

# MAINTENANCE MANUAL FOR SERIES 30 DISK DRIVE

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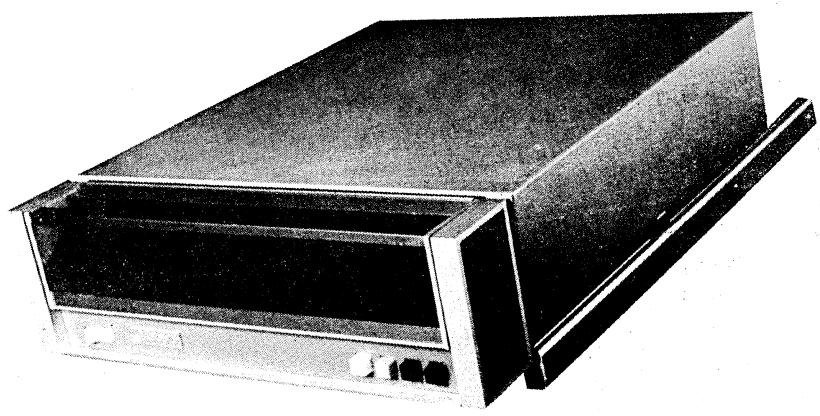
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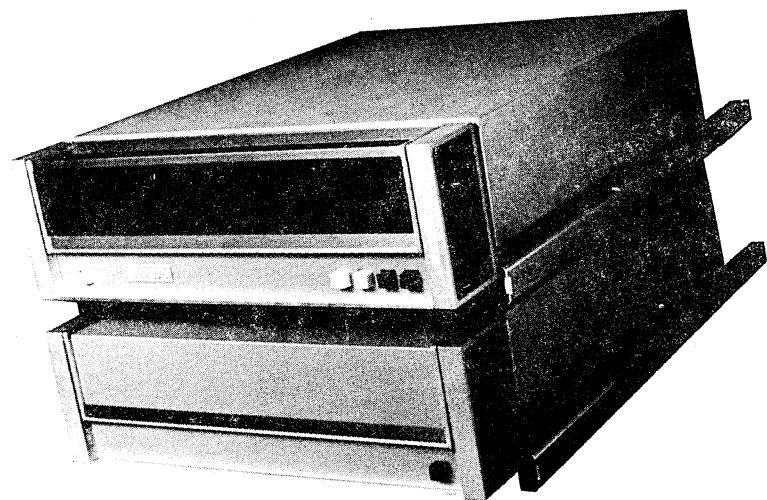
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MODEL 31



MODEL 33

Figure 1-1. SERIES 30 DISK DRIVES

## **SECTION 1**

### **GENERAL INFORMATION**

#### **1.1 OVERVIEW DESIGN**

The Diablo Series 30 Disk Drives consist of the Model 31 and the Model 33 Disk Drives, see Figure 1-1.

The Model 31 is a compact lightweight random access storage device. As its storage medium it uses a 2315 type single disk cartridge on which it writes 406 data tracks with two movable flying heads.

The Model 33 is two completely independent disk drives. One of these disk drives is a Model 31, the other disk drive identified as the Model 33F has a door assembly that is latched closed.

#### **1.2 MAINTENANCE PHILOSOPHY**

The weight and size of the Series 30 Disk Drive makes the philosophy of unit replacement practical and economical. There are three cable connectors on the standard Series 30 drive, one power and two input/output connectors. On-line or bench testing and repair is simplified by modular design. The electronics assembly can be easily raised to a servicing position to allow full access to the individual components. Each sub-assembly is easily replaced.

#### **1.3 SCOPE OF MANUAL**

This manual is intended as a reference for the maintenance and repair of the Series 30 disk drives. The circuit descriptions are general in nature. A comprehensive understanding of circuit functions will require careful study of the schematics, with this manual as a guide, or attendance at a training course offered by Diablo.

Maintenance of the control, data, and power supply functions external to the disk drive is not described in this manual. The companion publication "Series 30 Product Description," which provides details on specifications, operation and interfacing, should be acquired for a more thorough understanding of this equipment. Since the Model 33 is, in effect, two Model 31's this manual will concentrate on the Model 31. The differences between the Model 31 and the Model 33F are described in paragraph 1.7.

Machine changes may be made from time to time. Changes affecting fit and function will be discussed in Customer Engineer memoranda.

#### 1.4 WARRANTY

Diablo warrants that each Series 30 to be delivered shall, at the time of delivery and for a period of one year thereafter, be free from defects in material and workmanship. Diablo's liability shall be limited at its option and expense, to the repair or replacement, F.O.B. Diablo, of any defective or non-conforming product.

#### 1.5 MAINTENANCE FEATURES

Mechanical assemblies have been minimized. The Spindle Assembly and the Head Positioner Assembly (Figure 1-2) are the only relatively high speed mechanical assemblies. The remaining mechanical assemblies are the Cartridge Receiver Assembly and the Door Assembly. Each of these assemblies are easily removed, with a minimum number of adjustments required for re-assembly.

Electronic assemblies, consisting of six pluggable circuit cards, a motherboard and a heatsink assembly, are accessible and easily replaced. As shown in the Series 30 Interconnection Schematic, Section 6, each pluggable circuit card has well defined functions which further simplifies the maintenance effort.

The schematics have been planned to simplify the maintenance procedure. Signal functions are described on the schematics, and wave forms are shown where needed. Each component shown on a schematic has its location given with respect to a coordinate system, shown in Figure 1-3. A component shown on the J1 schematic as D55 will be found on the J1 board in row D, mid-way between grid lines 50 and 60. Pin 1 of each IC is indicated on the board by a square pad; a square pad is also used for the emitter of each transistor and the gate of each FET.

Two exercisers have been developed by Diablo to assist in troubleshooting the Series 30. Exerciser, Diablo option number O22, is designed to test the Seek and Restore functions, while the second exerciser, Diablo Option O23, will test Seek, Restore, Read/Write and has data checking ability.

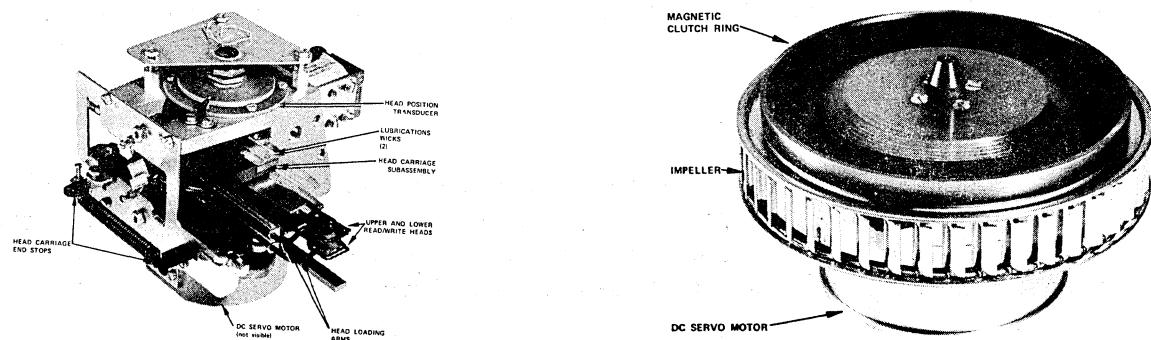


Figure 1-2. HEAD POSITIONER AND SPINDLE ASSEMBLIES

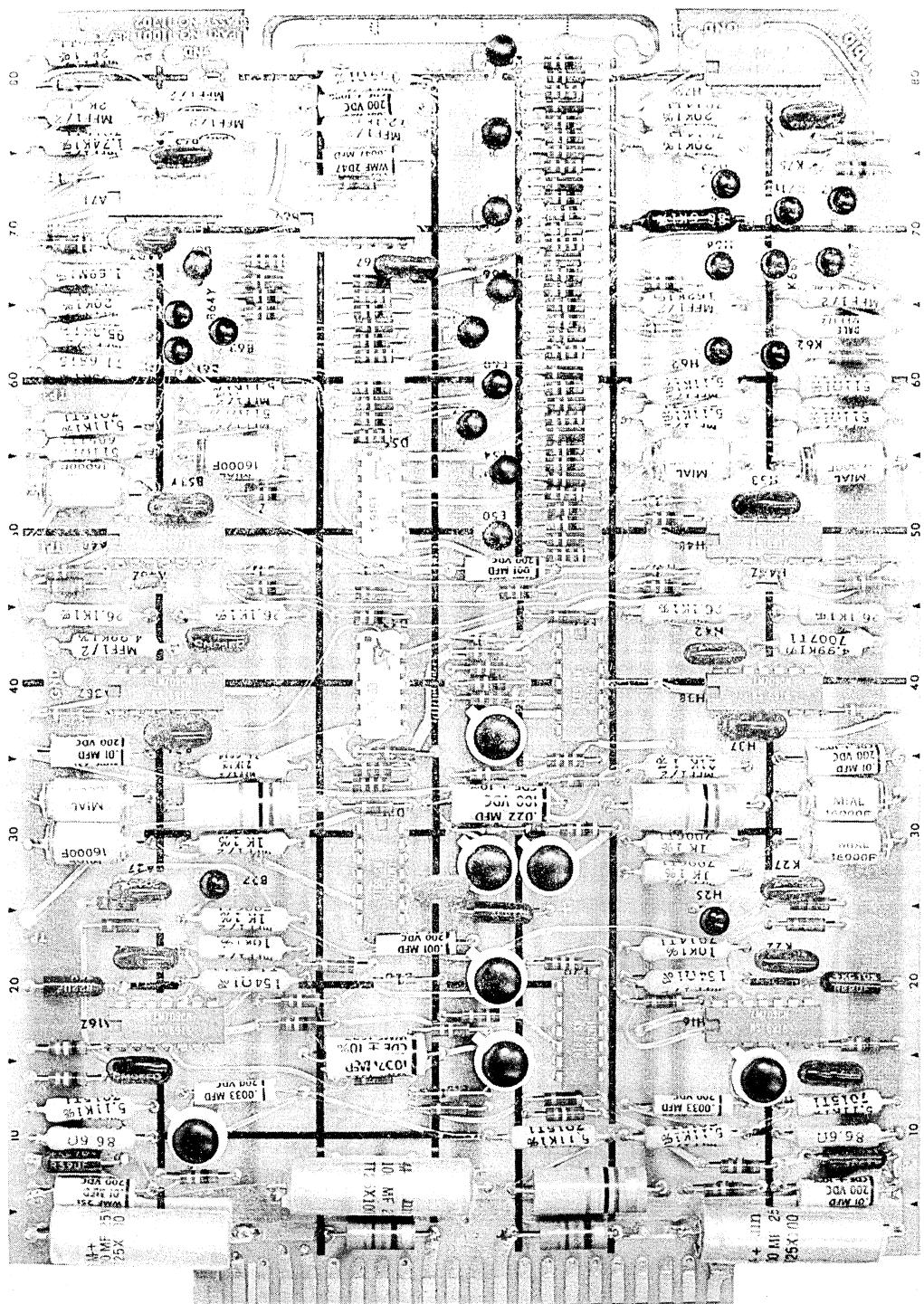


Figure 1-3. LAYOUT OF TYPICAL PLUGGABLE CIRCUIT CARD

## 1.6 OPERATION

The Model 31 has one switch and four indicator lights. The Model 33F has only one indicator light. A mechanical interlock flag on the Model 31 is visible and the door is locked whenever the power to the disk drive is off or an operation is in process which makes the opening of the door unsafe. The door on the Model 33F is latched shut.

The switch on the Model 31 is labelled "LOAD/RUN." In the LOAD position, when the LOAD light is on, the door is unlocked and a disk cartridge can be inserted. With a cartridge loaded, switching to the RUN position starts the disk rotating. The disk in the Model 33F will start to rotate when power is applied. It takes about one minute for completion of the start-up cycle. When the switch on the Model 31 is moved back to the LOAD position it should take about 10 seconds for the disk to stop rotating and the door to unlock. Switching to the LOAD position during a write operation results in garbling of data. It is the responsibility of the operator to insure that a write operation is not in process before transferring the switch to the LOAD position.

The white LOAD light on the Model 31 indicates that a cartridge can be loaded or unloaded. The yellow Ready light on the Model 31 indicates that the drive is ready to accept seek, read, or write commands. This light remains on during the seek, read, or write operation.

The orange Check light on the Model 31 indicates that a faulty write condition exists and all writing of data is inhibited.

The red Power light indicates a power on condition. This indicator is a backlit momentary contact pushbutton switch. When the Write Project option is installed on a Series 30 disk drive, the Power light is labelled Protect, and the switch is used to turn off this option.

## 1.7 Model 33F DIFFERENCES

The plexiglass door assembly is replaced with a black aluminum closure. The door lock mechanism is removed. The top cover of the drive and two manually operated latches retain the door closure. Cartridge receiver mechanism is unchanged from the Model 31 and accepts a 2315 or equivalent cartridge.

The LOAD/RUN switch and the LOAD, READY, and CHECK indicators are omitted. The front panel contains only the POWER/WRITE PROTECT pushbutton indicator.

The Track "0" microswitch assembly is omitted. The actuating lever for this microswitch is removed.

Pluggable circuit boards are completely interchangeable in either direction between the Model 31 and the Model 33F.

The Model 33F will always go through a start-up cycle when power is applied, and go through a cycle-down operation only when power is removed. It has the same protection

against line transients and other line disturbances as a Model 31. The circuitry on the heatsink assembly associated with the door lock solenoid is removed.

## 1.8 INPUT/OUTPUT CONSIDERATIONS

Definition of the Standard and optional input and output interface lines, as listed in Figure 1-4, are given in the following paragraphs. Signal polarity is 0 volt nominal for "true" and +5 volts nominal for "false."

### 1.8.1 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 five microseconds 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 five microseconds 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 microseconds or as late as 47.5 microseconds 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 microseconds.

**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 selects upper head, +5 volts nominal 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 microseconds 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 nanoseconds. Leading edge must have a transition time of not more than 50 nanoseconds. This line is held at nominal +5 volts when not writing.

**Figure 1-4. INTERFACE CONNECTOR PIN ASSIGNMENTS**

Signal Function	Pin	Signal Function	Pin
Track Address— bit 1 — bit 2 — bit 4 — bit 8 — bit 16 — bit 32 — bit 64 — bit 128	LL N RR J X FF T BB	Sector Mark Index Mark Sector Address— bit 1 — bit 2 — bit 4 — bit 8 — bit 16	W Y CC JJ KK MM UU S
Restore	VV	*Pseudo Sector-Mark	HH
Strobe	SS	Write Check	A
Head Select	AA	Read Clock	C
Write Gate	EE	Read Data	E
Write Data & Clock	B	Read Gate	L
*Write Protect Input	H	Select Line — Unit 1	R
*Write Protect Status Indication	P	— Unit 2	V
*Erase Gate	K	— Unit 3	Z
File Ready	U	— Unit 4	M
Ready to Seek, Read or Write	F	*High Density Indication	PP
Address Acknowledge	NN	**Daisy Chain Cable	D
*Logical Address Interlock	XX	Terminator, +5	DD
Seek Incomplete	TT	Ground	WW
		Ground	
		Ground	

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

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

**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.

### 1.8.2 Standard Output Lines

FILE READY — A 0 volt level on this line indicated that the disk drive 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 Start-up 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 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 microseconds 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 microseconds and a maximum width of 7.5 microseconds. 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 microseconds 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 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, 5 microsecond 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, 5 microsecond 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 microseconds 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 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 applied.

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 re-write 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 nanoseconds with a minimum of 50 nanoseconds and a maximum of 150 nanoseconds. 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 nanoseconds with a minimum of 50 nanoseconds and a maximum of 150 nanoseconds. The leading negative going edge must be used for reference.

**HIGH DENSITY INDICATION** — A 0 volt level of 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 five 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.

### 1.8.3 Optional Input Lines

**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.

**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 nanoseconds.

Write Protect is reset by the operator depressing the PROTECT switch. (See paragraph 1.6).

### 1.8.4 Optional Output Lines

**WRITE PROTECT STATUS** — A 0 volt nominal level indicates that the disk drive's write capability is inhibited. The operator can change the status manually by depressing the momentary action Protect pushbutton on the front panel thereby establishing the disk drive's write capability.

**ATTENTION LINE** — Four standard interface lines are reassigned with this option, these lines are listed below.

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 returns to +5 at the completion of the seek.

Completion of the seek 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 suppressed and a pulse corresponding to the Address Acknowledge pulse is presented on 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 description of option #046.

**INTERRUPT OPTION** — 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.

## **SECTION 2**

### **THEORY OF OPERATION**

#### **2.1 POWER OFF CONDITION**

With no power applied to the disk drive, the head load solenoid is de-energized, and the heads are held away from the disk surface. The heads are down only when disk speed is sufficient to allow the heads to fly properly.

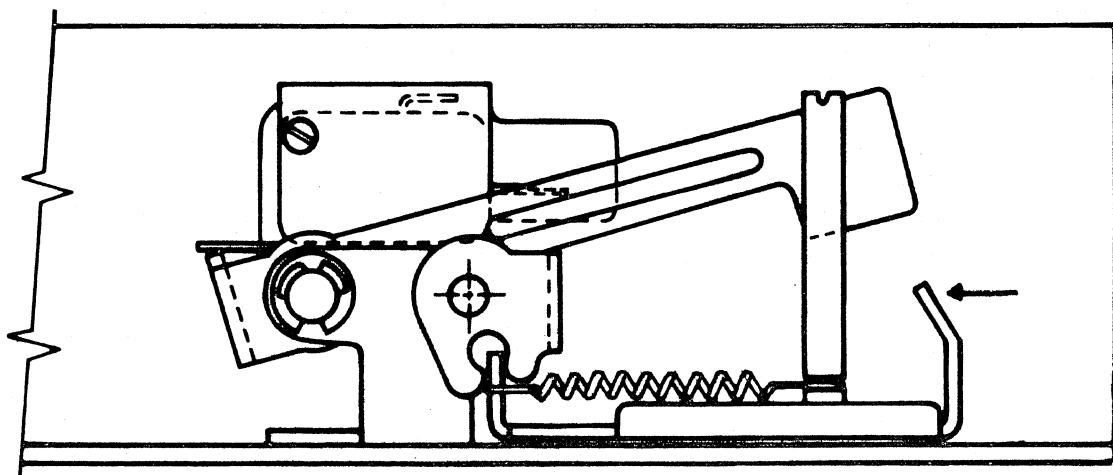
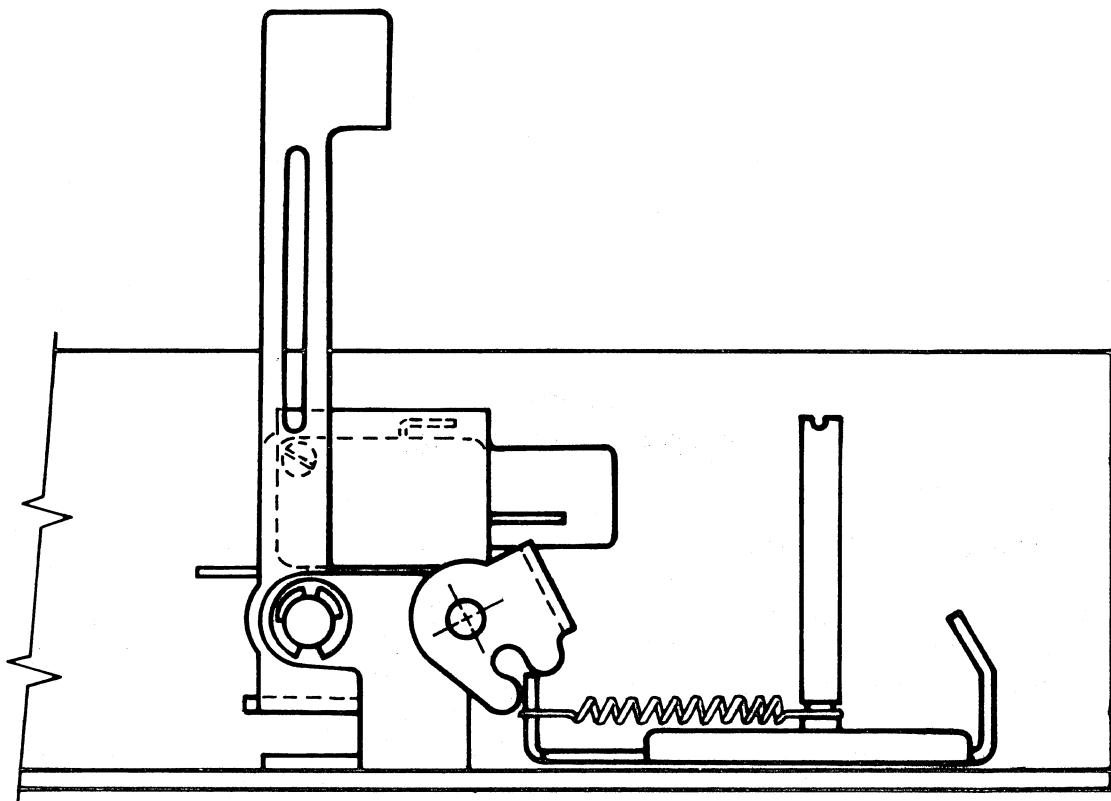
When power is removed from a disk drive, the heads could be left in a position other than at Cylinder "0." If the disk were to be removed under these conditions, the disk and/or heads could be damaged. To prevent this, the door on the Model 31 is locked whenever power is not applied. When power is applied, 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 rear-most 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 2-1.
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 down while removing or inserting a cartridge.

The top cover of the Model 33F must be removed and the latches, which prevent the door closure from opening, must be bypassed to load or replace the disk cartridge in the Model 33F.

**Caution:** Insure that power is off, disk rotation is stopped and the heads are retracted to the cylinder "0" location prior to opening the door closure of the Model 33F.



**Figure 2-1. DOOR LOCK MECHANISM**

A holding latch is located on each front side frame. The latch must be moved away from the frame to allow the cartridge raising arm to pass before the door closure can be opened.

## 2.2 POWER ON CONDITION (Load/Run Switch in Load)

The +5 volts for the disk drive is derived from the supplied +15 volts, see Schematic J8, Section 6. The regulating circuit uses a 4.3 volt zener diode as a voltage reference, and a 6.2 volt zener protects against overvoltage if the circuit should malfunction. The series pass transistor is located on the heat sink.

The externally supplied voltages (+15 and -15 volts DC) are monitored by circuits on the J8 board. If either voltage falls more than 10% below its rated value, a voltage error signal is generated. This signal goes to the J-9 and J-10 boards. On J-10 it causes the Write check indicator to light and a Write check output signal to be generated. The Write check FF is not set. The Start-Up delay circuit, on J-9, is activated, generating a load-run reset signal.

The 100 KHz crystal located on J-8 will start oscillating when power is supplied and 100 KHz square wave pulses will be provided to the "Two Phase Clock Generator" on the J-3 board (to be used in "Seek Command Sequence Logic") and to the J-9 board to be used in the spindle speed control circuit.

The 100 KHz square wave pulses are also divided by two by the flip/flop on J-9 and these derived 50 KHz pulses are used: 1) in the Speed Control circuits; 2) as Psuedo Sector Marks; 3) as input to the triangle waveform generator on the J-8 board, which drives the head position transducer.

## 2.3 INITIAL POWER-ON

A power-up reset on the J-9 board continues until 70 milliseconds after the end of any voltage error signal insuring that the supply voltages are within tolerance. This reset signal produces a Load-Run Reset. The Power-up Reset is taken through the J-8 board, relabeled Servohold, and directed to the J-2 and Servo Driver boards to prevent head motion during power-up transients.

The Servohold signal causes a Seek Incomplete status and an initial reset. The Address Register, the Subtractor, and the Difference Counter are set to the cylinder "0" status by the initial reset. The Seek Incomplete FF and the Servohold line inhibit any servo motion signals to be sent to the servo driver board. The falling edge of the Servohold signal causes a Restore, described in Section 2.5.

The door unlock solenoid on the Model 31 will be energized, to allow the door to be opened, only when the conditions listed below are true.

1. Heads unloaded and head carriage in cylinder "0" vicinity (carriage interlock switch closed).
2. Spindle rotation has stopped.

3. Load/Run switch in Load position.
4. Head in motion line from J2 P.C.B. in high state indicating no head motion.

## 2.4 LOAD/RUN RESET (See Schematic J-9)

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 state, resets the Write Check FF on J-10, sets the Write Protect FF if this option is installed, and causes a Restore operation.

## 2.5 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 2-2.

Refer to the timing chart Figure 2-3 and J-2 Schematic. The Initiate Restore pulse will cause the Restore One Shot: 16 ms to fire, causing its output to go low. This low output from the One Shot will Reset the Seek Incomplete flip/flop and the Seek flip/flop, and also set Restore F.F.1 and Restore F.F.2. Pseudo Motion is brought true by the loss of the Position Term.

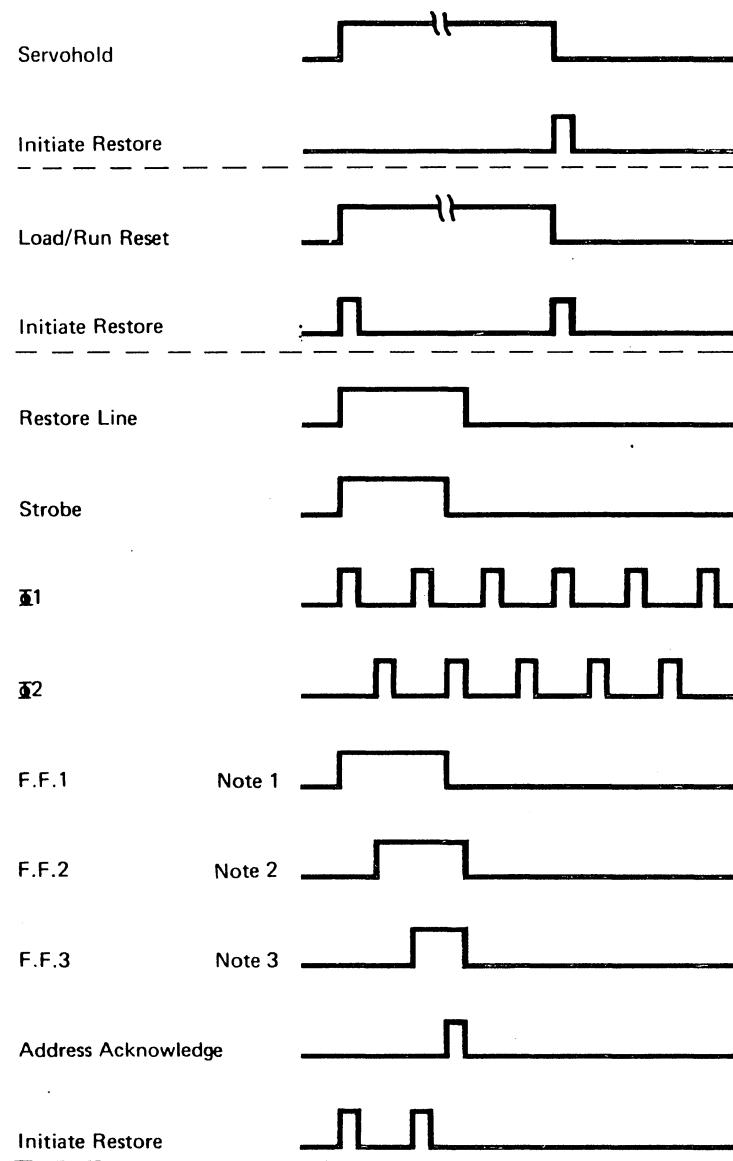
Restore F.F.1 causes the Address Register on the J-3 board and in turn the Difference Counter on the J-2 board to be set to the cylinder "0" state. This is accomplished by inhibiting the track address input gates on the J-3 board while the Address Register is being clocked. The output from the Subtractor, on the J-3 board, is all "1's" (high), without a carry, because of the inhibited track address input gates. The Subtractor output is gated into the Difference Counter on the J-2 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 high (position condition). Restore F.F.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.

Restore F.F.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. (See Track "0" stop adjustment, paragraph 5.4.4). The door remains locked during this operation because of the head in motion line from J-2.

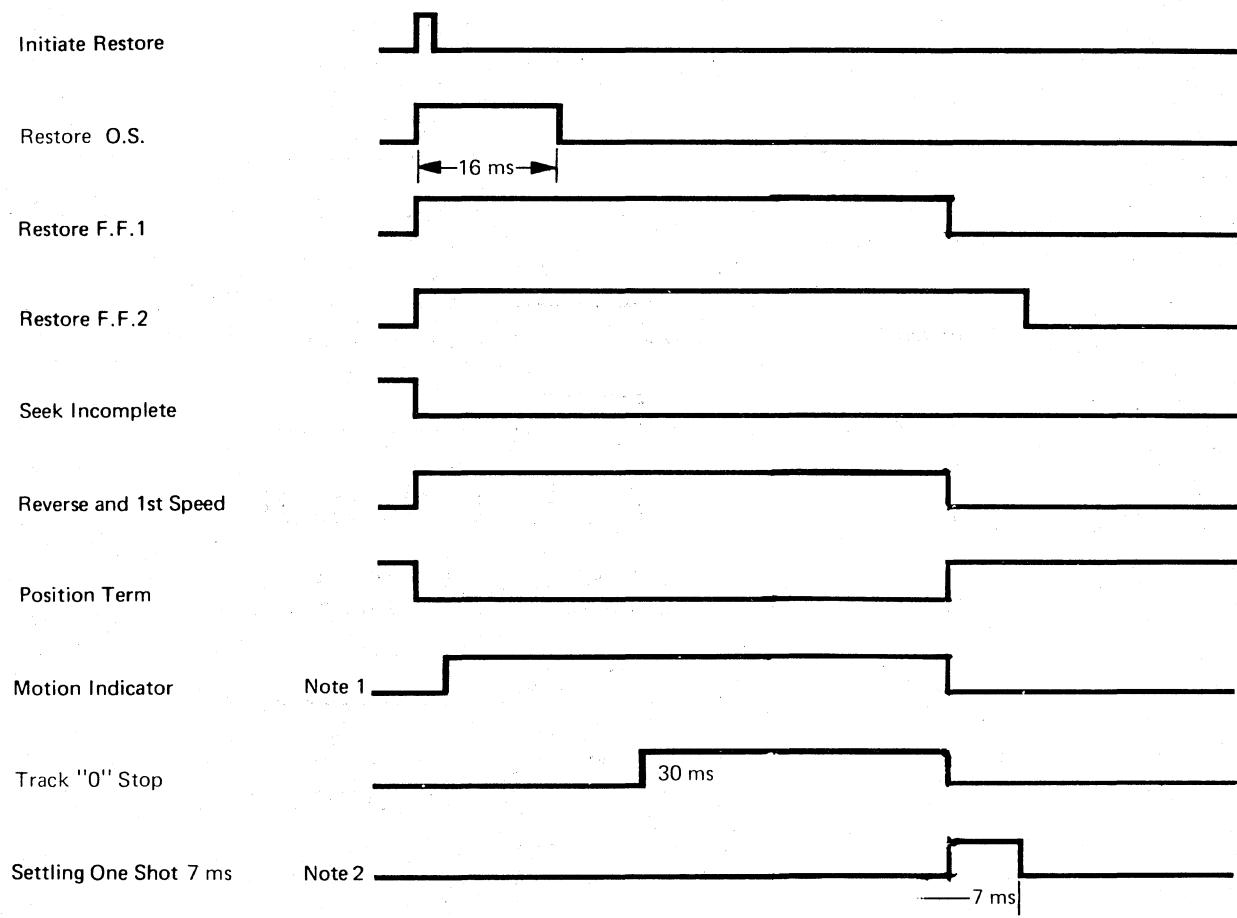
Lack of motion detected by J1 P.C.B., with Restore F.F.2 set causes Restore F.F.1 to be reset. With Restore F.F.1 reset the Settling O/S 7 ms is fired which clocks Restore F.F.2 completing the Restore Operation.



**Notes:**

1. Set with first  $\overline{Q}1$  after Strobe. Normally used to enable Address Register Gates on J3 board.
2. Set by first  $\overline{Q}2$  after F.F.1 set. Normally used to enable "Strobe Difference Counter", but this function is also set with Restore F.F.1- $\overline{Q}$  or Initial Reset.
3. Set by first  $\overline{Q}1$  after F.F.2 set. Normally used to provide "Address Acknowledge" and "Load Address"; however, "Load Address" function has been set with "Restore F.F.1- $\overline{Q}$  or "Initial Reset".

