

Panasonic

OEM Manual

3-inch Compact Floppy Disk Drive

EME-150 / 250



MARCH 1984

All the specifications are subject to change without notice.

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1. General

EME-150 (Single-sided) and EME-250 (Double-sided) are the compact floppy disk drives which drive 3-inch compact floppy disk (80mm wide, 100mm long and 5mm thick) as a new standard system in this field.

The size of these disk drives is 90mm wide, 150mm deep and 35 mm high, and it can be easily rested on your palm. Despite the compact size, EME-150 and EME-250 provide the capacity of 250K and 500K bytes equivalent to 5.25-inch floppy disk drives.

<Features>

Compatible with 5.25 inch disk drives.

Your controller can be used with the compact floppy disk drive as it is because the recording method, data transfer rate and disk rotation speed are the same as those of 5.25-inch floppy disk drives.

Low Power Consumption.

Low Profile and Light in Weight

One-touch loading/ejecting mechanism

A pocket-size compact floppy disk with a hard case and automatic head window shutters.

A one-touch loading mechanism is adopted for loading/ejecting a floppy disk into/from the drive.

Easy to use

- 1) The media is protected by a rigid hard shell giving increased durability and providing the facility for labelling with a ball point pen.
- 2) A head window shutter provides protection of the disk surface and is automatically opened and closed when the disk is inserted or withdrawn from the drive.
- 3) A simple one touch "write protect" mechanism prevents accidental writing on pre-recorded disks.
- 4) Up to two drives can be connected in daisy chain.
- 5) An IN USE display lamp is fitted and is controlled by DRIVE SELECT signal.

Long-life and reliable disk

The plastic center hub of the disk increases the reliability and life of the disk.

This feature combined with the internal cleaning liner within the case ensures consistent rotation and perfect alignment with heads.

2. Specification Summary

2.1 Performance

2.1.1 Performance Specifications of EME-150 (Single head)

Encoding Method	FM	MFM
Recording Capacity (Unformatted)	Single Density	Double Density
Single side	125K Byte	250K Byte
Double side	---	---
Per track	3125 Byte	6250 Byte
(Formatted)		
Byte/Sector(Byte)	128 256 512	256 512 1024
Sector/Track	16 9 5	16 9 5
Single side(Byte)	82K 92K 102K	164K 184K 204K
Double side(Byte)	164K 184K 205K	328K 369K 410K
Per track(Byte)	2048 2304 2560	4096 4608 5120
Transfer rate	125K bits/sec.	250K bits/sec.
Latency (average)	100msec.	
Access time		
Track to track	12msec.	
Average	171msec.	
Settling time	15msec.	
Motor start	1.0sec. max.	
Index	1	
Rotational Speed	300rpm	
Max. recording density	4473bpi	8946bpi
Track density	100tpi	
Number of tracks	40	
Mechanical dimensions		
Height	35mm (1.4")	
Width	90mm (3.5")	
Depth	150mm (5.9")	
Weight	460g	

Table 1-1.

2.1.2 Performance Specifications of EME-250 (Double head)

Encoding Method	FM	MFM
Recording Capacity (Unformatted) Single side Double side Per track	Single Density --- 250K Byte 3125 Byte	Double Density --- 500K Byte 6250 Byte
(Formatted) Byte/Sector(Byte) Sector/Track Single side(Byte) Double side(Byte) Per track(Byte)	128 256 512 16 9 5 82K 92K 102K 164K 184K 205K 2048 2304 2560	256 512 1024 16 9 5 164K 184K 204K 328K 369K 410K 4096 4608 5120
Transfer rate	125K bits/sec.	250K bits/sec.
Latency (average)	100msec.	
Access time Track to track Average Settling time Motor start	12 msec. 171 msec. 15 msec. 1.0sec.max.	
Index	1	
Rotational Speed	300rpm	
Max. recording density	4915bpi	9830bpi
Track density	100tpi	
Number of tracks	80 (40x2)	
Mechanical dimensions Height Width Depth Weight	35 mm (1.4") 90mm (3.5") 150mm (5.9") 460 g	

Table 1-2.

2.1.3 Power Requirements

DC Power Supply	Voltage Deviation	Current Consumption	Ripple
+ 5V +12V	± 5% ± 5%	Typ. 0.22 A 0.30 A	50mVp-p Max. 100mVp-p Max.
Power Consumption	<u>Mode</u> 2.5W TYP. <ul style="list-style-type: none"> . Drive selected . Spindle motor ON . TR00 STOP 		

Table 2.

<u>Mode</u>	<u>Power Consumption</u>		
1. Drive selected			
Spindle motor OFF	12 V	0.06A	TYP.
TR00 STOP	5 V	0.22A	TYP.
2. Drive selected			
Spindle motor ON	12 V	0.12A	TYP.
TR00 STOP	5 V	0.22A	TYP.
3. Drive selected			
Spindle motor ON	12 V	0.30A	TYP.
TR00 ↔ TR39 Serial seeks (Step Rate msec.)	5 V	0.15A	TYP.

2.1.4 Environmental Requirements

Operational

The following shall be applied to the drive in operation as described in Table 3.

Temperature Range: 5°C to 46°C
Humidity Range : 20% to 80% RH without condensation
Maximum Wet Bulb : 29°C

Table 3. Operational Environments

Non-Operational

In non-operation situation such as during shipping or storage, the following requirements shall be applied to the drive as described in Table 4:

Temperature Range: -25°C to 60°C
Humidity Range : 5% to 95% RH without condensation
Maximum Wet Bulb : 29°C max. (No condensation)

Table 4. Non-Operational Environments

2.2 Reliability

Reliability requirements for the 3" floppy disk drive shall be as follows:

MTBF	8000 POH *
MTTR	30 minutes
Drive life	5 years
Media life (Rotating) Insertion	3 x 10 ⁶ (Passes per Track) 10,000
Error Rates	
Soft Error Rate	1 per 10 ⁹ bits
Hard Error Rate	1 per 10 ¹² bits
Seek Error Rate	1 per 10 ⁶ seeks.

