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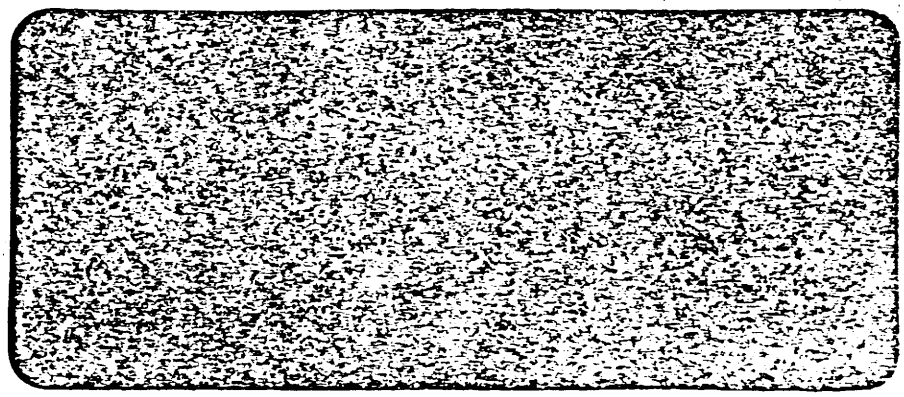
## OEM PRODUCTS



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PUBLICATION N° 50416.01

# FIXED DISK DRIVE

## HD 551

PRODUCT DESCRIPTION

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# 1. INTRODUCTION

## 1.1 GENERAL DESCRIPTION

This specification describes the HD 561, 5.25 inch hard disk drive family, its functional characteristics, physical and electrical interface and its performances.

Also described are the media used, their defects and track format suggestions as well as the timing relationship requirements of each I/O pin.

The family is composed of two types:

HD 561/1 = 1 media
HD 561/2 = 2 media

The logical interface is of industry standard and is composed of two connectors. A standard connector is also used for DC voltage requirements. A faston 187 type is used for frame connection.

The physical interface is totally compatible with all 5.25 inch Winchester drives with step motor actuator, using industry standard interface.

## 1.2 TRANSPORTATION SECURITY

The HD 561 has a screw which blocks the spindle motor to prevent damage during transportation. Before switch-on operations this screw has to be loosened. See Figure 1.1 .

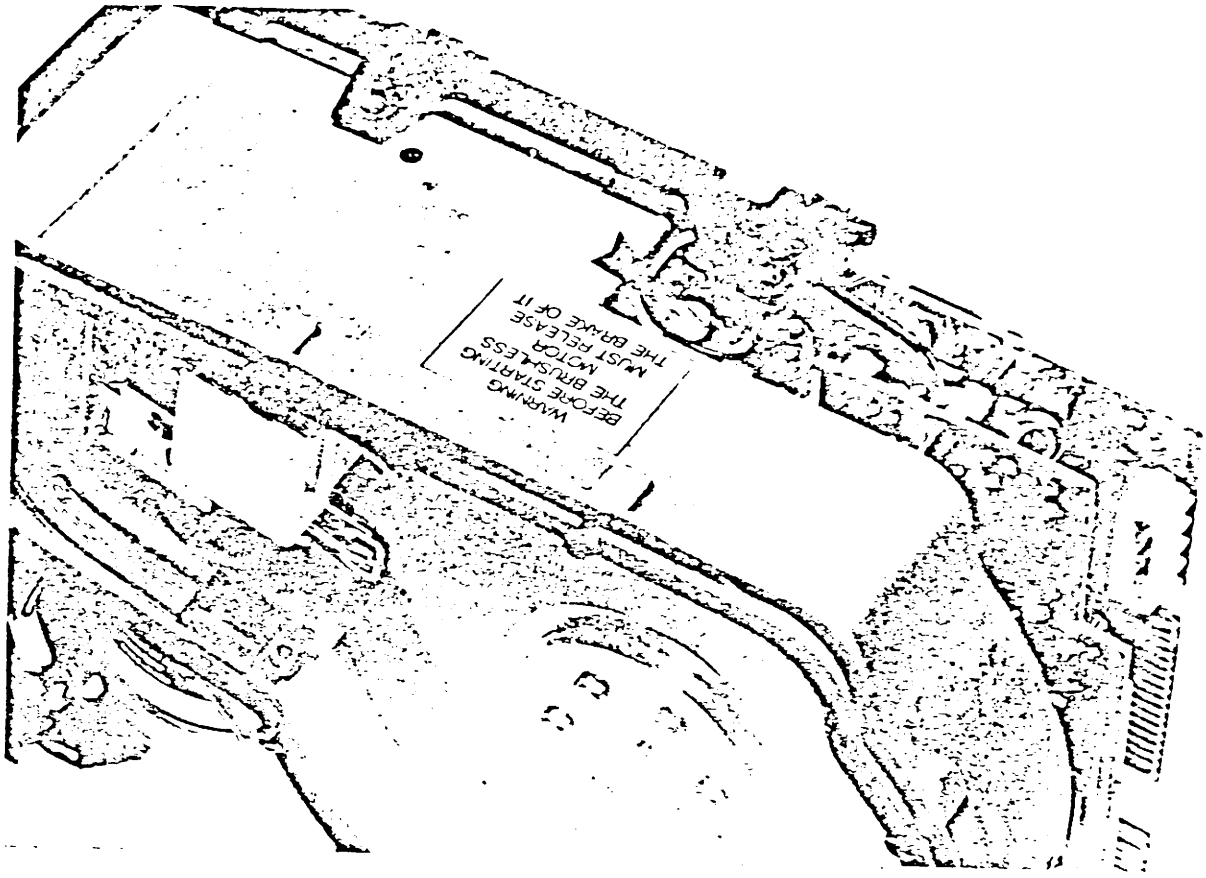



Figure 1.1 Blocking Screw of Spindle Motor

# 2. GENERAL CHARACTERISTICS

## 2.1 PERFORMANCE SPECIFICATIONS

| | | HD561/1 | HD561/2 |
|---|---|---|---|
| Capacity | | | |
| Unformatted: | | | |
| Per drive | Mbytes | 3.750 | 7.5 |
| Per surface | Mbytes | 1.875 | 1.875 |
| Per track | Kbytes | 1.0417 | 1.0417 |
| Formatted: | | | |
| Per drive | Mbytes | 3.04 | 6.08 |
| Per surface | Mbytes | 1.52 | 1.52 |
| Per track | Kbytes | 8.448 | 8.488 |
| Per sector | bytes | 256 | 256 |
| Sectors/track | | 33 | 33 |
| Transfer rate: | mbits/sec | 5 | 5 |
| Access time: | | | |
| Track to track | ms | 2 | 2 |
| Average | ms | 120 | 120 |
| Maximum | ms | 360 | 360 |
| Settling time | ms | 20 | 20 |
| Average latency: | ms | 8.33 | 8.33 |

