WANG

3105

CDC®CARTRIDGE MODULE DRIVE BK4xx

Models:

2280-1, 2280V-1, 6580V-1,	(26.8 MB)
2280-2, 2280V-2, 6580V-2,	(53.7 MB)
2280-3, 2280V-3, 6580V-3,	(80.5 MB)

Customer Engineering
Product Maintenance Manual
OEM Reprint

741-1063-A

PREFACE

The purpose of this manual is to provide the Wang-trained Customer Engineer (CE) with sufficient instructions to operate, troubleshoot, and repair the Cartridge Module Drive, Models 2280, 2280V and 6580.

Fifth Edition (August, 1986)

This publication is a reprint of the Control Data Corporation Cartridge Module Drive Manual (77683555), which obsoletes WLI Publication 741-1063 and incorporates PUB 741-1063-1. Use of the material in this publication is authorized only for the purpose stated in the Preface, above. Updates and/or changes to this publication will be published as Publications Update Bulletins (PUBs) or subsequent editions.

77683555

CONTROL DATA CORPORATION

CONTROL DATA®

CARTRIDGE MODULE DRIVE

(OEM)

OPERATION
INSTALLATION AND CHECKOUT
THEORY OF OPERATION
DIAGRAMS
MAINTENANCE
PARTS DATA
WIRE LISTS

MAGNETIC PERIPHERALS, INC
a Control Data Company

HARDWARE MAINTENANCE MANUAL

REVISION RECORD

REV	DATE	MANUAL SECTION REVISION STATUS										CHANGE AUTHORITY
		1	2	3	4	5	6	7	8	9	10	
W	Oct 16, 84lc	B	J	L	G	S	V	H	D			PL 60490
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MAGNETIC PERIPHERALS INC.
Printed in the United States of America

Address all comments concerning this publication to the distributor or use the enclosed user comment sheet located in the back of this publication.

PREFACE

This Manual provides the information needed to install, operate and maintain the Cartridge Module Drive (CMD) and is intended to serve customer engineers and operators who require detailed information about the Cartridge Disk Drive operations.

The total content of the Manual is comprised of eight sections, each having a unique publication number, and is contained in one volume. The manual's publication number is that of the Table of Contents and Front Matter (77683555). This number, along with the unit HPC number, should be used when making reference to the Cartridge Module Drive Product Manual.

The following table identifies the content of each volume:

SECTION NUMBER/TITLE		PUBLICATION NUMBER
1	GENERAL DESCRIPTION	77683556-3
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*In some instances the documentation for special option circuit boards is part of the Hardware Product Configuration (HPC) documentation package in front of this manual.

OPERATOR SAFETY INSTRUCTIONS

1. The power cord must be plugged into a power outlet. This outlet must be readily accessible to the operator in case of emergency.
2. To operate this unit, the operator must depress the START/-STOP pushbutton switch located at the front of the disk unit.
3. This unit must be serviced only by qualified technical personnel after removing power cord from outlet.
4. In case of emergency, operator must remove power cord from outlet and contact the proper technical service office.

SICHERHEITS - GEBRAUCHSANWEISUNG

1. Das Anschlusskabel ist in die Steckdose, die in der Nähe des Gerätes montiert ist, einzustecken. Der Netzstecker muss leicht und gefahrlos zugänglich sein.
2. Zur Inbetriebnahme, sowie zum Ausschalten des Gerätes, wird der Start-Stop Druckschalter an der Vorderseite betätigt.
3. Das Gerät darf nur von Fachpersonal nach dem Ziehen des Netzsteckers geöffnet werden.
4. Im Falle eines technischen Defektes, ist der Netzstecker zu ziehen und der kundendienst zu verständigen.

NOTICE

This equipment has been designed as component to high standards of design and construction. The product, however, must depend on receiving adequate power and environment from its host equipment in order to obtain optimum operation and to comply with applicable industry and governmental regulations. Special attention must be given by the host manufacturers in the areas of safety, power distribution, grounding, shielding, audible noise control, and temperature. Regulation of the device to insure specified performance and compliance with all applicable regulations.

WARNING

This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of the FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

WARNING

"This product is an electromechanical device which could present hazards if improperly handled. The device should be maintained only by qualified personnel in accordance with instructions contained in this manual and sound safety practices. Careless disassembly or maintenance procedures may result in damage to the device or injury to personnel. Observe all CAUTIONS or WARNINGS attached to the device or contained in this manual.

These WARNINGS and or CAUTIONS are not exhaustive. The manufacturer cannot know in advance all possible maintenance procedures, or tools, which may be devised by persons who choose not to follow the instructions in this manual. Any deviation from the prescribed procedures may entail risks which have not been evaluated by the manufacturer.

Any persons who use a non-approved procedure or tool must satisfy themselves that no injury to personnel, no damage to the device, and no deterioration of device performance will result."

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SECTION 1
GENERAL DESCRIPTION

SECTION 1
GENERAL DESCRIPTION

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1.1 INTRODUCTION

The Cartridge Module Disk Drive (CMD) is designed to interface with and provide peripheral storage capabilities for data processing systems.

1.2 GENERAL DESCRIPTION

1.2.1 PHYSICAL AND FUNCTIONAL

The standard CMD is a versatile rack mounted, high-performance, random access, mass-memory device with a 96 megabyte capacity. The device features a front-loading cartridge of 16 megabytes capacity with optional add-on memory capacity of 16, 48, or 80 megabytes from one, two, or three fixed disks. The CMD has a very fast average access time of 30 ms and the data-transfer rate is 9.67 MHz.

The Cartridge Module Drive can be connected to its associated controller in either a star or daisychain configuration of up to 8 CMD units, resulting in a maximum storage capacity of 768 megabytes.

A strapping option is provided in 16 megabyte increments on the fixed media surfaces. Programmable shunts on the Control/Mux PWA implement this option (i.e. a 96 megabyte unit may be strapped to become a lower capacity unit in 16 megabyte increments).

The drive contains: a cartridge receiver; spindle, drive motor and braking system; fixed-media, read/write and servo heads; voice-coil positioner and track-following servo; an Electronics Module containing read/write, microprocessor, I/O, servo and drive control electronics; filtered-air supply; and a DC power supply. See Figure 1-1 for the location of these elements. A hinged front door provides access for the insertion and removal of the front-load cartridge. A removable cover provides access to the electronics, heads, actuator and power supply.

1.2.2 STANDARD FEATURES

The standard CMD is mountable in a 19-inch rack in 10.5 inches of rack space, extending 31.75 inches to the rear. (See Figure 1-2.)

The following are standard features of the CMD:

- 16 MB front-load cartridge receiver (cartridge not included)
- Hard-sector configurations up to 127
- Spindle brake
- Address-mark detection
- Servo offset

- Early/late date strobing
- Write pre-compensation
- Independent manual write protect on fixed and/or cartridge media
- Internal fault monitoring
- Microprocessor control logic

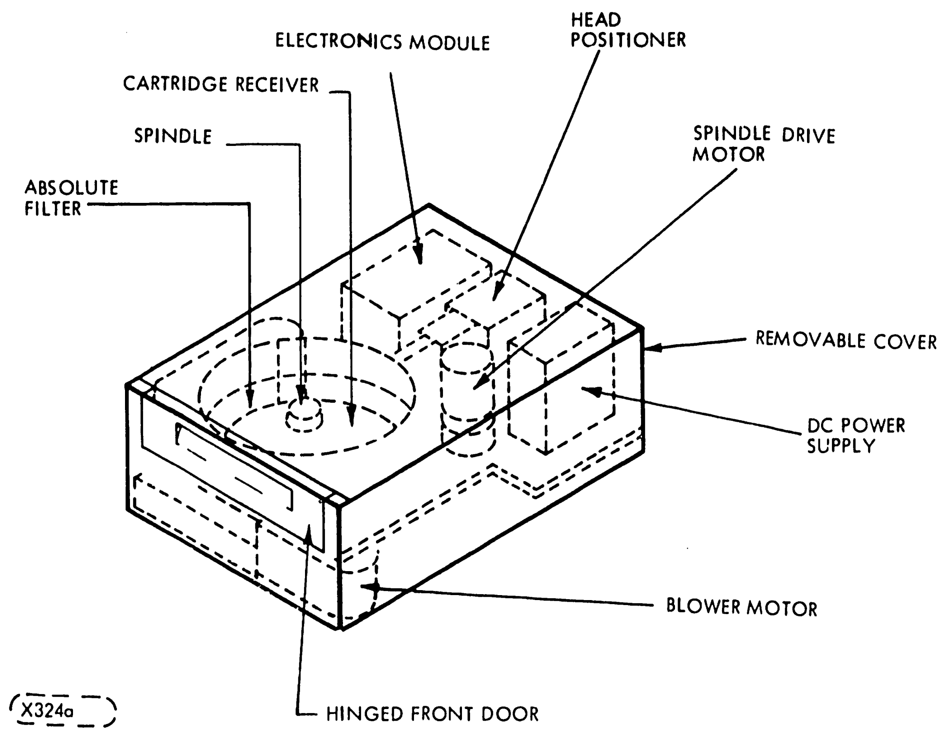
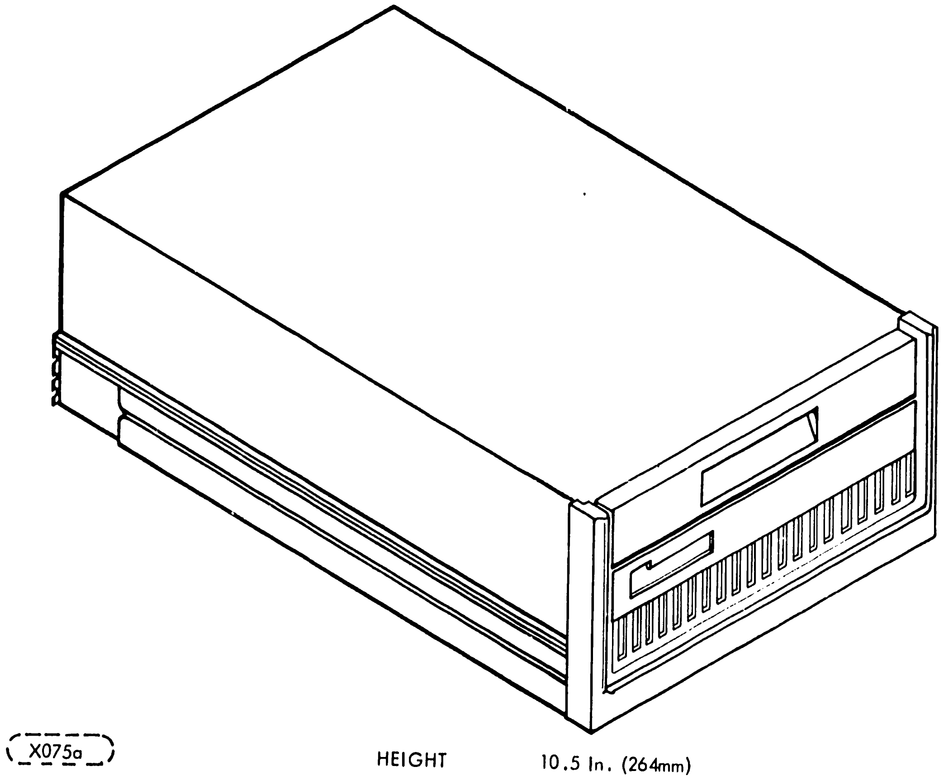


FIGURE 1-1. MAJOR COMPONENTS OF CARTRIDGE MODULE DRIVE



HEIGHT	10.5 In. (264mm)
WIDTH	19.0 In. (483mm) Max. (Panel) 17.25 In. (438mm) (Cover)
LENGTH	31.75 in. (806mm). Includes 1.25 in. (30mm) cable and switch clearance.
WEIGHT	170 lb (77.1 kg)

FIGURE 1-2. RACK MOUNTED CMD UNIT

1.2.3 OPTIONAL FEATURES

The following are optional features of the CMD:

- Quietized Unit

  The acoustically treated CMD is available as an option.

- Slides for Rack Mounting

- Power Options

  The CMD can be supplied for operation with single-phase input power of 100 V, 50 or 60 Hz; 120 V, 50 or 60 Hz; or 220/240 V, 50 Hz.

- I/O Cable Terminators

1.2.4 MAJOR COMPONENTS

The following major components make up the CMD:

- Electronics Module

  The logic is implemented using low power Schotky for commands and control logic and standard Schotky and ECL for the read/-write logic. The microprocessor is designed with standard microprocessor building blocks. The logic is mounted on five PWA boards which plug into a Mother Board.

- Voice-Coil Head Positioner

  Head positioning is performed using a closed-loop proportional servo system with acceleration, velocity and position feedbacks. The carriage is driven by a voice-coil linear actuator utilizing positioning information from dedicated servo surface.

- Deck and Spindle

  A rigid cast-aluminum deck and precision spindle insures positive registration and seating of cartridge. An AC induction motor provides spindle rotation through a flat belt and pulley.

- Air Supply and Filtering

  A direct-drive blower provides cooling air. The surrounding room air entering the receiver is filtered by a 0.3-micron absolute filter. Environmental requirements are given in detail in Section 3.

- Cartridge Receiver

  A front-load cartridge-receiving mechanism integral to the deck assembly facilitates the insertion and removal of cartridge media.

- Operator Control Panel

  Controls and indicators for the use of the operator are part of the front panel assembly. These are the START switch/-indicator, the READY or ACTIVE indicator, the FAULT reset switch/indicator, the PROTECT FIXED switch/indicator, and the PROTECT CART switch/indicator. Details of these are given in Section 2. Additional switches/indicators for use by the customer Engineer only, are found on the Control/Multiplexor PWA, Servo Fine PWA, the I/O PWA and the Servo Coarse PWA in the Electronics Module Assembly. These are discussed in detail in the Hardware Maintenance Manual.

1.2.5 OPERATIONAL CHARACTERISTICS

Operational characteristics of the CMD are summarized in Table 1-1.

TABLE 1-1. OPERATIONAL CHARACTERISTICS SUMMARY

CHARACTERISTICS	VALUE		
TRACK DENSITY	384 TPI		
POSITIONING TIME			
Maximum positioning time	55 ms (Track 0 to 822)		
Track-to-Track positioning time	6 ms		
Average positioning time	30 ms		
SPINDLE SPEED	3600 r/min (+2.5, -3.5%) Includes voltage and frequency variations specified in Table 3-1.		
LATENCY TIME (AVERAGE)	8.33 ms (at 3600 r/min)		
RECORDING			
Mode	MFM		
Density (inner track)	6038 bpi nominal		
(outer track)	4038 bpi nominal		
Bit rate (nominal)	9.677 MHz		
	DRIVE CAPACITY		
	32 Mbyte	64 Mbyte	96 Mbyte
Total number of removable disks	1	1	1
Total number of fixed disks	1	2	3
Servo surfaces	2	2	2
Data surfaces	2	4	6
Minimum Data tracks	1616	3232	4848
Spare tracks	30	60	90
Disk Diameter (inches	14	14	14
(millimeters)	356	356	356
Track spacing (inches)	0.0026	0.0026	0.0026
DATA CAPACITY (unformatted)			
No. of Fixed disks	1	2	3
Bytes/Track	20 160	20 160	20 160
Bytes/Surface (808 Tracks)	16 289 280	16 289 280	16 289 280
Bytes/Unit	32 578 560*	65 157 120*	97 735 680*
UNITS PER CONTROLLER I/O CHAN	8 (Daisychain or Star)		

*Includes 1 data surface on removable disk.

SECTION 2 OPERATION

SECTION 2
OPERATION

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2.1 INTRODUCTION

This section provides the instructions and information required to operate the CMD unit.

2.2 OPERATOR CONTROLS AND INDICATORS

Figure 2-1 depicts the locations of the operator controls and indicators. All switches and indicators are preassembled on a printed circuit board and mounted behind the control panel assembly. The control panel contains separate write protect switches and indicators for fixed and removable disks. A functional description of the normal operator controls and indicators is given in Table 2-1. Maintenance indicators and switches are described in paragraph 2.10.

2.3 OPERATING PRECAUTIONS

CAUTION

> Do not remove AC power from the unit with the circuit breaker until the disk has stopped rotating. The blower must remain ON anytime the disk is rotating to prevent the rotating disk from drawing in unfiltered air.

In addition to the above, the following precautions and practices should be observed while operating unit to obtain best performance and reliability of the equipment:

1. Keep the access door closed to prevent unnecessary entry of atmospheric dust.
2. If head-to-disk contact is suspected or recognized and persists, stop the unit by using the Stop and Power Down procedure of this section and then call the customer service engineer. Head-to-disk contact recognition is described in Section 2.10 and Head-to-disk contact recovery procedure is described in Section 6.7.22 of the Hardware Maintenance Manual.
3. The operator should not attempt to override any interlocks in the system.

NOTE

> Appropriate steps should be taken to safeguard valuable data until the head-to-disk contact can be remedied. Such steps may include leaving the unit powered down, replacing the data cartridge with a scratch cartridge, and/or immediate transfer of the data that is on the fixed disk. CALL CUSTOMER ENGINEER.

2.3.1 POWER UP FOR ON-LINE OPERATION

NOTE

Steps 1 and 4 to be performed by maintenance personnel only.

1. Verify connection of all power and I/O cables.
2. Verify installation of proper unit select plug in front control panel.
3. Verify that START/STOP switch is in STOP position (out).
4. Actuate AC circuit breaker, CB1 (rear of the unit), and verify operation of blower motor.
5. Install disk cartridge in accordance with Disk Cartridge Installation procedure. See Section 2.7.

CAUTION

The CMD shall contain a cartridge at all times whether operating or not. This is necessary to insure proper sealing of shroud area from environmental contaminants.

6. Operate the START/STOP switch and verify START/STOP indicator illuminates on those units which have the START indicator above the START/STOP switch. Also, verify that the READY indicator ceases blinking and remains constantly illuminated when the unit is up to speed and the heads are loaded. READY indicator may be either above UNIT SELECT plug or inside the START/STOP switch. Take note which of these options is applicable to unit.

NOTE

If FAULT indicator illuminates perform steps 1 through 3 of Fault Operating Instruction paragraph 2.4.

7. Within approximately 60 seconds after START/STOP switch is pressed, *READY is sent to the controller and the READY indicator illuminates. Disk drive is now ready to receive commands from the controller.

2.3.2 WRITE PROTECT

Operate the desired PROTECT switch (PROTECT FIXED or PROTECT CART.) and verify that the appropriate PROTECT lamp illuminates. Selected volume is now protected against controller Write commands.

---

*Proper state of PICK, HOLD and/or LOCAL/REMOTE is assumed.
In case the 2 minute purge option is selected on servo coarse, the total time from start to ready could reach 155 second maximum.

2.3.3 STOP

The disk drive can be stopped whether or not the unit is in the process of performing one of its functions. If START/STOP switch is operated during a seek the carriage will immediately perform a retract, ceasing the function it was performing.

To stop:

1. Operate START/STOP switch and verify that the READY indicator flashes ON and OFF until the spindle has stopped and then extinguishes when the spindle has stopped.
2. Remove the cartridge (if desired) in accordance with Disk Cartridge Removal (Normal) procedure. The cartridge access door will not unlock until the READY indicator has stopped flashing and has extinguished. READY indicator may be either above UNIT SELECT plug or inside the START/STOP switch. Take note which of these options is applicable to unit.

2.3.4 POWER DOWN

Set main circuit breaker CB1 to "OFF", but only after spindle has stopped rotating.

NOTE

> This is normally performed by maintenance personnel.

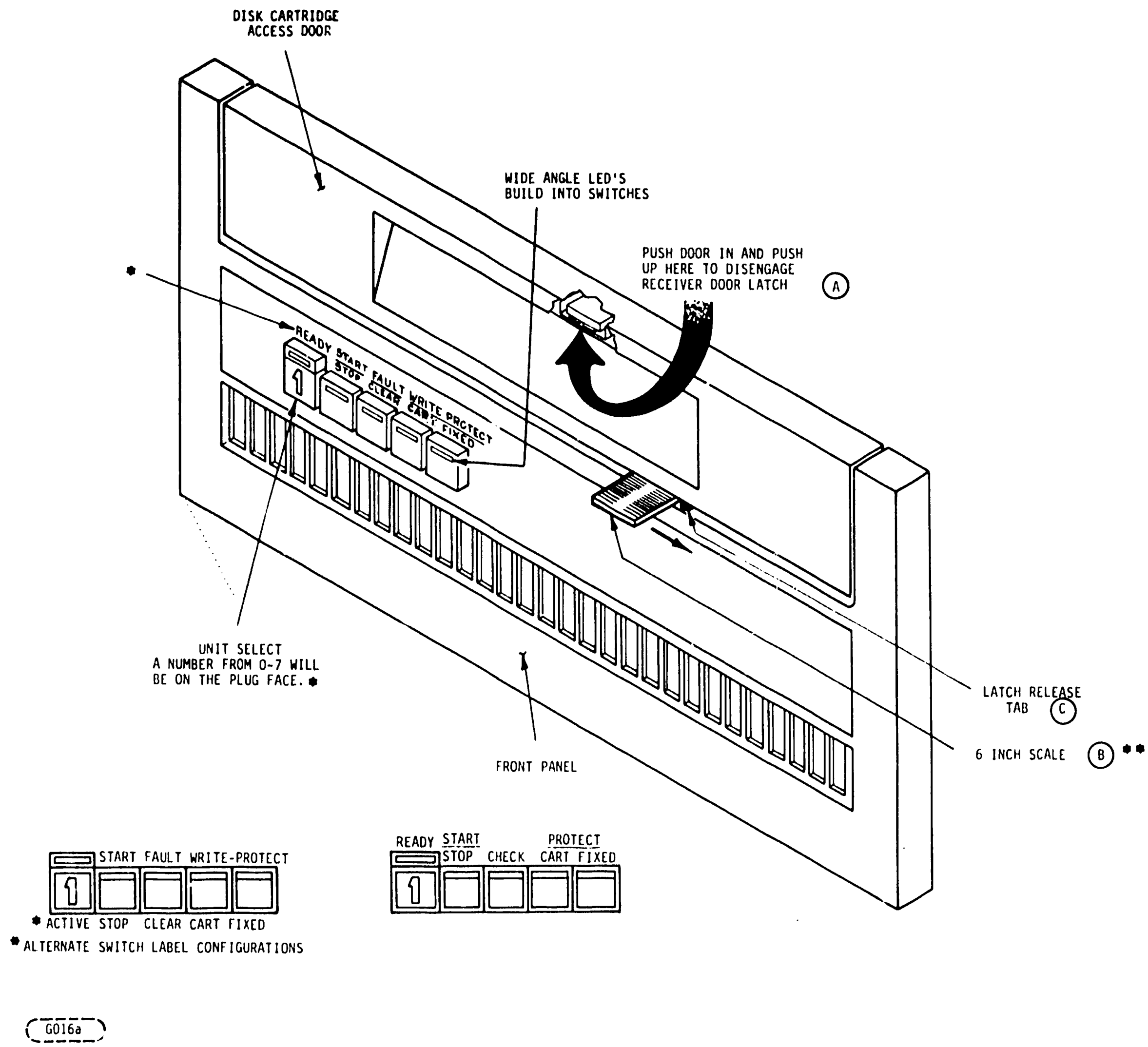

FIGURE 2-1. OPERATOR CONTROLS AND INDICATORS

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* See Table 2-1 for differences in function of this indicator.
** Emergency use only. See Paragraph 2.8.2.

TABLE 2-1. CONTROLS AND INDICATORS (SHEET 1 OF 3)

CONTROL OR INDICATOR	FUNCTION
	CONTROL PANEL
START/STOP switch/-Indicator	START switch energizes spindle motor and initiates the first seek mode provided the following conditions are met: 1. The AC circuit breaker is ON. 2. Disk cartridge loading door closed and latched with cartridge in place. 3. FAULT light is OFF (indicating certain fault conditions do not exist-see Section 2-9). 4. a. Switch S-1 on I/O PWA in "LOCAL" Position (see Figure 3-15). b. If S-1 on I/O PWA is in the "REMOTE" position, the CMD will start when ground is provided on the power sequence PICK and HOLD lines from the controller.
START Indicator	Located within the START/STOP switch, this indicator lights only when the START/STOP switch is operated inward, turns off when switch is released. Note all units have a START indicator.
READY Indicator	Positioned above the unit select plug on units which have START indicator within the START/STOP Switch. READY indicates unit ready status. READY indicator is illuminated whenever unit is up to speed and heads are loaded and no fault requiring manual intervention exists within the unit. The READY light will flash on and off throughout the spindle start and stop procedure. On units which have the ACTIVE indicator above the UNIT SELECT Plug, READY is in indicator within the START/STOP switch.
ACTIVE Indicator (optional)	Indicator illuminates when read, write, RTZS or seek operation is in process. This is an optional indicator and is not on all units. When used, it is above UNIT SELECT Plug.
FAULT switch/indicator	Clears certain fault conditions when operated. Refer to Section 2.9.

TABLE 2-1. CONTROLS AND INDICATORS (SHEET 2 OF 3)

CONTROL OR INDICATOR	FUNCTION
	CONTROL PANEL
FAULT Switch/Indicator	Indicator indicates that a fault has been detected. Operating the switch inward clears certain fault indications and turns off the FAULT indicator. The Microprocessor remembers certain faults though the FAULT indicator does not illuminate until the fault(s) are detected again during operation. Refer to paragraph 2.9 for more information. If FAULT indicator flashes off and on about twice per second*, it indicates that the air pressure of the cooling air inside the unit is not adequate to properly cool the unit. Customer Service Engineer should be summoned.
PROTECT FIXED Switch/ Indicator	When operated inward this switch disables the write driver for the fixed media. Alternate Action switch. The indicator indicates that the fixed volume of the drive is write-protected.
PROTECT CART Switch/ Indicator	When operated inward this switch disables the write driver for cartridge. Alternate action switch. The indicator indicates that the removable volume cartridge of the device is write protected.
UNIT SELECT Plug/ Socket	A plastic plug which generates the computer I/O channel unit number by closing coded switch contacts in the socket into which it fits. The top of the plug is marked with a number from 0 to 7 representing the unit number. The proper number plug is installed at installation time.

*Optional Lo-Air Detection Feature.

TABLE 2-1. CONTROLS AND INDICATORS (SHEET 3 OF 3)

CONTROL OR INDICATOR	FUNCTION
	DISK PACK ACCESS DOOR
DISK PACK ACCESS DOOR LATCH	The Disk Pack Access Door is unlatched as follows: 1. Press the door in to release the safety latch. 2. Lift up on the release lever (A) with the fingers (see Figure 2-1). 3. Pull out and down to open the door and unload the cartridge. The latch will not release the door catch until after the spindle motor has stopped rotating and the interlock solenoid releases the catch. The START/STOP switch must also be released (OUT) before the solenoid releases the catch. In the event of the loss of AC power the interlock solenoid does not release the catch in order to prevent damage to the cartridge. In units that have the AGC FLT-Door Lock option installed, under certain fault conditions the door will not be released after power down.

2.4 FAULT OPERATING INSTRUCTION

2.4.1 ELECTRICAL/ELECTRONIC FAULT

If FAULT indicator illuminates (not flashing ON and OFF), during operating or power up, proceed as follows:

1. Wait until READY stops flashing ON and OFF.
2. Operate START/STOP switch to STOP and allow spindle to stop rotating, then operate START/STOP switch to START. If FAULT lamp extinguishes, normal operation can be resumed. If lamp remains illuminated call Customer Service Engineer.
3. If smoke or odor is detected, turn AC breaker off and call Customer Service Engineer.
4. If door does not open and FAULT does not clear, the drive might have the AGC FLT-Door Lock option installed to prevent head-to-disc contact propagation. Customer engineering should be called.

2.4.2 NO-AIR FAULT

When air through the unit's absolute filter is sufficiently obstructed, the NO-AIR interlock switch opens, removing power from the spindle. The unit ceases the operation it was performing, the heads retract and the spindle stops rotating.

If not operating, the spindle will not start when the START/STOP switch is operated to the START position. In both of the above cases, the blower continues to supply cooling air to the electronics, so a fault is stored by the control Microprocessor and the FAULT indicator illuminates. Call the Customer Engineer to investigate the problem when stopping or failure to start occurs. Readout of the causes for faults is described in Section 6.9.

2.4.3 LOW-AIR FAULT OPTION

If the unit has the Lo-Air Pressure option installed, the FAULT indicator flashes ON and OFF about two times per second to indicate air flow coming from the absolute filter (in the base pan) is not adequate to properly cool the unit. The operator can clean or replace the Pre-filter filter (if that option is installed) and if the flashing FAULT indicator persists, the operator should call the Customer Service Engineer to investigate the problem. The unit will power-up and operate for a time, but when air flow is sufficiently obstructed, the No-Air interlock switch will open and not allow the unit to power up at all. Trouble shooting the lack of proper air flow problem is described in Section 6, Maintenance.

2.5 INPUT/OUTPUT LINES

Complete operations of the disk drive including spindle start/stop can be performed by the controller,* provided the START/STOP switch is in START position. Input/Output signals exchanged between disk drive and controller and their functions are explained in Table 5-3. I/O switch must be enabled and REMOTE/-LOCAL switch must be in remote position. The Customer Engineer can configure to customer request.

2.6 DISK CARTRIDGE HANDLING AND STORAGE

The following practices should be observed when handling or storing disk cartridges. Refer to the Manufacturer's instructions for more detailed maintenance and cleaning instructions.

1. The cartridge dust cover should be on the cartridge while it is out of the disk receiver. This will insure a positive dust seal and immobilize the disk inside.
2. Cartridges can be stored flat but never on the edge. They can be stacked on top of one another, but never more than four high.

2.7 DISK CARTRIDGE INSTALLATION

The disk cartridge must be stored in the same environment as the CMD for 60 minutes immediately preceding its use. Make certain disk cartridge has been cleaned and maintained in accordance with accepted preventive maintenance procedures. Refer to Figure 2-2 for the following procedure:

1. Press the door <u>in</u> to release the safety latch.
2. Lift <u>up</u> on the release lever (A) with the fingers (see Figure 2-1).
3. Pull <u>out</u> and <u>down</u> to open the door and unload the cartridge.

NOTE

> Power must be ON, the START/STOP switch out, and READY and FAULT lamps must be OFF to release lock on cartridge door.

4. To separate dust cover from the disk cartridge, push cover release button toward center of cartridge.
5. Disengage dust cover from disk cartridge. Set cover aside upside down to prevent dust from collecting within the cover.

<u>CAUTION</u>

> Make certain that the read/write heads are fully retracted.

---

*NOTE: This includes switching of AC input power to the unit.

6. Slide disk cartridge into receiver track, ensuring that the head opening is toward rear of the machine.
7. Push handle down. Push cartridge rearward until it stops.
8. Close cartridge access door and press the door closed until it is latched. The cartridge slides into place on the spindle automatically as the access door is closed.
9. Store cartridge cover upside down in some convenient location.
10. Operate START/STOP switch to apply power to spindle motor.

NOTE

> If the spindle motor will not rotate, disk cartridge access door may not be completely closed, the cartridge may not be properly seated on the spindle chuck or the cartridge receiver/base may not be all the way down on the lower chassis.

2.8 DISK CARTRIDGE REMOVAL

2.8.1 NORMAL REMOVAL

Refer to Figure 2-2 for the following procedure.

1. Operate START/STOP switch to STOP (out).
2. Pull down the cartridge access door after the READY indicator ceases flashing ON and OFF and extinguishes entirely. READY indicator may be either above UNIT SELECT plug or inside the START/STOP switch. Take note which of these options is applicable to unit.
3. Pull the cartridge out of the receiver with sufficient force to overcome the detent action.
4. Place the dust cover in position on the cartridge and fold over top handle.

NOTE

> The handle may be swung out to carry the cartridge, but do not push the cover release button.

5. Place another cartridge into the receiver and close cartridge access door. The CMD shall contain a cartridge at all times to insure proper sealing of shroud area.

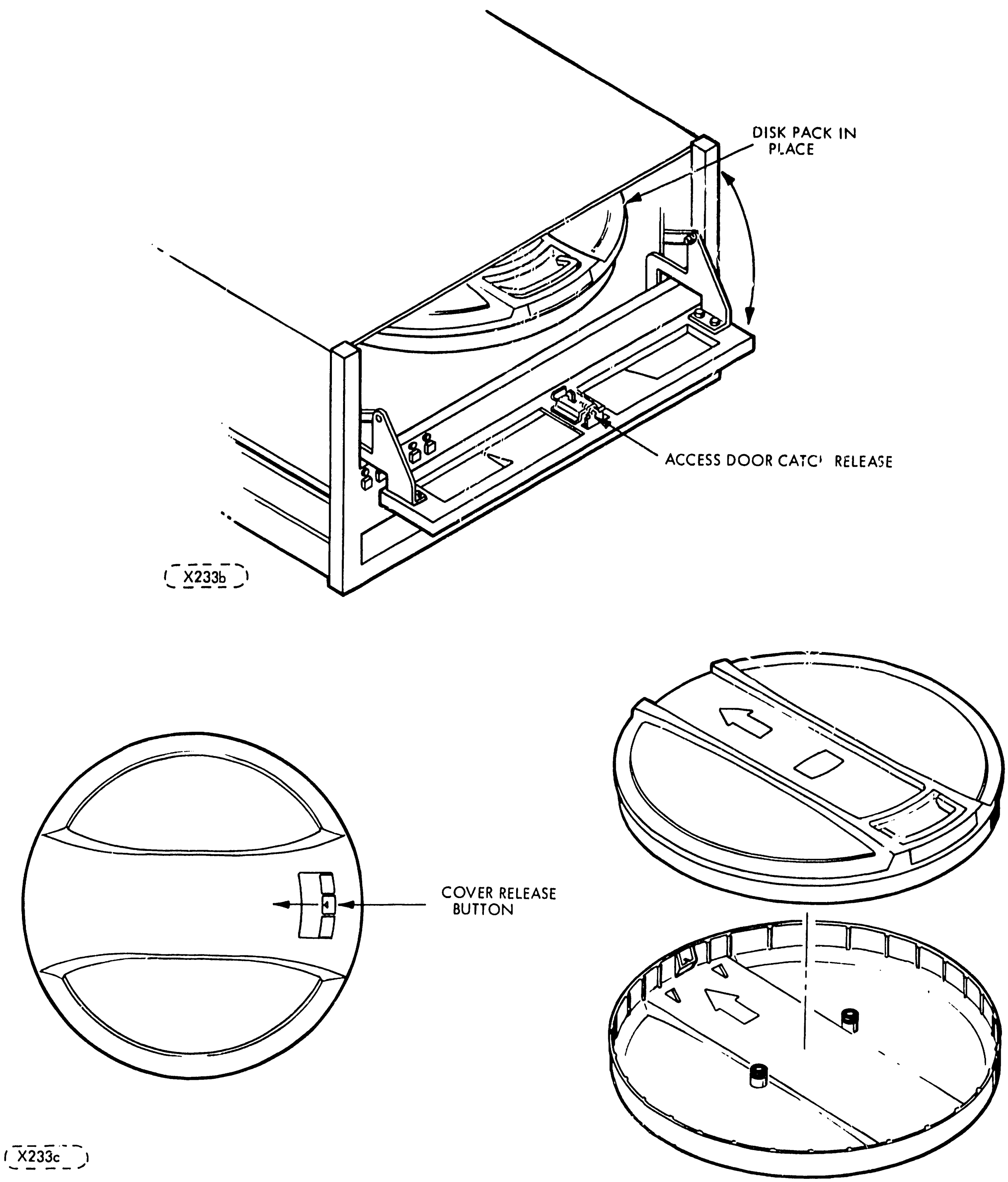

FIGURE 2-2. DISK CARTRIDGE INSTALLATION/REMOVAL

2.8.2 POWER FAILURE OR EMERGENCY STOP REMOVAL

Refer to Figure 2-1 for the following two procedures.

NOTE

> These two procedures below to be performed only by the Customer Engineer.

1. Wait approximately 8 minutes for cartridge to stop spinning.
2. Open cartridge access door. This automatically removes cartridge from spindle chuck. Door will not open if a problem exists. Power must be ON and START/STOP switch out to retract door latch solenoid.

   AC Power should not be turned OFF while heads are loaded or disks rotating. If AC must be turned OFF, do not allow it to stay OFF, if emergency retract fails to retract the heads. Retract the heads by hand before removing AC power again.

NOTE

> If heads have not retracted FAULT indicator will remain OFF, but spindle will continue to rotate until heads can be manually retracted (in the case where AC power is still applied). Top cover of unit must be removed to manually retract heads (see Section 6, Hardware Maintenance Manual).

3. With light downward pressure at the front edge of the cartridge (to release from detent) pull cartridge out from receiver.
4. Place cartridge cover in position on bottom of cartridge.
5. Place another cartridge into the receiver and close the cartridge access door.

2.8.3 CARTRIDGE REMOVAL FOR EMERGENCY CONDITIONS

When conditions occur such as power outage, loss of AC power to drive, (tripped circuit breaker) or the system cannot achieve drive response, proceed as follows:

1. Make sure the spindle motor is completely stopped. Either observe the motor with the top cover of the unit OFF or turn OFF AC power and wait a full 8 minutes before proceeding.
2. See Figure 2-1. Insert a 6 inch steel scale [B] between the access door and the front panel. Push the small tab [C] to the right with the scale. This unlocks the door allowing the door release [A] to be operated while the tab [C] is being pushed to the right.
3. Perform steps 3, 4 and 5 on page 2-12, paragraph 2.8.2.
4. Close the door in the normal manner when ready to do so.

2.9 MAINTENANCE SWITCHES AND INDICATORS

Maintenance switches and indicators are provided for aiding the maintenance personnel in diagnosing problems in the drive. These switches and indicators are mounted on the printed circuit boards in the Electronics Module and they should only be operated by maintenance personnel.

A set of seven LED fault display indicators are mounted on the top of the Control/Mux PWA in the electronics module. Two types of faults can be displayed on these indicators: non-microprocessor or logic detected faults and error conditions detected by the Servo Coarse PWA microprocessor (called the Microprocessor Fault Summary). Table 2-2 lists the logic detected faults and the Microprocessor Fault Summary errors displayed. Figure 2-3 shows the fault display indicators on the Control/Mux PWA and the reset switch (S1) which resets the display and brings up new information which is displayed on the indicators.* The FAULT CLEAR switch on the drive front Panel also resets the logic detected faults but does not reset the Fault history flip-flops as S1 on the Control/-Mux PWA does that. Also, the FAULT CLEAR switch does not place microprocessor faults on the LED fault displays whereas S1 does. In addition to logic detected faults and the Microprocessor Fault Summary the fault indicators can display the present cylinder address (from the last seek) and velocity status of the servo system (slow, fast or OK). The use and operation of the switches and indicators is described in more detail in Section 6-9 in the Maintenance Section of the Hardware Maintenance Manual.

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*The location on the PWA of this switch varies slightly among the various versions of the CNTL/MUX PWA.

TABLE 2-2. FAULT DISPLAY INDICATOR SUMMARY

IND	LOGIC DETECTED FAULT	M.P. DETECTED FAULT
CR1	NO HEAD SELECT FAULT (NH)	CR1 NOT USED
CR2	OFF	ON
CR3	WRITE FAULT	HIGHEST ORDER M.P. FLT CODE SUMMARY BIT (2^4).*
CR4	WRITE OR READ WHILE OFF CYL. (W+R)	M.P. FAULT CODE BIT 2^3.
CR5	WRITE AND READ FAULT (W·R)	M.P. FAULT CODE BIT 2^2.
CR6	VOLTAGE FAULT (VF)	M.P. FAULT CODE BIT 2^1.
CR7	HEAD SELECT FAULT (HS)	M.P. FAULT CODE BIT 2^0.

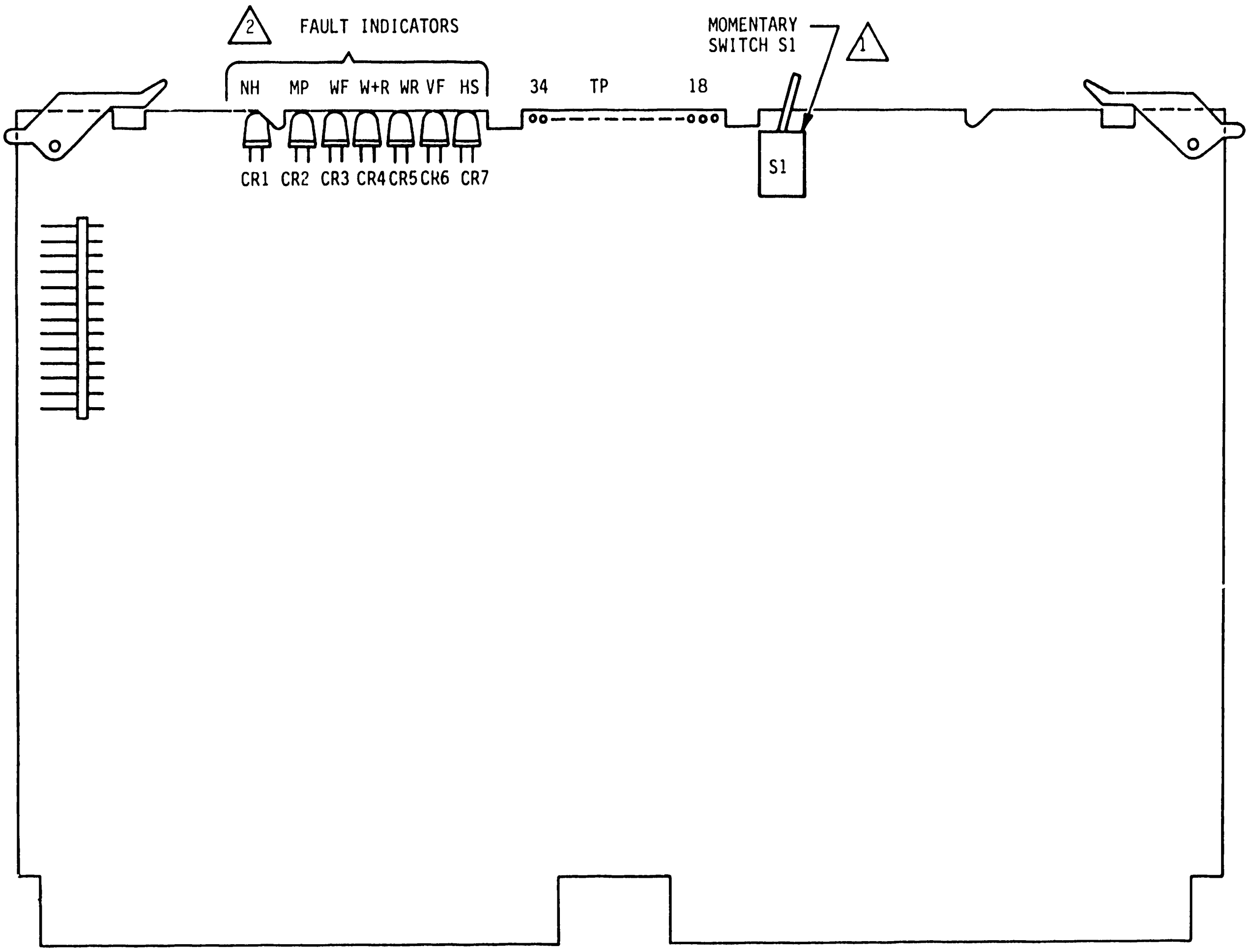
* In the Microprocessor Fault Code summary mode two types of information are displayed: The phase of operations where the fault occurred and the type fault. From 1 to 13 phases could be displayed and from 1 to 16 faults. All of the applicable phases are in serial order. See Table 6-7**.

** Maintenance Section of the Hardware Maintenance Manual.

TABLE 2-2. FAULT DISPLAY INDICATOR SUMMARY (CONTD.)

PHASE INDICATORS CODE (HEX)	PHASE	PHASE INDICATORS CODE (HEX)	PHASE
01	Return to Track Center	07	Head Load
02	Wait for Coarse Seek Comp.	08	Await AGC during Head Load
03	After Seek Settling	09	Await Track Center-Load or RTZ
04	Idle Loop	0A	Settling-Load or RTZ
05	Return to Zero Motion	0B	OFFSET Active
06	End of Velocity Table	0C	Clear OFFSET Settling
		0D	Resume Settling after False Termination

FAULT INDICATORS CODE (HEX)	FAULT TYPE
0F	Spindle did not Start/Stop in 2 minutes (10 or 14 was noted)
10	Spindle Start GT 70 SEC max.
11	No spindle movement or not up to speed in 2 MIN
12	No drive to Solid State Relay
13	Solid State Relay Failure
14	Stop Timeout
15	Emergency Retract Failure
16	Normal Retract Failure
17	Cylinder Address GT 822
18	OFF Track GT 1200 usec
19	Unexpected AGC in Head Load
1A	Lost AGC
1B	RPM Fault
1C	Lost Speed Pulses
1D	Allowed Time Expired
1E	No Track Lock in Settling
1F	Microprocessor Fault Code Summary Readout is Complete



1 SHOWN IN "OFF" POSITION. LOCATION OF THIS SWITCH VARIES SLIGHTLY WITH THE VARIOUS VERSIONS OF THE CNTL/MUX PWA.

2 THE FAULT TYPE ABBREVIATIONS SHOWN ARE ETCHED ON THE PWA UPSIDE DOWN NEXT TO THE APPLICABLE INDICATOR.

F030b

FIGURE 2-3. CONTROL/MUX PWA SHOWING FAULT INDICATORS AND FAULT RESET SWITCH

2.10 HEAD-TO-DISK CONTACT RECOGNITION

The following paragraphs will aid the operator to recognize head-to-disk contact. Head-to-disk contact recovery is described in the Maintenance Section 6.7.22.

2.10.1 READ/WRITE HEAD

The head-to-disk contact of a data head is first sensed by the operating system. Head contact, in the very early stages, will exhibit an escalating increase of read errors on that data surface.

If, after the head comes in contact with the disk, the drive is allowed to run long enough, an audible noise may be heard. This noise will be a tinging sound.

An aroma will eventually be noticed if the head is allowed to continue making contact with the rotating disk. This aroma will be the result of burning oxide caused by the head generated by the head-to-disk contact.

2.10.2 SERVO HEAD

Head-to-disk contact of the selected (fixed or removable) media's servo head will be apparent by the unloading of the heads. Unloading occurs when the head-to-disk contact is severe enough that the head can no longer read the servo dibits.

The realization of a head-to-disk contact on an unselected servo head may require more time. This contact will not become evident until either: 1) the servo surface where the contact occurred is selected causing the heads to unload; 2) the head-to-disk contact is severe enough to make an audible noise; or 3) oxide dust clouds contaminate other heads causing more head-to-disk contact.

<u>CAUTION</u>

> Once head-to-disk contact is suspected, to prevent further damage and/or data loss, do not continue to operate the unit. Power down the unit per Section 2.3.4 and call the maintenance person authorized to repair this kind of problem.

SECTION 3

INSTALLATION AND CHECKOUT

SECTION 3
INSTALLATION AND CHECKOUT

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3.2 UNPACKING... 3-1

3.3 SPACE ALLOCATION.. 3-2

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3.1 INTRODUCTION

This section provides the information and procedures necessary to install the CMD.

The 9448 CMD is listed by the safety agencies (UL and CSA) as a component. A suitable enclosure is required which meets the Product Safety standards imposed by agencies such as UL and CSA.

The CMD, as delivered, is designed for system integration and installation into a suitable enclosure prior to use by an end user. As such the CMD is supplied as a component and is not subject to Subpart J of Part 15 of the FCC rules. However, the unit has been tested using proper shielding and grounding and found to be compliant with Class A limits of Subpart J of Part 15 of the FCC rules. The physical design characteristics of the CMD serve to minimize radiation when packaged in an enclosure the provides reasonable shielding and will meet or exceed the Class A limits of Subpart J of Part 15 or the FCC rules.

If the enclosure does not provide adequate shielding, the use of shielded I/O cables is required. If I/O cables are installed external to the enclosure, shielded cables should be used, with the shields grounded to the CMD and to the host controller.

3.2 UNPACKING

During unpacking, exercise care so that any tools being used do not cause damage to the unit. As the unit is unpacked, inspect it for possible shipping damage. All claims for this type of damage should be filed promptly with the transporter involved. If a claim is filed for damages, save the original packing materials. Unpack the unit as follows:

A. Remove the top cover and inspect various items such as circuit boards, carriage assembly, and read/write heads for shipping damage. See Section 6 for procedure.
B. Check that all packing material pieces are removed, and that the unit is clean inside.
C. Refer to Figure 3-1. Remove the screw [4] which secures the carriage locking tool [1] . Lift the locking tool to remove the pin [2] from the hole in the carriage [6] . Swing the locking tool around to the operating position [B] . Reinstall the screw to secure the locking tool to the magnet in the operating position. Remove the shipping tags and line from locking tool.

CAUTION

Do not position the carriage manually. Such action could cause the read/write heads to load and to cause damage to the heads and disk.

The unit should never be shipped or even be moved any significant distance without the carriage lock pin in place to prevent the heads from loading and damaging the disk and/or heads.

D. Remove rear shipping bolt [C] of Figure 3-2, using a 3/16 inch hex bit*. Store the shipping bolt in the hole provided to the left of the magnet as shown at [D] in the figure. Before shipping, this bolt must be installed in the center hole again. Before placing the unit in operation remove screw [A] Figure 6-5.

CAUTION

AC-DC GRD short can occur if unit is operating and screw [A] has not been removed.

Store screw [A] in tapped hole in vertical leg of E Module brace next to base plate.

Before reshipping the unit, return screw [A] to its preinspection location and securely fasten.

E. If the deck hold down bolts [A] (Figure 3-3, Sheet 2 of 2) are installed, (customer option) remove using a 3/16 inch hex bit* and stow them below the deck in the Base Pan together with all the hardware as shown. If the deck hold down bolts are not installed, proceed to the next step.

F. If deck hold down bolts [A] were removed to raise deck, these should be replaced before placing the unit in operation. Before reshipping the unit, it should be inspected to make certain that the [A] bolts have been securely installed (See Figure 3-3).

G. Replace the unit cover. The cover should remain installed even if the unit is to be operated within a rack.

H. A plastic cover is shipped in place of a cartridge. Remove the plastic cover and install a cartridge before operating.

3.3 SPACE ALLOCATION

Figure 1-2 shows the unit overall dimensions for determining space allocation. In addition, Figure 3-4 gives detail dimensions. Figure 3-5 shows the base pan and electronics module maintenance envelope dimensions. See paragraph 3.4.1 for installation procedure.

*Used in Torque driver wrench, or use hex driver of same size.

3.4 INSTALLATION AND MAINTENANCE

Required connections to the device are power/signal cables and system ground consistent with normal peripheral equipment grounding practices. See Section 3.6 for cabling information. The physical requirements are adequate clearances for maintenance and air intake/exhaust and adequate cooling** of the space in which the unit is mounted. Detailed instructions for maintenance are found in Section 6 of this manual.

CAUTION

The CMD shall contain a cartridge at all times whether operating or not. This is necessary to insure proper sealing of shroud area from environmental contaminants.

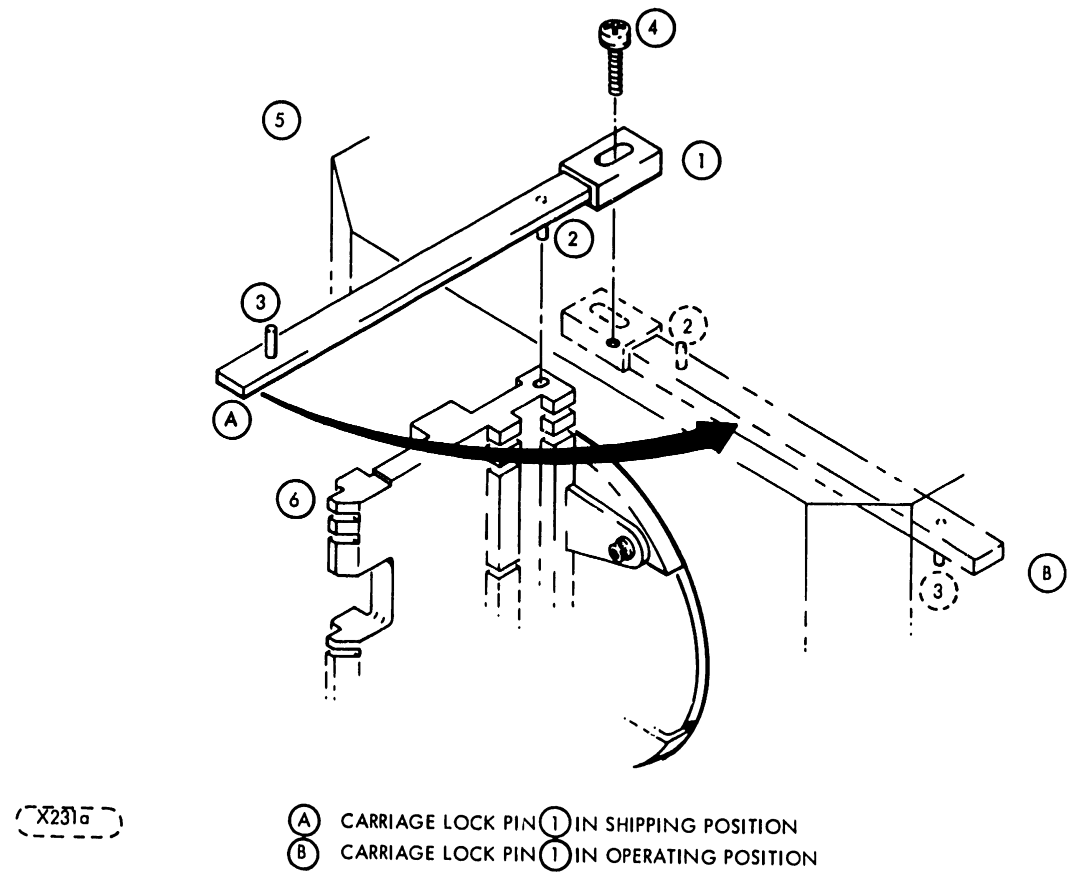


FIGURE 3-1. CARRIAGE LOCKING TOOL - SHIPPING POSITION

**See Section 3.8, "Cooling Requirements", which specifies the cooling required to maintain the intended reliability of the CMD.

3.4.1 INSTALLATION MECHANICAL INTERFACING

This section contains the mechanical interface specifications for the CMD. Figures 3-4 through 3-9 provide mechanical dimensions or mounting details for the various configurations. All dimensions are in inches and millimeters and are listed in tables in each figure. All dimensions are nominal and subject to the normal manufacturing tolerances. See Section 3.6.2 concerning cable retract mechanisms for rack mounted drives.

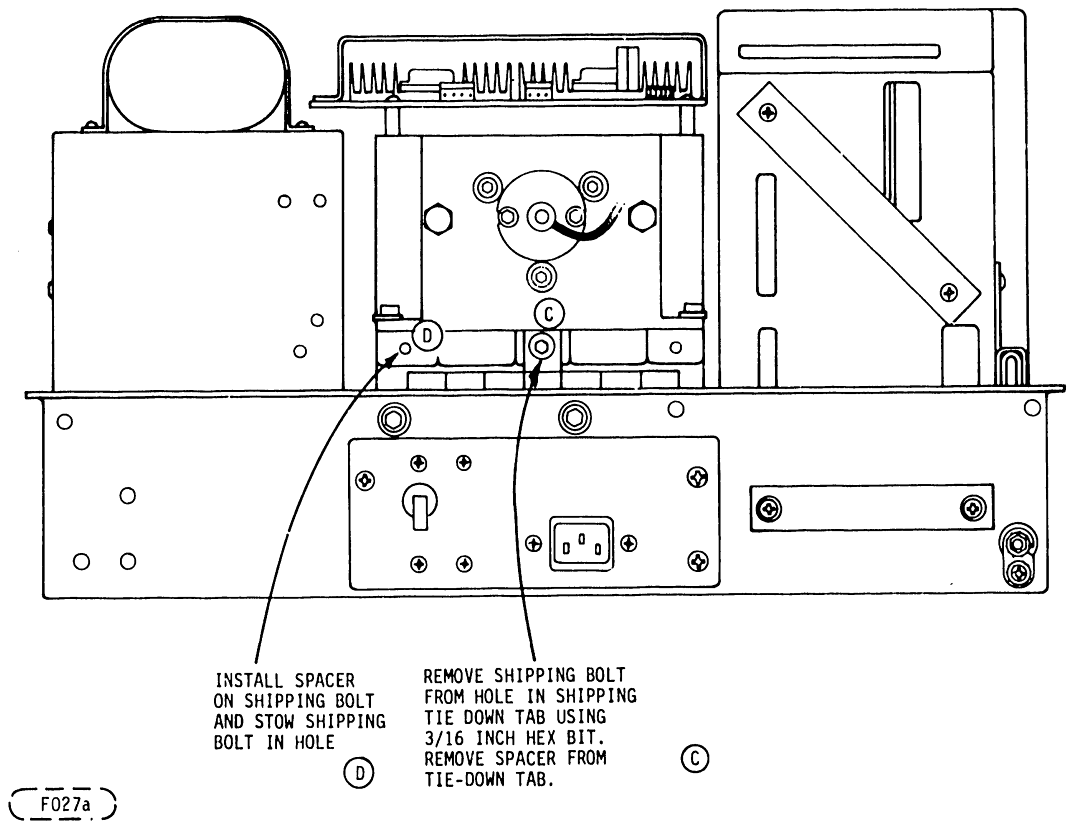


FIGURE 3-2. REAR SHIPPING BOLT LOCATION

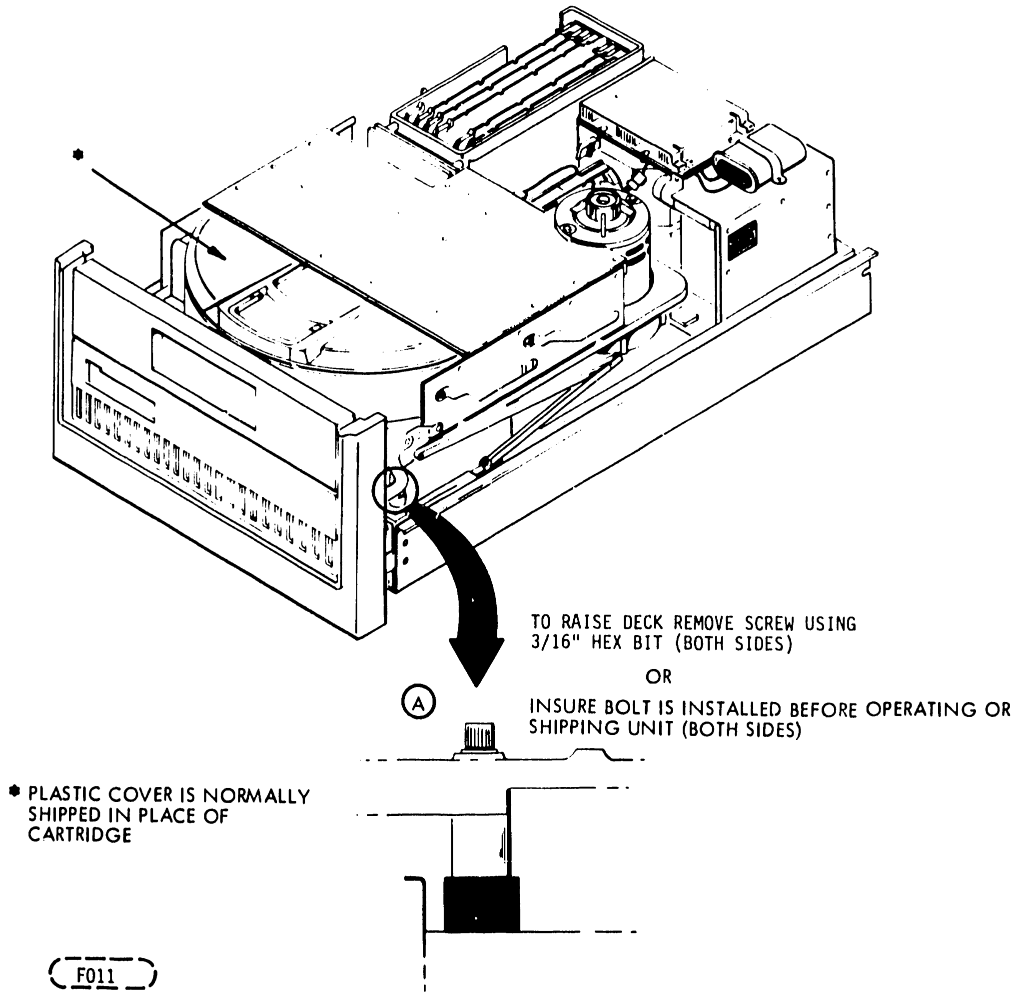


FIGURE 3-3. DECK HOLD DOWN BOLTS (SHEET 1 OF 2)

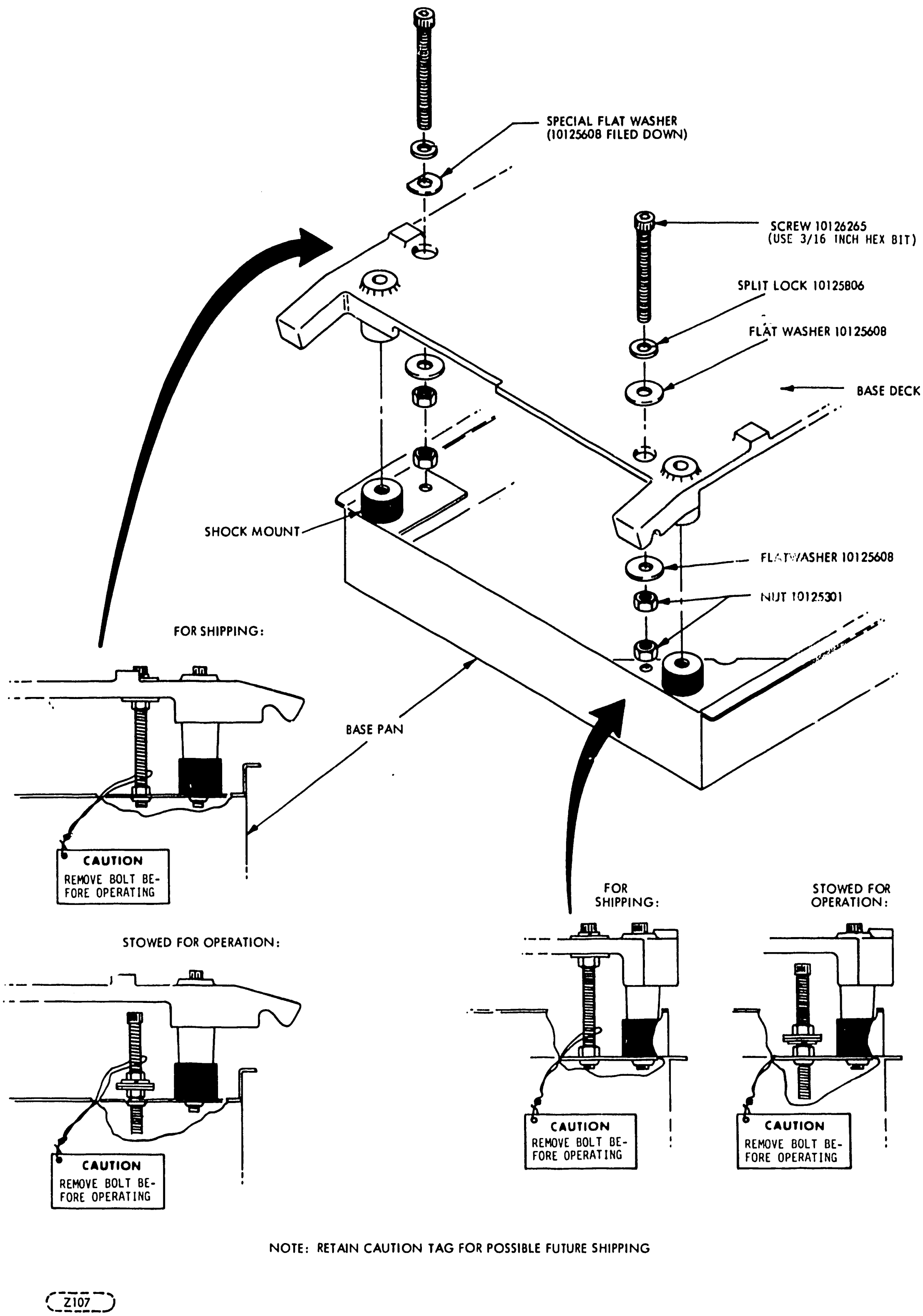
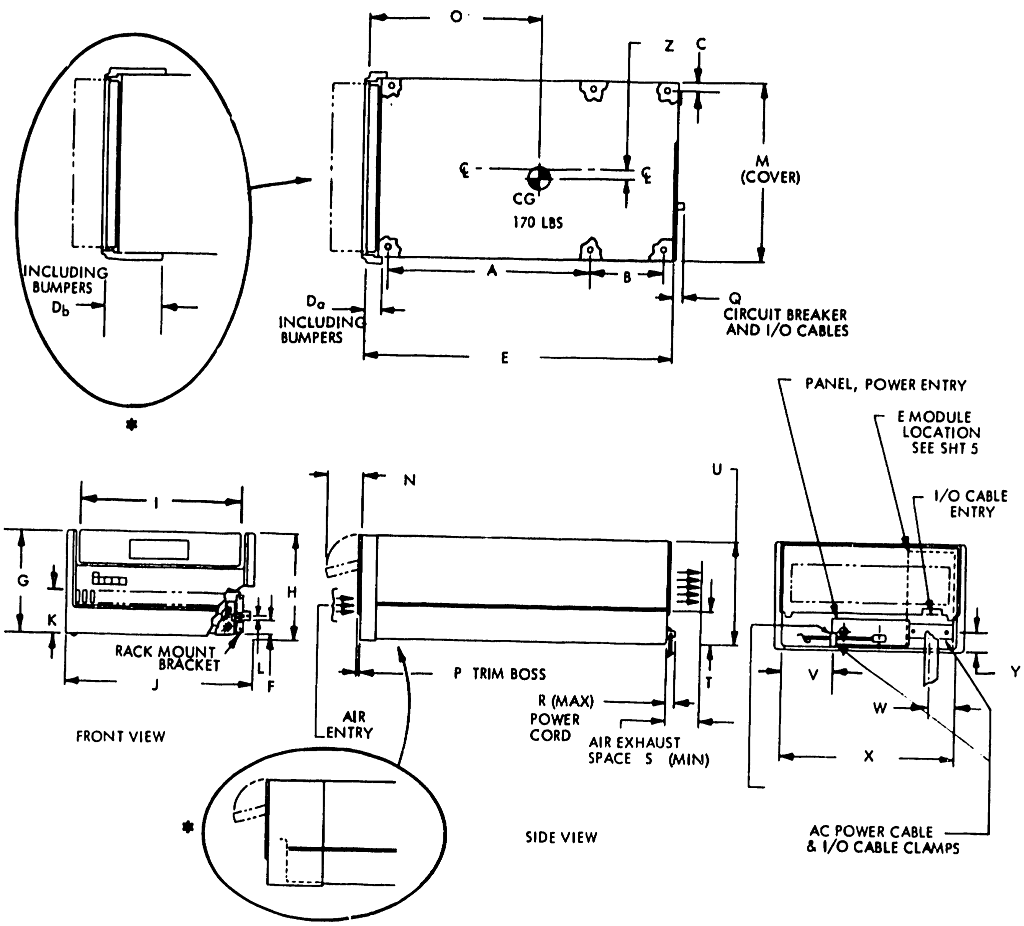


FIGURE 3-3. DECK HOLD DOWN BOLTS (SHEET 2 OF 2)

36 INCH (914 mm) RACK MOUNT CASE ENVELOPE



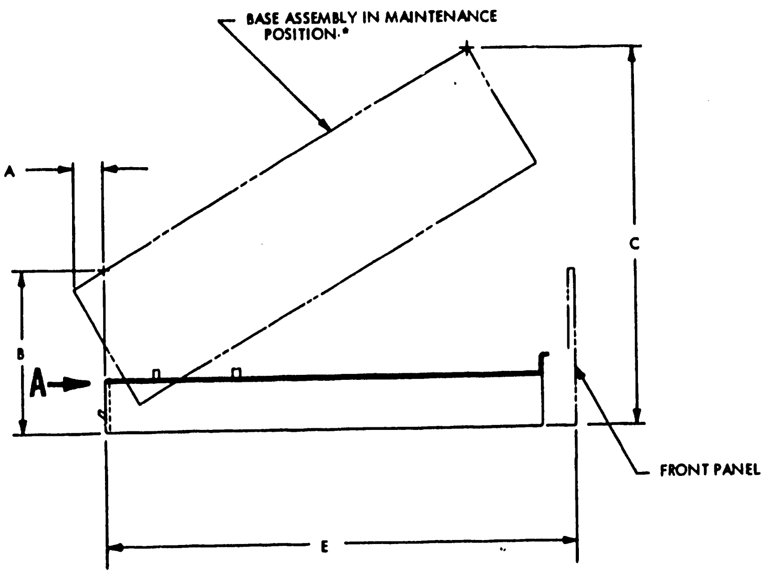
* 30 INCH (762 mm) RACK MOUNT CASE ENVELOPE

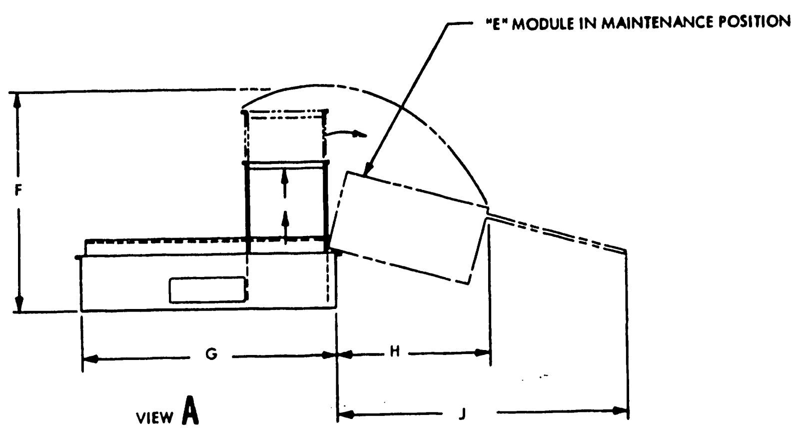
DIMENSION	INCHES	MILLIMETERS
A	17.76	451.1
B	10.0	254.0
C	0.38	9.7
D_a	1.50	38.1
D_b	2.53	64.3
E	30.50	774.7
F	1.56	39.62
G	10.28	261.1
H	10.34	262.7
I	17.0	431.8
J	18.94	481.1
K	4.4	111.8
L	0.44	11.18
M	17.50	444.5

DIMENSION	INCHES	MILLIMETERS
N	4.25	108.0
O	17.25	438.2
P	0.38	9.7
Q	0.75	19.1
R	1.25 max	31.7 max
S	1.25 min	31.7 min
T	3.38	85.9
U	10.15	257.8
V	5.5	139.7
W	2.80	71.1
X	16.70	424.2
Y	1.7	43.5
Z	0.90	22.9

XX215

FIGURE 3-4. DETAILED DIMENSIONS





VIEW **A**

DIMENSION	INCHES	MILLIMETERS	REMARKS
A	2.00 MAX	50.8	
B	10.50 MAX	266.7	
C	24.50	622.3	"E" MODULE RAISED TO MAINTENANCE POSITION
E	30.50 REF	774.7	
F	14.20	360.7	
G	16.70 REF	424.2	
H	9.00 MAX	228.6	
J	17.4	441.9	WITH BOARD EXTENSION

XX204a

FIGURE 3-5. BASE ASSEMBLY AND E MODULE MAINTENANCE ENVELOPE

3.4.2 INSTALLATION PROCEDURE FOR RACK MOUNTING OF THE CMD

1. Adjust the rack rails [22] front-to-back separation dimensions or the slide length or both (see detail "A" Figure 3-6) so that the slide fixed member can be mounted to the front and back rack rails as shown in details "A" and "B" of Figure 3-6. Dimensional specifications for installation are given in Figure 3-8 or 3-9.

2. Adjust the side-to-side separation of the rails (if possible) so that the width specification is met (Figure 3-8 or 3-9).

3. If the chassis mounting rail [4] and the slides are shipped attached, remove screw [5] which holds the two together. The hex nut removed with screw [5] can be discarded but save the flat washer, split lock washer and the screw.

4. Disengage mounting tooth [8] from its slot [24] in the mounting rail, thus separating slides and mounting rail. Separate both slide sets from mounting rails.

5. Using three 10-32 X 3/8 screws [2] and three external tooth washers [28] attach the chassis mounting rail [4] to the pan [3] of the CMD. Repeat on other side.

6. Install the slides into the rack cabinet at the desired location (see Figure 3-6 Details "A" and "B"). Loosen the adjusting screws, nut and washer ([13] , [15] , [16] and [17]) to adjust the length of the fixed slide number [7] . Position the slides so that the inside edges of the fixed slide members are 17.82 in. (452.7 mm) apart. Make sure that the slides are horizontal and equal distance from the base of the cabinet. To mount the slides, use one #10 lock washer [26] and one #10 flat washer [27] on each #10-32 mounting screw [20] . Insert the screw [20] through the cabinet mounting rail holes and the slots on the slide mounting surfaces and then into the holes in the nut plates as illustrated in Figure 3-6, details "A" and "B". Tighten screws.

7. Press the full extension release [11] (see arrow in Figure 3-6) on each side and pull the slides out to their full extension, approximately 29 in. (740 mm). The slides will lock again at full extension.

8. Enlist the aid of one or two more persons to assist in placing the CMD on the slides. First note Figure 3-6 detail "D", which shows the mounting tooth [8] on the chassis mounting rail [4] and the slot [24] into which the tooth fits.

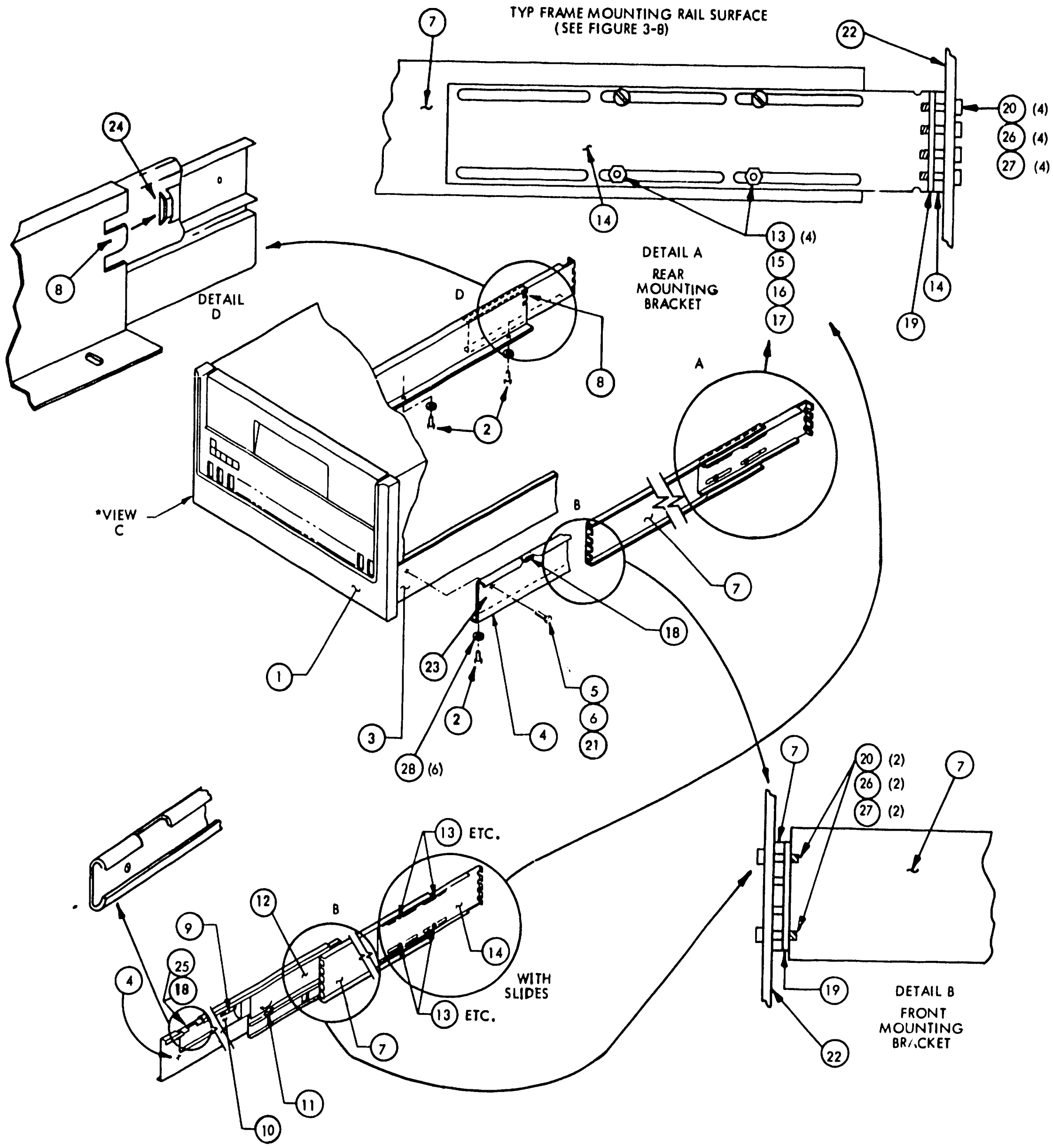
9. Lift the CMD and place it so that it rests with each chassis mounting rail [4] resting on the top of the slide on each side. Once the CMD is resting on the slides it can be slid toward the rear of the rack until the mounting tooth [8] engages in the slot [24] , and the mounting block [25] on each chassis mounting rail [4] fits into the slot [18] in each slide. If one or both of the chassis mounting rails [4] does not sit properly on the slides, the hardware which mounts the slides to the rack rail should be loosened slightly and the distance between the slides adjusted to allow each chassis mounting rail [4] to sit properly on the top of each set of slides.

10. Place flat washer [21] and lock washer [6] on screw [5] and insert the screw in the hole [23] . The matching hole in the base pan should be automatically lined up with hole [23] , but if it isn't the three screws [2] may have to be loosened slightly and the CMD moved slightly until hole [23] lines up with hole in the base pan. Now insert screw [5] .

11. Tighten screws [2] and [5] on both slides. Tighten the screws [20] if they were loosened while adjusting the separation of the slides.

12. With both hands unlock the slides by simultaneously pushing the spring locks [9] inward and pushing the CMD into the rack. If an increase in pressure is required as the CMD is pushed into the rack, loosen the twelve screws [20] . Adjust the separation between the sides so that the minimum amount of effort is required to push the CMD all the way into the rack. Slide the CMD into and out of the rack at least three times to check the freedom of travel. Tighten the twelve screws [20].

13. If the CMD is to be secured to the rack to prevent it from being slid out from the rack, refer to Section 6.6.1. Remove the front panel per instructions and install screw [8] in Figure 6-1 which is the same type as [20] in Figure 3-6. Reinstall the front panel.



*SEE FIGURE 3-7.

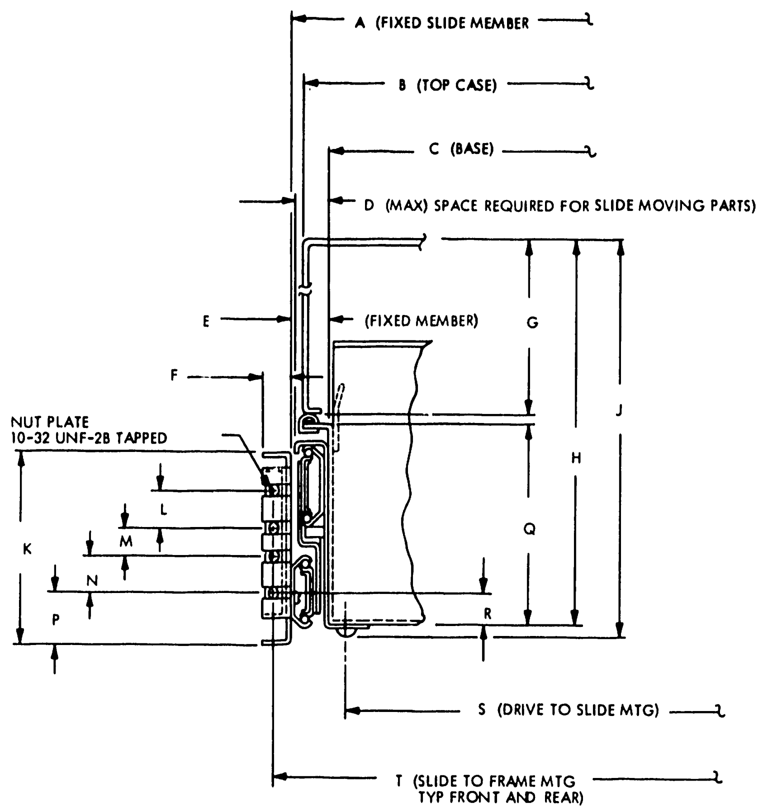
XX202a

FIGURE 3-6. RACK MOUNTING DETAILS (WITH OR WITHOUT SLIDES)
(SHEET 1 OF 2)

List of Items Tagged in Figure 3-6.

1. CMD Front Panel
2. Screw, Mach., Pan Hd 10-32 X 5/16, P/N 10127141
3. CMD Base Pan
4. Chassis Mounting Rail
5. Screw, Mach., Pan Hd 6-32 X 3/8, P/N 10127113
6. Washer, Lock #6, P/N 10125803
7. Fixed Slide Member
8. Mounting Tooth (fits into Item [24])
9. Full Extension Lock
10. Outer Slide
11. Full Extension Release
12. Inner Slide
13. Adjusting screws
14. Rear Recess Bracket
15. 16 and 17. Washers, not used on #13
18. Mounting block on chassis mounting real [4] (fits into item [25])
19. Plate, nut
20. Screw, Mach., Pan Hd 10-32 X 5/8, P/N 10127144
21. Washer, flat #6
22. Rack rail
23. Hole in fixed slide member for screw item #5 above
24. Mounting slot on end of outer slide member [10]
25. Mounting slot on top side of outer slide member [10]
26. Washer, lock #10, P/N 10125805
27. Washer, plain, flat, #10, P/N 94279113
28. Washer, external tooth, #10, P/N 10126403

FIGURE 3-6. RACK MOUNTING DETAILS (SHEET 2 OF 2)



VIEW C
FRONT PANEL REMOVED

DIMENSION	INCHES	MILLIMETERS	DIMENSION	INCHES	MILLIMETERS
A	17.82	452.6	L	0.[illegible]25	15.9
B	17.50	444.5	M	0.[illegible]00	12.7
C	16.70	424.2	N	0.625	15.9
D	0.52	13.2	P	0.88	22.4
E	0.56	14.2	Q	3.38	85.9
F	0.50	12.7	R	0.63	16.0
G	6.66	169.2	S	15.98	405.9
H	10.15 REF	257.8	T	18.312	465.1
J	10.34 REF	262.6			
K	3.24	82.3			

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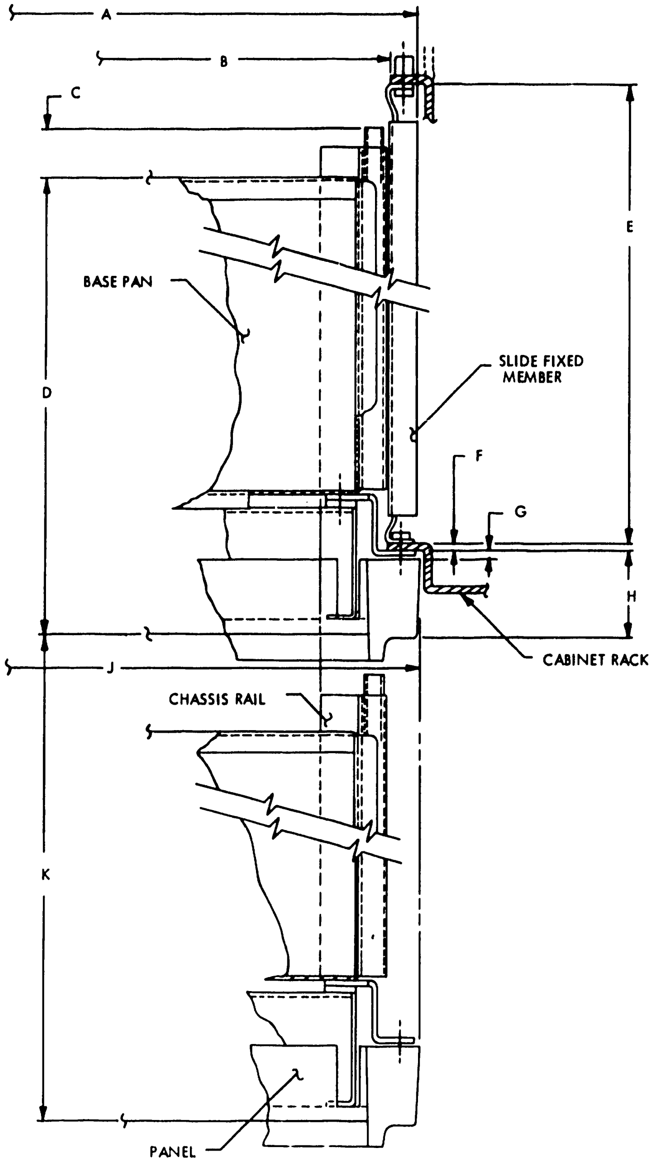
*See Figure 3-6.

FIGURE 3-7. SLIDE/DRIVE MOUNTING CROSS SECTION



DIMENSION	INCHES	MILLIMETERS	REMARKS
A	18.82	478.0	MIN ALLOWABLE CABINET CLEARANCE FOR FIXED SLIDE MEMBER
B	17.75	450.9	MIN ALLOWABLE CABINET OPENING FRONT AND REAR
C	1.18	30.0	
D	30.50	774.7	CASE
E	28.00 thru 33.75	711.2 thru 857.25	SLIDE ADJUSTMENT LIMITS
F	0.12	3.1	REFERENCE
G	0.12	3.1	BUMPER
H	1.50	38.1	
J	19.00	483.6	MAXIMUM
K	33.00	838.2	TRAVEL MAINTENANCE POSITION

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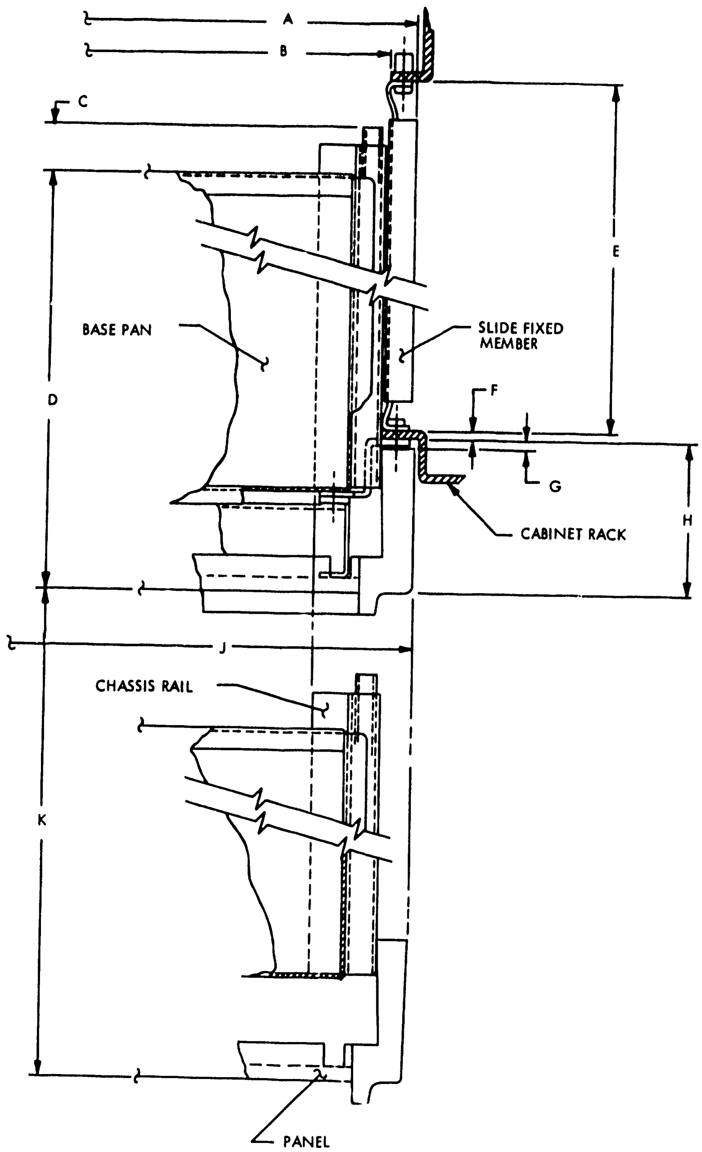
FIGURE 3-8. RACK MOUNT DETAILS FOR 36 INCH (914 MM) MOUNTING



DIMENSION	INCHES	MILLIMETERS	REMARKS
A	18.82	478.0	MIN ALLOWABLE CABINET CLEARANCE FOR FIXED SLIDE MEMBER
B	17.75	450.9	MIN ALLOWABLE CABINET OPENING FRONT AND REAR
C	1.18	30.0	
D	30.50	774.7	CASE
E	28.00 thru 33.75	711.2 thru 857.25	SLIDE ADJUSTMENT LIMITS
F	0.12	3.1	REFERENCE
G	0.12	3.1	BUMPER
H	2.62	66.6	
J	19.00	482.6	MAXIMUM
K	32.00	812.8	TRAVEL MAINTENANCE POSITION

(XX205a)

FIGURE 3-9. RACK MOUNT DETAILS FOR 30 INCH (762 MM) MOUNTING

3.5 POWER REQUIREMENTS

3.5.1 PRIMARY POWER REQUIREMENTS

The primary voltage and current requirements are shown in Tables 3-1 and 3-2. Start up current is shown in Figures 3-9.1a and 3-9.1b.

All devices use single phase power.

TABLE 3-1. PRIMARY VOLTAGE REQUIREMENTS

VOLTAGE (VAC)	TOLERANCE (VAC)	FREQUENCY (Hz)	TOLERANCE (Hz)
100	+7, -10	60	+0.6, -1.0
120	+8, -16	60	+0.6, -1.0
100	+7, -10	50	+0.5, -1.0
120	+7, -16	50	+0.5, -1.0
220	+15, -29	50	+0.5, -1.0
230	+15, -31	50	+0.5, -1.0
240	+16, -32	50	+0.5, -1.0

TABLE 3-2. PRIMARY CURRENT REQUIREMENTS (OPERATING)

Unit Status	AC Power (VAC/Hz)	Line Current (Max. Values)	Peak* Current	Consumption kW
Disks and Carriage in Motion	100/50	8.2	18.0	0.950
	100/60 120/60 120/50	8.2	15.0	0.950
	220/50 230/50 240/50	4.0	7.5	
Disks not in Motion (standby)	100/60 120/60 100/50 120/50	2.0		0.25
	220/50 230/50 240/50	1.0		

*Occurs on initial spin-up of disk for 30-second maximum duration.

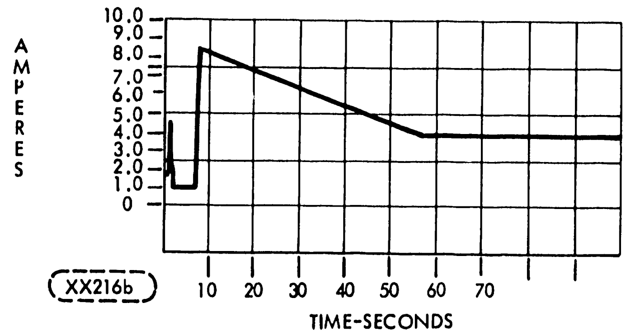


FIGURE 3-9.1A. START UP CURRENT (220-240 V, 50 HZ)

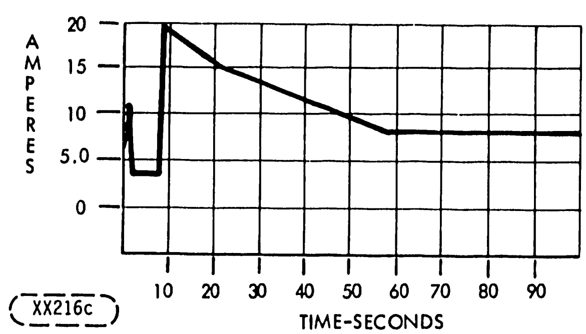


FIGURE 3-9.1B. START UP CURRENT (100 - 120 V, 50/60 HZ)

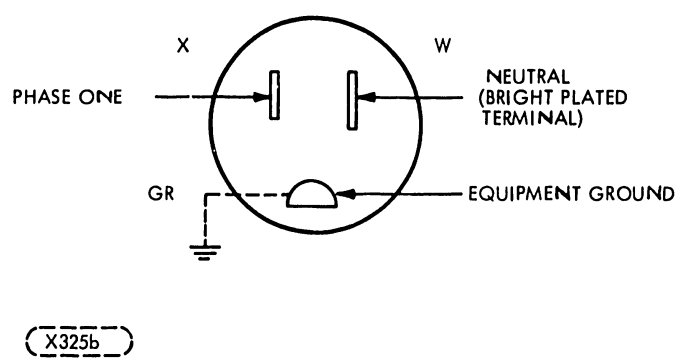


FIGURE 3-10. INPUT POWER CONNECTOR, 120 V, 60 HZ
(POWER SOURCE PLUG END)

3.5.2 POWER CABLE AND CONNECTOR FOR CMD

The power cable is 6 feet (1.83 meters) long. Connectors are defined as:

Description	CDC P/N	NEMA Configuration
120 V, 15 A rated, 60 Hz, 2-pole, 3-wire receptacle connector at CMD end;	75778719	5-15 R
2-pole, 3-wire plug connector at power source end.		5-15 P

A color-coded power cable is supplied with the 50-Hz CMD, but the 50-Hz power source end connector must be furnished by the user. The cable color code and unit power requirements are as follows:

Description	Color-Code	
220-240 V, 50 Hz	Brown	-Phase One
	Blue	-Neutral
	Green and Yellow	-AC Equipment Ground

3.6 CABLING AND CONNECTIONS

3.6.1 UNIT INTERCABLING

Inspect the cabling in the unit for proper seating of the connectors. Lift up and swing out the electronics module (see Section 6.7.2) and check that the connectors on its underside are properly seated on the pins. Figure 5-1 shows proper locations for these. Section 3-12 "Accessories" for applicable cable/connector part numbers.

It is recommended that shielded cable be used. However, unshielded cables may be used in a properly shielded cabinet and when cables do not go outside the cabinet.

All input/output cables exit at the rear of the disk drive (see Figure 3-12). Refer to Figure 3-13 and 3-14 for connector pin/-signal assignments for these cables. The function of each signal name is described in Table 5-3. If a terminator is used it is plugged into J2 on the I/O PWA (see Figure 3-12). Figure 3-11 shows the intercabling and terminator placement for the various drive connection arrangements. Shown are the star cabled system and the daisychained system. A single drive would be connected as shown for the star configuration. Terminators are not furnished with each unit but must be ordered as needed for the particular system configuration into which the CMD will be integrated.

CAUTION

The circuit assemblies contained in this equipment can be degraded or destroyed by ELECTRO-STATIC DISCHARGE (ESD).

Static electrical charges can accumulate quickly on personnel, clothing, and synthetic materials. When brought in close proximity to or, in contact with delicate components, ELECTROSTATIC DISCHARGE OR FIELDS can cause damage to these parts. This damage may result in degraded reliability or immediate failure of the affected component or assembly.

To insure optimum/reliable equipment operation, it is required that technical support personnel discharge themselves by periodically touching the chassis ground prior to and during the handling of ESD susceptible assemblies. This procedure is very important when handling Printed Circuit Boards.

Printed Circuit Boards should be handled or transported in electrically conductive plastic bags to insure optimum protection against potential ESD damage.

3.6.2 I/O AND POWER CABLE ROUTING INFORMATION

Rack Mount Drives

It is recommended that a cable retract mechanism be incorporated in the rack design. However, due to the variations in rack and cabinet configurations it is not possible to configure a mechanism or a method to satisfy all requirements and therefore such a device is not offered. Retract mechanisms can be purchased from a number of different manufacturers.

NOTE

Additional I/O cable lengths are required to raise the E module to the maintenance position.

CAUTION

Do not plug/unplug I/O cables with power applied on either end. Refer to paragraph 6.5.2 for more detail.

3.7 GROUNDING

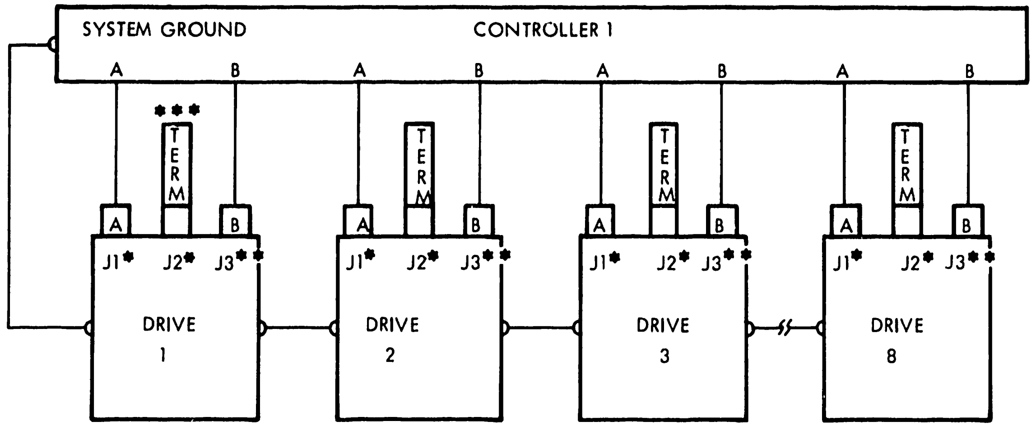
3.7.1 SYSTEM GROUNDING CONNECTIONS

The CMD frame and "DC" (DC power, Logic and analog signal) grounds are connected when the units are shipped. However, they can be isolated by the user. To do so disconnect the metal ground strap between the AC and DC ground studs (see Figure 3-13) at the rear of the unit. This can be done by loosening the outside nut on each ground stud and rotating the strap away from the frame ground stud or by complete removal.

3.7.2 FRAME GROUND

All parts of the CMD frame and associated metallic parts (not including the base deck and Electronics Module frame which are DC ground) are bonded together through low impedance contacts. A frame ground point is provided at the left rear corner of the base pan (as viewed from the front of the CMD). The CMD should be grounded to the system as mentioned in paragraph 3.7.1.

STAR CABLED SYSTEM

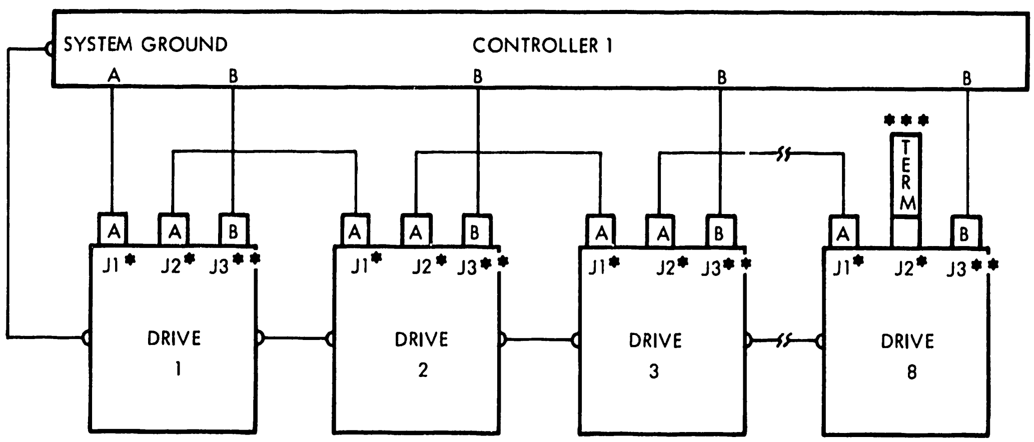


SYSTEM CONFIGURATION FOR 1 OR MORE UNITS (UP TO 8)

NOTES:

1. Maximum individual A cable lengths = 50 feet (15.24 meters).
2. Maximum individual B cable lengths = 50 feet (15.24 meters).

DAISY CHAINED SYSTEM



SYSTEM CONFIGURATION FOR 2 THROUGH 8 UNITS

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NOTES:

1. Terminators are required to terminate "A" cable lines at the last unit of the daisychain or each unit in a star and at controller receivers.
2. Termination of "B" cable receiver lines are required at the controller. The unit's CNTL/MUX card has termination integrated into its assembly.
3. Maximum cumulative A cable length = 100 feet (30.48 meters). Maximum individual B cable length = 50 feet (15.24 meters).
4. Do not plug/unplug I/O cables with power applied on either end. Refer to paragraph 6.5.2 for more detail.

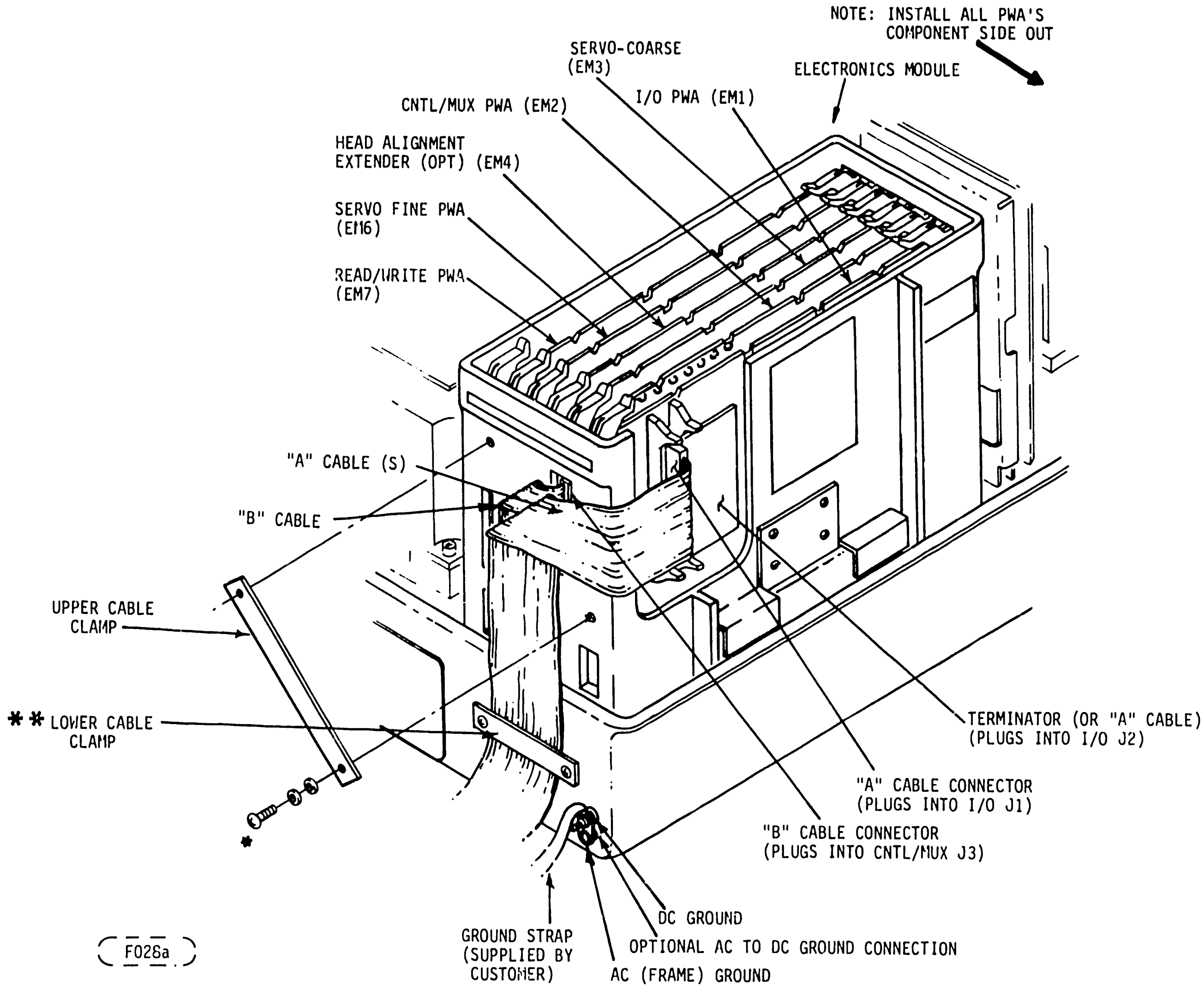
---

* I/O PWA

** CNTL/MUX PWA

*** Terminators must be ordered separately, since each unit may or may not need one. (For P/N see Figure 5-14.)

FIGURE 3-11. SINGLE CHANNEL INTERFACE



* PROTRUSION BEYOND INNER WALL SURFACE NOT TO EXCEED 0.12 INCHES (3 mm). SELECT PROPER LENGTH SCREW FROM ACCESSORY CARTON.

** THE SHIELD GROUND ON SHIELDED CABLES MUST BE GROUNDED TO THE UNIT AND CONTROLLER.

FIGURE 3-12. I/O CABLE INSTALLATION AND PWA NAMES/LOCATIONS

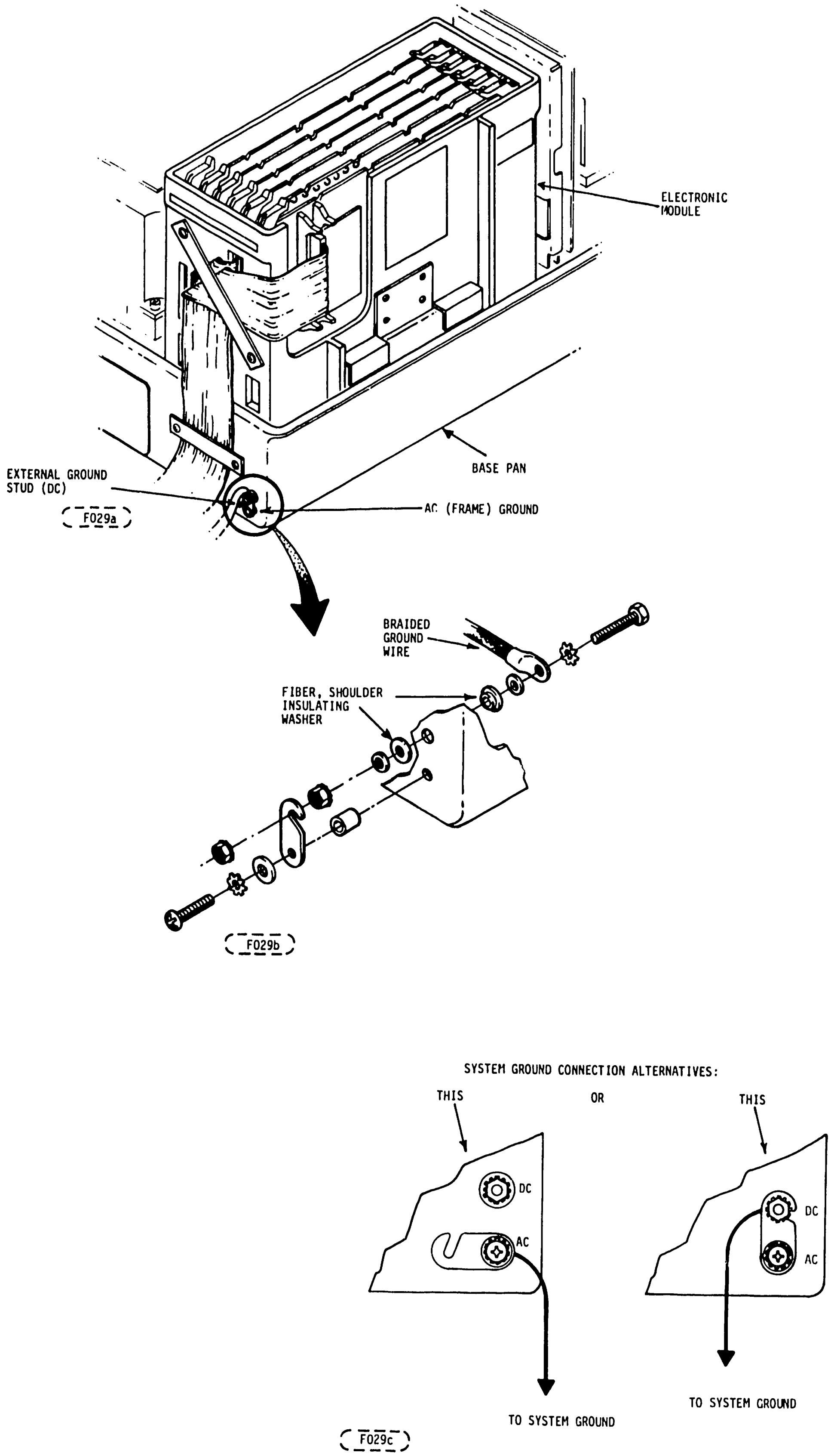


FIGURE 3-13. GROUNDING OPTION

3.7.3 DC/LOGIC/ANALOG GROUND

The CMD electronic circuits (DC power, logic and analog signals) utilize a common ground which is separate from AC or frame ground unless connected together at one point as described in paragraph 3.7.1. If static discharge susceptibility is a problem then the AC (frame) and DC grounds should be connected together with Jumper provided.

3.8 COOLING REQUIREMENTS

Cooling air is drawn in at the front of the unit and exhausted through the rear. A minimum of 1-1/4 inch (32 mm) clearance must be provided at the rear of the unit to maintain unrestricted air flow. A positive pressure near the rear exhaust should not exceed 0.03 inches of water (7.47 Pascal).

3.9 ENVIRONMENT

Operating and storage environmental limits of the unit are as follows:

Operating Environment

*Relative Humidity	20% to 80%
***Ambient Temperature	+50°F (10°C) to +95°F (35°C)**
Temperature Gradient	18°F/hour (10°C/hour)
Humidity Gradient	10%/hour

Storage Environment (up to 3 months)

*Relative Humidity	10% to 90%
Ambient Temperature	+14°F (-10°C) to +122°F (50°C)**
Temperature Gradient	27°F/hour (15°C/hour)
Humidity Gradient	10%/hour

Transient Environment (up to one week)

*Relative Humidity	0% to 100%
Ambient Temperature	-40°F (-40°C) to +158°F (65°C)**
Temperature Gradient	36°F/hour (+20°C/hour)
Humidity Gradient	10%/hour

* Providing there is no condensation.

** Maximum temperature reduced by 1.95°F/1000 ft. (1.08°C/305 m)

*** Ambient Temperature - Inlet air can reach 95°F provided the maximum air temperature at the hottest point around the 4 sides (excluding front and rear) of the device does not exceed 125°F.

3.10 PREPARATION FOR USE

3.10.1 SECTOR NUMBER OPTION SWITCHES

The number of sector pulses per disk revolution can be selected by positioning sections 1 through 7 of an 8 section DIP option switch on the Servo-Coarse PWA. See Figure 3-14. The settings of the DIP switch (S1) are factory set to customer requirements. The output from a section of the DIP switch will be a logic "0" when the "ON" or left side of the switch is pushed in ("ON" is embossed on the lower left corner of the switch also). The output of a switch is logic "1" when the right side of a switch is pushed in ("OFF").* Table 3-3 lists the number of sector pulses generated per disk revolution for each switch section setting of sections 1 through 7. Switch Section 8 is used for maintenance purposes and its use is described in Section 6 of this manual. For normal operation switch section 8 should be left in the ON position. "OFF" (right side pushed in) displays the actuator velocity adjustment and "ON" allows display of microprocessor faults and present seek address. Position S1-8 to "ON".

Switches S1-1 through S1-7 are interpreted by the microprocessor on the Servo Coarse PWA as a seven digit binary number, with S1-1 being the least significant bit and S1-7 being the most significant bit. Any number of sectors from 1 to 128 can be selected. The unique settings of the switch for each customer are shown in a document called "Device Specifications and Switch Selections" which is included in the front of every manual when shipped. These specifications can be used to check the switch settings of the unit before it is put into operation.

3.10.2 I/O PWA

The I/O PWA contains three switches. The toggle switch S1 selects remote (at the controller) or local (CMD control panel) control of the power sequence lines. The toggle switch S2 provides manual capability of inhibiting drive transmitted signals except for Read/Write Clocks and Data. Before operating the CMD, position these two switches to the desired positions (see Figure 3-15).

Switch S3 is an option selection switch not found on all I/O PWA versions that is set at the factory to customer requirements. When replacing the I/O PWA with a spare, consult the Device Specifications and Switch Selections document attached with the manual at the time the unit is shipped. It shows how S3 should be set.

---

*NOTE: The logic signals required from the switches are:
ON = 0, OFF = 1.
Therefore, when switches 2 through 7 are pushed down on the ON side and switch 1 is pushed down on the OFF side, the selection being made is one sector (S1-1 output is active LOW). When all switches are pushed down on the OFF side, the selection is 127 sectors.

TABLE 3-3. S1 SWITCH SETTINGS VS NUMBER OF SECTORS PER REVOLUTION

		S1--							
7	6	5	4	3	2	1		Number of Sectors	Includes Sector
64	32	16	8	4	2	1	(Binary Weight)	(in decimal)	Numbers
0	0	0	0	0	0	1		1	0
0	0	0	0	0	1	0		2	0-1
0	0	0	0	0	1	1		3	0-2
0	0	0	0	1	0	0		4	0-3
0	0	0	0	1	0	1		5	0-4
			:				- etc.* -		
0	0	0	1	0	0	0		8	0-7
			:				- etc.* -		
0	0	1	0	0	0	0		16	0-15
			:				- etc.* -		
0	1	0	0	0	0	0		32	0-31
			:				- etc.* -		
1	0	0	0	0	0	0		64	0-63
			:				- etc.* -		
1	1	1	1	1	1	0		126	0-125
1	1	1	1	1	1	1		127	0-126

*The intervening values follow the binary/decimal number equivalence rules and can easily be filled in by the reader.

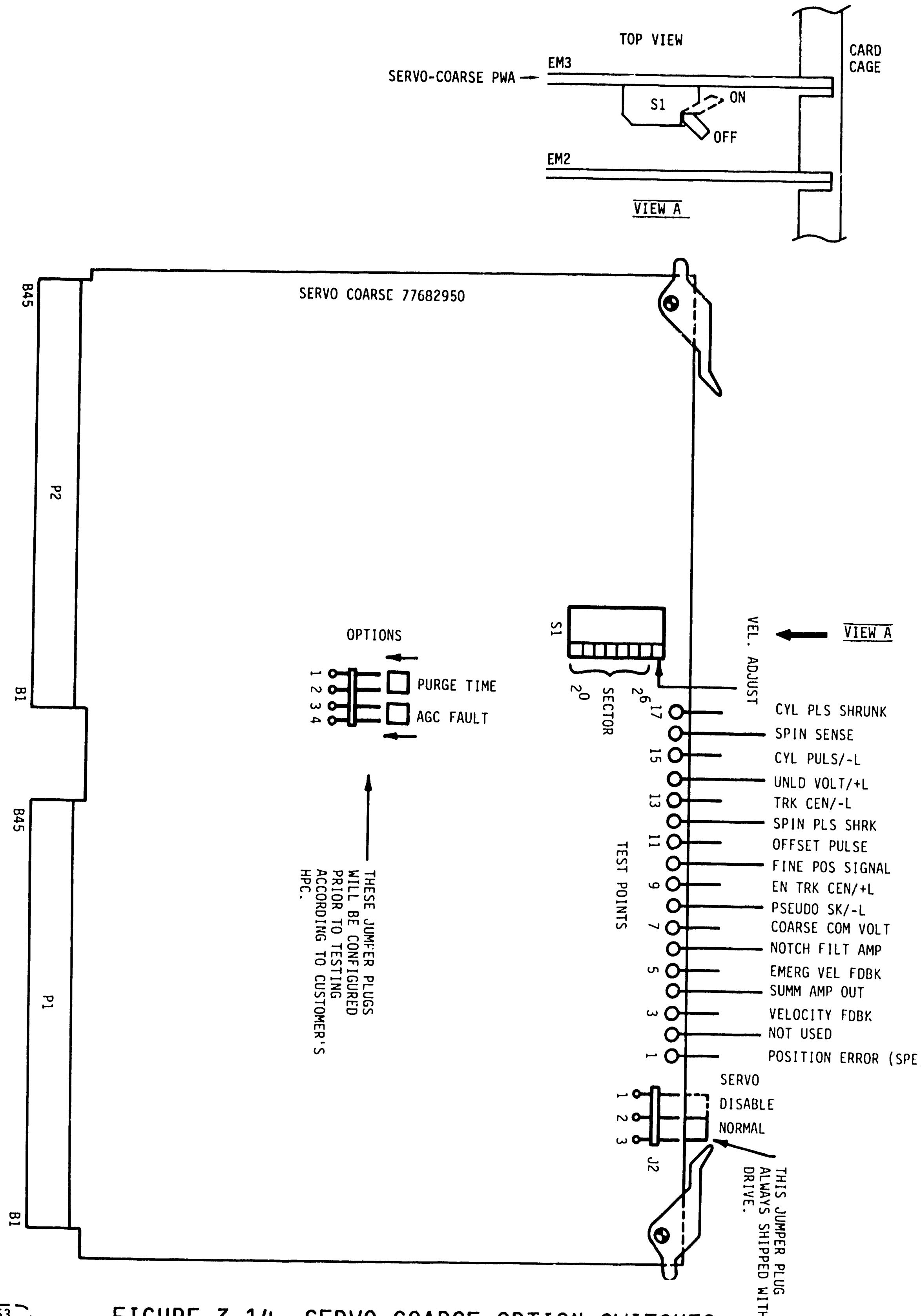


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FIGURE 3-14. SERVO-COARSE OPTION SWITCHES

3.10.3 SERVO-COARSE PWA OPTION SELECTION DESCRIPTION

3.10.3.1 INTERCHANGEABILITY

The Servo-Coarse PWA documented in Section 5 of this manual is plug compatible and both ways interchangeable with previously used Servo-Coarse PWAs. However this applies to function and basic performance only, not to options. Certain options in function and performance can be selected using DIP switch and jumper plug positioning on the Servo-Coarse PWA.

3.10.3.2 SWITCH AND JUMPER OPTIONS

Options selectable on the Servo-Coarse PWA and how to select them are given in the following paragraphs. Figure 3-14 shows the option switch and jumper connector placement on the Servo-Coarse PWA.

- Sector and Maintenance Switch

  For ease of access to the velocity adjustment switch, dip switch S1 has been changed to a 90° type (see Figure 3-14.1). This sector and maintenance switch assignments are as before. Paragraph 3.10.1 describes use of this switch.

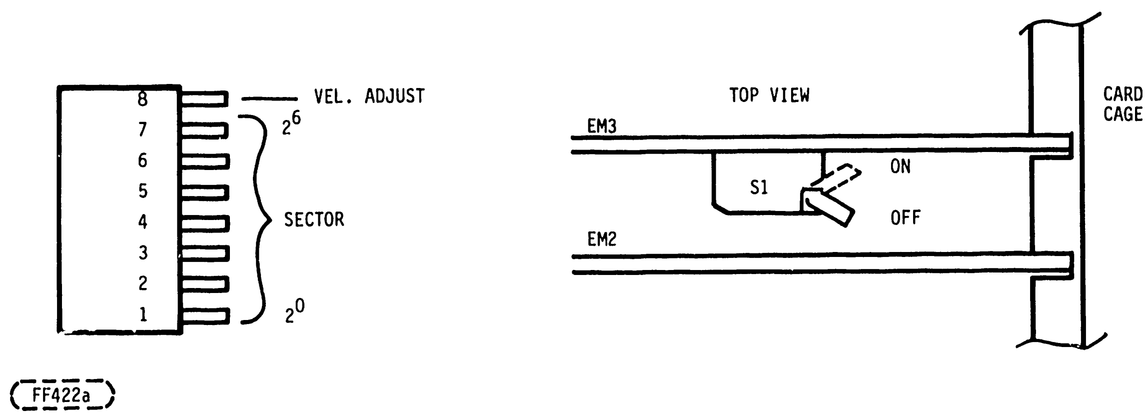


FIGURE 3-14.1 DIP OPTION SWITCH S1

- Servo Enable/Disable

  The E1/E2 pins of the older Servo-Coarse PWAs have been moved to the top of the board and are now a 3-pin header J2-1, 2, 3 as shown in Figure 3-14.2. This allows the service engineer to disable the servo operation by simply placing the jumper to the correct position.

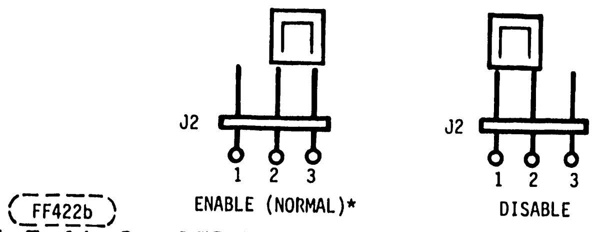


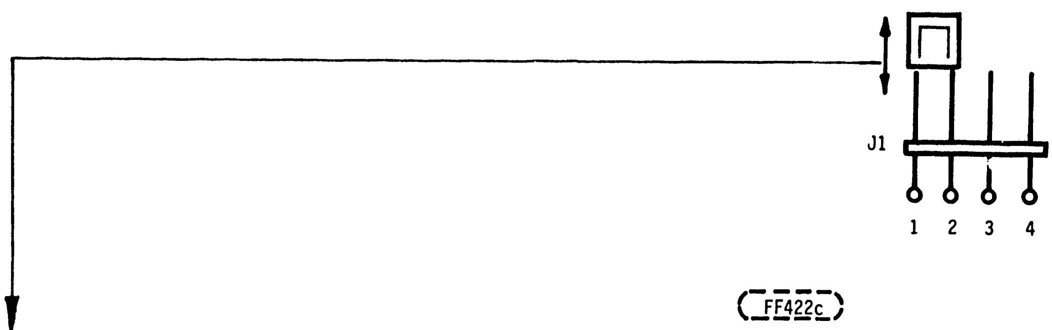
FIGURE 3-14.2. SERVO ENABLE/DISABLE JUMPER PLUG

- Purge Time Option and AGC-Door Lock Option

A 4-pin header J1 has been added to the PWA to incorporate two more options; selectable purge time and AGC Fault Door Lock Option.

1. Selectable Purge Time

To select 35 sec. purge time install a jumper on J1 as shown in Figure 3-14.3.



