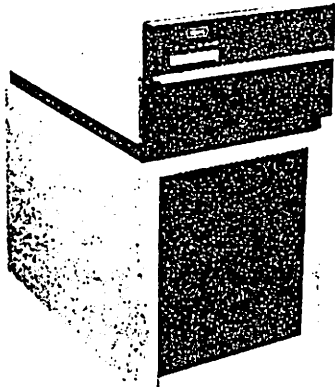


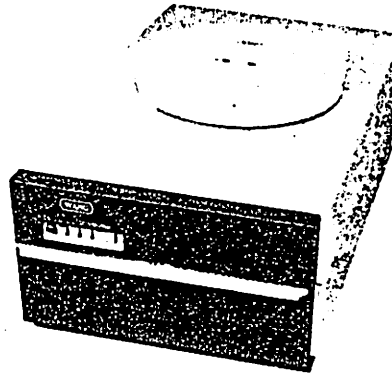
# PRODUCT BULLETIN

# NO. 172

## THE MODEL 2260BC AND MODEL 2260C SERIES DISK DRIVES



2260BC



2260C

This bulletin discusses the Wang Model 2260BC, and 2260C series disk drive features, formatting procedure, controls and indicators, allowable configurations, and specifications. The Model 2260BC and 2260C fixed/removable disk drives replace the 2260B series in the Wang disk product line. They are functionally and operationally similar to the Model 2260B disk drives (described in Chapter 2 of the Disk Reference Manual). For example, the procedures for loading and unloading the disk cartridge in a 2260BC or 2260C series disk drive are identical to those for the 2260B disk drives, and although the control panel switches and indicators are arranged differently on the 2260BC and 2260C than on the 2260B, the functions are identical. The major differences between the 2260BC, 2260C, and 2260B series are outlined below:

1. The Model 2260BC and 2260C series disk platters are formatted under software control using a prescribed \$GIO sequence. There is no format switch on the Model 2260BC and 2260C series disk units.
2. The Model 2260BC must be attached to controller Model 22C13. In order to be multiplexed, both the disk controller Model 22C13, and the disk multiplexer controller Model 2230MXA-1 must be used (i.e., multiplexing requires two I/O slots).
3. The Model 2260C series disk drives cannot be multiplexed. Only disk controller Model 22C12 can be used.

# PRODUCT BULLETIN NO. 172

4. The Model 2260B, 2260BC, and 2260C disk platters are interchangeable. They can be formatted, read from, or written onto when mounted in any 2260 series drive which has as large or larger storage capacity as the drive that created the platter.
5. The Model 2260BC and 2260C series disk drives can neither read, write or format Model 2230 series disk platters.

## OVERVIEW

The Wang Model 2260BC and 2260C Series Fixed/Removable Disk Drives provide fast, reliable, direct-access storage for Wang series 2200 systems (except for the PCS-II, WCS-15, and 2200VS) at a cost which is economically attractive, even for smaller scale users. The largest disk unit provides five million bytes of fixed disk storage and five million bytes of removable disk storage for a total of 10 million bytes, on-line. Twenty million bytes of on-line storage are available in a special configuration which consists of two 2260BC or 2260C disk units daisy-chained together and accessed as a single disk unit which contains four discretely addressable platters (i.e., two fixed and two removable). Removable disk platters make the off-line storage capacity virtually unlimited because they are easy to unload, store, and replace.

Additionally, the Model 2260BC Disk Drives can be multiplexed. Multiplexing allows two to four independent systems to share a single disk unit providing an effective means for optimally utilizing the disk while minimizing the per-user cost. The participating systems may share a common data base or each system may have a specified portion of the total on-line storage reserved for dedicated use. Disk operations for the multiplexed systems are interleaved in such a manner that all the systems have virtually concurrent access to the disk. Additionally, programmable "Hog Mode" feature is provided which allows one system to have a period of exclusive and uninterrupted access to the disk whenever necessary.

## PHYSICAL CHARACTERISTICS

The Model 2260BC Disk Drive is a free-standing unit ideally suited for integration into the office environment. The Model 2260C Series Disk Drive is a table-top unit which is otherwise similar to the 2260BC.

# PRODUCT BULLETIN NO. 172

## STORAGE CAPACITY

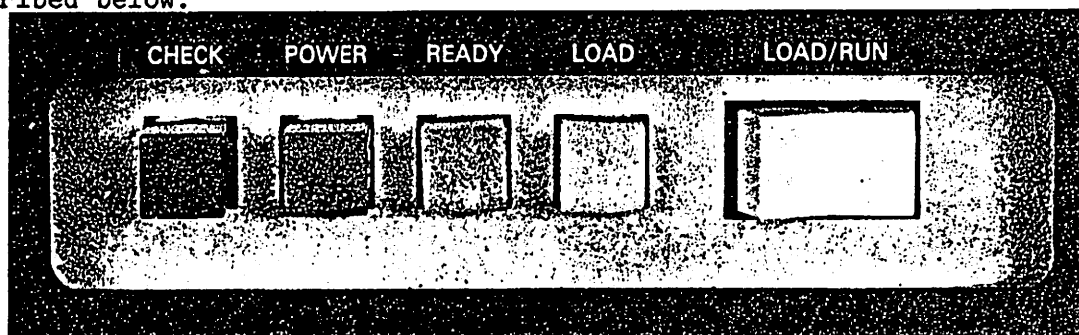
The storage medium of the disk unit is the disk platter, a rigid circular plate covered on both sides with a ferromagnetic coating in which recording takes place. The recording surfaces are divided into a number of concentric recording tracks. Every track is, in turn, subdivided into 24 "sectors". A sector is the smallest addressable unit on the disk and can store 256 bytes of information (program text or data). The sectors on each platter are sequentially numbered and individual sectors can be directly addressed.

The smallest 2260BC or 2260C disk model provides approximately 1.25 million bytes of fixed disk storage and 1.25 million bytes of removable disk storage for a total storage capacity of 2.5 million bytes. This model can be economically expanded to a larger capacity as the user's processing demands increase. The storage capacities of all 2260BC and 2260C series disk models are shown under specifications.

Translation from available storage in bytes to the amount of real data which can be stored is difficult; storage efficiency is determined by a number of factors, including the type of data being stored and the method of storage. For example, a full-precision number (13 digits) requires nine bytes of disk storage. The System 2200, however, will allow the user to store each number on the disk in as few as two bytes, if 13-digit accuracy is not needed. For purposes of general illustration, the Model 2260BC or 2260C (10-megabytes) can store about 1,100,000 full-precision (13-digit) numbers, or about 590,000 16-character alphanumeric values.

## CONTROLS AND INDICATORS

The 2260BC and 2260C series, unlike the 2260B series, have only an upper control panel. The electronics of the lower panel of the 2260B series are contained in the special disk controllers for the 2260BC and 2260C series disk units. The power switch located on the lower control panel of the 2260B series disk drives is located in the rear of the 2260BC and 2260C series units. The switches and indicators on the 2260BC and 2260C control panel are described below.



The Control Panel of the 2260BC and 2260C Series

# PRODUCT BULLETIN NO. 172

## Control or Indicator

## Function

### LOAD/RUN rocker switch

This dual-action switch energizes the spindle motor and puts the disk in operating mode (in the RUN position); readies the disk for "power-on" and removable platter loading or unloading (in the LOAD position). NOTE: The LOAD/RUN switch should never be set to the LOAD position for longer than 30 minutes whenever the power is ON or permanent damage to the disk may occur. The LOAD/RUN switch must be in the LOAD position whenever the disk is powered on.

### LOAD indicator

When the LOAD/RUN switch is in the LOAD position, the LOAD Indicator illuminates. The disk cartridge cannot be removed unless the LOAD indicator is illuminated.

### READY indicator

When the LOAD/RUN switch is in the RUN position and the disk has attained normal operating speed, the READY indicator illuminates (i.e., the unit is up to speed, the heads are loaded, etc.). The disk unit cannot be utilized unless the READY indicator is illuminated. This indicator is extinguished during fault (error), emergency retract, and LOAD.

### CHECK indicator

This indicator illuminates when a disk hardware error (fault) exists (e.g., write failure, servo failure, etc.). Consult the error codes in Appendix A of the Disk Reference Manual and correct the error; then re-execute the disk operation.

### POWER indicator

This indicator illuminates whenever the disk unit is receiving power.

## FORMATTING THE 2260BC AND 2260C DISK PLATTERS

Before either the fixed or removable platter is used to store programs or data, it must be formatted. Each platter is formatted separately under program control using a prescribed \$GIO instruction sequence. Formatting is

4

# PRODUCT BULLETIN NO. 172

performed only once for each platter, unless the platter begins to produce frequent read/write errors; in this case, reformatting may correct the problem. Reformatting, however, destroys all information previously recorded on the platter.

During the process of formatting, the disk controller writes control information (including a sector address and error checking information) into each disk sector, and then fills the 256-byte user data area of the sector with zeros. The disk controller also automatically performs a verification check to ensure that the format is valid. To format the platters on the Model 2260BC and 2260C, the user need only instruct the disk controller to begin formatting by issuing a prescribed \$GIO sequence. The formatting processes are performed automatically under software control. When all sectors on the platter are formatted, the platter is ready to store programs and data.

For users who are unfamiliar with the \$GIO statement, Wang provides a utility program with each 2260BC and 2260C disk drive which can be used to format the disk platters. This utility requests the operator to identify the platter which is to be formatted, and then automatically issues the appropriate \$GIO sequence to format and verify the designated platter. In general, users will find it convenient to use the Wang supplied utility for platter formatting.

In order, however, to permit the programmer to develop a customized formatting routine, the \$GIO sequence used to perform the formatting operation is described here.

## NOTE:

Press RESET on the keyboard to initialize the drive and controller. READY will be displayed on the CRT. Check that the READY indicator on the disk unit illuminates. The CPU must be in Console Input Mode and the disk must be in RUN mode prior to initiating the formatting procedure. The fixed and removable platters in a disk unit must be formatted individually.

# PRODUCT BULLETIN NO. 172

## To Format the Fixed Platter:

```
10 $GI0/xyy (0600 0700 70A0 68C0 7040 6820
            6802 4270 8B67, G$): IF
            STR (G$, 6, 3) < > HEX (000000) THEN 100: STOP "FORMAT
            COMPLETE"
```

```
100 PRINT " FORMAT ERROR": HEXPRINT STR (G$,6,3)
```

## To Format the Removable Platter:

```
20 $GI0/xyy (0600 0700 07A0 68C0 7040 6830
            6802 4270 8B67, G$): IF STR
            (G$, 6, 3) < > HEX (000000) THEN 200: STOP "FORMAT
            COMPLETE"
```

```
200 PRINT " FORMAT ERROR": HEXPRINT STR (G$,6,3)
```

where:

/xyy = the disk address

STR(G\$,6,3) = the error/return status bytes (three bytes of variable G\$)

If the format is properly executed, STOP FORMAT COMPLETE is displayed on the CRT (STR(G\$,6,3) = 000000). When a format error occurs, FORMAT ERROR and the error code are displayed (STR(G\$,6,3) <> 000000). Press RESET on the console keyboard, then consult the following table to determine the procedure to correct the problem and retry the format. If after several attempts a removable platter cannot be formatted, try another platter. If the fixed platter cannot be formatted call the Wang Service Representative. A sample error display similar to that which occurs on the CRT is shown below.

```
FORMAT ERROR
a b c d e f
```

where:

abcdef = 000000 No format error - format complete

ab = 01	Sector not on disk	(See Appendix A, and then retry.)
02	Disk Hardware Error	(See Appendix A, and then retry.)
04	Format Switch engaged	(See Appendix A, and then retry.)

# PRODUCT BULLETIN

# NO. 172

cd = 01	Seek error	(See Appendix A, and then retry.)
02	Format error	(See Appendix A, and then retry.)
04	CRC error	(See Appendix A, and then retry.)
ef = 04	Echo error	(Retry immediately.)

## DISK SPECIFICATIONS

### STORAGE CAPACITY

	2260BC-1/4	2260BC-1/2	2260BC	2260BC-2
Sectors per Platter	4,800	9,792	19,584	19,584
Total Sectors	9,600	19,584	36,168	78,336
Bytes per Platter	1,228,800	2,506,752	5,013,504	5,013,504
Total Bytes	2,457,600	5,013,504	10,027,008	20,054,016

### PERFORMANCE

#### Rotation Speed

2400 rpm

#### Access Time (Position Head to Track)

Minimum (one-track)	7.5 ms
Average (across one-half available tracks)	
2260BC-1/4 and 2260C-1/4	20 ms
2260BC-1/2 and 2260C-1/2	28 ms
2260BC and 2260C	40 ms
2260BC-2 and 2260C-2	40 ms

#### Latency Time

Average (one-half revolution) . . . . . 12.5 ms

# PRODUCT BULLETIN

# NO. 172

## Read/Write Time

One 256-byte sector including CPU/  
Controller Overhead . . . . . 15 ms

## Move/Copy Time

Approx 10 min for entire 5 megabyte platter

## PHYSICAL SPECIFICATIONS

### Power Requirements

Voltage 115 or 230 VAC  $\pm$  10%  
50 or 60 Hz  $\pm$  1 cycle  
Power 800 watts start-up  
325 watts running

### Heat Output

1050 BTU/hr

### Cabling

10 ft (3m) cable to the disk controller board in CPU.  
8 ft (2.5m) to power source.

### Operating Environment

50°F to 95°F (10°C to 35°C)  
20% to 80% relative humidity

### 2260C Physical Dimensions

Height . . . . 10.3 in. (26.2 cm)  
Width . . . . 19 in. (48.2 cm)  
Depth . . . . 30.7 in. (77.8 cm)  
  
Weight . . . . . 150 lb (68 kg)

### 2260BC Physical Dimensions (w/cabinet enclosure)

Height . . . . .36 in. (91.4 cm)  
Width . . . . .20.5 in. (52 cm)  
Depth . . . . .32 in. (81.6 cm)  
  
Weight . . . . .176 lb (80 kg)



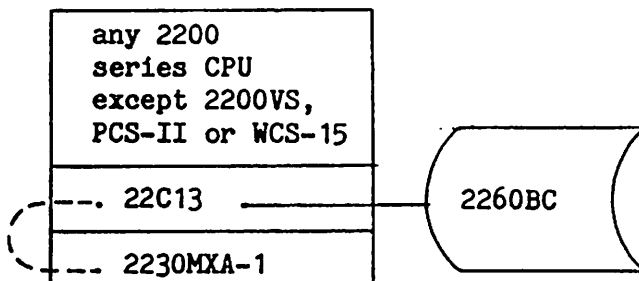


# PRODUCT BULLETIN NO. 172

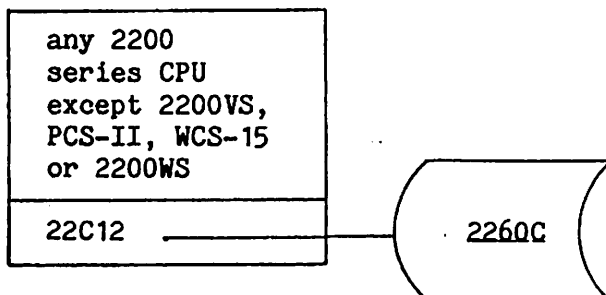
## DISK CONFIGURATIONS

### 2260BC Disk Unit

A single 2260BC disk unit can be multiplexed to a maximum for four (4) 2200 series CPU's (excluding WCS-15, PCS-II, and 2200VS).



### 2260C Disk Unit



Note: The 2260BC disk drives must always be configured with controller 22C13. The 2260BC requires two (2) I/O slots when multiplexed. The disk is configured with the 2260BC disk controller, the disk controller 22C13 is then interfaced to the disk jack on the multiplexer controller Model 2230MXA-1.

# PRODUCT BULLETIN NO. 172

## DOMESTIC USA STATISTICS

Release July 1978

Warranty: Standard

Classified: Mechanical

Part Number: 177-2260BC

Model Number: 2260BC

Delivery: 6 Weeks ARO

Release July 1978

Warranty: Standard

Classified: Mechanical

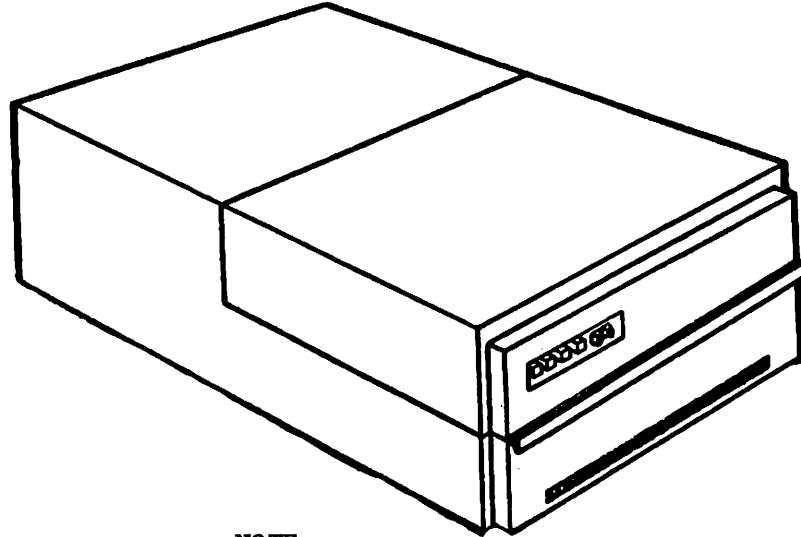
Part Number: 177-2260C

Model Number: 2260C

Delivery: 6 Weeks ARO

EDITED BY CUSTOMER ENGINEERING DIVISION

## 2260C & 2260BC DISK SYSTEM



**NOTE:**

This bulletin replaces Service Bulletin 86.

This bulletin, used in conjunction with the Diablo 44B or CDC Hawk Maintenance Manuals, describes 2260C/2260BC Disk System installations and operation. A theory of operation for the 22C12 and 22C13 disk controllers will be published in a separate document.

### TABLE OF CONTENTS

1.	DESCRIPTION .....	2
1.1	General .....	2
1.2	Specifications .....	2
1.3	Design Features .....	3
1.4	Model 2260C and 2260B Differences .....	4
2.	INSTALLATION .....	4
2.1	22C12 Installation .....	5
2.2	22C13 Installation .....	6
2.3	Operating System Requirements .....	9
2.4	System Installation Procedure .....	9
3.	OPERATION OF \$GIO UTILITIES FOR 2260C/2260BC .....	10
3.1	FORMAT Utility .....	11
3.2	Field Service Utility .....	12
4.	DIAGNOSTICS .....	14
5.	MAINTENANCE .....	14
6.	ELECTRICAL SCHEMATICS .....	14

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## 1. DESCRIPTION

### 1.1 General

The Wang 2260C Disk System consists of a new microprocessor-based controller (22C12) and one or two ten megabyte disk drives. (A special configuration of two daisy-chained 2260C disks provides 20 megabytes of on-line storage.) The Wang 2260BC also consists of one microprocessor-based controller (22C13), and one or two ten megabyte disk drives. The Wang Model 2260C and 2260BC Systems are functionally compatible with all Wang series 2200 systems, except for the 2200VS. The largest disk unit provides five megabytes of fixed storage and five megabytes of removable disk storage, for a total disk storage of 10 megabytes, on-line. Storage capacities of 2260C/2260BC Disk Systems are shown below:

DISK SYSTEM:	2260C 1/4	2260C 1/2	2260C	2260C-2*
(CDC Hawk or Diablo 44B)	2260BC 1/4	2260BC 1/2	2260BC	2260BC-2*
Bytes Removable	1,228,800	2,506,752	5,013,504	10,027,008
Bytes Fixed	1,228,800	2,506,752	5,013,504	10,027,008
Total Bytes	2,457,600	5,013,504	10,027,008	20,054,016

\*Consists of two disk drives daisy-chained

Each model 2260C disk drive holds two disk platters, one fixed and one removable. Each disk platter has two recording surfaces which are divided into a number of concentric recording tracks. Every track is, in turn, subdivided into 24 sectors. One sector can store 256 bytes of information (program text or data). Sectors on each platter are sequentially numbered, and individual sectors can be directly addressed.

### 1.2 Specifications

General specifications for the 2260C/2260BC Disk System are listed on page 3:

Storage Medium: Type 5440 Cartridge  
Recording Technique: Double Frequency  
Density: 2200 bpi  
Bit Transfer Rate: 2,500,000 bps  
Disk Rotation: 2400 rpm  
AC Line Voltage: 100/120/220/240 VAC  $\pm$  10% @ 50 or 60 Hz

Access Times:

Track to Track 8 ms  
Average 38 ms  
Full Stroke 70 ms

Environmental (Operating)

Temperature 50 F (10 C) to 104 F (40 C)  
Temp. Change Rate 18 F (10 C) per hour  
Relative Humidity 20% to 80%, non-condensing  
Maximum Altitude 10,000 ft. (3,048 M)

### 1.3 Design Features

There are two disk controller versions used in 2260C/2260BC System. The standard controller for 2260C systems, Model 22C12, consists of two logic boards (210-7486, 210-7487) mounted back-to-back. There are no controller boards in the disk cabinet. This eliminates the need for the 'under-slung' chassis and cabinet now used on the 2260B series. \$GIO statements in a Wang-supplied utility program control all formatting. The 2260BC controller, Model 22C13, consists of two logic boards (210-7488, 210-7487). This is the multiplexed version of the 22C12. The 22C13 allows either one or two disks (daisy-chained) to be shared by a maximum for four 2200 CPU's (n/a for 2200VS).

Note that customers ordering 2260B disks may now actually receive a 2260BC. This is a valid substitute, provided that the disk comes with a 22C13 controller (WL# 212-2260-C3, C4, C5) and a standard 2200 disk controller WL# 210-6541).

#### 1.4 Differences between Model 2260C/2260BC and 2260B

Since the FORMAT button and indicators have been removed, formatting is accomplished by a short utility program. This utility is stored on the fixed disk prior to shipment. The Diablo Model 44B Disk Drive used in the 2260B is also used in the 2260C and 2260BC. In addition, the CDC Hawk disk drive is also available. All components of the disk drive are directly compatible between "B" and "C / BC" series, with the exception of the I/O cable.

The 2260C does not come with a stand; the 2260 BC does.

#### NOTE:

Before attempting the installation of any 2260B/BC system, ascertain whether the system being delivered incorporates a Diablo 44B or a CDC Hawk disk drive. This precautionary measure should be taken, so that the customer engineer brings the correct tools, diagnostics, utilities, test equipment, and service spares to the installation site.

Determine the serial number of the drive supplied with the system; the customer can read this to you (via telephone) from the system packaging list or from the serial number on top of the shipping crate that the drive has been delivered in.

If the serial number starts with GZ, the system uses a Hawk drive; if the serial number starts with HA, the system uses a Diablo 44B disk drive.

#### 2. INSTALLATIONS (Ref: Figures 1, 2, 3, 4, & 5)

Before proceeding, it is important to note that the only format utility given to the customer is the one which may be copied from format utility diskette WL# 701-2403. That utility may also be found on the customer's fixed platter.

If the customer uses the Field Service Utility (WL# 701-2411), he may accidentally destroy some of his data files.

## 2.1 22C12 Installation

The two controller boards (7486, 7487) are mounted back to back and installed in one I/O slot in the 2200 chassis (n/a to 2200VS). That accomplished, recheck (and adjust, if necessary) all 2200 CPU regulated voltages.

<u>SYSTEM</u>	<u>WL#</u>
2260C (10 Meg)	212-2260C (Comprises a 210-7487A and a 210-7486)
2260C1/2 (5 Meg)	212-2260C1 (Comprises a 210-7487B and a 210-7486)
2260C1/4 (2.5 Meg)	212-2260C2 (Comprises a 210-7487C and a 210-7486)

Disk I/O cable configurations are listed below:

<u>Configuration</u>	<u>I/O Cable(s)</u>	
One 2260C disk	220-0188	Connects the 22C12 controller to disk I/O connector
Two 2260C disks daisy-chained	220-0169	Connects the 22C12 controller to the first disk in the daisy-chain.
	220-0187	Connects the first disk to second disk in the daisy chain.

The table below shows the PROM configuration for the 22C12 controller. (7487 board)

DISK:	LOADING	
	L2	L10
2260C	378-2211 R3	378-2210 R3
2260C-1/2	378-2213 R3	378-2212 R3
2260C-1/4	378-2215 R3	378-2214 R3
2260C-2	378-2211 R3	378-2210 R3

## 2.2 22C13 Installation (Single CPU; Ref: Figure 3)

The two controller boards (7488, 7487) are mounted back-to-back and installed in one I/O slot in the 2200 chassis. That accomplished, recheck (and adjust, if necessary) all 2200 CPU regulated voltages.

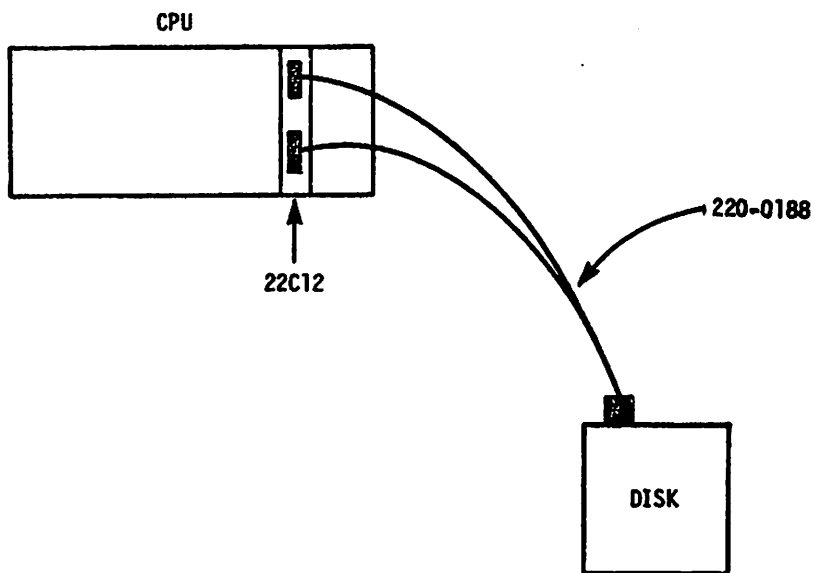
<u>SYSTEM</u>	<u>WL#</u>
2260BC (10 Meg)	212-2260C3 (Comprises a 210-7487A and a 210-7488)
2260BC (5 Meg)	212-2260C4 (Comprises a 210-7487B and a 210-7488)
2260BC (2.5 Meg)	212-2260C5 (Comprises a 210-7487C and a 210-7488)

The disk I/O cables use connectors #1 and #2 of this controller and are the same cables that are shown above for the 22C12 controller. A 22C03 (single disk controller) should be installed in an I/O slot adjacent to the 22C13 controller. Connect the flat cable (WL #220-3063) between the remaining connector on the 22C13 and the disk controller board.



FIGURE 1

SINGLE DISK SYSTEM



---

TWO DISK DAISY-CHAINED

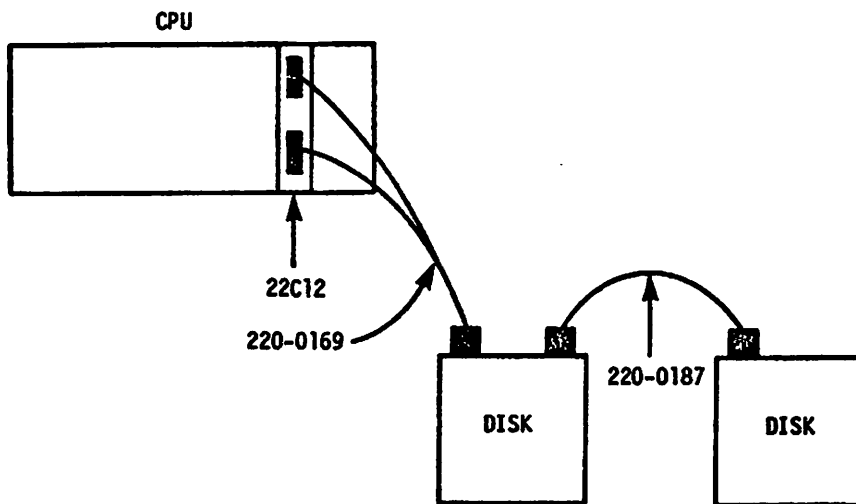


FIGURE 2

SINGLE DISK

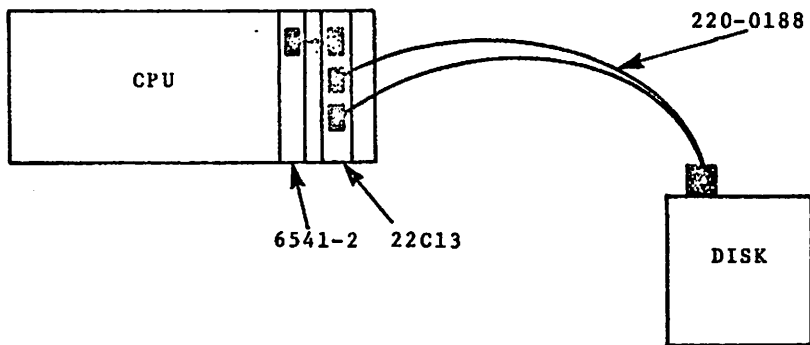


FIGURE 3

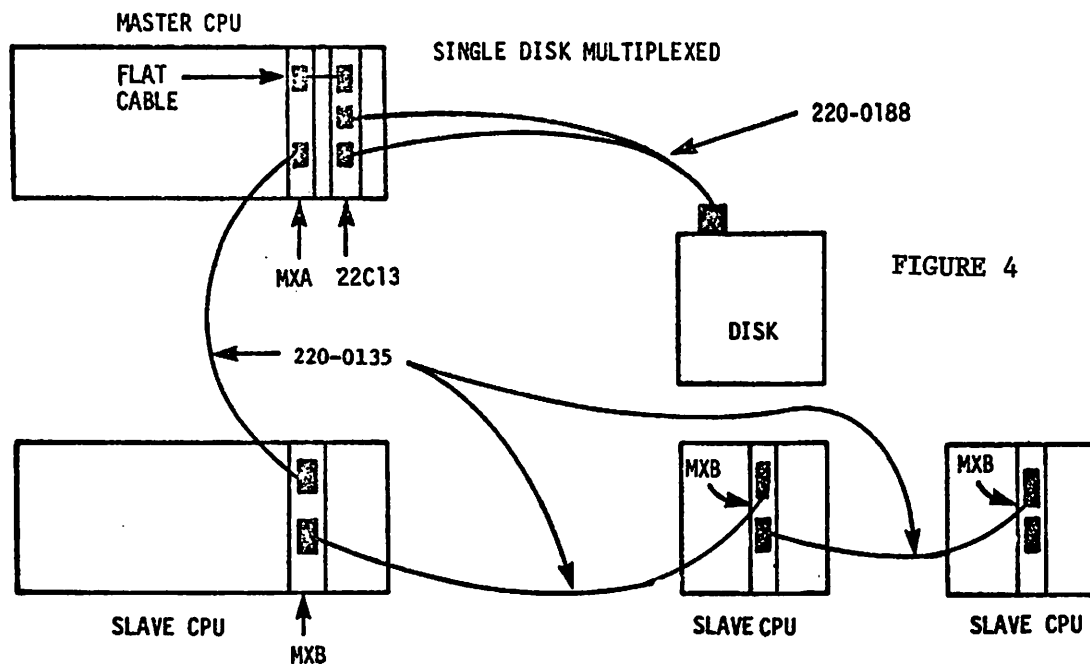


FIGURE 4

TWO DISK MULTIPLEXED

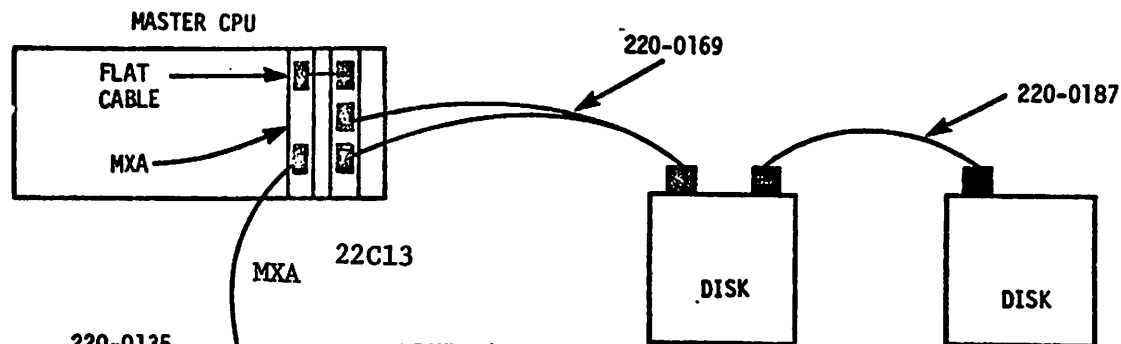
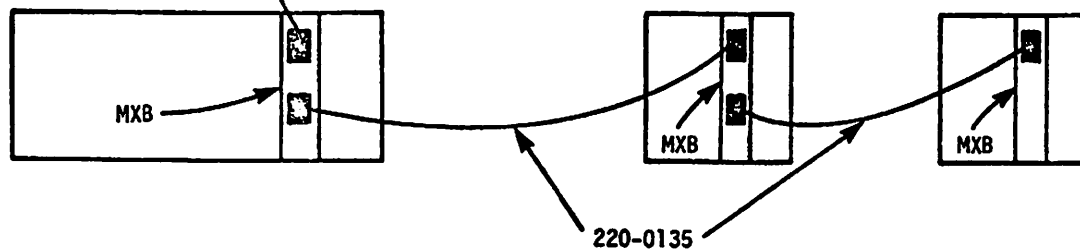


FIGURE 4

FIGURE 5



## 22C13 INSTALLATION (Multiplex System; Ref: Figures 4 & 5)

The disk I/O cable use connectors #1 and #2 of this controller, and are the same cables that are shown above for the 22C12 controller. A 2230 MXA board should be installed in an I/O slot adjacent to the 22C13 controller. Connect the flat cable (WL #220-3063) between the remaining connector on the 22C13 and the MXA board. Install an MXB board in every slave processor I/O chassis.

Connect a WL #220-0135 cable between the MXA board (master processor) and the first MXB board (slave processor). Also use the 220-0135 cable to connect between MXB boards for the remaining number of slave processors. The maximum limit is two disks shared by four CPU's (one master and three slaves in a daisy-chain configuration).

The PROM configuration for the 22C13 is the same as that shown above for the 22C12. A conversion kit, WL #200-0260-76, changes a standard 2260C system into a 2260BC multiplexed system.

### 2.3 Operating System Requirements

The following are the minimum Operating System (O.S.) requirements for the installation of a 2260C / 2260BC.

WHEN USING A:	USE <u>ONLY</u> O.S. REV#:
2200T	(N/A -- O.S. resident in ROMS)
2200VP	O.S. 1.8 -- Disk WL# 701-2118G
2200 MVP	O.S. 1.4 -- Disk WL# 701-2294D

A 2260C / 2260BC System will not operate on earlier revision software.

### 2.4 Installation Procedure

1. Set the address switches on the controller to the desired address. (Default address = Hex 310; Alternate addresses = Hex 320 and Hex 330). Connect the I/O cable(s) from the disk to the controller per paragraph 2.1. A separate terminator is not needed, since the terminating resistors are mounted on the I/O cable.

2. For a Diablo drive, refer to Section 2 of the Diablo 44B Maintenance Manual to aid in installing the disk(s). For a CDC drive, refer to CDC Hawk Installation Guide.
3. After the drive and controller have been installed, power up the drive and bring it to the ready state.
4. Enter the following on the 2200:

SELECT DISK (ADDRESS OF FIXED DISK) (EXEC)  
LIST DC F (EXEC)

If no errors have occurred, continue with step 5. If any error(s) have occurred, recheck the installation. If installation is indeed correct, either a hardware error exists or the fixed disk needs to be reformatted. To reformat, the FORMAT utility program must be obtained from a District or Area office. Refer to Section 3 of this publication for FORMAT utility operating instructions. When reformatting has been completed, repeat step 4.

5. Enter the following:

LOAD DC F "FORMAT" (EXEC)

Refer to Section 3 of this publication for FORMAT utility operating instructions.

### 3. OPERATION OF \$GIO UTILITIES FOR THE 2260C and 2260BC

At the present time, there are two programs available. One is a format utility that has been prewritten on the fixed disk before the drive is shipped for installation. This utility is also available on diskette under WL# 701-2403. FORMAT should be immediately duplicated for back-up when the drive is installed. The second utility program is for Field Service use only; this program aids in disk alignments and data recovery, and performs formatting on a sector or on a platter. This Field Service utility is available on diskette WL# 701-2448.

### 3.1 FORMAT UTILITY

To operate the format utility contained on the fixed disk, enter the following:

```
SELECT DISK (ADDRESS OF FIXED DISK) (EXEC)
LOAD DC F "FORMAT" (EXEC)
```

If any errors have occurred, refer to Section 2 (Installation).  
If no errors have occurred, enter the following:

```
RUN (EXEC)
```

The following should appear on the screen:

```
2260C DISK DRIVE FORMAT UTILITY
ENTER DISK ADDRESS TO FORMAT? _____
FOR USE ON:
```

```
2200 T
2200 VP (OS 1.8)
2200 MVP (OS 1.4)
```

After the address of the disk to be formatted has been entered, the following should appear:

```
2260 DISK DRIVE FORMAT UTILITY
DO YOU WANT TO FORMAT THIS PLATTER (Y/N) _____
FORMAT PLATTER (ADDRESS)
```

Verify that the correct address has been selected then enter Y (EXEC) to format. The following will appear:

```
FORMATING.....
```

When formatting is complete, the following appears on the screen:

```
FORMATTING COMPLETE
: _____
```

If formatting has not been completed after 1.5 minutes, a hardware error exists. Recheck the installation; if the installation was performed correctly, consult District or Area Technical Specialists.

### 3.2 FIELD SERVICE UTILITY

The Field Service Utility consists of the following:

- 01 CHANGE DISK ADDRESS
- 02 FORMAT PLATTER
- 03 FORMAT SECTOR
- 04 READ SECTOR HEADER
- 05 CLEAR ERROR COUNT
- 06 READ ERROR COUNT
- 07 READ BAD SECTOR
- 08 FIELD SERVICE COMMANDS

#### EXPLANATIONS

##### 01 CHANGE DISK ADDRESS

This program must be run prior to any other utility programs. The program selects either a fixed or removable platter.

##### 02 FORMAT PLATTER

This program should be used when the FORMAT program cannot be read from the fixed disk. Formatting of either a removable or fixed platter is accomplished by this program.

##### 03 FORMAT SECTOR

This is used to format only one sector of either the fixed or removable platters if the sector was somehow destroyed.

##### 04 READ SECTOR HEADER

When troubleshooting, this utility is used to ensure the disk is at the correct position.

05 CLEAR ERROR COUNT

This resets the error count which is kept in the 22C12 or 22C13 controller.

06 REAR ERROR COUNT

An error log of all disk-related errors is kept in the 22C12 or 22C13. This program allows the total error count to be displayed.

07 REAR BAD SECTOR

This program allows the data from a sector to be read and displayed even though a CRC or LRC has occurred. It is useful in attempting to recover data from a customer disk pack.

08 FIELD SERVICE COMMANDS

Six commands are used for on-line alignments on the Diablo or Hawk Disk. They are as follows:

A = Seek to track 10 and restore -- (used for Diablo track  
0 adjustment)

B = Constant restore -- (used for Diablo or Hawk track 0  
adjustment)

C = Alternate seek between 293 & 405 -- (used for Hawk  
'average - seek'  
adjustments)

D = Alternate seeks between 400 & 402 -- (used for Hawk  
'servo balance'  
adjustments)

E = Alternate seeks between 00 & 02 -- (used for Hawk  
'servo balance'  
adjustments)

F = Alternate seeks between 408/410 -- (used for Hawk FEOT  
adjustments)

These commands will not halt until RESET on the 2200 is keyed.

#### 4. DIAGNOSTICS

The standard diagnostics used on 2260B should also be used on  
2260C / 2260BC.

#### 5. MAINTENANCE

Disk drive maintenance should be performed as prescribed in the  
Diablo 44B Maintenance Manual or the CDC Hawk Field Level Maintenance  
Guide. CPU voltages must be checked and if necessary, adjusted after  
the controller has been installed.

#### 6. ELECTRICAL SCHEMATICS

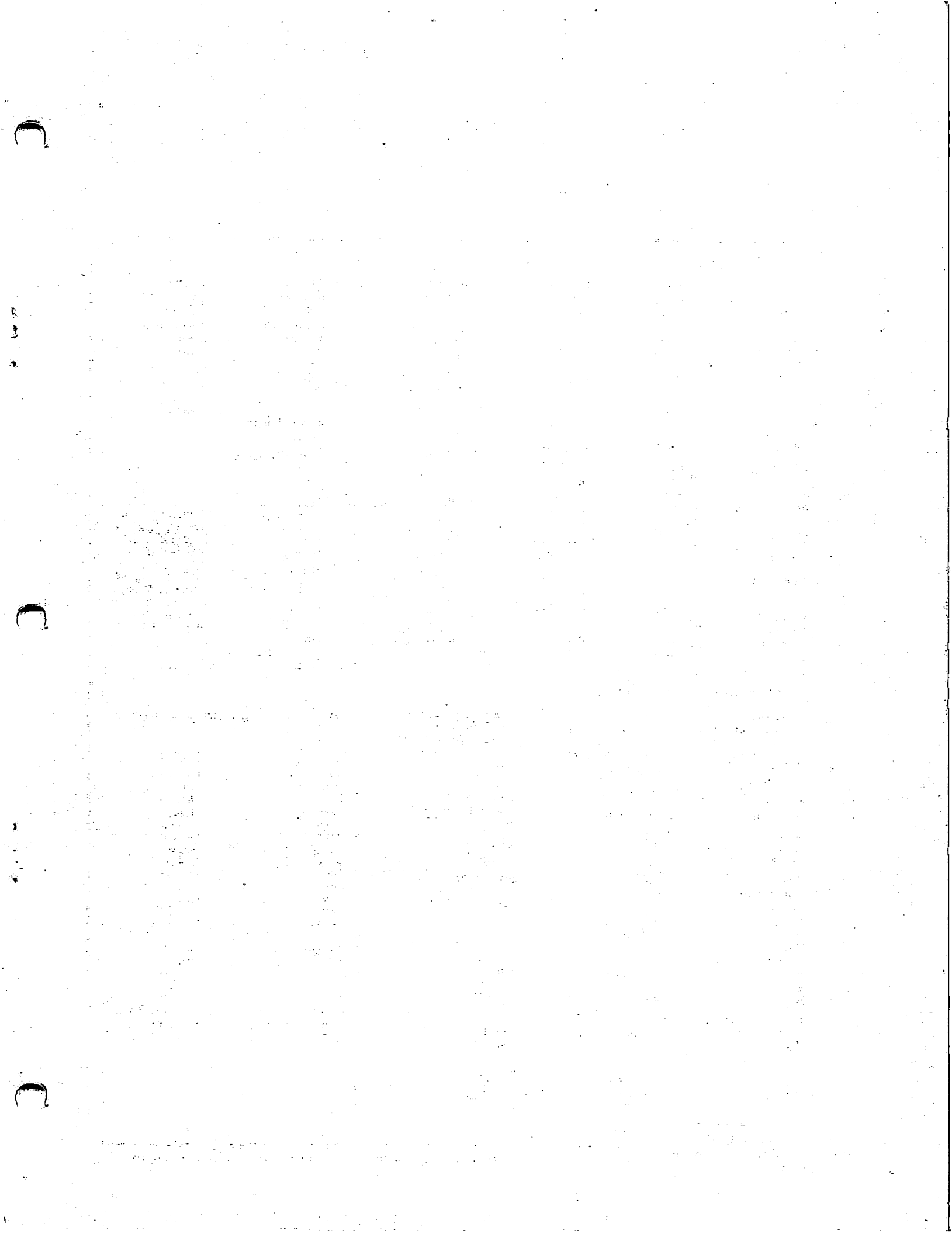
The following prints are included in this publication:

D7486; Sheets 1-3

D7487; Sheets 1-3

D7488; Sheets 1-3





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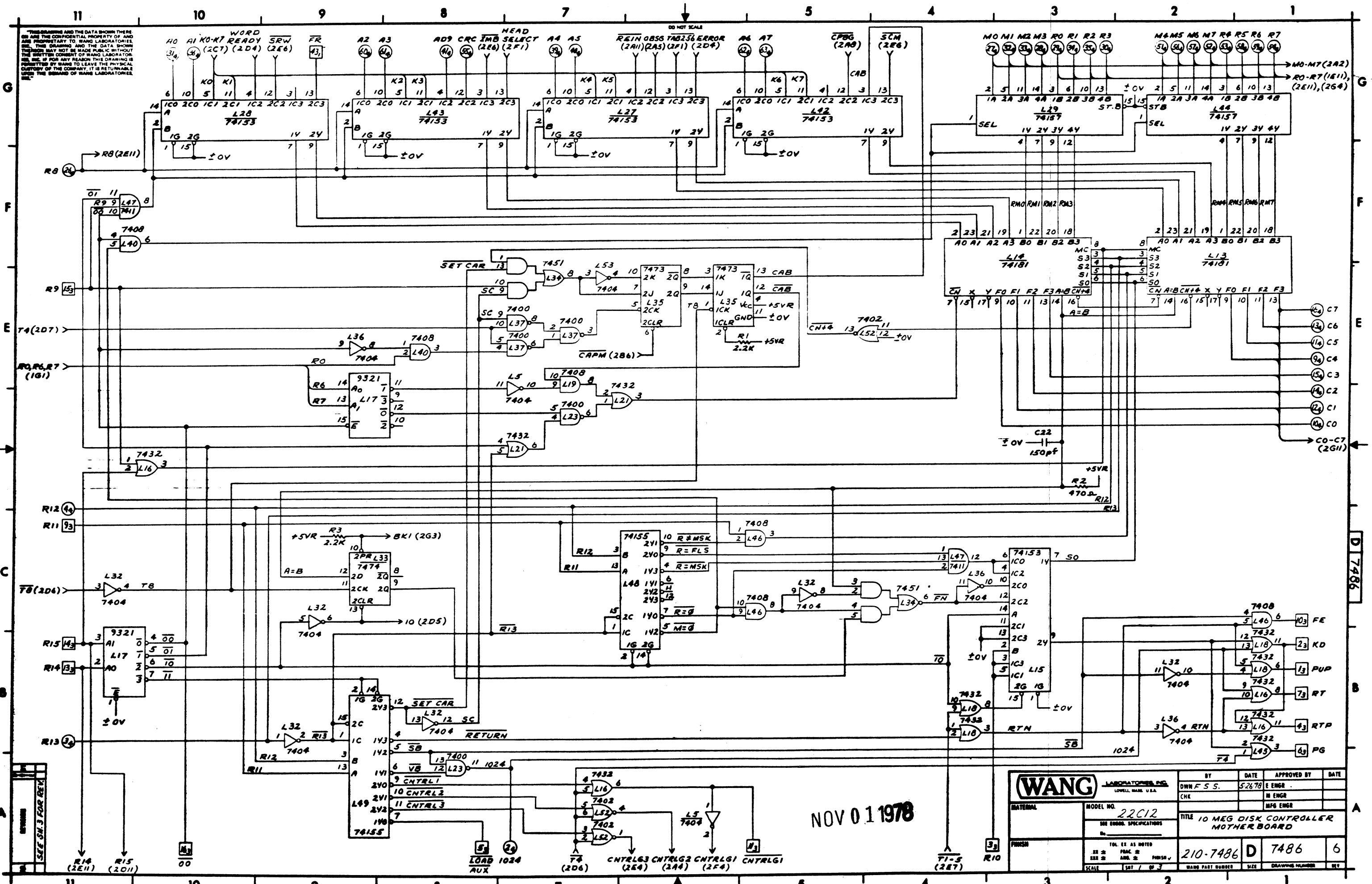
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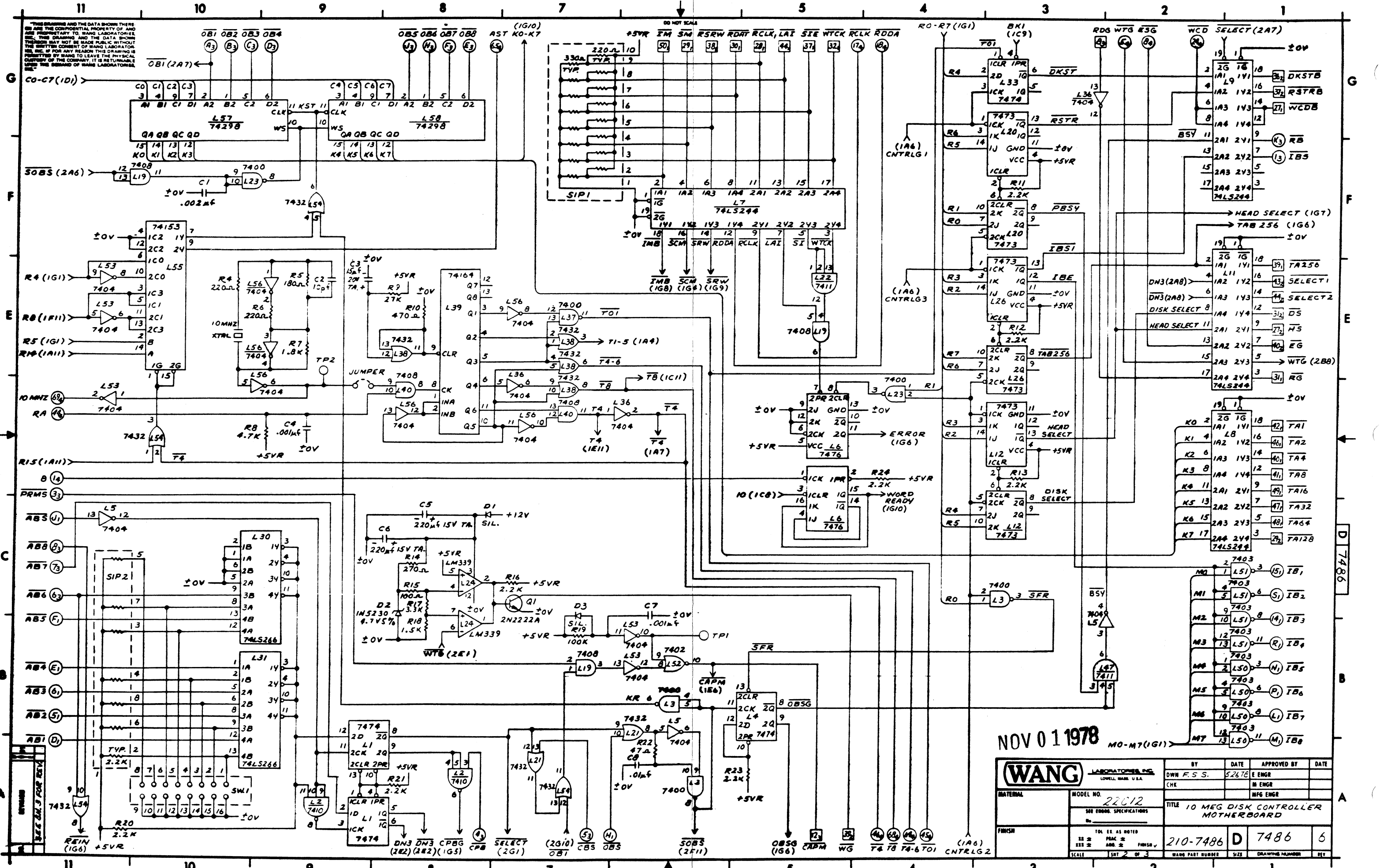
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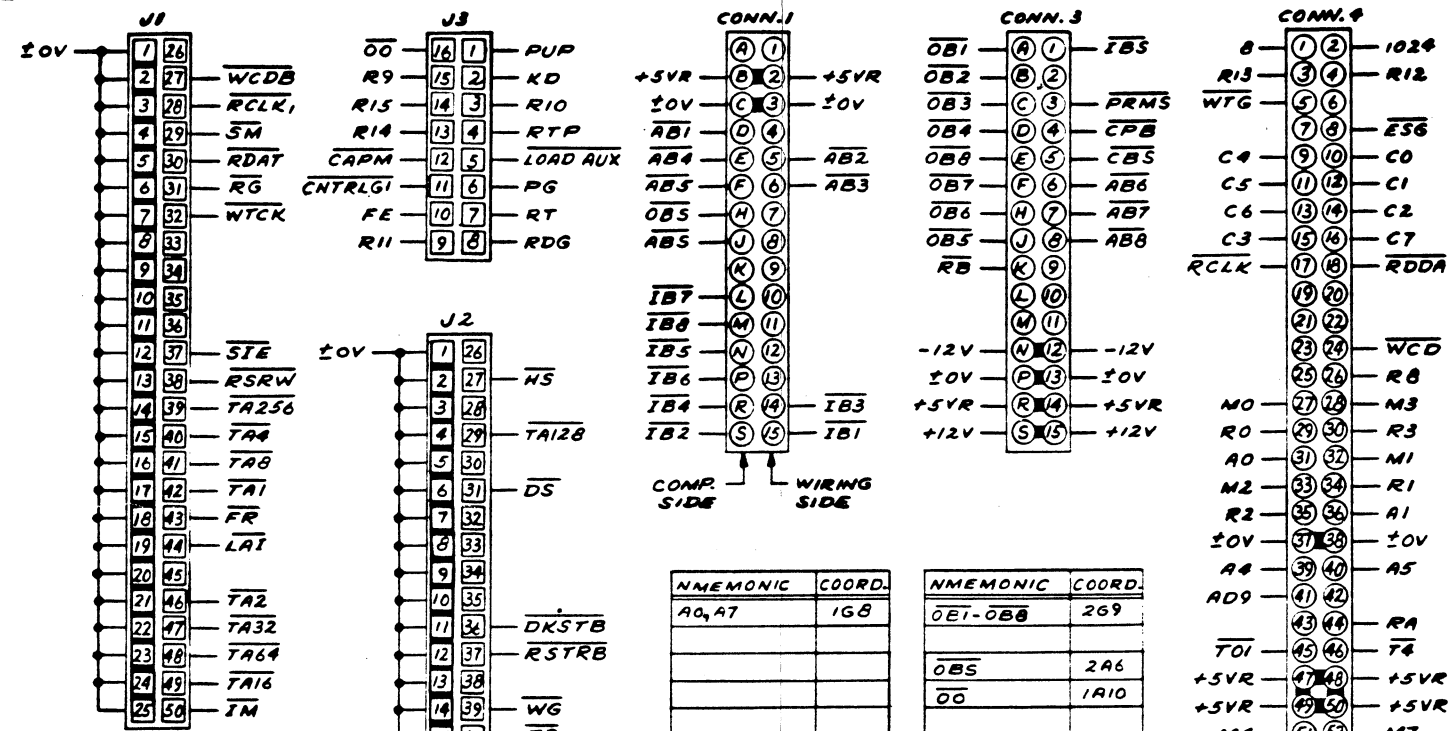
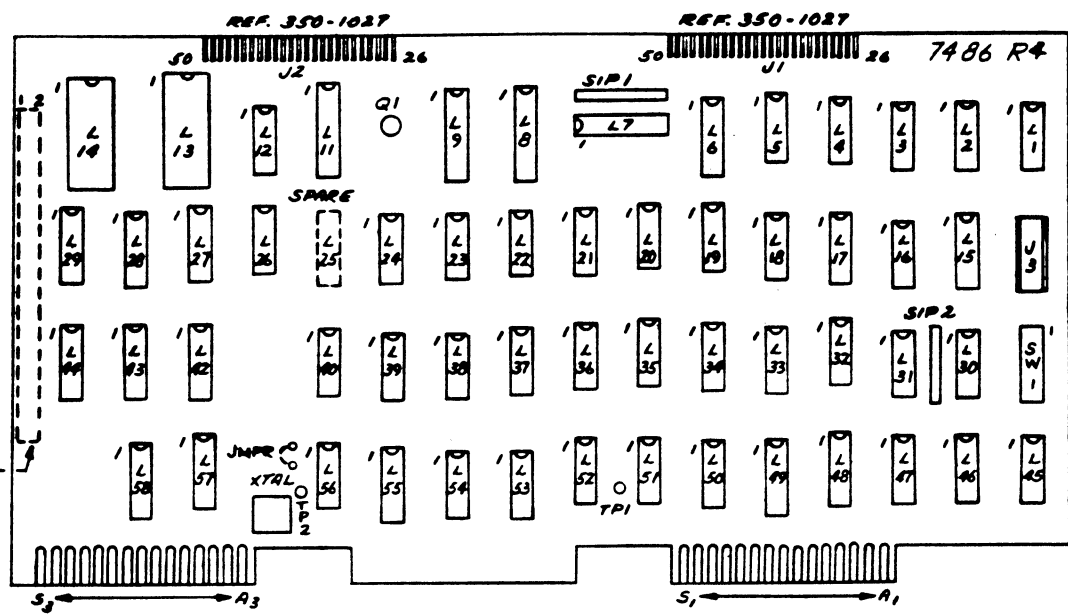




NOV 01 1978

<b>WANG</b> LABORATORIES INC. LOWELL, MASS. U.S.A.		BY DWN F.S.S.	DATE 5/26/78	APPROVED BY E ENGR	DATE
MATERIAL	MODEL NO. 22012	CHK		MFG ENGR	
SER 88000 SPECIFICATIONS		TITLE 10 MEG DISK CONTROLLER MOTHERBOARD			
FINISH	TOL. IS. AS NOTED	210-7486	D	7486	6
SCALE	SHT 2 OF 3	WAVE PART NUMBER	SIZE	DRAWING NUMBER	REV

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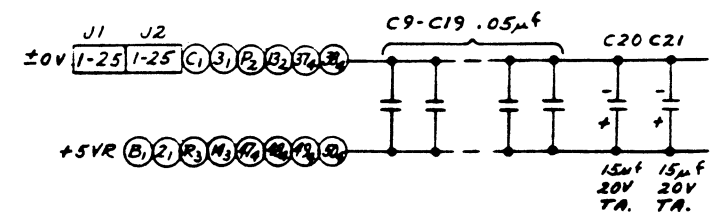


I.C. LOCATION	TYPE	W.L. NO.
L1, 4, 33	7474	376-0006
L2	7410	376-0003
L3, 23, 37	7400	376-0002
L5, 32, 36, 53, 56	7404	376-0010
L6	7476	376-0007
L10, 41	NOT USED	
L7-9, 11	74LS244	376-0288
L12, 20, 26, 35	7473	376-0005
L13, 14	74181	376-0099
L15, 27, 28, 42, 43, 55	74153	376-0048
L16, 18, 21, 38, 45, 54	7432	376-0093
L17	9321	376-0096
L19, 40, 46	7408	376-0081
L22, 47	7411	376-0194
L24	LM339	376-0240
L25	SPARE	
L29, 44	74157	376-0082
L30, 31	74LS266	376-0148
L34	7451	376-0012
L39	74164	376-0102
L48, 49	74155	376-0049
L50, 51	7403	376-0028
L52	7402	376-0016
L57, 58	74298	376-0232

LOCATION	TYPE	SPARES
L2	7410	1
L3	7400	1
L4	7474	1
L5	7404	1
L22	7411	2
L24	LM339	2
L45	7432	3
L46	7408	1

COMPONENT	TYPE	W.L. NO.
R1, 3, 11-13, 16, 20, 21, 23, 24	2.2K	330-3022
R2, 10	470Ω	330-2047
R4, 6	220Ω	330-2022
R5	180Ω	330-2018
R7	1.8K	330-3018
R8	4.7K	330-3047
R9	27K	330-4027
R14	270Ω	330-2027
R15	100Ω	330-2010
R17	3.3K	330-3033
R18	1.5K	330-3015
R19	100K	330-5010
R22	47Ω	330-1047
SIP1	330/220Ω	333-0807
SIP2	2.2K	333-0806
C1	.002μf	300-1913
C8	.01μf	300-1903
C2	10pf	300-1010
C3, 20, 21	15μf 20V TA.	300-4022
C4, 7	.001μf	300-1906
C5, 6	220μf 15V TA.	300-4045
C9-19	.05μf	300-1900
C22	150pf	300-1150

COMPONENT	TYPE	W.L. NO.
D1, 3	SIL.	380-1001
D2	1N5230 ZEN.	380-2048
SW1	8BANK RKR SW.	325-1503
XTAL	10 MHZ	321-0008
Q1	2N2222A	375-1005
J1, 2	5740500	350-1027
J3	16 PIN SKT.	376-9024
CONN.4	261-10036-2	350-0029



NMEMONIC	COORD.
AO, A7	1G8
ABI-AB8	2C11
AB5	2C11
AD9	1G8
AST	2G8
CO-C7	1E1
CAPM	2A5
CBS	2A7
CNTRLGI	1A5
CPB	2A8
CRC	1G8
DKSTB	2G1
DS	2E1
EG	2E1
ESG	2G2
FE	1C1
FR	1G9
NS	2E1
IB1-IB8	2B1
IB5	2F1
IM	2G6
KD	1B1
LAI	2G5
LOAD AUX	1A8
MO-M7	1G2

NMEMONIC	COORD.
OB1-OB8	2G9
OB5	2A6
OO	1A10
PG	1A1
PRMS	2D11
PUP	1B1
RO-R7	1G2
RB	1F11
R9	1E11
R10	1A3
R11, 12	1C11
R13-15	1B11
RA	2D11
RB	2G1
RCLK	2G5
RCLK1	2G5
RDAT	2G6
RDDA	2G4
RDG	2G3
RG	2E1
RSTRB	2G1
RSRW	2G6
RT	1B1
RTP	1B1
SELECT1	2E1
SELECT2	2E1
SIE	2G5
SM	2G6

NMEMONIC	COORD.
TA1-TA128	2D1
TA256	2E1
TC1	2A4
T4	2A4
T4-6	2A4
T8	2A4
WCD	2G2
WCDB	2G1
WG	2A5
WTCK	2G5
WTG	2G2
B	2D11
10 MHZ	2D11
1024	1A7

