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**Diablo Systems Incorporated**  
A Xerox Company

Series 30 Disk Drive  
Maintenance Manual

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Maintenance Manual**

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All requests for repairs should be directed to the Diablo Repair Depot in your area. This will assure you of the fastest possible service.

UL File #E48862

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## SECTION 1 GENERAL DESCRIPTION AND SPECIFICATIONS

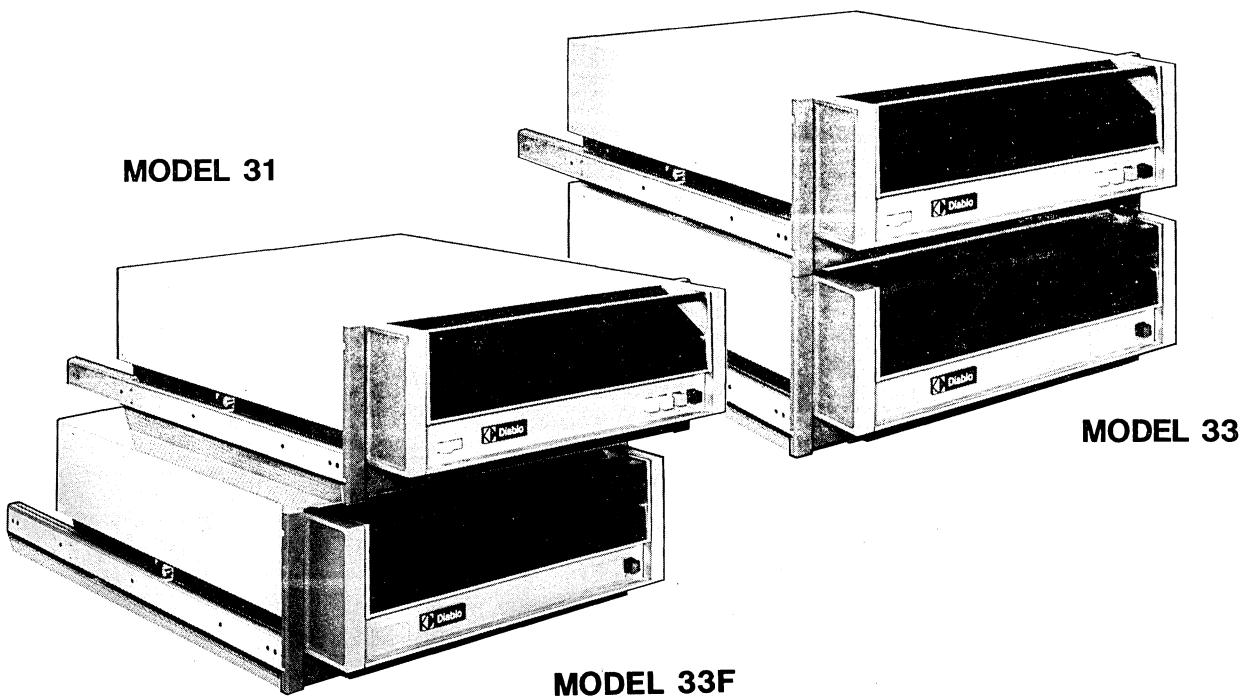


Figure 1-1 SERIES 30 DISK DRIVES

### 1.1 INTRODUCTION

The Series 30 Drives include Models 31, 33F and 33. Model 31 is the basic version and the major subject of this manual. It features an operator exchangeable Type 2315 Single Disk Cartridge. Model 33F is identical to the Model 31 in its data handling characteristics and capabilities. Its disk cartridge is, however, locked in and requires a technician to make an exchange. The Model 31's movable front panel door is eliminated along with associated interlock and safety circuitry, the LOAD/RUN switch, and the LOAD, READY and CHECK indicator lights. The Model 33 consists of one each Model 31 and Model 33F.

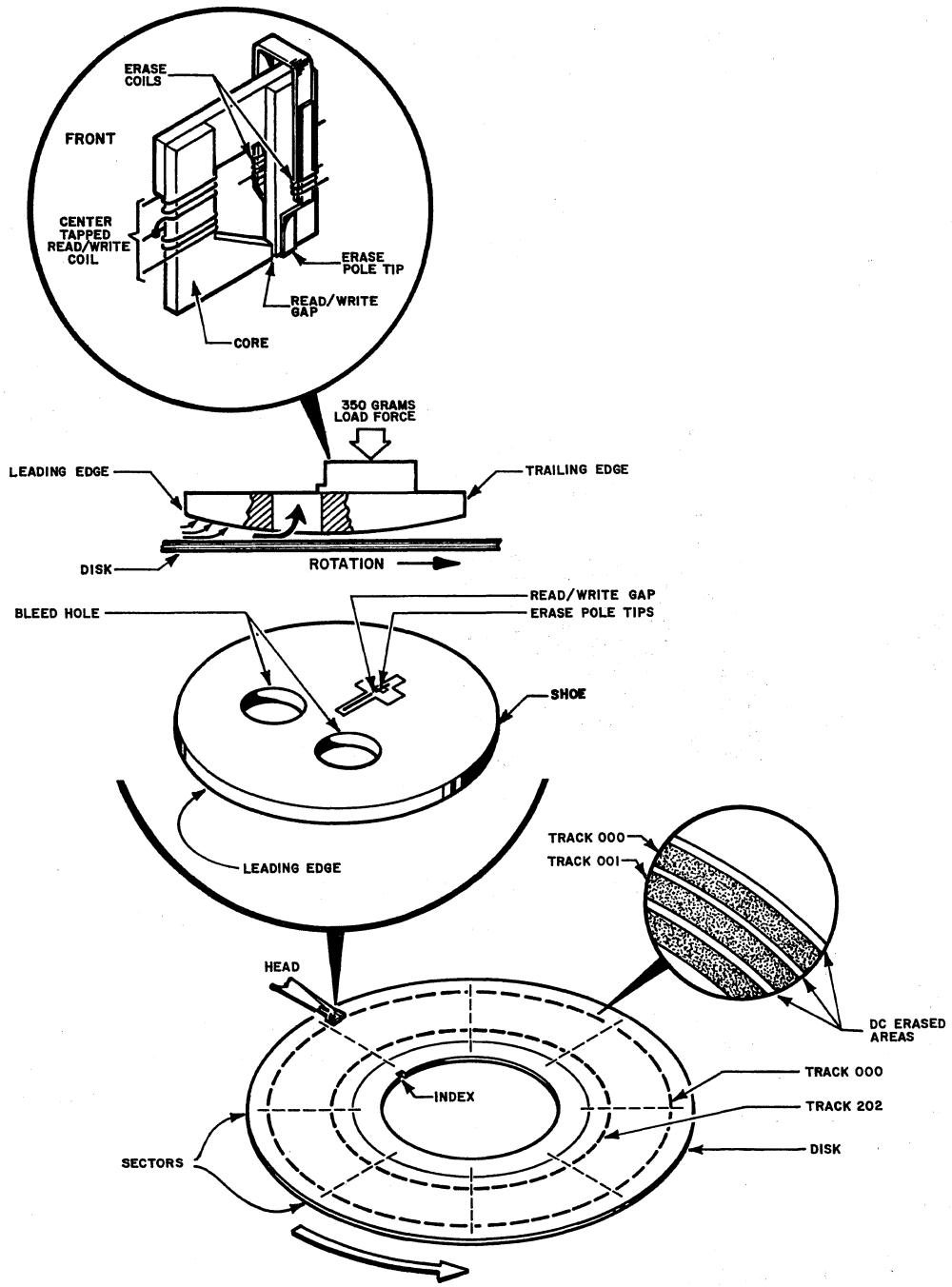
### 1.2 GENERAL SPECIFICATIONS

#### 1.2.1 Disk Format

The recording disk is a 14" (35.56 cm)<sup>\*</sup> aluminum plate which has been precision ground for flat and parallel surfaces. Its two surfaces are then coated with a 50-250 microinch thick layer of gamma-ferric oxide magnetic recording material and precision burnished to a flatness on the order of 30 microinches. These carefully prepared surfaces allow recording heads to fly in close proximity to them (within 70 microinches) without physical contact, which in turn allows extremely dense recording techniques. The disk is then mounted on a spindle and rotated at a constant speed.

The Diablo read/write (recording) head consists of two sets of coils and associated pole pieces arranged at right angles to each other and mounted on a circular ceramic head shoe. The design of this shoe utilizes the "boundary layer" of air associated with the rapidly moving disk surface to keep it from actual contact with the surface, even under mild spring pressure from its support arm.

\*In this manual, wherever both English and metric terms are specified, the metric term is in parentheses.



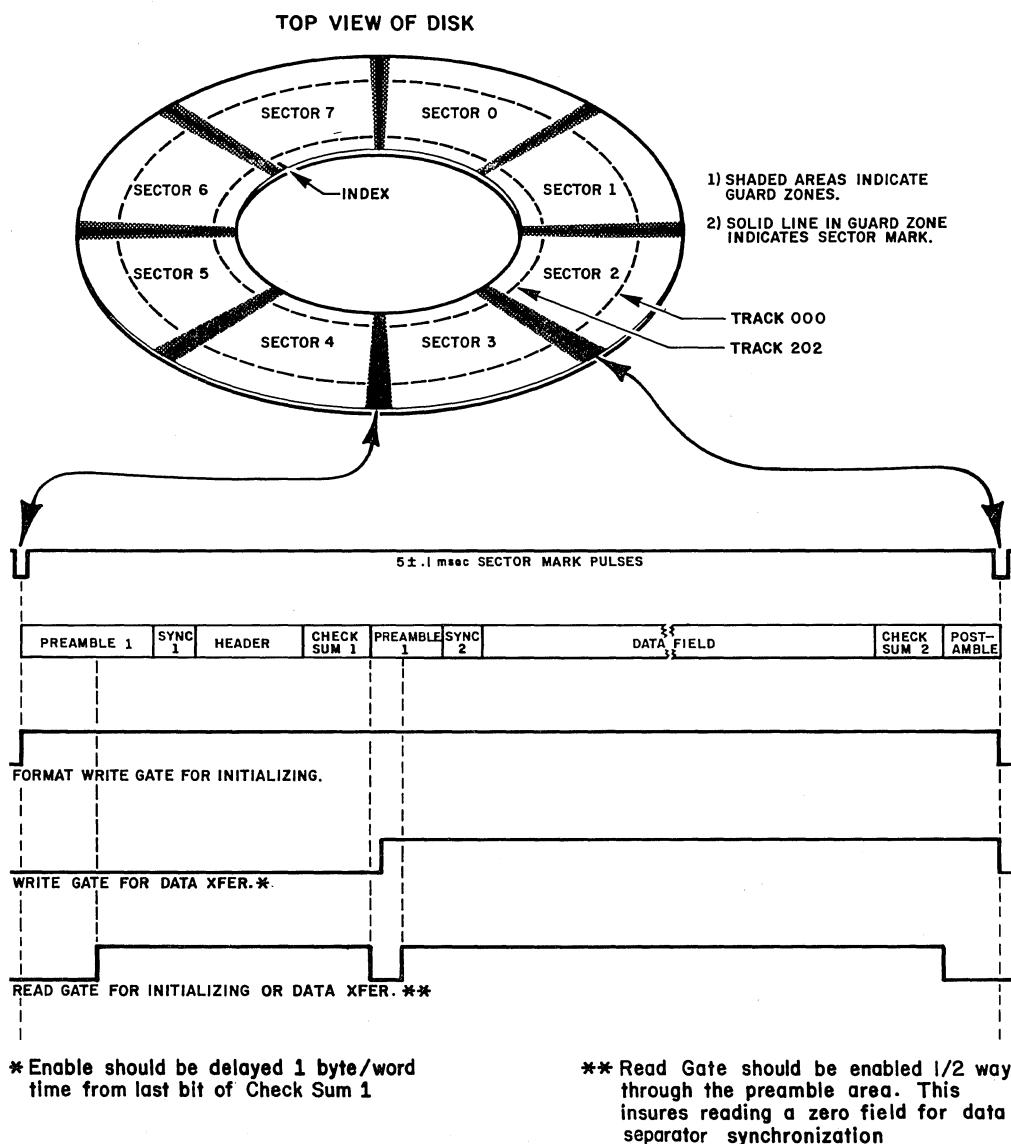
**Figure 1-2 DIABLO READ/WRITE HEADS AND RECORDING TECHNIQUES**

Figure 1-2 illustrates the shoe, and shows the two bleed holes which control the pressure of the entrapped air, and thus the height at which the shoe will fly. It should be noted that disk surface cleanliness is an absolute must, since the 70 microinch flying height is less than the thickness of a fingerprint.

The read/write heads are mounted on movable arms so they may be positioned over the rotating disk surfaces in their flying condition, one on each side of the disk. The larger read/write pole pieces are aligned circumferentially with the disk, while the smaller erase pole pieces straddle the larger and are aligned radially with the disk.

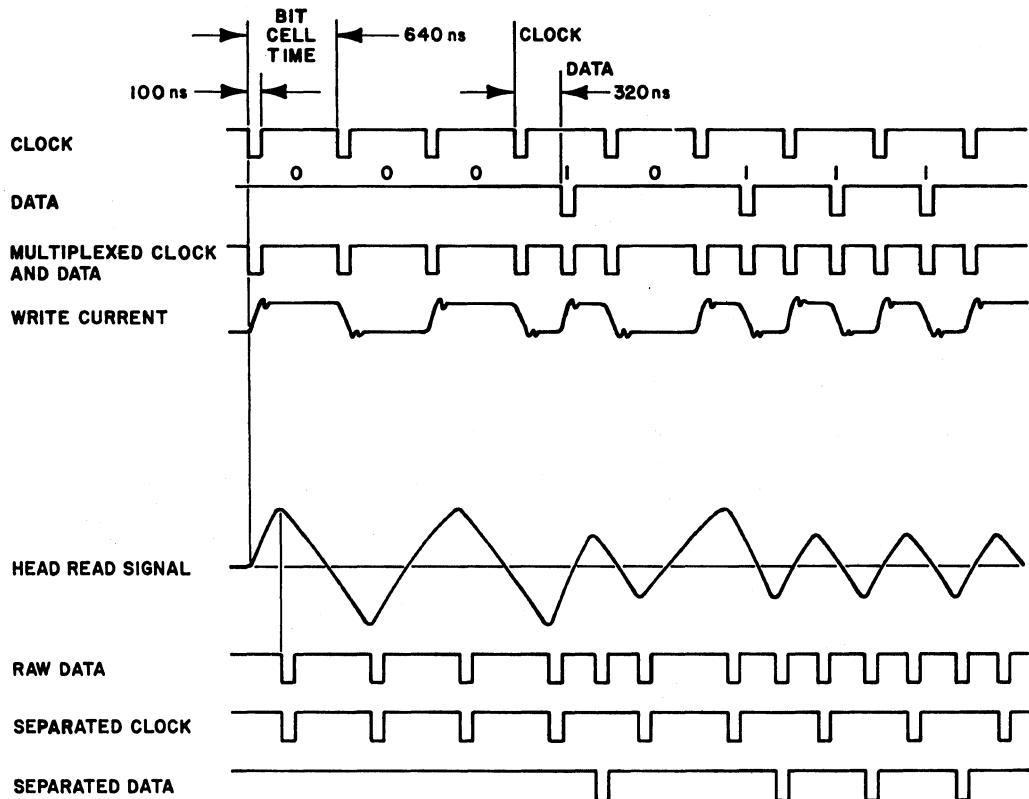
Data is recorded in concentric rings on each disk surface by positioning the heads accurately over the desired ring or track area. As data is recorded, DC current is passed through the erase coils to trim or DC erase a narrow band on each side of the recorded track, to provide a dead band between recorded tracks. Each disk side provides room for up to 203 recording tracks (200 normally used with 3 spares). Corresponding upper and lower tracks on the same disk are referred to as one cylinder. The tracks are approximately .010" (.025 cm) apart center to center, with an erased band approximately .003" (.008 cm) wide in between to prevent cross talk.

Each disk is provided with a metal ring containing an indexing slot and up to 24 sector slots (presently available are sector rings with 8, 12, 16, 20 or 24 slots, with 8 standard. A 32 sector ring is available as a special option). These slots are detected electronically, and used to first align the disk with its addressing circuitry, and then to divide the recording tracks into segments, or sectors. Data may then be identified by its track and sector address for accurate retrieval.



**Figure 1-3 TYPICAL TRACK – SECTOR FORMAT**

Figure 1-3 illustrates the track-sector concept. Diablo disk drives utilize the double frequency method for recording data on the disks. In the double frequency recording method, a flux transition (or polarity change) is recorded for each input pulse. Clock pulses are used to record transitions on the disk at regular intervals. The period of time between these transitions is referred to as a bit cell. An additional pulse or transition within the bit cell is a bit 1. A bit cell without the additional pulse or transition is designated a bit 0.



NOTE: TIMINGS ARE BASED ON A 1562 KHz CLOCK RATE.

**Figure 1-4 DOUBLE FREQUENCY RECORDING**

Figure 1-4 illustrates the arrangement of a typical double frequency recording sequence for recording data in one sector of one track on one side of the disk.

### 1.2.2 Power Requirements

Voltages: +15 VDC  $\pm$  5% @ 8A Peak, 4A Average  
-15 VDC  $\pm$  5% @ 8A Peak, 4A Average

Power: Less than 100 watts

The Diablo Models 029 and 210/215 Power Supplies are designed to supply all the power requirements of two Series 30 Disk Drives.

### 1.2.3 Physical Characteristics

Width - 17-1/2 inches (44.45 cm) [19 inches (48.26 cm) with rack mount flanges]

Depth - 22-7/8 inches (58.1 cm) [25-3/4 inches (65.4 cm) with connectors]

Height - 6-1/2 inches (16.5 cm) [table model]

Weight - 43 pounds (19.35 kg)

#### **1.2.4 Environmental Considerations**

Temperature — 60-90°F (15.6-32.2°C) ambient, to ensure cartridge interchangeability  
Relative Humidity — 20-80% with no condensation

#### **1.2.5 Features**

The Series 30 Disk Drives offer several features which enhance their use:

- Compatibility — Series 30 Drives are designed to be compatible with systems designed for other equipment.
- Daisy Chain Operation — Series 30 Drives may be operated in daisy chain fashion with up to four units per chain. They may also be intermixed with Series 20 and Series 40 Drives in chains of up to four units.
- Options — Several options are offered with the Series 30, to enhance its utilization in special situations. These are discussed in Section 6, and include interconnecting cables and terminators.

### **1.3 PERFORMANCE SPECIFICATIONS**

Table 1-1 lists the performance specifications for the standard and high-density Series 30 Disk Drives.

**Table 1-1  
PERFORMANCE SPECIFICATIONS – SERIES 30 DISK DRIVES**

#### **Operating Characteristics**

Recording Disk — IBM Type 2315 or equivalent  
Rotation (Spindle) Speed — 1500 RPM ± 1%  
Type of Recording — Double Frequency

#### **Access Times**

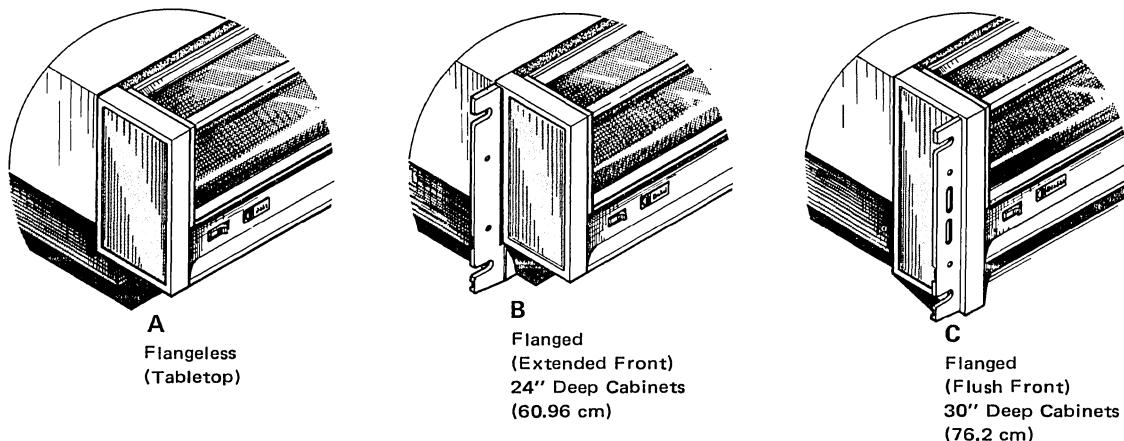
Average Latency	20 milliseconds
Head Positioning	
Track to adjacent track	15 milliseconds
Full move across disk	135 milliseconds
Average	70 milliseconds

#### **Capacity**

	<b>Standard</b>	<b>Hi-Density</b>
Bit Density (innermost track)	1100 bits/inch	2200 bits/inch
Track Density	100 tracks/inch	100 tracks/inch
Track Width	.0051 inch	.007 inch
Track Spacing	.010 inch	.010 inch
Bit Transfer Rate	781 KHz	1562 KHz
Bits per Cartridge (Drive)	12,000,000	24,000,000
Bits per Cylinder	60,000	120,000
Bits per Track	30,000	60,000
Cylinders per Cartridge	203	203
Tracks per Cartridge	406	406
Sectors per Track	8 (std) to 24	8 (std) to 24
Sectors per Cartridge	3248 (std) to 9744	3248 (std) to 9744
Bits per Sector — Standard	3750	7500



## SECTION 2 INSTALLATION AND OPERATION



**Figure 2-1 FRONT PANEL OPTIONS**

### 2.1 INSTALLATION

**NOTE:** After installation of the disk drive, if data bases which require interchangeability are to be generated, verify Track 0 Stop adjustment, Read/Write Head alignment and Sector Transducer adjustment as described in Section 5.

A Series 30 Disk Drive may be used as a tabletop unit, or mounted in a standard 19" (48.26 cm) rack. When the tabletop option is selected, the unit is fitted with a flangeless front panel assembly and rubber feet. When the unit is to be rack mounted, two more front panel options are available, along with rack slides. Figure 2-1 illustrates the three front panel options, while Figure 1-1 shows the units with rack slides installed.

The drive should always be supported on rack slides when in a cabinet, and they are included whenever the flanged front panel assemblies are selected. In addition, even though the flangeless front panel option can be accommodated in a rack mount installation, as suggested in Figure 1-1, Diablo recommends the use of the appropriate flanged front panel assembly for securing the drive to the rack. See Section 6.

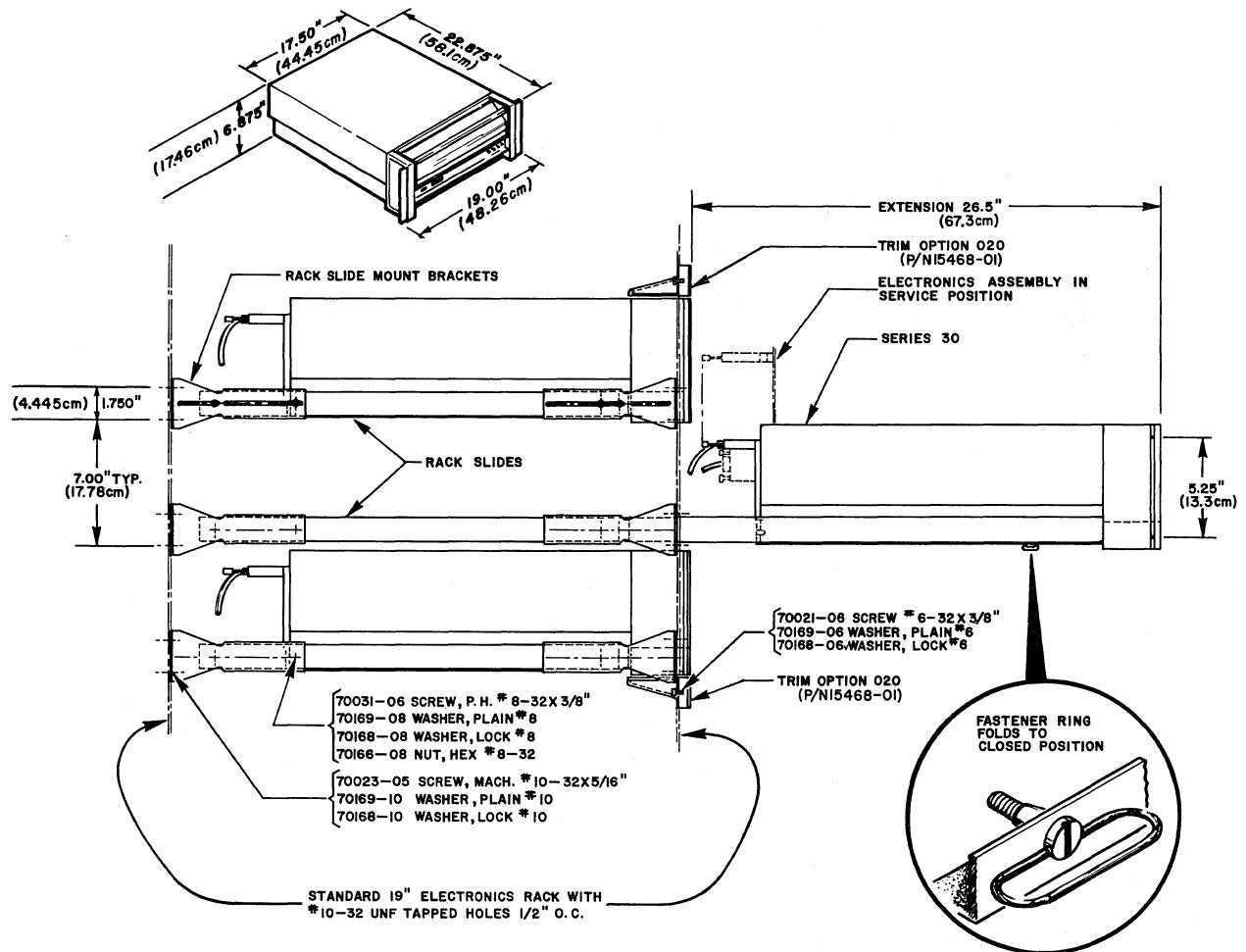
Figure 2-2 illustrates a flush mount Series 30 rack mounting while Figure 2-3 illustrates an extended front Series 30 rack mounting along with dimensional and hardware requirements. Diablo rack slides allow the drive to be pulled out of the cabinet far enough to remove the top cover and raise the electronics assembly to the service position without having to disconnect the cables attached to the rear panel. The extended mount's requirements for additional cabinet clearance are easily accommodated by the Diablo rack mount hardware.

Figure 2-4 shows a Series 30 with its electronics assembly raised to the service position.

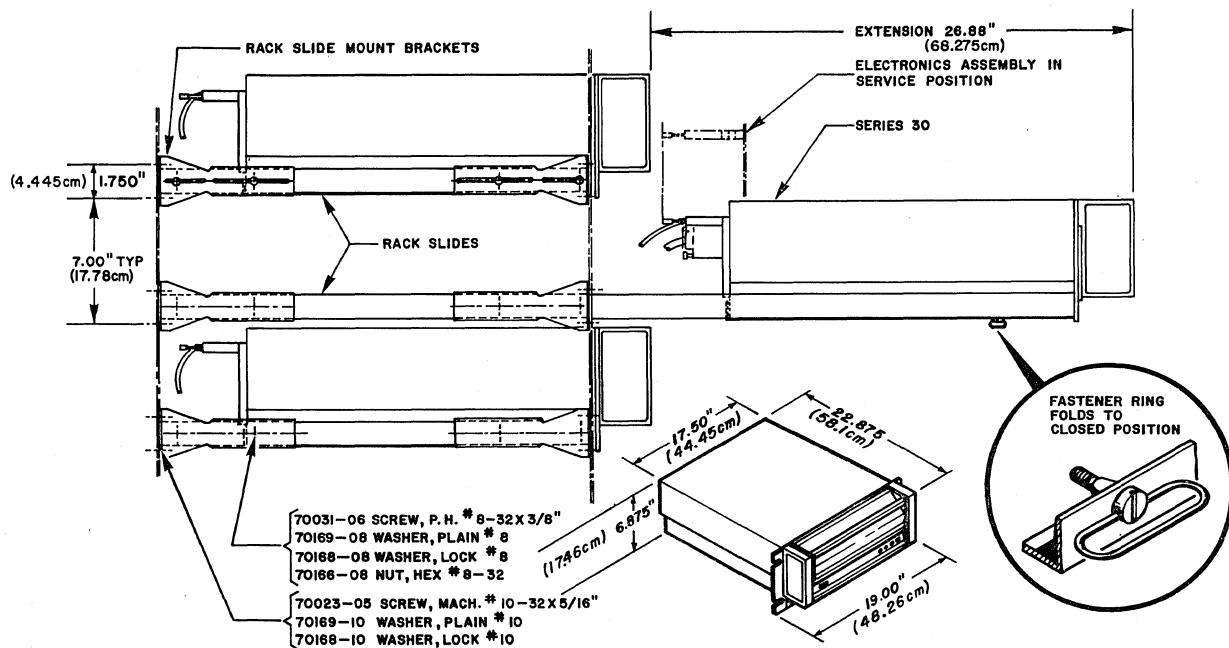
### 2.2 INTERCONNECTING CABLES

#### 2.2.1 Connector Parts

A standard Series 30 Disk Drive has two interface (Input/Output) and one power connector on its rear panel, as shown in Figure 2-5. The two I/O connectors are connected in parallel, pin for pin, by the drive's Motherboard PCB. Of these, connector P2 has pin (M) contacts, while connector P5 has socket (F) contacts. Table 2-1 lists the connector parts required for cable ends to mate with these rear I/O connectors.



**Figure 2-2 SERIES 30 RACK MOUNT**



**Figure 2-3 EXTENDED FRONT RACK MOUNT**

**Table 2-1**  
**CABLE CONNECTOR PARTS DESCRIPTION**

**Power Cable Connector**

- |                      |  |
|----------------------|--|
| 1. Plug              | — Winchester MRAC 14SJTCH13<br>Diablo P/N 10534-10 |
| 2. Contacts (socket) | — Winchester 100-51014S<br>Diablo P/N 10525-11     |

**Interface (I/O) Connector (Socket, left hand)**

- |                   |   |
|-------------------|---|
| 1. Plug           | — Winchester MRAC 42P<br>Diablo P/N 10523-11  |
| 2. Contacts (pin) | — Winchester 100-1024P<br>Diablo P/N 10525-12 |

**Interface (I/O) Connector (Pin, right hand)**

- |                      |  |
|----------------------|--|
| 1. Plug              | — Winchester MRAC 42S<br>Diablo P/N 10523-10   |
| 2. Contacts (socket) | — Winchester 100-51024S<br>Diablo P/N 10525-13 |

### 2.2.2 Connector Pin Assignments

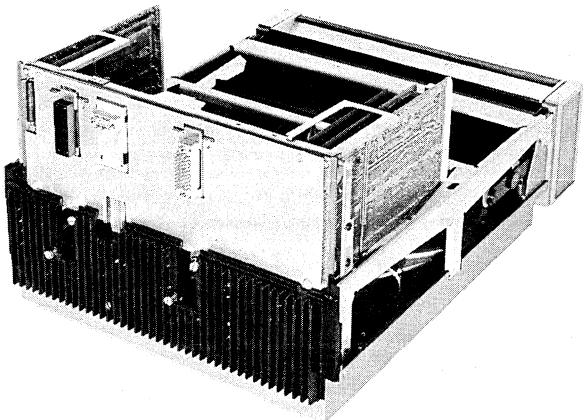
Table 2-2 lists the pin assignments for both Power and I/O connectors.

**Table 2-2**  
**POWER AND INTERFACE CONNECTOR PIN ASSIGNMENTS**

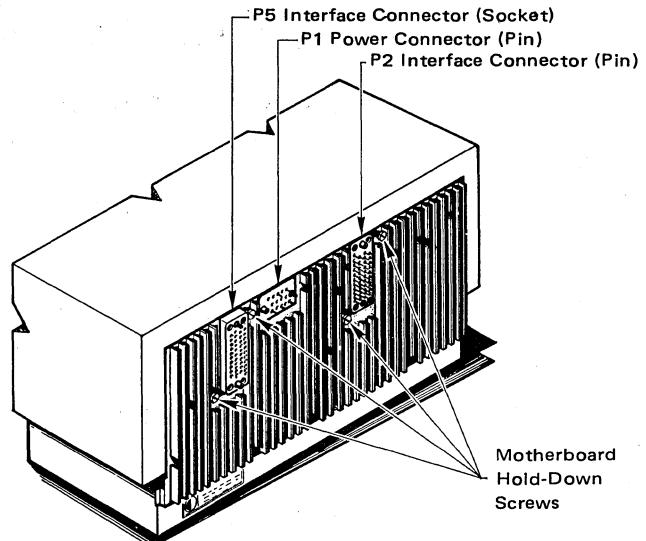
Signal Function	Pin	
<b>POWER CONNECTOR PIN ASSIGNMENTS</b>		
+ 15V High Current.....	K	Ready to Seek, Read, or Write .....
+ 15V Low Current.....	H	Address Acknowledge .....
- 15V High Current.....	R	*Logical Address Interlock.....
- 15V Low Current.....	P	Seek Incomplete .....
Ground Return .....	C	Sector Mark .....
		Index Mark.....
		Sector Address - bit 1 .....
		- bit 2 .....
		- bit 4 .....
		- bit 8 .....
		- bit 16 .....
		*Pseudo Sector Mark.....
Track Address- bit 1 .....	LL	Write Check .....
- bit 2 .....	N	Read Clock .....
- bit 4 .....	RR	Read Data .....
- bit 8 .....	J	Read Gate .....
- bit 16 .....	X	Select Line - Unit 1 .....
- bit 32 .....	FF	- Unit 2 .....
- bit 64 .....	T	- Unit 3 .....
- bit 128 .....	BB	- Unit 4 .....
Restore .....	VV	*High Density Indication .....
Strobe .....	SS	**Daisy Chain Cable Terminator, +5V .....
Head Select .....	AA	Ground .....
Write Gate .....	EE	Ground .....
Write Data & Clock .....	B	Ground .....
*Write Protect Input .....	H	Ground .....
*Write Protect Status Indication.....	P	Ground .....
*Erase Gate.....	K	Ground .....
File Ready .....	U	WW

\*Related to optional features

\*\*Pin (PP) supplies +5 volts to the cable terminator network



**Figure 2-4 ELECTRONICS ASSEMBLY IN SERVICE POSITION**



**Figure 2-5 SERIES 30 REAR PANEL INTERFACE CONNECTORS**

### 2.2.3 Cable Recommendations

#### 2.2.3.1 Power Input Cable

A Series 30 Disk Drive requires power inputs of  $\pm 15$  VDC  $\pm 15\%$  @ 8A peak (4A average) from an external source. Diablo Power Supplies Models 029, 210, 215 were designed for use with the Series 30 Drive, and are each capable of supplying all the power needs for two Series 30 Disk Drives. The Models 029 and 210 Power Supplies use a Diablo #11188 Power Cable to interconnect with the Series 30 Drive, while the Model 215 Power Supply uses a #17356 Power Cable.