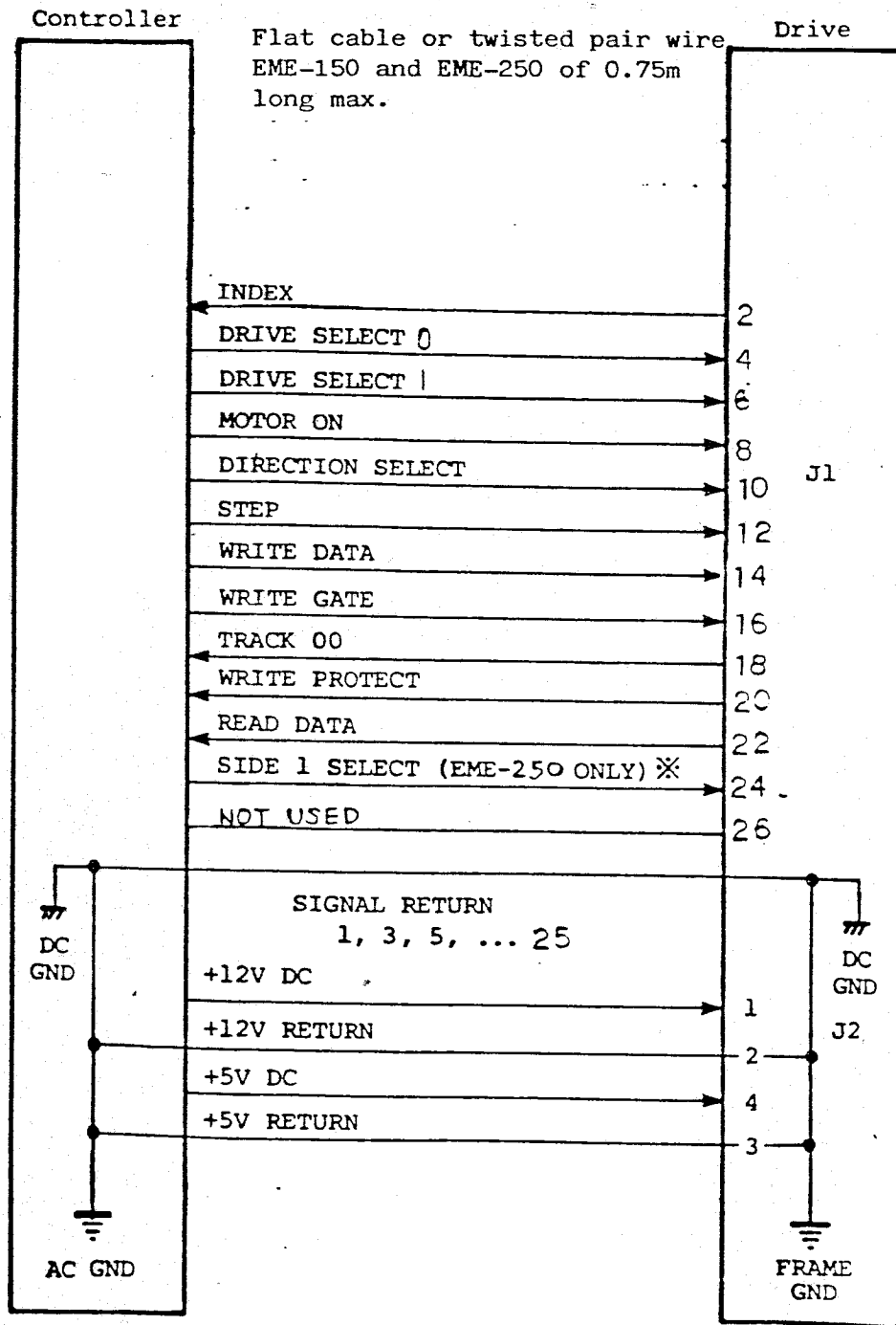
Table 5.

* Typical operating time of the spindle motor is 25% of POH.

3. Electrical Interface

3.1 Signal Interface Allocation

The assignment of interface signals shall be as shown in Figure 1. The function of each line, signal levels and connectors required are indicated in the following sections.



* On SIDE 1 SELECT, EME-150 will be NO USE.

3.1.1 Input Signals

EME-150 and EME-250 shall require the following input signals which are active at "LOW" level:

- (1) DRIVE SELECT 0 to 1
- (2) MOTOR ON
- (3) DIRECTION SELECT
- (4) STEP
- (5) WRITE GATE
- (6) WRITE DATA
- (8) SIDE 1 SELECT

These signals have the following electrical specifications.

LOW level	ACTIVE	0V to 0.4V
HIGH level	NO ACTIVE	2.5V to 5.25V
Input impedance		1K Ω to pull up to 5V

Table 6. Input Signal Voltage Level

(1) DRIVE SELECT 0 to 1

Up to two drives can be connected in daisy chain by setting the switch on the printed circuit board. The switch DS 0 to 1 correspond to DRIVE SELECT 0 to .

For example, the drive which short-circuits DS1 can send/receive a data signal only with DRIVE SELECT 1="LOW".

(2) MOTOR ON

The disk drive motor can be activated when this signal is at "LOW" level.

1.0 second is required from the activation until read/write operation.

(3) DIRECTION SELECT

The signal can determine the moving direction of the head when the step pulse is input. The head moves as follows when the step pulse is input:

HIGH level	OUT direction (away from the center of the disk)
LOW level	IN direction (toward the center of the disk)

Table 7. Step Direction Select Signal

The direction selection shall be made at least 1 μ s (min.) before the trailing edge of the step pulse, and held for 1 μ s (min.) from the trailing edge of the step pulse.

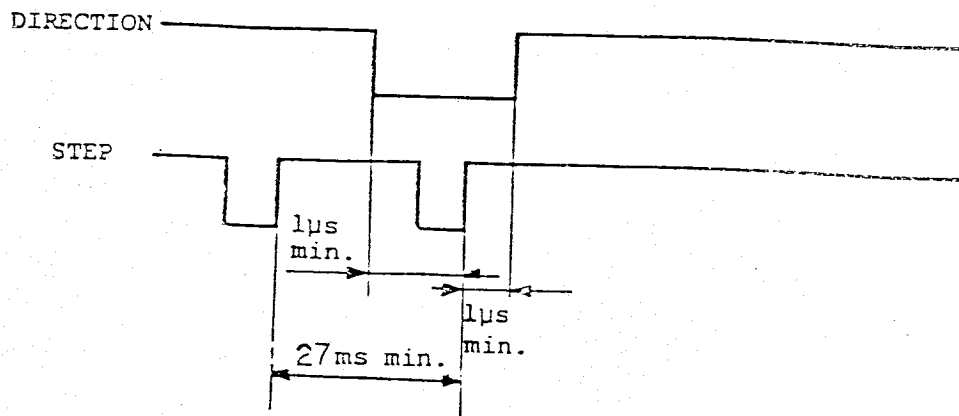


Figure 2. Step Direction Select Signal Timing

(4) STEP

This signal shall shift the head by one track by one pulse in the direction specified by the DIRECTION SELECT signal when the drive is selected. The pulse interval must be 2ms or more.

STEP

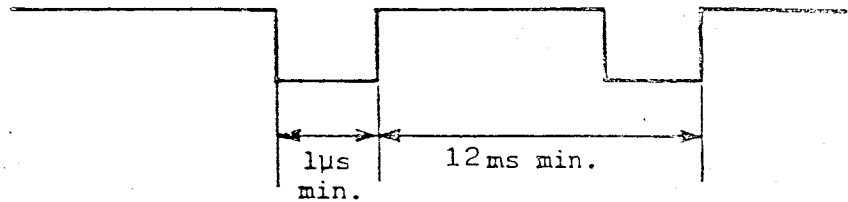


Figure 3. Step Signal

(5) WRITE GATE

Setting this signal at "LOW" level, the drive shall write data on the disk with WRITE PROTECT "OFF" and INDEX period at 200ms \pm 2.5%. While the signal is "LOW", the step signal shall not be accepted. Keep the DRIVE SELECT and MOTOR ON signals active because the erase head operates for 1.3ms (EME-250) or 1.7ms (EME-150) from the trailing edge of the WRITE GATE.

(6) WRITE DATA

This enables the head to write data on the disk. Each transition from "HIGH" to "LOW" causes the current through the READ/WRITE head to be reversed thereby writing a data bit. This writing can be performed with the WRITE GATE and INDEX period at 200ms \pm 2.5%, and the WRITE PROTECT of CFD cartridge "OFF", and DRIVE SELECT "ON". Refer to Figure 5. for timing.

