RODIME PLC

RO 200E SERIES DISK DRIVE

PRODUCT SPECIFICATION
PRO – 0033

Rev. 03

RO 200E SERIES DISK DRIVE

PRODUCT SPECIFICATION

PRO - 0033

Rev. 03

Rodime PLC,
Nasymth Road,
Southfield Industrial Estate,
Glenrothes, Fife,
KY6 2SD, SCOTLAND.

TABLE OF CONTENTS

FIGURES

TABLES

RO 200E DISK DRIVE PRODUCT SPECIFICATION

1.0 SCOPE

This document describes the physical and functional characteristics of the RODIME RO 200E series drives. It also specifies installation and environmental requirements.

2.0 RELATED DOCUMENTS

All detailed information referring to the use of the RO 200E disk drive on a host system is given in the Interface Specification INT-0034 and User Manual, USM-0038.

3.0 PRODUCT DESCRIPTION

3.1 General

The RO 200E series disk drives are random access storage devices which use 130mm (5¼") oriented oxide coated disks to provide about 53 Megabytes of unformatted on line capacity. Model types are designated as RO 201E, RO 202E, RO 203E and RO 204E denoting 1, 2, 3 and 4 disks with corresponding unformatted capacities of 13.33, 26.66, 40.00 and 53.33 Megabytes. Models RO 203E and RO 204E were originally introduced as RO 206 and RO 208 respectively.

A microprocessor with 2K of program memory is used for several drive operations and for all stepper motor control functions. These include ramp up/ramp down for multi track seeks, and microstepped electronic damping.

3.2 Mechanical Assemblies

The drive uses the sealed enclosure principle of Winchester head/disk technology and provides a minimum contamination enclosure to maintain head/media integrity. The Rodime drive housing has a unique design which optimises air flow, reduces contamination and minimises temperature gradients.
The drive housing consists of two sealed chambers connected by a recirculating filter.

The upper chamber contains the disks, drive motor hub and head/arm assemblies.

The lower chamber contains the positioner drive linkage, re-circulating filter and 'track-zero' transducer assembly.

The recirculating filter reduces the ingress into the upper chamber of any contaminants that may be caused by the drive mechanism in the lower chamber. A breather filter is fitted to the upper chamber cover on the disk centreline and reduces the ingress of contaminants through the bearings of the disk motor by minimising the pressure drop across them.

3.0 PRODUCT DESCRIPTION (Cont'd)

3.3 Disk Hub and Drive Motor

Up to four disks are directly fitted to a hub which is an integral part of the drive motor. The hub is designed to optimise air flow between the disks and thus provide stability to the flying heads. A ferrofluidic seal is fitted to the drive motor and this combines low friction with high integrity.

Commutation for the two phase brushless DC motor is derived from the output of a Hall generator chip which also supplies an index pulse and feedback for the speed control circuit. A spare Hall generator is supplied inside the motor and may be brought into use, if the first Hall element fails, by means of a simple link on the motor speed board.

On power off, the motor is braked dynamically using a failsafe brake. The brake also acts as a motor lock during transit.

3.4 Actuator

The rotary actuator is driven by a stepper motor controlled by a microprocessor. The actuator automatically compensates for head/track mis-registration due to thermal effects. The linkage between stepper motor and actuator is a stainless steel band mechanism located in the lower sealed chamber.

As an option, the RO 200E is fitted with a failsafe brake for the stepper motor rather than a label over the stepper pulley. On power off, this failsafe brake automatically locks the stepper motor and hence the actuator.

A velocity sensor is fitted to the stepper motor shaft, and velocity feedback is used as a means of damping.

3.5 Heads and Disks

There is one read/write Winchester head per disk surface. The drive can contain up to four disks. In this maximum configuration the eight heads are mounted on five die-cast arms.

The electrical interface between a head and the pre-amplifier is via a flat cable flexible circuit. The pre-amplifier board is mounted on the base plate outer wall.

The disks, 130mm in diameter, are coated with lubricated oriented oxide.