Should the user elect to provide power to the Series 30 from another source, the following parameters should be observed:

1. Maximum cable length without special considerations — 5' (152.4 cm)
2. Wire size for power circuits — 16 AWG, ground return — 15 AWG braid
3. Separate circuits should be provided for the high and low current inputs, to avoid common impedance problems
4. For cables over 5' in length, a 30,000  $\mu$ Fd 50V buffer capacitor should be included on each end of each power conductor, located within 2½' (76.2 cm) of the end.

#### 2.2.3.2 Input/Output (I/O) Cable

Two types of cable may be considered for use with the Series 30. One is the conventional round cable consisting of twisted pairs of wires for each signal, with a PVC jacket. The other type is a PVC flat cable with a flexible ground plane.

#### Round Cable

For those applications where, in spite of the drawbacks, a round cable is preferred, the type recommended is made of twisted pairs insulated with heat sealed overlapped MILENE tapes. Physical characteristics of round cables are:

Number of twisted pairs	50
Wire size	28 AWG (7/36)
Nominal OD of insulated wire	.023" (.058 cm)
Nominal OD of PVC jacket	.370" (.94 cm)
Underwriters' Laboratory rating Style	#2384

The characteristic wave impedance of one single twisted pair is approximately 85 Ohms. If all ground leads of the twisted pairs are grounded on both ends, the wave impedance is reduced to 75 Ohms. If the twisted pairs are jacketed by an overall braided shield, the wave impedance drops to approximately 45 Ohms, resulting in excessive current from the drive circuits. Individually shielded twisted pair cable is not recommended.

### Flat Cable

Because of the uniform transfer characteristics and production efficiency, a flat cable type is recommended. The characteristic wave impedance is 80 Ohms, with the shield plane grounded on both ends. The physical characteristics of the type of flat cable recommended by Diablo is as follows

Number of conductors	50
Wire size	30 AWG solid
Shield	Flexible ground plane
Insulation	PVC

### Cable Lengths

Diablo offers a wide selection of prepared transition cables for use with Series 30 Drives. These will be found listed and described in the Diablo Sales Literature, in the Diablo Series 30 Disk Drive Parts Catalog, Publication No. 81504 and in Section 6 of this manual. In planning an installation, the designer should keep in mind that the TOTAL cable run in any daisy chain configuration should NOT exceed 30 feet (9.14m).

#### 2.2.3.3 Terminating Resistors

The signal lines carrying pulses transmitted by any disk drive will cause reflection on both ends of the cable if the cable is not properly terminated.

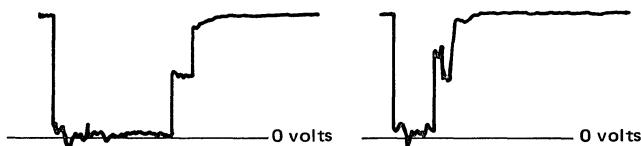


Figure 2-6 WAVESHAPES

Figure 2-6 shows two waveshapes taken on the terminated end of a cable when the other end was left unterminated. The negative going leading edge is not affected significantly, and can be used as an input to logic circuits if properly handled. The trailing edge, however, is determined by the time duration of the pulse, and the length of the cable. Those lines carrying signals of short duration should always be terminated on both ends. Satisfactory system performance cannot be achieved, even with relatively short cable lengths, if the signal lines are not properly terminated on both ends.

A typical circuit for termination of the cables is shown in Figure 2-7. Diablo offers a selection of terminators designed for use with the Series 30 Drives. These are also listed in sales literature, in the Series 30 Parts Catalog, and in Section 6 OPTIONS of this manual.

#### 2.2.3.4 System Interconnection

Figure 2-8 illustrates the typical scheme for connecting one to four drives to one controller, where more than one is referred to as a daisy chain system. Referring to Figure 2-5, it may be seen that both pin (M) and socket (F) connectors are available on the rear panel of the drive. The option schedule in Section 6 lists F/F, M/M and F/M styles of cables as well as both M and F contact terminators. The user thus has

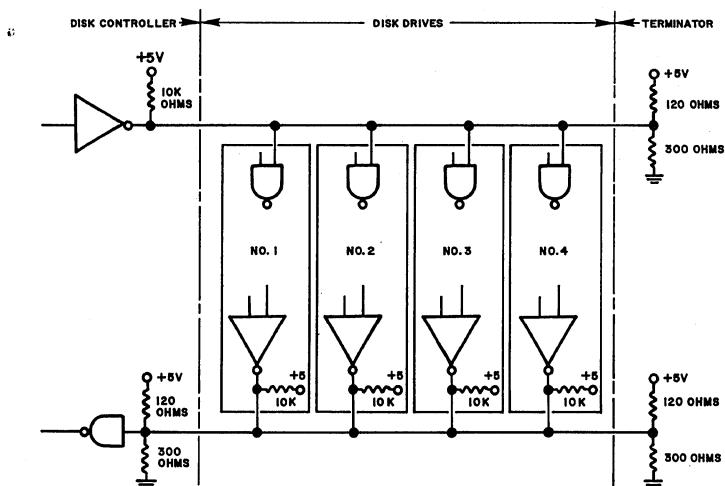


Figure 2-7 TYPICAL TERMINATION CIRCUITS

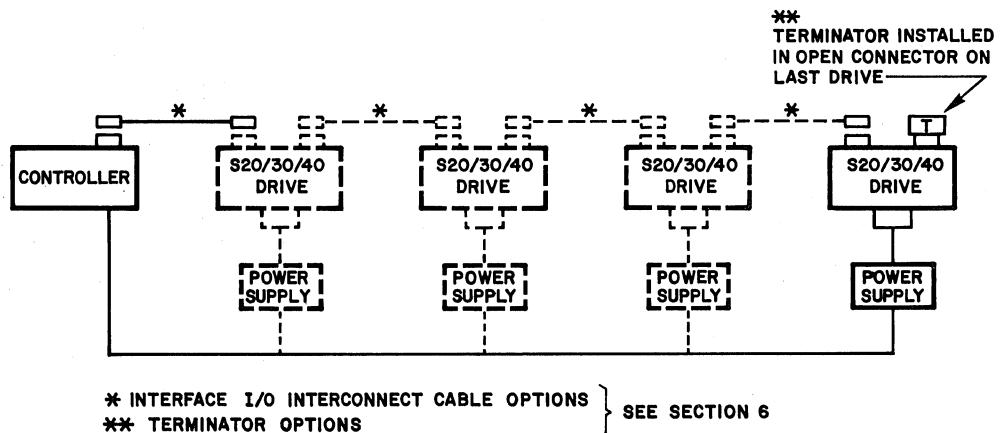


Figure 2-8 DISK DRIVE DAISY CHAIN INTERCONNECT AND TERMINATOR SCHEME

a wide choice of interconnecting schemes available. All are valid as long as the overall length of cable from controller through all drives to the terminator does not exceed 30 feet, and when an appropriate terminator is included as shown.

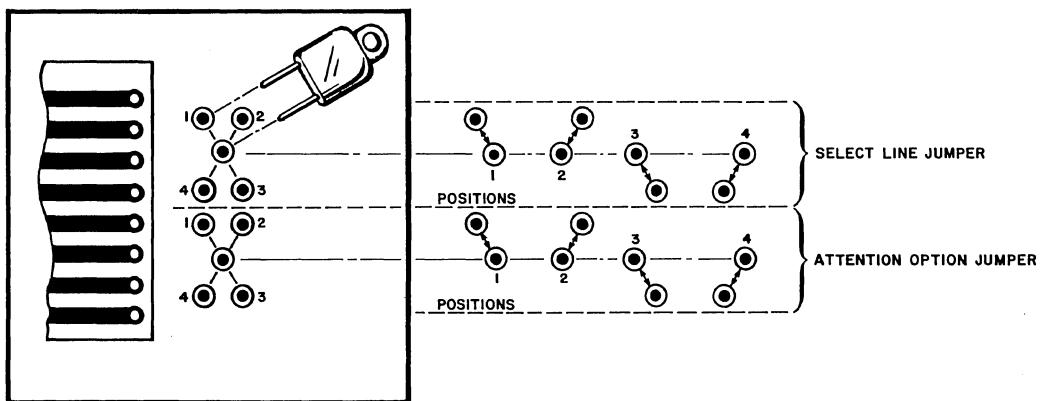
#### 2.2.3.5 Select/Attention Line Option Jumpers

When the Series 30 Disk Drive is shipped from the factory, its select line jumper plug is installed in the "1" position, for installation in a system as the only disk drive. If the drive is to be installed in a multi-drive (daisy chain) system, its select line jumper plug must be installed in the connectors corresponding to its position in the chain; i.e. the #3 unit in the daisy chain must have its jumper plug inserted in the C (common) - 3 position, etc. Figure 2-9 shows the location of the jumper plug and connectors on the upper right hand corner of the Motherboard PCB beside the J3 PCB connector, and describes how the plug is to be oriented. Access to the plug is gained by removing the top cover and raising the electronics assembly to its service position. Also shown is a similar set of connectors for the optional Attention Line feature listed in Section 6.

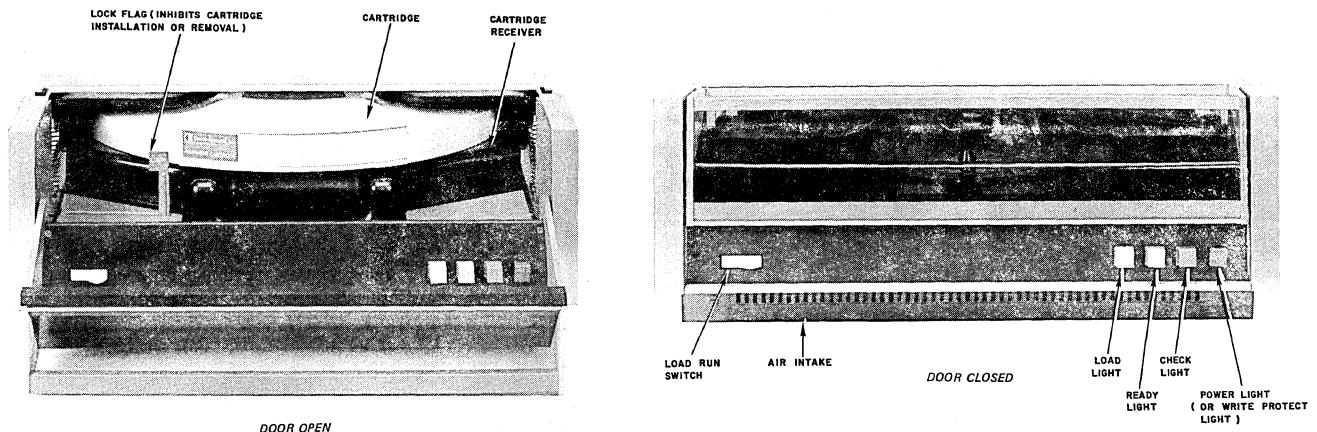
### 2.3 OPERATING

#### 2.3.1 Controls and Indicators

The Model 31 Disk Drive, as shown in Figure 2-10 has one control switch, four indicator lights, and an interlock (lock) flag. Table 2-3 describes the function of each.



**Figure 2-9 SELECT/ATTENTION OPTION LINE JUMPERS**



**Figure 2-10 MODEL 31 CONTROLS AND INDICATORS**

The control switch, three of the indicators, and the lock flag are all omitted in the Model 33F.

### 2.3.2 Operating the Model 31

The control switch is labeled LOAD/RUN. In the LOAD position, application of power will light the LOAD light, lower the lock flag and unlatch the front panel door. In this condition, the door may be opened and the disk cartridge inserted or removed. Opening the door disengages the cartridge disk from the drive spindle's magnetic clamp and lifts it clear for removal. Closing the door, with a cartridge inserted, lowers the disk into place properly aligned for operation, and allows the magnetic clamp to lock it into place.

Moving the LOAD/RUN switch to its RUN position latches the door closed, raises the flag, and initiates the startup sequence. When the spindle and disk are at proper operating speed, and the machine is ready for operation, the READY light comes on.

Switching the LOAD/RUN switch from RUN to LOAD extinguishes the READY light, and initiates the load sequence. The heads retract, and the spindle slows to a stop under dynamic braking. When the heads are fully retracted and the spindle has stopped, the door is unlatched, the lock flag is lowered, and the LOAD light comes on indicating that it is safe to open the door and remove or insert a cartridge.

### 2.3.3 Operating the Model 33F

The front panel door of the Model 33F is locked shut by the top cover. The spindle and disk rotate anytime power is applied to the drive, and the disk cartridge can be removed or replaced only by a technician. The POWER indicator is the only front panel device seen on this model.

**Table 2-3**  
**FRONT PANEL SWITCH AND INDICATORS**

Panel Name	Function
Load/Run	A two position rocker type switch that provides a means for starting and stopping disk rotation. Cartridge may be removed and inserted when the Load light is on and the switch is in the LOAD position. With a cartridge inserted, switching to the RUN position starts disk rotation and brings the disk up to its normal operating speed in about 50 seconds. If the switch is moved to the LOAD position, the disk decelerates to a stop in about 10 seconds, after which the Load light turns on, the door interlock releases, and the door can be opened.
Load	A white signal light which indicates that the spindle is not rotating, and that cartridges can be loaded, or unloaded. The light goes off whenever the LOAD/RUN switch is set to the RUN position.
Lock Flag	Lowers to allow cartridge removal when heads have been retracted and spindle is not moving.
Ready	A yellow light which indicates that the drive has completed its start-up cycle. The light comes on when the disk is rotating at its correct speed. The light remains on throughout a seek, read or write operation. The light extinguishes as soon as the LOAD/RUN switch is set in the LOAD position.
Check	An orange signal light which indicates that due to some abnormal condition, the Model 31 may be incapable of writing. The light is reset by moving the LOAD/RUN switch to LOAD position and then back to RUN. This light also indicates a low voltage condition.
Power	A red signal light that indicates the presence or absence of power. The light glows when operating power is present.
OPTIONAL Protect (Located in power light position)	A red backlit momentary contact pushbutton switch that is on those disk drives that are equipped with the Write Protect option. See subsection 6.3

## SECTION 3 INTERFACE INFORMATION

### **3.1 GENERAL**

Up to four disk drives may be connected in parallel with each other to one controller. These drives may be all Model 31's, all Model 33F's, a mixture of Model 31 and 33F, or Series 30's combined with Series 20 Drives. Note that two Model 33's would fulfill the four unit limit. Connecting two or more drives to one controller is referred to as a daisy chain installation. The final drive in any system will have an open I/O connector. This last connector must have a terminator installed to properly terminate each line, as was discussed in Section 2. Diablo Series 20 and Series 30 Disk Drives are signal compatible and are directly combinable in a daisy chain system with suitable transition cabling.

### **3.2 POWER REQUIREMENTS**

The Series 30 Disk Drives do not include power supplies or power controls. All unit power supply and control must be provided externally by the using system. As discussed earlier, the Series 30 Drive requires  $\pm 15$  VDC  $\pm 15\%$  at 4 Amperes average current drain, with an instantaneous peak demand of up to 8 Amperes.

**[CAUTION]** Connection to the rear panel power connector must not be made or broken while power is on, to avoid damage to the drive.

### **3.3 INPUT/OUTPUT CONSIDERATIONS**

Definition of the standard input and output interface lines are given in the following subsections. Signal polarity is 0 volt nominal for LO (true) and +5 volts nominal for HI (false).

### **3.4 STANDARD INPUT LINES**

**TRACK ADDRESS** — Eight lines which accept an 8-bit binary absolute track address. These signal lines are strobed with the strobe signal to perform a seek operation. The track address lines should be held true no longer than 5  $\mu$ sec after the trailing edge of the strobe signal.

**RESTORE** — One line which accepts a signal calling for "head positioner restore". After executing this command, the heads are located over track 0, the Address Register is set to address 0, and an Address Acknowledge signal is issued. (A logical address interlock pulse will be issued if an address greater than 202 is set on the track address line.) The Restore signal must be settled prior to the leading edge of the Track Address Strobe signal, and held for no longer than 5  $\mu$ sec after the trailing edge of the Strobe signal.

**STROBE** — This signal is used for sampling the Track Address and Restore lines. The leading edge of the Strobe should appear only after the appropriate signals have fully settled. The Strobe must be held until either the Address Acknowledge signal or the Logical Address Interlock signal is issued by the Disk Drive. This may be as soon as 22.5  $\mu$ sec or as late as 47.5  $\mu$ sec after the leading edge of the Strobe. When the Address Acknowledge or the Logical Address Interlock are issued, the Strobe signal must be removed within 5  $\mu$ sec.

**HEAD SELECT** — One line which allows the selection of one of the two heads for reading or writing. The signal on this line must be held for the entire duration of a read or write operation. Polarity: 0 volt nominal (LO) selects upper head, +5 volts nominal (HI) selects lower head.

**WRITE GATE** — One line which turns on write current and erase current simultaneously in the head which has been selected. This signal must be applied at least 2  $\mu$ sec prior to writing the first flux transition, and held for the entire duration of the write and erase operation.

**WRITE DATA & CLOCK** — One line which accepts multiplexed data and clock pulses for double frequency or phase encoding type recording, one complete pulse for each recorded flux reversal. Pulses must have a minimum width of 100  $\eta$ sec. Leading edge must have a transition time of not more than 50  $\eta$ sec. This line is held at nominal +5 volts when not writing.

**READ GATE** — One line which enables the Read Clock and Read Data output lines. Read Gate must be held at nominal 0 volt during the read operation.

**SELECT LINES** — In order to perform the selection of one particular unit in a system where more than one drive is used, four Select Lines and a corresponding internal jumper are accommodated. These lines select and activate the input/output lines of the jumpered unit either in a daisy chain or a party line system configuration. See subsection 6.3 for optional input lines.

### **3.5 STANDARD OUTPUT LINES**

**FILE READY** — A 0 volt level (LO) on this line indicates that the disk is in the following condition:

1. Drive supplied with proper power.
2. Loaded with a disk cartridge.
3. LOAD/RUN switch in RUN position.
4. Disk Startup cycle is completed.
5. Write Check flip/flop is reset.

**READY TO SEEK, READ OR WRITE** — (Ready to S/R/W). A 0 volt level (LO) on this line indicates that the disk drive is in the File Ready condition (see above) and it is not in the process of executing a seek operation. Following a seek command to a valid address (other than the present address) or a Restore command, the Ready to S/R/W line goes "false" in no less than 2.5  $\mu$ sec after detecting the leading edge of the Strobe signal. The return of the Ready to S/R/W line to the "true" state indicates that the seek (or Restore) operation has been completed, the Read/Write heads are fully settled and the machine is ready to accept a Read, Write or another Seek operation.

**ADDRESS ACKNOWLEDGE** — This signal line notifies the controller that a command to move the heads to a specified address has been accepted, and that execution of the command has commenced. An Address Acknowledge signal is issued in a minimum of 22.5  $\mu$ sec after the Strobe signal even if there is no change from the previous address. The Address Acknowledge signal is a pulse with a minimum width of 2.5  $\mu$ sec and a maximum width of 7.5  $\mu$ sec. The Address Acknowledge signal will not be issued if a command to move to a track position greater than 202 is received. In this case, execution is suppressed, and a Logical Address Interlock signal is issued on a different line (see below). The Address lines, as well as the Strobe signal, must be held until either the Address Acknowledge or the Logical Address Interlock signal is issued by the disk drive.

**LOGICAL ADDRESS INTERLOCK** — A pulse on this line indicates that a command to move the heads to a track address greater than 202 has been received and the command is therefore not executable. The seek command is suppressed. The Strobe signal must be removed within 5  $\mu$ sec after receipt of this signal. The Logical Address Interlock signal has the same timing relationship as the Address Acknowledge signal.

**SEEK INCOMPLETE** — A 0 volt level (LO) on this line indicates that, due to some malfunction, a seek operation was not completed. This signal level will be maintained until a Restore command (see above) is received and executed by the disk drive.

**SECTOR MARKS** — This line supplies one 0 volt nominal (LO) 5  $\mu$ sec pulse for each of the sector slots as they pass by the sector transducer. The leading edge should be used as reference. The "unusual" slot, which serves as the marker for the sector, is suppressed on this line and fed to a separate line called Index Marks (see below).

**INDEX MARKS** — This line supplies one 0 volt nominal (LO) 5  $\mu$ sec pulse per disk revolution to provide sector identification. The leading edge of this pulse follows the leading edge of the last sector pulse by a nominal 610  $\mu$ sec and signifies that the next Sector Mark following this pulse is the Sector Mark for the first sector.

**PSEUDO SECTOR MARKS** — Rotational speed of the spindle is servo controlled by counting the number of transitions provided by a crystal oscillator between Index Marks. This provides an extremely accurate speed control which is independent of line voltage or frequency fluctuations. The pseudo Sector Mark line carries these  $2000 \pm 1\%$  square-wave clock pulses to the interface. These pulses may be used to format the disk into the desired number of pseudo sectors.

**WRITE CHECK** — A 0 volt level (LO) on this line indicates that one or more of the below listed conditions are present within the Series 30 Disk Drive.

1. Write Current without a true Write Gate line.
2. Write Gate line true without Write Current.
3. Write and Select of both heads.
4. Erase Current without a true Erase Gate line.
5. Erase Gate line true without Erase Current.

When Write Check is set true by one of the above listed conditions, execution of all external commands is suppressed. To reset Write Check, on the Model 31, the operator must move the Load/Run switch to the Load position and then return it to the Run position. The Model 33F must have its power removed and then reapplied.

The Write Check line is also used to notify the controller that the supplied voltage to the Series 30 has dropped to less than a nominal 13.5 volts. If this occurs during a Write operation, it may be desirable to rewrite the affected record. Reset is not required when Write Check is caused by voltage fluctuation.

**READ CLOCK** — This line supplies pulses that represent clock signals which have been separated from the data signals during reading. Pulse width is nominally 100  $\eta$ sec with a minimum of 50  $\eta$ sec and a maximum of 150  $\eta$ sec. The leading negative going edge must be used for reference.

**READ DATA** — This line feeds out pulses that represent data signals which have been separated from clock signals during reading. Pulse width is nominally 100  $\eta$ sec with a minimum of 50  $\eta$ sec and a maximum of 150  $\eta$ sec. The leading negative going edge must be used for reference.

**HIGH DENSITY INDICATION** — A 0 volt level (LO) on this line indicates that the disk drive has the high density option installed. In a standard density disk drive this line is floating.

**SECTOR ADDRESS** — Five output lines which define, in binary encoded form, the sector under the Read/Write head. This address is derived from a 5-bit binary sector counter. This counter is advanced by the leading edge of each sector mark and is reset to zero by the leading edge of the sector mark following the index mark. The status of the Sector Address

Counter can be unambiguously evaluated if the readout occurs at the trailing edge of the Sector Mark signal. See subsection 6.3 for optional output lines.

### 3.6 INTERFACE TIMING CONSIDERATIONS

#### 3.6.1 Read Amplifier Recovery

A read amplifier recovery period of 50  $\mu$ sec is required after a change in head selection or after a write operation.

#### 3.6.2 Timing

Figures 3-1, 3-2 and 3-3 illustrate typical timing relationships. These figures contain numerous notations and should be carefully reviewed.

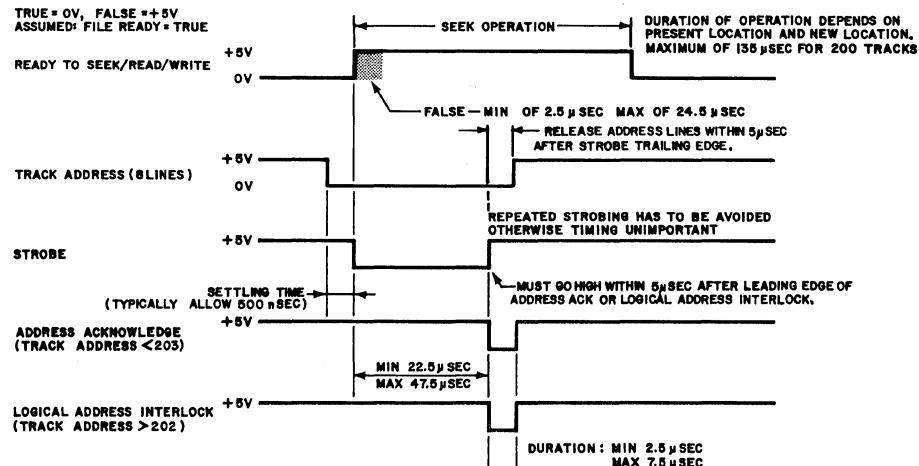


Figure 3-1 TYPICAL SEEK OPERATION

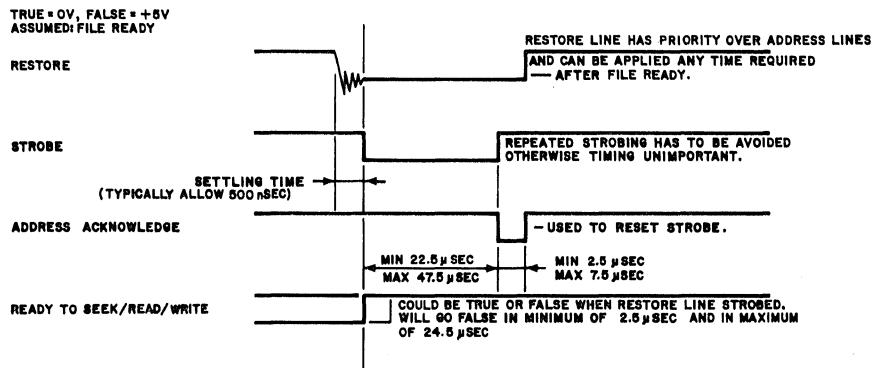


Figure 3-2 TYPICAL RESTORE OPERATION

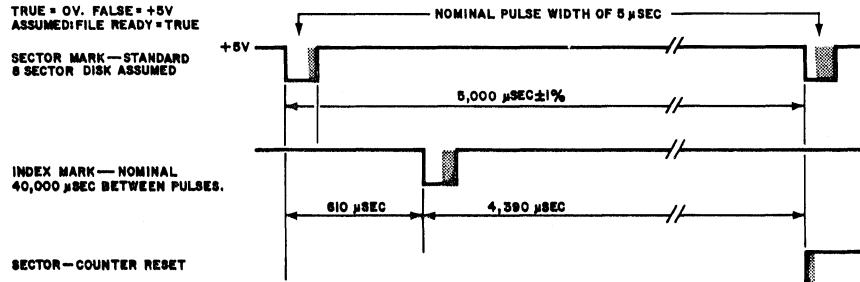


Figure 3-3 SECTOR AND INDEX MARK TIMING RELATIONSHIP

### **3.6.3 Data Record Format**

Since each system is likely to have significantly different requirements, the example given below is to be regarded as merely a suggested method of determining data format. The factors considered in this example, which affect the amount of time available for writing data between Sector Marks, are based on inner track timing and are the minimum amount of time to be considered.

1. Physical location of Erase and Write coils. The time difference between these coils at the standard density is 65  $\mu$ sec, at high density it is 25  $\mu$ sec. When these coils are activated and deactivated at the same time, there is a nominal gap of unerased data on the disk surface that must be considered.
2. Location of the Sector Mark slots on the disk hub. The relative placement of these slots from disk to disk will affect the amount of time available. Cartridge manufacturers specify this variance at  $\pm 0^\circ 12'$  or  $\pm 22.5 \mu$ sec.
3. Alignment of Sector Transducer in relationship to each head. There will be up to a  $\pm 5 \mu$ sec variance in this alignment from disk drive to disk drive.
4. Sector jitter and alignment cartridge variance may be as much as  $\pm 10 \mu$ sec.
5. Preamble used for synchronizing the data and clock separation circuits and for providing needed time intervals. The preamble considered in this example consists of all zero bits followed by a single one bit. The preamble must be started when the write gate is set true and must allow a minimum of 6  $\mu$ sec of preamble to be read (for synchronizing the separation circuits) prior to the single one bit.
6. Speed variation. Only the overspeed tolerance, which shortens the amount of available time, is considered.

**Note:** All check characters that are used to insure fidelity of data are considered as part of the data record.

### **3.6.4 Computation of Data Record**

1. Physical location of Erase and Write coils = 65  $\mu$ sec
2. Location of Sector Mark slots = 45  $\mu$ sec
3. Alignment of Sector Transducer = 10  $\mu$ sec
4. Sector jitter and alignment cartridge variance = 20  $\mu$ sec
5. Preamble for synchronizing = 6  $\mu$ sec
6. Speed variation = 1%
7. Nominal time per revolution = 40,000  $\mu$ sec
8. Nominal time per sector = 40,000  $\mu$ sec/n (Where n = number of sectors)

$$\text{Minimum time per sector} = (40,000/n - .99) - (65+45+10+20+6)$$

Where (.99) = Allowance for 1% speed variation

- 65 = Erase and Write coil
- 45 = Sector location
- 10 = Sector alignment
- 20 = Sector jitter
- 6 = Preamble sync

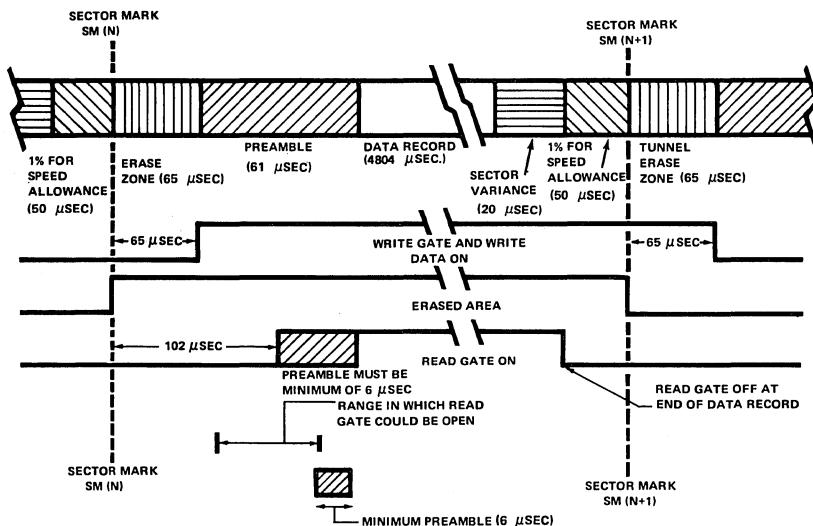
$$\text{Example (for } n = 8 \text{ sector): } (4950) - 146 = 4804 \mu\text{sec}$$

The actual maximum data length is equal to the next smaller whole number of computer words that will fit within 4804  $\mu$ sec at the disk recording bit rate.

At the 781 KHz rate, the maximum number of bits is  $4804 \mu\text{sec}/1.280 \mu\text{sec} = 3753$ , which would be

$3753/12 = 312$  12-bit words; or  $3753/8 = 469$  8-bit words. Where  $1.280 \text{ nsec} = \text{one bit cell at } 781 \text{ KHz}$ .

The bit cell duration for the 720 KHz, 1562 KHz, and the 1440 KHz is  $1.389 \mu\text{sec}$ ,  $640 \text{ nsec}$  and  $694 \text{ nsec}$ .



\*Sector variance is divided to contain 25 usec in preamble and 20 usec in postamble.

#### SUMMARY:

1. Preamble consists of all zeros concluded by a single one.
2. Write and Erase Gate turned on together —  $65 \mu\text{sec}$  after SM(N), ( $25 \mu\text{sec}$  with high density).
3. Start writing preamble concurrent with Write and Erase Gate.
4. Continue writing zeros until  $65 \mu\text{sec}$  SM(N+1); then turn off Write and Erase Gate ( $25 \mu\text{sec}$  with High Density).
5. Read Gate open  $102 \mu\text{sec}$  after SM(N).

**[CAUTION]** After a head select or the termination of a write operation, allow  $50 \mu\text{sec}$  for read amplifier recovery; this may be wholly or partly overlapped with other delays.

**Figure 3-4 DATA FORMAT**

#### 3.6.5 Write Operation

With the calculation given above, a typical Write operation would proceed as follows (see Figure 3-4).

1. Detection of the Sector Mark indicating the beginning of the desired sector to be written.
2. Wait  $65 \mu\text{sec}$ , then enable Write Gate and Erase Gate, thereby turning on current in the Write and Tunnel Erase heads.
3. Commence writing of the preamble, a continuous stream of zeros followed by a single one, for  $61 \mu\text{sec}$ . The next recorded bit will be the first bit of data record.
4. Write the data record, comprising no more than the computed maximum number of data bits, including check character. (In this example the maximum number of bits = 3753).
5. After writing the last bit of the data record, continue writing zeros until  $65 \mu\text{sec}$  after the next Sector Mark. At that time turn off the Write Gate, Erase Gate and stream of zeros.

**Note:** The entire surface of the disk that will be read must be recorded.

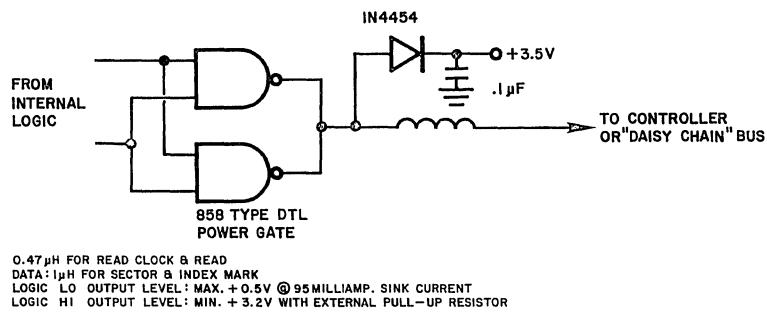
#### 3.6.6 Read Operation

When the data format has been written as above, a typical Read operation would proceed as follows (see Figure 3-4).

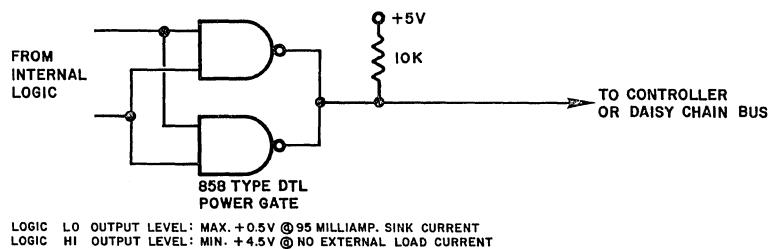
1. Detection of Sector Mark indicating the beginning of the desired sector to be read.
2. Wait 102  $\mu$ sec, then enable Read Gate, thereby reading the zeros from the preamble and synchronizing the separation circuits.
3. If at least 6  $\mu$ sec of zeros followed by a single one bit is detected, then the preamble has been properly read and the next bit is the first data record bit.
4. Disable Read Gate after reading the last bit of the Data Record.