## 2.2 FUNCTIONAL SPECIFICATIONS

| | | | |
|---|---|---|---|
| Rotational speed | rpm | 3600±1% | 3600±1% |
| Recording method | | MFM | MFM |
| Recording density | BPI | 7820 | 7820 |
| Track density | TPI | 254 | 254 |
| Cylinders | | 180 | 180 |
| Tracks | | 360 | 720 |
| Read/write heads | | 2 | 4 |
| Index | | 1 | 1 |
| Start time | sec | 10 | 12 |
| Stop time | sec | 8 | 10 |

## 2.3 RELIABILITY SPECIFICATIONS

| | |
|---|---|
| MTBF: | 8000 POH typical usage |
| Preventive maintenance: | Not required |
| MTTR: | 30 minutes |
| Component life: | 6 years |
| Error rates: | |
| Soft | $1/10^{10}$ bits read |
| Hard | $1/10^{12}$ bits read |
| Seek | $1/10^{6}$ seeks |

## 2.4 PHYSICAL SPECIFICATIONS

| | |
|---|---|
| **Environmental Limits:** | |
| Ambient temperature | 50° F to 115° F (10° C to 45° C) |
| Relative humidity | 8% to 80% |
| Maximum wet bulb | 78° F non-condensing (26° C) |
| Altitude | 3.000 m. max |
| Vibrations | Not available (TBD) |
| **Storage conditions:** | |
| Temperature | 0° C to 55° C (32° F to 130° F) |
| Relative humidity | 0% to 95% RH (non-condensing) |
| Maximum wet bulb | 30° C (86° F) |
| Vibrations | Not available (TBD) |
| **Transportation:** | |
| Temperature | - 40° C to +55° C (-104° F to 130° F) |
| Relative humidity | 5% to 95% RH (non-condensing) |
| Maximum wet bulb | 30° C (86° F) |
| AC Power Requirements: | None |

DC Voltage Requirements:

| | | |
|---|---|---|
| + 12 VDC ± 10% | 1.8A typical | 4.2A starting |
| + 5 VDC ± 5% | 0.9A typical | 1.2A max |

| | |
|---|---|
| Heat Dissipation: | 26.1 W typical |
| **Mechanical dimensions:** | |
| Height | 3.25 inches ( 82.5 mm) |
| Width | 5.75 inches (146 mm) |
| Depth | 8.00 inches (203.2 mm) |
| Weight | 3.5 lbs ( 2.4 kg) |

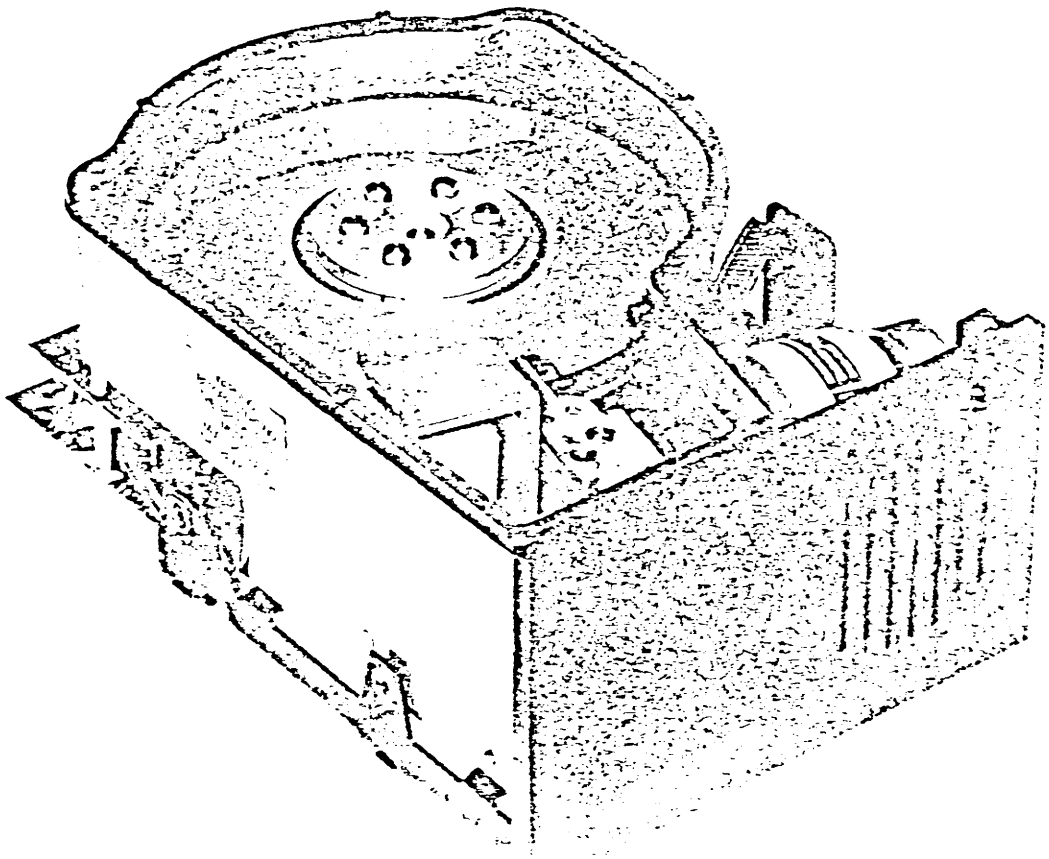


Figure 2.1 HD 561 Hard Disk Drive

# 3. HD 561 DRIVE INTERFACE

## 3.1 INTRODUCTION

The following specification describes the necessary requirements concerning the physical and electrical interface with the HD 561 hard disk drive family. The section on the physical interface, besides specifying the mechanical requirements, also lists recommended parts. The section on the electrical interface describes the functional and timing relationships required for each I/O pin.

### 3.1.1 PHYSICAL INTERFACE

The electrical interface between the HD 561 and the host system is comprised of four connectors:

- 01J - provides control signals for the device
- 02J - provides for radial connection of read/write data signals
- 03J - provides for DC power
- 04J - provides for frame ground

See Figure 3.1 for connector locations

### 3.1.2 01J/P1 CONNECTOR

A 34 pin edge connector provides the connection to 01J. The pins are numbered 1 through 34, and the even pins are located on the component side of the PCB. Pin 2 is labeled in its location near the end of the PCB connector, close to the DC power connector, 03J/P3. A key slot is provided, and is located between pins 4 and 6. AMP ribbon connector, part number 88373-3 is the recommended mating connector for P1.
See Figure 3.2 for the dimensions of 01J/P1 connector.

### 3.1.3 02J/P2 CONNECTOR

A 20 pin PCB edge connector provides the connection to 02J. The pins are numbered 1 through 20 with the even numbered pins located on the component side of the PCB. AMP ribbon connector, part number 88373-6 is the recommended mating connector for 02J. A key slot is located between pins 4 and 6. See Figure 3.3 for the dimensions of 02J/P2 connector.

### 3.1.4 03J/P3 CONNECTOR

The DC power connector, 03J, is mounted on the solder side of the PCB and is an AMP Mate-N-Lok connector, part number 350211-1. AMP part number 1-480424-0 is the recommended mating connector (P3) which utilizes AMP pins, part number 350078-4. 03J pins are labeled on 03J connector.
See Figure 3.4 for the dimensions of 03J/P3 connector.

