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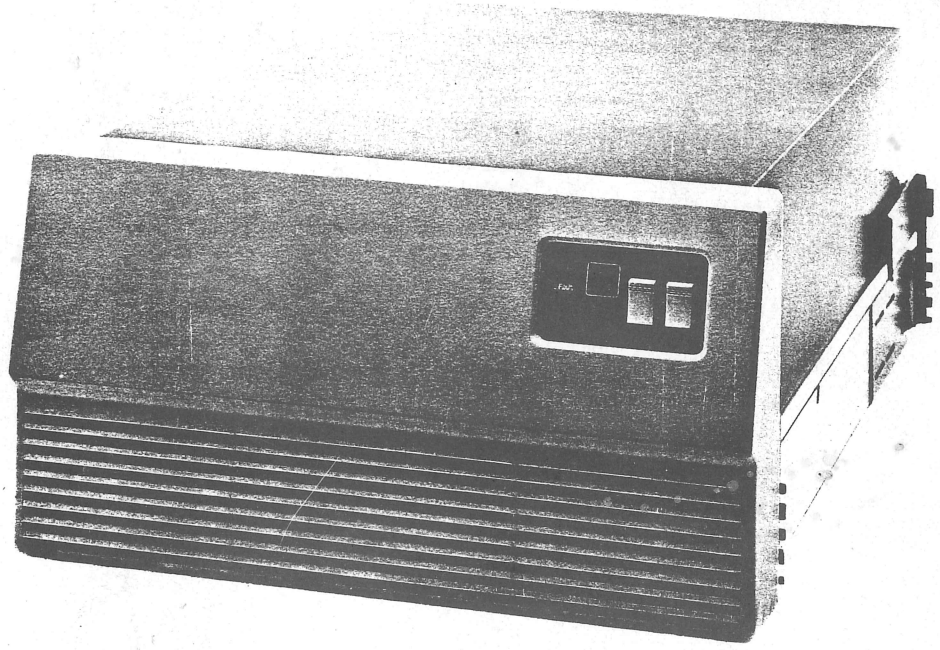
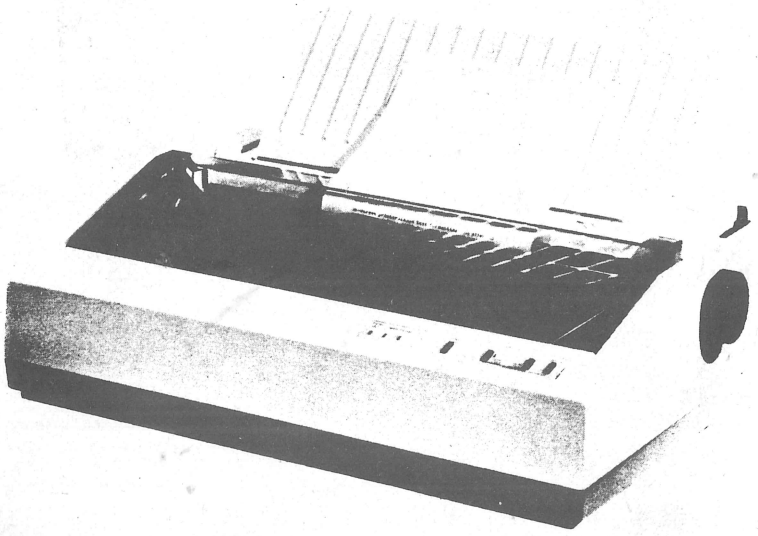
M2311/M2312 MICRO-DISK DRIVES OEM MANUAL





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B03P-4590-0101A-F

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M2311/M2312 MICRO-DISK DRIVES

OEM MANUAL

FUJITSU LIMITED
Communications and Electronics
Tokyo, Japan

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The contents of this manual may be revised without prior notice.

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1. GENERAL DESCRIPTION

This manual describes the Fujitsu 8-inch rigid disk drives M2311/M2312. These units contain non-removable disks in sealed modules. A rotary actuator using a closed loop servo performs head positioning.

These drives have floppy disk drive dimensions and can be mounted horizontally two drives wide in a 19-inch rack (with 3 pitch) or mounted vertically in a system cabinet.

The contact start/stop (CSS) type heads and media are of the Winchester technology type. These units feature high performance, high reliability and low cost.

The maximum unformatted storage capacities of the M2311 and M2312 units are 48MB and 84MB, respectively.

The M2311 and M2312 utilize the industry standard SMD interface, thereby allowing the drives to be added to an existing disk configuration.

By standardizing on this interface, development time for controllers and software will be substantially reduced. Also fixed and variable sector length formats are internally selectable.

To power the drives only DC voltages of +24, +5 and -12 volts are required, allowing for international versatility. Total nominal power consumption is less than 130 watts.

2. FEATURES

(1) High reliability

(a) Winchester type technology contact-start/stop (CSS) heads and media are used. The heads are returned to landing zone out of the data area during spindle start and stop functions.

(b) Each head has an LSI circuit on its arm to amplify the small signal thereby reducing read errors by increasing the signal to noise ratio.

(c) The heads, media and positioning mechanism are sealed in a closed-loop air filtration system.

(d) The electrical components located within the sealed disk area are minimized.

(2) Maintainability

No scheduled maintenance is required.
The adoption of built-in DC spindle motor (no belt), completely sealed DE, plus highly reliable printed circuit assemblies greatly reduce the necessity for maintenance.

(3) Compact, lightweight

This unit can be mounted two drives across in a standard 19-inch rack. The dimensions are almost floppy disk drive compatible. The weight of the unit is approximately 25 pounds (11.3 kg).

(4) Vertical/horizontal mount capability

These units may be mounted vertically or horizontally.

(5) Low accoustical noise level and low vibration make these units attractive for an office environment.

(6) Since this unit requires only DC voltages, only one configuration is required for domestic and foreign applications.

3. SPECIFICATIONS

3.1 Unit Specifications

The basic specifications of the unit are as follows:

Table 3-1 Basic Specifications

Model	Storage capacity
M2311K	48.2M bytes
M2312K	84.4M bytes

3.2 Data Recording Specifications

Table 3-2 Data Recording Specifications

ITEM	SPECIFICATIONS	
	M2311	M2312
Storage Capacity (Unformatted)	48,250,880 bytes	84,439,040 Bytes
Number of Cylinders	589	589
Tracks per Cylinder	4	7
Cylinder Capacity	81,920 Bytes	143,360 Bytes
Track Capacity	20,480 Bytes	
Average Rotational Latency	8.3ms	
Positioning Time		
Track to Track	5ms	
Average	20ms	
Maximum	40ms	
Rotational Speed	3,600 RPM ±1%	
Transfer Rate	1.229MB/sec	
Encoding Method	MFM	
Interface Data	NRZ	
Recording Density	9,550 BPI	
Track Density	720 TPI	
Start/Stop Time	<20/ <40 sec	
Interface	SMD	
Number of Sectors	128 (Maximum)	

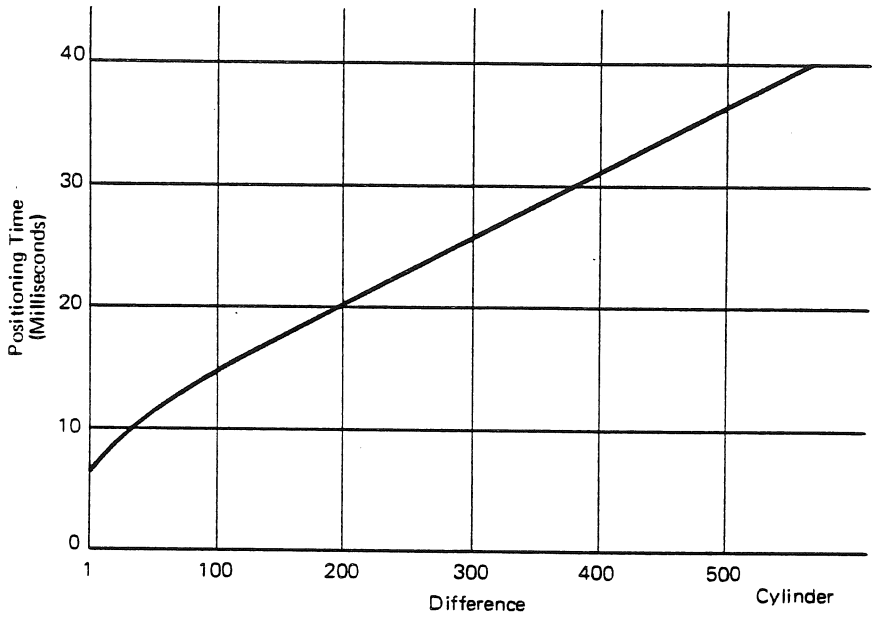


Figure 3-1 Positioning Time Profile

3.3 Physical Specifications

Table 3-3 Physical Specifications

Operating	
Temperature	41°F to 104°F (5°C to 40°C)
Relative Humidity	20% to 80% (no condensation)
Temperature Variation	<27°F/hr (15°C/hr) (no condensation)
Altitude	10,000 feet (3,000 m)
Vibration	0.2G max. (3 Hz to 60 Hz) Both ways 2 minutes × 30 cycle (sine wave)
Shock	<2.0G, 10 ms
Non-operating	
Temperature	-40°F to 140°F (-40°C to 60°C)
Relative Humidity	5% to 95% (no condensation)
Altitude	40,000 feet (12,000 m)
Vibration	0.4G max. (3 Hz to 60 Hz) Both ways 2 minutes × 30 cycle (sine wave)
Shock	<5.0G, 30 ms - in storage or during transportation

3.4 Mechanical Dimensions

Table 3-4 Mechanical Dimensions

Depth	15.0" (380 mm)
Width	8.5" (216 mm)
Height	5.0" (127 mm)
Weight	Approx. 25 lbs. (11.3 kg)
Mounting Axis	Horizontal/Vertical

(Refer to 3.8 Configuration)

3.5 DC Power Requirement

3.5.1 DC Power Requirement

The MDD M2311/2312K requires +5V, -12V and +24V DC voltages from an optional power supply or system power supply. Each load current required by the drive is shown in Table 3-5.

Table 3-5 DC Power Requirement

DC Voltage	Load Current (Basic)	Load Current (With Dual Port)
+5V ±5%	3.5A	4.5A
-12V ±5%	3.0A	4.0A
+24V ±10%	3.0A (Effective, typical) $6.0A_{o-p}$ Maximum	

The load currents of +5V DC and -12V DC will be stable even though any operation will be performed within the disk drive, however, the load current of +24V DC will be varied through a power up sequence or DC motor accelaration and/or seek operation.

The +24V DC load current profile during power up sequence is shown in Figure 3-2.

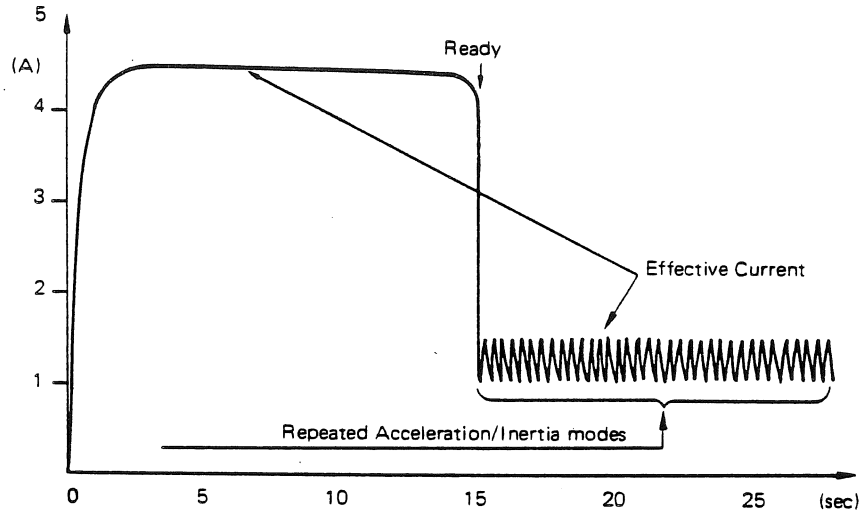


Figure 3-2 +24 VDC Load Current on Power Up Sequence

The +24V DC load current profile during the repeated accelaration/inertia modes of DC motor and/or seek operation after Ready status is shown in Figure 3-3.

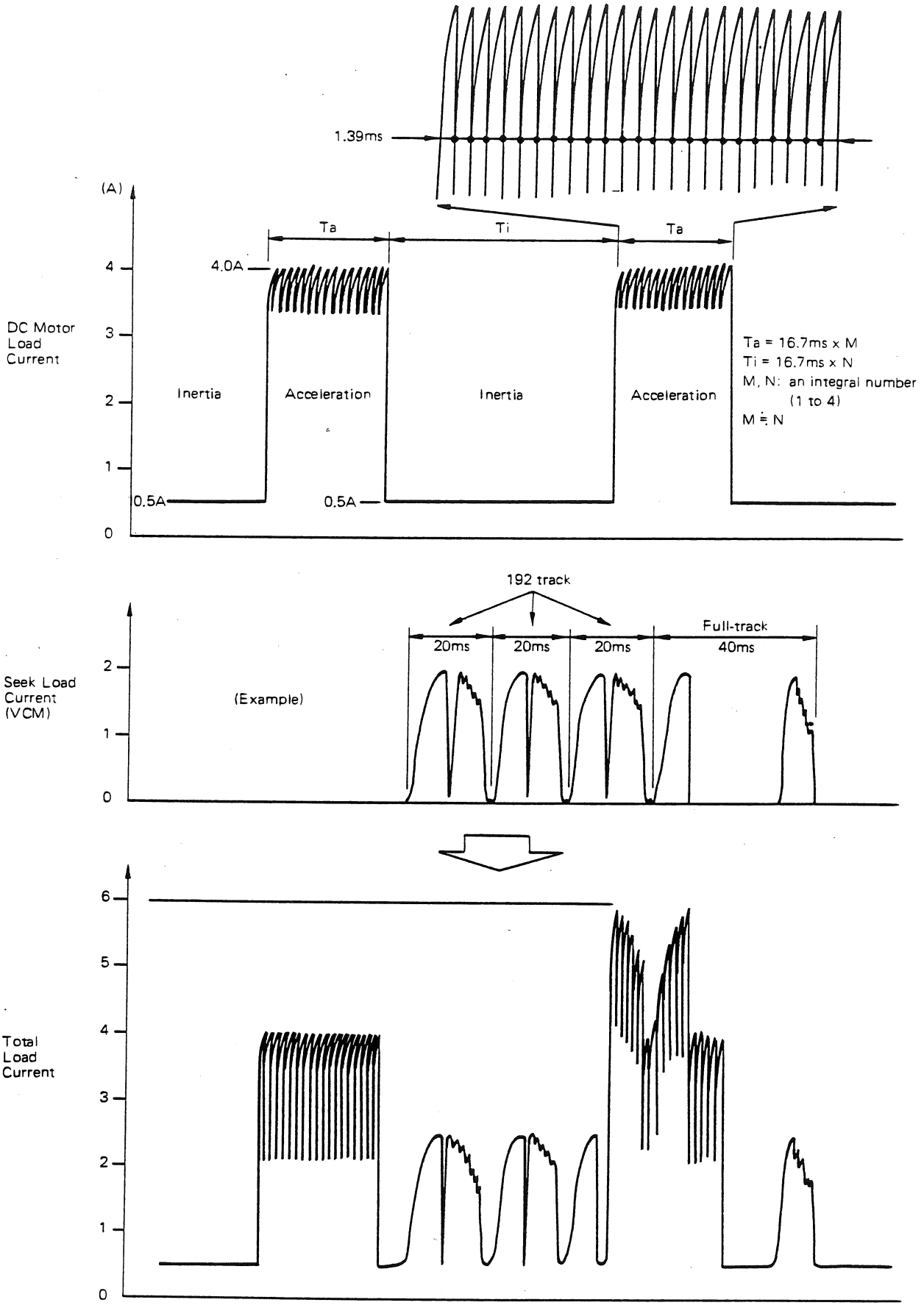


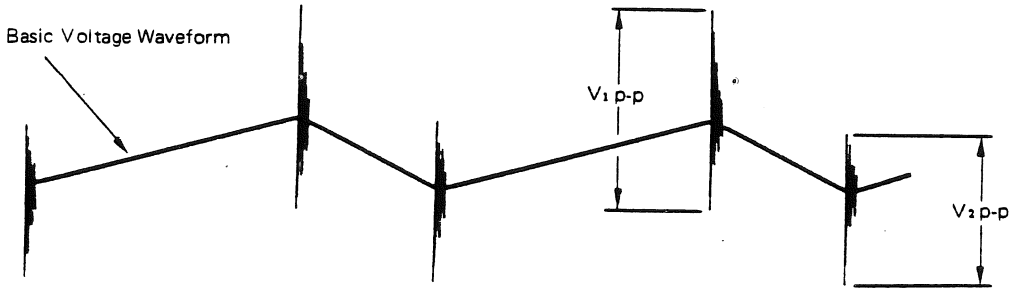
Figure 3-3 Total +24V DC Load Current (Ready)

3.5.2 High Frequency Noise Specification

When the DC power is supplied to the drive from a customer power supply with switching type regulation, the high frequency noise caused by switching regulator should be specified as follows:

1) High Frequency Noise Definition

It is defined that the High Frequency Noise is caused by a switching transient on basic voltage within the switching type regulator on the power supply unit as shown in Figure 3-4.



Note) A noise is defined as the higher spike, V_{1p-p} and V_{2p-p}.

Figure 3-4 High Frequency Noise

2) Measurement Procedure

A noise level should be measured on terminals of the power supply as shown in Figure 3-5.

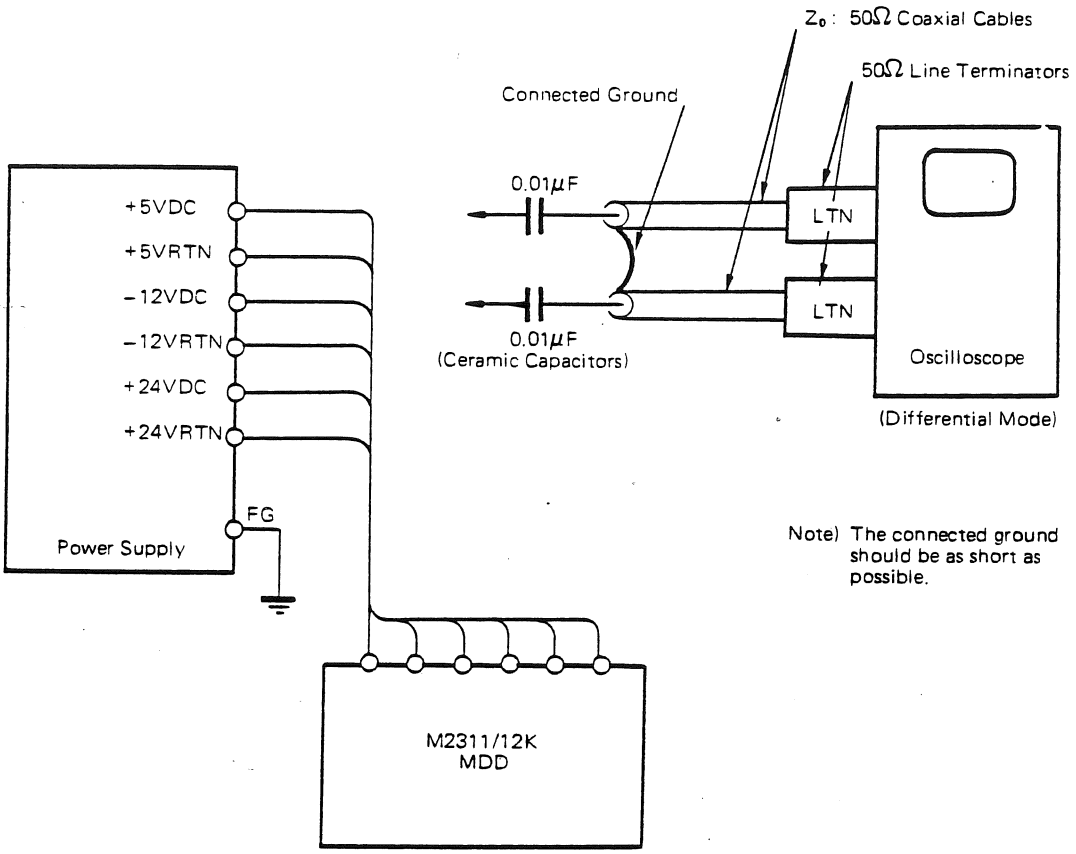


Figure 3-5 Measurement Procedure

3) Noise Specification

a. Noise between each DC output and return terminals.

V_{N1}: 0.1 V_{p-p} max.

b. Noise between each terminal (DC output and return) and Frame Ground (FG).

V_{N2}: 1.0V max.

c. This specification is not applied to an external line noise definition.

3.6 Reliability

(1) Mean Time Between Failure (MTBF)

The MTBF is defined as:

$$\text{MTBF} = \frac{\text{Estimated Operating Hours}}{\text{Number of Equipment Failures}}$$

The MTBF shall exceed 10,000 hours (design value). Estimated operating hours should not include any maintenance time. Equipment failures means any stoppage or substandard performance of the equipment because of equipment malfunction, excluding stoppages or substandard performance caused by operator error, cable failure, or other failure not caused by the equipment. To establish a meaningful MTBF, operating hours must be greater than 6,000 hours per year and shall include field performance data from all field sites.

For the purpose of this specification, equipment failures are defined as those failures necessitating repairs, or replacement on an unscheduled basis.

(2) Mean Time to Repair (MTTR)

The mean time to repair is 0.5 hour. It is defined as the time for an adequately trained and competent serviceman to diagnose and correct a malfunction.

(3) Preventive Maintenance Time

No scheduled maintenance is required.

(4) Service Life

The M2311/M2312 drive provides a useful life of five (5) years before factory overhaul or replacement is required.

(5) DC Power Loss

Data integrity is assured in the event of a power loss. Data is not assured during write operation.

3.7 Error Rate

The following error rates assume that the M2311/M2312 is being operated within specification. Errors caused by media defects or equipment failures are excluded.

3.7.1 Read Errors

Prior to determination of a read error rate, the data shall have been verified as written correctly and all media defects flagged.

(1) Recoverable Error Rate

A recoverable read error is one which can be read correctly within four retries when reading on track, and should not exceed ten per 10^{11} bits.

(2) Unrecoverable Error Rate

An unrecoverable read error is one which cannot be read correctly within sixteen retries and should not exceed ten per 10^{14} bits.

3.7.2 Positioning Error Rate

The positioning error which can be corrected within one retry should not exceed ten per 10^{8} seeks.

3.7.3 Media Defects

A media defect is defined as a repeative read error that occurs on a properly adjusted drive within specific operating conditions.

Valid data must not be written over known media defects, therefore, sector/track deallocation or skip displacement techniques must be utilized.

(1) Media Defect Characteristics

a) The maximum number of defects per drive is as follows:

M2311K (48MB): 56

M2312K (84MB): 98

b) The maximum number of defective tracks per drive is as follows:

M2311K (48MB): 8

M2312K (84MB): 14

A defective track is defined as a track having any of the following:

1. Two or three defects
2. Defective logging areas

Note: No track shall have more than three defects.

(2) Media defect free areas are defined as follows:

1. Cylinder 0, Head 0 through 2
2. Any error in logging area to extent defined in the Media Defect Format

3.7.4 Media Defect Information

All MDD will have a Media Defect List which will list the following information.

1. Cylinder Address
2. Head Address
3. Position (bytes from Index ±1 byte)
4. Length (bits ±1 bit)

The above information will be listed by hexadecimal code. The maximum media defect length at a defect is 64 bytes (512 bits).

3.7.5 Media Defect Format

The MDDs will be formatted at the factory with standard Media Defect Format. The Media Defect Format is divided into two parts. The first part is a hard-sectored format and is normally included in the first 56 bytes following Index signal. The second part is a soft-sectored format and is normally included in the next 49 bytes following Index signal as shown in Figure 3-6 Format 1. The format rules are as follows:

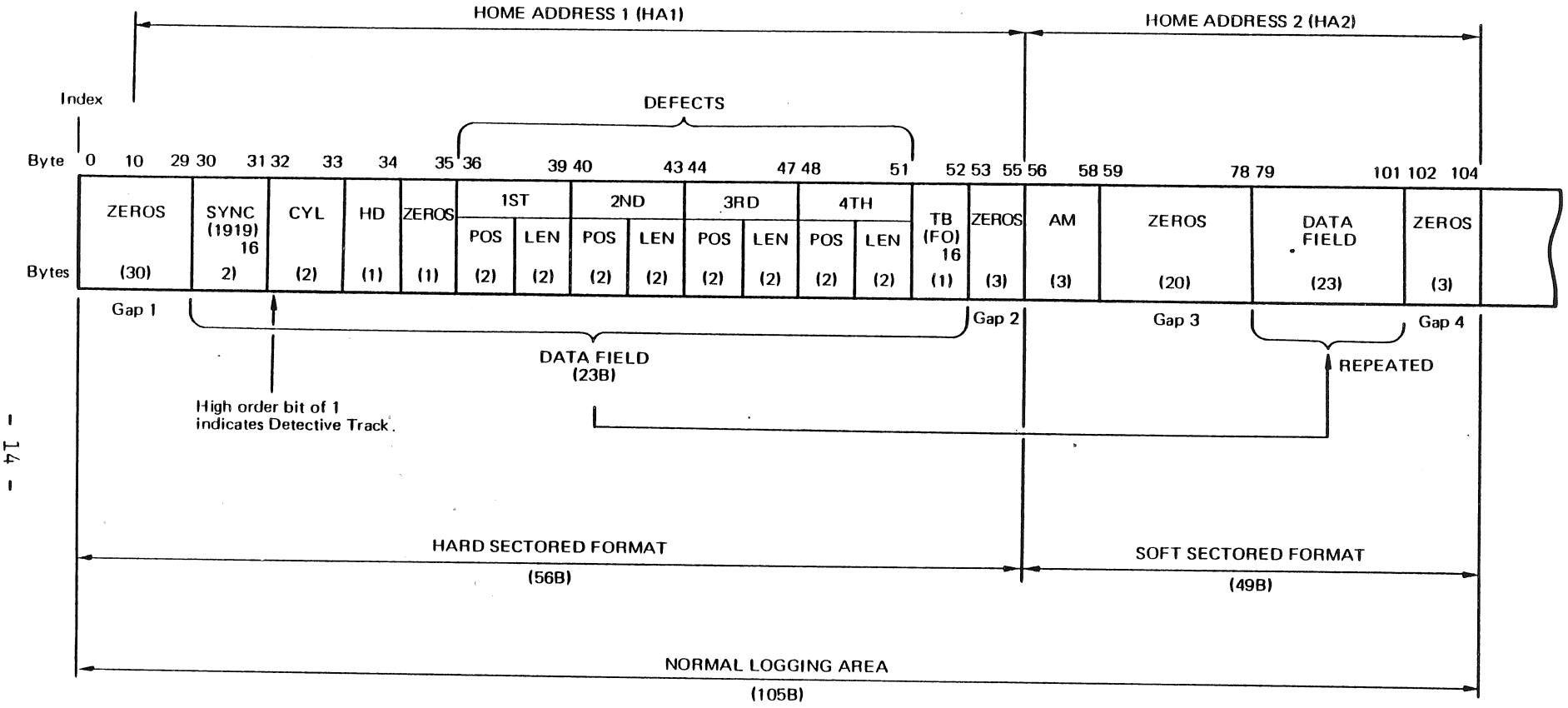
1. A track which has more than one defect is defined and flagged as a defective track. The first four media defects are logged.

2. If the beginning of a defect is located between Byte 10 to Byte 55 (HA1) after Index, 60 bytes of zeros are added to gap 1 (90 bytes total).
   In this case, if any part of a defect is located between Byte 69 and Byte 164 (HAR1' and HA2'), the track is flagged as defective. Refer to Figure 3-7 Format 2.

3. If the beginning of a defect is located between Byte 56 and Byte 104 (HA2) after Index, 60 bytes of zeros are added before Address Mark (AM). In this case, if any of

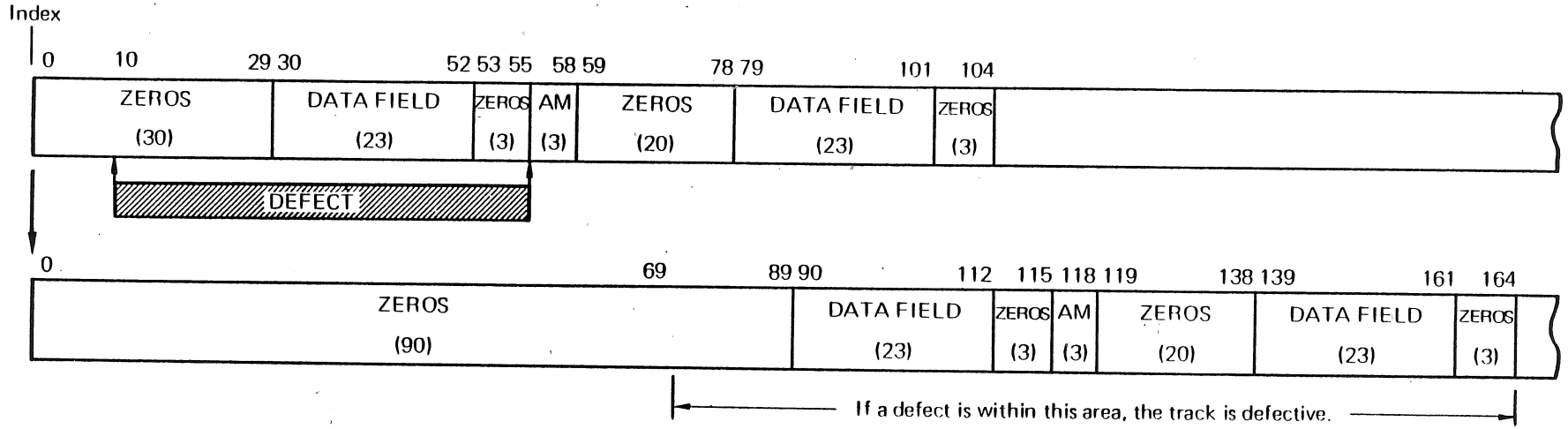
a defect is located between Byte 116 and Byte 164 (HAR"), the track is flogged as defective. Refer to Figure 3-7 Formats.

4. If the track is defined as a defective track according to above-mentioned Rule 1, 2 or 3, the high order bit of the first cylinder address byte is set to 1. Remaining information may or may not be valid.

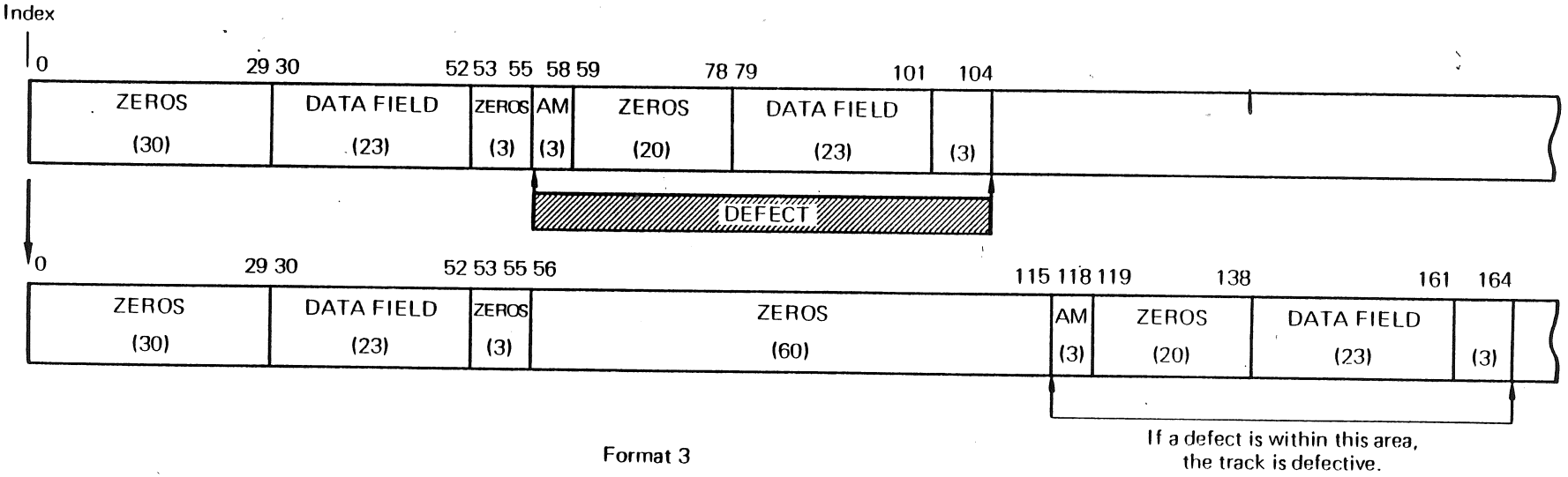


Note 1) Position (POS) of defect is in bytes after Index ±1 byte.
2) Length (LEN) of defect is in bits ±1 bit.
3) Unused defect locations are all zeros.

