

TECHNICAL MANUAL

DISKETTE DRIVE

MODELS: RFD4000-A RFD2000-A  
RFD4001-A RFD2001-A

## IMPORTANT INFORMATION

Changes to the equipment which are made between manual printings are listed in an addendum at the rear of the manual. As a convenience, a list of change pages is given as the last page in the manual. It is recommended that each of these pages be marked "Refer to Addendum" so that these changes can be identified.

**EX-CELL-O CORPORATION**

***REMEX***

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# FOR YOUR SAFETY

Before undertaking any maintenance procedure, whether it be a specific troubleshooting or maintenance procedure described herein or an exploratory procedure aimed at determining whether there has been a malfunction, read the applicable section of this manual and note carefully the

**WARNING**

and

**CAUTION**

contained therein.

The equipment described in this manual contains voltages hazardous to human life and safety and may contain mechanical components capable of inflicting personal injury. The cautionary and warning notes are included in this manual to alert operator and maintenance personnel to the electrical and mechanical hazards and thus prevent personal injury and damage to equipment.

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## SECTION I

### GENERAL DESCRIPTION

#### 1.1 EQUIPMENT DESCRIPTION

The REMEX RFD4000 and RFD4001 Diskette Drives are a small, portable, double-headed direct access storage devices which utilize a removable two-sided flexible diskette as the storage medium. See Figure 1-1. The mechanism consists of a belt driven spindle, spindle motor, two read/write heads and a split band stepping motor drive system for positioning the heads. The drive also uses a light emitting diode and phototransistor for index sensing, and a printed circuit board to provide all required internal electronic functions. The RFD4000 and RFD4001 are identical except the RFD4001 provides for data and clock separation from the data stream. The RFD2000 is identical to the RFD4000 except data is recorded only on one side; similarly the RFD2001 is identical to the RFD4001 for the same reason. All information given in this manual is identical to all four drives unless specifically noted.

Magnetic data is written on or read from the diskette surface by one of two read/write heads which are positioned to concentric tracks on the diskette surface by means of the stepper motor. The diskette spindle is belt driven at 360 RPM by a drive motor.

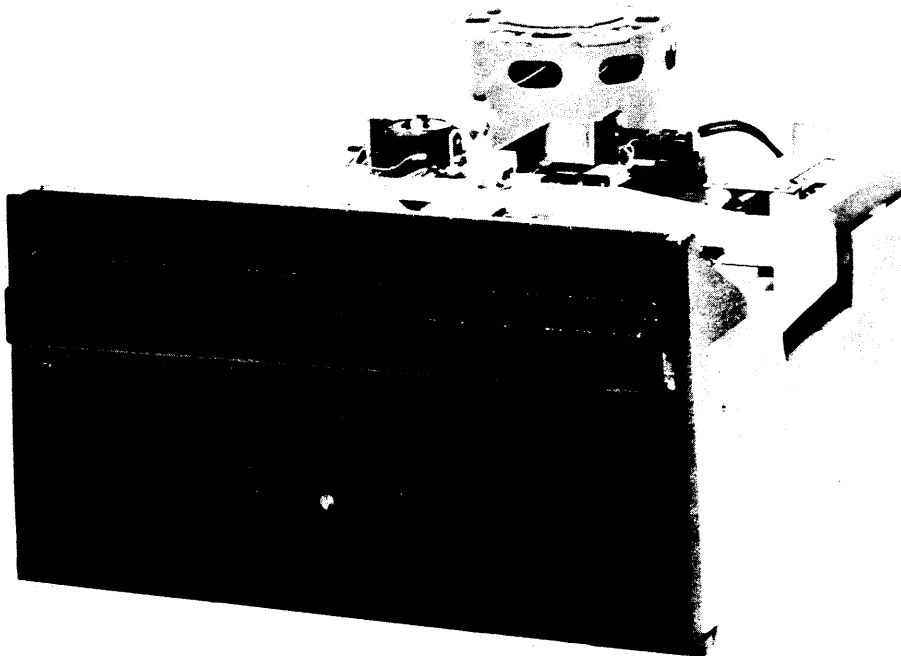


Figure 1-1. RFD4000 Diskette Drive. The RFD4001, RFD2000 and RFD2001 are Identical in Outward Appearance.

### 1.1.1 RFD4000 AND RFD2000 FEATURES

All units provide physical and electrical interface compatibility with the Shugart SA 850R/851R with the exception of the LOW CURRENT input which is used on the REMEX drives. The use of the LOW CURRENT input provides improved data integrity compared to similar models by other manufacturers. The RFD4000 and RFD4001 are media compatible with the single-sided IBM 33FD drives and two-sided IBM 43FD drives. Read/Write/Erase head geometry is identical to that in IBM diskette drives and the mechanism for positioning the head meets the precise requirements of track location, thereby allowing complete diskette interchangeability. For applications where IBM format compatibility is not a requirement, storage capacity may be increased by the use of hard-sectored diskettes or double density encoding. The drive employs specially designed electronics which allows data capacity of twice that used in single density recording techniques.

Drive select code circuitry is provided which allows the address code of an individual drive to be selected by a jumper. Up to four drives may be connected in parallel. This feature eliminates the unit select decode circuitry from the host system and makes it possible for the user to change the drive address without physically removing the drives and interchanging them. Unit select line features allows bussing of up to four drives on a ribbon cable.

The heads are ceramic and are positioned on a lightweight head carriage. The bottom head is fixed while the top head is mounted on a movable head load arm which provides less wear and higher overall reliability. Other features include automatic erase control which eliminates the need for erase gate electronics in the host system and a head load indicator, installed on the front panel, which is lit when the head is loaded.

### 1.1.2 RFD4001 AND RFD2001 FEATURES

The RFD4001 and RFD2001 contain the same features as described in Section 1.1.1 for the RFD4000 and RFD2000 except for a built in data and sector separator that provides separate output lines for sector signals when a 33 hole media is used and provides separate output lines for Data and Clock signals. In the RFD4000 and RFD2000 data and clock signals are contained in the Read Data output stream.

### 1.1.3 OPTIONS, FACTORY INSTALLED

The following options are available on all four model drives. A more complete description of each option is included in Section 3.5. In addition certain modifications are available for optional voltages and drive motors. See Section 1.8 and Table 1-2 which describes how these options are incorporated into the model number.

- a. Modification for 100/115/230 VAC, operation of a synchronous motor.

#### 1.1.4      OPTIONS, CUSTOMER INSTALLED

Several options can be implemented by the customer so that the diskette drives function differently than that described for the standard unit. Certain traces are added or subtracted and alternate I/O pins are used to implement these modifications. A shorting plug (AMP P/N 530153-2) is used in some cases as the connection. A 16-pin programmable shunt is provided for the eight most commonly used cut trace options. Section 3.6 describes in detail the various options available, as well as their installation. Table 3-2 lists the various options, their trace locations and how the circuit board is factory wired. It should be noted in those options that use the same traces and/or alternate I/O pins, only one option can be installed.

#### 1.2           MAINTENANCE EQUIPMENT REQUIRED BUT NOT SUPPLIED

The maintenance procedures in Section 5 require equipment that is not supplied. This equipment is listed in Table 5-1.

#### 1.3           EQUIPMENT WARRANTY

A statement covering the warranty of this equipment is given on page iii (second page in book). It should be read and understood. All preventive maintenance procedures must be performed as outlined in Section 5.2 during the warranty period in order that the warranty remain in effect. Any question arising concerning the warranty should be directed to the REMEX Service Department.

#### 1.4           SPECIFICATIONS

The specifications for the four diskette drives are listed in Table 1-1.

Table 1-1. Specifications for the RFD4000, RFD4001, RFD2000 and RFD2001.

Characteristic	Specification
Capacity/Side	400K Bytes, single density, unformatted 800K Bytes, double density, unformatted  250K Bytes, IBM Format (26 sectors), single density 500K Bytes, IBM Format (26 sectors), double density
Recording Density	RFD400X: 3408 BPI, single density; 6816 BPI, double density. RFD200X: 3268 BPI, single density; 6536 BPI, double density.
Track Density	48 TPI
Number of Tracks	154 (77 each side)
Heads	2 (RFD4000, RFD4001); 1 (RFD2000, RFD2001).
Recording Method	FM, single density; MFM or M <sup>2</sup> FM, double density
Rotational Speed	360 RPM
Transfer Rate	250K Bits/Sec, single density; 500K Bits/Sec, double density
Latency	83 ms, average
Access Time	3 ms, track to track; 15 ms, settle; 91 ms average (including settling).
Head Load Time	35 ms
Motor Start Time	2 sec
Media	IBM Diskette 1 (one side operation only), 2, 2D.
Error Rate	Read Error Rate (Recoverable): Less than 1 in 10 <sup>9</sup> bits read. Read Error Rate (Non-Recoverable): Less than 1 in 10 <sup>12</sup> bits read. Seek Error Rate: Less than 1 in 10 <sup>6</sup> seek operations.
MTBF	6000 power on hours
MTTR	30 minutes
Design Life	15,000 power on hours or 5 years
Media Life	3.5 x 10 <sup>6</sup> passes/track
A.C. Power	See Table 1-2. Current requirement for 100/115 VAC is 0.8A and for 220VAC is 0.4A.
D.C. Power	+24 Vdc ± 10% @ 0.6A, typical +5 Vdc ± 5% @ 1.0A, typical -7 to -16 Vdc @ 0.1A typical Optional -5 Vdc ±5% @ 0.05A typical
Temperature	40°F to 115°F, Operating -30°F to 150°F, Storage (without media)
Relative Humidity	20 to 80% Operating, without Condensation 5 to 93% Storage, without Condensation
Weight	13 lbs.
Outline Dimensions	See Figure 1-2.



## 1.5 DISKETTE

The storage element used is a two-sided ferromagnetic coated flexible disk enclosed within a protective plastic jacket. See Figure 1-3 for two sided diskette and Figure 1-8 for one sided diskette. The interior of the jacket is lined with a wiping material to clean the disk of contamination. The diskette is always kept in a storage and traveling envelope to further protect the recording surface. Characteristics of the storage element are as follows:

Track Width: 0.014 inch  
Track Spacing: 0.02083 inch (48 tracks/inch)  
Disk Diameter: 7.875 inches  
Envelope Size: 8 x 8 inches

## 1.6 RECORDING FORMAT

The format of the data recorded on the Diskette is totally a function of the host system and can be designed to the user's application to best take advantage of the total available bit capacity of any one track or diskette.

The following are four examples of data formatting:

Figure 1-4 shows the IBM track format.  
Figure 1-5 shows a recording format using index recording.  
Figure 1-6 shows a sample format used with MFM encoding.  
A discussion of MFM encoding is contained in Section 2.5.2.  
Figure 1-7 shows a recording format used with a 32 sectored diskette.

## 1.7 MAINTENANCE AND RELIABILITY

This section defines the long term unit reliability and data integrity of the diskette drive.

### 1.7.1 DESIGN LIFE

The drive is designed and constructed, to provide a useful life of 15,000 power on hours or 5 years. During the useful life repair or replacement of parts is permitted. The read head is designed for a minimum of 30,000 hours operation.

### 1.7.2 RECOVERABLE READ ERROR

The recoverable read error rate is less than one error in  $10^9$  bits.

### 1.7.3 NON-RECOVERABLE READ ERROR RATE

The non-recoverable read error rate is less than one error in  $10^{12}$  bits read. A read error is defined in Section 3.3.8.2. Errors attributed to the diskette are not included in determining the non-recoverable read error rate.

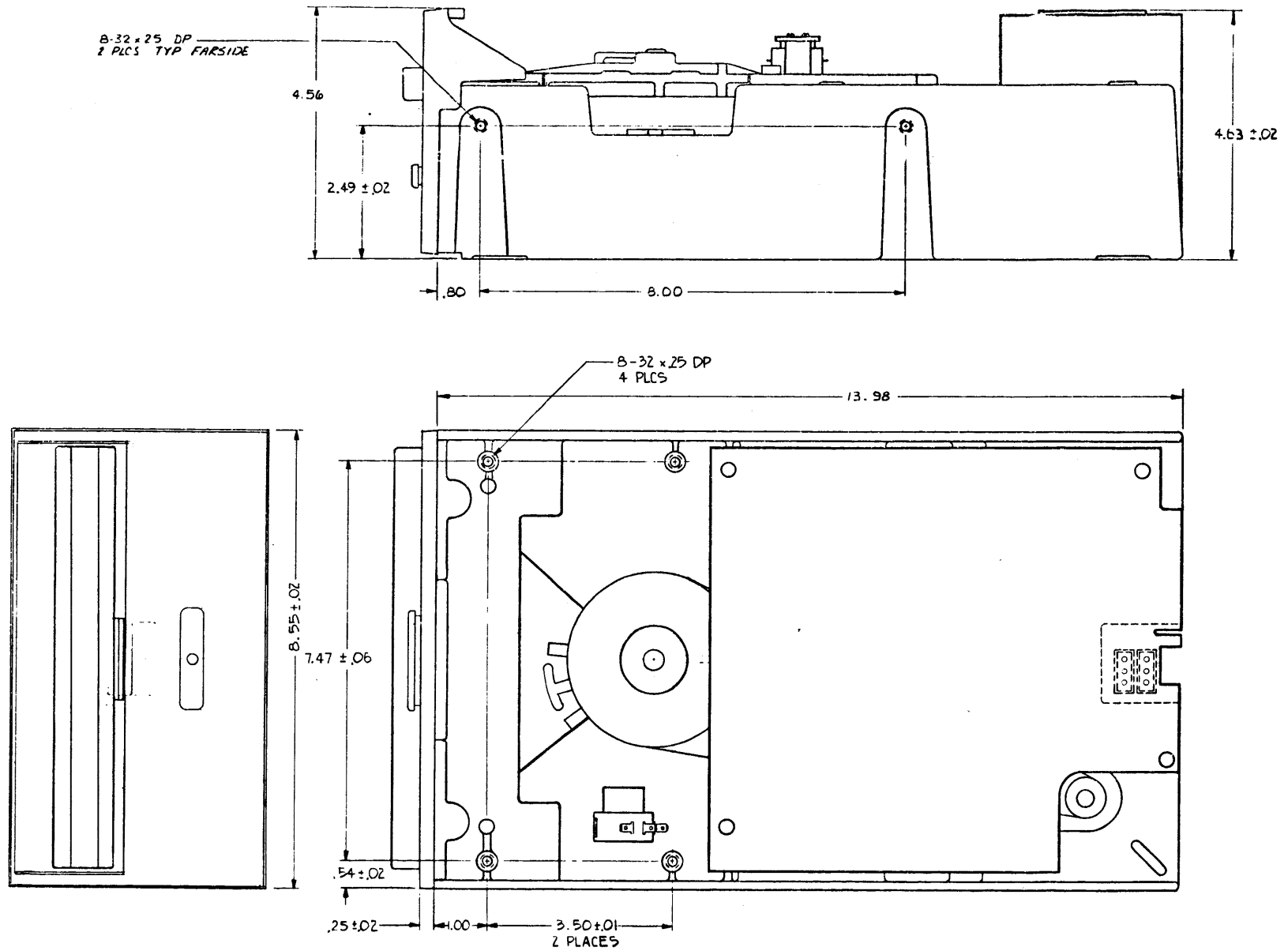
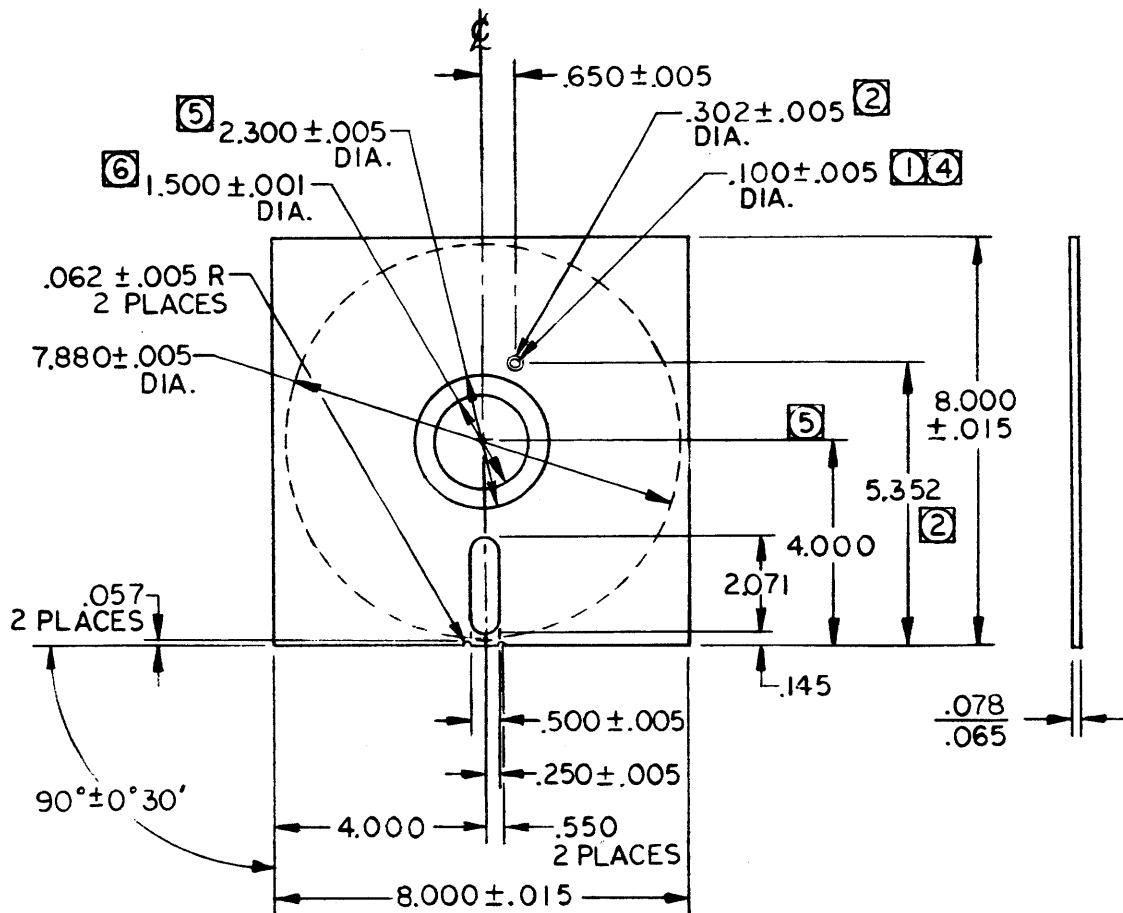


Figure 1-2. Installation Drawing, Models RFD4000, RFD4001, RFD2000 and RFD2001.



MMC 669

- ① INDEX HOLE IN DISK.
- ② INDEX HOLE IN JACKET - BOTH SIDES.
- 3. ALL DIMENSIONS ARE  $\pm .010$  INCH UNLESS OTHERWISE INDICATED.
- ④ CENTER OF MOUNTING HOLE TO CENTER OF INDEX HOLE IS  $1.500 \pm .002$  INCH.
- ⑤ MOUNTING HOLE IN JACKET - BOTH SIDES.
- ⑥ MOUNTING HOLE IN DISK.

Figure 1-3. Two Sided Storage Element Physical Dimensions.

	SINGLE DENSITY 26 SECTORS		SINGLE DENSITY 15 SECTORS		SINGLE DENSITY 8 SECTORS		DOUBLE DENSITY 26 SECTORS		DOUBLE DENSITY 15 SECTORS		DOUBLE DENSITY 8 SECTORS		
	#BYTES	HEX	#BYTES	HEX	#BYTES	HEX	#BYTES	HEX	#BYTES	HEX	#BYTES	HEX	
TRACK INDEX FIELD	PREAMBLE	40 6	FF 00	40 6	FF 00	40 6	FF 00	80 12	4E 00	80 12	4E 00	80 12	4E 00
	TRACK MARK	1 CLOCK =	FC D7	1 CLOCK =	FC D7	1 CLOCK =	FC D7	3 1	C2 (1) FC	3 1	C2 (1) FC	3 1	C2 (1) FC
	GAP 1	26	FF	26	FF	26	FF	50	4E	50	4E	50	4E
SECTOR FIELD	GAP 2	6	00	6	00	6	00	12	00	12	00	12	00
	ADDRESS MARK	1 CLOCK =	FE C7	1 CLOCK =	FE C7	1 CLOCK =	FE C7	3 1	A1 (2) FE	3 1	A1 (2) FE	3 1	A1 (2) FE
	TRACK #	1	01-4C	1	01-4C	1	01-4C	1	01-4C	1	01-4C	1	01-4C
	SIDE #	1	00-01	1	00-01	1	00-01	1	00-01	1	00-01	1	00-01
	SECTOR #	1	01-1A	1	01-0F	1	01-08	1	01-1A	1	01-1A	1	01-08
	SECTOR SIZE = $128 \times 2^N$	1	N = 00	1	N = 01	1	N = 02	1	N = 01	1	N = 02	1	N = 03
	CRC-PREVIOUS 'Y' BYTES	2 Y = 5	XX	2 Y = 5	XX	2 Y = 5	XX	2 Y = 8	XX	2 Y = 8	XX	2 Y = 8	XX
	GAP 3	11 6	FF 00	11 6	FF 00	11 6	FF 00	22 12	4E 00	22 12	4E 00	22 12	4E 00
	DATA MARK	1 CLOCK =	FB(3) C7	1 CLOCK =	FB(3) C7	1	FB(3)	3 1	A1 (2) FB(3)	3 1	A1 (2) FB(3)	3 1	A1 (2) FB(3)
	DATA	128	E5	1 255	C4 5E	1 511	C4 5E	256	40	512	40	1024	40
	CRC PREVIOUS 'Z' BYTES	2 Z = 129	XX	2 Z = 257	XX	2 Z = 513	XX	2 Z = 260	XX	2 Z = 516	XX	2 Z=1028	XX
	GAP 4	27	FF	42	FF	58	FF	54	4E	84	4E	116	4E
	REPEAT SECTOR 'M' TIMES	M = 26		M = 15		M = 8		M = 26		M = 15		M = 8	
	TRAILING GAP 5	247	FF	170	FF	311	FF	598	4E	400	4E	654	4E

(1) Missing clock between bits 3 and 4.

(2) Missing clock between bits 4 and 5.

(3) This is F8 for deleted data or IBM calls it "control data" when used on T00 Side 0 Sector 8-26 and T00 Side 1 all Sectors. This is not applicable to the Data Warehouse.

(4) Initialize parameters are estimated from other formats for which we have IBM Specs.

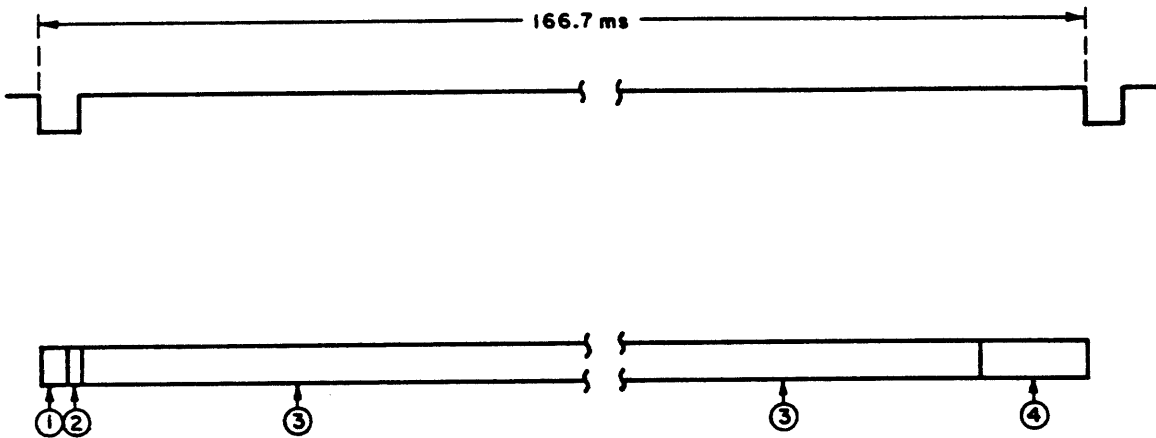
(5) Track 00 Side 0 is written similar to single density 26 sectors for all formats except data fields are different.

(6) Track 00 Side 1 is written in 26 sector pattern either single or double density to match rest of diskette.

$$XX = \text{CRC calculated by } 1 + x^5 + x^{12} + x^{16}$$

Figure 1-4. IBM Track Format. Hexidecimal Notation Used (X'00') In This Illustration.

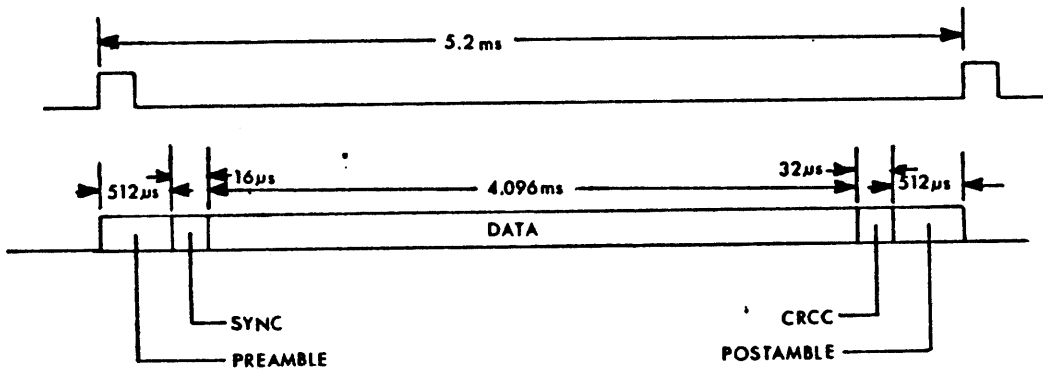
### INDEX FORMAT



MMC 421

- 1 Preamble = 175 Bits
- 2 Data Mark = 1 Byte
- 3 Data = 40,441 Bits
- 4 Postamble = 331 Bits

Figure 1-5. Recording Format Using Index Recording.

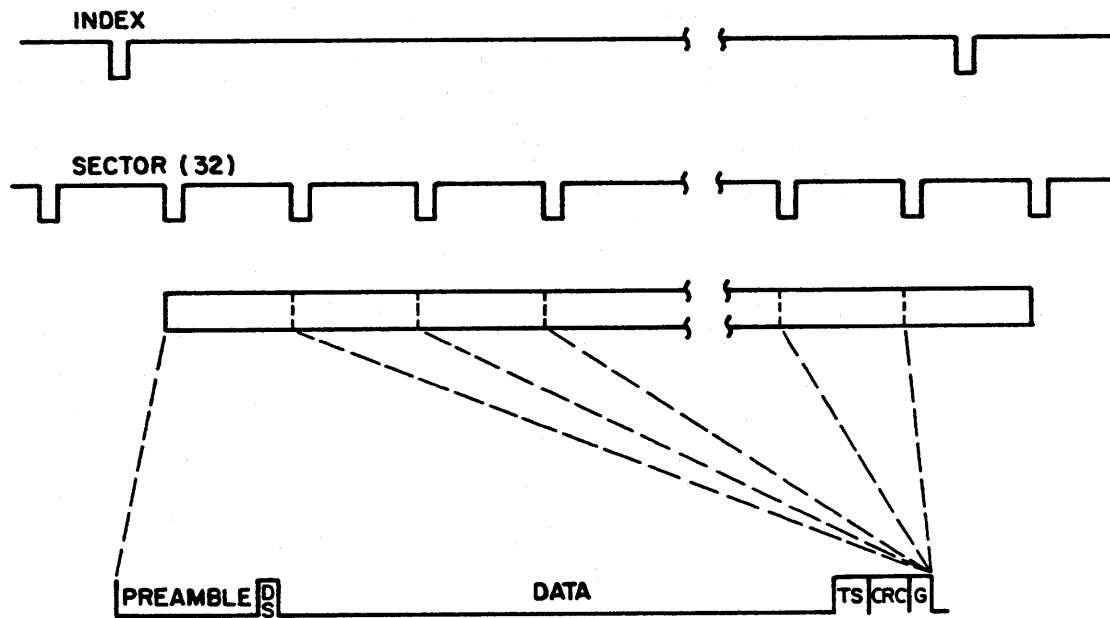


MMC 590

- Preamble - 7 words = 00<sub>16</sub>
- 8th word = AA<sub>16</sub>, AA<sub>16</sub>
- 7.5 words = 00<sub>16</sub>

- Sync - 1 Byte = FF<sub>16</sub>
- Data - 128 words
- CRCC - 1 word
- Postamble - 16 words = 00<sub>16</sub>

Figure 1-6. A Recording Format for MFM Encoding.



MMC 422

Preamble	= 22 Bytes '00'	32 Sector Data N	= 119 Bytes
Data Sync	= 1 Byte	16 Sector Data N	= 277 Bytes
Data	= N Bytes	8 Sector Data N	= 593 Bytes
Track and Sector	= 2 Bytes	4 Sector Data N	= 1237 Bytes
CRC	= 2 Bytes	2 Sector Data N	= 2488 Bytes
Guard	= 1 Byte		

Records/Track	Bits/Record	Bits/Track	Bits/Disk (77)
32	952	30,464	2,345,728
16	2,216	35,456	2,730,112
8	4,744	37,952	2,922,304
4	9,799	39,196	3,018,092
2	19,909	39,818	3,065,986

Figure 1-7. 32-Sector Format.

#### 1.7.4 ACCESS POSITIONING ERROR RATE

The access mechanism positioning error rate is less than one error per  $10^6$  seek executions.

#### 1.7.5 INTERCHANGEABILITY

The RFD4000 and RFD4001 diskette drives are designed to be media interchangeable with all other RFD4000 and RFD4001 drives with the two side IBM 43FD drives and Shugart SA850R/851R drives and with single side drives including REMEX RFS12X0 and RFS1100 subsystems and REMEX 1111A, 1112A, 120X, RFS7400 and RFS7500 systems and the RFD1000 and RFD7401 drives. Similarly, the media for the RFD2000 and RFD2001 are interchangeable with the single sided IBM 33FD drives and Shugart SA 800R/801R drives and the aforementioned single sided REMEX drives and systems.

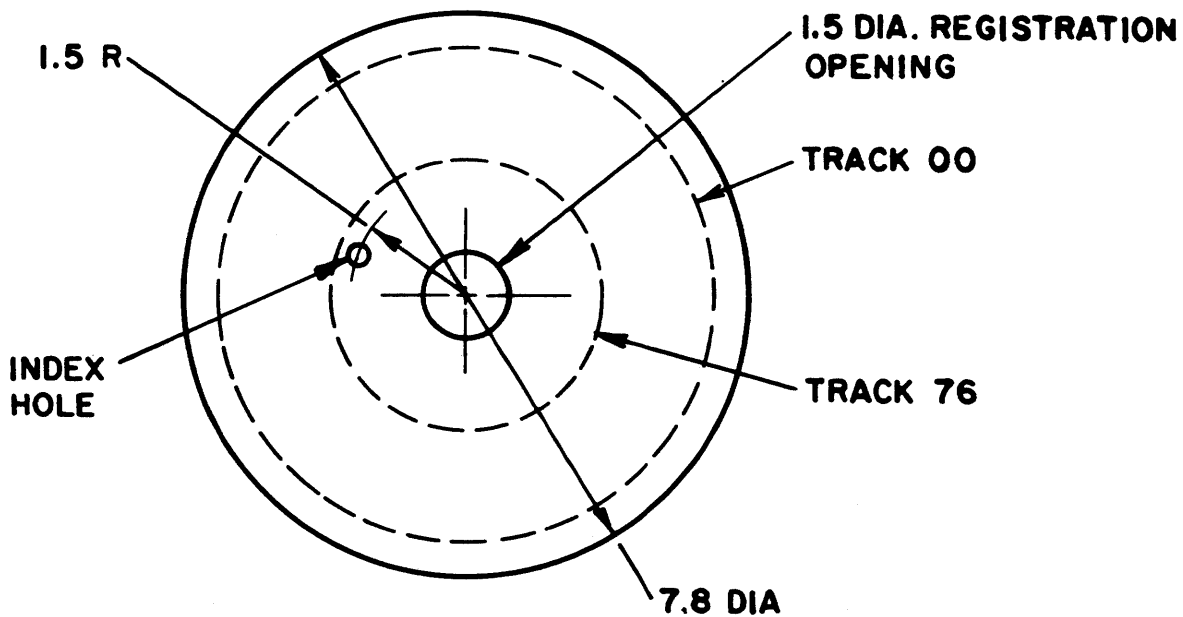
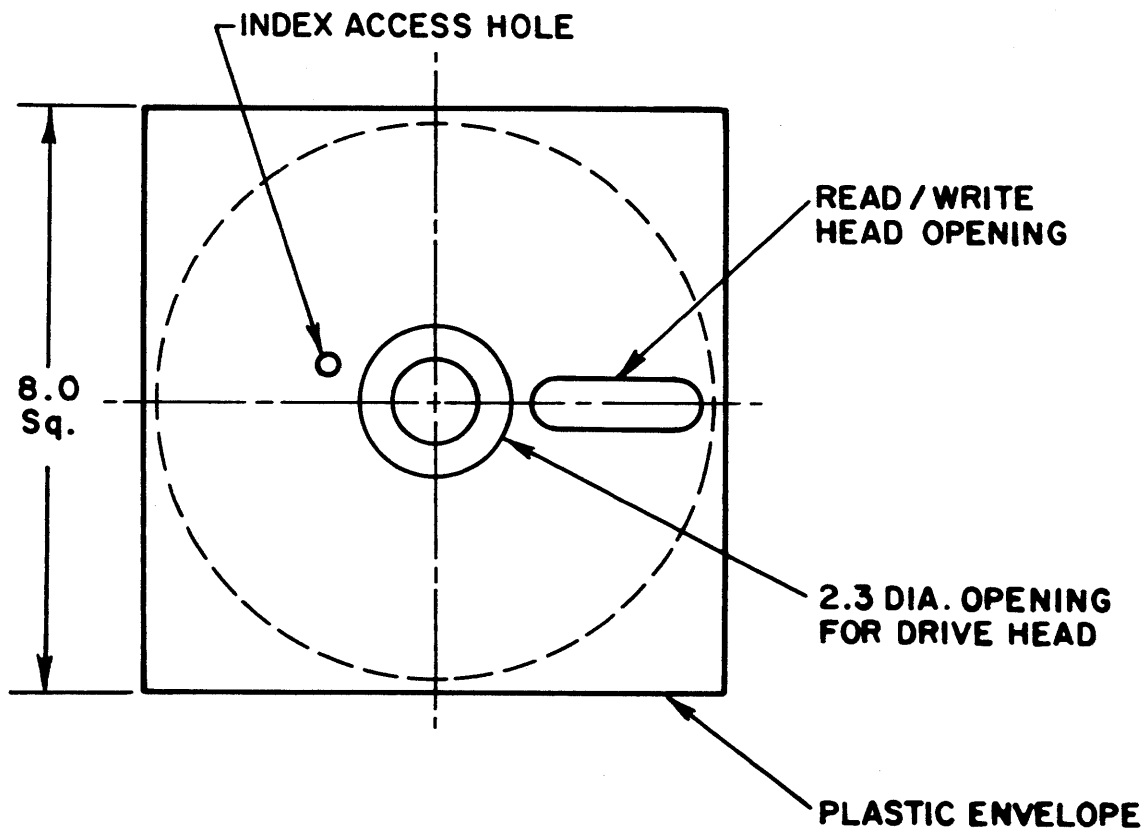
#### 1.8 MODEL NUMBER DESIGNATION AND OPTIONS

The model number system is used for product identification. It includes a basic model series number which is followed by a virgule (/) and then a six digit number and finally a three digit dash number. The model number is used to code and identify a particular combination of options used in a given product line. This number is printed on the Identification Decal and is located on one of the rear surfaces. Those digits to the left of the virgule are the basic model series of the product line (RFD4000). The six digits to the right and the three dash numbers give the top assembly number of the product. The three digit dash number is unique for any particular combination of options and configurations used in the basic assembly. Table 1-2 lists the various assemblies possible and a description of option combinations used for each dash number. An X in a model number (as used in many parts of the manual, especially the parts list) denotes any of the letters or digits used in that space is applicable in the situation cited.

