8 INCH FLEXIBLE-DISK DRIVE

MODEL M2896-63 HALF HEIGHT

OEM MANUAL

TJ2-30255 A
1/84

CHAPTER 1   INTRODUCTION

The Mitsubishi M2896 Flexible Disk Drives is a half-height double-side, disk drive employing a high-performance, economical, standard 8-inch diskette, providing the device with high reliability and the medium with a long service life to meet customer requirements.

- Main Features -

o   Half-high thickness and reduced depth as compared to standard 8-inch drive, keeping high performance double-sided double-density operations of M2894.

o   Brush-less and belt-less direct-drive DC spindle motor with no AC power supply, for simpler maintenance.

o   High quality and long life Mn-Zn read/write heads, requiring less or no write precompensation, enables interchangeability with IBM systems.

o   Enhanced tracking ability of the medium surface provided by a new type patented circular gimbal spring suspension of the read/write heads with lower loading pressure, same as the Mitsubishi M2894 FDD.

o   Equipped with head load/unload mechanism, and media tap-tap life reaching many hundreds of thousand load/unload operations for the same point of a track. Heads are unloaded for both sides during waiting, eliminating unnecessary contact with medium.

o   Media need not be specifically specified or designated by a special brand name. Diskette quality variation affects the performance of the drive only negligibly.

o   Reliable media interchangeability by larger window timing and off-track margins, and full coverage of environmental temperature and humidity ranges.

o   Further high reliability employing control logic by LSI.

1.1   General Description

o   The M2896 flexible disk drive is the 1 to 1.2
        megabyte formatted memory capacity disk drive,
        employing two magnetic heads for recording on both
        sides of the medium, at double density, thus
        providing a capacity four times higher than 250
        kilobytes offered by conventional single-side,
        standard density drives.

o   The M2896 reads and writes on an 8-inch diskette,
        either one or both sides, and in signle or double
        density, and media-compatible with IBM diskettes
        1,2 and 2D or equivalent.

o   The M2896 is plug-compatible to the Industrial
        Standard interface and same options with Shugart
        SA850/850R.

o   The M2896 provides a stabilized, soft media
        contact by suing an entirely new circular gimbal
        spring in the mechanism for holding the magnetic
        heads with lower loading pressure. Thus,
        excellent read/write operation and a long service
        life are offered. This mechanism significantly
        reduces the effects of jacket deformation or
        variations in thickness, thereby stabilizing read
        and write performance. Thus, it is unnecessary to
        select a special maker's product any more.

o   The magnetic read/write heads core are consisted
        of Mn-Zn ferrites, enabling a higher performance.
        The slider has a high-precision, pinhole-free
        sliding surface. The four corners and edges of
        the slider are smoothly blended and finished so
        that no stress is given to the medium, providing
        wear resistance and thus a prolonged service life.

o   The M2896 head loading mechanism uses a closed-
        loop electronic damping system employing a
        magnetic sensor. The magnetic heads load on the
        medium surface so softly that almost no scratchin
        is caused by repeated loading and unloading (tap-
        tap). (Many hundreds of thousands of tap-tap
        tests at the same point on the same track cause no
        error on the track and adjacent tracks.)

o   The M2896 can be mounted in a standard 19-inch
        RETMA rack as a set of parallel units.

o   Two M2896's can be mounted in a standard 8 inch
        FDD space.

1.2   Specifications

1.2.1   Performance specifications (Table 1-1)

Table 1-1 Performance Specifications

	Single Density	Double Density
Memory capacity		
Unformatted		
Disk (kilobytes)	800	1600
Surface (kilobytes)	400	800
Track (bytes)	5208	10,416
Formatted (bytes/sector)*	128 x 26 sectors	256 x 26 sectors
Disk (kilobytes)	499.2	998.4
Surface (kilobytes)	249.6	499.2
Track (bytes)	3328	6656
Transfer rate (kilobyts per second)	250	500
Average latency time (Milliseconds)	83	
Access time (milliseconds)		
Track to track	3	
Average	91 (Including step time of 3 milliseconds and settling time)	
Settling time	15	
Head-loading time	35	
Motor-start time (milliseconds)	500	

* example shown

1.2.2 Functional Specifications (Table 1-2)

Table 1-2 Functional Specifications

	Single Density	Double Density
Recording density (Bit per inch)	3408	6816
Magnetic flux inversion density (FCI)	6816	6816
Encoding method	FM	MFM
Track density (tracks per inch)	48	
Number of cylinders	77	
Number of tracks	154	
Number of heads	2	
Rotation speed (rpm)	360 +3% (instantaneous)	
Rotation period (milliseconds)	166.7 ±2%	
Index	1	
Media	8-inch Flexible Disk Cartridge equivalent to IBM diskette 1,2, or 2D	

1.2.3   Physical Specification (Table 1-3)

Table 1-3 Physical Specifications

DC power requirements	
+5 V	+5 V ± 5%, 0.8 A typical
+12 V	+24 V ± 10%, 0.8 A typical
Operating environmental conditions	
Ambient termperature	41 F to 109 (5 C to 43)
Relative humidity	20% to 80% (Maximum wet bulb temperatue: 84oF (29oC))
Vibration	0.25 g (10 to 100 Hz)
Non-operating environmental conditions	
Ambient temperature	-14 F to 122 F (-10 C to 51 C)
Relative humidity	20% to 80% (Without condensation)
Vibration	2 q (10 to 100 Hz)
Heat dissipation	79 BTU/hour typical (23 watts)
Physical dimensions	(Except for front panel)
Physical dimensions	(Excpet for front panel)
Height	2.25 inches (57 mm)
Width	8.55 inches (217 mm)
Depth	12.40 inches (315 mm)
Front panel dimensions	2.25 x 8.55 x 0.39 inches (57 x 217 x 10 mm)
Weight	7.8 lbs (3.5 kg)

1.2.4   Reliability Specifications (Table 1-4)

Table 1-4 Reliability Specifications

MTBF	10,000 POH or more (Note 1)
MTTR	30 minutes
Unit life	5 years or 20,000 energized hours, whichever comes first
Media life	
Rotational life	3.5×10^{6} pass/track or more
Tap-tap	10^{5} or more on the same spot of a track
Error rate	
Soft read error	10^{-9} bit (Note 2)
Hard read error	10^{-12} bit
Seek error	10^{-6} seek

Note 1) POH: Power On Hours

Note 2) With two retries

CHAPTER 2   OPERATION OF MAJOR COMPONENTS

2.1   System Operation

The M2896 Flexible Disk Drive consists of a mechanism to rotate the medium, two read/write heads, an actuator to position the read/write heads on tracks, a solenoid to load and unload the read/write heads on the medium, and electronic circuits to drive these components.

The rotation mechanism rotates a medium at 360 rpm. The medium is inserted in the drive and is clamped by the collet and spindle connected to the direct-drive DC motor. The positioning actuator positions the read/write heads to the desired track on the medium to perform a read or write operation. The heads are unloaded for both sides of the medium during non-perations.

2.2   Electronic Circuits

The circuits to drive all mechanisms in the disk drive are mounted on a printed-circuit board. The circuits on the printed-circuit board include:

o   Line driver and receiver, sending and receiving signals to and from the host system;

o   Drive slection circuit;

o   Index detection circuit;

o   Head-positioning actuator drive circuit;

o   Head-loading solenoid drive circuit;

o   Read/write circuit;

o   Write protect circuit;

o   Track 00 detection circuit;

o   Drive ready detection circuit;

o   Head selection circuit;

o   In use, door lock cirucit, and panel indicator LED drive circuit.

The spindle DC motor is driven by a control circuit on another printed-circuit board attached to the motor.

READ LOGIC

READ/WRITE HEAD 1

READ/WRITE HEAD 0

WRITE GATE →

WRITE DATA →

WRITE PROTECT ←

WRITE LOGIC

WRITE PROTECT

SIDE SELECT →

INUSE LED →

HEAD LOAD →

STEP →

DIRECTION SELECT →

DRIVE SELECT →

TRACK 00 ←

INDEX ←

READY ←

ALTERNATE I/O LINE

TWO SIDED ←

DISK CHANGE ←

CONTROL LOGIC

TRACK 00

ACTIVITY LED

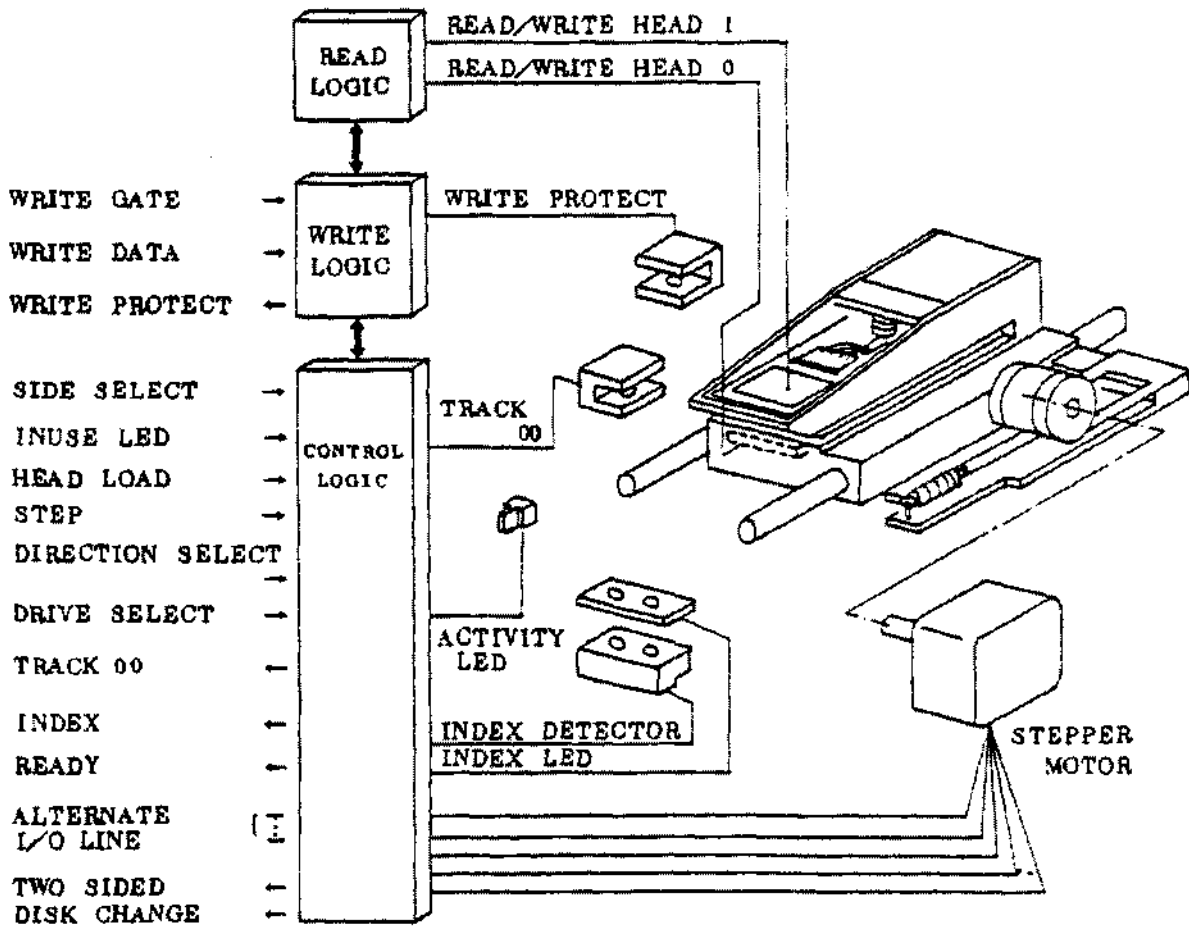INDEX DETECTOR

INDEX LED

STEPPER MOTOR

Figure 2-1 M2896 Functional View

2.3   Rotation Mechanism

The disk is rotated via the spindle at a speed of 360 rpm by a DC direct-drive brushless motor.

2.4   Positioning Mechanism

The read/write head is positioned as follows: The head carriage assembly is connected to a steel band hooked on the capstan on the 4-phase PM-type stepping motor. The capstan is located near the spindle, and a 3.6o turn of the stepping motor moves the read/write head a distance of one track to the specified direction.

2.5   Read/Write Head

The head incorporates three ferrite head cores; erase head cores for erasing the space between the tracks (tunnel erase) are arranged at both sides of the read/write core.   Both of the two facing heads, interposed with a disk, are moved by the head-loading solenoid and load on, or contact, the disk.

Each head is mounted on an adequately compliant, circular gimbal spring so that they correctly follow the track to maximize the signal reproduction from the disk.   This surface tracking of the circular gimbal head minimizes stress on the disk surface and contributes to an improved diskette service life, with lower loading pressure.

CHAPTER 3   ELECTRICAL INTERFACE

There are two electrical interfaces: signal interface and power interface.

The signal interface transmits and receives control signals and read/write data to and from the M2896 or the host system through the J1/P1 connector.

The DC power interface feeds power, via the J5/P5 connector, to the electronic circuits (a printed-circuit board) and to the stepping motor that drives the mechanism for positioning the read/write heads, door-lock magnet and the spindle motor.

The signals and pin arrangement of these two types of interfaces are shown in Tables 3-1 and 3-2.

Table 3-1 DC Power Connector Pin Arrangement (J5/P5)

Power Voltage	Pin Number
+23 V DC	1
+24 V GND (Return)	2
DC GND	3
(Not Used)	4
+5 V DC	5
+5 V GND (Return)	6

Table 3-2 Signal Connector Pin Arrangement (J1/P1)

Signal Name	Signal Pin Number	Ground Return Pin Number	Option
ALTERNATE I/O	2	1	-WRITE CURRENT SWITCH
ALTERNATE I/O	4	3	
ALTERNATE I/O	6	5	
ALTERNATE I/O	8	7	-TRUE READY
ALTERNATE I/O	10	9	-TWO-SIDED
ALTERNATE I/O	12	11	-DISK CHANGE
-SIDE SELECT	14	13	
ALTERNATE I/O	16	15	-IN USE
ALTERNATE I/O	18	17	-HEAD LOAD/(MOTOR START)
-INDEX	20	19	
-READY	22	21	
(NOT USED)	24	23	
-DRIVE SELECT 1	26	25	
-DRIVE SELECT 2	28	27	
-DRIVE SELECT 3	30	29	
-DRIVE SELECT 4	32	31	
-DIRECTION SELECT	34	33	
-STEP	36	35	
-WRITE DATA	38	37	
-WRITE GATE	40	39	
-TRACK 00	42	41	
-WRITE PROTECT	44	43	
-READ DATA	46	45	
(NOT USED)	48	47	
(NOT USED)	50	49	

3.1   Signal Interface

The signal interface is classified into control signals and data signals. These interface signal lines are all at TTL levels. The signal level meaning and characteristics are as follows:

o   True = Logical "0" = VL 0 V to +0.4 V
                                Iin 40 mA maximum

o   False = Logical "1" = VH + 2.5 V to +5.25 V
                                Iin 0 mA

o   Input impedance = 150 Ohms

3.1.1   Cabling method and input line termination

The M2896 cable connection uses a daisy chain system. Ribbon cables or twisted-pair cables are connected with multiple connectors, enabling a maximum of 4 drives to be connected.

These drives are controlled in a multiplex system using drive select lines so that any one drive can be accessed.

Fig. 3-1 shows the cabling method and input line termination.

The M2896 input signal lines must be terminated in a maximum of 8 lines, if alternate input is included, except for the drive select lines. In order to operate the drive correctly, the termination must be at the dive connected to the end of the interface cable farthest from the host system.

The M2896 allows a detachable resistor module to be mounted on its printed-circuit board to terminate these input signal lines.

The drive is delivered from the factor with a resistor module on the printed-circuit board. This terminator resistor must be removed from all the drives except the one that connects to the end of the interface cable.

The termination may be ended at the outside. To do so, connect the input signal lines to 150-ohm, 1/4-watt resistors, and tie the other lead to +5 V DC. In this external termination method, the resistor must be mounted near the drive connected to the end of the cable. When the cable end connector is open, terminate with this connector.

RIBBON OR TWISTED-PAIR CABLE

3 m MAX.

(DRIVE SELECT)

SIGNAL

HOST SYSTEM

FDD NO. 1   FDD NO. 2   FDD NO. 3   TERMINATOR
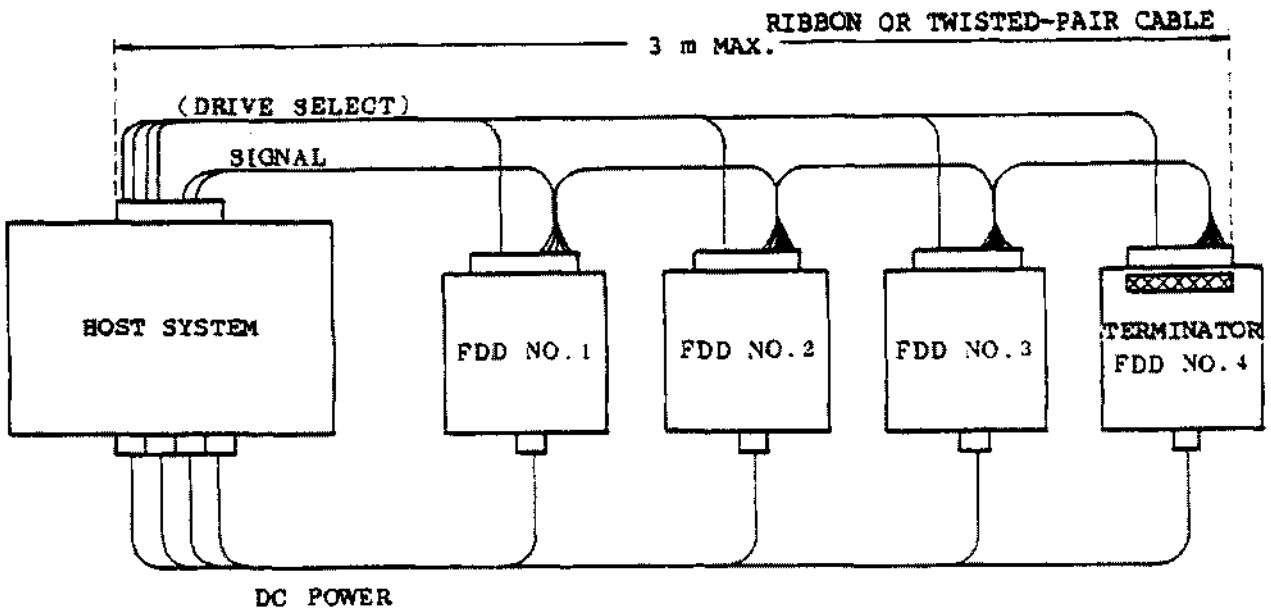FDD NO. 4

DC POWER

Fig. 3-1 Cabling Method (Schematic Diagram)

3.1.2   Line driver and line receiver

The recommended interface circuit for the line driver
and line receiver in the host system and the drives are
shown in Fig. 3-2.