Figure 3-6 Media Defect Format 1



Format 2

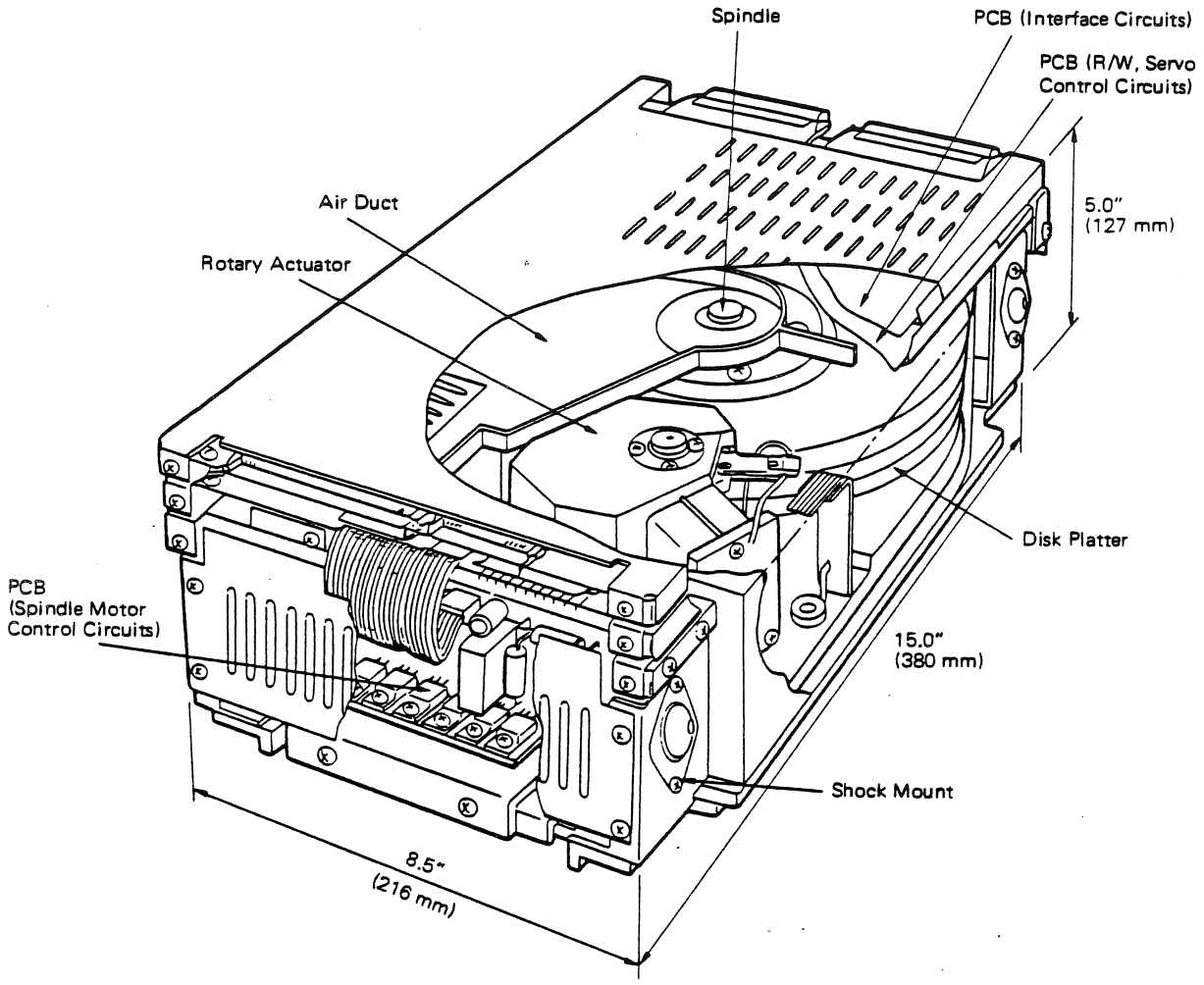


Format 3

Figure 3-7 Skip Displaced Format

3.8 Configuration

Figure 3-8 shows the fundamental configuration of the unit; Figure 3-9 shows the block diagram.



M2311 Three disks (Four R/W heads) in DE.
M2312 Four disks (Seven R/W heads) in DE.

Figure 3-8 Fundamental Unit Configuration

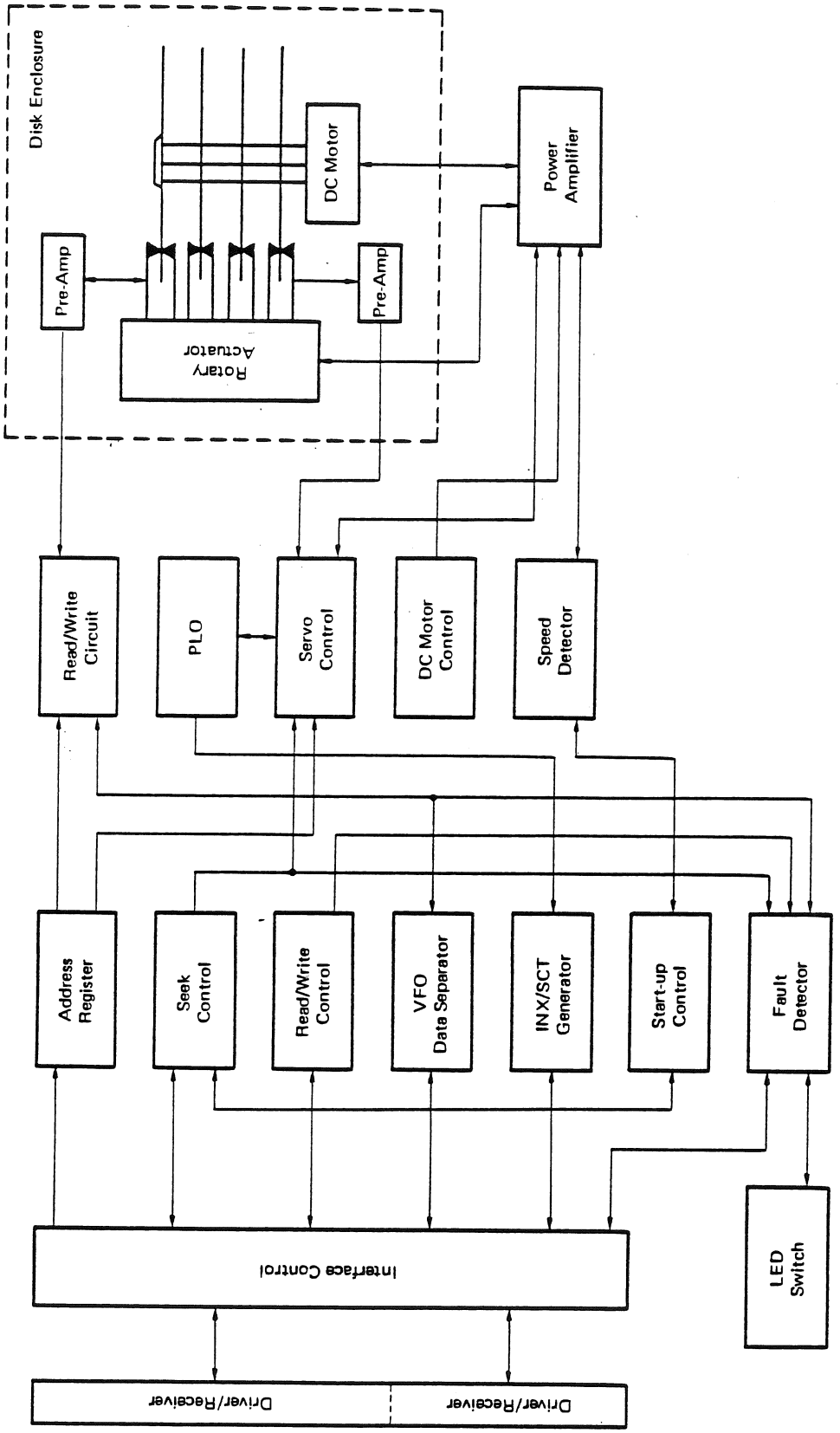


Figure 3-9 Block Diagram

3.9 Major Components

3.9.1 Disk Enclosure

The Disk Enclosure is a completely sealed unit containing the disks, spindle, actuator, and heads. Each of these are visible from the outside through a plastic cover. The DE is sealed at the factory and must not be opened in the field.

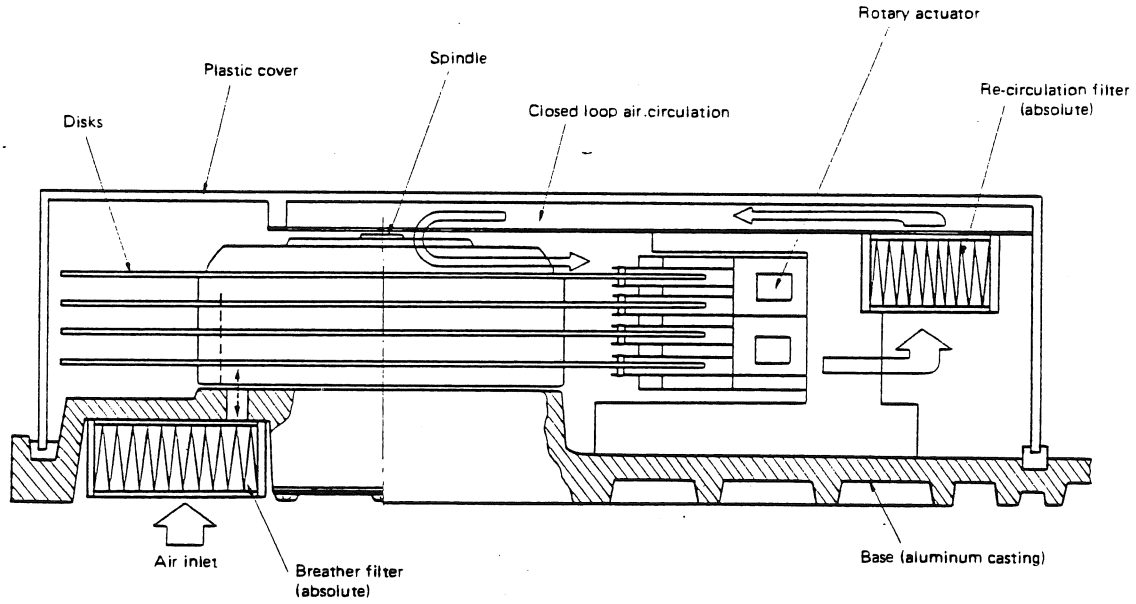
3.9.2 Air Circulation in DE

As the Contact Start/Stop (CSS) head used in this disk unit has a very low flying height (approximately 0.35 μm), head crashes could be caused by microscopic foreign particles. To keep the inside of the DE clean, this enclosure is completely sealed and clean air is supplied through two filters. The breather filter is used for external air intake, while the recirculation filter is used to keep the air inside the DE clean. The breather filter is used for the following purposes:

(a) Prevention of negative pressure in the vicinity of the spindle when the disk begins to rotate.

(b) Prevention of dust intake when the air in the DE contracts due to a temperature difference between the DE and its environment.

The re-circulation filter, attached to the closed loop duct in the DE, is used to keep the air free of foreign particles. When a pressure difference is caused in the DE by the rotation of the spindle, the air in the DE circulates through the closed loop. Because it continually passes through this filter, the air is always kept clean. These two filters can remove 99.97% of the dust particles (0.3 μm min.).



M3211 contains 3 disks in DE
M3212 contains 4 disks in DE

Figure 3-10 Air Circulation Inside DE

3.9.3 Spindle Drive Motor

The spindle/drive motor is an integral part of the chassis. The spindle/drive motor consists of seven major components: Shaft, Hub, Bearings, Stator, Rotor, Anti-static Brush and Speed Sensor. The motor shaft is fixed within the motor housing by upper and lower bearings which are sealed to prevent contamination of the disk platter environment. The stator is fixed to the outer radius of the cast motor housing. A hub is fixed to the top of the motor shaft and has the shape of an upside-down bowl. The rotor and disk platters are fixed to the hub. A ground brush contacts the bottom of the motor shaft and dissipates any electrostatic noise to the chassis. A Hall-effect sensor detects movement of a device mounted on the hub. The signal produced by this sensor is compared with an oscillator clock on the PCB in order to maintain the 3,600 RPM rotational speed within specification.

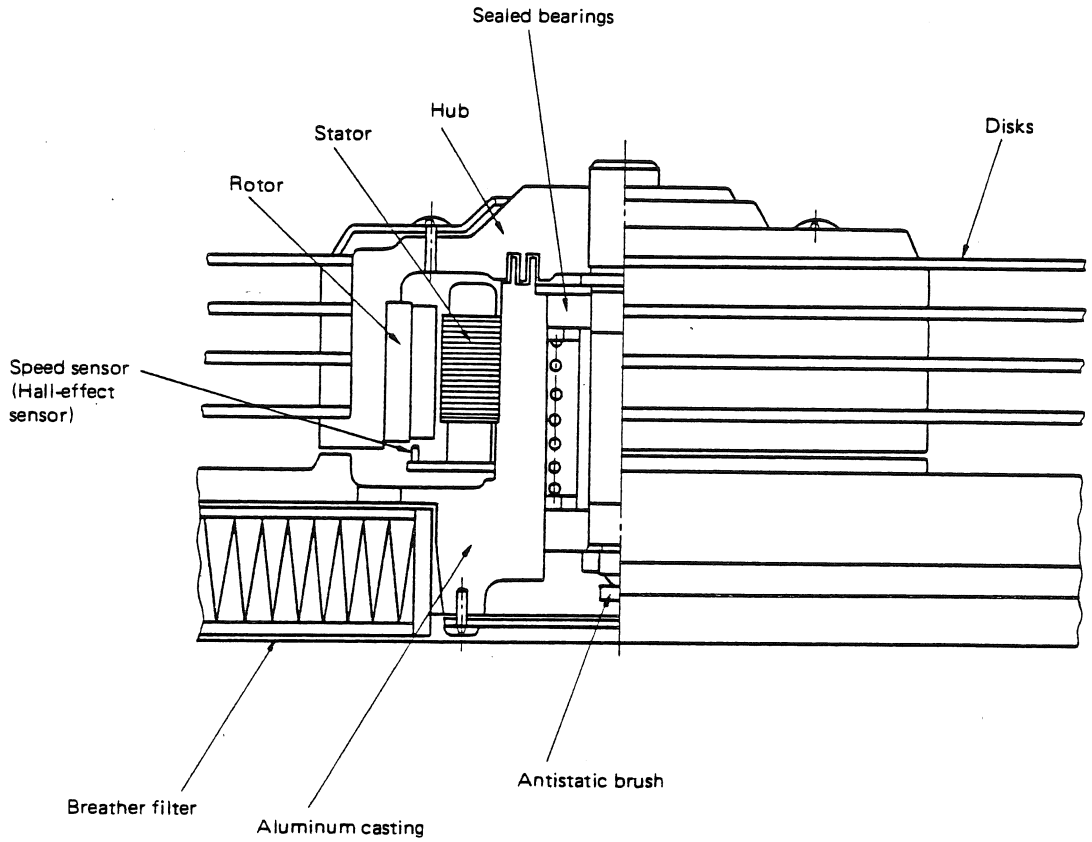


Figure 3-11 Spindle Drive Motor

3.9.4 Actuator Arm Assembly

A low power consumption rotary type actuator is used to move the data heads and servo head to the specified cylinder along a circular arc. A moving coil is attached to the other end of the actuator arm and moves freely between fixed parmanent magnets without contact. When current is applied to the coil, interaction occurs between the coil and magnets and the actuator moves around the pivot.

The actuator performs the following types of motion, which are controlled by servo feed-back current from the servo head.

(1) Seek

Heads are moved to the specified cylinder, counting track crossing signals.

(2) On Cylinder

Heads follow the specified tracks to prevent mispositioning from disturbances such as shock, vibration or temperature changes.

The servo head is located on the lower surface of the bottom disk where servo information is pre-written at the factory.

This servo information is used as a control signal for the actuator; that is, it provides track crossing signals during a seek operation, track following signal during On Cylinder, and timing information such as index and servo clock.

The heads are in contact with the disk surfaces during start and stop (CSS) at a fixed position called the landing zone. This zone is on the innermost area of the disk, separate from the recording zone. A spring force holds or fixes the actuator at this position. If no current is applied to the moving coil, the heads are fixed at the landing zone to prevent CSS in the recording zones.

Once the disks attain the required rotational speed, an initial seek function occurs. Current then flows in the coil and heads are released from the landing zone and moved to Cylinder 0.

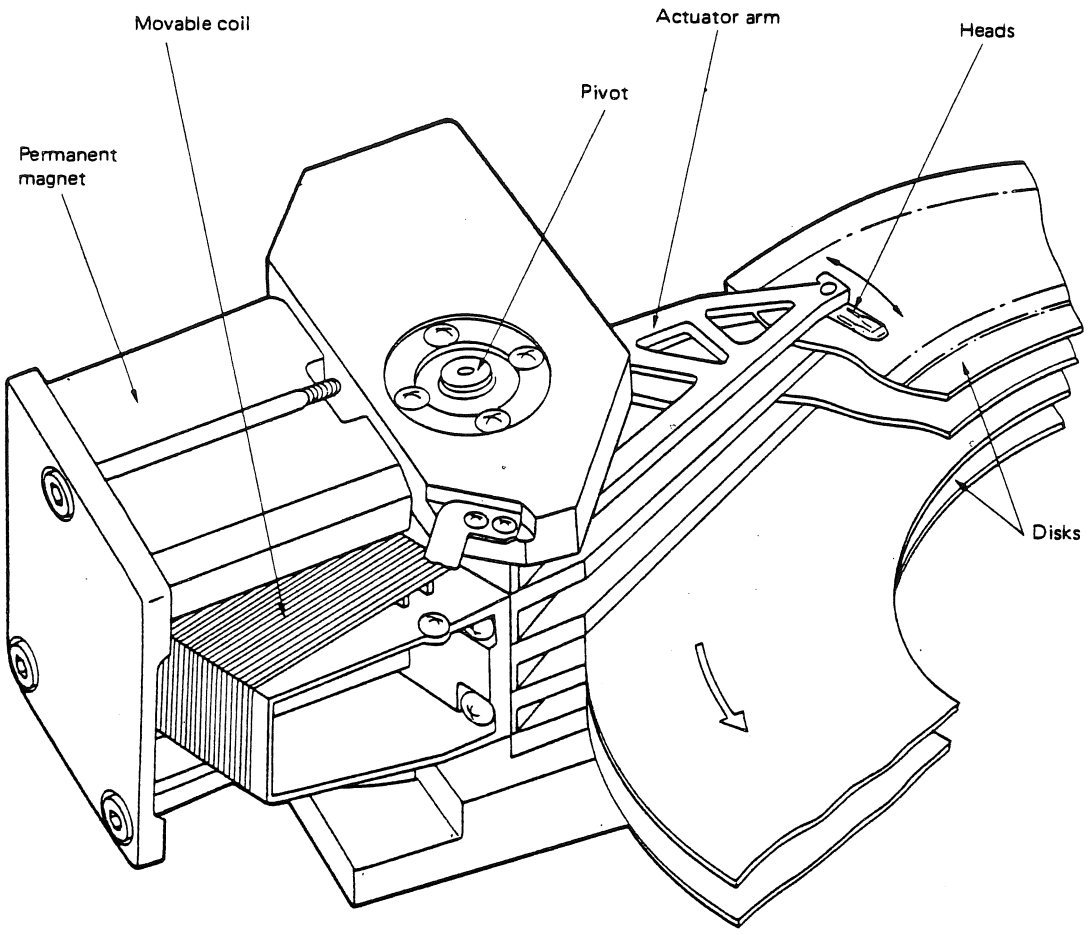


Figure 3-12 Actuator Arm Assembly

3.9.5 Disk Platters

The M2311 and M2312 disk drives contain three and four platters, respectively. These platters are 200 mm (eight-inch) diameter aluminum substrate-coated disks with a lubricated iron oxide coating. The bottom side of the lowest disk is pre-written at the factory with reference servo patterns. The platter surface can sustain 10,000 start/stops without damage.

3.9.6 Servo Head

A single servo head is mounted on the lower head arm to read a servo pattern pre-written at the factory on the bottom disk's lower surface. This information is used to control read/write operations and is used to provide seek control index and a selectable count of sector pulses.

3.9.7 Data Heads

The heads are in contact with the media surface when the platters are not rotating, and they lift-off with rotation. A landing zone is provided out of the data area which is use when the heads contact the media. Four heads are used in the M2311 and seven in the M2312.

3.9.8 Printed Circuit Boards

Three PCBs are mounted on both the topside and the backside of the M2311/M2312 micro disk drives. They are easily removed by unplugging the connectors and removing the screws securing the PCBs to the chassis. The basic functions performed on the PCBs are as follows:

(a) SMD Interface is enabled/disabled by the controller using the drive select function, thus allowing up to eight disk drives to be daisy-chained together.

(b) Drive Status such as On Cylinder, Fault, Seek Complete, Write Protect, Index and Ready are made available to the interface.

(c) Read/Write control includes conversion of NRZ interface write data to MFM coding. When the drive is instructed to read, the head select circuit decodes the selected head and the MFM data is converted back to NRZ for transmission to the controller.

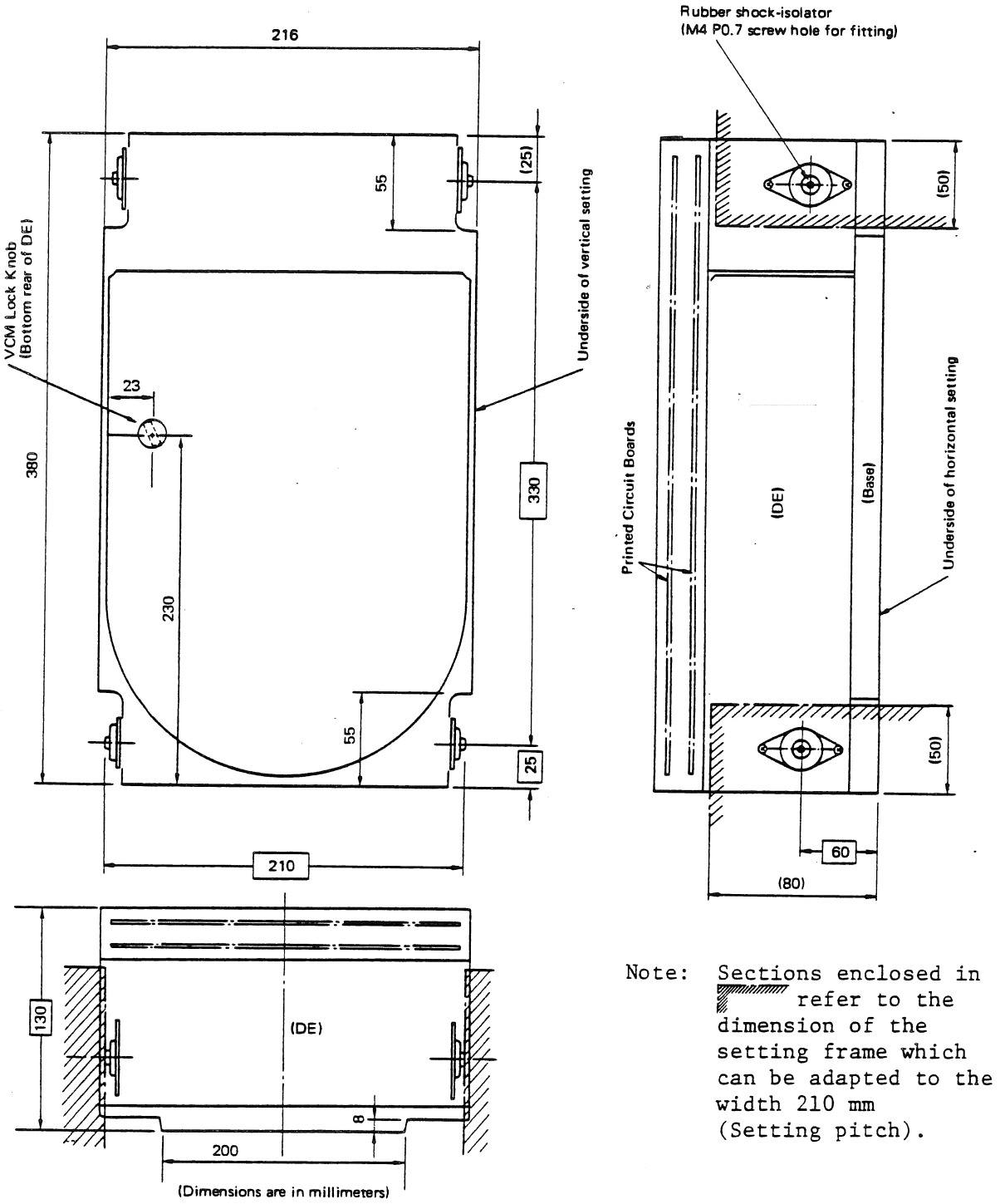
(d) Servo Control circuits take the Cylinder Address command from the interface and control the seek operation to any desired cylinder.

(e) Spindle Speed control circuits monitor the speed of the spindle/drive motor and maintain 3,600 RPM ±1%.

4. INSTALLATION

4.1 Installation in Locker

The accompanying diagram shows how to install the unit according to the dimensions and the structure of the frame.



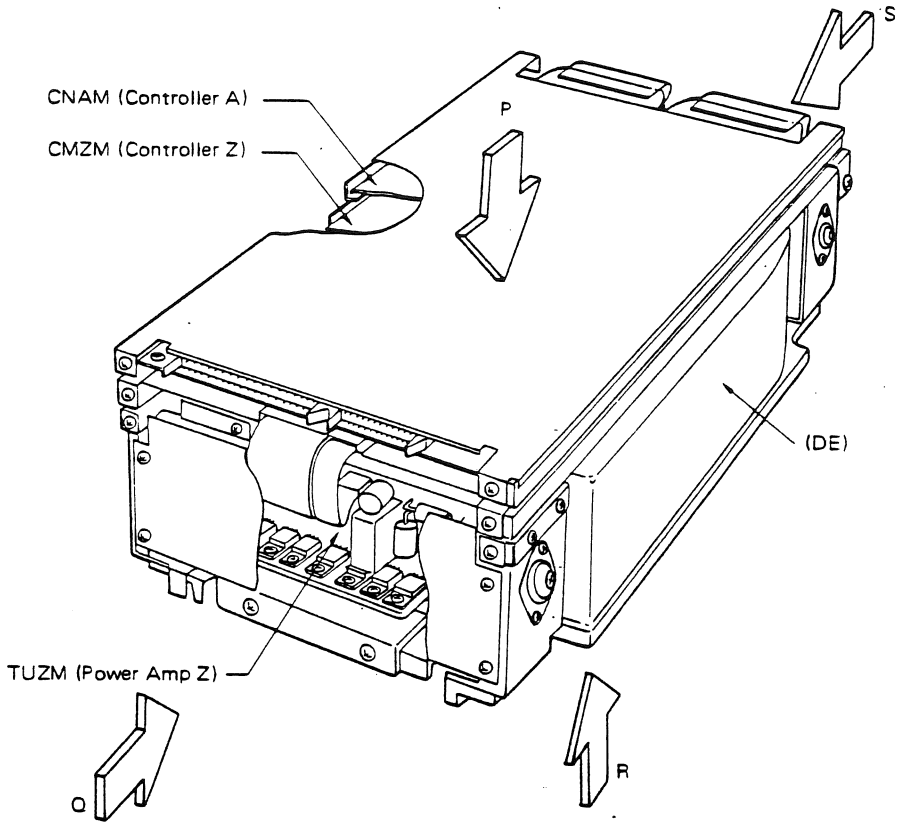
Note: Sections enclosed in ▨ refer to the dimension of the setting frame which can be adapted to the width 210 mm (Setting pitch).

Figure 4-1 Mounting Dimensions of the Unit

4.2 Service Area

Maintenance, securing for transportation, cable connection, are accessed as shown below.

When determining the service area and where to install the locker, make sure that there is enough room for maintenance work.



P side: Maintenance operation on PCB (CNAM, CMZM)

Q side: Maintenance operation on PCB (TUZM)
Cable connections

R side: Securing the unit. (Refer to 4-3)
Accessing the VCM lock knob to secure the VCM.

S side: Securing the unit. (Refer to 4-3)
Operating the panel unit (Optional)

Figure 4-2 Maintenance Access on the Unit

Figure 4-3, 4-4, 4-5 show how to replace the PCB assemblies, and Figure 4-6 shows how to lock the actuator.