Jumper On : 35 sec purge ($\leq$ 70 sec START READY)
Jumper Off : 120 sec purge ($\leq$ 155 sec START READY)

FIGURE 3-14.3. PURGE TIME SELECT JUMPER CONNECTOR

2. AGC Fault Door Lock Option

This option uses J1-3 and 4 to determine the unit's reaction to an operator stop after the drive had an AGC fault. Install jumper as shown in Figure 3-14.4.

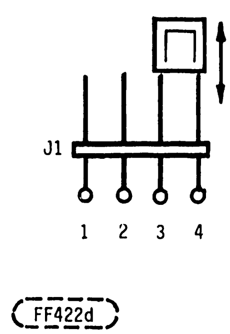


FIGURE 3-14.4. AGC FAULT DOOR LOCK OPTION JUMPER CONNECTOR

*NOTE: Each PWA will be delivered with a jumper plug on the enable (normal) position.

In case of a loss of AGC or missing AGC during head load (possible servo head crash), the heads will unload and seek error is set. As a result of this one of the following two reactions, each with two alternatives, could occur:

a. If an RTZ command is issued to the drive, its reaction depends on the J1-3/4 jumper:

   Jumper On - RTZ is accepted, seek error is cleared and heads will attempt to load again.

   Jumper Off- RTZ is rejected (in this particular case of an AGC fault only) Seek error is not cleared.

   Microprocessor Fault Code 08H (await AGC during head load) or 1AH (lost AGC) is stored in RAM and can be displayed on CNTL/MUX card.

b. If the operator, after the occurrence of an AGC fault and head unload, operates the START/STOP switch to the STOP position (out), the unit will spindle down with brake and when stopped, front panel fault is set and the door is kept locked. Eventually, an attempt will be made to clear the fault.

   The reaction of the unit to a fault clear depends on the jumper J1-3/4:

   Jumper On - The drive will reset fault, release the front door and allow the unit to be restarted.

   Jumper Off- The drive will ignore the fault clear and keep the door locked. Only AC OFF-ON can recover the drive from this mode.

Microprocessor Fault Codes 08H or 1AH are stored in RAM and can be displayed on CNTL/MUX card.

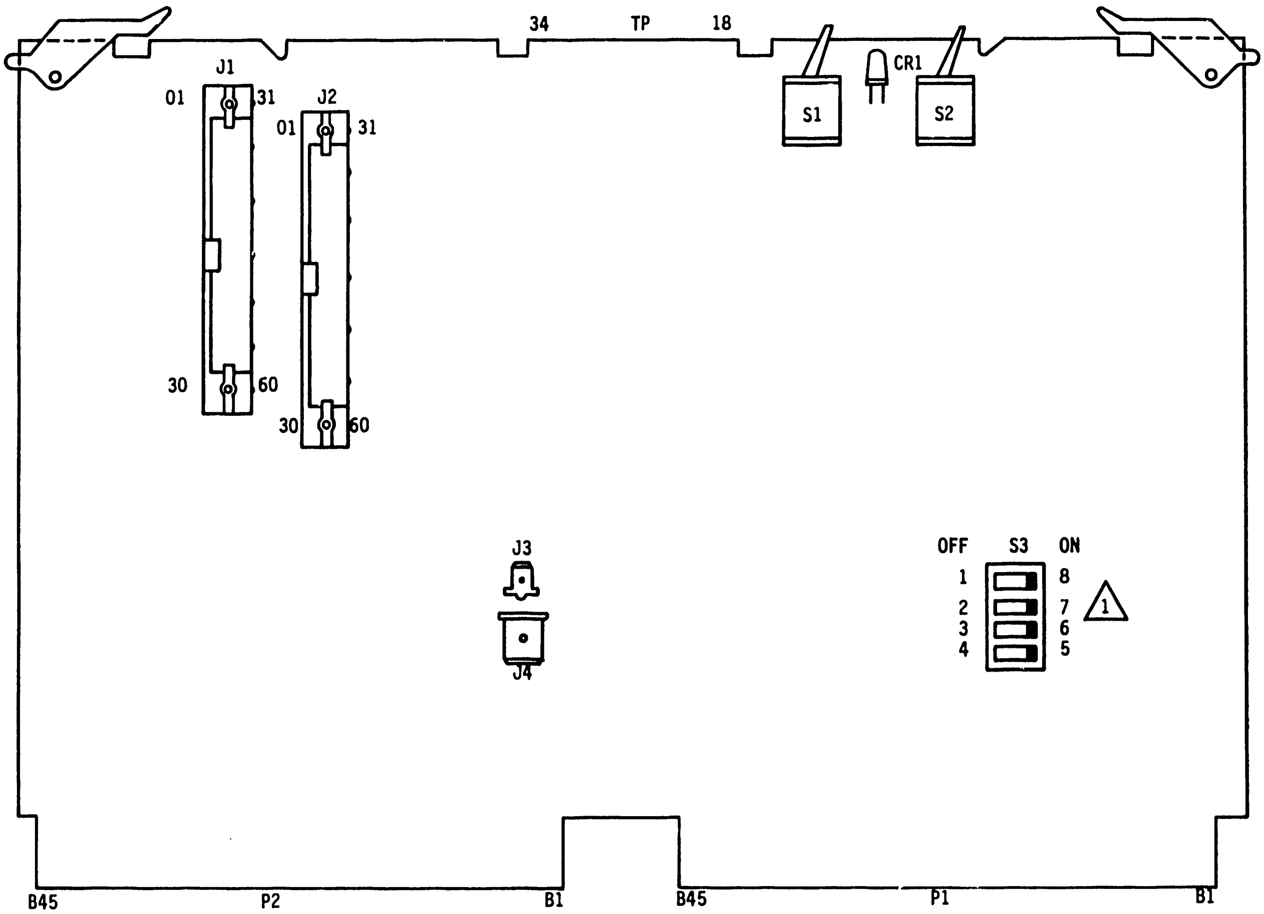
- Power Down VIA Illegal Seek Command

If the unit receives a seek command to an illegal address of 989_{10} (3DDH), heads will immediately unload, drive will power down with brake, and when stopped front panel fault is set. Microprocessor fault code 17H (address greater 822) is stored in RAM and can be displayed on CNTL/MUX card.

The unit will react to a fault clear exactly as described under paragraph 2b. above (Loss of AGC). Recovery to normal operation after this depends on the jumper J1-3/4.

NOTE

This is not an option. All PWAs will react as described in paragraph 2b above. However, the customer must choose whether or not to use this power down feature by performing seek to 3DDH.



1 NOT ALL VERSIONS OF THE I/O PWA HAVE THIS SWITCH. SEE HPC/SWITCH SETTINGS SPEC. FOR SETTINGS OF THIS SWITCH APPLICABLE TO UNIT IN WHICH BOARD HAVING THIS SWITCH IS USED.

F030a

FIGURE 3-15. I/O PWA SHOWING SWITCHES AND I/O CONNECTOR LOCATIONS

3.11 INITIAL CHECKOUT AND STARTUP PROCEDURE

This procedure should be used to make the first power application to the unit. The procedure assumes that the preceding procedures and requirements of this section have been performed.

CAUTION

THE AC POWER CIRCUIT BREAKER SHOULD NEVER BE POSITIONED TO OFF WHILE THE DISK IS ROTATING. WITH SPINDLE TURNING AND BLOWER STOPPED. THE POSSIBILITY FOR CONTAMINATION TO ENTER THE MEDIA AREA IS GREATLY INCREASED.

1. Check that the AC power circuit breaker is OFF.

2. Check that the front door is latched and cannot be opened with a 10 $\pm$5 pounds (4.5 $\pm$2.3 kg) of force. If the front door requires less force than specified, perform alignment procedure contained in Section 6.7.21.

3. Open the top cover (per Section 6.7.1).

CAUTION

DO NOT MANUALLY POSITION THE CARRIAGE, SUCH ACTION COULD CAUSE DAMAGE TO THE READ/WRITE HEADS AND/OR DISK SURFACES.

4. Make certain that the input power cable is connected to the correct external AC power source.

5. Install the terminator in J2 of the I/O PWA if star configuration is used for the system. For daisychain configurations, the terminator is installed in the last device only.

6. If the plastic bag surrounding the unit was damaged during shipping a 30 minute purge should be performed.

7. If a purge is to be performed, Disable Servo per paragraph 6.8.5.3, and raise the Base Deck Assembly per paragraph 6.7.2.

8. Turn on AC power circuit breaker. Make certain that the blower is operating and allow blower to purge the absolute filter for a minimum of 5 minutes.

9. Lower the base deck assembly per Section 6.7.2.

10. Remove plastic cover shipped in place of a cartridge and install a cartridge per Section 2-7.

11. On the I/O PWA switch the REM/LOC switch to LOC.

12. Operate the START/STOP switch on the operators panel to start the drive.

13. Check to see that the spindle drive motor is operating.

14. (Perform this step only if purge is to be performed). With Servo Disabled the heads will not load, but the disk will continue to spin. The unit should be allowed to purge for at least 25 minutes.

    a. Operate STOP switch on operator control panel.
    b. When a stopped condition is obtained, turn OFF AC breaker.
    c. Enable Servo, turn ON AC breaker, then operate the START switch to START.

15. Check that the positioner drives the carriage forward to load the Read/Write heads at Track 00 in a maximum of 70 seconds.

16. Operate START/STOP switch to STOP and check to see that the heads FULLY UNLOAD and the spindle stops.

17. On I/O PWA, switch REM/LOC switch to REM, unless the system requirement is for the power sequencing control to be at the unit rather than remote.

18. Install I/O cables per Section 3.7.

19. Replace top cover.

20. Operate the START/STOP switch to START to start the unit. Wait until the heads are loaded (READY light illuminated) and run on-line diagnostics as applicable (if available).

3.12 ACCESSORIES

3.12.1 I/O INTERFACE ACCESSORIES

I/O Interface Accessory items required, but not furnished with the device are shown in the following Tables:

TABLE 3-4. UNSHIELDED I/O CABLE AND TERMINATOR PART NUMBERS

DESCRIPTION	QUANTITY REQUIRED	NOTE	PART NO.
"A" Cable (Controller to Device) (Same Connector on each end, see para. 3.12.2)	One per Device in star, one per multi-spindle installation in Daisy-chain	2	775642XX
"A" Cable (Device to Device) (Same Connector on each end, see para. 3.12.2)	One less than total devices in the Daisy-chain	1,2	775642XX
"B" Cable (Controller to Device)	One per Device		775643XX
Terminator	One per Device in star, one per multi-spindle installation in Daisy-chain		75841300

1. Multiple, number of cables required depends on number of units in daisychain.

2. Last two digits denote length. (For cable length, see Table 3-5.)

The above accessories are required but not included with the units; they must be purchased separately.

TABLE 3-5. UNSHIELDED I/O CABLE LENGTH AND TABS

	PART NO. TAB	CABLE LENGTH IN FEET / METERS									
		5 / 1.52	6 / 1.83	8 / 2.44	10 / 3.05	15 / 4.58	20 / 6.96	25 / 7.63	30 / 9.15	40 / 12.2	50 / 15.24
TAB (XXX)	"A" Cable 775642XX	00	01	02	03	04	05	06	07	08	09
	"B" Cable 775643XX	00	01	02	03	04	05	06	07	08	09

3.12.2 DESCRIPTION OF I/O CABLE CHARACTERISTICS AND CONNECTOR PART NUMBERS

3.12.2.1 "A" CABLE (SEE FIGURE 3-16)

ITEM	DESCRIPTION	MPI P/N	BERG P/N	P/N SPECTRA-STRIP
1	Connector (60 Pos)	94361115	65043-007	
UNSHIELDED				
2	Flat Cable (twisted-pair) 30 pair, 28AWG	95043902		3CT-6028-3-05-100
SHIELDED				P/N 3M
2	Flat Cable, Jacketed, shielded 28AWG	77619362		3517/60
3	Contact, Insert	94245603	4808	------

"A" Cable Mating Receptacle on Unit or Controller.

ITEM	DESCRIPTION	MPI P/N	AMP P/N
4a	60 pin, right angle header	94369804	3-86479-4
4b	60 pin, vertical header	94385129	3-87227-0

3.12.2.2 "B" CABLE (SEE FIGURE 3-16)

ITEM	DESCRIPTION	MPI P/N	AMP P/N	P/N 3M
5	Connector (26 Pos)	65853402	3399-3000	
6	Connector Pull Tab	92004801	3490-2	
UNSHIELDED				
7	Flat Cable (26 Pos) with ground plane and drain wire	95028509	3476-26	
SHIELDED				
7	Flat Cable, Jacketed	77619357		3517/26

"B" Cable Mating Receptacle on Unit or Controller.

ITEM	DESCRIPTION	MPI P/N	AMP P/N
8a	26 pin, right angle header	94369802	1-86479-0
8b	26 pin, vertical header	94385112	1-87227-3

3.12.2.3 I/O CABLE CHARACTERISTICS

"A" CABLE UNSHIELDED

Type:	30 twisted pair, flat-cable
Twists per inch:	2
Impedance:	100 ±10 ohms
Wire size:	28 AWG, 7 strands
Propagation Delay:	1.6 to 1.8 ns/ft (5.28 to 5.9 ns/m)
Maximum cable length:	100 ft cumulative (30.48 m)
Voltage Rating:	300 V rms

"B" CABLE (WITH GROUND PLANE) UNSHIELDED

Type:	26 conductor, flat cable with ground plane and drain wire
Impedance:	65 ohms (3M P/N 3476-26)
Wire size:	28 AWG, 7 strands
Propagation Delay:	1.65 ns/ft (nominal) (5.41 ns/m)
Maximum cable length:	50 ft (15.24 m)
Voltage Rating:	300 V rms

"A" CABLE SHIELDED

Type:	60 conductor, flat cable, jacketed
Impedance:	55-105 ohms, 70 ohms nominal
Wire size:	28 AWG, 7 strands
Propagation Delay:	1.51 ±0.25% ns/ft (4.95 ±0.25% ns/m)
Maximum cable length:	100 ft cumulative (30.48 m)
Voltage rating:	150 V

"B" CABLE SHIELDED

Type:	26 conductor, flat cable, jacketed
Impedance:	55-105 ohms, 70 ohms nominal
Wire size:	28 AWG, 7 strands
Propagation Delay:	1.51 ±0.25% ns/ft (4.95 ±0.25% ns/m)
Maximum cable length:	50 ft (15.24 m)
Voltage rating:	150 V

3.12.3 REMOVABLE DISK CARTRIDGE

The removable disk cartridge is not furnished with the device, and should be ordered separately if one (or more) is desired. Part number of the Model 1204 Disk Cartridge is 76204001.

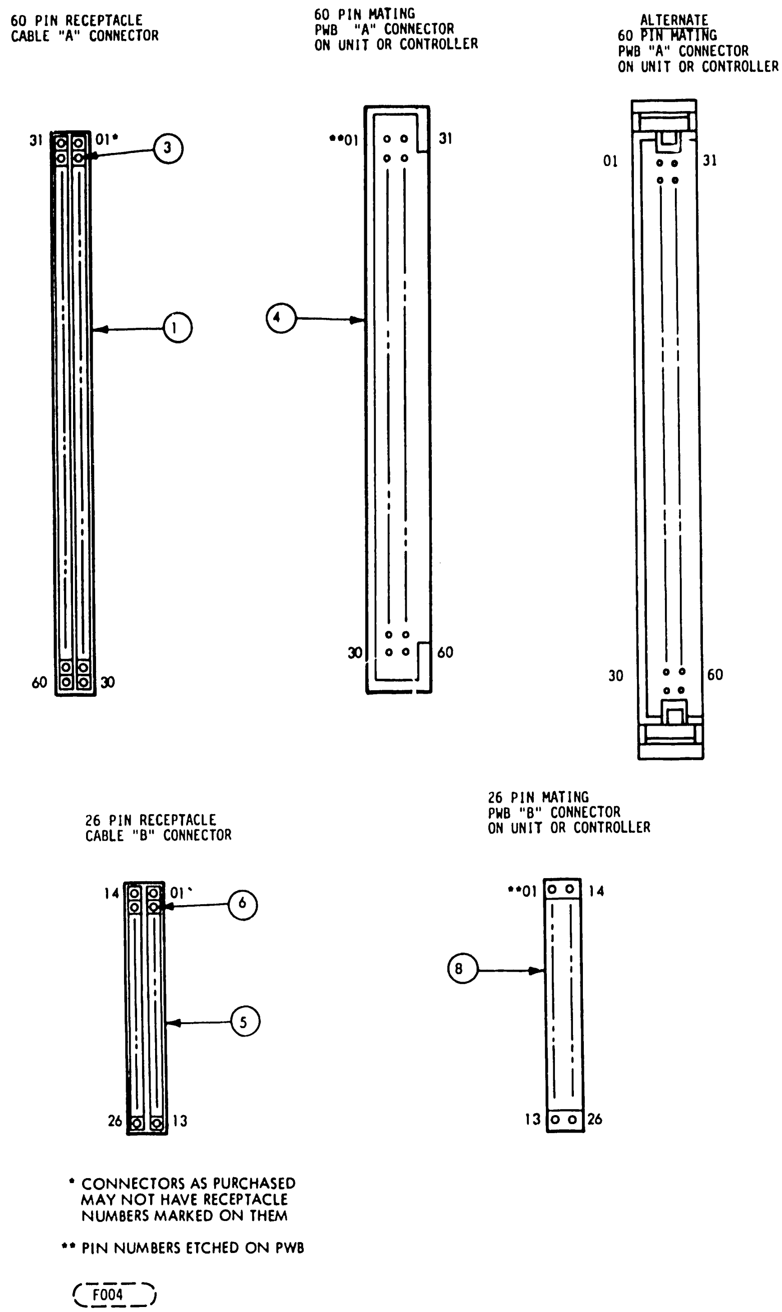


FIGURE 3-16. I/O CONNECTORS - CABLE MOUNT AND PWB MOUNT

SECTION 4

THEORY OF OPERATION

SECTION 4
THEORY OF OPERATION

4.1 INTRODUCTION.. 4-1

4.2 ASSEMBLIES.. 4-5

4.3 FUNCTIONS... 4-16

4.1 INTRODUCTION

The theory of operation for the drive is organized into two parts. The first part describes the major mechanical assemblies. The second part describes the power functions, the logical functions, and the signals exchanged with the controller. Logic signal names are followed by the symbol +L and -L indicating that the active (Logic "1") level of the signal is high (+4 Volts for TTL and -0.8 Volts for ECL) or low (nominal 0 Volts for TTL and -1.7 Volts for ECL) respectively. For example, the signal SEG-END-INT/+L indicates the signal is at a nominal +4 Volt level when active (Logic "1"). (See also paragraph 5.6.2.) Connector and pin nomenclature used in the text will be the same as that used in the wire lists. Following is a list of the connector designators used (see also Figure 5-1).

Electronics Module PWA Connectors

EM1	I/O PWA
EM2	Control/Mux PWA
EM3	Servo-Coarse PWA
EM4	Head Alignment PWA
EM6	Servo-Fine PWA
EM7	Read/Write PWA

Other Assemblies which may be referred to in this section

RC	Relay Control PWA
PA	Power Amplifier Assy
OP	Operator Control Panel
CMPB	Component PWA
SP	Servo Preamplifier
RWP	Read/Write Preamplifier
TM	Terminator PWA
VT1	Velocity Transducer
CR1	Spin Speed Sensor
	Lo-Air Pressure Transducer (Optional)
	No-Air Pressure Transducer

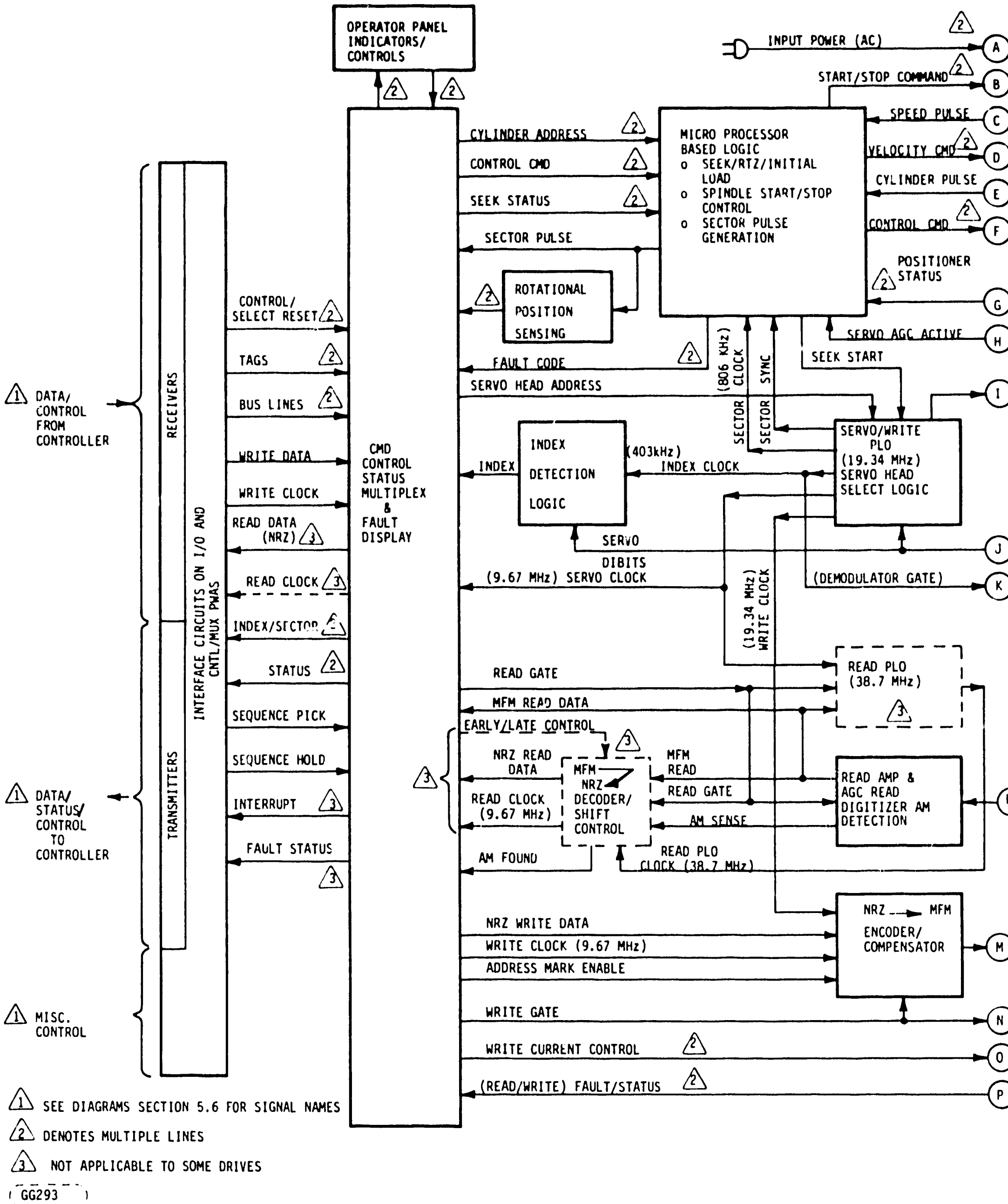


FIGURE 4-1. CMD BLOCK DIAGRAM (SHEET 1 OF 2)

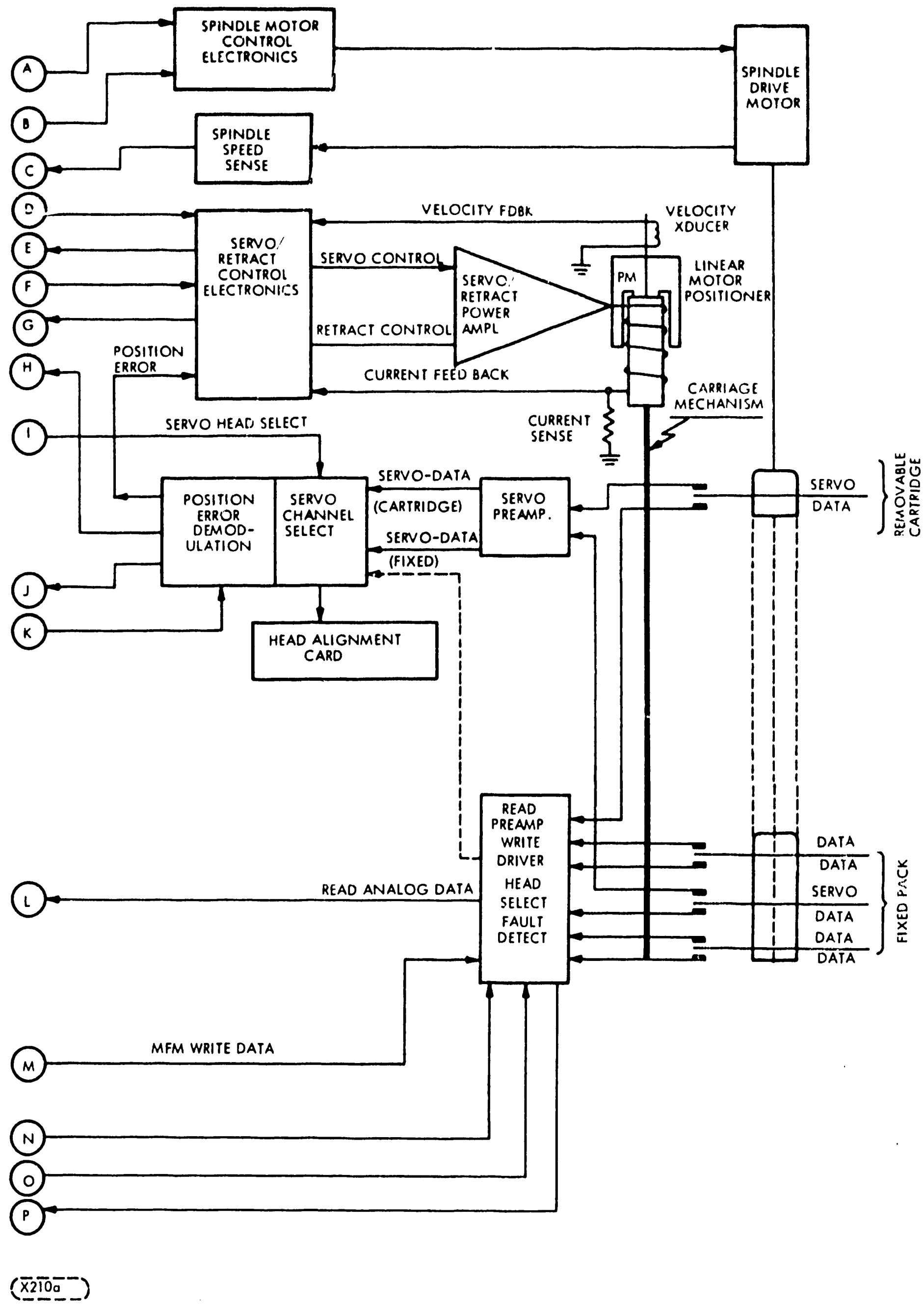


FIGURE 4-1. CMD BLOCK DIAGRAM (SHEET 2 OF 2)

Each Electronics Module (EM) PWA has two connectors called P1 and P2. These plug into J1 and J2 of the Mother Board PWA. In addition, eight other connectors connect to the back panel pins of the EM Mother PWA. These are EMP3 through EMP10 (EMP1 and EMP2 not used) on the wire lists and they route signals to/from assemblies other than Electronics Module PWAs. On the schematics, signals which connect between the Electronics Module PWAs will be labeled P1 or P2 plus pin number. For example, P1-B41 on the Servo-Fine PWA schematic is the "FXD-ADR/-L" signal which comes via the Mother Board connections from EM2P1-A41 which is the CNTL/MUX PWA. Sheet 1 of each PWA schematic is an Intercabling diagram which shows the connection of "FXD-ADR/-L" between two PWAs. Connectors labeled J1 or J2 on the Electronics Module PWA schematics refer to interconnection signals, i.e., signals going through the EMP3 through EMP10 connectors to assemblies not in the Electronics Module, such as the Servo Preamp PWA. The intracabing diagram (or interconnection diagram, in some cases) with each schematic gives a Cross Reference number which indicates figure number and sheet number where the signal in question is found as a source or destination. For example, the signal "P-DIBIT-REM" is shown on sheet 2 (Cross Ref. No. 0601) of the Servo-Fine PWA schematic has as its source/destination the schematic of Figure 5-10, which is the figure for the Servo Preamp schematic. A look at Figure 5-10, sheet 2 (Cross Ref. No. 0001) shows "P-DIBIT-REM" going out on J2-01.

The interconnection Diagram of Figure 5-10, sheet 1 (cross Ref. 0901) indicates J2-01 goes to P1B04 of Cross Reference 0602 (sheet 2 of Figure 5-7). A look at Figure 5-1, sheet 2 of 2 (the interconnection diagram for the whole unit) shows that there is a cable going from J2 of the Servo Preamp to P1 of EM6 which is the Servo-Fine PWA.

Reference should be made to paragraph 5.3 for a complete description of the usage of the cross referencing system discussed briefly here.

Integrated circuit components are designated as follows:

```
U25    -    12
 |          |
 |          |__________IC pin number
 |
 |_____________________IC Location
```

Functional descriptions are frequently accomplished by simplified diagrams. These diagrams are useful both for instructional purposes and as an aid in troubleshooting. The diagrams have been simplified to illustrate the principles of operation: Therefore, some elements are omitted. The logic diagrams in Section 5 of this manual should take precedence over the diagrams in this section whenever there is a conflict between the two types of diagrams.

The descriptions are limited to drive operations only. In addition, they explain typical operations and do not list variations or unusual conditions resulting from unique system hardware or software environments. Personnel using this manual should already be familiar with principles of operation of the computer system, the controller, programming considerations (including the correct sequencing of I/O commands and signals), and track format (i.e., data records and field organization).

4.2 ASSEMBLIES

Figure 4-2 illustrates the physical placement of the various major assemblies comprising the CMD. Figure 4-1 illustrates the functional relationships of these assemblies. The following paragraphs describe the operation of these assemblies.

4.2.1 POWER SUPPLY

Each drive has its own self-contained power supply. The power supply is located in the rear and cooled by air from a blower at the front of the drive cabinet. The power supply consists of a linear transformer and associated filter capacitors to supply ±5, ±20 and ±32 Volts. The ±5 Volt supply and the ±20 Volt supply are internally regulated.

The power supply has the following outputs:

1. ±20 Volts for use in generating ±15 Volts, ±12 Volts and ±6 Volts all of which are used in the various analog circuits (i.e., Servo and Read/Write and +12 Volts for the microprocessor and the microprocessor memory circuits.
2. ±5 Volts for the logic.
3. ±32 Volts for use by the voice coil positioner and the emergency retract relay.
4. 35 Volts AC for use by the motor breaking circuit.

Power is made available to the drive through a line filter and the closed contacts of the AC POWER circuit breaker. When the AC POWER circuit breaker is closed, the blower motor starts and all of the DC voltages go on. When the START switch contacts are closed (at the control panel) the microprocessor causes the solid state relay SSR1 and K1 to apply power to the spindle motor, assuming that the deck is down, the cartridge is seated, the cartridge access door is closed and there is sufficient airflow through the air filter.

<u>CAUTION</u>

> With AC power circuit breaker in OFF position AC power is still applied to AC line filter. To completely remove all AC power from unit AC line cord must be disconnected from power source.

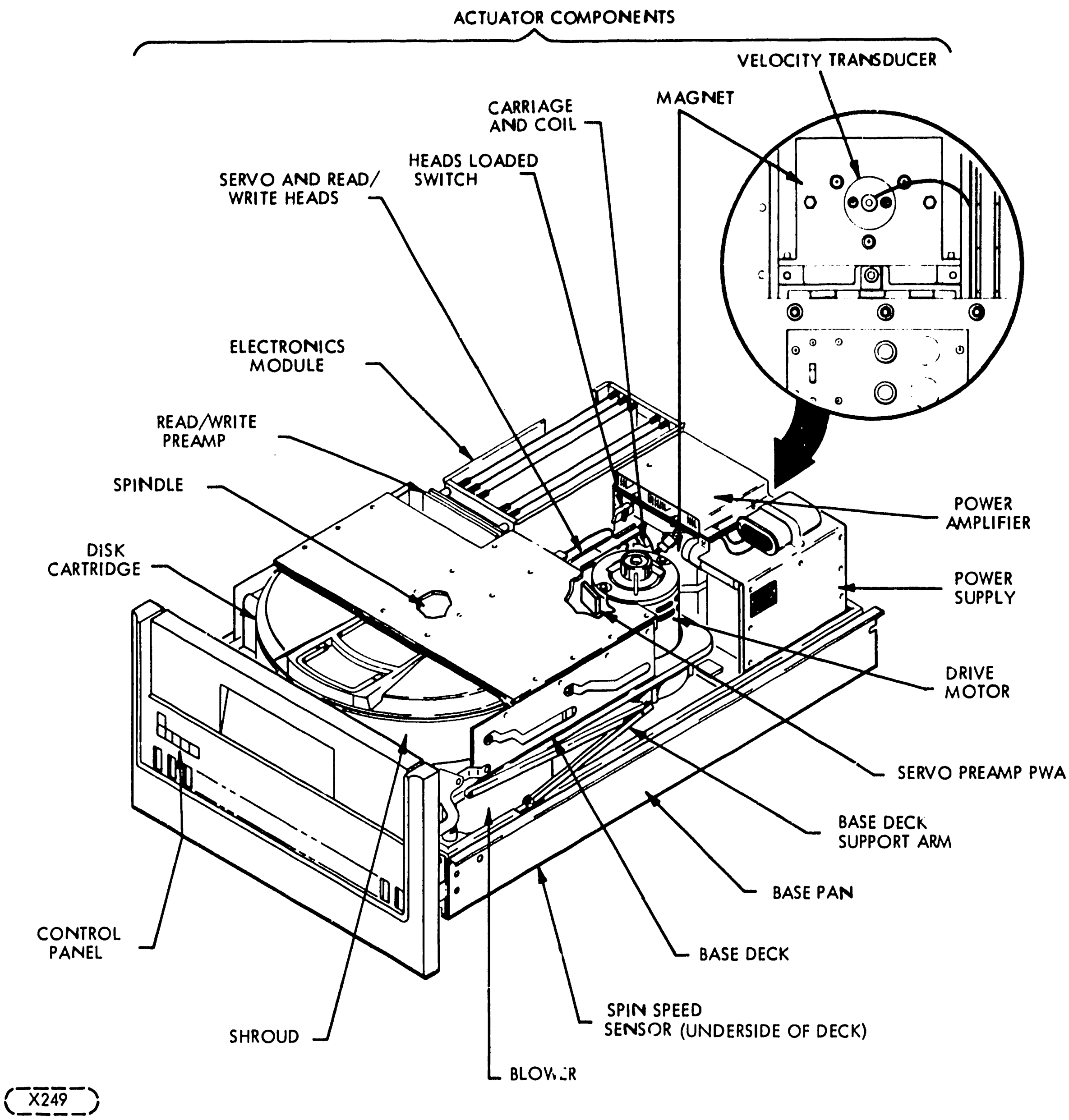


FIGURE 4-2. CMD MAJOR ASSEMBLIES

4.2.2 DRIVE MOTOR ASSEMBLY

The drive motor drives the spindle assembly. The motor is a 1/4 hp unit of the induction type. The motor is secured to a mounting plate which in turn attaches to the base casting. The motor mounting plate is secured to the underside of the deck using insulating hardware so that AC current from the motor does not circulate in the base deck. Power is transferred to the spindle via a flat, smooth surfaced belt that threads over the pulleys of the spindle and drive motor. A motor tensioning spring maintains a constant tension on the motor mounting plate to keep the belt tight. The motor is connected to chassis ground via wire in motor harness.

The temperature of the drive motor is monitored by an internal thermal overload switch. If the switch opens, power is removed from the motor. The loss of spindle speed causes the M.P. to retract the heads and initiate the STOP routine. The drive motor thermal overload switch closes again when the temperature drops to a safe level. If the fault has been manually reset, the M.P. initiates the START routine which operates relay K1 and connects power to the motor again. At least two minutes must elapse before the motor can start again.

4.2.3 SPINDLE ASSEMBLY

The spindle assembly is the physical interface between drive motor and disks. The surface of the spindle magnetic mounting plate mates directly with the steel ring on the bottom of the disk cartridge, and the spindle hub is counter-sunk in the center to accept a steel alignment ball in the center of the bottom of the disk cartridge. The mating surfaces of the disk cartridge and spindle are engaged by a force of 35 ±5 lbf (157 ±22N). When the cartridge access door is opened it operates a mechanism which applies the necessary force to separate the cartridge disk from the spindle magnet and moves the cartridge forward where the operator can grasp it for removal. The steel ball in the center of the cartridge hub centers the disk cartridge when it is installed in the unit.

The spindle is driven by a flat belt linking the spindle drive pulley to the drive motor pulley.

A ground spring is mounted at the lower end of the spindle assembly. The ground spring is mounted so that is is always in contact with the shaft to bleed off any accumulation of static electricity on the spindle through a ground strap. Mounted on the bottom of the spindle is a disk with 16 slots in its periphery. The disk periphery passes through a slot in the Spin Speed Sensor which puts out a pulse every time one of the 16 slots passes through the Spin Speed Sensor slot. See also paragraph 4.2.5 for Spin Speed Sensor details.

4.2.4 ACTUATOR

The actuator consists of the coil and carriage, rail bracket assembly, and magnet assembly. The actuator (Figure 4-3) is the device that supports and moves the Read/Write and Track Servo heads. The forward and reverse motions of the carriage on the carriage track are controlled by a servo signal. The basic signal is generated by the microprocessor on the Servo-Coarse PWA and processed by a power amplifying stage.

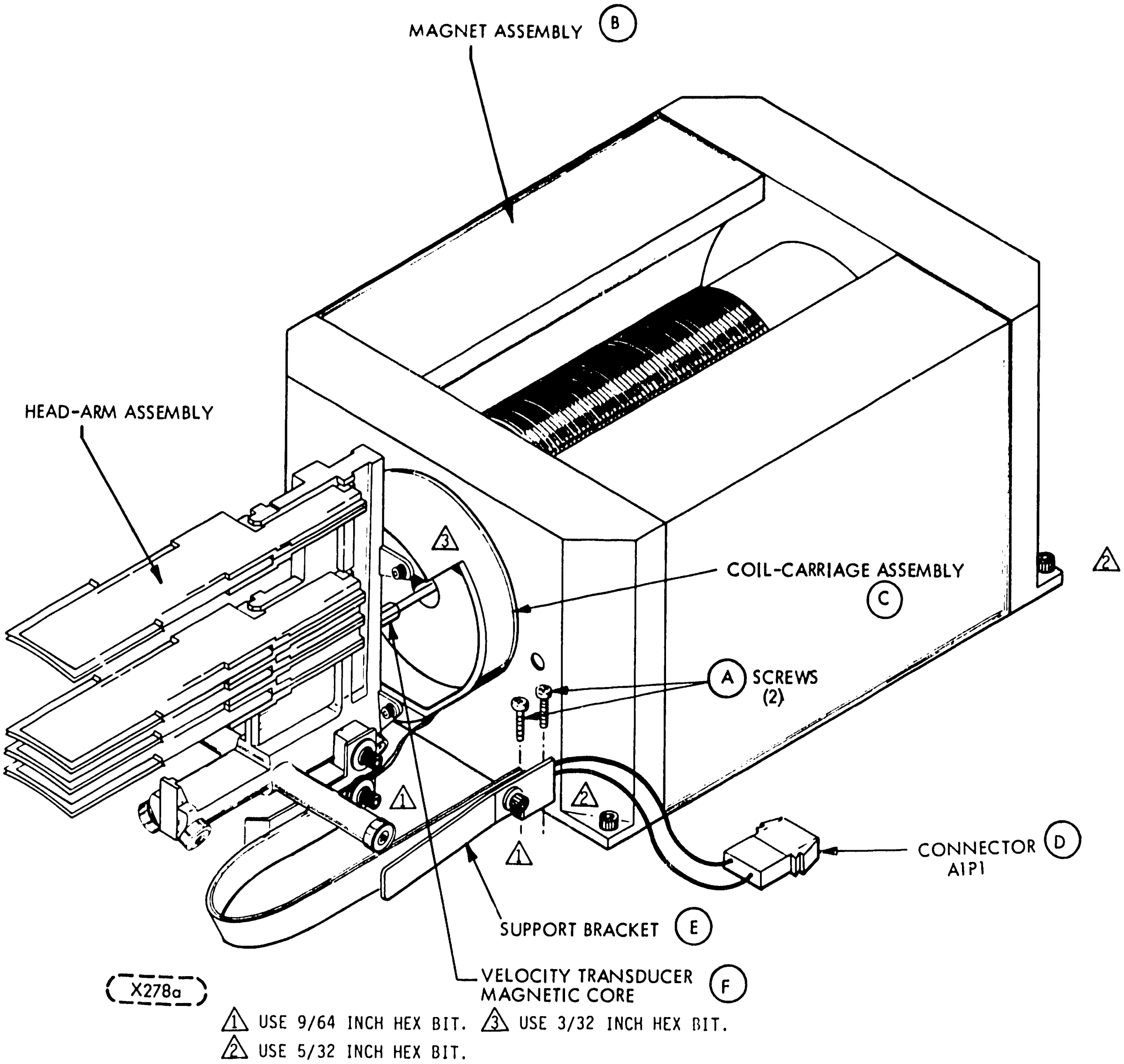


FIGURE 4-3. ACTUATOR ELEMENTS (VOICE COIL SLIGHTLY EXTENDED FROM RETRACTED POSITION)

The power amplifier output is applied to the voice coil positioner (part of carriage). The signal causes a magnetic field about the voice coil positioner. This magnetic field reacts with the permanent magnetic field existing in the air gap of the magnet assembly. The reaction either draws the voice coil into the permanent magnet field or forces it out. Signal polarity determines the direction of motion, while signal amplitude controls the acceleration of the motion.

The voice coil positioner is a mandrill-wound coil that is free to slide in and out of the gap section forward face of the magnet assembly. Fastened to the positioner is a head/arm receiver which holds up to 6 read/write heads and two servo heads. The head/arm receiver mounts on the coil and carriage assembly that moves along the carriage rail on six anti-friction bearings. Movement of the positioner in or out of the magnet causes the same motion to be imparted to the entire carriage assembly. This linear motion is the basis for positioning the read/write and track servo heads to a particular track of data on disk pack. (Refer to Head Loading paragraph for detailed information on read/write head loading and unloading.)

The positioning signal is applied to the voice coil positioner via two flexible, insulated, metal straps, the ends of which are secured to the carriage and bearing assembly. There is a third metal strap which grounds the carriage to the base deck assembly.

During any seek operation and I/O command gives the microprocessor the cylinder address to be accessed. The microprocessor compares this cylinder address with the current cylinder address which is stored within the M.P. memory and then issues a command to the positioner to move toward the new cylinder location with an acceleration and velocity that is proportional to the difference in position. The positioner moves in the direction of the new cylinder address under control of a velocity feedback loop, with the velocity signal being supplied by a velocity transducer.

The transducer is a two-piece device, one piece stationary and the other moveable. Refer to the Transducer paragraph for a complete description.

The actuator contains a stop mechanism to limit extremes in forward and reverse movement. The forward stop assembly consists of two rubber bumpers located in the shroud vicinity. If the carriage moves too far toward the disks the two bumpers contact the upper and lower front sides of the carriage. If the carriage is retracted far enough away from the disks the rear of the head/arm receiver contacts two rear cylindrical bumpers which protrude out of the front face of the magnet assembly.

4.2.4.1 HEAD LOADING

The read/write heads must be loaded to the disk surfaces before exchanging data with the controller. The heads must be removed (unloaded) from this position and driven clear of the disks either when power is removed from the unit or when the disk velocity falls below about 3240 r/min. The head load/unload cam actions are identified in Figure 4-4.

Heads are loaded by moving the aerodynamically shaped head face toward the related disk surface. When the cushion of air that exists on the surface of the spinning disk is encountered, it resists any further approach by the head. Head load spring pressure is designed to just equal the opposing cushion pressure (function of disk r/min) at the required height. As a result, the head flies. However, if the head load spring pressure exceeds the cushion pressure (as would happen if the disks lost enough speed), the head stops flying and contacts the disk surface. This could cause damage to the head as well as the disk surface.

To prevent damage to the heads and/or the disks during automatic operation, loading occurs at controlled velocity only after the disks are up to speed and the heads are over the disk surfaces. For the same reason, the heads unload automatically and are retracted at a controlled velocity if the disk r/min drops out of tolerance. During manual operations, heads should never be loaded on a disk that is not rotating. Head loading is a part of the Start Load function. Pressing the START switch initiates disk rotation and purge. Purge is 15 seconds after reaching 2890 r/min.

After the purge, the spindle RPM must be about 3240 r/min. If so, the microprocessor specifies a load command and the carriage moves forward toward track 0. Head loading occurs during this forward motion. The carriage continues to move toward the spindle until the servo detects track 0.

The head load spring (Figure 4-4) is designed to maintain a constant loading force. While the heads are retracted, head cams on the actuator housing bear against the head load spring cam surfaces. The cams support the loading force and hold the heads in the unloaded position. As the carriage moves forward, the head load spring cam surface rides off the head cam just after the read/write heads move out over the disk surface. The loading force moves the head face toward the air layer on the surface of the spinning disk until the opposing forces balance.

The heads loaded switch status reflects the state of the read/write heads (loaded or unloaded). This status is used in the microprocessor. The switch mounts on a bracket attached to the magnet top and is transferred by carriage motion. Whenever the carriage is fully retracted, the switch state reflects the unloaded status of the heads. As the carriage moves forward during a Power On/Load, the switch transfers at a point within about 0.1 inch forward of the retracted stop. This switch status remains unchanged until the carriage is retracted to the same position and, as such, does not precisely indicate the loaded/unloaded status of the heads. Precise status is determined by the logic when the servo track head senses dibits. This switch is interlocked to the drive motor via the microprocessor which will not allow spindle power to be removed until the heads are fully unloaded.

Head unloading occurs whenever power to the unit is removed, STOP switch is placed in STOP position, a voltage fault occurs or disk r/min drops below tolerance. Signals from the microprocessor cause the voice coil to drive the carriage in reverse from its current location toward the retracted stop. (Either normal or emergency methods can be used. Refer to Stop Sequence paragraph for additional information.) As the carriage retracts, the cam surfaces encounter the head load springs and each head rides vertically away from the related disk surface. The carriage continues back to the retracted position and stops.

4.2.4.2 HEAD/ARM ASSEMBLIES

Eight head/arm assemblies are mounted on the carriage. A read/write head assembly mounted at the end of a supporting arm structure. A track servo head/arm assembly consists of a read coil head assembly mounted at the end of a supporting arm structure.

The head assembly (Figure 4-5), which includes a cable and plug, is mounted on a gimbal spring which, in turn, is mounted on a head load spring. This method of mounting allows the head assembly to pivot (independent of the arm) tangentially and radially relative to a data track on the disk surface. Such motion is required to compensate for possible irregularities in the disk surface.

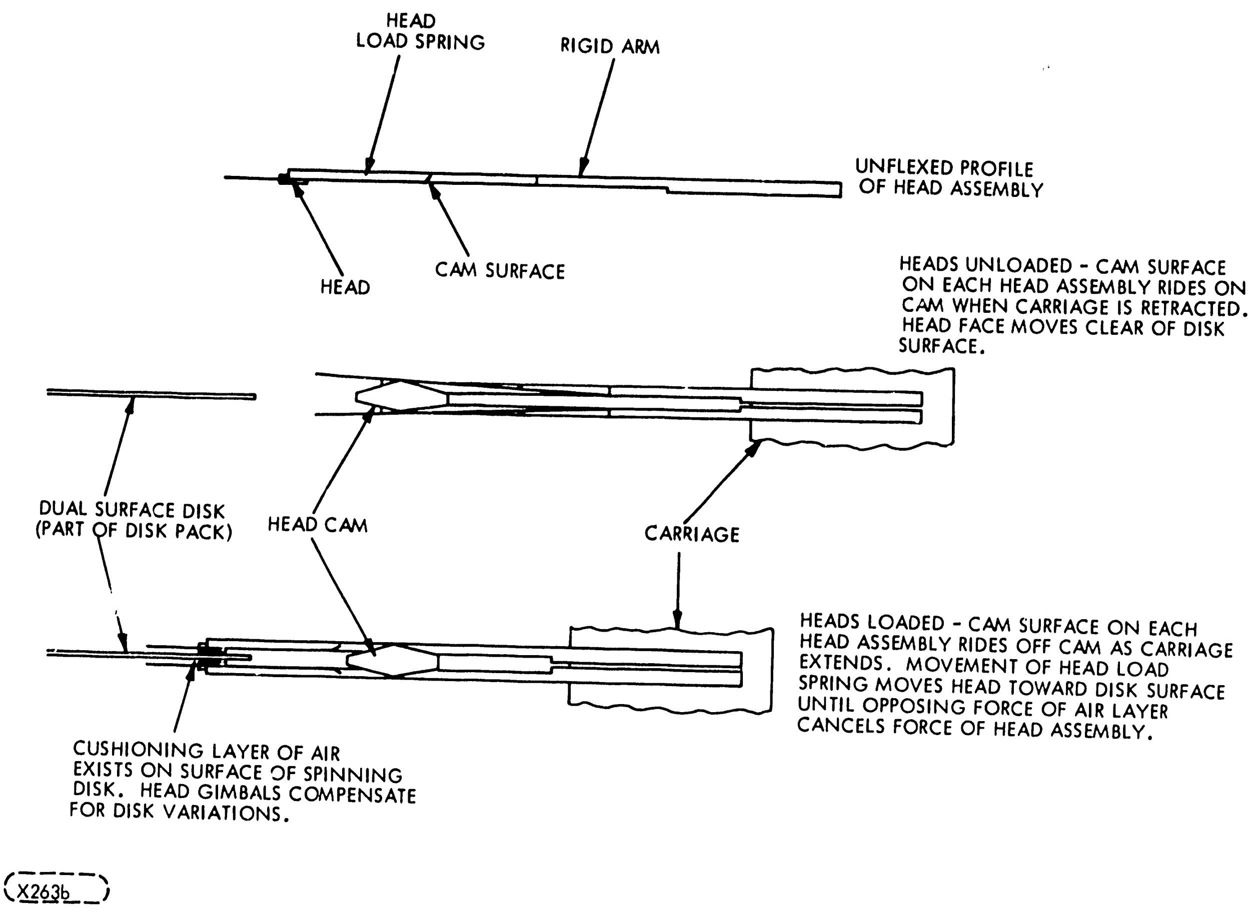


FIGURE 4-4. HEAD LOADING

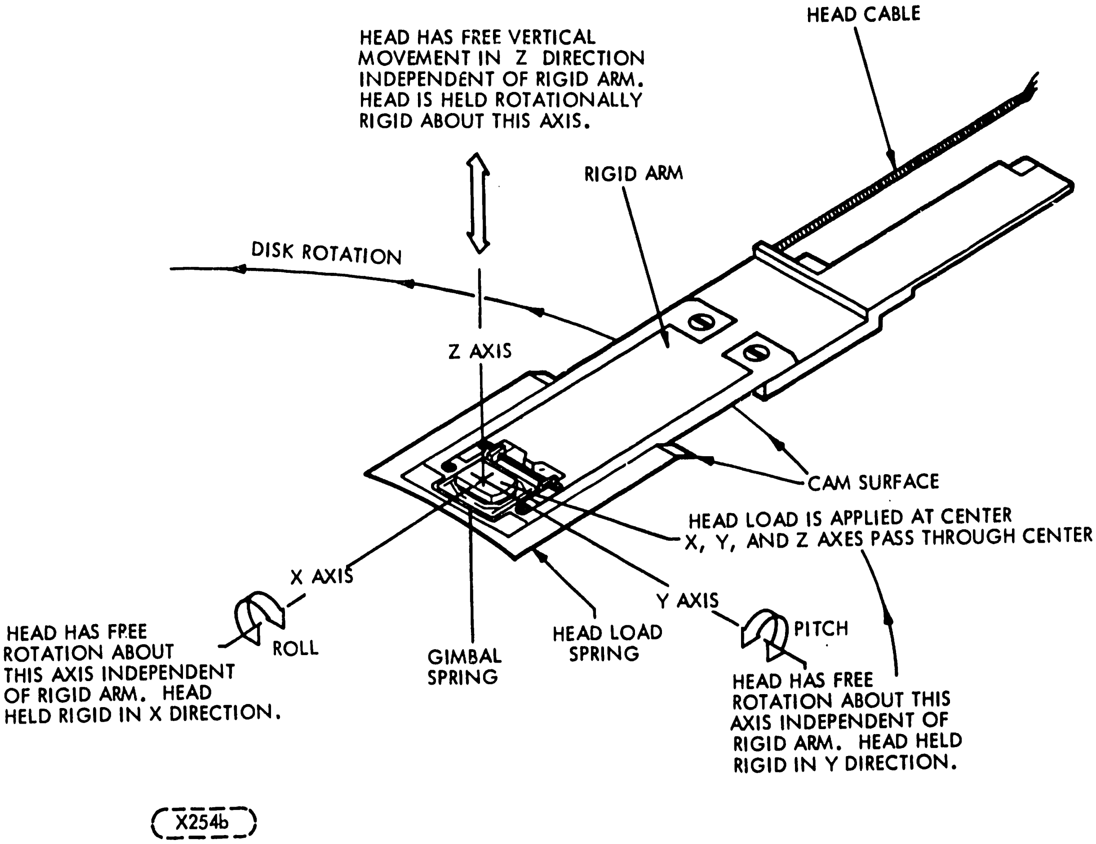


FIGURE 4-5. HEAD/ARM ASSEMBLY MOTION

The arm structure consists of a floating arm secured to a heavier fixed arm. The end of the fixed arm opposite the head mounts in the carriage receiver. The floating arm is mounting point for the head and is necessarily flexible so that it can flex during load and unload motions, onto and off of the cam surfaces.

During head loading, each floating arm is driven off the related cam and unflexes to force a head toward the air cushion on the spinning disk surface. The force applied by the floating arm causes the heads to fly or float on the air cushion. Vertical motion by a disk surface (due to warpage or imperfection) is countered by a move in the opposite direction by the gimballed head and/or floating arm. As a result, flight height remains nearly constant.

4.2.5 TRANSDUCERS

The deck assembly contains two transducers; spin speed sensing transducer and velocity transducer. These transducers provide signals that are used by the microprocessor to generally control the progression of most machine operations.

The Base Pan Assembly contains two pressure switch transducers one of which (Lo-Pressure) is optional. These pressure transducers provide signals that tell the system the condition of the absolute filter.

4.2.5.1 SPIN SPEED SENSOR

The Spin Speed Sensor generates a voltage pulse whenever a slot in a disk on the bottom of the spindle passes through the Spin Speed Sensor. The slot in the disk allows light from an infrared light emitting semiconductor to strike a light sensing semiconductor whose output current increases during the time the light through the disk slot strikes it. The resulting output is a train of pulses approximately 120 microseconds in duration with a pulse occurring once every millisecond (approximately). The period between Spin Speed Sensor pulses is checked by the microprocessor firmware every 20 ms (heads loaded, positioner in fine mode) and if the spin speed is greater than about 3200 r/min, an enable is provided for relay K2*. If the spin speed (r/min) is insufficient, the pulse repetition rate is also insufficient and this fact is detected by the microprocessor. This has either of two effects:

1. If the heads are not loaded K2 will not be energized and the microprocessor will not initiate the load sequence.

2. If the heads are already loaded, K2 is opened, and thus the voice coil is disconnected from the power amplifier and connected to the emergency retract circuit. The heads are immediately unloaded at a controlled velocity to the retracted stop.

In addition the "Spindle r/min Lost" fault will be stored in the microprocessor memory and the unit becomes "not ready". Displaying microprocessor-detected faults is discussed in Section 2.10.1. The Spin Speed sensor is illustrated in Figure 6-7.

4.2.5.2 VELOCITY TRANSDUCER

The Velocity Transducer (Figure 4-6) is a two-piece device consisting of a stationary tubular coil/housing and a movable magnetic core.

The magnetic core is connected via the extension rod to the rear surface of the carriage assembly. All motion of the carriage is therefore duplicated by the magnetic core. As the core moves, an emf is induced in the coil. The amplitude of the emf is directly related to the velocity of the core (and carriage). The polarity of the emf is an indication of the direction of motion by the core (and carriage). The transducer output drives a summing operational amplifier located on the Servo Coarse PWA in the Electronics Module. This signal is used by the servo logic to control acceleration/-deceleration and velocity of the carriage during Seek operations.

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*Figure 5-13.

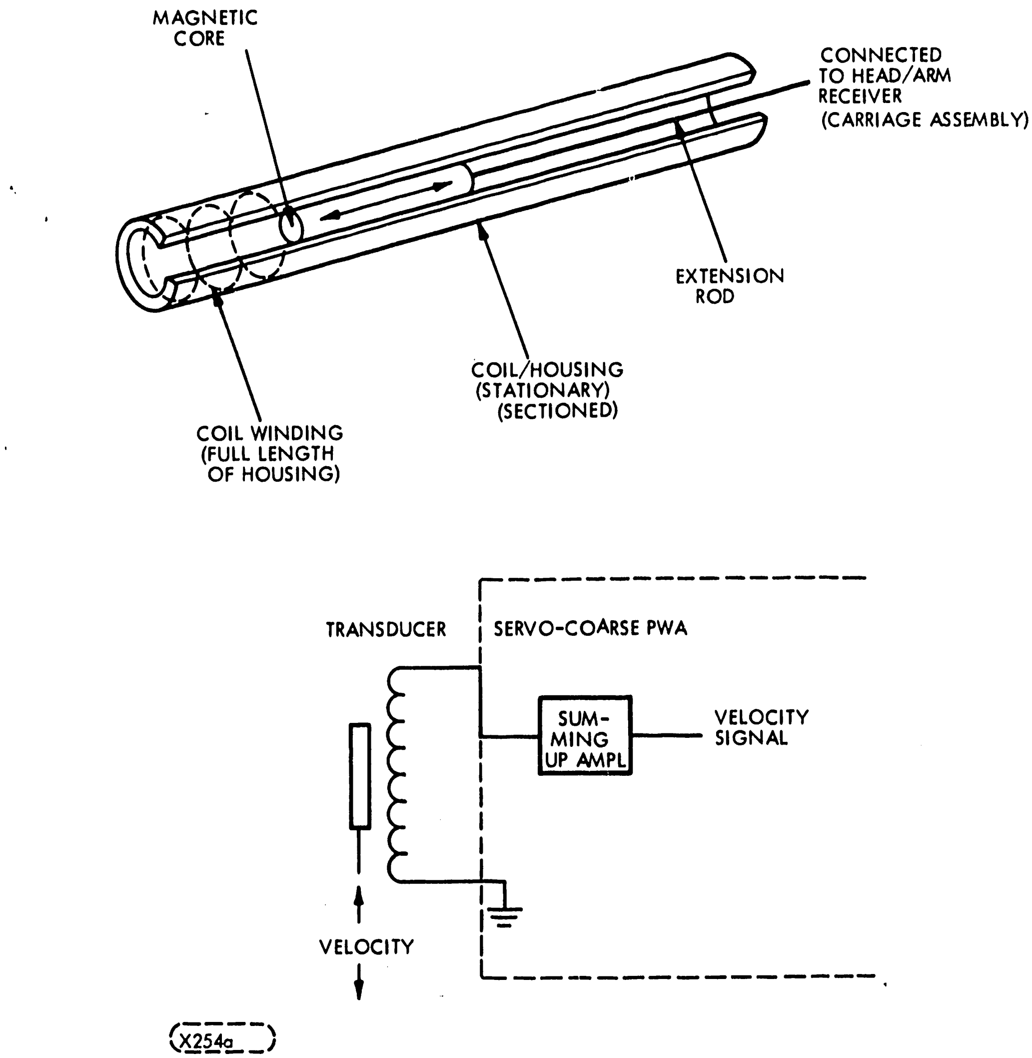

FIGURE 4-6. VELOCITY DETECTION

4.2.5.3 PRESSURE SWITCH

The pressure switch is a device that has a diaphragm and a set of electrical contacts. When pressure is applied the diaphragm is deflected and the contacts are closed making a completed circuit.

The pressure switches monitor the output of the absolute filter. The LO-AIR switch (installed as an option) is set at a level that indicates the absolute filter is in need of replacing. After the heads are loaded it triggers a timer circuit on the relay control PWA which in turn flashes the fault indicator at a rate of about two times a second on the control panel. When this occurs it does not stop the system from operating; it is only meant as an indication of the need to service the air filtering system.

The NO-AIR switch is set at a level that indicates the absolute filter must be replaced. It is in the Interlock Circuit and will shut down the system and not allow it to operate if and when the pressure drops below the pressure switch setting.

4.2.6 BLOWER SYSTEM

The blower system provides positive pressure in the disk area. The presence of this elevated pressure results in an outward dispersion of air preventing ingestion of contaminated air. This air flow greatly reduces possible contamination and resulting damage to the disk surfaces and the read/write heads.

Power to the blower motor is available whenever the AC POWER circuit breaker is ON.

4.2.7 DISKS

The disks are the recording media for the drive. The disks are 14 inches outer diameter. Three disks are mounted on the spindle (non-removable by the operator) and one center-mounted on a hub in an operator removable cartridge. The recording surface of each disk is coated with a layer of magnetic iron oxide and related binders and adhesives. The three fixed disks as a subassembly are called the Fixed Module.

On the fixed disks there are five recording surfaces and one track servo surface, and on the cartridge disk one surface is a recording surface and the other is a track servo surface. The servo surfaces contain prerecorded information that is used by the microprocessor to position the heads to the desired track.

The 823 recording tracks are grouped in a 2.14 inch (53.4 mm, approximately) band near the outer edge of the disk. Track 822 has a diameter of approximately 9 inches (230 mm, approximately); the diameter of track 0 is about 13 inches (330 mm, approximately). The tracks are spaced about 0.0026 inch (0.063 mm, approximately) apart.

The disk cartridge has a two-piece container. The bottom cover can be removed by simply pushing the cover release button forward the center of the bottom cover (see Figure 2-2). Removing the bottom cover reveals an inner cover which protects the lower disk surface. Removing the bottom cover only gives access to the head access hole and the ring and hub that mounts on the spindle magnetic hub. This design protects the disk cartridge from physical damage and greatly reduces the possibility of contamination of the disk recording surfaces.

4.2.8 ELECTRONICS MODULE

The Electronics Module Assembly consists of a "mother board" and six slots for printed wiring assembly boards (PWAs) that plug into connectors mounted on the mother board (EM1 through EM7). The mother board provides the connections between the six PWA connectors and furnishes the power busses which make available various Power Supply furnished voltages to the PWAs. Access to the inter and intra Electronics Module connections is gained by lifting upward on the Electronics Module and swinging it outward so that it hangs over the side of the unit.

The module is held in this position by a sliding support mounted on the side of the deck assembly. This is referred to in this as the maintenance position.

The Electronics Module contains all of the easily removable PWAs. There are other PWAs (i.e., Servo Preamp, Read/Write Preamp, Power Amp, Relay Control, Operator Panel Control and Component Board) in the unit but these are not the plug-in type and are not part of the Electronics Module. The Electronics Module boards are 7-1/2 by 10-1/2 inches (191 by 268 mm) and are installed vertically in numerically identified positions. The theory of operation for the PWAs is covered in Section 4.3, FUNCTIONS.

The Electronics Module frame is at "DC" ground and is isolated from frame or AC ground unless a wire at the rear of the unit is connected to the frame ground stud tab at the rear, left side of the frame. See Section 3.7 "Grounding". Connecting AC to DC ground is a customer option.

4.3 FUNCTIONS

4.3.1 I/O OPERATIONS

Input/Output signal definitions, pin number assignments and timing characteristics of interface signals are shown in Section 5.7.

4.3.2 POWER ON/OFF AND SPINDLE START/STOP FUNCTIONS

4.3.2.1 POWER SEQUENCING PICK AND HOLD

Power Sequencing requires AC and DC power ON, START indicator/Switch ON, and REMOTE START switch (switch selectable in CMD) in the Remote position. Applying ground to the Pick and Hold lines will cause the first CMD in sequence to power up. Once this CMD is up to speed (see paragraph 4.3.2.3), the Pick signal is transferred to the next active CMD and repeated until all active CMD's are powered up. Individual CMD's may be started and stopped manually once power sequencing is completed.

Interrupting the Hold line will cause all units to unload heads and stop the spindle. Single unit start up can be controlled by momentarily closing the Pick line with the Hold line grounded. Successive units will start each time the Pick line is grounded. Power sequencing circuits and timing are shown in Figures 4.7 and 4.8.

When in Local Start mode, each CMD is independently operated by its respective START switch.

A Pick or Hold is considered to be present from the Controller when a ground is present on the Pick or Hold lines. Each Pick and Hold Source must sink 4 mA per device. The Controller can provide this ground either through a mechanical contact (relay or switch) or through an electronic circuit. The maximum voltage considered as ground is 0.4 Volt. The open circuit voltage is 5 VDC maximum.

Pick and Hold Lines may be tied together and driven from a single source.

CMD's may be used in systems which are designed to recover automatically after power outages or brown out condition exceeding the transient voltage. To achieve this, the systems must monitor line power and utilize the CMD power sequencing functions to stop and restart the CMDs when an outage occurs. Upon restart the CMD must be initialized by the use of Clear Fault Status and RTZ. These must be executed after the CMD has achieved the Ready state.

4.3.2.2 POWER ON SEQUENCE

Manually closing the AC POWER circuit breaker starts the blower motor running and applies AC power to the power supply, which in turn supplies DC voltages to the electronics. The DC power is fused but not switched and powers the electronics whenever the AC POWER circuit breaker is ON. Once DC power is on the spindle start up sequence can begin.

4.3.2.3 SPINDLE START SEQUENCE

The start up of the CMD Spindle Motor is sequencing by microprocessor firmware and by relays (refer to Figures 4-16 and 4-20).

The spindle START sequence is as follows for a local controlled START:

1. Operating the START switch applies ground to a line (START) that passes through four other interlock switches-the deck down, cartridge seated, cartridge access door closed and NO-AIR switches and then goes as START/-L to PPI* port U27 on the Servo-Coarse PWA.

2. The microprocessor continually loops through a routine and as part of the routine it interrogates PPI port U36 and detects that the START/STOP switch is in the START position and that the SEQ-HOLD/-L signal is active low, which it will be with the REM/LOC switch in LOC position (I/O PWA).

3. After some checks the microprocessor sends out the command to PPI port U36 to activate RUN/-L which causes relay K1 on the Relay control PWA to connect the AC lines, to the spindle motor. Then the M.P. activates the Solid State Relay SSR1 which connects AC power to the motor through K1.

*See Section 4.3.4 for details of the microprocessor components.

4. The start up is monitored by the microprocessor and if the start up is too slow or does not occur an operational fault is stored in the microprocessor memory, AC power will be removed from the motor and the start will be aborted.

5. If the spindle speed gets above 3200 r/min before a 3-minute timeout, READY indicator ceases blinking and remains illuminated and the heads load.

The flow chart of Figures 4-17, 4-18, 4-20 and 4-21 illustrates the details of the power on sequence for a local start.

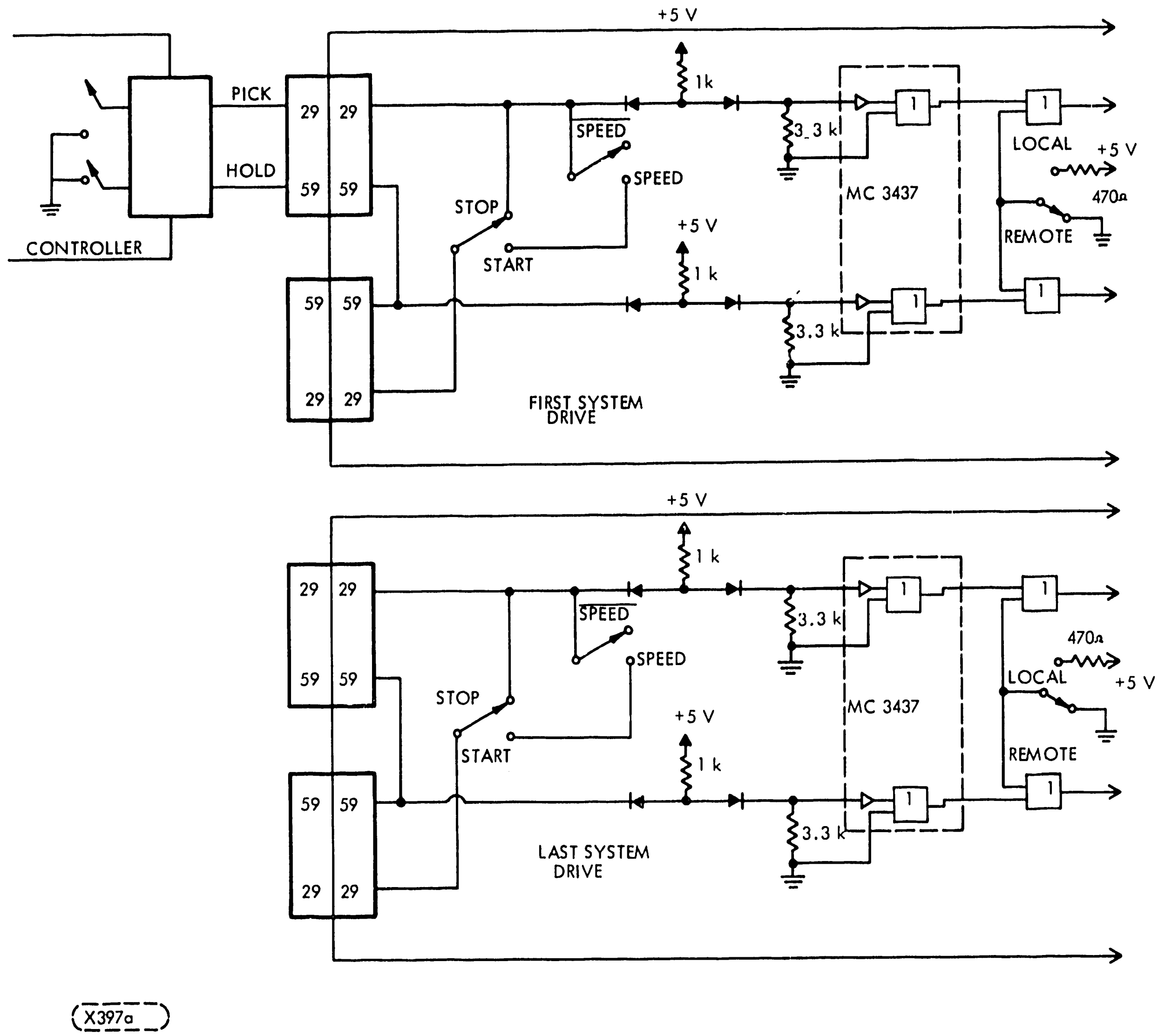

FIGURE 4-7. SEQUENCE POWER LINES - CMD

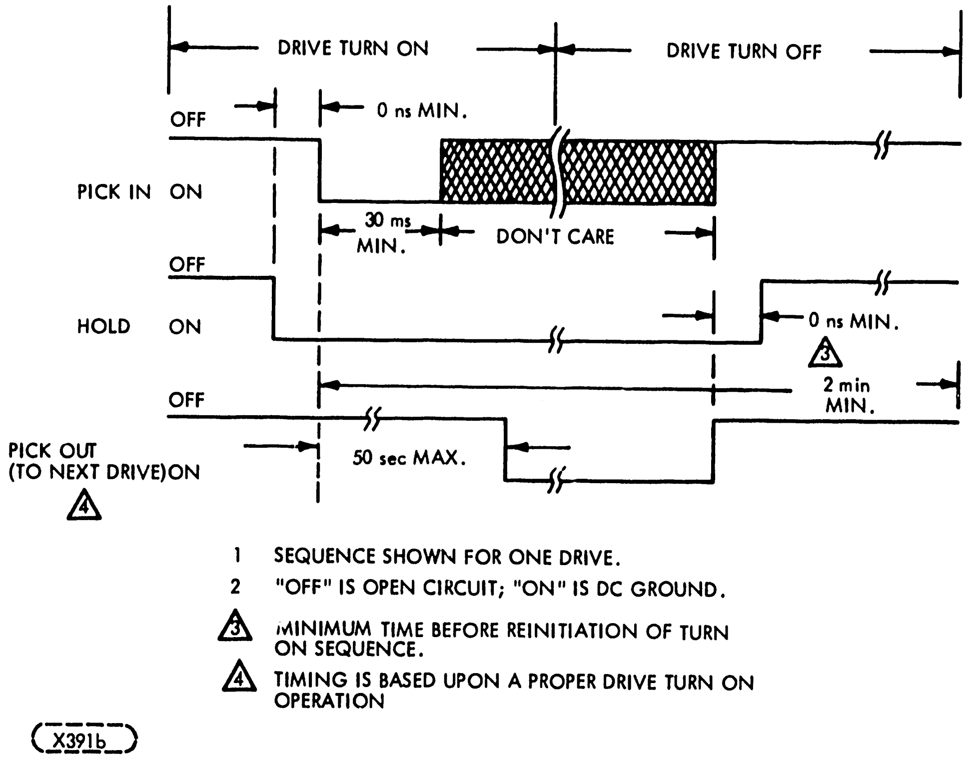

FIGURE 4-8. POWER SEQUENCE TIMING

4.3.2.4 SPINDLE STOP

The spindle stop sequence is mainly under the control of the microprocessor so refer to Section 4.3.3 and Figure 4-19 for more information. The spindle stop sequence should never begin with the opening of the AC circuit breaker, because opening the AC circuit breaker turns off the blower which may allow the motion of the disk to draw in contaminated air that could cause head/disk contact. The spindle stop sequence begins when the START/STOP switch is released or when the controller deactivates the SEQ-HOLD/-L line (remove ground). The microprocessor detects the open START switch contacts and sets the "START-STOP Cycle Flag" and enters the carriage retract subroutine. The M.P. stores a count in its internal operations counter which takes 30 seconds to count down to -1. The M.P. de-energizes the solid-state relay SSR-1 which removes AC power to the spindle motor Relay K1 is then de-energized connecting the breaking circuit to the motor. A 35 VAC tap on the primary of the power supply transformer is used in conjunction with a bridge rectifier on the Relay Control PWA to supply the DC breaking voltage when the solid state relay is re-energized. When the spindle speed drops below 14 r/min the M.P. delays 2 seconds, then turns off the DC to the motor field by again de-energizing SSR-1.

If the START/STOP switch is not in the START (down) position the M.P. allows access to the cartridge. No attempt to open the cartridge access door should be made under any circumstances until the interlock solenoid releases the door catch. If the spindle speed never reaches 14 r/min within the 30 second time-out period the M.P. sets the "Too Long to Stop" error (10100)* and sets up the counter again for a two minute timeout. If the motor has not reached less than 14 r/min within two minutes the "won't stop" error (01111)* is set and the "Operational Fault" routine takes over (see Figure 4-27).

4.3.2.5 POWER OFF SEQUENCE

To Power Off after spindle is stopped, open AC circuit breaker. To remove power from all points within the unit remove the AC power cord from the AC power source.

4.3.3 MICROPROCESSOR FUNCTIONS - GENERAL DESCRIPTION

Functions which the Microprocessor and associated logic perform are as follows:

- Spindle Start/Stop and Spindle speed monitoring
- Servo Coarse positioning
- Sector pulse generation
- Servo head change
- Microprocessor self diagnostics performance
- Control the monitoring and displaying of faults connected with the above five functions

General descriptions of these functions are discussed in the following paragraphs.**

4.3.3.1 SPINDLE START/STOP AND SPINDLE R/MIN MONITORING

- Spindle Start/Stop

The switch and control lines determining whether the spindle should be started or stopped are monitored periodically. There is a delay built into the monitoring routines so that noise on these signals is ignored. During execution of the spindle start routine a test is performed to determine whether or not spindle rotation actually begins. If not, the start is aborted and the fault indicator illuminated. During execution of the stop routine the break is applied and spindle spin speed is monitored until approximately 14 r/min is attained. Then, after a short interval for complete stop to occur, access is allowed to the cartridge, if the START/STOP switch is in the STOP position.

Since the brake and start cycles produce the greatest power dissipation in the motor, the minimum interval between start cycles is limited to two minutes.

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*See Table 6-7 for error codes.
**See General Block Diagrams in Figures 4-9 and 4-12.

- Spindle Spin Speed

A disk having 16 slots is attached to the spindle with an infrared emitter and detector on opposite sides of the disk. The time interval between two slots is measured by counting passes through a short program loop. The time resolution possible is ±16 microseconds with an 8080 having a 500 nanoseconds cycle period. The nominal interval between pulses from the disk at 3600 r/min is 1042 microseconds. The worst case mechanical tolerances can introduce an error of about 1%. Thus the total error is about 3%.

When the heads are loaded and the positioner is in the fine mode, the processor is interrupted every 20 milliseconds for a determination of spindle spin speed. If the speed is too low, the heads are retracted and becomes "not ready" with a fault.

If the infrared pulse emitter should fail, an emergency stop procedure will be used by the microprocessor since spindle speed monitoring will not be possible.

4.3.3.2 SERVO COARSE POSITIONING

Servo coarse positioning includes head load, head unload, return-to-zero and controlling the positioner velocity during a seek, i.e., movement from the origin cylinder to the destination cylinder. The CMD positioner servo is of the well proven linear motortachometer feedback type.

- Head Load

When spindle spin speed is determined to be correct, and no faults exist, a 10 ips forward velocity command is given the positioner servo to initiate loading the heads. After the outer guard band is detected (i.e. "AGC ACTIVE" is detected), the servo is switched from the coarse (velocity) mode to the fine (track following) mode. After a delay of about 3 milliseconds from the time that the center of track 0 is first detected, the "ready" and "on-cylinder" signals will be set true.

- Head Unload

Head unload is normally accomplished using the positioner servo under control of the microprocessor. A 10 ips reverse velocity command is given until the carriage closes the contacts on the heads loaded switch. The microprocessor senses the switch closure and removes the reverse velocity command, causing the carriage to stop moving. Relay K2 is de-energized so that the coil is disconnected from the servo amplifier and connected to the emergency retract circuit which maintains automatically the retracted condition. Should the positioner servo fail or should there be a voltage fault which would prevent microprocessor operation, an emergency retract circuit is activated.

- Return to Zero

Return-to-zero is accomplished by giving the positioner servo a 6 ips reverse velocity command until about 10 mils outside track 0 where the outer guard band is detected (rev. EOT). Then a 1 ips forward velocity command is given and the head load procedure is entered at the point just after the outer guard band has been detected. If a seek error caused the head unload, the head load procedure will be entered.

- Seek Control

The profile of distance to be traveled at a given velocity for any seek is stored in a table. When initiating a seek, the appropriate initial velocity command is found by means of a binary search procedure to locate the entry point in the table. The distance to be traveled (number of cylinders to be traversed) at the initial velocity is also a result of the search procedure. Thereafter, distance and velocity are taken from the table. When the end of the table is reached, the coarse positioning portion of the seek is completed and the servo is switched from the coarse (velocity) mode into the fine (track following) mode.

Distance and velocity information is placed by the microprocessor into a next distance register and a new velocity register from where it is transferred into a current distance counter and current velocity register. Each time "next" information becomes "current" information the microprocessor refills the two "next" registers with "next" information. See Figure 4-10. With each cylinder pulse, the value in the current distance counter is decremented. When the counter reaches zero, the value in the next distance register is transferred into the current distance counter, the value in the next velocity register is transferred into the current velocity register and the processor interrupted (see "Interrupt Logic", Section 4.3.4.3) so that new values will be loaded into the "next" registers.

The next distance register and current distance counter are implemented by one section (counter 0) of a type 8253 programmable counter (see Figure 5-3r), the next velocity register is implemented by one port of type 8255A programmable peripheral interface (see Figure 5-3p), and the current velocity register is implemented by two four-bit register logic elements (see Figure 5-3h).

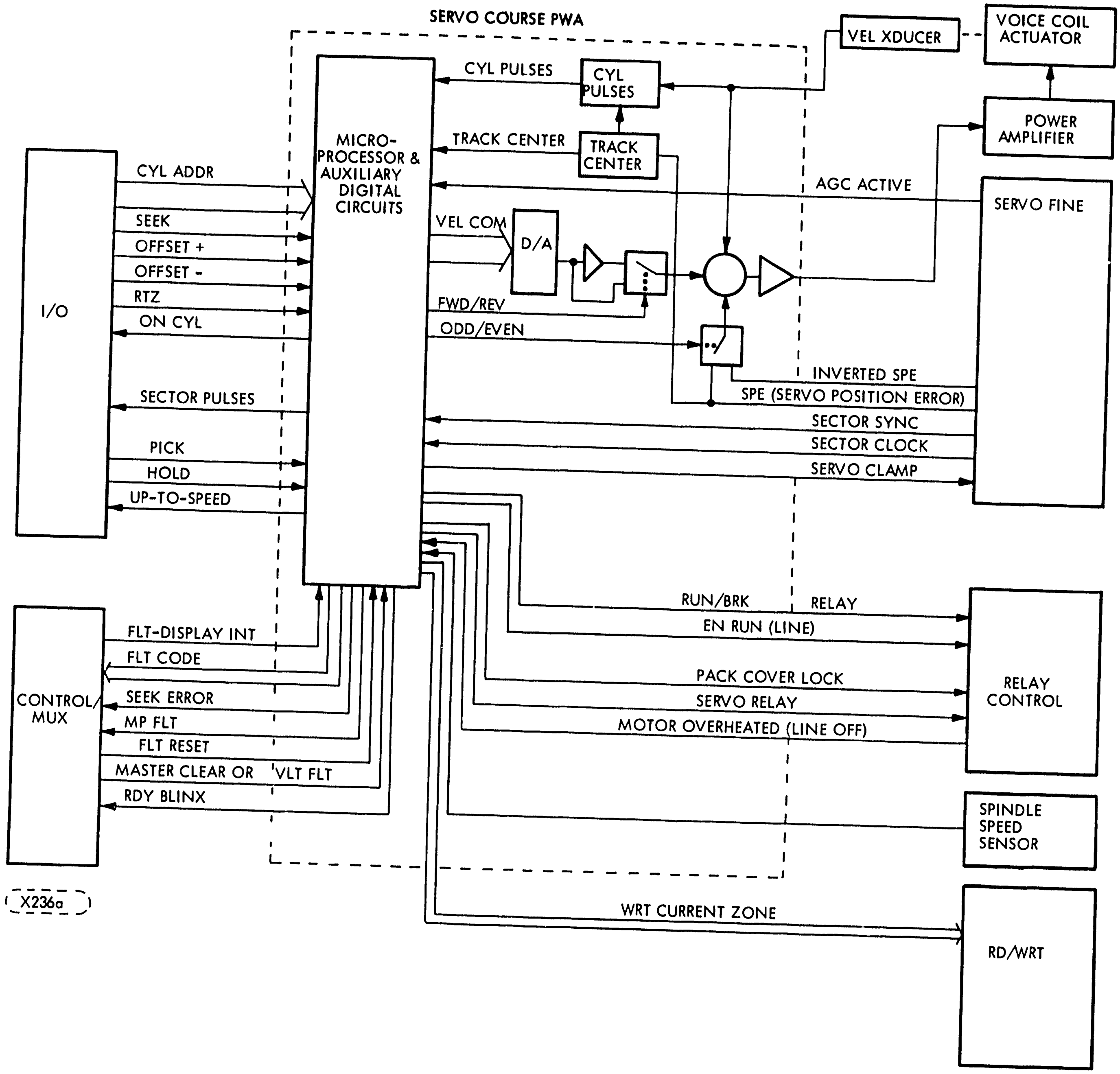


FIGURE 4-9. BLOCK DIAGRAM OF SERVO-COARSE PWA AND SUPPORTING ELEMENTS

4.3.3.3 SECTOR PULSE GENERATION

Sector pulses are obtained through division of an 806 kHz clock (derived from the servo surface) by the number of clock cycles per sector. The frequency divider is synchronized by the Index pulse (also derived from the servo surface). The sector pulse generator is one section of a type 8253 (U21) programmable counter operating as a frequency divider. The microprocessor reads the status of a set of switches to determine the number of sectors per revolution, computes the divisor, and loads the 8253 with the divisor.

4.3.3.4 SERVO HEAD CHANGE

When the system controller commands a read/write volume change (fixed to removable or vise versa) the microprocessor must initiate a change to the selection of the servo head. The microprocessor does not change the selection of the servo head, however, until the controller follows the "new" volume address with a seek command, which the microprocessor verifies before changing the selection of the servo head to match the selection of the read/write volume. After the validity of the seek has been verified, the M.P. switches the SVO CLAMP/-L signal active for 100 microseconds. The servo head selection change occurs at the beginning of the 100 microsecond period and then the phase locked loop circuitry locks in on the servo signals coming off the newly selected servo surface during the 100 microsecond period. Before the seek to a new track can begin the track center signal (TRK CEN/-L) must have been active for at least 1 millisecond, indicating that the newly selected servo head has locked on to the track nearest its position when the servo head selection change occurred. Figure 4-11 is a flow chart which illustrates the events described above.

4.3.3.5 MICROPROCESSOR SELF DIAGNOSTICS

Every time the power comes up on the CMD the microprocessor performs a series of self diagnostic tests. It performs a CRC test on the ROM, a write/read test on the RAM, a write/read test of the programmable ports, and a test of the interrupt system. The CMD will not become ready if any of the tests fail. Refer to Section 2.9, 4.3.4.5 (Figure 4-27) and 6.9 for more details on the microprocessor diagnostics.

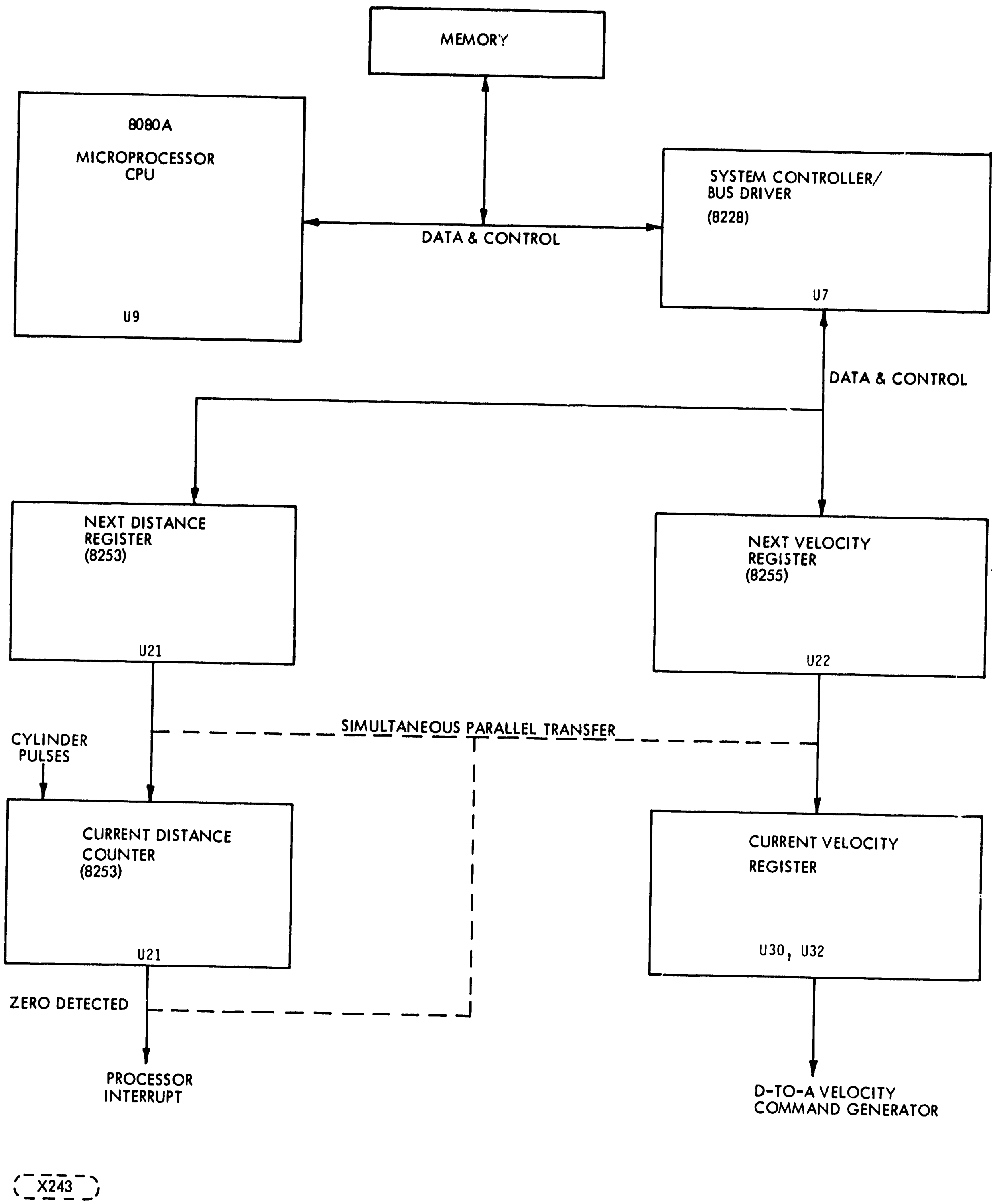


FIGURE 4-10. SEEK CONTROL (DIGITAL PORTION)
BLOCK DIAGRAM

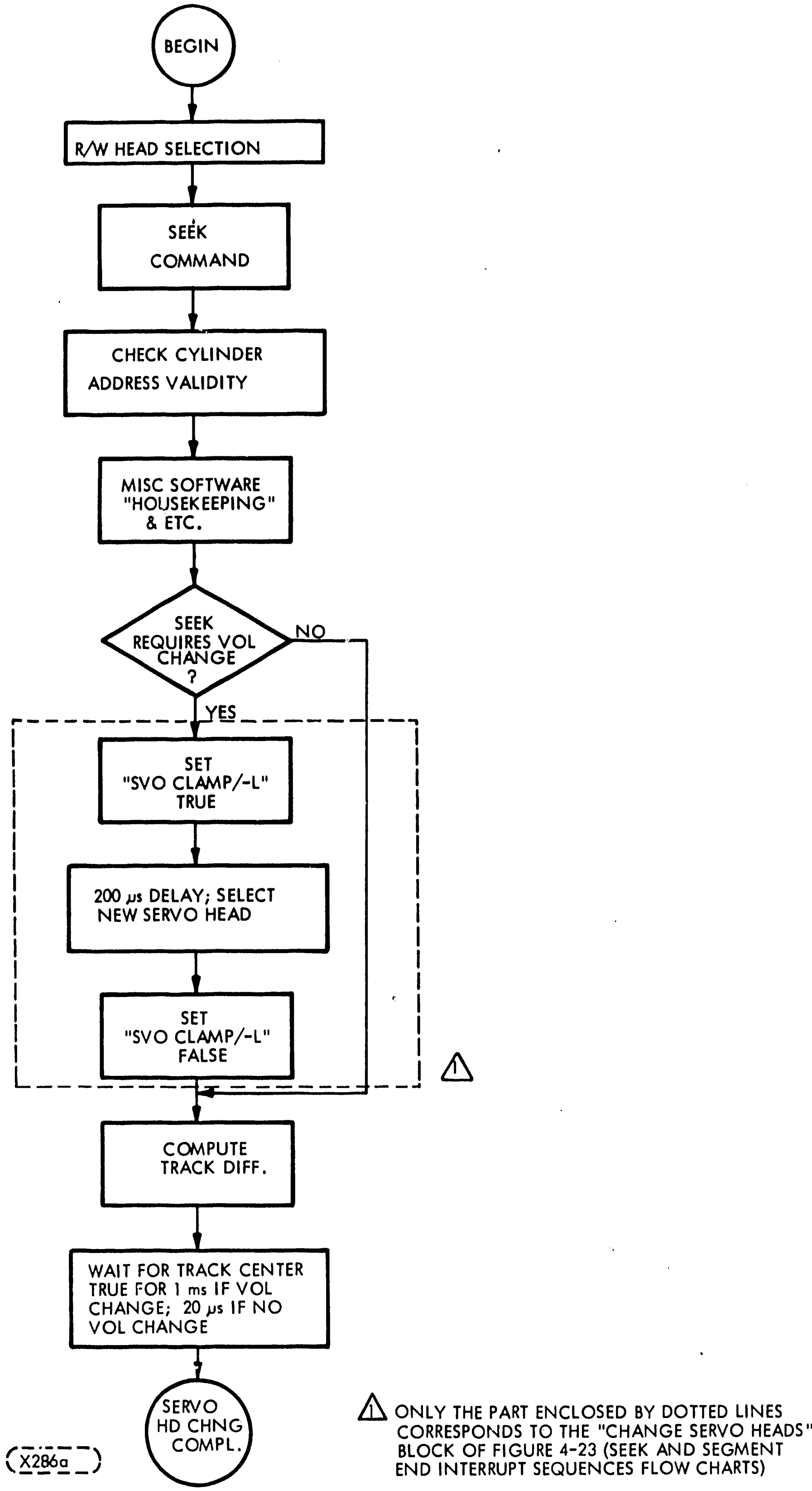


FIGURE 4-11. SERVO HEAD CHANGE
OPERATIONAL FLOW CHART

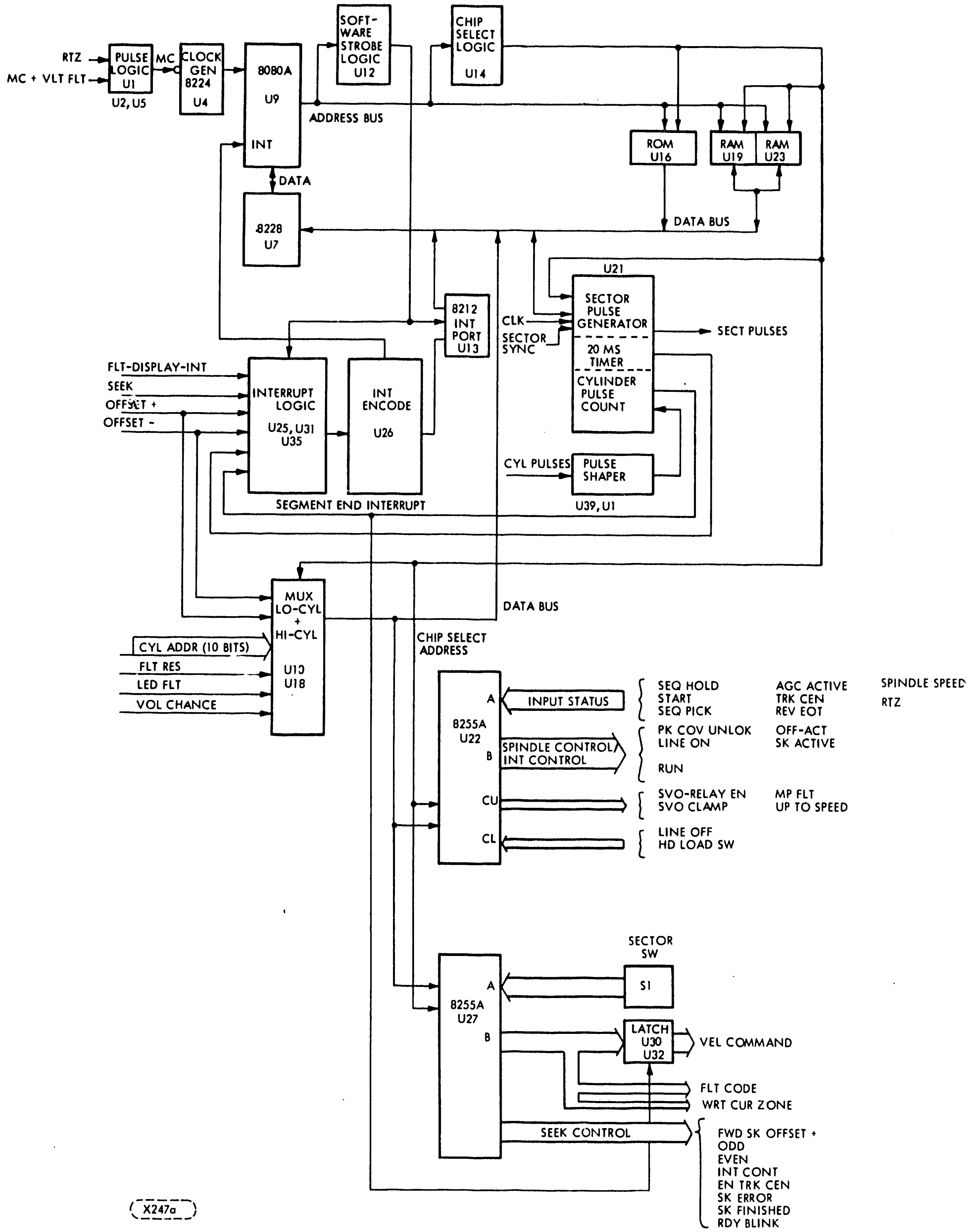


FIGURE 4-12. MICROPROCESSOR HARDWARE BLOCK DIAGRAM

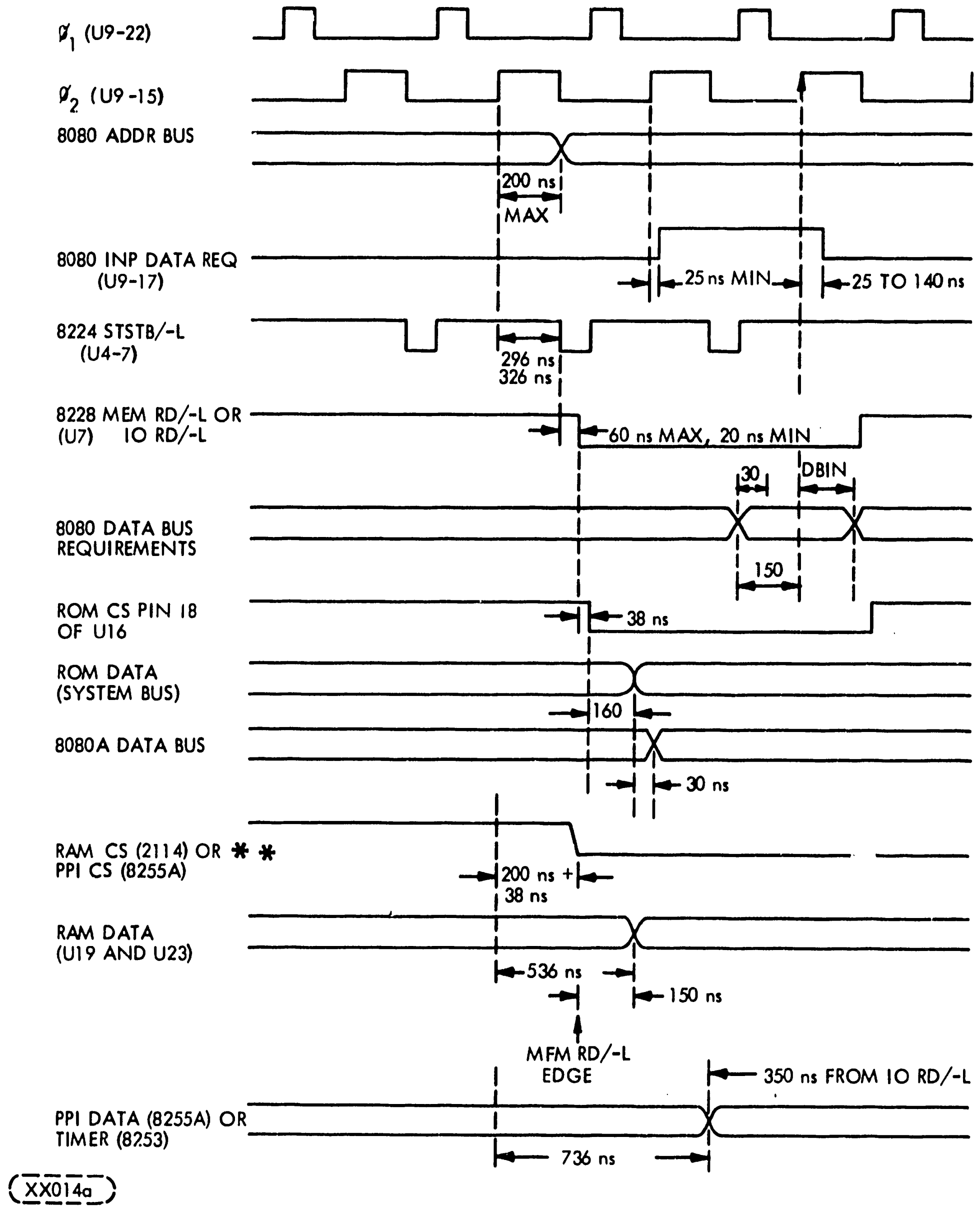


FIGURE 4-13. MICROPROCESSOR READ TIMING

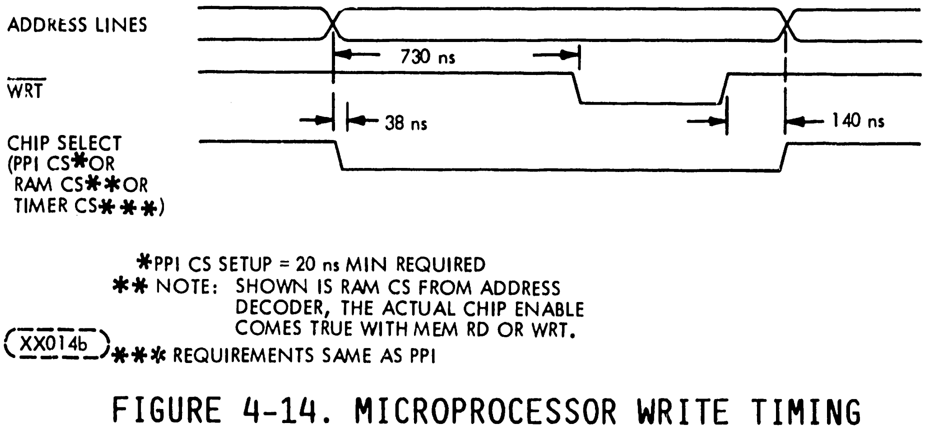


FIGURE 4-14. MICROPROCESSOR WRITE TIMING

4.3.4 MICROPROCESSOR DETAILED FUNCTIONAL DESCRIPTION

4.3.4.1 MICROPROCESSOR HARDWARE DESCRIPTION

The basic microprocessor hardware consists of a processor (8080A), clock generator (8224), system controller and bus driver (8228), instruction memory (2732), data memory (2114), interrupt logic, programmable timer (8253), and programmable peripheral interface units (8255A, called PPI). These elements are tied together on three common buses-control, data, and address. The timing relationships for these buses to perform memory read and write and I/O read and write are shown in Figure 4-13 and 4-14.

4.3.4.2 MEMORY ADDRESS CODE ASSIGNMENTS

The address decode logic of U14 provides the address line decoding which selects memory chips, I/O ports and etc. Table 4-1 shows the memory address codes used to select memory chips, select and control I/O ports and the interval timer and to generate certain "Software Strobes". The high order bit (MADR-F/+L) is used to select either chips/functions within the CMD, or to select memory external to the CMD via PWA slot EM4 (for factory test). It should be noted that for clarity and consistency Table 4-1 shows all of the memory address codes as "/+L" (nominal +4 Volt = Logic "1"). However, the A, B and C address lines are actually mechanized as "/-L" logic (nominal 0 Volt is Logic 1) in most places shown in the schematics.

4.3.4.3 INTERRUPT LOGIC

The interrupt logic consists of interrupt flip-flops and latches, an interrupt instruction encoder and an interrupt port. Offset, Seek and RTZ operations impose interface responses times on the microprocessor which require circuitry that will (1) memorize the command, (2) cause an interrupt and (3) drop ON CYLINDER. Flip-flops on the I/O and Servo Coarse PWAs store the commands from the controller. The interrupt logic is on the Servo Coarse PWA and it operates as follows. The interrupt encoder (U26) generates the interrupt to the 8080 microprocessor and prioritizes and encodes the interrupts into a 3 bit binary code AAA. When the 8080A responds to the interrupt, U13 forces the code 11AAA111 onto the data bus for the 8080 to use as a Restart instruction. The Restart instruction saves a return address and transfers 8080 program control to the instruction whose address is eight times the AAA field of the Restart instruction. The new instruction at 8 X AAA is the first instruction in the subroutine that services the requirements of the particular function that caused the interrupt.

TABLE 4-1. MICROPROCESSOR MEMORY ADDRESS CODE ASSIGNMENTS

FUNCTION	MEMORY ADDRESS LINES MADR F/+L THRU MADR 0/+L																8080CPU
SRVO COARSE PWA	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	MADR HEX
External Addr (EM4)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8000H and UP
Internal Address																	
Memory:																	
ROM U16,	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000H to
(4K)	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0FFFH
RAM U19,	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2000H to
U23	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	1	20FFH
Input Ports Addressed as Memory (U10, U18):																	
LO-CYL	0	0	1	0	1	1	X	X									2C2CH
HI-CYL	0	0	1	0	1	0	X	X									2828H
I/O Ports:																	
PP1-1 (U22)																	
Control	0	0	0	0	0	0	X	X									0000H
Port A	0	0	0	0	1	1	X	X									0C0CH
Port B	0	0	0	0	1	0	X	X									0808H
Port C	0	0	0	0	0	1	X	X									0404H
PP1-2 (U27)																	
Control	0	0	1	1	0	0	X	X									3030H
Port A	0	0	1	1	1	1	X	X									3C3CH
Port B	0	0	1	1	1	0	X	X									3838H
Port C	0	0	1	1	0	1	X	X									3434H
Timer:																	
(U21) Mode	0	1	0	X	0	0	X	X									4040H
CNT 0	0	1	0	X	1	1	X	X									4C4CH
CNT 1	0	1	0	X	1	0	X	X									4848H
CNT 2	0	1	0	X	0	1	X	X									4444H
Software Strobes (U12):																	
LD-VEL-RD-INT	0	1	1	1	1	1	X	X									7C7CH
RES-SK-INT	0	1	1	1	1	0	X	X									7878H
RES-EXT-INT	0	1	1	1	0	1	X	X									7474H
RES-RTZ	0	1	1	1	0	0	X	X									7070H
RES-OFF-INT	0	1	1	0	1	1	X	X									6C6CH
RES-SPD-LCH	0	1	1	0	1	0	X	X									6868H
RES-SEG-END-INT	0	1	1	0	0	1	X	X									6464H
SET-INT	0	1	1	0	0	0	X	X									6060H

Table 4-2 lists the Restart instruction produced by each interrupt and the priority attached to each interrupt.

TABLE 2. PRIORITY INTERRUPT RESTART INSTRUCTIONS

PRIORITY	INTERRUPT	RESTART INSTRUCTION
1	Clock (20 ms)	CFH (11001111)
2	Segment End	D7H (11010111)
3	External	DFH (11011111)
4	Offset	E7H (11100111)
5	Maintenance Fault	EFH (11101111)
6	Seek	F7H (11110111) AAA

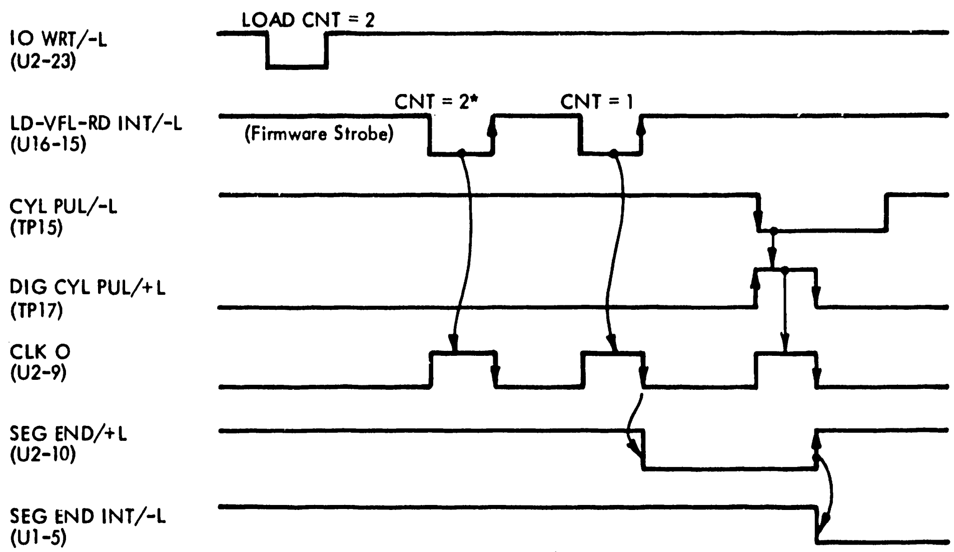
Clock (20 ms) Interrupt:
Counter #1 of the 8253 Programmable Interval Timer produces an interrupt every 20 ms which is the priority 1 Clock interrupt in Table 4-2. Firmware decrements two counters stored in RAM with the 20 ms clock and uses the two counters for various large timeout functions required by the CMD operations.

Segment End Interrupt:
Counter #0 of the 8253 produces the Segment End interrupt when the seek control logic requires the next velocity command as described in Section 4.3.3.2, "Seek Control". Refer also to the timing diagram of Figure 4-15. For the initial part of a seek the firmware loads a count into the "next distance" register of Counter 0 (using I/O WRT/-L) and then transfers that count (using "LD-VEL-RD-INT/-L") into the "present distance" register in Counter 0. The count transferred into the "present distance" register is the number of cylinders to be traversed at the "current velocity" in registers U30 and U32. The "next distance" is transferred into the "next distance" register at the same time. Figure 4-15 illustrates the case where the heads are programmed to travel a one track segment at the "present velocity" at the end of which the "segment end interrupt" occurs.

External Interrupt:
External Interrupt is reserved for later use.

Offset Interrupt:
A change in offset command lines detected by an edge detector circuit generates the offset interrupt. The microprocessor then commands an offset position through the velocity command port (PPI-1, Port B) to the D to A converter. In the fine mode (closed loop) the D to A output is a position offset, but in the coarse mode (open loop) the D to A output is a velocity command.

Maintenance Fault Interrupt:
The maintenance fault interrupt occurs as a result of a request from the Control/Mux PWA to output through the velocity command port any stored fault codes. This interrupt also triggers the velocity measurement routine if the microprocessor detects that switch S1-8 on the Servo-Coarse PWA is in the OFF position. The State of S1-8 is sensed through PPI-1 port PA7.



* THE INTERNAL OPERATION OF THE 8253 REQUIRES THIS EXTRA PULSE ON THE INITIAL SEGMENT OF A SEEK.

XX032a

FIGURE 4-15. INITIAL 1 TRACK SEGMENT TIMING (SEEK OPERATION)

Seek Interrupt:
The Seek Interrupt initiates a seek operation. The flow chart of Figure 4-23 illustrates the Seek and Segment End Interrupts.

4.3.4.4 MICROPROCESSOR I/O LOGIC

The input/output logic consists of two programmable peripheral interface PPI chips (U22/U27, type 8255A) and two multiplex chips (U10 and U18: type 74LS257). A binary 1 of 8 decoder (U12; type 74LS138) provides strobe pulses for the M.P. I/O logic. These are shown in their relationship to each other in the block diagram of Figure 4-12. Table 4-3 which follows lists the I/O ports and their functions.

TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS (SHEET 1 OF 5)

PPI 1 (U22)	Source/Destination	Function
PORT A	(Inputs)	
PA0 : : : PA6	Sector Selection Switch S1-1 (LSB) thru Sector Selection Switch S1-7	These seven inputs select the number of sector pulses per revolution. See also Table 3-3.
PA7	Sector Selection Switch S1-8	Defines the action taken when the maintenance fault interrupt occurs. (Vel. adjustment)
PORT B	(Outputs)	
PB0 : : : : : : PB7	Output Velocity commands to Vel. command registers or maintenance codes to Fault Displays on CNTL/MUX PWA and WRT CURR CONTROL BITS to RD/WR Preamp	During a seek these signals are servo velocity commands and during execution of a maintenance fault display the 5-bit error code is output. See Table 6-6 for more information the Fault Displays.
PORT C	(Outputs)	Port C is the seek control port.
PC0	RDY BLINK/-L	Turns ON and OFF at 2.5 Hertz. rate during spindle start and stop. When servo relay is enabled 0 volts on this line specifies a ready condition (heads loaded and on-cylinder.)
PC1	SK FINISHED/+L	Enables ON-CYLINDER when a seek is completed.
PC2	SK ERROR/+L	A seek error has occurred (Table 6-7).
PC3	EN TRK CEN/+L	Enables 60 Hz runout filter on the signal position error input. Actuated when in fine mode after track center has been detected.
PC4	INT CONT/-L	When active "low", enables all interrupts. When "high" disables all but 20 ms clock int.
PC5	EVEN/-L	Selects "+" polarity of signal position error (SPE) from Servo Fine PWA and closes servo loop (fine mode).
PC6	ODD/-L	Selects "-" polarity of SPE and closes servo loop (fine mode).

TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS
(SHEET 2 OF 5)

PPI 1 (U22)	Source/Destination	Function
PC7	FWR SK OFFSET+/-L	Selects polarity of D/A output which defines the direction of movement for a seek and the direction of position offset for an offset.
PPI 2 (U27)		
PORT A (Inputs)		Port A is hardware status inputs.
PA0	SEQ PICK/+L	Interface control line for sequencing start of spindle motor.
PA1	RTZ/-L	Indicates the state of the RTZ flip flop (U35).
PA2	REV EOT/-L	When active LOW the positioner has moved into outer guard band. It is used during an RTZ to tell the M.P. to reverse motion and lock on track 0.
PA3	TRK CEN/-L	Defines the positioner to be on track (see also Section 4.3.5.3).
PA4	AGC ACTIVE/-L	Signal from servo fine PWA which defines when the positioner is out of the servo recorded zone.
PA5	SPEED/+L	Used to measure spindle speed.
PA6	START/-L	Local Start Switch input.
PA7	SEQ HOLD/-L	Interface control line for sequencing start of spindle motor.
PORT B	(Outputs)	Spindle control port.
PB0	OFFSET-ACT/+L	Defines when a position offset is active so that when the offset is removed, ON CYLINDER may or may not drop according to option selected.
PB1	PK COV UNLOK/-L	When active LOW allows access to removable disk pack.
PB2	Not used	

TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS (SHEET 3 OF 5)

PPI 2 (U27)	Source/Destination	Function
PB3	RUN/-L	Controls the RUN relay which connects either a solid state relay controlled AC line or a transistor controlled DC line to the spindle motor windings.
PB4	BRK ON/-L	When active LOW and PB3 is HIGH this line turns on the DC brake current through the RUN relay to the motor.
PB5	LINE ON/-L	When active LOW and PB3 is active LOW this line turns on the solid-state relay which controls the spindle motor through the RUN relay.
PB6	SK-ACTIVE/-L	Disables the Seek Interrupt and Offset Interrupt latches during a seek.
PB7	Not used	
PORT C (Inputs)		
PC0	HD LOAD SW/+L	This signal is active HIGH when the heads are loaded (the switch is open-not activated).
PC1	AGC Fault Option	Door Lock/Unlock with AGC Fault.
PC2	Purge Time Option	35 Sec/2 Min Purge
PC3	LINE OFF/+L	Indicates solid-state relay (SSR) is disabled. If this line is active HIGH at the same time that LINE ON from PB5 is active LOW it indicates to the M.P. that the motor-over-heated switch has opened so the M.P. sets a fault.
PORT C (Outputs)		
PC4	UP-TO-SPEED/+L	Active LOW when the spindle motor has exceeded 80% of 3600 r/min during spindle start. Goes HIGH if r/min drops below 80% anytime the heads are loaded.
PC5	MP FLT/+L	Indicates a M.P. fault condition.

TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS
(SHEET 4 OF 5)

PPI 2 (U27)	Source/Destination	Function
PC6	SVO CLAMP/-L	Used on Servo Fine PWA. At the beginning of a seek operation requiring a volume change this signal triggers the servo head change. It inhibits the sector and index pulses and selects a greater than normal bandwidth for the servo clock.
PC7	SVO RLY EN/+L	When active HIGH this signal connects the normal servo power amplifier to the actuator through the servo relay. When LOW it switches the servo relay so the emergency retract amplifier is connected to the actuator.
U10, U18 Multiplexor Ports*		Outputs on Data bus lines DB-0 thru DB-7.
"1" INPUTS (all)	CYL-ADDR-0/+L thru CYL-ADDR-7/+L	Lower eight bits of cylinder address read at the beginning of a seek.
"0" INPUTS	CYL-ADDR-8/+L	Two high order bits of
1	CYL-ADDR 9/+L	cylinder address.
2	FLT-RESET/+L	Input from Control/Mux PWA requesting M.P. fault reset.
3	MP-MC/+L	M.P. checks this line during a master clear routine to determine if an RTZ or MC-VLT-FLT produced the MC condition.
4	LED FAULT/-L	Status from Control/Mux PWA indicating a fault condition exists. The M.P. will not load heads when this is active LOW.
5	OFFSET+/+L	Indicates a positive offset request.
6	OFFSET-/+L	Indicates a negative offset request.
7	VOL CHANGE/-L	M.P. checks this line at the beginning of each seek to see if a volume change is required.

*These are addressed as memory, not as I/O. That is, the address is qualified by MEM READ.

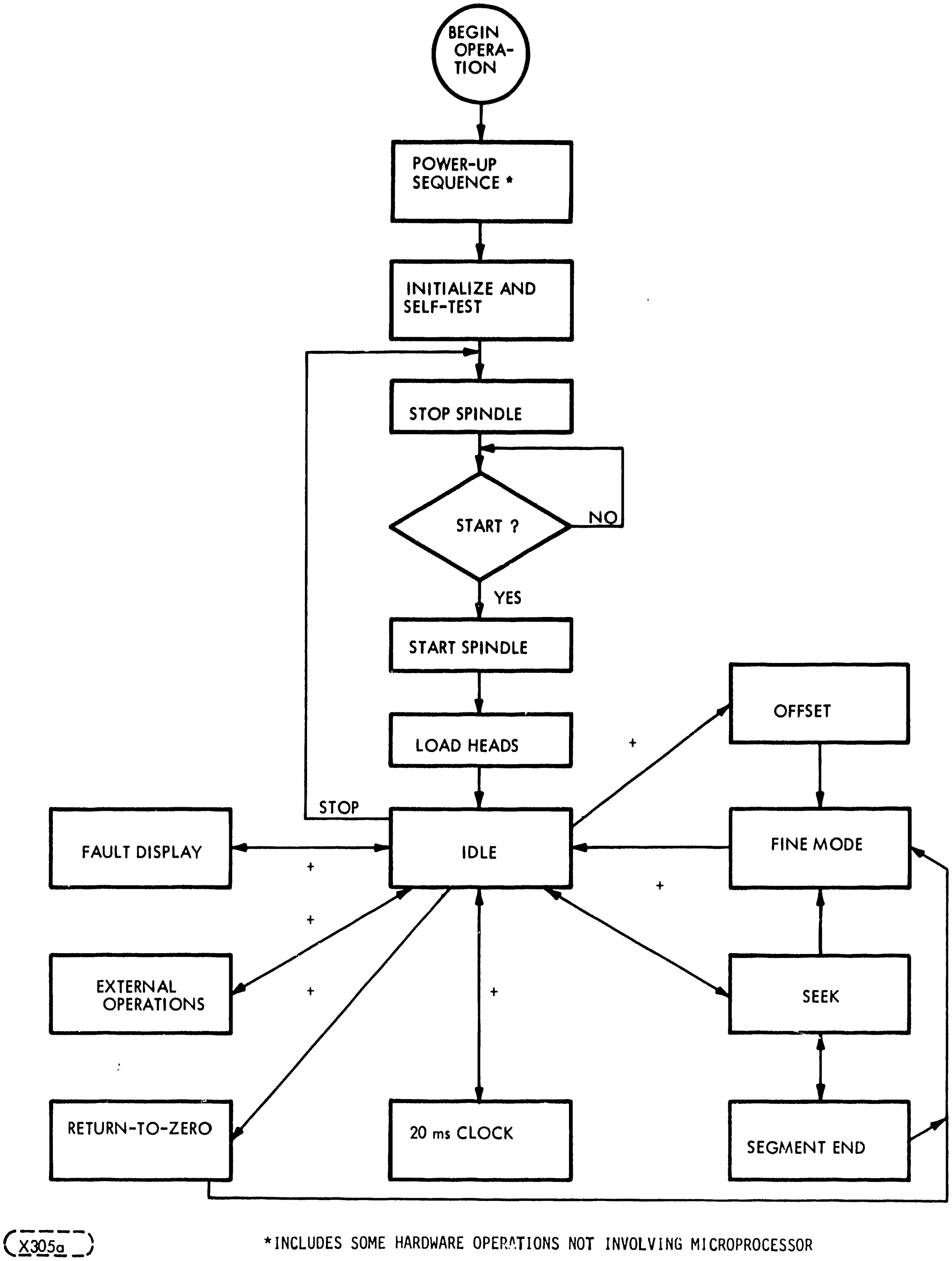
TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS
(SHEET 5 OF 5)

PPI 2 (U27) Source/Destination		Function
Inputs to PPI 2 from U12 Binary/1:8 Decoder		Software strobes decoded from input addresses
U12-15	LD-VEL-RD-INT/-L	Loads contents of velocity port into Velocity Command Registers and strobes the Segment End Counter. Also this strobe allows the reading of the interrupt instruction port for diagnostic purposes.
U12-14	RES-SK-INT/-L	Resets seek interrupt flip-flop.
U12-13	RES-EXT-INT/-L	Available for later external use.
U12-12	RES-RTZ/-L	Resets RTZ latch and MP-MC latch.
U12-11	RES-OFF-INT/-L	Resets offset interrupt latch.
U12-10	RES-SPD-LCH/-L	Resets speed latch.
U12-9	RES-SEG-END-INT/-L	Resets the segment end interrupt flip-flop.
U12-7	SET-INT/-L	Checks interrupt related hardware for diagnostic purposes.

4.3.4.5 MICROPROCESSOR OPERATION FLOW CHARTS

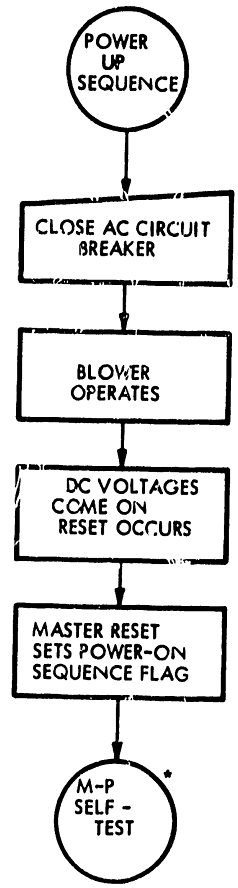
Flow charts illustrating microprocessor operation sequences are given in Figure 4-16 through 4-27.

