.40meg 5"

NEC

D5146H MAGNETIC DISK DRIVE

PRODUCT DESCRIPTION

(THIRD EDITION)

806-520307-0

NEC Corporation
TOKYO, JAPAN

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CONTENTS

1. INTRODUCTION

1.1 General Outline and Features

The D5146H magnetic Winchester disk drive is a random access storage device with 5.25" media and mini-Winchester type magnetic heads.

The formatted storage capacity is 40 Magabytes.
Average seek time is 40 milliseconds.

Major Feature include:-

* Light weight and compact size

  Size and installation requirement are the same as half height minifloppy disk drive. Horizontal and vertical installations are possible.

* An industry-standard interface.

* High-speed Seek

  By using DC servo motor with encoder instead of stepping motor, average seek time is reduced to 40 milliseconds.

* High performance servo mechanism

  Microprocessor controlled servo mechanism provides the high performance and high reliability.

* Hight reliability

  Disk and Head section are included in an air-tight enclosure for full protection against dust.

  Contact Start-Stop zone and automatic Carriage lock mechanism are provided.

* Maintenance-free concept

  Scheduled maintenance checks are not required.

1.2 Specifications

Summary specifications are listed in Table 1.1.

Table 1.1

No.	Item		D5146H
1.	Storage Capacity		
	(1) Unformatted		
	/drive	(MB)	51.24
	/cylinder	(bytes)	83,328
	/track	(bytes)	10,416
	(2) Formatted *		
	/drive	(MB)	40.30
	/cylinder	(bytes)	65,536
	/track	(bytes)	8,192
2.	Disk Configuration		
	Number of disks		4
	Number of heads (data sides)		8
3.	Number of cylinder		615
4.	Data transfer rate	(KB/sec)	625
5.	Access time	(ms)	**
	Maximum seek time		70
	Average seek time		40
	Minimum seek time		8
6.	Disk speed	(rpm)	3,600 ±0.5%
7.	Start/Stop times	(sec)	
	Start time		25 max.
	Stop time		30 max.
8.	Recording mathod		MFM

No.	Item		D5146 H
9.	Recording density		
	Bit density	(bpi)	9,000
	Track density	(tpi)	700
10.	Drive Selection		4

* 32 sectors/track, 256 bytes/sector

** Exclude calibration seek time.
Calibration seek is executed once every few minutes when a seek command is received.
Overhead of calibration seek is about 350 - 400 ms.

2. CONFIGURATION

2.1 Physical Configuration

D5146H consists of the following major component parts.

(1) DE assembly (Disk Enclosure assembly)

The disk Enclosure assembly includes base plate, spindle assembly, carriage assembly, head arm assembly, magnetic heads, magnetic disks, air filter, read/write ICs and so on.

With the interior shielded from the outside and kept clean by a circular air flow, the D5146H is assured of stable operation in normal office environment.

(2) PWA assembly (Printed Wiring assembly)

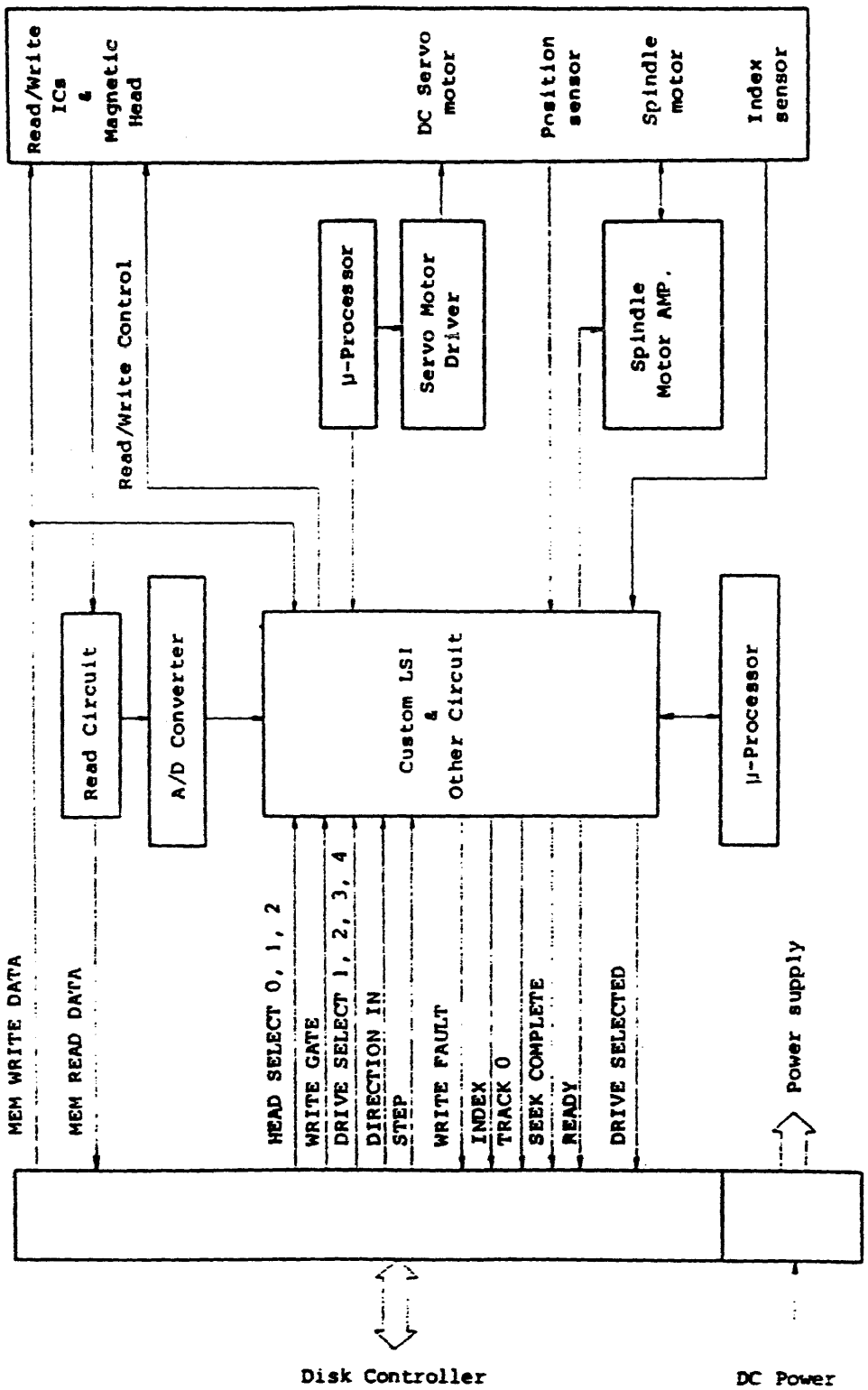
Include of microprocessors, custom LSI, interface Driver/Receiver, read circuit, motor driver and so on, this PWA handles signal interfacing with external control unit, execution of instructions, fault detection, seek operation, spindle motor drive. LED is mounted on the PWA assembly and indicates the drive status.

(3) Frame assembly

The frame assembly includes the frame and front plate.

2.2 Functional Configuration

The functional configuration of D5146H is outlined Figure 2.1 below.



3. PHYSICAL SPECIFICATIONS

3.1 Structural Outline

The basic structural specifications of D5146H are listed in Table 3.1.

Table 3.1

Item	D5146H	
Height (mm)	41	See Figure 3.1 for details.
Width (mm)	146	
Depth (mm)	208	
Weight (kg)	1.8	

3.2 Interface Connector and Switch Layout

3.2.1 Interface connector layout

The position for mounting the connector for signal, power and ground cables are shown in Figure 3.2.