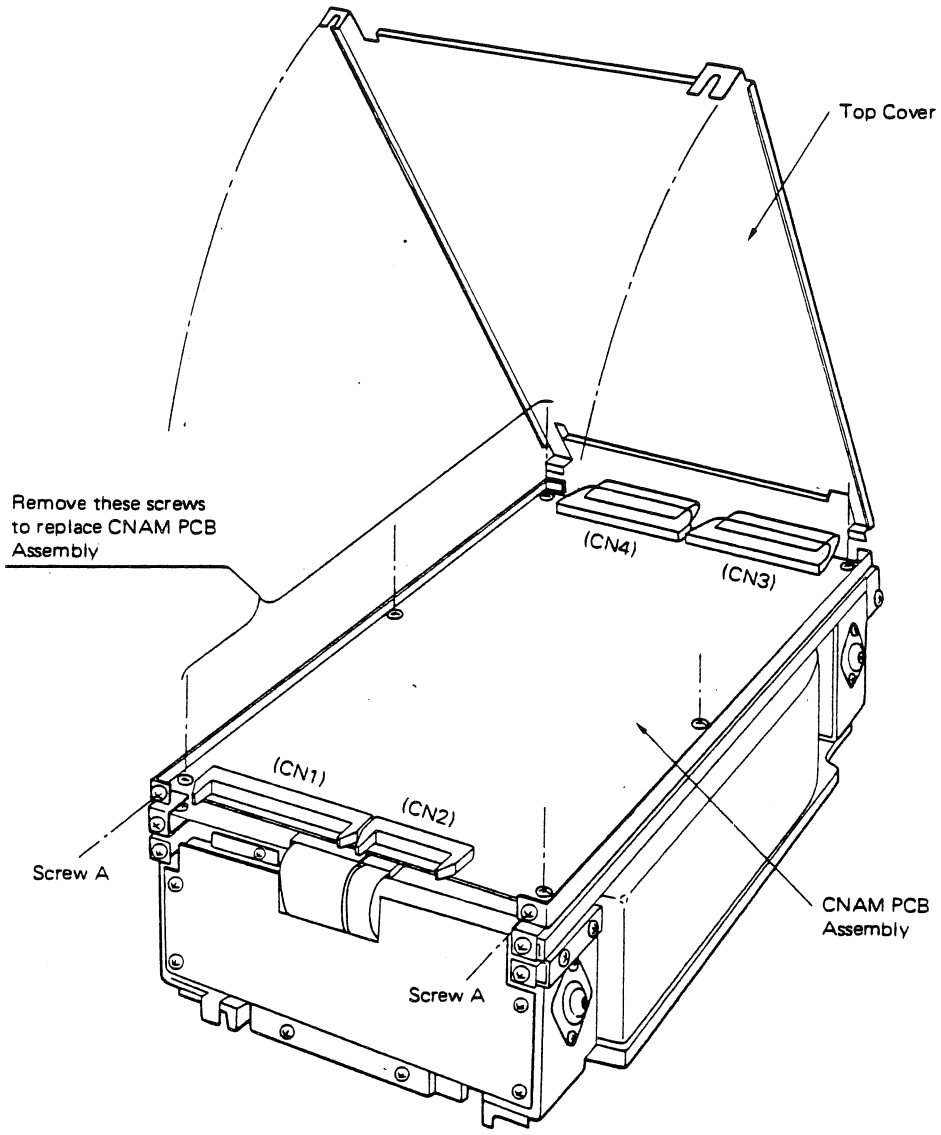


Figure 4-3 CNAM PCB Assembly Replacement

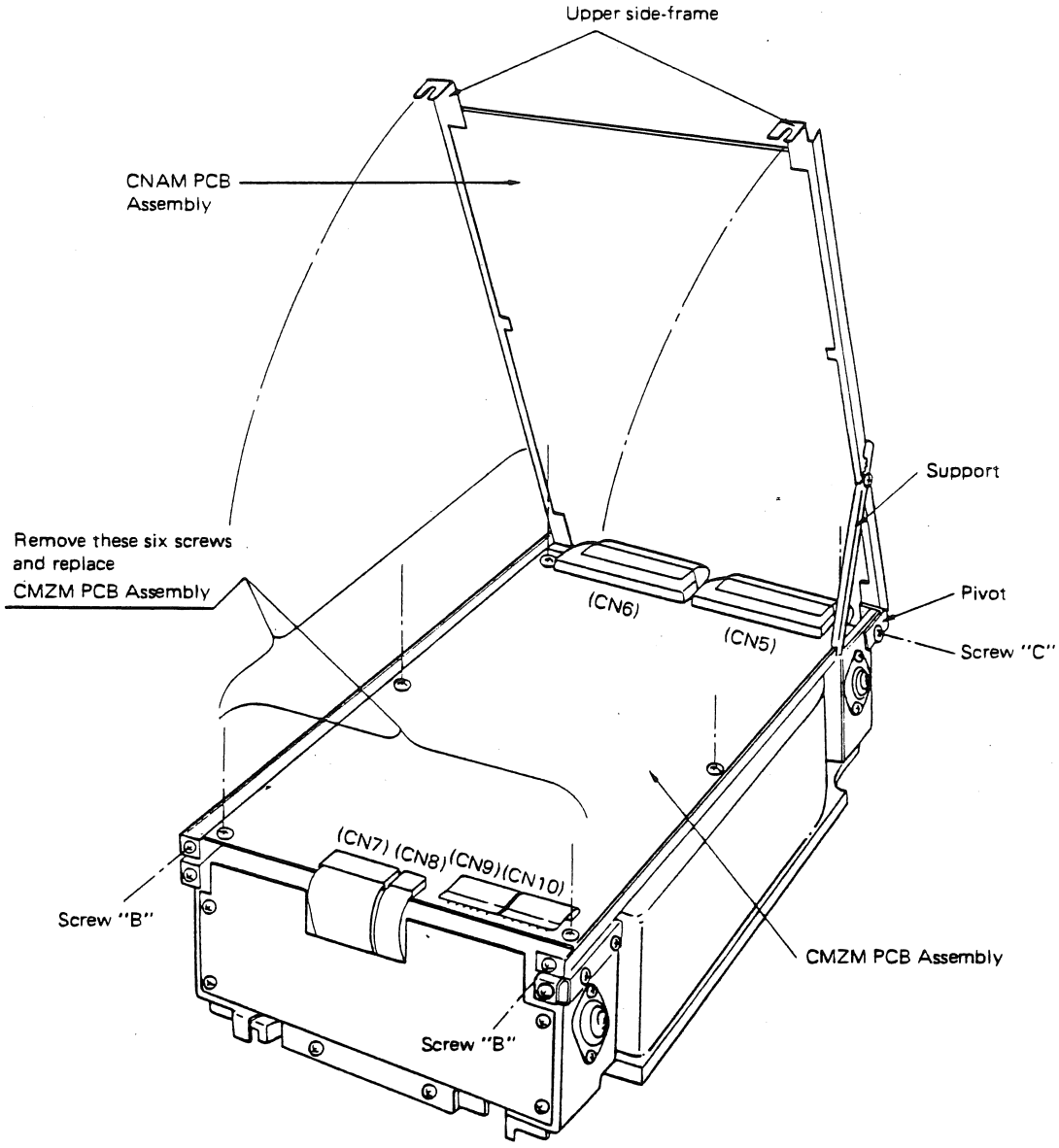


Figure 4-4 CMZM PCB Assembly Replacement

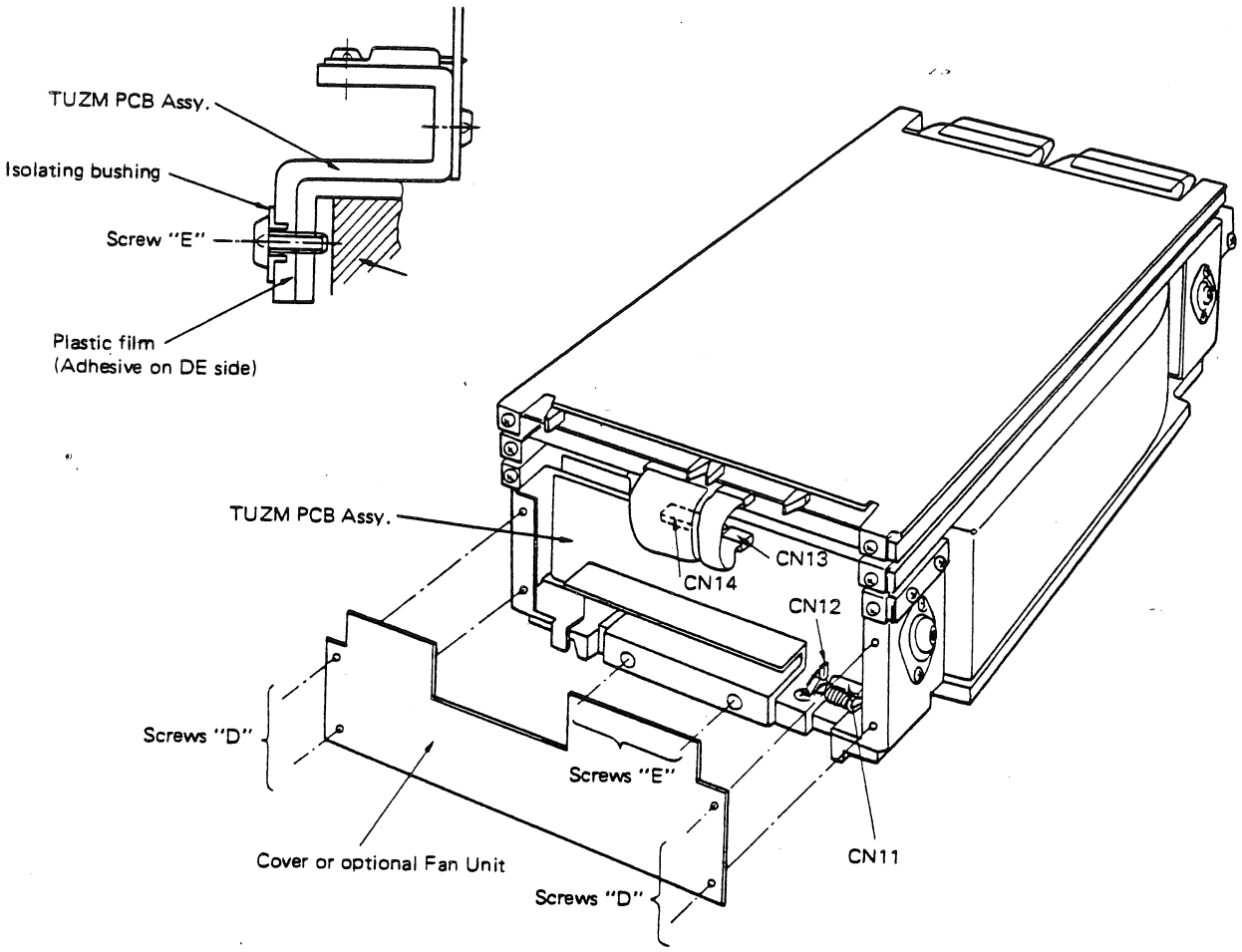
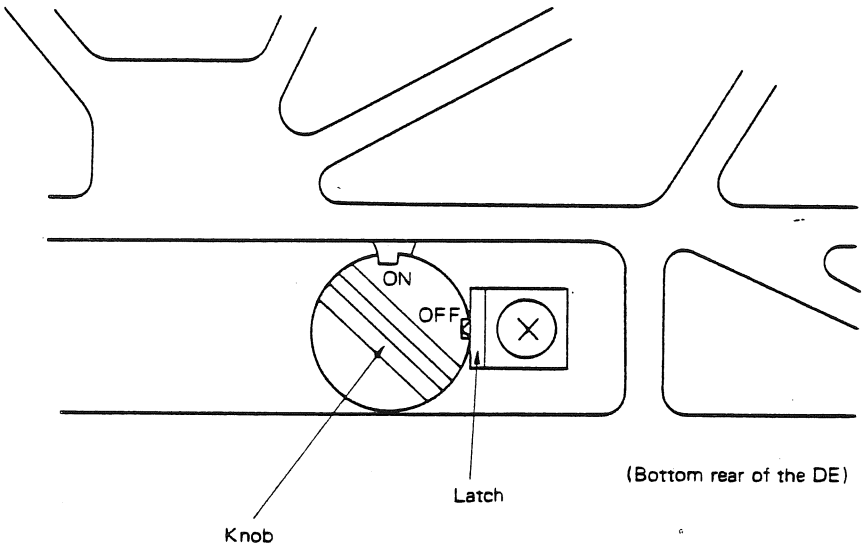
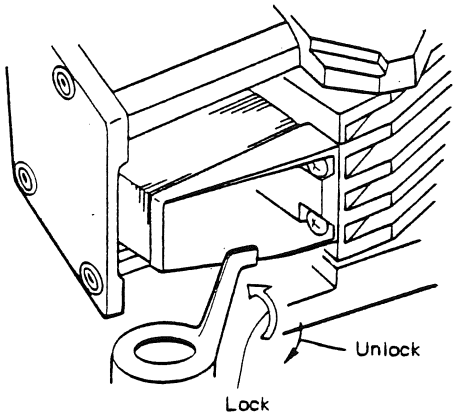


Figure 4-5 TUZM PCB Assembly Replacement





Note: Turn the knob manually or with a coin and check that the cover portion of the latch gears with the concavo portion.

ON : Lock
OFF: Unlock

Figure 4-6 Locking/Unlocking the Actuator

4.3 Securing the Unit

In installing the unit, it is important that an unit does not touch any other hard parts such as mounting plate, etc, when operating as well as non-operating (both storage and shipping).

To use this purpose, the unit is provided screw holes on Q side and S side (refer to Figure 4-2).

The holes are used to secure the unit to the mounting frame during shipment. Figure 4-7 shows an example of securing the unit.

Moreover, in a effective way, the holes are used to attach some elastic materials for the stopper. The stopper plays a part as a shock absorber. And keeping a suitable clearance, the stopper protects not only a device but also rubber shock-isolators from damage. Figure 4-8 shows recommended form of the stopper. This stopper is effective when operating as well as non-operating, and needless to remove after shipping.

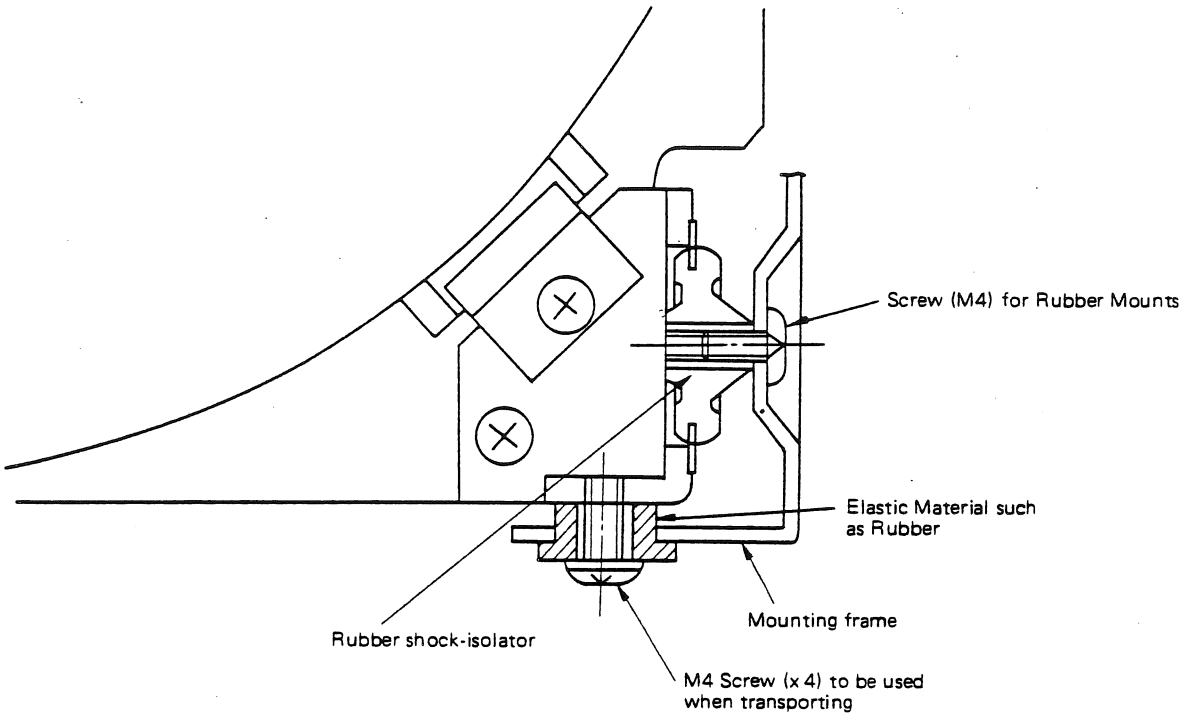
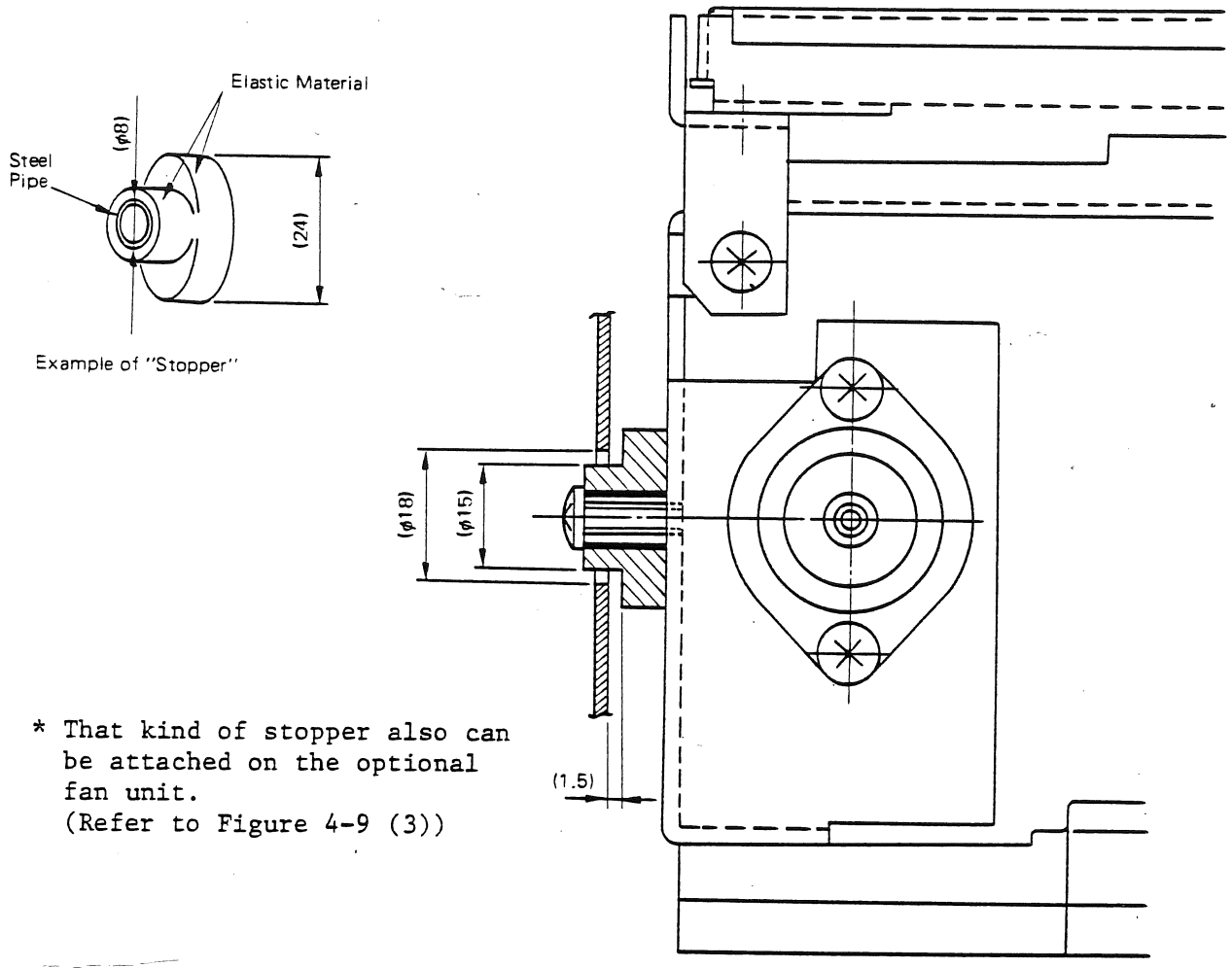


Figure 4-7 Securing the Unit



* That kind of stopper also can be attached on the optional fan unit. (Refer to Figure 4-9 (3))

Figure 4-8 Form of the Stopper

Figure 4-9 shows the dimensions of the screw holes.

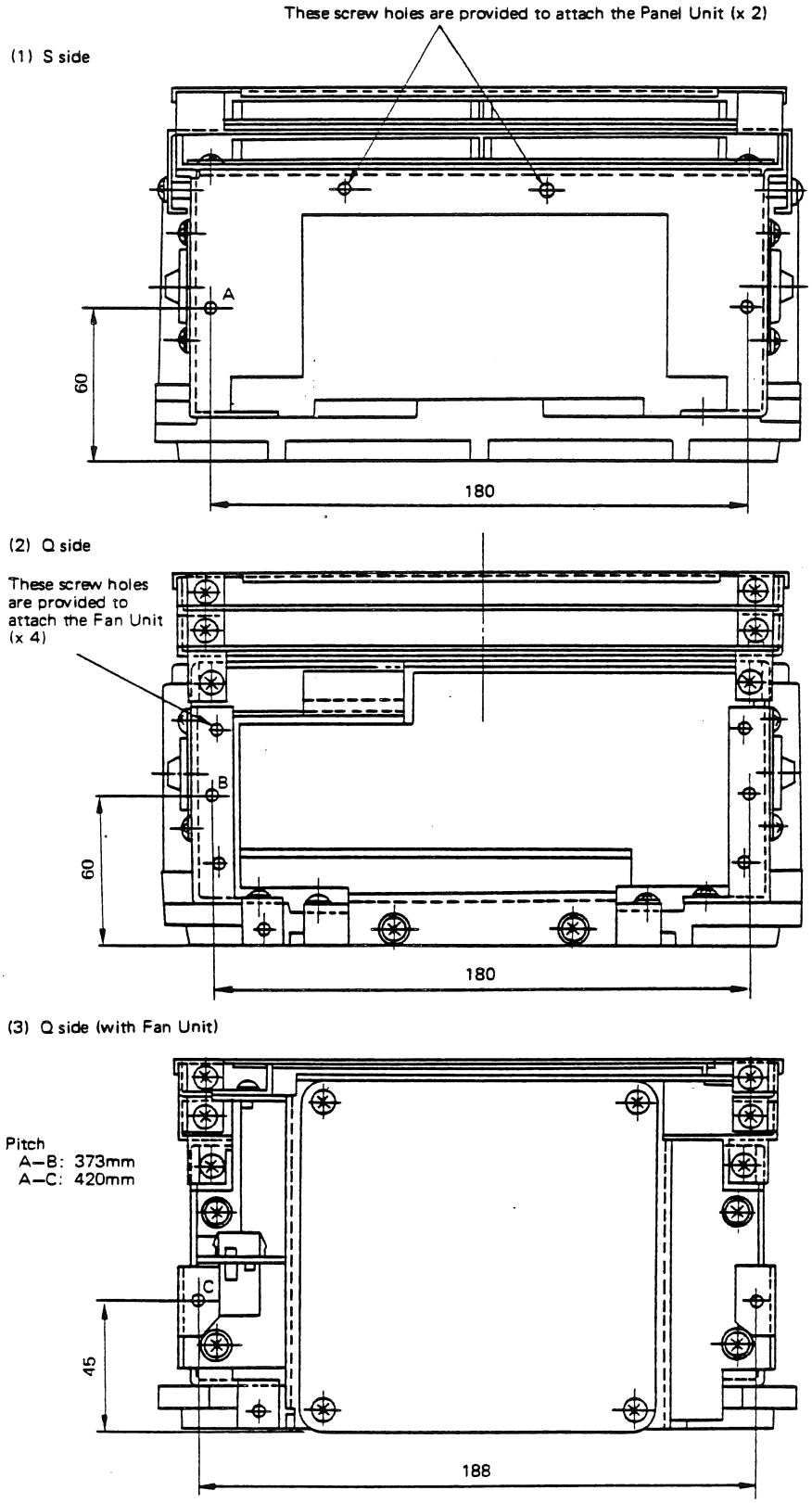


Figure 4-9 Dimensions of the Screw Holes

4.4 Cooling

This unit requires some means of cooling, since there is no internal blower motor.

Figure 4-10 shows the recommended air flow posture.

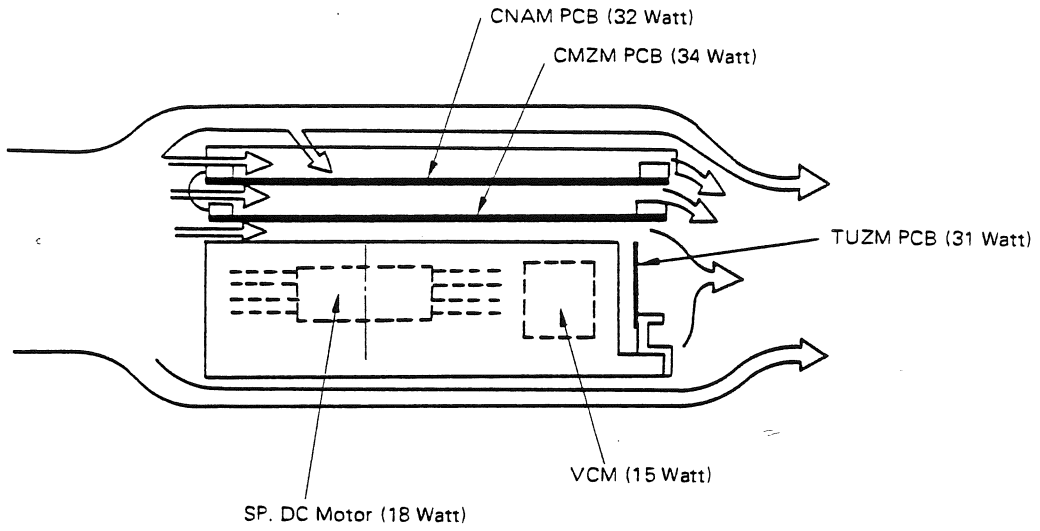


Figure 4-10 Recommended Air Flow Posture

* For this purpose, an optional fan unit is available.
  This fan unit will removes the generated heat most effectively.
  (Refer to 6.1)

The cooling condition can be confirmed by taking the surface temperature of some ICs and heat sinks.

The following IC's surface temperature must be kept under the temperature listed on the table 4-1.

Table 4-1 Thermal Check Point

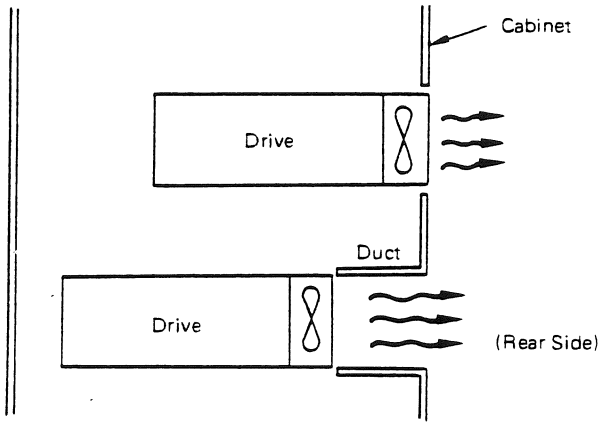
Part No.	On board	Maximum surface temperature (Tc)
M165 (Linear IC)	CNAM PCB	85°C
Q28 (-5.2V Tr)	CMZM PCB	85°C
Q9 (Power Tr)	TUZM PCB	80°C
Aluminum base (bottom surface)	DE	55°C

* At random seeking

* Even on max. environment temperature (40°C).

Figure 4-11 shows some examples of cooling installation.

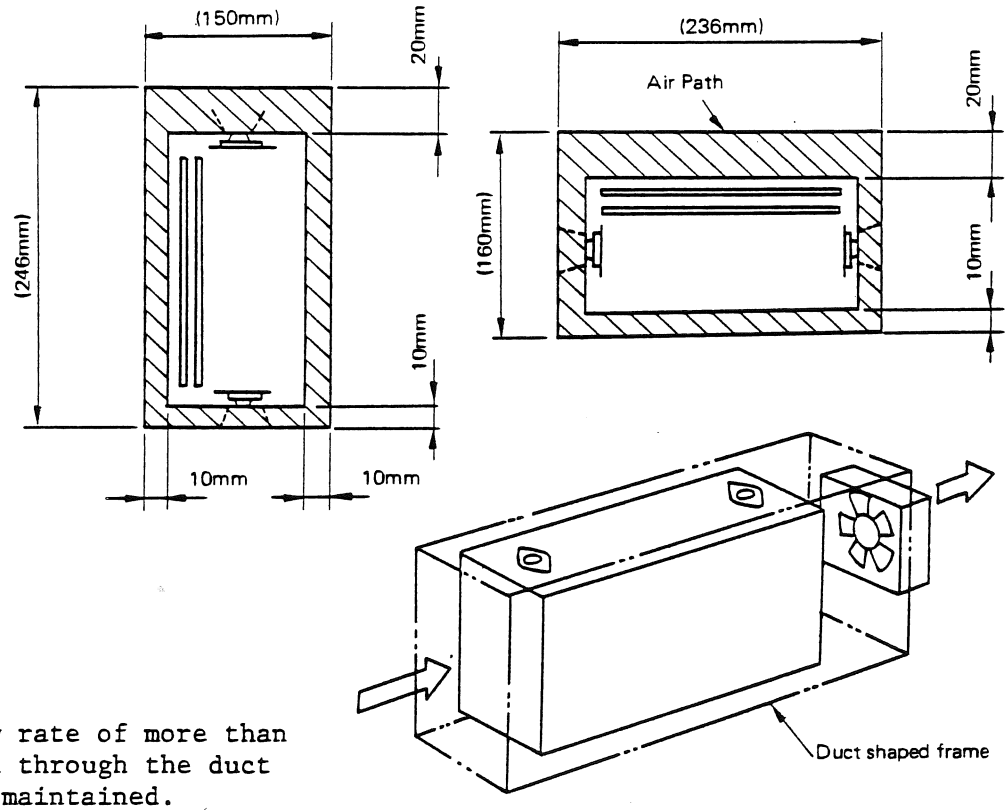
° Using optional fan unit



* Warmed air must be exhausted directly out of the cabinet.

° Without optional fan unit

We recommend that the installation frame is shaped like a duct and the cooling air flow path is illustrated as follows:



* Air flow rate of more than 1 m^3/min through the duct must be maintained.

Figure 4-11 Examples of Installation Cooling

4.5 Cabling

4.5.1 Connectors On Unit Side

Figure 4-12 shows the mounting positions of connectors on the unit side.

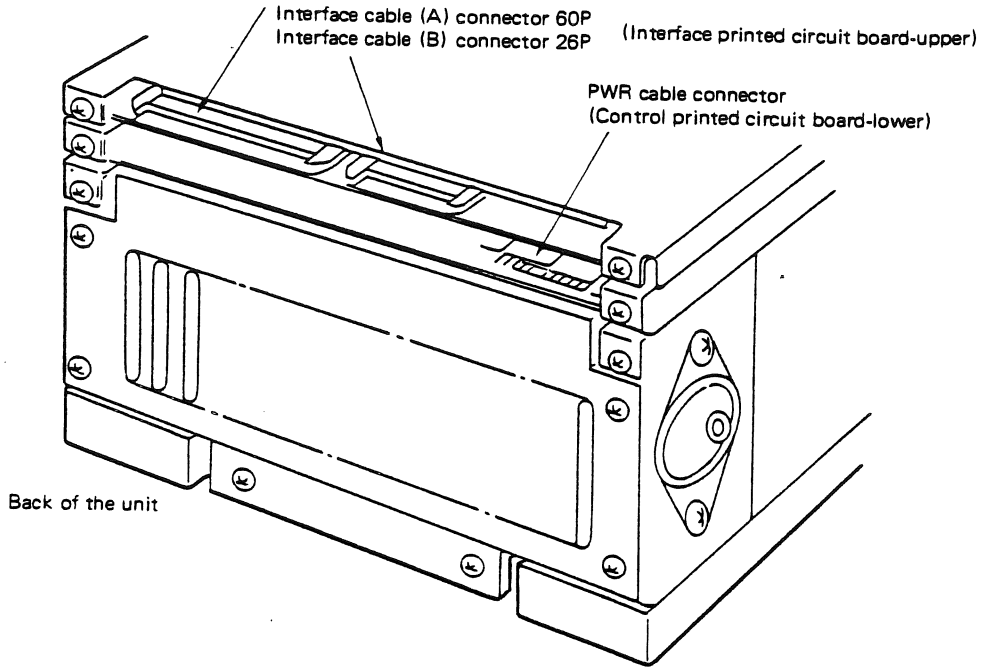


Figure 4-12 Mounting Positions of Connectors

Cables connected to this unit include interface cable (A) 60P, interface cable (B) 26P, and power cable (three types).

* The connectors for the power cable consist of two 7P connectors, while the cable side also requires two 7P connectors.

See Item 4.5.2.

4.5.2 Power Cable Connection

This unit use the DC power source only. The following shows the connector specification on the unit side, recommended specifications on the cable side, and correspondence between pin assignment and voltages.

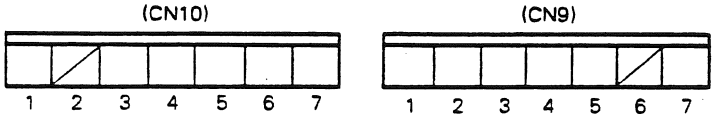
Specification on the unit side

Header C63L-0820-0008 (2420-07A-G manufactured by MOLEX)
(7P) × 2 units

Recommended specifications on the cable side

- Housing : MOLEX 2139-7
  (7P) × 2 units
- Contact : MOLEX 2478-GL
  (12 units)
- Key : MOLEX 2560-1
  (2 units)

Pin assignment and voltages



(CN10)		(CN9)	
1 0V	(-12V RTN)	1 +5V	
2 (Key)		2 +5V	
3 0V	(-12V RTN)	3 0V	(+24V RTN)
4 -12V		4 0V	(+24V RTN)
5 -12V		5 +24V	
6 0V	(+5V RTN)	6 (Key)	
7 0V	(+5V RTN)	7 +24V	

Note: 1) Use AWG 18 as the cable material.
2) The cable length must be less than 1.5m.

Also, if the power supply (option: B14L-5105-0070A) is used, the following power cable is provided.

Specification: B660-0625-T327A

Specify the length of the power cable as follow:

[For 50 cm (example)]

B660-0625-T327A	#L500R0
Cable specification	500 (mm)

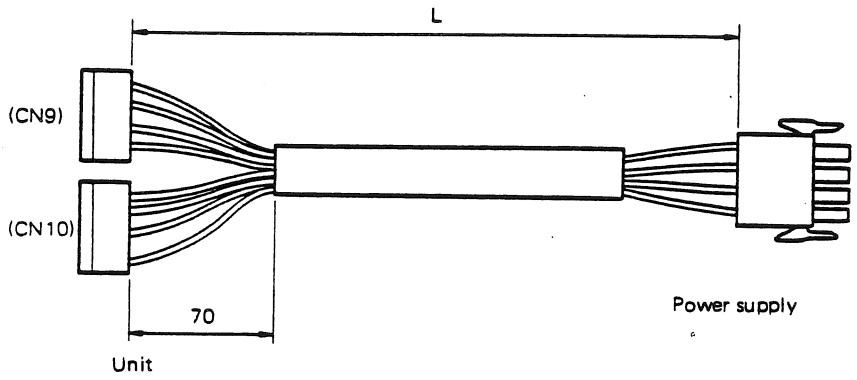


Figure 4-13 Power Cable

4.5.3 Interface Cabling

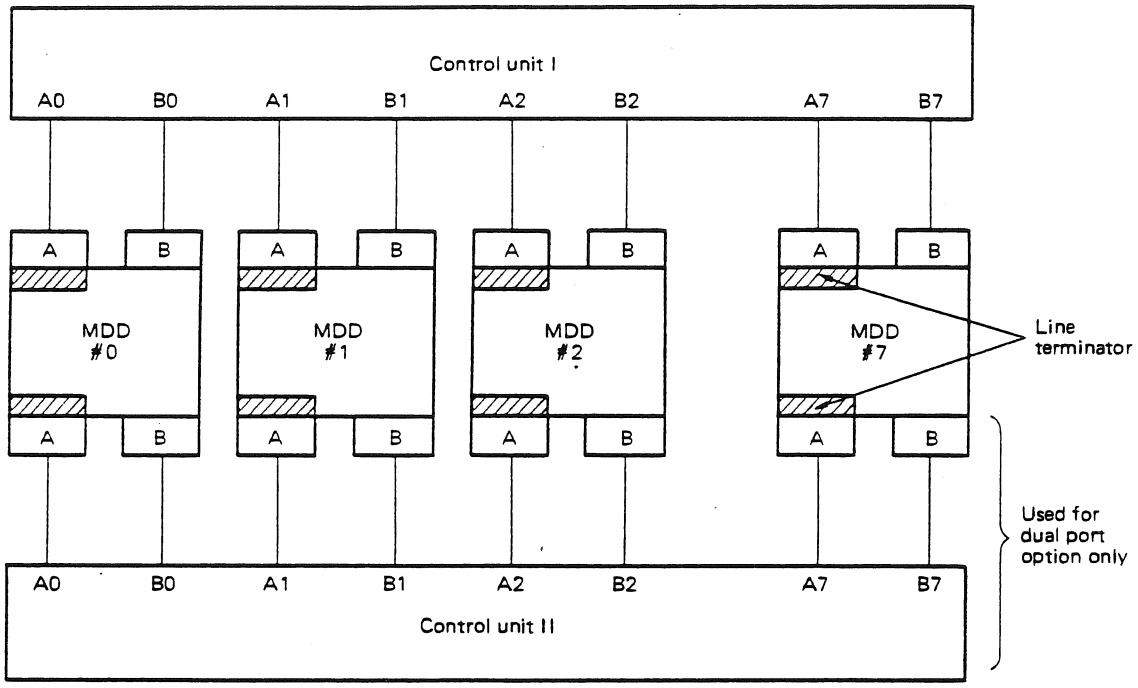
Interface cables include cable A (60P) for control signals and cable B (26P) for data signals.

(1) Cabling

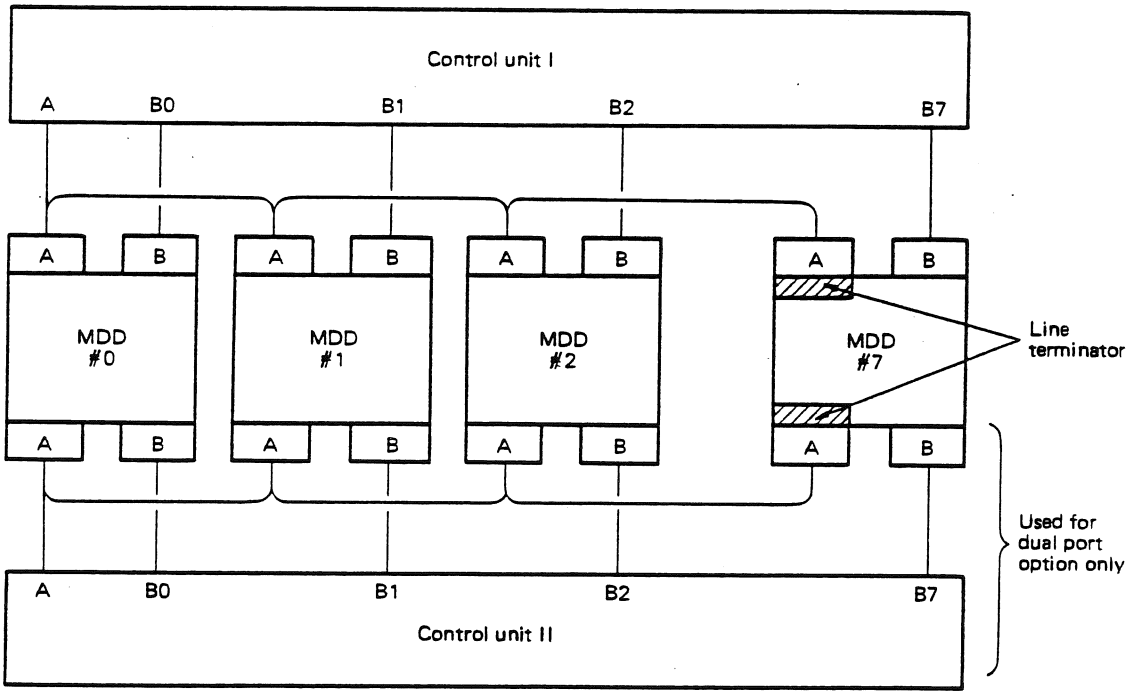
Interface cables may be connected to the system in the star-chain mode or the daisy-chain mode, as shown in Figure 4-14. For the star-chain mode, the Line Terminator resistor packs for cable A is necessary for every device to be connected. For the daisy chain mode, only the last device requires the Line Terminator.

The unit sides of cables A and B do not have polarizing keys, insert them in accord with the traingular marks (with 1 pin indication) shown in Figure 4-15. Then, lock them from both sides with the locking lever.