The preferred line receiver circuit is a Schmitt
trigger circuit having a hysteresis characteristic at
switching level in order to improve anti-noise
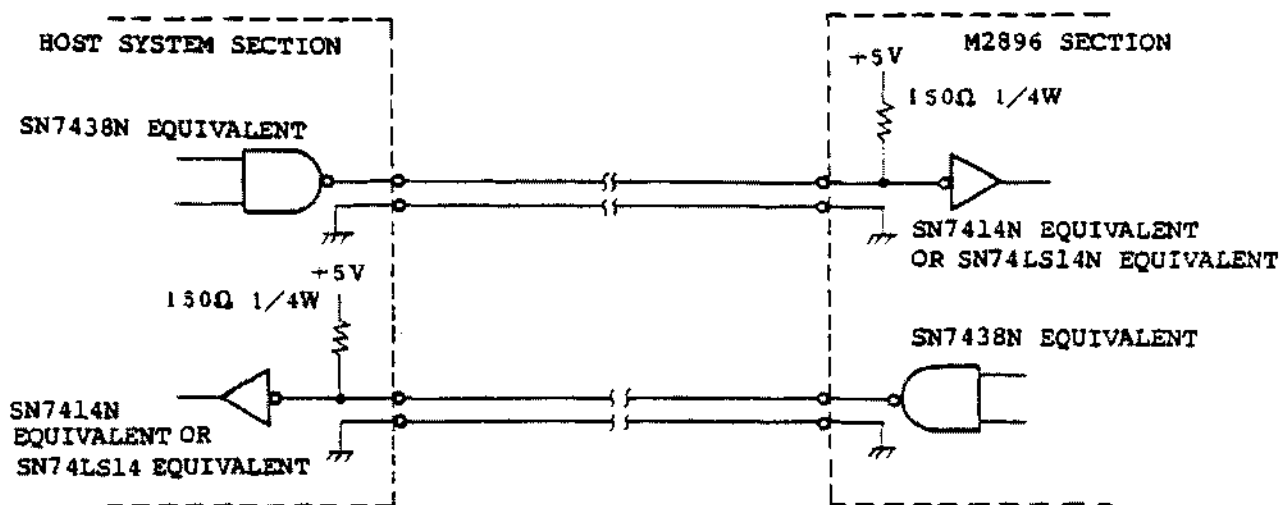properties in the interface line.

Fig. 3-2 Interface Circuit Recommended for Line
Driver and Line Receiver

3.1.3   Input signal lines

The M2896 has 12 input signal lines. Of these, 9 lines
are standard and 3 lines are options in accordance with
customer requirements.

There are two types of input signals; one is
multiplesed in a multi-drive system and the other
performs a multiplex operation.

The multiplex operating signals are:

o   Drive select 1

o   Drive select 2

o   Drive select 3

o   Drive select 4

(1)   Drive select 1 to 4

When these drive select lines are at the logical
"0" level, a multiplexed input/output line becomes
active to enable the read/write operation. These
4 seperate input signal lines, drive select 1 to
4, are provided to make it feasible to drive
connect 4 drives to one system and multiplex them

to one another. Traces DS1, DS2, DS3 and DS4 on the M2896 printed-circuit board are used to determine the drive select line to which the individual drives should correspond to become active. These changes of trace connections are made through jumpers. The jumpers are set to DS1 at factory shipment and so must be changed to other lines as required.

(2) Side select

This interface line is used to select, which disk surface of the diskette should be read or written. When this line is logical "1", the head at Side 0 is selected. A line at logical "0" selects the head at Side 1.

When the polarity of the side select signal is reversed, the read/write operation must be delayed 100 us before execution. When a write operation is completed, the side select signal polarity reversal must be delayed 720 us. The reason for this is as follows: The head uses a tunnel erase system and therefore the core gaps physically disagree between those in the read/write head and erase head. This, in turn, causes a timing difference between the areas at the data writing operation and erasing operation on the disk surface. This is corrected within the M2896 by delaying the erase current cutoff for several hundred microseconds. So, during this delay time, the head select must not be reversed.

(3) Direction select

When step signal pulses are given, this interface line signal controls the direction, inward or outward, in which the read/write head moves.

When this signal is logical "1", the read/write head moves toward the outside of the disk. Logical "0" moves the head in the reverse direction.

In the jumper select option, this interface line can time-share two operations: direction select during a track access operation and side select during a read/write operation.

The line then becomes effective as side select signal 14 ms after the track access operation is completed (after the last step signal pulse has been sent).

This option is described in detail in section 6.10.

The direction select line must be reversed 1 us or more before the leading edge of the first step pulse. It must be reversed again 25 us or more after the leading edge of the last step pulse.

(4) Step

This interface line is a pulse signal to move the read/write head in the direction defined by the direction select line.

Each time a signal pulse is given to the step line, the read/write head moves by one track.

This line normally maintains a logical "1" level; the step operation starts from the leading edge of a negative-going pulse (reversal from logical "1" to logical "0").

(5)   Write gate

At logical "0", this interface line makes the
write driver active, and the data given to the
write data line is written on the disk surface
that has been side-selected. At logical "1", the
line makes the write driver inactive to enable the
read data logic. The verified read data, however,
are not obtained during 590 us (MIN.) after the
write gate becomes inactive.

Refer to section 4, Fig. 4-4 for the timing.

(6)   Write data

This interface line receives data to be written on
the diskette. This line, normally at logical "1",
reverses the write current at the leading edge
(reversal from logical "1" to logical "0") of the
data pulse (negative-going pulse) and writes data
bits.

This line is enabled when the write gate is at
logical "0".

Fig. 3-3 shows the write data timing.

150ns TO 1100ns

2.00μs ±10 ns

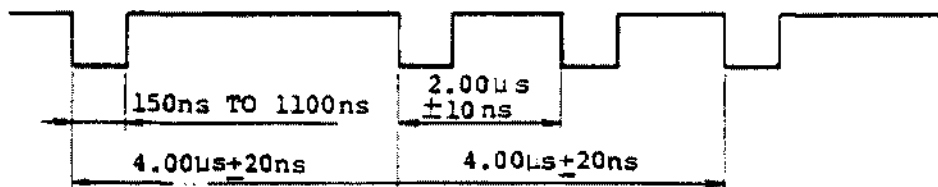4.00μs+20ns   4.00μs+20ns

Fig. 3-3 Write Data Timing (FM Encoding)

(7) Head load (alternate input option)

This interface line is an option selected by the customer. When the diskette is inserted, the door is closed and this line goes to logical "0", the read/write head loads on the disk surface. The read/write operation must be preformed 35 ms or more after the head load line has become active. Using this signal enables the spindle motor start/stop to be controlled. In this case, head loading must be effected with the in-use signal. Refer to section 6.1 for details of this option.

(8) In use (alternate input option)

This interface is an option selected by the customer. When this interface line is at logical "0", the front panel indicator LED lights and the door can be locked. In addition, the drive select "OR" in use for these functions are available.

Refer to section 6.6 for details.

When the head load signal is used for MOTOR START, this signal can be used for head load.

(9) Outside write current switch (alternate input option)

This interfaces line is an option selected by the customer.

This line at logical "1" for tracks 00 to 43 provide a large write current. Logical "0" in the range of tracks 44 to 76 gives a small write current.

The current switch is designed to reduce the read data bit shift magnitude in the inner tracks.

In the standard M2896, the track number is counted and current switching is performed by an internal circuit.

See section 6.13 for a detailed description of this signal.

3.1.4 Output signal lines

Five standard output signal lines are available from the M2896. In addition, two output line options and six alternate output lines can be selected.

(1) Index

This interface line is normally maintained at logical "1". Eash diskette turn (166.7 ms period) provides a 1 to 8 ms width output at logical "0". This signal indicates the start of a track on the rotating diskette. Because the index hole on the jacket is located differently on the single and two-sided diskettes, the drive has two detectors to find the index for whichever diskette is inserted.

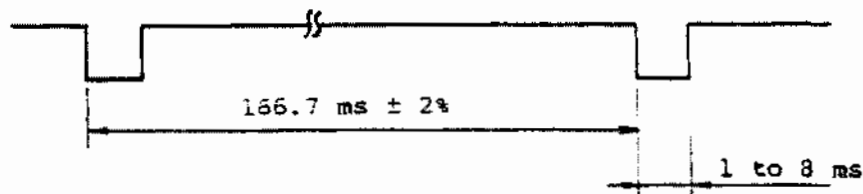Fig. 3-4 shows the index signal timing.

Fig. 3-4 Index Timing

(2) Track 00

When this interface line is at logical "0", it indicates that the read/write head in the drive is positioned to track 00. When the selected drive output is at logical "1", it indicates that the read/write head is positioned at a location other than track 00.

(2) Ready

When this interface line is at logical "1", the door is open or the diskette is not inserted into the drive. When the diskette is inserted into the drive, the door is closed, the index hole is correctly detected, DC power (+5 V and +24 V) is supplied, and thereafter the index is detected two or more times, then logical "0" (ready) occurs. During a single-sided diskette is inserted, if the read/write head at Side 0 is selected, this signal is logical "0", but at Side 1 selection, logical "1" is generated. For two-sided diskettes, logical "0" is maintained independently of side selection.

For a further description, refer to section 6.14.

(4)   Read data

This interface line causes the read/write head to read the data stored on the diskette surface and to output raw data (data and clock synthesis) converted to a pulse signal.

This line is normally at logical "1", but sends logical "0" (negative-going pulse) output pulses during the read operation. Fig. 3-5 shows the timing variation for the usual diskette and the allowance for bit shifts.
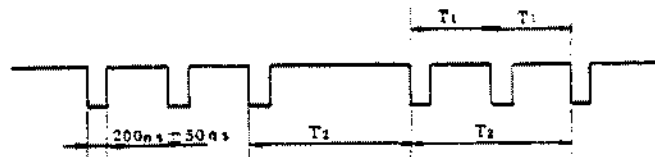
T_1 = 2.00 μs ±400 ns (Jitter due to rotation variation is not included.)

T_2 = 4.00 μs ±800 ns (Jitter due to rotation variation is not included.)

Fig. 3-5 Read Data Timing (FM Encoding)

(5)   Write protect

This interface signal informs the host system that a diskette with a write protect notch is inserted into the drive. Inserting the write-protected diskette into the drive generates a logical "0". When this signal is at logical "0", a write operation on the diskette is inhibited even when the write gate line is active.

(6)   Disk change (alternate output option)

Refer to section 6.8.

(7)   Two-sided (alternate output option)

Refer to section 6.12.

(8)   Alternate I/O pins

These interface pins are options selected by the customer. Use of the pins is described in section 6.

(9)   True ready (alternate output option)

When power is applied to the DC motor and the motor rotates at the rated rpm (READY condition),

and if, furthermore, the seek is completed, logical "0" occurs 23 ± 5 ms from the leading edge of the last step pulse. In addition, a logical "1" is generated 10 us or less from the leading edge of the first step pulse.

3.2 Power Interface

The M2896 requires two types of DC power supplies an no AC supply.

The printed-circuit board and stepping motor require +5V and +24 V supplies.

DC power is supplied through connector J5/P5 attached with the bracket on the printed-circuit board. Two DC voltage specifications are shown in Table 3-3, and the pin arrangement of connector J5/P5 is shown in Table 3-1.

Table 3-3 DC Power Specifications

DC voltage	Voltage Variation	Current	Maximum ripple voltage (peak-to-peak)
+5 V DC	±0.25 V (±5%)	0.8 A TYP. 1.0 A MAX.	100 mV
+24 V DC	±2.4 V (±10%)	0.8 A TYP. 1.0 A MAX. (NOTE)	200 mV

NOTE; 1.3 A MAX. when motor starts. (typically 10 ms)

CHAPTER 4   FUNCTIONAL OPERATION

4.1   Power On Sequencing

To operate the M2896, DC power must be turned on.
Read/write operation must not be performed within 0.5
second after the DC power supply is turned on to allow
the diskette rotation to stabilize and to become the
system ready.

After DC power turn on, probably the read/write head is
not correctly positioned on the track. Before a
read/write operation, make sure to perform a step-out
operation with the controller until the track 00 signal
is detected at the interface line to enable the
read/write head to be positioned correctly.

Fig. 4-1 shows the power on sequence timing.

4.2   Drive Selection

The M2896 uses a daisy chain cabling system in which
multiple drives connect to single cable. The selection
of individual drives is actuated when the drive select
line goes active. Only the drive whose selection line
is active can communicate with the host system. When
multiple drives are connected, the select line at the
drive side must be set to a different number for each
drive. If the same number is set in more than one
drive, the interface output signals mutually interfere
and operating errors occur.

4.3   Track Accessing

The seek operation moves the read/write head inward or
outward to the desired position as determined by the
polarity of the "direction" signal, using the "step"
signal to move the head. To move plural tracks, step
pulses should be emitted until the heads reach the
desired tracks. Head motion starts with the leading
edge of a step pulse. Fig. 4-2 shows the operation
timing.

4.4   Side Selection

The heads located on both sides of the diskette are
selected by the "side select" signal. When the side
select line is high, the head at Side 0 is selected;
when it is low, the head at Side 1 is selected.

4.5   Read Operation

Fig. 4-3 shows the timing relationship required for a read operation. These timing specifications are necessary for an accurate read operation to be performed. FM or MFM is used for coding data to be stored on the diskette. FM is used for single density, and MFM for double density recording. Sophisticated PLO data separator is recommended for data interchangeability with other system or drives.

Fig. 4-5 shows the coded data timing.

4.6   Write Operation

Fig. 4-4 shows the timing relationship required for a write operation. These timing specifications must be followed for an accurate write operation to be performed.

Either FM or MFM can be used for encoding write data. The M2896 incorporates high performance read/write heads having good contact stability between the head and diskette. It is therefore unnecessary, when writing data with MFM (double density), to apply precompensation that corrects bit shift effect at write operation. But to harmonize with other precompensated systems, a maximum of 200 ns write precompensation may be applied.

4.7   Special Operations

The M2896 is provided with a write current switch that
effectively reduces the bit shift value of read data
pulses from the diskette, and is also provided with a
function, in the drive, to generate signals that make
the data separator timing margin high even if the host
system does not have an interface signal for post
compensation, called a switch filter, compensating read
amplifier frequency band.

More specifically, the track numbers are sorted in the
drive circuit, with an LSI counter, so that the write
current is switched at track 44 or above, and the
switch filter is activated at track 60 or above.

In order for these functions, the counter must cause
the read/write heads to be moved to track 00, so that
the contents are initialized to track 00 under each fo
the following condtions:

o   Drive power is turned on,

o   Seek error occurs

These conditions in which the track number that the
host system tries to access is not clear. In any case
other than power turn-on, in which the read/write head
positioned-track numbers in each drive are clear, there
are no errors between the counter in the drives and the
host system. In such a case, it is unnecessary to move
the read/write head to track 00 to initialize counters
of the drives.

4.7.1   Internal write current switch

By connecting the trace "SI" on the M2896 printed-
circuit board, write current can be increased for
tracks 00 to 43 and decreased for tracks 44 to 76.

4.7.2   Internal switch filter

The LSI on the M2896 printed-circuit board decreases
the gain in the high area in the read preamplifier
frequency bandwidth for tracks 00 to 59, and increases
it for tracks 60 to 76, thereby effecting a decrease in
bit shift variation.
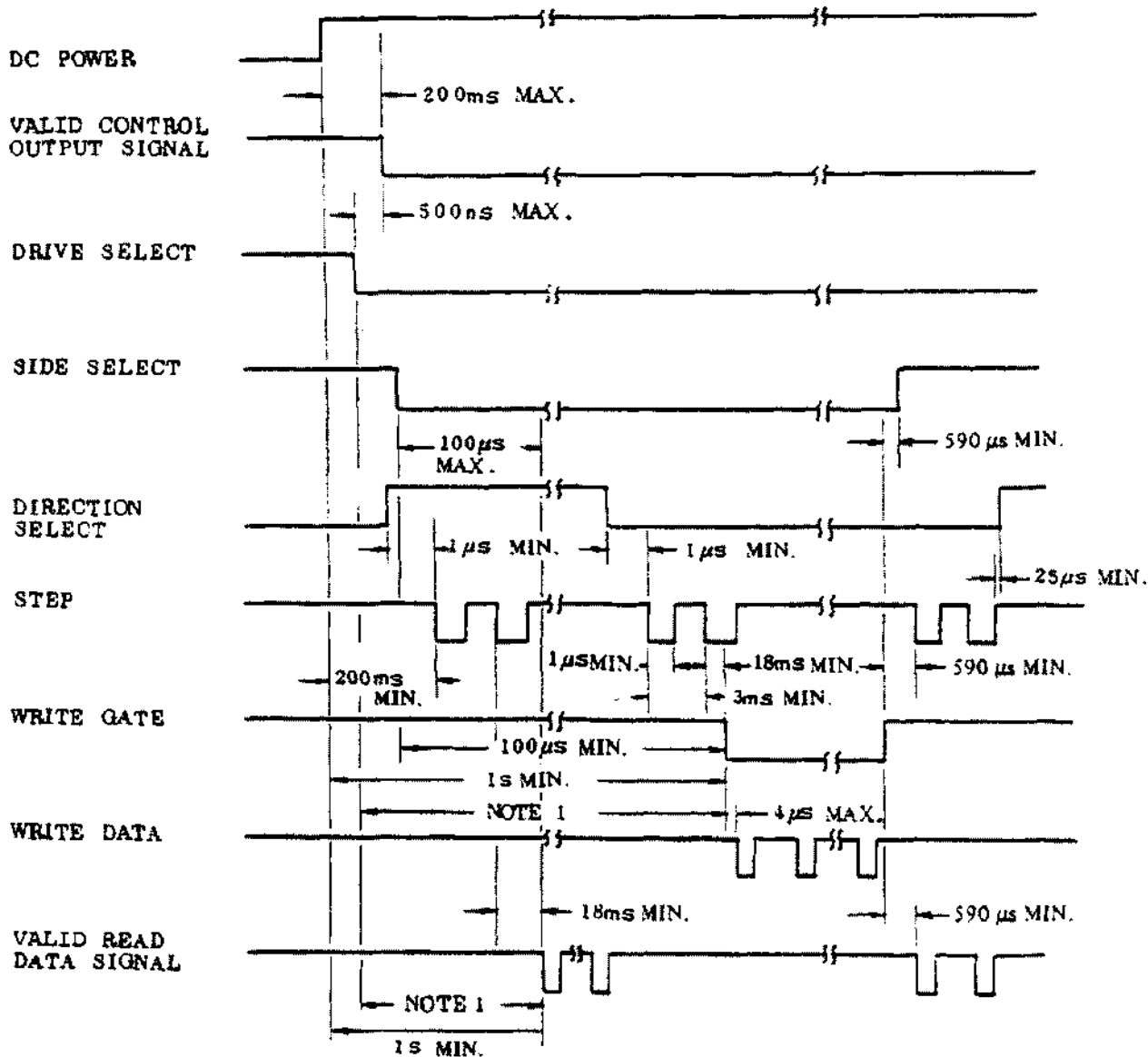
NOTE 1:   Refer to section 6 Customer installation options.

