RO 3000 SERIES DISK DRIVE

PRODUCT SPECIFICATION

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RO 3000 DISK DRIVE PRODUCT SPECIFICATION

1.0 SCOPE

This document describes the physical and functional characteristics of the RODIME RO 3000 series 3½" Winchester disk drives. It also specifies interface, installation and environmental requirements.

2.0 RELATED DOCUMENT

Further detailed information referring to the use of the RO 3000 series disk drives on a host system is given in the User Manual, USM-00098.

3.0 PRODUCT DESCRIPTION

3.1 General

The RO 3000 series disk drives are random access storage devices which use four 95mm magnetic disks to provide up to 54.50 Megabytes of unformatted on line capacity.

A servo surface is used in conjunction with a rotary voice-coil positioner to achieve an average access time of 30msec.

A microprocessor with 4K of program memory is used for several drive operations and for all positioner control functions. These include velocity control for all seeks, fault detection and interface.

3.2 Mechanical Assemblies

The drive uses the sealed enclosure principle of Winchester head/disk technology and provides a minimum contamination environment to maintain head/media integrity.

An internal filter minimises airborne contaminants within the drive housing. A breather filter on the drive housing cover reduces the ingress of contaminants through the bearings of the disk motor by minimising the pressure drop across them.

3.3 Disk Hub and Drive Motor

The disks are fitted to the hub of a three-phase brushless DC motor rotating at 3600rpm. Hall-effect devices are used for commutation of the motor windings and motor speed control. Ferrofluidic and labyrinth seals are fitted to the drive motor bearing to prevent contamination.

Cont'd

3.4 Positioner

The positioner consists of a rotatory voice-coil actuator, positioner arms and magnetic recording heads. The positioner is statically balanced about the actuator spindle.

Positioning is achieved by means of closed-loop servo control using information derived from a dedicated servo surface.

On power-down, the actuator is driven to the inner radius and a shipping lock is automatically applied.

3.5 Recording Heads and Disks

The drive contains four disks with one read/write head per disk surface. One surface is dedicated to the servo information for the positioner.

The electrical interface between the recording heads and the electronics board is by means of a flat flexible circuit cable which incorporates the pre-amplifier circuits for all of the recording heads.

3.6 Electronic Assemblies

The drive contains one printed circuit board whose functions include:

3.6.1 Read/write and head selection;

3.6.2 Motor speed control;

3.6.3 Closed-loop positioner controller;

3.6.4 Host controller interface;

3.6.5 Microprocessor, which provides:

- 3.6.5.1 full automatic power up sequence;
- 3.6.5.2 motor speed control check to +/- 1% during power up;
- 3.6.5.3 regular motor speed control checks to +10%, -5% after power-up;
- 3.6.5.4 control of output lines and latching of fault conditions;
- 3.6.5.5 voice-coil positioner control including mode select and velocity ramp generation;
- 3.6.5.6 fault codes on front panel LED;

Cont'd...

3.0 PRODUCTION DESCRIPTION (Cont'd)

3.7 Index

Index is derived from information recorded on the servo surface once per revolution of the disk.

3.8 Indicator and Fault Codes

A red LED indicator is provided on the facia and indicates that the drive is selected and ready. This LED is also used to flash error codes should certain fault conditions arise in the drive. These codes are listed in section 14.

3.9 Drive Dimensions

The dimensions of the drive and of the plastic front facia are given in Figure 1. Also shown are the mounting holes.

4.0 FUNCTIONAL DESCRIPTION

4.1 Recording Parameters

Data is recorded on both sides of the disks (except on the servo disk which uses only one side for data):

4.1.1	Bit density	: 15072 bits per inch (max)
4.1.2	Flux density	: 15072 flux changes per inch (max)
4.1.3	Coding	: M.F.M.
4.1.4	Track Density	: 1040 tracks per inch (max)

Cont'd...

4.0 FUNCTIONAL DESCRIPTION (Cont'd)

4.2 Storage Capacity (Unformatted)

			3055	3045
4.2.1	**Disks per drive**	:	**4**	**3**
4.2.2	**Cylinders**	:	**872**	**872**
4.2.3	Data tracks per cylinder	:	6	5
4.2.4	Data bytes per track	:	10,417	10,417
4.2.5	Data tracks per drive	:	5,232	4,360
4.2.6	Capacity (Megabytes)	:	54.50	45.42

4.3 Storage Capacity (Formatted)

Since the RO 3000 series disk drives are soft-sectored, various format schemes may be used for storing data. Here we quote the typical formatted capacity for the popular choice of 256 bytes per sector.

			3055	3045
4.3.1	Data bytes per sector	:	256	256
4.3.2	Data sectors per track	:	32	32
4.3.3	Data bytes per track	:	8,192	8,192
4.3.4	Capacity (Megabytes)	:	42.86	35.71

4.4 Rotational Parameters

Disk rotational speed : 3,600 +/- 36rpm

Data transfer rate : 5×10^6 bits per second

4.5 Cylinder Access Time

The cylinder access time is defined as the elapsed time from receipt at pin 24 of the interface control signal connector housing P1 on the electronics board of the first STEP command of a sequence of one or more STEP commands to the issue by the drive of SEEK COMPLETE status at pin 8 of the same connector. Thus, it includes both seek time and settling time.

4.0 FUNCTIONAL DESCRIPTION (Cont'd)

4.5 Cylinder Access Time (Cont'd)

The RO 3000 series disk drives can accept STEP pulses over a range of rates. They are buffered before being processed and the final step rate of the actuator depends on the pulse rate. There are two operating modes with corresponding access times depending on the interval, P, between successive step pulses.

4.5.1 Ramp Mode: P = 5us to 300us

The access time is dependent upon step rate. Figures for P = 30us are quoted below.

4.5.1.1	Single cylinder	: 7 ms
4.5.1.2	872 cylinders (P = 30us)	: 62 ms (maximum)
4.5.1.3	Average cylinder access (P = 30us)	: 30 ms

4.5.2 Unramped Mode: P = 350us to 15ms

Step rates in this range cause the positioner to seek in an unramped mode. Access time in this mode varies with incoming pulse rate. Figures for P = 3ms, popular on many controllers, are quoted below.

4.5.2.1	Single cylinder (P = 3ms)	: 7 ms
4.5.2.2	872 cylinders (P = 3ms)	: 2620 ms (max)
4.5.2.3	Average cylinder access (P = 3ms)	: 875 ms

Note:

1. **In the above, average cylinder access is defined as the total time for all possible cylinder accesses divided by the number of all possible cylinder accesses.**

2. **The transition region between ramped and unramped mode occurs for step intervals P in the approximate range 310 to 340us. In this range some seeks will be ramped, others unramped. To guarantee ramped operation P must be less than or equal to 300us as indicated in 4.5.1 above. Similarly, P greater than or equal to 350us results in unramped mode on all seek operations.**

Cont'd...

4.0 FUNCTIONAL DESCRIPTION (Cont'd)

4.6 Data Access Time

The data access time is defined as the cylinder access time plus rotational latency of the required address.

4.6.1	**Average latency**	:	**8.3ms**
4.6.2	**Average data access time ramp mode**	:	**38.3 ms**
4.6.3	**Head switching time**	:	**5us (maximum)**

4.7 Illegal Addresses

Each drive will be accompanied by a map indicating the number of bytes from INDEX which should not be used by the host. These will be identified by cylinder, head and byte number. No illegal addresses will exist in cylinders 0 and 1. This map will be supplied on a label fixed to the drive as well as on accompanying documentation. The maximum number of illegal addresses is as follows:

RO 3055	:	35
RO 3045	:	30

4.8 Weight

0.75kg (max.)

5.0 RELIABILITY AND SERVICE GOALS

5.1 Drive Life

The minimum drive service life is 36,000 Power On Hours. The drive is capable of 10,000 start/stop operations during service life.

5.2 Mean Time Between Failure

The mean time between failure (MTBF) of the RO 3000 series disk drives shall exceed 20,000 hours.

5.3 Service Goals

No preventative maintenance is required and there are no adjustments on the drive. The repair that may be effected on-site is replacement of the electronics board. The mean time to repair (MTTR) including initial verification is 0.5 hours.

5.0 RELIABILITY AND SERVICE GOALS (Cont'd)

5.4 Data Reliability

The drive is responsible for sending differential MFM data to the host controller where it is stabilised using a phase locked loop (PLL) circuit and decoded to NRZ data. A maximum MFM timing jitter is specified at the data bus connector housing P2. Note that the maximum allowed data window for MFM coding at 2.50MHz is 100 nanoseconds (+/- 50ns).

5.4.1 MFM timing error : +/- 30ns (maximum)

(Note: A soft error rate of less than 1 error in 10^{10} bits read should result if the PLL/decode timing error on the host controller does not exceed +/- 8 nanoseconds.)

5.5 Actuator Reliability

A seek error occurs when the actuator moves to an incorrect cylinder. This occurrence shall not exceed 1 seek error in 5×10^{6} seeks.