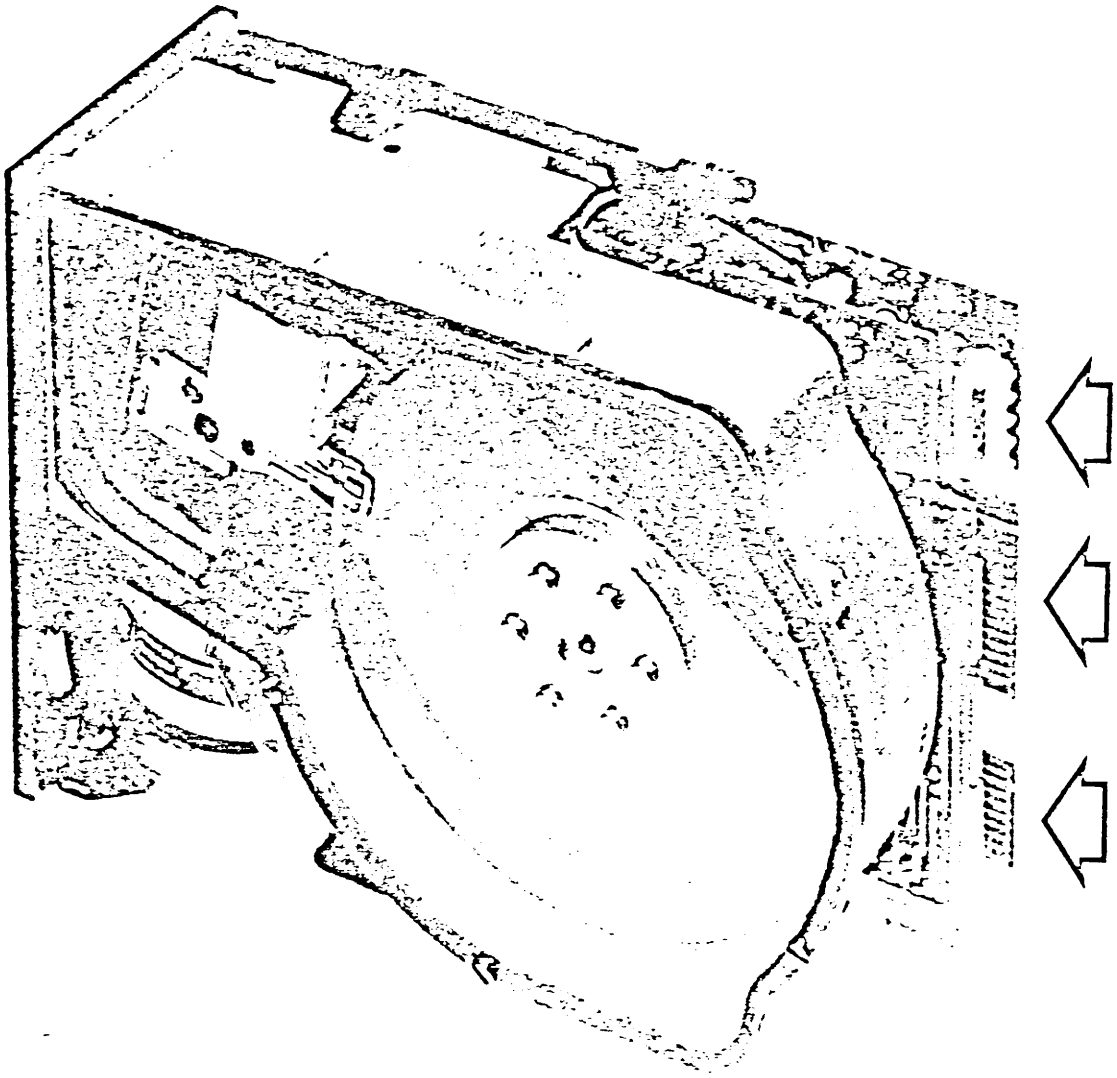


Figure 3.1 Connector Locations

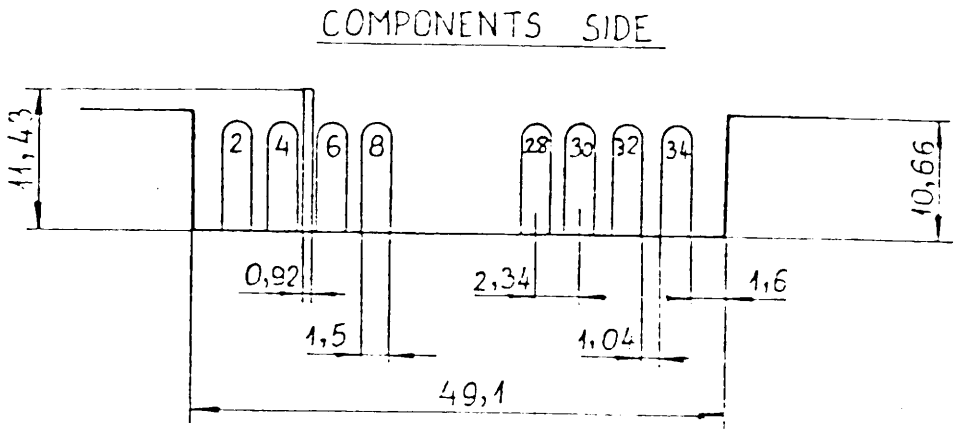



Figure 3.2 01J Connector

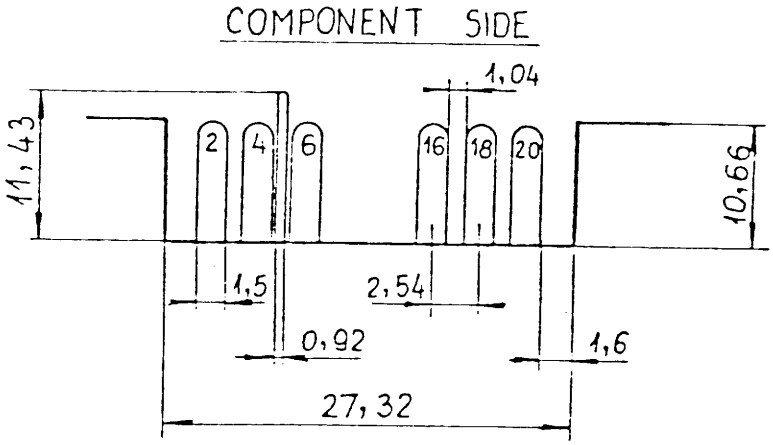
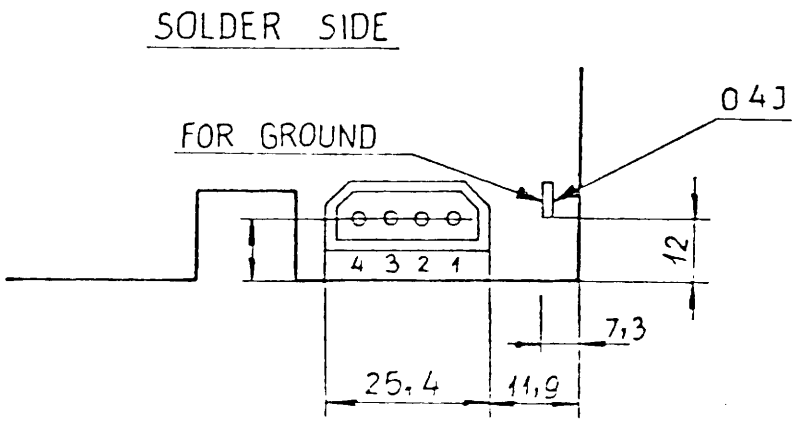



Figure 3.3 02J Connector




(AMP 187 Series)

Figure 3.4 03J and 04J Connector

### 3.1.5 04J/P4 FRAME GROUND CONNECTOR

Faston is AMP 187 Series. See Figure 3.4 for the dimensions of 04J/P4 connector.