If an optional fan unit is used, fix cables A and B at the upper section of the fan unit, as shown in Figure 6-1.



a) Star-chain cabling



b) Daisy-chain cabling

Figure 4-14 System Interface Cabling

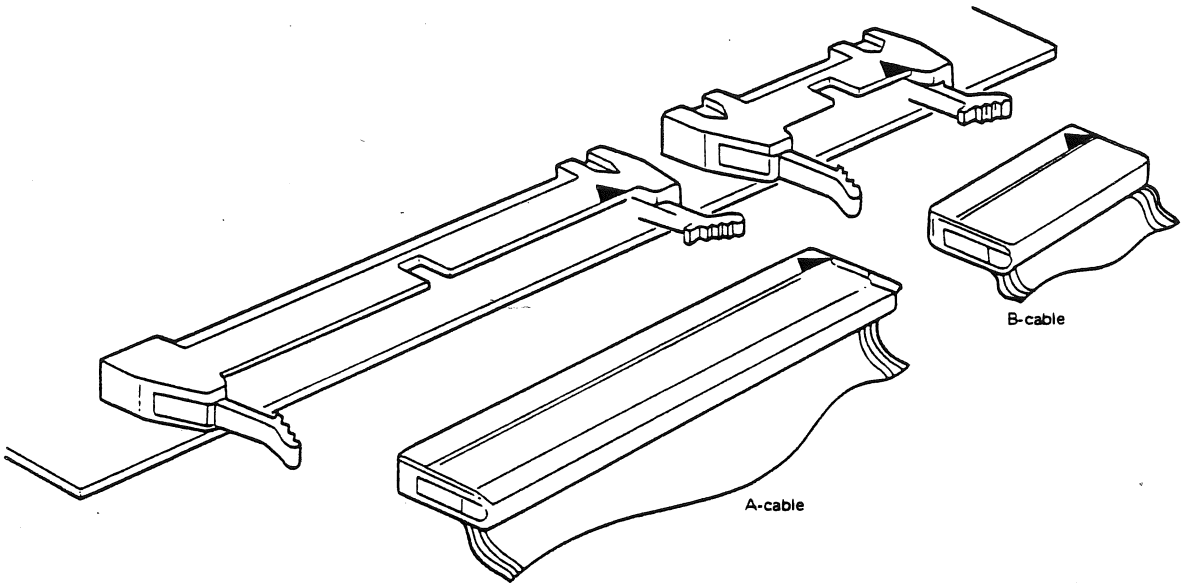


Figure 4-15 Interface Cabling

(2) Cable Termination

In daisy-chain configuration, A-cable signals must be terminated at the last disk drive with four module-resistors as shown in Figure 4-10. Four module-resistors are attached with all disk drives, therefore four module-resistors should be removed on the disk drive which the line termination is not necessary.

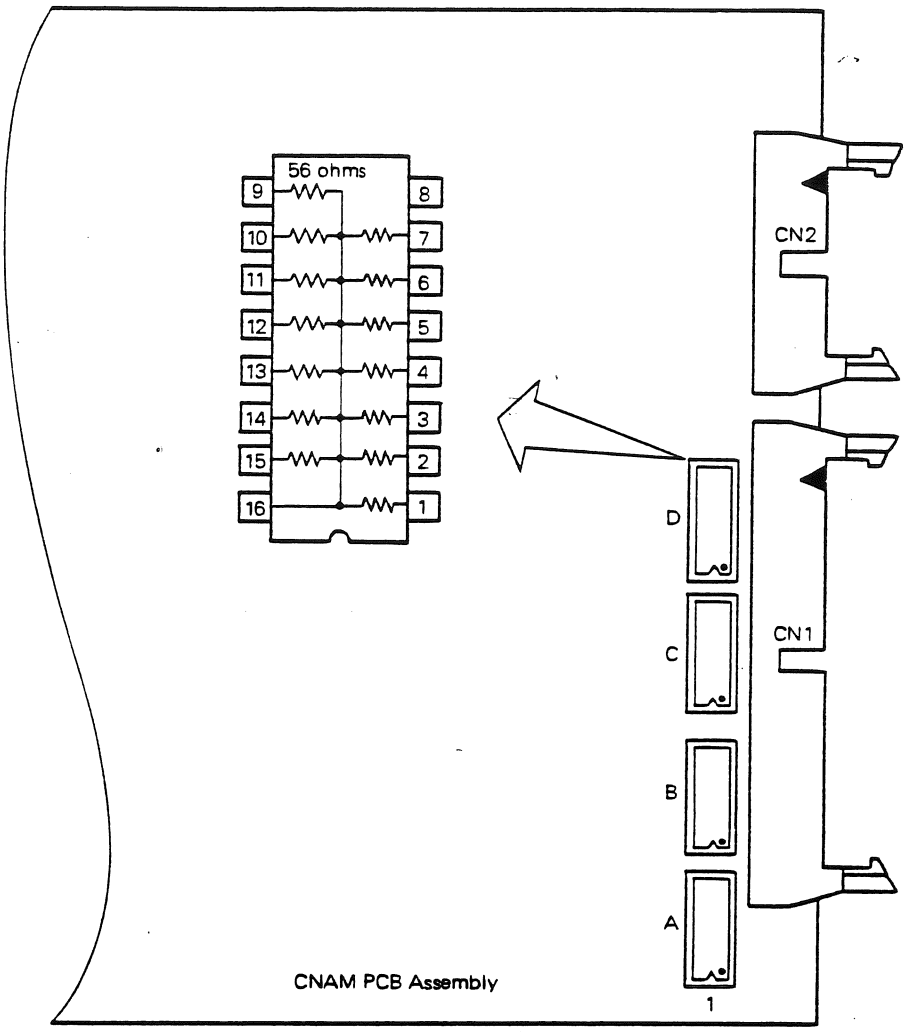


Figure 4-16 Cable Termination

4.5.4 System Grounding

(1) This drive unit is uniformly grounded in the signal ground (SG). If the FG and SG connection is required on the system, use the SG tap at the back of the unit as shown in Figure 4-17.

Also, the optional fan unit is grounded in the FG. In principle, the SG (drive) is separated from the FG (fan unit) with the insulating bushing when it is attached to the drive unit.

In this case, the grounding cable may be connected as shown in Figure 4-18, if it is required.

(2) The FG and SG terminals are provided with the optional power supply unit as shown in Figure 6-2. Connecting or disconnecting between FG and SG on the power supply unit can be performed according to system power distribution and system ground requirement.

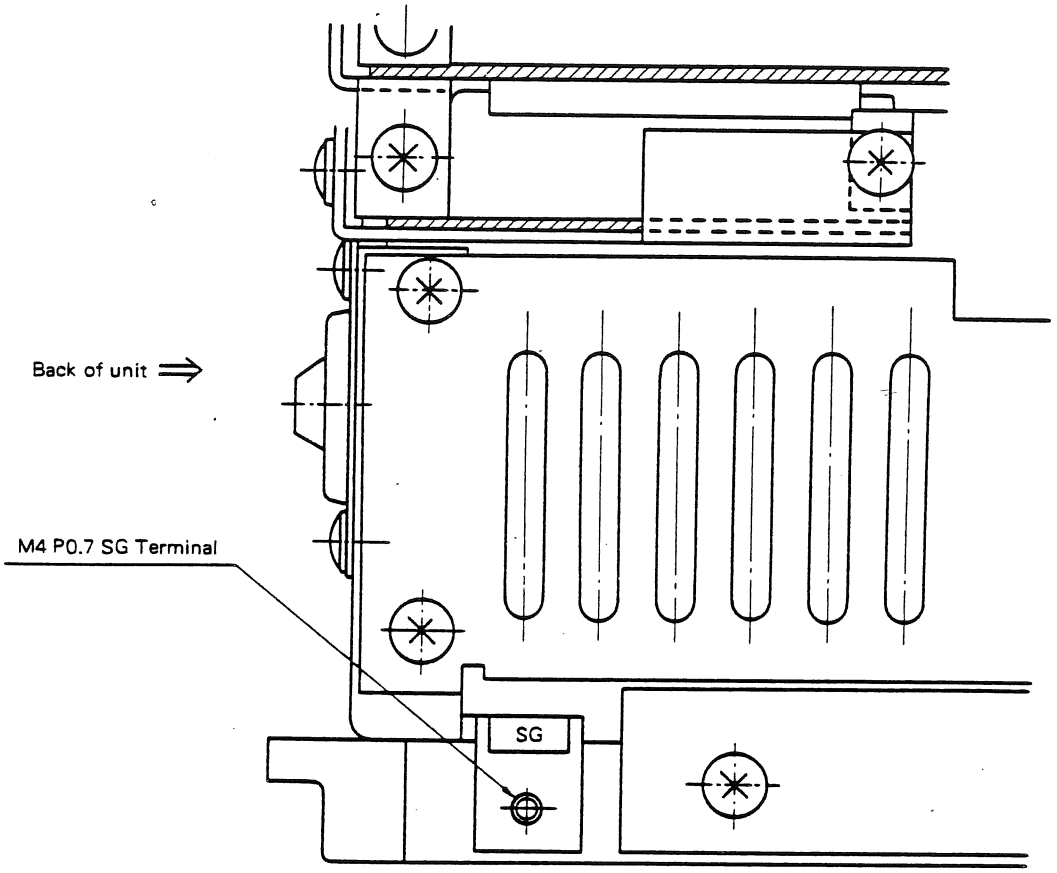


Figure 4-17 SG Terminal

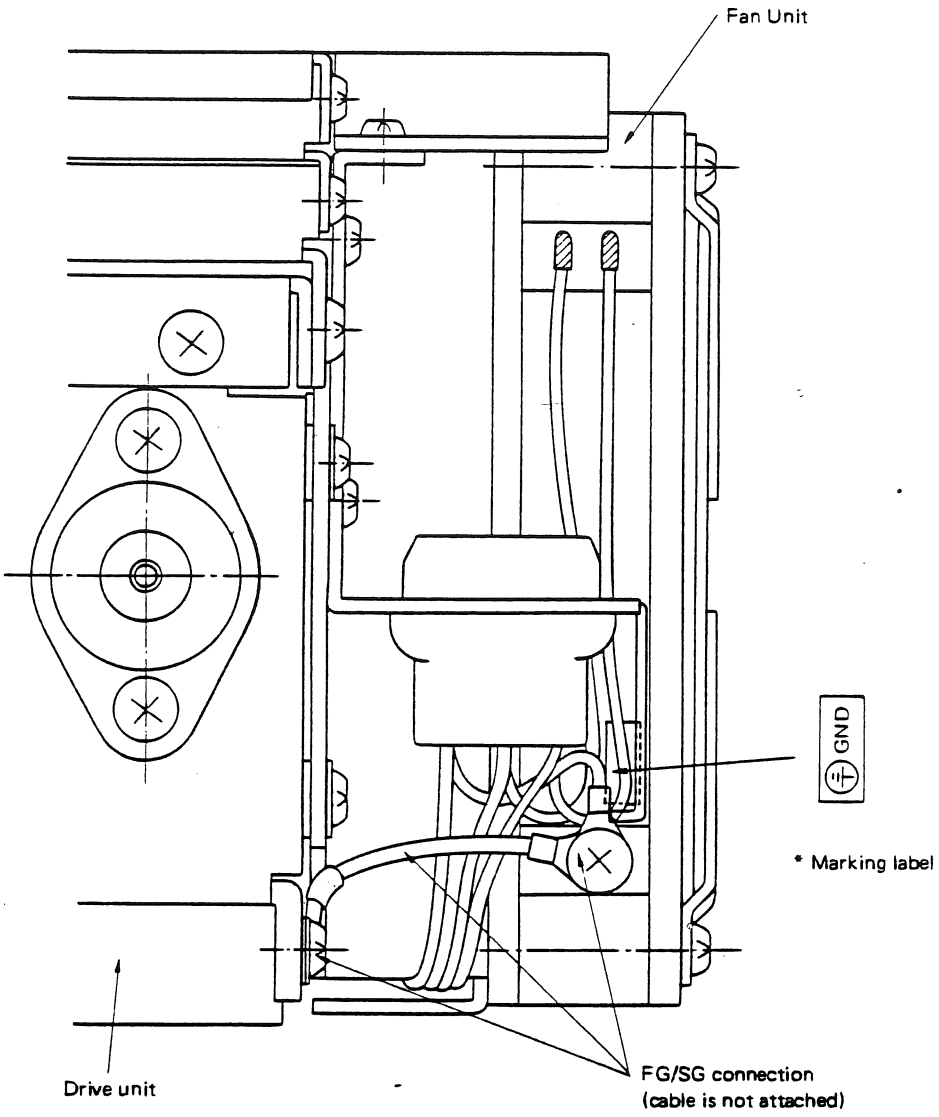


Figure 4-18 FG/SG Connection

5. INTERFACE

5.1 Introduction

5.1.1 Purpose

This specification describes the logical and physical signal transfer within the interface of M2311/M2312 micro-disk drive (hereafter called MDD).

5.1.2 Application

This specification is applicable to the following models:

(a)	M2311	48.2MB	1.229MB/s	3,600rpm
(b)	M2312	84.4MB	1.229MB/s	3,600rpm

5.1.3 Connection

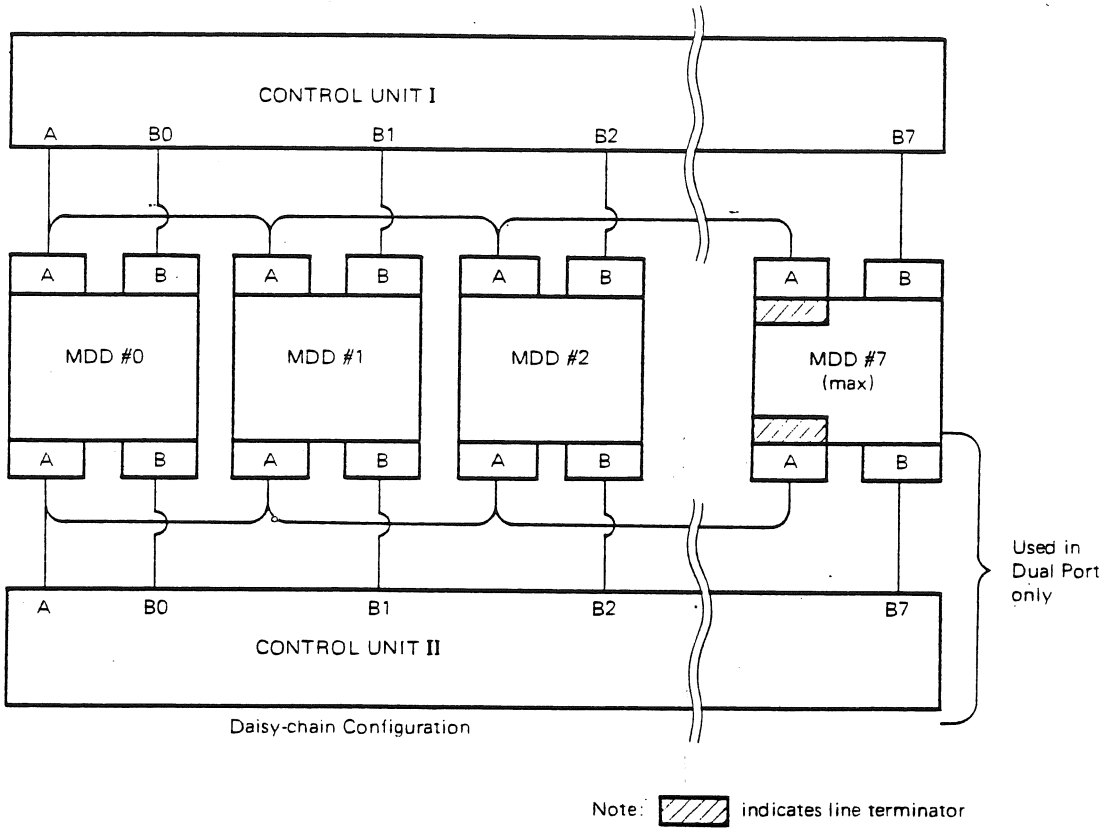
The interface connection between MDD and the control unit consists of two connectors "A" and "B". A cables, which are connected with connector "A", may be connected in a daisy-chain configuration. A line terminator must be inserted into the "A" connector of the last MDD. B cables, which are connected with connector "B", are connected in a radial configuration. "A" cables can also be connected in a radial configuration. Refer to Figure 5-1.

5.1.4 Timing Specification

Timings are specified at the connector position of the MDD unless otherwise specified. Accordingly, it is necessary for signal timings to consider both the delay time of the interface cables (approximately 5ns/m) and the circuits of the disk control unit.

5.1.5 Interface Transmission Level

Transmitters and receivers SN75110/SN75107, the industry standard, are used between the MDD and the disk control unit. Refer to Section 5.7 for details.



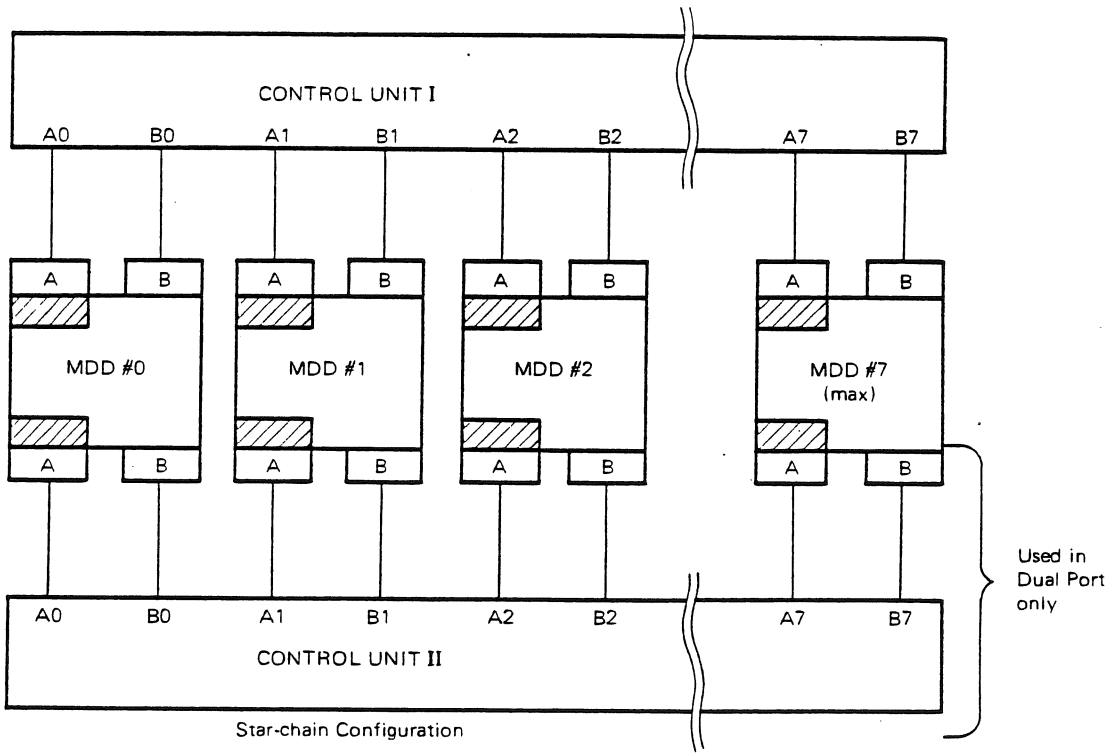


Figure 5-1 Connection to the Control Unit

5.2 Operation

5.2.1 General Description

Two M231X Micro Disk Drive can be horizontally mounted in a 19 inch rack with optional mounts hardware. The M231X may also be built into a system cabinet and mounted horizontally or vertically. An operator panel (with slide rails) is available.

The CNAM Printed-Circuit-Board Assembly in the M231X Micro Disk Drive is equipped with Maintenance Aid LED's and File Protect switch.

Powering up/down and the functions of the internal installed indicators (LED) and switches will be described in this section. The functions of the LED's and switches on the optional operator panel will also be described.

5.2.2 Powering up/down

The M231X Micro Disk Drive is not equipped with a power ON/OFF switch. Powering up/down of the M231XK's typically performed by a powering up/down of the system.

When the disk unit is equipped with an optional power supply, powering up/down may be performed by turning the power switch ON and OFF at the power supply.

5.2.3 Control and Indicators

5.2.3.1 Operator Panel (option)

The functions of the LED's and switches or optional operator panel (front panel) is described below.

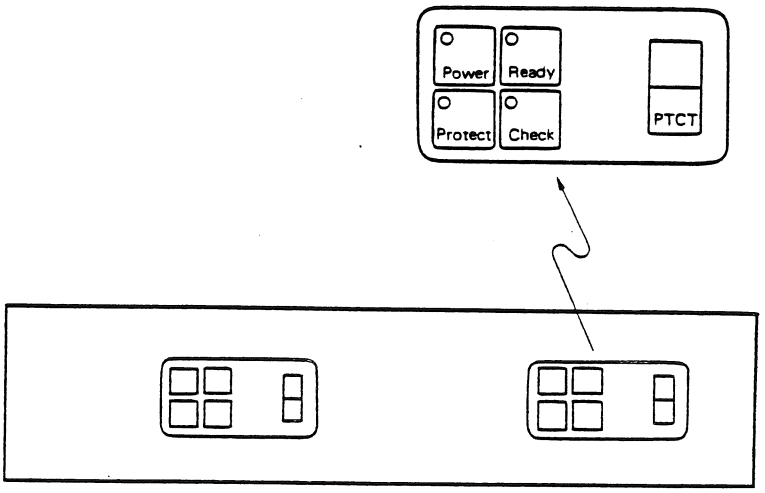


Figure 5-2 Operator Panel (Optional)

(1) Power indicator: Red

This LED lights when the power is turned on.

(2) Ready indicator: Red

This LED indicates the initial seek has performed or indicates the termination of a Seek or RTZ operation.

(3) Check indicator: Red

This LED indicates any fault condition.

(4) Protect indicator: Red

This LED indicates that writing is inhibited.

(5) Protect (PTCT) switch: White

This key inhibites the write operation.

(6) Check clear switch: Gray (flat key)

This key resets a Device Check status.

5.2.3.2 CNAM PCB Assembly

The unit contains fault display indicator (LED's) and File-protect switch as shown Figure 5-3. These are location on CNAM PCB.

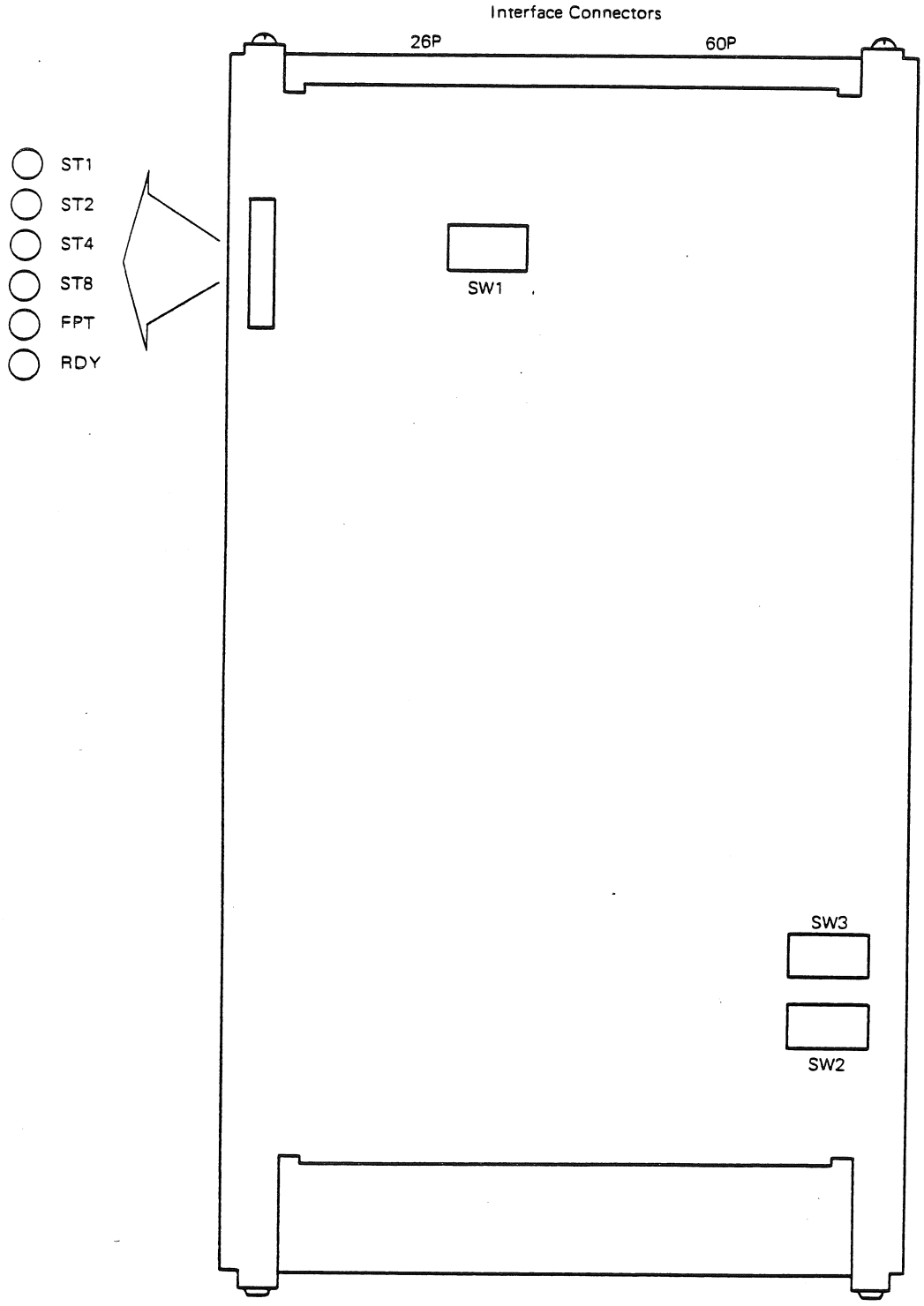


Figure 5-3 Fault Display Location On CNAM PCB

(1) FPT (File Protect) switch: SW1-Key 7

This switch inhibits the write operation. When an optional panel is installed on the drive, the switch should be in the OFF position.

(2) RDY (Ready) indicator: Green

This RDY LED indicates that the initial seek has been performed or indicates the termination of a Seek or RTZ operation.

(3) FPT (File Protect) indicator: Red

This LED indicates that writing is inhibited.

(4) ST1 to ST8 (Status 1 to 8) LEDs: Red

Fifteen fault statuses are visible by binary code as shown in Table 5-1.

Table 5-1 Fault Indicator

Status Bit				Code (Hex)	Fault Status	
ST8	ST4	ST2	ST1		Fault	Description
0	0	0	1	1	DC motor failure (DMFL)	indicates spindle motor failure.
0	0	1	0	2	VCM over heat (VCMHT)	indicate VCM over-heating.
0	0	1	1	3	Initial seek time out (INTMOT)	indicates initial seek has terminated with time-out.
0	1	0	0	4	Control check 1 (CTCK1)	indicates that a Read/Write command was issued during busy status.
0	1	0	1	5	Control check 2 (CTCK2)	indicates that write gate was issued during a fault condition.
0	1	1	0	6	Read/write check 1 (RWCK1)	indicates that write gate was issued during off-track.
0	1	1	1	7	Read/write check 2 (RWCK2)	indicates that write current did not flow to the head during a Write operation.
1	0	0	0	8	Read/write check 3 (RWCK3)	indicates that write gate was issued during File-Protected status.
1	0	0	1	9	Read/write check 4 (RWCK4)	indicates that write gate was issued during a multi-head-selected status.
1	0	1	0	A	Time-out (TMOT)	indicates that seek or RTZ sequence was not terminated within 500 ms.
1	0	1	1	B	Seek guard band (SEKGB)	indicates that a guard band was detected during a direct seek operation.
1	1	0	0	C	Linear mode guard band (LNMGB)	indicates that a guard band was detected during a linear mode.
1	1	0	1	D	RTZ outer guard band (RTOGB)	indicates that an outer guard band was detected during an RTZ operation.
1	1	1	0	E	Over-shoot check (OVSHT)	indicates that the head over-shoot the new cylinder address during settling time.
1	1	1	1	F	Illegal cylinder check (ILCYL)	indicates that an illegal cylinder address (>588) was issued by the controller.

5.2.3.3 CMZM PCB assembly

The CMZM PCB assembly is shown in Figure 5-4.

Three LEDs are located on the CMZM PCB assembly as follows:

ACDM (Orange): This LED indicates that accelerate Mode in DC motor control is activated. The LED comes on at power on and stays on continuously until the spindle has reached its nominal rotational value of 3600 RPMs, ±2%, (Approx. 20 sec). At this point the DC motor control changes to inertia mode for approximately 67 MSCC, and the LED goes out. As the spindle speed decreases to within 2% of 3600 RPMs, the DC motor control again activates accelerate mode for approximately 33 MSCC, and the LED comes on.

SPGD (Orange): This LED indicates that the spindle speed is within +6% of nominal rotational speed. This LED will not come on until approximately 20 seconds after power on.

PWRDY (Green): This LED indicates that +5V, -12V, +24V and internal +12V are within the nominal voltage.

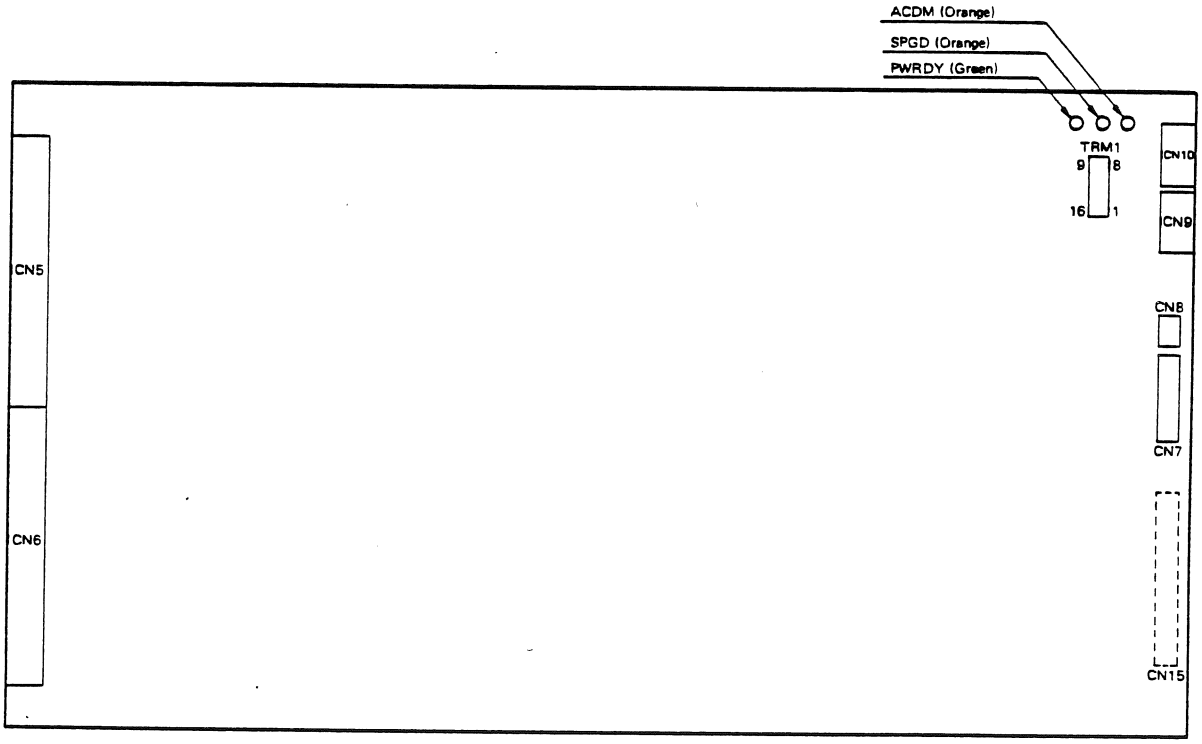


Figure 5-4 CMZM PCB Assembly

5.2.4 Power Supply

The optional power supply may be provided with the M231XK. The front view of the power supply is shown in Figure 5-5.

5.2.4.1 Main Line Switch

This switch controls application of site AC power to the power supply. Turning on the switch applies power to an optional fan unit and DC Power to the disk drive.

5.2.4.2 Indicators (LEDs)

(1) Power On LED

The Power On LED indicates that AC input is applied to the power supply.

(2) Power Alarm LED

The power alarm indicates the following mul-function has occurred on the power supply:

- +5 VDC: Over-current, Over-voltage and Non-voltage
- -12 VDC: Over-current and Non-voltage
- +24 VDC: Over-current and Non-voltage
- Over heat within the power supply
- AC Output to the fan: Over-current

5.2.4.3 Device Alarm

The Device Alarm indicates that the thermal switch has been closed on an optional fan.

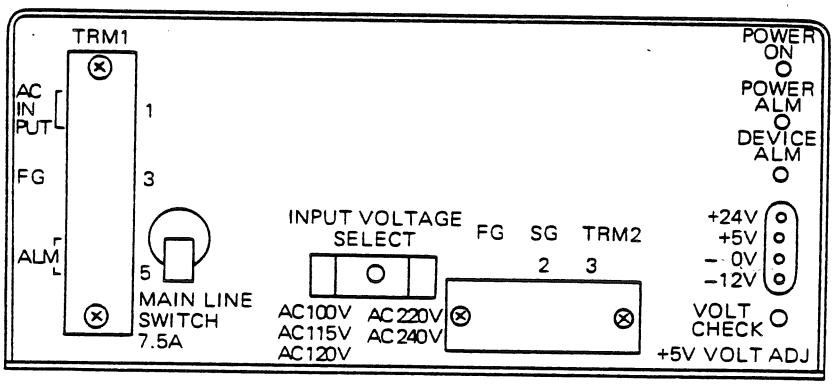


Figure 5-5 Front View of Power Supply Unit

5.2.5 Mode Select Settings

When the M231X Micro Disk Drive is installed in the system, the customer must set switch 1 through 3 according to system requirements; these switches determine, Disk Logical Unit Number, Sector Mode, Tag 4/5 Enable, File Protect and Sector Counting, Switch 1 through Switch 3 is located on the CNAM PCB Assembly, as shown in Figure 5-6.

