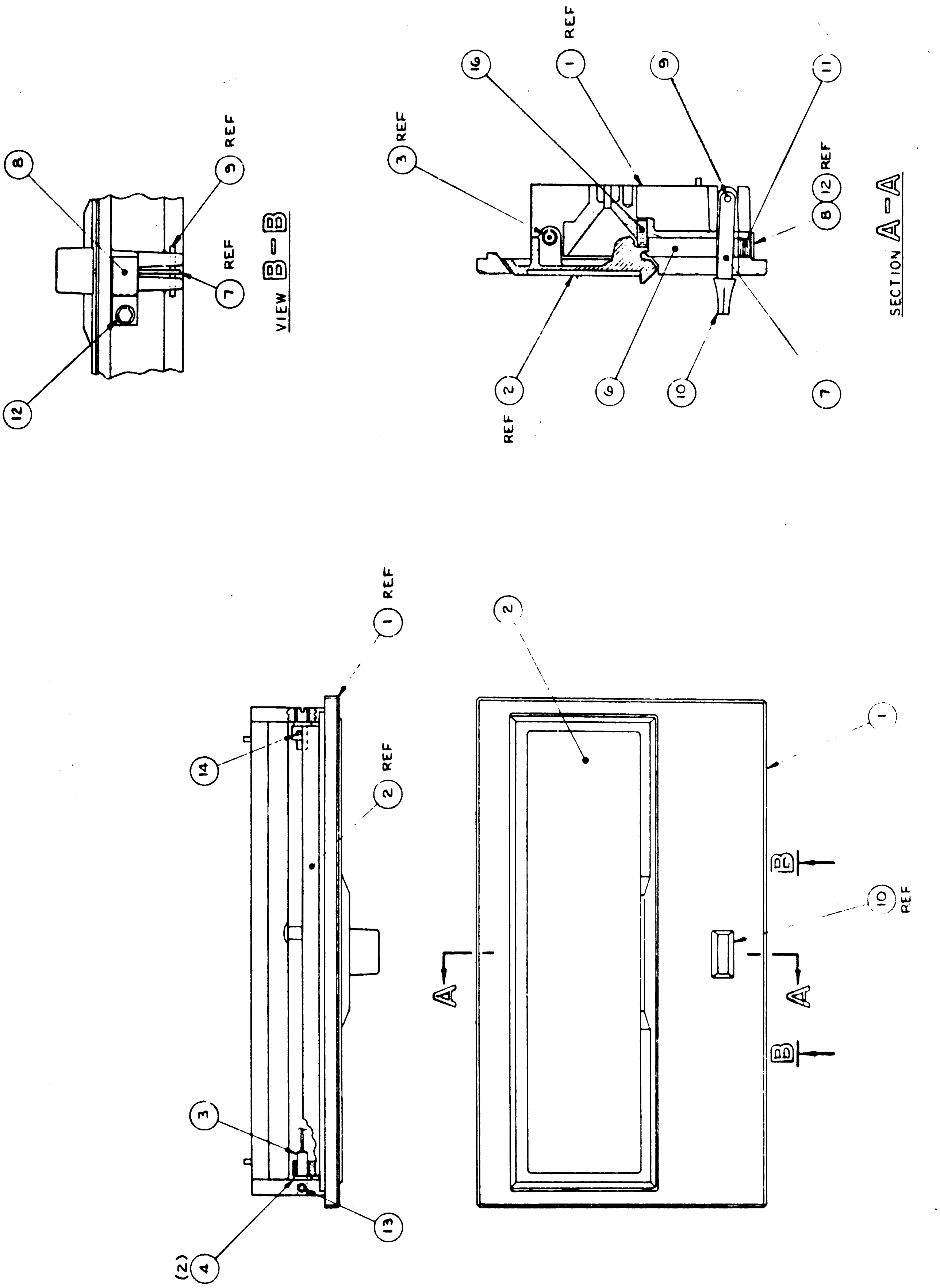

Figure 8-2. Front Panel Assembly (Model 9404)