## 3.2 INTERFACE LINES AND PIN ASSIGNMENTS

The drive interface comprises three categories; Control, Signal, and DC power. The following three tables show the pin assignments for these interface lines.

| GND RTN PIN | SIGNAL PIN | SIGNAL NAME |
|---|---|---|
| 1 | 2 | RICOO - Reduced Write Current |
| 3 | 4 | HEAD 3 - Head Select $2^2$* |
| 5 | 6 | WRAGA - Write Gate |
| 7 | 8 | OCCUO - Seek Complete |
| 9 | 10 | POZEN - Track 00 |
| 11 | 12 | WRIFN - Write Fault |
| 13 | 14 | HEAD 1 - Head Select $2^0$ |
| 15 | 16 | MACAN - Reserved (to 02J pin 7) |
| 17 | 18 | HEAD 2 - Head Select $2^1$ |
| 19 | 20 | GIRON - Index |
| 21 | 22 | MADIN - Ready |
| 23 | 24 | STEPN - Step |
| 25 | 26 | SEL 1 - Drive Select 1 |
| 27 | 28 | SEL 2 - Drive Select 2 |
| 29 | 30 | SEL 3 - Drive Select 3 |
| 31 | 32 | SEL 4 - Drive Select 4 |
| 33 | 34 | AVANN - Direction In |

Table 1. 01J/P1 Connector Pin Assignments

* Only for 5005, 11/12/13 version.

| GND RTN PIN | SIGNAL PIN | SIGNAL NAME |
|---|---|---|
| 2 | 1 | UNSEA - Drive Selected |
| 4 | 3 | RISE 1 - Reserved (5V) |
| 6 | 5 | RISE 2 - Spare |
| 8 | 7 | MACAN - Reserved (to 01J pin 16) |
| 10 | 11 | GROUND - GND |
| | 13 | WRIDO - + MFM Write Data |
| | 14 | WRIDN - - MFM Write Data |
| 16 | 15 | GROUND - GND |
| | 17 | READO - + MFM Read Data |
| | 18 | READN - - MFM Read Data |
| 20 | 19 | GROUND - GND |

Table 2. 02J/P2 Connector Pin Assignments

| | VOLTAGE | | GROUND |
|---|---|---|---|
| Pin 1 | +12V Volts DC ± 10% | Pin 2 | +12V Volt Return |
| Pin 4 | + 5V Volts DC ± 5% | Pin 3 | + 5V Volt Return |

Table 3. 0J3/P3 DC Connector Pin Assignments

## 3.3 CONNECTION MODE

The HD 561 hard disk drive family is connected in daisy chain on control signals and radially on read/write signals.
The maximum number of connected drives is 4 (see Figure 3.5). The maximum length of the daisy connection cable is 6 meters (18 feet). In the radial configuration the cables have to be the same length as the daisy cable. In either case the maximum length should be no more than 6 meters in order to minimize the possibility of noise.

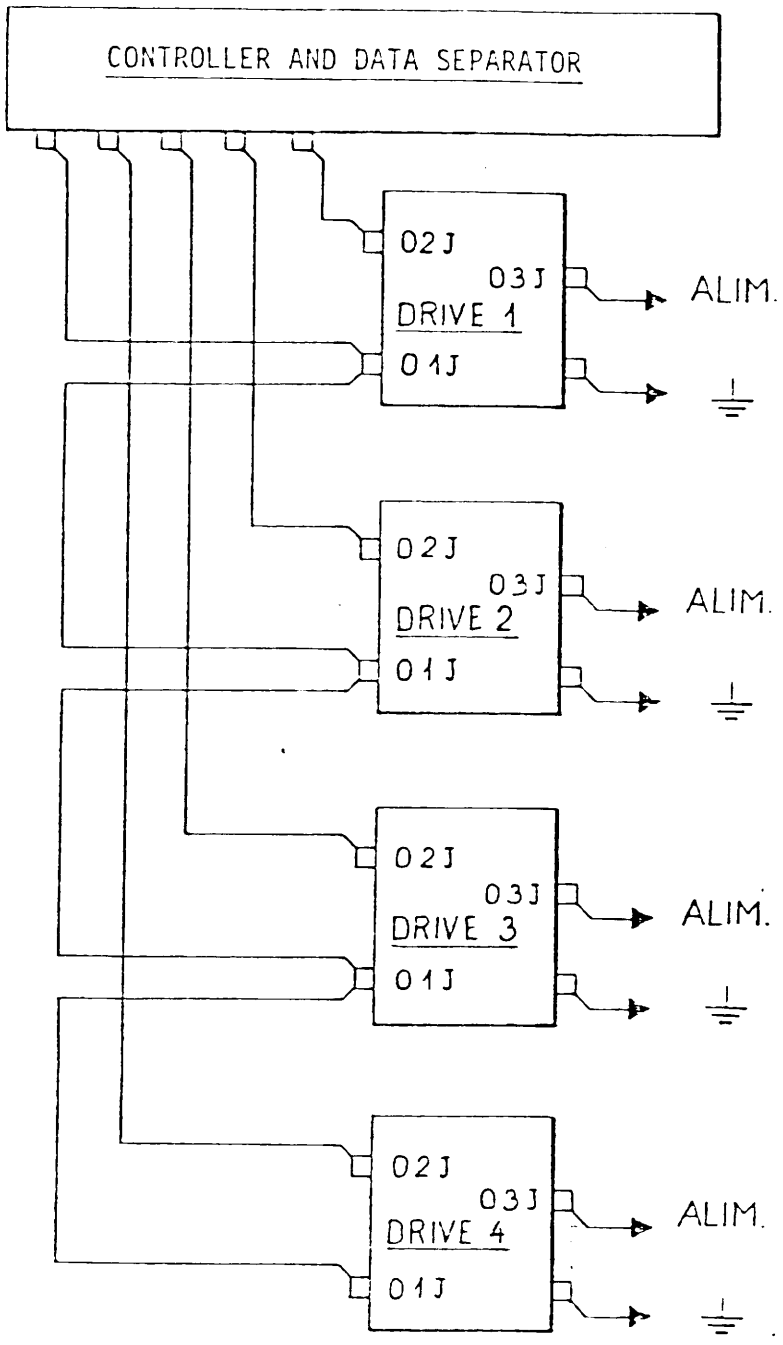



Figure 3.5 Typical Connection - 4 Drive System

# 4. INTERFACE LINES DESCRIPTION

## 4.1 CONTROL LINES

All the following lines are present in the 01J connector. The electrical specifications for these lines are as follows:

Low level = 0.0 VDC to 0.5 VDC
High level = 2.4 VDC to 5.25 VDC

STEPN - On this line the drive receives the steps for the command to position the head carriage on the desired track. The direction of the motor is given by the direction signal (AVANN). The speed is determined by the frequency of the step pulses. The maximum frequency of these pulses is 500 Hz and their minimum width, 3 microseconds.

