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Imprimis Product Specification
97229 2HP Sabre Disk Drive

IPI-2 Interface
1.1 GB

Document Number 64402402
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MAGNETIC PERIPHERALS INC.
a Control Data Company

ENGINEERING SPECIFICATION

TWIN CITIES DISK DIVISION

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REV J
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PRODUCT SPECIFICATION

FOR

97229 SABRE-2HP

1.153 GB, IPI-2 INTERFACE

Approved 10-19-88

Released JGL

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1.0 SCOPE

This document describes the MAGNETIC PERIPHERALS INC. 97229-11 (1.15GB) SABRE-2HP Eight Inch Module Drive with the IPI-2 I/O and its available configurations.

2.0 APPLICABLE DOCUMENTS

SPEC 64731600 - IPI-2 Interface
PUBL 83325660 - Reference Card
PUBL 83325700 - Parts Data Manual
PUBL 83325720 - Maintenance Manual
PUBL 83325730 - Diagrams Manual
PUBL 83326020 - Theory Manual
PUBL 83326010 - User's Manual
UL 478 - Electronic Data Processing Units and Systems
CSA 22.2 154 - Data Processing Equipment
CSA 22.2 220 - Information Processing and Business Equipment
VDE 0806 - Regulations for Electric Motor Operated Appliances
VDE 0871 - Radio Frequency Interference
CSA 22.2 220 - Information Process & Business Equipment

3.0 GENERAL DESCRIPTION

3.1 Equipment Definition

The SABRE-2HP is a two head parallel SABRE-5 disk drive with a 6.0 MB/s transfer rate. The spindle is run at 3600 rpm and can be synchronized to an external clock. Its maximum unformatted capacity is 1.153 gigabytes with 1635 cylinders.

The drive is designed to be rack or cabinet mounted in either domestic or European enclosures. Depending on integration requirements the drive may be mounted horizontally, vertically, or on end in a system cabinet. See Figure 1 for the placement of major components. Accessories are shown in Figures 2A and 2B, and the Plan Views are in Figure 3. The mechanical interface is shown in Appendix A.

The electronics for this drive utilize low power Schottky, CMOS, and ECL technology with extensive use of LSI in all functions. This drives closed loop positioner electronics uses a dedicated servo surface for both coarse and fine positioning activity. Write/Read circuits take advantage of the proven benefits of 2,7 run length coding techniques.

The module assembly contains thin film media disks, thin film heads, a direct coupled brushless dc motor, and balanced rotary actuator. See Figure 4 for the head disk scheme.

With the SABRE-2HP power supply accessory and a properly installed power cord set, compatibilities with all international voltages and compliance with FCC and VDE emission requirements is assured.

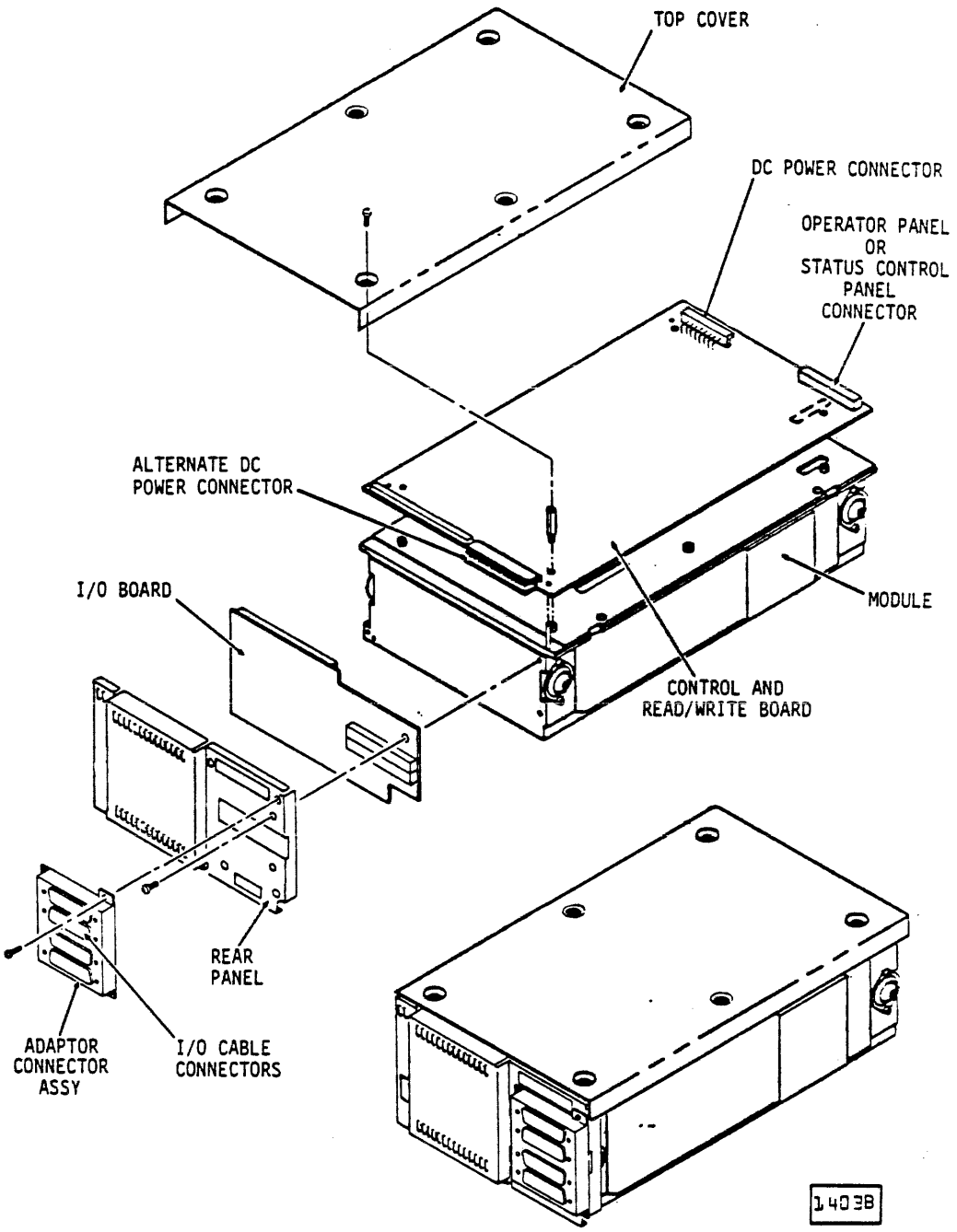
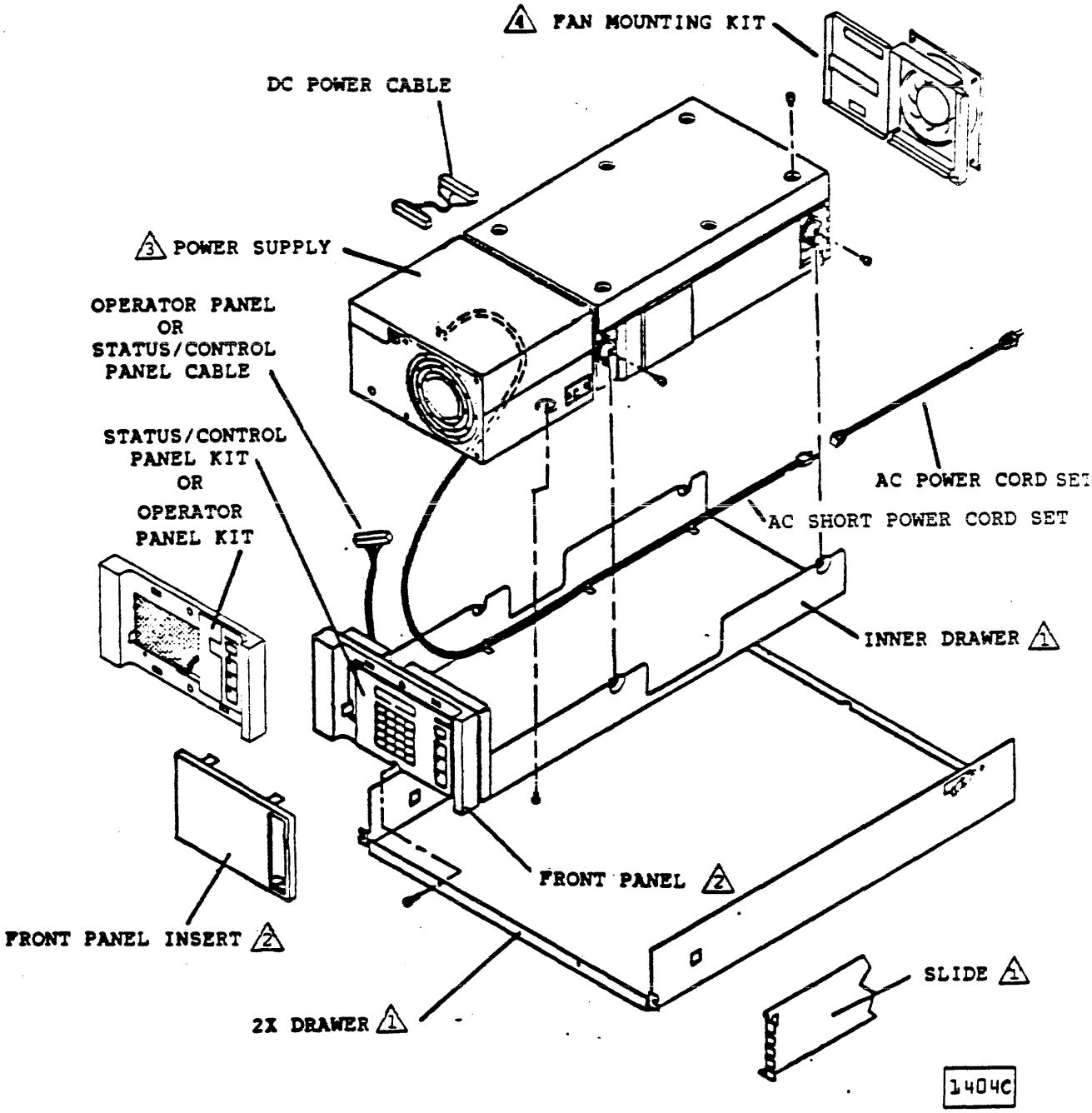


FIGURE 1. MAJOR COMPONENT PLACEMENT FOR BASIC SABRE



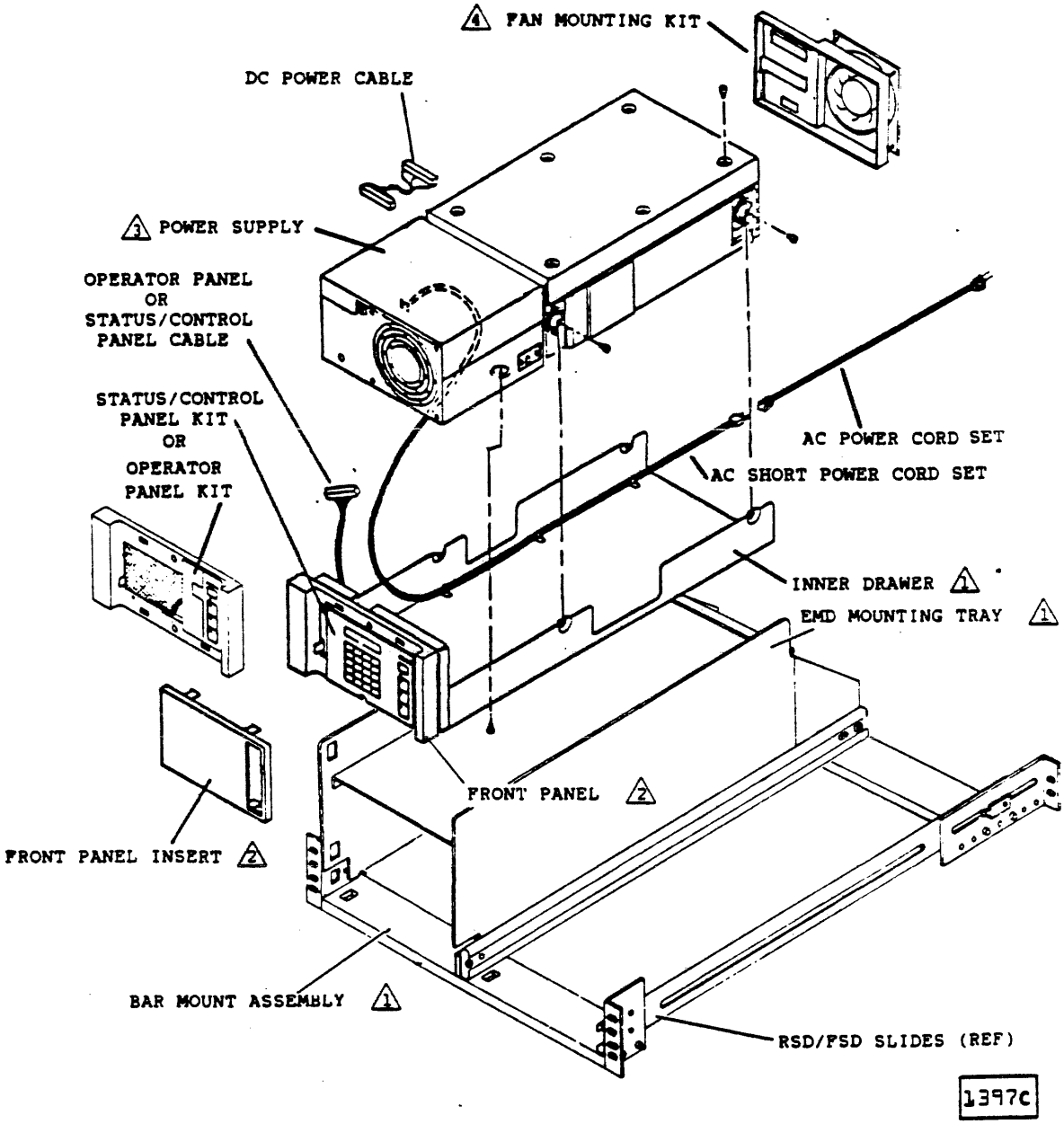
1 PART OF RACK MOUNTING KIT.

2 PART OF FRONT PANEL ASSEMBLY (SEE FIGURE A1A).

3 POWER SUPPLY HAS INTERNAL COOLING FAN.

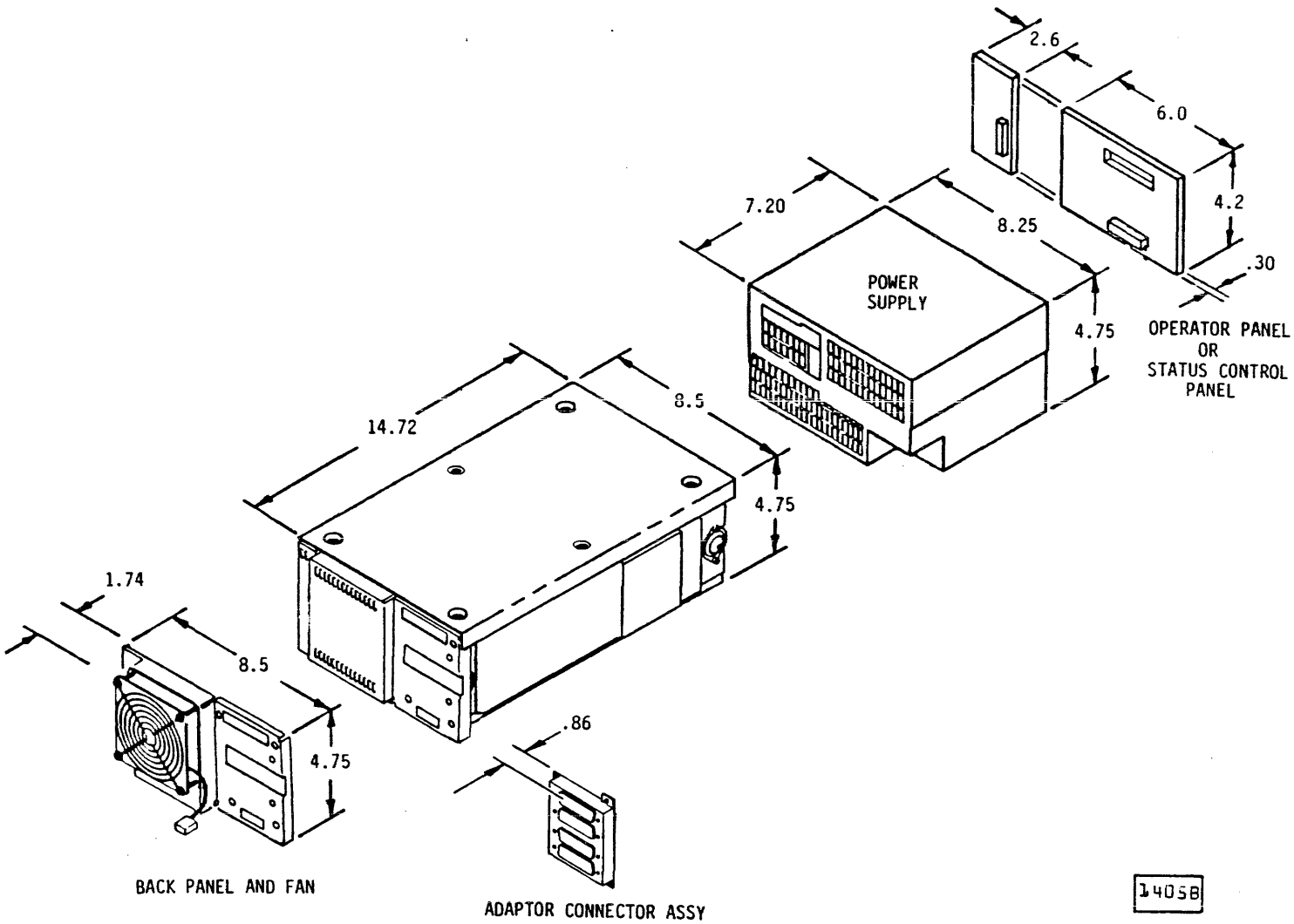
4 FAN MOUNTING KIT IS NOT USED WHEN COOLING IS ACCOMPLISHED BY AN ADJACENT POWER SUPPLY AS SHOWN.

FIGURE 2A. SABRE-2HP AND ACCESSORIES



1. PART OF O/U RACK MOUNTING KIT.
2. PART OF FRONT PANEL ASSEMBLY (SEE FIGURE A1B).
3. POWER SUPPLY HAS INTERNAL COOLING FAN.
4. FAN MOUNTING KIT IS NOT USED WHEN COOLING IS ACCOMPLISHED BY AN ADJACENT POWER SUPPLY AS SHOWN.