Table 1-2. Model Number Configurations

MODEL NUMBER	DESCRIPTION
RFD4000/814080-001	Basic Drive, 115VAC, 60Hz
RFD4001/814080-003	Basic Drive with Data Separator, 115VAC, 60Hz
RFD4000/814090-001	Basic Drive, 100/115VAC, 50Hz
RFD4000/814090-002	Basic Drive, 115VAC, 60Hz
RFD4000/814090-003	Basic Drive, 220VAC, 50Hz
RFD4001/814090-004	Basic Drive with Data Separator, 100/115VAC, 50Hz
RFD4001/814090-005	Basic Drive with Data Separator, 115VAC, 60Hz
RFD4001/814090-006	Basic Drive with Data Separator, 220VAC, 50Hz
RFD4000/814255-001	Basic Drive, 115VAC, 60Hz
RFD4001/814255-003	Basic Drive with Data Separator, 115VAC, 60Hz
RFD4000/814256-001	Basic Drive, 100/115VAC, 50Hz
RFD4000/814256-002	Basic Drive, 115VAC, 60Hz
RFD4000/814256-003	Basic Drive, 220VAC, 50Hz
RFD4001/814256-004	Basic Drive with Data Separator, 100/115VAC, 50Hz
RFD4001/814256-005	Basic Drive with Data Separator, 115VAC, 60Hz
RFD4001/814256-006	Basic Drive with Data Separator, 220VAC, 50Hz
RFD2000/814225-001	Basic Drive, 115VAC, 60Hz
RFD2001/814225-003	Basic Drive with Data Separator, 115VAC, 60Hz
RFD2000/814226-001	Basic Drive, 100/115VAC, 50Hz
RFD2000/814226-002	Basic Drive, 115VAC, 60Hz
RFD2000/814226-003	Basic Drive, 220VAC, 50Hz
RFD2001/814226-004	Basic Drive with Data Separator, 100/115VAC, 50Hz
RFD2001/814226-005	Basic Drive with Data Separator, 115VAC, 60Hz
RFD2001/814226-006	Basic Drive with Data Separator, 220VAC, 50Hz
RFD2000/814257-001	Basic Drive, 115VAC, 60Hz
RFD2001/814257-003	Basic Drive with Data Separator, 115VAC, 60Hz
RFD2000/814258-001	Basic Drive, 100/115VAC, 50Hz
RFD2000/814258-002	Basic Drive, 115VAC, 60Hz
RFD2000/814258-003	Basic Drive, 220VAC, 50Hz
RFD2001/814258-004	Basic Drive with Data Separator, 100/115VAC, 50Hz
RFD2001/814258-005	Basic Drive with Data Separator, 115VAC, 60Hz
RFD2001/814258-006	Basic Drive with Data Separator, 220VAC, 50Hz





**MMC 419**

Figure 1-8. Single Sided Storage Element Physical Dimensions.

## SECTION II

### INSTALLATION AND INTERFACE

#### 2.1 UNPACKING

To provide the most protection during transit, specially designed and reinforced packing cartons are used to ship the REMEX Diskette Drive. When removing the Diskette Drive from the carton, lift the unit with both hands under it. Never lift or attempt to carry the unit by any of the covers, drive door or other delicate parts. Carefully inspect the unit for any apparent damage as soon as it is removed from the carton. In the event the equipment has been damaged as a result of shipping, the carrier and REMEX must be notified as soon as possible.

#### **CAUTION**

It is important that during unpacking, installation and operation that the read/write heads do not come in contact with stray magnetic fields.

#### 2.2 MOUNTING

The drive is designed to operate in three planes: horizontal front load, vertical front load and vertical top load. Threaded holes in the main frame sides are provided for either slide or fixed mounting. See Figure 1-2. It should be placed in an environment so that the unit does not exceed the ambient temperature specification listed in Table 1-1.

#### 2.3 INITIAL ADJUSTMENTS

Each Diskette Drive has been accurately adjusted and aligned before leaving the factory. No adjustment or calibration should be required prior to installation or use. Two procedures, however, must be completed by the customer as described below. Section 3.6 lists additional customer options which can be made.

##### 2.3.1 LINE TERMINATOR

At location 7A on each drive, there is a removable resistor pack ( $220\Omega/330\Omega$ ) installed as shipped from the factory. This resistor pack is for input line terminations. If the drives are used in a daisy chain application, this resistor pack should be removed from all drives except the last drive on the interface line.

### 2.3.2 DRIVE SELECT JUMPERS

Traces DS1, DS2, DS3 and DS4 have been provided to select which Drive Select line will activate the interface signal for a unique drive. Each drive is shipped with the shorting plug installed at DS1 for selecting drive number 1. To change to another drive select number, remove the shorting plug and re-install it on the DS number desired.

### 2.4 POWER AND SYSTEM CONNECTIONS

Figure 2-1 shows the connections between the diskette drives and the host system via connectors P1/J1, P8/J8, and P5/J5. Data, control and status signals are routed through J1 and DC power is routed through J5. I/O cables must not exceed 10 feet in length. AC power is connected to a three contact jack (J8) illustrated in Figure 2-2. Table 2-1 gives the recommended mating connectors for J1, J8 and J5. Table 3-1 describes the interface signals. Figure 2-3 gives recommended interface circuits. The mating connectors are available in the form of a kit of parts. Order RMF0020 for connectors and manual or RMF0021 for connectors without manual. See Table 7-7.

#### **CAUTION**

Always consult the serial number tag and TBI wiring (if applicable) for the proper voltage and frequency to be used as coded in the model number. See Section 1.8 and Table 1-2. Failure to do so could result in damage to the unit.

Table 2-1. Recommended Connectors P1, P8 and P5

Connector	Cable Type	Manufacturer	Connector P/N	Contact P/N
P1	Twisted Pair #26	Amp	1-583717-1	583616-5 (Crimp) 583854-3 (Solder)
	Twisted Pair #26	Viking	3VH25/1JN-5	NA
	Flat Cable	Amp	88077-1	Polarizing Key 88113-1
P8	NA	Amp	1-480700-0	350550-1
P5	NA	Amp	1-480270-0	60619-1

<u>J1</u>	
① 1,2	_____ Low Current
3,4,5,6,7,8	_____ Alternate Pins for Customer Installed Options
9, 10	_____ Two-Sided (RFD4000 and RFD4001 Only)
11,12	_____ Disk Change
13,14	_____ Side Select (RFD4000 and RFD4001 Only)
15,16	_____ In Use
17,18	_____ Head Load
19,20	_____ Index
21,22	_____ Ready
23,24	_____ Sector (RFD4001 and RFD2001 Only)
25,26	_____ Drive Select 1
27,28	_____ Drive Select 2
29,30	_____ Drive Select 3
31,32	_____ Drive Select 4
33,34	_____ Direction Select
35,36	_____ Step
37,38	_____ Write Data
39,40	_____ Write Gate
41,42	_____ Track 00
43,44	_____ Write Protect
45,46	_____ Read Data
47,48	_____ Separate Data (RFD4001 and RFD2001 Only)
49,50	_____ Separate Clock (RFD4001 and RFD2001 Only)

J5

1	_____ +24 Vdc
2	_____ -24 Vdc Return
3	_____ -5 Vdc Return
4	_____ -7 to -16 Vdc (-5V Option)
5	_____ +5 Vdc
6	_____ +5 Vdc Return

J8

1	_____ AC Input
2	_____ Frame Ground
3	_____ AC Input

- ① All odd pins for J1 are used as return lines.  
 See Table 3-1 for description of all signals. See Section 3.6 for description of customer installed options.

Figure 2-1. Interface Signal Connections.

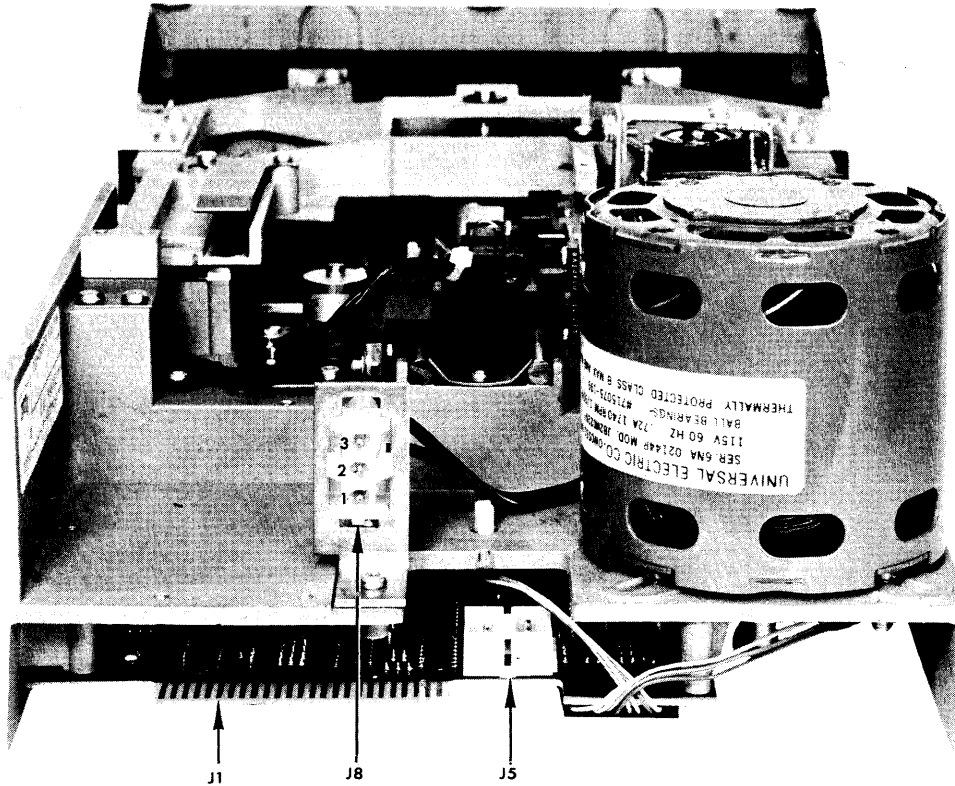


Figure 2-2. Interface Signal and Connector Locations. Pin numbers are shown for J8. Pin numbers for J1 and J5 can be read on the component side of the circuit card.

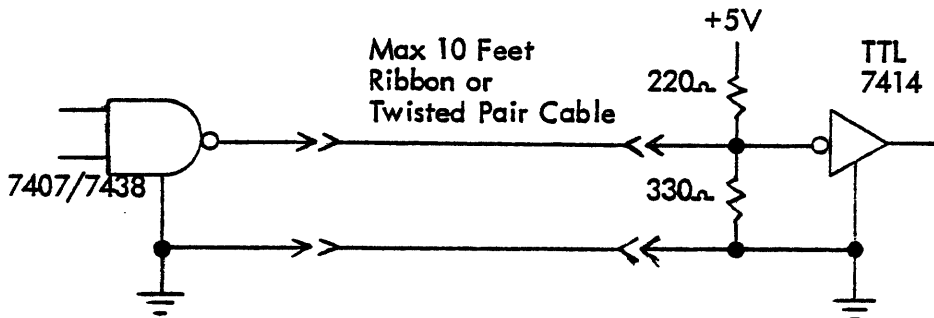


Figure 2-3. Recommended Interface Circuits.

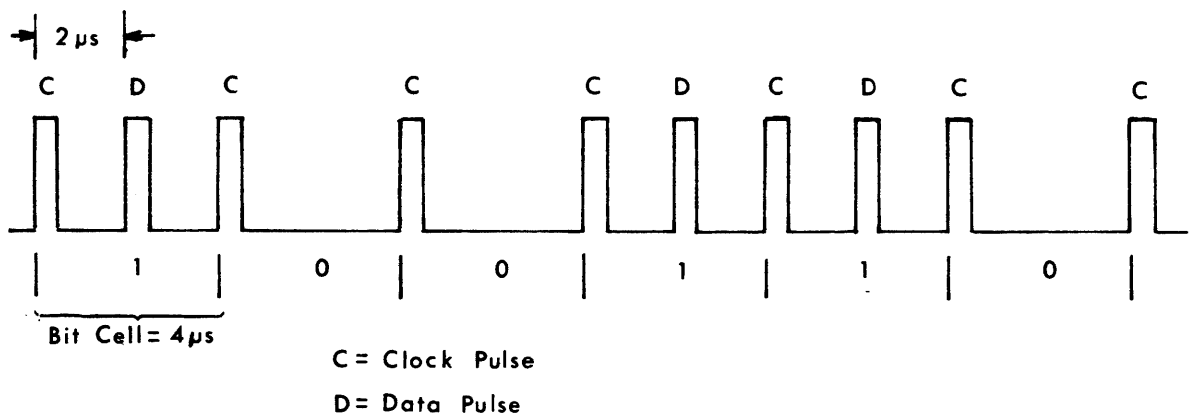
The REMEX Diskette Drives may be implemented in both single density and double density systems. By utilizing double density encoding schemes, the system designer is able to double the capacity of a standard IBM 3740 type flexible diskette. Standard diskettes, using double frequency recording, will store a maximum capacity of 6.4M bits on both sides. Double density encoding schemes will increase the maximum capacity of diskettes to 12.8M bits. This increase is achieved without increasing the number of flux reversals per inch on the diskette. The following discussion compares double frequency recording with double density and describes the basic circuit components required for implementation.

More than one type of double density recording is available to the designer. But it is important to realize that any double density drive will be optimized for only one type of recording technique. REMEX recommends either the modified frequency modulation (MFM) or the modified, frequency modulation (M<sup>2</sup>FM) be used with the diskette drives. Discussion in this section will be confined to techniques only.

### 2.5.1 DOUBLE FREQUENCY AND MFM ENCODING COMPARED

With either single density or double density schemes, the stream of data into or out of the drive is divided into bit cells. Each bit cell is encoded as either a "0" or a "1". The key to the various encoding schemes lies in the definition of the "0" or "1" within a bit cell.

Single density applications use a double frequency encoding scheme. Double frequency coded information incorporates a clock pulse at the beginning of each bit cell. See Figure 2-4. If a data pulse is present at the center of a bit cell, that cell represents a "1". If no data pulse is present between clock pulses, that bit cell represents a "0". The clock pulses are required to maintain synchronization in the event of a long stream of "0" bit cells. However, at least half of the diskette flux reversals are clock pulses, not useful data pulses.



MMC 585

Figure 2-4. Double Frequency Encoding.

Modified frequency modulation (MFM) is a self-clocking encoding scheme. By using MFM it is possible to double the number of recorded data bits without increasing the flux changes per inch on the media. Basically the rules for MFM encoding are as follows:

- a. A "1" is defined as a pulse occurring at the center of a bit cell.
- b. A "0" is defined as a pulse occurring at the beginning of a bit cell, except when preceded by a "1". In that case, no pulse occurs during the bit cell for a "0".

An example of a stream of data pulses using MFM encoding is shown in Figure 2-5. Note that by comparing Figures 2-4 and 2-5, the minimum time between pulses is  $2\mu\text{s}$  for both double frequency and MFM encoding. But the data transfer rate for MFM encoding is twice that for double frequency encoding, i.e., 250 kHz. MFM encoding is 100% efficient because of a 1 for 1 relationship between the flux changes per inch and the bits per inch recorded on the diskette. Double frequency encoding on the other hand is only 50% efficient.

### 2.5.2 IMPLEMENTATION OF MFM

MFM encoding and decoding can be implemented with the RFD400X by the addition of the following components to a system:

- a. Write encoding circuit with write precompensation.
- b. Read decoding circuit with a phase locked oscillator.

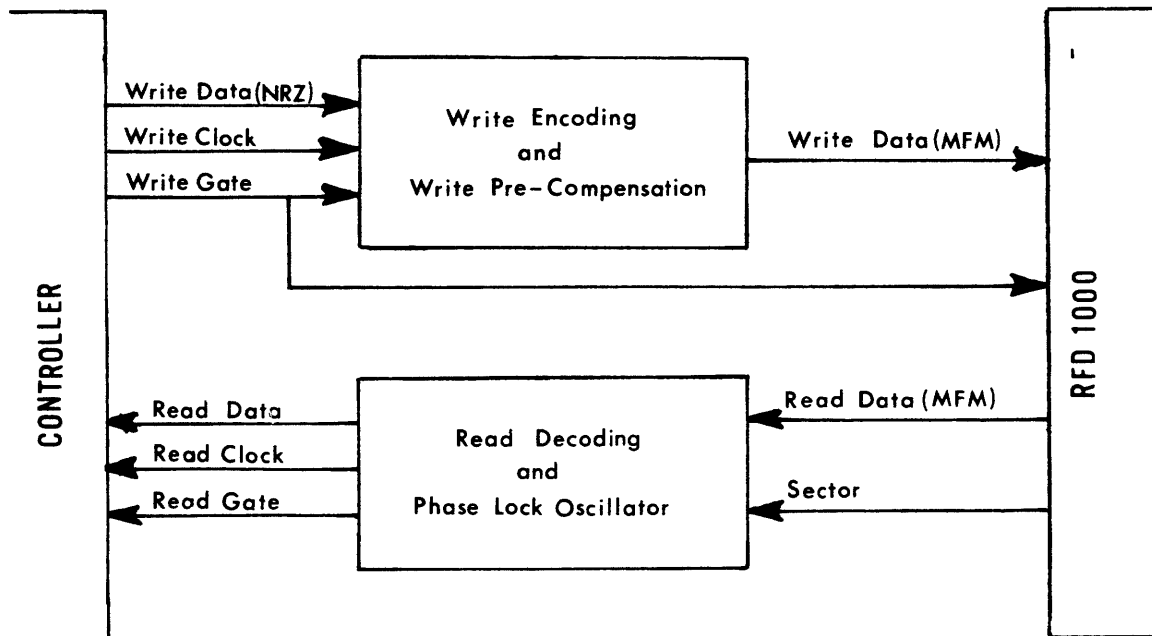
The block diagram for this implementation is shown in Figure 2-6.

Basically the write encoding circuit must receive serial write data from the controller and provide MFM encoded data. This circuit and the write precompensation circuit (described below) will usually be combined. The MFM encoded write data must consist of pulses 250 nanoseconds  $\pm 20\%$  in length and are true at the logic 1 level.



MMC 584

Figure 2-5. MFM Encoding.



MMC 586

Figure 2-6. Basic Components of Double Density System.

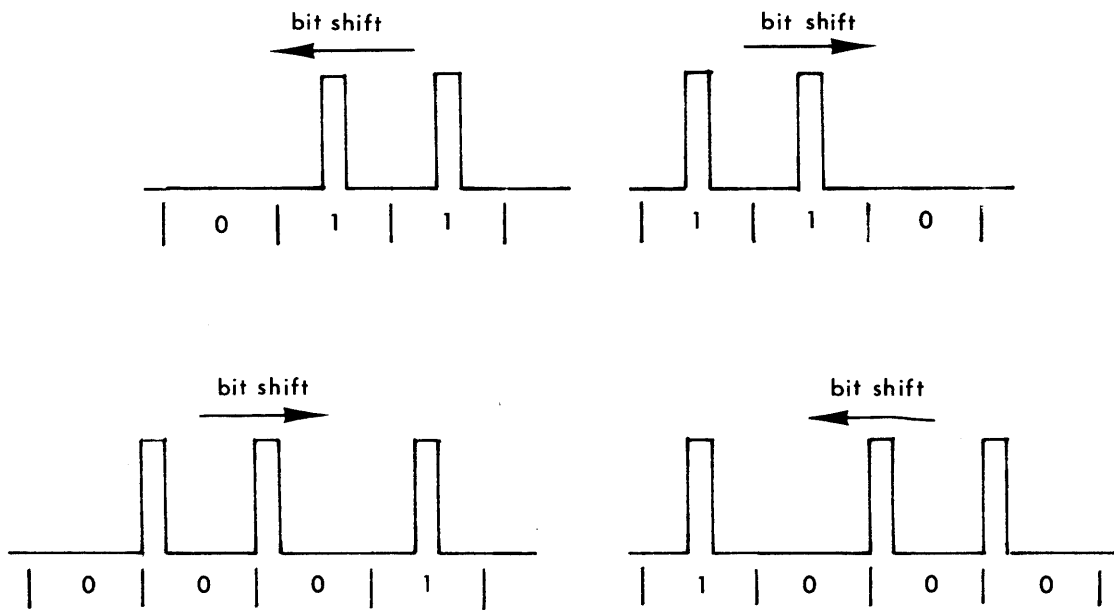
Since the bit cell time for double density is  $2\mu\text{s}$  versus  $4\mu\text{s}$  for single density, bit shifting becomes much more critical with double density. The allowable window for detecting a data pulse is only half as long as for single density. The Diskette Drive is designed for minimum possible bit shifting, but write precompensation of the data stream will be required to further minimize large bit shifting for certain data patterns. The data patterns with large bit shift tendencies are:

X011X  
 X110X  
 X0001X  
 X1000X

(an X denotes either a "0" or "1" can be in that digit)

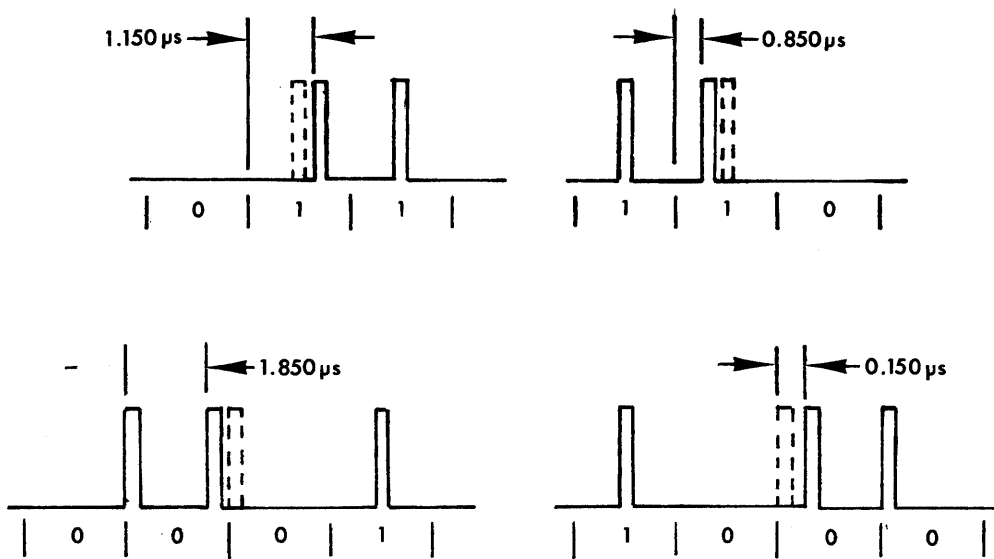
These data patterns will have bit shift tendencies as shown in Figure 2-7 which indicates the bit shift tendency on read back data. Note that the bits will shift away from a nearby pulse and towards a space with no pulse. Additional information on bit shifting can be obtained from the REMEX Applications Group. A write precompensation circuit must compensate for this expected read data bit shift by providing an equivalent, but opposite bit shift on the write data stream. Optimum compensation for the drives is 150 ns. In order to implement this compensation, it is necessary to sample data blocks of at least four bits. The precompensated data would appear as shown in Figure 2-8.





MMC 587

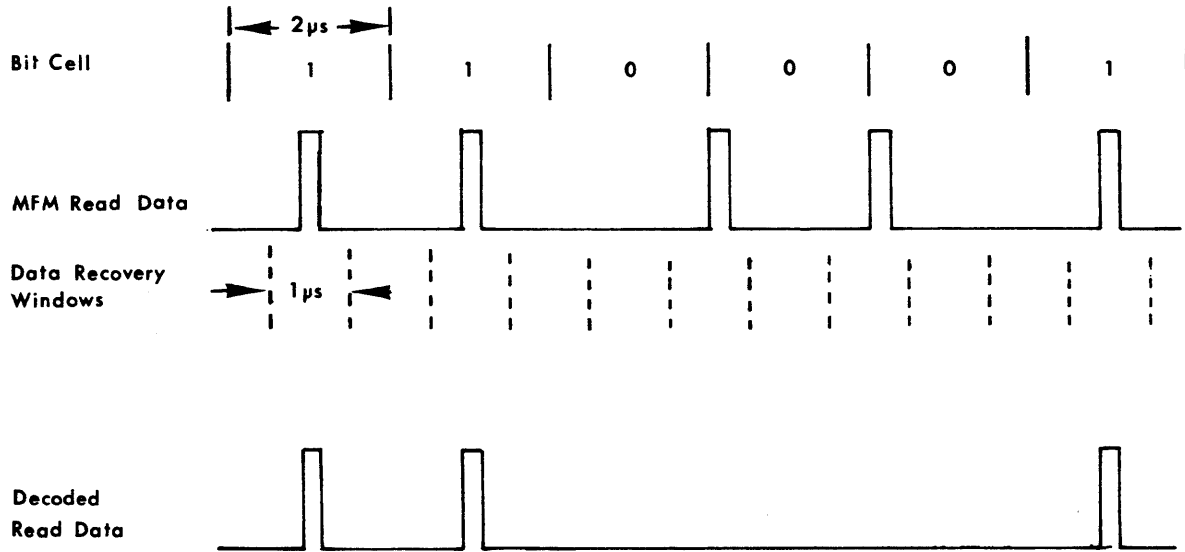
Figure 2-7. Expected Bit Shift on Read Back Data.



MMC 588

Figure 2-8. Precompensated Write Data.

The read decoding circuit must provide the opposite function as the write decoding circuit. The data stream at the output of drive will consist of 200 ns pulses encoded in MFM. Good design practice will combine the Read Decoding circuit with a phase lock oscillator for data recovery. Data recovery should be accomplished with 1  $\mu$ s windows centered on the expected bit location. See Figure 2-9. The read data is then transmitted to the controller.



MMC 589

Figure 2-9. Data Recovery Timing.

### 2.5.3 $M^2FM$ FORMAT DESCRIPTION

Modified, modified frequency modulation ( $M^2FM$ ) also provides a 1 for 1 relationship between the flux changes per inch and the bits recorded per inch on the diskette. The encoding scheme for  $M^2FM$  is as follows:

- a. A "1" is defined as a pulse occurring at the center of a bit cell.
- b. A "0" is defined as a pulse occurring at the beginning of a bit cell, except when preceded by cell containing a pulse (0 or 1). In that case, no pulse occurs during the bit cell for 0.

Figure 2-10 gives the same example for  $M^2FM$  that is used in Figure 2-5 for MFM encoding.



MMC 670

Figure 2-10.  $M^2$ FM Encoding.

## SECTION III

### OPERATION

#### 3.1 INPUT-OUTPUT SIGNALS

Section 2.4 and Table 3-1 describe the input, output and power signals which are routed through I/O connectors. Section 3.3 describes the various operations and timing required when operating the diskette drive.

#### 3.2 OPERATOR CONTROLS

The diskette drive is under full, automatic control of a computer controller except for loading and unloading the diskette. A front panel indicator LED indicates that drive is busy. Section 3.3.3 describes the loading and unloading of a diskette.

#### 3.3 LOADING AND OPERATING INSTRUCTIONS

The REMEX Diskette Drives are designed for ease of operator use and to facilitate a wide range of operator oriented applications. There are no complicated controls and indicators. The following section outlines the procedures for loading and operating the drive. Also included are some suggested software procedures for handling error conditions which might occur during writing or reading operations.

##### 3.3.1 POWER UP MODE

Applying AC and DC power to the drive can be done in any sequence. However, once AC power has been applied, a 2-second delay must be completed before any Read or Write operation is attempted. This delay is for stabilization of the Diskette rotational speed. When DC power is applied, a 90 msec power on reset automatically resets the electronics and inhibits inadvertent writing or erasing on the Diskette. See Figure 3-1. Thus, the drive is ready for operation 2-seconds after application of AC power and 90 msec after application of DC power. Also, initial position of the R/W head with respect to data tracks is indeterminate immediately after application of DC power. In order to assure proper positioning of the R/W head prior to any read/write operation, a Step Out operation should be performed until the Track 00 indicator becomes active.

Table 3-1. Interface Signal Descriptions.

Connector Pin	Description
J1-1 <sup>Ⓢ</sup> , 2	Low Current* Input. A low active level on this line is required when writing on tracks 44 through 76. This input is used to lower the write current by 20%.
J1-3 thru J1-8	Not Used.
J1-9, 10	Two-Sided Output (Customer Installed Option). A low active signal on this line indicates a two-sided diskette is rotating in the drive. An inactive signal indicates a single-sided diskette is installed. Used on RFD4000 and RFD4001 Only.
J1-11, 12	Disk Change Output (Customer Installed Option). This line is low active when the drive is selected (Drive Select true) provided during the previous period when the drive was not selected, Ready was lost. When Drive Select next goes inactive, this line goes inactive provided the drive has gone Ready.
J1-13, 14	Side Select Input. A low signal selects side 1 surface for reading or writing and a high signal select side 0 surface. A 100 $\mu$ s delay is required when switching from one head to the other before any Read or Write operation can be initiated. Deactivation of the Drive Select and/or changing the Side Select must be delayed at least 600 $\mu$ sec following a Write operation to ensure that the track is fully tunnel erased. Used on RFD4000 and RFD4001 Only.
J1-15, 16	In Use Input (Customer Installed Option). A low active signal will lock the door and turn on the BUSY LED.
J1-17, 18	Head Load Input (Customer Installed Option). A low active signal will cause the Read/Write head to be loaded against the diskette provided Ready is active. A 35 ms delay is required after the low active signal before Read data is valid or before the Write Gate and Write Data signals can be applied.
J1-19, 20	Index Output. The leading edge of this low active signal indicates the beginning of the track. This signal is present once each revolution (every 166.67 ms) and remains active for 0.4 ms. In order to properly detect the Index at the Host system, the transition from inactive to active should be recognized after the drive has been selected.
J1-21, 22	Ready Output. A low active signal indicates all of the following conditions have occurred: (1) a diskette has been properly inserted and is rotating, (2) two index holes have been recognized. Ready is also active if after DC power is applied, two index holes have been recognized (AC power previously applied and diskette properly inserted). If a single-sided diskette is installed and Side 0 is selected, this signal will be active. If Side 1 of a single-sided diskette is selected, this signal will be inactive. When either side of a two-sided diskette is selected, this signal will be active.
J1-23, 24	Sector Output (RFD4001 and RFD2001 Only). This signal is generated when a 33 hole diskette is inserted and is low active 32 times each revolution for a period of 0.4ms.
J1-25, 26 27, 28 29, 30 31, 32	Drive Select 1, 2, 3 and 4 Inputs. A low active signal is used to select one of four drives depending upon the line selected. The line selected must correspond to the Drive Select Jumper locations as described in Section 2.3.2. Under normal operation this Drive Select line will perform the following: (1) load the read/write heads, (2) apply power to stepper motor, (3) enable the input lines, (4) activate the output lines, (5) illuminate the BUSY LED and (6) lock the front door. Refer to Figure 3-1 for timing diagram.
J1-33, 34	Direction Select Input. A low signal will move the read/write head in toward the center of the diskette when the Step line is active. A high signal will move the read/write head out away from the center of the diskette when the step line is active. Refer to Figure 3-1 for timing diagram.
J1-35, 36	Step Input. This input is used in conjunction with the Direction Select Input and causes the read/write head to move in or out. When the trailing edge of this pulse goes from low to high the head is moved one track. The pulse width must be 1 $\mu$ s min. A 1 $\mu$ s delay must be made when any change in the Direction Select line is made before the trailing edge of the Step pulse. Refer to Figure 3-1 for timing diagram.
J1-37, 38	Write Data Input. Data to be written on the diskette is transferred on this line. An active Write Gate signal will enable this line. Current through the read/write head is reversed with each transition from a high level to a low level. The timing diagram is shown in Figure 3-4.
J1-39, 40	Write Gate Input. A low active signal enables Write Data to be written in the diskette. A high, inactive signal enables the read and stepper logic. The timing diagram is shown in Figure 3-4.
J1-41, 42	Track 00 Output. A low active signal indicates that the read/write head is located at track 00 and step motor phase 1 is energized. A high, inactive signal indicates that the read/write head is not located at track 00.
J1-43, 44	Write Protect Output. A low active signal indicates that a diskette with an uncovered ANSI Write protect notch is loaded, causing writing to be inhibited. A high level indicates that a diskette with a covered Write protect notch or a diskette with no notch has been inserted and writing may occur.

Table 3-1. Interface Signal Descriptions (Continued)

Connector Pin	Description
J1-45, 46	Read Data Output. This line provides the composite clock and data signals as read directly from the diskette. A low level indicates a data or clock bit is present and a high level indicates the absence of data. Each flux reversal causes a transition from the high inactive level to the low active level for a period of $200 \pm 30$ nanoseconds. Data output to the host is the same form as the write data received from the host.
J1-47, 48	Separate Data Output (RFD4001 and RFD2001 Only). This line provides the data signal which has been separated out of the composite read data (J1-46). This signal is low active for $200 \pm 30$ nanoseconds for each data bit.
J1-49, 50	Separate Clock Output (RFD4001 and RFD2001 Only). This line provides the clock signal which has been separated out of the composite data (J1-46). This signal is low active for $200 \pm 20$ nanoseconds for each clock pulse.
J8-1, 2, 3	A.C. Input. 100/115 VAC $\pm 10\%$ , 50/60 Hz $\pm 0.5$ Hz @ 0.8A or optional 200/230 VAC $\pm 10\%$ , 50/60 Hz $\pm 0.5$ Hz @ 0.4A. See Table 1-1 for complete AC specifications and Figure 1-8 for model description.
J5-1	+24 Vdc $\pm 10\%$ @ 0.8A.
J5-2	+24V Return.
J5-3	-5V Return.
J5-4	-7 to -16 Vdc @ 0.1A max. If the customer installed -5V option is used, this voltage will be -5Vdc $\pm 0.25$ Vdc @ 0.07A Max.
J5-5	+5 Vdc $\pm 0.25$ Vdc @ 1.1A Max.
J5-6	+4V Return.

① All odd pins on J1 are used as return lines.

All signals on J1 are TTL logic. Refer to Figure 2-3 for recommended interface circuits.

Input Lines have the following characteristics: Active (True) =  $0 < V < + 0.4$  @ 40mA max.  
Inactive (False) =  $+2.5 < V < + 5.25V$  @ 0 mA.

Output Lines are driven by TTL gate with open collector capable of sinking 40 mA @  $0 < V < + 0.4$  in the active state. In the inactive state the collector current is 250  $\mu$ A max. (drive off).

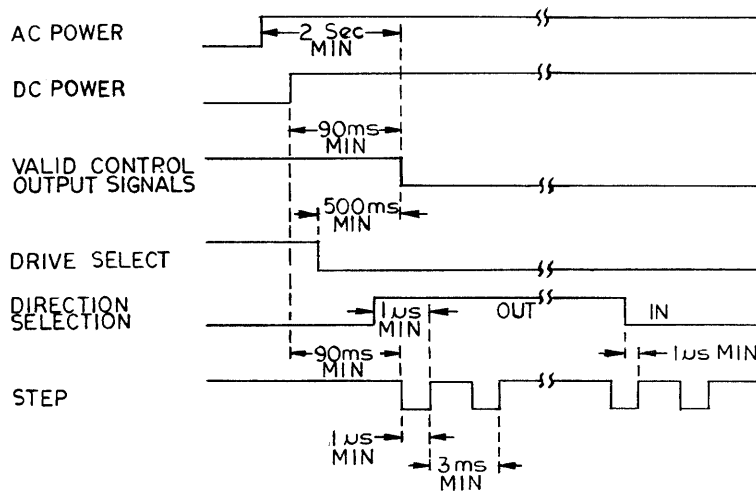
See Table 2-1 for Mating Connectors.

3.3.2 DISKETTE HANDLING

The Diskette consists of the flexible disk encased in a plastic jacket. When not in use the diskette is always stored in a protective envelope. An analogy of this protective storage envelope would be the same as the envelope used to store phonograph records used in your home. The storage envelope affords the same protection from dust and contaminants.

To protect the Diskette, the same care and handling procedures specified for computer magnetic tape apply. These precautionary procedures are as follows:

- a. Return the Diskette to its storage envelope whenever it is removed from file.
- b. Store Diskettes vertically.
- c. Keep Diskettes away from magnetic fields and from ferromagnetic materials which might become magnetized. Strong magnetic fields can distort recorded data on the disk.
- d. Replace storage envelopes when they become worn, cracked or distorted. Envelopes are designed to protect the Diskette.
- e. Do not write on the Diskette with a lead pencil or ball-point pen. Use a felt tip pen.
- f. Do not smoke while handling the Diskette. Heat and contamination from a carelessly dropped ash can damage the disk.
- g. Do not expose Diskettes to heat or sunlight. The read/write head cannot properly track a warped disk.
- h. Do not touch or attempt to clean the disk surface. Abrasions may cause loss of stored data.



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Figure 3-1. Power Up and Seek Sequence.

### 3.3.3 DISKETTE LOADING/UNLOADING

The following procedure should be followed when loading or unloading the diskette:

- a. Apply AC/DC power to the unit.
- b. Open the drive door by depressing the latch.
- c. Carefully remove the diskette from its storage envelope.

#### NOTE

On units containing the write protect option, if it is desired to protect the diskette data from inadvertent or accidental erasure and write-over, make sure the notch on the jacket is uncovered. An optional sensor senses the notch and if it is covered writing is allowed; if it is uncovered the write circuitry is disabled.