AVANN - On this line the controller sends to the HD 561 the signal which determines the direction of the head carriage motor. A low level moves the heads towards the center of the disk. A high level (or line open) moves the heads towards the outside of the disk.
The signals must be active at least 100 nanoseconds (ns) before the trailing edge of the first command step.

OCCUO - A high level on this line indicates that the drive is busy (is executing a positioning command) and during this time read and write operations must not be attempted.

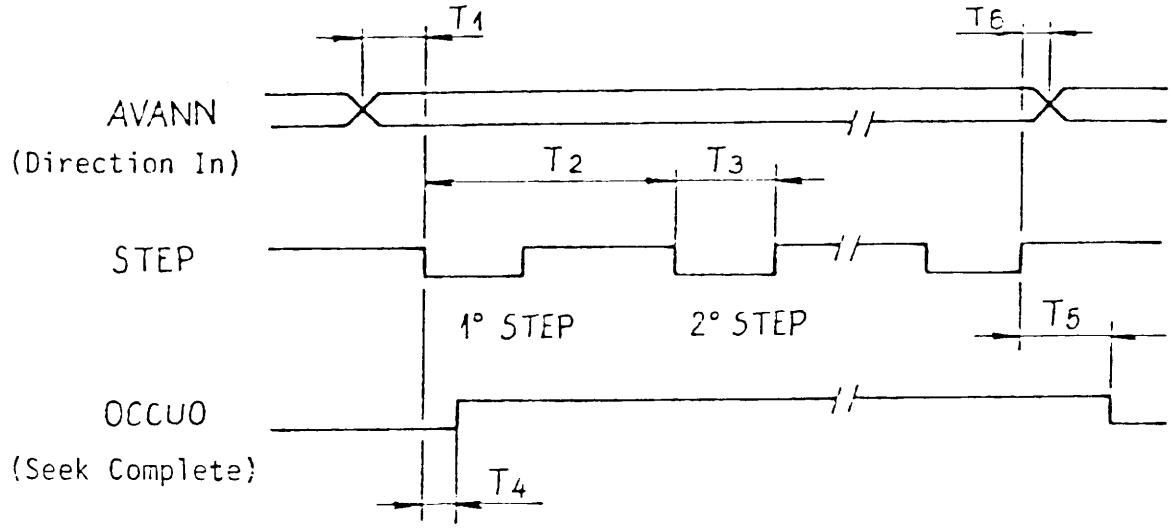
This signal will also go high during switch-on phase and remain in this condition until the head carriage is in track 00 and the spindle motor speed is in tolerance.

The timing relationship between all signals mentioned above are shown in Figure 4.1.

POZEN - This line goes low every time the head carriage is correctly positioned on track 00 and will go high in all other cases.

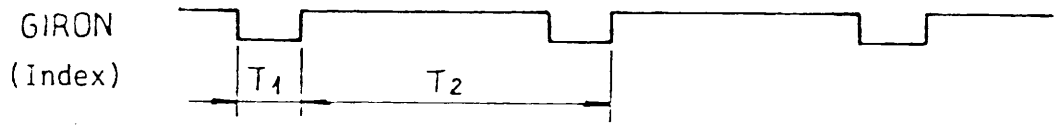
GIRON - On this line the drive sends the index signal to the controller. Figure 4.2 shows the timing relationship. This line is normally at high level. Only the trailing edge will be true to indicate the correct beginning of the track.

MADIN - This line, when at low level, together with OCCUO (seek complete) indicates that the drive is available for reading, writing or seeking. When this line is at high level all these operations are inhibited. During switch-on phase this line will be high for 13-17 seconds to ensure the initial reset and that the rotational speed of the spindle motor is in tolerance.




$T_1 = > 100$ ns
$T_2 = \geqslant 2$ ms
$T_3 = > 3\ \mu s$
$T_4 = < 500$ ns
$T_5 = \leqslant 20$ ms
$T_6 = > 500$ ns

Figure 4.1 Timing Relationship




$T_1 = 300\ \mu s \pm 20\%$
$T_2 = 16{,}667$ ms $\pm$ 1 %

Figure 4.2 Timing Relationship

WRIFN - This signal indicates that the drive is not properly executing a write operation, due to faults in the relative circuits. When this line is at low level, it indicates that:

1. The DC voltages are grossly out of tolerance.
2. There is current on the heads without a write command.
3. There is no current on the head with drive select and write command line is active.
4. More than one head or a non-existing head has been selected.

WRAGA - This line, when at a low level, allows the writing of data, while inhibiting head carriage positioning. When at a high level, it allows reading of data and positioning of carriage.

HEAD 1 - On these three lines the controller sends the head selection command
HEAD 2 as follows:
HEAD 3*

HEAD 1 = $2^0$

HEAD 2 = $2^1$

*HEAD 3 = $2^2$

The heads are numbered from 0 to 5. When these three lines are high, head 0 will be selected.

RICOO - When this line is active together with the WRAGA line, it allows writing at a reduced current.
This line will be low when write operations are performed between tracks 128 and 179; at high level between tracks 0 and 127.

MACAN - Pin no. 16 of the 01J is connected with pin no. 7 of the 02J on the PCB. This allows the controller to send a logic signal on this line and to receive it on pin 7 of 02J or vice versa. With this connection the controller can verify that cables are correctly connected. This operation is ignored by the peripheral unit.

SEL 1 - These lines when at a low level, permit the selection of the drives.
SEL 2 When selected, only one of these lines will be at a low level.
SEL 3
SEL 4

On the PCB a four-way dip switch is mounted for selection of the unit.

In a daisy chain configuration the resistors must be mounted only on the last drive.

(* Note: For future improvement 3 media version).

## 4.2 DATA LINES

All these lines are present on the 02J connector.

UNSEA - This line when at low level indicates to the controller that the drive has been selected.

RISE 1 - This line is reserved for future use.

RISE 2 - This line is reserved for future use.