FIGURE 2B. SABRE-2HP AND ACCESSORIES



DIMENSIONS ARE NOMINAL AND INTENDED FOR SITE PLANNING USE ONLY

FIGURE 3. PLAN VIEWS

LOGICAL HEAD	PHYSICAL HEAD R/W CHANNEL 0	R/W CHANNEL 1
0	4	6
1	3	5
2	8	10
3	7	9
4	12	14
5	11	13
6	0	2

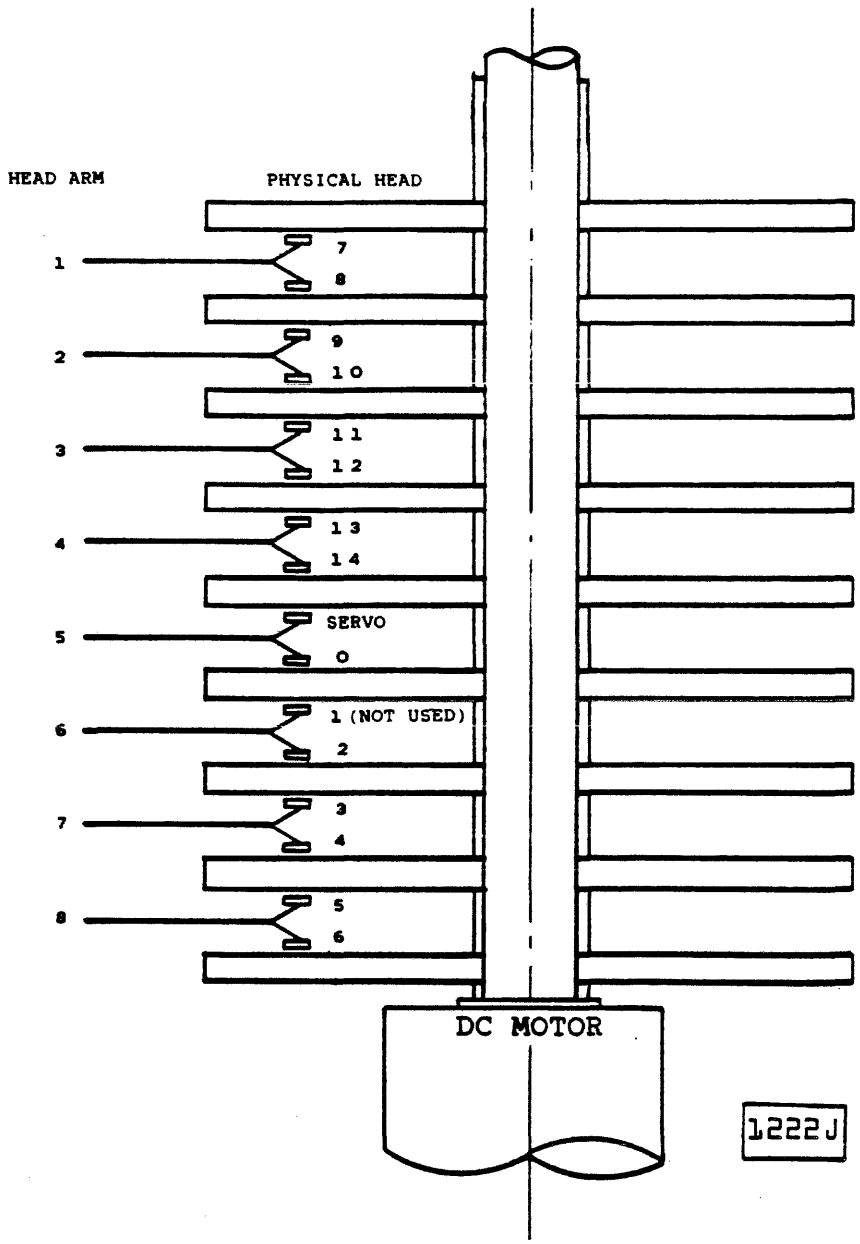


FIGURE 4. HEAD DISK SCHEME

3.2 Accessory and Supply Items

Accessories and supplies are not included with the units but must be purchased separately, see Table 1 and Figures 2A and 2B.

TABLE 1. ACCESSORY AND SUPPLY ITEMS

DESCRIPTION	QUANTITY REQUIRED	NOTE	PART NO
Power Supply (with internal cooling fan)	One per drive		45070625
AC Short Power Cord Set	One per Power Supply	1,9	47188871
AC Short Power Cord Set (50 Hz)	One per Power Supply	1,7, 10	47188872
AC Power Cable 5-15P (60Hz)	One per Power Supply	1	75168331
AC Power Cable 6-15P (60Hz)	One per Power Supply	1	75168346
AC Power Cable (50Hz)	One per Power Supply	1	15165427
DC Power Cable (supply to drive)	One per drive	2	925881XX
Fan Mounting Kit	One per drive	3	45419410
Operator Panel Kit	One per drive	4	470318XX
Status/Control Panel Kit	One per drive	4	932389XX
Front Panel Assembly	One per drive	5	47059601
Rack Mounting Kit (tray for 19 inch horizontal rack)	One per 2 drives mounted side by side	6	451403XX
Terminator Assembly	One per port on the end drive of a daisy chain	7	15458851
I/O Cable (shielded)	One per drive	7,8	471911XX
I/O Spindle Sync Cable	One per drive	8	705671XX
Spindle Sync Terminator	One per drive		70567151

(See Notes Next Page)

NOTES:
1. See Figures 15, 16 and 17 for ac power cable detail.
2. Last two digits denote cable length. See Table 2.
3. Fan Mounting Kit is not required when cooling is accomplished by an adjacent power supply.
4. Kits are tabulated according to the length of the cable in the kit. Last two digits of the kit part number denote the cable length. See Table 3. See 7.0 for panel functions.
5. Front Panel Assembly includes; Front Panel, Front Panel Insert, Filler Plate, and Filter. Standard Color: Light Grey with Imperial Blue Insert.
6. Last two digits denote kit configuration. See Table 4.
7. Twice the number of cables and terminators are required for dual channel operation.
8. Last two digits denote cable length. See Table 5.
9. Power cord set is necessary to meet FCC and VDE emission requirements.
10. 50 Hz power cord set for remote power supply installation.

TABLE 2. DC POWER SUPPLY CABLE LENGTHS AND TABS

CABLE LENGTH IN INCHES	2.5	60	96	
CABLE TABS 925881XX	00	01	02	

TABLE 3. OPERATOR PANEL, STATUS/CONTROL PANEL KIT TABS

CABLE LENGTH IN INCHES	22	48	96
OPERATOR PANEL KIT 470318XX	04	05	06
STATUS/CONTROL PANEL KIT 932389XX	03	04	05

TABLE 4. RACK MOUNTING KIT CONFIGURATIONS

KIT TABS 451403XX	CONFIGURATION
03	Without Front Panel Assembly
04	With Front Panel Assembly. See Note 5 above.
O/U KIT TABS 470748XX	
01	Without Front Panel Assembly
02	With Front Panel Assembly. See Note 5 above.

TABLE 5. I/O CABLE LENGTHS AND TABS (USED ON IPI-2 I/O)

CABLE LENGTH IN FEET	6	10	15	25	50	75	100	150
I/O CABLE TABS 471911XX		01	08	02	03	04	05	06
I/O SPINDLE SYNC CABLE 705671XX	41	42		43	44			

3.3 Reliability, Availability, Maintainability (RAM) Features

1. Reliability

- Whitney type technology with contact start/stop operations given a dedicated landing zone separate from the data recording area.
- Heads, media and actuator are contained within a sealed module assembly with its own closed loop air filtration system.
- Extensive use of LSI and minimum use of interconnects between two PWAs.

2. Availability

- Dual Channel I/O is standard.
- High performance access to data: 24.33 ms average (average seek + average latency).
- Automatic drive recovery after ac power loss without operator intervention.
- Accepts I/O commands for carriage offsets and read recovery circuit timing offsets (Strobe Offset).
- Logical address assignment of 0 to 7 if required.

3. Maintainability

- No preventive maintenance required.
- Built-in self test on dc power application. Firmware internal to the control MPU will test all MPU ROM + RAM memory, drive MPU bus, bus buffers, and IPI-2 I/O LSI.
- With Status/Control panel accessory, off line diagnostics can be run that vigorously test the actuator and its associated logic.
- With the IPI-2 I/O, on-line diagnostics can be run which test the drive servo system and the write/read electronics.
- With Status/Control panel accessory, drive internal machine/fault status can be made available for problem diagnosis.
- Automatic carriage lock/unlock on power down/up.
- Lightweight for easy handling (See 8.0 for component weights).
- Access to configuration switches is possible without removing logic covers.
- All I/O and dc Cable connectors have Key/Polarizing hardware.

4.0 PERFORMANCE

4.1 Access-to-Data Characteristics

4.1.1 Positioning Times

All positioning times are measured from initiating a seek to the On Cylinder condition.

The nominal zero cylinder seek time is 500 µs. The maximum RTZ time is 1 s.

The single cylinder seek, maximum positioning time does not exceed 5.1 ms. The typical average single cylinder seek time does not exceed 4 ms. Single cylinder seek is defined as a move between any pair of adjacent cylinders.

The typical average seek time is 15 ms. Average seek time is defined as the time to make all possible moves divided by the number of possible moves, see Figure 5.

The maximum seek, average positioning time does not exceed 30 ms. Maximum seek is defined as a move from cylinder 0 to cylinder 1634.

When the Servo Offset (either positive or negative) command is invoked, the On Cylinder Signal goes false and remains false for 2.75 ms (nominal).

4.1.2 Latency Time

The average latency time is 8.33 ms, based on a nominal disk speed of 3600 rpm.

The maximum latency time is 16.83 ms, based on a minimum disk speed of 3564 rpm (see 5.4).

Latency time is defined as the time required to reach a particular track location after positioning is complete.

4.1.3 Read Initialization Time

Between the deselection of one head and the selection of another head, there is a 2 µs delay within the drive due to circuit characteristics. The time from the initiation of a head change until data can be read with a selected head without error is 12.3 µs maximum (2 µs for head selection, 7 µs for read amplifier stabilization, and 3.3 µs for phase lock synchronization).

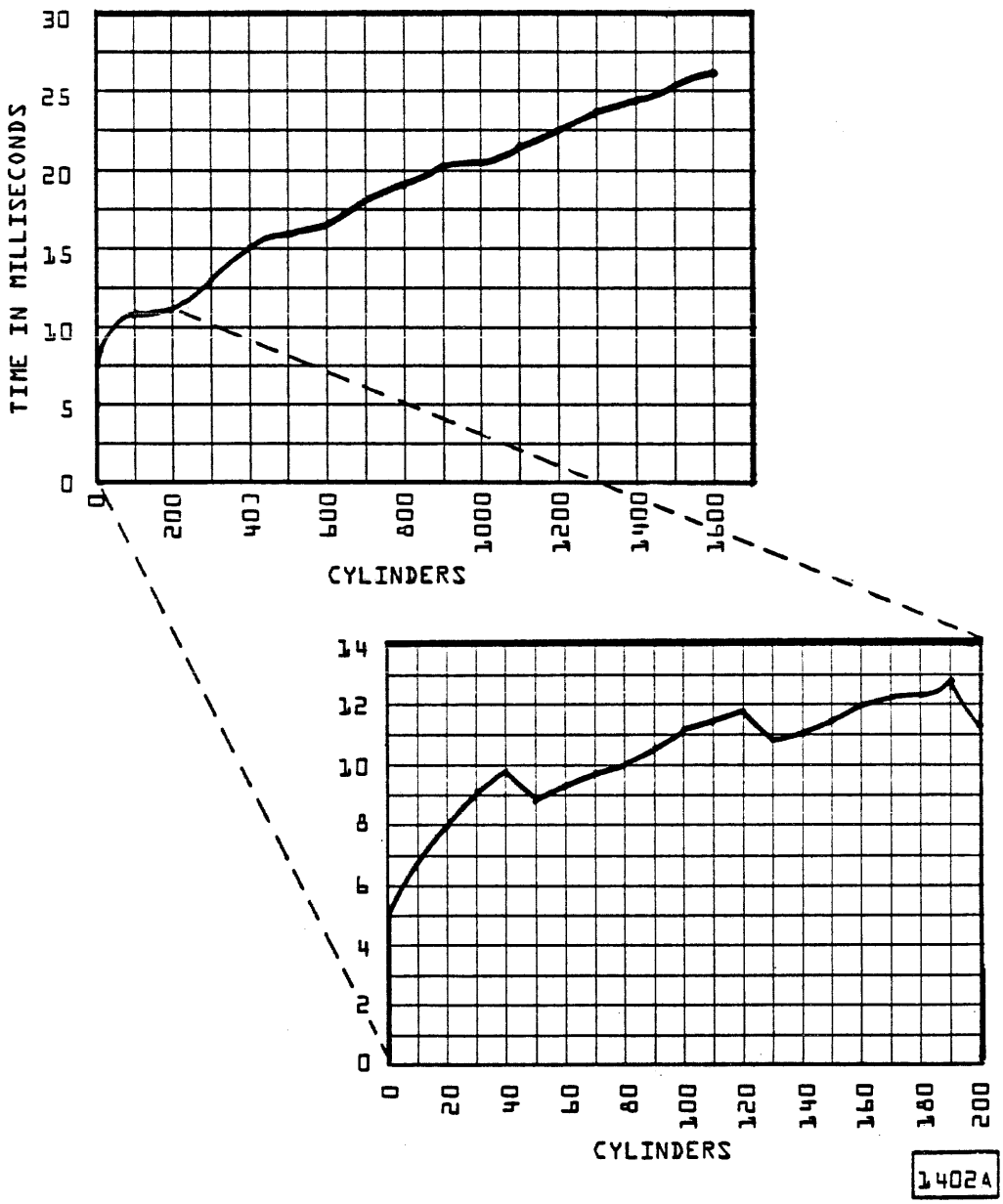


FIGURE 5. TYPICAL SEEK PROFILE

4.1.4 Spindle Speed and Syncronization

The spindle speed is 3600 ±36 rpm. This tolerance represents ±1% of nominal.

The drive synchronizes the spindle by synchronizing the Index to an external reference. If the reference signal is not present, the drive continues to operate in a non-sychronous mode.

The tolerance of the spindle lock is ±50 µs.

Synchronization is achieved within 30 s after:

1. The spindle achieves full speed (3600 rpm) during a motor start routine, provided that there is a reference signal present.

2. A reference signal is present that was not previously detected, and the spindle is operating at its specified speed.

Each disk drive capable of synchronous spindle operation is capable of providing the master synchronization reference signal or operating as a slave and synchronizing from an external reference signal. Only drives manufactured after July 1989 have the capability to provide the master synchronization reference signal.

Only one drive should be designated as a master and provide the master synchronization reference signal in a spindle synchronized daisy chain.

A jumper is provided on the I/O board to establish the drive as a master or slave, upon power-up, with respect to providing the master synchronization reference signal

If upon power-up, a drive detects the master synchronization jumper in place, that drive is a master and provides the synchronization reference signal to all drives and controllers connected to the spindle synchronized daisy chain.

A drive can be designated as a master via Bus Controls issued on the IPI-2 interface. Bus Control "Load Drive Function" (01) with function code 1F 'Enable Master Sync' causes the selected drive to become a master and provide the synchronization reference signal. If the 'Enable Master Sync' function is presented to a drive that is designated as a master via the master sync jumper, it will reject the 'Enable Master Sync' function and provide Slave Ending status "Bus Control Exception". This condition causes bit 5 of octet 0 in Status Response 'Bus Control Exception' and bit 6 of octet 2 in Status Response 'Invalid Parameter' to be set.

A Bus Control "Load Drive Function" (01) with function code 2E 'Disable Master Sync' will cause the selected drive to cease being a master and disable providing the synchronization reference signal. If the drive has been designated as a master via the master sync jumper being in place, it will reject the 'Disable Master Sync' function and provide Slave Ending status "Bus Control Exception". This condition causes bit 5 of octet 0 in Status Response 'Bus Control Exception' and bit 6 of octet 2 in Status Response 'Invalid Parameter' to be set.

4.2 Data Interleave

The drive writes and reads data in 1 of 4 modes. The mode of operation is specified by the controller by issuing a Bus Control "Load Drive Specific Information" (03) with the following parameters:

OCTET	VALUE	PARAMETER
0-1	0004	Number of Octets following
2-3	0080	Command Identifier (Load Drive Operating mode)
4-5	0000	One Head (factory usable only)
	0001	Two Head Bit Interleave
	0002	Two Head Octet Interleave
	0003	Two Head Word Interleave

1. In One Head mode, only 1 read/write channel is used and a SABRE-2HP appears as a single head drive. This mode is used in the factory only.

2. In 2HP Bit Interleave mode, the 16 bits of a word transferred across the IPI-2 interface are alternately written to the 2 heads, odd bits going to the head connected to R/W Channel 0 and even bits going to the head connected to R/W Channel 1, starting with the MSB. When reading, words are formed by taking bits alternately from the 2 heads, odd bits from the head connected to R/W Channel 0 and even bits from the head connected to R/W Channel 1, starting with the MSB.

3. In 2HP Byte Interleave mode, the 2 Bytes of a word transferred across the IPI are alternately written to the 2 heads, even Bytes going to the head connected to R/W Channel 0 and odd Bytes going to the head connected to R/W Channel 1. When reading, words are formed by taking Bytes alternately from the 2 heads, even Bytes from the head connected to R/W Channel 0 and odd Bytes from the head connected to R/W Channel 1.

4. In 2HP Word Interleave mode, the words transferred across the IPI are alternately written to the 2 heads, even words going to the head connected to R/W Channel 0 and odd words going to the head connected to R/W Channel 1. When reading, words are taken alternately from the 2 heads, even words from the head connected to R/W Channel 0 and odd words from the head connected to R/W Channel 1.

Upon power-up or completion of a Slave Reset, the drive defaults to Two Head Byte (octet) Interleave. Information written on the Defect Log Cylinder (1634) is written in Byte Interleave. When the drive has been directed to operate using the Imprimis format, the controller must switch the drive to Byte Interleave (if not already in that mode) by issuing the "Load Drive Operating mode" Bus Control as described above. The controller uses the same Bus Control with the appropriate parameters to place the drive in the required operating mode after the controller has issued a "Load Format Specification" Bus Control. When the Bus Control Load Drive Function (01) with function code 29 'Execute Internal Diagnostics' is to be issued to the drive, the drive must be placed in the Two Head Byte Interleave mode to allow the diagnostics to operate correctly.