6.0 OPERATING ENVIRONMENT (In system or free standing)

6.1 Temperature and Humidity

Temperature range	:	10°C to 50°C
Relative Humidity range (No condensation)	:	10% RH to 85% RH
Maximum wet bulb temperature	:	26°C
Maximum rate of change of temperature	:	10°C per hour

6.2 Shock and Vibration

The drive shall meet its specified performance while subjected to the following shock and vibration conditions injected through the mounting in any of three mutually perpendicular axes. Vibrations are sinusoidal and shocks half-cycle sinusoidal wave-forms.

Cont'd...

6.0 OPERATING ENVIRONMENT (Cont'd)

6.2 Shock and Vibration (Cont'd)

6.2.1 Vibration

1g pk acceleration, sinusoidal vibration 5-500Hz, 1 octave/minute sweep rate maximum of 2 complete cycles without interruption.

6.2.2 Shock

10g pk accln in axis perpendicular to P.C.B.
6g pk accln in two axes parallel to P.C.B.
Duration less than 10msec, half cycle sinusoidal waveform max 2 per second. Maximum 500 shocks, within any formatted period and max of 2E9 bits transferred.

6.3 Radio Frequency Interference

Electric field shall not exceed 2 volts/meter r.m.s. in the range 1.5Hz to 10GHz.

6.4 Magnetic Field

There shall be no source of constant magnetic field which yields more than 0.0002 Tesla measured in the location occupied by the magnetic heads when the drive is installed.

6.5 Altitude

Altitude relative to sea level	:	+6,000 feet, -1,000 feet

6.6 Emitted Acoustic Noise

Peak emitted noise	:	50dbA (continuous, maximum) at 1 metre from the nearest point on the drive.

7.0 NON-OPERATING ENVIRONMENT

7.1 Temperature and Humidity

Temperature range	:	-40°C to +70°C
Relative humidity range (No condensation)	:	5% RH to 90% RH
Maximum wet bulb temperature	:	30°C
Maximum rate of change of temperature	:	30°C per hour

Cont'd

7.0 NON-OPERATING ENVIRONMENT (Cont'd)

7.2 Shock and Vibration

7.2.1 Packed

The approved Rodime shipping container shall protect the drive against damage when the container is subjected to shock and vibration in accordance with ASTM, recommended practice for performance testing of shipping containers. Reference the following:

ASTMD775 Test method for drop test for loaded boxes.

ASTMD999 Methods for vibration testing of shipping containers.

7.2.2 Unpacked

7.2.2.1 Vibration : 2g pk acceleration, sinusoidal vibration 5-500Hz, 1 oct/min sweep rate. Max of 4 complete cycles without interruption.

7.2.2.2 Shock : 50g pk acceleration of maximum duration 10msec. Half cycle sinusoidal waveform. Maximum frequency 1 per 10 seconds. Maximum 5 shocks within any formatted period.

8.0 HARDWARE INTERFACE

8.1 Drive Mounting and Installation

The RO 3000 series disk drives may be mounted in a host system in any orientation. The shipping lock effectively locks the actuator during shipment and releases on application of 12V.

When installing the drive into an enclosure, the breather holes on the drive top cover must not be obstructed. At least 0.1 inch clearance must be provided between the top cover and the host frame.

There must be at least 0.1 inch clearance between the drive housing and the host frame to ensure functional vibration isolation.

The drive may be mounted in either a vertical or horizontal orientation. It is supplied complete with antivibration mounts and threaded mounting brackets. See Figure 1.

8.0 HARDWARE INTERFACE (Cont'd)

8.2 Electrical Interface

The electrical interface between the RO 3000 series disk drives and the host system consists of three connectors:

Connector J1	: Control
Connector J2	: Data
Connector J3	: DC power (+5V, +12V)

The position of these connectors on the drive is shown in Figure 2.

The pin assignments for the interface lines for control (J1), data (J2) and power (J3) are given in Tables 1, 2 and 3 respectively.

8.2.1 Control : Connector J1/P1

Control signals for the drive are provided via a 34 pin edge connector (P1/J1). The pins are numbered 1 through 34 with the even pins located on the component side of the board. Pin 2 is located on the end of the board connector farthest from the DC power connector and is labelled. A key slot is provided between pins 4 and 6. The recommended mating connector is AMP ribbon connector A/N 88373-3. J1 connector dimensions are given in Figure 3 and pin connections in Figure 6.

8.2.2 Data : Connector J2/P2

Radial connection of read/write data signals is provided via a 20 pin edge connector (P2/J2). The pins are numbered 1 through 20 with the even pins located on the component side of the board. The recommended mating connector is AMP ribbon connector A/N 88373-6. J2 connector dimensions are given in Figure 4 and pin connections in Figure 7.

8.2.3 Power : Connector J3/P3

DC power is provided via a 4 pin AMP Mate-N-Lok connector (P3/J3) P/N 350211-1 mounted via the solder side of the board. The recommended mating connector is AMP P/N 1-480424-0 utilising AMP pins P/N 350078-4. J3 connector dimensions are given in Figure 5 and pin connections in Figure 6.

Cont'd...

8.0 HARDWARE INTERFACE (Cont'd)

8.2 Electrical Interface (Cont'd)

8.2.4 Cabling

It is recommended that the control and data interface signals should be carried by flat ribbon or twisted pair cable of maximum length 20 feet. The power cables should likewise be twisted pairs of each line voltage and return. See Figure 6.

8.2.5 Multiple Drive Configuration

Up to four RO 3000 series disk drives may be connected to any host system. Each drive is provided with 4 pairs of pins to select the drive for drives numbering from 1 to 4. The position of these pins on the drive is shown in Figure 2. The pair of pins # 1 corresponding to "DRIVE SELECT 1" is at the furthest from the interface connector P1. A drive is selected by shorting the relevant pair of pins with the jumper provided.

When connecting more than one drive to a host, the control lines may be 'daisy-chained' but the data lines require to be radially (individually) connected. The typical system configuration is shown in Figure 8. Each drive is provided with a removable resistor terminator pack for the control interface (J1) lines and this pack must be removed from all except the last drive in the chain. (See Figures 2 and 11).

9.0 POWER INTERFACE : J3

The RO 3000 series disk drives require DC power only. The voltages are specified at connector J3 on the drive.

(DC)	Current Maximum (Amperes)	Current Typical (Amperes)
+5 (+/-5%)	1.0A	0.7A
+12 (+/-5%)	1.5A	0.8A

At power-on, the drive circuitry draws 2.0A max at +12V.

Cont'd...

9.0 POWER INTERFACE : J3 (Cont'd)

9.1 The 5V rise time must not exceed 1 second.

9.2 The 12V must follow the 5V within 5 seconds if the 5V is applied first.

9.3 When checking the power supplies, the following loads should be used:

For the 12V supply, the power-up current may be measured using a standard load of 6.8 ohms and the operating current may be measured using 12 ohms. With a 5.0 ohm resistive load on the 5V supply and the above loads on the 12V supply, noise and ripple should not exceed 100mV peak to peak up to 500Hz and 50mV peak to peak from 500Hz to 5MHz.

9.4 In operation, the maximum rate of change of the 12V load due to the disk drive is 1A/ms.

9.5 Average power dissipation : 11 watts

10.0 DATA INTERFACE : J2

The RO 3000 series disk drives transmit and receive differential data coded in MFM (modified frequency modulation). Decoding is performed by the host.

10.1 MFM Read Data J2/17,18

Data recovered by reading a pre-recorded track is transmitted to the host system using an EIA RS-422 standard differential line driver as shown in Figure 9. This balanced voltage signal will drive up to 20 feet of twisted pair or flat ribbon cable with an impedance Z = 105 ohms. The recommended receiver is shown in Figure 10. The transition of "+MFM READ DATA" going more positive than "-MFM READ DATA" represents a magnetic flux transition on the disk under the selected head. Timings are shown in Figure 13.

10.2 MFM Write Data J2/13,14

Data for writing on the drive should be transmitted from the host using an EIA RS-422 standard differential line driver as shown in Figure 9. The drive receiver is shown in Figure 10. The transition of "+MFM WRITE DATA" going more positive than "-MFM WRITE DATA" will result in a flux reversal on the disk under the selected head, provided "WRITE GATE" is TRUE and the drive is selected. Timings are shown in Figure 13. It is recommended that "MFM WRITE DATA" be inactive when "WRITE GATE" is FALSE.

Cont'd...

10.0 DATA INTERFACE : J2 (Cont'd)

10.3 Drive Selected J2/1

The "DRIVE SELECTED" line is TRUE when the drive is defined as drive N, using the appropriate drive select switch, and "DRIVE SELECT N" (on J1) is TRUE.