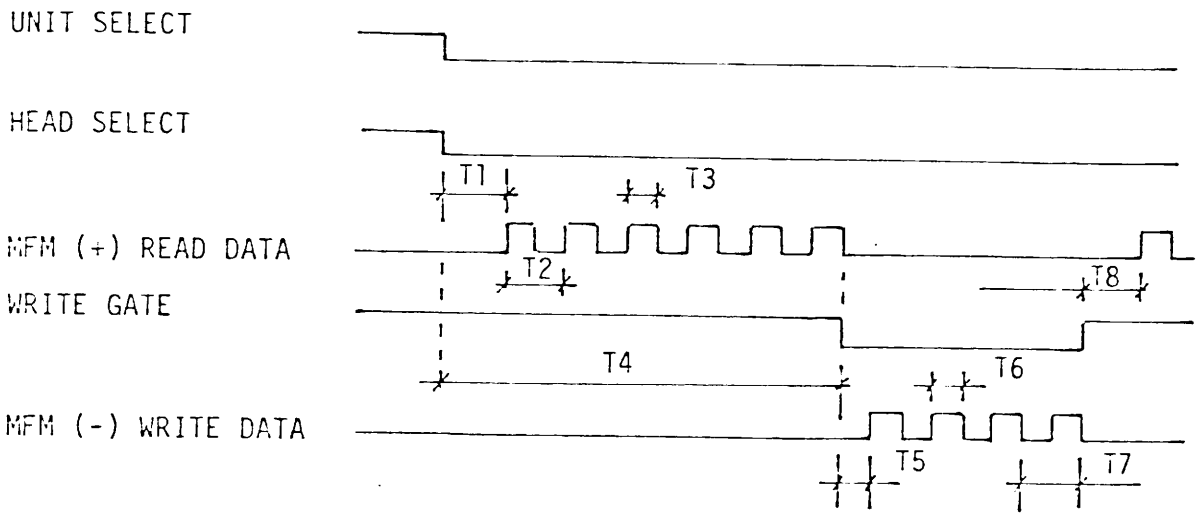
RISE 3 - This line is reserved for future use.

MACAN - Pin no. 7 of the 02J connector is connected to pin no. 16 of the 01J on the PCB.
See MACAN paragraph of control lines.

WRIDO
WRIDN - These two lines define the timing of the transitions to be written on the track.
The use of a 26LS31 high speed line driver is advised. These lines are received by the drive with a high speed differential line receiver of the 26LS32 type.
The levels are such that when WRIDO goes positive and WRIDN goes negative and both have the same value, one flux transition is provided at the head, provided the WRAGA line is active. When the WRAGA is not active the WRIDO line must be more negative than the WRIDN line.

READO
READN - The data recovered by reading a prerecorded track is transmitted via these two lines. When the transistions (positive and negative edges) between the READO and READN lines reaches the same value, this represents a flux transition on the track being read by the selected head. Data is true 20 microseconds after the selection of the head or at the end of the write operation as shown in Figure 4.3.

Figure 4.4 shows the recommended cable connections.




| | |
|---|---|
| T1 | 20 us |
| T2 | 200 ns typical |
| T3 | 100 ns typical |
| T4 | 20 us |
| T5 | 200 ns |
| T6 | 50 ns min. - 120 ns max. |
| T7 | 200 ns ± 1% |
| T8 | 20 us |

Figure 4.3 MFM Read/Write Data Timing Relationship

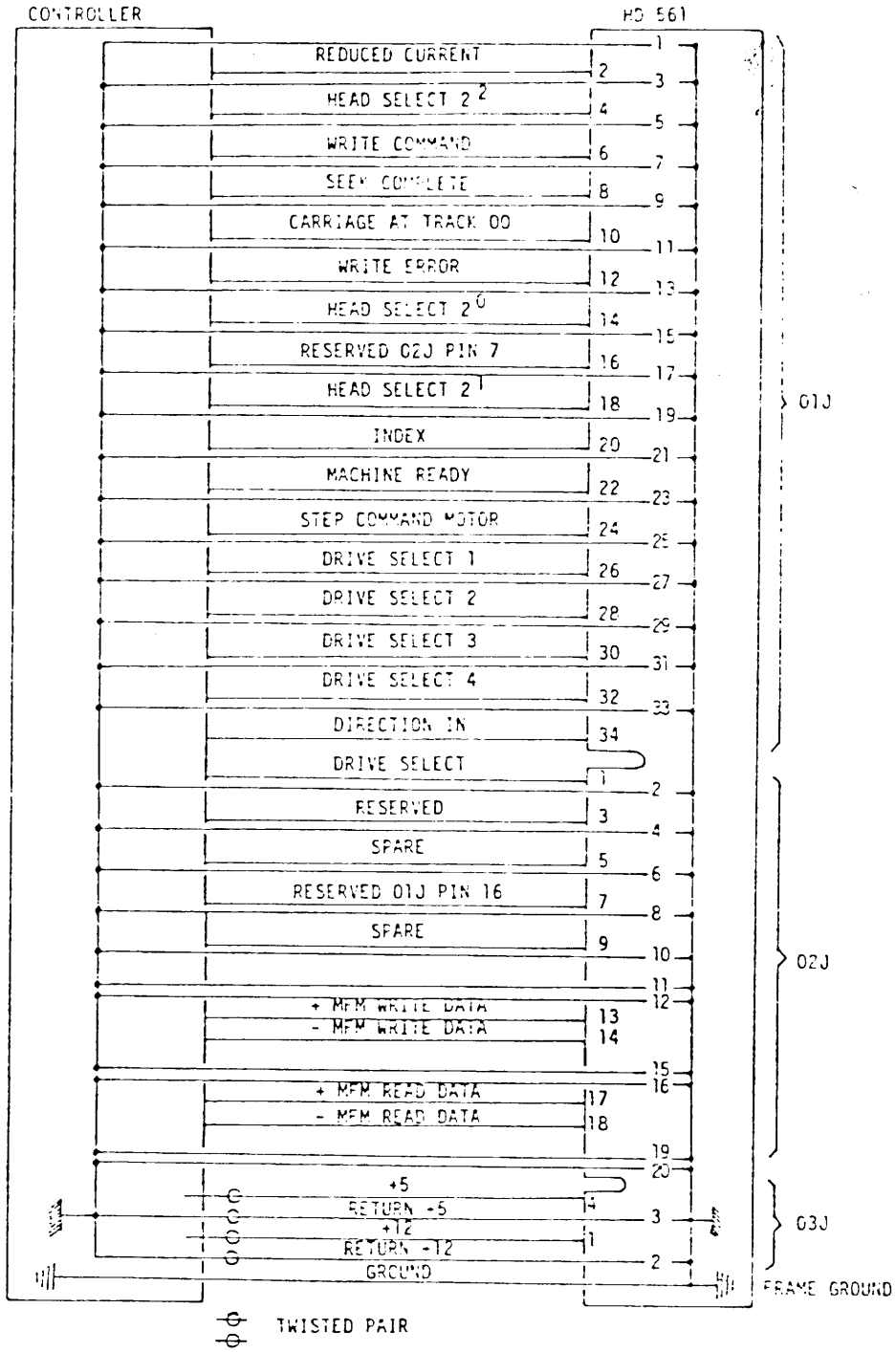



Figure 4.4 Cable Connections

## 5. ELECTRICAL INTERFACE

### 5.1 CONTROL LINES FROM DRIVE TO CONTROLLER

These lines are transmitted by a 75452 line driver with open connector. On the controller they have to be received by a Schmitt trigger. (74LS14 or equiv.)
Line impedance is terminated with a 220 - 330 ohm resistor pack. The signals are transmitted as follows:

OCCUO - Seek Complete
POZEN - Carriage on track 00
WRIFN - Write fault
GIRON - Index signal
MADIN - Unit ready
UNSEA - Unit selected

### 5.2 CONTROL LINES FROM CONTROLLER TO DRIVE

The lines are received by the drive with a 74LS14 Schmitt trigger and the lines are terminated with a 220 - 330 ohm resistor pack.
On the controller they have to be transmitted by an open connector 75452 or 7438 or equivalent device. In this way the following signals are received:

RICOO - Reduced current
WRAGA - Write Gate
HEAD 1 - Head Select $2^0$
HEAD 2 - Head Select $2^1$
HEAD 3 - Head Select $2^2$
STEPN - Step command
AVANN - Direction signal
SEL1N - Drive Select 1
SEL2N - Drive Select 2
SEL3N - Drive Select 3
SEL4N - Drive Select 4

### 5.3 WRITE SIGNALS

These signals are received by the drive with a differential line receiver 26LS32 and terminated with a 100 ohm resistor. They must be transmitted by the controller with a 26LS31 line driver.
The signals are received as follows:

WRIDO
WRIDN — Balanced write lines

Figure 5.3 shows the recommended circuits.

