



Diablo Systems Incorporated

Series 30 Disk Drive • Maintenance Manual



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PREFACE

This Maintenance Manual provides the user of a Diablo Series 30 Drive with complete specifications, systems interface information, installation and operation instructions, principles of operation, and maintenance procedures.

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TABLE OF REVISION LEVELS

J1	11078-XX (Standard Density)	N
	11981 (High Density)	A
J2	11111-XX	H
J3	11026-XX	L
J8	11085-XX	N
J9	11071-XX	M
J10	11113-XX (Standard Density)	M
	11082-XX (High Density)	AA

SECTION 1

GENERAL DESCRIPTION AND SPECIFICATIONS

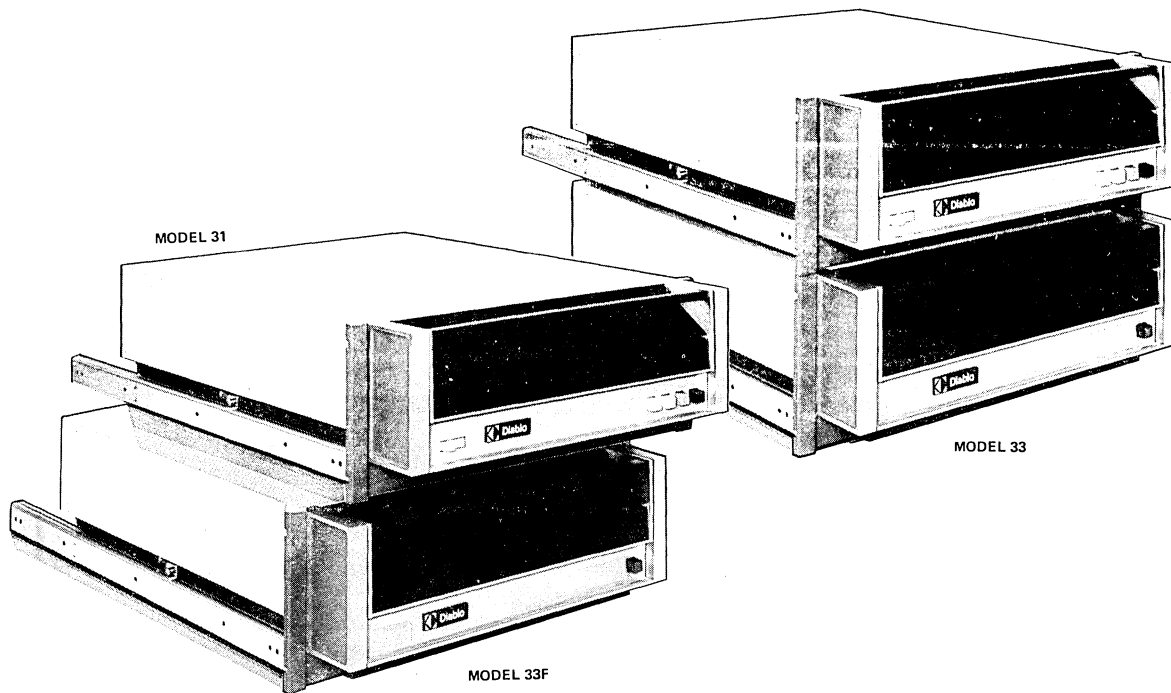


Figure 1-1 SERIES 30 DISK DRIVES

1.1 INTRODUCTION

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

1.2 GENERAL SPECIFICATIONS

1.2.1 Disk Format

The recording disk is a 14" aluminum plate which has been precision ground for flat and parallel surfaces. Its two surfaces are then coated with a 50-250 microinch thick layer of gamma-ferric oxide magnetic recording material and precision burnished to a flatness on the order of 30 microinches. These carefully prepared surfaces allow recording heads to "fly" in close proximity to them

(within 70 microinches) without physical contact, which in turn allows extremely dense recording techniques. The disk is then mounted on a spindle and rotated at a constant speed.

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

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

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

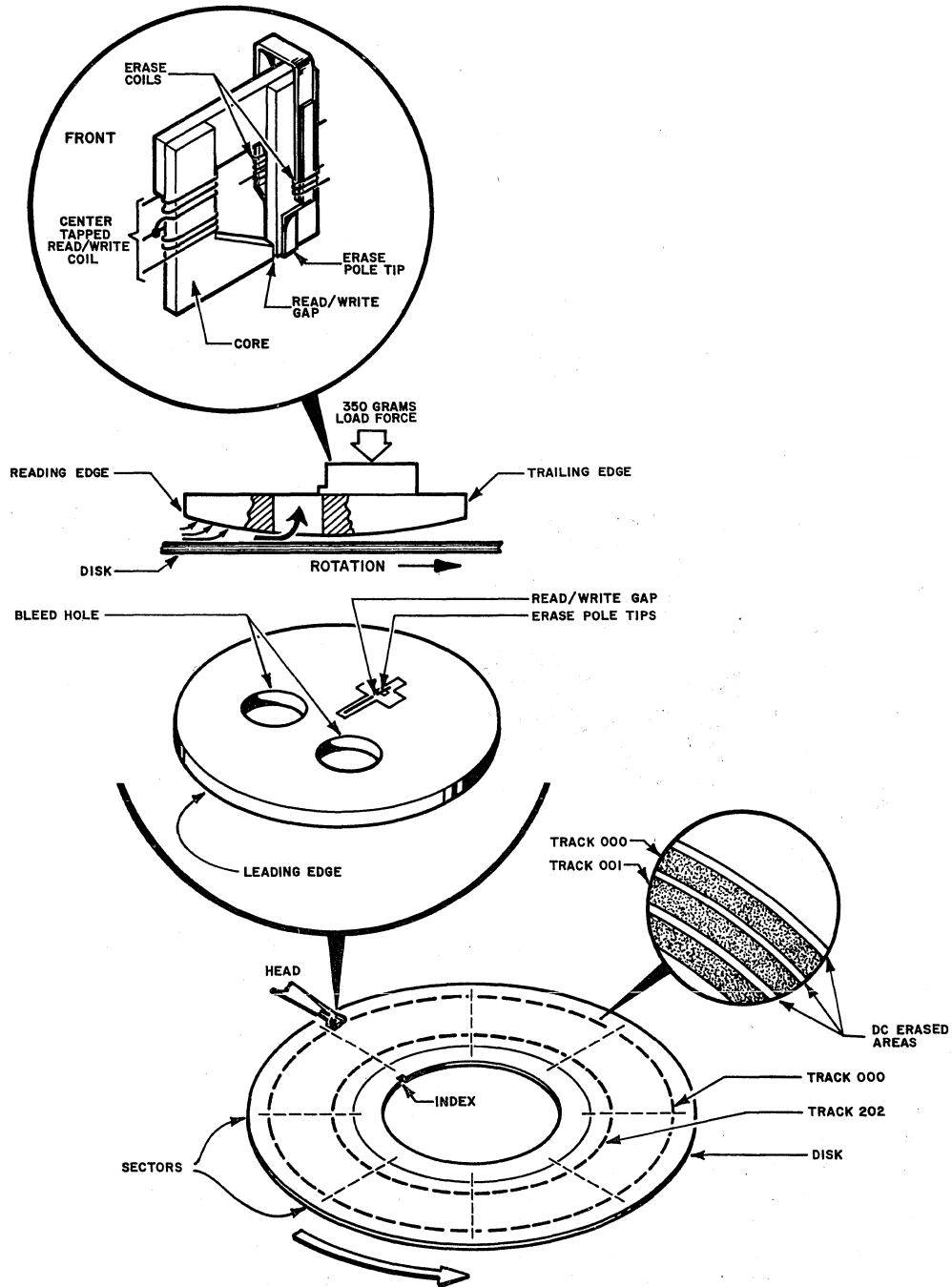


Figure 1-2 DIABLO READ/WRITE HEADS AND RECORDING TECHNIQUES

pieces straddle the larger and are aligned radially with the disk.

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

are approximately 0.010" apart center to center, with an erased band approximately 0.003" wide in between to prevent cross-talk.

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

TOP VIEW OF DISK

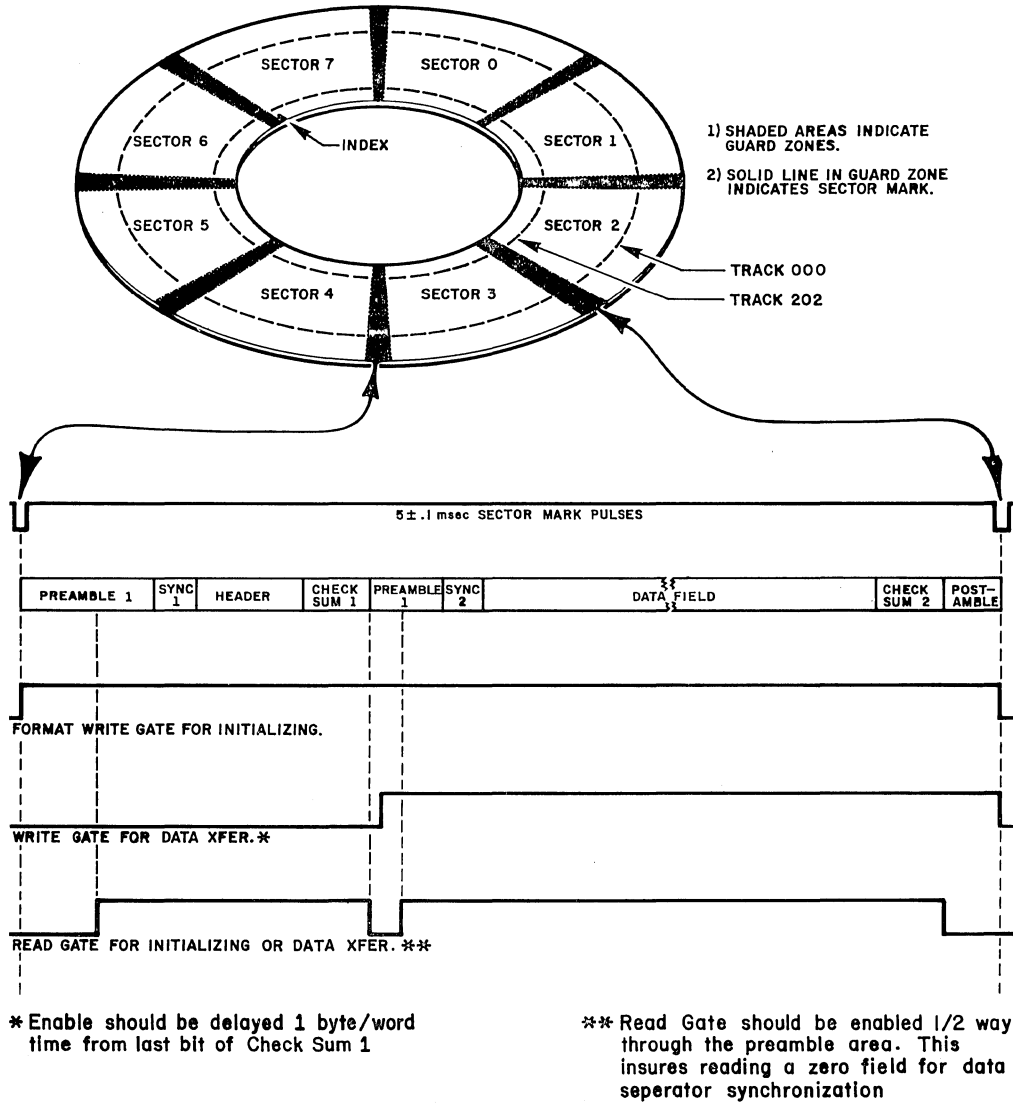


Figure 1-3 TYPICAL TRACK – SECTOR FORMAT

track and sector address for accurate retrieval.

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

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

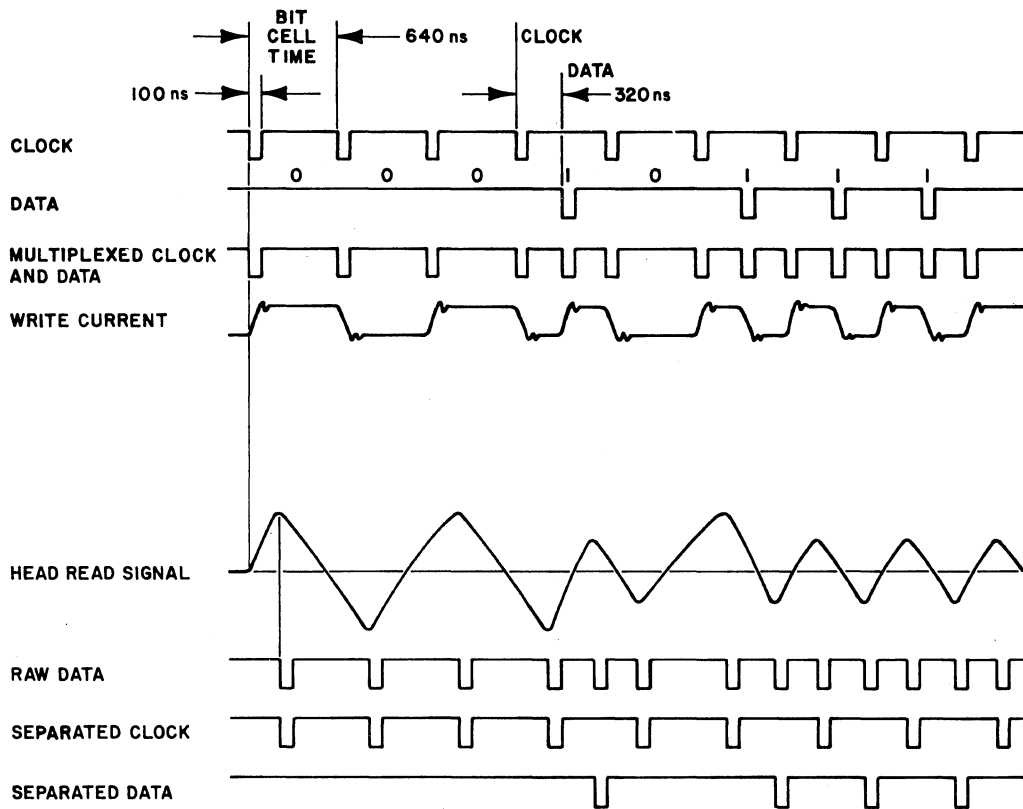
1.2.2 Power Requirements

- Voltages: +15 Vdc ± 5% @ 8A Peak, 4A Average
- 15 Vdc ± 5% @ 8A Peak, 4A Average
- Power: Less than 100 watts

The Diablo Model 029 Power Supply was designed to supply all the power requirements of two Series 30 Disk Drives.

1.2.3 Physical Characteristics

- Width — 17½ inches
(19 inches with rack mount flanges)
- Depth — 22-7/8 inches
(25¾ inches with connectors)
- Height — 6½ inches (table model)
- Weight — 43 pounds



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

Figure 1-4 DOUBLE FREQUENCY RECORDING

1.2.4 Environmental Considerations

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

1.2.5 Features

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

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

1.3 PERFORMANCE SPECIFICATIONS

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

TABLE 1-1
PERFORMANCE SPECIFICATIONS
SERIES 30 DISK DRIVES

Operating Characteristics		
Recording Disk:	IBM Type 2315 or equivalent	
Rotation (Spindle) Speed:	1500 RPM ± 1%	
Type of Recording:	Double Frequency	
Access Times		
Average Latency	20 milliseconds	
Head Positioning		
Track to adjacent track	15 milliseconds	
Full move across disk	135 milliseconds	
Average	70 milliseconds	
Capacity		
	Standard	Hi-Density
Bit Density (innermost track)	1100 bits/inch	2200 bits/inch
Track Density	100 tracks/inch	100 tracks/inch
Track Width	0.0051 inch	0.007 inch
Track Spacing	0.010 inch	0.010 inch
Bit Transfer Rate	781 KHz	1562 KHz
Bits per Cartridge (Drive)	12,000,000	24,000,000
Bits per Cylinder	60,000	120,000
Bits per Track	30,000	60,000
Cylinders per Cartridge	203	203
Tracks per Cartridge	406	406
Sectors per Track	8 (std) to 24	8 (std) to 24
Sectors per Cartridge	3248 (std) to 9744	3248 to 9744
Bits per Sector — Standard	3750	7500

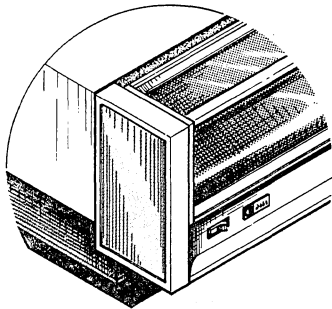
SECTION 2

INSTALLATION AND OPERATION

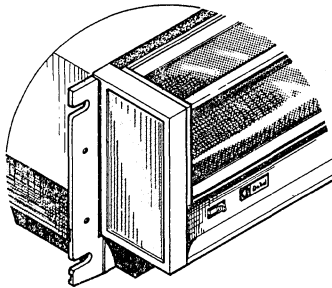
2.1 INSTALLATION

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

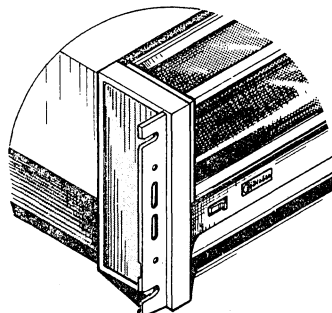
The drive should always be supported on rack slides when in a cabinet, and they are included whenever the flanged front panel assemblies are selected. In addition, even though the flangeless front panel option can be accom-



A
Flangeless
(Table Top)



B
Flanged
(Extended Front)
24" Deep Cabinets



C
Flanged
(Flush Front)
30" Deep Cabinets

Figure 2-1 FRONT PANEL OPTIONS

modated in a rack mount installation, as suggested in Figure 1-1, Diablo recommends the use of the appropriate flanged front panel assembly for securing the drive to the rack. See Section 6.

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

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

2.2 INTERCONNECTING CABLES

2.2.1 Connector Parts

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

TABLE 2-1

CABLE CONNECTOR PARTS DESCRIPTION

Power Cable Connector

- | | |
|----------------------|--|
| 1. Plug | — Winchester MRAC 14SJTDH
Diablo P/N 10534-10 |
| 2. Contacts (socket) | — Winchester 100-1014S
Diablo P/N 10525-11 |

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

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

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

- | | |
|----------------------|--|
| 1. Plug | — Winchester MRAC 42SJTDH
Diablo P/N 10523-10 |
| 2. Contacts (socket) | — Winchester 1024S
Diablo P/N 10523-13 |

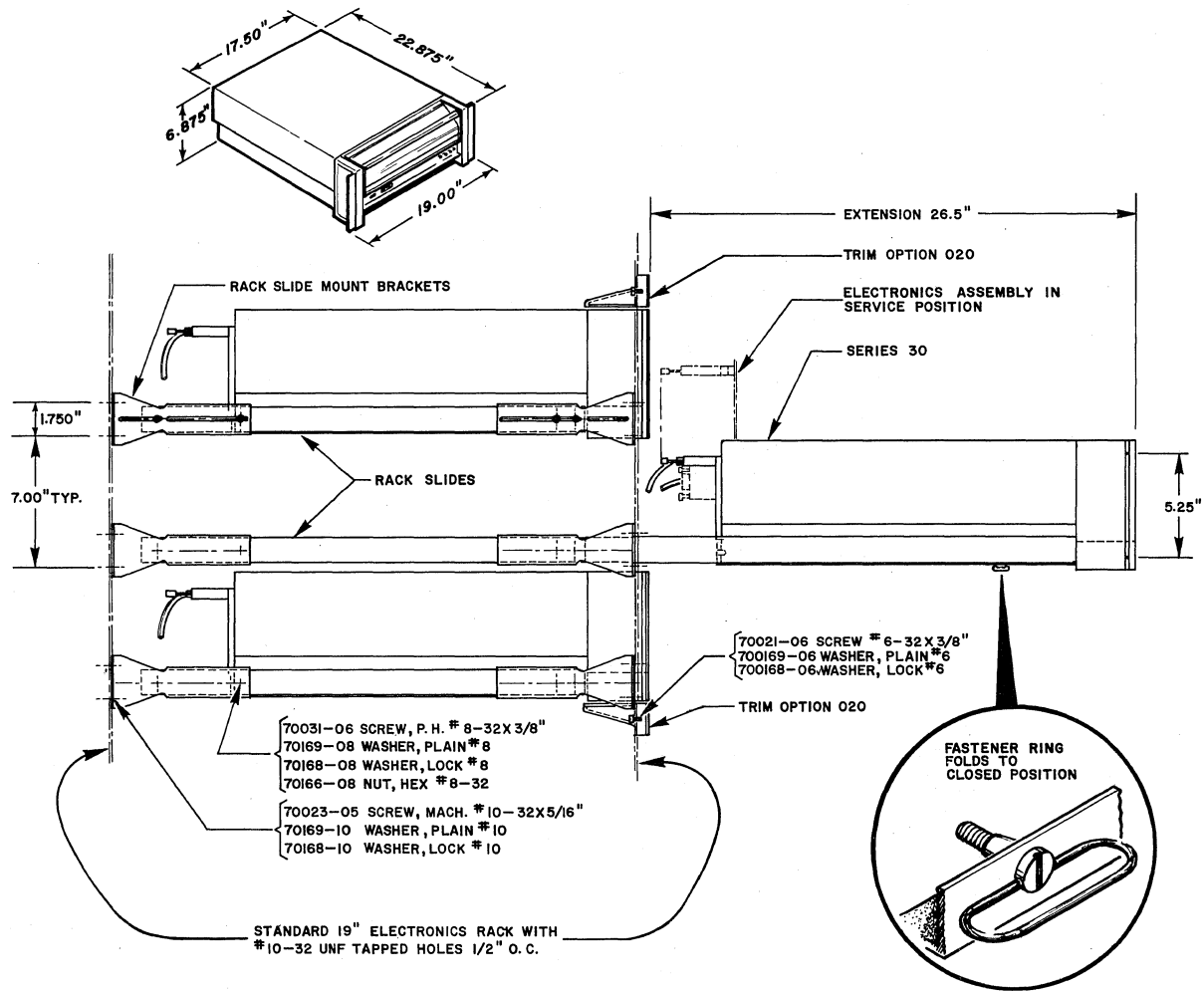


Figure 2-2 SERIES 30 RACK MOUNT

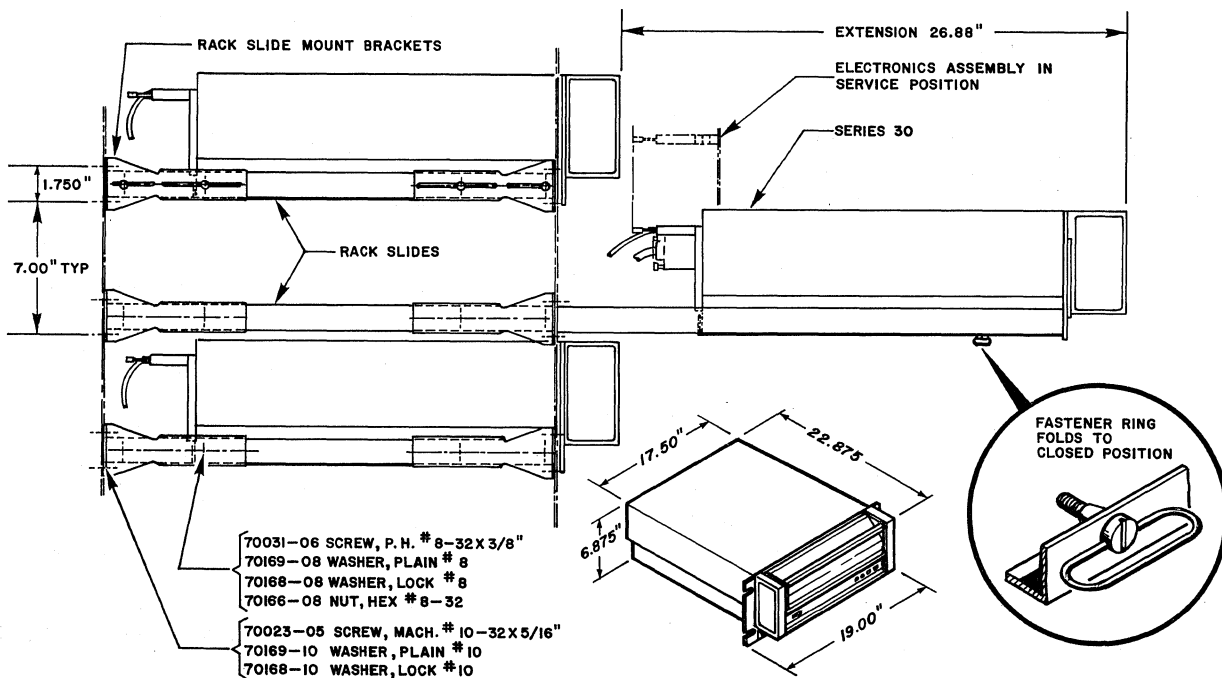


Figure 2-3 EXTENDED FRONT RACK MOUNT

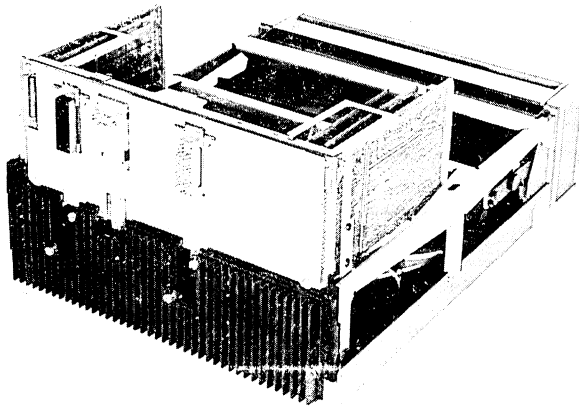


Figure 2-4 ELECTRONICS ASSEMBLY IN SERVICE POSITION

2.2.2 Connector Pin Assignments

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

2.2.3 Cable Recommendations

2.2.3.1 Power Input Cable

A Series 30 Disk Drive requires power inputs of ± 15 Vdc $\pm 15\%$ @ 8A peak (4A average) from an external source. Diablo's Model 029 Power Supply was designed for use with the Series 30 Drive. One Model 029 Power Supply, along with a Diablo #11188 5' Power Cable (see Section 6.3) will supply all the power needs for one Series 30 Disk Drive.

