

DMA SYSTEMS'

360 DRIVE

PRELIMINARY OEM MANUAL

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April 25, 1984

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I. Introduction and Drive Description

DMA Systems' 360 drive is a half-high drive that utilizes a 5.25-inch removable hard-disk cartridge for data storage. Total unformatted capacity is 12.75 MB (10 MBytes formatted). Data access is via 2 heads, one per disk surface. The heads are positioned by a stepper motor with a rack and pinion positioner using servo information written on the disk by the drive itself.

o Drive Features

Standard industry interface: Interface technology is patterned after the standard 5.25-inch Winchester drive interface and data transfer rate. This enables systems designers to interface existing 5.25-inch Winchester controllers easily as well as allowing the use of inexpensive controller chips.

Soft-sectored Format: The drive features a raw track capacity of 10,416 bytes. Sector configuration and data header format are left to the OEM for optimization of their systems.

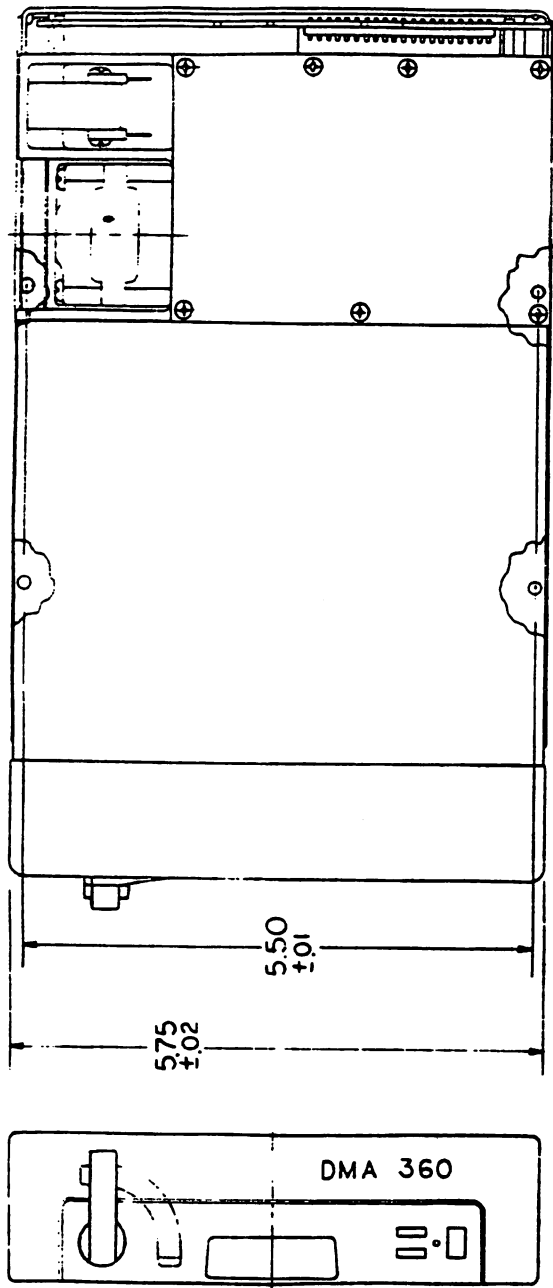
DMA Systems' Removable Disk Cartridge: The 360 disk cartridge features the same reliability, convenience, availability, and interchangeability as the ANSI standard Micro-Magnum removable disk cartridge. The cartridge has a formatted capacity of 10 MBytes, utilizes industry-standard oxide disk technol-

ogies and mechanical interface, and is tolerant of a wide range of environmental stress. The cartridge is available from multiple sources.

Innovative Packaging: The drive itself is contained in a drawer-like mechanism which is pulled from the cabinet for cartridge insertion and removal. When open, the drive extends about 4 inches from the system front panel; when closed and in the operating mode, the cartridge receiver compartment will protrude about 1.32 inches from the front panel (see Figure 1-1). The drive fits into an 8-inch space behind the system's front panel. It is 5.75 inches wide, 1.625 inches thick and weighs 3.5 pounds. A rotating lever on the front panel locks the drive door closed; the drive will neither slide back into the system nor operate unless this lever is in the locked position (see Figure 1-2). Two LEDs are located on the front panel as well and indicate whether the drive is active and what activity is current (see Section 5). Write Servo access is provided by an aperture next to the LEDs, and a Run/Stop switch on the right side of the panel permits drive spindle control.

o **Reliability Features**

Reliability is achieved through the use of DMA Systems' runout correcting servo system (patent pending), stepper motor micro-step positioning system, and dynamic head load. The drive features a self-contained, self-sealing air circulation system that cleans and recycles the air in a fast and effective manner.



□ 15 MAX. DEPTH THAT MOUNTING SCREWS CAN EXTEND INTO THE CHASSIS.

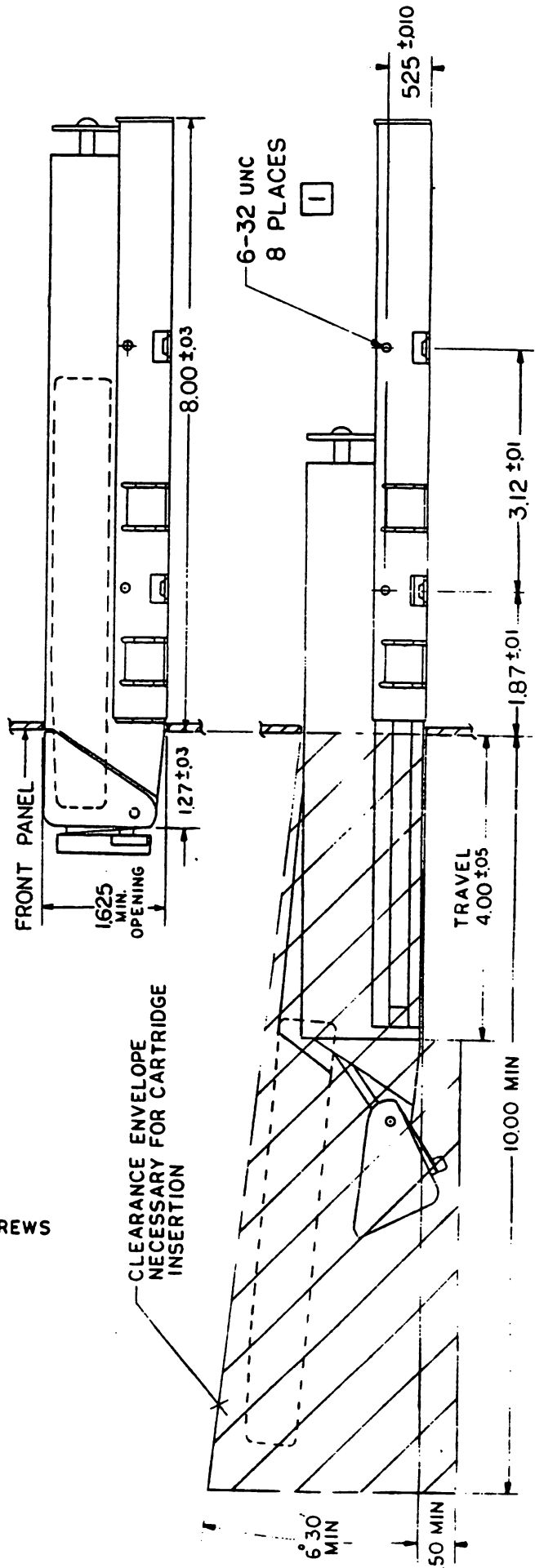


Figure 1-1. Drive dimensions and mounting hole locations.

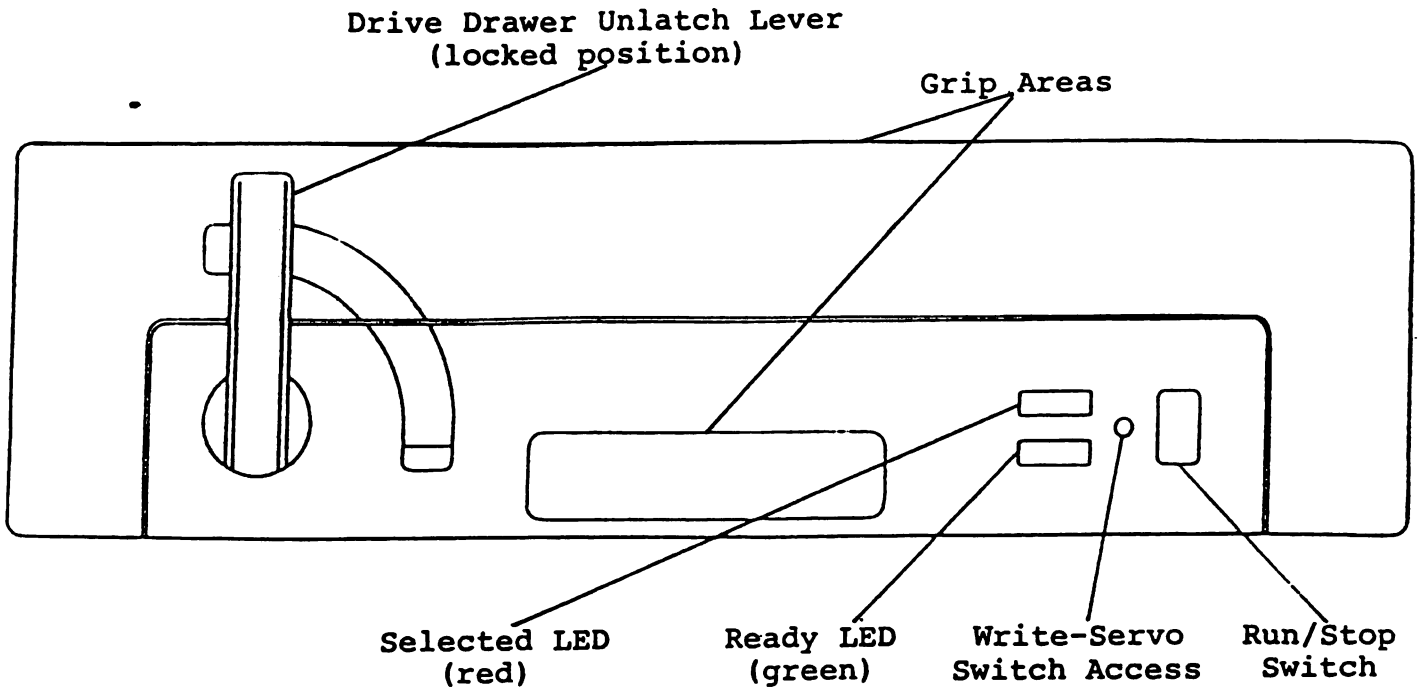


Figure 1-2. Drive front panel.

Self-Written Servo: The 360 drive allows each cartridge to be servo-written by the drive in which it is to be used. This enhances access time as each cartridge can be custom fitted to the drive in which it will ordinarily used while at the same time being completely interchangeable with any other 360 drive.

Dynamic Head Load: The DMA-designed head can be launched over the disk while it is rotating at full speed. This improves convenience as there is no need to stop the disk, load the heads over the disk surface, and then start up once again. More importantly, it greatly enhances reliability - the heads need never touch the disk. Thus, the risk of data destruction via head/disk contact is avoided.

Clean Air Purge: Within 30 seconds after the drive is turned on, the spindle is brought to operating speed. During this time the pumping action of the rotating disk and spindle is used to purge any particles that may have entered the cartridge and drive. The heads will be dynamically loaded at the end of this cycle.

o Drive Safety Features

Drive and data safety has been further enhanced by the inclusion of the following internal control functions.

Drawer closed and latched (DCL) switch: The DCL switch senses the presence or absence of the drawer-closed latch. Drive safety is insured as the drawer must be locked, and the switch closed, before the control logic turns the spindle.

Drawer unlock solenoid: Under microprocessor control, this solenoid-activated unlocking mechanism will allow the front panel Drawer Unlatch Lever to be unlocked permitting the operator to open the drawer. Loss of +12V DC power will deactivate the solenoid and lock the cartridge drawer for protection of the drive, cartridge, and customer data.

Write enable switch: This switch on the inside of the drive senses the presence or absence of the cartridge write-enable tab; closure of the switch will allow writing on the cartridge.

Index transducer: To insure drive safety, a magnetic transducer provides a spindle-speed control signal as well as acting as a cartridge-present sensor. If no cartridge is found to be present within 6 seconds of drive startup, the drive will automatically stop.

2.0 Product Specification

2.1 Performance:

	17-Sector Format	32-Sector Format	Unformatted
Drive (per cartridge)	10.6 MB	10.0 MB	12.75 MB
Surface	5.3 MB	5.0 MB	6.37 MB
Track	8,704 B	8,192 B	10,416 B
Per sector	512 B	256 B	NA

Access Times:

Move time - one track	3 ms maximum
204 tracks	85 ms maximum
612 tracks	250 ms maximum
Head switch	4 ms maximum
Settling time	13 ms maximum
Average latency	8.64 ms average

Self Written Cartridge -

Access: one track	25 ms average
204 tracks	107 ms average
612 tracks	272 ms average
head switch	26 ms average

Note: Write access assumes head is ontrack at first index burst.

Interchange Cartridge -

Access: one track	25 ms average
204 tracks	124 ms average
612 tracks	289 ms average
head switch	26 ms average

Note: Write access assumes head is ontrack at second index burst for long seeks.

2.2 Functional:

Rotational	3,473 RPM \pm 1%
Recording density	10,894 BPI
Flux density	10,894 FCI
Track density	612 TPI
Cylinders	612
Tracks	1,224
Heads	2
Purge cycle	20 seconds
Initialization cycle	10 seconds
Stop time	10 seconds

2.3 Interface:

ST 506/706 compatible	
Transfer rate	5 Mbit/second
Encoding	MFM

2.4 Cartridge:

- o ANSI Standard (X3B7-1983; April 1983)
5.25-inch mechanical compatibility
- o Standard oxide media

2.5 Power:

+ 5V DC \pm 5% @	0.6A
+ 12V DC \pm 10%	2.0A (max.- motor start)
\pm 5% @	1.3A (typical running)
Power dissipation	19 W typical

2.6 Reliability:

MTBF	10,000 hours
MTTR	30 min
Preventive maintenance	None required
Design life	5 years
Cartridge cycles	5,000

2.7 Error Rates (media defects mapped out):

Self servo-written cartridge -

Read	1 in 10^{10} bits
Write	1 in 10^{12} bits
Seek	1 in 10^6 seeks

Interchange cartridge -

Read	1 in 10^8 bits
Write	1 in 10^{12} bits
Seek	1 in 10^5 seeks

2.8 Environmental (operating):

Temperature	4° C to 50° C
Relative humidity	85% maximum (non-condensing)
Maximum Wet bulb temperature	28° C
Altitude	10,000 feet maximum
Air contamination	1 x 10 ⁶ particles/ cubic foot maximum @ ≥ 0.5 micron
Vibration	0.5 g maximum
Shock	10.0 g maximum
Electrostatic discharge	20,000 V maximum

*2-000000
10m/s*

2.9 Environmental (non operating):

Temperature	-40° to 70° C
Relative humidity	90% maximum (non-condensing)
Maximum Wet bulb temperature	28° C
Altitude	40,000 feet maximum
Vibration	1.0 g maximum
Shock	30 g maximum

*25 @ 2000 ft
40 @ 10m/s*

2.10 Package (see Figure 1-1):

Drawer Size -

Thickness	1.625 inches
Width	5.75 inches
Length	8.00 inches

Front Panel Overhang - 1.32 inches maximum

Drawer Motion - 4.00 inches maximum

Weight - 3.5 lbs.

3.0 DRIVE INSTALLATION

This section describes the recommended unpacking, inspection and mounting methods for the 360.

3.1 Unpacking and Inspection

The 360 is shipped in a sealed protective container designed to protect the drive from humidity, vibration and shock. Upon receipt of the unit from the carrier, first inspect the container for damage, then open it and unpack the drive. (Report any damage to the carrier immediately.) Save all packing materials in case reshipment becomes necessary.

3.2 Mounting

The 360 can be mounted horizontally or vertically. Mounting dimensions and hole locations are shown in Figure 1-1. Two mounting options are possible:

- o Four-point, bottom-mounted using the industry-standard minifloppy pattern.
- o Four point, side-mounted using the dimensions shown in Figure 1-1.

In all cases, use only # 6-32 screws of the appropriate lengths. Note that the maximum penetration depth is 0.15 inches.

See Figure 1-1 for drawer clearance and travel requirements. Take care that cables or other obstructions do not interfere with the running mechanism of the drive.

4.0 Drive Interface

4.1 General Description

The 360 interface to the host controller is provided via four connectors:

- o J1 - a 34-pin PCB edge connector for a flat cable carrying the control signal lines. This cable may be connected directly to the controller, or else linked in a daisy chain configuration with other drives. All signals are multiplexed by the -DRIVE SELECT n lines on this cable.
- o J2 - a 20-pin PCB edge connector for a flat cable carrying the data line pairs and control line signals. This cable may not be daisy-chained; it must be a direct radial connection to the controller.
- o J3 - a 4-pin connector providing DC power to the disk drive.
- o J4 - the frame ground connection.

Figure 4-1 shows a typical four-drive system connection.

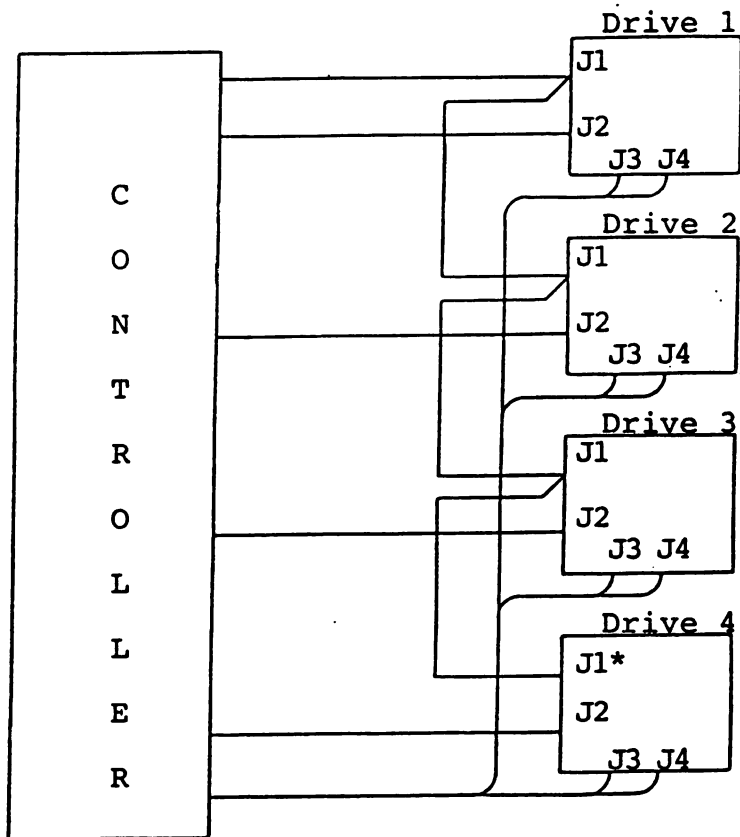


Figure 4-1. A typical connection for a 4-drive system (* = terminated).

4.2 Interface Logic, Electrical Requirements and Circuitry

4.2.1 Logic - Control Signals

Table 1 gives a summary of the control signal logic.

Table 1

Control Signals

Voltage Level	Signal State	Logical State	
		Table	Text
"Low"	Active	1 One	True
"High"	Inactive	0 Zero	False

4.2.2 Recommended Circuits, Control Signals

Figure 4-2 shows the recommended circuit configuration for the driver and receiver.

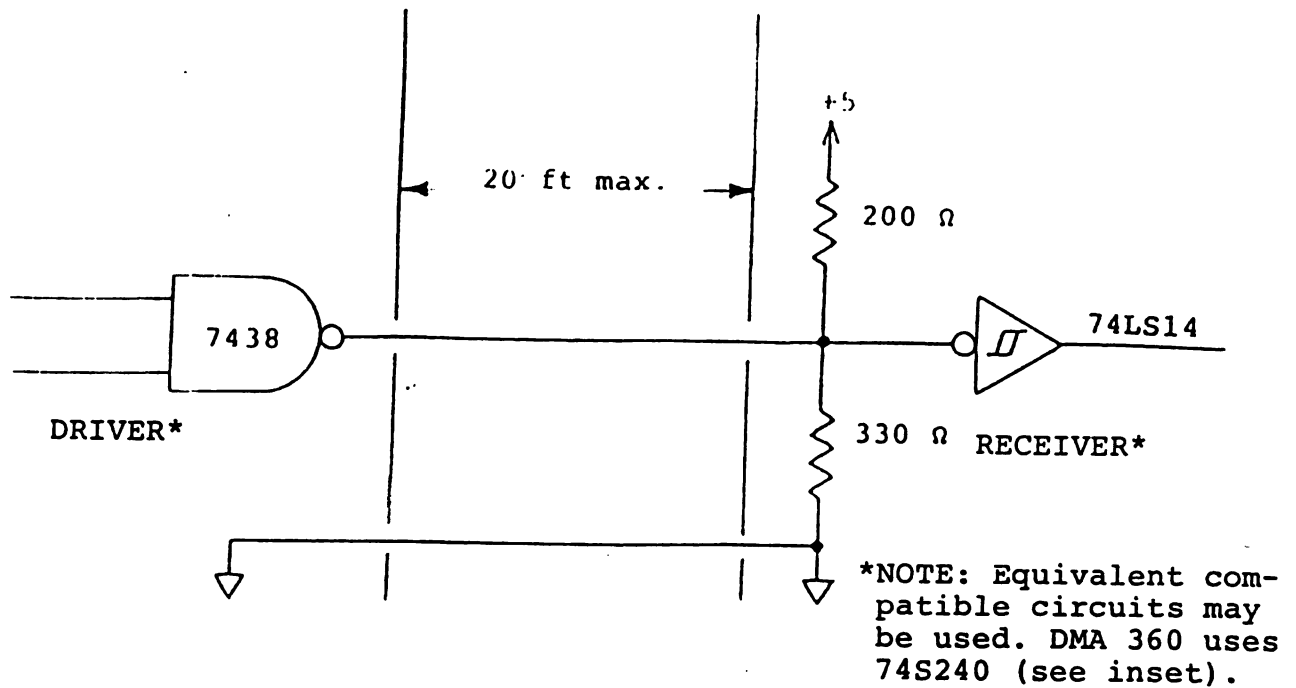


Figure 4-2. Control signals, driver/receiver.

A Schottky diode is provided on the output of the -DRIVE SELECTED driver to make it an open collector (see Figure 4-2a).

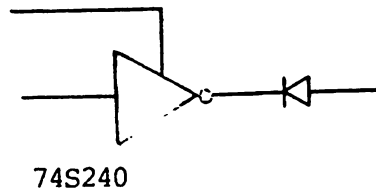


Figure 4-2a. Driver circuit (-DRIVE SELECTED).

The electrical specification for the driver circuit is as follows:

ACTIVE 0.0 to 0.4 volts dc @ 1 to 40 mA

INACTIVE 2.5 to 5.25 volts dc @ 1 to 250 μ A

o Termination

TBD

4.2.3 Cable Interface

o Connector Locations

TBD

See Figure 4-3.

4.2.4 J1 - Control Signals

Connection for J1 is through a 34-pin PCB edge connector. The dimensions for this connector are shown in Figure 4-4. The pins are numbered 1 through 34,

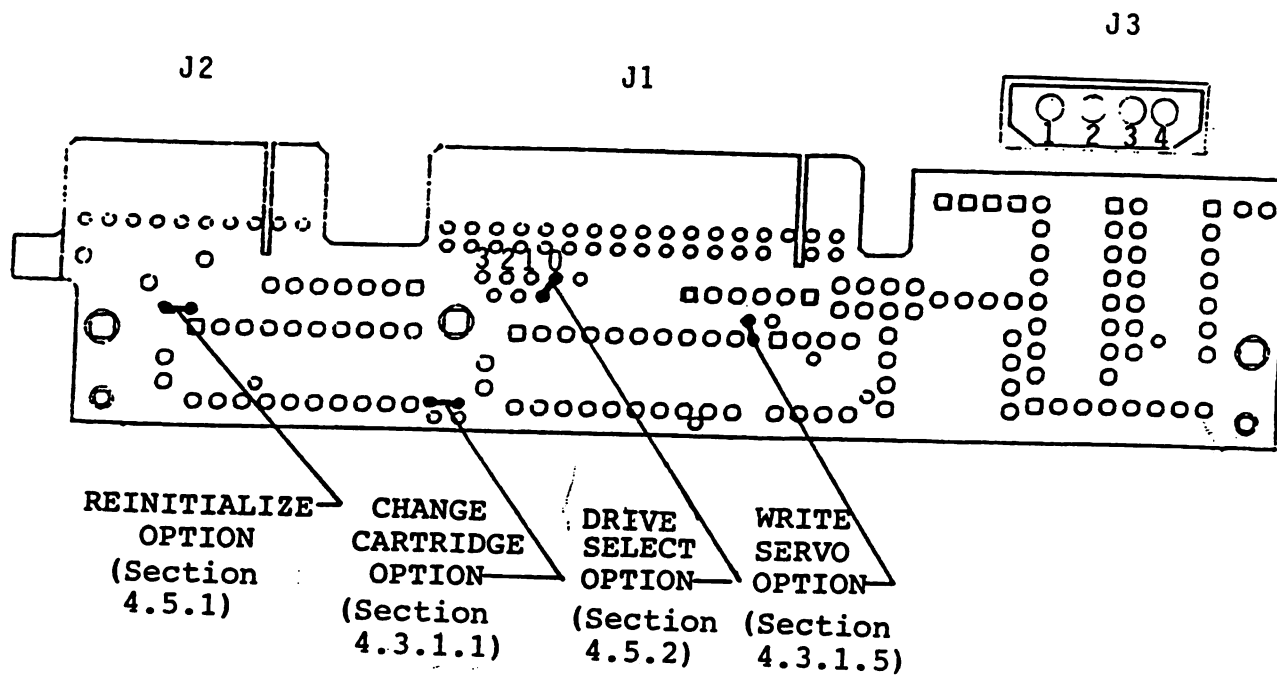
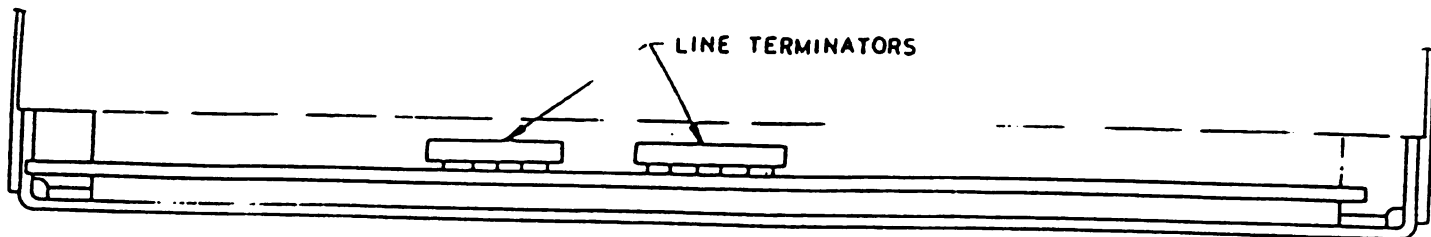


Figure 4-3. Connector and jumper option locations (Drive 1 shown selected).

with the even pins located on the component side of the PCB. A key slot is provided between pins 3 and 5. The recommended mating connector for P1 is AMP ribbon connector P/N 88373-3, key P/N 88113-1. All odd pins are ground.

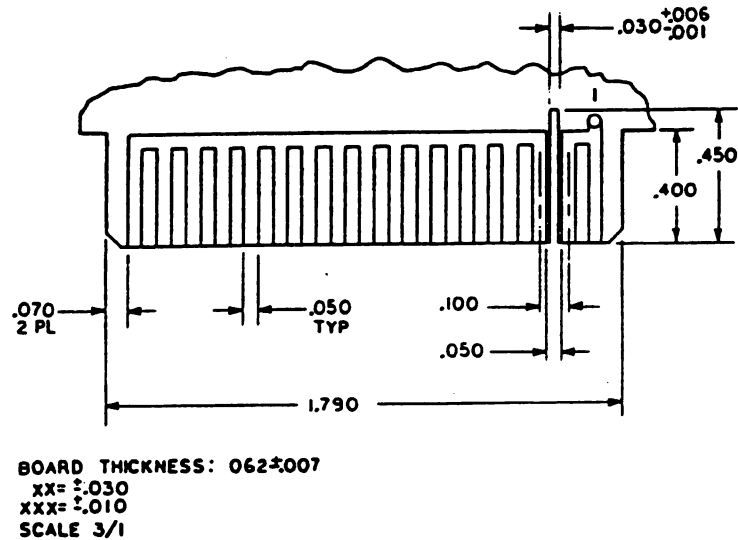


Figure 4-4. J1 dimensions (in inches).

4.2.5 J2 - Data Signals

Connection to J2 is through a 20-pin PCB edge connector. The dimensions for the connector are shown in Figure 4-5. The pins are numbered 1 through 20, with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector P/N 88373-6, key P/N 88113-1. A key slot is provided between pins 3 and 5.

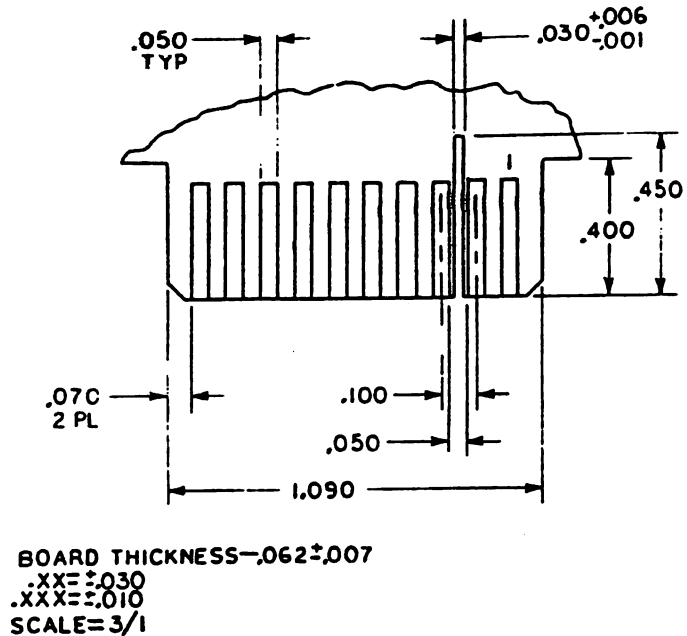


Figure 4-5. J2 dimensions (in inches).

4.3 Control Signals

Two types of control signals - multiplexed and multiplexing - facilitate the use of a multiple drive system; they are located on connector J1 (see Table 2 and Figure 4-6).

delay, the drive will commence a 3.5-minute sequence of first erasing the entire disk and then rewriting servo information. The Ready LED will flash at a 1Hz rate while servo is being written. Successful completion will be signaled by -SEEK COMPLETE, -READY, and -TRACK 000 becoming true. A write-protected cartridge will not be servo written. OPTION: This line on the connector (J1 pin 18) may be disconnected from the interface by cutting the PC board shunt as shown in Figure 4-3. This may be necessary on ST506 type controller using this line for Head Select 21.

4.3.1.6 -DIRECTION IN

The -DIRECTION IN signal defines the direction of motion of the read/write head when the -STEP line is pulsed. An inactive state, or logical zero, is defined as outward and if a pulse is applied to the -STEP line, the heads will move away from the center of the disk. If this line is active (a logical one), the direction of the motion is defined as inward and the heads will move toward the center of the disk. Any change in -DIRECTION IN must meet the requirements shown in Figure 4-8.

4.3.2 Output Control Signals

The output control signals are driven by the driver circuit shown in Figure 4-2. All J1 output lines are enabled by the respective drive select line.

4.3.2.1 -SEEK COMPLETE

The -SEEK COMPLETE line will become true when the heads have settled on the final track at the end of a seek or head switch.

-SEEK COMPLETE will become false in four cases:

1. A reinitialization or write-servo sequence is in process.
2. Less than 500 ns after the leading edge of a -STEP pulse or the first of a series of these pulses.
3. Less than 500 ns after a change in -HEAD SELECT.
4. At any time a write-fault condition exists in the drive; writing or seeking should not be attempted when -SEEK COMPLETE is false.

4.3.2.2 -TRACK 000

This interface signal indicates a true or active state only when the drive's heads are positioned at track 0 (the outermost data track) after the power-on initialization, a Rezero command or the reinitialization or servo writing sequences. It does not become true during a normal seek to track 0.

4.3.2.3 -WRITE FAULT

This signal becomes true whenever a condition arises which would make a write operation unsafe. These conditions are divided into two categories: controller resettable and nonresettable.

o Resettable Write Faults. The following conditions are generally caused by external factors, not drive hardware faults, and may be cleared by the controller from the interface:

A write is attempted on a write-protected cartridge; or,

-WRITE GATE asserted but no write data.

Either of these conditions will cause -WRITE FAULT to go true; -READY will remain true and the drive will seek and read at any time

-SEEK COMPLETE is true. Under these conditions the -WRITE FAULT line can be reset from the controller by a deselect lasting more than 1 ms.

o Nonresettable Write Faults. These fault conditions are serious and generally indicate one of the following:

- Open head
- Shorted head
- Spindle off speed
- Loss of +12V DC
- Loss of servo information

mandatory

Under these conditions -WRITE FAULT will be true; -SEEK COMPLETE and -READY will be false. The green Ready LED will flash at a 4Hz rate while the drive is in this condition. Reset may be attempted by the operator pushing the Run switch. If the fault condition has cleared, the drive will retract the heads, shut the spindle down and unlock the front door. -WRITE FAULT will also be cleared by a power-off reset sequence, a Write-Servo command, or a Reinitialize command.

If the fault persists, the drive will remain in the Fault mode with the door locked.

4.3.2.4 -INDEX

-INDEX is an interface signal provided by the drive once each revolution to indicate the beginning of a track. Normally, this signal is in the inactive state and makes the transition to the active state to indicate the index sector. Only the leading edge transition is valid (see Figure 4-9). -INDEX will not appear when -SEEK COMPLETE is false.

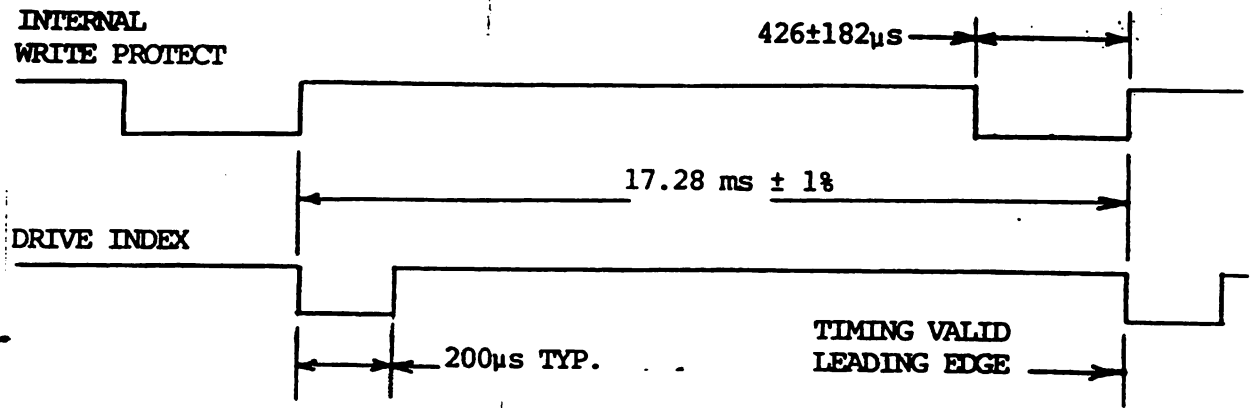


Figure 4-9. Index timing.