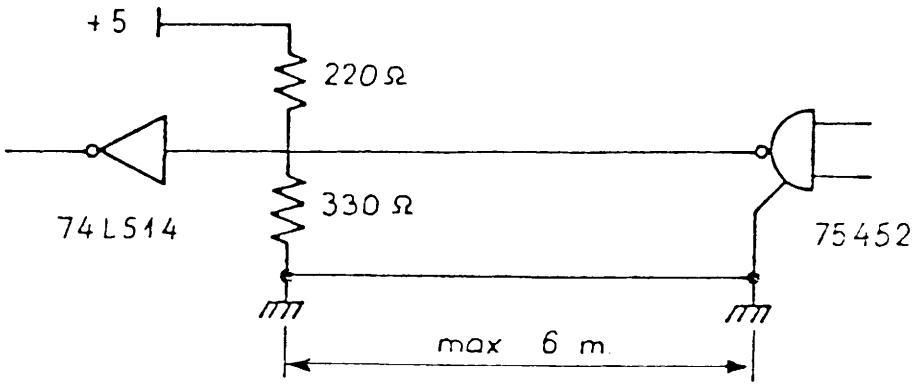



Figure 5.1 Cable Resistors

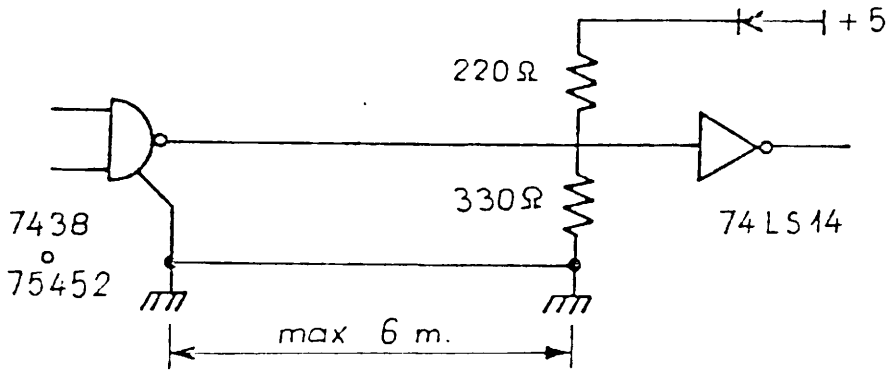



Figure 5.2 Line Resistors

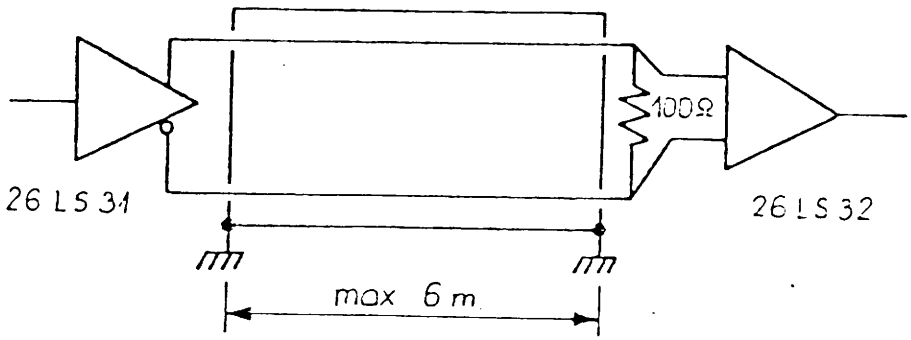



Figure 5.3 Recommended Circuit

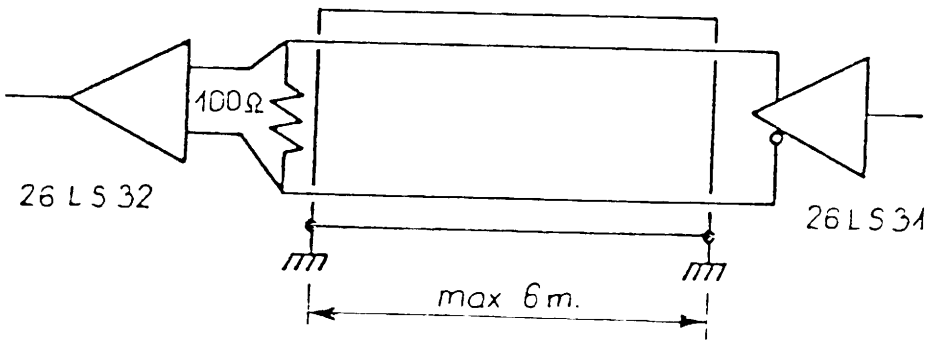



Figure 5.4 Recommended Circuit

## 5.4 READ SIGNALS

These signals are transmitted by the drive with a 26LS31 line driver and received by the controller with a 26LS32 line receiver.
The two balanced lines must be terminated with 100 ohm resistors.

The signals are transmitted as follows:

READO
Balanced read lines
READN

Figure 5.4 shows the recommended circuits.

## 5.5 CABLES

The connection with the 01J and the 02J has to be made with a Flat Ribbon cable or Twisted Pair cable with 105 ohm impedance.
The connection with the 03J has to be made with a Twisted Pair cable.

The DC power requirements of the HD 561 are shown in the following table.

| VOLTAGE | TOLERANCE | CURRENT | RIPPLE MAX (peak to peak) |
|---|---|---|---|
| + 5 | ± 5% | 0.9 A typical<br>1.2 A max | 50 mV |
| + 12 | ± 10% | 1.8 A typical<br>4.3 peak | 100 mV |

Table 4 DC Power Requirements

# 6. RELIABILITY CHARACTERISTICS

## 6.1 OPERATING SPECIFICATIONS

| | |
|---|---|
| POWER ON hours/day | 6 |
| Working days/year | 250 |
| Life | 6 years |
| Duty cycle | 0.5 |
| Exchanged bits/hour | $3.5 \cdot 10^7$ |
| Seeks/hour | 3600 |
| Seeks per life | $32 \cdot 10^6$ |

## 6.2 MEDIA DEFECTS

A defect is intended as a permanent error at a specific point on the media, defined by the track and the angular position.
The length of the defect shall not exceed 8 bits. The maximum number of defects per track is 1. The maximum number of defects per surface is 10.