Fig. 4-1 General Control and Data Timing
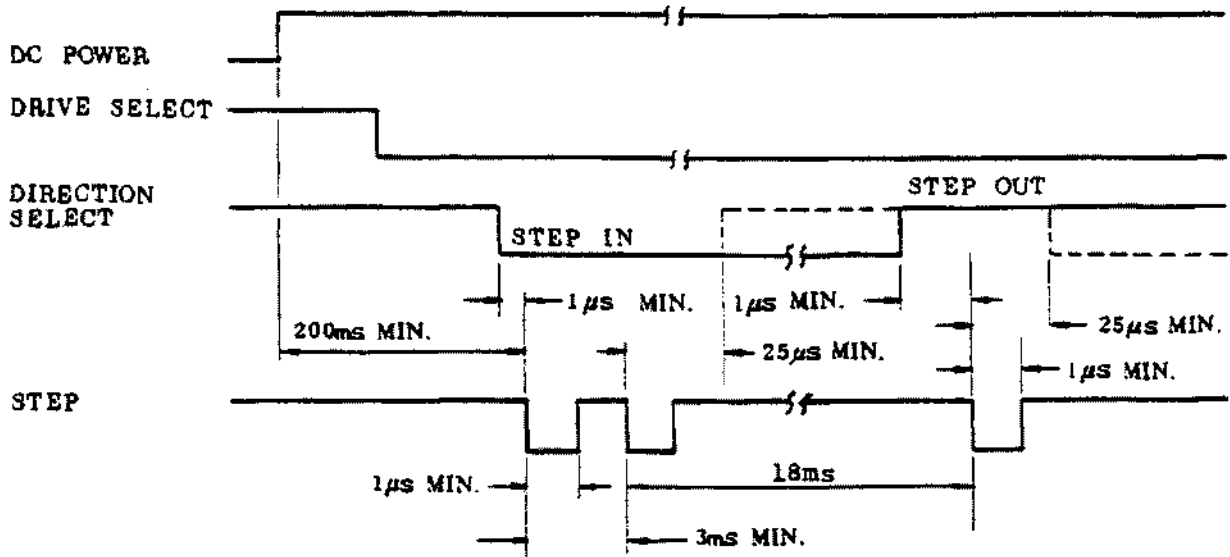
Fig. 4-2 Track Access Timing
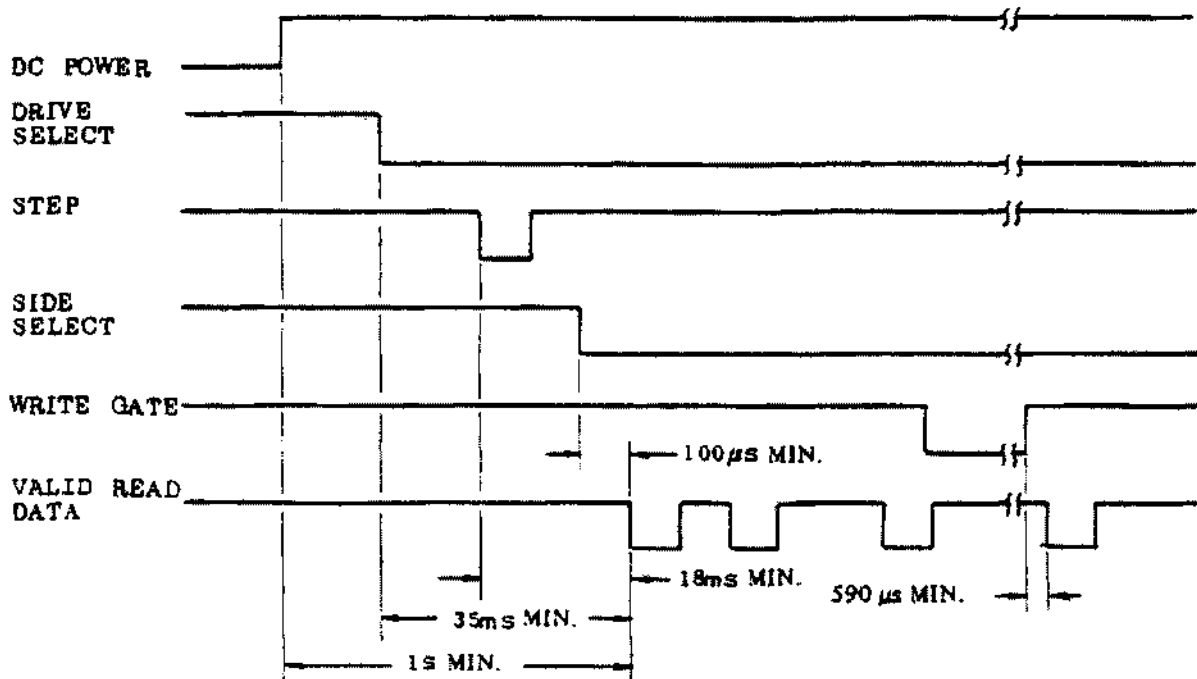
Fig. 4-3 Read Operation Start Timing

DC POWER

DRIVE
SELECT

|← 1S MIN. →|

|← 35ms MIN.

STEP

WRITE GATE

|← 18ms MIN.

590 μs MIN.

|← 4μs MAX. →|

WRITE DATA

Fig. 4-4 Write Operation Start Timing

DATA	1	1	1	0	1	0	0	0	1

FM

|← 2F →| |← 1F →|

DATA	1	1	1	0	1	0	0	0	1

MFM

Fig. 4-5 Comparison between FM and MFM Coding Systems

CHAPTER 5   PHYSICAL INTERFACE

Electronic interfaces between the M2896 and the host system are accomplished with two connectors. The J1 connector is for signal interfaces and the J5 connector is for DC power. Connectors used for the M2896, and recommended mating connectors are described below.

5.1   Signal Connector (J1/P1)

J1 is a card-edge type, 50-pin (both sides used with 25 pins per side) connector with the component side pins even numbered (2, 4, ...50) and the solder side pins odd numbered (1, 3, ...49). There is a key slot between pin 4 and pin 6 to allow the use of a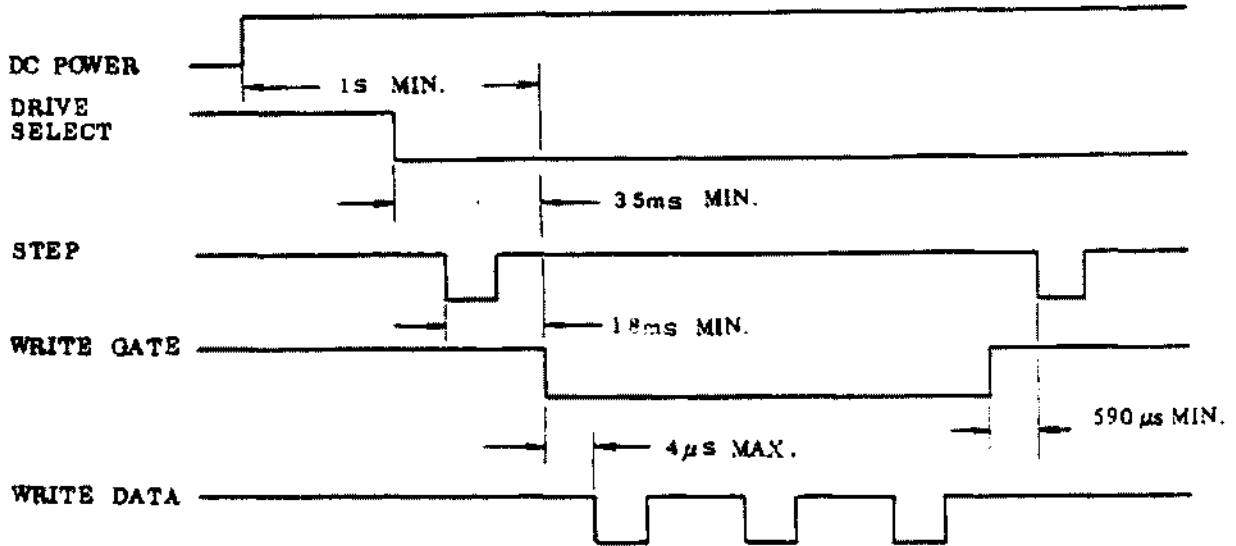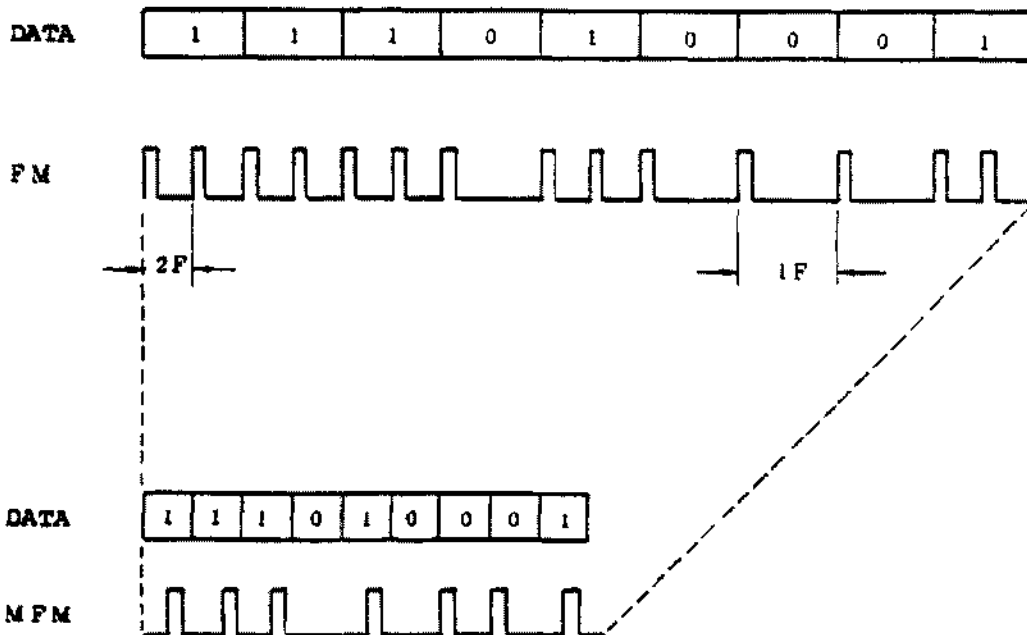 reverse-preventing key. J1 dimensions are shown in Fig. 5-1, and the recommended P1 connecotrs mating with J1 are shown in Table 5-1.

Table 5-1 Recommended P1 Connector Type

Cable used	Maker	Connector housing	Contact
Twisted-pair Cable No. 26	AMP	1-583717-1	583616-5 (Crimp) 583854-3 (Solder)
Flat cable	3M	3415-0001	NA
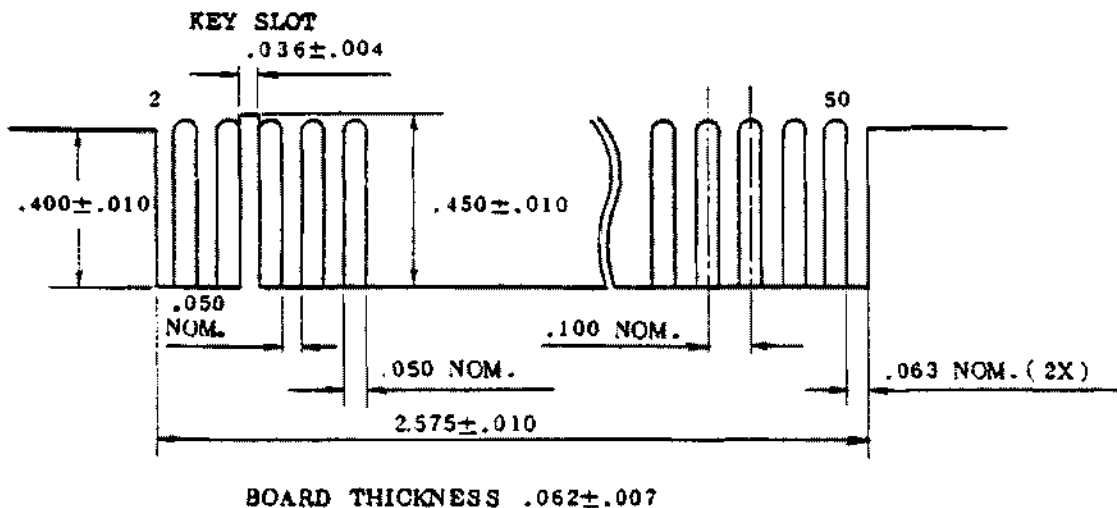
Fig. 5-1 J1 Connector Dimensions and Numbers (dimensions in inch)

5.2   DC Power Connector (J5/P5)

J5 is a DC power connector with six pins, attached to the printed-circuit board bracket.

Fig. 5-2 shows the pin arrangement for J5. The pin numbers are indicated on the component side.

Table 5-2 P5 Connector Type

Cable used	Maker	Connector housing	Contact
AWG 20 to 14	AMP	1-480270-0	60619-1
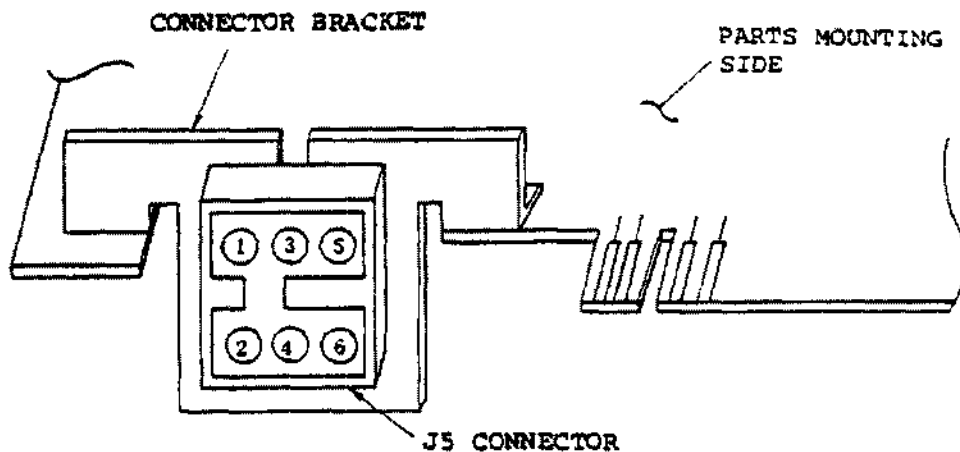
Fig. 5-2 J5 Connector Pin Arrangement

5.3 Interface Connector Physical Location

Fig. 5-3 shows the physical locations of the M2896 interface connectors.

J5 CONNECTOR

AMP P/N 1-480271-0

P5 CONNECTOR

AMP P/N 1-480270-0

P1 CONNECTOR

AMP
P/N 1-583717-1

PARTS
MOUNTING
SIDE

J1 CONNECTOR

PCB

FDD FRAME
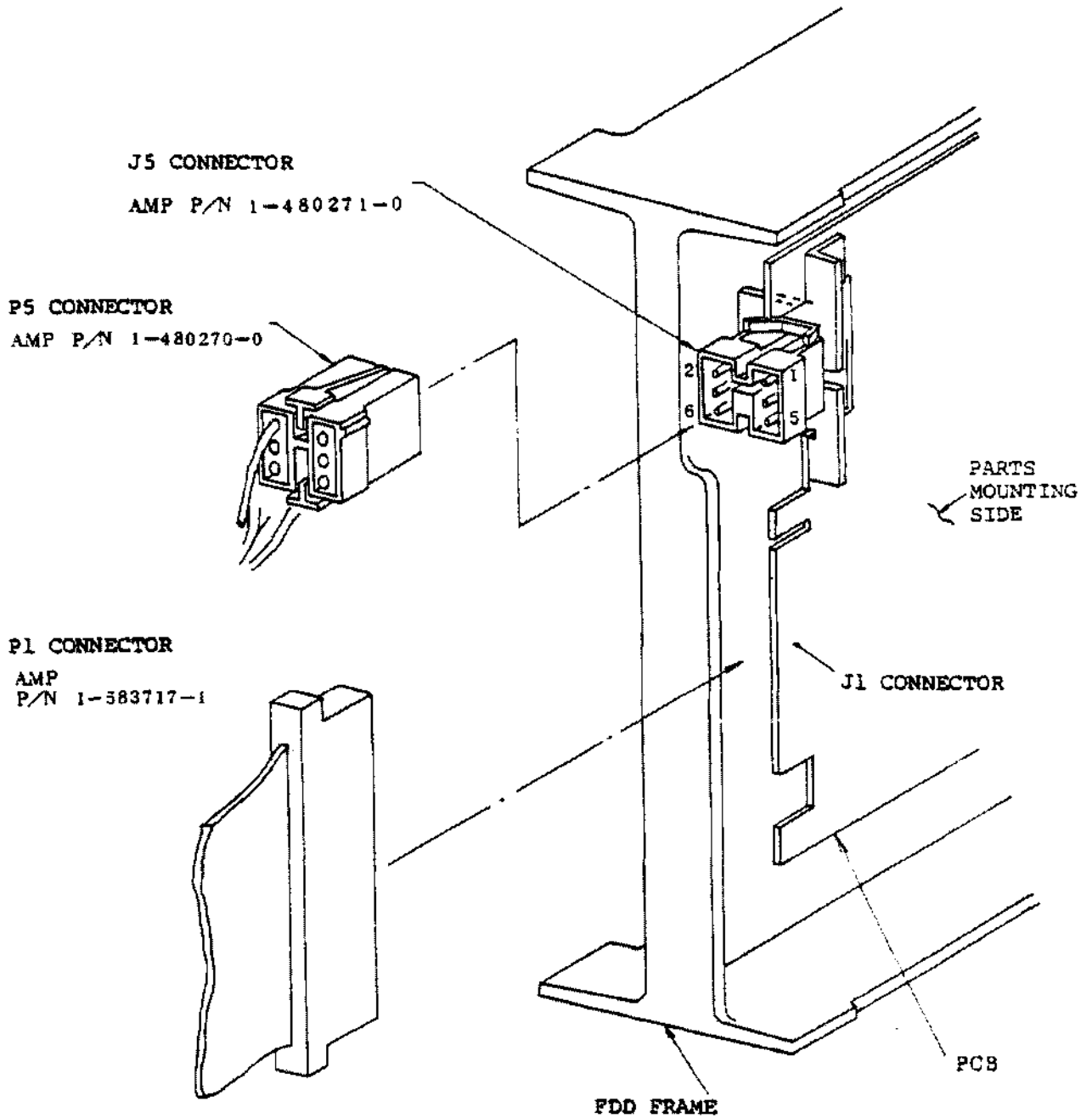
Fig. 5-3 Location of Interface Connectors

CHAPTER 6   CUSTOMER INSTALLATION OPTIONS

The M2896 can be modified so that the non-standard operation described in sections 3 and 4 are performed.