- d. Insert the diskette into the drive. The diskette is inserted with the index hole nearest the operator and the diskette label on the same side as (facing) the door. See Figure 3-2. Drives are equipped with a unique operator interlock to prevent damage to a diskette being loaded. Loading the diskette into a drive with this feature is a one-handed operation. To load the drive, insert a diskette into the open mouth of the drive until ejection mechanism is engaged and the door will shut when closed. Close the door to the drive.
- e. The drive may now be operated in any of the modes of operation described in Sections 3.3.4, 3.3.5, 3.3.6, 3.3.7, or 3.3.8.
- f. To unload the diskette, open the door (when busy light is off), by depressing the latch, remove the diskette (returning it to its protective storage envelope) and close the door.

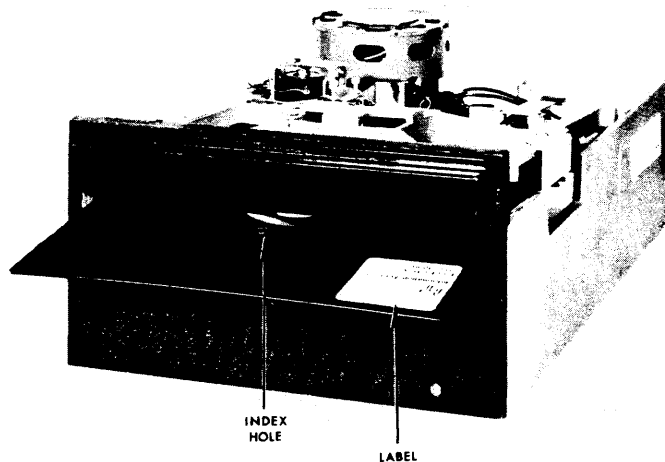


Figure 3-2. Diskette Insertion.



### 3.3.4 DRIVE SELECTION

Applying a 0V active signal to J1-26, J1-28, J1-30 or J1-32 for drive 1, 2, 3 or 4, respectively, will enable the selected drive only. The position of the drive select jumpers is used to select the number of the drive as described in Section 2.3.2. The functions of the drive select line are the following: (1) load the read/write heads, (2) apply power to the stepper motor, (3) enable the input lines, (4) activate the output lines, (5) illuminate the BUSY LED and (6) lock the front door. Drive select timing is shown in Figure 3-1.

### 3.3.5 TRACK POSITIONING

The following sequence should be used when stepping from one track to the other. Figure 3-1 show the track access timing.

- a. Place the desired drive select line in the active state. See Section 3.3.4.
- b. Place the Direction Select Input (J1-34) in the low (0V) state to move the head in toward the center of the diskette or in the high state to move the head out away from the center of the diskette.
- c. Apply the negative going step pulse to J1-36 for each track to be stepped. It is important that the Direction Select line be in the desired state and be stable at least 1 $\mu$ s before the positive going (trailing) edge of the step pulse appears. The minimum width of the step signal is 1 $\mu$ sec.

### 3.3.6 SIDE SELECTION (RFD4000 AND RFD4001 ONLY)

Applying a low (0V) signal to J1-14 selects side 1 surface for reading or writing or applying a high (+5V) signal selects side 0. The side selection must be made 100 $\mu$ s min before a read or write operation can be performed or before data can be considered valid. See Figures 3-3 and 3-4.

### 3.3.7 READ OPERATION

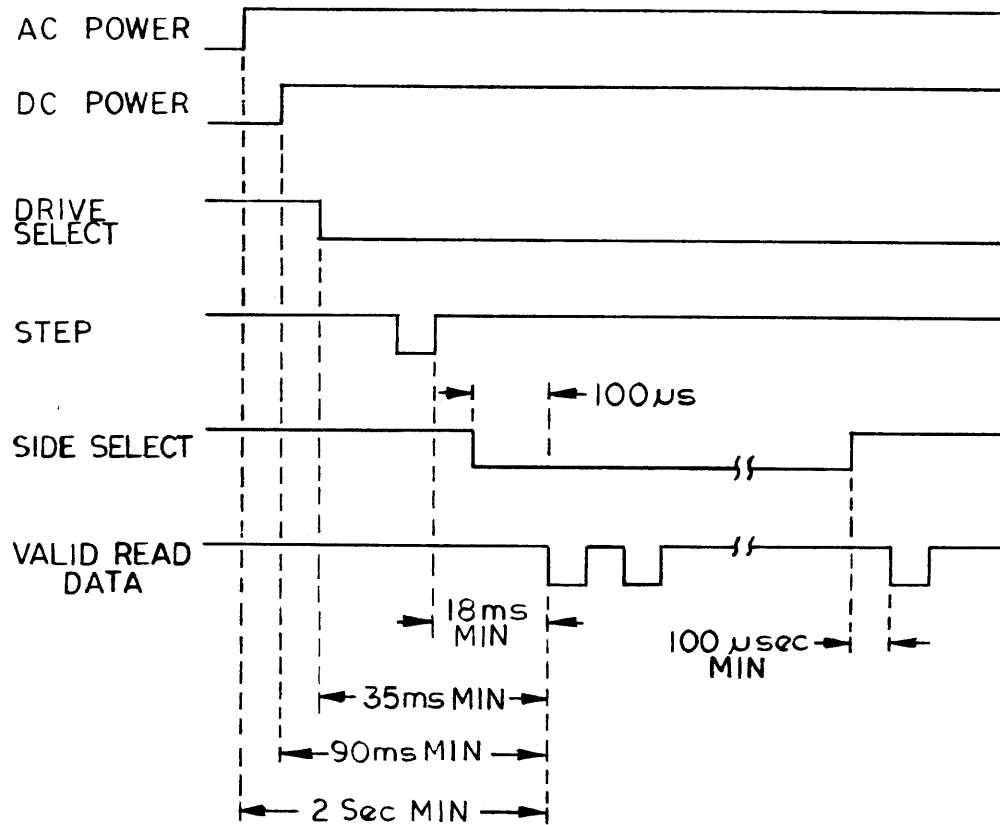
Figure 3-3 illustrates the read timing sequence. The following sequence should be followed:

- a. Place the desired drive select line in the active state. See Section 3.3.4. After applying the drive select signal a 35 ms min. delay must be present to allow for head load settling time.
- b. Make sure the Write Gate input J1-40 is high (false).
- c. Step the head to the desired track. See Section 3.3.5. A 15 ms delay must be present if stepper power is applied independent of head load to allow for head step settling time.
- d. Select the desired side by performing Section 3.3.6 (RFD4000 and RFD4001 Only).
- e. Valid read data will appear after the minimum delays shown in Figure 3-3 have occurred. The composite stream of data appears at J1-46. On models RFD4001 and RFD2001 the composite clock and data are separated into data signal only at J1-48 and clock signals only at J1-50. The data and clock separator is designed to work with double frequency code only.

### 3.3.8 WRITE OPERATION

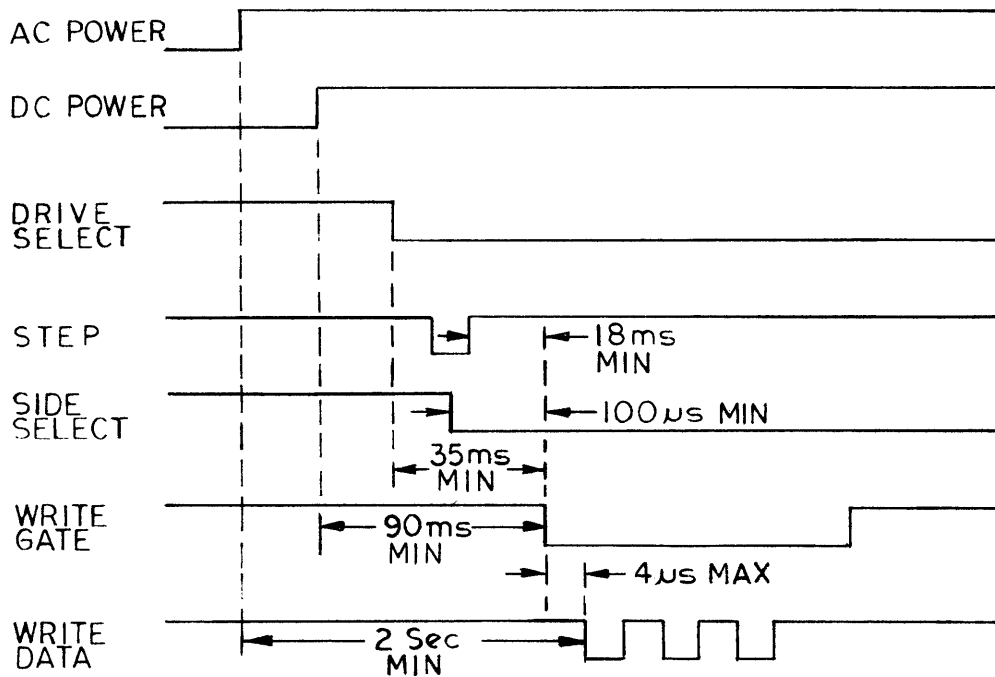
Figure 3-4 illustrates the write timing sequence. The following sequence should be followed:

- a. Place the desired drive select line in the active state. See Section 3.3.4. After applying the drive select signal, a 35 ms min. delay must be present to allow for head load settling time.
- b. Step the head to the desired track. See Section 3.3.5. A 15 ms delay must be present if stepper power is applied independent of head load to allow for head step settling time.
- c. Place the Write Gate input at J1-40 in the low (true) state.
- d. Select the desired side by performing Section 3.3.6 (RFD4000 and RFD4001 Only).
- e. Apply the data to be written on the Write Data input line at J1-38 after the minimum delays shown in Figure 3-4 have occurred. The coding scheme used for the data can be any of the methods described in Section 2.5.



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Figure 3-3. Read Sequence Operation.



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Figure 3-4. Write Sequence.

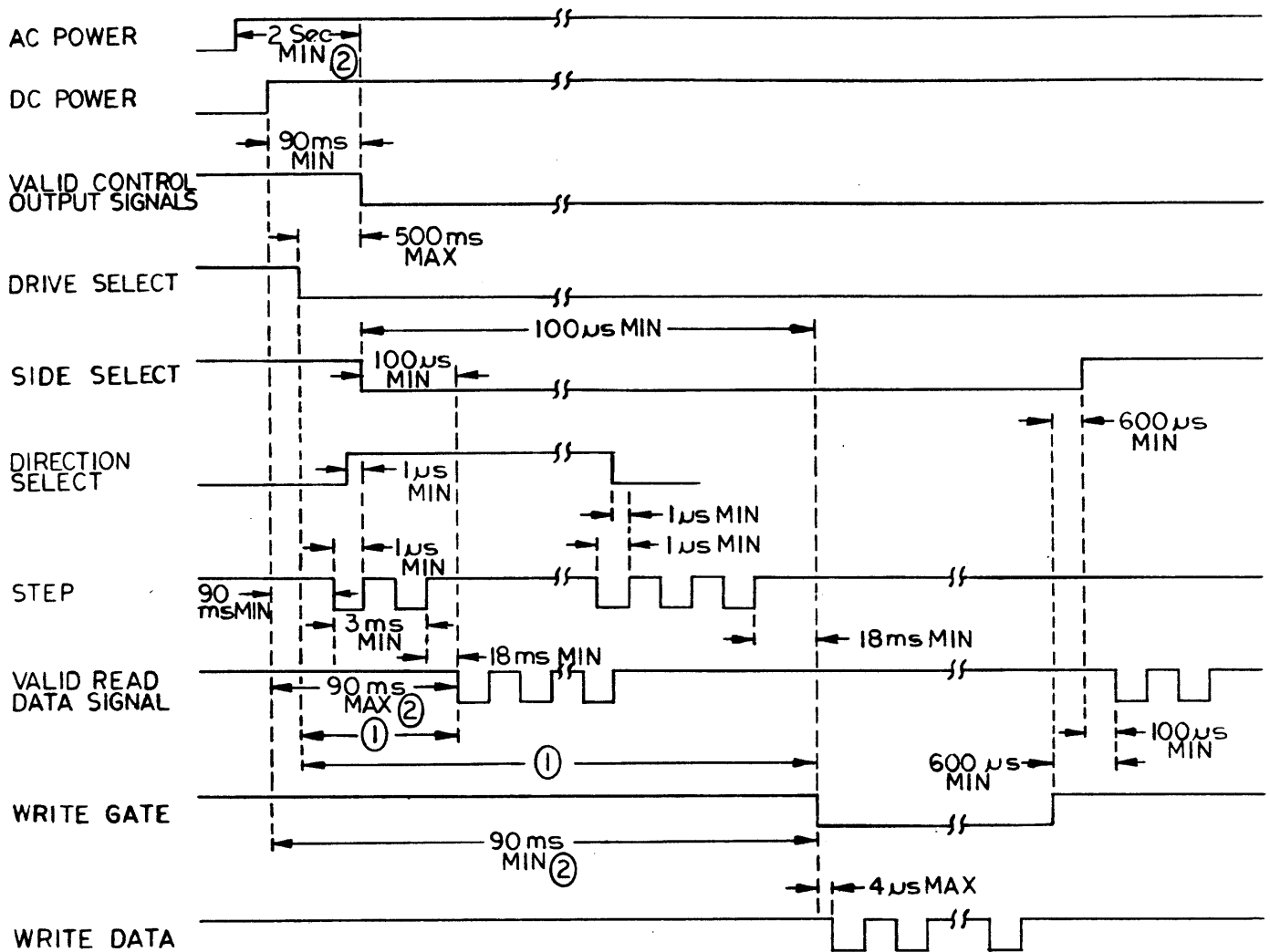
### 3.3.9 COMPOSITE SEQUENCE

Figure 3-5 illustrates the combining of both read and write operations in a typical sequence along with various timing restrictions, which are necessary for correct operation.

### 3.3.10 ERROR DETECTION AND CORRECTION

#### 3.3.10.1 Write Error

If an error occurs during a write operation, and is detected on the next revolution by doing a read operation, commonly called a "write check", to correct the error, another write and write check operation must be done. If the write operation is not successful after 4 attempts have been made, that sector or track should be labeled defective and error correction should be attempted on another track. If the error still persists, the Diskette should be considered defective and discarded.



- ① AFTER APPLYING DRIVE SELECT SIGNAL, A 35ms MIN. DELAY MUST BE PRESENT TO ALLOW FOR HEAD SETTING TIME. A 15ms DELAY MUST BE PRESENT IF STEPPER POWER IS APPLIED INDEPENDENT OF HEAD LOAD, AGAIN TO ALLOW FOR HEAD SETTLING TIME.
- ② IF DC AND AC POWER ARE APPLIED SIMULTANEOUSLY, THIS TIME BECOMES 2 SEC. IN ALL CASES, A 2 SEC. DELAY IS REQUIRED BEFORE ANY SIGNAL IS VALID WHEN AC IS TURNED ON.

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Figure 3-5. General Read and Write Sequences.

### 3.3.10.2 Read Error

Most errors that occur will be "soft" errors; that is, by performing an error recovery procedure the data will be recovered.

Soft errors are usually caused by:

- a. Airborne contaminants that pass between the read/write head and the disk. These contaminants will generally be removed by the cartridge self-cleaning wiper.
- b. Random electrical noise which usually lasts for a few microseconds.
- c. Small defects in the written data and/or track not detected during the write operation which may cause a soft error during a read.

The following procedures are recommended to recover from the above mentioned soft errors:

- 1) Reread the track 10 times or until such time as the data is recovered.
- 2) If data is not recovered after using Step 1, access the head to the adjacent track in the same direction previously moved, then return to the desired track.
- 3) Repeat Step 1.
- 4) If data is not recovered, the error is not recoverable.

Errors attributed to the Diskette will not be included in determining the Non-Recoverable Read Error Rate.

#### NOTE

Unloading the head when not transferring data will increase the data reliability and extend the diskette life.

### 3.3.10.3 Seek Errors

Seek errors rarely occur unless the stepping rate of 3 msec is significantly exceeded. In the event of a seek error, recalibration of track location is achieved by repetitive Step and Out Direction commands until the Track 00 signal is received.

### 3.4 RFD4001 AND RFD2001 FEATURES

The following features are applicable to the RFD4001 and RFD2001 Only.

#### 3.4.1 DATA SEPARATOR

The data separator included as a standard feature on the RFD4001 and RFD2001 separates the composite read data stream into a separate data output (J1-48) and a separate clock output (J1-50). The composite data signal at J1-46 is unaffected. This feature can be used only with single density recording. Figure 3-6 illustrates Data Separator Signals.

#### 3.4.2 SECTOR OUTPUT

Models RFD4001 and RFD2001 provide a separate output for the sector signal on J1-28. This line becomes active 32 times per revolution when used with a 33-hole diskette. In addition, the index line at J1-20 becomes active once each revolution. The sector and index timing is given in Figure 3-7.

### 3.5 FACTORY INSTALLED OPTIONS

The following options are available on both the diskette drives. These options are coded as part of the model number as shown in Table 1-2. Units are available which are designed to operate on 100VAC, 50Hz; 115VAC, 60Hz; or 220VAC, 50Hz. The parts list describes the differences between these changes. It is not recommended that these changes be made in the field.



### 3.6

#### CUSTOMER INSTALLED OPTIONS

The diskette drives can be modified by the user to function differently than outlined in Sections 3.1 thru 3.4. This is accomplished by adding or deleting traces and/or using shorting plugs. Certain I/O pins have been reserved for this usage. When shorting plugs are used, the type of plug recommended is AMP 530153-2 or equivalent. The following sections describe the options and their installation. Table 3-2 contains a summary of the customer cut/add trace options as they are shipped from the factory. Figures 3-8 and 3-9 show the trace locations on the circuit card. Section 4.2.13 describes the differences in theory for each option.

#### NOTE

Since many of the options, utilize the same traces or interface pins only one option using a given trace or interface pin must be used.

#### 3.6.1 SIDE SELECTION UTILIZING DRIVE SELECT LINES (RFD4000 AND RFD4001 ONLY)

With this option, the drive select lines can be used to select four read/write heads on two drives rather than select the four different drives. This can only be used in systems containing no more than two drives. It is implemented by moving jumper S2 to S3 (see Figure 3-9) and adding a jumper at DS<sub>n</sub> (see Figure 3-9) where n (n = 1, 2, 3 or 4) is the desired head select number for side 0. A jumper is also added at nB where n (n = 1, 2, 3, 4) is the desired head select number of side 1 of that drive. For example, to allow drive select lines 2 and 3 to select sides 0 and 1, respectively, change S2 to S3 and add jumpers at DS2 and 3B. It should be noted that 0V is required to select both sides. No drive select lines are to be duplicated.

#### 3.6.2 RADIAL READY

The purpose of this options is to allow the user to monitor the Ready line of each drive (including drives not selected). The following steps are required for the installation of this option:

- a. Cut trace R (see Figure 3-8).
- b. Cut trace RR (see Figure 3-8).
- c. Add a wire from pad R to one of the following:  
pin 4, 5 or 8. Do not use the same pins again on this drive or any other drive since all drives are daisy chained.

#### NOTE

If desired one of the drives can use pin 22 as its Ready output line thereby eliminating steps b and c. The remaining drives must incorporate all three steps and not use pin 22.



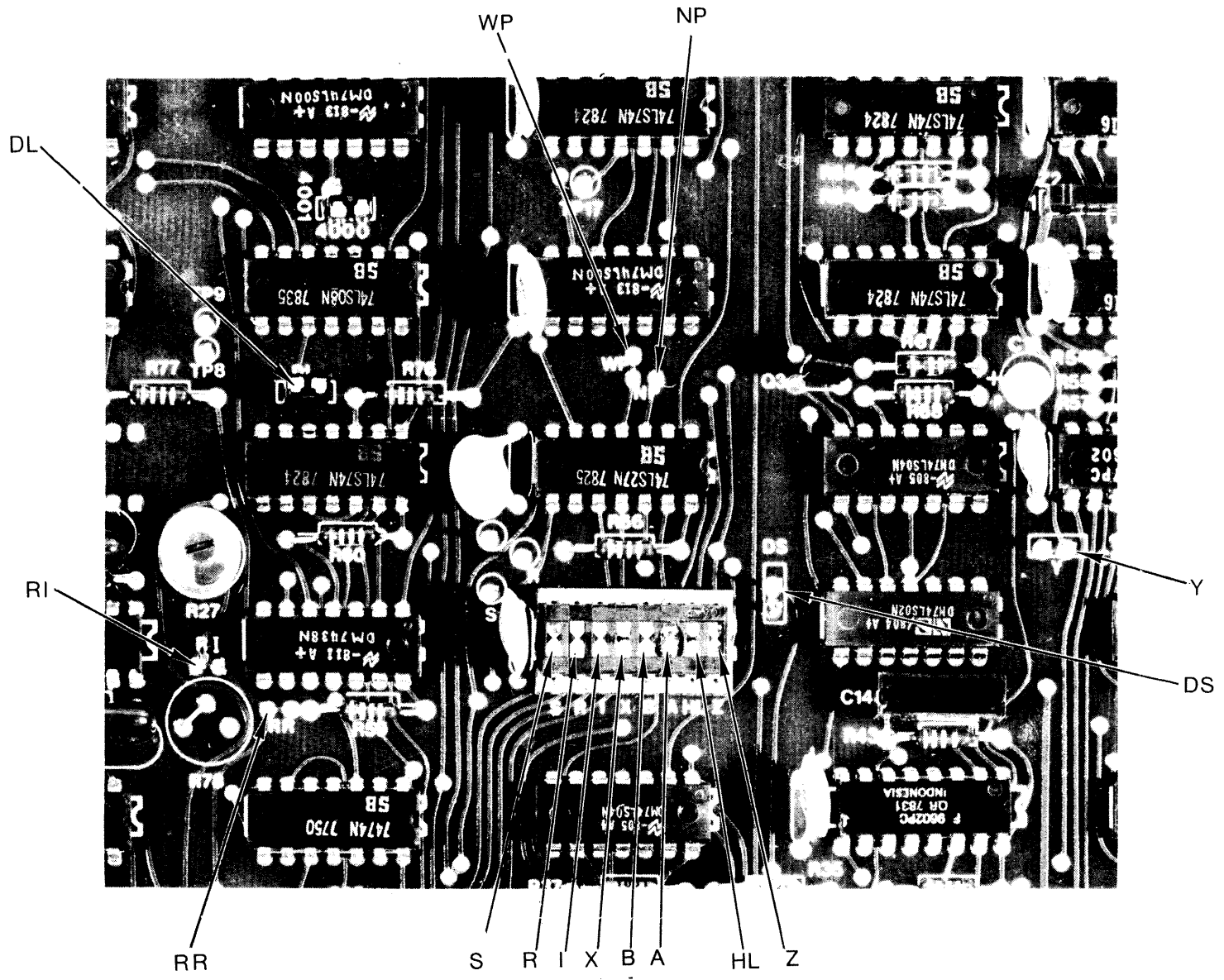


Figure 3-8. Trace and Jumper Locations for DL, WP, NP, RI, RR, S, A, I, X, B, A, HL, Z, DS, Y.

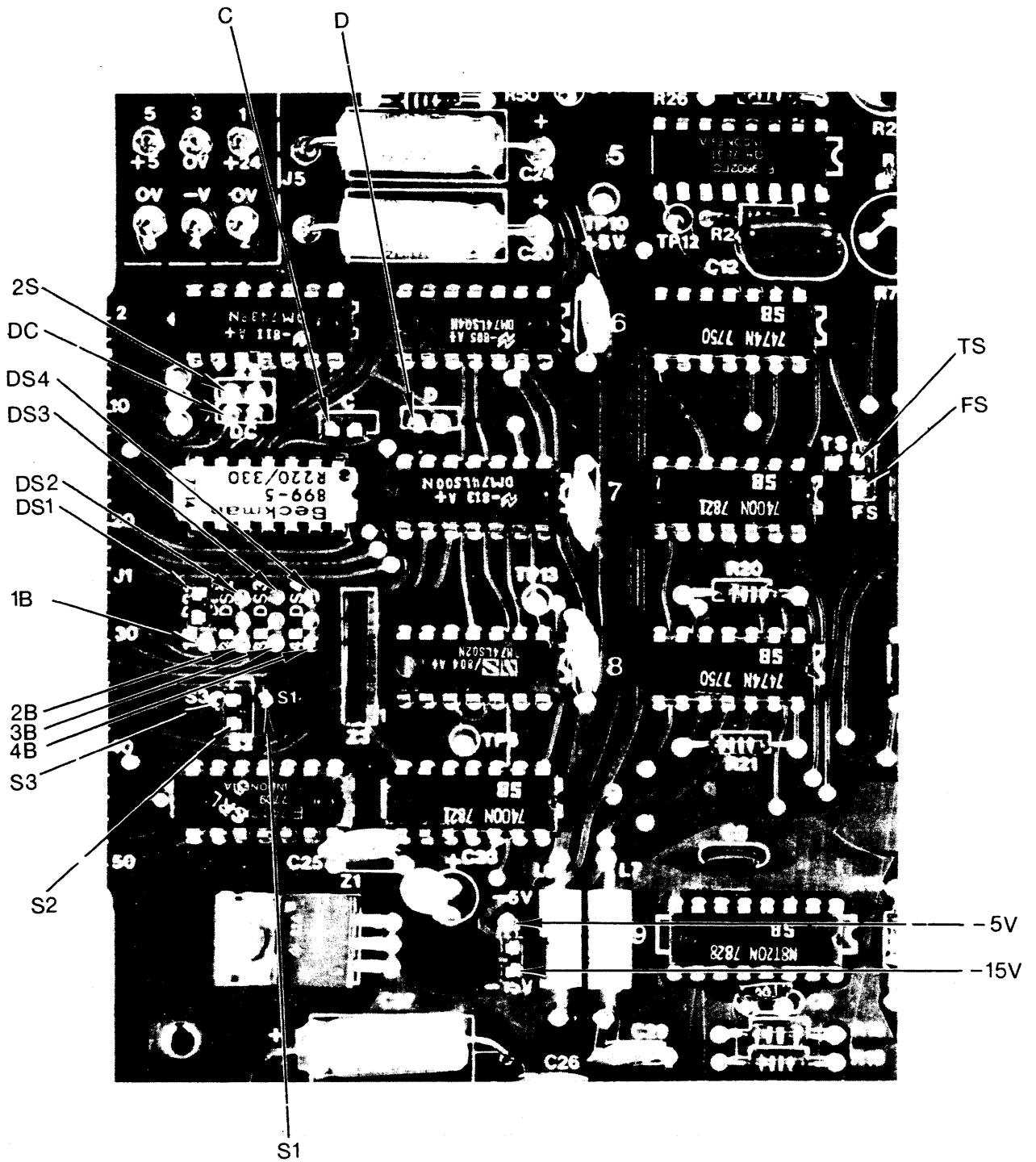


Figure 3-9. Trace and Jumper Locations for 2S, DC, C, D, TS, FS, DS1-DS4, 1B-4B, S1-S3.

Table 3-2. Customer Cut/Add Trace Options

Trace Designation	Description	Shipped From Factory	
		Open	Short
7A	Terminations for Multiplexed Inputs		Plugged
DS1	Drive Select 1 Input Pin		X
DS2,3,4	Drive Select 2,3,4 Input Pins	X	
1B,2B,3B,4B	Side Select Option Using Drive Select	X	
RR	Radial Ready		X
RI	Radial Index and Sector		X
R (Shunt 5E)*	Option Shunt for Ready Output		X
2S	Two-Sided Status Output	X	
4000/4001	Sector Option Enable	<del>4000</del> 2000	<del>4001</del> 2001
I (Shunt 5E)*	Index Output		X
S (Shunt 5E)*	Sector Output		X
DC	Disk Change Option	X	
HL (Shunt 5E)*	Stepper Power from Head Load		X
DS	Stepper Power from Drive Select	X	
WP	Inhibit Write When Write Protected		X
NP	Allow Write When Write Protected	X	
D	Alternate Input -- In Use	X	
DL	Door Lock Latch Option		X
A,B,X (Shunt 5E)*	Radial Head Load		X
C	Alternate Input -- Head Load	X	
Z (Shunt 5E)*	In Use from Drive Select		X
Y	In Use from Head Load	X	
S1	Side Select Option Using Direction Select	X	
S2	Standard Side Select Input		X
S3	Side Select Option Using Drive Select	X	
TS,FS	Data Separation Option Select TS - True Separation FS - False Separation (The Data Separation goes out of Phase in the IBM Address Mark Fields)	FS	TS
-5V, -15V	-5 Volt Supply Option		X

\*Part of 16-pin programmable shunt (at location 5E) these traces are usually shorted as shipped from the factory. These traces can be cut using a strap cutter AMP P/N 435705.

### 3.6.3 RADIAL INDEX AND SECTOR

This option permits constant monitoring of the Index and Sector lines. This results in reduced latency time since it permits the drive to be selected just prior to the sector that is to be processed. The following steps are required for the installation of this option:

- a. Cut Trace RI (see Figure 3-8).
- b. Cut Trace I (see Figure 3-8).
- c. Cut Trace S (see Figure 3-8).
- d. Add a wire from pad I (see Figure 3-8) to one of the following: pin 4, 6 or 8. Do not use the same pins again on this drive or any other drive since all drives are daisy chained.
- e. Add a wire from pad S (see Figure 3-8) to one of the following: pin 4, 6, or 8. Do not use same pin as step d. Do not use the same pins again on this drive or any other drive since all drives are daisy chained.

#### NOTE

If desired one of the drives can use pin 20 (Index) and pin 24 (Sector) as its Index and Sector output lines, thereby eliminating steps b, c, d and e. The remaining drives must incorporate all five steps and use pins other than 20 and 24.

### 3.6.4 TWO-SIDED STATUS OUTPUT (RFD4000 AND RFD4001 ONLY)

As indicated in Table 3-2, the two-sided option is shipped with the jumper removed. Installing the jumper at 2S provides the two-sided output interface signal described in Table 3-1 at J1-10. Refer to Figure 3-9 for jumper 2S location.

### 3.6.5 INDEX OUTPUT

As indicated in Table 3-2, the circuit card is shipped from the factory with a jumper installed at I. This provides the interface output signal at J1-20 as described in Table 3-1. Removing the jumper disconnects this interface signal. See Figure 3-8 for I location.

### 3.6.6 SECTOR OUTPUT

As indicated in Table 3-2, the circuit card is shipped from the factory with a jumper installed at S. This provides the interface output signal at J1-24 as described in Table 3-2. Removing the jumper disconnects this interface signal. Refer to Figure 3-8 for S location.

### 3.6.7 DISK CHANGE OPTION

As indicated in Table 3-2, the circuit card is shipped from the factory without a jumper installed at DC. If the customer selects this option and installs the jumper at DC, the interface signal at J1-12 will provide the Disk Change Output as described in Table 3-1. Refer to Figure 3-9 for DC location.

### 3.6.8 DRIVE SELECT WITHOUT LOADING HEADS OR ENABLING STEPPER MOTOR

Generally, the head is loaded and the step motor is enabled at the time a drive is selected. This option allows the head to remain unloaded until a Read, Write or Seek operation is required. When one of these operations is required, the controller would load the head via the Head Load Input at J1-20 which would also cause the step motor to be enabled. The benefit of this options is to minimize the length of time during which head is loaded, thereby extending the life of both the head and media. The following steps are required for the installation of this option:

- a. Cut trace X (see Figure 3-8).
- b. Install a jumper at trace C (see Figure 3-8).

A delay of 35 ms is required after the Head Load signal is applied and before Read data is valid or before the Write Gate and Write Data signals can be applied.

### 3.6.9 DRIVE SELECT AND STEP MOTOR ENABLE WITHOUT LOADING HEAD

This option allows the drive to perform a seek operation while the door is open and without loading the head. Normally the door must be closed and the head loaded for a seek operation to occur. This option may be useful during a power up sequence when it is necessary to position the head to track zero. In addition, this option also minimizes the length of time the head is loaded, thereby extending the life of both the head and media.

The following steps are required for the installation of this option:

- a. Cut trace B (see Figure 3-8).
- b. Jumper trace DS (see Figure 3-8).
- c. Cut trace HL (see Figure 3-8).
- d. Jumper trace C (see Figure 3-9).

### 3.6.10 HEAD LOAD WITHOUT SELECTING DRIVE OR ENABLING STEP MOTOR

The option makes use of head load input to allow the heads to be loaded on all drives at the same time. This eliminates the 35 ms head load time. This option also requires that the head be loaded before the drive can be selected.

The following steps are required for the installation of this option:

- a. Cut trace A (see Figure 3-8).
- b. Jumper trace DS (see Figure 3-8).
- c. Cut trace HL (see Figure 3-8).
- d. Jumper trace C (see Figure 3-9).

#### 3.6.11 IN USE ALTERNATE INPUT

As indicated in Table 3-2, the circuit card is shipped from the factory without a jumper installed at trace D. See Figure 3-9. If the customer selects this option and installs the jumper at D, the interface signal at J1-16 will provide the In Use function, i.e., will turn on the BUSY LED and lock the door.

#### 3.6.12 SIDE SELECTION USING DIRECTION SELECT

This option allows the Direction Select line (J1-34) to perform the normal function of Direction Select as described in Table 3-1, J1-34 and in addition, during read/write operations to perform the function of Side selection as described for J1-14. The following steps are required for installation of this option:

- a. Remove the jumper at trace S2 (see Figure 3-9).
- b. Install the jumper at trace S1 (see Figure 3-9).

#### 3.6.13 DOOR LOCK LATCH

This option allows the door latch circuit to be activated by the Drive Select line without maintaining the In Use line. This permits the door to remain locked without activating the In Use line. The door is unlocked by again activating the Drive Select line when the In Use line is inactive. The option is installed by installing jumpers at D (see Figure 3-9) and DL (see Figure 3-8).

#### 3.6.14 WRITE PROTECT OPTIONAL USE

In its standard configuration, the drive will inhibit writing when a write protected diskette is installed. This option allows writing on a Write Protected Diskette but the drive will still activate the Write Protect Output at J1-44. The following steps are required for the installation of this option:

- a. Cut trace WP (see Figure 3-8).
- b. Install jumper at NP (see Figure 3-8).

### 3.6.15 -5 VOLT OPTION

As shipped from the factory, the standard drive is set up to run with a -7V to -16 Vdc external power supply. This voltage is then applied to a -5Vdc regulator which generates the required -5 Vdc. To allow the drive to operate directly from a -5 Vdc external power supply, install jumper trace -5V (see Figure 3-9).

### 3.6.16 DATA SEPARATION OPTION SELECT (MODEL RFD4001 ONLY)

For FM applications using IBM soft sector (missing clocks) format with jumper at trace TS the data separator will provide a true data and clock separation during read. See Figure 3-9. With the jumper at TS removed and a jumper installed at FS (see Figure 3-9), the data separator may not decode the data and clock correctly in the missing clock field.

## SECTION IV

### THEORY OF OPERATION

#### 4.1 BLOCK DIAGRAM DESCRIPTION

The RFD4000, RFD4001, RFD2000 and RFD2001 are designed as a peripheral device to be attached to or made part of a host system. Their functional characteristics include the ability to (1) receive and generate control signals (2) position the read/write head to selected tracks and, (3) write or read data from the diskette when ordered. Figure 4-1 shows the functional Block Diagram for the REMEX 400X. The RFD4001 differs from the RFD4000 in that it has the capability to separate data from clocks signals (double frequency code) and provide an output line for each. The RFD4001 also provides sector outputs for 33 hole diskette. The drive consists mainly of the diskette drive mechanism, head positioning mechanism, head load actuator, read/write head and the control and read/write electronics. The RFD2000 and RFD2001 are identical to the RFD4000 and RFD4001, respectively except that only one head is used.

##### 4.1.1 DISKETTE DRIVE MECHANISM

A belt drive system is used to rotate the diskette spindle at 360 RPM. Some early drives use the 113949-001 shaded pole motor assembly. Later drives use either the 114166-001 or 114167-001 synchronous motor assembly depending upon the voltage and frequency. By changing the pulley and belt, either 50 or 60 Hz power can be accommodated. A drive motor change allows the use of 200/230 VAC in place of 110/115 VAC. A registration cone, centered on the face of the spindle, positions the diskette and a clamp which moves in conjunction with the door latch handle fixes the diskette to the registration cone.