## 6.3 ERROR RATE

To define the error rate it is necessary to check that all the defects of the media have been excluded for this evaluation. It is therefore necessary to differentiate between read and write errors.

### 6.3.1 WRITE ERRORS

The write errors may be caused by:

a) incorrect activation via interface of write data
b) data written on the defective zone of the media
c) general transient failure of the equipment.

Due to the above mentioned reasons, write errors are difficult to detect. Therefore it is advisable to always verify after each recording operation (with write and verify instructions).

- Transient write errors
  Write errors are considered transient when within three attempts of recording the write and verify are good.

- Permanent write errors
  When the write and verify are not good within three attempts of recording the error is classified as follows:

## 7. TRACK FORMAT

The HD 561 is a soft-sectoring, hard disk drive. The number of sectors per track and their organization can be fixed by the user, but the minimum length of the fields no. 8, 14 and 15 of the following table must be guaranteed.

The table shows a suggested track format. It is the same format that is used by OPE to test the peripheral unit.

The number of sectors per track is 33.

| | | |
|---|---|---|
| FIELD 1 | 13 BYTES | (00) FOR VFO SYNC. |
| FIELD 2 | 1 BYTE | A.M. FOR IDENTIFICATOR SYNC. |
| FIELD 3 | 1 BYTE | (FE) FOR FLAG IDENTIFICATOR |
| FIELD 4 | 1 BYTE | (00) TO (B3) FOR CYLINDER DEFINITION |
| FIELD 5 | 1 BYTE | (00) TO (05) FOR HEAD SELECTION |
| FIELD 6 | 1 BYTE | (00) TO (32) FOR SECTOR SELECTION |
| FIELD 7 | 3 BYTES | ECC |
| FIELD 8 | 2 BYTES | (00) WRITE GATE TURN-ON BY-PASS |
| FIELD 9 | 13 BYTES | (00) FOR VFO SYNC. |
| FIELD 10 | 1 BYTE | A.M. FOR DATA FIELD SYNC. |
| FIELD 11 | 1 BYTE | (F8) FOR DATA FIELD FLAG |
| FIELD 12 | 256 BYTES | FOR DATA FIELD |
| FIELD 13 | 3 BYTES | ECC |
| FIELD 14 | 2 BYTES | (00) FOR WRITE GATE TURN-OFF BY-PASS |
| FIELD 15 | 9 BYTES | (4E) FOR POSTAMBLE |

Total bytes per sector: 308

Table 5 Suggested Track Format

The following figure shows the track format.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 bytes 00 | a m | F E | c y l | h d | s e c | E C C | 0 0 | 13 bytes 00 | a m | F 8 | 256 bytes data | E C C | 0 0 | 9 bytes |

Figure 7.1 Track Format

## 8. DIMENSIONS AND MOUNTING

The dimensions of the HD 561 are shown in Figure 8.1.

The HD 561 can be mounted one of two ways:

a) Vertical - both sides can be used
b) Horizontal - solder side down

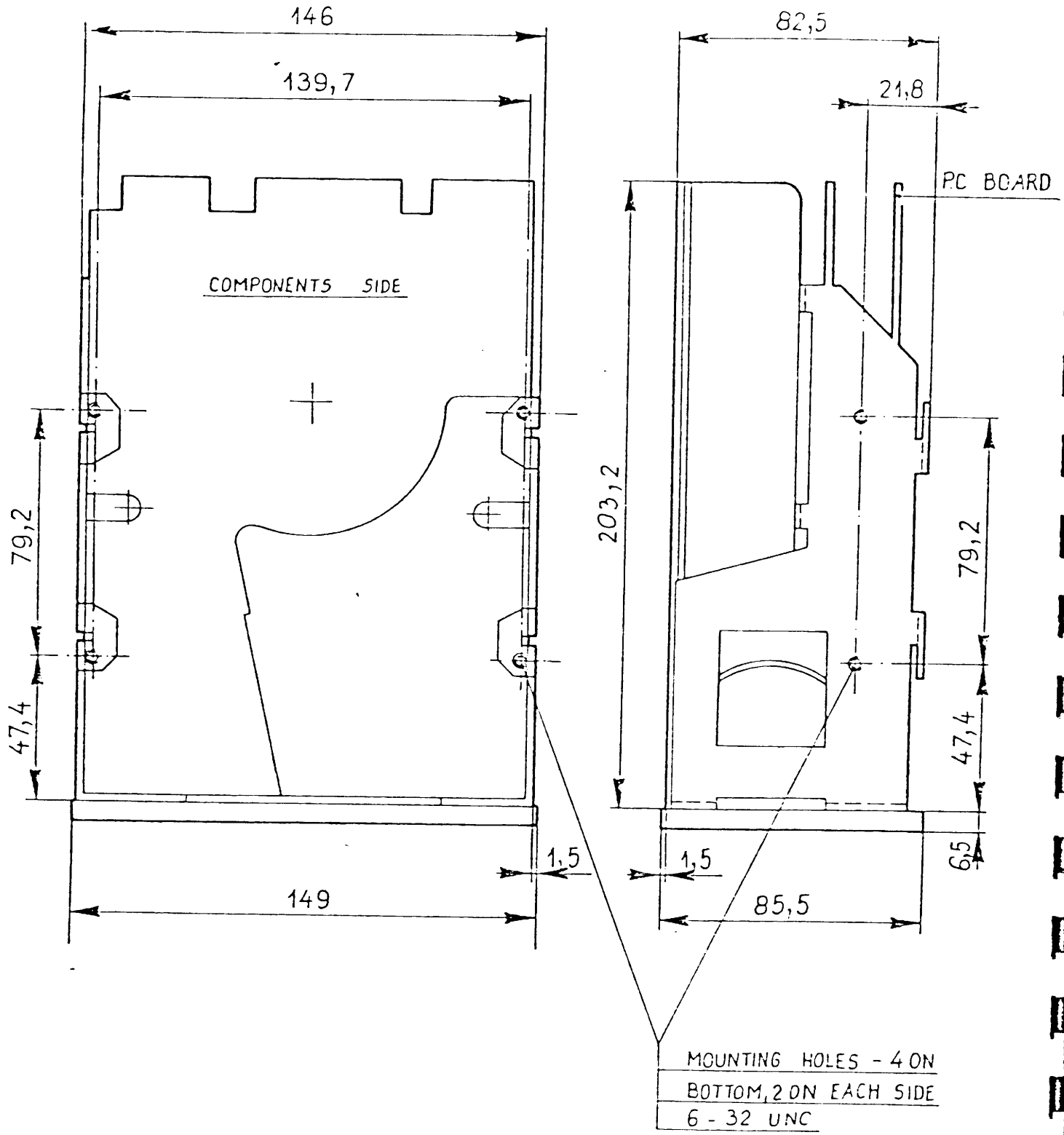



Figure 8.1 Dimensions

# 9. SPARE PARTS CATALOG

NOT AVAILABLE AT TIME OF PRINTING

## 10. SCHEMATICS SET

NOT AVAILABLE AT TIME OF PRINTING