4.3.2.5 -READY

This interface signal, when asserted with -SEEK COMPLETE, indicates that the drive is ready to read, write or seek, and that the input and output signals are valid. When this line is false, all writing and seeking are inhibited. -READY will become true 30 seconds after power on.

4.3.3 Multiplexing Signals

4.3.3.1 -DRIVE SELECT n

Four drive select lines are present on J1 (-DRIVE SELECT 1 through 4). A drive may be assigned a unit number by positioning a jumper (see Figure 4-3). When the -DRIVE SELECT n line corresponding to the preprogrammed unit number is asserted, the drive will respond to commands on the J1 bus.

4.4 Data Signals

All lines associated with the transfer of data between the drive and the host system are differential in nature and may not be multiplexed. These lines are provided at the J2/P2 connectors. See Table 3 and Figure 4-10 for pin assignments. Refer to Figure 4-11 for the recommended circuit.

Table 3. J2/P2 connector pin assignment.

GRN RTN <u>PIN</u>	SIGNAL <u>PIN</u>	SIGNAL <u>NAME</u>	
2	1	-DRIVE SELECTED	
4	3	-REINITIALIZE	<i>Reserved</i>
6	5	-WRITE PROTECTED	<i>Reserved</i>
8	7	Reserved (open)	
10	9	-CARTRIDGE CHANGED	<i>spare</i>
12	11	Ground	
	13	+MFM WRITE DATA	
	14	-MFM WRITE DATA	
16	15	Ground	
	17	+MFM READ DATA	
	18	-MFM READ DATA	
	19	Ground	
	20	Ground	

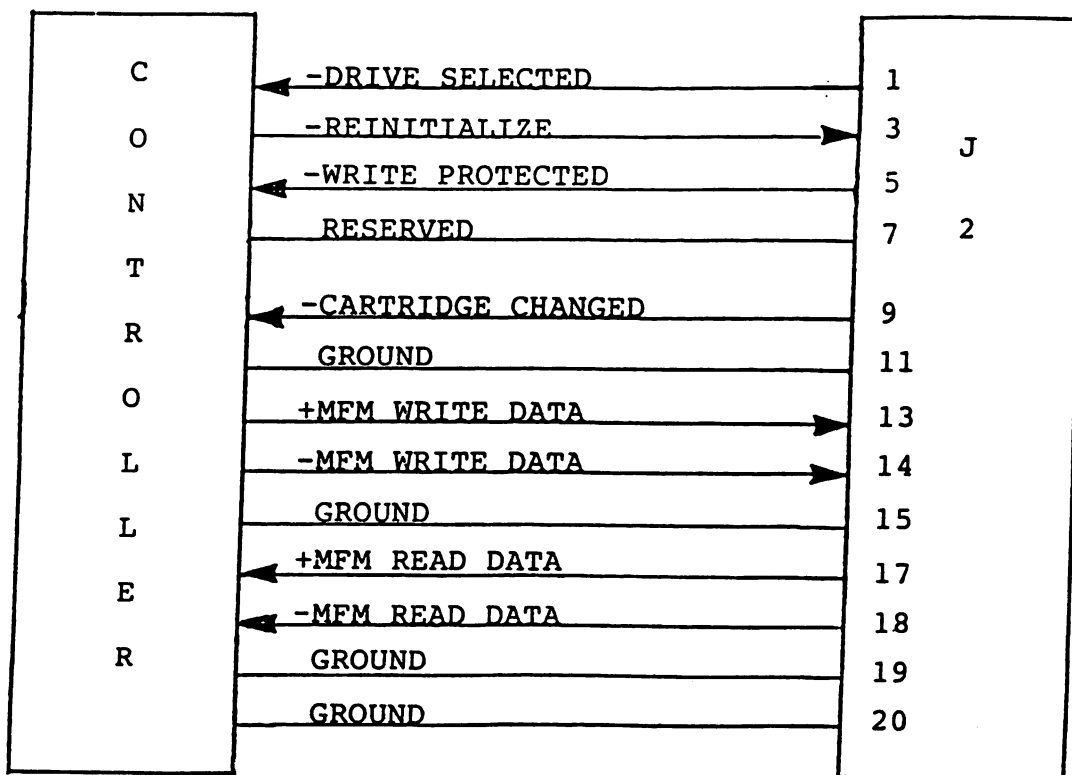


Figure 4-10. J2 pin assignments and controller-drive interface.

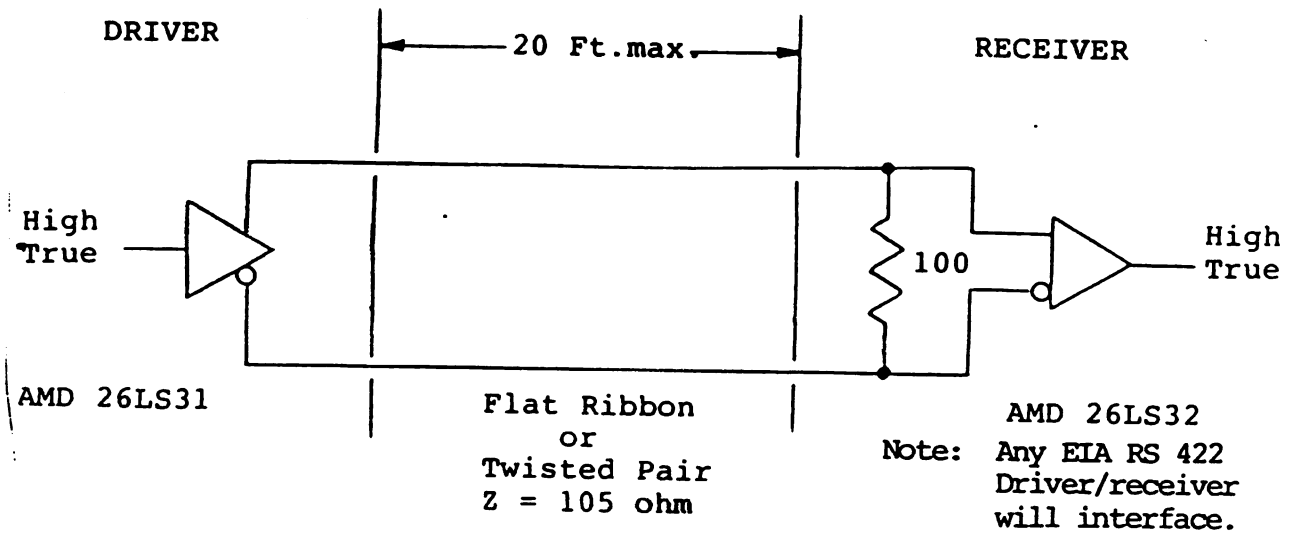


Figure 4-11. Data signal driver/receiver circuit.

4.5 Radial Control Lines

Control lines on J2 are not multiplexed by -DRIVE SELECT n.

These lines include:

Input Control Signals

-REINITIALIZE

Output Control Signals

-DRIVE SELECTED

-WRITE PROTECTED

-CARTRIDGE CHANGED

4.5.1 -REINITIALIZE

-REINITIALIZE provides a servo reinitialization cycle wherein track location and disk runout information are reprogrammed in the drive microprocessor.

This function may be employed by the host system to improve seek error rate, and is automatically provided on a power-up sequence or after a cartridge change.

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The reinitialization sequence is begun by bringing the -REINITIALIZE line active for a minimum of 500 ns along with -DRIVE SELECT n. -READY must be true; and -WRITE FAULT can be true - the fault will be cleared by this function. If the fault condition has cleared, the reinitialization sequence will proceed. This function may take up to 10 seconds to complete. The end of this process is signaled by -READY, -SEEK COMPLETE, and -TRACK 000 being true. -WRITE FAULT will be cleared.

OPTION: This line on the connector (J2 pin 3) may be disconnected from the interface by cutting the PC board shunt as shown on Figure 4-3. This may be necessary when using ST506 type controllers that do not support the Reinitialize function.

4.5.2 -DRIVE SELECTED

A status line is provided at the J2/P2 connector to inform the host system of the selection status of the drive.

The -DRIVE SELECTED line is driven by an active TTL (74S240) diode-isolated driver as shown in Figure 4-2. This signal will go active only when the drive is configured as drive n (n = 1,2,3 or 4), by positioning the jumper (see Figure 4-3) on the drive, and when the appropriate -DRIVE SELECT n line on J1/P1 is activated by the host system. As shipped the drive will be programmed as Drive 1.

OPTION: A radial select option is provided by shorting a jumper as shown on Figure 4-3. This may be used in single-drive systems where the drive will be in a permanently selected state.

4.5.3 -WRITE PROTECTED

This interface signal will be true during seeks, power-up (-READY false), and when a write-protected cartridge (Write-Enable tab removed) has been installed in the drive.

4.5.4 -CARTRIDGE CHANGED

This signal indicates to the host system that the cartridge has been changed. When the drive detects a drawer-open, drawer-closed signal sequence, the -CARTRIDGE CHANGED line becomes true. This line can be reset, after the host system has recognized that the cartridge has been changed, by selecting the drive after -READY becomes true and then deselecting it for more than 1 msec. This line will be set to true during a power-on sequence.

4.5.5 MFM WRITE DATA

This is a differential line pair that defines the transitions to be written on the track. The transition of the +MFM WRITE DATA line going more positive than the -MFM WRITE DATA will cause a flux reversal on the track provided -WRITE GATE is asserted. This signal must be driven to an inactive state (+MFM WRITE DATA more

negative than -MFM WRITE DATA) by the host system when in the read mode.

To insure data integrity at the error rate specified, Write Data signals presented to the drive by the host system must be pre-compensated on cylinders TBD through 611. The optimum amount of pre-compensation is 12 ns for both early and late bits.

4.5.6 MFM READ DATA

The data recovered by reading a pre-recorded track is transmitted to the host system via the differential pair of + and -MFM READ DATA lines. The transition of the +MFM READ DATA line going more positive than the -MFM READ DATA line represents a flux reversal on the track being read by the selected head. This data channel is gated to its active state by the combination of -WRITE GATE being false and -DRIVE SELECT n being true. At the index servo field when -SEEK COMPLETE is true, a crystal-derived AAA... pattern will be transmitted on the + and -MFM READ DATA lines so that no gaps are present in the data stream. In addition, the selected drive will transmit this pattern at any time -SEEK COMPLETE is false.

4.5.7 Write to Read Recovery

Write to read recovery time of the data channel will be a maximum of 3 μ s from the transition of -WRITE GATE (true to false).

Table 2. J1/P1 connector pin assignment.

GND RTN PIN	SIGNAL PIN	SIGNAL NAME	
1	2	-CHANGE CARTRIDGE	<i>Reserved</i>
3	④	— Reserved (open)	<i>head select 2</i>
5	6	-WRITE GATE	
7	8	-SEEK COMPLETE	
9	10	-TRACK 000	
11	12	-WRITE FAULT	
13	14	-HEAD SELECT (2 ⁰)	
15	⑩	Reserved (open)	
17	18	<i>Rev.</i> -WRITE SERVO	<i>head select 2</i>
19	20	-INDEX	
21	22	-READY	
23	24	-STEP	
25	26	-DRIVE SELECT 1	
27	28	-DRIVE SELECT 2	
29	30	-DRIVE SELECT 3	
31	32	-DRIVE SELECT 4	
33	34	-DIRECTION IN	

The multiplexed signals are:

Input Control Signals

- CHANGE CARTRIDGE
- WRITE GATE
- HEAD SELECT
- STEP
- WRITE SERVO
- DIRECTION IN

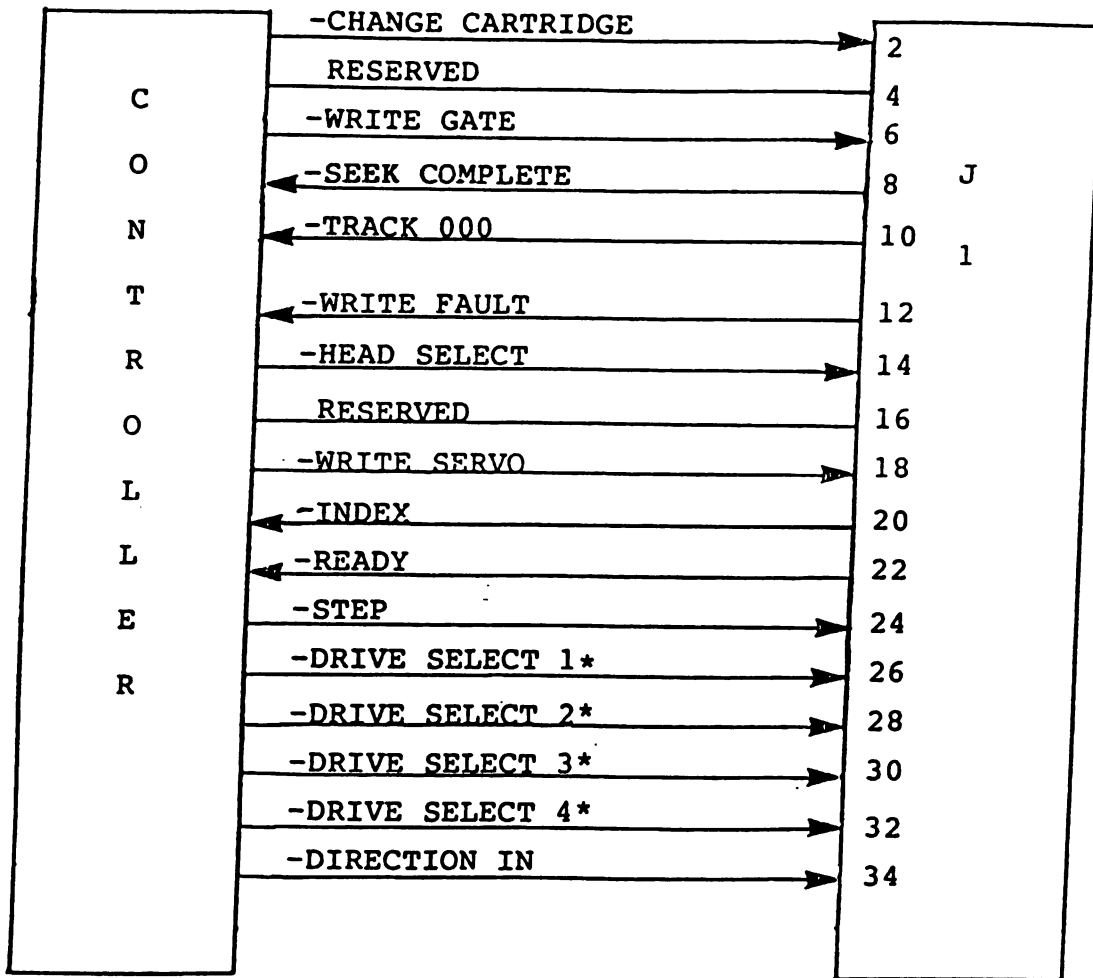


Figure 4-6. J-1 pin assignments and controller-drive interface. (* = multiplexing signals; all other signals are multiplexed).

Output Control Signals

- SEEK COMPLETE
- TRACK 000
- WRITE FAULT
- INDEX
- READY

The multiplexing signals are:

- DRIVE SELECT 1
- DRIVE SELECT 2
- DRIVE SELECT 3
- DRIVE SELECT 4

4.3.1 Input Control Signals

The following input control lines use the receiver circuit shown in Figure 4-2.

4.3.1.1 -CHANGE CARTRIDGE

This line, when active for a minimum of 500 ns, together with -DRIVE SELECT n and -READY or -FAULT, will cause a spindle power down sequence in the drive. This line can be used by the host system to initiate a cartridge change operation or to unload heads and stop the spindle in preparation for a system shut down. Once the drive spindle has been stopped by this command, it cannot be restarted from the interface. Restart may be accomplished by one of the following:

- a. operator changing a cartridge (opening drawer)
- b. operator pressing the Run switch
- c. a power-off reset

OPTION: This line on the connector (J1, pin 2) can be disconnected from the interface by cutting the PC board shunt as shown in Figure 4-3. This may be necessary when using ST506 type controllers which use this pin for the Reduced Write Current function.

4.3.1.2 -WRITE GATE

When this signal is active, data may be written on the cartridge; its inactive state permits data to be transferred from the disk and enables a seek or head change as well.

4.3.1.3 -HEAD SELECT

The -HEAD SELECT line provides head selection; the active (low) state of this line indicates head 1 (the lower head). A change in state of the -HEAD SELECT line will cause -SEEK COMPLETE to become inactive while the drive positions the newly selected head over the track. Head select timing is shown in Figure 4-7. A first step pulse acceptance delay is incorporated to allow a seek/head switch.

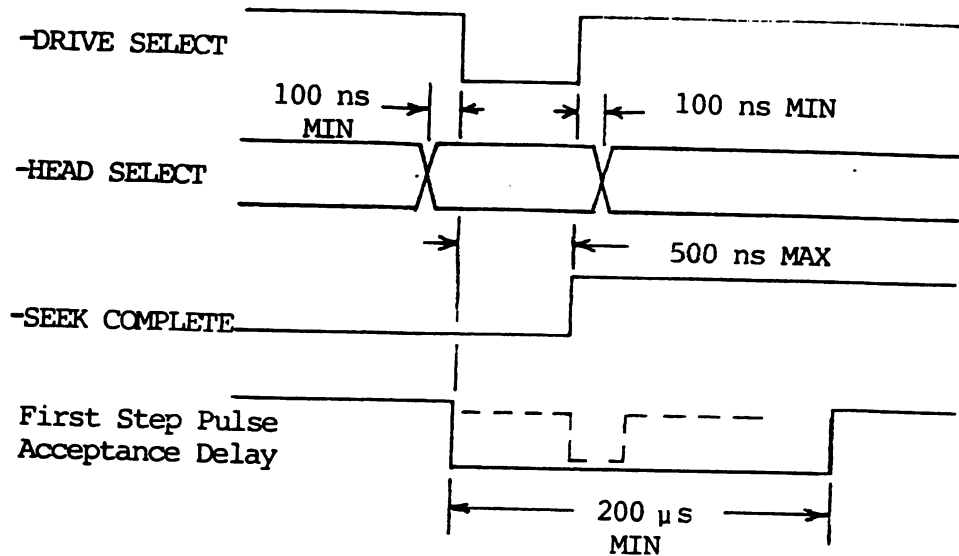


Figure 4-7. Head select timing.

4.3.1.4 -STEP

This interface line is a control signal causing the read/write head to move in the direction defined by the -DIRECTION IN line. Any change in the -DIRECTION IN line must be made at least 100 ns before the leading edge of the -STEP pulse. The drive operates in the buffered step mode, as described below, as well as in a form of low speed step mode (see Slow Step).

o **Buffered Seek Mode.** In the buffered step pulse mode, the -STEP pulses are received at a high rate and buffered into a counter. Each pulse transmitted represents a request for a single track move in the direction indicated by -DIRECTION IN.

A seek operation is initiated by the leading edge of the first -STEP pulse. As shown in Figure 4-8, -DRIVE SELECT n, -HEAD SELECT, and -DIRECTION IN lines must be true at least 100 ns prior to the leading edge of the first -STEP pulse and must remain true until after the last -STEP pulse. The end of the -STEP pulse burst is defined as a 200 μ s period with no pulses. -SEEK COMPLETE will go false no later than 500 ns after the first -STEP pulse.

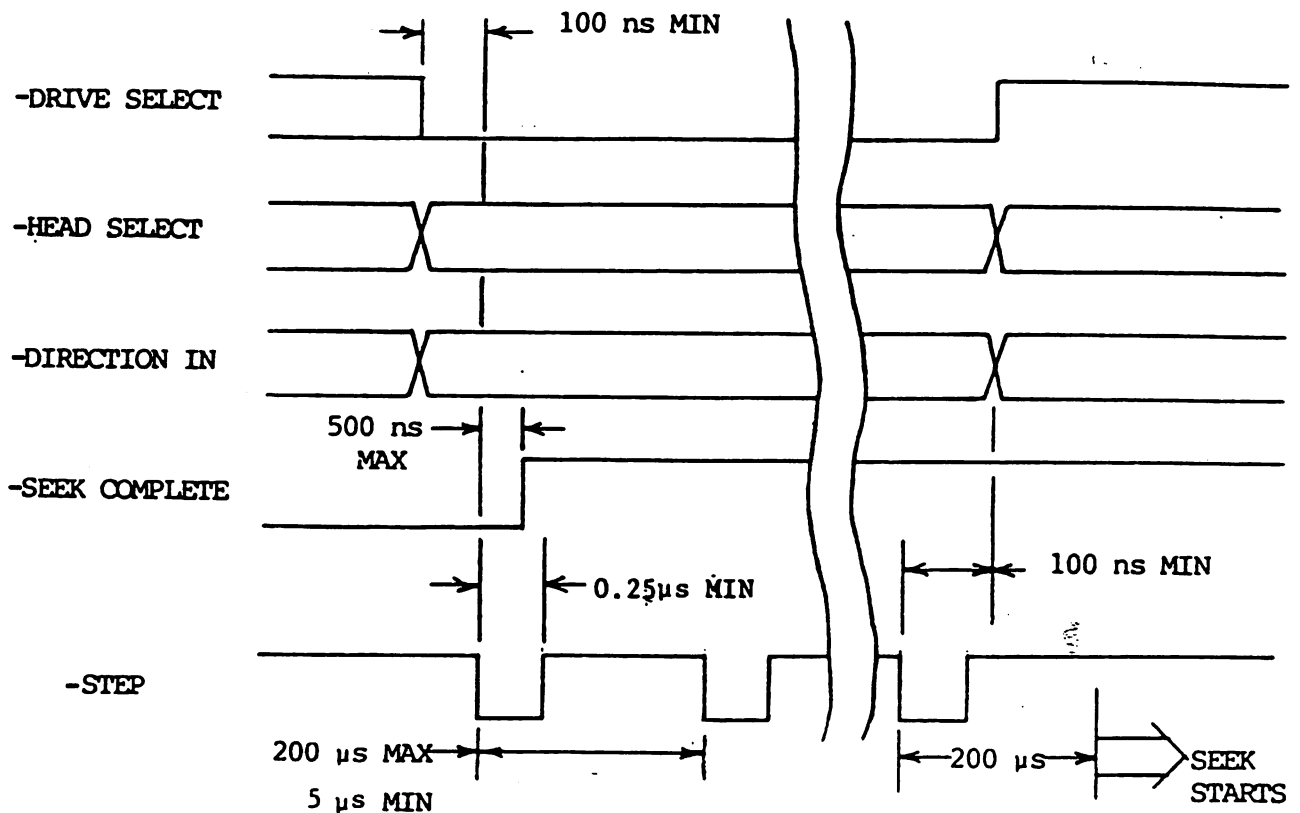


Figure 4-8. Buffered seek timing.

-DIRECTION IN and -HEAD SELECT will be sampled and latched at the end of the -STEP pulse burst. Therefore, these two lines must be held static until -DRIVE SELECT n goes false after the leading edge of the last step pulse. The drive may be deselected during a Seek operation.

Note that the -STEP pulses must begin not more than 200 μ s after any change in the state of -HEAD SELECT; if not, the drive will assume a head change only and ignore the late arriving -STEP pulses (see Figure 4-7).

o Slow Step

The ST506 Slow Step mode (3 ms Step period) is not supported in the strictest sense; however, a form of Slow Step is accomplished by using a series of 3 ms -STEP pulses in the following manner. The first pulse will be interpreted as a single-track seek and the drive will perform this operation. During the time the drive is performing the single-track seek it will also be accumulating any newly arriving pulses. At the end of the seek, the drive will then execute a 7-track seek since, typically, approximately 7 -STEP pulses will have arrived while the single-track Seek was being executed. This process will continue, with the drive executing longer and longer seeks until the Slow-Step burst fin-

ishes and the final seek has been executed.

- o Rezero

A rezero command will be assumed by the drive at any time the controller directs a seek to what the drive processor perceives to be a negative track number. The drive will execute a hardware search for track zero and then respond with -TRACK 000 and -SEEK COMPLETE on the interface.

- o Track Greater Than 611

If the controller issues a seek to a track greater than 611 by drive processor definition, the drive will stop at track 611 (drive definition) and await further instructions.

4.3.1.5 -WRITE SERVO

The Write-Servo function completely erases the existing servo information, and all other data, on the disk and then rewrites the servo information. This provides optimum alignment between cartridge and drive (and may enhance seek performance) as each cartridge can be servo-written by the drive in which it is to be used.

To initiate a Write-Servo sequence from the interface, -WRITE SERVO and -DRIVE SELECT n must be held active for 1 second. The drive must be in either the ready or write-fault state. After the 1-second command acceptance

4.6 J3 - DC Power

The DC power connector (J3) is a 4-pin AMP Mate-N-Lok connector (P/N 350211-1) mounted on the solder side of the PCB. The recommended mating connector is AMP P/N 1-430424-0 utilizing AMP pins P/N 350078-4 (strip) or P/N 61173-4 (loose-piece). J3 pins are numbered as shown in Figure 4-12.

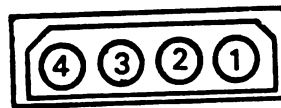


Figure 4-12. J3 - DC power connector.

	<u>Pin</u>
+12 Volt	1
+12 Volt return	2
+5 Volt return	3
+5 Volt	4

4.7 J4 - Frame Ground

DC logic ground is connected to the drive deck. J4 is provided so that the drive deck ground may be connected to the host frame ground. The drive deck is electrically isolated from the chassis drawer-slide rails bolted to the system mounting points.

4.8 Safety Interlock Features

4.8.1 Loss of +12V DC

If the +12V DC supply voltage drops below a safe level, the drive will write protect the cartridge, attempt to retract the heads, and keep the front door locked. The drive will assert -WRITE FAULT. If the +12V DC voltage is lost before retract can be completed, the heads will land on the disk surface.

4.8.2 Loss of +5V DC

In the event that +5V DC drops below a safe level, the drive will go into the Write Protect mode and shut down all processor functions. If +12V DC remains safe, the spindle will continue to run. In the event the +5V DC voltage returns to a normal level, the drive will execute the Power-On sequence (see Section 4.8.3).

4.8.3 Power-On Sequence

When power is supplied to it, the drive first checks for the drawer closed and latched condition (DCL switch, see Section I). If this is so, the drive will then bring the spindle up to speed and execute a head retract sequence. If the heads were already retracted, there will be no carriage motion. After the air purge cycle, the heads will be loaded, the drive will be initialized ready to accept commands from the interface.

4.8.4 Drawer Lock

At any time the drive is running, the drawer unlatch lever will be locked and the drawer latched in position.

4.8.5 Head Retract

The heads are retracted fully from the cartridge before the drawer can be unlocked. In this way the heads are protected at any time a cartridge is inserted or removed from the drive.

4.8.6 Dynamic Head Load

The heads are flown onto the disk surface only after the disk is fully up to speed, with the air system active and the drive fully purged of any foreign particles.

4.8.7 Read/Write Unsafe

A special circuit feature senses various head-related hardware failures which might endanger recorded data or servo information. Such conditions as an open head, shorted head, multiple-head select, or a write gate with no write data will cause an automatic write-protect condition.

4.8.8 No Cartridge

In the event that an operator starts the drive with no cartridge present, the drive will spin up for 6 seconds, sense the absence of the cartridge and then shut down the spindle without loading heads. The front door lock will be released after 12 seconds have elapsed since Run switch activation.

4.8.9 Excess Runout

If a cartridge with excessive runout is installed in the drive, data could be written off track preventing the drive from achieving the specified write-error rate.

To circumvent this, when a cartridge is first installed and initialized, runout is measured. If runout is excessive, the drive will write-protect the cartridge preventing further writing on the disk. Data, however, may still be read from the cartridge.

5.0 DRIVE DESCRIPTION and GUIDE TO OPERATION

5.1 Front Panel Layout and Mechanics*

The 360 drive front panel is composed of the following elements: Drawer Unlatch Lever; 2 LEDs; Write-Servo Switch Access; the RUN/STOP switch; and 2 grip areas (see Figure 5-17).

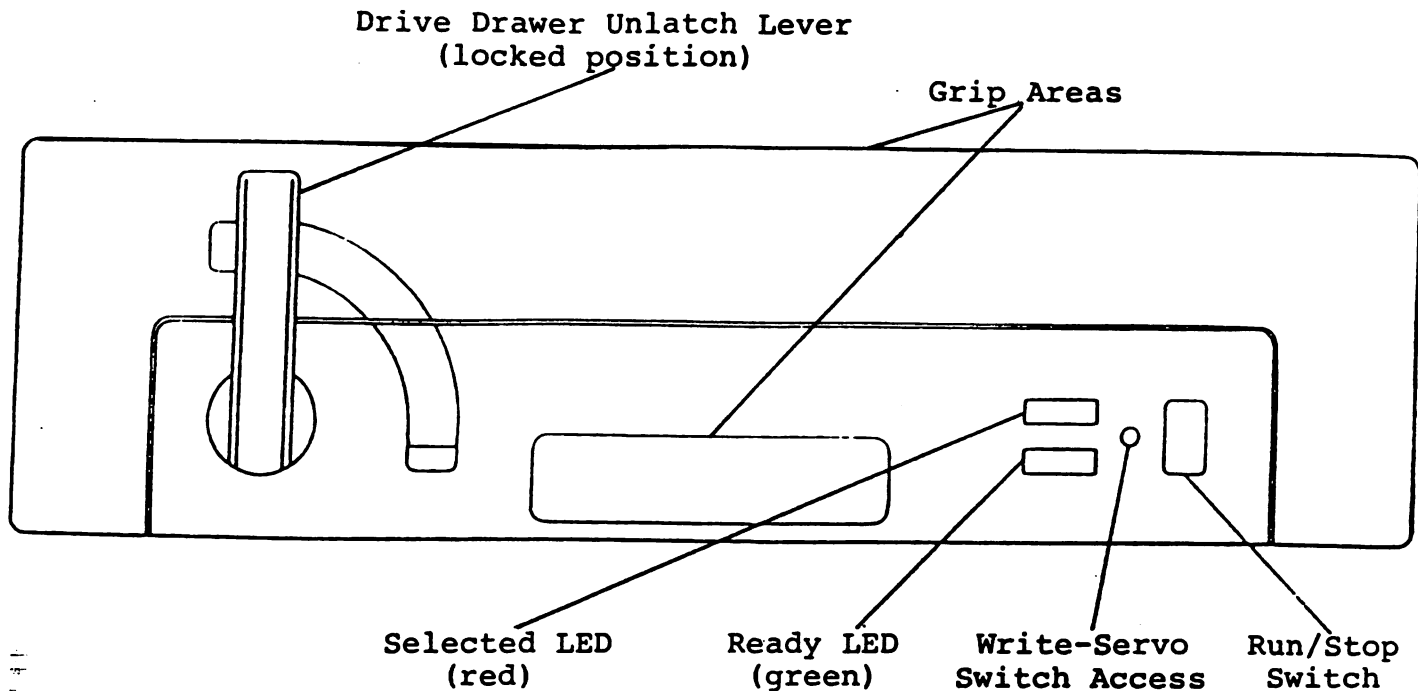


Figure 5-1. Front panel.

o Drive Drawer Unlatch Lever

The drive drawer is unlatched by a pivoting lever situated on the left side of the front panel. The lever operates a multifunction interlock system that protects drive components as well as customer data.

*A detailed description of the function of each element and of drive operation is given in Section 5.2.

- o Grip Areas

Two areas on the front panel have been textured to provide a sure grip for drawer movement: the top of the door and the recess in the middle of the lower half of the front panel.

- o Red and Green LEDs

Two LEDs are located to the right of the grip indentation. The top LED, red, indicates that the drive has been selected by the controller and is active. The green LED is an activity indicator and, by the following variations in flashing frequency, will indicate the current drive condition:

Steadily Lighted - the drive is ready for operation and will accept commands.

Flashing at a 1 Hz rate - the drive is either coming up to speed or else the Write Servo command is being executed. If the drive is in the spin-up mode, the flashing sequence should last no more than 30 seconds before the LED begins to shine steadily; if the drive is writing servo, the flashing sequence will last approximately 3.5 minutes.

Flashing at a 2 Hz rate - the spindle is coming to a stop. This should last no more than 10 seconds.

Flashing at a 4 Hz Rate - the drive is in an unresettable (by the interface/controller) fault condition. The fault may be cleared by the operator (see Section 4.3.2.3). If a new, not yet servo-written disk has just

been installed, the LED will flash at the 4 Hz rate. In this case the fault may be cleared by initiating a Write-Servo sequence (see Section 4.3.1.5 or 5.2). However, in any other circumstance this flashing sequence indicates a possible drive hardware failure: an open or shorted head; spindle out of speed tolerance; or loss of +12 V DC or servo information. The fault may be cleared by executing a stop/run sequence or by removing and then resupplying power to the drive. Before attempting a reset, consult Section 4.3.2.3 or call the factory. The LED will continue to flash at the 4 Hz rate as long as power is supplied to the drive or until the fault has been cleared.

o Write-Servo Access

The Write-Servo switch, located behind the front panel, is accessible only through an aperture situated between the LEDs and the Run/Stop switch (see Sections 4.3.1.5 and 5.2). Access to the Write-Servo switch has been restricted purposely as this function will **erase all existing servo and customer data from the disk**

o Run/Stop Switch

The Run/Stop switch is located on the right side of the panel. It is used to start or stop drive in order to change the cartridge (or for a major fault clearing sequence - see Section 4.3.2.3). Upon activation of this switch, the drive will change spindle control (i.e., from run to stop, or from stop to run). Main

power to the drive is provided by the system in which it is contained. Power to the drive should be removed only after either the Run/Stop switch has been used to unload the heads and stop the spindle or a -CHANGE CARTRIDGE signal from the controller has stopped the spindle. Otherwise, the heads will land on the disk. The cartridge cannot be removed after power is off.

5.2 Basic Drive Operation

First, power must be supplied to the drive. Otherwise, the drawer will remain locked.

o Cartridge Installation

To install a cartridge, unlatch the drive door by rotating the door Unlatch Lever clockwise 90°. Pull the drawer from the front panel until a click is heard (the drive will now extend approximately 5.25 inches from the front panel). Gently pivot the drive door downward until the cartridge receiver raises about 0.25 inch (door motion will be slightly more than 90°). The cartridge may now be inserted (see Figure 5-2).