(7) SIDE 1 SELECT (EME-250)

At "HIGH" level this signal selects SIDE 0 and at "LOW" level SIDE 1.

3.1.2 Output Signals

EME-150 and EME-250 shall have the following output signals which are active at "LOW" level:

- (1) TRACK 00
- (2) INDEX
- (3) WRITE PROTECT
- (4) READ DATA

These signals have the following power requirements.

LOW level	ACTIVE	0 to 0.4V (-10 mA)
HIGH level	NO ACTIVE	2.5V to 5.25V (+250 μ A)
		Open collector output

Table 8. Output Signal Voltage Level

All the output signals are at "HIGH" level when the drive is not selected.

(1) TRACK 00

This signal at "LOW" level indicates that the READ/WRITE head is on the track 00.

(2) INDEX

This is produced each time the index hole is detected by the sensor.

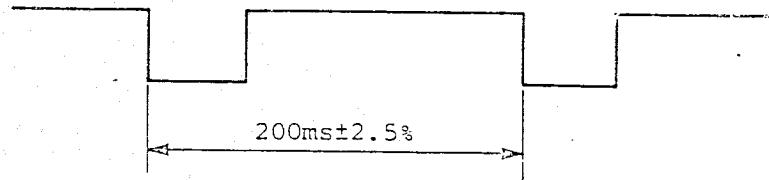


Figure 4. Index Signal

Detection of the INDEX signal shall be made with the leading edge, not with the level.

The signal is at "LOW" level when no CFD cartridge is in the drive.

(3) WRITE PROTECT

This indicates that the write protection of the loaded surface is set.

(4) READ DATA

This provides the "RAW READ" comprising of clock and data bit pulses read by the drive circuit.

The signal is output at every detection of data on the disk.

3.1.3 Drive/Receive Circuits

This drive shall use LSTTL (74LS14) equivalent as an input line receiver and TTL 7438 or equivalent as an output driver.

Figure 5 indicates the recommended interface circuits.

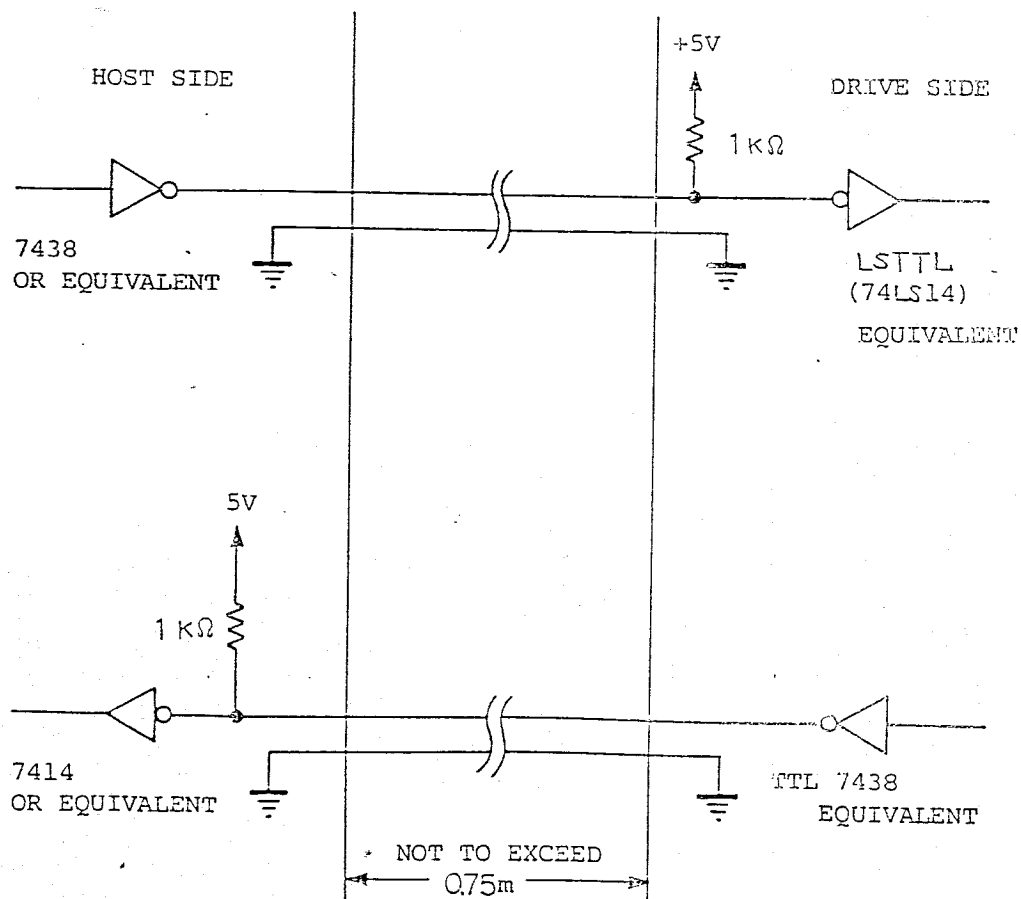
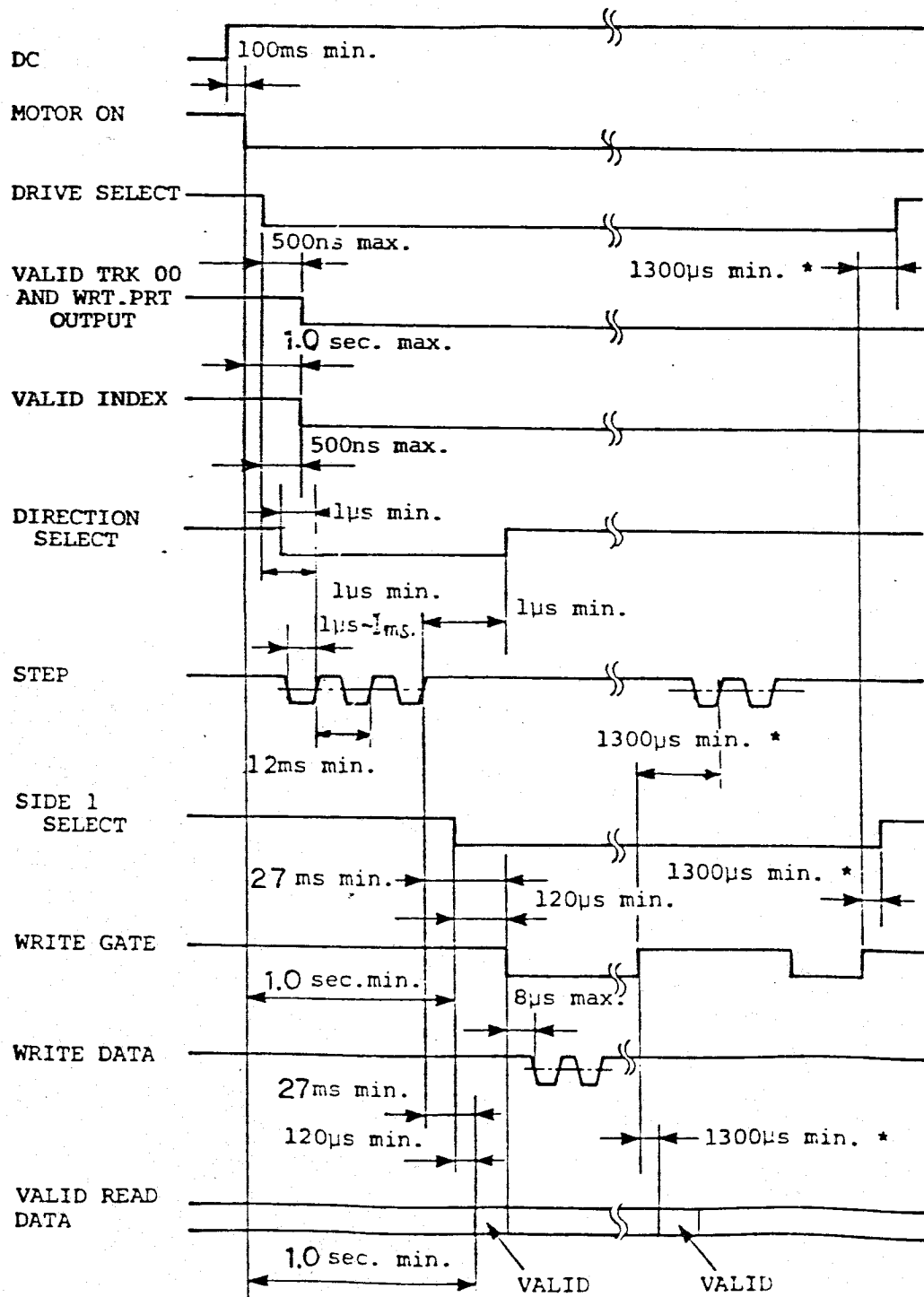