Operation described by the flow charts can be interrupted at most any point in the flow when an interrupt to the M.P. occurs. Register contents and anything else necessary is saved (if applicable) until operation returns from processing the interrupt and performing whatever operation is called for (if applicable).



*INCLUDES SOME HARDWARE OPERATIONS NOT INVOLVING MICROPROCESSOR
+INTERRUPT FROM IDLE

FIGURE 4-16. MICROPROCESSOR GENERAL OPERATION FLOW CHART



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NOTE: THESE ARE HARDWARE SEQUENCES OTHER THAN THOSE INVOLVING THE MICROPROCESSOR.

*FIGURE 4-18

FIGURE 4-17. POWER-UP HARDWARE SEQUENCES FLOW CHART

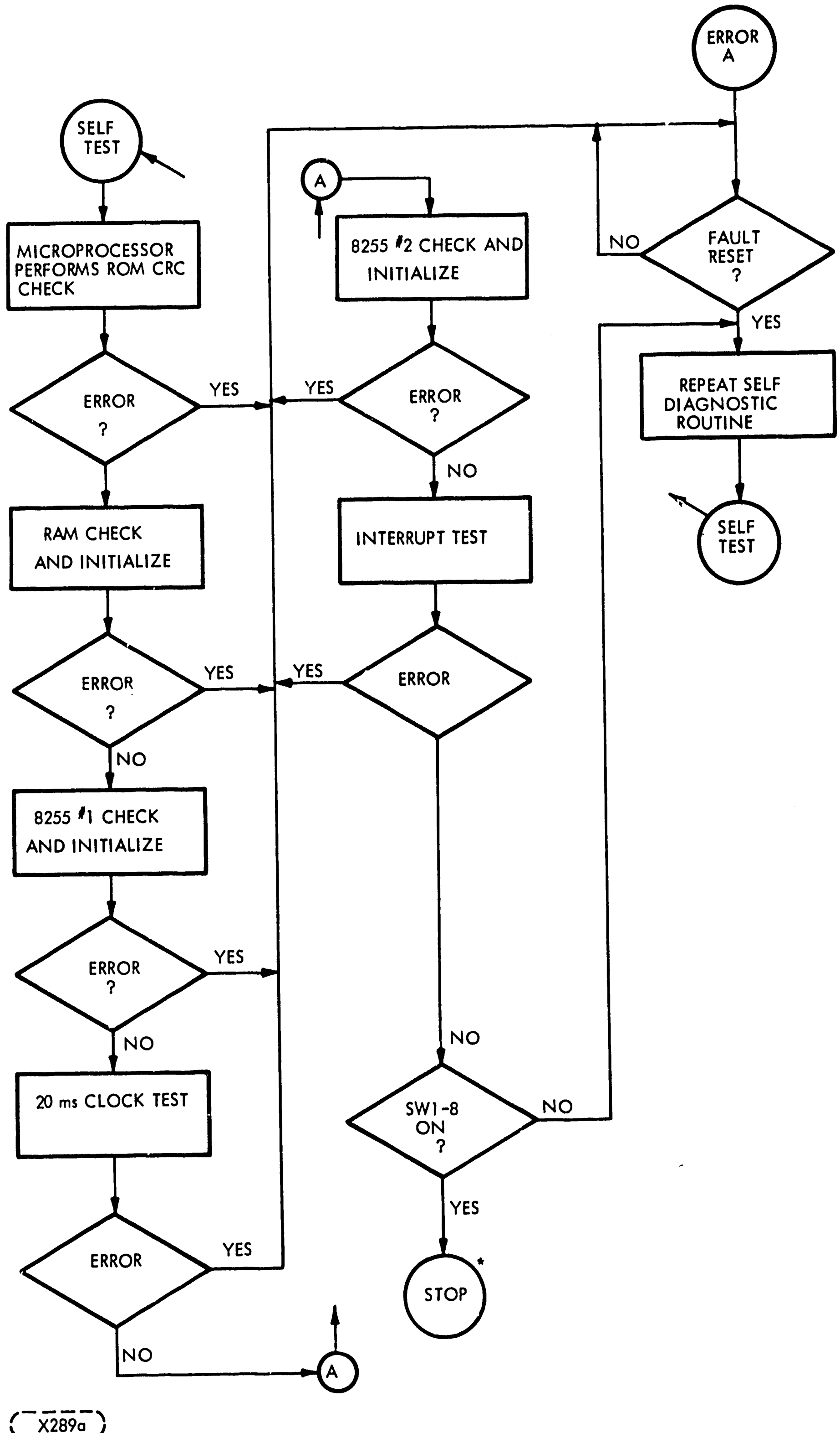


*FIGURE 4-19

FIGURE 4-18. INITIALIZATION AND SELF TEST SEQUENCE FLOW CHART

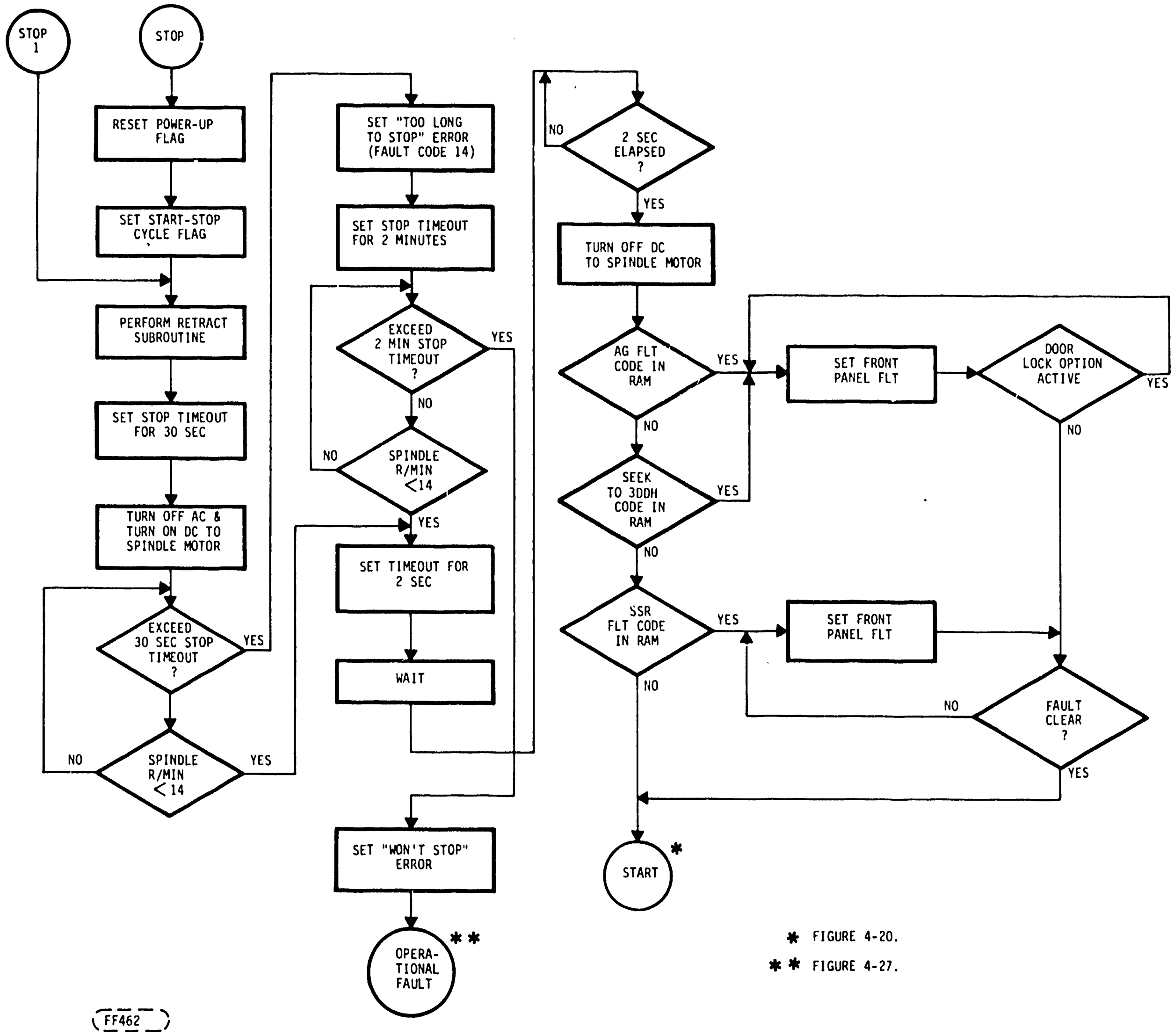
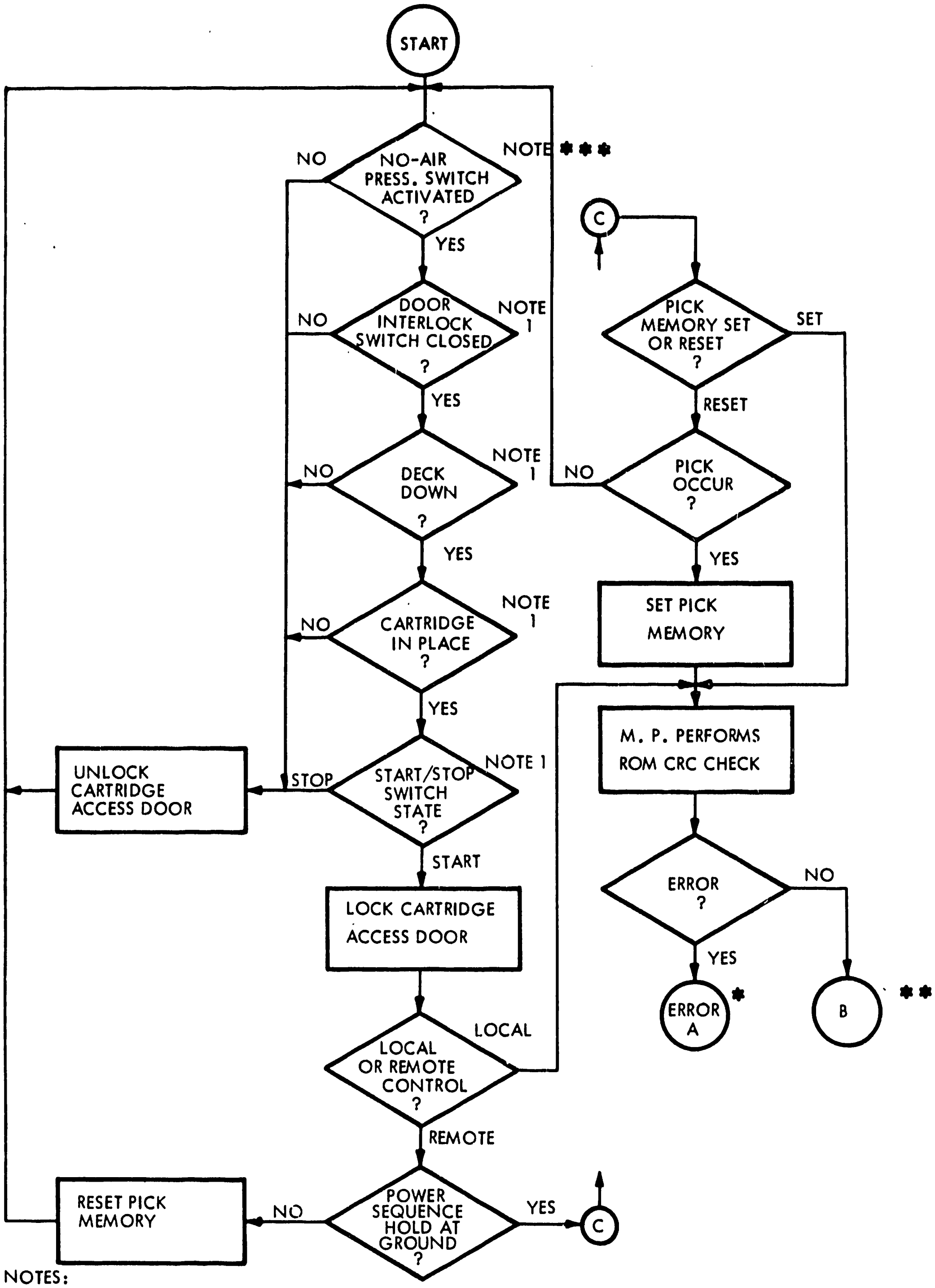


FIGURE 4-19. STOP SEQUENCE FLOW CHART



NOTES:
* FIGURE 4-18
* * SHEET 2 OF THIS CHART

* * * THIS SWITCH IS AN OPTIONAL COMPONENT THAT WILL BE REPLACED BY JUMPER WIRE WHEN NOT USED

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FIGURE 4-20. MICROPROCESSOR START SEQUENCE FLOW CHART (SHEET 1 OF 3)

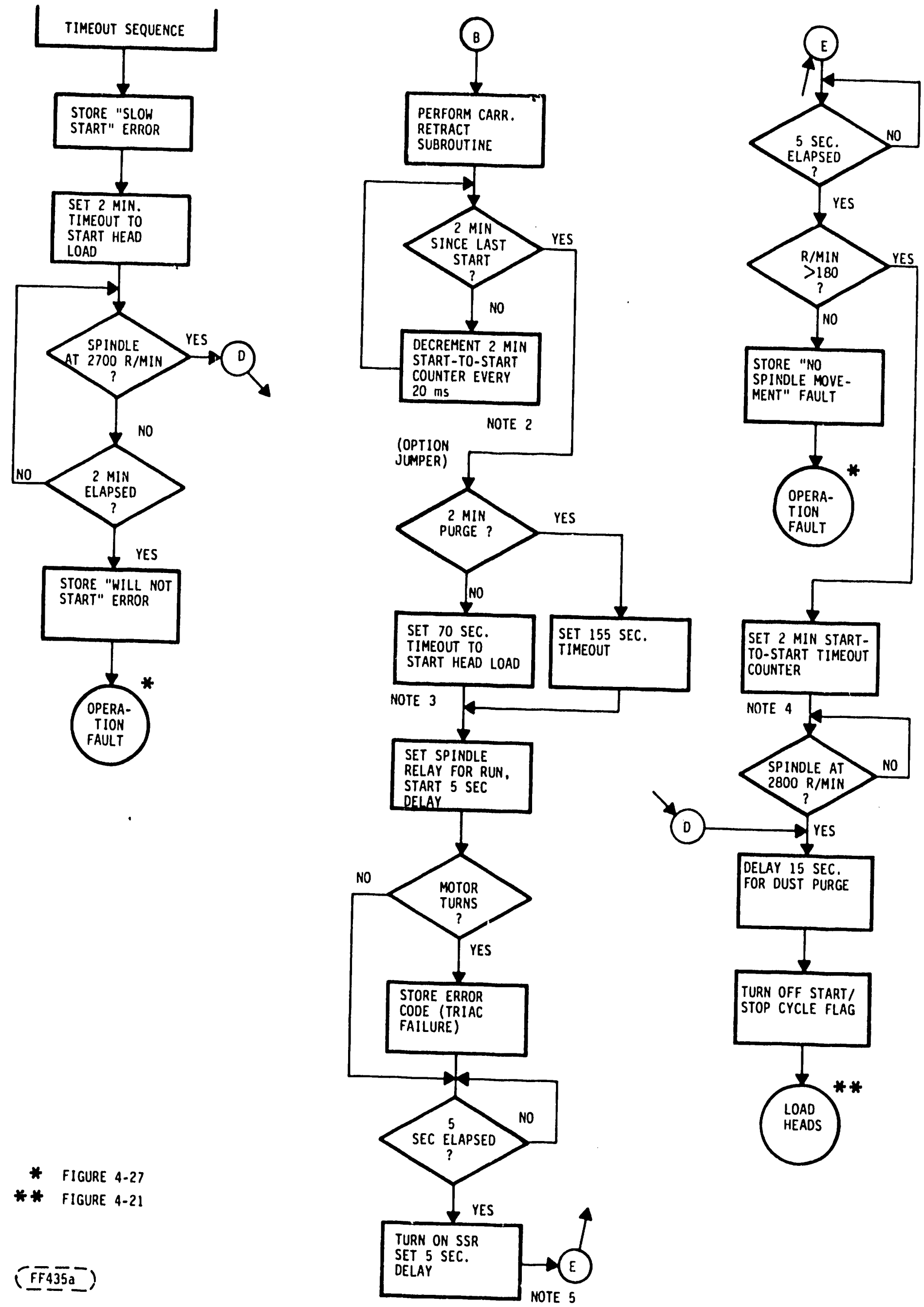


FIGURE 4-20. MICROPROCESSOR START SEQUENCE FLOW CHART (SHEET 2 OF 3)

START SEQUENCE NOTES

NOTE 1. These decision boxes are not operations taking place in the software or firmware, but only represent hardware interlocks which must be in the correct state before depressing the START switch will cause anything to happen. The microprocessor does not look at the state of these switches but they must be closed before the START switch can indicate "START".

NOTE 2. A few blocks previous to this point in the flow chart is was found that the START/STOP switch indicates START. However, a two minute timer will not allow operation to proceed until the two minute interval has elapsed. The two minute timer counter is decremented by the 20 ms idle interrupt clock (see Idle Interrupt Flow Chart). See also Note 4 below.

NOTE 3. The Spindle motor must reach 2890 r/min before 70 seconds has elapsed or a "too slow start" error will be stored in the fault store. A 70 second counter is set up to mark off the 70 second period and if it times out before 2890 r/min is reached a two minute counter is set up. If the two minute counter times out, the operational fault routine is called to stop the spindle. "Will not start" error is also stored in the fault store. These timing events occur in parallel to the events of the Power-up Sequence Flow Chart. A timeout could occur anywhere during the flow of events depicted, depending on what caused the delay in the spindle start up sequence.

NOTE 4. The two minute Start-to-Start Timer mentioned in Note 2 is initially set up at this point in the sequence. Regardless of what else may happen, a new start cannot begin after this time has been started until it has timed out after two minutes have elapsed.

NOTE 5. This loop tests to see if the spindle motor has started yet. If the Solid State Relay that controls power to the motor is on but the speed fails to rise above 180 r/min a "no spindle movement" fault is stored in the Fault store, and the operational fault routine routes operation to the stop sequence.

FIGURE 4-20. MICROPROCESSOR START SEQUENCE FLOW CHART
(SHEET 3 OF 3)

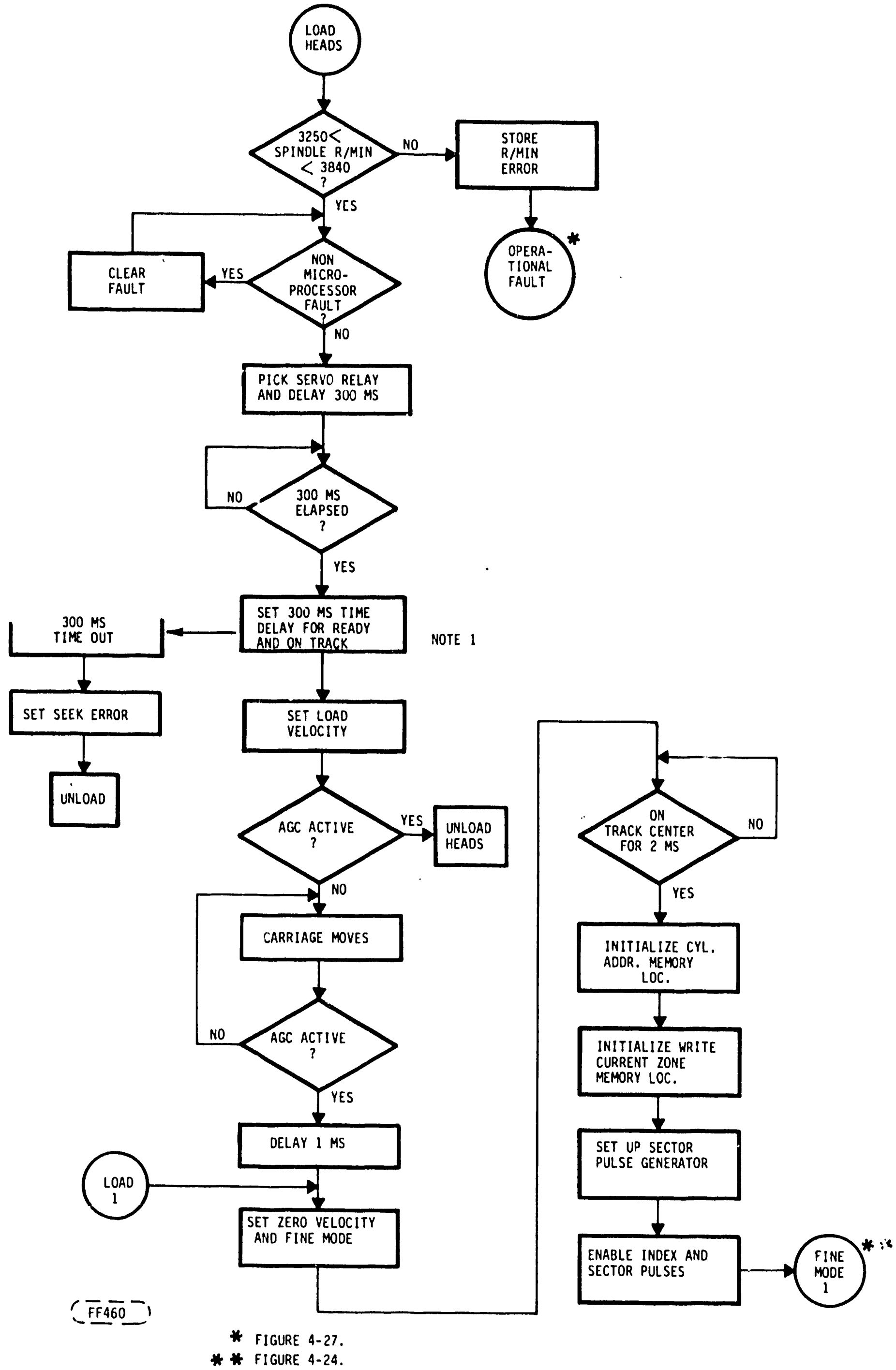
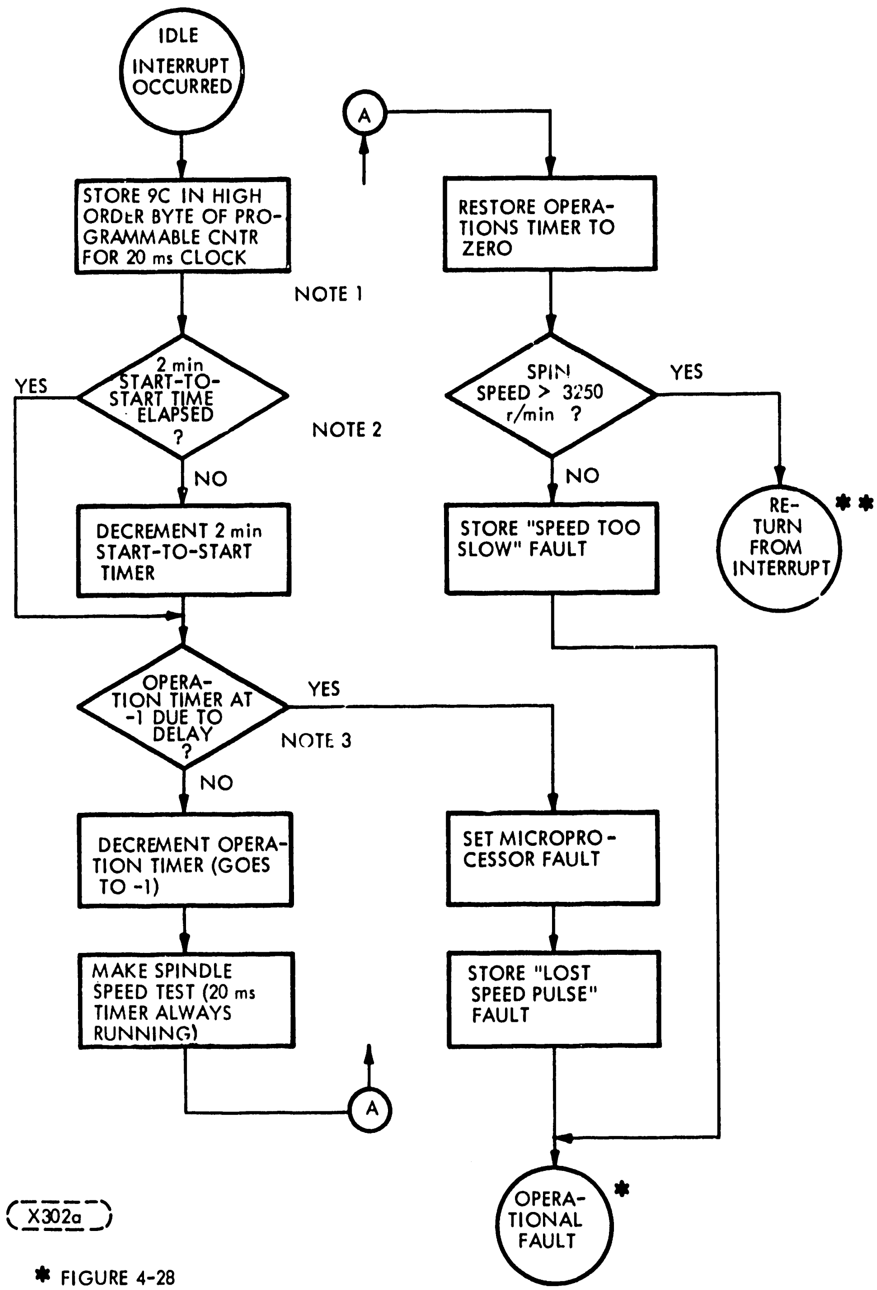


FIGURE 4-21. HEAD LOAD SEQUENCE FLOW CHART

NOTE 1. To time the head load operation a counter is set up which takes 300 ms to decrement to -1. If the counter times out, i.e., reaches -1 before the "Ready and on-track" condition occurs a Seek Error is stored in the M.P. fault storage. The time-out could occur at anytime during the Head Load or Fine Mode sequences, so the time-out sequence is shown off to the side of the main flow chart. If the "Set Ready" box in the Fine Mode flow chart is reached before the 300 ms time-out occurs, the 300 ms time-out counter is stopped.



* FIGURE 4-28

** RETURN TO THE ROUTINE WHICH WAS INTERRUPTED.

FIGURE 4-22. 20 MS CLOCK SEQUENCE FLOW CHART
(SHEET 1 OF 2)

20 ms CLOCK SEQUENCE FLOW CHART NOTES.*

NOTE 1. The Microprocessor loads 9CH into the high order byte of a 16 bit programmable counter U2. The counter is clocked by the 2 MHz 8080 Clock until it reaches zero, at which time the CPU is interrupted. The output of U2 is a level every 20 milliseconds when the CPU is able to process the interrupt and, as part of the interrupt subroutine, reload the 9CH value into U2 and restart the countdown.

Though it doesn't show up in all of the flow charts, the 20 ms clock counter is continually being decremented by the 2 MHz 8080 Clock. At the end of 20 ms the CPU is again interrupted.

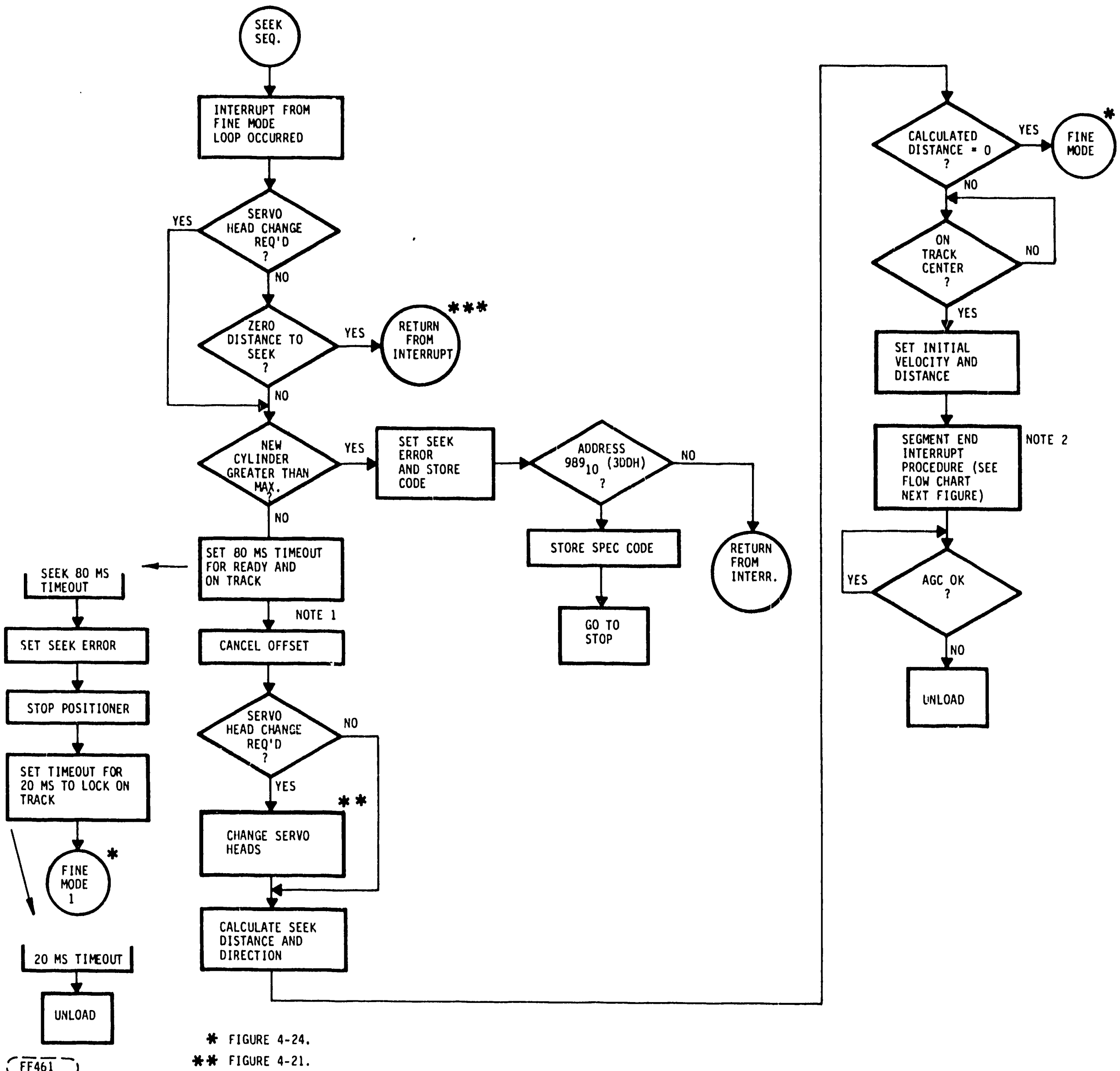
NOTE 2. To measure off a 2 minute Start-to-Start interval, the CPU loads a 16 bit location in RAM with a number to be decremented by the 20 ms clock (see Note 1). When the number has been decremented to -1 (2 minutes elapsed) a new start may be initiated (assuming the power up sequence is complete). This portion of the flow chart is not of any importance to the rest of the flow shown on the chart, and is only of concern in the Start Sequence. It is only shown here because of its relation to the 20 ms clock which decrements the 2 minute counter. The second sheet of the Power-On Sequence Flow Chart contains the box where the Start-to-Start timer was originally started.

Until a stop and an attempt to start again occurs the 2 minute Start-to-Start timer is not connected with any of the ongoing operations of the unit. The release of the START switch (STOP) does not depend on whether or not the two minute Start-to-Start Timer has timed out; a stop may occur anytime after a start.

NOTE 3. There is a location in RAM called the Operations 16 bit Timer which is used for storing some number which will be counted down to provide a time interval for some operation. The number stored there depends on the operation. When this counter location is used in the motor spindle speed check sequence it is loaded with zero. When the 20 ms clock interrupts the CPU the Operations Timer is checked for -1 which it will not be if everything is operating correctly. After the -1 check the timer is decremented to -1 and then the spindle speed check is made. After the spindle speed check is complete the Operations Timer is loaded again with zero. If during the spindle speed check some fault occurs (a CPU interrupt, for example) and the spindle speed check is not completed for the 20 ms clock times out, the operations Timer does not get set back to zero. When the -1 check is made the contents will still be zero. This is a fault condition and will be handled in accordance with the fault routines.

*Valid only for Idle Sequence.

FIGURE 4-22. 20 MS CLOCK SEQUENCE FLOW CHART (SHEET 2 OF 2)



* FIGURE 4-24.
** FIGURE 4-21.
*** RETURN TO ROUTINE WHICH WAS INTERRUPTED.

FIGURE 4-23. SEEK AND SEGMENT END INTERRUPT SEQUENCES FLOW CHARTS (SHEET 1 OF 3)

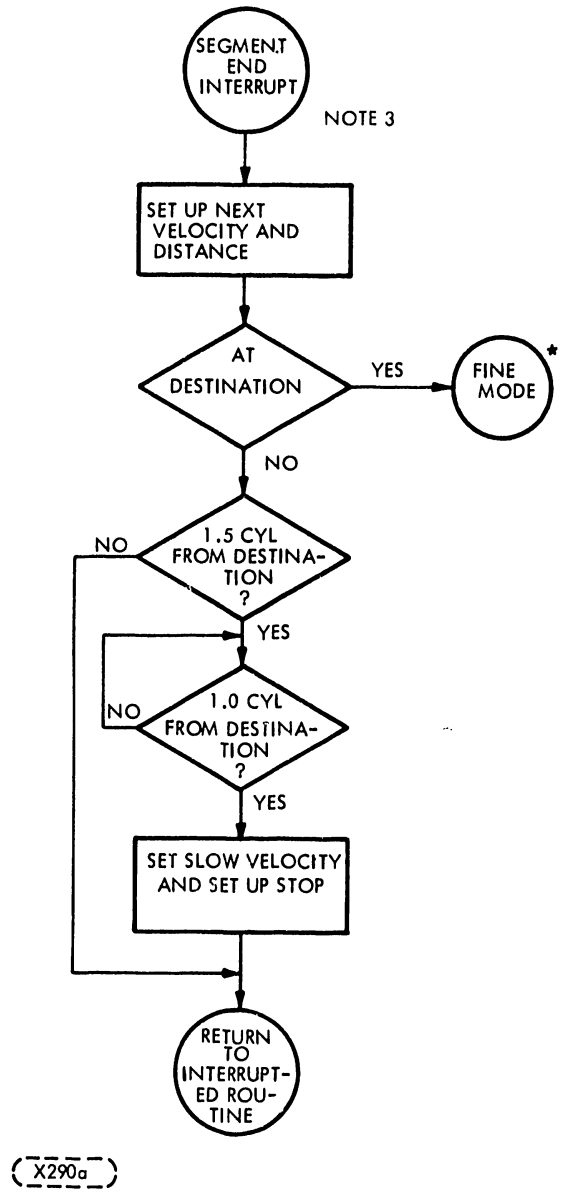


*Figure 4-24.

FIGURE 4-23. SEEK AND SEGMENT END INTERRUPT SEQUENCES FLOW CHARTS (SHEET 2 OF 3)

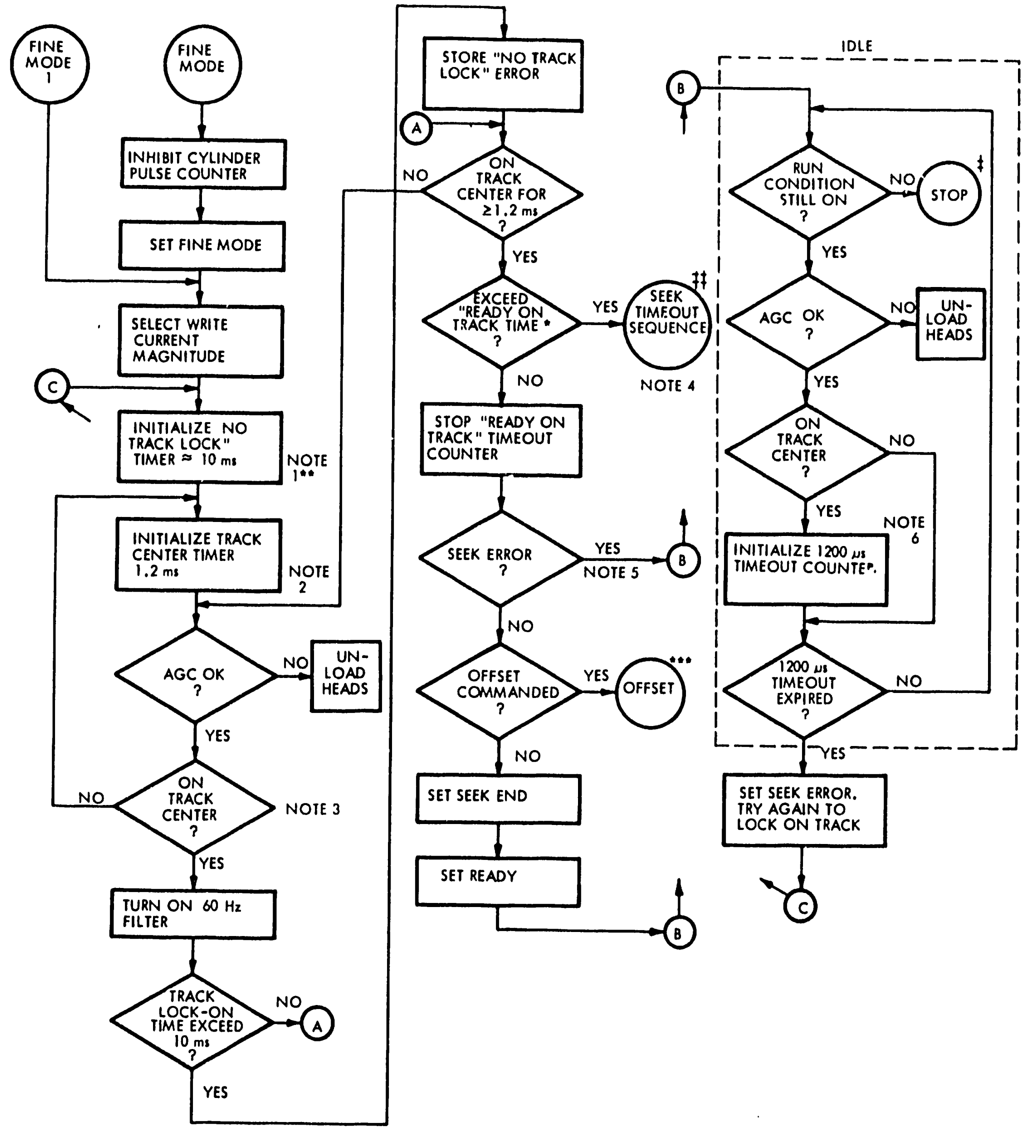
FIGURE 4-23. SEEK SEQUENCE FLOW CHARTS SUPPLEMENTARY NOTES.

NOTE 1. From the time a seek begins until the selected head is "Ready and on a Track" less than 80 ms should have elapsed. The M.P. sets up counter at this point to measure off the 80 ms time period. The counter could time out at any point in the seek or fine mode sequences if a malfunction occurs. For this reason the timeout sequence flow lies off to the side of the main flow.

NOTE 2. One or more distance/velocity segments makes up a seek operation. At the completion of the first segment the "Segment End Interrupt" occurs to signal the microprocessor that the next distance/velocity segment (if any) should be given to the servo system and the seek continued or operation switched to fine mode if at destination. See Note 3. The M.P. makes a continual check on the AGC system and unloads the heads when the AGC malfunctions.

NOTE 3. The Segment End Interrupt sets up the next distance/velocity segment. If final destination cylinder has been reached operation enters the "Fine Mode". A destination cylinder of greater than 1.5 cylinders away returns operation to the main seek routine which continues to monitor AGC while awaiting the next segment end interrupt. When the next segment end interrupt occurs the M.P. provides the "next distance and velocity" value. When only one cylinder from the destination cylinder the M.P. sets up slow velocity and stop operation. Less than one cylinder to destination left initiates Fine Mode Operation. Whenever the segment end interrupt occurs the logic circuits place the most recent "next distance and velocity" value in the "present distance and velocity" register.

FIGURE 4-23. SEEK AND SEGMENT END INTERRUPT SEQUENCES FLOW CHARTS (SHEET 3 OF 3)



* 80 ms FOR REGULAR SEEK AND 300 ms FOR POWER-UP SEQ. AND RTZ.
**SEE NOTES ON FOLLOWING PAGE.
***FIGURE 4-25.
‡FIGURE 4-19
‡‡FIGURE 4-23

FIGURE 4-24. FINE MODE SEQUENCE FLOW CHART
(SHEET 1 OF 2)

FIGURE 4-24. FINE MODE FLOW CHART SUPPLEMENTARY NOTES.

NOTE 1. During the fine mode of a seek, the time to lock onto track center can not exceed approximately 10 ms or the M.P. stores a "NO TRACK LOCK" error.

NOTE 2. Once the head locks on track the time locked on track should be at least 1.2 ms or the attempt to lock on track will be repeated. The 10 ms timer is still running and will time out if too many attempts are required to lock on track. The M.P. stops the 10 ms timer if on-track for more than 1.2 ms.

NOTE 3. In the event of a malfunction affecting the units ability to get and stay on track center, operation could conceivably never get past here, in which case the 80 ms (seek operation) or 300 ms (RTZ or head load operation) timeout could occur. See Note 4.

NOTE 4. Operation must reach this point before the 80 ms (seek) or 300 ms (RTZ or Head Load) timeout occurs or operation goes to the "Seek Timeout Sequence" in Figure 4-23.

NOTE 5. A seek error could have occurred previous to this point due to a timeout of one of the timers during the seek, or an error could occur due to the failure to stay on track once having reached track center. See Note 6.

NOTE 6. The servo system continually works to keep the heads of the selected volume on track center. If the heads stay on track center the 1200 µs counter never times out because the timer is repeatedly initialized before timeout occurs. If the heads get off and don't get back on track center before 1200 µs elapses, a seek error is stored in the M.P. fault storage. The M.P. then goes back to [C] and tries the 10 ms lock-on sequence again. Operation loops continually in the flow enclosed by the dotted lines. This corresponds to the "IDLE" block in Figure 4-16. Operation leaves the Idle phase when an interrupt to the M.P. occurs. The 1200 µs counter operation is suspended until operation returns.

FIGURE 4-24. FINE MODE SEQUENCE FLOW CHART
(SHEET 2 OF 2)

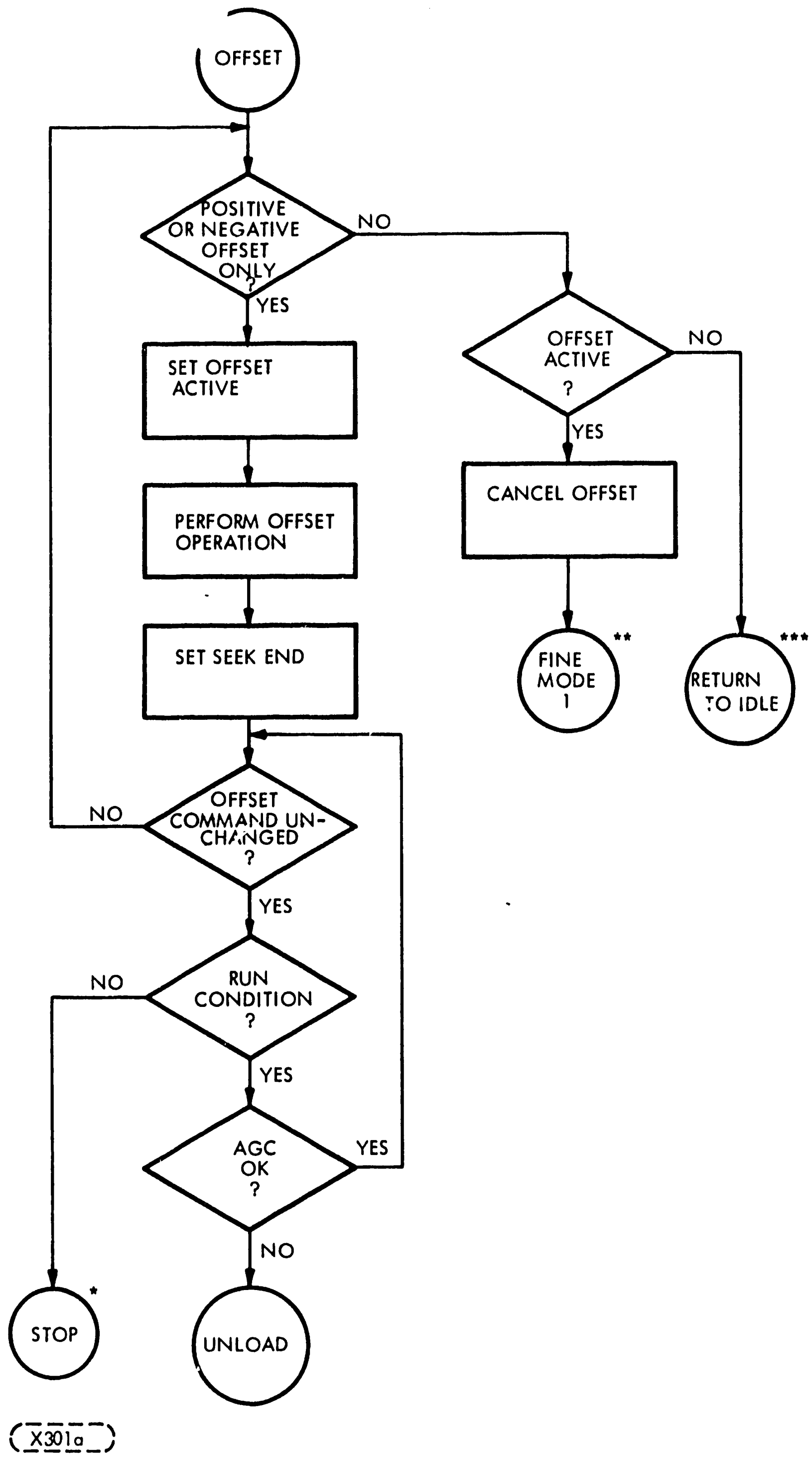


*FIGURE 4-19
**FIGURE 4-24
***FIGURE 4-16

FIGURE 4-25. OFFSET SEQUENCE FLOW CHART

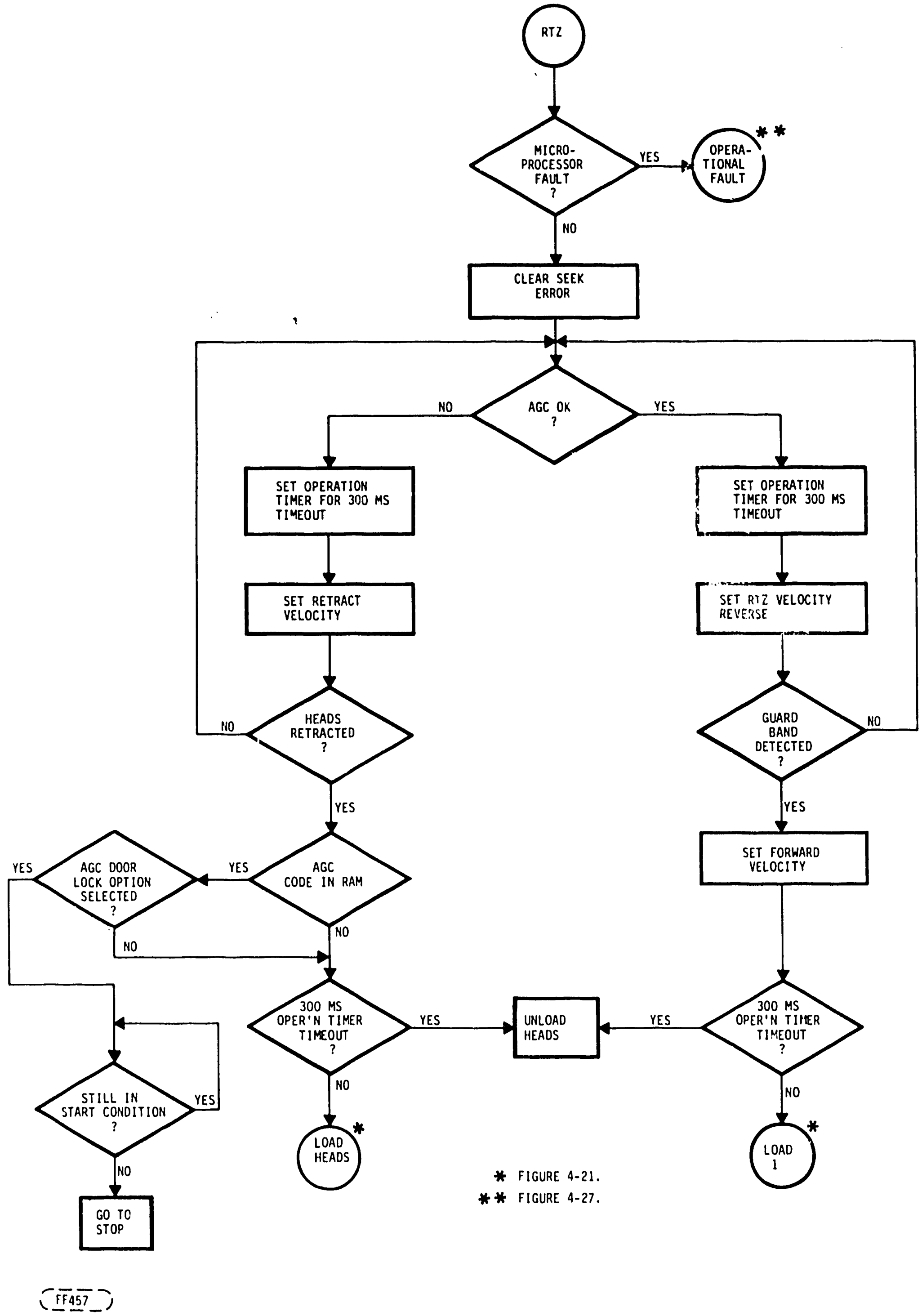


FIGURE 4-26. RTZ SEQUENCE FLOW CHART (SHEET 1 OF 3)

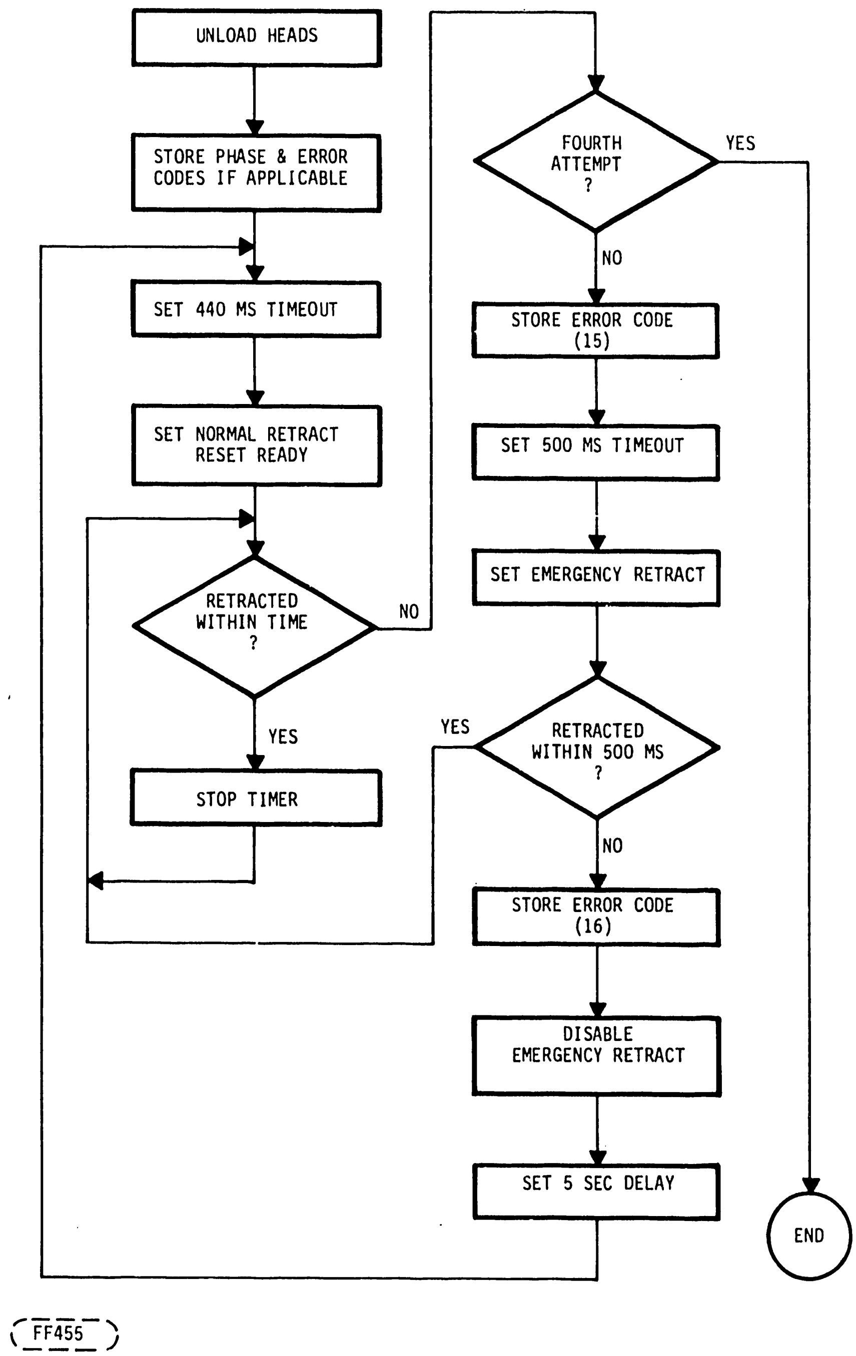


FIGURE 4-26. RTZ SEQUENCE SHOWING HEADS UNLOAD FLOW (SHEET 2 OF 3)

NOTES ON "UNLOAD HEADS" SEQUENCE OF FLOW.

NOTE 1. The code indicating the phase of operation where the error occurred and the error code are given in Table 6-7 in Section 6.

NOTE 2. During the wait for "Heads Retracted" condition the two time-out sequences "A" and "B" will also occur alternately if retract cannot be accomplished. (See Notes 3 and 4 below.)

NOTE 3. If the 440 ms time-out occurs flow sequence "A" takes place during the wait for the heads to become fully retracted. The error code denoting the time-out (see Table 6-7) is stored, a 500 ms time-out is set and the emergency retract is set. Operation returns to the "HEADS RETRACTED?" state. Flow sequence "A" also applies if the 5 second time-out occurs (see Note 4 below).

NOTE 4. When the 500 ms time-out occurs the flow sequence "B" takes place during the wait for the heads to become fully retracted. The applicable error code is set (see Table 6-7), the emergency retract is disabled (to prevent 100% duty cycle of the power applied for emergency retract), and a 5 second time-out is set up. Operation returns to the "HEADS RETRACTED?" state.

NOTE 5. When the "Heads Retracted" condition is detected the timers (set for the time-outs shown) will be stopped.

FIGURE 4-26. RTZ SEQUENCE SHOWING HEADS UNLOAD FLOW
(SHEET 3 OF 3)

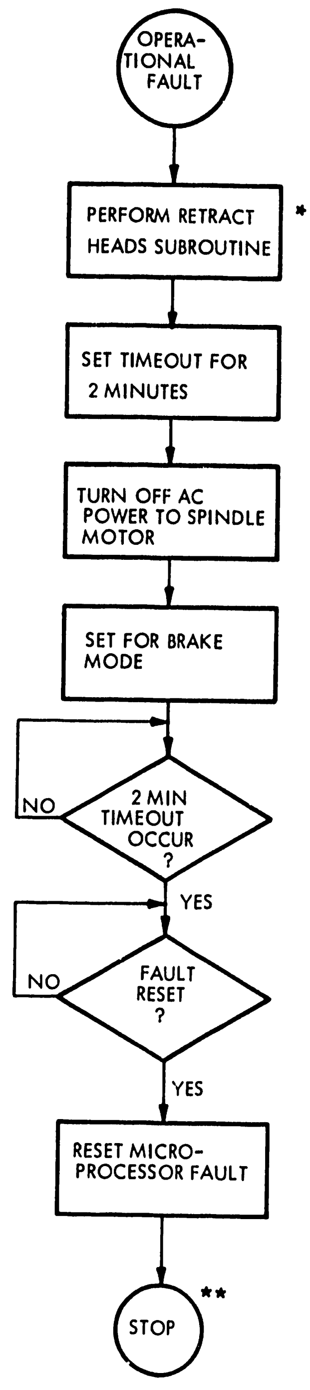


*FIGURE 4-19

FIGURE 4-27. OPERATIONAL FAULT SEQUENCE FLOW CHART

4.3.5 SEEK OPERATIONS

4.3.5.1 GENERAL

Seek operations are performed by the positioning servo system of the CMD which is made up of both digital and analog circuitry. The details of most of the digital portion are covered in Sections 4.3.3 and 4.3.4 which describe the microprocessor and auxiliary digital circuits. This section discusses mostly the operation of the analog portions with occasional references to microprocessor and other digital circuitry where applicable. Certain functions related to but not directly involved in positioning will also be described in this section.

The positioning servo system of the CMD is a closed loop servo system containing a position loop, a velocity loop, an acceleration loop and a compensation loop. Figure 4-28 is a very simplified block diagram of the CMD servo system. The compensation loop is not shown for simplicity. The velocity and acceleration loops are analog while the position loop is a combination of digital and analog circuitry.

4.3.5.2 SIMPLIFIED POSITIONING OPERATION

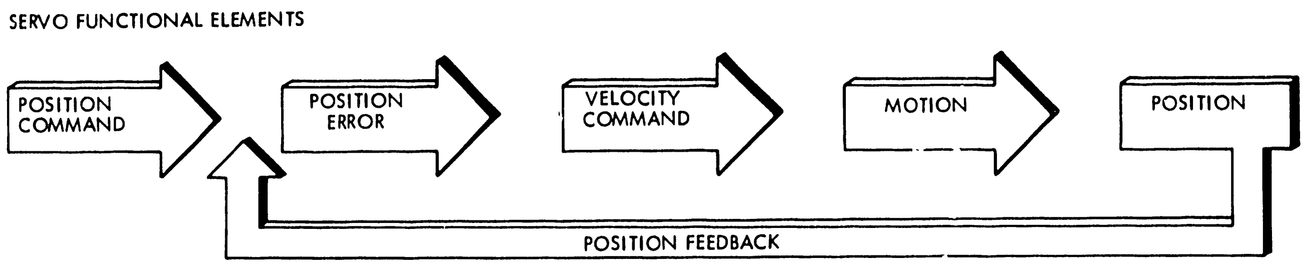
This section gives a simplified, overall description of the operation of the positioning servo system.

1. The positioning operation begins when the system controller communicates a SEEK command to the CMD. The CMD microprocessor receives the SEEK command and initiates and controls the positioning operation. There are also times when the microprocessor initiates a positioning operation without being commanded to do so by the system controller.
2. The microprocessor calculates the number of cylinders to be traversed during the positioning action by comparing the present cylinder number (stored in M.P. memory) with the destination cylinder number.
3. The microprocessor searches a table of velocity profiles for the correct velocity profile required for the commanded repositioning, and for the correct entry point into the table.
4. The digital (binary) number representing the initial velocity is taken from the velocity profile table and converted to an analog voltage in a digital-to-analog (D/A) converter.
5. The digital to analog converter output voltage is amplified and applied to the voice coil linear positioner.
6. The positioner begins moving toward the location of the destination cylinder.
7. An analog voltage proportional to positioner acceleration is fed back to provide the proper acceleration profile to the positioner.

8. A velocity transducer (see Section 4.2.5.2) senses the positioner velocity and feeds back a voltage proportional to velocity. This velocity feedback is subtracted from the positioning voltage applied from the D/A converter (item 4 above) creating a "following error" signal which continues to provide drive to the voice coil.
9. The positioner ceases accelerating when the desired "initial" velocity is reached and continues at the "initial" velocity until the microprocessor commands a change in velocity.
10. The position loop provides head positioning information to the positioning servo system. The positioning information includes the following:

    a. A signal that indicates the displacement of the heads from their nominal track centerline.
    b. Cylinder pulses during seeks to indicate each cylinder crossing.
    c. Signals that indicate that the position of the heads is outside of the region of the normal data cylinders.

    Information for the position loop is derived from the track servo head (Figure 4-31) which is physically similar to a data read/write head, except that it does not write. The track servo head reads information known as "dibits" from the servo track surface of the disk. "dibit" is a shortened term for dipole bit.
11. The microprocessor and associated digital circuits monitor position and number of tracks traversed using cylinder crossing information and change the velocity number in the D/A converter as required to provide the proper velocity profile for the positioning action in process. Figure 4-29 shows a velocity profile for a long seek. Every operation is made up of one or more of the distance/velocity segments like those shown in the expanded section.
12. When the positioning operation is completed to less than one cylinder away from the destination cylinder operation enters what is called the servo fine mode. In the servo fine mode fine position feedback derived from the track servo signal is switched in to bring the heads on track. The microprocessor monitors the time required to complete the seek and signals a seek error if the seek is not completed in time or if the heads do not stay on track when the track is reached.
13. The fine mode positioning circuit remains active following completion of a seek. If the servo head drifts off of its centered position, the track servo signal will no longer be at a null. The signal, functioning as the fine position analog signal acts as a position error signal to drive the positioner back into position.



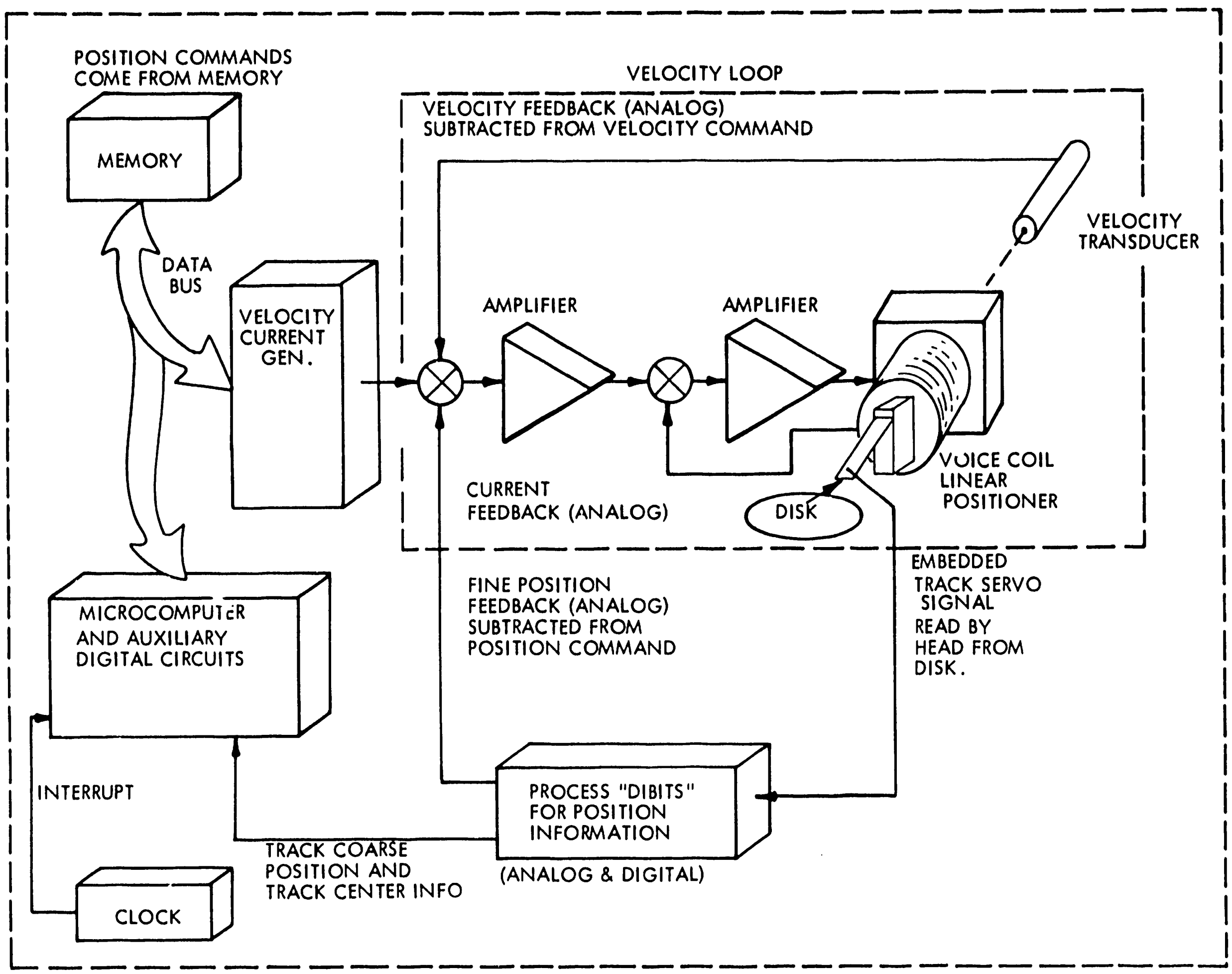


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FIGURE 4-28. SERVO SYSTEM GENERAL BLOCK DIAGRAM

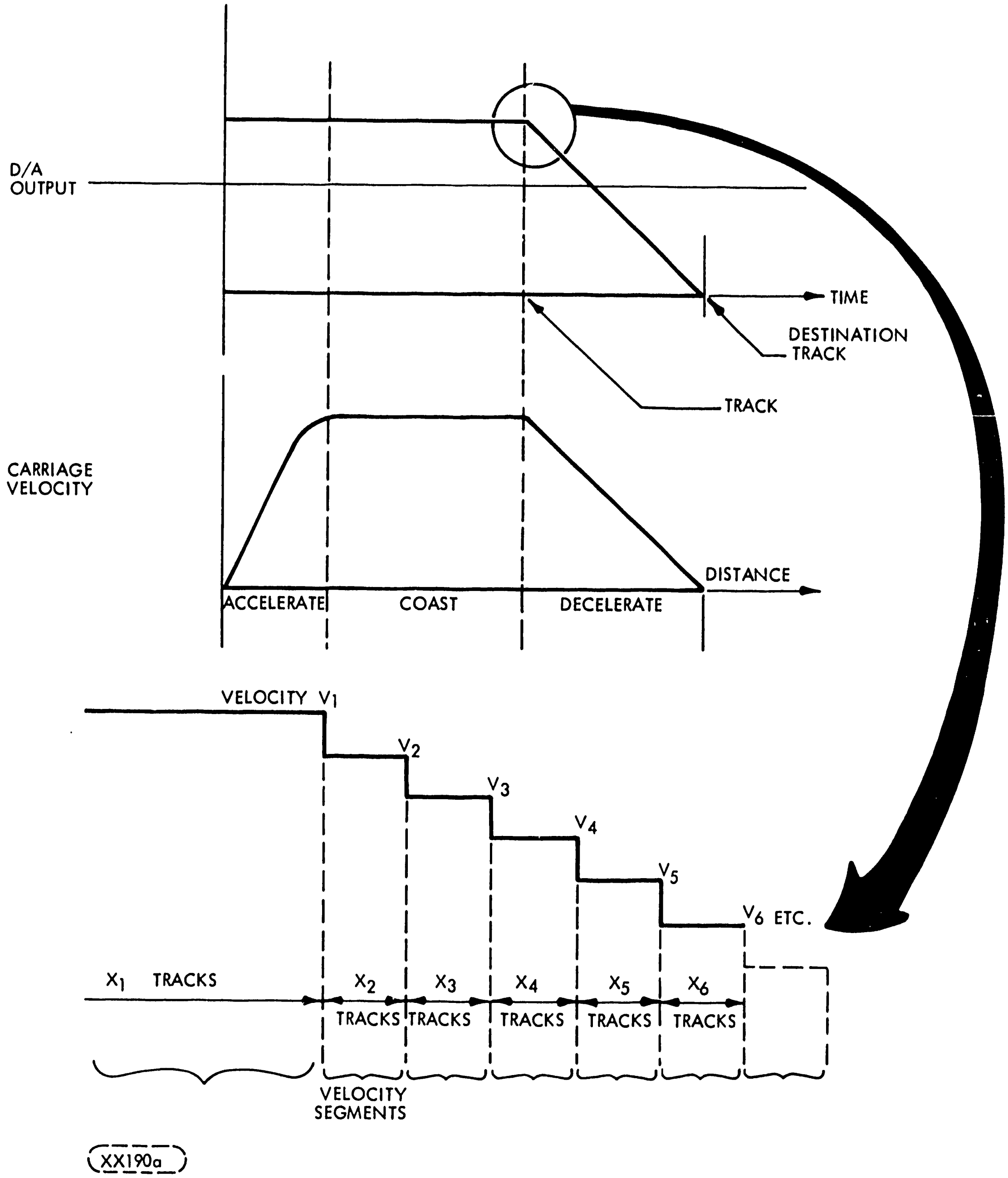


FIGURE 4-29. SEEK VELOCITY PROFILE

4.3.5.3 DETAILED POSITIONING SYSTEM THEORY OF OPERATION

POSITION LOOP DETAILS

The source of positioning information for the position loop is the servo surface of each disk module.

The servo head reads information from the servo track surface of the disk module. This information is known as dibits; dibit is a shortened term for dipole bit. Dibits are prerecorded on the servo surface during manufacture of the disk module. Do not confuse the servo surface with the other five disk module recording surfaces.

Dibits are the result of the manner in which flux reversals are recorded on the servo tracks. One type of track, known as the Even track, contains negative dibits. The other track, the Odd track, contains positive dibits. A positive dibit consists of a positivegoing waveform immediately followed by a negative-going waveform. On the other hand, a negative dibit consists of a negative-going waveform followed immediately by a positive-going waveform.

The "TP-13" waveform in Figure 4-30 shows an example of the odd and even dibit waveforms resulting from an "on track" position of the servo head. Figure 4-32 shows the dibit waveforms with the positioner in motion across a track center.

There are 883 dibit tracks on the servo surface. At the outer edge of the surface is a band of 24 positive dibit tracks. This area is the Reverse End of Travel (EOT) or outer guard band. Then, there are 823 servo tracks alternately recorded with negative and positive dibits. Finally, toward the inner edge of the pack, there are 36 tracks containing only negative dibits. There is the Forward EOT or inner guard band.

When the read/write heads are located at the centerline of a data track, the track servo head is actually centered between two of the prerecorded servo tracks and is reading an edge of each. The detected signal is a mixture of the two adjacent dibit signals. The amplitude of each dibit component is proportional to the read coil overlap of the recorded servo tracks. With the head centered, the amplitudes of the two types of dibits are equal. As the head moves away from its centered position, the amplitude of one dibit component increases while the other decreases. This produces an error voltage used for fine positioning called the track servo signal.

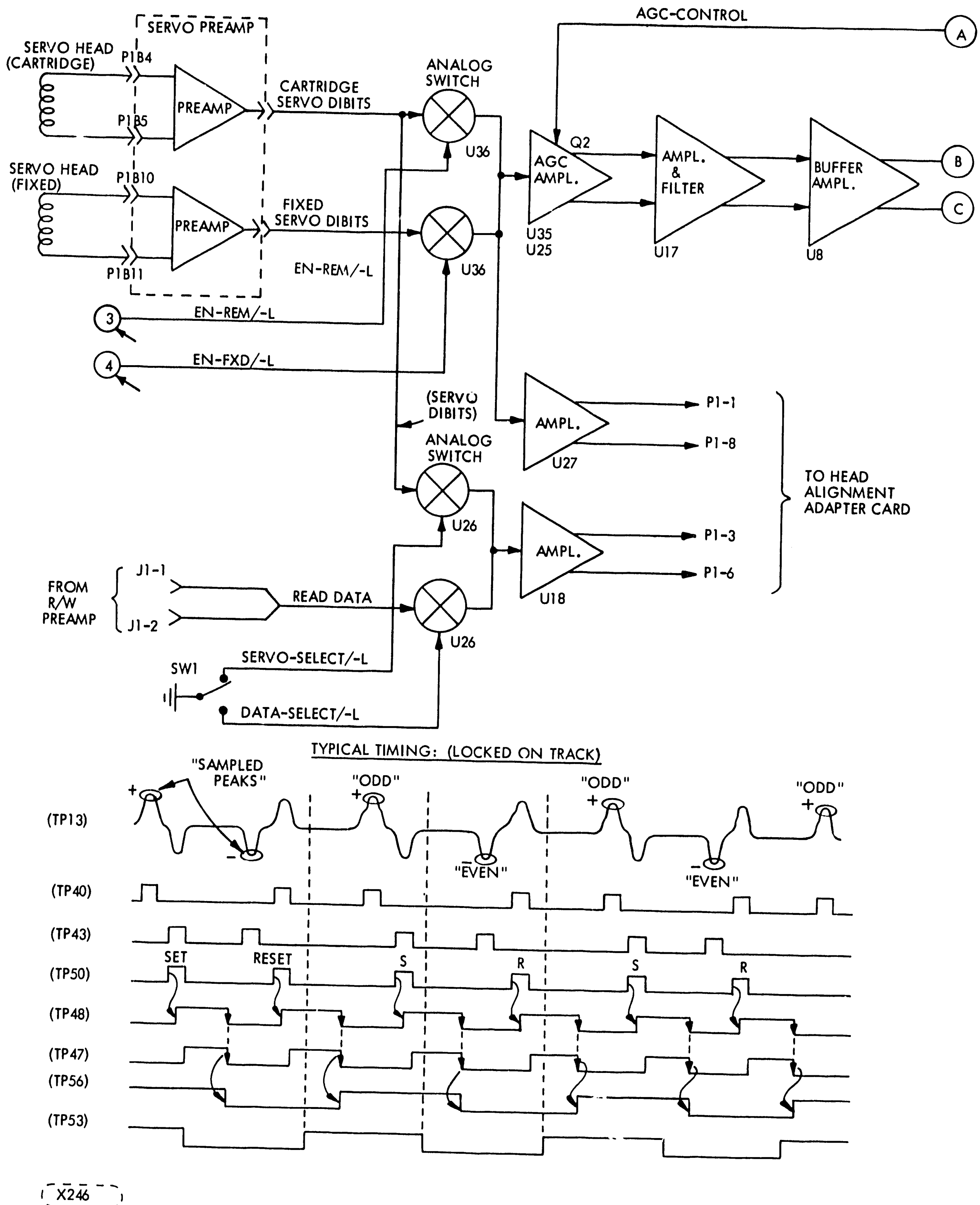


FIGURE 4-30. BLOCK DIAGRAM OF SERVO FINE CIRCUITRY
(SHEET 1 OF 2)

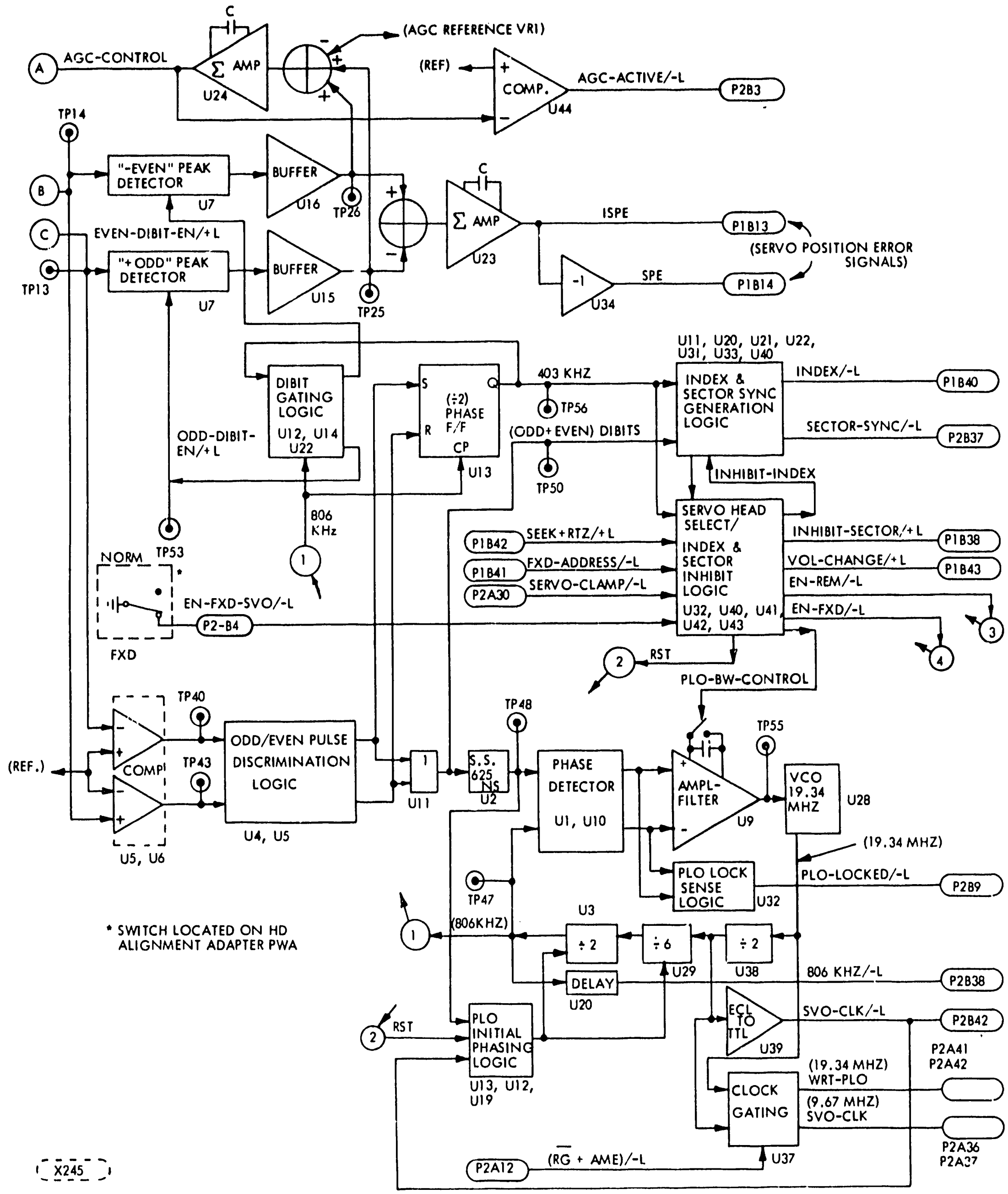


FIGURE 4-30. BLOCK DIAGRAM OF SERVO FINE CIRCUITRY
(SHEET 2 OF 2)

TRACK SERVO SIGNAL

The track servo signal indicates the displacement of the servo head from the on-track position. When the head is centered between dibit tracks, this signal is at a null. It swings in the positive direction when the amplitude of the even (negative) dibits being sensed exceeds the amplitude of the odd (positive) dibits, and vice-versa. Amplitude is maximum when the head is centered over one dibit track, that is, the head is at its maximum distance from the centerline of the data track.

The servo signal is generated by the peak detectors that monitor their respective dibits. If the positive dibit amplitude exceeds the negative dibit amplitude, the output of the + dibits peak detector is greater than that of the dibits peak detector. The outputs of these two detectors are applied to a summing amplifier whose output represents the distance between the two detector outputs. This output is the track servo signal. The signal is at its maximum negative value when the servo head is positioned over the outer guard band or over one of the odd dibit tracks. It is at its maximum positive value when the servo head is positioned over the inner guard band or over one of the even dibit tracks.

The track servo signal is applied to the servo circuit and to the cylinder detect circuit. In the servo circuit, it is used to generate the fine position analog signal that controls movement during the last one half track of a seek or during a Load sequence. The cylinder detect circuit generates cylinder passes as the track servo signal approaches a null.

The track servo circuit remains active following completion of a seek. If the servo head drifts off of its centered position, the track servo signal will no longer be at null. The signal, functioning as the fine position analog signal within the servo circuit, will act as a position error signal to drive the positioner back into position.

Circuit gain control is achieved by applying the outputs from the peak detectors to a second summing amplifier. Its output is negative and is proportion to signal strength: the stronger the signal, the less negative the AGC voltage. The signal is applied to the AGC amplifier to control the resistance of a FET within the amplifier. The FET is connected across the differential inputs to the amplifier. The less negative the AGC, the less the resistance; therefore, more of the signal is shunted by the FET to reduce circuit gain.

END OF TRAVEL DETECTION

The reverse end of travel circuit provides the information to the M.P. that the selected servo head has moved in reverse direction behind CYL 0 (into the outer guard band). This information (REOT/-L) issued by the M.P. during the Return to Zero (RTZ) operation only.

CYLINDER PULSE GENERATION

As the servo head crosses the interface of the even/odd dibit tracks (Figure 4-31), the servo signal decreases toward null. Voltage comparator circuits which switch their output states slightly before and slightly after the null, feed a Schmidt trigger circuit that generates a narrow pulse spanning the null at the track center.

This track center pulse generates the cylinder pulses which the microprocessor counts in keeping track of the actuator location.

4.3.5.4 DETAILED POSITIONING THEORY OF OPERATION

This section will be divided into two parts: operation of the Servo-Fine PWA and operation of the Servo-Coarse PWA.

A SERVO-FINE PWA OPERATION

The Servo-Fine PWA circuitry provides the following signals which are used in other places within the CMD:

- Various clocks generated by the phase locked loop circuitry
- Servo position error signals
- End-of-travel information (AGC active/not active)
- Index pulse and sector sync and inhibit logic signals
- Volume selection signals
- Head Alignment signals.

For aid in understanding the following description of the Servo-Fine operation, refer to Figures 4-30, 4-31 and 4-32, and schematic diagram Figure 5-7. Figure 4-1 also contains some helpful information, though of a more general nature. The general relationship of the Servo-Fine functions to those of the Servo-Coarse are shown in the block diagram of the Servo-Coarse analog circuits in Figures 4-30 and 4-34.

INPUT CIRCUITRY

The dibit signals read from the servo heads are boosted in amplitude by the servo preamplifiers on the Servo Preamp PWA and then input to the Servo-Fine PWA. Analog switches controlled by the servo head select logic, select either the cartridge servo signal or the fixed disk module servo signal to be processed. The selected servo signal is fed to amplifier U35 and then to U25 which has an FET transistor across its differential input terminals. The negative AGC voltage is applied to the gate of the FET to control the resistance from source to drain. The less negative the AGC voltage the less the resistance is resulting in shunting more of the incoming signal from the inputs of U25. The stronger the signal at the input to U24 the less negative the AGC voltage. The output of U25 is fed to a differential amplifier/filter network (U17) to increase signal level, common mode rejection capability, and reject high frequency noise. The double emitter follower circuit U8 buffers the signal from U17 and then the differential dibit signal from U8 branches two ways at TP13 and TP14. One branch drives circuitry which creates the Servo Position Error signal (SPE, ISPE) and the other branch provides the reference signal for the Phase Locked Loop (PLL) circuits. The PLL operation will be described first.

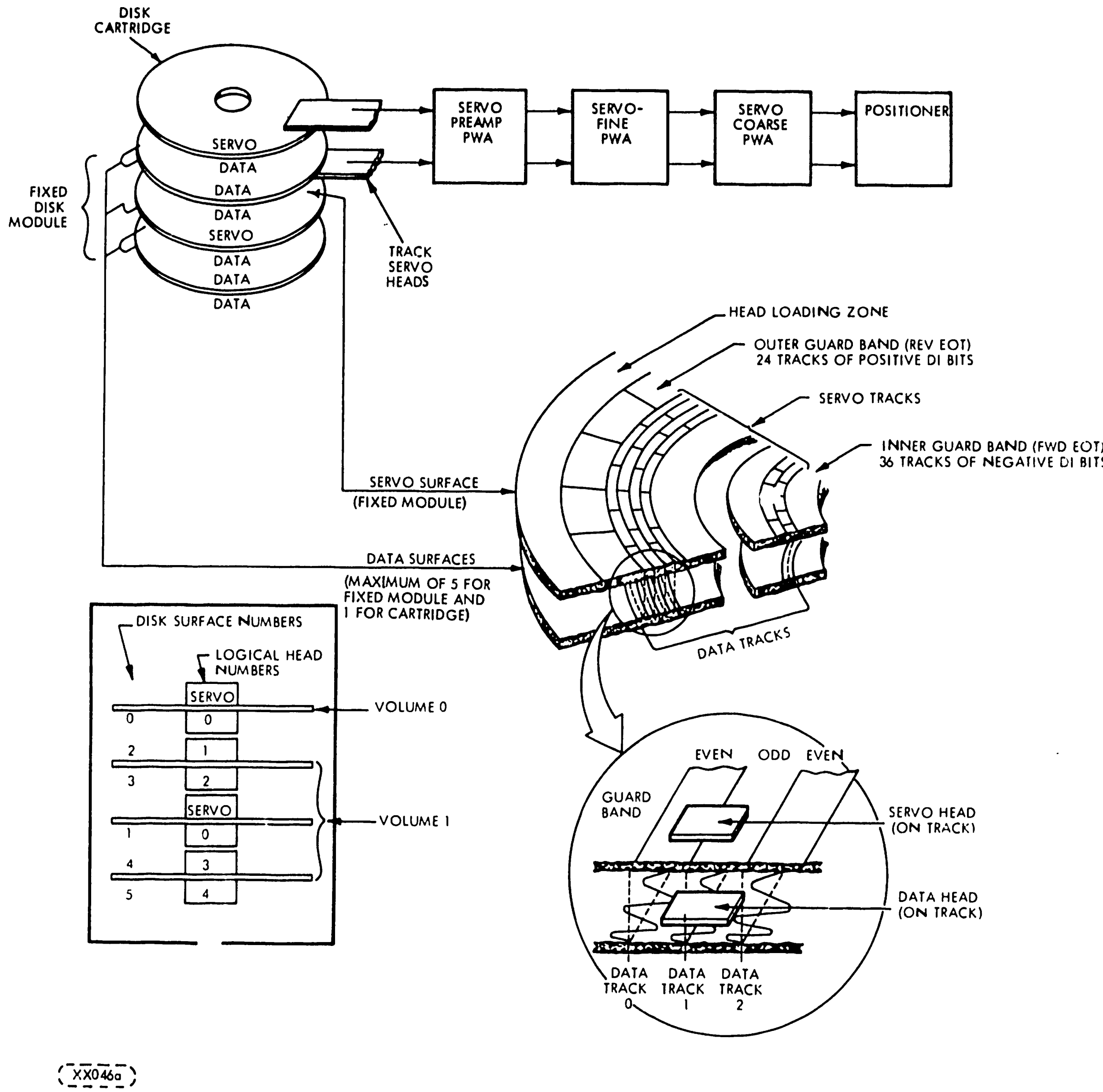


FIGURE 4-31. TRACK AND SERVO DISK LAYOUT

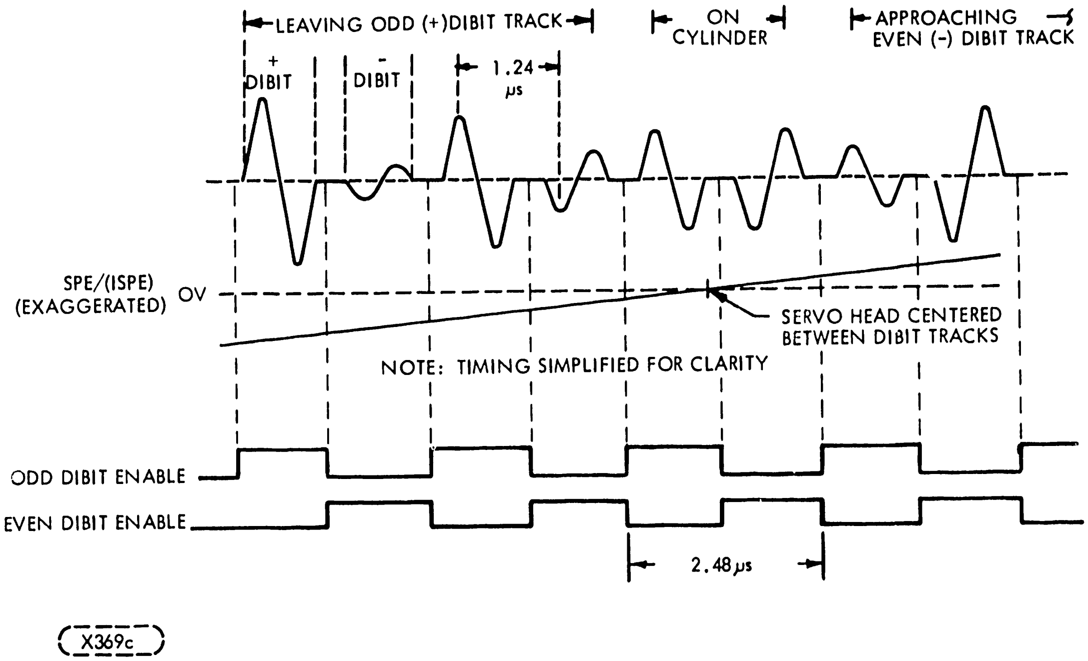


FIGURE 4-32. SERVO SYSTEM WAVEFORMS - POSITIONER IN MOTION

PHASE LOCKED LOOP CIRCUITS

The nominal frequency of the clock generated from the servo dibits is 806 kHz; however, the actual frequency is a function of the spindle motor speed. The phase locked loop PLL in the clock circuit synchronizes itself to the actual dibit rate. This permits the clock to react to variations in spindle speed. Signals derived from this circuit, such as servo clock (SVO-CLK/-L) are a function of actual spindle speed rather than functions of an absolute time base, and therefore bit density is independent of disk speed.

A pair of level comparators (U6) using a reference threshold converts the dibit signals into aperiodic digital signals. Refer to the TP40 and TP43 waveforms in the timing diagram of Figure 4-30. Alternate pulse discrimination logic (U4, U5) changes the two aperiodic signals to a periodic signal ODD + EVEN/+L (which can be seen at T.P.50). ODD + EVEN/+L is a pulse signal at 806 kHz if the servo is locked on track as shown in Figure 4-30. As the servo head moves towards an "odd dibit" or "even dibit" track, the corresponding pair of dibits increase in amplitude, resulting in a simultaneous decrease in the other pair of dibits. Figure 4-32 illustrates this. The signal at TP50 changes to 403 kHz as alternate dibit pairs fall below the comparator threshold. ODD + EVEN/+L drives the logic which creates the Index and Sector Sync signals and provides the PLL input to which the Phase Lock Oscillator (PLO) U28 must lock.

The Index and Sector Sync logic will be described in a section following this. Single Shot U2 stretches ODD + EVEN/+L to 625 ns and drives the Phase detector logic (U1, U10) and the PLO initial Phasing Logic (1/2 U12, 1/2 U13 and U19) with it. The 625 ns pulse can be seen on TP48. The phase difference between the 806 kHz which originated at the VCO (U28) and the signal at TP48 is detected by the logic of U1 and changed to a DC control voltage (TP55) by the current pump amplifier and filter made up of circuit elements U9, C64, C65, R83, R78 and R99. The control voltage controls the frequency of the voltage controlled oscillator (VCO) U28 by means of VVC1 which is a voltage variable capacitor. The nominal frequency of the VCO is 19.34 MHz. The VCO output is buffered in U37 and transmitted to the Read/Write PWA as the WRT-PLO signal (P2A40, P2A41) which is used as the write clock reference. Flip-flop U38 divides the VCO signal by two, converts it to TTL logic (U39) and goes over the interface to the controller as SVO-CLK/-L (P2B42). Counter U29 divides the U38 output by six and then one flip-flop in U3 divides the result by two again to produce the 806 kHz squarewave feedback signal (TP47) which is the VCO derived input to the phase detector mentioned above. Note that the PLL accepts both 403 kHz and 806 kHz inputs (TP48) and provides a phaselocked 806 kHz output (TP48).

SERVO POSITION ERROR SIGNALS

Flip-flop U22 delays the 403 kHz clock (TP56) and the resulting signal synchronously gates ODD-DIBIT-EN/+1 (TP53) and EVEN-DIBIT-EN/+L in the peak detector U7. The peak detector circuits store the peak level of their respective "odd" or "even" dibit signals in capacitors C37 and C20. The peak values are discharged at a constant rate through resistors R18 and R22 to facilitate "new sample" storage and hence a tracking demodulated envelope signal as the servo head slews across the disk and passes alternately across even and odd dibit tracks. The peak detector outputs are buffered in unity gain operational amplifiers (U15 and U16) and fed to the differential operational amplifier U23 to produce the position error signal SPE and its inverse ISPE. The Servo-Coarse PWA uses the two error signals as position control signals in the servo loop and generates cylinder pulses from the PSE and the velocity signal.

AGC CONTROL SIGNALS

For AGC control the buffered peak detector output (TP25 and TP26) are summed and compared to a DC reference (VR1) in operational amplifier U24 whose output is the AGC CONTROL signal (TP9). AGC CONTROL changes the source-to-drain resistance of Q2 at the input of U25. Comparator U44 compares AGC CONTROL with a reference voltage and produces a logic level at 0 volts when the selected servo head reads servo dibits on the disk. This output of U44 is the AGC-ACTIVE/-L signal sent to the Servo-Coarse PWA (P2B03). The microprocessor uses AGC-ACTIVE/-L as an indication of end-of-travel.

INDEX PULSE AND SECTOR SYNC AND INHIBIT

The Index pulse is derived from an index pattern read from the servo tracks. The index pattern is a specific sequence of missing "odd dibit" and "even dibit" pairs encoded on both odd and even dibit tracks in such a way that the pattern is detected once per revolution of the disk. Even when the servo head slews across the tracks the logic detects the index pattern uninterrupted. The index pattern detected logic performs as follows. The 403 kHz clock (TP56) serves as a reference and retimes the ODD + EVEN/-L signal in flip-flop U22, thus establishing a "recovery window" for the index pattern. The 403 kHz clock then shifts the index data on U22 pin 5 through the shift register U21. When the binary code in the shift register is (starting with pin 12 and going to pin 3) 1010110, then the binary code in the "A" side of comparator U31 will equal the code on side "B". "B" is wired in as 00110 (MSB to LSB). A seven bit comparator is formed by using the "1" bits in the shift register which output on pins 10 and 12 to enable the comparator via NAND gate U20. The comparator output is clocked into flip-flop U33 to provide spike free Index and Sectors Sync signals (P1B40, P2B37). The Sector Sync signal is identical to the Index signal except that the former occurs 1.24 ns earlier than the latter. INDEX/-L, SECTOR-SYNC/-L and 806 kHz/-L are transmitted to the Servo-Coarse PWA where a programmable counter uses them to generate sector pulses.

If a Sector Sync or Index decode is in progress and a volume change is required, the volume change is delayed until the Sector Sync and Index are fully decoded. Any subsequent Sector Sync or Index decode is inhibited until the "new" volume servo head has been selected and the PLL is stabilized. Timing waveforms illustrating these conditions are shown in Section 5-7.

VOLUME SELECTION

The fixed volume servo head is selected when the signal FXD-ADD/-L (P1B41) is at a logic low level and the SVO-CLAMP/-L (P2A30) signal is received from the Servo Coarse PWA. The head select level is stored in flip-flop U41 and compared to the level of FXD-ADD/-L in an exclusive OR circuit (U42). VOL-CHANGE/-L is active low when FXD-ADD/-L and SVO-CLAMP/-L are logic complements of each other (01 or 10). In addition to servo head selection, the SVO-CLAMP/-L signal triggers two single-shot circuits (U30), one of which conditions the PLL filter for a wide band mode of operation, and the other initializes PLL feedback counter U29 for a fast lock up.

HEAD ALIGNMENT SIGNALS

Head alignment requires buffered read data and servo track signals and these are supplied by the amplifiers U18 and U27 respectively. Analog switches (U36) switch the servo signal input to U27 between the cartridge and fixed module signals. The switching control signals EN-REM/-L and EN-FXD/-L come from gate and inverter U32 and U43, but the gate inputs come from the volume selection logic described above and from a switch on the Head Alignment Adapter PWA. The input to the read amplifier U18 is switched at analog switch U26 between servo data from the cartridge disk and read/write preamp. The switching control is SW1 on the Servo-Fine PWA. Section 6, Maintenance, describes the use of the head alignment signals described here.

B-SERVO-COARSE PWA OPERATION

The Servo-Coarse PWA provides the following circuit functional groups: (Refer to Figure 4-34.)

- Position velocity and offset command generation
- Actuator drive circuitry
- Servo system velocity feedback circuitry
- Servo system acceleration feedback circuitry
- Actuator retract (unload heads) circuitry
- Compensation circuitry
- Track center detection circuitry
- Cylinder pulse generation circuitry
- End-of-travel detection circuitry
- Spin speed pulse generation circuitry

The details of the first item above were described in detail in Section 4.3.3 and 4.3.4 "Microprocessor Functions", and will not be described here. Details of the other nine items are described in paragraphs which follow. Refer to Figures 4-33, 4-34 and 5-6 for circuit details.

ACTUATOR DRIVE CIRCUITRY

For purposes of this description the actuator drive circuitry is considered to consist of the Velocity and Position Offset Current Generator, the Summation Amplifier, the 3.8 kHz Notch Filter, the Pre-Driver OP Amp, the Driver Amp and the Power Amp. All but the last named item are located on the Servo-Coarse PWA. The Power Amp is mounted on a PWA on the top of the actuator magnet assembly. In Figure 4-34 all circuitry on sheet 1 of the figure is on the Servo-Coarse PWA.

The Velocity Offset Current Generator is made up of the D/A converter U37, two OP Amps U44, analog switch IC U43 and two gate circuits U24 and U33 on the input lines to U9. The Velocity/Offset Generator provides the input to the servo circuit that drives the actuator to move it to a new position or offset it slightly when on track. Sixteen different levels of velocity can be commanded from the microprocessor by proper activation of the COM-0/+L through COM-6/+L lines to the D/A converter and by choosing between the different resistances on the U44 amplifier output. The least significant bit of the D/A converter is not used to provide greater stability in the low end of the two velocity ranges. Scaling of the D/A output is accomplished at the factory by selecting the value of test select resistor R1 which provides a maximum output of 10.14 volts at TP-7.In operation precision resistor R39 is connected in parallel with R41 by analog switch U43-9, 10, 11 to provide the higher velocities of the 16 velocities that the Velocity Offset Generator commands. HI-COM/-L when active low closes the analog switch U43-10, 11 to allow a higher range of currents to be input to the summing amplifier U48. The velocity/offset current generator can be commanded (COM-0/+L thru COM-6/+L and HI-COM/-L) to inject current to offset the actuator a predetermined distance from the track center position where the servo head locates the nulled SPE signal. The direction of the offset is determined by FWD-SK-OFFSET+/-L (U24-13). A positive offset (U24-13 Low) places the heads closer to the spindle center.

The controller commands this capability in an attempt to recover data that is slightly off track. Analog switches U43-3 and U43-6, operated by FWD-SK-OFFSET+/-L, decide the input configuration of OP Amp U44-7; R32 either has ground on it or the output of OP Amp U44-1. The latter condition provides a positive drive to the summing amplifier U48. U44-7 is a unity gain amplifier which inverts or does not invert the drive signal, depending on whether analog switch U43-3 is open or closed. U43-14 attenuates the drive signal if the +5 volts is lost. Summing Amplifier U48 sums all of the signals which combine to create the signal which positions the actuator.

If the velocity feedback is lost, the additional position loop gain tends to make the servo system oscillatory.

Amplifier U47-14 supplies current to drive the two transistors Q1 and Q2 which drive the power amplifier on the Power Amp PWA. U47-14 sums the signal from a notch filter and the voice coil current feedback from differential amplifier U10-8. The power amplifier on the Power Amp PWA drives the voice coil actuator when connected SVO-RDY/-L when active low causes the relay driver amplifier on the Relay Control PWA to pull in the contacts of relay K2.

SERVO SYSTEM VELOCITY FEEDBACK CIRCUITRY

The velocity transducer described in paragraph 4.2.5.2 produces a voltage proportional to the velocity of the actuator. Tachometer Amplifier U50 amplifies the velocity signal with a gain that is controlled by the variable resistor R7. Paragraph 6.8.5.2 describes the procedure for adjusting the velocity gain and something of the theory of operation involved.

Amplifier U50 feeds back the velocity signal into the actuator drive circuitry at the summing node before amplifier U48.The velocity feedback subtracts from the commanded velocity drive signal and when the actuator velocity has reached the commanded velocity there is not enough actuator drive to cause an increase in velocity. A small amount of drive (called "steady-state error") remains to overcome system losses while the actuator moves at the commanded velocity. The velocity feedback acts to dampen possible overshoot when the Velocity Offset Current Generator makes changes in the commanded velocity, and also reduces the steady state velocity lag error. A quicker and smoother response to velocity step changes results.

SERVO SYSTEM ACCELERATION FEEDBACK CIRCUITRY

A large power resistor R1 (Figure 5-17) in series with the voice coil feeds back a voltage that is proportional to the current in the voice coil. This voltage is amplified by amplifier U47 and summed in with the actuator drive signal at a summing junction between the 3.8 kHz notch filter and another amplifier, also in U47. This voice coil current feedback is nearly proportional to the acceleration of the actuator and acts in the servo system to alter the apparent inertia of the system and thus improve transient response characteristics. It also decreases the dead band nonlinearity of the power amplifier.

ACTUATOR RETRACT (UNLOAD HEADS) CIRCUITRY

The Actuator retract circuitry operates in a way that provides a controlled retract current to the actuator voice coil. Proper control of the retracting of the heads prevents head-arm vibration that would cause head to disk contact when the head cam surfaces contact the head unload ramps during retract. Proper control is also needed to prevent the carriage from banging into the stops at the actuator magnet. Programmable OP Amp (U49) controls the retract velocity of the carriage in the following manner. Resistor R98 (on U49, pin 8) programs the quiescent currents within the OP Amp (U49) so that capacitors C69 and C70 can hold enough charge after power is lost to allow retraction to be completed at the proper rate. U49 operates as a velocity reference and compares the velocity signal directly from the Velocity Transducer with the reference voltage at U49-2 and thereby limits the drive current provided to transistor Q4. The amplifier chain Q4 and Q3, and Q1 on the Power Amp PWA will not drive the actuator beyond the proper velocity, but due to the small amount of current C69 and C70 must furnish, the retract velocity is uniform. The main retract power is supplied to Q1 by the energy stored in a large retract capacitor.

The sig' l HD-LOAD-SW/+L switches off the drive to Q4 when the carriage actuates the Heads Loaded switch. The large retract capacitor can then charge to a nominal -31 volts. Compatator U46 detects that the retract capacitor is charged and notifies the Microprocessor with signal UNLOD-VLT/+L. The microprocessor does not allow the heads to be loaded again until UNLOD-VLT/+L shows that the retract capacitor is adequately recharged. A low voltage Zener diode VR1 on the Relay Control PWA will deactivate K2 if the +5 V logic voltage drops. This will cause an emergency retract before the logic voltage drops completely.

COMPENSATION CIRCUITRY

The compensation feedback network around U47, Q1 and Q2 (C8, R6) is essentially a rolloff filter, to control the gain and bandwidth of the current loop and to reduce the deadband nonlinearity of Q1 and Q2.

The U48 feedback network (C36, R3, R124) controls the gain and roll off the velocity loop response a limited amount to aid in attenuating the loop gain at the mechanical resonant frequencies in the carriage and velocity transducer.

Following U47 is an active notch filter, centered at 3.8 kHz. This includes the circuitry from U47-6 to TP6. The notch filter provides additional attenuation of signals in the vicinity of the notch center frequency which otherwise would be greatly accentuated due to the mechanical resonances of the carriage and velocity transducer.

The 60 Hz Runout Compensation circuit consisting of U44, U39 and U45 essentially produces an increase in gain of 5: 1 for the SPE and ISPE signals (switched by U42-6, 14) in the band around 60 Hz. The increase in gain takes effect after the last 1/2 track of a seek operation after track center is first made active. This allows the servo system to remain on track when using a servo signal modulated by an eccentric track caused by mechanical imperfections in disk and spindle. On a machine having a disk rotation of 3600 r/min* eccentricity in the track will pass under the heads 60 times a second, thus causing an amplitude variation in the servo signal that is centered around 60 Hz.

The signal FN-TRK-CEN/+L operates the analog switch U45-6, 7 and U45-14, 15 thereby adding or removing the 60 Hz Runout Compensation circuit in series with the SPE/ISPE signal. When FN-TRK-CEN/+L is high the 60 Hz Runout Compensation is connected in the circuit.

*S1 units, means Revolutions per Minute.

TRACK CENTER DETECTION CIRCUITRY

To generate a pulse at the center of each servo track, two comparators U46 and a schmidt trigger (U39) detect the SPE zero crossings and form a pulse which straddles the zero crossings. The signal produced is TRK-CEN/-L. Each TRK-CEN/-L pulse specifies that the heads are positioned within prescribed offset limits. TRK-CEN/-L assists in generating the data cylinder pulses and goes to the microprocessor on command through PPI #2. To generate TRK-CEN/-L, comparator U46-13 is driven Low (OV) during most of the positive half of SPE and comparator U46-2 is driven Low (OV) during most of the negative half of SPE. The outputs of these two comparators form a "wired OR" gate which produces a narrow positive pulse during the short interval when neither of the two comparators are driven Low. These short intervals occur straddle of the zero crossing points of SPE which represent the center of each servo track. The relationship between SPE and TRK-CEN/-L is shown in Figure 4-35. The Schmidt trigger circuit U39 squares up the pulses and inverts them, thus creating the TRK-CEN/-L signal. The relationship between SPE and TRK-CEN/-L signal. The relationship between SPE and TRK-CEN/-L is shown in Figure 4-33.

CYLINDER PULSE GENERATION CIRCUITRY

The track center signal TRK-CEN/-L resets integrator U47 by closing analog switch U45-10, 11 and shorts VEL to ground using switch U45-2, 3. The integrator U47 integrates the VEL signal (TP3) which represents the head and carriage velocity. Because the integrator is reset by the track center signal, integrated output U47-7 is proportional to the distance traveled by the heads after the track center signal goes false.Comparators U51-13 and U51-2 compare the integrator output level (U47-7) with reference voltages (one for positive going VEL and one for negative going VEL) and switch to low logic output when the heads are nearly midway between adjacent servo track centers (TRK-CEN/-L). The two comparators form a "wire OR" gate which produces the CYL-PUL/-L or Cylinder Pulse signal (TP-15). CYL-PUL/-L remains low from data track center until TRK-CEN/-L resets the integrator U47-7. Figure 4-33 shows the timing relationship of Track Center, integrated velocity, and Cylinder Pulse signals during a forward and reverse head motion seek. For a reverse head motion seek the integrated velocity signal U47-7 is a negative going voltage. It should be noted that regardless of the velocity of the carriage, or whether positive going or negative going, the integrator will integrate to the threshold voltage of the comparators of a point representing the data track center.

The CYL-PUL/-L signal is then sent to a one shot U1-12 to produce 2.5 us pulse for each negative going edge. This shrunk cylinder pulse (TP17) goes to the timer module 8253 (U21) to count down the segment counter.

END-OF-TRAVEL DETECTION CIRCUITRY

There is no special circuit in the CMD for Forward End-of-Travel as that is taken care of by the microprocessor. There is, however, a circuit for Reverse End-of-Travel and it is used during Return to Zero cylinder. The Reverse End-of-Travel signal REV-EOT/+L goes active high (true) after reverse motion of the heads into the outer guard band. This occurs because velocity integrator U47-7 continues integrating beyond the normal voltage level where it would be reset by the TRK-CEN/-L signal, since no track center pulses occur in the guard band regions. Eventually the output of the integrator reaches the negative threshold voltage that will cause the comparator U51-1 to switch from low to active high. The switching of REV-EOT/+L to active high occurs when the selected servo head is approximately 10 mills (0.061 mm) from track zero into the guard band. The microprocessor commands the carriage to move back inward toward track zero and the integrator then integrates positively (it was not reset in the guard band). When the selected servo head reaches servo track zero TRK-CEN/-L resets the integrator as shown in Figure 4-33.

SPIN SPEED PULSE GENERATION CIRCUITRY

The Spin Speed Pulse Generation circuitry consists of an optical sensor which senses the presence of 16 slots in a disk on the bottom of the disk spindle, a comparator and a pulse shrinking circuit. The optical sensor consists of a light emitting diode and a light sensing transistor which senses the infrared light from the diode as the light passes through one of the 16 slots in the slotted disk. Comparator U46-1 squares up the edges of the pulse from the light sensing transistor and sends the pulse (approximately 120 µs wide) (TP16) on to the pulse shrinking circuit made up of U39, U40, U35 and U34 plus the delay filter R110 and C67. This pulse shrinking circuit produces a 1 µs negative going pulse at U34-3 at the point in time when the trailing positive going edge of the 120 µs pulse occurs. See Section 6.8.4 for specification on this pulse. The 1 µs pulse is made available for use by the microprocessor through the port U27.

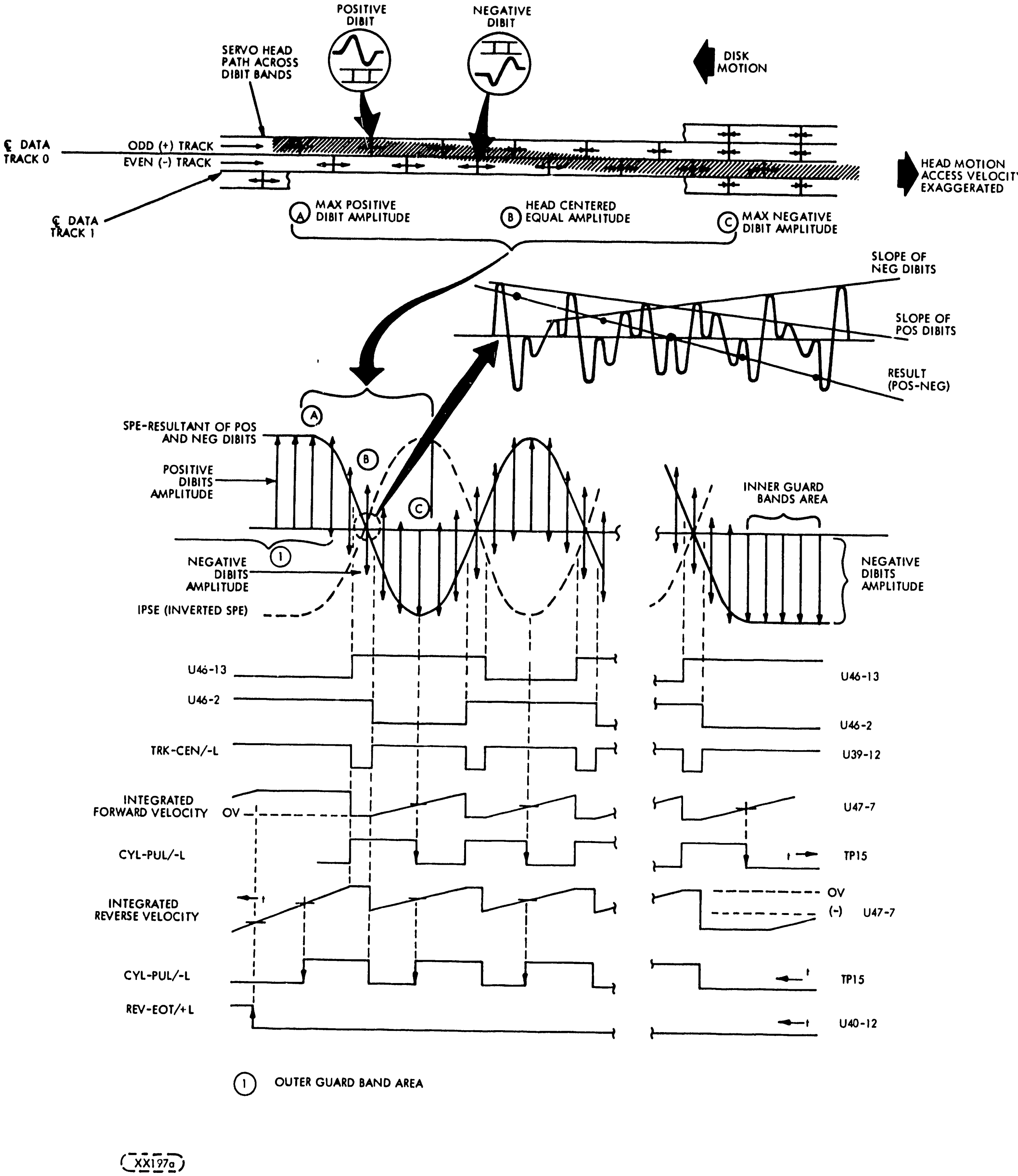


FIGURE 4-33. TRACK CENTER AND CYLINDER PULSE GENERATION

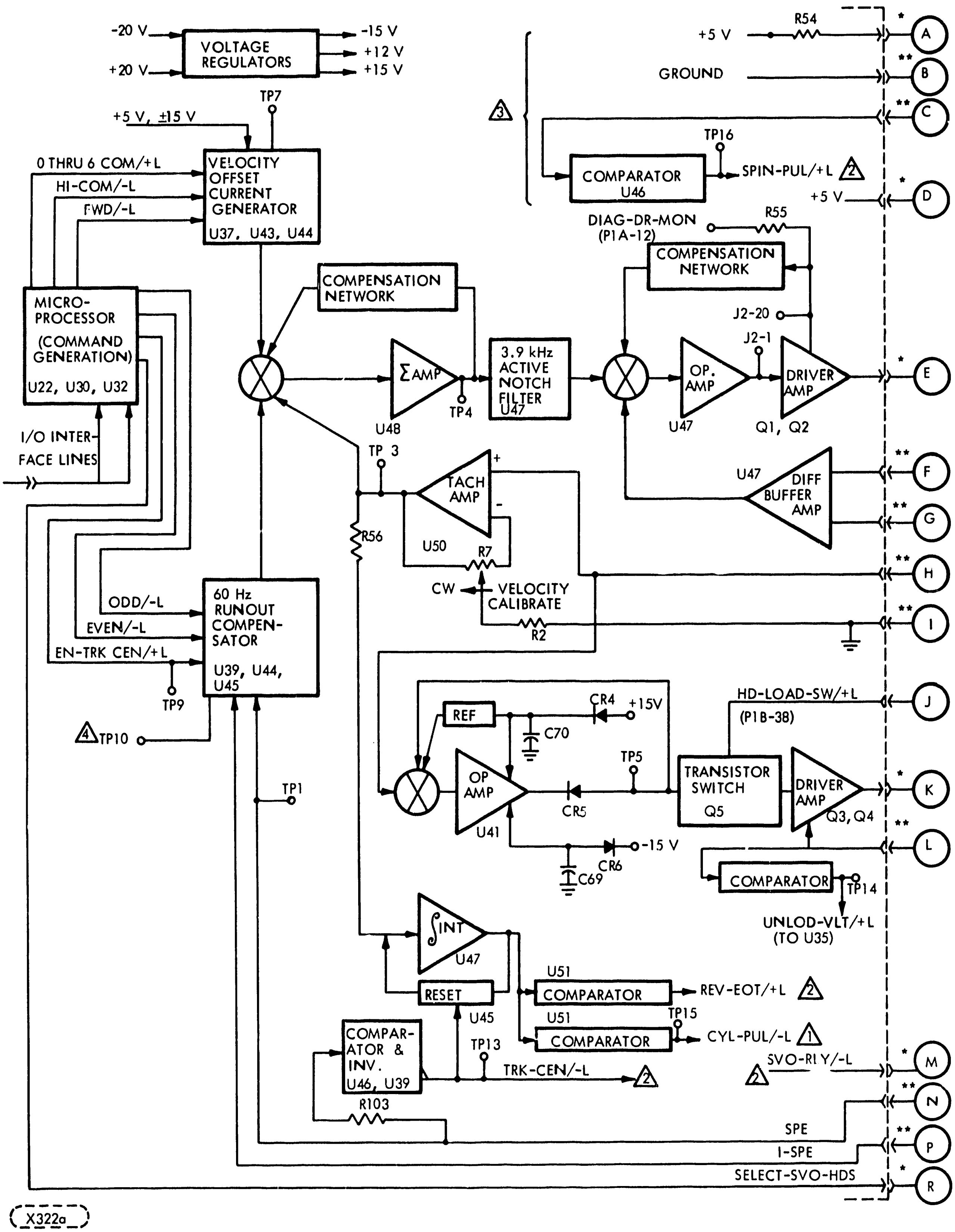


FIGURE 4-34. BLOCK DIAGRAM OF ANALOG PORTIONS OF SERVO SYSTEM
(SHEET 1 OF 3)

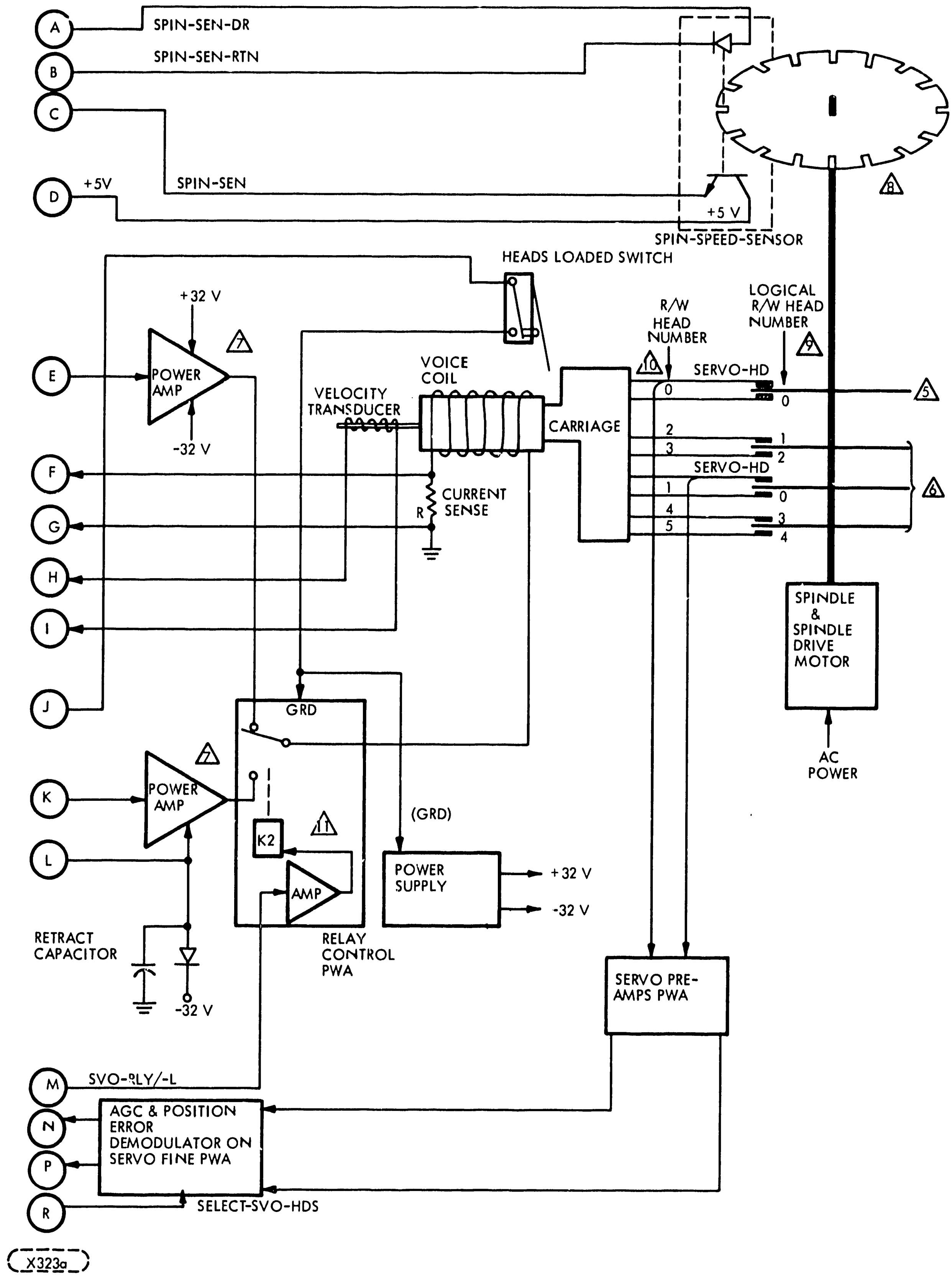


FIGURE 4-34. BLOCK DIAGRAM OF ANALOG PORTIONS OF SERVO SYSTEM (SHEET 2 OF 3)

NOTES:

*Outputs to circuitry external to Servo-Coarse PWA
**Feedback signals from circuits external to Servo-Coarse PWA

1. To cylinder pulse shrinker U39/U1, then to M.P. Programmable Interval Timer U21 (8253).
2. To M.P. via PPI U27.
3. Spin Speed Pulse Circuitry.
4. Switched SPE/I-SPE.
5. Removable cartridge disk (Volume 0).
6. Fixed pack disks (Volume 1).
7. Amplifiers mounted on top of voice coil magnet.
8. Though shown above disks here, the slotted wheel is actually on the bottom of the spindle.
9. Logical head number as addressed by the controller.
10. Use this number when selecting heads on factory tester.
11. Relay shown in energized portion.

FIGURE 4-34. BLOCK DIAGRAM OF ANALOG PORTIONS OF SERVO SYSTEM (SHEET 3 OF 3)

4.3.6 READ-WRITE FUNCTIONS

4.3.6.1 GENERAL

When the drive is on cylinder, has a head selected, and has oriented to the proper position on the data track, it is ready to perform a read or write operation. The controller initiates a read or write operation by sending to the drive the appropriate TAG and BUS OUT BIT combinations (refer to Interface Timing in Section 5-7 for details).

During a read operation, the drive recovers data from the disk and transfers it to the controller. During a write operation, the drive receives data from the controller and records it on the disk.

4.3.6.2 WRITE OPERATIONS

The Controller initiates Write Operation by transmitting appropriate TAG and BUS OUT bits along with NRZ Write Data and the Write Clock. The Write Data is received from the Controller via the Data lines in the "B" Cable. The Read/Write Control timing is shown in Figure 4-35. The drive first processes the Write Data through the NRZ to MFM encoder/compensator. The Write Compensation is applied to minimize effccts of bit crowding and frequency variations during readback. The compensated data is then processed by the Write driver circuits and then written on the disk. Figure 4-36 is a block diagram of the Write Encoder/Compensator.