### 3.7 DRIVE CAPABILITY OF OUTPUT LINES

Read Clock, Read Data, Sector Mark and Index Mark lines are driven as shown in Figure 3-5. All other output lines are driven by the circuit shown in Figure 3-6.



**Figure 3-5 OUTPUT DRIVER CIRCUIT OF READ CLOCK, READ DATA, SECTOR MARK AND INDEX MARK LINES**

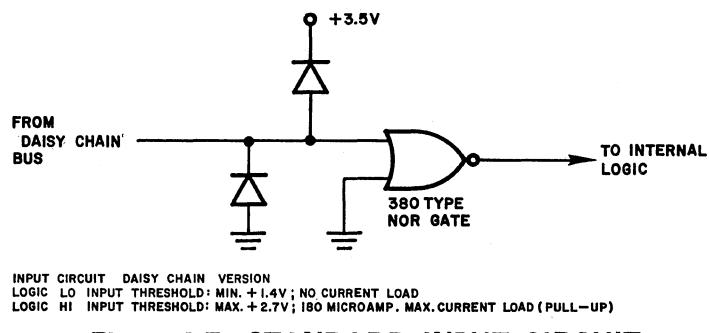


**Figure 3-6 OUTPUT DRIVER CIRCUIT**

### 3.8 INPUT GATES

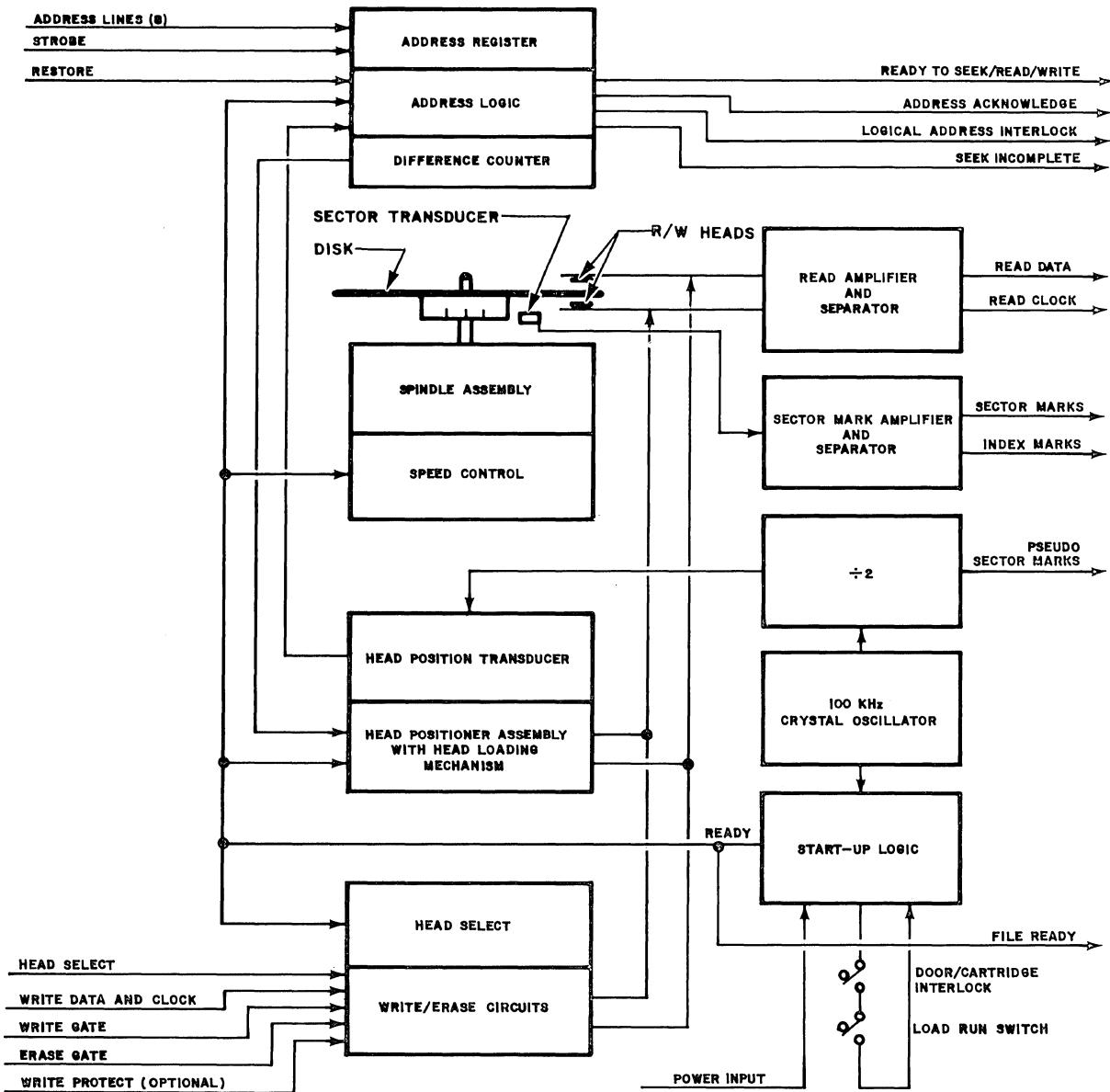
The Series 30 Disk Drives use a 380 type NOR gate as the input circuit. This integrated circuit is from the Utilogic family and because of its circuit structure has a higher input threshold in the low logic state than most commercially available DTL or TTL circuits. This assures a higher noise margin on all input lines. In addition, the 380 input circuit loads the signal transmission lines with significantly less input current, causing a lesser amount of local reflections on the line in a Daisy Chain configuration.

The input of the 380 circuit has to be pulled-up in the High logic state. For this reason it cannot be driven by an open collector driver stage without collector resistance. This collector resistance is installed by terminating the last Series 30 on the bus. Figure 3-7 shows the input circuit used in the Series 30.



**Figure 3-7 STANDARD INPUT CIRCUIT**

## SECTION 4 PRINCIPLES OF OPERATION



**Figure 4-1 SIMPLIFIED BLOCK DIAGRAM OF DISK DRIVE**

### 4.1 GENERAL INFORMATION

The Series 30 Disk Drive consists of those functional units described in the block diagram shown in Figure 4-1. Together, these units work to facilitate safe loading and unloading of disk cartridges, to spin the disk at proper speed, to precisely align the read/write heads over a specified track location and to perform data writing and reading functions. Each major functional part is described in more detail in the following subsections. Normal operating sequences for a Series 30 Drive are described in Section 3.

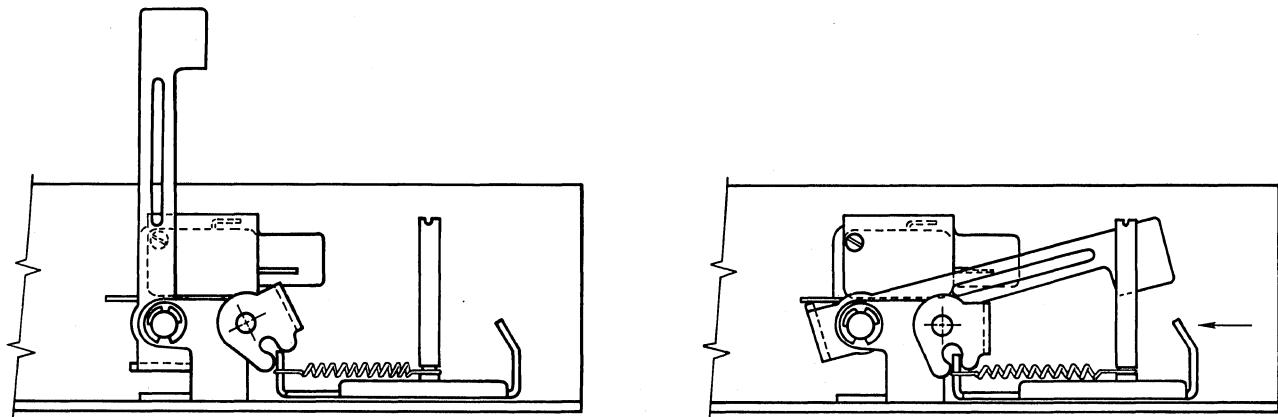
### 4.2 POWER OFF

With no power applied to the drive, the head load solenoid is not energized, and the heads are held away from the disk surface. The heads are down (loaded) only when power has been applied and disk speed is sufficient to allow the heads to fly properly.

When power is removed from a disk drive, although the heads may be lifted (unloaded) they could be left in a position over the disk other than fully retracted at cylinder 0. If the disk were to be removed under these conditions, the disk and/or heads could be damaged. To prevent this, the door on the Model 31 is locked whenever power is not applied. When power is applied, the heads are moved to cylinder 0 before the door is unlocked. On the Model 31 a LOCK flag, visible through the door, indicates the state of the lock.

The door lock, with its LOCK flag interlock on the Model 31, can be manually bypassed when the door must be opened without power applied by following the procedure given below:

1. Remove top cover.
2. Place the head carriage to the rearmost location, over Track 0.
3. With a thin rod placed against the bail holding the door locked, pull the bail toward the right-hand side of the machine. See Figure 4-2.
4. When the bail has released the door, the LOCK flag will be lowered and the door can be opened.
5. Hold the LOCK flag in its down position to remove or insert a cartridge.



**Figure 4-2 DOOR LOCK MECHANISM, MODEL 31 (REAR VIEW)**

The top cover of the Model 33F must be removed and the door opened for access to its cartridge.

**[CAUTION]** Ensure that power is off, disk rotation is stopped and that the heads are at the track (cylinder) 0 location prior to opening the Model 33F's door.

#### 4.3 INITIAL POWER-ON

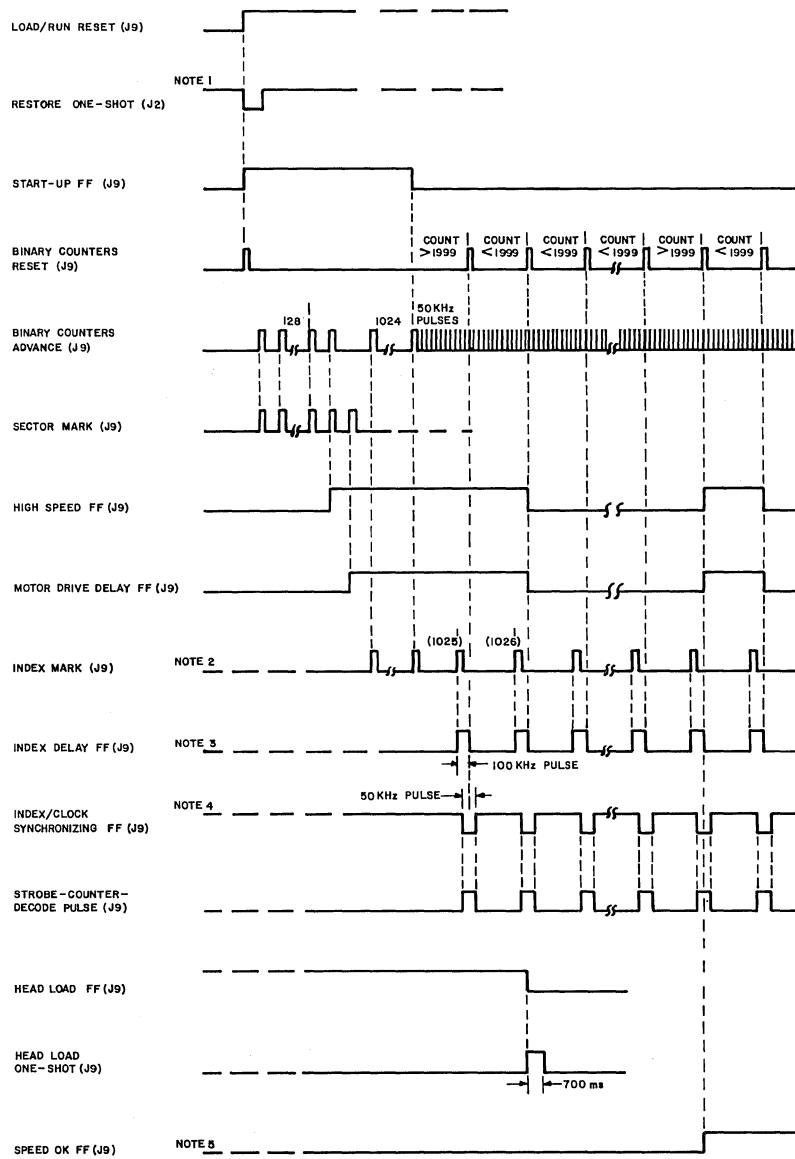
The externally supplied voltages ( $\pm 15$  VDC) are monitored by circuits on the J8 PCB. Upon application of power, the voltages are below 90% of their rated values and a Voltage Error signal is generated. This signal goes to the J9 and J10 PCB's. J10 circuits activate a WRITE CHECK condition to prevent any data writing activity. J9 circuits activate the start-up delay network to produce a load-run RESET signal. This condition continues until 70 msec after the end of any voltage error signal, to ensure that the supply voltages are within tolerance. The start-up delay signal is also taken through the J8 PCB where a -SERVO DISABLE signal is generated to prevent head motion during power transients. From J8, the delay is also sent to J2 PCB as a SERVO HOLD signal used to generate SEEK INCOMPLETE status and INITIAL RESET. INITIAL RESET sets the Address Register, the Subtractor, and the Difference Counter circuits to their cylinder 0 status. Finally, this sequence is also initiated anytime either of the supplied voltages falls more than 10% below its rated value.

The +5V supply is derived from the +15V input with a regulating circuit using zener diodes. The circuit is located on the J8 PCB, with the current handling series pass transistor being located on the heat sink.

#### 4.4 START-UP AND SPEED CONTROL OPERATION

The Model 33F performs this operation with power up. The Model 31 must have the power applied and disk cartridge properly loaded. (See Timing Chart Figure 4-3, Flow Chart Figure 4-4 and J9 Schematic). Sequence of explanation:

1. Load/Run Reset line initiates Restore.
2. Power to motor.
3. Lock Door.
4. Count Index pulses.
5. Set High Speed FF.
6. Reset High Speed FF, Load Heads.
7. Control.
8. Enable I/O lines.



**Figure 4-3 START-UP SEQUENCE TIMING CHART**

- NOTES:**
1. Load/Run Reset Line Going Low Causes Load/Run Reset.
  2. Index Pulse when Spindle at sufficient RPM to allow separation of Index Mark.
  3. Index Delay FF set with 1st Index Pulse after fall of Start-up FF and reset with 1st 100 KHz pulse after set of Index/Clock Sync FF (variable width 5 to 20  $\mu$ sec).
  4. Index/Clock Sync FF set with 1st 50 KHz pulse after set of Index Delay FF reset with 1st 50 KHz pulse after reset of Index Delay FF (set for 20  $\mu$ sec).
    - a) Used to strobe binary counter output, reset binary counters, set High Speed FF set Speed OK FF.
  5. Set 1st Time Binary Counters (Notes 1, 2 & 3) are greater than 1999 between Index Pulses with Head Loaded FF Set. If Binary Counters reach 2048 or greater, the heads are unloaded and Spindle Speed OK FF is reset.

START-UP SEQUENCE (Board J9)

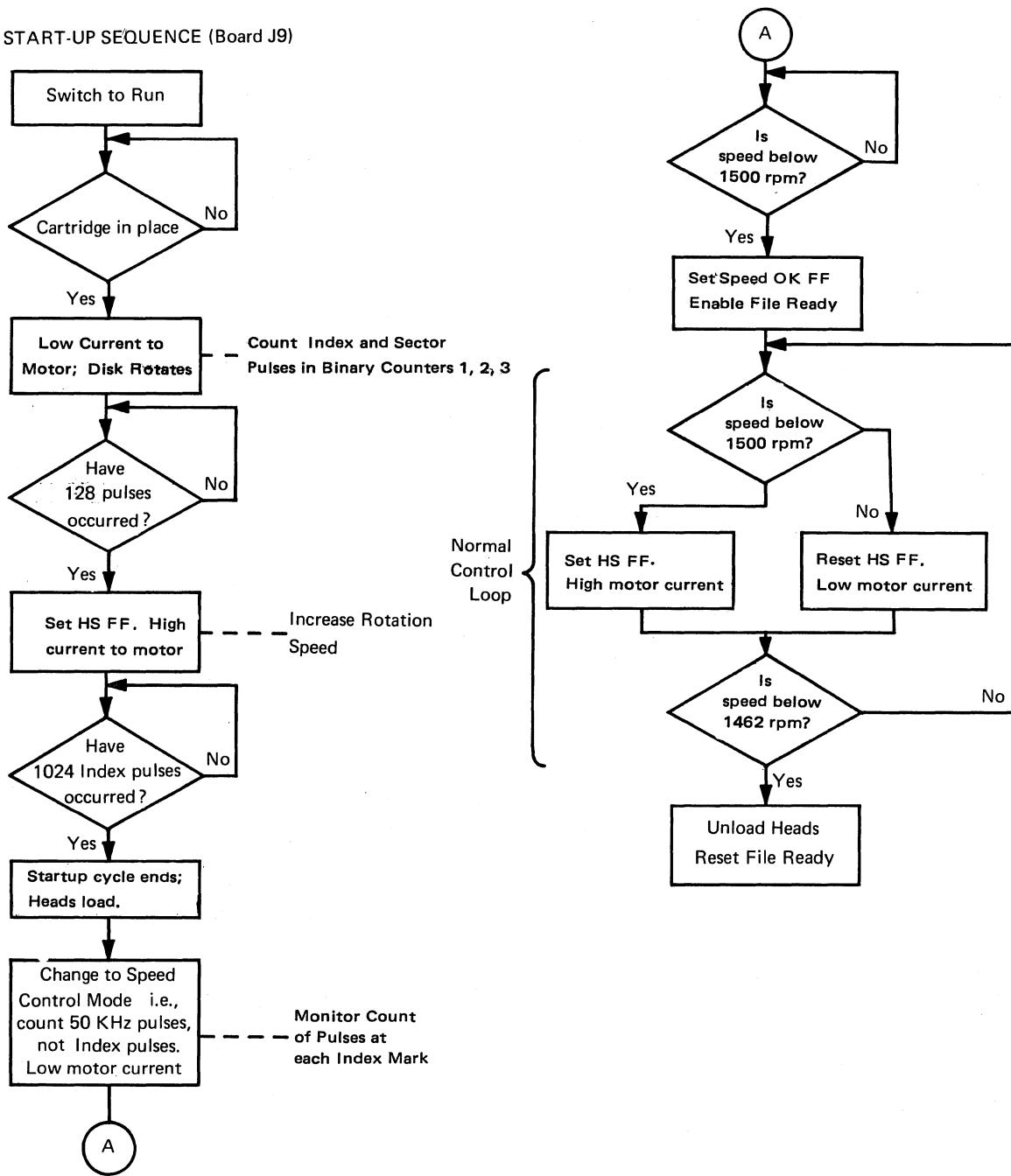


Figure 4-4 START-UP FLOW CHART

The Load/Run Reset line will go LO when the switch is placed into the Run position causing a Load/Run Reset.

The spindle motor circuit is completed through the resistor, located on the heat sink between the terminals marked U and T.

A spindle rotation sensing circuit on J9 keeps the door of the Model 31 locked whenever the voltage across the spindle motor is one volt or more. This condition exists when power is applied to the motor through the Load/Run switch or when the motor acting as a generator slows to a stop in the Load condition.

As the spindle rotates, the Sector and Index marks are detected and amplified. The spindle motor will shortly reach sufficient RPM to cause separation of the Index mark from the Sector marks. Sector mark pulses are directed to the binary counter on J9 PCB.

A count of 128 enables the next pulse to set the High Speed FF. At the following Sector pulse, the High Speed Delay FF sets, causing the motor drive circuit to connect a 4 Ohm resistor in parallel with the resistor between terminals U and T, increasing the current and accelerating the motor to high speed.

Index pulses are now counted until a count of 1024 is reached which will reset the Start-up FF. This causes the counter input to change from Index pulses to 50 KHz pulses. The Index Delay FF is no longer held reset, and the speed control circuits begin to operate. Note that the counter is at 1024 when this happens.

Since the counter was at 1024 when the Start-up FF was reset, the count will be greater than 2048 at the end of the next revolution when it is strobed and reset at Index time. The High Speed FF will remain set for the next revolution. At the next Index time the count will be less than 1999 as the disk is rotating well above normal speed. The High Speed FF will be reset, causing the disk to begin to slow down. At the same time the Heads Loaded FF changes state, triggering the Head Load One-shot, and supplying holding current to the head load solenoid. When the disk speed falls below 1500 RPM the High Speed FF sets again, and the Speed OK FF sets. The High Speed FF continues to be set and reset as necessary to maintain proper speed. If the disk should ever slow to the point that a count of 2048 was reached, the heads would be unloaded.

Speed control is performed by checking the number of 50 KHz pulses counted from one Index pulse to the next, and turning on or off the increased motor drive current as required. The counter output is decoded to produce a signal that is true for a count greater than 1999. At Index time the High Speed FF is set if the signal is high, and reset if it is low. The following Sector pulse causes the Motor Drive Delay FF to assume the same state as the High Speed FF, and thereby turn on or off the increased motor drive current.

Since the Index pulse may occur at a random time with respect to the 50 KHz pulses, it cannot be used directly to strobe the counter decoder. The Index pulse sets the Index Delay FF. The following 50 KHz pulse clocks in the Index/Clock Synchronizing FF generating the Strobe Counter Decode pulse. The next 100 KHz pulse resets the binary counter and the Index Delay FF. The next 50 KHz pulse resets the Index Clock Synchronizing FF.

The Speed OK signal causes the Ready lamp to turn on and qualifies all of the I/O lines. These lines are further qualified by the Unit Select Interface signal.

#### **4.5 INDEX AND SECTOR MARK CIRCUITS**

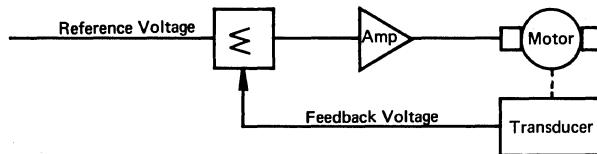
The Index and Sector Mark circuits supply timing pulses, related to the rotational position of the disk, to internal circuits and also to the interface. Internally, the Index Mark is delivered to the spindle speed control circuits (described in subsection 4.4) once per revolution. The Index Mark and Sector Marks are delivered to the system controller on two separate interface lines.

The Index and Sector Mark circuits develop their timing pulses by sensing physical slots in the hub of the 2315 type disk cartridges. The physical slots are sensed by a transducer, called the Sector Mark Transducer. Near one of the sector slots is a unique slot, labeled Index Mark slot, which originates a pulse to identify a complete rotation of the disk.

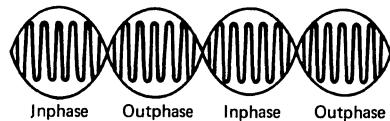
The equally spaced Sector Marks are normally used by the operating system to format tracks on the disk surface into sectors and the Index Mark is used to establish the beginning of a track. There is a

special circuit in the disk drive that separates the Index Mark from the Sector Marks, because, as they are supplied by the Sector Mark Transducer, they are indistinguishable.

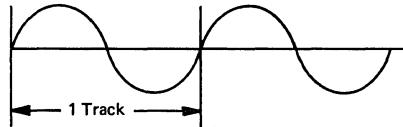
Pseudo Sector Marks are also available at the interface. These Pseudo Sector Marks are generated by utilizing alternate pulses of the 100 KHz crystal oscillator. These pulses are used to control the spindle speed (subsection 4.4), and may also be utilized to generate sector formats.



**Figure 4-5 GENERAL SERVO SYSTEM**



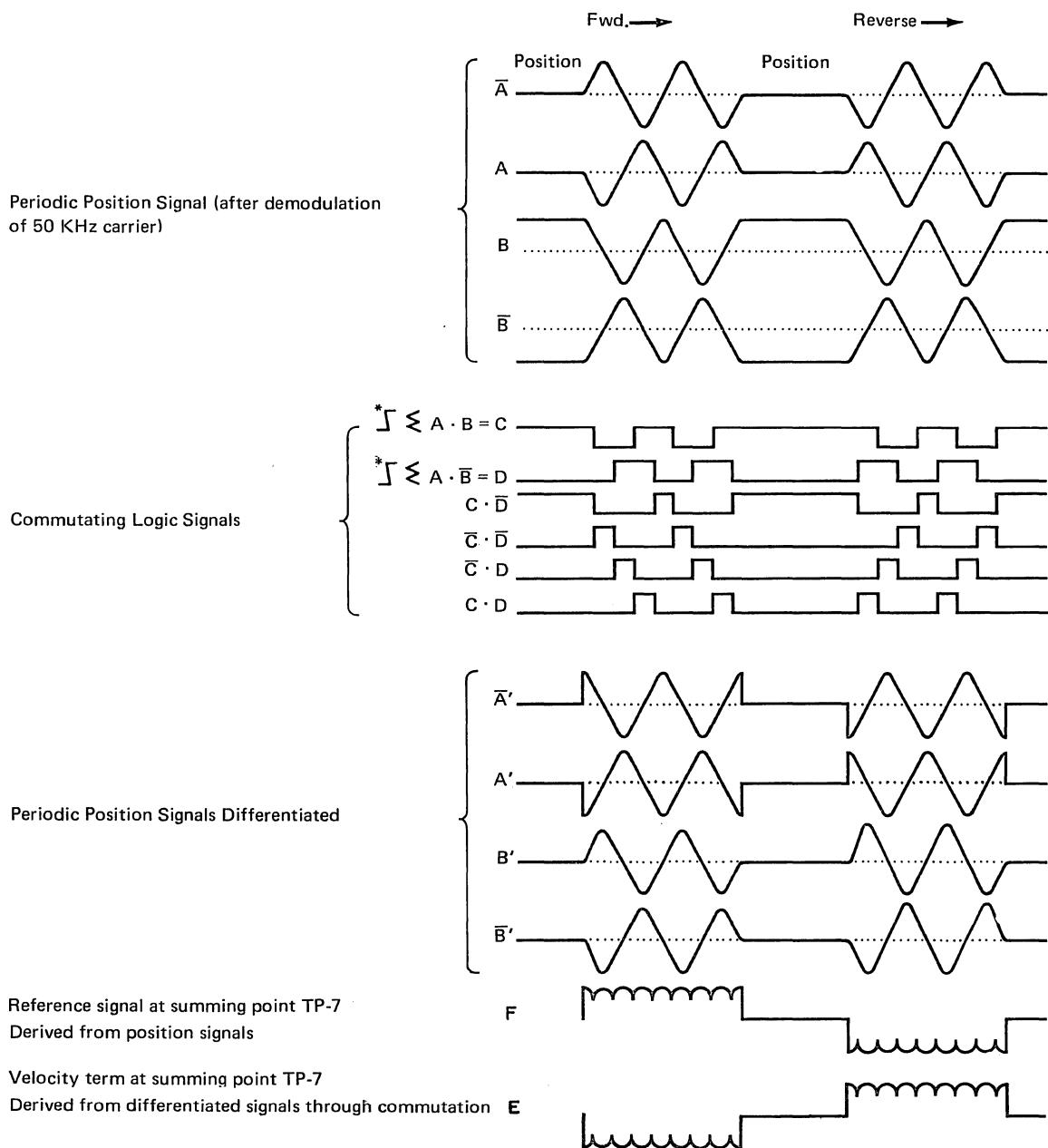
**Figure 4-6a TRANSDUCER SIGNAL ENVELOPE (MODULATED)**



**Figure 4-6b TRANSDUCER SIGNAL (DEMODULATED)**

#### 4.6 SERVO OPERATION

Figure 4-5 shows a general servo system. Polarity and amplitude of motor current is determined by the difference between the Reference Voltage and the Feedback Voltage. The source of reference and feedback voltage is the position transducer. This transducer, when fed with a 50 KHz triangular voltage waveform as a carrier, will develop a modulation on the 50 KHz waveform as shown in Figure 4-6a, which after demodulation, results in the position signal shown in Figure 4-6b, constant velocity assumed.



\*the  $\int \leq$  symbol designates a summing and squaring function

**Figure 4-7 POSITION TRANSDUCER SIGNALS TIMING RELATIONSHIP ONLY**

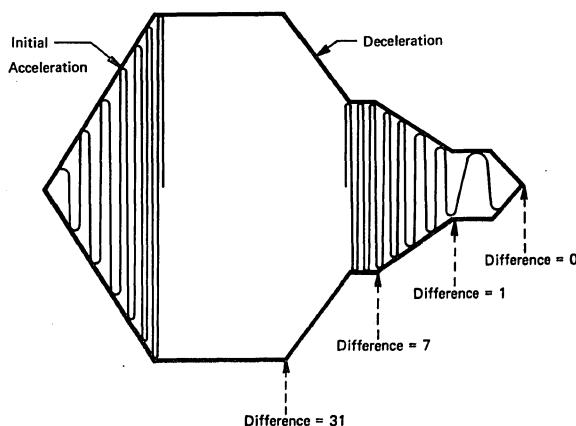
Figure 4-7 shows position signals A and B together with the inverted sine waves  $\bar{A}$  and  $\bar{B}$ . These four signals are differentiated by C-R networks and fed to a summing point via four commutator FET's. The four differentiated waveforms are also shown in Figure 4-7 and have an amplitude proportional to carriage velocity, regardless of direction of movement.

The commutating signals C and D are derived by summing and squaring the A and B signals. This commutation is equivalent to a phase-sensitive, four-phase rectification so that the net current into the summing point is a DC current proportional to the velocity plus a ripple current. This velocity feedback is E in Figure 4-7 where:

$$E = A' (\bar{C}D) + B' (CD) + \bar{A}' (\bar{C}\bar{D}) + B' (\bar{C}\bar{D})$$

The error due to ripple current is removed by constructing a velocity reference term F with an equal ripple content. The reference signal is also shown in Figure 4-7. This reference is derived from the position signals and is therefore independent of velocity. (See circuit diagram for J1 PCB).

When carrying out a Seek Operation the Position term FET is switched off and, depending on direction, either the two forward or the reverse FET is switched on. The velocity of the carriage is controlled by the speed increment terms which are gated into the summing point via three FET's. These FET's are directly controlled by the output of the Difference Counter. The first speed increment has maximum attenuation and is active whenever a directional FET is on. The second, third and fourth speed increment FET's parallel the first speed increment attenuation and, when on, will decrease the attenuation of the reference voltage, allowing more velocity. Thus if the differentiated position waveform (at J1-TP3) is monitored during a long seek, the waveform shown in Figure 4-8 is observed.



**Figure 4-8 DIFFERENTIATED WAVEFORM (J1-TP3)**

Until the Difference Counter is advanced to 255 (incremented at each track by the commutating logic) the servo imposes constant velocity control on the positioner with four discrete velocities depending on the number of tracks still to go.

The difference = 0 condition (Difference Counter equal to 255) occurs at 3/8 of a track still to go. At this time the Position term control FET is switched on. The inputs to the servo are now the velocity feedback term  $\bar{A}'$  and the position sine wave  $\bar{A}$ . The servo now behaves as a classical positioning servo; in other words, the servo locks on to the null on the position envelope. If, due to vibration or any other cause, the positioner is deflected from its true track position the position sine wave ( $\bar{A}$ ) becomes nonzero which creates a force to the motor placing it back on its null.

The remaining circuit on the J1 PCB is the Motion Indicator Level, which gives a low output at pins 14 and R only when the positioner has been stationary for the preceding 30 milliseconds. This signal is used to detect motion or the lack of motion during a Seek or Restore Operation.

#### 4.7 ADDRESS ARITHMETIC AND TRACK SELECTION LOGIC

The address arithmetic and track selection logic receives a binary 8-bit cylinder address from the controller and supplies decoded head positioning information to the head positioning servo circuit.

To derive head positioning information, an address register and two counters are employed. The address register stores the track address at which the heads are presently located (existing address). The new address is held on the interface lines and is subtracted from the existing address by the first counter. The difference is then entered into the second counter. Contents of the second counter, called the difference counter, are then decoded and used to indicate the direction in which the heads are to be

moved and the speed at which they are to move.

As the heads move, each track centerline is detected by the position transducer output. The difference counter is incremented at each of these centerline detections. A predetermined value in the difference counter indicates that the heads are in position at the new track address. As the difference counter increments, it also changes velocity instructions, such that the head motion is rapid at the beginning and slower as the correct track is approached. An absence of head movement when the difference counter is not at its predetermined value indicates a Seek Incomplete, which is fed to the interface.

When the difference counter is loaded, the address register accepts the new address from the interface lines and the old address is destroyed. The storage of the new address triggers the Address Acknowledge signal.

If a Track Address cannot be executed, because it is greater than 202, a Logic Address Interlock is generated and no head motion takes place.

When a Restore command is present, it takes precedence over Track Address inputs and causes the heads to withdraw to track 0.

#### **4.8 HEAD POSITIONING/SEEK OPERATION**

(See Figures 4-9 and 4-10, Schematics J1, J2 and J3)

Positioning of the head carriage is accomplished by the head positioner assembly under the control of a dual mode velocity and position servo circuit. The velocity and position servo circuit applies voltage of proper polarity and magnitude to the DC servo motor contained within the head positioner assembly.