Figure 5.

3.1.4. Timing



* in case of EME-150 change to 1700μs min.

Figure 6.

3.2 Power Interface

The drive requires both DC 5V and DC 12V for its operation. Supply each power to P2/J2 connector. The specifications of supply voltages and the pin arrangement of connector are as follows:

J2 Pin No.	Voltage	Tolerance	Ripple
1	DC +12V	±5%	100mVp-p
2	+12V RETURN		
3	+ 5V RETURN	±5%	50mVp-p
4	DC +5V		

Table 9.

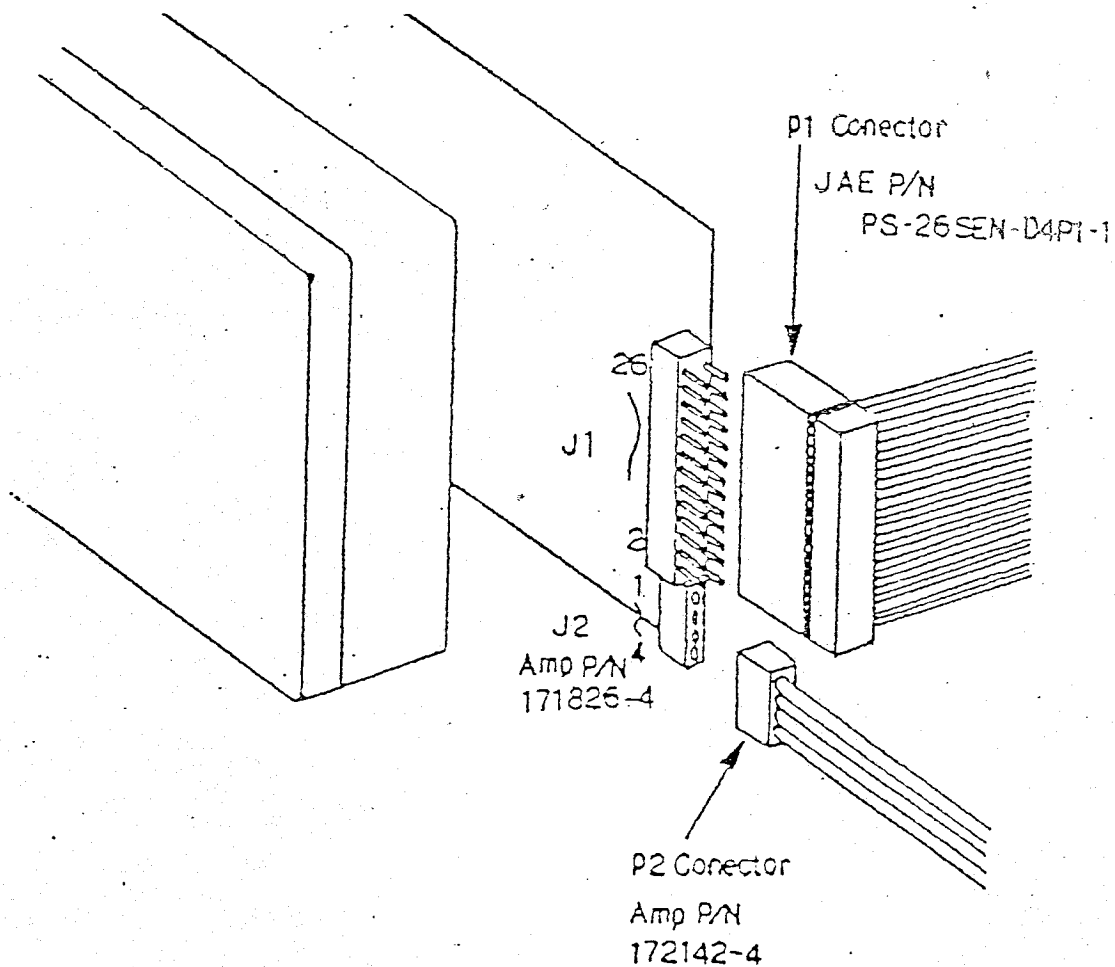


Figure 7. Interface Connectors-Mechanical Location Diagram

4. Mechanical Interface

The electrical interface between the drive and the host system is via a couple of connectors. J1 provides the signal interface and J2 the power.

Figure 7 shows the connector position.

4.1 J1/P1 Connector

The connection to J1 connector is through a 26-pin connector. The pc board side has even numbers and the opposite side odd numbers.

The recommended P1 connectors are shown below.

Manufacturer	Connector P/N
JAE	PS-26SEN-D4P1-1
HIROSE	HIF3-26D-254R

4.2 J2/P2 Connector

J2 connector uses a 4-pin AMP P/N 171826-4.

The recommended P2 connectors are shown below.

Manufacturer	Connector P/N	Contact P/N
AMP	172142-4	170355-1

Table 11. Recommended P2 Connector

5. Mounting and Drive Dimensions

Mounting Recommendations

See Figure .