**Figure 2-2. INITIATE RESTORE TIMING CHART**



**Notes:**

1. Motion Indicator line high while head carriage moving toward Track "0" stop and for an additional 30 milliseconds.
2. Restore F.F.2 (and Seek F.F., not shown) is reset by Settling One Shop pulse thereby completing Restore operation.

**Figure 2-3. RESTORE OPERATION TIMING CHART**

## 2.6 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 2-4, Flow Chart Figure 2-5 and J-9 Schematic). Sequence of explanation:

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

The Load-Run Reset line will go low when the switch is placed into the Run position causing a Load-Run Reset (see paragraph 2.4).

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 J-9 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.

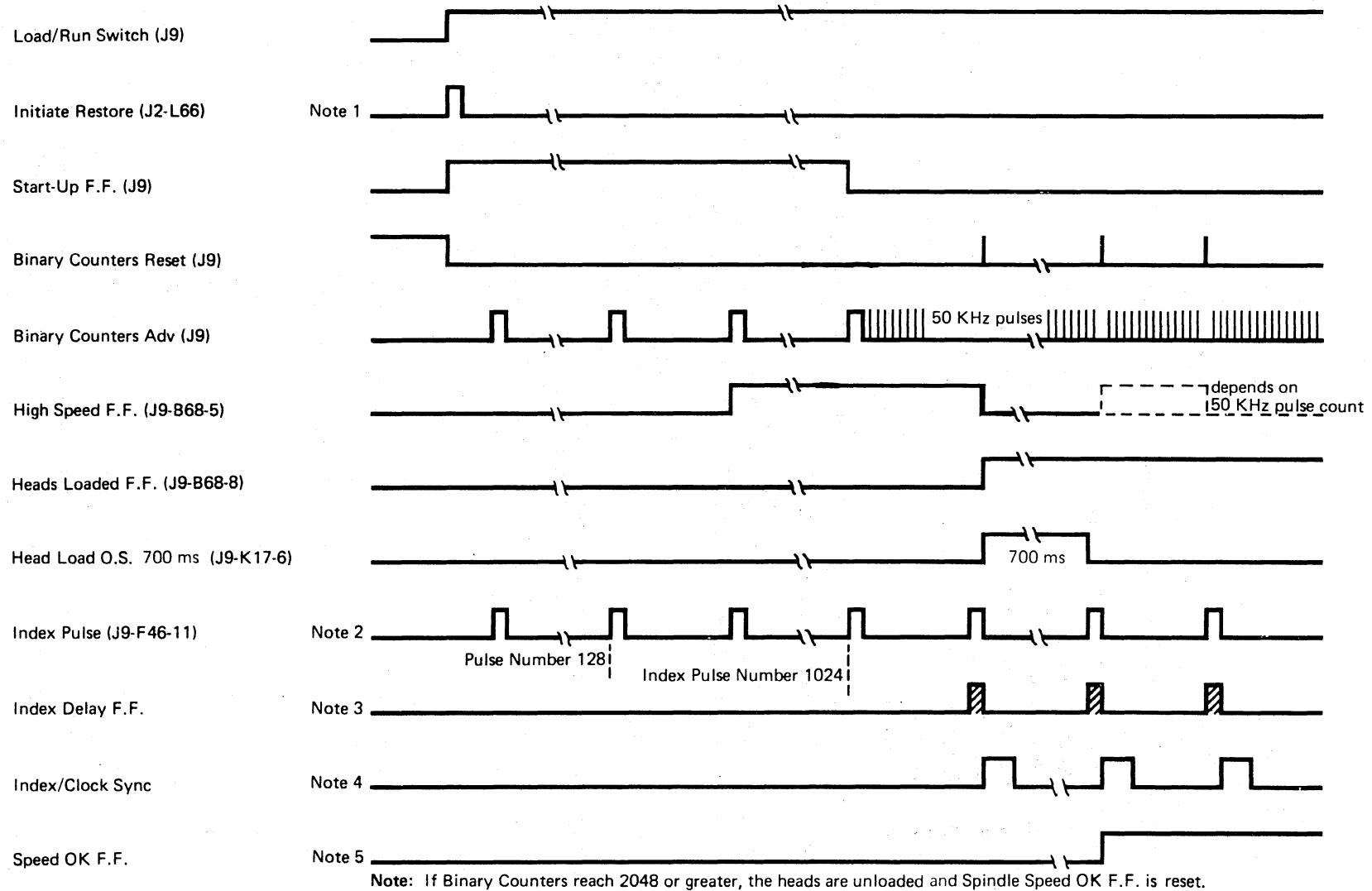
As the spindle rotates the Sector and Index marks are detected and amplified. The spindle motor will shortly reach sufficient RPM to cause separation of the Index mark from the Sector marks. Sector mark pulses are directed to the binary counter on J9.

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 OS, and supplying holding current to the head load solenoid. When the disk speed falls below 1500 RPM the High

Figure 2-4. 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 F.F. set with 1st Index Pulse after fall of Start-Up F.F. and reset with 1st 100 KHz pulse after set of Index/Clock Sync F.F. (variable width 5 to 20  $\mu$ s).
4. Index/Clock Sync F.F. set with 1st 50 KHz pulse after set of Index Delay F.F. reset with 1st 50 KHz pulse after reset of Index Delay F.F. (set for 20  $\mu$ sec).
  - a) Used to strobe binary counter output, reset binary counters, set High Speed F.F. set Speed OK F.F.
5. Set 1st Time Binary Counters (Notes 1, 2 & 3) are greater than 1999 between Index Pulses with Head Loaded F.F. Set.

START-UP SEQUENCE (Board J9)

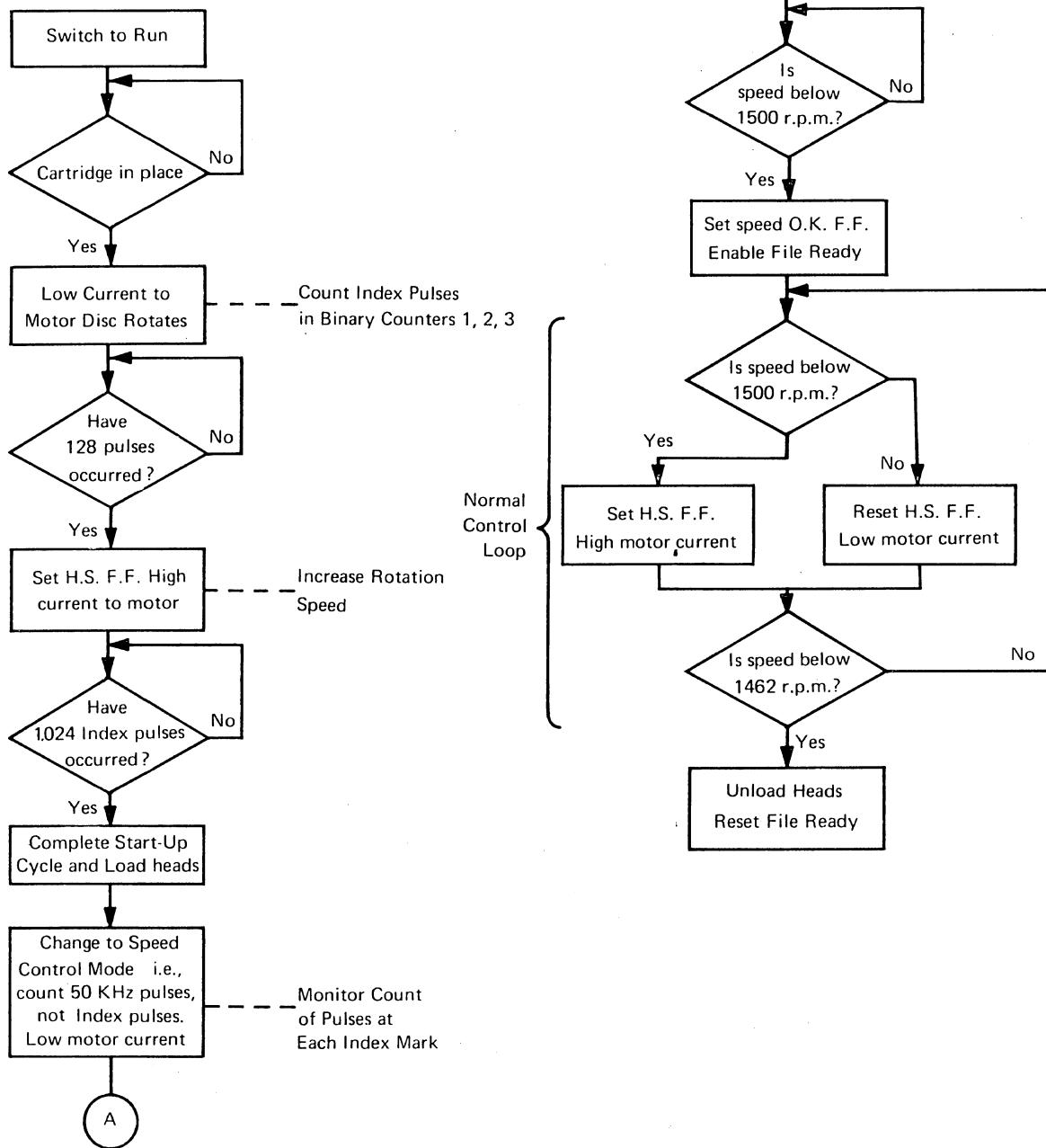


Figure 2-5. START-UP FLOW CHART

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 F.F. 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.

## 2.7 SERVO OPERATION

Figure 2-6 shows a general servo system. Polarity and amplitude of motor current is determined by the difference between the Reference Voltage and the Feedback Voltage.

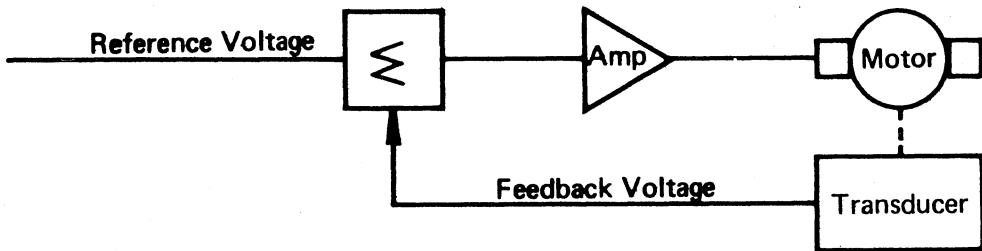


Figure 2-6. GENERAL SERVO SYSTEM

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 2-7a, which after demodulation, results in the position signal shown on Figure 2-7b, constant velocity assumed.

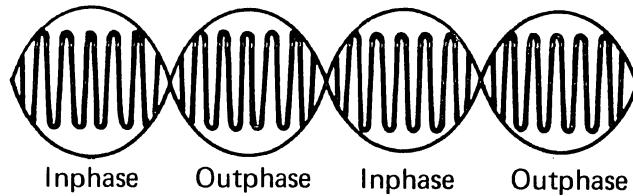


Figure 2-7a TRANSDUCER SIGNAL ENVELOPE (MODULATED)

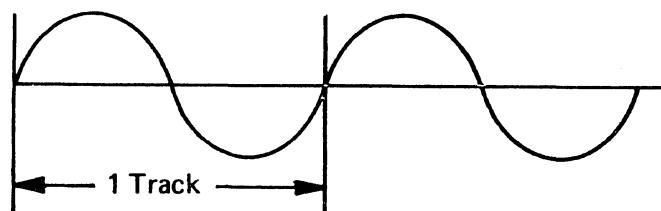


Figure 2-7b. TRANSDUCER SIGNAL (DEMODULATED)

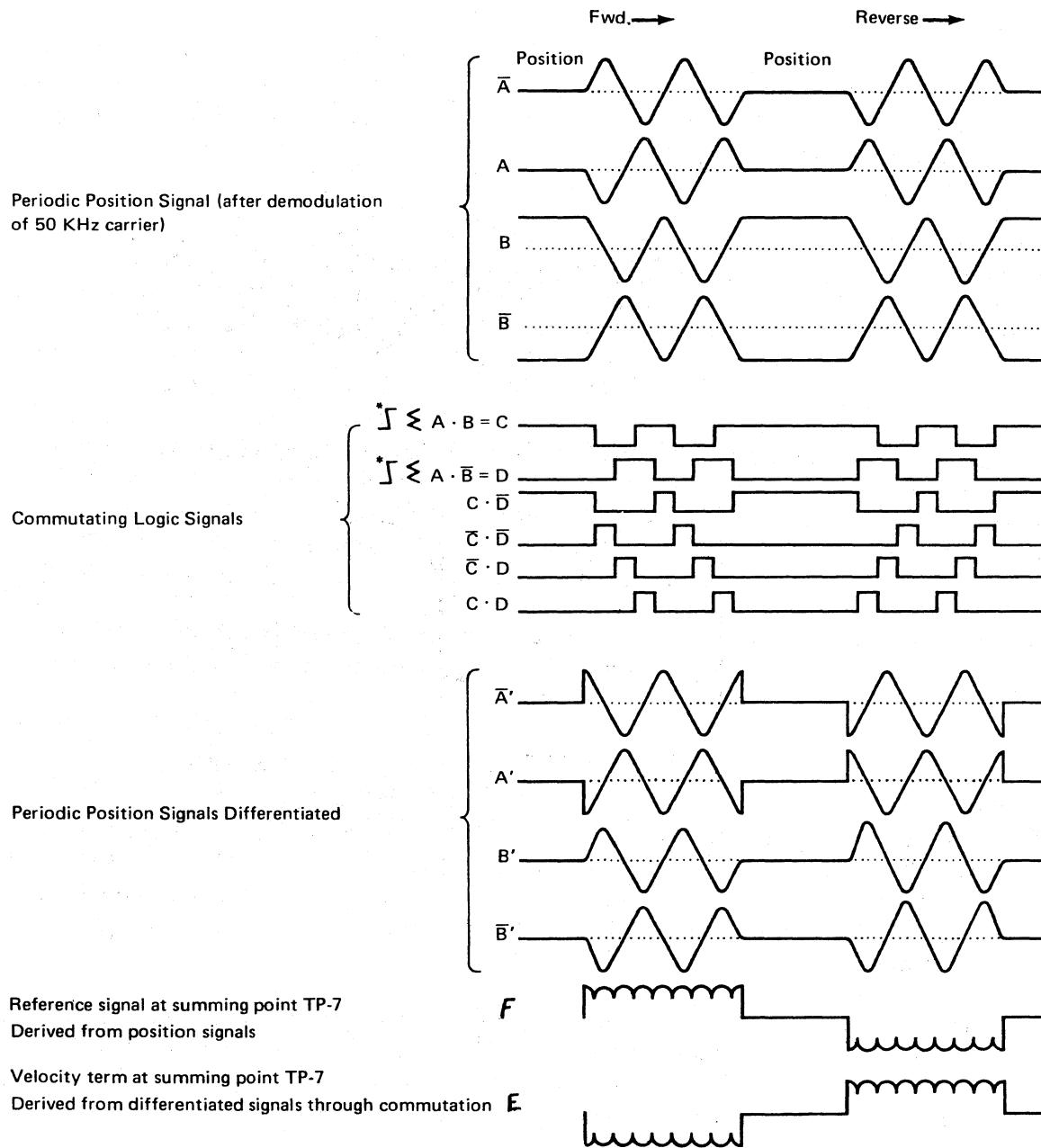
Figure 2-8 shows position signals "A" and "B" together with the inverted sine waves " $\bar{A}$ " and " $\bar{B}$ ." These four signals are differentiated (by C-R networks) and fed to a summing point via four commutator F.E.T.'s. The four differentiated waveforms are also shown in Figure 2-8 and have 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 2-8 where:

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

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 2-8. This reference is derived from the position signals and is therefore independent of velocity. (See circuit diagram for J1 P.C.B.).

When carrying out a Seek Operation the Position term F.E.T. is switched off and, depending on direction, either the two forward or the reverse F.E.T. is switched on. The velocity of the carriage is controlled by the speed increment terms which are gated into the summing point via three F.E.T.'s. These F.E.T.'s are directly controlled by the output



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

**Figure 2-8. POSITION TRANSDUCER SIGNALS TIMING RELATIONSHIP ONLY**

of the Difference Counter. The first speed increment has maximum attenuation and is active whenever a directional F.E.T. is on. The second, third, and fourth speed increment F.E.T.'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 2-9 is observed.

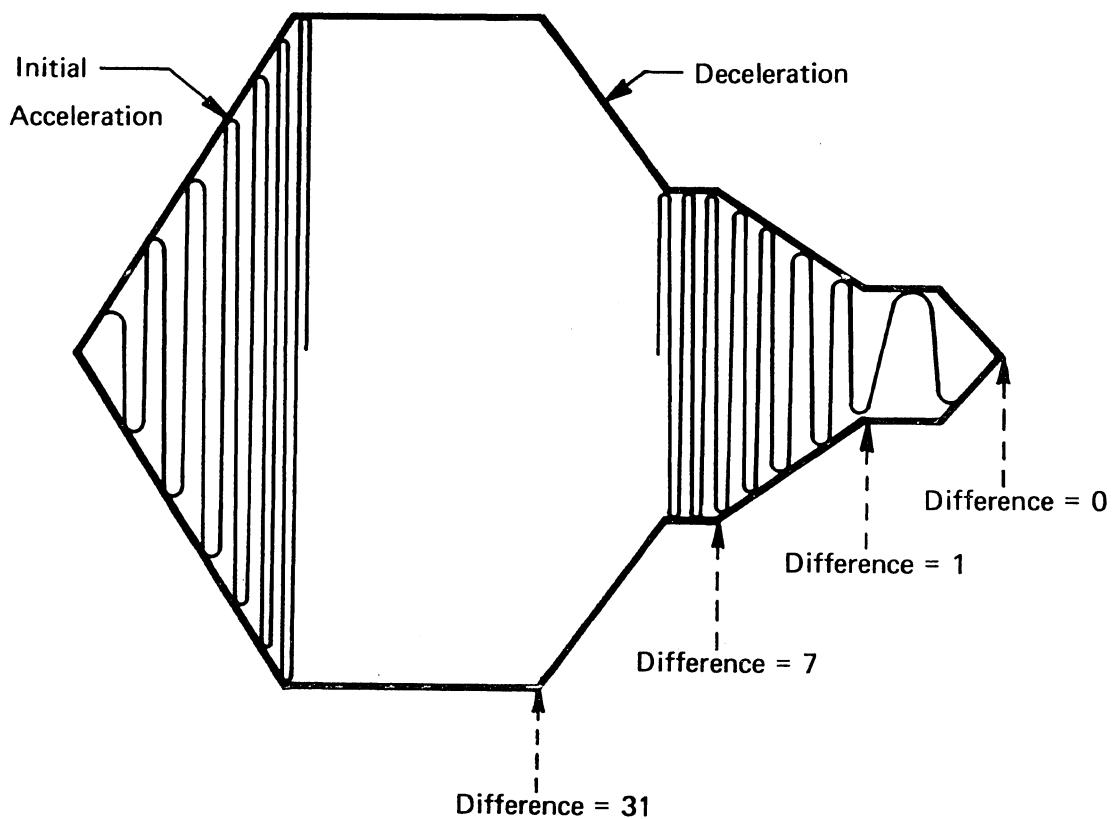


Figure 2-9. DIFFERENTIATED WAVEFORM (J1-TP3)

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 F.E.T. 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 non-zero which creates a force to the motor placing it back on its null.

The remaining circuit on the J1 P.C.B. 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.

## 2.8 SEEK OPERATION (See Figures 2-10 and 2-11, Schematics J1, J2 and J3)

Sequence of explanation:

1. Start Seek
2. Sequence F.F.1
3. Sequence F.F.2
4. Head Movement
5. Sequence F.F.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  $\overline{\Phi}$  1 and 2 pulses from the two phase clock generator (J3 schematic), are derived from the 100 KHz clock.

Sequence F.F.1, on J3, is set with the first  $\overline{\Phi}$  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 F.F.2, on J3, is set with the first  $\overline{\Phi}$  2 after F.F.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 F.F., on J2, which causes the head carriage to move under control of the Servo circuits.

Loss of Position term enables head movement and Pseudo Motion Injection. The Seek F.F. is set with position term false and motion, as long as Restore F.F.1 is reset. The Seek F.F. places the Ready for Address and the Ready to Seek, Read/Write lines false.

Sequence F.F.3 is set with the  $\overline{\Phi}$  1 following the set of F.F.2. The next  $\overline{\Phi}$  2 pulse will reset F.F.1, enable Address Acknowledge Interface line (or logical Address Interlock) and load the Address Register with the new address. F.F.2 and F.F.3 are reset at the fall of this  $\overline{\Phi}$  2.

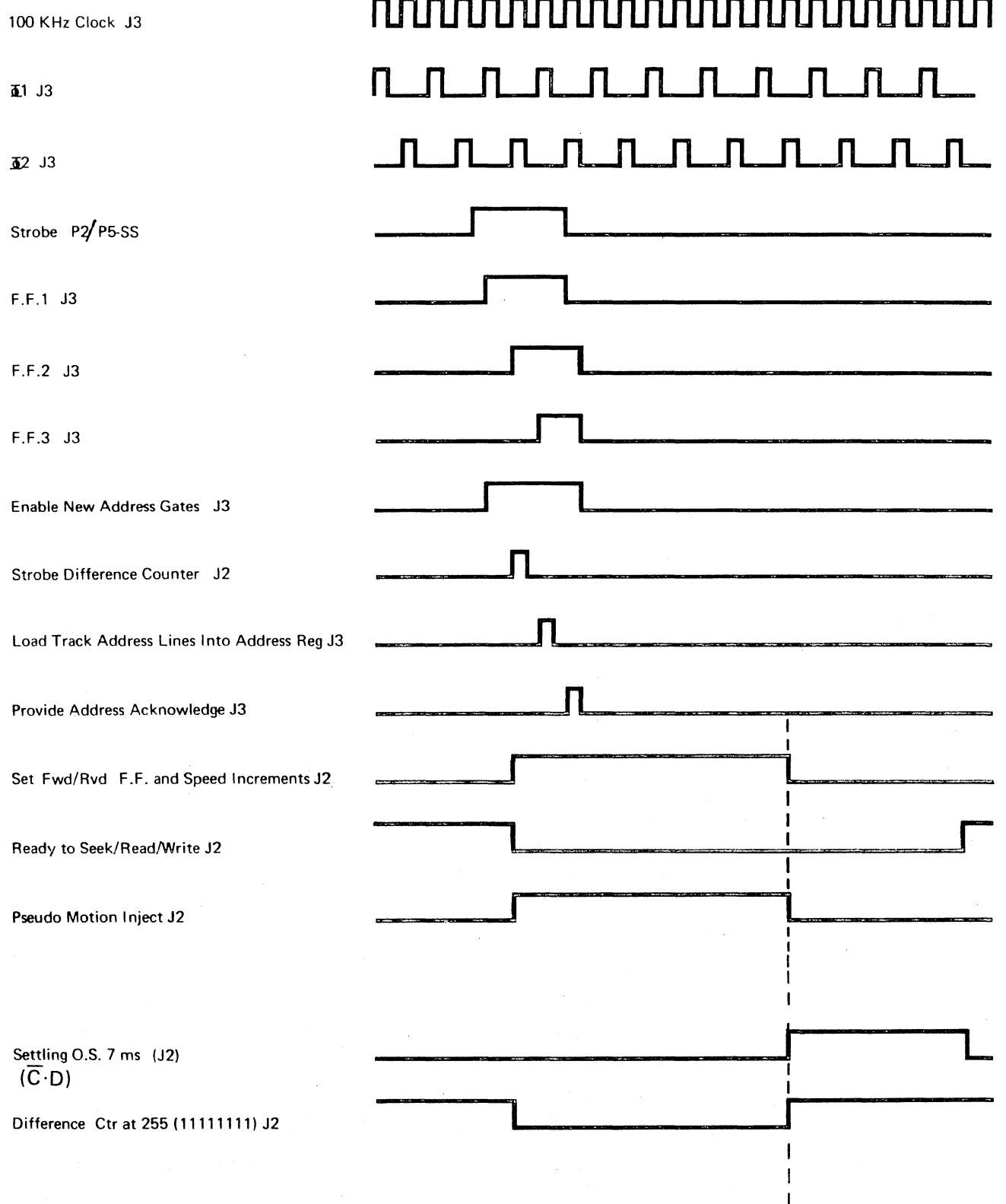
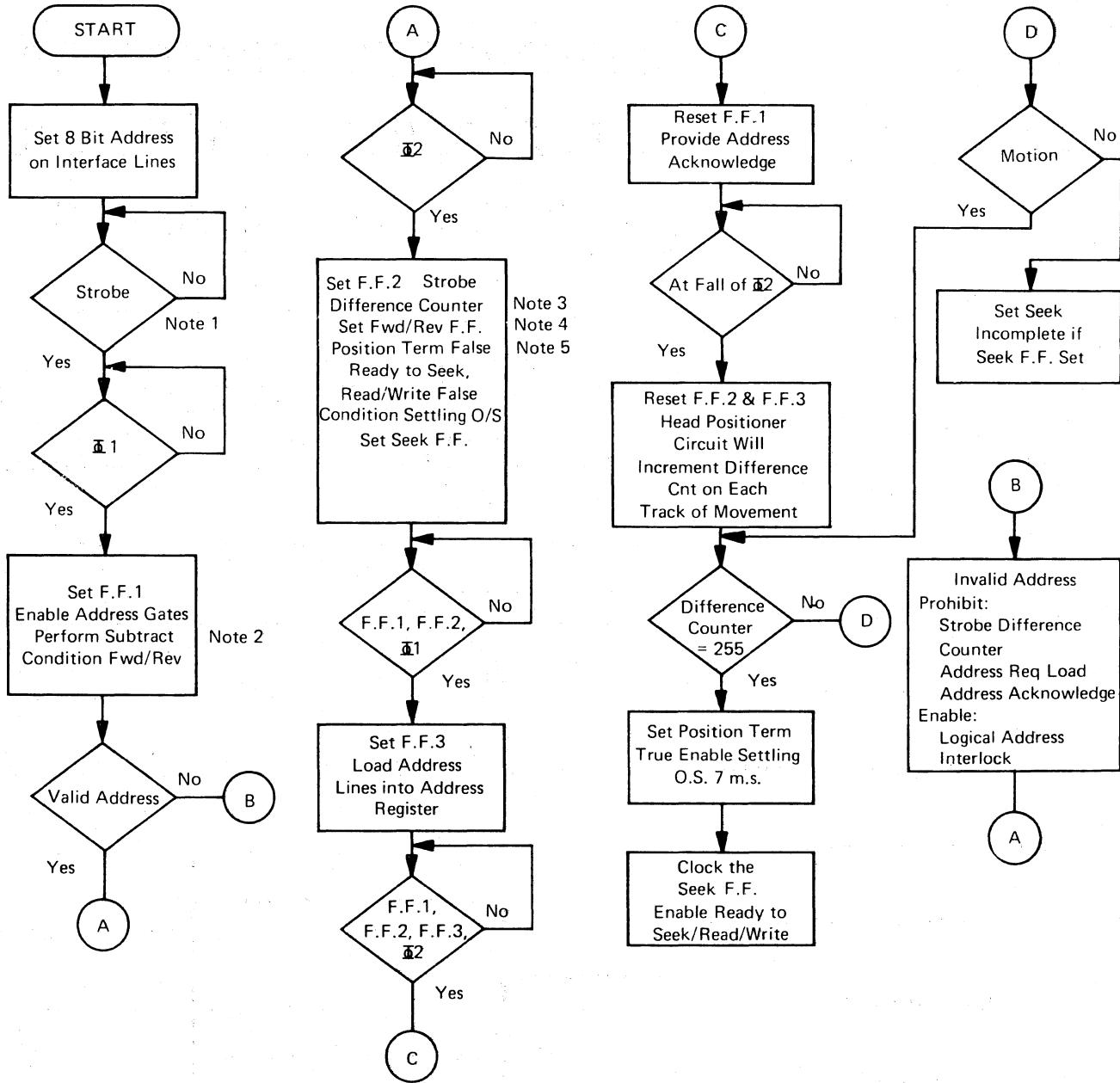


Figure 2-10. SEEK OPERATION TIMING CHART



## Notes:

1. Strobe ignored if Ready for Address is false – If Restore is True when Strobe is applied, the Restore sequence will be executed, status of Ready for Address is ignored for Strobe of Restore command.
  2. Binary subtract ( $A + \bar{B} = E$ ) carry is used.
  3. Output of Difference Counter when in Ready for Address = 11111111. Speed increment determined by distance to be traveled.
  4. Fwd set by carry from high order position.
  5. Pseudo motion injection provided to prevent false set of Seek Incomplete while Head Positioner is getting into motion.

**Figure 2-11. SEEK OPERATION FLOW CHART**

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  $\overline{C}$ " and "Servo Logic Control  $\overline{D}$ ." 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, Pseudo Motion Injection is set false and the Settling One Shot is allowed to trigger. The Settling One Shot pulse will clock the Seek F.F. 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 F.F. is set, the Seek Incomplete F.F. is set.

## 2.9 READ/WRITE OPERATION (See Schematic J10)

### Head Select

Head selection is based on a three level principle, with one head always selected. The not selected head is at approximately -1V. The center top of the selected head, with write gate false, sits at approximately +1 volt. When write gate is true the center top of the selected head is at approximately +14.0 volts.

### Write

The incoming Data and Clock pulses are fed to the Write F.F. so that Data and Clock pulses become head current transitions. The Q and  $\overline{Q}$  outputs of the Write F.F. 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 +14 volts.

### Erase

When the Erase gate is true, through the Erase interface face 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  $100 \pm 50$  nanoseconds, 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 read triggers the Data Separation One-Shot which is set at 900 nanoseconds (970 nanoseconds at 720 KHz). The Data Separation F.F. 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 occurring 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. Voltage supplied is down to a nominal 13.5 volts.
2. Write Current without Write Gate
3. Write Gate and no Write Current
4. Write Current through both heads
5. Erase Current without Erase Gate
6. Erase Gate and no Write Current
7. Erase Current through both heads

A Load-Run Reset, is required to reset the Write Check F.F. All functions are disabled while the Write Check F.F. is set.

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

#### **2.10 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 JR Schematic.

**Note:** Early production, unmodified, machines maybe equipped with a four position counter.

#### **2.11 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. See the "Series 30 Product Description" Diablo form D3031-670 for additional information on termination.

## 2.12 OPTIONAL FEATURES

### **Write Protect**

All write functions are disabled when Write Protect is true. When this option is installed the "Power" lamp on the front bezel is re-labeled "Protect." On initial Start-up the drive will come up in the Write Protected state. A switch, which is an integral part of the "Protect" lamp, is the only means of clearing the "Protect." The operator may place the Model 31 drive into a protected state by transferring the Load/Run switch from "Run" to "Load" and back to "Run." The interface has "Write Protect Input" and "Write Protect Status" lines added with this option. The controller may also place a Series 30 Disk Drive into the protected state with the "Write Protect Input" line.

### **Erase Gate**

In particular applications it may be desirable to have separate control over the Erase Gate and the Write Gate, thereby allowing a shorter guard zone in each sector record. The Erase Gate option provides one line for Erase Gate and a separate line for Write Gate, the controller now may turn on the Write Gate and the Erase Gate at the same nominal position on the disk and increase the capacity of each sector by a nominal 60  $\mu$ s.

**Note:** With the high density option the distance between the Write coil and tunnel erase coils is decreased. The capacity of the sector may therefore be increased by a nominal 20  $\mu$ s.

### **Density Options**

The Standard density for a Series 30 Disk Drive is 1100 BPI, a 781 KHz transfer rate. This is the industry standard for the IBM 2311 type disk drive. A deviation from the standard density, to allow compatibility with the IBM 2310 disk drive, used with the IBM 1130 and 1800 systems, is a no charge option. The 2310 has a density of 1024 BPI, a 720 KHz transfer rate. The change from 1100 BPI to 1024 BPI involves different values in the Data Separation circuit on the J10 board.

The High density option allows for 2048 or 2200 BPI (twice the lower density and transfer rates). The 2200 BPI density is the industry standard for the IBM 2314 disk drives. The High density machine has 2200 BPI Read/Write heads, a different spindle, a J10 card that differs from the standard machine, and uses a different disk in the 2315 cartridge.

### **Attention Line and Interrupt Options**

These options are described in paragraph 1.8.4 of this manual. Jumpers are added or removed on the J2, J3, J10, and motherboard to accomodate these options.