These modifications are performed by connecting or disconnecting traces on the printed-circuit board and/or using alternate input/output pins.

Traces are connected with short-plugs and jumpers. The positon of the traces at delivery from the factory is shown in Table 6-1. Fig. 6-1 shows the location of the traces on the printed-circuit board.

NOTE `▣` indicates plugged
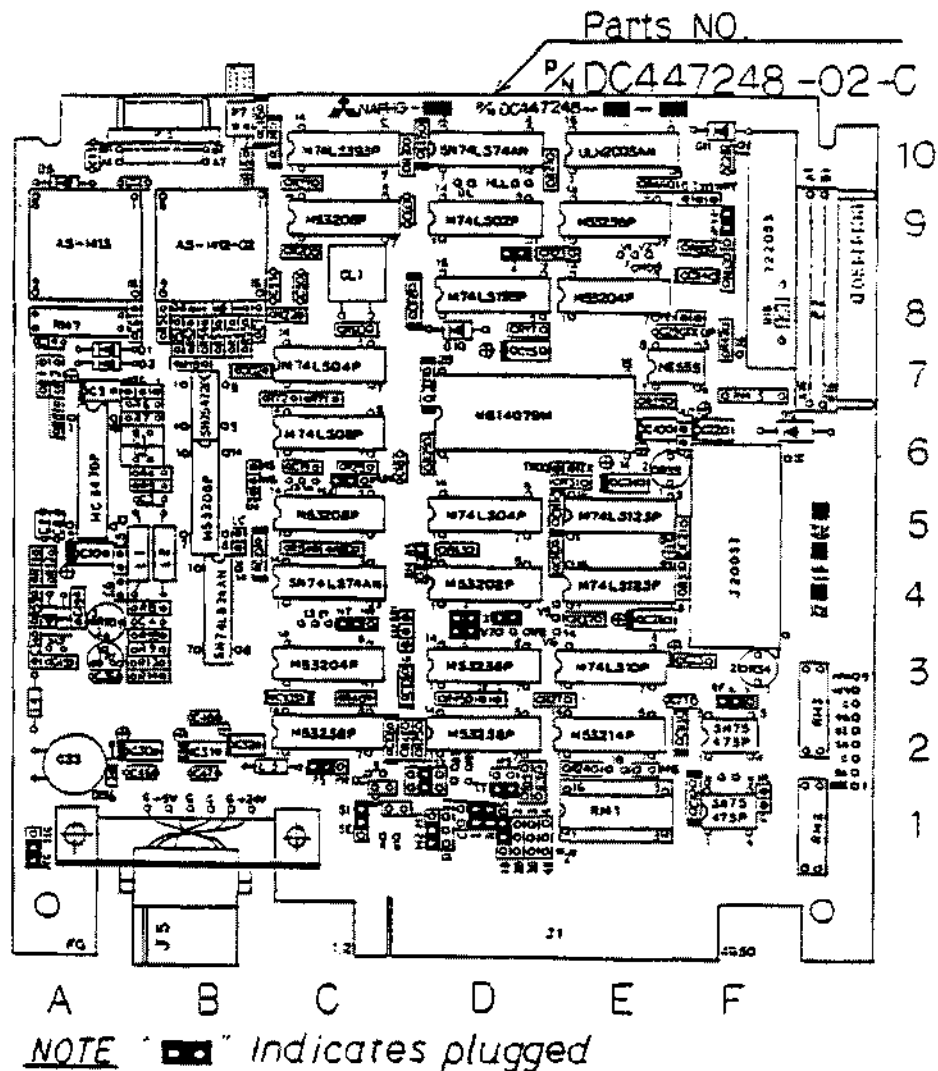
Fig. 6-1 Printed-Circuit Board Option Locations

Table 6-1 Customer CUT/ADD Trace Options

Trace Designator	Location	Description	Shipped From Factory	
			Open	Short
TERMINATOR	E1	Input line terminator		Plugged
JFG	A1	Frame ground and signal ground are shorted		Plugged
JSG	A1	Frame ground and signal ground are opened	X	
DS1	D1	DRIVE SELECT 1 Input		Plugged
DS2,DS3,DS4	D1	DRIVE SELECT 2,3,4 Input	X	
1B,2B,3B,4B	D1	SIDE SELECT Option using DRIVE SELECT	X	
SE	C1	External WRITE CURRENT SWITCH	X	
SI	C1	Internal WRITE CURRENT SWITCH		Plugged
S	C1	"Keep Open"	X	
DC	C1	DISK CHANGE Option	X	
2S	C1	TWO-SIDED Status Output		X
IT	D1	IN USE Terminator		Plugged
D	D1	Alternate Input - IN USE	X	
HI	D1	HEAD LOAD "OR" IN USE to the IN USE CIRCUIT	X	
C	D1	Alternate Input - HEAD LOAD	X	
I	D1	INDEX Output		Plugged
R	D1	READY Output		Plugged
S1	D1	SIDE SELECT Option using DIRECTION SELECT	X	
S2	D1	Standard SIDE SELECT Input		Plugged
S3	D1	SIDE SELECT Option using DRIVE SELECT	X	

Table 6-1 (Cont.)

Trace Designator	Location	Description	Shipped from factory Open	Short
RS	D4	READY Standard		Plugged
RM	D4	READY Modified	X	
RFa	F2	"Don't Remove"		Plugged
RFb	F2	"Keep Open"	X	
MO	E1	MOTOR ON from HEAD LOAD	X	
MS	D1	MOTOR ON from DRIVE SELECT	X	
Z	D9	IN USE LED from DRIVE SELECT		Plugged
NP	F9	Allow Write when WRITE PROTECTED	X	
WP	F9	Inhibit Write when WRITE PROTECTED		Plugged
A	D4	Radial HEAD LOAD		Plugged
B	D3	Radial HEAD LOAD		Plugged
X	D4	Radial HEAD LOAD		Plugged
RI	D1	Radial INDEX		X
RR	D1	Radial READY		X
RI	C2	Radial INDEX		X
RR	C3	Radial READY		X
Y	E8	IN USE from HEAD LOAD	X	
V	E8	Door Lock from HEAD LOAD		X
HLL	D10	HEAD LOAD Latch	X	
DL	D10	Door Lock Latch Option	X	
HUN	C5	HEAD UNLOAD Normal	X	
HUD	C5	HEAD UNLOAD Delay		Plugged

Table 6-1 (cont.)

Trace Designator	Location	Description	Shipped From Factory Open	Short
HR	C4	HOLD READY Output	X	
HY	C4	Standard READY		Plugged
M1	D1	Use J1 pin 4 for MOTOR START	X	
M2	D1	USE J1 pin 18 for MOTOR START		Plugged
PS	C2	HEAD LOAD Anded with Standard READY		Plugged
PH	C2	HEAD LOAD Anded with HOLD READY	X	
E1	C4	"Keep Open"	X	
E2	C4	"Do not cut"		X
V1	E9	"Do not cut"		X
V2	E9	"Keep Open"	X	
V3	C5	"Do not cut"		X
V4	C5	"Keep Open"	X	
V5	E4	"Keep Open"	X	
V6	E4	"Do not cut"		X
V7	D3	"Keep Open"	X	
V8	D3	"Do not cut"		X

6.1   Loading Heads With Drive Select "AND" Head Load Signal

In this option, loading head is accomplished by means of drive select signal "AND" head load signal and therefore the life of heads and media is further prolonged. When the system requires the drive to perform a read/write operation, the head load line is made active (logical "0"). This causes the heads to load and the step motor to be full powered.

The write or read operation must be performed 35 ms or more after the head load line goes active.

To perform the modification for this option, set traces as follows:

o   Short-plug "C" ---- short

o   Short-plug "X" ---- open

o   Short-plug "B" ---- short

o   Short-plug "A" ---- short

6.2   Loading Heads With Head Load Signal
(Selecting Drive is Accomplished By Means of Drive Signal)

This option enable a seek operation by drive selection without loading the heads or with the door open. In this case, as in the one above, make sure to perform the read or write operation 35 ms or more after the head load line goes active (logical "0").

This option is recommended because it provides longer media life.

To perform the modification for this option, set traces as follows:

o   Short-plug "C" ---- short

o   Short-plug "X" ---- short

o   Short-plug "B" ---- open

o   Short-plug "A" ---- short

6.3   Loading Heads With Head Load Signal
            (Selecting Drive is Accomplished By Means of Drive
            Select Signal "AND" Head Load Signal)

            Head loading is accomplished by means of head load
            signals. These are independent of the drive select
            signals.

            This option is used for a mutual copy operation between
            diskettes in which the need for considering head load
            time can be eliminated and copy time can thus be
            reduced. Each drive remains in the head load condition
            for alternate input/output pins.

            The read or write operation must be performed 18 ms or
            more after drive selection.

            In this option, the AND logic condition of the drive
            select signals and head load signals represents the
            drive select condition.

            To perform the modification for this option, set traces
            as follows:

            o   Short-plug "C"   ---- short

            o   Short-plug "X"   ---- short

            o   Short-plug "B"   ---- short

            o   Short-plug "A"   ---- open

6.4   Radial Ready

            This option enables the ready line of each drive to be
            monitored without drive selection.

            To perform the modification for this option, set traces
            as follows:

            The first drive;

            o   Short-plug "R"   ---- short

            o   Short-plug "RR" ---- open

            Others;

            o   Short-plug "R"   ---- open

            o   Pattern   "RR" ---- open

            o   Connect short-plug "R" and alternate I/O pin 4, 6
                   or 8.

Large block of content with Mitsubishi Electric header.

(To use alternate input/output pin No. 2, open trace "0-2" and set short-plug "SE" open).

The circuit relating to this modification is shown in Fig. 6-2.

NOTE: A stopper is controled in the power-down mode except during the seek operation.
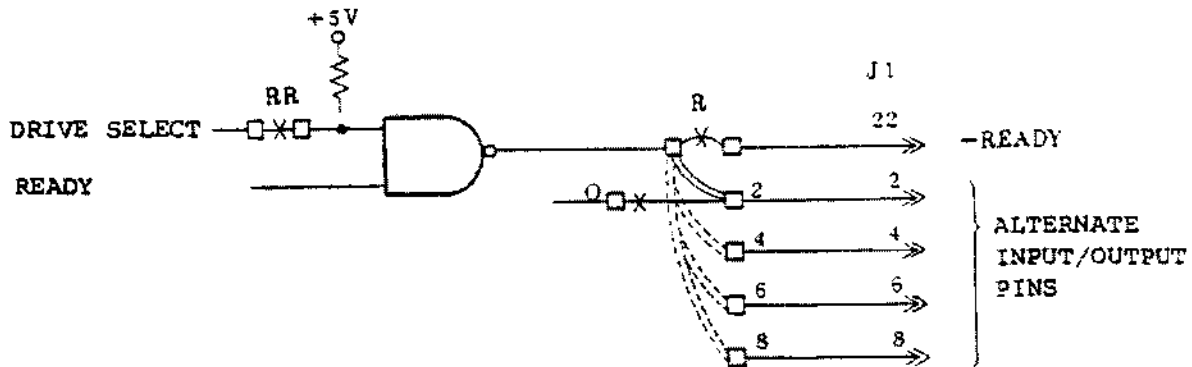

Fig. 6-2 Radial Ready Circuit

6.5   Radial Index

This option enables constant monitoring on the index line and reduces mean -latency time.

To perform the modification for this option, set traces as follows:

The first drive:

o   Short-plug "I"   ---- short

o   Pattern   "RI"   ---- open

Others;

o   Short-plug "I"   ---- open

o   Pattern   "RI"   ---- open

o   Connect short-plug "I" and alternate I/O pin 4, 6 or 8.

(To use alternate input/output pin No. 2, open trace "0-2" and set short-plug "SE" open).

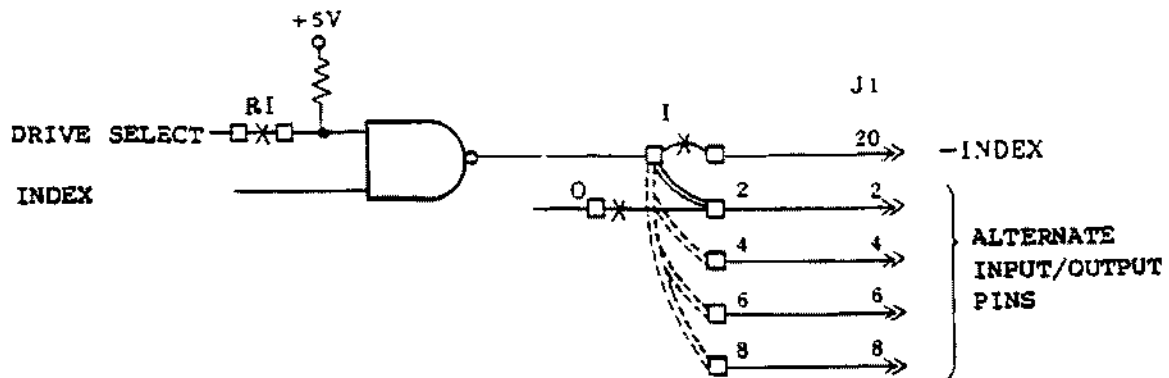The circuit relating to this modification is shown in Fig. 6-3.

Fig. 6-3 Radial Index

6.6   In Use Alternate Input (Activity LED)

when this alternate input becomes a logical "0", the
activity LED on the front panel lights and the door of
the drive locks.

The conditions under which the LED lights are selected
as follows by setting the short-plugs.

6.6.1   Plug settings to light LED with in use "OR" drive
select signal.

o   short-plug "D"   ---- short

o   Short-plug "IT"   ---- short

o   Pattern   "Y"   ---- open

o   Short-plug "Z"   ---- short

6.6.2   Plug settings to light LED with head load "OR" in use
signal.

o   Short-plug "D"   ---- short

o   ·Short-plug "IT"   ---- short

o   Pattern   "Y"   ---- short (jumper)

o   Short-plug "Z"   ---- open

nder the conditions listed above, the in use conditions
are not entered when the short-plug "D" is open. These
conditions are added when the in use switch (or head
load latch) is used.

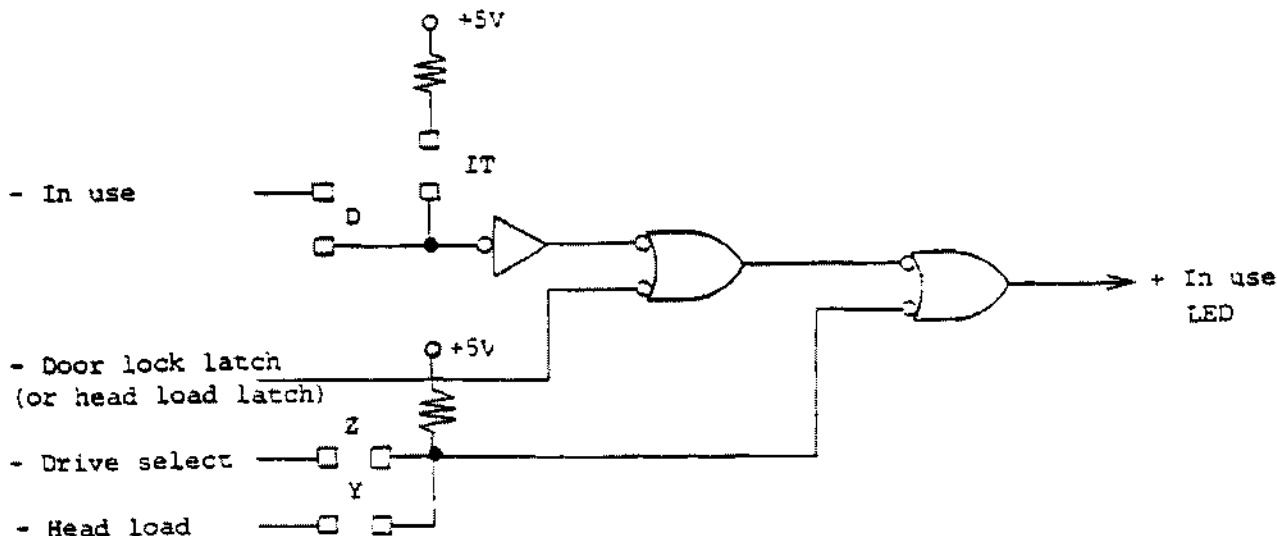The circuit relating to this modification is shown in
Fig. 6-4.

Fig. 6-4 In Use/Activity LED Circuit

6.7 Write Protection Option Use

When a diskette with write protect notch is inserted, the write protect is set so that writing is inhibited within the drive at delivery from the factory.

The modification for this option releases an inserted diskette with a write protect notch from write inhibition, and informs the interface that a protected diskette is inserted.

This option is used to identify a special-use diskette. To perform the modification for this option, set traces as follows:

o   Short-plug "WP"   ---- open

o   Short-plug "NP"   ---- short

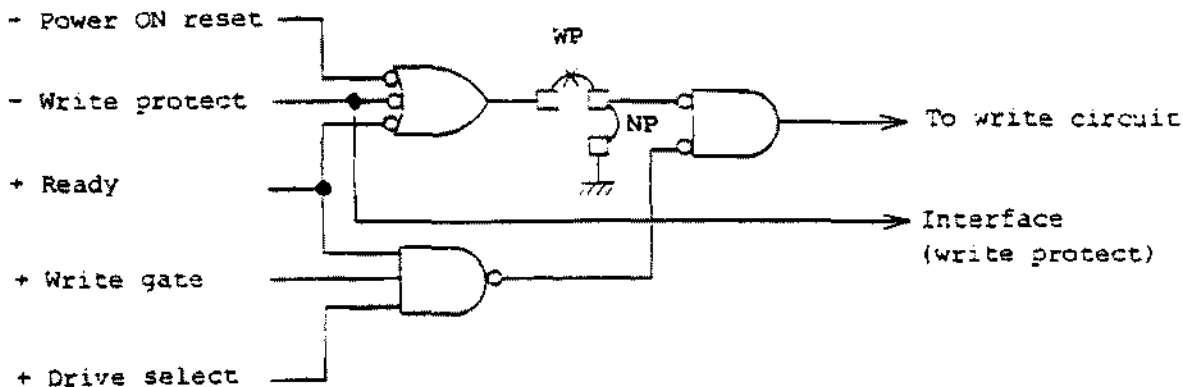The circuit relating to this modification is shown in Fig. 6-5.

Fig. 6-5 Write Protect Circuit

6.8   Disk Change (Alternate Output)

When a not-selected drive becomes Ready after Not Ready
(door is opened during not selected) and following
drive select goes active, the line of this option goes
to the logical "0" level. The line resets at the point
when the drive select reverses from logical "0" to
logical "1".

To perform the modification for this option, set traces
as follows:

o   Short-plug "DC" ---- short

6.9   Side Selection Using Direction Select

The side select can also be controlled by the direction
select line.