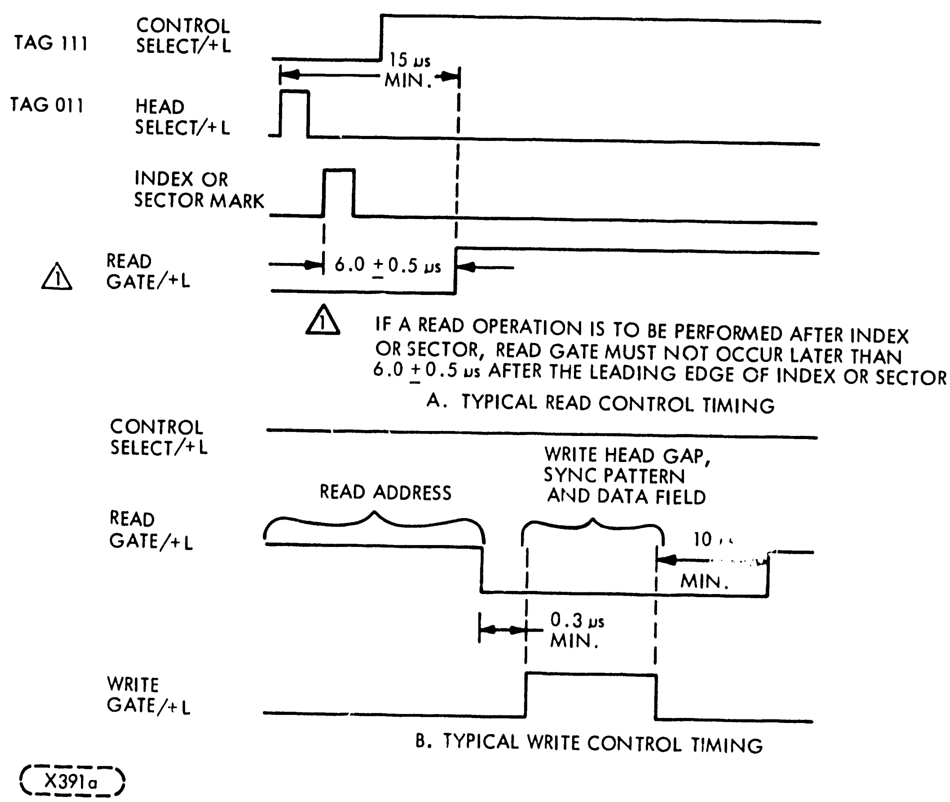


FIGURE 4-35. READ/WRITE CONTROL TIMING

PRINCIPLES OF MFM RECORDING

In order to define the binary dibits stored on the pack, the frequency of the flux reversals must be carefully controlled. Several recording methods are available; each has its advantages and disadvantages. This Unit uses Modified Frequency Modulation (MFM) technique.

The length of time required to define one bit of information is the cell. Each cell is nominally 103 ns in width. The data transfer rate is therefore, nominally 9.67 Mbits/sec.

MFM defines a "1" by writing a flux transition at mid cell time, and a "0" by writing a flux transition at the end of cell time except when the cell is followed by a "1".

The advantages and disadvantages of MFM recording are as follows:

- Fewer Flux reversals are needed to represent a given binary number because there are no compulsory flux reversals at the cell boundaries, achieving higher recording densities of data without increasing the number of flux reversals per inch.
- Signal-to-noise ratio, amplitude resolution, read chain operation, and operation of the heads are improved by the lower recording frequency achieved because of fewer flux reversals required for a given binary number.
- Pulse polarity has no relation to the value of a bit without defining the cell time along with cell polarity. This requires additional read/write logic and high quality recording media to be accomplished.

NRZ TO MFM ENCODER/WRITE COMPENSATION

The following functional description is written with reference to Block Diagram Figure 4-36, Timing Diagram of Figure 4-37 and the logic schematic of the PWA (Figure 5-8, Sheet 5).

Figure 4-36 depicts a Retime Flip Flop logic (U44, U35) where the received NRZ data is clocked with the accompanying Write Clock in order to reestablish the timing reference. The NRZ data is then clocked into two shift registers (U22, U36) using both polarities of a 9.67 MHz "phased clock". (See Figure 4-36.) In order to encode the NRZ into MFM, it is necessary to use both 9.67 MHz and 19.34 MHz frequencies with a known phase reference between the two clocks and the NRZ data. The blocks "WRT GATE Sync" (U34) and "PHASE F/F" (1/2 U33) perform the write gate synchronization and establish the phase relationship by producing a "new" 9.67 MHz-clock OA (Phase A) and OB (Phase B), which are used to clock the registers. A specific serial output of the shift register is used along with the OA clock and the 19.34 MHz clock in the Block labeled "NRZ-MFM ENCODER" (1/2 U45, 1/2 U33) to produce the MFM output. The Write Compensation circuitry is comprised of the block labeled "PATTERN DECODE LOGIC" (U25, U26, U37), the delay line (U46) and the multiplexing gate (U38). The write compensation is based on detection of frequency increase and decrease through an established algorithm described below:

The pattern decode logic analyses the NRZ data and determines if its frequency is constant, increasing or decreasing. This is necessary because if the frequency is increasing or decreasing, problems can occur during subsequent read operations. These problems are eliminated by compensating the data before writing it on the disk.

The data frequency is constant whenever all ones or all zeros are being recorded because all pulses are separated by one cell (103 ns). However, a 011 pattern represents a frequency increase since there is a delay of about 1.5 cell between the 01 and only one cell between the 11. On the other hand a 10 pattern represents a frequency decrease since a pulse is not written at all in the second cell. A 001 pattern is also a frequency decrease since there is a one cell interval between the first two bits and 1.5 cell between the last two.

The previous examples examined only two or three bits without regard to the preceding or subsequent data pattern. The actual combinations are somewhat more complex. The drive logic examines and defines the following patterns:

PATTERN	FREQUENCY CHANGE
011	Increasing
1000	Increasing
10	Decreasing
001	Decreasing

Any data pattern will have considerable overlapping of the data pattern frequency changes. Consider the overlap of these eight bits:

Increasing Frequency

0 0 1 1 0 1 1 0

Decreasing Frequency

The outputs from the pattern decode logic enable either the Early, Late or Nominal gate (depending on the input frequency) to provide compensated Write data as follows:

- If frequency is constant, there will be no peak shift. In this case the data is defined as nominal and is delayed 6 ns.
- If frequency is decreasing, the apparent readback peak would occur later than nominal. To compensate for this, the data is not delayed and is therefore 6 ns earlier than the nominal data.
- If frequency is increasing, the apparent readback peak would occur earlier than nominal. Therefore, this data is delayed 12 ns which is 6 ns later than nominal.

After being write compensated the data is transmitted to the write driver circuits.

An address Mark enable command interrupts the flow of data and produces approximately 3 bytes of erased mark on the disk producing a unique mark which is detected during read of a "soft sector" format. (Refer to Interface Format, Figure 5.7-4.).

WRITE DRIVE CIRCUIT

The compensated write data is sent to the write driver circuit located on the R/W Preamp PWA. As depicted by block diagram of Figure 4-38 and circuit schematic (Figure 5-9), the MFM compensated data is converted to flux reversals representation ÷ 2 F/F (1/2 U12) and the converted to write current (U14, Q3) which is in turn driven through the selected Read/Write coil to accomplish the write operation. The write current control is comprised of a programmable DC Current Source (U8, U13, U14, U15) whose operation is further described in the paragraph following.

WRITE CURRENT CONTROL

The magnitude of the write current sent to the heads is controlled as a function of cylinder address. This is referred to as write current zoning. There are seven write current zones (A through G). Write current is maximum at the outer cylinders, and is reduced as each zone bounder is crossed. The cylinders in each write current zone are defined in Table 4-4.

TABLE 4-4. WRITE CURRENT ZONES

ZONE	CYLINDERS
A	000-127
B	128-255
C	256-383
D	384-511
E	512-639
F	640-767
G	768-822

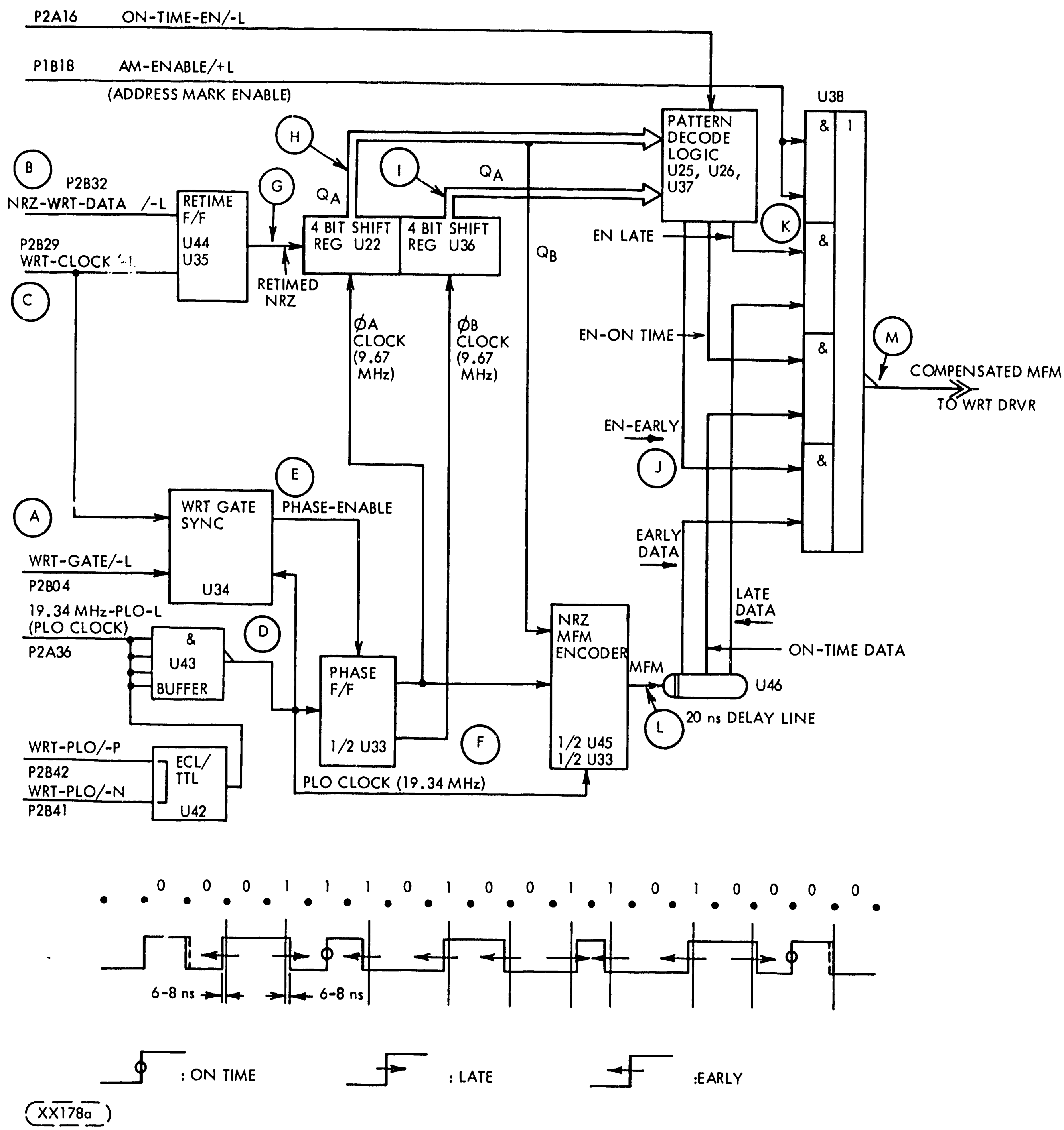


FIGURE 4-36. MFM ENCODER/WRITE COMPENSATOR

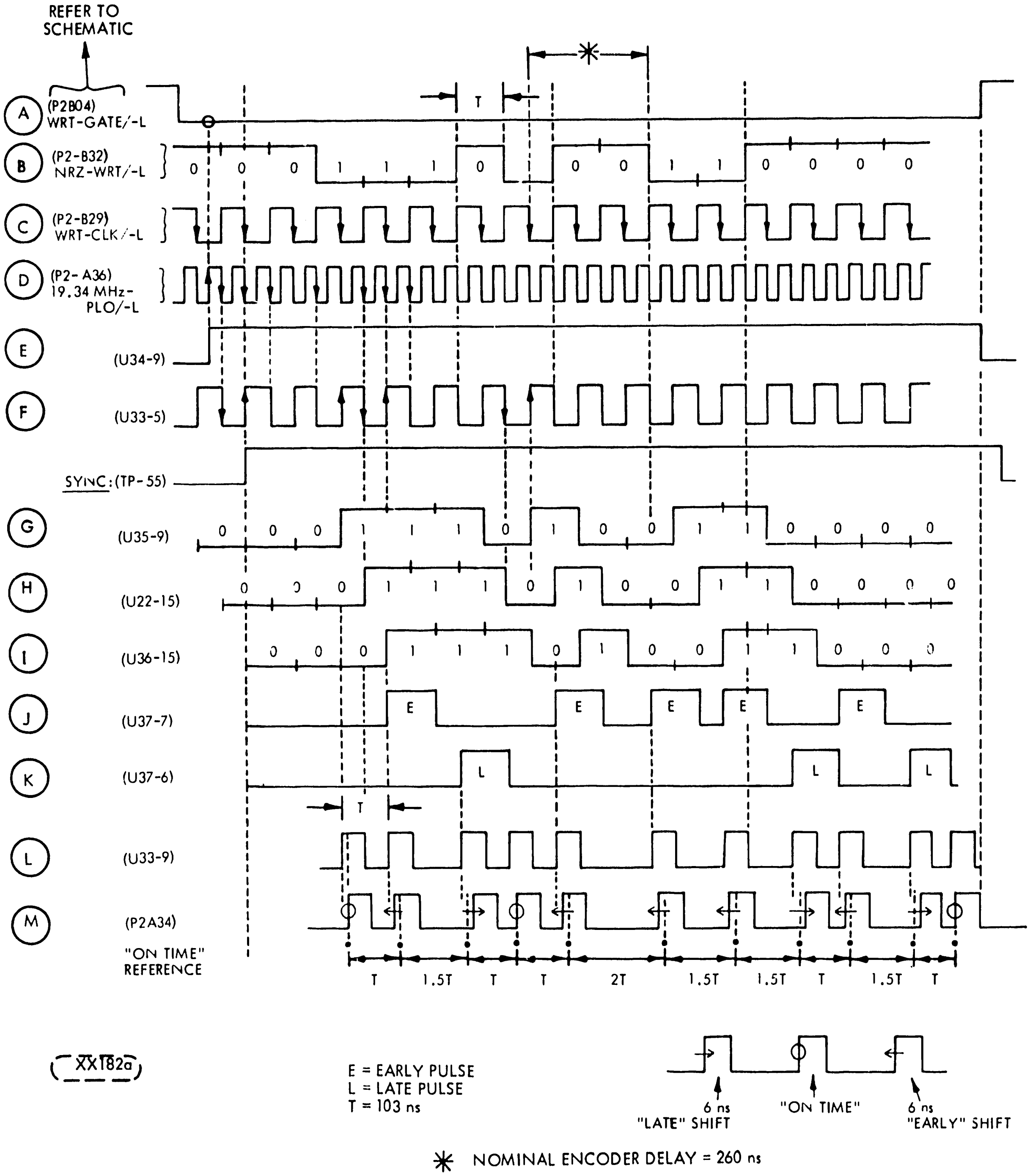


FIGURE 4-37. NRZ TO MFM ENCODER TIMING DIAGRAM

WRITE DATA PROTECTION

As part of data security system, the drive inhibits the write driver circuits whenever there is a danger of writing faulty data on the disk. The Write driver is inhibited by the WRITE-INHIBIT/+L signal which becomes active under any of the following conditions.

- Write protect switch(es) on the control panel is (are) set.
- A not up to speed condition exists.
- A Seek error is detected.
- Multiple commands (Read·Write) are decoded.
- Voltage fault condition is detected.
- Head Alignment is being performed.

In addition, the write driver circuitry is designed in such a manner that the loss of power will not cause inadvertent write operation to occur while the heads are retracting.

4.3.6.3 READ OPERATION

The Controller initiates Read Operation by transmitting appropriate TAG and BUS OUT bits to the drive. Upon decoding a Read Command, and depending on whether there is an Address Mark enable commanded or not the drive performs data recovery and transmits data over the interface in one of two sequences.

The description of read operation is divided into two sections of analog and digital partitions and their respective timing diagrams.

READ OPERATION (ANALOG SECTION)

The following description is made with reference to Block Diagram of Figures 4-38 and 4-39, Timing Diagram of Figure 4-40, and Circuit Schematics of Read/Write Preamp Figure 5-9 and Read/Write Figure 5-8.

The read preamp circuit of Figure 4-38 is enabled as soon as the Write enable is turned off, providing the small differentiated signal derived from the selected read/write head. This signal directed thru the diode switch (U9, 1/2 U2) is preamplified (Q1, Q2, 1/2 U2) and filtered and further amplified and buffered (U3, U4). One set of these outputs are transmitted to the analog read circuits and a similar set of differential outputs is used for head alignment.

The analog signal input to the Read/Write board is Gain Controlled using variable resistance Fet (Q2) and then amplified (U53) and differentiated in order to convert signal peaks to zero crossings. The differentiated signal is again amplified (U41) and filtered to reduce high frequency noise and fed to two parallel paths of zero crossing circuits. Path one (U32, 1/2 U21, 1/2 U11, U9, U10, U20) is referred to as the "high resolution path" since the signal is detected with no further attenuation of frequency response. The high resolution path also provides inputs to the full wave rectifier (1/2 U11) whose output is used for Automatic Gain Control (AGC), and also to a Comparator Circuit (U18, U29) which senses absence of flux reversals for an eventual detection of Address Mark.

Path two (U40, U31) referred to as the "low resolution" path employs a Low pass filter with a relatively low cutoff frequency to reject high frequence components of the differentiated signal. The Delay lines (U9, 10) employed in the high resolution path insure proper timing between the two channels. As depicted in the Timing Diagram of Figure 4-40 the high and low resolutions channel, are approximately one Quarter cell time (25 ns) delayed. This is necessary, in order to use the low resolution channel as a qualifying enable (U19) and to eliminate possibility of extraneous zero crossings of the high resolution channel being detected during low frequency data patterns.

The qualified output which is in the form of digital pulses of one pulse per flux reversal is fed to a pulse shaper (U30, U8) prior to being decoded to NRZ.

READ OPERATION (DIGITAL SECTION)

Refer to Block Diagram Figure 4-41, Timing Diagram Figure 4-42 and 4-43, and Sector Format Diagrams in Figure 4-44 and 4-45.

The Digital Section of the Read Circuits is comprised of the phase locked loop (PLL), the MFM to NRZ decoder, and the Address Mark detection logic as depicted in Figure 4-41. The PLL employs a phase/frequency detector (U4) during lock up time in an all 0's field, and after lock is acquired, a phase detector (1/2 U14, 1/2 U16) is switched in to provide phase error information between the reference input data and the voltage controlled oscillator (VCO). The phase error information is converted to current (Q1, U1, U2, U13), filtered, and then fed to the input of VCO (U12) as a variable voltage to control its frequence and phase. The VCO nominal frequency of 38.7 MHz is divided by 4 (1/2 U14, 1/2 U16) and fed back to complete the loop. The feedback input to the phase detector, however, is at 19.34 MHz, since it is operational during data field, and the frequency content of data requires this higher frequency for phase coherent information.

A 9.67 MHz reference clock (SVO-CLOCK) is fed to the PLL to keep it locked to the disk speed at all times except when in Read Mode and no address mark enable exists. This insures that upon switching from SVO-CLOCKS to MFM data pulse, as an input, the PLL must make only phase correction leading to improved response.

The timing Diagram of Figure 4-42 depicts an arbitrary pattern shown while PLL is at "lock" for the purpose of illustration. The MFM to NRZ decoder employs 1/2 of the phase detector (1/2 U14) and the NRZ DATA F/F (1/2 U27) to accomplish the decoding process. The NRZ data and the 9.67 MHz clock (Read Clock) are then translated to TTL levels (1/2 U47) and sent to the interface drivers located on CNTL/ MUX PWA.

Prior to data transmission to the interface the Data Enable signal must become true after PLL has been given sufficient time to lock and the MFM to NRZ decoding process has begun. Timing diagram of Figure 4-43 depicts two conditions leading to the start of PLL lock up time of 9 µs maximum.

In the event that an Address Mark Enable (AME) command accompanies a Read Command from the controller, the drive must detect the address mark through the address mark detection logic (U39, U48, U49, U50, U51, U52), Schematic Figure 5-8, and an "Address Mark Found" signal subsequently activated for a period of 9 µs maximum during which the PLL locks and data transmission begins. In the event that only a Read command is detected by the drive, the PLL lock time begins immediately upon detection of leading edge of Read Command and continues for a period of 9 µs maximum. Data transmission will similarly begin before this time is exhausted, as shown by the Data Enable signal of timing diagram Figure 4-43.

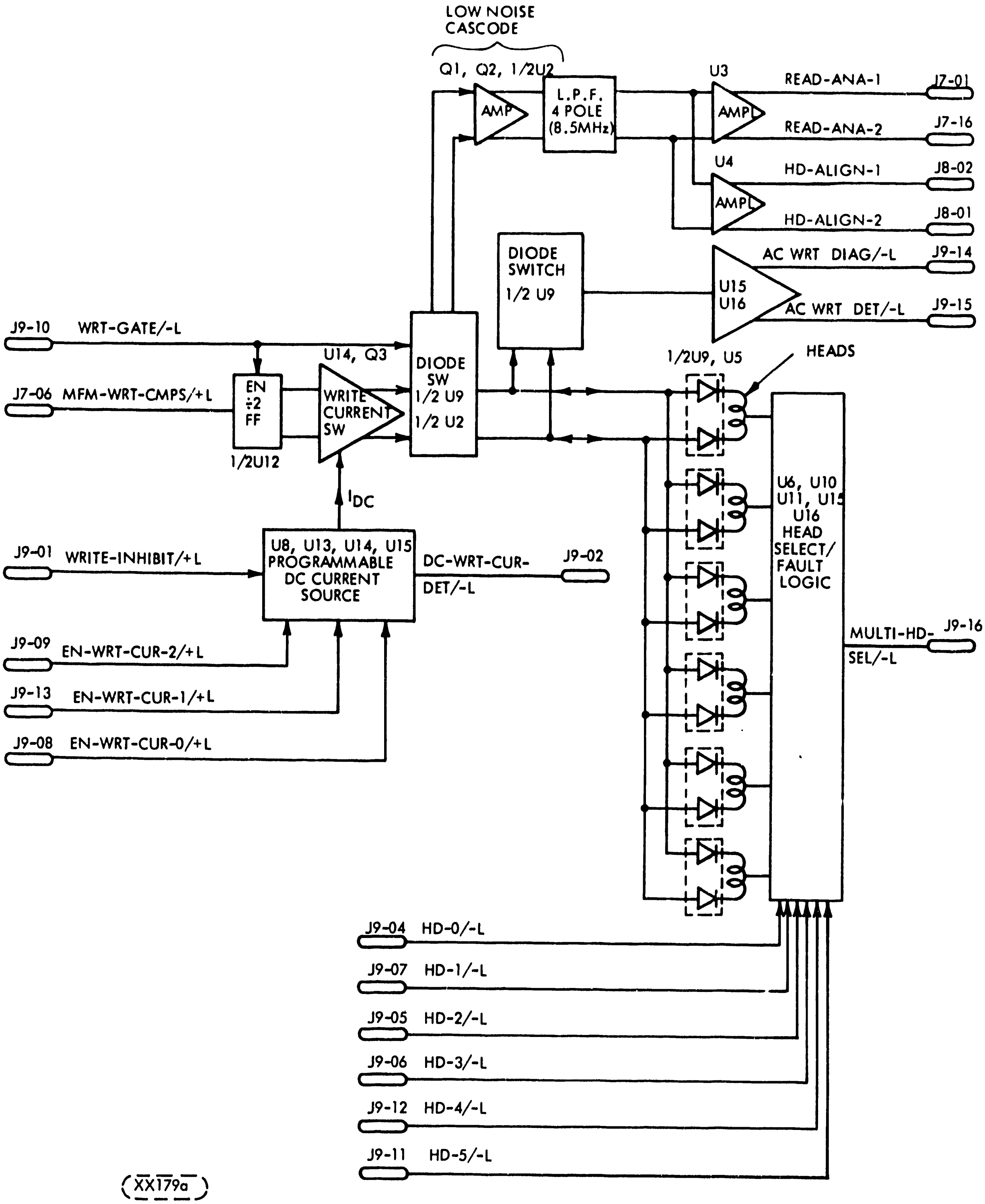


FIGURE 4-38. READ/WRITE PREAMP - BLOCK DIAGRAM

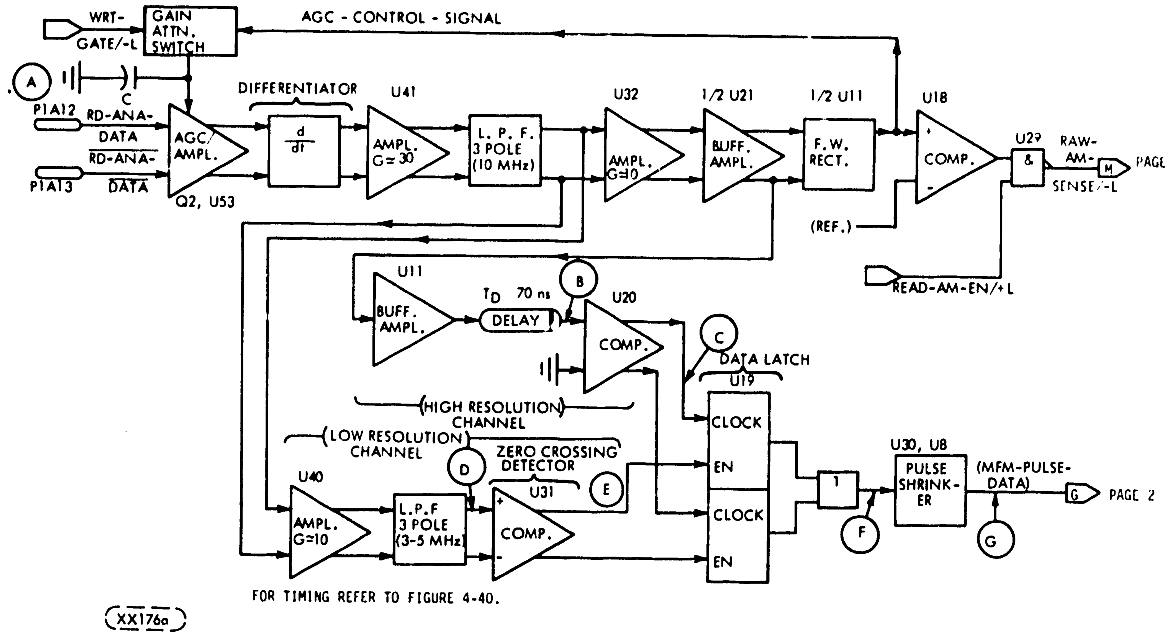


FIGURE 4-39. READ/WRITE - BLOCK DIAGRAM
PAGE 1/2 - ANALOG
(CONTINUED IN FIGURE 4-41)

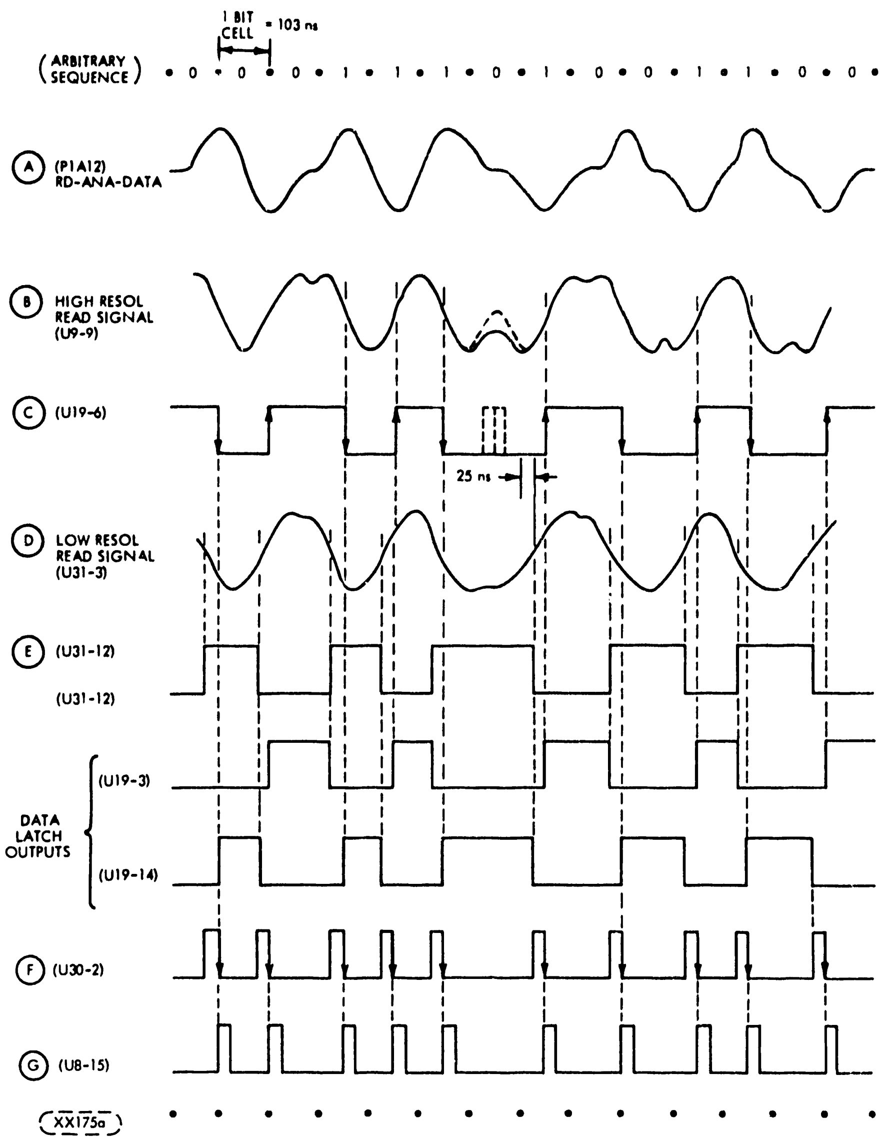


FIGURE 4-40. READ ANALOG/DATA LATCH TIMING DIAGRAM

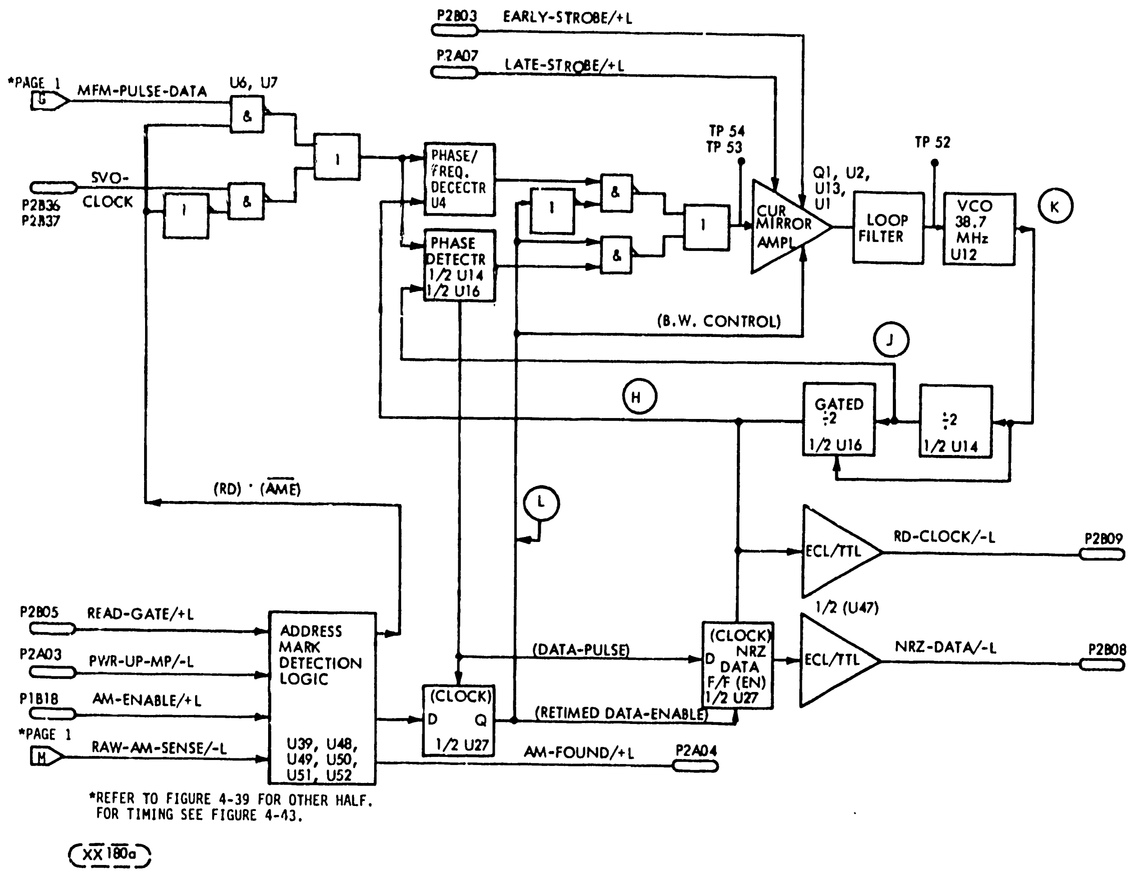


FIGURE 4-41. READ/WRITE - BLOCK DIAGRAM
PAGE 2/2 - DIGITAL

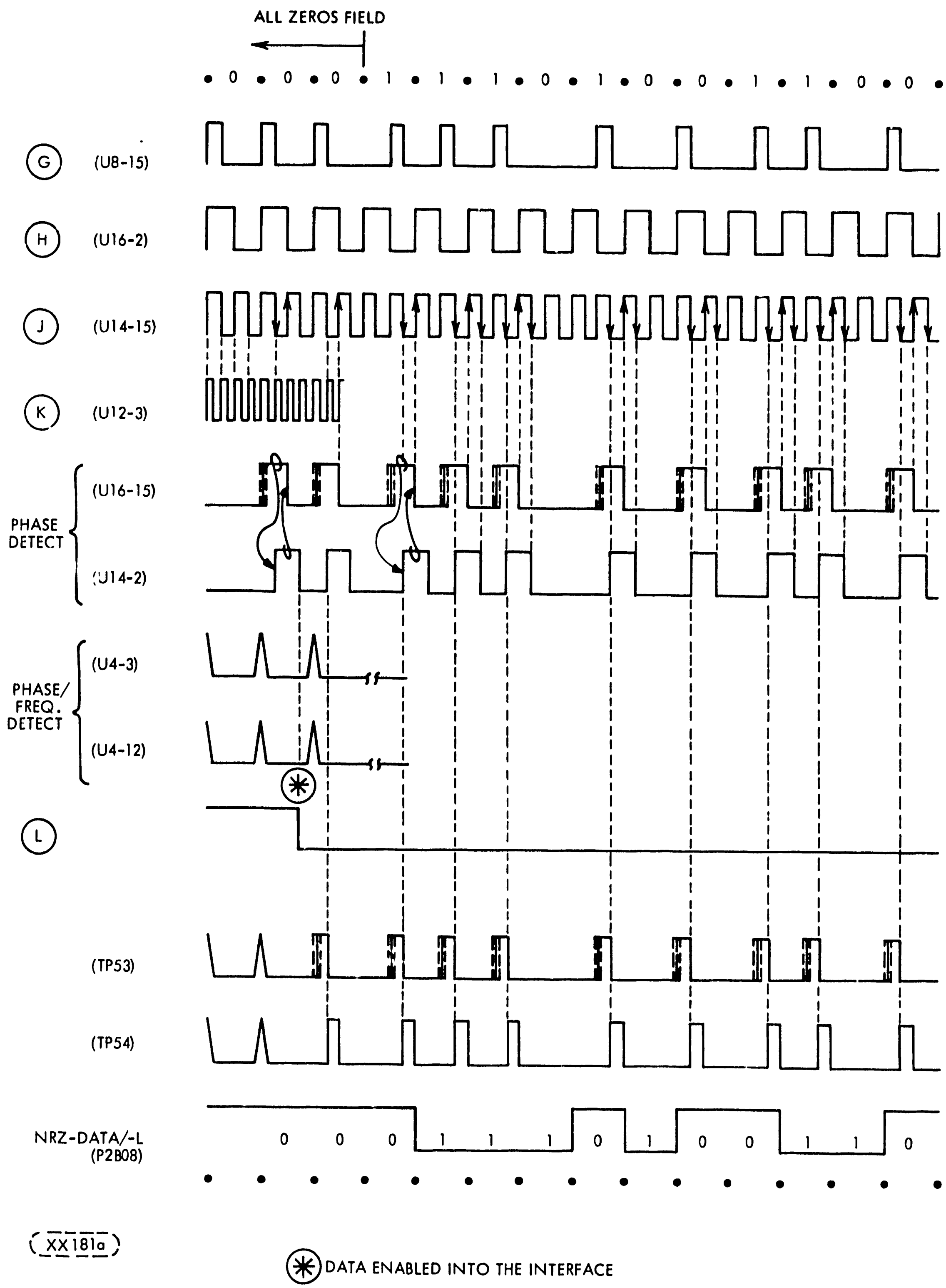


FIGURE 4-42. READ DIGITAL TIMING - PLL LOCKED

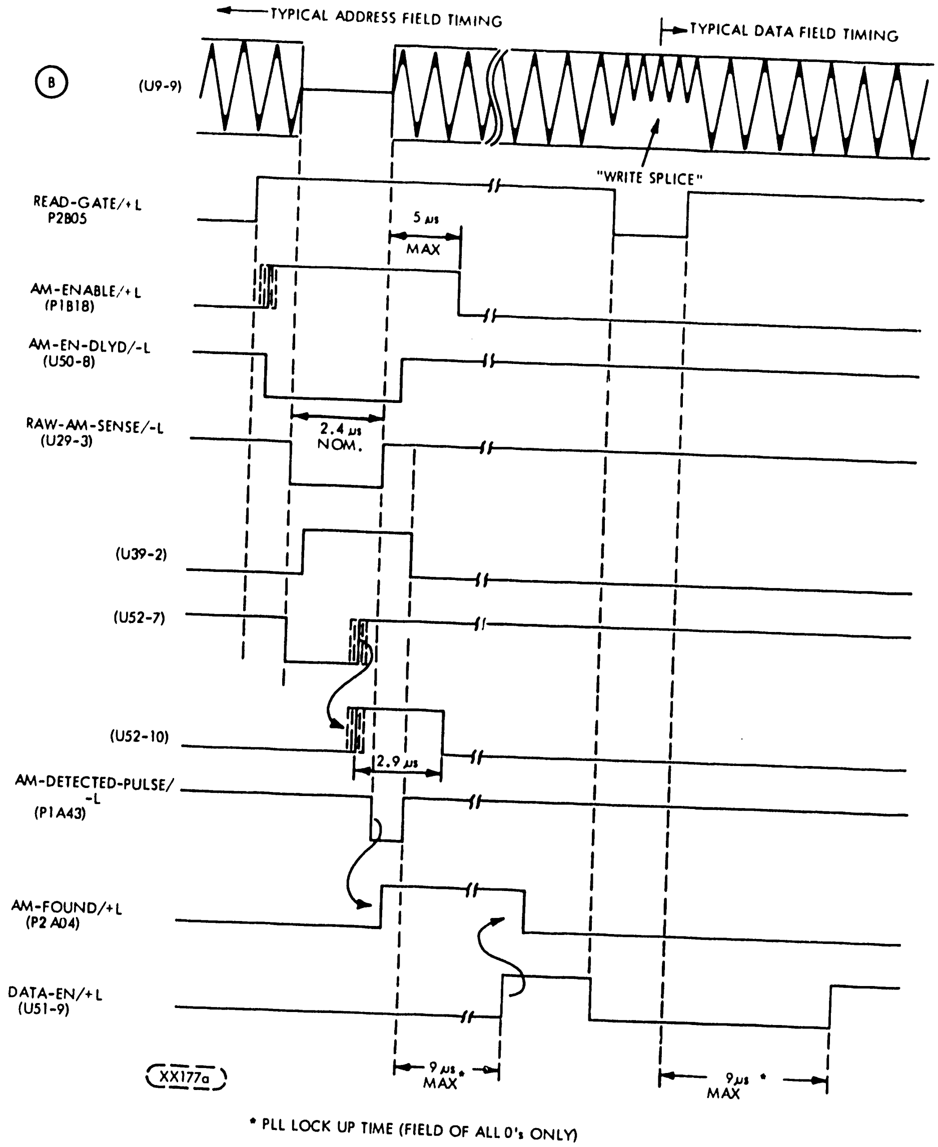
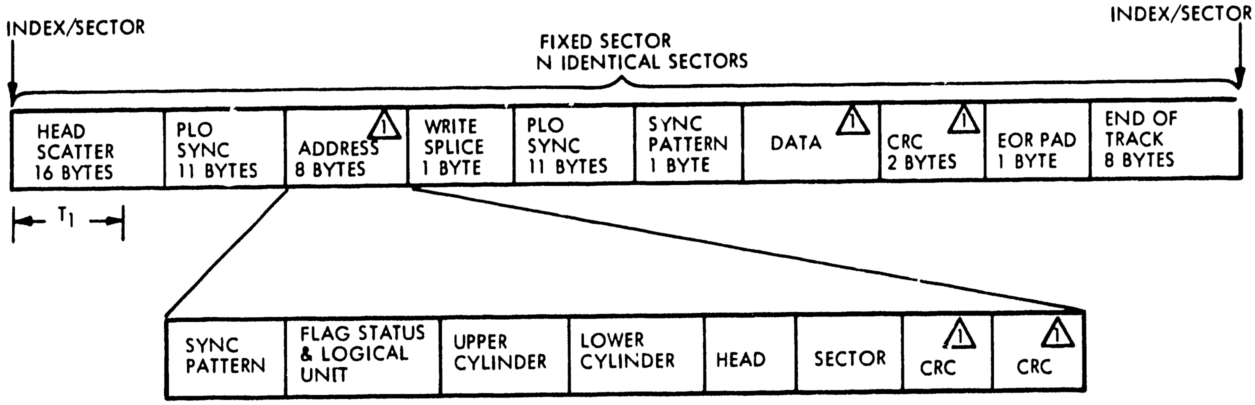


FIGURE 4-43. ADDRESS DETECTION AND DATA ENABLE TIMING DIAGRAM



T_1 = TIME BETWEEN LEADING EDGE OF INDEX/SECTOR AND READ GATE IS 8 BYTES. A SPLICE POINT MAY EXIST WITHIN THIS AREA.

EXAMPLE NO. 1: WHAT IS DATA FIELD LENGTH USING 64 SECTORS?

$$\text{DATA FIELD} = \frac{\text{TOTAL BYTES/TRACK}}{\text{NUMBER OF SECTORS/TRACK}} - \text{(SYNC FIELDS, TOLERANCE GAPS, AND ADDRESS)}$$

$$\text{DATA FIELD} = \frac{20\ 160}{64} - 59 = 256\ \frac{\text{BYTES}}{\text{SECTOR}}$$

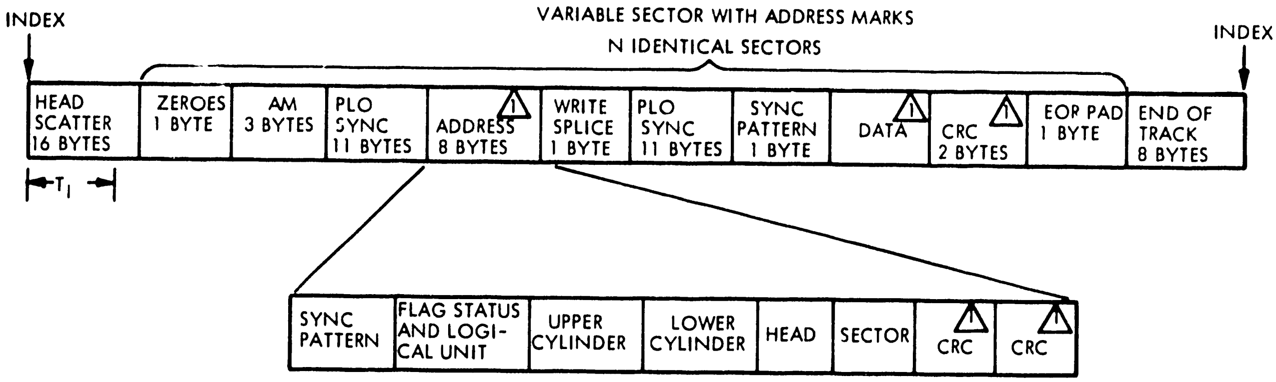
DATA = 256 BYTES/SECTOR

$$\%\ \text{EFFICIENCY} = \frac{256 \times 64}{20\ 160} \times 100 = 81\%$$

⚠1 THESE AREAS ARE EXAMPLES ONLY AND MAY BE STRUCTURED TO SUIT INDIVIDUAL CUSTOMER REQUIREMENTS.

X388b

FIGURE 4-44. FIXED SECTOR FORMAT



T_1 = TIME BETWEEN LEADING EDGE OF INDEX AND READ GATE IS 8 BYTES. A SPLICE POINT MAY EXIST WITHIN THIS AREA.

EXAMPLE NO. 1: WHAT IS DATA FIELD LENGTH USING 64 SECTORS?

$$\text{DATA FIELD} = \frac{\text{TOTAL BYTES/TRACK} - \text{MECHANICAL TOLERANCES}}{\text{NUMBER OF SECTORS/TRACK}} - \text{(SYNC FIELDS AND ADDRESS)}$$

$$\text{DATA FIELD} = \frac{20\,160\ \frac{\text{BYTES}}{\text{TRACK}} - 24\ \frac{\text{BYTES}}{\text{TRACK}}}{\frac{64\ \text{SECTORS}}{\text{TRACK}}} - 39\ \frac{\text{BYTES}}{\text{SECTOR}} = 275\ \frac{\text{BYTES}}{\text{SECTOR}}$$

$$\%\ \text{EFFICIENCY} = \frac{275 \times 64}{20\,160} \times 100 = 87\%$$

EXAMPLE NO. 2: WHAT IS NUMBER OF SECTORS USING 256 DATA BYTES?

$$\text{N SECTORS}\ \frac{20\,160 \ -24}{256 \ +39} = 68\ \text{SECTORS}$$

$$\%\ \text{EFFICIENCY} = \frac{256 \times 68}{20\,160} \times 100 = 86\%$$

⚠1 THESE AREAS ARE EXAMPLES ONLY AND MAY BE STRUCTURED TO SUIT INDIVIDUAL CUSTOMER REQUIREMENTS.

X393a

FIGURE 4-45. VARIABLE SECTOR FORMAT

SECTION
5
DIAGRAMS

SECTION 5
DIAGRAMS

5.1 INTRODUCTION.. 5-1

5.2 INTRACABLING DIAGRAM.................................... 5-1

5.3 CIRCUIT BOARD DIAGRAMS.................................. 5-1

5.4 MAJOR ELECTRICAL DIAGRAMS............................... 5-8

5.5 POWER SUPPLY DIAGRAMS................................... 5-8

5.6 LOGIC DIAGRAM SYMBOLOGY................................. 5-8

5.7 I/O OPERATIONS.. 5-12

5.1 INTRODUCTION

This section contains the intracabling diagram, a key to the logic diagram symbology, logic symbols and waveforms for the integrated circuits, printed circuit board documentation, and electrical schematics.

5.2 INTRACABLING DIAGRAM

The intracabling diagram is shown in Figure 5-1. Sheet 1 shows the overall cabling between the mother board, printed circuit boards, and base pan electronics. Sheet 2 shows the location on the back panel of the connectors that are used to interface signals external to the electronics module.

5.3 CIRCUIT BOARD DIAGRAMS

The CMD printed circuit boards and associated diagrams are listed in Table 5.3-1. Paragraph 5.3.1 describes how to track signals between the various circuit boards.

Special circuit board documentation (for boards not listed in Table 5.3-1) is included in the Hardware Product Configurator (HPC) Document Package located in front of the manual. It may be desirable to insert the special documentation portion with the other schematics in this section. I/O signal definitions and timing diagrams are given in Section 5.7.

Also included in the HPC package is a "Device Specification" which defines the correct switch settings for the option selection switches which are located on some of the circuit boards. In addition, documentation describing Special Options and other customer unique features are included in the HPC package.

Interchangeability of circuit boards listed in Table 5.3-1 with other boards is given by document 75895536 (not included in this manual).

TABLE 5.3-1 CMD CIRCUIT BOARDS

CKT BD IDENT	SLOT LOC	FIGURE	CROSS REF NO	TITLE
77665650	EM1	5-4	01XX	I/O CKT BD, OEM
77666950	EM2	5-5	02XX	CNTL/MUX CKT BD
77739650	EM3	5-6	03XX	SERVO COARSE CKT BD
77688750	EM6	5-7	06XX	SERVO FINE CKT BD
75886350	EM7	5-7	07XX	READ/WRITE CKT BD (INTCH**)
77683850	EM7	5-8	07XX	READ/WRITE CKT BD
77655250		5-9	08XX	READ/WRITE PREAMP CKT BD
75885800		5-10	09XX	SERVO PREAMP CKT BD
77680501		5-11	10XX	POWER AMPLIFIER CKT BD
77680700		5-12	11XX	OPERATOR CONTROL CKT BD
77680740		5-12	11XX	OPERATOR CONTROL CKT BD
77713900		5-13	12XX	RELAY CONTROL CKT BD
75886100		5-14	13XX	TERMINATOR CKT BD
77669900		5-15	14XX	COMPONENT BD (32 V FILTER) CKT BD
75886001	EM4	5-16	15XX	HEAD ALIGNMENT EXTENDER CKT BD
77688716		5-17	16XX	AC AND DC PWR DIST AND MISC WIRING
76873801*		5-18	17XX	POWER WIRING (60 Hz)
70116800*		5-19	18XX	POWER WIRING (50 Hz)
75832500		5-20	19XX	MOTHER BOARD (POWER SUPPLY)
75832900	PWR SPL	5-21	20XX	REGULATOR CKT BD AXHV
77737300		5-22	21XX	MOTOR SUPPRESSOR PWA
77648081	OR	5-1		ELECTRONICS MODULE-PWA (Ref only)
77648091	OR	5-1		ELECTRONICS MODULE-PWA (Ref only)
77648121		5-1		ELECTRONICS MODULE-PWA (Ref only)

*Not a PWA - Conventional Wiring.
**Listed for reference only.

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

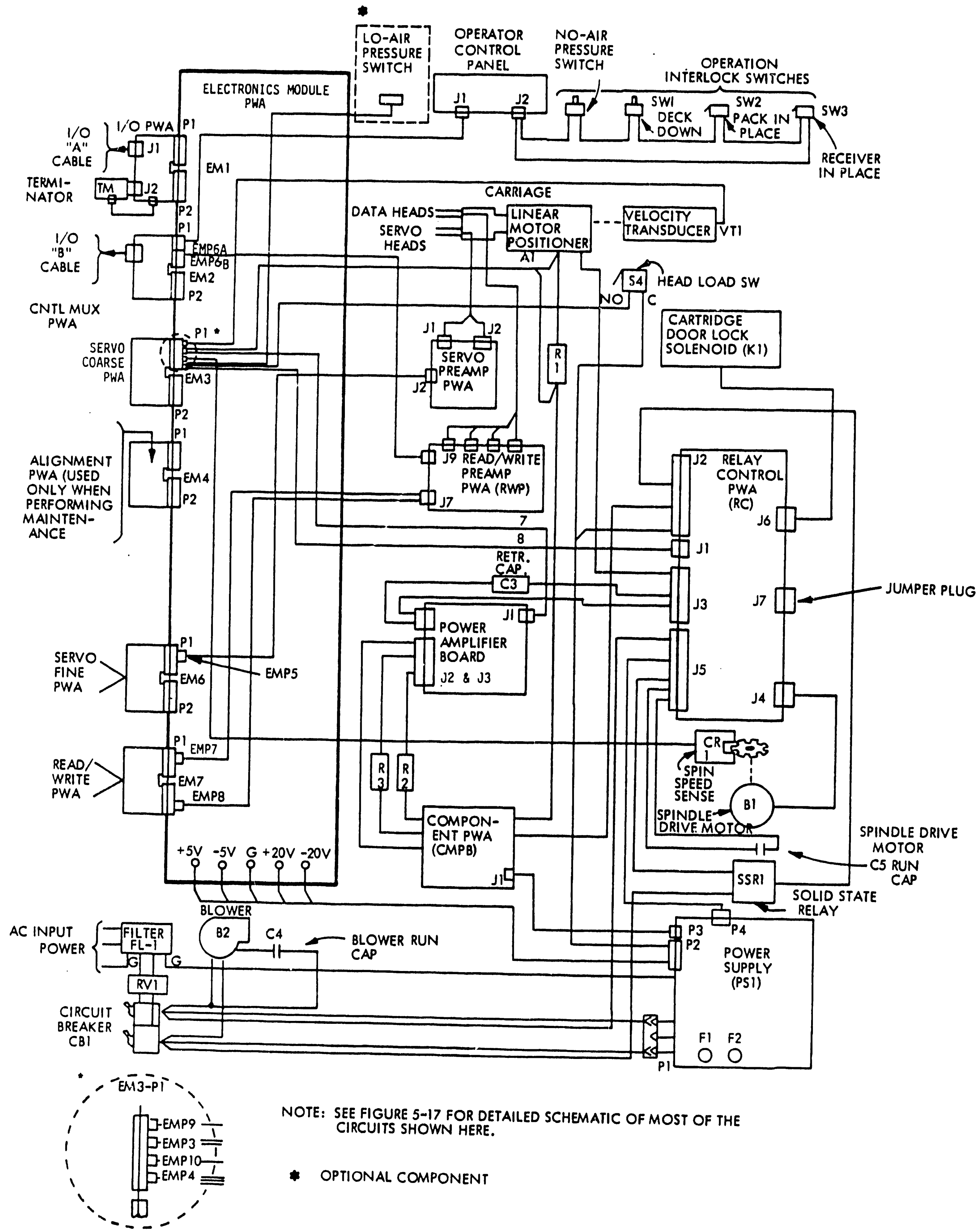


FIGURE 5-1. INTRACABLING DIAGRAM (SHEET 1 OF 2)

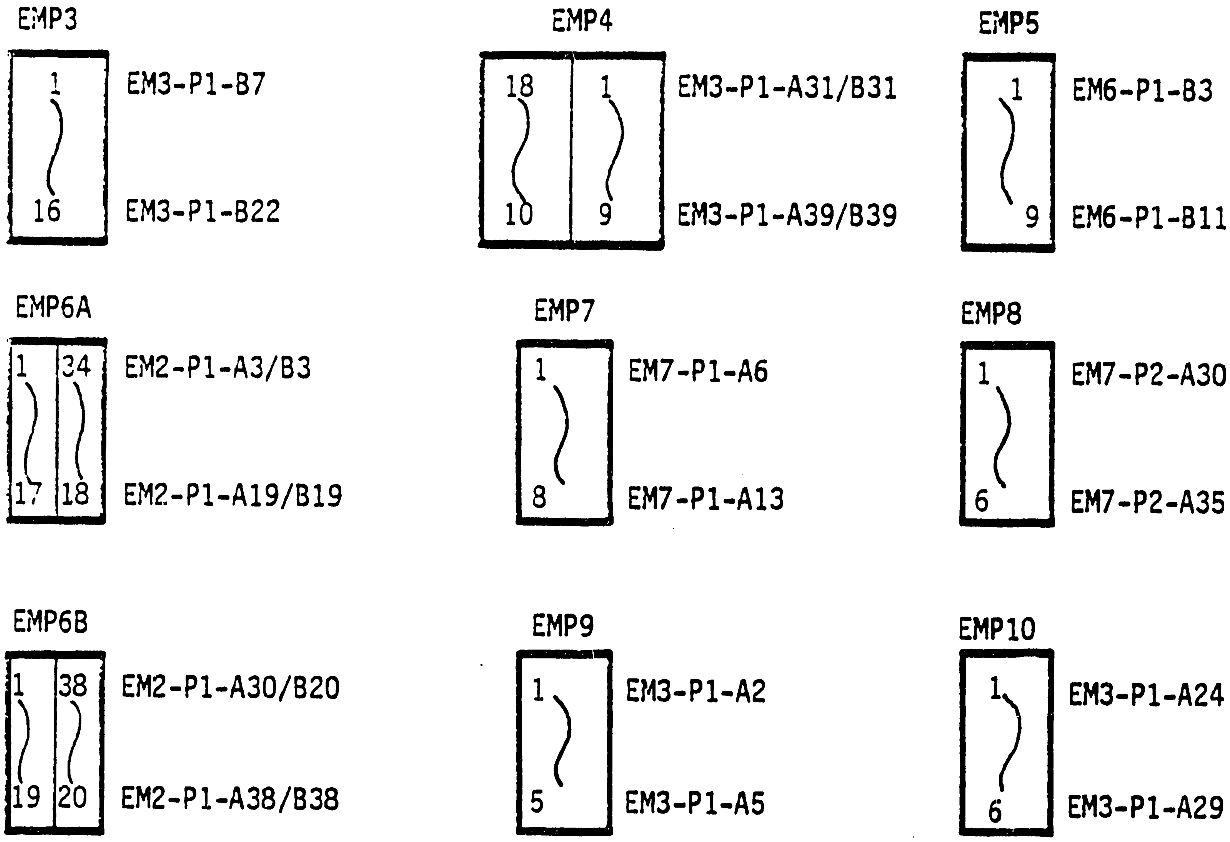


FIGURE 5-1. LOCATION OF CONNECTORS ON BACK PANEL
(SHEET 2 OF 2)

5.3.1 POINT-TO-POINT LOGIC INTERCONNECTIONS BETWEEN CIRCUIT BOARDS

An interconnection sheet is provided with each diagram set for the circuit boards and base pan electronics. This sheet contains interconnection data to allow the user to trace each signal to its source or destination. A typical entry for a signal is shown in Figure 5-2A.It should be noted that the total diagram set for each PWA consists of several "sheets" that are assigned a Cross Reference number.* To differentiate, the schematic subset for each PWA consists of a certain number of "pages".* For example, the Servo-Coarse PWA documentation set has 13 "sheets" total, but the schematic subset has only 7 "pages".* Table 5.3-1 (page 5-1) lists the Cross Reference number assigned to each assembly for which there is a schematic in Section 5 of this manual. Figure 5-2B illustrates the point to point interconnection procedure.

---

* The schematic page number is the last two digits of the cross reference number (XREF) which is found in the lower right corner of each schematic page. The first two digits are the assigned number of the diagram set (see Page 5-1).

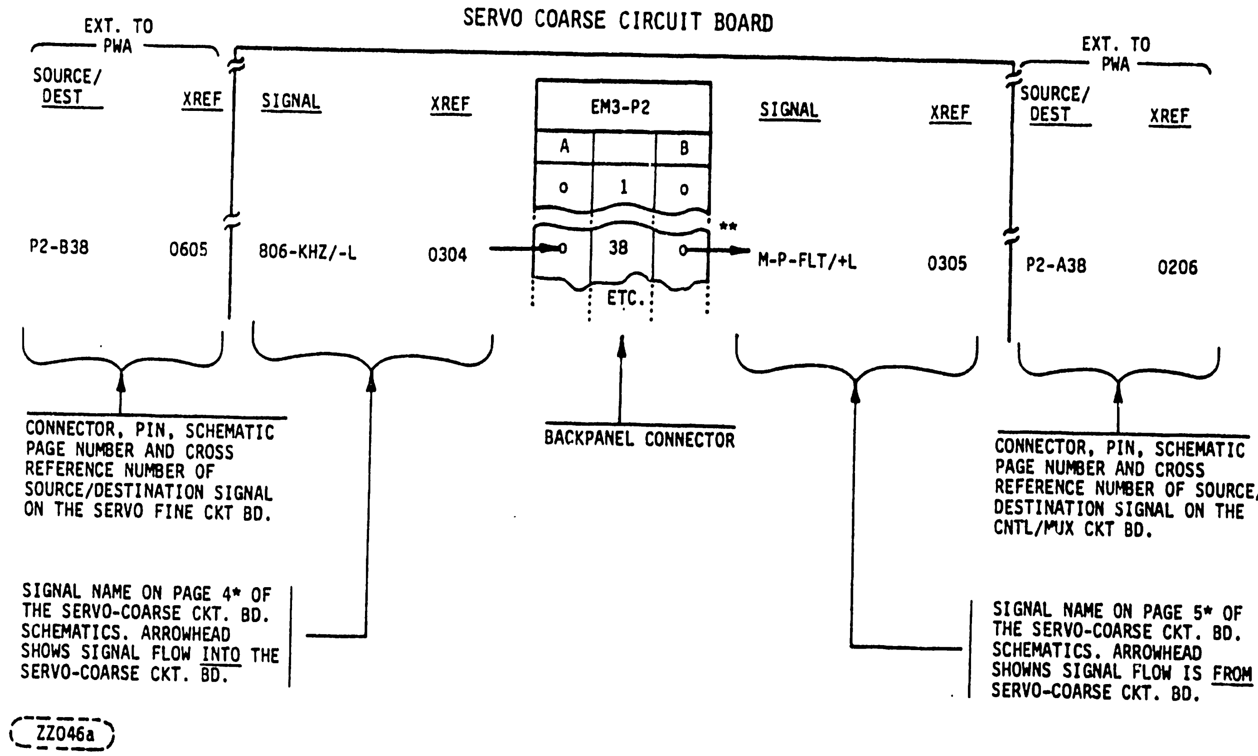


FIGURE 5-2A. TYPICAL INTERCONNECTION SHEET ENTRY

* The schematic page number is the last two digits of the cross reference number (XREF) which is found in the lower right corner of each schematic page. The first two digits are the assigned number of the diagram set (see Page 5-1).

** A line with no arrow head indicates that the pin is only a tie point for a signal which is not used on the PWA.

POINT TO POINT INTERCONNECTION TRACING PROCEDURE:

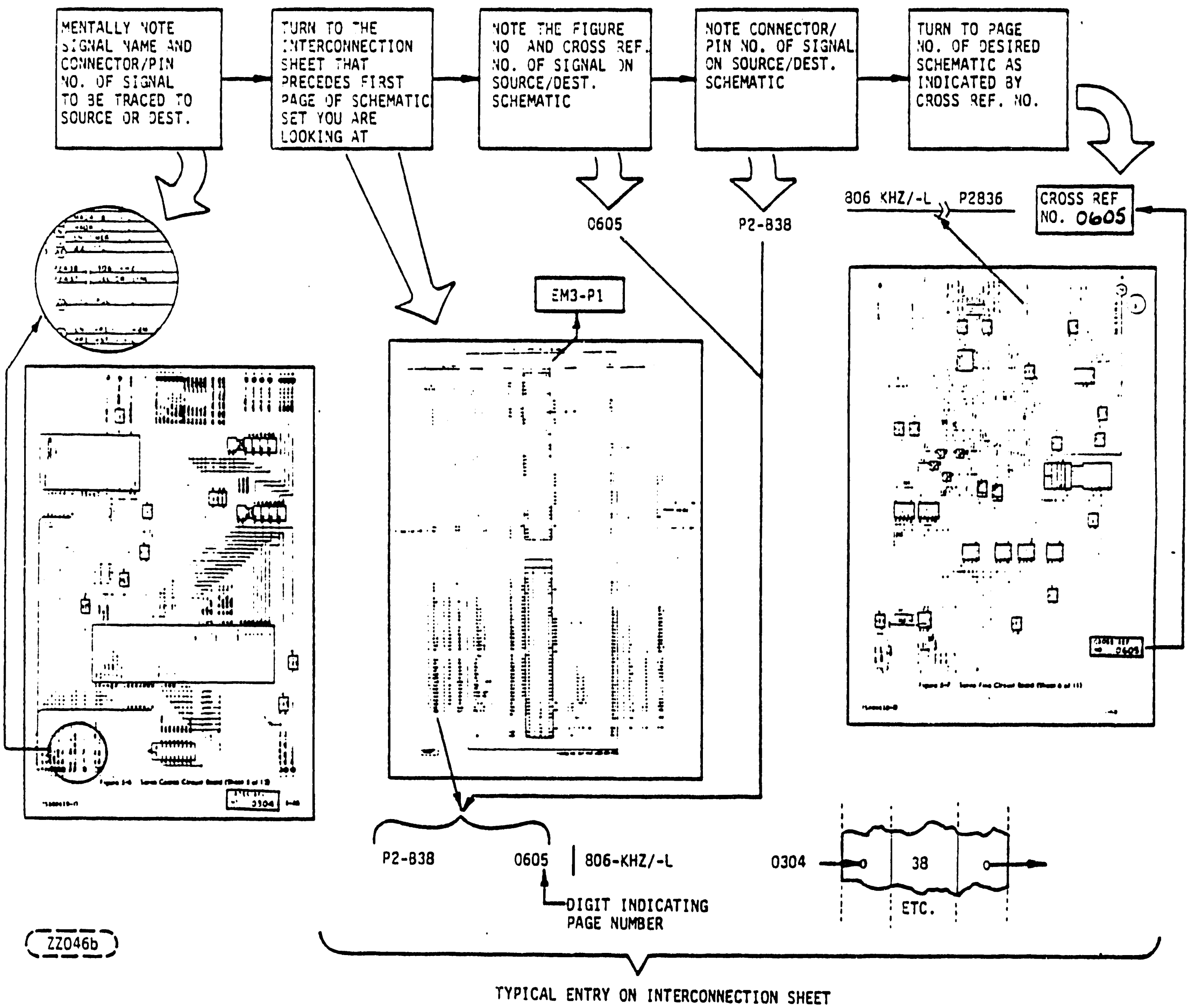
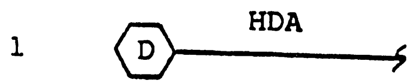


FIGURE 5-2B. ILLUSTRATION OF POINT TO POINT TRACING PROCEDURE

5.3.2 SCHEMATIC DIAGRAM INTERCONNECTION SYMBOLOGY

Multiple sheet (SET of pages) circuit board schematics are sequentially numbered (1, 2, 3 etc) in the lower right hand corner of each schematic sheet using the last (right-most) digit of the cross reference number. Symbology for sheet to sheet connections and board to board connections are as follows:

- Sheet-to-Sheet ON PAGE example:

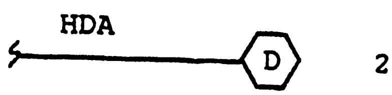


1 = Signal "from" sheet 1 of SET

D = ON sheet reference (from sht 1 of set)

HDA = Signal name (from sht 1 of set, location D)

- Sheet-to-Sheet OFF PAGE example:

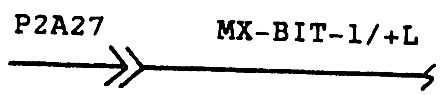


2 = Signal "to" sheet 2 of SET

D = OFF sheet reference (to sheet 2 of set)

HDA = Signal name (to sheet 2 of set, location D)

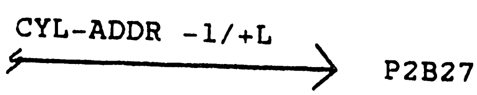
- Board-to-Board ON PAGE example:



A27 = Pin location of board connector (Ref Figure 5-2A)

MX-BIT-1/+L = Signal name (Ref Figure 5-2A)

- Board-to-Board OFF PAGE example:



B27 = Pin location of board connector (Ref Figure 5-2A)

CYL-ADDR-1/+L = Signal name (Ref Figure 5-2A)

For sheet-to-sheet signal tracking within a board schematic, the schematic sheet numbers referenced are the last digit of the cross reference number.

Some of the schematic sets use a sheet to sheet signal tracking reference method that is different than that described above. This alternate type schematic uses a zone and sheet number reference as shown in the example in Figure 5-2C.

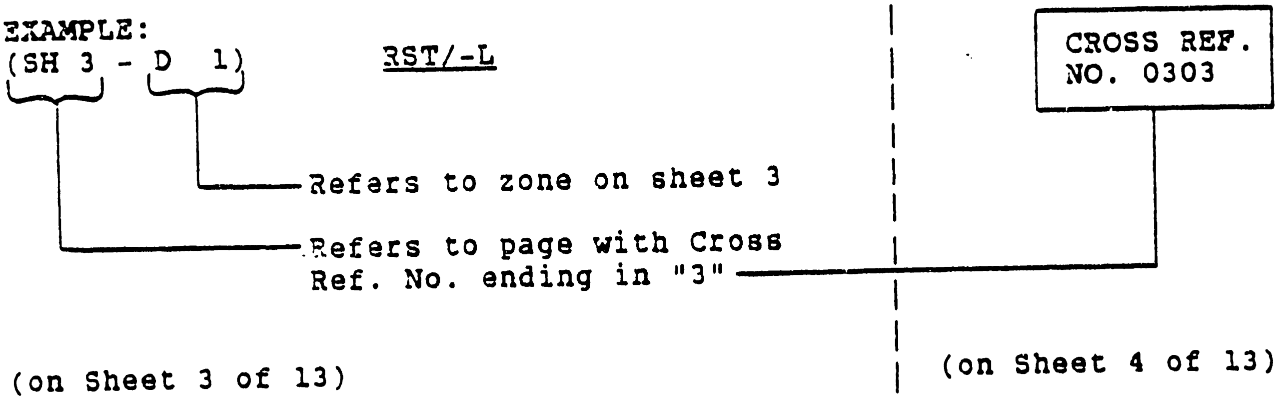


FIGURE 5-2C. TYPICAL ALTERNATE SHEET-TO-SHEET SIGNAL TRACKING REFERENCE

The above example reference, taken from page 3 of 13 of Figure 5-6 (Cross Ref. No. 0302), says that signal RST/-L came from sheet 3, zone D1. The alphanumeric zone grid is on two sides of each schematic page. To find "sheet 3", look for the Cross Ref. No. of the same schematic set having a Cross Reference number ending in "3" (0303 in Figure 5-2C above).

5.4 MAJOR ELECTRICAL DIAGRAMS

Base Pan Electrical diagram is provided in Figure 5-17. This includes AC Power and DC Power Distribution, Interlock Switches, No-Pressure Sensor and Speed Sensor CKT Diagram.

5.5 POWER SUPPLY DIAGRAMS

Power Supply Wiring Diagram (60 Hz)	Figure 5-18
Power Supply Wiring Diagram (50 Hz)	Figure 5-19
Mother Board Diagram	Figure 5-20
Regulator Board	Figure 5-21

5.6 LOGIC DIAGRAM SYMBOLOGY

5.6.1 GENERAL INFORMATION

Logic symbols are drawn with inputs on the left and outputs on the right whenever space and layout permit.

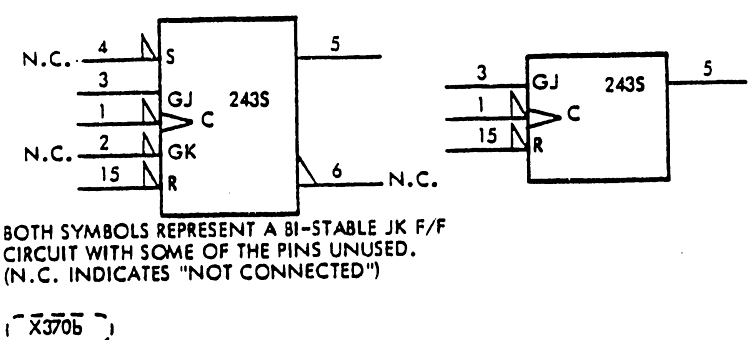


FIGURE 5-2D. FUNCTIONALLY EQUIVALENT SYMBOLS

Power supply connections, discrete timing components, etc, may be shown connected to the top or bottom of the symbol. Unused pins and unused elements need not be shown. Figure 5-2D illustrates functionally equivalent symbols.

5.6.2 GENERAL SIGNAL ANNOTATION

S	=	Set input to bistable device.
R	=	Reset (Clear) input to bistable device.
G	=	Gate input has no direct action on circuit, but must be present before inputs (and/or outputs) are able to function. If more than one gate is used a numeric suffix is added (G2, G2, etc.).
D	=	Identifies a signal which requires the presence of another signal to perform its function.
C	=	Strobe pulse. Usually used to gate "D" inputs into a bistable device.
T	=	Toggle input. Bistable device changes state each time "T" assumes its specified state.
J	=	J outputs conditioned by leading edge of dynamic toggle (G).
K	=	K output conditioned by leading edge of dynamic toggle (G).
243S	=	Example CDC element identifies.

Non-standard binary level (→←) indicators are generally shown where there was even a small expectation that one of the levels might be outside the standard defined tolerance of the logic family section. The logic levels may depend on such things as terminations or loads. The standard binary levels were assumed to be:

LOGIC FAMILY	LO LEVEL	HI LEVEL
DTL/TTL	-1.0 V to +0.8 V	+1.8 V to V
TCS	-1.86 V to -1.5 V	-1.03 V to -0.79 V
ECL	-2.0 V to -1.4 V	-1.0 V to -0.6 V
CMOS	0 to 30% V_{dd}	70% to 100% V_{dd}

Logic signals that are "Active-Hi" have the appendage /+L attached to their names, and Logic signals that are "Active-Lo" have the appendage /-L attached. For example, the signal FLT-RESET /+L will be "Low" (logic 0) most of the time except when the fault circuitry is to be reset (Fault indication cleared). FLT-RESET/+L will go "Active-Hi" (Logic 1) for a brief instant when the fault circuitry is to be cleared.

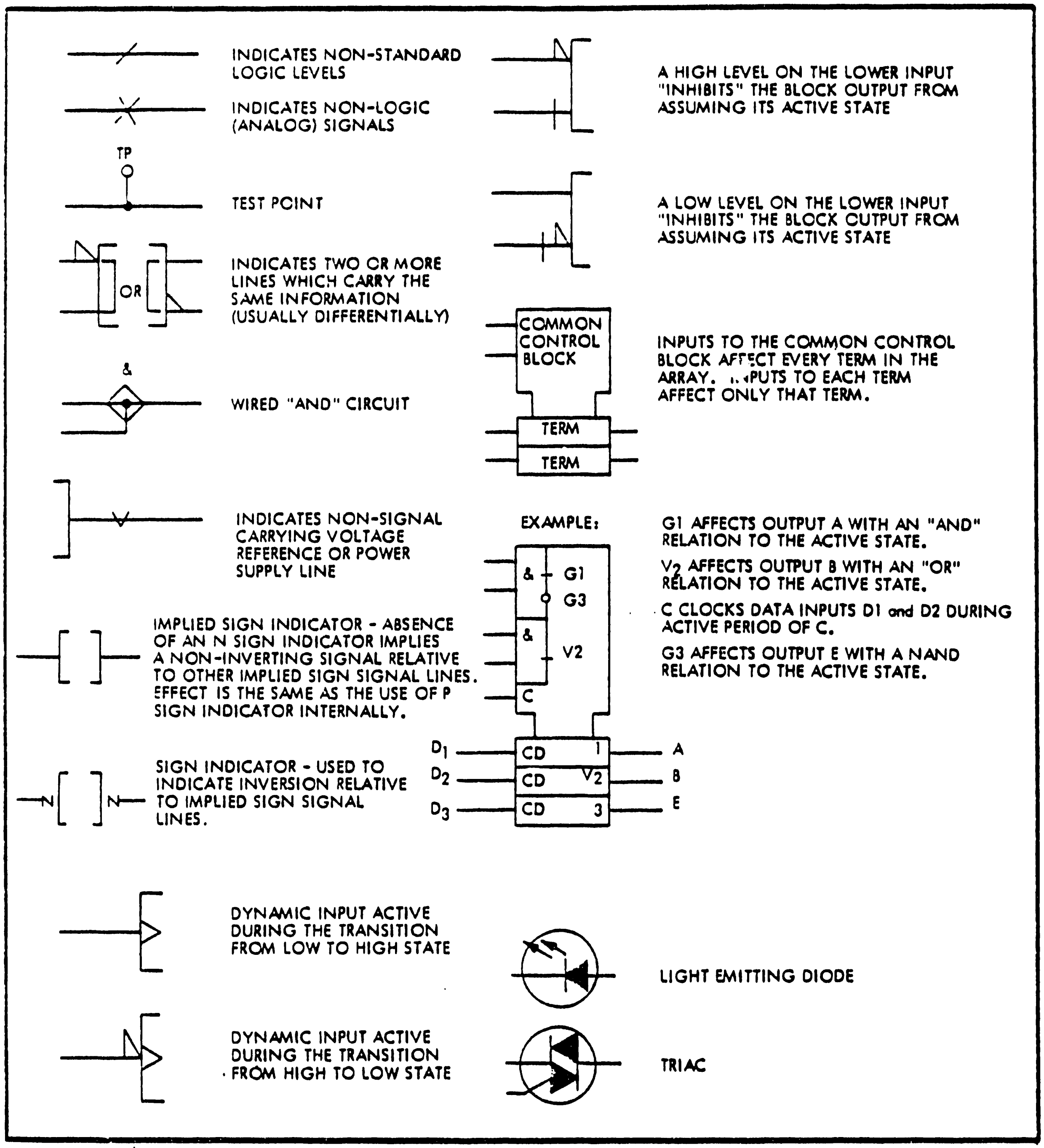
The signal MEM-RD/-L will be "Hi" much of the time but when the microprocessor memory is to be accessed (read out) MEM-RD/-L will go "Active-Lo" (to Logic 0) for a brief instant while the contents of some memory location is accessed (read).

Table above defines voltage levels for "Hi" and "Lo".

5.6.3 SYMBOLOGY

Logic Symbols are as described in Table 5-1.

TABLE 5-1. LOGIC SYMBOLOGY



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5.6.4 FUNCTION SYMBOLOGY

Function symbols are as described in Table 5-2.

TABLE 5-2. FUNCTION SYMBOLS

CONTROL GATE INPUT - AFFECTS INPUTS OR OUTPUTS WITH "AND" RELATION TO ACTIVE STATE

	OSCILLATOR	X → Y	DECODER
▷	AMPLIFIER	#/∩	DIGITAL TO ANALOG CONVERTER
&	"AND" GATE	mVR	VOLTAGE REGULATOR OUTPUT VALUE "m"
1	"OR" GATE	MUX	MULTIPLEXER
=1	"EXCLUSIVE OR"	SR	SHIFT REGISTER
F ▷	FUNCTION GENERATOR	CNTR	COUNTER
TTL/+5 V GND OR TTL/DIFF	LEVEL CONVERSION	ALU	ARITHMETIC LOGIC UNIT
	SCHMITT TRIGGER	RCVR	RECEIVER
1	SINGLE SHOT	(M)	ANNOTATION RESTRICTING THE NUMBER OF COINCIDENT INPUTS OR OUTPUTS GROUPED BELOW IT ACCORDING TO M. EXAMPLE: ($\leq$ 1) MEANS ONLY ONE OR LESS COINCIDENT INPUT OR OUTPUT BELOW ALLOWED.
Σ	SUMMING CIRCUIT		
>m <m	THRESHOLD (ANALOG OUTPUT) OR COMPARATOR (BINARY OUTPUT) PRODUCES A CHANGE IN THE OUTPUT SIGNAL WHEN INPUT EXCEEDS A PREDETERMINED LEVEL "m"	◇	WIRED "OR" OR WIRED "AND", OR OPEN COLLECTOR OR EMITTER CIRCUIT CAPABLE OF BEING USED AS WIRED "OR" OR "AND", SUCH AS ON BUS DRIVER CIRCUITS.
D	DATA INPUT		
C	CONTROL or CLOCK INPUT	O	NEGATING INDICATOR
G	CONTROL GATE INPUT - AFFECTS INPUTS OR OUTPUTS WITH "AND" RELATION TO ACTIVE STATE.		BILATERAL SWITCH. BINARY CONTROLLED, PASSES OR BLOCKS ANALOG OR BINARY SIGNALS IN EITHER DIRECTION.
V	CONTROL GATE INPUT - AFFECTS INPUTS OR OUTPUTS WITH AN "OR" RELATION TO THE ACTIVE STATE.		

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5.6.5 CIRCUIT TYPES AND WAVEFORMS

Figure 5-3A illustrates a typical integrated circuit. Figures 5-3B through 5-3S illustrates some of the more complicated circuits utilized in the logic.

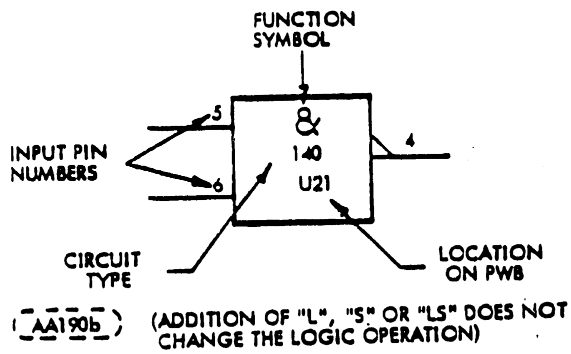


FIGURE 5-3A. TYPICAL INTEGRATED CIRCUIT

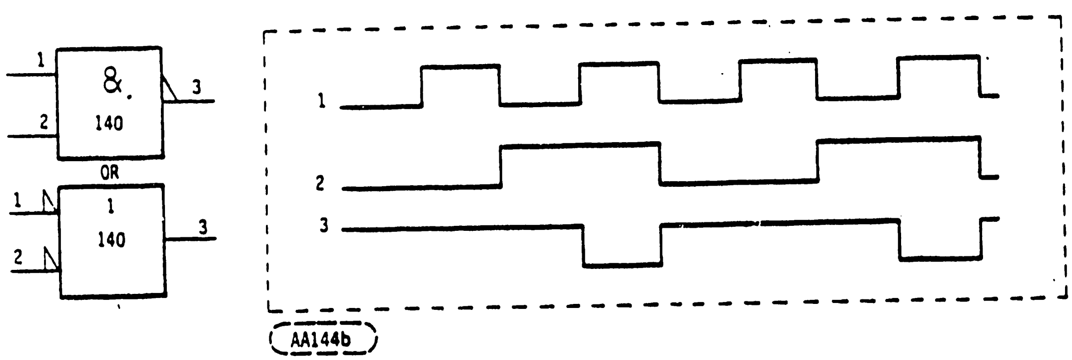


FIGURE 5-3B. POSITIVE NAND NEGATIVE NOR

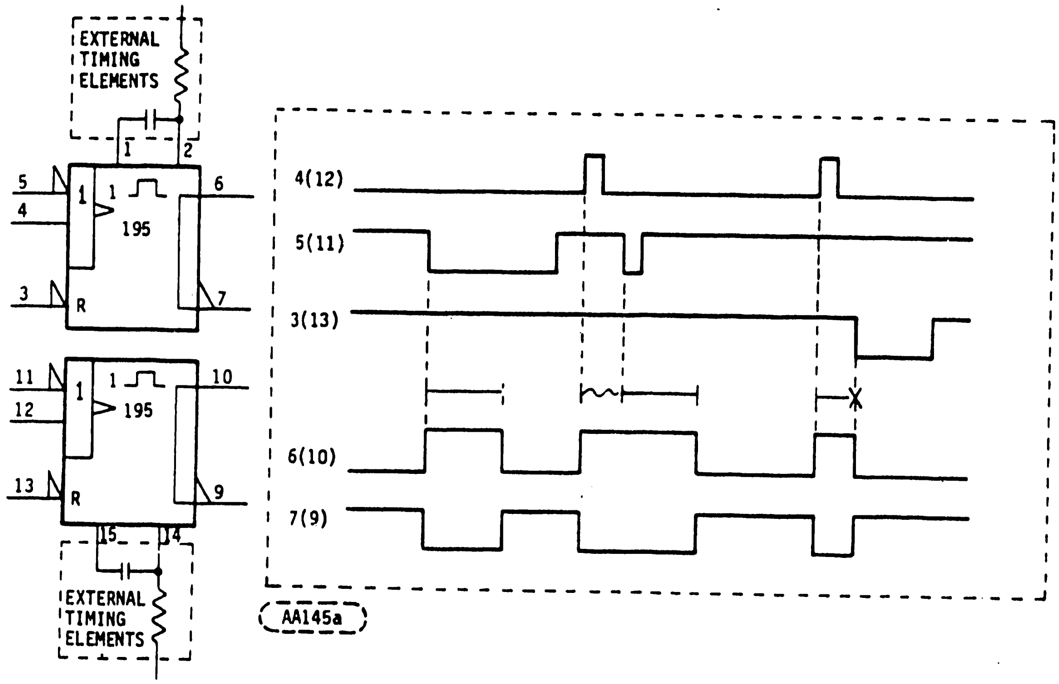


FIGURE 5-3C. RETRIGGERABLE, RESETTABLE, MONOSTABLE MULTIVIBRATOR (ONE SHOT)

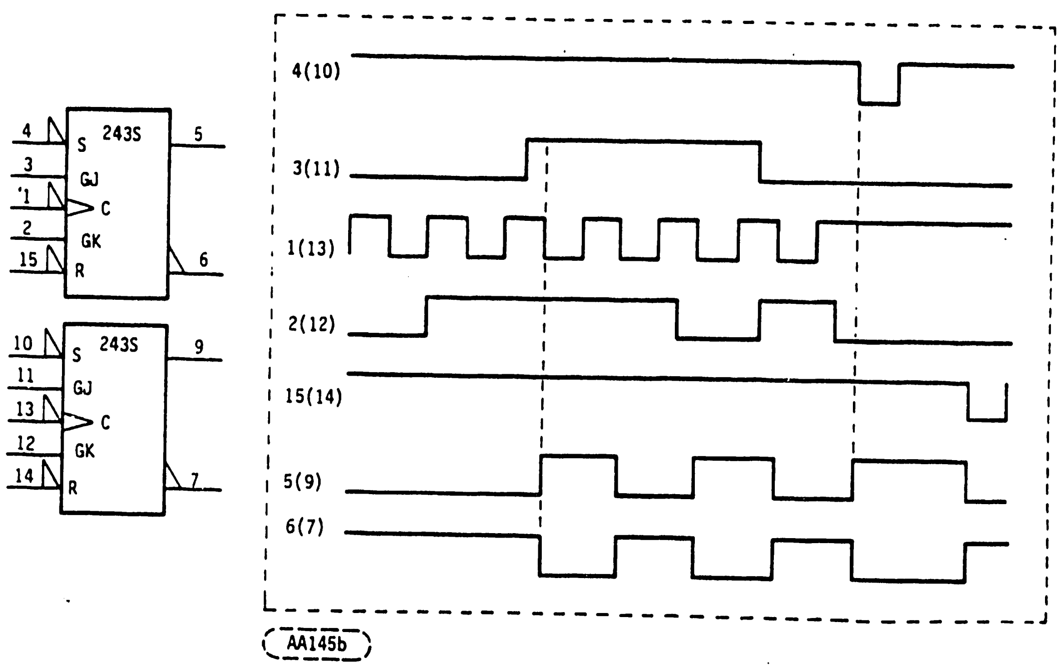


FIGURE 5-3D. "JK" NEGATIVE EDGE TRIGGERED TYPE F/F

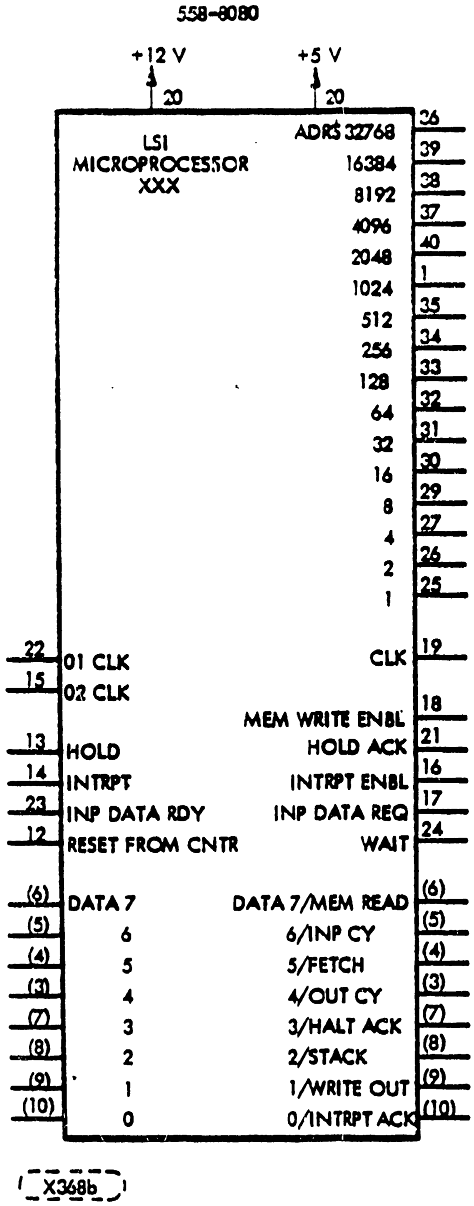


FIGURE 5-3E. 8080A MICROPROCESSOR
(SHEET 1 OF 2)

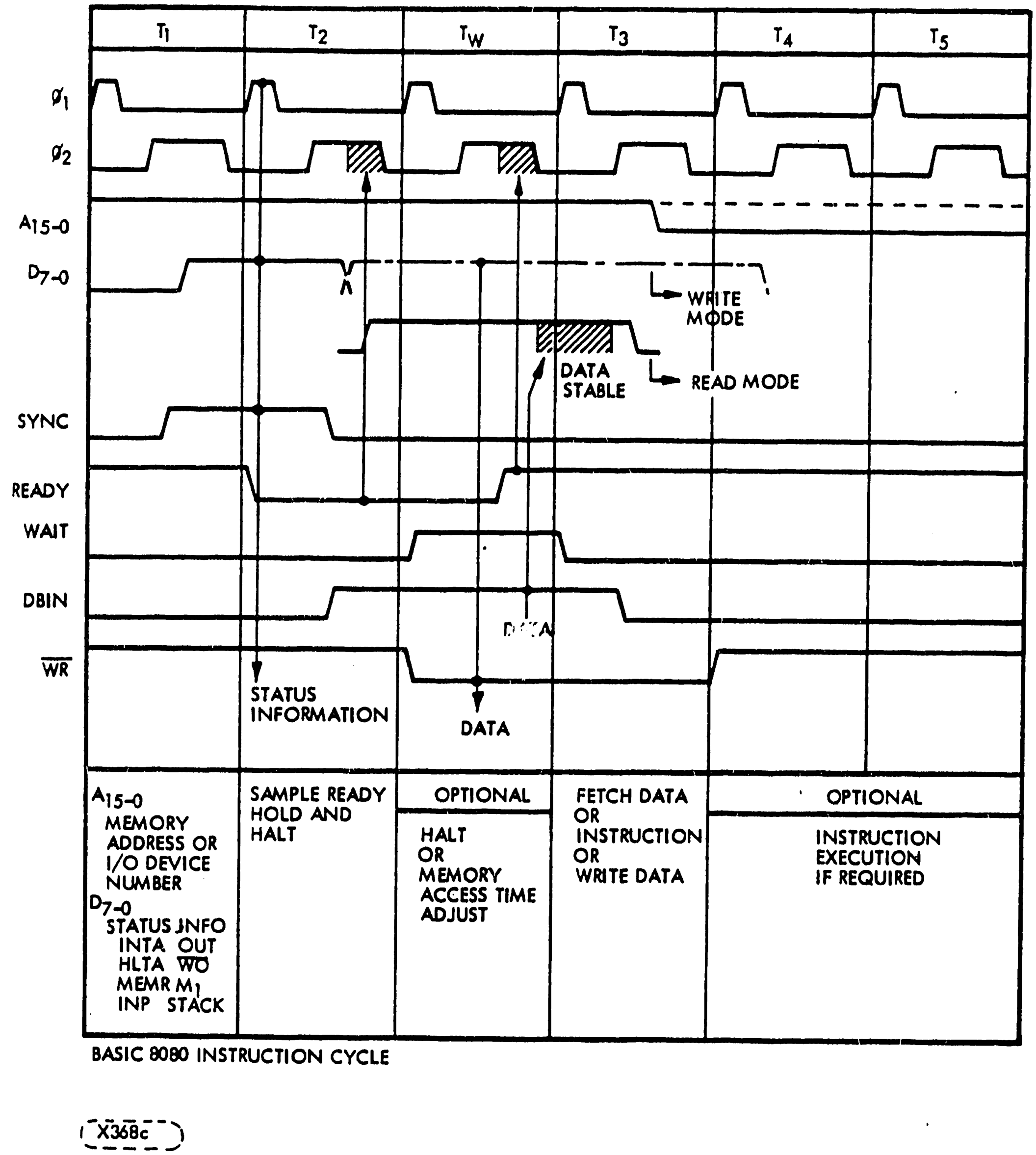


FIGURE 5-3E. 8080A MICROPROCESSOR
(SHEET 2 OF 2)

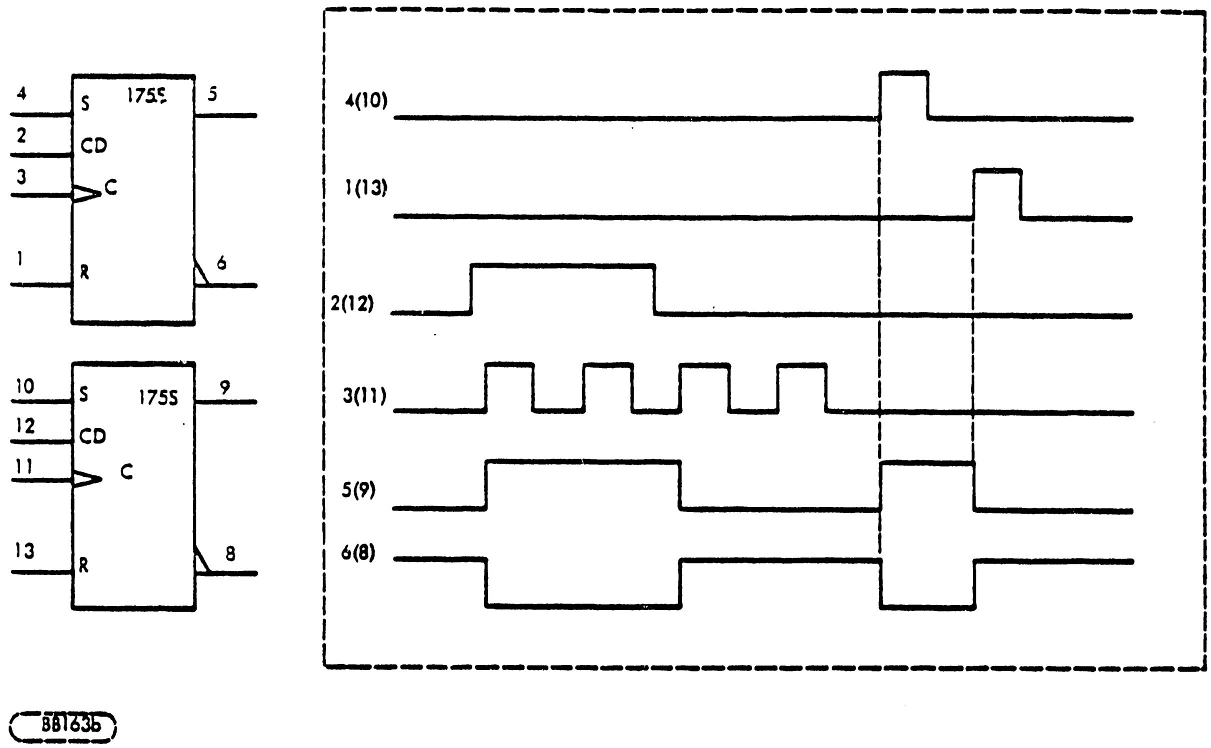


FIGURE 5-3F. "D" TYPE F/F

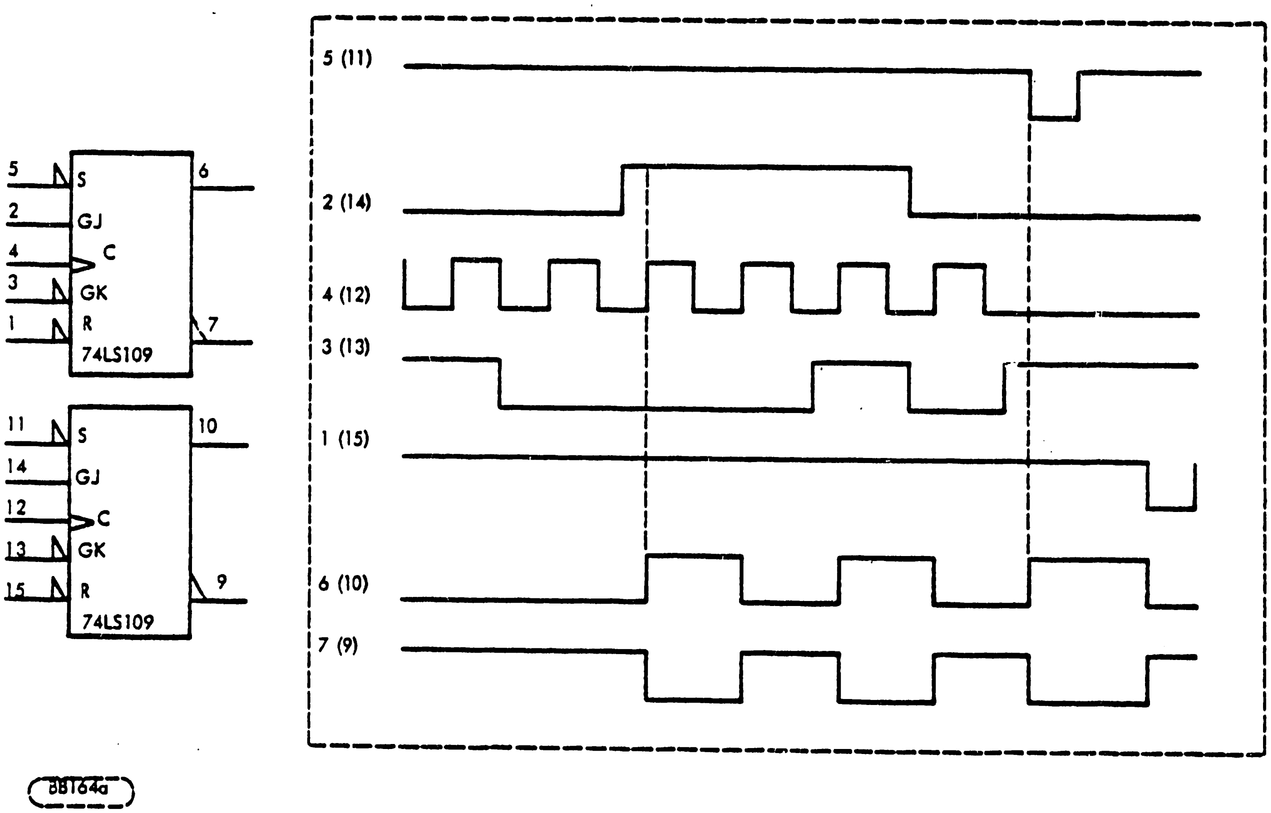


FIGURE 5-3G. "JK" POSITIVE EDGE TRIGGERED TYPE F/F

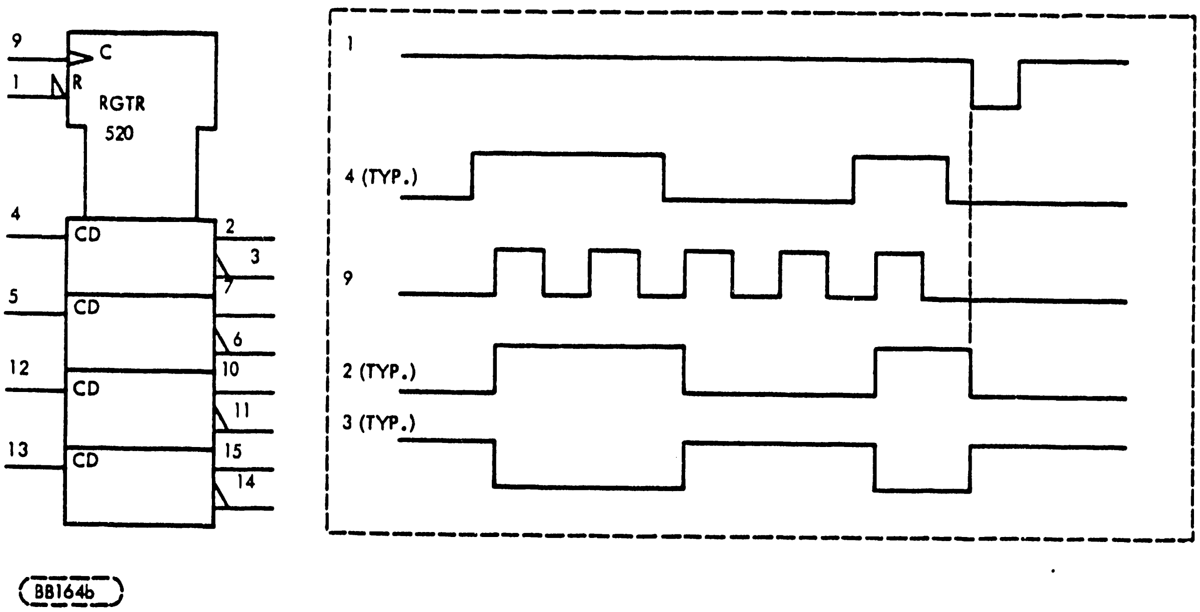
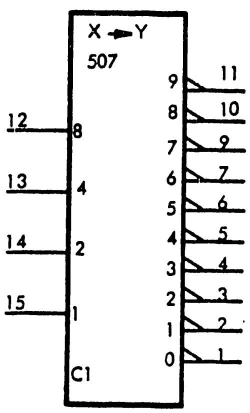


FIGURE 5-3H. QUAD TTL "D" TYPE F/F



INPUTS				OUTPUT COUNT (ONE LOW AT A TIME)										
8	4	2	1	9	8	7	6	5	4	3	2	1	0	
12	13	14	15	11	10	9	7	6	5	4	3	2	1	←PIN
L	L	L	L	H	H	H	H	H	H	H	H	H	L	
L	L	L	H	H	H	H	H	H	H	H	H	L	H	
L	L	H	L	H	H	H	H	H	H	H	L	H	H	
L	L	H	H	H	H	H	H	H	H	L	H	H	H	
L	H	L	L	H	H	H	H	H	L	H	H	H	H	
L	H	L	H	H	H	H	H	L	H	H	H	H	H	
L	H	H	L	H	H	H	L	H	H	H	H	H	H	
L	H	H	H	H	H	L	H	H	H	H	H	H	H	
H	L	L	L	H	L	H	H	H	H	H	H	H	H	
H	L	L	H	L	H	H	H	H	H	H	H	H	H	

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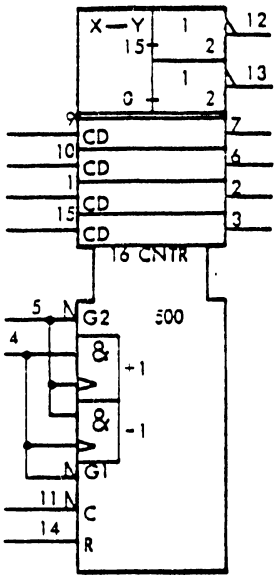
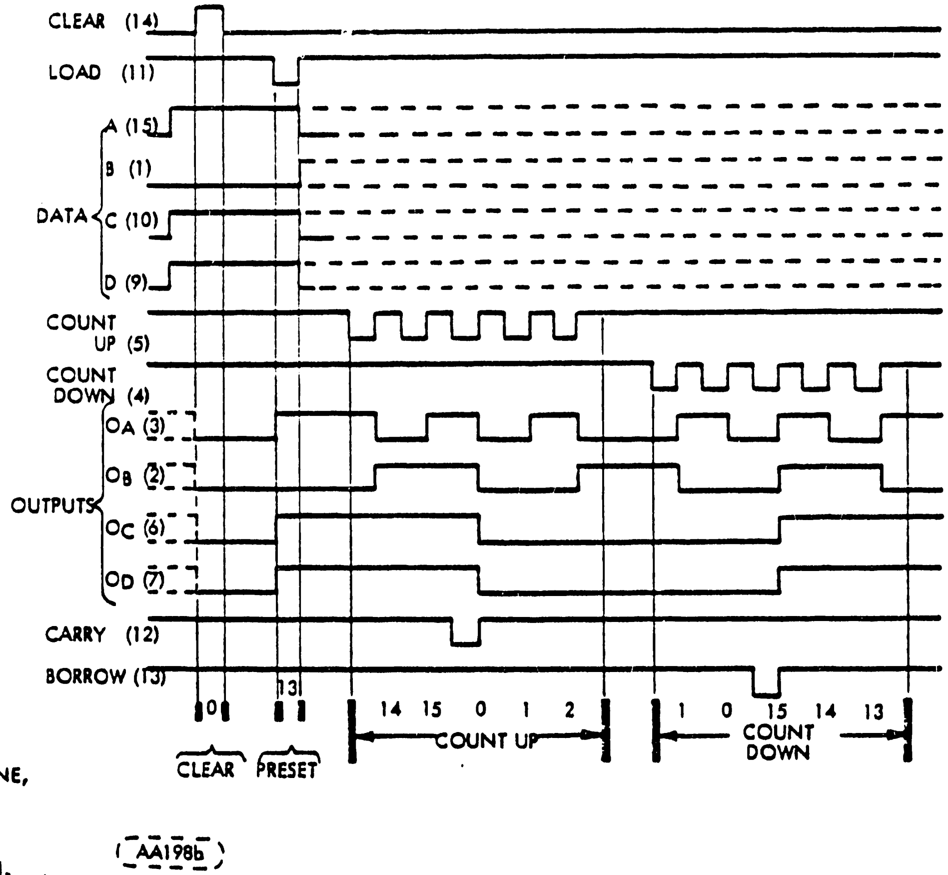
FIGURE 5-3I. BCD - DECIMAL DECODER





SEQUENCE:

(1) CLEAR OUTPUTS TO ZERO.

(2) LOAD (PRESET) TO BINARY THIRTEEN.

(3) COUNT UP TO FOURTEEN, FIFTEEN, CARY, ZERO, ONE, AND TWO.

(4) COUNT DOWN TO ONE, ZERO, BORROW, FIFTEEN, FOURTEEN, AND THIRTEEN.

NOTES:

(A) CLEAR OVERRIDES LOAD, DATA, AND COUNT INPUTS.

(B) WHEN COUNTING UP, COUNT-DOWN INPUT MUST BE HIGH: WHEN COUNTING DOWN, COUNT-UP INPUT MUST BE HIGH.

FIGURE 5-3J. 500 UP/DOWN COUNTER

TYPICAL CLEAR, PRESET, COUNT, AND INHIBIT SEQUENCES

ILLUSTRATED BELOW IS THE FOLLOWING SEQUENCE:

1. CLEAR OUTPUTS TO ZERO.
2. PRESET TO BINARY TWELVE.
3. COUNT TO THIRTEEN, FOURTEEN, FIFTEEN, ZERO, ONE, AND TWO.

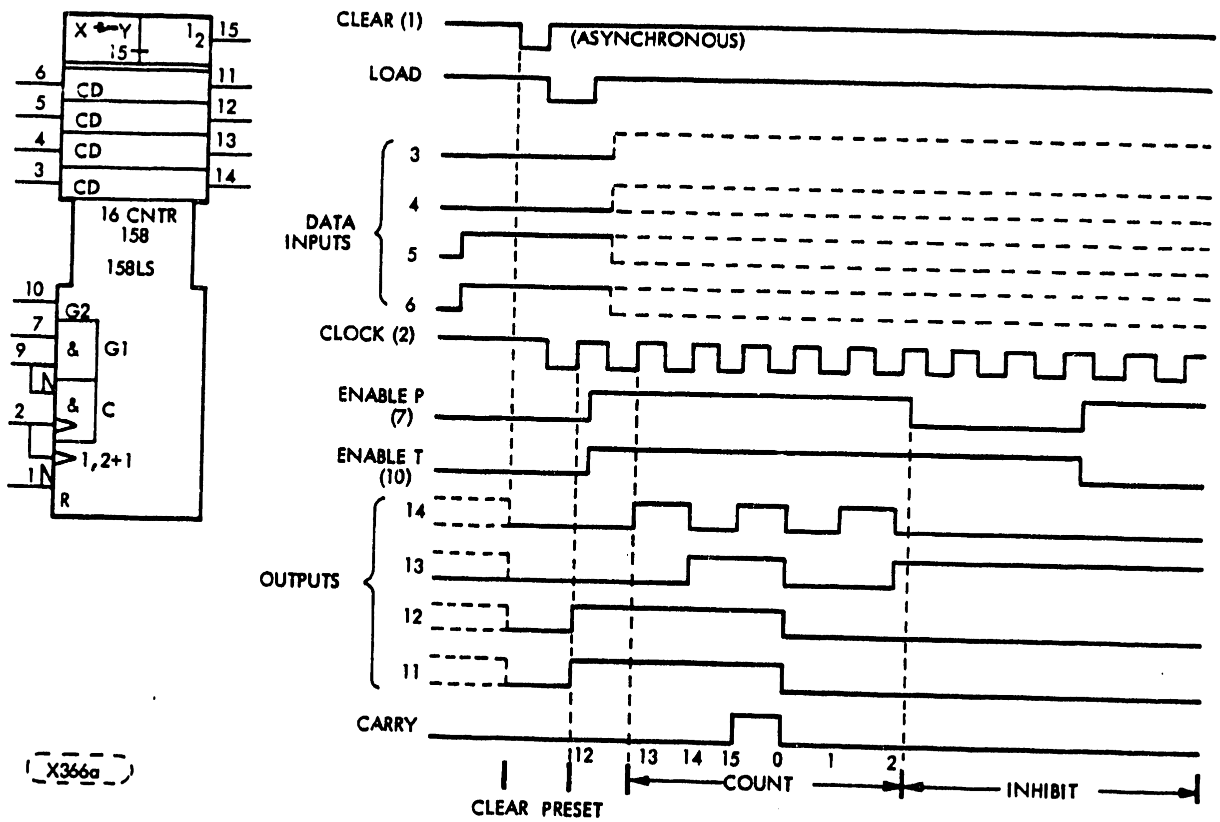


FIGURE 5-3K. 4-BIT BINARY COUNTER

TYPICAL CLEAR, SHIFT, AND CLEAR SEQUENCES

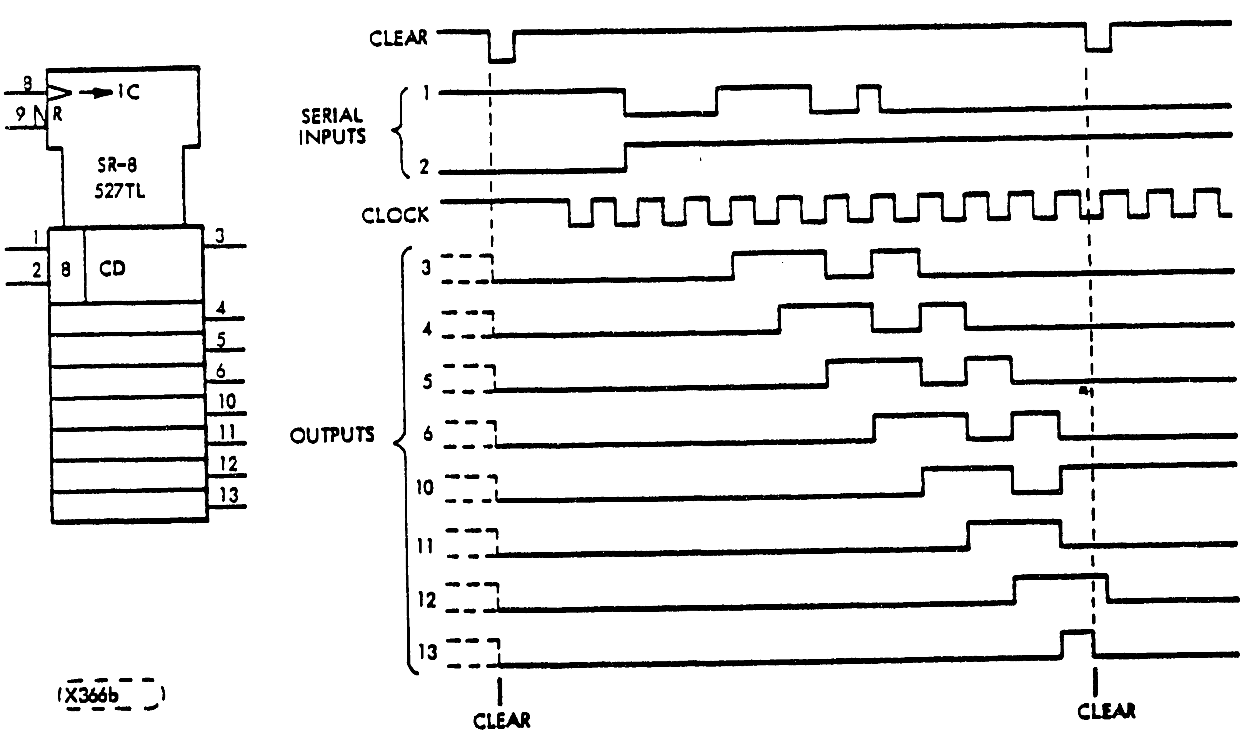


FIGURE 5-3L. SERIAL IN-PARALLEL OUT 8-BIT REGISTER

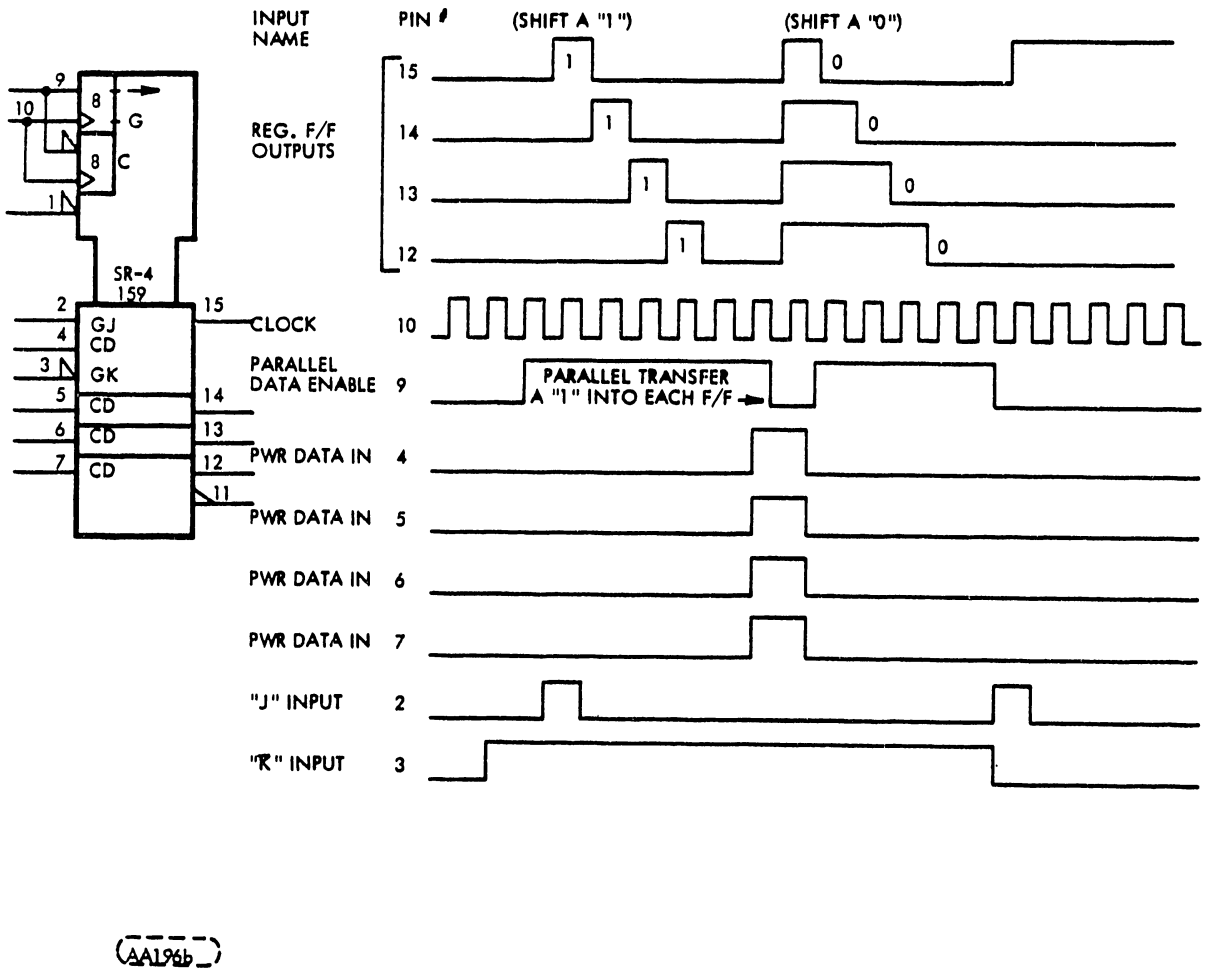
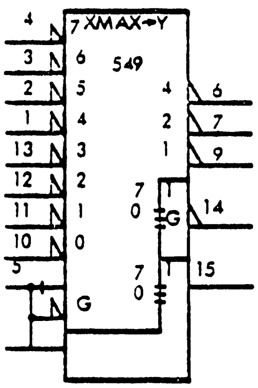


FIGURE 5-3M. FOUR FLIP-FLOP SHIFT REGISTER



INPUTS									OUTPUTS				
EN	0	1	2	3	4	5	6	7	4	2	1	G	E
5	10	11	12	13	1	2	3	4	6	7	9	14	15
H	X	X	X	X	X	X	X	X	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	X	X	X	X	X	X	X	L	L	L	L	L	H
L	X	X	X	X	X	X	L	H	L	L	H	L	H
L	X	X	X	X	X	L	H	H	L	H	L	L	H
L	X	X	X	X	L	H	H	H	L	H	H	L	H
L	X	X	X	L	H	H	H	H	H	L	L	L	H
L	X	X	L	H	H	H	H	H	H	L	H	L	H
L	X	L	H	H	H	H	H	H	H	H	L	L	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H

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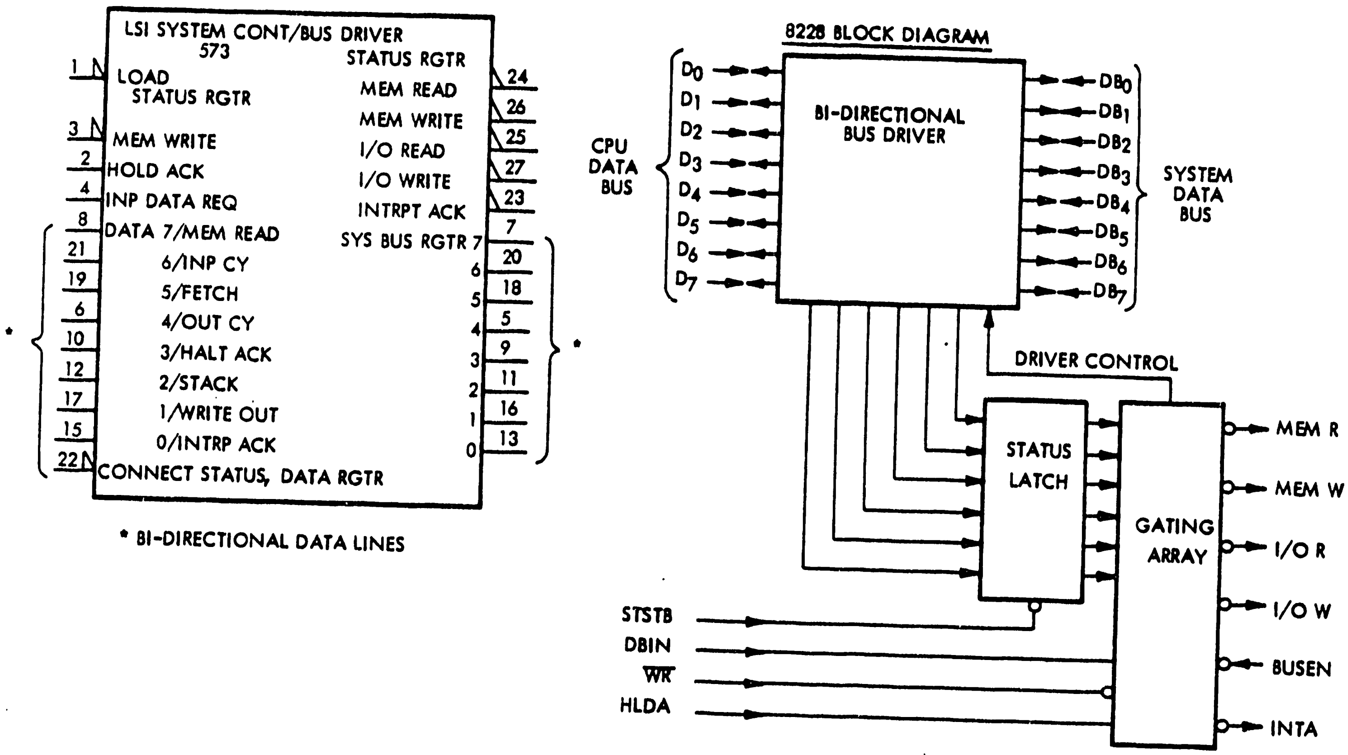
FIGURE 5-3N. 1 OUT OF 4 DECODER



PIN NAMES

D7-D0	DATA BUS (8080 SIDE)
DB7-DB0	DATA BUS (SYSTEM SIDE)
$\overline{\text{I/OR}}$	I/O READ
$\overline{\text{I/OW}}$	I/O WRITE
$\overline{\text{MEMR}}$	MEMORY READ
$\overline{\text{MEMW}}$	MEMORY WRITE
DBIN	DBIN (FROM 8080)

INTA	INTERRUPT ACKNOWLEDGE
HLDA	HLDA (FROM 8080)
$\overline{\text{WR}}$	WR (FROM 8080)
$\overline{\text{BUSEN}}$	BUS ENABLE INPUT
$\overline{\text{STSTB}}$	STATUS STROBE (FROM 8224)
V_{CC}	+5 V
GND	0 VOLTS

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FIGURE 5-30. SYSTEM CONTROLLER/BUS DRIVER FOR MICROPROCESSOR SYSTEM (SHEET 1 OF 2)

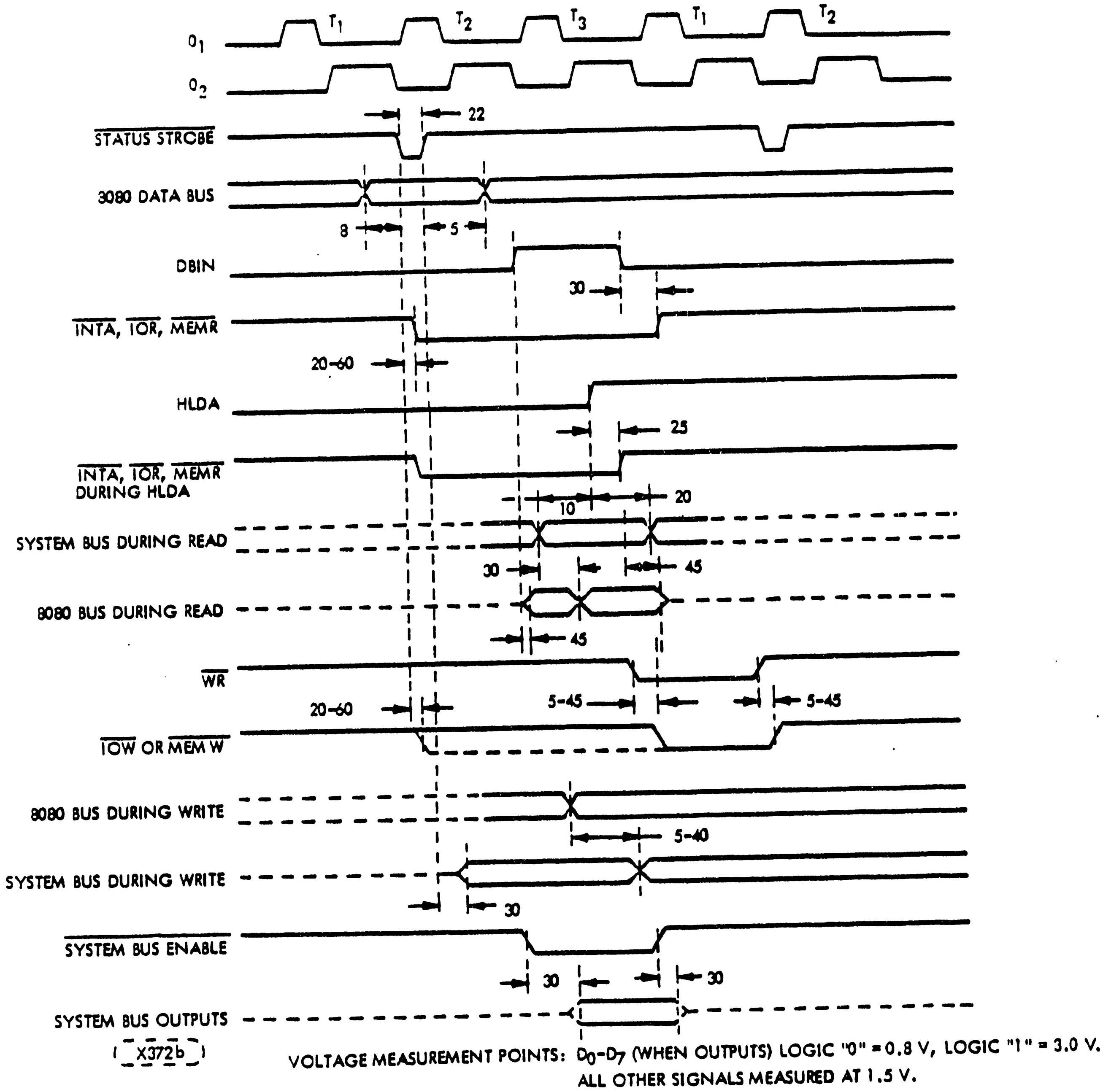


FIGURE 5-30. SYSTEM CONTROLLER/BUS DRIVER FOR MICROPROCESSOR SYSTEM (SHEET 2 OF 2)

SYSTEM CONTROLLER AND BUS DRIVER FUNCTIONAL DESCRIPTION

The 8228 System Controller and Bus Driver generates all signals required to directly interface the 8080A Microprocessor, RAM, ROM and I/O components.