## **SECTION 3**

### **PREVENTIVE MAINTENANCE**

#### **3.1 APPROACH TO PREVENTIVE MAINTENANCE**

Preventive Maintenance 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.

#### **3.2 VISUAL INSPECTION**

Visually inspect the machine. Look for corrosion, dirt, wear, cracks, binds, loose wiring connections, and loose hardware. Noticing these items and taking the appropriate action may minimize unavailable time.

#### **3.3 CLEAN**

Cleanliness is important in disk storage machines. The clearance between the head and the disk is in microinches and requires special attention. Very small particles of dust may accumulate between the heads and the disk. An accumulation of dust in this area could cause damage to the disk surface or head and result in an unusable track or a damaged head.

#### **3.4 PREVENTIVE MAINTENANCE PROCEDURES**

When operating in a normal office environment on a one-shift basis, preventive maintenance is to be performed at six month intervals, 1000 operating hours. Excessive cartridge loading may require a more frequent schedule. The motor brushes do not require preventive maintenance action. Figure 3-1 indicates the area that should receive preventive maintenance and the action to be performed.

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 if their color is white.
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 3-1. PREVENTIVE MAINTENANCE ACTION – 6 MONTH INTERVAL**

#### **Head Cleaning**

Clean heads with 91% isopropyl alcohol (or equivalent) using a lint free wiper to remove any alcohol residue. Complete removal of contamination, including fingerprints, is mandatory.

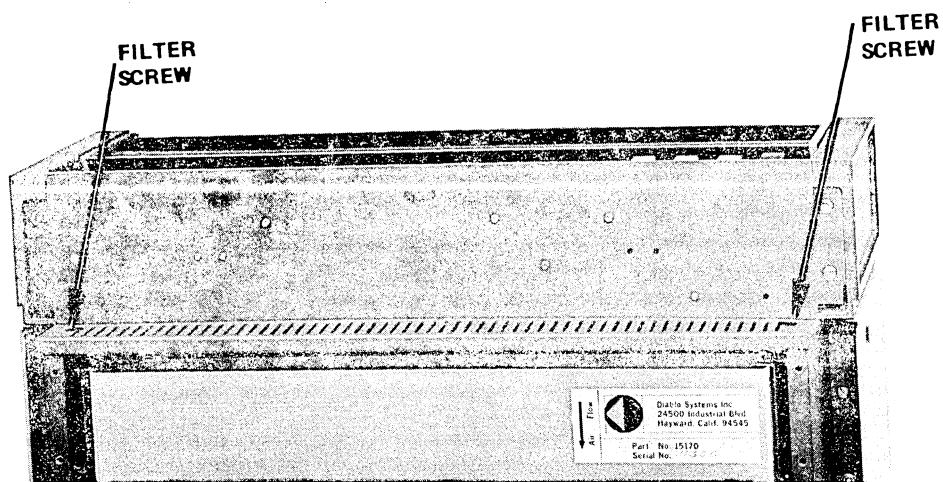
#### **Air Filter Replacement**

The air filter located beneath the cartridge door on the bottom of the machine, see figure 3-2. To replace the filter follow the procedure listed below:

1. Loosen the two filter screws and lift out filter element.
2. Install a new element (Diablo Part No. 15170), making sure that its orientation agrees with the air flow direction arrow shown on the filter element.
3. Tighten the filter screws.

#### **Lubrication**

Apply two drops of oil (Diablo Part No. 70243) to each of the two lubricating wicks, if their color is white, these wicks are shown in figure 5-2.



### **Figure 3-2. AIR FILTER REPLACEMENT**



## **SECTION 4**

### **DIAGNOSTIC TECHNIQUES**

#### **4.1 ERROR ANALYSIS**

The modular design of the Series 30 disk drives allows for easy exchange of suspected subassemblies. Refer to the Series 30 interconnection diagram Figure 6-1.

If the head positioner is erratic in operation, the problem is most likely due to a defective component in the J1 P.C.B.

Addressing errors or Restore failures are probably due to a failure in the J2 or J3 board.

All Data handling electronics are in the J10 board. A failure in data would normally be caused by a faulty component in the J10 board, the Read/Write heads, the head cable, or by the disk.

The functions contained in the J8 and J9 board are shown in the Series 30 interconnection diagram. Here again, P.C.B. replacement should resolve any problem.

There are a number of Power Transistors located on the Heatsink assembly. These power transistors are used in solenoid and motor drive circuits. The power transistor circuits for the Model 31 are shown in Figure 6-9, the door lock solenoid circuitry is not installed in the Model 33F.

#### **4.2 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 occurring on one disk when used on various disk drives.
2. Errors occurring in several disk drives attached to a particular control unit.
3. Errors occurring on many disk cartridges written on one disk drive.

A read error may have been created when the data was written. Therefore, a system of disk identification and data collection is encouraged.

#### **4.3 VISUAL ANALYSIS**

Inspect the disk cartridge, disk, and disk drive for dirt or clumps of oxide when data handling problems occur. Dirt or oxide particles can usually be removed by wiping the area with a clean, lint free cloth 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 problems. It is much better to replace a defective disk cartridge than attempting to use it in another drive, which may cause further problems.

#### **4.4 FIELD SERVICE AIDS**

Insert Field Service Aids for the Series 30 in this section of the manual. These service aids are prepared and distributed by Diablo's Customer Service Department.

## **SECTION 5**

### **REMOVALS, ADJUSTMENTS AND CHECKS**

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.

#### **5.1 ELECTRONIC ASSEMBLY**

Electronic Assembly, consisting of pluggable circuit cards, motherboard, and Heatsink assembly. There are no potentiometers or adjustments in the electronic assembly.

##### **Pluggable Circuit Boards**

Pluggable circuit boards are held in location by a spring loaded card retainer. For P.C.B. removal the retainer should be raised no higher than  $\frac{3}{4}$ " above the P.C.B. If the retainer is raised too high the rear tip could drop too far into its pivot point and be bent when released. There are no adjustments or switches on the P.C.B.'s.

Each P.C.B. is keyed to prevent incorrect insertion of the P.C.B. The extender board does not have these keys. Use extreme care when inserting a P.C.B.

##### **Motherboard and Heatsink Assembly**

The Motherboard and Heatsink assembly is easily removed as one unit. Perform steps 1 through 5 to obtain full access to all components mounted on the Heatsink assembly.

1. Remove the two sets of twisted pair wire from the motherboard to the head positioner transducer at the transducer.
2. Remove the two head positioner motor wires, white wire at motherboard. yellow wire at Heatsink.
3. Remove P3, P6, P7 and read/write head lead plug.
  - a. P3 and P6 (one connector) is located below P.C.B. J9.
  - b. The rear bottom cover must be removed to release P7 — Necessary only if the assembly is to be removed.
  - c. Read/Write head lead plug is on P.C.B. J10.

4. Remove the eight bolts holding the bottom of the Heatsink to the shadow box. (Two bolts on each side and four on the rear of the Heatsink).
5. Remove the four bolts holding the Heatsink to the H frame (two bolts on each side). The motherboard and Heatsink assembly is now unsupported and may be placed flat behind the Model 31.
6. To remove the Motherboard and Heatsink, remove the bolt holding the ground strap between the Heatsink and the head positioner at the positioner.
7. Replace in reverse order.
8. No adjustments required.

#### **Motherboard: Heatsink Separation**

1. Remove the power flex cable between the motherboard and heatsink by removing the cover on the rear of the motherboard, the rod interconnecting the motherboard pivot arms, the power plug (P1) and the flex cable connections on the motherboard.
2. Slide motherboard out of heatsink.
3. Assemble in reverse order.
4. No adjustment required.

### **5.2 CARTRIDGE RECEIVER – Removal and Adjustment**

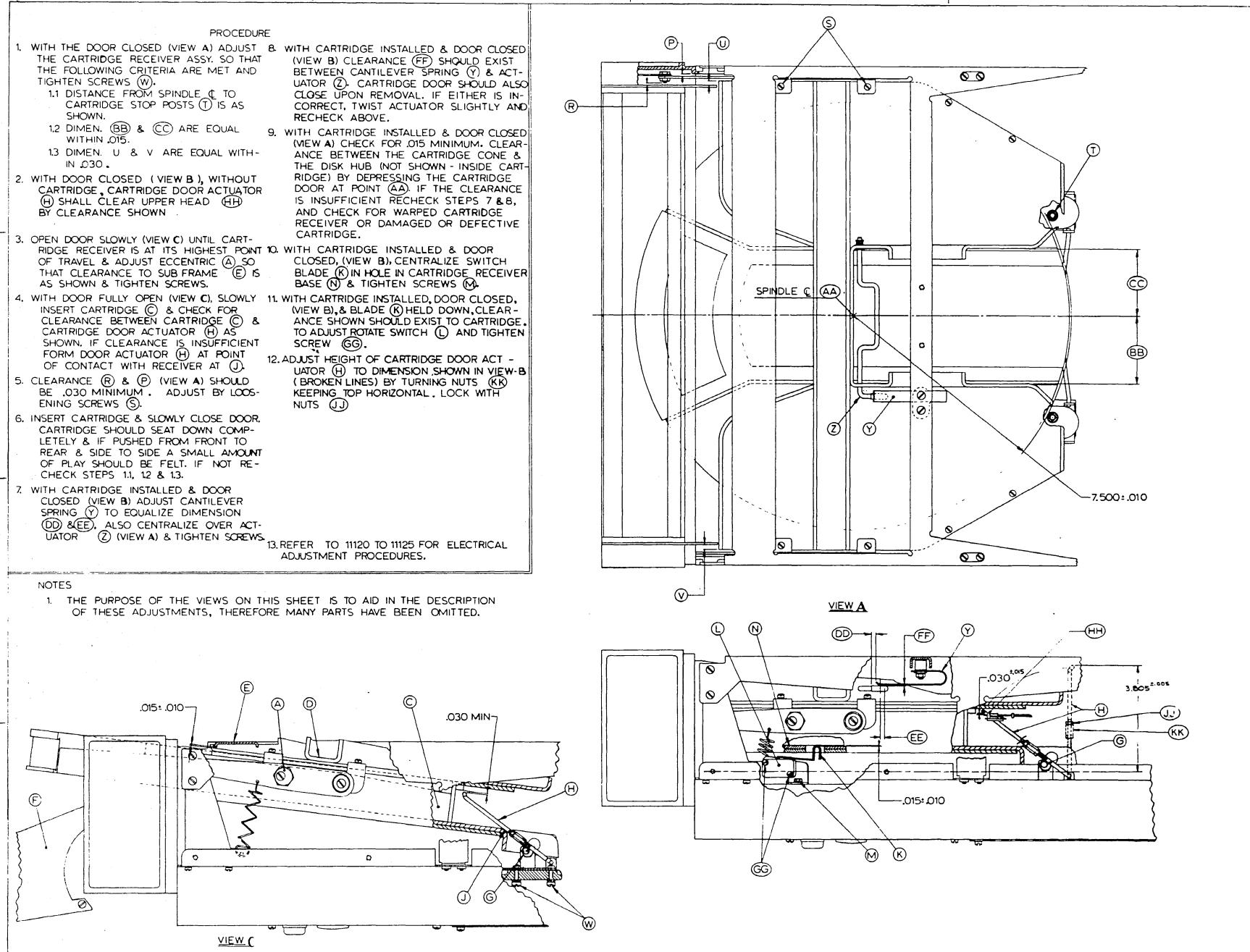
1. Remove the six bolts holding the H frame to the frame and remove H frame.
2. Remove the two bolts indicated as A and D in figure 5-1 on each side of the cartridge receiver assembly.
3. Remove the four bolts indicated as W in figure 5-1, holding the front of the cartridge receiver to the main base assembly.
  - a. The rear bottom cover must be removed to gain access to these bolts.
  - b. Two bolts on each side of receiver.
4. Open the door, remove the cartridge receiver.
5. Assemble in reverse order.
6. Adjustment procedure provided on Figure 5-1.

### **5.3 SECTOR TRANSDUCER – Removal and Adjustment**

1. Remove cartridge receiver to expose sector transducer (see paragraph 5.2).
2. Unsolder the two cable wires at the sector transducer.
3. Remove the two bolts holding the transducer to the base assembly and remove transducer.
  - a. The air filter must be removed to gain access to these bolts.
4. Assemble in reverse order.
5. Adjustment procedure. Locate transducer for  $0.592'' \pm .003''$  from centerline of dowel pins to front edge of transducer magnet and for  $1.286'' \pm 0.018''$  from base of machine to base of transducer.

**Note:** Head positioner, Read/Write head, Cartridge receiver and base adjustments are assumed to be correct.

**Figure 5-1. CARTRIDGE RECEIVER AND BASE ADJUSTMENTS**



- a. Install proper C.E. pack and start machine. Machine must be in ready status before proceeding.
- b. Trigger oscilloscope from leading edge of Index Mark. This is the negative going edge of pulse at TP6 of J9.
- c. Position Read/Write heads over pre-recorded track 95. On machines with high density option use track 100.
- d. Observe signal at TP2 of J10. Note the isolated pulse followed by a burst of pulses.
- e. See Figure 5-4 View D, adjust sector transducer by means of screw M to position the first peak of the isolated pulse 30 microseconds after the beginning of the sweep. Increase sweep rate to 5 microseconds per division for maximum resolution. Access to screw M is obtained by inserting a long shank  $\frac{1}{4}$ " tip screw driver through the hole located on the front right hand side of the drive.  
**Note:** With the I/O connector removed the lower head is selected. The above adjustment sets the relationship of the selected head to the Index and Sector Mark pulses.
- f. Alternately selecting each of the two heads, adjust the sector transducer to locate the isolated pulse (first peak) symmetrically around the 30 microsecond point. Their separation must remain less than 10 microseconds.  
**Note:** Ground pin 5 of J10 to select upper head.
- g. The adjustment screw is self locking.

## 5.4 HEAD POSITIONER ASSEMBLY

1. Remove Read/Write head lead plug at P.C.B. J10, the two sets of twisted pair wire at the positioner transducer, the two positioner motor wires, white on motherboard, yellow on heatsink, and P8 (located at primary of rotary transformer).
2. Remove the three bolts holding the head positioner to the main base frame.  
**Note:** The rear bottom must be removed to obtain access to these bolts.
3. With the motherboard in the service position the head positioner may be removed.
4. Assemble in reverse order.
5. Adjustments.
  - a. See Figure 5-2 for adjustments within the head positioner, these adjustments are **not** normally performed in the field, included for reference only.
  - b. See Figure 5-3 for head positioner to base and head positioner Mechanical alignment.

### 5.4.1 Cylinder Pointer adjustment — Figure 5-3, 5-4

1. Install tool 15172 in either head position on the head carriage, butted against the back plate, refer to Figure 5-3.
2. Place tool 15171 on spindle cone, flat portion of tool away from tool 15172.
3. Move carriage as far from the spindle as possible, until tool 15172 is butted against round portion of tool 15171.

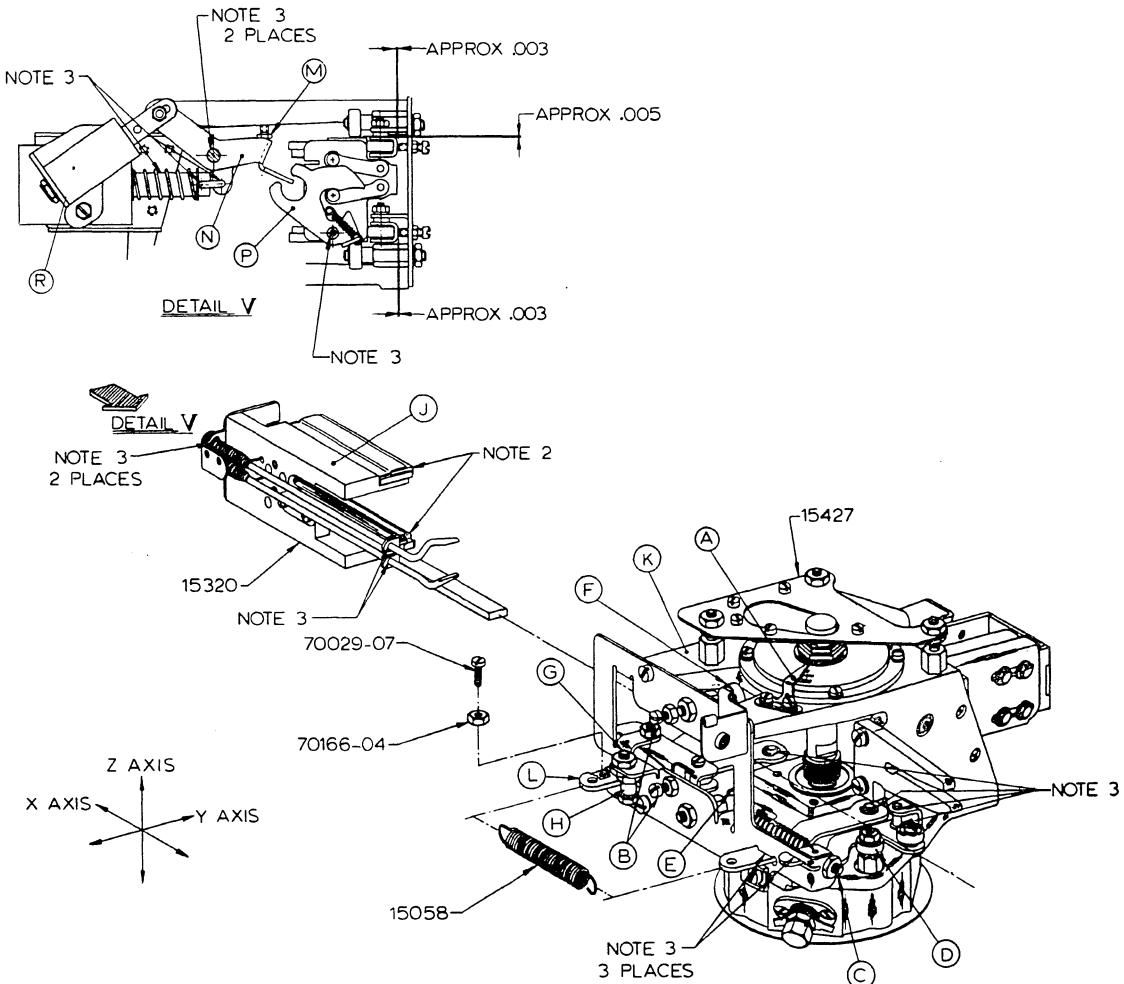
**Figure 5-2. HEAD POSITIONER INTERNAL ADJUSTMENTS**

PROCEDURE

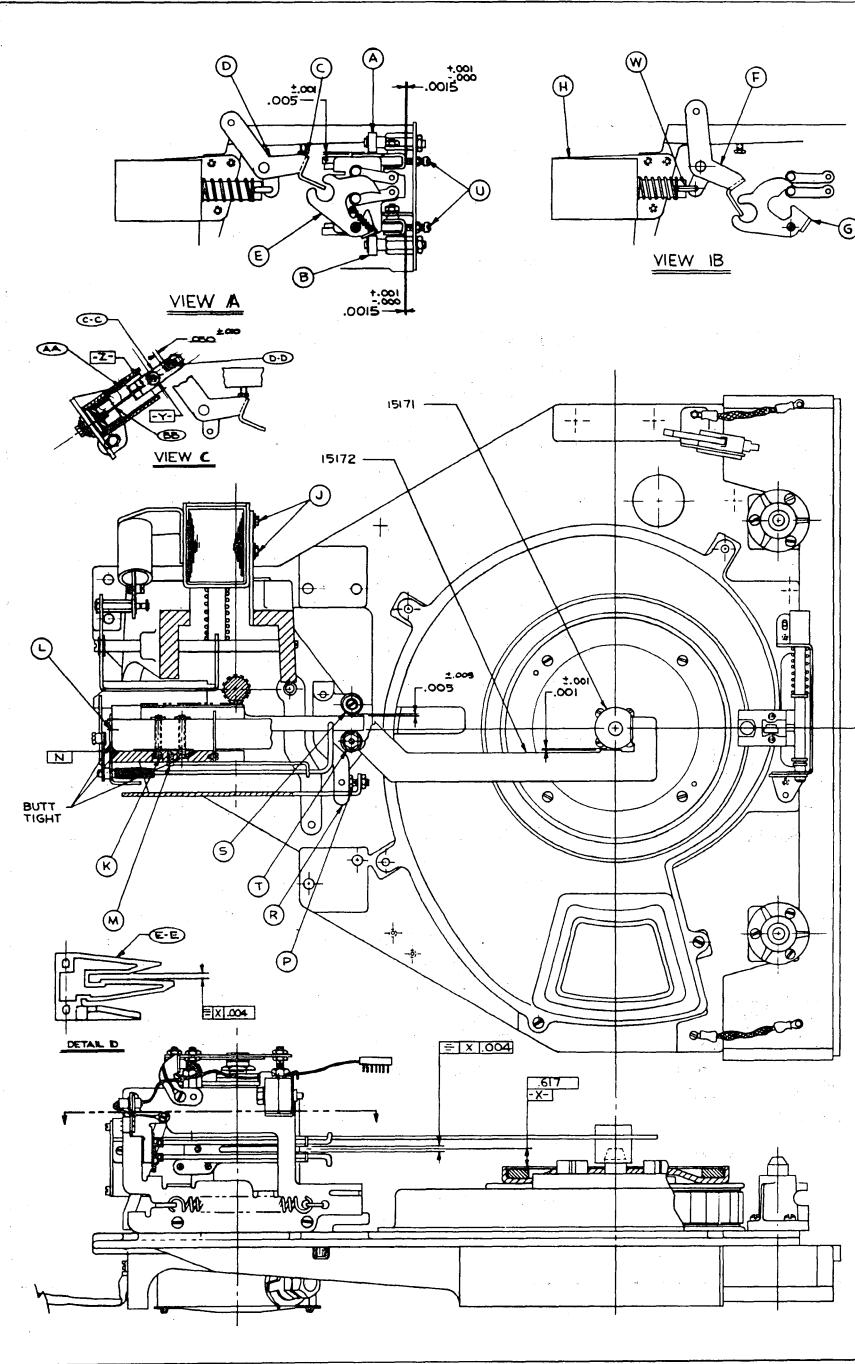
1. APPROXIMATELY CENTER POINTER **(A)** AND TIGHTEN SCREWS - NOTE 1.
2. LOOSEN NUT AND SCREW **(B)** SUFFICIENTLY TO ALLOW ASSY OF CARRIAGE 15320.
3. LOOSEN NUT AND TURN SCREW **(C)** SUFFICIENTLY TO ALLOW ASSY OF CARRIAGE 15320.
4. APPROXIMATELY CENTER ROLLER **(D)** ABOUT "AXIS X" AND TIGHTEN NUT - NOTE 1.
5. APPROXIMATELY CENTER ROLLER **(E)** ABOUT "AXIS X" AND TIGHTEN NUT - NOTE 1.
6. RAISE ROLLER **(F)** SUFFICIENTLY TO ALLOW ASSY OF CARRIAGE 15320.
7. APPROXIMATELY CENTER ECCENTRIC **(G)** ABOUT "Y AXIS" AND TIGHTEN NUT - NOTE 1.
8. APPROXIMATELY CENTER ECCENTRIC **(H)** ABOUT "Y AXIS" AND TIGHTEN NUT - NOTE 1.
9. INSTALL CARRIAGE SO THAT THE FOLLOWING CRITERIA ARE MET:
  - 9.1 SURFACE **(J)** IS PARALLEL TO SURFACE **(K)** WITHIN .010.
  - 9.2 WITH ARM **(L)** TIGHT AGAINST ECCENTRIC **(H)** AND THE CARRIAGE ASSEMBLY AT THE EXTREME LEFT POSITION AGAINST ARM **(L)** POINTER **(A)** IS POINTING AT CYLINDER INDICATION ZERO  $\pm$ 4 CYLINDERS.
10. INSTALL 15058, 70029-07 AND 70166-04 WITH 70029-07 AS HIGH AS POSSIBLE.
11. ADJUST ROLLER **(F)** TO ADJUSTMENT SHOWN IN DETAIL V AND TIGHTEN NUT - NOTE 1.
12. ADJUST SCREW **(B)** TO ADJUSTMENT SHOWN IN DETAIL V AND TIGHTEN NUT - NOTE 1.
13. ADJUST SCREW **(M)** SO THAT BAIL **(N)** IS APPROXIMATELY CENTERED IN CAM **(P)** - NOTE 1.
14. ADJUST DASHPOT **(R)** SO THAT PISTON DOESN'T BOTTOM IN CYLINDER - NOTE 1.

NOTES:

1. THIS ADJUSTMENT IS TEMPORARY AND WILL BE READJUSTED AT FINAL ASSY.
2. SATURATE FELT WITH OIL 70243, SQUEEZE LIGHTLY AND REMOVE EXCESS.
3. LUBRICATE WITH ONE DROP OF 70243 OIL.



**Figure 5-3. HEAD POSITIONER TO BASE ADJUSTMENTS**



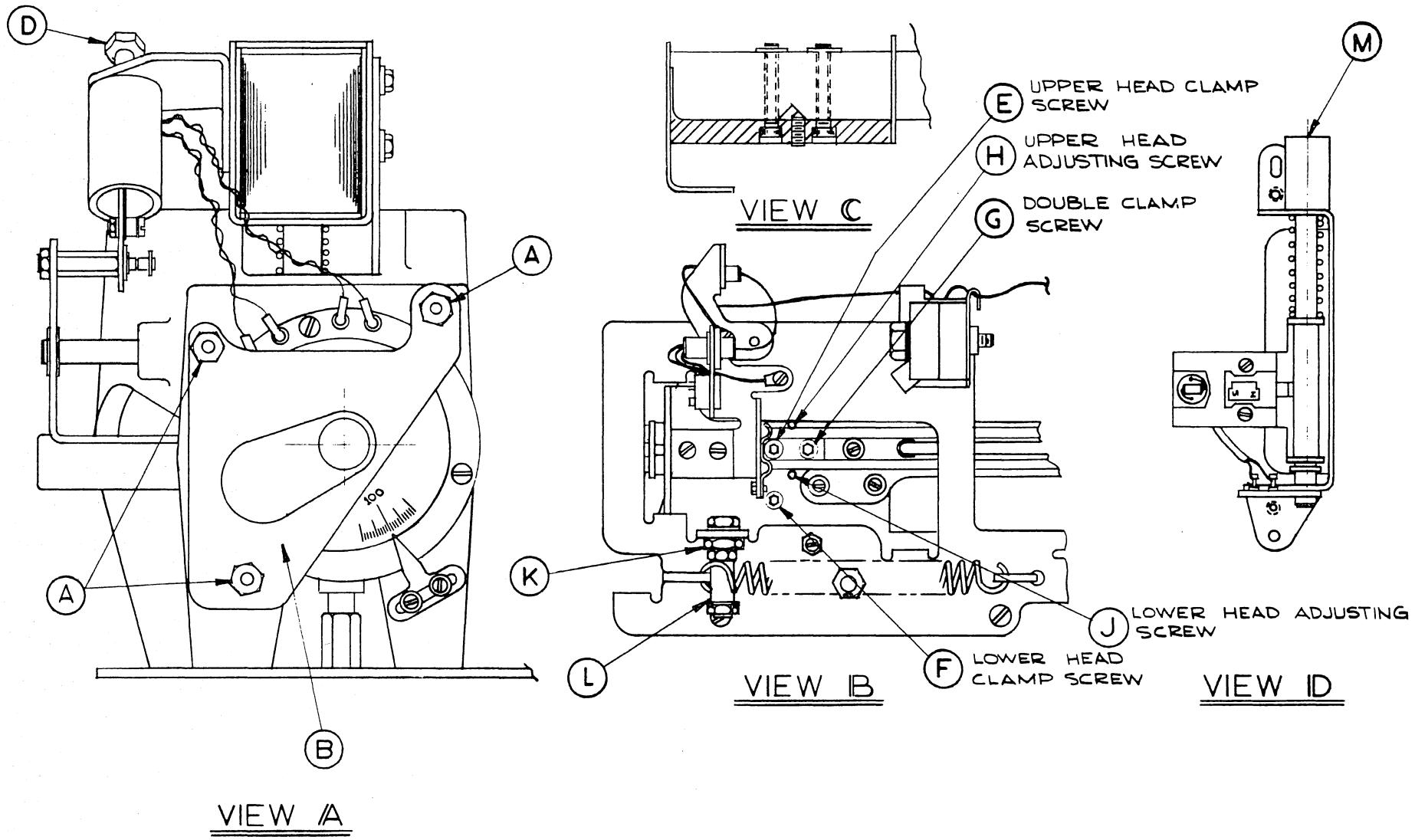
### PROCEDURE

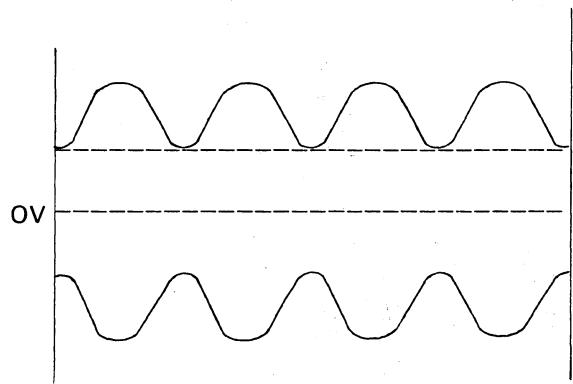
1. RAISE ROLLER **(A)** AS HIGH AS POSSIBLE.
  2. ADJUST CARRIAGE HEIGHT TO DIMENSION SHOWN BY TURNING ECCENTRIC AT ROLLER **(B)** AND TIGHTEN NUT.
  3. ADJUST ROLLER **(A)** TO DIMENSION SHOWN BY TURNING ECCENTRIC AND TIGHTEN NUT.
  4. ADJUST SCREW **(C)** SO THAT BAIL **(D)** IS CENTERED IN CAM **(E)** AS SHOWN IN VIEW **A**.
  5. ADJUST SOLENOID **(H)** SO THAT BAIL **(F)** IS CENTERED IN CAM **(G)** AS SHOWN IN VIEW **1B** AND TIGHTEN SOLENOID MOUNTING SCREWS **(J)**. - NOTE 3.
  6. LOOSEN SCREW **(M)** SO THAT TIP WILL NOT INTERFERE WITH TOOL 15172.
  7. INSTALL TOOL 15172 (IN EITHER HEAD POSITION) SO THAT IT IS TIGHT AGAINST PLATE **(I)** AND CARRIAGE SURFACE **(N)** AND TIGHTEN SCREW **(K)** - NOTE 2.
  8. INSTALL TOOL 15171 ON SPINDLE AS SHOWN.
  9. TURN STOP SCREW **(P)** CLOCKWISE AS FAR AS POSSIBLE.
  10. LOOSEN STOP SCREWS **(Q)** APPROXIMATELY .030.
  11. TURN ECCENTRIC AT ROLLER **(T)** SO THAT CLEARANCE BETWEEN TOOLS 15171 AND 15172 IS AS SHOWN AND TIGHTEN NUT.
  12. ADJUST STOP SCREW **(P)** SO THAT WITH ARM **(R)** HELD TIGHT AGAINST IT CLEARANCE BETWEEN ROLLER **(S)** AND CARRIAGE IS AS SHOWN. TIGHTEN NUT.
  13. ADJUST STOP SCREWS **(U)** TO CLEARANCE SHOWN AT TRACK ZERO AND CHECK FOR CLEARANCE AT ALL OTHER TRACK POSITIONS.
  14. ADJUST THE POSITION OF DASHPOT CYLINDER **(AA)** SO THAT CLEARANCE SHOWN EXISTS BETWEEN LINK **(CC)** AND SCREW **(DD)** WITH LINK **(CC)** HELD TO THE LEFT & PISTON **(BB)** BOTTOMED IN CYLINDER.
  15. ADJUST HEIGHT OF CARTRIDGE AND DISK GUIDE **(EE)** TO DIMENSION SHOWN IN DETAIL **D** AND TIGHTEN SCREWS.

## NOTES

1. THE PURPOSE OF THE VIEWS ON THIS SHEET IS TO AID IN THE DESCRIPTION OF THE ADJUSTMENTS, THEREFORE MANY PARTS HAVE BEEN OMITTED.
  2. SCREW (K) IS TO BE TIGHTENED TO  $50^{+5}$  INCH OUNCES (TIGHTENING TO A HIGHER TORQUE WILL DAMAGE HEAD CLAMP).
  3. KEEP SOLENOID (H) AND LINK (W) HORIZONTAL.