This option provides control two ways: one for
controlling head motion direction during a seek
operation; the other for head select control during a
read/write operation.

To perform the modification for this option, set traces
as follows:

o   Short-plug "S1"   ---- short

o   Short-plug "S2"   ---- open

o   Short-plug "S3"   ---- open

6.10   Side Selection Using Drive Select

In a system using one or two M2896,   it is possible to
separate each head and assign drive addresses to them.
In this event, four drive select lines are used to
select four read/write heads.

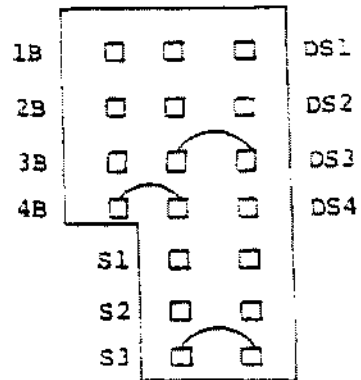To perform the modification for this option, set traces
as follows:

o   Both drives.

.   Short-plug "S1"   ---- open

.   Short-plug "S2"   ---- open

.   Short-plug "S3"   ---- short

o   The first drive

- Short-plug "DS1"   ---- short

- Short-plug "2B   ---- short

o   the second drive

- Short-plug "DS3"   ---- short

- Short-plug "4B"   ---- short

The first drive   The second drive

The drive select lines then perform side select operation as follows:

Drive select 1 selects the first drive side 0

Drive select 2 selects the first drive side 1

Drive select 3 selects the second drive side 0

Drive select 4 selects the second drive side 1

6.11   Door Lock Latch

This option causes the door to be latched and to remain
locked, under control of drive select, without
maintaining In Use active.

When the In Use line is active (logical "0"), and drive
select line becomes active (logical "0"), the door is
latched and a door lock condition is maintained. To
release the door lock condition, make the In Use line
inactive (logical "1"), and make the drive select line
active.

To perform the modification for this option, set traces
as follows:

o   Pattern   "DL" ---- short(Jumper)

o   Short-plug "D"   ---- short

o   Short-plug "HI" ---- open

6.12   Two-Sided

This signal discriminates which type of diskette (two-
sided or single-sided) is inserted. A logical "0" is
output for insertion of a two-side diskette.

To perform the modification for this option, short
traces as follows:

o   Short-plug "2S" ---- short

6.13   Write Current Switch

By making this interface signal logical "0" for tracks
44 to 76, write current can be decreased; otherwise the
current is controlled by internally.

To perform the modification for this option, set traces
as follows:

o   Short-plug "SI"   ---- open

o   Short-plug "SE"   ---- short

When this option is not used, interface connector pin
No. 2 can be used for an alternate input/output pin,
with trace "0-2" disconnected.

6.14   Ready Standard/Ready Modified

This option is used to cause Ready to maintain a
logical "0", when Side 1 is selected while using a
single-sided medium. This option is useful when
direction select is used as side select.

To perform the modification for this option, set traces
as follows:

o   Short-plug "RS"   ---- open

o   Short-plug "R7"   ---- short

6.15   Head Load Latch

This option is used to perform head load when the drive
is not selected. When the head load is latched it is
necessary to cause the drive select line to be active,
with the head load signal or in use signal line being
active (logical "0").

To perform the modification for this option, set traces
as follows:

6.15.1   When the head load signal is active and drive select is
to be latched.

.   Short-plug "IT"   ---- open

.   Short-plug "D"   ---- open

.   Short-plug "HI"   ---- short

.   Short-plug "C"   ---- open

.   short-plug "X"   ---- short

.   Short-plug "B"   ---- open

.   Short-plug "A"   ---- short

.   Pattern   "DL"   ---- short(jumper)

.   Pattern   "HLL"   ---- short(jumper)

6.15.2   When the in use signal is active and drive select is to
         be latched.

- Short-plug "IT" ---- short

- Short-plug "D"   ---- short

- Short-plug "HI" ---- open

- Short-plug "C"   ---- open

- Short-plug "X"   ---- short

- Short-plug "B"   ---- open

- Short-plug "A"   ---- short

- Pattern   "DL" ---- short(jumper)

- Pattern   "HLL" ---- short(jumper)

         To release head load latch, make the head load line or
         in use line inactive (logical "1") and then select the
         drive.

6.16   Door Lock Condition

6.16.1   Door lock with in use "OR" head load signals

         To perform the modification for this option, set traces
         as follows:

o   Short-plug "C" ---- short

o   short-plug "X" ---- short

o   Pattern   "V" ---- short(jumper)

o   Pattern   "Y" ---- open

6.16.2   Door lock with in use "OR" drive select signals

         To perform the modification for this option, set traces
         as follows:

o   Short-plug "A" ---- short

o   Short-plug "Z" ---- short

o   Pattern   "V" ---- open

o   Pattern   "Y" ---- short(jumper)

6.17   Motor Start

The spindle motor is normally actuated when the DC power supply is ON and a disk is inserted, however the short-plugs may be used to set the following three conditions. Read/write operation should not be performed during the 500 ms interval required between motor start and READY.

6.17.1 Motor start with head load signal Plug settings

o   Short-plug "MO" ---- short

o   Short-plug "MS" ---- open

6.17.2 Motor start with drive select signal Plug settings

o   short-plug "MO" ---- open

o   Short-plug "MS" ---- short

6.17.3 Motor start with head load "AND" drive select Plug settings

o   Short-plug "MO" ---- short

o   Short-plug "MS" ---- short

CHAPTER 6   CUSTOMER INSTALLATION OPTIONS

The M2896 can be modified so that the non-standard operations described in sections 3 and 4 are performed.

These modifications are performed by connecting or disconnecting traces on the printed-circuit board and/or using alternate input/output pins.

Traces are connected with short-plugs and jumpers. The position of the traces at delivery from the factory is shown in Table 6-1. Fig. 6-1 shows the location of the traces on the printed-circuit board.
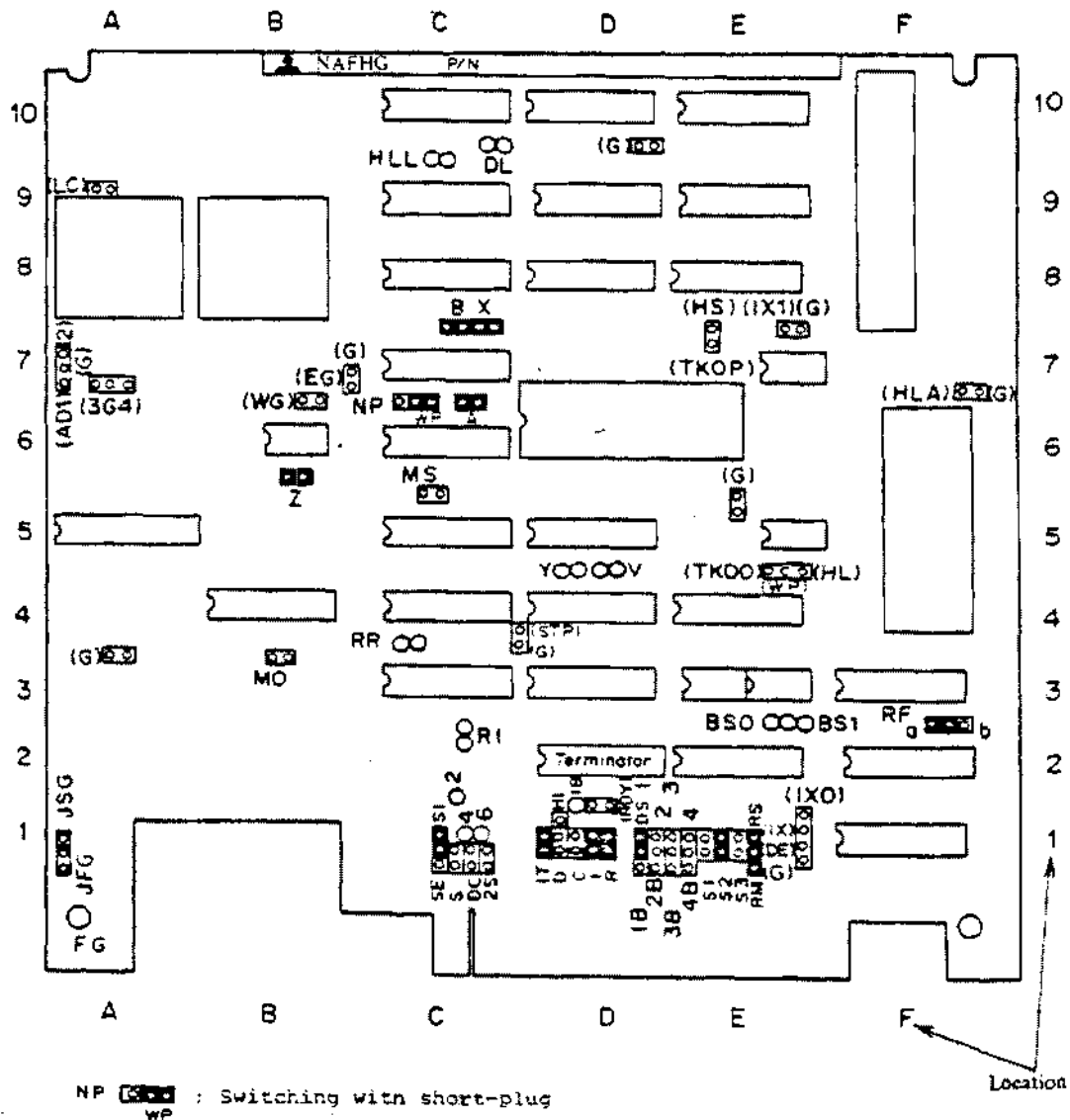

NP ▦ ; Switching with short-plug
   wP

HLL ∞ ; Switching by cutting the pattern and using jumpers.

Fig. 6-1 Printed-Circuit Board Trace Location

Table 6-1   Customer CUT/ADD Trace Options

Trace Designator	Location	Description	Shipped from Factory	
			Open	Short
TERMINATOR	D2	Input line terminator		Plugged
JFG	A1	Frame ground and signal ground are shorted		Plugged
JSG	A1	Frame ground and signal ground are opened	X	
DS1	D1	DRIVE SELECT 1 Input		Plugged
DS2,DS3,DS4	D1	DRIVE SELECT 2, 3, 4 Input	X	
1B, 2B, 3B, 4B	D1	SIDE SELECT Option using DRIVE SELECT	X	
SE	C1	External WRITE CURRENT SWITCH	X	
SI	C1	Internal WRITE CURRENT SWITCH		Plugged
S	C1	"Keep Open"	X	
DC	C1	DISK CHANGE Option	X	
2S	C1	TWO-SIDED Status Output	X	
IT	D1	IN USE Terminator		Plugged
D	D1	Alternate Input - IN USE	X	
HI	D1	HEAD LOAD "OR" IN USE to the IN USE CIRCUIT	X	
C	D1	Alternate Input - HEAD LOAD	X	
I	D1	INDEX Output		Plugged
R	D1	READY Output		Plugged
S1	E1	SIDE SELECT Option using DIRECTION SELECT	X	
S2	E1	Standard SIDE SELECT Input		Plugged
S3	E1	SIDE SELECT Option using DRIVE SELECT	X	

(CONTINUED ON NEXT PAGE)

Table 6.1 (cont.)

Trace Designator	Location	Description	Shipped from factory	
			Open	Short
RS	E1	READY Standard		Plugged
RM	E1	READY Modified	X	
RFa	F2	"Don't Remove"		Plugged
RFb	F2	"Keep Open"	X	
MO	B3	MOTOR ON from HEAD LOAD	X	
MS	C5	MOTOR ON from DRIVE SELECT	X	
Z	B5	IN USE LED from DRIVE SELECT		Plugged
NP	C6	Allow Write when WRITE PROTECTED	X	
WP	C6	Inhibit Write when WRITE PROTECTED		Plugged
A	C6	Radial HEAD LOAD		Plugged
B	C7	Radial HEAD LOAD		Plugged
X	C7	Radial HEAD LOAD		Plugged
BSO	E2	"Don't Cut"		X
BS1	E2	"Keep Open"	X	
RI	C2	Radial INDEX		X
RR	C3	Radial READY		X
Y	D4	IN USE from HEAD LOAD	X	
V	D4	Door Lock from HEAD LOAD		X
HLL	C9	HEAD LOAD Latch	X	
DL	C10	Door Lock Latch Option	X	

6.1 Loading Heads With Drive Select "AND" Head Load Signal (NOTE)

In this option, loading head is accomplished by means of drive select signal "AND" head load signal and therefore the life of heads and media is further prolonged. When the system requires the drive to perform a read/write operation, the head load line is made active (logical "0"). This causes the heads to load and the step motor to be full powered.

The write or read operation must be performed 35 ms or more after the head load line goes active.

To perform the modification for this option, set traces as follows.

o   Short-plug "C" (location D1) ----- short

o   Short-plug "X" (location C7) ----- open

o   Short-plug "B" (location C7) ----- short

o   Short-plug "A" (location C6) ----- short

6.2 Loading Heads With Head Load Signal (NOTE)
(Selecting Drive is Accomplished By Means of Drive Select Signal)

This option enables a seek operation by drive selection without loading the heads or with the door open. In this case, as in the one above, make sure to perform the read or write operation 35 ms or more after the head load line goes active (logical "0").

This option is recommended because it provides longer media life.

To perform the modification for this option, set traces as follows.

o   Short-plug "C" (location D1) ----- short

o   Short-plug "X" (location C7) ----- short

o   Short-plug "B" (location C7) ----- open

o   Short-plug "A" (location C6) ----- short

6.3 Loading Heads With Head Load Signal (NOTE)
(Selecting Drive is Accomplished By Means of Drive Select Signal "AND" Head Load Signal)

Head loading is accomplished by means of head load signals. These are independent of the drive select signals.

peration between diskettes

This option is used for a mutual copy operation between diskettes in which the need for considering head load time can be eliminated and copy time can thus be reduced. Each drive remains in the head load condition for alternate input/output pins.

The read or write operation must be performed 18 ms or more after drive selection.

In this option, the AND logic condition of the drive select signals and head load signals represents the drive select condition.

To perform the modification for this option, set traces as follows.

o Short-plug "C" (location D1) ----- short

o Short-plug "X" (location C7) ----- short

o Short-plug "B" (location C7) ----- short

o Short-plug "A" (location C6) ----- open

6.4   Radial Ready

This option enables the ready line of each drive to be monitored without drive selection.

To perform the modification for this option, set traces as follows.

The first drive:

o Short-plug "R" (location D1) ----- short

o Short-plug "RR" (location C3) ----- open

Others:

o Short-plug "R" (location D1) ----- open

o Pattern   "RR" (location C3) ----- open

o Connect short-plug "R" and alternate I/O pin 4, 6 or 8.

(To use alternate input/output pin No. 2, open trace "0-2" and set short-plug "SE" (location C1) open).

The circuit relating to this modification is shown in Fig. 6-2.

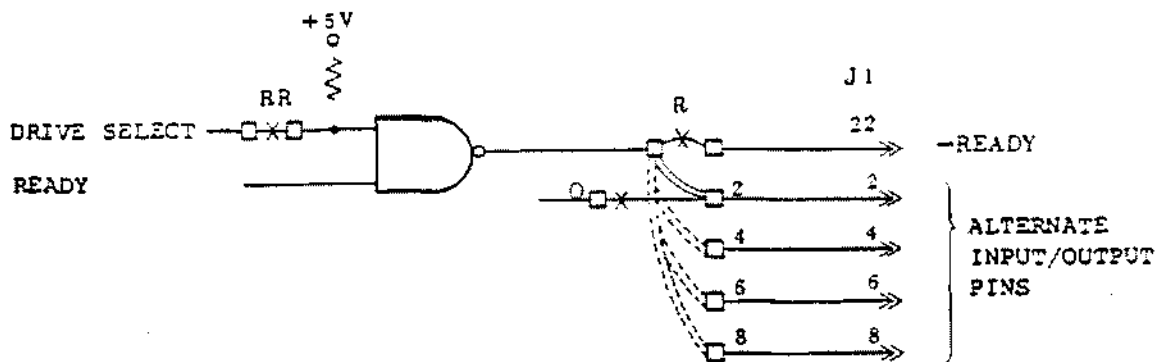NOTE: A stopper is controled in the power-down mode except during the seek operation.

Fig. 6-2   Radial Ready Circuit

6.5   Radial Index

This option enables constant monitoring on the index line and reduces mean latency time.

To perform the modification for this option, set traces as follows.

The first drive;

: Short-plug "I"   (location D1) ------ short

o Pattern   "RI" (location C2) ------ open

Others;

o Short-plug "I"   (location D1) ------ open

o Pattern   "RI" (location C2) ------ open

o Connect short-plug "I" and alternate I/O pin 4, 6 or 8.

(To use alternate input/output pin No. 2, open trace "O-2" and set short-plug "SE" (location C1) open).

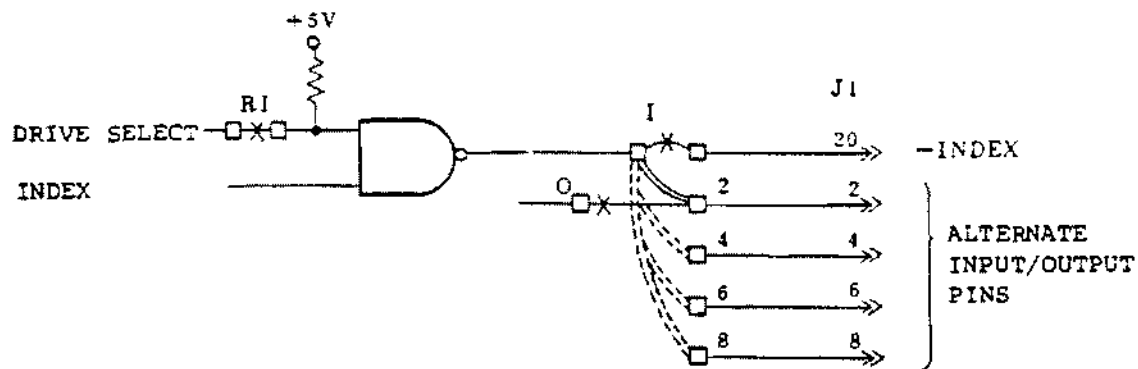The circuit relating to this modification is shown in Fig. 6-3.

Fig. 6-3   Radial Index

6.6   In Use Alternate Input (Activity LED)

When this alternate input becomes a logical "0", the activity LED on the front panel lights and the door of the drive locks.

The conditions under which the LED lights are selected as follows by setting the short-plugs.