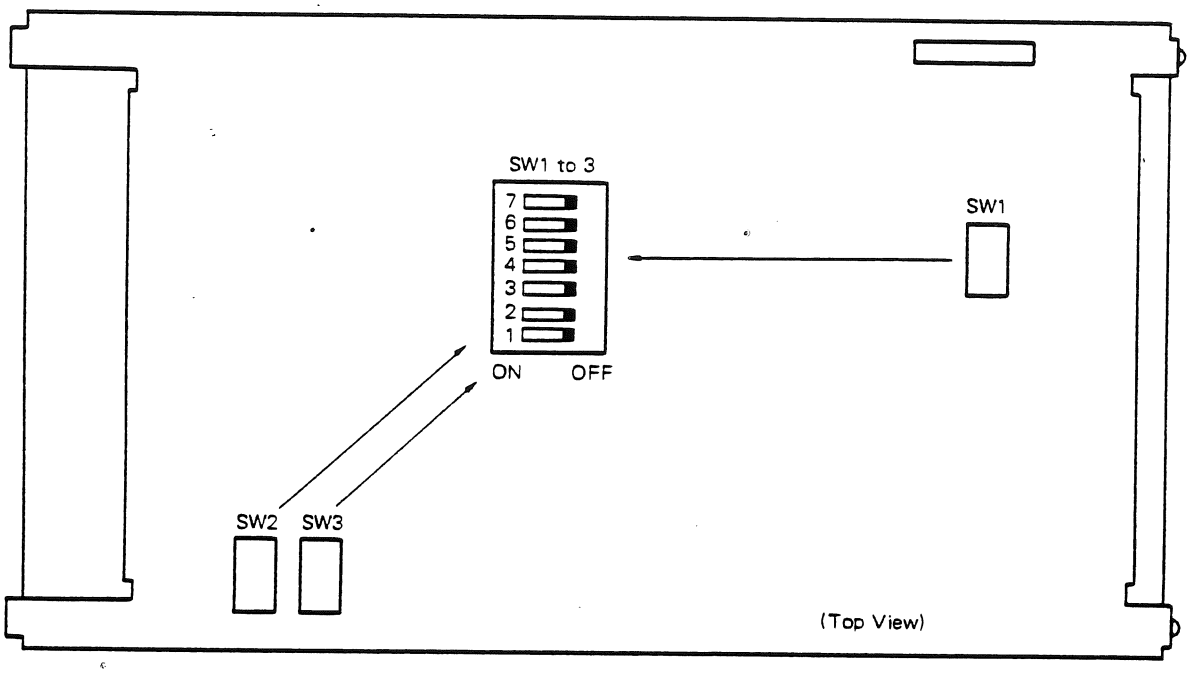


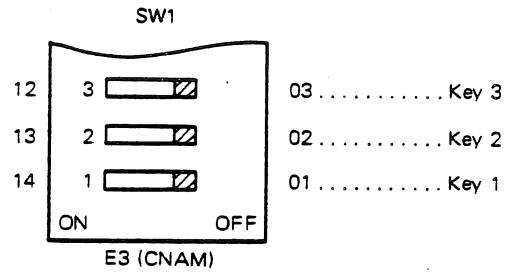
Figure 5-6 Mode Select Switch Location

5.2.5.1 Disk Addressing

Disk Logical Unit Number 0 to 7 is selected by SW1 at location E3 on the CNAM PCB assembly. Set the desired disk address with the three keys on SW1 using the binary code as shown in Table 5-2.

Table 5-2 Disk Addressing

Disk Address	Key 1	Key 2	Key 3
	2^1	2^2	2^3
0	OFF	OFF	OFF
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	OFF	ON
5	ON	OFF	ON
6	OFF	ON	ON
7	ON	ON	ON



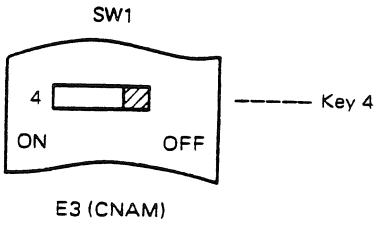
5.2.5.2 Device Type

The device type, M2311 or M2312, can be selected by setting Key 4 on SW1.

NOTE: Tag 4/5 feature must be enabled to obtain device type status.

Table 5-3 Device Type

Device Type	Key 4
M2311	OFF
M2312	ON

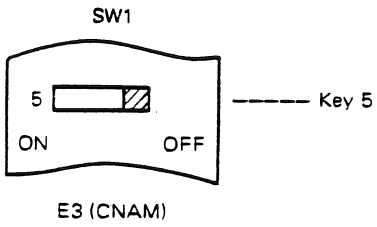


5.2.5.3 Tag 4/5 Enable

The M231XK provides optional Tag 4 and Tag 5 functions. The customer may disable or enable these optional functions using Key 5 on SW1 at location E3 on the CNAM PCB assembly. Refer to Table 5-4. Disabling the Tag 4 and Tag 5 functions inhibits the receivers of Tag 4 and Tag 5 receivers on the interface.

Table 5-4 Tag 4/5 Enable

Tag 4/5	Key 5
Disable	OFF
Enable	ON



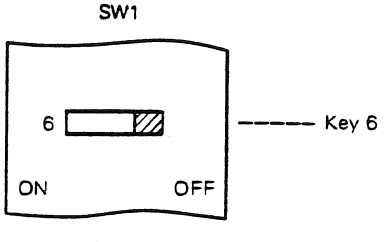
5.2.5.4 Sector Mode

The customer can select Hard Sector mode (1 to 128 sectors) or Variable Soft Sector mode, using Key 6 on SW1 at location E3 on the CNAM PCB assembly according to Table 5-5.

In the case of Hard Sector, the customer must set the number of sectors per disk revolution as described in 5.2.5.6 Sector Counting. Setting the number of sectors per revolution is also available in the Variable Soft Sector mode.

Table 5-5 Sector Mode

Sector Mode	Key 6
Hard Sector	OFF
Variable Soft Sector	ON

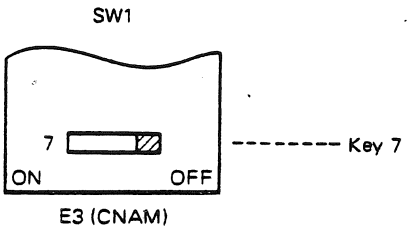


5.2.5.5 File Protect

When the customer desires to inhibit the write operation, the File Protect key may be set to the On position, using Key 7 on SW1 at location E3 on CNAM PCB assembly. Refer to Table 5-6.

Table 5-6 File Protect

File Protect	Key 7
Enable writing	OFF
Disable writing	ON



5.2.5.6 Sector Counting

Sector count configuration switches SW2 and SW3 are located at A26 and A24 respectively on the CNAM PCB assembly. Each key of SW2 and SW3 represents the binary powers of the Byte Clock as shown in Table 5-7.

Table 5-7 Sector Counting Keys

SW2 Key No.	Value	SW3 Key No.	Value
1	1	1	128
2	2	2	256
3	4	3	512
4	8	4	1024
5	16	5	2048
6	32	6	4096
7	64	7	8192

EXAMPLE
(Calculations for 9 Sectors)

(1) $\frac{20,480}{\text{Number of sectors}} = \frac{\text{Number of bytes}}{\text{per sector}}$ $\qquad \frac{20,480}{9} = 2,275.555$

EXAMPLE
(Calculations for 9 Sectors)

(2) If the above calculation results in a remainder, truncate the remainder and add one to the integer portion of "number of bytes per sector". 2,275 + 1 = 2,276

(3) Configure SW2 and SW3 to "number of bytes per sector" minus one to allow for sector counter reset clock. 2,276 - 1 = 2,275

2,275 = 2,048 + 128 + 64 + 32 + 2 + 1

Key # 5 ... 1 (SW3) 7 6 2 1 (SW2)

(4) To determine how many by bytes (if any) the last sector of each track will be short, multiply "number of bytes per sector" by "number of sectors" and subtract 20,480.

2,276 × 9 = 20,484
-20,480
Last sector short 4 bytes

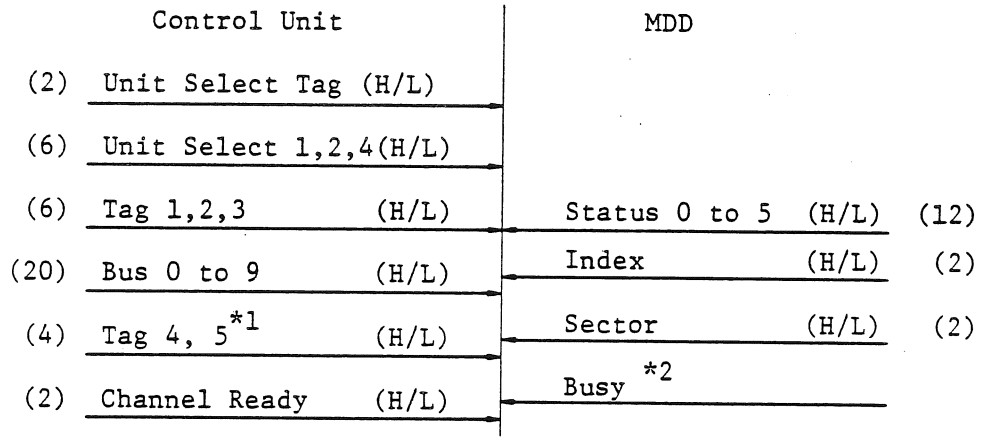
Table 5-8 Commonly Used Sector Counting

NO.OF SECTORS	S2	S3	BYTE/SECT	LAST SECTOR SHORT
	1 2 3 4 5 6 7	1 2 3 4 5 6 7		
4	1 1 1 1 1 1 1	1 1 1 0 0 1 0	5,120	0
8	1 1 1 1 1 1 1	1 1 0 0 1 0 0	2,560	0
12	0 1 0 1 0 1 0	1 0 1 1 0 0 0	1,707	-4
16	1 1 1 1 1 1 1	1 0 0 1 0 0 0	1,280	0
24	1 0 1 0 1 0 1	0 1 1 0 0 0 0	854	-16
32	1 1 1 1 1 1 1	0 0 1 0 0 0 0	640	0
64	1 1 1 1 1 1 0	0 1 0 0 0 0 0	320	0
128	1 1 1 1 1 0 0	1 0 0 0 0 0 0	160	0

NOTE: Refer to Table 5-5 for more detailed sector selection

5.3 Type of Signal Lines

5.3.1 A Cable Signal Lines



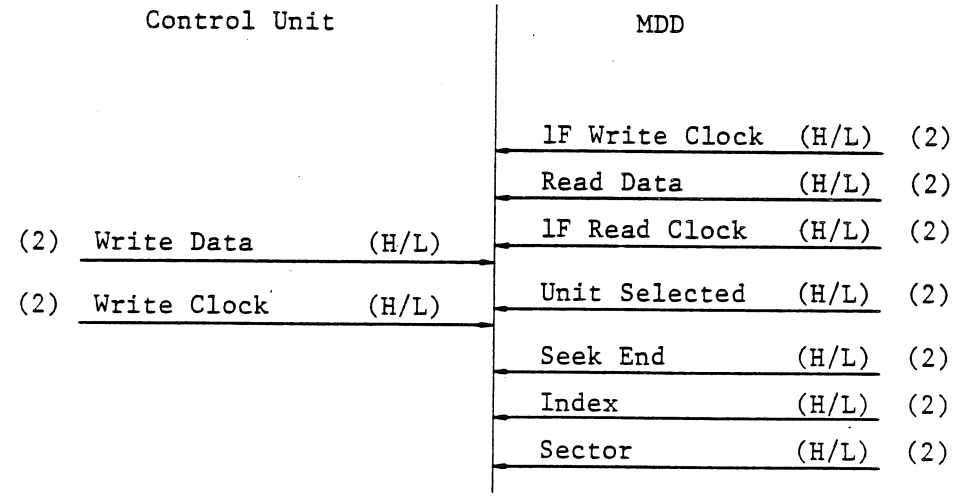
40 Lines

16 or (18) for dual port Lines

Total: 56 or (58) Lines for dual port

*Note: 1) Functions of Tag 4 and Tag 5 can be disabled. See section 5.3.1.
2) Busy signals are used only when the dual port option is used.

5.3.2 B Cable Signal Lines



4 Lines

14 Lines

Total: 18 Lines

5.4 Description of Signal Lines

5.4.1 A Cable Input Signals

(1) Unit Select Tag

This signal gates Unit Select 1, 2, 4 and is used to select the desired MDD. Refer to Figure 5-5 for timings.

(2) Unit Select 1, 2, 4

These three signals are binary coded to select the desired disk and are validated by the leading edge of Unit Select Tag. The MMD Logical Unit Number is selectable on a PCB by setting a DIP switch. LUN's of 0 to 7 are selectable.

(3) Tag/Bus

The contents of the 10-bit bus, defined by Tag 1, 2 and 3, are shown in Table 5-1.

Table 5-9 Tag/Bus Lines

BUS	Tag 1 Cylinder Address	Tag 2 Head Address	Tag 3 Control Select	Unit Select Tag
0	1	1	Write Gate	
1	2	2	Read Gate	
2	4	4	Servo Offset Plus	
3	8	-	Servo Offset Minus	
4	16	-	Fault Clear	
5	32	-	AM Enable	
6	64	-	RTZ	
7	128	-	-----	
8	256	-	-----	
9	512	-	Release *	Priority Select *

* Note: Used only with Dual Port option.

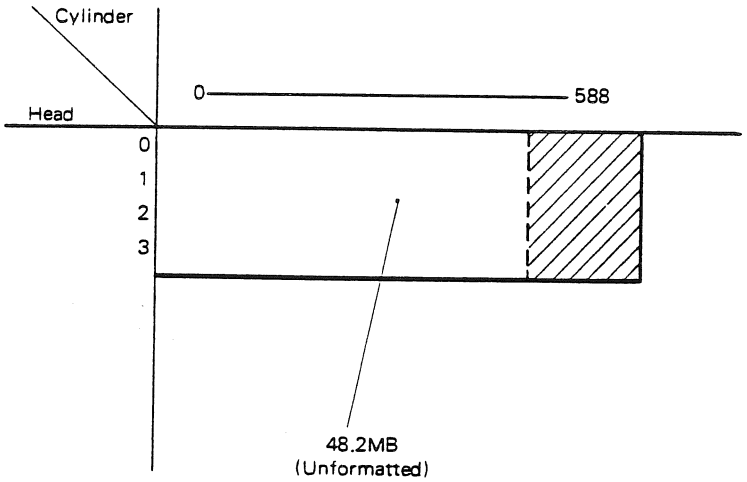


Figure 5-7 M2311 Cylinder/Head Addressing

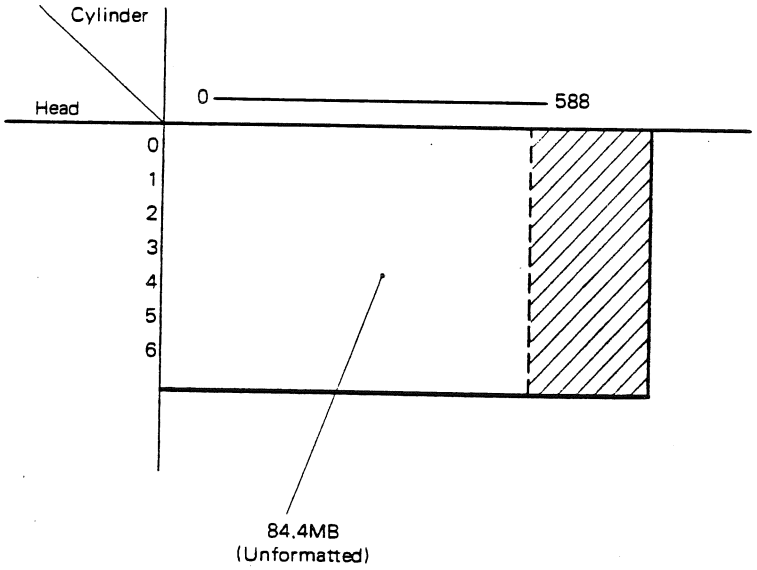


Figure 5-8 M2312 Cylinder/Head Addressing

(3) - 1 Cylinder Address (Tag 1)

The cylinder address is gated by the leading edge of Tag 1, and the contents of bus lines (Bus 0 to 9) are set in the cylinder address register of the MDD. The bus lines must be stable prior to Tag 1, and must be stable throughout Tag 1. Refer to Figures 5-6 and 5-7.

(3) - 2 Head Address (Tag 2)

The head address is gated by the leading edge of Tag 2, and the contents of bus lines (Bus 0 to 2) are set in the head address register of the MDD. The bus lines must be stable prior to Tag 2 and must be stable throughout Tag 2. Refer to Figures 5-8 and 5-9.

(3) - 3 Control Select (Tag 3)

Bus lines (0 to 9) enabled by Tag 3 have a different meaning in each bit. All signals are defined as control signals.

(a) Write Gate (Bus Bit 0)

This signal enables the write operation on the specified track/sector. This signal is validated under the following conditions:

Unit Ready	True
On Cylinder	True
Seek End	True
Seek Error	False
Fault	False
File Protect	False
Offset	False

If Write Gate is turned on in cases other than the above-mentioned conditions, Fault occurs and writing is inhibited. Refer to the definition of Fault.

(b) Read Gate (Bus Bit 1)

This signal is used to read data from the specified track/sector. Refer to the definition of Read Gate, Read Data and 1F Read Clock.

(c) Offset Plus (Bus Bit 2)

This signal is used to recover an error and the head is offset 2 - 3 μm in an outward direction. The unit will issue On Cylinder and Seek End signals to the controller when the operation is completed. Refer to Figure 5-10.

(d) Offset Minus (Bus Bit 3)

This signal is used to recover an error and the head is offset 2 - 3 μm in an inward direction. The unit will issue On Cylinder and Seek End signals to the controller when the operation is completed. Refer to Figure 5-10.

(e) Fault Clear (Bus Bit 4)

This signal clears the Fault status; however, if sources of a fault still exist, this status is not cleared. Refer to Figure 5-11.

(f) AM Enable (Bus Bit 5)

The AM (Address Mard) Enable, in conjunction with Read or Write Gate, is used in a variable sector format. When Write Gate and AM Enable are simultaneously set, AM is written. Refer to Figure 5-23.

When Read Gate and AM Enable are simultaneously set, the disk read circuit searches AM, and when it encounters 3 bytes of DC-erased area, the unit will issue the Address Mark Found signal to the controller. Refer to Figure 5-24.

(g) Return to Zero (RTZ) (Bus Bit 6)

No matter where the access heads are located on the disk, they are returned to cylinder zero and head zero by the RTZ signal. This signal clears Seek Error.

(h) Release (Bus Bit 9)

Asserting this command will release Channel Reserve and Unconditionally Reserve in the drive, making alternate channel access possible after selection by the other channel ceases.

If the customer desires to function with Release Timer feature using Release Timer switch on the optional Dual Port PCB assembly, release will occur 500 ms (nominal) following the deselection of the drive. Refer to Figure 5-4 and Figure 5-5.

(4) Priority Select (Unit Select Tag-Bus Bit 9: Dual Port)

When the control unit issues Unit Select Tag and Bus Bit 9 with specified disk address, the disk drive will be unconditionally selected and absolutely reserved by the channel issuing this command providing both channels are enabled and a priority select condition does not exist on the opposite channel.

Once the drive is unconditionally reserved by Priority Select command, the respective channel has exclusive access to the drive. The opposite channel can access only after Release command has been issued by the selected channel. Refer to Figure 5-5.

When the drive is unconditionally reserved, all interface signals are inhibited on the opposite channel including Unit Selected and Busy signals.

(5) Tag 4/5 (Optional)

The function of these signals can be inhibited by a switch in the unit. These signals gate additional information on Status 0 to 5 lines of the A Cable. Refer to Figure 5-13.

(6) Channel Ready

This signal is used to prevent damage to the file caused by interface disturbances when control unit power is lost. Therefore, this signal must be true when the controller is available and must be off before logic levels decay at the interface when a power failure of the controller occurs. Refer to Figure 5-17. Unit Select is impossible when Channel Ready is false.

5.4.2 A Cable Output Signals

(1) Status 0 to 5

The status 0 to 5 lines are determined by the logical combination of Tag 4 and Tag 5 signals as in Table 5-2.

Table 5-10 Status Lines Determined by Tag 4/5

Tag 4	False	True	False	True
Tag 5	False	False	True	True
Status	Unit Status	Sector Count Status	Fault Status	Device Type
0	Unit Ready	Sector Address 1	Control Check 1	Device Type 1
1	On Cylinder	2	2	2
2	Seek Error	4	Read/Write Check 1	4
3	Device Check	8	2	8
4	File Protected	16	3	16
5	AM Found	32	4	32

Must be defined for this drive what bits are section reset of M2311 or M2312.

* Note: Tag 4 and Tag 5 can be inhibited by the Tag 4 and Tag 5 disable switch in the unit. When Tag 4 and Tag 5 are disabled, Status 0 to 5 lines indicate Unit Status only.

(a) Unit Status (Unit must be selected)

1) Unit Ready

This signal is set on when initial seek is completed and goes false when the power is turned off.

2) On Cylinder

This signal is set on along with Unit Ready and it is cleared by the next seek or RTZ instruction. It is again turned on along with Seek End of the B calbe when a Seek or RTZ operation is completed. However, it may not be ture if a Seek Error occurs.

3) Seek Error

This signal indicates that a Seek or RTZ operation ended abnormally. In this case, On Cylinder may not be set but B cable Seek End will be set on. The Seek Error is cleared by an RTZ instruction. The conditions for such error status are as follows:

- RTZ or Seek did not complete within specified time.
- An illegal cylinder address was specified.
- The heads were moved to a position outside of the recording area.

4) Fault

This signal indicates that a fault condition exists in the unit. Fault conditions are defined as follows:

Control Check 1 (Fault Status 0 by Tag 5)

- Read/Write or Seek instruction received during Not Ready or Seek operation or Seek Error. However, a Write instruction received during Seek Error is excluded.

Control Check 2 (Fault Status 1 by Tag 5)

- Write instruction received during read operation, Offset condition or Seek Error.

Read/Write Check 1 (Fault Status 2 by Tag 5)

- The head went off track during Write operation.
- Abnormal current in VCM of the unit.
- Initial Seek terminated unsuccessfully.

Read/Write Check 2 (Fault Status 3 by Tag 5)

- Abnormal Write condition
- Write attempted during Read operation.

Read/Write Check 3 (Fault Status 4 by Tag 5)

- Write instruction received during File Protected status.

Read/Write Check 4 (Fault Status 5 by Tag 5)

- Write or Read instruction received when multiple heads are selected.

If any of the above-mentioned conditions have occured, writing is immediately inhibited and a Fault signal is issued to the controller. The Fault Status is cleared by Fault Clear (Tag 3 Bit 4).

5) File Protected

File Protected signal, enabled by a switch on the PCB assembly, indicates all tracks are in write-protected status. Attempting to write while this signal is on will cause a fault.

6) Address Mark Found

This signal is used only in variable sector mode. Address Mark Found is an 8-byte pulse which is sent to the controller after the recognition of a 3-byte DC-erased area on the specified tracks when the AM Read instruction is received. Refer to Figure 5-24.

(b) Sector Count Status (by Tag 4)

This signal is used in fixed sector mode and valid when the number of sectors per track is less than 64. This signal is reset by the trailing edge of Index, clocked by the trailing edge of Sector and indicates the current sector address in the unit. Sector Address (Status lines 0 to 5) will be issued to the control unit.

(c) Fault Status

Refer to Item 4).

(d) Device Type (by Tag 4 and Tag 5)

This signal indicates the device selected.

Table 5-11 Device Type

	Status 5	Status 4	Status 3	Status 2	Status 1	Status 0	
	2^5	2^4	2^3	2^2	2^1	2^0	
M2311	1	0	0	0	1	0	48MB
M2312	1	0	0	0	1	1	84MB

(2) Index

This signal is a two-byte pulse which occurs once per revolution and is used for reference in Read/Write operation. The index signal is invalid during initial seek or RTZ operation. Refer to Figure 5-14 for the timings of Index and Sector.

(3) Sector

The Sector Mark, a 1 1/2 pulse which occurs 1 to 128 times per track, is derived from the Index signal and Byte Clock of the servo surface. The number of bytes per track is selected by DIP switches. Each key of the DIP switches represents binary powers of Byte Clock (2^0 - 2^{13}) as shown below.

Table 5-12 Sector Counter Switches

SW2	Number of Bytes	SW3	Number of Bytes
Key1	1	Key1	128
2	2	2	256
3	4	3	512
4	8	4	1024
5	16	5	2048
6	32	6	4096
7	64	7	8192

The following formula shows the steps to obtain the desired number of sectors.

		EXAMPLE (Calculations for 9 sectors)
(1)	$\frac{20,480}{\text{Number of Sectors}}$ = Number of Bytes per Sector	$\frac{20,480}{9} = 2,275.555$
(2)	If the above calculation results in a remainder, truncate the remainder and add one to the integer portion of "number of bytes per sector"	2,275 + 1 = 2,276
(3)	Configure SW2 and SW3 to "number of bytes per sector" less one to allow for Sector Counter Reset Clock.	2,276 - 1 = 2,275

$$2,275 = \underset{\text{Key\#}\ 5}{2048} + \underset{1}{128} + \underset{7}{64} + \underset{6}{32} + \underset{2}{2} + \underset{1}{1}$$

SW3 SW2

(4)	To determine how many bytes (if any) the last sector of each track will be short, multiply "number of bytes per sector" by "number of sectors" and subtract 20,480	2,276 x 9 = 20,484 -20,480 Last sector short 4 bytes

Therefore, the number of bytes in the last sector is

2,276 - 4 = 2,272 (bytes)

Table 5-13 shows Sector Selection.

Table 5-13 Sector Selection

Sector	SW2							SW3							Byte/ Sector	Last Sector Shorter
	1	2	3	4	5	6	7	1	2	3	4	5	6	7		
1															20,480	0
2	1	1	1	1	1	1	1	1	1	1	1	0	0	1	10,240	0
3	0	1	0	1	0	1	0	1	0	1	0	1	1	0	6,827	-1
4	1	1	1	1	1	1	1	1	1	1	0	0	1	0	5,120	0
5	1	1	1	1	1	1	1	1	1	1	1	1	0	0	4,096	0
6	1	0	1	0	1	0	1	0	1	0	1	1	0	0	3,414	-4
7	1	0	1	1	0	1	1	0	1	1	0	1	0	0	2,926	-2
8	1	1	1	1	1	1	1	1	1	0	0	1	0	0	2,560	0
9	1	1	0	0	0	1	1	1	0	0	0	1	0	0	2,276	-4
10	1	1	1	1	1	1	1	1	1	1	1	0	0	0	2,048	0
11	1	0	1	0	0	0	1	0	1	1	1	0	0	0	1,862	-2
12	0	1	0	1	0	1	0	1	0	1	1	0	0	0	1,707	-4
13	1	1	1	0	0	1	0	0	0	1	1	0	0	0	1,576	-8
14	0	1	1	0	1	1	0	1	1	0	1	0	0	0	1,463	-2
15	1	0	1	0	1	0	1	0	1	0	1	0	0	0	1,366	-10
16	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1,280	0
17	0	0	1	0	1	1	0	1	0	0	1	0	0	0	1,205	-5
18	1	0	0	0	1	1	1	0	0	0	1	0	0	0	1,138	-4
19	1	0	1	0	1	1	0	0	0	0	1	0	0	0	1,078	-2
20	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1,024	0
21	1	1	1	1	0	0	1	1	1	1	0	0	0	0	976	-16
22	0	1	0	0	0	1	0	1	1	1	0	0	0	0	931	-2
23	0	1	0	1	1	1	1	0	1	1	0	0	0	0	891	-13
24	1	0	1	0	1	0	1	0	1	1	0	0	0	0	854	-16
25	1	1	0	0	1	1	0	0	1	1	0	0	0	0	820	-20
26	1	1	0	0	1	0	0	0	1	1	0	0	0	0	788	-8
27	0	1	1	0	1	1	1	1	0	1	0	0	0	0	759	-13
28	1	1	0	1	1	0	1	1	0	1	0	0	0	0	732	-16
29	0	1	0	0	0	0	1	1	0	1	0	0	0	0	707	-23
30	0	1	0	1	0	1	0	1	0	1	0	0	0	0	683	-10
31	0	0	1	0	1	0	0	1	0	1	0	0	0	0	661	-11
32	1	1	1	1	1	1	1	0	0	1	0	0	0	0	640	0
33	0	0	1	1	0	1	1	0	0	1	0	0	0	0	621	-13
34	0	1	0	1	1	0	1	0	0	1	0	0	0	0	603	-22
35	1	0	0	1	0	0	1	0	0	1	0	0	0	0	586	-30
36	0	0	0	1	1	1	0	0	0	1	0	0	0	0	569	-4
37	1	0	0	1	0	1	0	0	0	1	0	0	0	0	554	-18
38	0	1	0	1	1	0	0	0	0	1	0	0	0	0	539	-2
39	1	0	1	1	0	0	0	0	0	1	0	0	0	0	526	-34
40	1	1	1	1	1	1	1	1	1	0	0	0	0	0	512	0
41	1	1	0	0	1	1	1	1	1	0	0	0	0	0	500	-20
42	1	1	1	0	0	1	1	1	1	0	0	0	0	0	488	-16
43	0	0	1	1	1	0	1	1	1	0	0	0	0	0	477	-31
44	1	0	0	0	1	0	1	1	1	0	0	0	0	0	466	-24
45	1	1	1	0	0	0	1	1	1	0	0	0	0	0	456	-40
46	1	0	1	1	1	1	0	1	1	0	0	0	0	0	446	-36
47	1	1	0	0	1	1	0	1	1	0	0	0	0	0	436	-12
48	0	1	0	1	0	1	0	1	1	0	0	0	0	0	427	-16
49	1	0	0	0	0	1	0	1	1	0	0	0	0	0	418	-2

1 1 1 0 0 0 1 0 0 1 0 0 0 0

35 SECTORS 583 BYTES FOR 2 x 143K = 286K

Table 5-13 Sector Selection (continued)

Sector	SW2							SW3							Byte/ Sector	Last Sector Shorter
	1	2	3	4	5	6	7	1	2	3	4	5	6	7		
50	1	0	0	1	1	0	0	1	1	0	0	0	0	0	410	-20
51	1	0	0	0	1	0	0	1	1	0	0	0	0	0	402	-16
52	1	0	0	1	0	0	0	1	1	0	0	0	0	0	394	8
53	0	1	0	0	0	0	0	1	1	0	0	0	0	0	387	-31
54	1	1	0	1	1	1	1	0	1	0	0	0	0	0	380	-40
55	0	0	1	0	1	1	1	0	1	0	0	0	0	0	373	-35
56	1	0	1	1	0	1	1	0	1	0	0	0	0	0	366	-16
57	1	1	1	0	0	1	1	0	1	0	0	0	0	0	360	-40
58	1	0	0	0	0	1	1	0	1	0	0	0	0	0	354	-52
59	1	1	0	1	1	0	1	0	1	0	0	0	0	0	348	-52
60	1	0	1	0	1	0	1	0	1	0	0	0	0	0	342	-40
61	1	1	1	1	0	0	1	0	1	0	0	0	0	0	336	-16
62	0	1	0	1	0	0	1	0	1	0	0	0	0	0	331	-42
63	1	0	1	0	0	0	1	0	1	0	0	0	0	0	326	-58
64	1	1	1	1	1	1	0	0	1	0	0	0	0	0	320	0
65	1	1	0	1	1	1	0	0	1	0	0	0	0	0	316	-60
66	0	1	1	0	1	1	0	0	1	0	0	0	0	0	311	-46
67	1	0	0	0	1	1	0	0	1	0	0	0	0	0	306	-22
68	1	0	1	1	0	1	0	0	1	0	0	0	0	0	302	-56
69	0	0	0	1	0	1	0	0	1	0	0	0	0	0	297	-13
70	0	0	1	0	0	1	0	0	1	0	0	0	0	0	293	-30
71	0	0	0	0	0	1	0	0	1	0	0	0	0	0	289	-39
72	0	0	1	1	1	0	0	0	1	0	0	0	0	0	285	-40
80	1	1	1	1	1	1	1	1	0	0	0	0	0	0	256	0
128	1	1	1	1	1	0	0	1	0	0	0	0	0	0	160	0

Notes:
1. "1" indicates that the key is set to ON side.
2. "0" indicates that the key is set to OFF side.
3. The last sector is equal or shorter than nominal sector.

(4) Busy (Dual Port Only)

If the drive is already selected and/or reserved, a Busy signal will be issued to A-cable and Unit Selected signal will be issued to B-cable to the channel attempting the select. This busy signal will remain at this status until Unit Select Tag is negated or the drive is no longer busy. Unit Selected signal should be used to enable in the control unit. Refer to Figure 5-4.

5.4.3 B Cable Input Signals

(1) Write Data

This line carries NRZ data which is to be written on the disk surface and must be synchronized with Write Clock. Refer to Figure 5-15.

(2) Write Clock

Write Clock is a return signal of 1F Write Clock issued from the unit. Refer to Figure 5-15.

5.4.4 B Cable Output Signal

(1) 1F Write Clock

This signal is used by the control unit to synchronize Write Data Clock. 1F Write Clock is available during Unit Ready Status except during read operations. However, a fluctuation of 32 bits ±3 bits could occur in the last 4 bytes of Invalid Data. Refer to Figure 5-15.

(2) Read Data

This line transmits the recovered data in the form of NRZ data synchronized with 1F Read Clock. Refer to Figure 5-16.

(3) 1F Read Clock

This line transmits 1F Read Clock. The Read Data is synchronized with 1F Read Clock. Refer to Figure 5-16. This line is valid only during a read operation.

(4) Unit Selected

When the three unit select signals (gated by the Unit Select Tag) and the logical address of the unit compare, the status signals are issued from the MMD. The Unit Selected signal activates the drivers/receivers on A-cable.

(5) Seek End

Seek End signal indicates that a Seek, RTZ or Offset operation has terminated. This signal may be used as an interrupt to the control unit.

In dual port drive, the Seek End signal sent the unselected channel will normally be constant-true. However, if while the drive is selected on a channel,

and the opposite channel receives a select command, and then the selected channel resets: the Select and Reserve latches on the drive, the Seek End signal sent to the waiting channel will go false for 30 μs.