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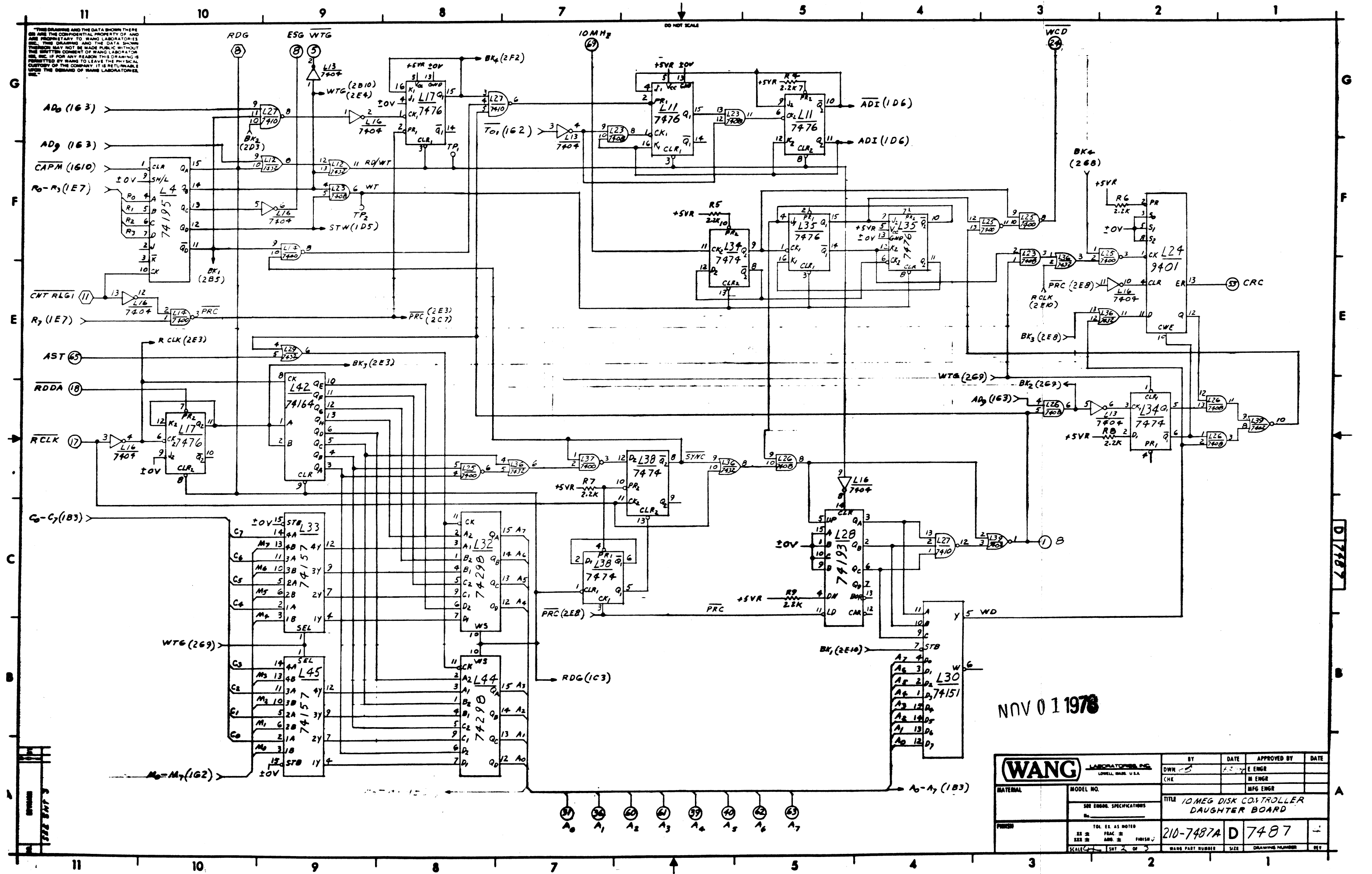
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MATERIAL		DWN F.E.S.	5-2-78	E ENGR DILLON	4/1/78
MODEL NO. 22C12		CHK S.D.	3-4-78	M ENGR	
FINISH		TITLE 10 MEG DISK CONTROLLER MOTHERBOARD		MFG ENGR	
TOL. EX. AS NOTED		210-7486	D	7486	6
SCALE		SHT. 3 OF 3	WANG PART NUMBER	SIZE	DRAWING NUMBER

REV.	DATE	BY	DESCRIPTION
0			ORIG. DRAWING
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2			REVISED PER
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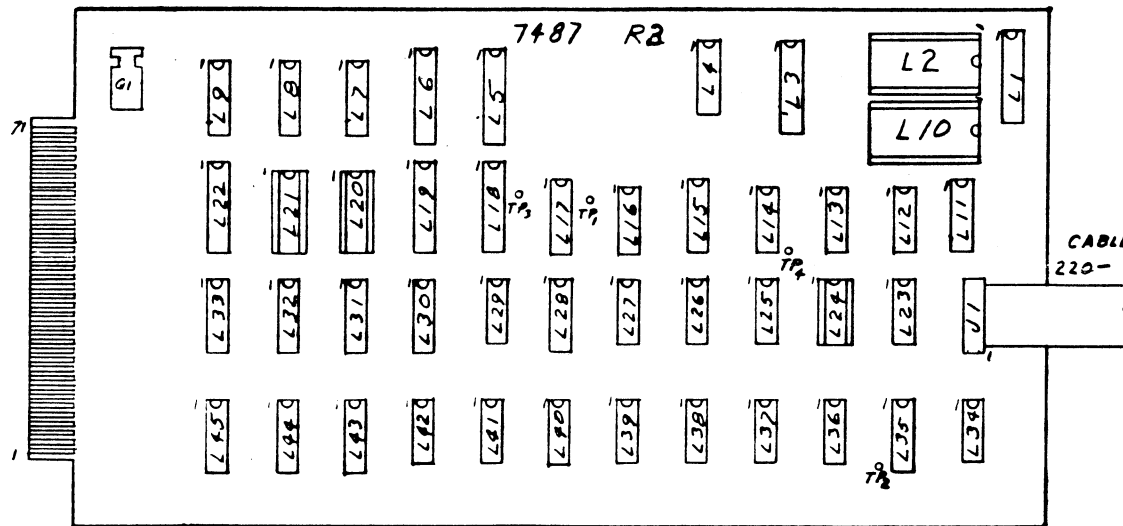
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MATERIAL		DWN	11/1	E ENGR	
MODEL NO.		CHK		M ENGR	
SER. ENGR. SPECIFICATIONS		TITLE 10 MEG DISK CONTROLLER DAUGHTER BOARD			
FINISH		210-7487A D 7487			
SCALE 1/8" = 1"		WANG PART NUMBER		SIZE	DRAWING NUMBER
TOL. AS NOTED		210-7487A		D	7487
FRAC. 1/16"		2			
INT. 1/8"		2			

D 7487

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DO NOT SCALE

MEMORNIC	COORDINATE
A0-A7	2A6
AD9	1G4
ASP	2E11
C0-C7	1A4
CAPM	1G11
CNT RLG1	2E11
CRC	2E1
ESG	2G9
FE	1G11
KD	1B11
LOAD AUX	1G6
M0-M7	1F2
PG	1F11
PUP	1G11
R0-15	1G9
RCLK	2D11
RDDA	2D11
RDG	2G10
RS	1E11
RT	1F11
RTP	1C11
T4	1C11
T8	1A6
T01	1G3
T3-7	1A6
WCD	2G3
WTG	2G9
8	2C3
10MH2	2G7



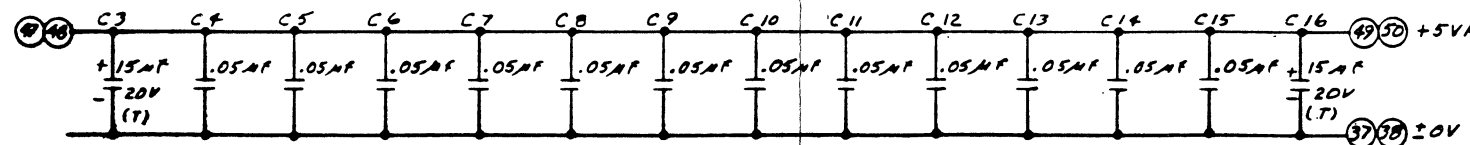
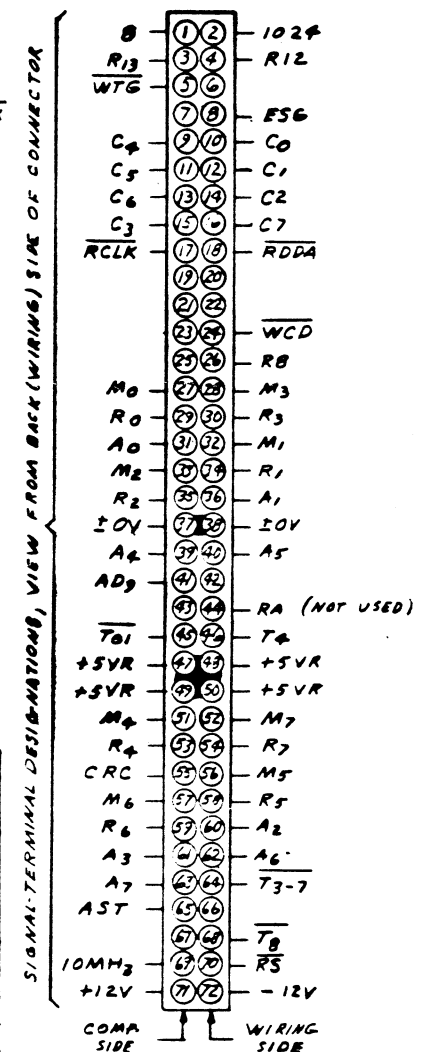
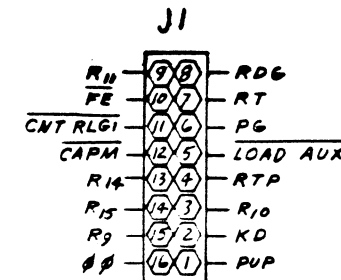
210 = 209 + 377 OR 378

MODEL	209	210	L2	L10
22C-12 10 MEG	7487	7487A	378-2210-R1	378-2211-R1
22GOC 5 MEG	7487	7487B	378-2212-R1	378-2213-R1
22GOC 2.5 MEG	7487	7487C	378-2214-R1	378-2215-R1

LOCATION	W.L. PART NO	TYPE
L1, 3, 22	376-0313	74LS377
L2, 10	SEE CHART	2708
L4	376-0097	74195
L5, 6, 18	377-0347	2911
L7, 8, 9, 28	376-0053	74193
L11, 17, 35	376-0007	7476
L12, 29, 36	376-0093	7432
L13, 16, 40	376-0010	7404
L14, 25, 37	376-0002	7400
L15	376-0096	9321
L19	376-0288	74LS244
L20, 21	377-0341	2114
L23, 26	376-0081	7408
L24	376-0250	9401
L27	376-0003	7410
L30	376-0047	74151
L31, 33, 43, 45	376-0082	74157
L32, 44	376-0138	74298
L34, 38	376-0006	7474
L39	376-0016	7402
L41	376-0125	7427
L42	376-0102	74164

IC TYPE	LOCATION	SPARE
7400	L37	3
	L14	1
7402	L39	1
7404	L40	5
7432	L12	2
9321	L15	1

COMPONENT	W.L. PART NO	TYPE
R1-9	330-3022	2.2K 1/2W 10%
C1	300-4000	1uF 35V (T)
C2, 3, 16	300-4022	15uF 20V (T)
C4-15	300-1900	.05uF CER
Q1	374-0002	7905 REG
L2, 10	376-9003	SOCKET 24 PIN
L20-21	376-9014	SOCKET 18 PIN
L24	376-9001	SOCKET 14 PIN
J1	376-9005	SOCKET 16 PIN
L5, 6, 18	376-9020	SOCKET 20 PIN



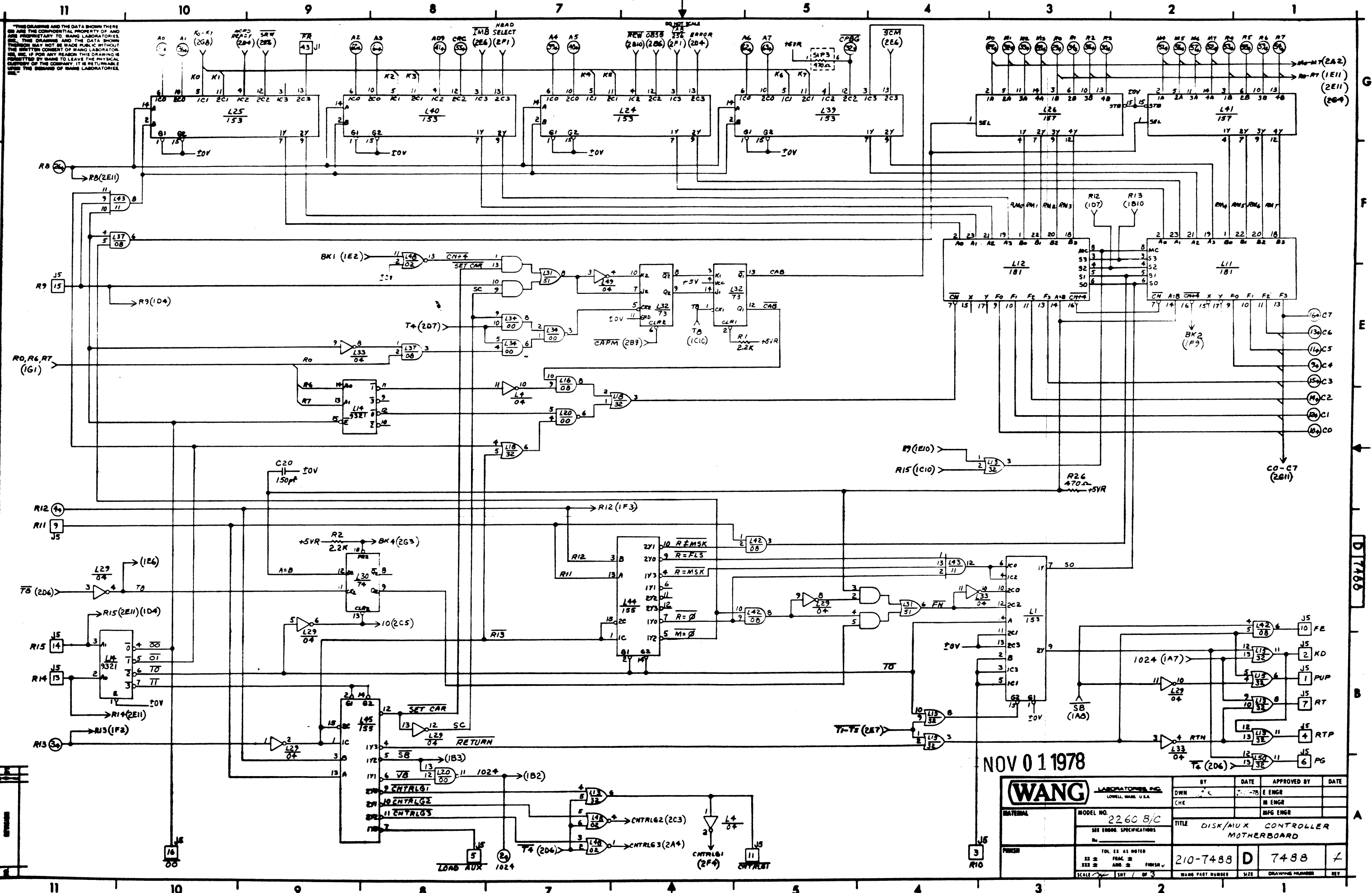
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3	10-15-78	...	...
4	10-15-78	...	...
5	10-15-78	...	...
6	10-15-78	...	...
7	10-15-78	...	...
8	10-15-78	...	...
9	10-15-78	...	...
10	10-15-78	...	...

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MODEL NO. 22C12		CHE: S-2	11/1/78	M ENGR	MFG ENGR
SEE ENGR. SPECIFICATIONS		TITLE: 10 MEG DISK CONTROLLER DAUGHTER BOARD			
TOL. EE. AS NOTED		210-7487A	D	7487	4
SCALE: 1:1		PART NUMBER		SIZE	DRAWING NUMBER

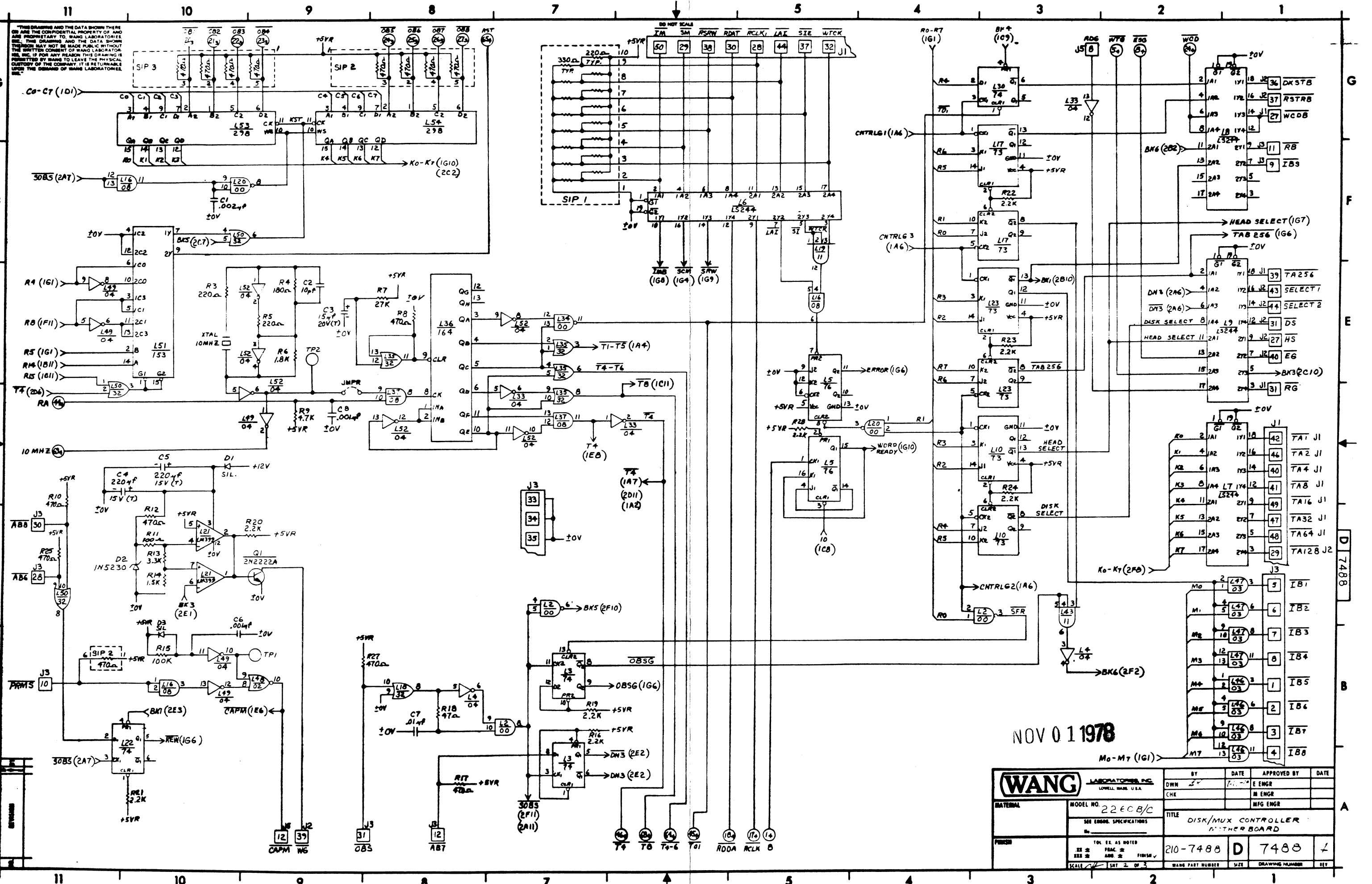




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		DWN	11-78	E ENGR	
MODEL NO. 2260 B/C SEE ENGR. SPECIFICATIONS		CHE		M ENGR	
				MFG ENGR	
TITLE		DISK/MUX CONTROLLER MOTHERBOARD			
FINISH		TOL. EX. AS NOTED	22 ±	FRAC. ±	FINISH
		22 ±	FRAC. ±	FINISH	210-7488
		SCALE	SHT 1 OF 3	WANG PART NUMBER	SIZE
				D	7488
					L



NOV 01 1978

<b>WANG</b> LABORATORIES, INC. LOWELL, MASS. U.S.A.		BY DWN	DATE 7-1-78	APPROVED BY E ENGR	DATE
MATERIAL	MODEL NO. 226CB/C	CHK		M ENGR	
	SEE ENDB. SPECIFICATIONS			MFG ENGR	
		TITLE DISK/MUX CONTROLLER MOTHER BOARD			
PURCH	TOI EX. AS NOTED	210-7488	D	7488	1
	SEE ENDB. SPECIFICATIONS	SCALE 1/8" = 1"	SHT 2 OF 3	WANG PART NUMBER	SIZE DRAWING NUMBER



Mike B

## 2260C & 2260BM DISK SYSTEMS

This bulletin, used in conjunction with the Diablo 44B Maintenance Manual, describes 2260C / 2260BM Disk System installations and operation. A theory of operation for the 22C12 and 22C13 disk controllers will be published in a separate document.

### TABLE OF CONTENTS

1.	DESCRIPTION	
1.1	General .....	2
1.2	Specifications .....	2
1.3	Design Features .....	3
1.4	Model 2260C and 2260B Differences .....	3
2.	INSTALLATION	
2.1	22C12 Installation .....	4
2.2	22C13 Installation .....	5
2.3	Operating System Requirements .....	6
2.4	System Installation Procedure .....	6
3.	OPERATION OF \$GIO UTILITIES FOR 2260C / 2260BM	
3.1	FORMAT Utility .....	7
3.2	Field Service Utility .....	9
4.	DIAGNOSTICS .....	11
5.	MAINTENANCE .....	11
6.	ELECTRICAL SCHEMATICS .....	11

## 1. DESCRIPTION

### 1.1 General

The Wang 2260C Disk System consists of one microprocessor-based controller (22C12), and one or two Diablo model 44B disk drives. (A special configuration of two daisy-chained 2260C disks provides 20 megabytes of on-line storage.) The Wang 2260BM also consists of one microprocessor-based controller (22C13), and one or two Diablo Model 44B disk drives. The Wang Model 2260C and 2260BM Systems are functionally compatible with all Wang series 2200 systems, except for the 2200VS. The largest disk unit provides five megabytes of fixed storage and five megabytes of removable storage, for a total disk storage of 10 megabytes, on-line. Storage capacities of 2260C/2260BM Disk Systems are shown below:

DISK SYSTEM:	2260C 1/4	2260C 1/2	2260C	2260C-2*
	2260BM 1/4	2260BM 1/2	2260BM	2260BM-2*
Bytes Removable:	1,228,800	2,506,752	5,013,504	10,027,008
Bytes Fixed:	1,228,800	2,506,752	5,013,504	10,027,008
Total Bytes:	2,457,600	5,013,504	10,027,008	20,054,016

\*Consists of two 44B disk drives daisy-chained

Each model disk drive holds two disk platters, one fixed and one removable. Each disk platter has two recording surfaces which are divided into a number of concentric recording tracks. Every track is, in turn, subdivided into 24 sectors. One sector can store 256 bytes of information (program text or data). Sectors on each platter are sequentially numbered, and individual sectors can be directly addressed.

### 1.2 Specifications

General specifications for the 2260C / 2260BM Disk Systems are listed on page 3:

Storage Medium: Type 5440 Cartridge  
Recording Technique: Double Frequency  
Density: 2200 bpi  
Bit Transfer Rate: 2,500,000 bps  
Disk Rotation: 2400 rpm  
AC Line Voltage: 100/120/220/240 VAC  $\pm$  10% @ 50 or 60 Hz

Access Times:

Track to Track: 8 ms  
Average: 38 ms  
Full Stroke: 70 ms

Environmental (Operating):

Temperature: 50 F (10 C) to 104 F (40 C)  
Temp. Change Rate: 18 F (10 C) per hour  
Relative Humidity: 20% to 80%, non-condensing  
Maximum Altitude: 10,000 ft. (3,048 M)

### 1.3 Design Features

There are two disk controller versions used in 2260C/2260BM Systems. The standard controller for 2260C systems, Model 22C12, consists of two logic boards (210-7486, 210-7487) mounted back-to-back. There are no controller boards in the disk cabinet. This eliminates the need for the 'under-slung' chassis and cabinet now used on the 2260B series. SGIO statements in a Wang-supplied utility program control all formatting. The 2260BM controller, Model 22C13, consists of two logic boards (210-7488, 210-7487). This is the multiplexed version of the 22C12. The 22C13 allows either one or two disks (daisy-chained) to be shared by a maximum of four 2200 CPU's (n/a for 2200VS).

### 1.4 Differences between Models 2260C/2260BM and 2260B

Since the FORMAT button and indicators have been removed, formatting is accomplished by a short utility program. This utility is stored on the fixed disk prior to shipment. The Diablo Model 44B Disk Drive used in the 2260B is also used in the 2260C and 2260BM. All components of the disk drive are directly compatible between "R" and

## INSTALLATION (Ref: Figures 1,2,3 &4)

### 2.1 22C12 Installation

The two controller boards (7486, 7487) are mounted back to back and installed in one I/O slot in the 2200 CPU chassis (n/a to 2200VS).

<u>SYSTEM</u>	<u>WL#</u>
2260C (10 Meg)	212-2260C (Comprises a 210-7487A and a 210-7486)
2260C $\frac{1}{2}$ (5 Meg)	212-2260C1 (Comprises a 210-7487B and a 210-7486)
2260C $\frac{1}{4}$ (2.5 Meg)	212-2260C2 (Comprises a 210-7487C and a 210-7486)

Disk I/O cable configurations are listed below:

<u>Configuration</u>	<u>I/O Cable(s)</u>	
One 2260C disk	220-0188	Connects the 22C12 controller to the disk I/O connector
Two 2260C disks daisy-chained	220-0169	Connects the 22C12 controller to the first disk in the daisy-chain.
	220-0187	Connects the first disk to second disk in the daisy chain

The table below shows the PROM loading configuration for the 22C12 controller. (7487 board)

DISK:	LOADING	
	L2	L10
2260C	378-2211	378-2210
2260C-1/2	378-2213	378-2212
2260C-1/4	378-2215	378-2214
2260C-2	378-2211	378-2210

## 2.2 22C13 Installation (Multiplexed System)

The two controller boards (7488, 7487) are mounted back-to-back and installed in one I/O slot in the 2200 chassis.

<u>SYSTEM</u>	<u>WL#</u>
2260BM (10 Meg)	212-2260C3 (Comprises a 210-7487A and a 210-7488)
2260BM $\frac{1}{2}$ (5 Meg)	212-2260C4 (Comprises a 210-7487B and a 210-7488)
2260BM $\frac{1}{4}$ (2.5 Meg)	212-2260C5 (Comprises a 210-7487C and a 210-7488)

The disk I/O cables use connectors #1 and #2 of this controller, and are the same cables that are shown above for the 22C12 controller. A 2230 MXA board should be installed in an I/O slot adjacent to the 22C13 controller. Connect the flat cable (WL# 220-3063) between the remaining connector on the 22C13 and the MXA board. Install an MXB board in every slave processor I/O chassis.



Connect a WL#220-0135 cable between the MXA board (master processor) and the first MXB board (slave processor). Also use the 220-0135 cable to connect between MXB boards for the remaining number of slave processors. The maximum limit is two disks shared by four CPU's (one master and three slaves). The PROM configuration for the 22C13 is the same as that shown above for the 22C12. A conversion kit, WL# 200-0260-76), changes a standard 2260C system into a 2260BM multiplexed system.

### 2.3 Operating System Requirements

The following are the minimum Operating System (O.S.) requirements for the installation of a 2260C / 2260BM.

WHEN USING A:	USE <u>ONLY</u> O.S. REV#:
2200 T	(N/A -- O.S resident in ROMS)
2200 VP	O.S. 1.8 -- Disk WL# 701-2118G
2200 MVP	O.S. 1.3 -- Disk WL# 701-2294C

A 2260C / 2260BM System will not operate on earlier revision software.

### 2.4 Installation Procedure

1. Set the address switches on the controller to the desired address (Default address = Hex 310; Alternate addresses = Hex 320 and Hex 330). Connect the I/O cable(s) from the disk to the controller per paragraph 2.1. A separate terminator is not needed, since the terminating resistors are mounted on the I/O cable.
2. Refer now to Section 2 of the Diablo 44B Maintenance Manual to aid in installing the disk(s).
3. After drive and controller have been installed, power up the drive and bring it to the ready state.
4. Enter the following on the 2200:

SELECT DISK (ADDRESS OF FIXED DISK) (EXEC)

LIST DC F (EXEC)

If no errors occur, continue with step 5. If any error(s) have occurred, recheck the installation. If installation is indeed correct, either a hardware error exists, or the fixed disk needs reformatting. To reformat, the FORMAT utility program must be obtained from a District or Area office. Refer to Section 3 of this publication for FORMAT utility operating instructions. When reformatting has been completed, repeat step 4.

5. Enter the following:

LOAD DC F "FORMAT" (EXEC)

Refer to Section 3 of this publication for FORMAT utility operating instructions.

### 3. OPERATION OF \$GIO UTILITIES FOR THE 2260C

At the present time, there are two programs available. One is a format utility that has been prewritten on the fixed disk before the drive is shipped for installation. This utility is also available on diskette under WL# 701-2403. FORMAT should be immediately duplicated for back-up when the drive is installed. The second utility program is for Field Service use; this program aids in disk alignments and data recovery, and performs formatting on a sector or on a platter. This Field Service utility is available on diskette WL# 701-2411.

#### 3.1 The FORMAT Utility

To operate the format utility contained on the fixed disk, enter the following:

SELECT DISK (ADDRESS OF FIXED DISK) (EXEC)

LOAD DC F "FORMAT" (EXEC)

If any errors have occurred, refer to Section 2 (Installation). If no errors have occurred, enter the following:

RUN (EXEC)

The following should appear on the screen:

2260C DISK DRIVE FORMAT UTILITY

For Use on:

2200 T

2200 VP (OS 1.8)

2200 MVP (OS 1.3)

ENTER DISK ADDRESS TO FORMAT \_\_\_\_\_

After the address of the disk (fixed or removable) to be formatted has been entered, the following should appear:

2260 DISK DRIVE FORMAT UTILITY

DO YOU WANT TO FORMAT THIS PLATTER (Y/N) \_\_\_\_\_

FORMAT PLATTER (ADDRESS)

Verify that the correct address has been selected, then enter Y (EXEC) to format. The following will appear:

FORMATTING.....

When formatting is complete, the following appears on the screen:

FORMATTING COMPLETE

: \_\_\_\_\_

If formatting has not been completed after four minutes, a hardware error exists. Recheck the installation; if the installation was performed correctly, consult District or Area Technical Specialists.

### 3.2 Field Service Utility

The Field Service Utility consists of the following:

- 01 CHANGE DISK ADDRESS
- 02 FORMAT PLATTER
- 03 FORMAT SECTOR
- 04 READ SECTOR HEADER
- 05 CLEAR ERROR COUNT
- 06 READ ERROR COUNT
- 07 READ BAD SECTOR
- 08 FIELD SERVICE COMMANDS

#### EXPLANATIONS:

##### 01 CHANGE DISK ADDRESS

This program must be run prior to any other utility programs. The program selects either a fixed or removable platter.

##### 02 FORMAT PLATTER

This program should be used when the FORMAT program cannot be read from the fixed disk. Formatting of either a removable or fixed platter is accomplished by this program.

03 FORMAT SECTOR

This is used to format only one sector of either the fixed or removable platters if that sector was somehow destroyed.

04 READ SECTOR HEADER

When troubleshooting, this utility is used to ensure that the disk heads are at the correct position.

05 CLEAR ERROR COUNT

This resets the error count which is stored in the 22C12 or 22C13 controller.

06 READ ERROR COUNT

An error log of all disk-related errors is stored in the 22C12 or 22C13. This program allows the total error count to be displayed.

07 READ BAD SECTOR

This program allows the data from a sector to be read and displayed, even though a CRC or LRC has occurred. It is useful in attempting to recover data from a customer disk pack.

08 FIELD SERVICE COMMANDS

Six commands are used for on-line alignments on the Diablo or Hawk Disk. They are as follows:

A = Seek to track 10 and restore -- (used for Diablo track  
0 adjustment)

B = Constant Restore

C = Constant Restore -- (used for Diablo or Hawk track 0

C = Alternate seek between tracks 293 & 405 -- (used for  
Hawk 'average -  
seek' adjustments)

D = Alternate seeks between tracks 400 & 402 -- (used for  
Hawk 'servo -  
balance' adjustments)

E = Alternate seeks between tracks 00 & 02 -- (used for Hawk  
'servo balance'  
adjustments)

F = Alternate seeks between tracks 408 & 410 -- (used for  
Hawk FEOT adjust-  
ments)

These commands will not halt until RESET on the 2200 is keyed.

#### 4. DIAGNOSTICS

The standard diagnostics used on 2260B should also be used on  
2260C / 2260BM.

#### 5. MAINTENANCE

Disk drive maintenance should be performed as prescribed in the  
Diablo 44B maintenance manual. The +5 volts for 2200 I/O should be  
checked and adjusted if necessary when the controller is installed.


#### 6. ELECTRICAL SCHEMATICS

The following prints are included in this publication:

D7486

D7487

(D7488 not available at date of this printing)

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 131	<b>DATE:</b> 3/3/77
	<b>CATEGORY</b>	
	MASS STORAGE DEVICES #6	
<b>SUBJECT</b>		
DIABLO MODEL 44B LEVEL 2 UPDATE KIT		

All 2260 and 2260-2 units manufactured prior to Wang serial #FK1092 using Diablo Model 44B Disk Drives have been experiencing problems attributed to the drive. These problems do not affect normal operation of the 2200 system, thus are not readily identified. The problems result in a low soft error rate and slow seek times.

There are numerous changes involved in correcting these problems. Not all of the changes described in this ISN will be implemented presently, due to delays expected in the redesign of certain Diablo PCs. This means that temporarily, there will be several different levels of disk drives in the field. In order to clarify drive revision levels, the following description is necessary. The total update is broken into 4 revision levels:

LEVEL 1 - Includes all units prior to serial #FK1092.

LEVEL 2 - Includes units with serial #FK1092 and above, with all changes described in subsequent text of this ISN.

LEVEL 3 - Includes units with all Level 2 changes, plus a new Address Logic PC (Diablo #12101; WL #726-0441) and Servo PC (Diablo #12099; WL #726-0442).

**NOTE:**

The #12099 (WL #726-0442) Servo board and a #12101 (WL #726-0441) Address Logic must be used together. They may be replaced by a #12064 Address Logic and a #12068 Servo, but they must be changed as a pair. Diablo will provide 12099 and 12101 PCBs for field upgrade as quickly as possible.



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13 757  
10-76-30

LEVEL 4 - In addition to all Level 2 changes, Level 4 drives will include a new Data Transfer board and a new Power Driver board. These boards further improve the reliability of the drive.

Presently, efforts will be directed towards bringing the Level 1 drives up to Level 2. Diablo will provide kits to the Home Office to accomplish this. These kits will be distributed to Area Offices on a drive-population basis. It will be up to Area Offices to distribute them to local offices.

The kits will consist of parts necessary to make the following changes and will contain additional information.

#### *Card Cage/Motherboard Assembly*

To improve card cage/motherboard grounding, a ground strap should be installed as follows:

1. Install one end of the ground strap to the right rear mounting screw of the power supply. To insure a solid ground, use the emery paper provided to remove the paint from around the screw hole. Then, use a flat washer, a split lockwasher, and a 6-32 x .500" (1.27 cm) screw in the following manner:

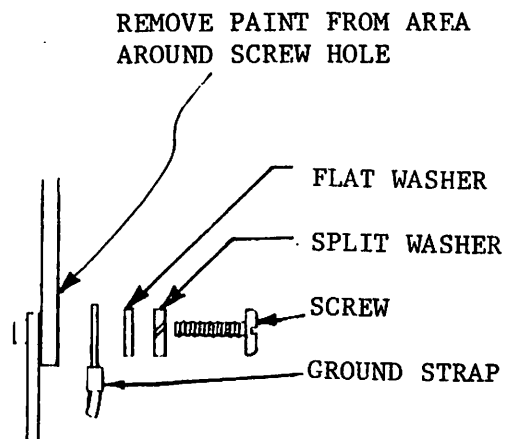
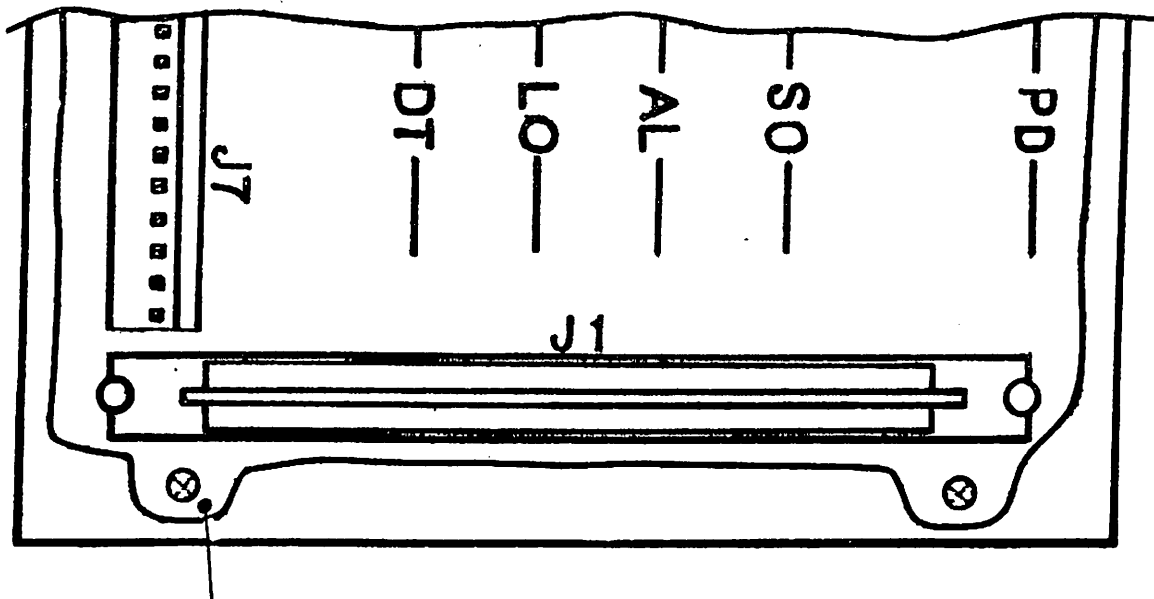


FIGURE 1

2. Remove the terminal lug from the other end of the ground strap. Strip the insulation back 3/8" (approx. 1 cm) and solder to the motherboard as shown in Figure 2.





SOLDER GROUND IN THIS AREA

FIGURE 2

*Power Supply Assembly*

1. Power Supplies manufactured by General Instruments may have bridge rectifiers that are sensitive to low frequency noise. These rectifiers are identified by a metallic silver casing. The correct rectifiers are manufactured by Varo Semiconductors, Inc., and have a black epoxy casing. When changing the General Instruments rectifiers, label connections to ensure correct replacement.

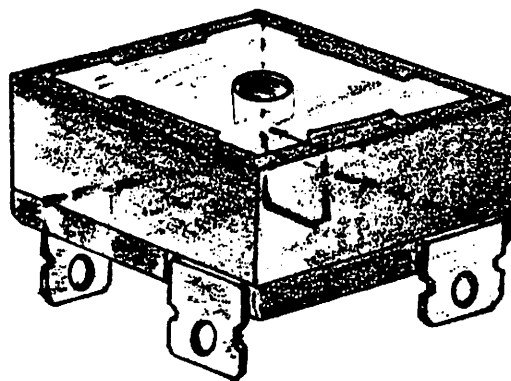


FIGURE 3

2. Some power supplies were assembled using Potter or Hopkins AC line filters. These two filters are inadequate for the application, and should be changed to a Corcom filter. The filter type can be determined as follows:
  - a) Corcom - Silver-colored, with a schematic of the filter printed on top of the casing. A green safety wire lug

is soldered on.

- b) Hopkins - Silver with nothing written on the casing. The green safety wire lug is riveted on.
- c) Potter - Black casing.

#### Filter Replacement

1. Remove the power supply assembly from the disk drive (refer to Diablo 44B Maintenance Manual, Section 5.7.1.5).
2. Remove the filter by depressing the tabs on each side of the filter, and sliding the filter out towards the rear of the power supply assembly.
3. Label and remove the wires connected to the filter.
4. Drill a 3/16" hole in the power supply chassis in the outside rear corner as shown in Figure 4. Remove paint from around the drilled hole with emery paper.

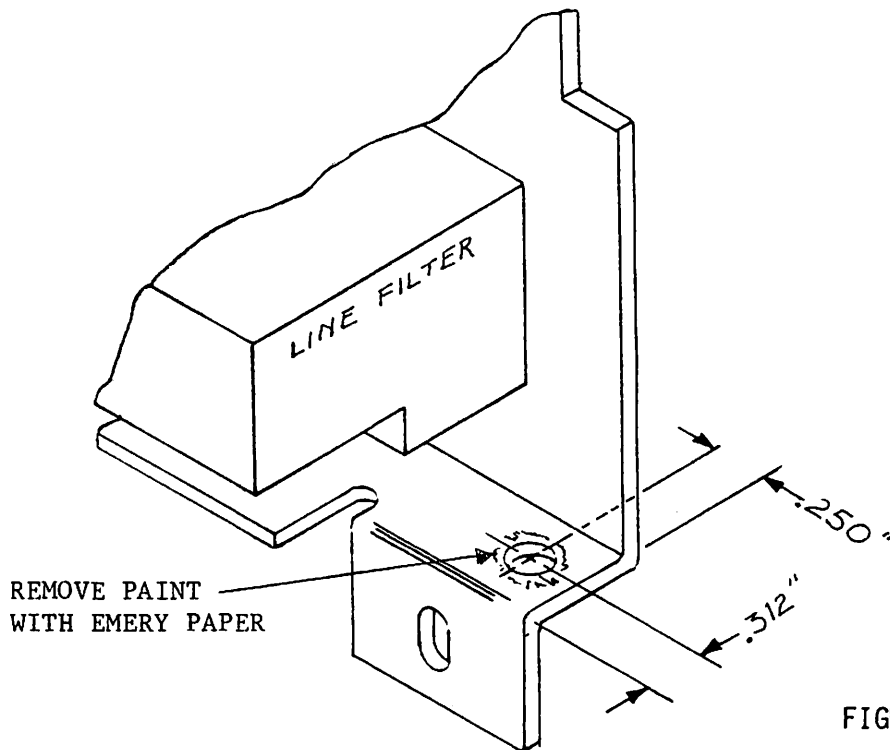


FIGURE 4

5. Reconnect all wires except the green ground wire to the new filter, in their correct locations.

6. Replace the filter in the power supply assembly by sliding it back until the tabs snap into place, securing the filter.
7. Cut and relocate the green ground wire as shown in Figure 5.

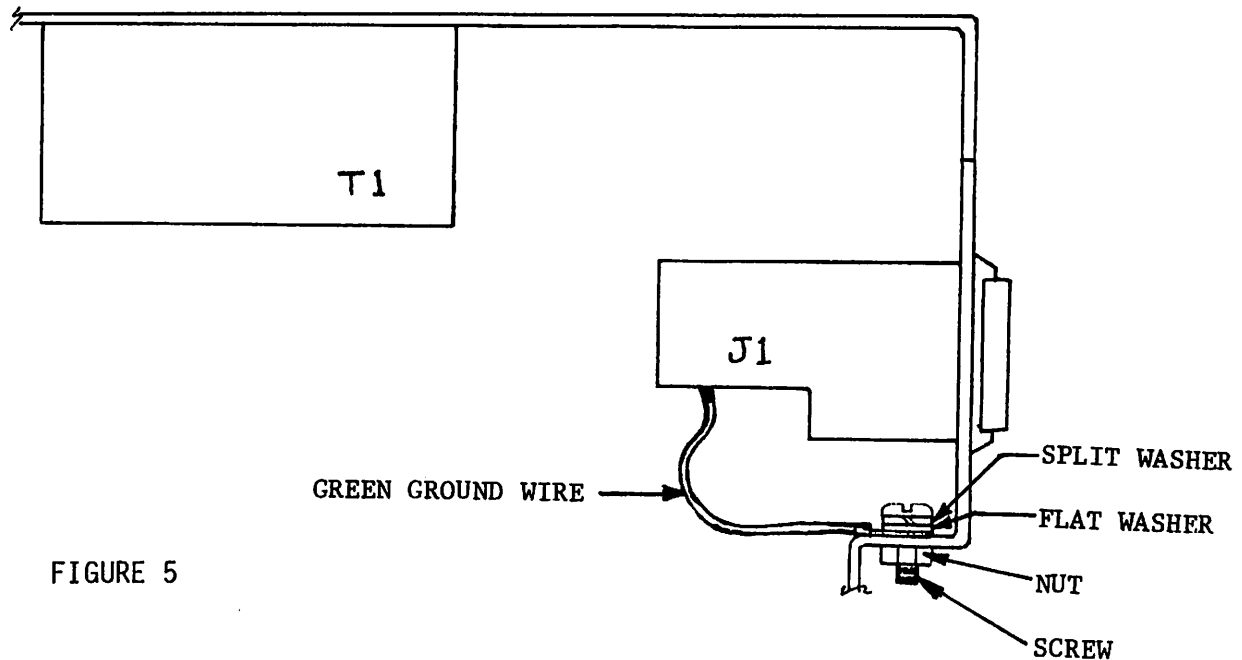


FIGURE 5

8. Replace the power supply assembly (per 44B Maintenance Manual, Section 5.7.1.5).

#### *Read/Write Head Assembly*

The R/W head cables have a tendency to 'creep', due to mechanical action of the R/W heads when seeking. If the insulation on these cables is made of Teflon (which is the case after Oct., 76), this creeping motion causes a static charge to build up. Subsequent static discharge causes errors.

To prevent the R/W head cables from creeping, apply 1 drop of Loctite 414 adhesive (provided by Diablo in kits) as shown in Figure 6. Secure the head cable as shown in Figure 6.

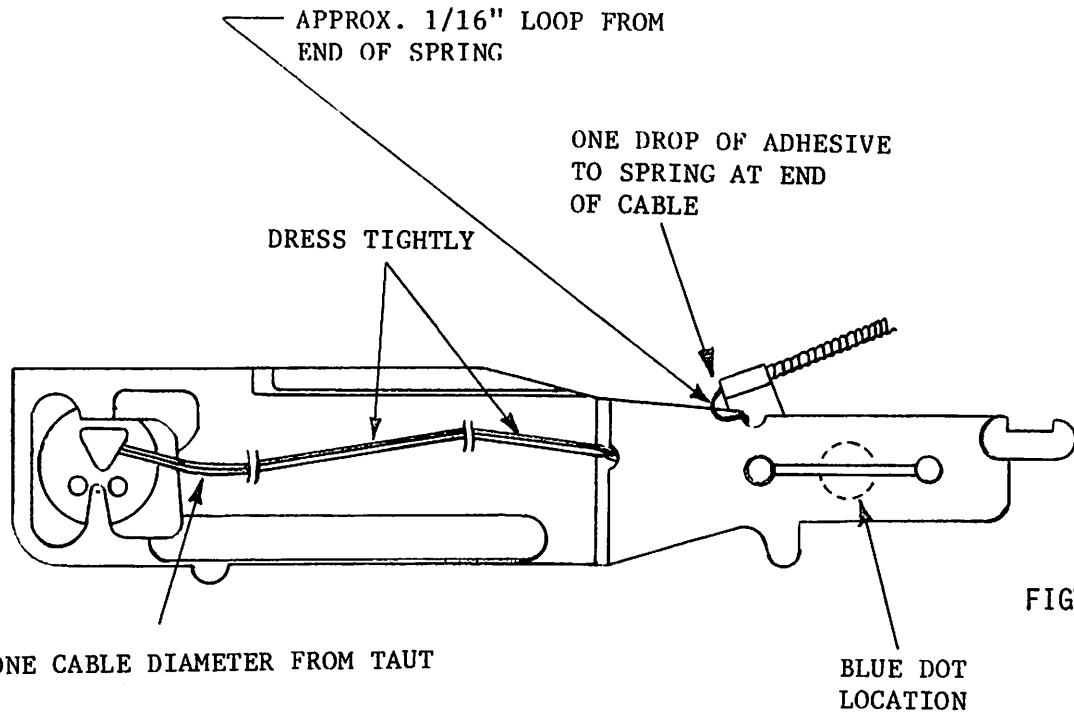


FIGURE 6

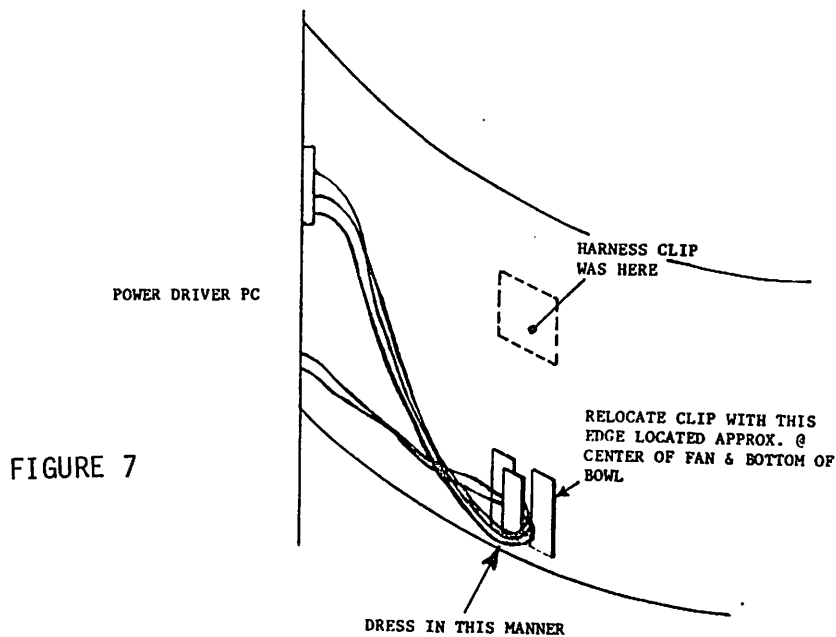
SLACK=ONE CABLE DIAMETER FROM TAUT

BLUE DOT LOCATION

Heads that have been reworked by Diablo will have a blue dot as shown in Figure 6.

*Power Driver Harness*

Relocate or install a new Power Driver Harness Clip as shown in Figure 7. Pull any slack from the power driver wires on the head positioner side of the clip, so that these driver wires do not run near the R/W head cables. Form wires as shown and place them in the relocated clip.



*Logic PCB (#12066)*

To prevent crosstalk of Index and Sector pulses, incorporate the following:

Change resistors A10 & B20 from 47K $\Omega$  to 20K $\Omega$  (provided by Diablo in kit).

To improve the stability of speed OKFF D60, replace diode at B59 with a 10 $\Omega$  resistor (provided by Diablo in kit).

These modifications change the LOGIC PC (Diablo #12066; WL #726-0440) to a revision S.

*Upper Index Transducer Adjustment*


(REF: Diablo 44B Maintenance Manual, Section 5.6.4.4)

To correct Index errors with cartridges that have narrow (.020") slots, the amplitude of the positive peaks should be 400 mv. (minimum) at pin 10 of the LOGIC PC (Diablo #12066; WL #726-0440).

*Card Cage Screws*

In some instances, the screws that secure the card cage have been overtightened, causing the threads in the rails to strip. To remedy this problem:


1. Remove the captive screws in the motherboard stop.
2. Install two #6 x 1" self tapping screws, WL #651-0013.

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 137	<b>DATE:</b> 5/5/77
	<b>CATEGORY</b> MASS STORAGE DEVICES #8	
	<b>SUBJECT</b> DIABLO MODEL 44B (WANG MODEL 2260B, -½, -¼)	

**TRACK ZERO ALIGNMENT WHEN CHANGING THE LOGIC PCB**

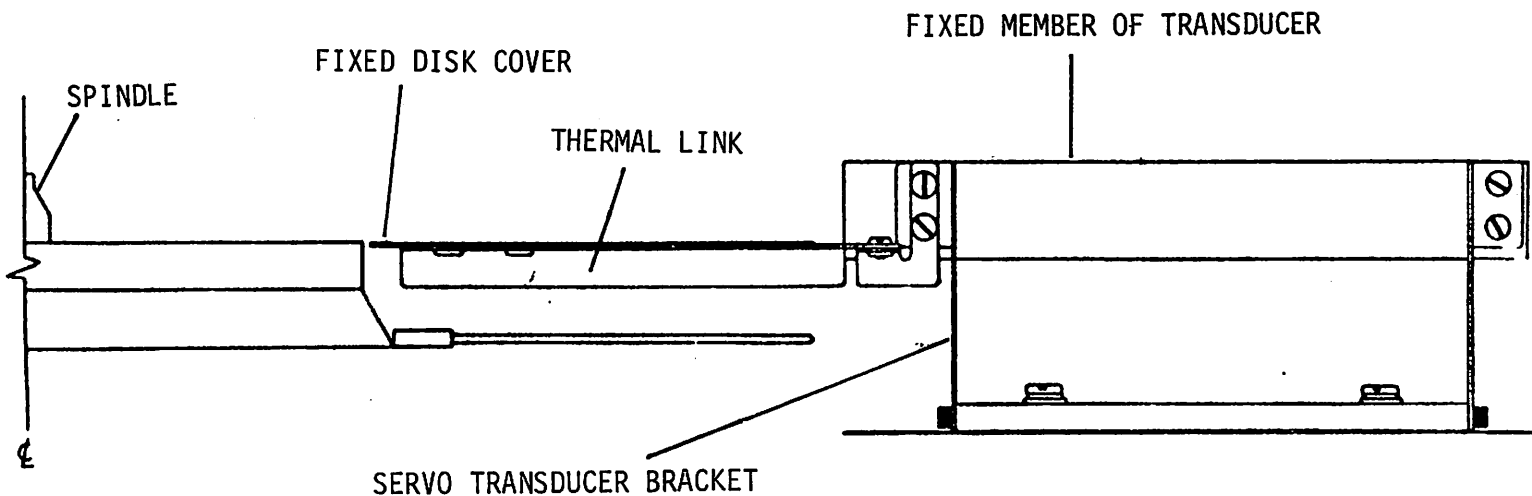
When changing the #12066-XX Logic PCB Assembly, it is imperative that Track Zero alignment be checked to insure proper operation. (Reference Service Newsletter #76.2). If an alignment is required, Head Alignment and Index Transducer Alignment should be checked.

The change in alignment is due to the different output characteristics of the Over Tracks Sensor.

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 142	<b>DATE:</b> 7/7/77
	<b>CATEGORY</b> MASS STORAGE DEVICES #9	
	<b>SUBJECT</b> MODEL 44B DISK DRIVE INFORMATION	

1. TEMPERATURE COMPENSATION

Temperature compensation in the Diablo Model 44B Disk Drive is accomplished mechanically. One end of a thermal link attaches to the fixed member of the Servo Transducer. The opposite end of this thermal link connects to the fixed disk cover, which expands at the same rate as a disk platter. If either end of the Servo Transducer fixed member has a poor connection, a positioning error will result as disk drive temperature changes.



2. LOOSE SERVO TRANSDUCER MOUNTING SCREWS

Servo Transducer mounting screws have been found loosened in a number of Model 44B drives. If this problem is suspected, prepare the drive for a head alignment (use the procedure in Service Newsletter #76.2, or when available, the Diablo Series 40 Disk Field Level Maintenance Guide #03-0057).

While observing the alignment pattern on an oscilloscope, push the fixed member of the Servo Transducer first forward then rearward. If the Servo Transducer mounting screws are tight, the alignment pattern should return upon releasing the transducer. If the alignment pattern does not return, the Servo Transducer screws are probably loose.

Correct the problem as follows:

- a) Tighten the Servo Transducer mounting screws.
- b) Perform the track zero alignment in Service Newsletter #76.2 or the Diablo Series 40 Disk FLMG #03-0057.
- c) Perform the head alignment in Service Newsletter #76.2 or the Diablo Series 40 Disk FLMG #03-0057.
- d) Recheck for the servo transducer being tight by: Observing the alignment pattern with an oscilloscope and push the fixed member of the Servo Transducer first forward then rearward. The alignment pattern should 'go out'; upon releasing the transducer the pattern should return.
- e) If this does not correct the problem, check the remaining mechanical connections in the thermal compensation link to ensure that there are no binds or loose connections in the linkage.

### 3. LOGIC BOARD REVISION

Diablo has made a new revision of the Model 44B LOGIC circuit board #12066, WL #726-XXXX.

When switch #4 on that board is in the OFF position, only removable disk sector and index clocks are supplied to the Wang microprocessor. SWITCH #4 MUST BE ON.

Artwork revisions involved are 12065-02 and above. This number is etched or stamped on the non-component side of the board.

To elucidate, if switch #4 is *not* ON, a fixed disk read or write attempted will result in an Error 67/I93. If the fixed disk is then formatted, disk operations can be performed without problems; however,



when the top disk is removed and then replaced, data on the fixed disk cannot be read (Err 67/I93). Data is lost because the top disk hub cannot be reinstalled in the exact position that it was in when data was recorded on the fixed disk.

The removable disk is read without error, regardless of the position of switch #4.

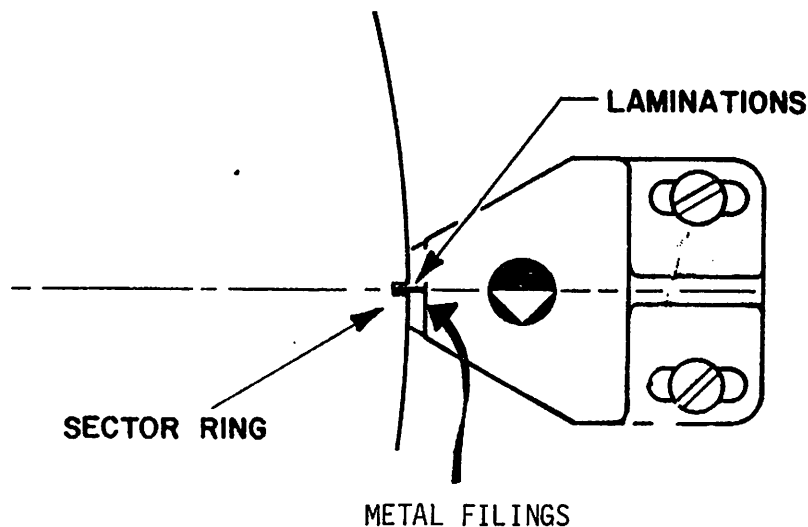
For simplicity, it is suggested that all LOGIC boards have switch #4 turned ON. Change SNL 76.2, page 21, section 5.2.1 accordingly.


#### 4. INDEX TRANSDUCER CLEANING

Small metal 'filings' will adhere to the Model 44B index transducer, causing erroneous sector/index pulses. These 'filings' can come from faulty cartridge hubs, which in some cases are crumbling.

This problem may cause erratic or even total failure of the upper index transducer.

Use adhesive tape to clean 'filings' from the transducer and replace the defective cartridge(s) causing the above problem.



	NO. 156	DATE: 12/5/77
	CATEGORY MASS STORAGE DEVICES #15	
	SUBJECT STATIC PROOFING THE MODEL 44B DISK DRIVES	

To decrease the susceptibility of the Model 44B Disk Drives to static discharge, especially in operating environments which are not optimum, the following improvements must be incorporated. All 44Bs must be modified. Newly manufactured units, beginning with Diablo Serial #2235, will already contain these improvements.

**Material and Parts required:**

Tool for removing paint: Exacto knife, file, or sandpaper  
two 8 inch ground straps  
one 4.5 inch ground strap

The Home Office will supply the ground straps to the field as soon as they become available.

**NOTE:**

Care must be taken during the following steps to prevent foreign materials, such as paint chips and dust, from entering the disk drive.

**1. FRONT PANEL ASSEMBLY**

- a) Loosen the two Hex screws (one each side) that hold on the front panel. Carefully lower the front panel to the maintenance position. See Figure 1.
- b) Using existing hardware, secure one end of each 8 inch ground strap to the front panel assembly; secure the other end to the base plate. Refer to Figures 2 and 3.
- c) Return the front panel to the operating position. Tighten the two Hex screws.