10.4 Write Pre-Compensation

During writing, it is required that an advance or delay be applied to MFM bits when they occur in certain patterns. This compensates for peak shift on the disk due to pulse crowding. From an analysis of 5 bit sequences, a preferred pre-compensation scheme is shown in 10.4.1 below. Note that LATE or EARLY compensation applies to the centre bit only of each pattern. No other patterns should be compensated. The value of compensation should be 10 to 12ns and be applied on cylinders 650 to 871.

10.4.1

DATA SEQUENCE LEFTMOST BIT FIRST	REQUIRED PRE-COMPENSATION OF CENTRE BIT
00 1 10	EARLY
00 0 11	EARLY
00 1 10	LATE
00 1 11	LATE
01 1 00	EARLY
01 1 01	EARLY
10 0 00	LATE
10 0 01	LATE
10 1 10	LATE
10 1 11	LATE
11 1 00	EARLY
11 1 01	EARLY

11.0 CONTROL INTERFACE : DRIVE INPUTS : J1

The control bus to the drive consists of 14 signals, namely 5 inputs, 5 outputs and 4 multiplex control lines for drive select. A removable resistor pack allows for line termination of all inputs. This is shown in Figure 11. Note that all signals are low TRUE.

INPUT LOW (TRUE)	:	0V to +0.8V at -24mA
INPUT HIGH (FALSE)	:	+5.25V to 3.5V at 0A

Cont'd...

11.0 CONTROL INTERFACE : DRIVE INPUTS : J1 (Cont'd)

11.1 Drive Select (J1/26, 28, 30, 32)

These four lines control the multiplexing of the control signals. A low level on "DRIVE SELECT N" will enable all drives addressed as N connected to the control bus.

11.2 Head Select (J1/4, 14, 18)

These three lines provide for unique selection of each read/write head (up to 7 maximum) according to the binary coded sequence shown in Table 4. Note that when all "HEAD SELECT" lines are FALSE head Ø will be selected.

11.3 Write Gate (J1/6)

When TRUE, this line enables data to be written by the drive. When FALSE, this line enables data to be transferred from the drive to the host. If "WRITE GATE" is TRUE and a "STEP" pulse is received by the drive then "WRITE FAULT" is returned by the drive.

11.4 Reduced Write Current (J1/2)

This signal is ignored by the drive. Reduced write current switching is controlled internally by the microprocessor.

11.5 Direction In (J1/34)

This signal defines the direction of motion of the read/write head when the "STEP" line is pulsed. When TRUE, the direction is IN towards the centre of the disk (increasing cylinder number). When FALSE, the direction is OUT towards the edge of the disk (decreasing cylinder number).

The "DIRECTION IN" line is sampled when the first step pulse of any seek is received from the host. Any change thereafter to the direction line will be ignored by the drive until "SEEK COMPLETE" is TRUE. This facility allows the drive to be used in an 'overlap seek' mode. Once a seek has been initiated no attempt should be made to alter the direction of motion while the "SEEK COMPLETE" line is FALSE.

Cont'd...

11.0 CONTROL INTERFACE : DRIVE INPUTS : J1 (Cont'd)

11.6 Step (J1/24)

When used in conjunction with the DIRECTION IN line, the "STEP" signal enables the read/write heads to be moved. If a command is given which implies head movement across N cylinders then the "STEP" line must be pulsed N times. The "STEP" line is active on a high to low transition (falling edge). The drive has two distinct modes of operation depending on the pulse rate of the "STEP" line.

1. ramp mode

2. unramped mode

Either mode is automatically selected by the drive by sampling the pulse rate. In both modes the step pulses are buffered in the drive before being processed. Step pulse timings are shown in Figure 14.

11.6.1 Ramp mode

If the time between successive step pulses, P, is in the range 5us to 300us, then the drive performs the seek operation by accelerating and decelerating the read/write heads in accordance with a defined velocity ramp.

11.6.2 Unramped Mode

If the time between successive pulses, P, is in the range 350us to 15ms then the drive performs the seek operation by stepping the read/write heads at a rate derived from the incoming pulse rate.

If the time between successive pulses, P, is in the range 350us to 5ms, then SEEK COMPLETE is set after all STEP pulses have been received and after the head settling time.

If the time between successive pulses, P, is in the range 6ms to 15ms, then SEEK COMPLETE is set after each STEP pulse has been received and after the head settling time.

If the time between successive pulses, P, is in the range 5ms to 6ms, then SEEK COMPLETE may sometimes be set after a STEP pulse, or may be set after all STEP pulses have been received.

Cont'd...

12.0 CONTROL INTERFACE : DRIVE OUTPUTS : J1

There are 5 output status lines from the drive to the host. These are valid only when the drive is selected. These are driven by a tri-state line driver as shown in Figure 12. Outputs are in the high impedance mode of tri-state logic when the drive is not selected.

OUTPUT LOW (TRUE)	:	0.5V (max) at +24mA
OUTPUT HIGH (FALSE)	:	2.4V (min) at -3mA
OFF STATE OUTPUT CURRENT	:	$I_{ozh} = I_{ozl} = 20$ uA

12.1 Index (J1,20)

This signal makes a transition from TRUE to FALSE (and vice versa) once for each revolution of the drive motor. The transition is referenced to a constant point on the rotating disk system. Only the leading edge of index should be used. The index timing is shown in Figure 15.

12.2 Track ØØØ (J1/10)

This line is TRUE when the read/write heads are positioned over cylinder ØØ.

12.3 Seek Complete (J1/8)

This line is TRUE when the read/write heads are settled on the final cylinder at the end of a seek. Reading or writing should not be attempted when "SEEK COMPLETE" is FALSE. A drive is ready for reading and writing when "SEEK COMPLETE" and "READY" are TRUE and "WRITE FAULT" is FALSE. The "SEEK COMPLETE" status is FALSE after 100ns, approximately, following the leading edge of a step pulse or series of step pulses. During power up of the drive, "SEEK COMPLETE" is indeterminate until the auto-calibration sequence is complete and "TRACK ØØØ" is TRUE. Then "SEEK COMPLETE" goes TRUE.

12.4 Ready (J1/22)

This line will be TRUE when the drive is ready to read or write (with or without an implied seek) and the other output lines are valid. "READY" will remain TRUE until power off or until "WRITE FAULT" is TRUE. In the latter case "READY" will remain FALSE until power off. It cannot be reset via the interface. When FALSE, the drive inhibits all reading and writing. There are three cases when "READY" is FALSE.

Cont'd...

12.0 CONTROL INTERFACE : DRIVE OUTPUTS : J1 (Cont'd)

12.4.1 During power up of the drive the power up sequence results in "READY" going TRUE, provided:

12.4.1.1 Track zero re-calibration is completed;
12.4.1.2 Motor speed settles to +/-1% of nominal;

12.4.2 Motor speed worse than approximately +10% or -5% of nominal.

12.4.3 "WRITE FAULT" is TRUE.

12.5 Write Fault (J1/12)

This line indicates a fault condition in the drive. When TRUE, "READY" goes FALSE and reading and writing are inhibited in the drive. There are seven fault conditions which cause "WRITE FAULT" to be TRUE.

12.5.1 Head input line open circuit while "WRITE GATE" TRUE.
12.5.2 Head centre tap open circuit while "WRITE GATE" TRUE.
12.5.3 No write data transitions while "WRITE GATE" TRUE.
12.5.4 No write current in head while "WRITE GATE" TRUE
12.5.5 Step pulse received when "WRITE GATE" is TRUE.
12.5.6 12V supply lower than 10.3V (approx).
12.5.7 5V supply lower than 4.5V (approx).
12.5.8 No servo fields detected.

Note: Only the selected head will be monitored for these faults.

If, after 2 seconds have elapsed, the "WRITE FAULT" condition no longer exists, the drive will perform the power-up sequence thus re-calibrating the actuator to track ØØ. The "READY" will become TRUE and "WRITE FAULT" will become FALSE. If, however, the "WRITE FAULT" condition still exists after 2 seconds the drive will display a fault code (section 14). A power-on reset should be performed in an attempt to clear the fault condition.

13.0 DRIVE FUNCTIONS

This section describes certain operations performed by the drive which relate to particular status lines on the control interface.

Cont'd...

13.0 DRIVE FUNCTIONS (Cont'd)

13.1 Power up/down

There is no specified power up/down sequence for the RO 810 series disk drives. The supplies of +12V and +5V may be applied or removed in any order. However, if the 5V is applied first, the 12V should follow within 5 seconds. On power up, the drive will perform an automatic re-calibration sequence which includes a disk speed check, accurate to 1% of nominal, and a seek to track ØØ. The host may use "READY" status to sense the completion of this sequence. The time until "READY" is TRUE for the RO 810 series disk drive is 12s (max).

Failure of the drive to complete the power-up routine correctly causes "READY" to remain FALSE.

The drive controller should be powered from the same 5V and 12V supplies as the drive. Where this is not possible, the drive controller power supplies must be within their specified tolerance before power is applied to the drive. The drive controller power supplies must be removed after power is removed from the drive.