TABLE 2-2

POWER AND INTERFACE CONNECTOR PIN ASSIGNMENTS

Signal Function	Pin
POWER CONNECTOR PIN ASSIGNMENTS	
+ 15V High Current	K
+ 15V Low Current	H
- 15V High Current	R
- 15V Low Current	P
Ground Return	C
INTERFACE CONNECTOR PIN ASSIGNMENTS	
Track Address - bit 1	LL
- bit 2	N
- bit 4	RR
- bit 8	J
- bit 16	X
- bit 32	FF
- bit 64	T
- bit 128	BB
Restore	VV
Strobe	SS
Head Select	AA
Write Gate	EE
Write Data & Clock	B
*Write Protect Input	H
*Write Protect Status Indication	P
*Erase Gate	K
File Ready	U
Ready to Seek, Read, or Write	F
Address Acknowledge	NN
*Logical Address Interlock	XX
Seek Incomplete	TT
Sector Mark	W
Index Mark	Y
Sector Address - bit 1	CC
- bit 2	JJ
- bit 4	KK
- bit 8	MM
- bit 16	UU
*Pseudo Sector Mark	S
Write Check	HH
Read Clock	A
Read Data	C
Read Gate	E
Select Line - Unit 1	L
- Unit 2	R
- Unit 3	V
- Unit 4	Z
*High Density Indication	M
**Daisy Chain Cable Terminator, +5V	PP
Ground	D
Ground	DD
Ground	WW

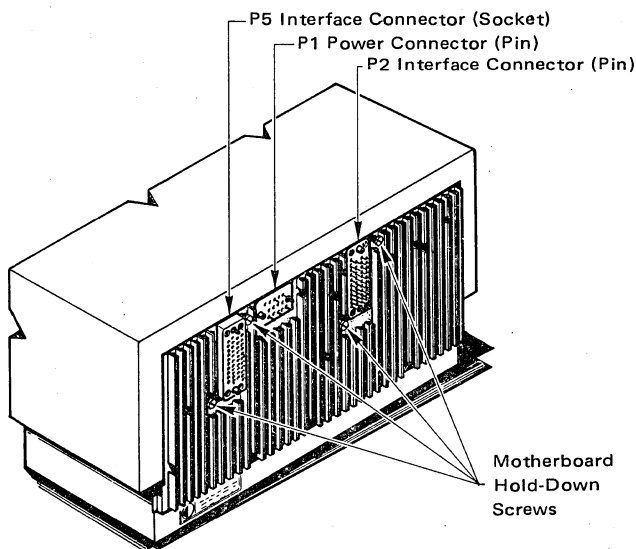


Figure 2-5 SERIES 30 REAR PANEL INTERFACE CONNECTORS

*Related to optional features

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

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

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

2.2.3.2 Input/Output (I/O) Cable

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

Round Cable

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

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

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

Flat Cable

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

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

Cable Lengths

Diablo offers a wide selection of prepared transition cables for use with Series 30 Drives. These will be found listed and described in the Diablo Sales Literature, in the Diablo Series 30 Disk Drive Parts Catalog, Publication # 81504 and in Section 6 of this manual. In planning an installation, the designer should keep in mind that the

TOTAL cable run in any daisy chain configuration should NOT exceed 30 feet.

2.2.3.3 Terminating Resistors

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

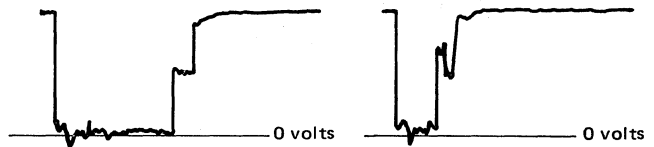


Figure 2-6 WAVE SHAPES

Figure 2-6 shows two waveshapes taken on the terminated end of a cable when the other end was left unterminated. The negative going leading edge is not affected significantly, and can be used as an input to logic circuits if properly handled. The trailing edge, however, is determined by the time duration of the pulse, and the length of the cable. Those lines carrying signals of short duration should always be terminated on both ends. No satisfactory system performance can be achieved, even with relatively short cable lengths, if the signal lines are not properly terminated on both ends.

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

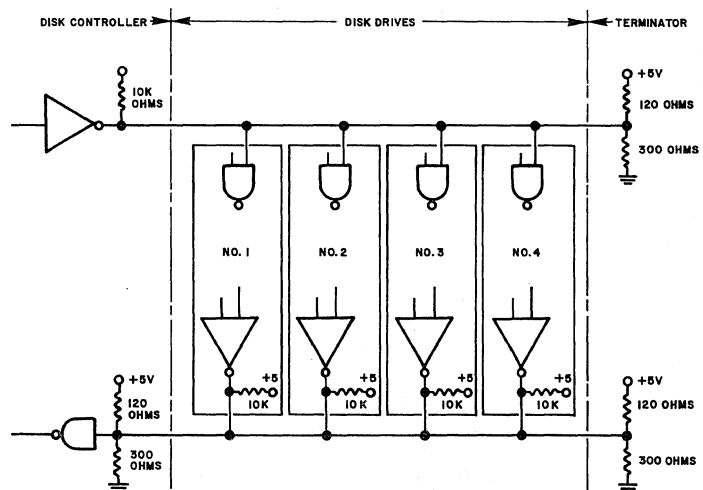


Figure 2-7 TYPICAL TERMINATION CIRCUITS

2.2.3.4 System Interconnection

Figure 2-8 illustrates the typical scheme for connecting one to four drives to one controller, where more-than-one is referred to as a "daisy-chain" system. Referring to Figure 2-5, it may be seen that both pin (M) and socket

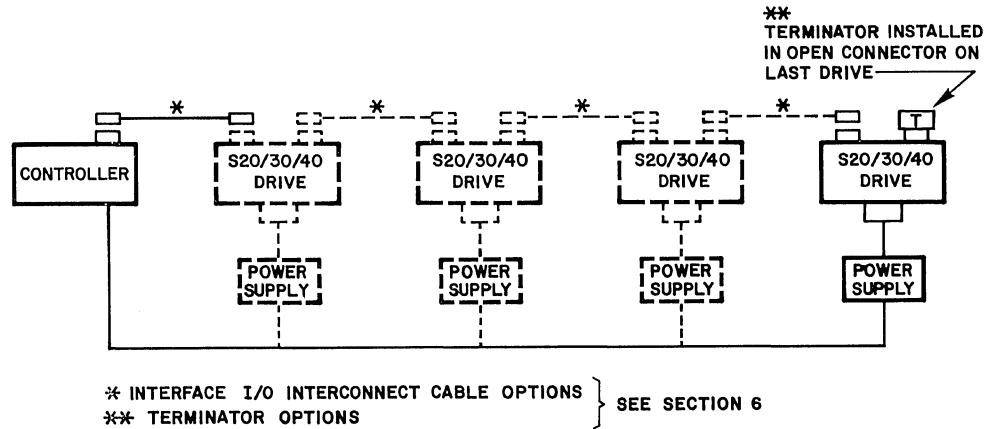


Figure 2-8 DISK DRIVE "DAISY CHAIN" INTERCONNECT AND TERMINATOR SCHEME

(F) connectors are available on the rear panel of the drive. The option schedule in Section 6 lists F/F, M/M, and F/M styles of cables as well as both M and F contact terminators. The user thus has a wide choice of interconnecting schemes available. All are valid as long as the overall length of cable from controller through all drives to the terminator does not exceed 30 feet, and when an appropriate terminator is included as shown.

2.2.3.5 Select/Attention Line Option Jumpers

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

up to its service position. Also shown is a similar set of connectors for the optional Attention Line feature listed in Section 6.

2.3 OPERATING

2.3.1 Controls and Indicators

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

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

2.3.2 Operating The Model 31

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

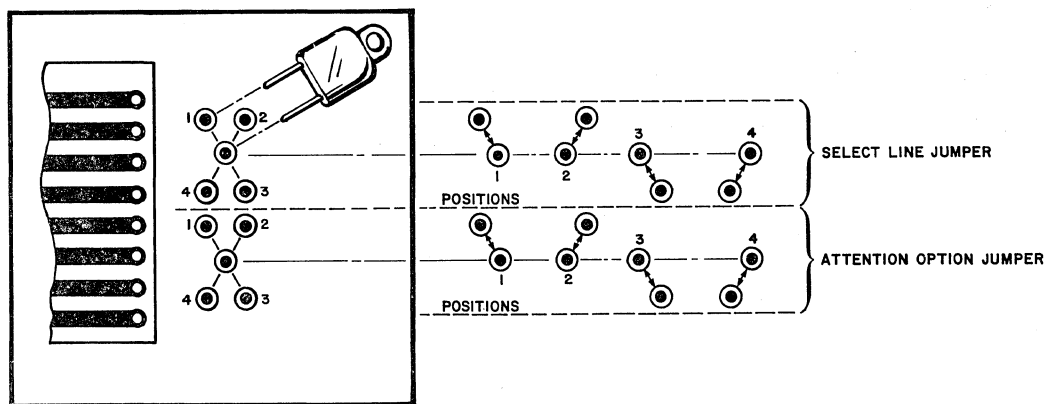


Figure 2-9 SELECT/ATTENTION OPTION LINE JUMPERS

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

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

2.3.3 Operating the Model 33F

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

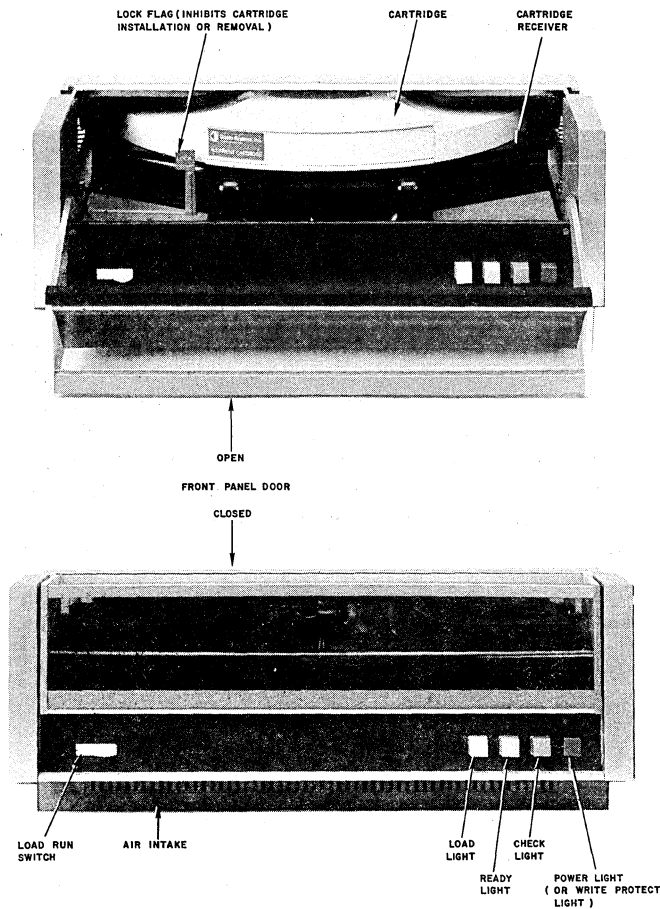


Figure 2-10 MODEL 31 CONTROLS AND INDICATORS

TABLE 2-3
FRONT PANEL
SWITCH AND INDICATORS

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

SECTION 3

INTERFACE INFORMATION

3.1 GENERAL

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

3.2 POWER REQUIREMENTS

The Series 30 Disk Drives do not include power supplies or power controls. All unit power supply and control must be provided externally by the using system. As discussed earlier, the Series 30 Drive requires ± 15 Vdc $\pm 15\%$ at 4 Amperes average current drain, with an instantaneous peak demand of up to 8 Amperes. Diablo's Model 029 Power Supply will support one Series 30 Disk Drive.

[CAUTION]

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

3.3 INPUT/OUTPUT CONSIDERATIONS

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

3.4 STANDARD INPUT LINES

TRACK ADDRESS — Eight lines which accept an 8-bit binary absolute track address. These signal lines are strobed with the strobe signal to perform a seek operation. The track address lines should be held true no longer than 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 (LO) selects upper head, +5 volts nominal (HI) selects lower head.

WRITE GATE — One line which turns on write current and erase current simultaneously in the head which has been selected. This signal must be applied at least 2 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.

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. See Section 6.3 for optional input lines.

3.5 STANDARD OUTPUT LINES

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

1. Drive supplied with proper power.
2. Loaded with a disk cartridge.
3. LOAD/RUN switch in RUN position.

4. Disk 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 (LO) on this line indicates that the disk drive is in the File Ready condition (see above) and it is not in the process of executing a seek operation. Following a seek command to a valid address (other than the present address) or a Restore command, the Ready to S/R/W line goes "false" in no less than 2.5 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 μ 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 (LO) on this line indicates that, due to some malfunction, a seek operation was not completed. This signal level will be maintained until a Restore command (see above) is received and executed by the disk drive.

SECTOR MARKS — This line supplies one 0 volt nominal (LO) 5 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 (LO) 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 (LO) on this line indicates that one or more of the below listed conditions are present within the Series 30 Disk Drive.

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

When Write Check is set true by one of the above listed conditions, execution of all external commands is suppressed. To reset Write Check, on the Model 31, the operator must move the Load/Run switch to the Load position and then return it to the Run position, the Model 33F must have its power removed and then 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 (LO) 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. See Section 6.3 for optional output lines.

3.6 INTERFACE TIMING CONSIDERATIONS

3.6.1 Read Amplifier Recovery

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

3.6.2 Timing

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

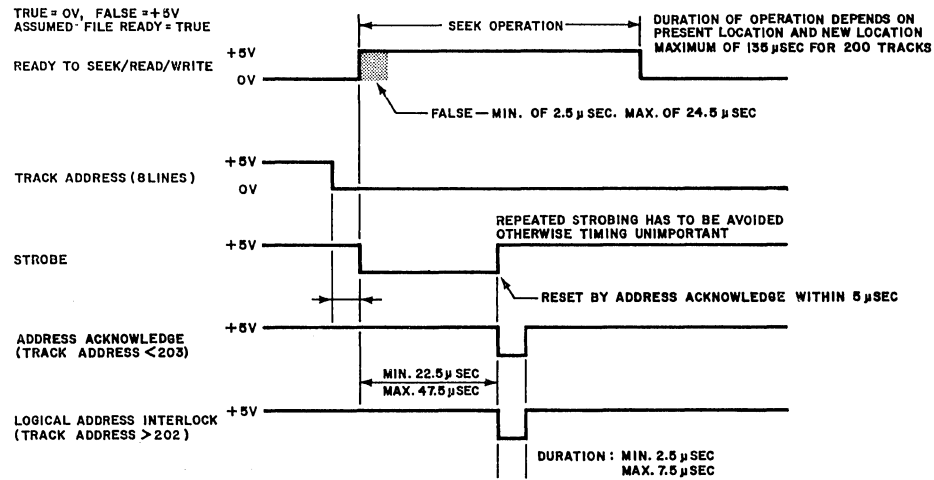


Figure 3-1 TYPICAL SEEK OPERATION

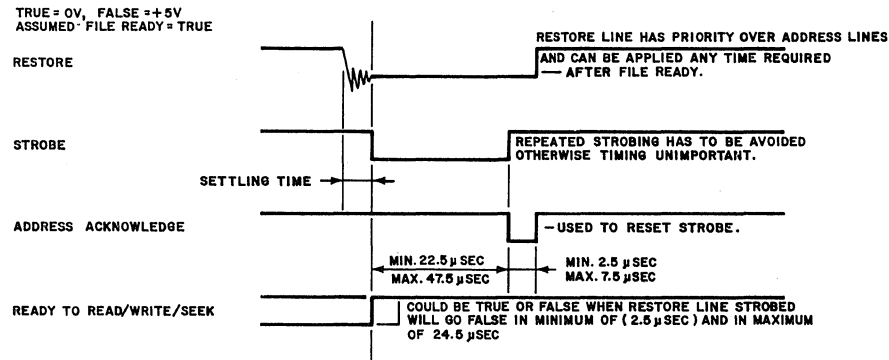


Figure 3-2 TYPICAL RESTORE OPERATION

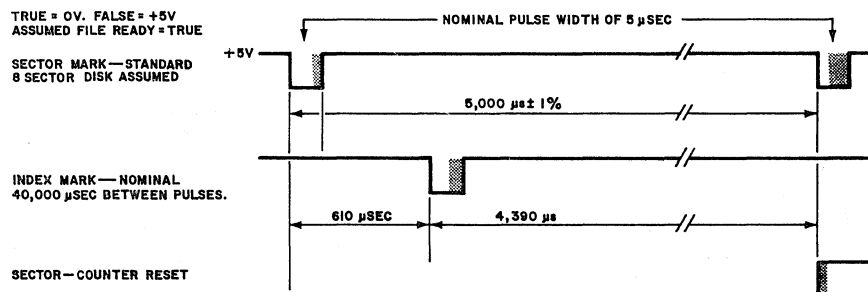


Figure 3-3 SECTOR AND INDEX MARK TIMING RELATIONSHIP

3.6.3 Data Record Format

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

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

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

3.6.4 Computation of Data Record

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

Minimum time per sector =

$$(40,000/n - 0.99) - (65+45+10+20+6)$$

Where (0.99) = Allowance for 1% speed variation

65 = Erase and Write coil

45 = Sector location

10 = Sector alignment

20 = Sector jitter

6 = Preamble sync

Example (for n = 8 sector):

$$(4950) - 146 = 4804 \mu\text{sec}$$

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

At the 781 KHz rate, the maximum number of bits is $4804 \mu\text{sec}/1.280 \mu\text{sec} = 3753$, which would be $3753/12 = 312$ twelve bit words; or $3753/8 = 469$ light bit words. Where 1.280 nsec = one bit cell at 781 KHz.

The bit cell duration for the 720 KHz, 1562 KHz, and the 1440 KHz is 1.389 μ sec, 640 nsec and 694 nsec.

3.6.5 Write Operation

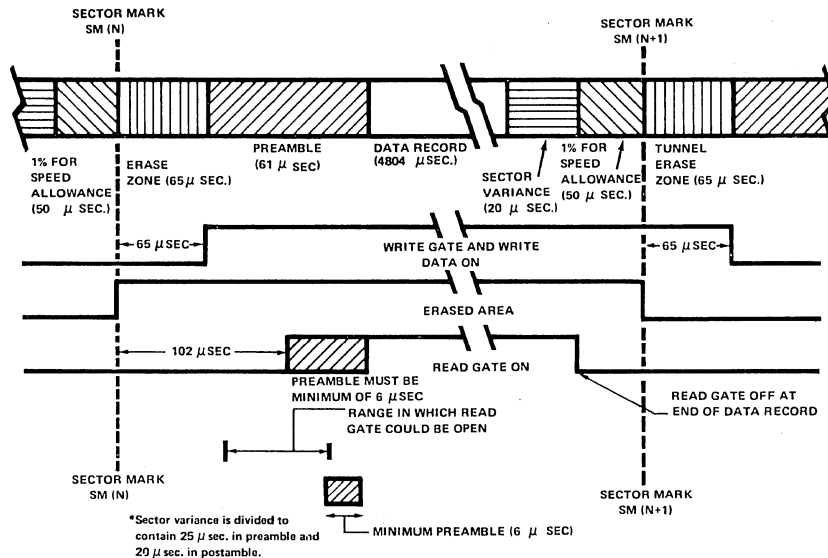
With the calculation given above, a typical Write operation would proceed as follows (see Figure 3-4).

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

3.6.6 Read Operation

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

1. Detection of Sector Mark indicating the beginning of the desired sector to be read.
2. Wait 102 μ sec, then enable Read Gate, thereby reading the zeros from the preamble and synchronizing the separation circuits.



SUMMARY:

1. Preamble consist of all zeros concluded by a single one.
2. Write and Erase Gate turned on together — 65 μsec after SM(N), (25 μsec with high density).
3. Start writing preamble concurrent with Write and Erase Gate.
4. Continue writing zeros until 65 μsec SM(N+1); then turn off Write and Erase Gates (25 μsec with H.D.)
5. Read Gate open 102 μsec after SM(N).

[CAUTION]

After a head select or the termination of a write operation, allow 50 μsec for read amplifier recover; this may be wholly or partly overlapped with other delays.

Figure 3-4 DATA FORMAT

3. If at least 6 μsec of zeros followed by a single one bit is detected, then the preamble has been properly read and the next bit is the first data record bit.
4. Disable Read Gate after reading the last bit of the Data Record.

3.7 DRIVE CAPABILITY OF OUTPUT LINES

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

3.8 INPUT GATES

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

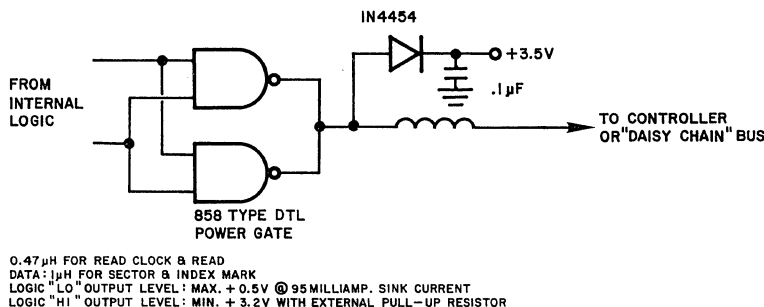


Figure 3-5 OUTPUT DRIVER CIRCUIT OF READ CLOCK, READ DATA, SECTOR MARK AND INDEX MARK LINES

The input of the 380 circuit has to be "pulled-up" in the "High" logic state. For this reason it cannot be driven by an open collector driver stage without collector resistance.