The eight bit bi-directional bus drivers used provide high system TTL fan-out. They also provide isolation of the 8080A data bus from memory and I/O.

At the beginning of each machine cycle the 8080A CPU issues "status" information (see time "T2" on the timing diagram) on its data bus that indicates the type of activity that will occur during the cycle. The 8228 stores this information in the Status Latch (see block diagram) when the $\overline{\text{STSTB}}$ signal from the clock chip goes "low". The output of the Status Latch is connected to the Gating Array and is part of the Control Signal generation. The Gating Array generates control signals ($\overline{\text{MEM R}}$, $\overline{\text{MEM W}}$, $\overline{\text{I/O R}}$, $\overline{\text{I/O W}}$ and $\overline{\text{INTA}}$) by gating the outputs of the Status Latch with signals from the 8080A CPU (DBIN, WR, and HLDA).

The "read" control signals ($\overline{\text{MEM R}}$, $\overline{\text{I/O R}}$ and $\overline{\text{INTA}}$) are derived from the logical combination of the appropriate Status bit (or bits) and the DBIN input from the 8080A CPU.

The "write" control signals from the 8228 ($\overline{\text{MEM W}}$, $\overline{\text{I/O W}}$) are derived from the logical combination of the appropriate Status Bit (or bits) and the WR input from the 8080A CPU.

All signals are "active low" and directly interface to the Microprocessor RAM, ROM and I/O components.

The $\overline{\text{INTA}}$ control signal is used to gate the interrupt instruction in the interrupt port onto the data bus.

The $\overline{\text{BUSEN}}$ (Bus Enable) input to the Gating Array is an asynchronous input that forces the data bus output buffers and control signal buffers into their high-impedance state if it is a "one". If $\overline{\text{BUSEN}}$ is a "zero" normal operation of the data buffer and control signals take place.

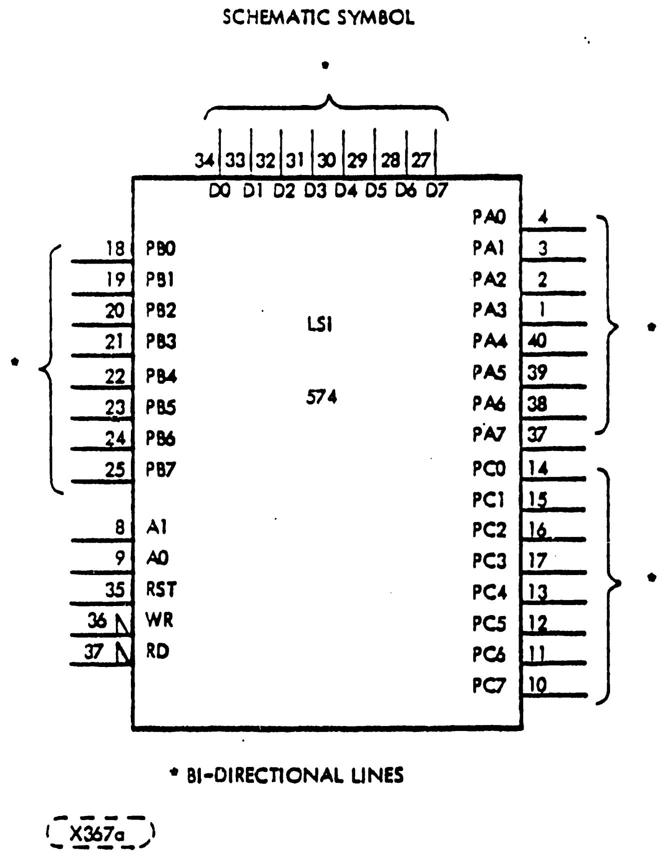
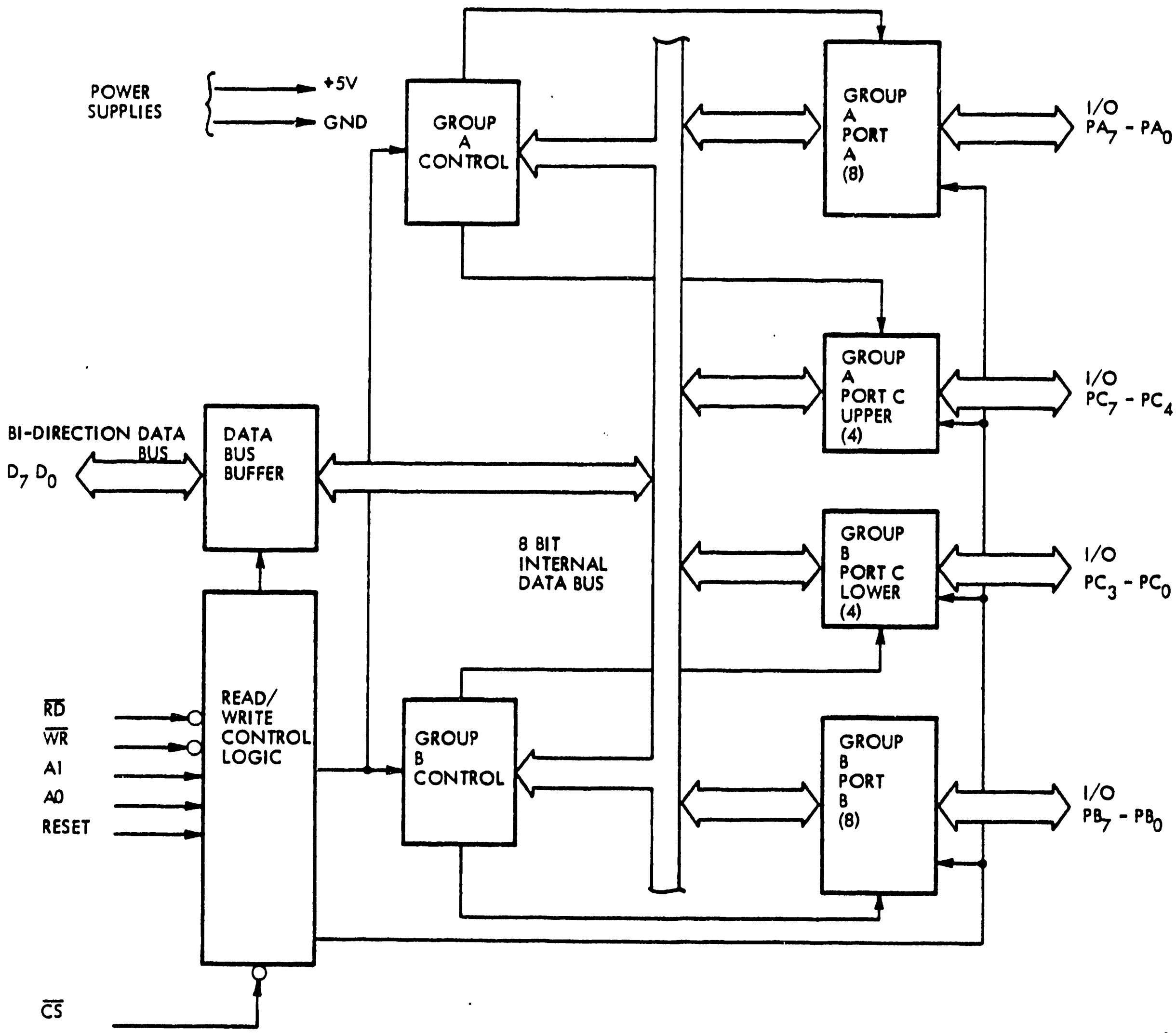


FIGURE 5-3P. 8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI) FOR MICROPROCESSOR (SHEET 1 OF 3)



8255 BASIC OPERATION

A1	A0	$\overline{RD}$	$\overline{WR}$	$\overline{CS}$	INPUT OPERATION (READ)
0	0	0	1	0	PORT A → DATA BUS
0	1	0	1	0	PORT B → DATA BUS
1	0	0	1	0	PORT C → DATA BUS
					OUTPUT OPERATION (WRITE)
0	0	1	0	0	DATA BUS → PORT A
0	1	1	0	0	DATA BUS → PORT B
1	0	1	0	0	DATA BUS → PORT C
1	1	1	0	0	DATA BUS → CONTROL
					DISABLE FUNCTION
X	X	X	X	1	DATA BUS → 3-STATE
1	1	0	1	0	ILLEGAL CONDITION

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FIGURE 5-3P. 8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI) FOR MICROPROCESSOR (SHEET 2 OF 3)

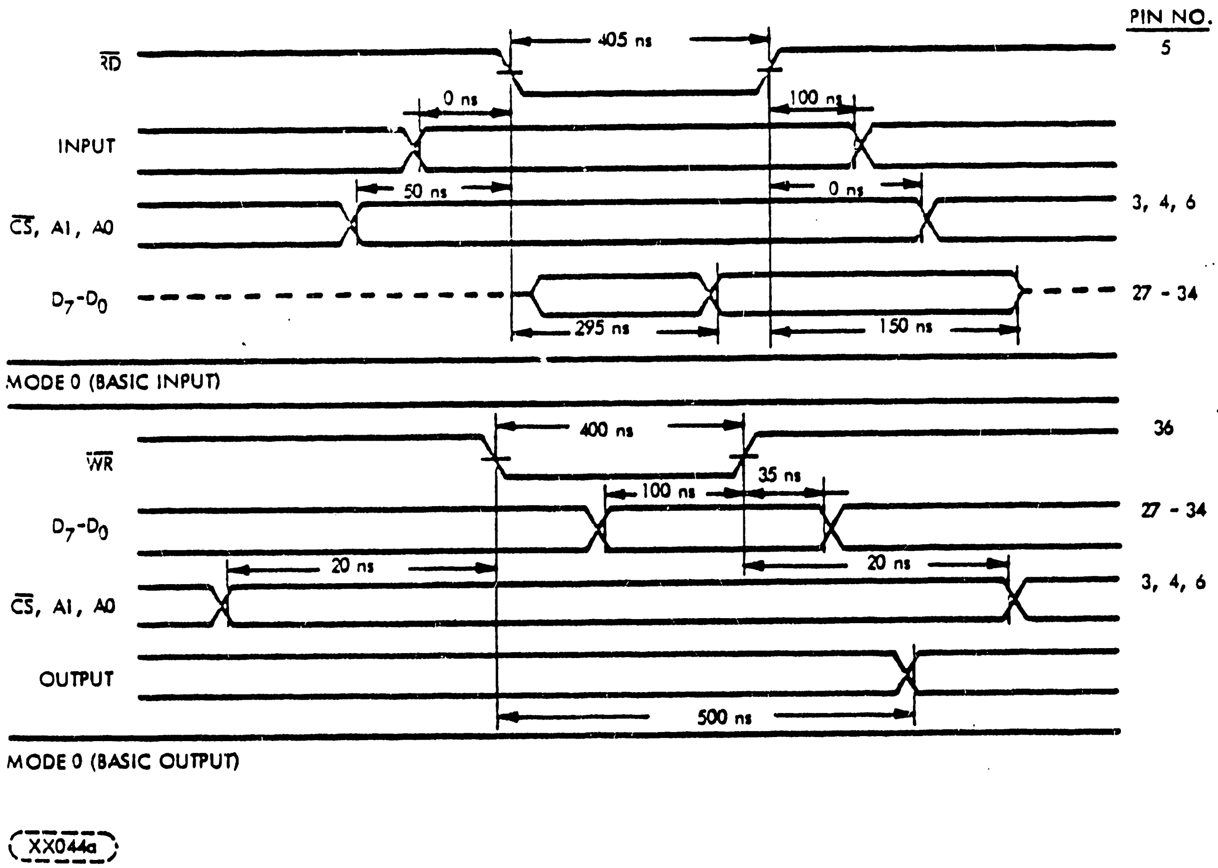


FIGURE 5-3P. 8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI) FOR MICROPROCESSOR (SHEET 3 OF 3)

8255A PROGRAMMABLE PERIPHERAL INTERFACE FUNCTIONAL DESCRIPTION

General

The 8255A is a Programmable Peripheral Interface (PPI) device designed for use in 8080A Microcomputer systems. Its function is that of a general purpose I/O component to interface peripheral devices to the 8080A system bus. The functional configuration of the 8255 is programmed by the 8080A software (or firmware) so that normally no external logic is necessary to interface peripheral devices or structures.

Functional descriptions of the logic subsections are given in the following paragraphs. See block diagram (Figure 5-3P) of the 8255A.

- Data Bus Buffer

  This 3-state, bi-directional, eight bit buffer is used to interface the 8255 to the 8080A system data bus. Data is transmitted or received by the buffer upon execution of Input or Output instructions by the 8080A CPU. Control Words and Status information are also transferred through the Data Bus buffer.

- Read/Write and Control Logic

  The Read/Write Control Logic in the 8255A manages all of the internal and external transfers of both Data and Control or Status words. It accepts inputs from the 8080A CPU Address and Control busses and in turn, issues commands to both of the Control Groups in the 8255A.

- I/O Ports A, B and C

  The 8255A contains three 8-bit ports (A, B and C). All can be configured in a wide variety of functional characteristics by the 8080A software (or firmware) but each has its own special features or "personality" to further enhance the power and flexibility of the 8255A.

  Port A: One 8-bit output latch/buffer and one 8-bit data input latch.
  Port B: One 8-bit data input/output latch/buffer and one 8-bit data input buffer.
  Port C: One 8-bit data output latch/buffer and one 8-bit data input buffer (no latch for input). This port can be divided into two 4-bit ports under the mode control. Each 4-bit port contains a 4-bit latch and it can be used for the control signal outputs and status signal inputs in conjunction with Ports A and B.

• Group A and Group B Controls

The 8080A software/firmware programs the functional configuration of each port. It does so by executing a single Output instruction during which the data bus D0--D7 contains the control code required to accomplish the setting up to the desired modes of operation of the 8255A unit. The coding on the memory address lines during the execution of the Output instruction take part in setting up the modes also, in that they define which PPI and which port the coded byte on the data bus lines is intended for (see Table 4-1).

"Group A Controls" control Port A and part of Port C and "Group B Controls" control Port B and the other part of Port C. Setting up of the various modes of operation involves setting the basic mode (0, 1 or 2), establishing for each port whether it will function as an input or output port, and setting or resetting individual bits in Port C. The CMD only uses the 8255A in Mode 0 which simply provides input and output operations for each port. No "handshaking" is required, data is simply written to or read from a specified port. Mode 1 provides strobed input/out (Port C provides the control lines for "handshaking") and Mode 2 provides a bi-directional bus (with Port C on the "handshakes" again). All operations involving the 8255 take place during 8080A instruction execution time. Therefore, the timing of all inputs/outputs/control signals to/from the 8255A are tied strictly to the timing of the 8080A I/O timing. This is shown in the timing diagrams in Figures 5-3P, 4-15 and 4-16.

8212

TIMING DIAGRAM

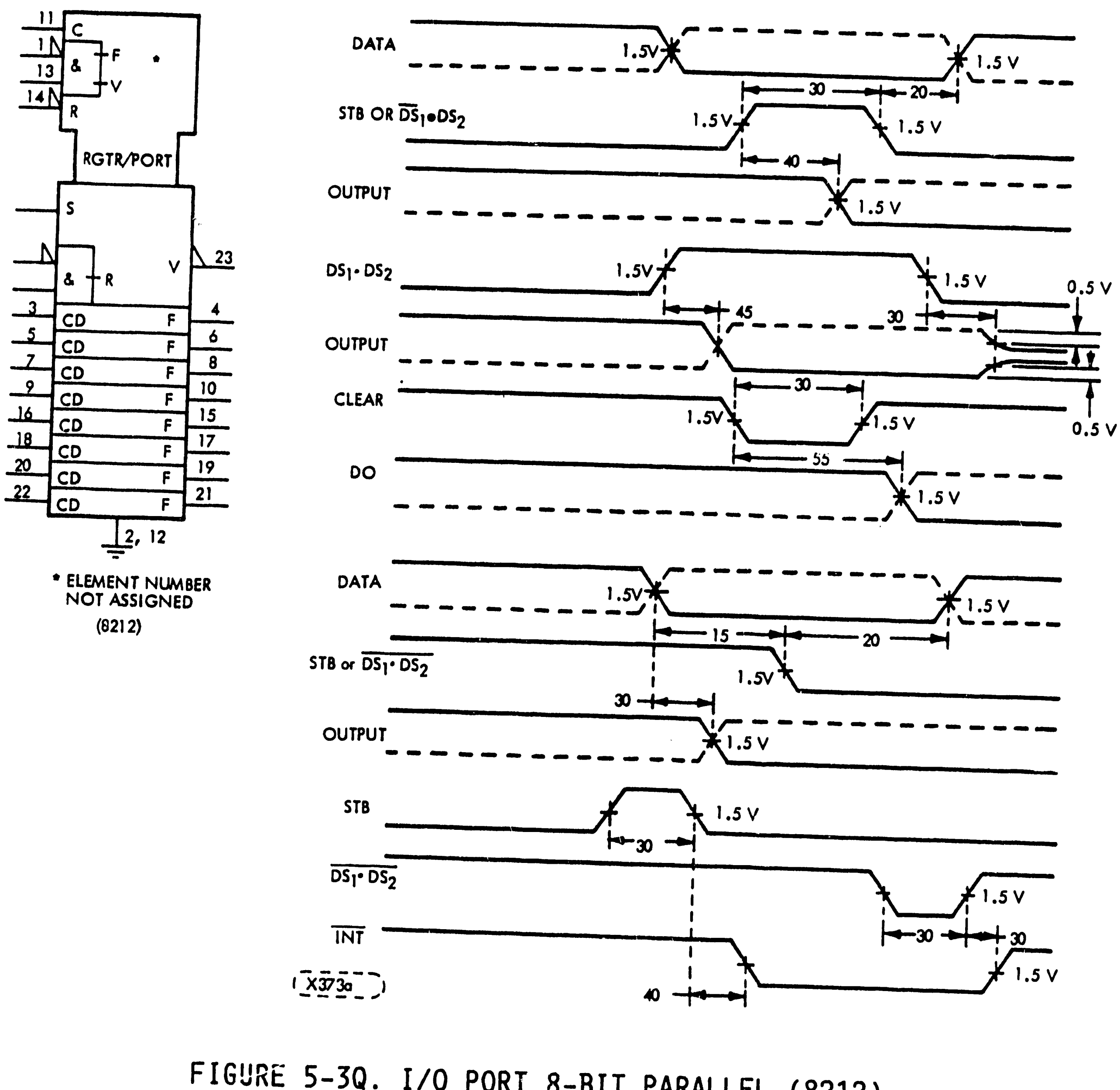


FIGURE 5-3Q. I/O PORT 8-BIT PARALLEL (8212)

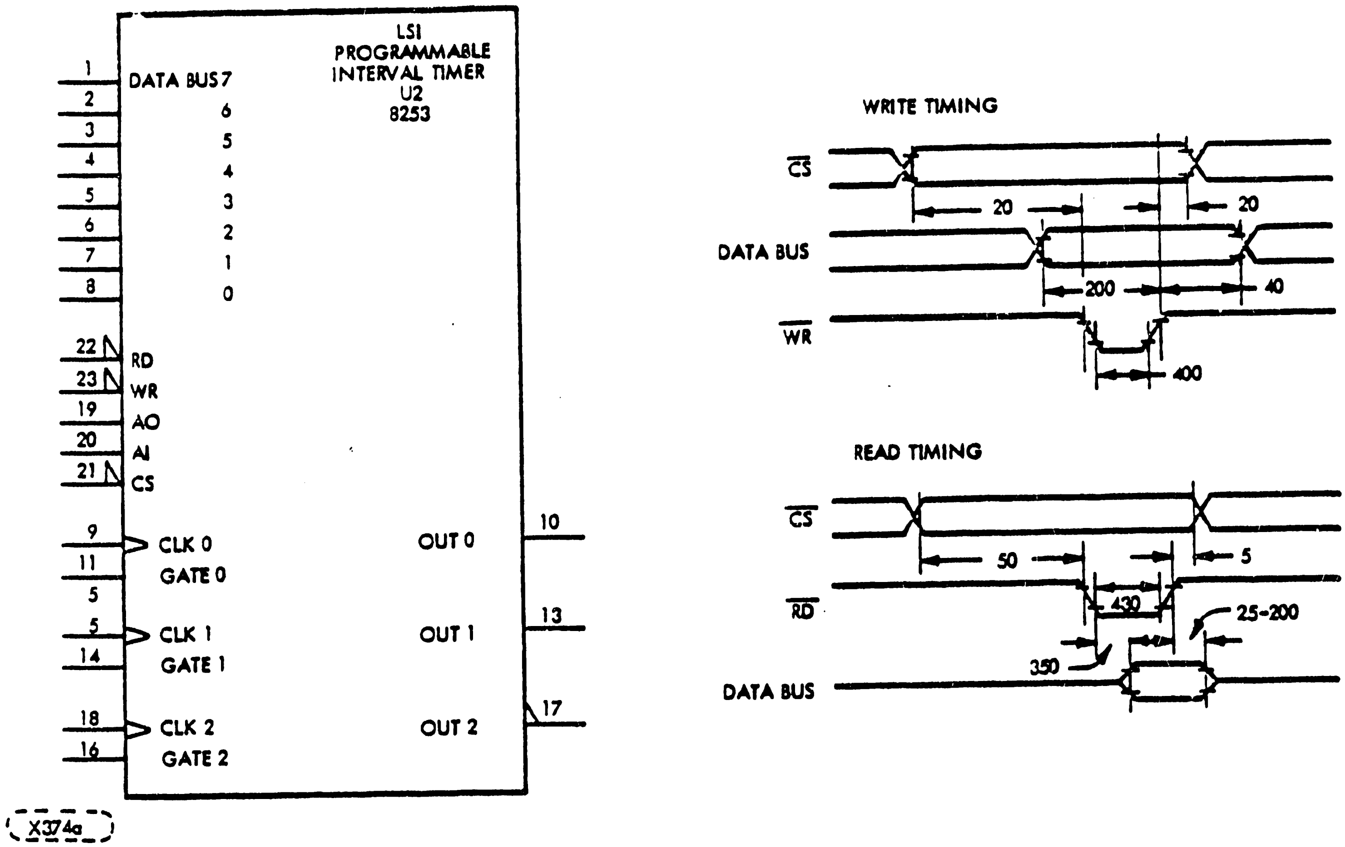


FIGURE 5-3R. 8253 LSI PROGRAMMABLE INTERVAL TIMER FOR 8080 SYSTEM (SHEET 1 OF 2)

CONTROL LINE TRUTH TABLE

$\overline{CS}$	$\overline{RD}$	$\overline{WR}$	A_1	A_0	
0	1	0	0	0	LOAD COUNTER NO. 0
0	1	0	0	1	LOAD COUNTER NO. 1
0	1	0	1	0	LOAD COUNTER NO. 2
0	1	0	1	1	WRITE MODE WORD
0	0	1	0	0	READ COUNTER NO. 0
0	0	1	0	1	READ COUNTER NO. 1
0	0	1	1	0	READ COUNTER NO. 2
0	0	1	1	1	NO-OPERATION 3-STATE
1	X	X	X	X	DISABLE 3-STATE
0	1	1	X	X	NO-OPERATION 3-STATE

CONTROL WORD FORMAT

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
SC1	SC0	RL1	RL0	M2	M1	M0	0

DEFINITION OF CONTROL FIELDS

SC-SELECT COUNTER

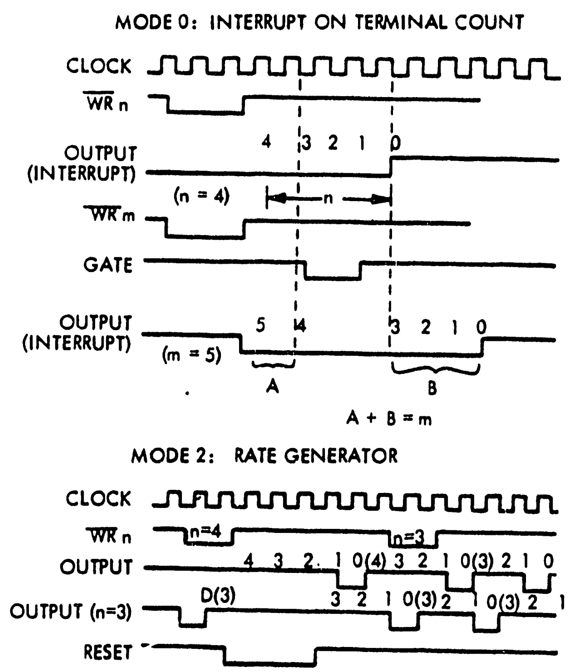
SC1	SC0	
0	0	SELECT COUNTER 0
0	1	SELECT COUNTER 1
1	0	SELECT COUNTER 2
1	1	ILLEGAL

RL-READ/LOAD

RL1	RL0	
0	0	COUNTER LATCHING OPERATION (SEE READ/WRITE PROCEDURE SECTION)
1	0	READ/LOAD MOST SIGNIFICANT BYTE ONLY
0	1	READ/LOAD LEAST SIGNIFICANT BYTE ONLY
1	1	READ/LOAD LEAST SIGNIFICANT BYTE FIRST, THEN MOST SIGNIFICANT BYTE.

X374b

TYPICAL TIMING FOR MODES USED

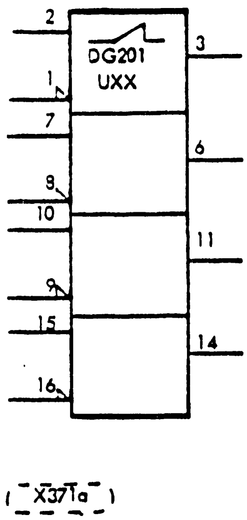


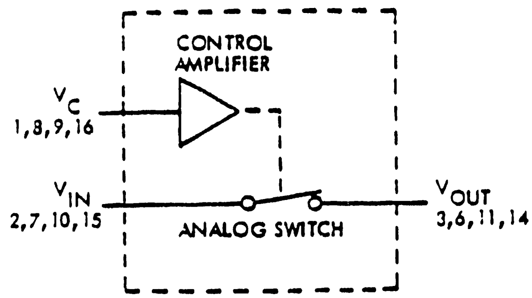
M-MODE

M2	M1	M0		
0	0	0	MODE 0	
0	0	1	MODE 1	*
X	1	0	MODE 2	
X	1	1	MODE 3	*
1	0	0	MODE 4	*
1	0	1	MODE 5	*

* NOT USED

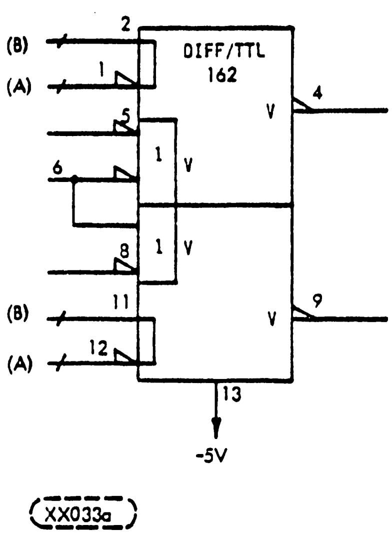
FIGURE 5-3R. 8253 LSI PROGRAMMABLE INTERVAL TIMER FOR 8080 SYSTEM (SHEET 2 OF 2)





V_C	V_{IN}	V_O	SWITCH POSITION
LOGIC 1	V_{IN}	OPEN CIRCUIT	OPEN
LOGIC 0	V_{IN}	V_{IN}	CLOSED

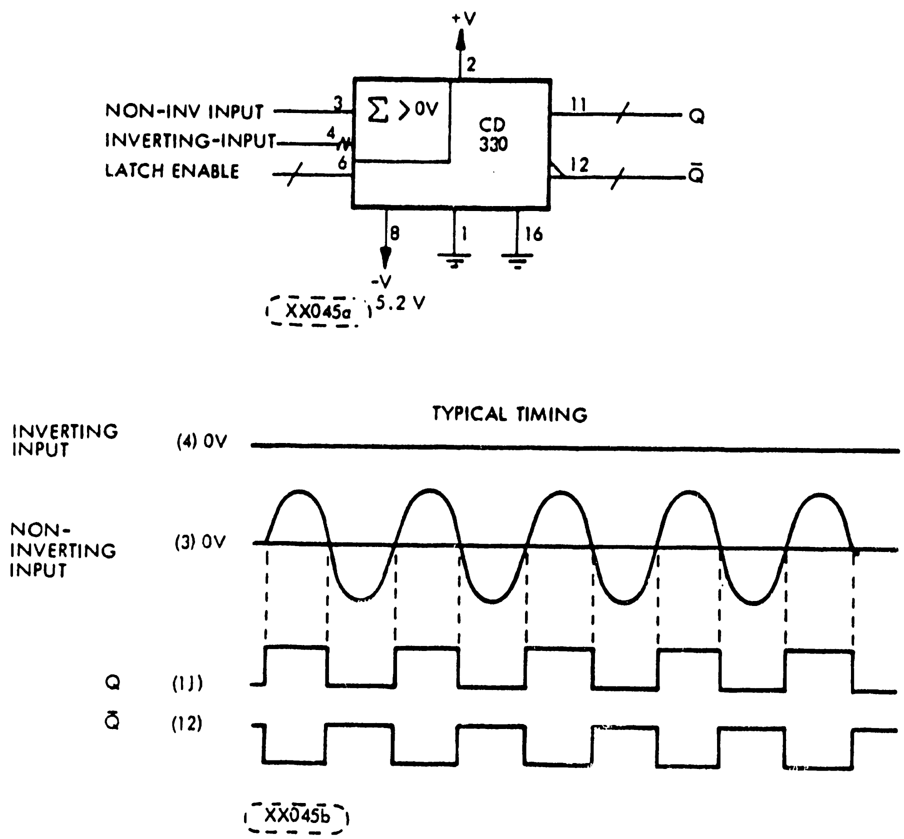
FIGURE 5-3S. ANALOG SWITCH



DIFFERENTIAL INPUTS	STROBES G1	STROBES G2	OUTPUT
$V_{ID} \geq$ 25 MV	L OR H	L OR H	H
-25MV < V_{ID} < 25MV	L OR H	L	H
	L	L OR H	H
	H	H	INDETERMINATE
$V_{ID} \leq$ -25MV	L OR H	L	H
	L	L OR H	H
	H	H	L

THE DIFFERENTIAL INPUT VOLTAGE POLARITIES SHOWN MEASURED AT PIN A WITH RESPECT TO PIN B. A MINUS POLARITY INDICATES THAT PIN A IS MORE NEGATIVE THAN PIN B.

FIGURE 5-3T. LINE RECEIVER, DTL/TTL DUAL DIFFERENTIAL



THE 330 CIRCUIT IS A DIFFERENTIAL VOLTAGE COMPARATOR. THE CIRCUIT HAS DIFFERENTIAL ANALOG INPUTS AND COMPLEMENTARY LOGIC OUTPUTS COMPATIBLE WITH ECL. A LATCH FUNCTION ALLOWS THE COMPARATOR TO BE USED IN A SAMPLE-H LD MODE. IF THE LATCH ENABLE INPUT IS HIGH, THE COMPARATOR FUNCTIONS NORMALLY. WHEN THE LATCH ENABLE GOES LOW, THE COMPARATOR OUTPUTS ARE LOCKED IN THEIR EXISTING LOGICAL STATES.

FIGURE 5-3U. DIFFERENTIAL VOLTAGE COMPARATOR

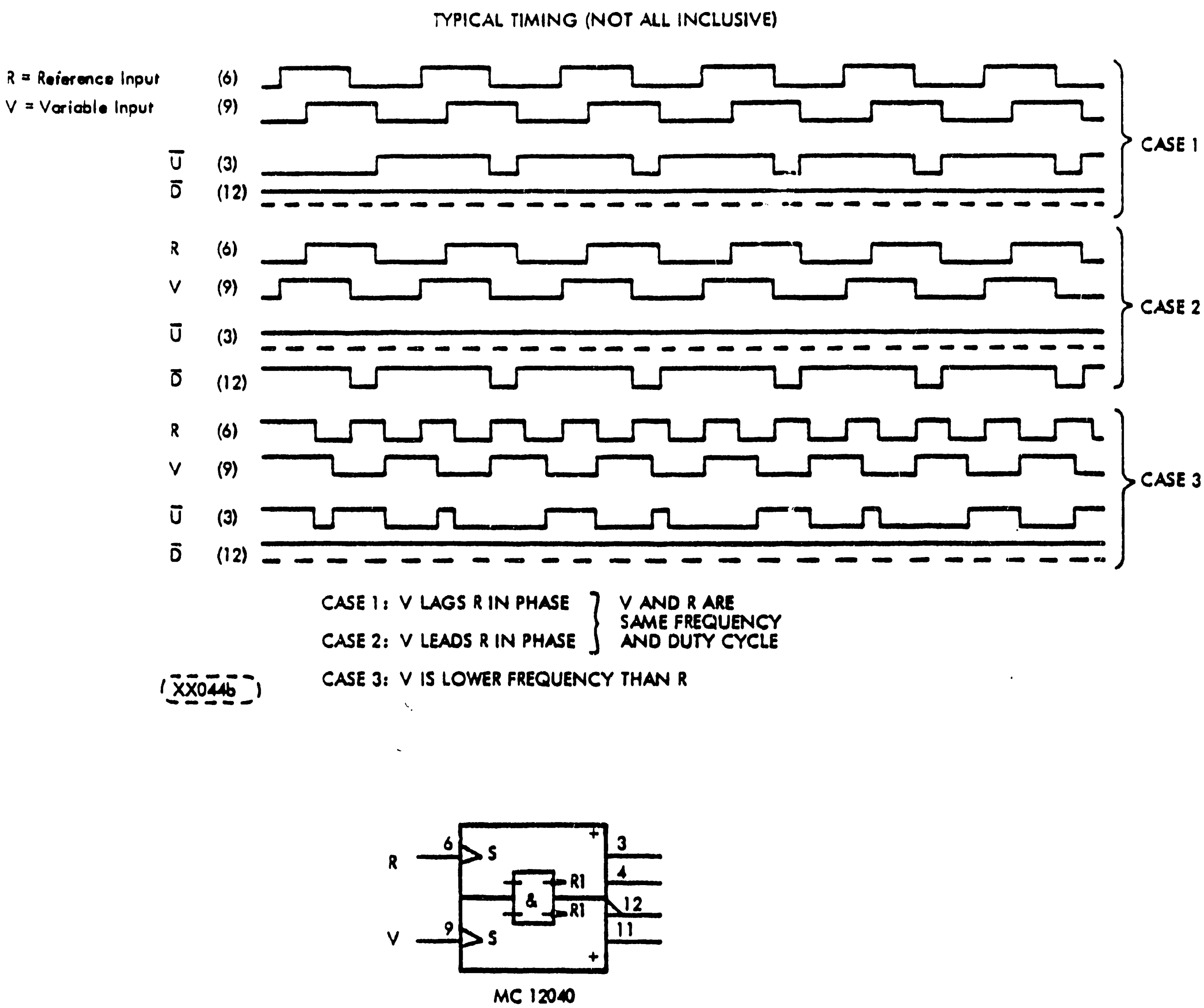


FIGURE 5-3V. PHASE-FREQUENCY DETECTOR

I/O CIRCUIT BOARD (01XX)

EM1-P1

SOURCE/DEST	X-REF	SIGNAL (A)	X-REF	PIN	SIGNAL (B)	X-REF	SOURCE/DEST	X-REF
		GND	0101	6	GND	0101		
J1-04 1101 P2-B11	0305	START/-L	0105	10				
P1-A13	0206	IDX-BUF/-L	0104	13				
P1-A14	0206	SEC-BUF/-L	0104	14				
P1-B21	0206	READY-GATE/+L	0,34	21				
				22	INHIB-SEC/-L	0104	P1-B22	0204
		GND	0101	23	GND	0101		
				30	PRES -SW/+L	010*	P1-B31	030*
P1-B36	0204	I/O-LATE-STROBE/-L	0103	36				
P1-B37	0204	I/O-EARLY-STROBE/-L	0103	37				
P1-B38	0606	INHIBIT-SECTOR/+L	0104	38				
		GND	0101	39	GND	0101		
P1-B40	0606	INDEX/-L	0104	40				
P1-B42	0204	I/O-WRT-GATE/-L	0102	42				
P1-B43	0204	I/O-READ-GATE/+L	0102	43	VOL-CHANGE/-L	0105	P1-A43	0204, P1-A43 0303
		+5 V	0101	44	+5 V	0101		

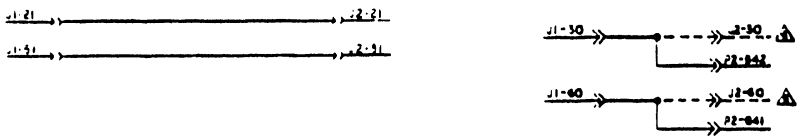
EM1-P2

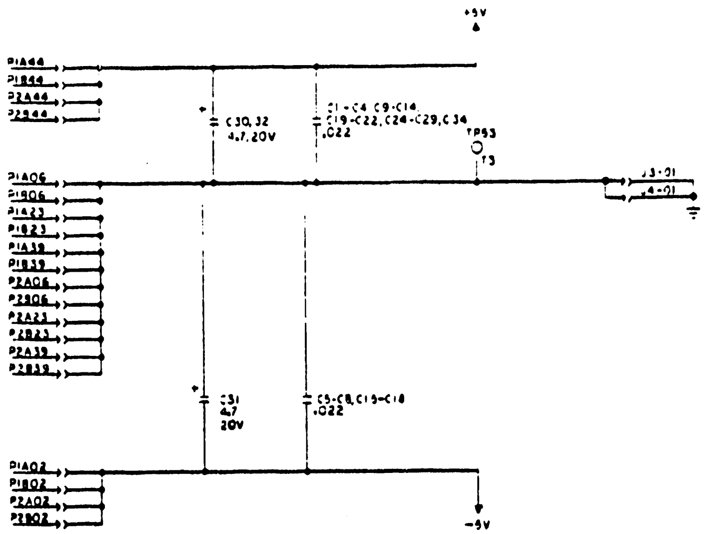
SOURCE/DEST	X-REF	SIGNAL (A)	X-REF	PIN	SIGNAL (B)	X-REF	SOURCE/DEST	X-REF
		-5 V	0101	2	-5 V	0101		
P2-B03	0305	SEQ-PICK/+L	0105	3				
P2-B04	0305	SEQ-HOLD/+L	0105	4				
P2-B05	0305	UP-TO-SPEED/+L	0105	5				
		GND	0101	6	GND	0101		
P2-B07	*	BUS-OUT-2WT7/+L	0102	7				
P2-B08	0205	BUS-OUT-2WT0/+L	0102	8				
P2-B09	0205	BUS-OUT-2WT1/+L	0102	9				
P2-B10	0205	BUS-OUT-2WT2/+L	0102	10				
				12	RTZ/-L	0103	P2-A12	0205
				13	ON-CYL	0104	P2-A13	0204
P2-B15	0306	OFFSET-ACT/+L	0103	15				
P2-B16	0205	SELECT/-L	0102	16				
P2-B17	0205	HD-ADDR/-L	0102	17				
P2-B18	0206	PWR-UP-MR/-L	0105	18				
P2-B20	0204	MOD-ADDR/-L	0102	20				
P2-B21	0202	TGO/-L	0103	21	SEEK/-L	0105	P2-A21	020*, P2-B21 0305
				22	FXD/+L	0103	P2-B22	0205
		GND	0101	23	GND	0101		
P2-B24	0203	CLR-FLT-STAT/-L	0103	24	OFFSET -/+L	0102	P2-B24	0305
				25	OFFSET +/+L	0102	P2-B25	0305
P2-B26	0206	FAULT/-L	0104	26	CYL-ADDR-0/+L	0102	P2-B26	0303
P2-B27	0204	SK-ERR/-L	0104	27	CYL-ADDR-1/+L	0102	P2-B27	0303
P2-B28	0205	AM-FND/-L	0104	28	CYL-ADDR-2/+L	0102	P2-B28	0303
P2-B29	0206	WRT-PROT/-L	0104	29	CYL-ADDR-3/+L	0102	P2-B29	0303
P2-B30	0205	I/O-AM-ENABLE/+L	0103	30	CYL-ADDR-4/+L	0103	P2-B30	0303
				31	CYL-ADDR-5/+L	0103	P2-B31	0303
				32	CYL-ADDR-6/+L	0103	P2-B32	0303
				33	CYL-ADDR-7/+L	0103	P2-B33	0303
				34	CYL-ADDR-8/+L	0103	P2-B34	0303
P2-B35	0205	SEL-0/+L	0103	35	CYL-ADDR-9/+L	0103	P2-B35	0303
P2-B36	0205	SEL-1/+L	0103	36				
P2-B37	0205	SEL-2/+L	0103	37				
P2-B38	0205	SEL-3/+L	0103	38				
		GND	0101	39	GND	0101		
				43	SECTOR-PULSE/-L	0104	P2-B43	0304
		+5 V	0101	44	+5 V	0101		

XX228

*WIRED TO, BUT NOT USED ON PWA

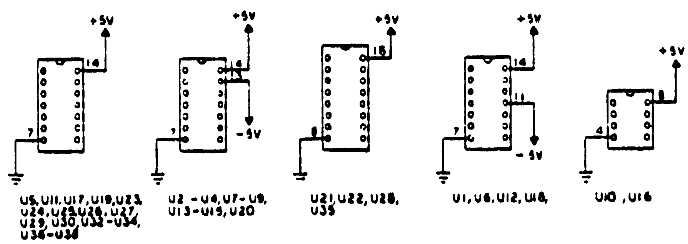
FIGURE 5-4. I/O CKT BOARD (SHEET 1 OF 9)





UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
216LS	74LS32	U5	11
943LS	74LS14	U25	4
203LS	74LS05	U11	6,8,10,12
213LS	74LS11	U29	6
139	9602	U35	5 or 7
148LS	74LS02	U33	1,4,10
224LS	74LS27	U30	8,12
46LS	74LS04	U38	10,12

TABLE A		
SWITCH CONFIGURATION		FUNCTION
S3-1	S3-2	
OFF	OFF	STANDARD
ON	—	Δ4
	ON	Δ5



NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS, 1/4 W, ±5%
2. CAPACITANCE VALUES ARE IN MICROFARADS
Δ3. SEE TABLE A FOR JUMPER CONFIGURATION
Δ4. S3-1=VALIDATE ON CYLINDER WITH VALID SECTOR
Δ5. S3-2=PSEUDO SEEK WITH VOLUME CHANGE
Δ6. NOT CONNECTED ON ASSY. 77667100

CROSS REF
NO. 0101

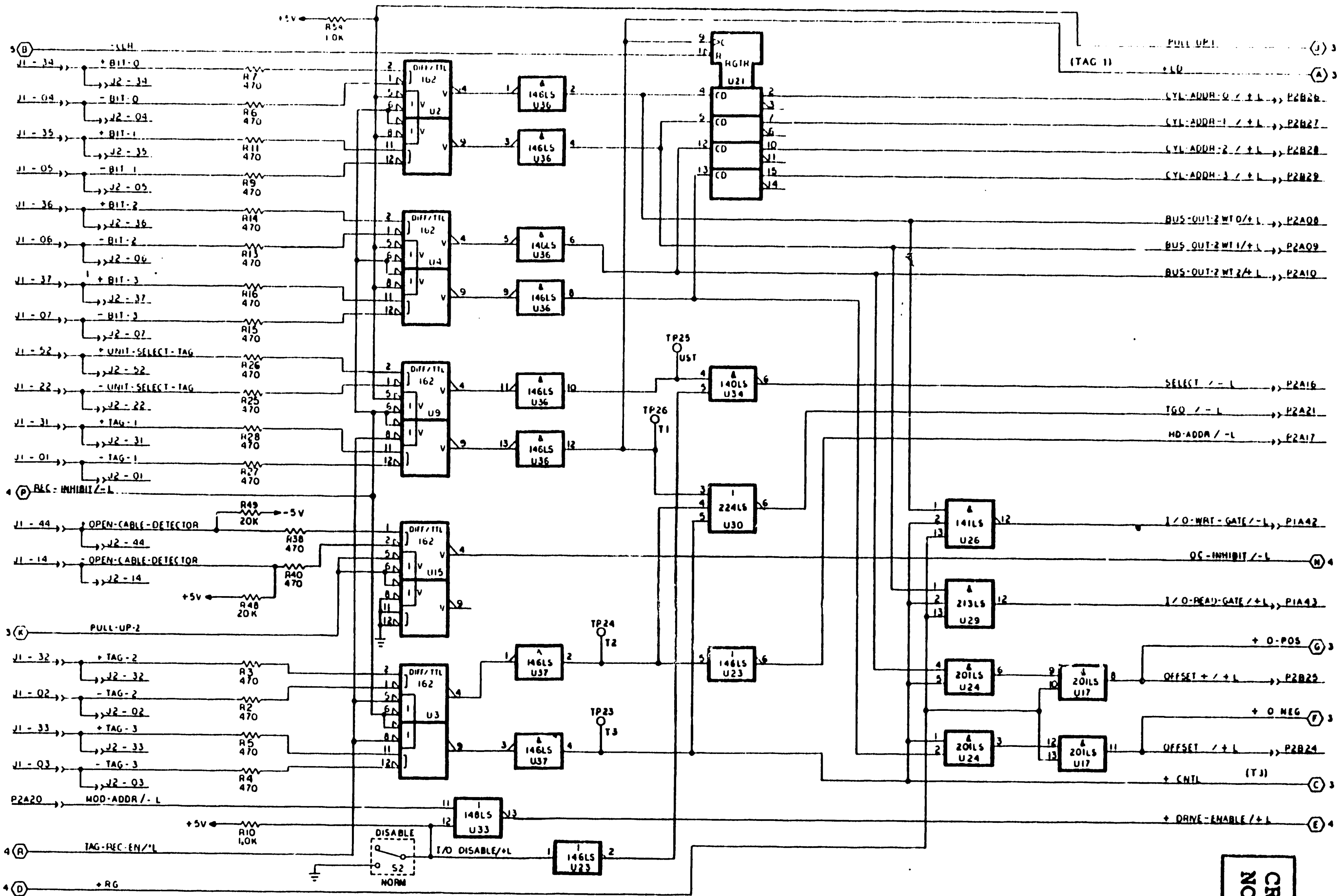
WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-4. I/O CKT BOARD (SHEET 2 OF 9)

77683560-R

FIGURE 5-4. I/O CKT BOARD (SHEET 3 OF 9)



CROSS REF NO. 0102

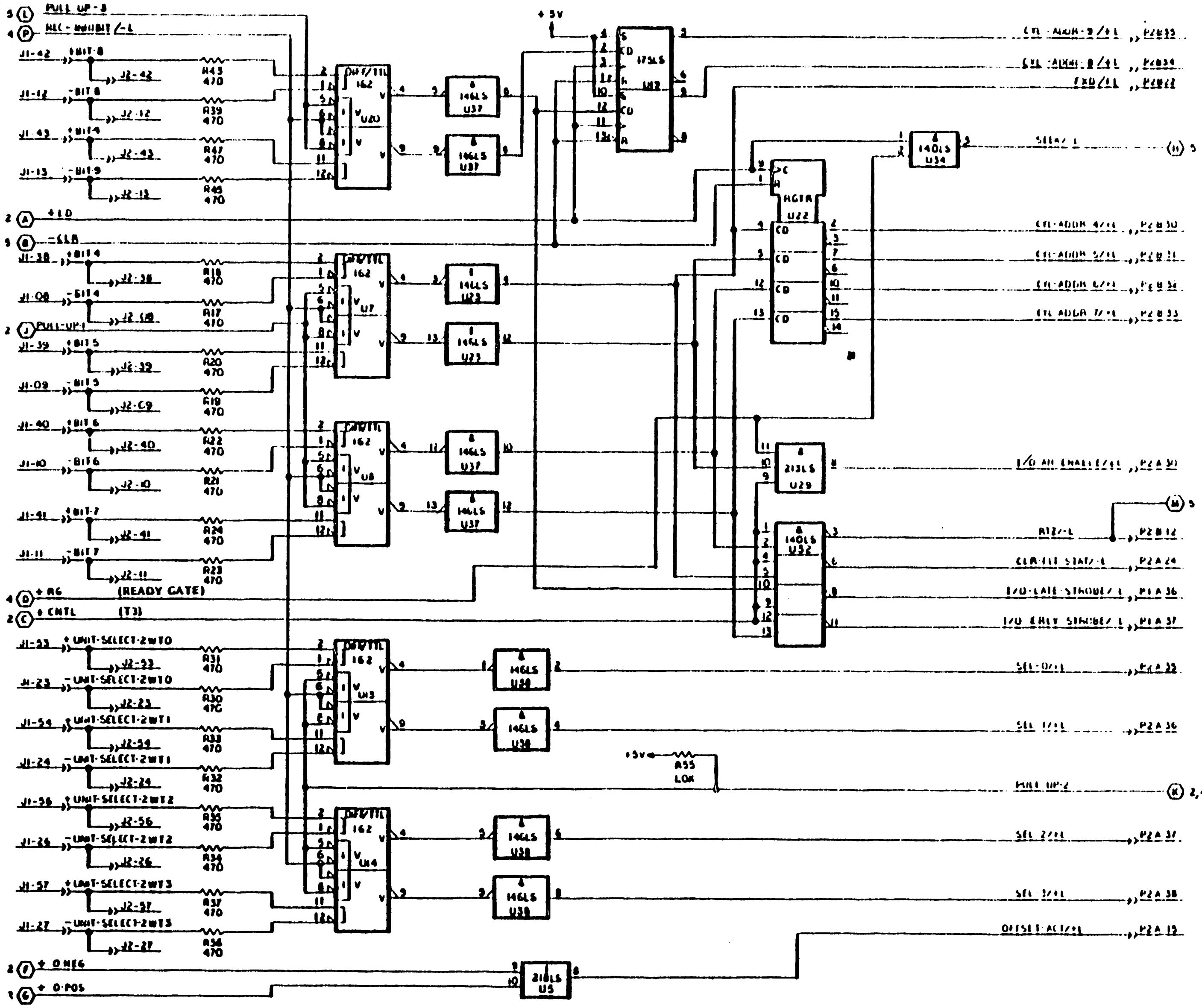


FIGURE 5-4. I/O CKT BOARD (SHEET 4 OF 9)

CROSS REF
NO. 0103

77683560-B

77683560-R

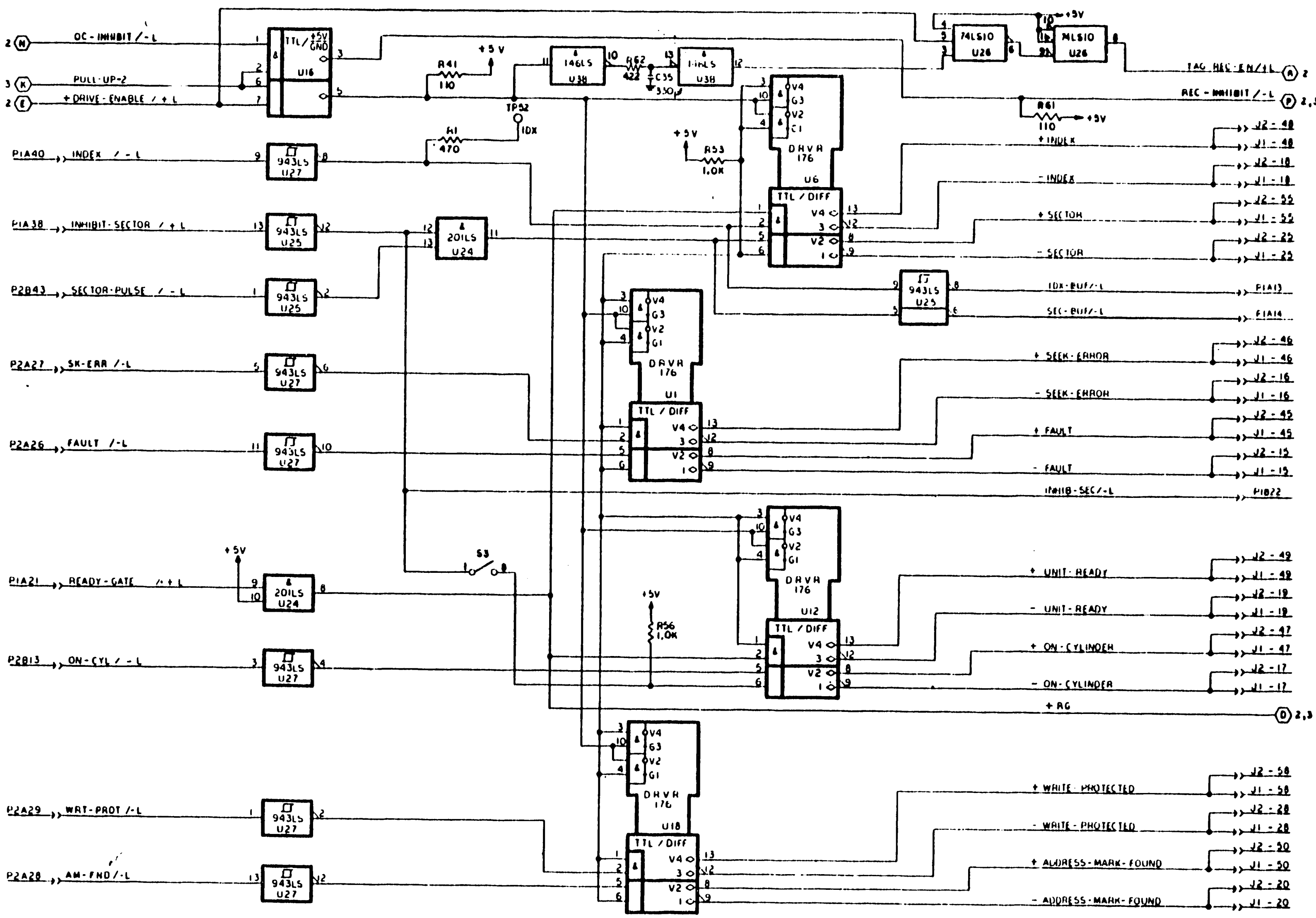
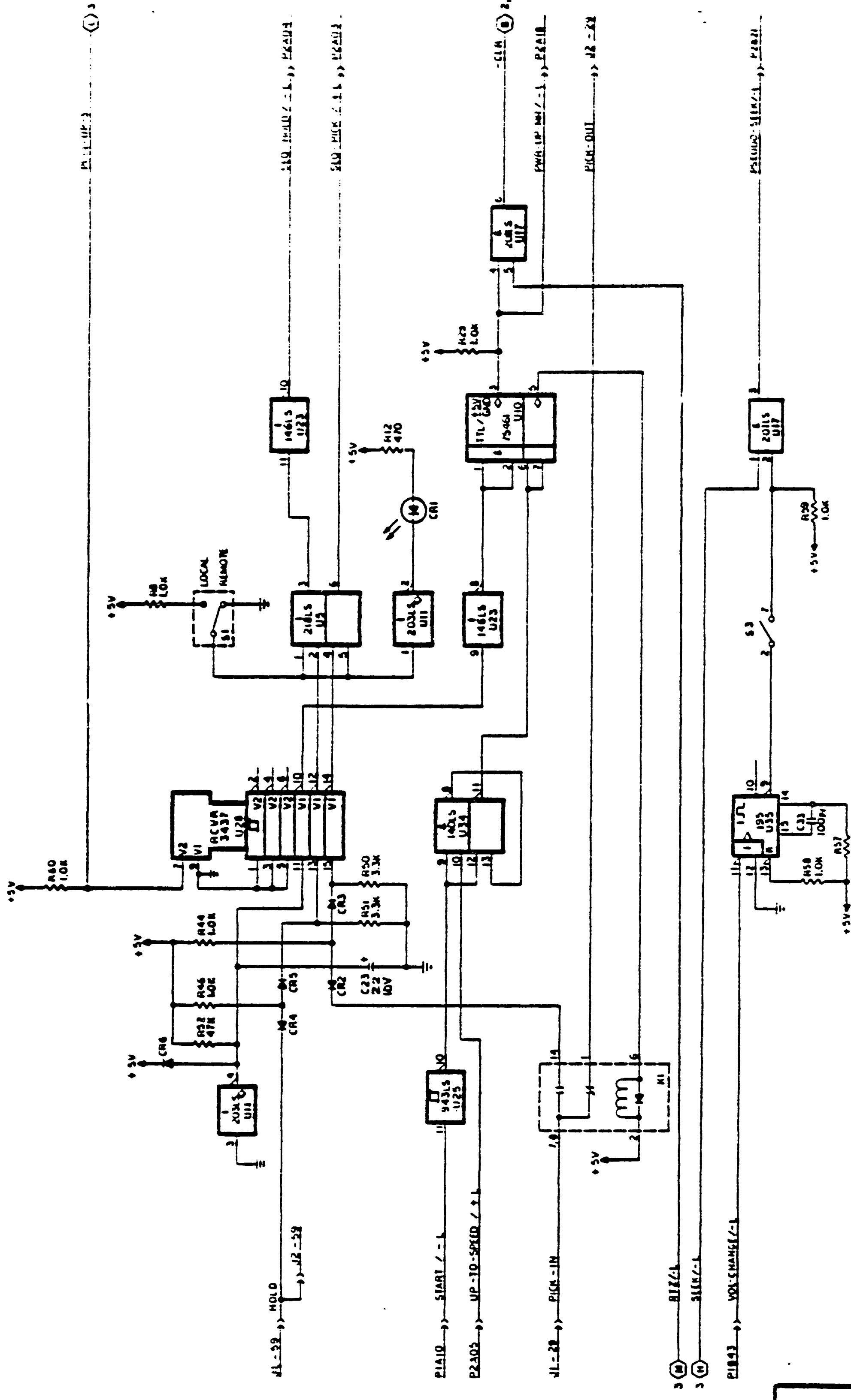


FIGURE 5-4. I/O CKT BOARD (SHEET 5 OF 9)

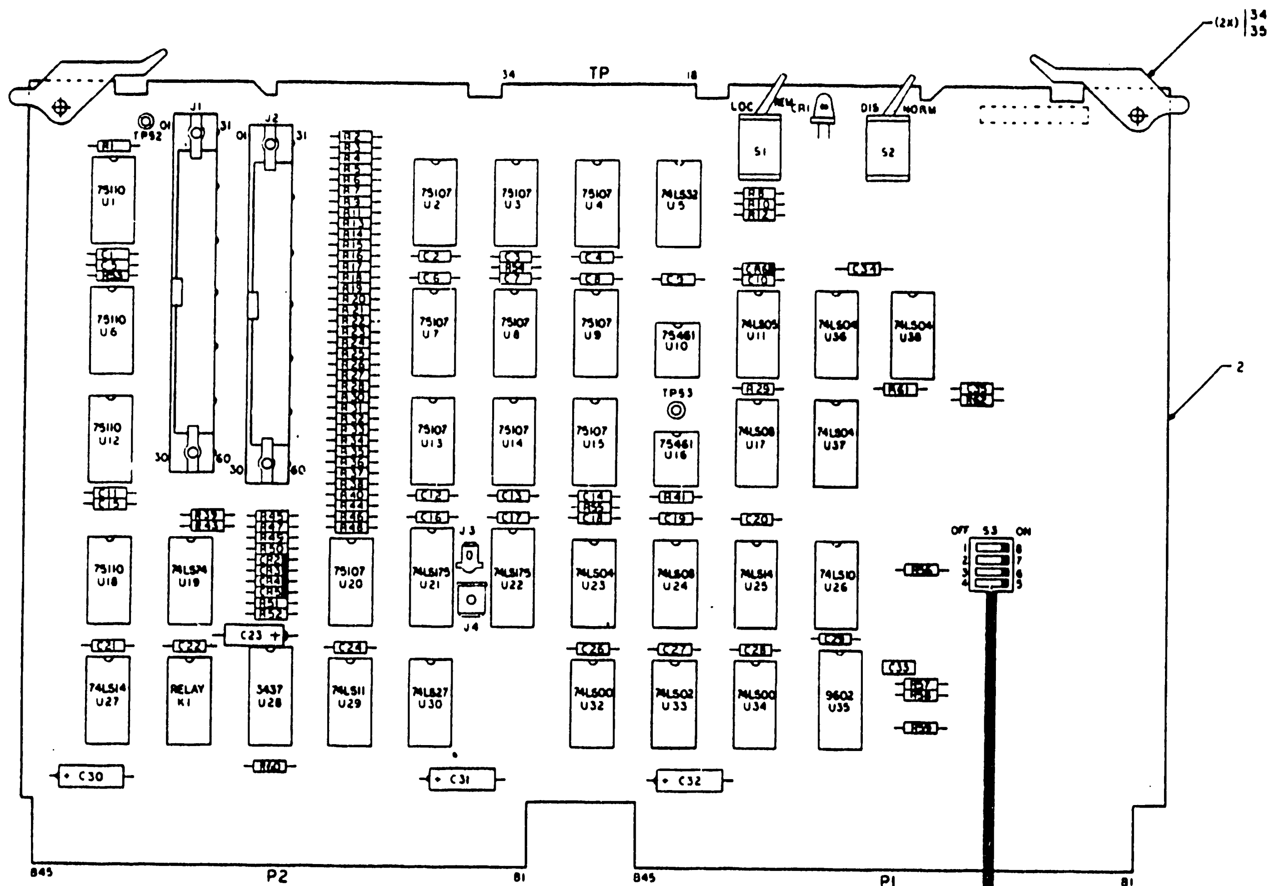
CROSS REF
NO. 0104



CROSS REF
NO. 0105

FIGURE 5-4. I/O CKT BOARD (SHEET 6 OF 9)

77683560-R



NOTES:

1. SWITCH SETTING OPTIONS

"ON" CYLINDER" IMMEDIAGELY FOLLOWING SEEK COMPLETE

NO PSEUDO SEEK WITH VOLUME CHANGE

OFF	S3	ON	
	1		VALIDATE "ON CYLINDER" WITH VALID SECTOR
	2		PSEUDO SEEK WITH VOLUME CHANGE
	3		SPARES
	4		

2. SEE HPC/SWITCH SETTING SPEC. FOR SETTINGS OF THIS SWITCH APPLICABLE TO THIS PARTICULAR UNIT.

F055a

FIGURE 5-4. I/O CKT BOARD (SHEET 7 OF 9)

CAP	PL ITEM
C1	22
C2	22
C3	22
C4	22
C5	22
C6	22
C7	22
C8	22
C9	22
C10	22
C11	22
C12	22
C13	22
C14	22
C15	22
C16	22
C17	22
C18	22
C19	22
C20	22
C21	22
C22	22
C23	21
C24	22
C25	—
C26	22
C27	22
C28	22
C29	22
C30	23
C31	23
C32	23
C33	40
C34	22
C35	45

IC	PL ITEM
U1	6
U2	5
U3	5
U4	5
U5	5
U6	6
U7	5
U8	5
U9	5
U10	16
U11	10
U12	6
U13	5
U14	5
U15	5
U16	16
U17	11
U18	6
U19	18
U20	5
U21	17
U22	17
U23	9
U24	11
U25	15
U26	37
U27	13
U28	19
U29	12
U30	14
U31	—
U32	7
U33	8
U34	7
U35	42
U36	9
U37	9
U38	9

RES	PL ITEM
R1	28
R2	28
R3	28
R4	28
R5	28
R6	28
R7	28
R8	29
R9	28
R10	29
R11	28
R12	28
R13	28
R14	28
R15	28
R16	28
R17	28
R18	28
R19	28
R20	28
R21	28
R22	28
R23	28
R24	28
R25	28
R26	28
R27	28
R28	28
R29	29
R30	28
R31	28
R32	28
R33	28
R34	28

RES	PL ITEM
R35	28
R36	28
R37	28
R38	28
R39	28
R40	28
R41	27
R42	—
R43	28
R44	29
R45	28
R46	29
R47	28
R48	32
R49	32
R50	30
R51	30
R52	31
R53	29
R54	29
R55	29
R56	29
R57	39
R58	29
R59	29
R60	29
R61	27
R62	44

DIODE	PL ITEM
CR1	36
CR2	24
CR3	24
CR4	24
CR5	24
CR6	24

TERM	PL ITEM
TP92	38
TP93	38

CONN	PL ITEM
J1	26
J2	26
J3	33
J4	43

SW	PL ITEM
S1	25
S2	25
S3	44

RLY	PL ITEM
K1	20

F055b

FIGURE 5-4. I/O CKT BOARD (SHEET 8 OF 9)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77665650	PWA, I/O OEM	
	77665670	PWB, I/O OEM	
5	15164426-7	I.C. 75107	
6	50252800-3	I.C. 75110	
7	15144900-6	I.C. 74LS00	
8	15145000-4	I.C. 74LS02	
9	15145100-2	I.C. 74LS04	
10	15145300-8	I.C. 74LS05	
11	15145400-6	I.C. 74LS08	
12	15145700-9	I.C. 74LS11	
13	15148500-0	I.C. 74LS14	
14	15146000-3	I.C. 74LS27	
15	15146200-9	I.C. 74LS32	
16	15161600-0	I.C. 754S1	
17	15146900-4	I.C. 74LS175	
18	15146300-7	I.C. 74LS74	
19	15156700-5	I.C. 3437	
20	95558701-9	Relay	
21	17706716	Cap 10 V 10% 22 μF	
22	94361416-4	Cap 50 V +80 -20% 0.022 μF	
23	24504380-7	Cap 20 V 20% 4.7 μF	
24	51706300-4	Diode IN4454	
25	41347800-9	Switch Toggle	
26	91904653-2	Header, Solder Tail	
27	94402133-6	Res 1/4 W 5% 110	
28	94402148-4	Res 1/4 W 5% 170	
29	94402156-7	Res 1/4 W 5% 1K	
30	94402168-2	Res 1/4 W 5% 3.3K	
31	94402196-3	Res 1/4 W 5% 47K	
32	94402187-2	Res 1/4 W 5% 20K	
33	95588300-4	Terminal Quick Conn	
34	82311900-3	Inject/Eject Card	
35	93533118-1	Pin, Rolled	
36	77612000-8	Lamp (LED)	
37	15145600-1	I.C. 74LS10	
38	92498021-2	Terminal Swaged	
39	94360446-2	Res 1/4 W 1% 30.1K	
40	94227226-1	Cap 300 V 2% 100	
42	15104301-5	I.C. 9602	
43	95524700-2	Terminal 0.250	
44	83452201-3	Switch - 4 Position	
45	94240426-0	Cap 50 V 10% 330 pF	
46	94360260-7	Res 1/4 W 1% 422 Ohm	

FIGURE 5-4. I/O CKT BOARD (SHEET 9 OF 9)

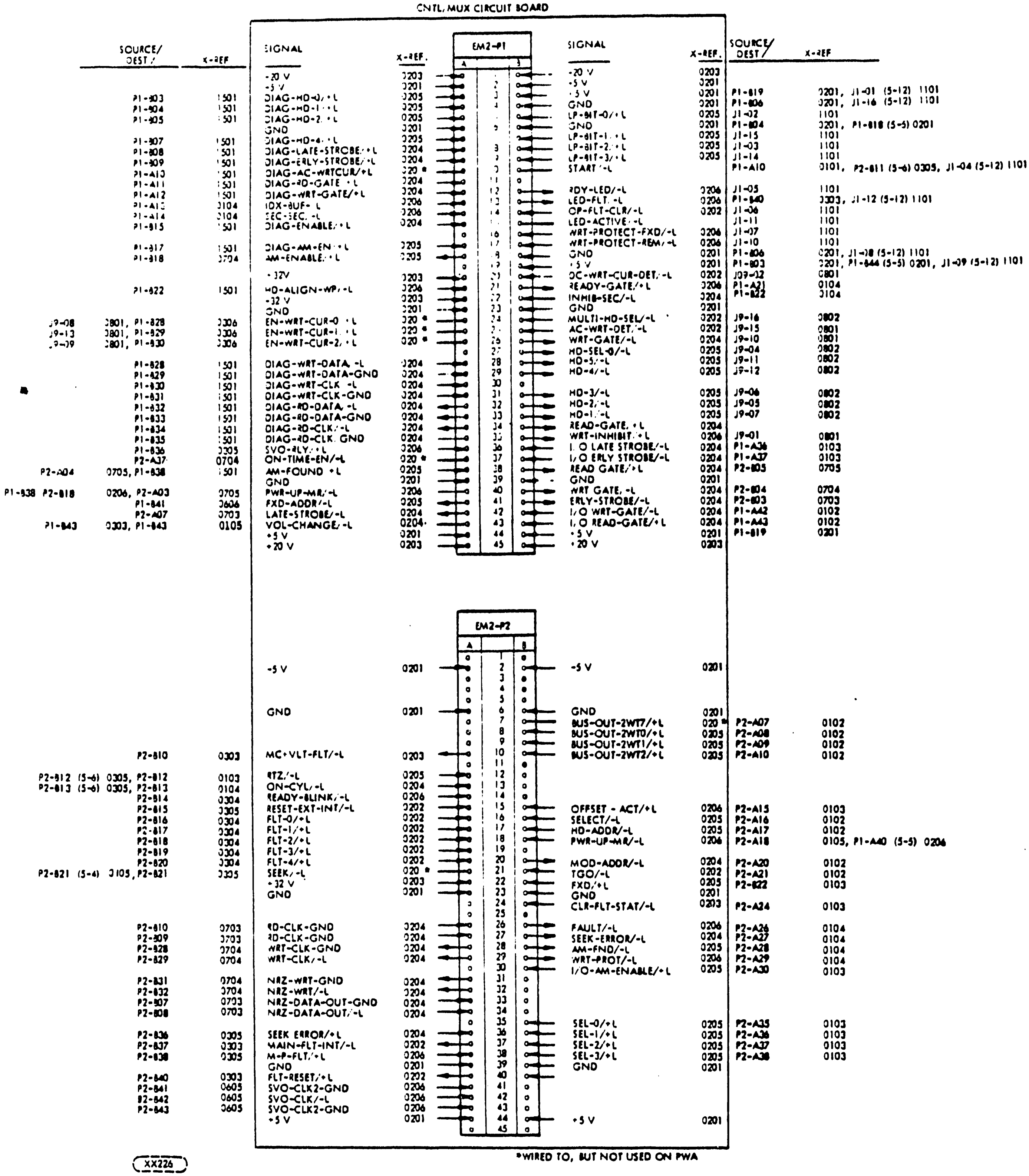
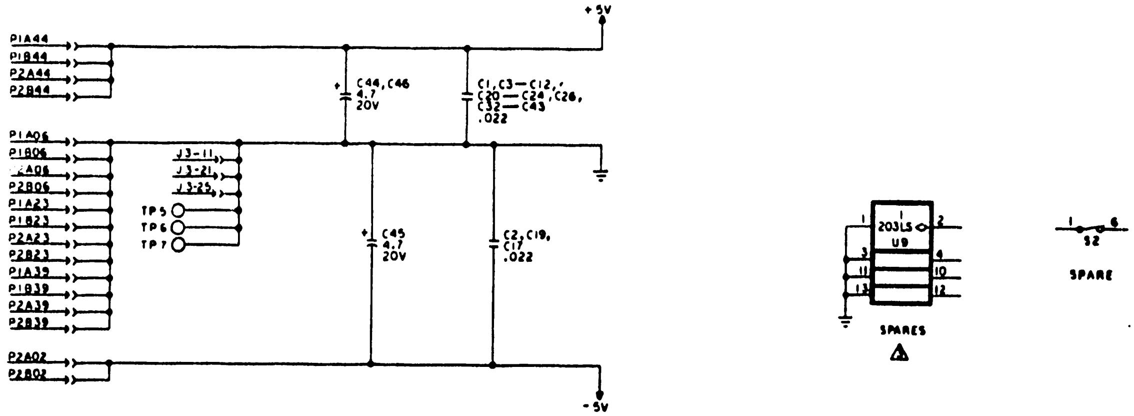
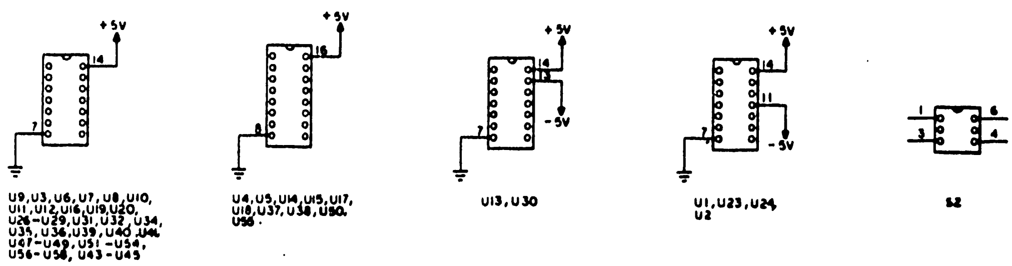


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 1 OF 10)

UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
203LS	74LS05	U9	2,4,10,12
943LS	74LS14	U57	4,12
175LS	74LS74	U20	8 OR 9
218LS	74LS32	U12	11
943LS	74LS14	U54	8,10
149LS	74LS86	U41	4





NOTES : UNLESS OTHERWISE SPECIFIED

1. RESISTORS VALUES ARE IN OHMS, 1/4W, ±5%
2. CAPACITANCE VALUES ARE IN MICROFARADS

△ 3. INPUT PINS ON U9 SPARES TIED TO GROUND TO REDUCE POWER DISSIPATION.

△ 4. S2-2 USED TO VALIDATE ON CYLINDER WITH VALID SECTOR.

CROSS REF
NO 0201

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 2 OF 10)

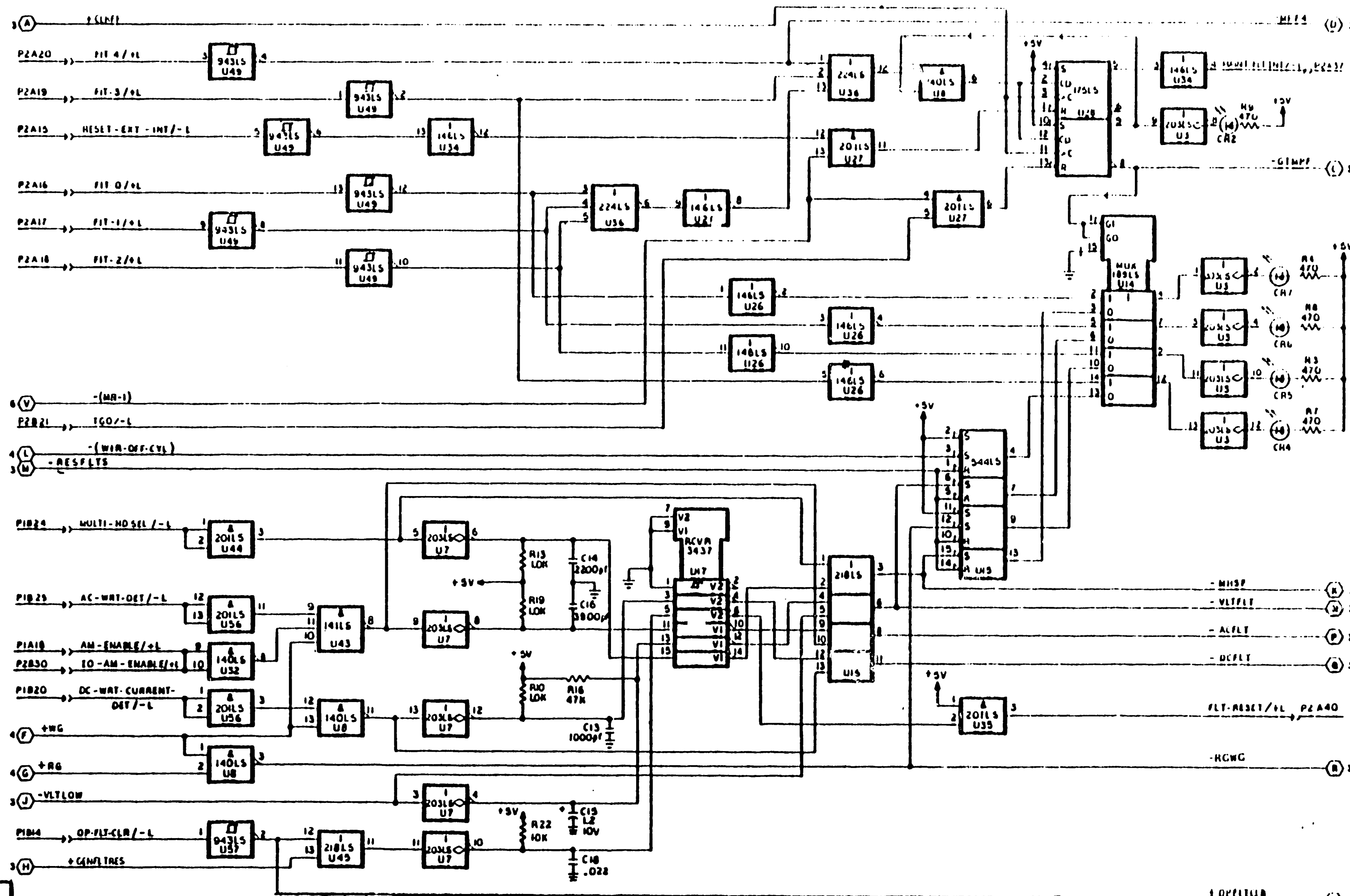


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 3 OF 10)

CROSS REF
NO. 0202

77683560-R

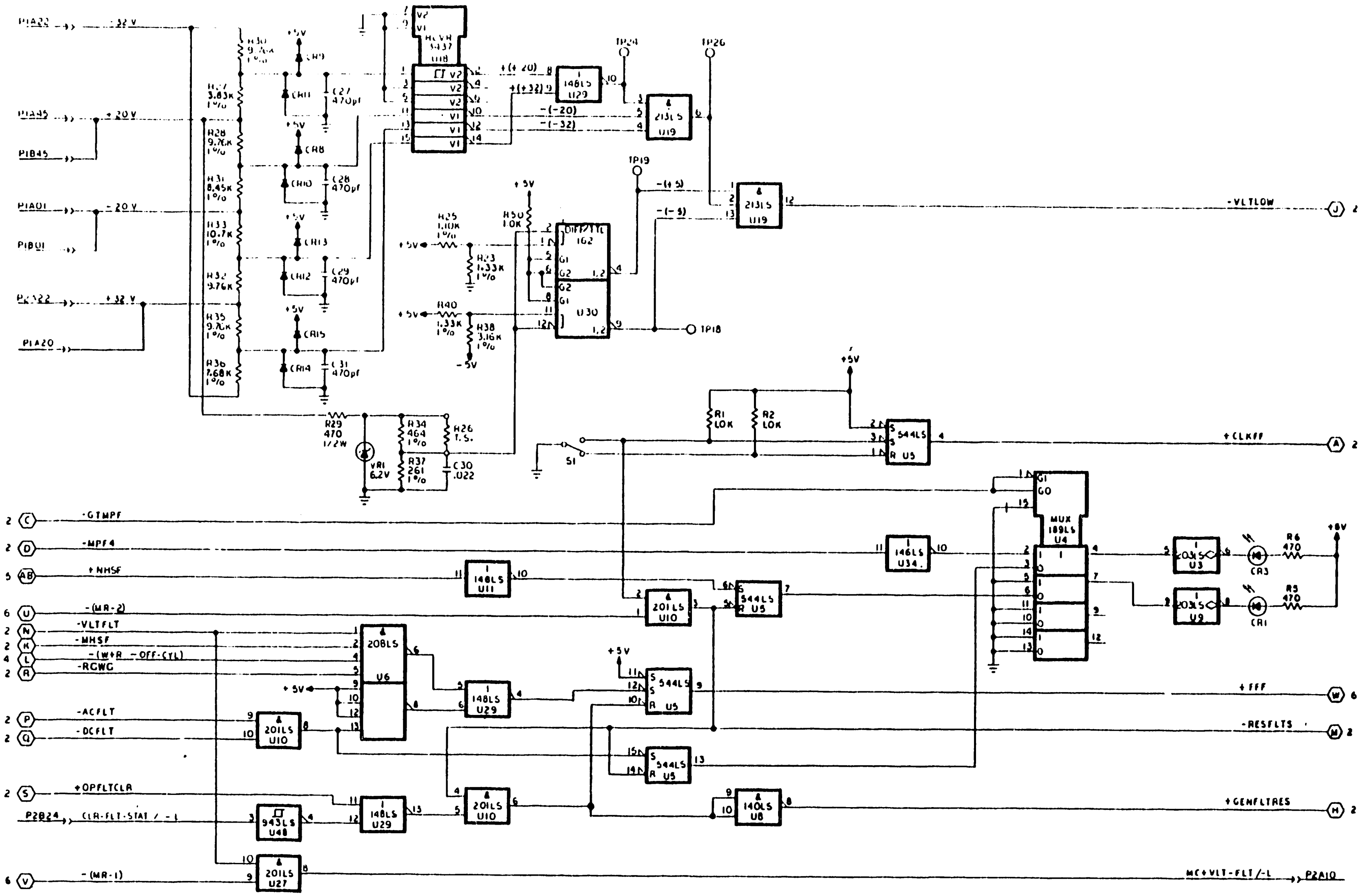


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 4 OF 10)

77683560-R

CROSS REF
NO. 0203

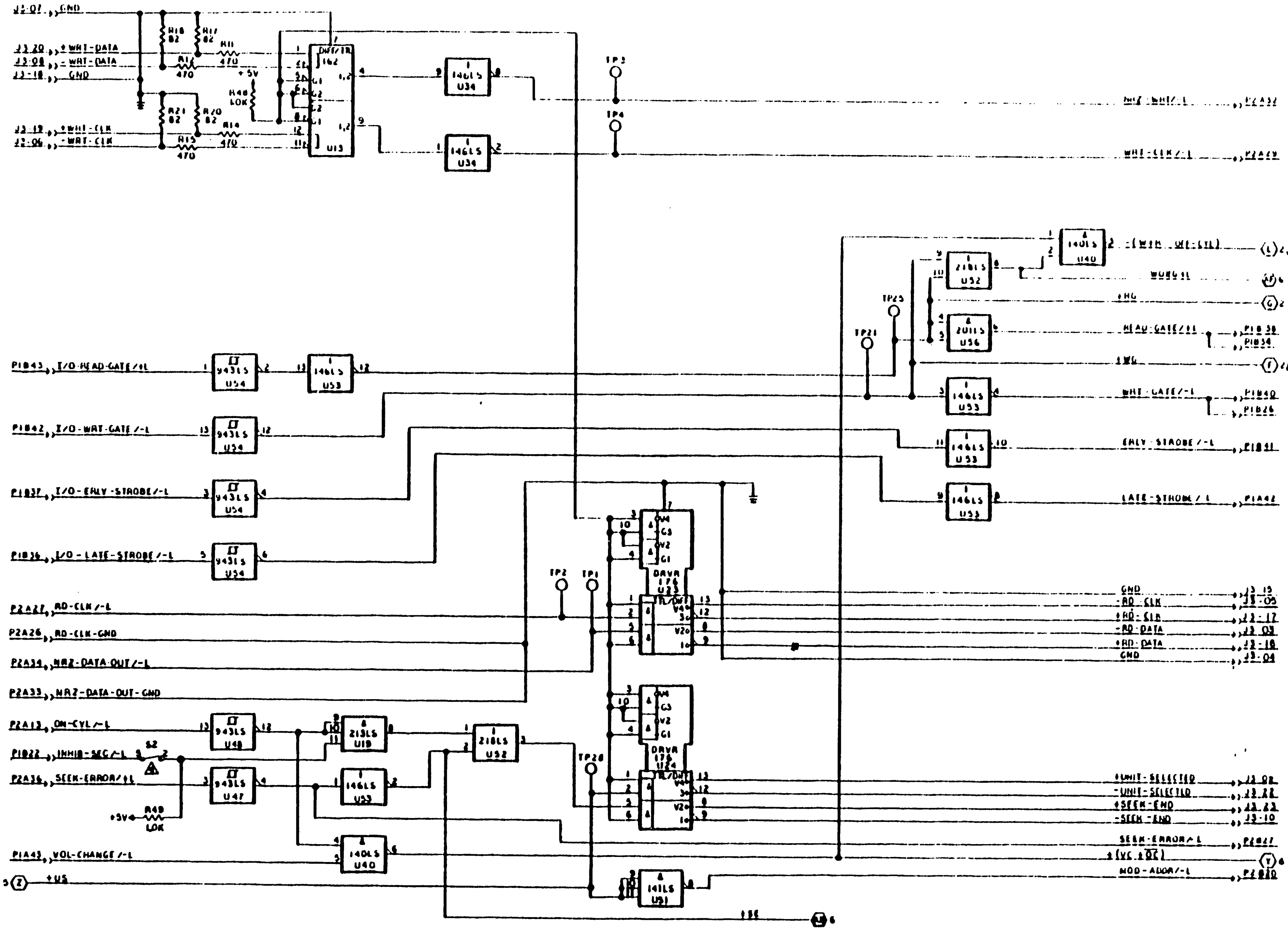


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 5 OF 10)

CROSS REF
NO. 0204

77683560-R

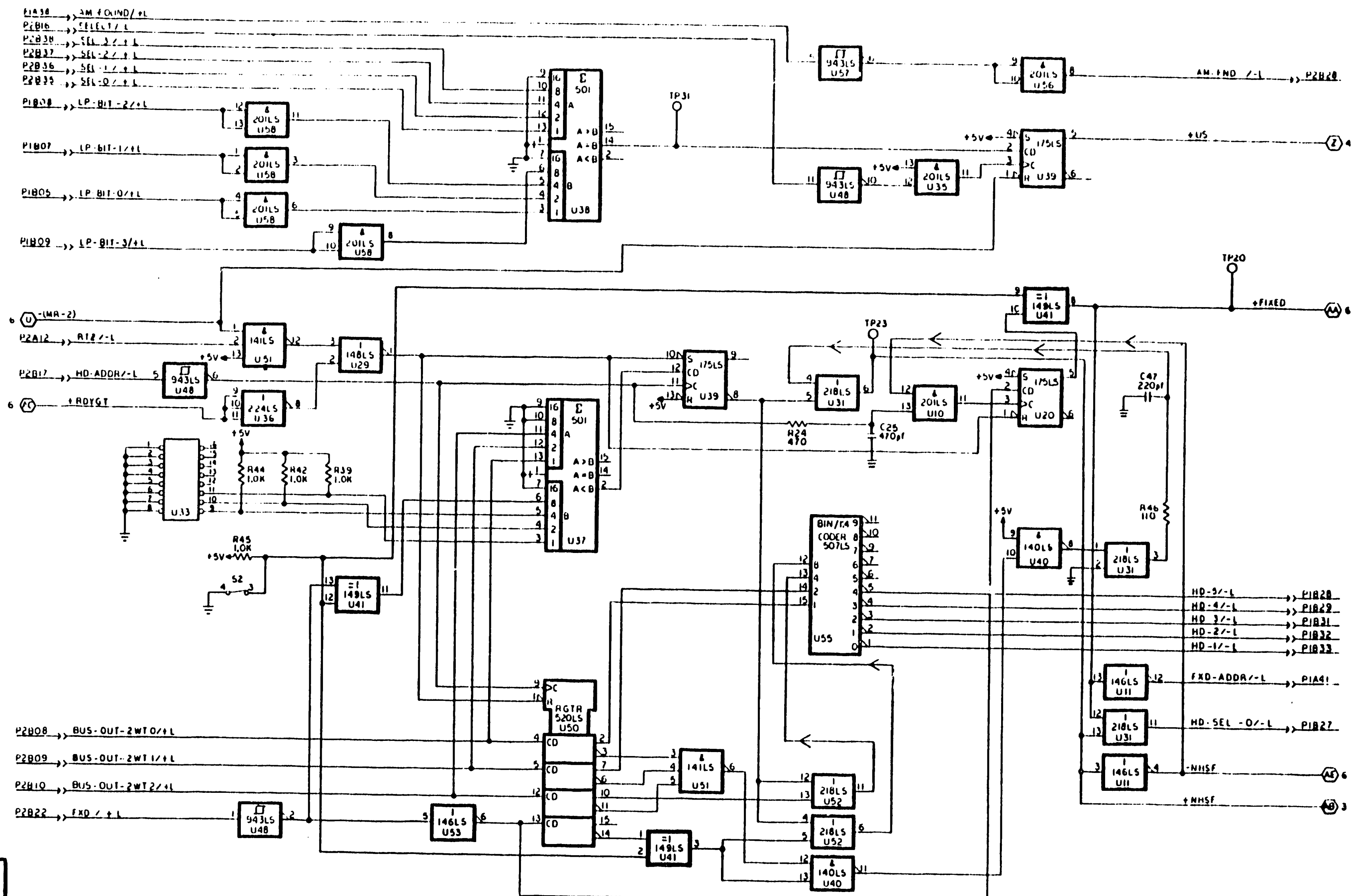


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 6 OF 10)

77683560-R

CROSS REF NO. 0205

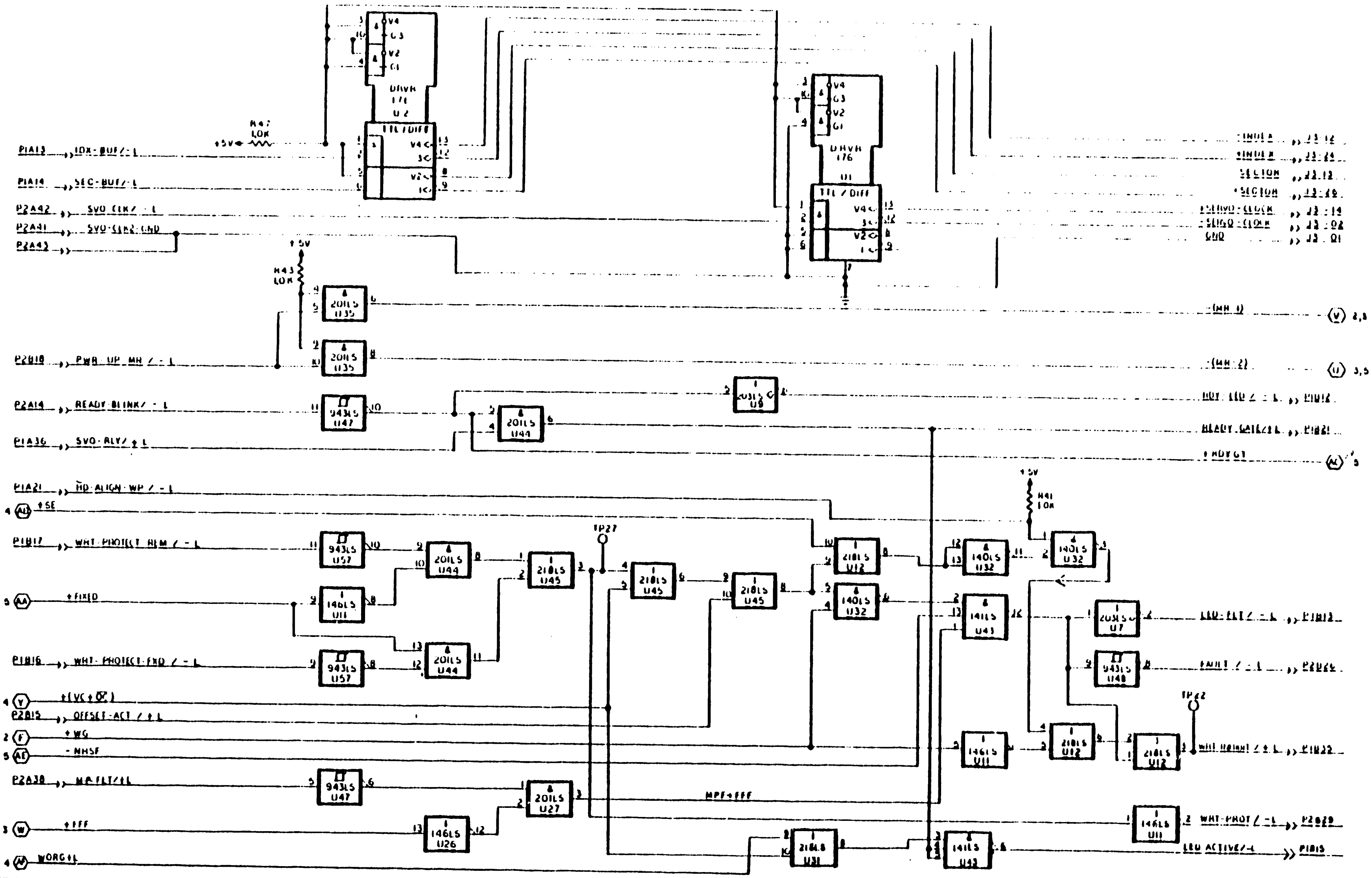
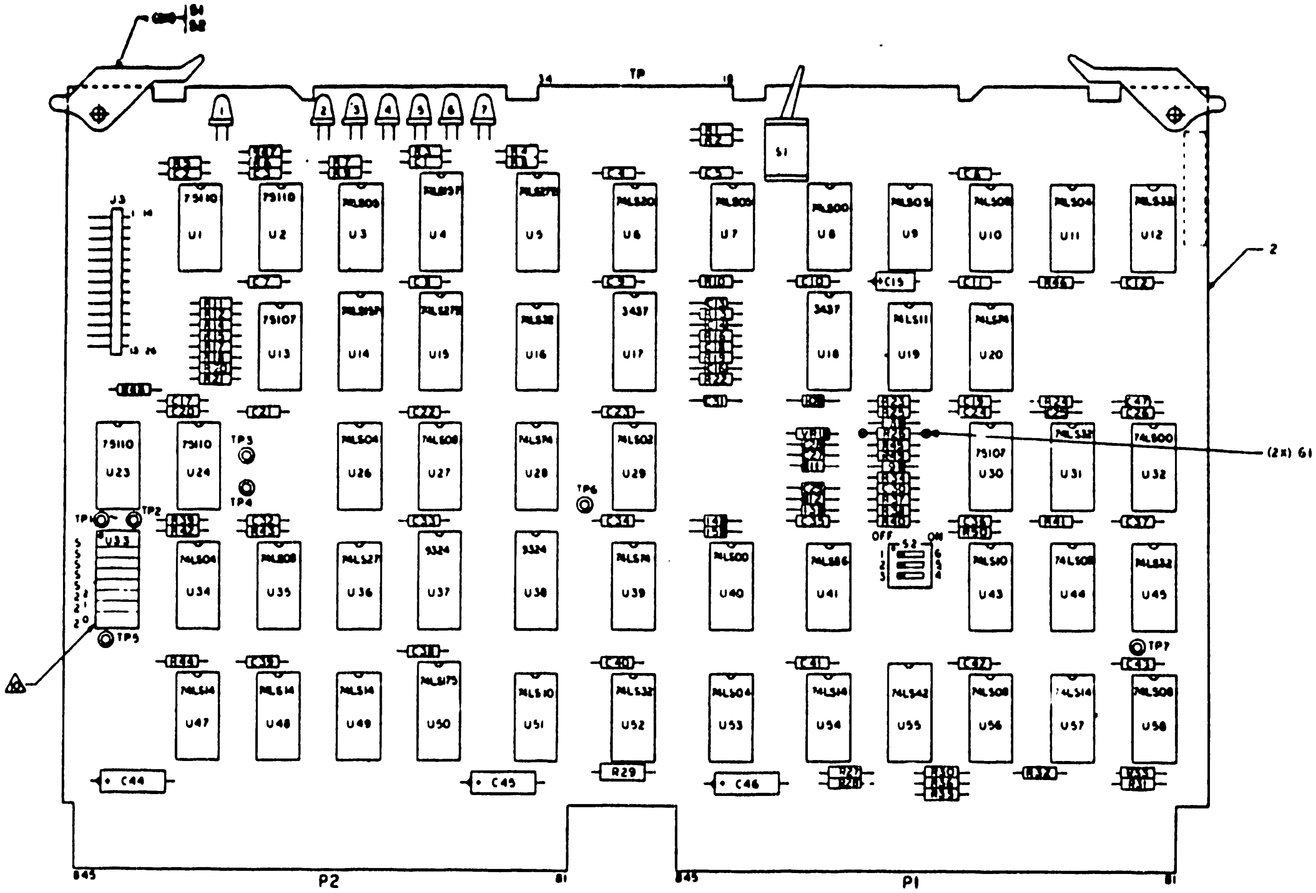


FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 7 OF 10)

CROSS REF
NO. 0206

77683560-R



△10. S IS SPARE, BINARY WEIGHTS MUST BE PROGRAMMED TO INDICATE DEVICE CAPACITY, BY INSERTING ITEM 62 INTO SOCKET U33 PWA TEST

DIO	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12	CR13	CR14	CR15
PL ITEM	34	←				→	34	32	←					→	32

SW	S1	S2
PL ITEM	49	60

CONN	J1	J2	J3
PL ITEM	—	—	48

IC	U47	U48	U49	U50	U51	U52	U53	U54	U55	U56	U57	U58	U59
PL ITEM	14	14	14	22	12	17	9	14	18	11	14	11	—

VOLT REG	VR1
PL ITEM	33

TERM	TP1	TP2	TP3	TP4	TP5	TP6	TP7
PL ITEM	50	←				→	50

IC	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	U13	U14	U15	U16	U17	U18	U19	U20	U21	U22	U23
PL ITEM	6	6	10	21	23	15	10	7	10	11	9	17	5	21	23	17	25	25	13	20	—	—	6

IC	U24	U25	U26	U27	U28	U29	U30	U31	U32	U33	U34	U35	U36	U37	U38	U39	U40	U41	U42	U43	U44	U45	U46
PL ITEM	6	—	9	11	20	8	5	17	7	53 62	9	11	16	26	26	20	7	24	—	12	11	17	—

CAP	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24
PL ITEM	30	←									→	30	29	27	58	64	30	←					→	30

CAP	C25	C26	C27	C28	C29	C30	C31	C32	C33	C34	C35	C36	C37	C38	C39	C40	C41	C42	C43	C44	C45	C46	C47
PL ITEM	28	30	28	28	28	30	28	30	←									→	30	31	31	31	59

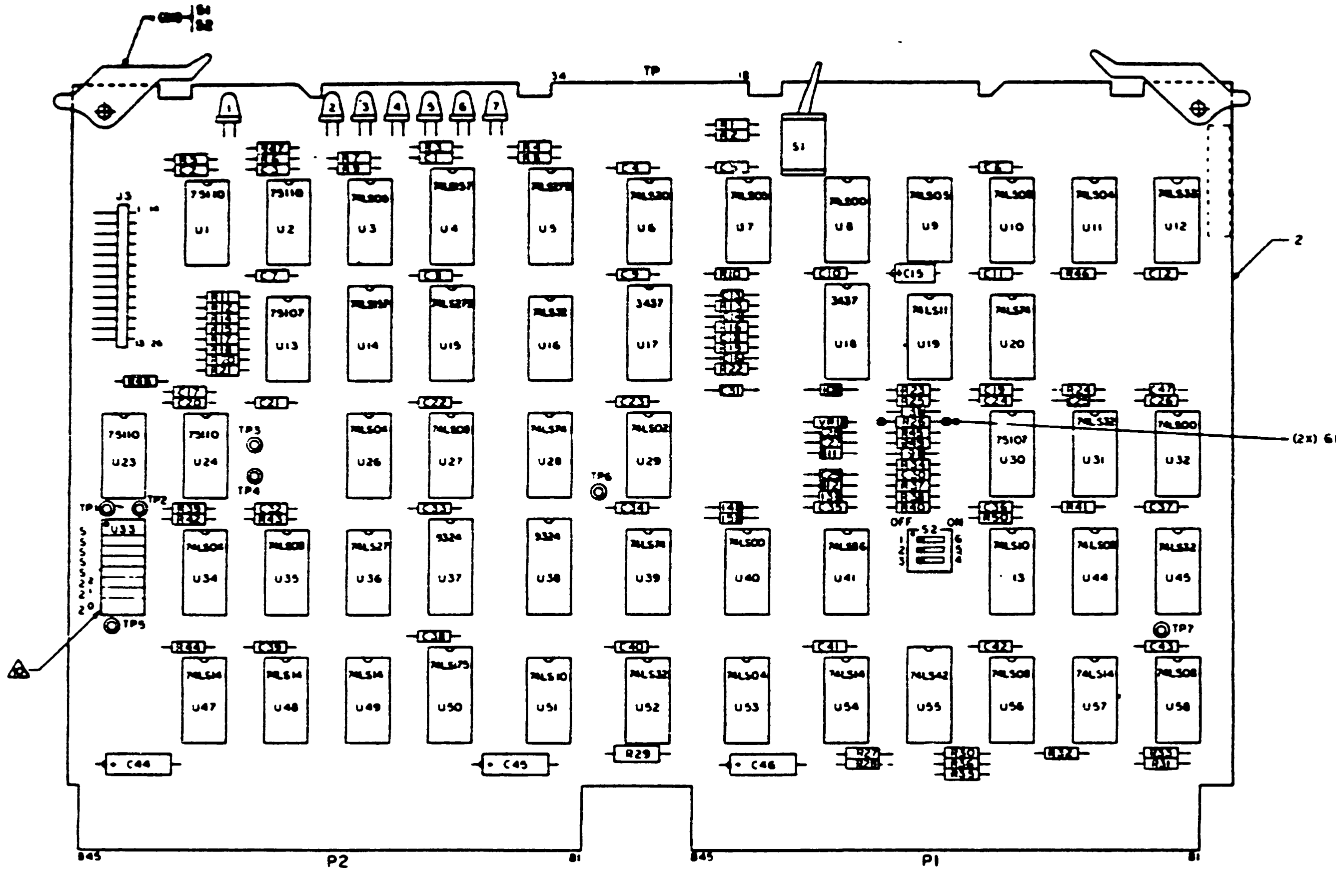
RES	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25
PL ITEM	47	47	46	←				→	46	47	46	46	47	46	46	55	44	44	47	44	44	45	38	46	37

RES	R26	R27	R28	R29	R30	R31	R32	R33	R34	R35	R36	R37	R38	R39	R40	R41	R42	R43	R44	R45	R46	R47	R48	R49	R50
PL ITEM	54	40	42	43	42	56	42	41	36	42	57	35	39	47	38	47	47	47	47	47	63	47	47	47	47

(F056)

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 8 OF 10)

77683560-R



△10. S1S SPARE, BINARY WEIGHTS MUST BE PROGRAMMED TO INDICATE DEVICE CAPACITY, BY INSERTING ITEM 62 INTO SOCKET U33 PWA TEST

DIO	PL ITEM
CR1	34
CR2	
CR3	
CR4	
CR5	
CR6	
CR7	34
CR8	32
CR9	
CR10	
CR11	
CR12	
CR13	
CR14	
CR15	32

SW	PL ITEM
S1	49
S2	60

CONN	PL ITEM
J1	—
J2	—
J3	48

IC	PL ITEM
U47	14
U48	14
U49	14
U50	22
U51	12
U52	17
U53	9
U54	14
U55	18
U56	11
U57	14
U58	11
U59	—

VOLT REG	PL ITEM
VR1	33

TERM	PL ITEM
TP1	50
TP2	
TP3	
TP4	
TP5	
TP6	
TP7	50

IC	PL ITEM
U1	6
U2	6
U3	10
U4	21
U5	23
U6	15
U7	10
U8	7
U9	10
U10	11
U11	9
U12	17
U13	5
U14	21
U15	23
U16	17
U17	25
U18	25
U19	13
U20	20
U21	—
U22	—
U23	6
U24	6
U25	—
U26	9
U27	11
U28	20
U29	6
U30	5
U31	17
U32	7
U33	53,62
U34	9
U35	11
U36	16
U37	26
U38	26
U39	20
U40	7
U41	24
U42	—
U43	12
U44	11
U45	17
U46	—

CAP	PL ITEM
C1	30
C2	
C3	
C4	
C5	
C6	
C7	
C8	
C9	
C10	
C11	
C12	30
C13	29
C14	27
C15	58
C16	64
C17	30
C18	
C19	
C20	
C21	
C22	
C23	
C24	30
C25	28
C26	30
C27	28
C28	28
C29	28
C30	30
C31	28
C32	30
C33	
C34	
C35	
C36	
C37	
C38	
C39	
C40	
C41	
C42	
C43	30
C44	31
C45	31
C46	31
C47	59

RES	PL ITEM
R1	47
R2	47
R3	46
R4	
R5	
R6	
R7	
R8	
R9	46
R10	47
R11	46
R12	46
R13	47
R14	46
R15	46
R16	55
R17	44
R18	44
R19	47
R20	44
R21	44
R22	45
R23	38
R24	46
R25	37
R26	54
R27	40
R28	42
R29	43
R30	42
R31	56
R32	42
R33	41
R34	36
R35	42
R36	57
R37	35
R38	39
R39	47
R40	38
R41	47
R42	47
R43	47
R44	47
R45	47
R46	63
R47	47
R48	47
R49	47
R50	47

(F056)

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 8 OF 10)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77666950	PWA, CNTL/MUX OEM	
	77666970	PWB, CNTL/MUX OEM	
5	15164426-7	I.C. 75107	
6	50252800-3	I.C. 75110	
7	15144900-6	I.C. 74LS00	
8	15145000-4	I.C. 74LS02	
9	15145100-2	I.C. 74LS04	
10	15145300-8	I.C. 74LS05	
11	15145400-6	I.C. 74LS08	
12	15145600-1	I.C. 74LS10	
13	15145700-9	I.C. 74LS11	
14	15148500-0	I.C. 74LS14	
15	15145900-5	I.C. 74LS20	
16	15146000-3	I.C. 74LS27	
17	15146200-9	I.C. 74LS32	
18	15147600-9	I.C. 74LS42	
19	15124700-4	I.C. 74LS51	
20	15146300-7	I.C. 74LS74	
21	15146700-8	I.C. 74LS157	
22	15146900-4	I.C. 74LS175	
23	15148300-5	I.C. 74LS279	
24	15146400-5	I.C. 74LS86	
25	15156700-5	I.C. 3437	
26	51783500-5	I.C. 9324	
27	75808529-4	Cap 100 V 10% 2200	
28	94240400-5	Cap 50 V 10% 470	
29	94240401-3	Cap 50 V 10% 1000	
30	94361416-4	Cap 50 V +80 -20% 0.022 µF	
31	24504380-7	Cap 20 V 20% 4.7 µF	
32	51706300-4	Diode IN4454	
33	50240108-6	Volt Req 6.2 V IN5234	
34	77612000-8	Lamp (LED)	
35	94360240-9	Res 1/4 W 1% 261	
36	94360264-9	Res 1/4 W 1% 464	
37	94360304-3	Res 1/4 W 1% 1.10K	
38	94360312-6	Res 1/4 W 1% 1.33K	
39	94360348-0	Res 1/4 W 1% 3.16K	
40	94360356-3	Res 1/4 W 1% 3.83K	
41	94360403-3	Res 1/4 W 1% 10.7K	
42	94360395-1	Res 1/4 W 1% 9.76K	
43	24500161-5	Res 1/2 W 5% 820	
44	94402130-2	Res 1/4 W 5% 82	
45	94402180-7	Res 1/4 W 5% 10K	
46	94402148-4	Res 1/4 W 5% 470	
47	94402156-7	Res 1/4 W 5% 1K	
48	77612196-4	Right Angle Header	
49	41347801-7	Switch Toggle PC Bd	
50	92498021-2	Terminal Swaged	

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 9 OF 10)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
51	82311900-3	Inject/Eject Card	
52	93533118-1	Pin, Rolled	
53	77832290-9	Socket, 16 Pin	
54	94357500-1	Resistor Test Select	
55	94402196-3	Res 1/4 W 5% 47K	
56	94360389-4	Res 1/4 W 1% 8.45K	
57	94360385-2	Res 1/4 W 1% 7.68K	
58	17706701-4	Cap 10 V 10% 1.2 µF	
59	94240407-0	Cap 50 V 10% 220	
60	83452211-2	Switch, Dual-in-Line	
61	77612167-5	Terminal, Slotted	
62	77612224-4	Shunt, Dip	
63	94402133-6	Res 1/4 W 5% 110	
64	75808532-8	Cap 100 V 10% 3900 pF	

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 10 OF 10)

SERVO COARSE CIRCUIT BOARD

SOURCE/ DEST/	X-REF	SOURCE/ DEST/	X-REF	SIGNAL	X-REF.	EM3-P1 (A / B)	SIGNAL	X-REF.	SOURCE/ DEST/	X-REF	SOURCE/ DEST/	X-REF
				-20 V	0301	1	-20 V	0301				
						2						
				TACH-SHLD	0306	3						
		VELOCITY XDUCER	1601	TACH	0306	4						
				TACH-RTN		5						
				ANALOG GND	0301	6	ANALOG GND	0301				
						7						
						8	PA-COM-P	0306	J1-01	1001		
						9	UNLOAD-CURR	0307	J1-02	1001		
		P1-B10	150●	DIAG-FG-MON	030*	10	PA-COM-N	0306	J1-03	1001		
		P1-B11	150●	DIAG-ACT-I-MON	030*	11	32 V RET	030*	J1-04	1001		
		P1-B12	150●	DIAG-DR-MON	030*	12						
		P1-B13	0603	I-SPE	0306	13	UNLOAD-COMMON	0307	J1-05	1001		
		P1-B14	0603	SPE	0306	14	-31-CAP	0307	J1-06	1001		
						15						
						16						
						17	+5 V RTN	0301				
						18						
						19						
						20	I-FBK-SIG	0306	P1-01 } R1	1601		
						21	I-FBK-RTN	0306	P1-02	1601		
						22						
				ANALOG AND	0301	23	ANALOG GND	0301				
		J10-01	1601	SPIN-SEN-OR	0307	24						
		J10-02	1601	SPIN-SEN-SHLD	0307	25						
		J10-03	1601	SPIN-SEN-RTN	0307	26						
		J10-04	1601	SPIN-SEN	0307	27						
		J10-05	1601	+5 V	0301	28	EN-WRT-CUR-0/+L	0304	P1-A24	020●	J9-08	0801
						29	EN-WRT-CUR-1/+L	0304	P1-A25	020●	J9-13	0801
						30	EN-WRT-CUR-2/+L	0304	P1-A26	020●	J9-09	0801
P1-B30	010*	P1-A32	030*	PRES-SW/+L	030*	31	BRK-PUL/+L	0305	J1-02	1201		
	1601	J1-01	1201	PRES-SW/+L	030*	32						
J1-02	1201	P1-B40	0303	LED-FLT/-L	030*	33	RUN/+L	0305	J1-03	1201		
		ANALOG GND		PRES-SW-GND	030*	34	LINE-EN/+L	0305	J1-04	1201		
						35	PK-COV-UNLOCK/+L	0305	J1-05	1201		
						36	SVO-RLY/+L	0305	J1-06	1201,	P1-A36	0206
						37	LINE-OFF/+L	0305	J1-07	1201		
						38	HD-LOAD-SW/+L	0305	SW4-N.O.	1601		
				ANALOG GND	0301	39	ANALOG GND	0301	J1-08	1201		
						40	LED-FLT/-L	0303	P1-B13	0207	J1-02	1202
P1-A41	020	P1-B41	0606	FXD-ADDR/-L	030●	41	FXD-ADDR/-L	030●	P1-A41	0205		
		P1-B42	0606	RTZ-OR-SEEK/+L	0305	42	RTZ-OR-SEEK/+L	0305				
P1-B43	0303,	P1-B43	0606	VOL-CHANGE/-L	0303	43	VOL-CHANGE/-L	0303	P1-A43	0204	, P1-A43	0303
				+5 V	0301	44	+5 V	0301				
				-20 V	0301	45	+20 V	0301				

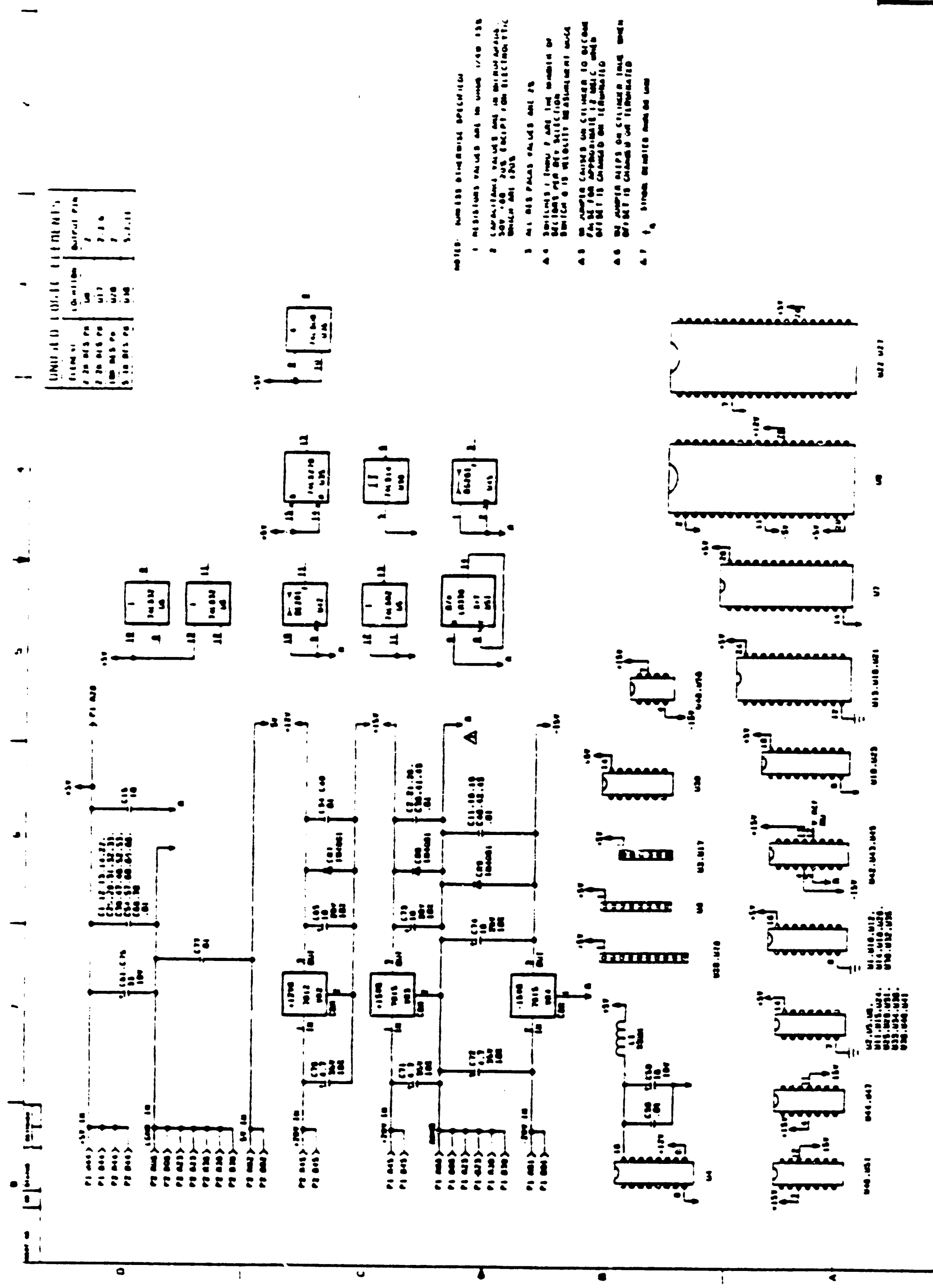
SOURCE/ DEST/	X-REF	SIGNAL	X-REF.	EM3-P2 (A / B)	SIGNAL	X-REF.	SOURCE/ DEST/	X-REF	SOURCE/ DEST/	X-REF
				1						
		-5 V	0301	2	-5 V	0301				
P2-B03	0603	AGC ACT/-L	0305	3	SEQ-PICK/+L	0305	P2-A03	0105		
P2-B04	150●	I/O-WRT/-L	0302	4	SEQ-HOLD/+L	0305	P2-A04	0105		
P2-B05	150●	I/O-RD/-L	0302	5	UP-TO-SPEED/+L	0305	P2-A05	0105		
		LOGIC GND	0301	6	LOGIC GND	0301				
P2-B07	150●	MADR-0/+L	0302	7						
P2-B08	150●	MADR-1/+L	0302	8						
P2-B09	150●	MADR-2/+L	0302	9						
P2-B10	150●	MADR-3/+L	0302	10	MC-VLT-FLT/+L	0303	P2-A10	0202		
P2-B11	150●	MADR-4/+L	0302	11	START/-L	0305	P1-A10	0105	P1-B10	020*
P2-B12	150●	MADR-5/+L	0302	12	RTZ/-L	0305	P2-A12	0205		
P2-B13	150●	MADR-6/+L	0302	13	ON-CYL/-L	0305	P2-A13	0204		
P2-B14	150●	MADR-7/+L	0302	14	READY-BLINK/-L	0304	P2-A14	0204		
P2-B15	150●	MADR-8/+L	0302	15	RESET-EXT-INT/-L	0305	P2-A15	0202		
P2-B16	150●	MADR-9/+L	0302	16	FLT-0/+L	0304	P2-A16	0202		
P2-B17	150●	MADR-A/-L	0302	17	FLT-1/+L	0304	P2-A17	0202		
P2-B18	150●	MADR-B/-L	0302	18	FLT-2/+L	0304	P2-A18	0202		
P2-B19	150●	MADR-C/-L	0302	19	FLT-3/+L	0304	P2-A19	0202		
P2-B20	150●	MADR-D/-L	0302	20	FLT-4/+L	0304	P2-A20	0202		
P2-B21	150●	MADR-E/-L	0302	21	PSUEDO SEEK/-L	0305	P2-A21	020●,	P2-B21	0105
				22	MADR-F/+L	0302	P2-B22	150●		
		LOGIC GND	0301	23	LOGIC GND	0301				
P2-B24	150●	DB0/+L	0302	24	OFFSET -/+L	0305	P2-B24	0102		
P2-B25	150●	DB1/+L	0302	25	OFFSET +/-L	0305	P2-B25	0102		
P2-B26	150●	DB2/+L	0302	26	CYL-ADDR-0/+L	0303	P2-B26	0102		
P2-B27	150●	DB3/+L	0302	27	CYL-ADDR-1/+L	0303	P2-B27	0102		
P2-B28	150●	DB4/+L	0302	28	CYL-ADDR-2/+L	0303	P2-B28	0102		
P2-B29	150●	DB5/+L	0302	29	CYL-ADDR-3/+L	0303	P2-B29	0102		
P2-A30	0606	SVO-CLAMP/-L	0305	30	CYL-ADDR-4/+L	0303	P2-B30	0103		
P2-B31	150●	DB6/+L	0302	31	CYL-ADDR-5/+L	0303	P2-B31	0103		
P2-B32	150●	DB7/+L	0302	32	CYL-ADDR-6/+L	0303	P2-B32	0103		
P2-B33	150●	MEM-WRT/-L	0302	33	CYL-ADDR-7/+L	0303	P2-B33	0103		
P2-B34	150●	MEM-RD/-L	0302	34	CYL-ADDR-8/+L	0303	P2-B34	0103		
P2-B35	150●	EXT-INT-1/-L	0303	35	CYL-ADDR-9/+L	0303	P2-B35	0103		
P2-B36	150●	LOGIC GND	0301	36	SEEK-ERROR/+L	0305	P2-A36	0206		
P2-B37	0606	SECTOR-SYNC/-L	0304	37	MAIN-FLT-INT/-L	0303	P2-A37	0203		
P2-B38	0605	806-KHZ/-L	0304	38	M-P-FLT/+L	0305	P2-A38	0203		
		LOGIC GND	0301	39	LOGIC GND	0301				
				40	FLT-RESET/+L	0303	P2-A40	0202		
				41						
				42						
				43	SECTOR-PULSE/-L	0304	P2-B43	0104		
		+5 V	0301	44	+5 V	0301				
		+20 V	0301	45	+20 V	0301				