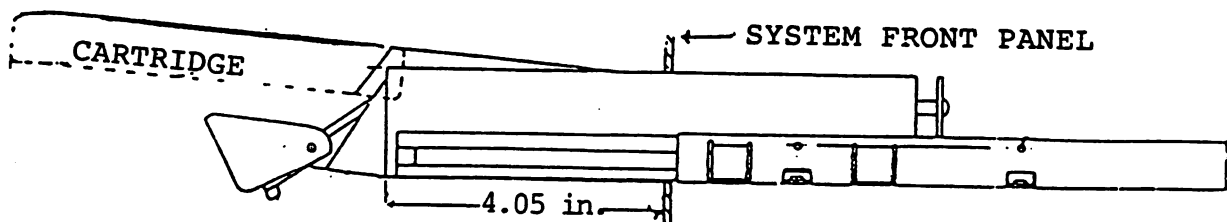


Figure 5-2. Cartridge Installation

To close the drive, the door should be slowly pivoted upward. This will cause the cartridge receiver to retract and seat. Move the door latch lever counter-clockwise until it is pointing straight up, locking the drive door. The drive may now be slid gently back into the housing. A click will be heard when it is in place. At this point the drive will be protruding approximately 1 inch from the housing (see Figure 5-3). The Run/Stop switch may now be used to start the drive spindle.

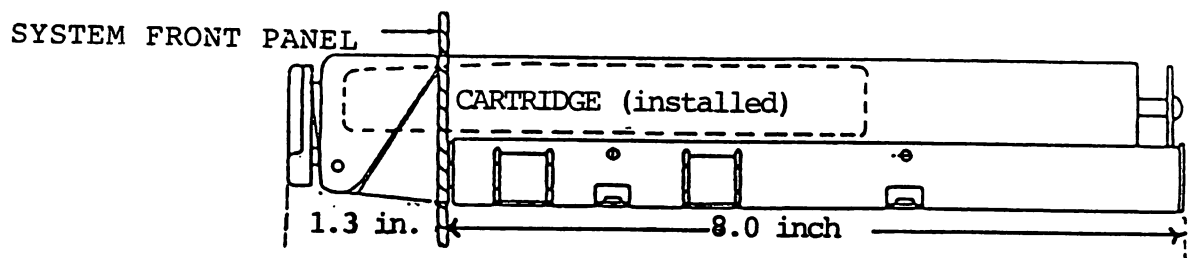


Figure 5-3. Drive ready for operation.

When power is supplied to the drive, the control system will initiate the Run sequence, if a cartridge is present, and bring the drive to the Ready state. The Ready LED (green) will be shining steadily.

o Write Servo

By using an unfolded paper clip the Write Servo switch may be activated through the Write Servo Access located between the LEDs and the Run/Stop switch (see Figure 5-1). To servo write a cartridge, insert the cartridge in the drive and activate the Run switch. **(Remember - the cartridge will be completely erased during this sequence.)** Once the drive is

up to speed and Ready (indicated by a steadily shining green LED) or faulted (indicated by the green LED flashing at 4 Hz) as would be the case with a new, blank cartridge, the Write-Servo command will be accepted. The servo writing sequence is begun by first holding the Write-Servo switch down with the paper clip while simultaneously pressing and then releasing the Run/Stop switch. The drive will indicate command acceptance by flashing the Ready LED at a 1 Hz rate. The drive will erase all data and then write new servo data on the cartridge. Servo writing takes approximately 3.5 minutes during which time the LED will flash at the 1Hz rate. At the end of the Servo-Write sequence the drive will re-initialize and become ready to accept commands.

6.0 DISK CARTRIDGE DESCRIPTION and SPECIFICATION

This section will describe the DMA Removable Disk Cartridge and its specifications.

6.1 General Description

The 360 cartridge utilizes ANSI-standard mechanical specifications. Although all of DMA Systems' Micro-Magnum cartridges adhere to this same standard, it must be remembered that those cartridges are intended for use with other members of the DMA Systems family of drives (the Micro-Magnum 5/5 and 5R, etc.) and are servo-written at the factory. Thus, in order to be used in the 360 drive, these cartridges would have to be rewritten with servo information by the 360 drive. **All data on the cartridge would be erased during this process.** The 360 cartridge cannot be used with other than the 360 drive as the servo information would either be non-existent (as in the case with a new 360 cartridge) or incompatible if servo-written by a 360 drive.

The disk cartridge consists of a standard 5.25-inch oxide disk (130mm ANSI proposed standard) clamped to a hub and enclosed in a plastic housing. The cartridge provides the industry standard (proposed ANSI standard) mechanical interface, with the interaction between the cartridge housing and disk hub defining the mechanical interface. The cartridge is designed for front loading applications and is dimensioned to preclude improper insertion. Both disk surfaces are available for data

storage, and are ready to be servo-written. When the cartridge is inserted into the drive, the door actuator mechanism opens the head access and air filtration ports. When the cartridge is removed, the door automatically closes, protecting the interior of the cartridge from contamination.

The following specifications delineate performance expectations and describe the environmental limits that the cartridge can be expected to withstand.

6.2 Performance:

	<u>17 Sectors Formatted</u>	<u>32 Sectors Formatted</u>	<u>Unformatted</u>
Capacity	10.6 MB	10.0 MB	12.75 MB
Per surface	5.3 MB	5.0 MB	6.37 MB
Per track	8,704 B	8,192 B	10,416 B
Per sector	512 B	256 B	NA
Sectors per track	17	32	NA
Transfer rate	5.0 Mbit/sec		

6.3 Functional:

Rotational speed	3,473 RPM
Recording density	10,894 BPI
Flux density	10,894 BPI
Track density	612 TPI
Cylinders	612
Tracks	1,224

6.4 Physical Characteristics:

Thickness	0.748 inches (19mm)
Length	5.551 inches (141mm)
Width	5.394 inches (137mm)
Weight	11 ounces

6.5 Environmental Limits:

Temperature range - operating 50° to 135° F
(10° to 57° C)

Temperature range -
non-operating -40° to 150° F
(-40° to 66° C)

Relative humidity 8 to 80% R.H.

Wet bulb maximum 79° F (26° C), non-condensing

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1.0 INTRODUCTION:

1.1 GENERAL DESCRIPTION:

THE 5 1/4 inch removable Winchester disk drive is a random access storage device with one removable 5 1/4 inch disk as storage media. The total formatted capacity of the two heads is 10 megabytes. (32 sector per tracks, 256 bytes per sector, 1224 tracks). This cartridge disk drive shall be compatible with the ANSI standard 5 1/4 inch disk cartridge standard.

1.2 PRODUCT APPROVAL:

All 5 1/4 inch removable Winchester disk drives received by Wang Laboratories, Inc. must conform to whatever general, physical, electrical or safety requirements imposed on this type of product by UL and CSA organizations.

Once the 5 1/4 inch removable Winchester disk drive (component) is installed in a Wang computer or word processing system, this drive must not, in itself, due to faulty design or assembly, prevent Wang from gaining EMI, RFI compliance of said system under FCC docket 20780/FCC 80-148 part 15.

This product must perform in all required Wang systems without exception.

1.3 ATTACHMENTS:

Shipping specifications 10-521 Rev A.
Test specifications.

2.0 SPECIFICATION SUMMARY:

2.1 Physical specifications:

Environmental limits:

Ambient temperature:


Operating +40° TO +122°F (4.4° TO 50°C).
Non-operating -14° TO -150°F (-10° TO 60°C).
Shipping -14° TO +150°F (-10° TO 60°C).

RATE OF CHANGE:

Operating/non-operating 18°F/hr. max.

RELATIVE HUMIDITY:

Operating/non-operating 8% to 80%, non-condensing.

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MAXIMUM WET BULB:

Operating/non-operating 79°F non-condensing.

MAX ALTITUDE:

Operating -1,000 to 10,000 ft.
Non-operating -1,000 to 30,000 ft.

DC POWER REQUIREMENTS:

+12 V \pm 5 % 1.3 A Max Ave 3.7 A Max Peak.
+ 5 V \pm 5 % 0.65 A Max.
+12 V \pm 5 V Max. ripple 50 mV P-P.

MECHANICAL DIMENSIONS:

Height = 1.625 inches.
Width = 5.75 inches.
Depth = 8.0 inches.
Weight = 3.5 lbs.

Heat Dissipation = 20 Watts Max.

2.2 RELIABILITY SPECIFICATIONS:

MTBF 10,000 power on hours.
PM not required.
MTTR 30 minutes.
Component design life 5 years.

ERROR FREE CYLINDERS:

Track 0, all heads shall be error free.


ERROR RATES:

* Soft read errors 1 per 10¹⁰ bits read.
Hard read errors 1 per 10¹² bits read.
Seeks errors 1 per 10⁶ seeks.

* Not recoverable within 16 re-tries.

PRECOMPENSATION:

The drive will function with 12 ns. of precompensation for both early and late shifted bits, precompensation shall be applied through 350 to 611 cylinders.

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2.3 EXTERNAL SHOCK:

Operating - (reading, writing and seeking):

Half sine shock (impulse) of 10 g's (peak) for 10 msec. durations measured on the drive frame, applied three times in all direction of the two orthogonal axes, horizontal and side MTD.

Non-operating:

half sine shock (impulse) of 40 g's (peak) for 10 msec. duration as measured on the drive frame, applied three times in all directions of the three orthogonal axes. (SEE SECTION 7.1). (powered off, non boxed and non system mounted conditions).

2.4 EXTERNAL VIBRATION:

Operating vibration:

The drive must operate while seeing operating levels of SEC. 2.3 and 2.4 and loose no more than 20 % signal amplitude. The test shall be applied once in each of the two orthogonal axes horizontal and side MTD.

Frequency

2 - 10 Hz	0.10"	Double amplitude
10 - 500 Hz	0.5 G	(Peak)

Non-operating vibration :


The drive must operate within error rate (SEC. 2.2) after the sine vibration test below. The test shall be applied once in each of the three orthogonal axes. Sweep rate of 1 octave/minute. (no power applied to the drive).

Frequency

2 - 10 Hz	0.40"	Double amplitude
10 - 500 Hz	2.0 G	(Peak)

2.5 DC POWER ON/OFF:

At no time during a power up or down sequence, shall data on the disk be damaged or otherwise be rendered unrecoverable. If power is lost during a write operation, damage will be confined to the sector being written at the instant of power loss. (These conditions are with the interface and disk drive powered from the same power supply).

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2.6 PERFORMANCE SPECIFICATIONS:

Transfer rate: 5.0 Megabits per second.

Maximum allowable access times: (including settle)

- * Track to track 85 Msec.
- * Average 135 Msec.
- * Max 370 Msec.
- * Using accelerated step mode (see section 4.4).

Average latency: 8.64 Msec.

2.7 FUNCTIONAL SPECIFICATIONS:

Rotational speed 3,473 RPM \pm 1 %
 Recording density 10,894 BPI Max.
 Flux density 10,894 FCI.
 Track density (Vendor dependent).
 Cylinders 612
 R/W heads 2

3.0 FUNCTIONAL CHARACTERISTICS:

3.1 GENERAL OPERATION:

The 5 1/4 inch removable Winchester disk drive consists of read/write and control electronics, read/write heads, track positioning actuator, media, and air filtration system. The components perform the following functions:

- 1) Interpret and generate control signals.
- 2) Position the heads over the desired track.
- 3) Read and write data.
- 4) Provide a contamination free environment.

3.2 DRIVE DOOR LOCK MECHANISM:

Power must be supplied to the drive. Otherwise the drawer will remain locked. This lock can be defected by inserting a paper clip or sharp object through the mylar seal on the left hand side of the front panel, and pushing to the right.

Specification for mylar seal is as follows:

Mylar 0.002 \pm 0.001 Thick
 Color Clear matte
 P/N DMA 71004461



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3.3 AIR FILTRATION SYSTEM:

The discs and read/write heads are fully enclosed in a module using an integral air recirculation system with an absolute filter to maintain a clean environment. A filter shall also be provided in the module to permit pressure equalization with the ambient air without contaminate entry.

3.4 SELECT OPTION:

All drives shall be set for drive select line number one before shipment to Wang Labs.

4.0 FUNCTIONAL OPERATIONS:

4.1 POWER SEQUENCING (FIGURE 1):

After unit is up to speed, the heads will automatically load on the media. Ready, track 0 and seek complete signals on the interface will become true. The drive will not perform read and write functions until ready and seek complete become true.

There shall be no specified sequence, for the application or removal of the +5 or +12 voltages, which will result in the damage of data, in the following operating modes:


- 1) Initial power up.
- 2) Power fault or failure.
- 3) Automatic power up (after fault or failure).
- 4) Stand-by.
- 5) Seeking.
- 6) Reading.
- 7) Writing.

(Only the data field within the selected sector to be written may be damaged.)

All fault conditions set and latched internally by the drive as a result of power (up/down), (fault/sequencing) states, must be reported and externally resettable via the interface, per write fault section.

4.2 DRIVE SELECTION:

Drive selection will occur when one of the drive select lines is activated. Only the drive selected shall respond to the input signals, and only that drives output signals should be gated to the controller interface. The MFM read data lines are not gated by drive selected.

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	APPR	DATE			
	APPR	DATE			

4.3 TRACK ACCESSING:

Read/Write head positioning is accomplished by:

- 1) Deactivating write gate.
- 2) Activating the appropriate drive select line.
- 3) Being in the ready condition with seek complete true.
- 4) Selecting the appropriate direction.
- 5) Pulsing the step line.

each step pulse will cause the heads to move either 1 track in or 1 track out, depending on the level of the direction line. A true on the direction line will cause a seek inward toward the spindle; a false outward toward track 0.

4.4 STEP MODES:

The drive may be stepped in either direction (determined by the direction line) any number of tracks from the first to and including the last logical track on the unit.

The drive may be measured without fault, to step between any two tracks in either direction within the range of tracks 0 to maximum track using the following modes.

Access time is measured from the leading edge of the last step pulse, until seek complete is true (active low).


ACCELERATED MODE:

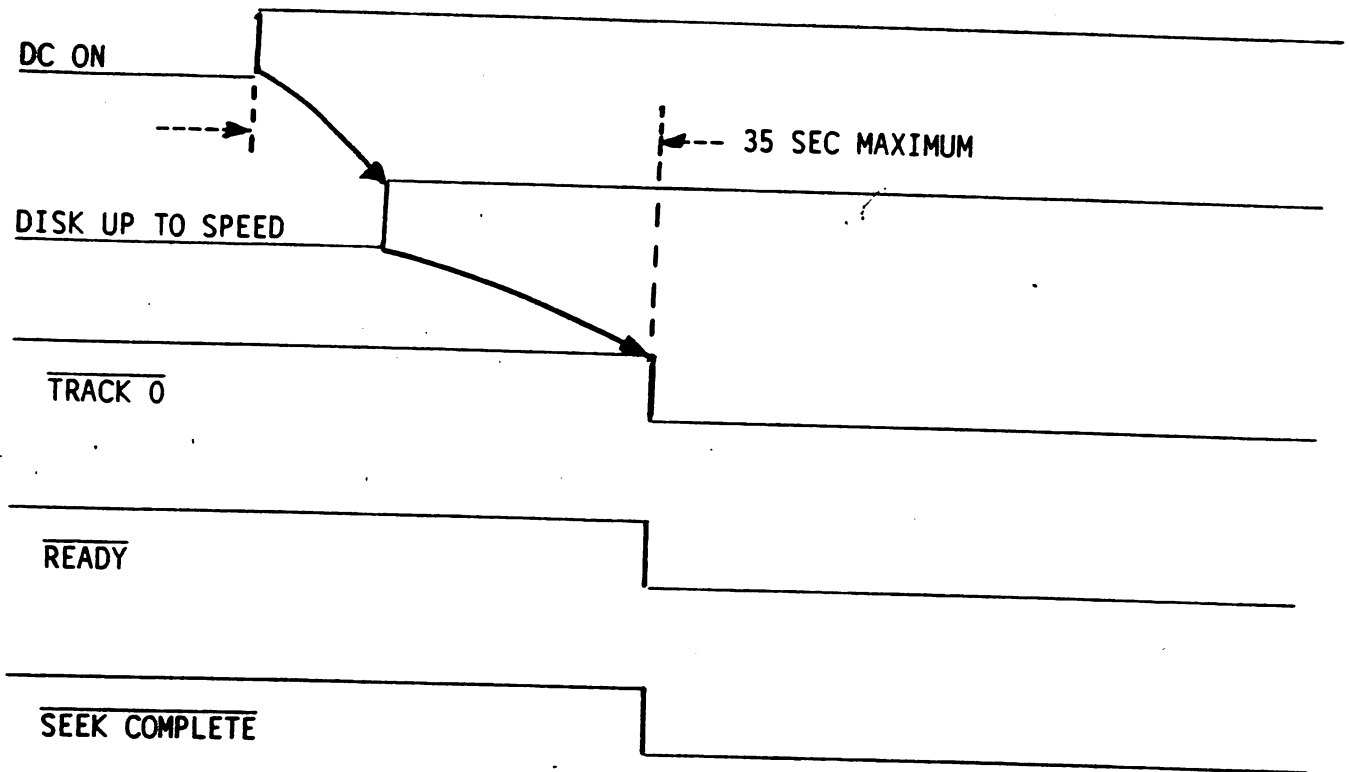
Offers reduced seek times for optimum performance when the step pulses are between 10 usec and 200 usec apart. With step pulse periods within this range, the drive will ramp the actuator speed to locate cylinders, within the specified access times.

SINGLE STEP MODE:

The step pulse period is 3 msec minimum for any number steps within the specified range of the drive.

When seek complete becomes true, the drive shall be ready for reading and writing.

 LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK-DRIVE HALF HEIGHT	WLI NUMBER 191-3032	
	CHK	DATE		9 OF 29	REV.
	APPR	DATE			A
	APPR	DATE			



POWER UP SEQUENCE:
FIGURE 1

4.5 HEAD SELECTIONS:

Any of the 2 heads can be selected by placing the heads binary address on the two head select lines, (low true). Head selection is not complete until seek complete is true.

4.6 READ OPERATION:

Reading data from the disk is accomplished by:

- 1) Deactivating the write gate line.
- 2) Activating the appropriated drive select line.
- 3) Assuring the drive is ready, and seek complete is true.
- 4) Selecting the appropriated head, and track waiting for seek complete to come true.

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	W/L NUMBER 191-3032		
	CHK	DATE		10 OF 29	REV. A	
	APPR	DATE				
	APPR	DATE				

4.7 WRITE OPERATION:

Writing data onto the disk is accomplished by:

- 1) Activating the appropriated drive select line.
- 2) Assuring that the drive is ready.
- 3) Selecting the proper head, and waiting for seek complete.
- 4) Insuring no write fault conditions exist.
- 5) Activating write gate and placing data on the write data line.

5.0

ELECTRICAL INTERFACE:


5.1 ELECTRICAL INTERFACE DESCRIPTION:

The interface to the removable Winchester 5 1/4 inch drive shall be divided into three categories each of which are physically separated.

- 1) Control signals.
- 2) Data signals.
- 3) DC power.

All control lines are to be digital in nature (TRI STATE TTL) and either provide signals to the drive (input) or signals to the host (output) via interface connection J1/P1. The data transfer signals are differential in nature and provide data either to (write) or from (read) the drive via J2/P2. (defined by EIA RS-422-A).

Tables 1 through 3 and figures 2 through 4 show connector pin assignments and interconnection of cabling between the host controller and drive.

 LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER 191-3032	
	CHK	DATE		11 OF 29	REV
	APPR	DATE			A
	APPR	DATE			

5 1/4 INCH REMOVABLE WINCHESTER DRIVE INTERFACE:
TABLE 1 - J1/P1 CONNECTOR PIN ASSIGNMENT:


<u>GND RTN PIN</u>	<u>SIGNAL PIN</u>	<u>SIGNAL NAME</u>
1	2	CHANGE CARTRIDGE.
3	4	Reserved (open).
5	6	- WRITE GATE.
7	8	- SEEK COMPLETE.
9	10	- TRACK 000.
11	12	- WRITE FAULT.
13	14	- HEAD SELECT 2°.
15	16	Reserved (open).
17	18	- WRITE SERVO.
19	20	- INDEX
21	22	- READY.
23	24	- STEP.
25	26	- DRIVE SELECT 1.
27	28	- DRIVE SELECT 2.
29	30	- DRIVE SELECT 3.
31	32	- DRIVE SELECT 4.
33	34	- DIRECTION IN.

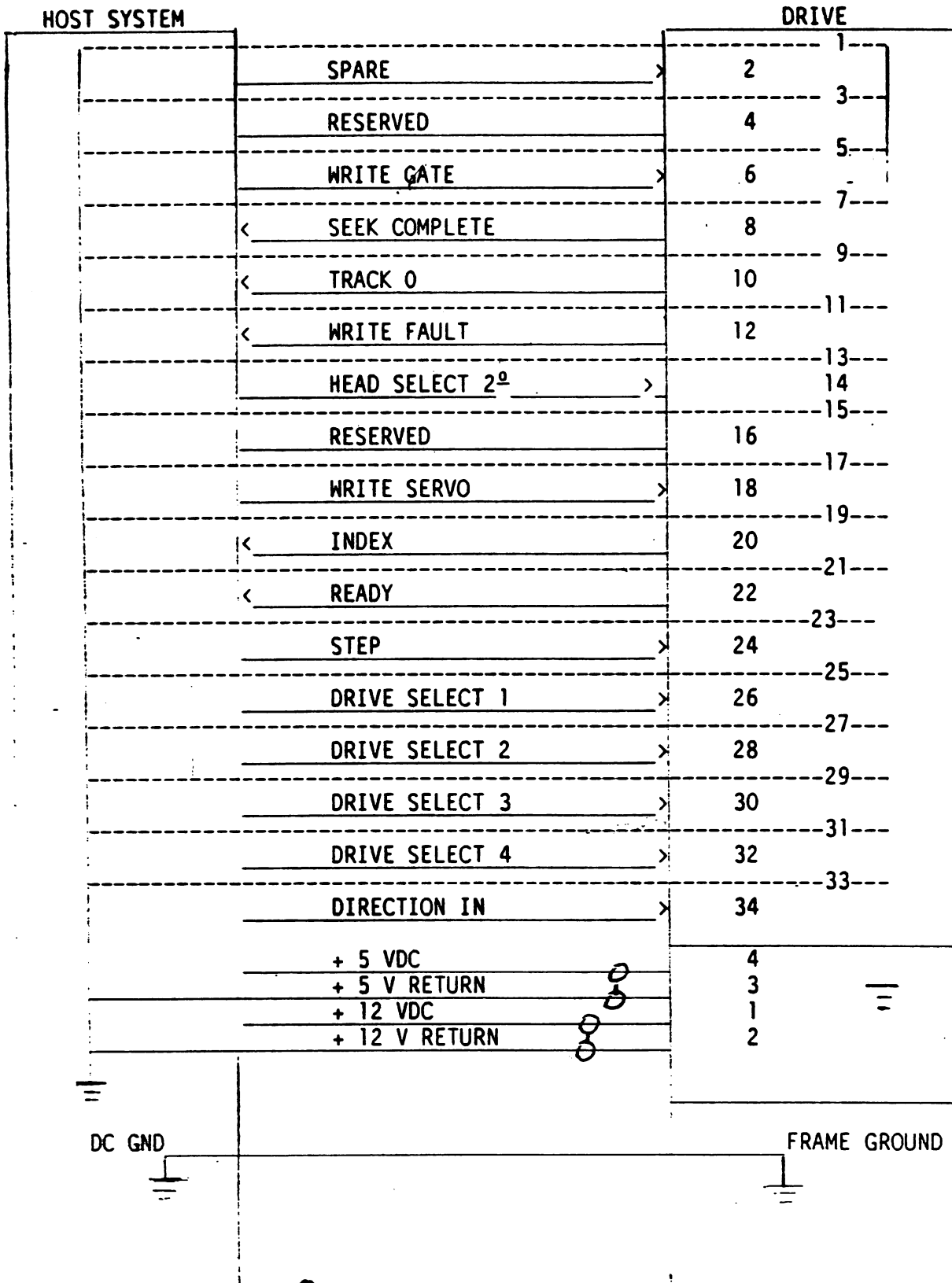
TABLE 2 - J2/P2 CONNECTOR PIN ASSIGNMENT:

<u>GND RTN PIN</u>	<u>SIGNAL PIN</u>	<u>SIGNAL NAME</u>
2	1	- DRIVE SELECTED.
4	3	- REINITIALIZE .
6	5	- WRITE PROTECTED.
8	7	Reserved (open).
10	9	- CARTRIDGE CHANGED.
12	11	Ground.
	13	+ MFM WRITE DATA.
	14	- MFM WRITE DATA.
16	15	Ground.
	17	+ MFM READ DATA.
	18	- MFM READ DATA.
20	19	Ground.


TABLE 3 J3 - P3 DC CONNECTOR PIN ASSIGNMENTS:

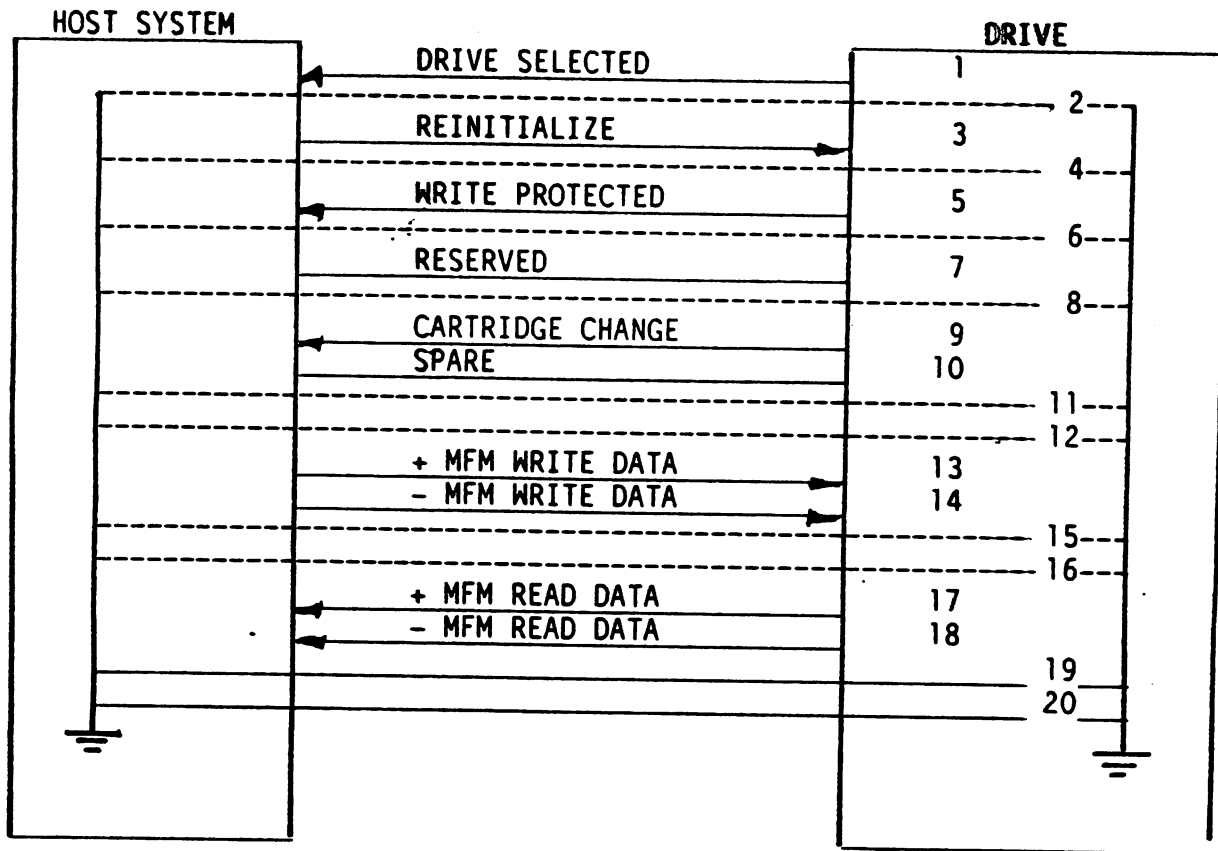
<u>GND RTN PIN</u>	<u>POWER PIN</u>	<u>DESCRIPTION</u>
2	1	+ 12 VOLTS DC
3	4	+ 5 VOLTS DC

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER	
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	APPR	DATE		12 OF 29	REV.
	APPR	DATE			A



○ TWISTED PAIR (20 GA (OR LARGER))
 FLAT CABLE OR TWISTED PAIR 20 FEET MAXIMUM.
 FIGURE 2 - CONTROL SIGNALS:

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	W/L NUMBER		
	CHK	DATE		191-3032		
	APPR	DATE		13 OF 29	REV.	A
	APPR	DATE				



FLAT CABLE OR TWISTED PAIR 20 FEET MAXIMUM:

FIGURE 3 - DATA SIGNALS:

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLNUMBER	
	CHK	DATE		191-3032	
	APPR	DATE		14 OF 29	REV.
	APPR	DATE			A

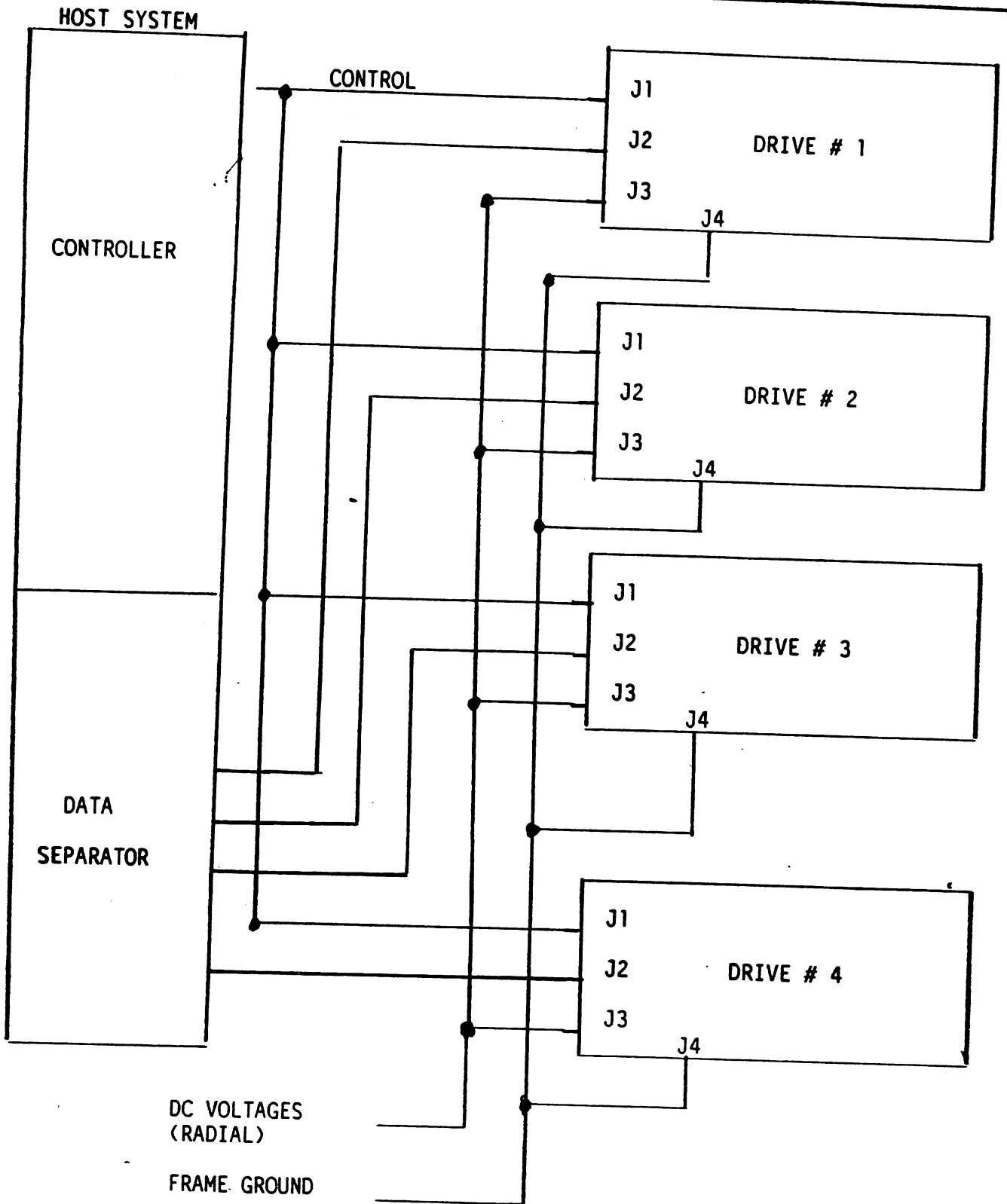



FIGURE 4 - TYPICAL CONNECTION, 4 DRIVE SYSTEM:

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	W/L NUMBER	
	CHK	DATE		191-3032	
	APPR	DATE		15 OF 29	REV
	APPR	DATE			A

5.2 CONTROL INPUT LINES:

The control input signals are of two types: Those to be multiplexed in a multiple drive system, and those intended to do the multiplexing. The control input signals to be multiplexed are, Write Gate, head select 2^o, Change Cartridge, Step, Write Servo, and Direction In. The signals to do the multiplexing are Drive Select 1, Drive Select 2, Drive Select 3, or Drive Select 4.

The input lines have following electrical specifications. Refer to figure for the recommended circuit.

True: 0.0VDC TO 0.4VDC @ I = 48 MA (Max).
 FALSE: 2.5VDC TO 5.25VDC @ I = 250 UA (open collector).

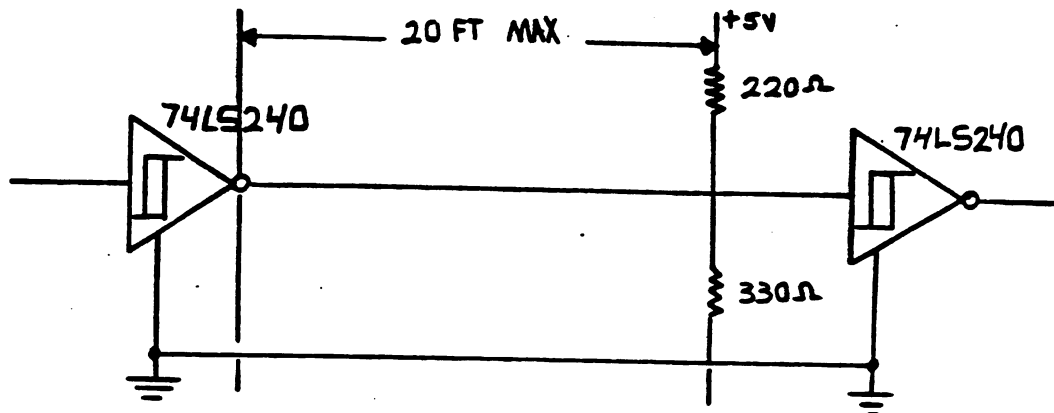



FIGURE 5 - CONTROL SIGNALS DRIVER/RECEIVER COMBINATION:

5.3 WRITE GATE:

The active state of this signal, or logical zero level, shall enable data to be written on the cartridge. The inactive state of this signal, or logical one level, enables data to be transferred from the drive. Also, the inactive state of this signal enables a seek or head change as well. A 220/330 resistor pack shall be used for line termination.

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	APPR	DATE		16 OF 29	REV.	A
	APPR	DATE				

5.4 HEAD SELECT 2^o:

This line provide for the selection of each individual read/write head in a binary coded sequence. Heads are numbered 0 through 1. When this signal is active, one is selected, otherwise head 0 is selected. A 220/330 resistor pack shall be used for line termination.