This collector resistance is installed by terminating the last Series 30 on the buss. Figure 3-7 shows the input circuit used in the Series 30.

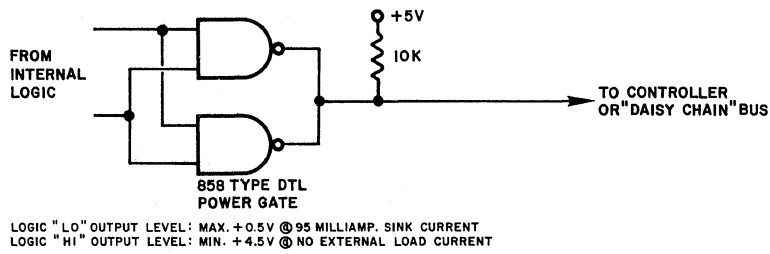


Figure 3-6 OUTPUT DRIVER CIRCUIT

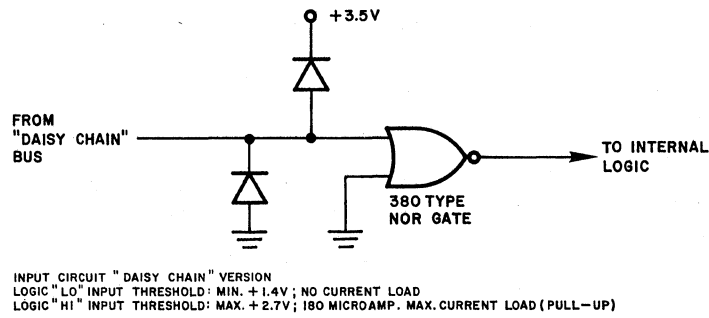


Figure 3-7 STANDARD INPUT CIRCUIT

SECTION 4
PRINCIPLES OF OPERATION

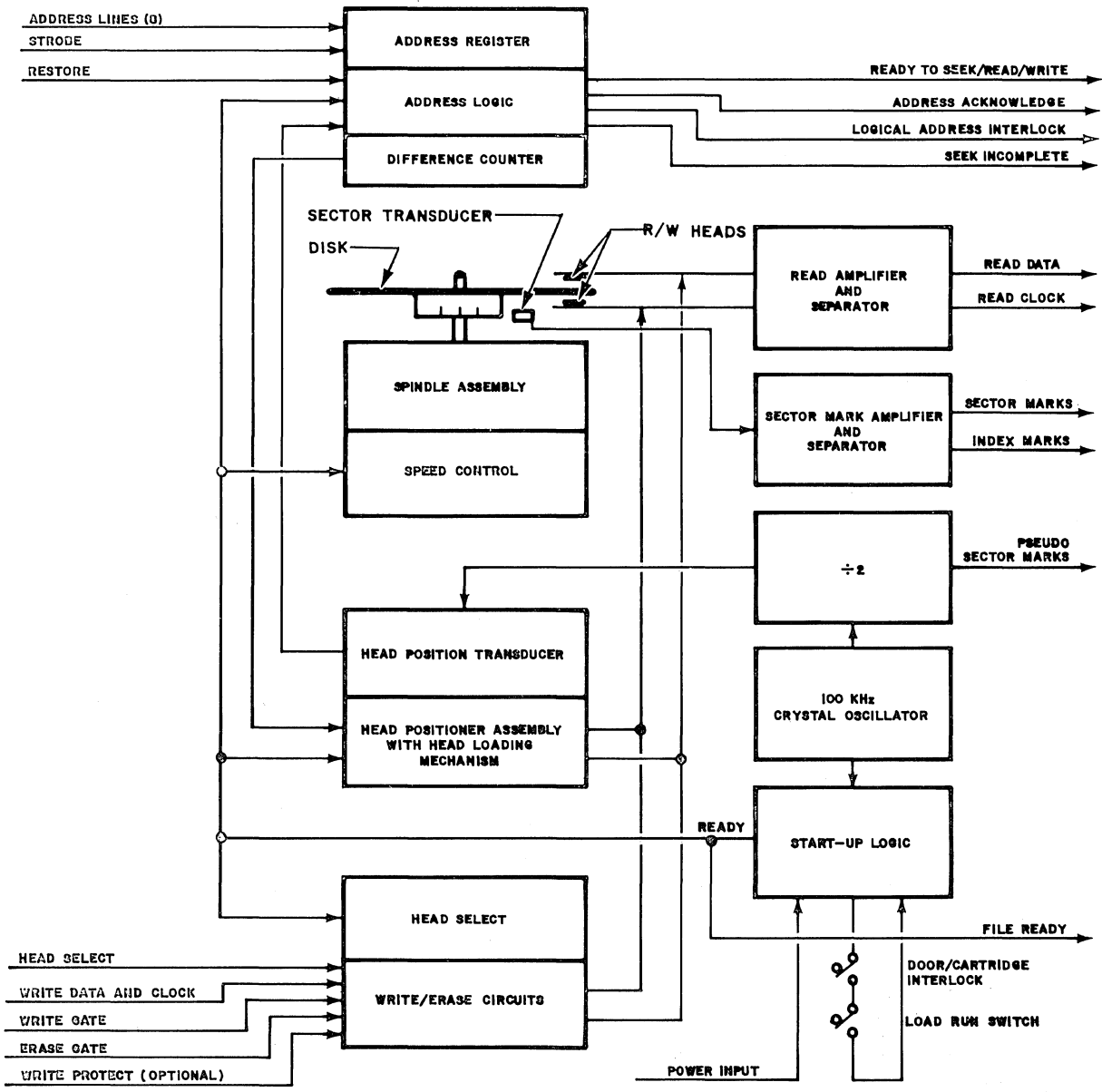


Figure 4-1 SIMPLIFIED BLOCK DIAGRAM OF DISK DRIVE

4.1 GENERAL INFORMATION

The Series 30 Disk Drive consists of those functional units described in the block diagram shown in Figure 4-1. Together, these units work to facilitate safe loading and unloading of disk cartridges, to spin the disk at proper speed, to precisely align the read/write heads over a specified track location, and to perform data writing and

reading functions. Each major functional part is described in more detail in the following paragraphs. Normal operating sequences for a Series 30 Drive are described in Section 3.

4.2 POWER OFF

With no power applied to the drive, the head load

solenoid is not energized, and the heads are held away from the disk surface. The heads are down (loaded) only when power has been applied and disk speed is sufficient to allow the heads to "fly" properly.

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

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

1. Remove top cover.
2. Place the head carriage to the 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 4-2.
4. When the bail has released the door the LOCK flag will be lowered and the door can be opened.
5. Hold the LOCK flag in its down position to remove or insert a cartridge.

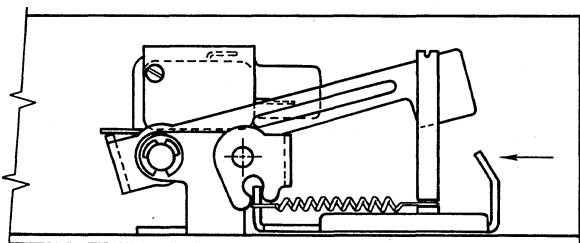
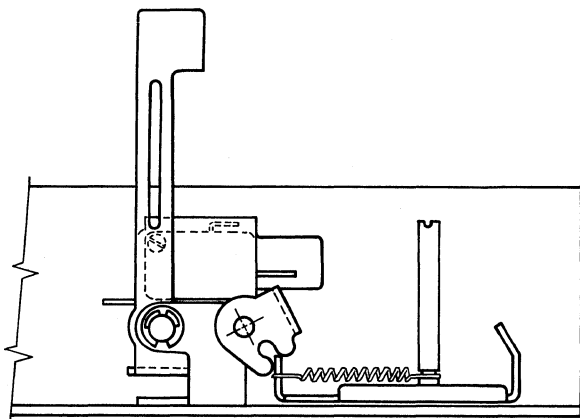


Figure 4-2 DOOR LOCK MECHANISM, MODEL 31

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

[CAUTION]

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

4.3 INITIAL POWER-ON

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

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

4.4 START-UP AND SPEED CONTROL OPERATION

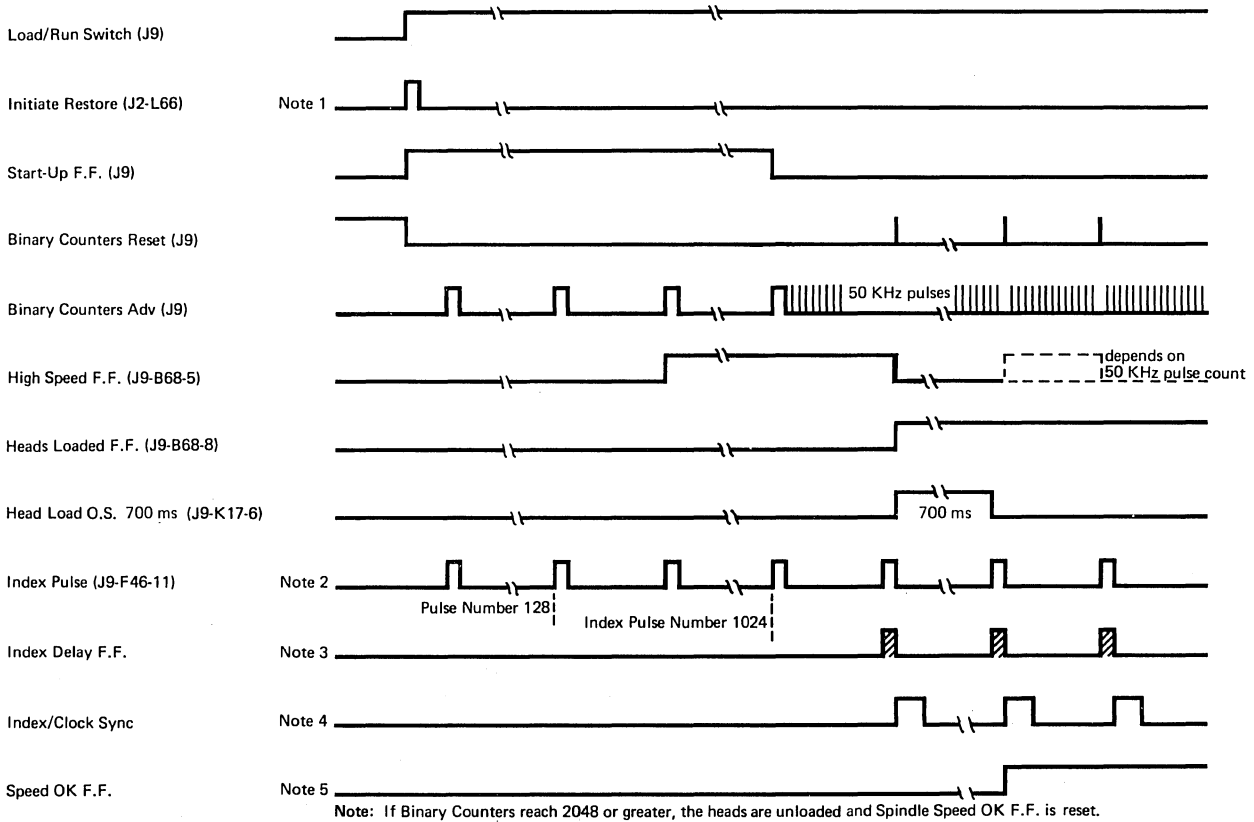
The Model 33F performs this operation with power up. The Model 31 must have the power applied and disk cartridge properly loaded. (See Timing Chart Figure 4-3, Flow Chart Figure 4-4 and J-9 Schematic). Sequence of explanation:

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 LO when the switch is placed into the Run position causing a Load-Run Reset.

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

A spindle rotation sensing circuit on J-9 keeps the door of



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 μ 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 μ 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.

Figure 4-3 START-UP SEQUENCE TIMING CHART

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 Speed FF sets again, and the Speed OK FF sets. The High Speed FF continues to be set and reset as necessary to maintain proper speed. If the disk should ever slow to the point that a count of 2048 was reached, the heads would be unloaded.

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

START-UP SEQUENCE (Board J9)

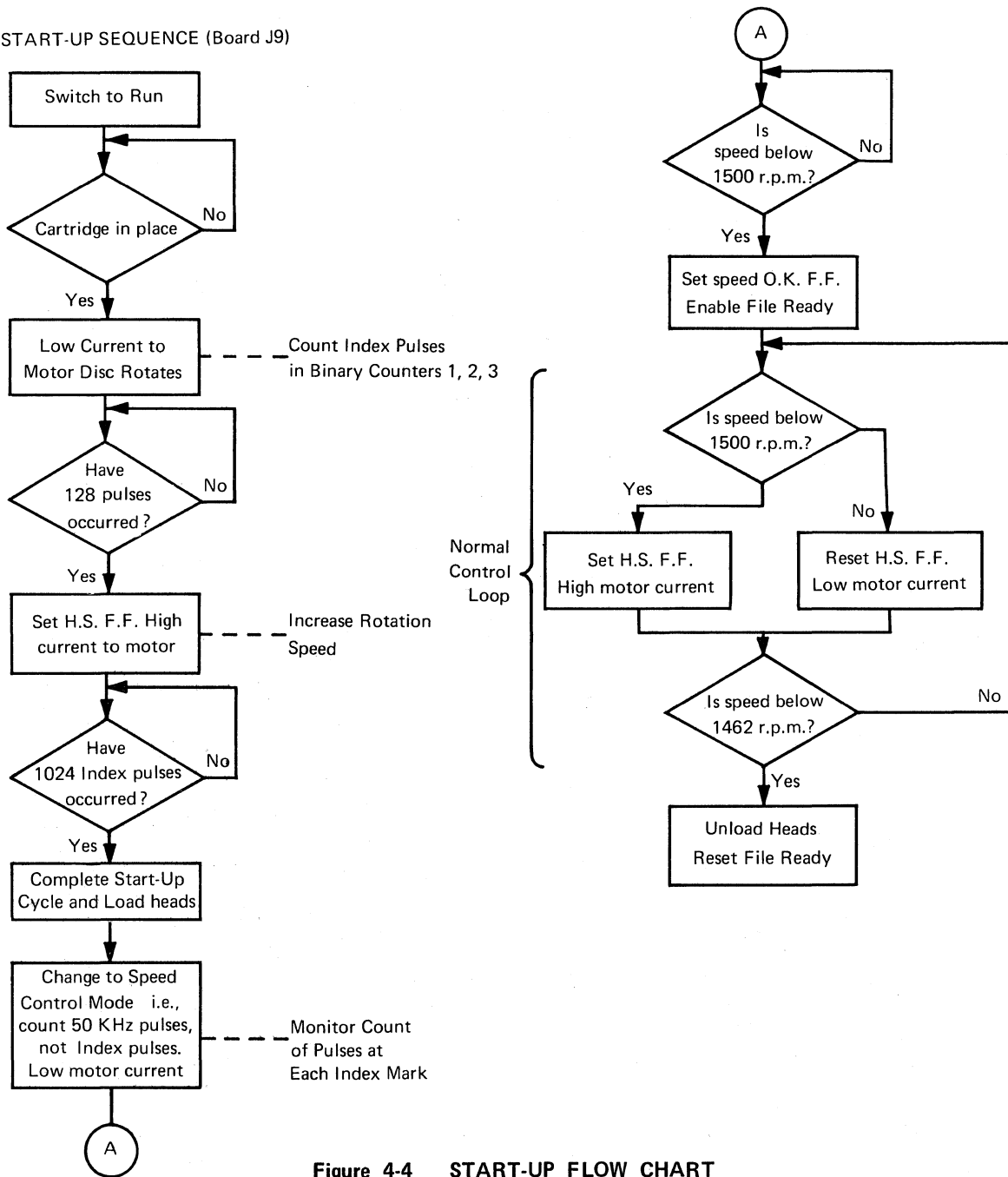


Figure 4-4 START-UP FLOW CHART

High Speed FF, and thereby turn on or off the increased motor drive current.

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

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

4.5 INDEX AND SECTOR MARK CIRCUITS

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

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

which originates a pulse to identify a complete rotation of the disk.

The equally spaced Sector Marks are normally used by the operating system to format tracks on the disk surface into sectors and the Index Mark is used to establish the beginning of a track. There is a special circuit in the disk drive that separates the Index Mark from the Sector Marks, because as they are supplied by the Sector Mark Transducer, they are indistinguishable.

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

4.6 SERVO OPERATION

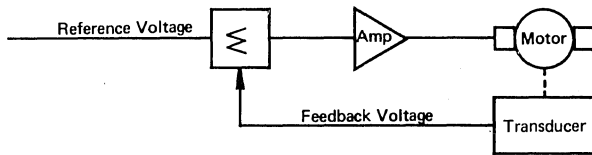


Figure 4-5 GENERAL SERVO SYSTEM

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

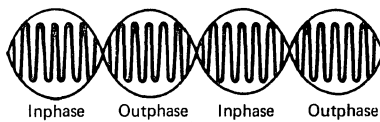


Figure 4-6a TRANSDUCER SIGNAL ENVELOPE (MODULATED)

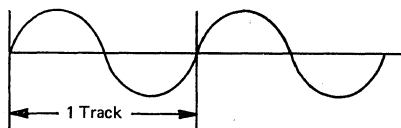


Figure 4-6b TRANSDUCER SIGNAL (DEMULATED)

Figure 4-7 shows position signals "A" and "B" together with the inverted sine waves " \bar{A} " and " \bar{B} ". These four signals are differentiated by C-R networks) and fed to a summing point via four commutator F.E.T.'s. The four differentiated waveforms are also shown in Figure 4-7 and have an amplitude proportional to carriage velocity, regardless of direction of movement.

The commutating signals C and D are derived by summing and squaring the A and B signals. This commutation is

equivalent to a phase sensitive, four phase rectification so that the net current into the summing point is a DC current proportional to the velocity plus a ripple current. This velocity feedback is "E" in Figure 4-7 where:

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

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

When carrying out a Seek Operation the Position term 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 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 4-8 is observed.

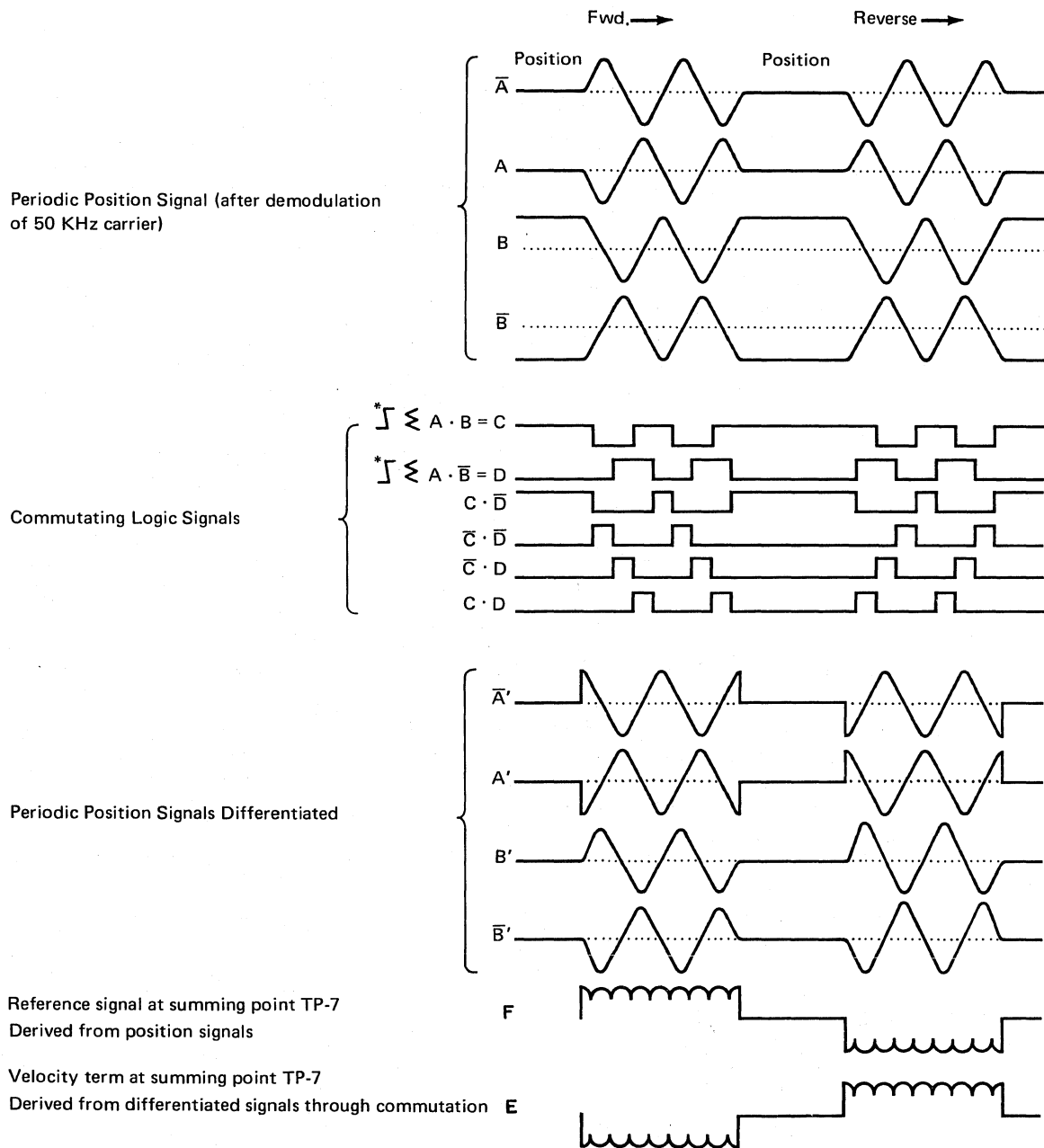
Until the Difference Counter is advanced to 255 (incremented at each track by the commutating logic) the servo imposes constant velocity control on the positioner with four discrete velocities depending on the number of tracks still to go.

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

4.7 ADDRESS ARITHMETIC AND TRACK SELECTION LOGIC

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



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

Figure 4-7 POSITION TRANSDUCER SIGNALS TIMING RELATIONSHIP ONLY

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

As the heads move, each track centerline is detected by the position transducer output. The difference counter is incremented at each of these centerline detections. A pre-determined value in the difference counter indicates that

the heads are in position at the new track address. As the difference counter increments, it also changes velocity instructions, such that the head motion is rapid at the beginning and slower as the correct track is approached. An absence of head movement when the difference counter is not at its pre-determined value indicates a Seek Incomplete, which is fed to the interface.

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

If a Track Address cannot be executed, because it is greater than 202, a Logic Address Interlock is generated and no

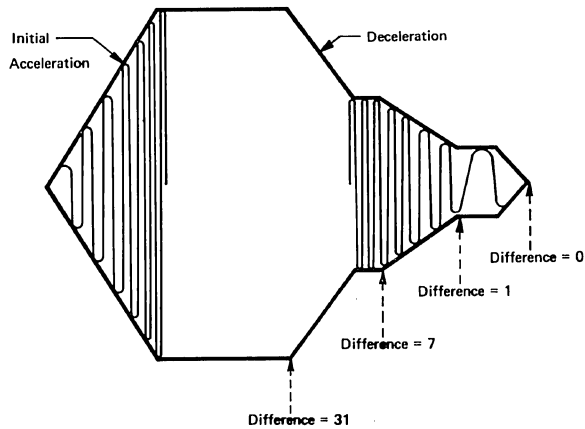


Figure 4-8 DIFFERENTIATED WAVEFORM (J1-TP3)

head motion takes place.

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

4.8 HEAD POSITIONING/SEEK OPERATION (See Figures 4-9 and 4-10, Schematics J1, J2 and J3)

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

Sequence of explanation:

1. Start Seek
2. Sequence 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 Φ 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 Φ 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 Φ 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 Φ 1 following the set of F.F.2. The next Φ 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 Φ 2.

With the Difference Counter at less than 255, the Servo will cause the head carriage to move at the correct velocity and, through the commutating logic, will provide "Servo Logic Control level 'C'" and "Servo Logic Control '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.