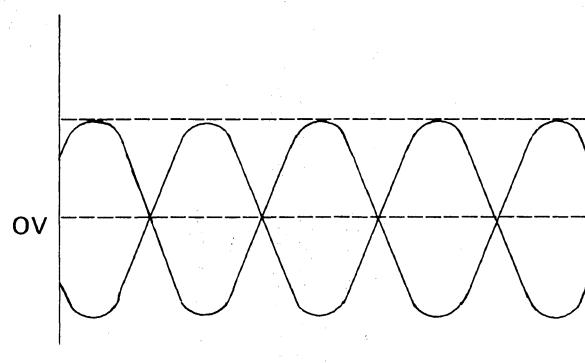
Figure 5-4A. HEAD POSITIONER TO BASE ADJUSTMENTS REFERENCE DRAWING





**High Density**

1 volt per vertical division.  
10 milliseconds per time division.



**Standard Density**

10 millivolt per vertical division.  
10 milliseconds per time division.

**Equal Decrease in Signal Amplitude** — adjustment required if successive dips differ by more than 20%. For example if maximum P.P. of signal is 5 volts and first dip is down to 4 volts while second dip is down to 3 volts or less the head should be adjusted. Successive dips should be of equal amplitude after adjustment.

**Equal Peak Amplitudes** — adjustment required if successive lobes differ by more than 20%. For example: if maximum P.P. amplitude of first lobe is 50 millivolts and second lobe is 40 millivolts or less the head should be adjusted. Successive lobes should be of equal amplitude after adjustment.

**Figure 5-4b. Head Adjustment patterns.**

4. Adjust carriage stop eccentric (K on Figure 5-4) until it is just inhibiting the carriage movement.
5. Adjust cylinder indicator pointer to track zero.

#### 5.4.2 Head Positioner Transducer — Adjustment and Service Check (Refer to Figure 5-4 View A)

1. Connect oscilloscope to TP1 of P.C.B. J1, allow automatic sweep.
2. With power applied and the servo release switch depressed, manually move the rotary member of the position transducer back and forth.
3. A sine wave signal with an amplitude of 15 volts **peak to peak** should appear on the oscilloscope. Loosen upper nuts A (shown in Figure 5-4) and rotate transformer mounting until 15 volts P-P is observed.
4. Connect scope to TP2 of P.C.B. J1, allow automatic sweep.
5. While rotating the position transducer as in step 2 above, observe sine wave, it should have the same amplitude  $\pm 0.2V$  P.P. as that observed at TP1.
6. Rotary transformer gap is set, when the top holding nuts are flat with their studs, by adjustment nuts below transformer mounting plate.
7. Positioner transducer gap is set for 0.005" by shims on positioner motor shaft.

#### 5.4.3 Read/Write Heads

**Alignment check — refer to Figure 5-4B.**

1. With the standard density J10 P.C.B. in the extender card and the head cable connector installed in the plug marked "For head alignment"; load proper C.E. cartridge.  
**Note:** Extender card **not** required with the high density unit. The High density C.E. cartridge has a shim installed in its hub.
2. Allow the machine to run for approximately 10 minutes for temperature stabilization.
3. Position the head carriage to cylinder 100.  
**Note:** Use cylinder 105 with a high density machine.
4. Trigger oscilloscope with the leading edge of Index mark (This is negative going edge of pulse at TP6 of J9 P.C.B.)
5. Monitor TP2 of J10 P.C.B. A correctly aligned head will meet the standard noted on Figure 5-4B. Be sure to check alignment of both heads. With the I/O connector removed the lower head is selected, the upper head may be selected by grounding pin 5 of J10, or by moving the head cable connector.

**Replacement — refer to Figure 5-4A.**

1. Loosen the cable clamp holding the two head plug cables.
  - a. Motherboard must be in servicing position to gain access from rear of machine.

2. Unplug the head plug, the upper head is the inner connector.
  3. Loosen the double clamp screw (indicated by G on Figure 5-4A) and the desired head clamp screw.
- Note:** Do not loosen clamp screw more than 1/2 turn.
4. Pull the loosen head toward the spindle until clear.
  5. Insert replacement head into head carriage insure that the head bracket is installed in clamps and is fully inserted into the plate on the rear of the head carriage.
  6. Apply 20 inches of torque to the head clamp screws and proceed with adjustment.

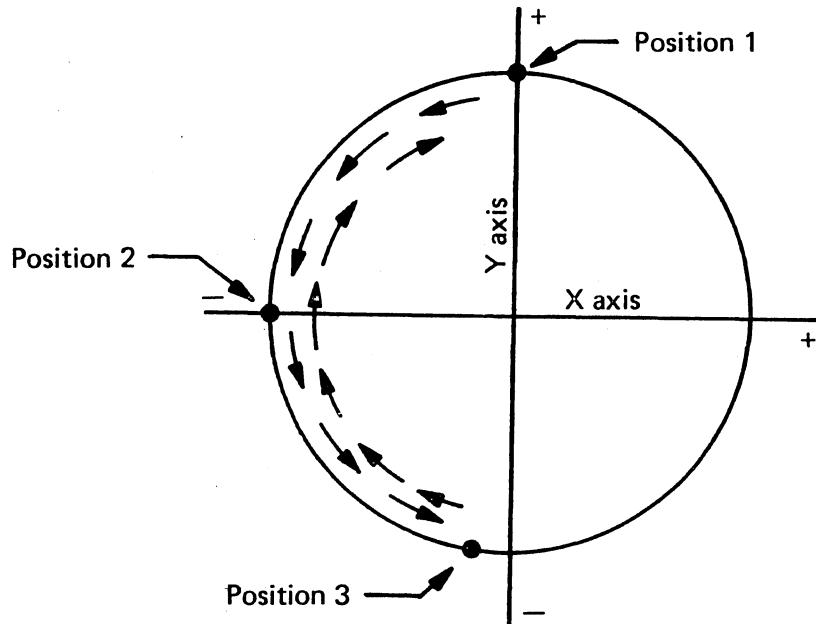
**Adjustment – Refer to Figure 5-4A and 5-4B.**

1. Perform steps 1 through 5 of the alignment check given above.
  2. The C.E. Cartridge has an eccentric recording on cylinder 100, the connector on the extender board will direct any output from the tunnel erase windings into the read amplifier.
- Note:** Output of the Read/Write winding is directed into the read amplifier with a high density machine.
3. Adjust the selected head by turning the adjusting set screw, see Figure 5-4A. When a head is installed in its rearmost position the head will be about five cylinders too far back, i.e., over about cylinder 95. As the head is adjusted towards cylinder 100, the only adjustment direction, the leading erase winding will read a portion of the eccentric recording. The head is correctly adjusted when an equal portion of the eccentrically recorded cylinder is read by each Erase winding, see Figure 5-4B.
- Note:** With a high density machine cylinder 105 is used. If the head is adjusted to far inward the setscrew must be backed out, the head clamps loosened, and the head must be manually pushed towards the rear of the machine.
4. A torque of 50 inches shall be applied to the common clamp bolt, G in Figure 5-4A and a torque of 26 inches shall be applied to clamp bolts E and F, see Figure 5-4A, when the head is correctly adjusted.
- Note:** Required torque wrench, bits and set screw is available from Diablo Systems, 24500 Industrial Boulevard, Hayward, California 94545.

#### 5.4.4 Track "0" Stop Adjustment

1. Before performing the Track Zero Stop Adjustment be sure that the cylinder pointer adjustment is within specification (paragraph 5.4.1).
2. Connect the vertical amplifier of an oscilloscope to TP2 and J1, and the horizontal amplifier input of the oscilloscope to TP1 of J1.
3. Depress the servo release switch (located at the top of the motherboard to the left of J3) and manually rotate the head positioner. The scope trace should be a lissajous pattern which in this case assumes a circular trace. Since the almost-sinusoidal input signals to the Vertical and Horizontal deflection plates of the scope are of equal gain and frequency and 90° out of phase, they will trace an approximate circle when allowed to pass through a full cycle.
4. Manually rotate the head positioner fully clockwise to retract the head carriage as far as possible and release the servo release button. The cylinder pointer should

- indicate Track "0." Using the Horizontal Position knob, center the dot on the top portion of the oscilloscope Y axis, see Figure 5-5, Position 1.
5. Depress the servo release button. With slight pressure, force the head positioner against its crash stop. Adjust the eccentrics, K and L, located directly below the head cable connector bracket (see Figure 5-4, view B) so that the trace comes to rest within position 2 of Figure 5-5, but not past it.



**Figure 5-5. TRACK "0" STOP ADJUSTMENT PATTERN**

6. Release the servo release button. The scope dot should return to the Y axis position of A.
7. Transfer the Load/Run switch from Load to Run to Load, several times. The trace should swing a maximum arc of 180° from the top Y axis position to an equivalent position on the negative portion of the Y axis traveling in a ccw direction (see Figure 5-5, Position 3). If it exceeds 180°, repeat steps 3 through 7.

#### 5.4.5 Head Load Dashpot Adjustment – See Figure 5-3 and 5-4

1. Install disk pack having information written at track zero, start machine, allowing a complete start-up cycle.
2. Trigger scope from leading edge of head load pick signal. This is a positive-going edge at pin W of J9.
3. Connect vertical input of oscilloscope to TP2 of J10.

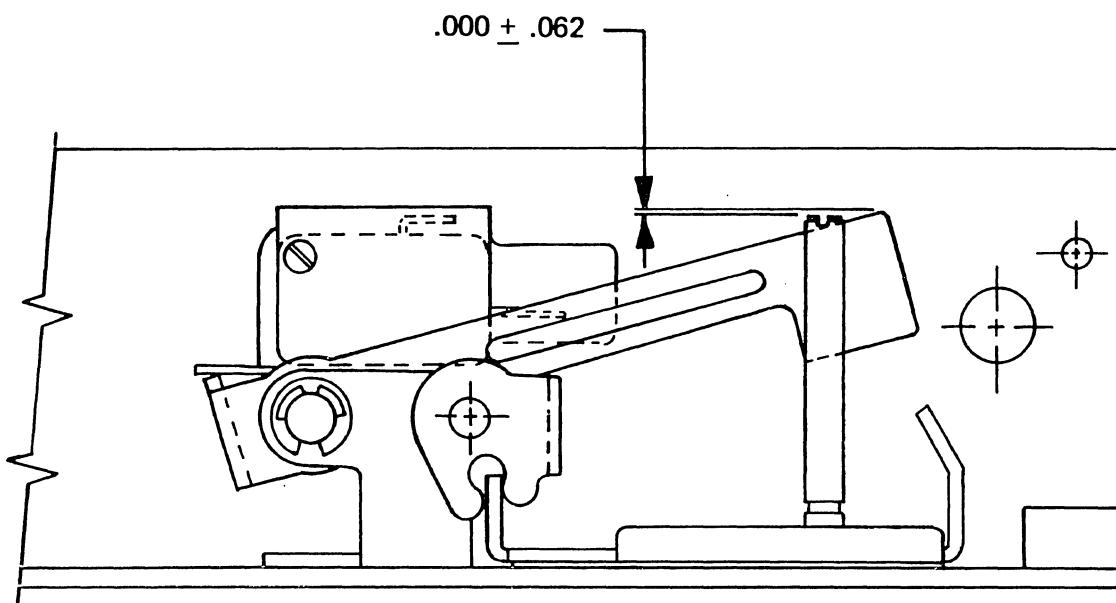
4. Trigger the head Load One Shot by momentarily grounding the Set input of the Heads Loaded F.F. Refer to schematic J9 for proper pin number.
5. Observe signal on scope, Read Data and Clock. Signal appears when heads are completely loaded against the disk.
6. Repeating steps 4 and 5, turn screw D, Figure 5-4, View A, until the data signal appears  $120 \pm 10$  milliseconds after the start of the sweep. Lock screw D with a drop of adhesive (Diablo Part No. 70226) when adjustment is completed.

## 5.5 SPINDLE ASSEMBLY

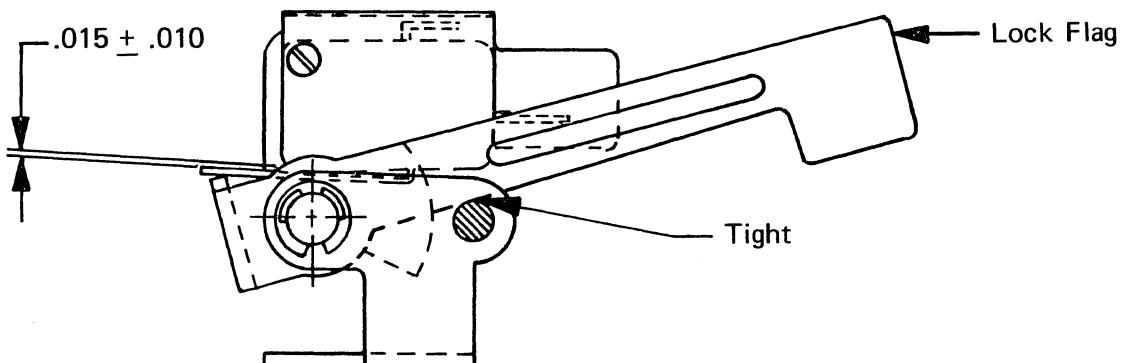
1. Remove cartridge receiver assembly (see paragraph 5.2) and sector transducer (see paragraph 5.3).
2. Remove the spindle motor leads from the filter board.  
**Note:** The front bottom cover must be removed to gain access to the filter board and bolts holding spindle assembly.
3. Remove the three bolts holding the spindle assembly to the base frame and remove spindle assembly.
4. Assemble in reverse order.
5. Adjustments — accomplished in order given below:
  - a. Perform Head Positioner assembly and Head/Write head adjustments, see paragraphs 5.4.1 through 5.4.4.
  - b. Perform Cartridge Receiver adjustment, see Figure 5-1.
  - c. Perform Sector Transducer adjustment, see paragraph 5.3.

## 5.6 DOOR LOCK ASSEMBLY — See Figure 5-6 (Model 31 only)

1. Remove lamps from front panel (pull out type).
2. With the door open, remove the two bolts holding the front trim piece to the frame assembly.
3. Raise the front trim piece slightly and pivot it towards the open door. This action will allow the trim piece to drop down between the door and frame.
4. Removal of front trim provides access to the bolts holding the trim piece above the door lock solenoid. Remove this trim piece also.
5. Dis-assemble as required.
6. Assemble in reverse order.
7. Adjustments, see Figure 5-6.
  - a. Particular attention to the adjustments affecting switch transfer is required. If the switch transfers too early the Lock flag will tend to bounce, if transfer of switch is not accomplished the door lock solenoid will heat up when energized.



View "A" Solenoid Energized



View "B" Lock Flag Held Down

Figure 5-6. DOOR LOCK MECHANISM



## **SECTION 6**

### **SCHEMATICS**

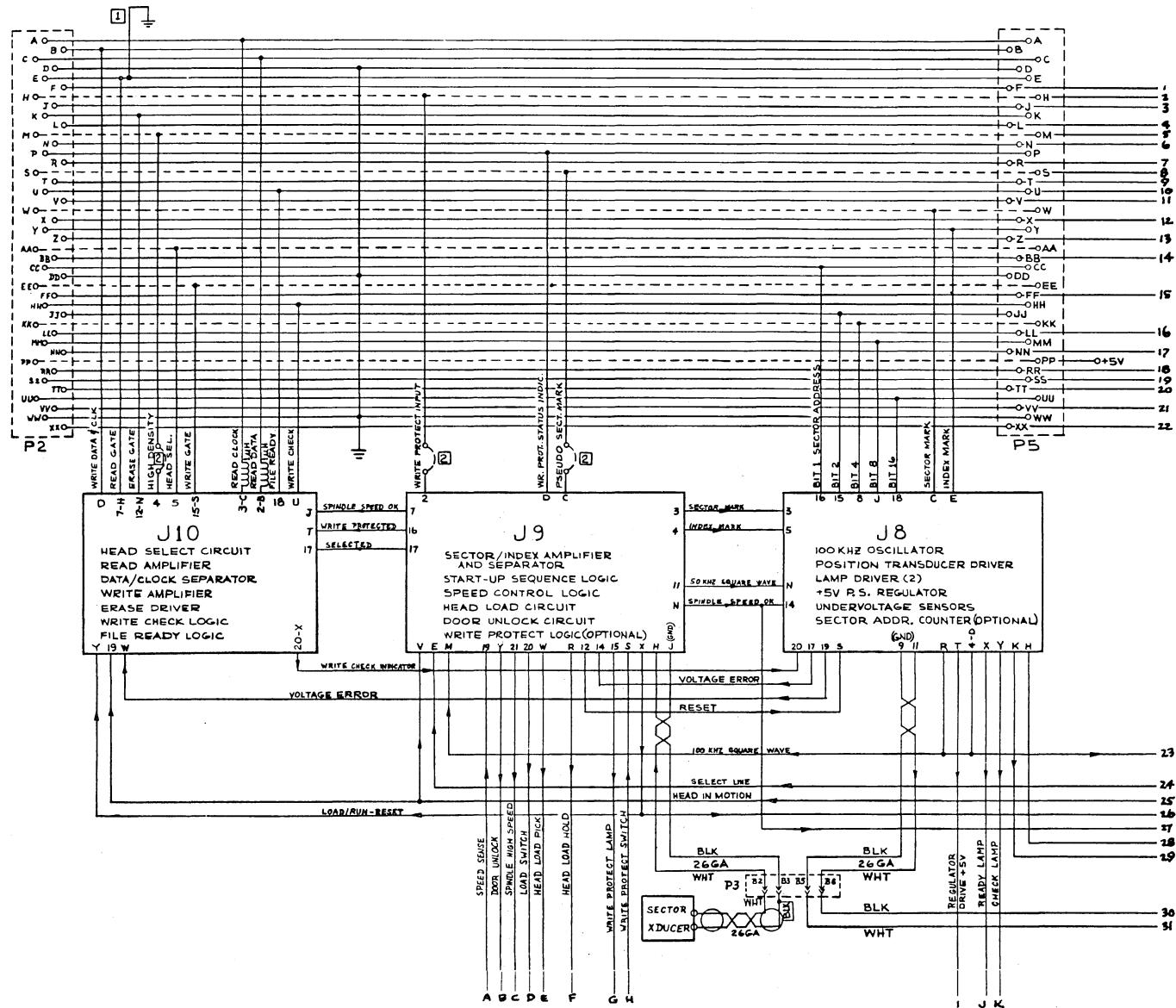
The actual machine components may vary slightly from the schematics shown in this section. The early production machines, which have not been updated, may have P.C.B.'s with part numbers that differ from the ones shown.

The "Standard Machine" referred to in these schematics does not have the daisy chain feature therefore internal terminating resistors are shown. The schematics showing these resistors are; figures 6-1, 6-4, 6-6, 6-7, and 6-8.

All option notes are contained on the schematic affected. When significant changes are introduced a new schematic will be distributed. Minor changes are distributed through the Field Service Aids (see Section 4 of this manual).

**Figure 6-1. INTERCONNECTIONS WITHIN SERIES 30 (sheet 1 of 3)**

**SCHEMATIC #11116 REVISION H**

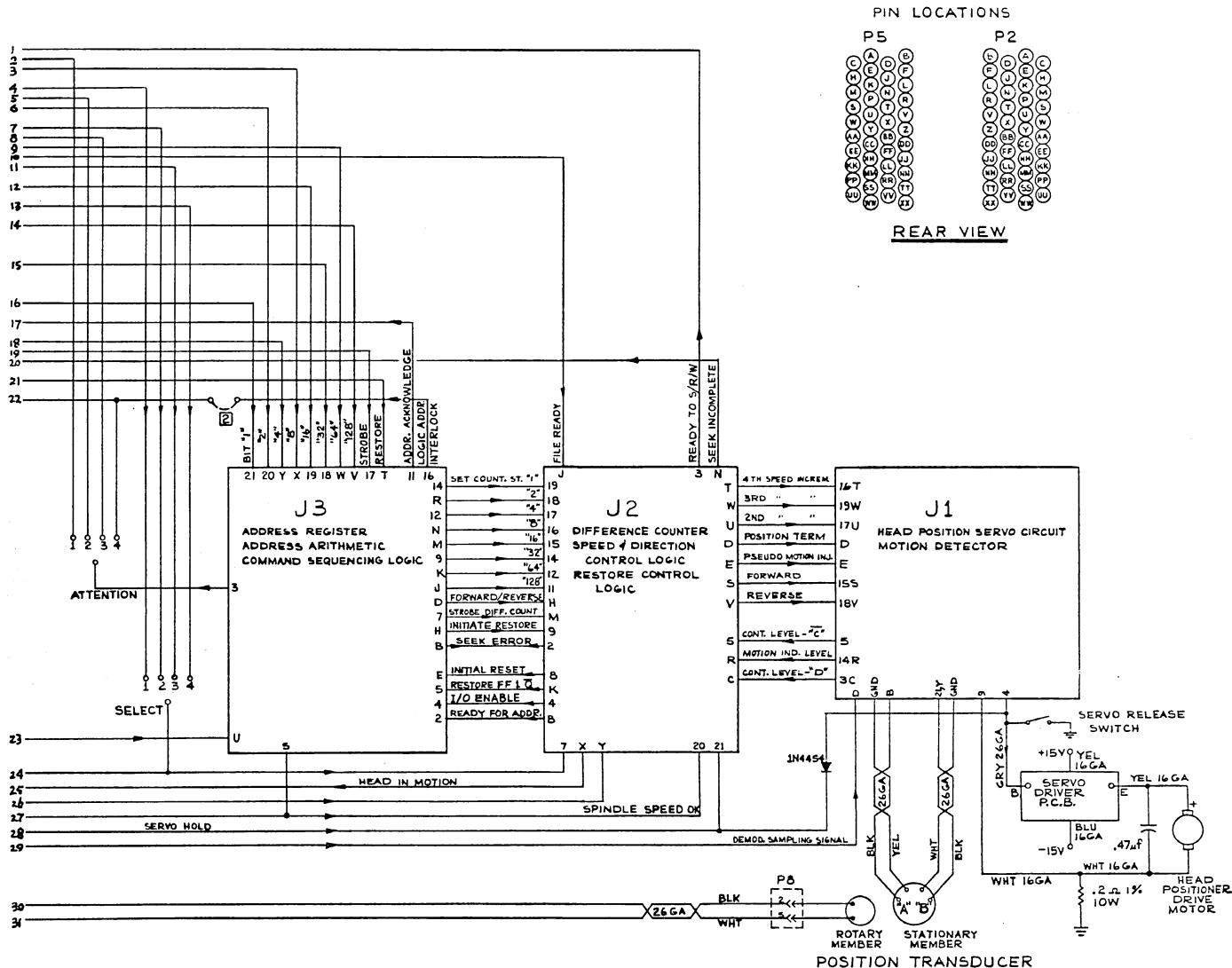


SEE  
SHEET  
2 OF 3

SEE SHEET 3 OF 3

**Figure 6-1. INTERCONNECTIONS WITHIN MODEL 31 (sheet 2 of 3)**  
**SCHEMATIC #11116 REVISION H**

SEE SHEET 1 OF 3



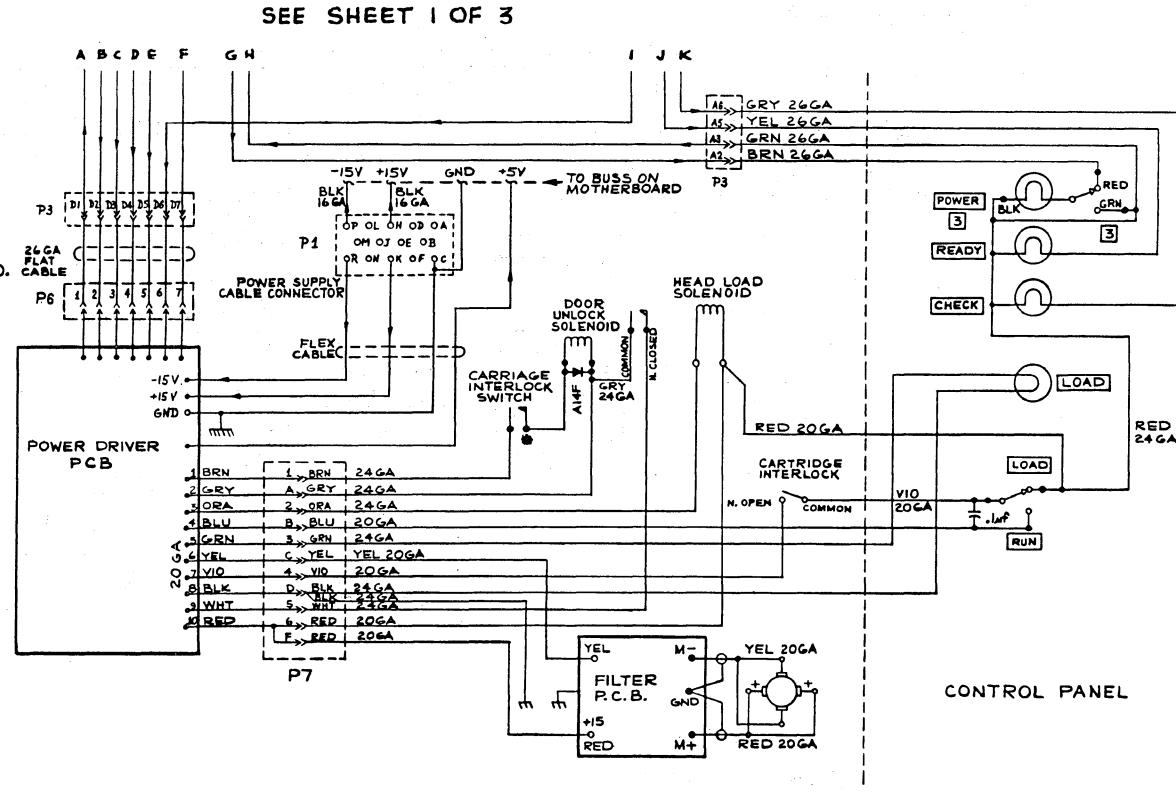
**Figure 6-1. INTERCONNECTIONS WITHIN SERIES 30 (sheet 3 of 3)**

SCHEMATIC #11116 REVISION H

NOTES:

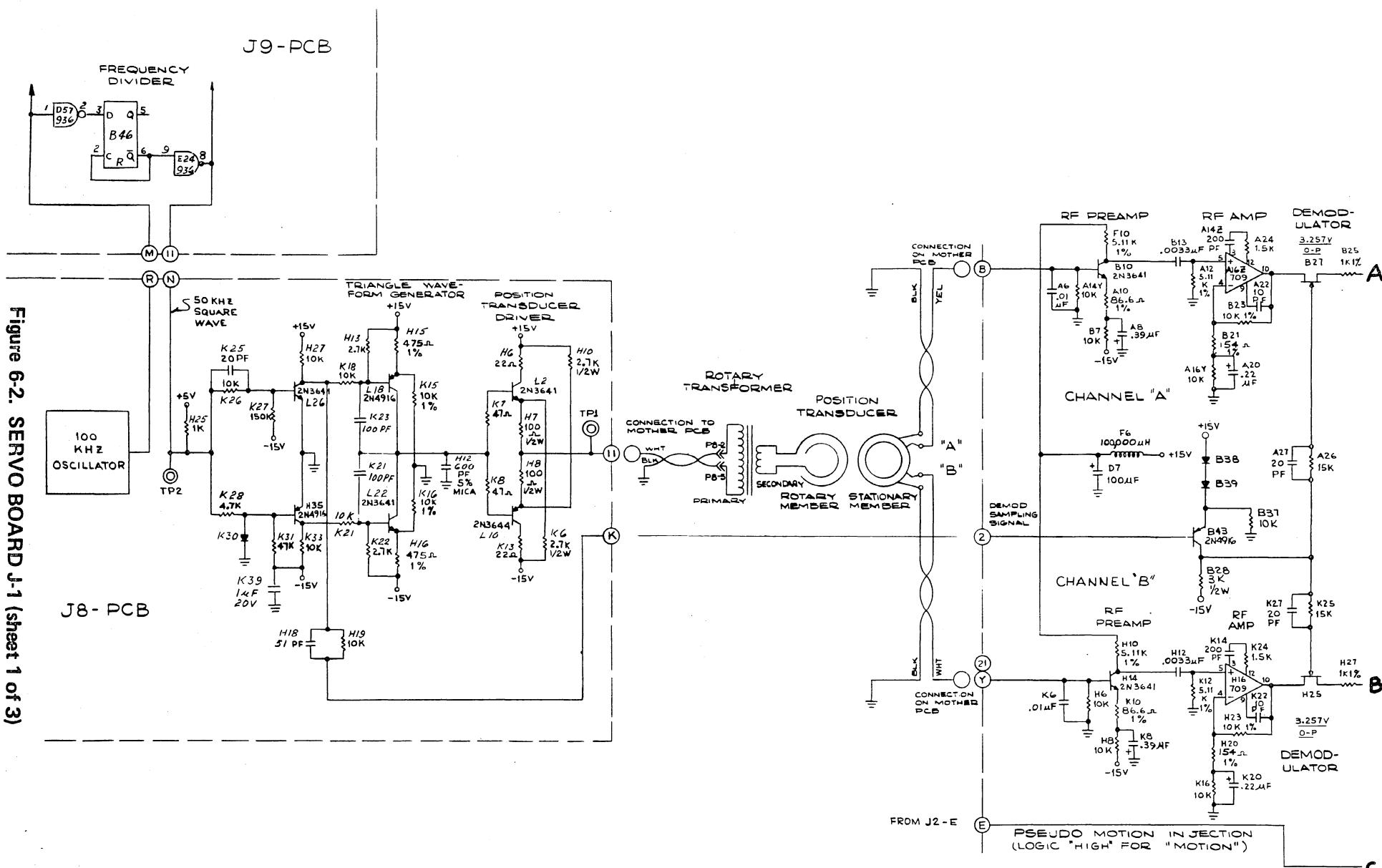
- 1.1 FOR "READ GATE" OPTION JUMPER WIRE MARKED [1] IS OMITTED
- 1.2 FOR "ATTENTION LINE" OPTIONS, JUMPER WIRES MARKED [2] ARE REMOVED.

- 1.3 INTERCONNECTIONS INDICATED BY DOTTED LINES BETWEEN P2 AND P5 ARE ON THE JUMPER P.C.B. 11036
- 1.4 FOR "WRITE PROTECT" OPTION, JUMPER WIRE MARKED [3] IS OMITTED, AND "POWER" LABEL ON FRONT PANEL IS REPLACED BY "WRITE PROTECT".