4.3 Data Capacity

The data capacity specified is based on the number of eight-bit bytes that are recorded on a track. The unsectored capacity below does not include an allowance for tolerance gaps.

Physical Useable Data Heads:	14
Bytes Per Physical Track:	50 400
Logical Heads:	7
Bytes Per Logical Track:	100 800
Bytes Per Cylinder:	705 600
Bytes Per Spindle:	1 153 656 000
Cylinders Per Unit:	1635

4.4 Data Transfer Rate

The nominal bit transfer rate is 48.4 MHz (6.0 MB/s).

4.5 Error Rates

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

4.5.1 Read Errors

Read error rates are based on the fact that all data has been verified as written correctly and all media defects have been flagged.

- Recoverable Error Rate $\leq$ 10 in 10^{11}

  The recoverable read error rate is the number of errors encountered which are recoverable within 27 retries as a function of the number of bits transferred (3 retries at each data strobe and carriage offset).

- Unrecoverable Error Rate $\leq$ 10 in 10^{13}

  The unrecoverable read error rate is the number of errors encountered which cannot be read correctly within 27 retries (3 retries at each combination of data strobe and carriage offset).

4.5.2 Write Errors

Unrecoverable write errors are those which cannot be corrected within 3 attempts at writing the record with a read verify after each attempt.

Write errors can occur as a result of the following:

- write data not being presented correctly
- media defects
- equipment malfunction

As such, write errors are not predictable as a function of the number of bits passed.

An unrecoverable write error that occurs because of a drive equipment malfunction is classified as a failure affecting drive MTBF.

4.5.3 Environmental Errors

When operating a low effective data transfer rate; e.g., random access of single short records, the effective error rate may be expected to exceed the limits of 4.4.1 due to external environmental interference. The resulting recoverable read error rate is less than 1 error in 8 hours of operation.

4.5.4 Access Errors

There are no more than 10 positioning errors in 10^8 seeks.

4.5.5 Media Defects

A media defect is a physical characteristic of the media which results in a repetitive read error when a unit is operated within specified operating conditions. Valid data must not be written over known media defects; therefore, sector/track deallocation or skip displacement techniques must be utilized.

Media Defect Characteristics

- The maximum number of media defects in the module is 574.
- The maximum number of defects on any track is 10.
- The maximum number of defects on any cylinder is 10.
- The maximum number of tracks with more than 1 but less than 11 defects is 40.

Media Defect Free Areas are defined as follows:

- The first 2048 Bytes from index of diagnostic cylinder 1633.

4.5.6 Media Defect Logging Information

All modules have a defect map attached which lists the following information:

- Logical Head
- Cylinder
- Location *
- Defect Length (bits)

* The information contained in the Location field is an offset value that specifies the location of a defect with respect to the ordered head that data is written to and index.

Each logical head has 2 physical heads mapped to it via read/write channels 0 and 1. Data is written to each physical head in an ordered sequence. The first ordered head is numbered 0.

If the value in the Location field is less than the physical track length in bytes (50,400) the defect is located on the first ordered head. The value then specifies the offset from Index (±1 Byte). If the value in the Location field is greater than 1 physical track length, the defect is resident on the second ordered head. To determine the offset from Index, subtract the physical track length from the value and the remainder is the offset from Index.

The location information can be represented by the following formula:

Location Value = (OH X TL) + OS

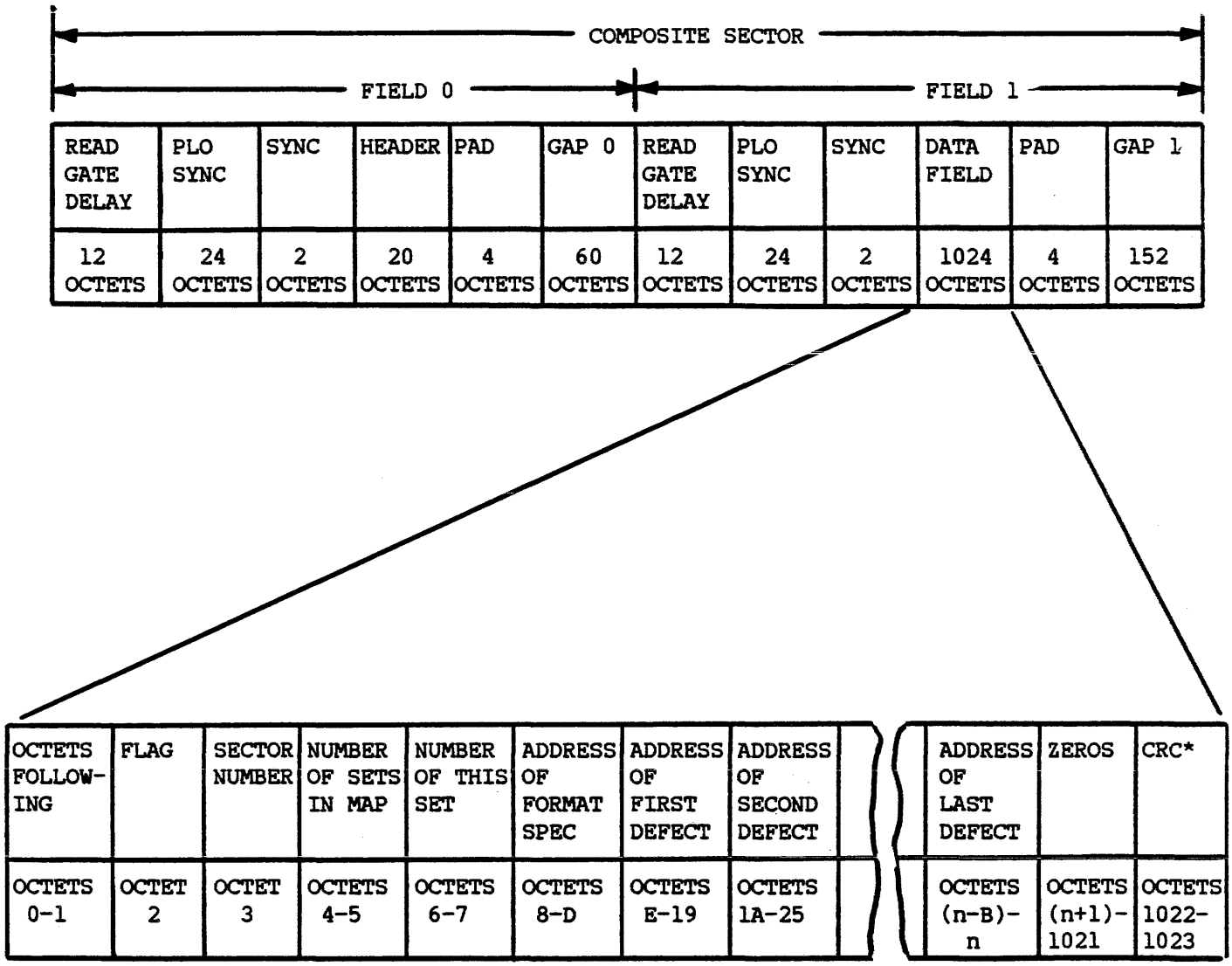
where: OH = Ordered Head Number (0 or 1)
TL = Physical Track Length in Bytes (50,400)
OS = Offset From Index

4.5.7 Defect Map Format

Defect information is recorded in two head parallel with Byte Interleave on the physical volume at cylinder location 1634. Figure 6 illustrates this defect cylinder format.

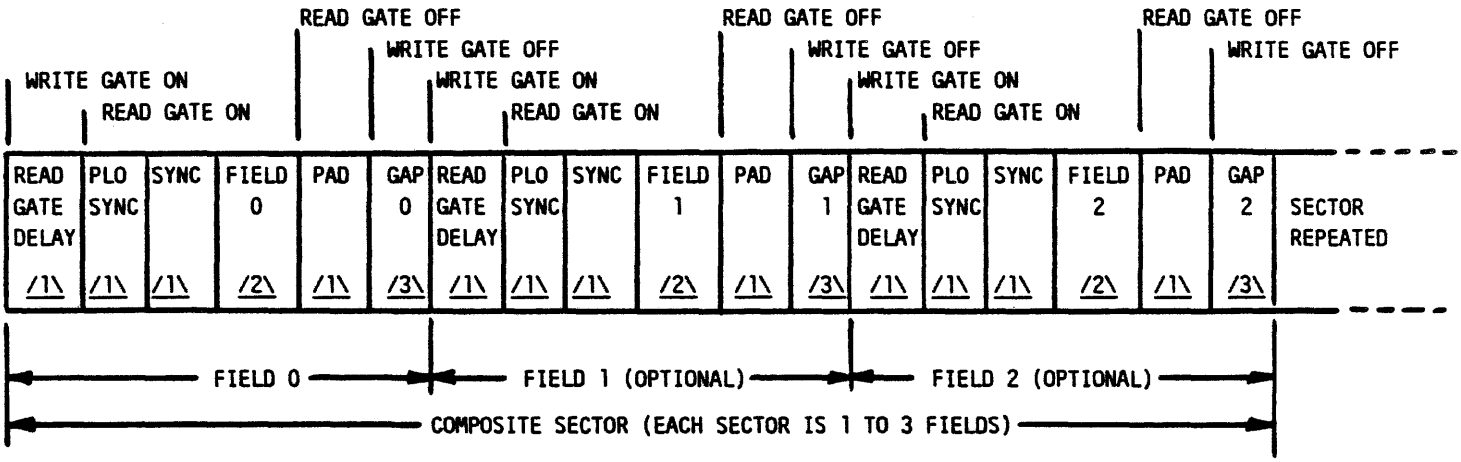
4.5.8 User Cylinder Sector Format

Figures 7 and 8 illustrate the hard sector format used on the SABRE/IPI-2. The SABRE/IPI-2 does not support a soft sector disk format.



* CRC - Cyclic Redundancy Code - Two bytes of parity information appended to the data field to verify its accuracy.

FIGURE 6. DEFECT MAP FORMAT

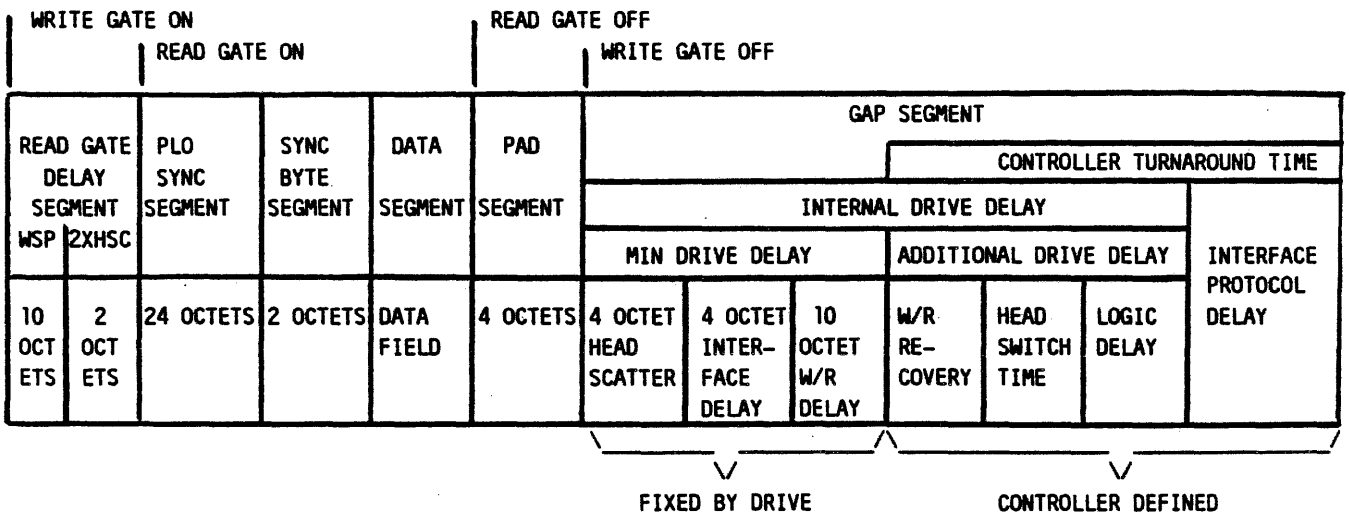


/1\ FIXED BY DRIVE

/2\ CONTROLLER DEFINED (10 OCTETS MINIMUM)

/3\ CONTROLLER/DRIVE DEFINED

FIGURE 7. HARD SECTOR DISK FORMAT



OCTET COUNT MINUS DATA FIELDS AND CONTROLLER GAPS = 32

FIGURE 8. TYPICAL FIELD COMPONENTS

4.6 Data Security

Under normal controller I/O operation, the drive will write only that pattern present on the write data lines. Both drive Selected and On Cylinder must be true before a valid write operation can be completed. Data is protected by inhibiting Write Gate in all fault conditions including a loss of On Cylinder, Seek Error or low dc voltage. This is accomplished by switching off the voltage required to write and/or performing an emergency retract of the Read/Write heads.

Under an ac power failure while performing a write operation, the data will be valid on all tracks except the sector/record on which the read/write heads were writing at the time of the ac power failure.

With the SABRE's Power Supply accessory used, a feature is available that provides an early warning of ac mains power failure. The Power OK signal will provide at least 5 ms of warning before any dc voltages drop out of spec.

4.7 Stop Time

The time to stop the spindle after the START/STOP switch has been turned off is 60 s maximum.

4.8 Start Time

The time for the drive to be in the Ready state after the START/STOP switch has been depressed is 90 s maximum.

4.9 Power Sequencing

The length of delay of the drive power-up sequence is determined by the drive logical address assignment in increments of 5 seconds; e.g., a logical address "0" has no delay; a logical address "7" has a 35 second delay.

NOTE: SABRE will start its delay to power up sequence upon receiving a drive function code "spin up" with the START switch ON.

5.0 RECORDING CHARACTERISTICS

5.1 Recording

Mode: 2,7 Code

Density:
(Inner Track) 24 307 bpi nominal
(Outer Track) 16 420 bpi nominal

5.2 Disk

Total number:	9
Servo surface:	1
Data surfaces:	14
Data tracks per surface:	1635
Tracks per inch:	1289

5.3 Heads

Servo head:	1
Recording heads:	14

5.4 Spindle

The spindle speed is 3600 ±36 rpm. These limits represent ±1% of nominal. The spindle can be synchronized to an external clock and the phase relationships will not exceed ±50 µs.

6.0 INTERFACE

6.1 Interface Definition

The IPI-2 Interface requirements are defined in Specification 64731600.

6.2 IPI-2 Interface Dependent Specifications

6.2.1 Read Configuration (Code 41)

Drive configuration may be read with the read configuration control as described in Specification 64731600.

6.2.1.1 Manufacturers Identification (Octets 2E-31)

This 4 octet parameter contains the drive manufacturers identification in ASCII. The SABRE-2HP contains "CDC " in this 4 octet parameter.

6.2.1.2 Model Number (Octets 32-39)

This 8 octet parameter contains the drive model number in ASCII. The SABRE-2HP contains "MPI S5L2" in this 8 octet parameter.

6.2.1.3 Revision Number (Octets 3A-3D)

This 4 octet parameter contains the drive revision number in ASCII. The SABRE-2HP contains "PA8Y" in this 4 octet parameter.

6.2.1.4 Switch Settings (Octets 46 and 47)

This 2 octet parameter contains the value of switch settings the drive reports via the configuration response.

6.2.1.4.1 Most Significant Octet (Octet 46)

This octet always contains the value of 00.

6.2.1.4.2 Least Significant Octet (Octet 47)

6.2.1.4.2.1 Local/Remote Switch (Bit 7)

This is a customer select switch which allows disk spin-up in local mode (without issuance of spin-up function) or in remote mode. This switch (labeled "1") is factory set to the remote position (closed).

6.2.1.4.2.2 Port Disable Switches

These are 2 switches used to disable Port A or Port B. These switches (labeled "2" and "3" respectively) are factory set to enable both ports (both switches open).

6.2.1.4.2.3 Disable Read/Write Diagnostics

This switch is used to inhibit the drive's internal diagnostic program from doing read/write operations. This switch (labeled "4") is factory set to enable read/write diagnostics (open).

6.2.1.4.2.4 ID Microcode Switches 2^3-2^0

This set of 4 switches is used by the internal microcode to identify the drive configuration. These switches are factory set with switches "5" and "7" Open, and switches "6" and "8" Closed.

6.2.2 Read Drive Specific Information (Code 43)

Drive dependent diagnostic status may be read with the read drive specific information bus control as described in Specification 64731600.

6.2.2.1 Native Controlled Internal Diagnostic Status Codes (Octets 02-11)

STATUS CODE	STATUS DESCRIPTION
80	Ready and On Cylinder
82	Motor Stopping
83	Motor Stopped
84	First Load/Calibrate
85	Sequence Delay
86	Waiting For (Hold + Local)
87	Starting Motor
88	Motor Up-to-Speed
89	I/O Self Test Passed
8A	Sweep Segment In Progress
8B	Heads Left On Last Cylinder Of Sweep
C6	Seek Time Out
CB	Off-Track Seek Error
CD	Illegal Cylinder Address
CF	Seek Error on Settle-in
D4	First Seek Fault on Retract
D5	First Seek Fault on Load
D6	First Seek Fault on RTZ
D7	First Seek Fault on Calibrate
D8	Speed Loss
D9	Motor Can't Start
DA	Emergency Retract
E0	Motor MPU Failure
E1	Servo MPU Failure
E2	I/O Status Transfer Failed
EE	I/O Self Diagnostic Test Failed

6.2.2.2 Native Controlled Internal Diagnostic FRU Codes (Octets 12-15)

In the event of equipment failure, the drives internal diagnostics will provide up to 4 codes indicating the FRU most probably at fault in order of likelihood.