3.2.2 Drive address swithc layout

Drive address switch must be set when installing D5146H. The position is shown in Figure 3.2.

3.2.3 Terminator resistor On/Off switch layout

Terminator resistor On/Off switch must be set in "Daisy chain" connection. The position is shown in Figure 3.2.

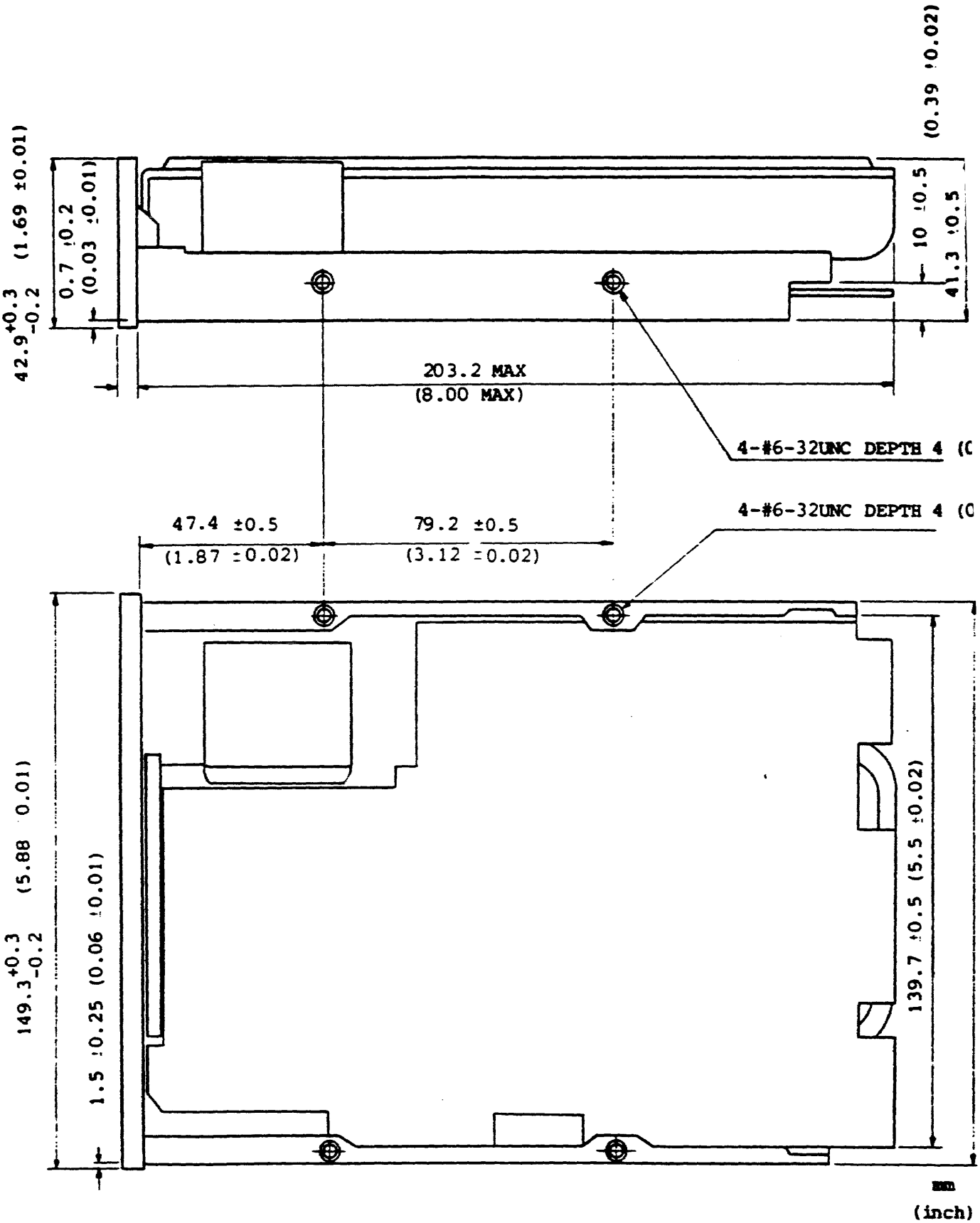


Fig.3.1 Installation Dimensions

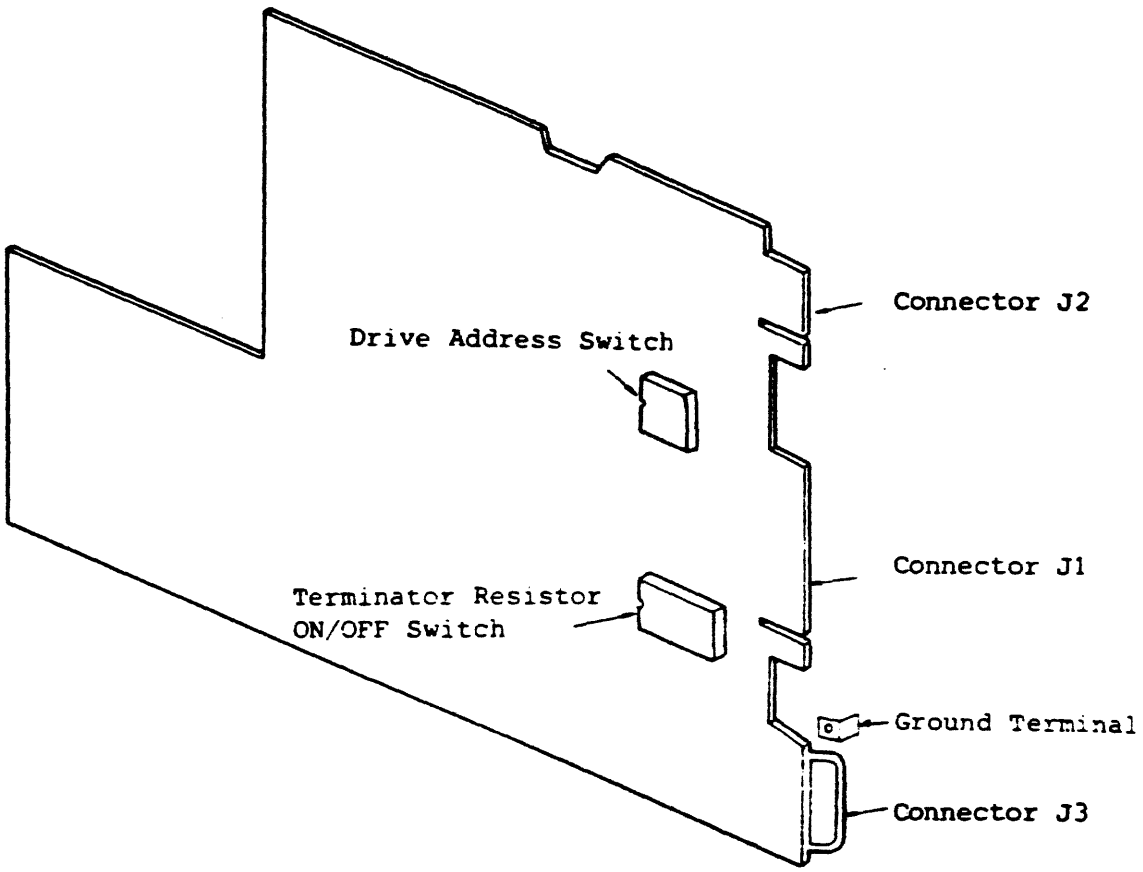


Fig.3.2 Connectors and Switches

3.3 Environmental Condition

The D5146H must always be handled under conditions conforming with the values given in the following table.