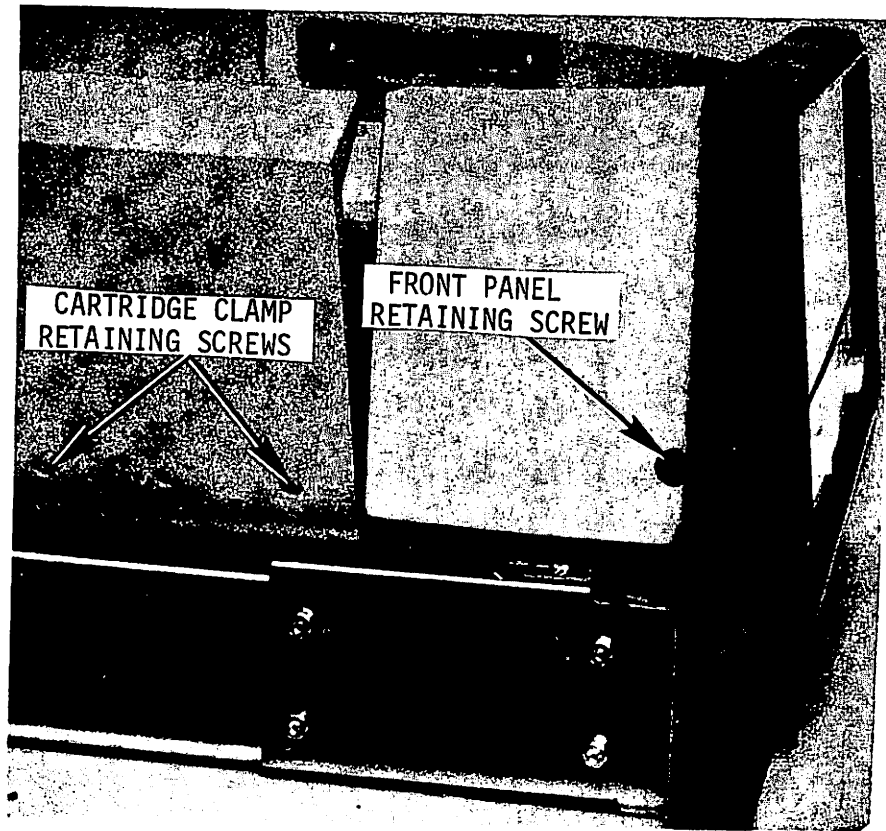


FIGURE 1

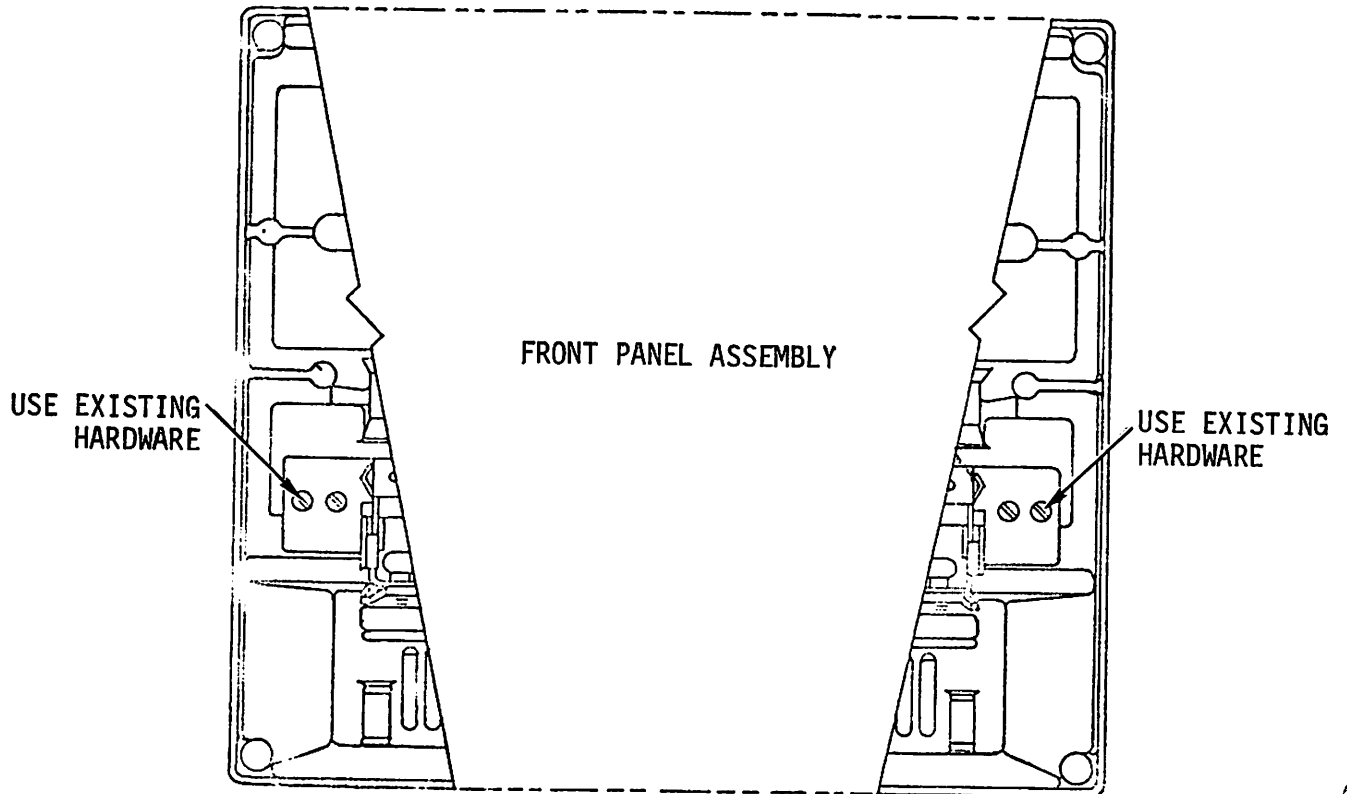


FIGURE 2

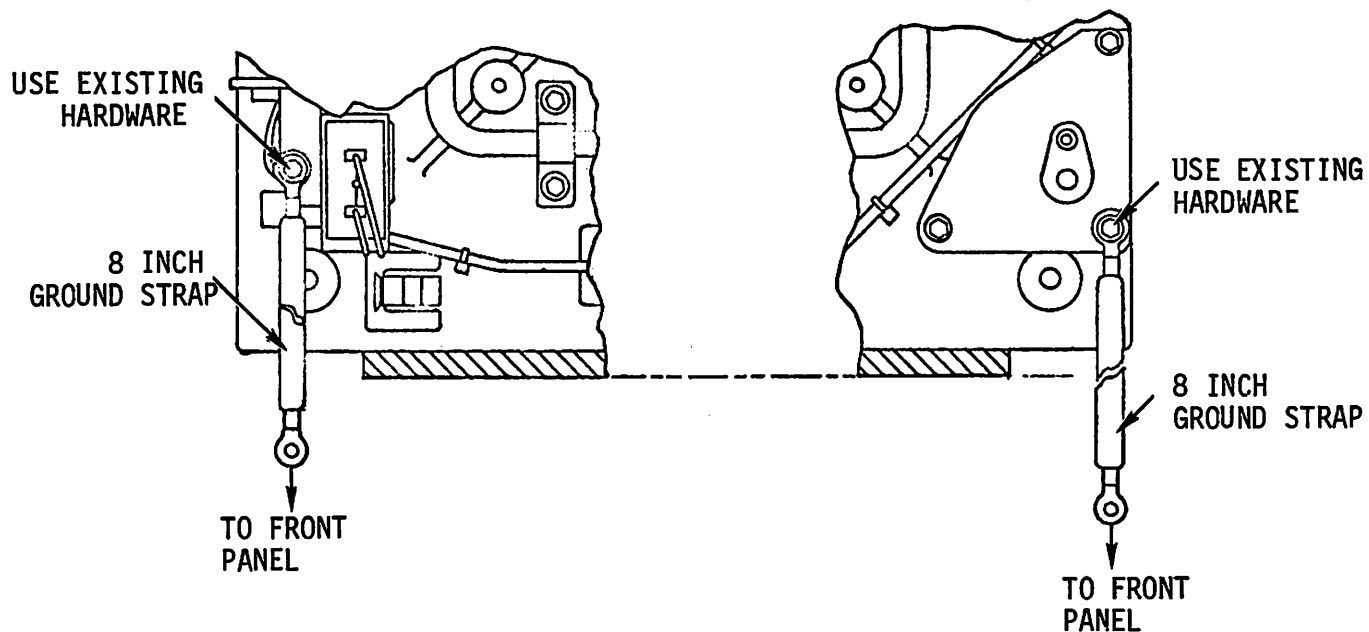


FIGURE 3

## 2. CARTRIDGE RETAINER ASSEMBLIES

- a) Remove both cartridge clamp mechanisms, each held in place by two Allen screws. See Figure 1. Before removing the lefthand cartridge clamp, disconnect the wires leading to the cartridge interlock switch.
- b) Using a file or sandpaper, remove the paint from the area indicated in figure 4.
- c) Carefully clean off the loose paint and reinstall the cartridge clamp mechanisms.

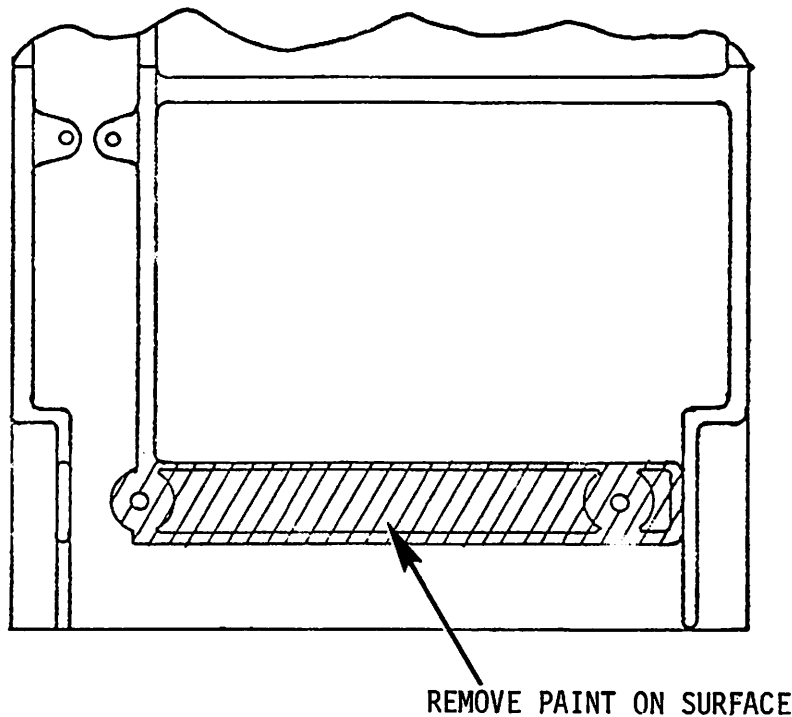


FIGURE 4

#### HEAD POSITION ASSEMBLY

Install the 4 1/2 inch ground strap from the head positioner to the card cage, using existing hardware. Refer to Figure 5.

#### 4. POWER SUPPLY ASSEMBLY

- a) Refer to Figure 6. Remove the two screws securing the power supply to the bottom pan.
- b) Disconnect the cable from the J7 connector on the Mother-board.
- c) Disconnect the brush and fan motor wires from the terminal block on the power supply: TB1-2, TB1-6, and TB1-7. Mark the wires for easy reinstallation.
- d) Lift the power supply from the drive.
- e) Remove the screw that secures the ground straps leading to the shock mount and card cage.
- f) Using a file or sandpaper, remove the paint from the pan assembly at the point where the card cage and shock mount straps fasten (area approximately 1/2 inch in diameter). Also on the pan assembly, remove the paint from the areas that contact the power supply tabs.

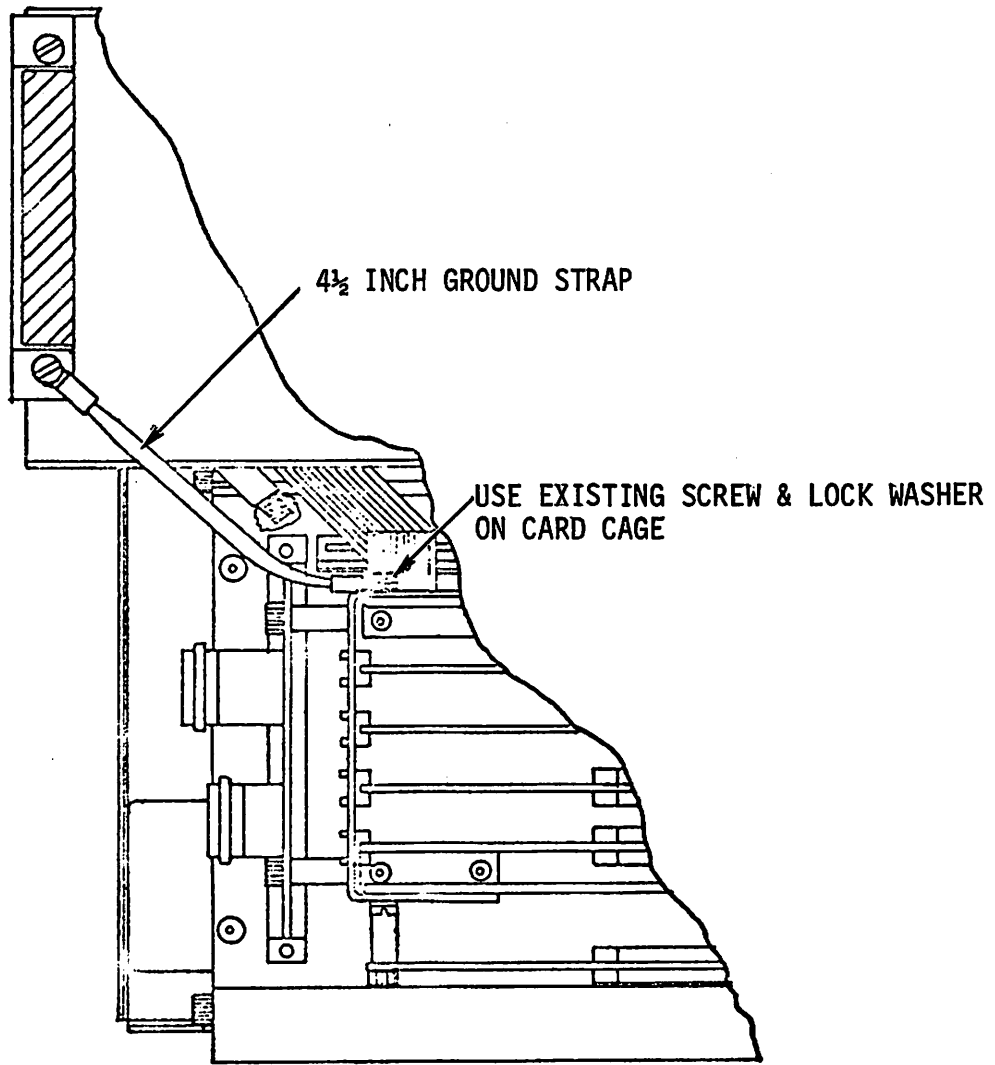


FIGURE 5

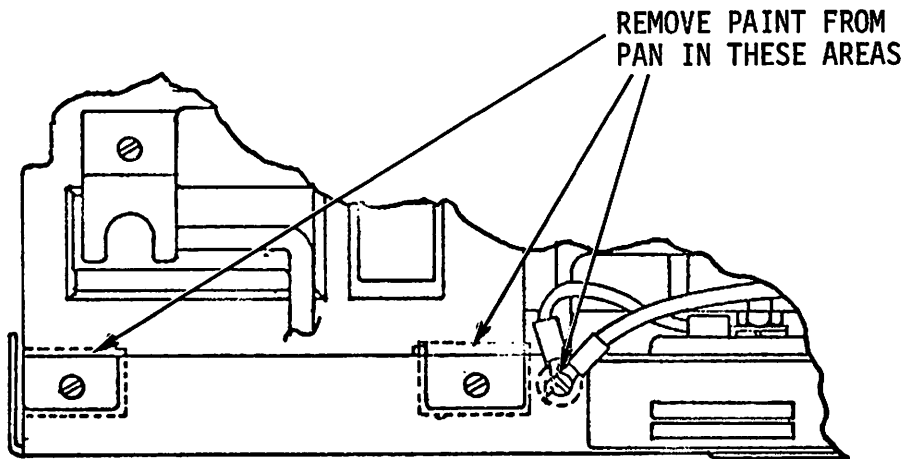


FIGURE 6

- g) Refer to Figure 7. Using a file or sandpaper, remove the anodized coating from both sides of the two power supply tabs.
- h) Reinstall and secure the power supply, and then reconnect the ground straps leading to the shock mount and card cage.

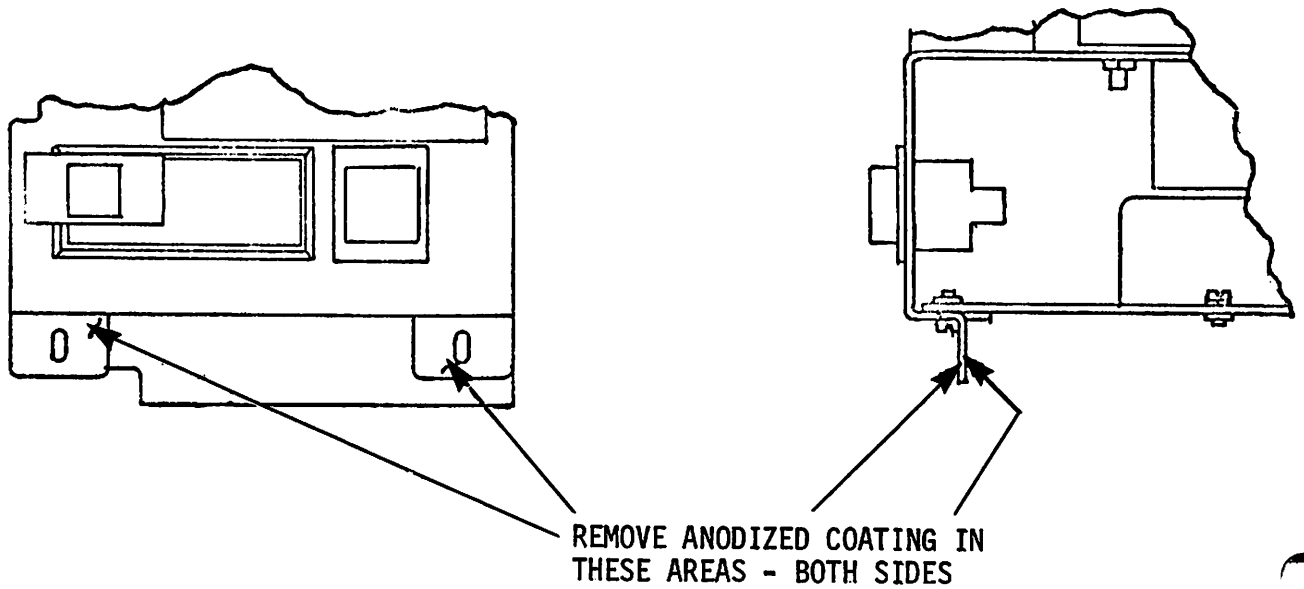



FIGURE 7

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 161	<b>DATE:</b> 1/20/78
	<b>CATEGORY</b>	
	MASS STORAGE DEVICES #17	
<b>SUBJECT</b>		
DIABLO MODEL 44B OVERSHOOT AT TRACK ZERO		

There is a slight possibility that overshoot can occur at track zero during long reverse seeks, due to an unbalanced condition of the 747 op-amp at location N50 on the #12099 Servo PCB. The effect of this overshoot is mispositioning of the carriage causing continuous address errors.

The following changes should correct this problem. The change is incorporated in the #12099 Servo Board and the #12062-01 Power Drive Board.

These changes should be installed in drives whose Diablo serial number is #3090 and below. Drives after #3090 have the change incorporated.

**Tools Needed:**

- Knife (X-Acto)
- Twist Drill, #60 bit
- Solder Iron
- Shrink Tubing
- Wire approximately 4" long

**Parts Needed for Changes:**

<u>Resistors</u>	<u>Diablo Part #</u>
1 - 1K 1/4W 2%	10429-49
1 - 1.2K 1/4W 2%	10429-51
1 - 150K 1/4W 2%	10430-05
 <u>Diodes</u>	
2 - 1N4454	10160



A. 12099 SERVO PCB CHANGES

1. On the etch side (non-component side), cut the etch on pin 09 of N50, approximately 1/8 inch from pin.
2. On the component side, directly above I.C. N50, cut the +15V bus (see diagram).
3. Holding PCB up to a light source, drill four holes in the following areas:
  - a) Drill one hole on the +15V bus, directly below the right side of M53 (10K resistor).
  - b) Drill two holes on the upper half of the etch that connects pin 09 and pin 13 of N50.

NOTE:

Caution is advised as there are two etches on the reverse side from pin 10 and pin 12. Drill one hole on each side of the etch from pin 10.

- c) Drill the fourth and last hole through the etch that connects the right side of N46 to the right side of N54 (about 1/8 inch above N46).
4. Add a wire from the right side of M54 resistor to the left side of P35 resistor.
5. Add a 1K 1/4W 2% resistor (N51) from the lower hole of the two that were drilled in the etch that connects pin 09 and 13 to the hole 1/8" above the right side of N46 (see diagram).
6. Connect two 1N4454 Diodes Cathode to Anode with 3/8" gap. Cover diodes with Heat Shrink Tubing and mount on PCB. Anode to hole drilled in +15V bus, Cathode to upper hole in the N50 etch pin 09 to 13.

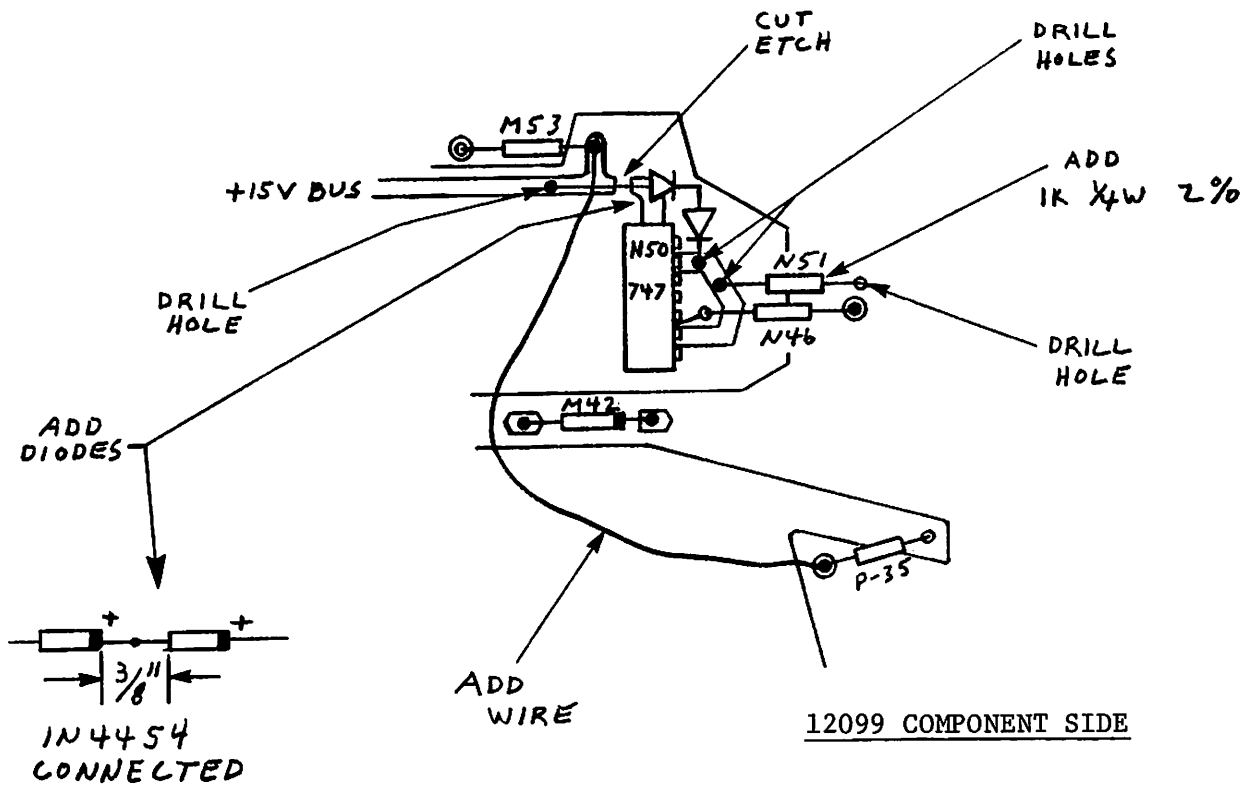
7. Change the revision of the #12099 PCB to revision "A".

B. 12062-01 POWER DRIVER PCB

1. Change the resistor at D22 from a 100K to a 150K 1/4W 2%.

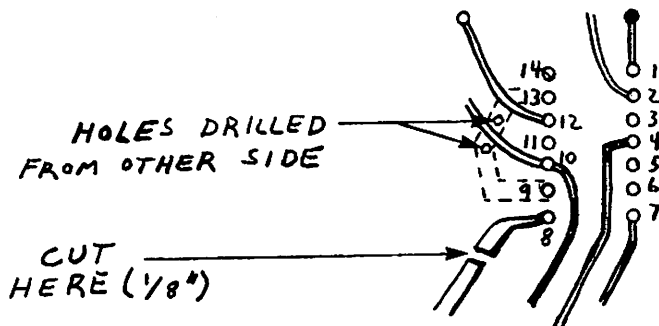
2. Change the resistor at D23 from 1K to 1.2K 1/4W 2%.


3. Change the revision of the PCB #12062-01 to revision "F".



ETCH SIDE

N50



 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 143	<b>DATE:</b> 7/22/77
	<b>CATEGORY</b> MASS STORAGE DEVICES #10	
	<b>SUBJECT</b> DIABLO MODEL 44B - EMERGENCY RETRACT WRITE INHIBIT CIRCUIT ADDITION	

To prevent a possible spiral write during emergency retract, the following should be incorporated on the 12046-xx Data Transfer PCB. This modification clamps write drive during emergency retract.

1. Remove Data Transfer PCB #12046-xx.
2. See Figure 1. Remove solder from K24, dip position holes.
3. Install a LM319, into K24 pins 1 to 7 and 10 to 16.
4. Install J19, 3.92K, 1/4 watt 1% resistor.
5. Install J20, 10K, 1/4 watt 1% resistor.
6. Install J21, .1uF, 50 V capacitor as shown.
7. Solder J19, J20, and J21 together on the side closest to K24. (On some PC Boards the three (3) points of J19, J20, and J21 may be already joined by runs.)
8. Install wire from J21, J26 junction, to K24-9.
9. Install wire from J19, J20, J21 junction to K24-10.
10. Install wire from K24-7 to K77-10.
11. Install wire form K24-8 to ground bus below K24.
12. Install wire from K24-6 to I/O pin 8. (see Figure 2)
13. Install wire from K24-11 to I/O pin 6.
14. Install wire from I/O pin 6 to J20, (closest to H25).

To increase the reliability of the 2N3725 write drivers, an 18K 1/4 watt resistor should be installed from the collector of E64 to -15V (see Figure 2).

To improve Read Amplifier performance, the 470pF capacitor at location B11 should be replaced with a 390pF capacitor (see Figure 1).



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Update Data Transfer PCB Schematic sheet 1 (12046) according to Figure 7-7.

Update Data Transfer PCB Schematic sheet 2 (12046) according to Figure 7-8.

The modifications increase the 12046 PCB to revision "XDL".

Field change kits will be distributed to the Area Offices from the Home Office as soon as they are received from Diablo.

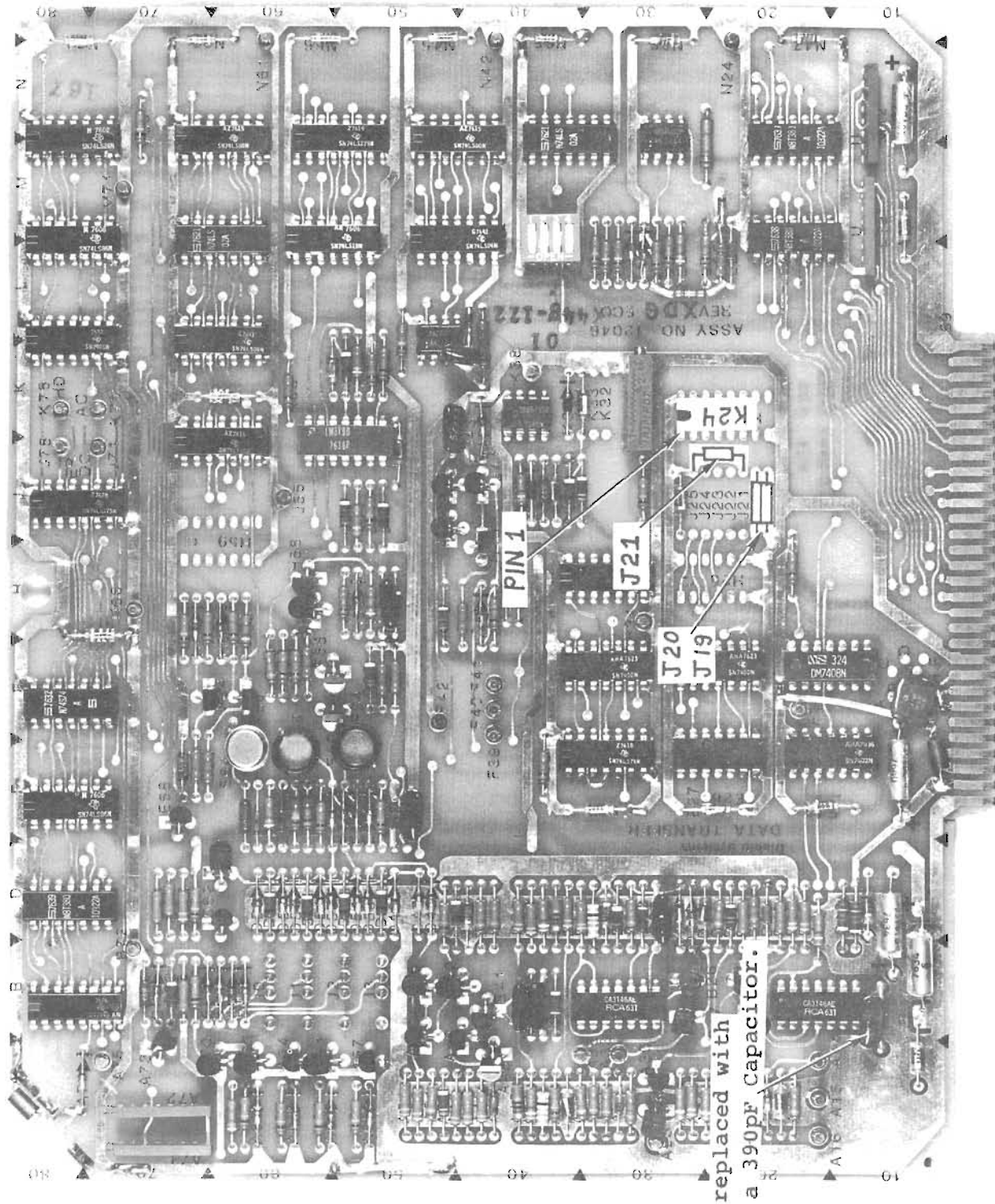


FIGURE 1

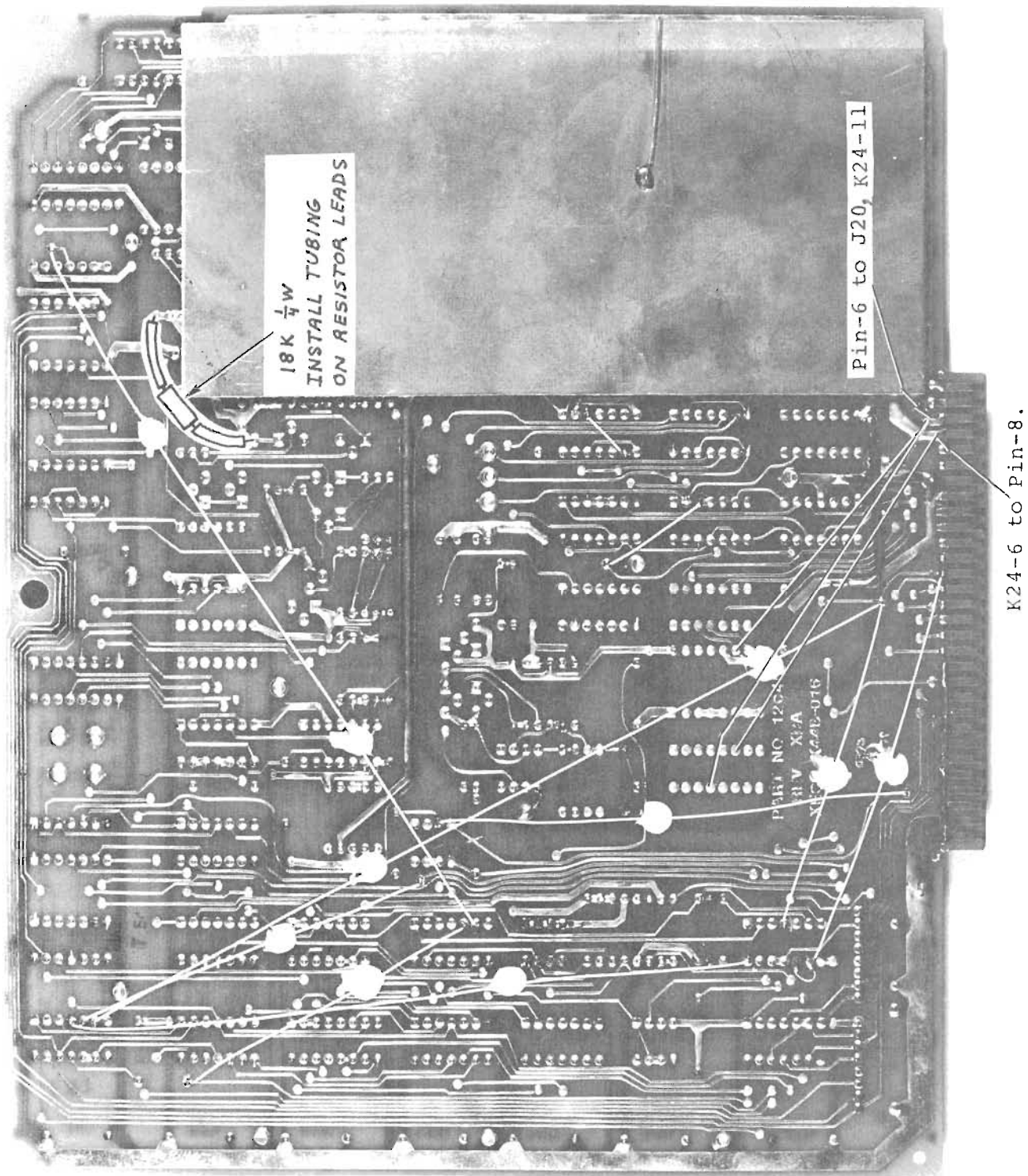


FIGURE 2

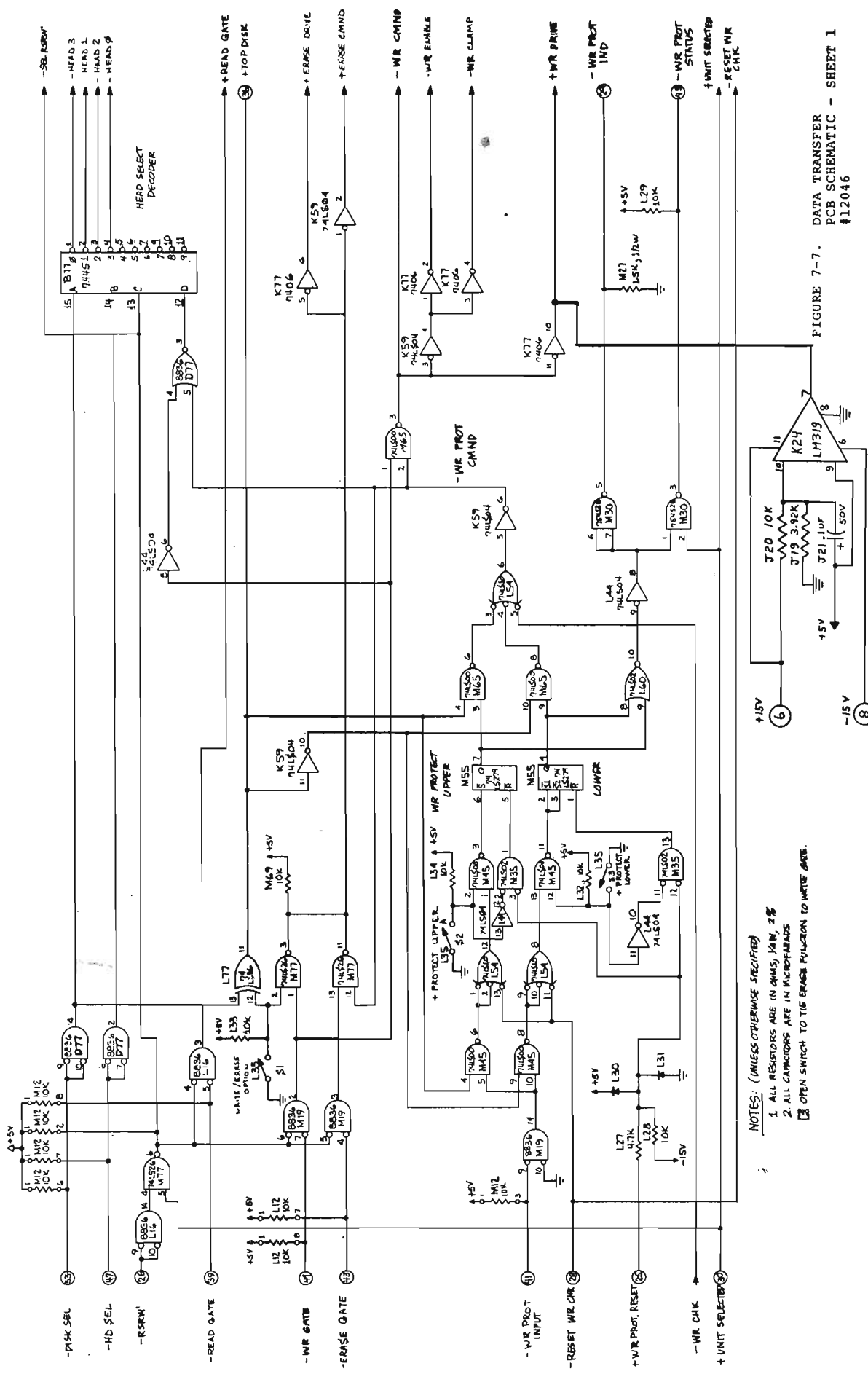


FIGURE 7-7. DATA TRANSFER PCB SCHEMATIC - SHEET 1 #12046

NOTES: (UNLESS OTHERWISE SPECIFIED)  
 1. ALL RESISTORS ARE IN OHMS, 1/4W, 2%  
 2. ALL CAPACITORS ARE IN MICROFARADS  
 ☐ OPEN SWITCH TO TIE ERASE PULLDOWN TO WRITE GATE.

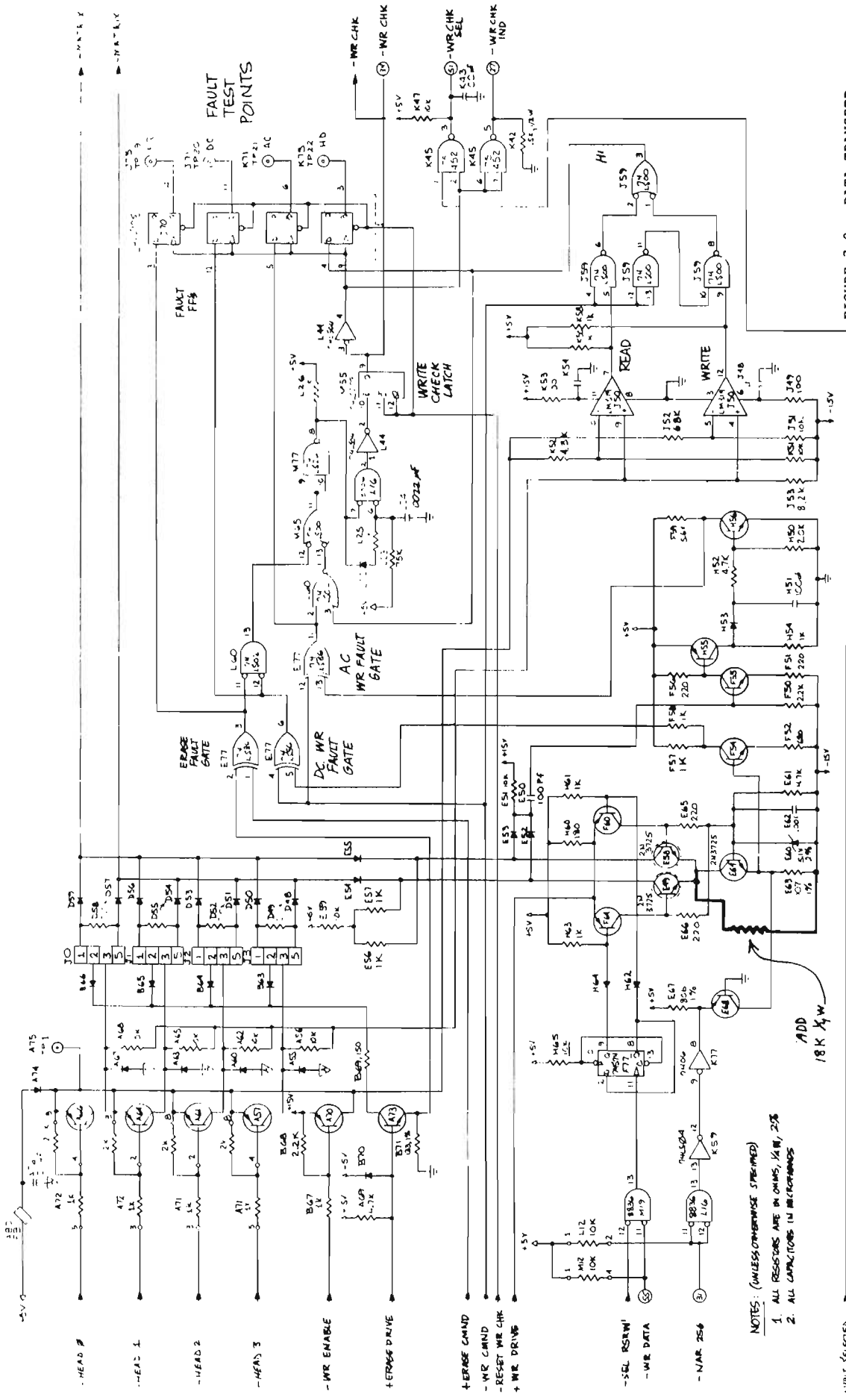



FIGURE 7-8. DATA TRANSFER PCB SCHEMATIC - SHEET 2 #12046

- NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL RESISTORS ARE IN OHMS,  $\frac{1}{2}$  W, 20%
  2. ALL CAPACITORS IN MICROFARADS

ADD  
18K  $\frac{1}{2}$  W



 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 164	<b>DATE:</b> 03/13/78
	<b>CATEGORY</b>	
	MASS STORAGE DEVICES #18	
<b>SUBJECT</b>		
DIABLO 44B DISK DRIVES TRACK 0 ADJUSTMENT		

This ISN corrects the Track 0 coarse & fine adjustment procedures for the Diablo Model 44B Disk Drives. These corrected procedures supersede those presented in:

- Service Newsletter 76.2, Sections 5.2.5.1 and 5.2.5.2
- Field Level Maintenance Guide on Diablo Disk Drives, Section 4.3.1
- Word Processing Newsletter No. 10, pages 20 through 26

Several problems have been encountered in the field because of the older procedures. It was discovered that, during the Track 0 adjustment, Test Point #1 on the 7013 exerciser board was being used even though it was not necessary. To use Test point #1 (op amp output), -5 volts is needed for the amplifier on the exerciser board; -5 volts is taken from the disk drive servo board.

When the -5 volts is taken from the new style servo board 12099 (with artwork 12098), it loads down to -4.3 volts. Furthermore, when a head is then plugged into the exerciser, the -5 volts loads down to -2.8V. This loading effect prevents an accurate Track 0 adjustment; as soon as the -5V lead is removed from the servo board, the adjustment changes.

When performing a Track 0 adjustment, do not connect the -5 volt lead from the exerciser to the servo pcb. This applies to both exerciser boards, the 7013 and the 7213. Connect the -5 volt lead only for head alignments and data burst/azimuth adjustments. This new procedure is for all Diablo Model 44B Disk Drives, regardless of their servo board revision level.

The following procedures mention only the 7013 exerciser, but note that these procedures apply to the 7213 exerciser as well.

#### TRACK 0 COARSE ADJUSTMENT PROCEDURE (TRIBIT)

Track zero adjustment requires the use of an alignment cartridge, 44B extender board, 7013 exerciser (or 7213), and oscilloscope.

#### CAUTION:

To ensure that the R/W heads do not retract too quickly when using the Diablo Disk Exerciser, set the exerciser address switches to zero before switching from the RUN mode to the LOAD mode. If this is not done, the heads will retract at high speed and hit the rear stop. This can cause misalignment of the R/W heads.

Do not lean on the drive when performing the adjustment since TRK 0 adjustment will change if the weight distribution is not equal.

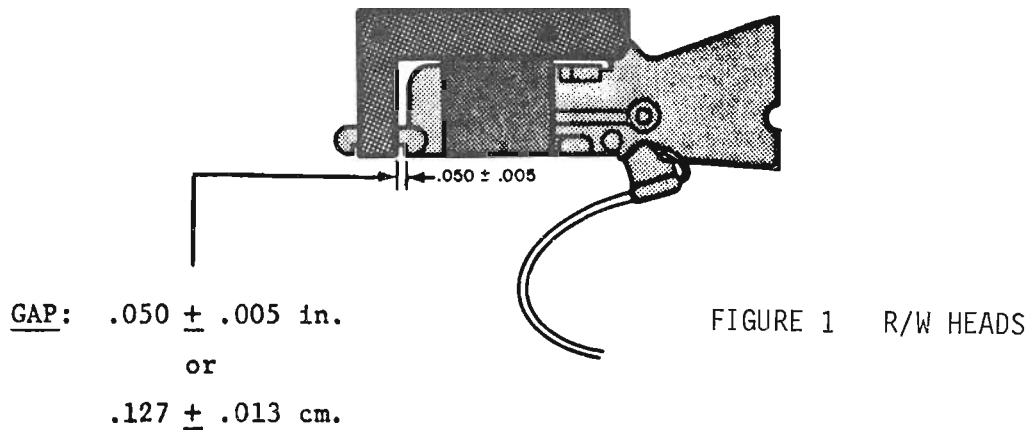
Do not perform the adjustment in incandescent or natural light. It may affect the output of the phototransistor. (Fluorescent lighting will not affect the phototransistor.)

1. Adjust the upper disk R/W heads for .050" gap (see Figure 1 for metric equivalent).
2. Set scope as follows:

Main Time Base

Mode - Normal

Coupling - DC



Source - External  
 Time Base - 2 ms/cm  
 Vertical Amplifiers  
 Display Mode - Channel 1  
 Trigger Source - Upper Index  
 Vertical Deflection - 50 mv/cm using a 10X probe  
 Coupling (Channel 1) - AC  
 Coupling (Channel 2) - DC

3. Install the alignment cartridge and set LOAD/RUN switch to RUN. Allow drive to stabilize for 30 minutes.
4. Connect the CH 1 scope probe to A33 or A36 on data transfer board #12046 (Figure 2), or connect CH 1 scope probe to B31 or B28 on data transfer board #12143 (Figure 3).
5. Trigger the oscilloscope externally on the negative edge of Upper Index TPF75 on Logic PCB's with 12065 Artwork; use TPE76 on Logic PCB's with 12065-01 or higher artwork.

NOTE:

Switch 1 at location B70 must be on.

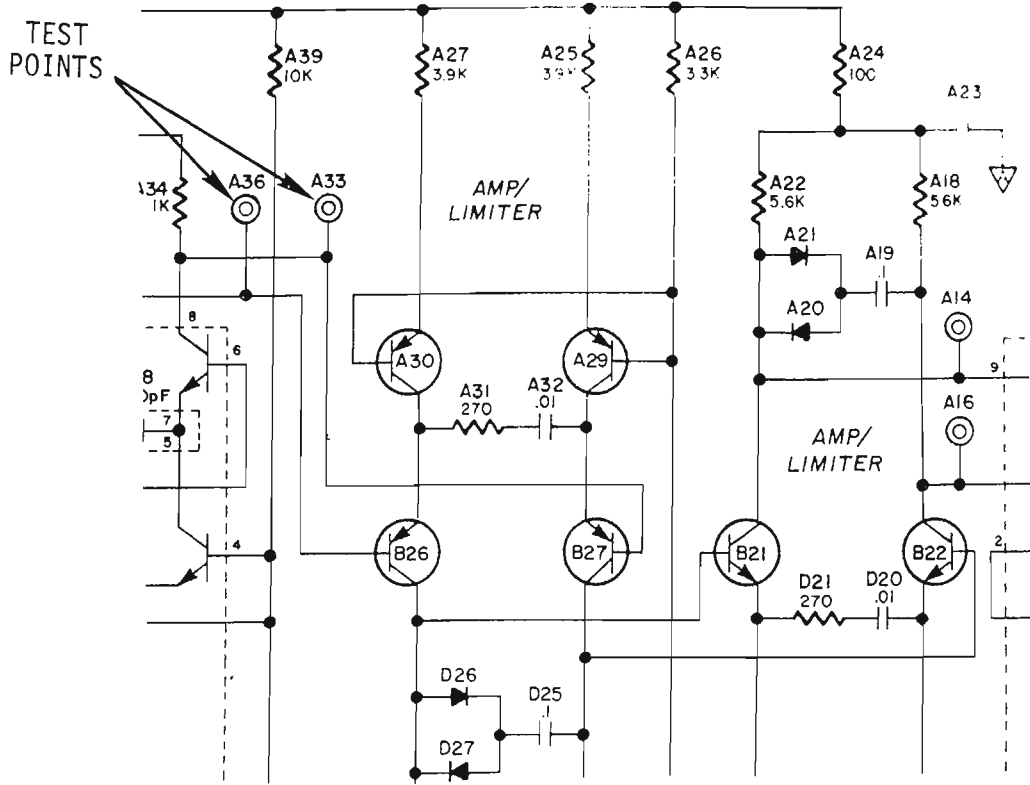


FIGURE 2 DATA TRANSFER BOARD #120146

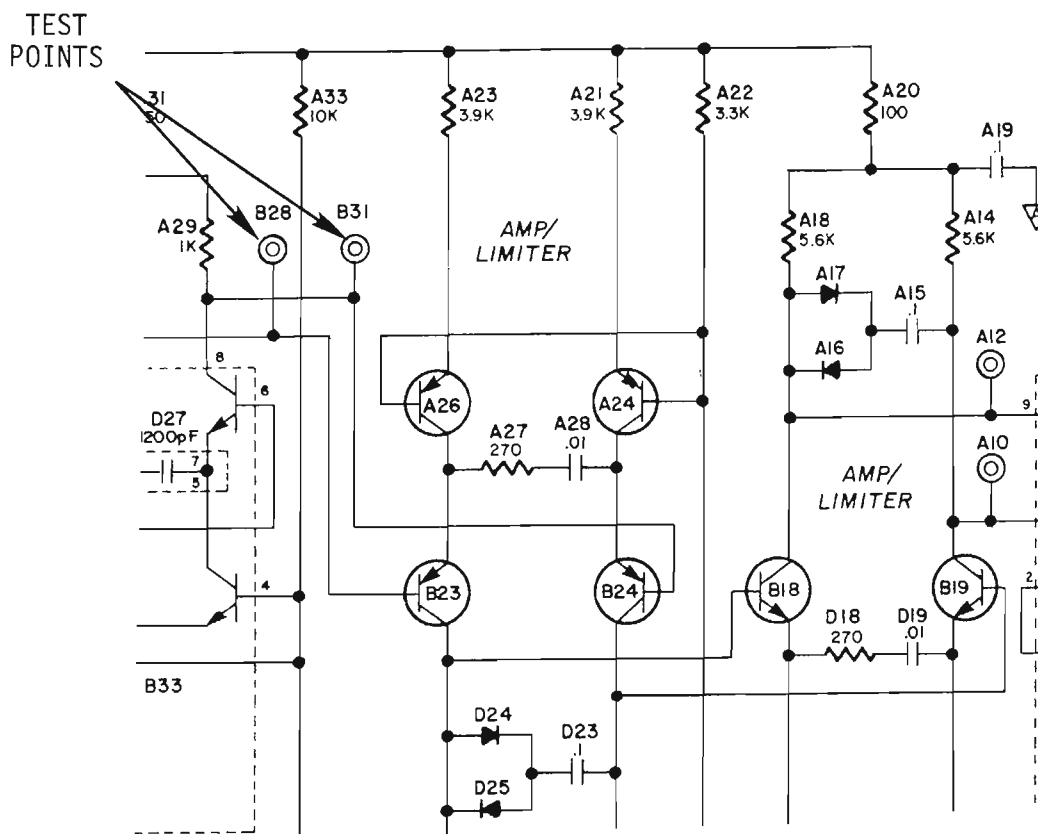


FIGURE 3 DATA TRANSFER BOARD #120143

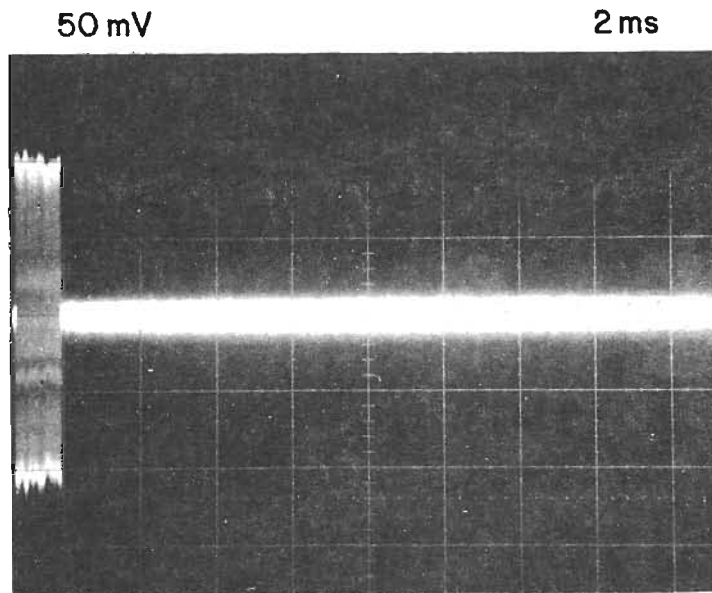
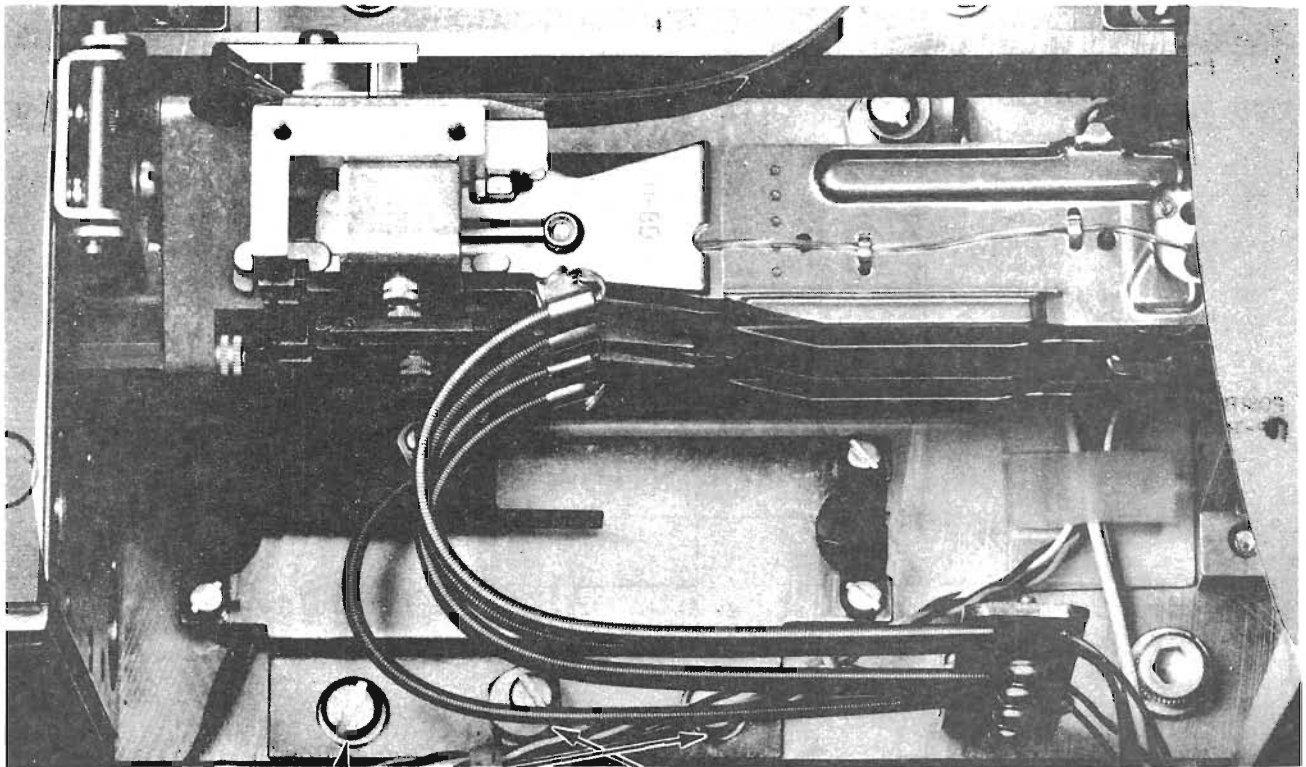


FIGURE 4 TRACK 10 DATA BURST

6. Set exerciser to perform a single seek to track 10. See the switch settings below. (If the Index Burst Pattern is seen at track 10, perform the Track 0 fine adjustment.)

TRK 8	ON	TA	ON
TRK 2	ON	ALL OTHERS	OFF

7. If the Index Burst Pattern is not found at track 10, seek to the tracks around 10 until the Index Burst Pattern is obtained, by altering the track address switch settings on the exerciser. See Figure 4.
8. Loosen the track zero assembly screws (Figure 5) slightly (approx. 1/4 turn).
9. Loosen the eccentric lock screw.
10. Note the track address where the burst is obtained, by checking the track address switches; then adjust the track zero eccentric accordingly. Refer to Figure 5.



TRACK 0 ASSEMBLY SECURING SCREWS

ECCENTRIC AND LOCK SCREW

FIGURE 5 TRACK 0 SENSOR ADJUSTMENT

Track Address less than 10 - turn eccentric clockwise

Track Address more than 10 - turn eccentric counterclockwise

11. Perform a RESTORE; then seek to track 10 again.
  
12. Repeat track searching and eccentric adjustment until scope display shows the Index Burst Pattern at track 10. Note that a restore and a seek to track 10 is required after each adjustment of the Track 0 Eccentric. When the burst pattern is obtained at track 10, do a Restore, and then re-seek track 10 to verify that the correct pattern is repeatedly obtainable at track 10.

## TRACK 0 FINE ADJUSTMENT PROCEDURE

The Track 0 fine adjustment procedure ensures that track 0 detenting occurs at the proper position on the Position Sawtooth Ramp. In this procedure, the position of Track 0 is adjusted to compensate for mechanical overshoot and temperature variations.

1. Connect the Channel 1 scope probe to P30-3 (TP P74 for Logic PCB's with artwork revision 12065-02) of the Logic PCB 12066 (over tracks output), and connect the Channel 2 probe to the Servo PCB, TP H72. With the oscilloscope in the chopped mode, change the trigger to Negative Internal Channel 1, with HF REJECT selected.
2. Establish a reference (ground) for servo T.P. H72 and adjust scope Channel 2 vertical sensitivity for 2 volts/cm.

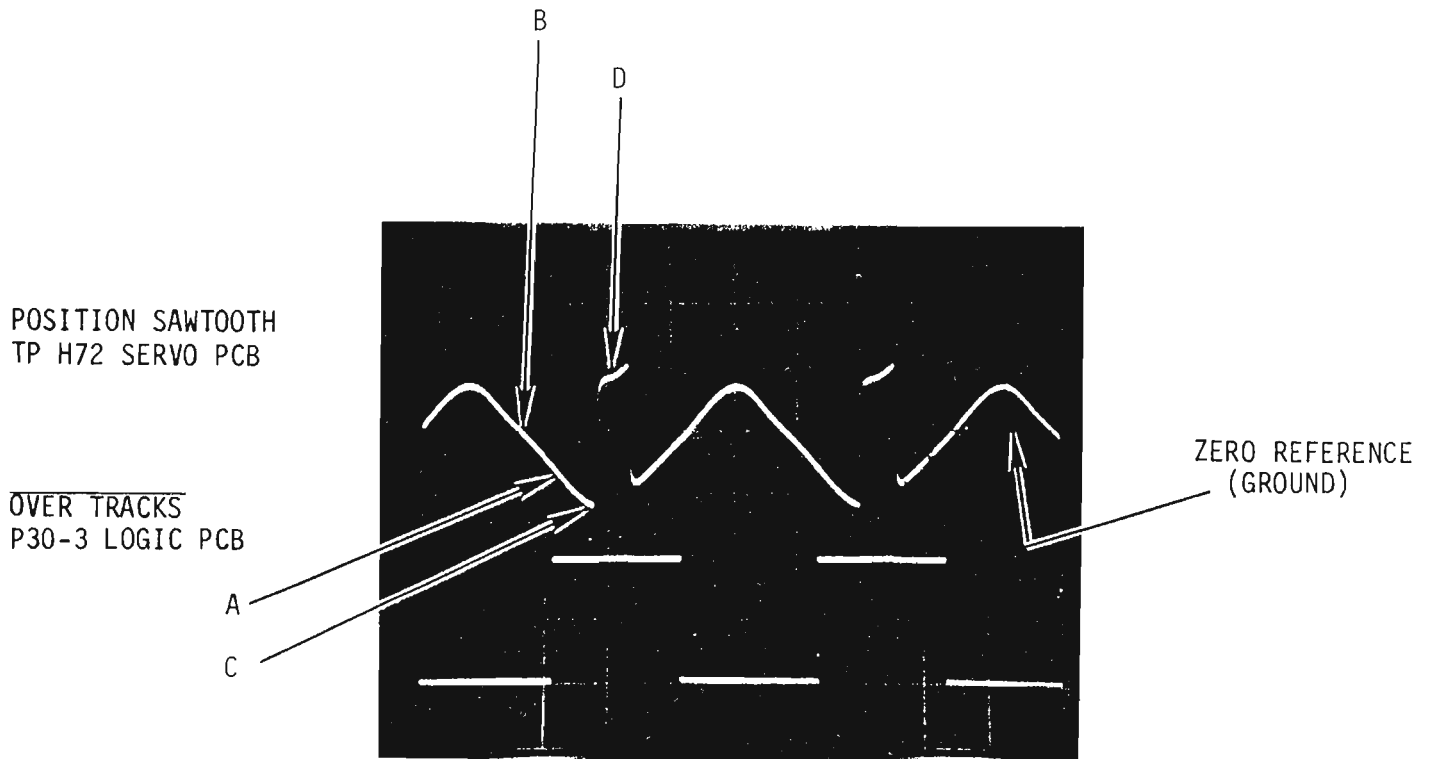



FIGURE 6 TRACK 0 SENSOR FINE ADJUSTMENT WAVESHAPES

3. Initiate a continuous RESTORE operation by turning the RST switch on the 7013 exerciser ON.
4. Adjust the position of the Track 0 sensor until P30-3 (TP P74 for 12065-01 artwork) switches high at point "A" in the Position Sawtooth waveshape as in Figure 6. Point "A" occurs at the vertical midpoint between points "B" (Reference point) and "C" (negative peak of Position Sawtooth waveshape). This may be seen more easily by superimposing the two waveshapes via readjustment of vertical position controls. When the adjustment is correct, pulse "D" will not exceed 1.5 ms in duration.
5. Secure Track 0 sensor bracket, reverify waveshape obtained in step 4, and then recheck the Index Burst Pattern on track 10 as explained in steps 2 through 12 of the coarse adjustment procedure.
6. Following track zero adjustment, check the R/W head alignment as per Section 4.3.2 of the Field Level Maintenance Guide.