FRU CODE	FRU DESCRIPTION
81	Control/Read-Write Board
82	Module (HDA)
83	Power Supply
84	I/O Board
85	Control/Read-Write Board
86	Module (HDA)

6.2.2.3 Native Controlled Internal Diagnostic Fault Codes (Octets 16-1D)

FAULT CODE	FAULT DESCRIPTION
80	Good Status
81	Read and Write Fault
82	Read or Write and Not On Cylinder Fault
84	First Seek Fault
88	Write Fault
90	Write and Write Protected Fault
A0	Head Select Fault
C0	Voltage Fault

6.2.2.4 IPI Controlled Internal Diagnostic Status Codes (Octets 1E-1F)

STATUS CODE	STATUS DESCRIPTION
Write/read tests	
00	Good Status
01	Failed during seek to diagnostic cylinder
02	Failed during RTZ seek from diagnostic cylinder
03	Spare
04	Spare
05	Failed during head select test
06	Failed during read header test
07	Failed during write data test
08	Failed during read data test
09	Sync byte error during read header test
0A	Data error during read header test
0B	Sync byte error during read data test
0C	Data error during read data test
Access tests	
13	Failed during servo test
14	Failed during random seek test
15	Failed during access RTZ test
Read slave specific tests	
20	Failed during read up diag status/error code log test
21	Failed during read up field replaceable unit log test
22	Failed during read up display fault log test

6.2.2.5 IPI Controlled Internal Diagnostic FRU Codes (Octets 20-21)

FRU CODE	FRU DESCRIPTION
01	Control/Read-Write Board
02	Module (HDA)
03	Power Supply
04	I/O Board
05	Control/Read-Write Board
06	Module (HDA)

6.2.2.6 IPI Controlled Internal Diagnostic Fault Codes (Octets 22-23)

FAULT CODE	FAULT DESCRIPTION
00	Good Status
01	Read and Write Fault
02	Read or Write and Not On Cylinder Fault
04	First Seek Fault
08	Write Fault
10	Write and Write Protected Fault
20	Head Select Fault
40	Voltage Fault

6.2.3 Read Correction Vectors (Code 45)

The drive does not support this code.

6.2.4 Enhanced Bus Controls

Bus controls are received and acted upon using both hardware and microcode. Certain Bus Controls are received and acted upon using hardware only. The Bus Controls that are hardware implemented present ending status much sooner than those requiring microcode implementation. The Bus Controls that are hardware implemented are: Reserve, Release, Load Cylinder, Load Head, Load Target, and Load Position.

6.2.4.1 Reserve - Release

These functions can be implemented using the hardware/microcode sequence by the Bus Control "Load Drive Function" (01) with function code 14 for Reserve or function code 15 for Release.

A hardware only implementation can be used which will perform the same functions in a shorter time frame by using the following bus controls:

Load Drive Function (01) with:
Function code 86 - Enable Reserve/Release Bus Controls
Function code 87 - Disable Reserve/ Release Bus Controls
Reserve (30)
Release (31)

Function code 86 enables the drive to accept Bus Controls Reserve (30) and Release (31). Function code 87 disables the drive from accepting the 30 and 31 Bus Controls.

When the drive powers-up or completes a Slave Reset it is disabled from accepting the 30 and 31 Bus Controls.

When using the Bus Controls 30 and 31 the following conditions apply:

Class 3 interrupts will not be cleared by accepting either of these Bus Controls.

Status and Extended Status will not be changed or reset.

6.2.4.2 Load Cylinder - Load Head

These Bus Controls, Load Cylinder (04) and Load Head (05), will cause bit 4 (Time Dependent Operation) of the Drive Status Octet to be set when Slave Ending status is returned.

A Class 1 Command Complete Interrupt will be generated, if enabled, when the drive comes "On Cylinder" for a Load Cylinder (04) Bus Control or when the "Load Head Function" is complete for the Load Head (05) Bus Control.

6.2.4.3 Load Target

This Bus Control consists of the following parameters:

OCTET	PARAMETERS
0-1	RPS Target Sector Address
2-3	RPS Pulse Width Extension
4-7	RPS Pulse Width
8-B	RPS Pulse Width Skew

When using the Load Target Bus Control (06), all parameters (octets 0-B) must be presented to the drive to ensure proper operation of the Bus Control.

Upon successful transfer of the Bus Control and parameters, the drive will cause bit 4 (Time Dependent Operation) of the Drive Ending Status octet to be set when Slave Ending Status is presented.

After calculations have been completed the drive will generate a Class 1 Command Complete interrupt, if enabled, and then generate a Class 2 RPS interrupt, if enabled, when the heads of the drive are over the specified target sector.

The extension parameters are used to change the width of the RPS interrupt pulse and the position of the pulse with respect to the target sector.

The RPS pulse width (octets 4-7) specifies the width in octets. Under normal conditions this contains the sector size specified in octets. A value of 0 in this parameter does not allow an RPS interrupt to be generated.

The RPS pulse width extension (octets 2-3) is used as a multiplier to the pulse width value. The value in octets 2-3 plus 1 are multiplied by the RPS pulse width and used for the final RPS interrupt pulse duration.

The pulse width skew is used to vary the position of the RPS interrupt pulse with respect to the end of the target sector. Any value in this octet will move the leading and trailing edge of the RPS interrupt pulse.

To use the IPI-2 "At Target" Data Controls, at the target sector specified in octets 0-1, the pulse width skew value should not be larger than 1 sector length.

6.2.4.4 Load Position

This Bus Control consists of the following parameters:

OCTET	PARAMETERS
0-3	Cylinder Address
4-5	Head Address
6-7	RPS Target Sector Address
8-9	RPS Pulse Width Extension
A-D	RPS Pulse Width
E-11	RPS Pulse Width Skew

When using the Load Position Bus Control (07), all parameters (octets 0-11) must be presented to the drive to ensure proper operation of the Bus Control.

Upon successful transfer of the Bus Control and parameters, the drive will cause bit 4 (Time Dependent Operation) of the drive status octet to be set when ending status is presented.

A Class 2 RPS interrupt, if enabled, will be generated when the drive has reached the specified cylinder and target sector. If RPS interrupts are not enabled, a Class 1 Command Complete interrupts, if enabled, will be generated when the drive has reached the specified cylinder.

The extension parameters (octets 8-11) operate the same as the extension parameters (octets 2-B) for the Load Target Bus Control as described in 6.2.4.3.

7.0 CONTROLS AND INDICATORS

7.1 Operator Panel, Status/Control Panel Accessories (See Figures 9 and 10)

Either of these 2 panels can be installed behind the drive front panel or remote to the unit. See User's Manual for further information.

7.1.1 Operator Panel

The Operator Panel provides a LOGIC ADDRESS SELECT switch, START/STOP switch/indicator, FAULT/CLEAR switch/indicator, a WRITE PROTECT switch/indicator, and a Unit Selected indicator.

NAME	TYPE		FUNCTION
	LIGHT	SW	
LOGIC ADDRESS SELECT	X	X	Establishes Logical Address of the device and displays binary value 0-7 using 4 Green LEDs.
START/STOP	X	X	Green LED indicates when the drive is Ready. Indicator flashes rapidly when START is activated until drive is Ready (Local or Remote Spin Up Enabled, see 6.2.1.4.2.1). Indicator flashes slowly when STOP is depressed until disk rotation is stopped.
FAULT/CLEAR	X	X	Red LED indicates any Fault condition. The switch clears the Fault indication if the problem that caused the Fault is no longer present.
WRITE PROTECT	X	X	Red LED indicator is on when the drive's write circuits are disabled. Write Protect is activated by a switch located on the Control Card assembly or on this control panel.
UNIT SELECTED	X		Green LED indicates when the unit is selected.

7.1.2 Status/Control Panel

The Status/Control Panel combines the above described Operator Panel functions with a Maintenance section. The Maintenance section adds a maintenance keyboard and a liquid crystal display.

The following are the additional functions available from this panel:

- Current Cylinder Address
- Fault Indication - Type and history of occurrence
- Internal Machine Status - Type and history of occurrence
- Off-line Diagnostic control and display

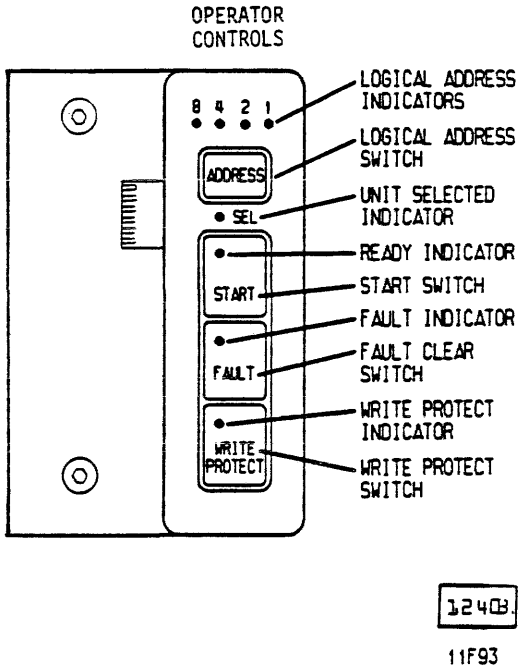


FIGURE 9. OPERATOR PANEL

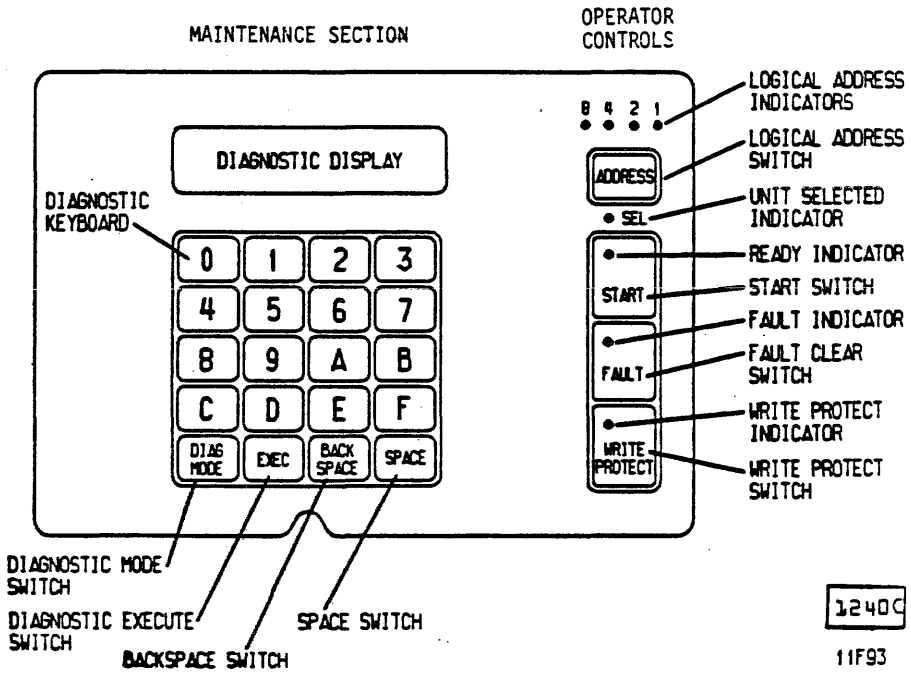


FIGURE 10. STATUS/CONTROL PANEL

7.2 Control Card Switches

7.2.1 Sector Select 2^0 - 2^{13}

Fourteen independent switches used for selecting the number of sectors per track. The number of sectors per track generated by the drive logic must be matched to the number required by the controller. These switches are factory set to provide 64 sectors per track.

NOTE: Sector Select Switches are not used with the IPI-2 Interface.

7.2.2 Unit Select 2^0 - 2^2

Four independent switches used for setting the logical address number of the unit, (0 thru 7). These switches are factory set to the closed position (unit 0). When either the Operator Panel or Status/Control Panel Accessory is used, these switch settings are ignored by the drive electronics.

7.2.3 Sector Clock Select C/B

This switch allows the selection of either 2.016 MHz or 3.024 MHz as the clock used to drive the sector length counter. In the B position (3.024 MHz) there are 50,400 clock increments per track; i.e., 1 byte per increment. In the C position (2.016 MHz) there are 33,600 clock increments per track; i.e., 1.5 bytes per increment. This switch is factory set in the C position (open).

7.2.4 Write Protect/Normal

This switch allows the user to activate the write inhibit logic within the drive. This switch is factory set in the NORMAL position (closed).

7.2.5 Runt sector Jumper

This jumper will provide selection of how the last sector mark of a track is managed.

Enable position - The last sector mark pulse on a track is suppressed.

Disable position - The last sector mark is not suppressed.

This jumper is factory set in the Disable position (disconnected).

7.2.6 Sweep Cycle Jumpers

Three sweep cycle jumpers identified as SWPD, SWP1, and RTN are used to control the sweep cycle operation of the drive. For proper operation of the sweep cycle with IPI, the jumpers must remain as shipped from the factory -- disconnected.

7.2.6.1 SWPD - Sweep Cycle Disabled

The drive is shipped from the factory with this jumper disconnected to enable the sweep cycle operation.

7.2.6.2 SWP1 and RTN - Sweep on Seeks and Return After Sweep

The drive is shipped from the factory with these jumpers disconnected to enable SWP1 and disable RTN.

7.2.6.3 Sweep Cycle Operation

With the 3 jumpers disconnected, the sweep cycle operates as follows:

After the drive has become Ready following a Power-On, or a Slave Reset, an internal 12 minute timer is started. When the 12 minutes have elapsed, the drive is in a Sweep Enable mode. When the drive is in a Sweep Enable mode, the first seek operation generated by the controller causes a sweep segment. A seek operation is generated when the controller issues a Load Cylinder Address (04) Bus Control or a Load Position (05) Bus Control.

After the sweep segment is performed, the drive will seek to the cylinder specified in the Bus Control and generate the normal response. At that time, the 12 minute timer is restarted and the cycle is repeated.

A sweep segment will add 150 ms to 200 ms to the overall time for that specific seek operation.

When the drive is in the Sweep Cycle mode and no seeks are generated by the controller, there will be no sweep segments.

It is recommended that if the sweep cycle is enabled and the drive will be in a non-active mode for long periods of time, non-zero track seek operations be generated by the controller at regular time intervals to cause sweep segments.

7.3 I/O Board

The switches on the I/O board at the rear of the drive are accessible through a hole in the rear panel as shown in Figure 11. Switches are factory set as described in Table 6.

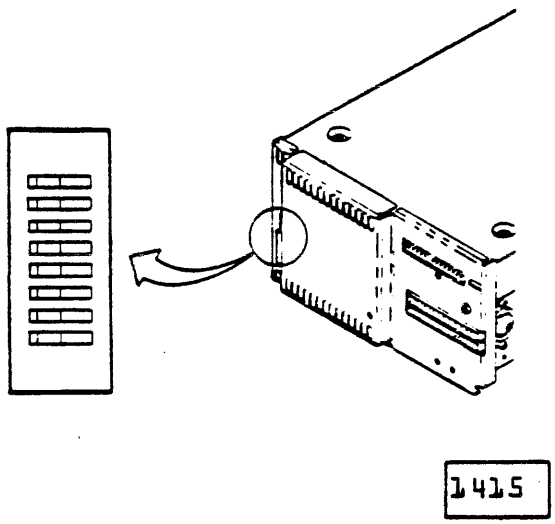


FIGURE 11. I/O BOARD SWITCHES

TABLE 6. I/O BOARD SWITCH SETTINGS

SWITCH	SETTING	DESCRIPTION
Local/Remote	Local (off)	Disk spin-up starts when dc power is applied, or when the START switch is pressed if the drive has an optional operator or status/control panel.
	Remote (on)	Spin-up command from interface is required to start drive. Factory set to this position.
Port Disable (A or B)	Enable (off)	Enables the port for normal operation. Factory set to this position.
	Disable (on)	Disables use of the port.
Disable R/W Diagnostics	Enable (off)	Enables internal diagnostic program to perform write operations. Factory set to this position.
	Disable (on)	Prevents internal diagnostic program from doing write operations.
Microcode ID (ID0 - ID3)		Assigns a unique device type that is interpreted by the internal microcode. Switches ID0 and ID2 are set to ON, and ID1 and ID3 are set to OFF at the factory and must not be changed.

7.4 OEM Operator Panel Connector - J21

This connector provides a convenient connection point for the SABRE-2HP drive integrator's status and/or control panel. The connector and pin assignments are described in Table 7. Status indications and control functions available thru this I/O are as follows:

7.4.1 Drive Status

1. Selected Port A

   Active Low - The port has been successfully selected; i.e., all I/O commands from controller are accepted and drive status is available.

2. Selected Port B

   Active Low - The port has been successfully selected; i.e., all I/O commands from controller are accepted and drive status is available.

3. Fault

   Active Low - Active Low signals that the drive has faulted in one of the categories shown in Paragraph 6.2.2.3.

4. Ready

   Active Low - The drive is up to speed, first seek was successful, and no fault condition exists.

7.4.2 Control Functions

1. Disable Port A

   Active Low - This control function will disable port A I/O receivers and transmitters.

2. Disable Port B

   Active Low - This control function will disable port B I/O receivers and transmitters.

3. Clear Fault

   Active Low - This control function will clear the drive's fault summary latch and remove fault status active on drive I/O. This control function is inhibited if the status/control panel accessory is used on J13.

4. Write Protect

   Active Low - This control function will inhibit any write command to the drive; i.e., the drive's write circuits are disabled.

5. Start

   Active High - This control function will initiate the drive's load operation (spin up the disks and perform the first seek) if all power sequencing requirements are satisfied (see 6.2.1.4.2.1).