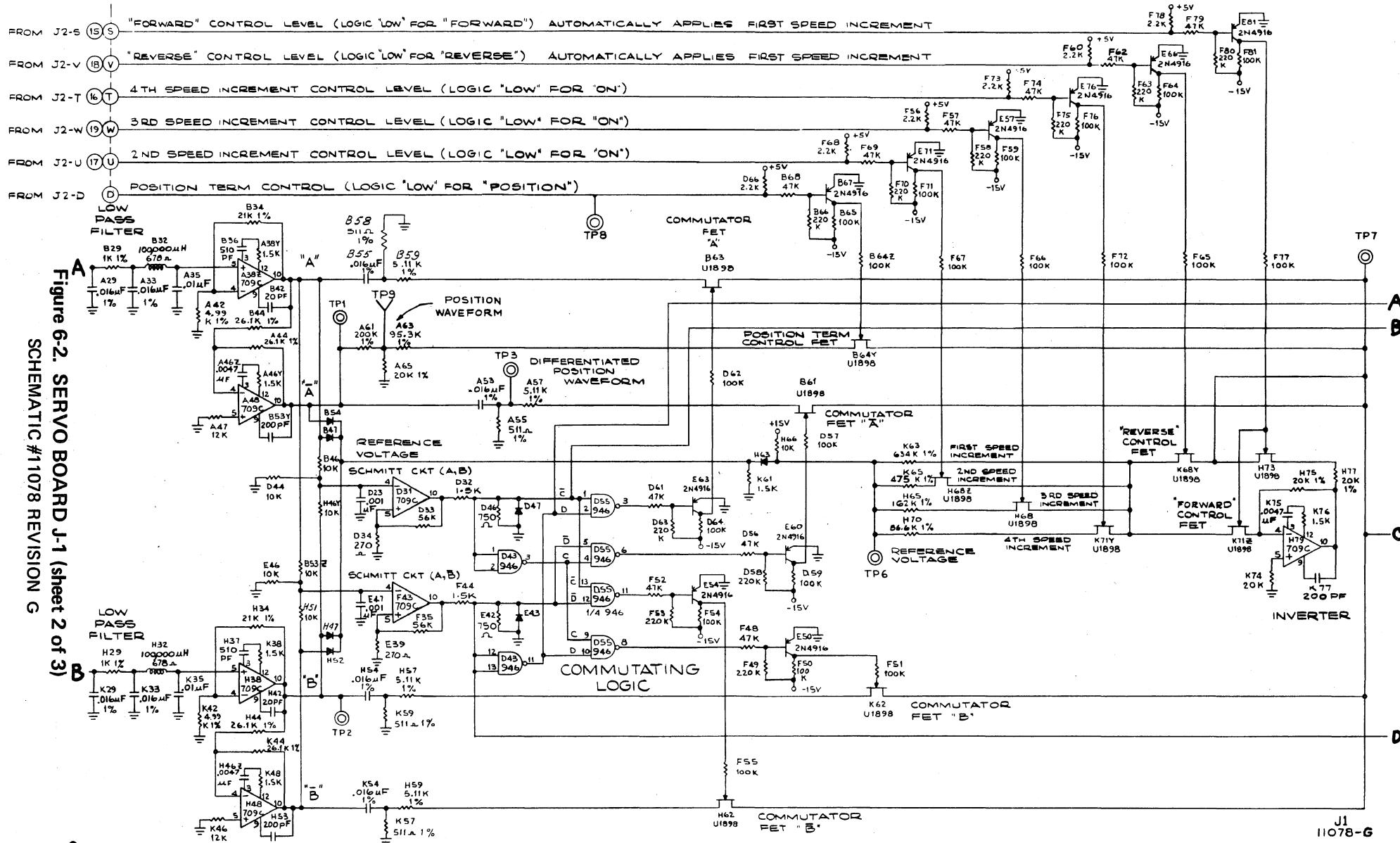


**SCHEMATIC #11078 REVISION G**

**6-2. SERVO BOARD J-1 (sheet**  
**SCHEMATIC #11078 REVISION G**

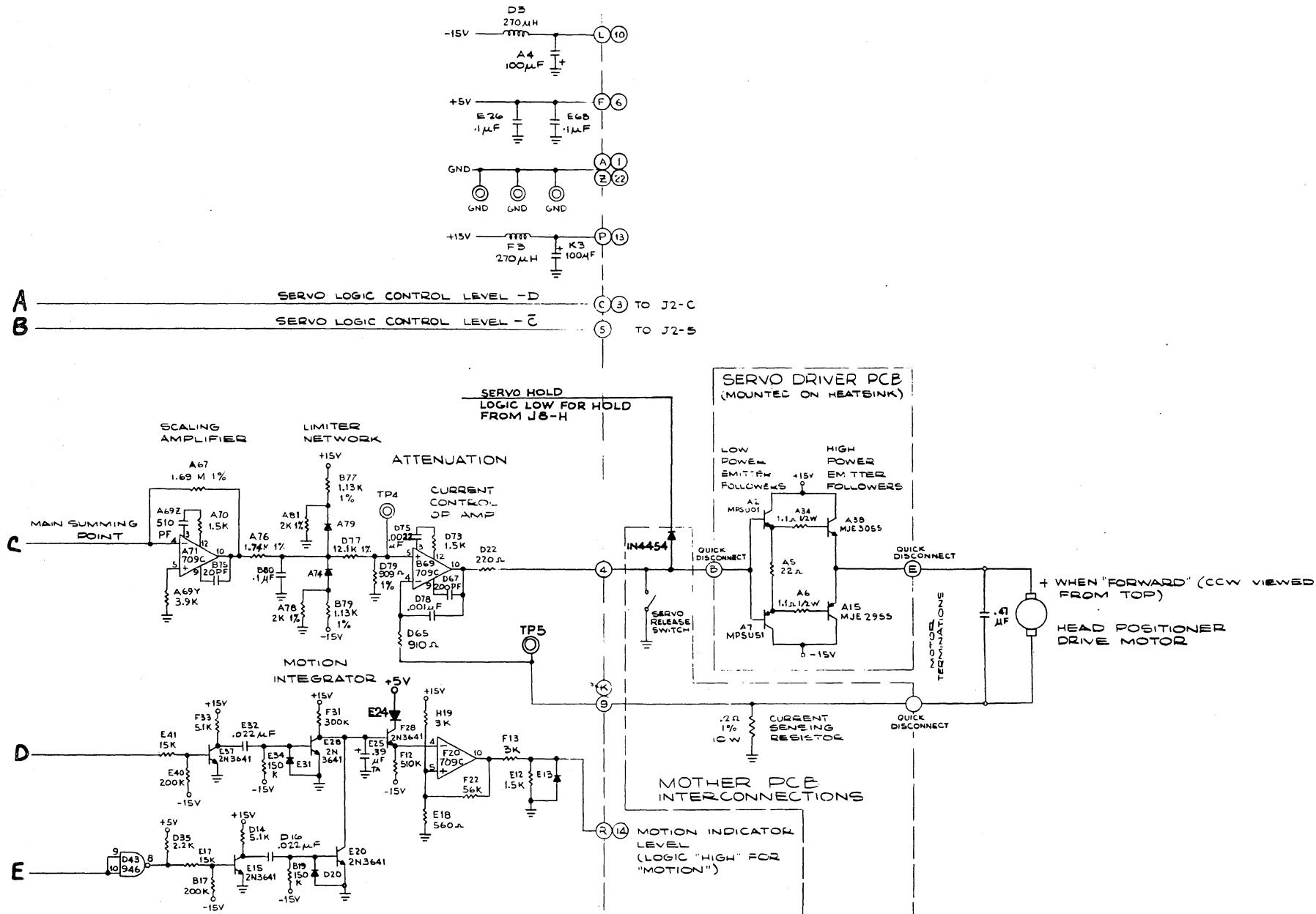


**Figure 6-2. SERVO BOARD J-1 (sheet 2 of 3)**  
SCHEMATIC #11078 REVISION G

J1  
11078-G

**Figure 6-2. SERVO BOARD J-1 (sheet 3 of 3)**

SCHEMATIC #11078 REVISION G



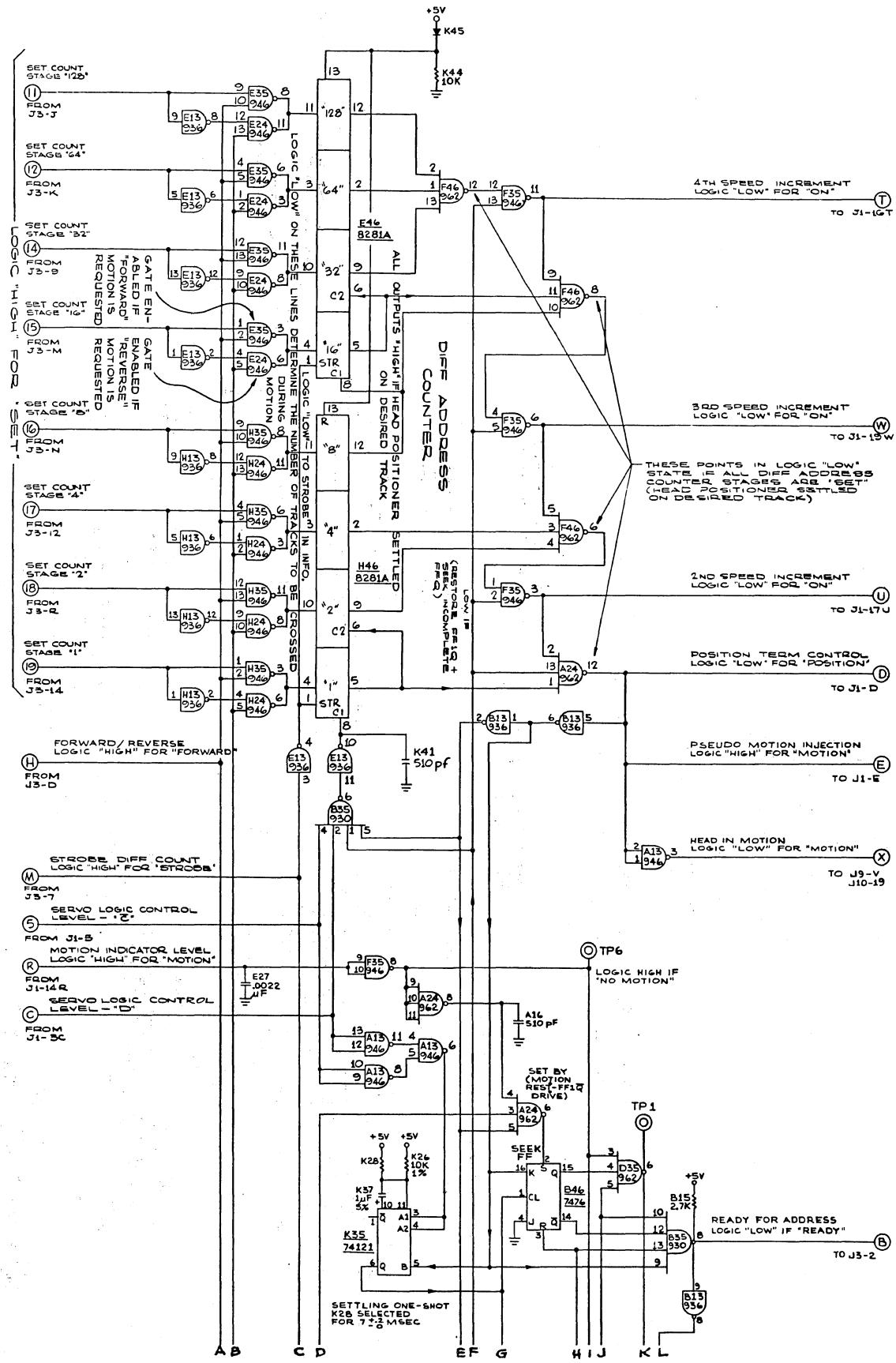


Figure 6-3. SEEK FUNCTIONS J-2 (sheet 1 of 2)  
SCHEMATIC #11111 REVISION E

SEE SHEET 1 OF 2

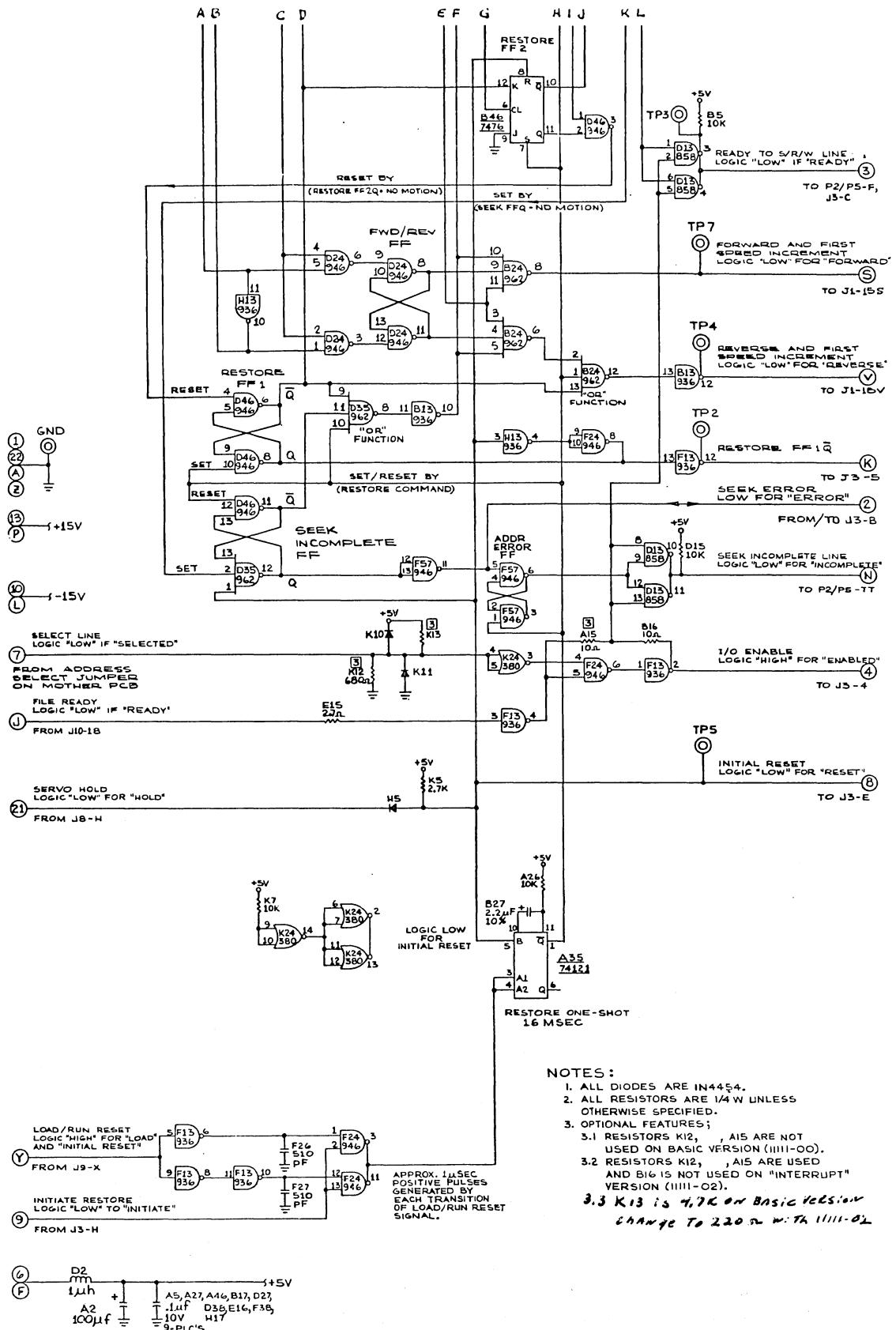
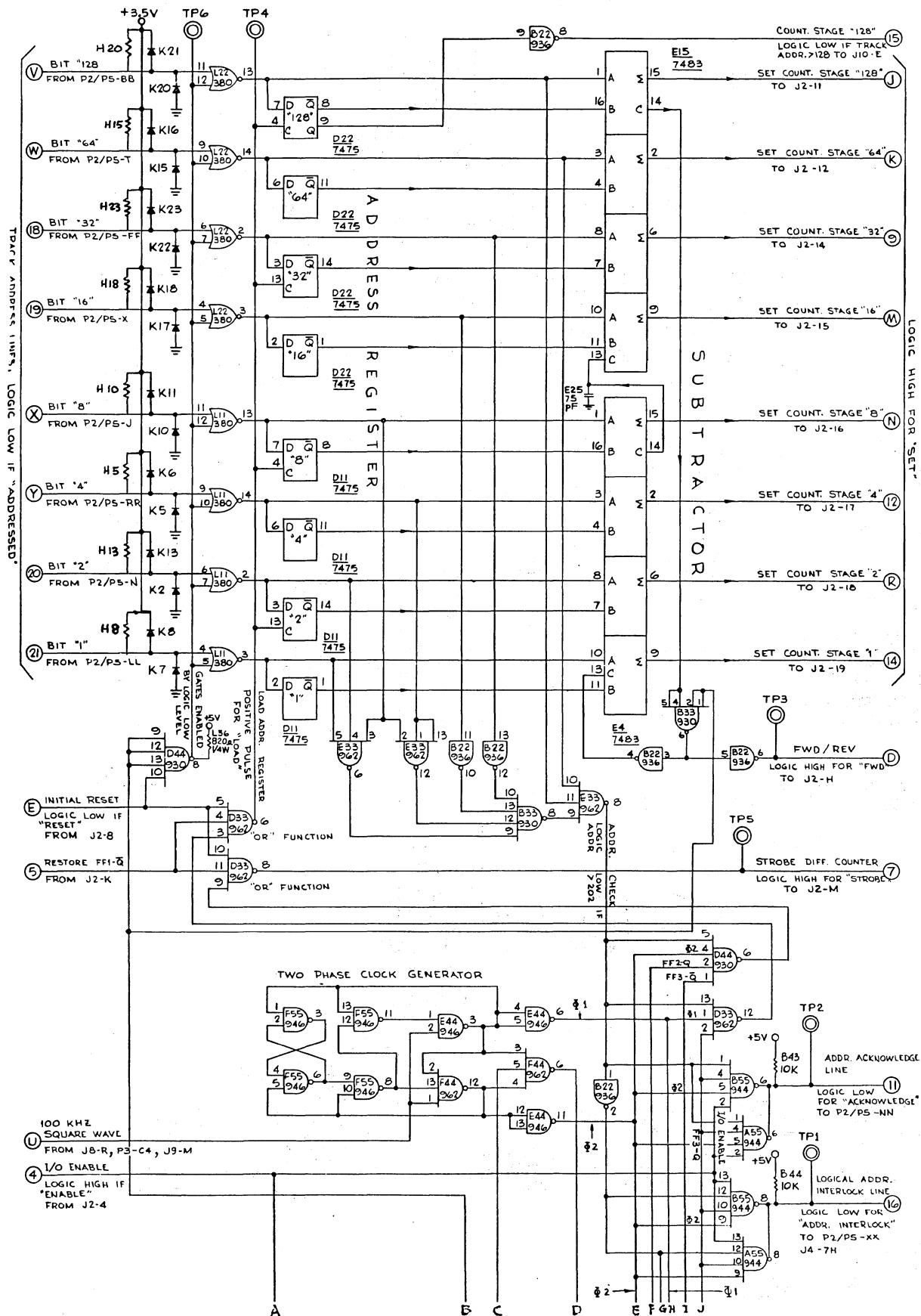


Figure 6-3. SEEK FUNCTIONS J-2 (sheet 2 of 2)  
SCHEMATIC #11111 REVISION F



SEE SHEET 2 OF 2

**Figure 6-4. ADDRESSING FUNCTIONS J-3 (sheet 1 of 2)**  
**SCHEMATIC #11026 REVISION J**

SEE SHEET 1 OF 2

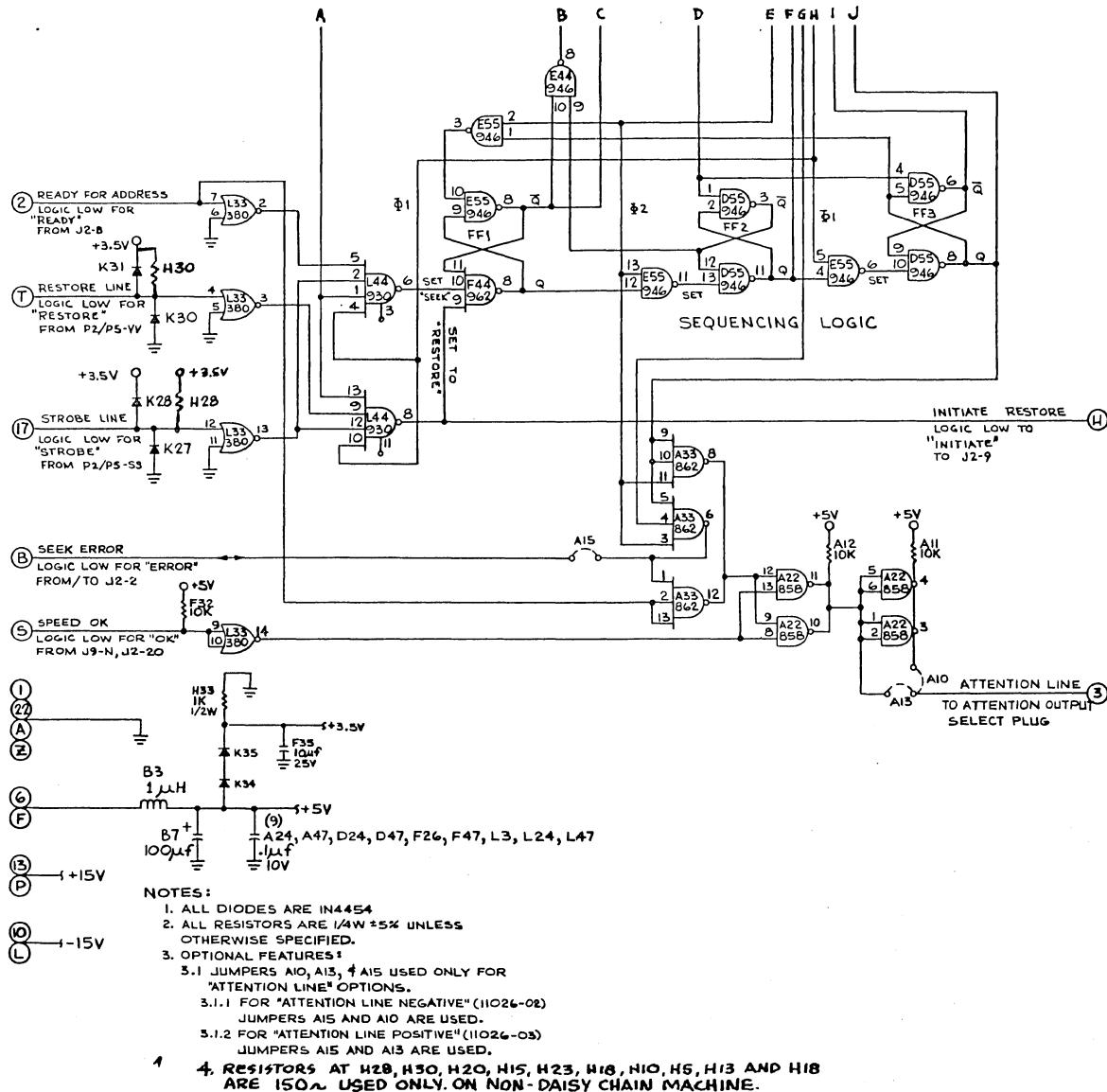
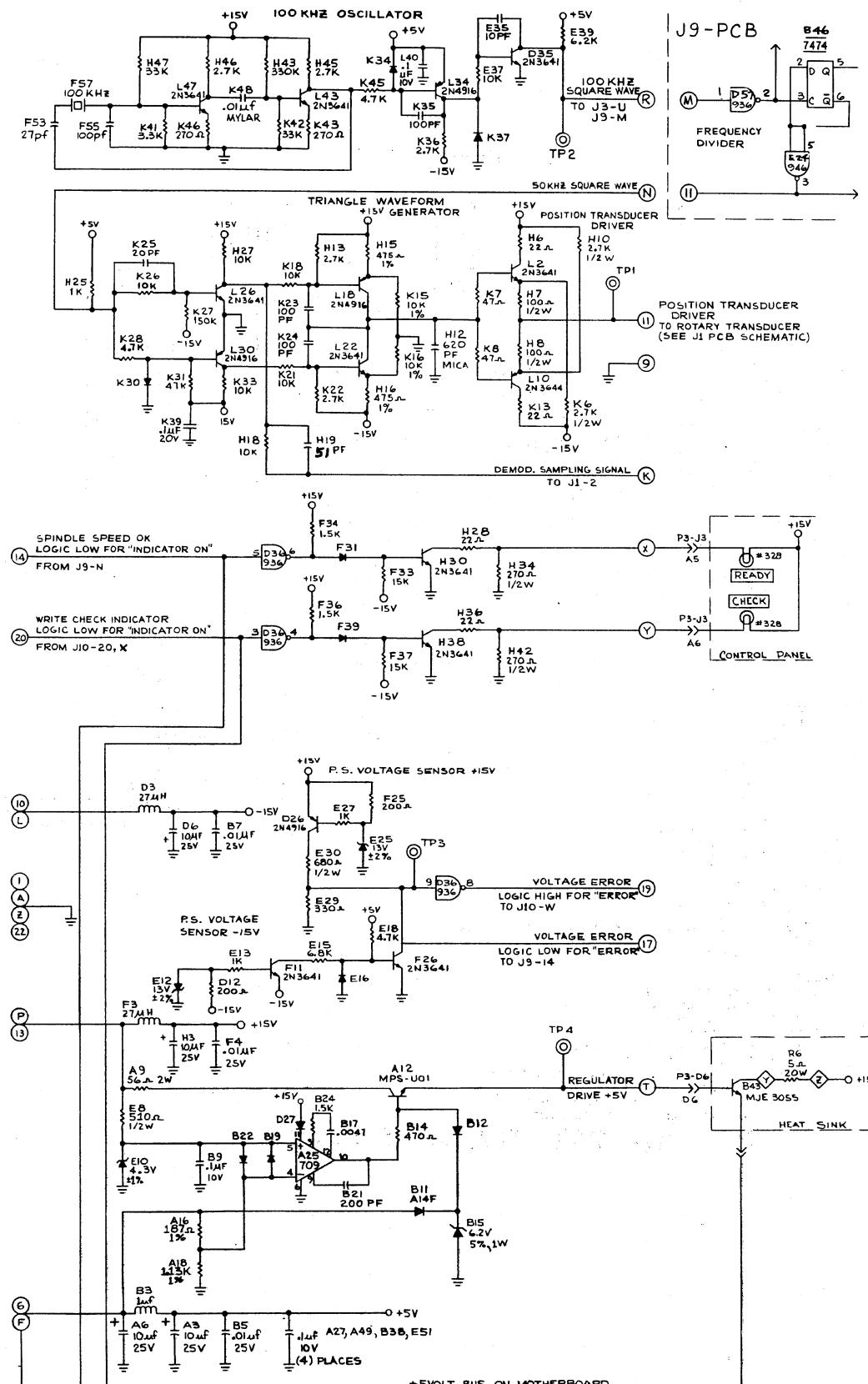


Figure 6-4. ADDRESSING FUNCTIONS J-3 (sheet 2 of 2)  
SCHEMATIC #11026 REVISION J

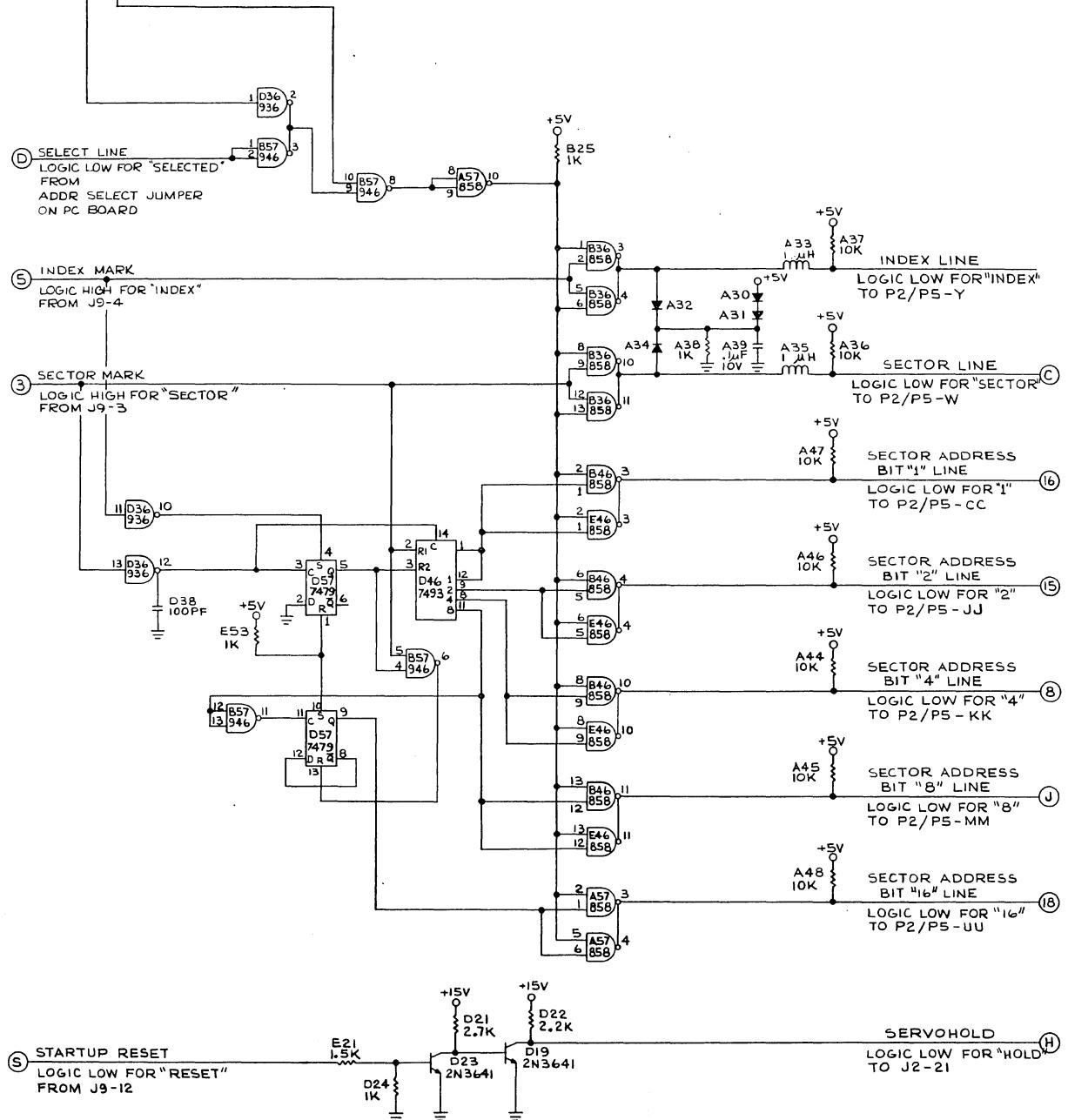


A B SEE SHEET 2

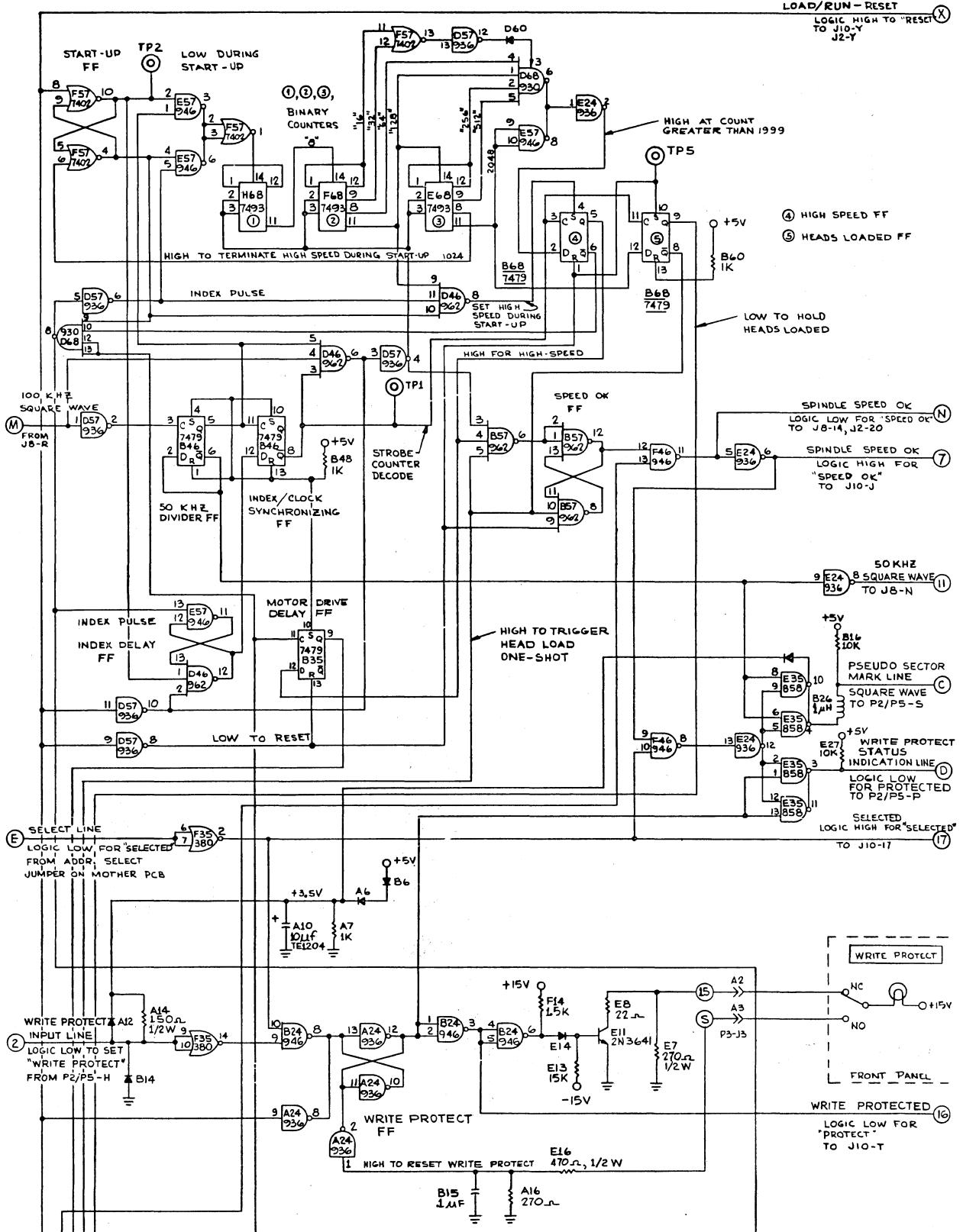
Figure 6-5. LOGIC DRAWING J-8 (Sheet 1 of 2)