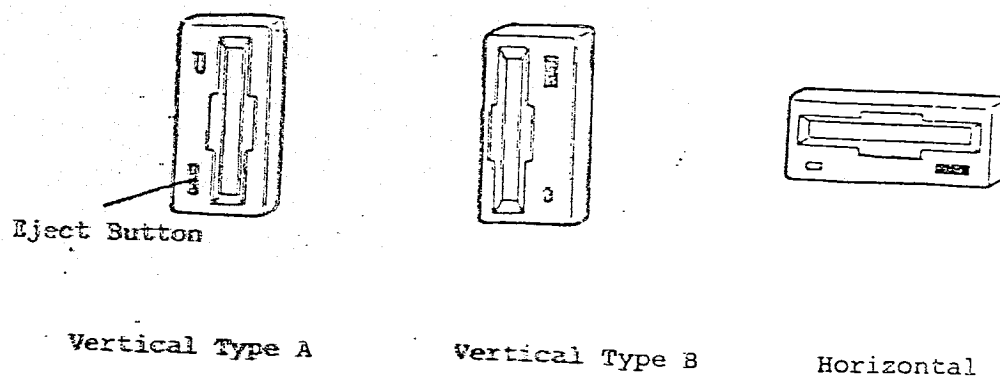


Figure 8 . Installation Direction

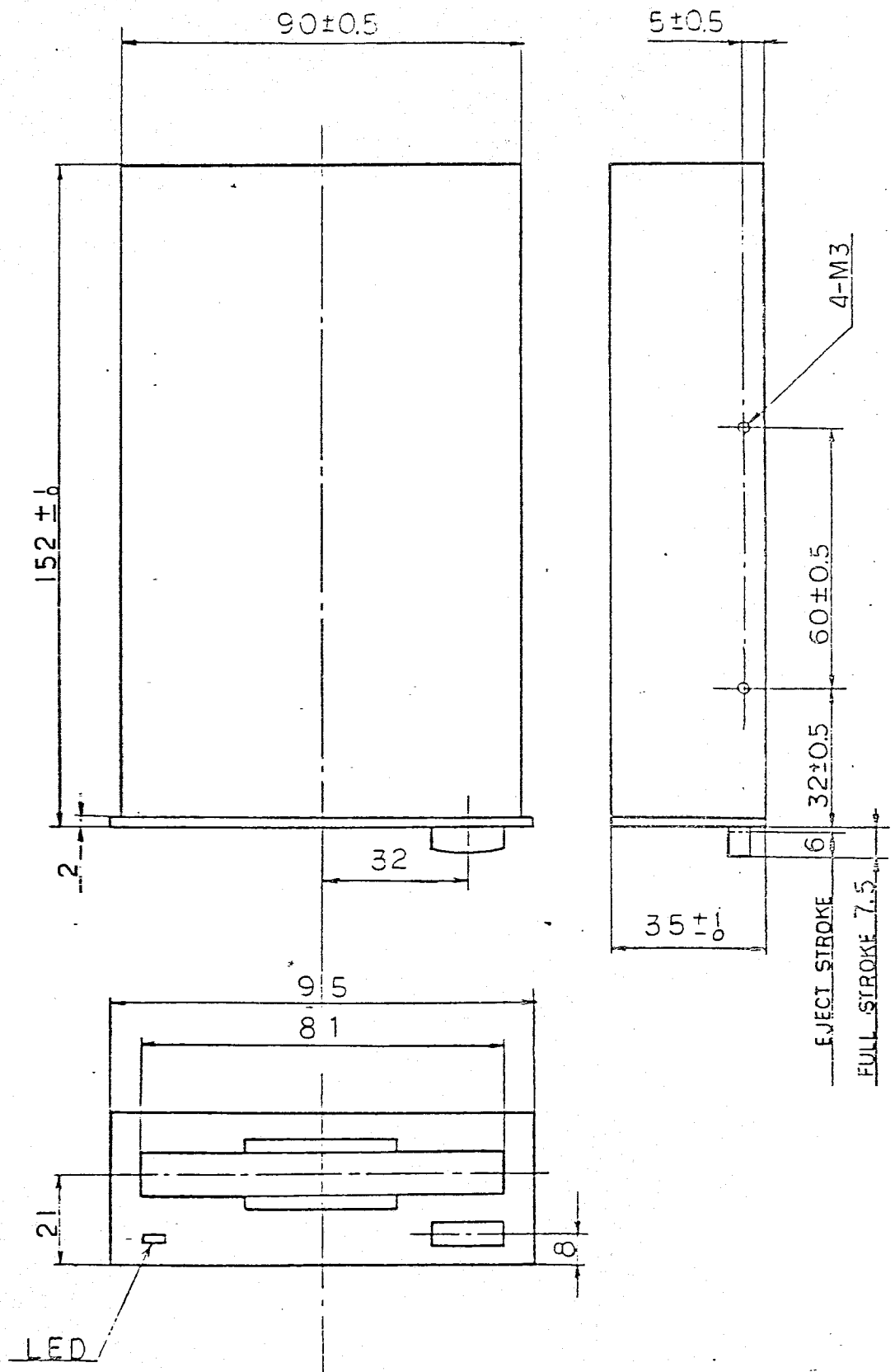


Figure 9. Outside Dimensions

6. Precautions for Installation

- 6.1 Set the rise time of the +5V power supply to 300 ns or less for the rising rates between 10 and 90%.
- 6.2 In installation, keep the drive as far away as possible from noise sources such as switching regulator, CRT monitor and others or take a shielding measure for them against noise.
- 6.3 When using a flat cable for the wiring material, observe the following rules:
 - In case of the daisy chain connection,
Total wire length $\leq 0.75\text{m}$
 - Characteristic impedance: 90 to 110 Ω
- 6.4 When you install two drives close together or install drive(s) in a sealed enclosure, installation of heat radiation holes is recommended to avoid excessive temperature increase mainly due to heat generation of the spindle motor.
- 6.5 When mounting on the framework, make sure that the framework contact with the drive chassis only at the area of the mounting holes, and that the movable part of the drive mechanism is free from the framework.
- 6.6 In installation, insulate between drive chassis and framework from view point of error rate and noise characteristics.

Panasonic

TECHNICAL
SPECIFICATION

EME-150M
3" COMPACT FLOPPY DISK DRIVE

All the specifications are subject to change without notice.

1. Specification Summary

1.1 Performance

Encoding Method	FM			MFM		
Recording Capacity (Unformatted)	Single Density			Double Density		
Single side	125K Byte			250K Byte		
Double side	---			---		
Per track	3125 Byte			6250 Byte		
(Formatted)						
Byte/Sector(Byte)	128	256	512	256	512	1024
Sector/Track	16	9	5	16	9	5
Single side(Byte)	82K	92K	102K	164K	184K	204K
Double side(Byte)	164K	184K	205K	328K	369K	410K
Per track(Byte)	2048	2304	2560	4096	4608	5120
Transfer rate	125K bits/sec.			250K bits/sec.		
Latency (average)	100msec.					
Access time						
Track to track	12msec.					
Average	171msec.					
Settling time	15msec.					
Motor start 1	1.0 sec. max.					
Index	1					
Rotational Speed	300rpm					
Max. recording density	4473bpi			8946bpi		
Track density	100tpi					
Number of tracks	40					
Mechanical dimensions						
Height	35mm (1.4")					
Width	90mm (3.5")					
Depth	150mm (5.9")					
Weight	460g					

Table 1-1.

1.2 Environmental Requirements

Operational

The following shall be applied to the drive in operation as described in Table 3.

Temperature Range: 5°C to 46°C

Humidity Range : 20% to 80% RH without condensation

Maximum Wet Bulb : 29°C

Table 3. Operational Environments

Non-Operational

In non-operation situation such as during shipping or storage, the following requirements shall be applied to the drive as described in Table 4.