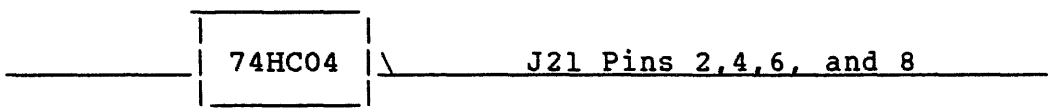
TABLE 7. J21 14 PIN CONNECTOR

3M P/N 35986002 14 pin vertical header or equivalent
(Mating connector: 3M P/N 3385-7000 14 pin)

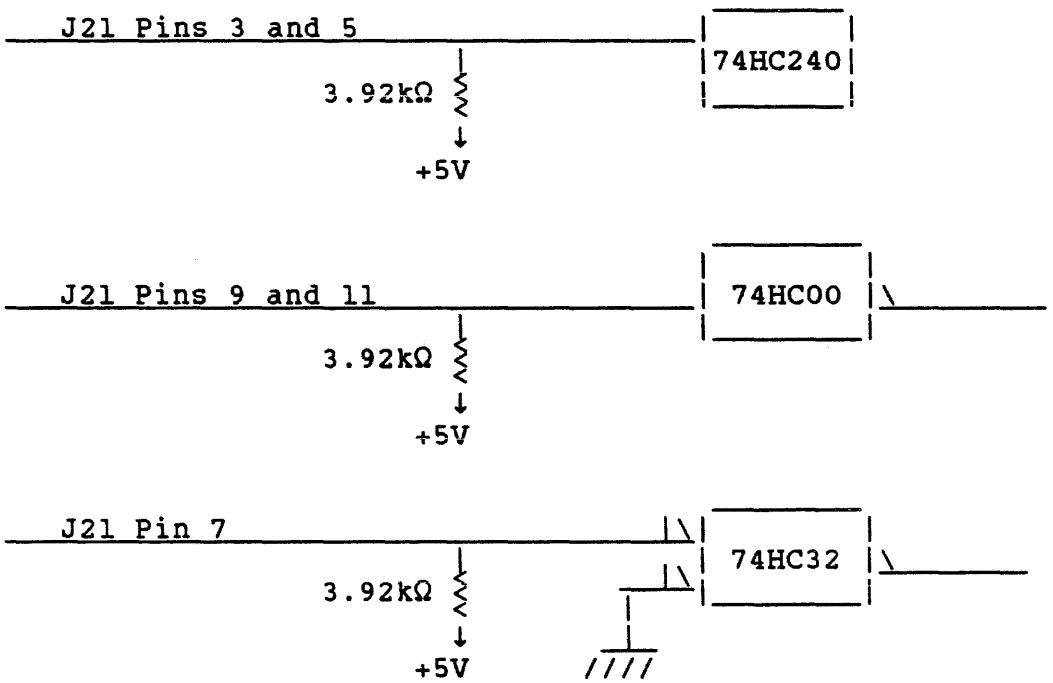
PIN NUMBER	ASSIGNMENT
1,14	GND
2	Port A Selected
3	Disable Port A
4	Port B Selected
5	Disable Port B
6	Fault
7	Clear Fault
8	Ready
9	Write Protect
10	+5 V (100 mA Max)
11	Start
12,13	No Connection

7.4.3 J21 I/O Buffer Logic (on _XDX)

1. Drive Status



2. Control Functions



8.0 PHYSICAL SPECIFICATIONS

Nominal dimensions of the drive and power supply are shown on the plan views of Figure 3.

The drive without a power supply weighs approximately 32 lbs.

The power supply weighs approximately 7 lbs.

For additional detail needed to mechanically integrate the SABRE into a user's system or subsystem cabinet see Appendix A.

9.0 RELIABILITY AND SERVICE GOALS

9.1 Mean Time Between Failure

Operating within a normal ambient environment the MTBF for the drive exceeds 100,000 hours and for the drive with the Power Supply accessory exceeds 80,000 hours.

The following expression defines MTBF:

$$\text{MTBF} = \frac{\text{Estimated power-on operating hours in the period}}{\text{Number of drive failures in the period}}$$

Estimated power-on operating hours means the estimated total power-on hours for all drives in service.

Drive failure means any stoppage or substandard performance caused by drive malfunction.

Data shall be calculated on a rolling average base for a minimum period of 6 months.

9.2 Mean Time to Repair

The mean time to repair does not exceed 0.5 hours. This is defined as the time for an adequately trained and competent service person to diagnose and correct a malfunction.

9.3 Preventive Maintenance Time

No scheduled PM is required.

9.4 Service Life

The drive is designed and constructed to provide a useful life of 5 years before factory refurbishment is required. Repair or replacement of major parts will be permitted during the lifetime. Operation in excess of this is permissible, but may result in a reduction of mature MTBF.

10.0 INSTALLATION AND MAINTENANCE

Required connections to the drive are dc power, signal cables, and a system ground consistent with User's Manual.

10.1 Power Requirements

10.1.1 DC Power Interface Requirements

The drive is a dc unit whose power requirements are shown in Table 8.

Table 8 shows the power criteria for a SABRE that operates with +5V, -5V, -12V, and +24V. It is equipped with a 13 pin connector to mate with the SABRE Power Supply accessory. The connector and pin assignments are described in Table 9.

TABLE 8. SABRE DC REQUIREMENTS

CHANNEL (Volts)	ALLOWABLE VOLTAGE RANGE (Volts) △1	OVERSHOOT UNDERSHOOT AT AC POWER-UP (Volts) △2	OVERVOLTAGE TRIP POINT (Volts) △3	RIPPLE NOISE MAX P-P	TRANSIENT RESPONSE <30 KHz MAX P-P △4 △5	LOAD CURRENT RANGE (Amperes)	OVERCURRENT RANGE (Amperes) △6
+ 5	+4.85 to +5.20 △7	0.25	+5.5 to +6.0	60 mV	100 mV	1.5 to 7.0 △8	7.5 to 9.5
- 5	-4.9 to -5.3 △9	1.0	-5.9 to -6.7	60 mV	100 mV	1.50 to 6.25	6.5 to 8.0
-12	-11.4 to -12.6	2.40		60 mV	100 mV	0.08 to 0.35	0.4 to 1.8
+24	+22.8 to +25.2	4.8		150 mV △10	2.0 V	0.12 to 9.0 △11	10 to 12

Notes for Table 8:

△1 Total allowable voltage range inclusive of ripple, noise, transient response, load variation, line voltage, frequency, and environmental conditions.

△2 All voltages must meet specifications within 1.1 s of ac power on.
All voltages must meet specifications within 100 ms after the first voltage reaches 10% of its specified value.
The +5 V output shall meet specifications at the same time or before the +24 V output is within specifications.

△3 An overvoltage of the ±5 V outputs shall cause the power supply to shut down. See Table 8 for overvoltage trip points. Shut down shall cause dc voltages to be interrupted.

△4 Transient response frequencies above 30 KHz will not be allowed.

△5 Transient response assumes +24 V changing from 0.5 A to 9.0 A within 200 us and all other voltages at a steady state.

(cont.)

6. All dc outputs shall be overcurrent protected. An overcurrent on +24 V shall cause the power supply to shut down. A -12 V overcurrent shall not shut down the power supply, the output shall be current limited by the power supply. Overcurrent on the ±5 V outputs shall reduce the output current to zero or shut down the power supply. Shut down shall cause the dc voltages to be interrupted.

7. +5 V to be centered at +5.00 ±0.05 V.

8. The +5 V Load Current range reflects the SABRE with IPI-2 Dual Channel I/O.

9. -5 V to be centered at -5.10 ±0.05 V.

10. Ripple below 1 KHz may be 1 V p-p on 24 V when the drive motor is running.

11. The +24 V average current during a 15 ms portion of the actuator signal will not exceed 3.5 A. See Figures 12, 13 and 14 for current waveforms.

12. The ±5 V ground, -12 V ground, and the +24 V ground will be shorted together in the drive. The +24 V ground return must be isolated from the ±5 V and -12 V ground returns within the power supply.

13. DC input requirements defined in Table 8 will be verified at the dc connector of the drive (J15B on GYBX PWA). -12 V dc checks should be made on the load side of inductor P121 at connector J80 pin 23 on the GYBX PWA. The SABRE must be On Cylinder; i.e., not seeking, and in a Read/Write mode.

14. Ripple + Noise limits given in Table 8 must be verified by looking at dc channel with a X1 probe. Grounding of test equipment and drive are critical to collecting accurate data; observe the following grounding requirements:

    - Oscilloscope must be plugged into the same power bus as the drive power supply.
    - X1 probe ground leads must be kept to a length of less than 3 inches.
    - A 1/4 inch wide ground braid, 4 inches or less in length, must be tied between dc ground on the module and ac ground on the power supply.

TABLE 9. J15 13 PIN CONNECTOR

AMP MTA 156 series, Post Header PN 1-641210-3 (13 pin) or equivalent
(Mating Connector: AMP 1-641217-3 (13 pin) and Cover: AMP 1-643069-3)
Mating Connector on dc cable must be keyed at Pin 9

PIN NUMBER	ASSIGNMENT
1	+5 Volts High
2	+5 V Sense
3	GND (± 5V, -12V)
4	±5 V Sense Return
5	-5 Volts High
6	-5 Volts Sense
7	-12V High
8 *	+ Power OK
9	Key
10,11	GND (+ 24V)
12,13	+24 Volts High

* Pin 8 (+Power OK) - Drive receiver is a 74F32 device with input termination of 1 kΩ pull up to +5 V and 0.1 µF capacitor to ground.

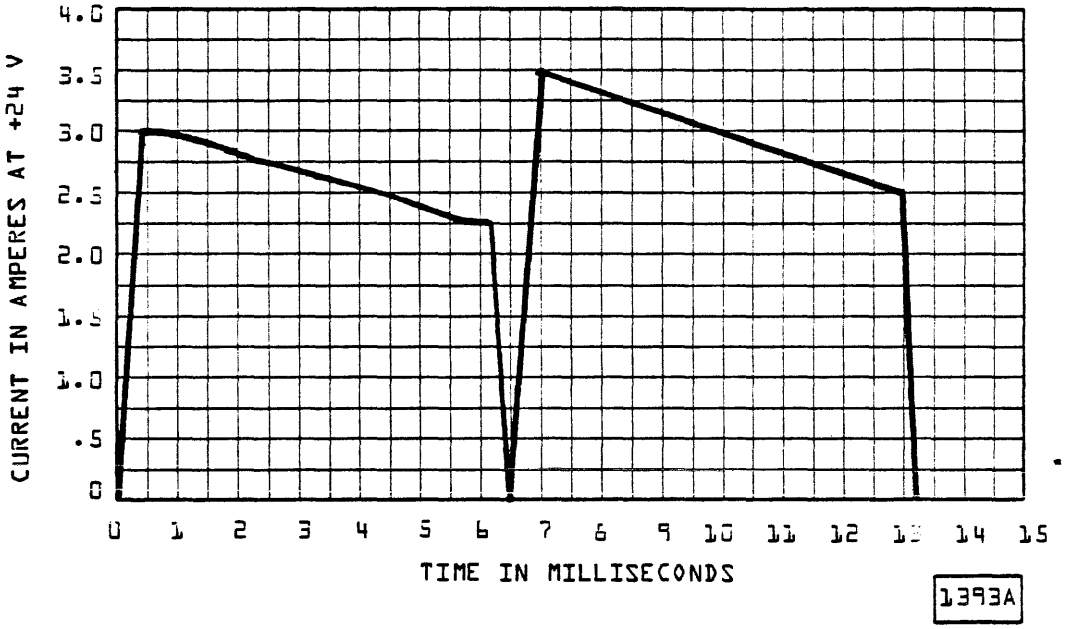
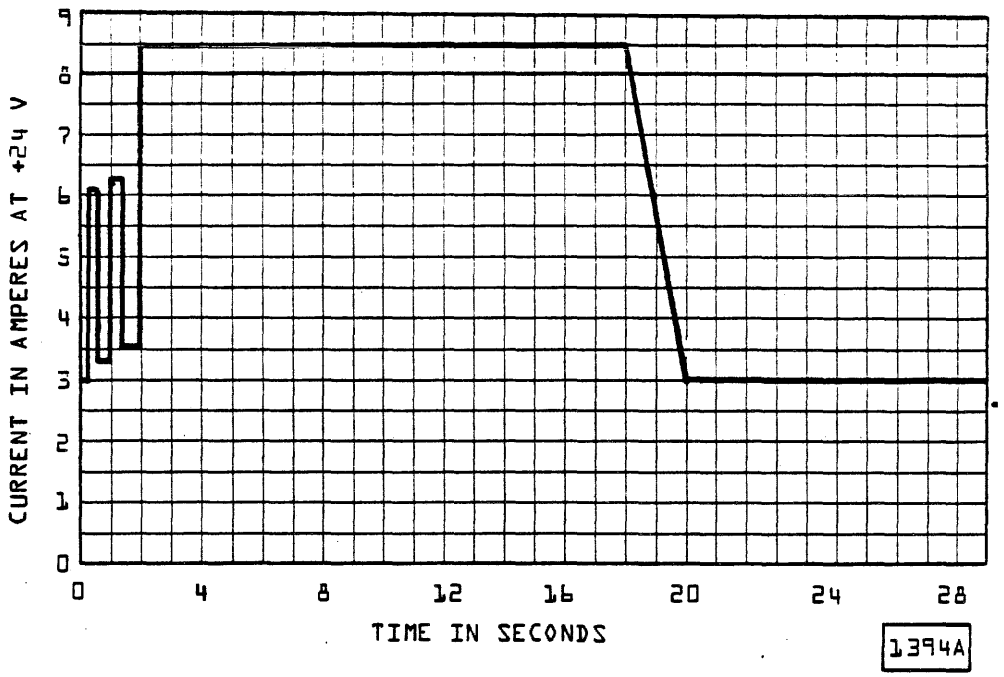
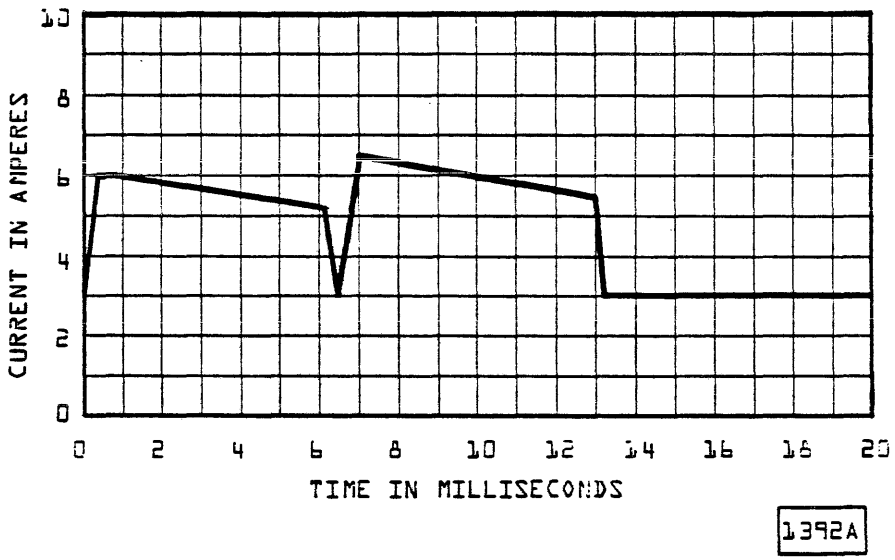


FIGURE 12. WORST CASE ACTUATOR CURRENT REQUIREMENT



NOTE: FOR TOTAL CURRENT DRAW ADD 0.5 A STEADY STATE TO THE MOTOR CURRENT TO ACCOUNT FOR OTHER DRIVE ELECTRONICS.

FIGURE 13. WORST CASE SPINDLE MOTOR CURRENT REQUIREMENTS



NOTE: FOR TOTAL +24 V CURRENT DRAW, ADD 0.5 A STEADY STATE TO ACCOUNT FOR OTHER DRIVE ELECTRONICS.

FIGURE 14. PREDICTED TOTAL WORST CASE CURRENT REQUIREMENTS FOR +24 V CHANNEL (DRIVE READY AND SEEKING)

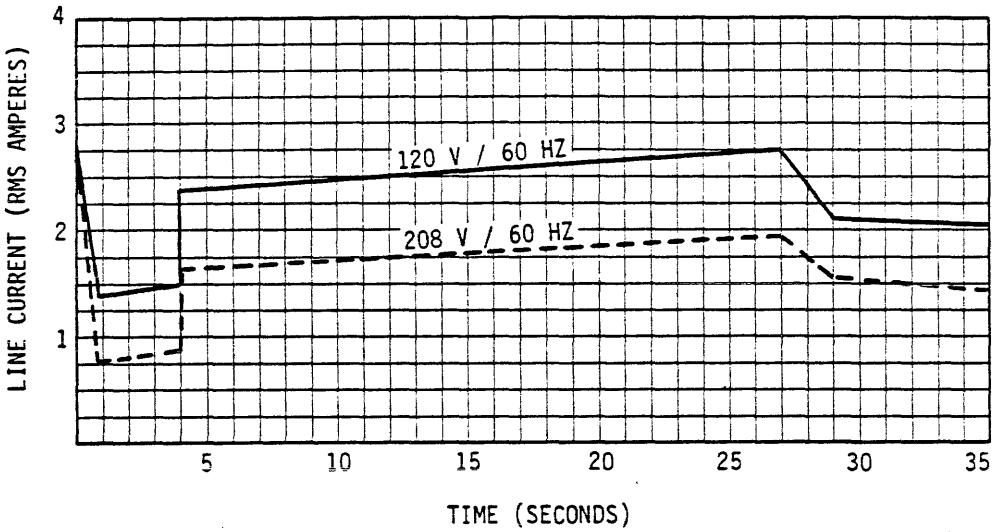
10.1.2 Primary Power Requirements

An SABRE power supply is available (see 3.2) which has input parameters as shown in Table 10. The 2 voltage ranges shown are switch selectable by the user. The range switch is factory set for 208 thru 240 V. See 10.1.3 for variations of the ac power cords.

TABLE 10. PRIMARY FREQUENCY, VOLTAGE, AND POWER REQUIREMENTS

FREQUENCY			VOLTAGE			DISKS AND CARRIAGE IN MOTION TYPICAL VALUES			
						LINE CURRENT AMPS	ENERGY CONSUMPTION KW	HEAT DISSIPATION BTU/H	POWER FACTOR
NOM	MIN	MAX	NOM	MIN	MAX				
50 THRU 60	48	62	100 THRU 120	85	132	2.24 THRU 1.93	.151 THRU .152	515 THRU 519	.67 THRU .66
			208 THRU 240	177	264	1.51 THRU 1.22	.151 THRU .152	515 THRU 519	.67 THRU .66

Start-up current is shown in Figure 15. Peak inrush current for 1/2 cycle will not exceed 48 A at low range or 32 A at high range.