INDEX NO.	PART NUMBER	DESCRIPTION	APPLICATION
	83401801	Front Panel Assembly (Std Blk)	
1	83426624	Panel, Front, Painted Std Blk	
2	75812124	Door, Painted Std Blk	
3	83403201	Bar, Torsion, Door	
4	83401500	Bushing, Door, Molded	
5		Not Applicable	
6	83402300	Latch, Door, Molded	
7	75746000	Lever, Door	
8	75746800	Bracket, Latch	
9	92096099	Pin, Grooved	
10	75292700	Knob, Lever	
11	83401200	Spring, Latch	
12	93592162	Screw, Mach., Hex Washer Hd., Self-tap	
13	93071246	Set Screw, Sock. Hd., 6-32 x 1/4	
14	93071165	Set Screw, Sock. Hd., 4-40 x .188	
15		Not Applicable	
16	83413404	Screw, Self Locking	

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Figure 8-2. Front Panel Assembly (Model 9404) 75736000-A

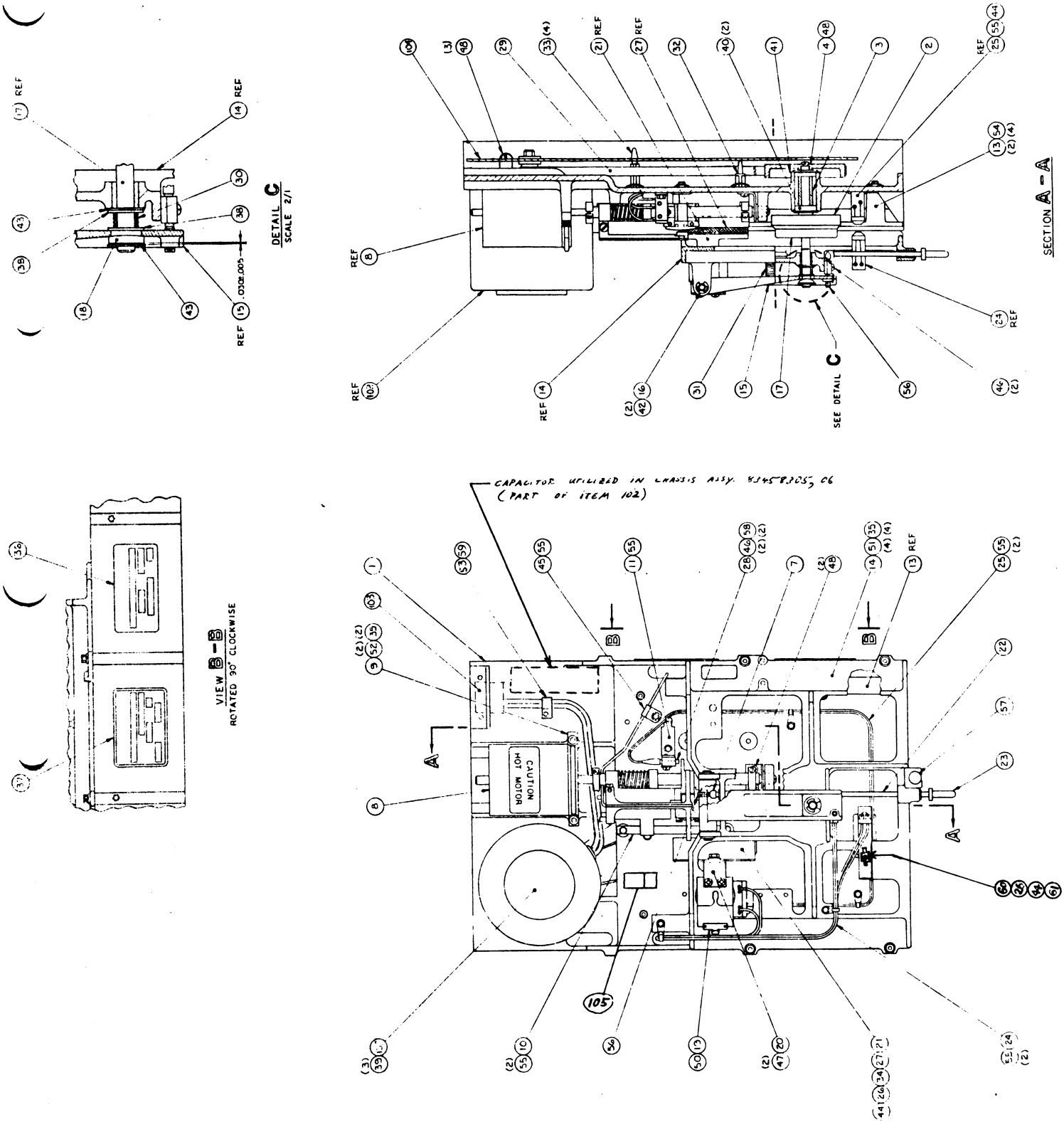

Figure 8-3. Common Parts Assembly

INDEX NO.	PART NUMBER	DESCRIPTION	APPLICATION
	83458201	Common Parts Kit	
1	74791700	Base Mechanism, Die Cast, Mach.	
2	83403601	Spindle	
3	75747000	Bearing, Spacer	
4	75745200	Pulley, Spindle, Die Cast	
5		Not Applicable	
6		Not Applicable	
7	83401000	Cap, Push Rod	
8	75791503	Actuator Assembly	
8-1	75747801	Stepper Motor Assembly	
8-2	83426302	Carriage Assembly	
8-2(6)	83403101	Pad, Head Load	
8-3	83427301	Nut, Carriage, Molded	
8-4	83427200	Spring, Carriage	
8-5	83426700	Stop, Carriage, Die-Cast	
8-6		Not Applicable	
8-7	10126209	Screw, Cap, Sock. Hd., 2-56 x 1/4	
8-8	75790000	Decal, Caution	
8-9	75813000	Bearing, Retainer	
8-10	92073020	Bearing, Flanged	
8-11	94217207	Bearing, Ball, Ext. Inner Race	
8-12	93529001	Washer, Spring Wave	
8-13	09000202	Screw, Binding Hd., 4-40 x 3/16	
9	75812800	Clamp, Stepper Motor, Die Cast	
10	75292400	Guide, Carriage	
11	75791600	Mount, Switch	
12		Not Applicable	
13	83401700	Rail, Disk, Injection Mold	
14	75812021	Support, Assembled	
15	83402800	Arm, Disk Load	
16	75273000	Pin, Disk Load Arm	
17	83402101	Cone Assembly	