Temperature Range: -25°C to 60°C

Humidity Range : 5% to 95% RH without condensation

Maximum Wet Bulb : 29°C max. (No condensation)

Table 4. Non-Operational Environments

2. Electrical specifications

2.1 Sensors and Light Emitting Diodes (LEDs)

2.1.1 This disk drive shall include a red LED driving indicator, the index track 00, and the write protect switch.

2.1.2 Terminal assignment

Pin#	Signal	Description
1	ALA	Drive LED anode
2	ALC	Drive LED cathode
3	ILA	Index LED anode
4	ILC	Index LED cathode
5	IPC	Index phototransistor collector
6	IPE	Index phototransistor emitter
7	TZLA	Track LED anode
8	TZLC	Track 00 LED cathode
9	TZPC	Track 00 phototransistor collector
10	TZPE	Track 00 phototransistor emitter

- | | | |
|----|------|---|
| 11 | WPA | Write protect LED anode |
| 12 | WPC | Write protect LED cathode |
| 13 | WPPC | Write protect phototransistor collector |
| 14 | WPPE | Write protect phototransistor emitter |

- | | | |
|-------|---------------------|-----------------------|
| 2.1.3 | LED CURRENT | 20 mA |
| 2.1.4 | Photosensor voltage | 1.0 V max. |
| | (illuminated) | ($I_c = 250 \mu A$) |
| 2.1.5 | Photosensor current | 45 μA max. |
| | (non-illuminated) | (leakage) |

2.2 Stepper Motor

- 2.2.1 The disk drive assembly shall include a stepper motor for read/write head positioning. It shall increment four step per track. (2 msec/step)

2-2-2 Nominal voltage 12 VDC — 5 VDC

* 12 VDC shall be held at the common terminal
for 25 ms only when moving the phase as
a measure for raising temperature.

2-2-3 Winding resistance 110 Ω (BIPOLAR)

2-2-4 Cable connector

2-2-5 PC board connector

2-2-6 Terminal assignment

Pin#	Signal	Description
------	--------	-------------

PH3		Phase 3
-----	--	---------

PH1		Phase 1
-----	--	---------

PH4		Phase 4
-----	--	---------

PH2		Phase 2
-----	--	---------

2-3 SPINDLE Motor

2-3-1 This drive shall employ a FG motor to rotate the
disk at 300 RPM.

2-3-2 Motor specifications

1 Nominal voltage 12 VDC

2 Rotation CCW (as viewed from output
shaft side)

3 Torque constant 10 g-cm/mA

2-3-3 Cord Connector

2-4 Read/write Head

2-4-1 The disk drive assembly shall include a read/write head capable of reading and writing on a three-inch Compact Floppy Disk.

2-4-2 The head should include a center-tapped read/write winding and an erase winding.

2-4-3 R/W gap $1.5 \pm 0.3 \mu\text{m}$

2-4-4 The head shall have tunnel-erase configuration.

2-4-5 Read voltage

1. Track 39	2F	1.2 mVp-p min
-------------	----	---------------

2. Track 00	1F	3.5 mVp-p max
-------------	----	---------------

2-4-6 Write current 3.5 mA o-p

2-4-7 Erase current 30 mA o-p

2-4-8 DC resistance

1. R/W full coil $45.6\Omega \pm 3\Omega$
2. Erase coil $5.3\Omega \pm 0.5\Omega$

2-4-9 Inductance

1. R/W full coil $1.95 \text{ mH} \pm 20\%$ (at 1 kHz)
2. Erase coil $48.5 \mu\text{H} \pm 20\%$ (at 100 kHz)

2-4-10 Resonance frequency

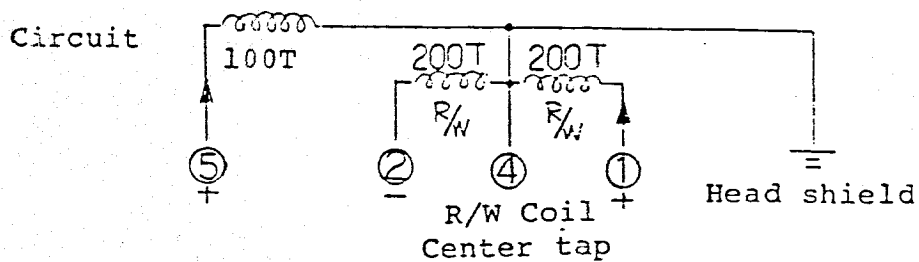
1. R/W full coil 400 kHz min

2-4-11 Cable connector Molex 2695-5 (Gold)

2-4-12 PC board connector Molex 7478-5 (Gold)

2-4-13 Terminal assignment

Pin#	Signal	Description
1	RW	R/W coil
2	RW	R/W coil
3		Shield (cable)
4	CT	R/W coil center tap and shield
5	Era	Erase coil



Alignment Specifications

3. Positioning precision

$$R_n = X - \frac{N}{100} \times 25.4 \pm 0.03$$

Rn : Distance from spindle motor center to track center.

X : 32,500

N : 0 — 39

Measuring track: N = 19

Measuring attitude: Lateral and longitudinal

4 Backlash

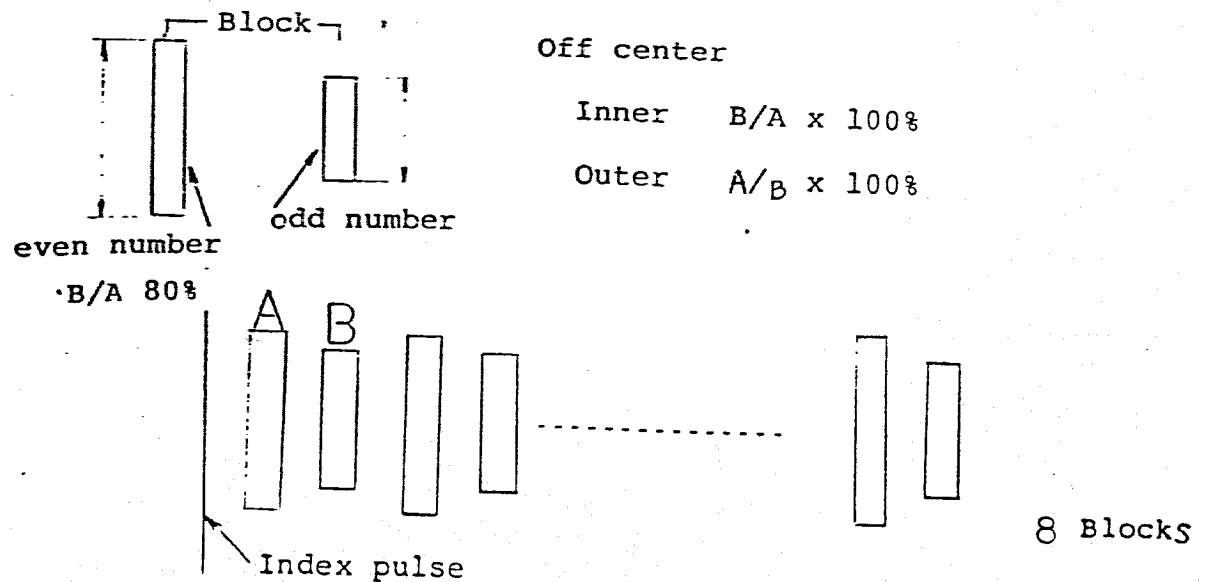
The following specification shall be met.

$$\text{Backlash} = |a - b| \leq 15 \mu\text{m},$$

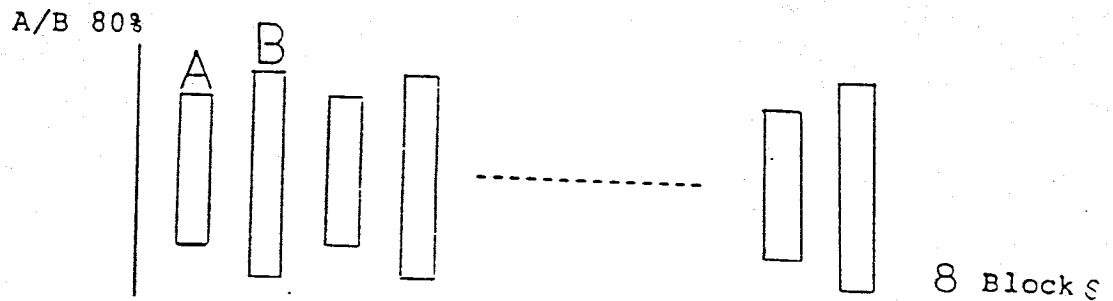
where, a: Amount of deviation with respect to the reference track position when sought to TR19 in the direction away from outer.

b: Amount of deviation with respect to the reference track position when sought to TR19 in the direction away from the inner.