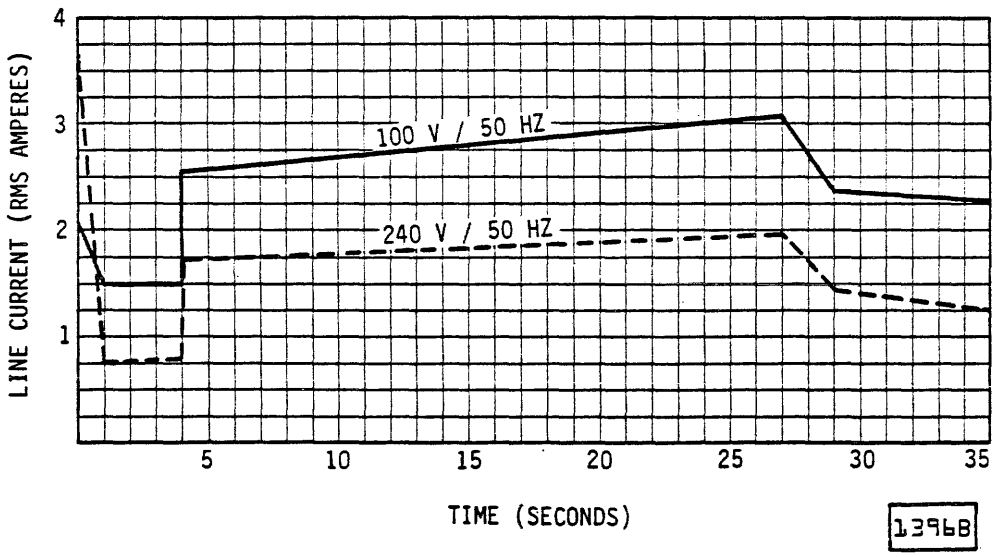
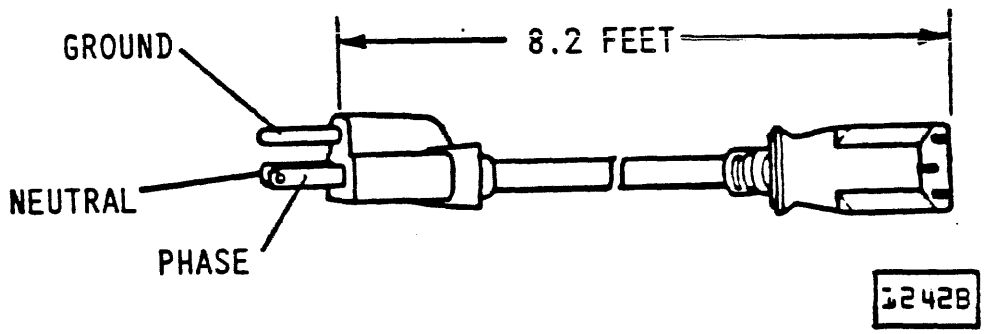


FIGURE 15. TYPICAL LINE CURRENT VERSUS START-UP TIME

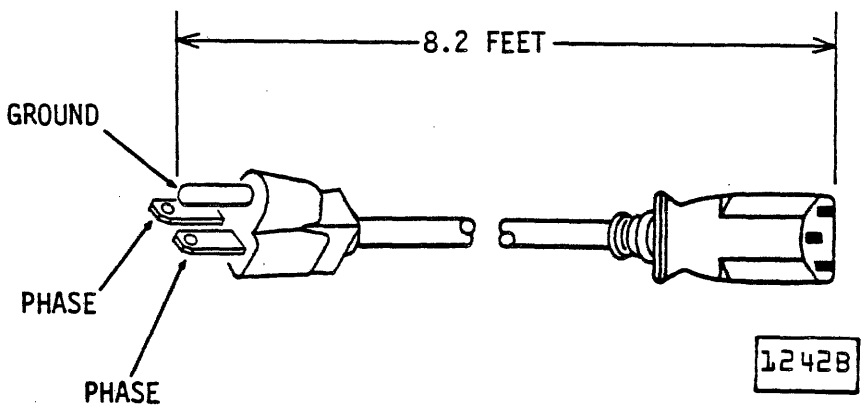
10.1.3 AC Power Connectors

10.1.3.1 60 Hz

A connector/cord assembly is available with each 60 Hz power supply in the configuration of Figure 16. A NEMA type 5-15P connector plug is provided on the 120 V Power Cord and a type 6-15P for the 208/220/240 V Power Cord.



A. 120 V POWER CORD



B. 208/220/240 V POWER CORD

FIGURE 16. 60 HZ POWER CONNECTORS

10.1.3.2 50 Hz

A connector/cord assembly is available with each 50 Hz power supply in the configuration of Figure 17. A European type connector plug is provided on each cord.

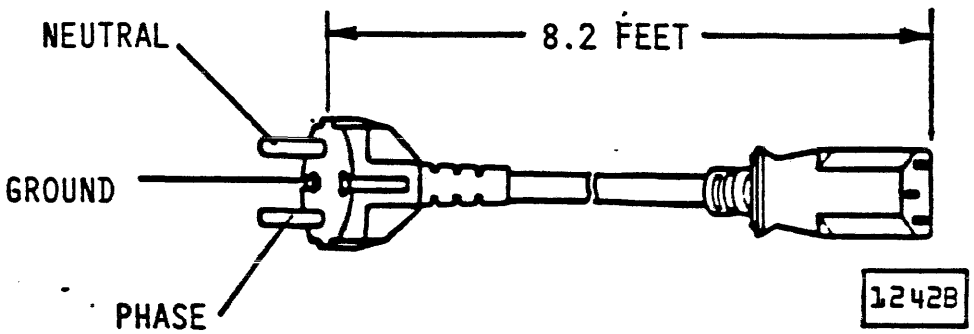


FIGURE 17. 50 HZ POWER CONNECTOR

10.1.3.3 Short Power Cable Set

An ac short power cable set is available with each power supply in the configuration of Figure 18. This cord mates with the power cords shown in Figures 16 and 17.

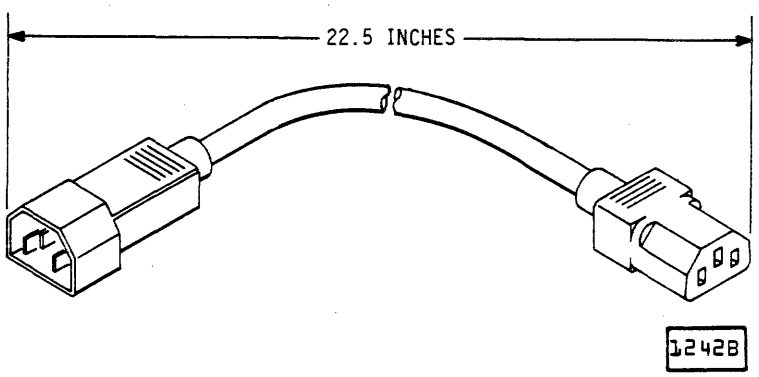


FIGURE 18. AC SHORT POWER CORD SET

10.2 Grounding Requirements

Proper grounding between the drive, power supply, and ac short power cord set must be established to meet FCC and VDE electronic emission requirements. Detailed instructions are in the User's Manual (see 2.0).

10.3 Environmental Limits (Drive and Accessories)

MPI certifies the SABRE for compliance with FCC and VDE class A emission requirements only when used with the power supply accessory listed in Table 1, and when properly grounded per 10.2; otherwise the package design for compliance is the responsibility of the end user.

10.3.1 Operating Environment

The unit will operate to Specifications when subjected to the following:

Temperature	10°C to 45°C (50°F to 113°F) with a maximum change of 15°C (27°F) per hour. Max wet bulb temp of 26°C (79°F).
Humidity	20% to 80% relative, no condensation.
Barometric Pressure	104 kPa to 69 kPa (-1000 ft to 10,000 ft)
Shock	3 g's for 10 ms, any axis. No more than 2 shocks per second.
Vibration	Sinusoidal vibration of 0.2 g's from 5 to 50 Hz, 1 g from 50 to 500 Hz, any axis.

During operation, shock and/or vibration caused system errors which are recoverable/resetable via the interface controlled signals, are allowed.

10.3.2 Non-Operating Environment (Unpackaged)

The unit, in the unpacked condition, with power off, will withstand the following environmental conditions without damage. Shock and vibration input must be thru the drive shock mount isolators:

Temperature	10°C to 45°C (50°F to 113°F) with a maximum change of 15°C (27°F) per hour. Max wet bulb temp of 26°C (70°F).
Humidity	20% to 80% relative, no condensation.
Barometric Pressure	104 kPa to 69 kPa (-1000 ft to 10,000 ft)
Shock	20 g's for 10 ms, any axis, with no less than 5 seconds between shocks.
Vibration	Sinusoidal vibration of 0.5 g's from 5 to 50 Hz, 1 g from 50 to 500 Hz, any axis.

10.3.3 Storage Environment (Packaged)

In its shipping container as packaged by MPI, the unit will withstand the following without damage while in storage for periods up to 3 years:

Temperature	-10°C to 50°C (14°F to 122°F) with a maximum change of 15°C (27°F) per hour.
Humidity	5% to 95% relative.
Barometric Pressure	104 kPa to 69 kPa (-1000 ft to 10,000 ft)
Shock	Packaged units will withstand 36 inch drop. See 10.3.5.
Vibration	Resonance - 4 Hz to 100 Hz at 0.5 g's.

10.3.4 Transit Environment (Packaged)

In its shipping container as packaged by MPI, the unit will withstand the following without damage while in transit in common carriers:

Temperature	-40°C to 60°C (-40°F to 140°F) with a maximum change of 20°C (36°F) per hour.
Humidity	5% to 95% relative.
Barometric Pressure	104 kPa to 19 kPa (-1000 ft to 40,000 ft)
Shock	Packaged units will withstand 36 in. drops. See 10.3.5.
Vibration	Resonance - 4 Hz to 100 Hz at 0.5 g's.

10.3.5 Multiple Equipment Packaging

When the SABRE Disk Drive is packaged with accessory items chosen from Table 1, the total packaged weight will vary according to the accessories included and the package configuration. Packages with a gross weight of 21 lbs. to 50 lbs. will withstand 36 in. drops. Packages with a gross weight of 51 lbs. to 100 lbs. will withstand 30 in. drops.

APPENDIX A

MECHANICAL INTERFACE

A1.0 SCOPE

This Appendix defines the mechanical interfaces for the SABRE-2HP, accessories, center of gravity, and cooling air flow.

A2.0 APPLICABLE DOCUMENTS

None

A3.0 MOUNTING CRITERIA

All components are designed to mount within the envelope of the Rack Mounting Kit which in turn is designed for a standard ANSI/EIA 19 inch rack. The kit will accommodate 1 or 2 SABREs. The components of the Rack Mount Kit are shown in Figures A1A and A1B, and the critical dimensions are shown in Figure A2A and A2B.

The user may elect not to use the Rack Mounting Kit in which case mounting dimensions for the drive are shown in Figure A3 and for the drive and fan mounting kit in Figure A4. The mounting dimensions for the power supply accessory are shown in Figure A5, the Status/Control Panel and Operator Panel accessories in Figures A6 and A7, and the I/O Cable Clamp in Figure A8.

SABREs may be mounted either horizontally or vertically as may the power supply. For interconnecting cable lengths see Table 2.

To prevent contact between the SABRE and any surrounding rigid surface when the SABRE is subjected to shock and vibration, a minimum clearance of 0.2 inches on all sides must be provided in the user's mounting design.

For Accessory part numbers see Table 1.

A4.0 CENTER OF GRAVITY

The SABRE has centers of gravity as shown in Figures A3 and A4. Mounting design should provide for a non-tip mechanism based on a weight of 32 lbs at this CG (or 32.8 lbs if the unit includes the Fan Mounting Kit). The power supply weight is 7 lbs max.

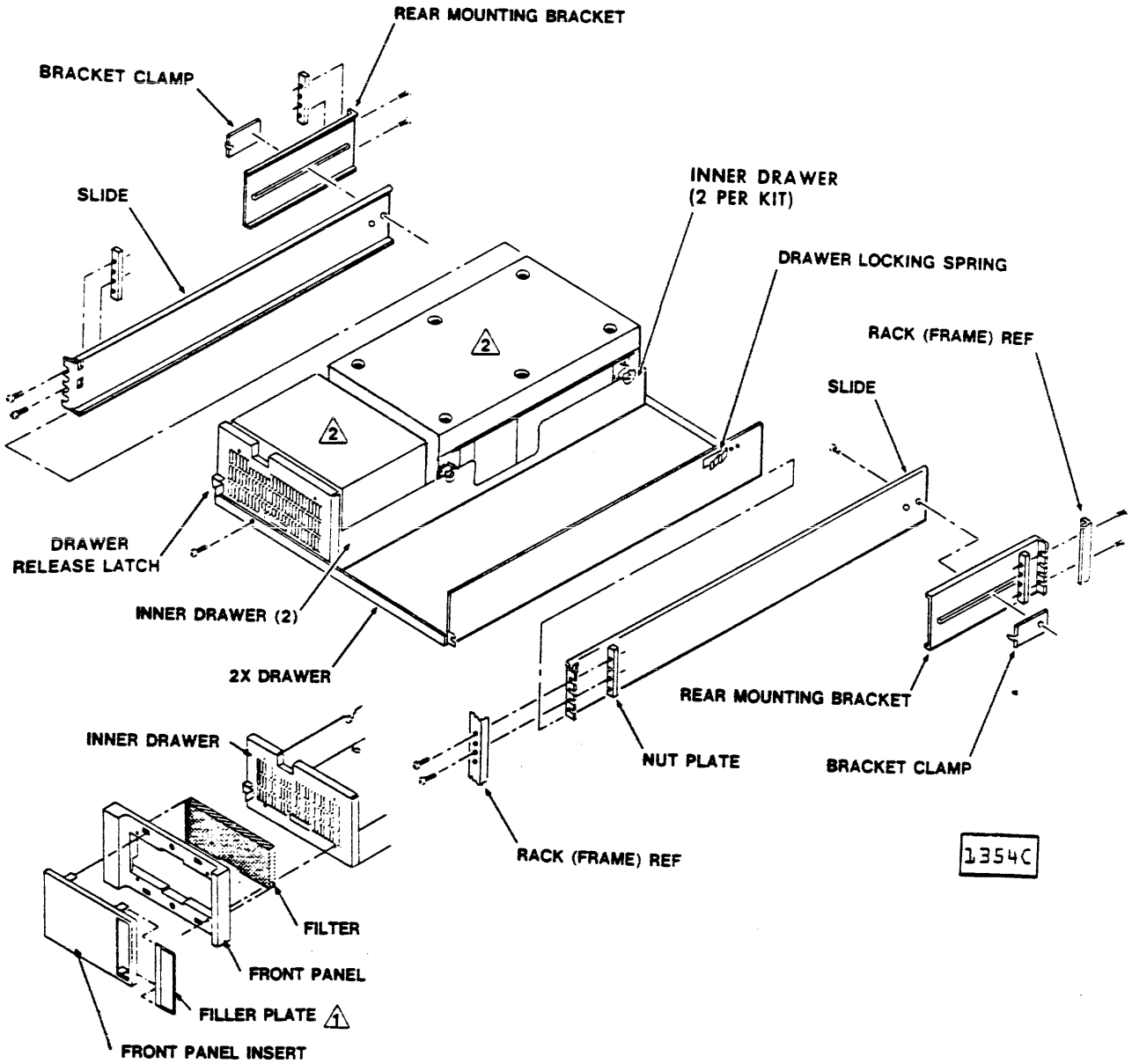
A5.0 AIR FLOW

Racks, cabinets, or other enclosures must provide inlet and exhaust openings for fan driven air flow across the SABRE electrical components, head disk assembly, and power supply (see Figure A9). An opening of 5 in^2 for each drive or drive and power supply combination can be used as a minimum design figure for each opening.

Air inlet and exhaust openings may be provided at any convenient points on the enclosure. It is recommended that the exhaust opening be selected to provide the shortest possible path for air heated by the SABRE to exit the enclosure.

To confirm that required cooling for the drive electronics is being provided, place the drive in a random seek mode and measure the case temperatures of the components listed below when they stabilize. The maximum case temperatures of the devices listed below linearly follow test ambient changes from +10°C to +45°C. The case temperatures shown in the table below are the maximum temperatures based on inlet air of +25°C.

COMPONENT	ASSY (PWA)	POSITION (X - Y)	MAX CASE TEMP (°C)
75176B (Tranceiver)	LYBX	G137	
U17 (Dibit Demodulator Array)	GYBX	Q249	
317 LM (+12 V Regulator)	GYBX	W7119	TBD
D44E3 (Spindle Motor Power Xistor Q13)	GYBX	R517	
D45H11 (Actuator Coil Power Xistor)	GYBX	K322	
10192 (ECL Transmitter)	GYBX	B1103	
XC32201-11 (2-7 Encode Decode)	GYBX	D599	

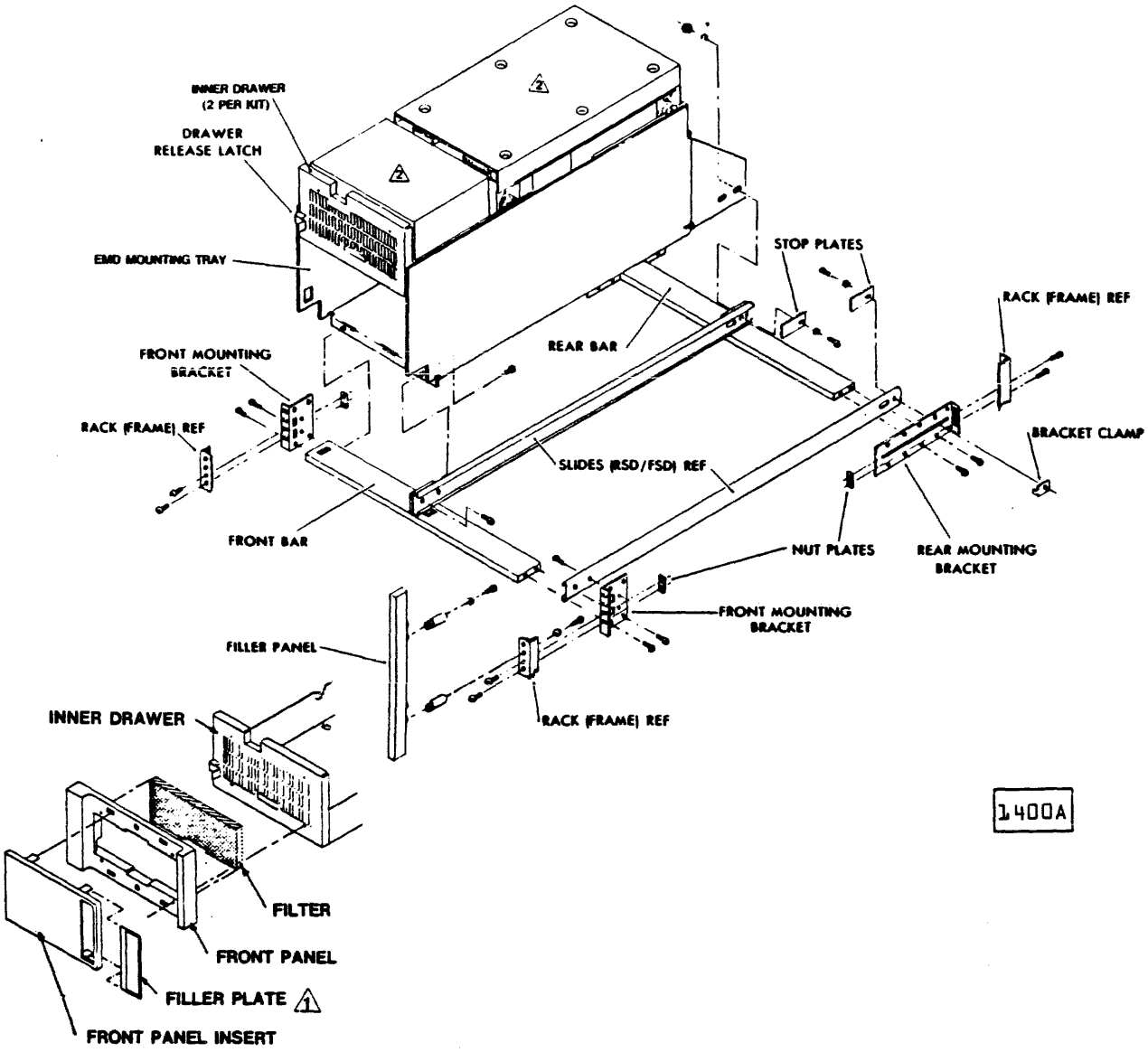


FRONT PANEL ASSEMBLY

1. FILLER PLATE IS USED TO COVER THE ACCESS PORT ON THE FRONT PANEL INSERT WHENEVER THE STATUS/CONTROL PANEL OR THE OPERATOR PANEL ACCESSORIES ARE NOT USED.