18	75273200	Bushing	
19	75747200	Solenoid, Clapper	
20	75745900	Extension, Armature	
21	75745800	Bail, Armature	
22	75813300	Rod, Push	
23	75813400	Plunger, Push Rod, Molded	
24	75747301	Harness Assembly, Upper	
25	83403502	Harness Assembly, Lower	
26	10125801	Washer, Spring Lock, No. 4	
27	75200930	Foam, Polyester, Open Cell, Blue	
28	75724402	Switch, Subminiature	
29	75293203	Belt, Flat	
30	75292609	Spring, Compression	
31	75292610	Spring, Compression	
32	75774732	Clip, Push-in, Nylon	
33	75774736	Clip, Push-in, Nylon	
34	83427000	Screw, Hex. Hd.	
35	10125803	Washer, Spring Lock, No. 6	

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Figure 8-3. COMMON PARTS ASSEMBLY

INDEX NO.	PART NUMBER	DESCRIPTION	QTY.	IDENTIFIER	ASS'Y LEVEL
		Common Parts Kit (Continued)			
36	15101800	Plate, Identification			
37	73454511	Plate, Identification			
38	93564002	Washer, Nylon			
39	94217702	Nut, Self-lock, 8-32			
40	92073022	Bearing, Flanged			
41	93529005	Washer, Spring, Wave			
42	92033037	Ring, Retaining			
43	92033038	Ring, Retaining			
44	10125603	Washer, Plain, No. 4			
45	16402506	Clamp, Cable			
46	09000005	Screw, Binding Head, 2-56 x 3/8			
47	09000202	Screw, Binding Head, 4-40 x 3/16			
48	09000403	Screw, Binding Head, 6-32 x 1/4			
49		Not Applicable			
50	09000504	Screw, Binding Head, 8-32 x 0.375			
51	10126218	Screw, Hex, Sock. Hd., 6-32 x 3/8			
52	10126220	Screw, Hex, Sock. Hd., 6-32 x 5/8			
53	93592162	Screw, Hex, Washer Head, Self-tap, 6-32 x 3/8			
54	92336002	Fastener, Triangular, Self-lock			
55	93592086	Screw, Hex, Washer Hd., 4-40 x 3/8			
56	83413403	Screw, Self-lock			
57	83411202	Bumper, Door			
58	10125602	Washer, Plain, No. 2			
59	92602003	Clamp, Cable			
60	10126214	Screw, Hex, Sock. Hd., 4-40 x 1/2			
61	83427900	Plate, Nut			
62	72959302	Label, FCO Log			
63	83458300	Drawing, Chassis Assembly (Ref.)			