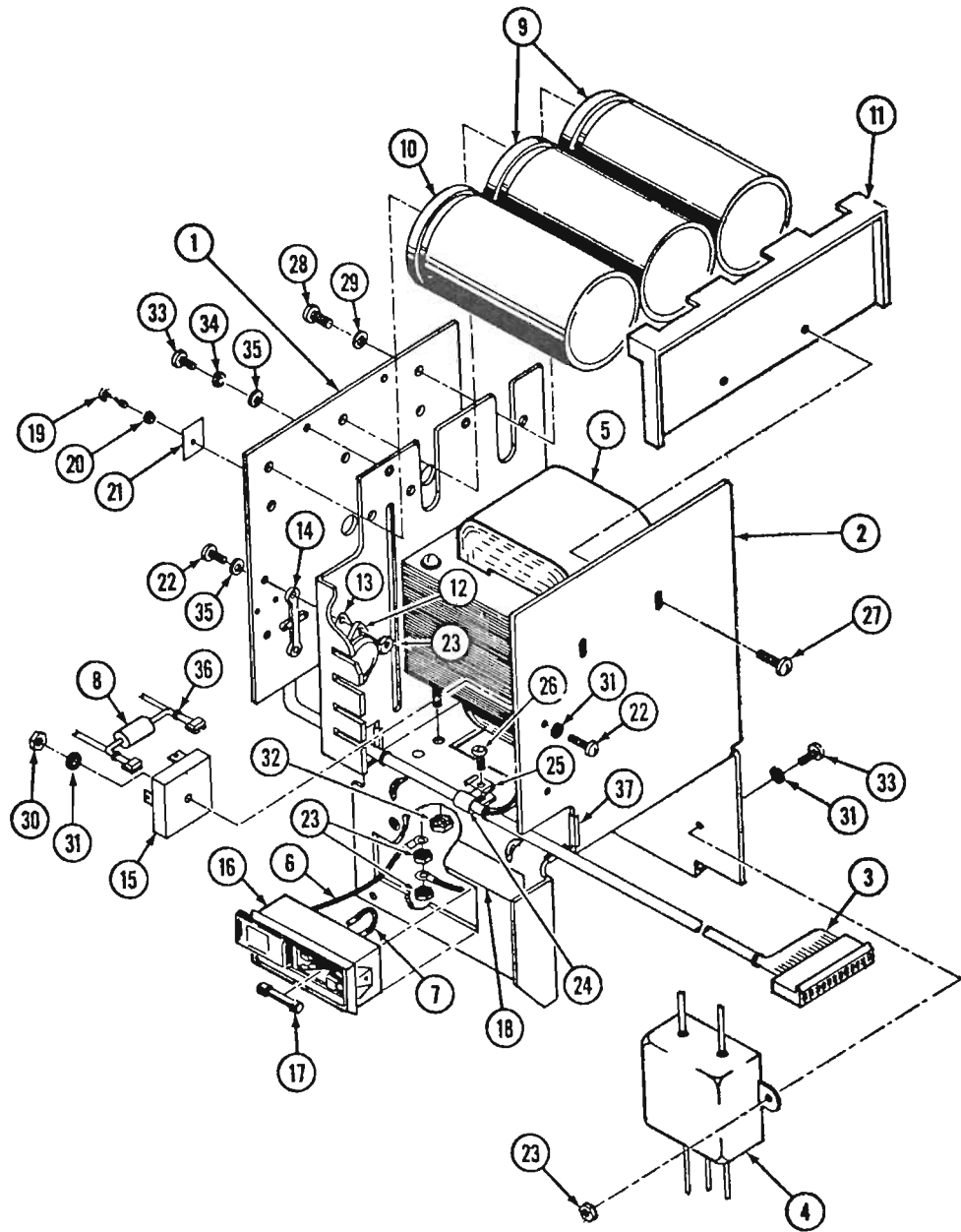
	<b>NO.</b> 174	<b>DATE:</b> 7/17/78
	<b>CATEGORY</b>	
	MASS STORAGE DEVICE #22	
<b>SUBJECT</b>		
NEW DIABLO 44B ASSEMBLIES		

DIABLO 44B DISK DRIVES - NEW ASSEMBLIES

1. A new Power Supply assembly, Diablo part #19240 (WL# 726-5250), has been installed in Diablo Model 44B disk drives, beginning with serial #5800. This assembly is interchangeable with previous versions of the Diablo power supply; however, the regulator board (Diablo #12045) on the new power supply is not interchangeable with the earlier version regulator board (Diablo #12035-02). In the new supply, the "AC OK" signal line has been connected directly to +5 volts, and the power on/off switch has been eliminated.
  
- b) Use the following summary of Diablo/Wang assembly numbers for cross-reference and ordering.

	Diablo #	Wang #
New Power Supply Assembly	19240	726-5250
Old Power Supply Assembly	19220/19033	726-0438
New Regulator Board	12045	726-5249
Old Regulator Board	12035-02	726-0434

2. A new Address Logic board, Diablo part #12152-XX (WL #726-5254), has been phased into production, and will be used in all Diablo 44B production units starting with Diablo serial #6535. This new assembly is interchangeable with the previous Address Logic board, Diablo #12101-XX (WL# 726-0431).




#19240-XXB POWER SUPPLY ASSEMBLY  
(see notes)

ITEM	PART NO.	DESCRIPTION
1	12045	Regulator PCB Assembly (see Section II.3a)
2	19237	Chassis, Power Supply
3	19245	Harness Assembly
4	19244	Line Filter Assembly
5	19243	Transformer Assembly
6	19136	Wire Assembly, Green
7	19274	Wire Assembly, Black
8	19273	Capacitor Assembly, 3uF 100V
9	100136-01	Capacitor, 28000uF 35V
10	100136-02	Capacitor, 42000uF 15V
11	19206	Clamp, Capacitor
12	10479-01	Transistor, NPN 2N6058
13	100025-02	Insulator, Transistor
14	19248	Spacer, Transistor TO-3
15	10162-01	Bridge Rectifier, 100V 30A
16	42653-01	Connector, Voltage Selecting and Fused
17	10962-10	Fuse, 2-1/2A 250V, Slow-Blow (Note 3)
	10745-03	Fuse, 5A 125V, Slow-Blow (Note 2)
18	19262	Label, Caution
19	70029-08	Screw, 4-40 X .500 P.H.
20	10914-01	Washer, Shoulder, Nylon
21	100025-06	Insulator, Semiconductor
22	70030-10	Screw, 6-32 X .625 P.H.
23	70701-06	Kepnut, 6-32
24	10535-24	Clip, Harness .375 Dia.
25	10537	Washer, "D"
26	70031-06	Screw, 8-32 X .375 P.H.
27	70031-10	Screw, 8-32 X .625 P.H.
28	70032-06	Screw, 10-32 X .375 P.H.
29	70169-10	Washer, Flat #10
30	70166-06	Nut, Hex, 6-32
31	70737-06	Lockwasher, External Tooth, #6
32	70701-08	Kepnut, 8-32
33	70030-06	Screw, 6-32 X .375 P.H.
34	70168-06	Lockwasher, #6
35	70179-06	Washer, Flat #6
36	10538-01	Strap, Cable Tie
37	70730-02	Grommet Strip (amount as required)

Notes:

- (1) Power Supply Assemblies:  
#19240-01 - 120VAC +10%/-15%  
#19240-02 - 220VAC +10%/-15%
- (2) Used on #19240-01 only.
- (3) Used on #19240-02 only.

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 178A	<b>DATE:</b> 11/8/78
	<b>CATEGORY</b> 2200/2600 #17A	
	<b>SUBJECT</b> 2260C DISK CONTROLLER INFORMATION	

3107

A. WL# 210-7486 HARDWARE CHANGES (Ref: Figures 1, 2, and 3)

Several mandatory ECNs that improve the design and operation of 2260C disk controllers are described below. These changes should be made on all WL# 210-7486 boards (E REV 0).

- 1) ECN #9392 - Add a 150 pf. capacitor (WL# 300-1150) between L14 pin 14 and + 0 v. L14-14 is the A=B line of the ALU. If this ECN is not implemented, intermittent format-read errors can occur. This ECN changes the 7486 E REV level from 0 to 1.
  
- 2) ECN #9462 - Change C1 from .01 uf. to .002 uf. (WL #300-1913). On R1 boards, this capacitor is located between L22 and L23; on R2 boards between L18 & L19. On the schematic diagram for the 7486 board, the capacitor can be found at coordinates 2F10 (Sheet 2, @ F10). Without this change, an intermittent error 61 (I92) may occur. This ECN changes the E REV from 1 to 2.
  
- 3) ECN #9628 - The cathode of diode D2 in the Write-Gate circuit should be attached to the junction of resistors R14 and R15, not the junction of resistors R15 and R17. Desolder and lift the cathode lead of D2 out, then connect it to the top of R14 (located next to D2). The top of R14 is connected to R15. (Ref: Figure 1)



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FIGURE 1

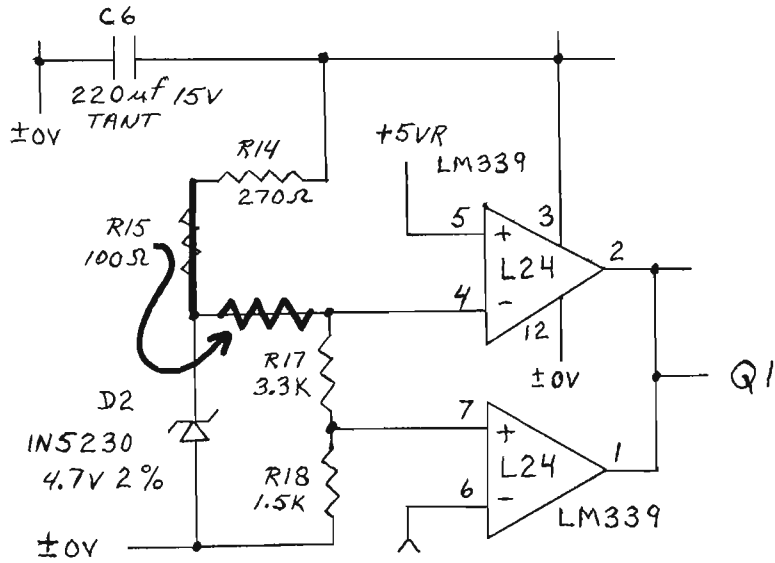


FIGURE 2

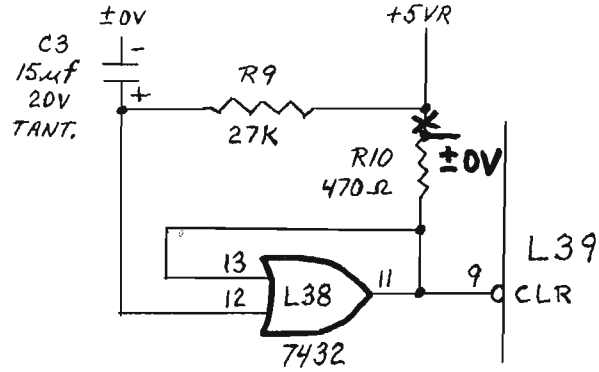
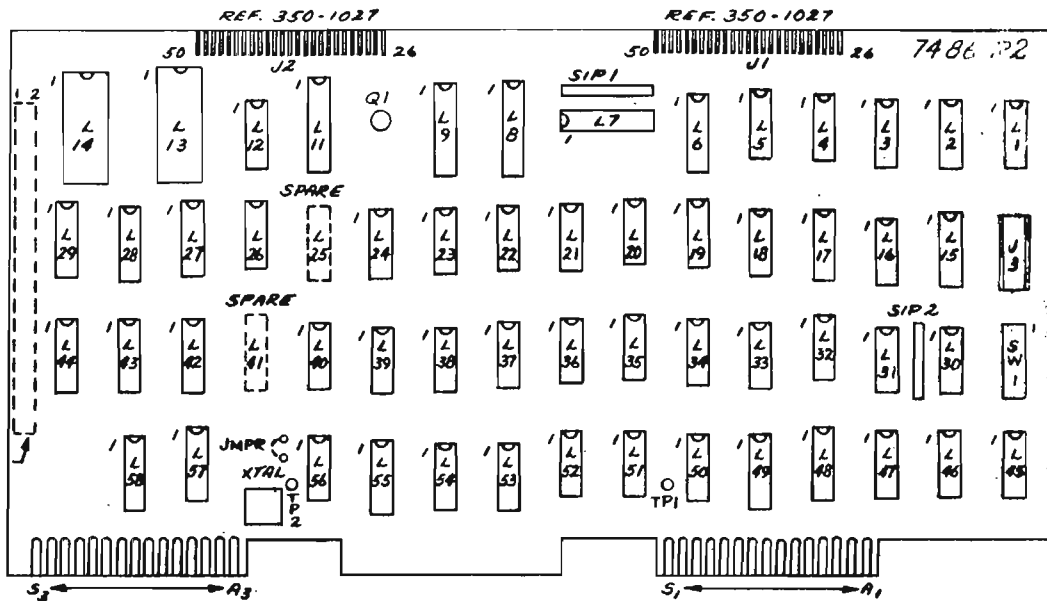


FIGURE 3  
7486 BOARD



Additionally, R10 (a 470-ohm resistor, located between L37 and L38) should be connected to + 0V, not +5VR. This resistor is part of the Clock Power-Up Clear circuit. (Ref: Figure 2).

Tie pin 2 of L6 to +5VR through a 2.2K resistor (WL# 330-3022-4B). Pin 2 is the preset input for the Word-Ready latch.

Cut the etches leading to L30, pins 1 and 2 only. Tie pins 1 and 2 to +0V. L30 is part of the Address Comparator circuit.

This ECN changes the 7486 E REV level from 2 to 3.

4. ECN #9257 - Resistor R14 in the Write-Gate circuit should be 270 ohms, not 390 ohms. There is no E REV change associated with this ECN. (Ref: Figure 1)

B. WL# 210-7488 HARDWARE CHANGES (Ref: Figures 4, 5, and 6)

- 1) ECN #9394 - Add a 150 pf capacitor (WL #300-1150) between L12 pin 14 and + 0 v. L12-14 is the A=B line of the ALU. If this ECN is not implemented, intermittent format-read errors can occur. There is no E REV change associated with this ECN.
- 2) ECN #9500 - Change C1 from .01 uf to .002 uf (WL #300-1913). On the schematic diagram for this board, the capacitor can be found at coordinates 2F10 (Sheet 2, @ F10). Without this change, intermittent error 61's (I92) may occur. This ECN changes the 7488 E REV level from 0 to 1.
- 3) ECN #9700 - The cathode of diode D2 in the Write-Gate circuit should be attached to the junction of resistors R11 and R12, not the junction of resistors R11 and R13. Desolder and lift the cathode lead of D2 out, then connect it to the top of R12 (located next to D2). The top of R12 is connected to R11. The schematic should be changed to reflect the update. (Ref: Figure 4)

FIGURE 4

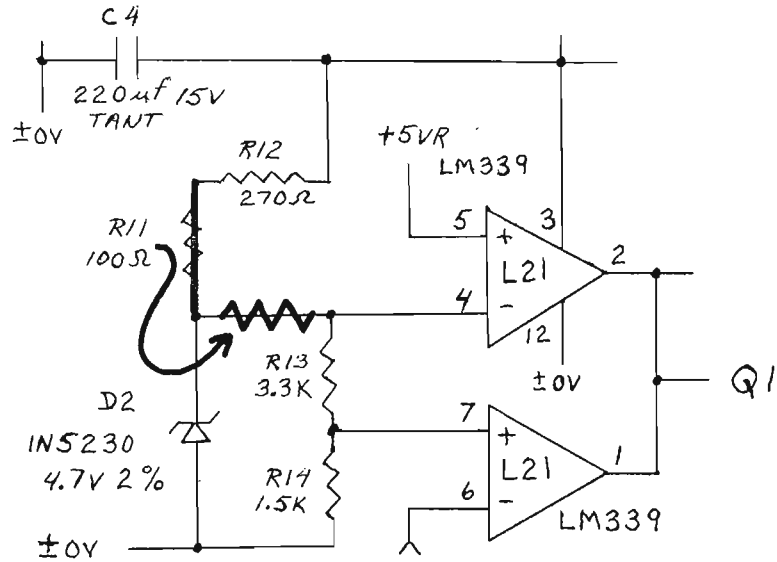
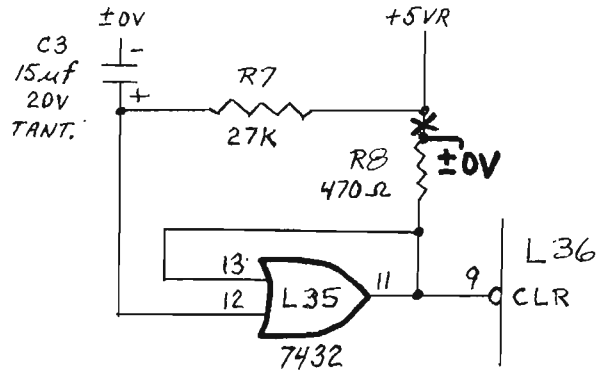


FIGURE 5



Additionally, R8 should be connected to +0V not +5VR. This resistor is part of the Clock Power-Up Clear circuit. (Ref: Figure 5)

Lift L5 pin 2 from its plate through, and then tie pin 2 to +5VR through a 2.2K resistor (WL# 330-3022-4B).

This ECN changes the 7488 E REV level from 1 to 2.

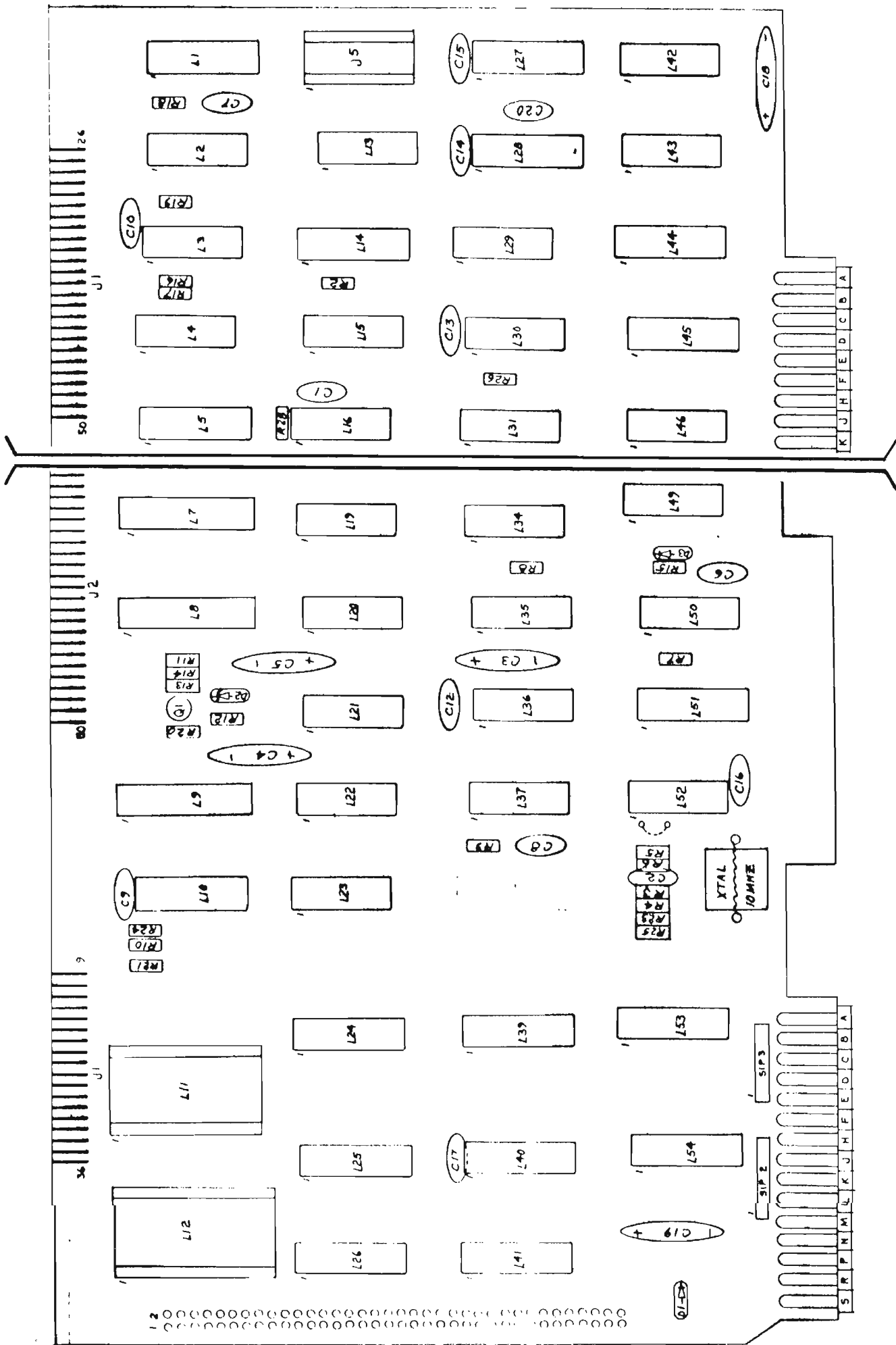


FIGURE 6 7488 BOARD




C. SOFTWARE CHANGES

ECN #9845 - The PROMS on the 7487 should be Revision 3 (R3). It is imperative that this update be incorporated as soon as possible. This ensures data compatibility between Diablo and CDC Hawk.

D. 2260/BC INSTALLATION WARNING

The ribbon cable that connects the daughter board to the Motherboard will interfere with the chassis fan if the controller is placed in any one of the four I/O slots in front of the fan. An I/O slot away from the fan should be chosen.

 <p><b>IMMEDIATE SERVICE NOTICE</b></p>	<b>NO.</b> 178A	DATE: 11/8/78
	<b>CATEGORY</b>	
	2200/2600 #17A	
<b>SUBJECT</b>		
2260C DISK CONTROLLER INFORMATION		

A. WL# 210-7486 HARDWARE CHANGES (Ref: Figures 1, 2, and 3)

Several mandatory ECNs that improve the design and operation of 2260C disk controllers are described below. These changes should be made on all WL# 210-7486 boards (E REV 0).

- 1) ECN #9392 - Add a 150 pf. capacitor (WL# 300-1150) between L14 pin 14 and + 0 v. L14-14 is the A=B line of the ALU. If this ECN is not implemented, intermittent format-read errors can occur. This ECN changes the 7486 E REV level from 0 to 1.
  
- 2) ECN #9462 - Change C1 from .01 uf. to .002 uf. (WL #300-1913). On R1 boards, this capacitor is located between L22 and L23; on R2 boards between L18 & L19. On the schematic diagram for the 7486 board, the capacitor can be found at coordinates 2F10 (Sheet 2, @ F10). Without this change, an intermittent error 61 (I92) may occur. This ECN changes the E REV from 1 to 2.
  
- 3) ECN #9628 - The cathode of diode D2 in the Write-Gate circuit should be attached to the junction of resistors R14 and R15, not the junction of resistors R15 and R17. Desolder and lift the cathode lead of D2 out, then connect it to the top of R14 (located next to D2). The top of R14 is connected to R15. (Ref: Figure 1)



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FIGURE 1

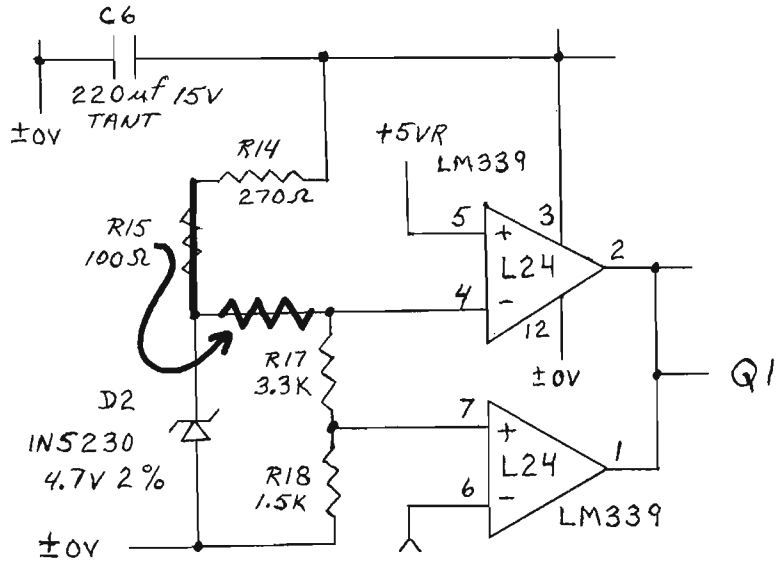


FIGURE 2

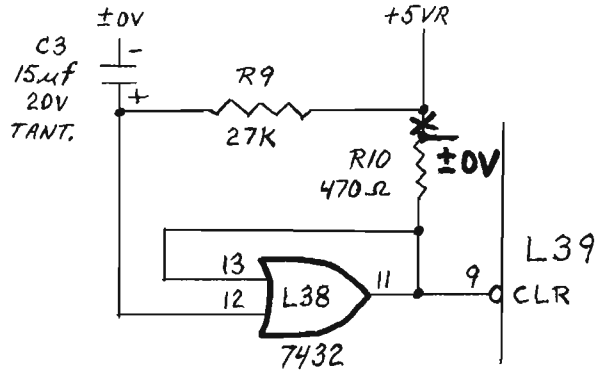
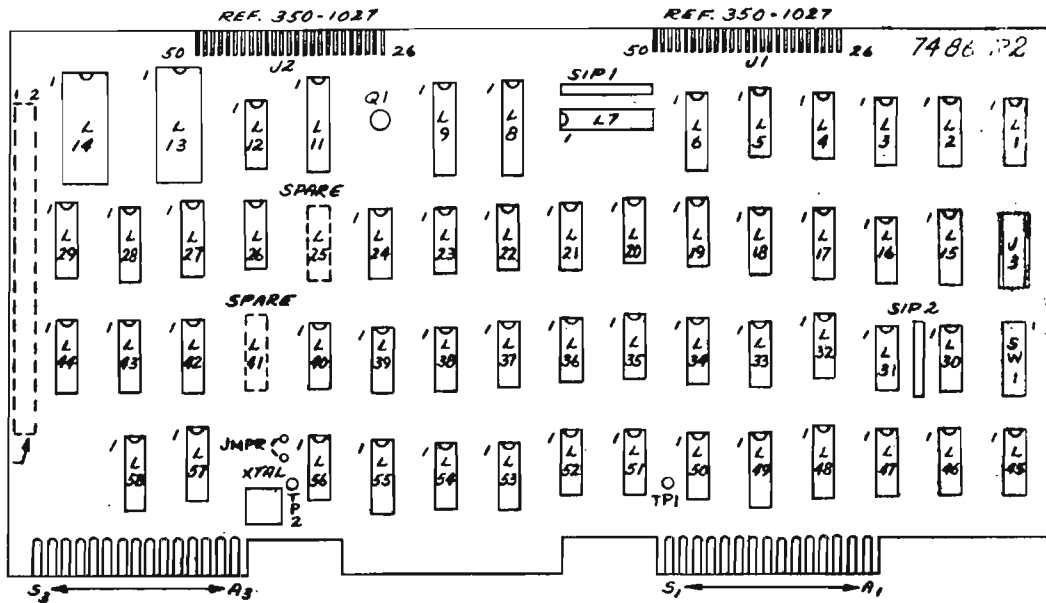


FIGURE 3  
7486 BOARD



Additionally, R10 (a 470-ohm resistor, located between L37 and L38) should be connected to + 0V, not +5VR. This resistor is part of the Clock Power-Up Clear circuit. (Ref: Figure 2).

Tie pin 2 of L6 to +5VR through a 2.2K resistor (WL# 330-3022-4B). Pin 2 is the preset input for the Word-Ready latch.

Cut the etches leading to L30, pins 1 and 2 only. Tie pins 1 and 2 to +0V. L30 is part of the Address Comparator circuit.

This ECN changes the 7486 E REV level from 2 to 3.

4. ECN #9257 - Resistor R14 in the Write-Gate circuit should be 270 ohms, not 390 ohms. There is no E REV change associated with this ECN. (Ref: Figure 1)

B. WL# 210-7488 HARDWARE CHANGES (Ref: Figures 4, 5, and 6)

- 1) ECN #9394 - Add a 150 pf capacitor (WL #300-1150) between L12 pin 14 and + 0 v. L12-14 is the A=B line of the ALU. If this ECN is not implemented, intermittent format-read errors can occur. There is no E REV change associated with this ECN.
- 2) ECN #9500 - Change C1 from .01 uf to .002 uf (WL #300-1913). On the schematic diagram for this board, the capacitor can be found at coordinates 2F10 (Sheet 2, @ F10). Without this change, intermittent error 61's (I92) may occur. This ECN changes the 7488 E REV level from 0 to 1.
- 3) ECN #9700 - The cathode of diode D2 in the Write-Gate circuit should be attached to the junction of resistors R11 and R12, not the junction of resistors R11 and R13. Desolder and lift the cathode lead of D2 out, then connect it to the top of R12 (located next to D2). The top of R12 is connected to R11. The schematic should be changed to reflect the update. (Ref: Figure 4)

FIGURE 4

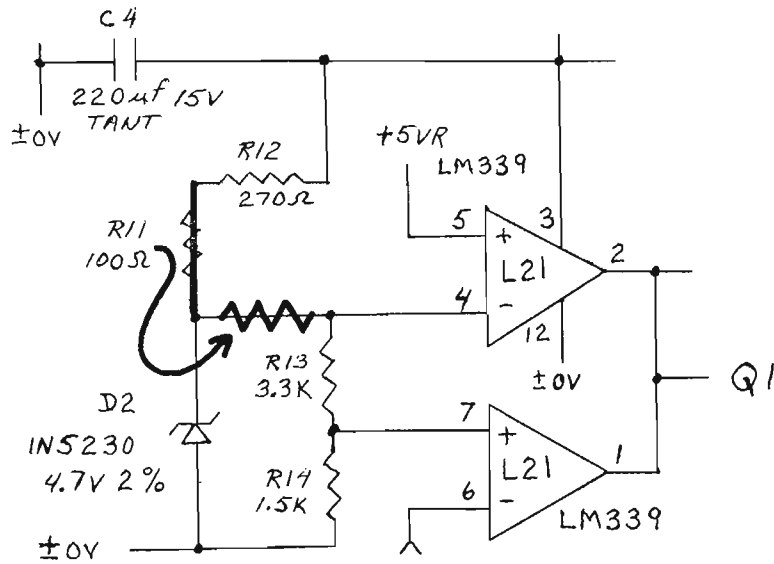
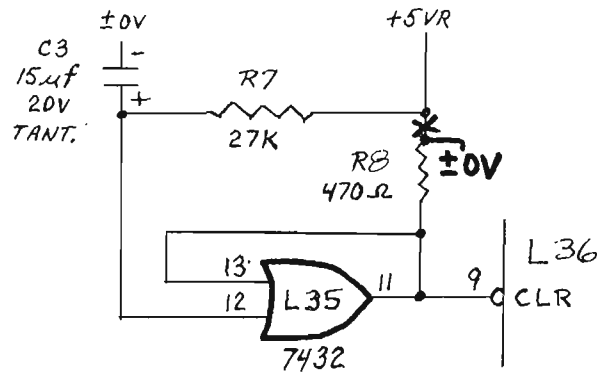


FIGURE 5



Additionally, R8 should be connected to ±0V not +5VR. This resistor is part of the Clock Power-Up Clear circuit. (Ref: Figure 5)

Lift L5 pin 2 from its plate through, and then tie pin 2 to +5VR through a 2.2K resistor (WL# 330-3022-4B).

This ECN changes the 7488 E REV level from 1 to 2.

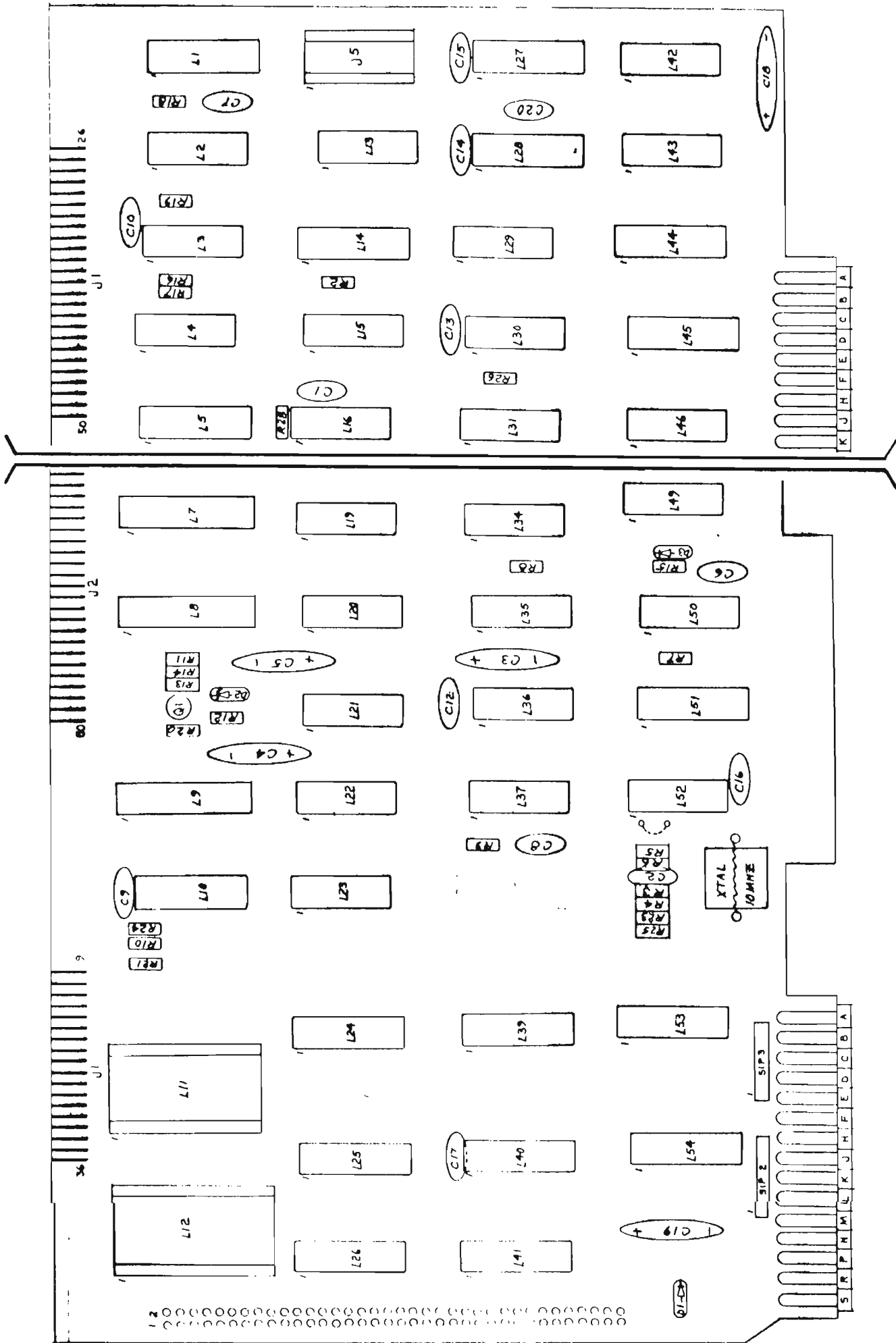


FIGURE 6 7488 BOARD

C. SOFTWARE CHANGES

ECN #9845 - The PROMS on the 7487 should be Revision 3 (R3). It is imperative that this update be incorporated as soon as possible. This ensures data compatibility between Diablo and CDC Hawk.

D. 2260/BC INSTALLATION WARNING

The ribbon cable that connects the daughter board to the Motherboard will interfere with the chassis fan if the controller is placed in any one of the four I/O slots in front of the fan. An I/O slot away from the fan should be chosen.

# Service Newsletter

No. 125

September 5, 1978

MASS STORAGE DEVICES #17

3107

## CORRECT OPERATION OF DIABLO SERIES 40 LOAD/RUN SWITCH

The procedure for operating the LOAD/RUN switch at power on is not sufficiently explained in the FLMG for Diablo Series 40 Disk Drives, or the Disk Reference Manual. This may or may not have been the cause of problems in the past, depending on the procedure used to power up the drives.

The two manuals state that if the LOAD indicator is off the cartridge retainers cannot be opened. If a cartridge is to be inserted at power on, there is no problem. You have to wait for the LOAD light. However, if the cartridge does not have to be changed, problems may arise because the manuals fail to mention that the operator should wait for the LOAD lamp to come on within 60 seconds after applying power. This should not cause any operating problems with a Model 43 or Model 44A because the LOAD lamp should come on immediately after power on. This is not exactly the case with the Model 44B due to a 22 second delay in activating the LOAD indicator. The operator may assume that the drive is operating correctly and decide not to wait the 22 seconds for the LOAD lamp to come on. This is where a problem occurs! If the drive is placed into RUN mode before the LOAD lamp comes on, the brush cycle is not initiated. If this practice is continued long enough, head crashes will occur. **WAIT FOR THE LOAD LAMP!**

All customers should be notified of this on a next call basis.

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# Service Newsletter

NO. 127

2200/2600 #27

September 25, 1978

2260C DISK CABLE

3107

There are three cables now being used in 2260C disk systems. One cable, WL# 220-0188, is used in a single-disk-drive system. For 2260C-2, the I/O-to-disk cable is a WL# 220-0169, and the inter-disk cable is a WL# 220-0151. Two versions of each cable now exist.

The earlier versions of these cables were used for 2260V disk interconnections (for 2200VS systems). Each cable was then modified to accommodate the 2260C, as well. By adding one additional signal wire (INDEX MARK) to the earlier version cables, an updated version of each cable was created that could be used for both 2200VS and standard 2200 applications. All cables presently being manufactured have INDEX MARK wired.

The easiest way to determine which version of cables WL# 220-0188 and WL# 220-0169 you have, is to check with a multimeter for continuity between pin 50 and pin Y of cable #1 on the Terminator board. If, in either cable, continuity exists between those two points, that cable is either the most recent manufacturing version, or has already been updated by Customer Engineering.

For 220-0151 cables, check for continuity between pin Y of either connector and ground. If continuity exists, it is the earlier version, non-updated.

Since the 2260 C needs INDEX MARK to operate, non-updated versions of any of the above cables cannot be used on a 2260 C. INDEX MARK must be wired in.

Early versions of the 220-0188 and 220-0169 cables can be modified to include INDEX MARK by adding jumper wires between the points described above.

Earlier versions of the 220-0151 cable cannot be modified because all unused wires are bussed to ground.

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# Service Newsletter

NO. 143

2200/2600 #30

12/7/78

## 2260C/BC DISK CABLE PROBLEM

The most common version of the disk-to-2260C/BC controller cable assembly (WL# 220-0188) has two coaxially-shielded cables. In many instances, the shielding is not trimmed cleanly, and if this is the case, the frayed shield-ends extend beyond the insulating jacket-ends of each cable (at the terminator board end of the cables). If the cable assembly is not positioned correctly, or if it is moved (improper strain relief), the frayed shielding can intermittently short out on the 210-7480 terminator board. The problems caused by this are rather difficult to locate and correct, due to the intermittent symptoms of failure.

To prevent a cable failure of this type, first add a tie-wrap around both cables in the assembly, two inches back from the terminator board end of the outer insulating jacket. Next, trim any frayed shielding at the jacket-ends, and then wrap the exposed area with electrical tape. Finally, add a second tie-wrap around the loose wires, above the area just taped (i.e., between the end of the insulating jacket and the 7480 terminator board); this will prevent movement of individual cable assembly wires. Do not position the latter tie too close to the terminator board, to prevent excessive strain on the cable wire connections to the terminator board.

Collectively, the above steps will keep the end of the cable secure and trouble free.

This modification should be performed on a next-call basis, for any 2260C/BC unit.

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# Service Newsletter

NO. 153A

July 17, 1979

NOTE: THIS NEWSLETTER VOIDS SERVICE NEWSLETTER NO. 153.

## MASS STORAGE DEVICES #28A DIABLO 44B NEW GUIDE SHAFT SUPPORT

A problem has arisen with the new (silver in color) Diablo Head Positioner Assembly (WLI #726-5253, Diablo #19300). It has been found that a forward head slam, which may occur as the result of a seek error, may cause the Guide Shaft Support to become misaligned. Because the Guide Shaft Support also holds the Head Load Ramp (Cam), misalignment of the Guide Shaft Support may result in possible format errors and/or an inability to access the first few tracks on the disk (the exact number depends on the extent of misalignment). To prevent this problem, a new, strong front crash stop (WLI #726-5317, Diablo #41621) is now being installed at the production level in all new Diablo head positioners.

In the field, if the Guide Shaft Support does become misaligned, remove the disk pack from the drive and gently tap the Guide Shaft Support towards the rear of the drive.

Once the Guide Shaft Support has been aligned, install the new forward crash stop (WLI #726-5317, Diablo #41621) to prevent the problem from reoccurring.

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**WANG**

LABORATORIES, INC.

BA #41

## MEMORANDUM

TO: ALL EASTERN AREA SERVICE OFFICES

FROM: SCOTT TAGEN

SUBJECT: 44B TRACK ZERO WITH NEW LOGIC BOARD

DATE: MARCH 28, 1977

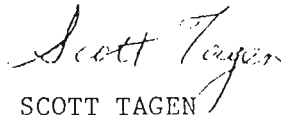
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The current revision level of Logic Board 12066 should be XDS. The last update was described in I.S.N. #131, which is currently being implemented. Diablo has issued a new 12066 Rev. XDS with a slightly different foil pattern. This board can be differentiated from the old style by a group of seven test points near the top center. The test points are as follows:

E74 Upper Index/Sector marks  
E75 Lower Index marks  
E76 Upper Index marks only when using alignment cartridge and switch #1 turned on  
E77 Upper Transducer Output  
F74 Lower Transducer Output  
F75 Over Tracks signal at P30-4 (The schematic in the 44B manual erroneously lists this as Upper Index marks)  
F76 Phase 2 of Spindle Drive

Using this board it is now possible to do a 44B Track Zero adjustment without having to solder wires to P30-3 and pin 14. Use channel 1 for test point H72 of Servo Board as usual. Use channel 2 to monitor test point F75 of Logic Board. You must invert channel 2. Trigger the scope off channel 2 also. The rest of the procedure is the same. You will probably find this new board shipped with newer 44B drives. You still have to obtain -5 volts from the Servo board to power the Exerciser.

Regards,



SCOTT TAGEN  
EASTERN AREA TECHNICAL SPECIALIST

ST/mf

cc: Dick Nichols  
Mike Whalen  
Tom Pickett  
James Dean  
Paul Pockoski

DIABLO (44B) ADJUSTMENTS

SIGNAL

-5v: To operater amplifier of 7013 excercizer  
Servo P.C.B. (12068 and 12099 up to Rev. XDG) - Junction M31  
and M33 (E)  
Servo P.C.B. (12099 - Rev. XDG) - Location H26, pins 7 and 9

UPPER INDEX:

Logic P.C.B. (12065 artwork) - TP - F75  
\* Logic P.C.B. (12065-01 artwork) - TP - E76  
Note: Switch 1 at Location B70 must be on  
~~12140 TP 7~~

POSITION SAWTOOTH:

Servo P.C.B. (12068 and 12099 up to Rev. XDG) - TP - H72  
Servo P.C.B. (12099 - Rev. XDG) - TP - H76

OVER TRACKS:

Logic P.C.B. (12065 artwork) - Location P30-3  
Logic P.C.B. (12065-01 artwork) - TP - F75 (Invert)  
Logic P.C.B. (12065-02 artwork) - TP - P74  
LOGIC P.C.B. 12140 TP P74

TRACK ZERO COURSE ADJUSTMENT

Set scope as follows:

- Main Time Base
- Mode - Normal
- Coupling - DC
- Source - Channel 2
- Time Base - 2ms/cm
- Vertical Amplifiers
- Display Mode - Channel 1
- Trigger Source - Upper Index
- Vertical Deflection - 50 mv/cm using a 10X probe
- Channel 1 - AC - TP1 on 7013 Exercizer
- Channel 2 - DC - Upper Index

CH. 1 - TP 1 EXERCIZER  
0.2V/CM  
1 MILLISEC/CM  
AUTO TRIGGER  
ADJ. TRACK 0 ECCENTRIC  
E.A. TIME MOVES ECCENTRIC DO  
RESTORE TO CHECK

1. Connect 44B head cable connector to 7013 Exercizer connector .
2. Connect cable 2 of 7013 to -5v.
3. Seek track 10.

IF DATA BURST ON < TRACK 10 MOVE TRACK 0 ASSY  
TOWARDS REAR OF UNIT

TRACK 10 SHOULD HAVE LARGER DATA BURST THAN TRK 9 or 11.

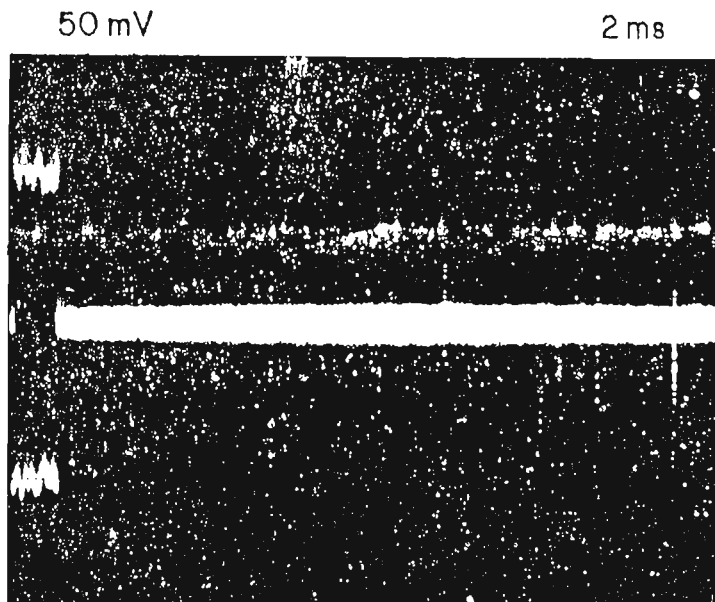


FIGURE 4-5 TRACK 10 DATA BURST

TRACK ZERO FINE ADJUSTMENT

Channel 1 - DC - Position Sawtooth (establish ground reference) -2v/cm

Channel 2 - DC - Over Tracks

Trigger - Channel 2, negative

Display mode - chopped

1. Continuous Restore On 7013.
2. Point A is vertical midpoint of points B and C. Pulse D is approx. 1.5ms.

-5V DISCONNECTED

1 VOLT/CM

1 MILLI SEC./CM

CHOP MODE

ADJ. TRACK 0 ASS'Y ECCENTRIC

NEW STYLE TRK  $\phi$  ADJ.

2.4 - 2.9 VDC

LOGIC BRD

12177 12176 E17

12141 12140 F75

12066-XX 12065-01 F75

12066 12065 K75

POSITION SAWTOOTH - SERVO 12068-12099 XDF TP H72

12099 XDC TP H76

OVER TRACKS - LOGIC 12065 LOCATION P30-3

12065-1 TP F75 (INVERT)

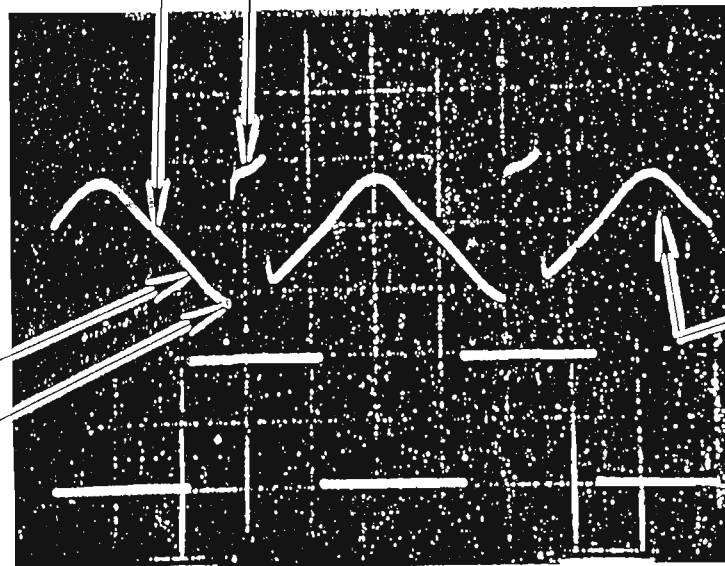
12065-2 & 12140 TP P74

POSITION SAWTOOTH  
TP H72 SERVO PCB

OVER TRACKS  
P30-3 LOGIC PCB

A

C



B ZERO REFERENCE (GROUND)

FIGURE 4-7 TRACK 0 SENSOR FINE ADJUSTMENT WAVESHAPES

HEAD ALIGNMENT

Channel 2 - AC - Invert - TP1 of 7013

Trigger - Channel 2, negative

1. Connect cable 1 of 7013 to each upper disk head cable.
2. Connect cable 2 of 7013 to -5v.
3. Seek Track 146.

CH 1 - TP 1  
0.2V/CM  
2  $\mu$ SEC/CM  
NEG. TRIGGER

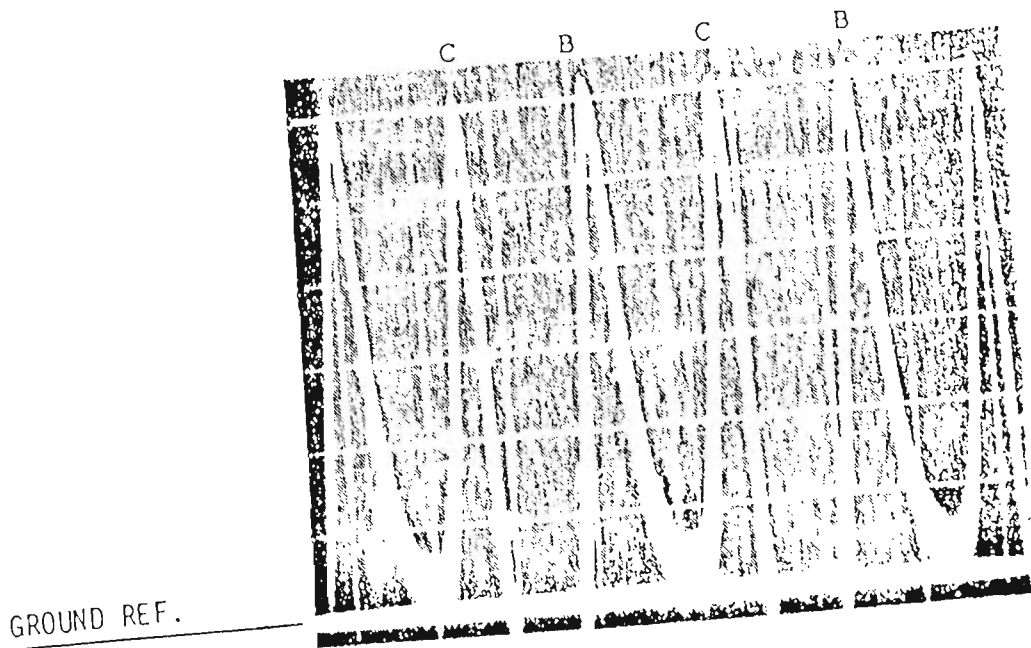


FIGURE 4-8 HEADS ALIGNED

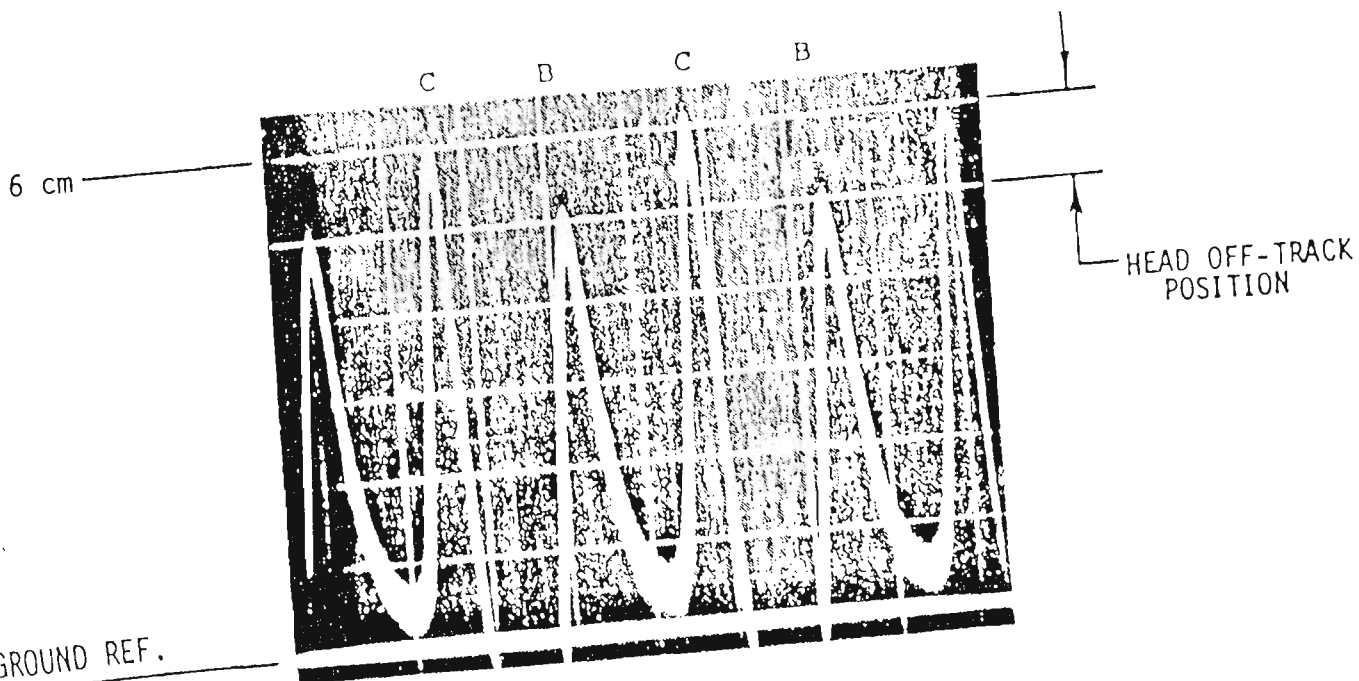


FIGURE 4-9 MEASURING HEAD OFF-TRACK DISTANCE



INDEX TRANSDUCER ALIGNMENT

CH 1 - UPPER INDEX  
2V/cm  
CH 2 - TP 1  
.2V/cm  
SYNC - CH 1 NEG  
DUAL TRACE

Channel 1 - AC - TP1 of 7013  
Channel 2 - DC - Upper Index  
Trigger - Channel 2, negative  
Display mode - Channel 1

1. Connect cable 1 of 7013 to each upper disk head cable.
2. Connect cable 2 to -5v.
3. Seek Track 10.

SW1 AT B70 MUST BE ON

CH. 1 - TP 1  
.2V/cm

SYNC - UPPER INDEX  
EXT NEG. Norm.  
5  $\mu$ SEC./CM

UPPER INDEX - LOGIC	12065	TP F75
	12065-1	TP E76

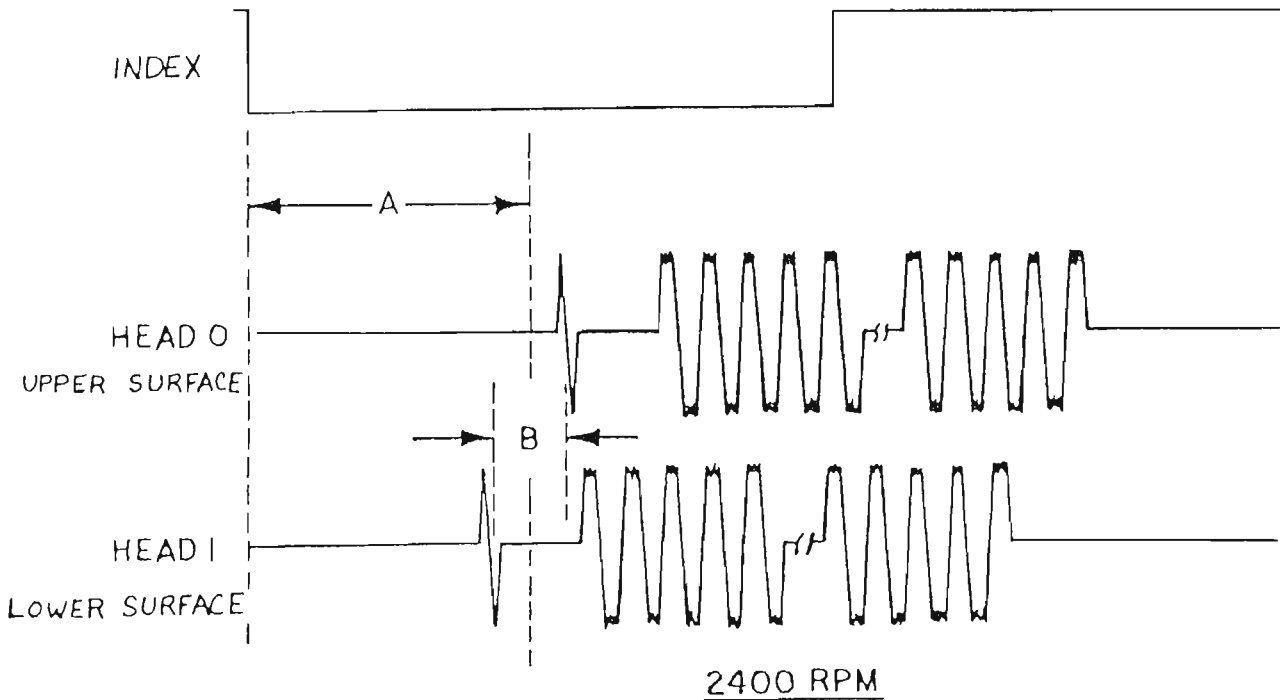


FIGURE 4-15 INDEX TRANSDUCER ALIGNMENT TIMING REQUIREMENTS

A = 19  $\mu$ s  
B = 6.2  $\mu$ s max.

# HEAD POSITION AZIMUTH ADJUSTMENT

Channel 1 - AC - TP1 of 7013

Channel 2 - DC - Upper Index

Trigger - Channel 2, negative

Display Mode - Channel 1

1. Connect cable 1 of 7013 to upper disk head cable.
2. Connect calbe 2 to -5v.
3. Seek Tracks 10 and 402.

SAME AS INDEX EXCEPT FOR TRACK ADDR.

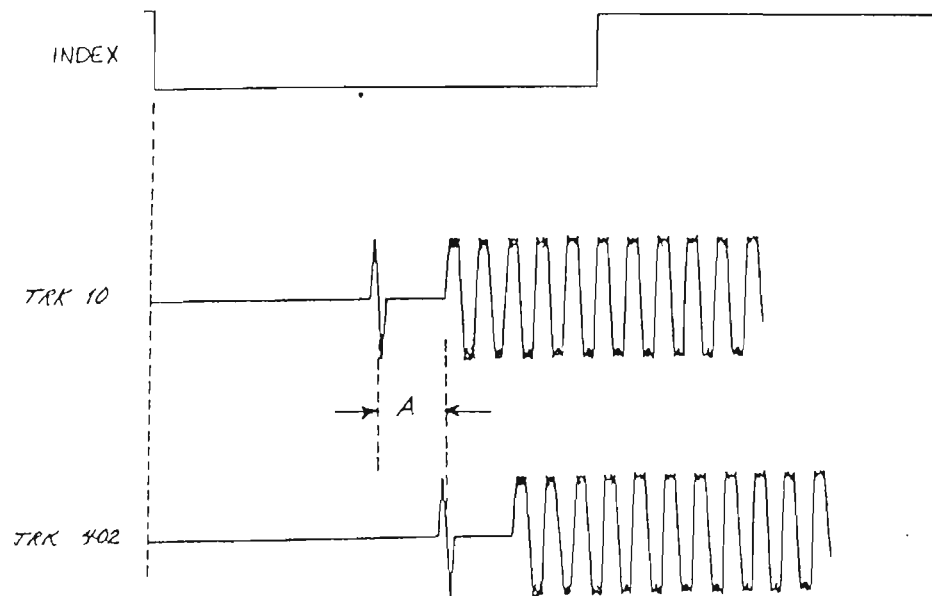


FIGURE 4-16 POINT "A" CANNOT EXCEED 6 USEC

# Field Service Aid

No. 28B

April 2, 1979

TO: Model 44B Disk Drive Customers

FROM: Diablo Customer Service

SUBJECT: Revised Track Zero Adjustment Procedure

This FSA #28B supersedes FSA #28A dated April 11, 1978.

Attached is a revised Track Zero Check and Adjustment Procedure. This procedure is included in a revision to the Model 44B Maintenance Manual, Publication No. 81903-02, due for release in the near future.

The level of the set up voltage has been raised to compensate for the thermal characteristics of the disk drive. Satisfactory results can be expected from units whenever the track zero voltage is found within the newly called out band of 2.4VDC to 2.9VDC.

This band should eliminate much unnecessary adjustment required in the past. The new set up points were selected so that the unit will stay within the new band, and therefore, proper alignment throughout the total operating temperature range of the disk drive.

To insure proper drive operation, Track Zero and R/W Head Alignment should be checked and adjusted, if required, prior to initial unit check out.