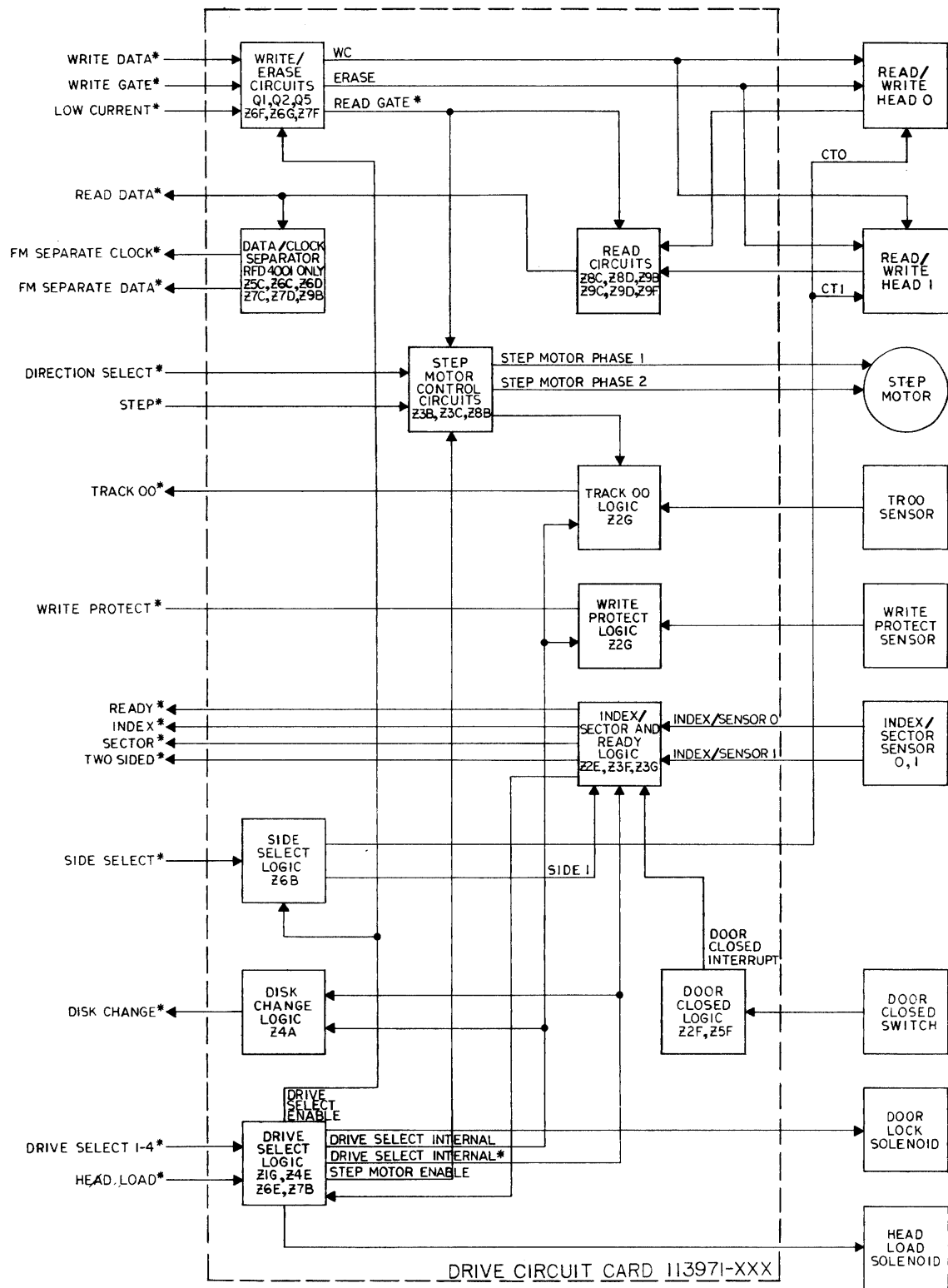
##### 4.1.2 HEAD POSITIONING MECHANISM

A split band/stepper motor system is used to position the read/write heads. The two-phase stepper motor assembly is set up so that each  $3.6^{\circ}$  rotation of the the stepper motor moves the read/write head precisely one track.

##### 4.1.3 READ/WRITE HEAD

The read/write head used is of the type with tunnel erase. Their contact surface is made of a ceramic material designed for maximum head life and minimum head and diskette wear. On the RFD400X the heads are positioned as described in Section 4.1.2 and when the head load solenoid is actuated, both heads are placed in direct contact with the diskette in such a manner to obtain maximum signal transfer to and from the magnetic surface.





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Figure 4-1. Block Diagram for the RFD4000 and RFD4001. The Block Diagram for the RFD2000 and RFD2001 is Identical except only one head is used.

The tunnel erase gaps are part of the complete head but trail the read/write gap. Their function is to trim the read/write track width to 13 mil typical. This insures diskette interchangeability as well as IBM compatibility.

#### 4.1.4 DRIVE ELECTRONICS

The electronics for the operation of the diskette drives are mounted on one printed circuit board. All input and output signals for reading and writing and for drive control functions are routed through this circuit card. Figure 4-1 shows the block diagram for the various functions. The drive is enabled only when the proper Drive Select line is true. These lines enable the Drive Select Logic and Side Select Logic, respectively.

The Drive Select Logic generates a Drive Select Enable signal which enables the Side Select logic and the Write/Erase circuits. One of the outputs from the Write/Erase Circuits is the Read Gate signal which enables the Read Circuits. Thus when the Drive Select\* line is active, reading or writing can occur. The Drive Select Logic also produces the Step Motor Enable signal which enables the stepper motor and two outputs which operate the Door Lock and Head Load solenoids. This logic also generates the Drive Select Internal signal and its inversion which are used in the Track 00 Logic, Index/Sector and Ready Logic and the Disk Change Logic.

The Side Select Logic sets up the desired head by use of the CT0 or CT1 lines and selects the proper Index signal at the Index/Sector and Ready Logic.

The Write/Erase Circuits require enabling by the Write Gate and when the Write Data is applied causes the write current (WC) to pass through the selected head. The Low Current\* input is used for tracks 44-76 to reduce write current. If the Write Gate\* signal is false, the Read Gate\* signal is active which causes data from the selected head to be processed and appear on the Read Data\* line. On models RFD4001 and RFD2001, a Data/Clock Separator is installed which provides clock and data outputs on separate lines.

Step motor control is accomplished by the Direction Select\* and Step\* lines provided the drive is not writing (Write Gate\* false causing the Read Gate\* to be true and disabling the Step line ). One other required step motor control signal is the Step Motor Enable signal generated from the Drive Select logic. The two motor phase outputs are used to operate the step motor in the forward or reverse directions.

The Index/Sector and Ready Logic is used to make sure the drive is rotating by counting two index pulses from the Index Sensors of the selected side and to make certain the Door is closed. An input from Door Closed switch is used to reset the Ready output if the door is opened. When the drive is ready, this circuit will produce a true Ready\* signal as well as the Index\* and Sector\* signals (RFD4001 and RFD2001 Only). It will also give a true Two Sided\* output if a two-sided diskette (Diskette 2) is present (RFD4000 and RFD4001 Only).

Two other sensors are used to perform the Write Protect and the Track 00 functions. The Track 00 Logic is the combination of a selected phase of the Step Motor Control Circuits, the Drive Select Internal signal and the output

from the Track 00 Sensor. The Write Protect logic gates the output from the Write Protect Sensor with the Drive Select Internal signal to give the true Write Protect\* output. The Disk Change Logic generates a true Disk Change\* signal when the drive is selected provided Ready\* was lost during the time the drive was not selected.

#### 4.1.5 SIGNAL MNEMONICS

Data and control lines are identified with abbreviations or mnemonic terms to indicate the function or identity of the signal. Table 4-1 lists these terms in alphabetical order and gives the full names, origin (schematic sheet and zone coordinates) and a brief description of their function.

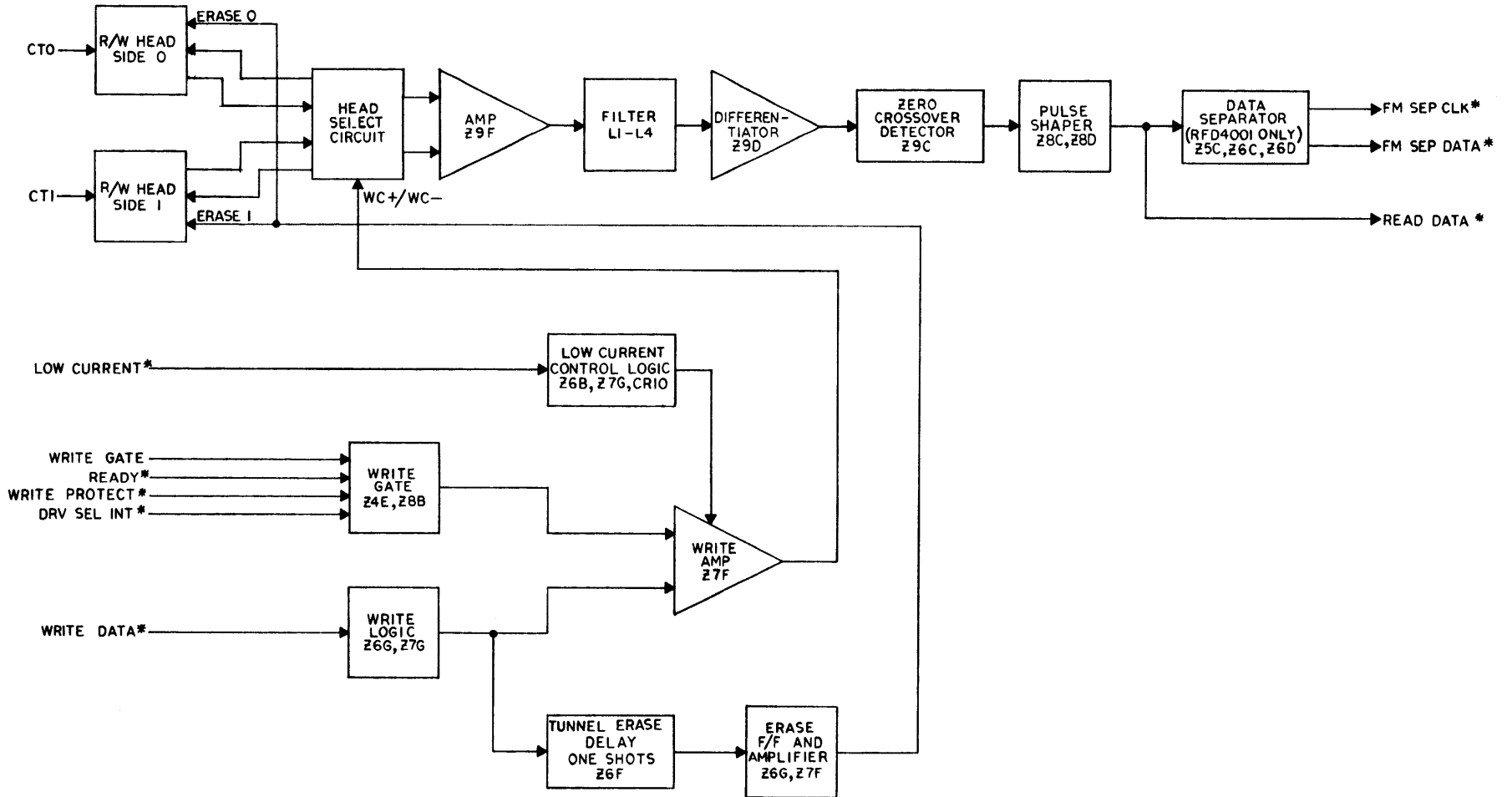
### 4.2 FUNCTIONAL DESCRIPTION

The following paragraphs describe the functional operation of the disk drive electronic circuits. In some cases functional block diagrams are used to illustrate circuit operation. When references are made to the schematic, the sheet and zone number are included to enable the reader to find the specific component or logic element easily and quickly. The schematic sheet and zone references appear as parenthetic suffixes. E.g., the drive select jumpers are located at (6C6), i.e., sheet 6, zone C6. Figure 8-2 (6 sheets) gives the schematic pages for the drive card. The overall system schematic is shown in Figure 8-1. sheet 1 for the RFD200X and sheet 2 for the RFD400X.

The material covered in Sections 4.2.1 through 4.1.12 describe the operation of the P.C. Drive Card 113971-001 and -002 as used on the standard units. Card 113971-001 is used on the RFD4000 and RFD2000 and the 113971-002 is used on the RFD4001 and RFD2001. The two units are identical except that the RFD4001 and RFD2001 provide for data and clock separation and for recognition of a 33-hole diskette by providing 32 sector pulses and one Index pulse per revolution. The circuit descriptions are written for the standard unit as shipped from the factory. Section 4.2.13 describes the circuit changes for the various customer installable options given in Section 3.6.

#### 4.2.1 READ CIRCUITS AND DATA SEPARATOR (RFD4001 AND RFD2001)

Figure 4-2 gives a block diagram for the read and write circuits. Figure 8-2, sheet 2 gives the schematic for the read and data separator circuits. When the diskette is being read, magnetized bits of prerecorded data are sensed by the selected read/write head. Either CT0 or CT1 from the Side Select logic (6D4) applies 0V to the selected head during read. The signal received from the head is in the form of a sine wave. This signal is amplified by Z9F, filtered by the L1-L4 network (TP1, TP2) and differentiated by Z9D. See Fig. 4-3. The differentiated signal is then applied to the zero cross-over detector Z9C, pins 5 and 6 which generate a negative going pulse at pin 10 of approximately 800ns whenever a flux transition is sensed on the diskette. The pulses at pin 10 are used to clock F/F Z8C at pin 11 (2D3). The alternate Q and  $\bar{Q}$  outputs at pins 9 and 8 trigger respective 200ns one-shots at Z8D-5 and Z8D-11. The Q outputs from the one-shots are then gated at pins 1 and 2 of the Z9B OR gate, inverted a Z9B-6, passed through driver Z9A to the output pin J1-46.



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Figure 4-2. Read/Write/Erase Block Diagram.

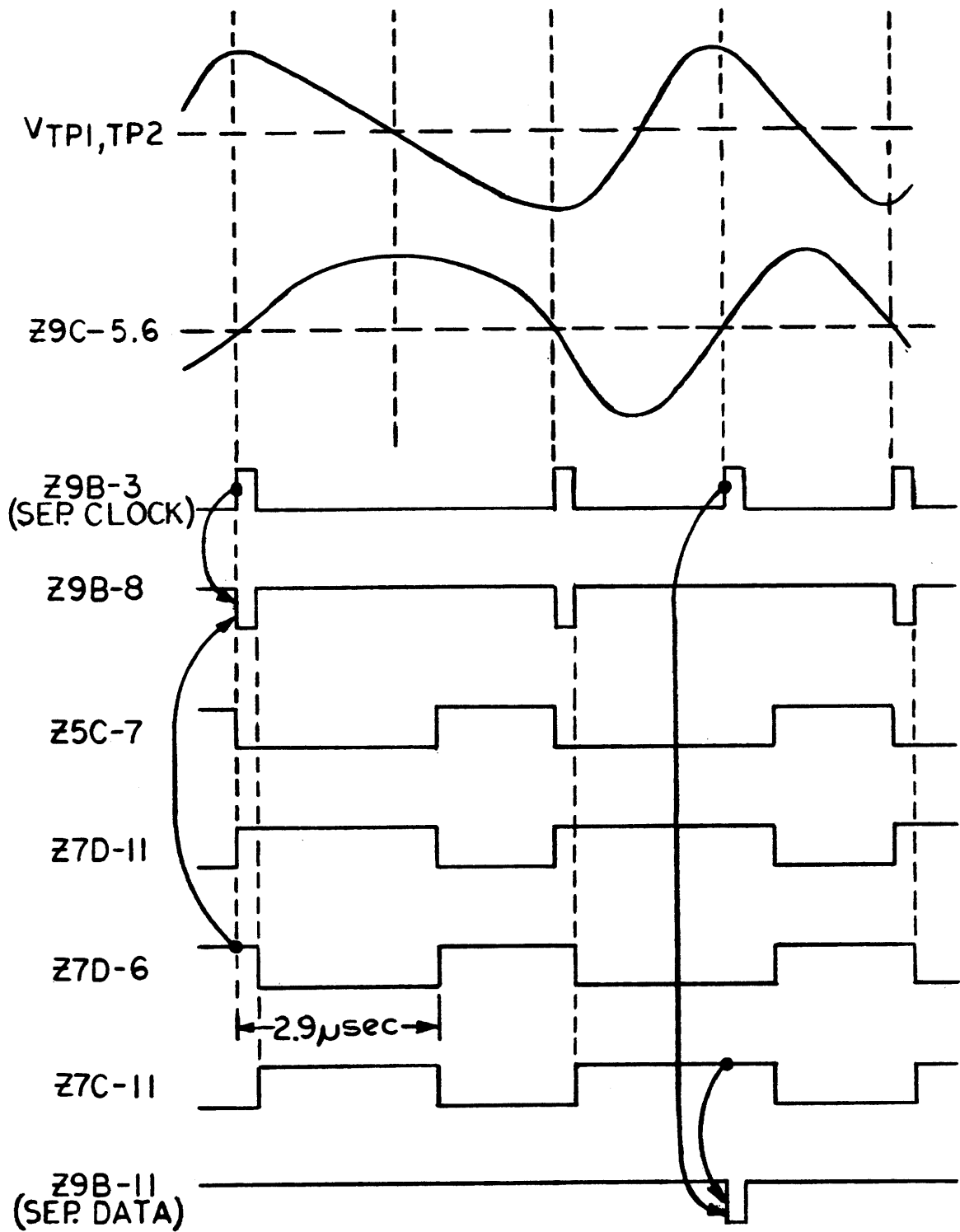
On models RFD4001 and RFD2001 the 113971-002 circuit card is used which contains the data separation circuitry shown on the lower half of Figure 8-2, sheet 2. This circuitry can be used only with single density FM recording formats. The circuit can be connected to either the TS (true separation) or the FS (false separation) configuration. When connected to the TS configuration and using the IBM Single density FM format, the circuit will provide correct data and clock separation in both the address field (with missing clocks) and data field. When connected to the FS configuration and using the IBM single density FM format, the circuit will provide correct data and clock separation in the data field only. Any other field containing missing clocks (such as address marks and data marks, etc.), the circuit will provide incorrect data and clock separation (data pulse may go out as clock pulse and vice versa).

Data and clock pulses are applied from Z9B-3 to both pins 9 and 12 of Z9B. See Figure 4-3 which gives the timing diagram for data separator circuit. The output at Z9B-8 sets the Z5C, 2.9  $\mu$ sec one-shot at Z5C-5. Z5C-7 then goes low causing Z7D-11 to go high. Z7D-6 goes low and inhibits the Z9B gate at pin 10 for 2.9  $\mu$ sec which is long enough so that the next pulse which is a data pulse (if present) is not seen at Z9B-8. Z9B-13, however, is now high so the next data pulse (if present) is seen at Z9B-11. At the end of the 2.9  $\mu$ s time period, Z7D-6 again goes high, enabling Z9B-10 and inhibiting Z9B-13. Since the interval between clock pulses is 4  $\mu$ sec., the circuits is reset when the next pulse is seen.

When the circuit is connected to the TS configuration, the circuit will separate exactly as the data is read. The 2.7  $\mu$ sec, Z5C one-shot and the Z6D and Z6C counter are used in this configuration. The portion described for the FS connection works in the same manner except when missing clocks are present. Z5C at pin 11 is triggered by each data pulse which sets the 2.7  $\mu$ sec one-shot and the first stage of counter Z6D. If a clock is present then it will reset both the one-shot and the counter. If no clock is present, at the end of the 2.7  $\mu$ sec period, Z5C-9 goes high which sets F/F Z6C at pin 11 and supplies the missing clock pulse to Z7C at pin 5. The counter permits up to 5 missing clocks in a row (IBM format has at the most only 3).

#### 4.2.2 WRITE CIRCUITS

The circuits which control the data and clock information to be written on the disk are shown in a block diagram in Figure 4-2 and on sheet 3 of Figure 8-2. Incoming composite write data is applied through an inverter Z8B-13 to pin 11 of the write F/F Z6G(3C6). The leading edge of each pulse in the write data stream triggers the F/F causing it to change state. Each output from the F/F at pins 9 and 8 controls identical drive amplifiers, Z7F at pin 9 and 13, respectively. As the F/F changes states, current is driven through one-side of the read/write head and then the other by means of the WC + and WC-lines. When the F/F is set Z6G-9 goes high and Z7G-4 goes low causing current to flow in the WC + line; when the F/F is reset, Z6G-8 is high and Z7G-2 is low causing current to flow in the WC-line. The F/F is enabled when the reset line at Z6G-13 is high. This line is the result of gating the Write Gate\* and Ready\* signals together at Z8B-8 and 9 (3E7) and inverting at Z6B-10 and Z7G-12. If either signal goes false (high), the F/F will be held in the reset state and writing will be inhibited.



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Figure 4-3. Read Circuit and Data Separator Timing Diagram.

Z7F at pin 1 (3D5) provides constant current for the two write amplifiers Z7F-8 and Z7F-14. A 10mA peak-to-peak write current is used when writing on tracks 1-43. At this time the Low Current\* input at J1-2 is false (high). Current supply is essentially thru R30 to Z7F-3. When writing on tracks 44-76, Low Current\* becomes true causing Z7G-6 to drop to 0V. CR10 then becomes forward biased, shunting some current away from Z7F-3. This results in a write current drop from 10mA peak-to-peak to 7mA. If either Write Gate\*, Ready\* or DRV SEL INT\* goes false (high) or Write Protect goes true (high), Z4E-6 (3E5) goes low causing Z7G-8 to go high which turns off Z7F at pin 2.

Q1, Q2 and Q5 serve to monitor the +5V supply and if it drops below +3.9Vdc, the write amplifiers and the erase amplifier are shut off. When power is first turned on, Q1 is shut off until the voltage reaches approximately +3.9 Vdc. With Q1 off, Q5 is on causing 0V to be applied to the anodes of CR12 and CR13, thereby inhibiting writing. Q2 is also on causing 0V to be at Z5G-13 (3B4) and thus inhibiting erasing. When the +5V level goes above +3.9 Vdc, Q1 turns on and Q5 and Q2 turn off thereby enabling the write and erase circuits.

#### 4.2.3 ERASE CIRCUITS

The erase element functions as a tunnel erase; i.e., it erases the area on both sides of the Read/Write track rather than the track itself. In this manner, the track is trimmed on both sides as the track is being written which eliminates stray interference between tracks. This also insures interchangeability between diskettes and drives. The erase gaps are located 0.036" behind the read/write gap.

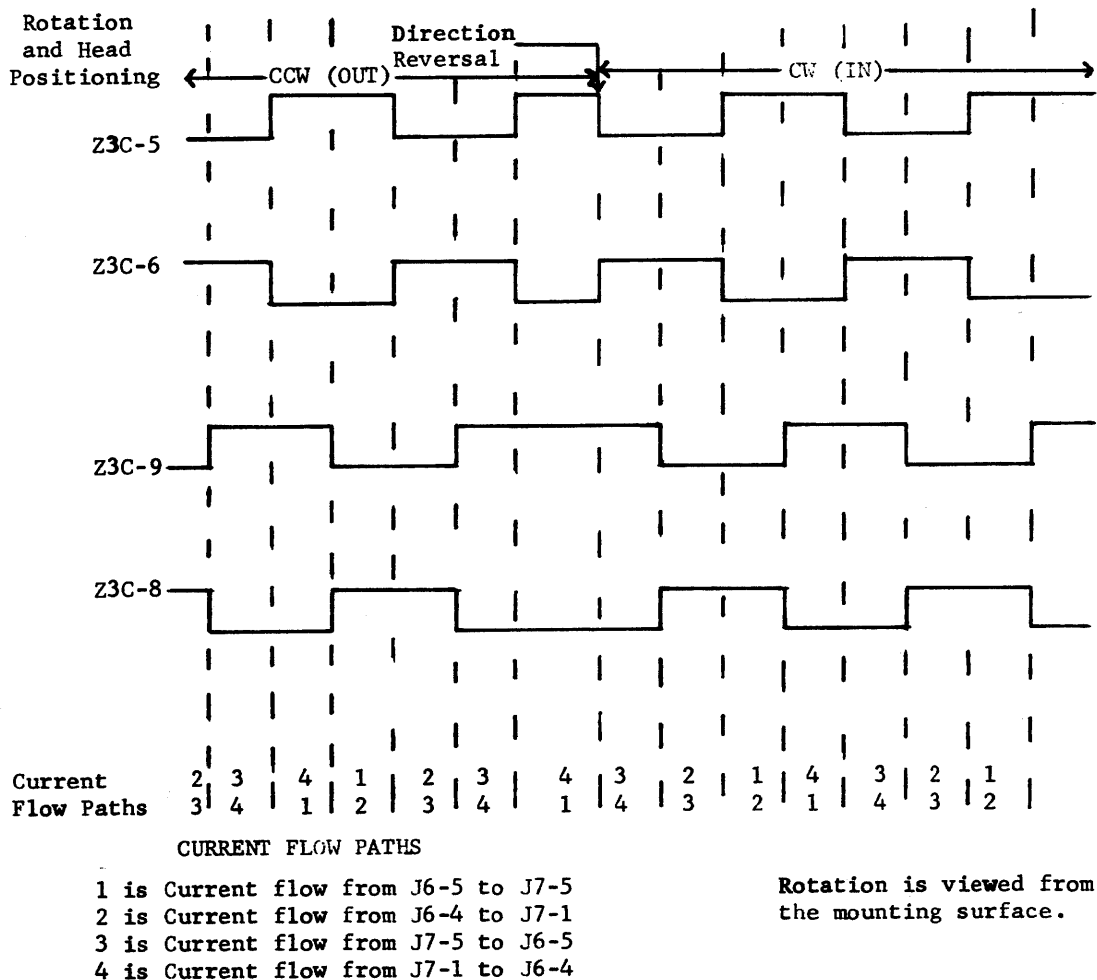
The erase current must be turned on shortly after write data is present. Circuits controlling the automatic erase as shown on sheet 3 of Figure 8-2, zones B5, B4 and B3 and in Block Diagram form, Figure 4-2. When the first bit is to be written, the write flip-flop is set and Z6G-9 goes high. On the second bit, the F/F is reset, Z6G-9 goes low and triggers the 550 $\mu$ s delay one-shot at Z6F-5. The Q output at Z6F-6, in turn, triggers the 187  $\mu$ sec delay one-shot at Z6F-12. When Z6F-9 again goes high it triggers the Z65 erase F/F causing pin 5 to go high. Since Z5G-13 is high (providing power to up to operating level; see Section 4.2.2), A5G-11 will go low and turn on the erase amplifier at Z7F-6. Z6F-5 is a retriggerable one-shot which stays on as long as Z6G-9 keeps changing states. When write data is no longer present, Z6F-6 will be reset after the 550  $\mu$ sec time out period. When Z6F-6 goes low it resets F/F Z6G at pin 1 causing the erase amplifier to shut off. Thus it is seen at the beginning of a write operation, the erase current is delayed 187  $\mu$ sec and at the end of write, the erase current remains on for 550 $\mu$ sec before turning off.

#### 4.2.4 STEP MOTOR DRIVE CIRCUITS

The step motor control circuits are shown on page 4 of Figure 8-2. A four stage counter composed of the two Z3C flip-flops is used to produce four combinations of drive current through the motor phases. The counter is stepped with each Step\* pulse received at J1-36. The direction of counting and, in turn, the in or out direction of the motor is determined by the Direction Select\* line at J1-34. A low

(0V) Direct Select\* signal causes the motor to move the head in toward track 76 and a +5V level causes the motor to move the head out toward track 00.

The motor phases are driven by the Z3B, Z4B amplifiers depending upon the state of the counter. Examining Z3B, pins 4 and 5 first, when Q at Z3C-6 is low, (Z3B-4 is low) the associated transistor is shut off. Pins 5, 10, (1) and 1 are always high when the Step Motor Enable signal is true (See Section 4.2.9). This turns on Z4B at pin 11 causing current to flow out pin 10 through step motor phase 1, through the power resistor mounted on the chassis, through CR19, into Z3B-9 to 0V (Z3B-11 is high at this time causing its associated amplifier to be on). When Z3C-5 is reset and goes low, Z3B is turned off at pin 11 and turned on at pin 4. Current flow through the Step Motor Phase is now reversed, coming from Z4B-15, through the resistor and winding and CR18 and into Z3B-6 to 0V. Figure 4-4 shows the timing diagram and the current flow paths for the various configurations of counter outputs. A mechanical damper is used to adjust the settling time of the motor after each step.



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Figure 4-4. Stepper Motor Energizing Sequence.



#### 4.2.5 INDEX/SECTOR CIRCUITS

Figure 8-2, sheet 5 shows the schematic for the sector and index circuitry. A combination of a light emitting diode (LED) and photo sensor is used to sense the index and sector holes. When a hole in the diskette passes the sensor, a pulse is emitted and sensed by Schmitt trigger Z3G at pins 8 and 12 for Index sensor 0 and pins 2 and 6 for Index sensor 1. The Schmitt trigger converts the hole sensor signals into standard TTL logic levels. The negative true signal from side 0 at Z3G-9 will be discussed. The circuitry for side 1 is identical. The negative true output from Z3G-9 is used two places:

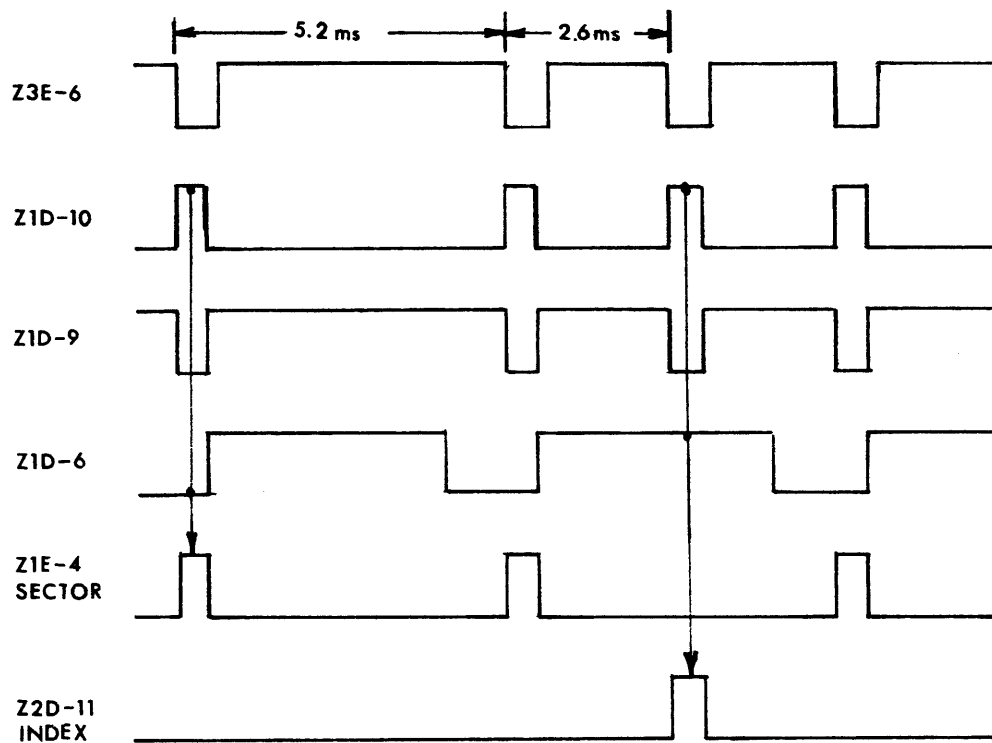
- (1) The trailing positive going edge sets the Z3F F/F at pin 11. This F/F remains set until it is reset by the DC INT (door close internal) signal generated when the door is opened. The F/F for the opposite side remains set.
- (2) The negative signal is inverted at Z1F-6 and then gated with the Q output from Z3F-6 at Z3E, pins 4 and 5 or the  $\bar{Q}$  output from Z3F-8 at Z20 pins 4 and 5 to generate the true Index pulse at Z2D-8.

The Index pulse from Z2D-8 is used two places:

- (1) It is gated with the Drive Select signal at Z5D, pins 4 and 5 to generate the true Index\* signal at J1-20 and
- (2) It is also used to clock the two stage counter at Z2E, pins 3 and 11.

The Z2E counter provides the Ready output after two index pulses have been counted. The Q output at Z2E-8 from the counter is gated with output of gate Z1E-13 which is composed of either the Q output from the Side 1 F/F from Z3F-5 or the Side 1\* signal to give the true positive signal at Z1E-10. This signal is further gated with the Drive Select signal at Z5D, pins 12 and 13 to give the true, low Ready\* output at J1-22. A positive true Ready signal is generated by the Q output of the counter at Z2E-9.

Models RFD4001 and RFD2001 accept the 33-hole media (32 equally spaced sector holes and one index hole) and provides separate outputs for index and sector signals. With the 33-hole media, each hole is recognized as previously described for the index on side 0. The output from Z3E-6 is applied to the Index/Sector separator which is shown at the bottom of Figure 8-2, sheet 5. The leading negative going edge of this pulse is used to trigger the 400 $\mu$ s single-shot at Z1D-11 and its output at Z1D-10 triggers the 3.6 ms single-shot at Z1D-5 on the trailing, negative going edge. In turn, the output at Z14-6 is true approximately four milliseconds after each hole is sensed. Refer to the timing relationship shown in Figure 4-5. Note that the index hole in the diskette is located midway between two sector holes. Thus, when an index hole is sensed, it occurs while Z1D-6 is high and is gated out through Z2D-3 and Z2D-11. Z1D-6 always goes false before the subsequent sector hole is sensed and therefore the sector pulses are gated out through the sector gate at Z1E-4. Both the index and sector are then gated with the drive select signal before being applied to the output lines at J1-20 and J1-24.



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Figure 4-5. Timing Diagram, Index and Sector Circuits (RFD4001 and RFD2001 Only).

#### 4.2.6 WRITE PROTECT CIRCUIT

The write protect circuit is shown on Figure 8-2, sheet 5. The uncovered write protect notch in the diskette jacket is sensed by the combination of a light emitting diode (LED) and photo sensor. When the uncovered notch is sensed, a dc level is applied to the Write Protect Schmitt trigger, Z2G, pins 2 and 6 (5D7). This Schmitt trigger converts the notch sensor signal to standard TTL logic levels. This signal is inverted at Z1F-8 and gated with the drive select signal at Z6A, pins 1 and 2 and sent to the output at J1-44. The signal stays at 0V until the jacket is removed.

#### 4.2.7 DISK CHANGE CIRCUIT

The disk change circuitry is shown on Figure 8-2, sheet 5, zones D3 and D2. Flip-flop Z4D at pin 11 is set whenever the Drive Select Internal (DRV SEL INT\*) goes away, i.e., the drive is no longer selected. If during the time the drive is not selected and Ready goes false (because of the DC INT goes false; see Section 4.2.12), F/F Z2E at pin 8 goes high causing Z1E-10 to go low and reset F/F Z4D at pin 13. Z4D-8 then goes high and when the drive is again selected (DRV SEL INT high) pin 10 of Z6A goes high causing the Disk Change\* output at Z6A-8 and J1-12 to go true.

#### 4.2.8 TWO-SIDED CIRCUITRY (RFD400X ONLY)

This circuit is shown on Figure 8-2, sheet 5 and is used to detect a two-sided disk (Diskette 2). When the index/sensor detector F/F for side 1 is set, Z3F-5 goes high. This signal is gated with the drive select line at Z6A, pins 12 and 13 causing Z6A-11 to go low and setting the Two-Sided\* output in the true low state.

#### 4.2.9 DRIVE SELECT LOGIC

This circuit is shown on Figure 8-2, sheet 6. A jumper wire placed between pads DS1, DS2, DS3 or DS5 is used to select the drive number for a particular drive. When the corresponding input line is selected by the host by placing J1-26, J1-28, J1-30 or J1-32, respectively, at 0V, pin 10 of Z7B goes low causing Z7B-8 to go high. This signal is then inverted at Z6E-8 resulting in Z4E-12 and Z4G-8 giving a true Drive Select Internal (DRV SEL INT). An inversion of this signal appears at Z4F-10. DRV SEL INT is gated with most logic circuits throughout the card so that before most functions can occur, the particular drive must be selected.

The signal from the inverter at Z6E-8 is gated at Z4E, pins 9, 10 and 11 with the Door Closed\* signal from the door closed F/F, Z2F-8. This causes Z4E-8 to go high which is used in three places:

- (1) As the Step Motor Enable signal to enable the Step Motor logic (See Section 4.2.4).
- (2) Is gated with the Ready signal at Z1G, pins 6 and 7 (6A2) to produce the 0V true Head Load Solenoid\* signal, and
- (3) It is inverted twice at Z4F-8 and Z5G-8 and used as the signal to turn on Q4 which operates the Door Lock Solenoid via J2-29.

#### 4.2.10 SIDE SELECT LOGIC (RFD4000 AND RFD4001 ONLY)

The side select logic is shown on Figure 8-2, sheet 6. In normal use, jumper S2 is installed (6D7). A +5V signal at J1-14 selects side 0. This causes Z6B-4 to go low, Z6E-2 to go high and when gated with the Drive Select signal at Z8G, pins 6 and 7, causes the CT0\* line to go low. This signal is used to select the side 0 head (2D8). Inversely 0V signal at J1-14 causes CT1\* to go low and causes the Side 1 signal at Z6E-2 to go low. On the RFD200X, J1-14 is not used, but since it has an internal pull up to +5V, side 0 is always selected.