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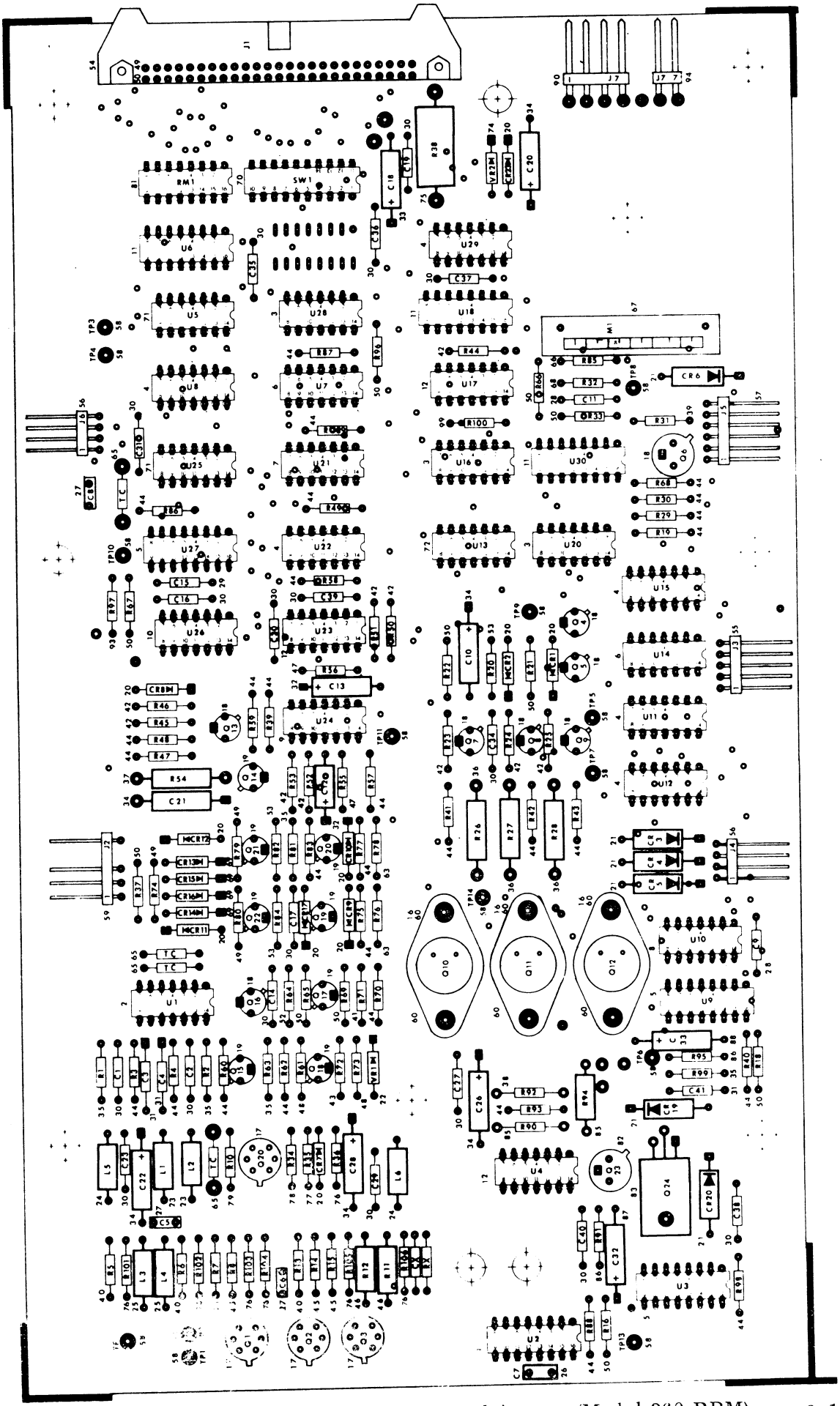
Figure 8-3. COMMON PARTS ASSEMBLY