13.2 Motor Speed

During normal operation the drive automatically monitors motor speed and causes "READY" to go FALSE AND "WRITE FAULT" to go TRUE if the speed is worse than +10% or -5%, approximately, of nominal. This check takes a minimum of one disk revolution (16.76ms) and is carried out when the drive is not seeking.

13.3 Restore/Recalibrate

Most hard disk controllers provide a macro command to restore or recalibrate the drive to Track ØØ. If the restore/recalibrate command is carried out as a result of a drive Seek Error, detected by the controller, then this must be done as a series of single cylinder seeks checking for TRACK ØØ status after every SEEK COMPLETE. (RECAL 1, Figure 16). Otherwise, the restore/recalibrate command may be carried out using any step interval in the range 5us to 15ms, with excess STEP pulses being issued if desired. This scheme is shown in Figure 16 under RECAL 2.

Cont'd...

14.0 FAULT CODES

The 'Selected and Ready' LED is used to flash error messages should certain fault conditions arise on the drive. A four bit binary code is used (long flash = logical 1, short flash = logical 0) with the most significant bit occurring first:

e.g. Short, short, long, short = 2 (0010)

Fault Code 1	(0001)	:	No Sync.
Fault Code 2	(0010)	:	No Track Zero.
Fault Code 3	(0011)	:	Motor speed outside +/-1% tolerance after power-up.
Fault Code 4	(0100)	:	Motor speed outside +10%, -5% tolerance in normal operation.
Fault Code 5	(0101)	:	Seek error.
Fault Code 6	(0110)	:	STEP received while WRITE GATE is TRUE.
Fault Code 7	(0111)	:	WRITE FAULT.
Fault Code 8	(1000)	:	Microprocessor self-test fail (RAM)
Fault Code 9	(1001)	:	Microprocessor self-test fail (ROM)
Fault Code 10	(1010)	:	No INDEX.
Fault Code 11	(1011)	:	Motor not up to speed.

15.0 SAFETY STANDARDS

The Rodime 3000 series disk drives shall comply with relevant product safety standards such as UL, CSA and FCC.

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
1	2	RESERVED
3	4	HEAD SELECT 2
5	6	WRITE GATE
7	8	SEEK COMPLETE
9	10	TRACK ØØØ
11	12	WRITE FAULT
13	14	HEAD SELECT 0
15	16	RESERVED
		(TO J2 PIN 7)
17	18	HEAD SELECT 1
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 1 : CONTROL INTERFACE J1

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
2	1	DRIVE SELECTED
4	3	RESERVED
6	5	SPARE
8	7	RESERVED
		(TO J1 PIN 16)
10	9	SPARE
12	11	GND
	13	+MFM WRITE DATA
	14	-MFM WRITE DATA
16	15	GND
	17	+MFM READ DATA
	18	-MFM READ DATA
20	19	GND

TABLE 2 : DATA INTERFACE J2

VOLTAGE	GROUND
PIN 1 : +12 VOLTS DC	PIN 2 : +12 VOLTS RETURN
PIN 4 : +5 VOLTS DC	PIN 3 : +5 VOLTS RETURN

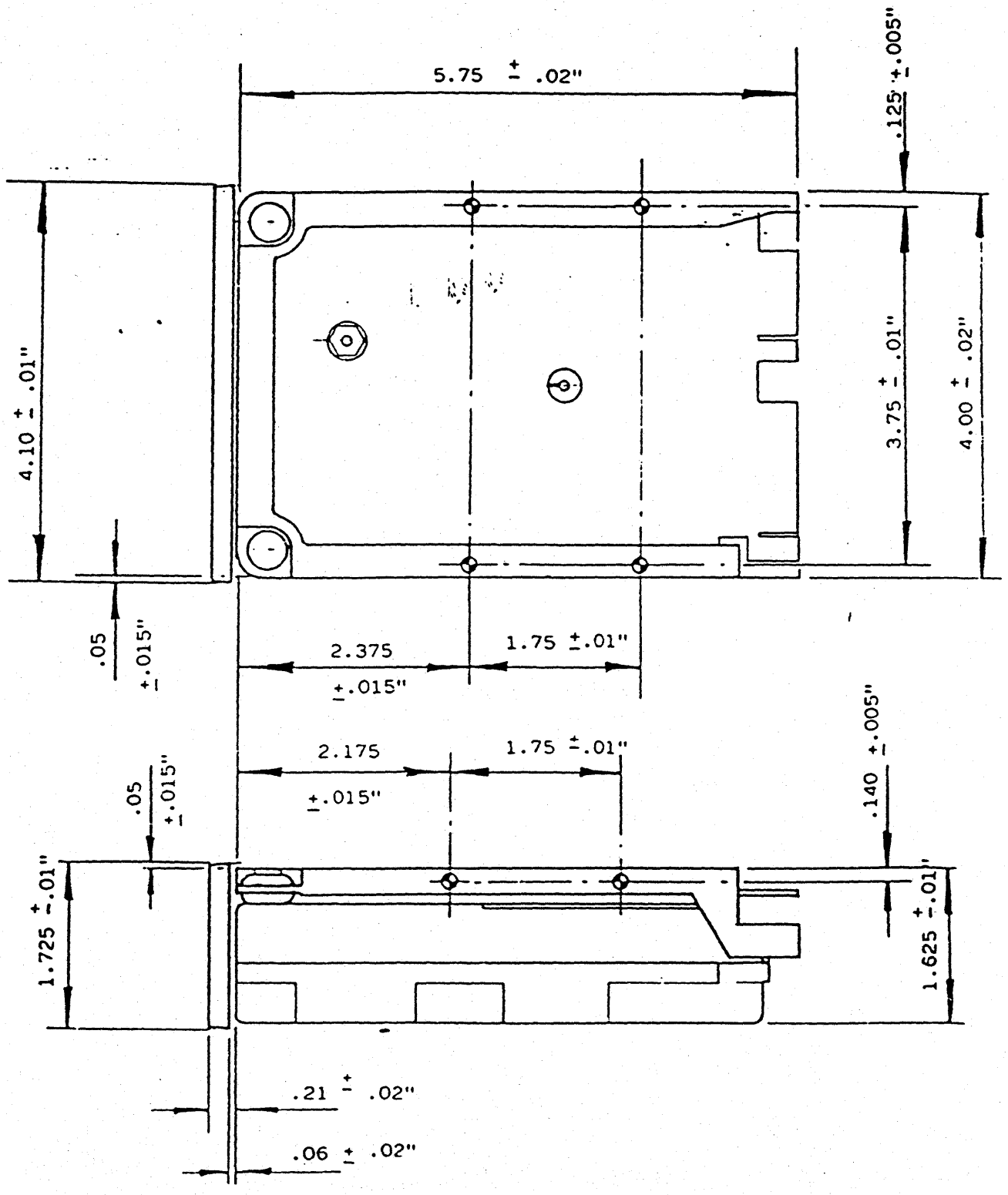
TABLE 3 : POWER INTERFACE J3

HEAD SELECT			HEAD SELECTED			
2	1	0	3065	3055	3045	3025
H	H	H	0	0	0	0
H	H	L	1	1	1	1
H	L	H	2	2	2	2
H	L	L	3	3	3	NHS
L	H	H	4	4	4	NHS
L	H	L	5	5	NHS	NHS
L	L	H	6	NHS	NHS	NHS
L	L	L	NHS	NHS	NHS	NHS

NHS = No head selected.

TABLE 4 : HEAD SELECT MATRIX

A B C D


5.75 ± .02"
.125 ±.005"
4.10 ± .01"
3.75 ± .01"
4.00 ± .02"
.05 ±.015"
2.375 ±.015"
1.75 ±.01"
2.175 ±.015"
1.75 ±.01"
.140 ±.005"
.05 ±.015"
1.725 ±.01"
1.625 ±.01"
.21 ± .02"
.06 ± .02"