6.6.1   Plug settings to light LED with in use "OR" drive select signal.

o Short-plug "D"   (location D1) ----- short

o Short-plug "IT" (location D1) ----- short

o Pattern   "Y"   (location D4) ----- open

o Short-plug "Z"   (location B5) ----- short

6.6.2   Plug settings to light LED with head load "OR" in use signal.

o Short-plug "D"   (location D1) ----- short

o Short-plug "IT" (location D1) ----- short

o Pattern   "Y"   (location D4) ----- short (jumper)

o Short-plug "Z"   (location B5) ----- open

Under the conditions listed above, the in use conditions are
not entered when the short-plug "D" is open. These conditions are
added when the in use switch (or head load latch) is used.

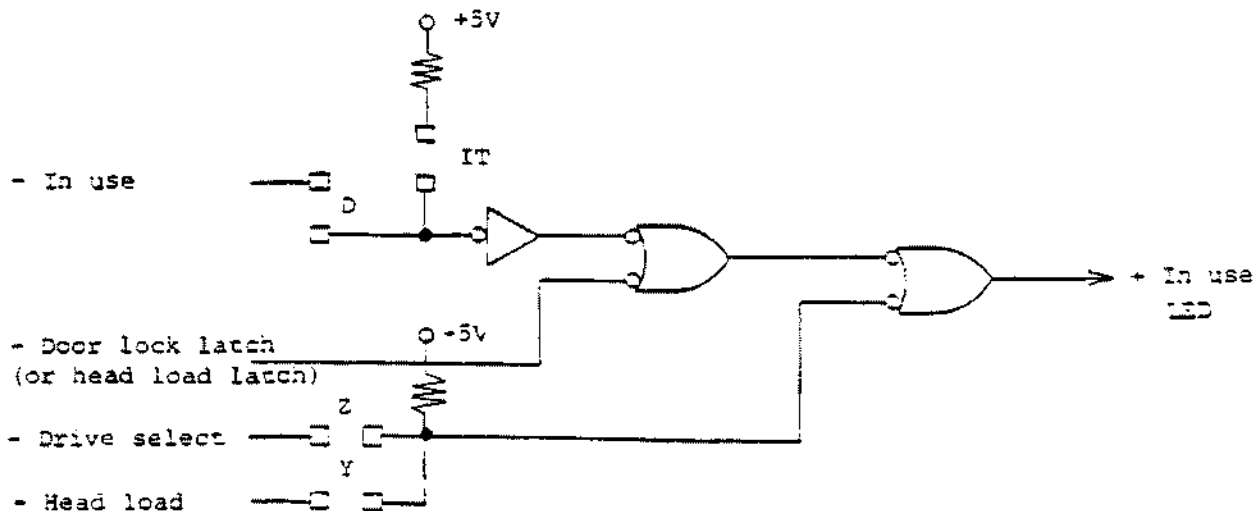The circuit relating to this modification is shown in Fig. 6-4.

Fig. 6-4   In Use/Activity LED Circuit

6.7   Write Protection Option Use

When a diskette with write protect notch is inserted, the write protect
is set so that writing is inhibited within the drive at delivery from
the factory.

The modification for this option releases an inserted diskette with
a write protect notch from write inhibition, and informs the interface
that a protected diskette is inserted.

This option is used to identify a special-use diskette. To perform
the modification for this option, set traces as follows.

o   Short-plug "WP" (location C6) ----- open

o   Short-plug "NP" (location C6) ----- short

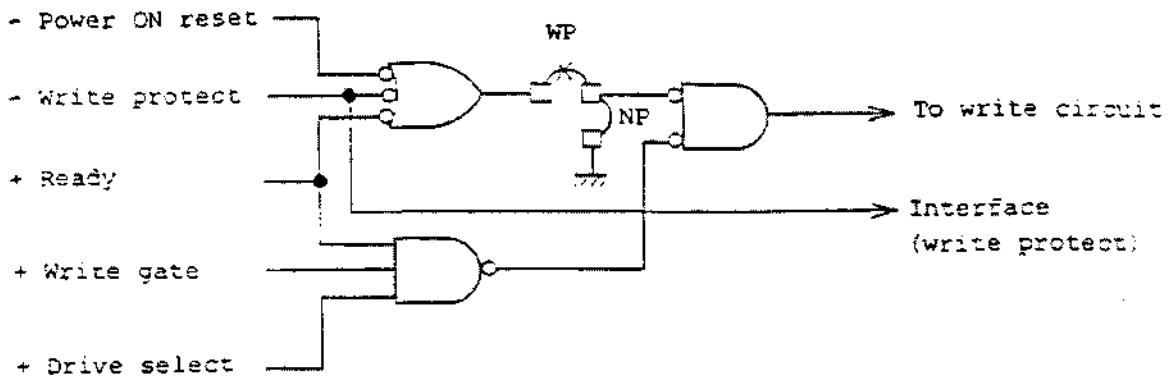The circuit relating to this modification is shown in Fig. 6-5.

Fig. 6-5   Write Protect Circuit

6.8   Disk Change (Alternate Output)

When a not-selected drive becomes Ready after Not Ready (door is
opened during not selected) and following drive select goes active,
the line of this option goes to the logical "0" level. The line resets
at the point when the drive select reverses from logical "0" to logical
"1".

To perform the modification for this option, set traces as follows.

> Short-plug "DC" (location C1) ----- short

6.9   Side Selection Using Direction Select

The side select can also be controlled by the direction select line.

This option provides control two ways: one for controlling head
motion direction during a seek operation; the other for head select
control during a read/write operation.

To perform the modification for this option, set traces as follows.

> Short-plug "S1" (location E1)   ----- short

> Short-plug "S2" (location E1)   ----- open

> Short-plug "S3" (location E1)   ----- open
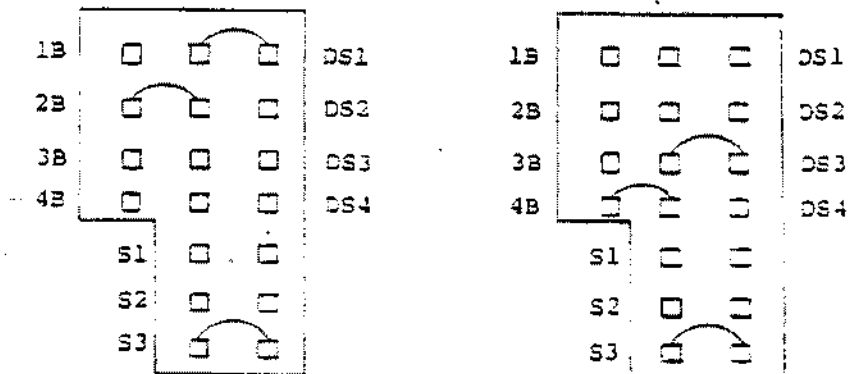
6.10 Side Selection Using Drive Select

In a system using one or two M2896, it is possible to separate each head and assign drive addresses to them. In this event, four drive select lines are used to select four read/write heads.

To perform the modification for this option, set traces as follows.

o Both drives.

. Short-plug "S1" (location E1) ----- open

. Short-plug "S2" (location E1) ----- open

. Short-plug "S3" (location E1) ----- short

o The first drive

. Short-plug "DS1" (location D1) ----- short

. Short-plug "2B" (location D1) ----- short

o The second drive

. Short-plug "DS3" (location D1) ----- short

. Short-plug "4B" (location D1) ----- short

The first drive   The second drive

The drive select lines then perform side select operation as follows.

Drive select 1 selects the first drive side 0

Drive select 2 selects the first drive side 1

Drive select 3 selects the second drive side 0

Drive select 4 selects the second drive side 1

6.11 Door Lock Latch

This option causes the door to be latched and to remain locked, under control of drive select, without maintaining In Use active.

When the In Use line is active (logical "0"), and drive select line becomes active (logical "0"), the door is latched and a door lock condition is maintained. To release the door lock condition, make the In Use line inactive (logical "1"), and make the drive select line active.

To perform the modification for this option, set traces as follows.

o Pattern   "DL" (location C10) ----- short (jumper)

o Short-plug "D"   (location D1)   ----- short

o Short-plug "HI" (location D1)   ----- open

6.12 Two-Sided

This signal discriminates which type of diskette (two-sided or single-sided) is inserted. A logical "0" is output for insertion of a two-sided diskette.

To perform the modification for this option, short traces as follows.

o Short-plug "2S" (location C1) ----- short

6.13 Write Current Switch

By making this interface signal logical "0" for tracks 44 to 76, write current can be decreased; otherwise the current is controlled internally.

To perform the modification for this option, set traces as follows.

    o Short-plug "SI" (location Cl) ----- open

    o Short-plug "SE" (location Cl) ----- short

When this option is not used, interface connector pin No. 2 can be
used for an alternate input/output pin, with trace "0-2" disconnected.

6.14   Ready Standard/Ready Modified

This option is used to cause Ready to maintain a logical "0", when
Side 1 is selected while using a single-sided medium. This option
is useful when direction select is used as side select.

To perform the modification for this option, set traces as follows.

    o Short-plug "RS" (location El) ----- open

    o Short-plug "R7" (location El) ----- short

6.15   Head Load Latch

This option is used to perform head load when the drive is not
selected. When the head load is latched it is necessary to cause
the drive select line to be active, with the head load signal or
in use signal line being active (logical "0").

To perform the modification for this option, set traces as follows.

6.15.1 When the head load signal is active and drive select is to be latched.

    • Short-plug "IT" (location Dl) ----- open

    • Short-plug "D" (location Dl) ----- open

    • Short-plug "HI" (location Dl) ----- short

    • Short-plug "C" (location Dl) ----- open

    • Short-plug "X" (location C7) ----- short

- Short-plug "9" (location C7) ----- open

- Short-plug "A" (location C6) ----- short

- Pattern "DL" (location C10) ----- short (jumper)

- Pattern "HLL" (location C9) ----- short (jumper)

6.15.2 When the in use signal is active and drive select is to be latched.

. Short-plug "IT" (location D1) ----- short

. Short-plug "D" (location D1) ----- short

. Short-plug "HI" (location D1) ----- open

. Short-plug "C" (location D1) ----- open

. Short-plug "X" (location C7) ----- short

. Short-plug "B" (location C7) ----- open

. Short-plug "A" (location C6) ----- short

. Pattern "DL" (location C10) ----- short (jumper)

. Pattern "HLL" (location C9) ----- short (jumper)

To release head load latch, make the head load line or in use line inactive (logical "1") and then select the drive.

6.16   Door Lock Condition

6.16.1 Door lock with in use "OR" head load signals

To perform the modification for this option, set traces as follows.

o Short-plug "C" (location D1) ----- short

o Short-plug "X" (location C7) ----- short

o Pattern "V" (location D4) ----- short (jumper)

o Pattern "Y" (location D4) ----- open

6.16.2 Door lock with in use "OR" drive select signals

To perform the modification for this option, set traces as follows.

o   Short-plug "A" (location C6) ----- short

o   Short-plug "Z" (location B5) ----- short

o   Pattern   "V" (location D4) ----- open

o   Pattern   "Y" (location D4) ----- short (jumper)

6.17   Motor Start

The spindle motor is normally actuated when the DC power supply is
ON and a disk is inserted, however the short-plugs may be used to
set the following three conditions. Read/write operation should
not be performed during the 500 ms interval required between motor
start and READY.

6.17.1 Motor start with head load signal Plug settings

o   Short-plug "MO" (location B3) ----- short

o   Short-plug "MS" (location C5) ----- open

6.17.2 Motor start with drive select signal Plug settings

o   Short-plug "MO" (location B3) ----- open

o   Short-plug "MS" (location C5) ----- short
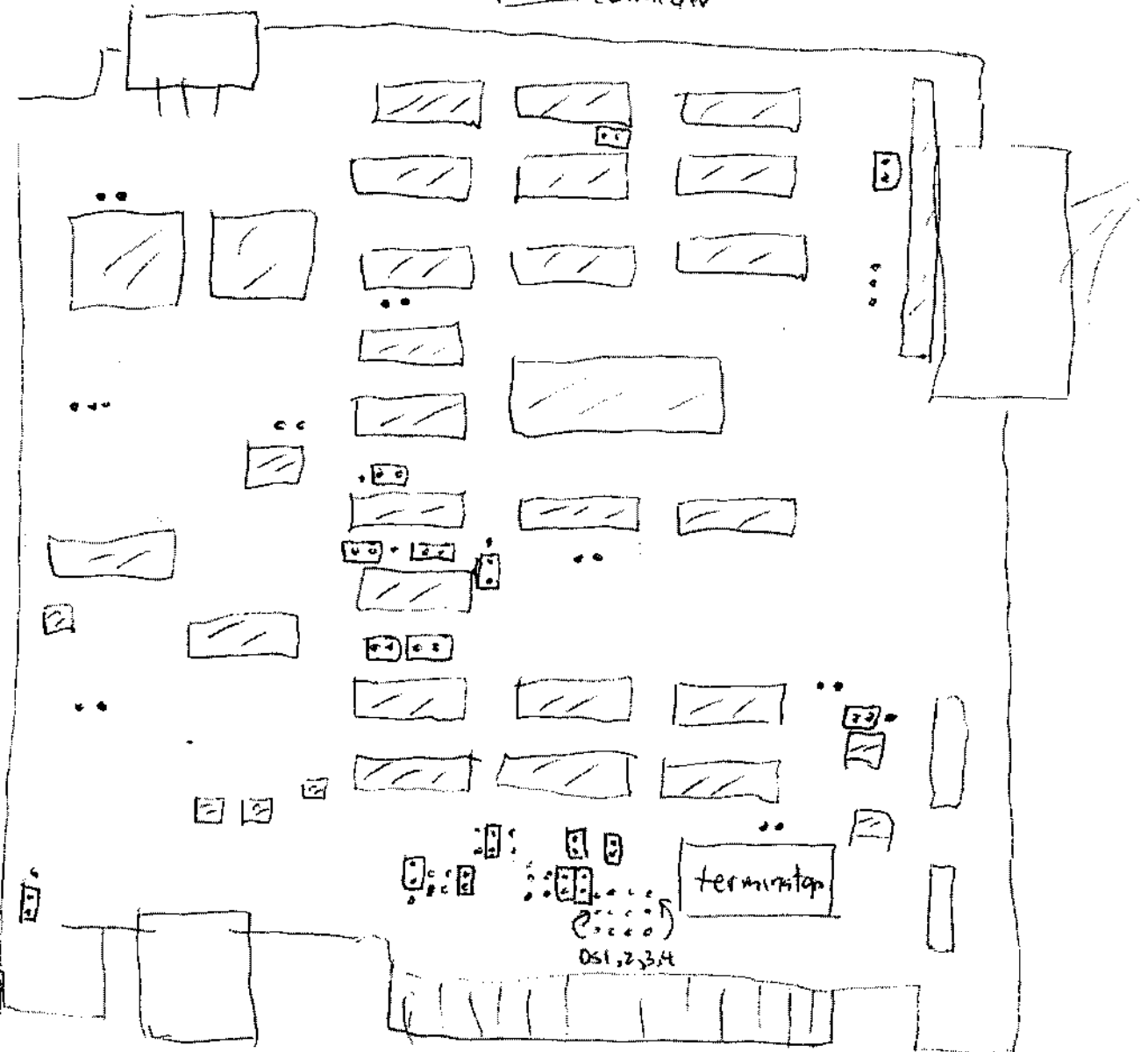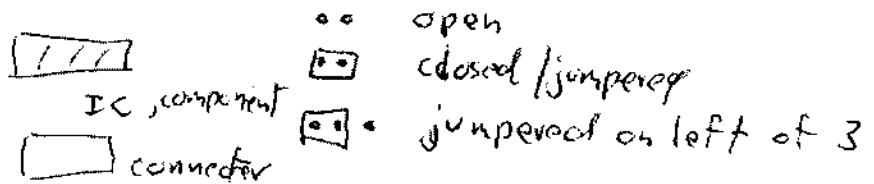
6.17.3 Motor start with head load "AND" drive select Plug settings

o   Short-plug "MO" (location B3) ----- short

o   Short-plug "MS" (location C5) ----- short

Mitsubishi M2896-63 02U
See circuit board for jumper names
jumpers shown allow basic operation - your results will vary

open
closed /jumpered
jumpered on left of 3

IC , component
connector

terminator

OS1,2,3,4

CHAPTER 7   DRIVE PHYSICAL SPECIFICATIONS

This section describes the M2896 dimensions and installation procedure.

7.1   Drive Dimensions

Fig. 7-1 shows the M2896 drive dimensions, screw mounting hole locations and dimensions, and front panel dimensions.

7.2   Mounting Recommendations

The M2896 can be installed in the following directions without mechanical adjustment:

o   Vertical: Door opens to the right or left.

o   Horizontal: Door open upward.

o   Slant mounting should be within 10 degrees.

7.3   Mounting

To mount the drive, use the six screw taps on the sides of the drive or the four taps on the bottom of the drive.

See Fig. 7-1 for details of the above mounting taps and for the overall dimensions of the M2896.