Table 3.2

No.	Item	Operating	Storage
1.	Temparature	5°C ∿ 50°C	-40°C ∿ 60°C
2.	Temperature gradient	10°C/H	no-condensation
3.	Humidity	8% ∿ 80%	no-condensation
4.	Max. Wet Bulb	29°C	no-condensation
5.	Vibration *	0.2G	0.5G
6.	Shock	2G	40G
7.	Altitude	0m ∿ 3,000m	-300m ∿ 3,600m

* 0 ∿ 60 Hz (amplitude less than 25mm)

4. INTERFACE SPECIFICATION

4.1 Outline

Signals transfered between D5146H and Disk Controller are passed through a 34-ply cable (Connector J1) and a 20-ply cable (Connector J2). Where a number of D5146H are used, these can be connected either by "daisy chain" or in a "radial" interface connection configuration.

The system examples are shown in Figure 4.2.

4.1.1 Signal interface physical specifications

The physical and electrical specifications for signal interfaces between D5146H and Disk Controller are included in this section.

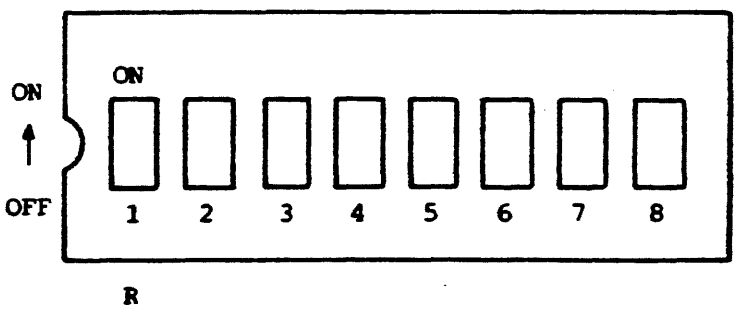
4.1.2 Cables and connectors

The dimensions of signal connector (J1 and J2) are shown in Figure 4.3 and the names of recommended mate connectors are listed in Table 4.2.

4.1.3 Terminator

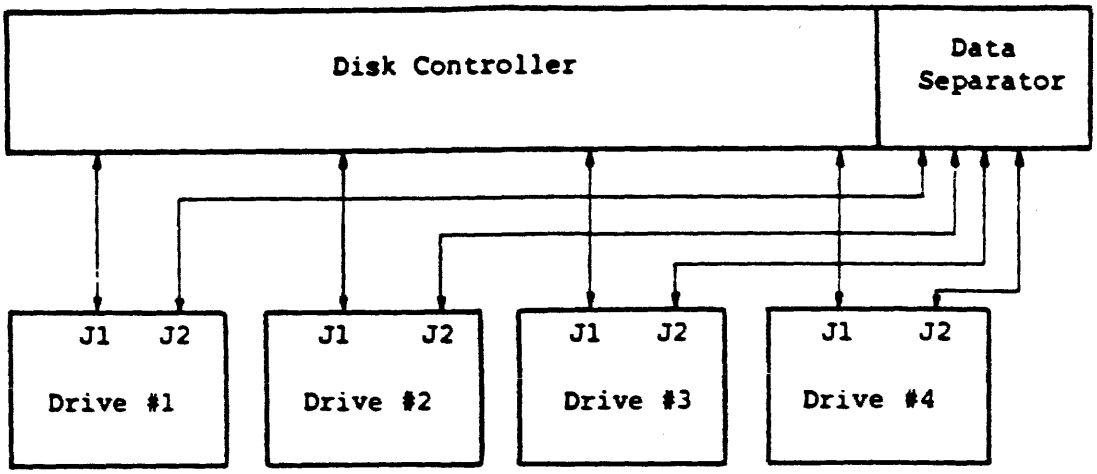
Disk controller and far-end D5146H requires Terminator. Terminator resistor ON/OFF switch is shown in Figure 4.1.

In "daisy chain", terminator register switch must be ON/OFF as Figure 4.2.



* R is the radial connection switch.

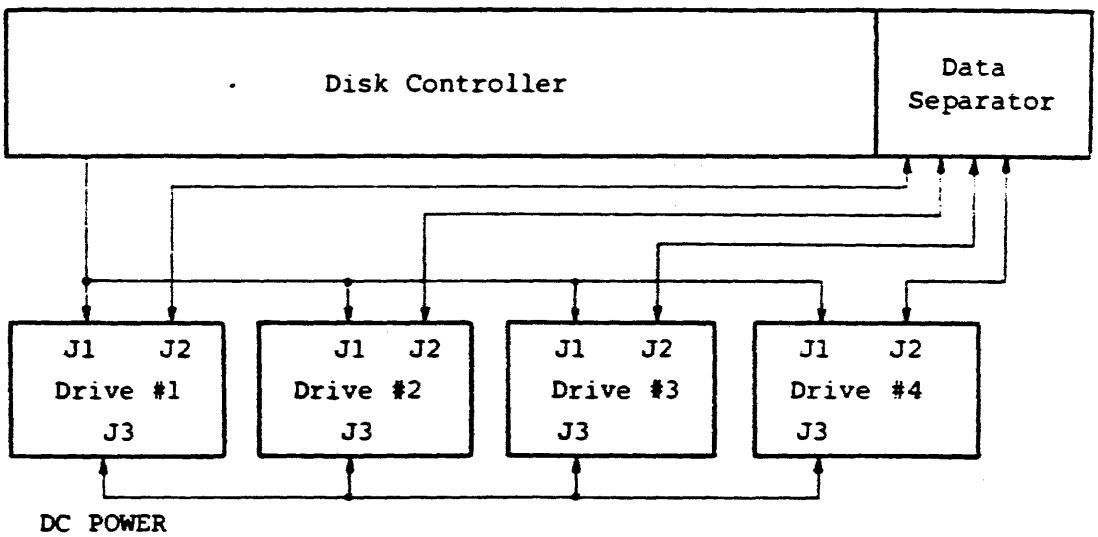
Fig.4-1 Terminator Resistor On/Off Switch (SW1)



(1) Radial Type

* each cable must be less than 6 m (20 feet)

** Terminator resistor on/off switch (SW1-1 to -8) of all drives must be ON.



(2) Daisy Chain Type

* each cable must be less than 6 m (20 feet)

** Terminator resistor on/off switch (SW1-2 to -8) of #1, #2 and #3 drives must be OFF. Terminator resistor on/off switch of far-end drive must be ON. SW1-1 of all drives must be OFF.