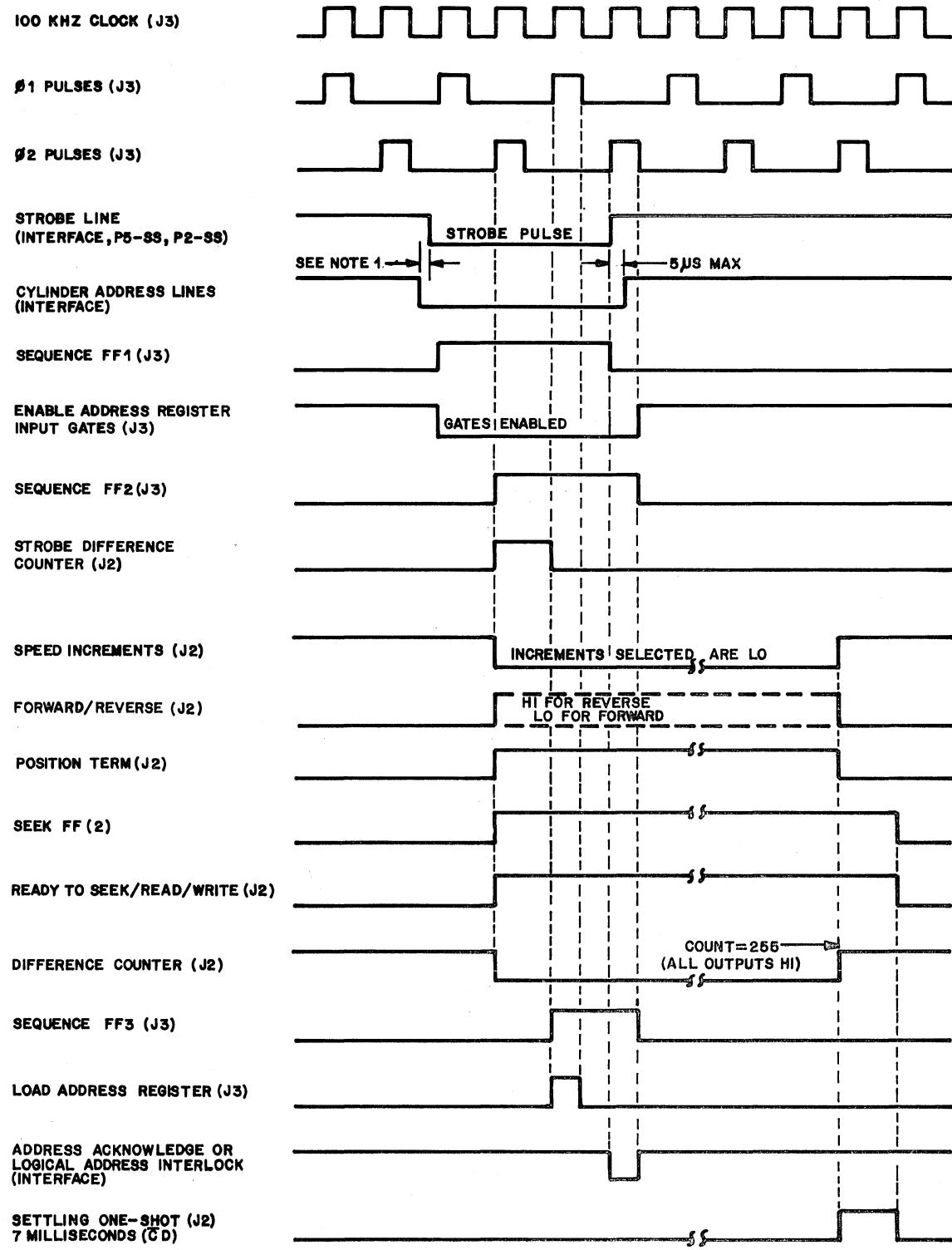
Sequence of explanation:

1. Start Seek
2. Sequence FF 1
3. Sequence FF 2
4. Head Movement
5. Sequence FF 3
6. Advance Difference Counter
7. Stop Seek
8. Seek Incomplete

At the beginning of a Seek Operation the Address Register (J3 schematic) contains the address of the head's present location. The new address, in absolute form, is on the interface lines. An Interface Strobe pulse will begin the Seek sequence. The  $\phi 1$  and 2 pulses from the two-phase clock generator (J3 schematic), are derived from the 100 KHz clock.

Sequence FF 1, on J3, is set with the first  $\phi 1$  after the Strobe and enables the Address Register input gates. The new address is checked for validity — any address less than 203 is considered valid. The new address is compared with the present address, contained in the Address Register, and the results of the comparison are present at the output of the Subtractor. A carry from the Subtractor indicates forward motion.

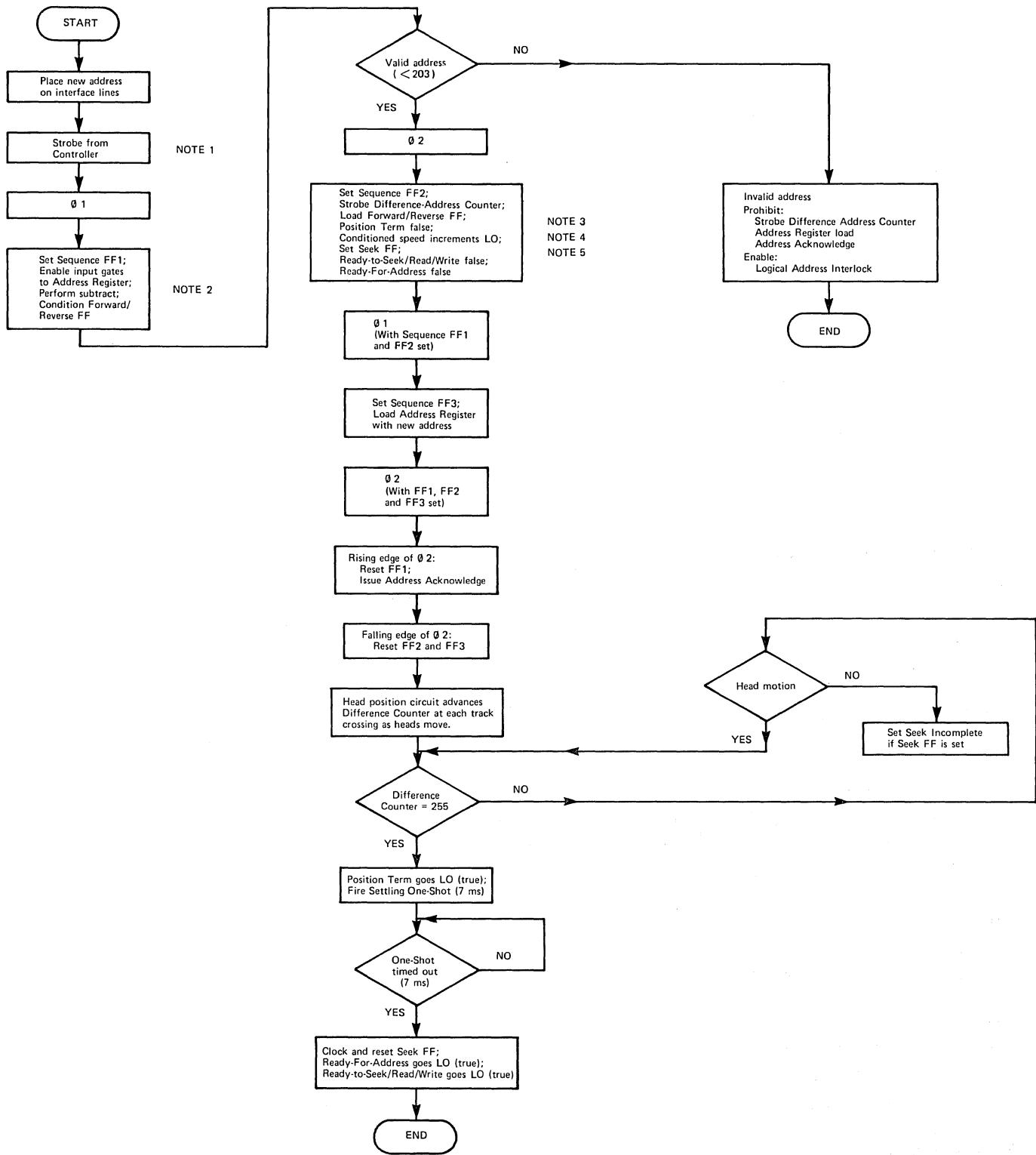
Sequence FF 2, on J3, is set with the first  $\phi 2$  after FF 1 is set and enables a Strobe of the Difference Counter. With a change in Cylinder Address, the Position Term goes false and any other conditioned speed increments true. The Difference Counter Strobe also sets the Forward/Reverse FF on J2, which causes the head carriage to move under control of the Servo circuits.



**NOTE:**

1. ALLOW ADEQUATE SETTLING TIME OF THE CYLINDER ADDRESS LINES (TYPICALLY 500ns) BEFORE APPLYING STROBE PULSE.

Figure 4-9 SEEK OPERATION TIMING CHART



- NOTES:**
1. Strobe ignored if Ready-For-Address is false. If Restore is true when Strobe is applied, the Restore sequence will be executed regardless of the status of Ready-For-Address.
  2. Binary subtract ( $A + \bar{B} = E$ ) carry is used.
  3. Ready-For-Address true when output of Difference Counter = 11111111. Speed increment determined by distance to be traveled.
  4. Fwd set by carry from high order position.
  5. Pseudomotion injection provided to prevent false set of Seek Incomplete while Head Positioner is starting into motion.

Figure 4-10 SEEK OPERATION FLOW CHART

Loss of Position Term enables head movement and Pseudomotion Injection. The Seek FF is set with Position Term false and motion, as long as Restore FF 1 is reset. The Seek FF places the Ready-for-Address and the Ready to Seek/Read/Write lines false.

Sequence FF 3 is set with the  $\phi_1$  following the set of FF 2. The next  $\phi_2$  pulse will reset FF 1, enable Address Acknowledge interface line (or Logical Address Interlock) and load the Address Register with the new address. FF 2 and FF 3 are reset at the fall of this  $\phi_2$ .

With the Difference Counter at less than 255, the Servo will cause the head carriage to move at the correct velocity and, through the commutating logic, will provide "Servo Logic Control Level  $\bar{C}$ " and "Servo Logic Control  $\bar{D}$ ". These logic levels will cause the Difference Counter to advance by one as each track centerline is passed.

When the Difference Counter has advanced to 255 (all outputs high) the Position Term is made true, Pseudomotion Injection is set false and the Settling One-Shot is allowed to trigger. The Settling One-Shot pulse will clock the Seek FF which enables the Ready to Seek/Read/Write line thus completing the Seek Operation.

If "Motion Indicator Level", from the J1 Servo board, should go false, indicating no motion, while the Seek FF is set, the Seek Incomplete FF is set.

## 4.9 READ/WRITE OPERATION

(See Schematic J10)

### Head Select

Head selection is based on a three-level principle, with one head always selected. The unselected head is at approximately -1V. The center tap of the selected head, with write gate false, sits at approximately +.1V. When write gate is true, the center tap of the selected head is at approximately +14V.

### Write

The incoming Data and Clock pulses are fed to the Write FF so that Data and Clock pulses become head current transitions. The Q and  $\bar{Q}$  outputs of the Write FF are fed through separate drivers to the Read/Write winding of both heads. Write Current flows in only that head whose select driver is at +14V.

### Erase

When the Erase gate is true, through the Erase interface line or the 10 ohm resistor to the Write Gate line, the Erase driver allows current to flow through the erase coils of the head selected for write.

### Read

The output from the selected head winding is amplified and clipped. Pulses are generated on both transitions of the clipped signal; these pulses have a width of  $100 \pm 50$  nsec, and are separated into data and clock pulses.

### Data Separation

The following applies to the Standard Transfer rate of 781 KHz and may be directly applied for a transfer rate of 720 KHz.

The leading edge of the first transition received triggers the Data Separation One-Shot which is set at 900 nsec (970 nsec at 720 KHz). The Data Separation FF is set on the trailing edge of this transition and reset on the trailing edge of the One-Shot. The result is that the Data Gate on J10-TP5 starts at the trailing edge of a clock pulse and extends for 70% of the entire bit cell time. Any pulse occur-

ring during this Data Gate On time is transmitted to the interface as Read Data; the remaining pulses are transmitted as Clock pulses.

With either high density option, two one-shots, a long and a short, and a one's trigger is added. These additional circuits provide a data gate at J10-TP5 which is shorter if the previous bit cell contained a data bit one. The shorter data gate allows for the natural phenomenon of pulse shifting.

### **Write Check**

A true Write Check and a false File Ready indication will be presented to the interface when any of the below listed conditions are present.

1. Write Current without Write Gate.
2. Write Gate and no Write Current.
3. Write Current through both heads.
4. Erase Current without Erase Gate.
5. Erase Gate and no Erase Current.
6. Erase Current through both heads.
7. Voltage supplied is down to a nominal 13.5 volts. (Does not produce false File Ready)

A Load/Run Reset is required to reset the Write Check FF. All functions are disabled while the Write Check FF is set.

Note: A low voltage condition will cause a Write Check indication only for the duration of the low voltage condition. The Write Check FF is not set.

### **4.10 LOAD/RUN RESET (See Schematic J9)**

The Load/Run Reset signal is generated by a voltage error signal, the Power-up Delay circuit or by the Load/Run switch being switched into the Load position (with a cartridge loaded). The Load/Run Reset signal places the flip-flop circuits in the speed control system into their start-up, resets the Write Check FF on J10, sets the Write Protect FF if this option is installed, and causes a Restore operation.

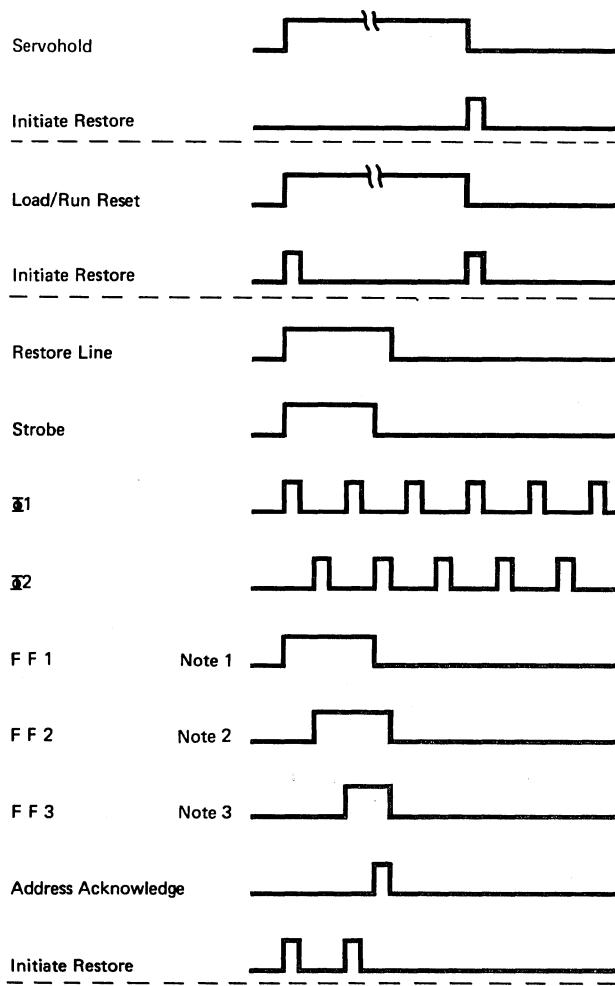
### **4.11 RESTORE OPERATION**

A Restore Operation is initiated by a Power-up Reset (Servohold), a rising or a falling edge of the Load /Run Reset signal, or by the Restore and Strobe interface lines. See Figure 4-11.

Refer to the timing chart Figure 4-12 and J2 Schematic. The Initiate Restore pulse will cause the Restore One-Shot to produce a 16 msec LO pulse. This LO output from the One-Shot will Reset the Seek Incomplete flip-flop and the Seek flip-flop, and also set Restore FF 1 and Restore FF 2. Pseudomotion is brought true by the loss of the Position Term.

Restore FF 1 causes the Address Register on the J3 board and, in turn, the Difference Counter on the J2 board to be set to the cylinder 0 state. This is accomplished by inhibiting the track address input gates on the J3 board while the Address Register is being clocked. The output from the Subtractor on the J3 board is all 1's (HI), without a carry, because of the inhibited track address input gates. The Subtractor output is gated into the Difference Counter on the J2 board and is double inverted because of the Reverse condition (Lack of Subtractor carry). The Difference Counter Strobe places the Subtractor's output into the Difference Counter, setting its outputs HI (position condition). Restore FF 1 also:

1. Sets reverse and 1st speed increment.
2. Sets Position Term false.
3. Sets 2nd, 3rd and 4th speed increments false.
4. Inhibits the Difference Counter advance pulse.



- NOTES:**
1. Set with first  $\phi_1$  after Strobe. Normally used to enable Address Register Gates on J3 board.
  2. Set by first  $\phi_2$  after FF 1 set. Normally used to enable Strobe Difference Counter, but this function is also set with Restore FF 1-Q or Initial Reset.
  3. Set by first  $\phi_1$  after FF 2 set. Normally used to provide Address Acknowledge and Load Address, however, Load Address function has been set with Restore FF 1-Q or Initial Reset .

**Figure 4-11 INITIATE RESTORE TIMING CHART**

Restore FF 2 inhibits the set of Seek Incomplete FF and the Ready for Address line.

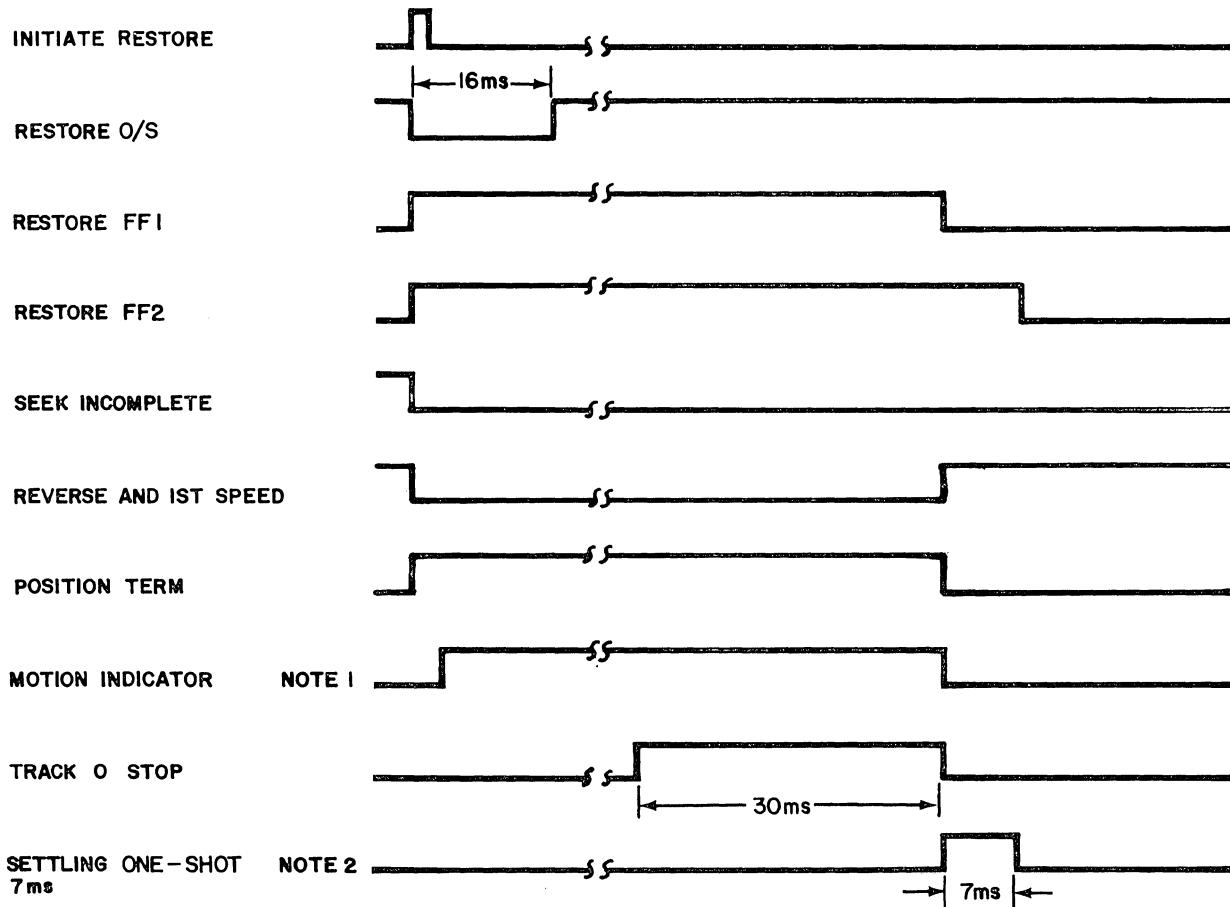
With the above conditions, the head carriage is being moved in its reverse direction at the 1st speed increment. This motion will continue until the head carriage is stopped by the Track 0 stop. The door remains locked during this operation because of the Head In Motion line from J2.

Lack of motion detected by J1 PCB, with Restore FF2 set causes Restore FF 1 to be reset. With Restore FF 1 reset, the Settling O/S (7ms) is fired, which clocks Restore FF 2, completing the Restore Operation.

#### 4.12 SECTOR COUNTER

A five-position binary counter which is reset to all zeros by the leading edge of the sector mark following the index mark, and advanced with the leading edge of each sector mark. This counter is located on the J8 board, see J8 Schematic.

**Note:** Early production, unmodified, machines may be equipped with a four-position counter.



- NOTES:**
1. Motion Indicator line High while head carriage moving toward Track 0 Stop and for an additional 30 milliseconds.
  2. Restore FF 2 and Seek FF (not shown) is reset by Settling One-Shot pulse, thereby completing restore operation.

**Figure 4-12 RESTORE OPERATION TIMING CHART**

#### 4.13 DAISY CHAIN

Enables up to four Model 31 Disk Drives to be controlled along a common series interface. Four Select lines and a four-position selector plug are provided.

All internal input line resistive termination is removed. The resistive termination must therefore be common and be installed on the last machine in the series interface.

A terminator must be installed on the last machine in the daisy chain.



## SECTION 5 MAINTENANCE

### 5.1 GENERAL INFORMATION

The Diablo Series 30 Disk Drive is designed to greatly reduce maintenance and repair procedures, by virtually eliminating those components usually associated with mechanical wear. The design has resulted in the removal of all potentiometers, belts, pulleys and other mechanisms normally requiring frequent field service and/or adjustment. All components are used well below their design limits, and moving components are controlled electronically with the minimum amount of mechanical hardware.

#### 5.1.1 Maintenance Philosophy

The objective of maintenance is to provide maximum utilization of the machine with minimum down time. Unless a preventive maintenance operation increases machine availability it is unnecessary. Properly functioning equipment is best left alone. In the event of a problem isolated to the drive, field maintenance philosophy is on-line diagnosis; rapid off-line repair, readjustment, and checkout; then back on-line for verification of performance. Should a repair become necessary, the machine's modular design minimizes down time by allowing the defective section to be worked on without disturbing the other sections. The semiannual preventive maintenance session on the Series 30 is comprised of visual inspection and cleaning. Do not alter any adjustment on equipment that is performing at a satisfactory level.

#### 5.1.2 Visual Inspection

Visually inspect the machine. Look for corrosion, dirt, wear, cracks, binds, loose wiring connections, loose hardware, etc. Noting these items and taking appropriate action will usually result in minimizing, if not preventing, future down time altogether.

#### 5.1.3 Cleaning

Cleanliness is important in disk storage machines. The clearance between the read/write heads and the disk surfaces during operation is measured in microinches. Even slight accumulations of dust or dirt can produce contact between head and disk, and cause damage.

AREA	ACTION
Read/Write Heads	Clean and inspect for scratches and build up of oxide.
Carriage Rail	Clean and inspect. Apply two drops of oil on each of the 2 wicks <i>only if dry</i> .
Spindle Assembly	Clean and inspect the magnetic ring. Magnetic particles may be removed using adhesive tape.
Base Plate and Covers	Clean and inspect for loose hardware.
Air Filter	Replace.

Figure 5-1 PREVENTIVE MAINTENANCE 6 MONTH INTERVAL

### 5.2 PREVENTIVE MAINTENANCE

Operating the disk drive in a normal office environment on a one-shift basis generates a need for preventive maintenance at six month or 1000 operating hour intervals. Operating the drive in a high dust environment, as well as frequent cartridge exchanges, will shorten the preventive maintenance interval.

#### 5.2.1 Preventive Maintenance Action

##### Head Cleaning

Clean the read/write heads with 91% isopropyl alcohol (or equivalent) using a lint free wiper to remove any residue. The *complete* removal of *all* contamination, including fingerprints, is mandatory.

## **Head Positioner Lubrication**

Refer to Figure 5-4. The lubrication wicks on a Series 30 Disk Drive Head Positioner require only a small amount of lubrication to distribute a thin film of oil to the rack and pinion. *TWO* drops of oil, Diablo P/N 70655, should be applied *ONLY* when the wicks appear to be dry. To check for dryness, slide a fingernail over the wicks. If a shiny residual film appears on the fingernail no additional lubrication is necessary.

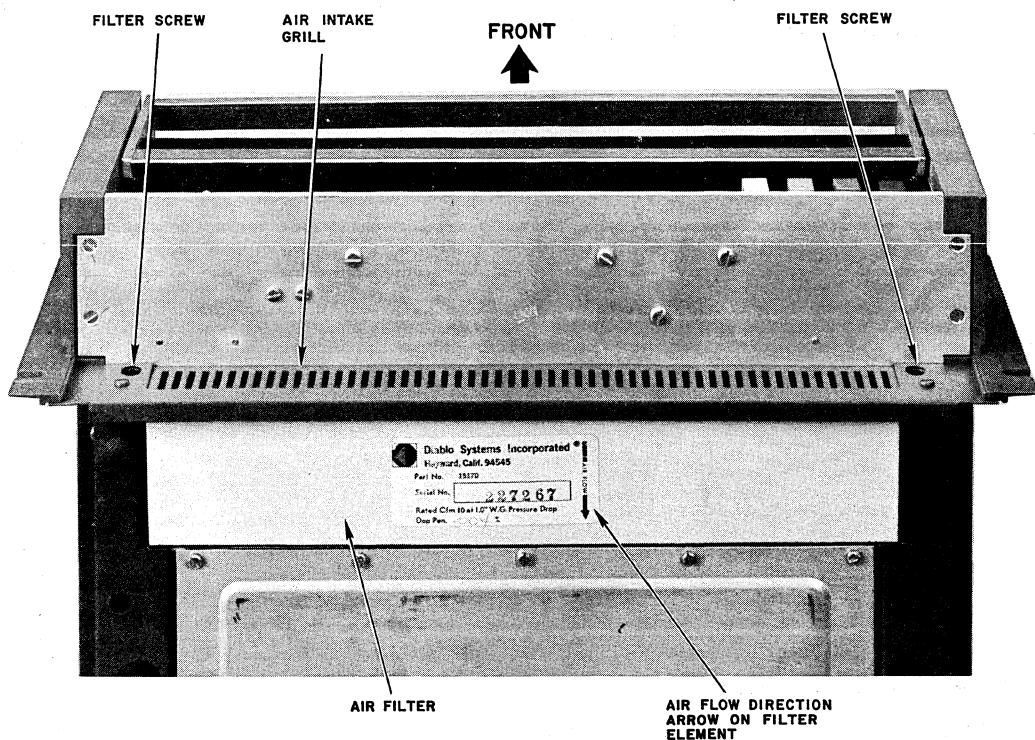
### **[CAUTION] WICKS MUST NOT BE SATURATED WITH OIL!**

Over oiling can cause the recording disk and the read/write heads to become contaminated with oil, resulting in catastrophic head crashes.

## **Air Filter Replacement**

The air filter is located on the bottom front of the machine, below the front panel door behind the grill. It is not necessary to remove the drive from its rack mounting if it can be slid out on the rack to gain access to the bottom.

1. Turn off all power to the drive.
2. If rack mounted, slide the drive out. If not rack mounted, remove it from its mounting and place it on its side.
3. Refer to Figure 5-2. Loosen the two filter screws to release the filter clamps.
4. Remove the old filter, and note carefully how it was oriented. The new filter must be installed as shown — label showing, and the arrow pointing toward the rear of the machine (the plastic foam screened side must be toward the grill opening).
5. Retighten the two filter screws, and check the filter for proper seating.
6. Return the drive to its operating position.



**Figure 5-2 AIR FILTER REPLACEMENT**

### **Head Positioner Commutator Cleaning**

Extensive head positioning may develop a carbon buildup in the head positioning motor from brush wear, and cause overshoot or oscillations of the positioner due to poor brush-commutator contact. Every 18 months, or oftener as required, check the brushes for wear and the commutator for carbon buildup.

1. Remove the bottom rear cover of the drive, and the bottom plate of the head positioner motor.
2. Remove the motor brushes, marking each brush and holder for the later return of the same brush to its holder exactly as removed.
3. Clean the commutator with a small brush (such as a toothbrush) and isopropyl alcohol. If necessary, use a wooden toothpick to remove carbon from the commutator gaps.
4. Reassemble the unit. When reinstalling the brushes, ensure they are installed in the same holder as removed. If new brushes are to be installed, ensure the brush curvature matches the commutator curvature.

## **5.3 DIAGNOSTIC TECHNIQUES**

### **5.3.1 Error Analysis**

The modular design of the Series 30 Disk Drive allows for easy exchange of suspected subassemblies. Refer to the Interconnection Diagram in Section 7.

If the head positioner is erratic in operation, the problem may be due to a defective component on the J1 PCB, or a dirty motor commutator.

Addressing errors or Restore failures are probably due to a failure on the J2 or J3 PCB.

All data handling circuits are on the J10 PCB. A failure in data handling would normally be caused by a failure on the J10 board, in the read/write heads, the head cable, or on the recording disk.

The functions contained on the J8 and J9 boards are shown on the Interconnection Diagram in Section 7. Here again, board replacement should resolve many problems.

There are a number of power transistors located on the Heatsink assembly. These are used in solenoid and motor drive circuits.

### **5.3.2 Data Collection**

Disk system problems are frequently resolved by analyzing error patterns. To obtain an error pattern, a comprehensive record of troubles must be maintained and analyzed. The following error patterns may appear:

1. Errors which transfer from drive to drive with a particular disk — suspect the disk cartridge.
2. Errors occurring in several disk drives associated with a particular control unit — suspect the control unit.
3. Errors occurring on several disk cartridges written on one disk drive — suspect the disk drive unit.
4. A read error may have been created when the data was written.

A system of disk identification and error data collection is encouraged.

### **5.3.3 Visual Analysis**

Inspect the disk cartridge, disk, and disk drive for dirt, or clumps of oxide when data handling problems occur. Dirt and oxide particles can usually be removed by wiping the area with a clean lint-free wiper moistened with 91% isopropyl alcohol.

Do not attempt to use a damaged disk or read/write head to recover data. A practice of this kind will result in compounding the problems. It is much better to replace a defective cartridge than to attempt to use it in another drive, which may result in damage to the second drive.

#### **5.3.4 Troubleshooting**

The following simplified procedures are to be used to determine whether the Series 30 is malfunctioning or whether the malfunction is actually being caused by some other reason. During the warranty period additional troubleshooting or repair should not be performed. Diablo Customer Service should be contacted for servicing assistance, instructions, or for return of the unit to the factory.

When an operating difficulty is encountered, check the software in the controlling system, the cartridge, and the operating system control inputs to the Series 30. Verify that all cable connections are made properly. If the difficulty has not been isolated, remove power to the unit and disconnect the I/O signal cable. Then turn on the equipment power again.

Load a cartridge into the drive and place the drive in the RUN mode. After the normal start-up delay (about 50 seconds), either the READY or CHECK light should be on and the corresponding output signal on the rear panel interface connectors (P2/P5) will be LO (true) if the unit is selected.

CHECK light on indicates low voltage, or trouble in the Write circuits. READY light on indicates that a cartridge is properly loaded, that the spindle speed is correct, and that the heads are loaded. If neither light comes on, the user may assume that a malfunction exists in the unit, and Diablo Customer Service should be contacted.

#### **5.3.5 Field Testers & Test Alignment Disk Cartridge**

Diablo offers two Field Testers to aid in troubleshooting and alignment of the Series 30 Disk Drive. One, the Model 31 Exerciser, will control the drive in the performance of basic Seek and Restore operations. The other, the Model 500 Programmable Tester, will control the drive in the performance of Seek, Restore, Read/Write and Data Checking functions.

The standard Alignment Cartridge contains two prerecorded tracks on each side of the disk. Track 100 is an eccentric track, containing 1100 bits per inch. A part of track 100 is written inward from centerline and a part is written outward from centerline. Read/Write head alignment is accomplished when equal amplitudes are present from this eccentric track signal when read by the tunnel erase heads at the standard density. With high density, track 105 is used and read by the Read/Write coils.

The Index Mark is adjusted by use of track 095, which is positioned so a time delay of  $30 \pm 5 \mu\text{sec}$  exists between the Index Mark and the first bit. Track 100 is used for sector alignment with the high density Alignment Cartridge. The standard Alignment Cartridge is modified to accommodate the high density option.

**[CAUTION]** DO NOT allow writing on the Alignment Cartridge to insure protection of the prerecorded tracks.

#### **5.3.6 Field Service Aids**

Field Service Aids covering a variety of operating and service problems are regularly prepared and distributed by Diablo Customer Service.

### **5.4 REMOVAL, REPLACEMENT AND ADJUSTMENT OF SUBASSEMBLIES**

The following text and figures provide service check, removal, replacement, and adjustment procedures for the Series 30 Disk Drive. Unless noted, the alteration of any one adjustment does not affect any other adjustment. The text follows the sequence suggested below for a complete disassembly of the

drive. A complete disassembly is seldom required, however, and since the design of the drive lends itself well to partial disassembly for servicing major assemblies, the user may excerpt only those portions of this sequence of immediate interest.

1. Place the drive in the LOAD mode, and remove the cartridge.
2. Remove all power, disconnect all interconnecting cables, and move the drive to a clean clear work area.
3. Remove the top cover, elevate the electronics frame and remove the circuit boards. Note text precaution in subsection 5.5.1 concerning manipulation of the circuit board hold-down clamps.
4. Remove the electronics frame and rear panel heat sink assembly.
5. Remove the H frame, the cartridge receiver assembly, and the air filter.
6. Remove the sector transducer.
7. Remove the head positioner assembly.
8. Remove the filter circuit board, and the spindle blower assembly.
9. Remove the front panel and door interlock assembly, and the base plate.

#### **5.4.1 Preliminary Steps**

Disk cartridges containing valuable data should be removed from the drive prior to any service or repair work being performed. The simplest way to accomplish this is to place the drive in its LOAD mode and remove the cartridge normally while power is still applied. Power should then be removed, with the front panel left open, and all interconnecting cables and/or terminators disconnected.

The drive can now be removed from its operating position (rack mounting or cabinet), taken to a clean work area for service, and its top cover removed.

**[CAUTION]** DO NOT remove power from the drive by removing the power cable. Shut off power at the controlling system. All power must be removed before either cable is disconnected.

#### **5.4.2 Spare Parts**

Those users of the Series 30 Disk Drive with a trained service force may wish to perform their own maintenance. In this or similar situations where return of a unit to Diablo for maintenance may be judged impractical, the on-site service force should be supported with spare machines, spare parts, or both. The following three lists of parts, supplies and equipment represent the three levels of recommended spares provisioning for supporting the Series 30. The "P/N" numbers listed are Diablo part numbers.

##### **List 1. Preventive Maintenance**

These items should be available to each person servicing the Series 30 on a scheduled basis. The list contains all the material needed for normal scheduled maintenance.