(XX227)

●WIRED TO, BUT NOT USED ON PWA

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 1 OF 13)

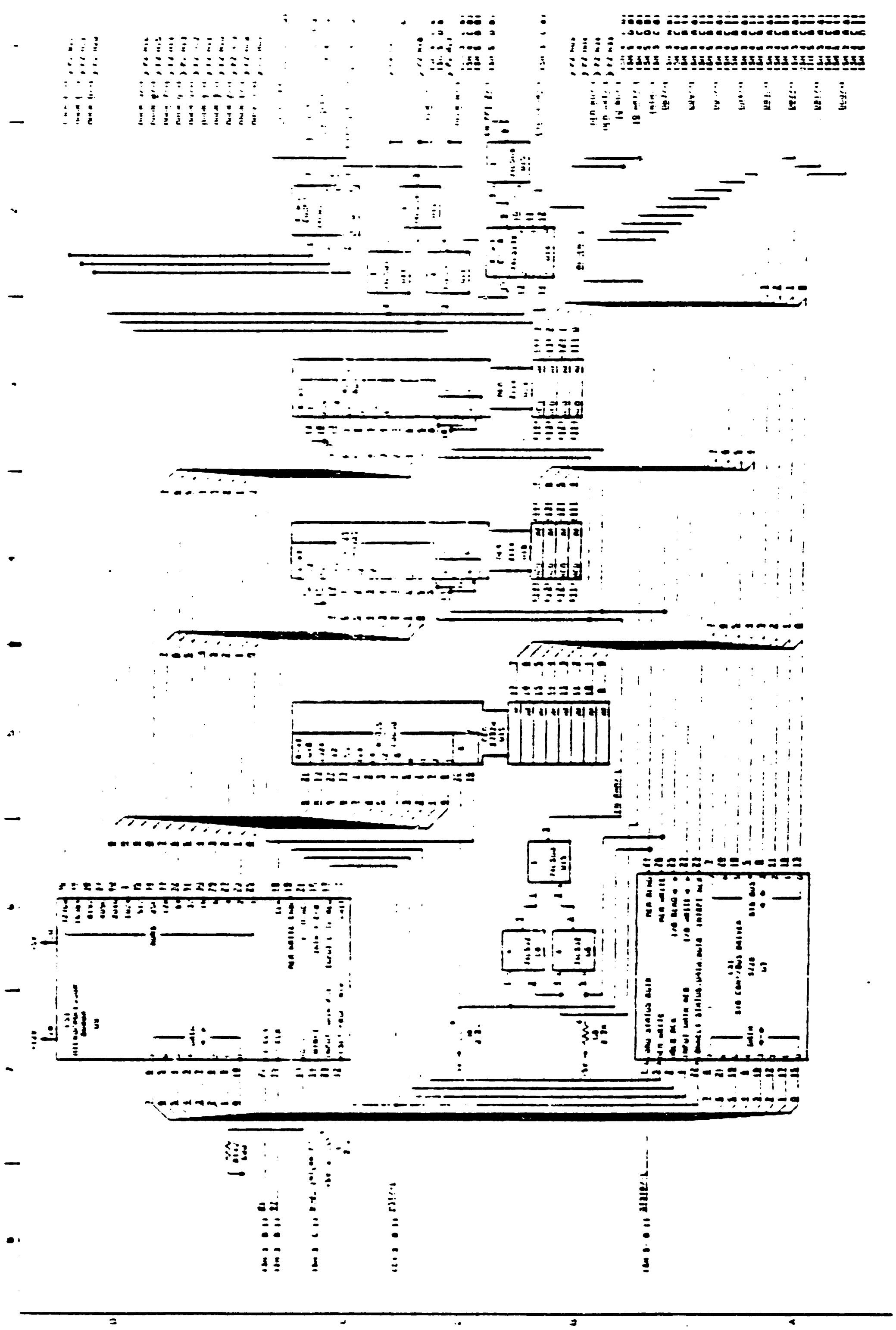
CROSS REF
NO. 0301



WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

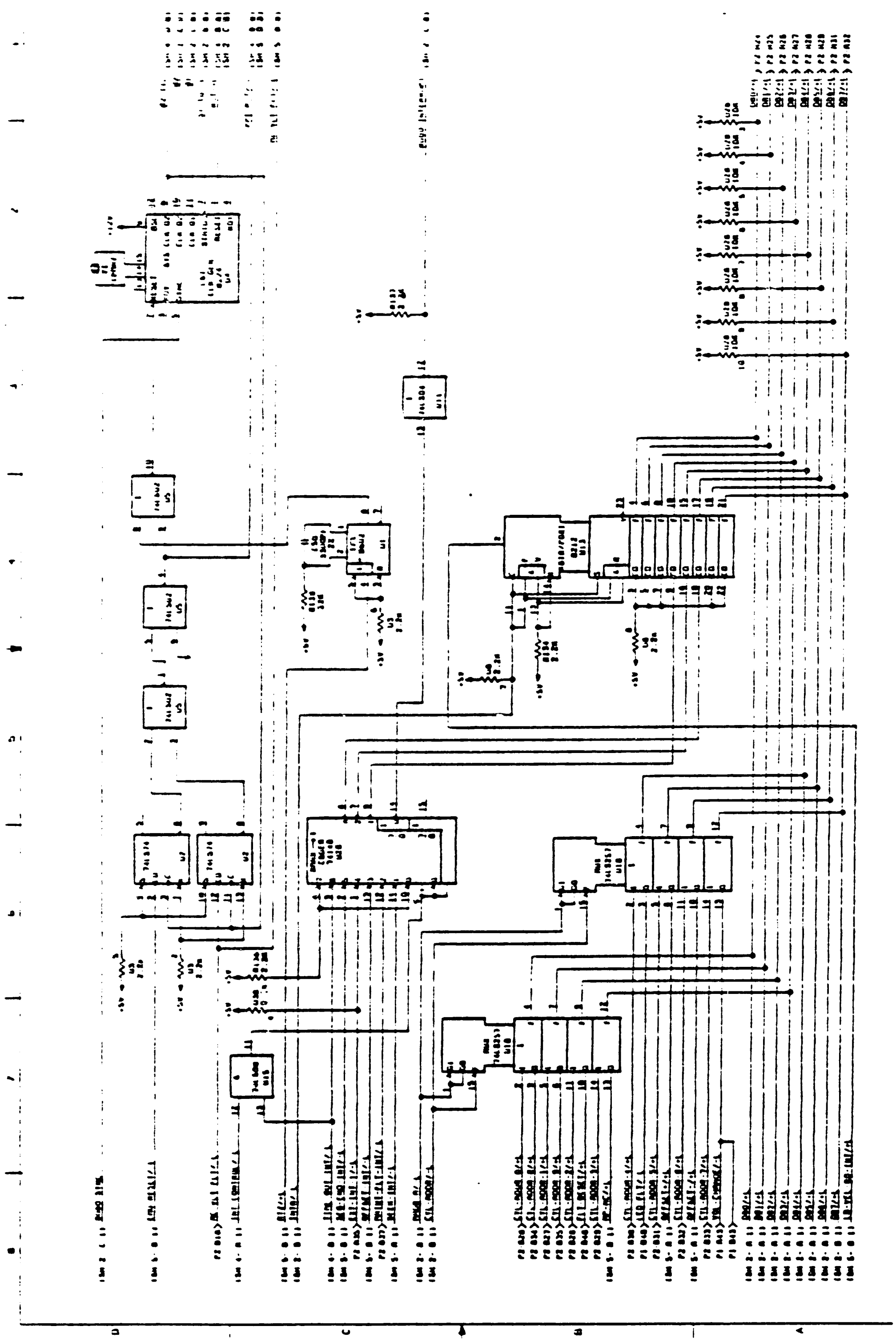
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 2 OF 13)



CROSS REF
NO. 0302

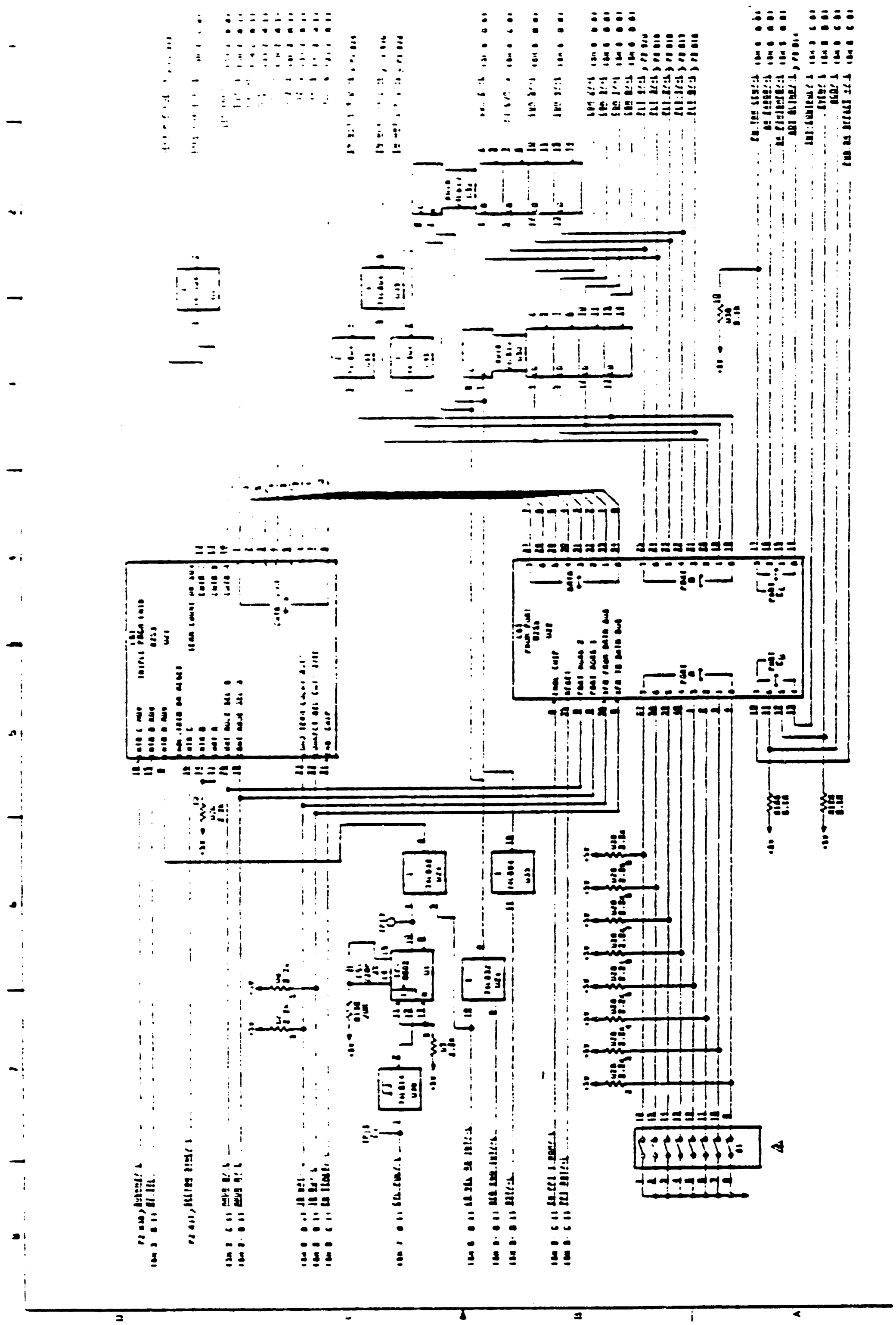
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 3 OF 13)

77683560-T



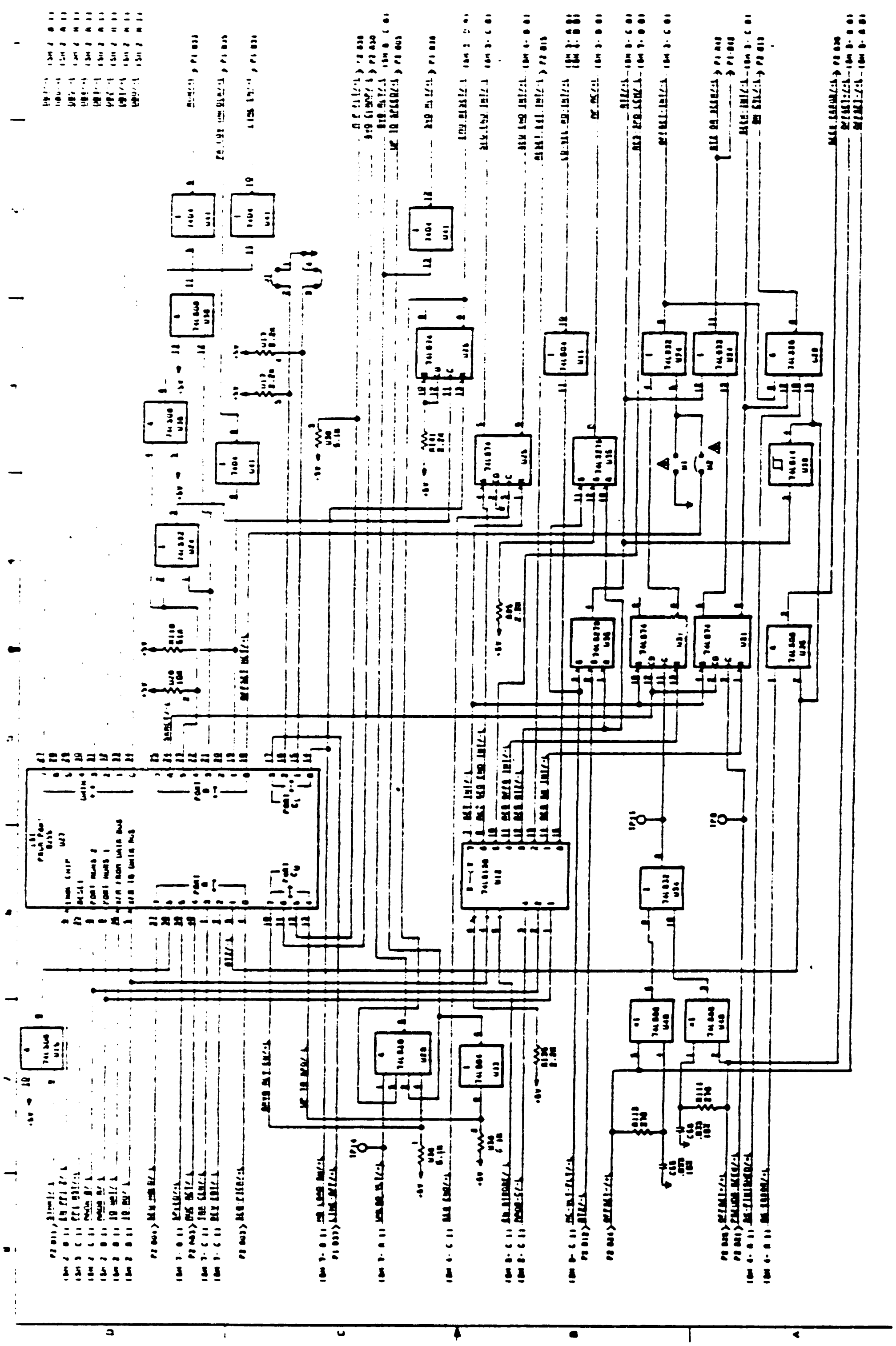
CROSS REF
NO. 0303

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 4 OF 13)



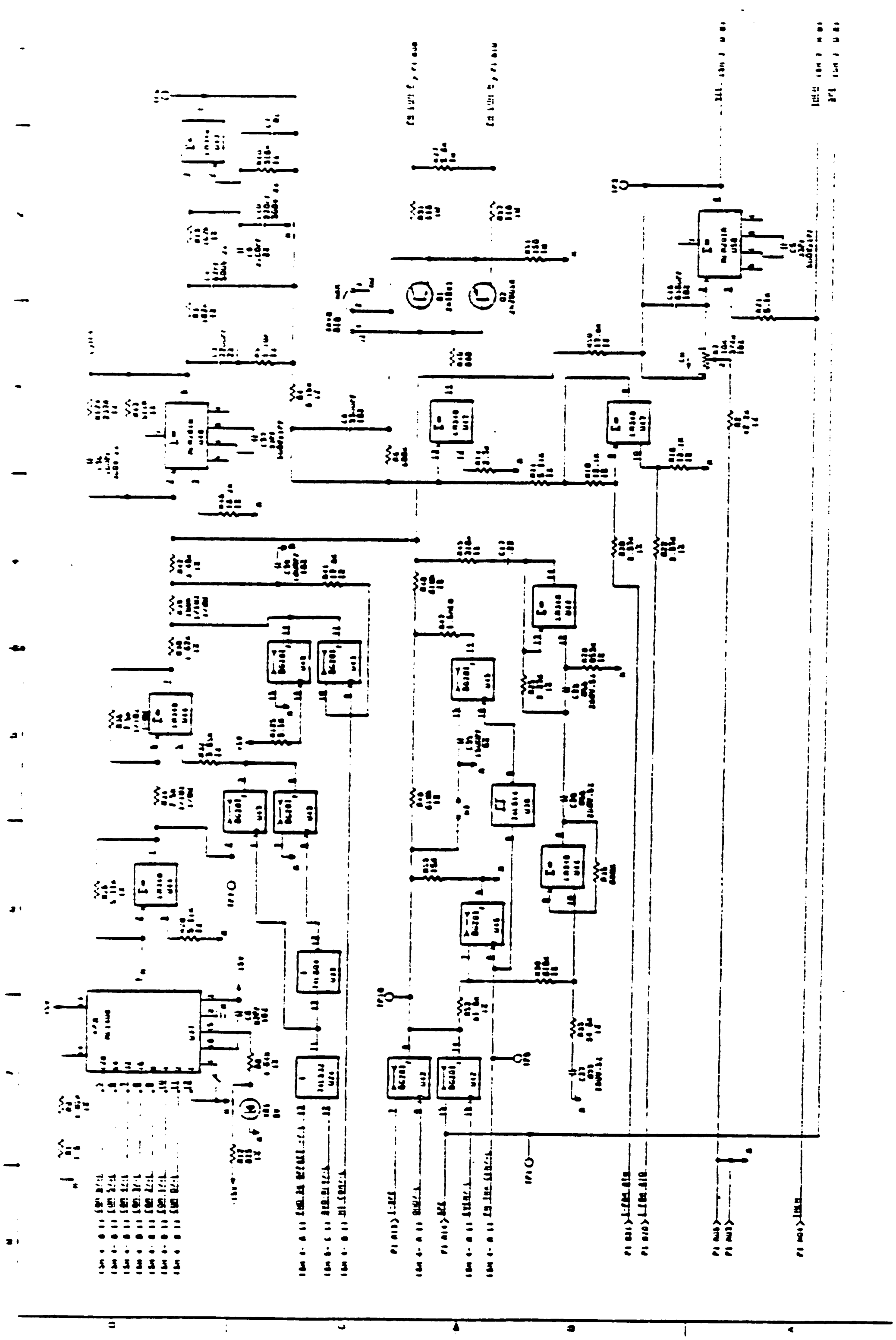
CROSS REF
NO. 0304

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 5 OF 13)



CROSS REF
NO. 0305

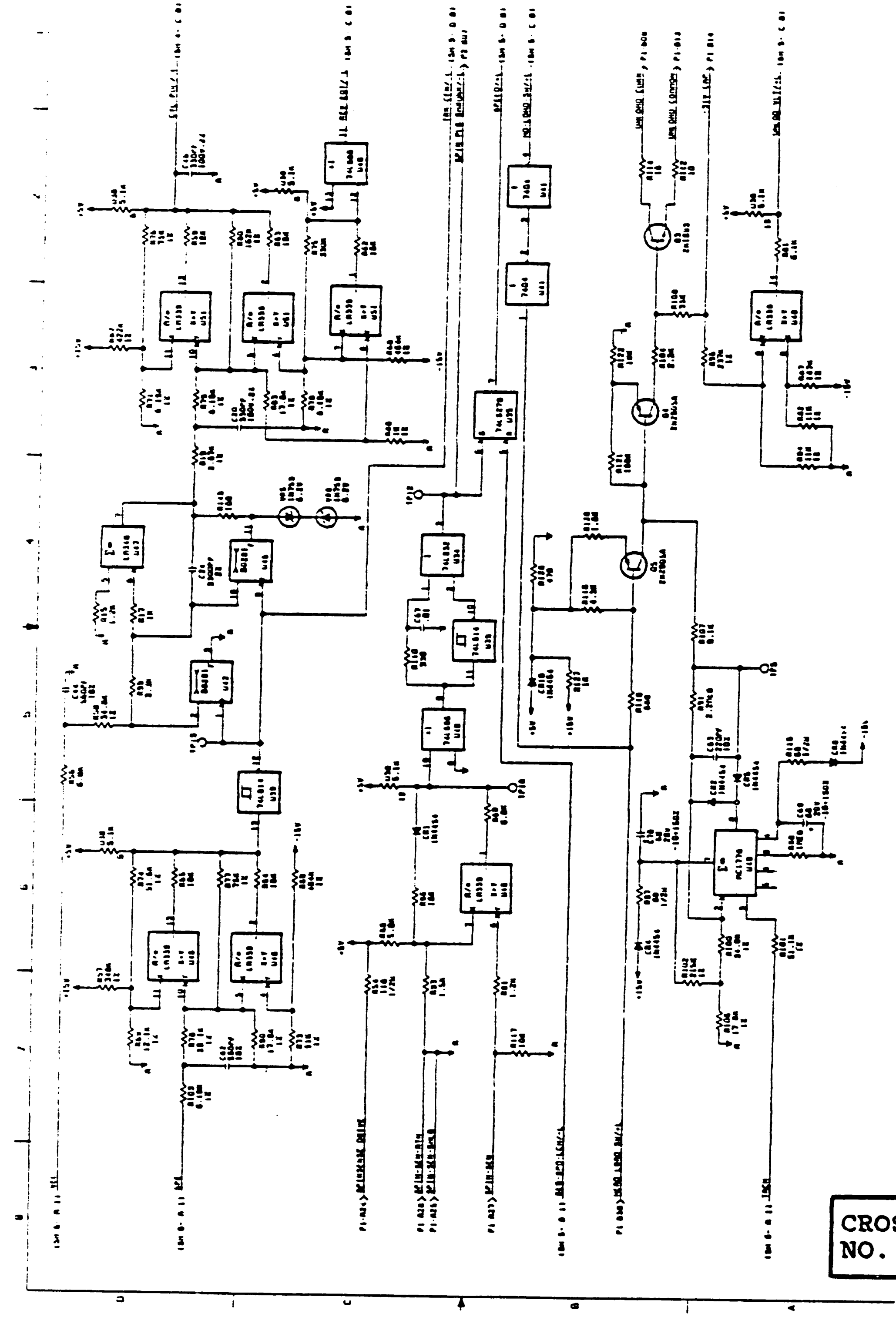
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 6 OF 13)



CROSS REF
NO. 0306

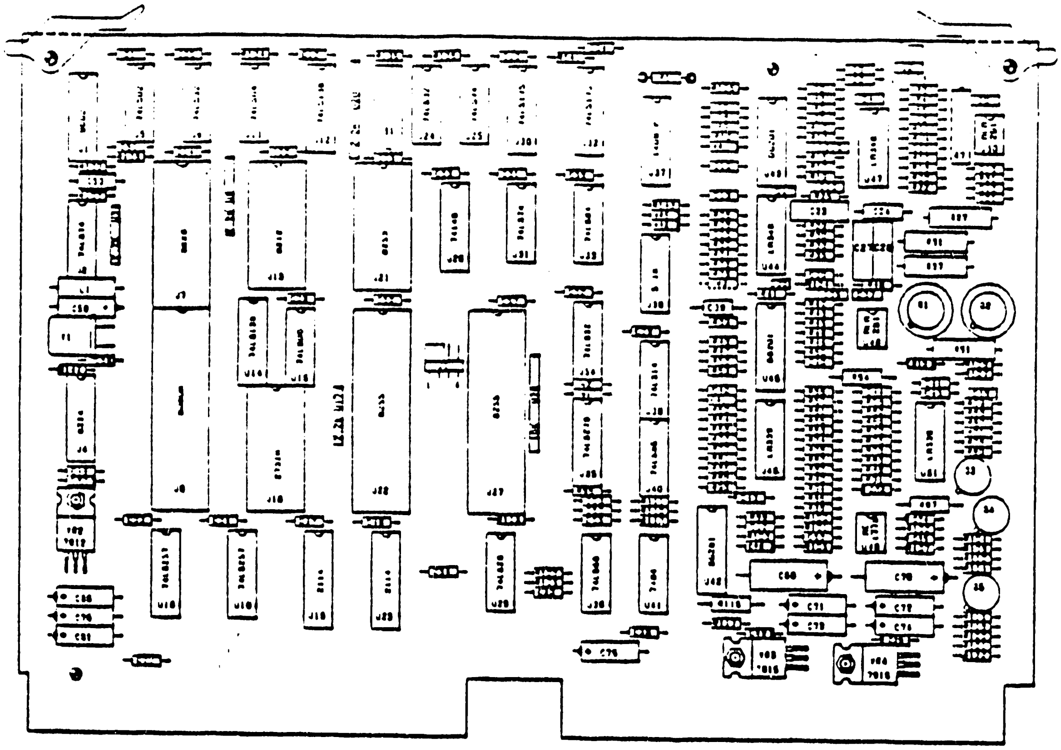
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 7 OF 13)

77683560-T



CROSS REF
NO. 0307

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 8 OF 13)



RES	PL ITEM
R1	144
R2	135
R3	155
R4	136
R5	86
R6	138
R7	146
R8	50
R9	88
R10	154
R11	81
R12	84
R13	155
R14	97
R15	122
R16	138
R17	121
R18	86
R19	87
R20	147
R21	127
R22	147
R23	-
R24	-
R25	147
R26	31
R27	108
R28	81
R29	115
R30	114
R31	83
R32	48
R33	103
R34	81
R35	138
R36	81
R37	93
R38	137
R39	112
R40	130
R41	130
R42	82
R43	56
R44	-
R45	154
R46	58
R47	140
R48	114
R49	114
R50	100
R51	108
R52	137
R53	132
R54	142
R55	-

RES	PL ITEM
R56	128
R57	50
R58	133
R59	131
R60	128
R61	27
R62	131
R63	131
R64	131
R65	131
R66	113
R67	74
R68	113
R69	98
R70	104
R71	134
R72	-
R73	84
R74	101
R75	79
R76	95
R77	95
R78	101
R79	124
R80	133
R81	122
R82	94
R83	100
R84	-
R85	-
R86	131
R87	95
R88	92
R89	128
R90	83
R91	125
R92	-
R93	123
R94	94
R95	124
R96	112
R97	113
R98	111
R99	129
R100	103
R101	128
R102	93
R103	104
R104	124
R105	127
R106	130
R107	128
R108	134
R109	-
R110	123

RES	PL ITEM
R111	118
R112	116
R113	118
R114	116
R115	143
R116	172
R117	131
R118	130
R119	171
R120	173
R121	130
R122	131
R123	-
R124	112
R125	127
R126	127
R127	121
R128	174
R129	-
R130	-
R131	-
R132	-
R133	-
R134	124
R135	124
R136	124
R137	124
R138	102
R139	133
R140	-
R141	124
R142	130
R143	163

CAP	PL ITEM
C1	80
C2	80
C3	73
C4	80
C5	59
C6	72
C7	80
C8	78
C9	70
C10	81
C11	96
C12	90
C13	80
C14	98
C15	73
C16	79
C17	93
C18	80
C19	96
C20	64
C21	80
C22	80
C23	58
C24	65
C25	80
C26	80
C27	57
C28	58
C29	60
C30	90
C31	80
C32	80
C33	93
C34	80
C35	88
C36	117
C37	58
C38	63
C39	77
C40	80
C41	60
C42	90
C43	90
C44	92
C45	98
C46	64
C47	80
C48	80
C49	90
C50	63
C51	160
C52	90
C53	90
C54	90
C55	78

CAP	PL ITEM
C56	80
C57	60
C58	16
C59	57
C60	80
C61	58
C62	92
C63	18
C64	90
C65	56
C66	80
C67	60
C68	80
C69	58
C70	58
C71	55
C72	55
C73	54
C74	54
C75	58
C76	55
C77	80
C78	90

IC	PL ITEM
U1	27
U2	19
U3	37
U4	6
	26
U5	11
U6	18
U7	7
U8	48
U9	5
U10	13
U11	16
U12	15
U13	13
U14	26
U15	113
U16	138
	35
	169
U17	37
U18	13
U19	9
U20	138
U21	12
U22	11
U23	9
U24	18
U25	19
U26	20
U27	11
U28	169
U29	22
U30	17
U31	18
U32	17
U33	15
U34	18
U35	23
U36	23
U37	32
U38	28
U39	25
U40	21
U41	14
U42	32
U43	32
U44	20
U45	32
U46	31
U47	29
U48	10
U49	140
U50	30
U51	31

DIO	PL ITEM
CR1	43
CR2	43
CR3	-
CR4	43
CR5	43
CR6	43
CR7	150
CR8	150
CR9	150
CR10	43

TSTR	PL ITEM
Q1	44
	46
	46
Q2	45
	46
	45
Q3	44
	46
Q4	45
	46
Q5	45
	46

VOLT REG	PL ITEM
VR1	42
VR2	39
VR3	40
VR4	41
VR5	167
VR6	167

JMPR	PL ITEM
W1	-
W2	-
W3	-

CONN	PL ITEM
J1	170
J2	47

IND	PL ITEM
L1	53

SW	PL ITEM
S1	136

XTAL	PL ITEM
Y1	52

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 9 OF 13)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77682950-0	PWA, Servo Coarse	
2	77682970-7	PWB, Servo Coarse	
5	15138300-7	I.C. 8080A	
6	15153500-2	I.C. 8224	
7	15153400-5	I.C. 8228	
9	15163472-2	I.C. TYPE 2114	INTCH
9	15163400-3	I.C. 2114	
10	15155400-3	I.C. 8212	
11	15164427-5	I.C. 8255A	INTCH
11	15153300-7	I.C. 8255	
12	15164419-2	I.C. 8253	INTCH
12	44680046-8	I.C. 8253-5	
13	15164402-8	I.C. 74LS257	
14	39389700-4	I.C. 7404	
15	15147400-4	I.C. 74LS138	
16	15145100-2	I.C. 74LS04	
17	15146900-4	I.C. 74LS175	
18	15146200-9	I.C. 74LS32	
19	15146300-7	I.C. 74LS74	
20	15148300-5	I.C. 74LS279	
21	15146400-5	I.C. 74LS86	
22	15145900-5	I.C. 74LS20	
23	15145400-6	I.C. 74LS08	
24	15162200-8	I.C. 74148	
25	15148500-0	I.C. 74LS14	
26	15146600-0	I.C. 74LS139	
27	15104301-5	I.C. 9602	
28	75009935-0	Res PAC 2% 5.1K (13)	
29	44670956-0	I.C. LM348	
30	15156600-7	I.C. MLM201A	
31	95794600-7	I.C. LM339	
32	15164438-2	I.C. DG201	
33	15132702-0	I.C. MC1408L-8	
33	15164442-4	I.C. 1408P-8	
34	83452230-2	Switch, Dual-in-Line	
35	94260302-8	Socket 24 Pin	
36	94260301-0	Socket 16 Pin	
37	91938444-6	Resistor Module & PN	
39	15151503-8	Volt Reg 7812	
40	15151504-6	I.C. 7815	
41	15151403-1	I.C. 7915	
42	50241502-9	Volt Reg 9.0 V	
43	51706300-4	Diode IN4454	
44	51751900-5	Trans, Silicon, 2N1893	
45	51585100-4	TSTR 2N2905A (PNP)	
46	77832363-4	Heat Sink	
47	75743603-5	Header 3 Pos	
48	94335900-0	Pad-Transistor Mtg	

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 10 OF 13)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
49	91938344-3	Res PK 2.2K 2% 8 Pos	
50	95663302-9	Stud, Press	
51	92583002-8	Nut Lock	
52	39465705-0	Crystal 18 MHz	
53	94233930-0	Inductor 33 uH	
54	17706766-7	Cap 20 V 10% 10 uF+	
55	24505237-8	Cap 35 V 10% 4.7 uF+	
56	77612232-7	Cap 20 V -10 +150 68 uF	
57	24504350-0	Cap 10 V 20% 10 uF+	
58	24504353-4	Cap 10 V 20% 33 uF+	
59	94227214-7	Cap 500 V +1 PF 33	
60	94227221-2	Cap 500 V 2% 62	
61	94227234-5	Cap 300 V 2% 220	
62	94240428-6	Cap 50 V 10% 560	
63	77830576-3	Cap 50 V +80 -20% 0.22 U	
64	94227238-6	Cap 100 V 2% 330	
65	15164270-9	Cap 50 V 2% 3300 PF	
66	75887697-3	Cap 50 V 5% 1500	
67	75888014-0	Cap 200 V 5% 0.033 uF	
68	75888017-3	Cap 200 V 5% 0.056 uF	
70	15164268-3	Cap 50 V 2% 2200 PF	
72	94240421-1	Cap 50 V 10% 82	
73	94361400-8	Cap 50 V +80 -20% 0.10 uF	INTCH
73	19115401-2	Cap 50 V 20 +80% 0.10 uF	
74	94360560-0	Res 1/4 W 1% 422 K	
75	94240410-4	Cap 50 V 10% 6800	
76	94240442-7	Cap 50 V 10% 0.033 uF	
77	94240401-3	Cap 50 V 10% 1000	
78	94240433-6	Cap 50 V 10% 3300	
79	94402216-9	Res 1/4 W 5% 330 K	
80	94361401-6	Cap 50 V 80 -20% 0.01 uF	INTCH
80	19115400-4	Cap 50 V 20 +80% 0.01 uF	
81	75721503-3	Res 1/8 W 0.1% 7.5 K	
82	94360352-2	Res 1/4 W 1% 3.48 K	
83	24507126-1	Res 1 W 5% 110	
84	94360288-8	Res 1/4 W 1% 825	
85	94360484-3	Res 1/4 W 1% 75.0 K	
86	94360304-3	Res 1/4 W 1% 1.10 K	
87	94360344-9	Res 1/4 W 1% 2.87 K	
88	94360354-8	Res 1/4 W 1% 3.65 K	
89	94360358-9	Res 1/4 W 1% 4.02 K	
90	94360364-7	Res 1/4 W 1% 4.64 K	
91	94360368-8	Res 1/4 W 1% 5.11 K	
92	94360300-1	Res 1/4 W 1% 1.00 K	
93	94360532-9	Res 1/4 W 1% 215 K	
94	94360404-1	Res 1/4 W 1% 11.0 K	
95	94360516-2	Res 1/4 W 1% 147 K	

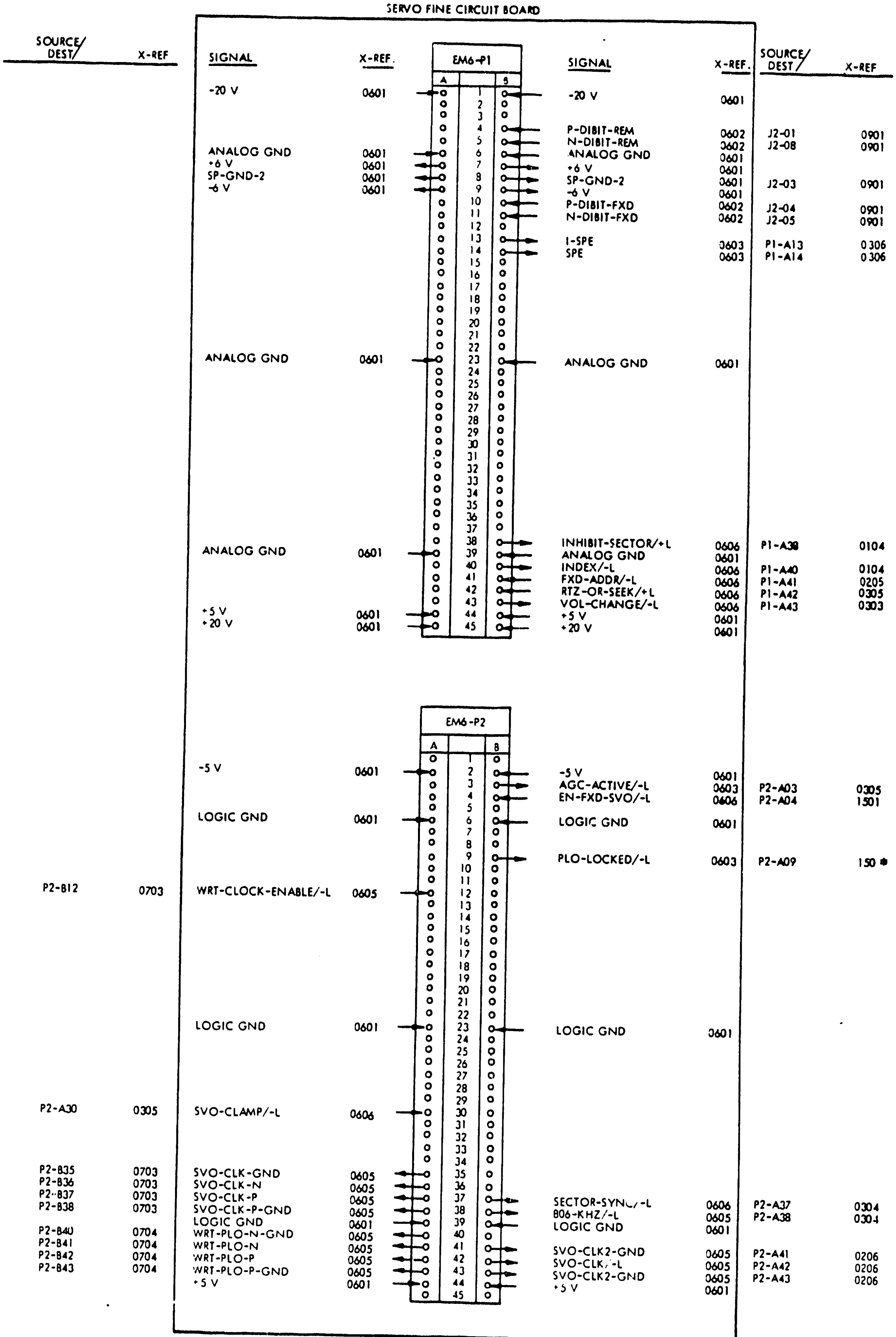
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 11 OF 13)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
96	94360408-2	Res 1/4 W 1% 12.1 K	
97	94402166-6	Res 1/4 W 5% 2.7 K	
98	94360420-7	Res 1/4 W 1% 16.2 K	
99	94360568-3	Res 1/4 W 1% 511 K	
100	94360424-9	Res 1/4 W 1% 17.8 K	
101	94360440-5	Res 1/4 W 1% 26.1 K	
103	94360452-0	Res 1/4 W 1% 34.8 K	
104	94360376-1	Res 1/4 W 1% 6.19 K	
105	94360460-3	Res 1/4 W 1% 42.2 K	
106	94360468-6	Res 1/4 W 1% 51.1 K	
107	94360476-9	Res 1/4 W 1% 61.9 K	
108	24507181-6	Res 1 W 5% 5.6 K	
109	24507129-5	Res 1 W 5% 150	
110	75721506-6	Res 1/8 W 0.1% 196 K	
111	15145000-4	I.C. 74LS02	
112	94360536-0	Res 1/4 W 1% 237 K	
113	94360564-2	Res 1/4 W 1% 464 K	
114	94360576-6	Res 1/4 W 1% 619 K	
115	94360594-0	Res 1/4 W 1% 953 K	
116	94402108-8	Res 1/4 W 5% 10	
117	94227226-1	Cap 300 V 2% 100 PF	
118	94240407-0	Cap 50 V 10% 220	
119	94402142-7	Res 1/4 W 5% 270	
120	94402144-3	Res 1/4 W 5% 330	
121	94402156-7	Res 1/4 W 5% 1 K	
122	94402158-3	Res 1/4 W 5% 1.2 K	
123	94402160-9	Res 1/4 W 5% 1.5 K	
124	94402164-1	Res 1/4 W 5% 2.2 K	
125	94402168-2	Res 1/4 W 5% 3.3 K	
126	94402179-9	Res 1/4 W 5% 9.1 K	
127	94402173-2	Res 1/4 W 5% 5.1 K	
128	94402174-0	Res 1/4 W 5% 5.6 K	
129	94402176-5	Res 1/4 W 5% 6.8 K	
130	94402152-6	Res 1/4 W 5% 680	
131	94402180-7	Res 1/4 W 5% 10 K	
132	94402184-9	Res 1/4 W 5% 15 K	
133	94402188-0	Res 1/4 W 5% 22 K	
134	94402192-2	Res 1/4 W 5% 33 K	
135	94402236-7	Res 1/4 W 5% 2.3 MEG	
136	96752412-5	Res PK 2.2 K 2% 10 PIN	
137	94360320-9	Res 1/4 W 1% 1.62 K	
138	94402204-5	Res 1/4 W 5% 100 K	
139	94402224-3	Res 1/4 W 5% 680 K	
140	94402232-6	Res 1/4 W 5% 1.5 M	
141	94402228-4	Res 1/4 W 5% 1.0 MEG	
142	24500140-9	Res 1/2 W 5% 110	
143	24500135-9	Res 1/2 W 5% 68	

FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 12 OF 13)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
144	94357500-1	Resistor Test Select	
145	77612039-6	Res VAR-3/4 W, 10%, 10 K	
146	77612165-9	Terminal, Slotted	INTCH
146	77612167-5	Terminal, Slotted	
147	94360336-5	Res 1/4 W 1% 2.37 K	
148	15164425-9	I.C. MC1776	
150	77670828-1	Injector/Ejector PWB	
154	94360548-5	Res 1/4 W 1% 316 K	
155	94360520-4	Res 1/4 W 1% 162 K	
156	77686184-1	I.C., EPROM	
158	95637301-3	Diode, IN4001	
160	94360552-7	Res 1/4 W 1% 348 K	
161	94360448-8	Res 1/4 W 1% 31.6 K	
162	94402187-2	Res 1/4 W 5% 20 K	
163	94402132-8	Res 1/4 W 5% 100	
165	96752420-8	Res PK 10 K 2% 10 PIN	
166	83433002-9	Shunt Assembly	
167	50240108-6	Volt Reg 6.2 V 5%	
168	15164256-8	Cap, 50 V 2% 220 PF	
169	77671523-7	Tape, Disk	
170	75743604-3	Header 4 Pos	
171	94402197-1	Res 1/4W 5% 51K	
172	94402171-6	Res 1/4W 5% 4.3K	
173	94402161-7	Res 1.6K OHMS	
174	94402148-4	Res 1/4W 5% 470	

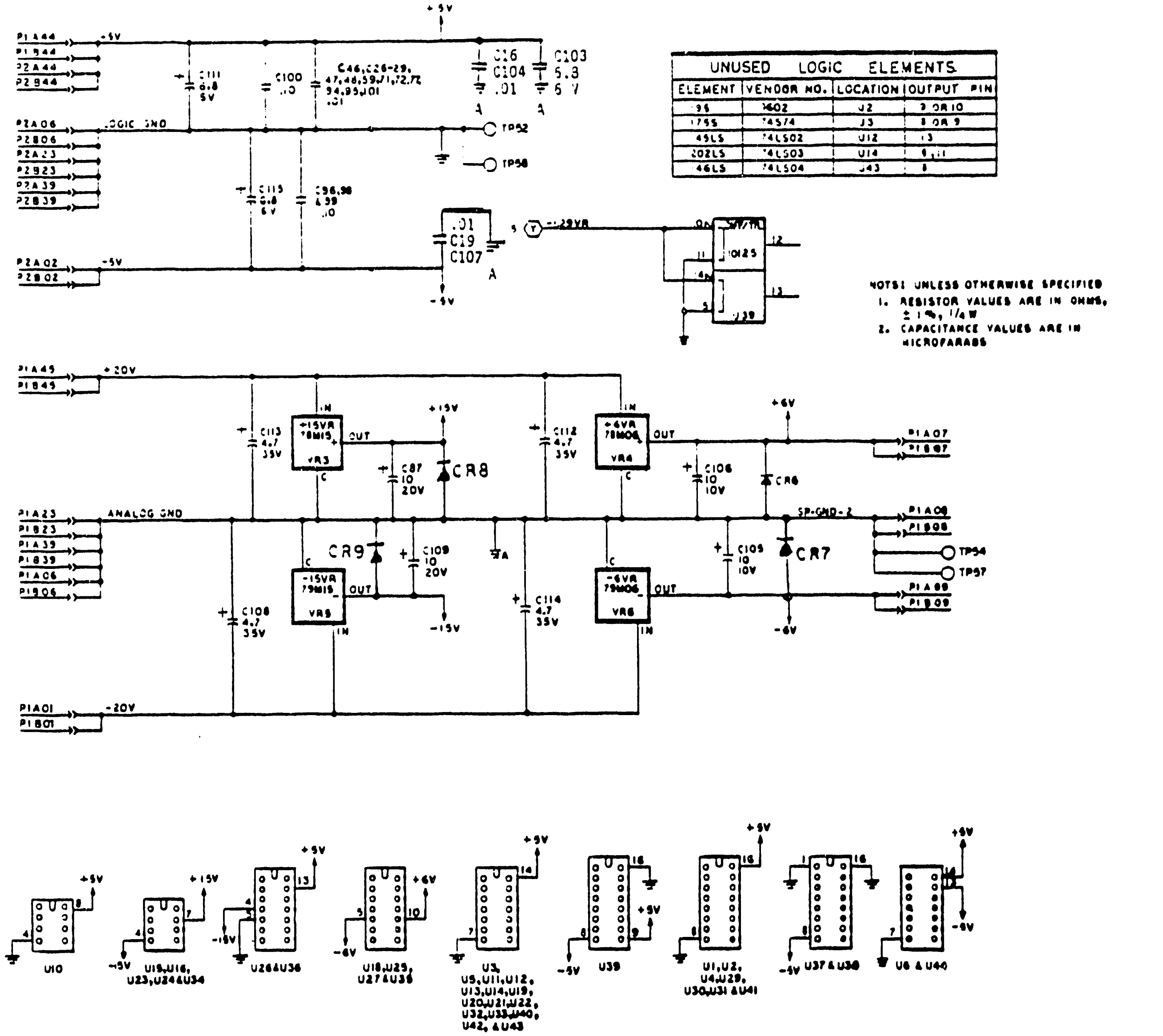
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 13 OF 13)



* WIRED TO, BUT NOT USED ON PWA

XX230

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 1 OF 11)



		SIGNAL	SH. NO.	SOURCE/DEST	XREF
J1	01	RD-DATA-PE	(2)	J8-01	0801
	02	RD-DATA-N	(2)	J8-02	0801
	01	SELECTED-SVO-P	(2)	J1-D1	1501
	02	GND	(2)		
	03	SVO/DATA-N	(2)	J1-03	1501
	04	GND	(2)		
	05	GND	(2)		
	06	SVO/DATA-N	(2)	J1-06	1501
	07	GND	(2)		
	08	SELECTED-SVO-N	(2)	J1-08	1501

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

CROSS REF NO. 0601

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 2 OF 11)

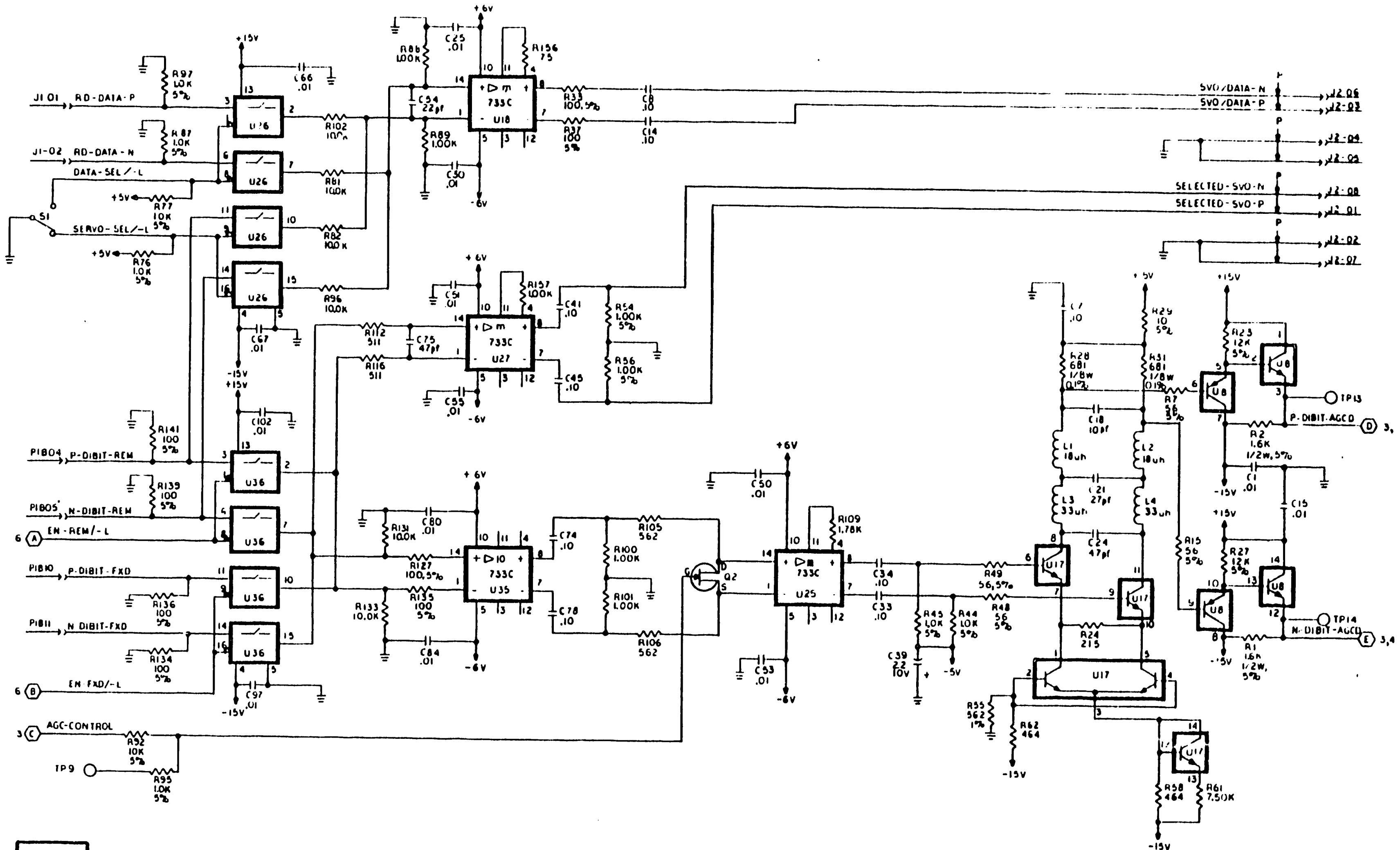


FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 3 OF 11)

77683560-R

CROSS REF
NO. 0602

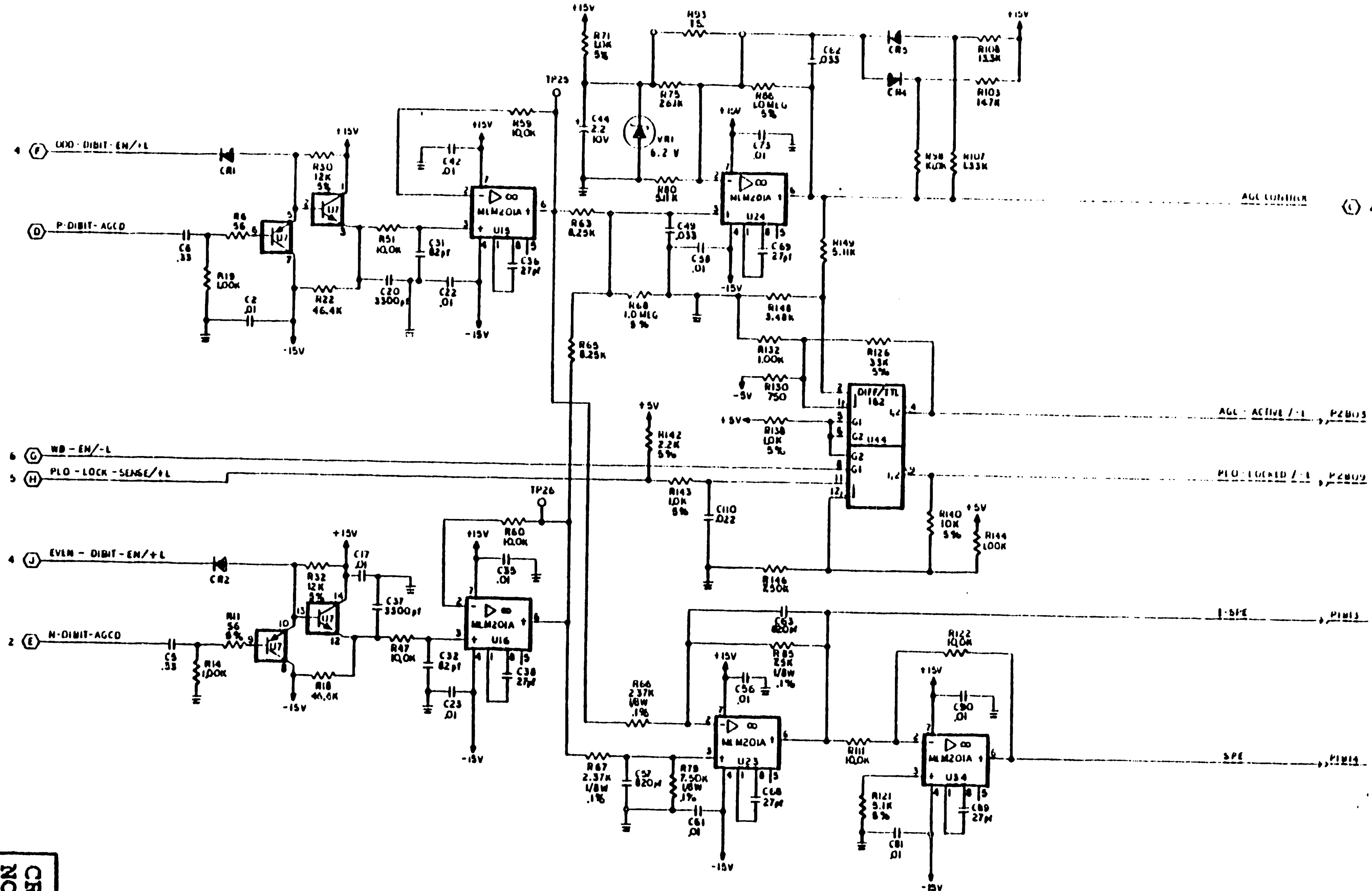


FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 4 OF 11)
77683560-R

CROSS REF
NO. 0603

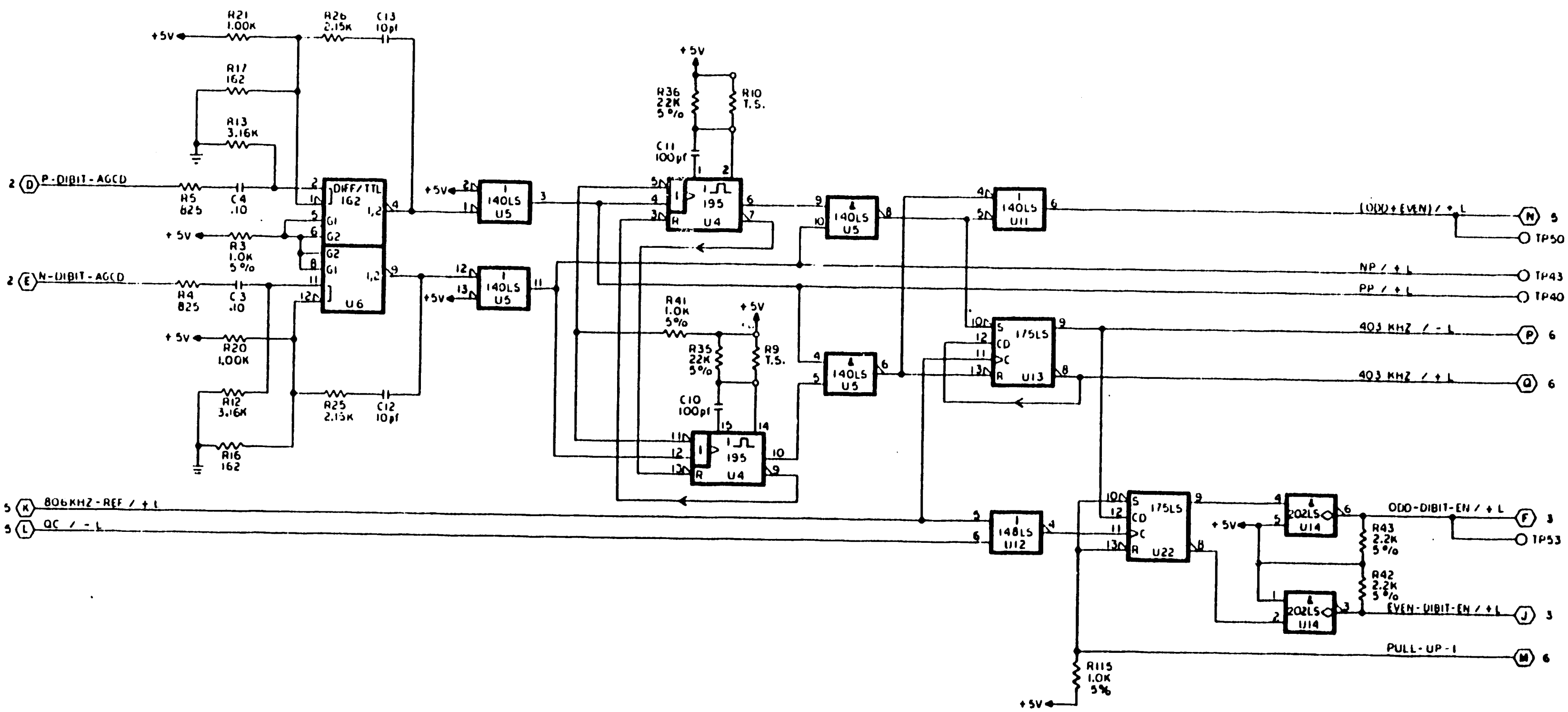


FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 5 OF 11)
77683560-R

CROSS REF
NO. 0604

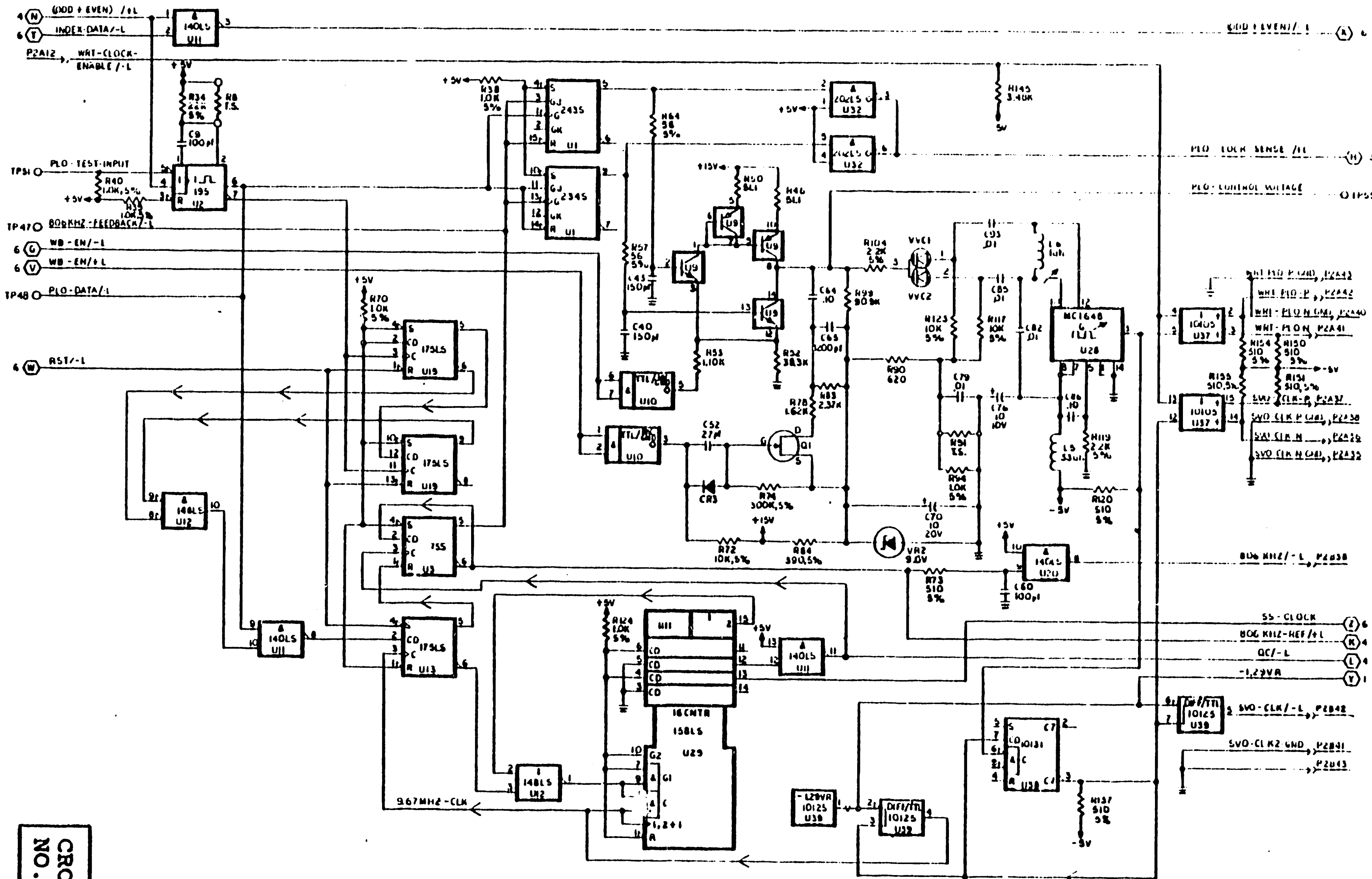


FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 6 OF 11)
77683560-R

CROSS REF
NO. 0605

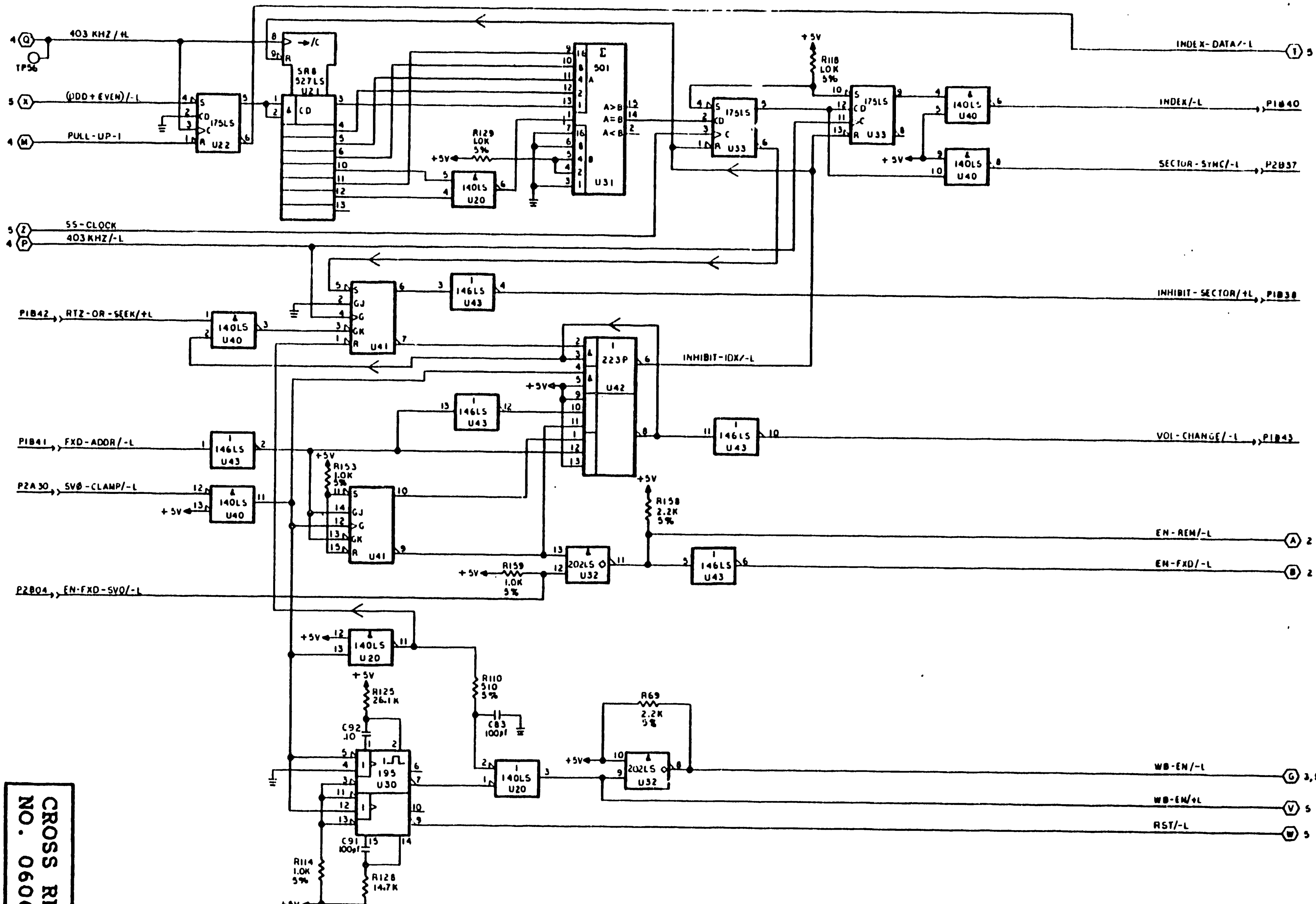
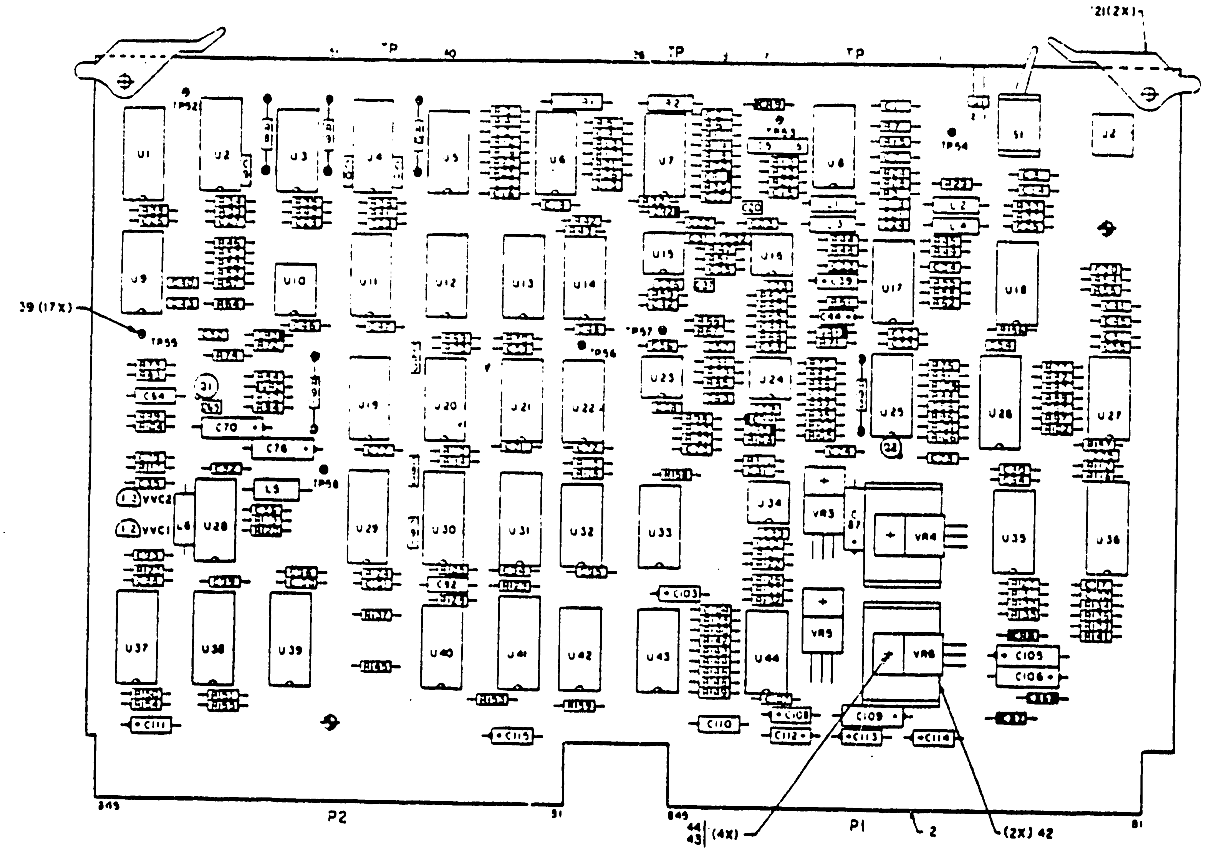


FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 7 OF 11)

77683560-R

CROSS REF NO. 0606



IND	PL ITEM
L1	37
L2	37
L3	38
L4	38
L5	38
L6	123

DIODE	PL ITEM
CR1	36
CR2	36
CR3	36
CR4	36
CR5	36
CR6	124
CR7	124
CR8	124
CR9	124

TSTR	PL ITEM
Q1	32
Q2	32

VOLT REG	PL ITEM
VR1	35
VR2	33
VR3	28
VR4	29
VR5	30
VR6	31

VARI CAP DIODE	PL ITEM
VVC1	46
VVC2	46

SW	PL ITEM
S1	120

CONN	PL ITEM
J1	40
J2	41

IC	PL ITEM
U1	14
U2	11
U3	34
U4	11
U5	25
U6	10
U7	27
U8	27
U9	27
U10	6
U11	25
U12	23
U13	17
U14	22
U15	9
U16	9
U17	26
U18	7
U19	17
U20	25
U21	20
U22	17
U23	9
U24	9
U25	7
U26	8
U27	7
U28	15
U29	16
U30	11
U31	21
U32	22
U33	17
U34	9
U35	7
U36	8
U37	13
U38	5
U39	12
U40	25
U41	18
U42	19
U43	24
U44	10

CAP	PL ITEM
C59	66
C60	57
C61	66
C62	63
C63	59
C64	61
C65	62
C66	66
C67	66
C68	54
C69	54
C70	49
C71	66
C72	66
C73	66
C74	67
C75	55
C76	48
C77	66
C78	67
C79	66
C80	66
C81	66
C82	66
C83	57
C84	66
C85	66
C86	67
C87	49
C88	—
C89	54
C90	66
C91	57
C92	61
C93	66
C94	66
C95	66
C96	67
C97	66
C98	67
C99	67
C100	67
C101	66
C102	66
C103	47
C104	66
C105	48
C106	48
C107	66
C108	50
C109	49
C110	64
C111	47
C112	50
C113	50
C114	50
C115	47

CAP	PL ITEM
C1	66
C2	66
C3	67
C4	67
C5	68
C6	68
C7	67
C8	67
C9	57
C10	57
C11	57
C12	52
C13	52
C14	67
C15	68
C16	66
C17	66
C18	52
C19	66
C20	60
C21	54
C22	66
C23	66
C24	55
C25	66
C26	66
C27	66
C28	66
C29	66
C30	66
C31	56
C32	56
C33	67
C34	67
C35	66
C36	54
C37	60
C38	54
C39	51
C40	58
C41	67
C42	66
C43	58
C44	51
C45	67
C46	66
C47	66
C48	66
C49	63
C50	68
C51	66
C52	54
C53	66
C54	53
C55	66
C56	66
C57	59
C58	68

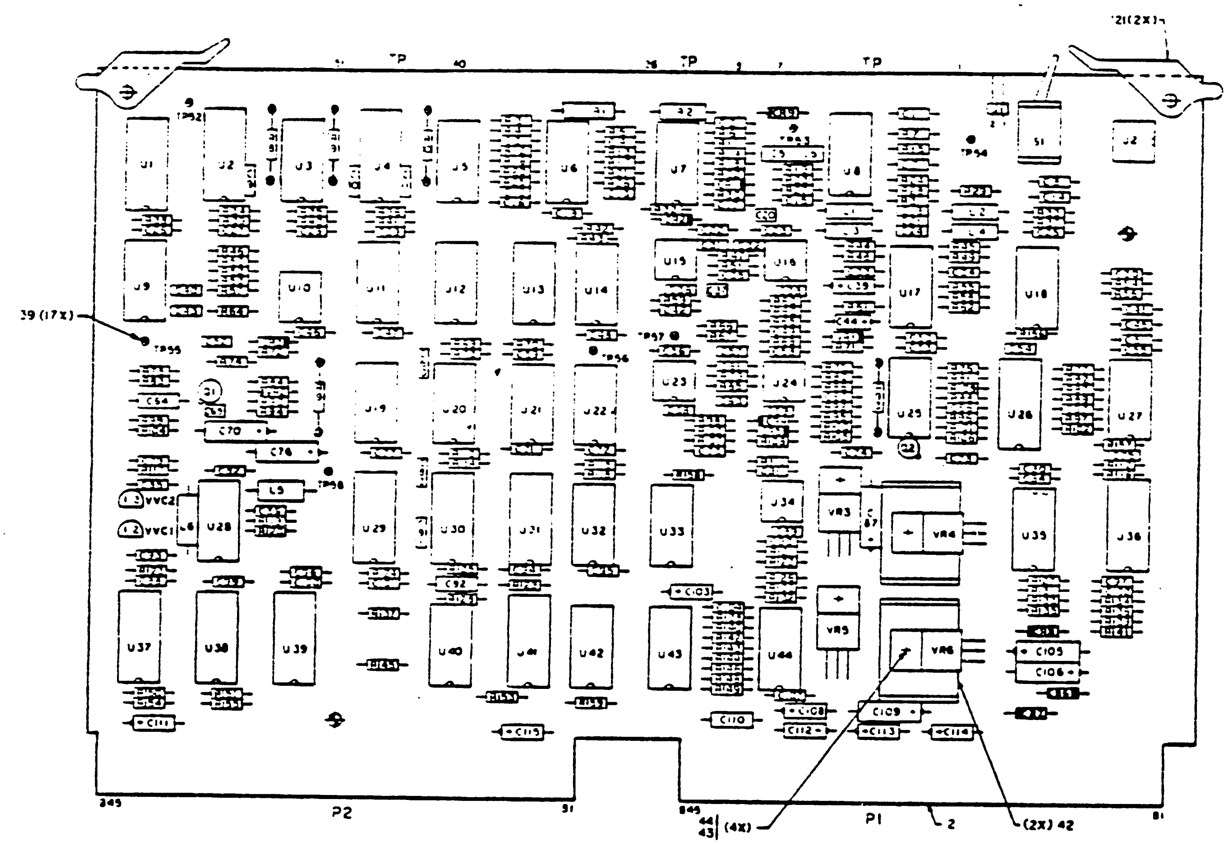
RES	PL ITEM
R117	112
R118	109
R119	110
R120	108
R121	111
R122	93
R123	112
R124	109
R125	96
R126	115
R127	105
R128	95
R129	109
R130	83
R131	93
R132	85
R133	93
R134	105
R135	105
R136	105
R137	108
R138	109
R139	105
R140	112
R141	105
R142	110
R143	109
R144	85
R145	89
R146	100
R147	—
R148	89
R149	91
R150	108
R151	108
R152	—
R153	109
R154	108
R155	108
R156	90
R157	85
R158	110
R159	109

RES	PL ITEM
R59	93
R60	93
R61	100
R62	79
R63	92
R64	104
R65	92
R66	71
R67	71
R68	118
R69	110
R70	109
R71	109
R72	112
R73	108
R74	116
R75	96
R76	109
R77	109
R78	78
R79	72
R80	91
R81	93
R82	93
R83	87
R84	106
R85	72
R86	118
R87	109
R88	85
R89	85
R90	107
R91	119
R92	112
R93	119
R94	109
R95	109
R96	93
R97	109
R98	93
R99	98
R100	109
R101	109
R102	93
R103	95
R104	110
R105	81
R106	81
R107	86
R108	94
R109	73
R110	108
R111	93
R112	60
R113	—
R114	109
R115	109
R116	80

RES	PL ITEM
R1	69
R2	69
R3	108
R4	84
R5	84
R6	104
R7	104
R8	119
R9	119
R10	119
R11	104
R12	88
R13	88
R14	85
R15	104
R16	74
R17	76
R18	97
R19	85
R20	85
R21	85
R22	97
R23	113
R24	77
R25	82
R26	82
R27	113
R28	70
R29	101
R30	113
R31	70
R32	113
R33	105
R34	114
R35	114
R36	114
R37	105
R38	109
R39	109
R40	109
R41	109
R42	110
R43	110
R44	109
R45	109
R46	75
R47	93
R48	104
R49	104
R50	75
R51	93
R52	99
R53	76
R54	109
R55	81
R56	109
R57	104
R58	78

FF312a

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 8 OF 11)



IND	PL ITEM
L1	37
L2	37
L3	38
L4	38
L5	38
L6	123

DIODE	PL ITEM
CR1	36
CR2	36
CR3	36
CR4	36
CR5	36
CR6	124
CR7	124
CR8	124
CR9	124

TSTR	PL ITEM
Q1	32
Q2	32

VOLT REG	PL ITEM
VR1	35
VR2	33
VR3	28
VR4	29
VR5	30
VR6	31

VARI CAP DIODE	PL ITEM
VVC1	46
VVC2	46

SW	PL ITEM
S1	120

CONN	PL ITEM
J1	40
J2	41

IC	PL ITEM
U1	14
U2	11
U3	34
U4	11
U5	25
U6	10
U7	27
U8	27
U9	27
U10	6
U11	25
U12	23
U13	17
U14	22
U15	9
U16	9
U17	26
U18	7
U19	17
U20	25
U21	20
U22	17
U23	9
U24	9
U25	7
U26	8
U27	7
U28	15
U29	16
U30	11
U31	21
U32	22
U33	17
U34	9
U35	7
U36	8
U37	13
U38	5
U39	12
U40	25
U41	18
U42	19
U43	24
U44	10

CAP	PL ITEM
C59	66
C60	57
C61	64
C62	63
C63	59
C64	61
C65	62
C66	66
C67	66
C68	54
C69	54
C70	49
C71	66
C72	66
C73	66
C74	67
C75	55
C76	48
C77	66
C78	67
C79	66
C80	66
C81	66
C82	64
C83	57
C84	66
C85	66
C86	67
C87	49
C88	—
C89	54
C90	66
C91	57
C92	61
C93	66
C94	66
C95	66
C96	67
C97	66
C98	67
C99	67
C100	67
C101	66
C102	66
C103	47
C104	66
C105	48
C106	48
C107	64
C108	50
C109	49
C110	64
C111	47
C112	50
C113	50
C114	50
C115	47

CAP	PL ITEM
C1	66
C2	66
C3	67
C4	67
C5	68
C6	68
C7	67
C8	67
C9	57
C10	57
C11	57
C12	52
C13	52
C14	67
C15	66
C16	66
C17	64
C18	52
C19	66
C20	60
C21	54
C22	66
C23	66
C24	55
C25	66
C26	66
C27	66
C28	66
C29	66
C30	66
C31	56
C32	56
C33	67
C34	67
C35	66
C36	54
C37	60
C38	54
C39	51
C40	58
C41	67
C42	66
C43	58
C44	51
C45	67
C46	66
C47	66
C48	66
C49	63
C50	66
C51	66
C52	54
C53	66
C54	53
C55	66
C56	66
C57	59
C58	66

RES	PL ITEM
R117	114
R118	109
R119	110
R120	108
R121	111
R122	93
R123	112
R124	105
R125	96
R126	115
R127	105
R128	95
R129	109
R130	83
R131	93
R132	85
R133	93
R134	105
R135	105
R136	105
R137	108
R138	109
R139	105
R140	112
R141	105
R142	110
R143	109
R144	85
R145	89
R146	100
R147	—
R148	89
R149	91
R150	108
R151	108
R152	—
R153	109
R154	108
R155	108
R156	90
R157	85
R158	110
R159	109

RES	PL ITEM
R59	93
R60	93
R61	100
R62	79
R63	92
R64	104
R65	92
R66	71
R67	71
R68	118
R69	110
R70	109
R71	109
R72	112
R73	108
R74	116
R75	96
R76	109
R77	109
R78	78
R79	72
R80	91
R81	93
R82	93
R83	87
R84	106
R85	72
R86	118
R87	109
R88	85
R89	85
R90	107
R91	119
R92	112
R93	119
R94	109
R95	109
R96	93
R97	109
R98	93
R99	98
R100	109
R101	108
R102	93
R103	95
R104	113
R105	81
R106	81
R107	86
R108	94
R109	73
R110	108
R111	93
R112	80
R113	—
R114	109
R115	109
R116	80

RES	PL ITEM
R1	69
R2	69
R3	109
R4	84
R5	84
R6	104
R7	104
R8	119
R9	119
R10	119
R11	104
R12	88
R13	88
R14	85
R15	104
R16	74
R17	76
R18	92
R19	85
R20	85
R21	85
R22	97
R23	113
R24	77
R25	82
R26	82
R27	113
R28	70
R29	101
R30	113
R31	70
R32	113
R33	105
R34	114
R35	114
R36	114
R37	105
R38	109
R39	109
R40	109
R41	109
R42	110
R43	110
R44	109
R45	108
R46	75
R47	93
R48	104
R49	104
R50	75
R51	93
R52	99
R53	76
R54	109
R55	81
R56	109
R57	104
R58	78

FF312a

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 8 OF 11)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77688750	PWA, Servo Fine	
2	77688770	PWB, Servo Fine	
5	15118500-6	I.C. ECL 10131	
6	15161600-0	I.C. 75461	
7	15163100-9	I.C. 733C	
8	15164438-2	I.C. 201	
9	15156600-7	I.C. 201A	
10	15164426-7	I.C. 75107	
11	15104301-5	I.C. 9602	
12	15119500-5	I.C. ECL 10125	
13	15118100-5	I.C. ECL 10105	
14	15158600-5	I.C. 74S112	
15	15164422-6	I.C. ECL 1648	
16	15146800-6	I.C. 74LS161	
17	15146300-7	I.C. 74LS74	
18	15148000-1	I.C. 74LS109	
19	15124700-4	I.C. 74LS51	
20	15163303-9	I.C. 74LS164	
21	51783500-5	I.C. 9324	
22	15145200-0	I.C. 74LS03	
23	15145000-4	I.C. 74LS02	
24	15145100-2	I.C. 74LS04	
25	15144900-6	I.C. 74LS00	
26	94675200-3	I.C. CA3046/CA3346	
27	75889250-9	I.C. 6600-1	
28	15151504-6	I.C. 7815	
29	15151501-2	I.C. 7806	
30	15151403-1	I.C. 7915	
31	15151404-9	I.C. 7906	
32	75888005-8	Transistor 2N4860A	
33	50241502-9	Volt Reg 9.0 V	
34	88923000-9	I.C. 74S74	
35	50241500-3	Volt Reg 6.2 V	
36	51706300-4	Diode IN4454	
37	94233927-6	Inductor 18 µH	
38	94233930-0	Inductor 33 µH	
39	77612167-5	Terminal Slotted	
40	75743602-7	Header-Right Angle	
41	77832292-5	Socket, 8 Pin	
42	77832299-0	Heat Sink	
43	95683502-9	Stud, Press	
44	92583002-8	Nut Lock	
45	77670995-8	Compound 340	
46	77612970-2	MVAM2	
47	24505259-2	Cap 6 V 10% 6.8 µF	
48	17706712-1	Cap 10 V 10% 10 µF	
49	17706766-7	Cap 20 V 10% 10 µF	

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 9 OF 11)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
50	24505237-8	Cap 35 V 10% 4.7 µF	
51	17706704-8	Cap 10 V 10% 2.2 µF	
52	94227205-5	Cap 500 V +1 PF 10	
53	94227210-5	Cap 500 V 5% 22	
54	94227212-1	Cap 500 V +1 PF 27	
55	94227218-8	Cap 500 V +/-1 PF 47	
56	94227224-6	Cap 300 V 2% 82	
57	94227226-1	Cap 300 V 2% 100	
58	94227230-3	Cap 500 V 2% 150	
59	94227248-5	Cap 100 V 2% 820	
60	75837701-3	Cap 50 V 5% 3300	
61	94240448-4	Cap 50 V 10% 10 µF	
62	75887696-5	Cap 50 V 5% 1200	
63	94240442-7	Cap 50 V 10% 0.033 µF	
64	94240440-1	Cap 50 V 10% 0.022 µF	
66	19115400-4	Cap 50 V 8-20% 0.01 µF	
67	19115401-2	Cap 50 V +80-20%, 0.10 µF	
68	94354816-4	Cap 50 V 20% 0.33 µF	
69	24500168-0	Res 1/2 W 5% 1.6 K	
70	75721504-1	Res 1/8 W 0.1% 681	
71	75721502-5	Res 1/8 W 0.1% 2.37 K	
72	75721503-3	Res 1/8 W 0.1% 7.5 K	
73	94360324-1	Res 1/4 W 1% 1.78 K	
74	94360220-1	Res 1/4 W 1% 162	
75	94360168-2	Res 1/4 W 1% 51.1	
76	94360304-3	Res 1/4 W 1% 1.10 K	
77	94360232-6	Res 1/4 W 1% 215	
78	94360320-9	Res 1/4 W 1% 1.62 K	
79	94360264-9	Res 1/4 W 1% 464	
80	94360268-0	Res 1/4 W 1% 511	
81	94360272-2	Res 1/4 W 1% 562	
82	94360332-4	Res 1/4 W 1% 2.15 K	
83	94360284-7	Res 1/4 W 1% 750	
84	94360288-8	Res 1/4 W 1% 825	
85	94360300-1	Res 1/4 W 1% 1.00 K	
86	94360312-6	Res 1/4 W 1% 1.33 K	
87	94360336-5	Res 1/4 W 1% 2.37 K	
88	94360348-0	Res 1/4 W 1% 3.16 K	
89	94360352-2	Res 1/4 W 1% 3.48 K	
90	94360184-9	Res 1/4 W 1% 75.0	
91	94360368-8	Res 1/4 W 1% 5.11 K	
92	94360388-6	Res 1/4 W 1% 8.25 K	
93	94360400-9	Res 1/4 W 1% 10.0 K	
94	94360412-4	Res 1/4 W 1% 13.3 K	
95	94360416-5	Res 1/4 W 1% 14.7 K	
96	94360440-5	Res 1/4 W 1% 26.1 K	
97	94360464-5	Res 1/4 W 1% 46.4 K	
98	94360492-6	Res 1/4 W 1% 90.9 K	

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 10 OF 11)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
99	94360456-1	Res 1/4 W 1% 38.3 K	
100	94360384-5	Res 1/4 W 1% 7.50 K	
101	94402108-8	Res 1/4 W 5% 10	
104	94402126-0	Res 1/4 W 5% 56	
105	94402132-8	Res 1/4 W 5% 100	
106	94402146-8	Res 1/4 W 5% 390	
107	94402151-8	Res 1/4 W 5% 620	
108	94402149-2	Res 1/4 W 5% 510	
109	94402156-7	Res 1/4 W 5% 1 K	
110	94402164-1	Res 1/4 W 5% 2.2 K	
111	94402173-2	Res 1/4 W 5% 5.1 K	
112	94402180-7	Res 1/4 W 5% 10 K	
113	94402182-3	Res 1/4 W 5% 12 K	
114	94402188-0	Res 1/4 W 5% 22 K	
115	94402192-2	Res 1/4 W 5% 33 K	
116	94402215-1	Res 1/4 W 5% 0.30 MEG	
118	94402228-4	Res 1/4 W 5% 1.0 MEG	
119	94357500-1	Resistor Test Select	
120	41347800-9	Switch Toggle	
121	77670828-1	Injector/Ejector - PWB	
123	75887583-5	Inductor 5% 1.0 µH	
124	95637301-3	Diode, IN4001	

FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 11 OF 11)

READ/WRITE CIRCUIT BOARD

EM7-P1

SOURCE/ DEST/	X-REF	SIGNAL	X-REF.	A	PIN	B	SIGNAL	X-REF.	SOURCE/ DEST/	X-REF
				o	1	o				
		ANALOG -5 V	0701	o	2	o	ANALOG -5 V	0701		
				o	3	o				
				o	4	o				
				o	5	o				
J1-05	0801	ANALOG GND	0701	o	6	o	ANALOG GND	0701		
J7-15	0801	-5 V		o	7	o				
J7-12	0801	+20 V		o	8	o				
J7-02	0801	+5 V		o	9	o				
J7-07	0801	ANALOG GND	0701	o	10	o	ANALOG GND	0701		
		ANALOG GND	0701	o	11	o	ANALOG GND	0701		
J7-01	0801	RD-ANA-DATA	0702	o	12	o	ANALOG GND	0701		
J7-16	0801	RD-ANA-DATA	0702	o	13	o	ANALOG GND	0701		
		ANALOG GND	0701	o	14	o	ANALOG GND	0701		
		ANALOG GND	0701	o	15	o	ANALOG GND	0701		
				o	16	o	DIAG-RD-AGC	0702	P1-A16	150*
				o	17	o				
				o	18	o	AM-ENABLE/+L	0704	P1-A18	0205
				o	19	o				
				o	20	o				
				o	21	o				
				o	22	o				
		ANALOG GND	0701	o	23	o	ANALOG GND	0701		
				o	24	o				
				o	25	o				
				o	26	o				
				o	27	o				
				o	28	o				
				o	29	o				
				o	30	o				
				o	31	o				
				o	32	o				
				o	33	o				
				o	34	o				
				o	35	o				
				o	36	o				
				o	37	o				
				o	38	o				
		GND	0701	o	39	o	GND	0701		
				o	40	o				
				o	41	o				
				o	42	o				
				o	43	o				
		+5 V	0701	o	44	o	+5 V	0701		
		+20 V	0701	o	45	o	+20 V	0701		

EM7-P2

SOURCE/ DEST/	X-REF	SIGNAL	X-REF.	A	PIN	B	SIGNAL	X-REF.	SOURCE/ DEST/	X-REF
		-20 V	0701	o	1	o	-20 V	0701		
		LOGIC -5	0701	o	2	o	LOGIC -5 V	0701		
P1-A40	0206	PWR-UP-MR/-L	0705	o	3	o	ERLY-STROBE/-L	0703	P1-B41	0204
P1-A38	0204	AM-FOUND/+L	0705	o	4	o	WRT-GATE/-L	0704	P1-B40	0204
				o	5	o	READ-GATE/+L	0705	P1-B38	0204
		GND	0701	o	6	o	GND	0701		
P1-A42	0204	LATE STROBE/-L	0703	o	7	o	NRZ-DATA-OUT-GND	0703	P2-A33	0204
				o	8	o	NRZ-DATA-OUT	0703	P2-A34	0204
				o	9	o	RD-CLK/-L	0703	P2-A27	0204
				o	10	o	RD-CLK-GND	0703	P2-A26	0204
				o	11	o				
				o	12	o	WRT-CLOCK-ENABLE/-L	0703	P2-A12	0605
				o	13	o				
				o	14	o				
				o	15	o				
P1-A37	020*	ON-TIME-EN/-L	0704	o	16	o				
				o	17	o				
				o	18	o				
				o	19	o				
				o	20	o				
				o	21	o				
				o	22	o				
		GND	0701	o	23	o	GND	0701		
				o	24	o				
				o	25	o	DIAG-RD-PLO-LOCK/+L	070*	P2-A25	150*
				o	26	o				
				o	27	o				
				o	28	o	WRT-CLK-GND	0704	P2-A28	0204
				o	29	o	WRT-CLK/-L	0704	P2-A29	0204
				o	30	o				
J7-13	0801	-12 V	0701	o	31	o	NRZ-WRT-GND	0704	P2-A31	0204
J7-04	0801	+12 V	0701	o	32	o	NRZ-WRT/-L	0704	P2-A32	0204
				o	33	o				
J7-06	0801	MFM-WRT-CMPS/+L	0704	o	34	o				
J7-11	0801	MFM-WRT-GND	0704	o	35	o	SVO-CLK-N-GND	0703	P2-A35	0605
				o	36	o	SVO-CLK-N	0703	P2-A36	0605
				o	37	o	SVO-CLK-P	0703	P2-A37	0605
				o	38	o	SVO-CLK-P-GND	0703	P2-A38	0605
		GND	0701	o	39	o	GND	0701		
				o	40	o	WRT-PLO-N-GND	0704	P2-A40	0605
				o	41	o	WRT-PLO-N	0074	P2-A41	0605
				o	42	o	WRT-PLO-P	0704	P2-A42	0605
				o	43	o	WRT-PLO-P-GND	0704	P2-A43	0605
		+5 V	0701	o	44	o	+5 V	0701		
				o	45	o				

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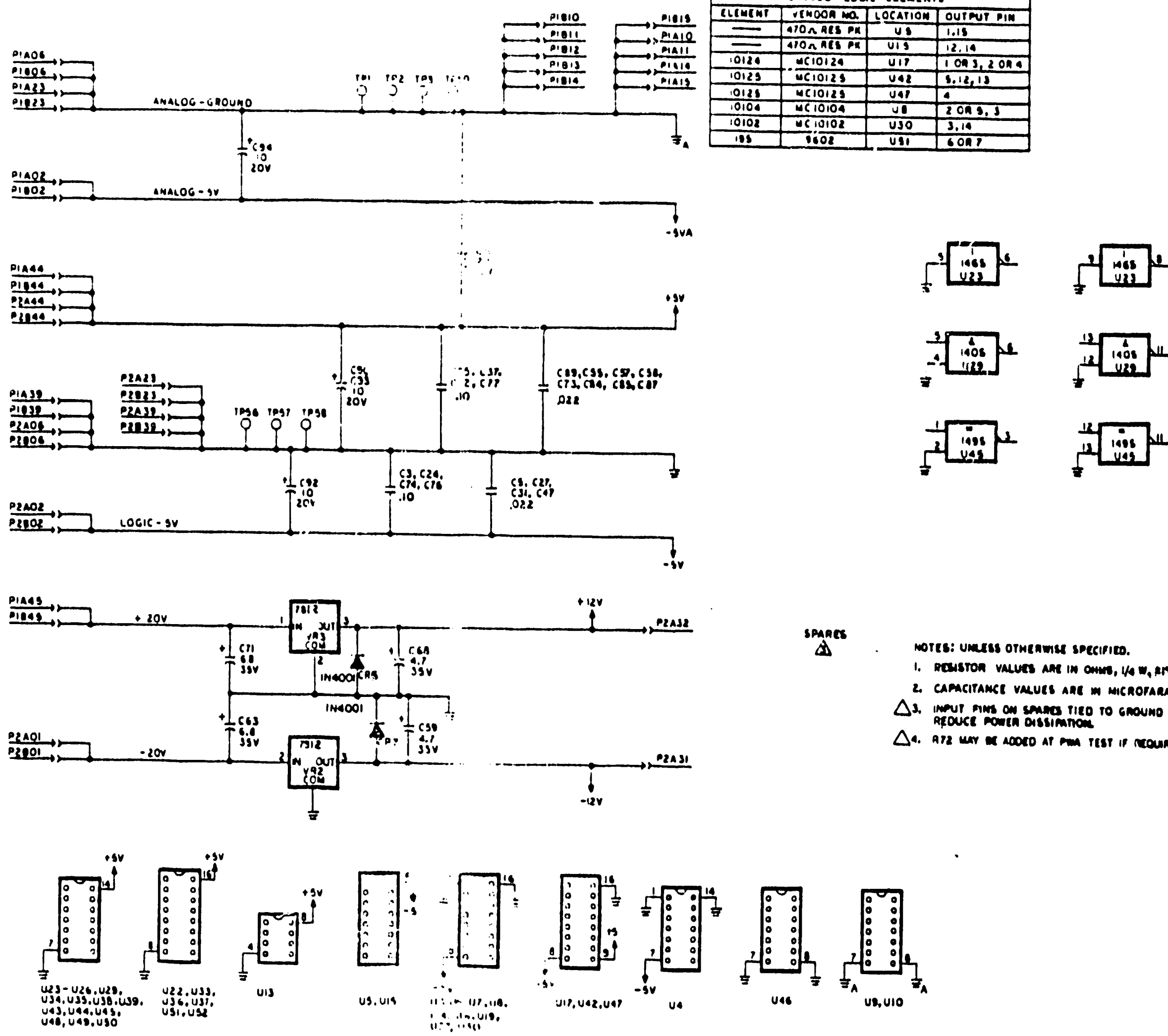
* WIRED TO, BUT NOT USED ON PWA

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 1 OF 10)



UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
—	470Ω RES PK	U5	1,15
—	470Ω RES PK	U15	12,14
10124	MC10124	U17	1 OR 3, 2 OR 4
10125	MC10125	U42	5,12,13
10125	MC10125	U47	4
10104	MC10104	U8	2 OR 5, 3
10102	MC10102	U30	3,14
195	9602	U51	6 OR 7

NOTES: UNLESS OTHERWISE SPECIFIED.

1. RESISTOR VALUES ARE IN OHMS, 1/4 W, ±1%.
2. CAPACITANCE VALUES ARE IN MICROFARADS.
3. INPUT PINS ON SPARES TIED TO GROUND TO REDUCE POWER DISSIPATION.
4. R72 MAY BE ADDED AT PWA TEST IF REQUIRED.

CROSS REF NO. 0701

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 2 OF 10)

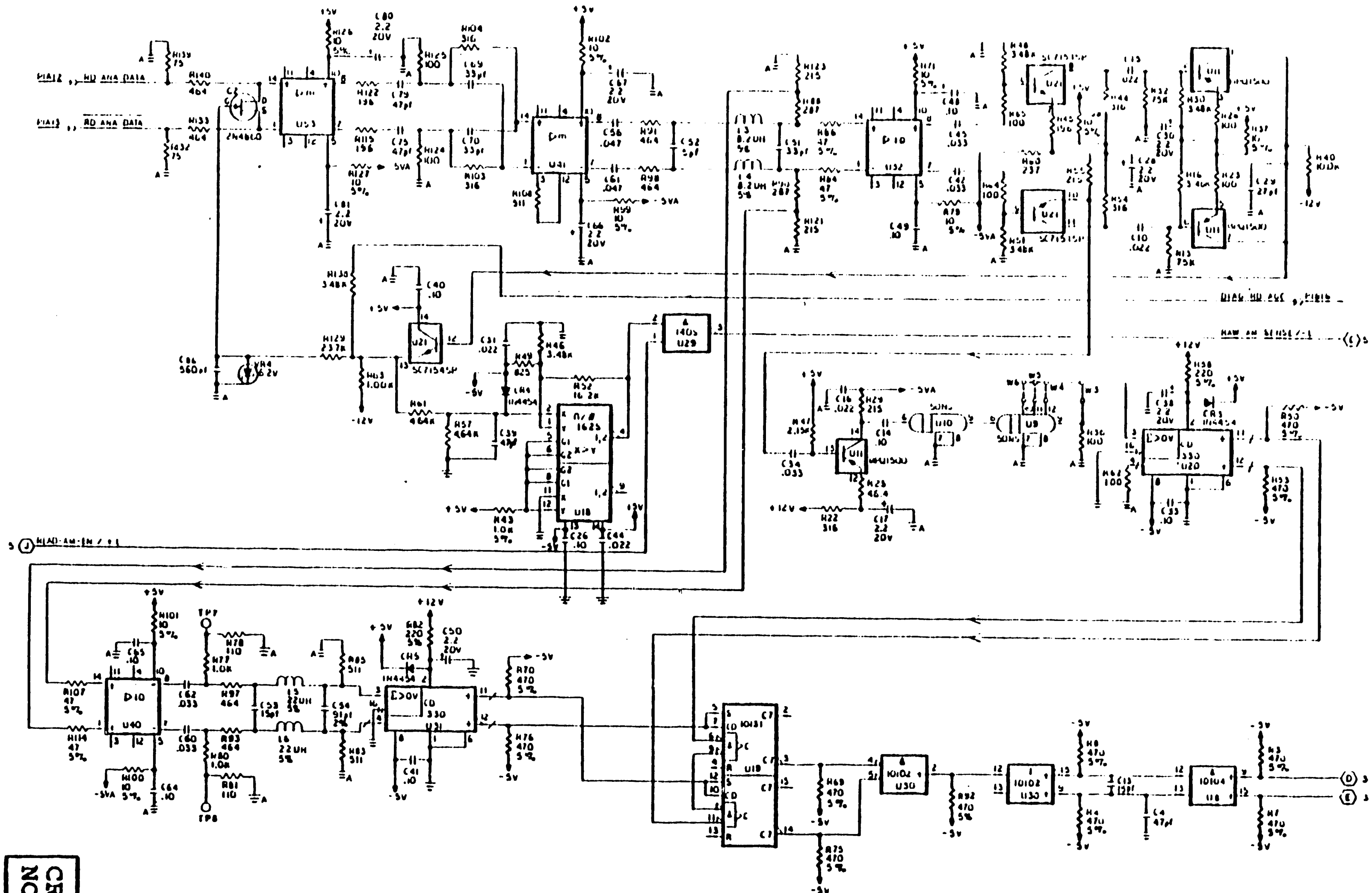


FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 3 OF 10)
77683560-R

CROSS REF
NO. 0702

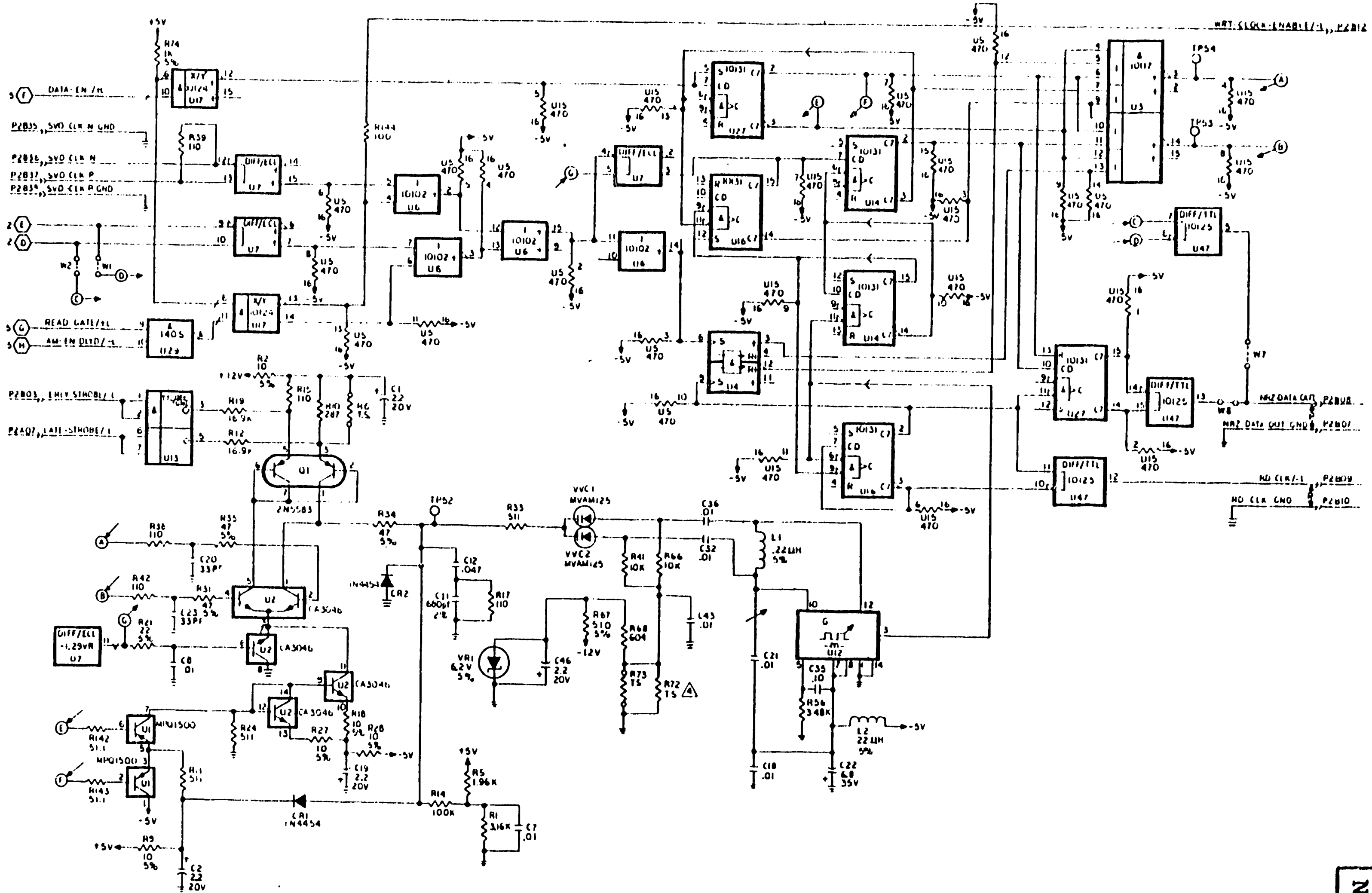


FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 4 OF 10)

77683560-R

CROSS REF NO. 0703

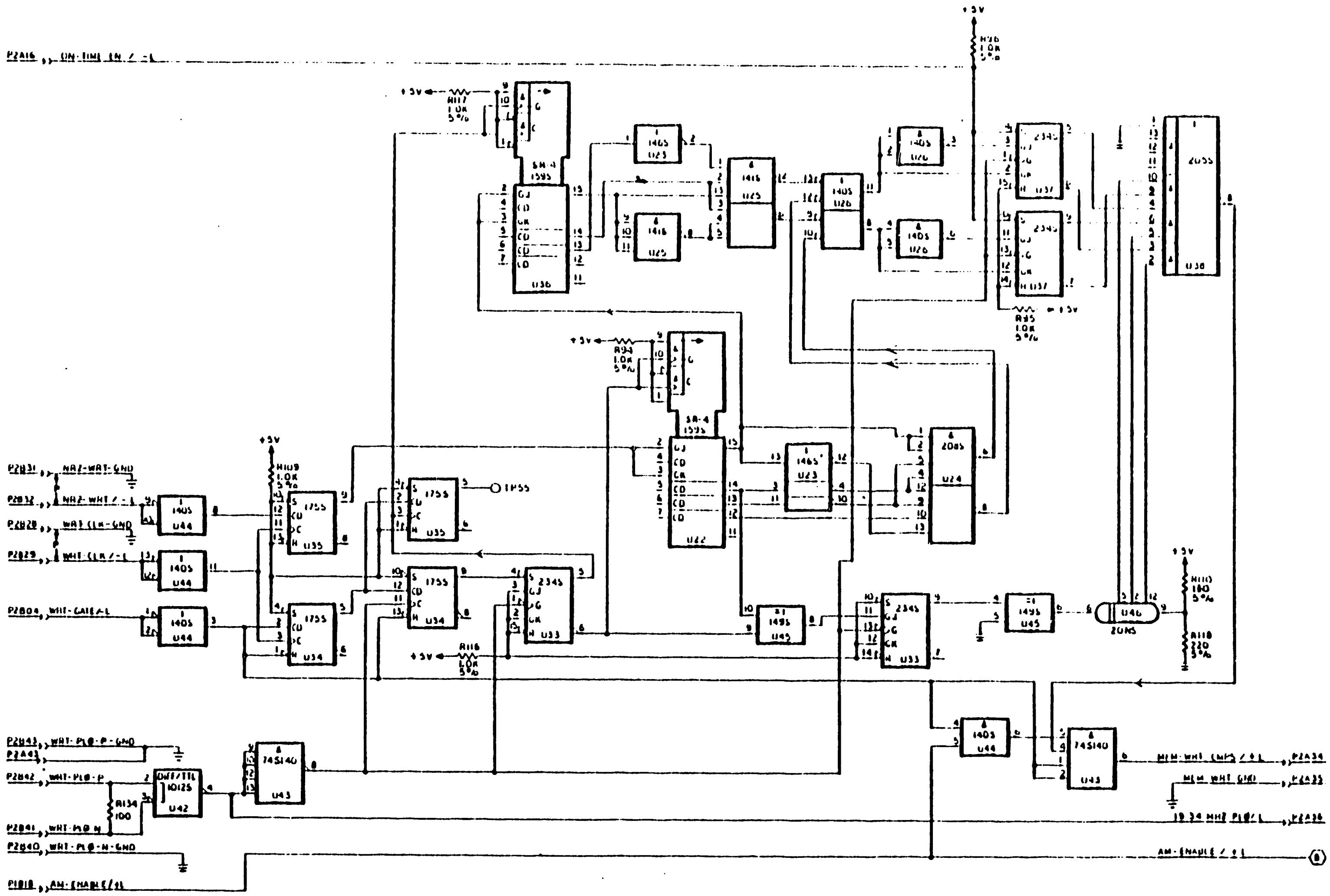


FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 5 OF 10)
77683560-R

CROSS REF
NO. 0704

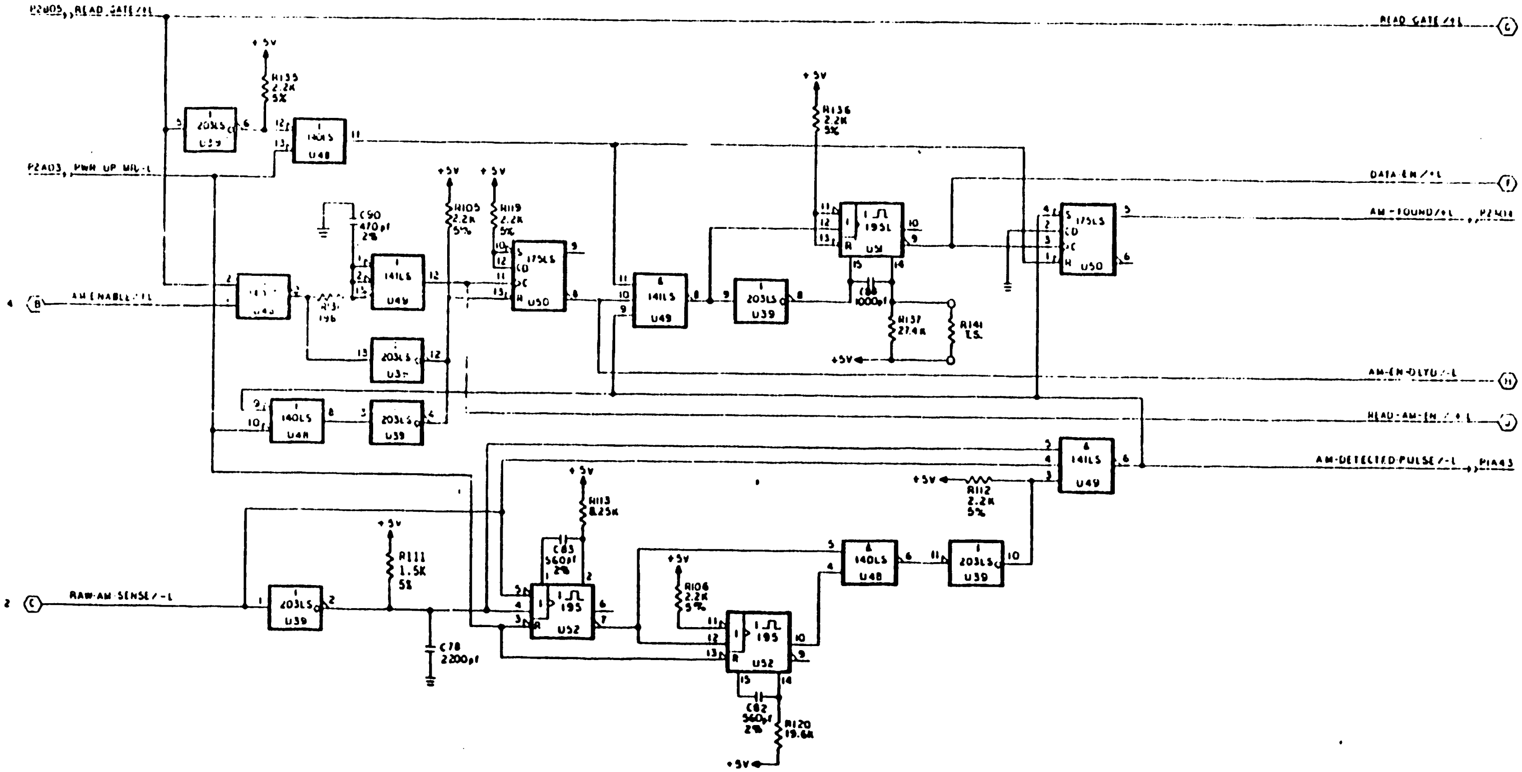
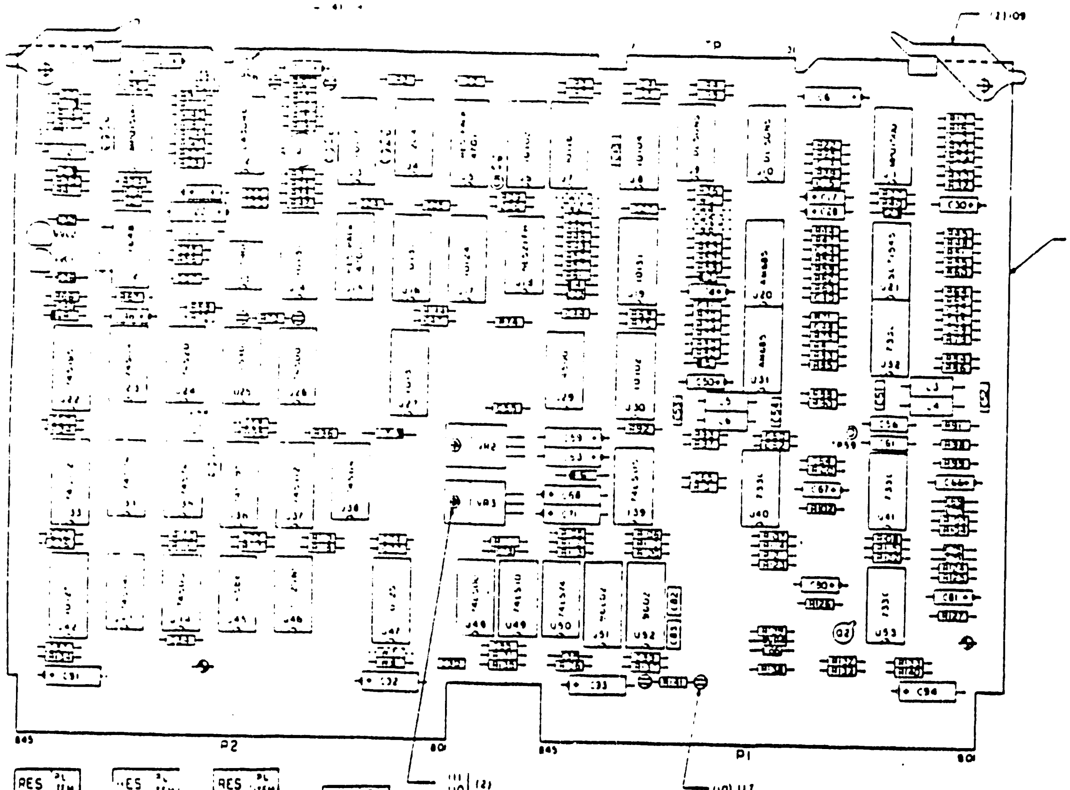


FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 6 OF 10)

77683560-S

CROSS REF NO. 0705



RES	PL ITEM
R1	[illegible]
R2	44
R3	49
R4	49
R5	68
R6	43
R7	49
R8	49
R9	44
R10	61
R11	55
R12	120
R13	[illegible]
R14	90
R15	57
R16	[illegible]
R17	57
R18	44
R19	120
R20	—
R21	46
R22	62
R23	56
R24	65
R25	53
R26	58
R27	44
R28	44
R29	59
R30	[illegible]
R31	45
R32	75
R33	55
R34	45
R35	45
R36	[illegible]
R37	44
R38	[illegible]
R39	[illegible]
R40	[illegible]
R41	[illegible]
R42	57
R43	[illegible]
R44	52
R45	[illegible]
R46	[illegible]
R47	[illegible]
R48	[illegible]
R49	46
R50	43
R51	[illegible]
R52	[illegible]
R53	43
R54	[illegible]
R55	53
R56	[illegible]
R57	[illegible]
R58	49

RES	PL ITEM
R59	44
R60	53
R61	[illegible]
R62	56
R63	57
R64	56
R65	56
R66	[illegible]
R67	11
R68	54
R69	49
R70	49
R71	44
R72	43
R73	43
R74	[illegible]
R75	43
R76	49
R77	57
R78	[illegible]
R79	44
R80	[illegible]
R81	[illegible]
R82	48
R83	55
R84	45
R85	55
R86	45
R87	—
R88	[illegible]
R89	—
R90	[illegible]
R91	64
R92	43
R93	[illegible]
R94	[illegible]
R95	[illegible]
R96	[illegible]
R97	[illegible]
R98	54
R99	44
R100	44
R101	44
R102	44
R103	[illegible]
R104	[illegible]
R105	[illegible]
R106	[illegible]
R107	[illegible]
R108	[illegible]
R109	53
R110	[illegible]
R111	125
R112	[illegible]
R113	[illegible]
R114	[illegible]
R115	[illegible]
R116	[illegible]

RES	PL ITEM
R117	50
R118	48
R119	[illegible]
R120	[illegible]
R121	49
R122	58
R123	59
R124	56
R125	56
R126	44
R127	44
R128	—
R129	52
R130	—
R131	53
R132	55
R133	54
R134	56
R135	[illegible]
R136	[illegible]
R137	121
R138	[illegible]
R139	55
R140	64
R141	43
R142	[illegible]
R143	[illegible]
R144	56

CAP	PL ITEM
C1	[illegible]
C2	104
C3	[illegible]
C4	92
C5	[illegible]
C6	[illegible]
C7	99
C8	99
C9	—
C10	[illegible]
C11	[illegible]
C12	[illegible]
C13	99
C14	[illegible]
C15	100
C16	[illegible]
C17	[illegible]
C18	99
C19	104
C20	90
C21	99
C22	107
C23	[illegible]
C24	103
C25	[illegible]
C26	103
C27	[illegible]
C28	[illegible]
C29	[illegible]
C30	[illegible]
C31	100
C32	[illegible]
C33	[illegible]
C34	[illegible]
C35	[illegible]
C36	99
C37	[illegible]
C38	[illegible]
C39	[illegible]
C40	[illegible]
C41	[illegible]
C42	[illegible]
C43	[illegible]
C44	100
C45	[illegible]
C46	[illegible]
C47	[illegible]
C48	[illegible]
C49	103
C50	104
C51	[illegible]
C52	99
C53	99
C54	[illegible]
C55	[illegible]
C56	[illegible]
C57	[illegible]
C58	[illegible]

CAP	PL ITEM
C59	106
C60	101
C61	102
C62	101
C63	107
C64	103
C65	103
C66	104
C67	[illegible]
C68	106
C69	91
C70	[illegible]
C71	107
C72	103
C73	100
C74	103
C75	92
C76	103
C77	[illegible]
C78	98
C79	92
C80	104
C81	104
C82	36
C83	36
C84	100
C85	[illegible]
C86	95
C87	100
C88	97
C89	[illegible]
C90	94
C91	[illegible]
C92	113
C93	[illegible]
C94	[illegible]

IC	PL ITEM
U1	37
U2	36
U3	[illegible]
U4	17
U5	39
U6	[illegible]
U7	12
U8	11
U9	35
U10	35
U11	37
U12	9
U13	32
U14	[illegible]
U15	39
U16	16
U17	14
U18	5
U19	16
U20	5
U21	123
U22	31
U23	20
U24	24
U25	23
U26	[illegible]
U27	6
U28	—
U29	19
U30	[illegible]
U31	6
U32	[illegible]
U33	29
U34	27
U35	27
U36	31
U37	29
U38	[illegible]
U39	[illegible]
U40	[illegible]
U41	7
U42	5
U43	30
U44	[illegible]
U45	[illegible]
U46	34
U47	[illegible]
U48	5
U49	22
U50	26
U51	22
U52	33
U53	[illegible]

IND	PL ITEM
L1	87
L2	86
L3	85
L4	85
L5	86
L6	86

DIO	PL ITEM
CR1	83
CR2	83
CR3	83
CR4	83
CR5	83
CR6	124
CR7	124

TSTR	PL ITEM
Q1	38
Q2	40

VOLT REG	PL ITEM
VR1	118
VR2	81
VR3	92
VR4	118

VARI CAP DIODE	PL ITEM
VVC1	94
VVC2	84

JMPR	PL ITEM
W1	—
W2	—
W3	42
W4	—
W5	—
W6	—
W7	—
W8	42

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 7 OF 10)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75886350	PWA Read/Write	INTCH
	77683850	PWA Read/Write	
2	77683860	PWB, Read/Write	
5	15123100-8	I.C. NE521FH	
6	15164430-9	I.C. AM685	
7	15163100-9	I.C. 733C	
9	15164422-6	I.C. ECL 1648	
10	15118000-7	I.C. ECL 10102	
11	15120900-4	I.C. ECL 10104	
12	15121100-0	I.C. ECL 10116	
13	15118600-4	I.C. ECL 10117	
14	15119400-8	I.C. ECL 10124	
15	15119500-5	I.C. ECL 10125	
16	15118500-6	I.C. ECL 10131	
17	15126400-9	I.C. ECL 12040	
18	15144900-6	I.C. 74LS00	
19	88884500-5	I.C. 74S00	
20	88883700-2	I.C. 74S04	
21	15145300-8	I.C. 74LS05	
22	15145600-1	I.C. 74LS10	
23	88884200-2	I.C. 74S10	
24	88885300-9	I.C. 74S20	
25	15164407-7	I.C. 74S64	
26	15146300-7	I.C. 74LS74	
27	88923000-9	I.C. 74S74	
28	88922900-1	I.C. 74S86	
29	15158600-5	I.C. 74S112	
30	15158700-3	I.C. 74S140	
31	15164418-4	I.C. 74S195	
32	15161600-0	I.C. 75461	
33	15104301-5	I.C. 9602	
34	94262301-8	Delay Line 20 ns	
35	94262302-6	Delay Line 50 ns	
36	94675202-9	I.C. CA3046/CA3346	
37	77832298-2	I.C. MPZ 1500	
38	77612002-4	Tstr Dual 2N5583	
39	75738656-0	Res Pac 2% 470 (.5)	
40	75888005-8	Transistor 2N4860A	
41	24500056-7	Res 1/4 W 5% 510	
42	94358500-0	Jmpr Wire, Molded	
43	94357500-1	Resistor Test Select	
44	24500015-3	Res 1/4 W 5% 10	
45	24500031-0	Res 1/4 W 5% 47	
46	24500023-7	Res 1/4 W 5% 22	
47	24500045-0	Res 1/4 W 5% 180	
48	24500047-6	Res 1/4 W 5% 220	
49	24500055-9	Res 1/4 W 5% 470	

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 8 OF 10)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
50	24500063-3	Res 1/4 W 5% 1 K	
51	24500071-6	Res 1/4 W 5% 2.2 K	
52	94360436-3	Res 1/4 W 5% 23.7 K	
53	94360164-1	Res 1/4 W 1% 46.4 K	
54	94360275-5	Res 1/4 W 1% 604	
55	94360184-9	Res 1/4 W 1% 75.0	
56	94360200-3	Res 1/4 W 1% 100	
57	94360204-5	Res 1/4 W 1% 110	
58	94360228-4	Res 1/4 W 1% 196	
59	94360232-6	Res 1/4 W 1% 215	
60	94360236-7	Res 1/4 W 1% 237	
61	94360244-1	Res 1/4 W 1% 287	
62	94360248-2	Res 1/4 W 1% 316	
64	94360264-9	Res 1/4 W 1% 464	
65	94360268-0	Res 1/4 W 1% 511	
66	94360288-8	Res 1/4 W 1% 825	
67	94360300-1	Res 1/4 W 1% 1.00 K	
68	94360328-2	Res 1/4 W 1% 1.96 K	
69	94360332-4	Res 1/4 W 1% 2.15 K	
70	94360336-5	Res 1/4 W 1% 2.37 K	
71	94360352-2	Res 1/4 W 1% 3.48 K	
72	94360348-0	Res 1/4 W 1% 3.16 K	
73	94360168-2	Res 1/4 W 1% 51.1	
74	94360364-7	Res 1/4 W 1% 4.64 K	
75	94360484-3	Res 1/4 W 1% 75.0 K	
76	94360388-6	Res 1/4 W 1% 8.25 K	
77	94360400-9	Res 1/4 W 1% 10.0 K	
78	94360420-7	Res 1/4 W 1% 16.2 K	
79	94360428-0	Res 1/4 W 1% 19.6 K	
80	94360500-6	Res 1/4 W 1% 100 K	
81	15137903-9	Volt Reg 79M12	
82	15161100-1	Volt Reg 78M12	
83	51706300-4	Diode IN4454	
84	77612970-2	MVAM2	
85	75887594-2	Inductor 5% 8.2 μH	
86	75887599-1	Inductor 5% 22 μH	
87	75887575-1	Inductor 5% 0.22 μH	
88	94227201-4	Cap 500 V +1 PF 5	
89	94227207-1	Cap 500 V +1 PF 15	
90	94227214-7	Cap 500 V +1 PF 33	
91	94240417-9	Cap 50 V 10% 33	
92	94240419-5	Cap 50 V 10% 47	
93	94227225-3	Cap 300 V 2% 91	
94	94227242-8	Cap 100 V 2% 470	
95	94240428-6	Cap 50 V 10% 560	
96	94227244-4	Cap 100 V 2% 560	
97	94240409-6	Cap 50 V 10% 1500	
98	94240402-1	Cap 50 V 10% 2200	
99	94240411-2	Cap 50 V 10% 0.01 μF	

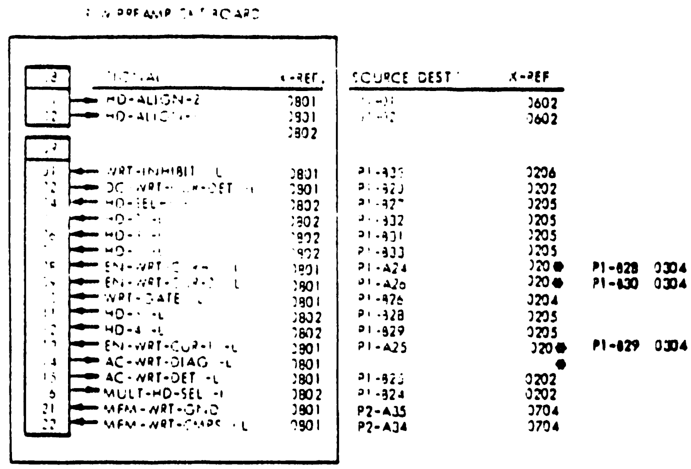
FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 9 OF 10)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
100	94361416-4	Cap 50 V +80-20% 0.022 µF	
101	94240442-7	Cap 50 V 10% 0.033 µF	
102	94240444-3	Cap 50 V 10% 0.047 µF	
103	94361400-8	Cap 50 V +80-20% 10 uF	
104	24504342-7	Cap 10 V 20% 2.2 µF	
105	24504378-1	Cap 20 V 20% 2.2 µF	
106	24504380-7	Cap 20 V 20% 4.7 µF	
107	24504348-4	Cap 10 V 20% 6.8 µF	
108	93533118-1	Pin, Rolled	
109	82311900-3	Inject/Eject-Card	
110	95683502-9	Stud, Press	
111	92583002-8	Nut Lock	
112	24504339-3	Cap 35 V 20% 6.8 µF	
113	24504350-0	Cap 10 V 20% 10 µF	
114	24504352-6	Cap 10 V 20% 22 µF	
115	94240416-1	Cap 50 V 10% 27	
116	94227246-9	Cap 100 V 2% 680	
117	77612167-5	Terminal, Slotted	
118	50241500-3	Volt Reg 6.2 V	
119	92498021-2	Terminal Swaged	
120	94360422-3	Res 1/4 W 1% 16.9 K	
121	94360442-1	Res 1/4 W 1% 27.4 K	
122	15150700-1	I.C. 96L02	
123	94675202-9	I.C. SC71545P	
124	15165583-4	Schottky Rectifier	
125	94402160-9	Res 1/4 W 5% 1.5 K	

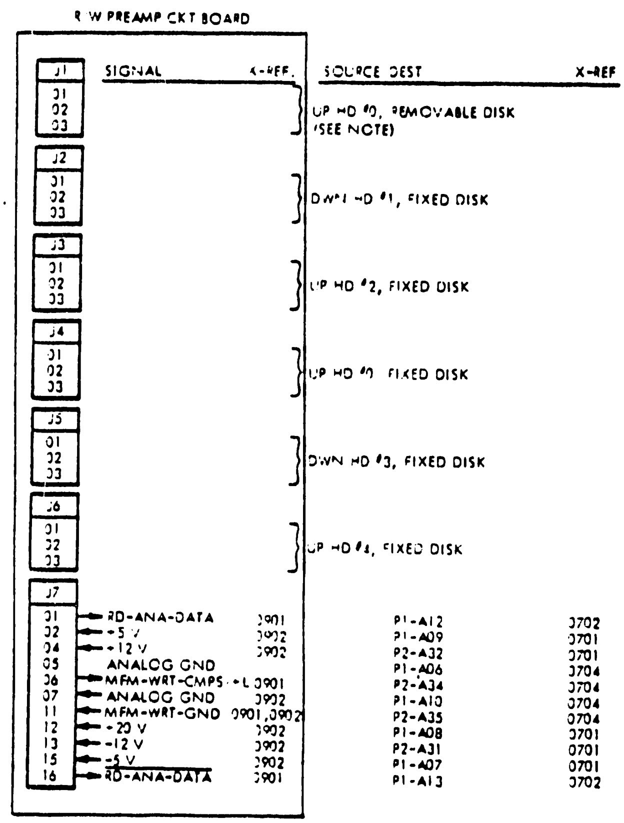
FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 10 OF 10)

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.