2. DRIVE AND POWER SUPPLY ARE SHOWN WITH THE RACK MOUNT KIT FOR REFERENCE ONLY.

FIGURE A1A. RACK MOUNT KIT COMPONENTS



FRONT PANEL ASSEMBLY

1 FILLER PLATE IS USED TO COVER THE ACCESS PORT ON THE FRONT PANEL INSERT WHENEVER THE STATUS/CONTROL PANEL OR THE OPERATOR PANEL ACCESSORIES ARE NOT USED.

2 DRIVE AND POWER SUPPLY ARE SHOWN WITH THE RACK MOUNT KIT FOR REFERENCE ONLY.

FIGURE A1B. O/U RACK MOUNT KIT COMPONENTS

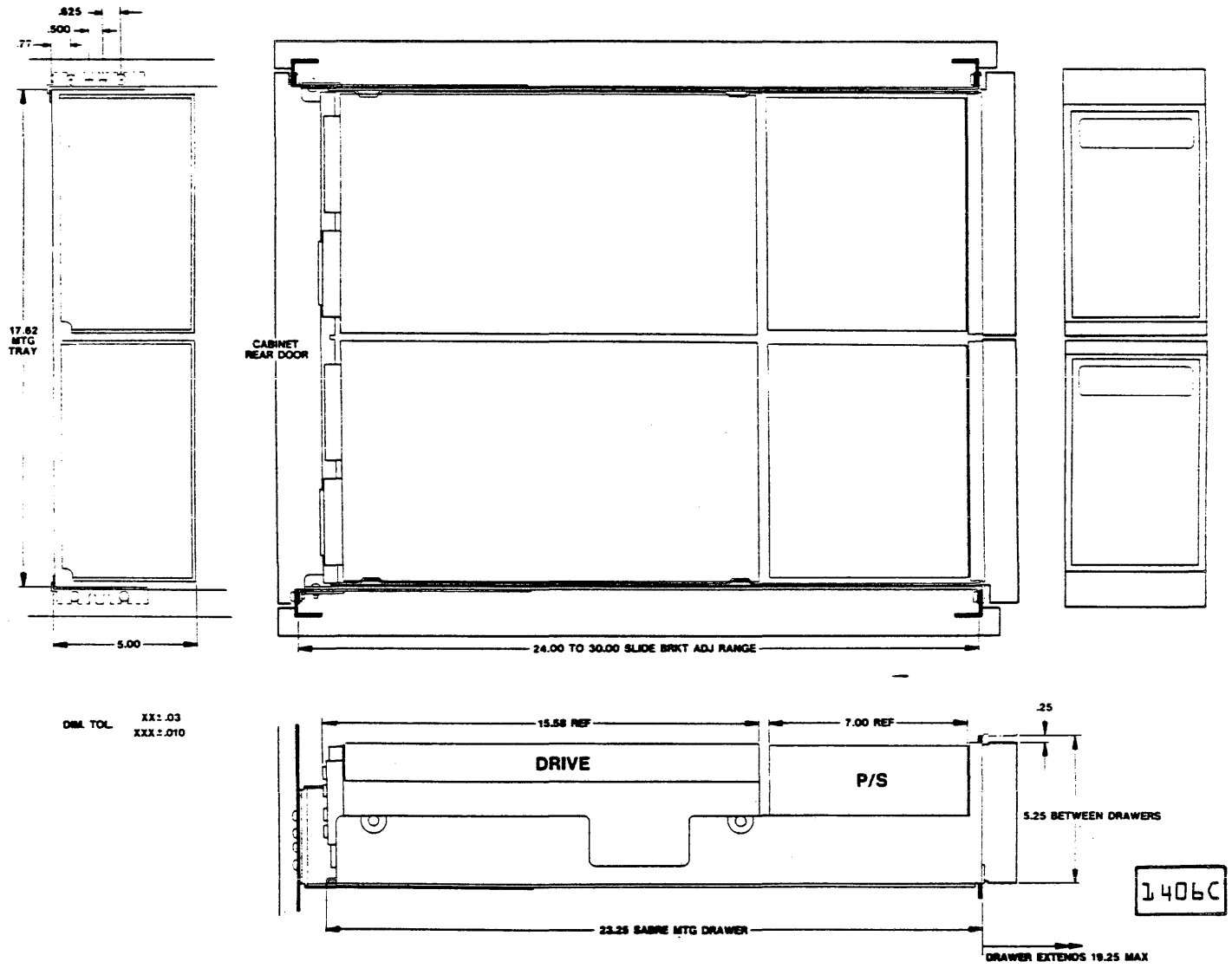


FIGURE A2A. CRITICAL DIMENSIONS OF THE RACK MOUNT KIT

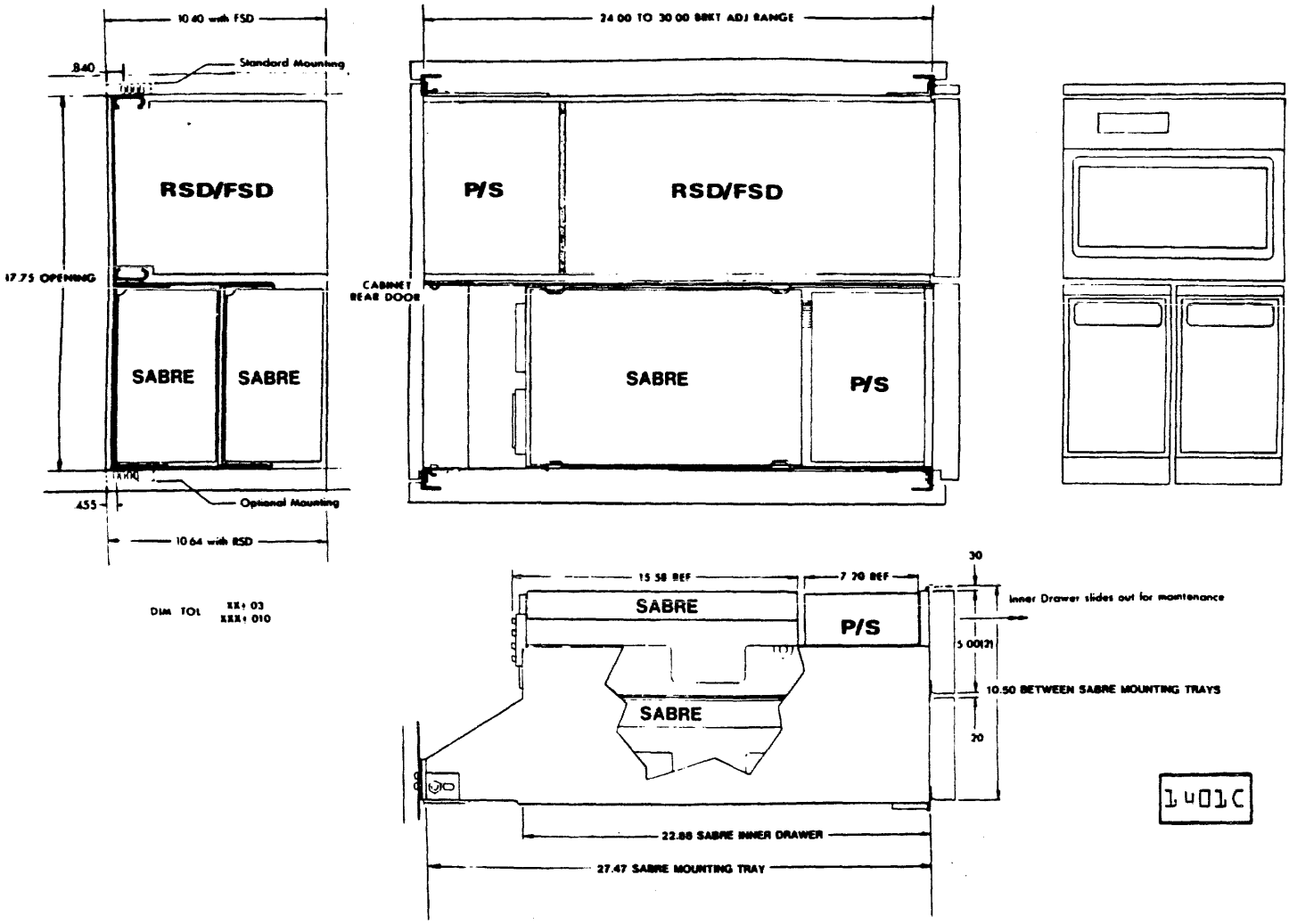


FIGURE A2B. CRITICAL DIMENSIONS OF THE O/U RACK MOUNT KIT

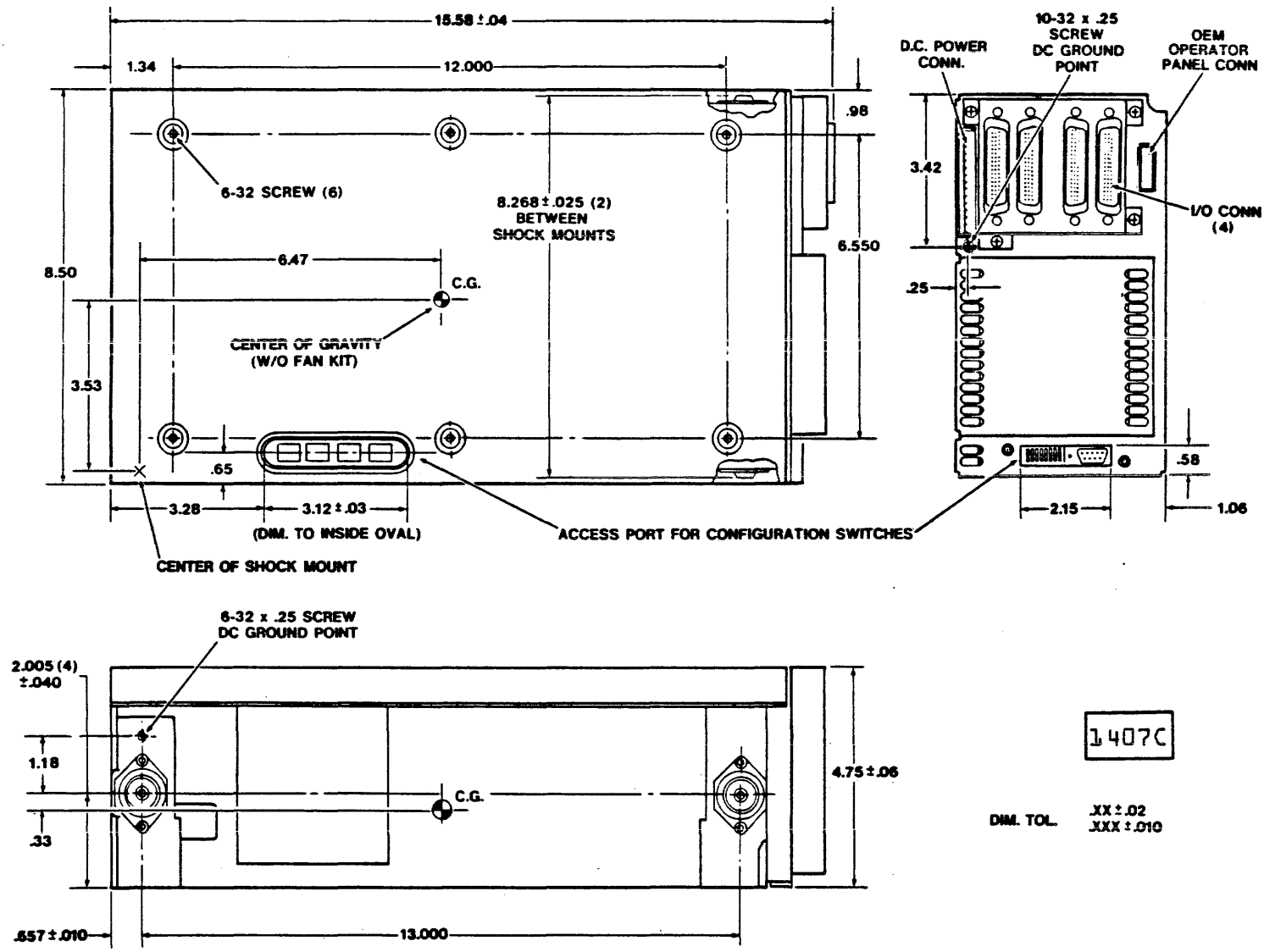


FIGURE A3. CRITICAL DIMENSIONS OF THE SABRE

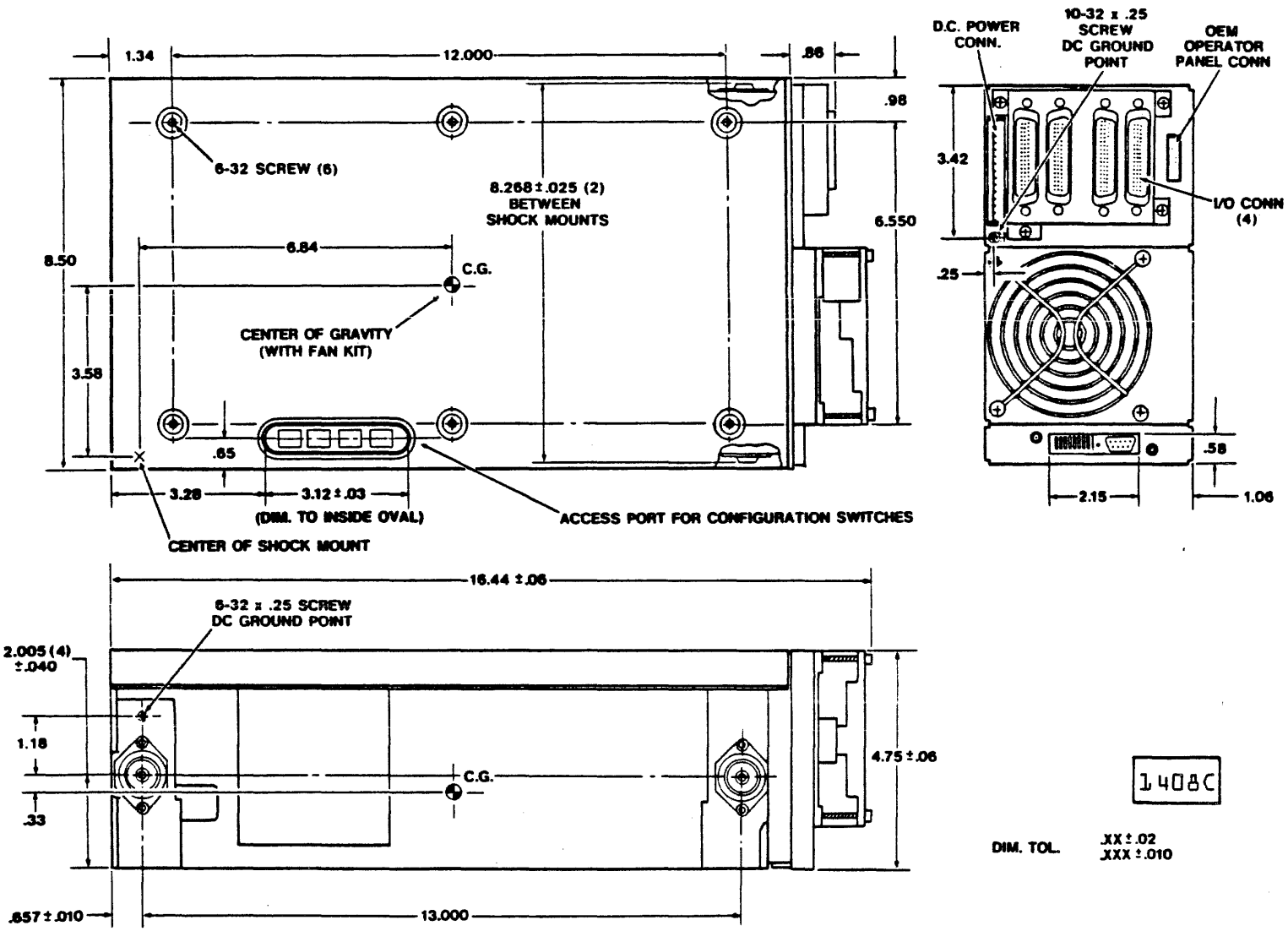
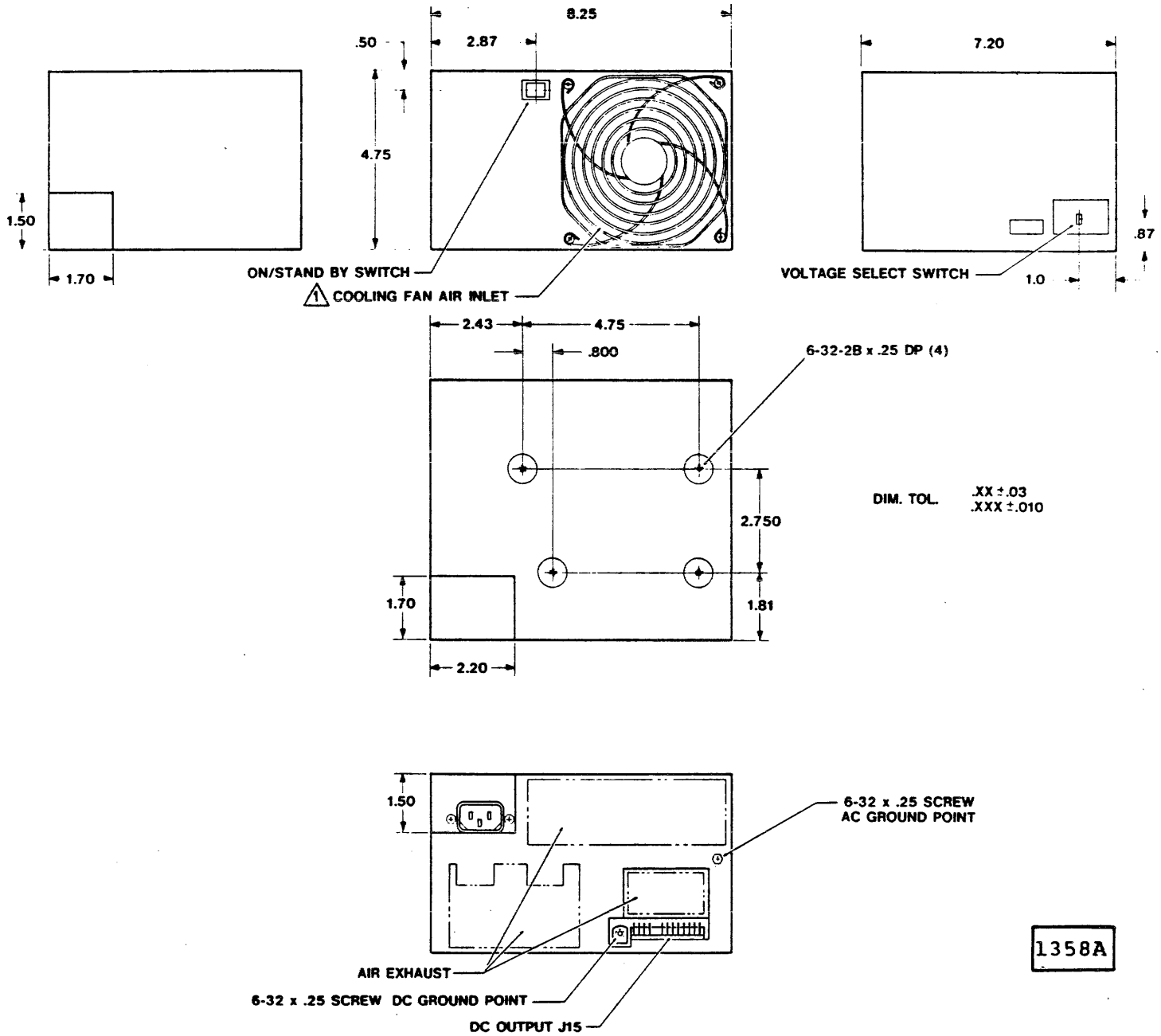