1. Alcohol pads (91% Isopropyl alcohol) P/N 99000-01
2. Lint-free wipers P/N 41127-51
3. Syringe oiler P/N 99000-02
4. Touch-up paint, Old Gray P/N 99003-01
5. Touch-up paint, Gold P/N 99003-02
6. Touch-up paint, Dark Gray P/N 99003-03
7. Air filter P/N 15170
8. Adhesive, LOCTITE 222 or equivalent P/N 70185
9. Oil, P/N 70655

## List 2. Corrective Maintenance Items

This list contains all the subassemblies, tools and equipment that would be required to effectively repair the Series 30 almost 100% of the time.

1. One set of PC Boards
2. A Diablo Exerciser (P/N 11142) or Tester (P/N 20900)
3. One Alignment Cartridge P/N 70268
4. One each upper and lower R/W Head
5. One R/W Head Cable Assy P/N 11114
6. One each PCB Retainer, left and right
7. Power transistors
8. Light bulbs
9. PCB Extender Board P/N 11040-01
10. Oscilloscope
11. Torque wrench set P/N 99001
12. Common hand tools

## List 3. Parts Support

This is the highest level of spare parts provisioning recommended by Diablo Customer Service. This level would be appropriate for the self-sufficient customer who has a large number of Series 30 Disk Drives.

1. Additional Items from List 1
2. Additional Items from List 2
3. Spindle/Blower Assembly
4. Head Positioner Assembly
5. Motherboard PCB/Heatsink Assembly
6. Cartridge Receiver Assembly
7. Model 31 Front Panel Door Lock Assembly

### 5.4.3 Components/Assemblies Locations

This section contains descriptions and illustrations of major components and their location within the Series 30 Disk Drive.

#### Baseplate Assembly

A rigid aluminum casting, around which the entire disk drive is structured. The baseplate itself rests on three resilient shock mounts in the bottom of the Shadow Box assembly, and provides mounting for the spindle assembly, head positioner assembly, cartridge handling components, and the sector transducer.

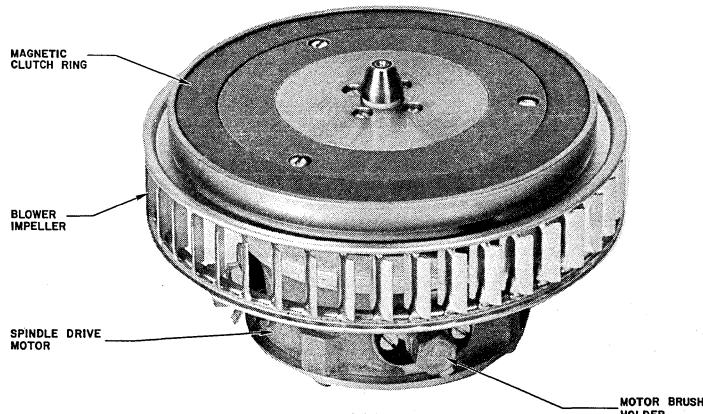
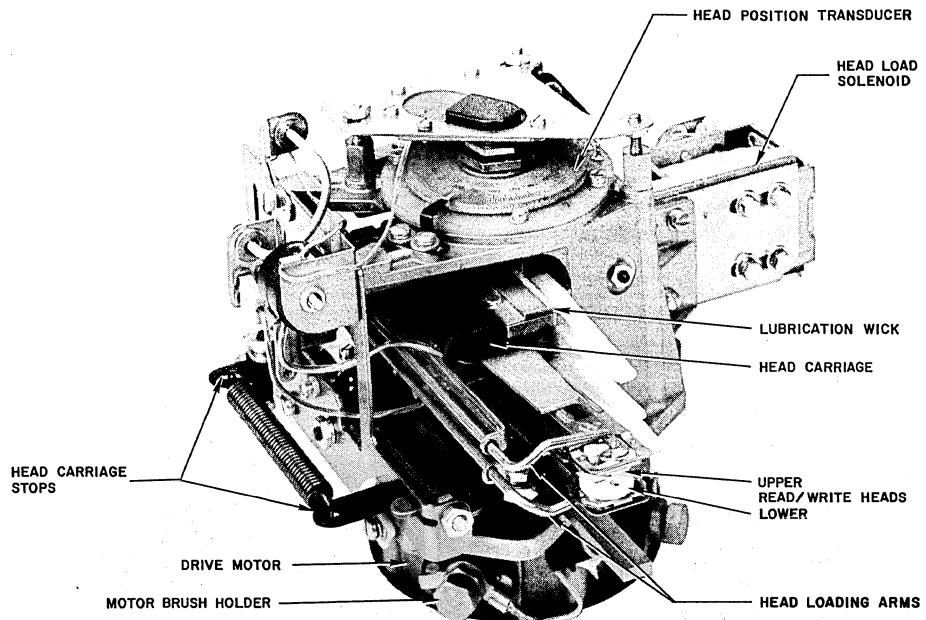


Figure 5-3 SPINDLE/BLOWER ASSEMBLY

## **Spindle/Blower Assembly**

This assembly, shown in Figure 5-3, consists of a DC servo motor and shaft, on which is mounted the air blower impeller and a magnetic clutch ring for holding the recording disk in place. This assembly mounts on the top front of the baseplate.



**Figure 5-4 HEAD POSITIONER ASSEMBLY**

## **Head Positioner Assembly**

This assembly consists of a head carriage subassembly that holds the heads, a head position transducer that provides feedback to the servo circuits, and a head loading mechanism that lowers or retracts the heads from their operational position. Motion is imparted to the head carriage by a built-in DC servo motor via a rack and pinion gear.

## **Door and Cartridge Receiver Assembly**

The front assembly includes the cartridge access door, control panel and the cartridge removal interlock components. The cartridge access door constitutes a single subassembly with linkage to the cartridge receiver that raises the cartridge off the spindle assembly when the door is opened.

## **Cartridge Handling Components**

Includes the cartridge receiver, a cartridge sense microswitch, the cartridge door opening mechanism, and two pins on which the cartridge aligns itself when inserted.

## **Air Filtering Components**

Includes the filter, impeller (mounted on spindle), and scroll case through which the air travels from the filter to the cartridge.

## Electronics Assembly

A heatsink extends across the width of the equipment enclosure and, together with the motherboard, constitutes the entire back part of the equipment. On the inside face of the heatsink panel are power transistor circuits. Parallel and adjacent to the heatsink is a motherboard to which all circuit board connectors and also the external cable connectors are attached. There are six pluggable circuit boards and space is provided for four additional boards. The entire motherboard and pluggable circuit boards can be raised for maintenance access.

## 5.5 DISASSEMBLY/REASSEMBLY/ADJUSTMENTS

The initial steps of moving the drive from its operating position to a work area, and removing the top cover, must be accomplished prior to performing any of the following sequences.

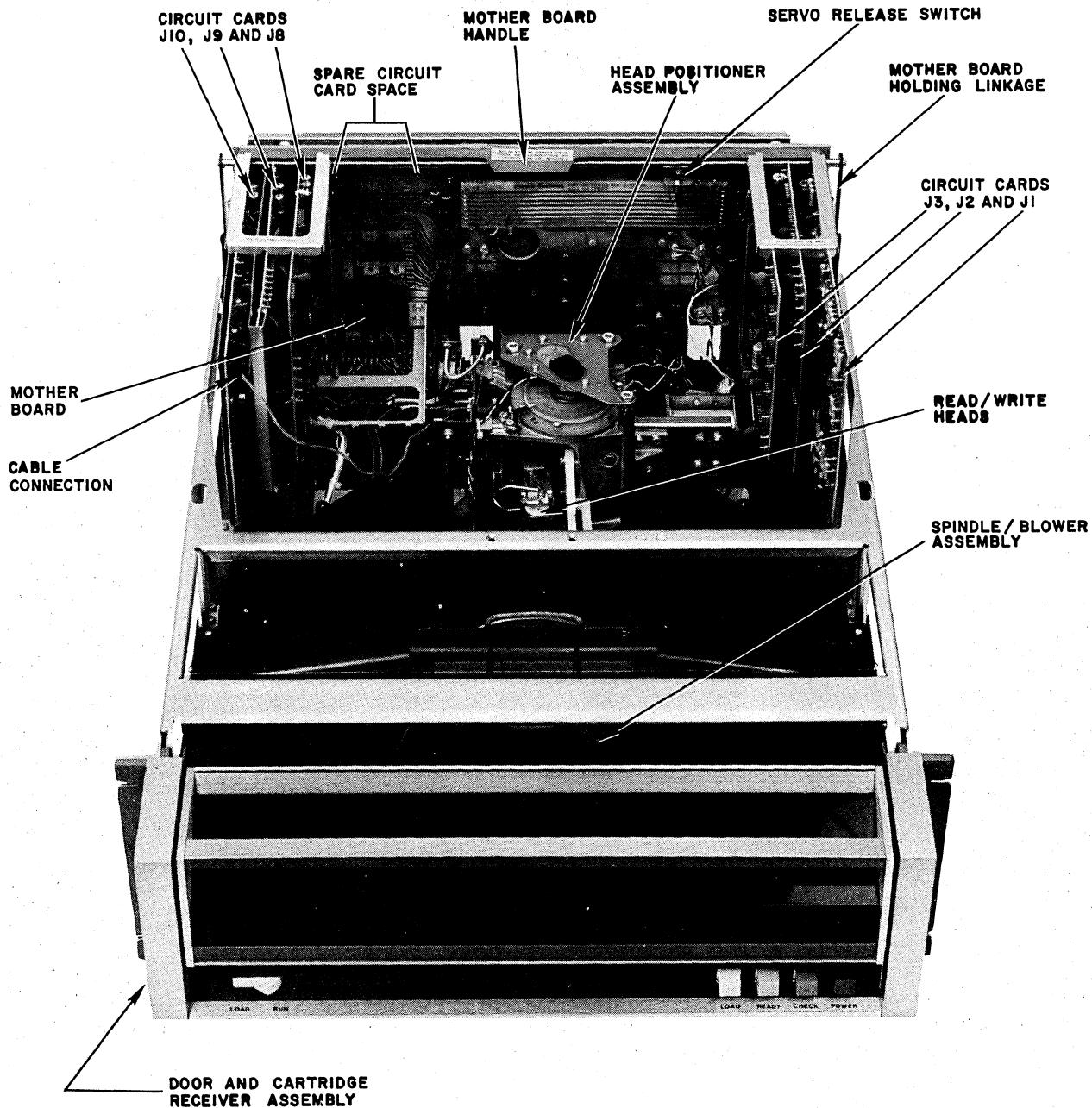


Figure 5-5 INTERNAL COMPONENTS

### **5.5.1 Removal of the Printed Circuit Boards (PCB's)**

Refer to Figures 2-4, 2-5 and 5-5. Release the four rear panel Motherboard Holddown Screws, and release the Head Lead cable (connected to the J10 PCB) from the clip on the cartridge receiver. The Electronics Assembly may now be raised into its service position. It may be held in this position by the Motherboard Holding Linkage for easy removal and insertion of the 6 PCB's (J1, J2, J3, J8, J9 and J10).

**Note:** Unplug the Head Lead cable before removing the J10 PCB.

The PCB's are held in position by spring loaded retainers. For removal or insertion of a board, the retainer should be raised no higher than  $\frac{3}{4}$ " above the board edge. If the retainer is raised too high its rear tabs could drop too far into their pivot slots and be bent when the retainer is released. There are no adjustable components or switches on the boards.

**[CAUTION]** Carefully study Figure 5-5. The several PCB's MUST be inserted ONLY in their proper connector, and MUST always be properly oriented with their component side facing toward the centerline of the machine. Failure to observe this precaution will result in damage to the circuit boards, and will void the warranty.

### **5.5.2 Electronics Frame (Motherboard) and Heatsink Assembly**

Refer to Figures 2-4 and 5-5. Remove the Top Cover and the PCB's as outlined in 5.5.1 above.

1. Disconnect the two sets of twisted pair wires going from the Motherboard to the head position transducer — at the transducer, and release them from their clamp located on the Positioner's head-loading dashpot bracket.
2. Disconnect the white head positioner motor wire at the Motherboard.
3. Disconnect connector P3/P4 (one connector) located on the Motherboard below J9 PCB.
4. Remove the eight screws holding the bottom of the Heatsink Assembly to the Shadow Box (two on each side, and four along the bottom of the Heatsink).
5. Remove the four screws holding the Heatsink to the H Frame (two screws on each side). The Electronics Frame and Heatsink Assembly is now unsupported, and may be placed flat behind the end of the Shadow Box. The user may wish to stop here, having gained access to the interior of the drive.
6. To remove the assembly entirely, disconnect the head positioner drive motor's yellow wire at terminal E, and the gray wire at terminal B on the Servo Drive PCB on the Heatsink, the grounding strap going from the Heatsink to the Baseplate at the Baseplate, the small ribbon cable connector P6 at the Heatsink and the larger ribbon cable at connector P7 located under the edge of the Baseplate on the Shadow Box frame.

**Note:** The rear bottom cover plate must be removed to gain access to connector P7's hold-down screw.

7. Reinstall the Electronics Frame and Heatsink Assembly by reversing the procedure outlined above. No adjustments are required.

## **Electronics Frame – Heatsink Separation**

1. Slide the Electronics Frame up out of the Heatsink casting.
2. Remove the metal cover on the rear of the Motherboard.
3. Remove the eight screws holding the interconnecting flex cable and Power Plug P1 to the Motherboard.
4. Remove the C clips, and slide the Electronics Frame-to-pivot arm interconnecting rod out.
5. Slide the Electronics Frame up out of the Heatsink.
6. Reinstall the Electronics Frame in the Heatsink by reversing the procedure outlined above.  
No adjustments are required.

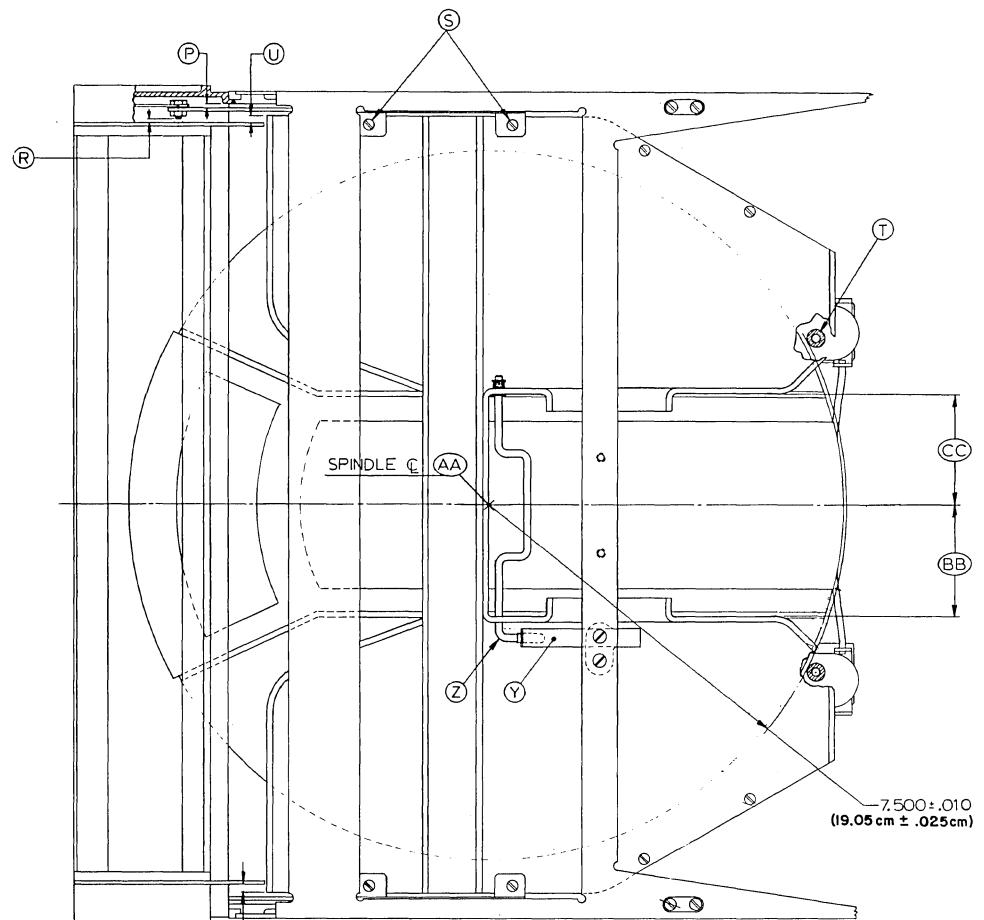
### **5.5.3 H Frame and Cartridge Receiver**

#### **5.5.3.1 Removal**

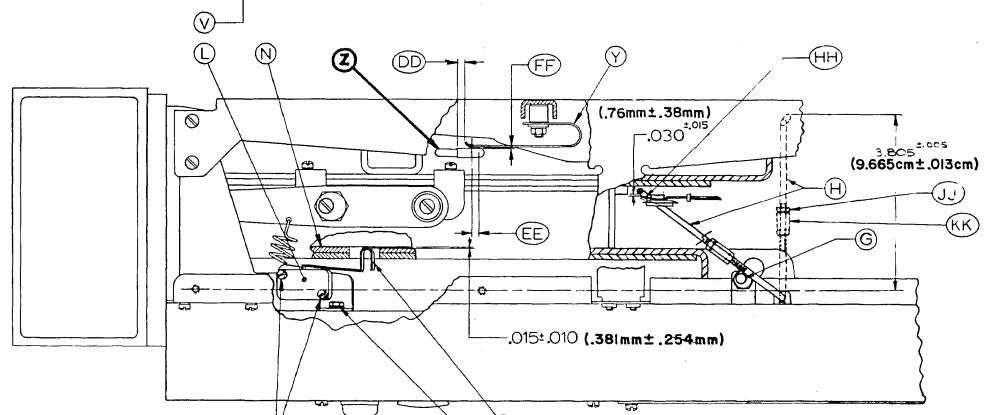
1. Remove the twelve screws holding the H Frame to Heatsink, Shadow Box and Front Panel, and remove the H Frame. Remove the screw holding the ground straps on the receiver's left-hand side.
2. Refer to Figure 5-6. Remove the eccentric (A) and pivot (D) screws on each side of the cartridge receiver. Remove the four screws (W) holding the cartridge receiver's rear metal mounting bracket to the baseplate.
3. Lift the cartridge receiver out of the Shadow Box. Exercise care that its rear metal bracket does not damage the wire bundle behind it.
4. Reinstall the cartridge receiver by reversing the procedure outlined above, and perform the position adjustment procedure which follows.

#### **5.5.3.2 Adjustment**

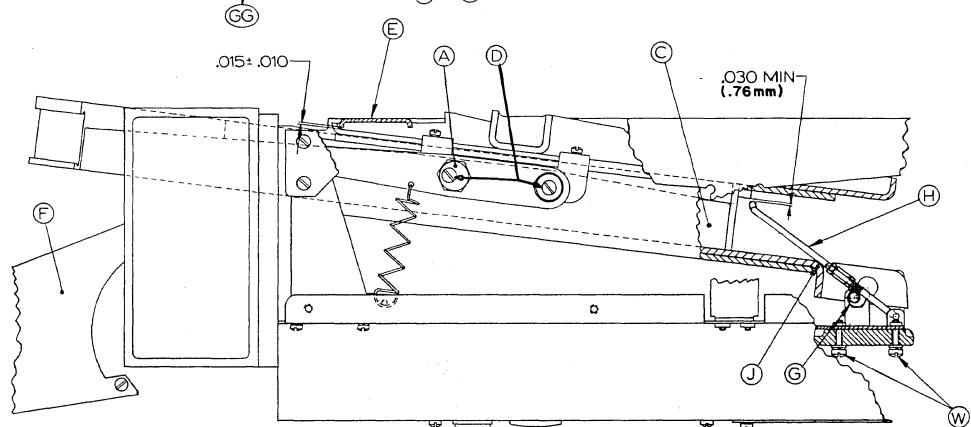
1. With the door closed (view A), adjust the cartridge receiver assembly so that the following criteria are met and tighten screws (W – view C).
  - 1.1 Distance from spindle centerline to cartridge stop posts (T) is as shown.
  - 1.2 Dimensions (BB) and (CC) are equal within .015" (.38mm).
  - 1.3 Dimensions (U) and (V) are equal within .030" (.76mm).
2. With door closed (view B), without cartridge, cartridge door actuator (H) must clear upper head (HH) by clearance shown.
3. Open door slowly (view C) until cartridge receiver is at its highest point of travel and adjust eccentric (A) so that clearance to subframe (E) is as shown. Tighten screws (D).
4. With door fully open (view C), slowly insert cartridge (C) and check for clearance between cartridge (C) and cartridge door actuator (H) as shown. If clearance is insufficient, form door actuator (H) at point of contact (J) with receiver.
5. Clearance (R) and (P) (view A) should be .030" (.76mm) minimum. Adjust by loosening screws (S).
6. Insert cartridge and slowly close door. Cartridge should seat down completely and, if pushed from front to rear and side to side, a small amount of play should be felt. If not, recheck steps 1.1 and 1.2.
7. With cartridge installed and door closed (view B) adjust cantilever spring (Y) to equalize dimensions (DD) and (EE). Also centralize over actuator (Z) (view A) and tighten screws.
8. With cartridge installed and door closed (view B), slight clearance (FF) should exist between cantilever spring (Y) and actuator (Z). Cartridge door should also close upon removal. If either is incorrect, twist actuator slightly and recheck above.
9. With cartridge installed and door closed (view A) check for .015" (.38mm) minimum clearance between the cartridge cone and the disk hub (not shown – inside cartridge) by depressing the cartridge door at point (AA). If the clearance is insufficient, recheck steps 7 and 8, and check for warped cartridge receiver or damaged or defective cartridge.
10. With cartridge installed and door closed (view B), centralize switch blade (K) in hole in cartridge receiver base (N) and tighten screws (M).
11. With cartridge installed, door closed (view B) and blade (K) held down, clearance shown should exist to cartridge. To adjust, rotate switch (L) and tighten screws (GG).
12. Adjust height of cartridge door actuator (H) to dimension shown in view B (broken lines) by turning nuts (KK), keeping top horizontal. Lock with nuts (JJ).



**VIEW A**



**VIEW B**



**VIEW C**

**Figure 5-6 CARTRIDGE RECEIVER AND BASE ADJUSTMENTS**

## **5.5.4 Head Positioner Assembly**

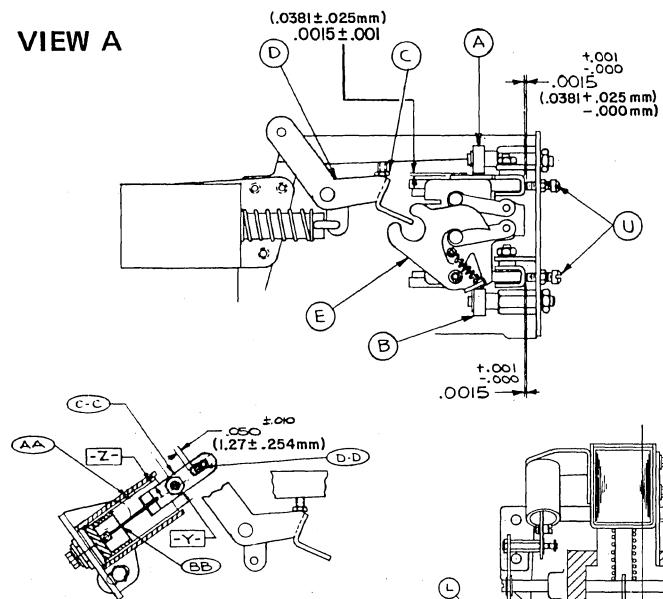
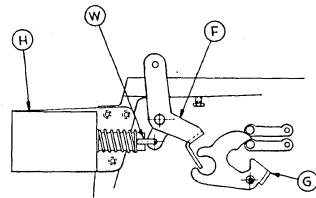
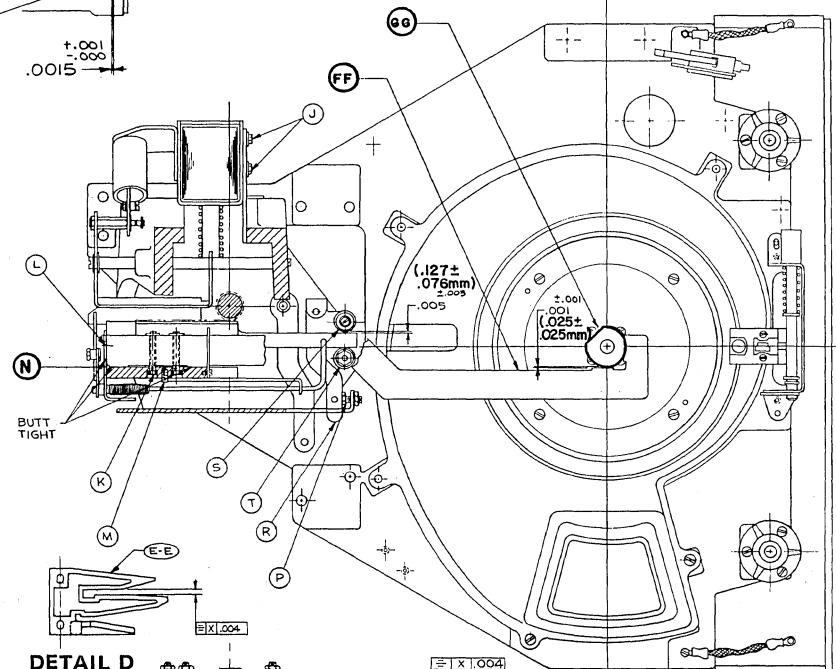
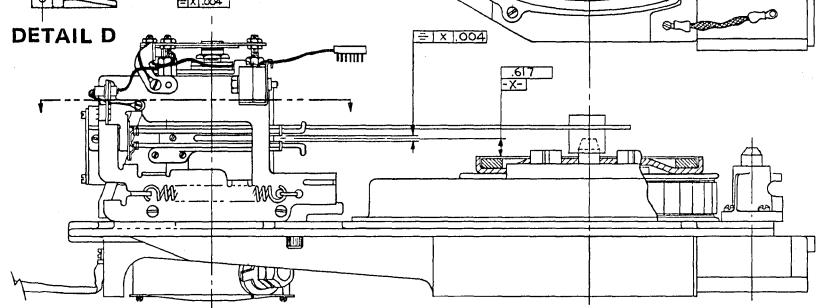
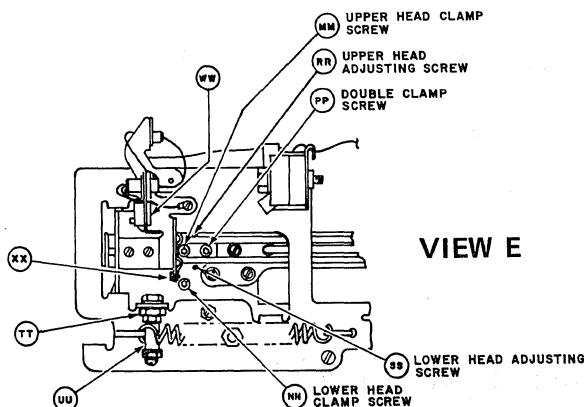
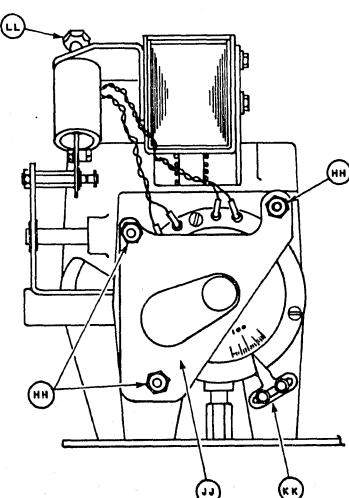
### **5.5.4.1 Head Positioner Assembly Removal**

1. Prepare the Series 30 for disassembly as previously described. Raise its Electronics Frame Assembly into the service position, and remove all six PCB's. Remove the disk cartridge if installed.
2. Disconnect the two sets of twisted pair wires (Wht/Blk and Yel/Blk) at the Position Transducer, the two positioner motor wires (Wht and Yel) at the Motherboard and Heatsink, the rotary transformer cable (Wht/Blk twisted pair) plug P8 located under the transformer plate, and the red and orange wires to the Head Load Solenoid. Unsolder the two brown twisted pair wires from the Track 0 switch. Free all wires from their clamps.
3. Position the drive on its side, and remove the rear bottom cover plate.
4. While holding the Head Positioner with one hand, remove the three socket head machine screws holding it to the Baseplate (accessible from the bottom) and remove the assembly.
5. Reinstall the Head Positioner Assembly by reversing the procedure outlined above, and such other assemblies as are necessary to operate the drive.

### **5.5.4.2 Head Positioner Adjustment**

Refer to Figure 5-7. Note that it may be necessary to remove the Cartridge Receiver to gain access to eccentric (T) for the adjustment in Step 11.

1. Refer to View A. Raise roller (A) as high as possible.
2. Adjust carriage height to the dimension shown, by adjusting eccentric (B). Retighten its holding nut.
3. Adjust eccentric (A) to dimension shown. Retighten its nut.
4. Adjust screw (C) so that bail (D) is centered in cam (E) as shown.
5. Refer to View B. Loosen mounting screws holding solenoid (H). Adjust solenoid (H) so that bail (F) is centered in cam (G) as shown. Retighten solenoid mounting screws, keeping solenoid (H) and link (W) horizontal.
6. Loosen screw (M) so that its tip will not interfere with bar tool (FF) in the next step.
7. Refer to View D. Remove the upper head. Install bar tool (FF) in its place, so that it is tight against end plate (L) and carriage surface (N). Tighten the head clamp screws to  $50 \pm 5$  inch-ounces (tightening to a higher torque will damage the head clamps). Install cone tool (GG). Rotate tool (GG) so that only round surfaces are presented to tool (FF). Move the carriage back against its rear stop.
8. Adjust the carriage stop eccentric (TT, View E) until bar tool (FF) just touches cone tool (GG).
9. Adjust cylinder pointer (KK, View F) to align with the 0 mark on the Head Position Transducer plate.
10. Turn stop screw (P, View D) clockwise as far as possible, and loosen stop screws (U, View A) approximately .030" (.76 mm).
11. Loosen its clamp nut, and turn eccentric (T, View D) so that the clearance between bar tool (FF) and cone tool (GG) is as shown, and retighten the clamp nut. Adjust stop screw (P) so that with arm (R) held tight against it the clearance between roller (S) and the carriage arm is as shown. Tighten the lock nut on screw (P).
12. Adjust stop screws (U, View A) for the clearance shown while the carriage is at the track 0 position, and then check at other positions.
13. Referring to View C, adjust the position of cylinder (AA) so that the clearance shown exists between link (CC) and screw (DD) with link (CC) held to the left and piston (BB) bottomed in the cylinder.
14. Adjust the height of the cartridge and disk guide (EE, detail D), and tighten its hold-down screws.
15. Make a final check of all clearances, remove the tools and reinstall the upper Read/Write head.

**VIEW A****VIEW B****VIEW C****VIEW D****VIEW E****VIEW F****Figure 5-7 HEAD POSITIONER ADJUSTMENTS**

#### 5.5.4.3 Head Positioner Transducer Adjustment

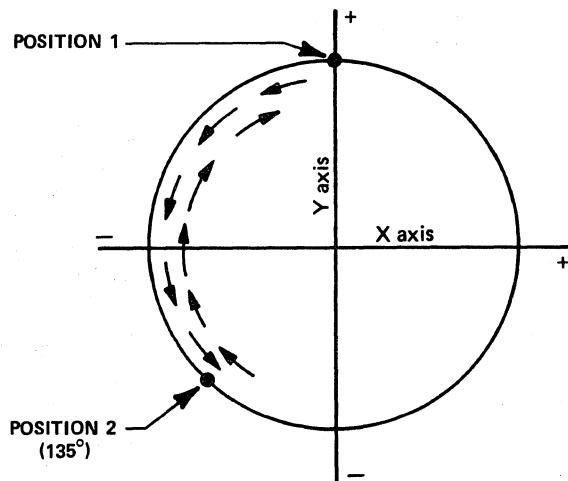
1. Connect an oscilloscope to TP1 of PCB J1, and set the oscilloscope for automatic sweep.
2. With power applied and the Servo Release Switch (see Figure 5-5) depressed, manually move the rotary member of the Position Transducer back and forth.
3. A 15 volt p-p sine wave should be seen on the oscilloscope. If not, loosen upper nuts (HH) (Figure 5-7, View F) and rotate the transformer mounting plate until a signal of  $15 \pm 1$  volts p-p is observed. Retighten the nuts.
4. Connect the oscilloscope to TP2 of PCB J1, and again move the rotary member of the Position Transducer as before.
5. A sine wave should be observed which is within  $\pm 1$  volt of the signal seen at TP1. If this is not true, troubleshoot PCB J1.
6. Check that the rotary transformer gap is properly set. This gap should be a minimum of .010 inch (.254 mm). If it is necessary to raise the transformer plate, recheck steps 1 through 5 above.

#### 5.5.4.4 Track 0 Stop (Rear Carriage Stop) Adjustment

This adjustment must be correct before performing read/write head adjustment. The Track 0 Stop Adjustment adjusts the Rear Carriage Stop to allow the correct amount of carriage overtravel outward past track 0.

1. Before performing the Track 0 Stop adjustment, be sure that the cylinder pointer adjustment is correct as described in subsection 5.5.4.2.
2. Connect the vertical amplifier of the oscilloscope to TP2 of PCB J1, and the horizontal amplifier to TP1 of PCB J1. Then set the scope controls for external horizontal sweep. The means for doing this varies, depending on the type of scope being used.
3. Using the scope's Horizontal Position control, center the display dot on the top portion of the display Y axis, shown in Figure 5-8 as Position 1.
4. Switch the drive between LOAD and RUN several times. The trace should swing an arc of  $135 \pm 40^\circ$  from Position 1 in a counterclockwise direction toward Position 2. If it does not fall within this range, adjust eccentrics (TT) and (UU) (Figure 5-7, View E), so that it does.

**Note:** With a Model 33F drive, which has no LOAD/RUN switch, the required scope display can be obtained by using an exerciser to perform continuous restore operations.



**Figure 5-8 TRACK 0 STOP ADJUSTMENT PATTERN**

5. After successful completion of the Track 0 Stop adjustment, proceed with the R/W head alignment procedure.

#### 5.5.4.5 Read/Write Heads Alignment Checks and Adjustment

**Note:** If Rear Carriage Stop adjustment is needed, it must be performed *before* Read/Write head alignment is performed.

The following procedures make use of the Diablo Alignment Cartridge or an IBM C.E. Pack (with or without shim). Also required are an oscilloscope, an exerciser and a terminator.

##### Initial Scope Setup

Channel 1: Probe to TP2 on J10 PCB. 1V/Div

Channel 2: Probe to TP6 on J9 PCB. 2V/Div

Trigger: Internal, Ch 2, (-) Slope

Time Base: 5 ms/Div

##### 5.5.4.5.1 Alignment Checks

Apply power to the drive, in the LOAD mode, and install the Alignment Cartridge. Switch to the RUN mode, and allow the drive to run for approximately 15 minutes for temperature stabilization.