5.5 DIRECTION IN:

This signal defines direction of motion of the R/W head when the step line is pulsed. An open circuit or logical one defines the direction as "out" and if a pulse is applied to the step line, the R/W heads will move away from the center of the disk. If this line is a logical zero, the direction of motion is defined as "in" and the R/W heads will move toward the center of the disk. Change in direction must meet the requirement shown in FIGURE 6.

A 220/330 resistor pack shall be used for line termination.

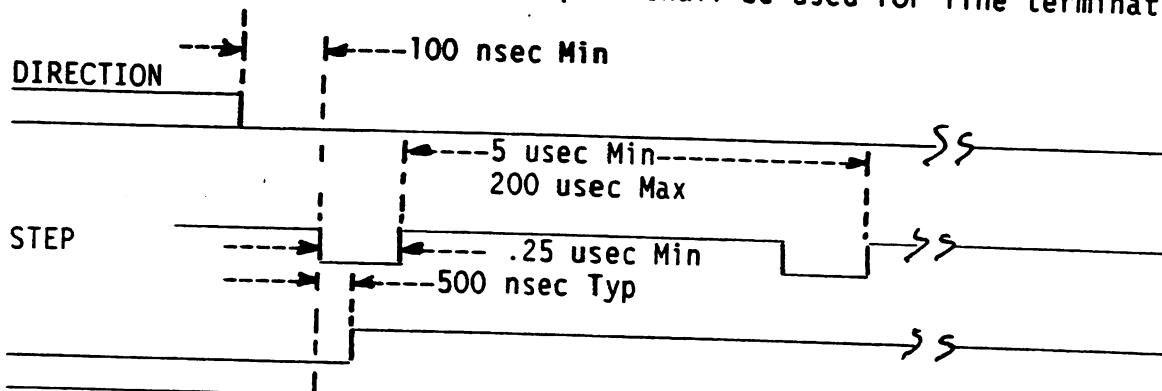
NOTE: Direction will not change during step pulse.

5.6 STEP:

This interface line is a control signal causing the read/write head to move with the direction of motion defined by the DIRECTION IN line.

The access motion is initiated at the logical zero to logical one transition or the trailing edge of this signal pulse. Any change in the DIRECTION IN line must be made at least 100 ms before the leading edge of the step pulse. Nominal step time shall be 3 milliseconds in slow step mode, and 5 to 200 usec in buffered mode.

A 220/330 resistor pack shall be used for line termination.



SEEK COMPLETE

* CHANGE IN DIRECTION CANNOT BE MADE PRIOR TO SEEK COMPLETE.

FIGURE 6 - STEP MODE TIMING:

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	CHK	DATE		191-3032		
	APPR	DATE		17 OF 29	REV.	
	APPR	DATE			A	

5.7 CONTROL OUTPUT LINES:

The output control signals are driven with an tri state driver stage capable of sinking a maximum of 48 ma at low level or true stage with maximum voltage of 0.4v measured at the driver. When the drive is deselected control output lines shall sink less than 250 ua.

All J1 output lines are to be enabled only by the respective drive select line.

FIGURE 5 shows the recommended circuit.

5.8 SEEK COMPLETE:

This line should go to true when the Read/Write heads have settled on the final track at the end of a seek. Reading or writing should not be attempted when seek complete is false.

Seek complete will go false in three cases:

- 1) A reinitialization or write-servo sequence is in process.
- 2) Less than 500 ns after the leading edge of a step pulse or the first of a series of these pulses.
- 3) Less than 500 ns after a change in head select.

5.9 TRACK 0:

This interface signal indicates a true state or logical zero only when the drive's read/write heads are positioned at track 0 (the outermost data track), except on initial power on sequence, prior to ready.

5.10 WRITE FAULT:


This signal is used to indicate an existing condition(s) at the drive which if not detected by the host, could cause improper writing on the disk. When this line is true, further writing is inhibited at the drive until the condition is corrected.

MINIMUM CONDITIONS DETECTED:

- 1) Write gate is active when the operation cartridge does not have a write enable Tab installed.
- 2) DC voltages are out of tolerance.
 - A) 12 VDC -20%
 - B) 5 VDC -15%
- 3) WRITE GATE BUT NO WRITE DATA.

FAULT CLEAR:

Source of fault no longer exists, WHEN the selected drive is de-selected and re-selected.

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	APPR	DATE			

5.11 INDEX:

This interface signal is provided by the drive once each revolution to indicate the beginning of the track. Normally, this signal is a logical one level and makes the transition to the logical zero level to indicate index. Only the transition from one to zero is valid. SEE FIGURE 7.

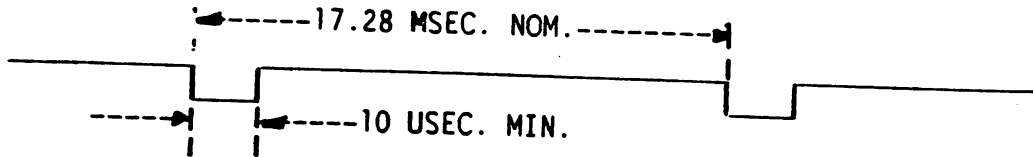


FIGURE 7 - INDEX TIMING.

5.12 READY:

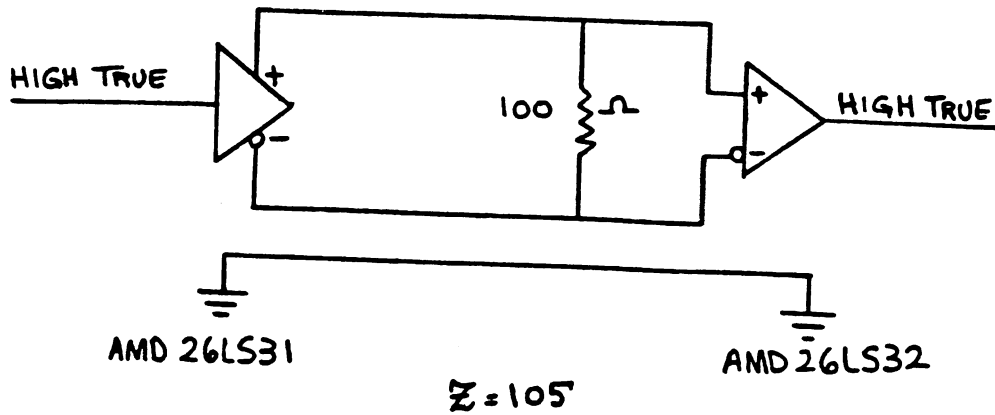
This interface signal when true, shall indicate the drive is ready to receive any interface command and that the input and output signals are valid. When this line is false, all writing and seeking are inhibited.

5.13 DATA TRANSFER LINES:

All lines associated with the transfer of data between the drive and the host system are differential in nature and are not to be multiplexed. These lines are provided at the J2/P2 connectors on all drives.

Two pairs of balanced signals are used for the transfer of data: Write data and read data. FIGURE 8 illustrates the driver/receiver combination used in the 5 1/4 inch removable Winchester drive for data transfer signals.

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER 191-3032	
	CHK	DATE		REV. A	
	APPR	DATE			
	APPR	DATE		19 OF 29	



Flat ribbon or twisted pair max 20 feet.
 NOTE: Any RS422 driver/receiver pair will interface:

FIGURE 8 - DATA LINE DRIVER/RECEIVER COMBINATION

5.14 MFM WRITE DATA:

This is a differential pair that defines the transitions to be written on the track. The transition of the +MFM WRITE DATA line going more positive than the -MFM WRITE GATE is active. This signal must be driven to an inactive state (+MFM WRITE DATA more negative than -MFM WRITE DATA) by the host system when in the read mode.

To insure data integrity at the error rate specified, the Write Data signals presented by the controller will be pre-compensated on tracks 350 through 611.

The amount of pre-compensation used is 12 nsec for both early and late written bits. FIGURE 9 shows the bit patterns to be compensated. All other patterns are written "on time".

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER	
	CHK	DATE		191-3032	
	APPR	DATE		20 OF 29	REV
	APPR	DATE			A

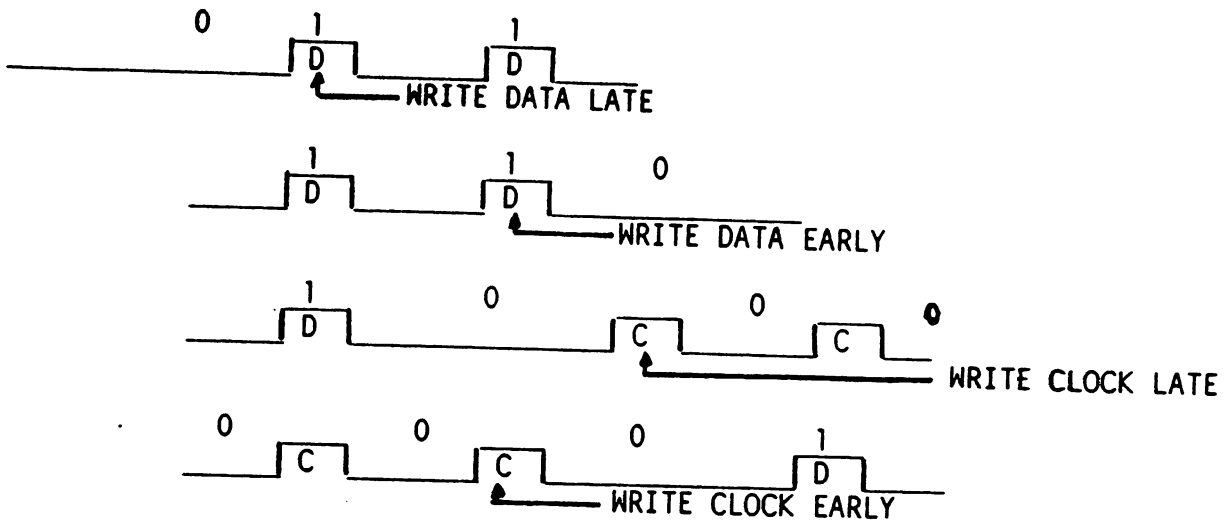


FIGURE 9 - WRITE PRE-COMPENSATION PATTERNS:

5.15 MFM READ DATA:

The data recovered by reading a pre-recorded track shall be transmitted to the host system via the differential pair of MFM READ DATA lines. The transition of the +MFM READ DATA line going more positive than the -MFM READ DATA line represents a flux reversal on the track of the selected head.

5.16 READ/WRITE TIMING:

The timing diagram as shown in FIGURE 10, shows the necessary sequence of events (with associated timing restrictions) for proper read/write operation of the drive.

	DWN	DATE	PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER		
	CHK	DATE		191-3032		
	APPR	DATE		21 OF 29	REV	
	APPR	DATE			A	

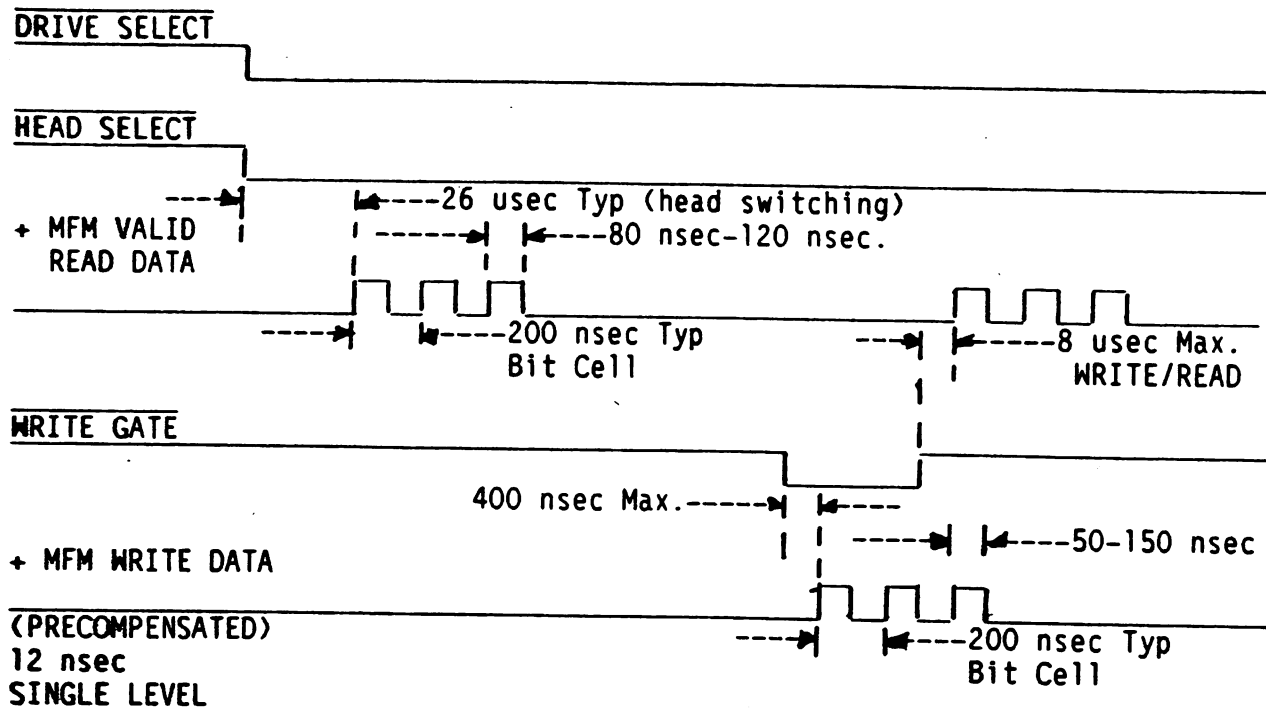


FIGURE 10 - READ/WRITE DATA TIMINGS:

5.17 DRIVE SELECTED:

A status line is provided at the J2/P2 connector to inform the host system of the selection status of the drive.

The DRIVE SELECTED line shall be a TTL open collector driver as shown in FIGURE 5. This signal will go active only when the drive is programmed as drive X (X= 1, 2, 3 or 4) by programming the shunt on the drive, and that DRIVE SELECT X line at J1/P1 is activated by the host system.

5.18 WRITE PROTECTED

When the cartridge's write enable tab is removed, the drive is prevented from writing on the disk and this signal is active. This signal shall also indicate all other times that writing is inhibited on the disk with the signal exception of index burst servo time.

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	APPR	DATE				
	APPR	DATE				

5.19 CARTRIDGE CHANGED


This signal indicates to the host system that the cartridge has been changed. When the drive detects a drawer-open, the CARTRIDGE CHANGED line becomes true. This line can be reset, after the host system has recognized that the cartridge has been changed, by selecting the drive after READY becomes true and then deselecting it for more than 1 msec. This line will be set to true during a power-on sequence.

6.0 PHYSICAL INTERFACE:

6.1 PHYSICAL INTERFACE DESCRIPTION:

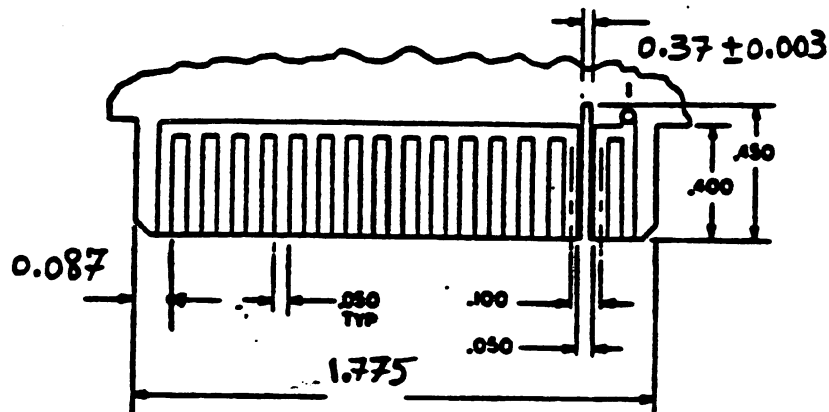
The electrical interface between the drive and the host controller is via four connectors:

- 1) J1- Control signals, multiplexed.
- 2) J2- Read/Write signals, radial.
- 3) J3- DC power input.
- 4) J4- Frame ground.

 LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER	
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	APPR	DATE		23 OF 29	A
	APPR	DATE			

6.2 J1/P1 CONNECTOR - CONTROL SIGNALS:

Connection to J1 is through a 34 pin PCB edge connector. The dimensions for this connector are shown in FIGURE 11. The pins are numbered 1 through 34 with the even pins located on the component side of the PCB. A key slot is provided between pins 3 and 5. The recommended mating connector for P1 is AMP ribbon connector P/N 88373-3. All odd pins are ground.



BOARD THICKNESS 0.062 ± 0.007

TOLERANCE UNLESS NOTED, .XX = $\pm .030$, .XXX = $\pm .010$

FIGURE 11 - J1 CONNECTOR DIMENSIONS:

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER	
	CHK	DATE		191-3032	
	APPR	DATE		24 OF 29	REV
	APPR	DATE			A

6.3 J2/P2 CONNECTOR - DATA SIGNALS:

Connection to J2 is through a 20 pin edge connector. The dimensions for the connector are shown in FIGURE 12. The pins are numbered 1 through 20 with the even pins located on the component side of the PCB. The recommended mating connector for P2 is AMP ribbon connector p/n 88373-6.

A key slot is provided between pins 3 and 5.

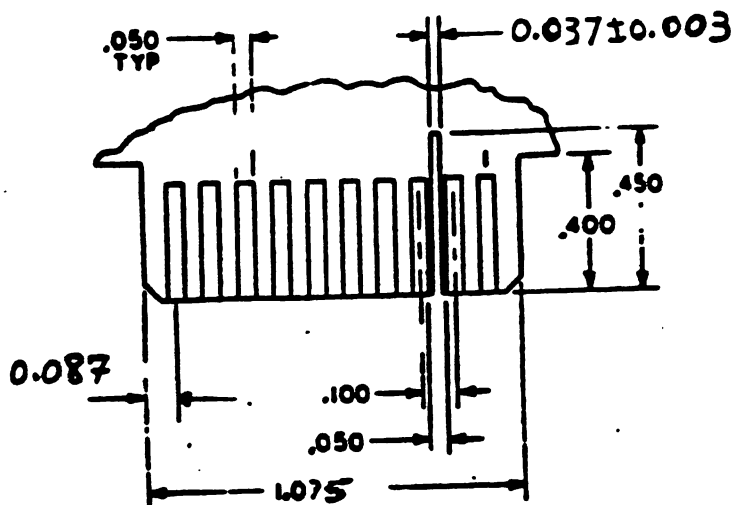


FIGURE 12 - J2 CONNECTOR DIMENSIONS:

6.4 J3/P3 CONNECTOR - DC POWER:

DC power connector (J3) is a 4 pin amp mate-n-lok connector P/N 3502111-1 mounted on the solder side of the PCB. The recommended mating connector (P3) is AMP P/N1-470424-0 utilizing AMP pins P/N 360078-4. J3 pins are numbered as shown in FIGURE 13.

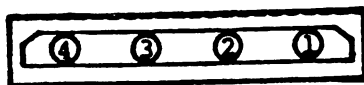


FIGURE 13 - J3 CONNECTOR - DRIVE PCB SOLDER SIDE:

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER		
	CHK	DATE		191-3032		
	APPR	DATE		25 OF 29	REV.	A
	APPR	DATE				

Current requirements and connector pin numbers are shown in TABLE 4.

TABLE 4 - DC POWER REQUIREMENTS:

<u>J3 CONNECTOR</u>	<u>CURRENT AMPS</u>
Pin 1 +12 Volts DC \pm 5% *	3.7 **
Pin 2 +12 Volts Return	
Pin 3 +5 Volts DC \pm 5%	0.65
Pin 3 +5 Volts Return	

* \pm 10% on unit power up or seeking, \pm 5% for read or write.

** Occurs only during power disk spin up.

6.5 J4/P4 FRAME GROUND CONNECTOR:

Fastener, AMP P/N 61761-2
 Recommended mating connector AMP 62187-1

7.0 PHYSICAL SPECIFICATIONS:

This section describes the mechanical dimensions and mounting recommendations for the drive.

7.1 MOUNTING ORIENTATION:


Accepted orientation is either side or horizontal with PCB down. A prohibited orientation is horizontal with PCB up (disk surface down, parallel and next to mounting surface). In the final mounting configuration, insure that operation of the four shock mounts which isolate the aluminum base casting from the frame is not restricted. When mounting this drive in system, suspension design to be to limits as stated in SECTION 2.3 AND 2.4.

7.2 MOUNTING HOLES:

Eight mounting holes, four on bottom and two on each side, are provided for mounting the drive into an enclosure. The size and location of these holes, shown in FIGURE 14.

7.3 PHYSICAL DIMENSIONS:

Overall height/width/depth and other key dimensions are shown in FIGURE 14. As in the case of the mounting holes, the dimensions are identical to the minifloppy, allowing a direct physical replacement.

 WANG LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	W/L NUMBER 191-3032	
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	APPR	DATE			A
	APPR	DATE			

8.0 SHIPPING/PACKAGING:

8.1 TRANSPORTATION MODE:

The level of packaging required at the individual unit level shall (as accelerated in test reference below) protect the product when it is transported by motor freight (other than air suspension), rail, parcel post, express type parcel service, loose ocean freight or ocean containers in which freight is removed and/or added during transshipment.

8.2 PACKAGING/PRODUCT PERFORMANCE:

Packaged product shall be subjected to applicable tests per Wang Standard SPI 10-521 "Shipping Container Performance Test" for individual unit packages. At completion of tests, unit shall show no signs of mechanical damage nor shall the operational performance be impaired. Alignment or adjustment of operator accessible controls may be employed.


8.3 TEST REQUIREMENTS:

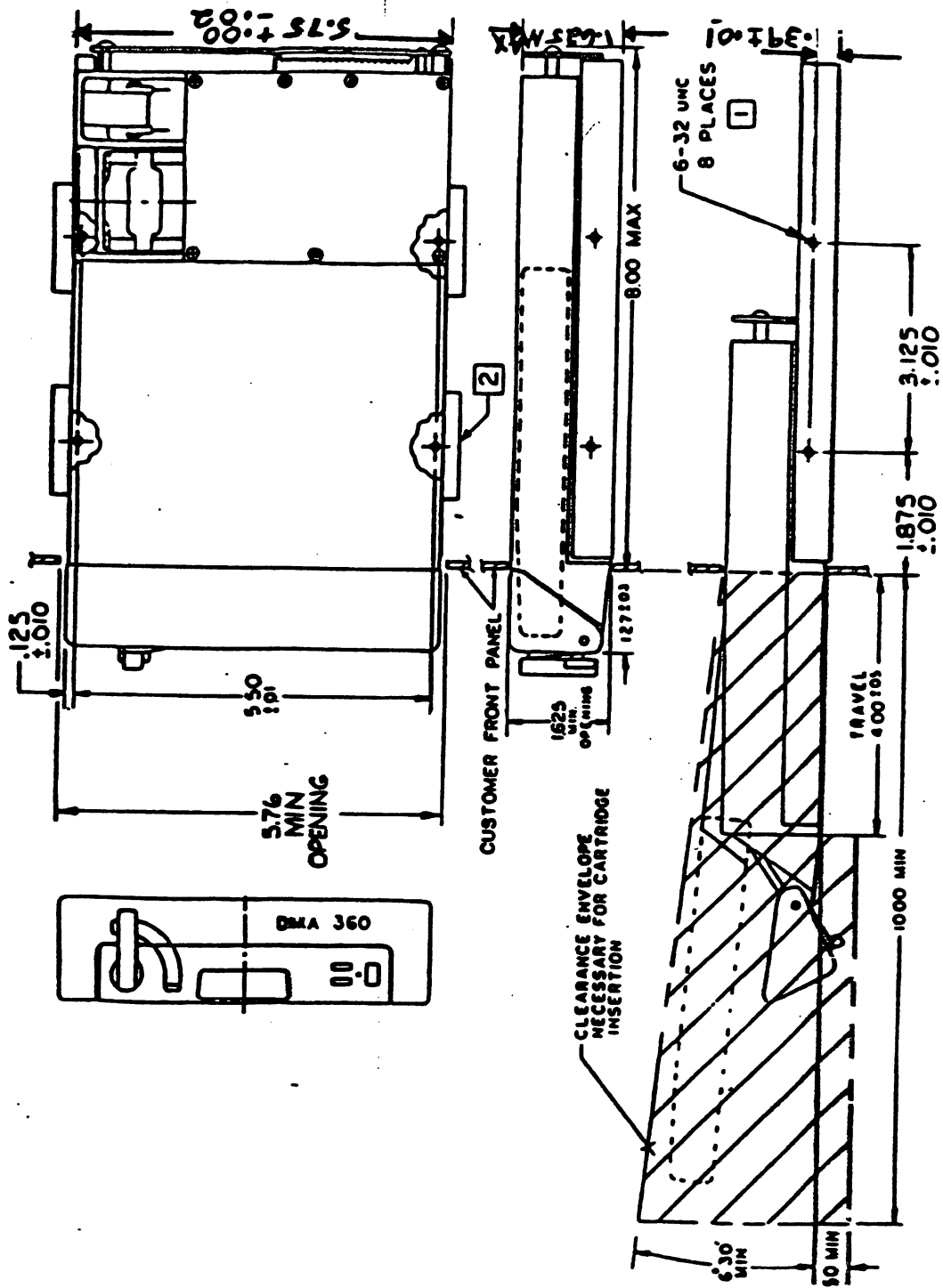
Prior to acceptance of vendor packaging, a representative, functional product and package shall be subjected to the tests specified. This testing may be performed by Wang Laboratories Package Engineering, an approved independent package testing laboratory or other laboratory acceptable to Wang Laboratories, Inc. The report of these tests will, in addition to the information called in SPI 10-521 Rev. A, contain engineering drawings of the package tested so that they may be used to determine continuing compliance with performance requirements of this standard. Should a change in package design be made, retesting and recertification are required.

8.4 INTERNATIONAL (SEA FREIGHT):

The additional of environmental protection for Sea Freight shall not modify the approved packaging configuration or isolation properties.

If such modification is necessary, the package must be requalified. The vendor shall supply a process sheet to Wang Labs prior to approved of product to show method of protection.

 LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	W/L NUMBER 191-3032	
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	APPR	DATE			A
	APPR	DATE			



NOTE: All internal Electro/Mechanical components will maintain a minimum of 0.020 clearance referenced from the bottom edge of the casting or mounting surface.

() = millimeters


FIGURE 14 MOUNTING PHYSICAL DIMENSIONS

	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER	
	CHK	DATE		191-3032	
	APPR	DATE		28 OF 29	
	APPR	DATE			

QUALIFIED VENDOR LIST

DMA SYSTEMS
601 PINE AVENUE.
GOLETA CALIFORNIA 93117

0049 DOC
JJS 11/29/84

 LABORATORIES, INC.	DWN	DATE	TITLE PRODUCT SPECIFICATION 5 1/4 INCH 10 MEGABYTES REMOVABLE WINCHESTER DISK DRIVE HALF HEIGHT	WLI NUMBER		
	CHK	DATE		191-3032	REV.	
	APPR	DATE		29 OF 29	A	
	APPR	DATE				

RICOH REMOVABLE HARD DISK DRIVE

RH5130

SERVICE MANUAL

RICOH Co., LTD.

**DRP-442-501
March 1986**

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I. INTRODUCTION

The RICOH Removable Hard Disk Drive RH5130 is a half-height hard disk drive and it uses removable hard disk cartridges. The unformatted Disk Cartridges can store up to 12.75M bytes; whereas, the formatted capacity is 10M bytes.

This manual explains about the knowledge necessary for maintenance RH5130. It also covers changeable parts and assemblies.

1. Features

Head Movement

The heads of the RH5130 are positioned by a stepper motor using a rack and pinion positioner. The stepper motor uses the self-written servo information on the disk to position the head. This self-written mode allows the drive to be servo-written by the drive it is being used in, which ensures interchangeability between drives and a short access time.

The Removable Disk Cartridge

The removable Disk Cartridge conforms to the ANSI standard and standard hard disk technology that ensures the reliability and interchangeability under various environmental conditions.

Interface

The interface and data transfer rate is the 5.25" Winchester Drive Standard (ST506).

Further Reliability

The runout correction servo system, the stepper motor micro-step positioning system and the dynamic head load enhances the reliability. These features are supported by the self-contained, self-sealing air circulation system that cleans and recycles the air fast and efficient.

2. Specifications

These specifications conform to the UL and CSA safety standards.

The cleanliness in the Disk Cartridge is Class 500 (grain diameter of 0.5 um).

Recording Mode

Mode:	Modified Frequency Modulation (MFM)
Maximum bit density:	10,894 bits/inch
Track density:	612 tracks/inch
Data transfer rate:	5M bits/second

Recording Capacity

Unformatted disk:	12.75M bytes (one side is 6.37M bytes)
Formatted disk:	10M bytes (256 bytes x 32 sectors)
Formatted disk track:	10,416 bytes/track

Reliability

MTBF:	10,000 hours
MTTR:	30 minutes

Error Rate

Self-written servo information

Read:	$1/10^{10}$ bits
Write:	$1/10^{12}$ bits
Seek:	$1/10^6$ seeks

Information written by another drive

Read:	$1/10^8$ bits
Write:	$1/10^{12}$ bits
Seek:	$1/10^5$ seeks

Device Life

Life:	Either 5 yrs or 5000 sets/resets of the disk cartridge which ever comes first
-------	---

Disk

No. of disks:	1 removable
No. of recording sides:	2
No. of cylinders:	612
Total No. of tracks:	1224

Magnetic Head

No. of read/write heads:	2
--------------------------	---

Rotation

Speed:	3473 RPM
Accuracy:	<u>+ 1%</u>

Seek Process Time

One track:	3 ms or less
204 tracks:	85 ms or less
612 tracks:	250 ms or less
Head change:	4 ms or less
Settling:	13 ms or less
Average rotational delay:	8.64 ms

Start/Stop Process Time

Purge cycle:	20 seconds
Start:	30 seconds (including purge time)
Stop:	10 seconds

Access Time

Access time is the average time from receiving a step pulse to enabling a write operation, which includes seek time, settling time, positioning time, and average rotational delay.

Assume that ON-TRACK occurs at the first burst after settling.

One track:	25 ms (average)
204 tracks:	107 ms (average)
612 tracks:	272 ms (average)
Head change:	26 ms (average)

Power

Voltage:	12 VDC \pm 5% (read/write)
	12 VDC \pm 10% (motor start)
	5 VDC \pm 5%
Ripple voltage:	50 mVp-p or less
12 VDC max. current:	2.0 Amp (3.5 Amp motor start)
5 VDC max. current:	0.8 Amp
12 VDC ave. operation current:	1.3 Amp
5 VDC ave. operation current:	0.7 Amp
Power consumption:	20 watts typical

Noise

Standby:	48 dB or less (1 meter in front)
Operating:	55 dB or less (1 meter in front)

Environment

The following table provides the specifications for the environment during operation and for non-operation. Note that the humidity is high but condensation and dew is not allowed.

Table I-2-1

Item		Requirements	
		Operating	Not operating
Temperature and relative humidity	Temperature	4 - 50°C	-40 - 70°C
	Relative humidity	85% or less	90% or less
	Maximum wet bulb temperature	28°C	28°C
	Maximum temperature fluctuation	10°C/H	_____
	Vibration		0.5 G or less
Shock		10 G or less	30 G or less
Allowable altitude		3,000 m or less	12,000 m or less
Dust		Class 1 million (1 x 10 ⁶ grains/ft ³ or less)	

Granule diameter
0.5 μm

II. PACKAGING AND TRANSPORTING

1. Packaging

Before packing or moving, insure that the Disk Cartridge is removed, because if it is not, the vibration and shock during the move will damage the head and disk.

The following table provides the environment conditions.

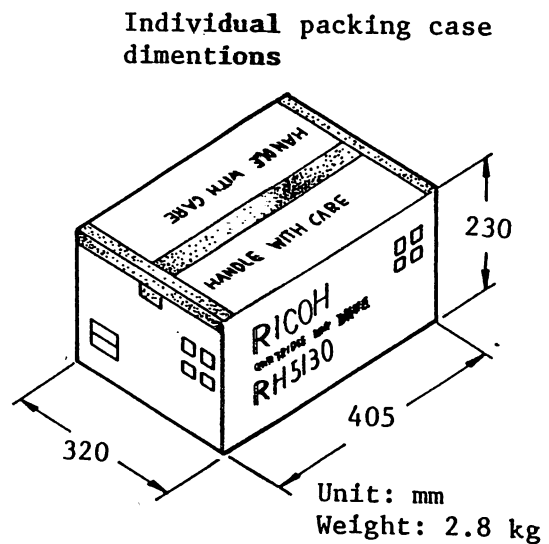
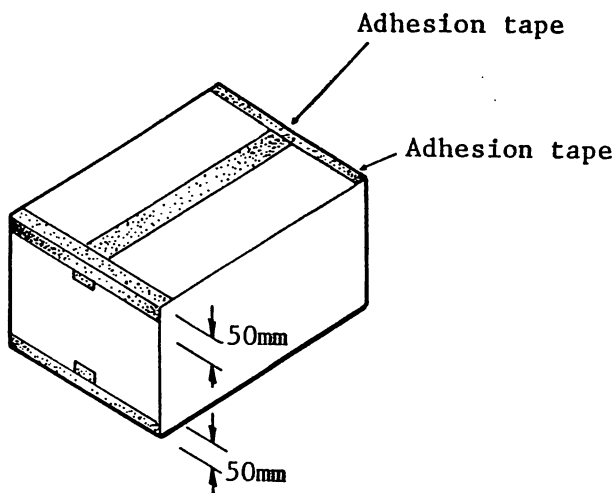
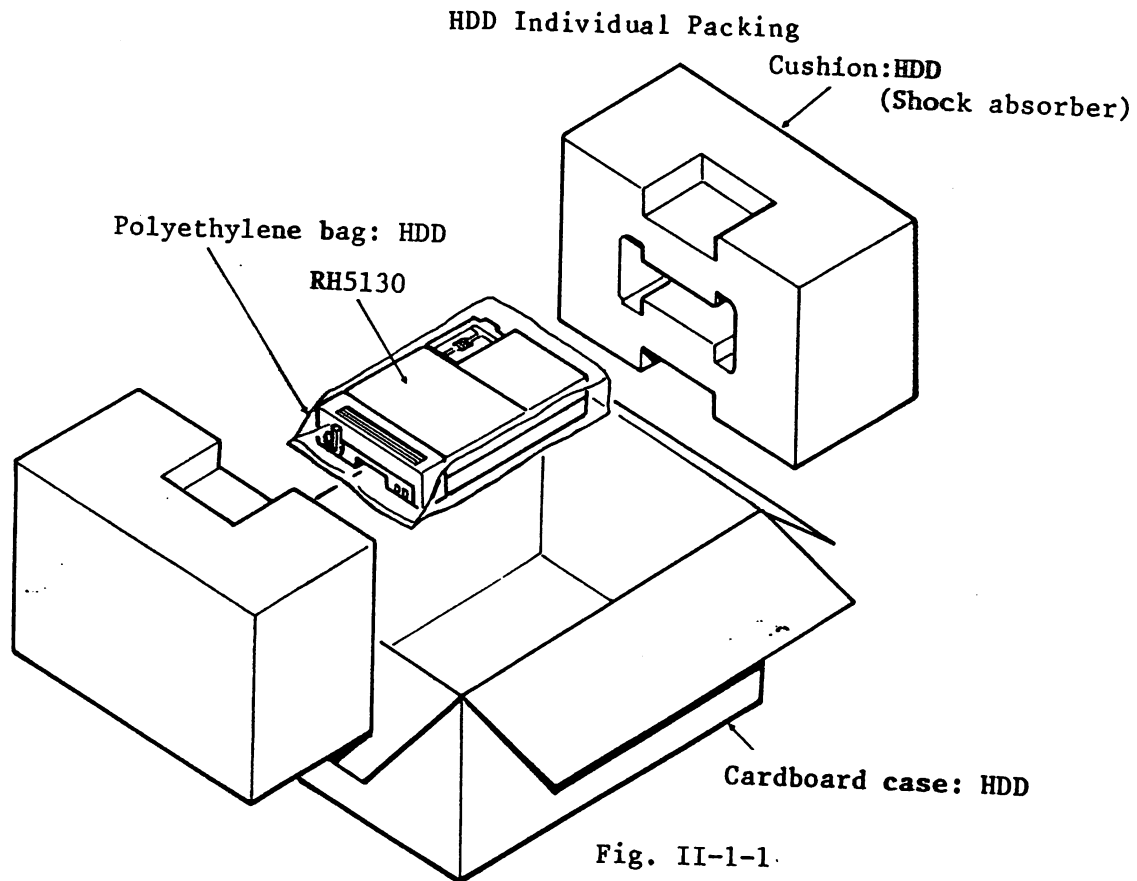
Table II-1-1 Environment Conditions

Item	Standard value
Temperature	-40 - 70°C
Temperature gradient	10°C/H
Humidity	90% RH (No condensation)
Wet bulb temperature	28°C
Height (Above sea level)	12,000 m maximum
Vibration	1.0 G maximum
Shock	40 G maximum

Note: The Disk Cartridge can be removed after releasing the drawer lock by turning the power ON.