4.9 READ/WRITE OPERATION (See Schematic J10)

Head Select

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

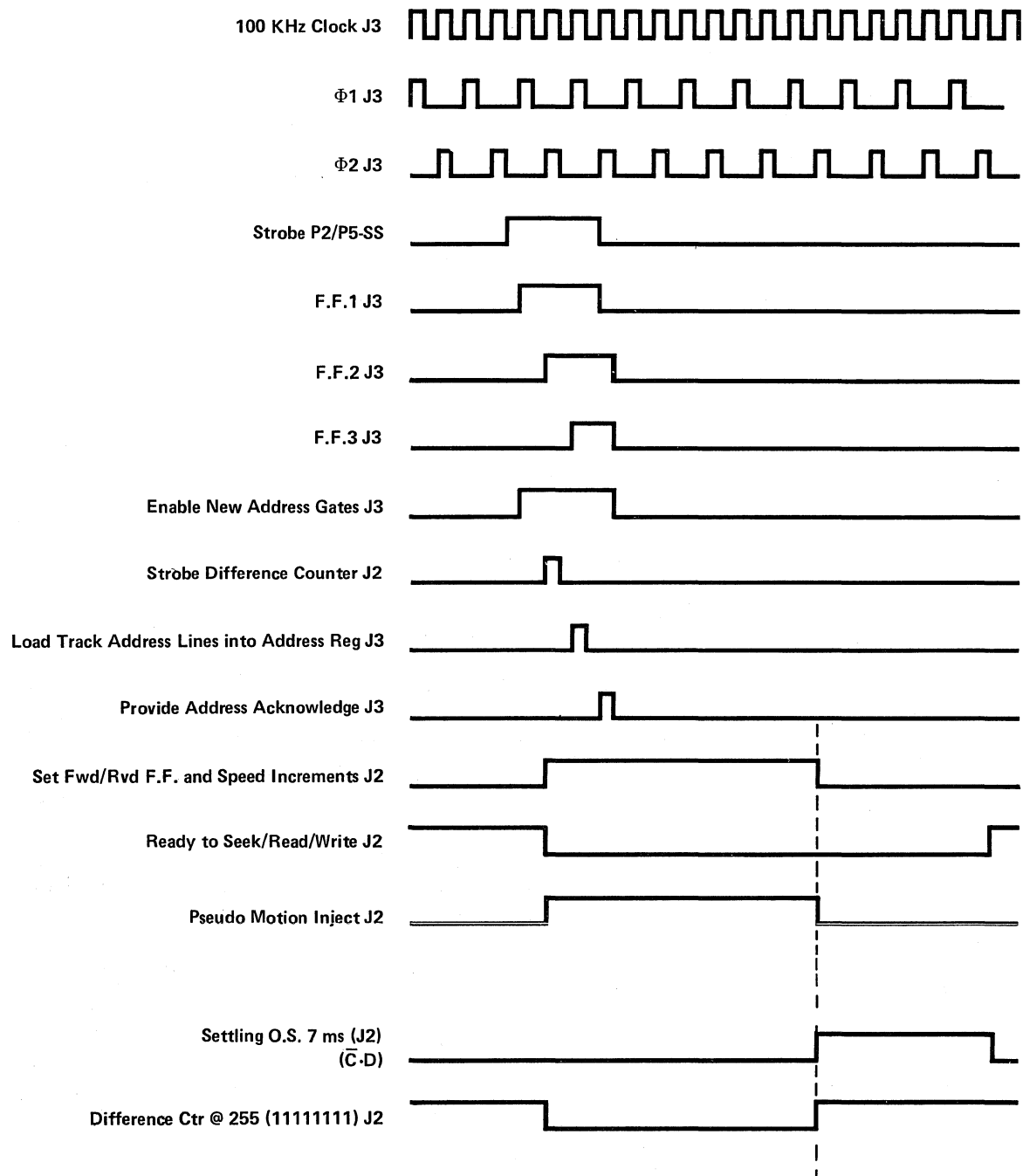


Figure 4-9 SEEK OPERATION TIMING CHART

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 ± 50 nanoseconds, and are separated into data and clock pulses.

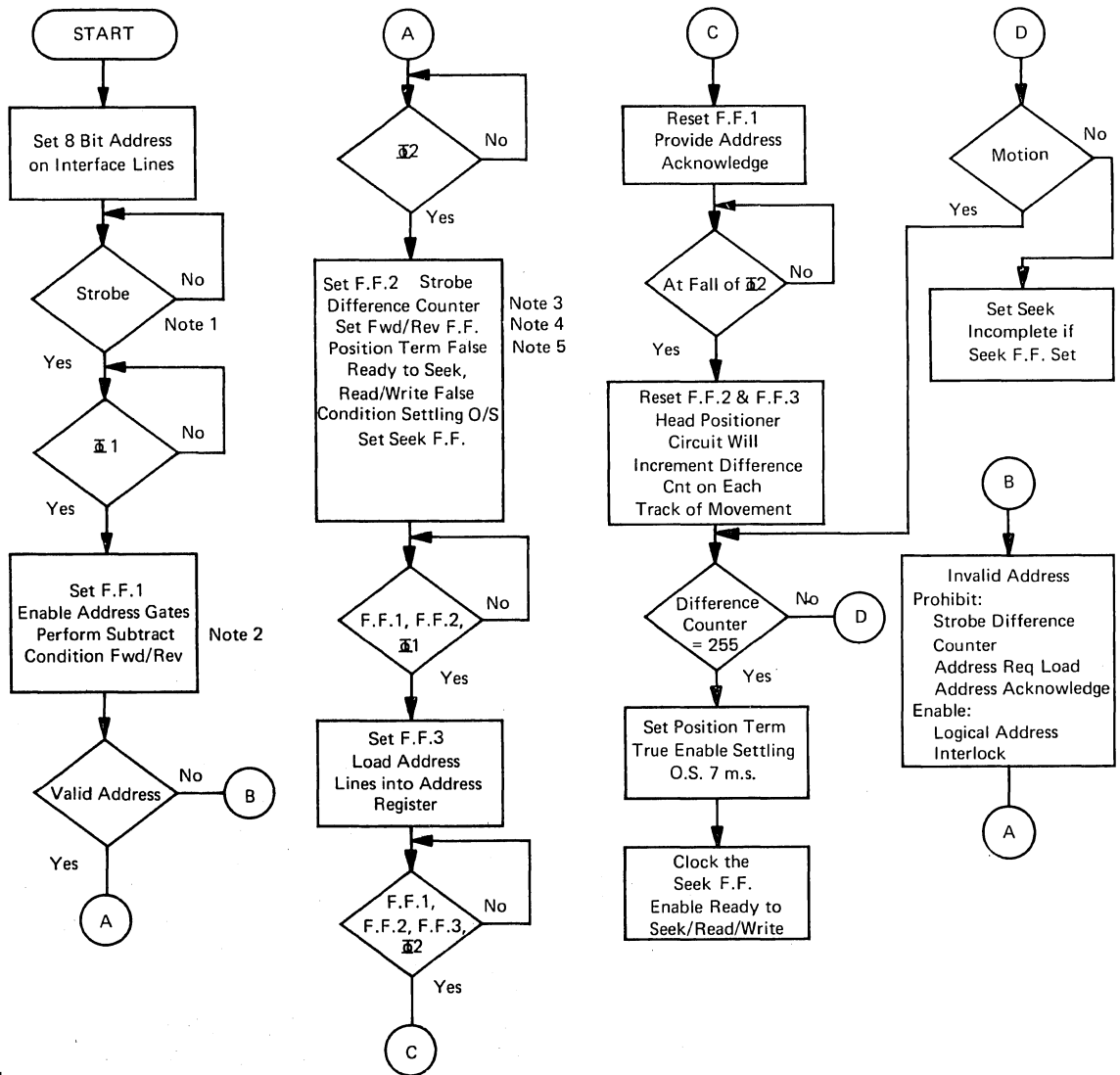
Data Separation

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



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 4-10 SEEK OPERATION FLOW CHART

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.

4.10 LOAD/RUN RESET (See Schematic J-9)

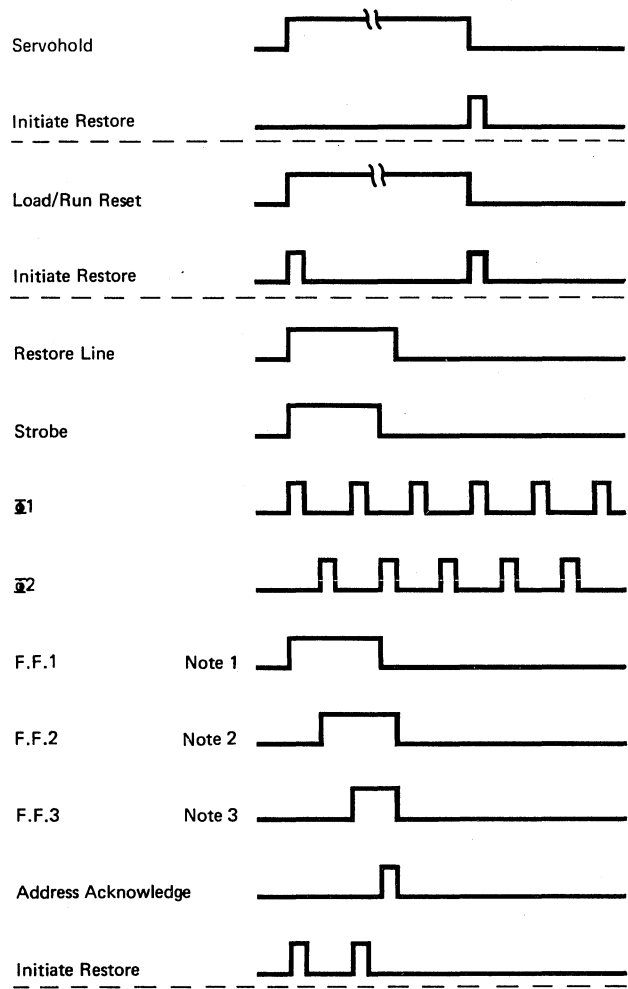
The Load-Run Reset signal is generated by a voltage error signal, the Power-up Delay circuit or by the Load-Run switch being switched into the Load position (with a cartridge loaded). The Load-Run Reset signal places the

flip flop circuits in the speed control system into their start-up, resets the Write Check FF on J-10, sets the Write Protect FF if this option is installed, and causes a Restore operation.

4.11 RESTORE OPERATION

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

Refer to the timing chart Figure 4-12 and J-2 Schematic. The Initiate Restore pulse will cause the Restore One Shot: 16 ms to fire, causing its output to go LO. This LO output



NOTES:

1. Set with first $\phi 1$ after Strobe. Normally used to enable Address Register Gates on J3 board.
2. Set by first $\phi 2$ after F.F.1 set. Normally used to enable "Strobe Difference Counter", but this function is also set with Restore F.F.1-Q or Initial Reset.
3. Set by first $\phi 1$ 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-Q or "Initial Reset".

Figure 4-11 INITIATE RESTORE TIMING CHART

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" (HI), 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 HI (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. 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 7ms is fired which clocks Restore F.F.2 completing the Restore Operation.

4.12 SECTOR COUNTER

A five position binary counter which is reset to all zeros by the leading edge of the sector mark following the index mark, and advanced with the leading edge of each sector mark.

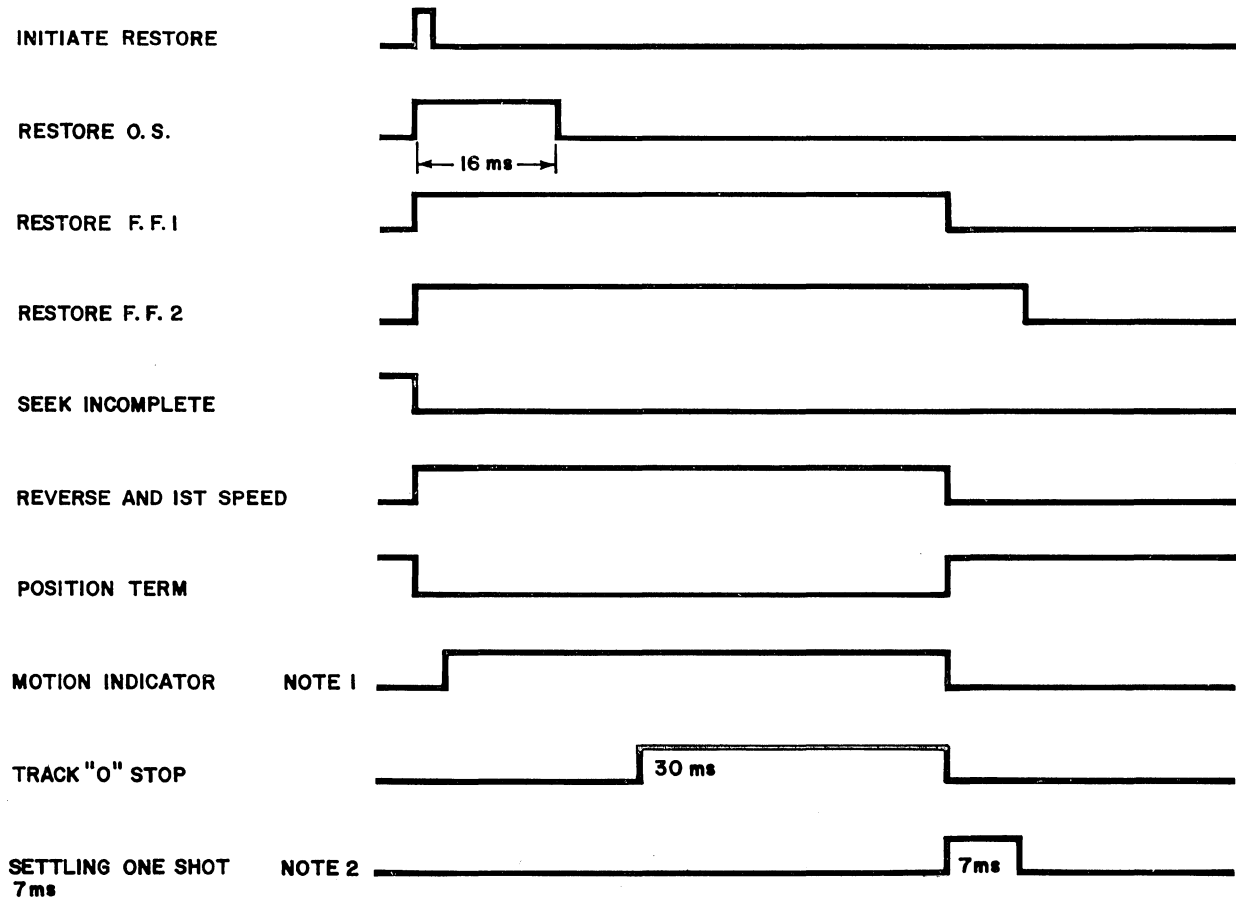
This counter is located on the J8 board, see J8 Schematic.

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

4.13 DAISY CHAIN

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

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



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-SHOT PULSE THEREBY COMPLETING RESTORE OPERATION.

Figure 4-12 RESTORE OPERATION TIMING CHART

NOTES

SECTION 5
MAINTENANCE

5.1 GENERAL INFORMATION

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

5.1.1 Maintenance Philosophy

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

5.1.2 Visual Inspection

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

5.1.3 Cleaning

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

5.2 PREVENTIVE MAINTENANCE

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

5.2.1 Preventive Maintenance Action

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 only if dry.
Spindle Assembly	Clean and inspect the magnetic ring. Magnetic particles may be removed using adhesive tape.
Base Plate and Covers	Clean and inspect for loose hardware.
Air Filter	Replace

**Figure 5-1 PREVENTIVE MAINTENANCE
6 MONTH INTERVAL**

Head Cleaning

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

Head Positioner Lubrication

Refer to Figure 5-4. The lubrication wicks on a Series 30 Disk Drive Head Positioner require only a small amount of lubrication to distribute a thin film of oil to the rack and pinion. *TWO* drops of oil, Diablo P/N 70243, should be applied *ONLY* when the wicks appear to be dry. To check for dryness; slide a fingernail over the wicks. If a shiny residual film appears on the fingernail no additional lubrication is necessary.

[CAUTION]

WICKS MUST NOT BE SATURATED WITH OIL!
Over oiling can cause the recording disk and the read/write heads to become contaminated with oil, resulting in catastrophic head crashes.

Air Filter Replacement

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

1. Turn off all power to the drive.
2. If rack mounted, slide the drive out. If not rack

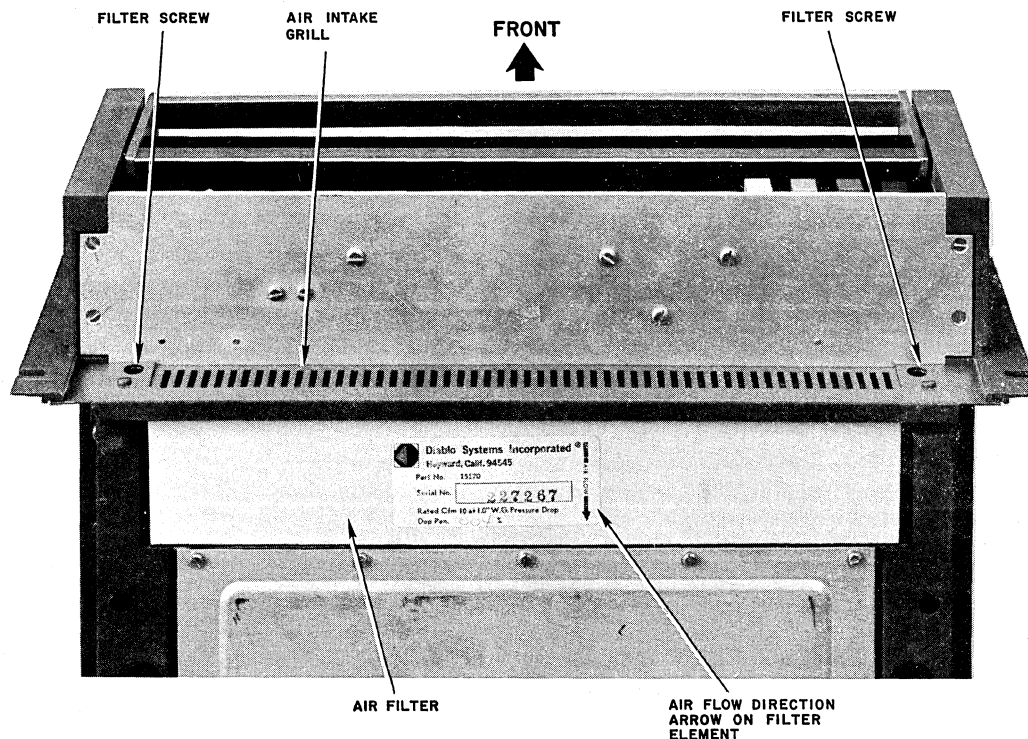


Figure 5-2 AIR FILTER REPLACEMENT

3. Refer to Figure 5-2. Loosen the two "filter screws" to release the filter clamps.
4. Remove the old filter, and note carefully how it was oriented. The new filter must be installed as shown — label showing, and the arrow pointing toward the rear of the machine. (the plastic foam screened side must be toward the grill opening). The filter element is Diablo P/N 15170.
5. Retighten the two "filter screws", and check the filter for proper seating.
6. Return the drive to its operating position.
4. Reassemble the unit. When reinstalling the brushes, ensure they are installed in the same holder as removed. If new brushes are to be installed, ensure the brush curvature matches the commutator curvature.

5.3 DIAGNOSTIC TECHNIQUES

5.3.1 Error Analysis

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

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

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

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

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

There are a number of power transistors located on the

Head Positioner Commutator Cleaning

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

1. Remove the bottom rear cover of the drive, and the bottom plate of the head positioner motor.
2. Remove the motor brushes, marking each brush and holder for the later return of the same brush to its holder exactly as removed.
3. Clean the commutator with a small brush (such as a toothbrush) and isopropyl alcohol. If necessary, use a wood type toothpick to remove carbon from the commutator gaps.

Heatsink assembly. These are used in solenoid and motor drive circuits.

5.3.2 Data Collection

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

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

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

5.3.3 Visual Analysis

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

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

5.3.4 Troubleshooting

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

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

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

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

Diablo Customer Service should be contacted.

5.3.5 Field Testers & Test Alignment Disk Cartridge (C.E. Pack)

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

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

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

[CAUTION]

DO NOT allow writing on the bank of tracks from 90 to 110 to insure protection of the pre-recorded tracks.

5.3.6 Field Service Aids

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

5.4 REMOVAL, REPLACEMENT, AND ADJUSTMENT OF SUBASSEMBLIES

The following text and figures provide service check, removal, replacement, and adjustment procedures for the Series 30 Disk Drive. Unless noted, the alteration of any one adjustment does not affect any other adjustment. The text follows the sequence suggested below for a complete disassembly of the drive. A complete disassembly is seldom required, however, and since the design of the drive lends itself well to partial disassembly for servicing major assemblies, the user may excerpt only those portions of this sequence of immediate interest.

1. Place the drive in the LOAD mode, and remove the cartridge.
2. Remove all power, disconnect all interconnecting cables, and move the drive to a clean clear work area.
3. Remove the top cover, elevate the electronics frame, and remove the circuit boards. Note text precaution on manipulation of the circuit board hold-down clamps.

4. Remove the electronics frame and rear panel heat sink assembly.
5. Remove the "H" frame, the cartridge receiver assembly, and the air filter.
6. Remove the sector transducer.
7. Remove the head positioner assembly.
8. Remove the filter circuit board, and the spindle blower assembly.
9. Remove the front panel and door interlock assembly, and the base plate.