7.4   Air Flow

Ensure tha the ambient temperature in the FDD case does not exceed 43 degrees while in operation.
NOTE: The ambient temperature in the FDD case is taken as that at point B in Fig. 7-2. An example of the recommended air flow is shown in Fig. 7-2, it should be referred to at system installation.
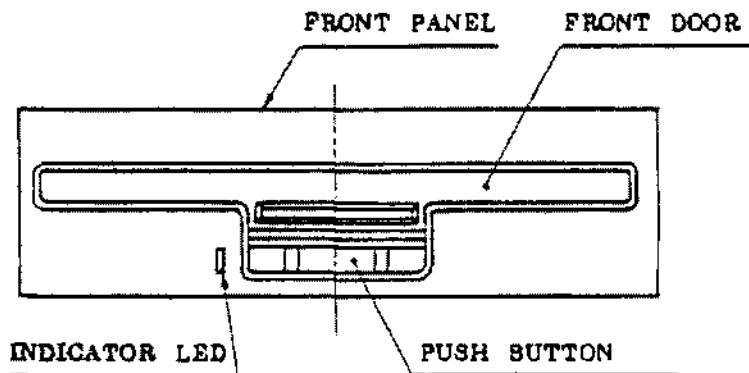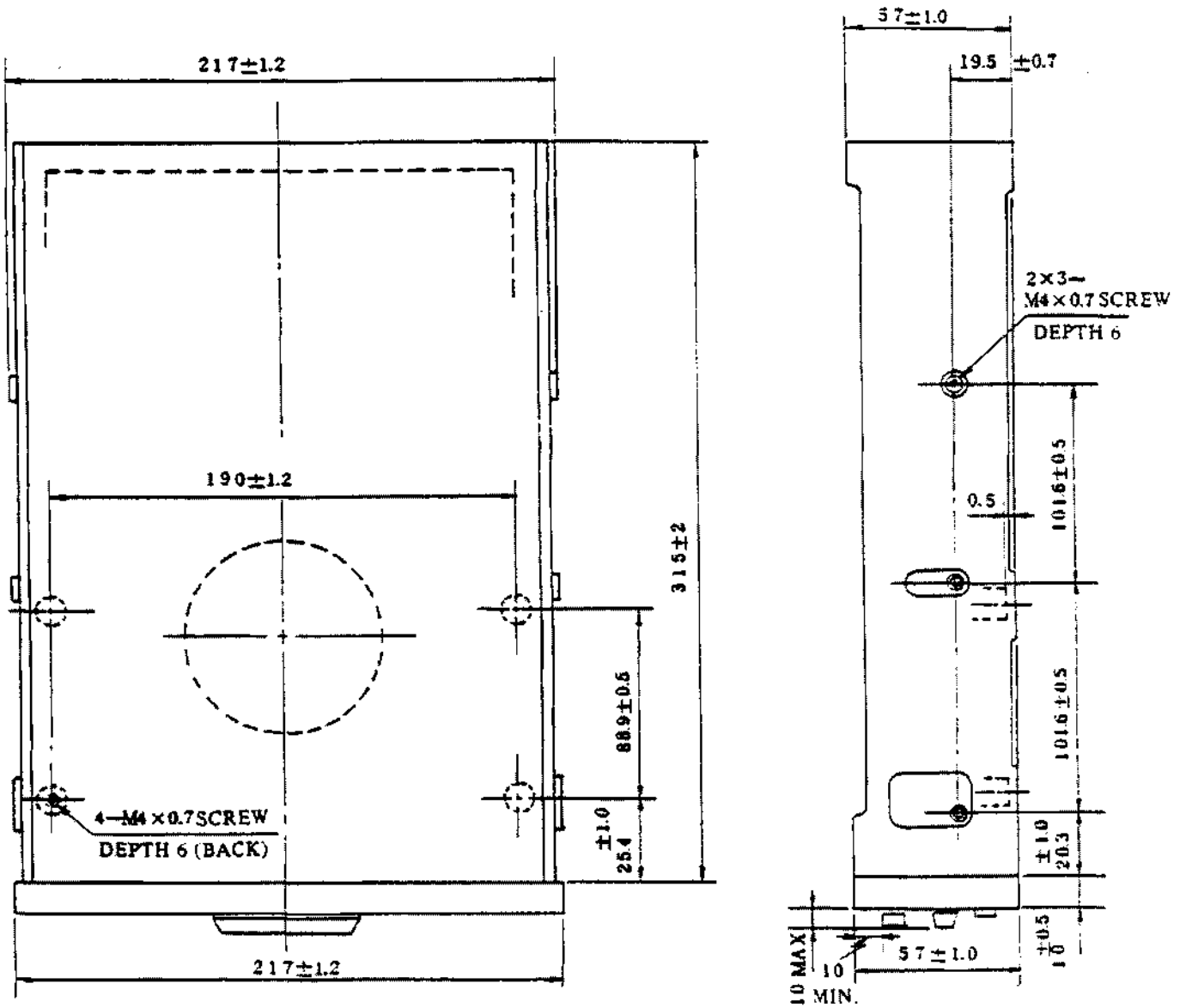
Fig. 7-1 M2896 Drive Diminsions

(.12)

B

.60 MIN.

.60 MIN.

B

System case

A

FDD

(4.62 in)

(.40 in MIN.)

.40 MIN.   .40 MIN.

One FDD

Two FDDs

4.0~6.0

System case

B

0.3 m³/min.
(10.6 ft³/min.)

Viewed from A

Fig. 7-2   Recommended Air Flow (dimensions in inch)
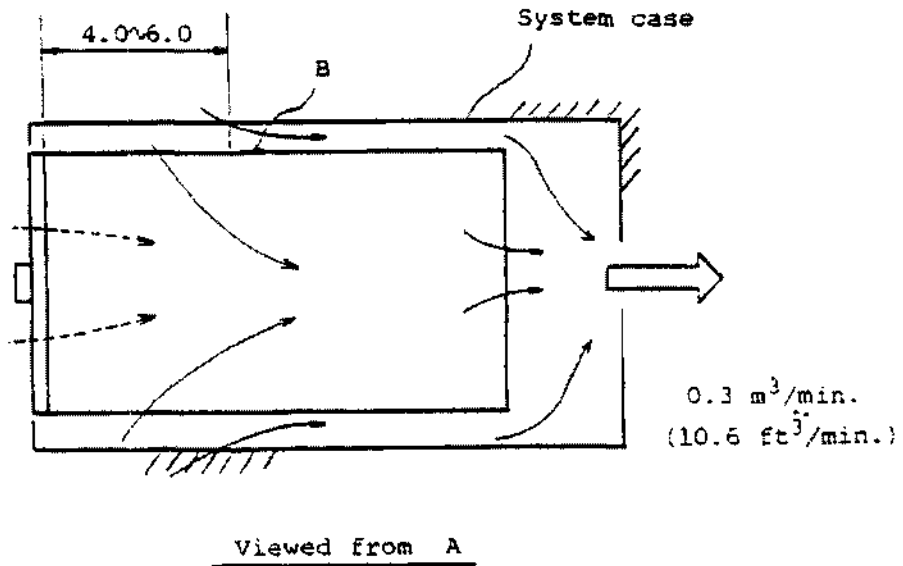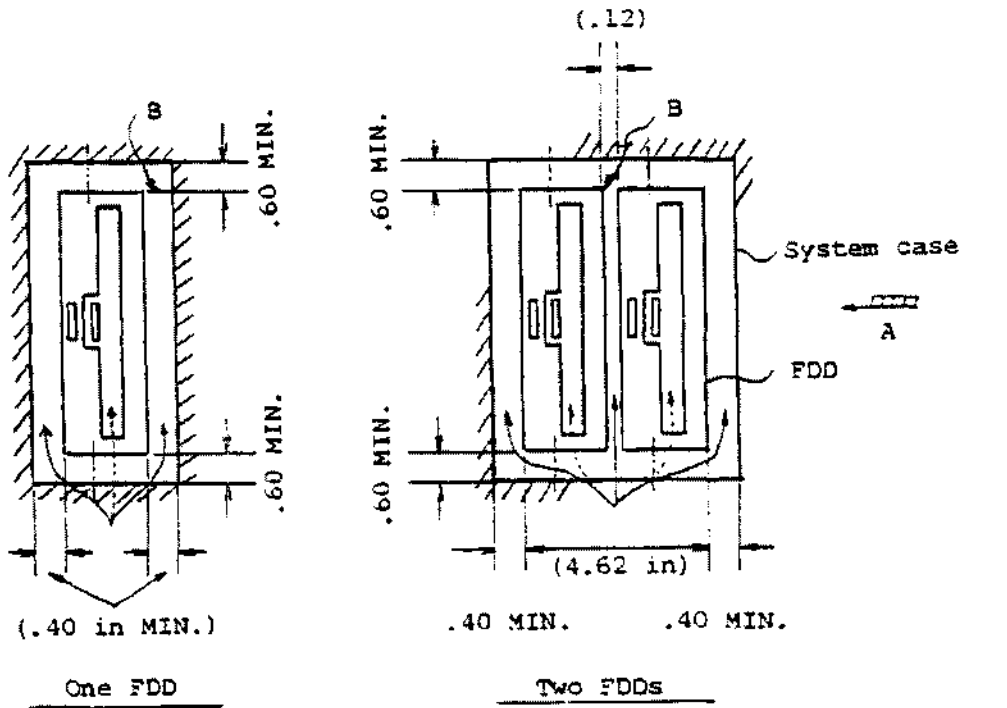
CHAPTER 8   ERROR DETECTION AND CORRECTION

This section describes general analysis of data errors and data correction.

8.1   Write Error

If a write error occurs during a write operation, it will be detected on the next revolution by performing a read operation, commonly called a "write check". To correct the error, another write and write check operation must be done. If the write operation is not successful after several attempts have been made, a read operation should be attempted on another track to determine if the drive is safe. If the other track is read correctly, the track on which write failed is a defective track and operation should be changed to another track or another medium.

8.2   Read Error

Most read errors that occur will be "soft" errors; that is, by performing an error-recovery procedure, the data will be recovered.

Soft errors are usually caused by:

o   Airborne contaminants that pass between the read/write head and the disk medium. These contaminants will generally be removed by the cartridge self-cleaning wiper. However, in an environment with expremely large amounts of dust contamination, the disk surface may be impaired during prolonged read/write operation, causing hard errors.

o   Random electrical noise, which usually lasts for a few microseconds to several milliseconds. Spike noise, especially those caused by short-period switching regulators, affect the S/N ratio and lead to a higher frequency of re-read operations necessary for dat recovery. It is therefore essential to check the noise levels of the DC power supply to the drive and of the frame ground.

o   Small defects in the written data and/or track not detected during the write operation, which may cause a soft error during a read.

o   Dust adheres to the disk surface, e.j., as a result of fingerprints, after the write operation, this may lead to temporary errors. It should be remembered however, that these temporary or transient errors will turn into hard errors if the unit is continuously operated for a long time with

such dust adhering to the disk surface.

The following procedures are recommended to recover from these soft errors:

Step 1:   Re-read the track several times or until such time as the data is recovered.

Step 2:   If data is not recovered after step 1, access the head to the adjacent track in the same direction as previously moved, then return to the desired track.

Step 3:   Repeat step 1.

Step 4:   If data is not recoverable, the resulting error is considered a hard error.

CHAPTER 9 RESHIPMENT PRECAUTIONS

Be sure to insert the shipping disk that was shipped with the unit, and close the door when reshipping it.

CHAPTER 10   TYPE REFERENCES TO BE STATED WHEN ORDERING

10.1   Table Listing Changes in Type Reference Designations (indicated by three alphabetic characters in the secondary name chart)

M2896-63- X   Y   Z

Alphabetic character; mounting screw (See Fig. 7-1)

Alphabetic character: Front panel color

Alphabetic character;   front panel size

X   Front panel size

X	Dimensions
0	2.25 x 8.55 x 0.39 inches
1	

Y   Front panel color

Y	Panel color	Handle/button color
0	Ivory-white	Ivory-white
2	Black	Black

Z   Mounting screw

Z	Mounting screw specifications
U	Unified screw No. 8-32UNC x .25 DP
M	Metric secre M4 x 0.7 Screw Depth .25

NOTE: M2896-63-02U is the standard model No. Check catalog before ordering other models.

TITLE M2896-63 (PCB, NAFHG)	DATE '83-9-9
	APPROVED *H. Taketa*
ITEM 1. Improvement in the PCB, NAFHG	CHECKED *signature*
2. Automatic motor-start / stop operation.	DRAWN *signature*

1. Improvement in the PCB, NAFHG.

We redesigned the wiring-pattern to add the options for customer.

RECEIVED NOV 8 1983

(Additional options are described on following sheets.)

Available for Part No. P/N DC447248-02-C

2. Automatic motor - start /stop operation.

We redesigned the circuit to add the automatic motor - start / stop operation for better media clamp.

The operation is as following.

(1) Spindle Motor starts to rotate when Diskette is inserted in the disk drive. (i,e. Micro-Switch is opened)

(2) It stops to rotate when the Hold READY comes true.

(3) In the condition the Hold READY is true, the spindle motor can be controlled by the MOTOR START signal. There is the 2.6 sec delay time from the motor stop signal to the motor stop.

(4) If the DC power is turned on when the diskette is inside and the door is closed, the motor will start to rotate and stop like (2)

MITSUBISHI ELECTRIC CORP.	DWG NO. TT7-63017(	REV. A	SHEET 1 ~ 5

FLEXIBLE DISK DRIVE
ENGINEERING INFORMATION

−MOTOR START

IC E07 2.63 (NE555)

+MOTOR START

MOTOR OFF Delay Timer

IC E09 (38)

RDY

IC D02 (38)

+READY

+5T

S D IC N TC04 R C (LS74)

+READY (HY)

+READY

+DRIVE SELECT

R48 +5T

E PZ-A11 −MOTOR ON Wired OR

HR HY

+POWER ON RESET

(06) Wired OR

R84 +5T

E01 (38)

A

DISK OUT

NC P7-1 S P7-Z NO 777

DISK IN DISK OUT (Pin No 4,9 of IC E09)

Time Chart
DC POWER OFF, ON

A (IN!)

+READY (HY) (Standard READY) B

+READY (HR) (Hold READY) C

+MOTOR START (Pin No 5 of IC E09) D

Spindle { Rotating
Motor { Stopping } E

2.6s MAX

(Stop!) (Stop!) (Stop!)

(Delay Timer covers)

2.6 sec

DWG NO.	REV.	SHEET
TT2-G30196	A	2 OF 5

3. Location change (P/N DC447248-01-B → DC447248-02-?)

Table 6-1 Customer CNT/ACO. Trace Options

Trace Designator	Location 01-B	Location 02-C	Description	Shipped from Factory Open	Shipped from Factory Short.
TERMINATOR	EI	EI	Input line terminator		Plugged
JFG	AI	AI	Frame ground and signal ground are shorted		Plugged
JSG	AI	AI	Frame ground and signal ground are opened	x	
DS1	DI	DI	DRIVE SELECT 1 input		Plugged
DS2,DS3,DS4	DI	DI	DRIVE SELECT 2, 3, 4 input	x	
1L, 2L, 3L, 4L	DI	DI	SIDE SELECT Option using DRIVE SELECT	x	
EE	CI	CI	External WRITE CURRENT SWITCH	x	
SI	CI	CI	Internal WRITE CURRENT SWITCH		Plugged
S	CI	—	"Keep Open"	x	
DC	CI	CI	DISK CHANGE Option	x	
2S	CI	CI	TWO-SIDED Status Output	x	
IT	DI	DI	IN USE Terminator		Plugged
D	DI	DI	Alternate Input - IN USE	x	
HI	DI	DI	HEAD LOAD "OR" IN USE to the IN USE CIRCUIT	x	
C	DI	DI	Alternate Input - HEAD LOAD	x	
I	DI	DI	INDEX Output		Plugged
R	DI	DI	READY Output		Plugged
s1	CI	DI	SIDE SELECT Option using DIRECTION SELECT	x	
s2	DI	DI	Standard SIDE SELECT Input		Plugged
s3	DI	DI	SIDE SELECT Option using DRIVE SELECT	x	

(CONTINUED ON NEXT PAGE)

6 - 2

MITSUBISHI ELECTRIC CORP.	DWG No. TJ2-G30196	REV. A	SHEET 3 OF 5

Table 6.1 (cont.)

Trace Designator	Location		Description	Shipped from factory	
	01-B	02-C		Open	Short
RS	C5	D4	READY Standard		Plugged
RM	C5	D4	READY Modified	X	
RFa	F3	F2	"Don't Remove"		Plugged
RFb	F3	F2	"Keep Open"	X	
HO	E1	E1	MOTOR ON from HEAD LOAD	X	
XS	D1	D1	MOTOR ON from DRIVE SELECT	X	
I	D9	D9	IN USE LED from DRIVE SELECT		Plugged
WP	C5	F9	Allow Write when WRITE PROTECTED	X	
WP	C5	F9	Inhibit Write when WRITE PROTECTED		Plugged
A	C4	D4	Radial HEAD LOAD		Plugged
B	C5	D3	Radial HEAD LOAD		Plugged
X	C4	D4	Radial HEAD LOAD		Plugged
SS0	D4	—	"Don't Cut"		X
SS1	D4	—	"Keep Open"	X	
RI	D2	D1	Radial INDEX		X
RR	D2	D1	Radial READY		X
T	D8	E3	IN USE from HEAD LOAD	X	
V	E9	E3	Door Lock from HEAD LOAD		X
HLL	D10	D10	HEAD LOAD Latch	X	
DL	B10	D10	Door Lock Latch Option	X	
HUN	C6	C5	Head Unload Normal	X	
HUD	C6	C5	Head Unload Delay		Plugged

6 - 3

FLEXIBLE DISK DRIVE
ENGINEERING INFORMATION

4. Additional options on P/N DC447248-02-c

Trace Designator	Location 01-B	Location 02-C	Description	Shipped from Factory Open	Shipped from Factory Short
HR	—	C4	Hold READY Output	X	
HY	—	C4	Standard READY Output		plugged
M1	—	D1	Use J1 pin 4 for Motor Start	X	
M2	—	D1	Use J1 pin 18 for Motor Start		plugged
PS	—	C2	HEAD LOAD Anded with Standard READY		plugged
PH	—	C2	HEAD LOAD Anded with Hold READY	X	
E1	—	C4	"Keep open"	X	
E2	—	C4	"Do not cut"		X
V1	—	E9	"Do not cut"		X
V2	—	E9	"Keep open"	X	
V3	—	C5	"Do not cut"		X
V4	—	C5	"Keep open"	X	
V5	—	E4	"Keep open"	X	
V6	—	E4	"Do not cut"		X
V7	—	D3	"Keep open"	X	
V8	—	D3	"Do not cut"		X

Customer Option (rows HR–PH)
Factory Option. (Internal use for makers) (rows E1–V8)

MITSUBISHI ELECTRIC CORP.	DWG NO. TJ2-G30196	REV. A	SHEET 5 OF 5

CUSTOMER INSTALLATION OPTIONS

The M2896 can be modified so that the non-standard operations described in sections 3 and 4 are performed.