Package the HDD using the following procedure:

- (a) Envelope the HDD with a polyethylene bag and heat seal it.
- (b) Place the HDD in the cushions and place in the cardboard case.
- (c) Seal the cardboard case with cloth adhesive tape.



Packing 5 HDDs

Individual packing	
• Weight:	Approximately 9.3 kg
• Dimensions:	504 mm x 323 mm x 273 mm (L) (W) (H)
• Volume:	0.044442216 m ³
• Storage stack:	5

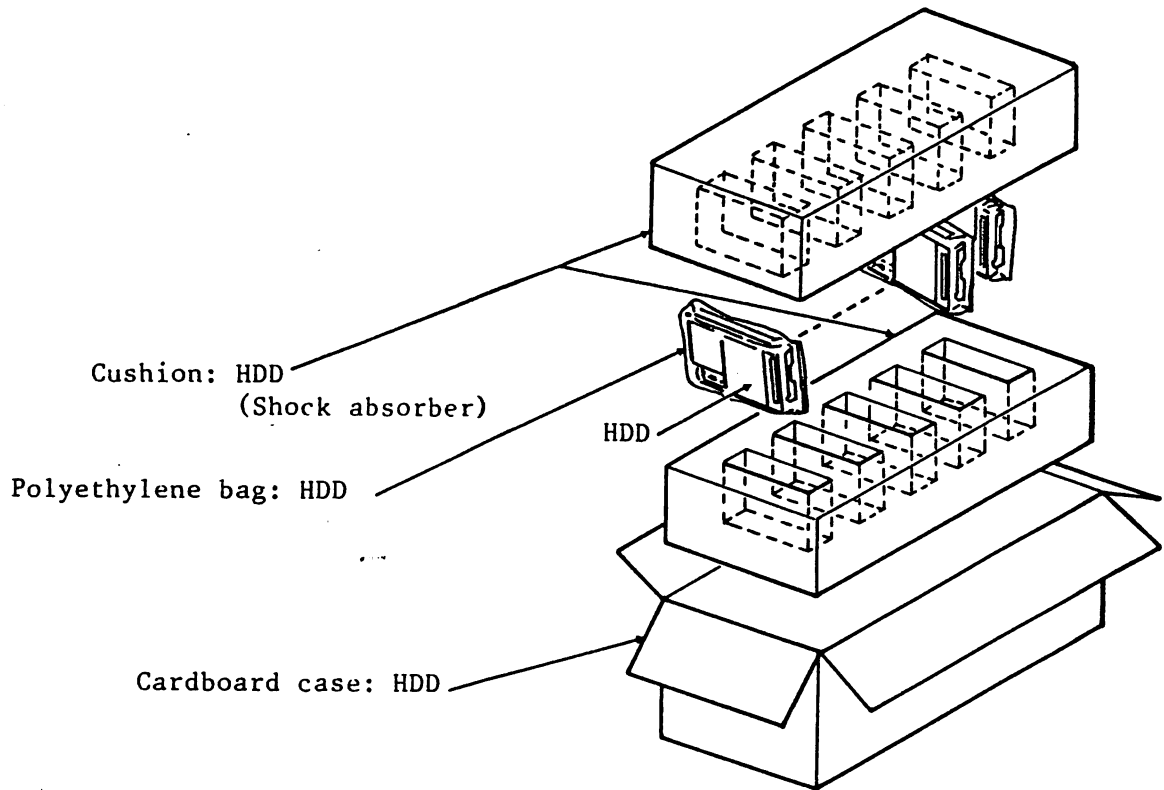


Fig. II-1-4

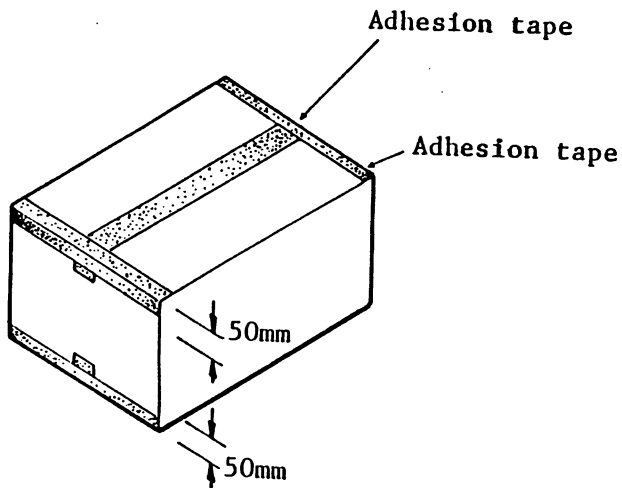


Fig. II-1-5

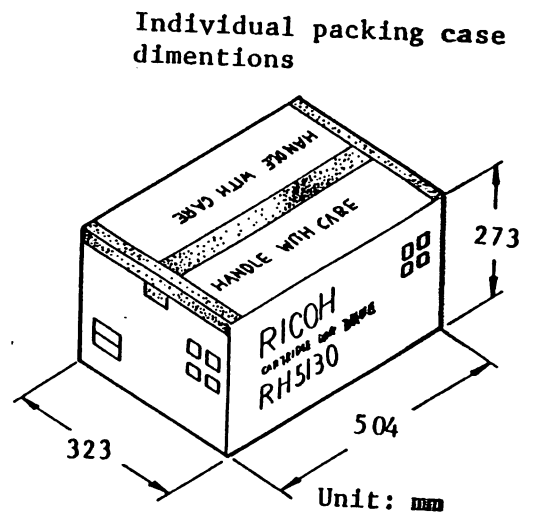


Fig. II-1-6

2. Transporting

The following table provides the transporting requirements of the HDDs.

Table II-2-1 Transportation Requirements

Item	Standard value
Packing style	Cardboard case (a shock absorber required)
Stowage	Compound stowage possible
Stack of packing boxes	5 stack maximum
Attachments	None

III. INSTALLATION

1. Physical Description

Table III-1-1

Item		Drawer	Front panel
Outside dimensions	Width	146.1 mm	146.5 mm
	Height	41.3 mm	41.3 mm
	Depth	203.2 mm	32.3 mm
Weight		1.6 kg	

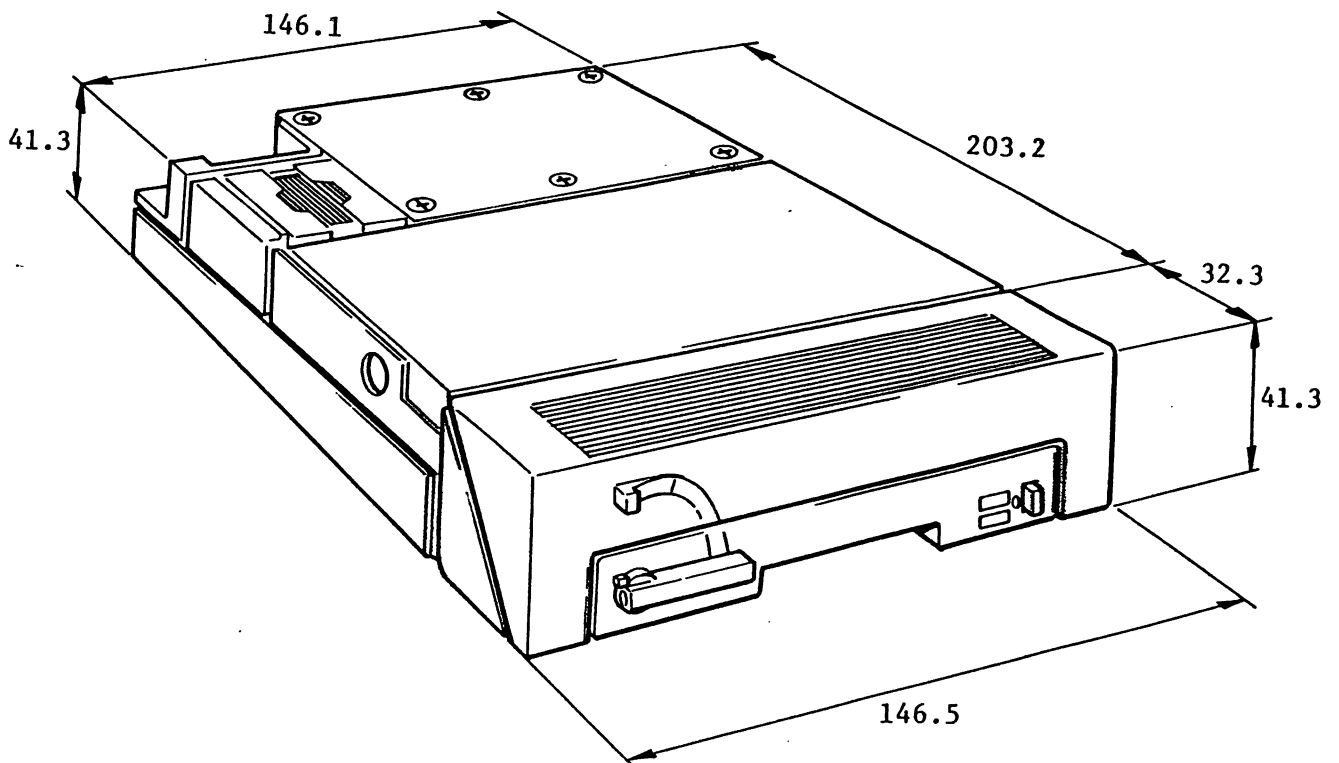


Fig. III-1-1

Note: The drawer stroke is 102.9 mm maximum.

2. Unpacking

The HDD is packed individually or in a lot of 5. In either case, the units are sealed in a polyethylene bag and set in cushions to protect it against vibration and shock during the shipment.

After unpacking, save the packing material in case re-shipment is necessary.

3. Preparations

After the unit has been unpacked, insure that the jumpers are inserted in the proper locations for the functions desired.

3-1. Jumper Locations

Table III-3-1

JP1: Change Cartridge

Signal Name	Jumper Location	
<u>CHANGE CARTRIDGE</u>	[o o]	Standard
<u>REDUCED WRITE CURRENT</u>	o o	Optional

Use jumper plug JP1 to set whether the signal for J1 connector pin 2 will have the standard or the optional signal for ST506 interface.

Table III-3-2

JP2: Drive Select Jumper



Drive No.	Jumper Location
1	 o o o o
2	o [o o] o o o
3	o o o [o o] o
4	o o o o [o o]

Table III-3-3



JP3: Reinitialize Jumper

Signal Name	Jumper Location	
<u>REINITIALIZE</u>		Standard
None	o o	Optional

Use jumper JP3 to set whether the signal for J2 pin 3 will be the standard or a optional signal for the ST506.

Table III-3-4

JP4: Write Servo Jumper

Signal Name	Jumper Location	
WRITE SERVO		Standard
HEAD SELECT 2'		Optional

Use jumper JP4 to set whether the signal from J1 pin 18 will use the standard or optional signal for ST506 interface.

INTERFACE BOARD

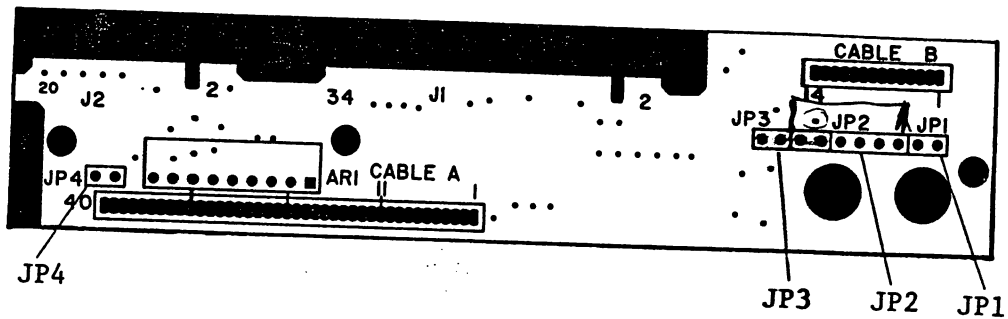


Fig. III-3-1

Main Circuit Board

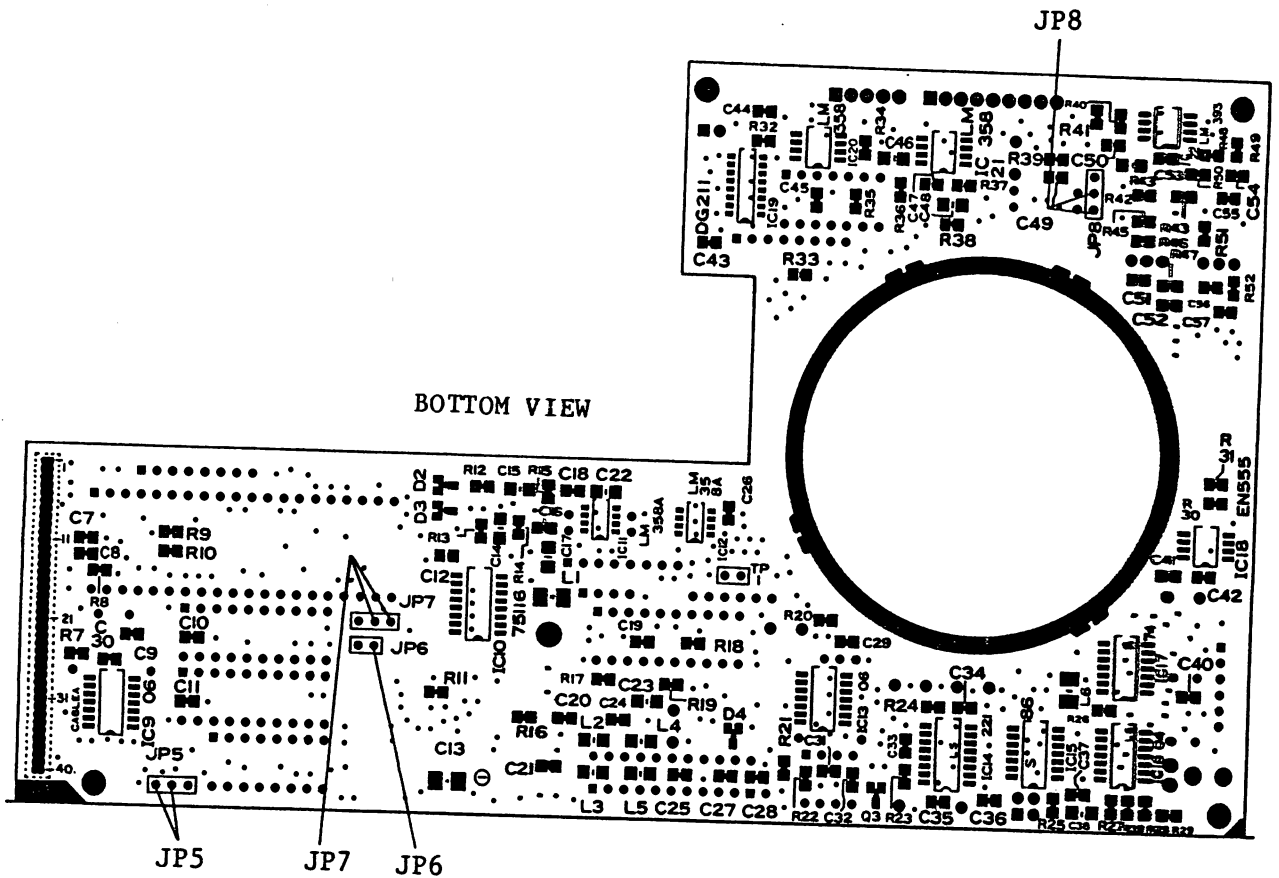


Fig. III-3-2

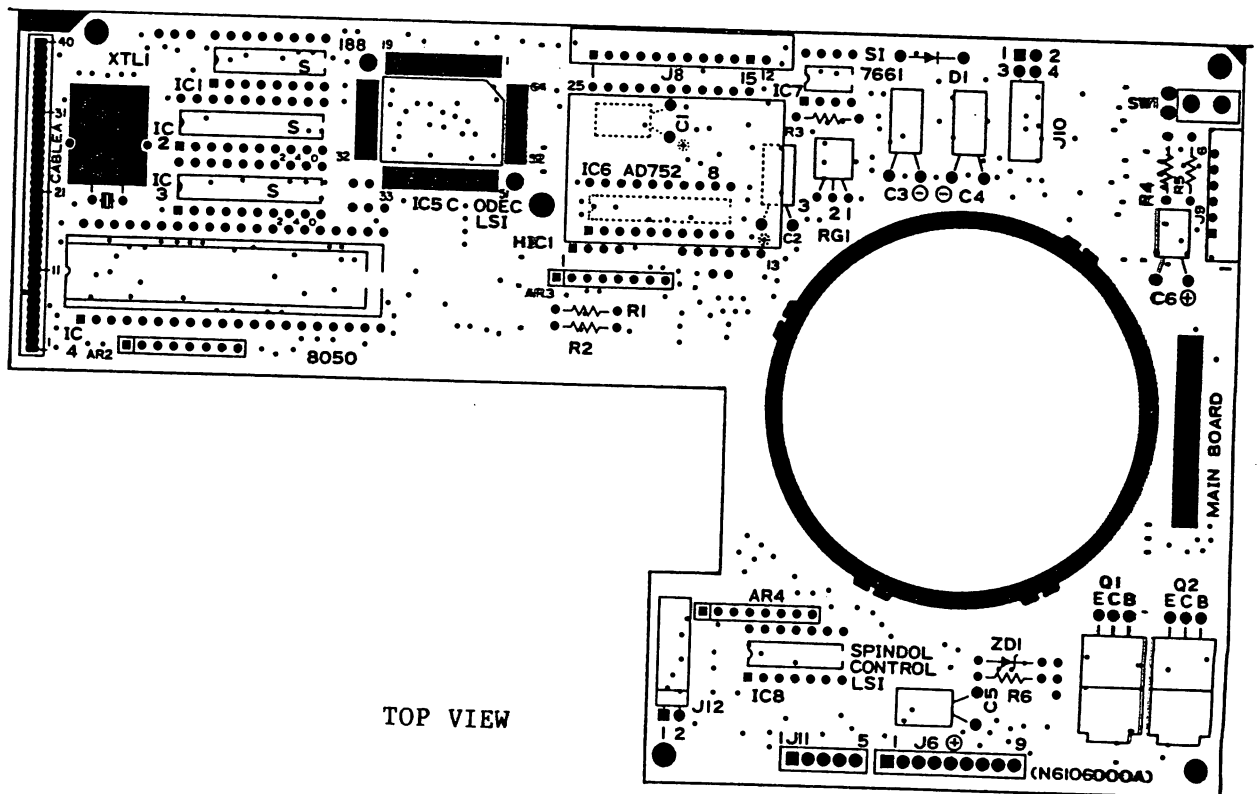


Fig. III-3-3

Terminal resistor (A socket is on the ARI side.
The mark indicates pin 1.)

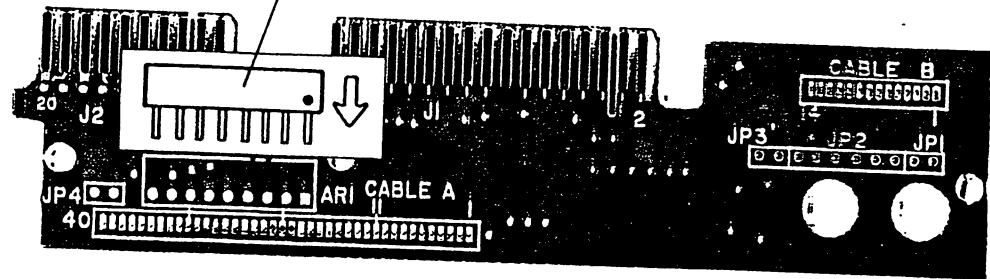


Fig. III-3-5

3-3. Mounting

Pre-cautions

- (1) Avoid the obstacles, such as cables to prevent damaging the unit.
- (2) Cool the HDD with a fan, but be careful not to draw in air through the front panel.
- (3) The bowl mounted to the unit must be designed not to warp the disk unit frame.
- (4) Attach a vibration isolator to the unit.
- (5) For the clearance and stroke of the unit.

There are three directions that the HDD can be mounted, which are shown in the figure below.

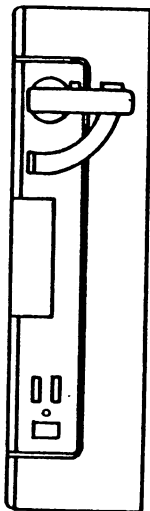


Fig. III-3-6

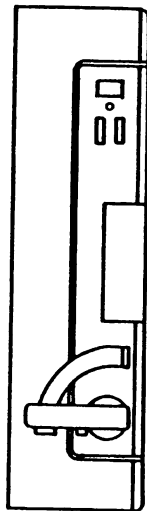


Fig. III-3-7

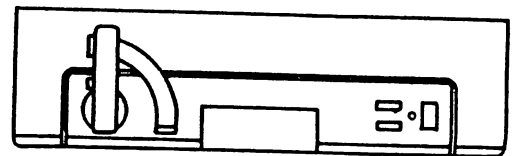


Fig. III-3-8

The following figure shows the mounting angle and measurements. Be careful because the maximum depth for the screws is 3.5 mm, and mount the unit with the four screws (No. 6-32 UNC) from the side or bottom of the unit.

Mounting Diagram

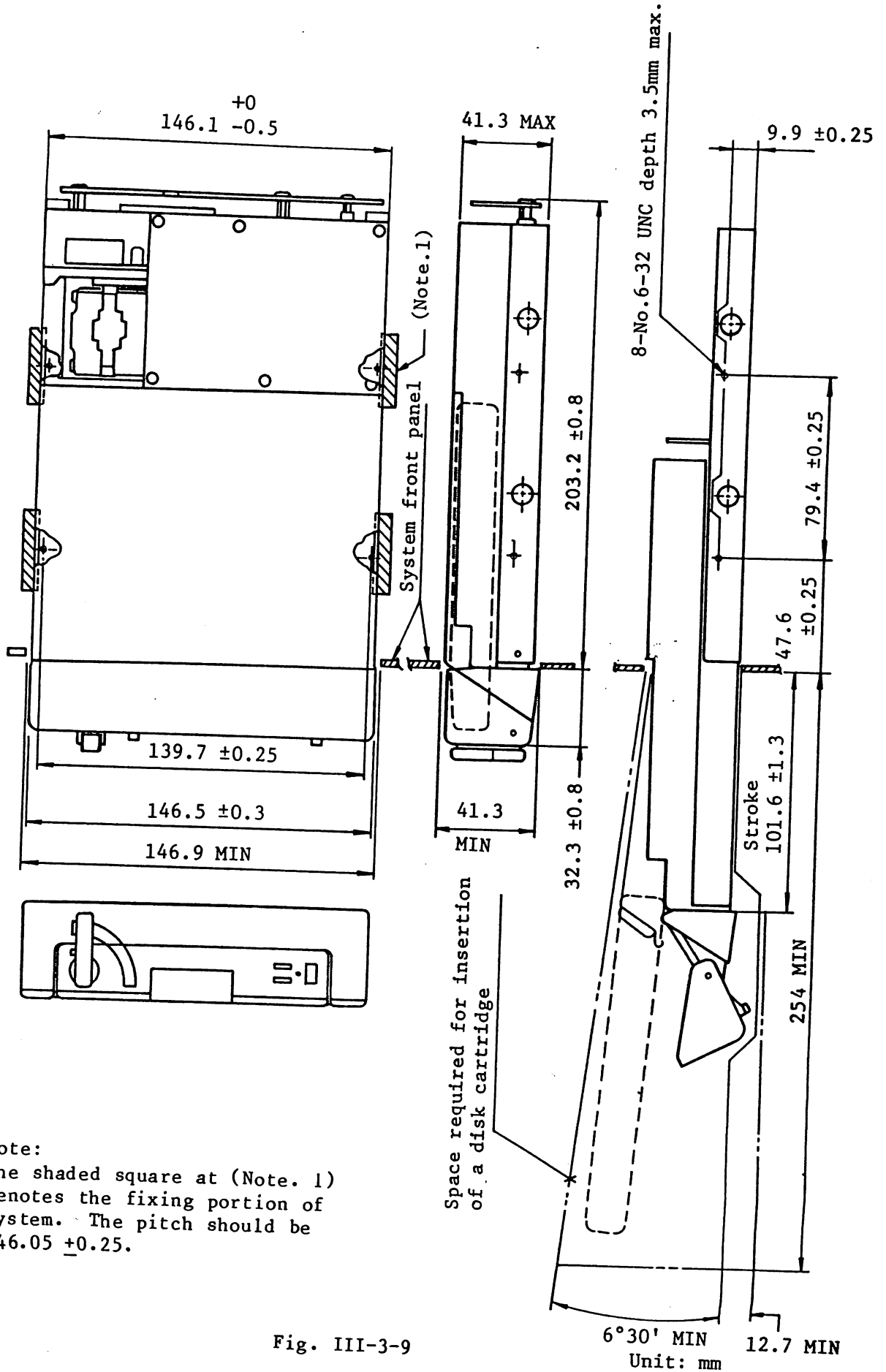


Fig. III-3-9

IV. OPERATION

1. Introduction of the Front Panel

The front panel consists of the following parts:

- Drawer unlatch lever
- Two LEDs (red and green)
- Write servo button
- Start/Stop button

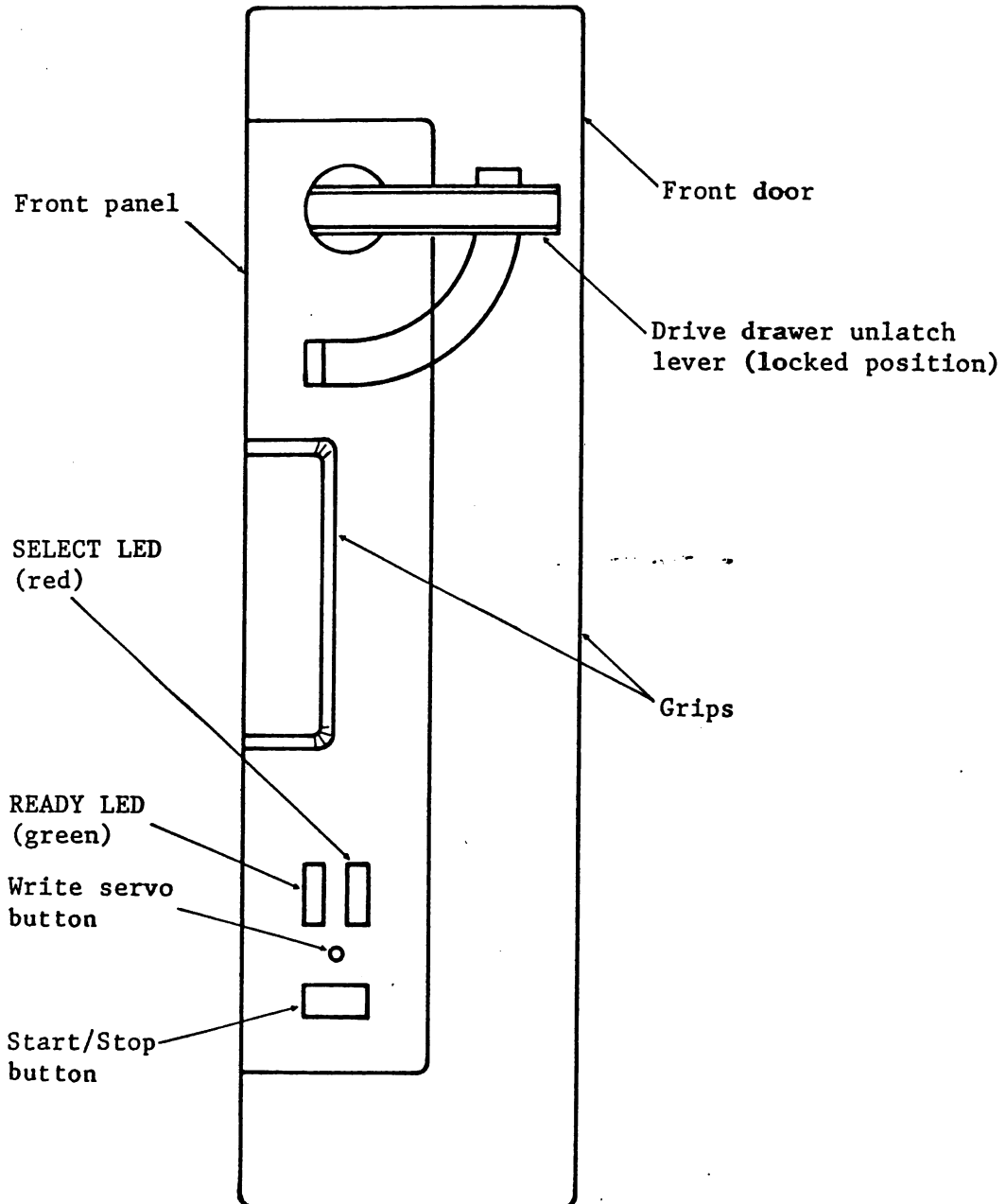


Fig. IV-1-1

2. Front Panel

2-1. Drawer Unlatch Lever

The drawer can be unlatched by turning the drawer unlatch lever 90°. This lever is interlocked with multiple functions to protect the drive components and data. The lock mechanism consists of a link connected to a solenoid and the lever cam.

When the start/stop button is pressed, allow about 8 seconds for the head to retract and the spindle motor to stop; also, during this time, the door is locked to protect the head and disk surface. If the drawer unlock lever is turned before the 8 seconds is up, the lever will turn about 5 mm and stop. The lever will then be stuck and it will stay that way even after the ready light goes on, because the solenoid will not function.

Therefore, use caution and follow the below steps.

- (a) When removing the Disk Cartridge, turn the lever to the right after the green light goes off.
- (b) When inserting the Disk Cartridge, turn the lever to the left until it stops.

2-2. Grip

Two areas have been provided to insure a firm grip of the HDD when moving. The right top of the drawer and the recess are the locations of the grips.

2-3. LEDs

The unit has two LEDs. The red LED indicated that the host has selected the HDD and it is active.

Whereas, the green LED has a variety of purposes. It indicates the activity in process as the following describes:

- (a) When the LED is constantly lit, the HDD has set the disk and it is ready for operation.
- (b) When the LED is flashes once every second, the HDD is increasing the motor RPMs to operation speed, which lasts about 30 seconds, or the HDD is in the write servo mode, which lasts about 3.5 minutes.
- (c) When the LED is flashing twice a second, the spindle motor is going to stop, in which case the flashing lasts about 10 seconds.
- (d) When the LED flashes four times a second, a fault that the controller cannot reset has occurred. The following are examples of possible faults:
 - This Disk Cartridge does not have any servo information. It can be cleared by running a WRITE SERVO command.
 - Head wires are damaged.*
 - The spindle motor speed is out of tolerance.*

- +12 volt power is low.*
- The servo information cannot be read.*
- The WRITE PROTECT (signal) is detected during manual WRITE SERVO operation.*

Note: * can be reset by pressing the start/stop or the on/off buttons.

2-4. Start/Stop Button

This button is used to start and stop the spindle motor.

CAUTION

Before turning the power off, be sure to stop the spindle motor with this button or the CHANGE CARTRIDGE signal.

2-5. Write Servo Button

This button is used to manually request a write servo operation.

To start this operation:

- (a) Insert the desired Disk Cartridge.
- (b) Press the start/stop button to start the spindle motor.
- (c) After the green Ready Light has lit or it is flashing four times a second, press the Write Servo Button to start writing the servo information.

CAUTION

When this operation starts, all existing data on the disk is erased.

3. Basic Operation

- (a) Power must be turned ON or the drawer will remain locked. To insert the Disk Cartridge, turn the drawer unlatch lever 90° to the right.
- (b) Pull the drawer out until it clicks, which is about 102.9 mm from the front panel.
- (c) Open the front door slowly until the cartridge receiver moves about 6.4 mm and the door moves about 90°.

Now the disk is ready to be inserted as shown in the figure below.

Ready for Insertion

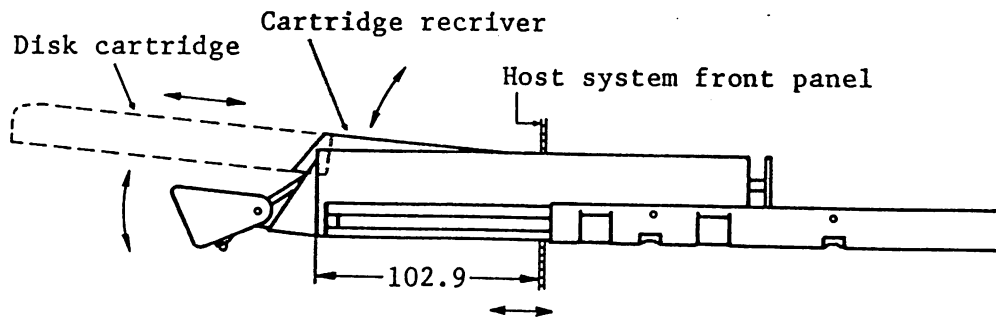


Fig. IV-3-1

Disk Cartridge Inserted

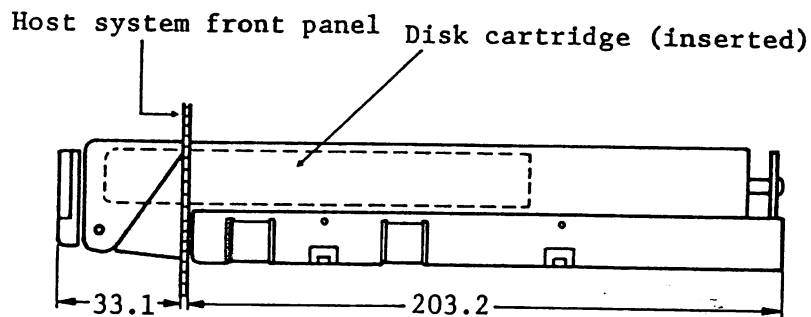


Fig. IV-3-2

To insert the Disk Cartridge:

Take the Disk Cartridge out of the protective sleeve. Keep the protective sleeve to store the cartridge disk in when it is not being used.