5. One head cable
6. One each PCB retainer, left and right
7. Power transistors (MJE2955, MJE3055, MPSU01, and MPSU51)
8. Light bulbs
9. PCB extender board
10. Oscilloscope
11. Hand tools (long blade screwdriver, Phillips screwdriver, Track "0" deflection tools, and a Torque wrench set)

5.4.1 Preliminary Steps

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

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

[CAUTION]

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

5.4.2 Spare Parts

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

List 1. Preventive Maintenance

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

1. 91% Isopropyl alcohol
2. Lint free wipers
3. Syringe oiler
4. Touch-up paint
5. Air filter elements

List 2. Corrective Maintenance Items

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

1. One of each PCB
2. A Diablo exerciser or tester
3. One C.E. Disk Cartridge (standard or high density)
4. One each upper and lower read/write head

List 3. Parts Support

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

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

5.4.3 Components/Assemblies Locations

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

Baseplate Assembly

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

Spindle/Blower Assembly

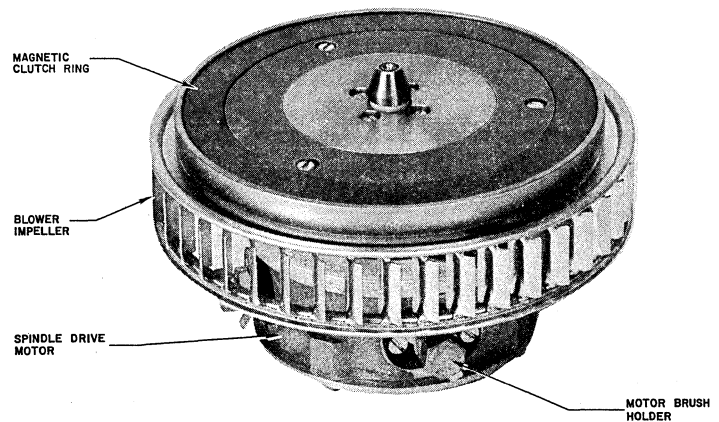


Figure 5-3 SPINDLE/BLOWER ASSEMBLY

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

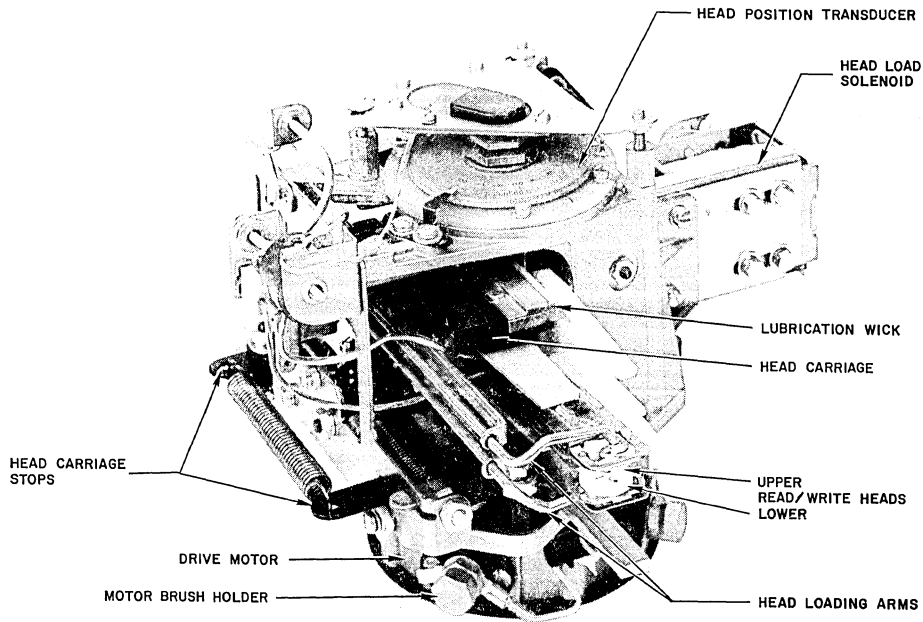


Figure 5-4 HEAD POSITIONER ASSEMBLY

Head Positioner Assembly

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

Door and Cartridge Receiver Assembly

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

Cartridge Handling Components

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

Air Filtering Components

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

Electronics Assembly

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

5.5 DISASSEMBLY/REASSEMBLY/ADJUSTMENTS

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

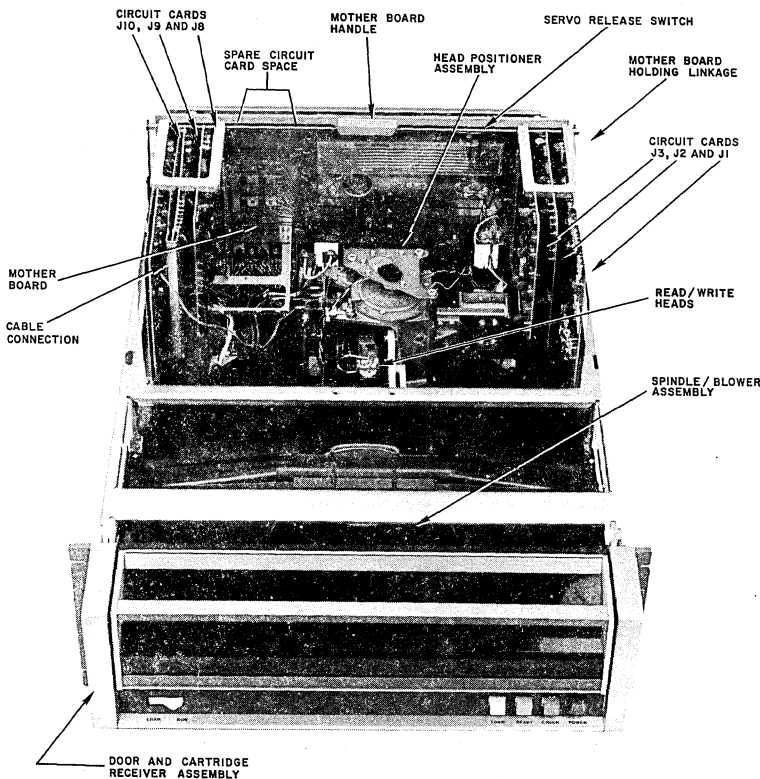


Figure 5-5 INTERNAL COMPONENTS

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

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

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

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

[CAUTION]

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

5.5.2 The Electronics Frame (Motherboard) and Heatsink Assembly

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

1. Disconnect the two sets of twisted pair wires going from the Motherboard to the head position transducer — at the transducer, and release them from their clamp located on the Positioner's head-loading dashpot bracket.
2. Disconnect the white head positioner motor wire at the Motherboard.
3. Disconnect connector P3/P4 (one connector) located on the Motherboard below PCB J9.
4. Remove the eight screws holding the bottom of the Heatsink Assembly to the Shadow Box (two on each side, and four along the bottom of the Heatsink).
5. Remove the four screws holding the Heatsink to the "H" Frame (two screws on each side). The Electronics Frame and Heatsink Assembly is not unsupported, and may be placed flat behind the end of the Shadow Box. The user may wish to stop here, having gained access to the interior of the drive.
6. To remove the assembly entirely, disconnect the head positioner drive motor's yellow wire at terminal E, and the grey wire at terminal B on the Servo Drive PCB on the Heatsink, the grounding strap going from the Heatsink to the Baseplate at the Baseplate, the small ribbon cable connector P6 at the Heatsink and the larger ribbon cable at connector P7 located under the edge of the

Baseplate on the Shadow Box frame.

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

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

Electronics Frame — Heatsink Separation

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

5.5.3 The "H" Frame and Cartridge Receiver

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

5.5.4 The Sector Transducer

1. Remove the "H" Frame, Cartridge Receiver and Air Filter as previously described to expose the Sector Transducer.
2. Unsolder the two interconnecting wires at the transducer.
3. Remove the two screws holding the Transducer to the Baseplate, and lift out the Transducer.

Note: These screws are accessible from the bottom through the air filter compartment.

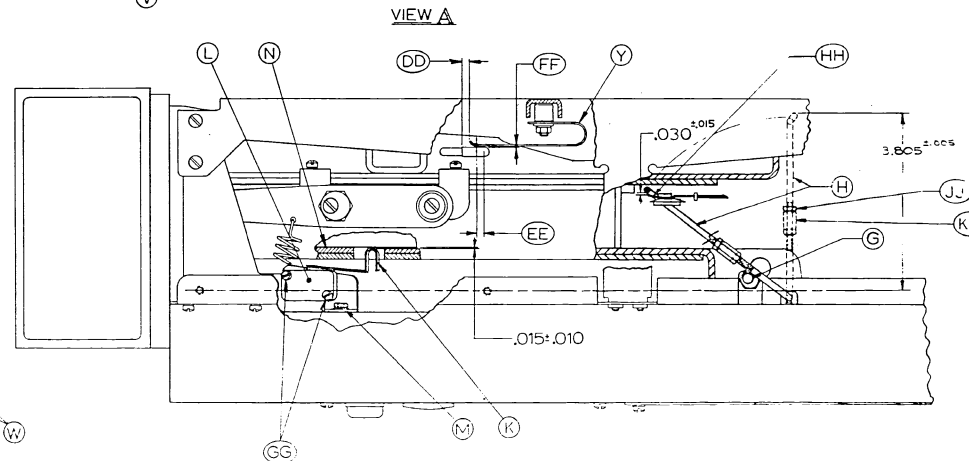
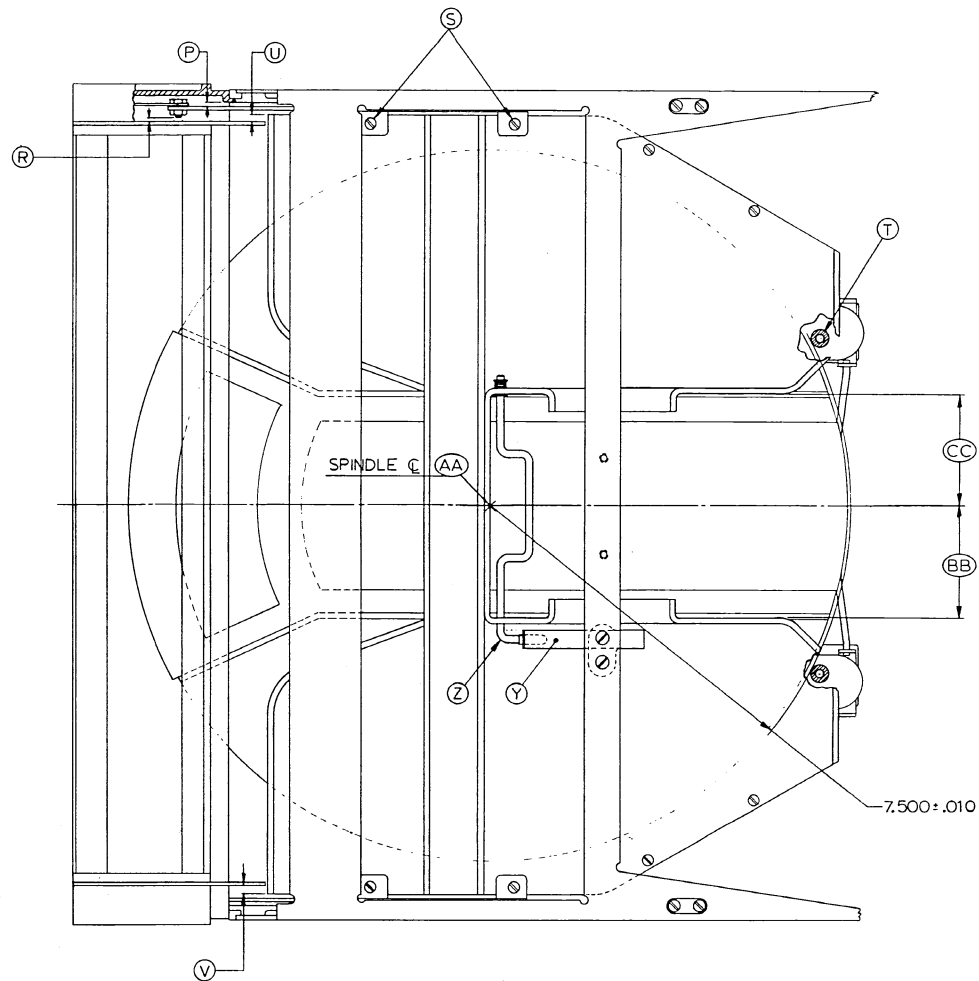
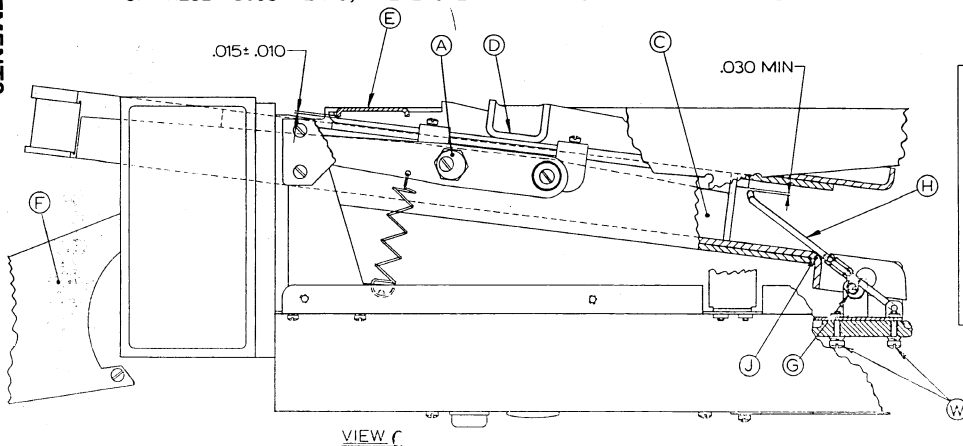
4. Reinstall the Sector Transducer by reversing the procedure outlined above. When placing the Transducer in position on the Baseplate, make sure it is seated properly over its two locator pins. Reinstall the other assemblies necessary to operate the drive.

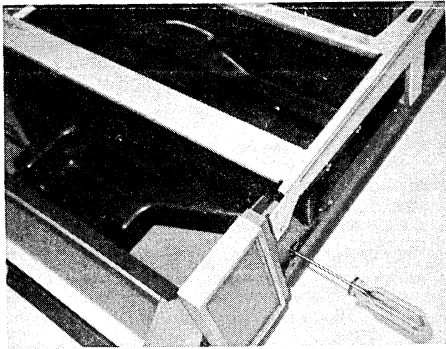
PROCEDURE

1. WITH THE DOOR CLOSED (VIEW A) ADJUST THE CARTRIDGE RECEIVER ASSY. SO THAT THE FOLLOWING CRITERIA ARE MET AND TIGHTEN SCREWS (W).
 - 1.1 DISTANCE FROM SPINDLE (C) TO CARTRIDGE STOP POSTS (T) IS AS SHOWN.
 - 1.2 DIMEN. (BB) & (CC) ARE EQUAL WITHIN .015.
 - 1.3 DIMEN. U & V ARE EQUAL WITHIN .030.
2. WITH DOOR CLOSED (VIEW B), WITHOUT CARTRIDGE, CARTRIDGE DOOR ACTUATOR (H) SHALL CLEAR UPPER HEAD (HH) BY CLEARANCE SHOWN.
3. OPEN DOOR SLOWLY (VIEW C) UNTIL CARTRIDGE RECEIVER IS AT ITS HIGHEST POINT OF TRAVEL & ADJUST ECCENTRIC (A) SO THAT CLEARANCE TO SUB FRAME (E) IS AS SHOWN & TIGHTEN SCREWS.
4. WITH DOOR FULLY OPEN (VIEW C), SLOWLY INSERT CARTRIDGE (C) & CHECK FOR CLEARANCE BETWEEN CARTRIDGE (C) & CARTRIDGE DOOR ACTUATOR (H) AS SHOWN. IF CLEARANCE IS INSUFFICIENT FORM DOOR ACTUATOR (H) AT POINT OF CONTACT WITH RECEIVER AT (J).
5. CLEARANCE (R) & (P) (VIEW A) SHOULD BE .030 MINIMUM. ADJUST BY LOOSENING SCREWS (S).
6. INSERT CARTRIDGE & SLOWLY CLOSE DOOR. CARTRIDGE SHOULD SEAT DOWN COMPLETELY & IF PUSHED FROM FRONT TO REAR & SIDE TO SIDE A SMALL AMOUNT OF PLAY SHOULD BE FELT. IF NOT RECHECK STEPS 11, 12 & 13.
7. WITH CARTRIDGE INSTALLED & DOOR CLOSED (VIEW B) ADJUST CANTILEVER SPRING (Y) TO EQUALIZE DIMENSION (DD) & (EE). ALSO CENTRALIZE OVER ACTUATOR (Z) (VIEW A) & TIGHTEN SCREWS.
8. WITH CARTRIDGE INSTALLED & DOOR CLOSED (VIEW B) CLEARANCE (FF) SHOULD EXIST BETWEEN CANTILEVER SPRING (Y) & ACTUATOR (Z). CARTRIDGE DOOR SHOULD ALSO CLOSE UPON REMOVAL. IF EITHER IS INCORRECT, TWIST ACTUATOR SLIGHTLY AND RECHECK ABOVE.
9. WITH CARTRIDGE INSTALLED & DOOR CLOSED (VIEW A) CHECK FOR .015 MINIMUM CLEARANCE BETWEEN THE CARTRIDGE CONE & THE DISK HUB (NOT SHOWN - INSIDE CARTRIDGE) BY DEPRESSING THE CARTRIDGE DOOR AT POINT (AA). IF THE CLEARANCE IS INSUFFICIENT RECHECK STEPS 7 & 8, AND CHECK FOR WARPED CARTRIDGE RECEIVER OR DEFECTIVE CARTRIDGE.
10. WITH CARTRIDGE INSTALLED & DOOR CLOSED, (VIEW B), CENTRALIZE SWITCH BLADE (K) IN HOLE IN CARTRIDGE RECEIVER BASE (N) & TIGHTEN SCREWS (M).
11. WITH CARTRIDGE INSTALLED, DOOR CLOSED, (VIEW B), & BLADE (K) HELD DOWN, CLEARANCE SHOWN SHOULD EXIST TO CARTRIDGE. TO ADJUST ROTATE SWITCH (L) AND TIGHTEN SCREW (GG).
12. ADJUST HEIGHT OF CARTRIDGE DOOR ACTUATOR (H) TO DIMENSION SHOWN IN VIEW B (BROKEN LINES) BY TURNING NUTS (KK) KEEPING TOP HORIZONTAL. LOCK WITH NUTS (JJ).
13. REFER TO 11120 TO 11125 FOR ELECTRICAL ADJUSTMENT PROCEDURES.

NOTES

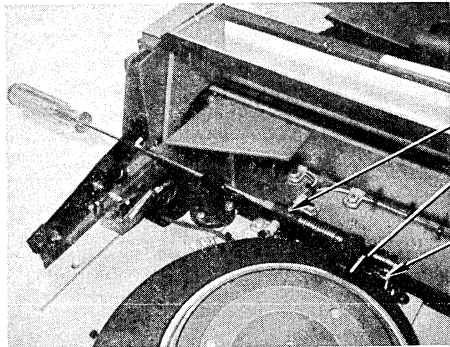
1. THE PURPOSE OF THE VIEWS ON THIS SHEET IS TO AID IN THE DESCRIPTION OF THESE ADJUSTMENTS, THEREFORE MANY PARTS HAVE BEEN OMITTED.





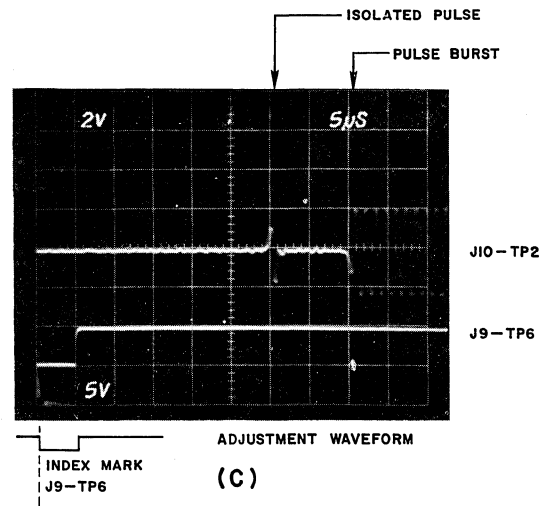
WITH "H" FRAME AND CARTRIDGE RECEIVER IN PLACE

(A)



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

(B)



(C)

Figure 5-7 SECTOR TRANSDUCER ADJUSTMENT

Sector Transducer Adjustment Procedure

5. Refer to Figure 5-7 for aid in performing this adjustment procedure. This procedure requires a dual beam oscilloscope, an exerciser, a ¼" blade screwdriver with a 6" minimum shank length, and a C.E. Pack (alignment cartridge). The Electronics Frame should be in its raised position. Connect a power supply, a proper terminator, and the exerciser.
 - a) Apply power to the drive in the LOAD mode, and install a proper C.E. Pack. Switch to the RUN mode, and wait for the READY light.
 - b) Trigger the oscilloscope on the leading edge of the Index Mark, a negative going pulse available at TP6 on PCB J9.
 - c) Using the Exerciser's controls, position the Read/Write heads over pre-recorded track 095 (hi-density option machines use track 100). Adjust the oscilloscope to produce the lower trace shown in Figure 5-7C.
 - d) Observe the signal at TP2 on PCB J10. It should be similar to that shown as the upper trace in Figure 5-7C.
 - e) Refer to Figure 5-7A and B. Insert the screwdriver as shown to engage the adjustment screwhead of the transducer. Adjust the Trans-

ducer laterally to position the upper trace first peak of the Isolated Pulse 30 microseconds after the beginning of the sweep. Increase oscilloscope sweep rate to 5 microseconds per division for maximum resolution.

- f) Alternately select the two heads, and readjust the Transducer to locate the first peak of the isolated pulse symmetrically around the 30 microsecond point. Their separation must remain less than 10 microseconds. Excessive separation indicates a misalignment of the heads vertically in relation to each other. This condition must be corrected before the Sector Transducer can be correctly adjusted.

5.5.5 The Head Positioner Assembly

1. Prepare the Series 30 for disassembly as previously described. Raise its Electronics Frame Assembly into the service position, and remove all six PCB's. Remove the disk cartridge if installed.
2. Disconnect the two sets of twisted pair wires (Wht/Blk, and Yel/Blk) at the Position Transducer, the two positioner motor wires (Wht and Yel) at the Motherboard and Heatsink, the rotary transformer cable (Wht/Blk twisted pair) plug P8 located under the transformer plate, and the red

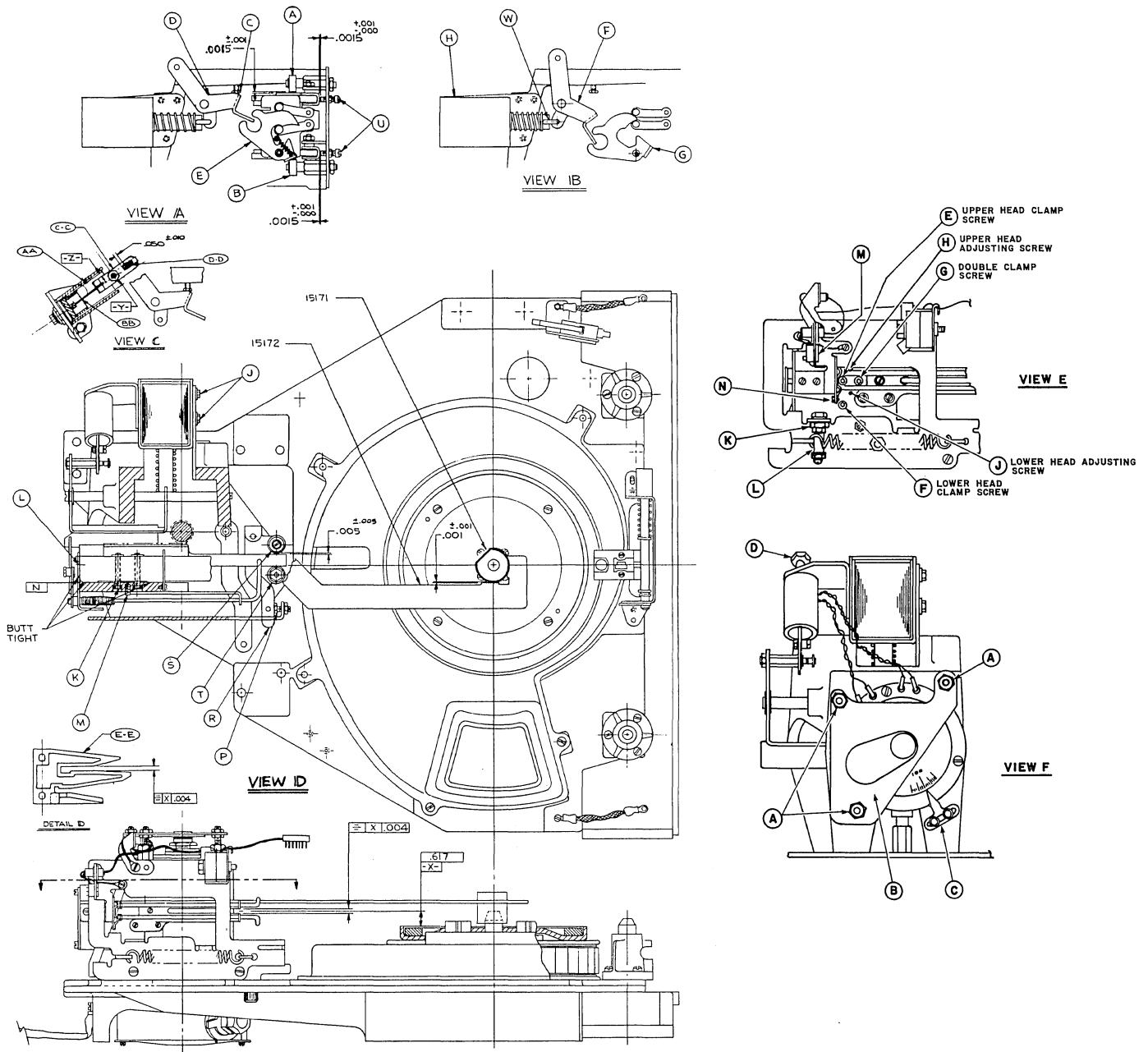


Figure 5-8 HEAD POSITIONER ADJUSTMENTS

and orange wires to the Head Load Solenoid. Unsolder the two brown twisted pair wires from the Track "O" switch. Free all wires from their clamps.