#### 4.2.11 POWER UP RESET

The Power Up Reset circuit is shown on Figure 8-2, sheet 6, zone B5. As power reaches the operating level C18 charges to the point where Q3 turns on. Before it reaches that point, pin 5 of Z4F rises sufficiently high to cause Z4F-6 to go to 0V. This short 0V Power Up Reset signal is used to reset many of the F/F's used throughout the circuit card. When Q3 turns on a short time later, the collector of Q3 drops to 0V and Z4F-6 goes positive.

#### 4.2.12 DOOR CLOSED CIRCUIT

The Door Closed circuit is shown in Figure 8-2, sheet 6. When the door is closed, 0V is applied from J2-28 through the switch to J2-12 which sets the Door Closed F/F, Z2F at pin 10 (6B6). Output  $\bar{Q}$  at pin 8 drops to 0V and is gated with the 0V Power Up Reset\* signal at Z5F, pins 5 and 6. The Door Closed Internal\* (DC INT\*) at Z5F-4 is then at +5V. When the door is opened, J2-13 goes to 0V which resets the F/F at pin 13 causing DC INT\* to go to 0V and reset the Index and Ready circuits (5D7). See Section 4.2.5.

#### 4.2.13 CUSTOMER INSTALLABLE OPTIONS

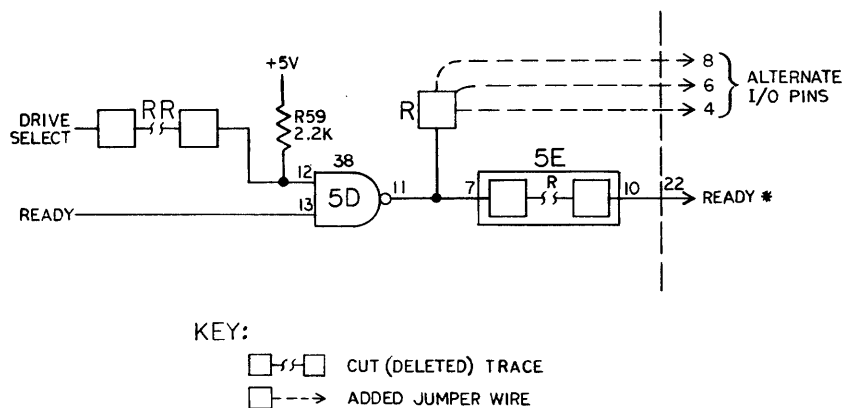
This section describes the changes in the function of the standard circuitry to achieve the various customer installable options described in Section 3.6. The reader should first become familiar with the operation of the standard unit as described in Sections 4.2.1 thru 4.2.12.

##### 4.2.13.1 Side Selection Utilizing Drive Select Lines

During standard operation, the drive select lines are used to select the particular drive number. See Section 4.2.9. When the S2 jumper is moved from S2 to S3, the drive select line selected by 1B, 2B, 3B or 4B is used to route the drive select signal to the side select logic. See Figure 8-2, sheet 6, zones C7 and D7. Thus, if Drive Select 1\* is used to select Side 1 a jumper at 1B will route the input from J1-26 to Z6B-3. To select side 0, a jumper is placed across one of the other three inputs not selected by side 1. When the selected drive line for side 1 is 0V, the other drive line selected for side 1 is high and places +5V at Z6B-3 as in normal operation. In this modification 0V is required to select both sides. Note that both selections are tied to Z7B, pins 9 and 10 and will activate the Drive Select logic in the normal manner.

##### 4.2.13.2 Radial Ready

In normal operation, the Ready\* line becomes true only when the drive is ready and selected. In this option, the Drive Select line to the ready gating at RR is removed and the R59 pull up is used to hold Z5D-12 high permanently. See Figure 4-6. The output can remain at J1-22 or the R jumper can be removed and a wire from pad R to J1-4, 6 or 8 can be installed. In this way the Ready\* signal will always be true when the Drive is ready regardless of whether the drive is selected or not.



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Figure 4-6. Radial Ready Circuit

#### 4.2.13.3 Radial Index and Sector

In normal operation, the Index\* and Sector\* outputs are true only when the drive is selected and the Index\* and Sector\* signals are true. This option removes jumper RI thus removing the Drive Select line input and causes pull up resistor R60 to hold Z5D-4 and Z5D-2 high permanently. See Figure 4-7. The outputs can remain at J1-20 and J1-24 or the I and S jumpers can be removed and a wire from pads I and S to J1-4, 6 or 8 can be installed. In this way, the Index and Sector signals will always be true when the Index and Sector signals are true regardless of whether the drive is selected or not.

#### 4.2.13.4 Two Sided Status Output

Normally the drive is shipped with jumper 2S (5E2) installed which provides a Two Sided\* output at J1-10. See Table 3-1. Removing the 2S jumper disconnects this output from the interface.

#### 4.2.13.5 Disk Change Option

Normally the drive is shipped with jumper DC (5D2) removed. To provide a Disk Change\* output at J1-12 a jumper is installed at DC which provides the signal as described in Table 3-1 for J1-10.

#### 4.2.13.6 Drive Select Without Loading Heads or Enabling Stepper Motor

In normal operation, the head is loaded and the step motor is enabled at the time the drive is selected. This option allows the head to be loaded and the step motor enabled only when the Head Load signal at J1-18 is active. This is accomplished by cutting trace X (6B6) so that the head load gate is not enabled by the drive select line. See Figure 4-8. A jumper across C connects the head load circuit of J1-18.

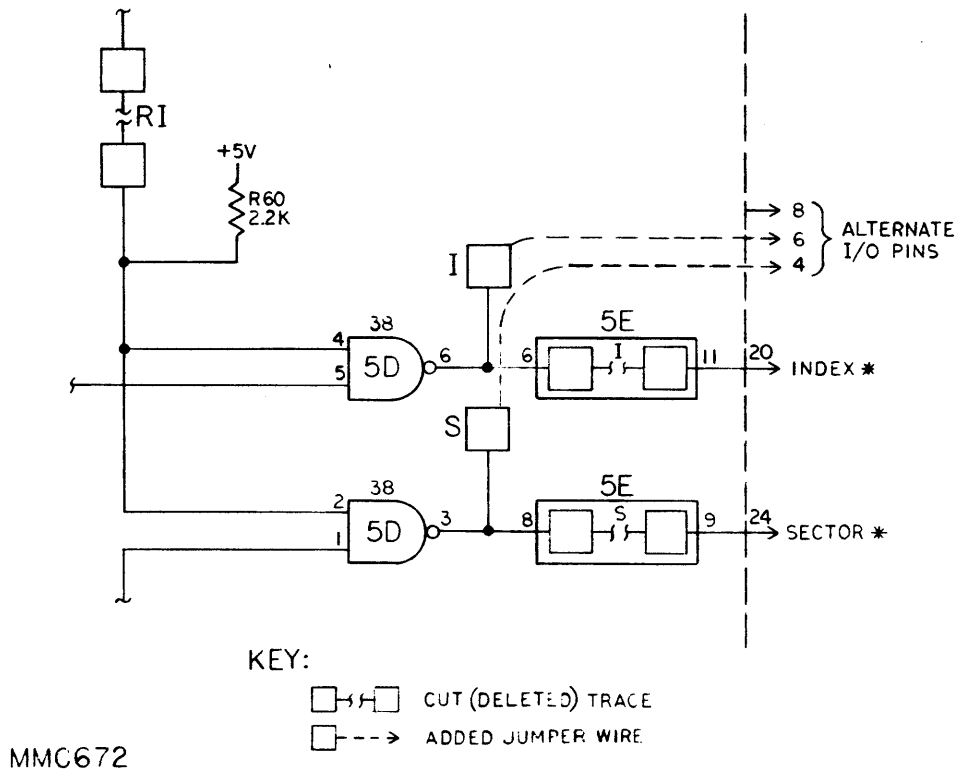


Figure 4-7. Radial Index/Sector Circuits.

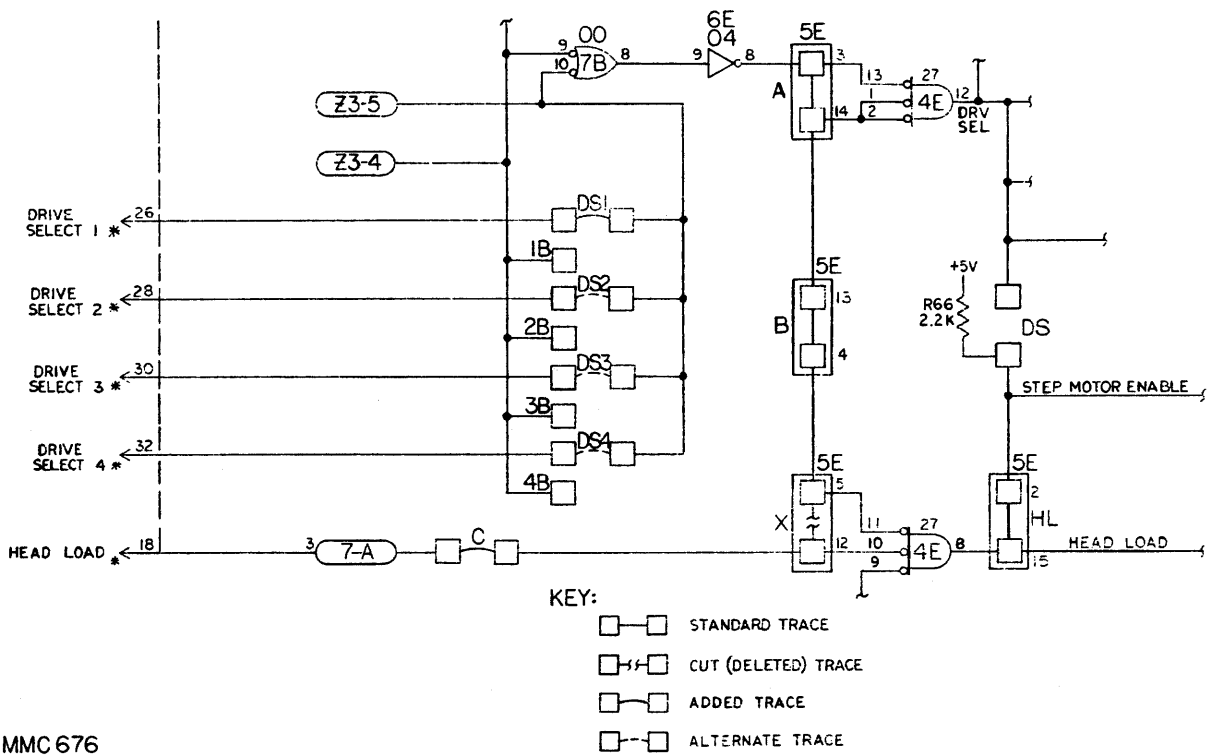
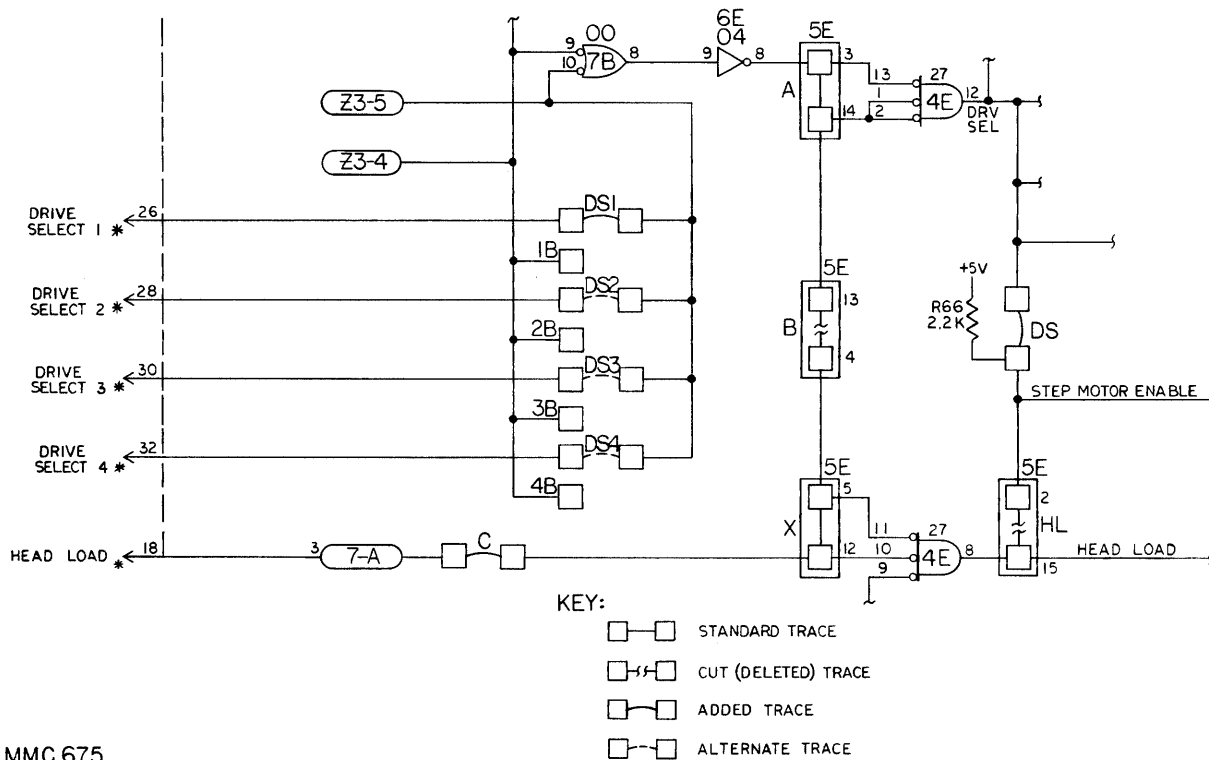


Figure 4-8. Drive Select Without Loading Heads or Enabling Stepper Motor.

### 4.2.13.7 Drive Select and Motor Enable Without Loading Head

In normal operation, the head is loaded and the step motor is enabled at the time the drive is selected. This option allows the drive to be selected and the motor enabled without loading the head. This is accomplished by cutting trace B (see Figure 4-9) so that the head load gate and stepper motor enable circuit is not enabled by the Drive Select\* line but only by the Head Load\* line. Jumper HL is removed to prevent the head load circuit from activating the Step Motor Enable line. Jumper DS is installed to allow the Step Motor Enable line to be activated by the Drive Select Int line. Finally a jumper across C connects the head load circuit to J1-18.



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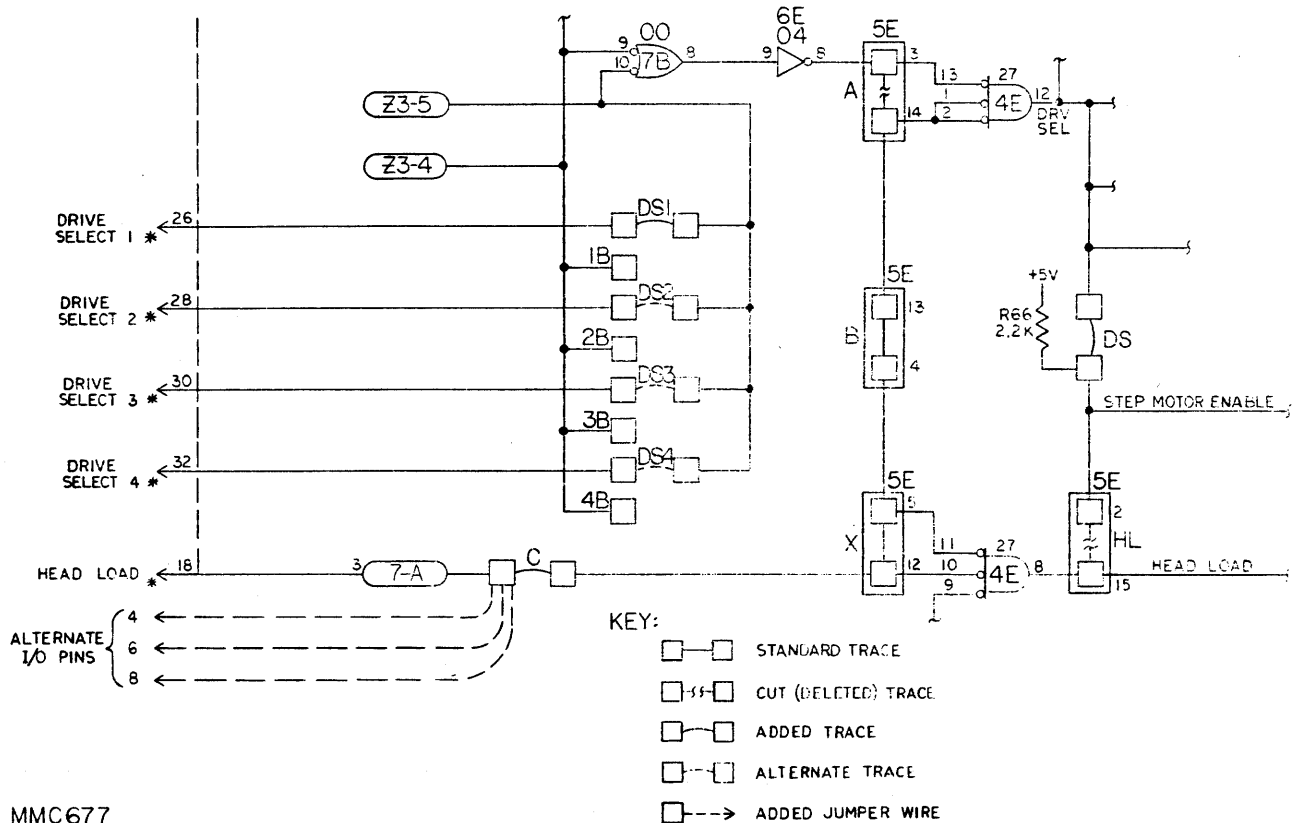
Figure 4-9. Drive Select and Motor Enable Without Loading Head.

#### 4.2.13.8 Head Load Without Selecting Drive or Enabling Step Motor

In normal operation, the head is loaded and the stepper motor is enabled at the time the drive is selected. This option allows the head to be loaded independent of drive selection. But it also requires the head to be loaded before the drive can be selected. This is accomplished by cutting trace A to insure the drive is selected by both the Drive Select\* and the Head Load\* lines. See Figure 4-10. A jumper is added across DS and removed from HL so that the Step Motor Enable line is controlled only by the DRV SEL INT line. A jumper is also installed at C to connect the head load circuit to J1-18.

#### 4.2.13.9 In Use Alternate Input

Normally the drive is shipped with jumper D(6E7) removed. To make use of the In Use\* input signal at J1-16, jumper D is installed. A low active signal on this line will lock the door by turning on Q4 and turning on the BUSY LED by causing Z5F-10 to be low and Z1G-3 to be high.



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Figure 4-10. Head Load Without Selecting Drive or Enabling Step Motor.

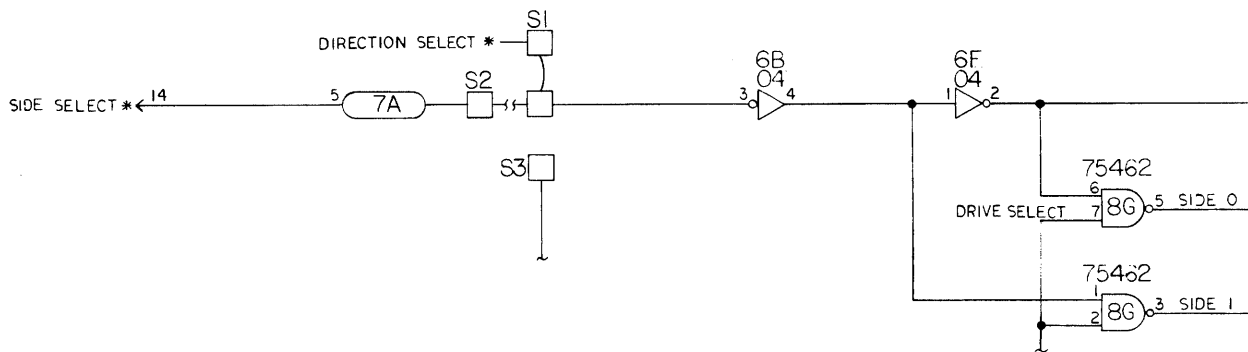


4.2.13.10 Side Selection Using Direction Select (RFD400X ONLY)



In normal operation, J1-14 is used to select the side and J1-34 is used to select the motor direction. The option allows J1-34 to perform both operations. This is accomplished by removing jumper S2 which connects J1-14 to the side select logic and installing S1 which connects J1-34 to the side select logic. See Figure 4-11. With this option the side select circuitry will be activated each time the motor is positioned. However, since no reading or writing occurs until after positioning is complete, the side select logic can again be activated when a read or write command is required.

4.2.13.11 Door Lock Latch

In normal operation, the door lock solenoid is activated from the head load circuitry via Z4F-8 (6B3) and Z5G-10 (6E3). This option allows the door to be locked when the Drive Select\* and In Use\* lines are activated without constantly holding the In Use\* line active. This is accomplished by installing jumper DL so that when DRV SEL INT goes high (true), F/F Z4D is set at pin 3 (6D4). The Q output at pin 5 then is gated at Z5F-9 causing Z5F-10 to be low. Jumper D is also installed so that the in use circuitry can be connected to J1-16.



KEY:

-  CUT (DELETED) TRACE
-  ADDED TRACE

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Figure 4-11. Side Selection Using Direction Select.

#### 4.2.13.12 Write Protect Optional Use

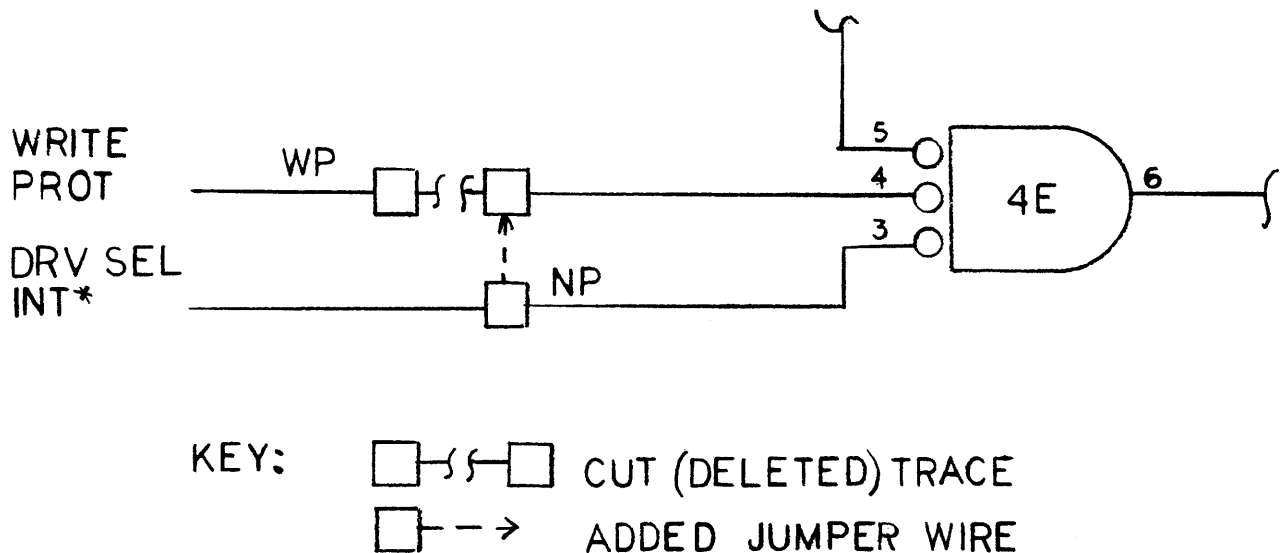
In normal operation, the Write Protect line inhibits writing by placing Z4E-4 high (3E5) when a write protect notch is sensed. This option allows writing on a Write Protected Diskette. The Write Protect\* Output at J1-44 is still active. This is accomplished by cutting the WP jumper (3E7) and connecting the NP jumper (3E6). See Figure 4-12. This substitutes the DRV SEL INT\* signal for the Write Protect signal at Z4E-4 causing it to always be 0V when the drive is selected.

#### 4.2.13.13 -5 Volt Option

In normal operation, the voltage applied to J5-4 is between -7 to -16 Vdc and is subsequently converted to -5 Vdc by regulator Z1 (4A7). To allow the drive to operate directly from -5 Vdc, Z1 is bypassed by adding the -5V jumper (4A7).

#### 4.2.3.14 Data Separation Option Select (Models RFD4001 and RFD2001 Only)

On models RFD4001 and RFD2001 only the jumper installed at TS (2A8) will provide true data and clock separation outputs at J1-48 and J1-50 for FM applications using IBM soft sector (missing clock) formats. FS provides false separation at IMB Address Mark and data mark fields (missing clock areas) but true data and clock separation at the data fields.



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Figure 4-12. Write Protect Optional Use.

Table 4-1. Drive Mnemonics.

Mnemonic	Origin	Signal Description
CT0,CT1	6D4	Center Tap 0 and Center Tap 1. Used at 2D8 and 2C8 to select the particular head of the side selected.
DC INT	6A4	Door Close Internal. True signal indicates the drive door is closed and power is up to operating level.
DIRECTION SELECT*	4E7	Direction Select is a direct input from Direction Select* interface line at J1-34.
DRSE	6C4	Drive Select Enable. In the standard configuration it indicates that particular drive has been selected. It is used to enable the Read Gate*.
DRV SEL INT DRV SEL INT*	6C4 6D4	Drive Select Internal. In the standard configuration it indicates that particular drive has been selected. These two signals are used to (1) enable the write circuitry (3D7), (2) to enable the TR00 signal (4A4), (3) to clock the disk change F/F (5D3) and (4) to enable the following output signals: Two Sided*, Disk Change*, Ready*, Index* and Sector (5E4).
ERASE 0 ERASE 1	3B3 3B2	Erase 0, 1. Output from the erase circuit supplies current to the selected erase head (2D8).
POWER UP RESET	6B4	Power Up Reset. Output of the Power Up Reset which goes to 0V for a short period while power is coming up to operating level. The short 0V pulse is used to reset the In Use F/F (6D4), the Erase Delay F/F (3B5), and the Stepper Motor Counter (4D6, 4D5).
READ GATE*	3E3	Read Gate. Inversion of Write Gate signal when drive is selected and ready. It is used in read operation to enable read detection circuit (2C4) and to prevent the step motor from stepping when the write gate is active (4D7).
READY	5D4	Ready. Signal indicates diskette is installed and rotating and two index pulses have been counted. Used to gate Head Load Solenoid signal (6A2) and prevent head loading when drive is not ready.
READY 1 READY 1*	5C4	Ready Side 1. Signal indicates side 1 has been selected and Index Sensor 1 is also detected. This signal will disable the Read/Write Circuitry if the wrong combination of Side Select and Index Signal is detected.
SIDE 1*	6D4	Side 1. Output from side select circuit. Low signal indicates Side 1 has been selected; high signal indicates side 0 has been selected. Used in combination with other signals to generate Ready*, and Ready 1 signals (5C7).
STEP MOTOR ENABLE	6C4	Step Motor Enable. In normal configuration, indicates drive has been selected. Used to enable Step Motor circuit (4D4).
TR00	5E7	Track 00. Output from Track 00 Sensor. Gated with DRV SEL INT (4A4) to give the Track 00* output.
WC+ WC-	3C3	Write Current. Output from the write amplifier. Used to supply current to the write head (2E8).
WRITE PROT	5D4	Write Protect. Output from the Write Protect detection circuit. Used to inhibit Write Circuit (2E7) when signal is active.

## SECTION V

### MAINTENANCE

#### 5.1 GENERAL

The REMEX Diskette Drive has been designed to keep maintenance as simple and infrequent as possible. Table 5-1 lists the maintenance equipment required for the various procedures. Section 5.2 and Table 5-2 contain the recommended inspection and maintenance procedures. The remaining sections describe the required adjustment procedures. Replacement procedures are given in Section 6.

Table 5-1. Maintenance Equipment Required

	Quantity
Alignment Diskette Dysan 360 (REMEX P/N 716083-002), RFD200X	1
Alignment Diskette Dysan 360/2A (REMEX P/N 716083-006), RFD400X	1
*Dual Trace Oscilloscope, DC to 10 MHz	1
*Torque Driver	1
*Voltmeter, Digital 0-0.1 mA, 0-100 mVdc, 0-10M ohm, 0-100 Vdc, 100K impedance or greater.	1
*Taptite Driver #4 and #6 (Torx part numbers TX-09 and TX-15 respective; available from Apex Machine and Tool, Dayton, Ohio).	1

\*These items not available from REMEX

#### 5.2 MAINTENANCE PROCEDURES

Under normal circumstances preventive maintenance is not required for the drive. If severely dirty environments are encountered, an occasional cleaning of the drive may be performed to assure continued reliable performance. If a drive malfunctions, it is recommended that it be inspected and cleaned as described below.

Visual inspection is the first step in any maintenance operation. Always look for corrosion, dirt, wear, binds and loose connections. Noticing these items may save downtime later. Inspection and preventive maintenance operations are listed in Table 5-2. These should be performed at 12 month intervals or after 6000 power on hours. During normal maintenance, only those operations listed on the chart should be performed. Details on adjustments and service checks are found in Section 5.3. Observe all safety precautions. Cleanliness cannot be overemphasized in the maintenance of the drive.

## CAUTION

Do not lubricate the drive except as specifically directed. Oil will allow dust and dirt to accumulate.

### 5.2.1 READ/WRITE HEAD CLEANING

#### 5.2.1.1 Read/Write Head Cleaning, RFD400X Only

On the RFD400X, REMEX does not recommend touching or cleaning the Read/Write head. In addition, when maintaining the system the following caution should be observed.

## CAUTION

It is important when performing maintenance on the RFD400X drive that the heads are not touched or disturbed. Certain maintenance procedures give instructions to place a piece of clean paper between the heads to make sure they don't come into contact with each other when working in that vicinity. Do not smoke or permit dirt or lint in this area or any other area of the drive.

#### 5.2.1.2 Read/Write Head Cleaning, RFD200X Only

On the RFD200X only, the head should be cleaned only when signs of oxide build-up are present. The following procedure is recommended. Refer to Figure 7-1 for reference designations.

- a. Retract the carriage to Track 00.
- b. Remove all power and control signals by disconnecting P1/J1, P5/J5 and P8/J8.
- c. Remove the Head Shield (57) by removing screw (J) and nut (KK).
- d. Inspect the face of the head for reddish-brown oxide deposits. Clean head only if deposits are present.

## CAUTION

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

- e. If oxide deposits are present, use a lint-free gauze to lightly dry-buff the head face. If necessary dampen (do not soak) gauze with denatured alcohol and wipe head until the deposits are removed. Use dry gauze to lightly buff head after deposits are removed.

- f. Check Head Pad Cartridge (MM) for trapped oxide particles. Replace pad if oxide or dirt is present or if excessively worn. See Section 5.4.3.
- g. Perform the reverse of steps c and b.

Table 5-2. Inspection and Maintenance procedures.

Part	Inspection	Procedure
Actuator Band and Capstan	Inspect for cleanliness	Clean all oil and dust if necessary
Read/Write Head (RFD200X only)	Oxide Build-Up	Clean head ONLY IF NECESSARY. See Section 5.2.1.2.
Head Pad Cartridge (RFD2000 and RFD2001 only)	Excessive Wear	Replace if excessively worn or once each 6000 hours of operation. See Section 5.4.3.
Belt	Frayed or weakened areas.	Replace belt as described in Section 6.3.
Head Carriage Guide Rods	Inspect for dirt and binding conditions.	Clean off all dust, dirt, and excessive lubrication. If necessary, relubricate with light oil. Use only a small amount of oil.
Diskette Carrier	Diskette loads into drive without interference and door latches correctly.	Replace carrier assembly if required. See Section 6.9.
Base	Inspect for cleanliness.	Clean dust from base and check for loose screws and wires. Check all conditions.

Troubleshooting is presented in the form of a chart, Table 5-3, which should be consulted whenever diskette drive performance is unsatisfactory. The chart is divided into three columns: Indication, the way in which the malfunction becomes evident; Probable Cause, the possible reason or reasons for the malfunction; and Remedy, the manner in which the malfunction may be corrected.

**WARNING**

The equipment described in this manual contains hazardous voltages capable of inflicting personal injury. These voltages appear at the AC connector, J8, and at the capacitor (59) if synchronous motor is installed. See Section 1.8. The cautionary and warning notes are included in this manual to alert operator and maintenance personnel to these possible hazards.

Table 5-3. Troubleshooting Chart.

Indication	Probable Cause	Remedy
1. No output data, any track.	1. No data written on a write protected diskette.	1. Check to make sure diskette was not write protected when writing occurred.
	2. Drive not addressed properly	1. Check J1-26 through J1-32 to make sure proper select line is at 0V. 2. Check DS1 through DS4 to make sure drive select jumper is set for proper input line.
	3. Head not loaded.	1. Check to make sure Z4E-8 is +5V and as a result the head is properly loaded.
	4. Read circuitry malfunctions.	1. Replace drive card.
2. Output present on all but a couple of tracks.	1. Defective diskette.	1. If more than two tracks are defective, replace diskette.
3. No data being written; data present from host equipment.	1. Write protect diskette being used.	1. Check to make sure diskette is not write protected.
	2. Side Selected Wrong.	1. Check to make sure J1-14 is at the desired level for the side being read. See Table 3-1.
	3. Drive Not Ready.	1. Check J1-22 to make sure Ready signal is 0V true. If not true check to make sure a diskette is inserted properly and two index holes have been recognized.
	4. Drive not addressed properly.	1. Check J1-26 through J1-32 for proper selection line. 2. Check DS1 through DS4 jumper plugs to make sure drive select is set for proper input line.
	5. Media not in or rotating properly.	1. Belt broken. Replace belt if required. See Section 6.4. 2. Check to see that media is in and rotating and that index pulses are being counted (J1-21 is 0V). 3. Index alignment incorrect. See Section 5.3.3.



Table 5-3. Troubleshooting Chart (Continued)

Indication	Probable Cause	Remedy
3. No data being written; data present from host equipment, (Cont.)	6. Head Solenoid or circuitry faulty.	1. Check head solenoid and associated circuitry for proper operation.
4. Incorrect data being read.	1. Read/Write head dirty.	1. Clean head as described in Section 5.2.1 (RFD200X Only).
	2. Track alignment not correct.	1. Perform Section 5.3.1 and readjust as required.
	3. Data being read from wrong track.	1. Check to see that host equipment is processing track location properly. 2. Check to see that step circuitry is working when 0V is present at J1-36. 3. Head wasn't relocated at track 00 when power was turned on.
	4. Track 00 alignment not correct.	1. Check to see that J1-42 is 0V when head is at track 00. Perform Section 5.3.2 if required.
	5. Circuit Malfunction.	1. Check data circuitry on drive card for proper operation.
5. No Index or Sector Pulses	1. Index sensor dirty.	1. Check index sensor and clean if required.
	2. Index sensor faulty.	1. Check for index sensor output at TP15 for side 0 or TP16 for side 1 and replace sensor if required.
	3. Index circuitry faulty.	1. Check index circuitry for proper operation and replace card if faulty.

Table 5-3. Troubleshooting Chart (Continued)

Indication	Probable Cause	Remedy
6. Head does not step.	1. Step* command not present at J1-36.	1. Check J1-36 for proper signal from host equipment.
	2. Head at mechanical stop (either 00 or 76).	1. Reverse direction.
	3. Drive not ready.	1. Check drive for rotating media and proper address at J1-26, 28, 30 or 32.
	4. Step circuitry faulty.	1. Check step circuitry for proper operation and replace card if required.
	5. Step motor faulty.	1. Check step motor for proper operation and replace if faulty.
7. Head steps in wrong direction.	1. Direction Select line not set properly.	1. Check Direction Select input at J1-34 for proper input.
	2. Direction control logic faulty.	1. Check direction control logic on card and replace card if required.

### 5.3

#### ELECTRICAL ADJUSTMENTS

It is recommended, in most cases, that the unit be returned to the factory or an authorized REMEX service center for repair and adjustment of the carriage (read/write head) or the split band/stepper motor assemblies. If customer maintenance is to be performed, the following procedures are to be followed. These procedures give an outline which describe the steps to take and the desired results. In some cases, the method of performing a particular step or function is not explicit because of the many possible host equipment variations. It is also possible that some host systems and companion software may not be compatible and that a test fixture or special test set-up will be required.

##### 5.3.1 TRACK ALIGNMENT

The following procedure describes the radial track alignment and must be performed any time the stepper motor or carriage assembly (read/write head) is replaced.