Remove the plastic tape that comes on every new disk cartridge that was applied to the armature plate on the bottom of the Disk Cartridge.

There is a write protection plug, so remove it or insert it as desired. Thus, when writing the servo information on to the disk, the write protection plug must be inserted.

Insert the Disk Cartridge into the drawer. Close the door slowly so that the Disk Cartridge receiver can retract and seat completely.

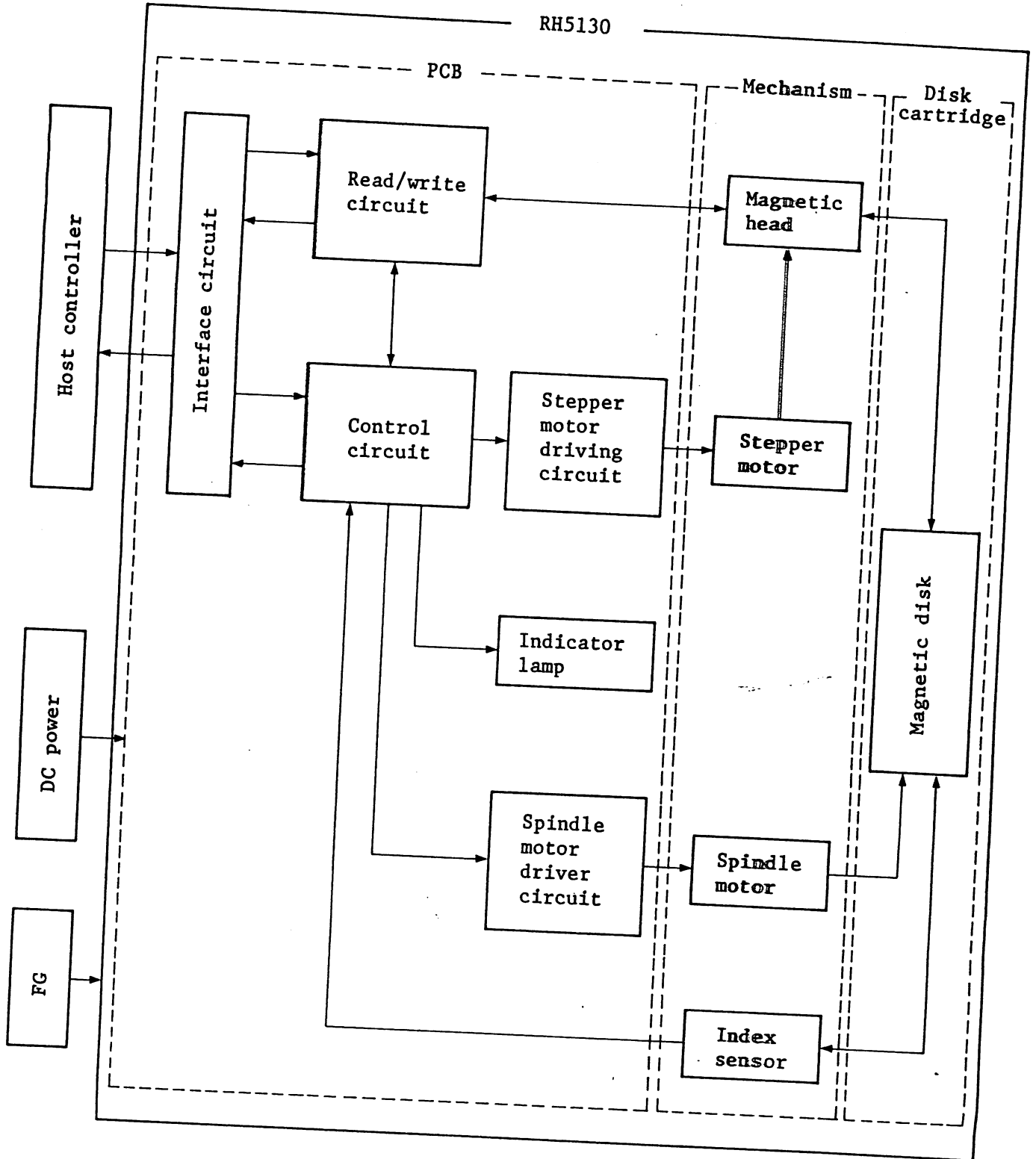
Turn the drive drawer unlatch lever 90° up to the front door locking position. Push the drive slowly until it clicks. The drive is now approximately 33.1 mm ahead from the housing (host system front panel).

The spindle motor can be started by pressing the start/stop button. If the drive power is on, the control system initiates the control system. The drive becomes ready if it mounts a disk cartridge.

The HDD is now ready for use.

V. SYSTEM DESCRIPTION

1. System Block Diagram



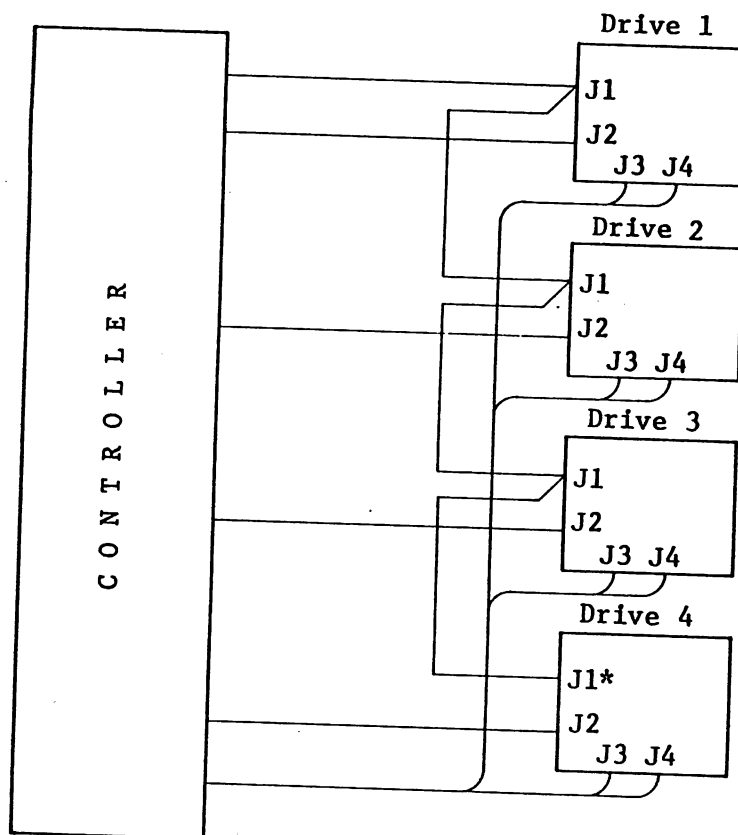
2. Interface configuration

The interface for this system is based on the ST506 for 5.25" hard disk drives.

- J1 (34 pin): Control Signals
- J2 (20 pin): Read/Write Data
- J3 (4 pin): DC Power
- J4 (terminal): Ground

The J1 connector allows multiple drives to be daisy chained and controlled by a central unit.

The J2 connector cannot be daisy chained and it must be direct radial connected to the controller.



Example of connecting four drives. Mark "*" indicates a terminator resistor .

Fig. V-2-1

3. Interface Circuits and Signals

Both the data and the control signals use negative logic as described in the below table.

Table V-3-1

Voltage level	Signal status	Logical value	State
Low	ON	1	True
High	OFF	0	False

Note: ON --- 0.0 - 0.4 V DC / 1 - 40 mA
 OFF --- 2.5 - 5.25 V DC / 1 - 250 μ A

4. Control Interface Circuits

A terminator is needed on the control signal line at the end of the multiple HDDs daisy chain. The terminator consists of a 220/330 array resistor. Connect or disconnect the socket (ARI) to turn ON or OFF the terminator.

TTL interface circuit

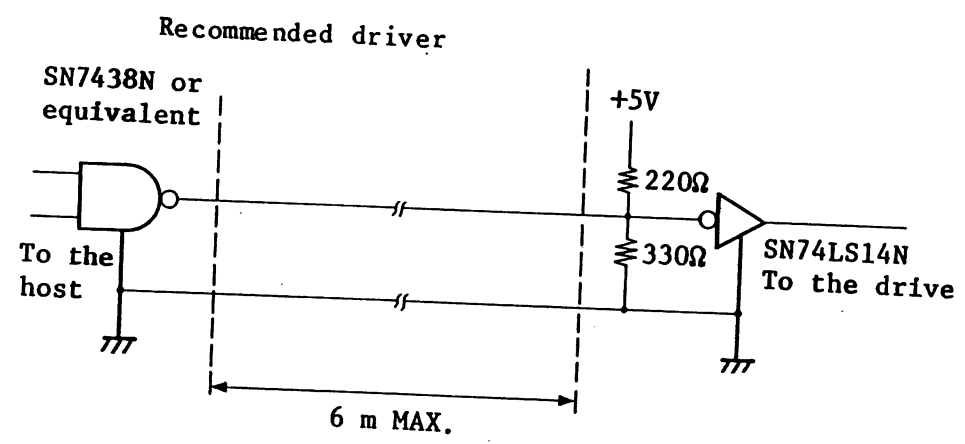
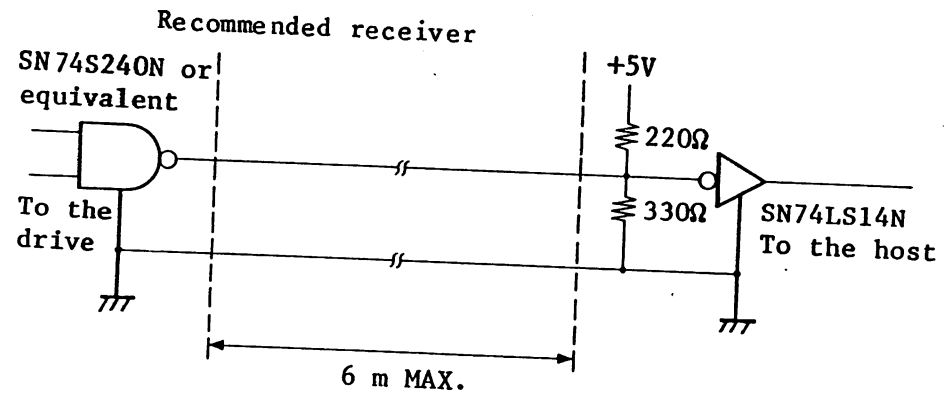


Fig. V-4-1



Note: The RH5130 uses SN74S240 (or equivalent) as the driver and receiver.

Fig. V-4-2

5. J1 Physical Description

This is a 34 pin connector, which is keyed between pins 3 and 5. The connector plug for this connector jack is P/N 88373-3 manufactured by AMP, but there are equivalents.

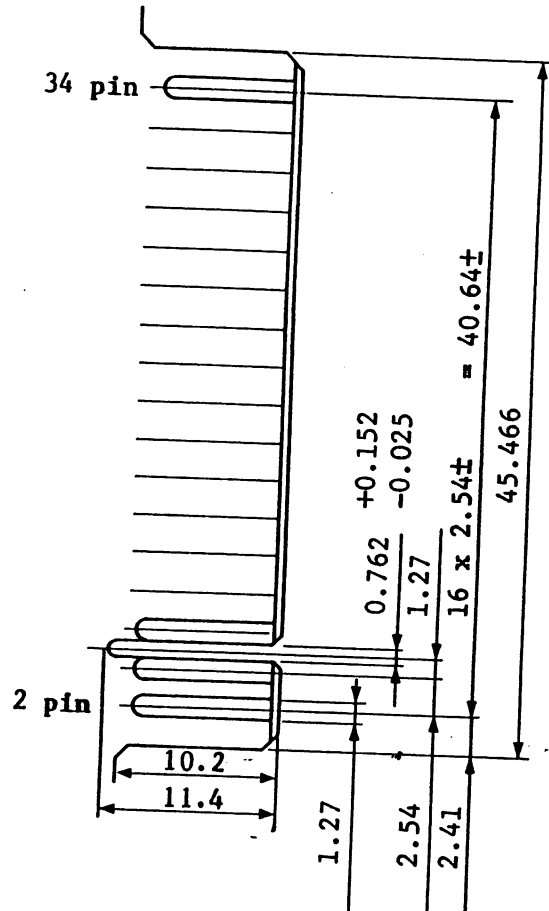


Fig. V-5-1

6. J1 Signal and Pin Assignments

Table V-6-1

SIGNAL PIN	GND RTN PIN	SIGNAL NAME	SIGNAL DIRECTION	
			HOST	DRIVE
2	1	$\overline{\text{CHANGE CARTRIDGE}} (*1)$	—————→	—————→
4	3	Reserved (open) (*2)	(-----)	(-----)
6	5	$\overline{\text{WRITE GATE}}$	—————→	—————→
8	7	$\overline{\text{SEEK COMPLETE}}$	←————	—————
10	9	$\overline{\text{TRACK 000}}$	←————	—————
12	11	$\overline{\text{WRITE FAULT}}$	←————	—————
14	13	$\overline{\text{HEAD SELECT}} (2^0)$	—————→	—————→
16	15	Reserved (open)	(-----)	(-----)
18	17	$\overline{\text{WRITE SERVO}} (*1)$	—————→	—————→
20	19	$\overline{\text{INDEX}}$	←————	—————
22	21	$\overline{\text{READY}}$	←————	—————
24	23	$\overline{\text{STEP}}$	—————→	—————→
26	25	$\overline{\text{DRIVE SELECT 1}}$	—————→	—————→
28	27	$\overline{\text{DRIVE SELECT 2}}$	—————→	—————→
30	29	$\overline{\text{DRIVE SELECT 3}}$	—————→	—————→
32	31	$\overline{\text{DRIVE SELECT 4}}$	—————→	—————→
34	33	$\overline{\text{DIRECTION IN}}$	—————→	—————→

Note:

- 1) Signals marked with *1 do not follow the ST506 interface specifications.
- 2) A terminator can be connected to the pin marked with a *2.
- 3) The signal marked with the 2^0 has two active states. The low active state will select head 1, and the high active state will select head 2.

7. Data Interface Circuits

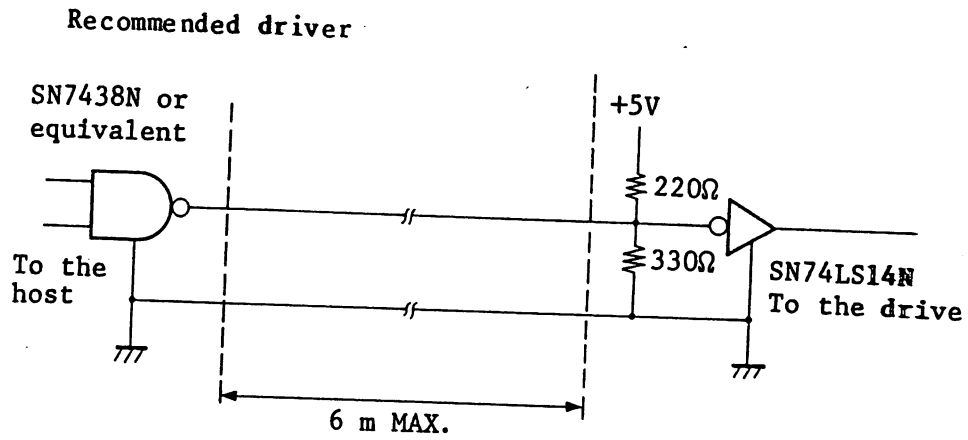
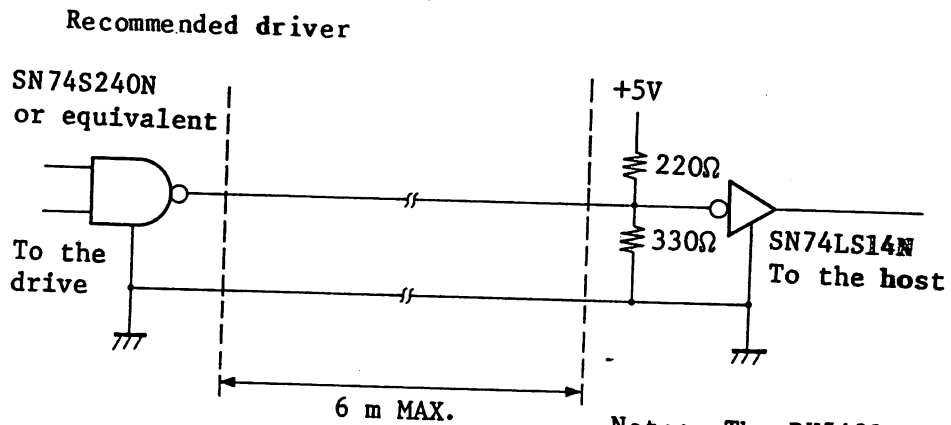


Fig. V-7-1



Note: The RH5130 uses SN74S240 (or equivalent) as the driver and receiver.

Fig. V-7-2

8. RS422 I/O Circuit

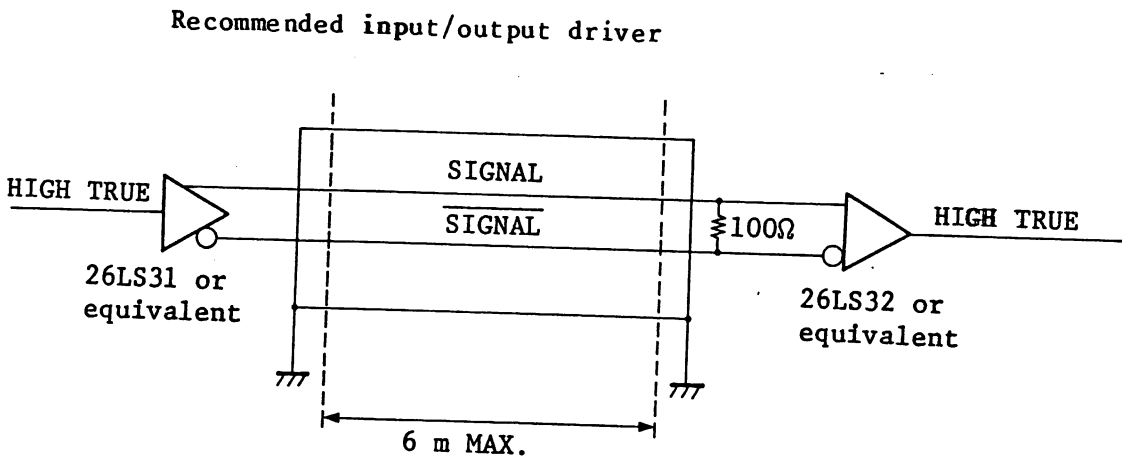


Fig. V-8-1

9. J2 Physical Description

This is a 20 pin connector, which is keyed between pins 3 and 5. The connector plug for this connector is P/N 88373-6 manufactured by AMP, but there are equivalents.

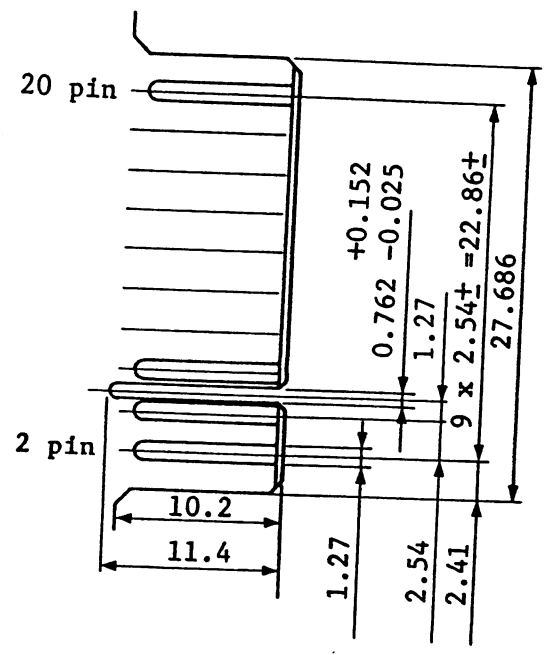


Fig. V-9-1

10. J2 SIGNAL AND PIN ASSIGNMENTS

Table V-10-1

SIGNAL PIN	GND RTN PIN	SIGNAL NAME	SIGNAL DIRECTION	
			HOST	DRIVE
1	2	$\overline{\text{DRIVE SELECTED}}$ (*1)	←	—
3	4	$\overline{\text{REINITIALIZE}}$ (*2)	—	→
5	6	$\overline{\text{WRITE PROTECTED}}$ (*2)	←	—
7	8	Reserved (open) (*2)	(-----)	(-----)
9	10	$\overline{\text{CARTRIDGE CHANGED}}$ (*2)	←	—
11	12	Ground		
13		MFM WRITE DATA	—	→
14		$\overline{\text{MFM WRITE DATA}}$	—	→
15	16	Ground		
17		MFM READ DATA	←	—
18		$\overline{\text{MFM READ DATA}}$	←	—
19		Ground		
20		Ground		

Notes: "*1" indicates a TTL level signal.
 "*2" indicates a TTL level signal not conforming with the ST506 interface specifications.

11. J3 Signal and Pin Assignments

Table V-11-1

Pin. No.	Signal name
1	DC +12V
2	DC +12V return
3	DC +5V return
4	DC +5V

DC power connector

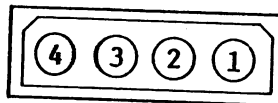


Fig. V-11-1

Drive side

Mate-N-Lock connector ... P/N 350211-1 (or equivalent) manufactured by AMP

Host side

Recommended connector are as follows:

Housing ... P/N 1-480424-0 or equivalent manufactured by AMP

Plug P/N 350078-4 (STRIP) or equivalent manufactured by AMP
..... P/N 61173-4 (LOOSE-PIECE) or equivalent manufactured by AMP

12. Power Sequence

The power supply is recommended to come from the host system.

However, when using a different power supply, the following conditions must be followed:

- 1) The host system power must be on before the power to the HDD.
- 2) The HDD power must be turned OFF before the host power is turned OFF.

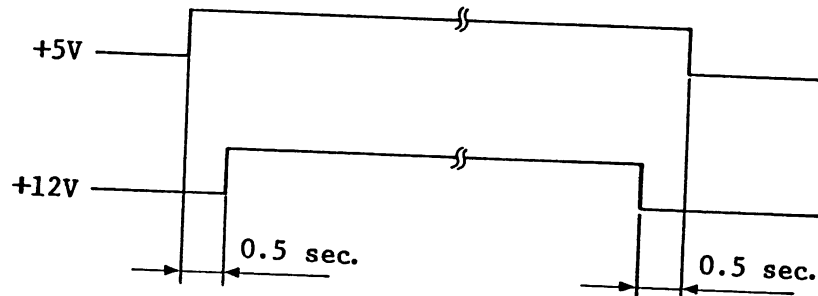


Fig. V-12-1

In any case the 5 volt and 12 volt power-on sequences must be as follows:

Power-on

The 5 volts needs to be turned ON before the 12 volt. If it is, the time lag between them must be 0.5 second or less.

Power-off

The 12 volt power supply needs to be turned OFF before the 5 Volt power supply. If the 5 volt is turned off prior to the 12 volt, the time lag between them needs to be 0.5 second.

13. J4 Frame Ground

The frame ground is usually the ground connection of J3. The framed ground connection is then connected to the framed of the host system. The slide rail is isolated from the drive frame.

VI. SIGNAL DESCRIPTIONS

The active state of all signals is the negative logic.

Table VI-1

Voltage level	Signal status	Logical value	State
Low	ON	1	True
High	OFF	0	False

Note: ON ---- 0.0 - 0.4 V DC / 1 - 40 mA
OFF --- 2.5 - 5.25 V DC / 1 - 250 μ A

1. Input Control Signals

1-1. CHANGE CARTRIDGE J1 pin 2

When this signal is active for more than 500 ns while the DRIVE SELECT n and the WRITE FAULT are active, the HDD spindle motor power down sequence starts. If the host system uses this command, it can prepare the HDD to change Disk Cartridges, to unload the head and stoop the spindle motor in preparation to stop the system. However, once the spindle motor is stopped, it can be restarted by one of the following steps:

- The operator presses the start/stop button
- Power-off reset.

Optional condition

The signal line from J1 connector pin 2 can be disconnected from the interface by removing the jumper from J1. If the HDD is to be used with the ST506 controller, which uses J1 pin 2 for the REDUCED WRITE CURRENT signal, the jumper at J1 must be disconnected.

1-2. WRITE GATE J1 pin 6

When this signal is active, data can be written onto the Disk Cartridge. However, when this signal is inactive, the HDD can read, seek and change the head.

1-3. HEAD SELECT J1 pin 14

This signal uses the low active level for the lower head (head 1) and the high active level for the upper head (head 2). So, when the active state changes, the heads will change, and when they do change, the SEEK COMPLETE signal is deactivated while the HDD positions the newly selected head over the track. When the HDD receives the HEAD SELECT signal, it generates the first step pulse after at least 200 micro-seconds. IF step pulses are not generated during this period, only a head change operation occurs. See STEP signal for more details.

When changing the head, the drive moves the head to assure interchangeability of the Disk Cartridge. Therefore, the SEEK COMPLETE signal is deactivated during head change to inform the controller that read/write is disabled.

1-4. STEP J1 pin 24

This signal moves the read/write heads in the direction specified by the DIRECTION IN signal. Any change in the DIRECTION IN signal needs to occur at least 100 ns before the leading edge of the STEP pulse. The HDD operates in the Buffered Seek mode and the Slow Step mode.

(1) Buffered Seek Mode

The buffer seek mode receives the STEP pulses at high speed and holds them in the counter, where each STEP pulse moves the head one track in the direction that the DIRECTION IN signal indicates. The SEEK operation starts at the leading edge of the STEP pulse, even though the actual head movement begins at the trailing edge of the last STEP pulse. As shown on the Buffer Seek Timing Chart, the DRIVE SELECT, HEAD SELECT, and DIRECTION IN signals must be determined at least 100 ns before the leading edge of the STEP pulse and they must be maintained at least 100 ns after the last STEP pulse. The STEP pulse string is completed when STEP pulses are not received for 200 microseconds or more. The SEEK COMPLETE signal is deactivated within 500 ns from the first STEP pulse. The DIRECTION IN and HEAD SELECT signals are sampled and latched when the STEP pulse string ends. Therefore, these signals must be held until the DRIVE SELECT n is deactivated after the leading edge of the last STEP pulse.

The output of the STEP pulse must be within 200 microseconds after changing the HEAD SELECT signal status, and if not, then the HDD only recognizes the head change and no subsequent STEP pulse.

(2) SLOW STEP Mode

The ST506 slow step mode (3 ms STEP intervals) is not fully supported.

However, the slow step mode can be used by a series of 3 ms STEP pulses. The HDD recognizes the first STEP pulse as a single track seek operation and it will perform this operation; however, as this operation takes place, the HDD is remembering any other STEP pulses that may be received during this operation. Then, the HDD will perform each single track seek operation until all STEP pulses have been performed.

If the HDD receives a request from the controller to seek an outer track while the microprocessor in the drive recognizes track 0, the HDD will recognize it as a re-zero command, and the HDD will start a re-zero sequence. At the end of the re-zero sequence, the TRACK 000 and SEEK COMPLETE signals are activated.

(3) Seeking Tracks 611 and Up

The microprocessor in the drive inhibits seeking tracks 611 and up. The head stops at track 611.

1-5. WRITE SERVO J1 pin 18

This signal clears all previous servo information and all data stored on the Disk Cartridge so that the new servo information can be written on the Disk Cartridge.

Because the servo information comes from the HDD, the Disk Cartridge has the best alignment between it and the HDD, and the seek function is improved.

To start the write servo sequence from the controller, the drive must be in the READY state or else the drive goes into the WRITE FAULT state. The drive holds the WRITE SERVO and DRIVE SELECT n signals active for one second or more. After one second, the HDD clears the whole disk, and then it writes the servo information onto the disk. The whole sequence requires 3.5 minutes, and during this time the green LED flashes every second.

Optional Condition

The WRITE SERVO signal from J1 pin 18 can be disconnected from the interface by removing the jumper from JP4. If the HDD is to be used with the ST506 controller, which uses J1 pin 18 for the HEAD SELECT 2ⁱ signal, the jumper at JP4 must be disconnected.

1-6. DIRECTION IN J1 pin 34

This signal determines the direction of the read/write head movement and it is latched by the STEP signal. The head moves inward on a low signal and outward on the high signal. The timing that is shown on the following figure must meet the timing specifications.

1-7. DRIVE SELECT n (1 TO 4) J1 PINS 26, 28, 30, and 32

This signal is used for multiplexing the up to four HDDs. First each drive needs to be given a designated DRIVE SELECT number. Then, when the DRIVE SELECT number corresponding to the target HDD is selected, the HDD and the I/O control signals are activated. Two or more HDDs cannot be activated at one time.

Head selection timing chart

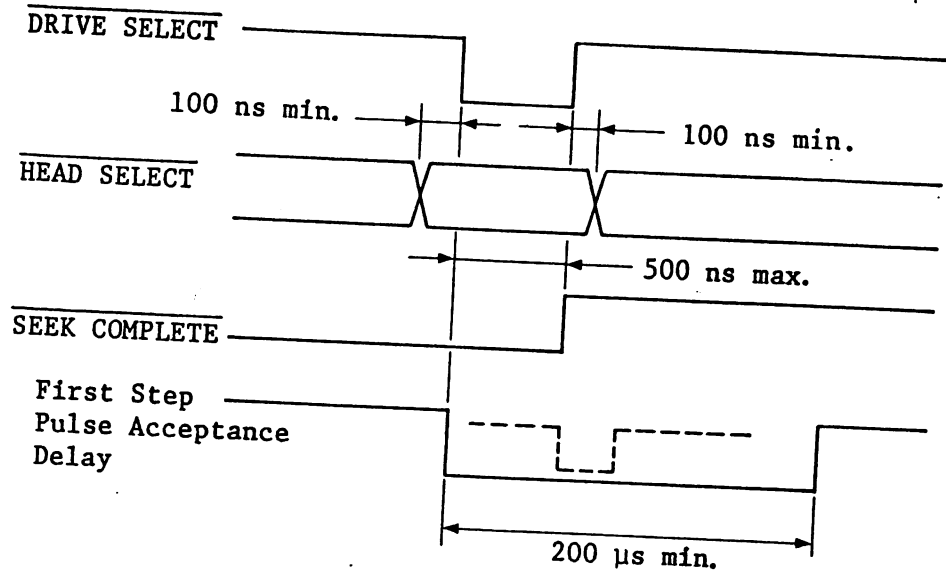
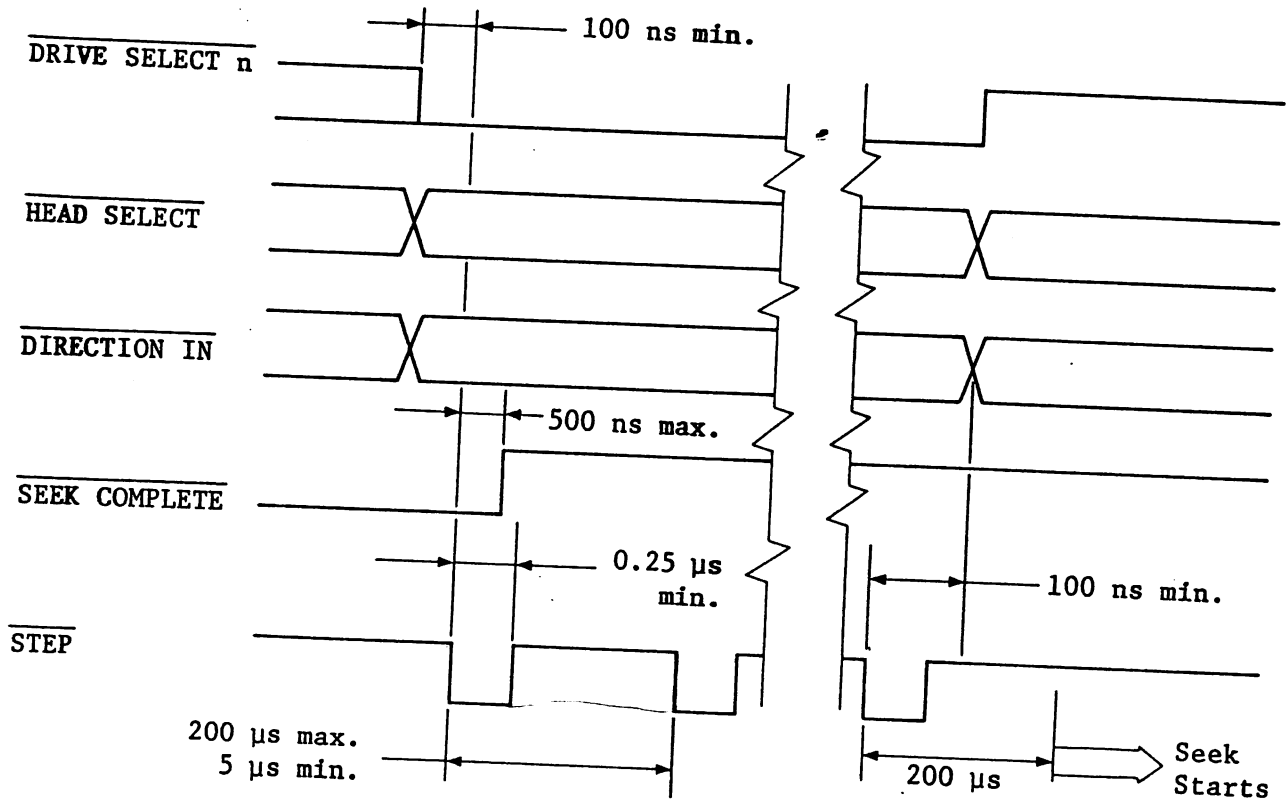


Fig. VI-1-1 Head selection timing chart

Buffered seek timing chart



Buffered seek timing chart

Fig. VI-1-2

2. Output Control Signals

2-1. SEEK COMPLETE J1 pin 8

After the track seek or head change, the head is positioned on the target track and the SEEK COMPLETE signal is activated. When the SEEK COMPLETE signal is deactivated, do not try to write or seek. This signal is deactivated for the following cases:

- During REINITIALIZE or WRITE SERVO
- Within 500 ns from the leading edge of the STEP pulse
- Within 500 ns after head change with HEAD SELECT
- When the WRITE FAULT state that cannot be reset is activated.

2-2. TRACK 000 J1 pin 10

This drive will always output the information of this track, TK 000, whenever the head is positioned here.

2-3. WRITE FAULT J1 pin 12

When any state that might disable writing has occurred, this signal is activated. However, the READY and SEEK COMPLETE signals remain active so that they can continue their operations. The controller can reset this signal for some faults but not all.