**Note:** On Model 33F, ensure that the head carriage is fully retracted with AC power *OFF* before the alignment disk is installed.

##### Standard or High Density Machine

(Using Diablo's Alignment Cartridge or IBM C.E. Pack *with* hub shim)

1. Position the head carriage to cylinder 100 in the Standard Density machine, or cylinder 105 in the High Density machine.

Note: This can be done manually while depressing the Servo Release button if the cylinder pointer has been adjusted correctly.

2. Monitor the signal at TP2 of PCB J10 to observe the signal shown in Figure 5-9. Then set scope Ch1 to 200 mV/Div and readjust the scope for the pattern shown in Figure 5-10. The signal from the lower head will normally be selected and its output seen at TP2. The signal from the upper head may be selected for observation at TP2 by replugging the R/W head cable connector so that the top row of pins on the plug are inserted into the bottom row of socket terminals on the J10 PCB. This leaves the bottom row of plug pins and the top row of socket terminals disconnected. Both heads should be checked.

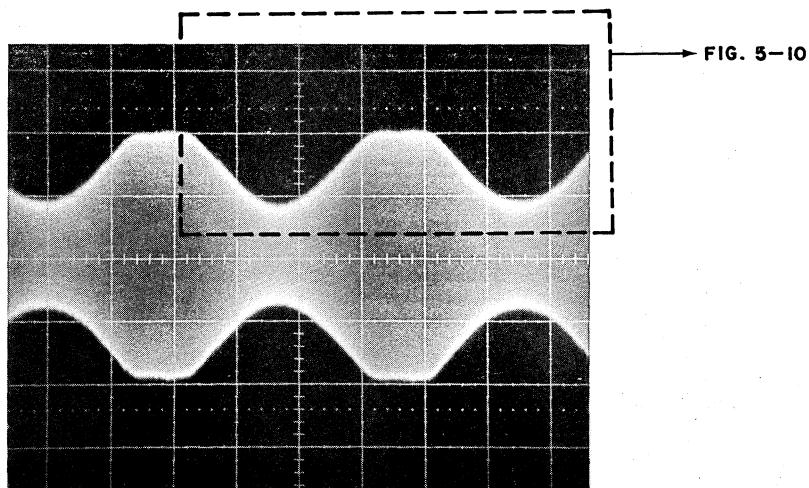
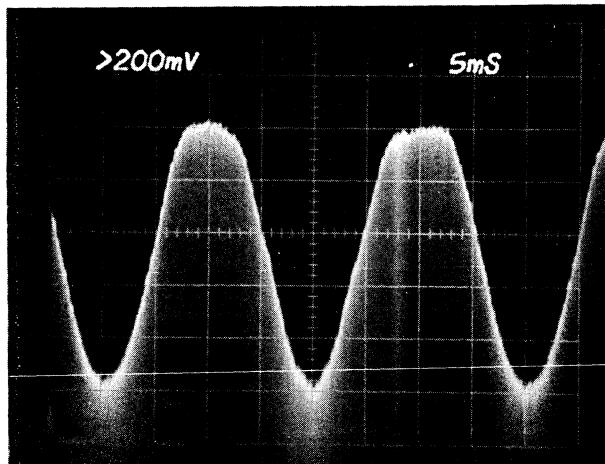
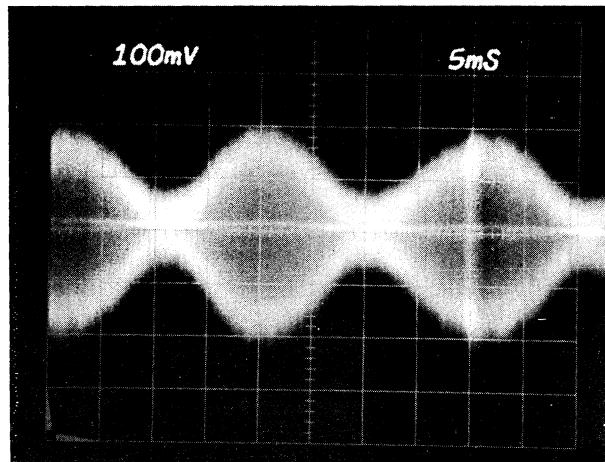


Figure 5-9 R/W HEAD ALIGNMENT CHECK WAVEFORM



**Figure 5-10 R/W HEAD ALIGNMENT CHECK WAVEFORM**



**Figure 5-11 R/W HEAD ALIGNMENT CHECK WAVEFORM**

3. The signal from a correctly aligned head will appear as shown in Figure 5-10. Adjustment is required if successive dips differ by more than 60%. Figure 5-12A shows a 40% misadjustment and Figure 5-12B shows 80% misadjustment using the Diablo Alignment Cartridge or the IBM C.E. Pack with hub shim. If the waveform is not within the specified acceptable range, perform the Alignment Procedure (subsection 5.5.4.5.2).

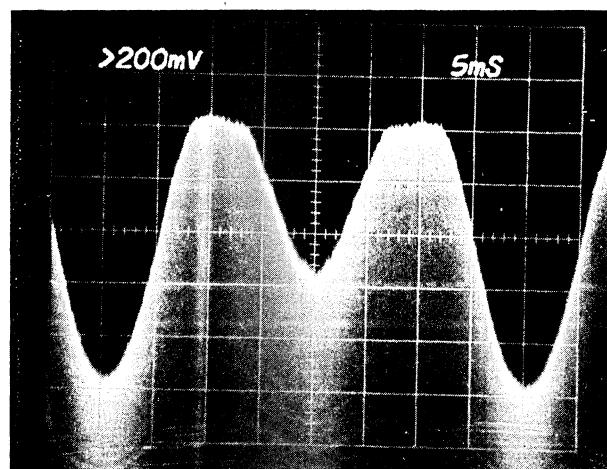
#### **Standard Density Machine**

(IBM C.E. Pack *without* the hub shim)

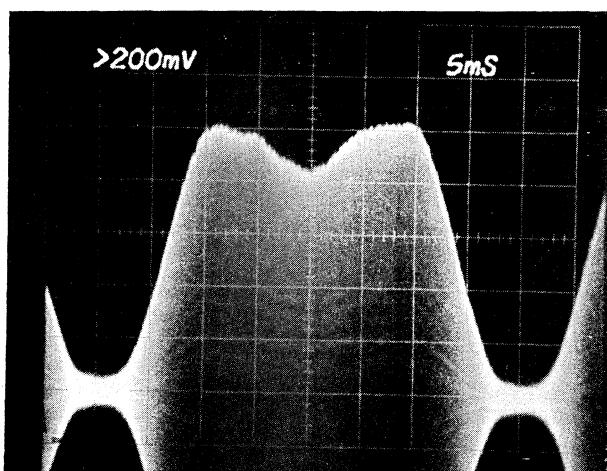
1. Position the head carriage to cylinder 100.

**Note:** This can be done manually while depressing the Servo Release button if the cylinder pointer has been aligned correctly.

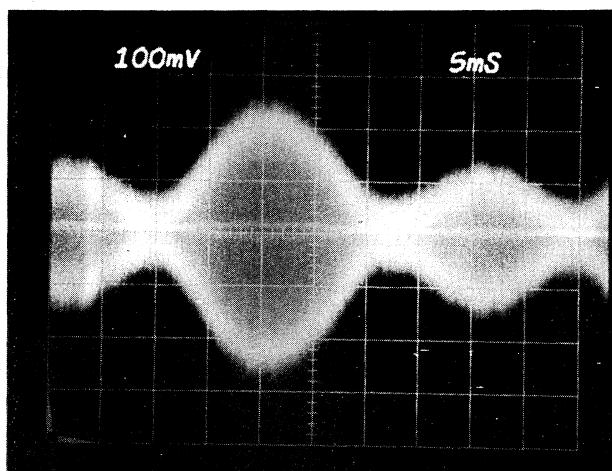
2. Set the scope Ch1 to 100 mV/Div and monitor the signal at TP2 of PCB J10. The signal from the lower head will normally be selected and its output seen at TP2. The signal from the upper head may be selected for observation at TP2 by replugging the R/W head cable connector so that the top row of pins on the plug are inserted into the bottom row of socket terminals on the J10 PCB. This leaves the bottom row of plug pins and the top row of socket terminals disconnected. Both heads should be checked.



A



B



C

Figure 5-12 READ/WRITE HEAD ADJUSTMENT WAVEFORMS

3. The signal from a correctly aligned head will appear as shown in Figure 5-11. Adjustment is required if successive lobes differ by more than 20%. For example; if the maximum p-p amplitude of the first lobe is 150 millivolts or less, the head should be adjusted. Figure 5-12C shows 60% misadjustment of a standard density machine using the IBM C.E. Pack without the hub shim. If the waveform is not within the specified acceptable range, perform the Alignment Procedure (subsection 5.5.4.5.2).

#### **5.5.4.5.2 R/W Head Alignment Procedure**

In addition to the equipment used in the Alignment Checks, the Alignment Procedure requires use of the Diablo Torque Wrench Set #99001.

1. Perform the steps of the appropriate Head Alignment Check outlined above.

**Note:** If the R/W Head is severely out of alignment, the alignment waveform will not be obtained until adjustment is performed.

2. Torque all of the head clamp screws to 26 inch-ounces.
3. When a R/W Head is in its rearmost position, the head will be about 5 cylinders too far back. A head is adjusted by inserting a set screw (part of torque wrench set #99001) in the proper threaded screw hole (see Figure 5-7, View E), and turning it in against a diagonal surface on the edge of the head support arm. This will move the head assembly toward the spindle *only*. If the head is moved too far, the screw must be removed, the head clamps loosened, and the head moved rearward to begin again. As the head is moved toward the spindle by the set screw, it will approach the pre-recorded alignment track (track 100 or 105 as described earlier). Standard Density machines read track 100 with the erase coils, while High Density machines read track 105 with the read/write coils. The head is correctly adjusted when an equal portion of the eccentrically recorded track is read by each half of the winding. Figures 5-9, 5-10 and 5-11 all depict 0% error in head adjustment.
4. Adjust the R/W Head to the specification given in Alignment Check.
5. Following adjustment, the head clamps must be tightened. Refer to Figure 5-7, View E. A torque of 50 inch-ounces must be applied to the double (common) head clamp (PP), and a torque of 26 inch-ounces must be applied to single head clamp (MM) and/or (NN).
6. Proceed to the Sector Transducer Adjustment procedure 5.5.5.2.

#### **5.5.4.6 Read/Write Head Replacement**

1. Refer to Figure 5-7, View E. Raise the Electronics Frame into the service position to gain access to the rear of the Head Positioner through the Heat Sink, and loosen the head plug cable clamp (XX).
  2. Unplug the appropriate head plug (WW). The upper head is the inner connector.
  3. Loosen the double (common) head clamp screw (PP) and the desired single head clamp screw (MM) or (NN).
- Note:** Do not loosen a clamp screw MORE than  $\frac{1}{2}$  turn.
4. Pull the loosened head assembly toward the spindle until clear.
  5. Install the replacement head assembly by reversing the above procedure.
  6. Apply 26 inch-ounces of torque to the head clamp screws, and proceed with head adjustment.

#### **5.5.4.7 Head Load Dashpot Adjustment**

1. Install a disk pack having information written at track 0, start the machine, and allow a complete startup cycle.
2. Trigger the oscilloscope on the leading edge of the head load pick signal. This is a positive-going signal at pin W of PCB J9.
3. Connect the scope's vertical input to TP2 of PCB J10.
4. Trigger the drive's Head Load One-Shot by momentarily grounding TP5 on PCB J9.
5. Observe the signal on the scope. The Read Data and Clock signal appears when the heads are completely loaded against the disk.

6. Refer to Figure 5-7, View F. Turn dashpot adjustment screw (LL) until the data signal appears  $140 \pm 40$  milliseconds after the start of the sweep. Lock screw (LL) with a drop of adhesive when the adjustment is completed.

### 5.5.5 Sector Transducer

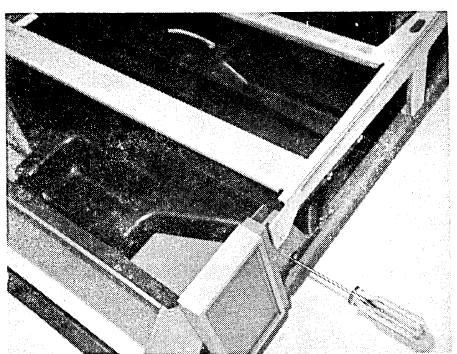
#### 5.5.5.1 Sector Transducer Removal

1. Remove the H Frame, Cartridge Receiver and Air Filter, as previously described, to expose the Sector Transducer.
2. Unsolder the two interconnecting wires at the transducer.
3. Remove the two screws holding the Transducer to the Baseplate, and lift out the Transducer.  
*Note:* These screws are accessible from the bottom through the air filter compartment.
4. Reinstall the Sector Transducer by reversing the procedure outlined above. When placing the Transducer in position on the Baseplate, make sure it is seated properly over its two locator pins. Reinstall the other assemblies necessary to operate the drive.

#### 5.5.5.2 Sector Transducer Adjustment

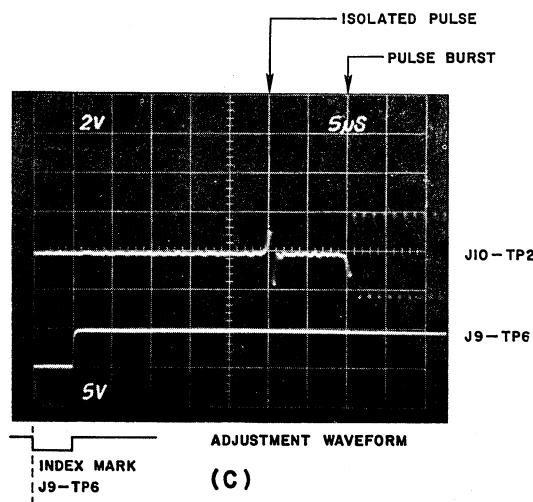
**Note:** Sector Transducer adjustment should be performed only *after* Track 0 Stop adjustment and Read/Write Head alignment are correct.

Refer to Figure 5-13 for aid in performing this adjustment procedure. This procedure requires a dual trace oscilloscope, an exerciser, a  $\frac{1}{4}$ " blade screwdriver with a 6" minimum shank length, and an alignment cartridge. The Electronics Frame should be in its raised position. Connect a power supply, a proper terminator, and the exerciser.

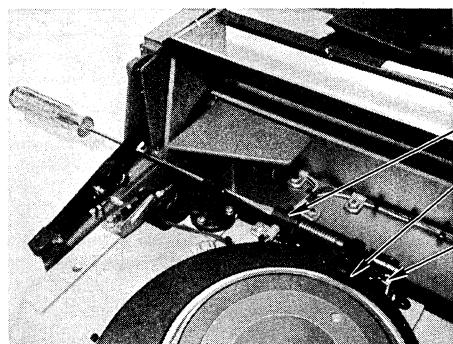


WITH "H" FRAME AND CARTRIDGE RECEIVER IN PLACE

(A)



(C)



"H" FRAME AND CARTRIDGE RECEIVER REMOVED TO  
ILLUSTRATE SCREWDRIVER INSERTION FOR ADJUSTMENT

(B)

Figure 5-13 SECTOR TRANSDUCER ADJUSTMENT

1. Apply power to the drive in the LOAD mode, and install a proper alignment cartridge. Switch to the RUN mode, and wait for the READY light.
2. Trigger the oscilloscope on the leading edge of the Index Mark, a negative-going pulse available at TP6 on PCB J9.
3. Using the Exerciser's controls, position the R/W heads over prerecorded track 095 (high density machines use track 100). Adjust the oscilloscope to produce the lower trace shown in Figure 5-13C.
4. Observe the signal at TP2 on PCB J10. It should be similar to that shown as the upper trace in Figure 5-13C.
5. Refer to Figure 5-13A and B. Insert the screwdriver as shown to engage the adjustment screwhead of the transducer. Adjust the Transducer laterally so that the first peak of the isolated pulse on the upper trace occurs 30  $\mu$ sec after the beginning of the sweep. Increase the oscilloscope sweep rate to 5  $\mu$ sec/Div for maximum resolution.
6. Alternately select the two heads, and readjust the Transducer to position the first peak of the isolated pulse from each of the two heads symmetrically around the 30  $\mu$ sec point. Their separation must remain less than 10  $\mu$ sec. Excessive separation indicates a misalignment of the heads vertically in relation to each other. This condition must be corrected before the Sector Transducer can be correctly adjusted.

#### **5.5.6 Spindle Assembly**

1. Refer to subsections 5.5.3 and 5.5.5 for those disassembly procedures necessary to gain access to the Spindle Assembly. Note that it will not be necessary to unbolt the Cartridge Receiver's rear mounting bracket, as this component will hinge up far enough, with its front edge released, to allow removal and installation of the spindle. It is also unnecessary to unsolder the Sector Transducer's interconnecting wires.
2. Position the drive on its left-hand side.
3. Remove the bottom front panel.  
**Note:** This uncovers the filtered air plenum chamber. Keep this chamber clean. The air passing through this chamber goes directly into the disk cartridge.
4. Disconnect the four spindle motor wires, after carefully noting how they are connected, and remove the two screws holding the Filter PCB in place. Let the board hang free.
5. Loosen the motor's brush holder clamp nuts, and position the connector tabs parallel to the motor shaft.
6. Remove the three socket head machine screws holding the Spindle Assembly in place, and carefully slide the assembly out through the top of the Baseplate.
7. Reinstall a Spindle Assembly as follows. Loosen its brush holder clamp nuts and position the connector tabs parallel to the motor shaft. Locate the motor mounting flange which is in line with one of the motor's baseplate screws, and equidistant from two of the motor brush holders. The motor is to be installed with this flange toward the rear of the drive.
8. Properly orient the motor and insert it through the top of the Baseplate. Secure the motor in place with the three socket head machine screws, and tighten them down.
9. Orient the motor brush tabs parallel with the Baseplate, and tighten their clamp nuts. Then bend the tabs away from the motor body at a 45° angle.
10. Reconnect the four Spindle Motor wires, and remount the Filter PCB.
11. Reassemble the drive, and perform the Cartridge Receiver and Sector Transducer Alignment Procedures outlined earlier in this section.

#### **5.5.7 Front Panel and Door Lock Assembly**

(Model 31 Only)

1. Remove the indicator lamps from the front panel by pulling out on them. Carefully note which color hood goes where.
2. With the door open, remove the two flat head screws holding the front trim piece in place and

- allow the trim piece to drop down between the door and frame for removal.
3. Locate and remove the two flat head screws holding the interior trim shield over the door lock solenoid and mechanism, and remove the trim piece.
  4. Further disassembly may be carried out as required.
  5. Reassemble in reverse order.
  6. Refer to Figure 4-2. Check for proper operation of the door lock switch as follows. Connect an oscilloscope to Terminal 2 on the Power Driver PCB on the Heat Sink. Terminal 2 has a grey wire attached. Apply power to the drive in the LOAD mode. Manually raise and lower the LOCK flag. With the flag raised, approximately +7 volts should be observed, and with the flag lowered, approximately -7 volts should be observed. Particular attention is required to the adjustments affecting switch transfer. If the switch transfers too early, the flag will tend to bounce. If switch transfer is not accomplished at all, the door lock solenoid will overheat.



## **SECTION 6 OPTIONS**

### **6.1 GENERAL INFORMATION**

The following subsections first outline the standard Series 30 Disk Drive, and then describe several major options which may be included during manufacture or added later. Table 6-1 at the end lists all currently available options.

Any questions regarding options should be discussed with your Diablo Sales Representative.

### **6.2 STANDARD SERIES 30 DISK DRIVE**

The standard, or basic Series 30 Disk Drive includes mechanisms and circuitry to produce all data, control, and status functions with TTL or DTL compatible logic signals in standard density format (1100 BPI) housed in a standard cabinet.

### **6.3 OPTIONS**

#### **6.3.1 Mounting Options**

Series 30 Disk Drives may be used as tabletop units, or mounted in a 19" rack cabinet. When mounted in a rack, the disk drive should be supported on slide rails and be equipped with a front panel assembly that attaches to the rack. Diablo supplies slide rails, mounting brackets and hardware with units ordered with the extended or flush mount option (#15376-01 LH Slide, -02 RH Slide/#15558 Rail-to-Rack Mounting Brackets/and #15691-01 Rack Mounting Hardware Kit).

Diablo slide rails allow the disk drive to be pulled out from the cabinet far enough to raise the electronics assembly, with the rear panel cable connectors attached, to an elevated service position. The user must specify the physical mounting configuration at the time of ordering. Refer to Figure 2-1.

OPTION 017 – Flangeless Front Mount. This configuration does not have the mounting flanges used to fasten the drive into a cabinet. This configuration is considered a tabletop model, even though it may be mounted on slide rails and installed in a rack.

OPTION 018 – Flush Mount. The front of the Series 30 is fastened flush with the front of the cabinet with this configuration. This option requires a cabinet at least 30" deep, and may require a trim piece (OPTION 020) at the top and bottom of the installation.

OPTION 019 – Extended Mount. This configuration will fit into a 24" deep cabinet. The front of the Series 30 will extend 3¼" from the front of the cabinet.

#### **6.3.2 Density and Sector Options**

The user must specify the required density at the time of ordering. The data separation circuits and, possibly, other assemblies are affected by the density ordered.

OPTION 001 – 1020BPI and 720 KHz

OPTION 002 – 1100BPI and 781 KHz (Standard Density)

OPTION 003 – 2040BPI and 1440 KHz

OPTION 004 – 2200BPI and 1562 KHz (High Density)

The user may also select various sector configurations.

OPTION 025 – Standard Density 8 Sector

OPTION 026 – High Density 8 Sector

OPTION 039 – Standard Density 12 Sector

OPTION 041 – High Density 12 Sector

OPTION 052 – High Density 16 Sector

OPTION 040 – Standard Density 24 Sector

OPTION 042 – High Density 24 Sector

OPTION 054 – 32 Sector

### **6.3.3 Input Line Options**

OPTION 008 — ERASE GATE. One line normally tied internally to the Write Gate which turns on the Erase Current. With the Erase Gate Option, this line is brought out separately. There is no built-in delay of Erase Current.

OPTION 005 — WRITE PROTECT INPUT. The Write Protect option prevents writing by inhibiting Write Current. Write Protect is set when power is applied or when the LOAD/RUN switch is activated. It may also be set by this Write Protect input line with a 0 volt nominal signal with a minimum duration of 350 nsec. Write Protect is reset by the operator depressing the PROTECT switch.

### **6.3.4 Output Line Options**

OPTION 005 — WRITE PROTECT STATUS. A 0 volt nominal level indicates that the drive's write capability is inhibited. The operator can change the status manually by depressing the momentary action PROTECT switch on the front panel. This reestablishes the drive's write capability.

OPTION 046 (-) — ATTENTION LINE.  
OPTION 047 (+) — ATTENTION LINE.

Four standard interface lines are reassigned with this option. These lines are:

Attention Unit #1 Pin H was Write Protect Input  
Attention Unit #2 Pin M was High Density Indication  
Attention Unit #3 Pin S was Pseudo Sector Marks  
Attention Unit #4 Pin xx was Logical Address Interlock

An internal attention jumper plug is added in each drive. This jumper plug connects that drive to one of these four Attention lines. The Attention line number and the Select line number must correspond.

The Attention line signal is a logical combination of internal disk drive signals and serves the purpose of informing the controller when a disk drive becomes ready, completes a seek operation, fails to complete a seek operation, or accepts a cylinder address.

With Attention line negative (Option 046), the Attention line is at a nominal 0 volts in the not ready state, and goes to +5 volts when the disk drive reaches the Ready status. The Attention line will go to 0 volts at the start of a seek operation, and will return to +5 volts at the completion of the seek. This occurs when the read/write heads are settled over the new cylinder, or upon detection of a Seek incomplete condition. In the event of a seek to the present cylinder address, the Attention line presents a pulse coincident with the Address Acknowledge pulse. In the event of an illegal cylinder address, the Address Acknowledge pulse is presented to the Attention line; the Seek Incomplete line is also set true with an illegal address and must be reset by a restore operation.

With Attention line positive (Option 047), the Attention line is at +5 volts in the not ready state, and goes to 0 volts when the disk drive reaches the ready status. The output level of the Attention is in the opposite polarity, but operates exactly as explained in the above description of Option 046.

OPTION 048 — INTERRUPT. With this option the File Ready, Ready to Seek/Read or Write, and Seek Incomplete are not conditioned by the Select line. Therefore they present their status to the interface at all times. This option may require special cabling not provided by Diablo except by quotation.

**Table 6-1**  
**SERIES 30 OPTIONS**

Option	Description
001	720 KHz – 1020BPI – IBM Compatible
002	781 KHz – 1100BPI – Diablo Standard
003	1440 KHz – 2040BPI – Option
004	1562 KHz – 2200BPI – Option
005	Write Protect
008	Erase Gate (Not tied to Write Gate)
013	Paint – Orange with Diablo Logo
014	Paint – Orange without logo
015	Unpainted without logo
017	Flangeless Mount (tabletop trim)
018	Flush Mount
019	Extended Mount
020	Upper and Lower Trim for Flush Mount
024	Extender Board Assembly
025	Standard Density – 8 Sector
026	High Density – 8 Sector
027	Standard Density Alignment Pack
029	Dual Unit Power Supply
030	High Density Alignment Pack
032	Power Supply Cable
033-05'	Receptacle Connectors on 5' flat cable (female)
033-07'	Receptacle Connectors on 7' flat cable (female)
034-05'	Pin Connectors on 5' flat cable (male)
034-07'	Pin Connectors on 7' flat cable (male)
035	Receptacle terminator with resistors (female)
036	Pin terminator with resistors (male)
037	Receptacle terminator without resistors (female)
038	Pin terminator without resistors (male)
039	Standard Density – 12 Sector
040	Standard Density – 24 Sector
041	High Density – 12 Sector
042	High Density – 24 Sector
044	Rack Mounting for Power Supply
045	Paint – Black without logo
046	Attention Line Negative
047	Attention Line Positive
048	Interrupt Option
050	DTC Card FPC Interdata Controller (no longer available)
051	Standard Density – 16 Sector
052	High Density – 16 Sector
053-05'	M/F Cable 5'
053-07'	M/F Cable 7'
054	32 Sector
056	Cable Assembly (Interdata Controller)
057	Terminator (no erase gate) Female with resistors
058	Terminator (no erase gate) Male with resistors
060	Paint – Grey/Green without logo
061	Paint – Blue without logo
062	Grained without logo
063	Paint – Off White (Varian)
064	Attention line with logical address interlock (Varian)
065	Cartridge Closing Bail Assembly



## SECTION 7

### CIRCUIT DIAGRAMS AND LOGIC SYMBOL CONVENTIONS

#### **7.1 GENERAL DISCUSSION**

Diablo Systems logic diagrams emphasize the functions performed by the logic elements rather than the kinds of devices used. For example, a NAND gate may appear on a Diablo diagram as either a positive logic AND function with the output inverted (NAND), or as a negative logic OR function with the inputs inverted (NOR). This practice runs contrary to some logic drawing standards which require the use of the NAND symbol for both functions, but aids field service personnel in troubleshooting and system design engineers in understanding a design's principles of operation.

This functional approach to logic symbology is basic to the logic documentation conventions employed by Diablo Systems. The conventions that govern logic symbology, signal nomenclature, and other drawing standards that may help the reader interpret Diablo logic diagrams are discussed in the following subsections.

#### **7.2 LOGIC SYMBOLOGY**

The logic function symbols used in Diablo Systems logic diagrams conform closely to those set forth in MIL-STD-806 & ANSI Y32.14. Small scale integration (SSI) circuits are represented by their function symbol. Medium scale (MSI) and large scale (LSI) integration devices, such as shift registers, RAM's, ROM's, etc., are represented by rectangles with function labels. Since both positive and negative logic conventions can appear in a single diagram, the unfilled circle negation symbol specified by MIL-STD-806 & ANSI Y32.14 is used to distinguish between LO true and HI true signals.

Usually, all logic symbols are drawn with inputs on the left and outputs on the right. Some device symbols, such as flip flops, show inputs and other external connections on the top and bottom of the symbol for clarity. Also, the drawings themselves are usually drawn with major signal flows from left to right, top to bottom. However, drawing layout restrictions occasionally require the reverse of this, and that some symbols be drawn with a vertical orientation.

Figure 7-0 is a sample diagram, drawn to include examples of most, if not all, of the drawing conventions used. Note that in some cases two "grid coordinate" systems are used. One, shown on the perimeter of the diagram, is useful in locating a portion of a circuit or a particular component on the diagram itself, and has no other meaning. The other involves the component identifiers, such as "Resistor H35". The identifier is a "grid coordinate" code for locating that component on its printed circuit board. Further, textual reference to a device, such as flip-flop, will usually further identify the device by its major output terminal. In the case of flip-flops, the "Q" output is usually used, i.e. FF B25-9.

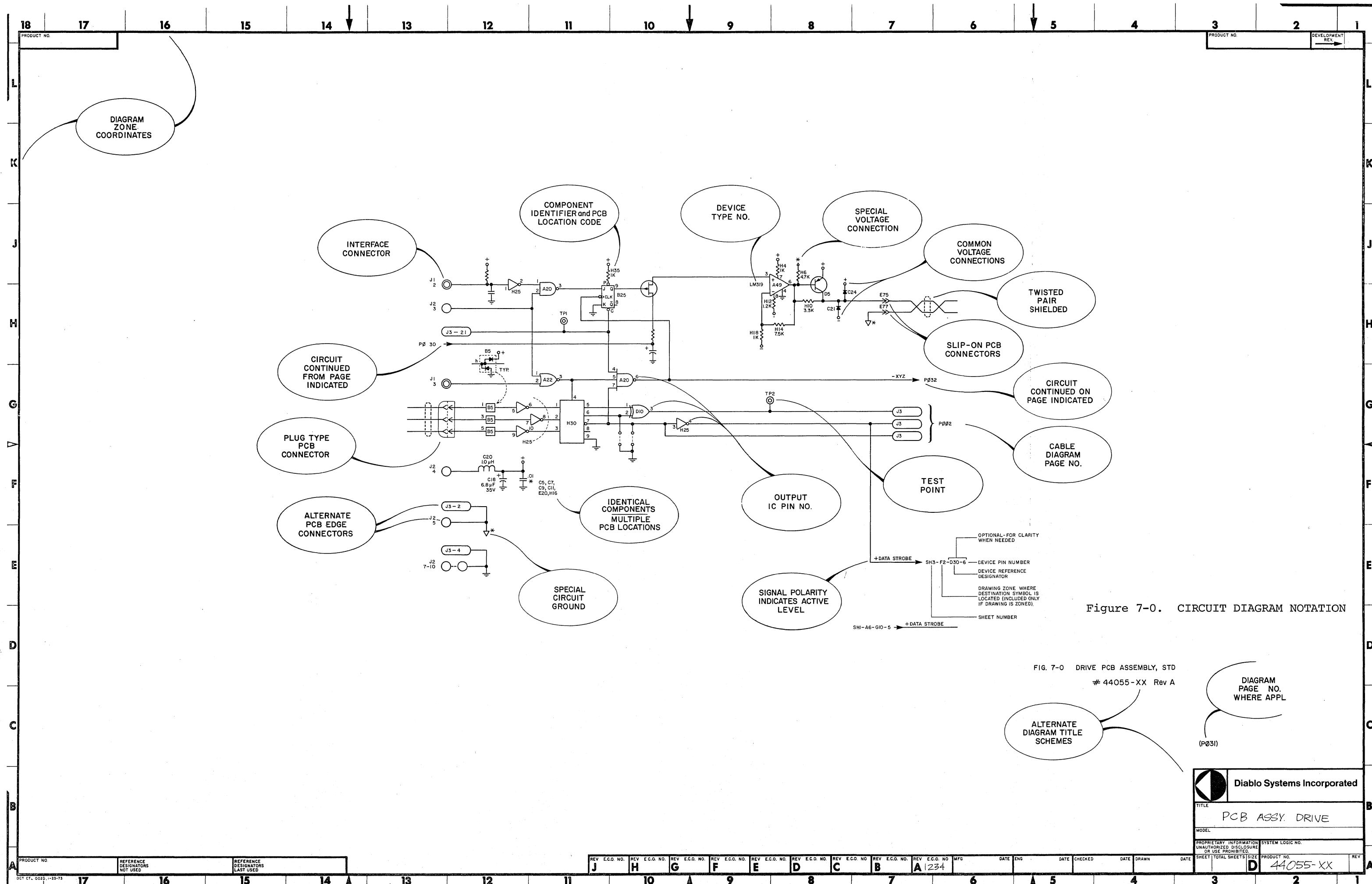
#### **7.3 CIRCUIT DIAGRAMS**

The schematic diagrams contained in this section are listed below. Each schematic has its revision history listed on the back, along with a Components List identifying the semiconductor component types used on the PCB.

Each schematic is drawn to the latest revision level listed in its Revision History. Appropriate option notes are contained on each schematic affected.