3.0 PRODUCT DESCRIPTION (Cont'd)

3.6 Electronic Assemblies

The drive contains three printed circuit boards:

(a) Pre-amplifier board;

(b) Motor speed control board;

(c) Master electronics board.

The pre-amplifier provides a read data amplifier, a write data amplifier, head selection/isolation circuitry and a write fault monitor circuit.

The motor speed control board provides the spindle motor speed control circuit, the spindle brake/actuator lock drive circuits and the stepper motor drive circuit.

The master electronics board provides:

(a) Read data channel and interface;

(b) Write data interface;

(c) Stepper motor control circuits;

(d) Drive control interface circuits;

(e) Fault monitor circuits;

(e) Microprocessor which provides:

(i) full automatic power up sequence

(ii) motor speed control check to +/-1% during power up;

(iii) regular motor speed control checks to +10%, -5% after power-up;

(iv) selection of unique index pulse;

(v) control of output lines and latching of fault conditions;

(vi) stepper motor control including step function, velocity ramp, hysteresis elimination and damping.

(vii) fault codes on front panel LED

3.0 PRODUCT DESCRIPTION (Cont'd)

3.7 Index

The RO 200E disk drive is not fitted with a separate transducer for generating an index pulse. Instead, the Hall generator in the DC motor is used. However, this provides two identical edges per disk revolution. A unique edge is selected during the power up sequence by moving the actuator, under automatic micro processor control, to cylinder -2 (minus 2) where head zero detects a pre-recorded data burst. The index phase which is active when the data burst is detected is automatically selected. Fault code 1 will be displayed if the data burst is not found. Cutting link A on the Master Electronics Board will cause the loss of the data burst to be ignored during the power-up sequence.

3.8 Indicators and Faults Codes.

Two identical red LED indicators are provided on the master electronics board. When active they are visible through the facia. One LED indicates that 5V is supplied to the drive. This LED is also used to flash error codes should certain fault conditions arise in the drive. The second LED indicates that the drive is selected.

For the fault codes, 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 index track data burst

Fault Code 2 (0010) : No Flag ØØ

Fault Code 3 (0011) : Motor speed outside + 1% tolerance in normal operation.

Fault Code 4 (0100) : Motor speed outside +10%,-5% tolerance in normal operation

Fault Code 5 (0101) : FLAG ØØ stays TRUE

Fault Code 6 (0110) : STEP received while WRITE GATE is TRUE

Fault Code 7 (0111) : WRITE FAULT

Fault Code 8 (1000) : Not used

Fault Code 9 (1001) : Not used

Fault Code 10 (1010) : No INDEX

3.0 PRODUCTION DESCRIPTION (Cont'd)

3.8 Indicators and Faults Codes. (Cont'd)

Fault Code 11 (1011) : Motor not up to speed

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. Note that these holes are in an identical position to most mini-floppy drives.

4.0 FUNCTIONAL DESCRIPTION

4.1 Recording Parameters

Data is recorded on both sides of the disks:

4.1.1	Bit density	:	10,200 bits per inch (inner track nominal)
4.1.2	Coding	:	M.F.M.
4.1.3	Track density	:	600 tracks per inch (average)

4.2 Storage Capacity (Unformatted)

4.2.1	Disks per drive:		1, 2, 3, 4
4.2.2	Cylinders	:	640
4.2.3	Tracks per Cylinder	:	2, 4, 6, 8
4.2.4	Data bytes per track	:	10,417
4.2.5	Tracks per drive	:	1280, 2560, 3840, 5120
4.2.6	Capacity (Megabytes)	:	13.33, 26.66, 40.00, 53.33

4.0 FUNCTIONAL DESCRIPTION (Cont'd)

4.3 Storage Capacity (Formatted)

Since the RO 200E disk drive is 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.

4.3.1	Data bytes per sector	:	256
4.3.2	Data sectors per track	:	32
4.3.3	Data bytes per track	:	8192
4.3.4	Capacity (Megabytes)	:	10.49, 20.97, 31.45, 41.94

4.4 Rotational Parameters

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

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 master 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.