Fig.4-2 Interface Connection Examples

Table 4.1 List of Interface Signals (J1)

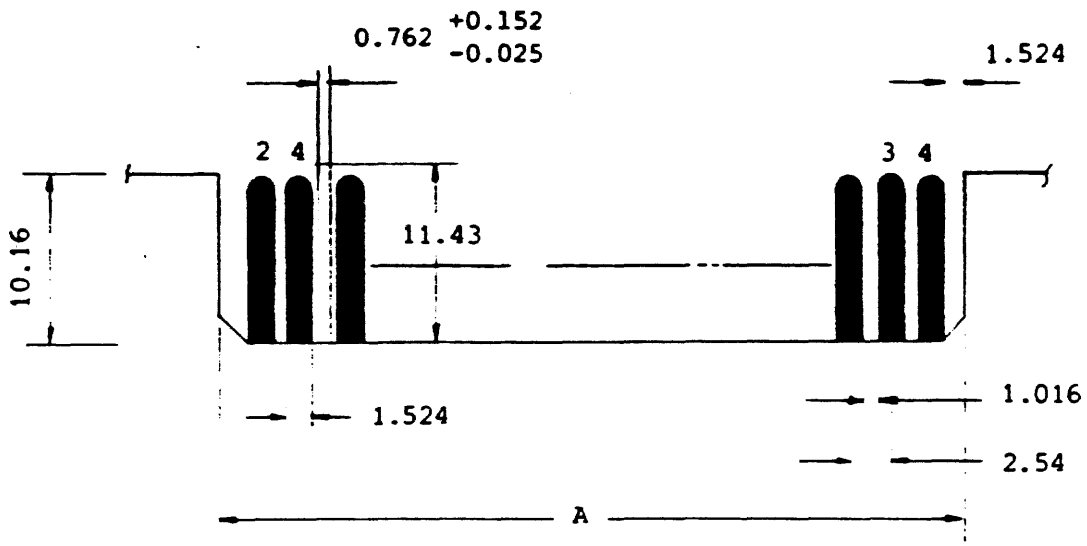
Pin No.		Signal Name	Input/Output
GND	SIG.		
1	2	(RESERVED)	Input
3	4	-HEAD SELECT 2	Input
5	6	-WRITE GATE	Input
7	8	-SEEK COMPLETE	Output
9	10	-TRACK 0	Output
11	12	-WRITE FAULT	Output
13	14	-HEAD SELECT 0	Input
15	16	(To J2 PIN 7)	-
17	18	-HEAD SELECT 1	Input
19	20	-INDEX	Output
21	22	-READY	Output
23	24	-STEP	Input
25	26	-DRIVE SELECT 1	Input
27	28	-DRIVE SELECT 2	Input
29	30	-DRIVE SELECT 3	Input
31	32	-DRIVE SELECT 4	Input
33	34	-DIRECTION IN	Input

List of Interface Signals (J2)

I/O	Signal Name	Pin No.	Pin No.	Signal Name	I/O
Out put	-DRIVE SELECTED	1	2	GND	-
Output	(RESERVED)	3	4	GND	-
-	(RESERVED)	5	6	GND	-
-	(TO J1 PIN 16)	7	8	GND	-
-	(RESERVED)	9	10	(RESERVED)	-
-	GND	11	12	GND	-
Input	+MFM WRITE DATA	13	14	-MFM WRITE DATA	Input
-	GND	15	16	GND	-
Output	+MFM READ DATA	17	18	-MFM READ DATA	Output
-	GND	19	20	GND	-

Table 4.2 Interface Cable Connector Specification

Item	Recommended Connector
J1 (34 ply)	AMP ribbon connector P/N 88373-3
J2 (20 ply)	AMP ribbon connector P/N 88373-6



Board thickness 1.6 $^{+0.2}_{-0.15}$

Tolerance .XX = ±0.762
.XXX = ±0.254

A J1 = 45.085
J2 = 27.305 mm

Fig.4.3 J1/J2 Connector Dimensions

4.2 Interface Circuit

The signal interface circuits are outlined below in Figure 4.4.