3. Position the drive on its side, and remove the rear bottom cover plate.
4. While holding the Head Positioner with one hand, remove the three socket head machine screws holding it to the Baseplate (accessible from the bottom) and remove the assembly.
5. Reinstall the Head Positioner Assembly by reversing the procedure outlined above, and such other assemblies as are necessary to operate the drive.

Head Positioner Adjustment Procedure

Refer to Figure 5-8. Note that it may be necessary to remove the Cartridge Receiver to gain access to eccentric "T" for the adjustment in Step # 11.

1. Raise roller "A" as high as possible.
2. Adjust carriage height to the dimension shown by adjusting eccentric "B". Retighten its holding nut.
3. Adjust eccentric "A" to dimension shown. Retighten its nut.
4. Refer to View A. Adjust screw "C" so that bail "D" is centered in cam "E" as shown.
5. Refer to View B. Loosen Solenoid mounting screws "J". Adjust the Solenoid "H" so that bail

"F" is centered in cam "G" as shown. Retighten mounting screws "J", keeping Solenoid "H" and link "W" horizontal.

6. Loosen screw "M" so that its tip will not interfere with tool # 15172 in the next step.
7. Remove the upper head. Install tool # 15172 in its place, so that it is tight against end plate "L" and carriage surface "N". Tighten the head clamp screws to 50 ± 5 inch ounces (tightening to a higher torque will damage the head clamps). Install tool # 15171. Rotate tool # 15171 so that only round surfaces are presented to tool # 15172. Move the carriage back against its rear stop.
8. Adjust the carriage stop eccentric ("K", View E) until bar tool # 15172 just touches cone tool # 15171.
9. Adjust cylinder pointer ("C", View F) to align with the "0" mark on the Head Position Transducer plate.
10. Turn stop screw "P" (View D) clockwise as far as possible, and loosen stop screws "U" (View A) approximately .030".
11. Loosen its clamp nut, and turn eccentric "T" (View D) so that the clearance between bar tool # 15172 and cone tool # 15171 is as shown, and retighten the clamp nut. Adjust stop screw "P" so that with arm "R" held tight against it the clearance between roller "S" and the carriage arm is as shown. Tighten the clamp nut on screw "P".
12. Adjust stop screws "U" (View A) for the clearance shown while the carriage is at the track "0" position, and then check at other positions.
13. Referring to View C, adjust the position of cylinder "AA" so that the clearance shown exists between link "CC" and screw "DD" with link "CC" held to the left and piston "BB" bottomed in the cylinder.
14. Adjust the height of the cartridge and disk guide "EE" (detail D), and tighten its hold-down screws.
15. Make a final check of all clearances, remove the tools, and reinstall the upper Read/Write head.

Head Positioner Transducer

1. Connect an oscilloscope to TP1 of PCB J1, and set the oscilloscope for automatic sweep.
2. With power applied and the Servo Release Switch (see Figure 5-5) depressed, manually move the rotary member of the Position Transducer back and forth.
3. A 15 volt p-p sine wave should be seen on the oscilloscope. If not, loosen upper nuts "A" (Figure 5-8, View F) and rotate the transformer mounting plate until a signal of 15 ± 1 volts p-p is observed. Retighten the nuts.
4. Connect the oscilloscope to TP2 of PCB J1, and again move the rotary member of the Position Transducer as before.
5. A sine wave should be observed which is within ± 1 volt of the signal seen at TP1. If this is not true, troubleshoot PCB J1.
6. Check that the rotary transformer gap is properly set. This gap should be a minimum of .010 inch. If it is necessary to raise the transformer plate, recheck steps 1 through 5 above.

Read/Write Heads

The following *Alignment Checks* make use of the Diablo C.E. Pack # 70268 of an IBM C.E. Pack (with or without shim). These checks require the use of an oscilloscope, a PCB Extender Card with interconnect cable, an exerciser, and a terminator.

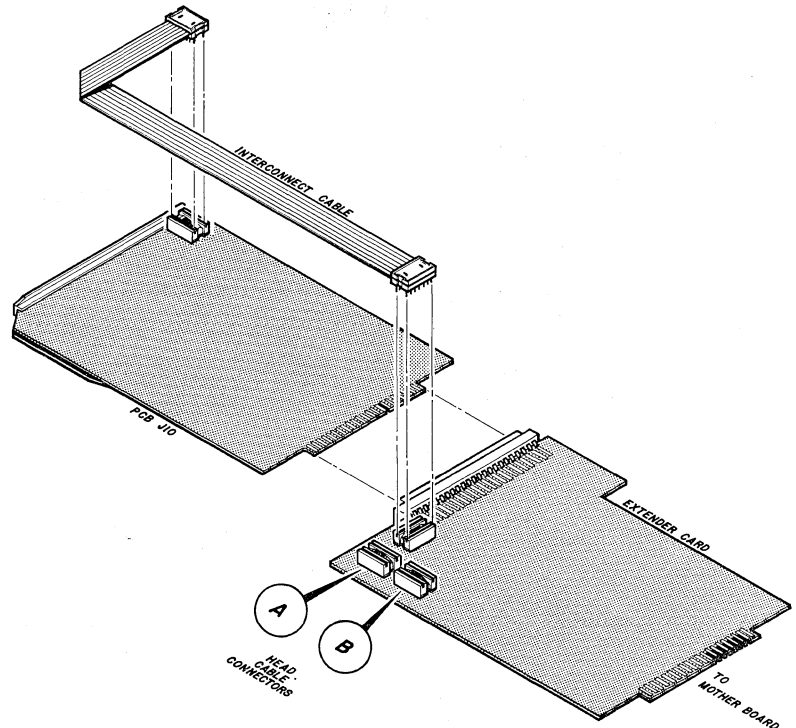


Figure 5-9 PCB J10/EXTENDER CARD INSTALLATION

1. Refer to Figure 5-9. Install the extender card between the J10 PCB and the Motherboard, and install the interconnect cable as shown. Plug the head cable into the appropriate connector on the extender (see specific procedure below), and connect the exerciser and the terminator to the drive's I/O connectors.
2. Apply power to the drive, in the LOAD mode, and install the C.E. Pack. Switch to the RUN mode, and allow the drive to run for approximately 10 minutes for temperature stabilization.

Standard Density Machine (Diablo's C.E. Pack, or the IBM C.E. Pack *with* hub shim)

3. Connect the head cable to Extender Card connector "A" (Figure 5-9), and position the head carriage electronically to cylinder 100.
Note: This can be done manually if the cylinder pointer has been aligned correctly.
4. Trigger the oscilloscope on the negative going leading edge of the Index Mark pulse (TP6 on PCB J9). See Figure 5-7C.
5. Monitor TP2 of PCB J10. The signal from the lower head will normally be selected and its output seen at TP2. The upper head may be selected for observation of its output at TP2 by

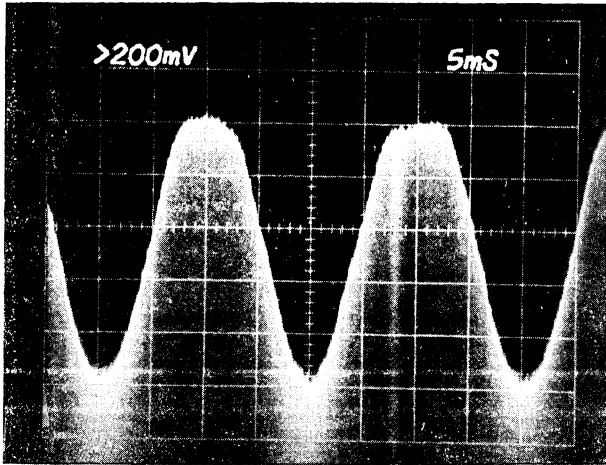


Figure 5-10 WAVEFORMS

grounding TP5 on PCB J10. Both heads should be checked. A correctly aligned head will meet the standard shown in Figure 5-10. See Adjustment Procedures immediately following this section if the above is not true.

High Density Machine (Diablo's C.E. Pack, or the IBM C.E. Pack *with* hub shim)

6. Connect the head cable to Extender Card connector "A" (Figure 5-9), and position the head carriage electronically to cylinder 105.
Note: This can be done manually if the cylinder pointer has been aligned correctly.
7. Trigger the oscilloscope on the negative going leading edge of the Index Mark pulse (TP6 on PCB J9). See Figure 5-7C.

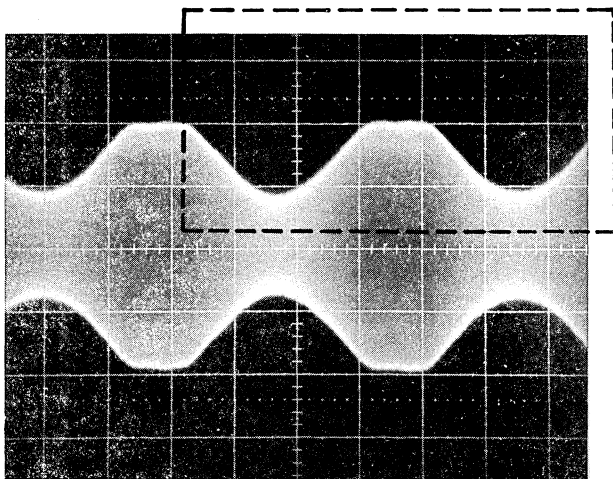


Figure 5-11 WAVEFORMS

8. Monitor TP2 of PCB J10 to observe the waveform shown in Figure 5-11, then readjust the oscilloscope for the pattern shown in Figure 5-10. The signal from the lower head will normally be selected and its output seen at TP2. The upper head may be selected for observation of its output by grounding TP5 on PCB J10. Both heads should be checked. A correctly aligned head will meet the standard shown in Figure 5-10. See Adjustment Procedures immediately following this section if the above is not true.

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

9. Connect the head cable to Extender Card connector "B" (Figure 5-9), and position the head carriage electronically to cylinder 100.
Note: This can be done manually if the cylinder pointer has been aligned correctly.
10. Trigger the oscilloscope on the negative going leading edge of the Index Mark pulse (TP6 on PCB J9). See Figure 5-7C.

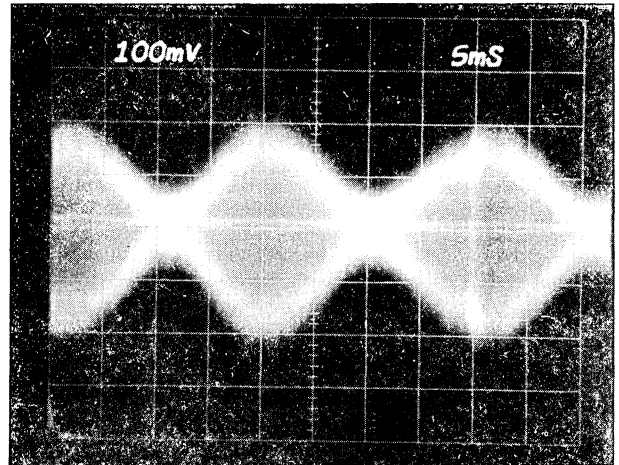


Figure 5-12 WAVEFORMS

11. Monitor TP2 of PCB J10. The signal from the lower head will normally be selected and its output seen at TP2. The upper head may be selected for observation of its output at TP2 by grounding TP5 on PCB J10. Both heads should be checked. A correctly aligned head will meet the standard shown in Figure 5-12. See Adjustment Procedures immediately following this section if the above is not true.

Read/Write Head Adjustment

The performance of the following adjustments requires the use of Diablo Torque Wrench Set # 99001, and an oscilloscope. Note that the "Track 0" adjustment must be

correct before attempting to adjust the Read/Write heads. This procedure therefore starts with the "Track 0" adjustment and proceeds to the R/W Head adjustment.

1. Before performing the Track 0 stop adjustment, be sure that the cylinder pointer adjustment is correct as described earlier in this section.
2. Connect the vertical amplifier of the oscilloscope to TP2 on PCB J1, and the horizontal amplifier to TP1 of PCB J1.
3. Depress the Servo Release Switch (see Figure 5-5), and manually rotate the head positioner. The scope trace should be a lissajous pattern which in this case assumes a circular trace, as depicted in Figure 5-13.

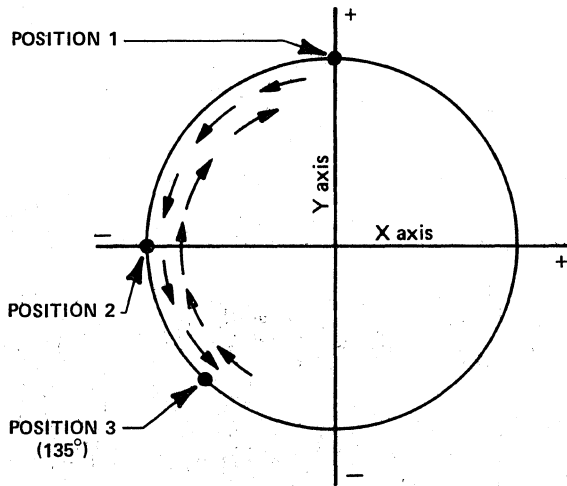


Figure 5-13 TRACK "0" STOP ADJUSTMENT PATTERN

4. Manually rotate the head positioner fully clockwise to retract the head carriage as far as possible and release the Servo Release switch. The cylinder pointer (Figure 5-8, View F, Item C) should indicate Track "0". Using the scope's Horizontal Position control, center the dot on the top portion of the display "Y" axis, shown in Figure 5-13 as Position 1.
5. Depress the Servo Release Switch and, with slight pressure, force the head positioner against its rear (crash) stop. Adjust eccentrics "K" and "L" (Figure 5-8, View E), so that the scope trace comes to rest within Position 2 of Figure 5-13, but not past it.
6. Release the Servo Release Switch. The scope dot should return to Position 1.
7. Switch the drive between LOAD and RUN mode several times. The trace should swing a maximum arc of $135 \pm 40^\circ$ from Position 1 in a counter-clockwise direction toward Position 3. If it exceeds this limit, repeat steps 3 through 7.

With successful completion of the "Track 0" adjustment, continue with the Read/Write Head adjustment procedure.

8. Perform the steps of the appropriate Head Alignment Check procedure outlined above.
9. When a Read/Write Head is installed in its rearmost position, the head will be about 5 cylinders too far back. A head is adjusted by inserting a set screw (part of tool set #99001) in the proper

threaded screw hole (see Figure 5-8, View E), and turning it in against a diagonal surface on the edge of the head support arm. This will move the head assembly toward the spindle ONLY. If the head is moved too far, the screw must be removed, the head clamps loosened, and the head moved rearward to begin again. As the head is moved toward the spindle by the set screw, it will approach the pre-recorded alignment track (cylinder 100 or 105 as described above). Standard Density machines read track 100 with the erase coils, while High Density machines read track 105 with the read/write coils. The head is correctly adjusted when an equal portion of the eccentrically recorded track is read by each half of the winding. See Figures 5-10, 5-11 and 5-12, all of which depict 0% error in head adjustment.

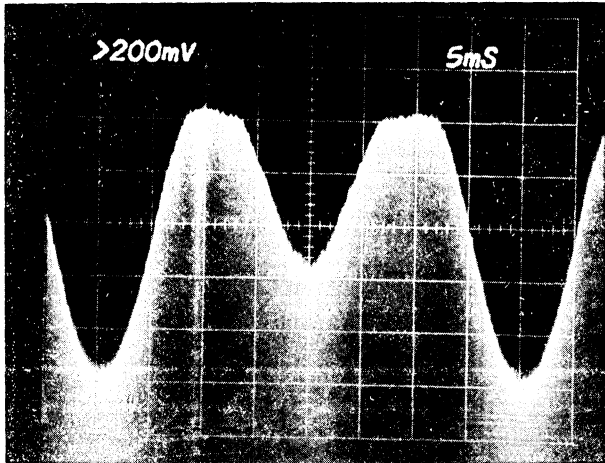
10. Figure 5-14 illustrates read/write head adjustment error. Figure 5-14A shows a 40% misadjustment, and B shows 80% misadjustment using the Diablo C.E. Pack or the IBM C.E. Pack with hub shim. Adjustment is required if successive dips differ by more than 60%. Figure 5-14C shows 60% misadjustment of a standard density machine using the IBM C.E. Pack without the hub shim. Adjustment is required if successive lobes differ by more than 20% — for example: if the maximum p-p amplitude of the first lobe is 150 millivolts and the second lobe is 120 millivolts or less, the head should be adjusted.
11. Following adjustment, the head clamps must be torqued down. Refer to Figure 5-8, View E. A torque of 50 inch/ounces shall be applied to the double (common) head clamp "G", while a torque of 26 inch/ounces shall be applied to single head clamp "E" and/or "F".

Read/Write Head Replacement

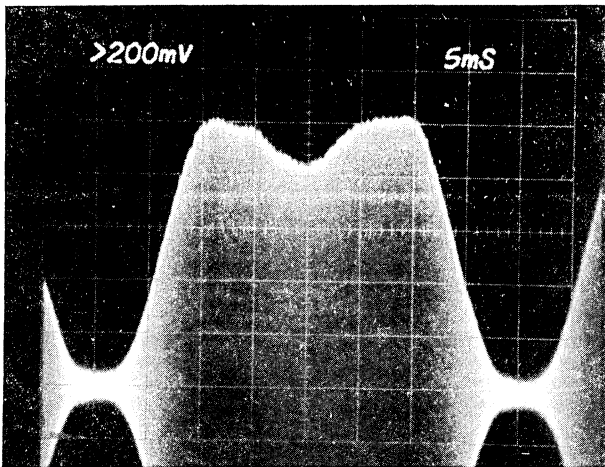
1. Refer to Figure 5-8, View E. Raise the Electronics Frame into the service position to gain access to the rear of the Head Positioner through the Heat Sink, and loosen the head plug cable clamp "N".
2. Unplug the appropriate head plug "M". The upper head is the inner connector.
3. Loosen the double (common) head clamp screw "G" and the desired single head clamp screw "E" or "F".
Note: Do not loosen a clamp screw MORE than $\frac{1}{2}$ turn.
4. Pull the loosened head assembly toward the spindle until clear.
5. Install the replacement head assembly by reversing the above procedure.
6. Apply 26 inch/ounces of torque to the head clamp screws, and proceed with head adjustment.

Head Load Dashpot Adjustment

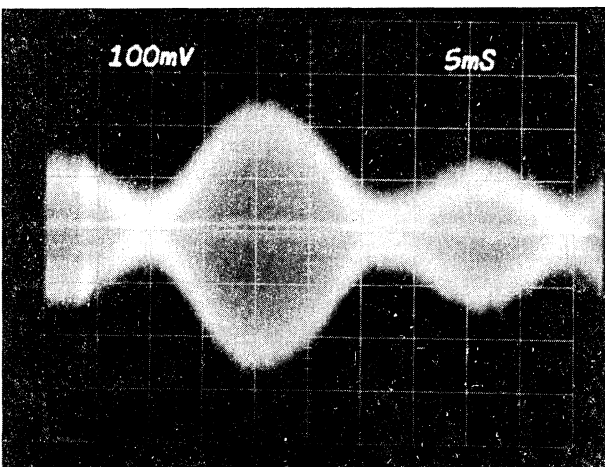
1. Install a disk pack having information written at



A



B



C

Figure 5-14 READ/WRITE HEAD ADJUSTMENT WAVEFORMS

track 0, start the machine, and allow a complete start-up cycle.

2. Trigger the oscilloscope on the leading edge of the head load pick signal. This is a positive going signal at pin W of PCB J9.

3. Connect the scope's vertical input to TP2 of PCB J10.
4. Trigger the drive's Head Load One Shot FF by momentarily grounding the Set input of the Heads Loaded FF. Refer to J9 Schematic for proper pin number.
5. Observe the signal on the scope. The Read Data and Clock signal appears when the heads are completely loaded against the disk.
6. Refer to Figure 5-8, View F. Turn dashpot adjustment screw "D" until the data signal appears 140 ± 40 milliseconds after the start of the sweep. Lock screw "D" with a drop of adhesive (Diablo # 70226) when the adjustment is completed.

5.5.6 Spindle Assembly

1. Refer to Section 5.5.3 and 5.5.4 for those disassembly procedures necessary to gain access to the Spindle Assembly. Note that it will not be necessary to unbolt the Cartridge Receiver's rear mounting bracket, as this component will hinge up far enough, with its front edge released, to allow removal and installation of the spindle. It is also not necessary to unsolder the Sector Transducer's interconnecting wires.
2. Remove the bottom front panel.

Note: This uncovers the filtered air plenum chamber. Keep this chamber clean. The air passing through this chamber goes directly into the disk cartridge.
3. Position the drive on its left hand side.
4. Disconnect the four spindle motor wires, after carefully noting how they are connected, and remove the two screws holding the Filter PCB in place. Let the board hang free.
5. Loosen the motor's brush holder clamp nuts, and position the connector tabs parallel to the motor shaft.
6. Remove the three socket head machine screws holding the Spindle Assembly in place, and carefully slide the assembly out through the top of the Baseplate.
7. Reinstall a Spindle Assembly as follows. Loosen its brush holder clamp nuts and position the connector tabs parallel to the motor shaft. Locate the motor mounting flange which is in-line with one of the motor's baseplate screws, and equidistant from two of the motor brush holders. The motor is to be installed with this flange toward the rear of the drive.
8. Properly orient the motor and insert it through the top of the Baseplate. Secure the motor in place with the three socket head machine screws, and tighten them down.
9. Orient the motor brush tabs parallel with the Baseplate, and tighten their clamp nuts. Then bend the tabs away from the motor body at a 45° angle.
10. Reconnect the four Spindle Motor wires, and remount the Filter PCB.
11. Reassemble the drive, and perform the Cartridge Receiver and Sector Transducer Alignment Procedures outlined earlier in this section.

5.5.7 Front Panel and Door Lock Assembly (Model 31 Only)

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

SECTION 6

OPTIONS

6.1 GENERAL INFORMATION

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

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

6.2 THE STANDARD SERIES 30 DISK DRIVE

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

6.3 OPTIONS

6.3.1 Mounting Options

Series 30 Disk Drives may be used as desk top units, or mounted in a 19" rack cabinet. When mounted in a rack cabinet, the disk drive should be supported on slide rails and be equipped with a front panel assembly that attaches to the rack cabinet. Diablo supplies slide rails, mounting brackets, and hardware with units ordered with the extended or flush mount option (# 15376-01 LH Slide, -02 RH Slide/# 15558 Rail-to-Rack Mounting Brackets/and # 15601-01 Hardware Kit).

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

1. OPTION 017 — Flangeless front mount. This configuration does not have the mounting flanges used to fasten the drive into a cabinet. This configuration is considered a desk top model, even though it may be mounted on slide rails and installed in a rack cabinet.
2. OPTION 018 — Flush Mount. The front of the Series 30 is fastened flush with the front of the cabinet with this configuration. This option requires a cabinet at least 30" deep, and may require a trim piece (OPTION 020) at the top and bottom of the installation.
3. OPTION 019 — Extended Mount. This configuration will fit into a 24" deep cabinet. The front of

the Series 30 will extend 3/4" from the front of the cabinet.

6.3.2 Density and Sector Options

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

1. OPTION 001 — 1020BPI and 720 KHz
2. OPTION 002 — 1100BPI and 781 KHz (Standard Density)
3. OPTION 003 — 2040BPI and 1440 KHz
4. OPTION 004 — 2200BPI and 1562 KHz (High Density)

The user may also select various sector configurations.