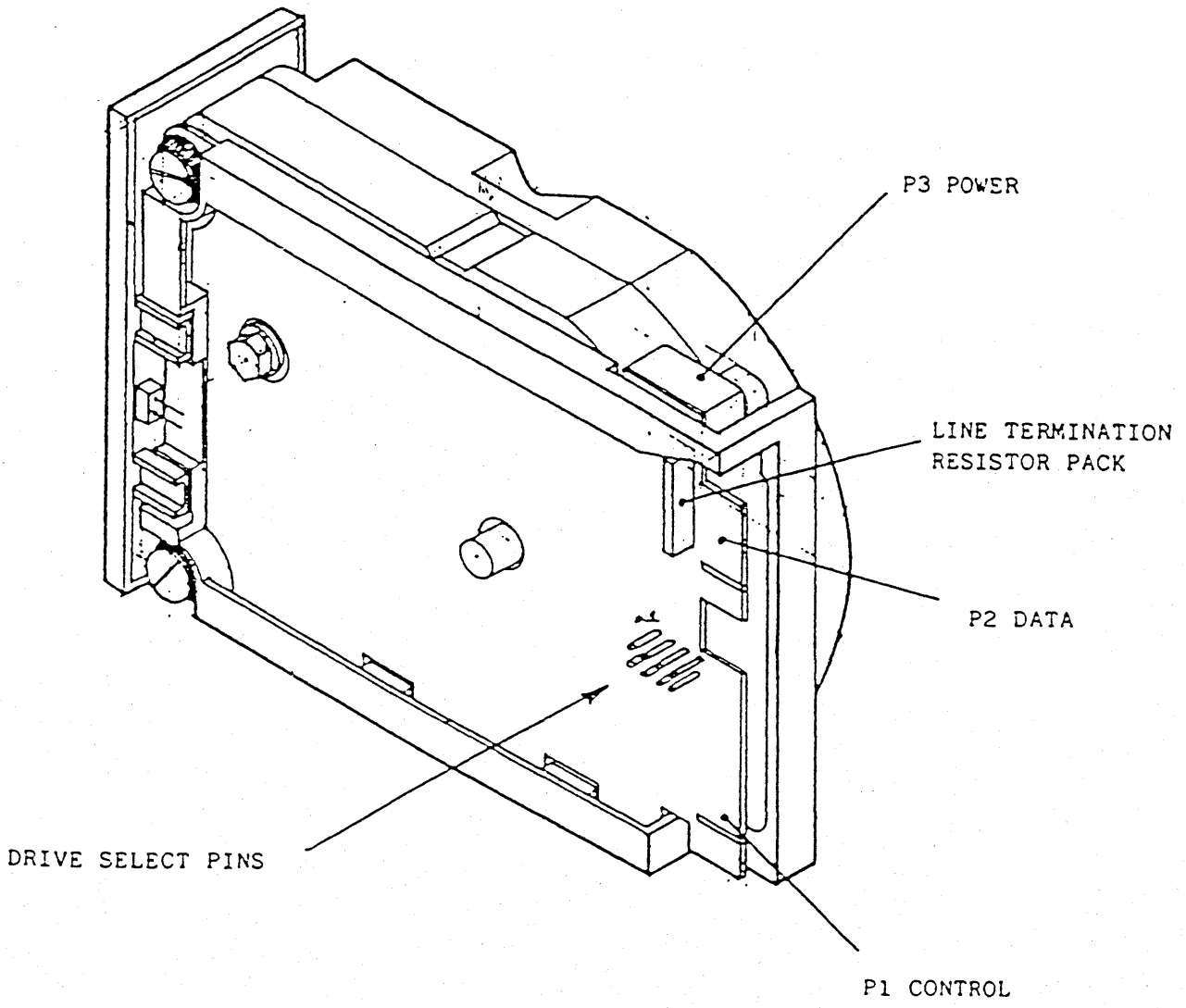


FIGURE 2 : CONNECTOR AND DRIVE SELECT PIN POSITIONS

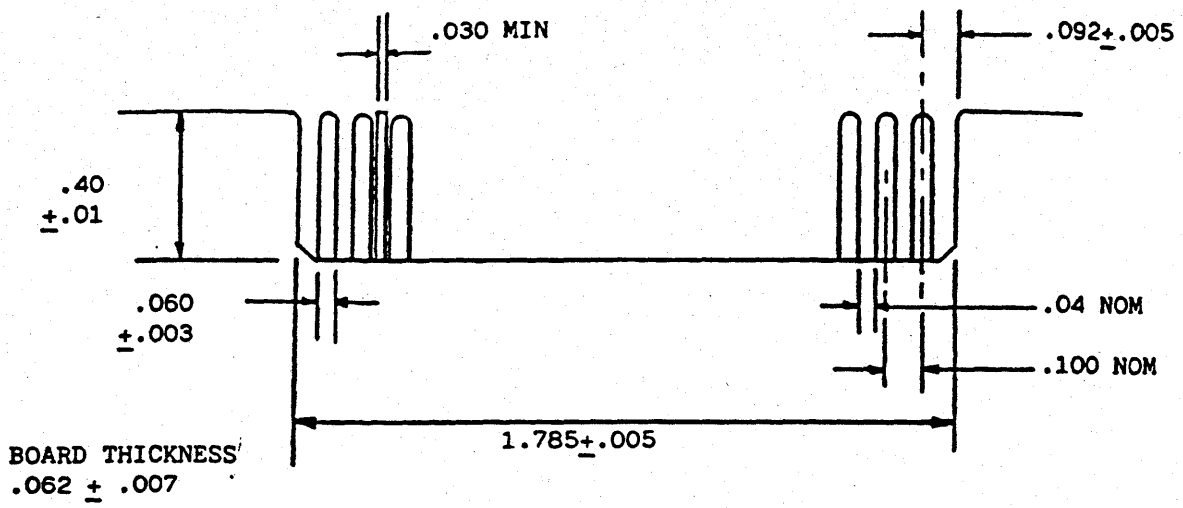


FIGURE 3 : J1 CONNECTOR

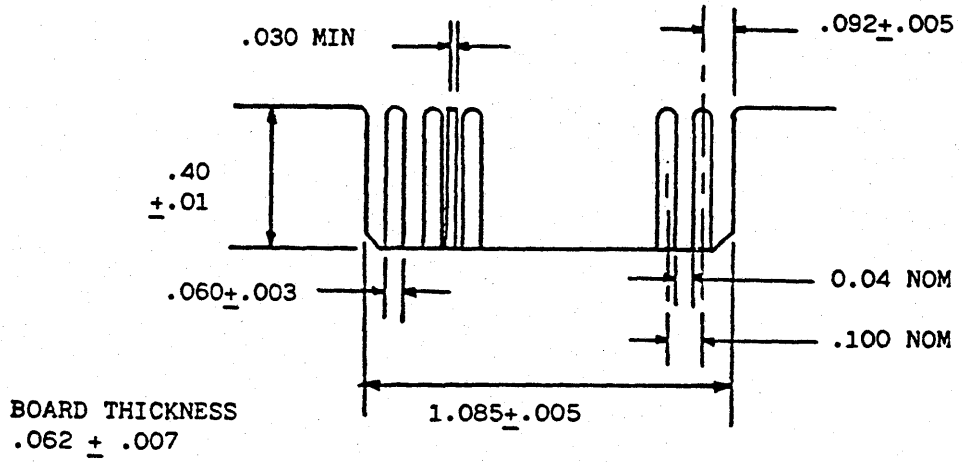


FIGURE 4 : J2 CONNECTOR

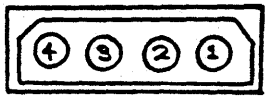


FIGURE 5 : J3 CONNECTOR