- a. Insert an alignment diskette, Dysan 360/2A (REMEX P/N 716083-006) into the RFD400X or a Dysan 360 (REMEX P/N 716083-002) into the RFD200X.
- b. Select side 0 on the RFD400X.
- c. Step the drive to track 38 and perform a read operation. At track 38, J6-4 should be low and J6-5 should be high.
- d. Monitor TP1 and TP2 on the circuit card differentially and observe the cats eye pattern while synchronizing the scope on the Index pulse (TP15 for side 0 and TP16 for side 1).
- e. The signals displayed from TP1 and TP2 should be as shown in Figure 5-1 and should be within 5%. If the amplitude of T1 and T2 are not equal (or within 10%), loosen the two screws (Item BB, Figure 7-1) holding the stepper motor just enough to be able to slide the motor assembly.
- f. Slide the stepper motor assembly in the appropriate direction until the amplitude of T1 is equal to T2. Tighten screws. Verify track 38 by stepping from tracks 37 and 39 to ensure alignment.
- g. Select side 1 on the RFD400X and repeat steps c - f to verify proper alignment.

##### NOTE

If after adjusting for head 0 to within specification and head 1 is off then the difference should be split between the two heads.

- h. Apply glyptol to the two screws.

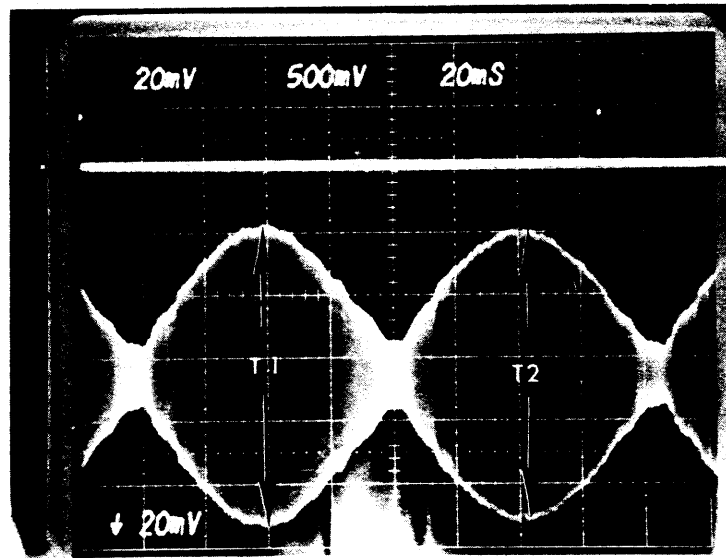


Figure 5-1. TP1 and TP2 Outputs at Track 38 Using the Alignment Diskette.

### 5.3.2 TRACK 00 SWITCH AND MECHANICAL STOP ADJUSTMENT

The following procedure describes the alignment of Track 00 switch and must be performed any time the stepper motor assembly, carriage assembly (read/write head) or track 00 sensor is replaced. Refer to Figure 7-1 for letter and number reference designations.

- a. Check Track Alignment procedure 5.3.1 and perform alignment if required.
- b. Insert a Dysan 360/2A into the RFD400X or a Dysan 360 into the RFD200X.
- c. Step to track 06. At track 06, J6-4 should be low and J6-5 should be high. If not, repeat step a.
- d. Monitor Track 00 Optical Switch at 2G-8.
- e. Step to track 02, 01 and 00. The Track 00 Optical Switch should be high at track 02 and low at 01 and 00. If this is not the case, loosen the screw (R) which holds the Track 00 Bracket (36) and move the bracket until these conditions exist. Do not loosen screw (S) which hold the Optical Switch (56) to the Bracket (36).
- f. Step to track 76 and back to track 00. The Damper (53) should be set so that the operator does not hear the Pulley on the Carriage hit the stops on the Damper at either track 76 or track 00.

- g. If this is not the case loosen screw AA and rotate the damper slightly so that the conditions in step f are met. Tighten screw (AA) only enough to keep the damper from moving. Excessive torque could cause the Track Alignment to go out of adjustment.

NOTE

In some cases it is possible that the track 00 stop may prevent the Track 00 Optical Switch from being adjusted. In that case the stops may have to be set at the same time as Track 00 Switch Adjustment.

### 5.3.3 INDEX ALIGNMENT

The following procedure describes the alignment of the index sensor assembly and must be performed any time the index sensor is replaced. Refer to Figure 7-1 for number and letter reference designations.

- a. Insert a Dysan 360/2A alignment diskette into the drive.
- b. Select side 0.
- c. Position the carriage to Track 1 and perform a read operation.
- d. Trigger an oscilloscope on the leading edge of the Index\* pulse at TP15. Observe TP1 and TP2 differentially on the scope.
- e. The time period between the leading edge of the Index\* pulse and the occurrence of the first data pulse shall be  $200 \pm 50$  microseconds. See Figure 5-2.
- f. If the conditions of step e are not present, loosen slightly the screw (Item U, Figure 7-1) which holds the Single Sided Sensor (47) and move the sensor slightly until the conditions of step e are present.
- g. Tighten the screw.
- h. Step the carriage to Track 76 and repeat steps d, e and f as required.
- i. Reinsert the diskette several times and ensure that the adjustment made in step f is  $200 \pm 50$  microseconds.
- j. Select side 1 and repeat steps c, d, e, f, g, h and i using TP16 instead of TP15. Also use screw (T) and the Two Sided Sensor (48). Readjust as required until both sides meet the requirements of step e and i.
- k. Insert a 33-hole diskette and verify 33-pulses are present at TP15. This step is required only if usage of a 33-hole diskette is required.
- l. Measure the amplitude of index pulses at J2-6 and J2-9. Minimum amplitude shall be 4V.
- m. Remove the alignment diskette.

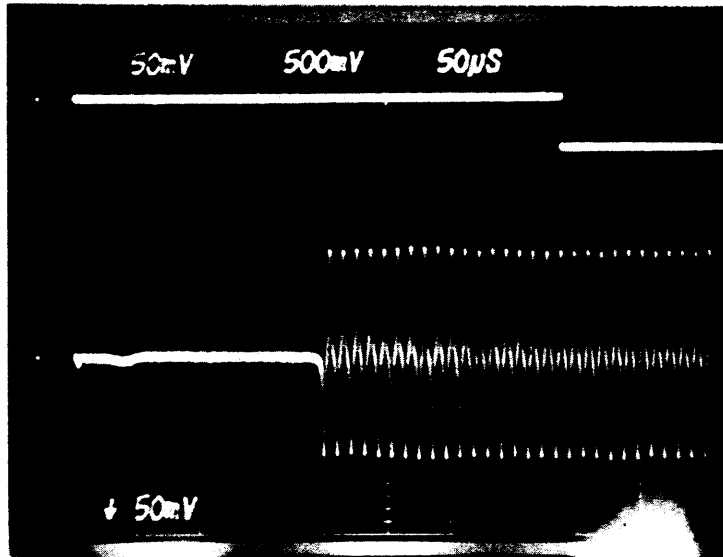


Figure 5-2. Waveforms - Index/Sector Adjustment.

#### 5.3.4 WRITE PROTECT ADJUSTMENT

The following procedure describes the adjustment of the optical write protect switch and must be performed any time the write protect switch is replaced. Refer to Figure 7-1 for number and reference designations.

- a. Insert a write protected diskette into the drive.
- b. Using an oscilloscope, observe 2G-2 and insure that the signal reaches a peak of 3V minimum and has a rise and fall time of less than 300 µs.
- c. If the conditions of step b do not exist loosen the screw (EE) which holds the Write Protect Switch Assembly (28) and adjust the switch in the slot provided until conditions are met.

#### CAUTION

Make sure the diskette jacket does not interfere with the write protect switch when door is closed.

- d. As a check, try to perform a write operation and observe 1F-8 on the drive card. In order to inhibit writing, this point must be at +5V.

### 5.3.5 R16 CROSSOVER DETECTOR INPUT DC BALANCE ADJUSTMENT

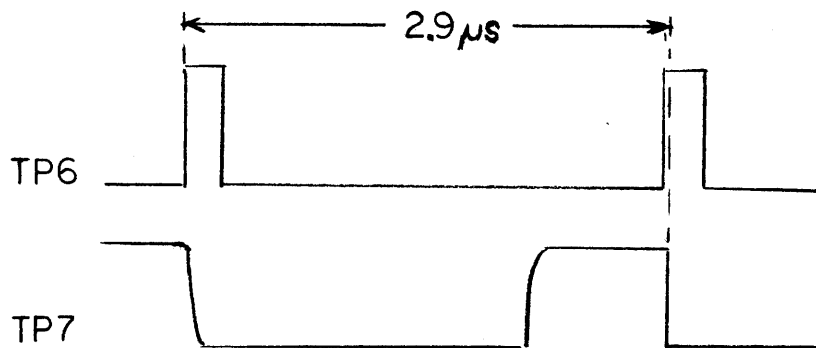
The following steps must be taken to eliminate switching noise into this system:

- a. Connect the two leads of a digital voltmeter to TP4 and TP5. The DVM leads should be as short as possible and of equal length.
- b. Disconnect P3/J3 and P4/J4 and ground pin 1 and 3 on both J3 and J4.
- c. Select side 0.
- d. Adjust R16 so that the DC voltage between TP4 and TP5 is less than 3 mV.
- e. Repeat steps c and d and select side 1.
- f. Remove the voltmeter leads.

### 5.3.6 R27 - 3/4 CELL ONE SHOT ADJUSTMENT (RFD4001 and RFD2001 ONLY)

The following adjustment sets the Z5C 3/4 one shot used only on the RFD4001 and RFD2001:

- a. Insert a blank diskette.
- b. Select side 0.
- c. Write all 0's on track 00. Use a dual track oscilloscope and monitor TP6 and TP7. Synchronize internally positive on TP6.
- d. Measure the time interval from the positive going edge of  $V_{TP6}$  to the negative going edge of  $V_{TP7}$ . This should be  $2.9 \pm 0.05 \mu\text{s}$ . See Figure 5-3.
- e. If this is not the case adjust R27 to obtain the specified time.



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Figure 5-3. 3/4 Cell One Shot Adjustment, RFD4001.

## 5.4

### MECHANICAL ADJUSTMENTS

Proper operation depends upon maintaining accurate adjustments. No adjustments are required when a new unit is first installed. However, when operational performance is unsatisfactory or when parts are replaced, it may be necessary to perform certain mechanical adjustments.

#### 5.4.1 LATCH PLATE/CARRIER ADJUSTMENT

The following procedure adjusts the clearance between the diskette guide rails and bottom of the carrier. This adjustment should be made whenever the Carrier Assembly or the Latch Plate Assembly is removed or replaced. See Figure 7-1 for number and letter designations.

- a. Remove all power and control signals by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Open the front door and remove any diskette which may be present.
- c. Lay a  $0.125 \pm 0.005$  metal shim on the diskette guide rails. This shim should be long enough to span the two guide rails (approximately 8 inches).
- d. Close the door and check to see that the carrier is in contact with the metal shim when the door is fully closed. There should also be an end play of between .01 - .030 on Clutch shaft (21).
- e. If the door does not close properly or if there is a gap between the carrier and shim, loosen the three screws (Item D, Figure 7-1) which hold the Latch Plate (Item 41, Figure 7-1) and adjust the Latch Plate until the conditions of step d are met. Tighten screws (D).
- f. Open the front door and remove the shim.
- g. Perform the reverse of step a.

#### 5.4.2 DISKETTE LOAD ARM ADJUSTMENT

The following adjustment sets the distance between the Diskette Load Arm (16) and the Head Load Arm on the carriage assembly. See Figure 7-1 for number and letter reference designations.

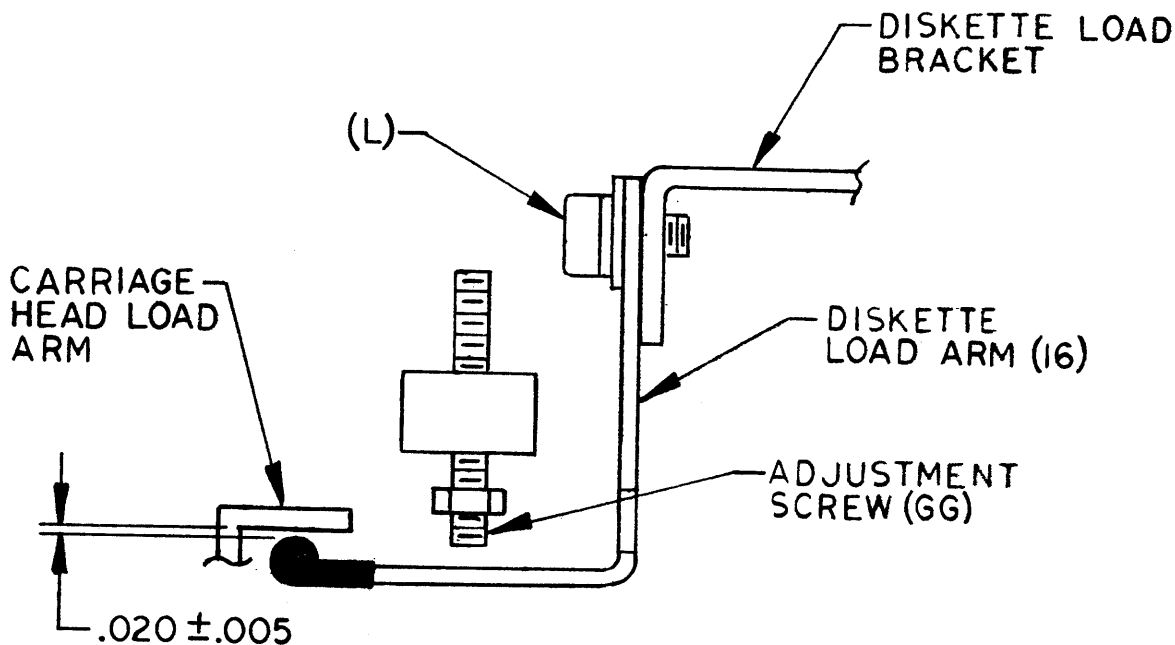
- a. Apply power to the unit and place the unit in a mode of operation so that the Head Load Solenoid is energized. Remove any diskette and close the door.
- b. Remove the Head Shield (57).
- c. Insert a piece of clean paper (approximately .003 thick) between the heads during the following procedures.



NOTE

It is important that during this procedure that caution be taken to protect the read/write heads and that no objects or dirt come in contact with the heads.

- d. Measure the air gap between the lip of the Diskette Load Arm and the arm on the carriage assembly. This should be  $0.020 \pm .005$ . See Figure 5-4.
- e. If this is not the case, loosen the two screws (L) which hold the Diskette Load Arm (16) to the Diskette Load Bracket (17) and move the Load Arm until the conditions of step d are satisfied.
- f. Deenergize the solenoid and measure the rise in the Diskette Load Arm which should be  $0.025 \pm .005$  inch.
- g. If this is not the case adjust screw (GG) until the conditions of step e are met.
- h. Replace the Head Shield (57).



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Figure 5-4. Diskette Load Arm Adjustment. All Number and Letter Designations Refer to Item Called Out in Figure 7-1.

### 5.4.3 HEAD PAD CARTRIDGE ASSEMBLY REPLACEMENT (RFD200X ONLY)

The head pad cartridge assembly (REMEX P/N 112800-001) should be replaced if excessive wear occurs or once every 6000 hours of operation, whichever comes first. The following procedure is recommended. Refer to Figure 7-1 for callout designations.

- a. Remove all power and control signals by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Loosen the Head Pad Cartridge (MM). It is not necessary to remove the screw entirely, only enough to align the flat side of the cartridge with the flat of the hole. Remove the cartridge.
- c. Replacement is the reverse of steps b and a.

## SECTION VI

### PARTS REPLACEMENT

#### 6.1 GENERAL

REMEX maintains service facilities at its manufacturing location and at service centers in major population areas for repair or replacement of components for their products. It is recommended that one of these centers be contacted for assistance in case of equipment malfunction. For the locations of service facilities in any area, contact REMEX at the address listed on the title page of the manual. Please direct inquiries to the attention of the Service Department.

When any parts require replacement or disassembly, the procedures below should be followed closely. In many cases, it is recommended that parts be replaced at a subassembly level rather than as a detail part. Because of the special tools and alignment equipment needed and the time and labor involved it is generally more economical to repair at this level with a prealigned and assembled part rather than at the more detailed level. The warnings and cautions are included to protect personnel and equipment. Notes are included to assist persons unfamiliar with the equipment. Before attempting any procedure, all instructions for that disassembly should be read and understood.

Replaceable items recommended as spare parts are listed in Table 7-1. All system components are identified in Section VII of this manual along with illustrations showing part locations.

#### **WARNING**

Potentially dangerous line voltage is applied to components within this equipment. If adjustments must be performed with power applied, these points must be located and avoided. High voltage can be accidentally contacted at connector J8. Always remove power before disconnecting internal plugs and removing the cards.

Figure 7-1 should be folded out from Section VII during these procedures and should prove very helpful in replacing various assemblies. Figures 7-2 through 7-4 also show the location of various parts and assemblies. Circled numbers in Figure 7-1 identify parts listed in Table 7-2 and circled letters refer to various hardware items referred to in the following procedures.

## 6.2 PRINTED CIRCUIT CARD REPLACEMENT

The following procedure is recommended when replacing the printed circuit card assembly. Refer to Figure 7-1 for letter and number designations.

- a. Remove all power and control signals from the drive by disconnecting J1, J5 and J8.
- b. Disconnect P2/J2, P3/J3, P4/J4, P6/J6 and P7/J7.
- c. Remove the four 6-32 taptite screws (Item X, Figure 7-1) which hold the Printed Circuit Card (PC1) to the Mainframe casting.
- d. Installation is the reverse of steps c, b and then a. Replacement cards are prealigned and no adjustments on the circuit card should be required.

## 6.3 MOTOR DRIVE BELT REPLACEMENT

The following procedure is recommended when replacing the drive belt:

- a. Follow procedure of 6.2 to remove printed circuit board.
- b. Slide the belt (Item 1, Figure 7-1) off the Drive and Motor pulleys.
- c. Replacement is the reverse of steps b and then a. Before reapplying a.c. power, manually rotate the pulleys to make sure the belt is properly installed on the pulleys.

## 6.4 DRIVE MOTOR ASSEMBLY REPLACEMENT

When replacing the 113949-001, 114166-001 or 114167-001 drive motor assembly it is recommended that the entire assembly including the connector and grounding strap be replaced. Refer to Figure 7-1 for letter and number designations.

- a. Follow procedure of 6.2 to remove Printed Circuit Board.
- b. Slide the belt off the Drive and Motor pulleys.
- c. Remove the three 8-32 Taptite screws (UU) and washers which hold the 114166-001 and 114167-001 Drive Motor Assembly (7) to the mainframe. Drive Motor Assembly 113949-001 (alternate drive motor in Figure 7-1) is held to the Mainframe by three 10-32 kep nuts and washers.
- d. Remove the 6-32 taptite screw which holds grounding lug to the Mainframe. Note the installation of the grounding lug so that it is replaced correctly.
- e. Remove the connector from the bracket.

- f. On assemblies 114166-001 and 114167-001 it is also necessary to remove the two 6-32 Taptite screws (Z) which hold the Capacitor Bracket (2) to the Mainframe and remove the Capacitor (59). The Capacitor is part of the Drive Motor Assembly and should be changed with the Motor.
- g. Install the new Motor Assembly by performing the reverse of steps f, e, d, c, b and then a.

#### 6.5 HUB PULLEY REPLACEMENT

The following procedure is recommended when replacing the Hub Pulley. Refer to Figure 7-1 for letter and number designations.

- a. Remove the Drive Belt. See Section 6.3.
- b. Loosen the two set screws (V) which hold the Hub Pulley (46) to the Hub Assembly (38) and remove the Hub Pulley.
- c. Install the new Hub Pulley by performing the reverse of steps b and then a.  
Caution: Pulley should clear rib of Mainframe by approximately .060.

#### 6.6 INDEX L.E.D. ASSEMBLY REPLACEMENT

The following procedure is recommended when replacing the Index L.E.D Housing assembly. Refer to Figure 7-1 for letter and number designations.

- a. Remove all power to the drive by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Unsolder the red and orange wires on the index L.E.D. housing (20).
- c. Loosen the 6-32 screw (PP) which holds the Index L.E.D. Housing (20) to the Carrier Assembly and remove the Index L.E.D. Housing.
- d. Install the new Index L.E.D. Housing Assembly by performing the reverse of steps c, b and then a.
- e. Perform Section 5.3.3.

#### 6.7 TRACK 00 OPTICAL SWITCH REPLACEMENT

The following procedure is recommended when replacing the Track 00 Optical Switch (56). Refer to Figure 7-1 for letter and number designations.

- a. Remove all power and control signals from the drive by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Slide off the red, brown, orange and black wires from the Optical Switch (56). Note the terminal locations for each wire so they can be replaced correctly.

- c. Remove the two 4-40 taptite screws (S) which hold the Track 00 Optical Switch to the Track 00 Bracket (36).
- d. Replacement is the reverse of steps c, b and then a.
- e. Perform Section 5.3.2.

## 6.8 EXPANDING CLUTCH ASSEMBLY REMOVAL

The expanding clutch (15) can be removed either when the carrier assembly is removed or by the following procedure. See Figure 7-1 for number and letter reference designations.

- a. Remove all power and control signals from the drive by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Remove two screws (F) which hold the carrier assembly to the Latch Plate (32). This will allow the carrier to raise enough to permit the expanding clutch to drop down.
- c. Remove the Retaining Ring (23) and drop the Spring (26), Shim (24), Pin (21) and Expanding Clutch (15) down from the bottom.
- d. Reassembly is the reverse of steps c, b and then a. When reassembling the items in step c, make sure there is an end play in the clutch shaft of between .010 and .030 inch.

## 6.9 CARRIER ASSEMBLY REPLACEMENT

Many items on the carrier including the Diskette Brackets (9,10), Carrier Eject Assembly (11,12,13), portions of the Head Load Solenoid Assembly (16,17,18), Index Housing L.E.D. Assembly (20) and Write Protect Switch Assembly (28 and 29) can be changed without removing the Carrier Assembly. See Figure 7-1 for callouts. However, to gain access to certain items on the Mainframe, the carrier must be removed. The following procedure is recommended when removing the Carrier Assembly:

- a. Remove all power and control signals by disconnecting P1/J1, P5/J5 and P8/J8. Remove the Head Shield (57).
- b. Unsolder the blue and violet wires which attach to the Head Load Solenoid (18).
- c. Slide the four wires off the Write Protect Optical Switch (29). Identify the wires for correct replacement.
- d. Remove the Index L.E.D. Housing Assembly (20). See Section 6.6.
- e. Protect the read/write heads by inserting a non-abrasive sheet of paper between the heads.
- f. Remove the two screws (K) which hold the Disk Load Bracket (17) to the Solenoid (18). The Diskette Load Arm (16) will be attached. Do not disturb the two screws (L) which hold the Diskette Load Arm (16) to the Disk Load Bracket (17).

- g. Remove two screws (F) which hold the Carrier to the Latch Plate (32) at the front of the drive.
- h. Remove four screws (FF) which hold the Carrier Spring to the Mainframe (37). These screws are accessible through the two Cover Supports (58).
- i. The Carrier Assembly is now free.
- j. To replace the Expanding Clutch Assembly (15) remove the Retaining Ring (23) and drop the Spring (26), Shim (24), Pin (21), and Expanding Clutch (15) down from the bottom.
- k. Reassembly is the reverse of steps j, i, h, g, f, e, d, c, b and then a. When reassembling the items in step j make sure there is an end play in the clutch shaft of between .010 and .030 inch.
- l. Perform Sections 5.3.4, 5.4.1 and 5.4.2.

## 6.10

### SINGLE SIDED AND TWO SIDED INDEX SENSOR ASSEMBLIES REPLACEMENT

The Single Sided Index Sensor Assembly (47) and the Two Sided Index Sensor Assembly (48) are used in conjunction with the Index L.E.D. Housing Assembly (20). Refer to Figure 7-1 for letter and number designations. The following procedure is recommended when replacing the Single Sided or the Two Sided Sensor Assembly:

- a. Remove all power and control signals to the drive by disconnecting P1/J1, P5/J5 and P8/J8.
- b. Loosen the single 6-32 Taptite screw (T or U) which holds either sensor to the Mainframe (37). On some units it may be necessary to remove the P.C. card to gain access to these screws.
- c. Remove the two screws (F) which hold the Carrier to the Latch Plate (32) at the front of the drive. This will provide room to move the Single or Two Sided Sensor to the left and give space for unsoldering.
- d. Unsolder the black and white wires attached to the Single Sided Sensor (47) or unsolder the gray and violet wires attached to the Two Sided Sensor Assembly (48). Note the wire locations so they can be replaced on the same terminals.
- e. Replacement is the reverse of steps c, b and then a.
- f. Perform Section 5.3.3.

## 6.11 DRIVE HUB REPLACEMENT

The following procedure is required when replacing Drive Hub (38). Refer to Figure 7-1 for number and letter designations. When ordering a new Drive Hub, it is recommended that the Upper Bearing (34) and the Lower Bearing (33) be replaced at the same time.

- a. Follow procedure 6.3 to remove Drive Belt (1).
- b. Follow procedure 6.8 to remove the Carrier Assembly, steps a through i.
- c. Remove the two set screws (V) which hold the Pulley Hub (46) to the Drive Hub (38) shaft. Use care not to lose the parts since these items are spring loaded (49). Note the order of assembly (from top to bottom, items 38, QQ, 34, 33, RR, 49 and 46) so that they are replaced in the same manner. Replace also the Upper Bearing (34) and the Lower Bearing (33).
- d. Replacement is the reverse of steps c, b and then a.

## 6.12 HEAD LOAD SOLENOID REPLACEMENT

The following procedure is recommended when replacing the Head Load Solenoid and Spring (18). Refer to Figure 7-1 for letter and number designations.

- a. Remove the Carrier Assembly. Refer to Procedure 6.9.
- b. Remove the two 4-40 screws (K) which hold the Solenoid (18) to the Disk Load Bracket (17). Do not disturb the two screws (L) which hold the Diskette Load Arm (16) to the Disk Load Bracket (17).
- c. Remove the brass 6-32 x 3/8 screw (Q) which holds the solenoid (18) to the Carrier. Make sure the brass screw (P/N 709221-306) is used during replacement.
- d. If the spring on the new solenoid is different than the old spring, replace the solenoid spring with the old spring (P/N 714090-164). Later model units have the 714090-164 spring included as part of the solenoid.
- e. Replacement is the reverse of steps d, c, b and then a.
- f. Check Adjustment Procedure 5.4.2.



## SECTION VII

### PARTS LIST

#### 7.1 GENERAL

This section lists the electronic and mechanical parts used on the RFD4000/4001. Standard hardware items are not listed. Model number identification is given in Section 1.8. Two basic parts lists are used for the RFD4000. Table 7-3 lists the parts for the earlier models RFD400X/814080-XXX and RFD400X/814090-XXX. Table 7-4 lists the parts used in later model version, models RFD400X/814255-XXX and RFD400X/814256-XXX. To obtain correct parts, the model number must be obtained from the identification tag located on the unit. Tables 7-5 and 7-6 list the parts used on the various RFD200X units in a manner similar to the RFD400X.

Indented items are part of the assembly under which they are indented and the quantity of these items are per each assembly. Reference designations refer to the parts illustrated in Figures 7-1 through 7-4. The designations in Figures 7-2 through 7-4 are the same for the part illustrated in Figure 7-1. The reference designations include a figure number and a part designation number which appears on that figure to locate the part. All electronic components are identified by letter-number combinations such as S1 and T1. Mechanical parts are identified by number only. Reference designations in parenthesis are associated with the parenthetical item. These items are generally individual items and not part of the referenced assembly, but are related back to the associated item for ease of location and association. Table 7-7 contains the printed circuit card components.

All parts are available from REMEX Spares Order Desk, 1733 Alton St., P.O. Box C-19533, Irvine, CA 92713.

#### 7.2 OPTIONAL KIT OF PARTS

The kit of parts is an optional item used for installation and maintenance. Refer to Table 1-2.

#### 7.3 RECOMMENDED SPARE PARTS

Tables 7-1 and 7-2 list the recommended spare parts. It is important when ordering spare parts, that the model number be identified and the spare parts be ordered accordingly.

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-1. Recommended Spare Parts List, RFD 400X

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Belt, Drive, Top Assemblies 814080-001,-003, 814090-002, -005, 814255-001, -003, 814256-002, -005 Only	716001-105	1	1
Belt, Drive, Top Assemblies 814090-001,-003, -004, -006, 814256-001, -003, -004 and -006 Only	716001-106	1	1
Carriage Assembly	113946-001	1	6
Housing, Index L.E.D. Assembly	113948-001	1	20
Motor Assembly, Drive, Top Assemblies 814080-001, -003, 814255-001, -003 Only	113949-001	1	7
Motor Assembly, Drive, Top Assemblies 814090-001, -002, -004, -005, 814256-001, -002, -004 and -005	114166-001	1	7
Motor Assembly, Drive, Top Assemblies 814090-003, -006, 814256-003, -006	114167-001	1	7
Motor, Subassembly, Stepper	113945-001	1	39
Printed Circuit Card Assembly, Drive Assemblies, 814080-001, 814090-001, -002,-003 814255-001, 814256-001, 002, -003 Only	113971-001	1	PC1
Printed Circuit Card Assembly, Drive 814080-003, 814090-004, -005, -006, 824255-003, 814256-004, -005, -006	113971-002	1	PC1
Pad, Diskette Load	112761-001	1	50
Release, Button Assembly with LED 814080-001, -003, 814090-001, -002, -003, -004, -005 and -006 Only	114169-001	1	44
Release, Button Assembly with LED 814255-001, -003, 814256-001, -002, -003, -004, -005 and -006 Only	114244-001	1	44
Solenoid, Head Load, REMEX Specification	715067-110	1	18
Solenoid, Front Panel	703500-129	1	45
Switch, Door Open, SPDT, Micro Switch IDM79MNA6943	715059-194	1	S1
Switch Assembly, Write Protect	114086-001	1	29

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-2. Recommended Spare Parts List, RFD 200X

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Belt, Drive, Top Assemblies, 814225-001, -003, 814226-002, -005, 814257-001, -003, 814258-002, -005 Only	716001-105	1	1
Belt, Drive, Top Assemblies 814226-001, -003, -004, -006, 814258-001, -003, -004 and -006 Only	716001-106	1	1
Carriage Assembly	114241-001	1	6
Head Pad Cartridge Assembly	112800-001	1	MM
Housing, Index LED Assembly	113948-001	1	20
Motor Assembly, Drive, Top Assemblies 814225-001, -003, 814257-001, -003 Only	113949-001	1	7
Motor Assembly, Drive, Top Assemblies 814226-001, -002, -004, -005, 814258-001, -002, -004 and -005	114166-001	1	7
Motor Assembly, Drive, Top Assemblies 814226-003, -006, 814258-003, -006	114167-001	1	7
Motor, Subassembly, Stepper	113945-001	1	39
Printed Circuit Card Assembly, Drive Assemblies, 814225-001, 814226-001, -002, -003, 814257-001, 814258-001, -002, -003 Only	113971-001	1	PC1
Printed Circuit Card Assembly, Drive 814225-003, 814226-004, -005, -006, 814257-003, 814258-004, -005, -006	113971-002	1	PC1
Pad, Diskette Load	112761-001	1	50
Release, Button Assembly with LED 814225-001, -003, 814226-001, -002, -003 -004, -005 and -006 Only	114169-001	1	44
Release, Button Assembly with LED 814257-001, -003, 814258-001, -002, -003, -004, -005 and -006 Only	114244-001	1	44
Solenoid, Head Load, REMEX Specification	715067-110	1	18
Solenoid, Front Panel	703500-129	1	45
Switch, Door Open, SPDT, Micro Switch IDM79MNA6943	715059-194	1	S1
Switch Assembly, Write Protect	114086-001	1	29

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List RFD400X/814080-XXX and RFD400X/814090-XXX

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
RFD4000/814080-001 (Code 1)	814080-001	1	
RFD4001/814080-003 (Code 2)	814080-003	1	
RFD4000/814090-001 (Code 3)	814090-001	1	
RFD4000/814090-002 (Code 4)	814090-002	1	
RFD4000/814090-003 (Code 5)	814090-003	1	
RFD4001/814090-004 (Code 6)	814090-004	1	
RFD4001/814090-005 (Code 7)	814090-005	1	
RFD4001/814090-006 (Code 8)	814090-006	1	
Unless the specific code is noted, the following subassemblies are applicable to all models:			
Belt, Drive (Codes 1, 2, 4 and 7)	716001-105	1	1
Belt, Drive (Codes 3, 5, 6 and 8)	716001-106	1	1
Bracket, Capacitor (Codes 4-8)	114165-001	1	2
Clamp, Cable	715040-158	1	3
Clamp, Guide Rod	113926-001	2	4
Clamp, Head Cable, Weckesser 1/8-4	715040-111	1	5
Carriage, Subassembly	113946-001	1	6
Except for the items listed below, the entire Carriage, Subassembly should be replaced as a complete unit.			
Band, Carriage Drive	113817-001	1	
Pulley, Band	113900-001	1	
Spring, Carriage Band	113927-001	1	
Drive Motor Assembly (Codes 1 and 2)	113949-001	1	7
Drive Motor Assembly (Codes 3, 4, 6 and 7)	114166-001	1	7
Except for Capacitor, it is recommended that this item be replaced as a complete assembly.			
Capacitor	702458-305	1	59
Drive Motor Assembly (Codes 5 and 8)	114167-001	1	7
Except for Capacitor, it is recommended that this item be replaced as a complete assembly.			
Capacitor	702458-305	1	59
Flexible Disk Drive Subassembly	114093-001	1	Ref.
Clamp Cable	715040-147	4	8
Carrier Assembly	114081-001	1	Ref.
Except for the following parts, it is recommended that this item be replaced as a complete assembly.			
Bracket, Diskette Lift, Left	114155-001	1	9
Bracket, Diskette Lift, Right	114155-002	1	10

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List RFD400X/814080-XXX and RFD400X/814090-XXX (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Flexible Disk Drive Subassembly (Continued)			
Carrier Eject Assembly	114084-001	1	
Carrier, Eject	113915-001	1	11
Roll Pin	713730-005	1	12
Spring	714090-160	1	13
Clamp, Cable Weckesser 3/32-2	715040-158	1	14
Expanding, Clutch Assembly	112747-001	1	15
Head Load Solenoid Assembly	114085-001	1	
Arm, Diskette Load	114150-001	1	16
Bracket, Disk Load	114088-001	1	17
Solenoid, REMEX Specification	715067-110	1	18
Housing, Index, LED Assembly	113948-001	1	20
Pin, Clutch	114273-001	1	21
Pin, Roll, Spring	713810-002	1	22
Ring, Retaining, Truarc 5133-25	715025-136	1	23
Shim, Bearing, Allied Devices AD3080	715030-226	1	24
Spring, Carrier	113922-001	2	25
Spring, Compression, Associated Spring Co. C0360-040-0620M	714090-151	1	26
Spring, Eject Carrier	113921-001	1	27
Switch Assembly, Write Protect Housing	114086-001	1	
Switch, Optical	113918-001	1	28
	704214-014	1	29
Decal Identification	716018-113	1	
Door, Latch Plate Assembly	114098-001	1	
Door	114079-001	1	30
Pad, Foam, Arlon 7AN Neoprene	716004-141	1	31
Plate, Latch	113914-001	1	32
Harness Assembly, Flexible Disk Drive Except for the items listed below it is recommended that the Harness Assembly be replaced as a complete assembly.	113947-001	1	(P2)
Connector, 34-pin black, Amp 3-87456-0	706510-335	1	P2
Contact, Amp 87667-5	706530-179	24	(P2)
Contact, Berg 75374-004	706530-181	9	
Key, Polarizing, Amp 87077	706540-158	1	(P2)
Terminal, Push-On	715005-143	3	

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List RFD400X/814080-XXX and RFD400X/814090-XXX (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Flexible Disk Drive Subassembly (Continued)			
Harness Assembly, Power Resistor Except for the items listed below, it is recommended that the Harness Assembly, Power Resistor be replaced as a complete assembly:	114151-001	1	(P7)
Connector, 5-Pin Amp 87499-9	706510-336	1	P7
Contact, Amp 876675	706530-179	4	(P7)
Contact, Push-On Amp 42470-1	715005-125	4	
Key Polarizing, Amp 87077	706540-158	1	(P7)
Resistor, 62 ohm, 10W	701020-005	2	R1, R2
Main Frame Subassembly			
Bearing, Lower, New Hamp. SFR1883PPK25/122	714000-141	1	33
Bearing, Upper, Nippon Miniature R-4ZZRA3P15LG-20	714000-125	1	34
Bracket, AC Connector	113929-001	1	(J8)35
Bracket, Track 00 Assembly, Bracket	114094-001	1	Ref.
Optical Switch	114082-001	1	36
Frame, Main	704214-014	1	56
Hub, Drive (when ordering new drive hub, also order Bearing, Lower and Bearing, Upper)	113902-001	1	37
	113934-001	1	38
Motor Assembly, Stepper			
Damper	113944-001	1	Ref.
Motor Subassembly	113906-001	1	53
Plate	113945-001	1	39
Spring, Damper	113928-001	1	54
	714090-161	1	55
Panel Assembly, Front			
Except for the items listed below, it is recommended that the Panel Assembly be replaced as a complete assembly.	114095-001	1	
Catch	113909-001	1	40
Latch Assembly	114096-001	1	41
L.E.D. AND 107R	704004-010	1	42
Panel	114091-001	1	43
Release, Button Assembly	114169-001	1	44
Solenoid, 24Vdc, Deltrol Controls 100C-29172-61	703500-129	1	45