* WIRED TO, BUT NOT USED ON PWA LISTED



NOTE" "LOGICAL" HEAD NUMBERS USED HERE (SEE FIGURE 4-36)

ZZ158a

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 1 OF 6)

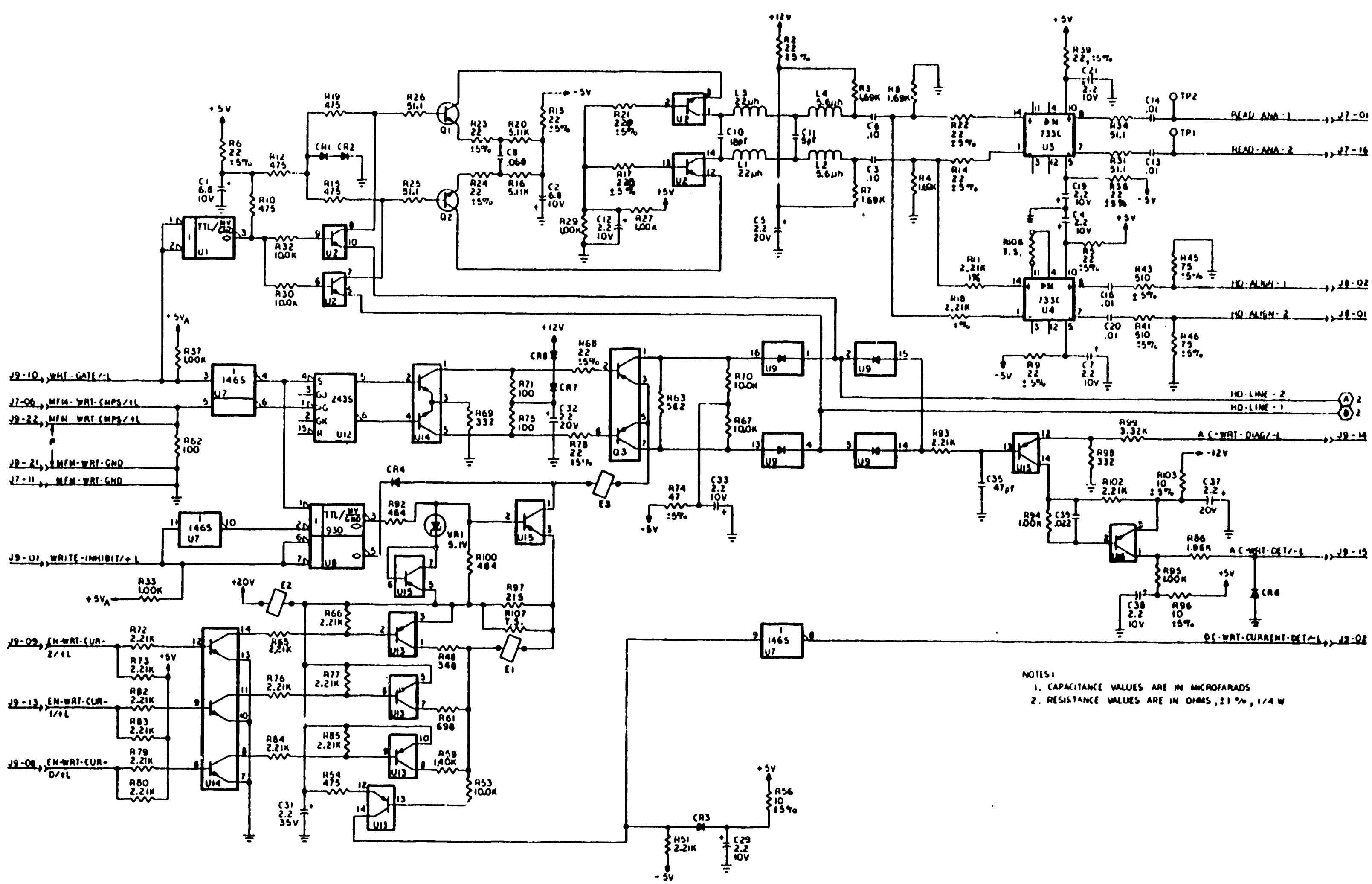
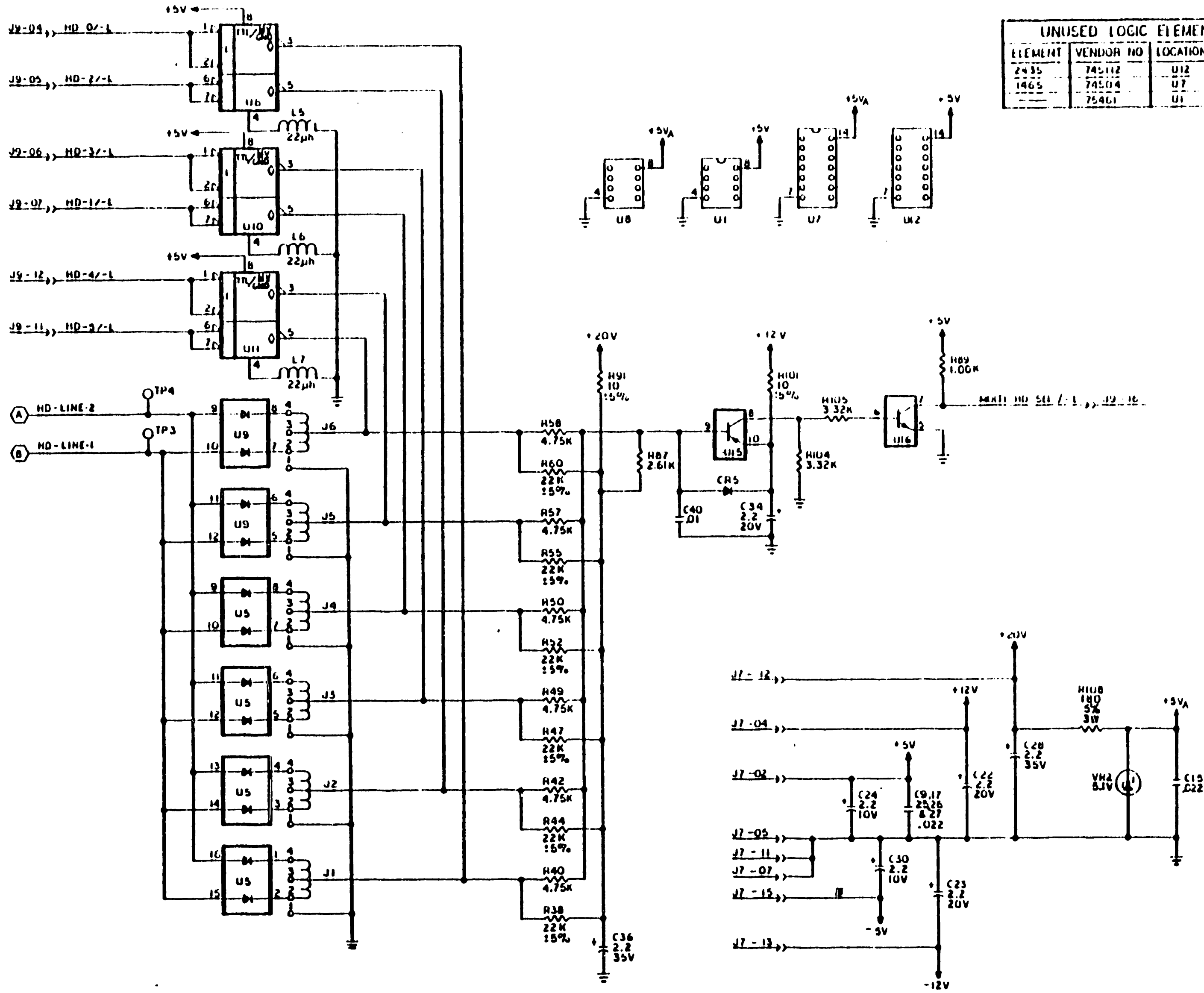


FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 2 OF 6)

77683560-R

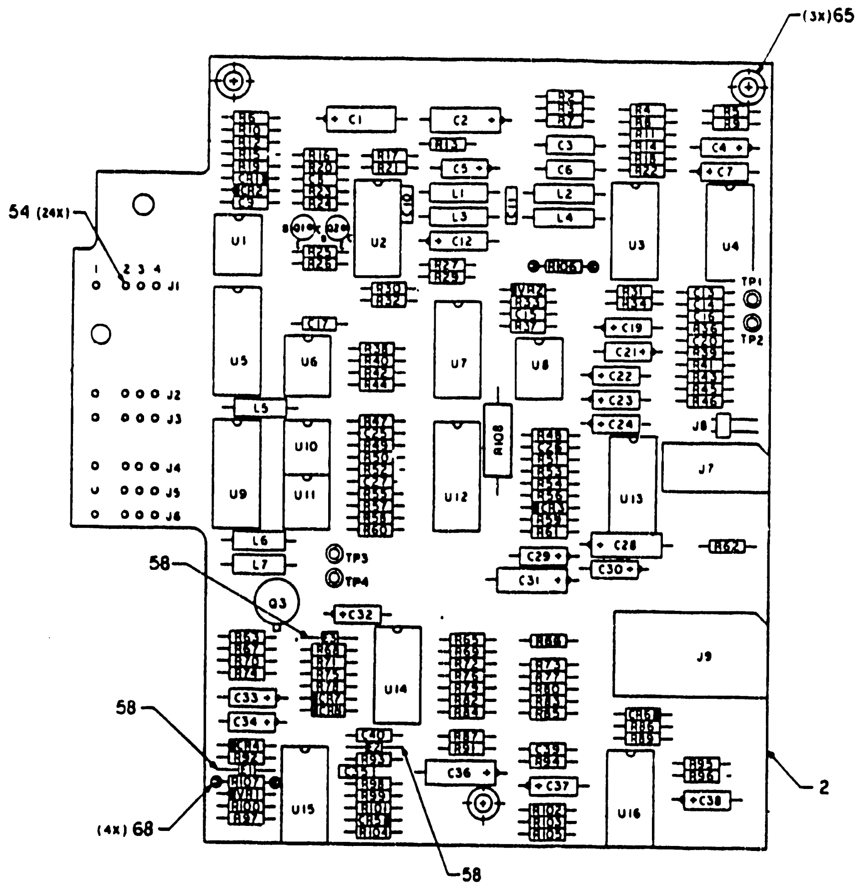
CROSS REF NO. 0801



UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO	LOCATION	OUTPUT PIN
2435	74S112	U12	7,9
1465	74S04	U7	2,12
——	75461	U1	5

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 3 OF 6)
77683560-R

CROSS REF
NO. 0802



IND	PL ITEM
L1	16
L2	17
L3	16
L4	17
L5	16
L6	16
L7	16

DIO	PL ITEM
CR1	18
CR2	←
CR3	
CR4	
CR5	
CR6	
CR7	→
CR8	18

TERM	PL ITEM
TP 1	59
TP 2	59
TP 3	59
TP 4	59

IC	PL ITEM
U1	9
U2	11
U3	5
U4	5
U5	10
U6	9
U7	8
U8	7
U9	10
U10	9
U11	9
U12	6
U13	13
U14	12
U15	13
U16	11

TSTR	PL ITEM
Q1	15
Q2	15
Q3	14
Q4	—

CONN	PL ITEM
J7	57
J8	55
J9	56

CAP	PL ITEM
C1	29
C2	29
C3	24
C4	26
C5	27
C6	24
C7	26
C8	67
C9	20
C10	23
C11	22
C12	26
C13	25
C14	25
C15	20
C16	25
C17	20
C18	—
C19	26
C20	25
C21	26
C22	27
C23	27
C24	26
C25	20
C26	20
C27	20
C28	28
C29	26
C30	26
C31	28
C32	27
C33	26
C34	27
C35	21
C36	28
C37	27
C38	26
C39	20
C40	25

BEAD	PL ITEM
E1	53
E2	53
E3	53

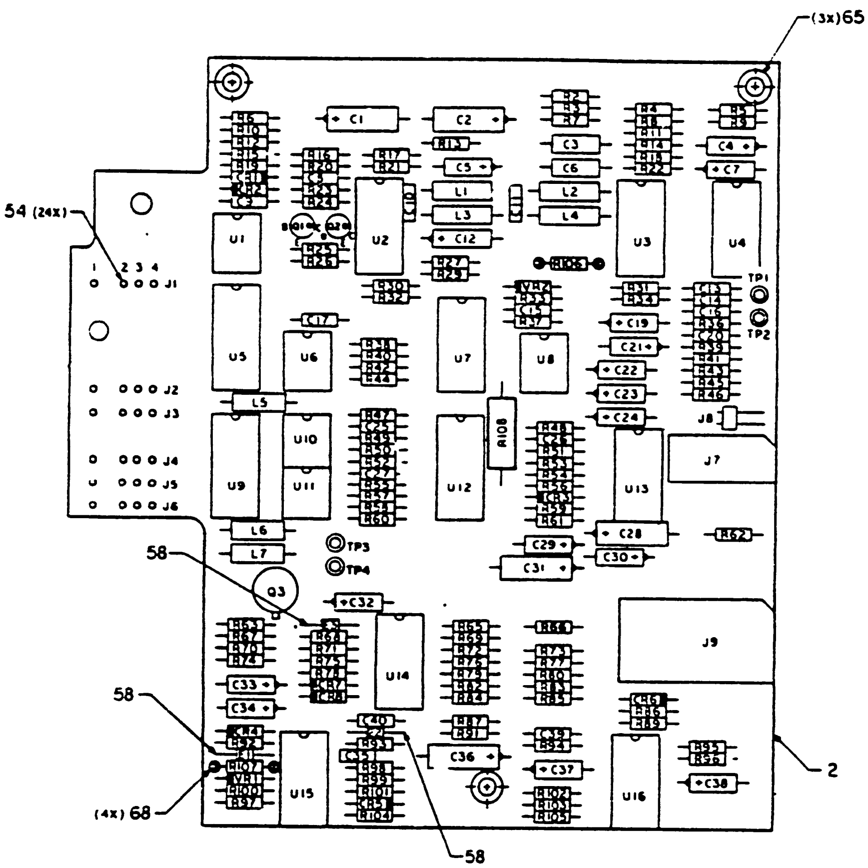
RES	PL ITEM
R54	43
R55	36
R56	33
R57	50
R58	50
R59	66
R60	36
R61	69
R62	38
R63	42
R64	—
R65	48
R66	48
R67	52
R68	34
R69	41
R70	52
R71	38
R72	48
R73	48
R74	35
R75	38
R76	48
R77	48
R78	34
R79	48
R80	48
R81	—
R82	48
R83	48
R84	48
R85	48
R86	60
R87	61
R88	—
R89	45
R90	—
R91	33
R92	44
R93	48
R94	45
R95	45
R96	33
R97	39
R98	41
R99	49
R100	44
R101	33
R102	48
R103	33
R104	49
R105	49
R106	62
R107	62
R108	70

F060

RES	PL ITEM
R1	—
R2	34
R3	46
R4	46
R5	34
R6	34
R7	46
R8	46
R9	34
R10	43
R11	48
R12	43
R13	34
R14	34
R15	43
R16	51
R17	71
R18	48
R19	43
R20	51
R21	71
R22	34
R23	34
R24	34
R25	37
R26	37
R27	45
R28	—
R29	45
R30	52
R31	37
R32	52
R33	45
R34	37
R35	—
R36	34
R37	45
R38	36
R39	34
R40	50
R41	63
R42	50
R43	63
R44	36
R45	64
R46	64
R47	36
R48	40
R49	50
R50	50
R51	48
R52	36
R53	52

VOLT REG	PL ITEM
VR1	19
VR2	19

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 4 OF 6)



IND	PL ITEM
L1	16
L2	17
L3	16
L4	17
L5	16
L6	16
L7	16

DIO	PL ITEM
CR1	18
CR2	
CR3	
CR4	
CR5	
CR6	
CR7	
CR8	18

TERM	PL ITEM
TP1	59
TP2	59
TP3	59
TP4	59

IC	PL ITEM
U1	9
U2	11
U3	5
U4	5
U5	10
U6	9
U7	8
U8	7
U9	10
U10	9
U11	9
U12	6
U13	13
U14	12
U15	13
U16	11

TSTR	PL ITEM
Q1	15
Q2	15
Q3	14
Q4	—

CONN	PL ITEM
J7	57
J8	55
J9	56

CAP	PL ITEM
C1	29
C2	29
C3	24
C4	26
C5	27
C6	24
C7	26
C8	67
C9	20
C10	23
C11	22
C12	26
C13	25
C14	25
C15	20
C16	25
C17	20
C18	—
C19	26
C20	25
C21	26
C22	27
C23	27
C24	26
C25	20
C26	20
C27	20
C28	28
C29	26
C30	26
C31	28
C32	27
C33	26
C34	27
C35	21
C36	28
C37	27
C38	26
C39	20
C40	25

BEAD	PL ITEM
E1	53
E2	53
E3	53

RES	PL ITEM
R54	43
R55	36
R56	33
R57	50
R58	50
R59	66
R60	36
R61	69
R62	38
R63	42
R64	—
R65	48
R66	48
R67	52
R68	34
R69	41
R70	52
R71	38
R72	48
R73	48
R74	35
R75	38
R76	48
R77	48
R78	34
R79	48
R80	48
R81	—
R82	48
R83	48
R84	48
R85	48
R86	60
R87	61
R88	—
R89	45
R90	—
R91	33
R92	44
R93	48
R94	45
R95	45
R96	33
R97	39
R98	41
R99	49
R100	44
R101	33
R102	48
R103	33
R104	49
R105	49
R106	62
R107	62
R108	70

RES	PL ITEM
R1	—
R2	34
R3	46
R4	46
R5	34
R6	34
R7	46
R8	46
R9	34
R10	43
R11	48
R12	43
R13	34
R14	34
R15	43
R16	51
R17	71
R18	48
R19	43
R20	51
R21	71
R22	34
R23	34
R24	34
R25	37
R26	37
R27	45
R28	—
R29	45
R30	52
R31	37
R32	52
R33	45
R34	37
R35	—
R36	34
R37	45
R38	36
R39	34
R40	50
R41	63
R42	50
R43	63
R44	36
R45	64
R46	64
R47	36
R48	40
R49	50
R50	50
R51	48
R52	36
R53	52

VOLT REG	PL ITEM
VR1	19
VR2	19

F060

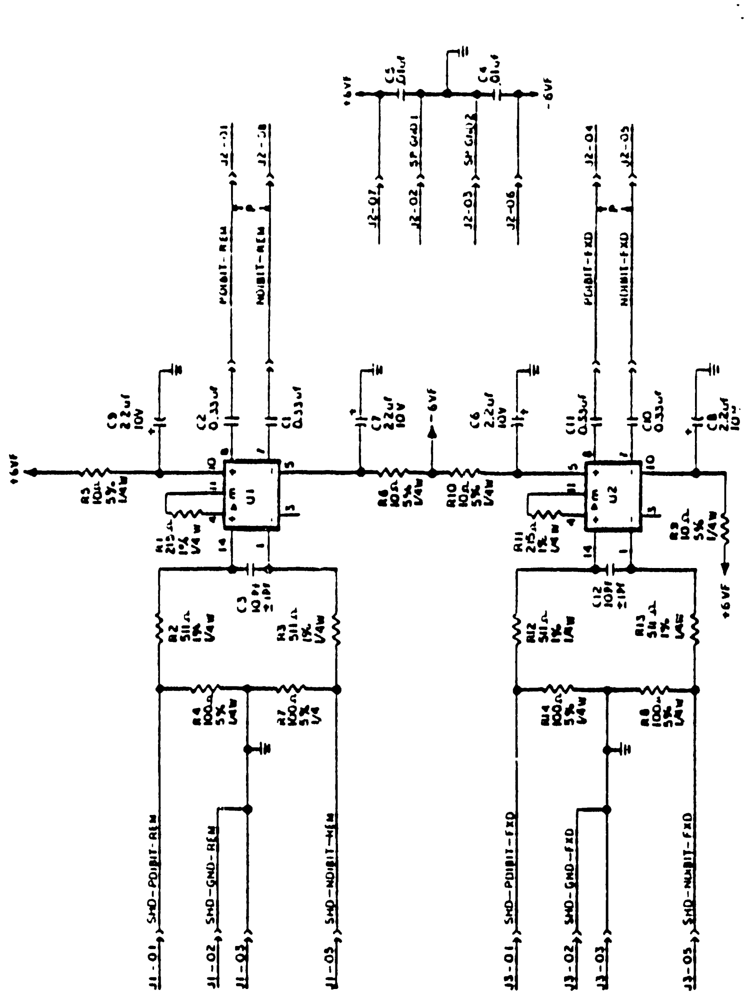
FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 4 OF 6)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77655250	PWA Read/Write Preamp	
2	77655270	PWB Read/Write Preamp	
5	15163100-9	I.C. 733C	
6	15158600-5	I.C. 74S112	
7	15113000-2	I.C. 75452	
8	88883700-2	I.C. 74S04	
9	15161600-0	I.C. 75461	
10	50241802-3	Diode Array, 8, D1C16	
11	77832297-4	I.C. MPQ 1000	
12	94675200-3	I.C. CA3046/CA3346	
13	77832298-2	I.C. MPQ 1500	
14	77612002-4	Tstr Dual 2N5583	
15	77612004-0	Transistor BFR91	
16	75887599-1	Inductor 5% 22 µH	
17	75887592-6	Inductor 5% 5.6 µH	
18	51706300-4	Diode IN4454	
19	95318110-9	Volt Reg 5.1 V IN5231	
20	94240440-1	Cap 50 V 10% 0.022 µF	
21	94227218-8	Cap 500 V +/-1 pF 47	
22	94227201-4	Cap 500 V +1 pF 5	
23	94227208-9	Cap 500 V 1% 18	
24	94240448-4	Cap 50 V 10% 0.10 µF	
25	94240411-2	Cap 50 V 10% 0.01 µF	
26	24504342-7	Cap 10 V 20% 2.2 µF	
27	24504378-1	Cap 20 V 20% 2.2 µF	
28	24504333-6	Cap 35 V 20% 2.2 µF	
29	24504348-4	Cap 10 V 20% 6.8 µF	
33	24500015-3	Res 1/4 W 5% 10	
34	24500023-7	Res 1/4 W 5% 22	
35	24500031-0	Res 1/4 W 5% 47	
36	24500095-5	Res 1/4 W 5% 22 K	
37	94360168-2	Res 1/4 W 1% 51.1	
38	94360200-3	Res 1/4 W 1% 100	
39	94360232-6	Res 1/4 W 1% 215	
40	94360252-4	Res 1/4 W 1% 348	
41	94360250-8	Res 1/4 W 1% 332	
42	94360272-2	Res 1/4 W 1% 562	
43	94360265-6	Res 1/4 W 1% 475	
44	94360264-9	Res 1/4 W 1% 464	
45	94360300-1	Res 1/4 W 1% 1.00 K	
46	94360322-5	Res 1/4 W 1% 1.69 K	
48	94360333-2	Res 1/4 W 1% 2.21 K	
49	94360350-5	Res 1/4 W 1% 3.32 K	
50	94360365-4	Res 1/4 W 1% 4.75 K	
51	94360368-8	Res 1/4 W 1% 5.11 K	

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 5 OF 6)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
52	94360400-9	Res 1/4 W 1% 10.0 K	
53	77832209-9	Bead Shielding	
54	94245412-5	Post-Wire Wrap	
55	75743702-5	Header-Right Angle	
56	77832294-1	Socket, 24 Pin	
57	77832290-9	Socket, 16 Pin	
58	92294022-6	Wire Bare Tinned	
59	92498021-2	Terminal Swaged	
60	94360328-2	Res 1/4 W 1% 1.96 K	
61	94360340-7	Res 1/4 W 1% 2.61 K	
62	94357500-1	Resistor Test Select	
63	24500056-7	Res 1/4 W 5% 510	
64	24500036-9	Res 1/4 W 5% 75	
65	77612307-7	Standoff, PWB	
66	94360314-2	Res 1/4 W 1% 1.40 K	
67	94240446-8	Cap 50 V 10% 0.068 μF	
68	77612167-5	Terminal Slotted	
69	94360281-3	Res 1/4 W 1% 698	
70	92222041-3	Res 3 W 5% 180	
71	94402140-1	Res 1/4 W 5% 220	

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 6 OF 6)



SERVO PREAMP CKT BD

J1		SIGNAL	SOURCE/DEST
01	←	SHD-PDIBIT-REM	TO REM SERVO HEAD
02	←	SHD-GND-REM	
03	←	SHD-GND-REM	
05	←	SHD-NDIBIT-REM	

J2		SIGNAL	SOURCE/DEST	XREF
01	→	PDIBIT-REM	P1-B04	0602
02	←	SP GND 1	P1-B06	0601
03	←	SPGND 2	P1-B08	0601
04	→	P-DIBIT-FXD	P1-B10	0602
06	→	N-DIBIT-FXD	P1-B11	0602
06	←	-6VF	P1-B09	0601
07	←	+6VF	P1-B07	0601
08	→	NDIBIT-REM	P1-B05	0602

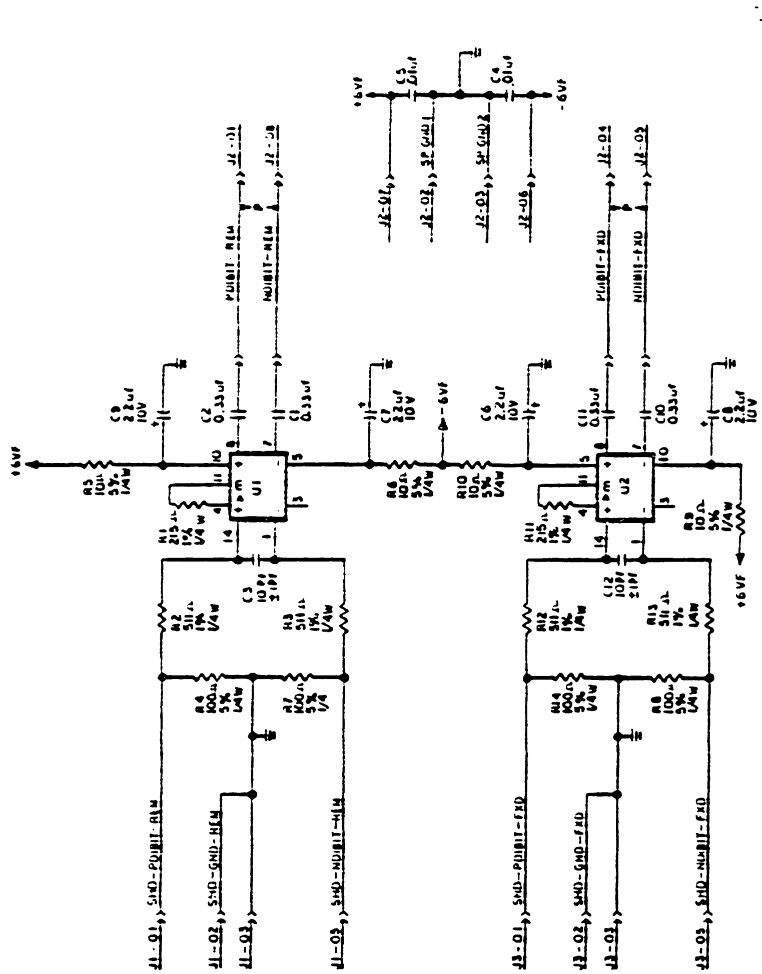
J3		SIGNAL	SOURCE/DEST
01	←	SHD-PDIBIT-FXD	TO FIXED SERVO HEAD
02	←	SHD-GND-FXD	
03	←	SHD-GND-FXD	
05	←	SHD-NDIBIT-FXD	

CROSS REF
NO. 0901

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-10. SERVO PREAMP CIRCUIT BOARD (SHEET 1 OF 3)



SERVO PREAMP CKT BD

J1	SIGNAL	SOURCE/DEST
01	SHD-PDIBIT-REM	TO REM SERVO HEAD
02	SHD-GND-REM	
03	SHD-GND-REM	
05	SHD-NDIBIT-REM	

J2	SIGNAL	SOURCE/DEST	XREF
01	PDIBIT-REM	P1-B04	0602
02	SP GND 1	P1-B08	0601
03	SPGND 2	P1-B08	0601
04	P-DIBIT-FXD	P1-B10	0602
05	N-DIBIT-FXD	P1-B11	0602
06	-4VF	P1-B09	0601
07	-4VF	P1-B07	0601
08	NDIBIT-REM	P1-B05	0602

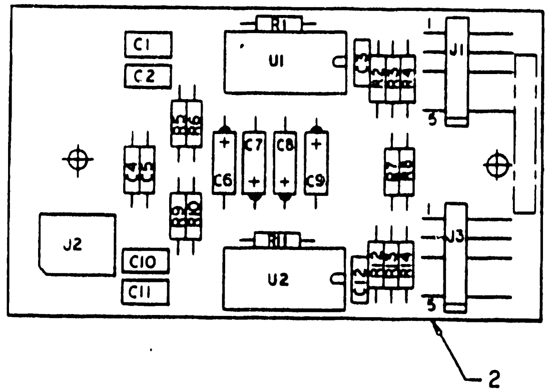
J3	SIGNAL	SOURCE/DEST
01	SHD-PDIBIT-FXD	TO FIXED SERVO HEAD
02	SHD-GND-FXD	
03	SHD-GND-FXD	
05	SHD-NDIBIT-FXD	

CROSS REF
NO. 0901

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-10. SERVO PREAMP CIRCUIT BOARD (SHEET 1 OF 3)



RES	PL ITEM
R1	8
R2	7
R3	7
R4	6
R5	9
R6	9
R7	6
R8	6
R9	9
R10	9
R11	8
R12	7
R13	7
R14	6

CAP	PL ITEM
C1	12
C2	12
C3	10
C4	13
C5	13
C6	11
C7	11
C8	11
C9	11
C10	12
C11	12
C12	10

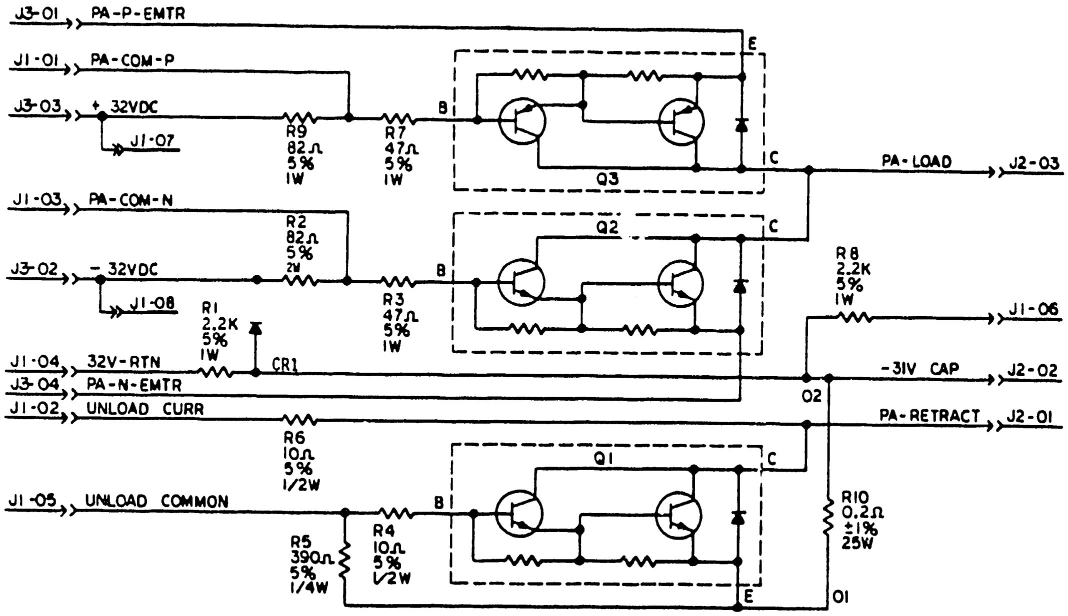
IC	PL ITEM
U1	5
U2	5

CONN	PL ITEM
J1	14
J2	15
J3	14

FIGURE 5-10. SERVO PREAMP CIRCUIT BOARD (SHEET 2 OF 3)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75885800-5	PWA Servo Preamp	
2	75885820-3	PWB Servo Preamp	
5	15163100-9	IC 733C	
6	24500039-3	Res 1/4 W 5% 100	
7	94360268-0	Res 1/4 W 1% 511	
8	94360232-6	Res 1/4 W 1% 215	
9	24500015-3	Res 1/4 W 5% 10	
10	94227205-5	Cap 500 V +1 pF 10	
11	24504342-7	Cap 10 V 20% 2.2 µF	
12	94354816-4	Cap 50 V 20% 0.33 µF	
13	75808537-7	Cap 100 V 10% 0.01 µF	
14	75772401-8	Connector Hdr	
15	77832292-5	Socket, 8 Pin	

FIGURE 5-10. SERVO PREAMP CIRCUIT BOARD (SHEET 3 OF 3)



POWER AMP CKT BD

J1		SIGNAL	SOURCE/DEST	XREF
01	→	PA-COM-P	P1-B08	0306
02	←	UNLOAD CURR	P1-B09	0307
03	←	PA-COM-N	P1-B10	0306
04	←	32 V RET	P1-B11	030*
05	←	UNLOAD COMMON	P1-B13	0307
06	→	-31-CAP	P1-B14	0307
07	→	+32 V DC	P1-A20	0203
08	→	-32 V DC	P1-A22	0203

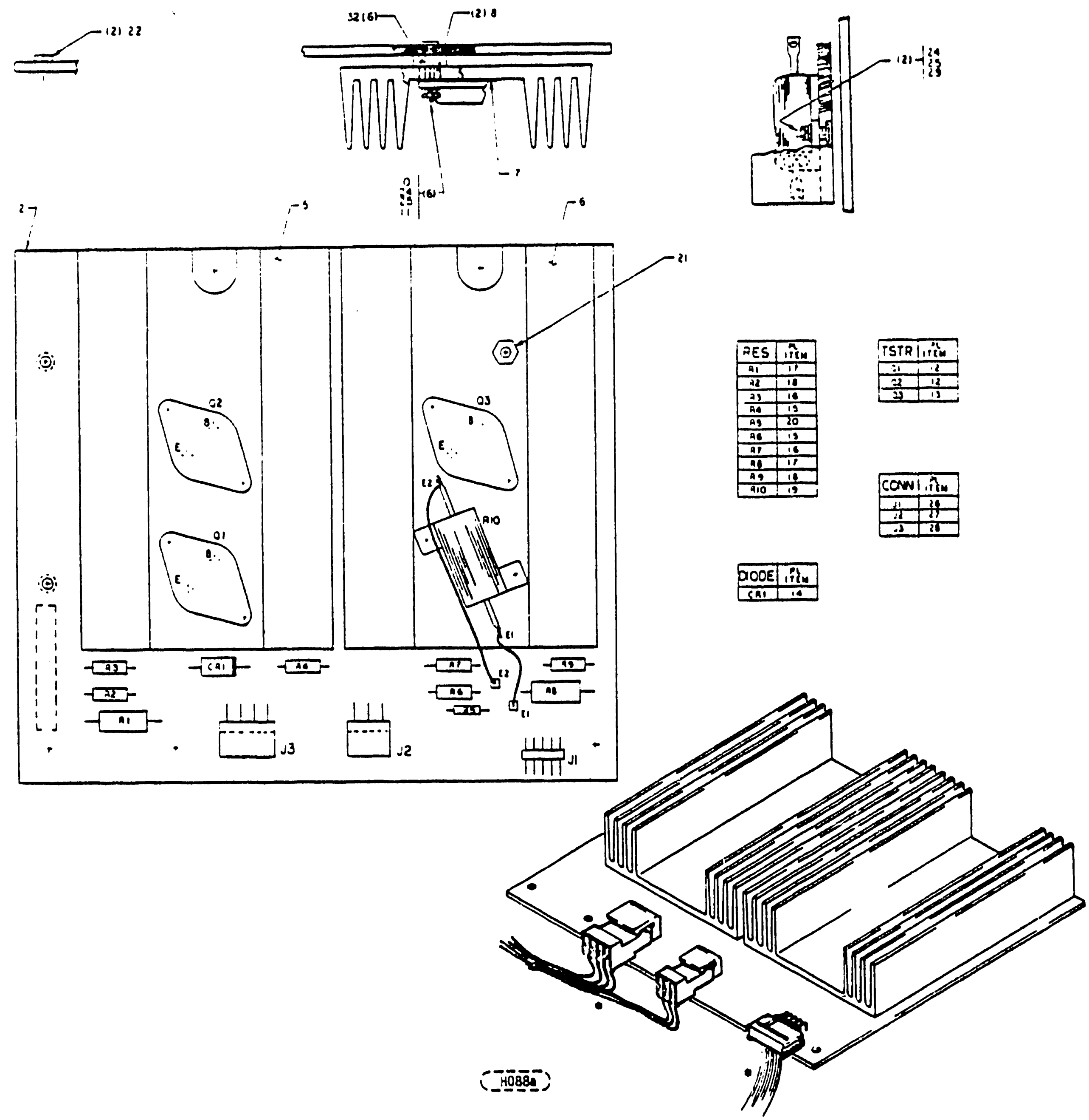
J2		SIGNAL	SOURCE/DEST	XREF
01	→	PA-RETRACT	RCP3-03	1201
02	→	-31 V CAP	C3-NEGATIVE	1601
03	→	PA-LOAD	RCP3-02	1201

J3		SIGNAL	SOURCE/DEST	XREF
01	←	PA-P-EMTR	R2-01	1601
02	←	-32 V DC	CMPB-TB1-03T	1401
03	←	+32 V DC	CMPB-TB1-01T	1401
04	←	PA-N-EMTR	R3-01	1601

*Wired to, but not used on PWA.

CROSS REF NO. 1001

FIGURE 5-11. POWER AMP CIRCUIT BOARD (SHEET 1 OF 3)



RES	PL ITEM
R1	17
R2	18
R3	16
R4	19
R5	20
R6	15
R7	16
R8	17
R9	18
R10	19

TSTR	PL ITEM
Q1	12
Q2	12
Q3	13

CONN	PL ITEM
J1	26
J2	27
J3	28

DIODE	PL ITEM
CR1	14

WARNING

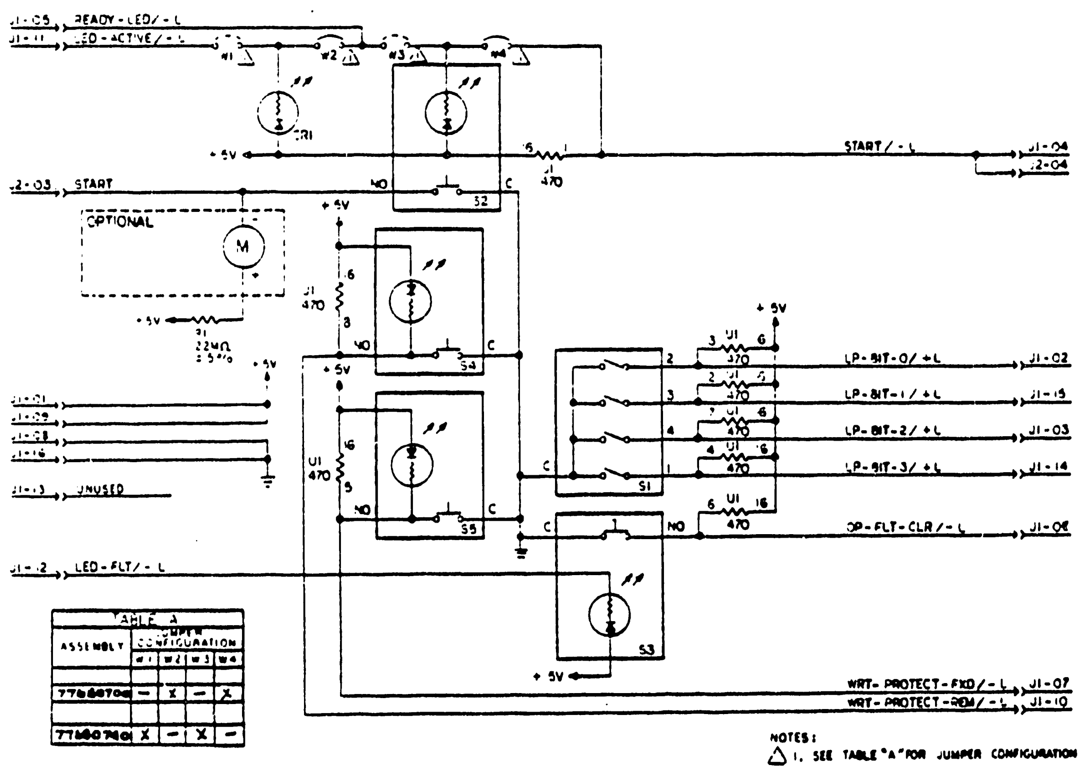
PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

*NOTE: Connect connectors so cables are oriented as shown.

FIGURE 5-11. POWER AMP CIRCUIT BOARD (SHEET 2 OF 3)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77680501	PWA, Power Amp	
2	77680520-2	PWB, Power Amp	
5	75886735-2	Heat Sink	
6	77665625-8	Heat Sink Assy.	
7	16798707-2	Wafer	
8	77832275-0	Spacer, Fibre	
9	77670995-8	Compound 340	
10	95683506-0	Stud, Press	
11	10125103-1	Nut Lock	
12	15165691-5	Transistor, Darlington Pwr	
13	15165690-7	Transistor	
14	75887484-6	Pwr Rectifier MR500	
15	24500115-1	Res 1/2 W 5% 10	
16	77612864-7	Res 1 W 5% 47	
17	24507171-7	Res 1 W 5% 2.2 K	
18	94389170-5	Res 2 W 5% 82	
19	75888776-4	Res Wirewound 0.2 Ohm	
20	94402146-8	Res 1/4 W 5% 390	
21	51885504-4	Standoff, male-female	
22	94375501-7	Insert - PC Bd.	
24	94047067-7	Washer	
25	10125801-0	Spring Lock Washer	
26	51860814-6	Connector	
27	10129565-7	Header 3 pos. rt. ang.	
28	10129566-5	Header 4 pos. rt. ang.	
29	95510024-3	Nut Hex mach. (nc)	
30	15003309	Wire	
31	15003309	Wire	
32	75887830	Spacer Fiber	

FIGURE 5-11. POWER AMP CIRCUIT BOARD (SHEET 3 OF 3)



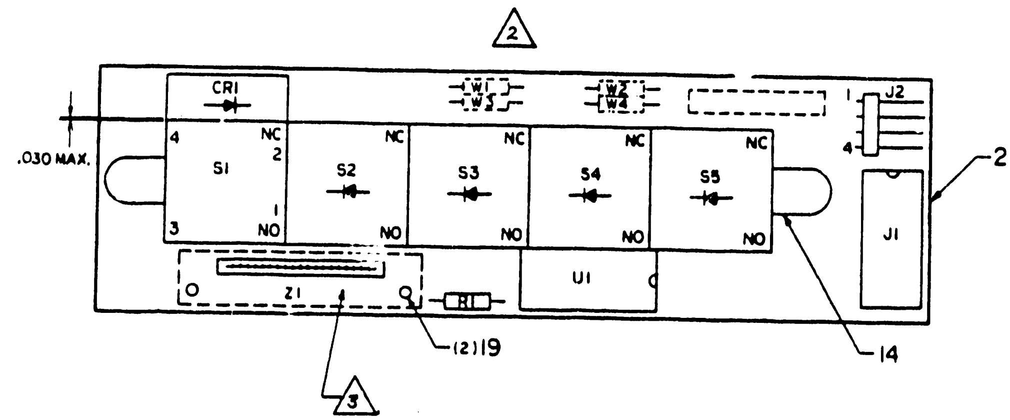
OPR CNTL CKT BD

J1		SIGNAL	SOURCE/DEST	XREF
01	←	+5 V	P1-B03	020*
02	→	LP-BIT-0/+L	P1-B05	0205
03	→	LP-BIT-2/+L	P1-B08	0205
04	→	START/-L	P1-A10	0103
05	←	READY-LED/-L	P1-B12	0206
06	→	OP-FLT-CLR/-L	P1-B14	0202
07	→	WRT-PROTECT-FXD/-L	P1-B16	0206
08	←	GND	P1-B18	020*
09	←	+5 V	P1-B19	020*
10	→	WRT-PROTECT-REM/-L	P1-B17	0206
11	←	LED-ACTIVE/-L	P1-B15	C206
12	←	LED-FLT/-L	P1-B13	0206
14	→	LP-BIT-3/+L	P1-B09	0205
15	→	LP-BIT-1/+L	P1-B07	0205
16	←	GND	P1-B04	020*
J2				
03	←	START	S3-N.O.	1601
04	→	START/-L	S1-C	1601

*Wired to, but not used on PWA.

CROSS REF
NO. 1101

FIGURE 5-12. OPERATOR CONTROL CIRCUIT BOARD (SHEET 1 OF 3)



1

SW	PL ITEM
S1	5,18
S2	6,17
S3	7,17
S4	8,17
S5	8,17

2

JMPR	PL ITEM
W1	10
W2	10
W3	10
W4	10

CONN	PL ITEM
J1	11
J2	12

DIODE	PL ITEM
CR1	9

IC	PL ITEM
U1	13

RES	PL ITEM
R1	21

3

METR	PL ITEM
Z1	—

2

TABLE "A"		
JMPR	PL ITEM	ASSEMBLY P/N
W1	10	77680740
W2	10	77680700
W3	10	77680740
W4	10	77680700

1

TABLE "B"		
PART NO.	CD	CODING PLUG IDENTIFICATION
94398801	4	"1"
94398802	2	"2"
94398803	0	"3"
94398804	8	"4"
94398805	5	"5"
94398806	3	"6"
94398807	1	"7"

NOTES:

1. If other than "0" plug is required order replacement from Table "B".
2. See Table "A" for jumper configuration.
3. Optional run time meter.

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-12. OPERATOR CONTROL CIRCUIT BOARD (SHEET 2 OF 3)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77680700	PWA OP Cntl	
	77680740	PWA OP Cntl	
2	77680720	PWB OP Cntl	
5	94398900	Switch, Encoding	
6	94394019	Switch, Grn LED	
7	94394020	Switch, Red LED	
8	94394018	Switch, Yel LED	
9	94394103	Indicator, Grn LED	
10	94358500	Jumper Wire-Molded	
11	77832290	Socket, 16 Pin	
12	75743604	Header-Right Angle	
13	75738656	Res Pack 2% 470 Ohm (15)	
14	94398700	Mtg Bracket	
15	10127322	Screw, Pan Hd Mach 4-40	
16	53777900	Nut & Captive Washer	
17	94394311	Lens, Black	
18	94398833	Encoding Button "0"	
19	65832104	Socket-Mini Spring	
21	17705968	Res 1/4 W 5% 22 MEG	

FIGURE 5-12. OPERATOR CONTROL CIRCUIT BOARD (SHEET 3 OF 3)

RELAY CONTROL BD

J1		SIGNAL	SOURCE/DEST	XREF
01	←	PRES-SW/+L	P1-A32	030*
02	→	LED-FLT/-L	P1-A33	030*
03	←	RUN/+L	P1-B33	0305
04	←	LINE-EN/+L	P1-B34	0305
05	←	PK-COV-UNLOCK/+L	P1-B35	0305
06	←	SVO-RLY/+L	P1-B36	0305
07	→	LINE-OFF/+L	P1-B37	0305
08	←	ANALOG GND	P1-B39	0305

J2		SIGNAL	SOURCE/DEST	XREF
01	←	+5 V DC	PS1J2-05	1701
02	→	SSR+5	SSR-03	1601
03	→	SSR-CNTL	SSR-04	1601
04	←	GND	PS1J2-06	1701
05	→	SPARE		
06	←	32 V RET	CMPB-TB1-02T	1401
07	←	-32 V DC	CMPB-TB1-03T	1401
08	←	+32 V DC	CMPB-TB1-01T	1401

J3		SIGNAL	SOURCE/DEST	XREF
01	→	HD-ACT	A1P1-02	1601
02	←	PA-LOAD	PAP2-03	1001
03	←	PA-RETRACT	PAP2-01	1001

J4		SIGNAL	SOURCE/DEST	XREF
01	→	SP-MOT-AUX	SPINDLE DRIVE MOTOR See Figure 5-17	1601
02	→	SP-MOT-COM		
03	→	SP-MOT-MAIN		
04	→	CASE GROUND		

J5		SIGNAL	SOURCE/DEST	XREF
01	→	SP-MOT-CAP	C5-02	1601
02	←	FIL-AC-LINE (L)	CB1-04B	1601
03	→	SP-MOT-CAP	C5-01	1601
04	←	CASE GROUND	GND LUG BY LINE FILTER	1601
05	←	AC-TAP	PS1J4-1	1601
06	←	SSR-LOAD	SSR-2	1601

J6		SIGNAL	SOURCE/DEST	XREF
01	→	PK-COV +32	PACK LOCK SOLENOID	1601
02	→	PK-COV-SOL		

J7		
01	←	VOLTAGE DETERMINATION JUMPER PLUG-SEE TABLE A FOR CONNECTIONS/VOLTAGES
02	←	
03	→	
04	←	
05	—	SPARE

TABLE A

VOLTAGE	J7 CONNECTIONS
220,230,240	J7-01 to J7-02 J7-03 to J7-04
100,120	J7-01 to J7-03

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 1 OF 5)

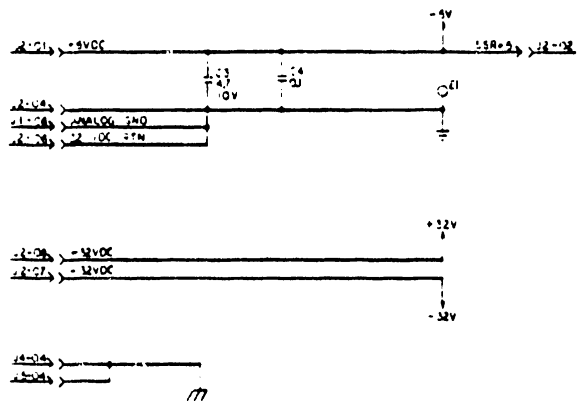
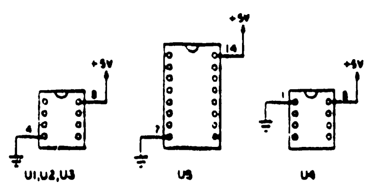


TABLE A	
VOLTAGE	J7 CONNECTIONS
220,230 240	J7-01 to J7-02 J7-03 to J7-04
100,120	J7-01 to J7-03

NOTES: UNLESS OTHERWISE SPECIFIED

1 Resistor values are in ohms, 1/4 W, ±5%.
2 Capacitor values are in microfarads.
3 For J7 external connectors see Table A.
4 Connections depend on relay supplied.



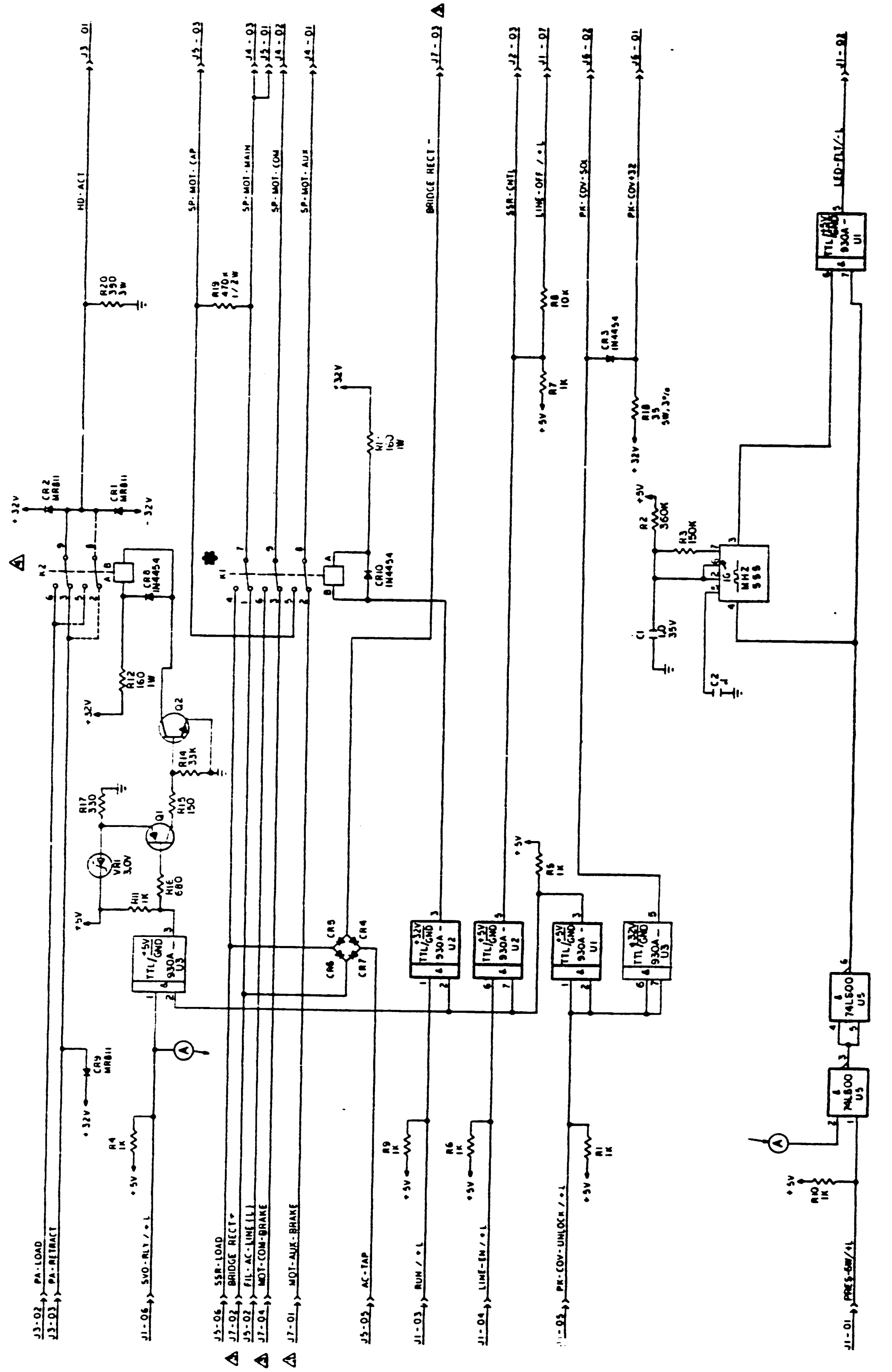
RELAY SHOWN IN DE-ENERGIZED POSITION.

CROSS REF
NO. 1201

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

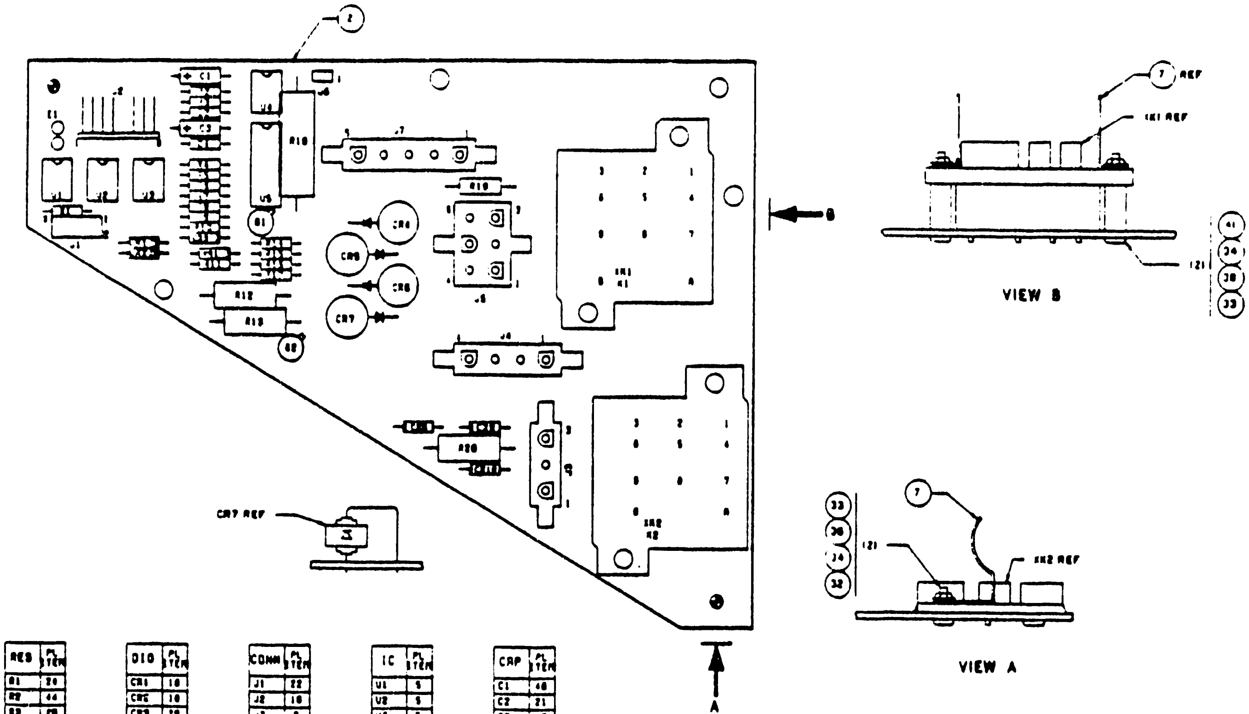
FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 2 OF 5)



*Relay shown in De-Energized Position.

CROSS REF
NO. 1201

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 3 OF 5)



RES	PL ITEM
R1	20
R2	44
R3	28
R4	24
R5	20
R6	24
R7	26
R8	28
R9	24
R10	26
R11	24
R12	30
R13	30
R14	45
R15	51
R16	49
R17	50
R18	15
R19	30
R20	23

DIO	PL ITEM
CR1	18
CR2	18
CR3	28
CR4	19
CR5	19
CR6	18
CR7	18
CR8	28
CR9	18
CR10	28

VOLT REG	PL ITEM
VR1	17

CONN	PL ITEM
J1	22
J2	18
J3	9
J4	18
J5	14
J6	8
J7	13
E1	25

TSTR	PL ITEM
Q1	32
Q2	33

IC	PL ITEM
U1	5
U2	5
U3	5
U4	43
U5	42

SOCKET	PL ITEM
XK1	40
XK2	8

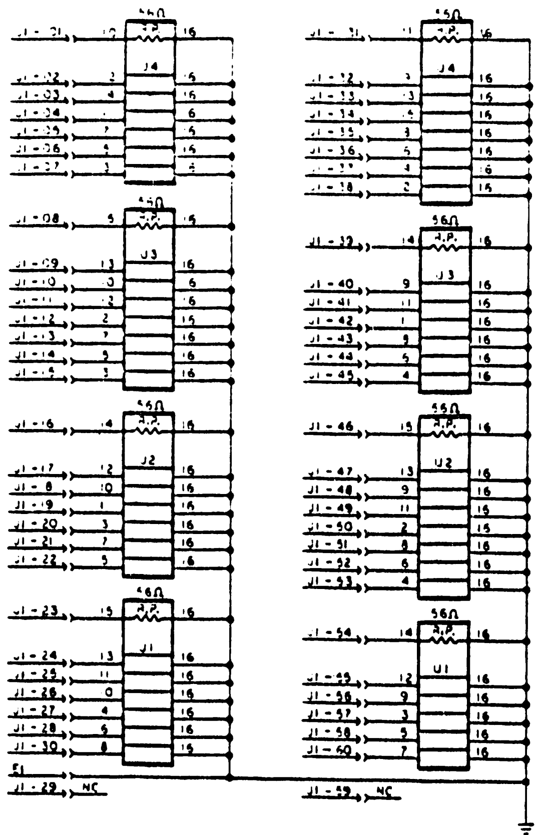
RELY	PL ITEM
K1	11
K2	12

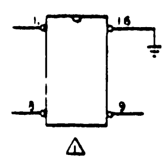
CAP	PL ITEM
C1	48
C2	21
C3	47
C4	21

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 4 OF 5)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77713900	PWA Relay Control	
2	77713920	PWB, Relay Control	
5	15164423	I.C. 75472	
6	22940901	Relay Socket	
7	22940903	Relay Retainer	
8	76379300	Header Straight 2 pin	
9	83435452	Connector, Plug/Cap	
10	83435453	Connector, Plug/Cap	
11	77612660	Relay	
12	22940808	Relay 15 AMP	INTCH
12	22940809	Relay Gen Purp SPDT	
13	83435458	Connector, Plug/Cap	
14	83435454	Connector, Plug/Cap	
15	38846808	Res 5 W 3% 35	
16	75743608	Header 8 Pos	
17	50240147	Volt Reg 3 V	
18	77612650	PWR Rectifier MR811	
19	95575001	Rectifier-Sil	
20	51706300	Diode IN4454	
21	19115401	Cap 50 V +80 -20% 10 µF	
21	94361400	Cap 50 V +80 -20% 10 µF	INTCH
22	51860823	Connector, PC	
23	92222046	Res 3 W 5% 390	
24	94402156	Res 1/4 W 5% 1 K	
25	95524700	Terminal, 0.250	
28	94402208	Res 1/4 W 5% 150 K	
29	94402180	Res 1/4 W 5% 10 K	
30	24507130	Res 1/4 W 5% 160	
32	95683505	Stud, Press	
33	10125103	Scr Nut-Hex Mach 4-4	
34	10125603	Washer Plain #4	
38	10125801	Spring Lock Washer 4	
39	17720528	Res-Fxd Comp, 1/2 W 5%	
40	22940904	Relay Socket/Retainer	
41	95683506	Stud, Press	
42	15144900	I.C. 74LS00	
43	15112100	I.C. NE555	
44	94402217	Res 1/4 W 5% 360 K	
45	94402192	Res 1/4 W 5% 33 K	
46	24505229	Cap 35 V 10% 1.0 µF	
49	94402152	Res 1/4 W 5% 680	
50	94402144	Res 1/4 W 5% 330	
51	94402136	Res 1/4 W 5% 150	
52	77835186	Transistor 2N2907A	
53	51795600	Transistor 2N2222A (NPN)	

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 5 OF 5)



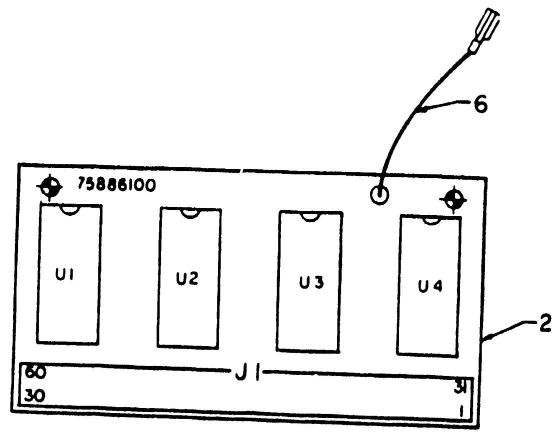


J1 = Terminator Connector, mates with J2 shown in Figure 5-4.

GND receptacle, mates with J3 shown in Figure 5-4.

NOTE: △ 1. Typical module for resistor packs.

FIGURE 5-14. TERMINATOR CIRCUIT BOARD (SHEET 1 OF 2)

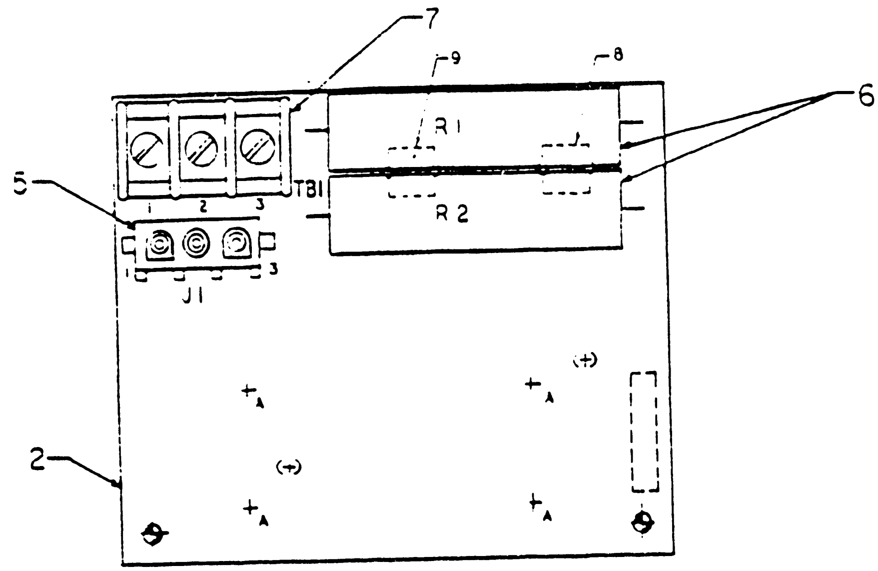


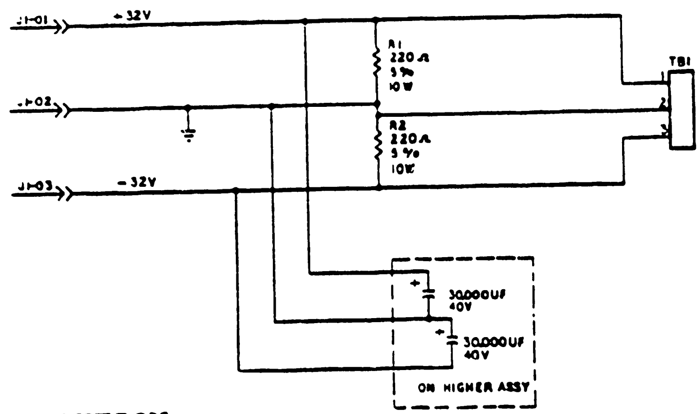
IC	PL ITEM
U1	8
U2	↑
U3	↓
U4	8

CONN	PL ITEM
J1	5

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75886100-9	PWA Terminator	
2	75886120-7	PWB Terminator	
5	75887432-5	Conn, Receptacle Assy	
6	75880638-4	Wire, Receptacle Assy	
8	62012927-0	Res Pac 5% 56 (8)	

FIGURE 5-14. TERMINATOR CIRCUIT BOARD (SHEET 2 OF 2)





CAUTION

Observe correct mounting procedures. See Section 6.7.24.

NOTE: For Component Board interconnections see Figure 5-17.

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77669900	PWA, Component Board	
2	77669920	PWB, Component Board	
5	83435452	Connector, Plug/Cap	
6	77612692	Res 10 W 5% 220	
7	94792383	Term Strip 3 Pos	
8	95588405	Fuse Clip	
9	95588400	Fuse Clip	

CROSS REF NO. 1401

FIGURE 5-15. COMPONENT BOARD (32 V FILTER)

DIAGNOSTIC/HEAD ALIGNMENT EXTENDER CKT BD

EM4-P1

SOURCE/ DEST	X-REF	SOURCE/ DEST	X-REF	SIGNAL	X-REF.	A	PIN	B	SIGNAL	X-REF.	SOURCE/ DEST	XREF	SOURCE/ DEST	X-REF
				-20 V	1501		1		-20 V	1501				
							2							
							3		DIAG-HD-0	•	P1-A3	0205		
							4		DIAG-HD-1	•	P1-A4	0205		
							5		DIAG-HD-2	•	P1-A5	205		
				GND	1501		6		GND	1501				
							7		DIAG-HD-4	•	P1-A7	0205		
							8		DIAG-LATE-STROBE/+L	•	P1-A8	0204		
							9		DIAG-ERLY-STROBE/+L	•	P1-A9	0204		
		P1-A10	020•	DIAG-AC-WRTCUR/	•		10		DIAG-F.G.-MON/+L	•	P1-A10	0306		
		P1-A11	0204	DIAG-RD-GATE	•		11		DIAG-ACT-I-MON/+L	•	P1-A11	0306		
		P1-A12	0204	DIAG-WRT-GATE	•		12		DIAG-DR-MON/+L	•	P1-A12	0306		
		P1-B13	0603	I-SPE	•		13		I-SPE/+L	•	P1-A13	0306		
		P1-B14	0603	SPE	•		14		SPE/+L	•	P1-A14	0306		
							15		DIAG-ENABLE/+L	•	P1-A15	0204		
		P1-B16	0702	DIAG-RD-AGC	•		16							
							17		DIAG-AM-EN	•	P1-A17	0205		
							18							
							19							
							20							
							21							
							22		HD-ALIGN-WP/-L	1501	P1-A21	0206		
				GND	1501		23		GND	1501				
							24							
							25							
							26							
							27							
							28				P1-A28	0204		
							29				P1-A29	0204		
							30		DIAG-WRT-CLK	•	P1-A30	0204		
							31		DIAG-WRT-CLK-GND	•	P1-A31	0204		
							32				P1-A32	0204		
							33				P1-A33	0204		
							34		DIAG-RD-CLK	•	P1-A34	0204		
							35		DIAG-RD-CLK-GND	•	P1-A35	0204		
							36							
							37							
							38		AM-FOUND/+L	•	P1-A38	0205		
				GND	1501		39		GND	1501				
		P1-B40	0606	INDEX/-L	•		40		INDEX/-L	•	P1-A40	0104		
							41							
							42							
							43							
				+5 V	1501		44		+5 V	1501				
				+20 V	1501		45		+20 V	1501				

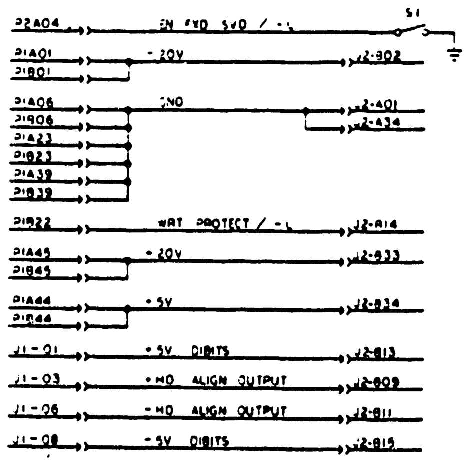
EM4-P2

SOURCE/ DEST	X-REF	SOURCE/ DEST	X-REF	SIGNAL	X-REF.	A	PIN	B	SIGNAL	X-REF.	SOURCE/ DEST	XREF	SOURCE/ DEST	X-REF
							1							
							2							
							3							
		P2-B04	0606	EN-FXD-SVO/-L	1501		4		I/O WRT/-L	•	P2-A04	0302		
							5		I/O RD/-L	•	P2-A05	0302		
							6							
							7		MADR-0/+L	•	P2-A07	0302		
							8		MADR-1/+L	•	P2-A08	0302		
		P2-B09	0603	PLO-LOCKED/-L	•		9		MADR-2/+L	•	P2-A09	0302		
							10		MADR-3/+L	•	P2-A10	0302		
							11		MADR-4/+L	•	P2-A11	0302		
							12		MADR-5/+L	•	P2-A12	0302		
							13		MADR-6/+L	•	P2-A13	0302		
							14		MADR-7/+L	•	P2-A14	0302		
							15		MADR-8/+L	•	P2-A15	0302		
							16		MADR-9/+L	•	P2-A16	0302		
							17		MADR-A/+L	•	P2-A17	0302		
							18		MADR-B/+L	•	P2-A18	0302		
							19		MADR-C/+L	•	P2-A19	0302		
							20		MADR-D/+L	•	P2-A20	0302		
							21		MADR-E/+L	•	P2-A21	0302		
							22		MADR-F/+L	•	P2-A22	0302		
							23							
							24		DB0/+L	•	P2-A24	0302		
		P2-B25	0901	DIAG-RD-PLO-LOCK/+L	•		25		DB1/+L	•	P2-A25	0302		
							26		DB2/+L	•	P2-A26	0302		
							27		DB3/+L	•	P2-A27	0302		
							28		DB4/+L	•	P2-A28	0302		
							29		DB5/+L	•	P2-A29	0302		
							30							
							31		DB6/+L	•	P2-A31	0302		
							32		DB7/+L	•	P2-A32	0302		
							33		MEM-WRT/-L	•	P2-A33	0302		
							34		MEM-RD/-L	•	P2-A34	0302		
							35		EXT-INT-1/-L	•	P2-A35	0303		
							36		GND	1501	P2-A36	0301		
							37							
							38							
							39							
							40							
							41							
							42							
							43							
							44							
							45							

• WIRED TO, BUT NOT USED ON PWA

XX218

FIGURE 5-16. DIAGNOSTIC/HD ALIGNMENT CKT BOARD (SHEET 1 OF 4)

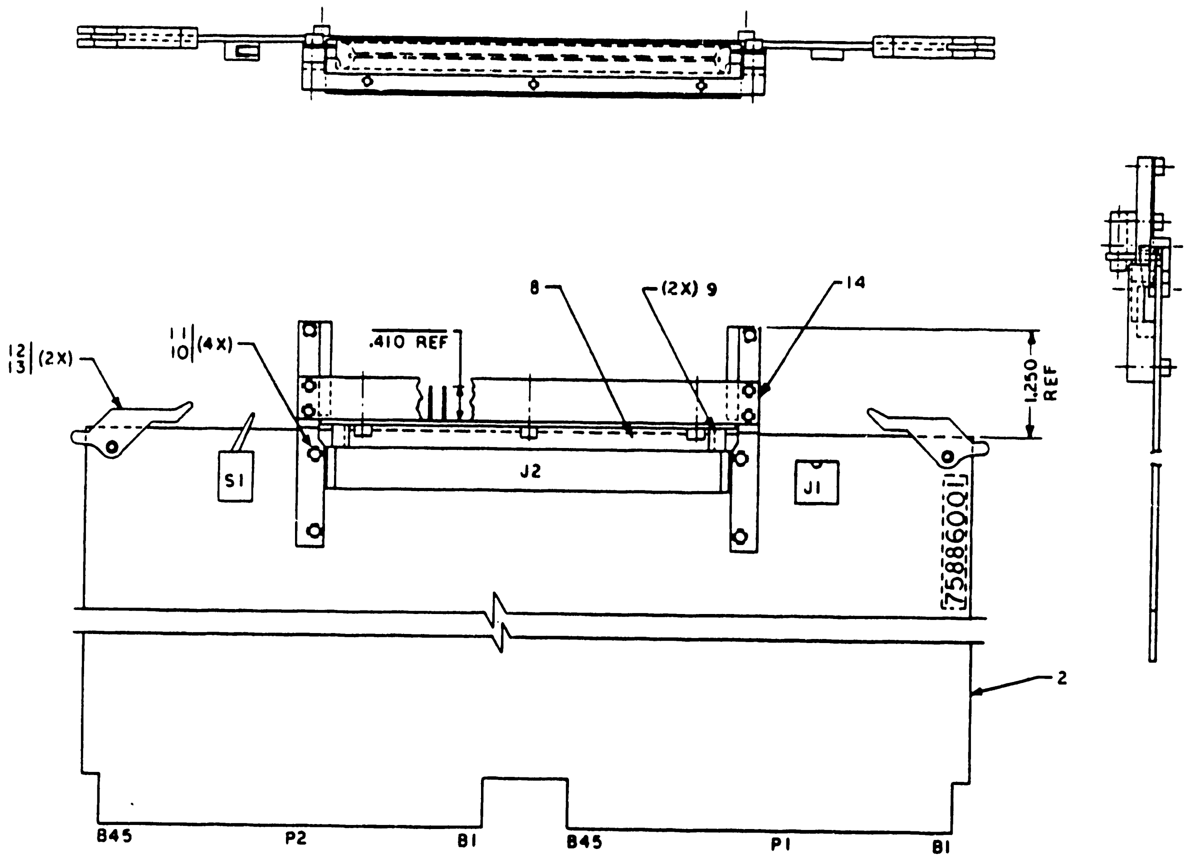


DIAG/HD ALIGN CKT BD

J1		SIGNAL	SOURCE/DEST	XREF
01	←	SELECTED-SVO-P	J2-01	0602
03	←	SVO/DATA-P	J2-03	0602
06	←	SVO/DATA-N	J2-06	0602
08	←	SELECTED-SVO-N	J2-08	0602

CROSS REF
NO. 1501

FIGURE 5-16. DIAGNOSTIC/HD ALIGNMENT CKT BOARD (SHEET 2 OF 4)



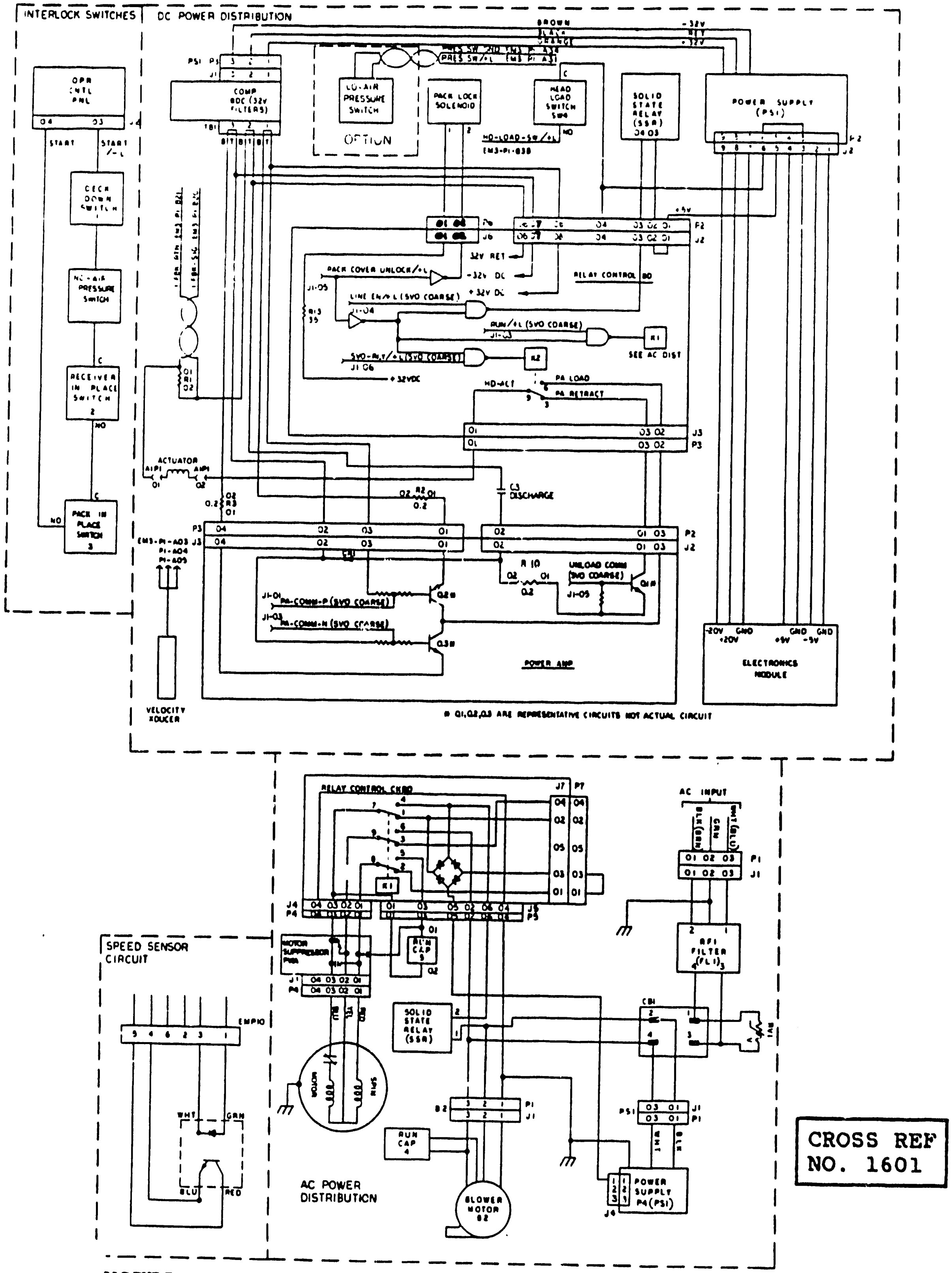
CONN	PL ITEM
J1	6
J2	5

SW	PL ITEM
S1	7

FIGURE 5-16. DIAGNOSTIC/HEAD ALIGNMENT CKT BOARD (SHEET 3 OF 4)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75886001-9	PWA Hd Alignment Ext	
2	75836021-7	PWB Hd Alignment Ext	
5	94243400-2	Conn-Card Mtd 62 SOCX	
6	77832292-5	Socket, 8 Pin	
7	41347800-9	Switch Toggle	
8	46488401-4	Insulator, Pin	
9	46488500-3	Spacer	
10	10127113-8	Screw Pan Hd Mach	
11	10126401-8	Washers Ext Tooth Lo	
12	82311900-3	Inject-Eject Card	
13	93533118-1	Pin, Rolled	
14	75895336-8	Extender, Short	

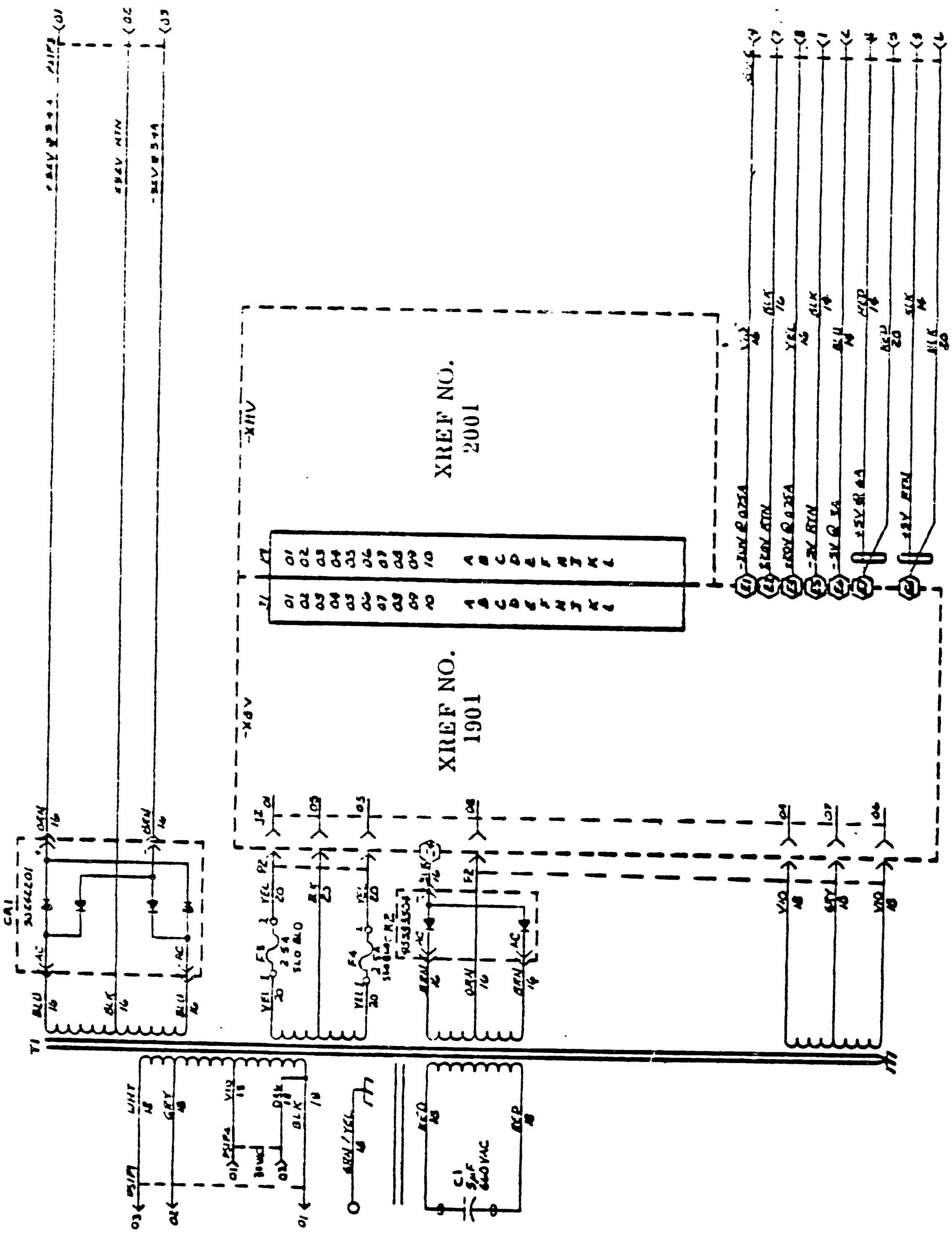
FIGURE 5-16. DIAGNOSTIC/HEAD ALIGNMENT CKT BOARD
(SHEET 4 OF 4)



CROSS REF NO. 1601

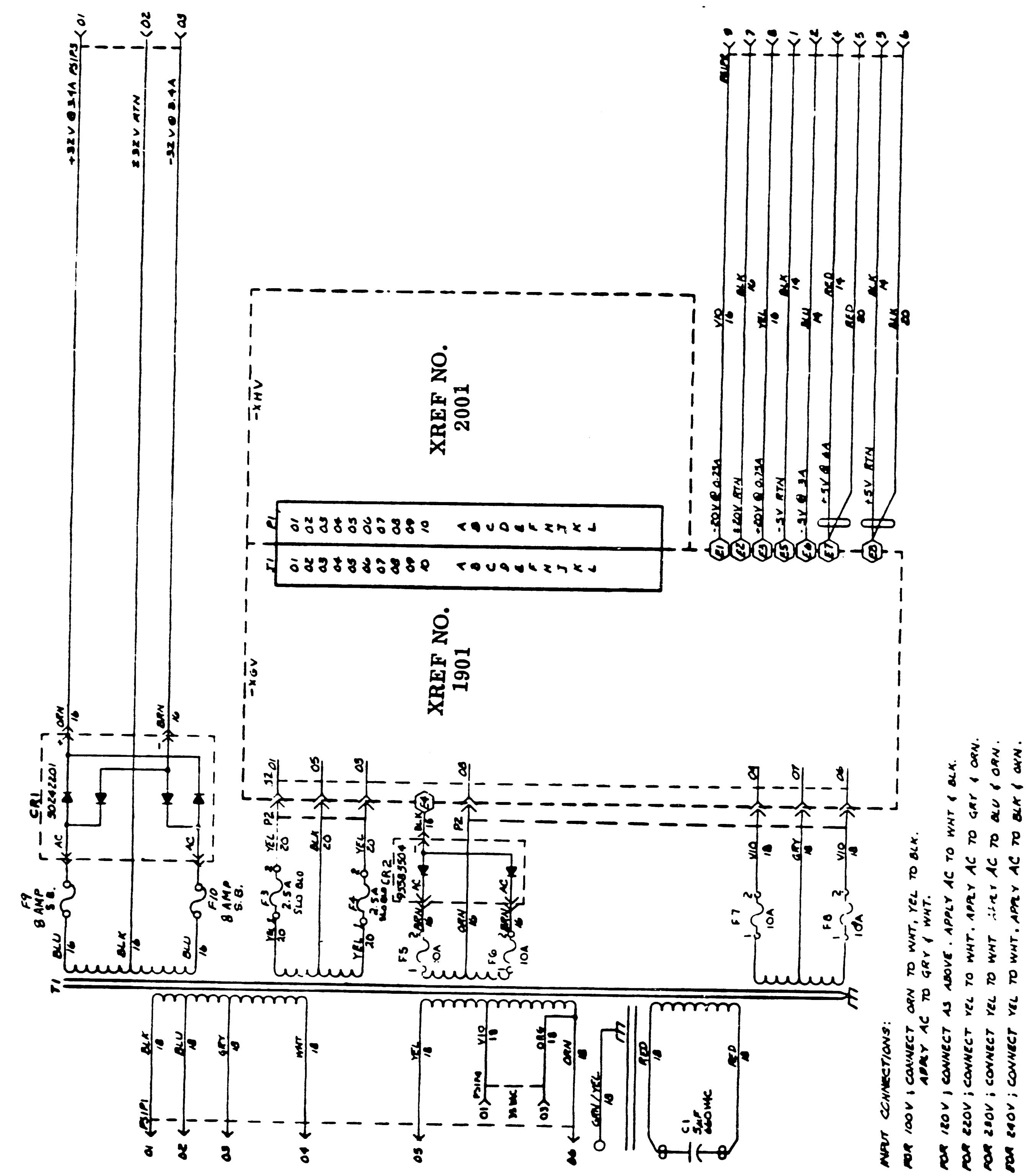
NOTES: 1. THIS HOOK UP IS FOR 120 V 60 HZ POWER.
2. RELAY K1 SHOWN IN DE-ENERGIZED POSITION.

FIGURE 5-17. AC POWER AND DC POWER DISTR. INTERLOCK SWITCHES AND SPEED SENSOR CKT DIAGRAM



NOTES: 1. ⬭ Denotes two wires in one lug.
2. See Figure 6-17 for fuse locations.

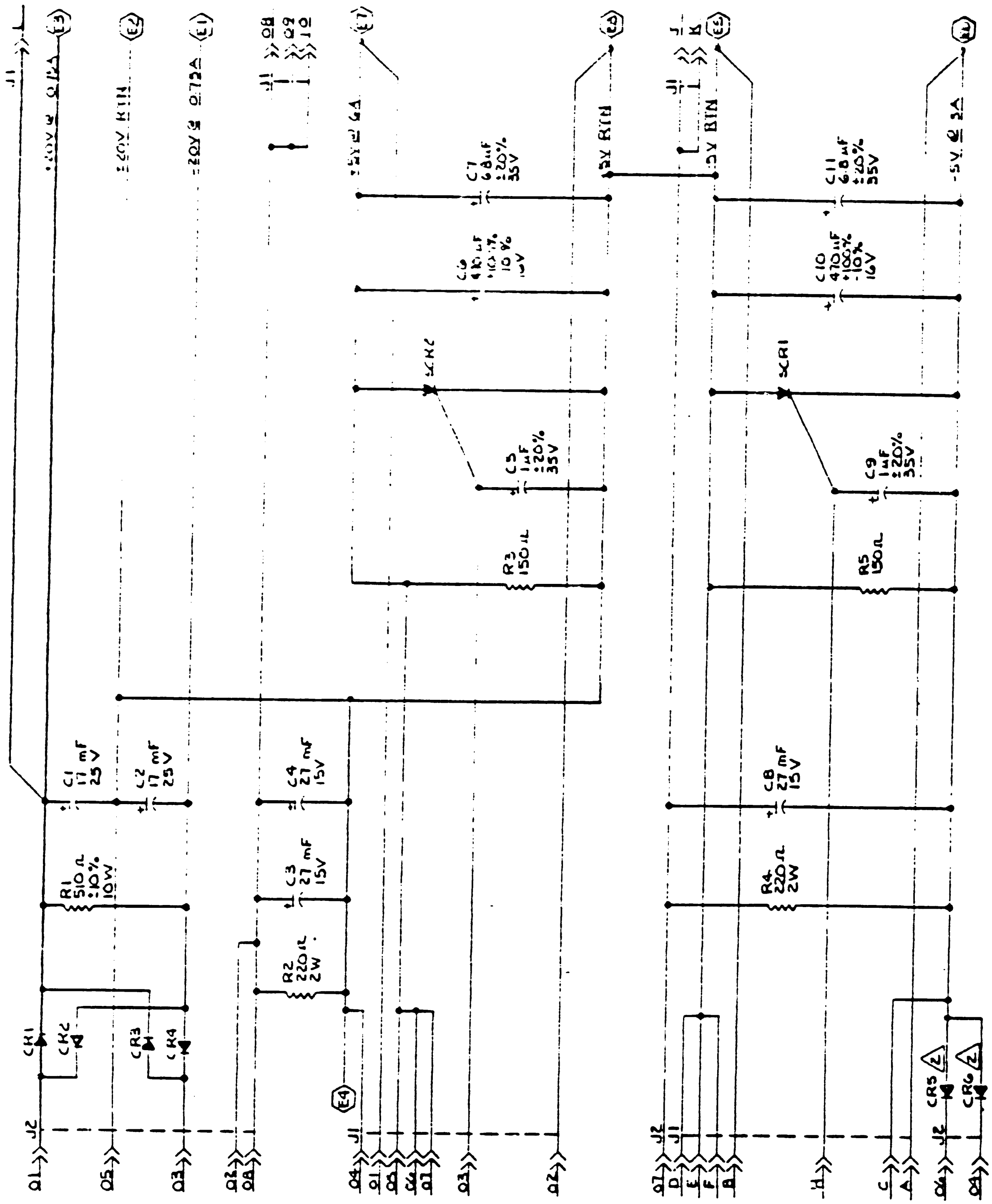
FIGURE 5-18. POWER SUPPLY WIRING DIAGRAM (60 HZ)



NOTES: 1. ⬭ Denotes 2 wires in 1 lug.
2. See Figure 6-17 for fuse locations.

CROSS REF NO. 1801

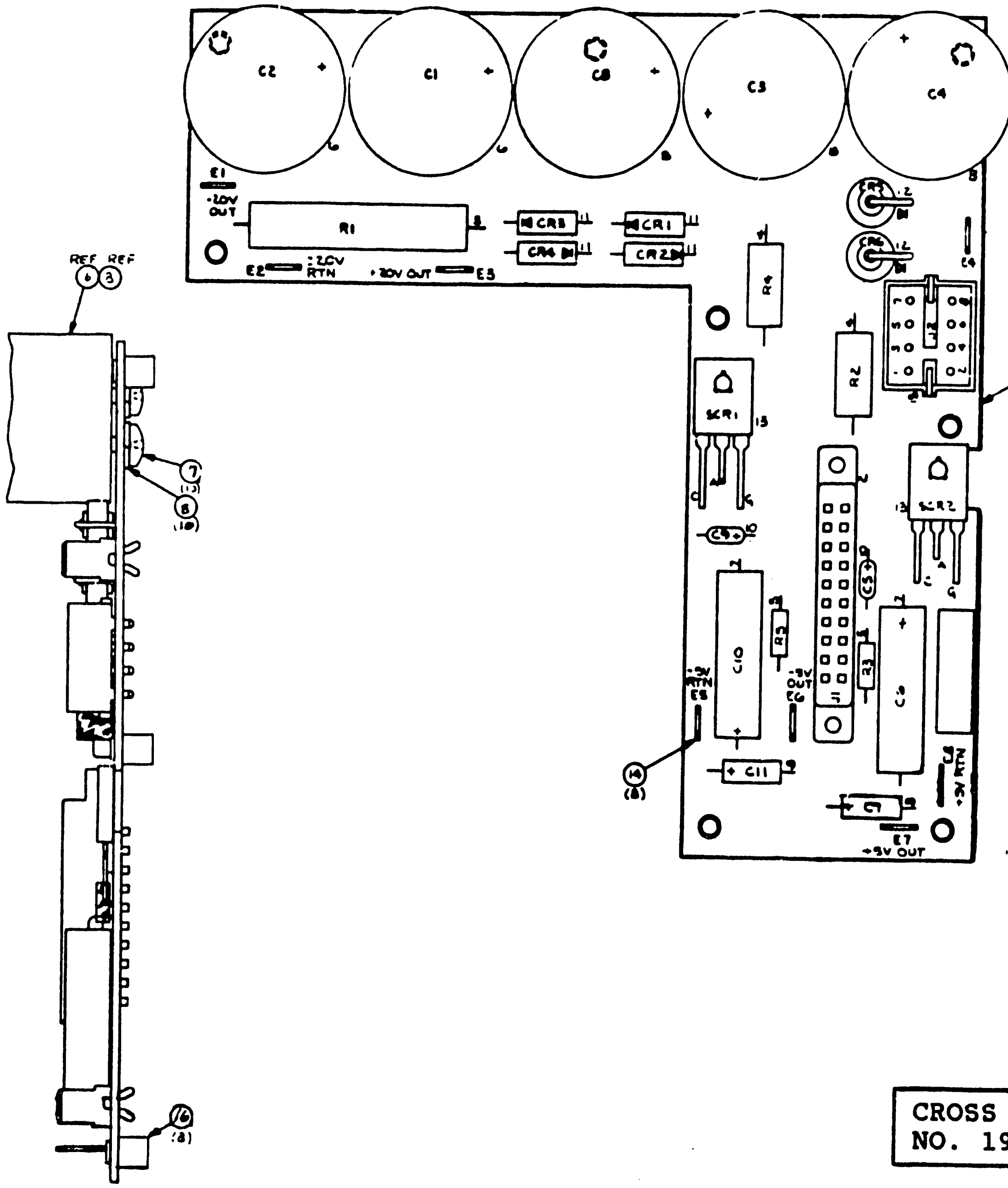
FIGURE 5-19. POWER SUPPLY WIRING DIAGRAM (50 HZ)



NOTES: 1. Unless otherwise specified:
All diodes, Silicon, 95588200.
All SCR's 2N4441, 94825900.
All ◯ indicates quick-connect terminals.

FIGURE 5-20. POWER SUPPLY MOTHER BOARD (SHEET 1 OF 3)

CROSS REF NO. 1901

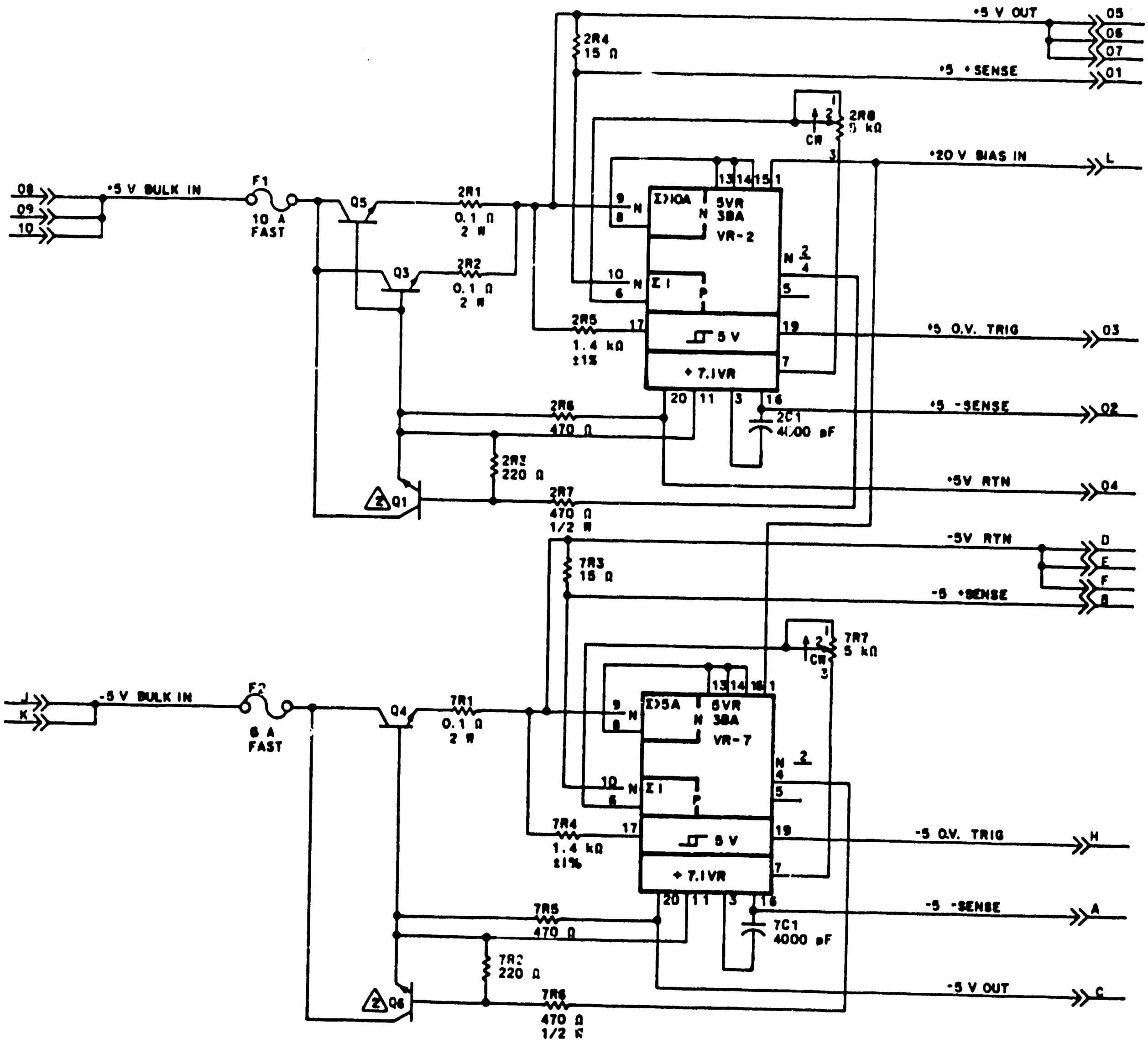


CROSS REF
NO. 1901

FIGURE 5-20. POWER SUPPLY MOTHER BOARD (SHEET 2 OF 3)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75832500	Mother Board	
1	75832400-8	AXGV Board Blank	
2	95595301-3	Connector, P.C. Mount	
3	95594119-0	Resistor, Fixed 10 W 510 Ohms	
4	92512571-8	Resistor 2 W 220 Ohms	
5	92512809-2	Res 1/2 W 150 Ohm	
6	95642426-1	Cap, Electro 30 V DC	
7	92427153-9	Cap, Electro 470 µF 16 V	
8	95661328-5	Cap 18 V DC 27,000 µF	
9	92427039-0	Cap Electro 6.8 MF 35 V	
10	92427023-4	Cap Electro 1 µF 35 V	
11	95588200-6	Rectifier-Sil, 3 Amp 100 V	
12	95575000-5	Rectifier-Sil, Hi-Current	
13	94825900-7	Rectifier-Sil Controlled	
14	95524700-2	Terminal 0.250 Quick Connect	
15	95882801-4	Pin Header Assy (Double Row)	
16	94363101-0	Standoff-Threaded Swage	
17	9[illegible]234236-3	Scr, Mach Pan Hd pH-0-32X5/16	
18	95524402-5	Washer, Lock	

FIGURE 5-20. POWER SUPPLY MOTHER BOARD (SHEET 3 OF 3)



NOTES: 1. All Transistors, 2N3771, 94791000.
2. All Potentiometers 1/2 W ±10%.
3. All Transistors, NPN, 95689901.

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Special Maintenance Precautions in Section 6.2.2.

FIGURE 5-21. REGULATOR BOARD (SHEET 1 OF 3)

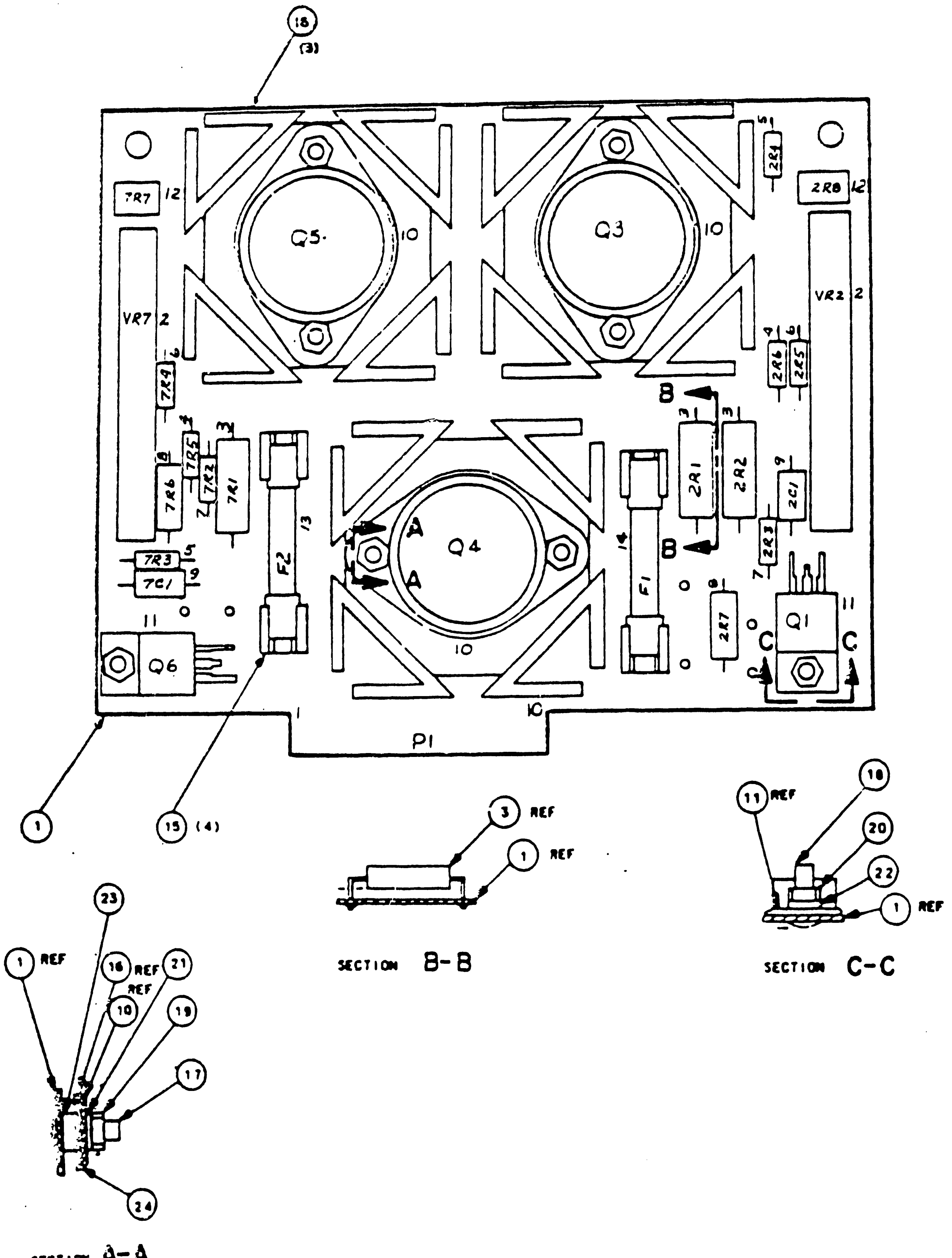
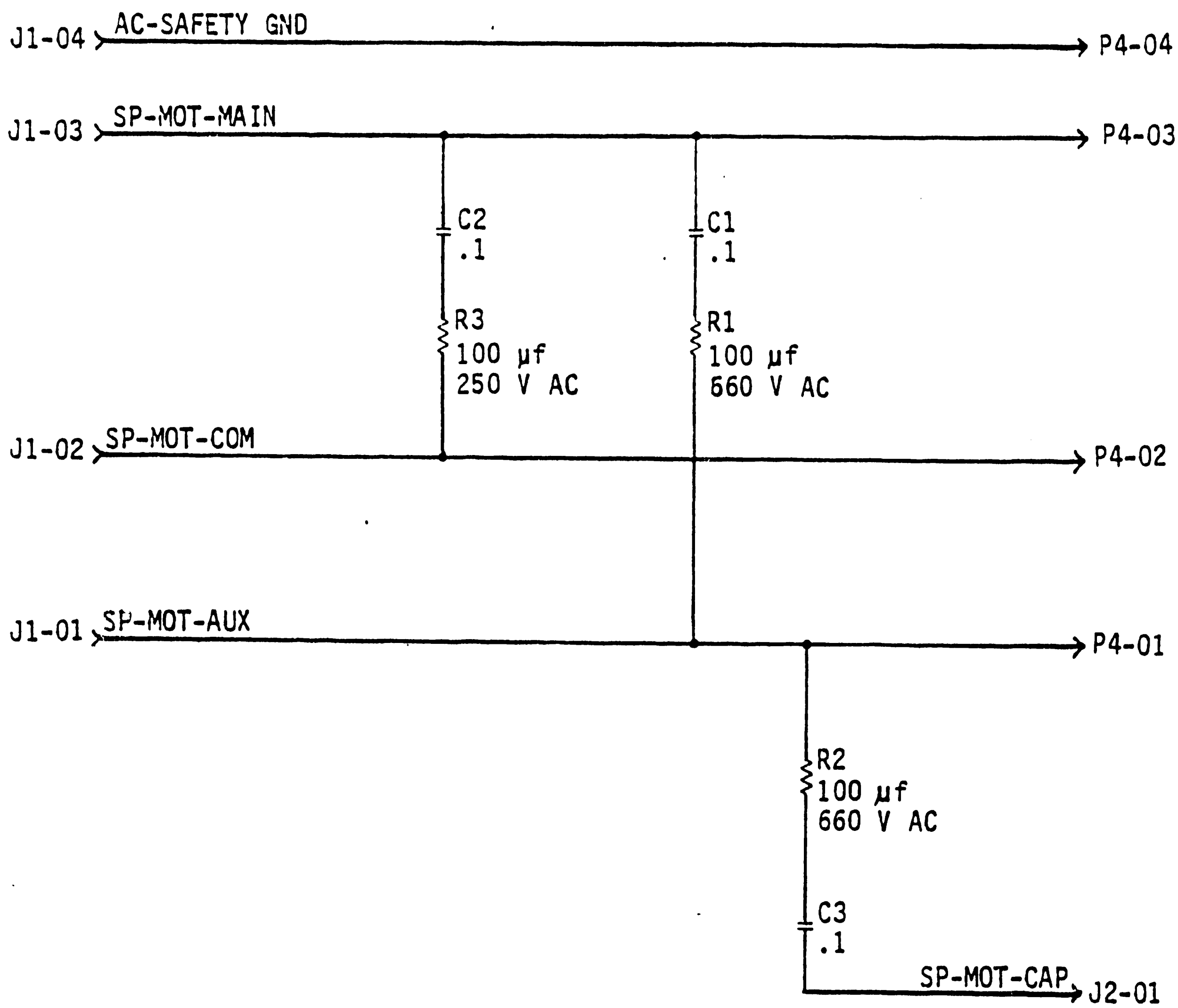


FIGURE 5-21. REGULATOR BOARD (SHEET 2 OF 3)

ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	75832900	Regulator Board	
1	75832800-9	AXHV Board Blank	
2	15162000-2	Hybrid, Voltage Regulator	
3	24565788-7	Res-Fxd, WW 2 W 0.10 Ohms	
4	92512157-6	Resistor 1/4 W 470 Ohms	
5	92512242-6	Resistor 1/4 W 15 Ohms	
6	94360314-2	Resistor 1400 Ohms	
7	92512155-0	Resistor 1/4 W 220 Ohms	
8	92512817-5	Resistor 1/2 W 470 Ohms	
9	92496369-7	Cap Non-Electro 4000 pF 80 V	
10	94791000-6	Tstr Sil NPN 150 W 40 V 2N3771	
11	95689901-7	Transistor 7 Amp	
12	94391208-9	Potentiometer, Trimmer	
13	93418334-4	Fuse 1/4 X 1 1/4 Glass 6 A	
14	93418239-5	Fuse 1/4 X/ 1/4 Glass 10 A	
15	95588400-2	Clip, Fuse	
16	94261000-7	Heat-Sink-Transistor	
17	95683511-0	Stud, Press	
18	95683503-7	Stud, Press	
19	95510030-0	Nut, Hex Brass 6-32	
20	95510031-8	Nut, Hex Machine Screw 4-40	
21	95524401-7	Washer, Lock	
22	95524407-4	Washer, Lock	
23	95797300-1	Washer, Phenolic	
24	95533600-3	Grease Dielectric 4 oz. Tube	

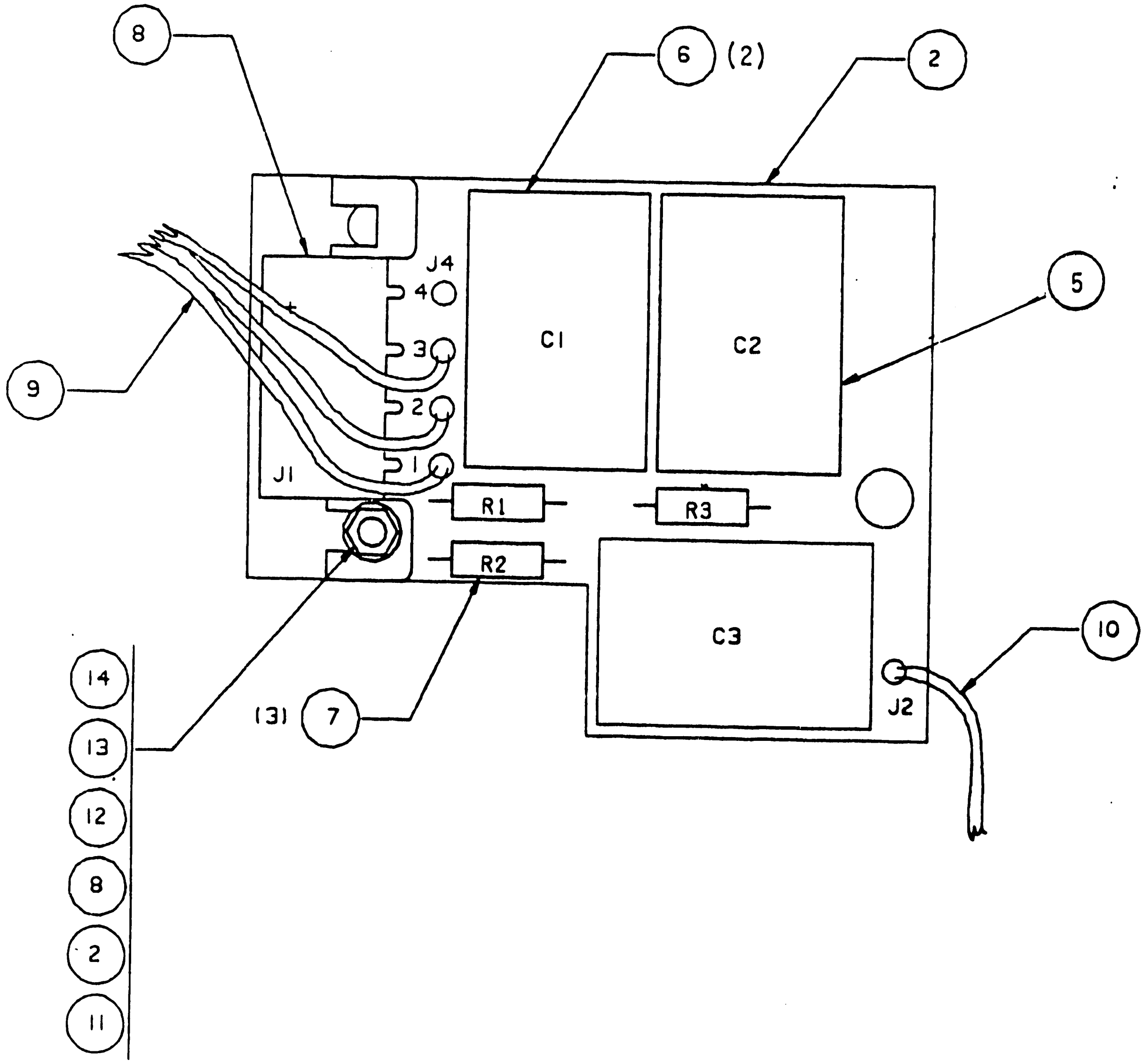
FIGURE 5-21. REGULATOR BOARD (SHEET 3 OF 3)



NOTE: SEE FIGURE 5-17 FOR CONNECTIONS.