5. OPTION 025 — Standard Density 8 Sector
6. OPTION 026 — High Density 8 Sector
7. OPTION 039 — Standard Density 12 Sector
8. OPTION 041 — High Density 12 Sector
9. OPTION 052 — High Density 16 Sector
10. OPTION 040 — Standard Density 24 Sector
11. OPTION 042 — High Density 24 Sector
12. OPTION 054 — 32 Sector

6.3.3 Input Line Options

1. OPTION 008 — ERASE GATE. One line normally tied internally to the Write Gate which turns on the Erase Current. With the Erase Gate Option, this line is brought out separately. There is no built-in delay of Erase Current.
2. OPTION 005 — WRITE PROTECT INPUT. The Write Protect option prevents writing by inhibiting Write Current. Write Protect is set when power is applied or when the LOAD/RUN switch is activated. It may also be set by this Write Protect input line with a 0 volt nominal signal with a minimum duration of 350 nsec. Write Protect is reset by the operator depressing the PROTECT switch.

6.3.4 Output Line Options

1. OPTION 005 — WRITE PROTECT STATUS. A 0 volt nominal level indicates that the drive's write capability is inhibited. The operator can change the status manually by depressing the momentary action PROTECT switch on the front panel. This reestablishes the drive's write capability.
2. OPTION 046 (-) — ATTENTION LINE.
OPTION 047 (+) — ATTENTION LINE.
Four standard interface lines are reassigned with this option. These lines are:

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

TABLE 6-1

SERIES 30 OPTIONS

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 No.046), the Attention line is at a nominal 0 volts in the not ready state, and goes to +5 volts when the disk drive reaches the Ready status. The Attention line will go to 0 volts at the start of a seek operation, and will return to +5 volts at the completion of the seek. This occurs when the read/write heads are settled over the new cylinder, or upon detection of a Seek incomplete condition. In the event of a seek to the present cylinder address, the Attention line presents a pulse coincident with the Address Acknowledge pulse. In the event of a illegal cylinder address, the Address Acknowledge pulse is presented to the Attention line; the Seek Incomplete line is also set true with an illegal address and must be reset by a restore operation.

With Attention line positive (Option No. 047), the Attention line is at +5 volts in the not ready state, and goes to 0 volts when the disk drive reaches the ready status. The output level of the Attention is in the opposite polarity, but operates exactly as explained in the above description of Option No. 046.

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

OPTION	DESCRIPTION
001	720 KHz – 1020BPI – IBM Compatible
002	781 KHz – 1100BPI – Diablo Standard
003	1440 KHz – 2040BPI – Option
004	1562 KHz – 2200BPI – Option
005	Write Protect
008	Erase Gate (Not tied to Write Gate)
013	Paint – Orange with Diablo Logo
014	Paint – Orange without logo
015	Unpainted without logo
017	Flangless Mount (table top trim)
018	Flush Mount
019	Extended Front
020	Upper and Lower Trim for Flush Mount
023	Drive Tester with Read/Write Data
024	Extender Board Assembly
025	Standard Density – 8 Sector
026	High Density – 8 Sector
027	Standard Density Alignment Pack
029	Dual Unit Power Supply
030	High Density Alignment Pack
032	Power Supply Cable
033-05'	Receptacle Connectors on 5' flat cable (female)
033-07'	Receptacle Connectors on 7' flat cable (female)
034-05'	Pin Connectors on 5' flat cable (male)
034-07'	Pin Connectors on 7' flat cable (male)
035	Receptacle terminator with resistors (female)
036	Pin terminator with resistors (male)
037	Receptacle terminator without resistors (female)
038	Pin terminator without resistors (male)
039	Standard Density – 12 Sector
040	Standard Density – 24 Sector
041	High Density – 12 Sector
042	High Density – 24 Sector
043	Option 023 using external power
044	Rack Mounting for Power Supply
045	Paint – Black without logo
046	Attention Line Negative
047	Attention Line Positive
048	Interrupt Option
050	DTC Card FPC Interdata Controller
051	Standard Density – 16 Sector
052	High Density – 16 Sector
053-05'	M/F Cable 5'
053-07'	M/F Cable 7'
054	32 Sector
056	Cable Assembly (Interdata Controller)
057	Terminator (no erase gate) Female with resistors
058	Terminator (no erase gate) Male with resistors
060	Paint – Grey/Green without logo
061	Paint – Blue without logo
062	Grained without logo
063	Paint – White White (Varian)
064	Attention line with logical address interlock (Varian)
065	Cartridge Closing Bail Assembly

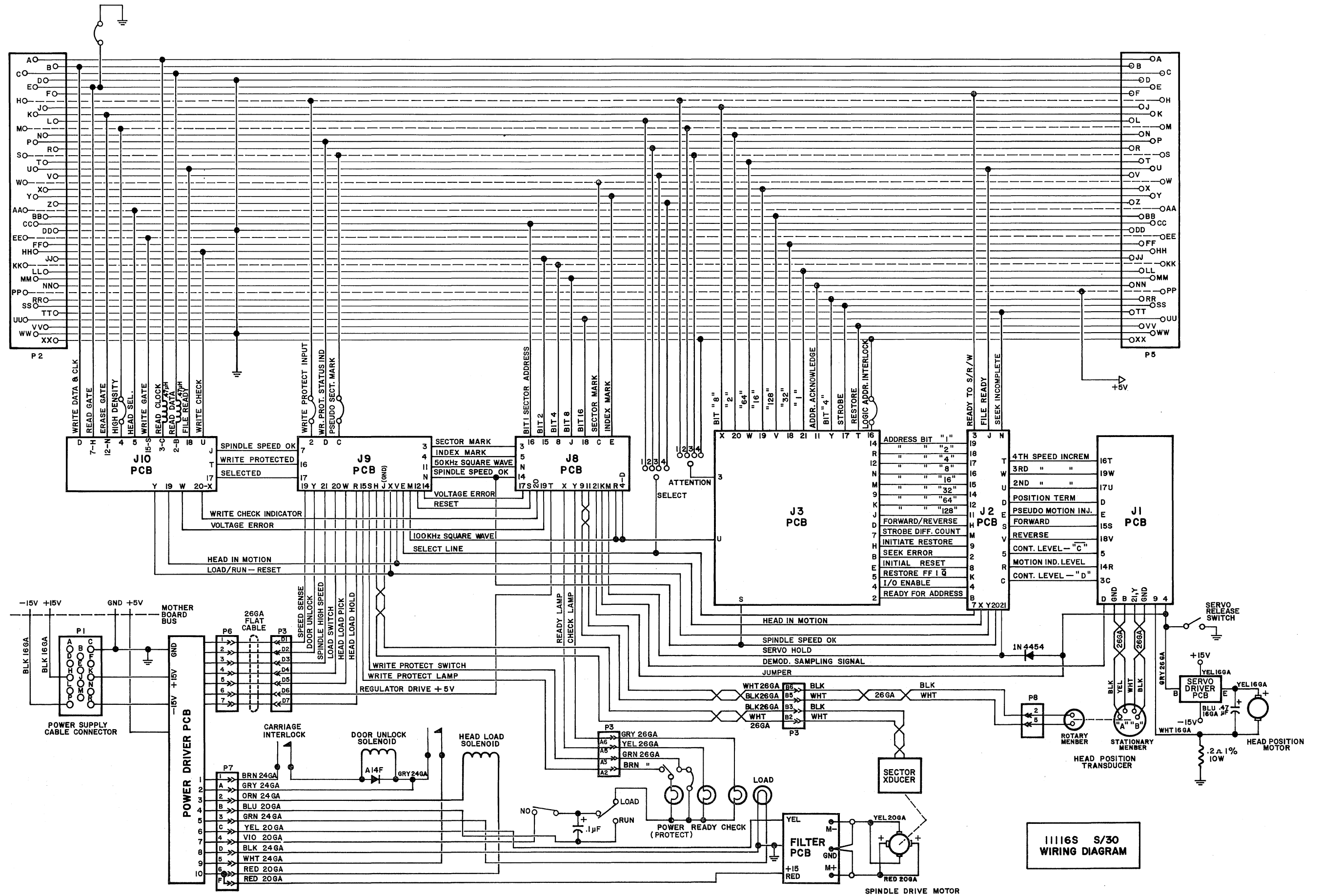
SECTION 7

SCHEMATICS

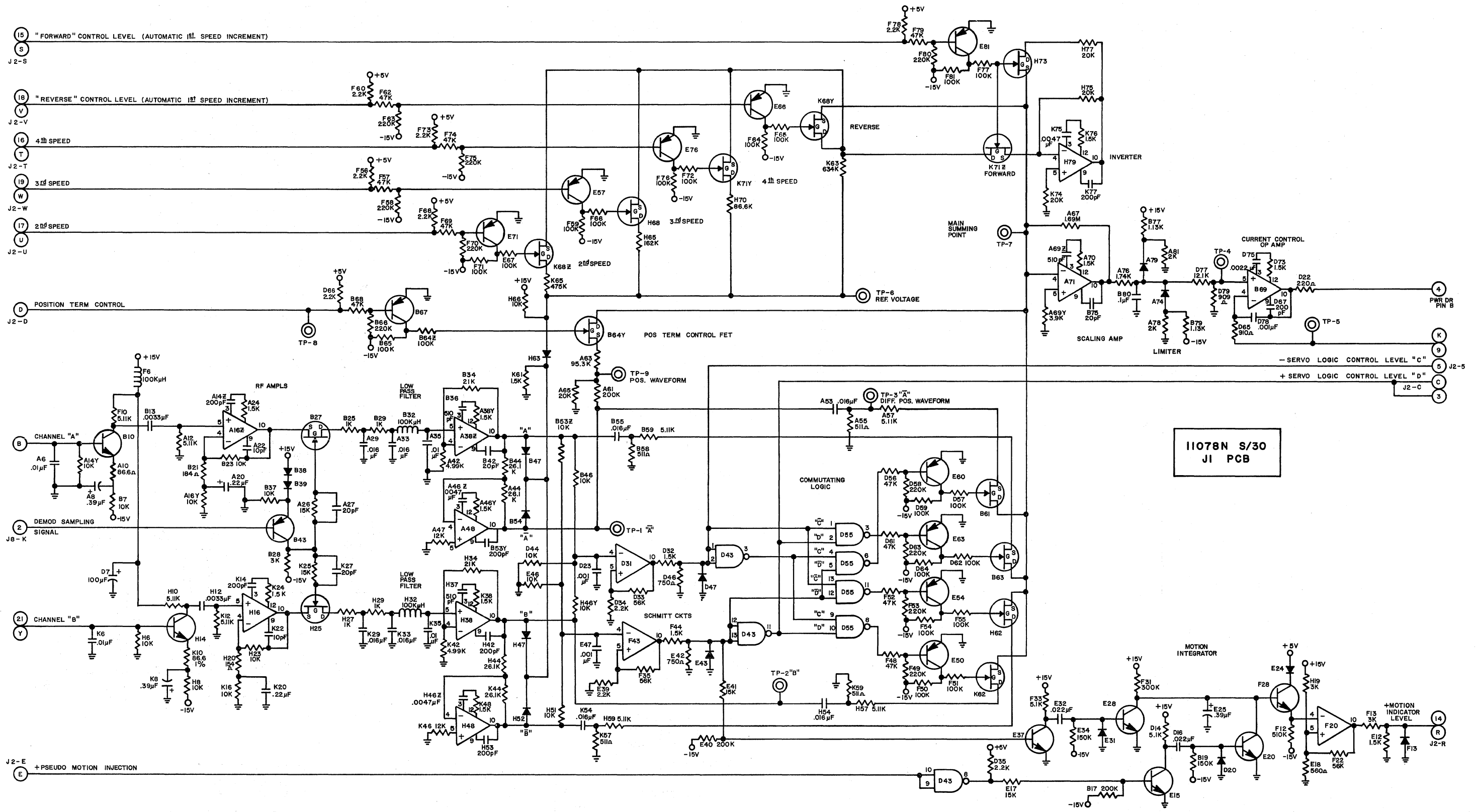
Appropriate option notes are included on each schematic affected. When significant changes are introduced a new

schematic will be distributed. Minor changes are distributed via Field Service Aids by Diablo Customer Service.