Paul Miller, Manager  
Customer Service Publications

kc

### 5.6.4.3 Track Ø Check and Adjustment

#### Precautions

Replacement of Servo or Logic PCB Assemblies requires that Track Ø and R/W Head Alignment be rechecked.

Do not lean or place objects on the disk drive while taking readings for Track Ø check and adjustment. Any such unusual forces will slightly bow the base plate and cause erroneous adjustment.

Track Ø check and adjustment should be performed only after the disk drive is installed in its intended operating location (rack or desk top).

The Track Ø sensor is affected by ambient light, especially the red wavelengths. Maintain a low level of daylight and incandescent light during Track Ø adjustment. Reasonable levels of fluorescent light are acceptable.

#### Check and Adjustment Procedure

Track Ø check and adjustment requires the use of an alignment cartridge, exerciser, oscilloscope and digital voltmeter.

1. Set exerciser WRITE switch to OFF position to prevent writing on alignment cartridge.
2. Set scope as follows:

##### Main Trigger Amplifier

Mode - AUTO  
Coupling - DC  
Trigger Source - INTERNAL (INT)  
Trigger Slope - NEGATIVE (-)  
Time Base - 2ms/Div

##### Vertical Amplifier

Trigger Source - CH 1  
Display Mode - CH 2  
CH 1 - 2V/Div  
CH 2 - 50mV/Div (AC coupled)

3. Set SW 1 on Logic PCB to ON position ("INDEX ONLY").
4. Connect CH 1 scope probe to UPPER INDEX at TP-E76. (With Logic PCB etch 12065, use TP-F75).
5. Connect CH 2 scope probe to DIFFERENTIATED DATA signal on the Data Transfer PCB as follows:

<u>Assy. No.</u>	<u>Test Point</u>
12046	A33
12121-XX	B32
12143-XX	B31

6. Install alignment cartridge and set Load/Run switch to RUN. Allow 15 minutes for drive and cartridge to thermally stabilize.
7. Using the exerciser, seek to Track 10 and monitor the upper head on the scope display for an "Index to Data Burst" signal similar to that shown in Figure-1.
8. If the burst pattern does appear at Track 10, proceed directly to step 14 and continue.  
If the burst pattern does not appear at Track 10, loosen both Track  $\emptyset$  assembly securing screws 1/8 turn and eccentric lock screw 1/4 turn (see Figure-2). Continue the coarse adjustment beginning with step 9.
9. Adjust upper disk R/W heads for .015 (.4mm) gap, as shown in Figure-3.
10. Turn eccentric nut until the Track  $\emptyset$  assembly is at its rearmost position.
11. Using the exerciser, perform successive cycles of Track 10 Seek and Restore operations while turning the Track  $\emptyset$  eccentric counter-clockwise. Examine the scope display for an "Index to Data Burst" signal similar to that shown in Figure-1. Stop when the waveform appears.
12. Tighten both Track  $\emptyset$  assembly securing screws. Care should be taken to avoid disturbing the assembly position.
13. Restore and seek to Track 10 to verify that the position was not disturbed, then tighten the eccentric lock screw.

NOTE: Initially it will be found that the scope display is easier to interpret by stepping the exerciser through each seek and restore cycle one step at a time. After gaining experience, the exerciser can be set for continuous 10-track seek and restore operations while making the adjustment.

14. Using the exerciser, restore the heads to Track  $\emptyset$ .
15. Set up the digital voltmeter to read up to 3VDC.
16. Measure the voltage between test point F75 on the Logic PCB assembly and ground. A reading of +2.4 to +2.9VDC indicates that Track  $\emptyset$  is properly adjusted; proceed directly to R/W head alignment. If a reading within this band is not obtained, continue with step 17.
17. Loosen the Track  $\emptyset$  assembly securing screws and the eccentric lock screw.
18. Adjust the Track  $\emptyset$  assembly eccentric nut for a reading of 2.8VDC + .1V on the DVM.

NOTE: If the unit is exceptionally warm (such as after a long testing period) this set up voltage should be 2.7VDC + .1V.

19. Retighten the Track 0 assembly securing screws and the eccentric lock screw.
20. Seek to Track 10 using the exerciser and recheck that the burst pattern is present.
21. Issue a Restore command and verify that the DVM reading is within the band of 2.4 to 2.9VDC.
22. Proceed to R/W Head Alignment.

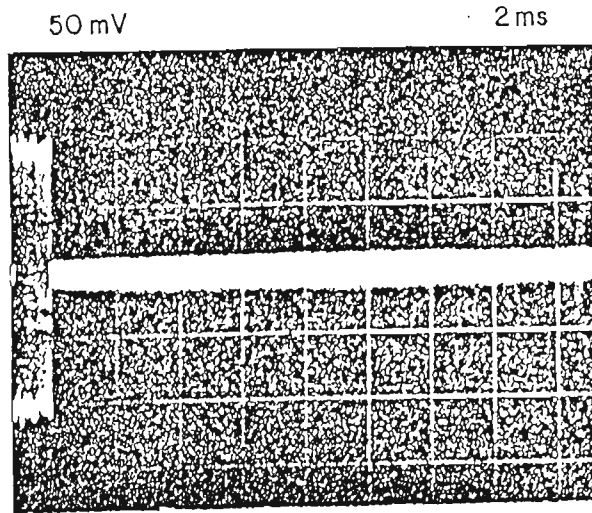


Figure-1

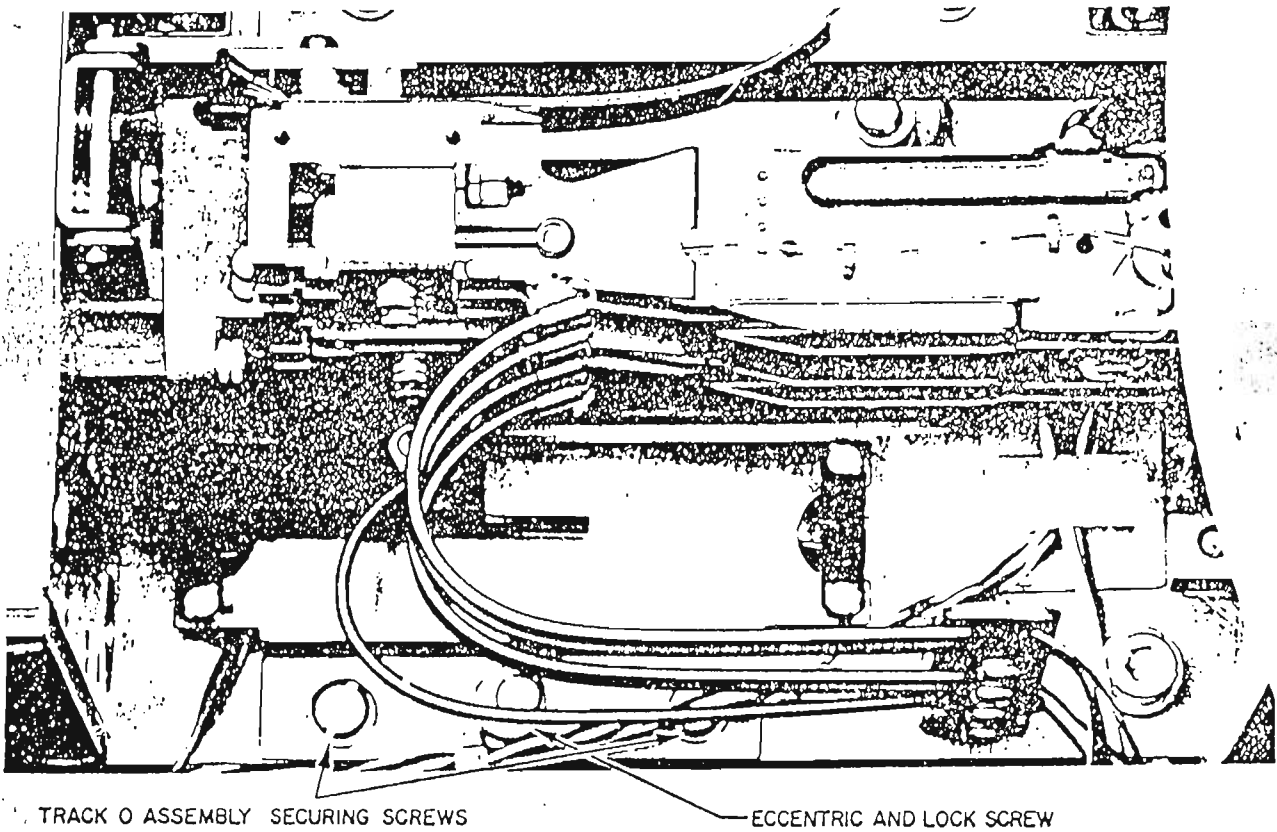


Figure-2

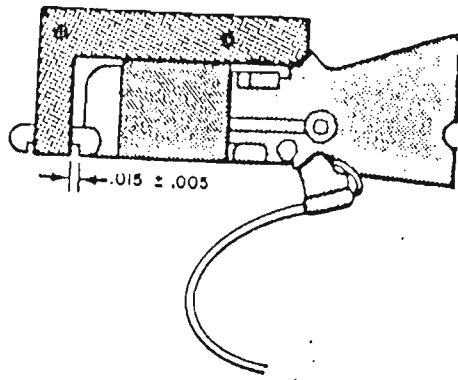
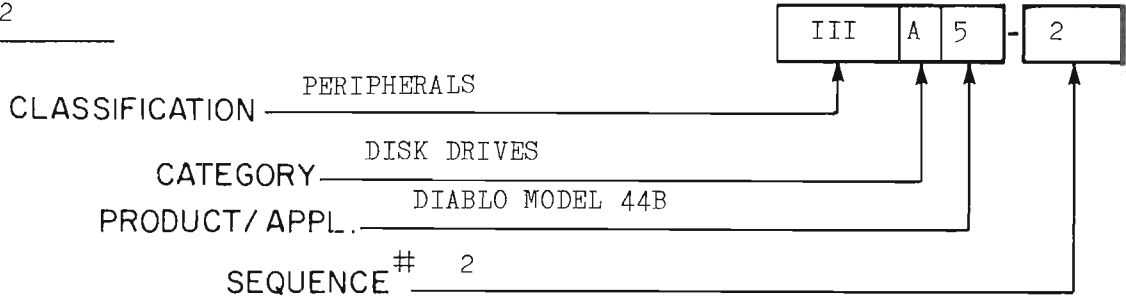


Figure-3

# PRODUCT SERVICE NOTICE

DATE : 04/08/82



TITLE:

DIABLO TRACK ZERO ADJUSTMENT

SCOPE

This PSN provides a corrected step-by-step track zero adjustment procedure for the Diablo 44B Disk Drives.

AFFECTED DOCUMENTATION

The procedure contained in this PSN supersedes those presented in the following documents:

- a. Diablo Series 40 Disk Drives Preliminary Field Level Maintenance Guide 03-0057 (III.A.4), Section 4.3.1
- b. Word Processing Newsletter No.10 (V.A.2), pages 20 through 26

In addition, the following track-zero adjustment related publications should be discarded:

- a. Service Newsletter No.165 (III.A.5)
- b. Intermediate Service Notice No.137 (III.A.5)
- c. Intermediate Service Notice No.164 (III.A.5)





CAUTIONS

The following Cautions must be observed when performing the Diablo Track-Zero adjustments:

Replacement of the Servo or Logic printed circuit boards (PCB's) requires rechecking track-zero and read/write head alignment.

Do not lean or place heavy objects on the disk drive while performing the track-zero adjustment. Any excessive force/weight will slightly bow the base plate and cause erroneous adjustments.

The track-zero adjustment must be performed only after the disk drive has been installed in its intended operating location.

The track-zero sensor is affected by ambient light, especially the red wavelengths. This makes it necessary to maintain a low level of daylight and incandescent light during track-zero adjustment. Reasonable levels of fluorescent light are acceptable.

TRACK-ZERO CHECK AND ADJUSTMENT.

The track-zero check and adjustment procedure requires the use of an alignment cartridge, disk exerciser, oscilloscope and digital voltmeter. The procedure is as follows:

- a. On Data Transfer PCB 12046, 12121 or 12143, set dip switch SW 2 (see figures 1 and 2) to the OFF position to write protect the alignment cartridge.

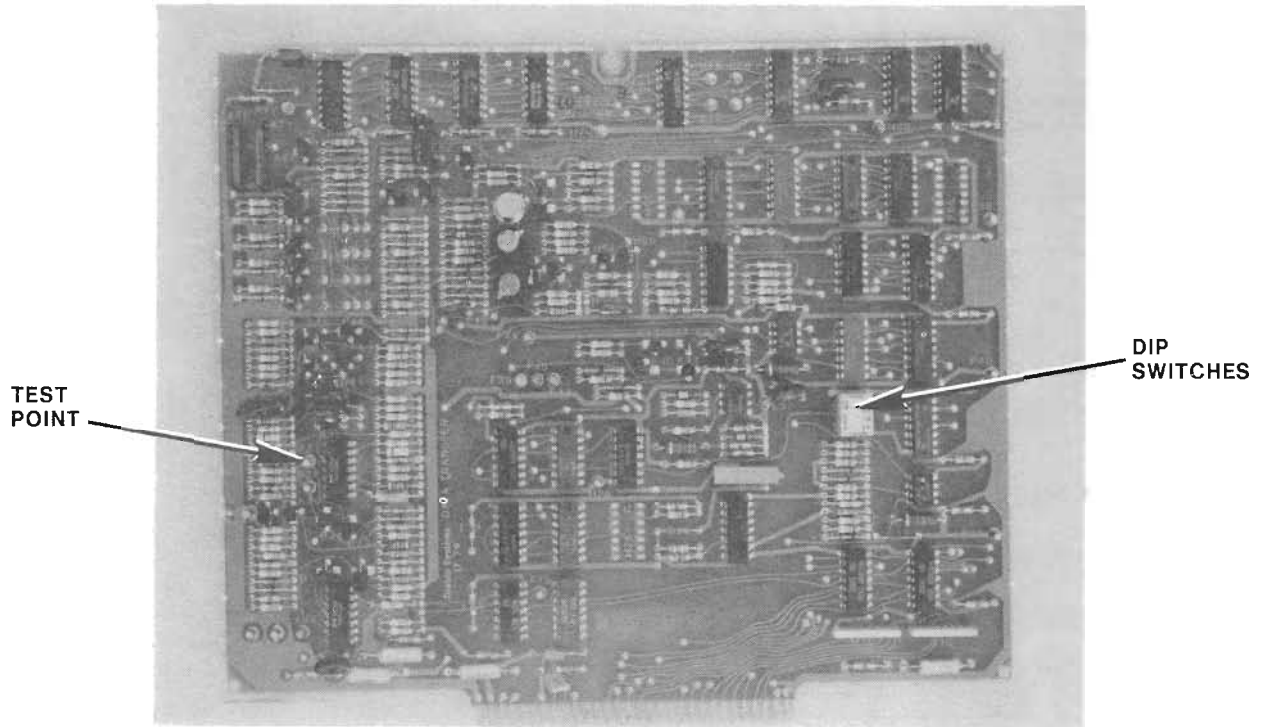


FIGURE 1 DATA TRANSFER PCB NO. 12143-PARTS LOCATION

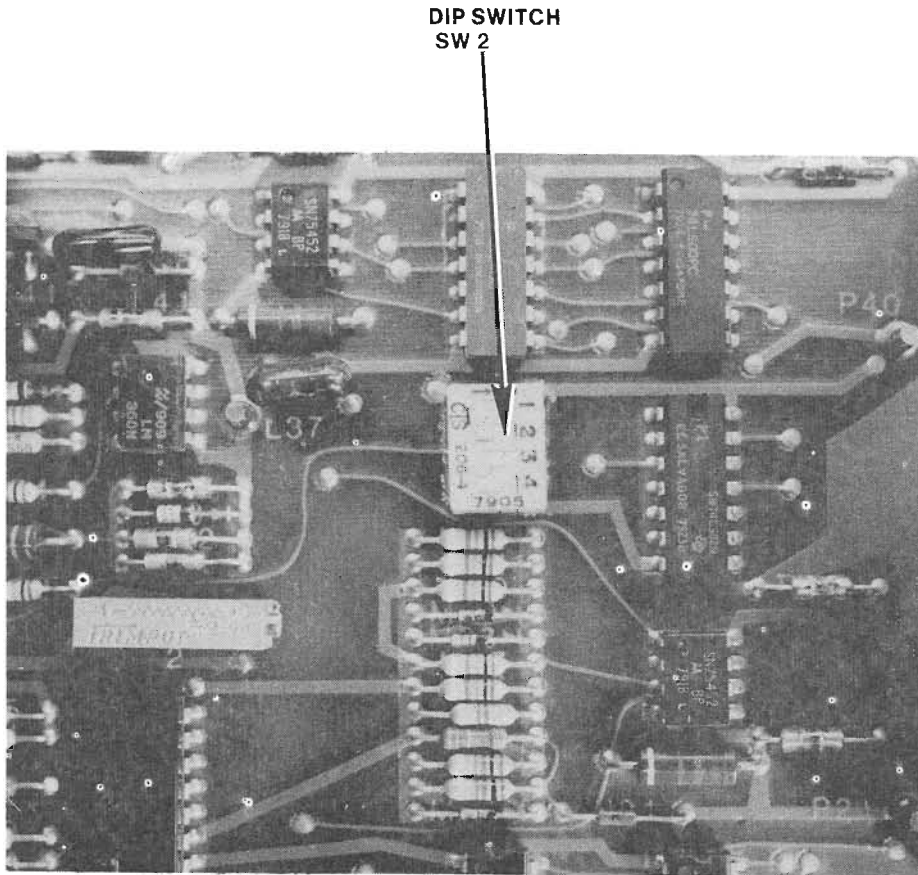


FIGURE 2 DATA TRANSFER PCB NO.12143-DIP SWITCH LOCATION

- b. Set oscilloscope controls as follows:

Main Trigger Amplifier:

MODE	AUTO
COUPLING	DC
TRIGGER SOURCE	INTERNAL (INT)
TRIGGER SLOPE	NEGATIVE (-)
TIME BASE	10ms/cm

Vertical Amplifier:

Trigger source	CH 1
Display Mode	CH 2
CH 1	2V/cm
CH 2	100mv/cm(AC coupled)

- c. On Logic PCB 12141 or 12065, set switch SW 1 to ON position (see figures 3 and 4) "INDEX ONLY".
- d. Depending on the logic PCB used, connect oscilloscope CH 1 probe (SYNC) to UPPER INDEX at TP-E76 on Logic PCB 12141 or TP-F75 on Logic PCB 12065 (see figure 4).
- e. Connect oscilloscope CH 2 probe to the DIFFERENTIATED DATA signal on the Data Transfer PCB test point TP-A33 on 12046, test point TP-B32 on 12121 or test point TP-B31 on 12143 (see figure 5).
- f. Install alignment cartridge(Catseye 726-8037 or Tribit 726-9601) and set disk drive LOAD/RUN switch to RUN position. Allow 15 minutes for drive and cartridge to thermally stabilize.

NOTE

A Restore operation must be performed after each SEEK commanded in this procedure by momentarily depressing the disk exerciser RESTORE switch (see figure 6).

- g. Using Disk Exerciser 190-0703 (see figure 6), command a SEEK to Track 10 by setting TRACK ADDRESS switches 2 and 8 to ON and momentarily depress the SEEK pushbutton switch. Now monitor the upper head signal on the oscilloscope display for an "Index to Data Burst" signal as shown in figure 7.

NOTE

If the Index to Data Burst pattern (see figure 7) does appear at Track 10, proceed directly to step l. and continue the procedure. If the Index to Data Burst pattern does not appear at Track 10, loosen both track-zero assembly securing screws (see figure 8) 1/8 turn and then the eccentric nut lock screw 1/4 turn (see figure 8). Perform the adjustment procedure presented in steps h. thru n.

- h. Turn eccentric nut (see figure 8) until the track-zero assembly is at its rearmost position on the positioner assembly.

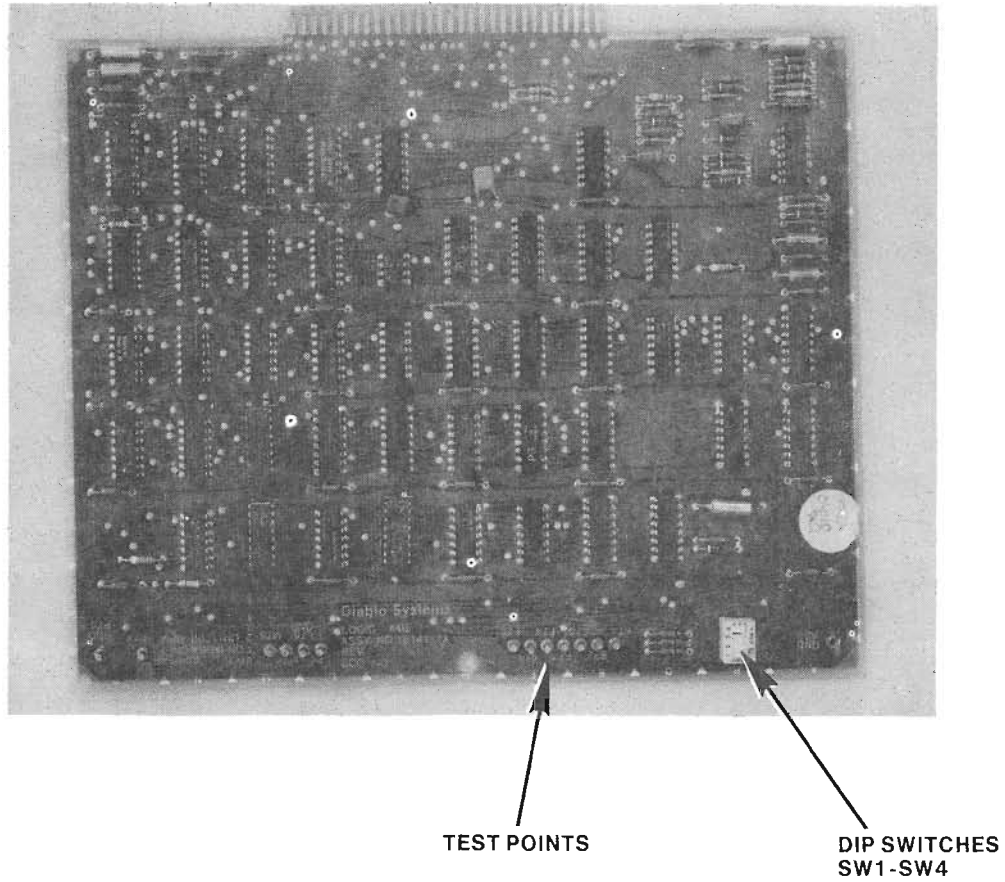


FIGURE 3 LOGIC PCB NO. 12141-PARTS LOCATION

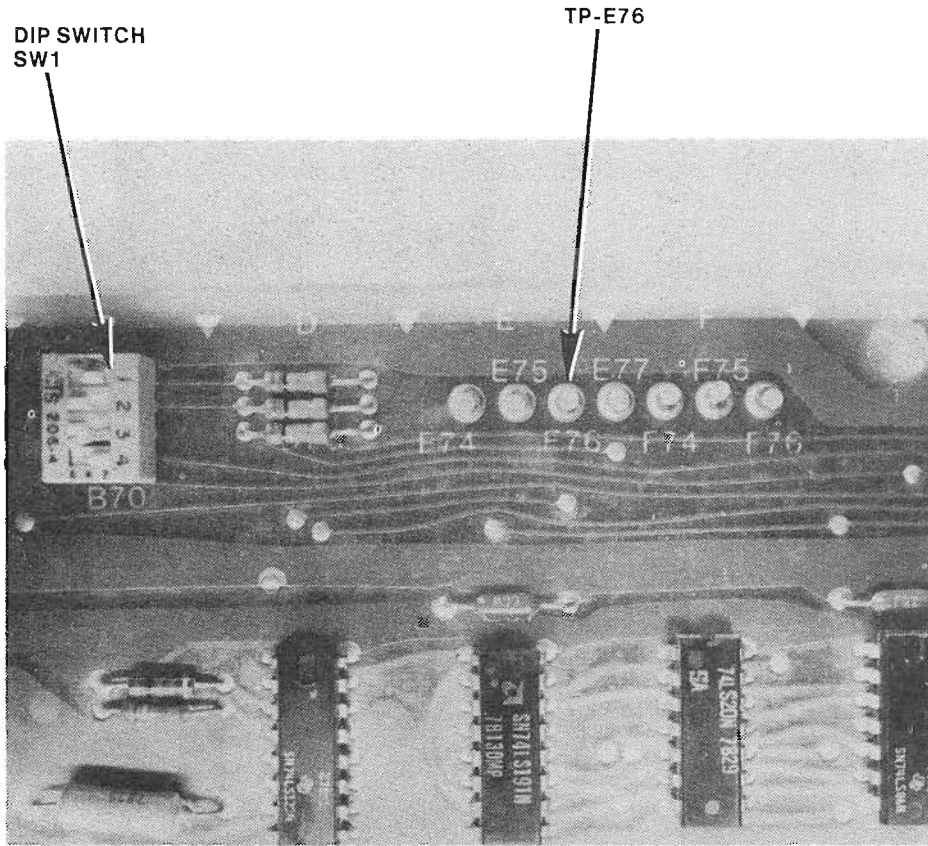


FIGURE 4 LOGIC PCB NO. 12141-DIP SWITCH AND TEST POINT LOCATION

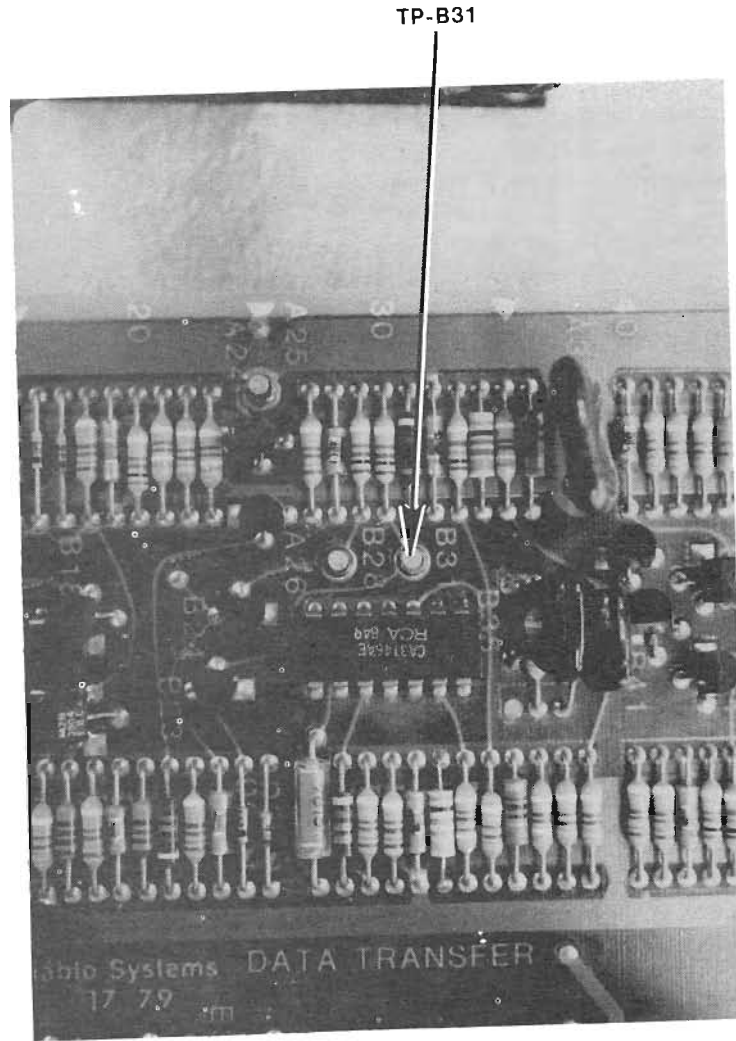


FIGURE 5 DATA TRANSFER PCB NO. 12143-TEST POINT LOCATION

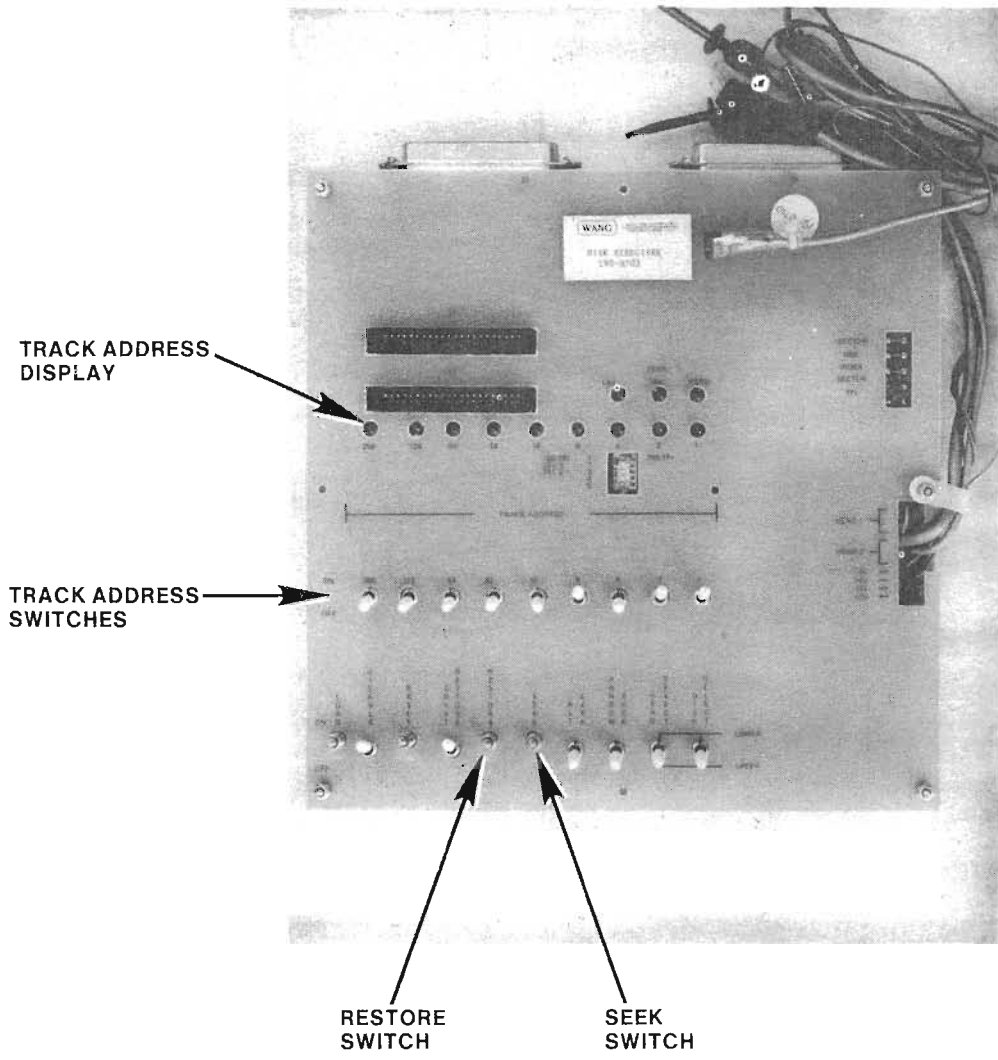


FIGURE 6 DISK EXERCISER CONTROL PANEL



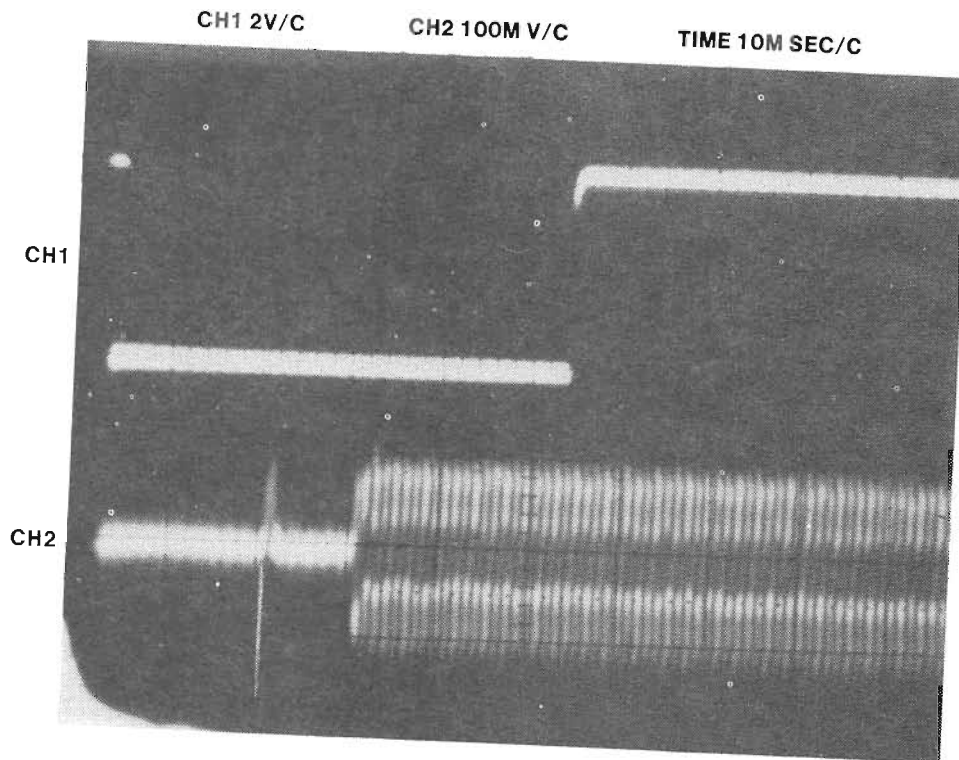


FIGURE 7. INDEX TO DATA BURST SIGNAL

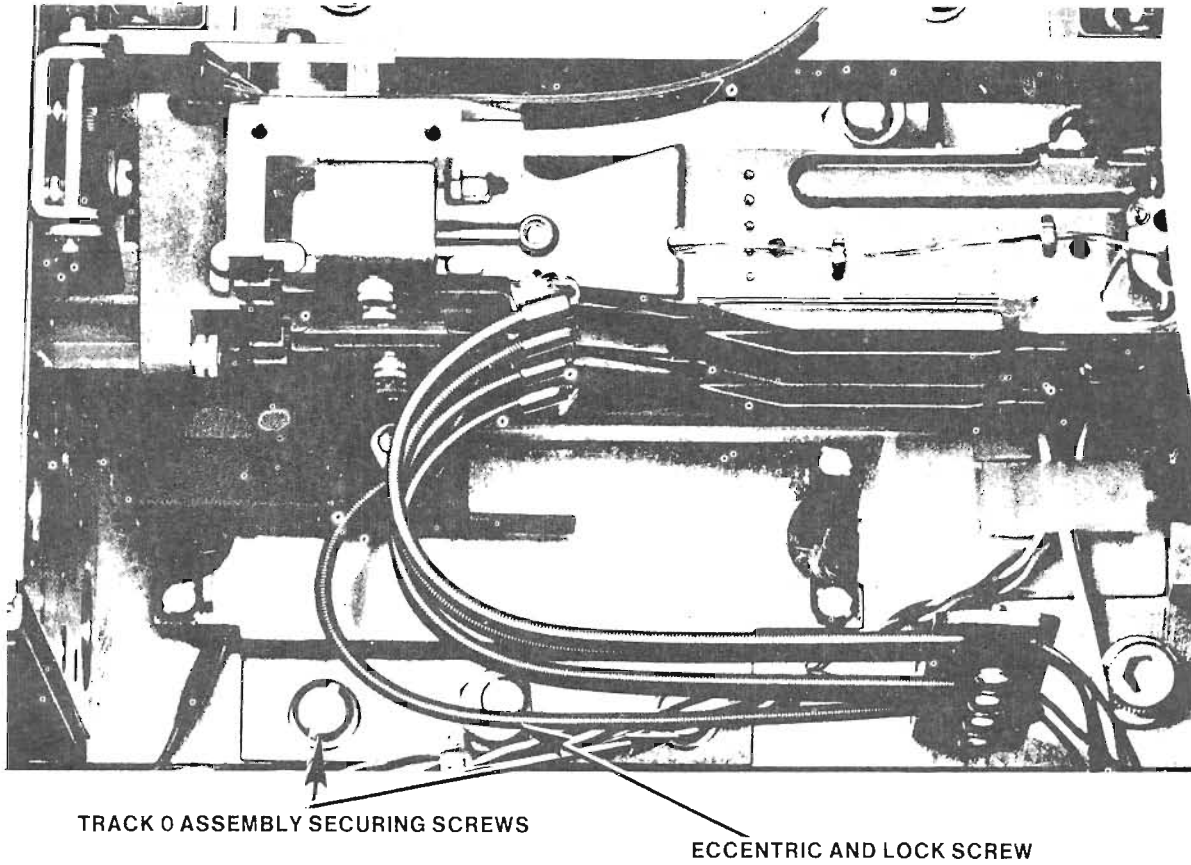


FIGURE 8. TRACK-ZERO ASSEMBLY-SENSOR ADJUSTMENT AND SECURING SCREWS

- i. Using Disk Exerciser 190-0703 (see figure 6), perform successive cycles of Track 10 "SEEK and RESTORE" operations by momentarily pressing first the SEEK and then the RESTORE pushbutton switch while turning the track-zero eccentric nut (see figure 8) counterclockwise to obtain the Index to Data Burst" signal on oscilloscope display as shown in figure 7.
- j. Hold track-zero Assembly securely to the positioner assembly (to prevent changing the track-zero adjustment) and then tighten the two track-zero assembly securing screws (see figure 8).
- k. Repeat step i. above (Track 10 SEEK and RESTORE operations) to ensure that the track-zero Assembly adjustment position was not disturbed when tightening the securing screws and then tighten the eccentric nut lock screw (see figure 8).
- l. Using Disk Exerciser 190-0703 (see figure 6), restore the heads to track-zero position by momentarily pressing the RESTORE switch.
- m. Connect the digital voltmeter from ground to either test point TP-E76 on Logic PCB 12141 or test point TP-F75 on Logic PCB 12065 (see figure 4). A reading of  $2.6 \pm 0.2$  Vdc indicates that track-zero position is properly adjusted. Now proceed to the R/W Head Adjustment procedures contained in the Model 44B Disk Drive Maintenance Manual.

NOTE

If a reading of  $+2.6 \pm 0.2$  Vdc is not obtained, loosen the two track-zero assembly securing screws 1/8 turn and the eccentric nut locking screw 1/4 turn (see figure 8). Now adjust the track-zero assembly eccentric nut for a reading of  $+2.6 \pm 0.2$  Vdc on the digital voltmeter connected between ground and either test point TP-E76 on the Logic PCB 12141 or test point TP-F75 on Logic PCB 12065 (see figure 4).

- n. Repeat steps j. through m. to secure the track-zero assembly to the positioner assembly and to ensure that the track-zero position has been adjusted successfully. Now proceed to the R/W Head Adjustment procedures contained in the Model 44B Disk Drive Maintenance Manual.

# Service Newsletter

NO. 76.2

MASS STORAGE DEVICES #9

May 4, 1977

DIABLO MODEL 44B - MAJOR ADJUSTMENTS/ALIGNMENTS

THIS NEWSLETTER REPLACES SERVICE NEWSLETTERS #67, 68, 76 AND 76.1  
AND SECTION D OF WORD PROCESSING #10

The information contained within this Service Newsletter is assembled to consolidate information concerning Diablo Model 44B (Wang Model 2260B, 2260B1/2 and 2260B1/4), operation, updates, and major adjustment procedures using a TRIBIT alignment cartridge. This information was previously contained in SNL 67, SNL 68, SNL 76, SNL 76.1 and WPNL #10. *This Newsletter supersedes SNL's 67, 68, 76, and 76.1.* WPNL #10 contains information pertaining to the System 30, but this Newsletter should be used instead of section D for disk alignments until WPNL #10 can be updated.

In the near future, these adjustment procedures will become part of a Field Level Maintenance Manual on Disk Drives.

The adjustment/alignment procedures contained in this Service Newsletter are:

Track  $\emptyset$  Adjustment Procedure  
Head Alignment Procedure  
Index Transducer Adjustment Procedure  
Head Positioner Azimuth Adjustment Procedure  
Voltage Check Points

NOTE:

Information pertaining to adjustments not contained in this Newsletter can be found in the Diablo 44B Maintenance Manual.

**WANG**

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Printed in U.S.A.  
13-266

# 1. DIABLO 44B DISK DRIVE OPERATION

## 1.1 CONTROLS AND INDICATORS

Model 44B Disk Drives have one front panel switch, three front panel indicators and a switchlight as follows:

- LOAD/RUN switch
- LOAD indicator
- READY indicator
- CHECK indicator
- PROTECT switchlight

A pushbutton, backlighted switch for on-off control of AC power is located at the rear of the Model 44B. This switch is not considered a normal operating control, but is provided for convenience during service procedures.

The control and indicators are shown in Figure 1. The paragraphs which follow, explain the functions of the control and indicators.

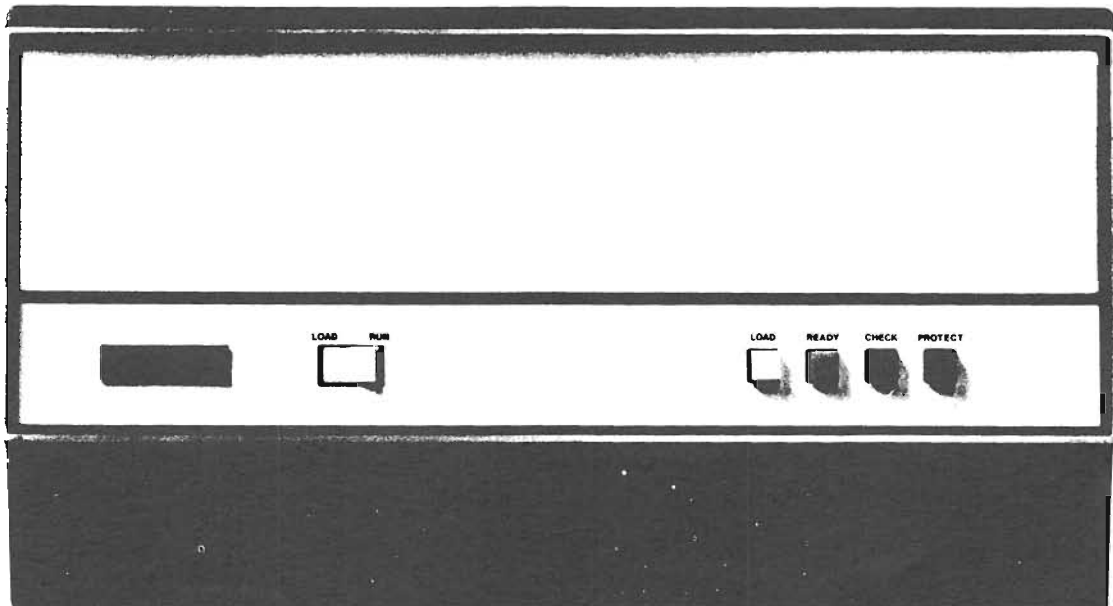


FIGURE 1 FRONT PANEL, MODEL 44B

1. LOAD/RUN Switch:

A two-position rocker-type switch that provides a means for starting and stopping rotation of the disk drive spindle. Cartridges may be removed and inserted when the switch is in the LOAD position and the LOAD light is on. With a cartridge inserted, and the cartridge retainers closed, switching to the RUN position starts the disk drive and brings the disks up to normal operating speed in about 60 seconds. When the switch is moved to the LOAD position, the disks decelerate to a stop in about 15 seconds, after which the LOAD light turns on and the cartridge retainers can be opened.

2. LOAD Indicator:

A white indicator light which shows that cartridges can be loaded or unloaded. The light is on only when the LOAD/RUN switch is in the LOAD position, the disk is not rotating, the brushes are retracted, the heads are retracted, and power is on.

3. READY Indicator:

A yellow indicator light which shows when the drive has completed its start-up sequence. The light comes on when the disk is rotating at its correct speed, brush cycle is complete, and heads are in position. The light remains on through a seek, read, or write operation. The light extinguishes when the LOAD/RUN switch is set in the LOAD position.

4. CHECK Indicator:

An orange indicator light which shows that due to some abnormal condition, the Model 44B may be incapable of writing. In the case of low voltage detection, the CHECK indicator will automatically be reset by drive electronics. For all other causes, when the abnormal condition no longer exists, the Model 44B must be reset by moving the LOAD/RUN switch to LOAD, and then back to RUN.

5. PROTECT Switchlight:

A red indicator light with momentary-contact pushbutton which is lit when a) operating power is present and b) writing is inhibited in accord with the settings of the write protect option switches on the Data Transfer PCB. If it is desired to write on a disk normally protected by the setting of the write protect option switches, the operator may momentarily press the pushbutton. This action overrides the settings of the write protect option switches and turns off the red indicator light to indicate "not protected". The drive is returned to the write protect mode by the LOAD/RUN switch or by a pulse on the Write Protect line.

For installations where it is desired that interruptions of AC power not result in write protect, the write protect option switches on the Data Transfer PCB can be set to the "off" position.

1.2 TYPICAL OPERATING PROCEDURE

The following is a typical procedure for operation of a standard Model 44B Disk Drive. If the cartridge cannot be installed or removed because of the interlock, do not use force.

1. Observe Load lamp. The cartridge retainers cannot be opened if the light is off. (If light is off, check power to drive. Power must be on.)
2. Open the cartridge retaining clamps located at the sides of the spindle bowl.
3. To load a cartridge, press the tab on the cartridge handle to the left. Then raise the cartridge handle. This action will separate the dust cover from the disk cartridge.

4. Place the disk cartridge over the spindle hub. Insure that the cartridge opening for head entry is located at the rear of the spindle bowl. When the cartridge is correctly located it will not rotate. Lower the cartridge handle to lock the cartridge to the spindle.
5. Place the dust cover, open end down, on top of the disk cartridge.
6. Close the cartridge retaining clamps.
7. Set the LOAD/RUN switch to the RUN position.
8. Observe the front panel LOAD light go out. The disk is now rotating and the start-up cycle is taking place.
9. Allow the equipment about 60 seconds to complete its start-up cycle. At the completion of the start-up cycle, the READY light will come on.
10. The machine may be selected to perform Seek, Read or Write operations with the READY light on.
11. If the READY light does not come on, or if the orange CHECK light does come on, there is a problem. Basic troubleshooting is described in the Model 44B Maintenance Manual.
12. When disk operation is complete, if it is desired to remove the cartridge, set the LOAD/RUN switch to LOAD. Wait for the LOAD light to come on (this takes about 15 seconds).
13. To remove the cartridge, open the cartridge retaining clamps, remove the dust cover, press the tab on the cartridge handle to the left, and raise the cartridge handle. This allows the disk cartridge to be lifted out of the disk drive.



14. Place the dust cover on the bottom of the cartridge and lower the handle. This attaches the dust cover to the cartridge.
15. Install another cartridge and dust cover. If no cartridge is to be installed, cover the bowl with a plastic sheet or other lint-free cover.

### 1.3 OPERATING PRECAUTIONS

To obtain the best performance and reliability from the Model 44B, and to prevent equipment damage, the following precautions should be observed:

1. Do not connect or disconnect the I/O or power cable while power is applied to the Model 44B.
2. Keep the cartridge bowl of the Model 44B covered to prevent unnecessary entry of atmospheric dust. Either a cartridge or the dust cover should be in place at all times.
3. Whenever possible, the drive should be left in the RUN mode so that clean air is drawn through the filter and supplied to the interior of the unit.
4. A sustained audible tinging or scratching sound may be caused by head-to-disk contact. If it persists, discontinue use of the unit and cartridge and investigate the cause.
5. The operator should not force or attempt to override the interlock in the Model 44B.

### 1.4 CARTRIDGE HANDLING AND STORAGE

The following practices should be observed when handling and storing disk cartridges:

1. Cartridges should be kept away from large rotating electrical machines or any other source of a strong magnetic field.

2. Cartridges that are stored in the same environment as the drive should be allowed to run in a drive for 15 minutes before any attempt is made to format or write on the disk. This insures temperature stabilization and therefore data integrity.

NOTE:

Cartridges that are from outside the operating environment of the drive should be allowed to run in a drive for 2 hours to insure temperature stabilization.

3. The cartridge dust cover should be on the cartridge while it is out of the disk drive. This ensures a positive dust seal and immobilizes the disk inside.
4. Cartridges can be stored flat or on edge. Although several can be stacked on top of one another, heavy top loading should be avoided.
5. Refer to the cartridge manufacturer's instructions for maintenance and cleaning procedures.

## 1.5 INTERLOCKS

The cartridge retaining clamps cannot be opened while the heads or disk cleaning brushes are positioned over the disk surface or when equipment power is off.

The spindle motor will not rotate if the cartridge dust cover is not installed, or if the cartridge holding clamps are open.

## 2. INTRODUCTION TO MODEL 44B

### 2.1 44B DESCRIPTION

The Model 44B consists basically of five major functional groups as follows:

- 1) Spindle Assembly - The spindle rotates the fixed and cartridge disks at a constant speed and provides ventilation for the disk drive.
- 2) Read/Write Head Assemblies - There are four read/write heads which "write" data onto the disk or "read" data from the disk.
- 3) Head Positioner - The head positioner assembly uses a movable coil within magnetic field to move the heads at high speed to the disk location commanded by the using system.
- 4) Controls, Indicators and Interlocks - This group provides the means for front panel operation of the disk drive and prevents improper operation sequences.
- 5) Internal Power Supply - This group converts AC line power to the necessary DC operating voltages.

An integrated spindle assembly, driven by an AC induction motor mounted directly on the spindle shaft, is used in Model 44B Drives. Spindle speed is electronically controlled and is independent of normal fluctuations in line frequency or voltage.

The head positioning system's case is designed to contain the strong magnetic field of its ceramic magnets and drive coil. This reduces stray magnetic flux at the read/write heads to a negligible level, eliminating a common cause of disk system data error. The thermal characteristics of the drive are designed to minimize head-to-track error due to ambient temperature, rate of change of ambient temperature, start-up transients, cold packs placed on warm drives, etc. By minimizing head-to-track alignment error, highly reliable data transfer is achieved.

Head loading is accomplished gently, with no head-to-disk contact, by a ramp load mechanism. The heads load automatically as they arrive over the disk from the retract position. In the event of power failure, the heads immediately retract and unload, providing protection for heads, disks, and data. A system of interlocks guards against operator error which could otherwise damage the heads and disk surfaces.

CAUTION:

Do not manually load the heads with the spindle stopped or without a removable disc loaded. Doing this can cause damage to both the platter and the heads.

2.2 DIFFERENCES BETWEEN MODEL 44B AND MODEL 44

1. Removable disk must be in to operate (upper index is required).
2. Power lamp is off unless the disk is write protected in which case the lamp is on until the lamp/switch is depressed.
3. In order to allow index only packs (CE Alignment Cartridges) to be used, SW1 location B70 of the logic assembly must be on. Thus, to perform index or head alignments this switch must be on.
4. The shipping clamp on the 44B unit is located on top of the head carriage. It butts against the bowl, holding the heads in the home position.
5. PCB compliment - The 44B is made up of 8 major PCB Assemblies:

J1 I/O PCB Assembly #12025.

J2 Power Driver PCB Assembly #19032 (WL #726-0443).

J3 Servo PCB Assembly #12068 (WL #726-0442). Will be replaced by a 12099 Servo PCB WLI #726-0432\*.

J4 Address Logic PCB Assembly #12064 (WL #726-0441). Will be replaced by a 12101 Address Logic PCB WLI #726-0431\*.

J5 Logic PCB Assembly #12066 (WL #726-0440).

J6 Data Transfer PCB Assembly #12046 (WL #726-0439). Will be replaced by a 12095 Data Transfer PCB WLI #726-0430.

Power Supply Assembly #19033 (WL #726-0438).

Motherboard Assembly #12023.

\*The Address Logic & Servo PCB's must be replaced as a pair.

6. The 44B power supply is internal.
7. The heads in the 44B are ramp loaded.

8. The 44B air filter is smaller because of the addition of the power supply to the drive (WL #726-0414).
9. Input voltage conversion (100, 120, 220, 240 VAC) is accomplished by changing the position of a printed circuit board in the rear of the unit (beside the power cord).

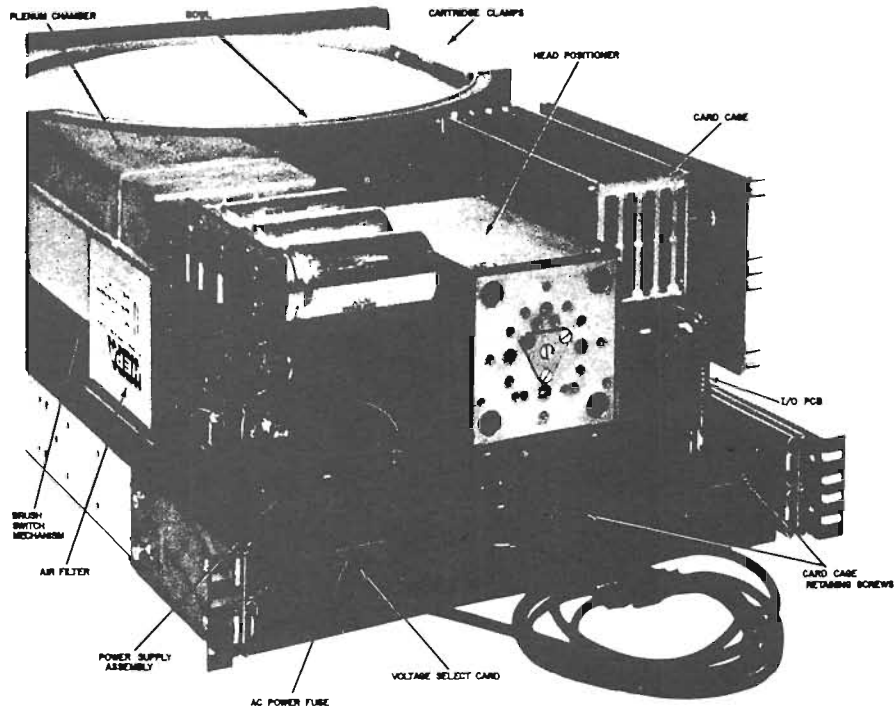


FIGURE 2 LOCATION OF ASSEMBLIES

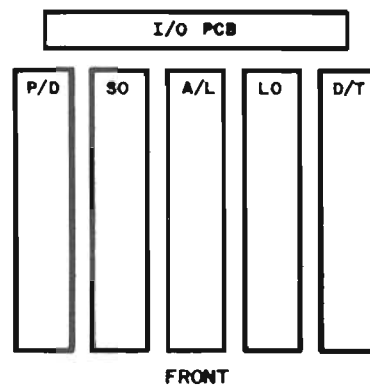


FIGURE 3 CARD CAGE PCB LOCATIONS

### 3. MAINTENANCE

The information contained in this section has been compiled to clarify maintenance and alignment procedures on the Diablo 44B disk drive, using a TRIBIT alignment cartridge.

#### 3.1 MAINTENANCE PRECAUTIONS

To avoid damage to the Model 44B or an associated disk cartridge, observe the following precautions during maintenance:

1. Electronic detenting holds the head carriage in position when power is applied. Do not attempt to move the carriage by hand unless the spindle is rotating at operating speed and the servo release switch is in the release position. This switch is located on the Power Driver PCB. With the spindle stationary, or rotating below operating speed, head crash will occur if the R/W heads are moved out over the disks.
2. Never connect or disconnect any cable assembly to or from the Model 44B with AC power applied.
3. When the lower disk is exposed, avoid scratching, nicking, fingerprints or other contact with the coated surface of the disk.
4. Keep the Model 44B as clean as possible. When the drive is open for maintenance but is not actually being worked on, protect it from dust with a lint-free cover. The assembled disk drive should never be stored without either a cartridge dust cover or a plastic bag in place.
5. When the top cover is in place, the drive should be left in the RUN mode whenever possible. This will insure that clean air will be drawn through the filter and supplied to the interior of the disk drive.

## 3.2 PREVENTIVE MAINTENANCE

### 3.2.1 *PREVENTIVE MAINTENANCE PHILOSOPHY*

The principle of maximum machine available time governs the preventive maintenance recommendations contained herein. Unless a preventive maintenance procedure increases overall machine available time, it is not recommended. Except for the procedures recommended in Preventive Maintenance Procedures, no maintenance or adjustment should be performed on a drive that is operating satisfactorily.

### 3.2.2 *PREVENTIVE MAINTENANCE PROCEDURES*

Table 1 summarizes the recommended preventive maintenance procedures, and is based on a one-shift-per-day operation in a normal office environment. Operation in an abnormally dirty environment, a high frequency of cartridge changing, or multi-shift operation would increase the frequency of preventive maintenance required. In addition to the maintenance listed in Table 1, the base plate should be wiped with a lint-free cloth and vacuumed whenever the bowl is removed.

TABLE 1  
Preventive Maintenance Action

Interval	Action
Semi-annually	Clean and inspect R/W Heads
Semi-annually	Clean and inspect magnetic ring
Semi-annually	Replace air filter

Prior to performing any of the preventive maintenance procedures listed in Table 1, ensure that there is no disk cartridge installed, and that power to the Model 44B is off. See paragraph on Defeat of Interlocks for removal of disk cartridge with power off. Remove the top cover by removing the 4 securing screws, located around the rear periphery of the bowl, and lifting the cover from the drive.

### 3.3 CLEANING OF R/W HEADS

In order to clean the R/W heads, the card cage must be pulled back to provide access to the lower heads. To accomplish this, proceed as follows:

1. Unplug the R/W head connectors from the D/T PCB.
2. Remove the two card cage retaining screws shown in Figure 2.
3. Slide the card cage rearward enough to allow access to the R/W heads.

Access to the lower heads is now possible when the head carriage is all the way to the rear. Clean both lower heads by rubbing lightly with a pad soaked with 91% isopropyl alcohol (Texpad, or equivalent). The pad should be wrapped around a tongue depressor, so that light to moderate pressure can be exerted. Use a lint-free wiper to remove alcohol residue. Clean the upper heads in a similar manner.

Complete removal of all contamination from the heads is mandatory, including fingerprints.

### 3.4 CLEANING AND INSPECTION OF THE MAGNETIC RING

Use adhesive tape to remove any particles from the magnetic ring at the top of the Spindle Assembly. If there is any sign of corrosion on the magnetic clutch surface, remove the corrosion as follows:

1. Using a very small quantity of metal cleaner (Diablo P/N 70677) on the end of a cotton swab, rub the clutch surface (see Figure 4) until the corrosion is lifted. Exercise care to ensure that fluid does not run between the magnet and the clutch.

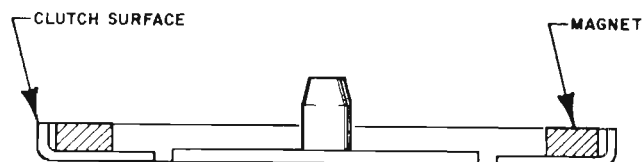


FIGURE 4 CLUTCH SURFACE AND MAGNET



2. Clean the clutch surface with an alcohol pad.
3. Repeat Steps 1 and 2 until all traces of corrosion are removed.
4. Thoroughly clean clutch surface and sides with alcohol. Exercise caution to ensure that the clutch surface is not touched with fingers after performing this step.

### 3.5 REPLACING THE AIR FILTER

To replace the air filter, first remove the plenum chamber (see Figure 2), which is held in place with two screws. Exercise caution so that the gasket around the sealing edges of the plenum chamber is not damaged. The air filter and pad can now be lifted straight up. Install a new air filter and pad, observing the air-flow direction printed on the filter label (arrow up), and replace the plenum chamber. Ensure that both gaskets are well-seated on their sealing edges.

### 3.6 CORRECTIVE MAINTENANCE

#### 3.6.1 *GENERAL TROUBLESHOOTING TECHNIQUES*

The recommended first step in troubleshooting is to identify in which of the following categories the malfunction falls:

- Model 44B problem
- Non-Model 44B problem
- Interchangeability problem

If all indications are normal except for the presence of non-intermittent data errors, the problem is probably one of disk pack interchangeability. The alignment of the Read/Write heads may be off. In this case, verify machine alignment by performing the adjustments described in paragraphs TRK Ø, HEAD ALIGNMENT, and INDEX TRANSDUCER.

If the problem is not one of disk interchangeability, it should then be determined if the Model 44B is malfunctioning or if the problem

is actually originating externally to the disk drive. Check the cartridge seating, verify that all cable connections (including the terminator) are properly made, and that correct signals are being presented to the Model 44B interface. Check that the card cage retaining screws are properly installed. If malfunctioning persists, turn off the AC power, disconnect the I/O cable, and turn on and verify DC power.

Load a cartridge onto the disk drive, and attempt to place the drive in the RUN mode. If the spindle does not start, the problem is with the disk drive, and trouble in the Logic PCB, Power Driver PCB, or mechanical interlocking is indicated. Also, the +5V fuse may be blown.

If the spindle starts, either the READY or CHECK light should come on within one minute, and the corresponding output at the interface connector should be true if the unit is selected.

CHECK light ON indicates trouble in the "write" or "read" circuitry. The READY light on indicates that the cartridge is properly seated, the spindle speed is correct, and heads are loaded.

If neither light comes on within one minute, power or other internal difficulty is indicated.

The Model 44B is designed so that each PCB has well-defined functions. The interchange of PCBs should be used to isolate faulty PCBs.

### 3.6.2 HEAD CRASH

A "head crash" (head touches disk surface) is usually detectable audibly. If this occurs, both the disk and the "crashed" head must be replaced as described in Diablo 44B Maintenance Manual, in addition to rectification of the cause of the head crash.

NOTE:

The vast majority of head crashes are due to contamination caused by careless handling and careless operation of the drive, and by failure to replace the air filter at the recommended intervals, see Section 3.2 Preventive Maintenance.

#### 4. ADJUSTMENTS

##### 4.1 ADJUSTMENT REQUIREMENTS

Table 2 shows the conditions under which adjustments are normally required. Except under these conditions, no adjustment should be attempted unless equipment malfunction indicates a definite need for a specific adjustment. For adjustments other than those covered in this document, refer to Diablo 44B Maintenance Manual.

The adjustments described require the use of an alignment cartridge. When using the cartridge for making adjustments on disk drives with the Write Protect Option installed, Write Protect should be set to prevent inadvertent writing on the disk.