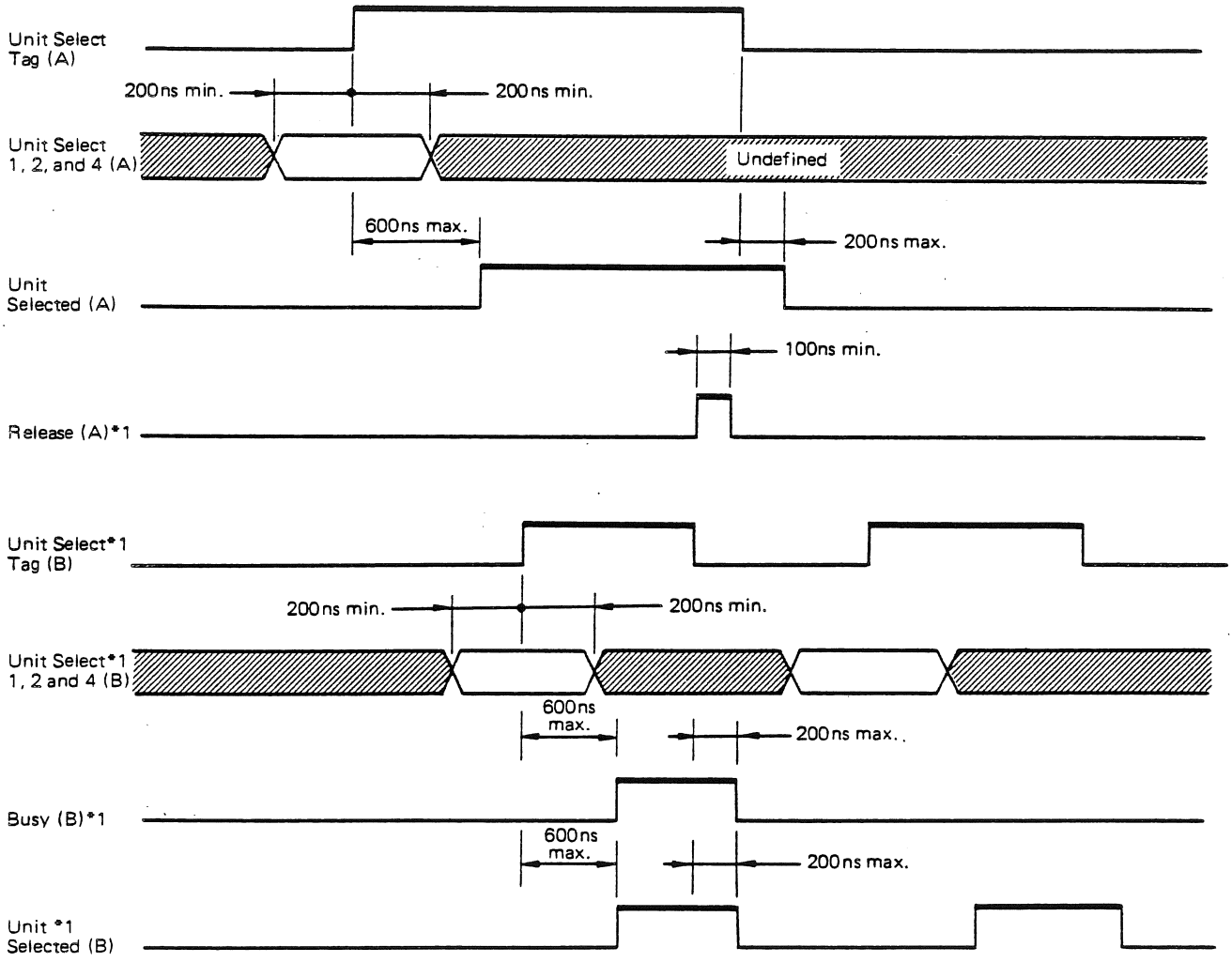
(6) Index/Sector

Exactly the same as A Cable Signals.

5.5 Timing

Polarities are defined in positive logic. The shaded area is undefined.

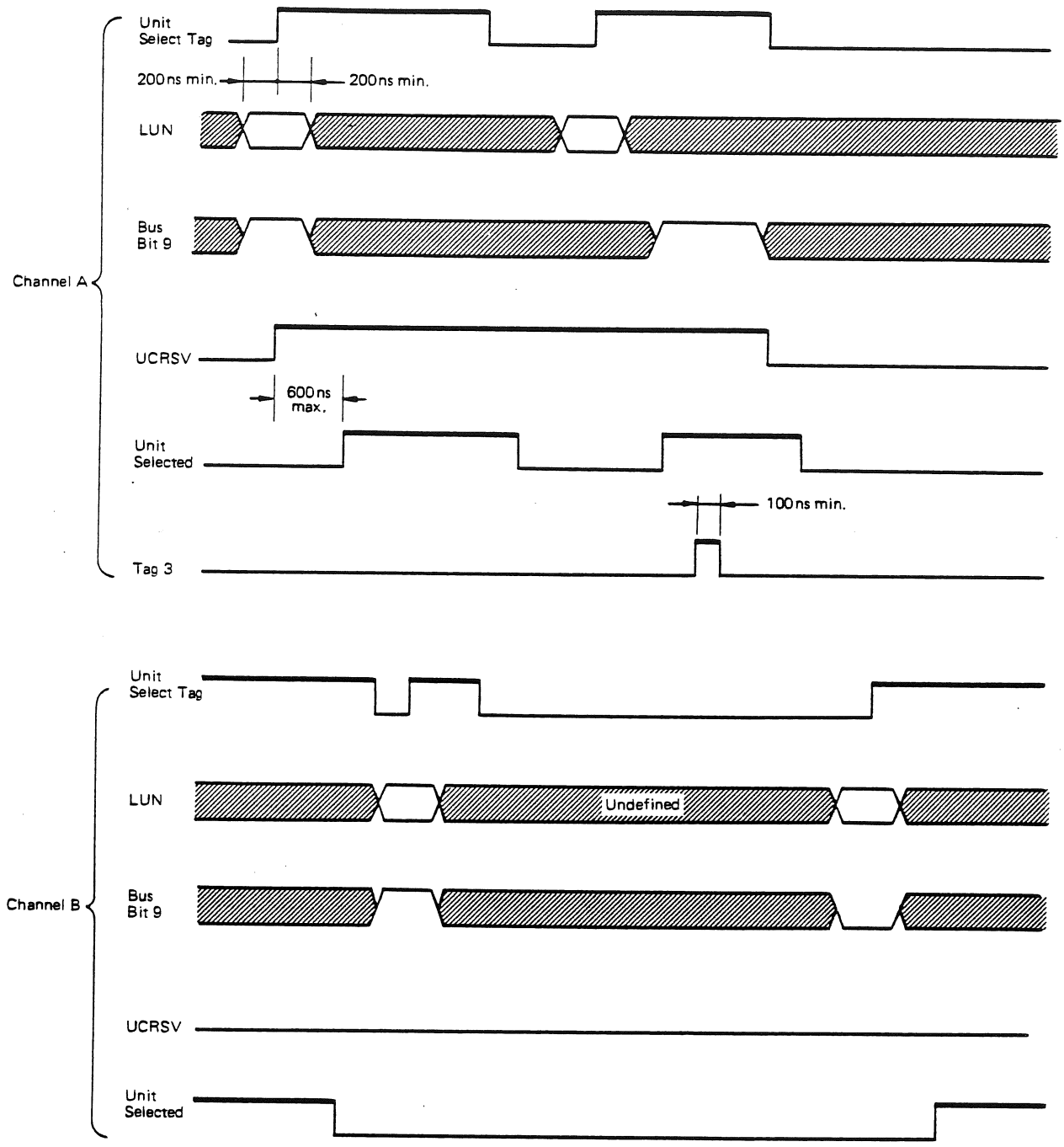
5.5.1 Unit Selection



Note *1) Dual Port only.

Figure 5-9 Unit Select Timing

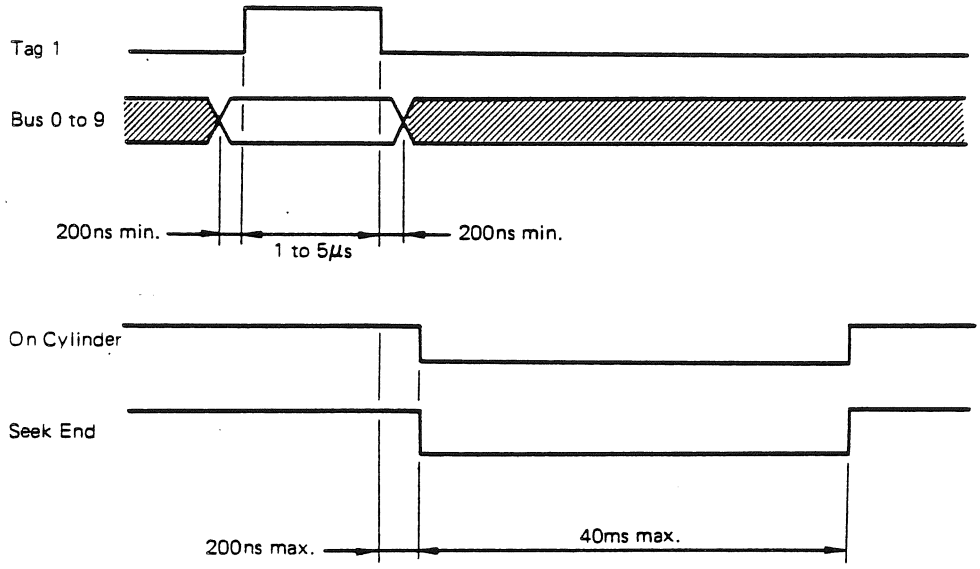
5.5.2 Priority Select Timing (Sample)



Notes 1) LUN : Logical Unit Number (Unit Select 1, 2 and 4).
2) UCRSV: Unconditionally Reserved (Priority Selected).
3) Sample Sequence is as follows:
CHB Selected → CHA Priority Select → CHB Priority Select → CHA Release → CHB Select

Figure 5-10 Priority Select Timing

5.5.3 Seek Timing (Tag 1)



Note: Cylinder address must be valid.

Figure 5-11 Seek Timing

5.5.4 Same Cylinder Address

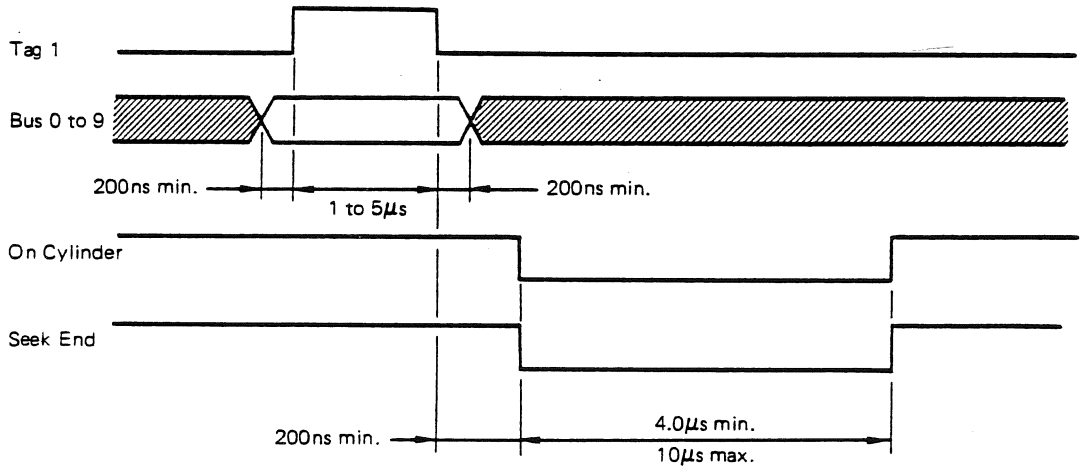


Figure 5-12 Same Cylinder Address

5.5.5 Tag 1/Tag 2 Timing

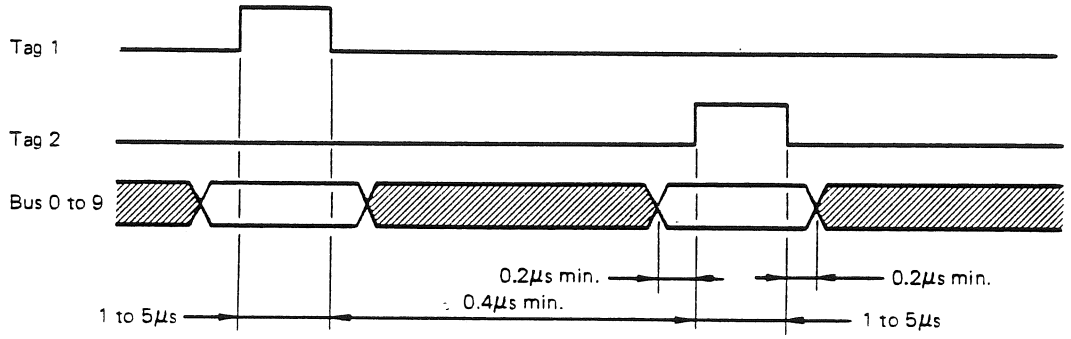


Figure 5-13 Tag 1/Tag 2 Timing

5.5.6 Tag 2 Read/Write Timing

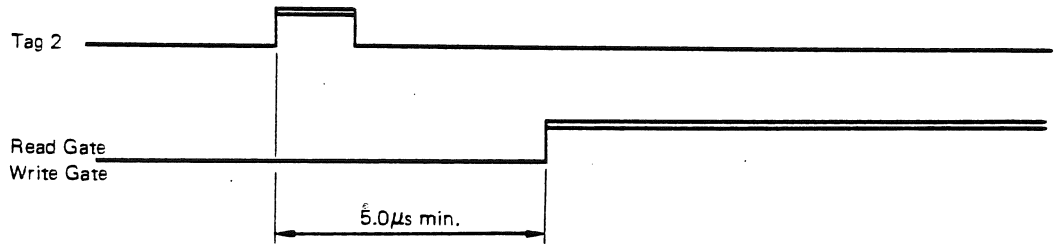
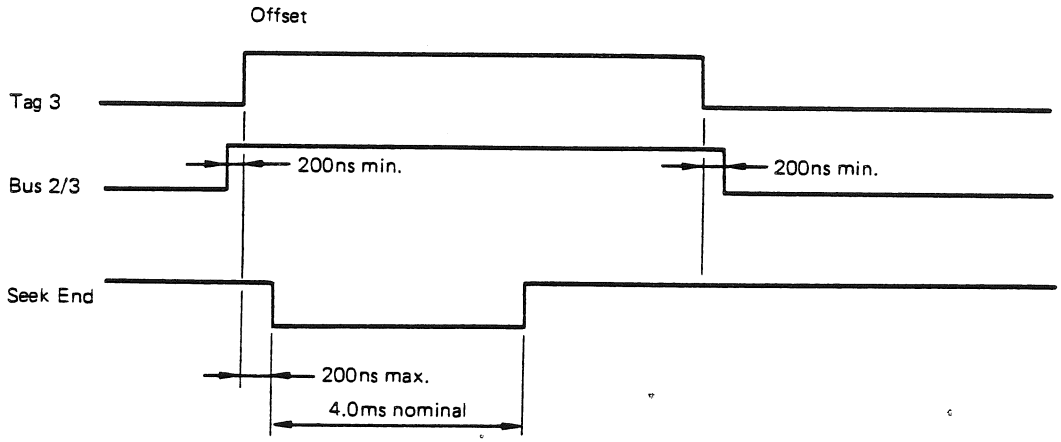


Figure 5-14 Tag 2 Read/Write Timing

5.5.7 Offset Timing



Note: The control unit must inhibit the write operation for 4 ms after offset end sequence.

Figure 5-15 Offset Timing

5.5.8 Fault Clear Timing

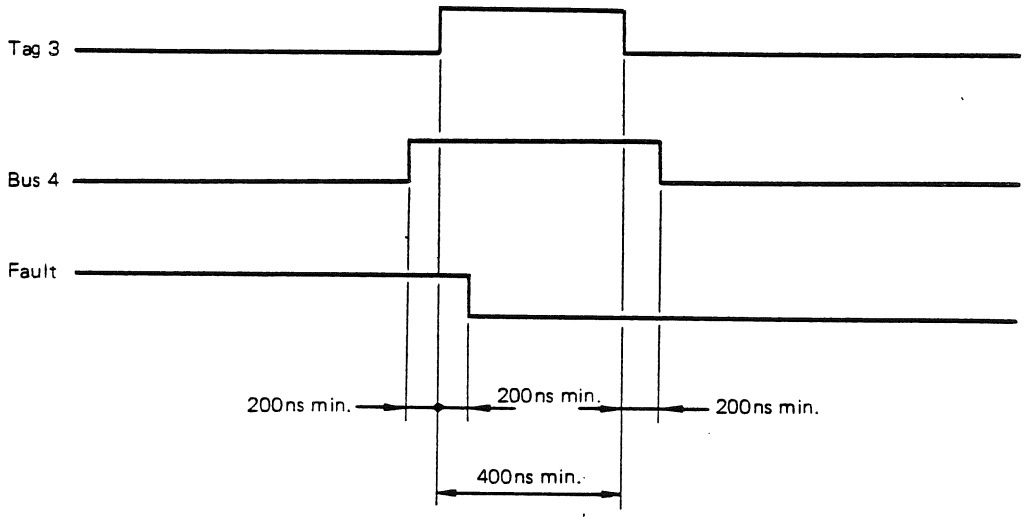


Figure 5-16 Fault Clear Timing

5.5.9 RTZ Timing

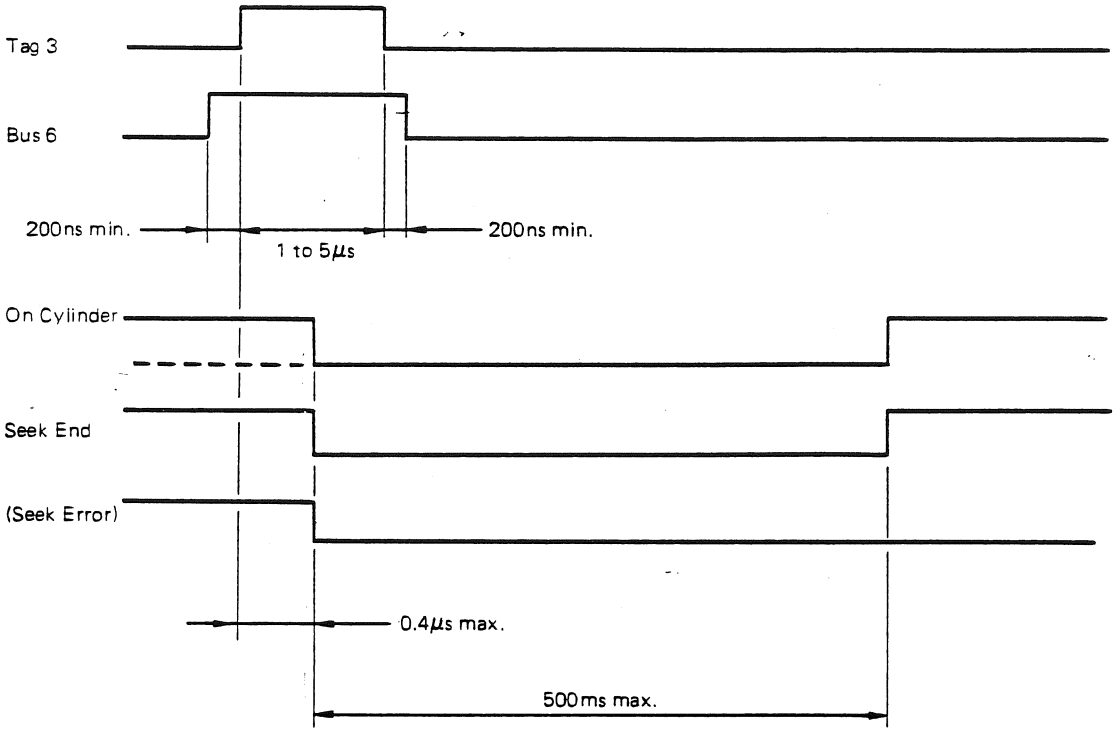


Figure 5-17 RTZ Timing

5.5.10 Tag 4/5 and Status Lines (Optional)

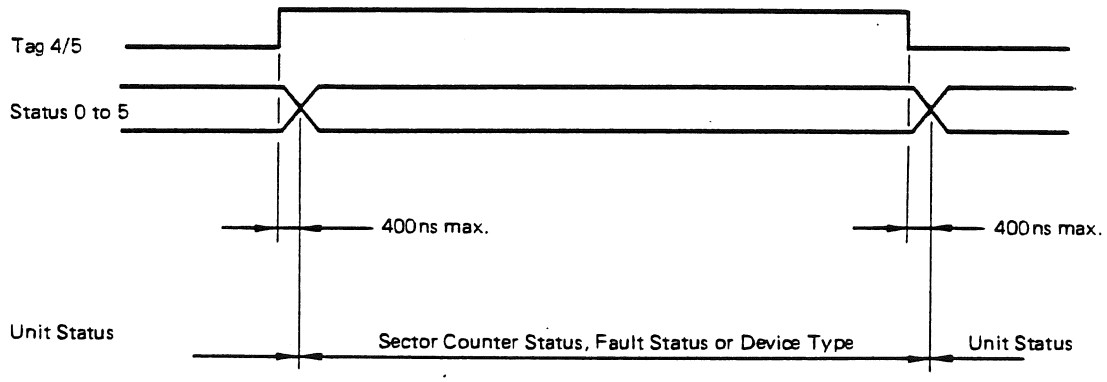


Figure 5-18 Tag 4/5 and Status Lines

5.5.11 Index/Sector

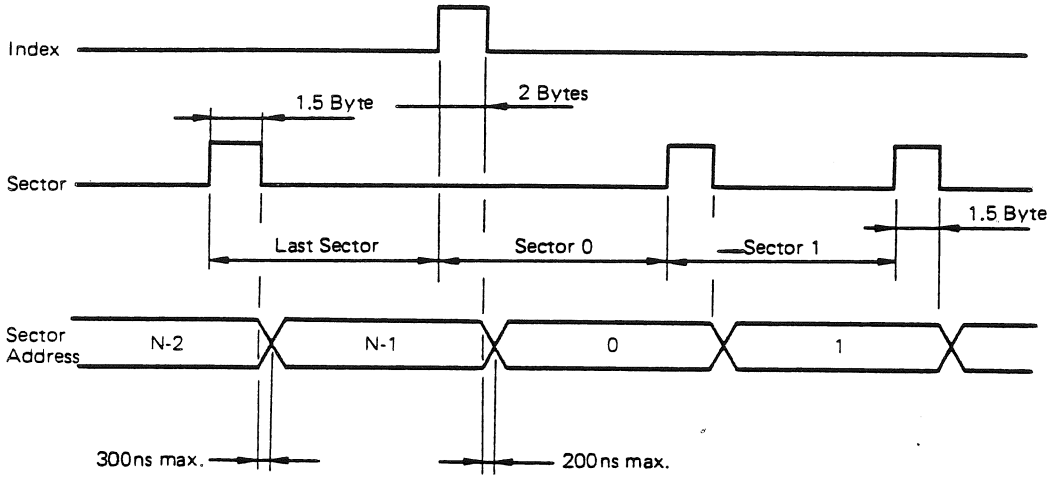
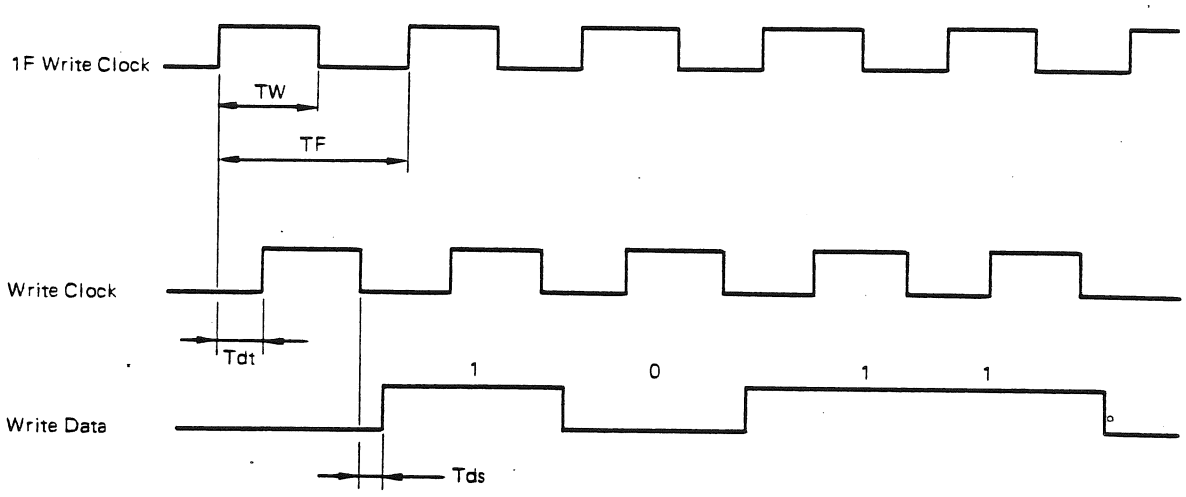


Figure 5-19 Index/Sector Timing

5.5.12 1F Write Clock, Write Data/Write Clock



Tf = 101.7 ns ± 2 ns

Tw = Tf/2

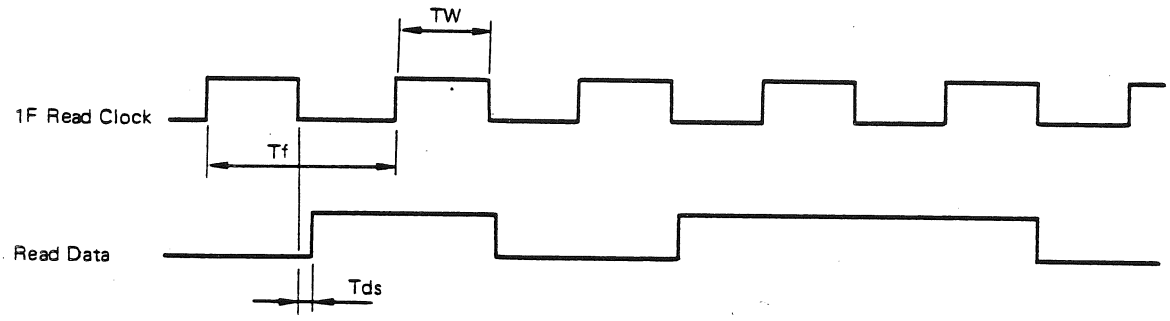
Tdt = 2 bit maximum

Tds = 0 ± 10 ns

Note: 1) Write Clock/Write Data timing shall be specified at the output connector of the control unit.
2) The permissible value of Tf timing is 2% which includes the disk rotational variation, ±1% and jitter, ±1%.
3) NRZ Write Data from the control unit is phase-compensated and then MFM-modulated for writing on the disk surface.

Figure 5-20 1F Write Clock, Write Clock/Write Data

5.5.13 Read Clock/Read Data



Tf = 101.7 ns ± 2 ns

Tw = Tf/2

Tds = 6 ± 4 ns

Note: 1) Read Clock and Read Data timing shall be specified at the output connector of the disk unit.

2) Read Data Signal should be clocked at the rising edge of Read Clock.

Figure 5-21 Read Clock/Read Data Timing

5.5.14 Channel Ready

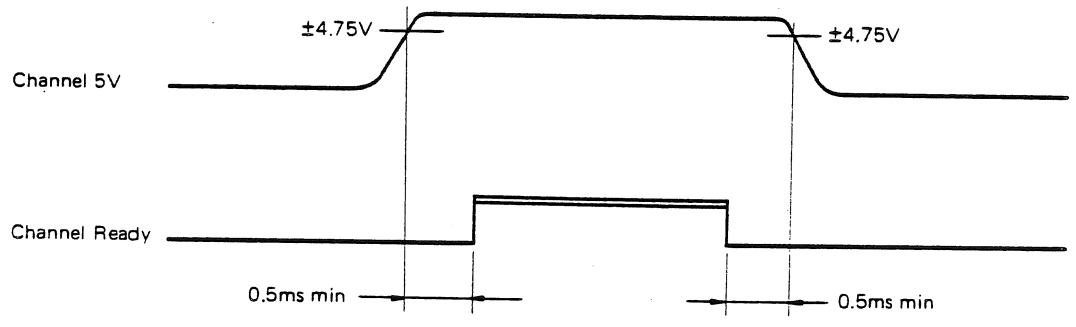


Figure 5-22 Channel Ready Timing

5.6 Format

5.6.1 Format Control

The Record Format is controlled by the control unit. The Index and Sector signals are used to indicate the beginning of a track and sector by the control unit. Recommended format for fixed and variable sectors to meet a conventional standard disk drive are shown in 5.5.2 and 5.5.3.

Some disk drive dependent constrains must be recognized to accomplish a format. The following is a list of those format parameters:

1. Gap 1 Tolerance

   This tolerance is required for conventional disk pack/ cartridge drive, in MDD M2311/2312 is not required, however, this tolerance must be provided to allow for head selection or read-after-write transient.

2. VFO Fast Synchronization

   The synchronization time required to allow Variable-Frequency-Oscillator (VFO) to synchronize is 11 bytes minimum before Synchronous Patterns of address field and data field.

3. Write Driver Turn On Time

   The Write Driver Turn on time is approximately 800 ns (8 bits). This time has to be accounted for in order to know write splice locations.

4. Synchronous Byte

   Synchronous Byte is one-byte field containing non-zero pattern to identify the beginning of the address field and data field of record. The pattern is OE (hexadecimal) for address field and 09 (hexadecimal) for data field.

5. End-Of-Record (EOR) Pad

   This tolerance is a one-byte of zeros to allow the internal encoding delay time during write operation.

6. Gap 3 Tolerance

   Gap 3 is 4-byte minimum of zeros to prevent the write turn-off transient and write/read encoding/decoding delay time.

7. Head Select Transient

The control unit must provide a 5 μs minimum delay time between a head select and initiating a read gate. Normally this delay time will be provided by adding zeros within Gap 3 and/or Gap 1 depending the control unit function.

8. Read-after-Write Transient

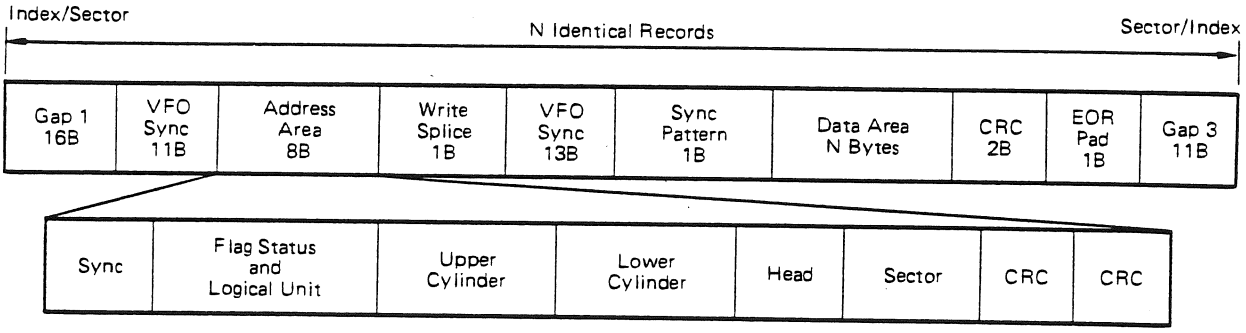
The control unit must provided a 10 μs minimum delay time between the trailing-edge of a write gate and the leading-edge of a read gate.

Normally this delay time will be provided by adding zeros within Gap 3 and/or Gap 1 depending on the control unit function.

9. Read/Write Encoding/Decoding Time

The NRZ write data is encoded into MFM write data pulse and written on the specified record during write operation. The MFM read data pulse is decoded into NRZ read data and then sent to the control unit during read operation. Through encoding and decoding circuitry, a read data signal will be delayed by approximately one-byte against a write data.

5.6.2 Fixed Sector Format



Example: 64 Sectors/Track

$$\text{Data Area} = \frac{\text{Total Bytes/Track}}{\text{Sector/Track}} - (\text{Gap loss} + \text{Check Bytes})$$

$$= \frac{20480}{64} - 64 = 256 \text{ Bytes/Sector}$$

$$\text{Track Efficiency} = \frac{256 \times 64}{20480} \times 100 = 80\%$$

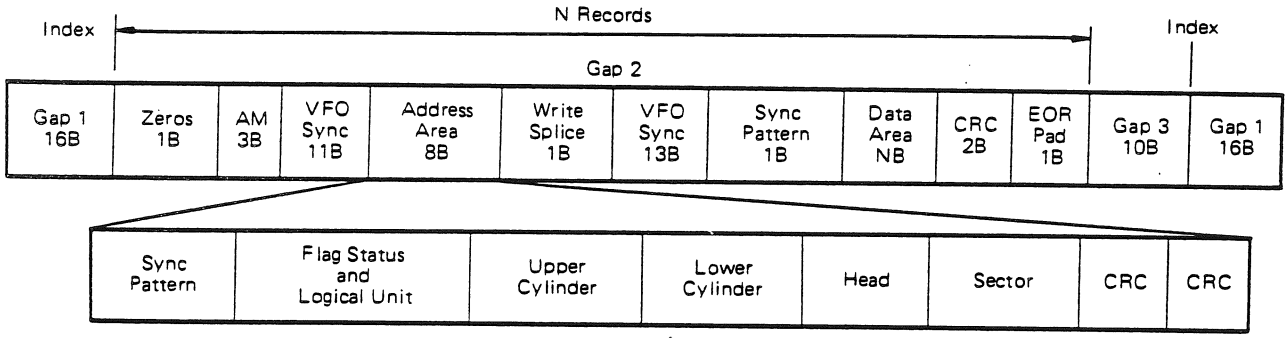
Note: 1) This format is an example only and may be structured to suit individual requirements.

2) Sync Byte patterns for address and data areas may be different. It is recommended that Sync Byte patterns are $OE_{(Hex)}$ for address areas and $09_{(Hex)}$ for data areas.

3) Data patterns for Gap 1, VFO Sync., Write Splice EOR Pad and Gap 3 are all "0".

4) Fixed sectors per track may be any number from 1 through 128 and can be selected by setting the configuration switches on the PCB.

5.6.3 Variable Sector Format



$$\text{Data Area} = \frac{\text{Total Bytes/Track} - \text{Index Loss}}{\text{Records/Track}} - (\text{Sync} + \text{Address Area})$$

Example 1: 64 Records/Track

$$\text{Data Area} = \frac{20480 - 26}{64} - 41 = 278 \text{ Bytes/Records}$$

$$\text{Track Efficiency} = \frac{278 \times 64}{20480} \times 100 = 87\%$$

Example 2: 256 Bytes/Sector

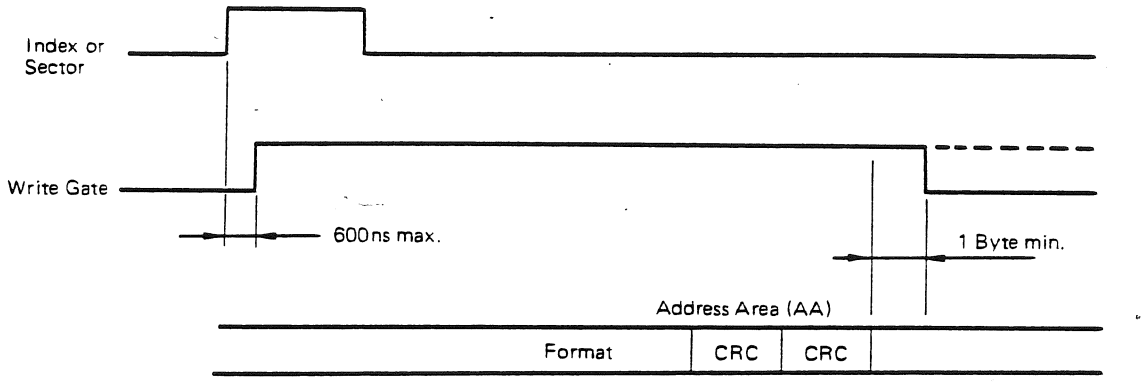
$$\text{N Records} = \frac{20480 - 26}{256 + 41} = 68 \text{ Records/Track}$$

$$\text{Track Efficiency} = \frac{256 \times 68}{20480} = 85\%$$

Note: This format is an example only and may be structured to suit individual requirements.

5.7 Format Timing Specification

5.7.1 Format Write



Note: Write Gate may stay on at broken line.