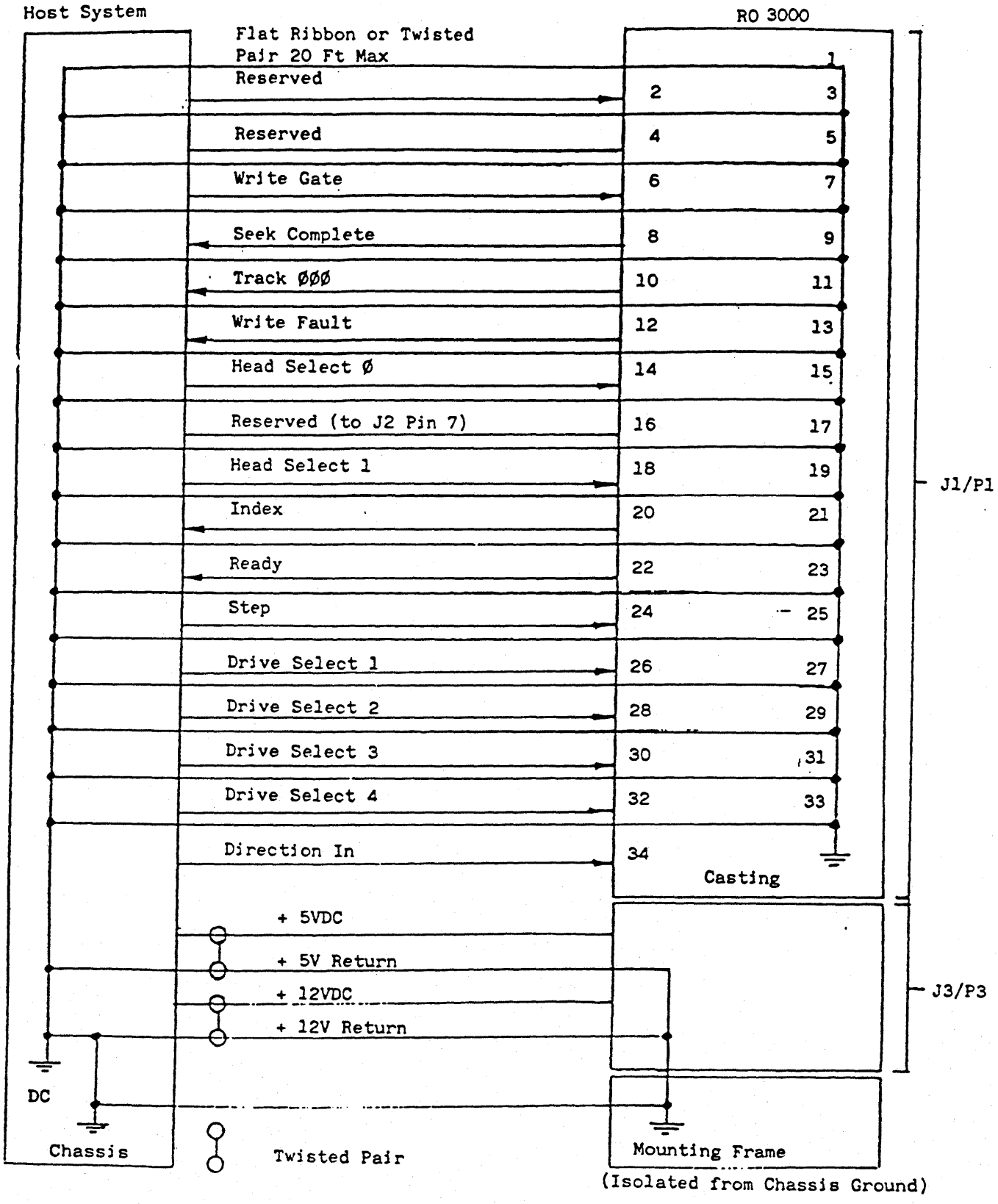


FIGURE 6 : CONTROL AND POWER BUS J1/P1

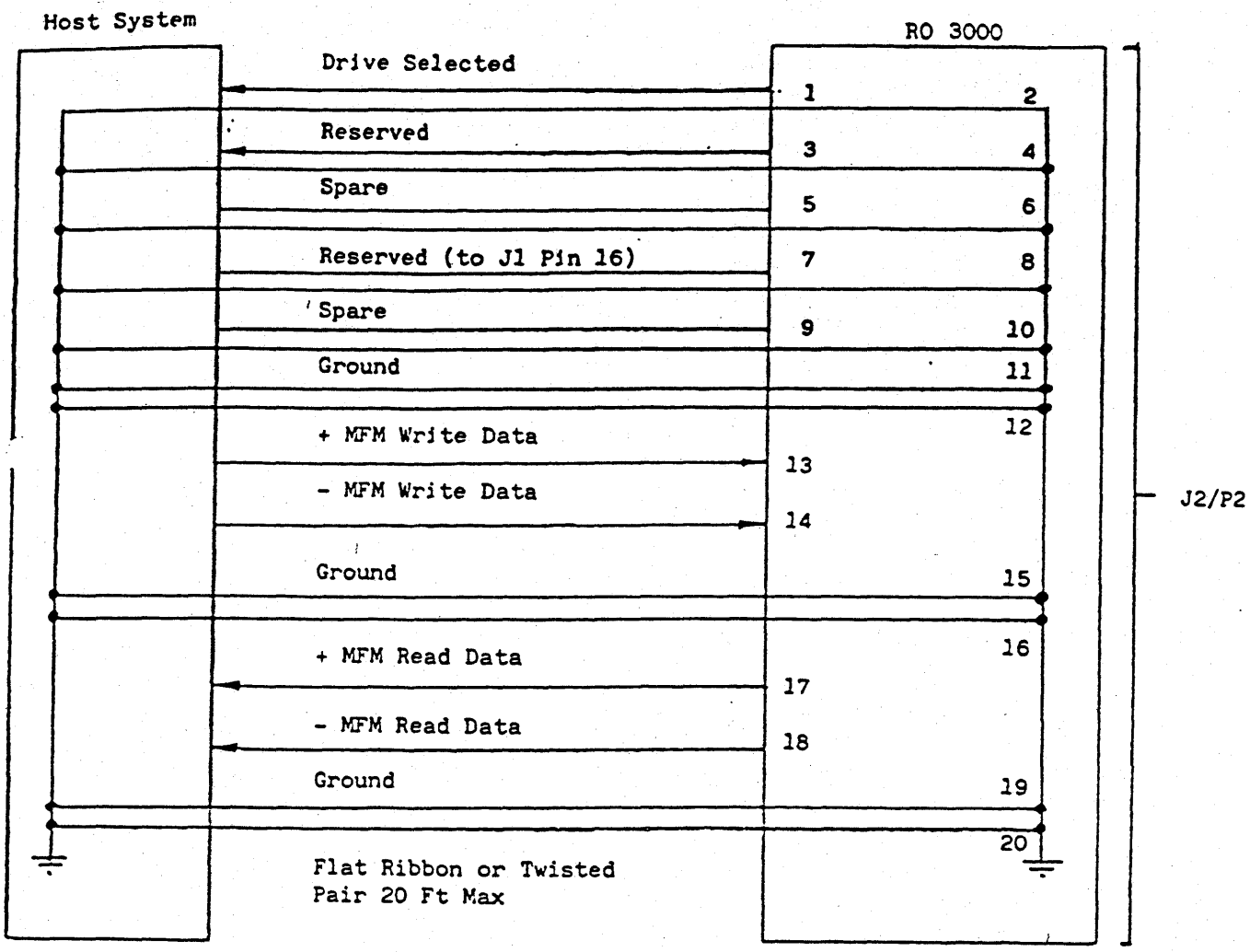


FIGURE 7 : DATA BUS J2/P2

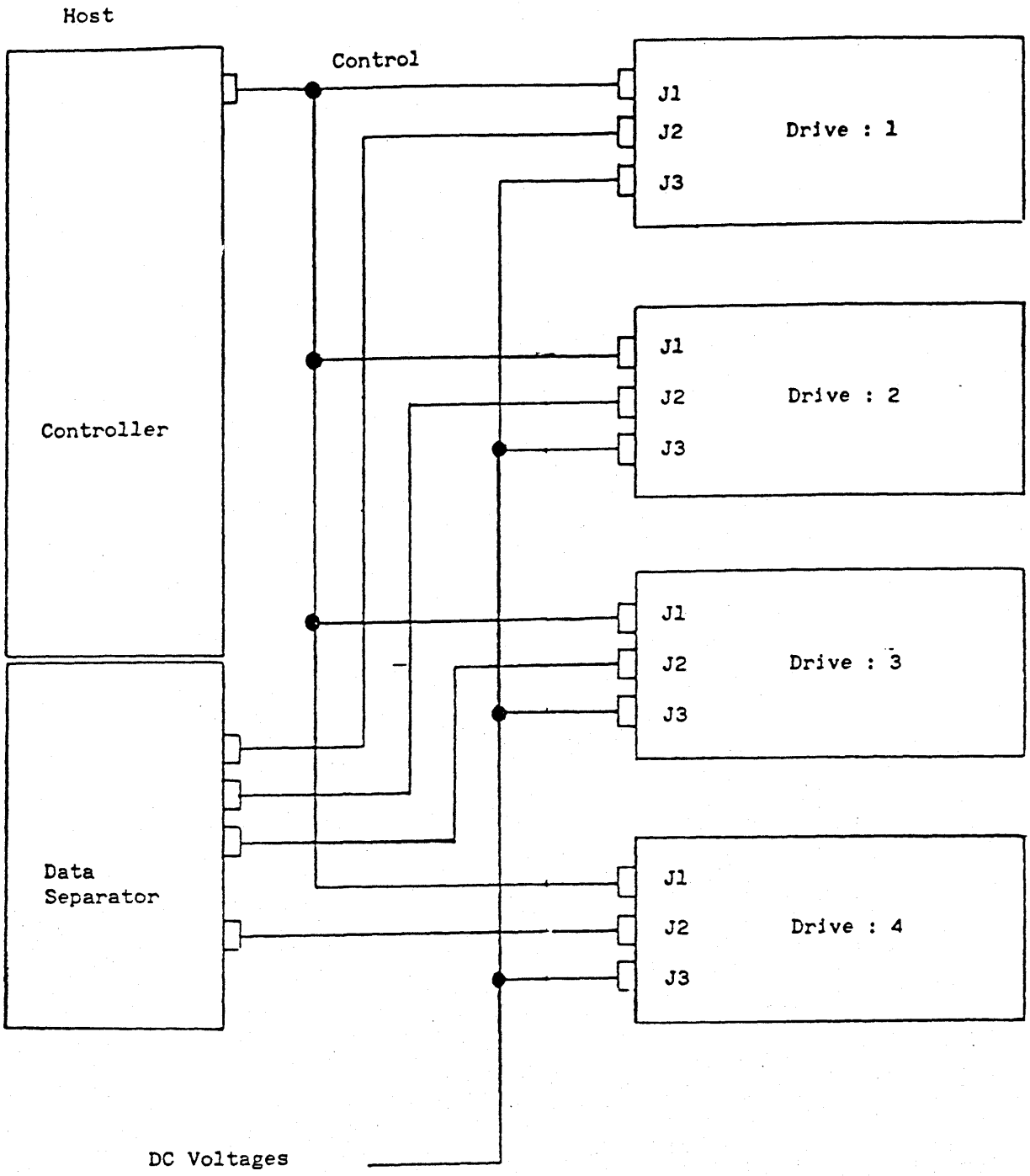


FIGURE 8 : SYSTEM WITH 4 DRIVES

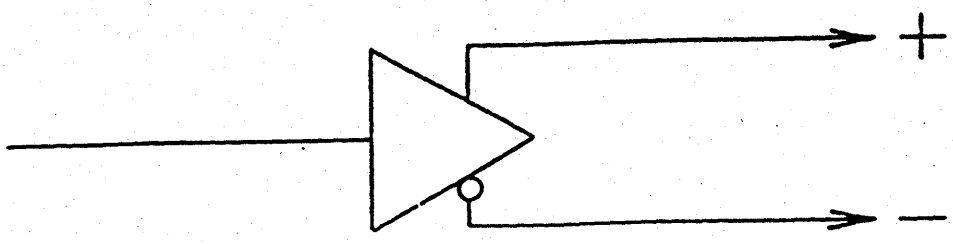


FIGURE 9 : RS 422 DIFFERENTIAL LINE DRIVER