SCHEMATIC #11085 REVISION F

A| B| SEE SHEET 1



**Figure 6-5. LOGIC DRAWING J-8 (sheet 2 of 2)**  
**SCHEMATIC # 11085 REVISION F**



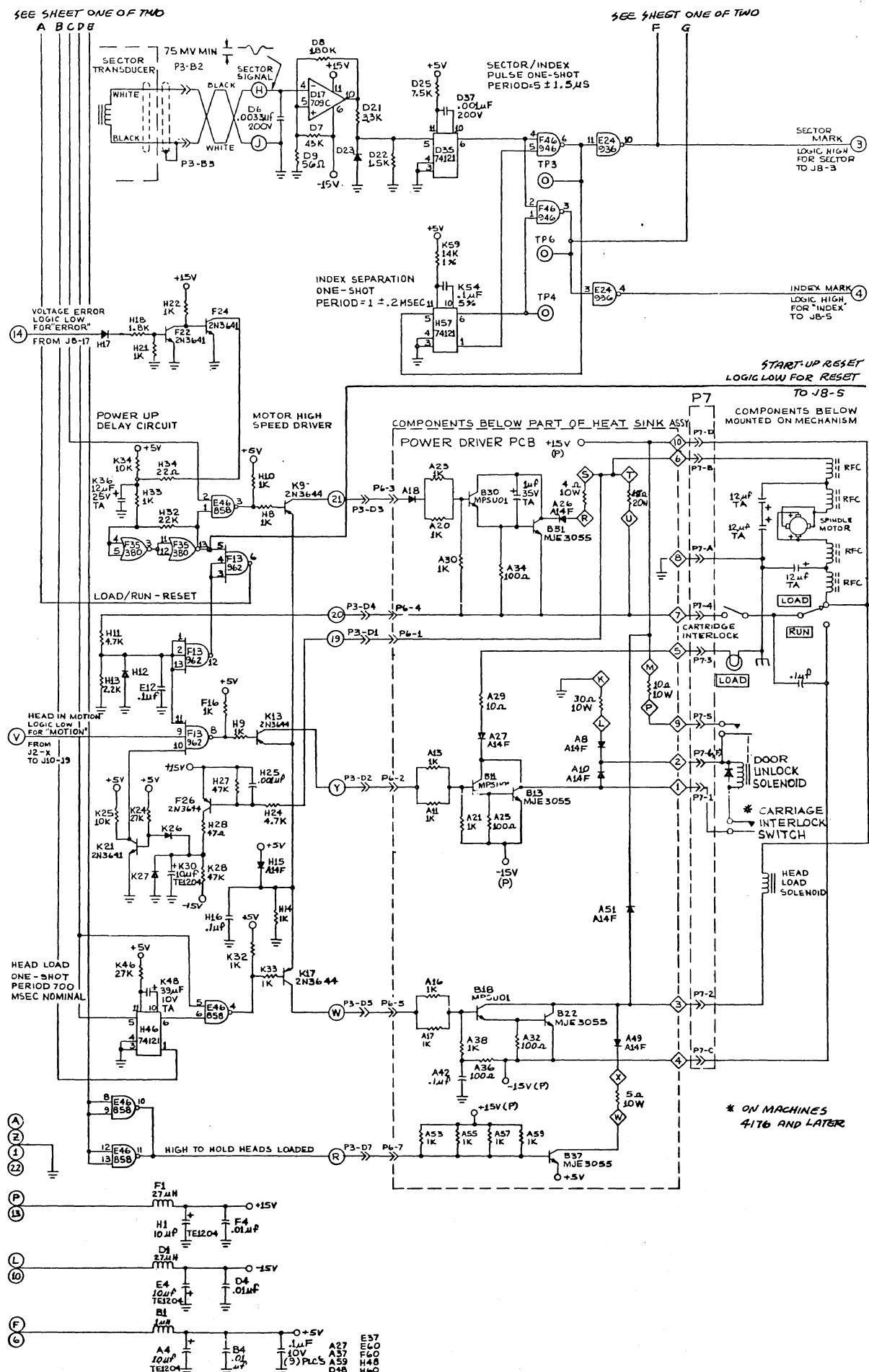
NOTES:

- VOLTAGES MARKED (P) ARE SUPPLIED FROM POWER SUPPLY CABLE CONNECTOR (P1) PINS K & R RATHER THAN H & R WHICH SUPPLY VOLTAGE TO MOTHER-BOARD DISTRIBUTION BUSS.
- THIS SCHEMATIC REPRESENTS "WRITE PROTECT" OPTION E8, E11, E13, E14, E16, F14 ARE OMITTED. RESISTOR E7 IS 22Ω, ±5%, 1/2 W. PIN 11 OF POSITION A24 IS GROUNDED.
- FOR "WRITE PROTECT" OPTION, THE COMPONENTS OMITTED IN STANDARD MACHINE ARE USED. RESISTOR E7 IS 270Ω, ±5%, 1/2 W; A14 IS 150Ω, ±5%, 1/2 W. PIN 11 OF A24 IS NOT GROUNDED.

F 6

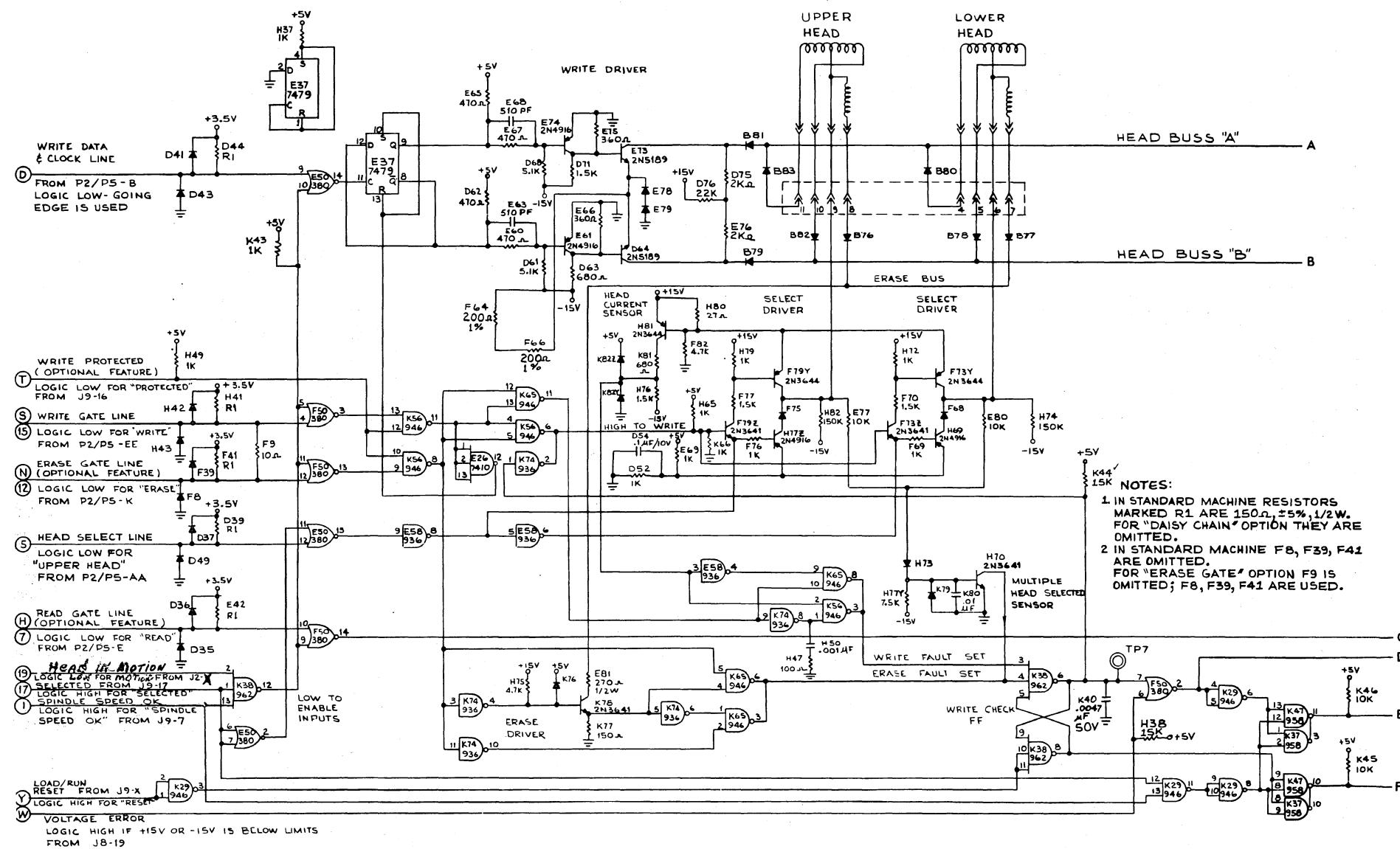
A B C D E  
SEE SHEET 2 OF 2

SEE SHEET 2 OF 2



**Figure 6-6. START-UP AND LOGIC J-9 (sheet 2 of 2)**  
**SCHEMATIC #11071 REVISION H**

**Figure 6-7. STANDARD DENSITY DATA CARD (sheet 1 of 2)**



**Figure 6-7. STANDARD DENSITY DATA CARD J-10 (sheet 2 of 2)**

SCHEMATIC #11113 REVISION G

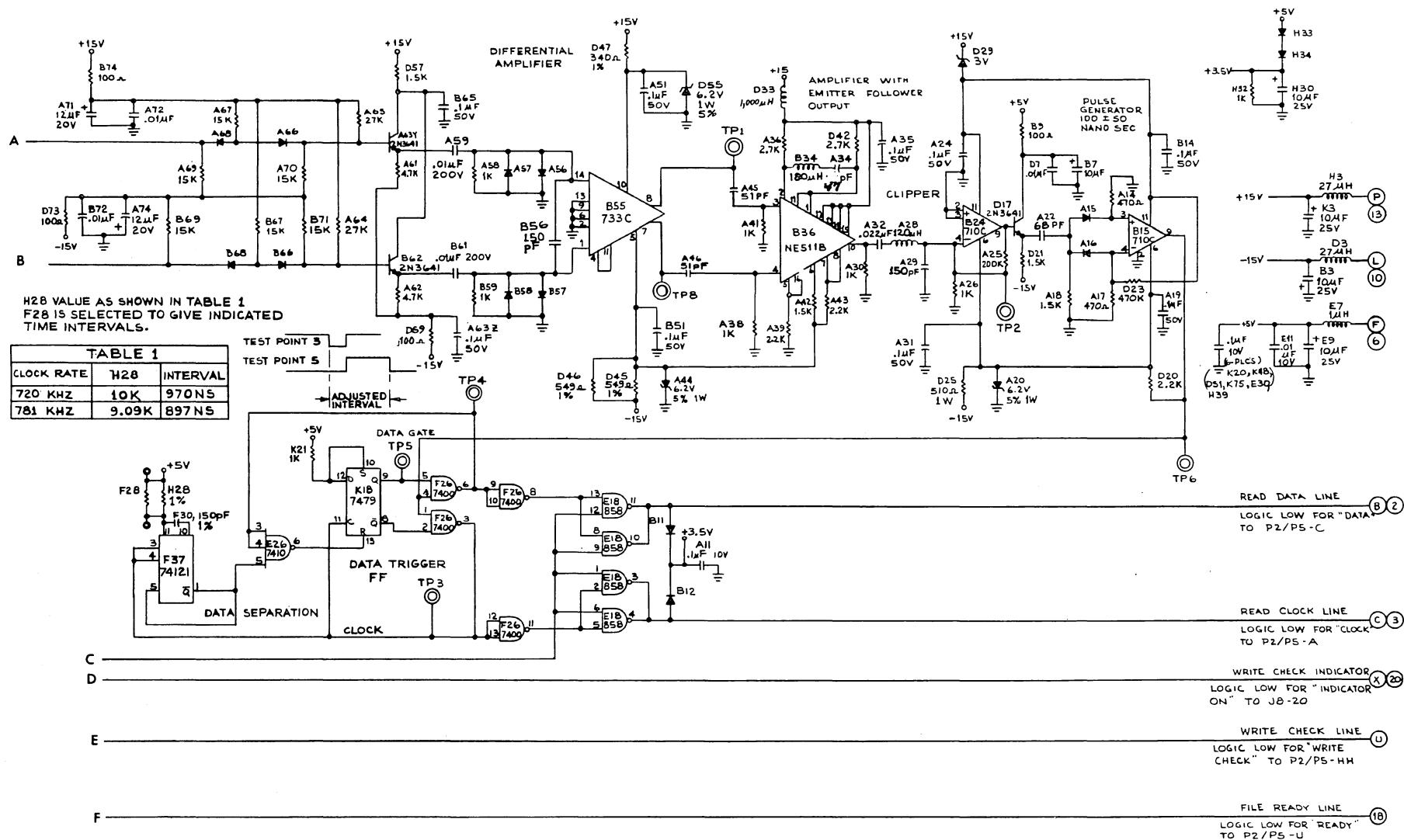
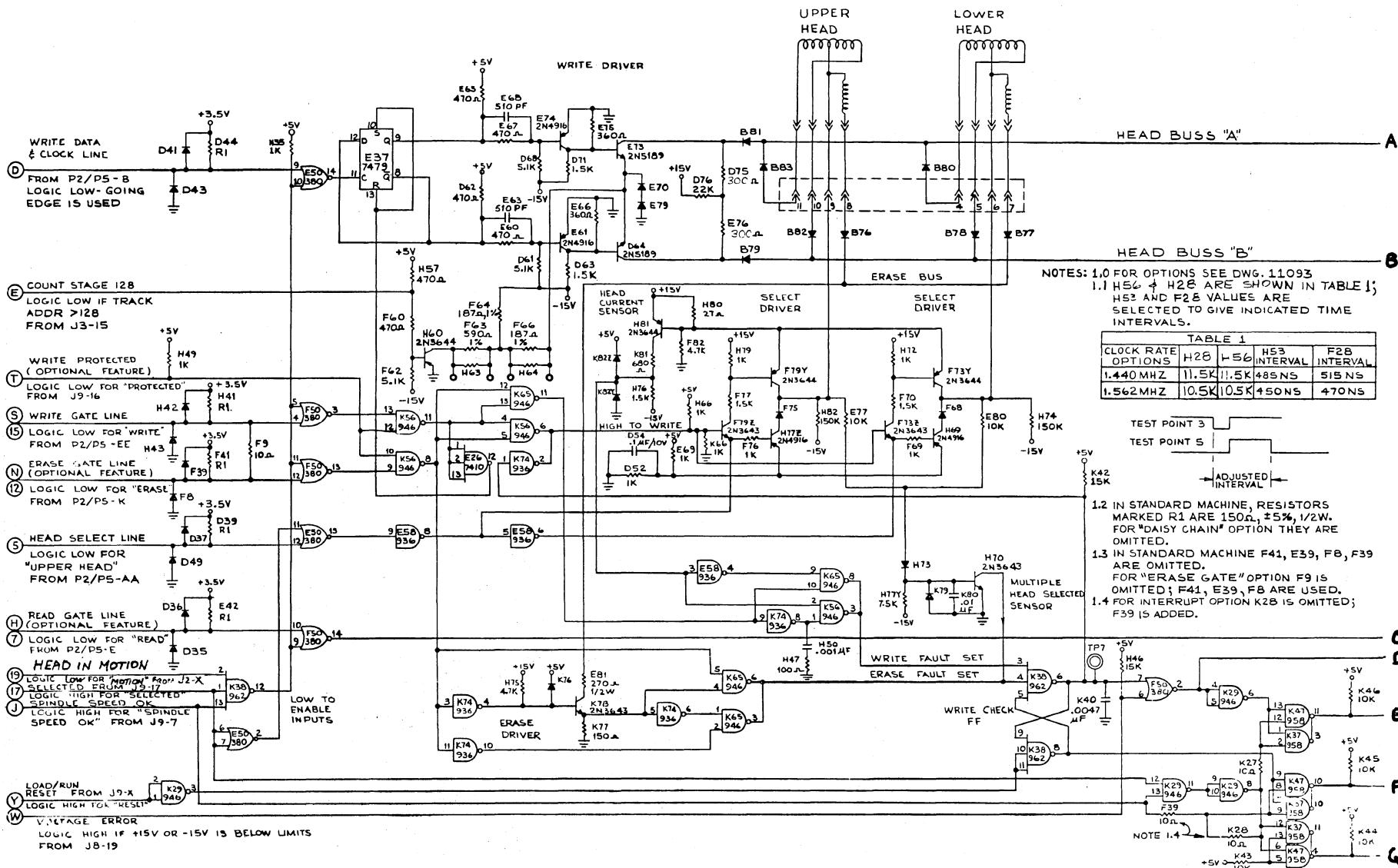
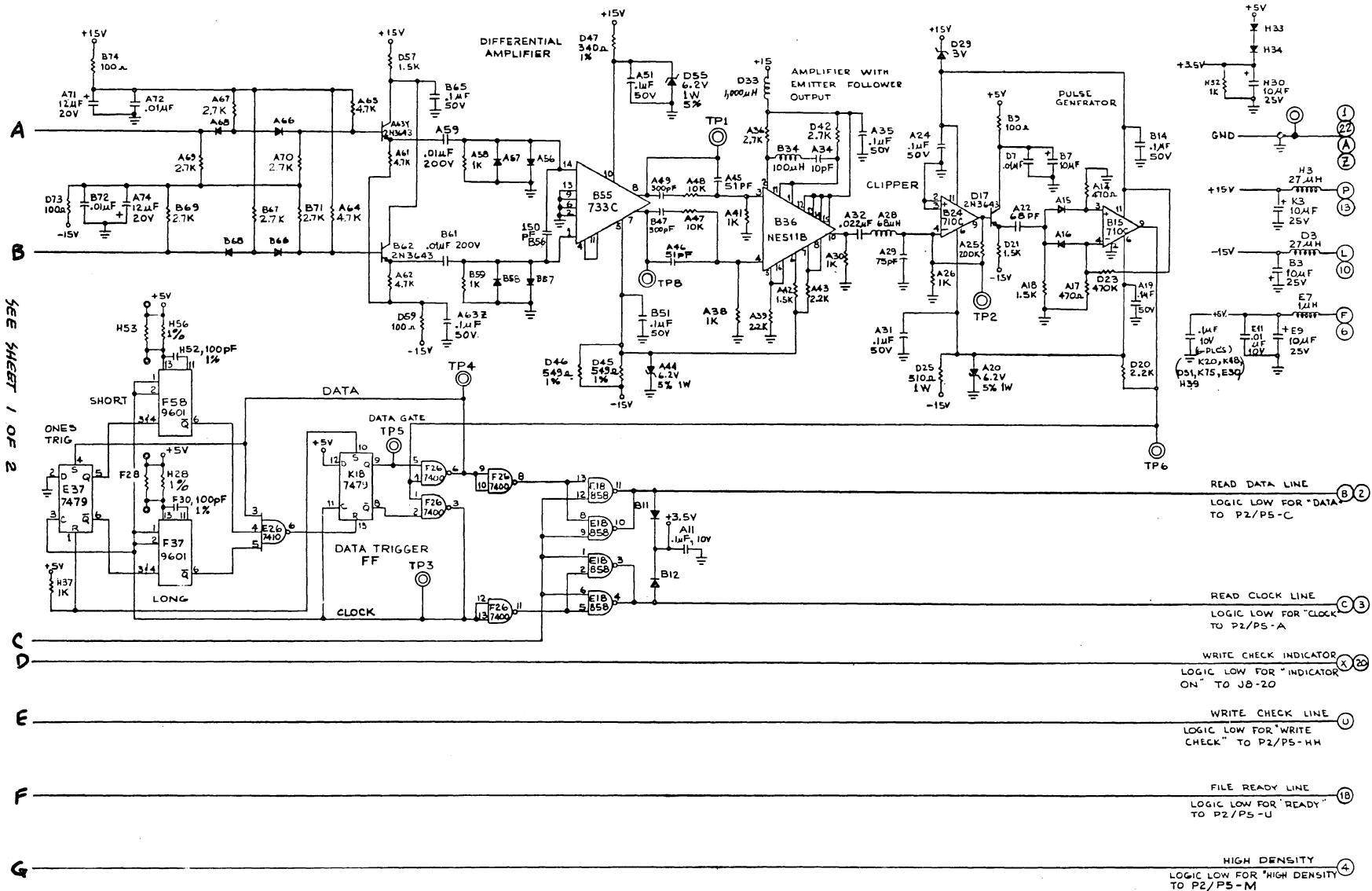
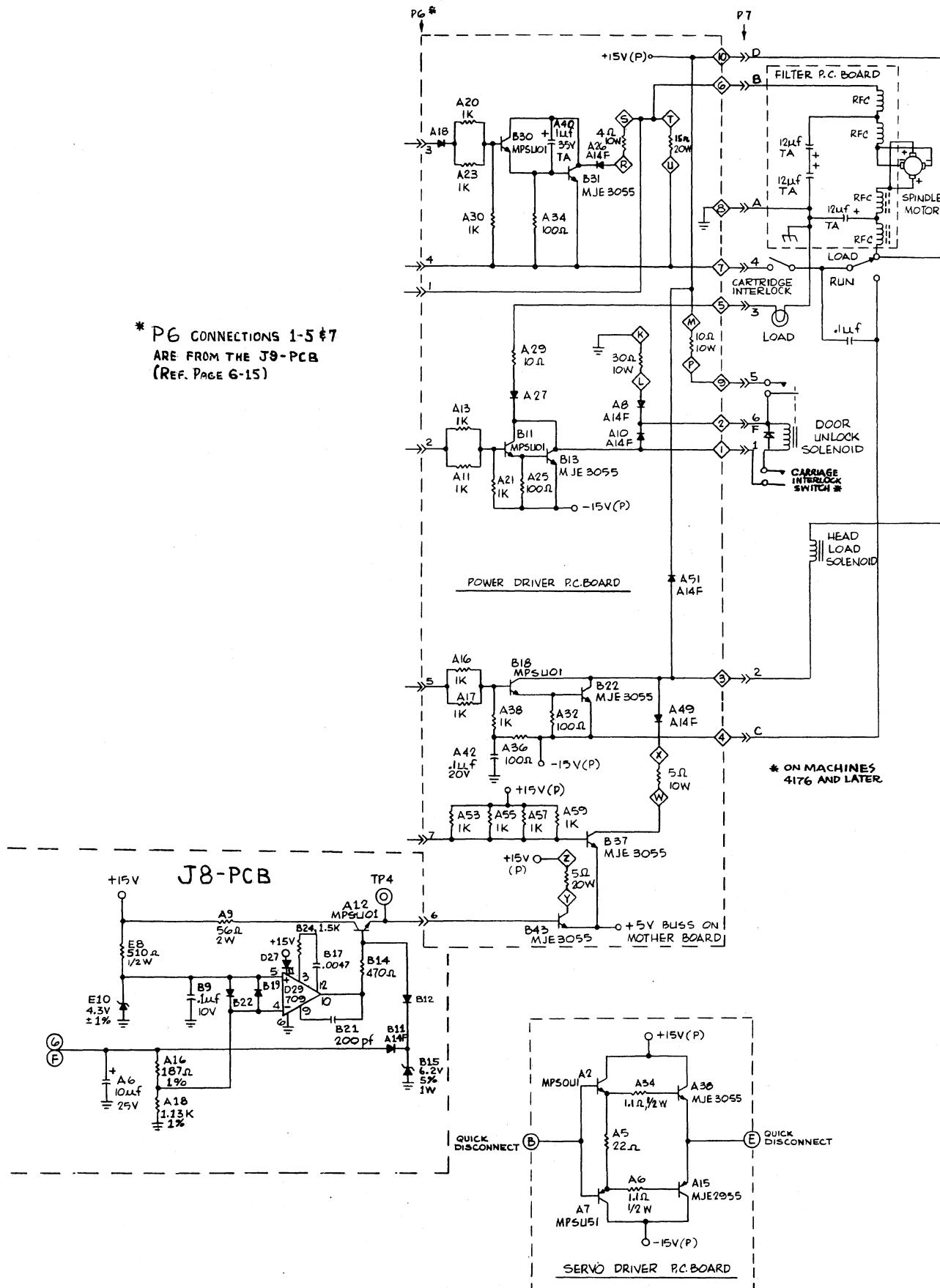


Figure 6-8. HIGH DENSITY DATA CARD J-10 (sheet 1 of 2)



**Figure 6-8. HIGH DENSITY DATA CARD J-10 (sheet 2 of 2)**





**Figure 6-9. POWER DRIVERS**

**SCHEMATIC # 11030 REVISION A**

## **SECTION 7**

### **PARTS LIST**

The purpose of this section is to provide Diablo part numbers for replacement and spare parts ordering. A price list of the recommended spare parts is available and will be provided upon request. Pricing on each item shown in this section is also available upon request.

This section is helpful in determining mechanical placement of components during training or maintenance and should not be overlooked.

Maintenance items, not shown, are listed below.

1. Preventive Maintenance Kit — 99000-xx
  - a) Cleaning pads 99000-01
  - b) Syringe Oiler 99000-02
  - c) Bottle of Oil 99000-07
  - d) Light Bulb 10545-xx
  - e) Air Filter 15170-xx
  - f) Carrying Case 99000-06
2. Tools required for Corrective Maintenance
  - a) Extender Card 11040-xx
  - b) C.E. Cartridge Note #1
  - c) Torque Wrench  
Set 99001-xx
3. Optional tools for Corrective Maintenance.
  - a) Exerciser 11142
  - b) Tester xxxxx
  - c) Track "O" bar 15172  
and cone 15171

See item 90, of List 1, for components supplied with the slide mounting kit.

Series 30 Disk Drives are shipped in a reusable carton. This carton is part number 15488-xx.

Note 1: Std. Density P/N 70257  
High Density P/N 70268

## 7.1 SPARE PARTS LIST – See Figure 7-2a and 7-2b

Item	Part Number	Qty	Description
1	11062-00	1	Heatsink and Motherboard assembly. See Figures 7-6 and 7-7 for additional details. Specify serial number of machine and options installed for replacement.
2	15395-xx	1	Shadow Box Assembly - Rack Mount unit.
3	15434-01	1	Base Plate assembly - See Figure 7-3 for additional details.
4	15481-01	1	Panel and Door assembly - See Figures 7-5 a and b for additional details.
5	15342-00	1	P-7 Connector bracket.
6	15226-xx	2	Gasket - P.C. board.
7	10535-11	1	Cable Clamp 1/8".
8	10535-12	5	Cable Clamp 1/4".
9	10537-00	6	D-Washer
10	70031-08	10	Machine Screw No. 8-32.
11	70168-08	14	Lock Washer No. 8.
12	70030-04	40	Machine Screw No. 6-32.
13	70168-06	40	Lock Washer No. 6.
14	70029-04	5	Machine Screw No. 4-40.
15	70168-04	7	Lock Washer No. 4.
16	70029-07	2	Machine Screw No. 4-40.
17	70169-04	2	Washer No. 4.
18	70166-04	2	Hex Nut No. 4-40.
19	15283-xx	2	Snap Button Plug
20	70244-xx	3	Hex Nut 5/16-18
21	70168-14	3	Lock Washer 5/16
22	10513-xx	2	Quick Disconnect Terminal
23	10538-xx	1	Tie Wrap
24	70039-04	10	Machine Screw No. 6-32
25	15221-xx	1	Retainer - P.C. board
26	15194-xx	4	Spring
27	15189-xx	4	Spring Cover
28	Not Used	-----	Location for additional P.C.B.
29	Not Used	-----	Location for additional P.C.B.
30	Not Used	-----	Location for additional P.C.B.
31	Not Used	-----	Location for additional P.C.B.

Item	Part Number	Qty	Description
32	11085-xx	1	P.C.B. J8 Note 1
33	11071-xx	1	P.C.B. J9 Note 1
34	11113-xx	1	P.C.B. J10 Note 1. Use 11082 for High Density.
35	15185-xx	1	Retainer - P.C.B.
36	11026-xx	1	P.C.B. J3 Note 1
37	11111-xx	1	P.C.B. J2 Note 1
38	11078-xx	1	P.C.B. J1 Note 1
39	15486-xx	2	Spacer - cartridge closing
40	70039-12	2	Flat Head No. 6-32 Screw
41	70169-06	2	Plain Washer No. 6
42	70166-06	2	Hex Nut No. 6-32
43	15487-xx	1	Spring - Cartridge closing
44	15414-xx	1	Shipping Restraint
45	15277-xx	1	H-Frame
46	15404-xx	1	Cartridge Receiver Assembly - See Figure 7-8 for additional details.
47	15099-xx	2	Eccentric - Cartridge Receiver
48	15095-xx	2	Bushing - Cartridge Receiver
49	70031-10	4	Screw No. 8-32
50	70169-08	4	Washer No. 8
51	25046-xx	1	Upper Head Assembly, 1100 BPI use Part No. 25065 for 2200 BPI head
52	25047-xx	1	Lower Head Assembly, 1100 BPI use Part No. 25066 for 2200 BPI head
53	15549-xx	1	Bottom Rear Cover - Shadow box
54	15406-xx	1	Bottom Front Cover - Plenum Chamber
55	15245-xx	2	Spring - Cartridge Receiver
56	15170-xx	1	Air Filter
57	15295-xx	1	Reflector Assembly
58	70030-06	4	Screw No. 6-32
59	70066-04	2	Undercut Screw No. 6-32
60	10544-02	1	Lens - Red
61	10544-03	1	Lens - Orange
62	10544-04	1	Lens - Yellow
63	10544-09	1	Lens - White
64	10545-xx	4	Lamp

<b>Item</b>	<b>Part Number</b>	<b>Qty</b>	<b>Description</b>
65	15471-xx	1	Strip Assembly - Front Trim - Orange Diablo logo, use Part No. 15224-01 for Orange no logo, use Part No. 15224-02 for unpainted no logo.
66	15438-xx	1	Narrow indicator trim - Power - use Part No. 15439-xx for Write Protect Option.
67	15546-xx	1	Top cover assembly.
68	15386-xx	8	Truss Screw No. 8-32
69	15387-xx	8	Washer
70	15453-xx	2	Trim - Window support
71	15455-xx	2	Magnet - Retainer assembly
72	15476-xx		Screw
73	15383-xx		Trim Shadow Box
74	11114-xx	1	R/W Head Cable assembly. Use 11061 with J10-11006.
75	15442-xx	1	Label - Caution
76	15449-xx	2	Label - P.C.B. retainer
77	15445-xx	1	Label - Serial number
78	15428-xx	1	Head Positioner assembly - See Figures 7-4a, b and c for additional details
79	15536-01	1	Spindle Assembly 1100 BPI; use Part No. 15536-02 for 2200 BPI option.
80	15415-xx	1	Sector Tranducer - See Figure 7-9.
81	11048-xx	1	Filter Board Assembly - See Figure 7-10.
82	70229-xx	6	Rubber Feet
83	11116-xx	1	Motherboard assembly - order by part number, specify options installed and serial number of machine when ordering replacement. See Figure 7-6 for additional details.
84	11050-xx	1	Heatsink assembly - Specify serial number of machine when ordering replacement. See Figure 7-7.
85	Not Used	----	Not Used
86	Not Used	----	Not Used
87	Not Used	----	Not Used
88	Not Used	----	Not Used
89	Not Used	----	Not Used
90	Not Shown		Slide Mounting Kit assembly

Item	Part Number	Qty	S Description
	15376-xx	2	Slides
	70023-05	8	Screw No. 10-32 x 5/16
	70168-10	8	Lock Washer No. 10
	70169-10	8	Flatwasher No. 10
	70005-08	4	Phillips Truss head Screw No. 10-32 x 1/2
	15558-xx	4	Brackets
	70031-06	8	Screw No. 8-32 x 3/8
	70166-08	8	Hex Nut No. 8-32
	70168-08	8	Lock Washer No. 8
	70169-08	8	Flat Washer No. 8
91	15488-xx	1	Shipping Container (not shown)
92	15587-xx	1	Shipping Restraint

**Note 1:** Specify options and serial number of machine when ordering replacements. Each P.C.B. is marked with an assembly number and option code, if applicable. The two suffix numbers designate option code. Early production P.C.B.'s have part numbers that differ from those listed above and may not be compatible with present level machines.