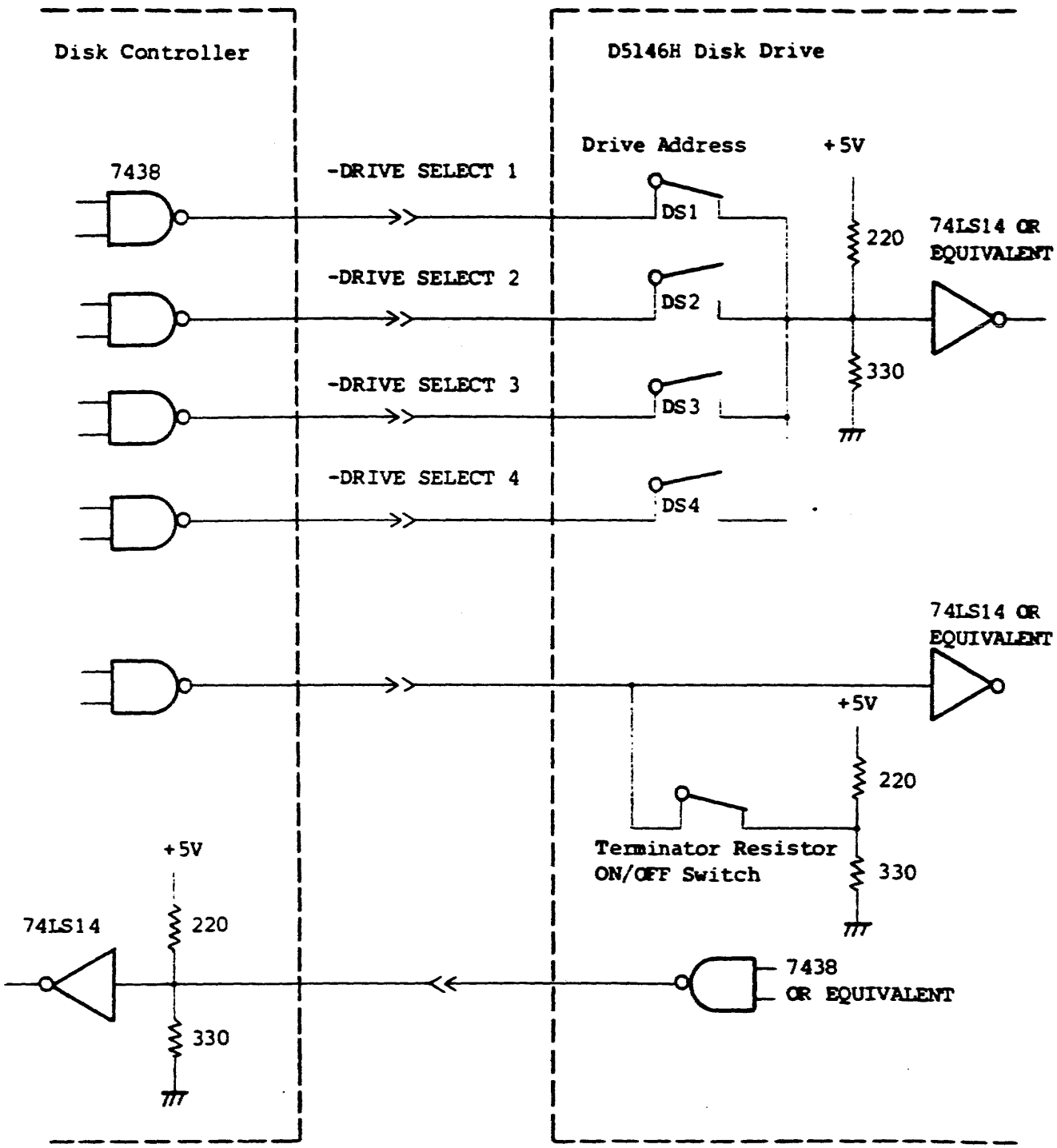


Fig.4.4-1 J1 Interface Circuit

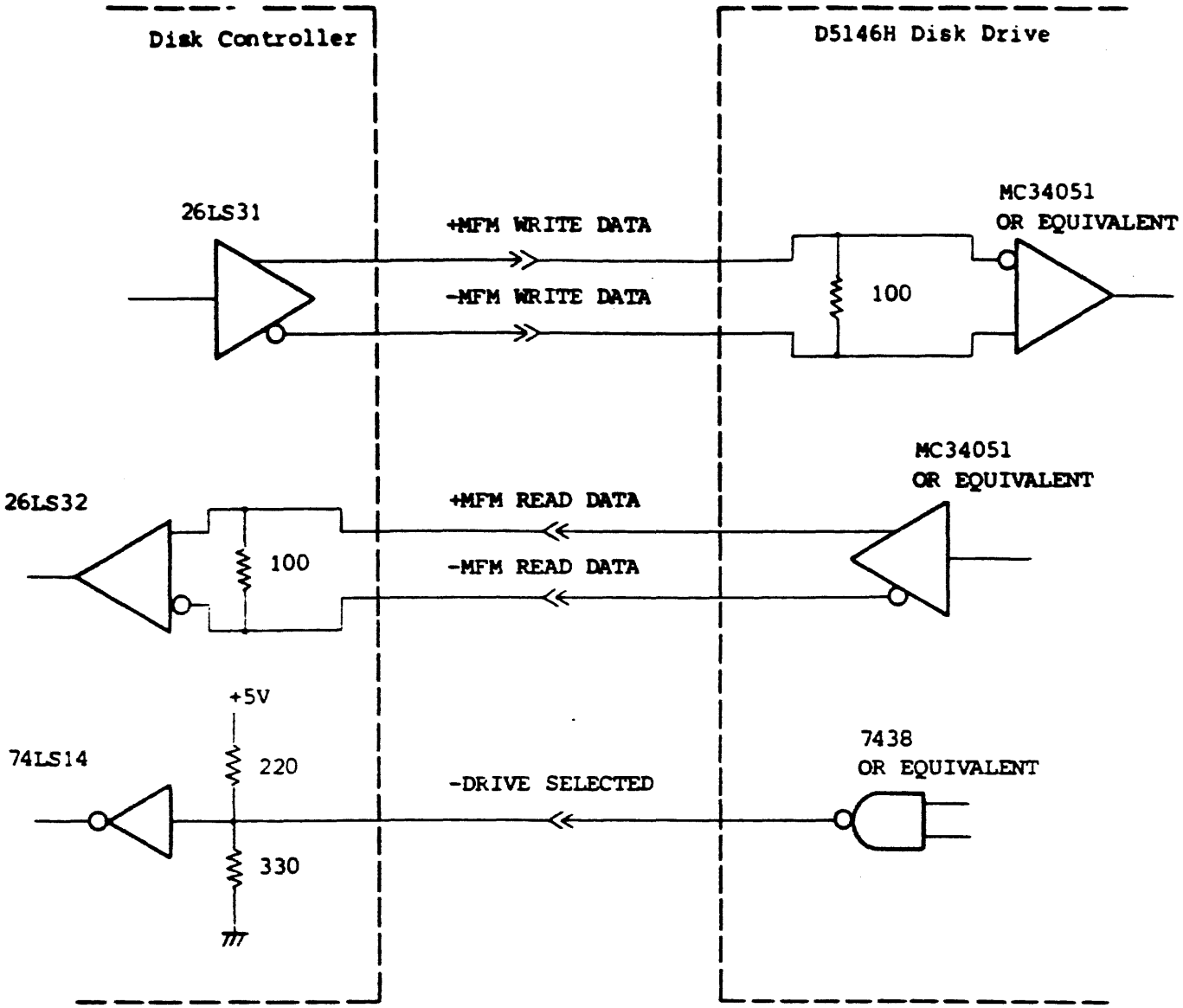


Fig.4.4-2 J2 Interface Circuit

4.3 Interface Signal Function

The input lines have the following electrical specification.

TRUE : 0.0 VDC to 0.5 VDC @ I = -24 mA

FALSE : 50% Vcc to Vcc @ I = 0 mA

(Where Vcc is 4.75 VDC to 5.25 VDC)

(1) -DRIVE SELECT 1,2,3,4

The -DRIVE SELECT 1,2,3,4 signals are conrol signals used for logical connection between the disk controller and the disk drive to be accessed.

With any one of the -DRIVE SELECT signals set to be 'true', the interface signal of connector J1 on the disk drive that has been given the same number by the drive address switch is effective.

At the time of shipment the drive address is preset to allow selection only when -DRIVE SELECT 1 is 'true". If only one disk drive is connected, -DRIVE SELECT 1 can be used without change.

If two or more disk drives are connected to a disk controller, change the drive address switch according to Table 4.3.

Table 4.3 Drive Adress Setting

Drive Adress	DS1	DS2	DS3	DS4
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	ON

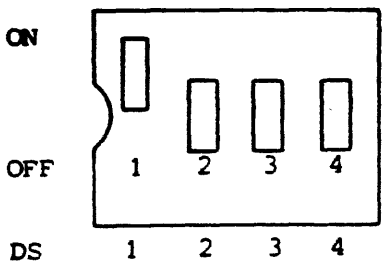


Fig.4.5 Drive Address Switch (SW2)

The front-panel LED illuminates when the disk drive is selected by the corresponding -DRIVE SELECT signal and is in the READY state.

This disk drive allows functional change of control signal (connector J1 signal) to the Radial system. Changing to the Radial system is available by setting the radial connection switch "R" (Figure 4.1) to ON.

In this condition all input and output signals are effective independently of the -DRIVE SELECT signal. There is no change in the turn-on conditions of the front-panel LED.

(2) -STEP

The -STEP signal is a 'true' pulse signal that causes the read/write head to move in the direction specified by the -DIRECTION IN signal. The read/write head moves one cylinder each time the -STEP signal becomes true. Timing constraints of the -STEP, -DRIVE SELECT, -DIRECTION IN and -SEEK COMPLETE signals are shown in Figure 4.6.

-DIRECTION IN needs to be settled earlier than 100 nsec before the -STEP signal transfers from 'false' to 'true' and be maintained until later than 100 nsec after the 'true' to 'false' tansition. When direction of read/write head movement is to be changed, a -STEP signal must be issued after the -SEEK COMPLETE signal has transfered to 'true'