Figure 5-23 Format Write Timing

5.7.2 Data Write

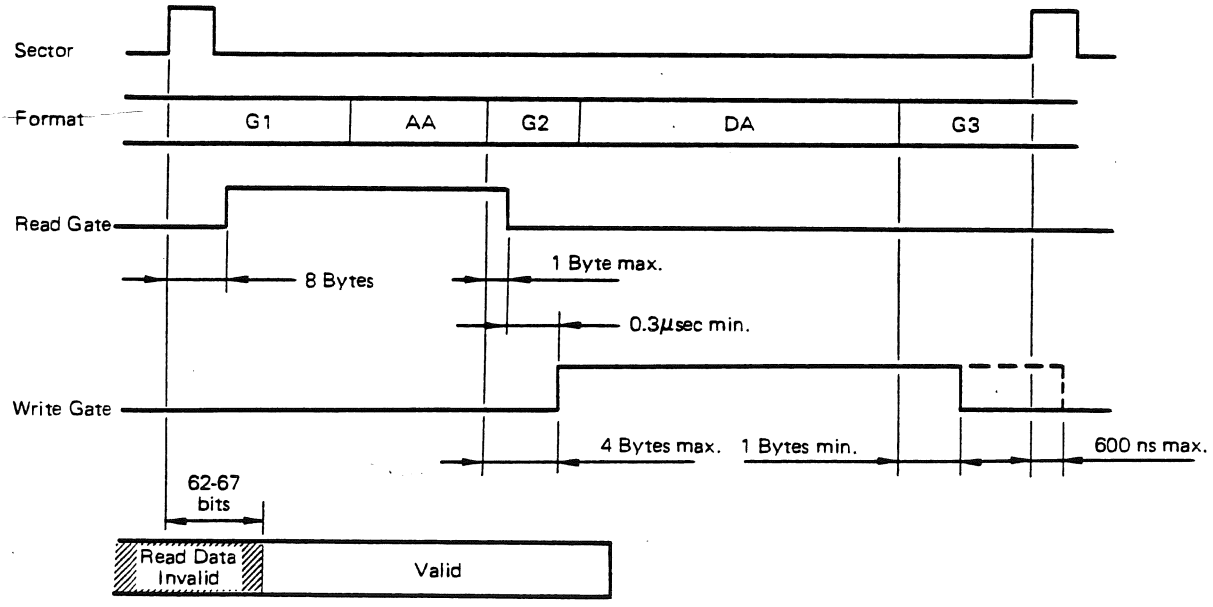
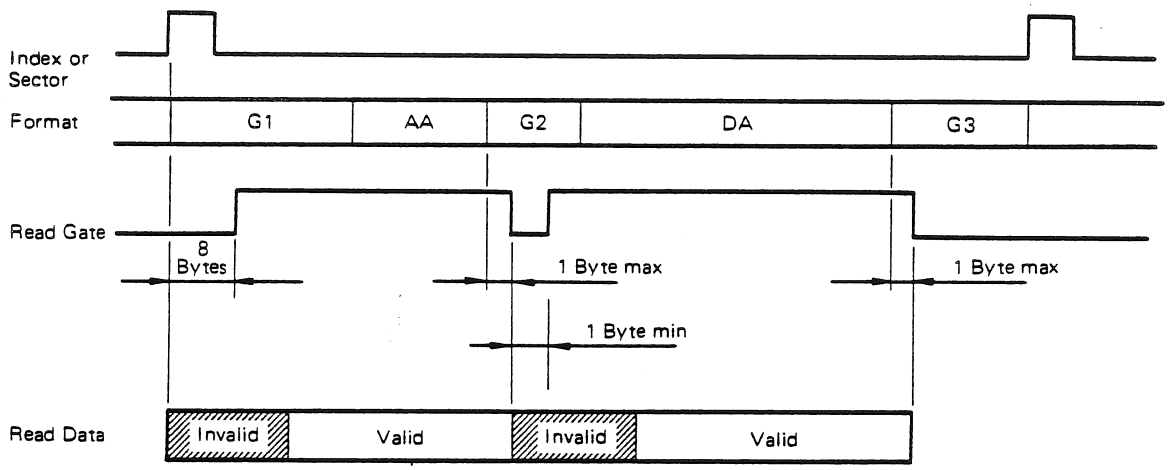


Figure 5-24 Data Write Timing

5.7.3 Data Read Timing

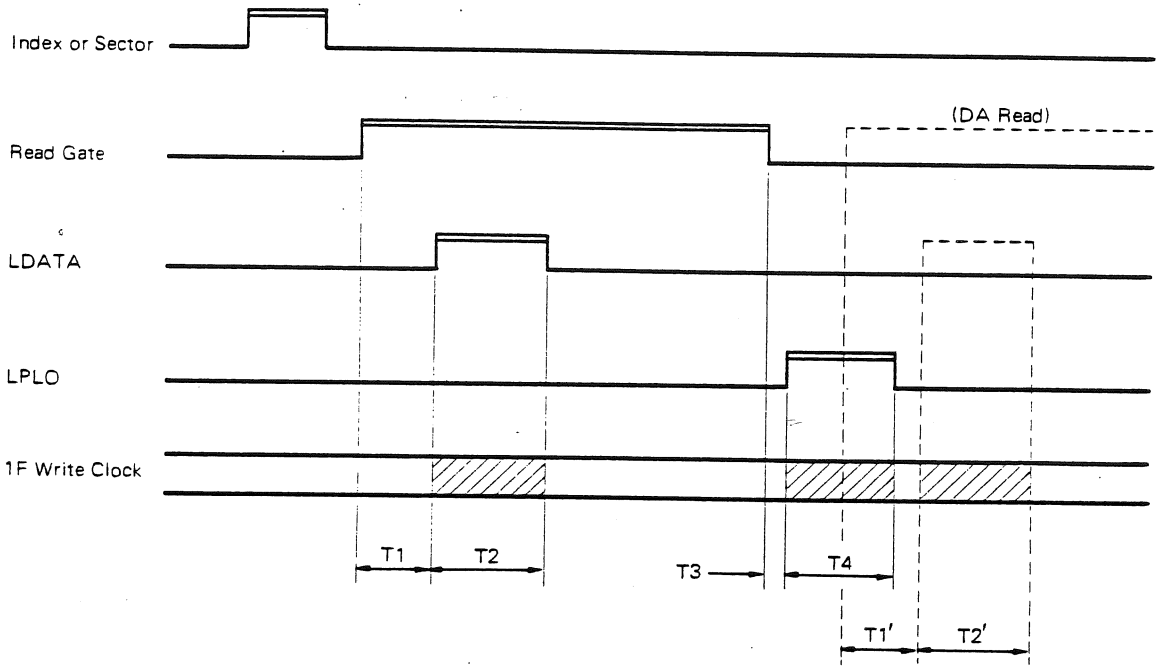


Note: 1) The Invalid data in the above figure may be ignored since they are controlled in the unit.
2) The timing for switching to Read Clock should be performed after the invalid data. In this case a phase adjustment of 1 or 2 bits is required.
3) Address Area and Data Area each includes CRC bytes.

Figure 5-25 Data Read Timing

5.7.4 1F Write Clock in Reading

When Data Area is written, after reading Address Area, 1F Write Clock fluctuates slightly while it activates VFO (Variable Frequency Oscillator) in the disk drive. LDATA and LPLO are signals used within the disk drive.



T1, T1': 30 to 35 bits

T2, T4, T2': 32 bits (4 bytes)

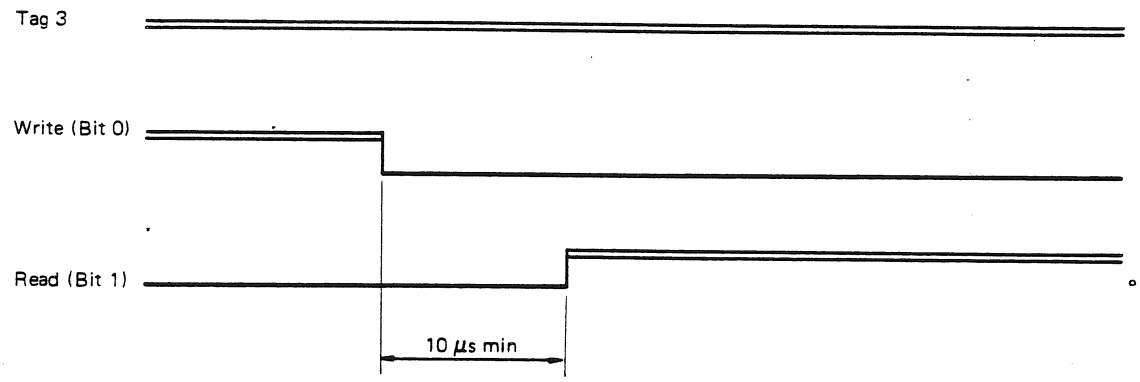
T3 : 2 to 11 bits

Note: Shaded area (4 bytes) is equal to 32 ± 3 bits of clock count.

Figure 5-26 1F Write Clock in Reading

5.7.5 Write-to-Read Transient Specification

Due to the transient in the Read circuit of the unit, Read operation is not possible immediately after Write operation. The timing is specified in this section.



Note: 1) Tag 2 (Head Select) transient of 5 μs must be considered in controlling Read/Write operation. See Paragraph 5.5.1.

Figure 5-27 Write-to-Read Transient

5.7.6 AM Write (Variable Mode only)

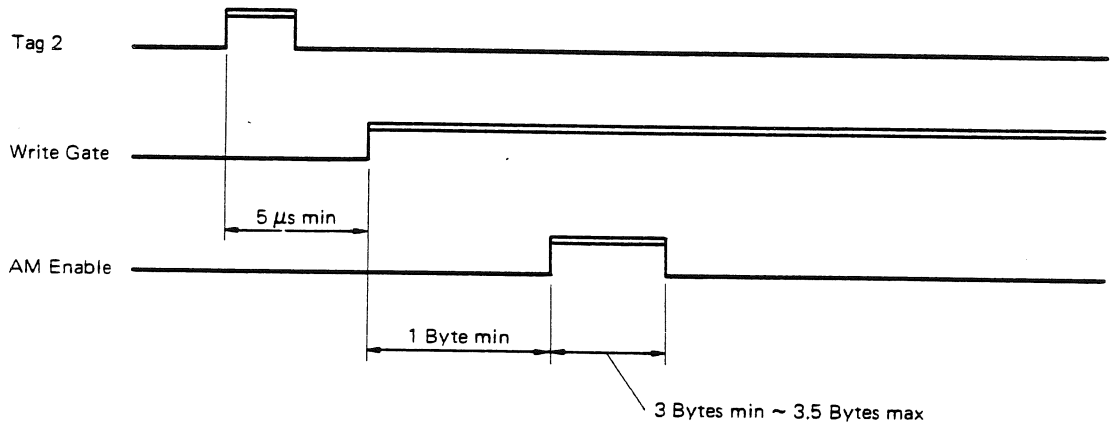


Figure 5-28 AM Write Timing

5.7.7 AM Read (Variable Mode only)

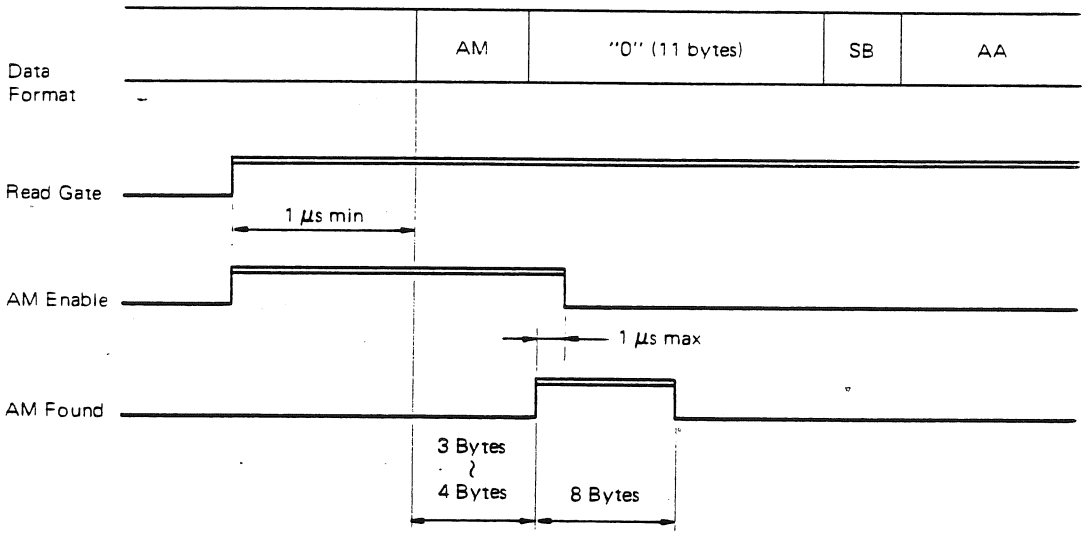


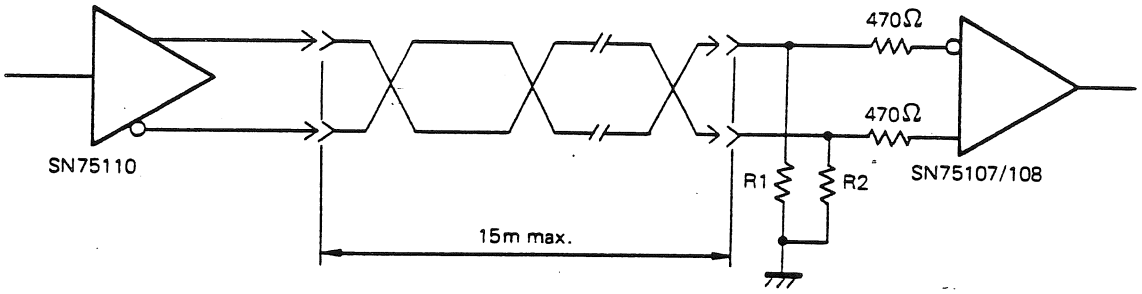
Figure 5-29 AM Read Timing

5.8 Signal Transmission Driver/Receiver

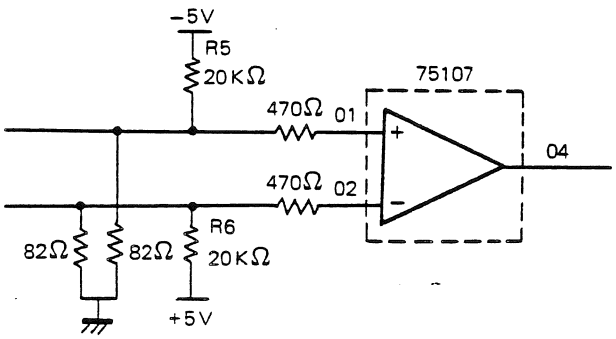
Balanced transmission method is used in transferring signal within the interface. This method is suitable for only range transmission and also not susceptible to external noise.

Driver	SN75110 or equivalent
Receiver	SN75107/SN75108 or equivalent

5.8.1 B Cable (Data Cable)



Note:
1) The cable shall be flat with characteristic impedance of 130Ω ± 13Ω. Refer to Section 5.8 for cable usage.
2) Line terminators R1 and R2 (82Ω ±5%, 1/10W) are located on the control unit or the input terminal of the disk drive.
3) Line protectors R3 and R4 (470Ω ± 5%, 1/10W) are located on the control unit or the input terminal of the disk drive.
4) Time delay of the cable is approximately 5ns/m. Transfer time and delay of the Receiver (SN75107) is 19ns nominal for both high and low signals.
5) To prevent false operation of the receiver, due to interface disturbances during a power failure of the unit, the bias resistors, as shown below, are used on the controller side for Unit Selected and Seek End signals.
6) Maximum cable length is 15 meters.



R5 and R6 (20KΩ ± 5%, 1/10W) are used to prevent the receiver output signal from oscillating when input signals are both high.

Figure 5-30 B Cable Driver/Receiver

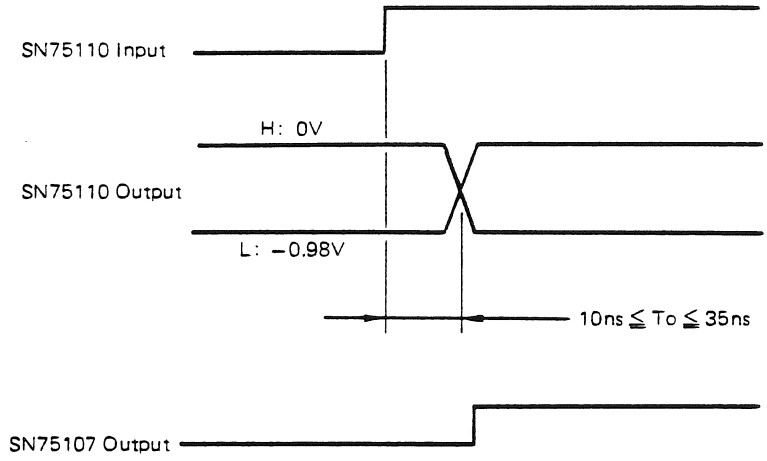
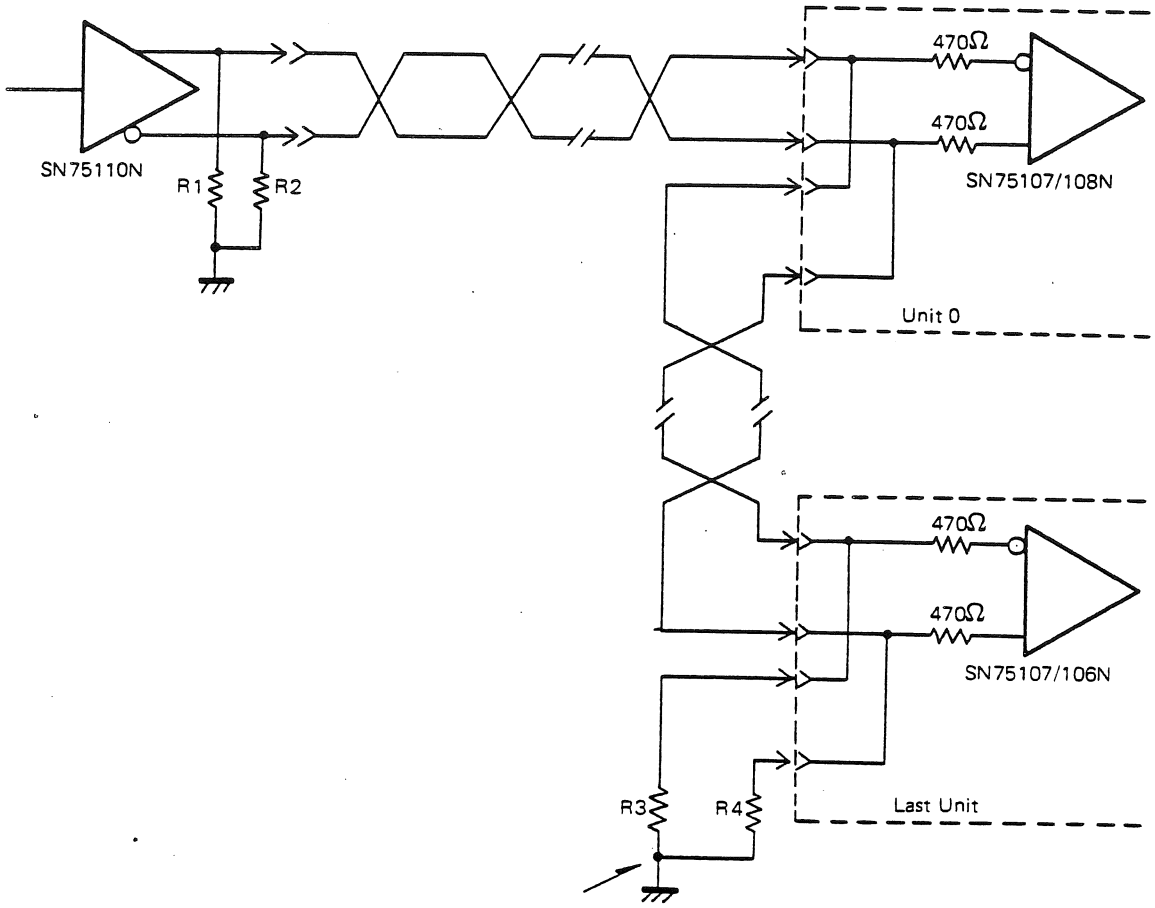


Figure 5-31 B Cable Driver/Receiver Level

5.8.2 A Cable (Control Cable)



Note: 1) Line terminators R1 and R2 (56Ω ±5%, 1/10W) are located on the driver side and R3 and R4 (56Ω ±5%, 1/10W) are located on the receiver side. The line terminators are required on the control unit and the terminator assembly of the last disk unit.
2) The maximum cable length is 30 meters.

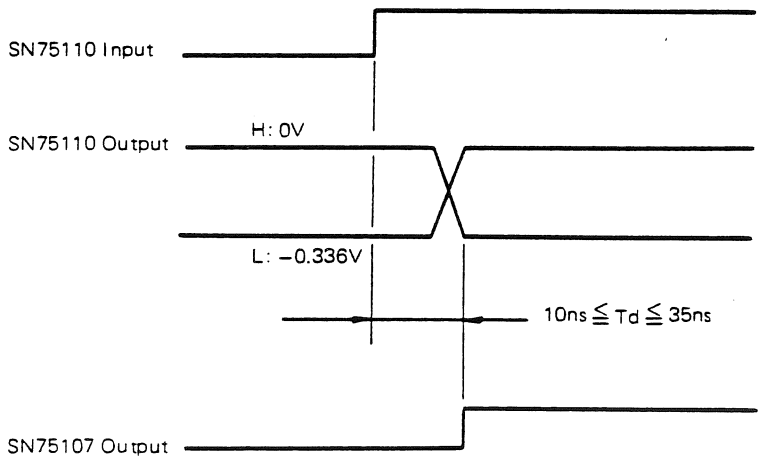


Figure 5-32 A Cable Driver/Receiver

5.8.3 Channel Ready

The Channel Ready signal must be issued to protect data due to interface disturbances during a power failure of the control unit. It is preferrable to use some type of bias circuit, i.e. a relay circuit or a circuit using passive elements, in transmitting this signal.

If SN75110 is used as a driver, it is desirable to use two of them in parallel.

Whatever type of circuit is used, as far as this signal is concerned, the line terminator on the driver side is not needed.

5.9 Connector and Cable

5.9.1 A Cable Connector (60 pos.)

Header Specification	FCN-702P060-AU/M (Wire wrapping) FCN-704P060-AU/M (Straight) FCN-705P060-AU/M (Right Angle)
Socket Specification	FCN-707J060-AU/B (Closed End) FCN-707J060-AU/O (Through End)

5.9.2 B Cable Connector (26 pos.)

Header Specification	FCN-702P026-AU/M (Wire wrapping) FCN-704P026-AU/M (Straight) FCN-705P026-AU/M (Right Angle)
Socket Specification	FCN-707J026-AU/B (Closed End) FCN-707J026-AU/O (Through End)

5.9.3 A Cable

Specification	455-248-60 Spectra Strip Zo = 100Ω ± 10Ω 28 AWG, 7 strands

5.9.4 B Cable

Specification	174-26 Ansley/3476-26 3M Zo = 100Ω ± 10Ω/Zo = 130Ω ± 15Ω 28 AWG, 7 strands

5.10 Connector Pin Assignment

5.10.1 A Cable Connector (60 pos.)

Table 5-14 A Cable Pin Assignment

1	Tag 1 L	31	Tag 1 H
2	Tag 2 L	32	Tag 2 H
3	Tag 3 L	33	Tag 3 H
4	Bus 0 L	34	Bus 0 H
5	Bus 1 L	35	Bus 1 H
6	Bus 2 L	36	Bus 2 H
7	Bus 3 L	37	Bus 3 H
8	Bus 4 L	48	Bus 4 H
9	Bus 5 L	39	Bus 5 H
10	Bus 6 L	40	Bus 6 H
11	Bus 7 L	41	Bus 7 H
12	Bus 8 L	42	Bus 8 H
13	Bus 9 L	43	Bus 9 H
14	Channel 1 Ready L	44	Channel Ready H
15	Status 3 L	45	Status 3 H
16	Status 2 L	46	Status 2 H
17	Status 1 L	47	Status 1 H
18	Index L	48	Index H
19	Status 0 L	49	Status 0 H
20	Status 5 L	50	Status 5 H
21	Busy L	51	Busy H
22	Unit Select Tag L	52	Unit Select Tag H
23	Unit Select 1 L	53	Unit Select 1 H
24	Unit Select 2 L	54	Unit Select 2 H
25	Sector L	55	Sector H
26	Unit Select 4 L	56	Unit Select 4 H
27	Tag 5 L (Selectable)	57	Tag 5 H (Selectable)
28	Status 4 L	58	Status 4 H
29	----	59	----
30	Tag 4 L (Selectable)	60	Tag 4 H (Selectable)

Note: 1) The function of Tag 4 of Tag 5 signals can be inhibited by a switch.
2) Pin 29 and pin 59 should not be used.
3) Busy signal is used with Dual Port Option only.

5.10.2 B Cable Connector (26 pin)

Table 5-15 B Cable Pin Assignment

1	GND	14	1F Write Clock H
2	1F Write Clock L	15	GND
3	Read Data L	16	Read Data H
4	GND	17	1F Read Clock H
5	1F Read Clock L	18	GND
6	Write Clock L	19	Write Clock H
7	GND	20	Write Data H
8	Write Data L	21	GND
9	Unit Selected H	22	Unit Selected L
10	Seek End L	23	Seek End H
11	GND	24	Index H
12	Index L	25	GND
13	Sector L	26	Sector H

6. OPTIONS

Table 6-1 Options

Item No.	Component name	Specification (Drawing No.)	Remarks
1-1	Fan unit	B03B-4590-E002A	100/115/120 V AC; 50/60 Hz
1-2	Fan unit	B03B-4590-E003A	220/240 V AC; 60 Hz
2-1	Power supply unit	B14L-5105-0100A	• 100/115/120/220/240 V AC • With connectors for feeding power to fan units and dual channel printed board unit.
3-1	Cable	B660-1065-T006A	Interface cable (A) 60P flat cable
3-2	Cable	B660-1065-T008A	Interface cable (B) 26P flat cable
3-3	Cable	B660-1865-T020A	Interface cable (A) for 2 units daisy chain
3-4	Cable	B660-1865-T030A	Interface cable (A) for 3 units daisy chain
3-5	Cable	B660-1865-T040A	Interface cable (A) for 4 units daisy chain
3-6	Cable	B660-1865-T050A	Interface cable (A) for 5 units daisy chain
3-7	Cable	B660-1865-T060A	Interface cable (A) for 6 daisy chain
3-8	Cable	B660-1865-T070A	Interface cable (A) for 7 units daisy chain
3-9	Cable	B660-1865-T080A	Interface cable (A) for 8 units daisy chain
4-1	Panel unit	B03B-4590-E501A	Flat key type control panel board
5-1	Mounting tray	B030-4590-T500A	For mounting two units of 19 inch rack with 3 pitches (inside frame)
5-2	Mounting tray	B030-4590-T501A	For mounting two units of 19 inch rack with 3 pitches (inside frame), and the front panel has the windows for operating the panel unit.

Table 6-1 (Continued)

Item No.	Component name	Specification (Drawing No.)	Remarks
5-3	Brackets	B030-4590-T550A	• For mounting two units of 19 inch rack with 3 pitches (outside frame) • Length setting pitch: 586 mm - 686 mm
6-1	Dual channel PCB assembly	B03B-4590-E401A	To be mounted on optional PSU.
		B03B-4590-E402A	To be mounted on drive unit.
7-1	Power cable	B660-0625-T327A	Drive unit - power supply unit connecting
8-1	Cable	B660-0625-T328A	E002A fan unit - power supply unit connecting
8-2	Cable	B660-0625-T355A	E003A fan unit connecting
9-1	Cable	B660-1995-T003A	E501A panel unit - drive unit connecting
10-1	Cable	B660-0625-T329A	Dual channel PCB assy. - Power supply unit connecting

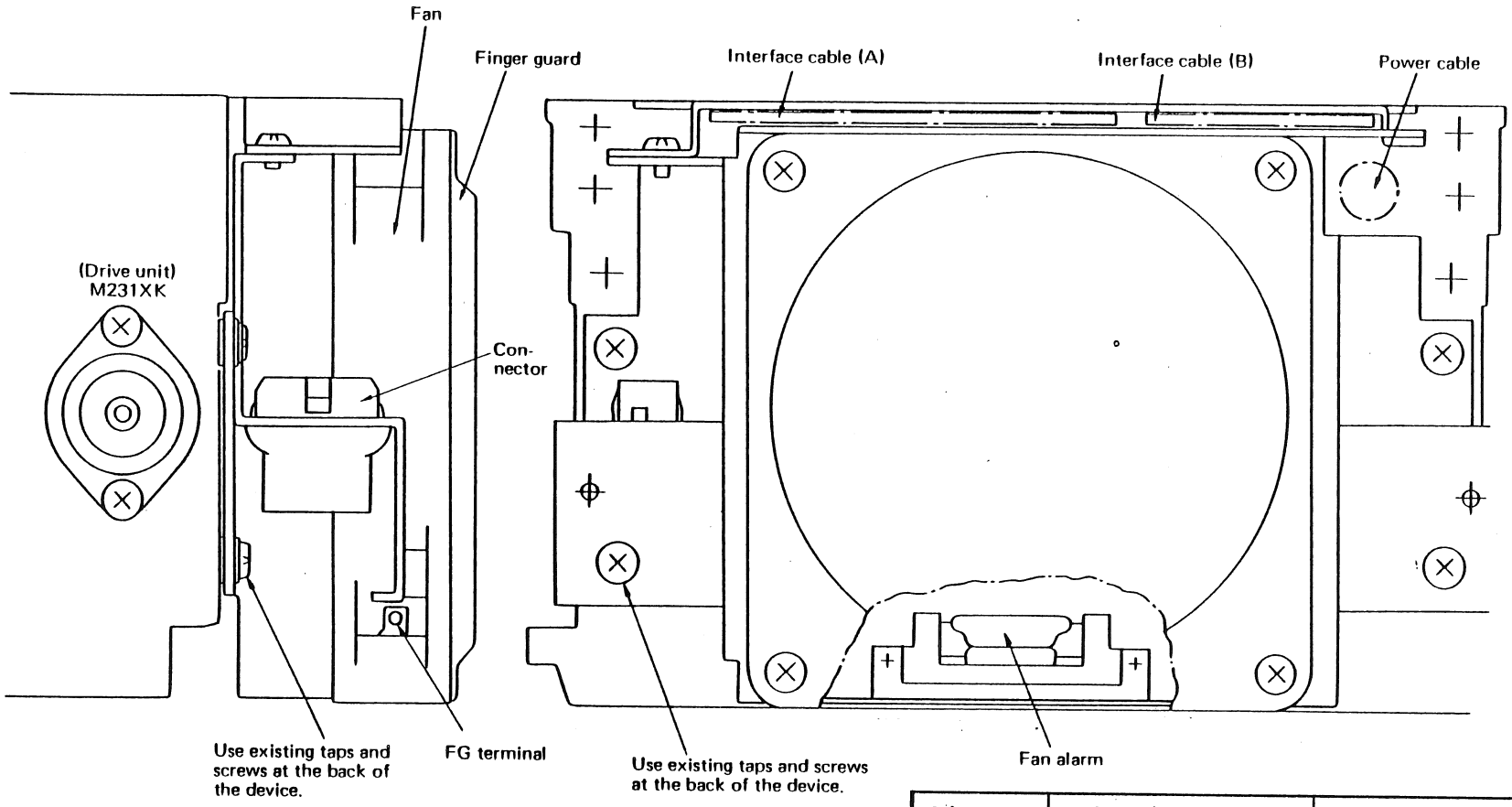
Note: Items in the above table are optional and not fundamental components of this unit. These items must be ordered separately conforming to the above specifications as occasion demands.

6.1 Fan Unit

The M2311/M2312 requires some means of cooling, since there is no internal blower motor. For this purpose, optional fan units is available. The fan unit is available in the event that adequate cooling is not provided within the mounting cabinet. This fan unit is directly mountable onto the hind of the device, and be mounted also at the field by using the existing screws and taps.

The fan unit may be ordered in any of the following voltage ratings: 100/115/120V AC or 220/240V AC. When the input power of the fan unit is supplied from the optional power supply unit, the fan unit must be ordered the type for 100/115/120V AC (B03B-4590-E002A) regardless of system AC voltage.

The Figure 6-1 shows the mounting status, I/O terminals, etc., of the fan unit.



*1: The overall length after mounting the fan unit is 430 mm (380 mm + 50 mm).

Pin No.	B03B-4590-E002A	B03B-4590-E003A
1	100/115/120V AC	220/240V AC
2	100/115/120V AC	
3	FG	FG
4		220/240V AC
5	ALARM (*2)	ALARM (*2)
6	ALARM (*2)	ALARM (*2)

Fan Unit Connector Part Number

Connector Amp 1-480704-0

Contact Amp 350550-1

Figure 6-1 Fan Unit

*2: Fan Alarm Specification

Type of contact point:		Normal open
Contact capacity	:	0.5A DC Max. 200V DC Max. * However: i(A) × E(V) ≦ 10W DC
Rated power (Heater)	:	4.2W (at 100V AC)
Response time	:	5 - 300 sec.
Circuit	:	as follows

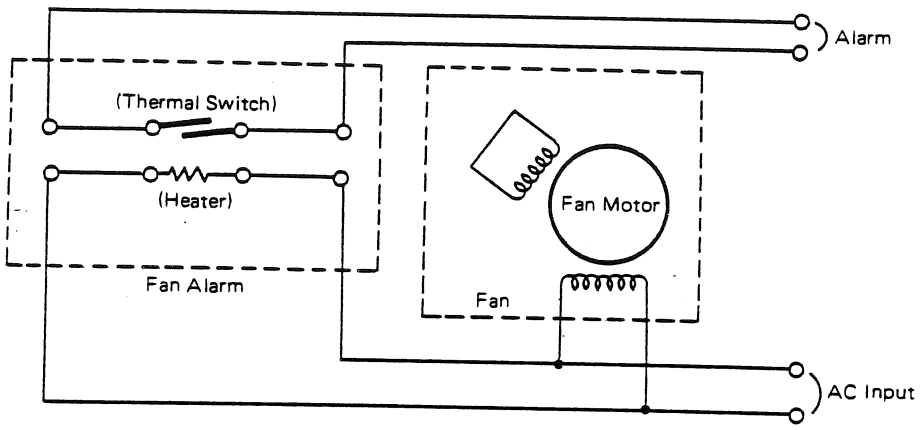


Figure 6-2 Optional Fan Unit Alarm

6.2 Power Supply Unit

A power supply unit may either be mounted horizontally behind the disk drive or may be mounted virtically. Figure 6-3 shows the details of I/O terminals and the external dimensions of the power supply unit.