The RO 200E disk drive can accept STEP pulses over a range of rates from 5 us to 5 ms.

If the step interval is in the range 5 us to 130 us, then the drive is operated in the ramped seek mode. The seek operation will begin if 32 step pulses have been received or 180 us has elapsed since the last step pulse was received. In this mode of operation the drive step rate is determined by firmware although the access times will vary with step interval. The following access times are specified for a step interval of 10 us.

4.5.1	Single cylinder	:	8 ms (average)
4.5.2	639 cylinders	:	130 ms (maximum)
4.5.3	Average cylinder access	:	60 ms

4.0 FUNCTIONAL DESCRIPTION (Cont'd)

4.5 Cylinder Access Time (Cont'd)

If the step interval is in the range 130 us to 5 ms, then the drive step rate will vary with step interval. Consequently, the access times are not specified.

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	:	8.3 ms
4.6.2	Average data access time in ramp mode	:	68.3 ms
4.6.3	Head switching time	:	5 us (maximum)

4.7 Illegal Addresses

Each drive will be accompanied by a map indicating the addresses of sectors which should not be used by the host. These will be identified by cylinder, head and sector. No illegal addresses will exist in cylinders Ø, 1 and 2. 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 201E	:	4
RO 202E	:	8
RO 203E	:	12
RO 204E	:	16

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 12,000 start/stop operations during service life.

5.2 Mean Time Between Failure

The mean time between failure (MTBF) of any of the Rodime 200E series drives shall exceed 12,000 hours where the first 50 hours of actual usage are excluded.

5.0 RELIABILITY AND SERVICE GOALS (Cont'd)

5.3 Service Goals

No preventive maintenance is required and there are no adjustments on the drive. The repairs that may be effected on site are replacement of electronics boards, connection of the spare Hall element on the motor speed board and removal of link B. The mean time to repair (MTTR) including initial verification is 0.5 hours.

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. This includes the effects of pre-compensation applied to certain data bits during writing. A recommended compensation scheme is detailed in Interface Specification INT-0034. 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 in 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 is moved to the incorrect cylinder. This occurrence shall not exceed 1 seek error in 5×10^{6} seeks.

6.0 INSTALLATION

6.1 Power Requirements

The unit requires D.C. power. All voltages are measured at the D.C. power connector in the drive.

Voltage (V.D.C.)	Current Maximum (Amperes)	Current Typical (Amperes)
+5 (+/-5%)	0.75	0.65
+12 (+/-5%)	2.4	2.0
(+/-10% at power-on)		

At power-on, the drive circuitry draws 4A (max) at +12V See Figure 3.

6.0 INSTALLATION (Cont'd)

6.1 Power Requirements (Cont'd)

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

6.1.2 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 3 ohms in series with 1mH and the operating current may be measured using 5 ohms in series with 1mH. With a 7 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 500 Hz to 5 MHz.

6.1.3 In operation, the maximum rate of change of 12V load due to the disk drive is 8A/ms.

6.1.4 Average power dissipation : 27 watts

6.2 Installation Procedure

The failsafe brake effectively locks the drive motor during shipment and releases on application of 12V. The shipping lock for the stepper motor is a label on the top cover which covers a plastic pulley on the motor shaft. This label must be removed. Once removed, the stepper motor shaft should never be rotated by hand since this could lead to head/disk damage. (Note: the label is not present on units which are fitted with the automatic stepper motor lock. This lock also 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.

6.0 INSTALLATION (Cont'd)

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.

6.3 Drive Select

When multiple drives are used on a single controller the decimal number of each drive is selected on a switch bank located on the master electronics board. Up to 4 such drives may be so selected. Each drive is provided with a removable resistor terminator pack for the control interface lines and this pack must be removed from all except the last drive in the chain. See Figure 2.

7.0 OPERATING ENVIRONMENT (In system or free standing)

7.1 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

7.2 Shock and Vibration

The drive shall meet its specified performance while subjected to the following shock and vibration conditions injected through the mounting brackets in any of three mutually perpendicular axes.