75736000-A1a Figure 8-4. Component Board Assy. (Model 360 RPM) (75881705) 8-11

INDEX NO.	PART NUMBER	DESCRIPTION	APPLICATION
	75881705	Component Board Assy., 360 RPM	ECO PL12518
1	15127000	IC TTL BDBTL	
2	15126900	IC Diff. Video Ampf	
3	51801200	IC 7408	
4	51651900	IC TTL4 2nd G	
5	15104300	IC 9602 Multi-Vibrat	
6	15104800	IC 7474	
7	15105000	TTL Dual Mstr	
8	50251600	IC TTL4	
9	50254200	IC TTL6	
10	50250700	IC 741019003	
11	50254500	IC Rec2	
12	51768200	IC Dual	
16	50220601	Transistor NPN Pwr	
17	75722700	Transistor Dual NPN	
18	75722200	Transistor NPN	
19	16547200	Transistor PNP 2N290	
20	51736700	Diode IN914A	
21	56142000	Diode-Silicon	
22	50240107	Diode Zener	
23	94356336	Inductor 100UH	
24	94356341	Inductor 270 UH	
25	94356328	Inductor 22 UH	
26	94227215	Capacitor, Dipped MIC	
27	94227247	Capacitor MICA 750 P	
28	92496215	Capacitor 1000 PF	
29	92496219	Capacitor 2200 PF	
30	92496227	Cap 100V 20% .01UF	
31	38879319	Capacitor	
32	38879328	Capacitor	
33	38879335	Cap 50V 20% 3.9 UF	
34	24504351	Cap 10V 20% 15UF	
35	94360100	Res 1/4W 1% 10.0	
36	24507117	Resistor	
37	24507119	Resistor	
38	24500139	Res 100 OHM 1/2W 5 P	
39	94360201	Res 1/4W 1% 102	
40	94360229	Res 1/4W 1% 200	
41	94360261	Res 1/4W 1% 432	
42	94360265	Res 1/4W 1% 475	
43	94360293	Res 1/4W 1% 931	
44	94360300	Res 1/4W 1% 1.00K	
45	94360317	Res 1/4W 1% 1.50K	
46	75721500	Resistor	
47	94360329	Res 1/4W 1% 2.00K	
48	94360357	Res 1/4W 1% 3.92K	
49	94360388	Res 1/4W 1% 8.25K	
50	94360400	Res 1/4W 1% 10.0K	
52	94360411	Res 1/4W 1% 13.0K	
53	94360446	Res 1/4W 1% 30.1K	
54	94359504	Header Right Angle 3	
55	75743705	Header-Right Angle	
56	75743704	Header-Right Angle	
57	75743706	Header-Right Angle	
58	92498021	Terminal, Swaged	

Figure 8-4. Component Board Assembly (Model 360 RPM)