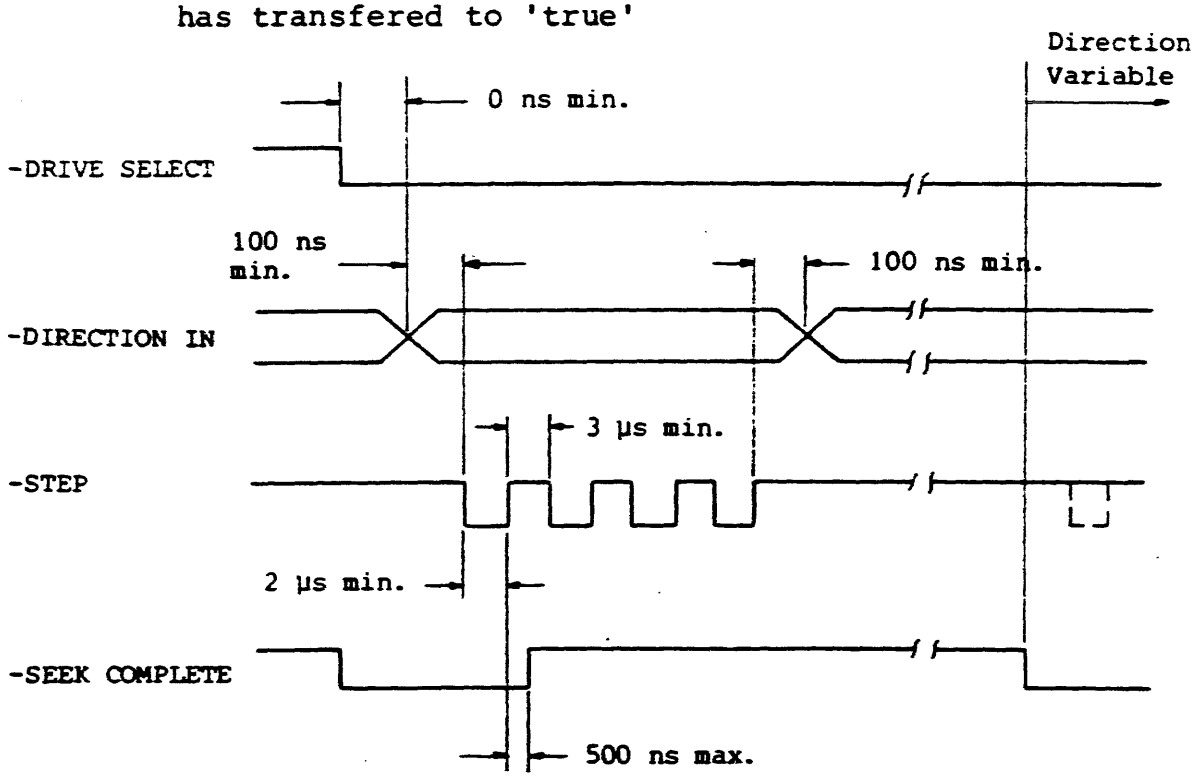


Fig.4.6 Step Timing

(3) -DIRECTION IN

This signal specifies the direction of read/write head movement effected by the -STEP signal. 'False indicates the direction toward outer cylider (cylinder 0); 'true' indicates the direction toward inner cylinder.

(4) -SEEK COMPLETE

This signal is 'true' when the read/write head has moved to the desired cylinder, indicating, together with the -READY signal, that read/write operation and seek operation including a change in the direction of head movement are available.

(5) -READY

This signal indicates the status of the disk drive. The signal, when 'true', indicates that the disk drive is ready for seek operation. When both the -READY and -SEEK COMPLETE signals are 'true', the disk drive is ready for read/write operation.

The -READY signal is 'false' under the following conditions.

(i) During the time from power on to the completion of start-up operation.

(ii) When +5V power is not supplied.

(iii) When write fault condition is detected (refer to (10) in this paragraph).

(6) -Track 0

This signal indicates that the read/write head is positioned at cylinder 0 (outermost cylinder). The 'true' state denotes cylinder 0.

(7) -INDEX

This is a pulse signal that indicates the beginning of a track. Each time the disk rotates one turn, a 'true' signal is generated. The transition point from 'false' to 'true' state indicates the beginning of a track.

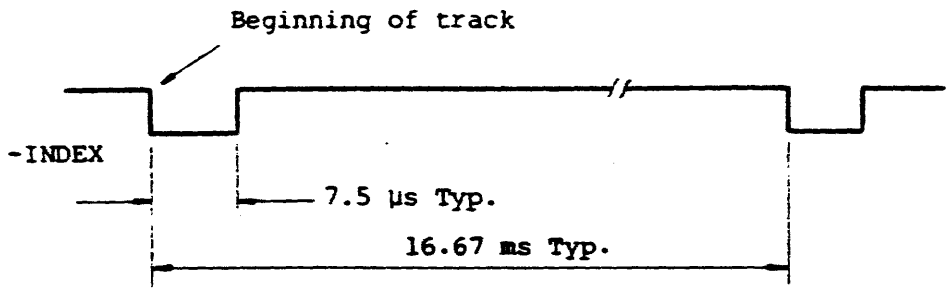


Fig.4.7 -INDEX Timing

(8) -HEAD SELECT 0, 1, 2

The -HEAD SELECT 0, 1, 2 signals are used to select the desired read/write head of the disk drive. The relationships between signal status and read/write heads to be selected are shown in Table 4.4.

The timing relation of the -HEAD SELECT signals to -WRITE GATE, ±MFM WRITE DATA and ±MFM READ DATA are given in Figure 4.9.

Table 4.4 Selected Head No. and -HEAD SELECT 0, 1, 2

Head No.	-HEAD SELECT		
D5146H	0	1	2
0	false	false	false
1	true	false	false
2	false	true	false
3	true	true	false
4	false	false	true
5	true	false	true
6	false	true	true
7	true	true	true

(9) -WRITE GATE

When this signal is 'true', data entry is made available by transferring write data on the ±MFM WRITE DATA signal.

The -WRITE GATE signal cannot be 'true' while the -STEP signal is in the 'true' state. Write operation is inhibited by the protection circuit in the disk drive while the -READY or-SEEK COMPLETE sngnal is the 'false' state.

(10) -WRITE FAULT

The 'true' state of this signal indicates the abnormal condition of the disk drive. When the -WRITE FAULT signal is 'true', both the seek and write operations are inhibited by the protection circuit in the disk drive.

This signal cannot be reset by the interface signal so far as the abnormal condition of the drive is not recovered. That is, when the abnormal condition is removed, the -WRITE FAULT signal goes back to the 'false' state. Detection of a short-time Write Fault state requires the disk controller to detect and maintain the 'false' to 'true' transition of the -WRITE FAULT signal.

The following are the conditions where the -WRITE FAULT signal is 'true'.

(i) Write current is flowing in the read/write head when -WRITE GATE signal is 'false'.

(ii) No write current is flowing in the read/write head when -WRITE GATE signal is 'true'.

(iii) After -WRITE GATE signal is accepted at the drive, transition of ±MFM WRITE DATA signals has stopped.

(iv) DC voltage are out of tolerance.

(v) Spindle speed is out of tolerance.

(vi) Abnormality is present at the 0-track sensor while the disk drive is performing auto-recalibration at power on.

(vii) Starting of spindle motor is not available at power on.

(viii) The drive is in a state of seek error.

(11) ±MFM WRITE DATA

These signals specify the reversal of magnetization of data to be written on the disk. The reversal is caused when the +MFM WRITE DATA voltage exceeds the -MFM WRITE DATA voltage.

To improve the reliability of the write data on the cylinders numbered 128 or more, Write Precompensation must be performed by the disk controller. The data pattern requiring Write Pre-compensation is shown in Figure 4.8, where the optimum value is 10 ns.
Timing relations among -DRIVE SELECT, -HEAD SELECT and -WRITE GATE are shown in Figure 4.9.