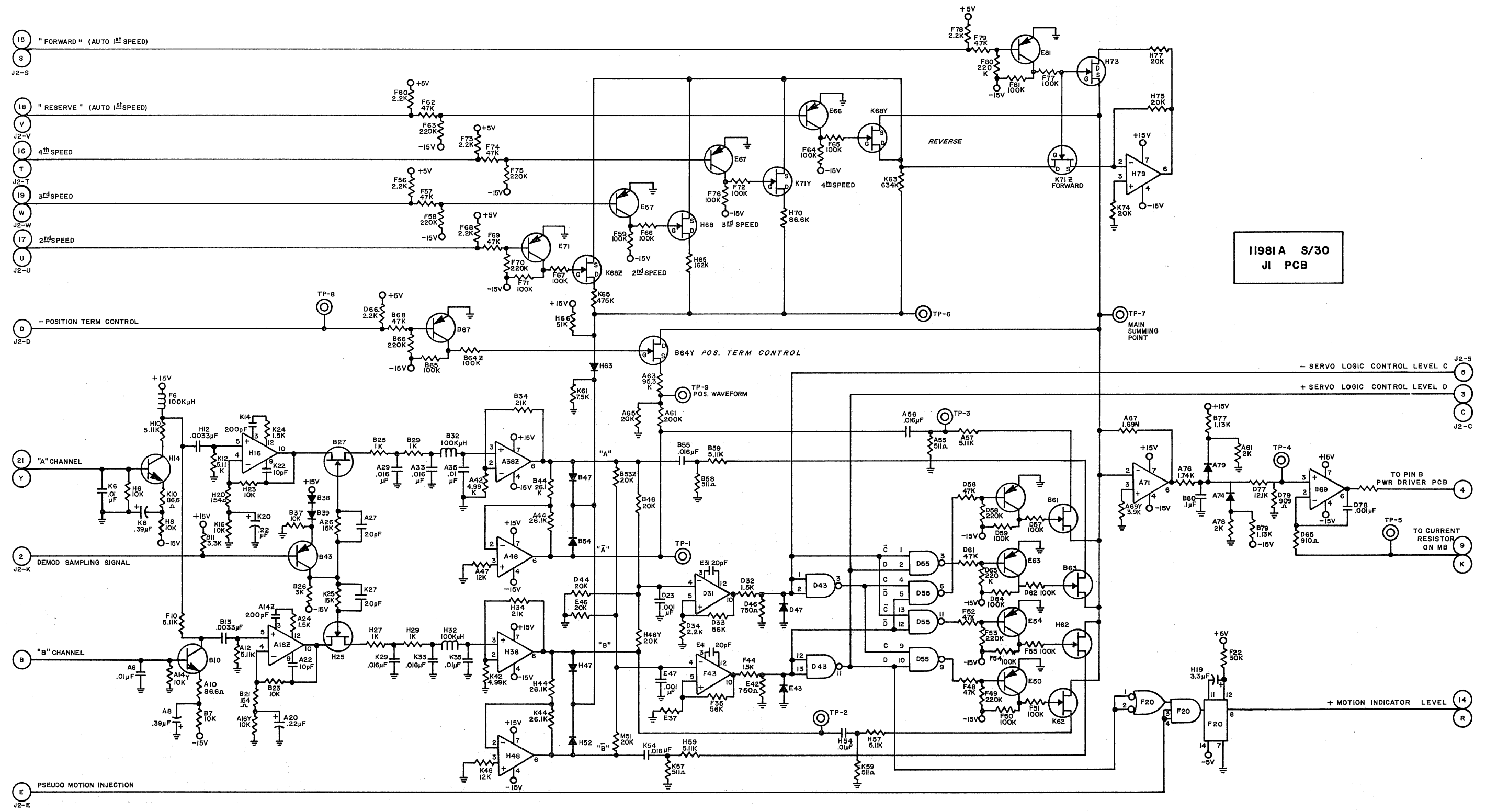
NOTES



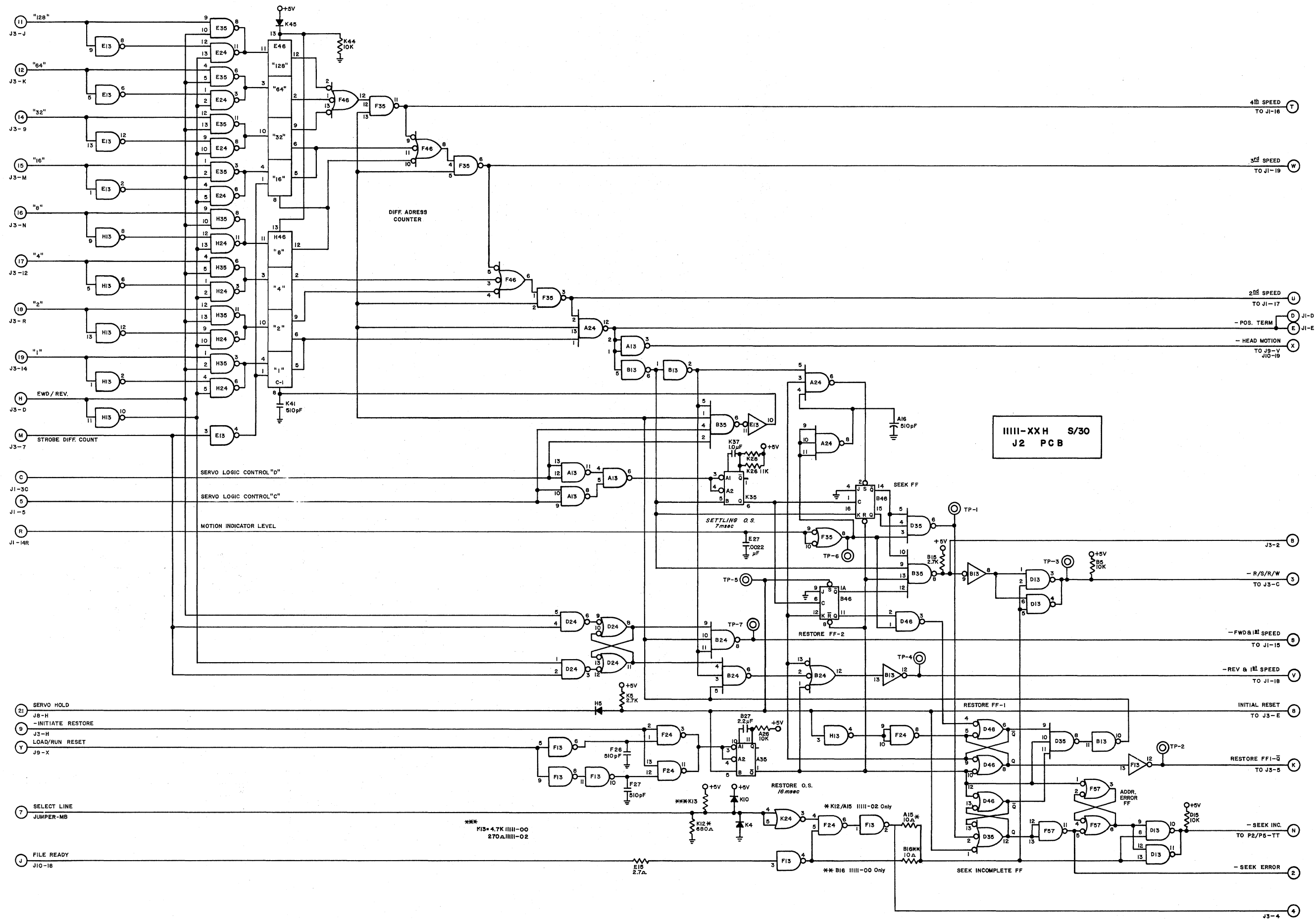
1116S S/30
WIRING DIAGRAM

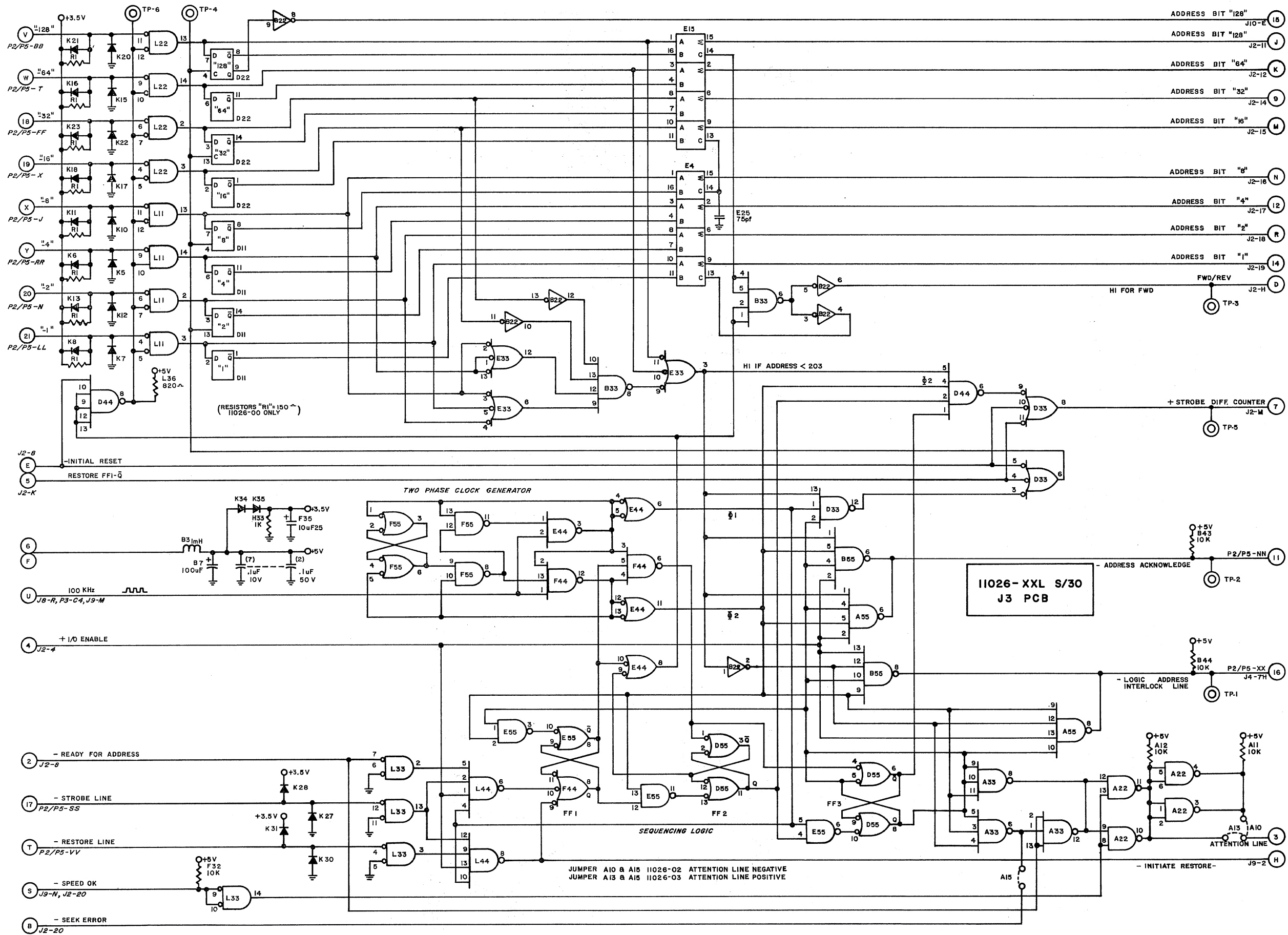


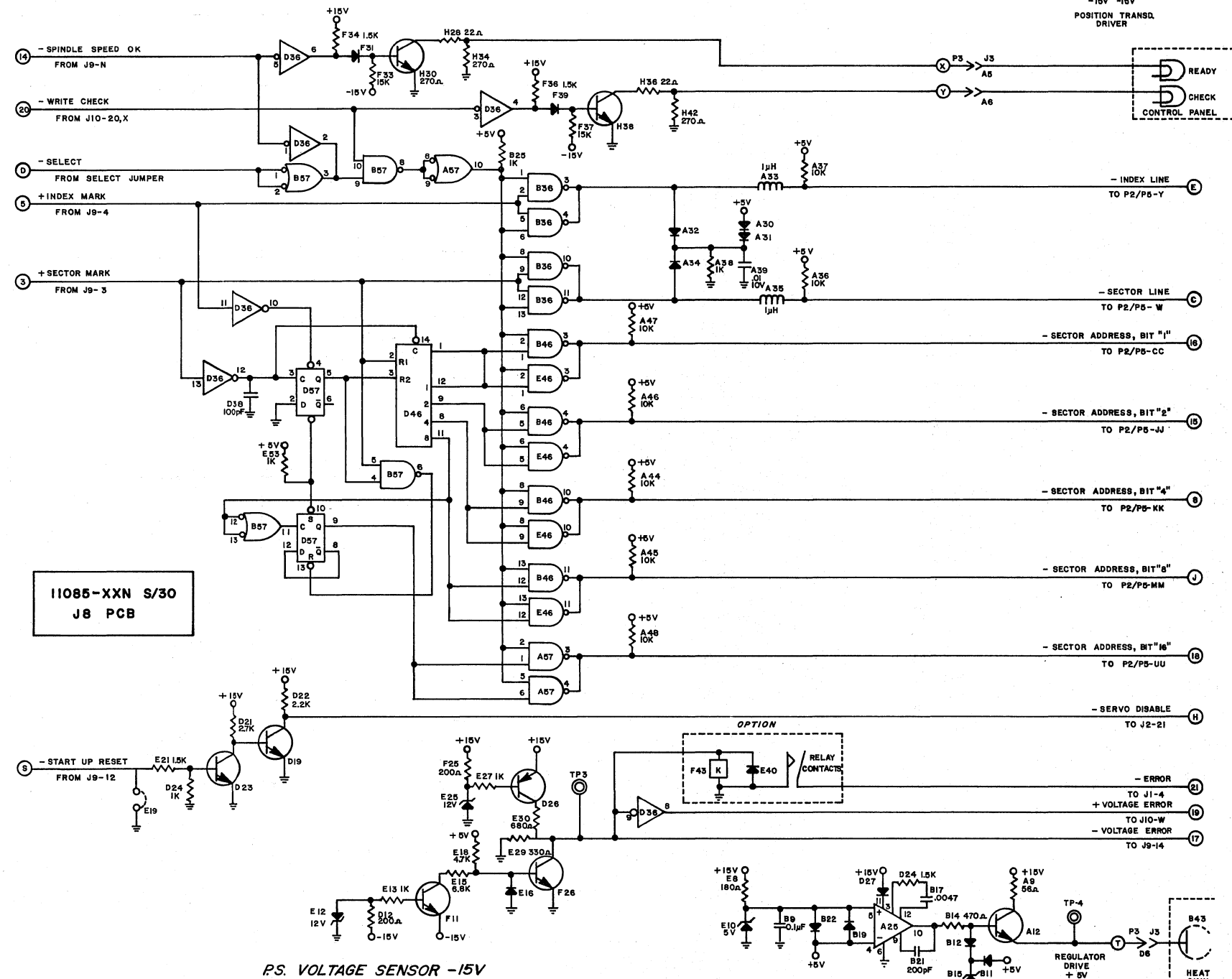
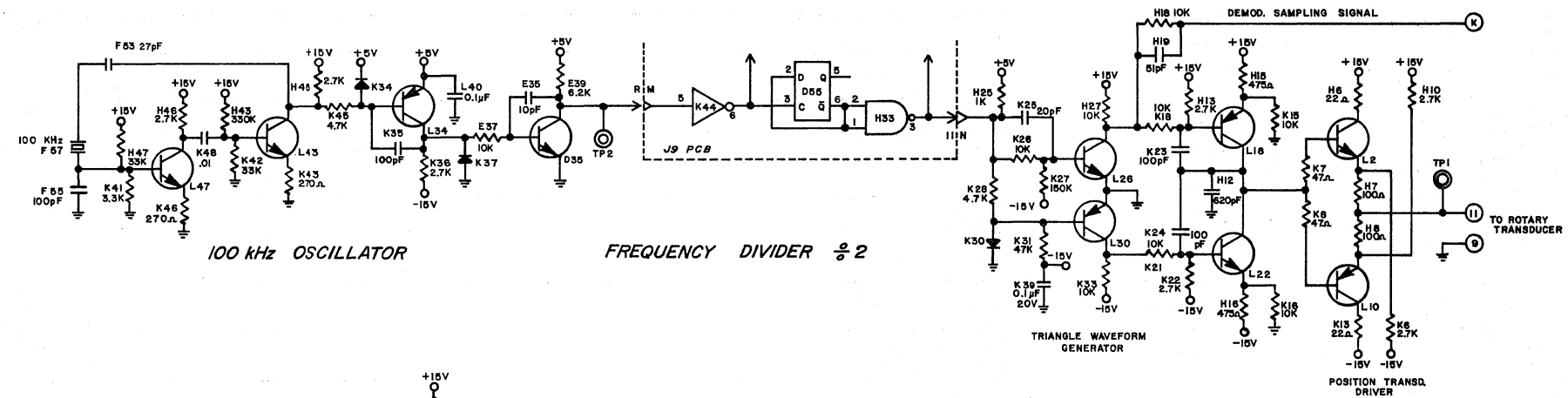
11078N S/30
J1 PCB

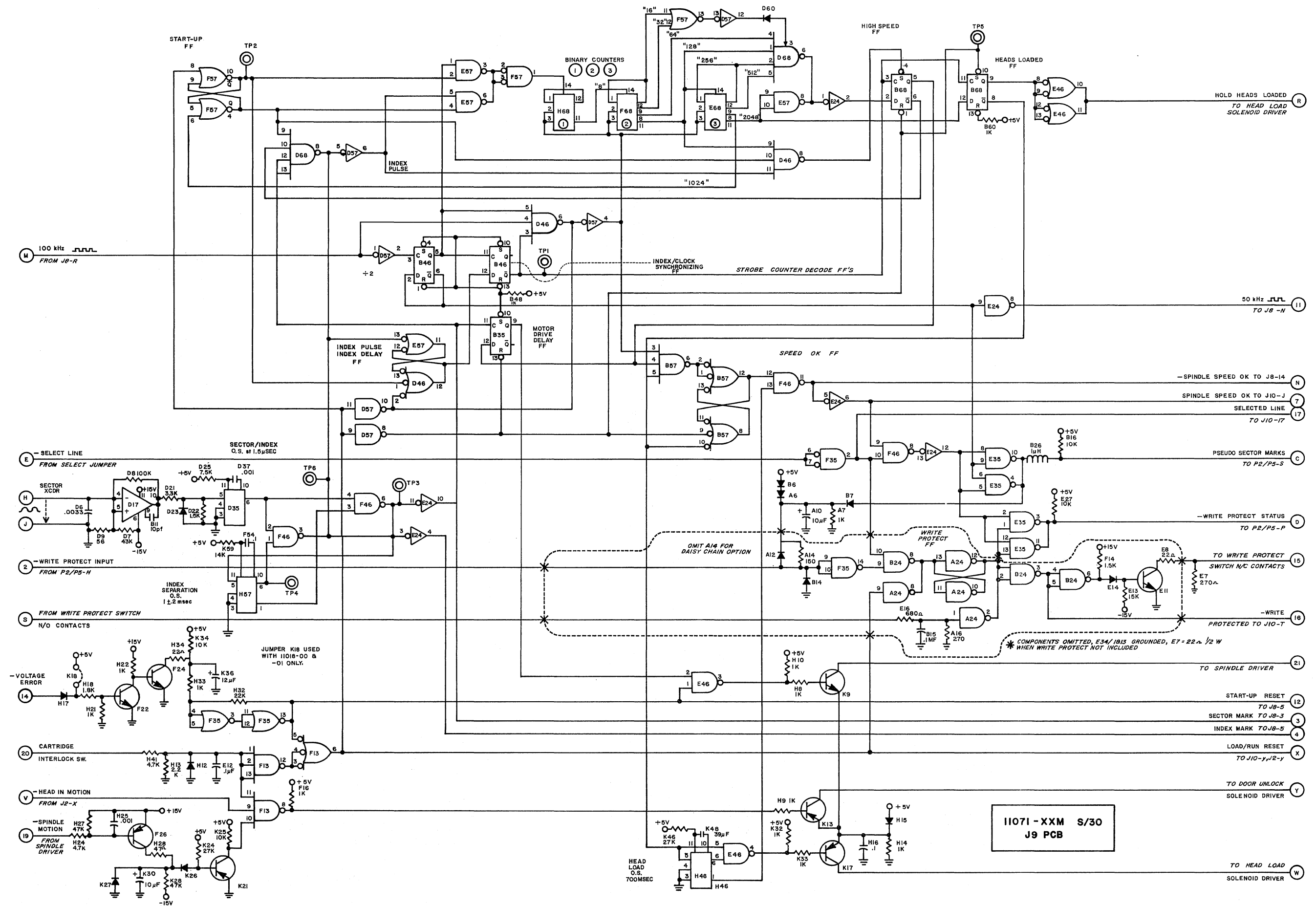


11981A S/30
J1 PCB

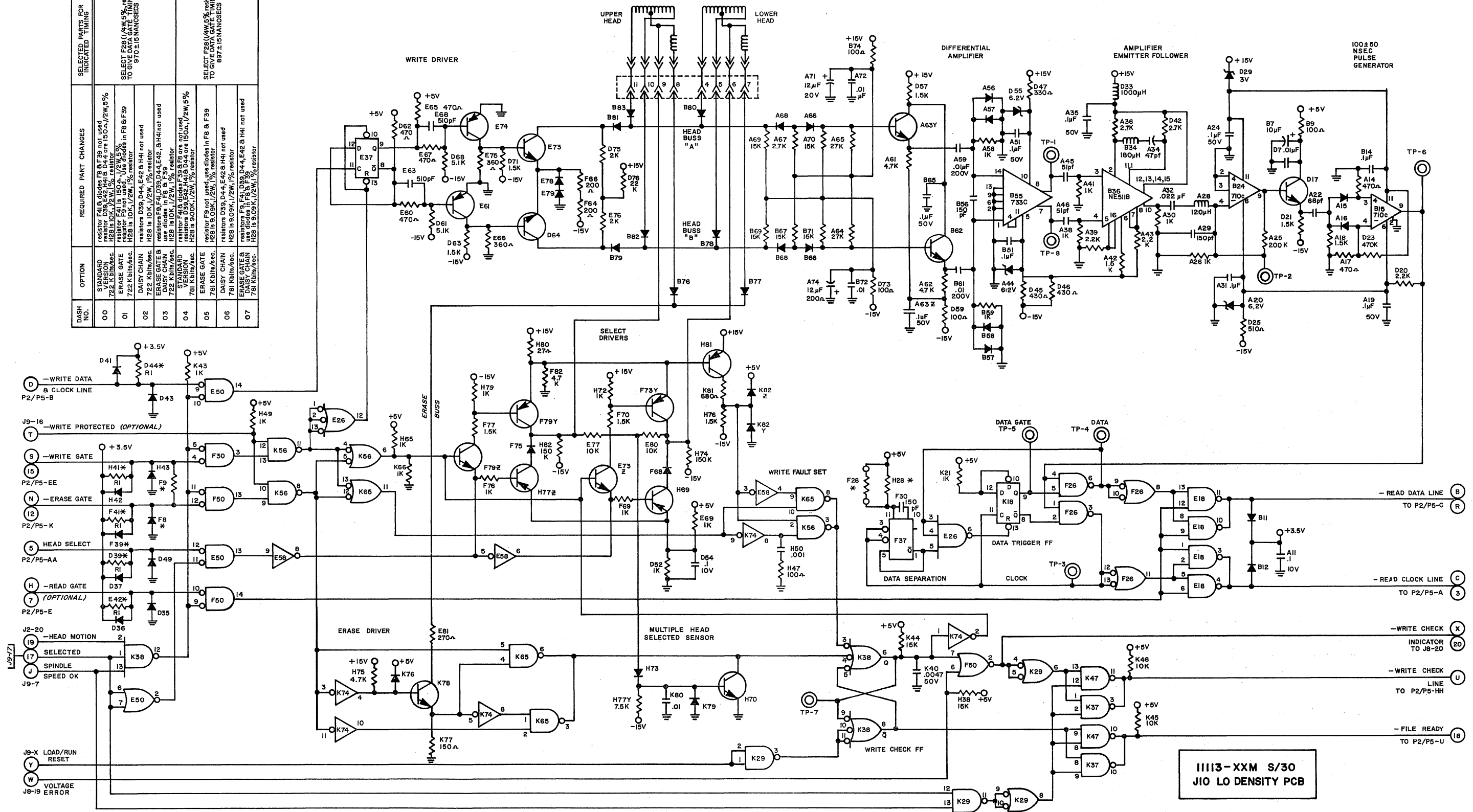




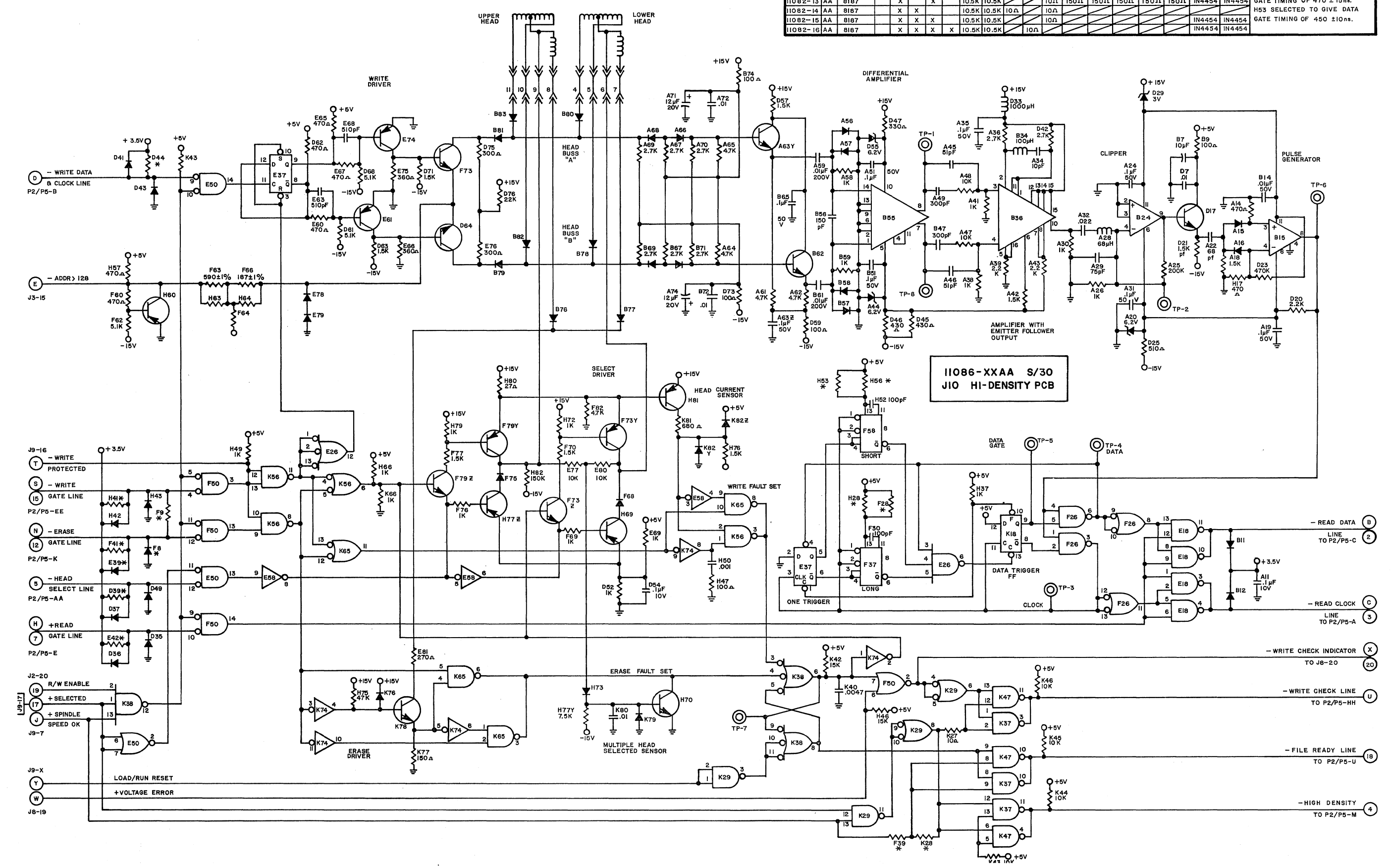




DASH NO.	OPTION	REQUIRED PART CHANGES	SELECTED PARTS FOR INDICATED TIMING
00	STANDARD VERSION	resistor F41 & diodes F8 & F39 not used resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% H28 is 1.5K, 1/2W, 1% resistor resistor F9 not used. Use diodes in F8 & F39	SELECT F28 (1/4W, 5% resistor) TO GIVE DATA GATE TIMING OF 970 ± 10 NANSECS
01	ERASE GATE	resistor F41 & diodes F8 & F39 not used resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% H28 is 1.5K, 1/2W, 1% resistor	
02	DAISY CHAIN	resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% resistor F9 not used. Use diodes in F8 & F39	
03	ERASE GATE & DAISY CHAIN	resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% resistor F9 not used. Use diodes in F8 & F39	
04	STANDARD VERSION	resistor F41 & diodes F8 & F39 not used resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% H28 is 1.5K, 1/2W, 1% resistor	SELECT F28 (1/4W, 5% resistor) TO GIVE DATA GATE TIMING OF 897.2 ± 15 NANSECS
05	ERASE GATE	resistor F41 & diodes F8 & F39 not used resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% H28 is 1.5K, 1/2W, 1% resistor	
06	DAISY CHAIN	resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% resistor F9 not used. Use diodes in F8 & F39	
07	ERASE GATE & DAISY CHAIN	resistor D39, E42, H41 & D44 are 150Ω, 1/2W, 5% resistor F9 not used. Use diodes in F8 & F39	

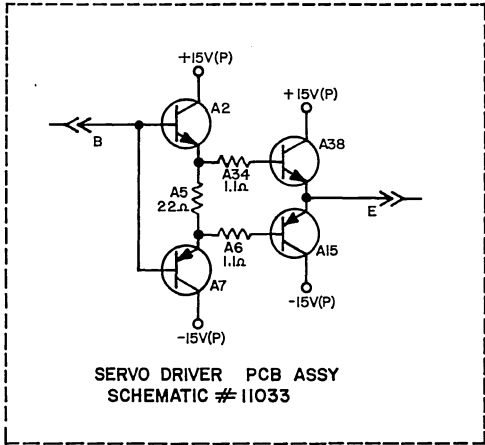
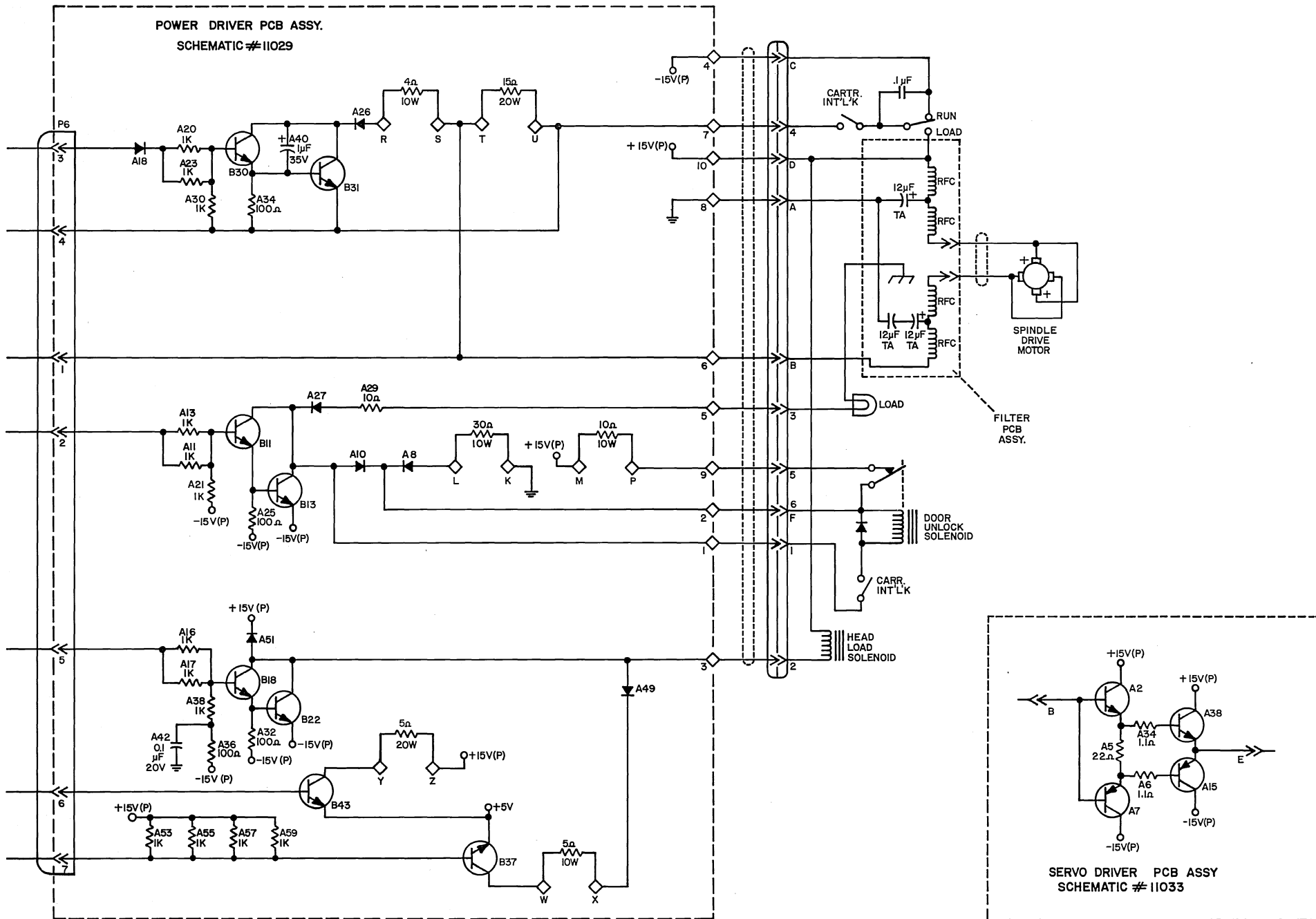


ASSY. NO.	REV.	ECO NO.	DESCRIPTION								RESISTORS								JUMPERS				TERMINATOR RESISTORS				INPUT CLAMP DIODES		TIMING RESISTORS			
			1440 BPS OPTION 005	1566X BPS OPTION 004	DAISY CHAIN OPTION 006	ERASE GATE OPTION 007	INTERLUPT OPTION 008	H28	H56	F9	F39	K28	F41	D39	D44	E42	H41	E39	F8	F28	H53											
11082-08	AA	8187	X								11.5K	11.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										F28 SELECTED TO GIVE DATA	
11082-09	AA	8187	X			X					11.5K	11.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										GATE TIMING OF 515 ± 10ns	
11082-10	AA	8187	X		X						11.5K	11.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										H53 SELECTED TO GIVE DATA	
11082-11	AA	8187	X	X	X						11.5K	11.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										GATE TIMING OF 485 ± 10ns	
11082-12	AA	8187	X		X						10.5K	10.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										F28 SELECTED TO GIVE DATA	
11082-13	AA	8187	X		X						10.5K	10.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										GATE TIMING OF 470 ± 15ns	
11082-14	AA	8187	X	X	X						10.5K	10.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										H53 SELECTED TO GIVE DATA	
11082-15	AA	8187	X	X	X						10.5K	10.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω										GATE TIMING OF 450 ± 10ns	
11082-16	AA	8187	X	X	X	X					10.5K	10.5K	10Ω		10Ω		150Ω	150Ω	150Ω	150Ω	150Ω											



11086-XXAA S/30
J10 HI-DENSITY PCB

POWER DRIVER PCB ASSY.
SCHEMATIC #11029



SERVO DRIVER PCB ASSY
SCHEMATIC #11033