Vibrations are sinusoidal and shocks half-cycle sinusoidal waveforms.

7.2.1 Vibration

0.006 inches peak to peak displacement, 5Hz to 60Hz; 1.0 g acceleration, 60Hz to 500 Hz except for vibrations along an axis perpendicular to the front facia of the drive in which axis the acceleration is 0.5g from 60Hz to 100Hz and 1.0g from 100Hz to 500Hz.

7.2.2 Shock

3 g peak acceleration of duration less than 10ms, maximum frequency 2 per second.

7.0 OPERATING ENVIRONMENT (Cont'd)

7.3 Radio Frequency Interference

Electric field shall not exceed 1 volt/meter r.m.s. in the range 1.5Hz to 10GHz.

7.4 Magnetic Field

There shall be no source of constant magnetic field which yields more than 0.0003 Tesla measured in the location occupied by the magnetic heads when the drive is installed.

7.5 Altitude

Altitude relative to sea level : +6000 feet, -1000 feet.

7.6 Emitted Acoustic Noise

Peak emitted noise : 54dbA (continuous, maximum) at 1 Metre

8.0 NON-OPERATING ENVIRONMENT (In system or free standing or handled or shipped in system or shipped in container)

8.1 Temperature and Humidity

Temperature range : -40°C to + 70°C

Relative humidity range (no condensation) : 5% RH to 90% RH

8.2 Shock and Vibration

8.2.1 Shipping

The approved Rodime shipping container will protect the drive against damage when the container is subjected to the following shipping shock and vibration:

(a) Vibration : 0.2 inches peak to peak displacement, 5 Hz to 20 Hz;

3.5 g peak acceleration, 20 Hz to 50 Hz.

(b) Shock : Dropped to ground on any side or corner from 36 inches.

8.0 NON-OPERATING ENVIRONMENT (Cont'd)

8.2 Shock and Vibration (Cont'd)

8.2.2 Unpacked (Cont'd)

(a) Vibration : 0.040 inches peak to peak displacement, 5 Hz to 30 Hz;

2 g peak acceleration, 30 Hz to 500 Hz.

(b) Shock (with stepper unlocked): 3 g peak acceleration of duration less than 10ms maximum frequency 2 per second.

(c) Shock (with stepper locked): 30 g peak acceleration of duration less than 10 ms , maximum frequency 1 per 10 seconds.

9.0 INTERFACE CONNECTORS

The detailed electrical interface between the RO 200E disk drive and a host system is defined in Interface Specification INT-0034. The connectors are also described below.

9.1 Control

Control signals for the drive are provided via a 34 pin edge connector (P1/J1). The pins are numbered 1 through 34 with even pins located on the solder side of the board. Pin 2 is located on the end of the board connector closest to the D.C. 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. See Table I for connector pin assignment.

9.2 Data

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 in the solder side of the board. The recommended mating connector is AMP ribbon connector A/N 88373-6. See Table II for connector pin assignments.

9.0 INTERFACE CONNECTORS (Cont'd)

9.3 Power

D.C. power is provided via a 4 pin AMP Mate-N-Lok connector (P3/J3) P/N 350211-1 mounted via the component side of the board. The recommended mating connector is AMP P/N 1-480424-0 utilising AMP pins P/N 350078-4. See Table III for connector pin assignments.

9.4 Ground

Chassis ground connection is provided via a "Faston" connector AMP P/N 61664-1 located on a metal stand-off on the chassis between the power and control signal connectors.

10.0 SAFETY STANDARDS

The Rodime 200E series disk drive shall comply with relevant product safety standards such as UL, VDE, CSA and FCC.