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-3. Parts List RFD400X/814080-XXX and RFD400X/814090-XXX (Continued)

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Flexible Disk Drive Subassembly (Continued)			
Main Frame Subassembly (Continued)			
Pulley, Hub	112818-002	1	46
Sensor, Single-Sided Assembly	114075-001	1	47
Sensor, Two-Sided Assembly	114076-001	1	48
Spring	714090-146	1	49
Switch, Door Open, SPDT, Micro Switch Switch IDM79MNA6943	715059-194	1	S1
Pad, Diskette Load	112761-001	1	50
Guide Rod	113904-002	2	51
Printed Circuit Card Assembly (Codes 1, 3, 4 and 5)	113971-001	1	PC1
Printed Circuit Card Assembly (Codes 2, 6, 7 and 8)	113971-002	1	PC1
Pulley, Drive Motor (Codes 1 and 2)	112819-001	1	52
Pulley, Drive Motor (Codes 3, 5, 6 and 8)	112819-004	1	52
Pulley, Drive Motor (Codes 4 and 7)	112819-002	1	52
Shield, Head	114251-001	1	57
Support, Cover	114171-001	2	58

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-4. Parts List RFD400X/814255-XXX and RFD400X/814256-XXX.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
RFD4000/814255-001 (Code 1)	814255-001	1	
RFD4001/814255-003 (Code 2)	814255-003	1	
RFD4000/814256-001 (Code 3)	814256-001	1	
RFD4000/814256-002 (Code 4)	814256-002	1	
RFD4000/814256-003 (Code 5)	814256-003	1	
RFD4001/814256-004 (Code 6)	814256-004	1	
RFD4001/814256-005 (Code 7)	814256-005	1	
RFD4001/814256-006 (Code 8)	814256-006	1	
Unless the specific code is noted, the following subassemblies are applicable to all models:			
Belt, Drive (Codes 1,2,4 and 7)	716001-105	1	1
Belt, Drive (Codes 3,5,6 and 8)	716001-106	1	1
Bracket, Capacitor (Codes 4-8)	114165-001	1	2
Clamp, Cable	715040-158	1	3
Clamp, Guide Rod	113926-001	2	4
Clamp, Head Cable, Weckesser 1/8-4	715040-111	1	5
Carriage Sub Assembly	113946-001	1	6
Except for the items listed below, the entire Carriage, Sub Assembly should be replaced as a complete unit.			
Band, Carriage Drive	113817-001	1	
Pulley, Band	113900-001	1	
Spring, Carriage Band	113927-001	1	
Drive Motor Assembly (codes 1 and 2)	113949-001	1	7
Drive Motor Assembly (codes 3,4,6 and 7)	114166-001	1	7
Except for Capacitor, it is recommended that this item be replaced as a complete assembly.			
Capacitor	702458-305	1	59
Drive Motor Assembly (codes 5 and 8)	114167-001	1	7
Except for Capacitor, it is recommended that this item be replaced as a complete assembly.			
Capacitor	702458-305	1	59
Flexible Disk Drive Sub Assembly	114247-001	1	Ref.
Clamp Cable	715040-147	4	8
Carrier Assembly	114248-001	1	Ref.
Except for the following parts, it is recommended that this item be replaced as a complete assembly.			
Bracket, Diskette Lift, Left	114155-001	1	9
Bracket, Diskette Lift, Right	114155-002	1	10
Carrier Eject Assembly	114084-001	1	
Carrier, Eject	113915-001	1	11
Roll Pin	713730-005	1	12



NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-4. Parts List RFD400X/814255-XXX and RFD400X/814256-XXX (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Carrier Eject Assembly (Cont)			
Spring	714090-160	1	13
Clamp, Cable, Weckesser 3/32-2	715040-158	1	14
Expanding Clutch Assembly	112747-001	1	15
Head Load Solenoid Assembly	114085-001	1	
Arm, Diskette Load	114150-001	1	16
Bracket, Disk Load	114088-001	1	17
Solenoid, REMEX Spec.	715067-110	1	18
Housing, Index, L.E.D. Assembly	113948-001	1	20
Pin, Clutch	114273-001	1	21
Pin, Roll, Spring	713810-002	1	22
Ring, Retaining, Truarc 5133-25	715025-136	1	23
Shim, Bearing, Allied Devices AD3080	715030-226	1	24
Spring, Carrier	113922-001	2	25
Spring, Compression, Associated Spring Co. C0360-040-0620M	714090-151	1	26
Spring, Eject Carrier	113921-001	1	27
Switch Assembly, Write Protect Housing	114086-001	1	
Switch, Optical	113918-001	1	28
Switch, Optical	704214-014	1	29
Decal, Identification	716018-113	1	
Door, Latch Plate Assembly	114249-001	1	
Door	114079-001	1	30
Pad, Foam, Arlon 7AN Neoprene	716004-141	1	31
Plate, Latch	114156-001	1	32
Harness Assembly, Flexible Disk Drive	113947-001	1	(P2)
Except for the items listed below it is recommended that the Harness Assembly be replaced as a complete assembly:			
Connector, 34 pin, black, Amp 3-87456-0	706510-335	1	P2
Contact, Amp 87667-5	706530-179	24	(P2)
Contact, Berg 75374-004	706530-181	9	
Key, Polarizing, Amp 87077	706540-158	1	(P2)
Terminal, Push-On	715005-143	3	
Harness Assembly, Power Resistor	114151-001	1	(P7)
Except for the items listed below, it is recommended that the Harness Assembly, Power Resistor be replaced as a complete assembly:			
Connector, 5 pin, Amp 87499-9	706510-336	1	P7
Contact, Amp 876675	706530-179	4	(P7)
Contact, Push-On, Amp 42470-1	715005-125	4	
Key, Polarizing, Amp 87077	706540-158	1	(P7)
Resistor, 62 ohm, 10W	701020-005	2	R1,R2

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-4. Parts List RFD400X/814255-XXX and RFD400X/814256-XXX (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Main Frame Sub Assembly	114246-001	1	
Bearing, Lower, New Hamp. SFR1883PPK25/122	714000-141	1	33
Bearing, Upper, Nippon Miniature Bearing R-4ZZRA3P15LG-20	714000-125	1	34
Bracket, AC Connector	113929-001	1	(J8) 35
Bracket, Track 00 Assembly	114094-001	1	Ref.
Bracket	114082-001	1	36
Optical Switch	704214-014	1	56
Frame, Main	113937-001	1	37
Hub, Drive (when ordering a new drive hub, also order Bearing, Lower and Bearing, Upper)	113934-001	1	38
Motor Assembly, Stepper	113944-001	1	Ref.
Damper	113906-001	1	53
Motor Subassembly	113945-001	1	39
Plate	113928-001	1	54
Spring, Damper	714090-161	1	55
Panel Assembly, Front	114245-001	1	
Except for the items listed below, it is recommended that the Panel Assembly be replaced as a complete assembly.			
Catch	113909-001	1	40
Latch Assembly	114096-001	1	41
L.E.D. AND 107R	704004-010	1	42
Panel	114078-001	1	43
Release, Button Assembly	114244-001	1	44
Solenoid, 24 VDC, Deltrol Controls 100C-29172-61	703500-129	1	45
Pulley, Hub	112818-002	1	46
Sensor, Single-Sided Assembly	114075-001	1	47
Sensor, Two-Sided Assembly	114076-001	1	48
Spring	714090-146	1	49
Switch, Door Open, SPDT, Micro Switch IDM79MNA6943	715059-194	1	S1
Pad, Diskette Load	112761-001	1	50
Guide Rod	113904-002	2	51
Printed Circuit Card Assembly (codes 1,3,4 and 5)	113971-001	1	PC1
Printed Circuit Card Assembly (codes 2,6,7 and 8)	113971-002	1	PC1
Pulley, Drive Motor (codes 1 and 2)	112819-001	1	52
Pulley, Drive Motor (codes 3,5,6 and 8)	112819-004	1	52
Pulley, Drive Motor (codes 4 and 7)	112819-002	1	52
Shield, Head	114251-001	1	57
Support, Corner	114171-001	2	58

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-7. Miscellaneous and Optional Parts.

Description and Manufacturer's Part No.	REMEX Part No.	Quantity	Reference Designation
Kit of Parts, (RMF0020) Connector, 50 pin, Amp 88077-1 Connector, Housing, 6 pin, Amp 1-480270-0 Connector, Housing, 3 pin, Amp 1-480700-0 Contact, Connector, Amp 60619-1 Contact, Connector, Amp 350550-1 Key, Polarizing, Amp 88113-1 Manual	114164-001 706510-313 706510-325 706500-343 706530-180 706530-176 706540-157 112670-103	1 1 1 1 6 3 1 1	P1 P5 P8 (P5) (P8) (P1)
Kit of Parts, (RMF0021) Contents are identical to 114164-001 except delete manual.	114164-002	1	
Connector, 2 pin, Amp 530153-2 (Used as jumpers when connecting customer installed options)	706510-314		
Diskette 2, IBM 2736700 Diskette 2D, IBM 1766872 Diskette 1, IBM 23058-30	716083-005 716083-004 716083-001		

NOTE: WHEN ORDERING SPARE PARTS, CONTACT REMEX SPARES ORDER DESK AND REFERENCE COMPLETE MODEL AND SERIAL NUMBER OF UNIT. ALWAYS REFER TO ADDENDUM AT THE REAR OF THE MANUAL (IF APPLICABLE) FOR POSSIBLE PART NUMBER CHANGES.

Table 7-8. Printed Circuit Card Assembly, Drive, 113971-001, 002.

The following parts list was written for the C assembly and the D schematic revision. Subsequent changes are contained on a P.C. Card Change Record Form contained in the addendum.

Description and Manufacturer's Part No.	REMEX Part No.	-001,-002 Quantity		Reference Designation
Capacitor, .01 $\mu$ f, 200V, Type CK06	702128-103	2	2	C1,C2
Capacitor, 0.22 $\mu$ f, 35V, Polarized, Solid Tantalum, Sprague 196D224X9035JA1	702396-224	2	2	C3,C4
Capacitor, 0.1 $\mu$ f, 50V, Metallized Mylar ELPAC Z5R104K	702180-104	2	3	C5,C14,C16
Capacitor, 1000 pf, 100V, Dipped Mica, El Menco DM15-102J	702124-102	2	4	C6,C7,C12,C13
Capacitor, 39 pf, 300V, Dipped Mica, El Menco DM5	702123-390	4	4	C8-C11
Capacitor, 0.015 $\mu$ f, 100V, Metallized Mylar, Electrocube 217A1B153K	702181-153	1	1	C15
Capacitor, 0.27 $\mu$ f, 50V, Metallized Polyester, ELPAC Z5R274K	702180-274	-	1	C17
Capacitor, 10 $\mu$ f, 25V, Solid Tantalum, Polarized, Sprague 196D106X9025KA1	702395-106	2	2	C18,C28
Capacitor, 100 $\mu$ f, 25V, Electrolytic, Sprague 501D107F025XX	702641-107	1	1	C19
Capacitor, 10 $\mu$ f, 50V, Electrolytic, Sprague Type TE	702372-106	2	2	C20,C27
Capacitor, 0.01 $\mu$ f, 100V, Ceramic Disk, Erie 805X5V103Z	702121-103	25	25	C21-C23,C25,C26, C29,2G-GG,6F, 1E-5E,8D,1C-4C, 6C-8C
Capacitor, 10 $\mu$ f, 12V, Electrolytic, Sptague, Type TE	702371-106	1	1	C24
Choke, 33 $\mu$ H, DINK-33	702500-125	2	2	L3,L4
Choke, 150 $\mu$ H, DINK-150	702500-126	5	5	L1,L2,L5-L7
Connector, 34 pin, Amp 1-87230-7	706500-335	1	1	J2
Connector, 6 pin, Molex 22-12-2061	706500-295	2	2	J3,J4
Connector, 6 pin, Amp 1-380999-0	706500-334	1	1	J5
Connector, 10 pin, Amp 1-87233-0	706500-340	1	1	J6,J7
Connector, Socket, 2 pin, Amp 530153-2	706510-314	5	6	DS1,DL,TS,S2, 4000/4001 -15V
Diode, FDH6666	704000-110	15	15	CR1-CR8,CR10, CR12-CR17
Diode, Zener, 3.6V, 1N747A	704010-126	1	1	CR9
Diode, Zener, 5.1V, 1N751A	704010-116	1	1	CR11
Diode, 1N4003	704005-137	6	6	CR18-CR23
I.C. Package, Voltage Regulator MC7905	704520-137	1	1	Z1
I.C. Package, Resistor Pack, 10K	701900-007	1	1	Z2
I.C. Package, Resistor Pack, 220/330	701900-022	1	1	Z3
I.C. Package, 220/330	701900-011	1	1	Z7A
I.C. Package, Q2T2905	704202-113	1	1	Z7F
I.C. Package, UHP 407	704900-110	1	1	Z3B

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Table 7-8. Printed Circuit Card Assembly, Drive, 113971-001, 002 (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	-001 -002		Reference Designation
		Quantity		
I.C. Package, ULN2074B	704900-111	1	1	Z4B
I.C. Package, 75462	704600-160	2	2	Z1G, Z8G
I.C. Package, 74LS86	704620-086	1	1	Z2C
I.C. Package, 74LS74	704620-074	5	5	Z2E, Z2F, Z3C, Z3F, Z4D
I.C. Package, 74LS27	704620-027	1	1	Z4E
I.C. Package, 74LS08	704620-008	1	1	Z3D
I.C. Package, 74LS04	704620-004	4	4	Z1F, Z4F, Z6B, Z6E
I.C. Package, 74LS02	704620-002	3	3	Z1E, Z5F, Z8B
I.C. Package, 74LS00	704620-000	4	4	Z2D, Z3E, Z5G, Z7B
I.C. Package, 8T20	704610-172	1	1	Z9C
I.C. Package, 9602	704610-127	2	4	Z1D, Z5C, Z6F, Z8D
I.C. Package, 7474	704610-110	1	4	Z6C, Z6D, Z6G, Z8C
I.C. Package, 7438	704600-149	2	2	Z5D, Z6A
I.C. Package, 7417	704600-141	2	2	Z4G, Z9A
I.C. Package, 7406	704600-111	1	1	Z7G
I.C. Package, 7400	704600-101	1	3	Z7C, Z7D, Z9B
I.C. Package, NE592	704520-145	2	2	Z9D, Z9F
I.C. Package, NE556	704520-134	2	2	Z2G, Z3G
Resistor, 5.62K, 1/8W, $\pm 1\%$	701205-621	2	2	R1, R2
Resistor, 10 ohm, 1/4W, $\pm 5\%$	701003-100	2	2	R3, R6
Resistor, 10K, 1/8W, $\pm 1\%$	701201-002	2	2	R4, R5
Resistor, 150 ohm, 1/4W, $\pm 5\%$	701003-150	4	4	R7, R12, R79, R80
Resistor, 221 ohm, 1/8W, $\pm 1\%$	701202-210	3	3	R8, R9, R39
Resistor, 75 ohm, 1/4W, $\pm 5\%$	701003-750	3	3	R10, R11, R38
Resistor, 33K, 1/4W, $\pm 5\%$	701003-333	2	2	R13, R17
Resistor, 1.5K, 1/4W, $\pm 5\%$	701003-152	3	3	R14, R15, R32
Resistor, 2.2K, 1/4W, $\pm 5\%$	701003-222	12	14	R18, R20, R21, R25, R49, R58-R61, R66, R68, R72, R76, R77
Resistor, 24K, 1/4W, $\pm 5\%$	701003-243	1	1	R19
Resistor, 10K, 1/4W, $\pm 5\%$	701003-103	8	8	R22, R23, R41, R48, R56, R67, R69, R70
Resistor, 9.1K, 1/4W, $\pm 5\%$	701003-912	-	1	R24
Resistor, 5.6K, 1/4W, $\pm 5\%$	701003-562	-	1	R26
Resistor, 18K, 1/4W, $\pm 5\%$	701003-183	2	2	R28, R43
Resistor, 12.1K, 1/8W, $\pm 1\%$	701201-212	1	1	R29
Resistor, 866 ohm, 1/8W, $\pm 1\%$	701208-660	1	1	R30
Resistor, 1K, 1/4W, $\pm 5\%$	701003-102	7	7	R31, R33, R42, R45, R46, R71, R81
Resistor, 1.33K, 1/8W, $\pm 5\%$	701201-331	2	2	R34, R35
Resistor, 1K, 1/8W, $\pm 1\%$	701201-001	2	2	R36, R37

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Table 7-8. Printed Circuit Card Assembly, Drive, 113971-001, 002 (Continued).

Description and Manufacturer's Part No.	REMEX Part No.	-001 -002 Quantity		Reference Designation
Resistor, 1.8K, 1/4W, $\pm 5\%$	701003-182	1	1	R40
Resistor, 39K, 1/4W, $\pm 5\%$	701003-393	1	1	R44
Resistor, 43 ohm, 1/2W, $\pm 5\%$	701004-430	1	1	R47
Resistor, 3.3K, 1/4W, $\pm 5\%$	701003-332	4	4	R50-R53
Resistor, 100 ohm, 1/4W, $\pm 5\%$	701003-101	6	6	R54, R55, R57, R64, R65, R73
Resistor, 15K, 1/4W, $\pm 5\%$	701003-153	-	1	R62
Resistor, 43K, 1/4W, $\pm 5\%$	701003-433	-	1	R63
Resistor, 100 ohm, 2W, $\pm 5\%$	701014-101	1	1	R74
Resistor, 68 ohm, 2W, $\pm 5\%$	701014-680	1	1	R75
Resistor, Variable, 50K, 1/2W, Spectrol 64W	701676-503	1	1	R16
Resistor, Variable, 1/2W, $\pm 5\%$ , Spectrol 53-1-1	701659-502	-	1	R27
Socket, I.C., 16 pin, Robinson Nugent Inc., ICA-163-SG	706515-144	1	1	(5E)
Socket, I.C., 14 pin, Amphenol 821-20011-144	706515-133	1	1	(Z7A)
Shunt, 8 position, Amp 435704-8	716053-163	1	1	5E
Terminal, Male, Amp 87307-2	706530-175	59	64	
Transistor, 2N4401	704203-114	5	5	Q1-Q5

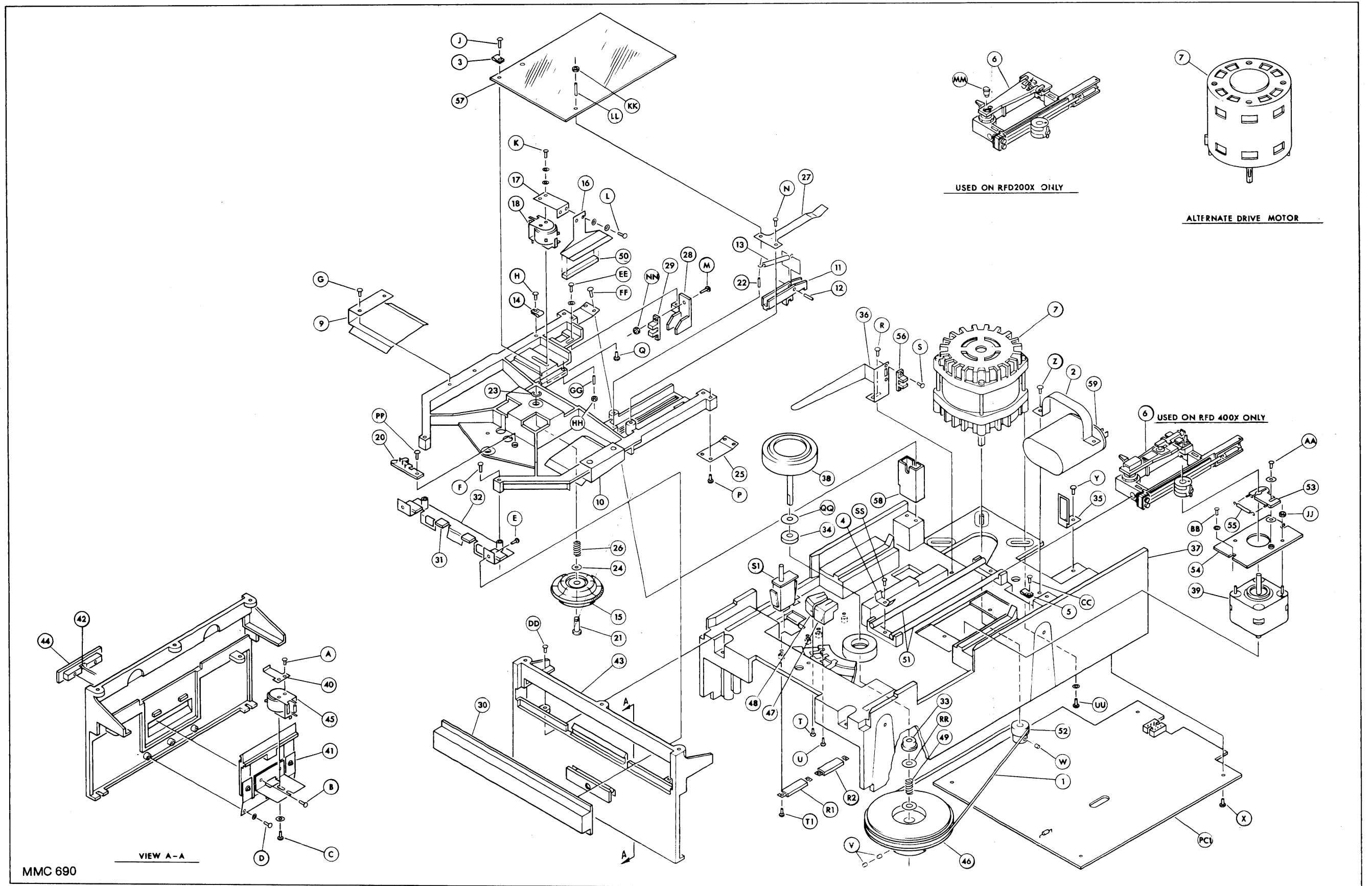


Figure 7-1. Exploded View of RFD4000.

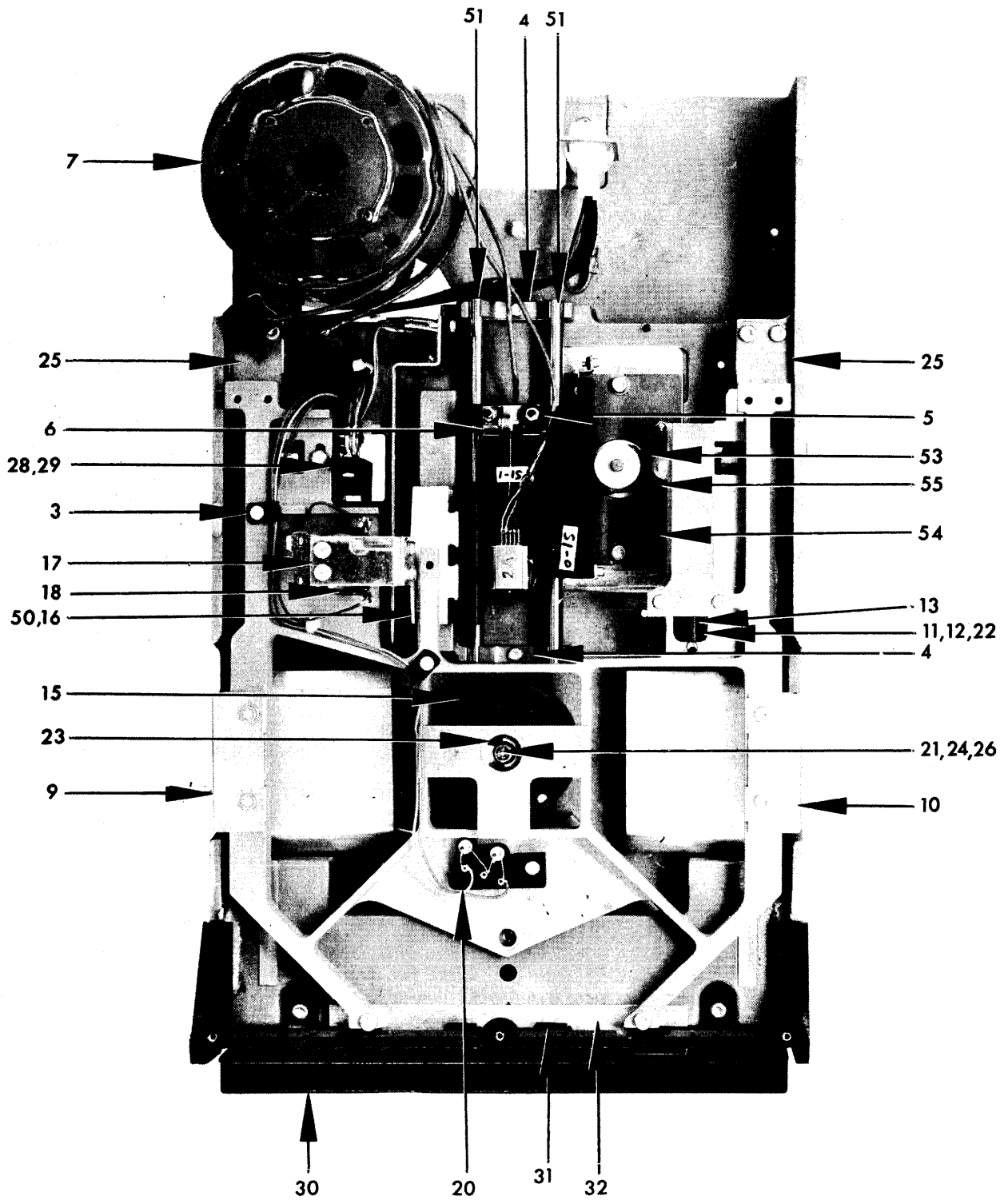


Figure 7-2. Top View, RFD4000.



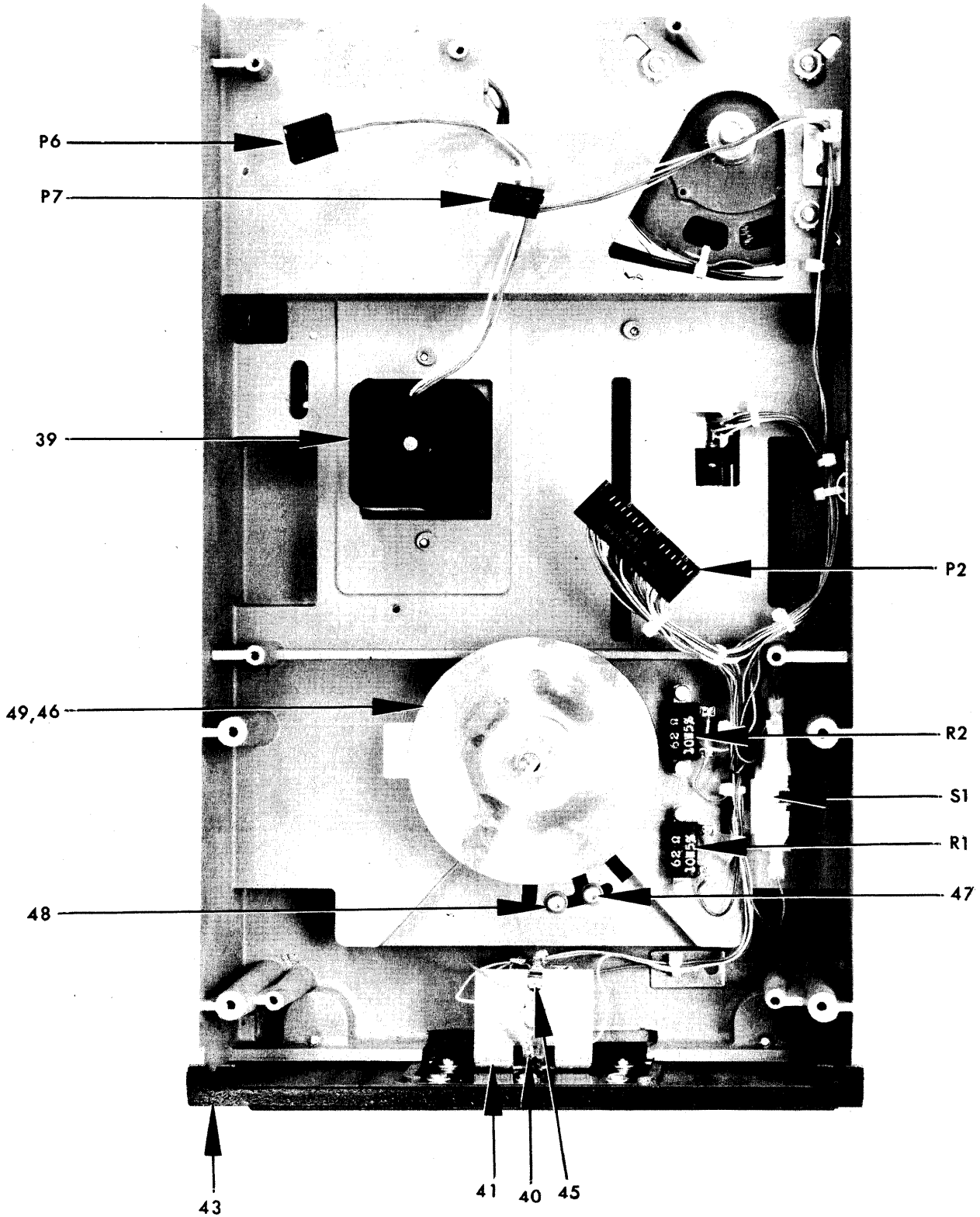


Figure 7-3. Bottom View with P.C. Card Removed.

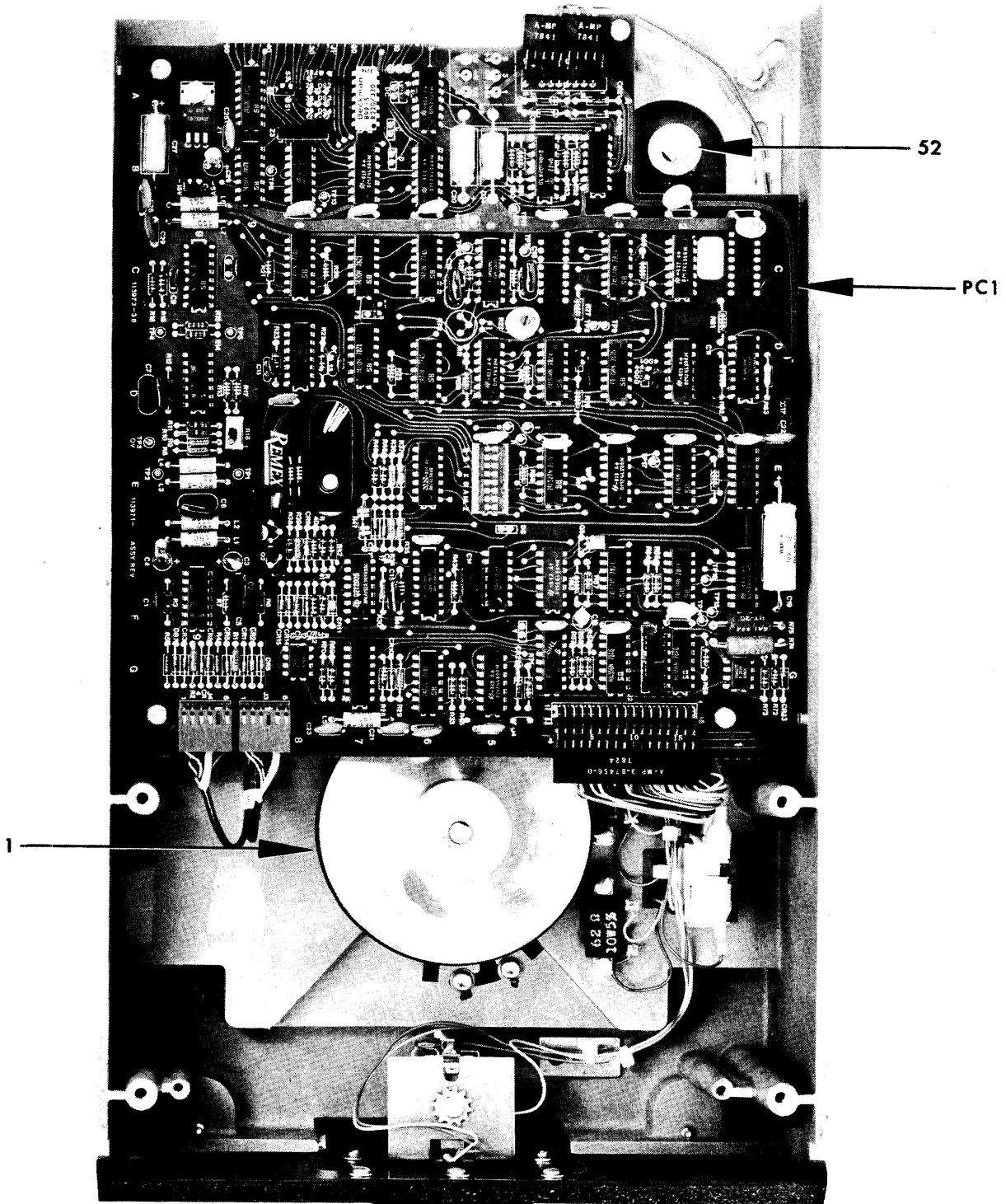


Figure 7-4. Bottom View with P.C. Card.

## SECTION VIII

### SCHEMATIC DRAWINGS

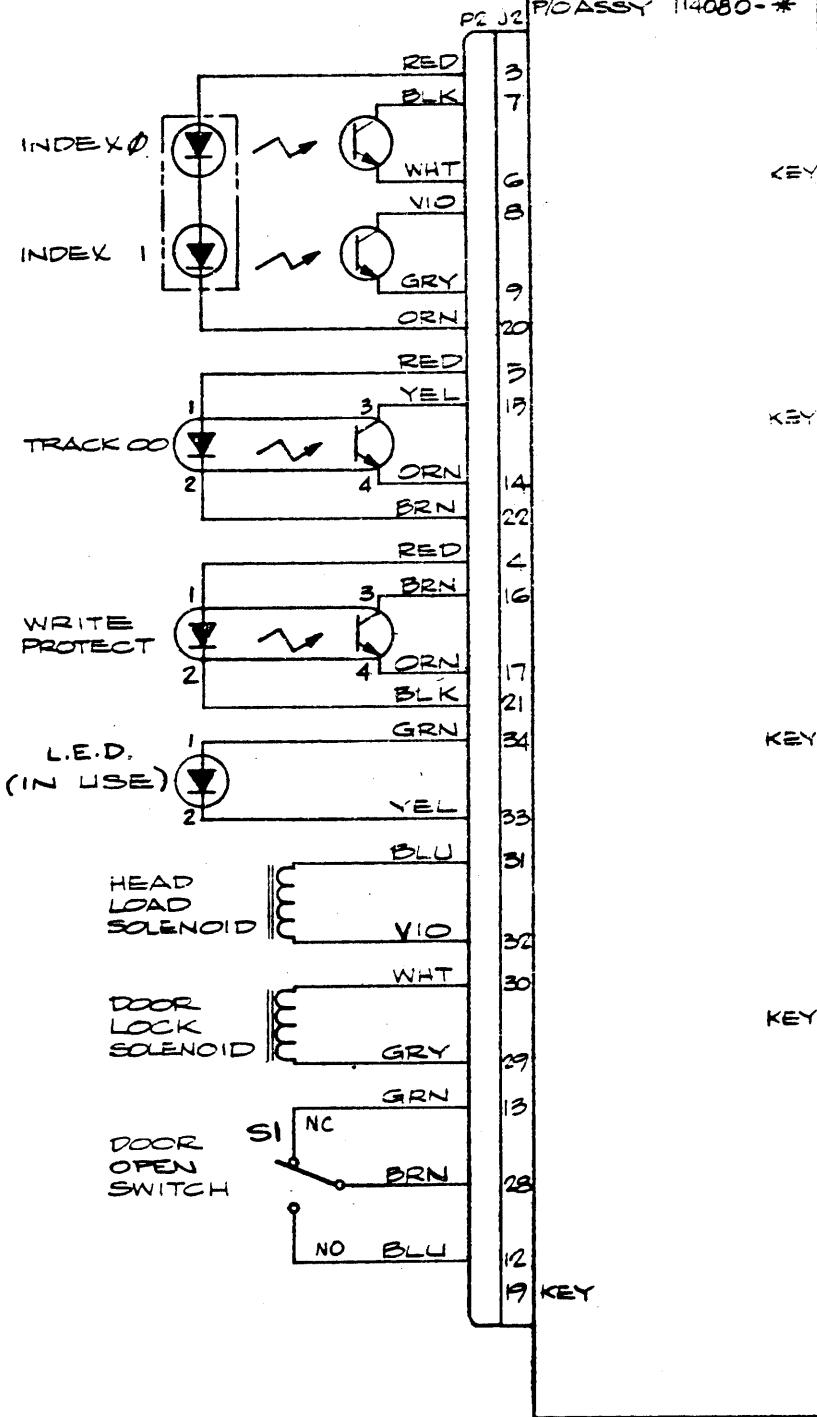
#### 8.1 GENERAL

Figure 8-1, sheet 1, contains the system schematic for the RFD200X and sheet 2 contains the overall schematic for the RFD400X. Figure 8-2 contains the schematic for the Drive Card.