Write protect is switch selectable on the Data Transfer PCB. To protect the removable disk, SW2 in the switch bank located at position L35 on the Data Transfer PCB must be set to the off position. SW3 controls protection of the fixed disk in the same manner.

##### 4.2 DEFEAT OF INTERLOCKS

Some of the adjustment procedures described herein require defeat of one or both interlocks. Defeat of the interlocks is accomplished as described below.

	Adjustments Required								
	Lower Head, Cartridge	Upper Head, Cartridge	Lower Head, Fixed	Upper Head, Fixed	Track 0 Sensor	Carriage Azimuth	Upper Index Transducer	Lower Index Transducer	Brush Mechanism
Replaced									
Lower Head, Cartridge	X								
Upper Head, Cartridge	X	X							
Lower Head, Fixed Disk			X	X					
Upper Head, Fixed Disk				X					
Head Positioner	X	X	X(1)	X(1)	X	X			
Spindle	X	X	X(1)	X(1)	X	X	X	X	
Bowl	X	X	X(1)	X(1)	X		X	X	X
Upper Index Transducer	X	X	X(1)	X(1)	X		X		
Lower Index Transducer	X	X	X(1)	X(1)	X		X	X	
Fixed Disk	X	X	X(1)	X(1)	X		X		

Notes: (1) - No method available for checking adjustment. Dump data from fixed disk before disassembly and reload it after reassembly.

TABLE 2 ADJUSTMENT REQUIREMENTS

CAUTION:

Before defeating the cartridge clamp interlock to remove the cartridge with power off, ensure that the R/W heads and brushes are fully retracted.

1. Opening the cartridge clamps: With the top cover removed, the cartridge clamps can be spread under any conditions of power, head position, or brush position by manually moving the cartridge clamp interlock link forward. This is most easily accomplished by pulling forward on the link pin of the cartridge interlock solenoid located beneath the bowl on the *left* side.
  
2. Operating the Spindle with no cartridge installed: The spindle motor can be operated by manual operation of the cartridge interlock switch located inside of the left hand cartridge clamp. (R/W heads will not load if upper index marks are not present.)

## 5. DIABLO MODEL 44B TRIBIT ALIGNMENT PROCEDURES

### 5.1 DIABLO DISK EXERCISER

The Diablo Disk Exerciser, the 7013 board, is a testing device that allows the user to operate the Model 44B Diablo Disk Drives independent of a CPU. The 7013 can be used for disk drive testing and is useful for performing disk drive alignment.

#### 5.1.1 DESCRIPTION

The 7013 tester has two banks of switches, four indicators, two cables and two test points. Their labels and functions are:

- a) TA - Track Address. When ON, the disk receives the track address from the track address switches. When OFF, the track address is generated randomly or sequentially by circuitry on the 7013 as selected by RND.

- b) DISP - Disable. When ON, the track address is disabled. The head will remain positioned wherever it is when the DISP switch is turned ON.
- c) RST - Restore. When ON, the head is repeatedly positioned to TRACK 0. RST overrides the TA and RND switches.
- d) HUP - Head Upper/Lower. ON selects the upper head, OFF selects the lower head.
- e) DUP - Disk Upper/Lower. ON selects the upper (removable) disk, OFF selects the lower (fixed) disk.
- f) RND - Random Track Generator. When ON, a random track address is generated. When OFF, a sequential track address is generated. In both cases, the TA switch must be OFF.
- g) TK1 through TK256. These are the track address switches. Setting a track address switch ON causes the head to move to the appropriate track, but only when the TA switch is ON.

NOTE:

Switch 8 of Switch Bank 1 is easily mistaken for Track Address Bit 4, however, Switch 7 controls this Track Address Bit and Switch 8 is not used.

- h) LAI - Logical Address Interlock. If ON, an illegal address has been selected.
- i) SI - Seek Incomplete. If ON, indicates the head did not move to the track address requested.
- j) FR - File Ready. When ON, indicates the drive is ready for use.
- k) RSRW - Ready to Seek, Read or Write. When ON, indicates the drive is ready to do another read or write operation.

- l) CABLE 1 - Plugs into the upper or lower head cable of the top disk. (On 44B Drives use head connector adapter.)
- m) CABLE 2 - Connects to the Diablo Servo board to provide -5 volts for the amplifier on the 7013.
- n) TP1 - The output of the amplifier of the 7013.
- o) TP2 - +0 volts.

### 5.1.2 OPERATION

Remove the I/O cable from the rear of the Diablo Drive and install the 7013 Exerciser. Install the terminator block (see Figure 5). Set the switches for the desired type of operation and apply power to the disk drive.

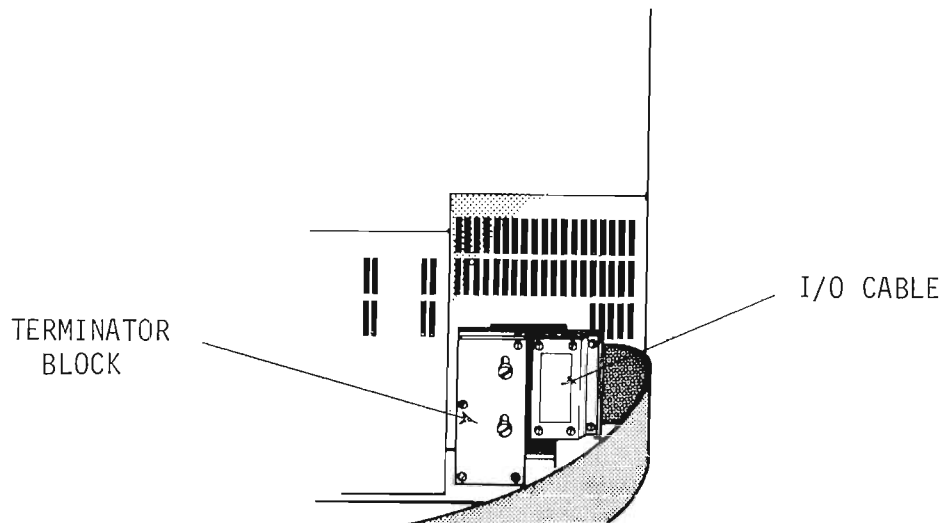


FIGURE 5 I/O CONNECTIONS

With all switches in the OFF position (both banks), the track address will be incremented sequentially, and hence, move the head at 10 milli-second intervals. Setting the TA switch to ON will select a track address as set by the Track Address switches. An illegal track address will turn the LAI indicator on.

Setting the RND switch to ON generates random track addresses and causes the head to move accordingly.

5.1.3 USING THE ALIGNMENT CARTRIDGE WITH THE 7013 EXERCISER

The alignment procedures should be performed in the following order:

1. Track Ø Adjustment.
2. R/W Head Alignment (Top Platter).
3. Upper Index Transducer Alignment.

To align the disk drive with the disk exerciser:

- a) Install the Disk Exerciser on the disk drive. Set the TA, HUP, and DUP switches ON and all others OFF. Apply power to the drive.
- b) Check the Track Ø alignment as described below. The Track Ø adjustment should only need to be performed when the head positioner has been changed or when the TRK Ø assembly has been removed. If the Logic PCB (12066) is replaced, the TRK Ø adjustment should be checked.

5.2 DIABLO MODEL 44B ALIGNMENT-PREPARATION

5.2.1 DIABLO OPTION SELECTION SWITCHES

Diablo 44B options are switch selectable; the option-select switches are contained on three circuit boards:

DATA TRANSFER - DIABLO #12046 (Replaced by 12095)  
 ADDRESS LOGIC - DIABLO #12064 (Replaced by 12101)  
 LOGIC - DIABLO #12066

For Diablo Model 44B Disk Drives to function properly with Wang interface logic, option-select switches must be set to the following configurations:

	<u>SW1</u>	<u>SW2</u>	<u>SW3</u>	<u>SW4</u>	** For Logic PCB's
DATA TRANSFER	ON	ON	ON	OFF	with artwork revision
ADDRESS LOGIC	OFF	OFF	ON	ON	12065-01 or above,
LOGIC	*OFF	OFF	X	**X	this switch must be
					on for proper operation.

X = Not Used.

\*This switch must be on when using an alignment cartridge.



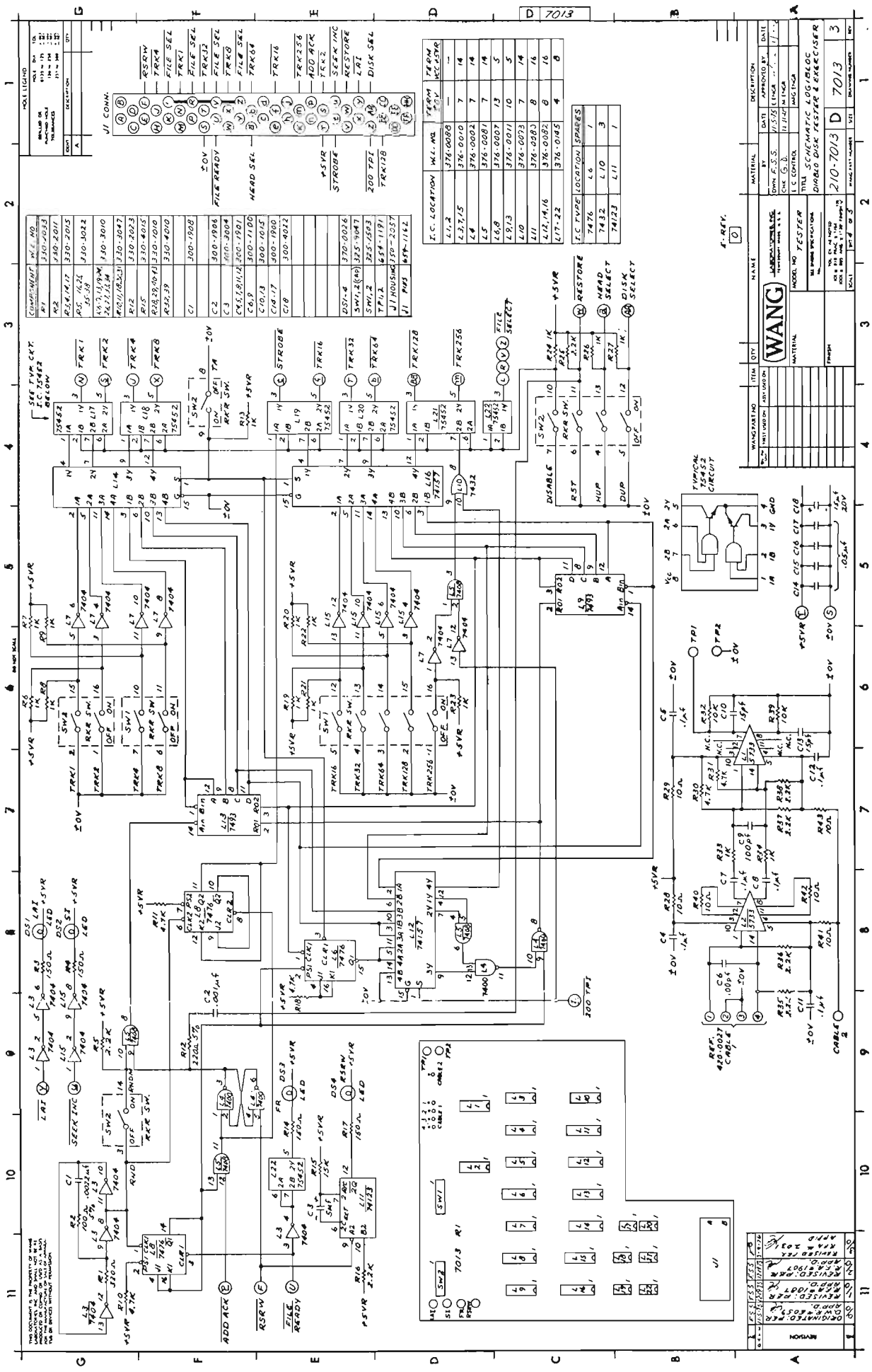


FIGURE 6 DIABLO MODEL 44/44B EXERCISER

### 5.2.2 *TEMPERATURE STABILIZATION*

The alignment cartridge shall be temperature stabilized to the disk drive operating temperature prior to attempting alignment.

#### CAUTION:

Only after the disk drive has been temperature stabilized can the alignment cartridge stabilization be accomplished.

#### 5.2.2.1 Drive Temperature Stabilization

The Model 44B Disk Drive is temperature stabilized after two hours of head-loaded operation from a cold start-up in the recommended machine operating environment.

#### 5.2.2.2 Alignment Cartridge Temperature Stabilization

The time required for temperature stabilization of the alignment cartridge is dependent upon the cartridge storage environment.

Storage in the Drive Operating Environment - if the cartridge storage temperature is essentially the same as the recommended machine operating environment, the cartridge shall be allowed to run in the drive with heads loaded for 15 minutes prior to attempting the alignment procedure.

Storage in other than the Drive Operating Environment - if the cartridge storage temperature is essentially different from the recommended drive operating environment, the cartridge shall be allowed to run in the drive with heads loaded for 30 minutes. After this initial period, the cartridge shall be removed, reinstalled, and the drive operated with heads loaded for an additional 15 minutes prior to attempting the alignment procedure.

### 5.2.3 *HEAD CLEANING POSITION*

Removal of the top cover constitutes the first step of each of the adjustments described herein. For simplicity, however, the removal procedure is not cited in each adjustment.

Top Cover Removal: The top cover is held in place by 4 securing screws located around the rear periphery of the bowl.

The card cage must be pulled back to allow access to the Read/Write heads. To accomplish this, proceed as follows:

1. Loosen the two retaining screws near the rear of the card cage. Caution, these screws can be easily stripped.
2. Slide the card cage rearward enough to allow access to the R/W heads. Take care not to damage the wires and connectors on the side of the card cage.
3. By unplugging the R/W head connector from the D/T PCB, the card cage can be moved further back. This should not be necessary for the following adjustments.

#### 5.2.4 *DIABLO CIRCUIT CHANGES & PCB REVISION LEVELS*

The following changes to Diablo circuitry are required to resolve the Track 0 problems encountered on Diablo Model 44B disk drives. Also, included, is a list of drive units (by Diablo serial numbers) requiring these changes, and the circuit board revision levels these drives should have in them.

To update the "over tracks" detect circuit located on the LOGIC circuit board (Diablo #12066) the following additions and changes must be installed (see Figure 7 for circuitry added).

- a. Change F10 and F11 to 20K resistors (WL #330-4023) if they are not that value.
- b. Cut the etch running between F11 (20K resistor) and P30-4.
- c. Connect pin 14 through a 3.9K (WL #330-3040) resistor to A20 pin 5.
- d. Connect A20 pin 5 to A20 pin 2 through a 1M resistor (WL #330-6010).
- e. Connect A20 pin 4 to +5V through a 3K resistor (WL #333-0068).

- f. Connect A20 pin 4 to logic ground through a 2K resistor (WL #333-0007).
- g. Connect A20 pin 2 to +5V through a 2K resistor (WL #333-0007).
- h. Connect A20 pin 2 to P30 pin 4.

This change brings the LOGIC PC revision level to L.

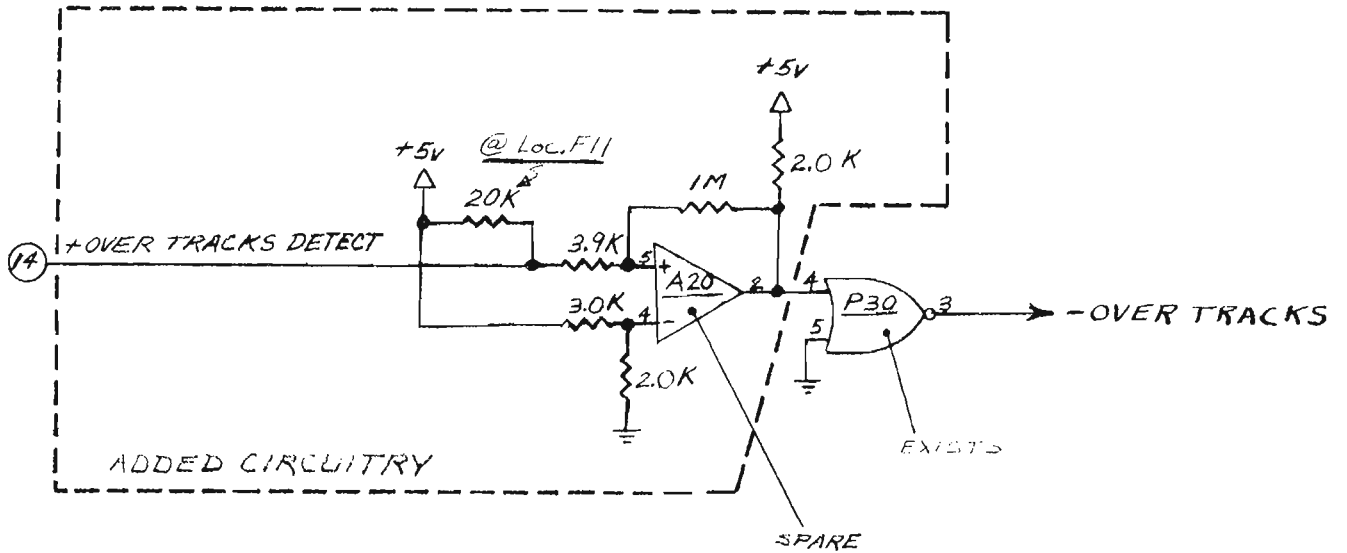


FIGURE 7 CIRCUITRY ADDED TO LOGIC BOARD

As of November 9, 1976, the 44B units listed below have a 12066 Logic PCB at Revision F.

<u>Serial Number</u>	<u>Serial Number</u>	<u>Serial Number</u>	<u>Serial Number</u>
101	132	159	189
102	133	162	191
103	134	163	192
104	136	164	193
105	137	165	194
115	138	166	195
116	139	167	196
117	140	168	197
118	141	169	198
119	143	176	199
120	144	177	200
121	145	178	201
122	147	179	203
123	148	180	204
124	151	181	205
125	152	182	220
126	153	183	221
127	154	184	222
128	155	185	223
129	156	186	231
130	157	187	232
131	158	188	238

To update 12066 Logic PCB from Revision F to Revision H, install jumper from M20 pin 9 to M20 pin 2. The addition of the Track Ø circuit change brings the revision level of this PCB to revision L.

NOTE:

Model 44B Unit Serial Number 138 only

Logic PCB is Revision C and Address Logic is Revision C.

To update 12064 Address Logic from Revision C to Revision D, install jumper from D50 pin 2 of H50 pin 2.

The 12066 Logic PCB in unit 138 should be returned to Diablo Systems, Inc., Attention Rich Maas, for exchange. (3190 Corporate Place, Hayward, California 94545)

The current revision level of Logic Board 12066 should be XDS. The last update (Revision R) was described in ISN #131, which is currently being implemented in the field. Diablo has issued a new 12066 Rev. XDS with revised artwork. This board can be differentiated from the old style by the artwork revision level which is etched on the wire side of the PCB. The old style is artwork revision 12065, the new style is artwork revision 12065-01. Also, a group of seven test points near the top center have signal assignments that differ from those on the old artwork. They are as follows:

- E74 Upper Index/Sector marks
- E75 Lower Index marks
- E76 Upper Index marks only when using alignment cartridge and switch 1 at location B70 is on
- E77 Upper Transducer Output
- F74 Lower Transducer Output
- F75 Over Tracks Detect signal at P30-4
- F76 Phase 2 of Spindle Drive
- P74 P30-3 Over Tracks

Using this board, it is now possible to do a 44B Track Zero adjustment without having to solder wires to P30-3 and pin 14. The necessary signals are available on test points.

The following is a list of the current revision levels of the PCB's in a Diablo 44B disk drive.

Data Transfer	12046	Revision XDG
Address Logic	12064	Revision XDD (Address Logic 12101 XDD replaces 12064)
Servo	12068	Revision XDD (Servo 12099 XDC replaces 12068)*
Power Driver	12062	Revision XDH (Power Driver 12062-01 XDG replaces 12062)

\*Drives that are presently being received from Diablo have 12099 circuitry incorporated on a PCB with 12067 artwork.

#### 5.2.5 *TRIBIT*

The following procedures are used with the TRIBIT Alignment Cartridge.

##### 5.2.5.1 Track 0 Adjustment Procedure (TRIBIT)

Track zero adjustment requires the use of an alignment cartridge, 44B extender board, 7013 exerciser, and oscilloscope.

#### CAUTION:

To ensure that the R/W heads do not retract too quickly when using the Diablo Disk Exerciser, set the exerciser address switches to zero before switching from the RUN mode to the LOAD mode. If this is not done, the heads will retract at a high speed and hit the rear stop. This can cause misalignment of the R/W heads.

Also, TRK  $\emptyset$  adjustment will change if the weight distribution is not equal (do not lean on the drive when performing the adjustment).

Also, so as not to affect the output of the phototransistor, do not perform the adjustment in incandescent or natural light (fluorescent lighting will not affect the phototransistor).

1. Adjust the upper disk R/W heads for .050" gap (see Figure 8 below for metric equivalent).

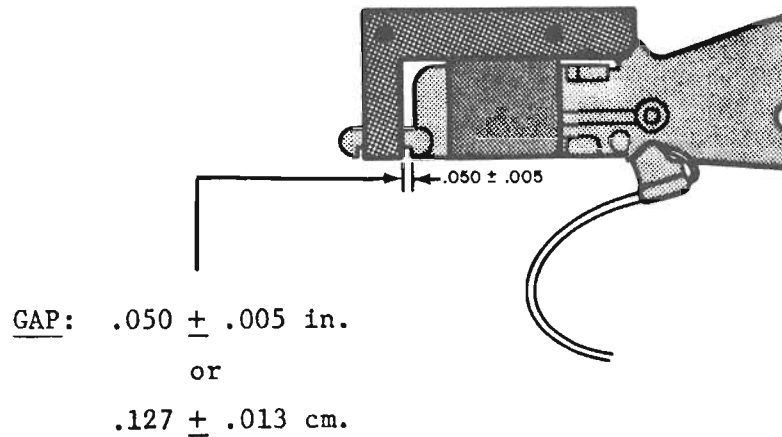


FIGURE 8 HEAD ADJUSTMENT

To use a TRIBIT CE cartridge, the following must be performed to adapt to a 44B:

2. A cable adapting the 44B head cable connector to the 7013 exerciser connector is necessary to perform this adjustment. A limited quantity of these adapters were supplied to Area Offices (7 each) as of this printing; therefore, the following interconnection method must be used if an adapter cable is not already available.
3. The R/W coil (pins 1 & 4) must be connected to pins 1 and 4 respectively of the amplifier input cable connector.

In order for the R/W head to work, its center tap must be grounded, therefore, pin 3 of the 44B connector must be connected to pin 2 or 3 of the exerciser connector (see

Figure 9). Also, to ensure that Erase heads are OFF, pin 2 of the 44B connector must be connected to pin 2 or 3 of the exerciser connector.

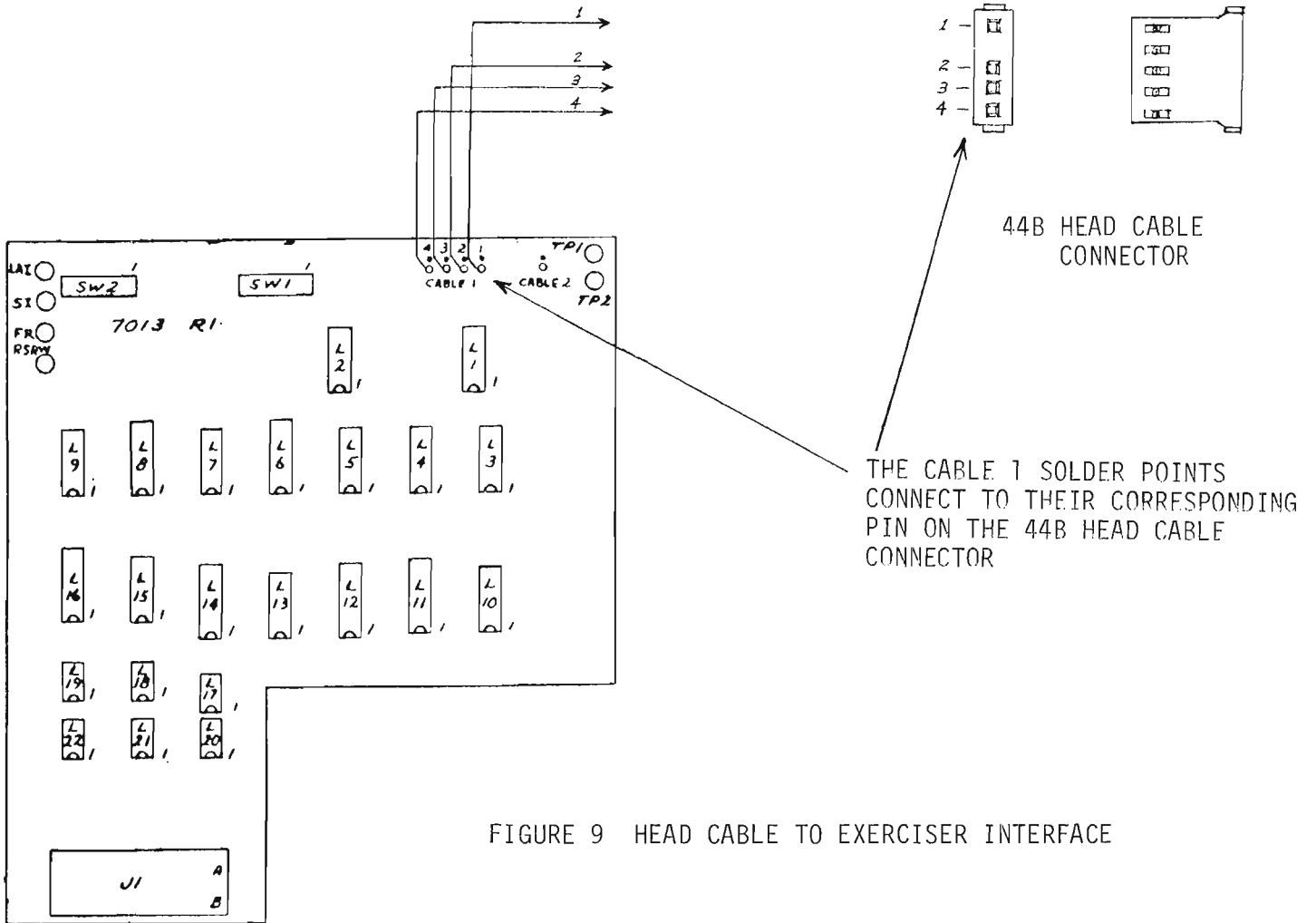


FIGURE 9 HEAD CABLE TO EXERCISER INTERFACE

Last, the exerciser board requires -5V to operate the amplifier. Negative five volts is found at M31 on the SERVO board (12067 artwork), (H26 pins 7 & 9 on Servo board with 12098 artwork, see Figure 10B).

(Ref: Figure 3 for PC locations; also, see Figure 10 below).



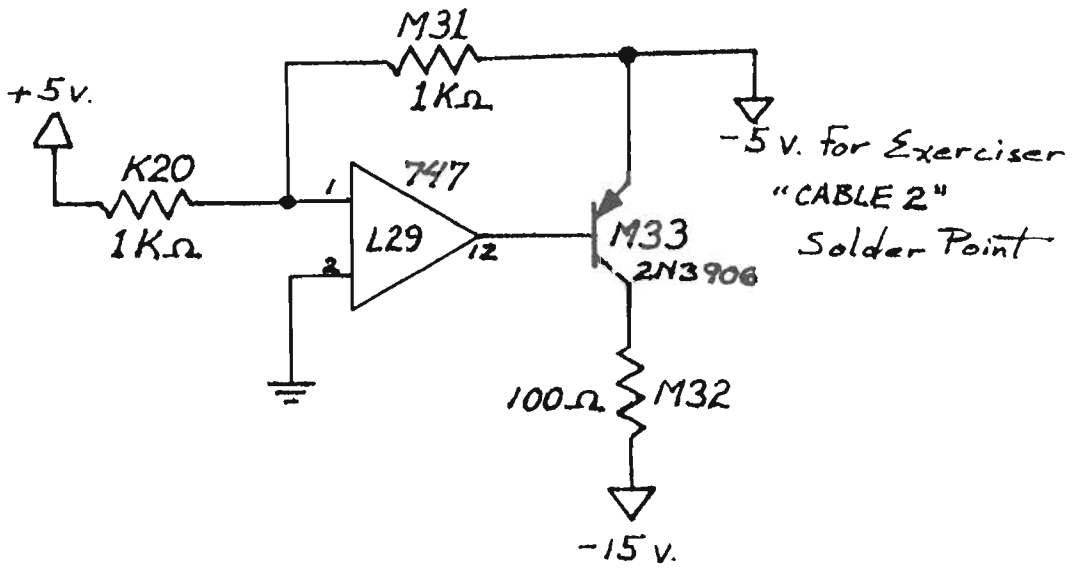


FIGURE 10A SERVO REGULATOR (-5 VOLTS)  
for servo boards with 12067 artwork\*

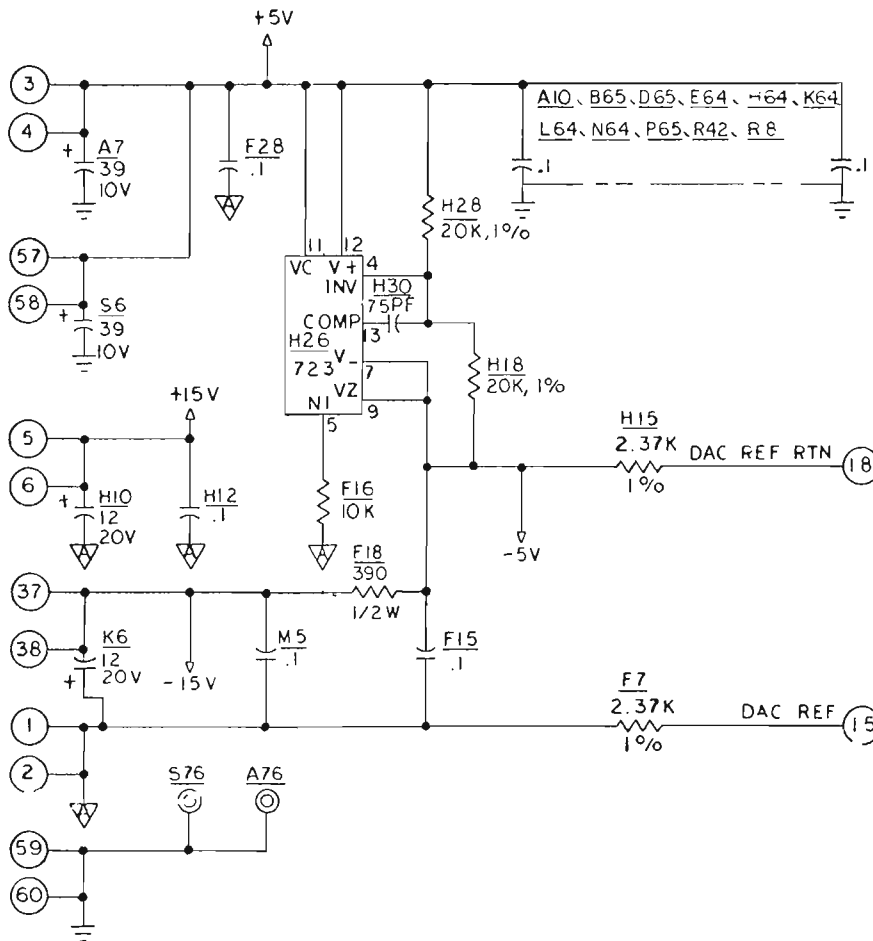


FIGURE 10B -5V REGULATOR ON THE SERVO BOARD  
for boards with 12098 artwork\*

\* The artwork revision is etched on the wire side of Diablo 44B PCB's

Cable 2 connects to this point.

4. Set scope as follows:

Main Time Base

Mode - Normal

Coupling - DC

Source - External

Time Base - 2 ms./cm

Vertical Amplifiers

Display Mode - Channel 1

Trigger Source - upper index

Vertical Deflection - 50 MV/cm (using a 10X probe)

Coupling (Channel 1) - AC

Coupling (Channel 2) - DC

5. Install alignment cartridge and set LOAD/RUN switch to RUN. Allow drive to stabilize for 30 minutes.
6. Connect Channel 1 scope probe to TP-1 on the 7013 exerciser circuit board.
7. Trigger scope externally on the negative edge of Upper Index TPF75 on Logic PCB's with 12065 Artwork; TPE76 on Logic PCB's with 12065-01 Artwork. Note: Switch 1 at location B70 must be on.
8. Set exerciser to perform a single seek to track 10. See switch settings below. (If the Index Burst Pattern is seen at track 10, go to track 0 fine adjustment.)

TRK 8	ON	TA	ON
TRK 2	ON	ALL OTHERS	OFF

9. If the Index Burst Pattern is not found at track 10, with the exerciser, seek to tracks around 10 until the Index Burst Pattern is obtained (Ref: Figure 11).

10. Loosen track zero assembly screws (Figure 12) slightly (approx. 1/4 turn).
11. Loosen the eccentric lock screw.
12. Note track address on exerciser switches where the burst pattern is obtained; then adjust track zero eccentric accordingly (Ref: Figure 12):

Track Address less than 10 - turn eccentric clockwise

Track Address more than 10 - turn eccentric counterclockwise

13. Perform a RESTORE then seek to track 10 again.
14. Repeat track searching and eccentric adjustment until scope display shows the index burst pattern at track 10. Note that a restore and a seek to track 10 is required after each eccentric adjustment of the Track 0 Eccentric (Ref: Figure 12). When the burst pattern is obtained at track 10, do a Restore, then re-seek track 10 to verify that the correct pattern is repeatedly accessible at track 10.

#### 5.2.5.2 Track 0 Fine Adjustment

The remaining steps comprise a fine adjustment procedure which ensures that track 0 detenting occurs at the proper position on the Position Sawtooth Ramp. The position at which track 0 is detected is selected to compensate for mechanical overshoot and temperature variations.

1. Move Channel 1 scope probe from 7013 Exerciser PCB to P30-3 (TP P74 for Logic PCB's with artwork revision 12065-01) of **the** Logic PCB 12066 (over tracks output); also, remove the probe used in the coarse alignment from the external trigger input and connect the probe to the channel 2 input, then connect it to the Servo PCB, TP H72. With the oscilloscope in the *chopped* mode, change trigger to negative internal channel 1, with HF REJECT selected.

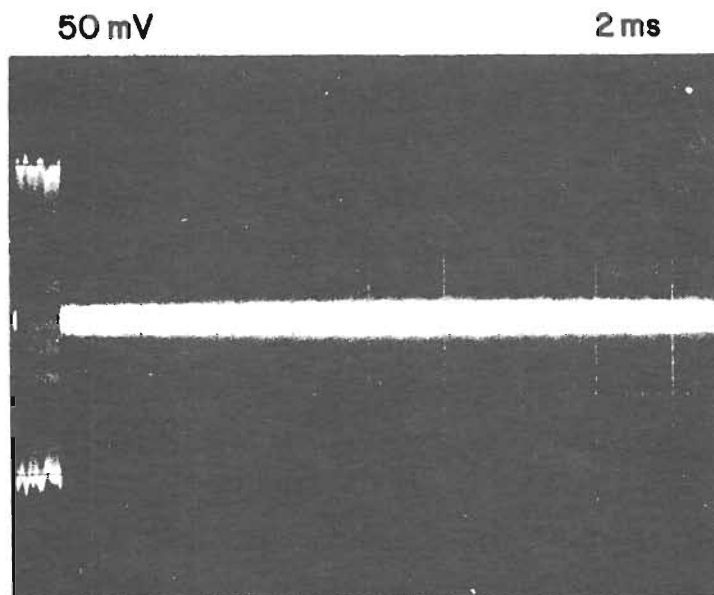
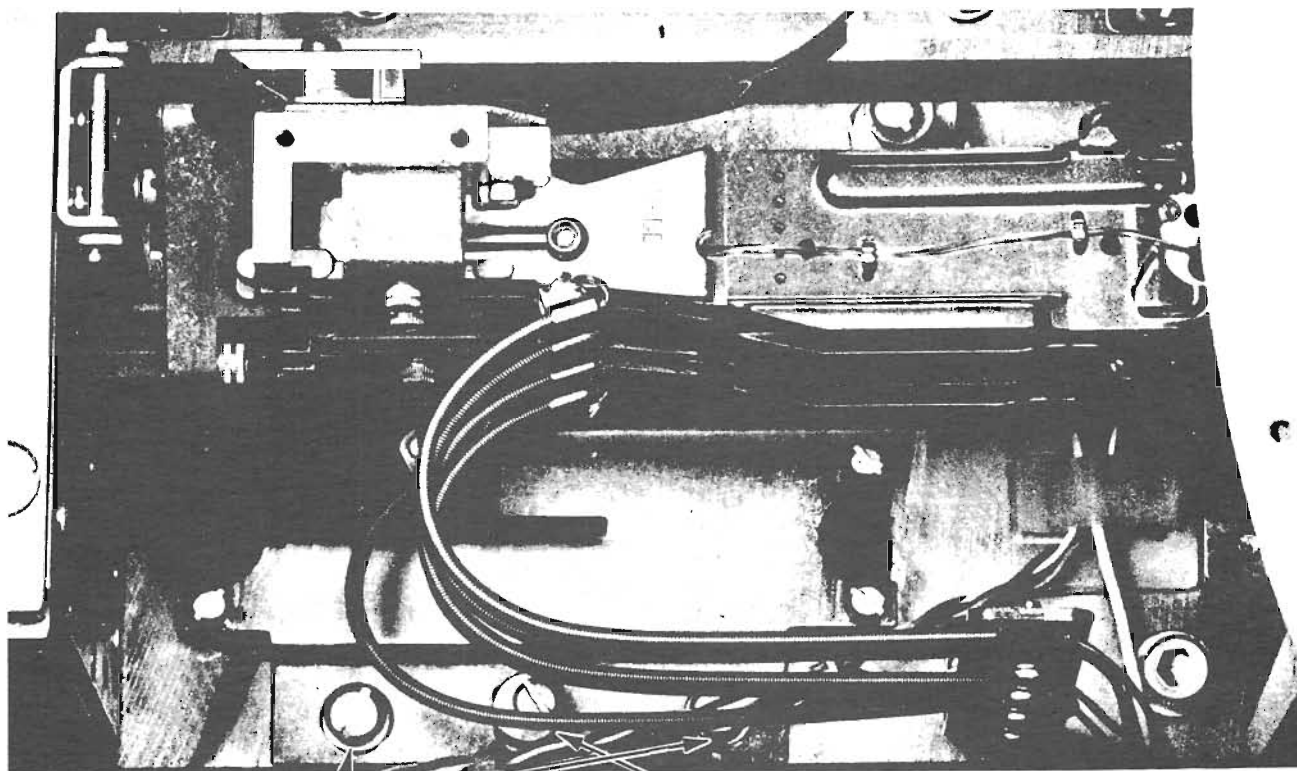


FIGURE 11 TRACK 10 DATA BURST



TRACK 0 ASSEMBLY SECURING SCREWS

ECCENTRIC AND LOCK SCREW

FIGURE 12 TRACK 0 SENSOR ADJUSTMENT

2. Establish a reference (ground) for servo T.P. H72 and adjust scope channel 2 vertical sensitivity for 2 volts/cm.
3. Initiate a continuous RESTORE operation by turning the RST switch on the 7013 exerciser ON.
4. Adjust the position of the Track  $\emptyset$  sensor until P30-3 (TP P74 for 12065-01 artwork) switches high at point "A" in the *Position Sawtooth* waveshape, Figure 13. Point "A" occurs at the vertical midpoint between points "B" (Reference point) and "C" (negative peak of *Position Sawtooth* waveshape). This may be seen more easily by superimposing the two waveshapes via re-adjustment of vertical position controls. When the adjustment is correct, pulse "D" will not exceed 1.5 ms in duration.

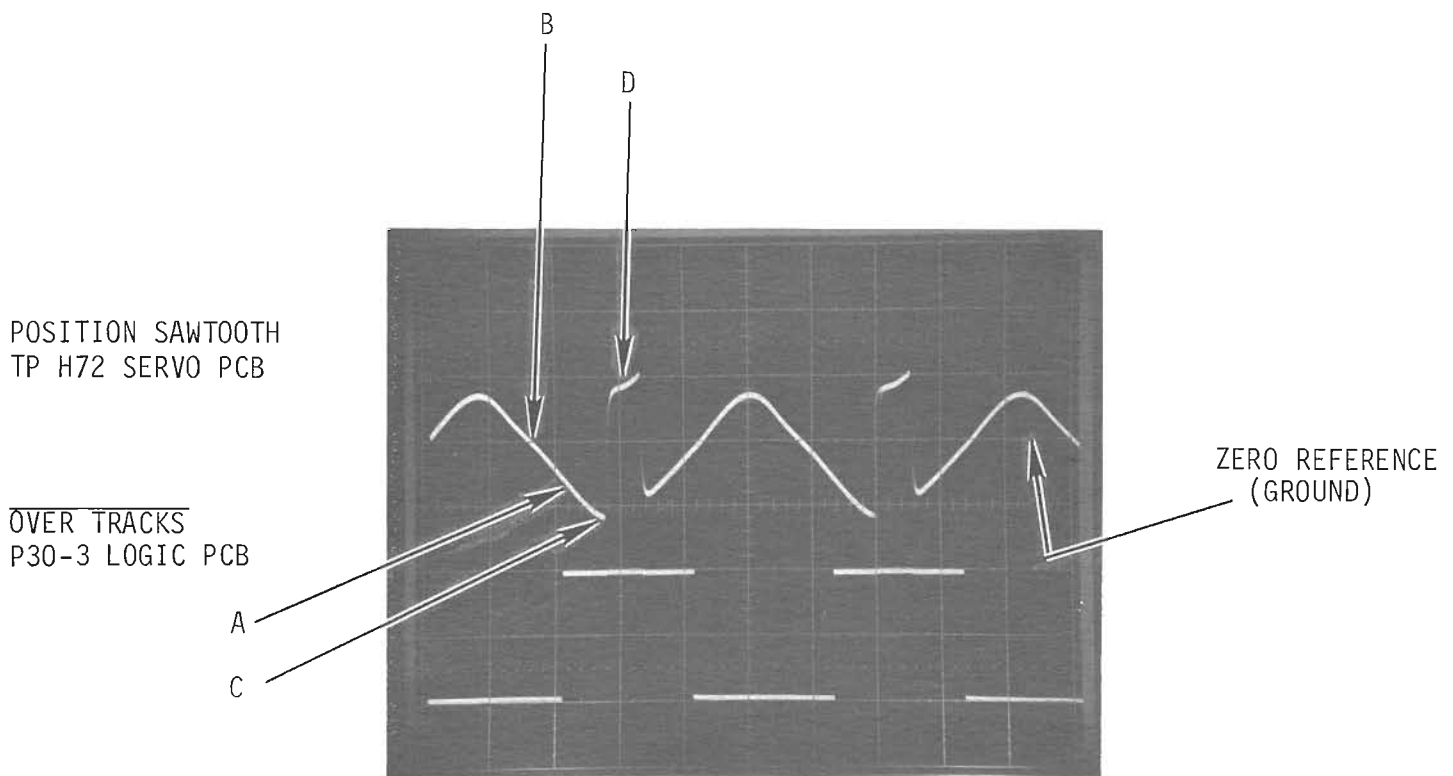


FIGURE 13 TRACK 0 SENSOR FINE ADJUSTMENT WAVESHAPES

5. Secure Track Ø sensor bracket, reverify waveshape obtained in step 4, then recheck burst pattern on track 1Ø as explained in 5.2.5.1 steps 4-14.
6. Following track zero adjustment, check R/W head alignment.

### 5.2.5.3 Head Alignment (TRIBIT)

Head Alignment (Tribit). Set the exerciser switches as follows:

```
TRK 128....ON
TRK 16.....ON
TRK 2.....ON
TA.....ON
All Others.....OFF
```

Connect cable 2 of the 7013 Exerciser to 1K resistor, M31 on the Servo Board (12068 and 12099 PCB's with 12067 artwork, location H26 pins 7 & 9 on 12099 PCB's with 12098 artwork, see Figure 10B).

Locate the four Head Plugs on the D/T PCB (#12046). These plugs are oriented from the top down: upper head/upper disk; lower head/upper disk. The lower two plugs are for the lower disk heads.

Remove the removable disk upper head cable from the Data Transfer Board to align the upper head, or the removable disk lower head cable to align the lower head\*. Connect the head cable to cable described in Figure 9.

\*The upper head should be aligned first.

Connect channel 2 of the oscilloscope to TP1 on the 7013. Set the scope to INVERT. Trigger the oscilloscope on TP1, SLOPE & LEVEL NEGATIVE.

#### NOTE:

If the scope being used does not have the INVERT capability, signals shown in Figures 14 & 15 will be inverted.

Install the alignment cartridge, set the LOAD/RUN switch to RUN.

Allow the drive and alignment cartridge to temperature stabilize, according to the temperature stabilization criteria outlined earlier. After temperature stabilization a pattern similar to Figure 14 or 15 should be seen. Set a ground reference line on the oscilloscope and adjust the Vertical Sensitivity and Variable controls for a vertical deflection of six divisions from the ground reference to the highest peak. If the difference of the two peaks is more than 1/2 of a division, adjust the head as described below.

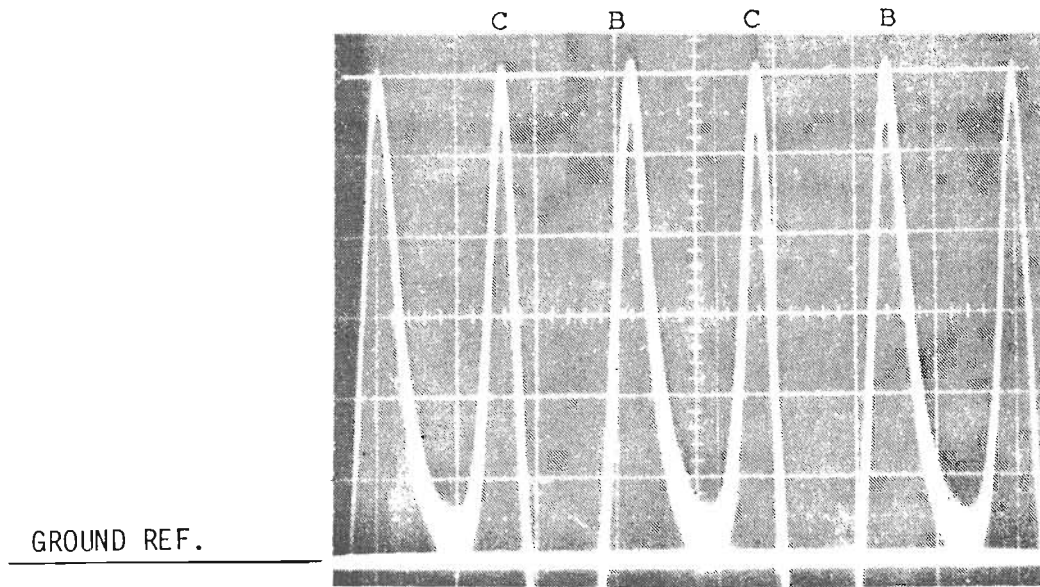


FIGURE 14 HEADS ALIGNED

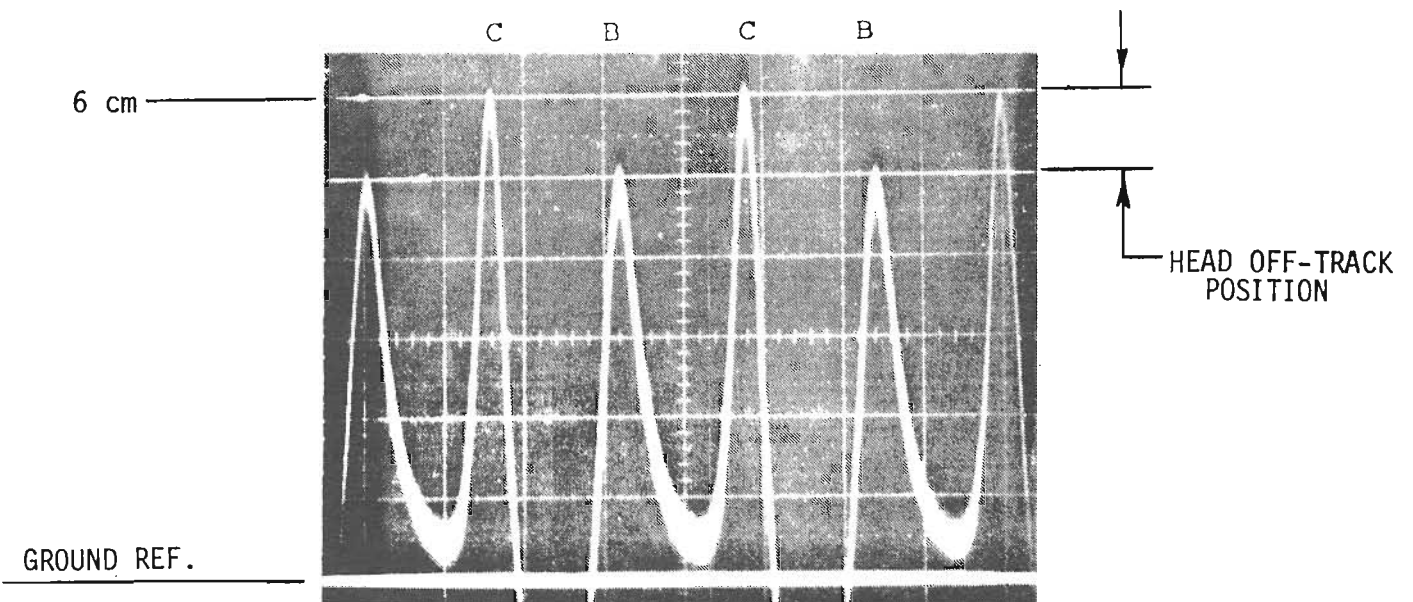


FIGURE 15 MEASURING HEAD OFF-TRACK DISTANCE

CAUTION:

Thoroughly clean all cartridge/spindle mating surfaces using head cleaning pads. Be certain the cartridge is write protected. If write protect option is not installed, disable write function at controller or CPU.

1. Move the card cage to the head-cleaning position as described earlier.
2. Position the heads to track 146 (200 tpi).

NOTE:

Head positioning cannot be done manually. Slew the heads into position using the exerciser.

3. If the head(s) requires alignment, proceed as follows: (Note: If both heads require alignment, the upper head must be adjusted first.)

Removable Disk Upper Head Only

- a. If not already done, connect cable 1 of the exerciser to the upper head cable.
- b. Slightly loosen the two screws holding both head assembly clamps.
- c. Position a screwdriver at the point indicated in Figure 16, and manually move the head assembly in or out to obtain the correct alignment waveform.



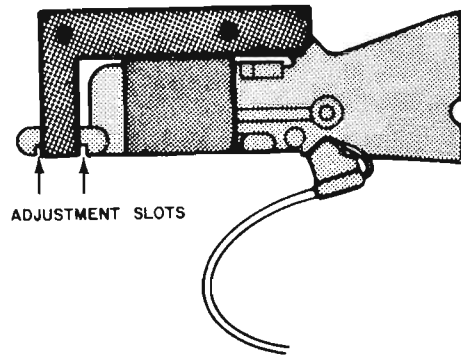


FIGURE 16 HEAD ADJUSTMENT

NOTE:

While adjusting the head, readjust the oscilloscope variable control to maintain a deflection of 6 divisions. It is imperative that a 6 division deflection be maintained to measure the head deviation properly. The head is aligned when the two peaks are of equal amplitude.

- d. Torque the upper head assembly clamp screw to 128 inch ounces.
- e. Recheck head alignment to insure that torquing the clamp screw did not change the heads position.
- f. Check alignment of lower head and adjust as necessary.
- g. Torque the lower head assembly clamp screw to 128 inch ounces.

NOTE:

As the clamp screw is tightened, the head may move slightly. If necessary, readjust the head position, allowing for any head movement caused by tightening the screw.

Removable Disk Lower Head Only

- a. Disconnect cable 1 from the upper head cable and connect to lower head cable.
- b. Slightly loosen the screw holding the lower head assembly clamp.

- c. Position a screwdriver at the point indicated in Figure 16, and manually move the head assembly in or out to obtain the correct alignment waveform.
- d. Torque the head assembly clamp screw to 128 inch ounces.
- e. Recheck head alignment to insure that torquing the clamp screw did not change the heads position.
- f. Switch the unit from RUN to LOAD to retract the heads, and then return to the RUN mode of operation. (Set TRK Address Switches to 0 before switching to LOAD.)
- g. Reposition the R/W heads back to the alignment track (146), and recheck the alignment of the heads. Repeat the adjustment procedure as necessary.

#### Fixed Disk Upper and Lower Heads

#### NOTE:

This adjustment should only be performed in an initial installation or after the fixed disk or the lower heads have been replaced.

Since disk interchangeability is not affected by the lower heads, the adjustment consists of merely moving the card cage to the head-cleaning position, inserting a  $0.050 \pm .005$  shim between the head mounting plate and the carriage roller plate, tightening the set screw to 128 inch ounces, and removing the shim. This adjustment is shown in Figure 17.

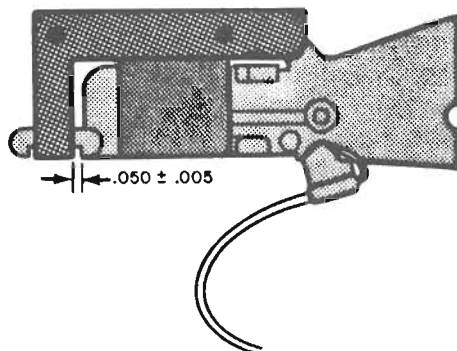


FIGURE 17 HEAD ADJUSTMENT - LOWER SET

#### 5.2.5.4 Upper Index Transducer Adjustment (TRIBIT)

NOTE:

A disk hub and sector ring, retrieved from a defective disk cartridge and used here in a manner similar to the procedure outlined for the lower transducer, will appreciably shorten the time needed to achieve this adjustment.

Install an alignment cartridge. Place the drive in the RUN mode, and observe the signal at pin 10 on the Logic PCB (#12066) (TP E77 on Logic PCB's with 12065-01 artwork). The amplitude of the positive peaks of the index transducer output should be  $400 \text{ mV} \pm 100 \text{ mV}$  for narrow sector slots (.020 slots), or  $1000 \text{ mV} \pm 200 \text{ mV}$  for wide sector slots (.080 slots). If the signal falls outside the appropriate range, proceed as follows:

1. Place the drive in the LOAD mode and, when able, remove the alignment cartridge.
2. Verify the transducer lamination-to-sector ring clearance of  $.008'' \pm .003''$  by laying a straight-edge across the spindle hub and checking the gap between its lower edge and the top of the lamination with a plastic feeler gauge. If the clearance is out of tolerance, loosen the hold-down screws (screws A in Figure 18), and add or remove shims (Diablo P/N 16358) as required. Retighten the screws just enough to secure the transducer and still allow slight lateral movement.
3. Align the transducer/lamination center line with the spindle hub center, and move the transducer in or out radially until the tip of the lamination clears the outside of the spindle hub flange by approximately  $3/64''$ . Tighten the hold-down screws a little.
4. Reinstall the alignment cartridge, switch from LOAD to RUN mode and, when able, recheck the signal level of the index transducer output. If the signal is in tolerance, the cartridge may be removed and

the hold-down screws tightened firmly. If the signal is not in tolerance, repeat step 3 - moving the transducer radially a small amount either in or out each time until optimum signal level is achieved.

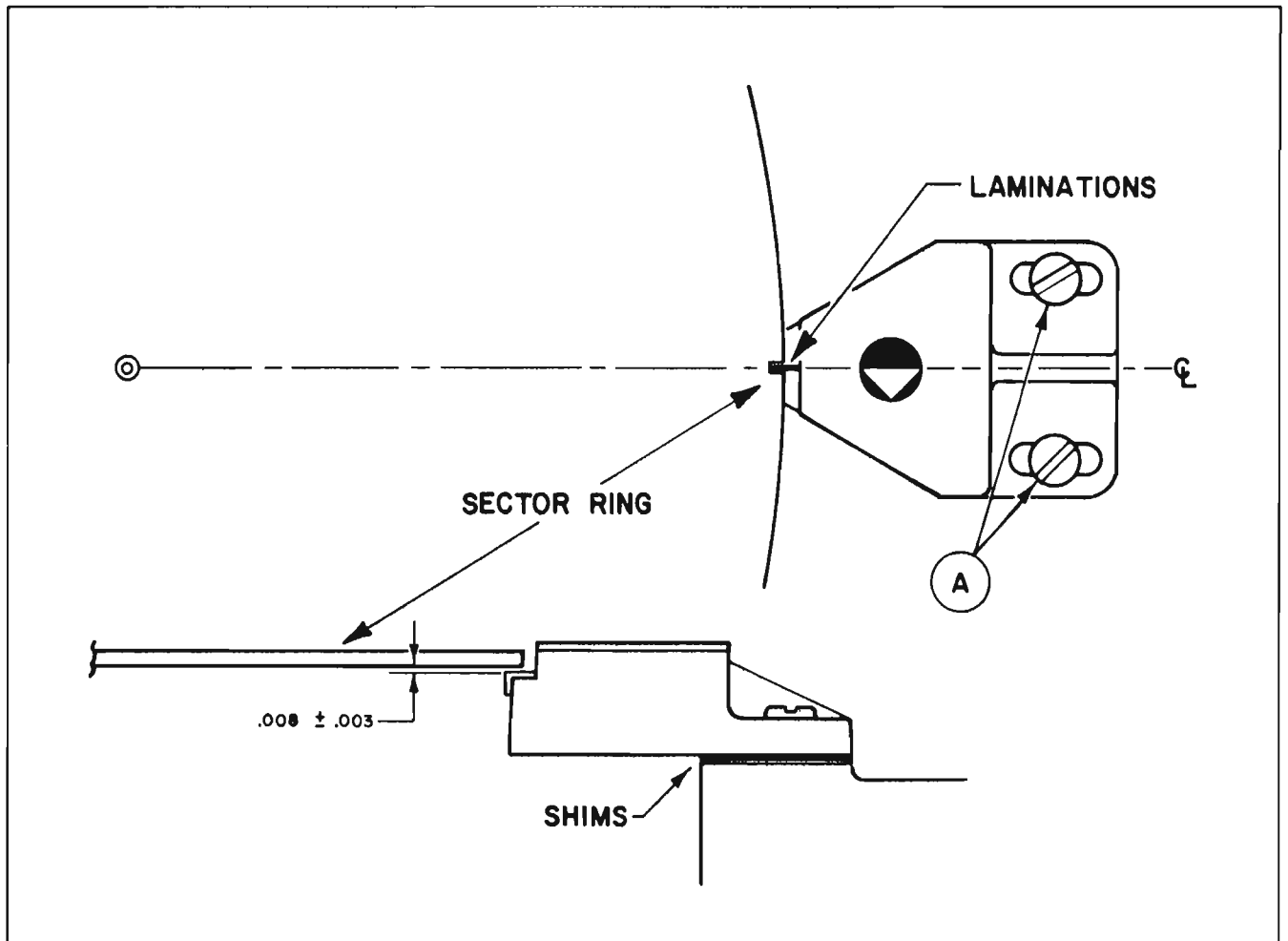


FIGURE 18 INDEX TRANSDUCER ADJUSTMENT

5. Front-panel components are accessible for removal or replacement by loosening the two hexagon socket screws which hold the front panel in position. Access to these screws is through two holes, one on each side of the bowl, as shown in Figure 19. To permit the front panel to swing freely, two lower screws, one on each side may require loosening. These screws are located between the front panel and the lower section of the slide inner member. The

front panel now swings down partially, giving access to components mounted on the rear of the front panel. Some components mounted on the pan or baseplate are also accessible by lowering the front panel.

6. Locate the index transducer baseplate, which is screwed to the outside front of the bowl assembly at the centerline. This plate, shown in Figure 20, has four hex-head fastening screws ("A") and a slotted-head adjustment screw ("B").

Index Transducer Alignment. Set the exerciser switches as follows:

TRK 8....ON  
TRK 2....ON  
TA.....ON  
All Others....OFF

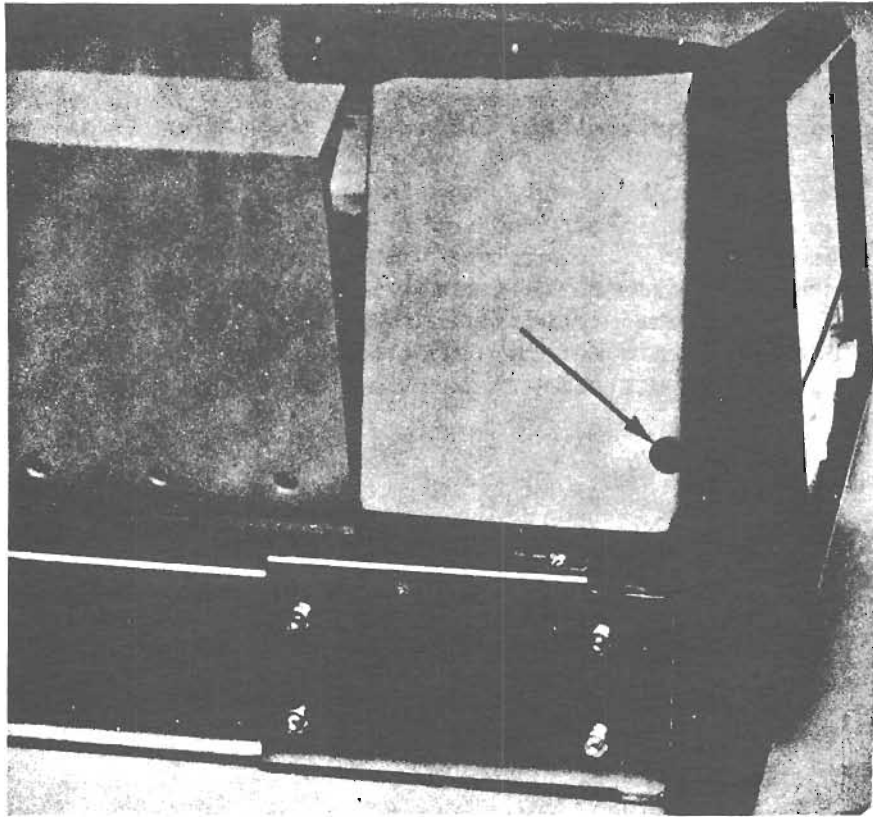


FIGURE 19 FRONT PANEL RETAINING SCREW ACCESS

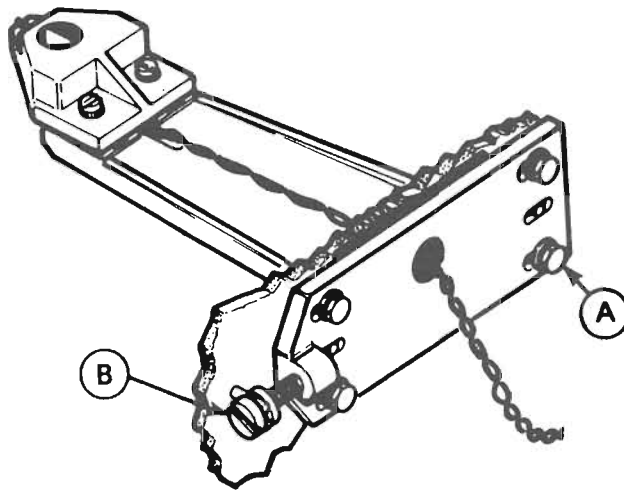


FIGURE 20 UPPER INDEX TRANSDUCER ADJUSTMENT

Connect cable 2 of the 7013 Exerciser to 1K resistor M31 on the early Servo board (12068) or the 12099 with 12067 artwork. On 12099 PCB's with 12098 artwork -5V is available at location H26 pins 7 & 9, see Figure 10B.