INDEX NO.	PART NUMBER	DESCRIPTION	APPLICATION
		Component Board Assy., 360 RPM (cont'd)	
59	75772401	Connector Hdr	
60	75738300	Rivet	
63	94360312	Res 1/4W 1% 1.33K	
64	75881604	Bare Board	
65	94357500	Resistor Test Select	
66	92512653	Res 1/4W 22 Meg	
67	94257605	Meter-Elapsed Time M	
68	94360325	Res 1/4W 1% 1.82K	
69	83432400	Diode 3650 - Disk	
70	83452207	Switch-10 Position	
71	62031200	IC 7438	
72	36187100	IC 7404/9016	
74	50240906	Diode-Zener 1W 5.6V	
75	24504834	Resisotr	
76	94360208	Res 1/4W 1% 121	
77	94360274	Res 1/4W 1% 590	
78	94360240	Res 1/4W 1% 261	
79	94360243	Res 1/4W 1% 280	
81	94260301	Socket 16 Pin	
82	51585100	Transistor	
83	75752400	Transistor	
85	24500167	Resistor	
86	94360438	Res 1/4W 1% 24.9K	
87	17706834	Capacitor Fxd	
88	24504353	Cap 10V 25% 33UF	
90	77600002	Amp 4-Pin Rt Angle H	
83	24500135	Resistor	
94	77600000	Amp 2-Pin Rt Angle H	
95	94335901	Pad-Transistor Mount	
97	83409905	Jumper Wire .5 In	
98	83409903	Jumper Wire .3 In	
99	94360367	Res 1/4W 1% 4.99K	
100	77600600	Connector	
101	95894500	Resistor Module	
901	75881804	Schematic	

Figure 8-4. Component Board Assy. (Model 360 RPM)

SECTION 9:

WIRE LISTS

SECTION 9:

WIRE LISTS

INTRODUCTION

TERMINOLOGY

The following is an example of a non-logic wire list, with an explanation of the block or column titles:

TITLE: DC POWER CABLE ASSY.								WL	SHEET NO. 1	DOCUMENT NO. 83430300	REV. 01
IDENTIFIER	WIRE SIZE	COLOR CODE	WIRE LENGTH	ORIGIN LOCATION	ORIGIN PIN NO.	DESTINATION LOCATION	DESTINATION PIN NO.	REMARKS			
1A	16	0	12	P3	1	TB2	1				
1B	16	9	12	P3	2	TB2	4				
1C	16	54	12	P3	4	TB2	5				
1D	16	2	12	P3	5	TB2	6				
1E	16	3	12	P3	6	TB2	7				
1F	16	6	12	P3	7	TB2	8				
1G	16	90	12	P3	8	TB2	9				
1H	16	20	12	P3	9	TB2	10				

TITLE: Name of particular harness assembly

SHEET NO.: Sequential numbering of sheets related to same harness assembly

DOCUMENT NO.: Assembly number of harness

REV: Revision level of documented assembly

IDENTIFIER: Logic diagram individual wire identifier

WIRE SIZE: Gauge of conductor (AWG)

COLOR CODE: Insulation color code

WIRE LENGTH: Length of conductor in inches

ORIGIN: Origin point of conductor (at mating conn.)

DESTINATION: Destination point of conductor (at mating conn.)

LOCATION: Connector identifier

PIN NO.: Connector pin number

COLOR CODE

The color code column utilizes numbers to identify the insulator color. Multi-colored wires are identified by a number having two or three digits, with each digit representing one of the colors.

In multi-colored wires, the first digit denotes the base color, and the remaining digits denote tracer colors. The code numbers are identified as follows:

0 - Black
1 - Brown
2 - Red
3 - Orange
4 - Yellow
5 - Green
6 - Blue
7 - Violet
8 - Gray
9 - White

S - Shield

HARNESS ASSEMBLIES

UPPER WIRE ASSEMBLY

Start	Wire Color	Destination	Approximate Length Inches
Solenoid-A	Red	J5-5	11.0"
Solenoid-B	Black	J5-2	11.0"
Interlock Common	Brown	J5-6	13.5"
Interlock N.O.	White	J5-4	13.5"
Lamp-Emitter	Blue	J5-1	13.5"
Lamp-Collector	Yellow	J5-3	13.5"

LOWER WIRE ASSEMBLY

Start	Wire Color	Destination	Approximate Length Inches
Track 0 Common	Black	J3-5	20.0"
Track 0 N.C.	Red	J3-3	20.0"
Track 0 N.O.	White	J3-2	20.0"
Photo Cell Emitter	Blue	J3-4	9.0"
Photo Cell Collector	Yellow	J3-1	9.0"

STEPPER MOTOR

Wire Color	Destination	Approximate Length Inches
Brown	J4-1	13.0"
Red	J4-2	13.0"
Orange	J4-3	13.0"
Black	J4-4	13.0"

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