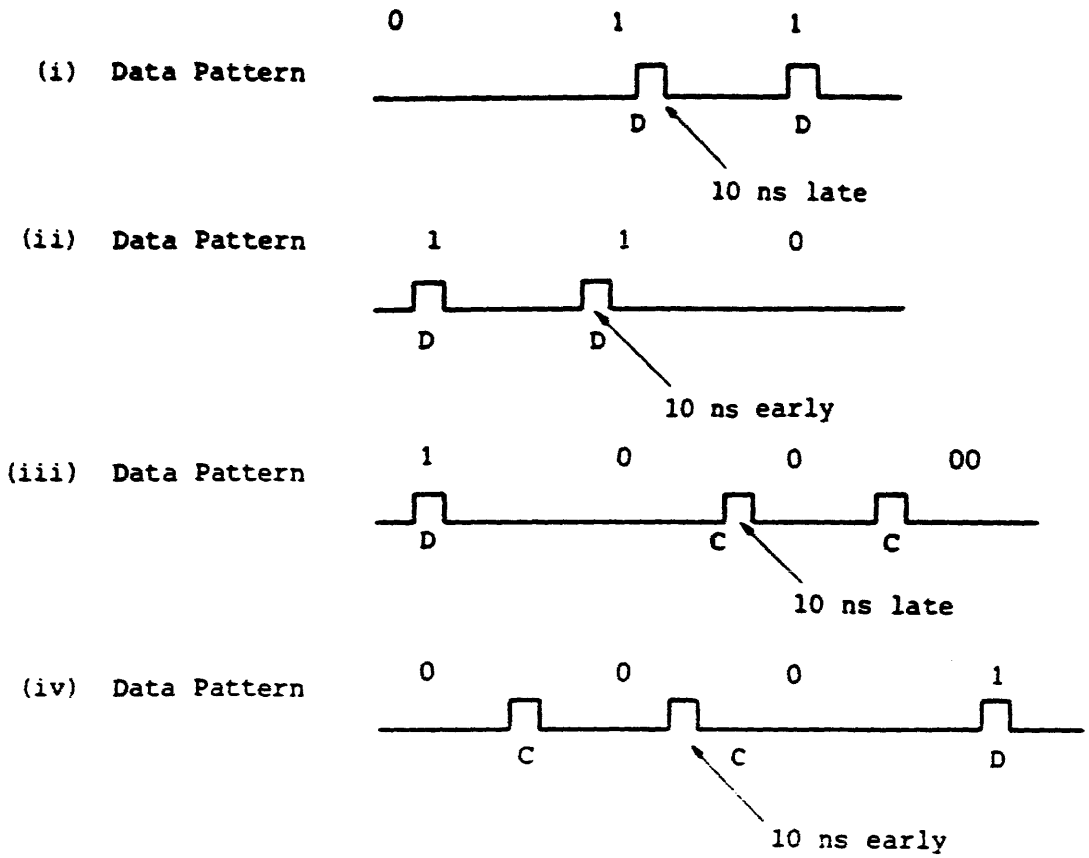


Fig.4.8 Data Patterns Requiring Write Pre-Compensation

(13) :MFM READ DATA

These signals are used to transmit the data in the track. The reversal of magnetizing is indicated when the +MFM READ DATA voltage exceeds the -MFM READ DATA voltage. These signals are invalid when the -READY or -SEEK COMPLETE signal is 'false'. The timing relation among -DRIVE SELECT, -HEAD SELECT and -WRITE GATE are given in Figure 4.9.

(14) -DRIVE SELECTED

This signal indicates that the disk drive is selcted. It is 'true' while the disk drive is being selected by the -DRIVE SELECT signal.

When the radial connection switch "R" (SW1-1) is on, the -DRIVE SELECTED signal is always in the 'true' state (Refer to Section 4.3(1)).

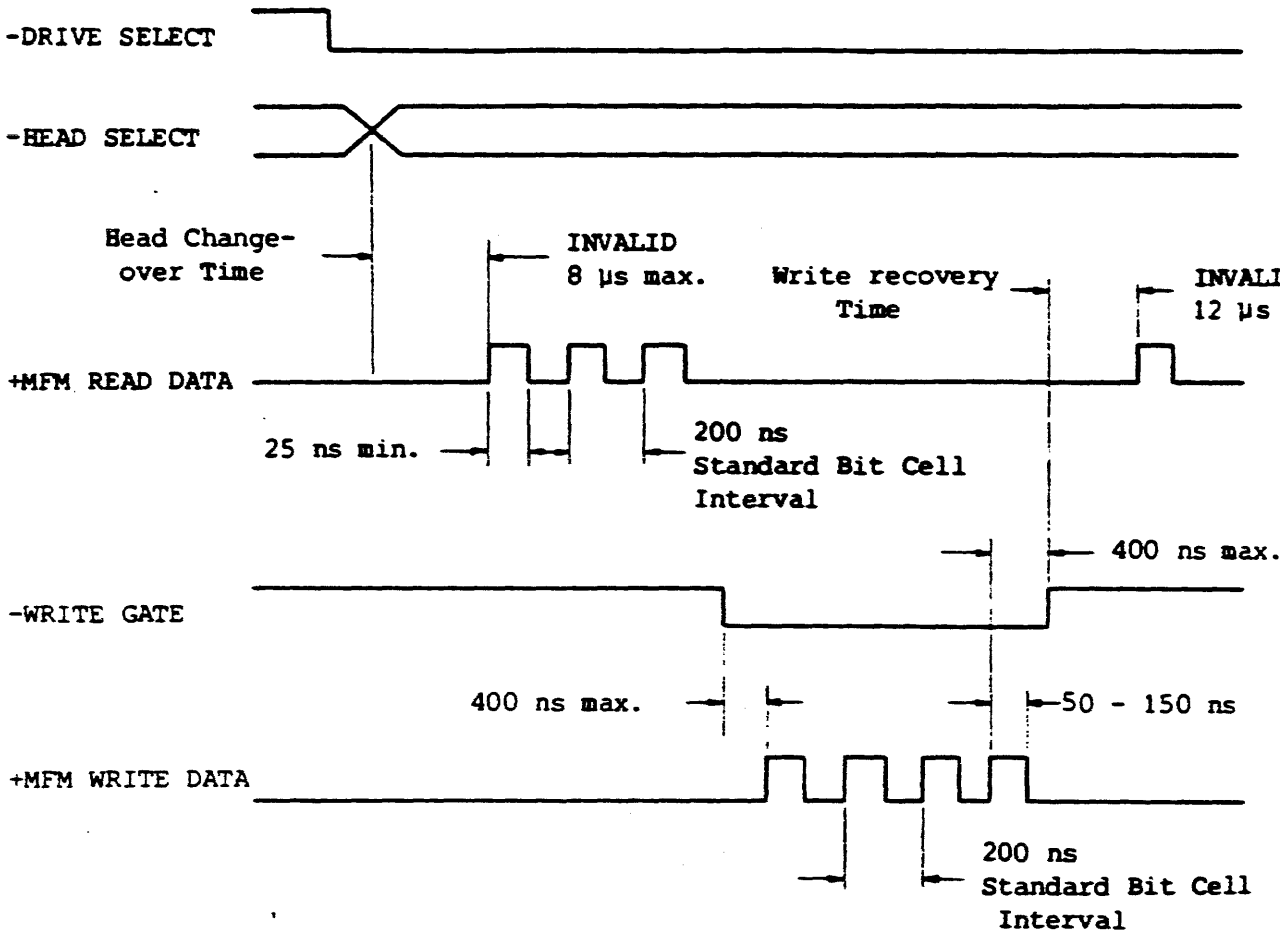
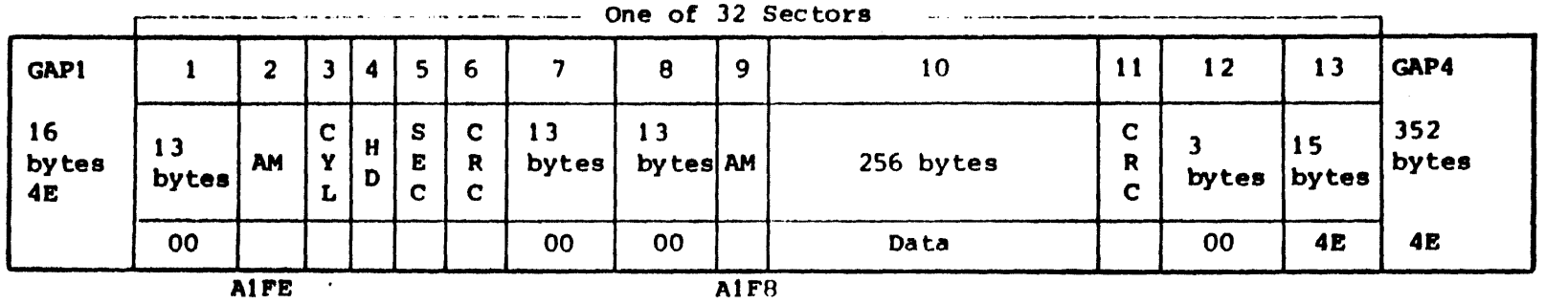


Fig.4.9 Data Timing

4.4 Recording Data Format

The D5146H magnetic disk drive employs the soft sector format. An example of the recommended format is shown below.