Locate the four Head Plugs on the D/T PCB (#12046). These plugs are oriented from the top down: upper head/upper disk; lower head/upper disk, etc. The lower two plugs are for the lower disk heads.

Remove upper disk/lower head cable from the Data Transfer board and connect it to cable described in Figure 9.

Connect channel 1 of the oscilloscope to TP1 on the 7013 Exerciser. Trigger EXT. NEGATIVE on TP F75 of Logic PCB's with 12065 Artwork; TP E76 of Logic PCB's with 12065-01 Artwork. Perform the index transducer alignment as described below:

1. Install the alignment cartridge, place the drive in the RUN mode. (Allow time for temperature stabilization.)
2. Using the exerciser, seek to track 10 (200 tpi).
3. Slightly loosen the four fastening screws just enough to permit side movement of the transducer baseplate.

4. Using the adjustment screw ("B" Figure 20), position the index transducer so that the leading edge of the read gate occurs 19 usec  $\pm$  3 usec after the leading edge of the index mark. Do not tighten the fastening screws yet. See "A" in Figure 21.
5. Alternately selecting each of the upper heads, adjust the index transducer so that the read gate is symmetrical around the 19 usec point. Total pulse separation between the heads shall not exceed 6.25 usec. If this tolerance is exceeded, the heads must be checked for proper seating. See "B" in Figure 21.

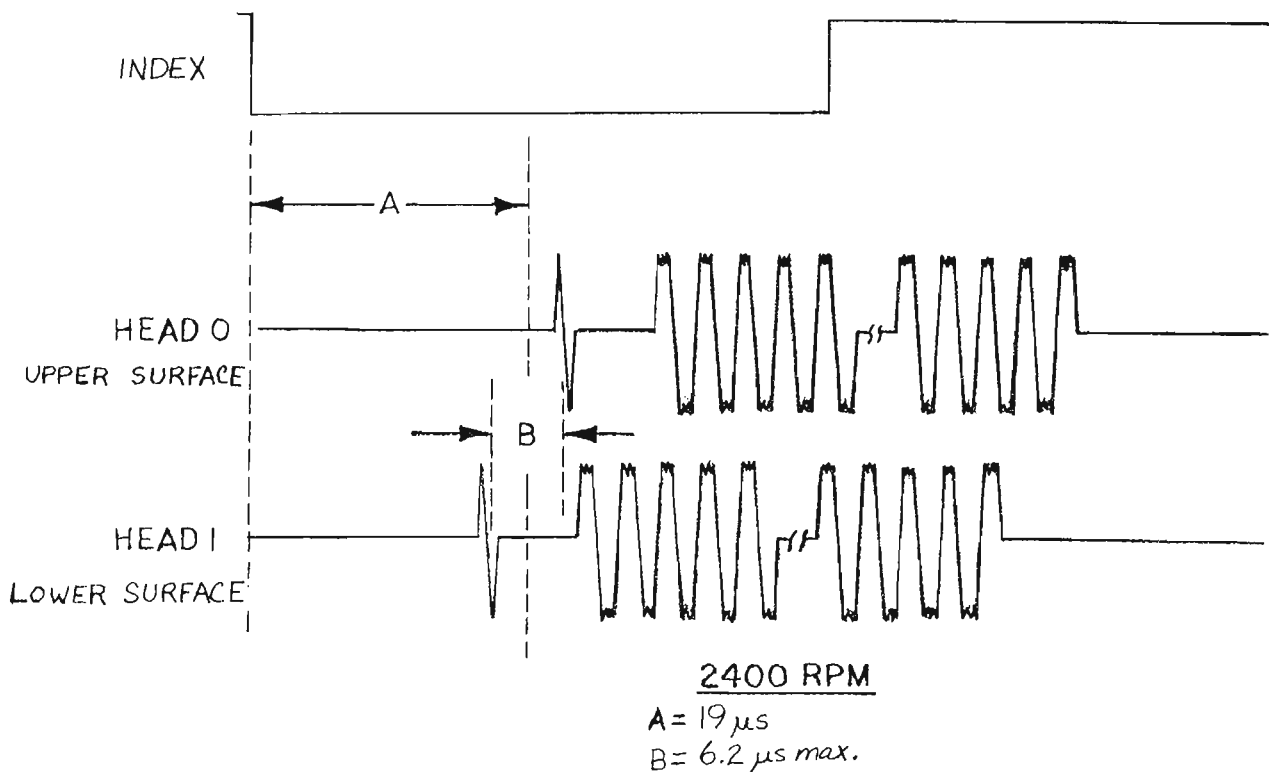


FIGURE 21 INDEX TRANSDUCER ALIGNMENT TIMING REQUIREMENTS

6. Tighten the four fastening screws, observing that tightening the screws does not result in misalignment.
7. Return the front panel to the operating position.

### 5.2.5.5 Head Positioner Azimuth Adjustment

#### NOTE:

Presently the TRIBIT alignment cartridges that we have do not have azimuth information recorded at track 402. As we receive cartridges that contain this information, they will be rotated so that cartridges presently in the field can be updated.

#### Check Procedure:

1. Trigger scope externally on negative going edge of index at TP F75 for Logic PCB's with 12065 Artwork; TP E76 for Logic PCB's with 12065-01 Artwork.
2. Measure the Index-to-Data burst time for one of the upper disk heads at track 10 and then at track 402. Note the time difference in the Index-to-Data burst time, between track 10 and track 402 (see Figure 22). The time difference "A" must not exceed 6  $\mu$ sec. If the time difference is greater than 6  $\mu$ sec perform the following adjustment.

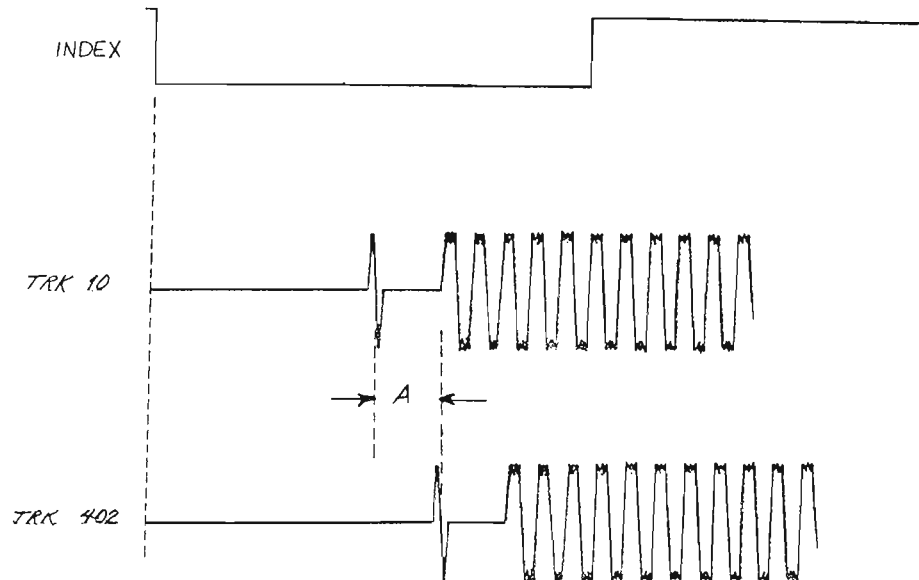


FIGURE 22 POINT "A" CANNOT EXCEED 6 USEC



Adjustment Procedure:

1. Break the holding torque of Allen screw holding rear of positioner base plate.
2. Loosen two Allen screws holding front end of positioner base plate.
3. Loosen temperature compensation arm screw.
4. Use large screwdriver to shift positioner to left or right while standing at the side of the disk drive.
5. Verify index-to-data burst on both upper disk heads is within 6 usec at track 10 and track 402.
6. Secure the three head positioner screws and repeat index-to-data burst verification.
7. Check track-zero adjustment according to 5.6.4.5, and adjust if necessary.

5.2.5.6 Voltage Check Points

The power supply assembly produces the following DC voltages required by the disk drive circuitry.

+24 VDC, -24 VDC, -24 VDC Unfused

+15 VDC, -15 VDC

+5 VDC

NOTE:

-24 VDC Unfused output is used to drive the emergency head retract circuit.

All the above voltages can be checked at TB2 of the Regulator PCB.

+24 VDC (TB2-11)  
24V Return (TB2-9 & 10)  
-24 VDC (TB2-8)  
-24 VDC Unfused (TB2-12)  
5V Common (TB2-6)  
+5VDC (TB2-7)  
15V Common (TB2-1)  
+15VDC (TB2-2)  
-15VDC (TB2-3)

The amplitude of the +5 VDC output is adjustable by means of 500 $\Omega$  potentiometer at location D31.

# Service Newsletter

NO. 87

May 5, 1977

## MASS STORAGE DEVICES #11 CDC DISK PACKS REPRINT

This Newsletter contains a reprint of a brochure published by Control Data Corporation explaining in general terms:

Disk Pack Terminology  
Introduction To Disk Packs  
Data Recording And Recovery  
Disk Pack Manufacturing & Testing Guide  
Disk Pack Comparison Chart

Wang Laboratories will be offering several disk drives manufactured by CDC in different speeds and storage capacities and most of the enclosed information should be understood by personnel performing maintenance on our current disk drive products (Diablo 43, 44, 44B).

For instance, the Diablo Series 40 disk drives that we presently use, utilize the FM (Frequency Modulation) recording technique, and use a 5440 type cartridge. The CDC Storage Module Drives that will be used in future products utilize the MFM (Modified Frequency Modulation) recording technique, and use a cartridge capable of 400 TPI track density and 6000 BPI bit density on the inner tracks. The packs used on the Storage Module Drive line are not shown in the Disk Pack Comparison Chart.

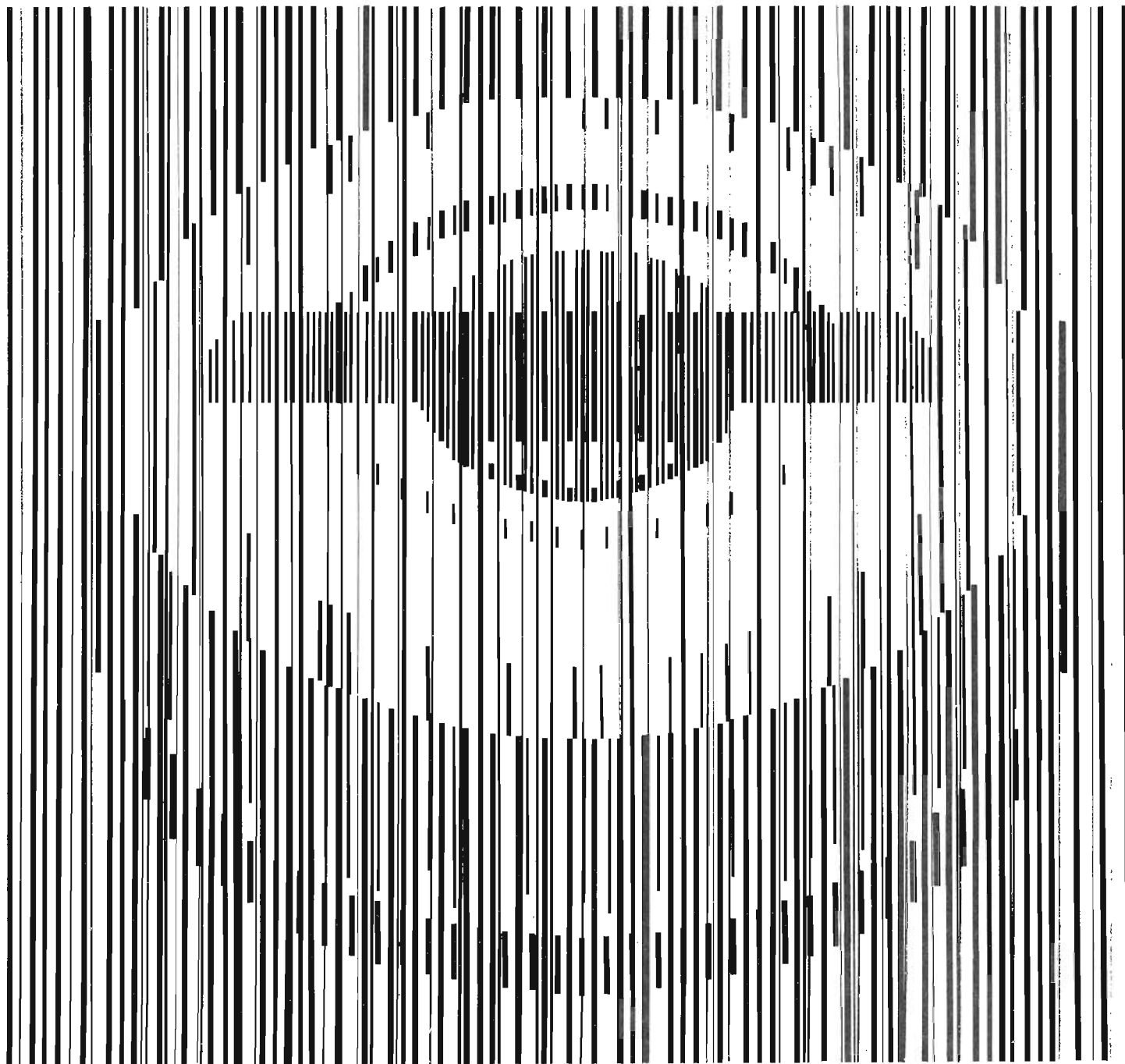
**WANG**

LABORATORIES, INC.

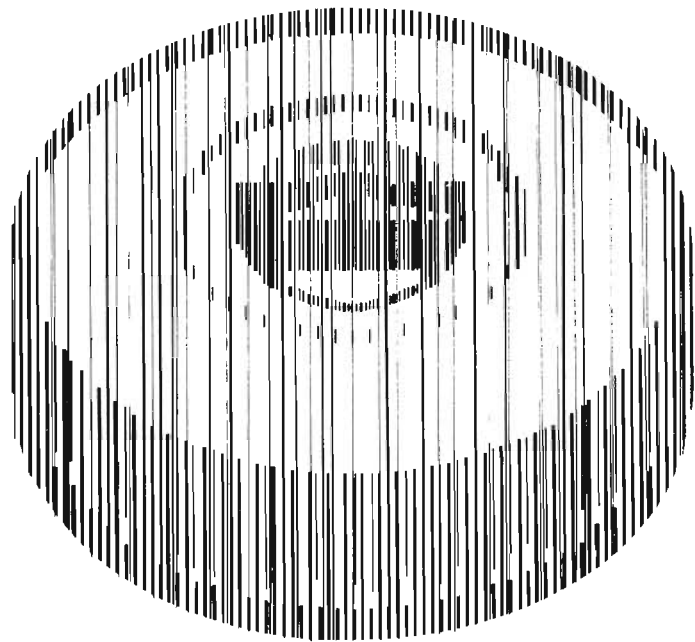
ONE INDUSTRIAL AVENUE, LOWELL, MASSACHUSETTS 01851, TEL. (617) 851-4111, TWX 710 343-6769, TELEX 94-7421

Printed in U.S.A.  
13-266

# DISK PACKS



CONTROL DATA CORPORATION



# DISK PACK TERMINOLOGY

## SUBSTRATE

**Acceleration of Axial Runout**—the vertical change of velocity with respect to time. Acceleration is a measure of the abruptness of the change in axial runout.

**Axial Runout**—the displacement perpendicular to the disk surface. Runout is generally specified in terms of Full Indicator Movement (FIM).

**Full Indicator Movement (FIM)**—the total movement indicated by the transducer measuring the surface under test. Identical in meaning to and formerly called TIR.

**Horizontal Runout**—the displacement parallel to the disk surface, specified in terms of FIM.

**Micron**—40 microinches.

**Parallelism**—the local variation in disk thickness, measured independently of thickness itself.

**Radial Runout**—the variation of a surface above or below a reference plane as measured along a radius from inside diameter to outside diameter.

**Substrate**—the base to which the magnetic medium is bonded. In most disk cartridges and disk packs, the substrate is an aluminum disk.

**Surface Roughness**—consists of the finer irregularities in the surface texture. Usually includes those irregularities within the roughness width cut off which result from the inherent action of the production process.

**Thickness**—the absolute value of the difference between top and bottom surfaces independent of local minor variations.

**Velocity of Axial Runout**—the vertical change with respect to time of the disk surface when viewed from a point perpendicular to the surface.

**AGC**—Automatic Gain Control.

**Agglomerate**—a minute defect in surface coating where oxide has built up and is thicker than surrounding areas.

**BPI**—bits per inch.

**Burnish**—a method by which the surface roughness of the disk is reduced. It generally involves flying a head with a ceramic or other hard slider material over the disk surface.

**Cateyes**—a term that characterizes a two-lobe pattern present in the read signal of a head positioned over a head alignment track of some CE packs. The head is properly aligned when the two lobes are exactly equal in duration.

**CE Pack**—a customer engineer's pack prerecorded with data required to check head alignment, carriage alignment and, in some cases, index transducer alignment.

**Double Frequency (2F) Encoding**—a modulated frequency encoding method which utilizes two basic frequencies, 1F and 2F, for recording of binary information.

**Extra Pulse**—any spurious signal measured on a previously d.c. erased track whose amplitude exceeds an established acceptance limit and would therefore be erroneously detected as data.

**Gap Length**—the air gap dimension of a core in the direction of disk motion. Gap length is a primary factor in determining the packing density achievable with a read/write head.

**Gap Width**—the dimension of a core air gap along a disk radial. Gap width is the primary factor in determining track width and therefore, the track density achievable with a read/write head.

**Hard Errors**—errors which are permanent and which continuously recur on successive retries to read information correctly.

**Head-Disk Interference (HDI)**—contact between the slider of the magnetic head and the surface of the magnetic disk.

**Index to Burst**—a term that identifies a pattern written on some CE packs used in index transducer and carriage alignments.

**Inner Guard Band**—a circumferential area near the inner diameter of a servo surface used to define

the inner boundary of the recording area on data surfaces. On 3336-type packs, the inner guard band is prerecorded with 18 minus-even tracks.

**MFRS**—millions of flux reversals per second.

**Misregistration**—the error that exists between the centerline of a recorded track and the nominal centerline of that track.

**Missing Pulse**—any pulse in a recording pattern whose amplitude is lower than an established acceptance limit.

**Modified Frequency Modulation Encoding (MFM or 3F)**—an encoding method which utilizes three fundamental frequencies: 1F, 2F, and 3/2F, for recording of binary information.

**Modulation**—increases or decreases in the nominal amplitude of a playback signal generally occurring at frequencies significantly lower than the fundamental data recording frequency.

**MTS**—millions of transitions per second.

**Outerguard Band**—a circumferential area near the outer diameter of a servo surface used to define the outer boundary (track 000) of the recording area on data surfaces. On 3336-type disk packs, the outer guard band is prerecorded with twelve consecutive plus-odd tracks.

**Overwrite Modulation**—modulation of a recorded 2F pattern by the remanent portions of a previously recorded 1F pattern.

**Peak Shift**—a time variation in the peaks of a recorded playback signal from their expected time slots or position.

**Pinhole**—a minute defect in surface coating where magnetic media is missing.

**Read Pulse Amplitude**—generally used in reference to testing 1316/2316 type disks, it is the average peak-to-peak value of the highest 50 microsecond sector on a data track.

**Read/Write Head**—a transducer that produces a magnetic field upon application of a current to one of its windings (write) or produces an electrical

voltage across its windings when a changing magnetic field is present across the air gap of the core upon which the coils are wound (read).

**Remanent Amplitude**—also referred to as residual noise, is the average value of the noise signal measured on an erased track.

**Residual Noise**—same as remanent amplitude.

**Resolution**—the ratio between the readback signal voltage recorded at 2F frequency and the readback signal voltage recorded at 1F frequency.

**Saturation Current**—the value of write current which just saturates the complete magnetic coating. On reading recorded data, the playback voltage is maximum for this current.

**Servo Surface**—a dedicated surface prerecorded with servo tracks. The information recorded on the servo surface is used for the precise positioning of the actuator at the radial location specified for each data track. Additionally, the servo surface can be used to provide the clock data necessary to decode the information recorded on data surfaces.

**Servo Track**—a track of a servo surface that is recorded with either positive odd or negative even dibits. Each servo track is divided into 13 440 (3336 type pack) equal intervals of 1240 nano-seconds each. On positive odd tracks, positive dibits are recorded at the leading edge of odd-numbered intervals. On negative even tracks, negative dibits are recorded on the leading edge of the even numbered intervals.

**Servo Zone**—on a servo surface, a prerecorded circumferential area bounded by the outer and inner guard bands. Within the two limits of the servo zone, the prerecorded servo tracks alternate between plus-odd and minus-even tracks. The boundary between a plus-odd track and a minus-even track defines the radial location of the cylinder on which the centerlines of the data track occur.

**Soft Errors**—errors which occur spuriously and which may not appear on successive retries to read information correctly.

**Straddle Erase**— a feature of second generation disk pack head to provide a narrow write/wide read track. Two magnetic structures that are independent of the read/write magnetic structure straddle the track. The read/write head writes a track wider than prescribed; the track is then trimmed to the proper width by the straddle erase coils.

**Track Average Amplitude**— the average amplitude of a constantly recurring pattern on a data track measured over one full disk revolution.

**Tunnel Erase**— a feature of early disk pack heads to provide greater tolerance on head positioning. The leading edge of the read/write gap was wider than the trailing edge. The "tunneling" of track width causes the recorded track width to be determined by the narrower trailing edge. However, on readback the wider leading edge permits greater tolerance in positioning the gap over the recorded track.

## PACK

**Access Time**— generally, the time interval between the instant at which information is either: 1) called for from storage and delivery is completed (read time) or 2) ready for storage and storage is completed (write time). If restricted to disk storage drives, access time means the time required to move the read/write heads from their existing location to the cylinder specified by the controller. Latency time would not be included.

**Alternate Track**— spare tracks on each surface used in the event that a normal track becomes damaged or inoperable.

**ANSI**— the American National Standards Institute.

**Block**— a group of consecutive words or characters considered or transferred as a unit.

**Byte**— a sequence of digital bits usually operated upon as a unit. A byte is usually eight bits long.

**Correctable Error**— refers to systems using error detection and correction techniques; a single or

multiple bit error which can be 100% corrected, thereby preventing the loss of data.

**Cylinder**— the set of data tracks, one per data disk surface, which are at the same radial position and which are accessed simultaneously on a seek command to the head actuator.

**Dibit**— a shortened form of dipole bit. The read back signal produced by a pair of recorded magnetic poles that are separated by a fixed interval.

**Field**— a set of one or more bit positions (or words) consistently used to record similar information. In disk storage drives, the shortest field contains eight bits (one byte).

**File**— a collection of records or an organized collection of information. The records in a file may or may not be sequenced according to a key contained in each record.

**Flag**— a field used to store information, usually regarding status.

**Format**— a predetermined arrangement of characters and fields.

**Formatting**— the part of disk pack initializing in which the Home Address and Record 0 areas are written. A disk pack must be formatted before it can be used on a disk storage drive.

**Head Loading Zone**— a circumferential area near the outside diameter of each disk surface in which heads are loaded onto the surface to establish flying stability. Head-disk contact may occur in some instances; no data is recorded in this area.

**Home Address**— the area immediately following the Index gap in which the information defining the physical location (cylinder number and head number) and characteristics of that track are recorded.

**Index**— the point which defines the beginning and end of a track. Index can be derived from slots cut into a non-recording disk (IBM-1316) or can be derived from a pattern recorded on a disk (IBM-3330).

**Initialization**— with respect to disk packs, the



process in which each track is checked for errors and then prerecorded with addresses and other information in the format required for use in a disk sub system.

**Latency Time**— in disk storage drives, the time required for the addressed record to be available at the read/write head after the move to the addressed cylinder is complete.

**Memory**— a device or media used to store information in a form that can be understood by the computer hardware.

**Minus Even Track**— a track recorded with negative dibits located at the even-numbered intervals around a track.

**Negative Dibit**— the read back signal associated with a South-South then North-North pole sequence. The dibit consists of a negative going wave form followed immediately by a positive going wave form.

**Plus Odd Track**— a track recorded with positive dibits located at the odd-numbered intervals around a track.

**Positive Dibit**— the read back signal associated with a North-North then South-South pole sequence. The positive dibit consists of a positive going wave form (North-North transition) immediately followed by a negative going wave form (South-South transition).

**Random Access Memory**— a memory in which the desired information is organized into discrete locations, each of which is identified by a unique address. Data may be obtained or stored in such a memory by specifying the address and the operation (read or write) desired.

**Record**— a set of fields which usually contain all the information concerning one specific item.

**Sector**— an addressable portion of a track in which data can be sequentially stored and retrieved. The number of sectors available per track depend upon the type pack in use.

**Sequential Access Memory**— a memory in which information is not organized into discrete

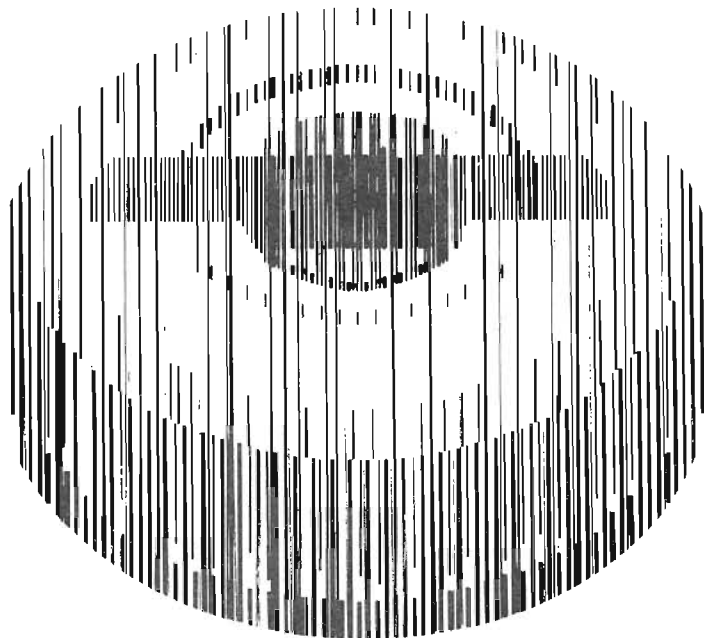
addresses. Such a memory requires that the stored information be searched sequentially until the desired record is available for a read/write operation.

**TPI**— tracks per inch.

**Track**— an addressable portion of a recording surface in which data can be stored or retrieved. The tracks of a recording surface form concentric circles, with the location or address of each track being at a specific radial distance from the disk pack centerline. Adjacent tracks are separated by an unaddressable portion of the data surface.

**Track Flag**— in disk storage drives, a field consisting of one byte in the Home Address area used to indicate that the addressed track is a good original track, that it is a good alternative assigned track, or that it is a defective alternative track.

**Uncorrectable Error**— refers to systems using error detection and correction techniques, a single or multiple-bit error which cannot be corrected, thereby causing loss of data.



# INTRODUCTION

A disk system is the result of a successful marriage of many sciences and technologies. Mechanics, metallurgy, thermodynamics, aerodynamics, chemistry, electronics and the physics of magnetism play extremely important roles in the system design. Precision machining to state of the art tolerances is vital for all components of the disk pack and the disk storage drive. Precision measurement of mechanical, chemical and magnetic properties must be performed throughout the disk pack manufacturing cycle. Stringent process controls are required to insure that key parameters are kept within allowable limits. Precise testing of the magnetic recording and readback characteristics of each disk minimizes the possibility of microscopic defects creating errors at the system level. The end result is a disk pack that can operate reliably on any appropriate drive. Both a knowledge of magnetic recording and data recovery, and an insight into the manufacturing process of disk packs, are helpful in understanding how this reliability is achieved.

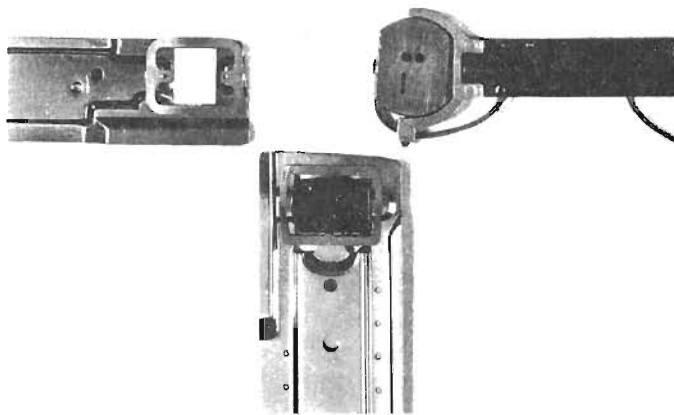


Figure 1

The disks making up a pack have aluminum substrates that are approximately 14 inches in diameter. A magnetic coating bonded to the substrate provides the information storage medium. Electro-magnetic transducers known as "flying heads"

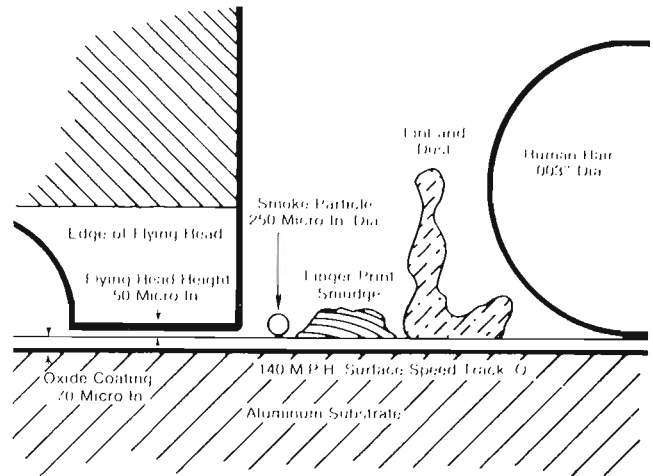


Figure 2

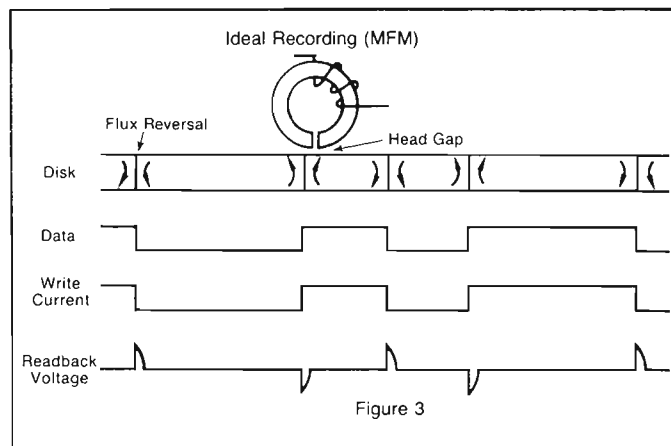
furnish the interface between the magnetic coating and the rest of the system. (Fig. 1) The slider, or pad, of a flying head and the surface of a coated disk form an aero-dynamic system. In operation the disks rotate at a high speed, typically 2400, 2964, or 3600 RPM. Air entrained by the disk surface forces the head away from the disk due to the curvature machined in the slider. The distance the head is forced away from the disk surface depends upon the slider curvature, the disk surface speed, the disk surface finish and the spring loading built into the head arm which forces the head toward the disk. Generally, the higher the bit packing density the closer the heads fly, due to system requirements on coating thickness and readback amplitude. Figure 2 illustrates a typical head/disk separation. Read/write coils wound on a magnetic core are embedded in the head slider. The uniformity of the head/disk spacing is a controlling factor in the uniformity of the signal generated during a read operation. The low order of magnitude of the typical head/disk spacing and the requirement for uniformity of this spacing are indications of the type precision required in disk pack manufacturing.

# DATA RECORDING AND RECOVERY

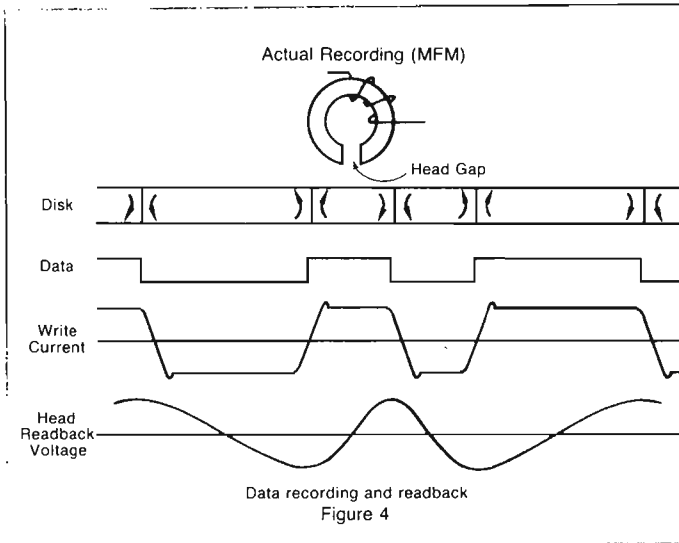
Data is written on a coated disk by passing a current through the read/write coil which generates a flux field across the head gap. This magnetizes the iron oxide particles directly beneath the gap. The direction of write current controls the direction of the flux field thereby controlling the orientation of the magnetic field recorded on the disk. The strength of the flux field, which is determined by the amplitude of write current, controls the number of particles of iron oxide that are affected up to the point of saturation. Information is recorded by switching the direction of the write current to correspond with the encoding method used in the drive. In all commonly used drives, the direction of the recorded magnetic field contains no information. Information is contained exclusively in the transitions where flux reversals occur in the recorded field. However, these transitions have meaning only when their time of occurrence with respect to the data clock is known.

Data recovery involves detecting the presence of the recorded flux transitions, determining the time of their occurrence with respect to clock, and then decoding the result into a serial data stream that is forwarded to the drive controller. During readback, a flux transition passing beneath the head gap induces voltage into the coil. This voltage is proportional to  $d\phi/dt$ , the rate of change of flux with respect to time. The peak of the readback signal is generated where the rate of change of flux is maximum, i.e., where the flux is minimum. This peak readback signal occurs at either the cell or the half-cell boundary, which is the point where write current crossed zero during the write current reversal. Recovering the recorded data involves comparing the time at which the peak of the signal occurred to the time that the cell or half-cell boundary occurred. It is extremely difficult to determine the exact time of occurrence of a peak due to both the low rate of change at the peak and the probability of slight changes in amplitude from peak to peak. Therefore, the readback signal is generally phase-shifted by

90° through a differentiator, causing a simultaneous zero-crossing at the output and a peak at the input. This permits a more precise comparison of timing relationships and thus a more accurate decoding of the readback signal. Prior to differentiation, if any condition exists on the disk that causes the peak of the readback signal to shift abnormally from its nominal position, an error can result in the data sent to the computer.



Peak shift is caused by departures from the ideal in the recording/readback process. Ideally, the gap in the read/write head core would be infinitesimal, the head would be an infinitesimal distance above the disk surface, and the write current reversal would be instantaneous. (Fig. 3) This would result in such discrete and narrow flux reversals on the disk that the departure of their occurring time with respect to nominal would be insignificant. The head readback voltage would consist of a train of very narrow pulses. Since the ideal gap is infinitesimal and very close to the disk, it would intercept only those flux changes due to a single flux reversal—there would be no merging at the head of the flux changes due to successive reversals. In actual recording, the flux reversals on the disk are not instantaneous. (Fig. 4) It takes time for the write current reversal to occur; the head gap is finite; and



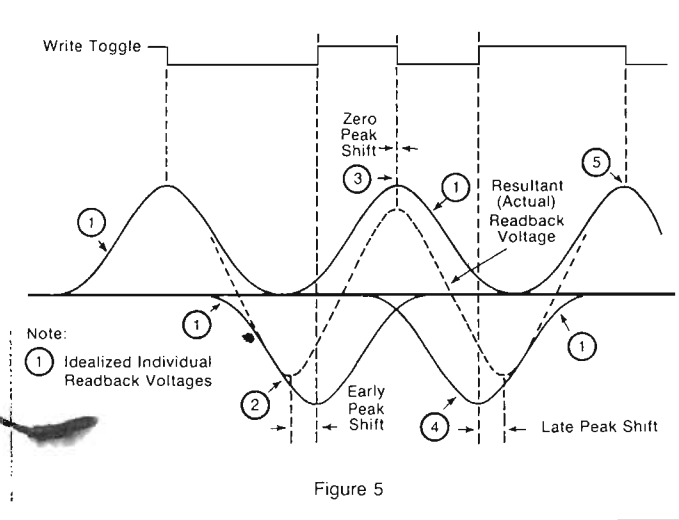
due to disk imperfections, the head must fly far enough away from the disk to prevent head/disk contact. Therefore, there will, at the head, be a merging of flux changes due to successive flux reversals. The net effect is that there will always be a peak shift present in the resultant head readback voltage unless the written pattern is all 0's or all

1's. Reference to Figure 5, PEAK SHIFT, illustrates this effect. Reversals 1 and 2 illustrate an 01 pattern. If reversal 2 were displaced from reversal 1 far enough, then readback voltage 1 would be the resultant head voltage. The dashed line represents the resultant head voltage due to the crowding and early peak shift occurs. Reversals 2, 3, and 4 are a 111 pattern and there is no peak shift on reversal 3. Reversals 4 and 5 represent a 10 pattern and late peak shift occurs. Thus peak shift is a normal occurrence in disk recording. The data recovery circuits of the drive are designed to compensate for the peak shift that occurs as a result of the data pattern. In addition, the drive data recovery circuits provide a timing margin, or data recovery window, at the output of the zero crossing detector. This window compensates for the expected production tolerances in coating uniformity, the substrate surface, and variations from drive to drive. Generally, when peak shift is mentioned, the meaning is understood to be restricted to peak shifts caused by factors other than the recording pattern itself.

MAGNETIC RECORDING OF DATA ON DISK  
DISK PACKS AND DISK CARTRIDGE

NRZI

**NON RETURN TO ZERO INDISCRETE.** A logic 1 is recorded by a reversal in write current direction. A logic 0 is recorded by *no* reversal of current. In the readback signal, only logic 1's appear as pulses and can be either positive-going or negative-going. Logic 0's are recognized by the absence of a signal. A primary *disadvantage* is that NRZI is not self-clocking and therefore requires the writing of a separate clock track. A primary *advantage* is that a maximum of one flux change (current reversal) is required per bit. NRZI was used only on IBM 1311 type drives and is now obsolete as a disk pack recording technique. (Fig. 6)



FM:

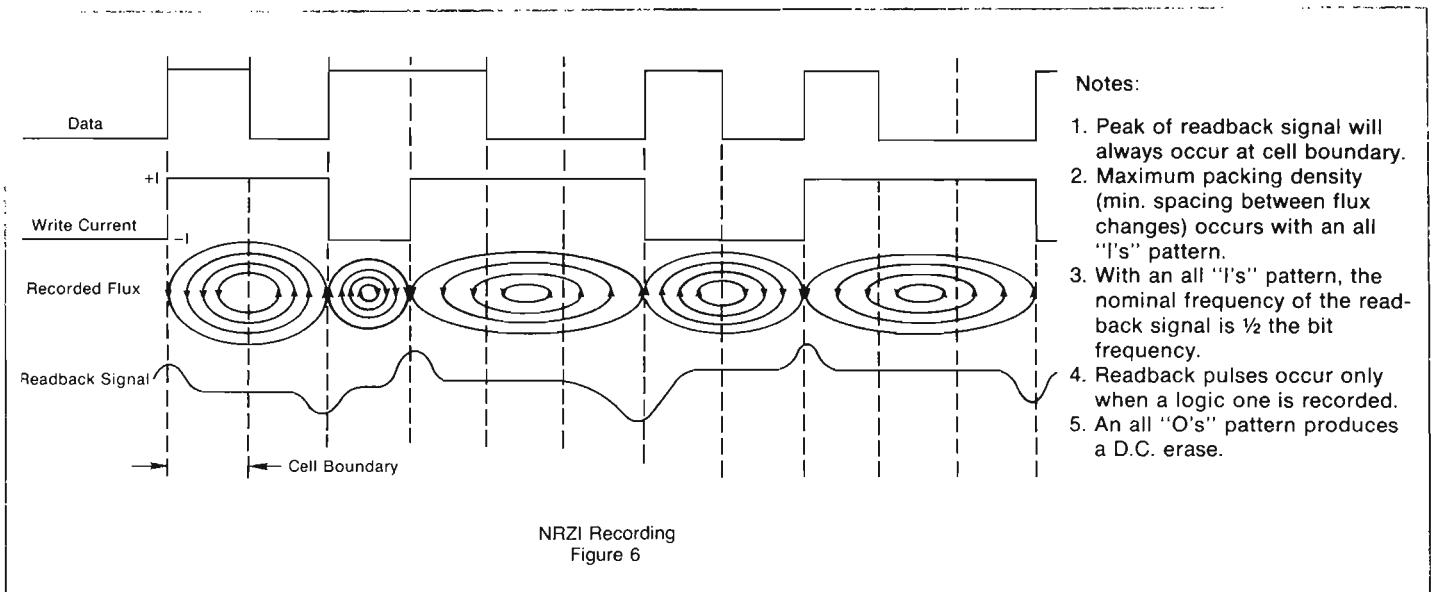
**FREQUENCY MODULATION – ALSO KNOWN AS DOUBLE FREQUENCY (2F) RECORDING.** A logic 1 is recorded by a write current reversal at the middle of a bit cell. A logic 0 is recorded by *no* reversal at the middle. There is always a write current reversal at the start of a bit cell. Thus in the readback signal, a logic 0 is characterized by a single pulse occurring at the start of the bit cell. A logic 1 is characterized by two pulses, one occurring at the start of the bit cell and the second occurring at the middle of the bit cell. A primary advantage to FM recording is the inherent self-clocking that occurs in the readback data. A primary disadvantage is the need for two flux reversals to record a logic 1, thereby limiting the packing density that can be achieved in a given system. FM recording was the predominant recording technique used in disk storage drives until the introduction of the 3330-type drive. (Fig. 7)

MFM:

**MODIFIED FREQUENCY MODULATION ALSO KNOWN AS 3F RECORDING** A logic 1 is recorded by a write current reversal at the middle of the bit cell. A logic 0 is recorded by *no* write current reversal at the middle of the bit cell. A write current reversal occurring at the beginning of the bit cell is known as "CLOCK," however "CLOCK" may be suppressed. If the cell contains a logic 1 or if the previous cell contained a logic 1, then clock is suppressed. In summary, the rules of MFM recording are as follows:

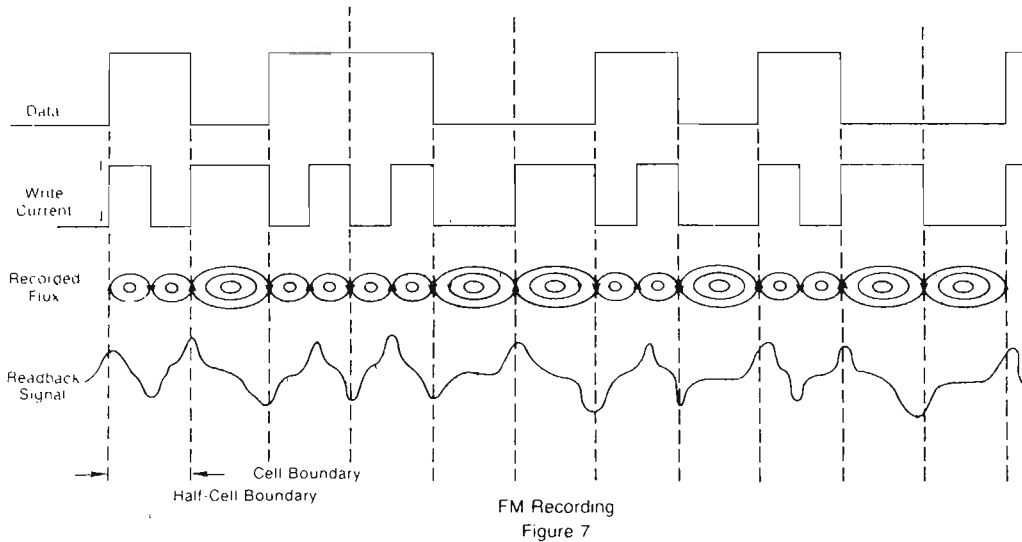
1. There is a write current reversal for each logic 1, occurring at the middle of the bit cell.
2. There is a write current reversal for each pair of logic 0 bits, occurring at the boundary between the two bits.
3. There is no write current reversal at the boundaries between a logic 01 or a logic 10 combination.

A primary advantage of MFM recording is that a maximum of one write current reversal occurs



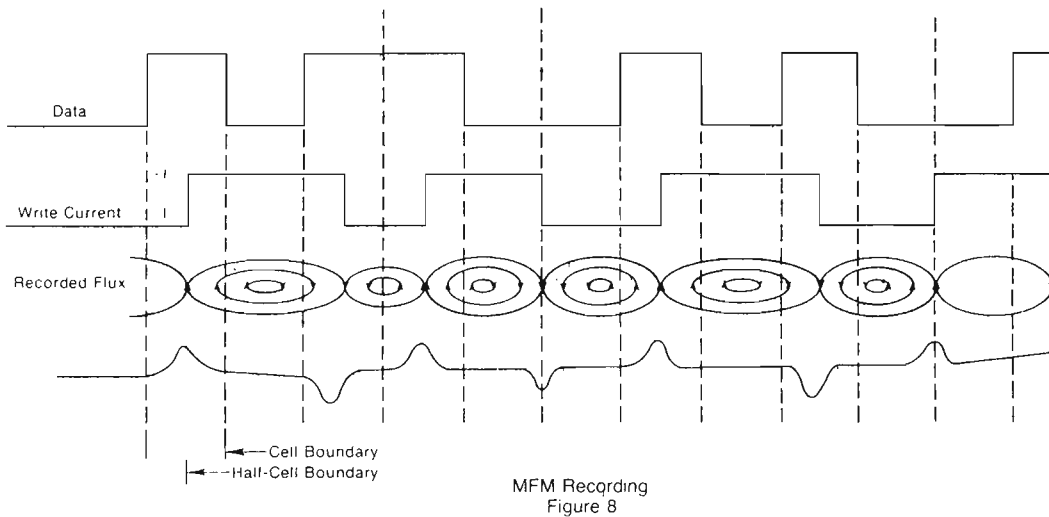
each interval. The maximum number of reversals occurs for either an all 1's or an all 0's pattern. The minimum number occurs for a pattern with alternating 1's and 0's. Therefore, it is possible to achieve a

greater packing density than would be possible with FM recording. A second advantage to MFM is that it is semi-self-clocking so that a separate clock track is not required for data recovery. (Fig. 8)



Notes:

1. There will always be a peak readback signal at a cell boundary.
2. There will be a peak readback signal at a half-cell boundary only if a logic one is recorded.
3. With an all "1's" pattern, the nominal frequency of the readback signal is equal to the bit frequency.
4. With an all "0's" pattern, the nominal frequency of the readback signal is equal to  $\frac{1}{2}$  the bit frequency.



Notes

1. If a readback pulse occurs at a half-cell boundary, a logic "1" is recorded in the cell.
2. If a readback pulse occurs at the cell boundary, a logic "0" is recorded in that cell, as well as in the previous cell.
3. If there is no readback pulse at either the cell or the half-cell boundary, there is a logic "0" recorded in the previous cell.
4. Maximum packing density occurs with either an all "1's" or an all "0's" pattern. Minimum density occurs with an alternating pattern 0101...

# **DISK PACK MANUFACTURING & TESTING CYCLE**

## **MACHINING OPERATIONS:**

The aluminum blank received from the mill must be machined both to proper thickness and to the proper ID. and OD. Additionally, the blank must be heat treated to relieve stresses created in the milling operations and be left in a zero anneal state. Machining operations are the primary factor in determining how well a head will fly over the coated disks. Therefore, following machining, the disks are subjected to very stringent tests that determine surface finish, radial flatness, runout and axial accelerations.

## **CLEAN AND ETCH OPERATIONS:**

The disk surfaces must be properly prepared prior to coating. The surfaces are mechanically and chemically cleaned to remove oxides and contaminants that would decrease coating adhesion. Additionally, the disks are chemically etched to improve adhesion.

## **COATING AND POLISHING OPERATIONS:**

The coating operation is crucial to the proper performance of the disk pack. The coating consists of magnetic iron oxide particles that are dispersed in a binder that provides the necessary coating adhesion to the substrate and keeps the individual particles separated. The uniformity of the dispersion is extremely important since voids and agglomerates of the oxide particles can create unuseable surfaces.

Prior to application of the coating, the dispersion is a rather thick liquid whose viscosity is closely controlled. The method normally used to apply the dispersion is by spin-coating, a process in which excess coating is applied to a slowly rotating substrate. Excess is then spun off by increasing the speed of rotation. Coating thickness is determined by the rate at which the speed is increased, the final speed, and the viscosity of the dispersion. Following coating, the disks undergo a curing cycle which "fixes" the binder. The disks are then buffed to specified coating thickness and polished to provide the surface finish required by head flying char-

acteristics. The coated disks are sample tested for surface finish, coating thickness, adhesion and durability before being processed further.

## **DISK TESTING OPERATIONS:**

Prior to assembly as a pack, the polished disks are subjected to extremely stringent tests to insure both the magnetic performance of the disk and the ability of the coated surface to fly a read/write head. The initial operation is the head flying test, in which a special head, called a burnishing head, is flown at approximately one-half the flying height of a normal read/write head. As the burnishing head moves across the disk, it contacts any microscopic surface protrusions left by the polishing operation. Detection of a head/disk contact causes the head to burnish the protrusion until either head/disk contact is no longer made or a reject is signalled. In addition to insuring the head flying characteristics of the disk surface, the burnishing operation decreases the effect of localized increases in coating thickness, occurring because of the surface protrusions.

Checking the magnetic performance of the disk requires two rather broad testing procedures: 1. Locating coating defects which could lead to excessive peak shift; 2. Locating coating defects which create excessive degradation in signal-to-noise ratio and thereby increase the probability of error in the readback signal. Some types of coating defects can trigger both problems. Additionally, the entire disk surface between the inner and outer track limits must be tested to guard against the effect of head misregistration in the drives on which the disk is to be used. There are a number of tests commonly used by manufacturers to characterize the magnetic performance of disk pack recording surfaces. Some of the tests, and the coating conditions they are designed to detect are:

1. Amplitude test. In general, the average amplitude of the readback signal is indicative of average coating thickness as long as the coating is not oversaturated or the recording frequency is not

high enough to permit resolution to enter the measurement. If the amplitude is too low, signal to noise ratio is degraded and error probability is increased, especially if a head misregistration occurs on readback. If the amplitude is too high, resolution will decrease and the probability of excessive peak shift occurring will increase.

2. Resolution test. Resolution is defined as the ratio of the average amplitude of a readback signal written at a test frequency to the average amplitude of a readback signal written at a reference frequency, which is usually lower. The amplitude of the readback signal at each flux transition is a function of the rate of change of flux at the read/write head gap. As the spacing between transitions starts to approach the gap length during a write operation, the head, at each transition, erases a part of the prior transition. Therefore, on readback, the rate of change of flux is decreased due to this pulse crowding, and the readback level is decreased. Many factors influence resolution. Among them are head flying height, gap length, write current levels, write current transition time, and coating thickness. The factor of importance to disk pack manufacturers is coating thickness. With all other factors held constant, resolution decreases as coating thickness increases. Resolution thus indicates the average peak shift to be expected with variations in the average coating thickness when the disk is recorded with a particular data pattern. It should also be noted that, with certain data patterns, a low resolution would cause a degradation in the signal to noise ratio.

3. Extra Pulse Test. Sometimes referred to as an extra bit test or a peak noise test. The purpose of the test is to locate sharp discontinuities in coating uniformity such as occur at the edges of pinholes, voids and scratches. The sharp discontinuities create phase shifts in the readback signal, thereby causing peak shift errors. It is difficult to detect and to measure the effect of the sharp discontinuities on

a track written with a pattern. Therefore, the track is recorded with a uniform magnetic field by performing a d.c. erase operation. Readback on a perfectly uniform track would contain no change in the flux field at the read/write gap. As a result, the head would produce no output signal since it is sensitive only to the rate of change of flux. However, on tracks containing a discontinuity, a flux change would be sensed at the edges of the defect. With all other factors such as surface speed, flying height and gap length held constant, the rate of change of flux and, therefore, the amplitude of the read back signal depends upon the geometry of the defect with respect to the head read/write gap. It is not unusual for the same defect to produce an extra pulse signal as well as another defect indication, such as a missing pulse signal.

4. Missing Pulse Test. Sometimes referred to as a missing bit test. As the name implies, the missing pulse test is designed to locate coating non-uniformities which lead to less than minimal read back signal levels. To locate these non-uniformities, the track is first recorded with a pattern in which flux transitions occur at fixed intervals. The level of the readback pulse from each of these transitions is tested to insure that it is greater than the prescribed minimum. Coating voids, scratches and pinholes are obvious candidates for missing pulses (as well as extra pulses). Readback level may well decrease to zero in these areas. There may also be areas in which the coating is characterized by a decreased concentration of oxide as opposed to a void, or in which coating thickness decreases momentarily. Areas such as these lead to decreased signal levels, rather than the absence of signals. Generally in a system, coating non-uniformities that create missing pulses of one or two bit duration lead to peak shift errors. Those of longer duration create peak shift errors at the leading and trailing edges, plus a degraded signal to noise ratio.

5. Modulation Tests. If the head flying height



remained constant over a track of absolutely uniform coating, a recording pattern in which the flux transitions were spaced at equal intervals would produce read back pulses of equal amplitude. The envelope of these pulses would consist of two parallel straight lines, one at the positive peak and the second at the negative peak. The flatness of the substrate controls the variations in head flying height. Due to earlier substrate testing, variations in the read pulse amplitude due to changes in head flying height should be less than some nominal level. A major cause of changes in read pulse amplitude is lack of coating uniformity. The long-term low frequency type changes are called modulation and are due primarily to localized changes in coating thickness or to the presence of agglomerates. The presence of modulation on the read signal can lead to both excessive peak shift and degraded signal to noise ratios.

6. Remanent Amplitude Test. Sometimes referred to as residual noise or average noise. The ideal coating mixture would be composed of extremely small, needle-like particles of oxide uniformly dispersed in a binder containing no impurities that would influence a magnetic field. If such a coating were applied with uniform thickness around a track and uniformly magnetized by a DC erase operation, there would be no readback signal produced in a head flying at constant height, since there would be no change in flux at the read-write gap. In practice, departure of the oxide particle shape from the ideal causes a small, random fluctuation in flux at the head; minute changes in coating thickness and the presence of minute impurities cause similar changes in flux; and slight changes in head flying height, though at a relatively low frequency, compound the other effects. The net result is the presence in the head output of a randomly fluctuating signal whose amplitude is one of the primary determinants in system signal to noise ratio, and therefore, a primary factor in the probability of generating an error.

Localized increases in the noise level can be created by localized concentrations of impurities, small oxide voids, and coating thickness variations. These localized increases in noise level further degrade system signal to noise ratio and also may cause additional peak shift, both of which increase error probability in that area.

#### **PACK ASSEMBLY OPERATIONS:**

The individual piece parts making up a pack, hardware as well as disks, have been checked prior to assembly to insure that they are in tolerance. Following assembly, the pack must be tested as a system to insure that system tolerances have not been exceeded. The initial checks are to insure that mechanical tolerances are met. These include:

a. Stacking Height. The vertical position of each disk is checked with respect to the pack vertical datum reference. This is primarily a check on the hub assembly and spacers separating the individual disks.

b. Axial Runout. The axial runout of each disk surface is checked to verify the flatness of the individual spacers, the proper torquing for the bolts which hold the pack assembly together, and any warping of the disks that may have occurred.

c. Radial Runout. The radial runout of each disk is checked to verify the concentricity of the disk with respect to the spindle center line.

d. Balance. The pack is dynamically balanced in two planes to prevent the wobble associated with an imbalance. The wobble can cause head misregistration which could lead to an extremely serious degradation in signal to noise ratio. Additionally, an imbalance can cause undue wear on the bearings in the spindle of the drive on which the pack is operated.

#### **SERVO TRACK WRITING:**

Packs having dedicated servo surfaces must have the servo data recorded in proper format before further testing is possible. Since the servo data

controls head positioning, its accuracy is extremely important and therefore is verified following the recording. The data recorded on the servo surface of 3336-compatible disk packs is typical and its format is used to illustrate the functioning of a servo surface.

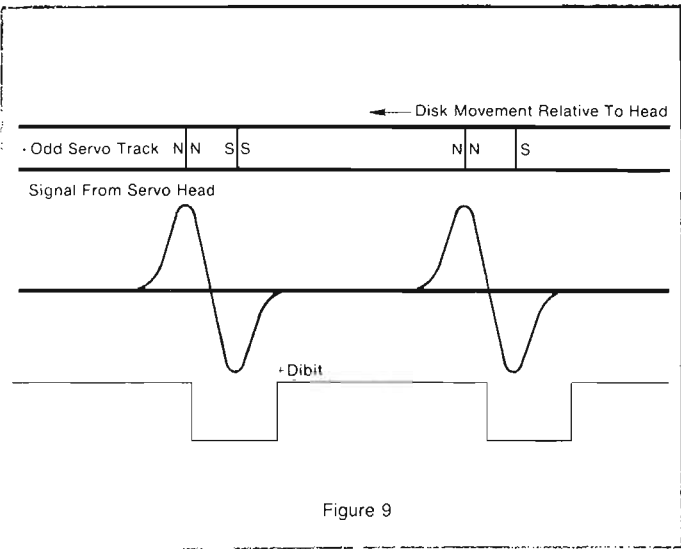


Figure 9

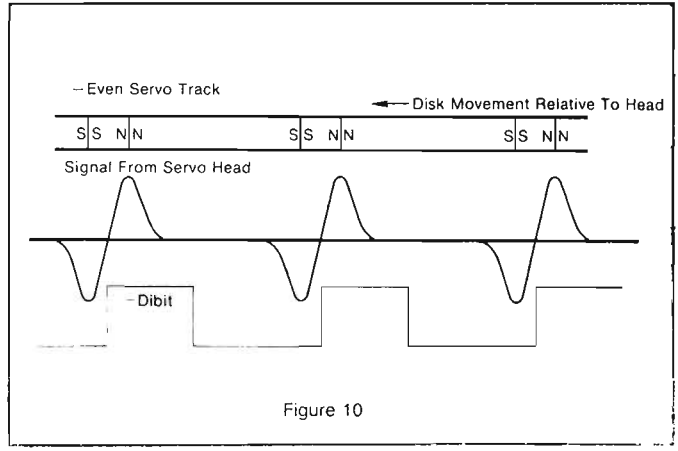


Figure 10

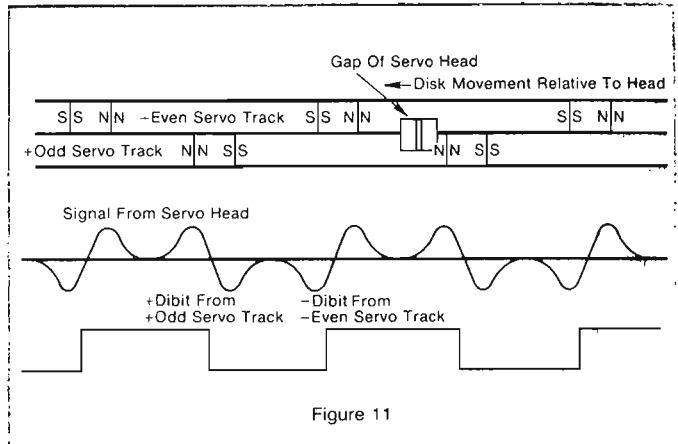


Figure 11

The servo surface is recorded with two types of tracks, designated for reference purposes as plus-odd and minus-even tracks. Figures 9 and 10 illustrate the readback signal that would be seen if the servo head were positioned on the electrical center of each of the two types of servo tracks. If the readback signal from a plus-odd track is applied to a form of zero-crossing detector, the time interval for the positive output of the detector is longer than the negative output. Therefore, the average detector output would be positive, thus the track can be recognized as one recorded with plus dibits. Conversely, if the servo head were positioned over a minus even track, the average detector output would be negative. (Fig. 10)

Each servo track is divided into 13, 440 possible intervals, counting from the index point. Each interval is 1240 nanoseconds long, corresponding to one byte of data on a data surface. On a plus-odd

track, the plus dibits are recorded only at the odd-numbered intervals. On a minus-even track, minus dibits are recorded only at the even-numbered intervals. The servo loop is conditioned so that a positive average from the detector (plus-odd track) causes the head actuator to move toward the ID and a negative output causes movement toward the O.D. Therefore, the actuator can stop only when the detector average output is zero. This condition can exist only when the servo head is positioned HALFWAY BETWEEN a plus-odd and a minus-even track and when it is reading back equal signal levels from each track. (Fig. 11) Therefore, the

boundary between a plus-odd and a minus-even servo track defines the location of the center of a data track.