5 . Positioning Sig (Track 19)



10 μm off track in the direction towards the spindle.



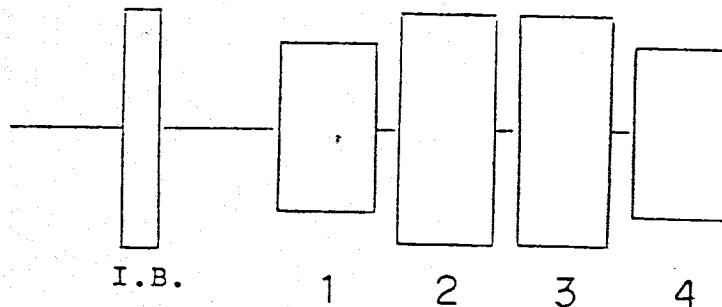
10 μ m off track in the direction away from the spindle.

6. Azimuth

The azimuth at track 39 shall be within 12 minutes of 0° degree using the following CFD Alignment Disk.

Azimuth Alignment Disk

Track 39 contains the following information:



(Index Burst)

Each burst is written at an angle determined by the deviation from a radial line passing through the center of the written transition as viewed from the recorded side of the disk.

Burst #

1

2

3

4

Angle

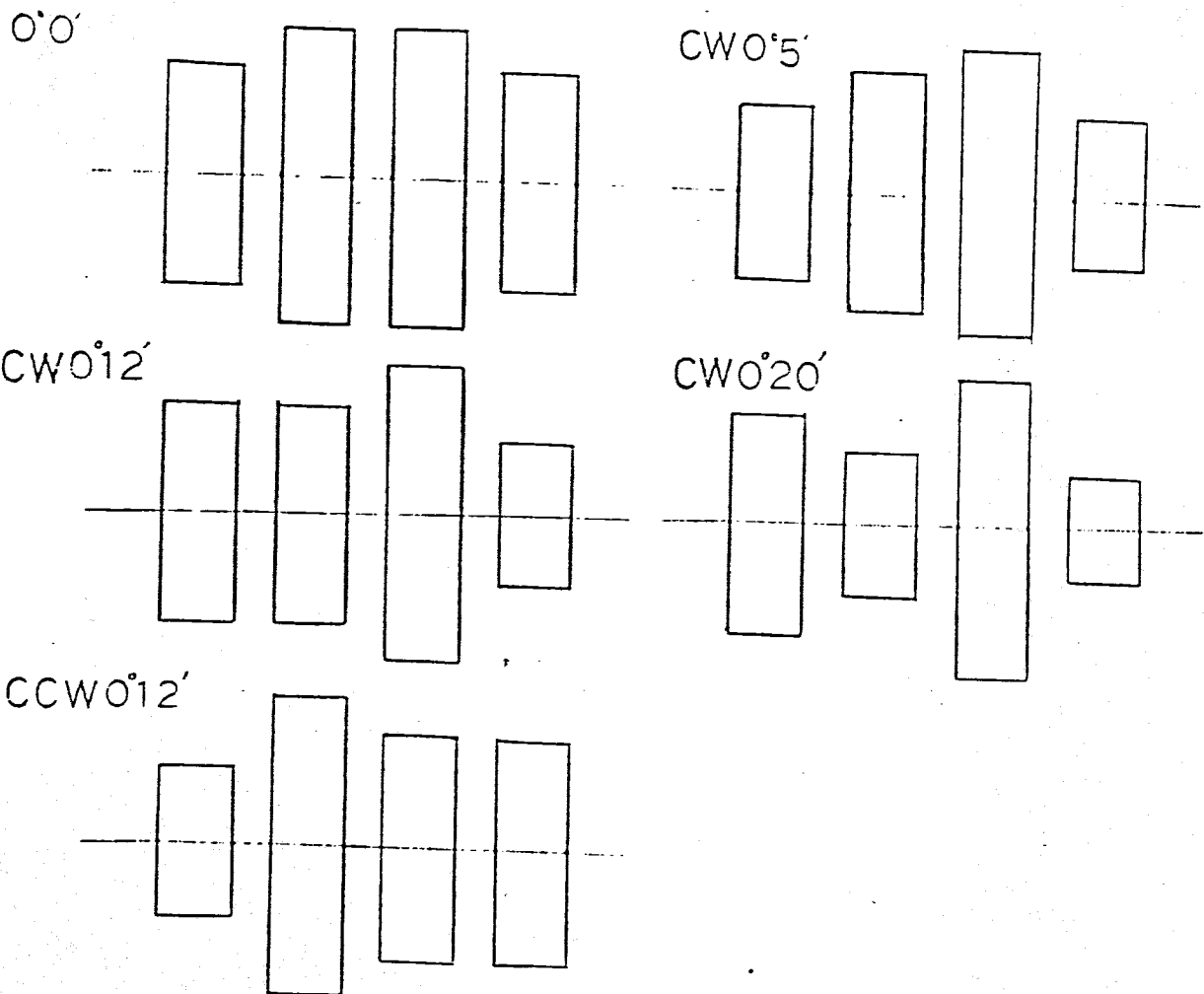
0 72' CW

0 48' CCW

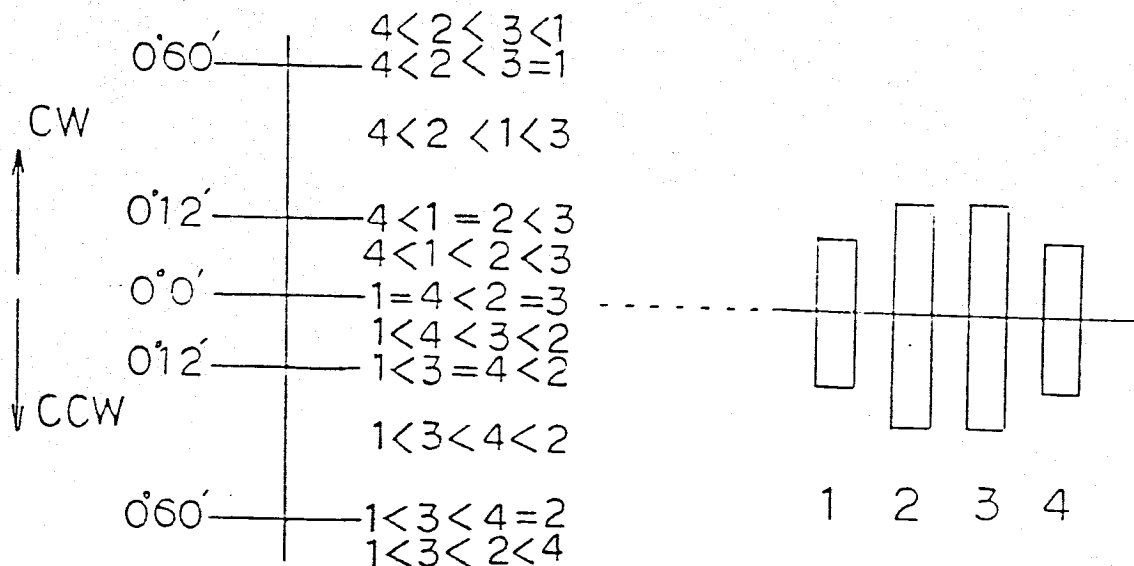
0 48' CCW

0 72' CW

Change in waveform depending upon the head azimuth angle