1. 13 bytes (00) - VFO SYNC area
2. (A1FE) - ID address mark (including missing clock)
3. 1 byte - Cylinder address
4. 1 byte - Head address (bit 7=1 denotes defective sector, bit 5 indicates higher bit of cylinder address)
5. 1 byte - Sector address
6. 2 bytes, CRC - $G(X) = X^{16} \times X^{12} + X^5 + X^0$
7. 3 bytes (00) - Write switching gap
8. 13 bytes (00) - VFO SYNC area
9. (A1F8) - Data address mark (including missing clock)
10. 256 bytes data - Data area
11. 2 bytes, CRC - $G(X) = X^{16} + X^{12} + X^5 + X^0$
12. 3 bytes (00) - Write switching gap
13. 15 bytes (4E) - Sector partitioning gap

5. POWER AND GROUND INTERFACE

5.1 Input Power

Power required by the D5146H is shown in Table 5.1.

Table 5.1

Normal voltage	Tolerance allowed	Maximum Current	Tolerance allowed
+5V DC	±5%	1.0 A	50 mVp-p
+12V DC			
(Power up)	±10%	3.5 A	100 mVp-p
(Seek)	±5%	2.5 A	100 mVp-p
(Read/Write)	±5%	1.2 A	100 mVp-p

* Tolerance allowed in the following range 50 Hz to 5 MHz

+5V and +12V may be applied in any order.
The power settling time shall be within 1 second.

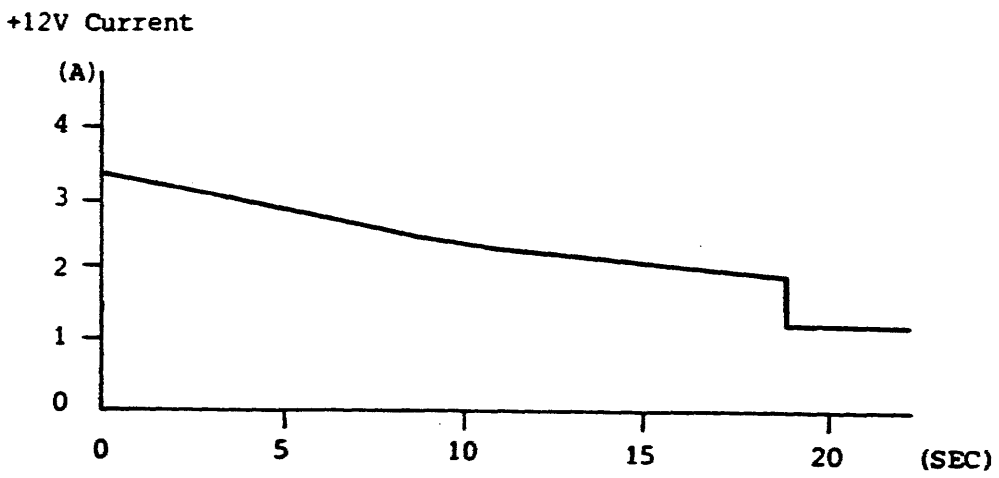


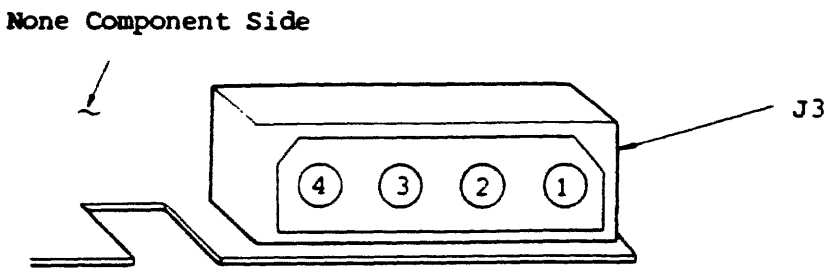
Fig.5.1 +12V Current Power Up Cycle

5.2 Power Interface Physical Specifications

Power interface parts is listed in Table 5.2, and the pin assignment in Figure 5.2.

Table 5-2

Connector J3	AMP Mate-N-Lock P/N 172294-1
Mate connector	AMP Mate-N-Lock P/N 1-480424-0



1: DC +12V
2: +12V RETURN (GND)
3: +5V RETURN (GND)
4: DC +5V

Fig.5.2 J3 Connector Pin Assignment

5.3 Ground Interface Physical Specifications

Ground terminal is a Faston AMP P/N 61761-2. The recommended mate connector is a Faston AMP P/N 62187-1.

6. INSTALLATION

The D5146H magnetic disk drive can be installed either horizontally or vertically. When horizontal, the PWA side must be bottom.

The D5146H disk drive is mounted the same way as half height mini-floppy disk drive. See Figure 3.1 for details on mounting screw positions. There are eight screw holes for UNC screws.

7. TRANSPORTATION

Cylinder 664 (Inner most cylinder) is provided for shipping.

Before power off, for transportation, it is recommended that controller commands the drive to seek to cylinder 664.

8. RELIABILITY AND MAINTENANCE

The D5146H magnetic disk drive has been designed to meet the following reliability levels when used correctly under the mentioned conditions. Regular maintenance checks are not required.

(1) MTBF

20,000 POH

(2) MTTR

30 minutes max.

This time does not include parts transport and CE dispatch times.

(3) Component Design Life

5 years or 20,000 POH with normal operation.

Media defects are listed up on the following media defect label (refer to Fig 9.1). The label is on the drive top cover.

The media defect is indicated cylinder No., head No., and bytes from Index.

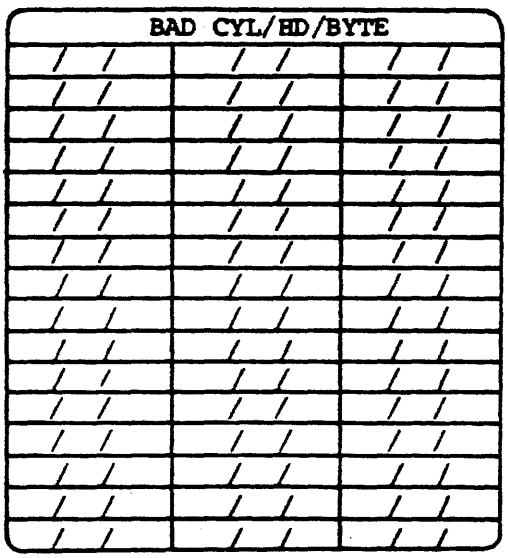


Fig.9.1 Media Defect Label (Example)

(4) Error Rate

(a) Seekkerror rate

1 per 10^6 seeks max.

(b) Recoverable read error rate

1 per 10^{10} bits read max.

(within 16 retries including recalibration)

(c) Non-recoverable read eoor rate

1 per 10^{12} bits read max.

9. MEDIA DEFECTS

The D5146H magnetic disk drive is checked for presence of media defects before shipped from the factory.

Maximum defects allowed are 48 locations per drive, and cylinder 0 is error free.

Media defects are indicated by the presence of a "1" bit in bit position 7 of the HD byte in the ID field. (See RECODING DATA FORMAT).