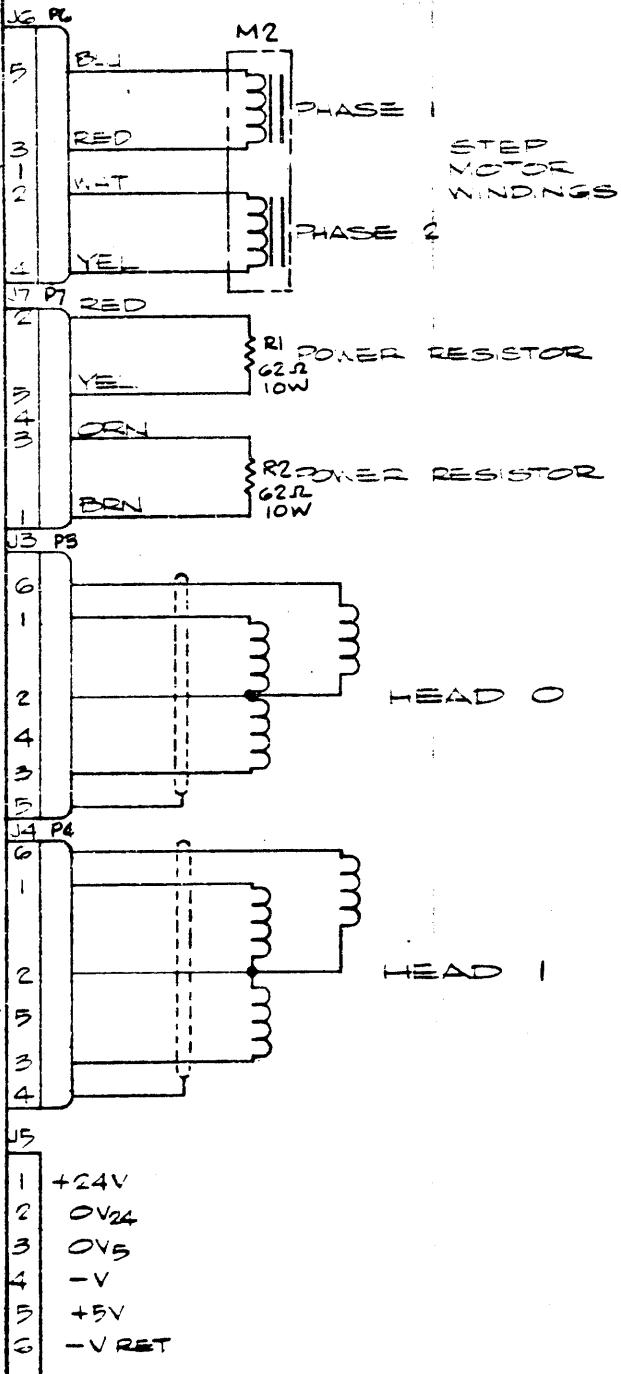
SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPRD
	2175	RELEASED			2/15/73	SK
B	18100	2.16.73	REVISE PER ECO	DP		

FLEXIBLE DISK DRIVE CARD  
 ASSEMBLY 114090-00\*  
 SCHEMATIC 113976-001  
 P/O ASSY 114080-00\*  
 OR  
 P/O ASSY 114090-00\*

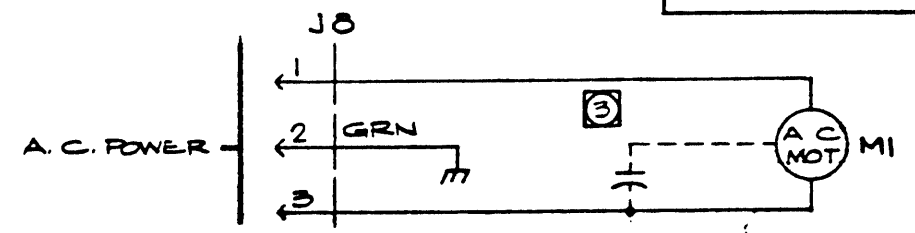
- 11 P1B
- 2 LOW CURRENT \*
  - 4 SPARE
  - 6 SPARE
  - 8 TWO SIDED \*
  - 10 DISK CHANGE \*
  - 12 SIDE SELECT \*
  - 14 IN USE \*
  - 16 LOAD HEAD \*
  - 18 INDEX \*
  - 20 READY \*
  - 22 SECTOR \* (4001 ONLY)
  - 24 DRIVE SELECT 1 \*
  - 26 DRIVE SELECT 2 \*
  - 28 DRIVE SELECT 3 \*
  - 30 DRIVE SELECT 4 \*
  - 32 DIRECTION \*
  - 34 STEP \*
  - 36 WRITE DATA \*
  - 38 WRITE GATE \*
  - 40 TRACK 00 \*
  - 42 WRITE PROTECT \*
  - 44 READ DATA \*
  - 46 SEP DATA \* (4001 ONLY)
  - 48 SEP CLOCK \* (4001 ONLY)
- 49 ODD NUMBERS 1 THRU 49
- OV



FLEXIBLE DISK DRIVE CARD  
 ASSEMBLY 113976-001  
 SCHEMATIC 113976-001  
 P/O ASSY 114080-00\*



- NOTE: UNLESS OTHERWISE SPECIFIED -
1. REFERENCE ASSEMBLY DWG NO. 114080-00\*
  2. SYMBOL \* INDICATES NEGATIVE TRUE SIGNAL.
  3. CAPACITOR USED ON SYNCHRONOUS MOTOR ASSY PN 114090-001 THRU 114090-006.



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Figure 8-1. Sheet 2, System Schematic, RFD400X.  
 112670-103A 8-5/8-6

DESIGNATION	LAST USED
CAPACITOR	C19
DIODE	CR23
INTEGRATED CIRCUIT	IC9F
RESISTOR	R81
RESISTOR NET	R3, 7A
TRANSISTOR	Q3
CHOKE	L7

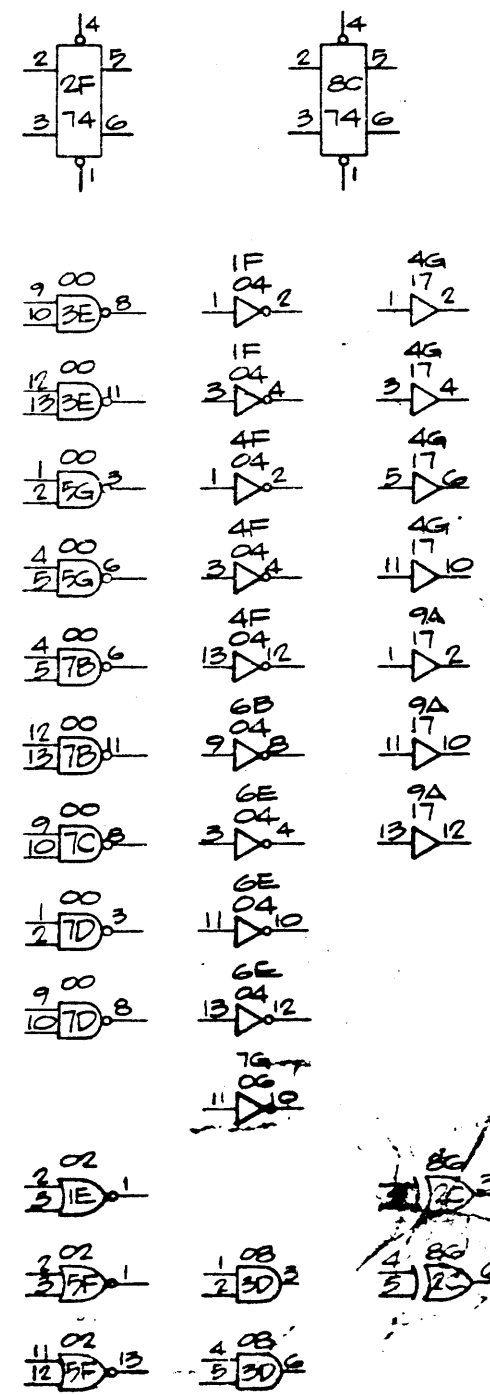
STANDARD JUMPER TABLE	
MODEL	JUMPERS
4000	DS1, DL, S2, 4000, -15V, UU
4001	DS1, DL, S2, 4001, -15V, TS, UU
2000	DS1, DL, S3, 4000, -15V, UU
2001	DS1, DL, S3, 4001, -15V, TS, UU

REVISION STATUS		
FAB	SCHEM	ASSY
A	-	-
B	A	A
C	B	A, B
C	D	C

SYM	ECO	EFFECT	REVISIONS	BY	DATE	APP
A	-	RELEASED				
B	1	ADDED 2E1				
C	2	ADDED 2E1				
D	3	ADDED 2E1				

SIGNAL INDEX			
SIGNAL	DEFINITION	SOURCE	LOCATION
CTO	CENTER TAP 0	GD4	2DB
CTI	CENTER TAP 1	GD4	2CB
DC INT	DISC CHANGE INTERRUPT	GA4	5DG
DIRECTION SELECT*	DIRECTION SELECT	4E7	6E7
DRSE	DRIVE SELECT ENABLE	GC4	3E7
DRV SEL INT	DRIVE SELECT INTERRUPT	GD4	4A4 5E4
DRV SEL INT*	DRIVE SELECT INTERRUPT	GC4	3D7 5D3
ERASE 0	ERASE 0	2DB	3B2
ERASE 1	ERASE 1	2DB	3A2
POWER UP RESET	POWER UP RESET	GB4	3A7 4D7
READ GATE*	READ GATE	3E3	2C4 4D7
READY	READY	5D4	6A2
READY 1	READY SIDE 1	5C4	2C3
READY 1*	READY SIDE 1	5C4	3E7
SIDE 1*	SIDE 1	GD4	5C7
STEP MOTOR ENABLE	STEP MOTOR ENABLE	GC4	4D4
TROO	TRACK 00	5E7	4A4
U RDY*	UNSELECTED READY	5C2	2C2
WC +	WRITE CURRENT	2E8	3C3
WC -	WRITE CURRENT	2E8	3C3
WRITE PROT	WRITE PROTECT	5D4	3E7

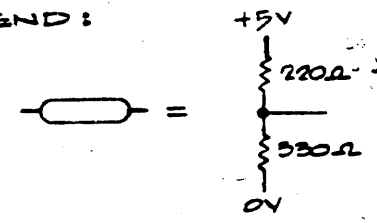
SPARES:



NOTE: UNLESS OTHERWISE SPECIFIED -

- REFERENCE DRAWINGS-ASSEMBLY 113971-\*
- CAPACITORS ARE IN MF, 100V
- RESISTORS ARE IN OHMS, ±5%, 1/4W.
- THE THREE CHARACTER ADDRESS IS: SHEET NUMBER-HORIZONTAL ZONE-VERTICAL ZONE
- AN ASTERISK FOLLOWING SIGNAL NOMENCLATURE INDICATES THE NEGATIVE FUNCTION. +5V OV
- 21 IS (MCT905) 704520-137
- 22 IS 701900-007
- 23 IS 701900-022
- 24 IS (9602) 704610-127.
- 25 IS (74LS02) 704620-002.
- 26 IS (74LS04) 704620-004.
- 27 IS (7462) 704600-160.
- 28 IS (74LS86) 704620-086.
- 29 IS (74LS00) 704620-000.
- 30 IS (NE555) 704520-134.
- 31 IS (UHP401) 704900-110.
- 32 IS (74LS08) 704620-008.
- 33 IS (ULN2074B) 704900-111.
- 34 IS (74LS27) 704620-027.
- 35 IS (74LS74) 704600-141.
- 36 IS (7438) 704600-149.
- 37 IS (7474) 704610-110.
- 38 IS 701900-011.
- 39 IS (7400) 704600-101.
- 40 IS (Q2T2905) 704202-113.
- 41 IS (7466) 704600-111.
- 42 IS (BT20) 704610-172.
- 43 IS (NE592) 704520-145.
- 44 IS (74LS74) 704620-074.
- 45 IS (FDH6666) 704000-110.
- 46 IS (IN747A) 704010-126.
- 47 IS (IN751A) 704010-116.
- 48 IS (IN4003) 704005-157.
- 49 IS (2N4401) 704203-114.

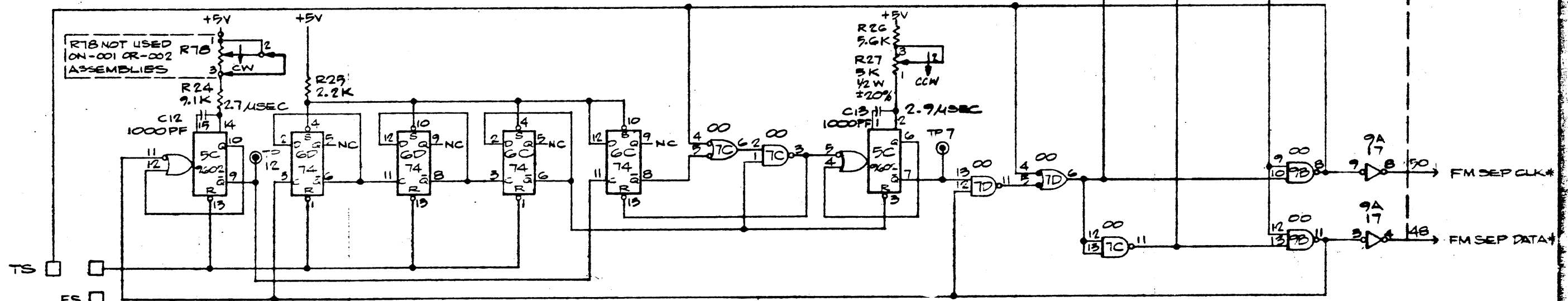
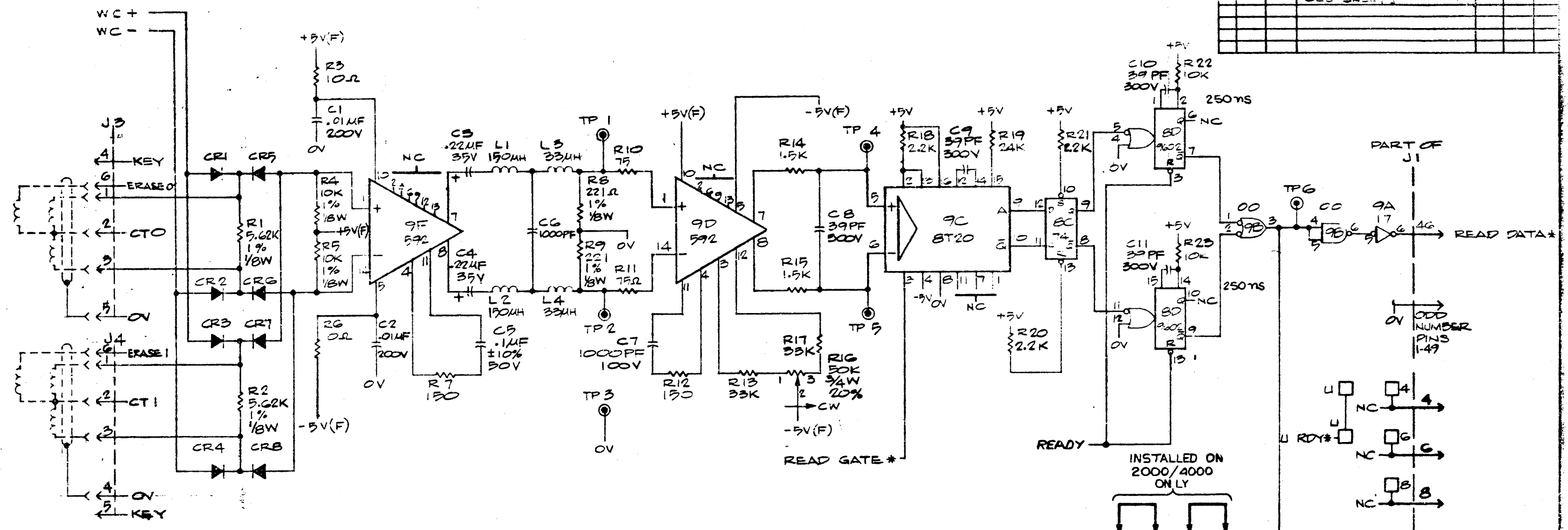
LEGEND:



REF	QTY	DESCRIPTION
2F	2	CAPACITOR
8C	2	CAPACITOR
3E	1	DIODE
3F	1	DIODE
3G	1	DIODE
3H	1	DIODE
3I	1	DIODE
3J	1	DIODE
3K	1	DIODE
3L	1	DIODE
3M	1	DIODE
3N	1	DIODE
3O	1	DIODE
3P	1	DIODE
3Q	1	DIODE
3R	1	DIODE
3S	1	DIODE
3T	1	DIODE
3U	1	DIODE
3V	1	DIODE
3W	1	DIODE
3X	1	DIODE
3Y	1	DIODE
3Z	1	DIODE
3A	1	TRANSISTOR
3B	1	TRANSISTOR
3C	1	TRANSISTOR
3D	1	TRANSISTOR
3E	1	TRANSISTOR
3F	1	TRANSISTOR
3G	1	TRANSISTOR
3H	1	TRANSISTOR
3I	1	TRANSISTOR
3J	1	TRANSISTOR
3K	1	TRANSISTOR
3L	1	TRANSISTOR
3M	1	TRANSISTOR
3N	1	TRANSISTOR
3O	1	TRANSISTOR
3P	1	TRANSISTOR
3Q	1	TRANSISTOR
3R	1	TRANSISTOR
3S	1	TRANSISTOR
3T	1	TRANSISTOR
3U	1	TRANSISTOR
3V	1	TRANSISTOR
3W	1	TRANSISTOR
3X	1	TRANSISTOR
3Y	1	TRANSISTOR
3Z	1	TRANSISTOR

Figure 8-2. Sheet 1, Schematic Drive Card 113971-XXX.

SYM	ECO	EFFECT	REVISIONS	BY	DATE
			SEE SHEET 1		



MODEL 4001 ONLY  
(-002 ASSY)

Figure 8-2. Sheet 2, Schematic Drive Card 113971-XXX.

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SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPR
			SEE SHEET 1			

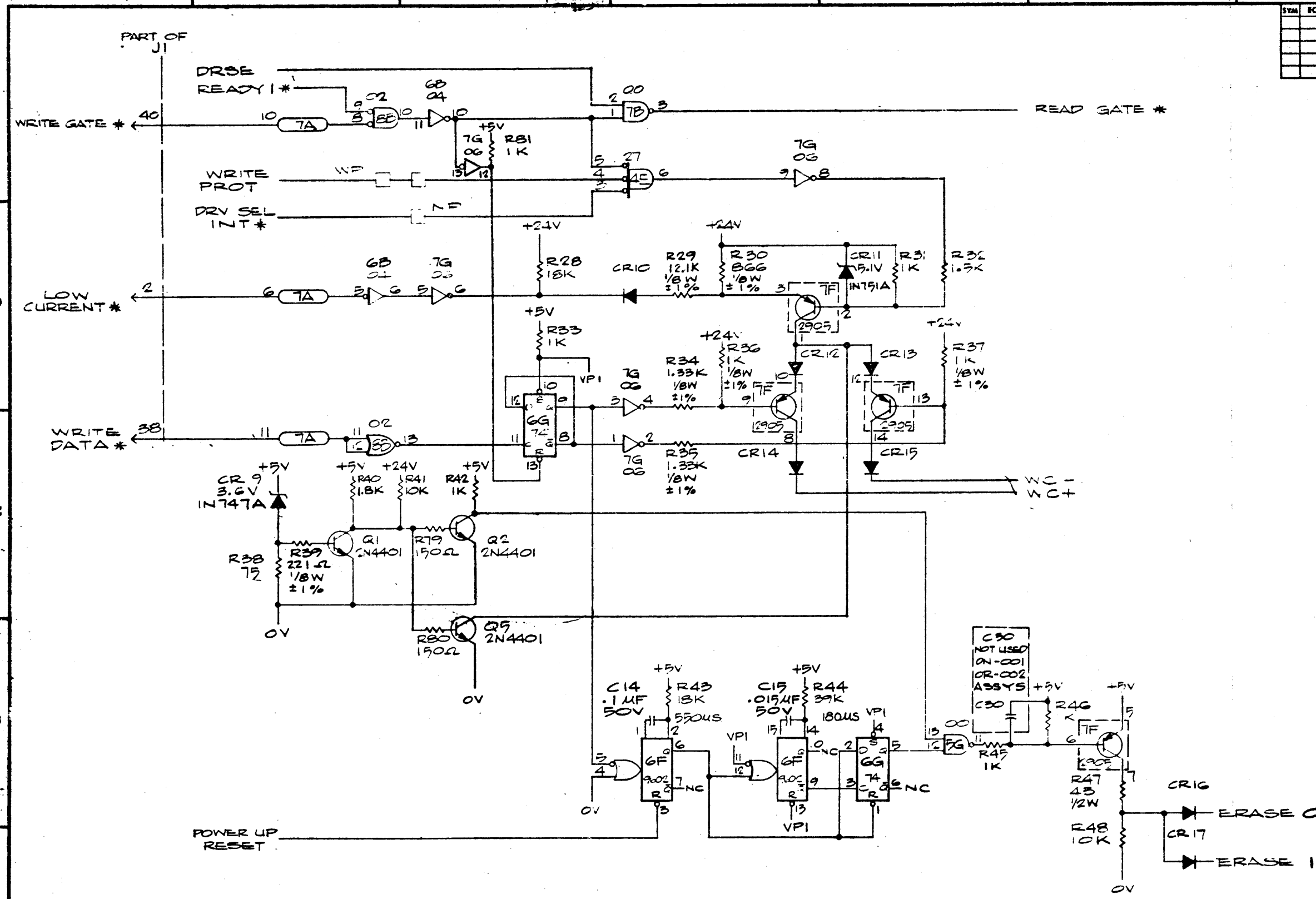


Figure 8-2. Sheet 3, Schematic Drive Card 113971-XXX.  
112670-103A 8-11/8-12

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SYM	ECO	EFFECT	REVISIONS		BY	DATE	APPV

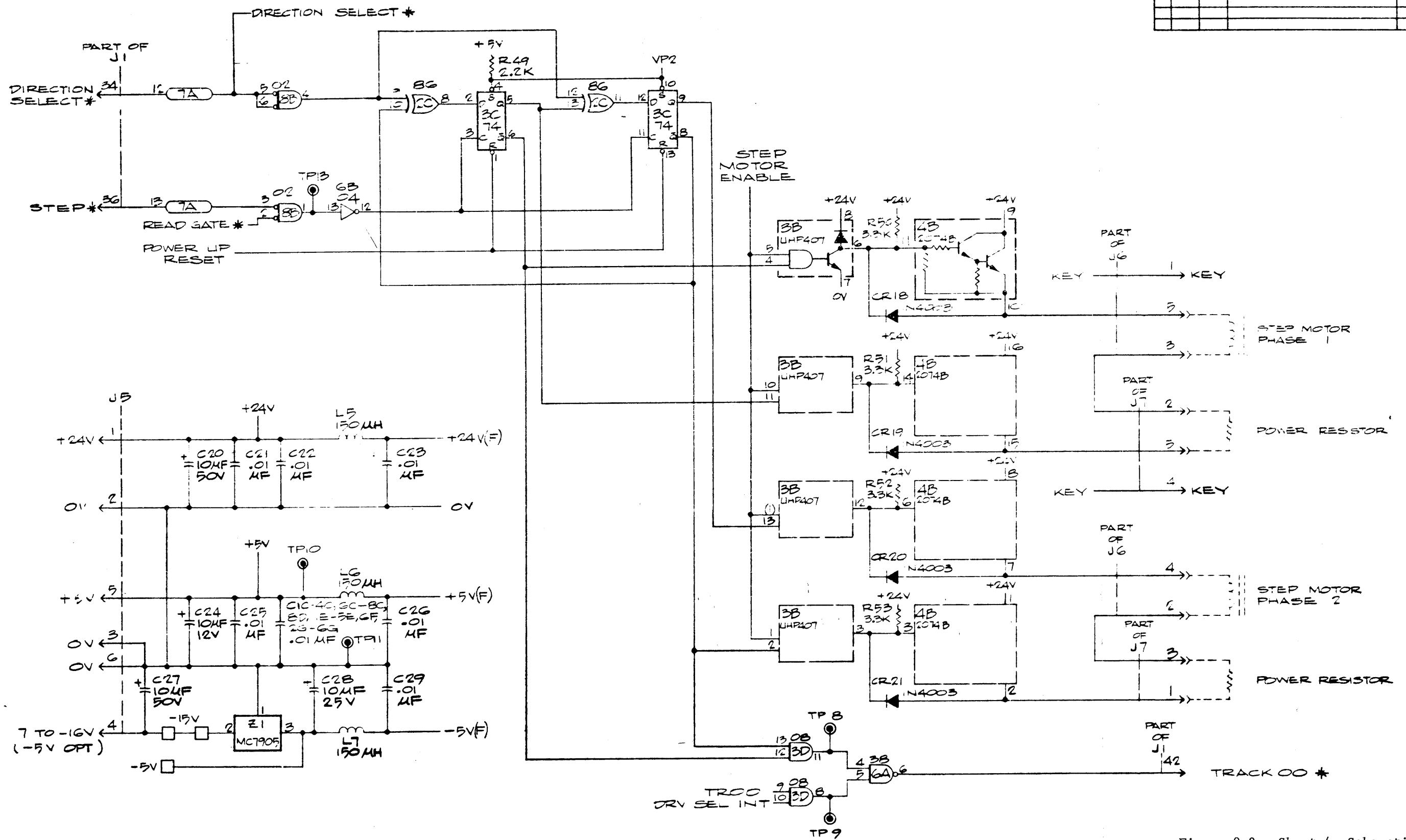
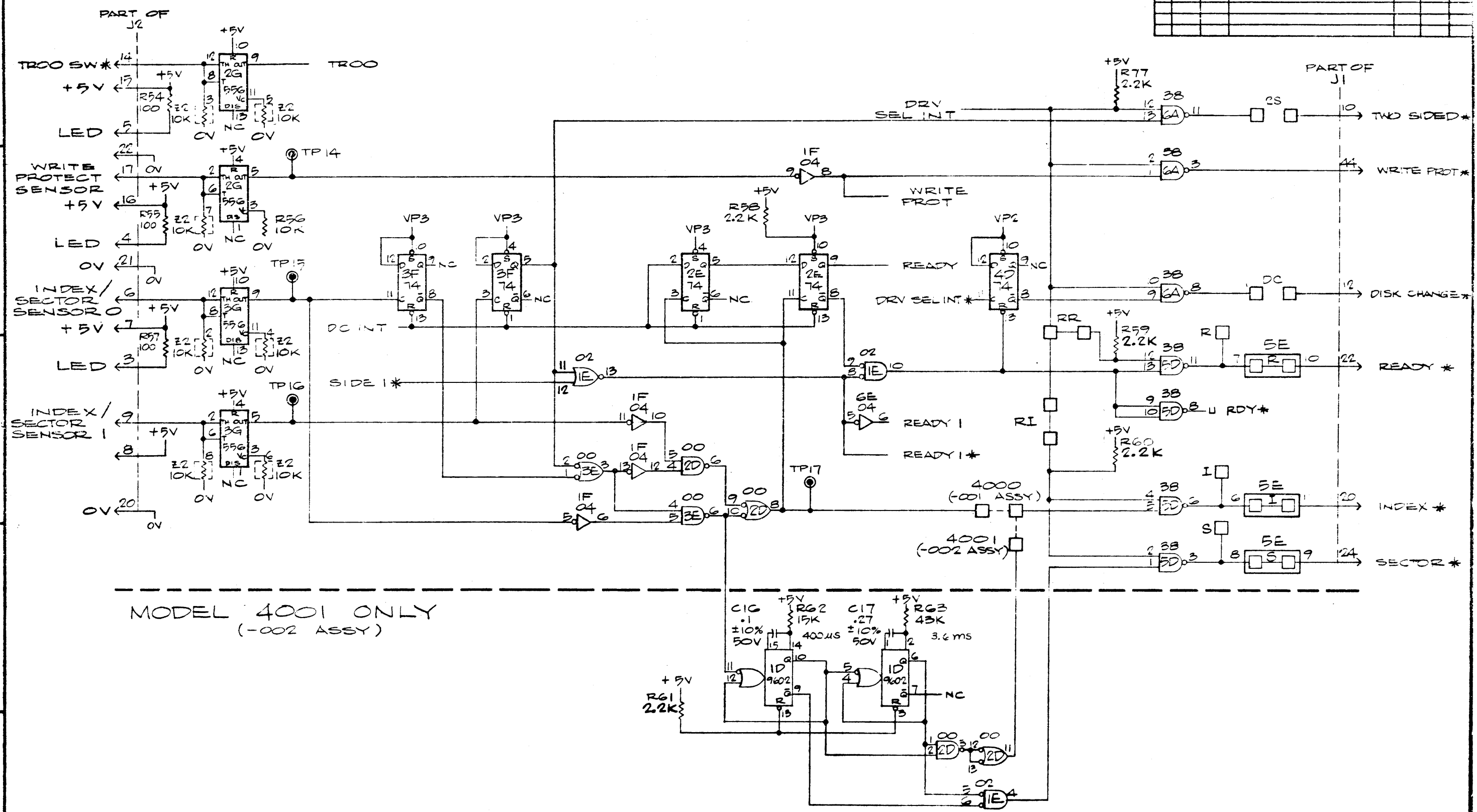


Figure 8-2. Sheet 4, Schematic Drive Card 113971-XXX.

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			EEB ELECT		



MODEL 4001 ONLY  
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Figure 8-2. Sheet 5, Schematic Drive Card 113971-XXX.

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SYM	ECO	EFFECT	REVISIONS	BY	DATE	APPR
			SEE SHEET 1			

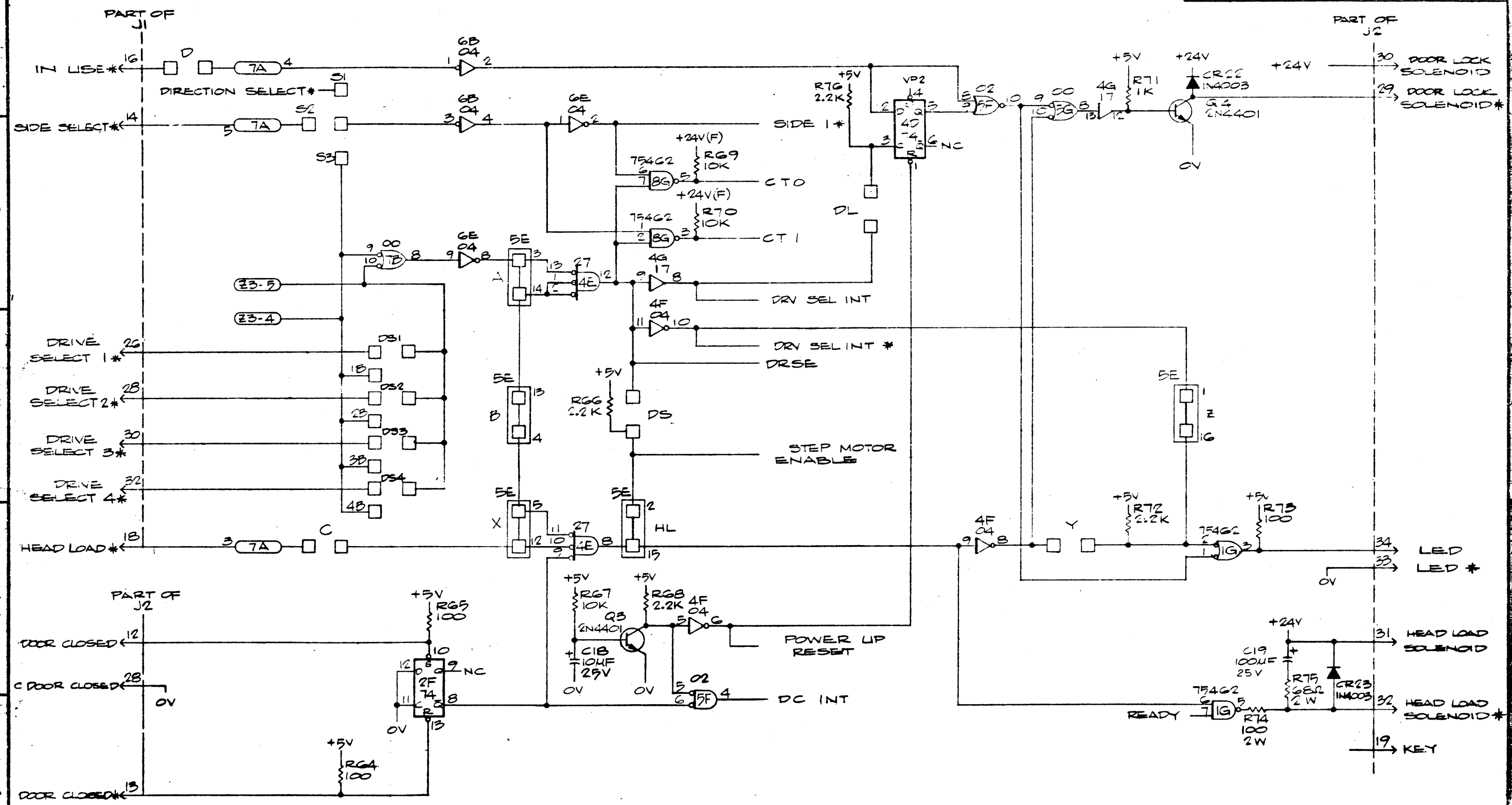


Figure 8-2. Sheet 6, Schematic Drive Card 113971-XXX

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ADDENDUM SHEET

The following changes in the manual are required:

1. On pages 7-2, 7-4, and 7-8, later model units use Carriage, Subassembly 113942-001. The former 113946-001 assembly can be identified as item 6, Figure 7-2, page 7-25 and the new part is shown as item 6 (RFD400X) on Figure 7-1, page 7-23/7-24.

The following replaces item 6 in the parts list for the RFD400X models:

Carriage Sub Assembly	113942-001	1	6
Except for the items listed below, the entire Carriage Sub Assembly should be replaced as a complete unit.			
Band	114159-001	1	
Pulley, Band	113900-001	1	
Spring	114243-001	1	

2. On pages 7-3, 7-11 and 7-15, later model units use:

Carriage, Subassembly 114240-001. The new part is shown as item 6 (RFD200X), Figure 7-1, page 7-23/7-24. The following replaces item 6 in the parts list for the RFD200X models:

Carriage Sub Assembly	114240-001	1	6
Except for the items listed below, the entire Carriage Sub Assembly should be replaced as a complete unit.			
Band	114159-001	1	
Head Pad Cartridge Assembly	112800-001	1	
Pulley, Band	113900-001	1	
Spring, Carriage Band	114243-001	1	

3. On pages 7-5, 7-9, 7-12, 7-16 as part of the Door, Latch Plate Assembly, replace Pad Foam Arlon 7AN Neoprene P/N 716004-141 (item 31) with the following two parts:

Pad, Foam, 1/8 x 3/8 x 5/16	114325-001	2	31
Pad, Foam, 1/8 x 3/8 x 3/4	114320-001	2	31A

4. Add the following to Sections 3.6.2 and 4.2.13.2:

Later model cards (113971-001 or 002 B assembly or higher) which contain the U (Unselect Ready) pin can select Radial Ready by adding a jumper from the U pin to one of the adjacent unused pins 4, 6 or 8. Thus the procedure of Section 3.6.2 can be eliminated.

ADDENDUM SHEET (CONTINUED)

5. On pages 7-8 and 7-15 as part of Carrier Assembly 114248-001, the part number for Bracket, Diskette Lift, Left should be 113920-001 and for Bracket, Diskette Lift, Right should be 113920-002.