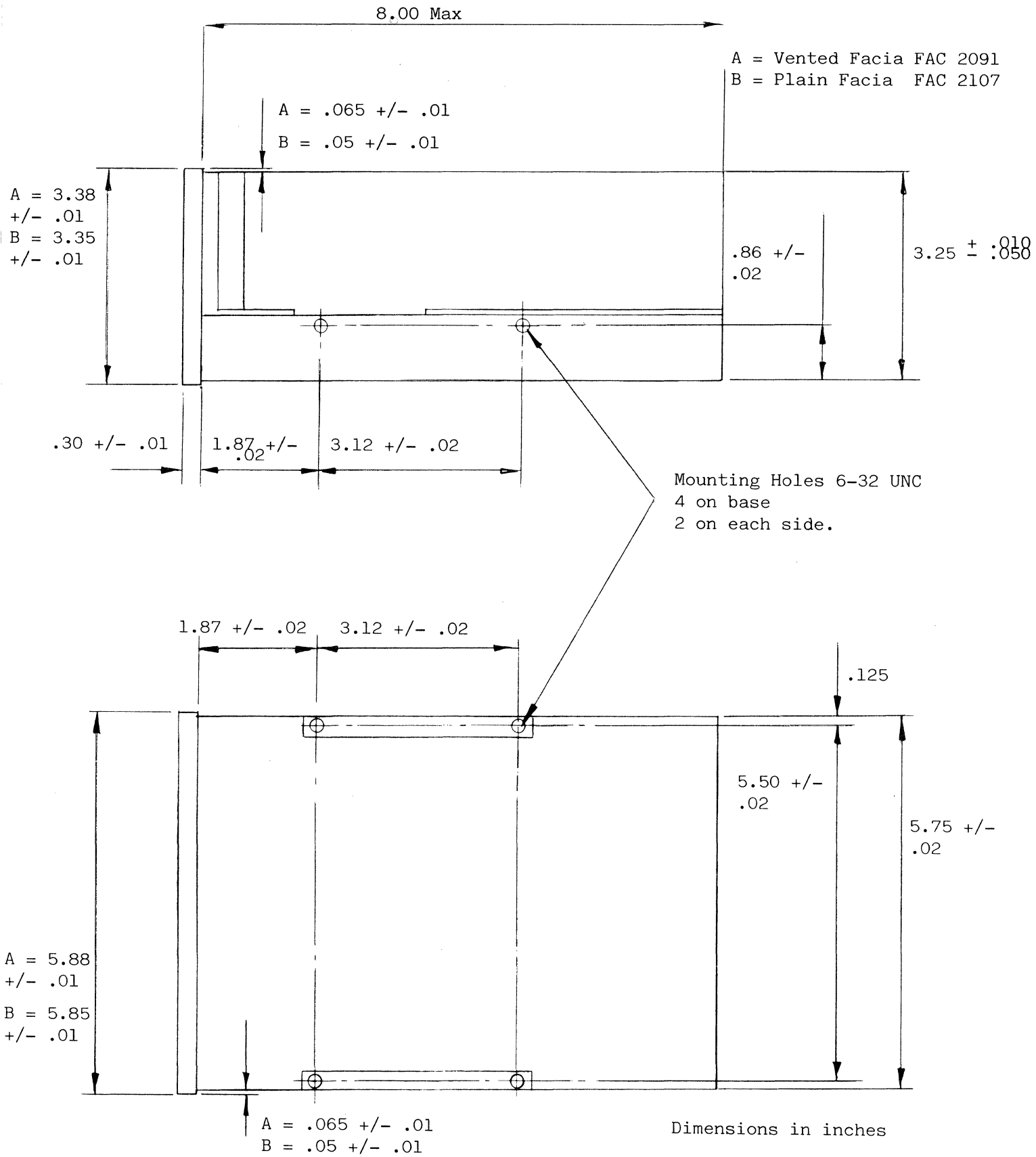

FIGURE 1 : MOUNTING DETAILS

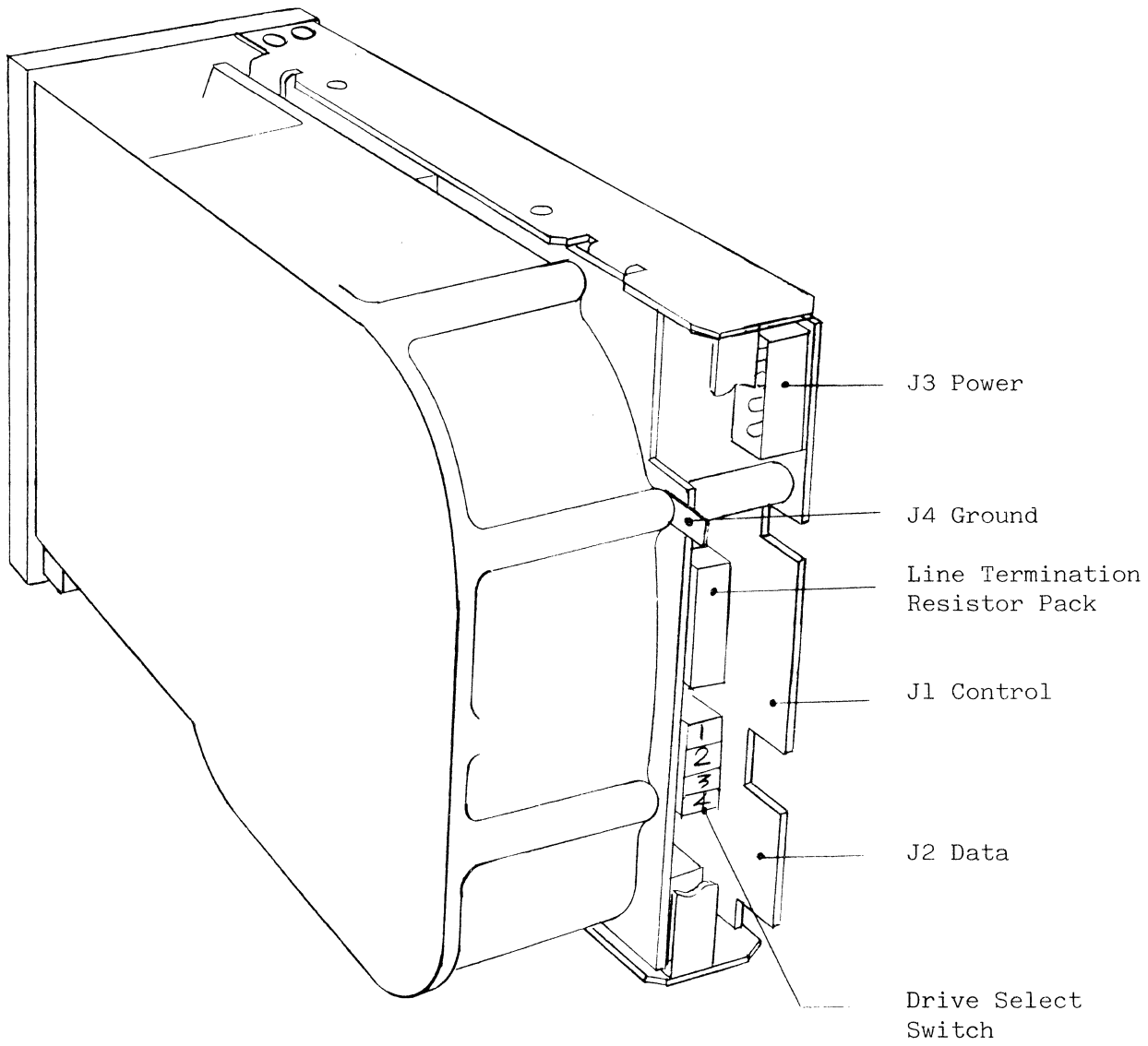

FIGURE 2 : CONNECTOR POSITIONS

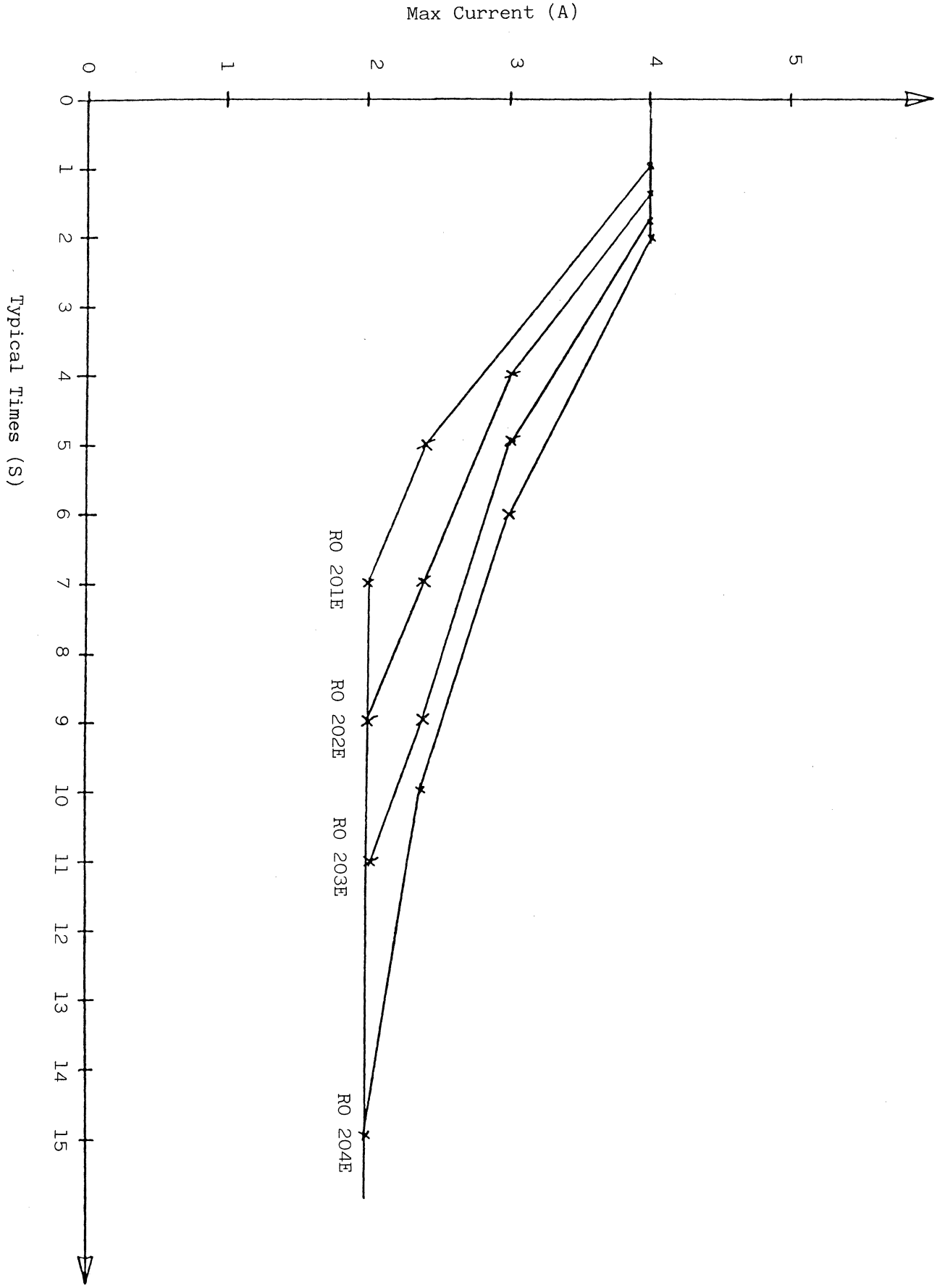

FIGURE 3 : STARTING CURRENT

TABLE I CONTROL SIGNAL PIN ASSIGNMENTS

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
1	2	RESERVED
2	4	HEAD SELECT 2
5	6	WRITE GATE
7	8	SEEK COMPLETE
9	10	TRACK ØØØ
11	12	WRITE FAULT
13	14	HEAD SELECT Ø
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 II DATA SIGNAL ASSIGNMENT

GND RTN PIN	SIGNAL PIN	SIGNAL NAME
2	1	DRIVE SELECTED
4	3	RESERVED
6	5	RESET (OPTIONAL)
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 III DC CONNECTOR PIN ASSIGNMENTS

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