Figure 7-2a. MAIN ASSEMBLY DRAWING

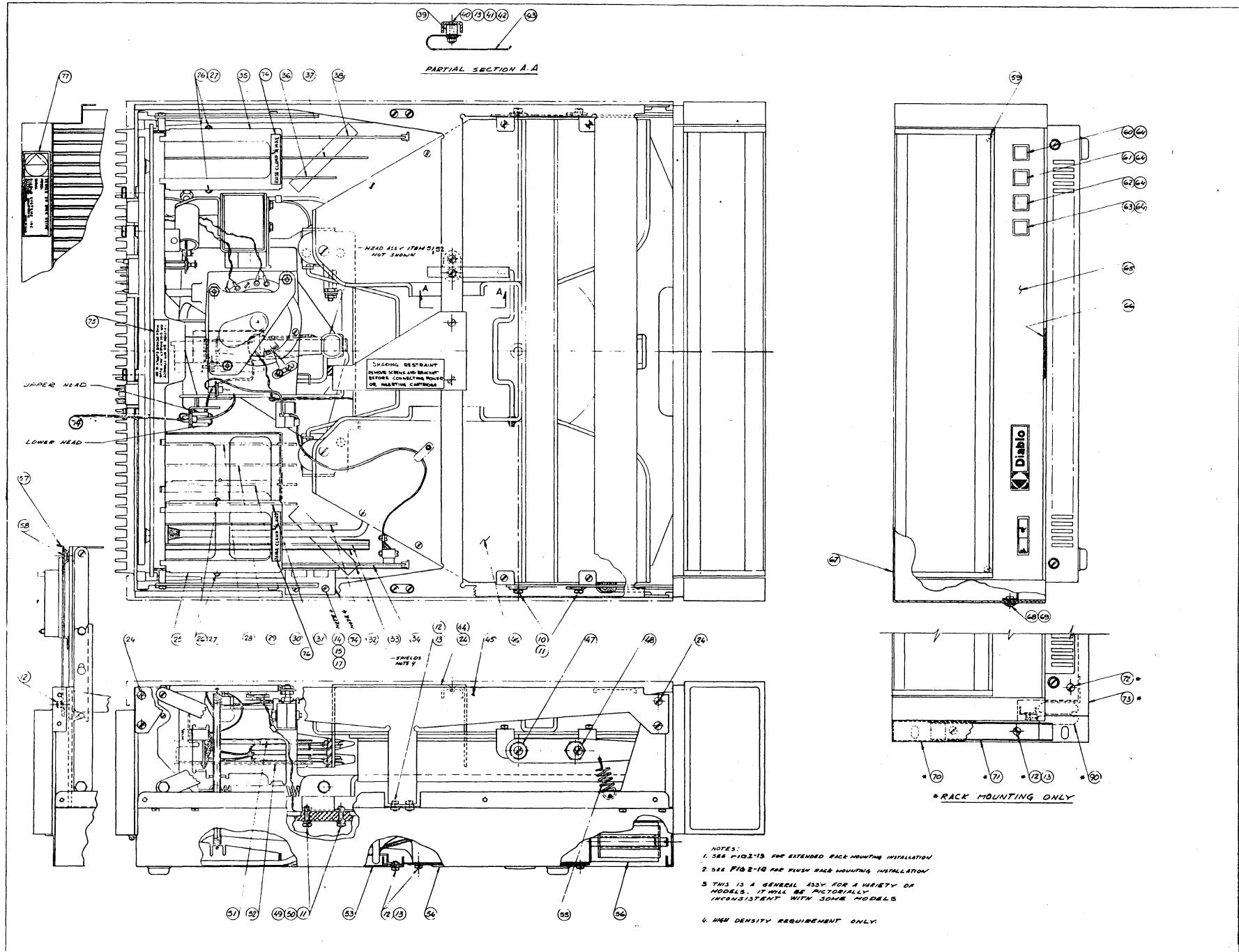
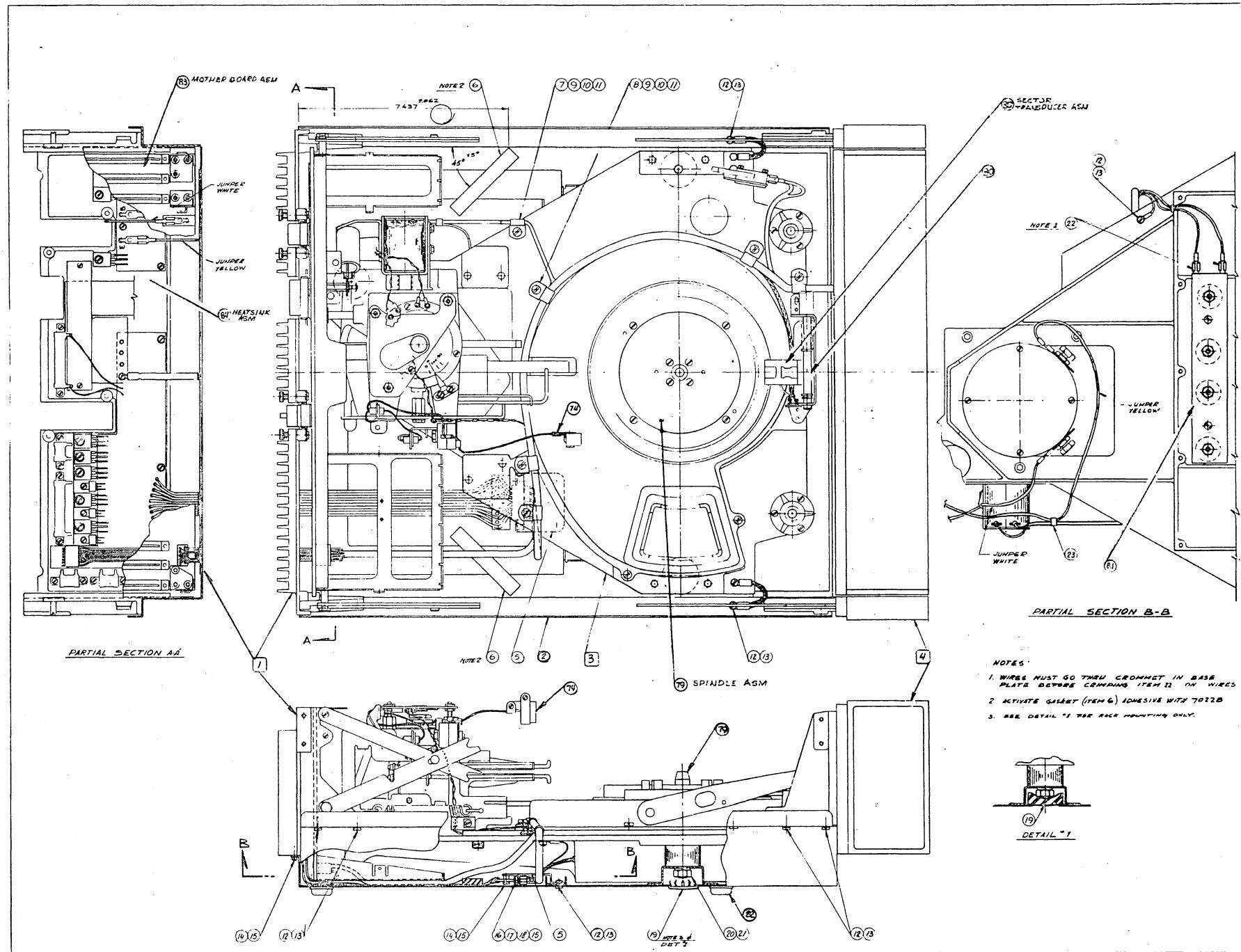


Figure 7-2b. MAIN ASSEMBLY DRAWING



**Figure 7-3.** BASE PLATE ASSEMBLY

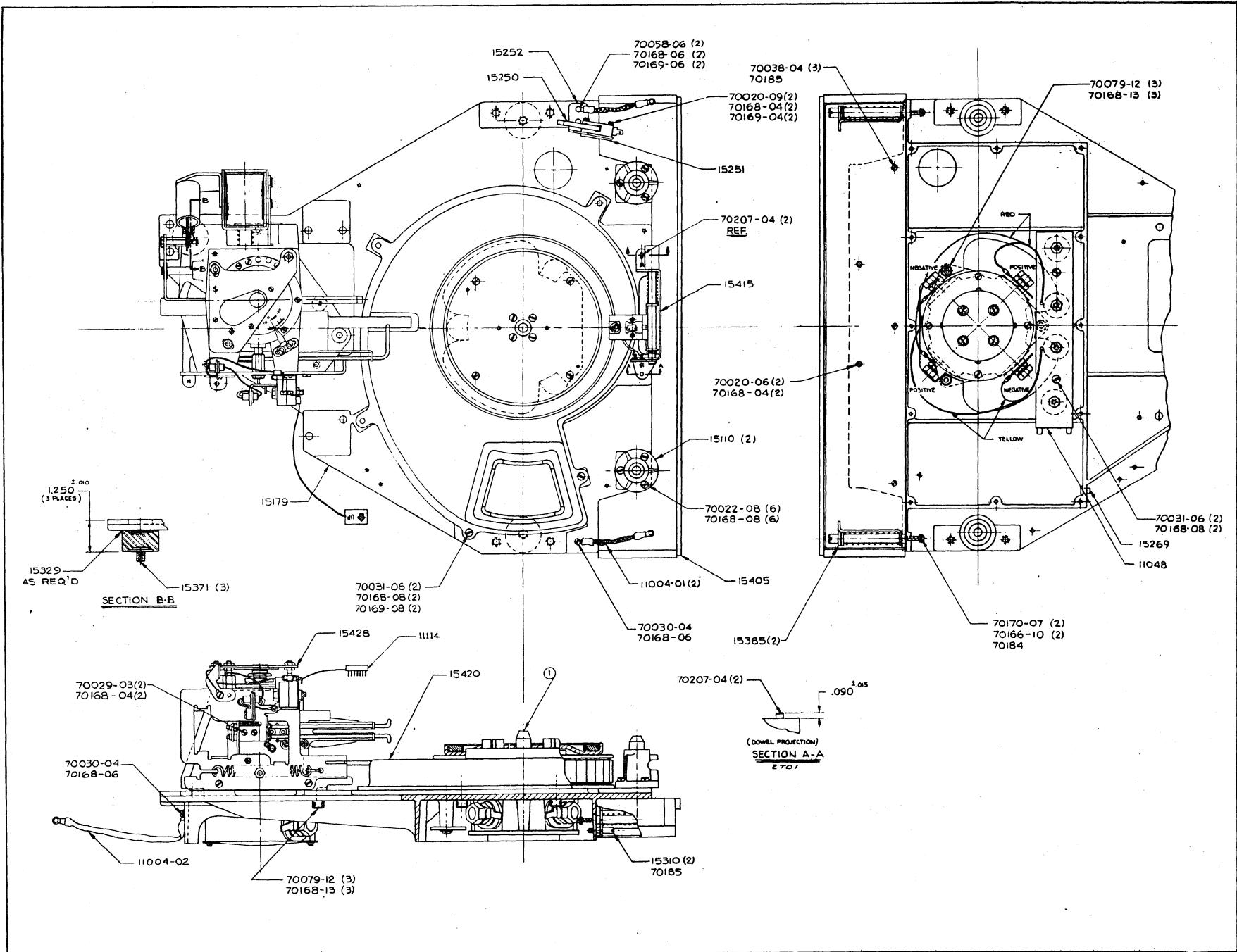
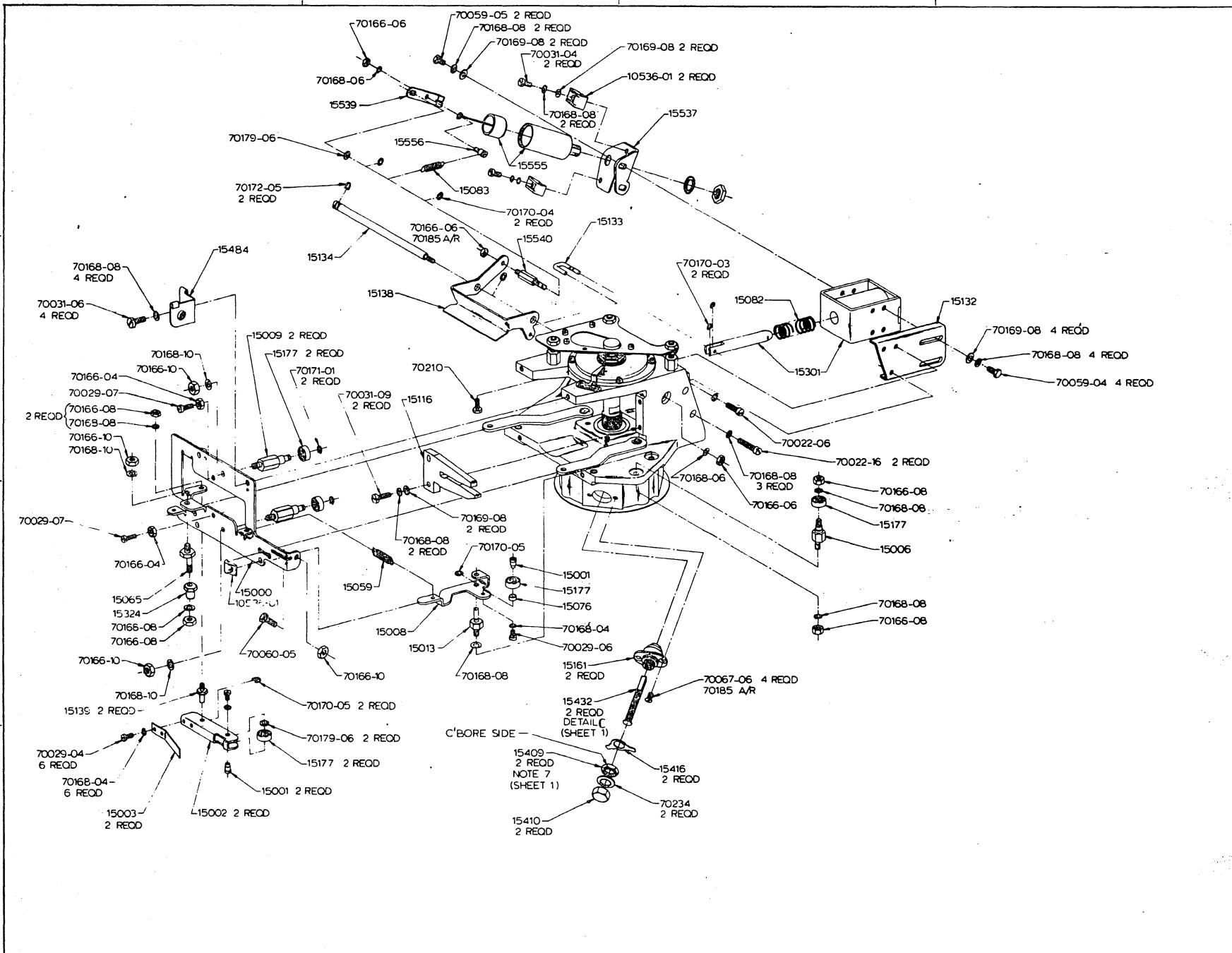
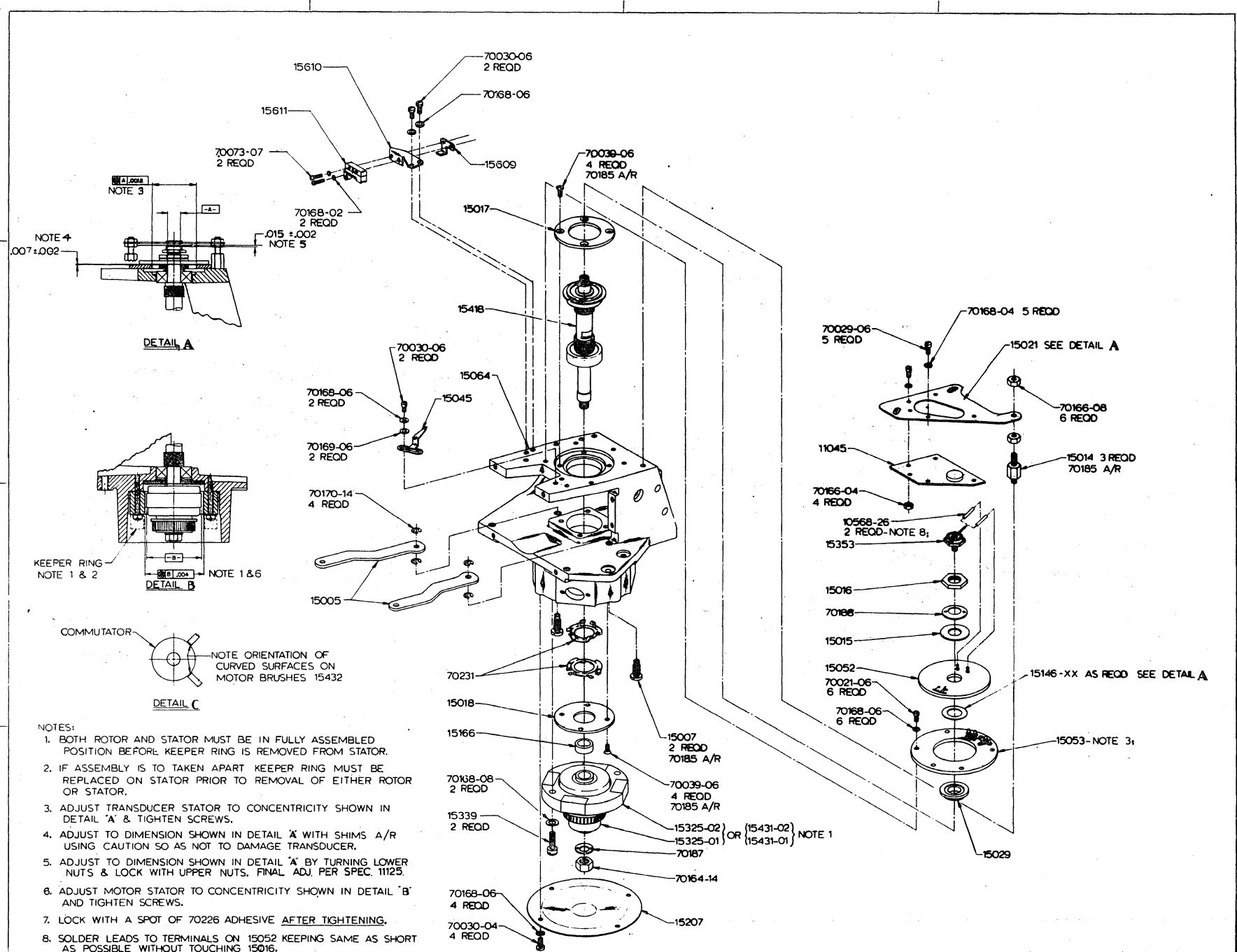


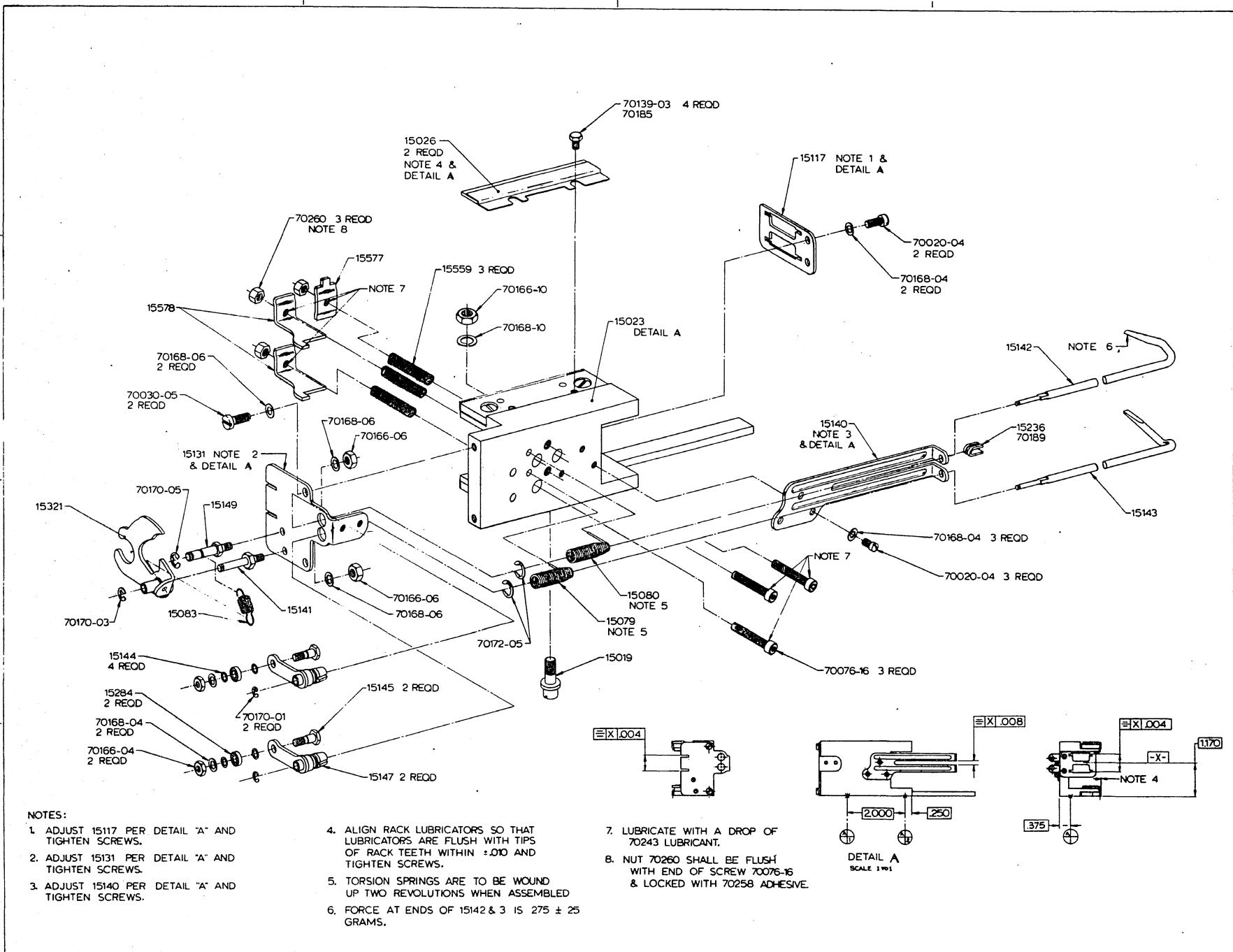
Figure 7-4a. HEAD POSITIONER, HOUSING ASSEMBLY



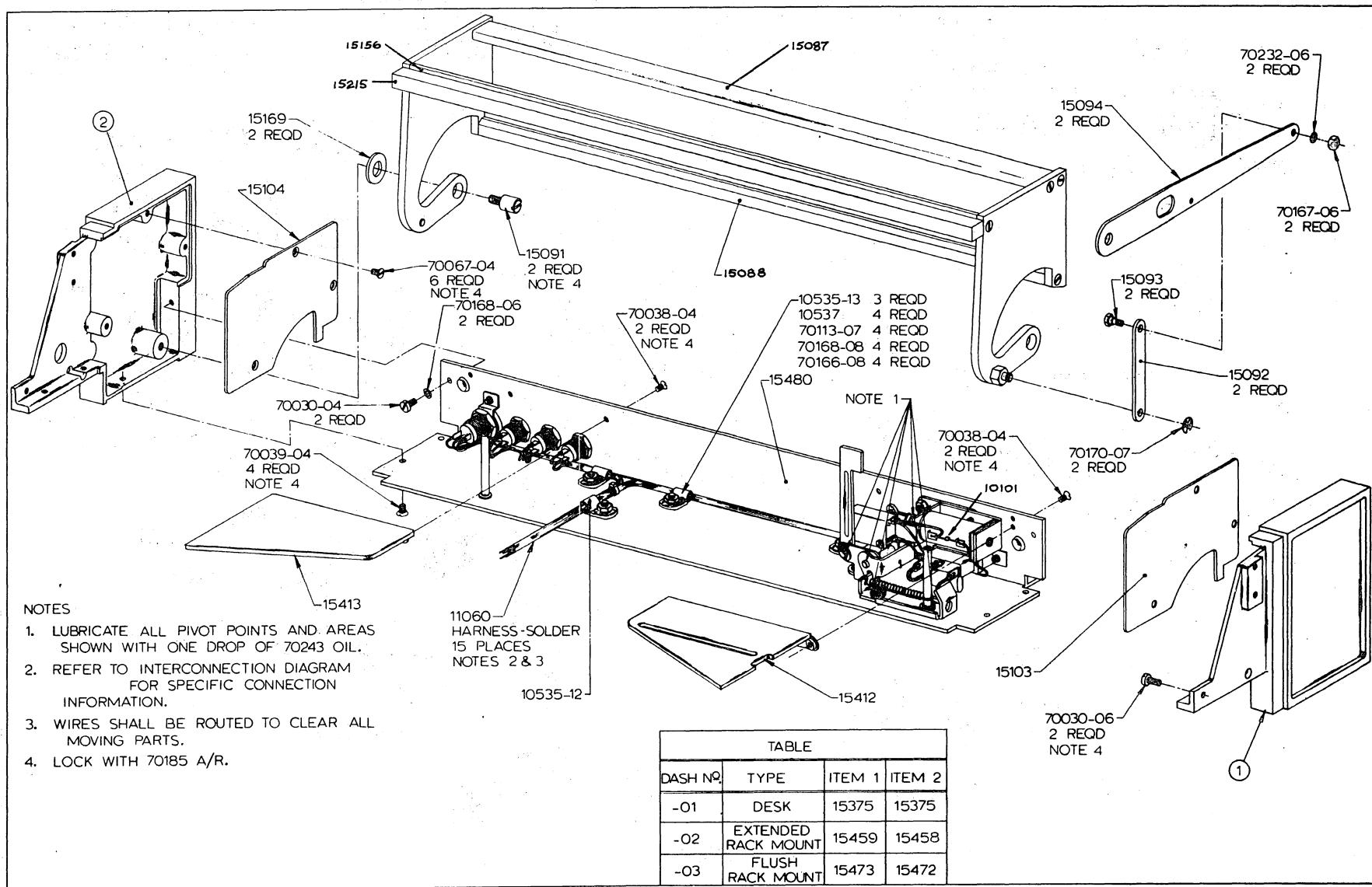
## **HEAD POSITIONER, HOUSING ASSEMBLY**