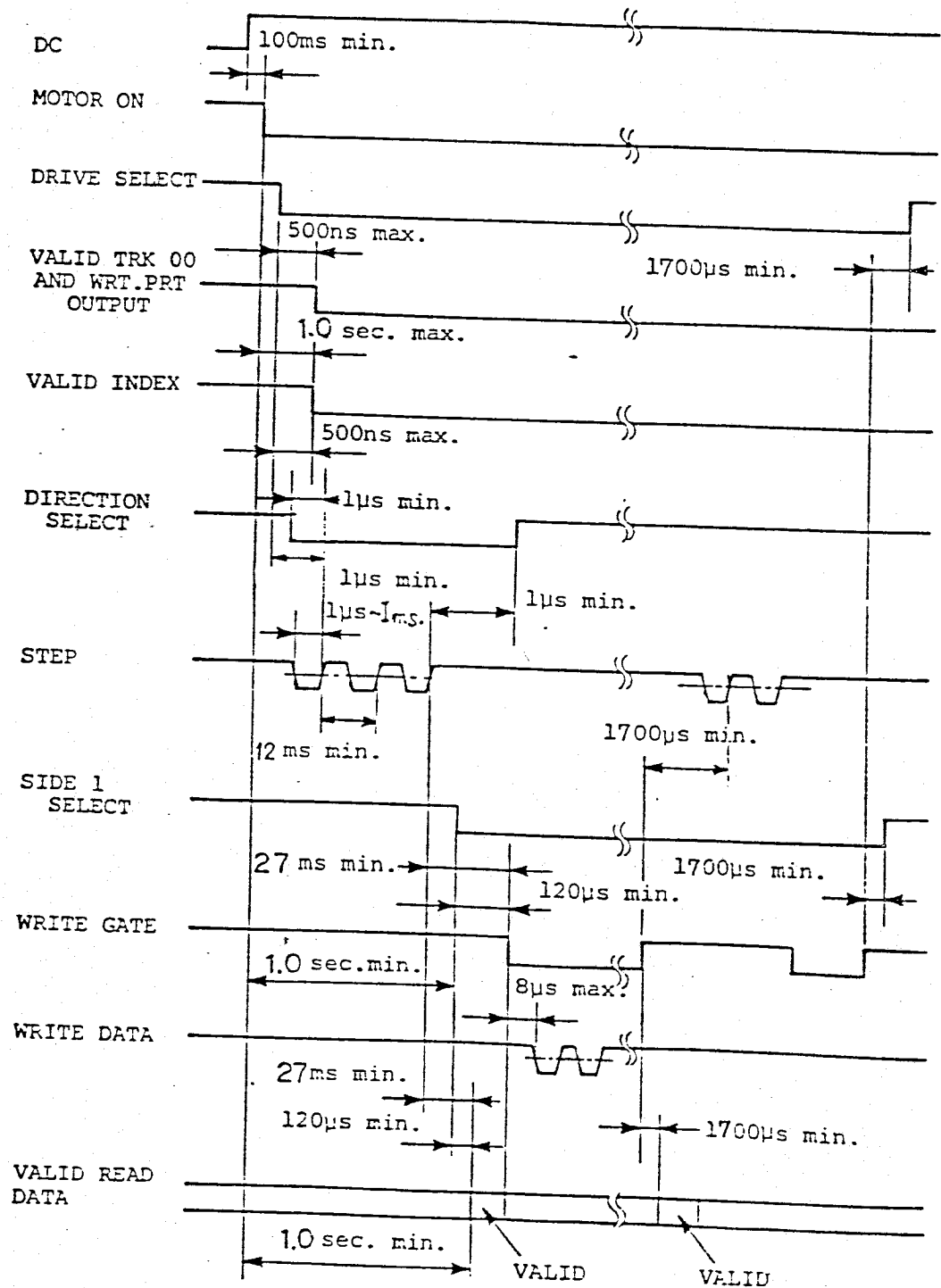


As obvious from the above photos, the relative amplitude of each burst varies as follows depending upon the azimuth angle.



Modulation. After writing a 1F pattern on track 39 of a Compact Floppy Disk, the media is resealed five times, and the amplitude of the envelope is measured. The ratio of the minimum value to the maximum value shall not be less than 75%.

7 Timing



Mounting and Drive Dimensions

Mounting is by means of (4) M3 screws located as shown in Figure 11.

Outside Dimensions are: Width : 90 mm $+0.5/-0.5$ mm
Height : 35 mm $+1/-0.5$ mm
Length : 150 mm $+1/-0.5$ mm
Weight : 0.46 kg (1.0 pounds)

Mounting Recommendations

See Figure 10.

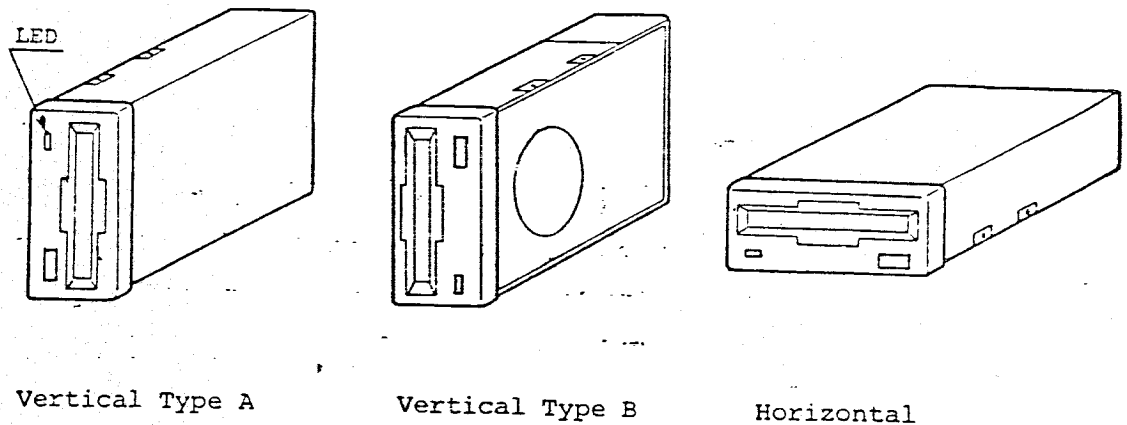


Figure 10. Installation Direction

Dimensional Drawing

IN USE LED