WRITE FAULT state that can be controller reset

These causes are external problems and not HDD error.

- (a) The controller has tried to write data on a write-protected Disk Cartridge.
- (b) A WRITE GATE signal is active and write data pulses are not being generated.
- (c) Momentary loss of 12 volt power.
- (d) The spindle motor RPMs have momentarily changed.

To reset this signal, deactivate the DRIVE SELECT n signal for the HDD that has the fault for more than 1 ms.

WRITE FAULT state that cannot be controller reset

Usually this signal means that the HDD has one of the following serious faults.

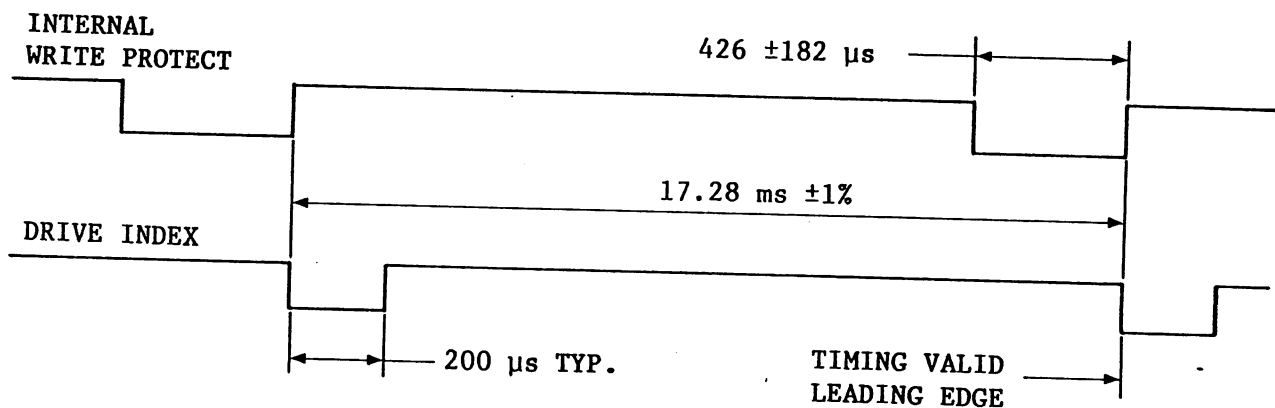
- (a) The head wires are damaged.
- (b) The spindle motor rotation is faulty.
- (c) The 12 volt power supply is abnormal.
- (d) The servo information is lost.

Under these conditions the WRITE FAULT and READY signals will remain activated, but the SEEK COMPLETE signal will be deactivated. The green Ready LED will flash four times a second to inform the operator that there is a fault in the system.

If the fault has been cleared, pressing the start/stop button will reset the WRITE FAULT signal, and the HDD will retract the heads, the spindle motor stops, and unlock the front door. This signal can also be reset by a power-off sequence, a WRITE SERVO command, or REINITIALIZE command; however, if the fault has not been cleared, the door remains locked and the HDD remains in the WRITE FAULT state.

2-4. INDEX J1 pin 20

The output INDEX signal for each disk rotation is to indicate the beginning of each track. Normally this signal is deactivated and only the leading edge is effective. When the drive is ready and the SEEK COMPLETE is deactivated, the INDEX signal is not sent.



INDEX Timing Chart

2-5. READY J1 pin 22

When the READY and SEEK COMPLETE signals are active, the drive is ready for the READ/WRITE, SEEK and other signals. If the READY signal is deactivate, write and seek operations are inhibited. The READY signal is activated after 30 seconds from the power is turned ON. When the SEEK COMPLETE signal is deactivated and the READY signal is active, the drive microprocessor is ready to receive controller commands, such as WRITE SERVO, FAULT RESET (select and deselect), REINITIALIZE and CHANGE CARTRIDGE.

3. Input Data Signals

The control signals arranged in the J2 connector are gated by DRIVE SELECT n (1 to 4).

3-1. MFM WRITE DATA: Pos. for J2 pin 13; Neg. for J2 pin 14

Note: The signal for J2 pin 13 is one of the few signals that use the positive (Pos.) logic or it is active on the positive side of the signal.

The data that is received from the host is defined and written on the track by a differential pair of signals. When the WRITE GATE is, the Pos. MFM WRITE DATA signal, and the Neg. MFM WRITE DATA signal are active, the flux on the track is reversed. The Pos. and Neg. MFM WRITE DATA signals must be deactivated when in the read mode. To insure data integrity at the error rate specified, WRITE DATA signals must be pre-compensated on the tracks 400 to 611. The optimum amount of pre-compensation is 12 ns for both the early and late bits.

3-2. REINITIALIZE J2 pin 3

This signal is used to update the track position information and off-center information of the disk. Such information is automatically read into the microprocessor of the HDD after power-on sequence or changing the Disk Cartridge, which is called the initializing sequence.

This signal may eliminate seek errors when they occur frequently due to significant environment condition changes. If this signal is remains active for more than 500 ns and the DRIVE SELECT signal is active, the initialize sequence will start. The initialize sequence ends with in 10 sec, activating the READY, SEEK COMPLETE, and TRACK 000 signals. If WRITE FAULT is active and its cause has been cleared when starting this sequence, the WRITE FAULT signal is deactivated.

Optional Conditions

This signal on J2 pin 3 can be disconnected by removing the jumper from JP3. It is necessary to remove the jumper at JP3 when using the ST506 controller, which does not support the REINITIALIZE function.

Pos.: positive, Neg.: means negative.

4. Output Data Signals

4-1. MFM READ DATA: Pos. for J2 pin 17; Neg. for J2 pin 18

When a track containing data is read, the regenerated data is sent to the host system by the differential pair signals Pos. MFM READ DATA and Neg. MFM READ DATA. The leading edge of the Pos. MFM READ DATA signal; indicates a flux reverse in the track read by the selected head. This signal is gated by the WRITE GATE and the DRIVE SELECT n signals. When the SEEK COMPLETE signal is active, the drive automatically outputs AAA... (hexadecimal) to the index servo area; therefore, the output data exists in every state. When the SEEK COMPLETE signal is deactivated, the drive output keeps this pattern.

Write/Read Recovery

The maximum write/read recovery time for the data channel is 3 microseconds after the WRITE GATE is deactivated.

4-2. DRIVE SELECTED J2 pin 1

This signal is activated when the DRIVE SELECT n signal on the J1 connector latches the drive selected by jumper JP2. The select jumper is set to drive 1 when shipped.

Optional condition

A radial select state can be set by shorting JP5. This is necessary, for example, for a single drive system in which the drive is always selected.

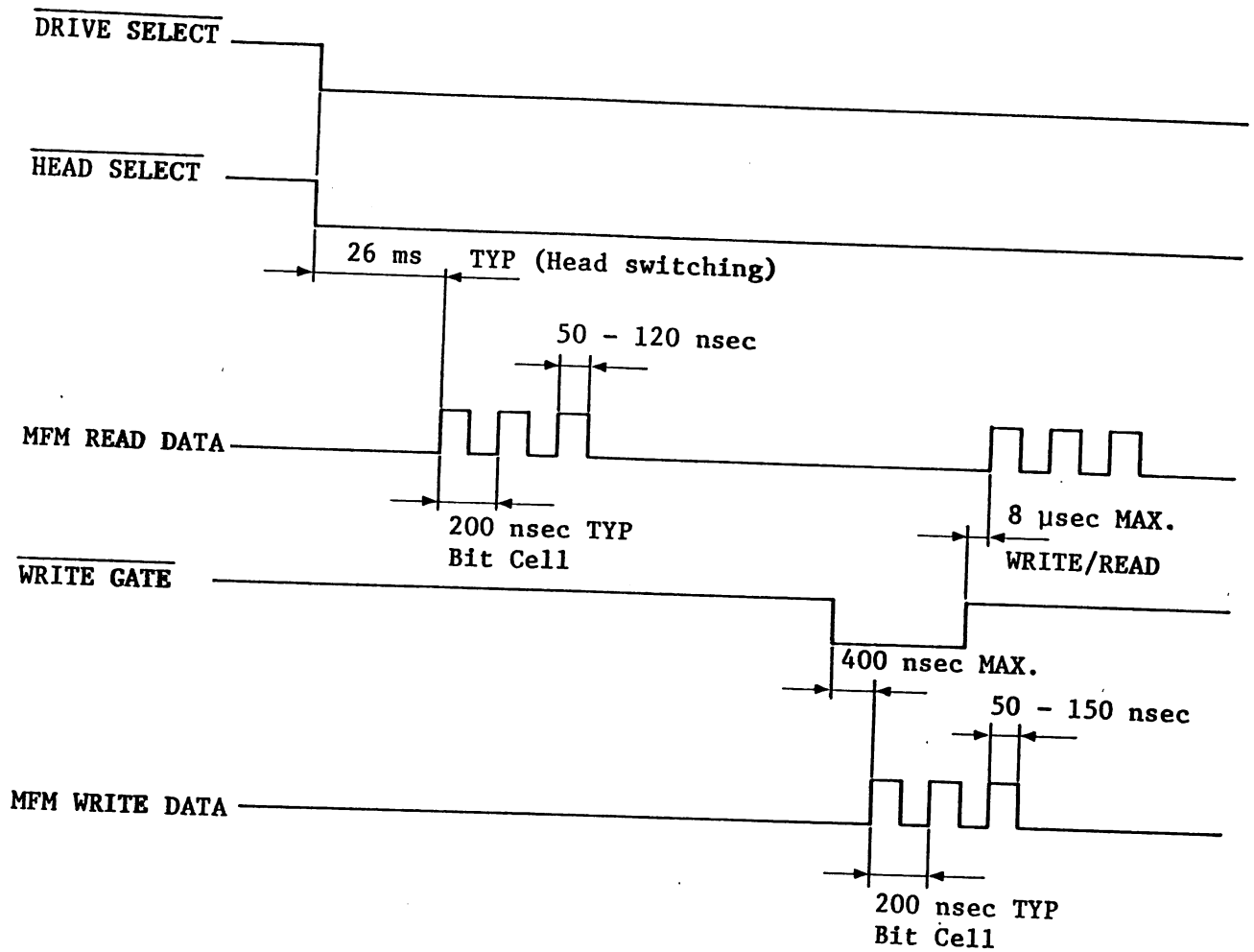
4-3. WRITE PROTECTED J2 pin 5

This WRITE PROTECTED signal is activated during the following conditions:

- The drive is in the seek operation.
- The drive is in the power-on sequence.
- The drive contains a write protected Disk Cartridge.
- The drive contains an extremely eccentric disk cartridge.

4-4. CARTRIDGE CHANGED J2 pin 9

This signal informs the host controller that the Disk Cartridge has been changed. It is activated when the drive detects the drawer open/close state. To deactivate this signal, activate the DRIVE SELECT n signal and select the drive while the drive is in the READY state. Then, place the drive once in the non-selected state for more than 1 ms. This signal will remain active during the power-on sequence.



Timing chart (data signals)

Fig. VI-4-1

VII. MAINTENANCE

1. Pre-cautions

- (a) The head stack, carriage, stepper motor, and spindle motor assemblies have all been adjusted and inspected before shipping.
- (b) The head stack and carriage assemblies are sealed to prevent dust. Handle them carefully, do not use a magnetic screwdriver for the head stack assembly.
- (c) The control signal lines must be terminated only at the end of the daisy chain configuration. After maintenance, check the AR 1 (terminator) of the interface circuit board, and be sure to restore it to its original condition.

2. Tools

- Phillips standard 6" screwdriver
- Standard flathead 6" screwdriver
- Allen wrenches
- Tweezers

Jigs

- Not required

3. RH5130 Main Circuit Board

CAUTION

Handle with care the Main circuit board to prevent the damage to the under wires and ESPECIALLY the Write Protect Switch.

This switch arm is attached to the Main Circuit Board. Be careful not to lose the PCB Spacer, Holder Plate, Lug Terminal, or the washers.

3-1. Disassemble

Since the Interface, Driver, and Main Circuit Boards are all attached into one solid assembly, they cannot be removed individually. Therefore, the following procedure is the process of removing the entire assembly.

- (1) Remove two screws securing the front panel and remove the front panel.
- (2) Remove five screws securing the circuit board cover, the cover, and the spacers between the cover and the circuit board.

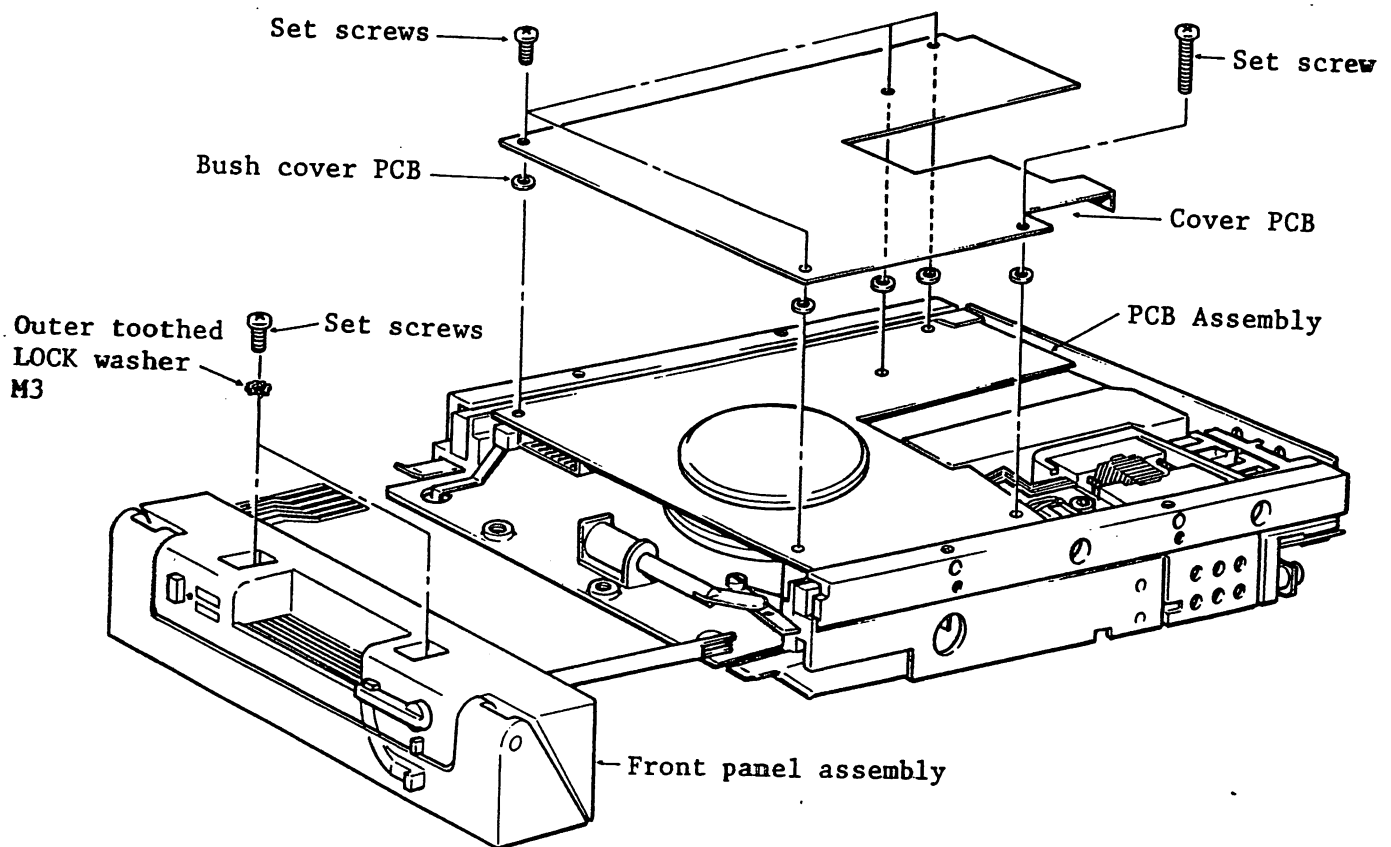


Fig. VII-3-1

- (3) Remove the Stepper Motor Connectors
- (4) Remove the five screws securing the Driver Circuit Board.
- (5) Remove the three screws securing the Interface Circuit Board.

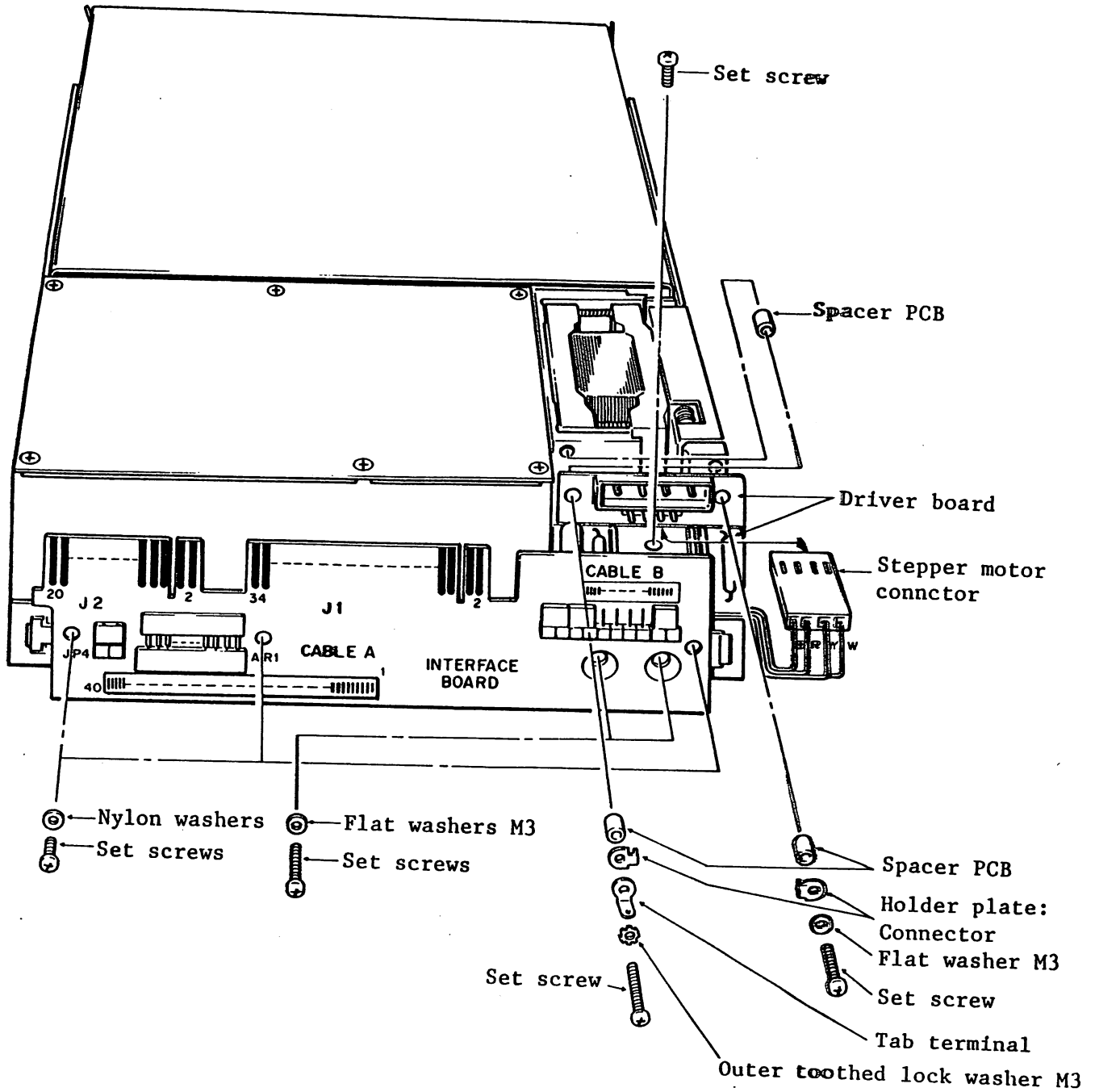


Fig. VII-3-2

(6) Remove the Circuit Board Assembly.

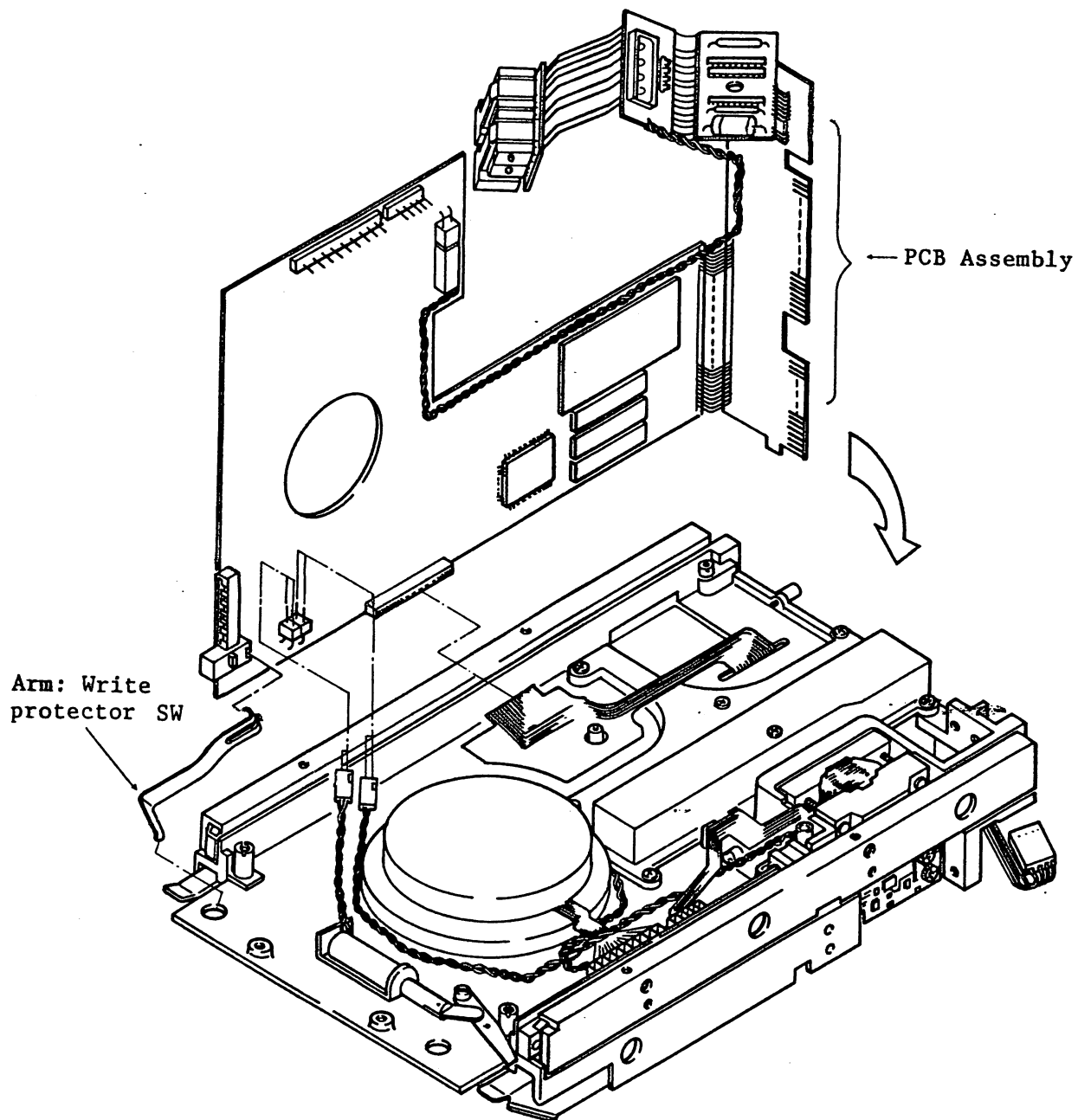


Fig. VII-3-3

3-2. Reassemble

CAUTION

Be careful when placing the Main Circuit Board on the drive, because the write protection switch arm is attached to the board.

Be careful to connect all connectors and route all wires so that they cannot be pinched.

- (1) Connect the connectors and place the Main Circuit Board on the drive.
- (2) Align the holes of the Interface Circuit Board and the Frame. Then, loosely secure it with three screws and their appropriate washers.
- (3) Secure the Driver Circuit Board with five screws and their appropriate washers and spacers.
- (4) Place the five spacers over each hole to separate the board and the cover.
- (5) Place the cover on the board and secure it with five screws.
- (6) Mount the front panel and secure it with two screws.

Note: Connector (short wire) should be connected with placing the Main Circuit Board.

4. Drawer Latch

4-1. Disassemble

CAUTION

When removing the drawer latch, be careful not to loosen the upper latch slide and the lower shaft latch.

Note: When the microswitch is faulty, the whole Drawer Latch must be changed, because the switch is permanently attached to the Drawer Latch.

- (1) Disconnect the connector to the microswitch.
- (2) Remove the PFB cable from the double-sided tape.
- (3) Remove the hexagon screw and remove the Drawer Latch.

CAUTION

When removing the drawer latch, be careful not to loosen the upper latch slide, the lower latch slide, and the shaft latch.

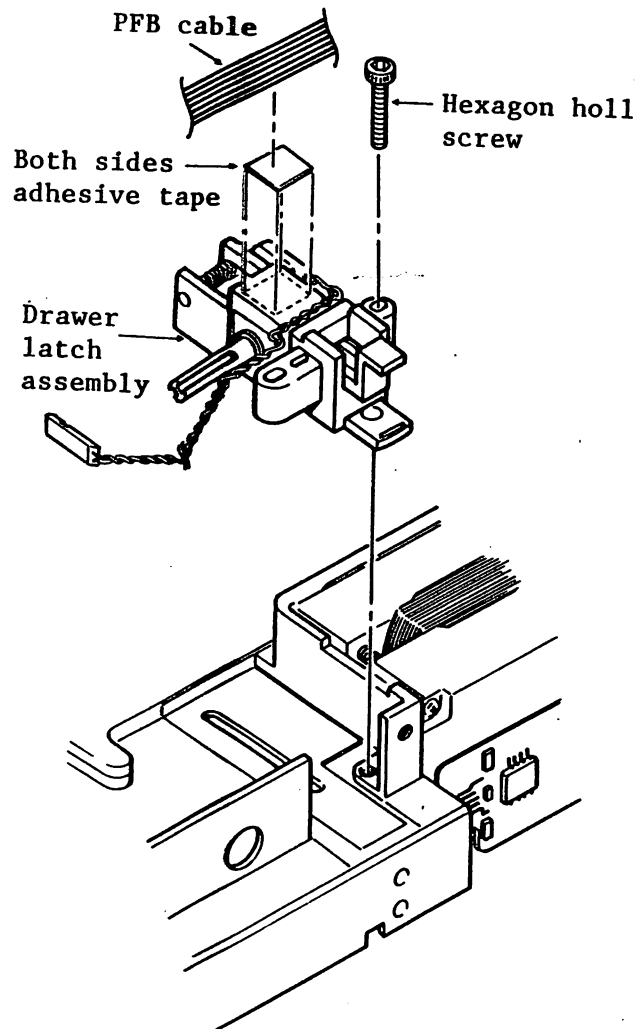


Fig. VII-4-1

4-2. Reassemble

CAUTION

The new Drawer latch is held together with taking off the rubber bands. Be sure to prevent it from falling apart before reassembly.

- (1) Check with the figure to the left to see if the new Drawer Latch is assembled right, but if not, then, assemble it right.
- (2) Place the Drawer Latch on the drawer and secure it with a hexagonal screw.
- (3) Attach double-sided tape to the drawer and secure the PFB cable to the drawer.

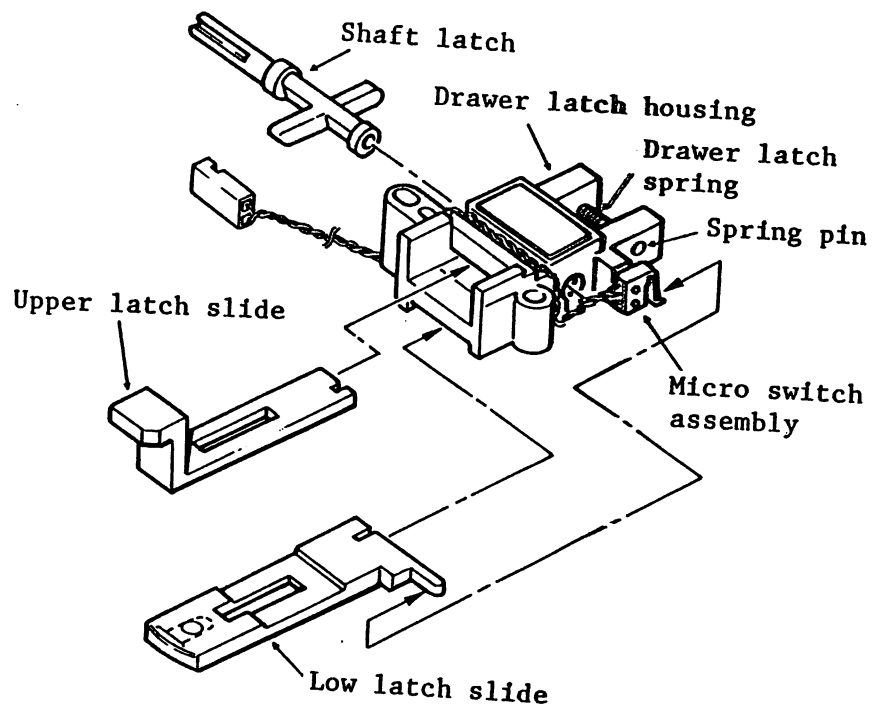


Fig. VII-4-2

5. Receiver Cover and Spring

5-1. Disassemble

- (1) While pushing the Receiver Cover in the directions of the arrows in the figure below, remove the receiver cover pins from the Frame holes.
- (2) The Receiver Spring and the nylon washers are now disassembled.

5-2. Reassemble

- (1) First, place the new nylon washers of the Receiver Cover Pins. Then, set the Receiver washer on the Receiver Cover and into place on the Frame, and at the same time place the Receiver Cover Pin on the spring side into its Frame hole.
- (2) Now push the Receiver Cover as in the figure and place the other Receiver Cover Pin into its hole.

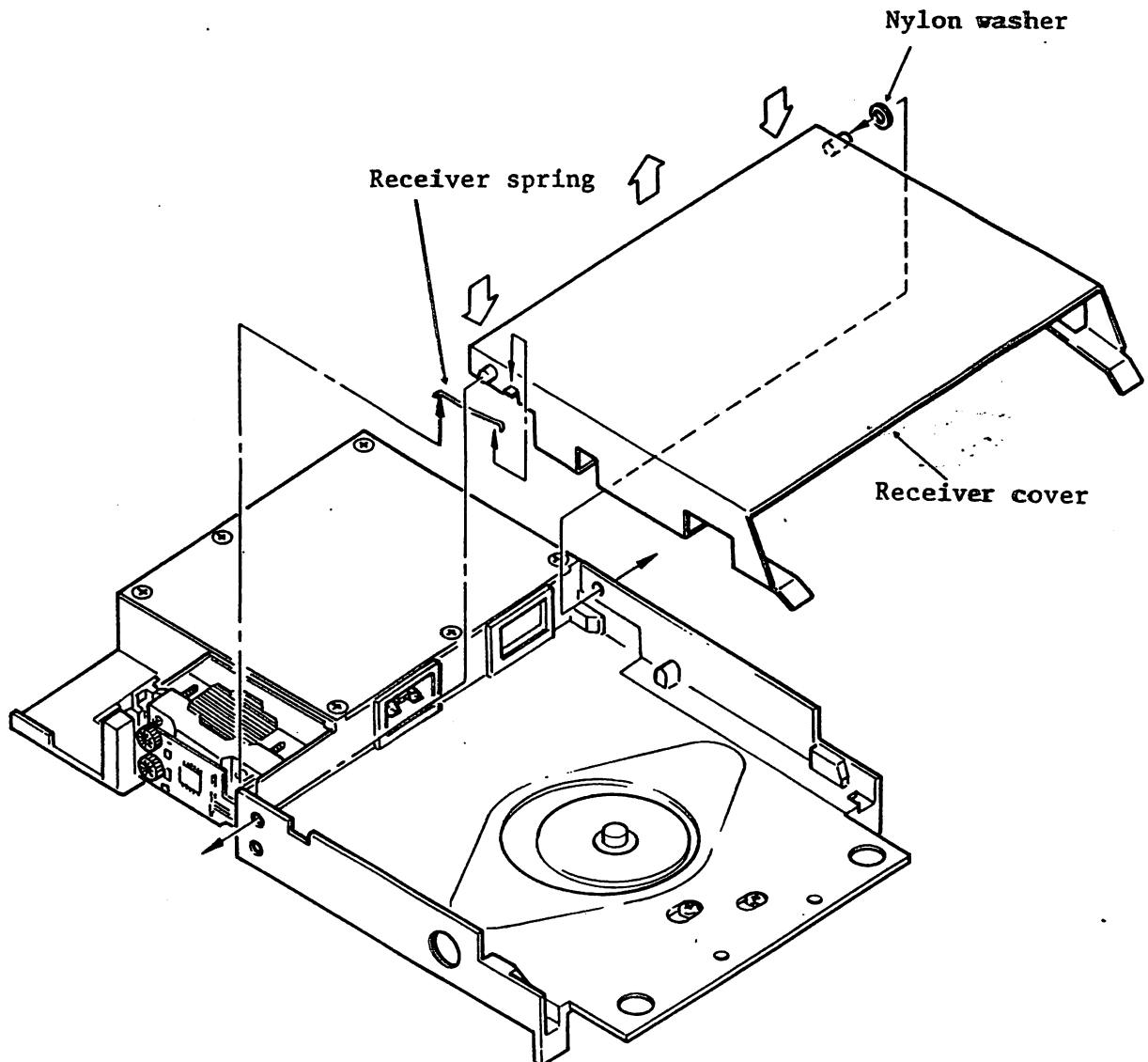


Fig. VII-5-1

5-3. Changing Side Rail

- (1) Move the side rail so that the set screws fixing the slide side rail can be seen, then remove the two set screws.
- (2) Move the slide side rail in the side rail and remove the slide side rail.

Note: The left and right side rails differ each other.

- (3) When mounting, reverse the steps above.