**Figure 7-4c. HEAD POSITIONER (CARRIAGE)**



**Figure 7-5a. PANEL AND DOOR ASSEMBLY**



**Figure 7-5b. PANEL AND DOOR ASSEMBLY**

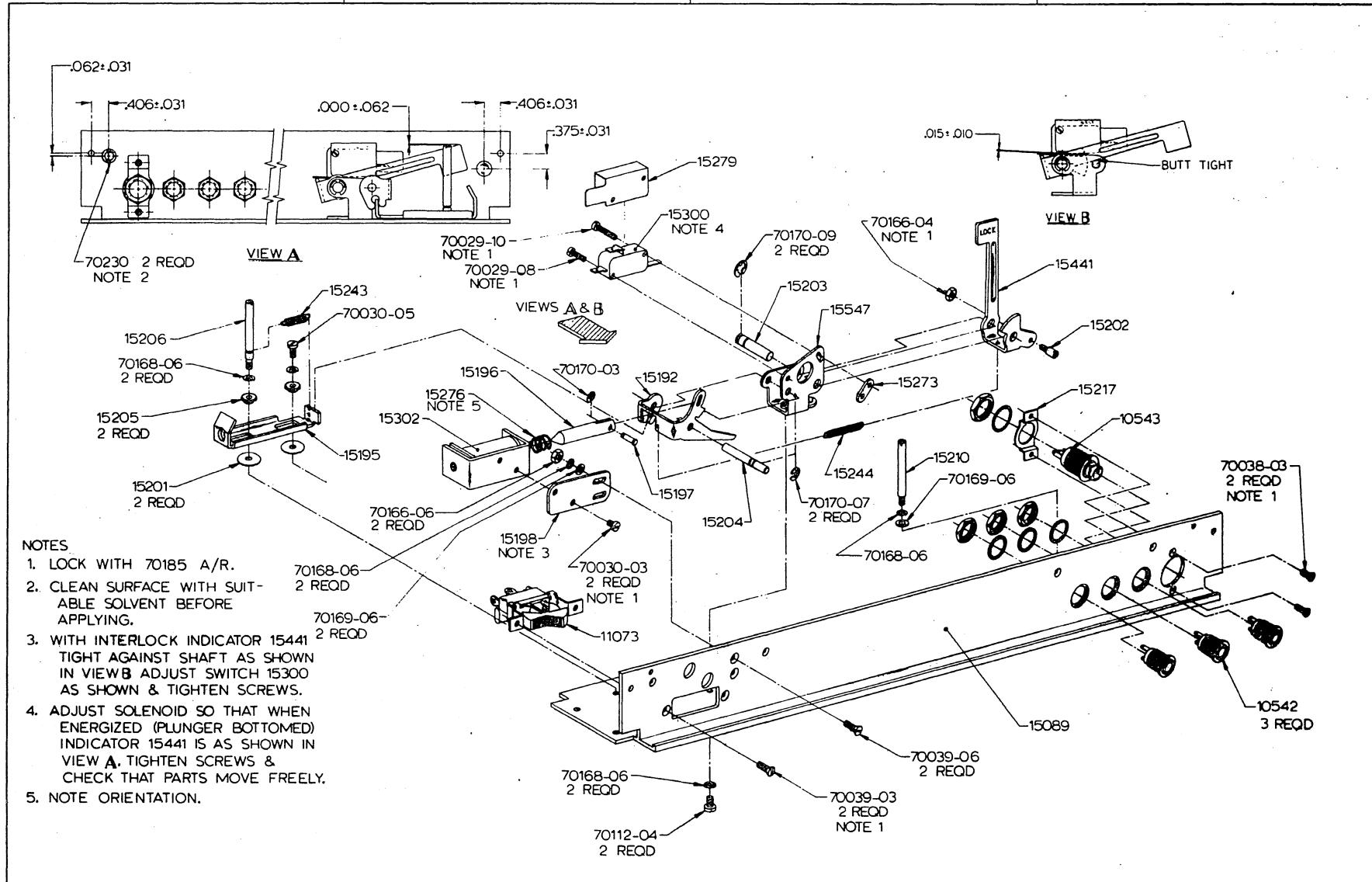
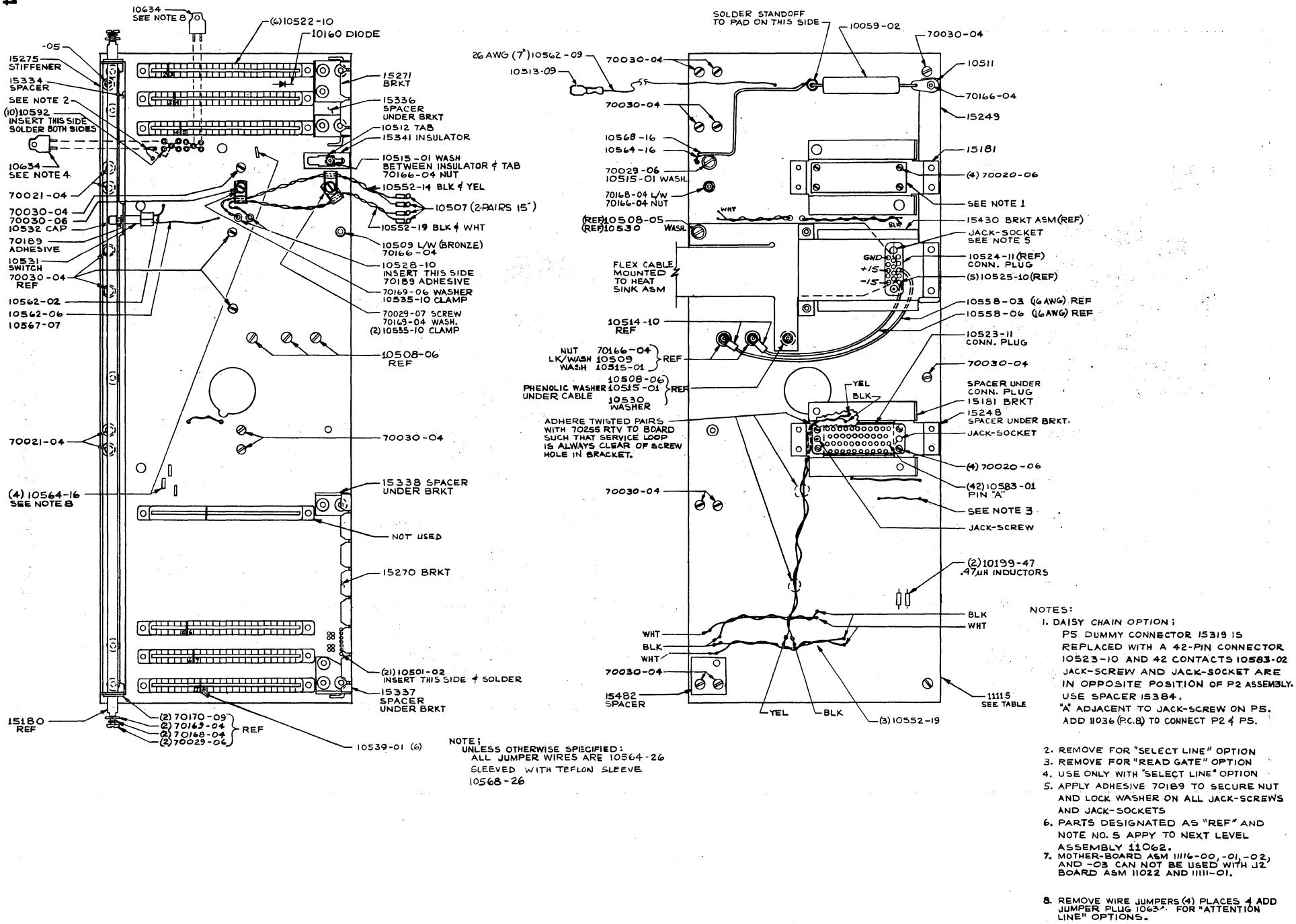
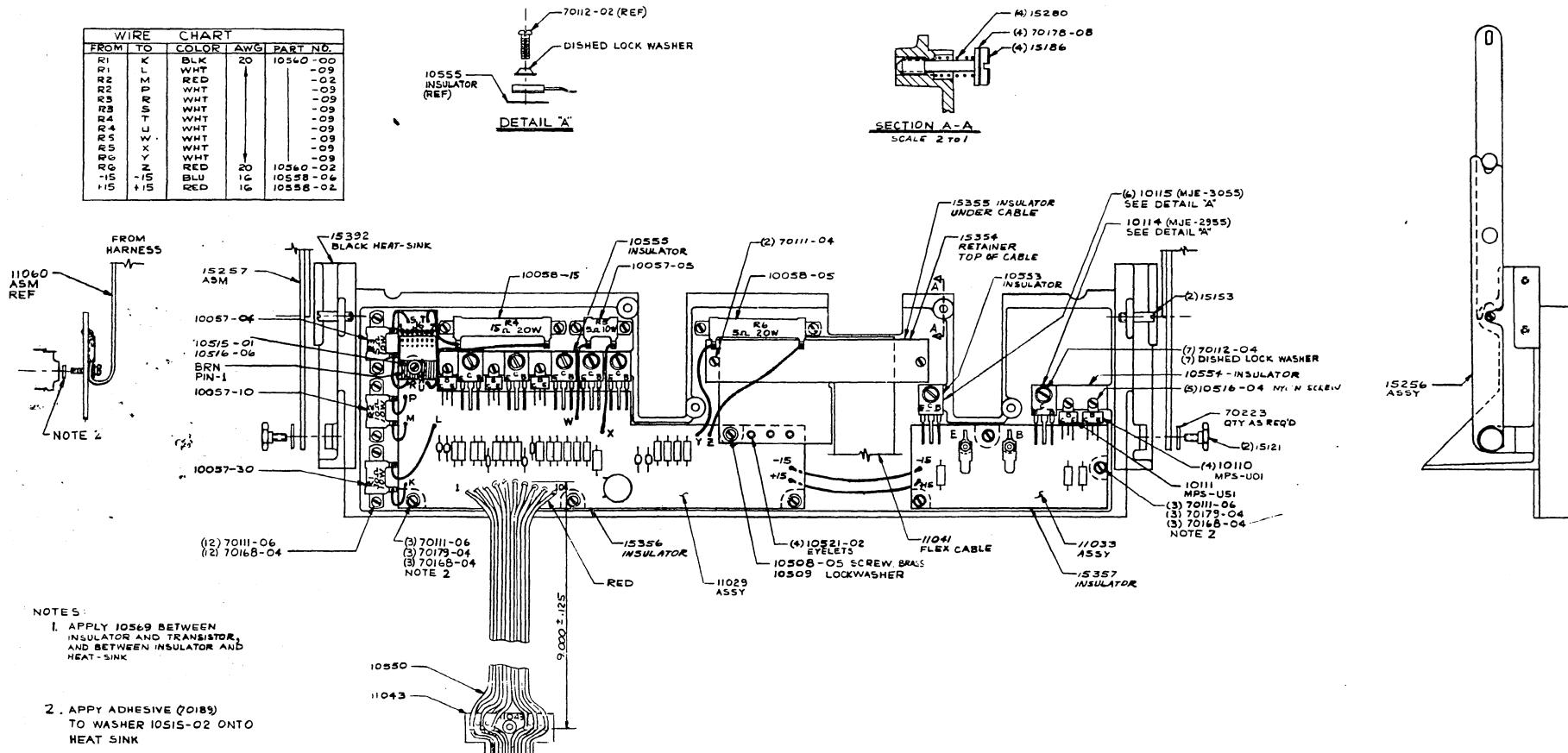


Figure 7-6. MOTHERBOARD ASSEMBLY



**Figure 7-7. HEATSINK ASSEMBLY**



**Figure 7-8.** DISK CARTRIDGE RECEIVER ASSEMBLY

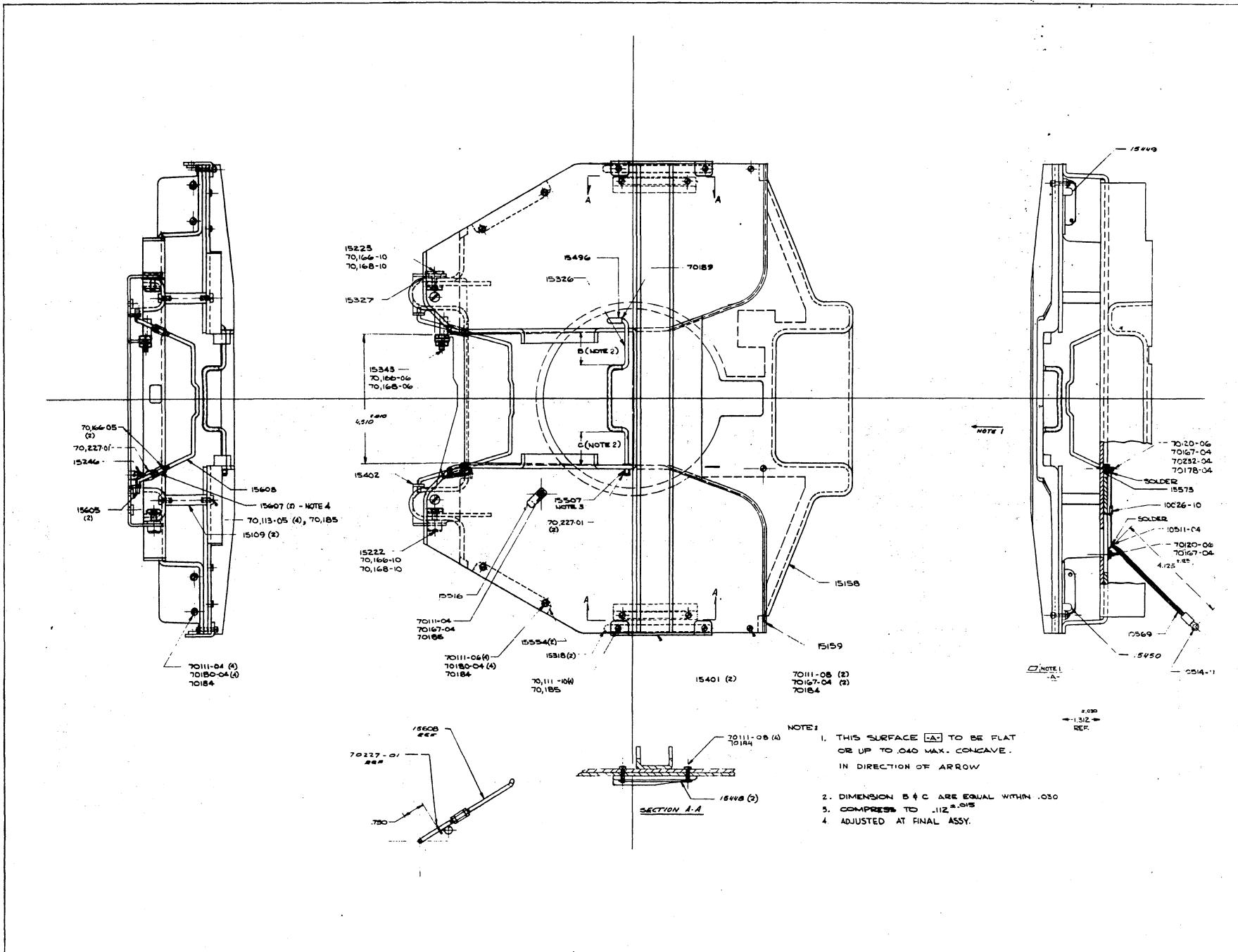


Figure 7-9. SECTOR TRANSDUCER ASSEMBLY

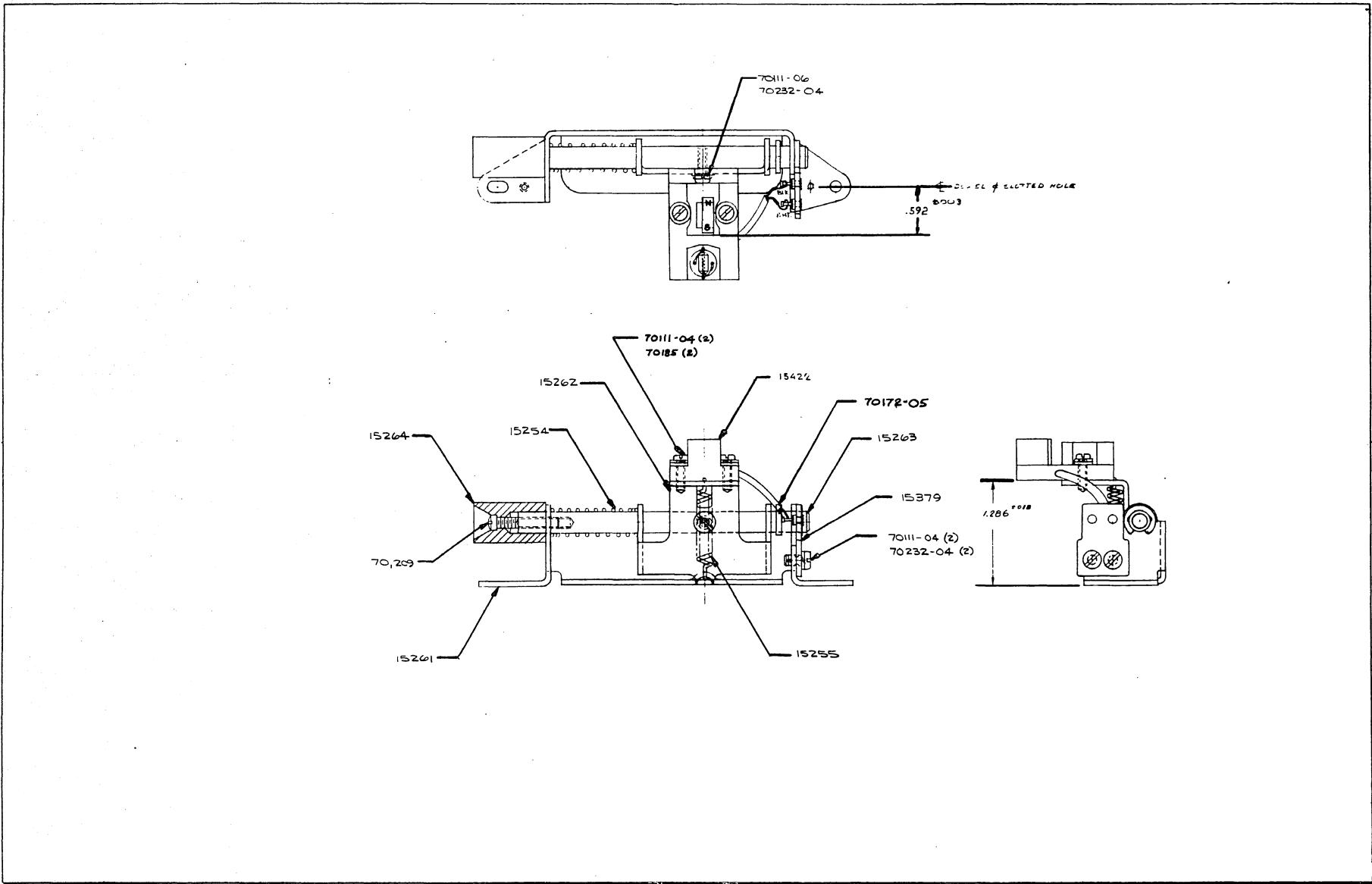
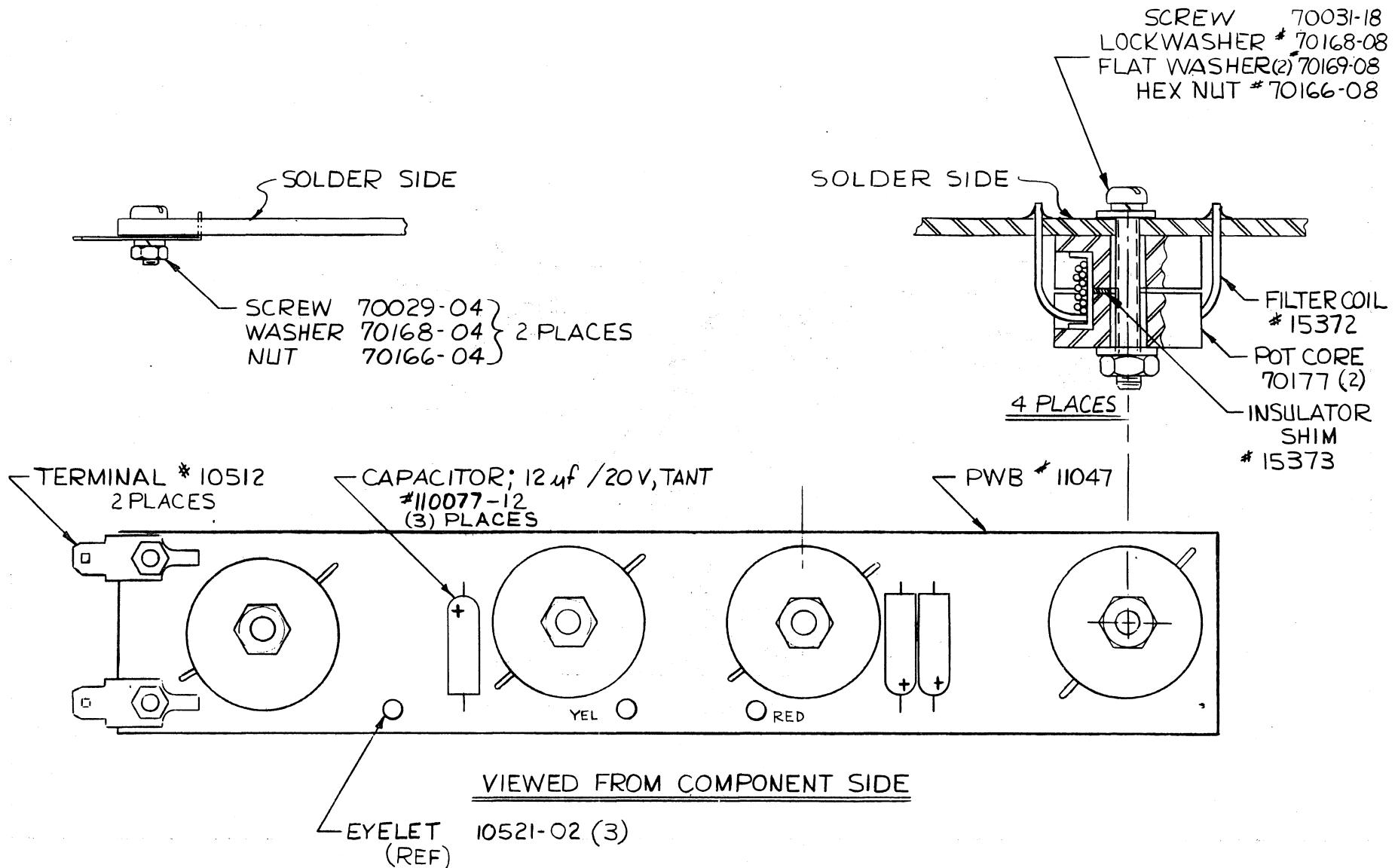


Figure 7-10. FILTER BOARD ASSEMBLY





September 16, 1971

FIELD SERVICE AID #1

MEMO TO: Diablo Series 30 Customers

FROM: Diablo Field Service Manager, J. Petruk

SUBJECT: Control of Engineering Changes and Options on Pluggable Circuit Cards

Each pluggable circuit board(PCB) is assigned a unique five digit schematic number, a five digit basic PCB part number, a two digit option code and two engineering change revision letters. One revision letter is for the schematic number, the other revision letter is for the basic PCB number.

The etched schematic number of each PCB is the same as its assembly number and is changed only if fit or function is changed. Presently used schematic numbers are listed below.

<u>Location</u>	<u>Schematic</u>	<u>Location</u>	<u>Schematic</u>
J1	11078	J8	11085
J2	11111	J9	11071
J3	11026	J10	11113 (std. density) 11082 (high density)

The option code indicates the configuration of the PCB. This option code is stamped on each PCB. The option codes presently used are listed below.

<u>Location</u>	<u>Schematic</u>	<u>Option</u>	<u>Configuration</u>
J1	11078	xx	No options
J2	11111	00	Standard
		01	Not used
		02	Interrupt option #048
J3	11026	00	With terminating resistors
		01	Without terminating resistors
		02	Attention Line Negative #046
		03	Attention Line Positive #047
J8	11085	00	With terminating resistors
		01	Without terminating resistors

<u>Location</u>	<u>Schematic</u>	<u>Option</u>	<u>Configuration</u>
J9	11071	00	Without terminating resistors or Write Protect
		01	Write Protect & terminating resistors
		02	Not used
		03	Write Protect & without terminating resistors
J10 (Std.)	11113 (720 or 781 KHz)	00 04 01 05 02 06 03 07	With terminating resistors With terminating resistors & Erase Gate Without terminating resistors Without terminating resistors & with Erase Gate
J10 (High)	11082 (1440 or 1562 KHz)	08 12 09 13 10 14 11 15 16	With terminating resistors With terminating resistors & Erase Gate Without terminating resistors Without terminating resistors & with Erase Gate Interrupt Option #048

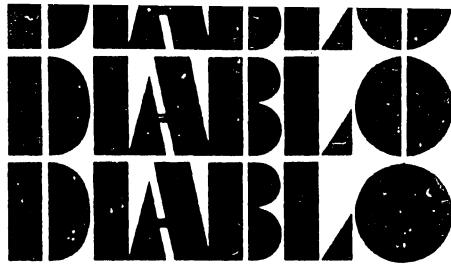
Schematics in the present Maintenance Manual, issued October 1971, indicate the changes necessary to change a PCB from one common option code to another. PCB's with an earlier revision level than shown in this Maintenance Manual may not be compatible for some changes.

Revision letters indicate changes. A change in both revision letters will occur whenever there is new artwork issued for the Pluggable circuit board. A change in the schematic revision letter will occur whenever an individual component is changed. A paperwork change or correction could change both or only one revision letter. Field Service Aid #2 will contain pertinent revision letter history for each of the presently used schematics.



J. Petruk  
Field Service Manager

JP:jr



October 18, 1971

FIELD SERVICE AID #2

MEMO TO: Diablo Series 30 Customers

FROM: Diablo Field Service Manager, J. Petruk

SUBJECT: Pertinent Revision Level History of Pluggable Circuit Board Assemblies

Each P.C.B. has two revision level letters. One revision letter is for the schematic drawing, which is the same as the assembly drawing. The second revision letter is associated with the basic board. This Field Service Aid will attempt to list the revision level history of each P.C.B. schematic drawing starting with the present level and tracing back to as far as practical. The revision level of the basic board will be disregarded unless it is pertinent to the schematic level.

P.C.B. J1-11078

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
E	June 24, 1971	<ol style="list-style-type: none"><li>1. Changed J1-A8, J1-K8 &amp; J1-E25 from 0.39 microfarad tantalum capacitors to 0.39 microfarad ceramic capacitors, Diablo P/N 10075-39.</li><li>2. Changed J1-A20 &amp; J1-K20 from 0.22 microfarad tantalum capacitors to 0.22 microfarad ceramic capacitors, Diablo P/N 10086-22.</li><li>3. Changed J1-A4 to a 100 microfarad tantalum capacitor, Diablo P/N 10078-01.</li><li>4. Changed J1-D75 from a 4.7 nanofarad capacitor to a 2.2 nanofarad capacitor, Diablo P/N 11070-22</li><li>5. Changed J1-B80 to a 0.1 microfarad capacitor, Diablo P/N 10086-10.</li></ol> <p>Changes 1 thru 4 were for increased stability, change 5 was for a packaging change.</p>
D	Dec. 2, 1970	<ol style="list-style-type: none"><li>1. Released for production.</li></ol>

Note: Machines prior to this time used J1-11002 which is not directly interchangeable with J1-11078 because of additional circuitry on J1-11078.

P.C.B. J2-11111

Schematic Level	Date of Change	Description of Change
E	Aug. 18, 1971	1. Addition of 946 I.C. at F57 & resistors at K12, K13, A15 & B16 for option numbers 046 & 047.
D	July 14, 1971	1. Change in dimension to be compatible with J8 & J9.
C	Feb. 23, 1971	1. Rework of assembly to add a capacitor at A16, Diablo P/N 10062-51 & to add Restore FF2-Q to J2-D35 pin 5.
B	Feb. 18, 1971	1. Addition of diode at D39 to cause a reset of Restore FF1 by the Servohold signal during the power-up reset. 2. Release to Production.

Note: Machines prior to this time used J2-11021 which is not directly interchangeable with J2-11111 because of various circuit changes.

P.C.B. J3-11026

Schematic Level	Date of Change	Description of Change
J	Aug. 8, 1971	1. Addition of two I.C.'s for option numbers 046 & 047.
H	July 14, 1971	1. Removal of 10 Ohm resistors at B13 & F32.
G	Jan. 15, 1971	1. Addition of 10 Ohm resistors at B13 & F32.
F	Dec. 23, 1970	1. Addition of 820 Ohm resistor Diablo P/N 10022-82 at L36.
E	Dec. 10, 1970	1. Change documentation to reflect A-55 as a 944 type I.C., it had been shown as a 380 type I.C.
D	Dec. 2, 1970	1. Release to Production.

Note: Machines prior to this time used J3-11025 which is not directly interchangeable with J3-11026 because of circuit changes.

P.C.B. J8-11085

Schematic Level	Date of Change	Description of Change
E	March 9, 1971	1. Changed 10 microhenry inductors at A33 & A35 to 1 microhenry inductor, Diablo P/N 10200, to decrease the rise & fall time of the Sector & Index pulses.
D	Dec. 8, 1970	1. Release to Production.

Note: Machines prior to this time used J8's 11084, 11067, or 11014 which are not directly interchangeable with J8-11085 because of various circuit changes.

P.C.B. J9-11071

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
H	March 22, 1971	1. Change to schematic to show diode across door unlock solenoid.
G	March 9, 1971	1. Change 10 microhenry inductor at B26 to 1 microhenry inductor, Diablo P/N 10200-xx, to decrease rise & fall time of Pseudo Sector pulse.
F	Feb. 18, 1971	1. Addition of compatibility notes to schematic.
E	Dec. 8, 1970	1. Release to Production.

Note: Machines prior to this time used J9 11069 or 11010 which are not directly interchangeable with J9-11071 E or greater because of various circuit changes.

P.C.B. J10-11113

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
G	Oct. 8, 1971	1. Changed capacitor at J10-A34 from 20 picofarad to 47 picofarad, Diablo P/N 10061-47, to compensate for change in head characteristics. Changed 0.1 $\mu$ fd capacitors at A19, A24, A31, A35, A51, A63z, B14, B51, & B65 to Diablo P/N 10086-10 with no change in value for manufacturing convenience.
F	June 25, 1971	Omit two unused test points from assembly.
E	June 15, 1971	1. Component & location changes to make assembly compatible with P.C.B. revision B as listed below:
D	April 6, 1971	

<u>New</u>	<u>Was</u>
B56	Hard Wired
K43	H36
K44, H38	None
B59	B58
B58	B57

C	March 9, 1971	2. K40 changed from 510 pfd to .0047 $\mu$ fd capacitor.
B	Feb. 11, 1971	1. Change J10-A22 from 51 pfd to 68 pfd capacitor Diablo P/N 10061-68. To increase the width of the Read Clock & Data signals.
		1. Release to Production.

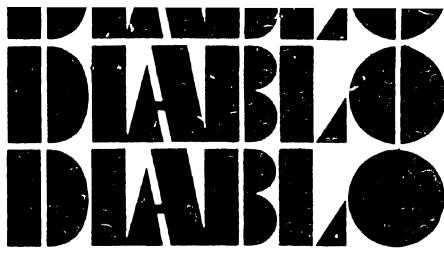
Note: Machines prior to this time used J10-11006 which is not directly interchangeable with J10-11113 because of head cable changes and circuit changes.

P.C.B. J10-11082

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
R	June 25, 1971	1. Changed 0.1 $\mu$ fd capacitor at A19, A24, A31, A35, A51, A63z, B14, B51 & B65 to Diablo P/N 10086-10 with no change in value for manufacturing convenience. 2. Replaced 74121 I.C.'s at F37 & F58 with 9601 type I.C.'s, Diablo P/N 10159.
P	May 8, 1971	2. Adapted change for option 048. 3. Add provisions to allow trimming of Write current. 4. Omit four unused jack connectors. 5. Changed location of H65 to H66 & F39 to E39. 6. Added 10 Ohm trim resistors at K27 and K28. 7. Changed H28 & H56 to 10K ohm resistors.
N	March 9, 1971	1. Changed capacitor at J10-A22 from 51 pfd to 68 pfd Diablo P/N 10061-68 to increase width of Read Clock & Data signal.
M	Feb. 11, 1971	1. Addition of a 150 pfd capacitor at J10-B55 between pin 1 and pin 14 to improve read reliability. 2. Change head socket from grey 14 pin to brown 14 pin Diablo P/N 10596.
L	Jan. 21, 1971	1. Released to Production.

Note: Machines prior to this time used J10-11082K, or an earlier revision, there may also be machines using a J10-11081. These boards are directly interchangeable if the transistor at B27 is changed to a 3V zener, but Diablo recommends replacing these boards with a J10-11082L or later.





December 23, 1971

FIELD SERVICE AID 2A

TO: Diablo Series 30 Customers  
FROM: J. Petruk, Customer Service Manager  
SUBJECT: Additional Information to Revision Level History

This Field Service Aid is intended to update FSA #2 dated October 18, 1971, to reflect present level production and to indicate corrections to Field Service Aid #2.

<u>PCB J1-11078</u>	<u>Date of Change</u>	<u>Description of Change</u>
Revision F	Oct. 22, 1971	1. Correction of the schematic portion showing J8 PCB components. Use figure 6-5 page 6-12 for correct locations and values for J8 PCB.
PCB J8-11085	Oct. 25, 1971	1. To improve signal, change value of capacitor at H19 from 20 pfd to 51 pfd, P/N 10061-51.
PCB J10-11082	Nov. 19, 1971	1. To improve the reliability of writing and reading on disk surfaces with microscopic defects, change 15K resistors at A67, A69, A70, B67, B69, and B71 to 2.7K, P/N 10023-27. 2. Change 27K resistors at A64 and A65 to 4.7K, P/N 10023-47. 3. Change 680 ohm resistor at D63 to 1.5K, P/N 10023-15. 4. Change 560 ohm resistor at D75 & E76 to 300 ohm, P/N 10023-30.

Corrections Required to Field Service Aid #2

PCB J1-11078	1. The Diablo P/N listed in paragraph 4 of Revision E should be changed from 10086-10 to 11070-22.
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Field Service Aid #2A - Page 2

PCB J2-11111

1. Location of added resistors in Paragraph 1 of Revision E should be changed from K12, K13, K15 and B16 to K12, K13, A15 and B16.

2. Change last line of paragraph 1 of Revision C from "to J2-D35 pin 6," to "to J2-D35 pin 5".

PCB J9-11071

1. Note addition of 930 I.C. at J9-D68 pins 8 through 13. This gate was added to insure that the Binary counters reach a count of 128 by gating sector pulses into the Binary counters during the start-up cycle. (See figure 6-6 page 6-14).

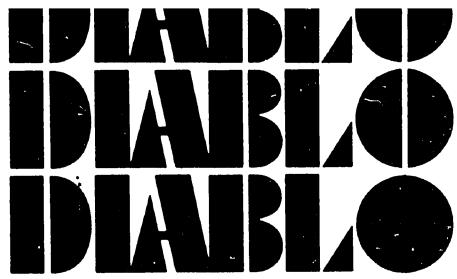
Power Driver Board

1. For your information, machines shipped prior to June 1971 may have a 12 ohm 20 watt resistor mounted between terminator marked **T** & **U**. See pages 6-15 & 6-20. With a 12 ohm value the disk drive may not complete the start-up cycle, i.e., lack of Ready. If you are experiencing a long start-up cycle, insure that this resistor is 15 ohms, P/N 10058-15.



J. Petruk  
Customer Service Manager

JP:jr



April 5, 1972

FIELD SERVICE AID #2B

TO:           Diablo Series 30 Customers  
SUBJECT:      Revision Level History

This Field Service Aid is intended to update FSA #2A dated December 23, 1972, and FSA #2 dated October 18, 1972, to reflect present level product. These changes should not be considered as mandatory and are being distributed for information purposes only.

PCB J1-11078

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
Revision G	1-22-72	a) Diode added to collector of F28. b) 709 Part Number 10122-02 used in Position A71. P/N 10122-00 is temperature cycled 709. P/N 10122-01 is not temperature cycled. P/N 10122-02 is 709 with: $V_{io} < 0.3mv$ $I_{bi} < 0.33 \mu a$ $I_{b2} < 0.33 \mu a$

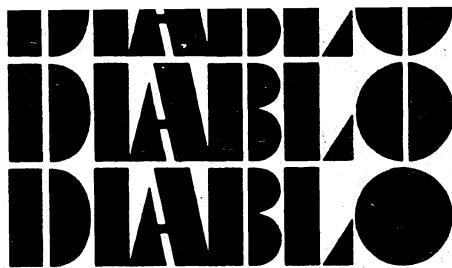
PCB J8-11085

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
Revision G	2-22-72	Change E8 from 510 ohm 1/2W to 180 ohm 1W when E10 contains a 1N4731 zener.

J. Petruk  
Customer Service Manager

JP/slm

Diablo Systems Incorporated  
24500 Industrial Blvd.  
Hayward, California 94545  
Phone 415-783-3910



June 12, 1972

FIELD SERVICE AID #2C

TO: Diablo Series 30 Customers

SUBJECT: Revision Level History

This Field Service Aid is intended to add to the previously published FSA Nos. 2A and 2B to reflect present level production of PCB's.

These changes should not be considered as mandatory and are distributed for information purposes only.

PCB J2-11111

<u>Schematic Level</u>	<u>Date of Change</u>	<u>Description of Change</u>
Revision F	2-23-72	Add a 4.7K 5% 1/4W 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.

  
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J. Petruk  
Customer Service Manager

JP/slm