**FIGURE No. ASSY P/N REV LEVEL SCHEMATIC TITLE**

7-1	11116	S	Interconnection Diagram
7-2	11078	N	J1 PCB Assy
7-3	11981	A	J1 PCB Assy
7-4	11981	E	J1 PCB Assy
7-5	11111-XX	J	J2 PCB Assy
7-6	11026-XX	M	J3 PCB Assy
7-7	11085-XX	N	J8 PCB Assy
7-8	11071-XX	N	J9 PCB Assy
7-9	11113-XX	M	J10 PCB Assy – Standard Density
7-10	11082-XX	AB	J10 PCB Assy – High Density
7-11	11029-XX	F	Power Driver PCB Assy
	11033	—	Servo Driver PCB Assy
7-12	11174-01	—	Terminator Assy
7-13	11175-01	—	Terminator Assy



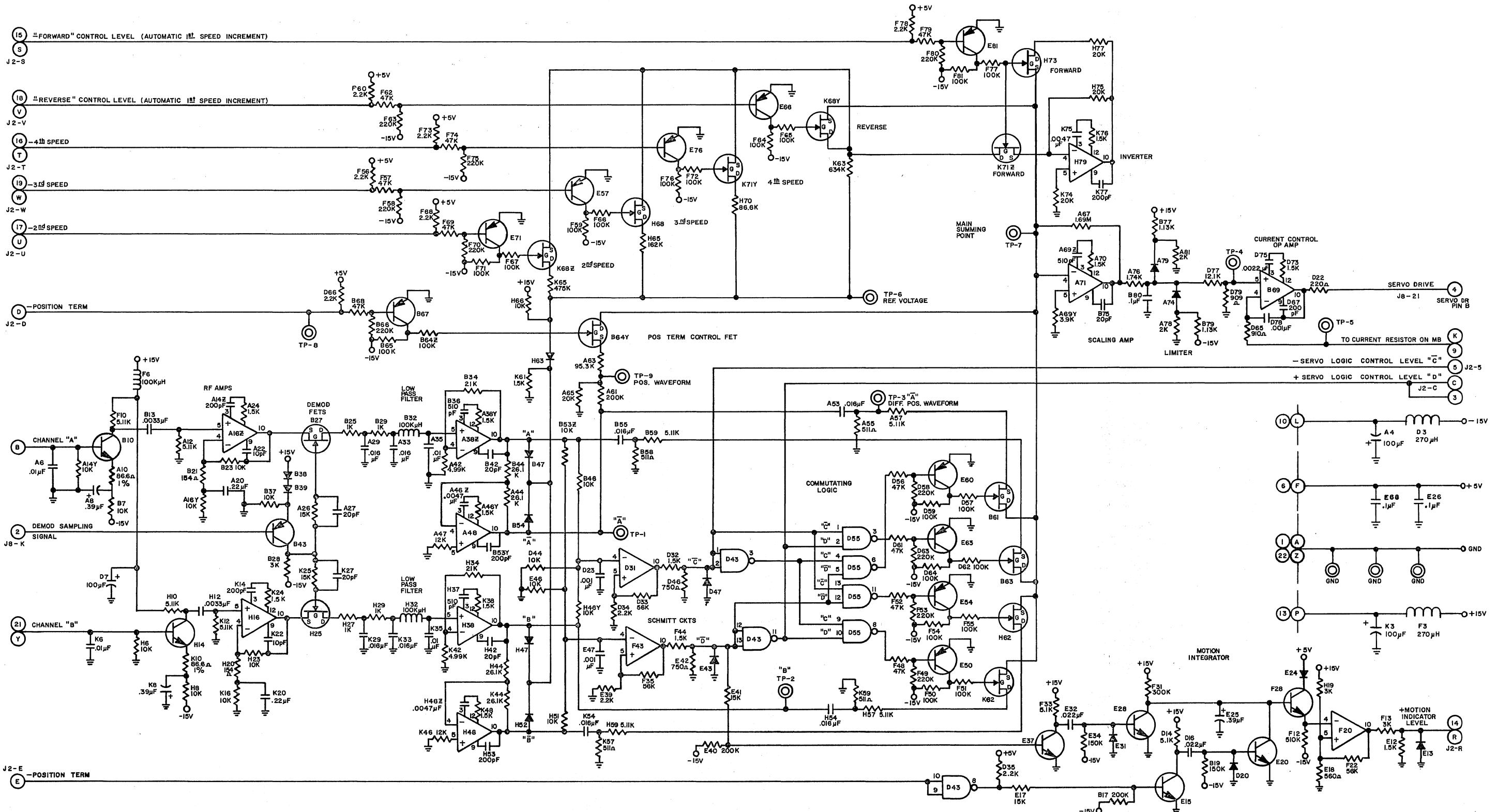


Figure 7-2. J1 PCB ASSY.  
11078 Rev. N

REVISION HISTORY

Prior to the earliest Rev. listed, machines used J1 11002 which is not directly interchangeable with 11078.

<u>Rev.</u>	<u>Date</u>	
D	12/2/70	Release to production.
E	6/24/71	Changed A8, K8 and E25 from .39uf tantalum to .39uf ceramic capacitors, part #10075-39. Changed A20 and K20 from .22uf tantalum to .22uf ceramic capacitors, part #10086-22. Changed A4 from a 100uf aluminum electrolytic to a 100uf tantalum, part #10078-01. Changed D75 from a 4.7nf to a 2.2nf capacitor, part #11070-22. Changed B80 part number from 10085-10 to 10086-10.
F	10/22/71	Schematic change only - showing J8 PCB components.
G	1/22/72	Diode added to collector of F28.
H	6/27/72	Schematic change only - as follows:

<u>Was</u>	<u>Is</u>
K21	K24
H35	L30
600pF (at H12)	620pF (at H12)
H18	H19
H68Z	K68Z

D3 relocated next to connector pins L & 10. F3 relocated next to collector of F28.

J	6/7/73	Schematic change only - transistors at locations B10, E15, E20, E28, E37, F28 and H14 are 2N3641, should be 2N3643.
K	10/1/73	Schematic change only - to correct error. TP2 on J8 PCB shown in dotted area is connected to pin N (J8) should be connected to pin R (J8).
L	7/19/74	Schmitt threshold changed to eliminate noise sensitivity. Resistors D34 and E39 changed from 270 Ohm 1/4W 5% to 2.2K 1/4W 5%, Part #10023-22.
M	2/5/75	Released new drawing format for schematic diagram and removed plastic edge piece.
N	10/15/75	Filter capacitor for -15V line changed from 100mFd, 20V to 100mFd, 25V.

COMPONENT TYPES

Diode, 1N4454	A74, A79, B38, B39, B47, B54, D20, D47, E13, E24, E31, E43, H47, H52, H63
Transistor, U1898	B27, B61, B63, B64Y, H25, H62, H68, H73, K62, K68Y, K68Z, K71Y, K71Z
Transistor, 2N3643	B10, E15, E20, E28, E37, F28, H14
Transistor, 2N4916	B43, B67, E50, E54, E57, E60, E63, E66, E71, E76, E81
IC, 709	A16Z, A38Z, A48, B69, D31, F20, F43, H16, H38, H48, H79
IC, 709	A71 (Factory selected - see Parts Catalog)
IC, 946	D43, D55

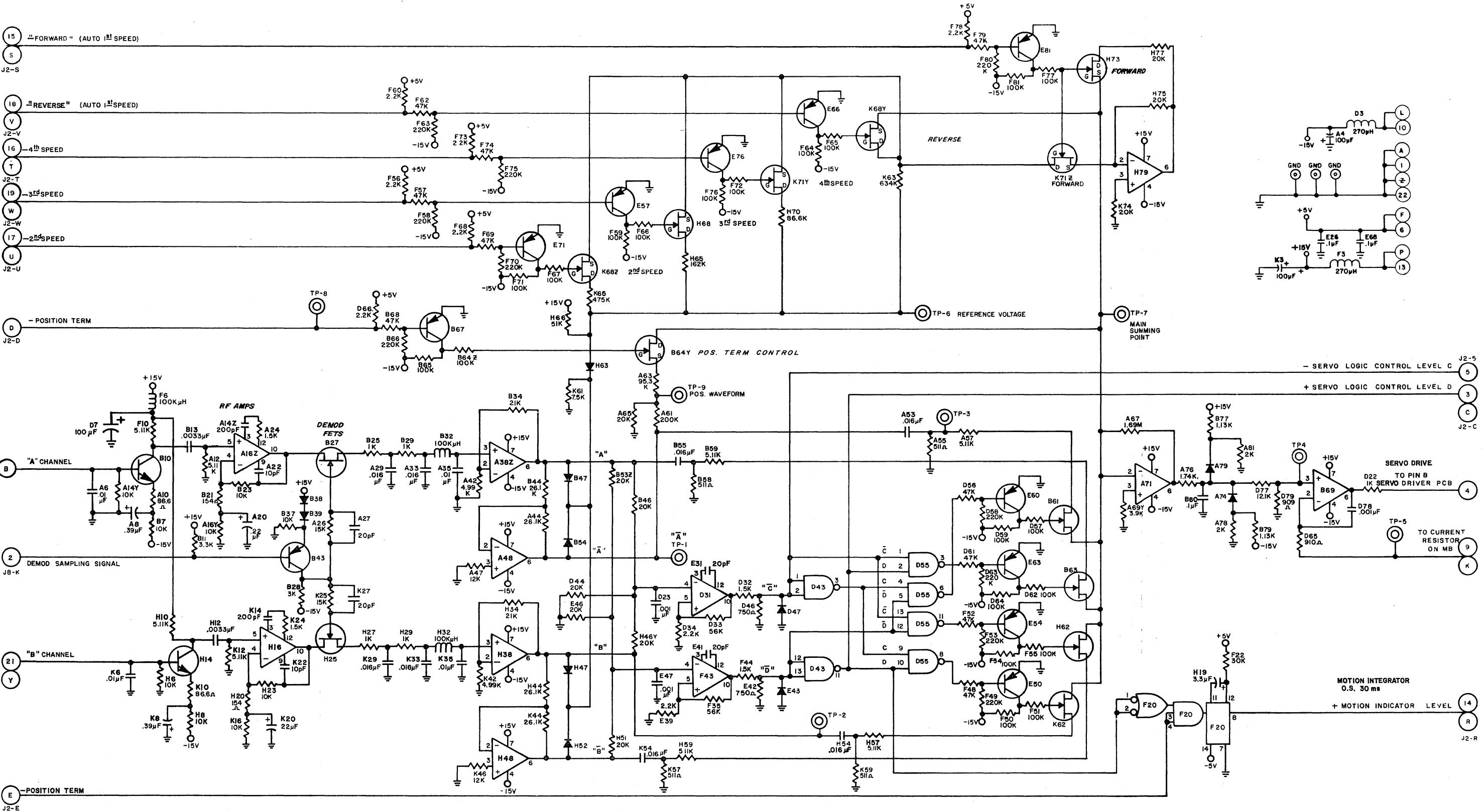


Figure 7-3. J1 PCB ASSY.  
11981 Rev. A

REVISION HISTORY

For later revision levels, refer to the schematic diagram for 11981 Rev. E.

Rev.    Date

A    4/11/75    Released to production.

COMPONENT TYPES

Diode, 1N4454	A74, A79, B38, B39, B47, B54, D47, E43, H47, H52, H63
Transistor, U1898	B61, B63, B64Y, H62, H68, H73, K62, K68Y, K68Z, K71Y, K71Z
Transistor, 2N3643	B10, H14
Transistor, 2N4916	B43, B67, E50, E54, E57, E60, E63, E66, E71, E76, E81
Transistor, U1899	B27, H25
IC, LM709CM	A16Z, D31, F43, H16
IC, DM946NM	D43, D55
IC, 9601	F20
IC, 72741P	A38Z, A48, A71, B69, H38, H48, H79

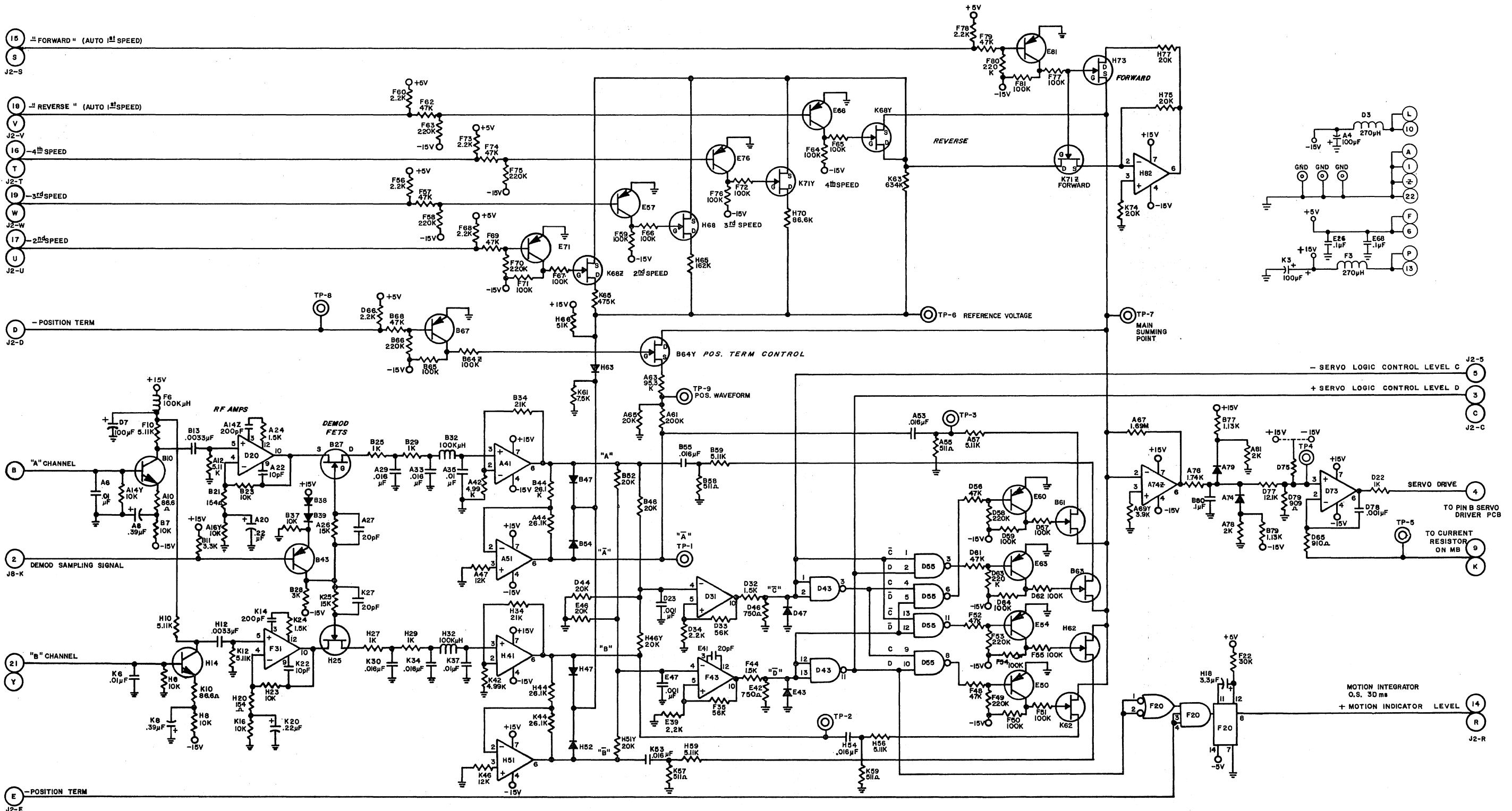


Figure 7-4. J1 PCB ASSY.  
11981 Rev. E

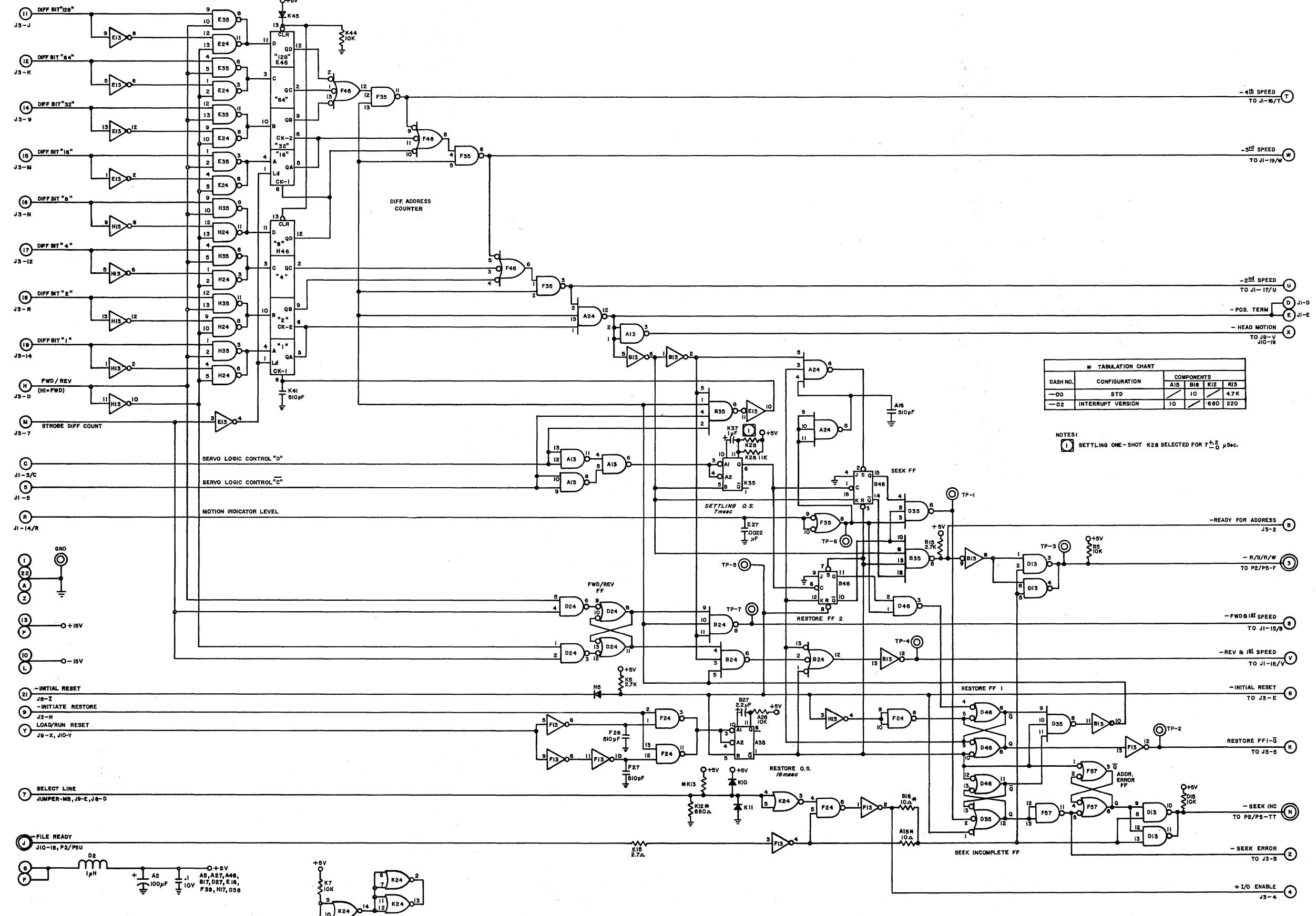
REVISION HISTORY

For revision level A, refer to the schematic diagram for 11981 Rev. A.

<u>Rev.</u>	<u>Date</u>	
B	2/10/76	Adds "select-on-test" resistor D75 between TP4 line and either +15V or -15V.
C	2/10/76	Releases PCB assembly using new PCB etch incorporating all Rev. A and B changes.
<sup>1</sup> C	5/28/76	Correction of drafting error on schematic.
D	3/14/77	Capacitor E31 removed from D31 amplifier circuit to prevent improper Seek Incomplete signal.
E	3/30/78	Transistors at locations B27 and H25 changed from U1898 to U1899 to eliminate need for hand selecting to match.

COMPONENT TYPES

Diode, 1N4454	A74, A79, B38, B39, B47, B54, D47, E43, H47, H52, H63
Transistor, U1898	B61, B63, B64Y, H62, H68, H73, K62, K68Y, K68Z, K71Y, K71Z
Transistor, 2N3643	B10, H14
Transistor, 2N4916	B43, B67, E50, E54, E57, E60, E63, E66, E71, E76, E81
Transistor, U1899	B27, H25
IC, LM709CM	D20, D31, F31, F43
IC, DM946NM	D43, D55
IC, 9601	F20
IC, 72741P	A41, A51, A74Z, D73, H41, H51, H82



## J2 PCB ASSY. 11111-XX

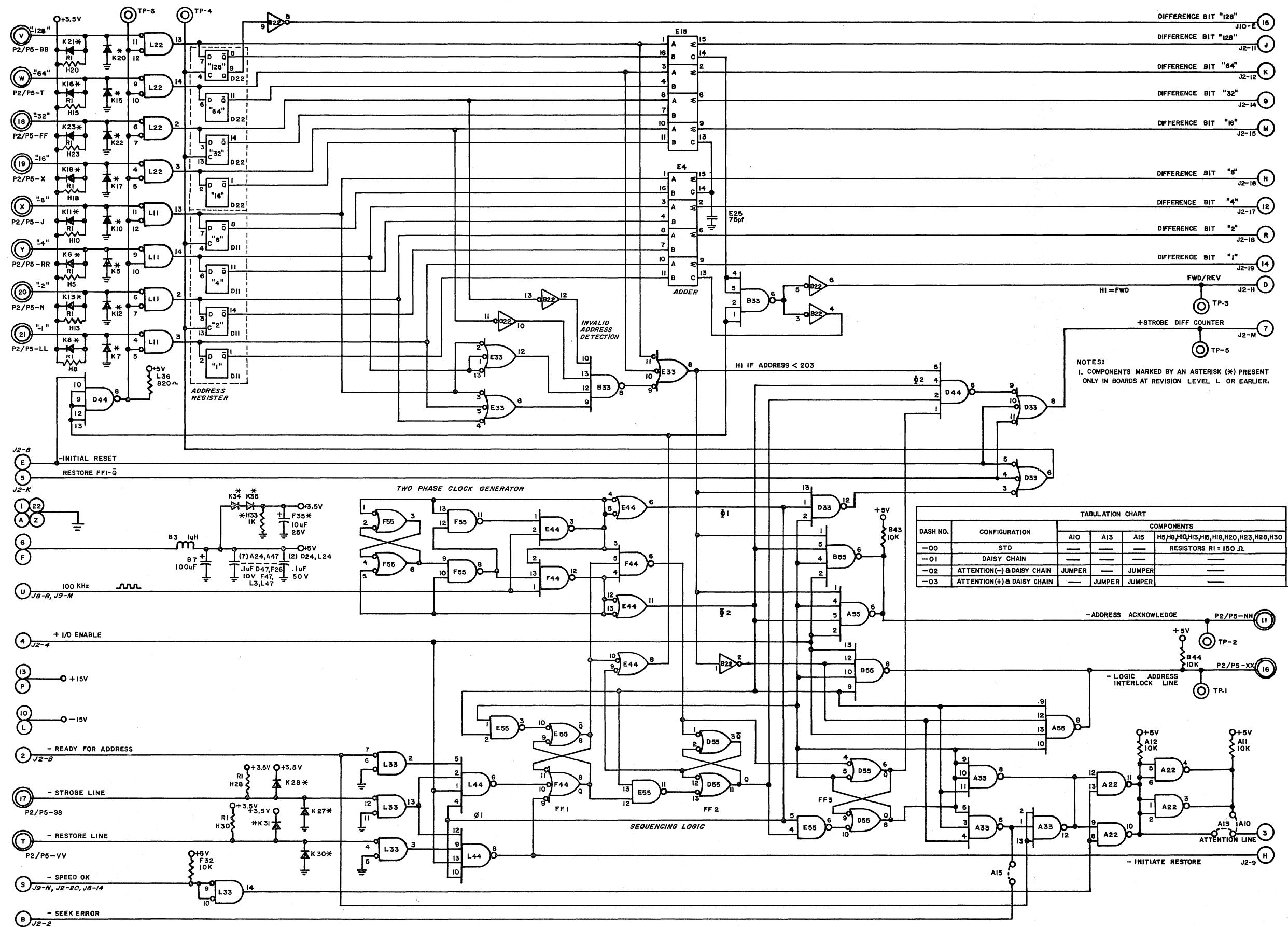
REVISION HISTORY

Prior to the earliest Rev. listed, machines used J2 11021 which is not directly interchangeable with 11111 because of circuit changes.

<u>Rev.</u>	<u>Date</u>	
B	2/18/71	Addition of diode at D39 to cause reset of Restore F/F by the Servo Hold signal during the power-up reset. Release to production.
C	2/23/71	Rework of assembly to add a capacitor at A16 and add restore F/F2-Q to D35, pin 5.
D	7/14/71	Change in dimension to be compatible with J8 and J9 PCB's.
E	8/18/71	Addition of 946 type IC at F57 and resistors at K12, K13, A15 and B16 for options #046 and #047.
F	2/23/72	Add a 4.7K, 1/4W 5% resistor to location K13. This pull-up resistor for the Select Line is to prevent a loose select jumper plug from appearing as a select command.
G	2/8/73	Change resistor K26 from 10K 1% to 11K 1%, part #10004-05.
H	3/15/73	Documentation correction - resistor K26 part #10014-01 should be #10004-05.
H'	11/26/74	Documentation correction - Note 3.1 changed to read "Resistors K12 and A15 are not used on basic version (11111-00).
J	4/13/78	IC at H46 changed from P/N 10143 to 10143-01.

COMPONENT TYPES

Diode, 1N4454	H5, K10, K11, K45
IC, SP380A	K24
IC, DM930NM	B35
IC, DM936	B13, E13, F13, H13
IC, DM946NM	A13, D24, D46, E24, E35, F24, F35, F57, H24, H35
IC, DM962NM	A24, B24, D35, F46
IC, SN7476N	B46
IC, SNN8291A	E46
IC, 8291A	H46
IC, SN15858N	D13
IC, SN74121N	A35, K35



REVISION HISTORY

Prior to the earliest Rev. listed, machines used J3 11025 which is not directly interchangeable with 11026 because of circuit changes.

<u>Rev.</u>	<u>Date</u>	
D	12/2/70	Release to production.
E	12/10/70	Documentation change only - IC at A55 was type 380, should be type 944.
F	12/23/70	Addition of 820 Ohm resistor at L36, part #10022-82.
G	1/15/71	Addition of 10 Ohm resistors at B13 and F32.
H	7/14/71	Removal of 10 Ohm resistors at B13 and F32.
J	8/8/71	Addition of two IC's for options #046 and #047.
K	7/3/73	Assembly drawing correction only - resistor value 150 Ohm 1/2W at location H28 removed.
L	9/24/73	.luf capacitors at locations D24 and L24 changed from part #10095-01 to 10086-10. Smaller size not so easily broken.
M	3/25/76	IC's at locations L11, L22 and L33 changed from SP380 to DM8836 to correct circuit defect. This reduces number of associated components required, as indicated in "NOTES" on schematic.

COMPONENT TYPES

Diode, 1N4454	K5, K6, K7, K8, K10, K11, K12, K13, K15, K16, K17, K18, K20, K21, K22, K23, K27, K28, K30, K31, K34, K35
IC, DM930NM	B33, D44, L44
IC, DM936	B22
IC, DM944NM	A55, B55
IC, DM946NM	D55, E44, E55, F55
IC, DM962NM	A33, D33, E33, F44
IC, SN7475N	D11, D22
IC, SN7483N	E4, E15
IC, DM8836	L11, L22, L33
IC, SN15858N	A22

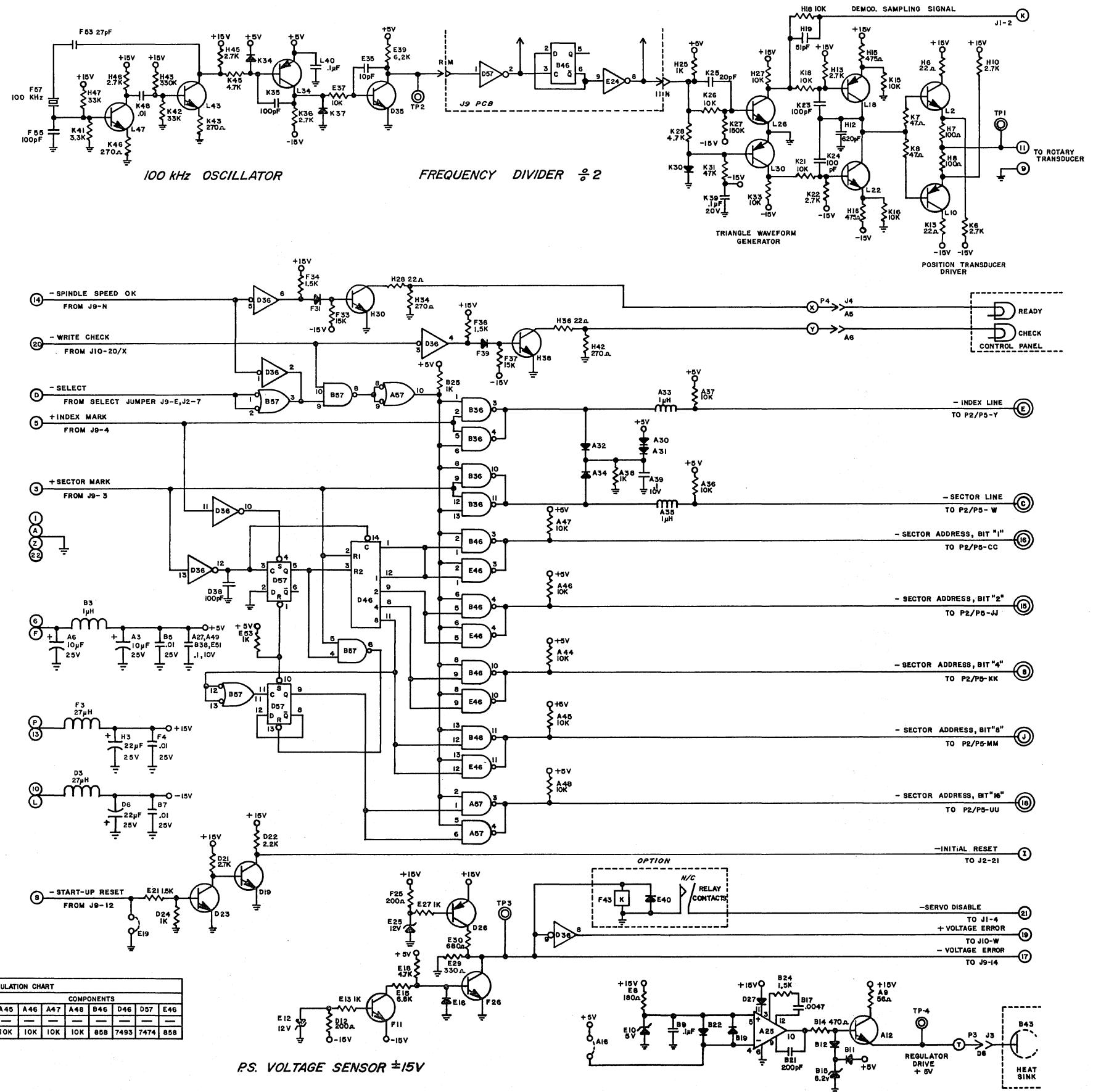


Figure 7-7. J8 PCB ASSY.  
11085-XX Rev. N

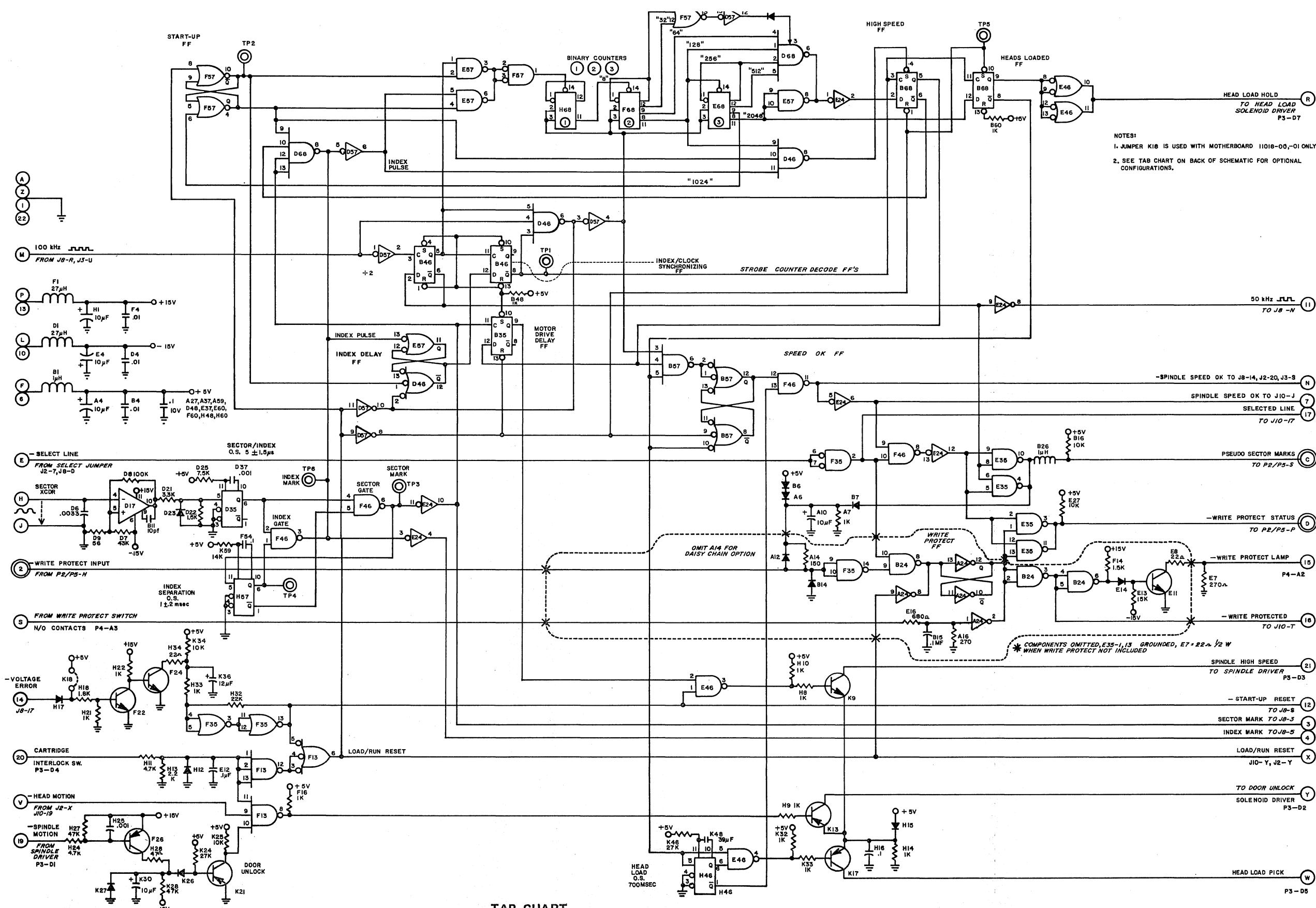
REVISION HISTORY

Prior to the earliest Rev. listed, machines used J8 11084, 11067 or 11014 which are not directly interchangeable with 11085 because of circuit changes.

<u>Rev.</u>	<u>Date</u>	
D	12/8/70	Release to production.
E	3/9/71	Change 10uh inductors at A33 and A35 to luh, part #10200, to decrease rise and fall for sector and index pulses.
F	10/25/71	Change 20pf capacitor at H19 to 51pF, part #10061-51 for signal improvement.
G	2/22/72	Change E8 from 510 Ohm 1/2W to 180 Ohm 1W resistor when E10 contains a 1N4731 zener diode to adjust zener current to correct value.
H	10/2/72	Addition of -02 option.
J	1/23/73	Drawing correction only - remove 330 Ohm resistor at E39 and add 6.2K resistor at E39.
K	8/21/73	Drawing correction only - from 2N3641 transistor to 2N3643, part #10109, 12 places.
L	9/7/73	Drawing correction only - to show components for -01 version.
M	10/9/73	Change 13V 1W 1% zener diodes at E12 and E25 to 12V 1/2W 5%, part #10103-07. Change 10uf capacitor at D6 and H3 to 22uf, tantalum, part #10077-22. Reason to better suppress noise on <u>+15V</u> .
N	1/22/74	Replaced 4.3V zener diode at E10 with 5V zener diode. Replaced 187 Ohm 1% resistor at A16 with wire jumper.
N (Added change)	6/19/74	Documentation change only - Changes 7479 F/F designations to 7474.