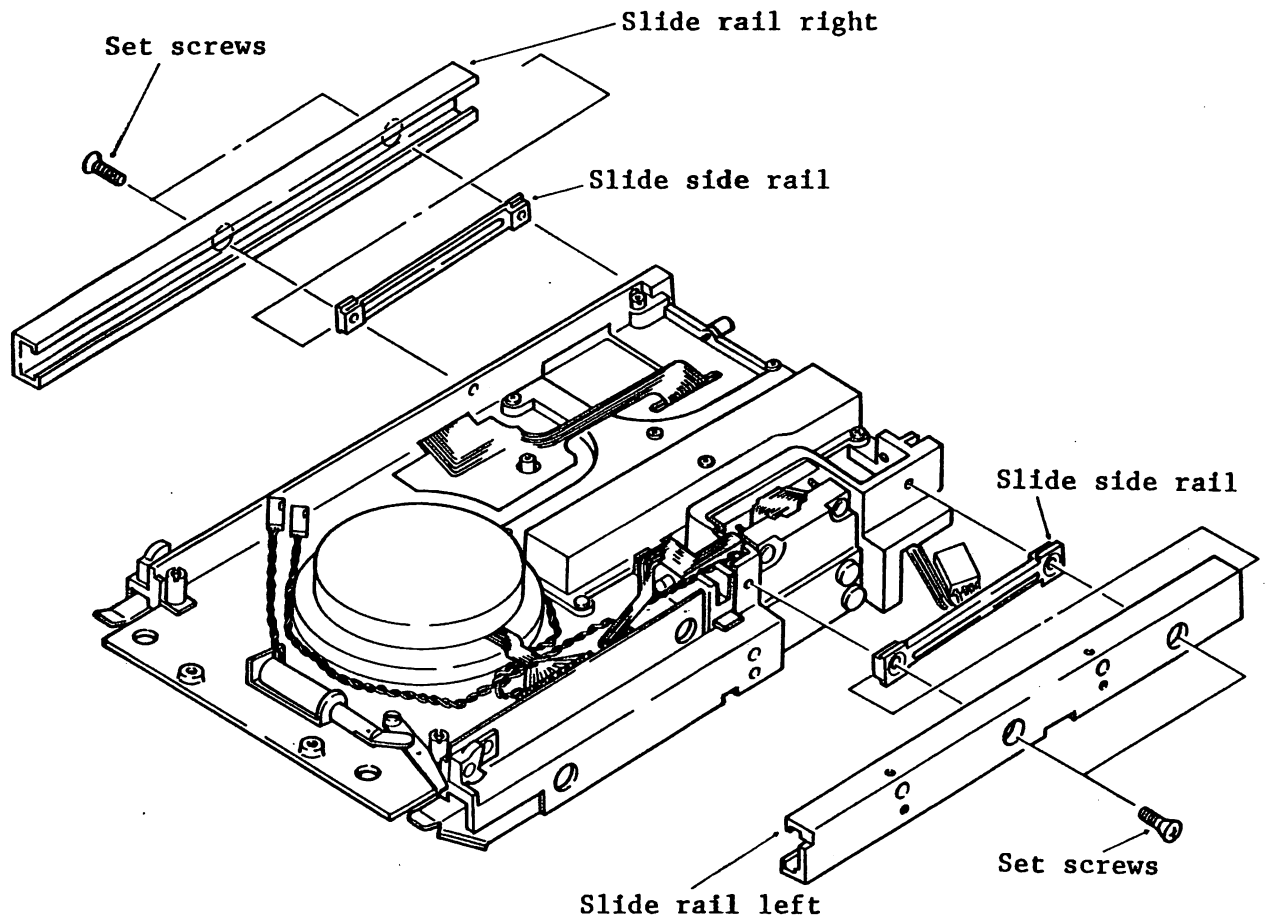


Fig. VII-5-2

5-4. Changing Door Lock Solenoid Assembly

- (1) Remove the PCB assembly referring to the section "RH5130 PCB Assembly".
- (2) Remove the two set screws fixing the door lock solenoid assembly.
- (3) Remove the lock spring and door lock solenoid assembly by removing the door lock shoulder screw.

Note: Remove the lock spring it can be correctly mounted.

- (4) When mounting, reverse the steps above.

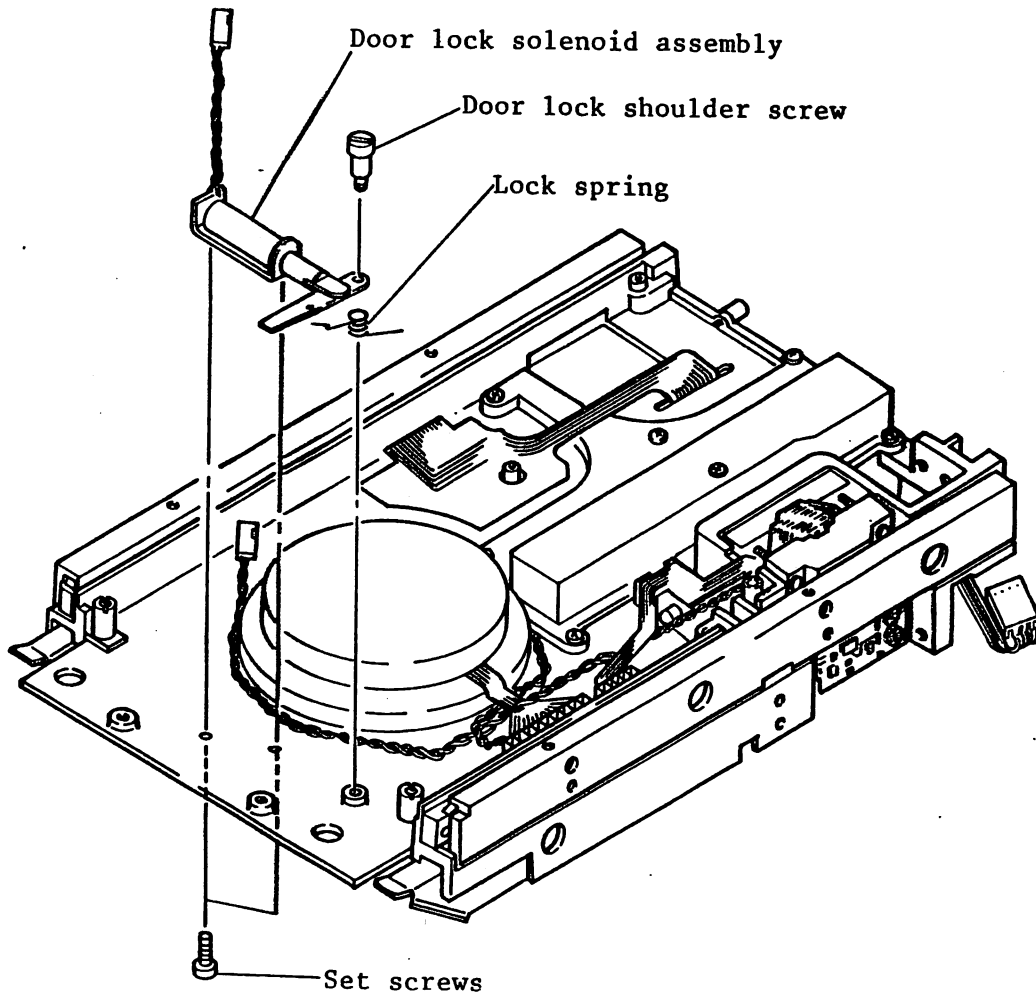


Fig. VII-5-3

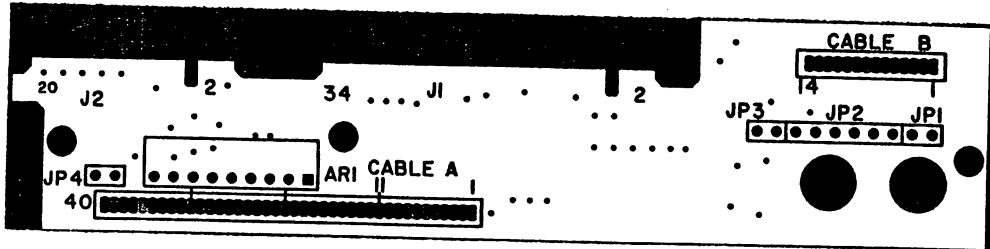
MAIN FRAME ASSEMBLY

SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
1	PCB ASSEMBLY: RH5130 (WANG)	N6107017	1
2	GASKET: FACE HEAD	R6001005	1
3	GASKET: FACE AIR	R6001006	1
4	INSULATOR: STRIP	R6001010	1
5	INSULATOR: HEAT SINK	R6001013	1
6	INSULATOR: POWER	R6001015	1
7	LABEL: AIR SEAL	R6001016	6
8	STAND OFF: LONG	R6001020	3
9	STAND OFF: SHORT	R6001021	3
10	HOLDER PLATE: CONNECTOR	R6001022	2
11	ARM: WRITE PROTECT SWITCH	R6001030	1
12	COUNTERSUNK HEAD SCREW M3*18	R6001040	1
13	FRONT PANEL ASSEMBLY (WANG)	R6001215	1
14	BUTTON: FRONT PANEL	R6001208	1
15	DETENT PLUNGER	R6001210	2
16	OVER CENTER SPRING	R6001211	1
17	PLUNGER SPRING	R6001212	2
18	RETAINER: FRONT PANEL	R6001214	1
19	FRONT PANEL PCB ASSEMBLY	R6007400	1
20	DOOR LOCK SOLENOID ASSEMBLY (WANG)	R6001234	1
21	LOCK SPRING	R6001229	1
22	DOOR LOCK SHOULDER SCREW	R6001233	1
23	RECEIVER COVER	R6001250	1
24	RECEIVER SPRING	R6001251	1
25	NYLON WASHER	R6001252	6
26	BOTTOM PAN ASSEMBLY	R6001530	1
27	TOP COVER ASSEMBLY	R6001540	1
28	COVER PCB	R6001700	1
29	BUSH COVER PCB	R6001701	5
30	INSULATOR	R6001705	1
31	SPACER PCB	R6001710	3
32	SLIDE SIDE RAIL	R6002000	2
33	END GUIDE	R6002001	2
34	SIDE RAIL LEFT (WANG)	R6002005	1
35	SIDE RAIL RIGHT (WANG)	R6002006	1
36	DAMPER SIDE RAIL	R6002004	2
37	DRAWER LATCH ASSEMBLY	R6002100	1
38	EMF SENSE COVER	R6002150	1
39	HEAD AMPLIFIER ASSEMBLY	R6002500	1
40	GUIDE: SLC	R6002510	1
41	SPRING PAD: SLC	R6002511	1
42	CLAMP PLATE: SLC	R6002512	1
43	BUTTON HEAD SCREW M3*8	R6001044	1
100	COUNTERSUNK HEAD SCREW M2.6*4	02026040G	2
101	PAN HEAD SCREW M2.6*6	03126060B	2
102	PAN HEAD SCREW M2*3	02520030G	2
103	PAN HEAD SCREW M3*5	03130050G	7
104	BINDING HEAD SCREW M3*6	03130060G	2
105	PAN HEAD SCREW M3*8	03130080G	5
106	PAN HEAD SCREW M3*10	03130100G	4
107	PAN HEAD SCREW M3*14	03130140G	3
108	COUNTERSUNK HEAD SCREW M3*8	03230080B	14
109	HEXAGON SOCKET SET SCREW M4*4	05540040G	2
110	HEXAGON SOCKET HEAD SET SCREW M3*8	05930080G	1

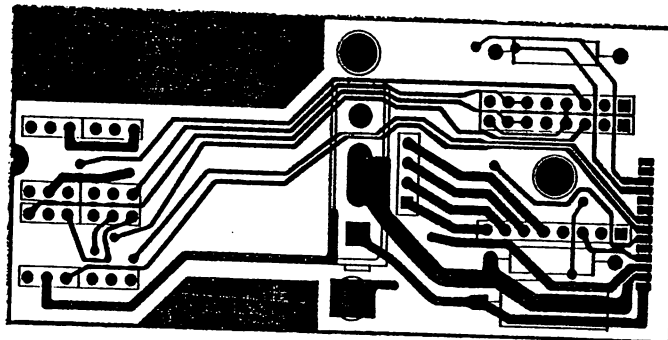
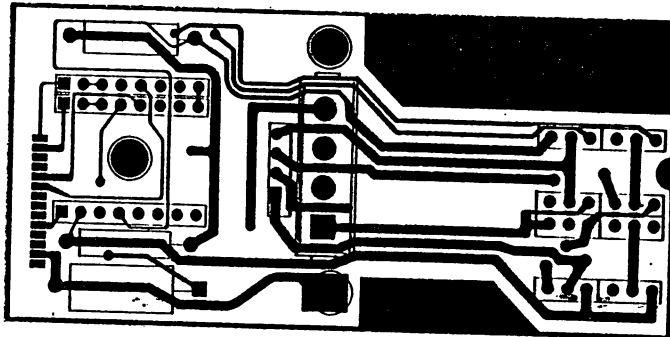
SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
111	HEXAGON SOCKET HEAD SET SCREW M3*14	05930140G	1
120	FLAT WASHER M3	07000030G	4
121	SPRING LOCK WASHER M3	07030030B	4
122	OUTER TOOTHED LOCK WASHER M3	07050030B	3
130	TAB TERMINAL	11000650	1

PCB ASSEMBLY: RH5130

Interface board



Driver Board



PCB ASSEMBLY: RH5130

SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
	INTERFACE BOARD		
	RESISTORS		
ARI	ARRAY RES.: 220/330ohm*7	16017512	1
	CONNECTOR & SOCKETS		
ARI	IC SOCKET: 9 PIN	N6106818	1
JP1-4	SOCKET: DIC-252	11010395	4
JP1-3	CONNECTOR: FFC-10LAMEP1	11022141	1
JP4	CONNECTOR: FFC-2LAMEP1	11022142	1
	MISCELLANEOUS		
CABLE B	PC JOINER: 14 PIN	N6105000	1
	PWB: INTERFACE BOARD: RH5130	N6106001	1
	DRIVER BOARD		
	RESISTORS		
R12, 13	WINDING RES.: 1ohm +1% 1W	16000691	2
AR5, 6	ARRAY RES.: 1Kohm +2% 1/8W	16017470	2
AR4	ARRAY RES.: 1Kohm +1% 1/8W	16017471	1
	CAPASITORS		
C14	ELECTROLYTIC CAP.: 10uF 25V	16040706	1
	TRANSISTORS		
Q4, 5, 10 11	TRANSISTOR: 2SD1376K	14010334	4
Q6, 7, 8, 9	TRANSISTOR: 2SB1012K	14010335	4
	CONNECTORS & SOCKETS		
J3	POWER CABLE ASSEMBLY	N6105002	1
J5	CONNECTOR: 350211-1	11010396	1
	CONNECTOR: FFC-4AMEP1	11010398	1
	MISCELLANEOUS		
	PWB: DRIVER BOARD	N6106002	1
	HEAT SINK	N6106812	2
	COOL SHEET: 5530-1674	N6106817	4
	PANHEAD SCREW: M3*25	03130250B	2
	FLAT WASHER: M3	07010030B	2
	SPRING LOCK WASHER: M3	07030030B	2
	HEXAGON NUT: M3	07100030B	2

SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
MAIN BOARD			
RESISTORS			
AR3, 4	ARRY RES.: 10Kohm $\pm 1\%$ 1/8W		
AR2	ARRY RES.: 1Kohm $\pm 2\%$ 1/8W	16017469	2
R20, 22	CHIP RES.: 10ohm $\pm 1/10W$	16017470	1
R24	CHIP RES.: 2.7Kohm $\pm 5\%$ 1/10W	16019037	2
R27, 28	CHIP RES.: 820ohm $\pm 5\%$ 1/10W	16019056	1
R34, 37	CHIP RES.: 15Kohm $\pm 5\%$ 1/10W	16019059	2
R16, 21	CHIP RES.: 220ohm $\pm 5\%$ 1/10W	16100215	2
R11	CHIP RES.: 120ohm $\pm 5\%$ 1/10W	16100216	2
R7, 10, 17,	CHIP RES.: 330ohm $\pm 5\%$ 1/10W	16100217	1
18, 46, 51		16100218	6
R14, 15	CHIP RES.: 33Kohm $\pm 5\%$ 1/10W		
R32, 33	CHIP RES.: 4.7Kohm $\pm 5\%$ 1/10W	16100219	2
R30, 31	CHIP RES.: 47Kohm $\pm 5\%$ 1/10W	16100220	2
R43	CHIP RES.: 4.7Mohm $\pm 5\%$ 1/8W	16100222	2
R49	CHIP RES.: 820Kohm $\pm 5\%$ 1/10W	16100223	1
R25, 29	CHIP RES.: 100ohm $\pm 5\%$ 1/10W	16100224	1
R26, 41, 50	CHIP RES.: 1Kohm $\pm 5\%$ 1/10W	16100225	2
R35, 39,	CHIP RES.: 10Kohm $\pm 5\%$ 1/10W	16100226	3
40, 48		16100227	4
R36, 38	CHIP RES.: 100Kohm $\pm 5\%$ 1/10W		
R42, 44, 45	CHIP RES.: 1.5Kohm $\pm 5\%$ 1/10W	16100228	2
R9, 8	CHIP RES.: 220ohm $\pm 5\%$ 1/10W	16100229	3
R12, 13, 19	CHIP RES.: 3.3Kohm $\pm 5\%$ 1/10W	16100230	2
R23	CHIP RES.: 6.8Kohm $\pm 5\%$ 1/10W	16100231	3
R3	CARBON FILM RES.: 330ohm $\pm 5\%$ 1/4W	16100232	1
R6	CARBON FILM RES.: 430ohm $\pm 5\%$ 1/4W	16114301	1
R4, 5	CARBON FILM RES.: 68ohm $\pm 5\%$ 1/4W	16114431	1
R1, 2	CARBON FILM RES.: 4.99Kohm $\pm 1\%$ 1/4W	16114680	2
		16224991	2
CAPACITORS			
C1, 2	TANTALUM CAP.: 6.8uF $\pm 20\%$		
C3, 4, 6	ELECTROLYTIC CAP.: 10uF $\pm 20\%$ 16V	16041041	2
C5	TANTALUM CAP.: 2.2uF $\pm 10\%$ 25V	16041098	3
C13	CHIP TANTALUM CAP: 1uF 16V	16041295	1
C16, 18	CHIP CERAMIC CAP.: 2200pF	16041309	1
C14, 15, 23	CHIP CERAMIC CAP.: 0.1uF $\pm 15\%$	16050101	2
C46, 48	CHIP CERAMIC CAP.: 1500pF	16050103	3
C38	CHIP CERAMIC CAP.: 820pF	16050104	2
C52, 57	CHIP CERAMIC CAP.: 0.068uF $\pm 80 -20\%$ 50V	16050105	1
C9, 33	CHIP CERAMIC CAP.: 10pF $\pm 5\%$ 50V	16050112	2
C34	CHIP CERAMIC CAP.: 22pF $\pm 5\%$	16061131	2
C20, 28,	CHIP CERAMIC CAP.: 470pF $\pm 5\%$ 50V	16061133	1
39, 54		16061135	4
C21	CHIP CERAMIC CAP.: 1000pF $\pm 10\%$		
C50	CHIP CERAMIC CAP.: 4700pF $\pm 20\%$	16061136	1
C7, 8,	CHIP CERAMIC CAP.: 0.01uF $\pm 20\%$ 50V	16061138	1
10-12, 19,		16061139	21
25-27, 29,			
30, 35-37,			
40, 44, 47,			
53			

SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
C31, 32, 45, 49, 51, 55, 56	CHIP CERAMIC CAP.: 0.1uF +80 -20% 25V	16061140	7
C24	CHIP CERAMIC CAP.: 100pF +5%	16061208	1
C17, 22	CHIP CERAMIC CAP.: 0.22uF +80 -20%	16061293	2
TRANSISTORS			
Q3	TRANSISTOR: 2SC3265 OTE85L	14000351	1
Q1, 2	TRANSISTOR: 2SD1414	14010349	2
IC'S			
IC1	IC: P-ROM: DM74S188N 1R1	N6106700	1
IC5	IC: RF5G03-016	N6106701	1
IC8	LSI: SPINDLE	N6106708	1
H.IC1	READ HYBRID IC: GT165	N6106703	1
IC4	MASK CPU8050: R1.1	N6106709	1
IC2, 3	TTL IC: SN74S240N	14071194	2
IC9, 13	TTL IC: SN7406NS	14071305	2
IC16	TTL IC: HD74LS04FP	14071309	1
IC17	TTL IC: SN74S74NS	14071667	1
IC15	TTL IC: SN74S86NS	14071668	1
IC14	TTL IC: SN74LS221NS	14071669	1
IC19	IC: DG211CY	14071805	1
IC18	IC: NE555PS	14080346	1
IC6	IC: AD7528JN	14080424	1
RG1	IC: NJM79L05A	14080425	1
IC20, 21	IC: LM358PS	14080426	2
IC22	IC: LM393PS	14080427	1
IC10	IC: SN75116NS	14080428	1
IC7	IC: SI7661CJ	14080430	1
IC11, 12	IC: LM358AM	14080452	2
DIODES			
D4	SILICON DIODE: 1SS187TE	14020477	1
D2, 3	SILICON DIODE: 1SS226TE	14020478	2
ZD1	ZENER DIODE: RD5.1E-B2	14020499	1
D1	DIODE: V17A	14020531	1
CONNECTORS & SOCKETS			
J10	CONNECTOR: FFC-4LBMEP2	11010397	1
J9	CONNECTOR: HBLB6R-1J	11022137	1
J8	CONNECTOR: HBLB12S-1J	11022139	1
J11	CONNECTOR: FFC-5AMEP	11022185	1
J6	CONNECTOR: FFC-9AMEP-1	11022306	1
J12	CONNECTOR: ANGLE PIN HEADER: 2 PIN	11022392	1
INDUCTORS			
L3, 5	CHIP INDUCTOR: 10uH	16070120	2
L6	CHIP INDUCTOR: 22uH	16070121	1
L1	CHIP INDUCTOR: 33uH	16070122	1
L2, 4	CHIP INDUCTOR: 5.6uH	16070123	2

SYMBOL CODES	DESCRIPTION	PART NO.	Q,TY
	MISCELLANEOUS		
CABLE A	PC JOINER: 20 PIN	N6105001	2
	PWB: MAIN BOARD (W2)	N6106000	1
SW1	SW: D2F TYPE MICRO-SWITCH	12041425	1
XTL1	CRYSTAL: HC-18/U: 10MHZ	54707106	1

RECOMMEND PARTS LISTS

PCB ASSEMBLY: RH5130 (WA)	N6107017
FRONT PANEL ASSEMBLY (WA)	R6001215
FRONT PANEL PCB ASSEMBLY	R6007400
DOOR LOCK SOLENOID ASSEMBLY (WA)	R6001234
DRAWER LATCH ASSEMBLY	R6002100
HEAD AMPLIFIER ASSEMBLY	R6002500

APPENDIX

1. Disk Cartridge

1-1. Overview

The Disk Cartridge for the RH5130 contains a 5.25" magnetic hard disk (130 mm ANSI Standard). It is clamped by the hub and installed in a plastic. The cartridge follows the ANSI Standard mechanical interface specifications, which are determined by the relationship between the cartridge housing and the disk hub.

The Disk Cartridge is designed to enable front loading to prevent improper insertion to the HDD.

The Disk Cartridge can store data including the servo information on both sides. When the Disk Cartridge is inserted into the HDD, the Disk Cartridge Door Actuator Mechanism opens the head entrance and the air filter. When the Disk Cartridge is removed, the Disk Cartridge Door Actuator mechanism Door Unlatch Lever automatically closes the door to protect inside of the Disk Cartridge from dust.

1-2. Layout of the Disk Cartridge Exterior

1. The right side of cartridge

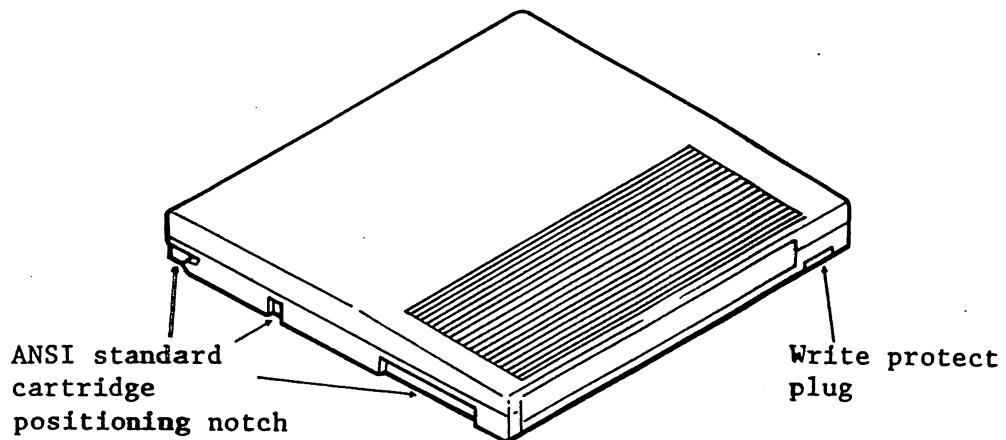


Fig. A-1-1

2. The back side of cartridge

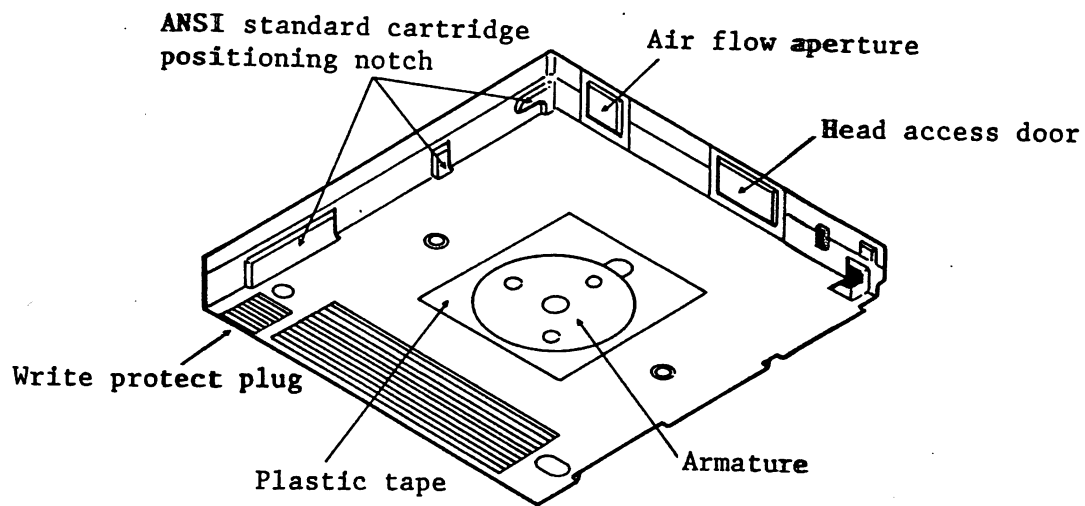


Fig. A-1-2

1-3. Layout of the Disk Cartridge Interior

The below figure is only to show how the dust-proof mechanism works. The Operators must not disassemble the Disk Cartridge due to the special clean room needed.

Disk cartridge inner view

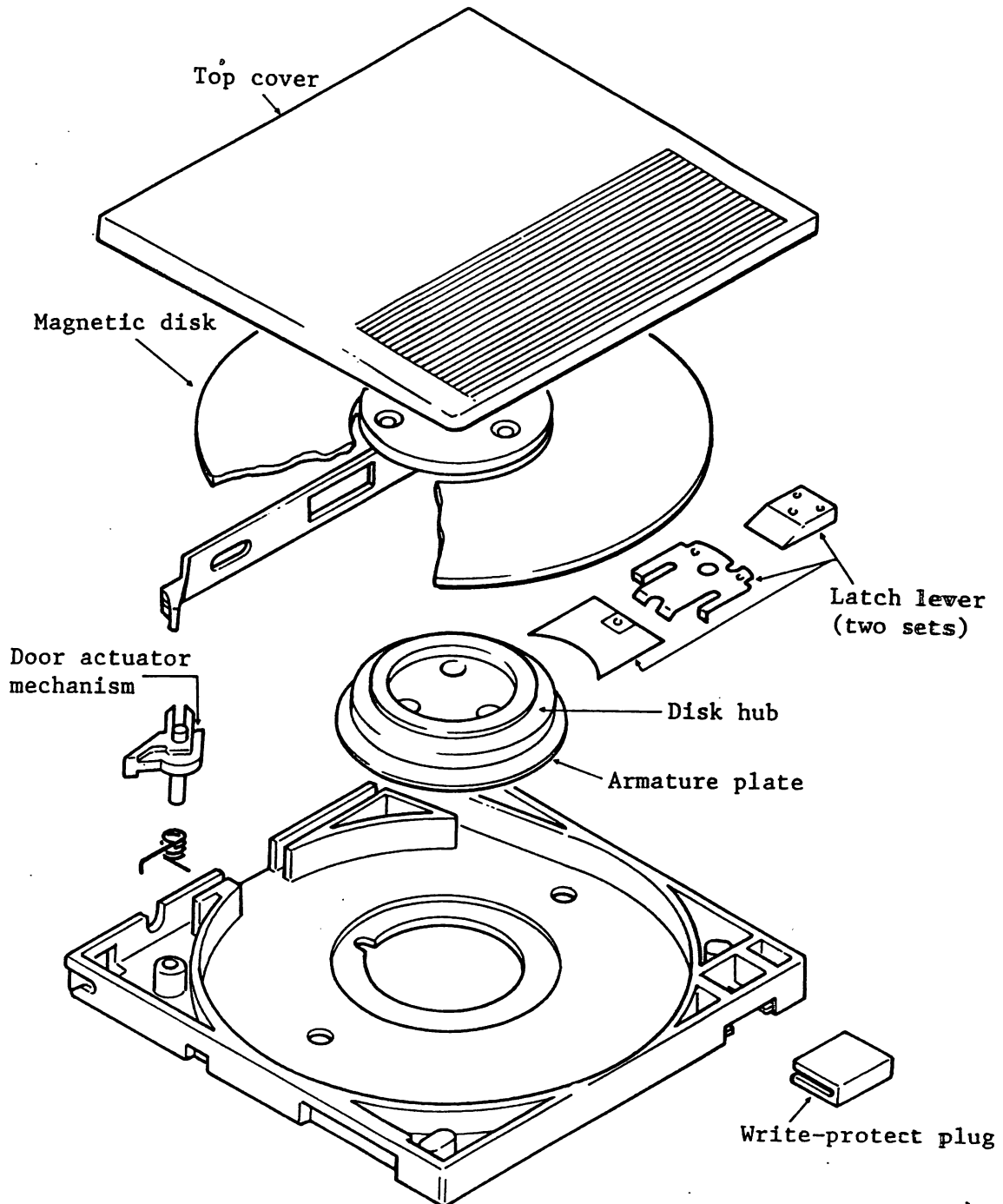


Fig. A-1-3

Note: Fig. A-1-3 is given only to show the dust-proof mechanism of the cartridge. Users must not disassemble the disk cartridge.

1-4. Specifications

Storage capacity

Unformatted disk

12.75M bytes per cartridge
6.37M bytes per side
10.416 bytes per track
NA for sector

17-sector formatted disk

10.6M bytes per cartridge
5.3M bytes per side
8,704 bytes per track
512 bytes per sector

32-sector formatted disk

10.0M bytes per cartridge
5.0M bytes per side
8,192 bytes per track
256 bytes per sector

Seek time

1 track 3 ms (maximum)
204 tracks ... 85 ms (maximum)
612 tracks ... 250 ms (maximum)

Head change time	4 ms (maximum)
Settling time	13 ms (maximum)
Average rotational delay	8.64 ms

Functional Specifications

Rotation speed	3,473 rpm <u>+1%</u>
Recording density	10,894 BPI
Flux density	10,894 FCI
Track density	612 TPI
Number of cylinders	612
Number of tracks	1,224
Number of heads	2
Purge cycle	30 sec
Reinitialize cycle	10 sec
Stop time	10 sec

Physical Specifications

Thickness	19 mm
Length	141 mm
Width	137 mm
Weight	312 g

Cartridge Operation Environment Conditions

Temperature range

Operating: 10 to 57°C

Storage: -40 to 66°C

Relative humidity: 8 to 80%

Maximum wet bulb
temperature: 26°C (No dew condensation)

1-5. Defect Standard and Format

The Disk Cartridge is AC-erased prior to shipment. So, it does not contain any information, such as servo or format information.

The Disk Cartridge does not have any defects on the disk surface that stores the servo and track 000 information. Each disk contains no more than 10 defects of greater than 2 bits on the disk surface.

-Positional Repeatability

The hub shall be capable of repositioning itself such that a change in radial runout of no more than 2.54 μm (100 μin) TIR occurs upon removal and subsequent reinstallation of hub to spindle, regardless of its rotational relationship with the spindle. This test shall be performed on a spindle with no more than 0.508 μm (20 μin) TIR.

-Defects and Short Range Modulation

The cartridge disk surfaces shall be free of defects and short range modulation in the areas shown in Fig. A-1-4.

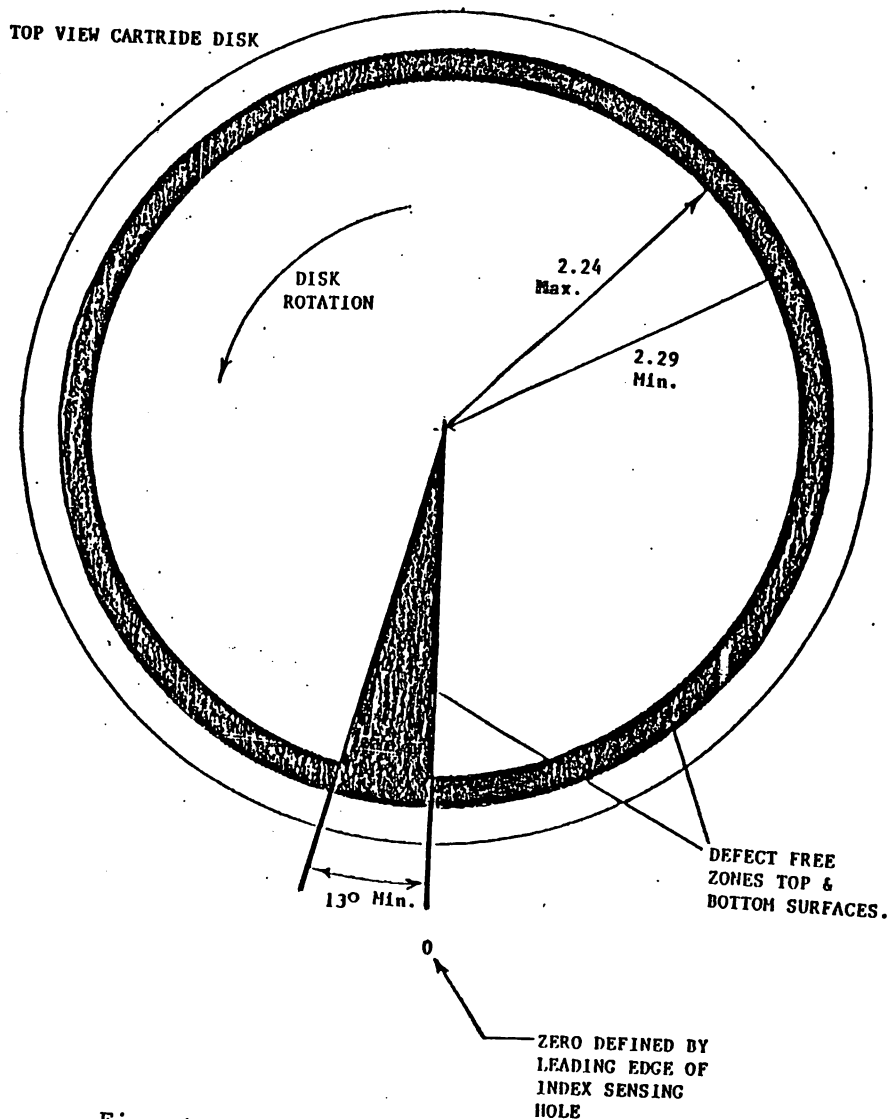


Fig. A-1-4 DEFECT FREE ZONES