Specification: B14L-5105-0100A

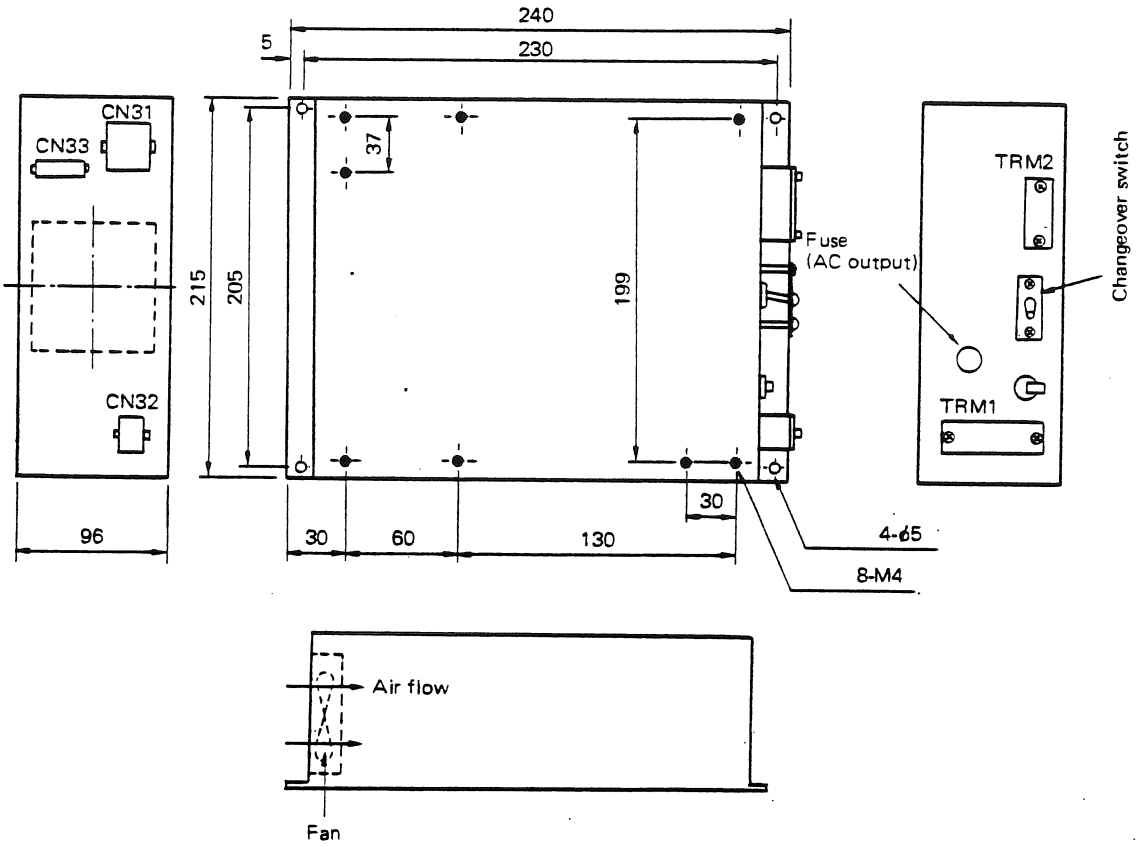


Figure 6-3 Power Supply Unit

TRM1: AC power input and alarm sending.

TRM2: FG-SG coupling terminal. (Normally open)

CN31: Drive unit power feeding connector
(for cable B660-0625-T327A (Option))

CN32: Fan unit power feeding connector
(for cable B660-0625-T328A/T355A (Option))

CN33: Dual channel PCB unit power feeding connector
(for cable B660-0625-T329A (Option))

AC input voltage selection from 100/115/120V AC to 220/240V AC is switched selectable.

Also, regardless of AC input voltage, AC output voltage from CN2 (fan unit power supplying connector) is kept 115V $^{+15\%}_{-24\%}$ AC.

Therefore when using the option power supply only the 115V AC fan is required.

6.3 Panel Unit

The panel unit includes function lights which indicate power on, ready, write protect, check, and also includes a write protect switch.

Figure 6-4 shows the mounting dimensions and mounting status of panel unit B03B-4590-E501A.

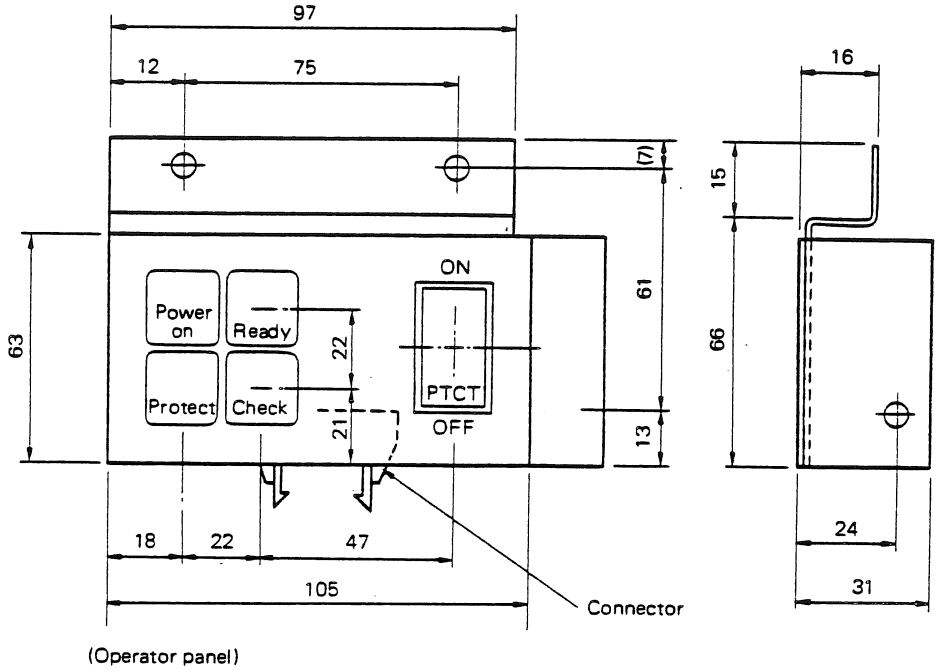


Figure 6-4 Panel Unit

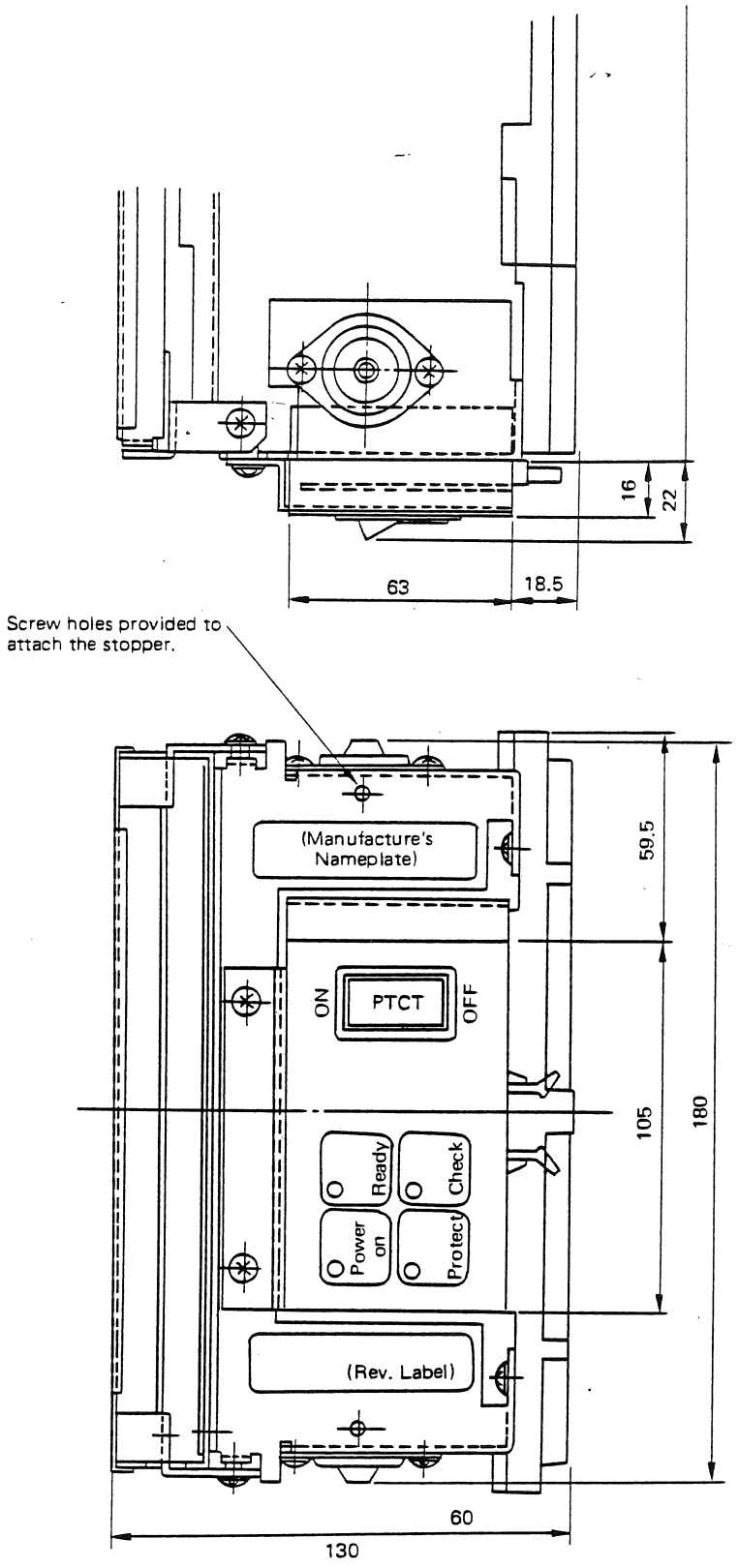


Figure 6-5 Mounting Dimensions of Panel Unit

6.4 19" Rack Mount Installation

Mounting-tray with brackets is possible to install two drives, side by side in a 19" rack, three pitches. It can also accommodate the optional fan units and/or power supply units for each of the two drives.

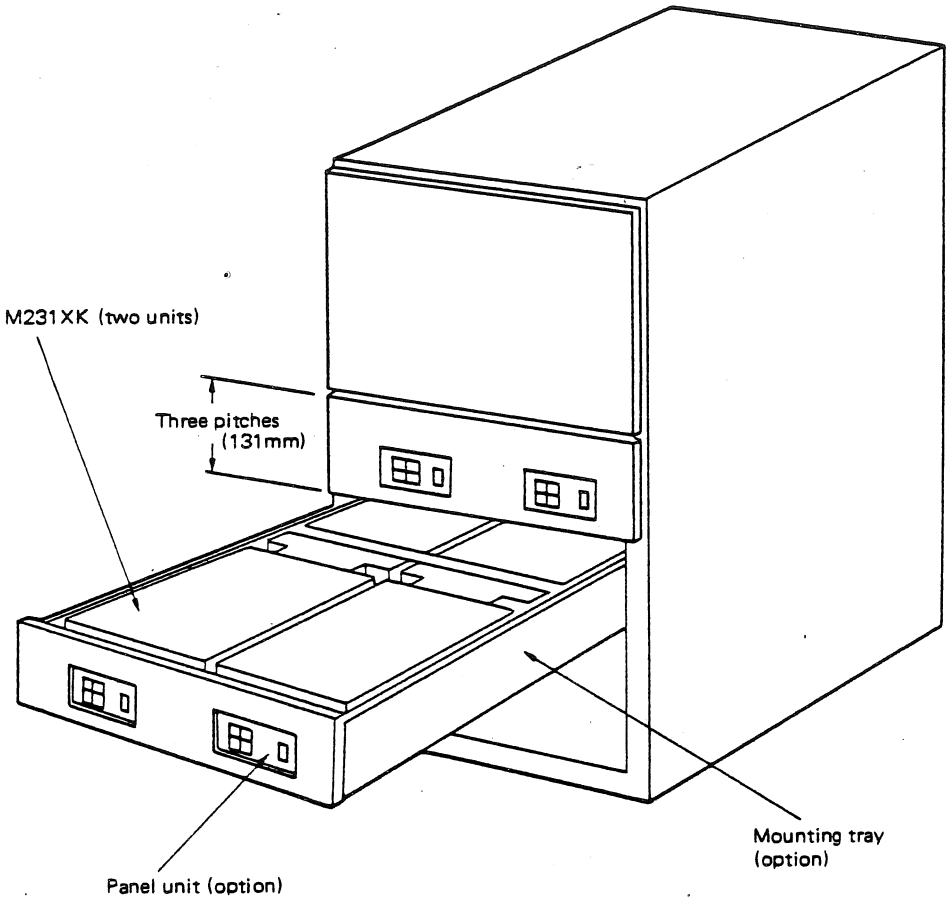
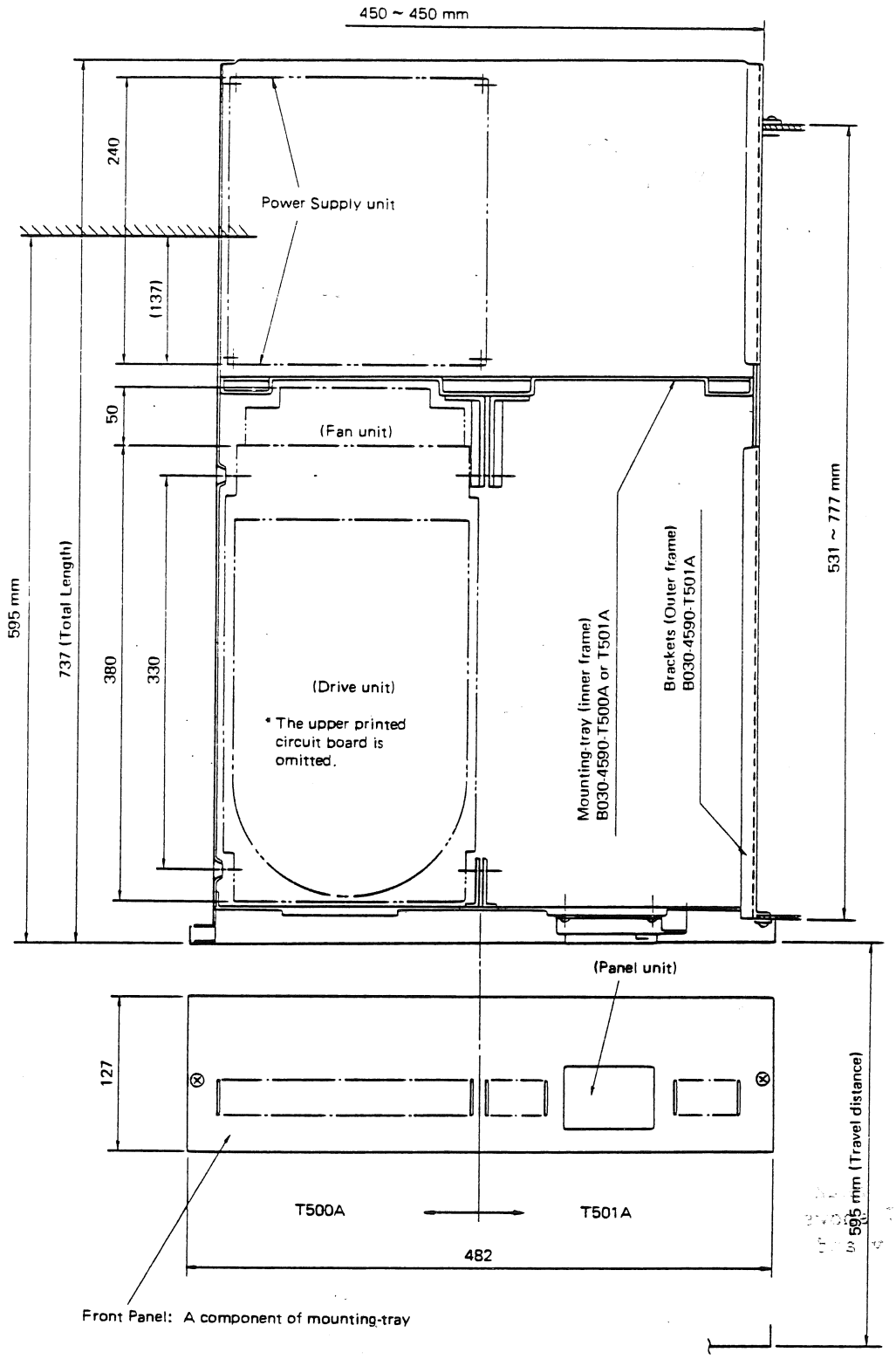


Figure 6-6 19" Rack Mount Installation

Mounting-tray (inner frame) guided by brackets (outer frame) can be drawn out forward. (Travel distance is approximately 23.4").

19" rack mounting method is illustrated in Figure 6-6. And Figure 6-7 shows the appearance where the units are mounted in mounting-tray and brackets.



Note: Mounting-tray (T500A) cannot accommodate the drive unit with Panel unit. In that case, T501A-type must be specified.

Figure 6-7 Mounting-Tray and Brackets

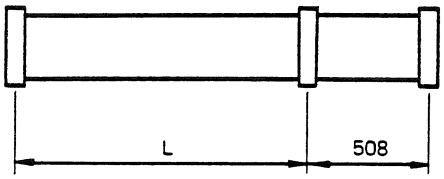
6.5 Cables

The interface cable (A) is up to 30m long (to the drive unit at the final step in case of daisy chain mode). The length of the cable can be specified in every 20 inches (508 mm).

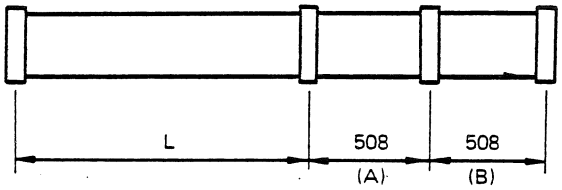
The interface cable (B) is up to 15m long. The length of this cable can be specified in every 500 mm.

The (A) cables for daisy-chain connection shown at items 3-3 to 3-9 in Table 6-1 are of the forms as shown in Figure 6-8. Cable length "L" (specifiable by "#L") refers to the corresponding sections of the following drawings:

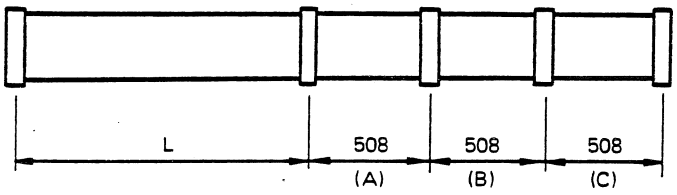
- For B660-1865-T020A



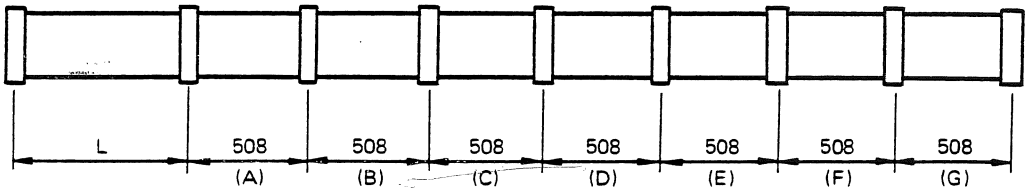
- For B660-1865-T030A



- For B660-1865-T040A



- For B660-1865-T080A



* The connectors at both ends are of close-end, while the intermediate connectors are of through-end.

Figure 6-8 A-Cables for Daisy-Chain

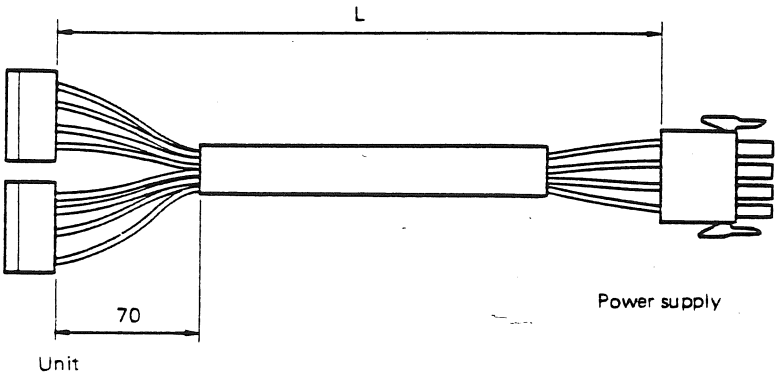


Figure 6-9 Power Cable B660-0625-T327A

How to specify cable lengths

(For 3.5m: Example 1)

B660-1065-T008A	#L3R503
Cable specification	3.5×10^{3} (mm)

(For 50 cm: Example 2)

B660-0625-T327A	#L500R0
Cable specification	500×10^{0} (mm)

The lengths of cables at Items 7, 8, 9, and 10 in Table 6-1 must also be specified.

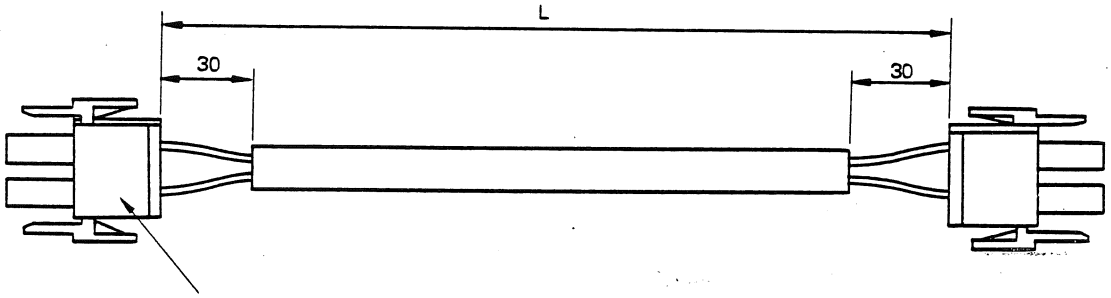


Figure 6-10 Cable B660-0625-T328A, T355A
(Fan unit - Power supply unit)

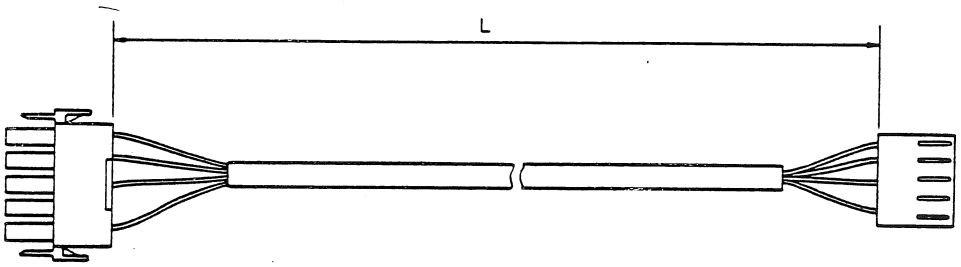


Figure 6-11 Cable B660-0625-T329A
(Dual Channel PCB assy. - Power supply unit)

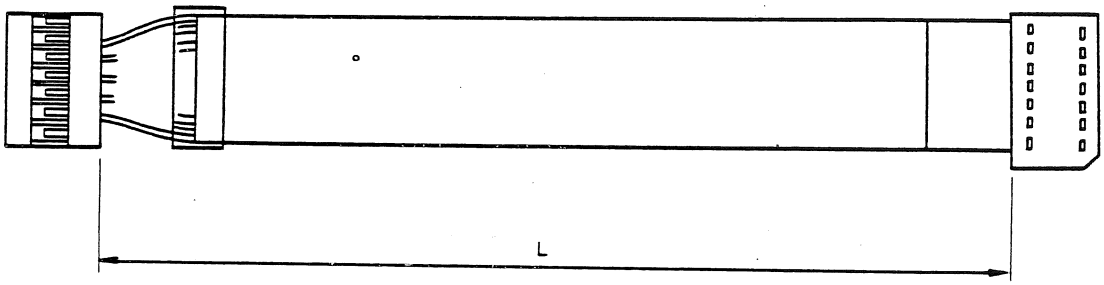


Figure 6-12 Cable B660-1995-T003A
(E501A Panel unit - Drive unit connecting)

The length of this cable can be specified in every 60 mm.
(Minimum length is 90 mm.)

Operator Panel Connection

The CNAM PCB allows for connection of an optional control panel. At location A5 on this PCB, there is a 14 pin DIP socket for the control panel connection. Following is pin-out for this DIP socket.

PIN NUMBER	SIGNAL MNEMONIC	DEFINITION
1	+5V	+5 Volt
2	*FPTK	File Protect Switch
3	*CKCLR	Check Clear Switch
4	*LRDY	Ready LED
5	OV	Signal Ground
6	*LUSLD	Unit Selected LED
7	OV	Signal Ground
8	OV	Signal Ground
9	*PWRDY	Power Ready LED
10	*LFPT	File Protect LED
11	*LDYCK	Device Check LED
12	OV	Signal Ground
13	OV	Signal Ground
14	+5V	+5 Volt

"*" Indicates a low active signal

6.6 Dual Channel PCB Assembly

This unit is provided with the dual channel option to add the crosscall function, and it is possible to be mounted on the circuit or the power supply.

Drive's hight are:

- In case of mounting on the unit; 154 mm
- In case of mounting on the power supply;

  It is possible to be mounted in the 19 inch rack with 3 pitch by using the optional power supply (B030-4590-T500A or T501A), the mounting-tray (B030-4590-T500A or T501A), and the bracket assembly.

The specifications and the rating of dual channel option are shown in Table 6-2.

Table 6-2 Dual Channel Option

Specifications	B03B-4590-E401A	B03B-4590-E402A
Mounting location	on the power supply	on the unit
Input condition	+5V, 4.5A -12V, 4.0A	

Note: The dual channel option is connected with optional power supply by using the connecting cable. (See Item 6.5.)

Dimensions after mounting of Dual channel PCB Assembly are shown in Figure 6-13 (E401A) or Figure 6-14 (E402A).

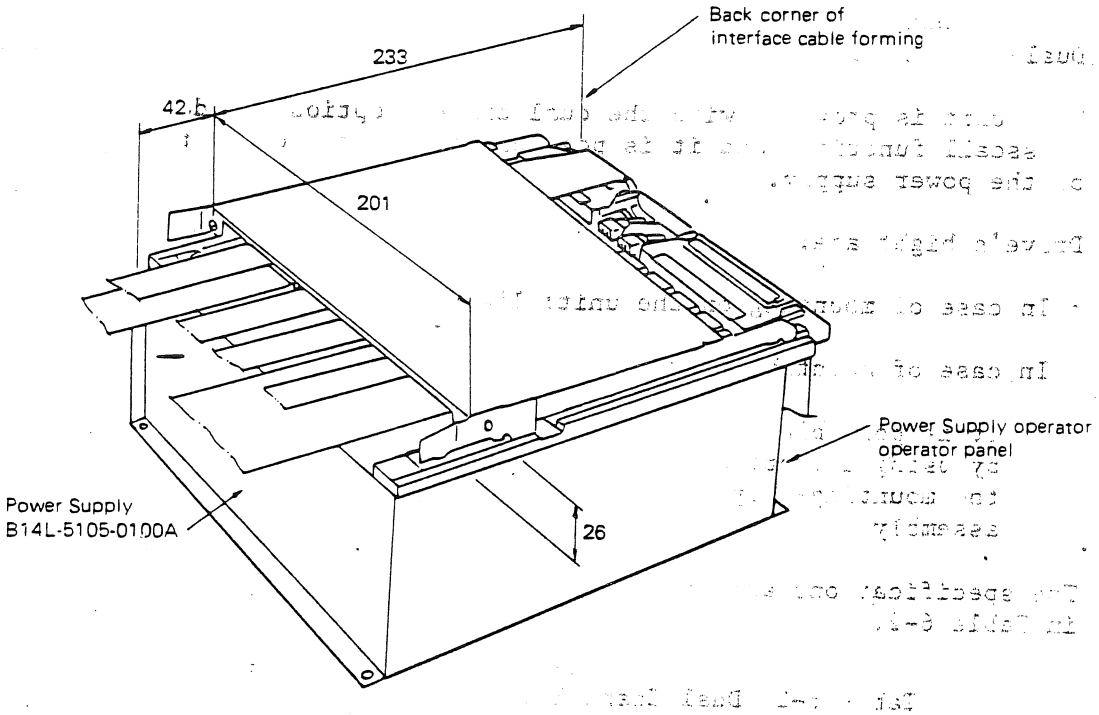


Figure 6-13 Dual Channel Option (E401A)

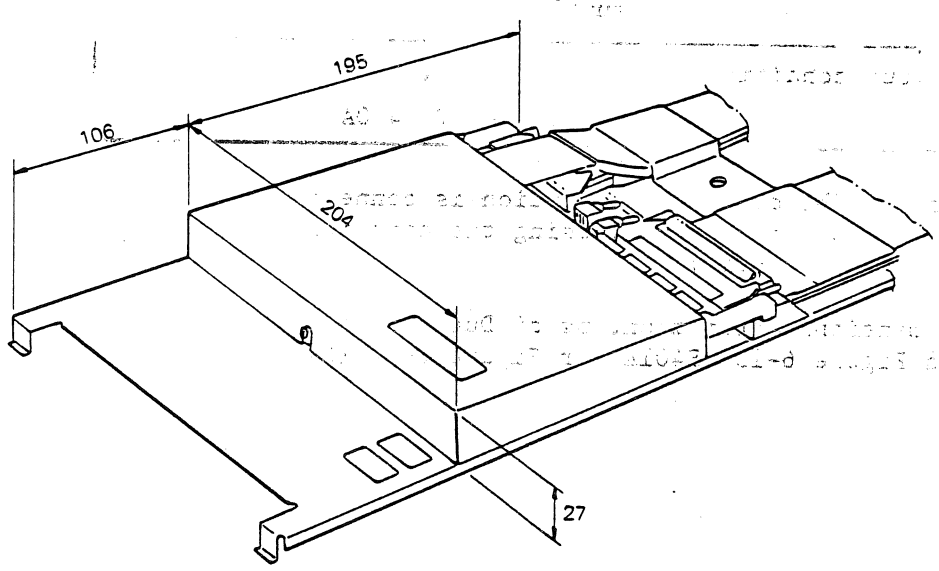


Figure 6-14 Dual Channel Option (E402A)

Note: In case of mounting on the power supply, fix Brackets with screws on the power supply.

Note: In case of mounting on the unit, change the usual unit cover to the cover for this option.

Connection location on the PCA are shown in Figure 6-15.

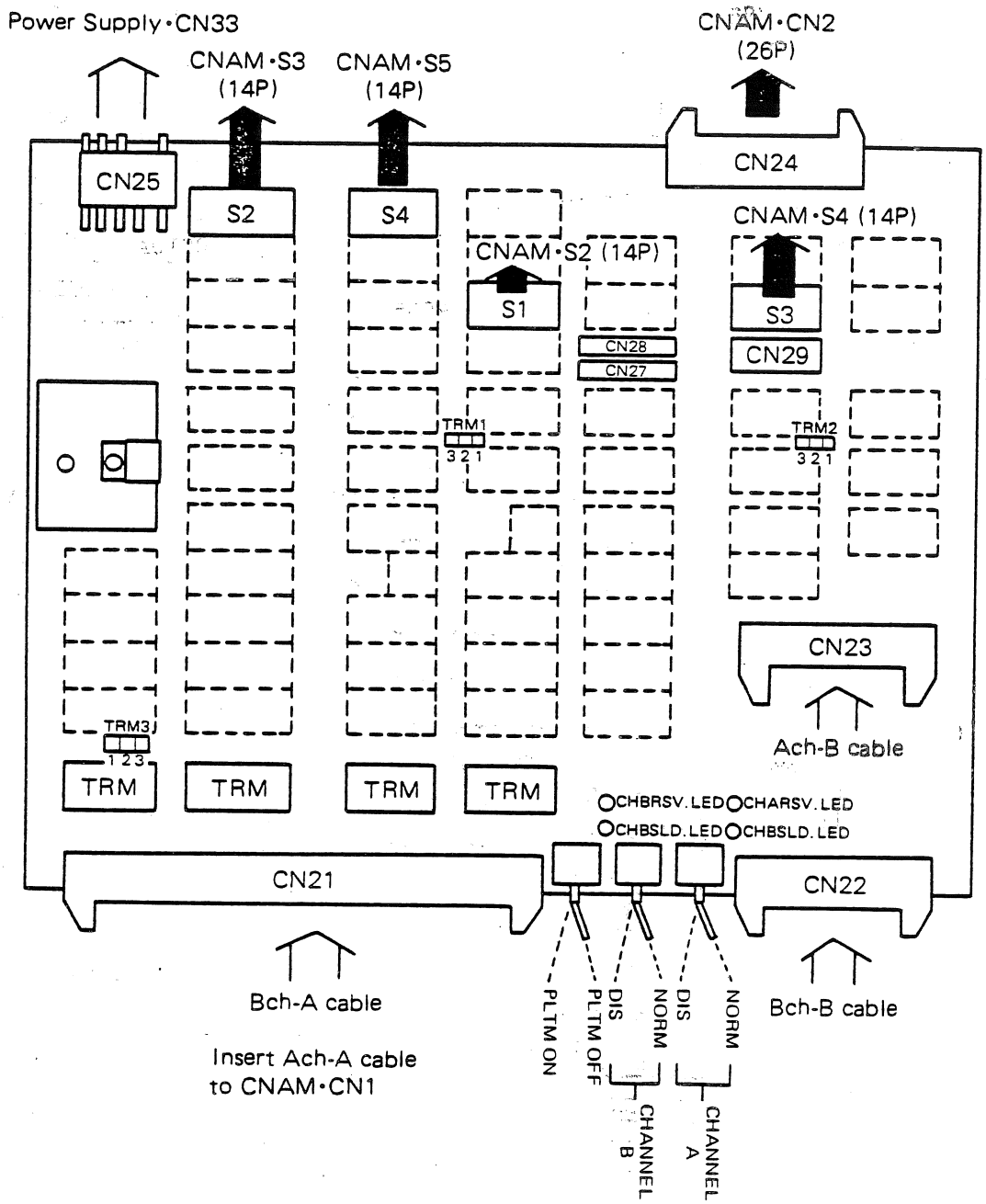


Figure 6-15 Dual Channel PCB Assembly Connector Location

7. SPARE PARTS LIST

7.1 Spare Parts List

Table 7-1 Spare Parts List

Item	Designation	Specification
1	Controller A (CNAM) PCB Assembly	B16B-6970-0010A
2	Controller Z (CMZM) PCM Assembly	B16B-6960-0010A
3	Power Amp Z (TUZM) PCB Assembly	B16B-7640-0010A