These modifications are performed by connecting or disconnecting traces on the printed-circuit board and/or using alternate input/output pins.
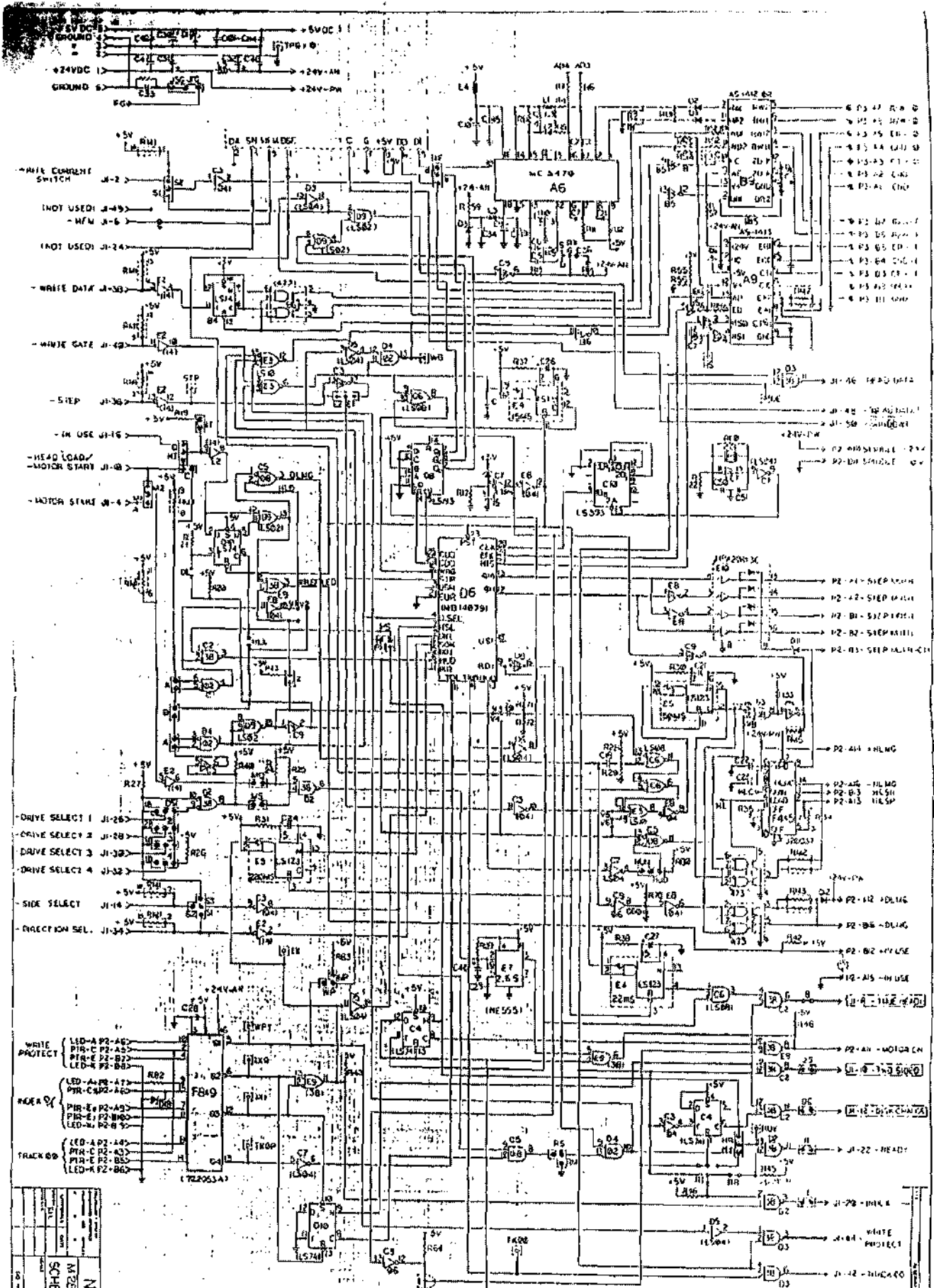
Traces are connected with short-plugs and jumpers. The position of the traces at delivery from the factory is shown in Table 6-1. Fig. 6-1 shows the location of the traces on the printed-circuit board.
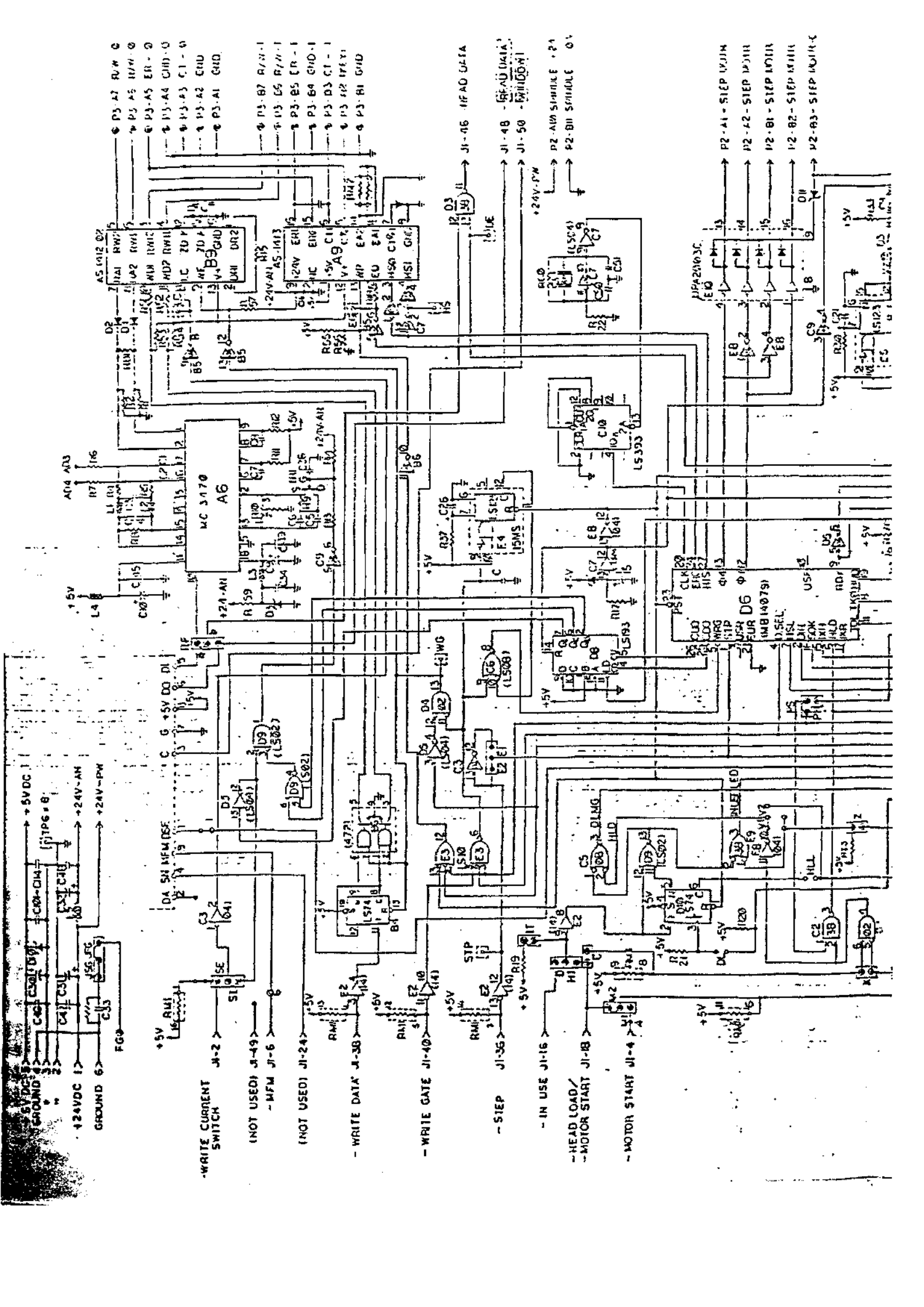

Y = LED or for see light
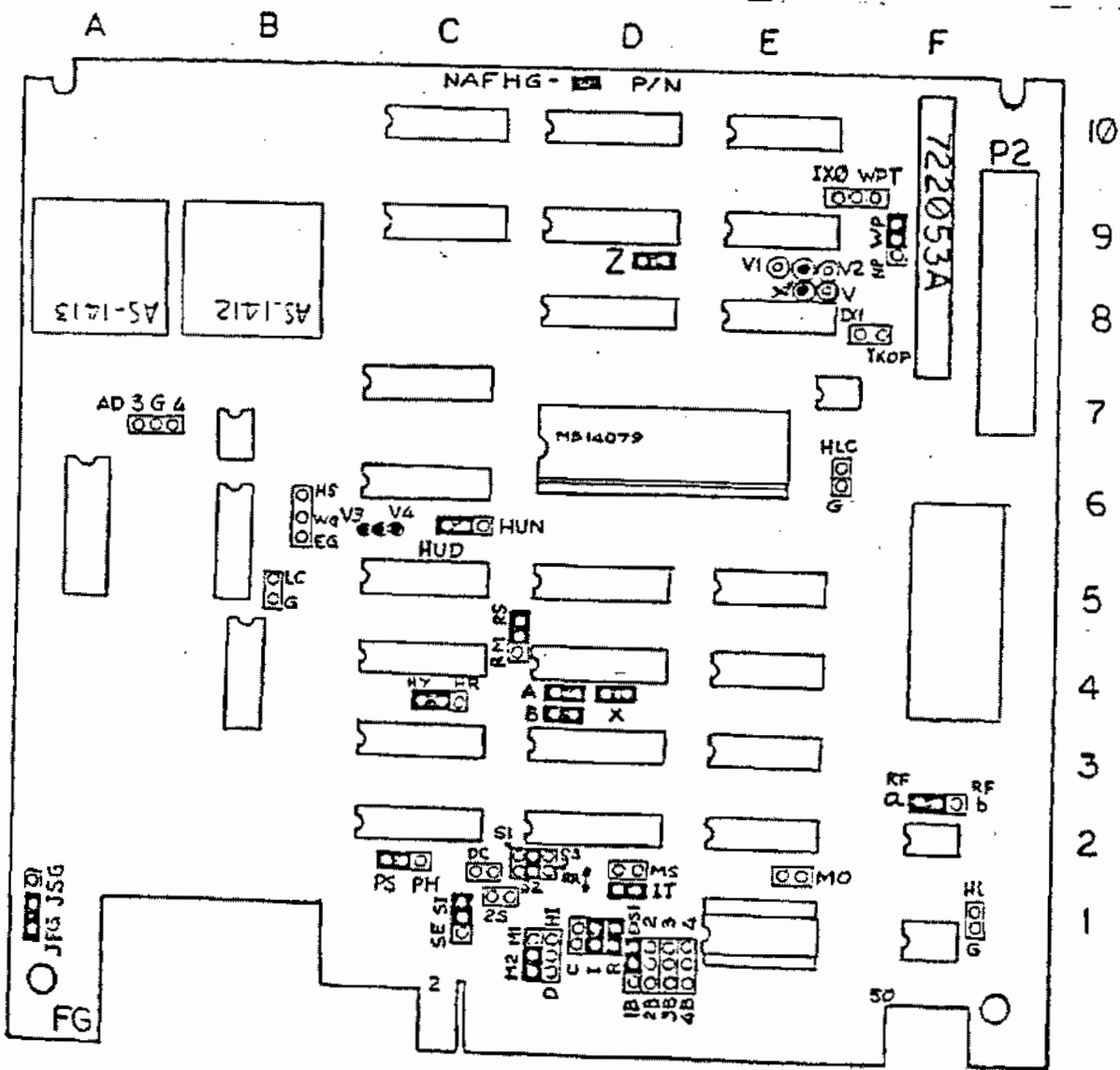
HP [○ ■] : Switching with short-plug

HLL ∞ : Switching by cutting the pattern and using jumpers.
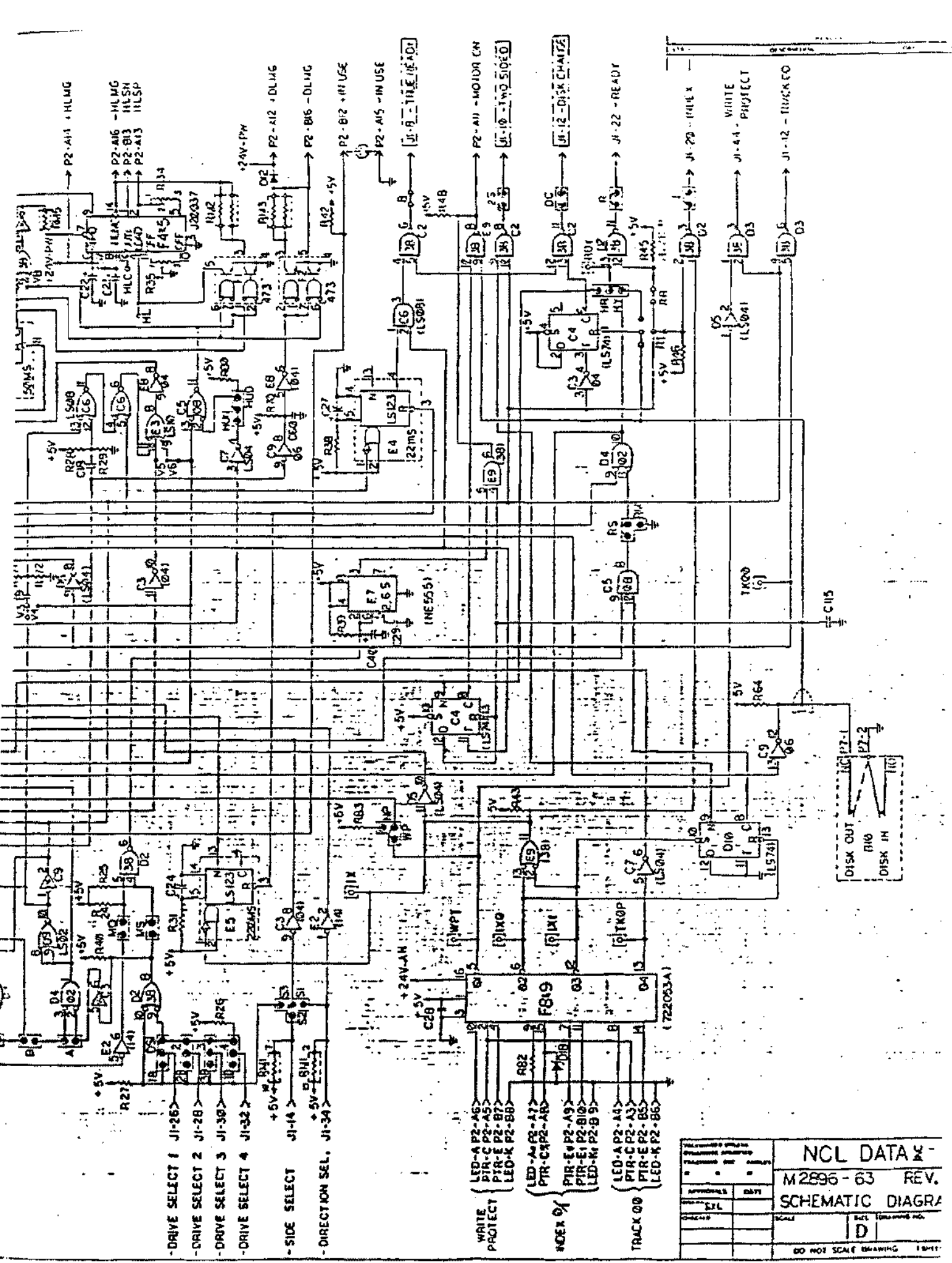
REV. "G"

Fig. 6-1 Printed-Circuit Board Trace Location

NCL DATA+
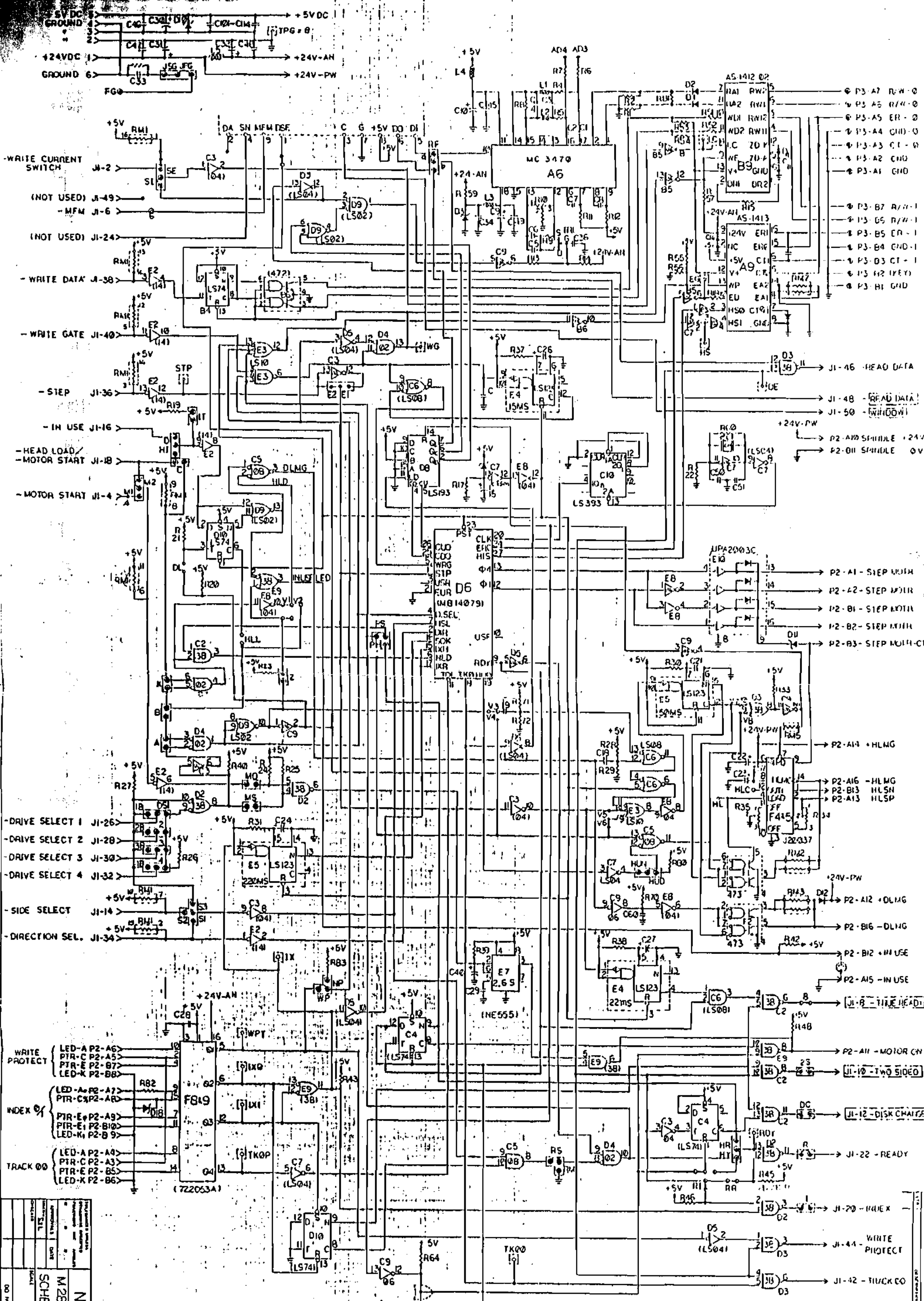M 2896 - 63 REV. G
SCHEMATIC DIAGRAM
D

- DRIVE SELECT 1   JI-26
- DRIVE SELECT 2   JI-28
- DRIVE SELECT 3   JI-30
- DRIVE SELECT 4   JI-32
- SIDE SELECT   JI-14
- DIRECTION SEL. JI-34

WRITE PROTECT
{ LED-A P2-A6
  PTR-C P2-A5
  PTR-E P2-B7
  LED-K P2-B8 }

INDEX Q/
{ LED-A P2-A7
  PTR-C P2-A8
  PTR-E P2-A9
  LED-K P2-B10 }

TRACK 00
{ LED-A P2-A4
  PTR-C P2-A3
  PTR-E P2-B5
  LED-K P2-B6 }

P2-A11 + HLMG
P2-A16 - HLMG HLSH HLSP
P2-B13
P2-A13
P2-A12 + DLMG
P2-B16 - DLMG
P2-B12 + IN USE
P2-A15 - IN USE
JI-8 - TWO SIDED
P2-A11 - MOTOR ON
JI-10 - TWO SIDED
JI-12 - DISK CHANGE
JI-22 - READY
JI-20 - INDEX
JI-44 - WRITE PROTECT
JI-12 - TRACK 00

DISK OUT
DISK IN

NCL DATA
M2296-63 REV. G
SCHEMATIC DIAGRAM
DO NOT SCALE DRAWING