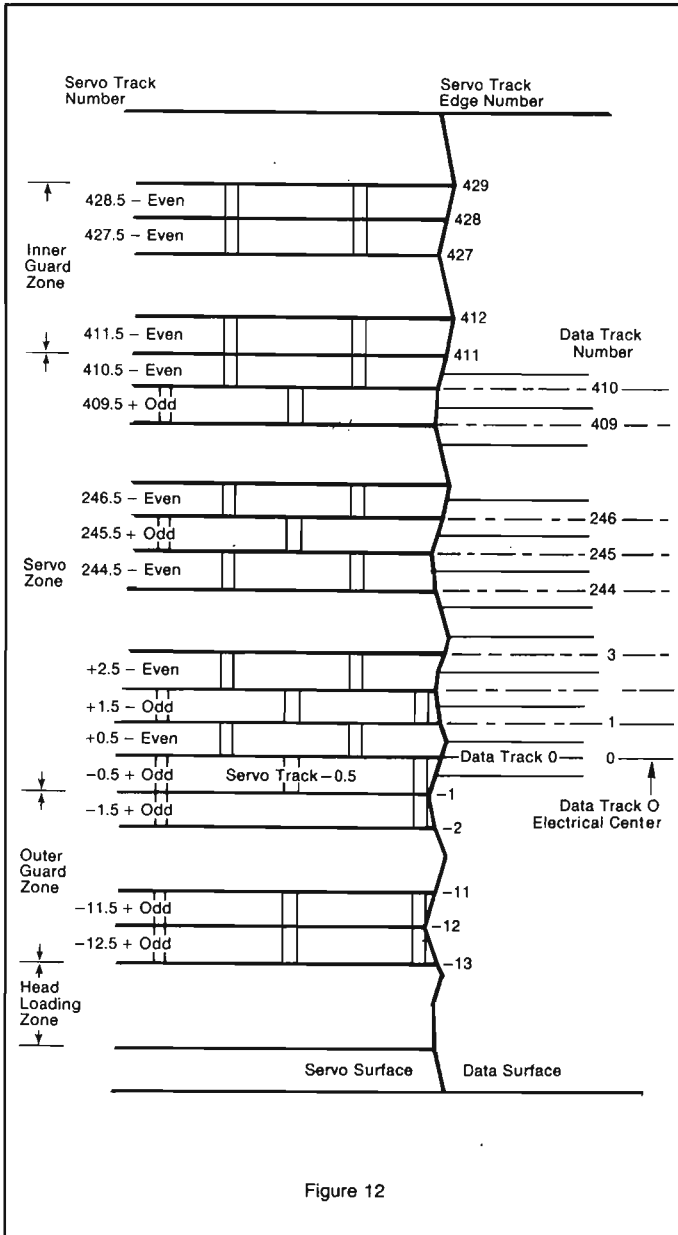


Figure 12

The servo surface is divided into three zones of pre-recorded data; the outer guard zone, the servo zone, and the inner guard zone (Fig. 12) The outer guard zone consists of 12 consecutive plus-odd tracks. The servo zone consists of 412 servo tracks alternating between plus-odd and minus-even. The inner guard band consists of 18 consecutive minus-even servo tracks. The servo zone defines the boundaries of the useable area on the data surfaces. The inner guard zone limits actuator movement toward the ID. The outer guard zone limits actuator movement toward the OD during a normal track addressing movement. The boundary between the outer guard zone and the servo zone provides the data necessary to reset the track counter in the controller, which operates the drive on which the pack is installed.

In addition to providing the actuator positioning data, the servo zone provides the means to implement additional features in the drive on which the pack is used.

1. Track following. Slight changes in the actuator position on track may be necessary to compensate for any eccentricity in the recorded servo track.

2. Write timing. When the actuator is correctly positioned on track, the servo head readback signal establishes the boundaries for each of the 13,440 byte intervals on a data surface. Since the servo data is prerecorded, the data timing is relatively independent of the drive on which the pack is operated. Therefore, data written on one drive can be read back accurately on another drive.

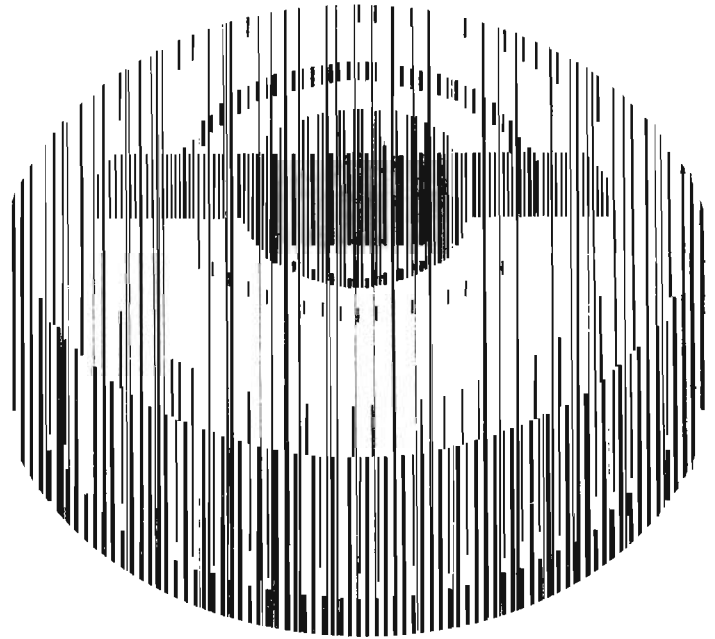
3. Index sensing. All compatible packs have identical index patterns and therefore, all drives will have the same reference from which to establish byte count.

4. Rotational position sensing. Since index establishes the zero reference for a byte count, every byte on the track is at a discrete and addressable location.

### **PACK CERTIFICATION AND FORMATTING:**

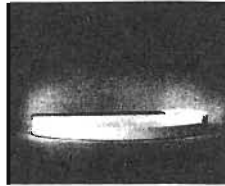
Following pack assembly, and where applicable, servo track writing, the disk pack is ready for its final functional tests. Each bit location on each track of every surface is tested to determine the total disk pack performance. The tests are basically the same as those performed at the single disk level; at the pack level there are additional requirements concerning error free areas. While some defective tracks are permissible in a pack assembly, the Home Address of every track must be error free. Pack certification verifies that each disk pack shipped meets these requirements.

All disk packs must be initialized before they can be used in a computer system. Initialization involves writing the Home Address and Record O areas of each track in the prescribed format and then writing an all O's pattern for the remainder of the track. As the name implies, the data in the Home Address area identifies the physical address of the track being read. It also identifies the track as useable or defective and, in some type disk packs, contains the error correcting data necessary to compensate for an error occurring at a specific location on the track. The Record O area is used to supply the physical address if an alternate track is assigned to replace a defective track. Initialization under computer control at the users location is possible with some disk packs, however, packs such as the 3336-compatible disk packs must be initialized prior to shipment.



# DISK PACK COMPARISON CHART (GENERALIZED)

	Disk Cartridges		
CDC Model Number	9/846	9/847	9/849
IBM Model Number	2315	5440	1316
IBM Drive Number	2310	5444	1311/2311
Tracks Per Inch (TPI)	100	100	100
Bits Per Inch (BPI)	1100	2200	1100
Capacity (Mega Bytes)	1.2	3.1	7.3
No. of Data Surfaces	2	2	10
No. of Servo Surfaces	0	0	0
Disk Diameter	14"	14"	14"
Disk Thickness	.050"	.050"	.050"
Rotational Speed	1500	2400	2400
CDC CE Alignment Pack			
Model Number	846-51	847-51	850-52
IBM Model Number	2315CE	5440CE	1316CE



## Disk Packs

9/869	9/879	9/882	9/889	9/892
2316	3336	3336-11	3348-35	3348-70
2314	3330	3330-11	3340-35	3340-70
100	200	400	300	300
2200	4000	4000	5500	5500
29.1	100	200	35	70
20	19	19	3	6
0	1	1	1	1
14"	14"	14"	14"	14"
.050"	.075"	.075"	.075"	.075"
2400	3600	3600	3000	3000

870-55	880-52	882-52	--	--
2316CE	3336CE	3336-11CE	--	--



201.273A Litho in U.S.A. 1/76

CORPORATE HEADQUARTERS  
8100 34TH AVENUE SOUTH  
MINNEAPOLIS, MINNESOTA 55420

SALES OFFICES AND SERVICE CENTERS  
IN MAJOR CITIES  
THROUGHOUT THE WORLD



CONTROL DATA CORPORATION

**WANG**

LABORATORIES, INC.

BA #48

## MEMORANDUM

TO: ALL EASTERN AREA CUSTOMER ENGINEERS

FROM: SCOTT TAGEN

SUBJECT: 44B

DATE: SEPTEMBER 8, 1977

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ISN #143 describes how to update Data Transfer boards to prevent spiral writing. In the event of an emergency retract, the disk had a tendency to randomly write as the heads moved back. Symptoms of this occurring would be errors, (typically on the fixed disk), every 48 sectors for anywhere from 3 to 40 sectors. Until these update kits are in plentiful supply, only those units that exhibit this problem will be updated. Eventually all boards will be updated.

ISN #131 described an incompatibility in 44B Address Logic and Servo boards. The 12064 and 12068 must be used together, while the 12099 and 12101 must be used together. Eventually Diablo will replace all older boards, but until then, please be careful that these boards are matched.

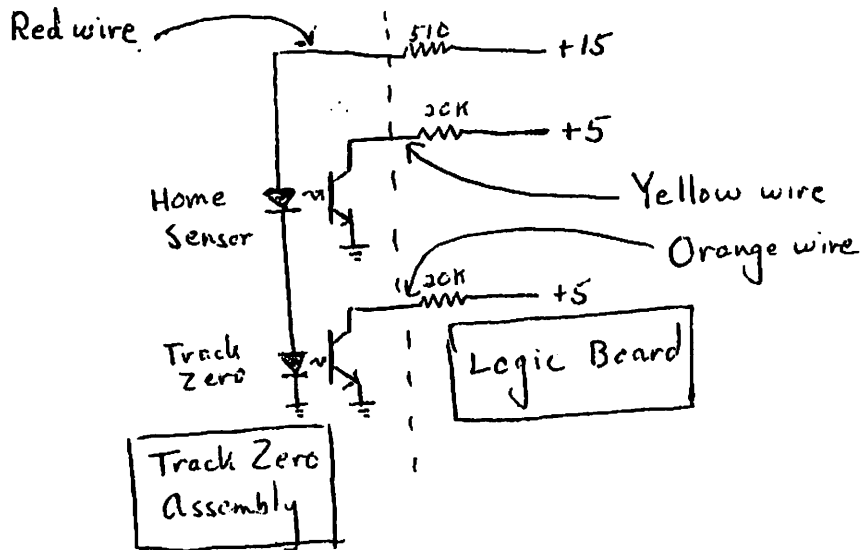


PAGE 2

44B

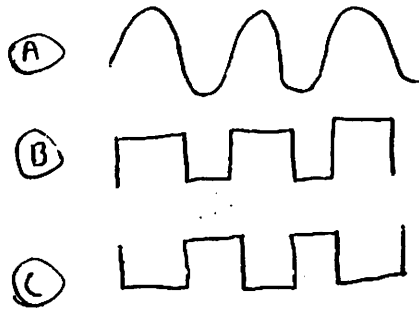
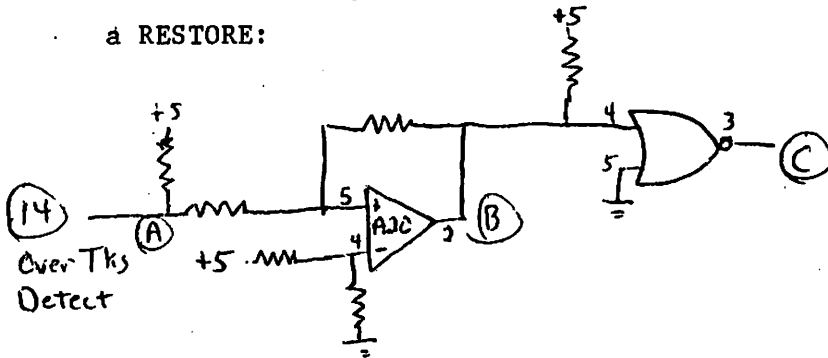
I have sent a Track Zero Assembly to every office. If you suspect either a Track Zero or Home Sensor failure, use the following procedure to check the sensors:

1. Move Servo Release switch 'ON'.
2. Power unit up, wait until spindle is up to normal speed.
3. Measure DC voltage between Red wire and ground - should be about 2.4 volts, (LEDs typically drop about 1.2 volts - two LEDs are in series).
4. Measure DC voltage between Yellow wire and ground while moving carriage such that flag cuts home sensor - voltage should shift between approximately .4 volts and 4.8 volts.
5. Measure DC voltage between Orange wire and ground while cutting Track Zero sensor - results should be the same as in step 4.



Using a long pointed probe, it is easy to measure these voltages right on the connector that goes to the Mother board.

When doing a 44B Track Zero Fine Adjustment, various Logic Boards have different test points. The boards and wave forms are shown below while doing a RESTORE:



Using the original board 12066 (test points marked Upper Index, Lower Index, and Sector/Index), a wire had to be attached to P30-3 for the Over Tracks signal. Scope operation was described in original 44B Preliminary Manual.

The next board 12066 (12065-01 Artwork) had a group of seven test points. With this board it was possible to use TP F75 for Over Tracks signal. However, since F75 was connected to P30-4, it was necessary to invert the waveform (using channel two of the scope) in order to get the proper relationship for Track Zero adjustment.

**WANG**

LABORATORIES, INC.

PAGE 4

44B

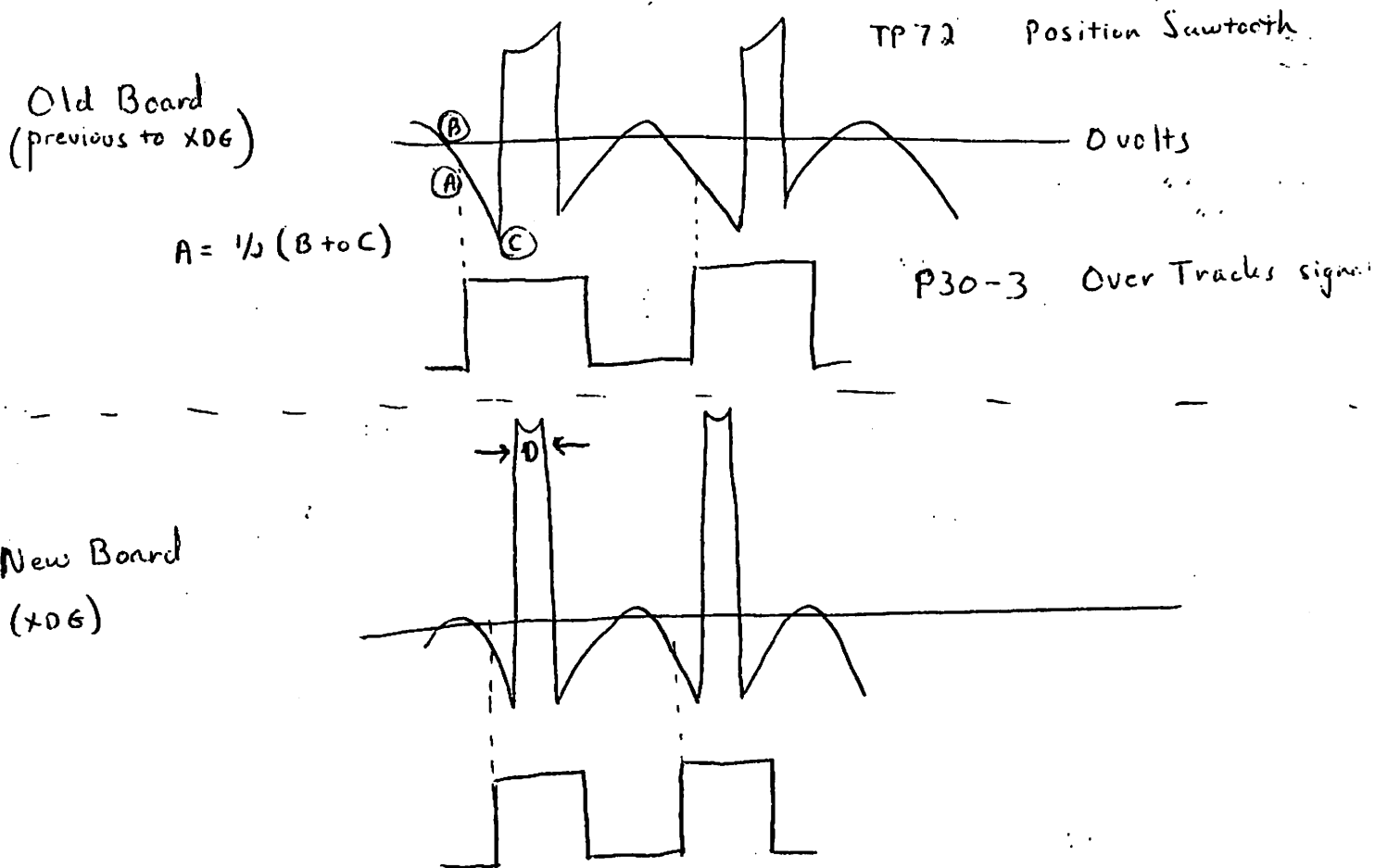
Logic Board 12066 (Artwork 12065-01), is the newest board. This has TP F75 connected to Pin 14, hence the signal is a sine wave. When using this board, it is again necessary to use P30-3 for Over Tracks.

If all this seems confusing, there is an easy way around it. Regardless of the board type, use P30-3 and do not invert. This will work on all current boards.

PAGE 5

44B

The latest curve ball thrown to us by Diablo is a new Servo Board 12099 Rev XDG. This is an entirely new layout with different test points. When doing alignments, -5 volts may be obtained at H25-9, and for Track Zero alignment Position Sawtooth is TP76 (TP72 on old boards). This wave form appears slightly different from the older board.



When doing the fine adjustment with the new board, the width at point D should be about 1.5 milliseconds, and should concur with the high level of Over Tracks signal.

Book.  
2260



LABORATORIES, INC.

TO: ALL COMPUTER PERSONNEL

FROM: KEITH JONES  
 JOE McDERMOTT  
 TIM DAWSON  
 DICK KNAPP

SUBJ.: WEEKLY COMPUTER TELEX #40

DATE: JULY 29, 1980

2265V-1

In the past three to five weeks, the Southern Area has experienced three head crashes on CDC 75 Meg disk drives caused by the head positioner bearing physically falling apart. These bearings should be checked on a next call basis.

Three ways to check for defective bearings are:

1. Excessive errors on a certain disk drive.
2. Bring drive to run conditions with voice coil unplugged. Then manually load heads and feel for any loose motion, rough spots, or binds.
3. Red powdery substance around bearing and rails.

If you are experiencing any of these symptoms and the head positioner bearing is suspected, notify the Eastern Area Office immediately.

2260C/BC CONTROLLERS

Check list for C/BC Controller for 2260 Disks as of July 15, 1980.

Boards should be at the following E Revs:

210-7487A, B, C	E Rev 2
210-7486	E Rev 5
210-7488	E Rev 4
210-7686	E Rev 1
210-7688	E Rev 1

All boards should be loaded with R6 PROM's.

An artwork error exists on the 210-7686 board. The A<sub>1</sub> and 1<sub>1</sub> finger pads are too wide. If improperly seated, this board can cause the regulator board to fail. A field fix is to trim both pads to the width of a normal pad. An artwork ECN has been generated to correct future boards.



WEEKLY COMPUTER TELEX #40  
PG. 2

60 C PROM History

- R4 Restore command issued to drive if seek incomplete status is true upon power up of drive. This was done to overcome the sticky backstop problem with Diablo 44B silver colored head positioner.
- R5 Changes made to allow 8503 CRC chip to be used as replacement for 9411 or 9401. R5 PROM's generate 193 errors when formatting on a Hawk Disk R&D has now determined that 8503 chips may generate intermittent errors and therefore, should not be used at all on 60C controllers. R5 PROMS's should not be used at all. Because of intermittent operation, it has become necessary to stop using MC 8503 CRC chips (376-0250) on 2260 C/BC controllers. When replacing, use 9401 or 9411 CRC chips (376-0440). Appropriate ECN's will follow:
- R6 Correct format problem in which sectors 0-23 may not get formatted. This condition only occurs where the previous disk operating leaves the head select line selected to the upper head. Changes for Diablo head positioner problems (R4) still included in this PROM set.

81W:

Carriage drive motors manufactured by Clifton have been found defective. Any motors presently in production units have passed the QC test and should work, however, all spares of this manufacturer are suspect.

The Clifton motor can be identified by its silver color case. All other motors are gold. Please make sure to purge all Clifton motors from your stock. (400-0034)

22C32 TRIPLE CONTROLLER/MVP:

If the controller is used as the main console port, the device switch setting are: SW1 - ON, SW2-5 - OFF

If the controller is used as port 5 the settings are:  
SW1 - ON                      SW2 - OFF  
SW4 - ON                      SW3 - OFF  
   SW5 - OFF

If the controller is used as port 9 the settings are:  
SW1 - ON                      SW2 - OFF  
SW5 - ON                      SW3 - OFF  
   SW4 - OFF

If the controller is used as port 13 the settings are:  
SW1 - ON                      SW2 - OFF  
SW4 - ON                      SW3 - OFF  
SW5 - ON

44B

CUSTOMER ENGINEERING  
TECHNICAL ASSISTANCE CENTER  
NEWSLETTER

#00916

III.A.10

PERIPHERALS-DISK DRIVES-2200 DISK FUNCTION PROCESSORS.

TOPIC: 2260C DATA LOSS ON FIXED PLATTER

A problem has been discovered concerning the 60C controller in which the data on the fixed platter in sectors 0 - 23 may intermittently get erased. Once these sectors are erased any attempt to access them will result in a system hang. This is because the header information is erased along with the data field. The "\$FORMAT DISK" statement must be used to recover from this problem. The "@FORMAT" program will hang if used.

To verify that you have the above mentioned problem, attempt to access the bad sectors (data load or verify) and monitor the read clock/data lines on the drive I/O. Read data and read clock are located at 30 and 28, respectively on the 210-7686 board. On the read clock line there should be a consistent stream of clock pulses. The read data line should be at a DC level of +3.5 volts.

At the present time this problem appears to be associated with the new 60C controller which contains the 210-7686 board. R & D is still investigating this problem, however, as a temporary solution, an old style controller can be used to prevent this loss of data.

SILVER HEAD POSITIONER PROBLEM SERIAL # < 10933

CUSTOMER ENGINEERING  
TECHNICAL ASSISTANCE CENTER  
NEWSLETTER

#00916

III.C.4  
PERIPHERALS-PRINTERS/PLOTTERS-WANG MATRIX 61/62 (31W).

TOPIC: 2231W\_CARRIAGE\_BEARING\_WEAR

Europe has been having a head adjust problem on the 2231W.

It was found after many repeat calls for head solenoid adjustment that the top print solenoids had to be moved back slightly and the bottom print solenoids toward the striker plate to obtain good print quality.

Actually, the plastic carriage bearing 449-0136 had stopped rolling, bound up and wore a flat spot on the outside diameter of the bearing.

Since these bearings are plastic and there is no great force on them, they continue to slide.

This tips the whole carriage forward and calls for the wierd print head solenoid adjustment described above.

If you get repeat calls for print quality, check the plastic carriage bearings and replace any that are defective. We would like to have the defective rollers sent back to Lawrence Attn: Walter Jackson.



2-200

CUSTOMER ENGINEERING  
TECHNICAL ASSISTANCE CENTER  
NEWSLETTER

#01223

III.A.10

PERIPHERALS-DISK DRIVES-2200 DISK FUNCTION PROCESSORS.

TOPIC: 2260C/BC CONTROLLER

Two ECN's have just been released to cure the problem as described in TAC Newsletters 00916 & 01007. These ECNs will also have a positive effect when the drive is used with the LVP. These ECN's are 16963 for 210-7681 and 16972 for 210-7688. This information will be in the next MUB.

ECN 16963 PCB 210-7686

Purpose: To synchronize reset with the processor timing cycle to fix occasional writing on the disk when reset is used.

Procedure: Comp-side

- CUT ETCH AT L51 PIN 10 BEFORE PLATE THRU
1. Jumper L51-10 to L5-9
  2. Jumper L5-8 to L4-2
  3. Jumper L4-1 to L4-4
  4. Jumper L4-1 to L4-10
  5. Jumper L4-3 to J4-45
  6. Jumper L4-6 to J3-12

ECN 16972 PCB 210-7688

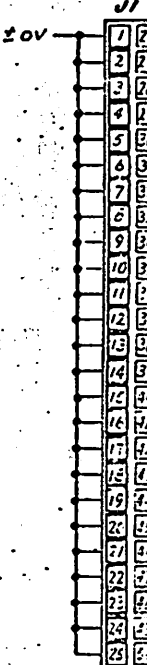
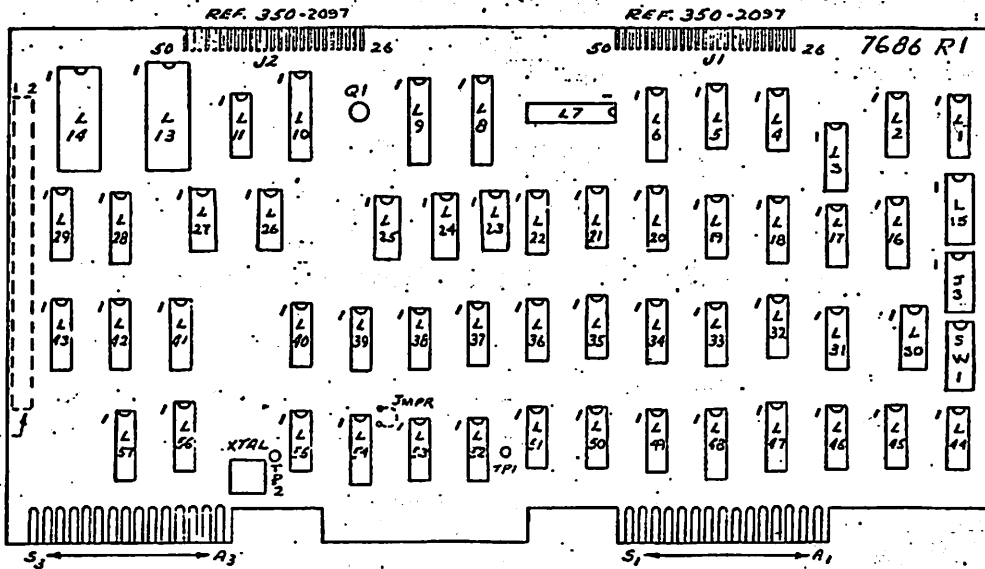
Purpose: To synchronize reset with the processor timing cycle to fix occasional writing on the disk when reset is used.

Procedure: Comp-side

1. Jumper L40-1 to L17-1
2. Jumper L17-2 to L47-12
3. Jumper L47-10 to L47-13
4. Jumper L47-13 to the lower leg of R45 (edge connectors toward you).
5. Jumper L47-11 to L45-13
6. JUMPER FROM PLATE THRU OF J5-12 TO PLATE THRU OF L41-6
7. ISOLATE L40-1

"THIS DRAWING AND THE DATA SHOWN THEREON ARE THE CONFIDENTIAL PROPERTY OF RAND AND PROPRIETARY TO RAND LABORATORIES, INC. THE DRAWING AND THE DATA SHOWN HEREON MAY NOT BE MADE PUBLIC WITHOUT THE WRITTEN CONSENT OF RAND LABORATORIES, INC. IN NO EVENT SHALL THE DRAWING OR DATA BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF RAND LABORATORIES, INC."

DO NOT SCALE

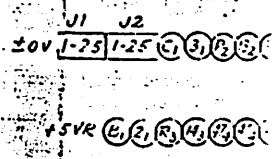


I.C. LOCATION	TYPE	W.L. NO.
L1,4,33	7474	376-0066
L2	7410	376-0063
L3,24,37	7400	376-0002
L5,32,33,52,53	7404	376-0010
L6	7476	376-0007
L12	NOT USED	
L7-10	74LS244	376-025E
L11,12,26,35	7473	376-0005
L13,14	74181	376-0099
L16,27,28,41,42,54	74153	376-004E
L17,19,21,38,44,53	7432	376-0053
L18	9321	376-009E
L20,40,45	7408	376-0081
L23,46	7411	376-0154
L25	LM339	376-024C
L15	SPARE	
L29,43	74157	376-0025
L30,31	74LS266	376-0145
L34	7451	376-0012
L39	74164	376-0112
L47,48	74155	376-0045
L49,50	7403	376-0023
L51	7402	376-0011
L56,57	74239	376-0133

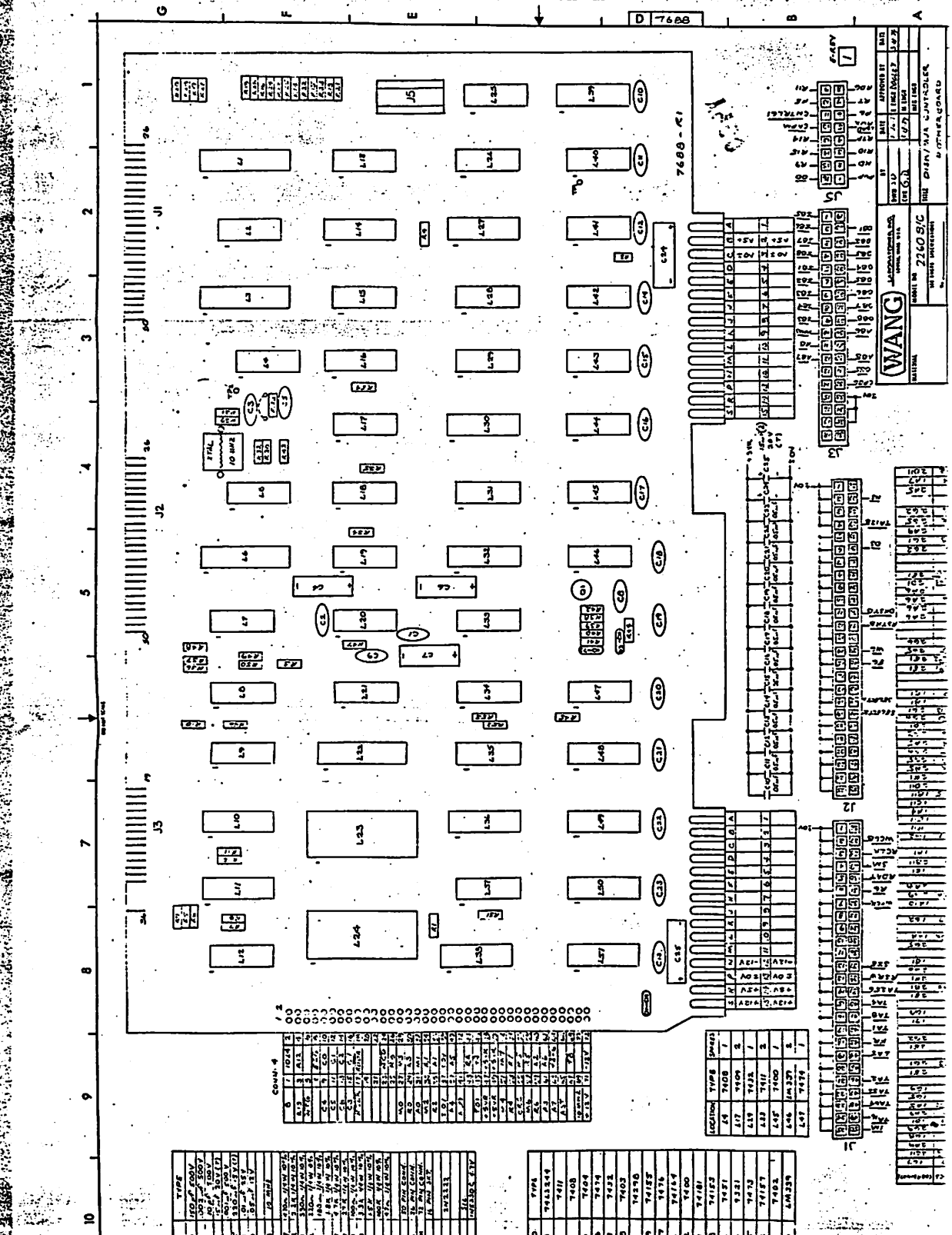
LOCATION	TYPE	SPARES
L2	7410	1
L3	7400	1
L4	7474	1
L5	7404	1
L23	7411	2
L44	7432	3
L45	7403	1

COMPONENT	TYPE	W.L. NO.
R1,3,27-36,41,43,44,46,47,48	2.2K	330-3022
R2,26	470Ω	330-2047
R1-11	330Ω	330-2033
R12-19,20,22	220Ω	330-2012
R21	180Ω	330-2018
R23	1.8K	330-3018
R24	4.7K	330-3047
R25	27K	330-4027
R37	270Ω	330-2027
R38	100Ω	330-2010
R39	5.3K	330-3033
R40	1.5K	330-3015
R42	100K	330-5010
R45	47Ω	330-1047
C1	.002μf	300-1913
C8	.01μf	300-1903
C2	10pf	300-1810
C3,26,27	15μf 20V TA.	300-4022
C4,7	.001μf	300-1901
C5,6	220μf 15V TA.	300-4045
C9-25	.05μf	300-1900
C28	150V	300-1150

COMPONENT	TYPE	W.L. NO.
D1,3	SIL.	3
D2	INS230 ZEN.	2
SW1	5BANK RKR SW	3
XTAL	10MHZ	5
Q1,2	2N2222A	5
J1,2	5740500	5
J3	16 PIN SKT.	5
CONN.4	261-10036-2	3



REVISION  
 REV. 1  
 REV. 2  
 REV. 3  
 REV. 4  
 REV. 5  
 REV. 6  
 REV. 7  
 REV. 8  
 REV. 9  
 REV. 10  
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 REV. 92  
 REV. 93  
 REV. 94  
 REV. 95  
 REV. 96  
 REV. 97  
 REV. 98  
 REV. 99  
 REV. 100



**WANG**  
 MODEL NO. 2260 S/C  
 SERIAL NO. 10000000000  
 UNIT CONTROL BOARD

DATE	TIME	OPERATOR

LOCATIONS TYPE UNIT

1	LOC	1000
2	LOC	1001
3	LOC	1002
4	LOC	1003
5	LOC	1004
6	LOC	1005
7	LOC	1006
8	LOC	1007
9	LOC	1008
10	LOC	1009
11	LOC	1010
12	LOC	1011
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15	LOC	1014
16	LOC	1015
17	LOC	1016
18	LOC	1017
19	LOC	1018
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21	LOC	1020
22	LOC	1021
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24	LOC	1023
25	LOC	1024
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32	LOC	1031
33	LOC	1032
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38	LOC	1037
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93	LOC	1092
94	LOC	1093
95	LOC	1094
96	LOC	1095
97	LOC	1096
98	LOC	1097
99	LOC	1098
100	LOC	1099
101	LOC	1100

CONV. #

1	1024	1
2	1025	1
3	1026	1
4	1027	1
5	1028	1
6	1029	1
7	1030	1
8	1031	1
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77	1100	1

NO.	TYPE	UNIT
1	LOC	1000
2	LOC	1001
3	LOC	1002
4	LOC	1003
5	LOC	1004
6	LOC	1005
7	LOC	1006
8	LOC	1007
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95	LOC	1094
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97	LOC	1096
98	LOC	1097
99	LOC	1098
100	LOC	1099
101	LOC	1100

CUSTOMER ENGINEERING  
TECHNICAL ASSISTANCE CENTER  
NEWSLETTER

#10127

III.A.10

PERIPHERALS-DISK DRIVES-2200 DISK FUNCTION PROCESSORS.

TOPIC: 2260C/BC CONTROLLER

It has been reported that the ECN's, 16963 and 16972, as released in MUB release #14 and in TAC newsletter #01223 do not work correctly. The following is a reprint of TAC newsletter #01223 with the corrections included.

Two ECN's have just been released to cure the problem as described in TAC Newsletters 00916 & 01007. These ECNs will also have a positive effect when the drive is used with the LVP. These ECN's are 16963 for 210-7686 and 16972 for 210-7688. This information will be in the next MUB.

ECN 16963 PCB 210-7686

Purpose: To synchronize reset with the processor timing cycle to fix occasional writing on the disk when reset is used.

Procedure: Comp-side

1. Jumper L51-10 to L5-9
2. Jumper L5-8 to L4-2
3. Jumper L4-1 to L4-4
4. Jumper L4-1 to L4-10
5. Jumper L4-3 to Conn 4-45
6. Jumper L4-6 to J3-12
7. 1.5 inches up from L51-10 is a plate-thru, cut the etch between L51-10 and the plate-thru at the plate-thru.

ECN 16972 PCB 210-7688

Purpose: To synchronize reset with the processor timing cycle to fix occasional writing on the disk when reset is used.

Procedure: Comp-side

1. Jumper L40-1 to L17-1
2. Jumper L17-2 to L47-12
3. Jumper L47-10 to L47-13
4. Jumper L47-13 to the lower leg of R45 (edge connectors toward you).
5. Jumper L47-11 to L45-13
6. Install a jumper from the platethru of J5-12 to the platethru of L41-6.
7. On the non-comp side, isolate L40-1. (Cut both etches)

## DIABLO\_44B\_DISK\_DRIVE

### New\_Spindle\_Bearings

If you have a problem with oil on the fixed disk platter there are now new leak resistant bearings to replace the faulty ones inside the spindle motor.

Bearings	726-1824
Bearing Puller	726-1825

### Repairing\_Heat\_Sinks

Since the 44B Heat Sink is such a high use item, and quite often not in stock, the following information should be helpful in repairing many of them in the field. Frequently the problem may just be a bad transistor on the heat sink, which is normally the case for instance with no spindle movement. Looking at the heat sink side and starting on the left, the first 4 xsistors on the top row make up 1/2 of a set with the 4 xsistors directly below them. (see picture) With the use of a scope these 8 xsistors can easily be checked. The head servo xsistors and the emergency retract xsistor cannot be checked in this method.

1. Set Scope up as follows:

Ch 1-10V/div.	AC or DC
5 mil/sec	Auto trigger

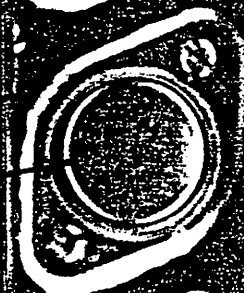
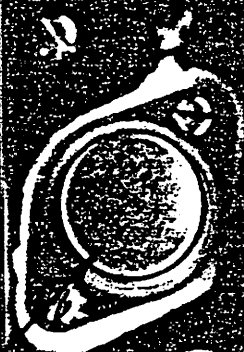
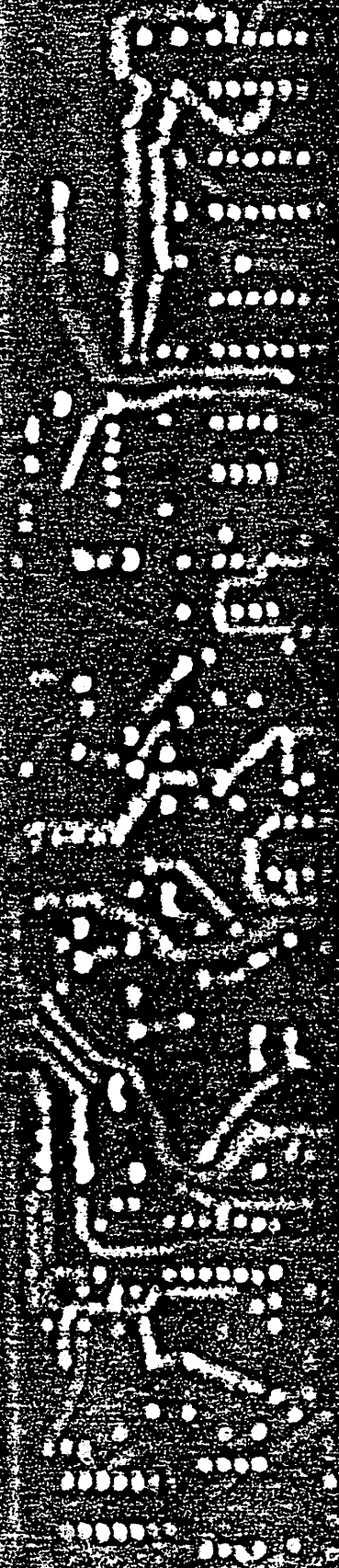
2. Install bad heat sink in drive, power on and switch to run (remember to put a platter or hub in, make dust cover interlock with latter, and don't worry if spindle is not moving because that is why your checking it)
3. By putting the tip of your probe on the collector (see picture) of any of the 8 left most xsistors a 50 or 60V signal should be seen.
4. Replace in sets, top and bottom, any xsistors giving low readings.

Heat Sink Transistors	2N6057/10479-01	726-0377
	2N6050/10480/PMD11K80	726-0373

Two other common problems are:

1. Cartridge ears won't open:  
Usually xsistor at E29 on PCB (part number 726-0376)
2. No Load lite  
Usually xsistor at M25 on PCB (part number 726-5115)

Thanks to Don Campbell and Brian Weir of Burlington North for there help in obtaining this information.



2260C/BC CONTROLLER ECOs AVAILABLE

ECOs 16963 and 16972, have been released to correct the following problems:

1. As reported in TAC Newsletter #01007, the 2260C/BC controller may read or write to the wrong sector without generating an error; symptoms of this are usually program errors.
2. As reported in TAC Newsletter #00916, data on the fixed platter in sectors 0 through 23 may intermittently get erased. Once erased, any attempt to access the data will result in a system hang because header information is erased as well.

ECO 16963 should be applied to the 210-7686 PC board, and ECO 16972 should be applied to the 219-7688 PC board, following the procedures described in TAC Newsletter #10127. These ECOs synchronize Reset with the processor timing cycle to fix occasional writing on the disk when Reset is used. These ECOs will also have a positive effect when the drive is used with the LVP.

2240C/BC CONTROLLERS

The following ECO's correct occasional writing on disk when reset is used\*

ECN 16963-----210-7486

1. Jumper L51-10 to L5-9
2. Jumper L5-8 to L4-2
3. Jumper L4-1 to L4-4
4. Jumper L4-1 to L4-10
5. Jumper L4-3 to "J" 4-45
6. Jumper L4-6 to J3-12
7. Cust Etch from L51-10 running up 1.5" to a Plate-Thru at the Plate-Thru

ECN 16972-----210-7488

1. Jumper L40-1 to L17-1
2. Jumper L17-2 to L47-12
3. Jumper L47-10 to L47-13
4. Jumper L47-13 to bottom leg of R45 (connectors down)
5. Jumper L47-11 to L45-11
6. Jumper Plate-Thru of J5-12 to Plate-Thru of L41-6
7. On non-component side isolate L40-1

ECN 18412-----210-7488

1. Cut Etch at L48 Pin 10
2. Jumper L48-10 to L4-9
3. Jumper L4-8 to L22-12
4. Jumper L22-1 to L22-10
5. Jumper L22-10 to L22-13
6. Jumper L22-8 to J5-12
7. Jumper L22-11 to L34-11

ECN 18413-----210-7486

1. Cut Etch at L52 Pin 10
2. Jumper L52-10 to L5-9
3. Jumper L5-8 to L4-2
4. Jumper L4-3 to J4-45
5. Jumper L4-6 to J3-12
6. Jumper L4-4 to L4-1
7. Jumper L4-1 to L4-10



WANG 280

ECN

CE# 92

ECN No. 10263

SHEET 1 OF 1  
DATE 12-14-78  
RFA NO. (REF)

ECN NO. 10263

ORIGINATOR Dave Reeder DEPT. 05 EXT. 555 DATE 12/8/78  
MODEL NO. 2260C TITLE

PART NO. See Below PART NAME 10 Meg Disk Control REV. F T PC REV. FROM TO ELEC. REV. FROM TO  
DWG. NO. 7486/7488 (DWG. TITLE) - - - - See Below

ASSY. PART NO. ASSY. TITLE EFFECTED [ ] NO EFFECT [ ]

DESCRIPTION OF CHANGE

Change 210-7486 assembly drawing and schematic as follows:  
Change C22 from 150 pf Cap to 330 pf Cap  
Change E-Rev of 7486 from 3 to 4  
Change 210-7488 assembly drawing and schematic as follows:  
Change C20 from 150 pf Cap to 330 pf Cap  
Change E-Rev of 7488 from 2 to 3  
Change BOM's 210-7486 and 210-7488 as follows:

WL#	QTY	DESCRIPTION
Delete: 300-1150	1	150 pf Cap
Add: 300-1330	1	330 pf Cap

RECEIVED  
DEC 22 1978  
PRINT ROOM

REASON FOR CHANGE

To prevent format errors

2148J/38

NEW PURCHASE REQ'D. [ ] SHOP REWORK REQ'D. [ ] VENDOR REWORK REQ'D. [ ]

CUSTOMER ENGINEERING  
 IMMEDIATE CUST.  
 CUST. PER NEXT CALL  
 INFORMATION ONLY  
 NONE

ACKNOWLEDGE  
BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

MANDATORY CHANGE  
 DOCUMENTATION CHANGE (PL, BOM, DWG)  
 EASE OF MFG., COST REDUCTION  
 PRODUCT IMPROVEMENT

DISPOSITION	Bonded	FINAL ASSY AREA	SUB ASSY AREA	PARTS		Future MFG.
				IN House	Outside Vendor	
USE AS IS TO PREVIOUS REV.						
TO CONFORM		X	X			
TO CONFORM IF NOT BEYOND OPERATIONS EFFECTED						

FINAL APPROVAL [Signature]  
APPROVED DESIGN ENGRG. [Signature]  
APPROVED MFG. ENGRG. [Signature]  
WRITTEN BY [Signature]

(WANG)

# ECN

ECN No. 10249

SHEET 1 OF 1  
DATE 12-14-78  
RFA NO. (REF)

ORIGINATOR Warren Joyce DEPT. 16 EXT. 2014 DATE 12/7/78  
MODEL NO. 928 TITLE \_\_\_\_\_

PART NO. <u>210-7328 &amp; -1</u>	PART NAME <u>WS Motherboard</u>	REV. F	REV. T	PC.REV. FROM	PC.REV. TO	ELEC.REV. FROM	ELEC.REV. TO
DWG. NO. <u>7328</u>	(DWG. TITLE)	-	-	-	-	0	1

ASSY. PART NO.	ASSY. TITLE	EFFECTED NO.	EFFECTED
			<input type="checkbox"/>
			NO EFFECT <input type="checkbox"/>

DESCRIPTION OF CHANGE

ECN NO. 10249

THIS ECN VOIDS ECN 10159

Change artwork, assembly drawing and schematic as follows:

1. Isolate Pin 24 of the keyboard cable and then reconnect all this etch to Pin 23 of the keyboard cable.
2. Take Pin 24 and run a wire to Pin H1 of the 7425 board

No BOM changes required

RECEIVED

DEC 19 1978

PRINT ROOM

NOTE: This ECN is required for Work Stations with a Katakana keyboard option

REASON FOR CHANGE

To add katakana option to VS

(42)

139J/38

NEW PURCHASE REQ'D. <input type="checkbox"/>	SHOP REWORK REQ'D. <input type="checkbox"/>	VENDOR REWORK REQ'D. <input type="checkbox"/>
--	---	---

CUSTOMER ENGINEERING <input type="checkbox"/> IMMEDIATE CUST. <input type="checkbox"/> CUST. PER NEXT CALL <input type="checkbox"/> INFORMATION ONLY <input type="checkbox"/> NONE	ACKNOWLEDGE BY: _____ DATE: _____	<input checked="" type="checkbox"/> MANDATORY CHANGE <input type="checkbox"/> DOCUMENTATION CHANGE (PL, BOM, DWG) <input type="checkbox"/> EASE OF MFG., COST REDUCTION <input type="checkbox"/> PRODUCT IMPROVEMENT
--	--------------------------------------	---

DISPOSITION	Bonded	FINAL ASSY AREA	SUB ASSY AREA	PARTS		Future MFG.
				IN House	Outside Vendor	
USE AS IS TO PREVIOUS REV.						
TO CONFORM						X
TO CONFORM IF NOT BEYOND OPERATIONS EFFECTED						

FINAL APPROVAL: *[Signature]*  
APPROVED DESIGN ENGRG: *[Signature]*  
APPROVED MFG. ENGRG. *[Signature]*  
WRITTEN BY: *[Signature]*

WANG

ECN

CE#94

ECN No. 10288

SHEET 1 OF 1  
DATE 12-15-78  
RFA NO. (REF)

10288  
ECN NO.

ORIGINATOR Dave Angel DEPT. 40 EXT. 2213 DATE 12/13/78  
MODEL NO. 2236MXD TITLE MVP Terminal Multiplexer

PART NO. 210-7291D	PART NAME Interactive Term WS Electronics	REV. F T	PC REV. FROM TO	ELEC. REV. FROM TO
DWG. NO. 7291	(DWG. TITLE)	- -	- -	- -
ASSY. PART NO.	ASSY. TITLE	EFFECTED <input type="checkbox"/>		NO EFFECT <input type="checkbox"/>

DESCRIPTION OF CHANGE

Change schematic, software loading chart and BOM as follows:

FROM	TO	
378-2140-R4	378-2140-R5	Qtys remain the same
378-2141-R4	378-2141-R5	
378-2142-R4	378-2142-R5	
378-2143-R4	378-2143-R5	

This code is call Release 1.5

REASON FOR CHANGE

On some MXD's, the R4 version will cause system hangups if trying to print to a non-ready printer at address 215

2168J/38 (4)

NEW PURCHASE REQ'D.  SHOP REWORK REQ'D.  VENDOR REWORK REQ'D.

CUSTOMER ENGINEERING  
 IMMEDIATE CUST.  
 CUST. PER NEXT CALL  
 INFORMATION ONLY  
 NONE

ACKNOWLEDGE  
 BY: \_\_\_\_\_  
 DATE: \_\_\_\_\_

MANDATORY CHANGE  
 DOCUMENTATION CHANGE (PL, BOM, DWG)  
 EASE OF MFG., COST REDUCTION  
 PRODUCT IMPROVEMENT

DISPOSITION	Bonded	FINAL ASSY AREA	SUB ASSY AREA	PARTS		Future MFG.
				IN House	Outside Vendor	
USE AS IS TO PREVIOUS REV.						
TO CONFORM	X	X				
TO CONFORM IF NOT BEYOND OPERATIONS.. EFFECTED						

FINAL P.L. APPROVAL *X R.S. Keith*

APPROVED DESIGN ENGRG. *David J. Angel*

APPROVED MFG. ENGRG. *RP*

WRITTEN BY *David J. Angel*

WANG 200

ECN

CE#93

ECN No. 10275  
SHEET 1 OF 1  
DATE 12-15-78  
RFA NO. (REF)

ECN NO. 10275

ORIGINATOR Harold Koplow DEPT. 40 EXT. 2785 DATE 12/12/78  
MODEL NO. System 5 TITLE

PART NO. 210-7310-A	PART NAME (DWG. TITLE) 114 Memory Board	REV. F T	PC REV. FROM TO	ELEC REV. FROM TO
DWG. NO. 7310		- -	- -	- -
ASSY. PART NO.	ASSY. TITLE	EFFECTED <input type="checkbox"/> NO EFFECT <input type="checkbox"/>		

DESCRIPTION OF CHANGE

Change schematic, software loading chart and BOM as follows:

FROM	TO
378-2219-R4	378-2219-R5
378-2220-R4	378-2220-R5

No other documentation changes required

REASON FOR CHANGE

To prevent floppy disk arm from moving behind track zero

2161J/38 (35)

NEW PURCHASE REQ'D.  SHOP REWORK REQ'D.  VENDOR REWORK REQ'D.

CUSTOMER ENGINEERING <input type="checkbox"/> IMMEDIATE CUST. <input type="checkbox"/> CUST. PER NEXT CALL <input checked="" type="checkbox"/> INFORMATION ONLY <input type="checkbox"/> NONE	ACKNOWLEDGE BY: _____ DATE: _____	<input checked="" type="checkbox"/> MANDATORY CHANGE <input checked="" type="checkbox"/> DOCUMENTATION CHANGE (PL, BOM, DWG) <input type="checkbox"/> EASE OF MFG., COST REDUCTION <input type="checkbox"/> PRODUCT IMPROVEMENT
---	---	--

DISPOSITION	Bonded	FINAL ASSY AREA	SUB ASSY AREA	PARTS		Future MFG.
				IN House	Outside Vendor	
USE AS IS TO PREVIOUS REV.						
TO CONFORM		X	X			X
TO CONFORM IF NOT BEYOND OPERATIONS EFFECTED						

FINAL APPROVAL \_\_\_\_\_  
 APPROVED DESIGN ENGRG. \_\_\_\_\_  
 APPROVED MFG. ENGRG. \_\_\_\_\_  
 WRITTEN BY: \_\_\_\_\_ RP

WANG 200

ECN

CE # 95

ECN No. 10306

SHEET 1 OF 2  
DATE 12-18-78  
RFA NO. (REF)

ECN NO. 10306

ORIGINATOR Pete Seymour DEPT. 40 EXT. 2217 DATE 12/15/78  
MODEL NO. 2281P TITLE \_\_\_\_\_

PART NO. <u>210-7443-1A</u>	PART NAME <u>Plotter Control</u>	REV. F	REV. T	PC.REV. FROM	PC.REV. TO	ELEC.REV. FROM	ELEC.REV. TO
DWG. NO. <u>7443</u>	(DWG. TITLE)	-	-	-	-	-	1

ASSY. PART NO. \_\_\_\_\_ ASSY. TITLE \_\_\_\_\_ EFFECTED   
NO EFFECT

DESCRIPTION OF CHANGE

Change schematic, software loading chart and BOM as follows:

FROM	TO
378-2150-R2	378-2150-R3
378-2151-R2	378-2151-R3
378-2152-R2	378-2152-R3
378-2153-R2	378-2153-R3

No other documentation changes required

RECEIVED  
DEC 22 1978  
PRINT ROOM

REASON FOR CHANGE

See Attached Sheet 2

2180J/38

37

NEW PURCHASE REQ'D.  SHOP REWORK REQ'D.  VENDOR REWORK REQ'D.

- CUSTOMER ENGINEERING
- IMMEDIATE CUST.
  - CUST. PER NEXT CALL
  - INFORMATION ONLY
  - NONE

ACKNOWLEDGE  
BY: \_\_\_\_\_  
DATE: \_\_\_\_\_

- MANDATORY CHANGE
- DOCUMENTATION CHANGE (PL, BOM, DWG)
- EASE OF MFG., COST REDUCTION
- PRODUCT IMPROVEMENT

DISPOSITION	Bonded	FINAL ASSY AREA	SUB ASSY AREA	PARTS		Future MFG.
				IN House	Outside Vendor	

USE AS IS TO PREVIOUS REV.

TO CONFORM

TO CONFORM IF NOT BEYOND OPERATIONS EFFECTED

FINAL APPROVAL

APPROVED DESIGN ENGR. *Pete Seymour*

APPROVED MFG. ENGR.

WRITTEN BY *D. K...*

Paul Ricker  
Parkwood



LABORATORIES, INC.

MEMORANDUM

TO: Paul Ricker  
cc: S. K. Ho, Perry Talley, Ron Flaughner  
FROM: Peter Seymour  
DATE: December 11, 1978  
SUBJECT: Microcode ECN for 2281P

Three separate bugs have recently been discovered in the microcode for the 2281P. Each of them has been corrected in this latest revision of the code. A description of the problems follows:

1. The programmable set home code (HEX(E4)) worked correctly if enclosed in a PLOT statement, but not if used in a PRINT HEX statement.  
  
PLOT <,, HEX(E4)> worked  
PRINT HEX(E4) printed a d character
2. On the 2200MVP, a problem arose when the 2281P was plugged into the CPU of a multi-terminal system. With one terminal using the 2281P, use of any other terminal would sometimes interfere with the printed output.
3. The latest revision of the PCS TEXT EDITING package exhibited two problems with character underscoring.
  - a. The code sequence PRINT HEX(5F0841) which should have produced A was printing only an underscore.
  - b. The code sequence used by the text editor to print a hyphen was producing an underscore.

Problem 'a' was the fault of the 2281P microcode, problem 'b' was caused by the TEXT EDITING package. Both have been fixed.

BOARD NO: 7443-1A

OLD CHIP NUMBERS	NEW CHIP NUMBERS
378-2150R2	378-2150R3
378-2151R2	378-2151R3
378-2152R2	378-2152R3
378-2153R2	378-2153R3

ECN No. 10306  
 SHEET No. 2 of 2 (37)  
 DWG No. \_\_\_\_\_



LABORATORIES, INC.

2260 C FORMAT PROGRAM

```

10 STR(G$,1,1)=HEX(20):REM HEX(30) FOR REMOVEABLE
20 $GIO/310(0600 0700 70A0 68C0 7040 6A10 6802 4270 8B67 ,G$)
30 IF STR(G$,6,3)=HEX(000000) THEN 50
40 STOP: "FORMAT ERROR"
50 STOP: "FORMAT COMPLETE"

```

TWO BYTE HEADER (DEFINITION)

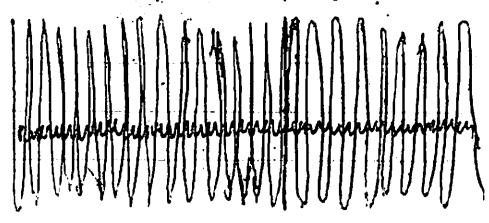
BYTE 1	BIT 8	Cylinder	Address	Bit	128	
	4	"	"	"	64	
	2	"	"	"	32	
	1	"	"	"	16	
	8	"	"	"	8	
	4	"	"	"	4	
	2	"	"	"	2	
	1	"	"	"	1	
BYTE 2	Bit 8	"	"	"	256	
	4	Disk Select Bit				- 1=Removeable Platter - 0=Fixed Platter
	2	Head Select Bit				- 1=Upper Head - 0=Lower Head
	1	Sector	Address	Bit	16	
	8	"	"	"	8	
	4	"	"	"	4	
	2	"	"	"	2	
	1	"	"	"	1	

2260 DISK SECTORING

SECTOR ADDRESSED DECIMAL	SECTOR HEADER HEX
00	00
01	0C
02	01
03	0D
04	02
05	0E
06	03
07	0F
08	04
09	10
10	05
11	11
12	06
13	12
14	07
15	13
16	08
17	14
18	09
19	15
20	0A
21	16
22	0B
23	17

SAMEL 50mV/ 10mV/

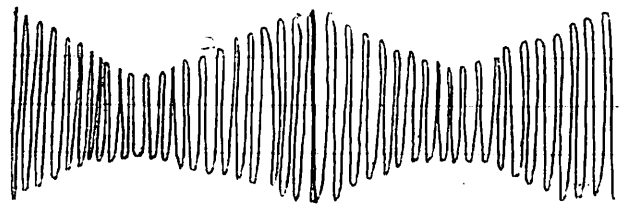
UPPER



GOOD

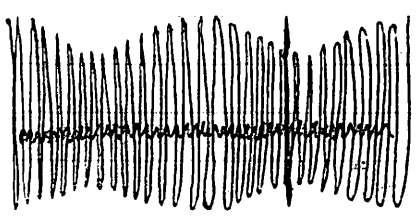
RUH

UPPER



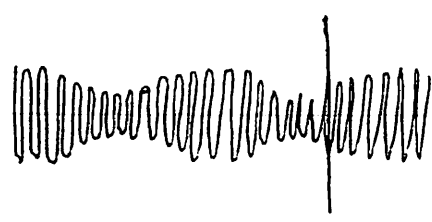
BAD

LOWER



UPPER INDEX  
LOGIC BRD. 12141

LOWER



J14 PIN 1  
E77

LOWER INDEX  
LOGIC BRD 12141

J13 PIN 1  
F74



# 44B ALIGNMENT

TRACK  $\emptyset$

SEEK TO TRACK  $\emptyset$ . -5V DISCONNECTED.

ADJUST TRACK  $\emptyset$  ASS'Y FOR READING OF  $2.65V \pm .25$  MEASURED AT:

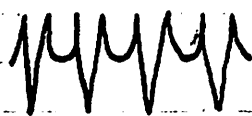
LOGIC BRO.	12177	12176	E17
	12141	12140	F75
	12066-XX	12065-01	F75
	12066	12065	K75 (MAY HAVE TO BE UPDATED)

SHOULD NOT CHANGE MORE THAN .1V FROM HIGHEST TO LOWEST READING.

RADIAL HEAD

SEEK TRACK 146. PLUG IN HEAD. CONNECT -5V.

TRIBIT CH 1 - TP1 .2V/50mV AC 2  $\mu$ /DIV AUTO



← BALANCE PEAKS

CATSEYE w/ LINES

CH 1 - TP1 .2V/DIV AC 1 OR 2  $\mu$ SEC/DIV  
 SYNC AC EXT UPPER INDEX (LOGIC BRO 12065) F75  
 12065-1 E76



BALANCE LINES ON EITHER SIDE OF CROSSOVER

CATSEYE CH 1 - TP1 .2V/DIV AC 20  $\mu$ SEC/DIV  
 SYNC AC EXT UPPER INDEX (LOGIC BRO. 12065) F75  
 12065-1 E76



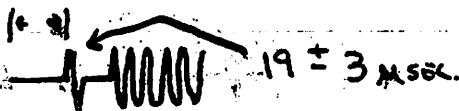
CROSSOVER SMALL AS POSSIBLE

MAY HAVE NO INDEX SIGNAL ON 402

INDEX TO DATA BURST

SEEK TRACK 402. PLUG IN HEAD. CONNECT -5V.

CH 1 - TP1 .2V/DIV AC 5  $\mu$ SEC/DIV SYNC EXT <sup>NEG</sup> AC UPPER INDEX  
 LOGIC BRO.  
 12065-1 E76  
 12065 F75



SEEK TRACK 10.