FIGURE A4. CRITICAL DIMENSIONS OF THE SABRE AND FAN MOUNTING KIT



1 COOLING FAN AIR INLET AREA WILL BE COVERED BY EITHER A PUNCHED (SLOTTED) FRAME OR BY A ROUND WIRE FAN GUARD.

FIGURE A5. POWER SUPPLY PHYSICAL DIMENSIONS

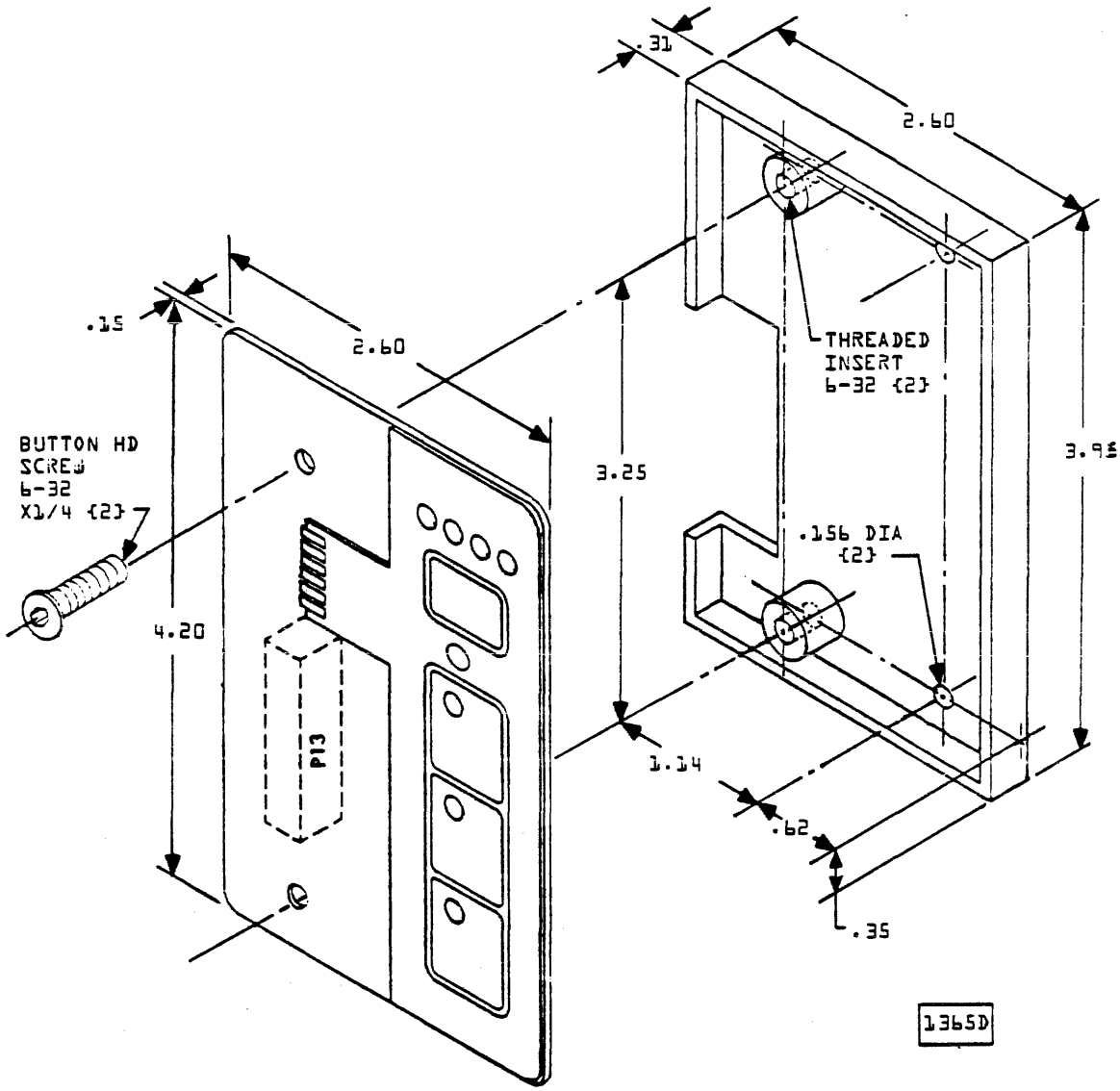


FIGURE A6. OPERATOR PANEL DIMENSIONS

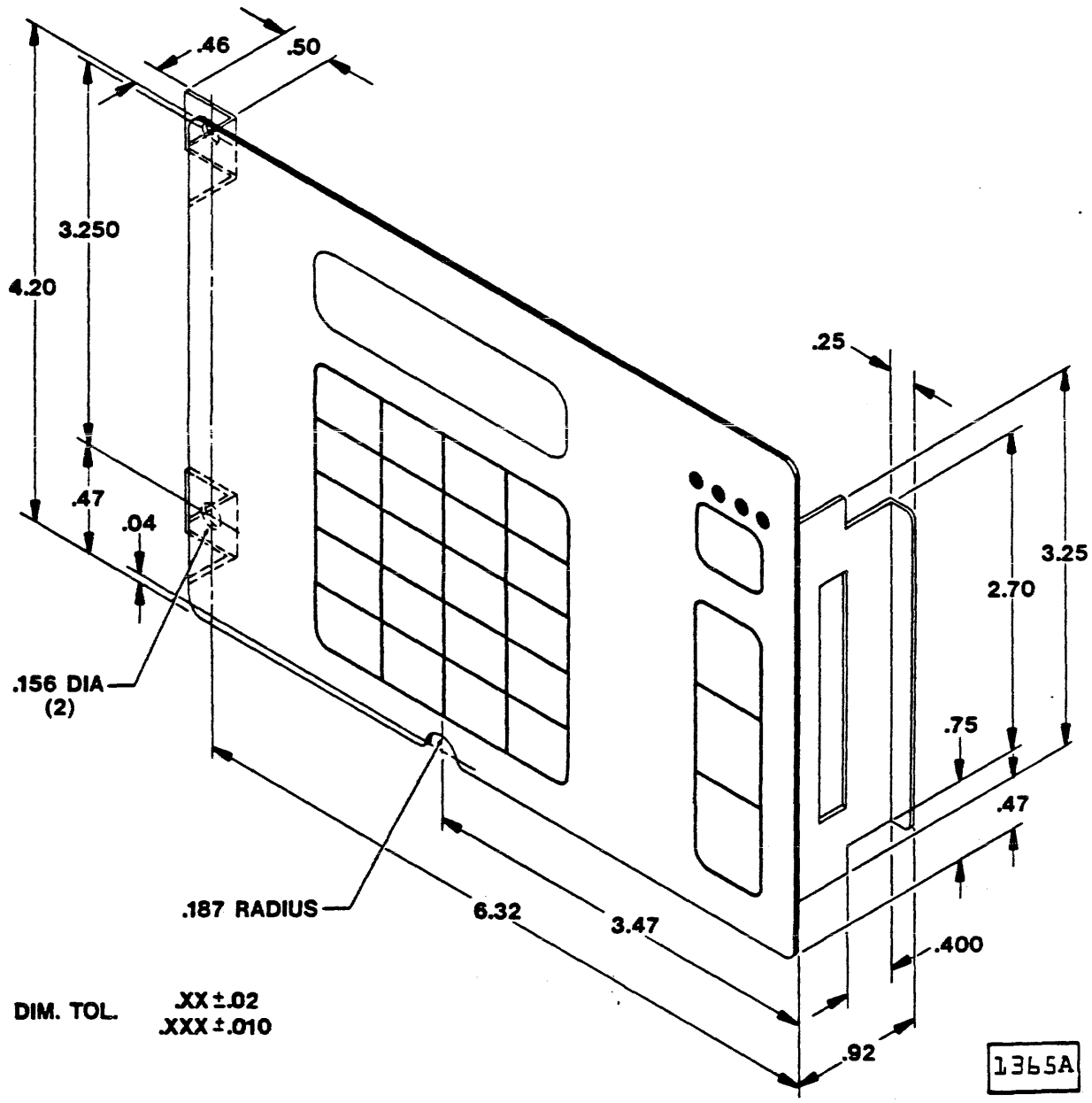


FIGURE A7. STATUS/CONTROL PANEL DIMENSIONS

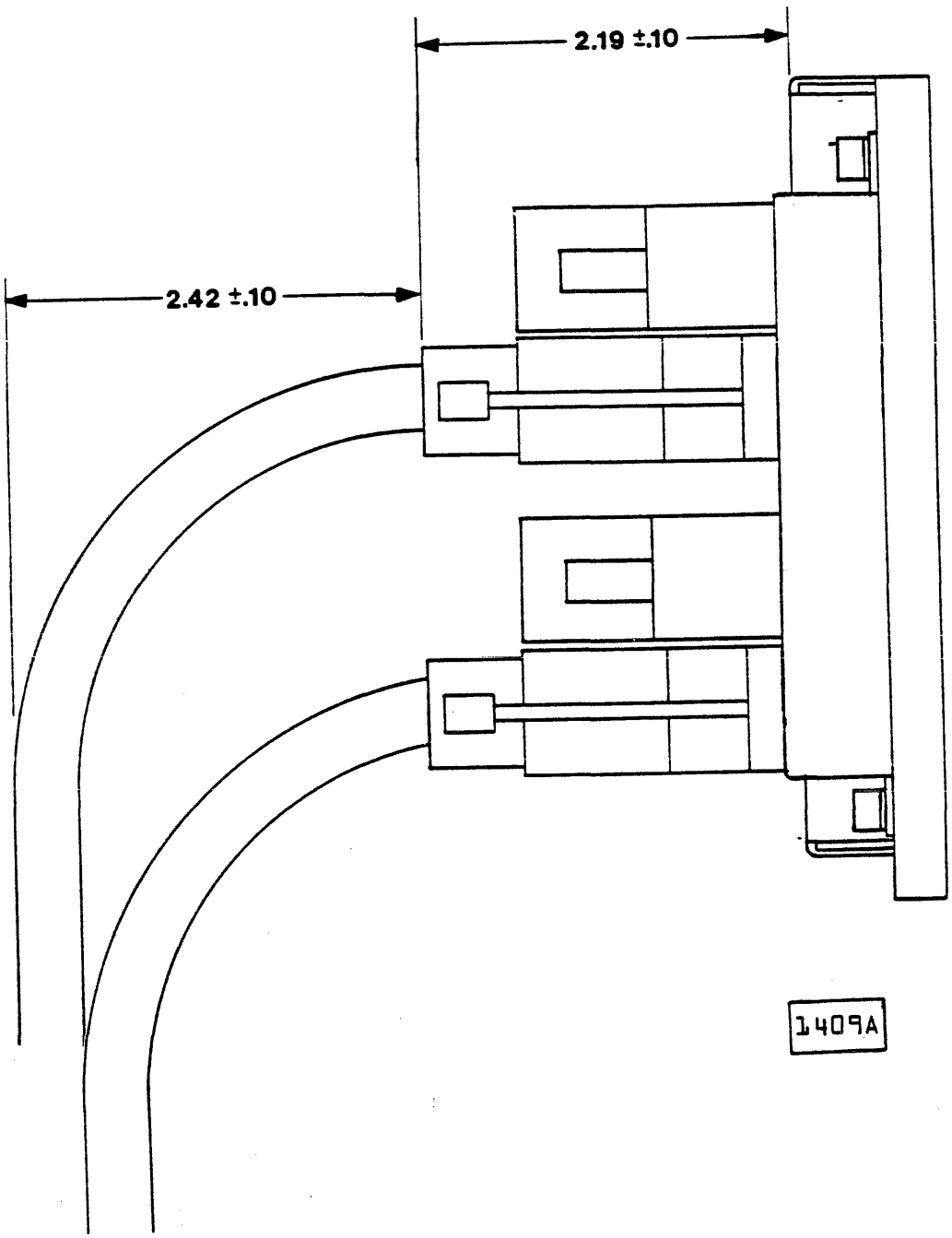


FIGURE A8. I/O CABLE STRAIN RELIEF AND SHIELD

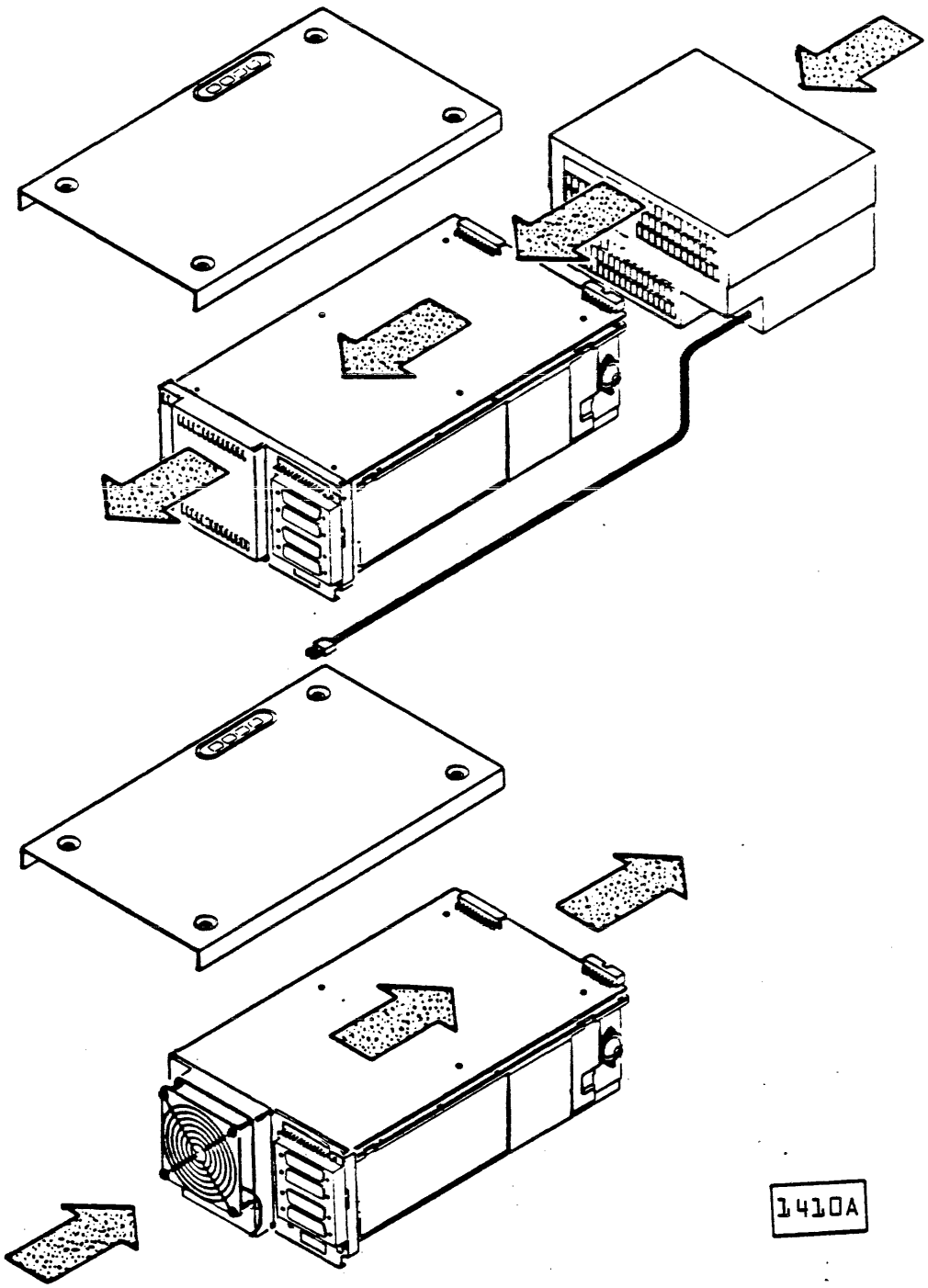


FIGURE A9. SABRE AIR FLOW SYSTEM