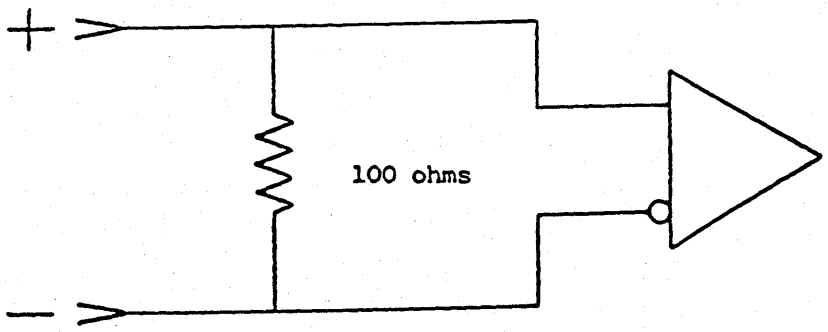


FIGURE 10 : RS 422 DIFFERENTIAL LINE RECEIVER

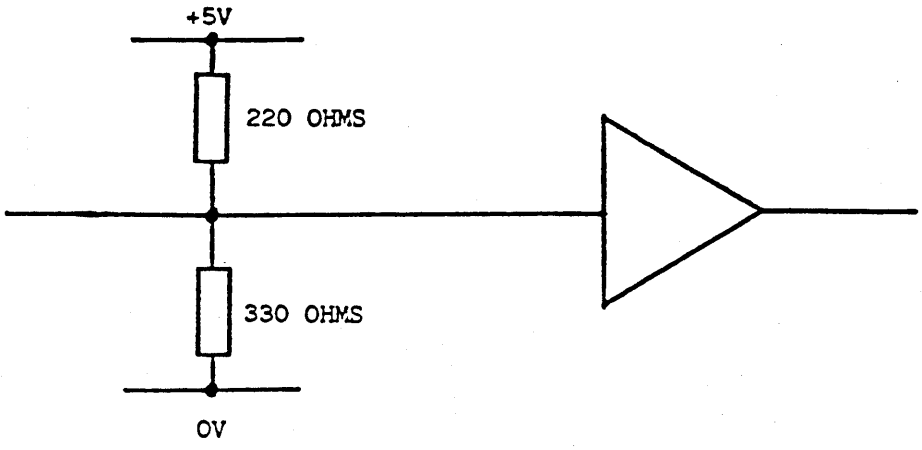


FIGURE 11 : CONTROL LINE TERMINATION

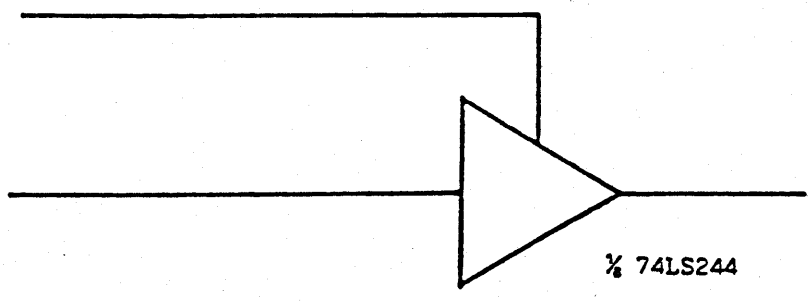
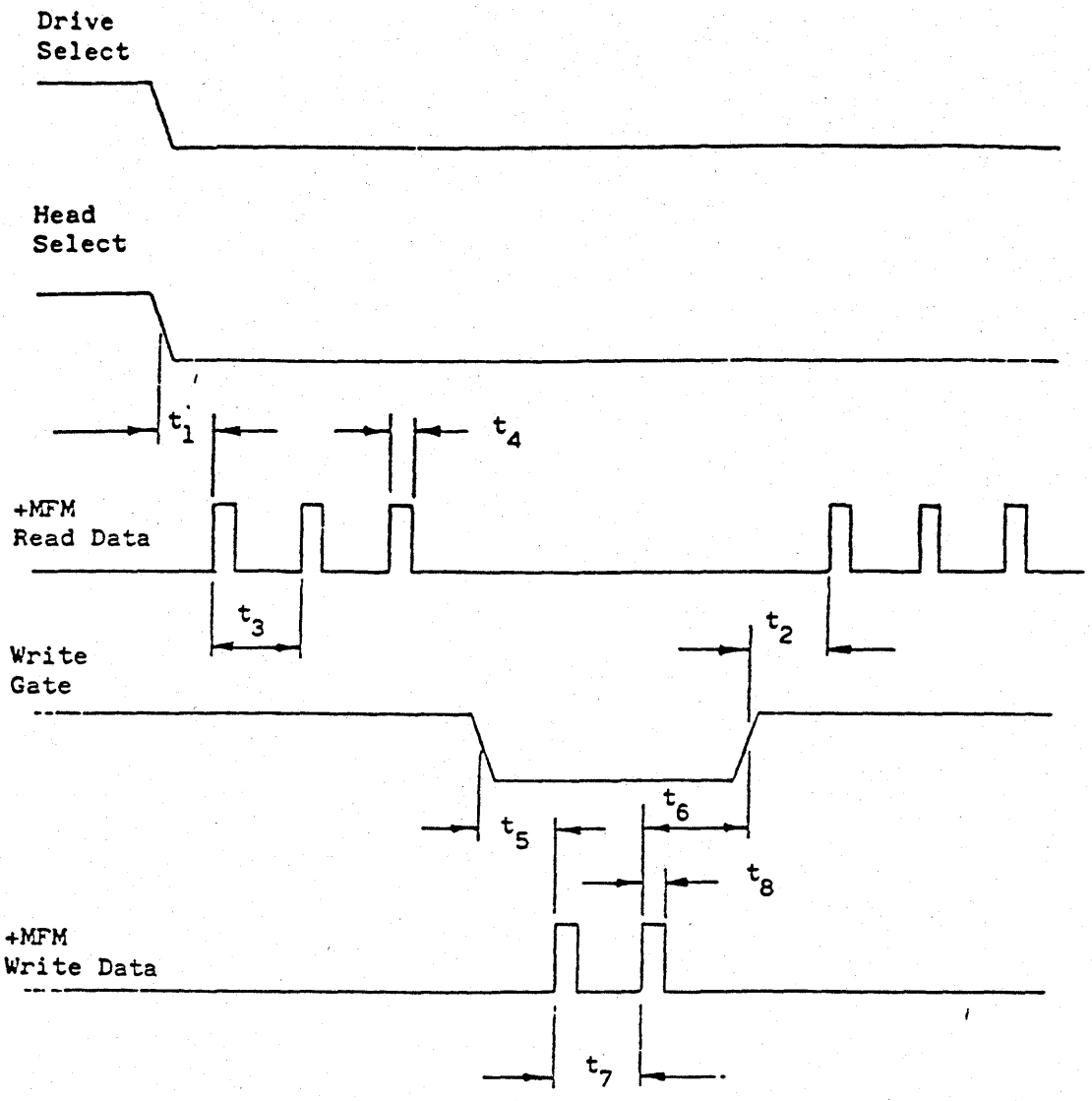
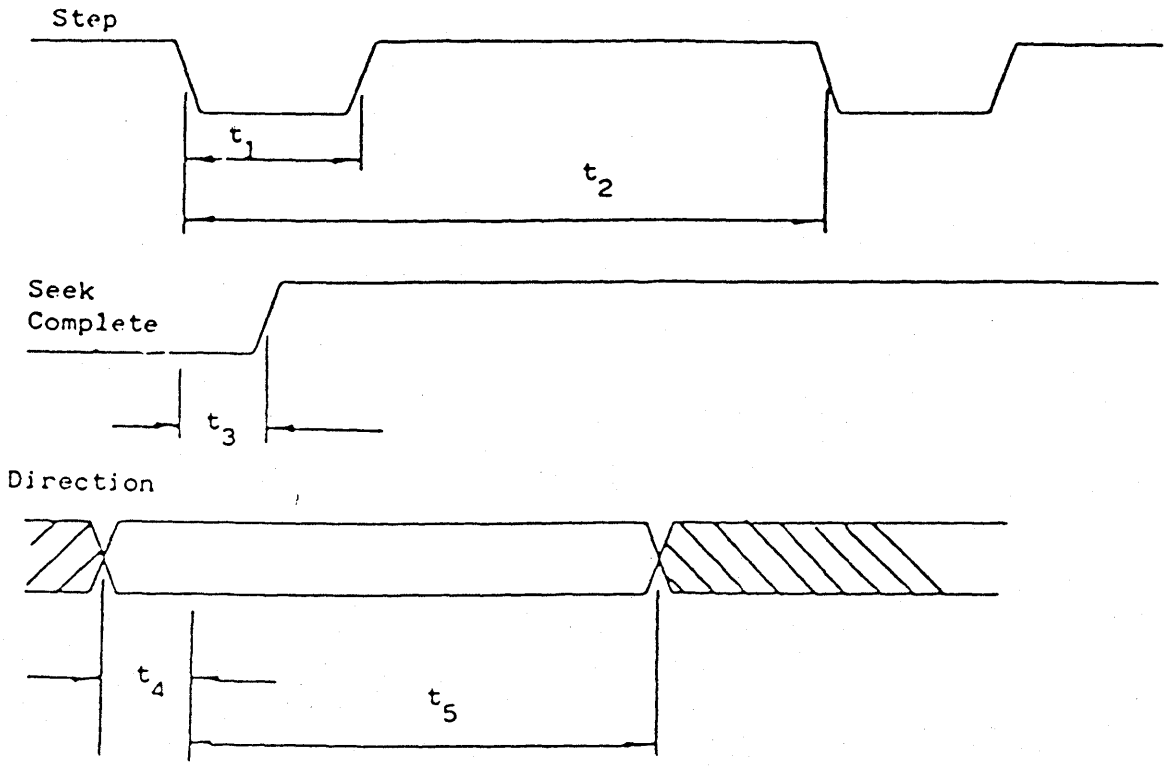