COMPONENT TYPES

Diode, A14F	B11
Diode, 1N4454	A30, A31, A32, A34, B12, B19, B22, D27, E16, E40, F31, F39, K30, K34, K37
Diode, Zener 5V	E10
Diode, Zener 6.2V	B15
Diode, Zener 12V	E12, E25
Transistor, 2N3643	D19, D23, D35, F11, F26, H30, H38, L2, L22, L26, L43, L47
Transistor, 2N3644	L10
Transistor, 2N4916	D26, L18, L30, L34
Transistor, MPS-U01	A12
IC, LM709CM	A25
IC, DM936NM	D36
IC, DM946N	B57
IC, SN7474	D57
IC, SN7493	D46
IC, SN15858N	A57, B36, B46, E46



## TAB CHART

Dash No.	Configuration	Components
-00	Standard or Daisy Chain	1) Write Protect components omitted. See schematic. 2) Resistor E7 = 22 ohms 3) Jumper installed from pin 11 to pin 7 of location A24.
-01	Wr Protect or Wr Protect/Attn Line or Wr Protect/Attn Line/ Daisy Chain	1) Write Protect components installed. See schematic. 2) Resistor E7 = 270 ohms 3) No jumper in A24 location.
-03	Wr Protect/Daisy Chain	1) All components installed as listed for -01 version, but resistor A14 (150 ohms) is omitted.
-30	Same as -00 plus 32 sector	For 32 sector option, resistor K59 is selected to produce a
-31	Same as -01 plus 32 sector	Sector/Index One-Shot period of .8 to .95 ms.
-33	Same as -03 plus 32 sector	

Figure 7-8. J9 PCB ASSY.  
11071-XX Rev. M

REVISION HISTORY

Prior to the earliest Rev. listed, machines used J9 11069 or 11010 which are not directly interchangeable with 11071 revision E or later because of circuit changes.

<u>Rev.</u>	<u>Date</u>	
E	12/8/70	Release to production.
F	2/18/71	Addition of compatibility note to schematic drawing.
G	3/9/71	Change 10uh inductor at B26 to luh, part #10200 to reduce rise and fall time of psuedo Sector pulse.
H	3/22/71	Change to schematic to show diode across door unlock solenoid.
J	12/16/71	Ground plane moved back to provide space for diode and increase space for components at K54 and K59.
K	2/7/73	Change 180K 1/4W resistor at D8 to 100K 1/4W, part #10061-10 across pins 9 and 10 of IC at D17, to eliminate noise.
L	2/7/73	Change 470 Ohm 1/2W resistor at E16 to 680 Ohm, 1/2W, to reduce input voltage on the IC at A24.
M	10/4/73	Documentation change only - No schematic change.
M <sup>1</sup>	6/19/74	Documentation change only - Changes 7479 F/F designations to 7474.
N	11/10/75	Documentation change only - No schematic change.

COMPONENT TYPES

Diode, A14F	H15
Diode, 1N4454	A6, A12, B6, B7, B14, D23, D60, E14, H12, H17, K26, K27
Transistor, 2N3643	E11, F22, F24, K21
Transistor, 2N3644	F26, K9, K13, K17
IC, SP380A	F35
IC, LM709CM	D17
IC, DM930NM	D68
IC, DM936	A24, D57, E24
IC, DM946NM	B24, E57, F46
IC, DM962NM	B57, D46, F13
IC, SN7402	F57
IC, SN7474	B35, B46, B68
IC, SN7493	E68, F68, H68
IC, SN74121N	D35, H46, H57
IC, SN15858N	E35, E46

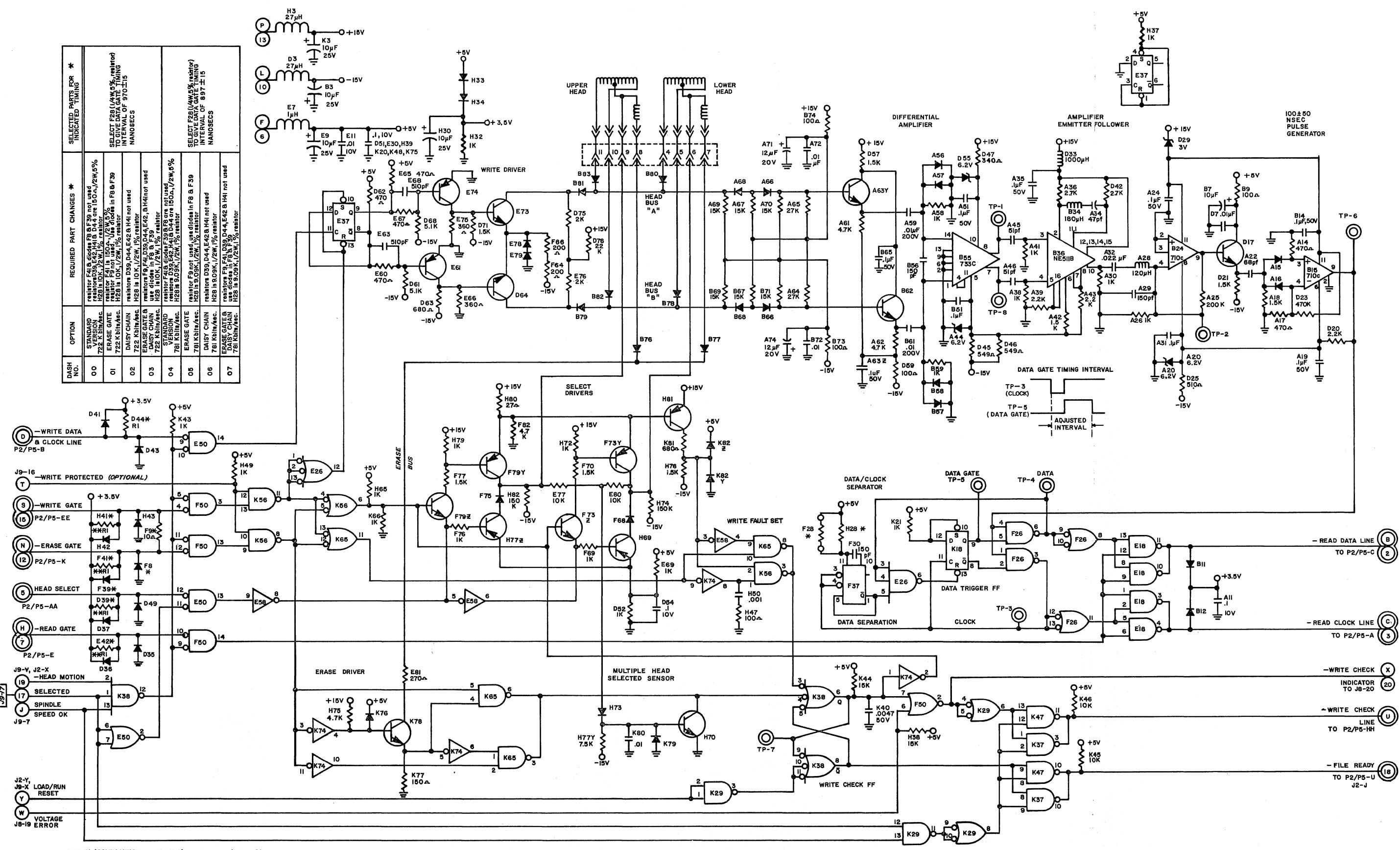


Figure 7-9. J10 PCB ASSY. - Standard Density  
11113-XX Rev. M

## J10 PCB ASSY. 11113-XX (STANDARD DENSITY)

REVISION HISTORY

Prior to the earliest Rev. listed, machines used J10 11006 which is not directly interchangeable with 11113 because of head cable changes and circuit changes.

<u>Rev.</u>	<u>Date</u>	<u>Description</u>												
B	2/11/71	Release to production.												
C	3/9/71	Change A22 from 51pf to 68pf capacitor, part #10061-68 to increase the width of the Read Clock and Data signals.												
D	4/6/71	Component and location changes to make assembly compatible with PCB revision B as listed below:												
		<table border="0"> <thead> <tr> <th><u>Was</u></th> <th><u>Is</u></th> </tr> </thead> <tbody> <tr> <td>Hard Wired</td> <td>B56</td></tr> <tr> <td>H36</td> <td>K43</td></tr> <tr> <td>None</td> <td>K44, H38</td></tr> <tr> <td>B58</td> <td>B59</td></tr> <tr> <td>B57</td> <td>B58</td></tr> </tbody> </table> <p>K40 changed from 510pf to .0047uf capacitor.</p>	<u>Was</u>	<u>Is</u>	Hard Wired	B56	H36	K43	None	K44, H38	B58	B59	B57	B58
<u>Was</u>	<u>Is</u>													
Hard Wired	B56													
H36	K43													
None	K44, H38													
B58	B59													
B57	B58													
E	6/15/71	Omit two unused test points from assembly.												
F	6/25/71	Changed .1uf capacitors at A19, A24, A31, A35, A51, A63Z, B14, B51, and B65 to part #10086-10 with no change in value for manufacturing convenience.												
G	10/8/71	Changed capacitor at A34 from 20pf to 47pf, part #10061-47, to compensate for change in head characteristics.												
H	9/18/73	Drawing correction only - 7479 IC at K18 and E37 should be 7474, 2N3641 transistor at D17, A63Y, B62, F73Z, H70, F79Z and K78 should be 2N3643.												
J	12/17/73	Change in bill of materials, 540 Ohm 1% resistor at D45 to 430 Ohm 5%, 549 Ohm 1% resistor at D46 to 430 Ohm 5%, 340 Ohm resistor at D47 to 330 Ohm 5%, to eliminate the use of precision resistors that are not required.												
K	4/4/74	Documentation change only - miscellaneous corrections to assembly drawing. Add option page table of options.												
L	8/12/74	Changed from plastic to glass encapsulated zener diodes, Part #10470, at locations D55, A20 and A44.												
M	10/22/74	Changed 1N4454 diodes to 1N4607, Part #10260, at locations A66, A68, B66, B68, B78, B79, B80, B81, B82 and B83. Removed plastic edge piece from PCB.												

COMPONENT TYPES

Diode, 1N4454	A15, A16, A56, A57, B11, B12, B57, B58, B76, B77, D35, D36, D37, D41, D43, D49, E78, E79, F8, F39, F68, F75, H33, H34, H42, H43, H73, K76, K79, K82Y, K82Z
Diode, 1N4607	A66, A68, B66, B68, B78, B79, B80, B81, B82, B83
Diode, Zener, 3V	D29
Diode, Zener, 6.2V	A20, A44, D55
Transistor, 2N3643	A63Y, B62, D17, F73Z, F79Z, H70, K78
Transistor, 2N3644	F73Y, F79Y, H81
Transistor, 2N4916	E61, E74, H69, H77Z
Transistor, 2N5189	D64, E73
IC, SP380A	E50, F50
IC, NE511B	B36
IC, DM936	E58, K74
IC, DM946NM	K29, K56, K65
IC, DM962NM	K38
IC, N5710CM	B15, B24
IC, N5733CM	B55
IC, SN7400N	F26
IC, 7410	E26
IC, SN7412	F37
IC, SN7474	E37, K18
IC, SN15858N	E18, K37, K47

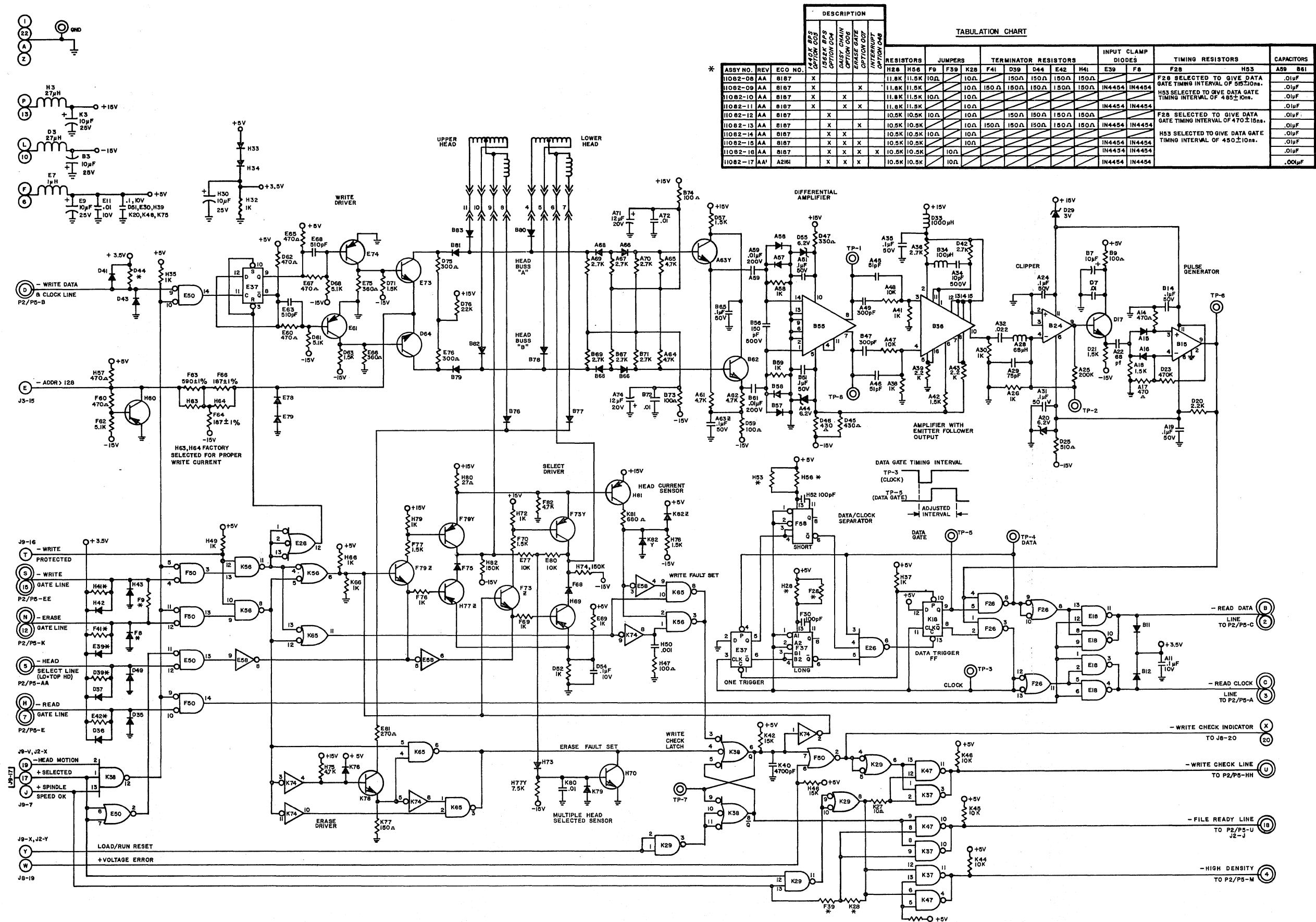


Figure 7-10. J10 PCB ASSY. - High Density  
11082-XX Rev. AB

## J10 PCB ASSY. 11082-XX (HIGH DENSITY)

REVISION HISTORY

Prior to the earliest Rev. listed, machines used J10 11082K, or an earlier revision. There may also be machines using 11081. These boards are directly interchangeable if the transistor at B27 is changed to a 3V zener, but Diablo recommends replacing these boards with a 11082L or later.

<u>Rev.</u>	<u>Date</u>	
L	1/21/71	Released to production.
M	2/11/71	Addition of a 150pf capacitor at B55, between pin 1 and pin 14 to improve read reliability. Change head socket from gray 14 pin to brown 14 pin, part #10596.
N	3/9/71	Changed capacitor at A22 from 51pf to 68pf part #10061-68, to increase width of Read Clock and Data signal.
P	5/8/71	Replaced 74121 IC at F37 and F58 with 9601 type IC's part #10159. Adapted change for option #048. Add provisions for trimming of write current. Omit four unused jack connectors. Changed location of H65 to H66 and F39 to E39. Added 10 Ohm trim resistors at K27 and K28. Changed H28 and H56 to 10K resistors.
R	6/25/71	Changed .luf capacitor at A19, A24, A31, A35, A51, A63Z, B14, B51 and B65 to part #10086-10 with no change in value for manufacturing convenience.
S	11/19/71	Change resistors A67, A69, A70, B67, B69 and B71 from 15K 1/4W 5% to 2.7K 1/4W 5%, part #10023-27. Change resistors A64 and A65 from 27K 1/4W 5% to 4.7K 1/4W 5%, part #10023-47. Change resistors D75 and E76 from 560 Ohm 1/4W 5% to 300 Ohm 1/4W 5%, part #10022-30. Change resistor D63 from 680 Ohm 1/4W 5% to 1.5K 1/4W 5%, part #10023-15. The above to correct for marginal disk cartridges.
T	6/1/73	Drawing correction only - change B67 from 15K to 2.7K resistor.
U	9/18/73	Drawing correction only - change type 7479 IC at K18 and E37 to type 7474.
V	1/2/74	Change D45 and D46 from 549 Ohm 1% to 430 Ohm 5% resistor, part #10032-43, D47 from 430 Ohm 1% to 330 Ohm 5% resistor, part #10032-33, eliminate the use of precision resistors that are not required.
X	2/11/74	Assembly drawing change only - change reference designation of diode F39 to E39. Add component location and value at E39, F8, F39, and F41 to complete assembly drawing and assign values to components not shown.
Y	5/24/74	Changed to preformed wire jumpers for test points 3, 4 and 5.
Z	8/12/74	Changed from plastic to glass encapsulated zener diodes, Part #10470, at locations D55, A20 and A44.
AA	9/6/74	Changed 1N4454 diodes to 1N4607, Part #10260, at locations A66, A68, B66, B68, B78, B79, B80, B81, B82 and B83. Removed plastic edge piece from PCB.
AA <sup>1</sup>	2/4/77	Adds version 11082-17 to Tab Chart on schematic.
AB	4/14/78	Resistor H28 on Tab Chart changed from 11.5K to 11.8K for 11082-08 thru 11082-11, to increase minimum pulse width from one-shot F37.

COMPONENT TYPES

Diode, 1N4454	A15, A16, A56, A57, B11, B12, B57, B58, B76, B77, D35, D36, D37, D41, D43, D49, E39, E78, E79, F8, F68, F75, H33, H34, H42, H43, H73, K76, K79, K82Y, K82Z
Diode, 1N4607	A66, A68, B66, B68, B78, B79, B80, B81, B82, B83
Diode, Zener, 3V	D29
Diode, Zener, 6.2V	A20, A44, D55
Transistor, 2N3643	A63Y, B62, D17, F73Z, F79Z, H70, K78
Transistor, 2N3644	F73Y, F79Y, H60, H81
Transistor, 2N4916	E61, E74, H69, H77Z
Transistor, 2N5189	D64, E73
IC, SP380A	E50, F50
IC, NE511B	B36
IC, DM936	E58, K74
IC, DM946NM	K29, K56, K65
IC, DM962NM	K38
IC, N5710CM	B15, B24
IC, N5733CM	B55
IC, SN7400N	F26
IC, 7410	E26
IC, SN7474	E37, K18
IC, SN15858N	E18, K37, K47
IC, 9601	F37, F58

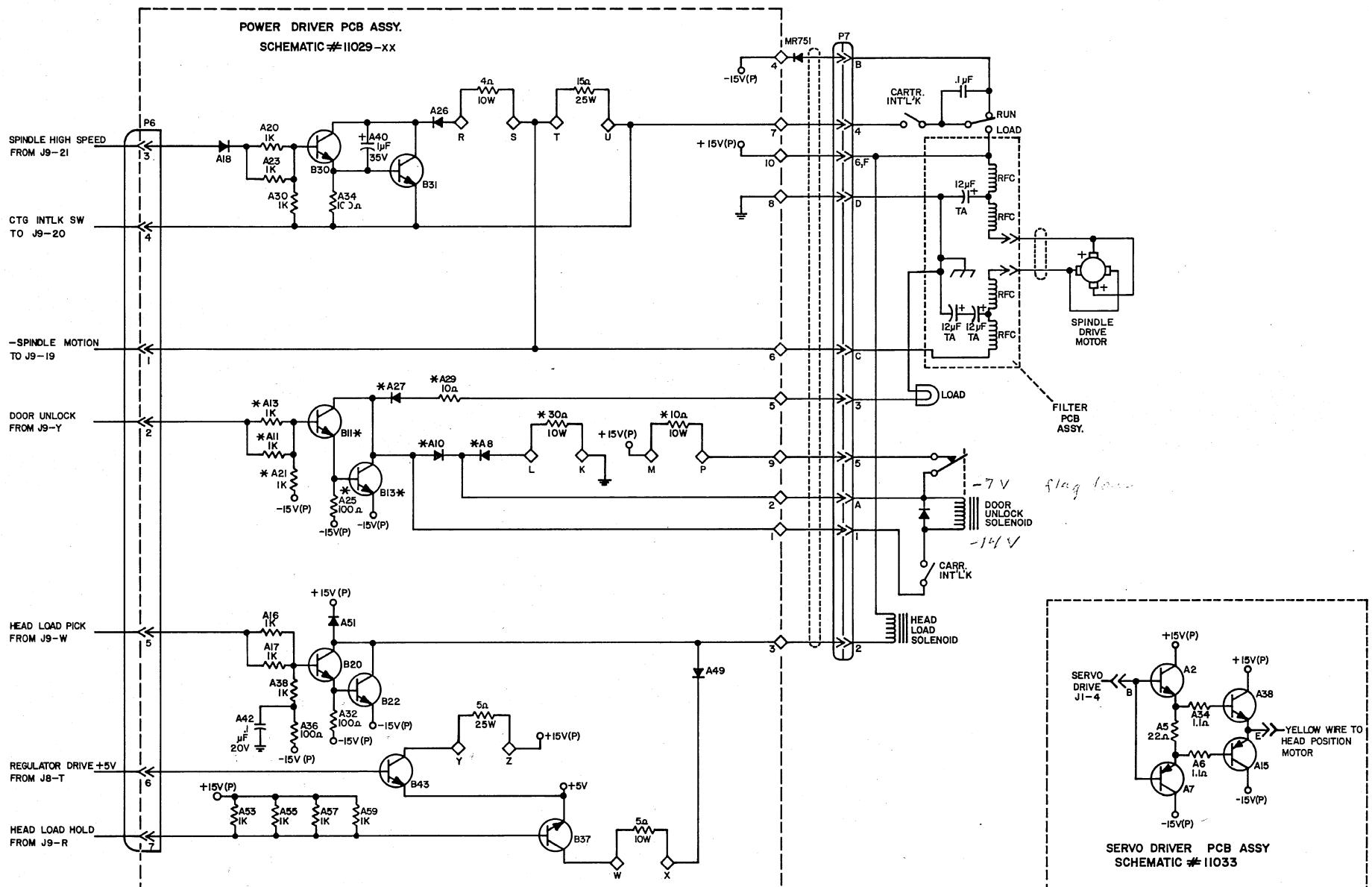


Figure 7-11. POWER DRIVER PCB ASSY. - 11029-XX Rev. F  
SERVO DRIVER PCB ASSY. - 11033

POWER DRIVER PCB ASSY. 11029-XX  
SERVO DRIVE PCB ASSY. 11033

REVISION HISTORY

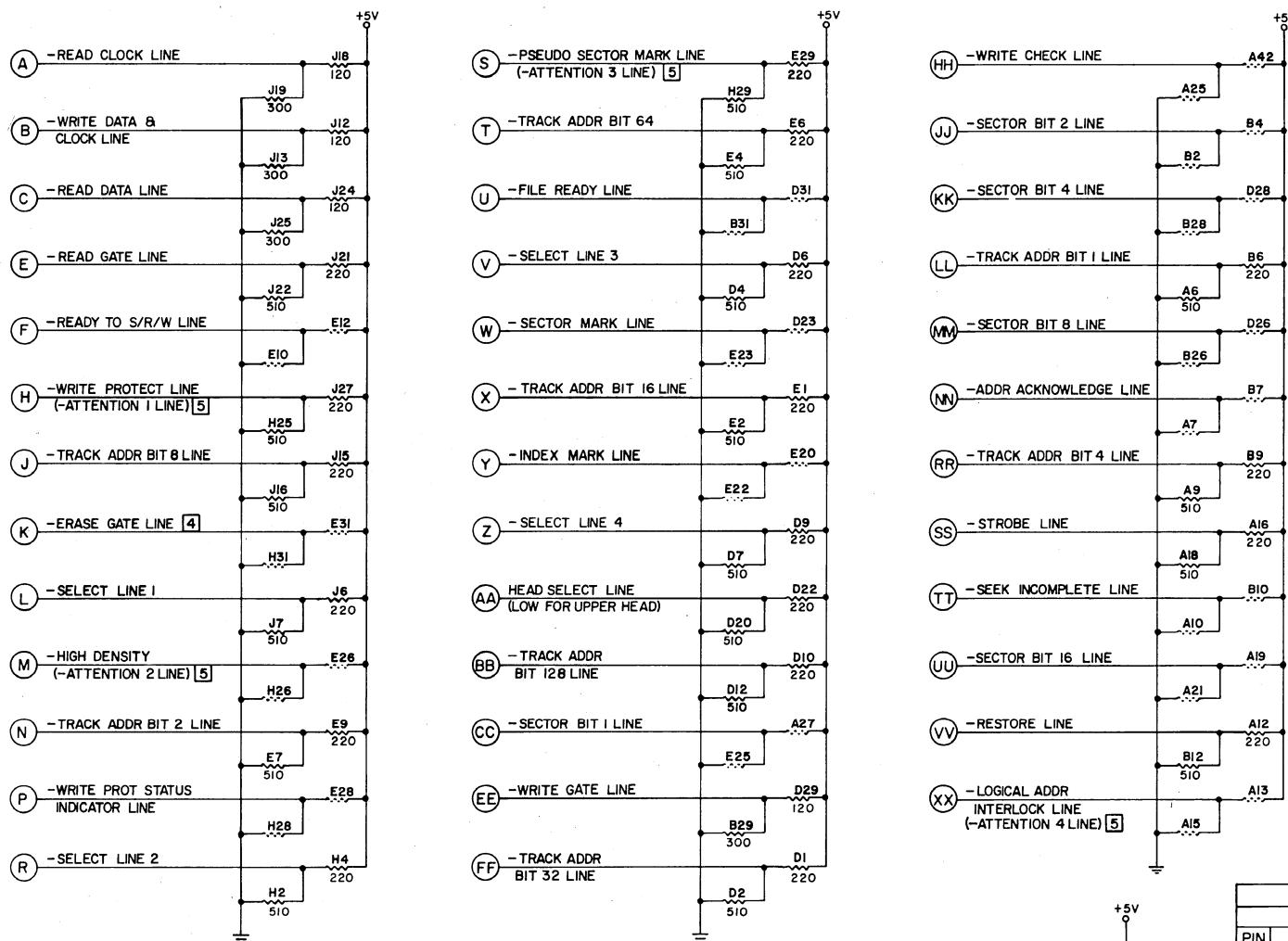
The revision history of these two PCB's is incorporated into the J9 PCB Revision History.

COMPONENT TYPES - POWER DRIVER 11029

Diode, A14F	A8, A10, A26, A27, A49, A51
Diode, 1N4454	A18
Transistor, MPS-U01	B11, B20, B30
Transistor, MJE-3055	B13, B22, B31, B37, B43

COMPONENT TYPES - SERVO DRIVE PCB ASSY. 11033

Transistor, MPS-U01	A2
Transistor, MPS-U51	A7
Transistor, MJE-2955	A15
Transistor, MJE-3055	A38



TABULATION CHART		
DASH NO.	OPTION	RESISTORS
		E3I H3I
-01	ERASE OPTION	220 510
-03	NO ERASE OPTION	— —

NOTES: UNLESS OTHERWISE SPECIFIED  
 1. USE PRINTED CIRCUIT BOARD II097-01  
 2. ALL RESISTORS ARE IN OHMS  
 3. ALL RESISTORS ARE 1/2W, 5%  
 4. ERASE OPTION, SEE TABULATION CHART ABOVE  
 5. STANDARD-ATTENTION OPTION FEATURE,  
 SEE REFERENCE CHART  
 6. PHANTOM RESISTORS ARE UNUSED

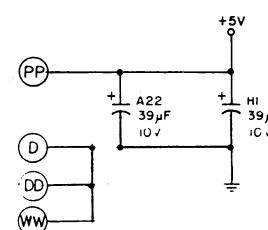
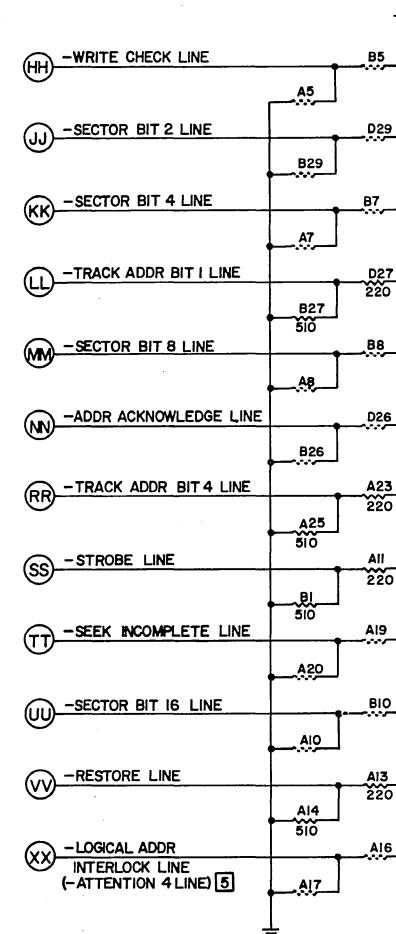
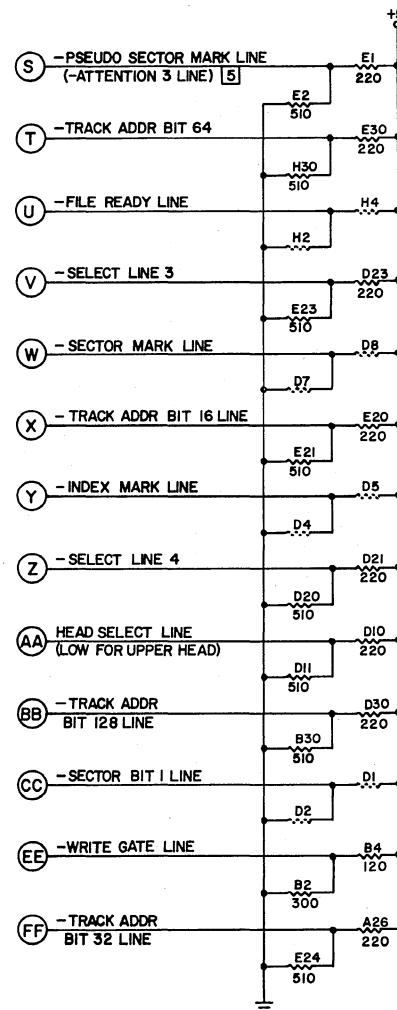
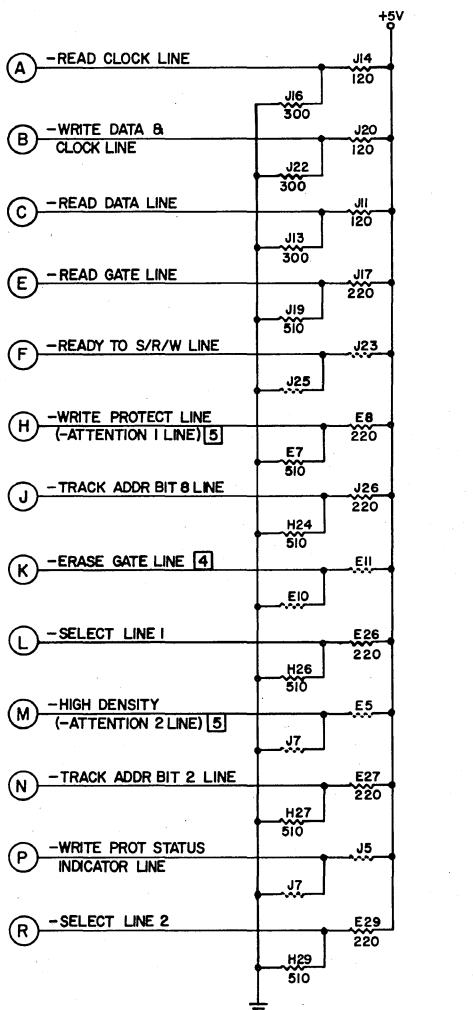
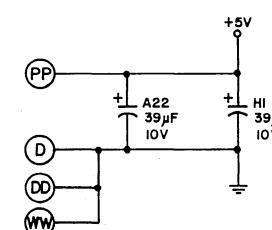


Figure 7-12. TERMINATOR ASSY.  
11174-01



TABULATION CHART		
DASH NO.	OPTION	RESISTORS
		E11 E10
-01	ERASE OPTION	220 510
-03	NO ERASE OPTION	— —

NOTES: UNLESS OTHERWISE SPECIFIED  
 1. USE PRINTED CIRCUIT BOARD 11097-02  
 2. ALL RESISTORS ARE IN OHMS  
 3. ALL RESISTORS ARE 1/2W, 5%  
 4. ERASE OPTION, SEE TABULATION CHART ABOVE  
 5. STANDARD-ATTENTION OPTION FEATURE,  
 SEE REFERENCE CHART  
 6. PHANTOM RESISTORS ARE UNUSED



REFERENCE CHART	
STANDARD SIGNAL	ATTENTION OPTION SIGNAL
PIN	PIN
H - WRITE PROTECT LINE	H - ATTENTION 1 LINE
M - HIGH DENSITY LINE	M - ATTENTION 2 LINE
S - PSEUDO SECTOR MARK LINE	S - ATTENTION 3 LINE
XX - LOGICAL ADDR INTERLOCK LINE	XX - ATTENTION 4 LINE

Figure 7-13. TERMINATOR ASSY.  
 11175-01

## COMMENT SHEET

FROM

NAME \_\_\_\_\_ OFFICE/DEPT NO. \_\_\_\_\_

CITY/STATE \_\_\_\_\_ DATE \_\_\_\_\_

To make this manual more useful to you, we want your comments: what additional information should be included in the manual; what description or figure could be clarified; what subject requires more explanation; what presentation is particularly helpful to you; and so forth.

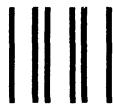
CUT ALONG LINE

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