FIGURE 12 : TRI-STATE OUTPUT DRIVER



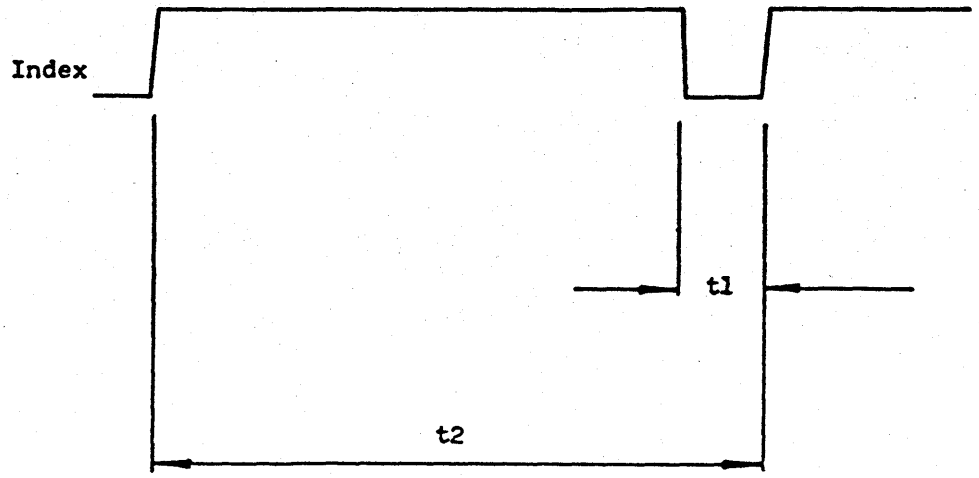
Label	Description	Min	Typ	Max	Units
t_1	Select to Read Data	-	-	5	us
t_2	Write to Read Recovery	-	-	5	us
t_3	Read bit cell	-	200	-	ns
t_4	Read Data pulse width	25	-	85	ns
t_5	Write Gate true to Write Data	-	-	400	ns
t_6	Write Data to Write Gate False	-	-	400	ns
t_7	Write bit cell	-	200	-	ns
t_8	Write Data pulse width	25	-	-	ns

FIGURE 13 : READ/WRITE DATA TIMING



Label	Description	Min	Typ	Max	Units
t_1	Width of Step pulse	2.0	5	-	us
t_2	Time between Step pulses	5	-	15000	us
t_3	Time from first Step to Seek Complete False	40	100	-	ns
t_4	Direction set to first Step	0	-	-	ns
t_5	First Step to direction change (for overlap seek)	150	-	-	us

FIGURE 14 : STEP PULSE TIMING



Label	Description	Min	Typ	Max	Units
t_1	Index pulse width	-	175	-	us
t_2	Index period	16.59	16.76	16.93	ms

FIGURE 15 : INDEX TIMING

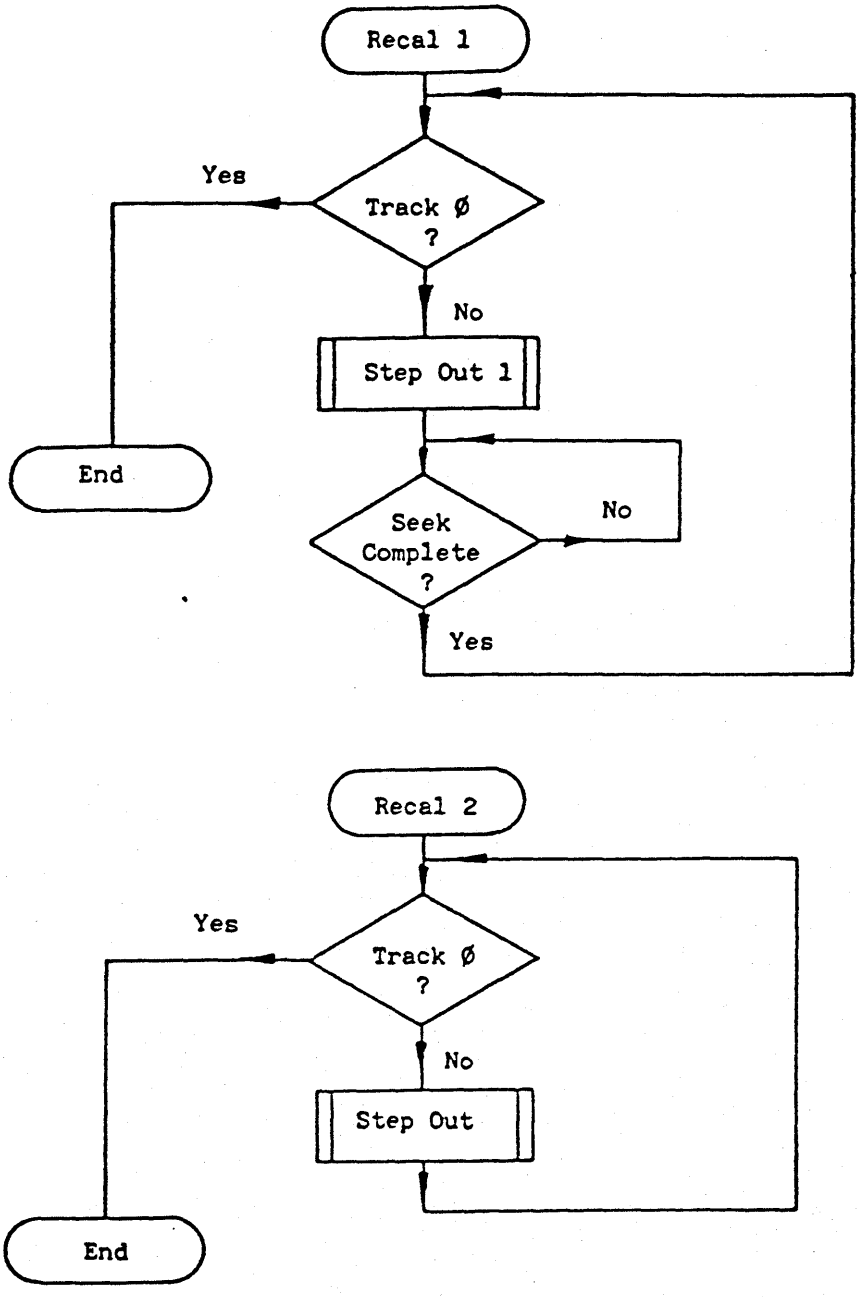


FIGURE 16 : RECALIBRATION SCHEMES