CROSS REF NO. 2101

FIGURE 5-22. MOTOR SUPPRESSOR PWA (SHEET 1 OF 2)



ITEM NO.	DRAWING NO.	DESCRIPTION	REMARKS
	77737300	PWA Motor Suppressor	
2	77737320-0	PWB, Suppressor	
5	15181827-5	Cap, 250 V	
6	15181826-7	Cap, 660 V	
7	77612872-0	Res 1 W 5% 100	
8	44681852-8	Header Rt Angle	
9	77681855-1	Mtr. Suppression Cable	
10	77714292-8	Wire Jumper	
11	95683502-9	Stud, Press	
12	75806502-3	Washer-Reduced O.D.	
13	10125801-0	Spring Lock Washer #4	
14	95510024-3	Nut Hex Mach (NC)	

FIGURE 5-22. MOTOR SUPPRESSOR PWA (SHEET 2 OF 2)

5.7 I/O OPERATIONS

Input/Output signal definitions are shown in Table 5-3. Pin number assignments are shown in Figures 5.7-1 and 5.7-2.

Timing characteristics of the interface signals are shown in the timing diagrams in Figures 5.7-3, 5.7-4, 5.7-5 and 5.7-6.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE)*
(SHEET 1 OF 5)

SIGNAL	FUNCTION
	"A" CABLE SIGNALS FROM THE CMD TO THE CONTROLLER*
INDEX**	Pulse which occurs once per disk revolution; its leading edge being considered the leading edge of the Sector Zero. Pulse width is typically 2.5 µs. Index to controller is gated off during volume change and RTZ.
SECTOR**	Pulse derived from the servo track which divides each track into sectors. Up to 127 sector pulses are available per cylinder depending on the setting of sector switches in the CMD. Sector to controller is gated off during volume change and RTZ.
FAULT	This line when active indicates a fault condition exists in the device. Section 6.9.1 describes the types of faults that the CMD is designed to detect and how the Fault indicators are read. The FAULT line may be cleared by Control Select, Fault Clear on the operator panel, or by the Fault Reset switch on the Control/Mux PWA. Table 6-7 summarizes the faults detected.
SEEK ERROR	When this line is active a Seek Error has occurred. The error may only be cleared by performing an RTZ. Seek Error means that the carriage was unable to complete a move within the specified time or that it moved to a position outside the recording field or received an illegal track address.

CAUTION

Do not connect or disconnect I/O Cables when power is on the unit.

*
** See end of Table.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE)
(SHEET 2 OF 5)

SIGNAL	FUNCTION
	"A" CABLE SIGNALS FROM THE CMD TO THE CONTROLLER*
ON CYLINDER	This status signal indicates the servo system has positioned the heads of the selected volume over a track. The status is cleared with any seek instruction causing the carriage to move or a zero distance seek. A carriage offset will result in loss of On Cylinder for a period of 2.75 ms (nominal).
UNIT READY	When active and the device is selected, this line indicates that the device is up to speed, the heads are positioned over the recording tracks and no fault condition exists within the device.
ADDRESS MARK FOUND	Pulse sent following recognition of at least 16 missing transitions and the first zero of the zeros pattern.
WRITE PROTECTED	When active this line indicates that the write protect function in the CMD is active. The Write Protected Indicator on the operator panel will also be illuminated when write protect function is active.
BUSY (Dual Channel Units)	The CMD does not have capability to operate dual channel.

* See end of Table.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE)
(SHEET 3 OF 5)

SIGNAL	FUNCTION
	"A" CABLE SIGNALS FROM THE CONTROLLER TO THE CMD*
UNIT SELECT TAG	This signal gates the desired logic number (coded on the UNIT SELECT 2^x lines) into the logic number compare circuit.
UNIT SELECT (2^0-2^2)***	These lines are binary coded to select the logical number of 1 of 8 devices. The lines are compared with the unit number (0-7) coded on three lines coming from a logic plug on the device operator panel (see Table 2-1).
TAG 1 (CYLINDER ADDRESS)	This line when active indicates to the device that the information on the ten bus lines (Bit 0-9) represents a binary coded cylinder address number.
TAG 2 (HEAD/VOL. SELECT)	This line when active indicates that Head/Volume select information is coded on bus lines Bit 0-2 (head) and Bit 4 (volume). TAG 2 must precede TAG 1 when a volume change is made.
TAG 3 (CONTROL SELECT)	This line when active indicates to the device that the ten Bus lines contain control signals. Table 5-4 lists these control signals.

*
** } See end of Table.
***

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE)
(SHEET 4 OF 5)

SIGNAL	FUNCTION
	"A" CABLE SIGNALS FROM THE CONTROLLER TO THE CMD*
POWER SEQ PICK POWER SEQ HOLD	Power sequencing levels. Ground on these two will cause the first CMD in sequence to begin its spindle start sequence. Once the first is up to speed, the PICK signal is transferred to the next active CMD which starts up and sends the PICK signal on, and so forth until all the CMD units are up to speed. Individual units may be started and stopped manually once the start sequencing is completed. All units power down the spindles when ground on SEQUENCE HOLD is removed.
OPEN CABLE DETECTOR	This line allows information to be received over the interface. This signal must be true in order for selection and control to take place.
BUS LINES (BITS 0-9)	The input bus lines on the "A" cable (see Table 5-4) are multipurpose lines used to input data and also cylinder addresses, head addresses and control functions. These bus lines are used with the A cable TAG lines as shown in Table 5-4.
	"B" CABLE SIGNALS FROM THE CONTROLLER TO THE CMD
WRITE DATA	This line carries data which is to be recorded on the disk pack.
WRITE CLOCK	This clock signal synchronizes the NRZ Write Data signal in the CMD. It is the SERVO CLOCK signal from the CMD retransmitted to the CMD during a write operation.

*
**
*** } See end of Table.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE)
(SHEET 5 OF 5)

SIGNAL	FUNCTION
	"B" CABLE SIGNAL FROM THE CMD TO THE CONTROLLER
SERVO CLOCK	Phase-locked 9.677 MHz clock generated from the servo track dibits. Returned by the controller to the CMD as WRITE CLOCK.
READ DATA	This line transmits the recovered data in the NRZ form.
READ CLOCK	This clock defines the beginning of the data cell. It is internally derived and is synchronous with the detected data.
SEEK END	This line combines the ON CYLINDER or SEEK ERROR signals indicating that a seek operation has terminated.
UNIT SELECTED	If the code on the three Unit Select lines is equal to the lines coming from the logic plug on the operator panel while UNIT SELECT TAG is true, then the CMD sends UNIT SELECTED to the controller.
INDEX**	Pulse which occurs once per disk revolution; its leading edge being considered the leading edge of the Sector Zero. Pulse width is typically 2.5 us. Index to controller is gated off during volume change and RTZ.
SECTOR**	Pulse derived from the servo track which divides each track into sectors. Up to 127 sector pulses are available per cylinder depending on the setting of sector switches in the CMD. Sector to controller is gated off during volume change and RTZ.

* See Figure 3-7 for Interface Cabling Diagram.

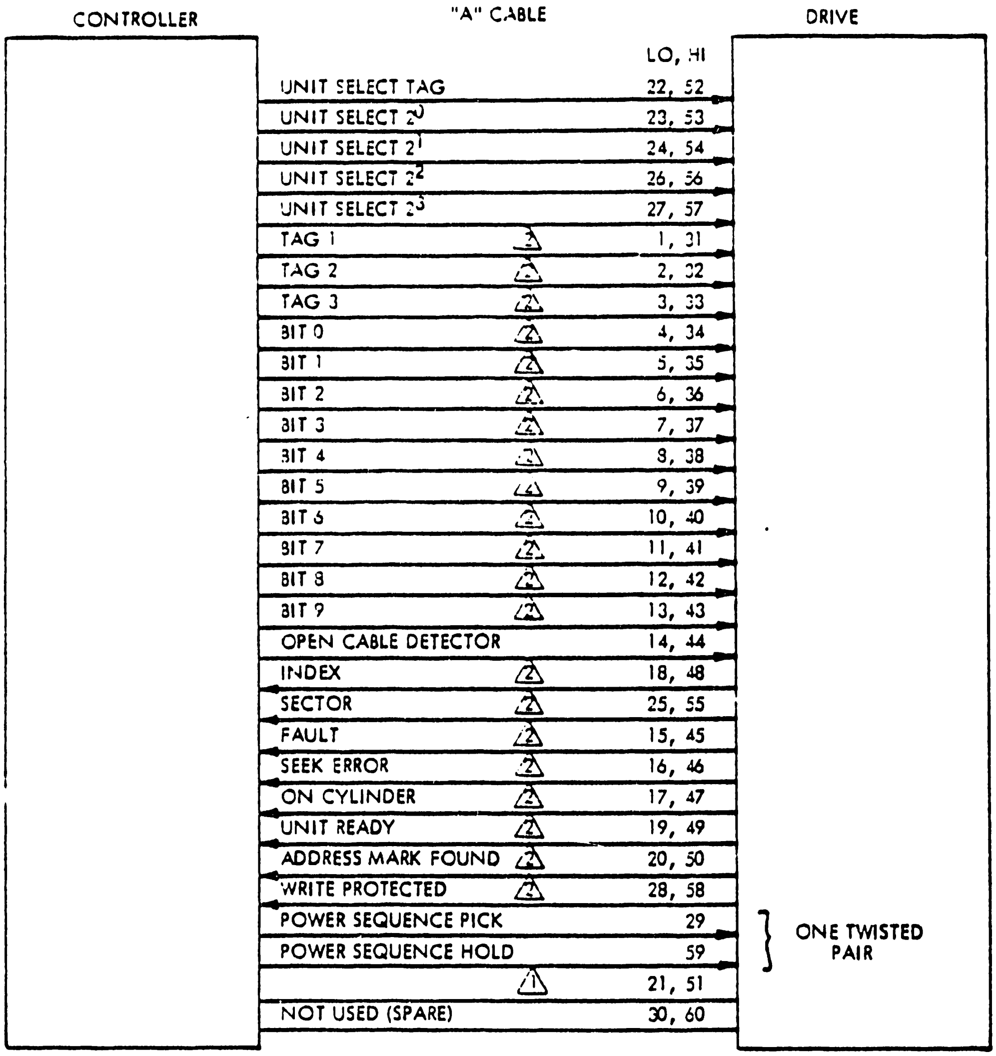
** Both Index and Sector pulses are inhibited during selection of a data head on the other volume until the first index detected after initiation of a Seek, and during an RTZ.

*** Unit Select 2^3 must be zero.

TABLE 5-4. TAG BUS DECODE

	TAG 1	TAG 2	TAG 3
BUS	CYLINDER ADDRESS	HEAD/VOLUME SELECT	CONTROL SELECT
BIT 0	2^0	2^0	WRITE GATE
1	2^1	2^1	READ GATE
2	2^2	2^2	SERVO OFFSET PLUS
3	2^3		SERVO OFFSET MINUS
4	2^4	2^4 △1	FAULT CLEAR
5	2^5		AM ENABLE
6	2^6		RTZ
7	2^7		DATA STROBE EARLY
8	2^8		DATA STROBE LATE
9	2^9		

△1 This BIT is volume address which is stored in a bistable within the CMD. The stored volume address and "TAG 1" result in a volume select if the cylinder address is valid. Refer to Figures for Timing. A zero denotes the removable cartridge and a one denotes the fixed disks.



NOTE: 60 POSITION
28 AWG, 30 PAIR, TWISTED-STRAIGHT FLAT CABLE
MAXIMUM LENGTH - 100 FT

1 RESERVED

2 GATED BY UNIT SELECTED

XX020a

FIGURE 5.7-1. TAG BUS I/O INTERFACE, "A" CABLE

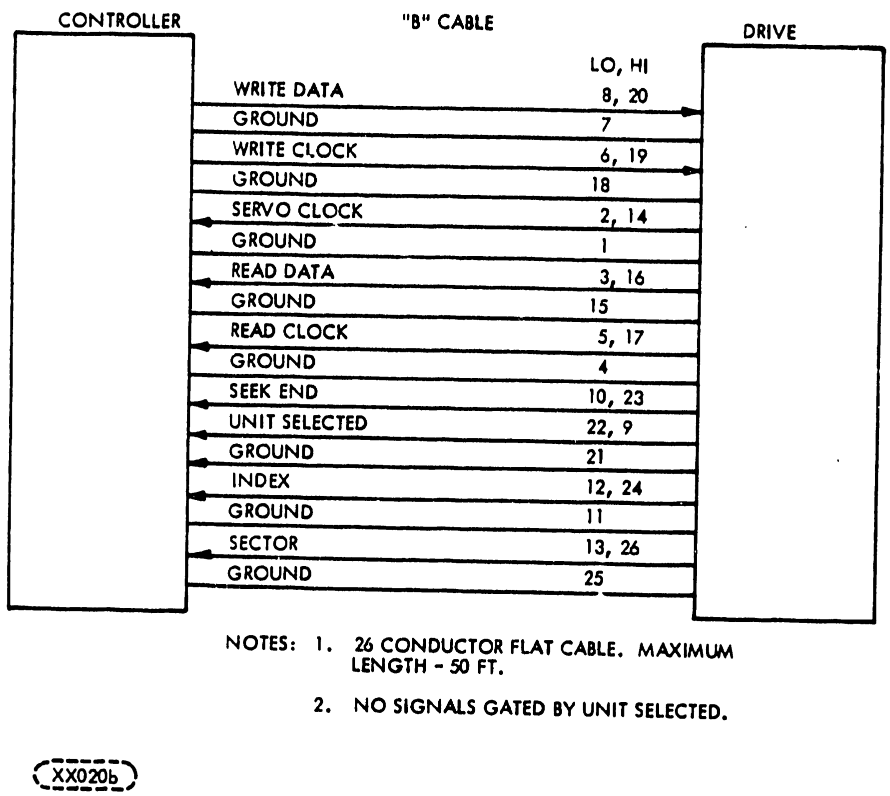
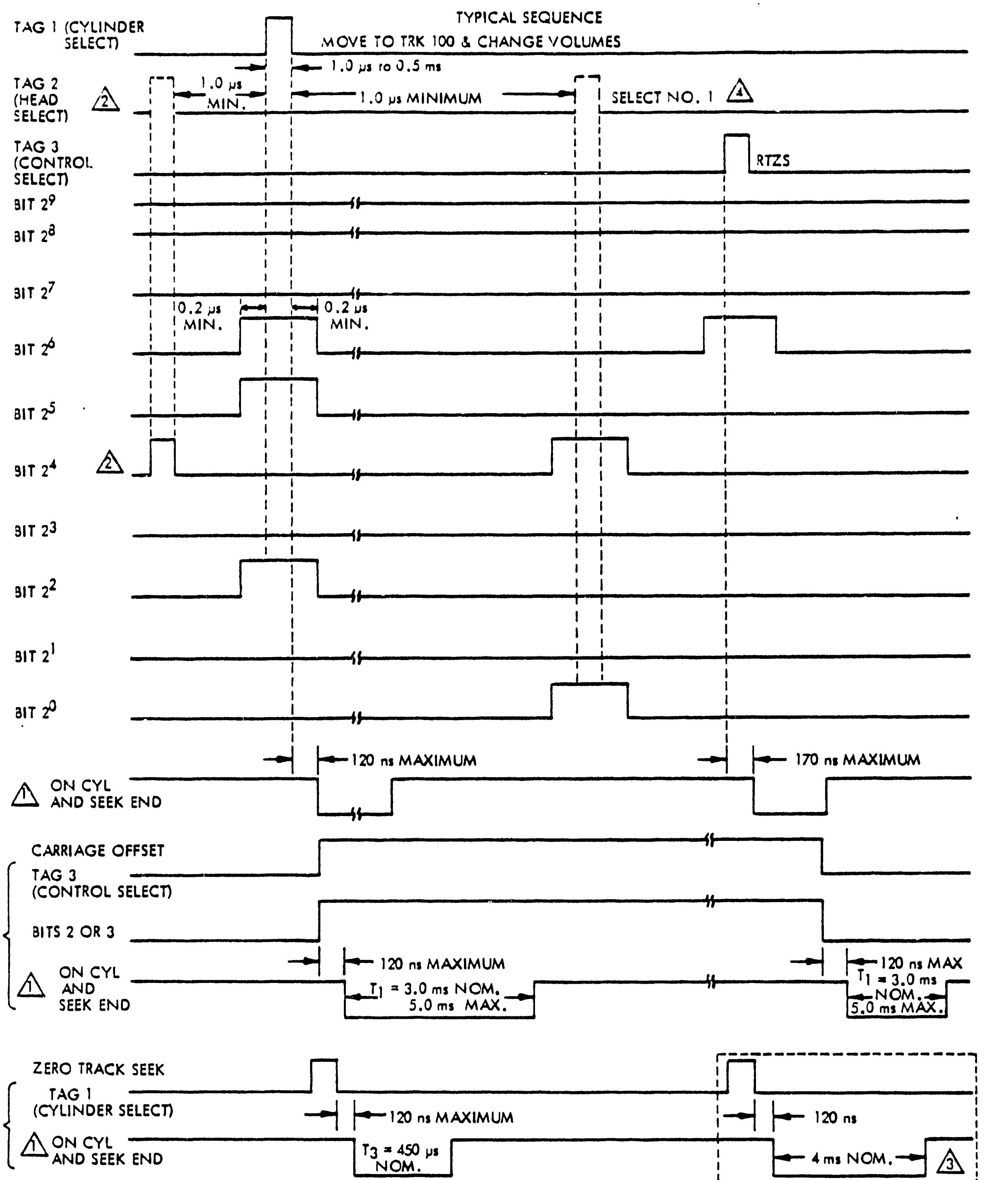


FIGURE 5.7-2. TAG BUS I/O INTERFACE, "B" CABLE



⚠1 ON CYL AND SEEK END SIGNALS ARE IDENTICAL UNLESS SEEK ERROR OCCURS. SEEK ERROR INITIATES A CONSTANT SEEK END. TIMING SHOWN IS AT THE INPUT TO THE TRANSMITTER, ALSO SEE 5.8.2.11.

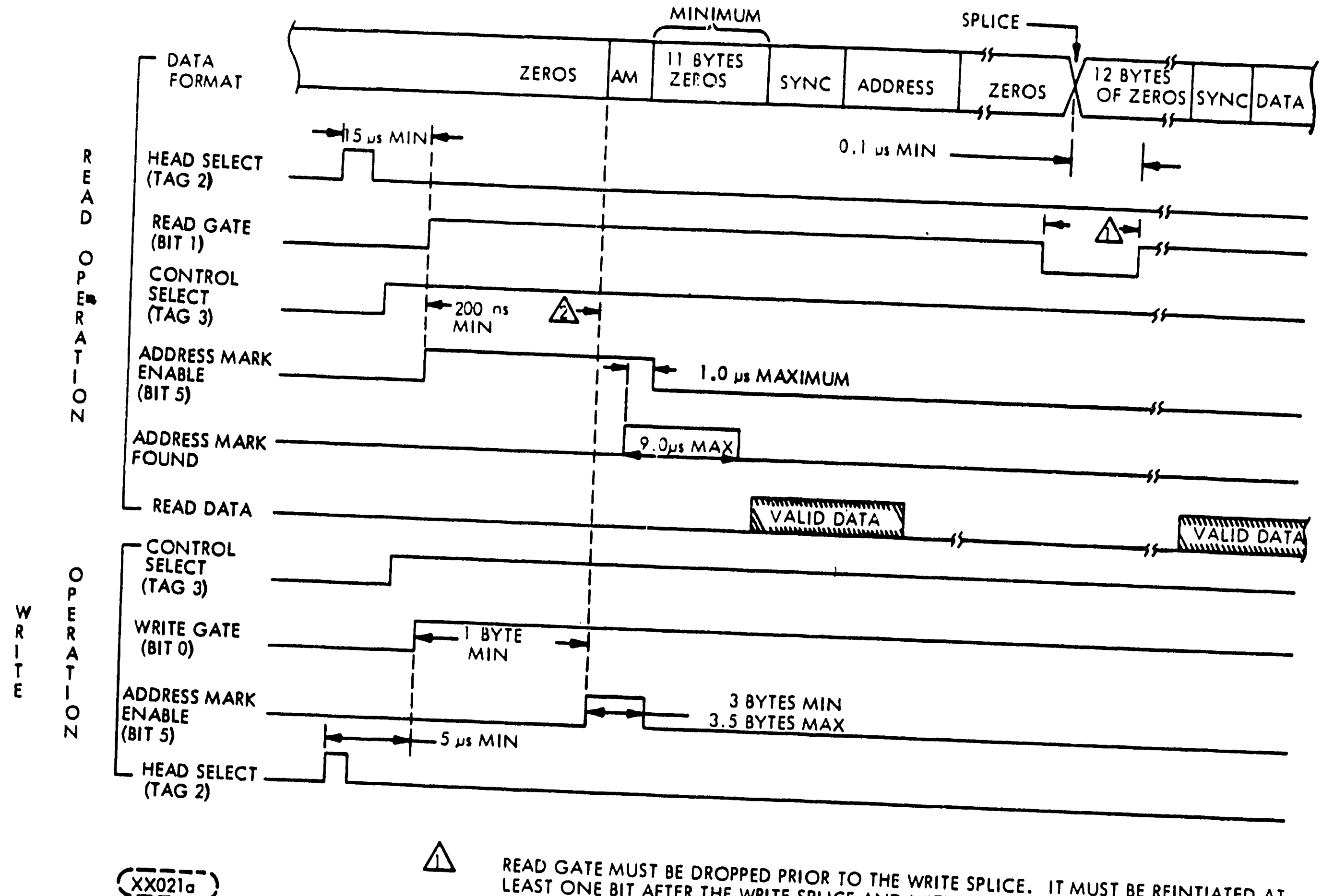
⚠2 TAG AND BUS TIMING REQUIREMENTS FOR A VOLUME CHANGE. TAG 2 PRECEEDS TAG 1 ON VOLUME CHANGE.

⚠3 ZERO TRACK SEEK TIMING WITH VOLUME CHANGE.

⚠4 TAG 2 COMES AFTER TAG 1 ONLY IF NO VOLUME CHANGE.

(XX005)

FIGURE 5.7-3. I/O TAG AND BUS TIMING



1. READ GATE MUST BE DROPPED PRIOR TO THE WRITE SPLICE. IT MUST BE REINTIATED AT LEAST ONE BIT AFTER THE WRITE SPLICE AND WITH AT LEAST 11 BYTES OF ZERO BITS REMAINING IN THE SYNC FIELD. 12 BYTE (EXAMPLE) CONSISTS OF ONE BYTE FOR WRITE SPLICE AND 11 BYTES FOR PLO SYNC.

2. ADDRESS MARK ENABLE SHOULD OCCUR SIMULTANEOUS WITH READ ENABLE.

FIGURE 5.7-4. TYPICAL READ/WRITE TIMING WITH ADDRESS MARK

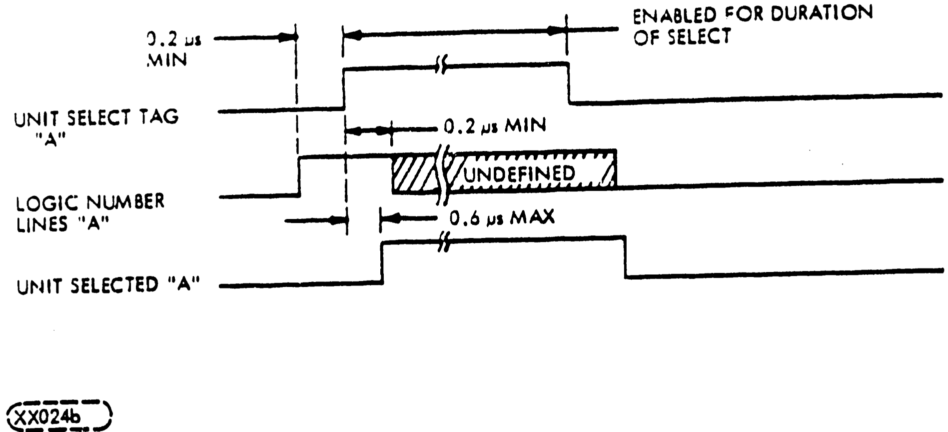


FIGURE 5.7-5. LOGIC NUMBER SELECT AND TIMING DIAGRAM

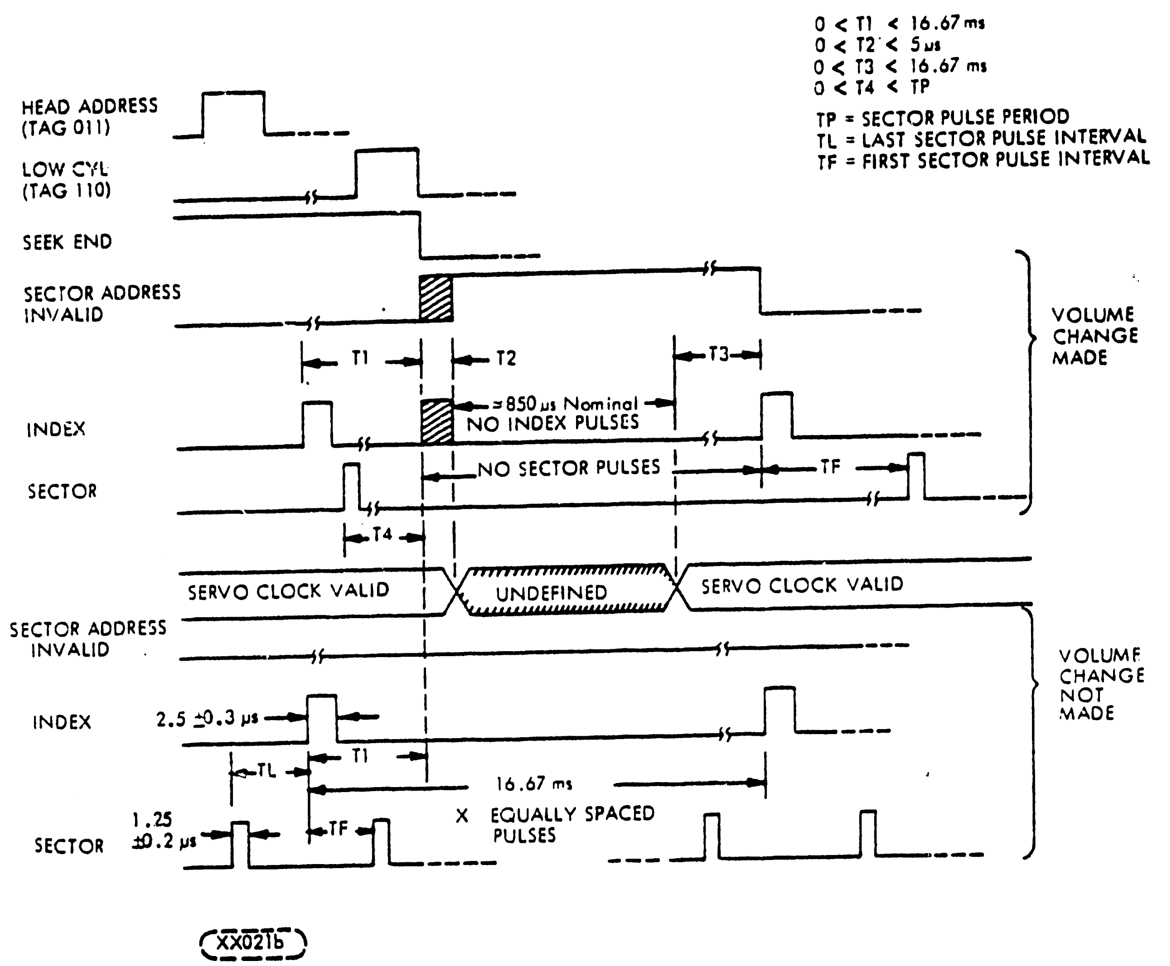


FIGURE 5.7-6. INDEX AND SECTOR DURING A SEEK

SECTION
6
MAINTENANCE

SECTION 6
MAINTENANCE

6.1 INTRODUCTION.. 6-1

6.2 SAFETY AND SPECIAL MAINTENANCE PRECAUTIONS............... 6-1

6.3 MAINTENANCE TOOLS.. 6-3

6.4 MAINTENANCE MATERIAL..................................... 6-5

6.5 MAINTENANCE PROCEDURES - GENERAL......................... 6-5

6.6 PREVENTATIVE MAINTENANCE................................. 6-8

6.7 CORRECTIVE MAINTENANCE................................... 6-17

6.8 DRIVE TESTS AND ADJUSTMENTS.............................. 6-73

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6.11 PHOENIX POWER SUPPLY AND AMPLIFIER PROBLEM ISOLATION..... 6-149

6.1 INTRODUCTION

This section contains the instructions required to maintain the Cartridge Model Drive (CMD). The information is provided in the form of preventive maintenance and corrective maintenance. All maintenance should be performed by qualified and trained service personnel, using the procedures specified in this section.

In general, before performing any drive adjustments or maintenance procedures, install a scratch pack or its equivalent on the drive and switch the drive to an "Off-Line" mode of operation to prevent system interference.

NOTE

> The paragraphs following safety precautions describe, in general terms, the methods used for gaining access to the various servicing areas of the drive. Once these procedures have been described, they will not be repeated in subsequent maintenance instructions. Therefore, maintenance personnel are urged to read through the general procedures at least once to become familiar with these standard procedures.

6.2 SAFETY AND SPECIAL MAINTENANCE PRECAUTIONS

Before proceeding with any maintenance, maintenance personnel should become familiar with the precautions given in paragraphs 6.2.1 and 6.2.2. Failure to practice these precautions may result in equipment damage and/or personal injury.

6.2.1 SAFETY PRECAUTIONS

- Use care when power is applied to the unit. Various voltages are present on connectors J1 and J2 on top of the voice coil magnet.
- Keep hands away from the actuator during seek operations and when reconnecting leads to the voice coil. Emergency retract voltage may be present which could cause sudden reverse motion of the carriage.
- Utilize the carriage locking pin when performing head alignment to prevent personal injury.
- Get help when raising and lowering the deck.

6.2.2 SPECIAL MAINTENANCE PRECAUTIONS

CAUTION

Do not use the circuit breaker to remove AC power from unit until the disk has stopped rotating. The blower must remain ON any time the disk is rotating to prevent the rotating disk from drawing in unfiltered air. The CMD shall contain a cartridge at all times whether operating or not. This is necessary to insure proper sealing of shroud area from environmental contaminants.

WARNING

The circuit assemblies contained in this equipment can be degraded or destroyed by ELECTROSTATIC OVERSTRESS (EOS) or by ELECTRO STATIC DISCHARGE (ESD).

Static electrical charges can accumulate quickly on personnel, clothing, and synthetic materials. The ELECTROSTATIC FIELDS due to these charges, when brought in close proximity to delicate components, cause ELECTROSTATIC OVERSTRESS or ELECTROSTATIC DISCHARGE to these components, either of which can damage or destroy them. The damage will result in degraded reliability or possible immediate failure of the affected component or assembly.

To insure optimum/reliable equipment operation, it is required that technical support personnel discharge themselves by wearing a grounded strap around the wrist and be connected to grounding terminal at all times while working in the vicinity of and during the handling of EOS/ESD susceptable assemblies/parts. This procedure is especially very important when handling printed circuit boards.

Circuit boards/assemblies should be placed on a static-dissipative work surface which has been installed according to established procedures during all maintenance procedures on these circuit boards/assemblies. If possible, all personnel coming near the equipment should stand on a static dissipative floor mat installed according to established procedures.

Printed Circuit Boards should be handled or transported in electrically conductive plastic bags to insure optimum protection against potential EOS/ESD damage. Delicate components soldered into circuits are not immune to EOS/ESD damage.

In addition to the above special cautions the following precautions should be taken:

- Use caution while working near heads. If heads are touched, fingerprints can damage them. Clean heads immediately if they are touched.
- Keep pack access door closed unless it must be open for maintenance. This prevents entrance of dust into pack area. Deck should be left in the raised position only while absolutely necessary for maintenance. When leaving the area of the unit lower the deck. Contamination falling into the absolute filter exit could be blown into the disk area when normal operation is restored.
- Keep all watches, disk packs, meters, and other test equipment at least two feet away from the voice coil magnet when the cover of the unit is off.
- Use scratch pack for maintenance procedures, do not use data pack; otherwise customer data may be destroyed.
- Do not use CE alignment disk pack unless specifically directed to do so. These packs contain prerecorded alignment data that can be destroyed if test procedure requires drive to write. This alignment data cannot be generated in the field.
- Do not insert or remove any PWA board without first turning AC Power circuit breaker off.
- If power to spindle motor is lost while heads are loaded and voice coil lead wire is disconnected, immediately manually retract carriage. Otherwise head-to-disk contact will be made when disk speed is insufficient to permit heads to fly.
- If drive fails to retract heads and stop spindle when START/STOP switch is placed in STOP position, disconnect voice coil lead wire connector and manually retract carriage before troubleshooting the malfunction.
- Never load head manually when spindle is not up to speed. It is recommended that the heads not be loaded manually though they are up to speed.
- When changing or inspecting fixed modules, minimize exposure time to the open atmosphere. Keep the module in a closed shipping container whenever possible.

6.3 MAINTENANCE TOOLS

The special tools required to maintain the disk drive are listed in Table 6-1. Tool sizes required for hex head hardware shown in the figures of this section are shown on the figures and mentioned in the accompanying text. If figures of the parts breakdown in Section 7 are used as an aid in assembly/disassembly, Table 6-1.1 can be referred to for the proper size tool. The hardware part numbers are found under the figures of Section 7.

TABLE 6-1. MAINTENANCE TOOLS

	DESCRIPTION	PART NUMBER	
	Dust Cover	77734693	
	Oscilloscope, Tek 475 or equiv.	Commercially available	
	Head Adjusting Tool	75893963	
	Model 1204-51 CE Disk Cartridge	76204400	*6
*1	Bit, 1/4 Hex Drive, 3/32 Hex End, 1 inch long	87016704	*2
	PWA Extender Board	75882560 or 77643160	
	Head Alignment Kit	75899096	*5
	Jumper Connector	77612622	*4
	Torque Driver Wrench, 1-35 lbf inch	77611696 (for hex bits)	
	Torque Driver Wrench 5-150 lbf-inch	77611697	
*8	Bit, 1/4 Square Drive, 3/16 Hex End	77611698	
*1	Bit, 1/4 Hex Drive, 1/8 Hex End, 5 inch long	87016703	*3
*1	Bit, 1/4 Hex Drive, 7/64 Hex End, 1.94 inch long	77670516	*3
	Air Gage Assembly	77732543	
	Fixed Module Inspector	DML1204 FMD	*7
	Alignment Tool Assembly	76204640	
	Alignment Tool & Cannister	76205461	

TABLE 6-1.1. HEX SOCKET HEAD HARDWARE P/N VS TOOL REQUIRED

HEAD HARDWARE P/N	1/4 " DRIVE HEX END SIZE *1	HEAD HARDWARE P/N	1/4" DRIVE HEX END SIZE *1
10126222	7/64 inch	10126255	3/16 inch
10126226	9/64 inch	10126256	3/16 inch
10126227	9/64 inch	77670257	5/64 inch
10126245	5/32 inch	92720396	3/16 inch
10126246	5/32 inch	92805266	5/32 inch
10126252	5/32 inch	92815099	3/32 inch
10126253	3/16 inch	93749082	9/64 inch
10126254	3/16 inch		

*1 Use with torque driver wrench of Table 6-1.
*2 For head alignment.
*3 For fixed module installation.
*4 Used to Jumper E1 to E2 on Servo Coarse PWA to defeat servo amp.
*5 See Table 6-1.2 for Kit Parts List.
*6 This should not be used as a "scratch" disk for use in troubleshooting. A regular M1204 data disk Part No. 76204001 should be used. Use a disk that does not contain valuable data.
*7 Supplier for this tool is Data Maintenance Limited, DML House, 191 Selhurst Road, South Norwood, London SE25 6LB. Telephone: 01-771 7111 Telex: 947533, Answerback DML GB
*8 For Spindle Installation.

TABLE 6-1.2

Parts List for Head Alignment Kit P/N 75899096		
ITEM NO.	PARTS NO.	ITEM
1	75886001	PWA Hd Alignment Ext
2	73576400	Meter-Hd Align
3	54285300	Comp Asm AZPV
4	77612337	Cable Asm 8 Pin 20 inch
5	75882394	Hd Align Cable Asm
6	77614917	Head Align Proc

6.4 MAINTENANCE MATERIAL

The materials used in the procedures of this section are listed in Table 6-2.

TABLE 6-2. MAINTENANCE MATERIALS

MATERIAL	SOURCE
Gauze Lint-Free	Control Data 94211400
* Media Cleaning Solution	Control Data 95033502
Tongue Depressors	Commercially available
Dust Remover, Super Dry	Control Data 95047800
Computer Card	No. 5084
Gloves	Control Data 76205442
Face Mask	Control Data 76205450

6.5 MAINTENANCE PROCEDURES - GENERAL

6.5.1 MAINTENANCE INDEX AND SCHEDULE

The CMD is designed to require minimal preventive maintenance. The preventive maintenance index provided in Table 6-3 is meant to be used only as a general guideline. The preventive maintenance index consists of seven levels based on a calendar period or on hours of operation (whichever comes first).

The corrective maintenance procedures listed in Table 6-3 are included to facilitate replacement of malfunctioning assemblies. Adjustment procedures are provided to adjust the unit to the published specifications. Maintenance personnel should read the entire procedure prior to performing any of the steps. Steps of these procedures should be performed in sequence.

---

*NOTE

The disk surfaces of the CMD fixed module and cartridge are NOT to be cleaned. The media cleaning solution is listed for use only in cleaning heads and other CMD assemblies.

6.5.2 REMOVAL AND REPLACEMENT OF ASSEMBLIES, PWA BOARDS, AND I/O CABLES

No electrical or electronic component/assembly should be removed and/or replaced when the AC power is applied to the unit. Anytime the AC power is ON, the DC voltages are present on the electronics.

NOTE

For the correct way to install the plugs (PAP1, PAP2, PAP3) onto the power amp board refer to Figure 5-11.

CAUTION

I/O cables must never be installed or removed with power applied at either end of the cable, or damage to the line driver/receiver circuits can occur. This applies to I/O connection between drives as well as drive to controller or field testers.

Procedures for removal and replacement for maintenance purposes are given in Section 6.7. Table 6-3 lists the removal and replacement procedures found in Section 6.7. Figure 6-1a illustrates the location of the Printed Wire Assemblies.

TABLE 6-3. MAINTENANCE INDEX AND SCHEDULE
(SHEET 1 OF 2)

PREVENTIVE MAINTENANCE	PARA.	SCHEDULE
Prefilter Removal and Replacement	6.6.1	4*
Inspect Actuator Assembly (Disks in)	6.6.2	4
Check Power Supply Outputs	6.6.4	4
Inspect Spindle Hub	6.6.5	4
Absolute Filter Removal and Replacement	6.6.1	6**
Clean Carriage Rails and Bearings (All Disks out)	6.6.3	7

DEFINITION OF SCHEDULE

Level 0 -Daily, depending on conditions stated
Level 1 -Weekly or 150 hours
Level 2 -Monthly or 500 hours
Level 3 -Quarterly or 500 hours
Level 4 -Semi-annually or 3000 hours
Level 5 -Annually or 6000 hours
Level 6 -3000 to 9000 hours, depending on the operating environment contamination level.
Level 7 -Only when required with-corrective maintenance (not p.m.)

CORRECTIVE MAINTENANCE, REMOVAL AND REPLACEMENT PROCEDURE, ADJUSTMENTS & TESTS	PARA.
DC Voltage Measurements	6.6.4
Cover Removal and Replacement	6.7.1
Raising and Lowering Base Deck	6.7.2
Slide Mounted CMD Unit Removal and Replacement	6.7.3
Spin Speed Sensor Removal and Replacement	6.7.4
Static Ground Brush Removal and Replacement	6.7.5
Removal and Replacement of Cartridge Receiver	6.7.6
Fixed Disk Module Removal and Replacement	6.7.7
Procedure for Cleaning Fixed Disk Module Area	6.7.8
Head Removal and Replacement (R/W and Servo)	6.7.9, 6.7.10
Head Inspection and Cleaning	6.7.11
Motor Removal and Replacement	6.7.12
Blower Removal and Replacement	6.7.13
Spindle Removal and Replacement	6.7.14
Power Supply Removal and Replacement	6.7.15
Heads Loaded Switch Replacement	6.7.16

* Maximum Times. Preventive maintenance may be required more frequently depending on dust contamination level of operation area.

** The NO-AIR feature indicates the need of filter replacement by not allowing the unit to power up. When the LO-AIR option is present, a flashing FAULT indicator shows the need to service the air filtering system to prevent a NO-AIR condition.

TABLE 6-3. MAINTENANCE INDEX AND SCHEDULE (SHEET 2 OF 2)

CORRECTIVE MAINTENANCE, REMOVAL AND REPLACEMENT PROCEDURES, ADJUSTMENTS & TESTS (CONTINUED)	PARA.
Actuator Magnet Removal and Replacement	6.7.17
Carriage Assembly Removal and Replacement	6.7.18
Carriage Rail Removal and Replacement	6.7.19
Velocity Transducer Removal and Replacement	6.7.20
Removal and Replacement of Cartridge Access Door Lock Solenoid	6.7.21
Head-to-Disk Contact Recovery Procedure	6.7.22
Removal and Replacement of NO-AIR Pressure Switch	6.7.23
Removal and Replacement of Component Board Assy.	6.7.24
Removal and Replacement of R/W Preamp	6.7.25
Fixed Pack Certification	6.8.2
Interlock Switch Adjustments	6.8.3
Pulse Circuits Tests	6.8.4
Servo System Adjustments	6.8.5
Carriage Restraint Block Adjustment	6.8.6
Air Pressure Switch Test	6.8.7
Air Gage Preparation for Use	6.8.8
Fixed Module Inspector Preparation for Use	6.8.9

6.6 PREVENTIVE MAINTENANCE

6.6.1 PREFILTER AND ABSOLUTE FILTER REMOVAL AND REPLACEMENT

The flow chart in Figure 6-1 shows the sequence for follow for filter maintenance.

Refer to Figure 6-1.1 for items identified in the following procedure:

Steps 1 through 7 describe prefilter cleaning and replacement.
Steps 8 through 13 describe filter pressure measurement.
Steps 14 through 23 describe absolute filter replacement.

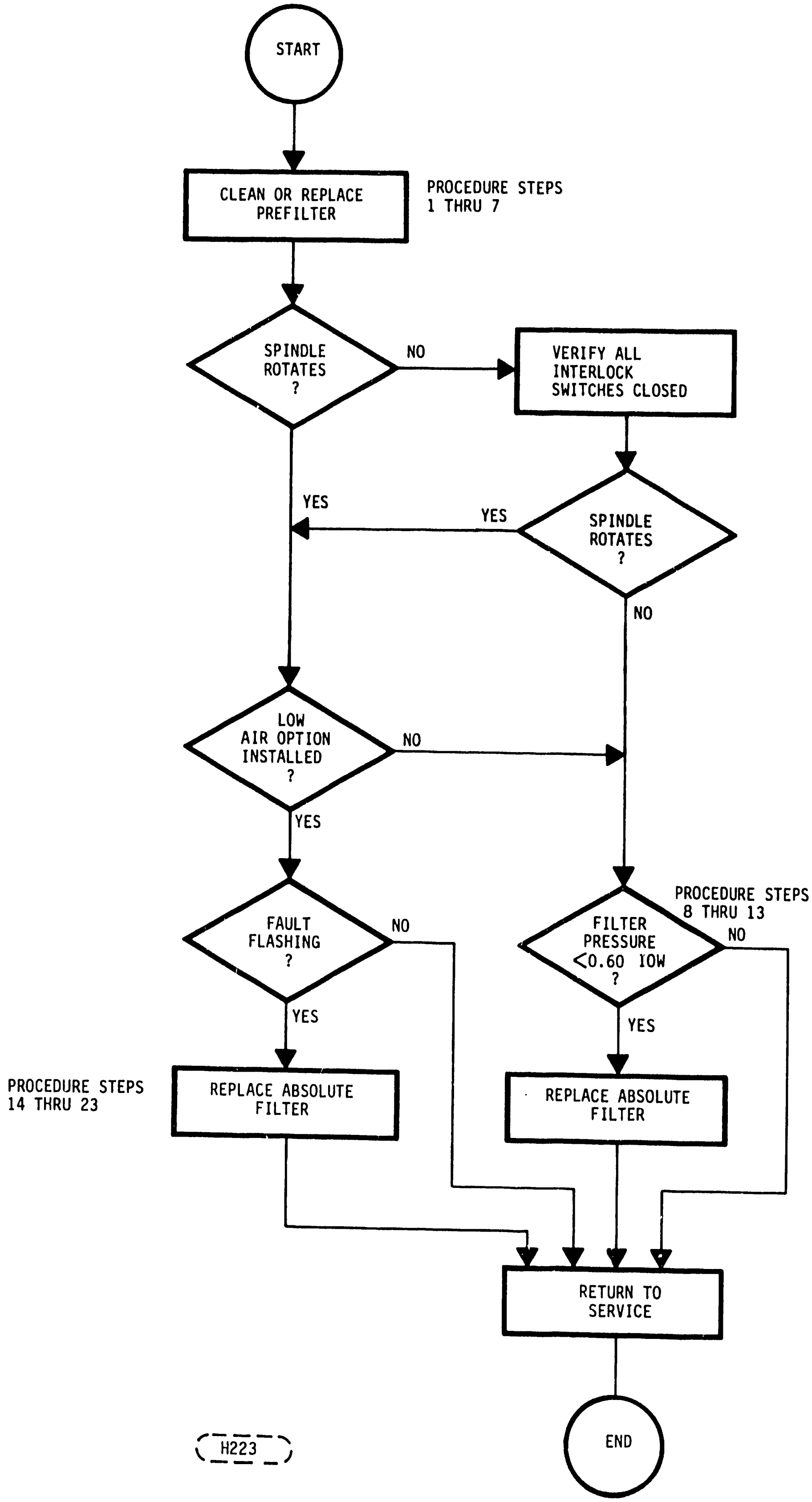


FIGURE 6-1. FILTER MAINTENANCE FLOW CHART

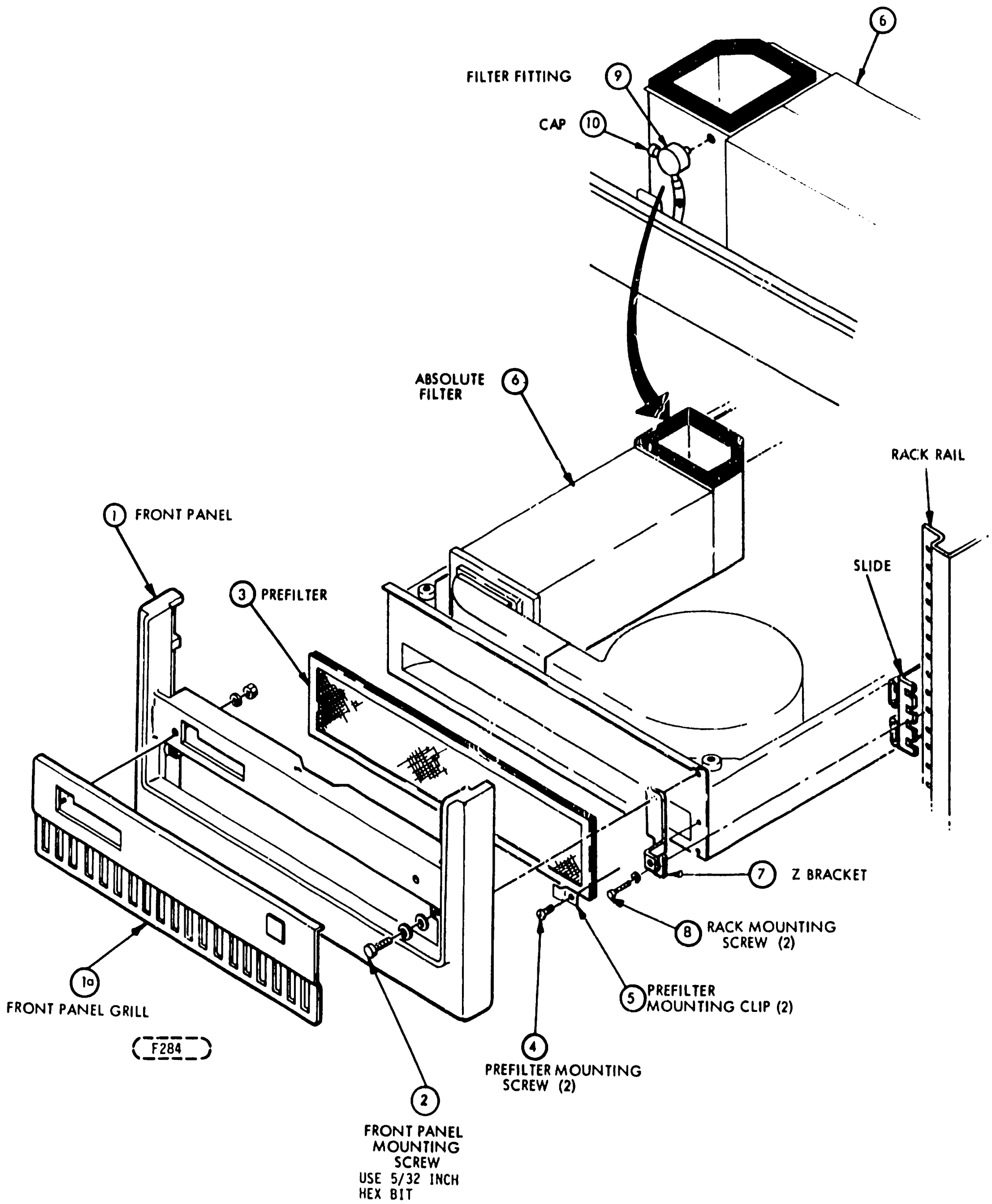


FIGURE 6-1.1. FILTER REMOVAL AND REPLACEMENT

PREFILTER CLEANING AND REPLACEMENT

1. Operate the START/STOP switch to the STOP position and wait for the spindle to stop rotating.
2. Turn off power at AC circuit breaker (CB-1).
3. Remove the front panel [1] mounting screws [2] which are accessed through the front panel air inlet slot at each side, and at the back of the inlet hole.
4. Remove the front panel.
5. The prefilter [3] is secured at the right and left edges by a bracket [5] at each edge. Remove the screw [4] holding each bracket and remove the brackets. Remove the prefilter [3].

6. The prefilter can be cleaned or replaced. To clean the prefilter agitate it in a mild detergent solution. Blow in the reverse direction with a low pressure nozzle until dry.

NOTE

> After cleaning, filter may be coated with filter coat adhesive (R.P. Super Filter Coat or equivalent) if desired. However, it is not required. Recoating should not be done in the same area with the drive.

7. Reinstall the prefilter by reversing steps 1, 2 and 3.

ABSOLUTE FILTER PRESSURE MEASUREMENT

8. Prepare gage 77732543 for use according to procedure 6.8.8.
9. Remove top cover (paragraph 6.7.1).
10. Connect gage tube to filter fitting [9] located on the absolute filter outlet plenum. Two types of fittings are used as shown in Figure 6-1.2.

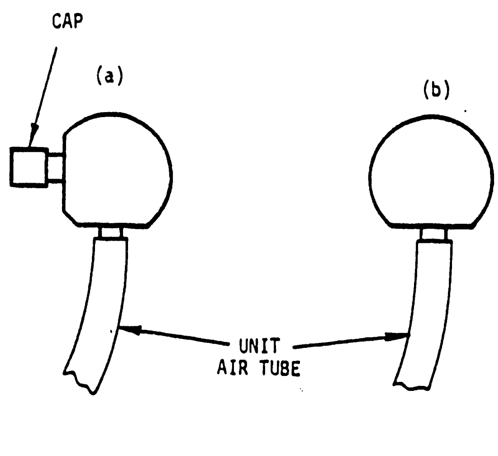


FIGURE 6-1.2. FILTER FITTING FOR PRESSURE SENSING TUBE

If type (a) fitting, remove tee assembly A from gage (Figure 6-28.2); if type (b) fitting leave tee assembly attached. Install gage tube on filter fitting. If type (a), remove cap; type (b) insert tee in line between unit air tube and filter fitting.

11. Turn on unit AC power, circuit breaker (CB-1).
12. Operate START/STOP switch to START position.
13. After heads are loaded at track zero, read the gage. If pressure is below 0.60 inches of water (IOW), replace the absolute filter as described below in steps 14 through 23.

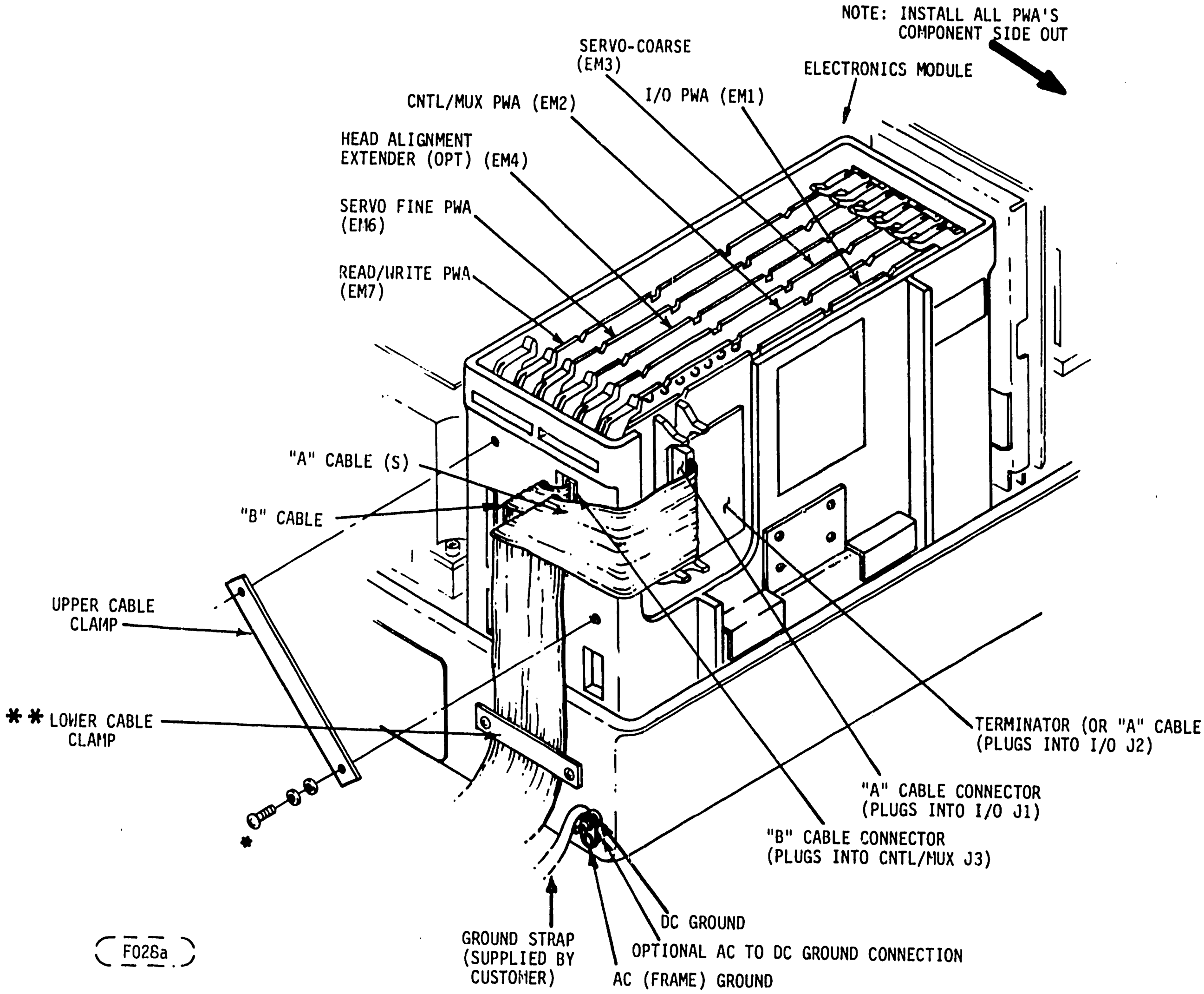
14. Operate START/STOP switch to STOP position.
15. Turn off power at AC circuit breaker (CB-1).
16. Wipe, with dry lint free cloth, receiver bearing tracks and entire outside diameters of the four bearing.
17. Raise deck to maintenance position per paragraph 6.7.1.
18. To remove the absolute filter [6] lift it at its rear end enough to allow it to be pulled toward the rear of the unit. This should free the front end from the outlet of the manifold. Lift the filter out of the unit. Disconnect manifold from blower. Inspect the Poly Film Tape securing the foam to the outlets of the blower and manifold. When loose tape is found, remove by trimming with a sharp knife. Reconnect manifold to blower. Replace the filter with movements the reverse of those required for removal.

NOTE

When the absolute filter is replaced through either normal preventive maintenance or the deck raised to the maintenance position, the filter must be purged prior to operation of the drive.

19. The static ground brush rides on the bottom of the spindle and discharges static electricity from the spindle assembly to DC ground. The brush will eventually wear down to the point of needing replacement. Periodic inspection is necessary to prevent excessive wear of the ground brush and subsequent damage to the spindle assembly. Refer to Figure 6-7.

    Inspect the ground spring for excessive wear. For replacement procedure refer to paragraph 6.7.5.
20. Remove power to the voice coil by disconnecting A1P1. Lower the deck, turn AC breaker (CB-1) "ON".
21. Operate the START/STOP switch to START position and allow the unit to purge for a minimum of thirty (30) minutes with the deck lowered, A1P1 disconnected and disks spinning.
22. Operate the START/STOP switch to STOP position. When the spindle has stopped, turn AC breaker "OFF" and reconnect A1P1.
23. Restore drive to normal operating condition.



* PROTRUSION BEYOND INNER WALL SURFACE NOT TO EXCEED 0.12 INCHES (3 mm). SELECT PROPER LENGTH SCREW FROM ACCESSORY CARTON.

** THE SHIELD GROUND ON SHIELDED CABLES MUST BE GROUNDED TO THE UNIT AND CONTROLLER.

FIGURE 6-1A. I/O CABLE INSTALLATION AND PWA NAMES/LOCATIONS

6.6.2 ACTUATOR ASSEMBLY INSPECTION AND CLEANING WITH FIXED DISK MODULE STILL IN THE DRIVE

1. Set AC POWER circuit breaker to OFF.
2. Remove top cover per paragraph 6.7.1.
3. Remove disk cartridge disk module.

4. WITHOUT LOADING THE HEADS inspect entire actuator for presence of dust and other foreign materials. Pay particular attention to the guide rod surfaces of the carriage and bearing assembly, but do not load heads. The heads may be moved up to 1/2 inch (12 mm) toward the spindle in order to inspect the guide road and bearings.
5. Use lint-free gauze dampened with media cleaning solution (not soaked) to remove deposits or attached particles.
6. Push the carriage back into the fully retracted position.
7. Restore drive to normal operating conditions.

6.6.3 INSPECT AND CLEAN CARRIAGE GUIDE ROD AND BEARINGS WITH BOTH DISK MODULES REMOVED FROM THE DRIVE

To ensure that the carriage moves freely along the guide rod, it is essential that the guide rod and bearing plate surfaces be kept clean. Any obstruction to free movement of the carriage may cause cylinder address errors. This procedure assumes that all heads have been removed from the carriage, thus allowing the carriage to be moved in and out between its mechanical end of travel limits. This procedure can also be performed at the time the carriage is replaced or removed.

1. Lift the electronics module and swing it out to the side.
2. Gently slide carriage and coil assembly back and forth along full length of rails. While moving coil be aware of any possible irregularity (bumps or jerks) in movement. A sudden irregularity indicates dirt on guide rod or bearings. Do not confuse pressure of flex leads with a sudden irregularity in motion. Pressure from leads is a smooth change.
3. If a sudden irregularity in motion was noted in previous step proceed to next step. If no sudden irregularity in motion was noted, cleaning is not required. Terminate procedure by returning carriage to the fully retracted position.
4. Use a lint free cloth, dampened with media solution to clean guide rod, side bearing plate and bearing surfaces. Move carriage back and forth carefully to insure all surfaces are reached. See Figure 6-3.

<u>CAUTION</u>

> Do not apply media cleaning solution or alcohol directly onto guide rod, side bearing plate, or bearing surfaces, as this could cash out the bearing self lubricant.

5. When guide rod, bearing plate and bearing cleaning is completed, repeat step 3 to ensure that the carriage moves freely without sudden irregularities in its motion. If carriage now moves smoothly throughout its travel, proceed to next step. If sudden irregularities persist, visually inspect guide rod and bearings using a strong light. Look for deterioration of guide rod or bearing surfaces. If no problem can be seen, remove the side bearing plates and inspect them for deterioration. Surface deterioration requires replacement of defective parts.

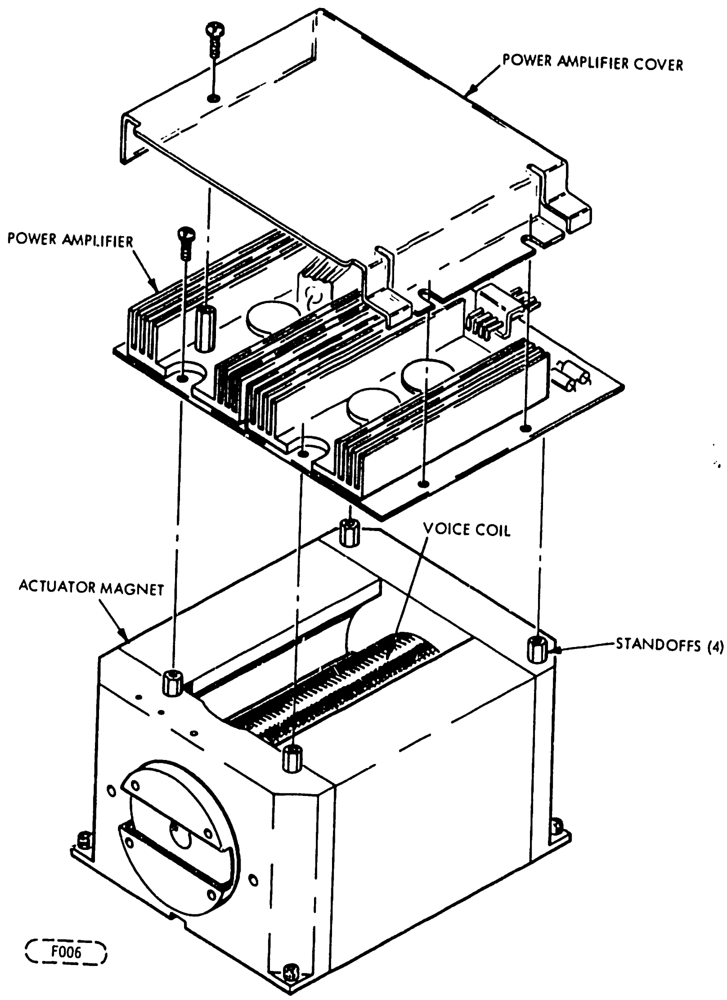


FIGURE 6-2. REMOVAL OF POWER AMPLIFIER FOR ACCESS TO VOICE COIL

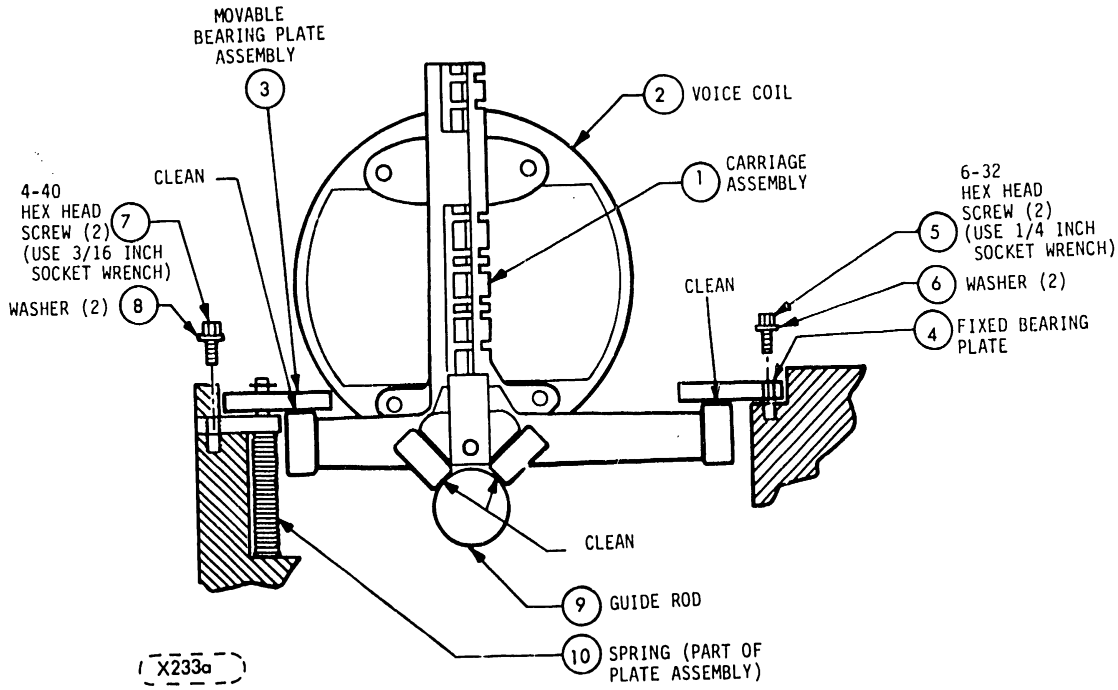


FIGURE 6-3. CARRIAGE RAILS AND BEARINGS

6. Return carriage to fully retracted position.
7. Install the head arms. See Section 6.7.9 and 6.7.10. Align the heads per Section 6.8.5.4.
8. Replace Electronics Module into unit. Lower deck to normal position if it was raised to aid in the cleaning and inspection procedure.
9. Install disk cartridge if applicable, see section 6.7.7.
10. Replace top cover.
11. Restore power to unit.

6.6.4 CHECK POWER SUPPLY OUTPUTS

Check Power Supply outputs using the following procedure:

1. Remove top cover per paragraph 6.7.1
2. Access voltage terminals on bottom of Electronics Module per paragraph 6.7.2.2.
3. Using the DC ground terminal at the rear of the base pan (see Figure 6-1a) as a reference point, check the DC voltages at points shown in Figure 6-6.

6.6.5 SPINDLE, INSPECTION AND CLEANING OF HUB

1. Operate START/STOP switch to out position to stop rotation of motor.
2. Remove cartridge (paragraph 2.8).
3. Set AC POWER Circuit breaker to OFF.

4. Remove top cover (paragraph 6.7.1).
5. Open cartridge access door.
6. In good available light or with the aid of a flashlight, look for loose debris on the spindle hub while rotating the spindle hub slowly by hand. Especially observe the cone, magnet, magnetic chuck and the interface between the magnetic chuck and the magnet (Figure 6-3.1).

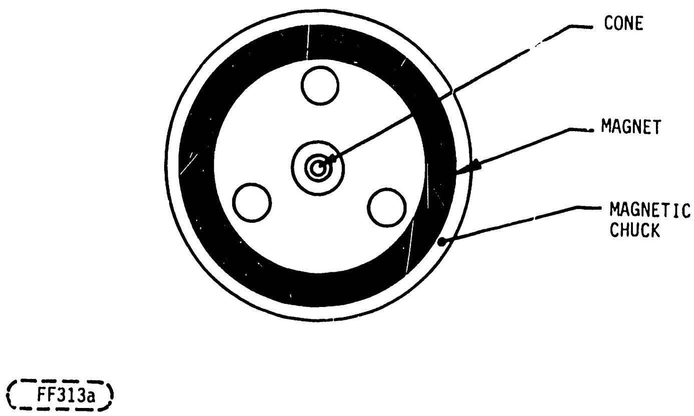


FIGURE 6-3.1. SPINDLE HUB

If the spindle is clean, restore the drive to normal operating condition. If the spindle requires cleaning, proceed to Step 7.

7. Remove the cartridge receiver assembly (paragraph 6.7.6).
8. Vacuum clean the spindle hub and cone. Use a clean cotton swab (Q-Tip) to break loose particles while vacuum cleaning.
9. Cut a lint free cloth (94211400) into four equal parts approximately three inches square. Fold twice and wipe the magnetic chuck and magnet. Refold the cloth as necessary to turn out a clean surface. Finally, wipe all surfaces with a clean dry lint free cloth.
10. Restore drive to normal operating condition.

6.7 CORRECTIVE MAINTENANCE

6.7.1 COVER REMOVAL AND REPLACEMENT

Perform the following procedure to remove and replace the cover on the unit.

1. Insure that power is removed from the unit.
2. Release the two fasteners at the rear of the unit which secure the top cover. Lift the cover up and to the rear to remove it from the unit. The front end of the cover is secured only by two short tabs which fit into two slots in the front panel.

CAUTION

> The CMD top cover is an integral part of the cooling system as well as a deterrent to contaminants entering the unit. Operating the drive with the top cover removed during troubleshooting or adjustments is expected. The storing or operation of the unit for extended lengths of time with the top cover removed may possible cause contamination or thermal related problems.

3. To replace the cover insert the two tabs at the front of the cover into the two slots in the front panel. Lower the cover into place and fasten the two fasteners at the rear of the unit to secure the cover.

6.7.2 RAISING AND LOWERING THE BASE DECK ASSEMBLY

Perform the following procedure to gain access to items under the base deck assembly (remove the top cover first per 6.7.1). Refer to Figure 6-4, 6-5 and 6-6.

1. Using a 3/16 inch hex driver remove the two screws [A] which secure the deck casting to the shock mounts at the front of the unit. Make sure rear shipping bolt and spacer have been installed so that the weight of the deck does not shear the rear shock mounts (see Figure 3-2).
2. Loosen or remove the lower I/O cable clamp by loosening or removing one or both of the screws securing it. If access is required to the lower part of the Electronics Module or head area, remove screw [A] and store it in the tapped hole on the inner wall of the Electronics Module brace. Lift the Electronics Module and swing it out to the side (Figure 6-5).
3. Remove the two screws [2] which secure the front panel and remove the front panel [1] . Refer to Figure 6-1.
4. Lift the deck assembly until the two support legs are straight, then lower the deck to the point where the two legs support the deck. Help should be obtained in straightening the two legs.
5. Insert dust cover into absolute filter. Refer to Figure 6-5.1.
6. To lower the base deck assembly again: Lift the deck until the support legs can be pushed toward the rear to unlatch them. Hold the deck with both hands and push both support arms to the rear with one of the fingers on each hand. Use both hands to lower the deck into place. The deck is capable of a small amount of sidewise movement so be careful not to allow the pack access door mounting bracket to strike the control panel PWA or the speed sensor disk to strike the blower. Also, be sure that the wiring bundle to the Electronics Module does not get pinched between the deck and the base pan. Be sure motor pulley is clear of cables.
7. Reinstall the two screws which secure the deck to the shock mounts.

8. If raised during step 2. Restore the Electronics Module to its normal position by swinging it up and lowering it into the base pan (Figure 6-5). Reinstall the screw [A] to secure the Electronics Module and secure the I/O cable clamp by tightening the two screws which secure it.
9. Purge system per page 6-6.2. Refer to NOTE and steps 20 and 21.
10. Replace the front panel and secure it with the two screws removed in Step 3.
11. Replace the top cover per 6.7.1.
12. Remove the rear shipping bolt and spacer which were installed in Step 1. Insert the bolt through the hole in the spacer and insert bolt into storage hole (Figure 3-2).

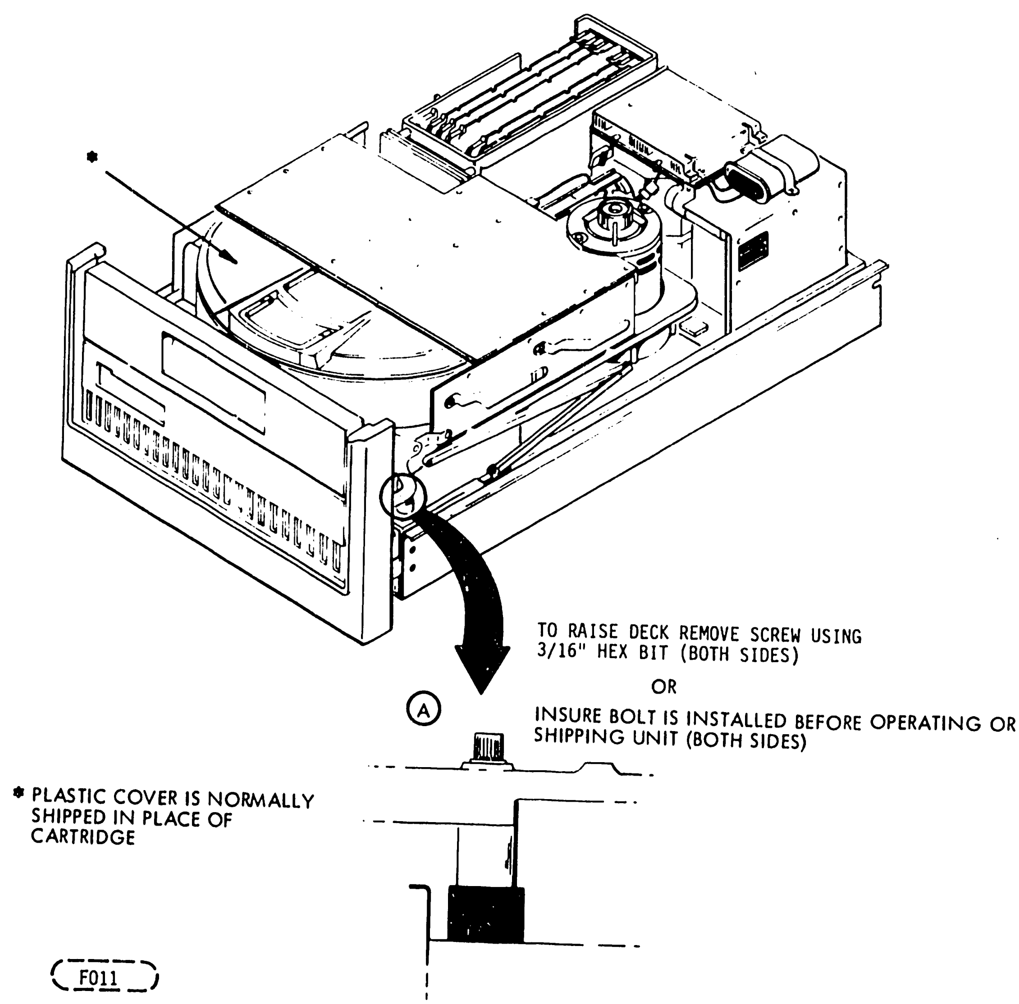


FIGURE 6-4. DECK HOLD DOWN BOLT LOCATION

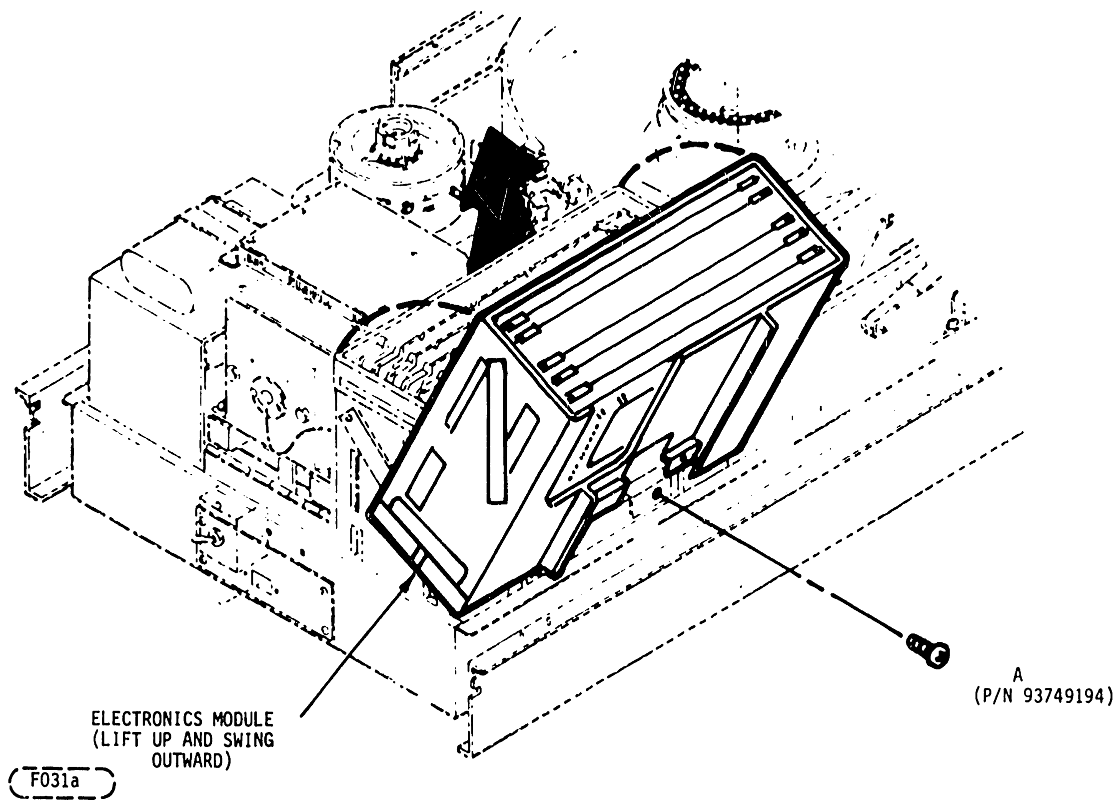


FIGURE 6-5. ACCESSING UNDERSIDE OF ELECTRONICS MODULE

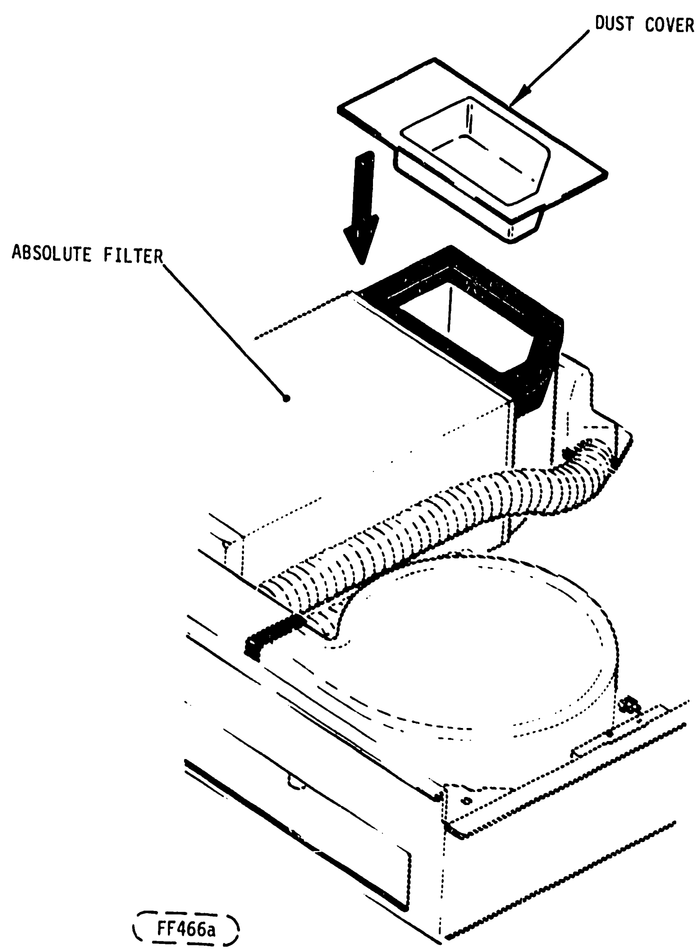
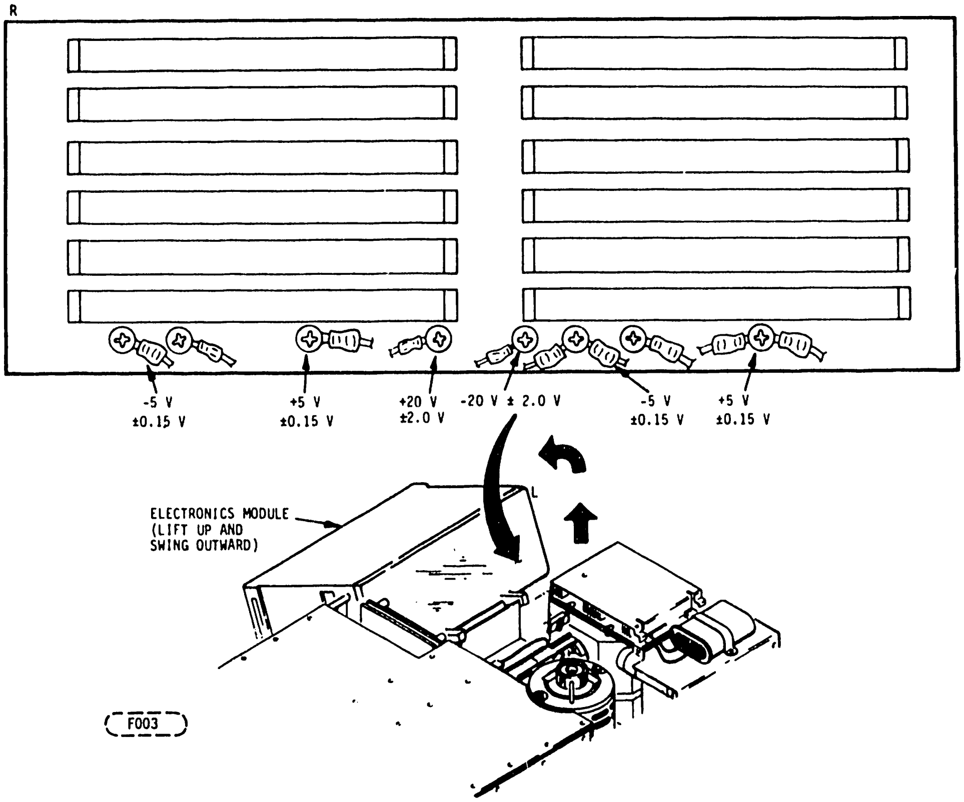
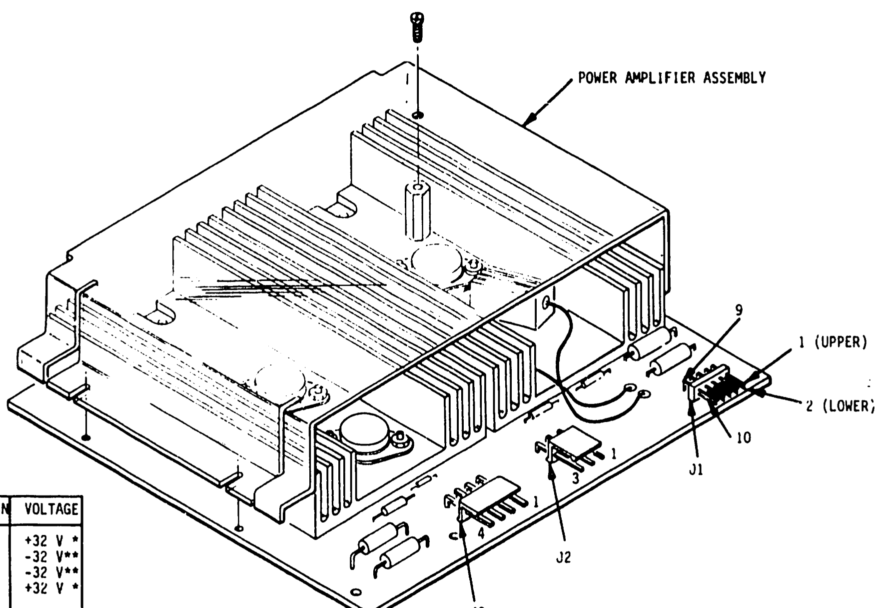


FIGURE 6-5.1. FILTER PROTECTION WITH DECK RAISED





CONN/PIN	VOLTAGE
J1-07	+32 V *
J1-08	-32 V**
J3-02	-32 V**
J3-03	+32 V *

* +28.8 V to +38 V
** -38 V to -28.8 V

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FIGURE 6-6. DC POWER MEASUREMENTS

6.7.3 SLIDE MOUNTED CMD, REMOVAL AND REPLACEMENT

Refer to Figure 6-1 for the following procedure.

1. Remove the front panel [1] mounting screws [2] which are accessed through the front panel air inlet slot at each side, and at the back of the inlet hole.
2. Remove the front panel.
3. Remove the rack mounting screw [6] from each side of the Z bracket [7] and pull the device out of the rack on its slides.

CAUTION

> Because this device may be mounted in various cabinet configurations, care shall be taken when extending the device from the rack to insure that the cabinet and device remain stable and the cabinet does not overturn.

4. Replace by following steps 1 - 3 in reverse order.

6.7.4 SPIN SPEED SENSOR REMOVAL AND REPLACEMENT

Perform the following procedure to remove and replace the spin speed sensor. Refer to Figure 6-7.

1. Press START switch to stop rotation of motor.
2. Set AC circuit breaker to OFF.
3. Remove top cover. Refer to paragraph 6.7.1.
4. Raise base deck to maintenance position. Refer to paragraph 6.7.2.
5. Using a 9/64 inch hex screwdriver remove the screw [2] which secures the spin speed sensor assembly to the spindle housing [9].
6. Disconnect the spin speed sensor cable connector [5] (EMP 10) from the Servo-Coarse PWA connector EM3-P1 [8] at the Mother Board. Numerous cable ties will have to be removed to free the spin speed sensor cable.
7. Remove the spin speed sensor [3] from the spin speed sensor mounting bracket [1] by removing a small flat head screw [4].
8. Install the new spin speed sensor on the mounting bracket [1]. Make sure the alignment pin [6] on the sensor is inserted in the bracket alignment hole [7]. Secure with the flat head screw [4] removed in step 7.
9. Connect the connector on the spin speed sensor cable ([5], EMP 10) to wire wrap pins A24 through A28 of EM3-P1 on the Mother Board (three other cables are connected to EM3-P1). Be sure to orient the connector [5] so that the unused pin in the connector connects to pin A25 of EM3-P1. Replace cable ties tying cable into cabling system.
10. Replace spin speed sensor assembly on bracket [1].
11. Replace bracket [1] on spindle housing [9].

NOTE

There is no tolerance adjustment necessary as the mounting holes of the sensor and the bracket provide sufficient alignment accuracy for proper operation of the sensor.

12. Replace static ground brush [10] with a new one (optional, but desirable if a new one is available). See Paragraph 6.7.5 for Removal and Replacement procedure.
13. Lower base deck, swing Electronics Module back into position and replace top cover.
14. Restore power to unit.

6.7.5 REMOVAL AND REPLACEMENT OF STATIC GROUND BRUSH

The static ground brush rides on the bottom of the spindle and removes static electricity from the spindle assembly. The brush will eventually wear excessively but this can be avoided if the brush is inspected for wear anytime the underside of the base deck is being accessed for some other maintenance work. Replace the brush whenever it starts showing signs of wear. The removal and replacement procedure is as follows:

1. Press the START switch to stop rotation of the motor.
2. Set AC circuit breaker to OFF.
3. Remove top cover. Refer to paragraph 6.7.1.
4. Raise the deck to maintenance position. Refer to paragraph 6.7.2.
5. Refer to Figure 6-7. Remove the two screws [11] and ground terminal [12] which retain the static ground brush [10].
6. Remove and replace the static ground brush. Align center of brush contact with center of spindle within tolerance shown in Figure 6-7. (Note View A.)
7. Replace and tighten the two screws [1] which retain the brush to the spin speed sensor bracket [1].
8. Perform steps 1-4 in reverse order.

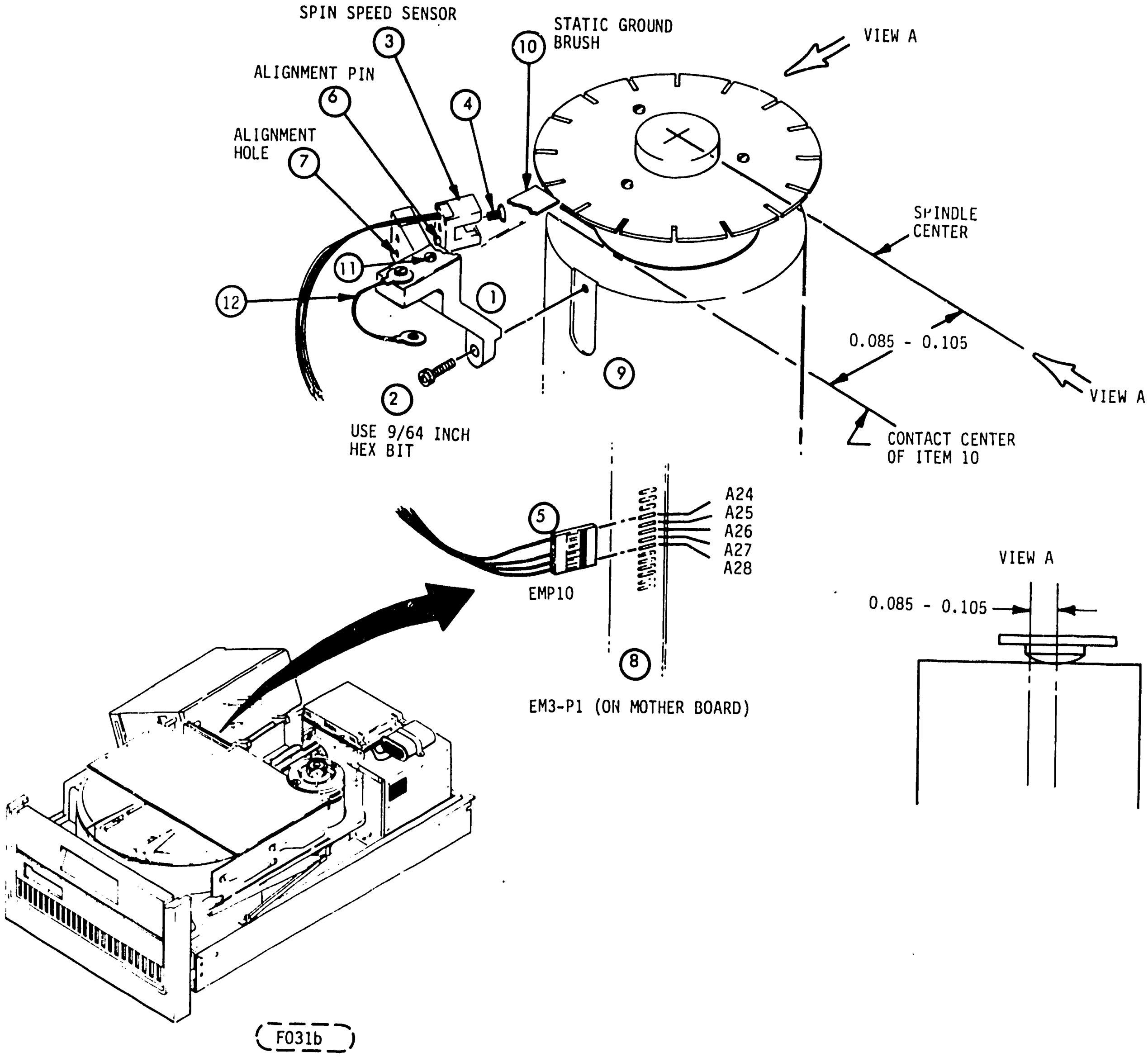


FIGURE 6-7. REMOVAL AND REPLACEMENT OF SPIN SPEED SENSOR ASSEMBLY

6.7.6 REMOVAL AND REPLACEMENT OF CARTRIDGE RECEIVER ASSEMBLY

Refer to Figure 6-8 which illustrates the parts called out in the following description.

6.7.6.1 REMOVAL OF CARTRIDGE RECEIVER ASSEMBLY

1. Remove cartridge from the unit per Section 2.7.
2. Remove unit cover per Section 6.7.1.

3. To detach the front access door from the receiver assembly remove retaining clip [D] using a small screw driver or long nose plier (both sides), and remove the pin [F] and bushing [E] from both sides. Store the three parts [D], [E], and [F] in a safe place to avoid losing.
4. Remove retaining clip [I], slide bearing [J] off threaded stud [K].
5. Remove stud [K]. Use 5/16 inch wrench.
6. Lift disengaged side of cartridge receiver assembly [B] shifting it to the opposite side until bearings clear receiver cam tracks, lift the receiver assembly from the unit.

6.7.6.2 REMOVAL OF CAM LEVER ASSEMBLY

1. Remove cartridge receiver assembly per Section 6.7.6.1.
2. Disconnect the spring [R] from the cam lever [Q].
3. Loosen set screw [P]. Use 5/64 inch hex bit.
4. Remove cam lever [Q] from a shaft assembly [T].
5. Disconnect S2 leads, thread leads through hole in cam lever plate [W].
6. Remove screw [Z]. Remove cam lever plate [W] and nylon washer [S] from shaft assembly [T].
7. Remove shaft assembly [T] by sliding it out of the base deck wall and the shaft support bearing [U].

6.7.6.3 REPLACEMENT OF CARTRIDGE RECEIVER ASSEMBLY

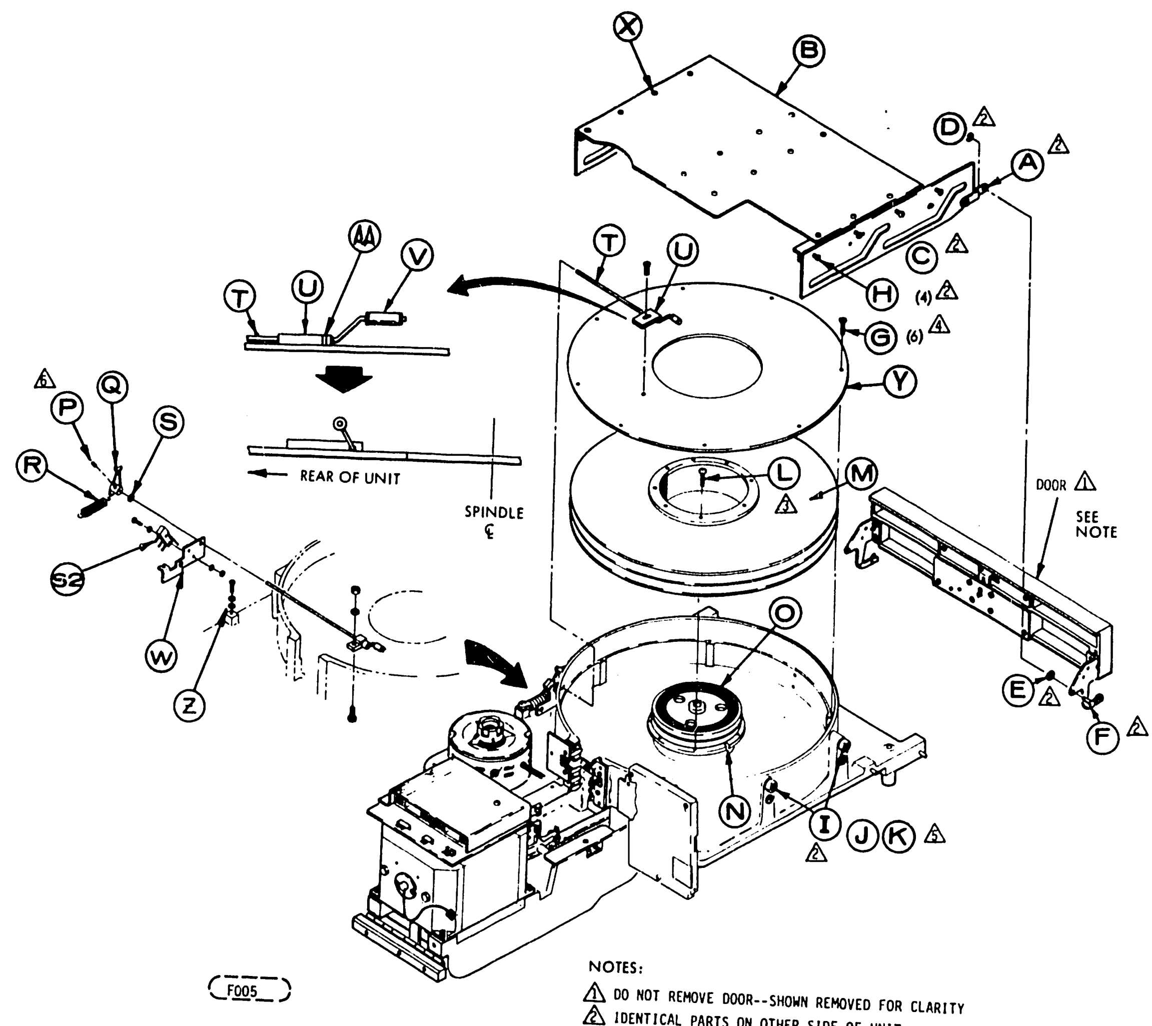
1. Carefully slide the shaft assembly [T] into the shaft support bearing [U] and through the hole in the side of the base deck wall.
2. Slide cam lever plate [W] onto shaft [T]. Install under screw [Z] and tighten screw.
3. Thread S2 leads from the inside, through hole in cam lever plate [W] and reconnect to S2.
4. Slide the nylon washer [S] onto the shaft.
5. Slide cam lever [Q] onto shaft assembly [T] with set screw [P] positioned over flat of shaft bearing [AA]. Tighten screw to 12 $\pm$1 lbf-in (1.32 $\pm$0.1 Nm) torque.

NOTE

> The stop on the shaft assembly [T] must be against the bearing support [U] and the cam lever [Q] must be against the nylon washer [S], corresponding surfaces between [S] and [W] to be separated 0.001 inches (0.025 mm) to 0.010 inches (0.25 mm).

6. Re-attach the spring [R] to the cam lever [Q].
7. Remove dried thread sealant from threaded studs [K] and corresponding tapped holes in base plate.
8. Reinstall cartridge receiver assembly [B] by positioning the right side bearings [I] in their respective cam slots.

9. Apply thread sealant to threads of stud [K].
10. Align tapped holes of base plate, left side, with corresponding cam slots of receiver assembly [B] and install the threaded studs [K] through the left side of receiver assembly [B]. Tighten studs.
11. Install bearing [J] and retaining clip [I] on threaded studs [K].
12. On each side re-attach the front access door to the linkage to the cam plate using pin [F], nylon bushing [E] and the clip [D].



NOTES:
1. DO NOT REMOVE DOOR--SHOWN REMOVED FOR CLARITY
2. IDENTICAL PARTS ON OTHER SIDE OF UNIT
3. USE 7/64 INCH HEX X 1.938 LONG BIT
4. USE 3/32 I'CH HEX BIT
5. USE 5/16 INCH WRENCH
6. USE 5/64 INCH HEX BIT

FIGURE 6-8. REMOVAL OF RECEIVER PLATE ASSEMBLY AND FIXED DISK PACK

13. Close the cartridge access door and watch the pin on cam lever [Q]. Make sure that the pin on the cam lever goes into the groove in a nylon cam block mounted on the inside of the right (as viewed from the front of the unit) cam plate. Make sure that as the access door is opened roller [V] lifts off the surface of the separator plate [Y] and ends up 0.540 $\pm$0.005 inches (1.37 $\pm$0.01 mm) off the surface of the separator plate, as shown in Figure 6-8.
14. Replace the top cover per Section 6.7.1.
15. Replace the cartridge in the unit.

6.7.7 FIXED MODULE REMOVAL, REPLACEMENT AND INSPECTION

This procedure describes removal and replacement of a fixed module.

- Use steps 1 through 27 to install a new module.
- Use steps 28 through 38 to remove the module for media inspection and to reinstall the same module in the same unit.

The fixed module is replaceable in the field only by trained personnel and in an environment as clean as possible. Minimum conditions shall be a clean office type area where no smoking is allowed during this maintenance operation.

When installing a new fixed module the alignment tool* that comes with the new module should be returned for reuse. The procedure below must be followed meticulously. Refer to Figures 6-8 and 6-9 for location of referenced parts. In this procedure the fixed module, alignment tool and fixed module/alignment tool are called the module, tool and module/tool respectively.

INSTALLATION OF A NEW MODULE

1. Place the unit in a clean environment as described previously.
2. Remove the cartridge receiver per Section 6.7.6.
3. Remove the 6 screws [G] which retain the separator plate [Y].
4. Remove the separator plate [Y].
5. Remove the 8 screws [L] which fasten the fixed module [M] to the spindle [O].
6. Lift the module up and out and place it on a clean, flat surface for later attachment of the tool. Temporary installation of two #6-32 screws in opposite tool screw holes [E] provides lifting points to facilitate handling during module removal.
7. Clean and inspect the spindle and module area as detailed in Section 6.7.8. If there has been mechanical damage to the removed module or if the cartridge guide rod and bearings are dirty, clean and inspect per Section 6.6.3.

*Called "Spare Module XXM" in parts catalog in Section 7. Figure 6-9 shows top view of pack and alignment tool.

WARNING

The gloves and mask provided with the spare module MUST be worn when performing steps 8 thru 20.

8. Remove the module/tool from its shipping container.

CAUTION

Extreme care must be taken in handling of the module to insure that it is not damaged or contaminated by body contact or dirty environment. If module is dropped it must not be used.

9. Refer to Figure 6-9. Four plastic shipping screws [A] or two captive screws [B] are used to hold the module/tool in the shipping container. As applicable, remove screws [A] or loosen screws [B] to remove the module/tool.
10. Carefully inspect the bottom of the disk module for contamination of the mounting surface. In particular, inspect the ball on the bottom of fixed pack, the countersunk hole at top of spindle shaft and the spindle hole where fixed pack is mounted. Wipe clean with a lint free clean cloth.
11. Note the orientation of the plastic pins [C] on the bottom of the fixed module. Place the fixed module/alignment tool assembly onto the spindle insuring that the plastic pins fit into the slots ([N] in Figure 6-8) on the unit spindle hub. This alignment insures that the holes in the spindle and captivated screws in the tool at [B] (Figure 6-9) are also aligned. The fixed module hub shall fit firmly against the spindle hub.
12. Start the two screws [B] by hand making certain that they engage correctly with the threads of the corresponding hole in the spindle. Advance the two screws alternately to insure that the plate [D] is kept level relative to the tool. Tighten the screws and torque them to 4 lbf-inch (0.45 Nm). Rotate the tool and module and inspect for any large observable radial or axial runout on the module. Close visual inspection of the fixed disks may show a radial runout of 0.01 inches* or less which is within normal limits. Axial runout which is the vertical disk displacement or wobble may also be observable but this should be less than 0.005 inches*. The top disk which is a protective disk should be ignored in this visual inspection.

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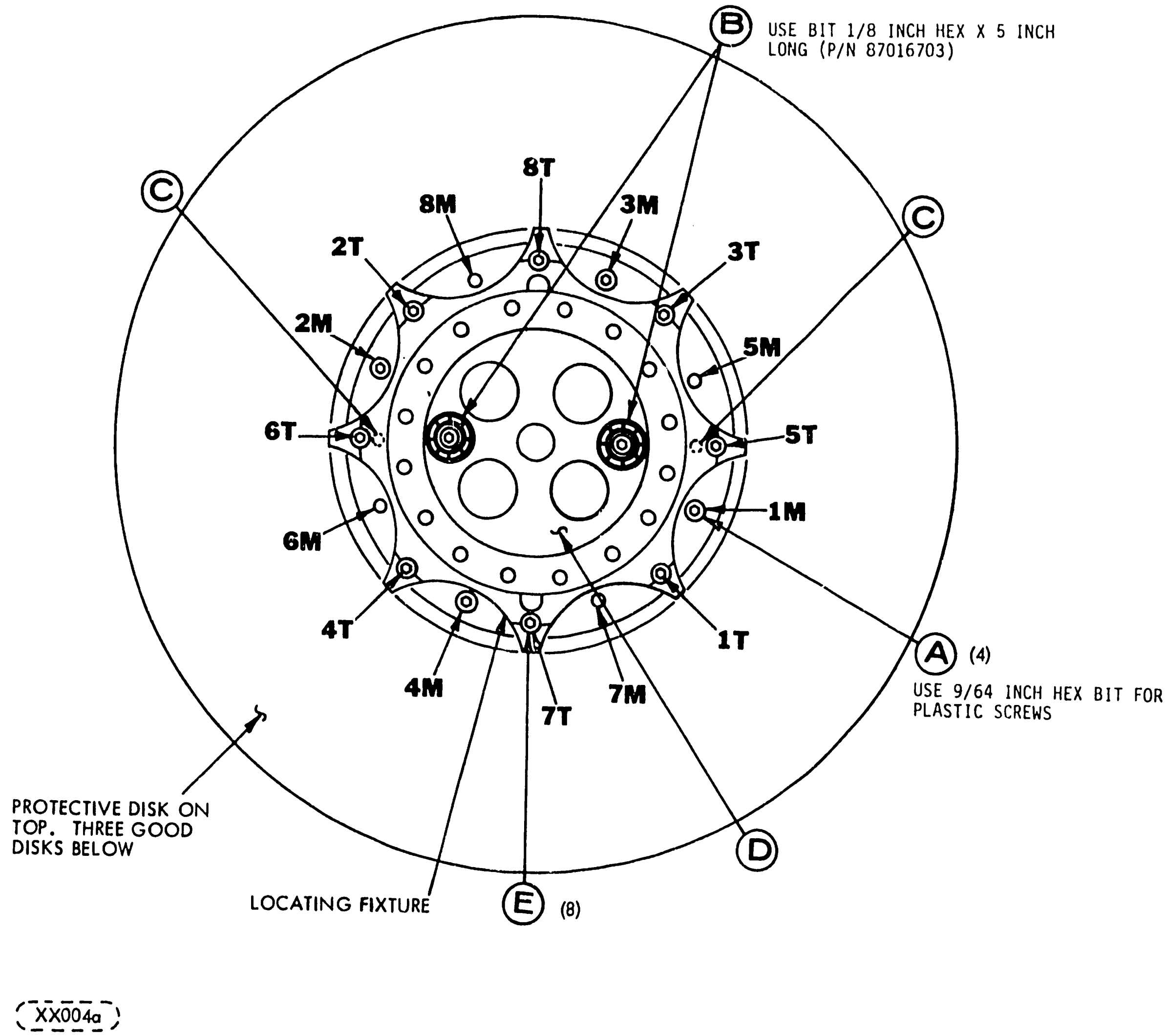
*These values cannot be actually measured but are given as a guide to show the order of magnitude of the acceptable runout. Except in very rare instances, unacceptable runout will be so great that it will be easy to discern when compared with the 0.01 and 0.005 values given here.

13. If any excessive runout is observed loosen the two screws [B] and re-seat the module/tool assembly on the spindle. When the ball on the bottom of the tool properly seats in the counter-sunk hole in the top of the spindle shaft the radial and axial runout shall be within the limits defined in item 12 above.



NOTE: NUMBERS WITH M AND T SUFFIXES INDICATE TORQUE SEQUENCES FOR MODULE AND TOOL SCREWS.

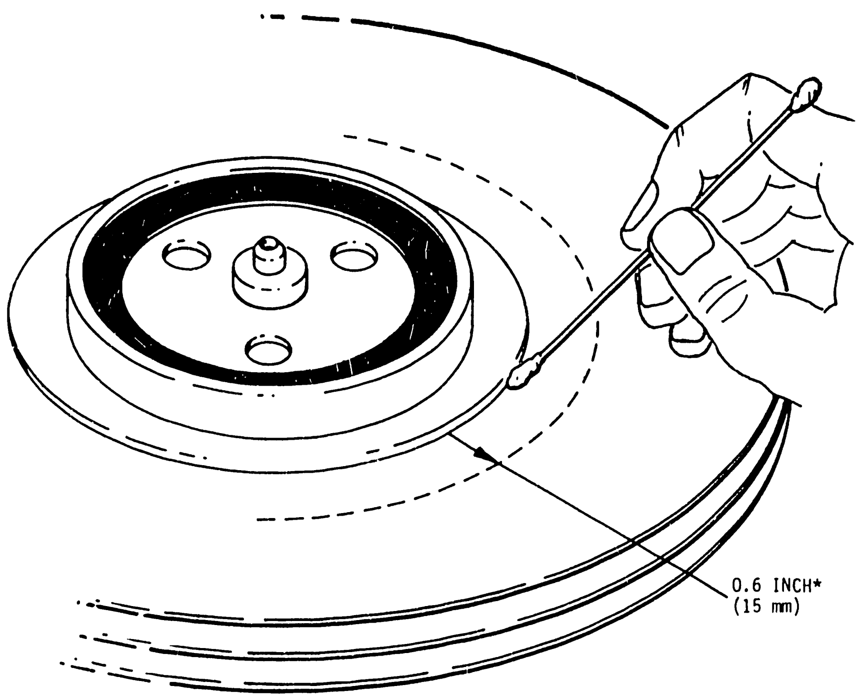
FIGURE 6-9. FIXED DISK PACK LOCATING FIXTURE AND PROTECTIVE DISK

14. Install the 8 screws [L] (Figure 6-8) which were removed in step 5. Install these in the holes marked 1M through 8M in Figure 6-9. Tighten these 8 screws in numerical order as shown in Figure 6-9, and in the torque steps specified. Torque the 8 screws in numerical order using 4 lbf-inch (0.45 Nm). Repeat the sequence using 8 lbf-inch (0.9 Nm) and then again using 12 lbf-inch (1.35 Nm).
15. The module is now located to the unit spindle. Rotate the module to insure that there is no large observable radial or axial runout on the module. If there is, remove the 8 screws and the two captive screws and start over from step 10.
16. When the module is located on the spindle, the tool must be removed from the module and spindle.
17. Remove the 8 screws [E] which fasten the tool to the module (Figure 6-9).
18. Disengage the two captive screws [B] (Figure 6-9).
19. The tool is now free and can be lifted up and out of the unit. The protective disk comes off with the tool. The top disk which is now exposed is a good disk and care should be exercised to not drop anything on this top disk. Do not get any moisture on or touch any of the disks in the module.
20. Replace the separator plate [Y] (Figure 6-8) back into the unit as soon as possible. Replace and torque the 6 screws [G] that secure the separator plate to 8 ±1 lbf-inch (0.9 ±0.1 Nm).
21. Carefully vacuum tool holes at [B]. Rotate module mounting flange while vacuuming through one of the three holes in flange face to remove any loose debris.
22. Install the tool on the removed module using the 8 screws at [E] (Figure 6-9).
23. Place the module/tool into the container and secure using the 4 screws at [A] (Figure 6-9), or two screws [B] as applicable.
24. If the module is not to be returned with the tool, fasten the tool to the shipping container at two "[E]" hole locations using two screws supplied in the container, or two screws [B] as applicable.
25. Replace the cover on the container and place back into the shipping box.
26. Replace the receiver plate assembly ([B] Figure 6-8) per Section 6.7.6.3. However, do not replace the top cover as called out in that section.
27. Check fixed module runout per Section 6.7.7.2.

INSPECTION OF MODULE MEDIA

28. Perform steps 1 through 4 above.
29. If a film of contamination is present on the module, it must be replaced and no further inspection is required.

    To detect contamination dampen a clean, white cotton swab (Q-Tip) with clean media cleaning solution. Carefully hold the swab against the module as shown in Figure 6-9.1. Rotate the spindle one turn by hand. Be very careful not to touch or otherwise contaminate the media except where indicated in Figure 6-9.1. If contamination is present, the cotton swab will pick up a color and the module must be replaced (steps 5 through 27). If no contamination is present continue visual inspection below.
30. Prepare Fixed Module Inspector for use (see paragraph 6.8.9).
31. Carefully place the alignment tool (P/N 76204640) on the spindle (over the existing module). Note the position of the plastic pins [C] on the tool. These pins must fit into the large diameter holes in the module hub.
32. Torque two screws [B] alternately and evenly to 4 lbf-inch (0.45 Nm).



*WIPE DISK ONLY WITHIN THE 0.6 INCH (15 mm) WIDE AREA NEXT TO SPINDLE EDGE AS SHOWN

FIGURE 6-9.1. CHECKING FOR DISK CONTAMINATION

33. Install eight screws [E] (supplied with tool). Tighten the screws using the sequence shown in Figure 6-9. Torque all screws to 4 lbf-inch (0.45 Nm), then to 8 lbf-inch (0.9 Nm) and finally to 12 lbf-inch (1.35 Nm).

NOTE

Check the orientation of the module/tool relative to the spindle so that it can be reinstalled in the same position after inspection.

34. Remove and save eight screws [A] that attach the module to the spindle. Use the sequence shown in Figure 6-9 to loosen the screws.
35. Loosen two screws [B].
36. Carefully lift the module/tool from the spindle and install on the inspector spindle. Check that both plastic alignment pins [C] are aligned with open slots of the inspector spindle. Torque two screws [B] alternately to 4 lbf-inch (0.45 Nm).
37. The module is now ready for media inspector. Refer to Figure 4-31 to determine which disk surfaces require inspection: 96 MB, all surfaces; 64 MB, surfaces 1, 2, 3 and servo; 32 MB, surfaces 1 and servo.

NOTE

The media consists of an aluminum disk substrate on which a thin, smooth magnetic film is applied. In normal operation the head flys in a stable manner in close proximity to the magnetic film. A defect or contaminant on the media that changes the texture of the surface presented to the flying head causes head instability (flutter) that may result in media contact. The purpose of this visual inspection is to reject media that may result in head flying instability or functional problems in data recovery or servo tracking.

MEDIA REJECTION GUIDELINES. (Refer to Figure 6-9.2)

- Concentric rings at any head flying location. These may be darker or lighter than the background.
- Light or dark colored track(s), spiraling toward the center of the disk in the head flying area.
- Scratch at any location in the head flying area. Scratch may be in any direction random, radial, spiral, circumferential, etc.
- High spot at any location.
- Contamination spot or streak at any location. If contaminant cannot be removed with jet of dry air or nitrogen, module must be replaced.
- Missing magnetic film at any head flying location. Aluminum substrate will be visible.

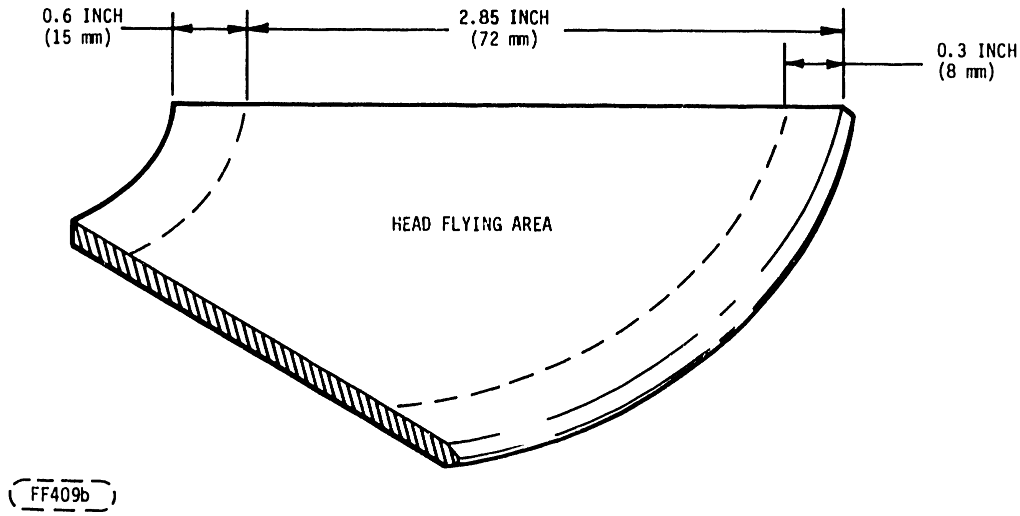


FIGURE 6-9.2. SECTION OF DISK SHOWING HEAD FLYING AREA

38. If module is acceptable, remove it from the inspector and proceed to step 39.

    If module is unacceptable install a new module using procedure above steps 8 through 27.

39. Perform steps 10 through 21 and steps 26 and 27. When reinstalling the module check that orientation is the same as during removal (step 33).

6.7.7.1 HEAD TO MEDIA INTERFACE ESTABLISHMENT

CAUTION

With the exception of Head Load and RTZ, do not perform any kind of seek before completing this procedure.

- Connect TB216 FTU to disk drive*.
- Set AC breaker ON. Press START and wait for drive to come ready.

*Note: If no TB216 FTU is available, use systems diagnostic program to simulate this operation. The stop time on Cyl between the single track forward and reverse seeks should be at least 10 revolutions or about 170 ms.

- Select drive from FTU and set FTU switches as follows:

ACC SEL SW:	SEQ FWD/REV
RD/WR SEL SW:	ACCESS ONLY
DATA ENTRY SW:	STATUS BYTE (PRESS 1 for CYL DISPLAY)
SINGL/CONT SW:	SINGLE
EOT SW:	ON

- Manually Operate Go-Switch time after time in order to move carriage forward (Ø->822) and reverse (822->Ø) in single track seeks for one complete pass. Observe drive carriage and TB216 CYL Display to ensure proper operation.
- Proceed with Head Alignment per Section 6.8.5.4 and fixed media certification per Section 6.8.2.

6.7.7.2 FIXED MODULE RUNOUT CHECK

CAUTION

Do not perform any seeks, except head load, during this procedure. Before performing any seeks, perform paragraph 6.7.7.1 - 'Head to Media Interface Establishment'

- Disable servo per Section 6.8.5.3.
- Install head alignment extender card into E-Module slot EM4.*
- Connect unit to ext. power source and set AC breaker to ON.
- Power up drive by pressing START.

NOTE

As servo is disabled, unit will not load heads. Let unit purge with spindle rotating at normal operating speed for 30 minutes.

- Power down unit by pressing STOP.
- After motor has stopped spinning, turn AC breaker OFF, and re-enable servo.
- Set EM4 card switch to position "FXD". (This will select the FXD SRVO HD for tracking.)
- Using a suitable jumper, ground TP9 on EM3 card. This will disable the runout filter amp.
- Connect CH1 of oscilloscope to TP10 on EM3 card. (Fine Pos signal).
- Set AC breaker to ON position and power up drive by pressing START.
- After unit is ready, observe fine pos signal waveform. Peak to peak voltage should be 2 V or less ref to Figure 6-9.3.
- If the above limit is exceeded, the fixed module should be replaced.

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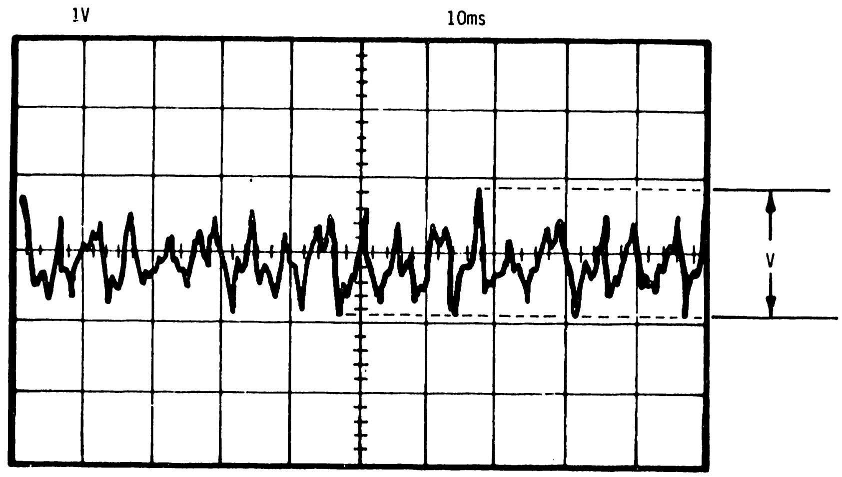
*Note: If unit has the VOL INV Option switch on EM2, activate it. EM4 card is not needed then.

- Power down unit and turn AC breaker OFF.
- Remove TP9-Gnd Jumper. TP10-Probe. EM4-Card and/or set EM2-SW back to standard volume, if applicable.
- Proceed with paragraph 6.7.7.1-Head to Media Interface.



OSCILLOSCOPE SETTINGS:

VOLT/DIV: 1 VOLT
TIME/DIV: 10 ms
TRIGGERING: INTERNAL POSITIVE
PROBE CONNECTIONS: TP10 ON SERVO-COARSE PWA

ZZ069a

FIGURE 6-9.3. VOLTAGE INDICATING AMOUNT OF FIXED DISK MODULE RUNOUT

6.7.8 PROCEDURE FOR CLEANING FIXED DISK MODULE AREA

In order to prevent head to disk contact, it is imperative that the disk module be cleaned. The following procedure assumes that the fixed disk module has been removed from the device.

1. Carefully vacuum entire fixed disk module shroud area and parts removed from the module area. This does not include the fixed module itself.
2. Using a wad of adhesive type tape, remove any particles not removed during vacuuming. This can also be used to remove particles which have attached themselves to the spindle magnet.
3. Using a clean piece of lint free cloth dampened in media cleaning solution, carefully clean the receiver plate (Item [Y] Figure 6-8) and wipe all surfaces of the shroud clean of dirt and smudges.

CAUTION

Do not wipe the spindle magnet with the alcohol dampened cloth.

6.7.9 READ/WRITE HEAD REMOVAL AND REPLACEMENT

Head/Arm replacement criteria are given in paragraph 6.7.11.

Perform the following procedure to remove and replace the heads. Refer to Figure 6-10.

1. Press START switch to stop drive motor.
2. Set AC circuit breaker to OFF. Remove power cord from power source.
3. Remove the disk pack. Refer to paragraph 2.8.
4. Remove the cover from the unit. Refer to paragraph 6.7.1.
5. Remove the head connector retainer [D] in Figure 6-11.
6. Unplug the head cable [2] of the head to be removed.
7. Remove the screw [3] (Figure 6-10) which secures the head to be removed using a 3/32 inch hex head-alignment bit (87016704) in the torque driver. Hold the head arm with one hand while removing the screw because the arm easily slips out of its mounting grooves and it could fail and damage the head. Do not drop the screw or flat washer as it may be drawn into the magnet assembly area.
8. While holding the head with the head cam arm [9] supported by the cam tower [10], very carefully move it slightly clockwise and forward into the disk area until the head/arm is clear of the carriage [1] and the cable [2] clears the carriage. Move the head/arm [4] to the spindle motor side of the carriage and then to the rear, up and out of the unit.

CAUTION

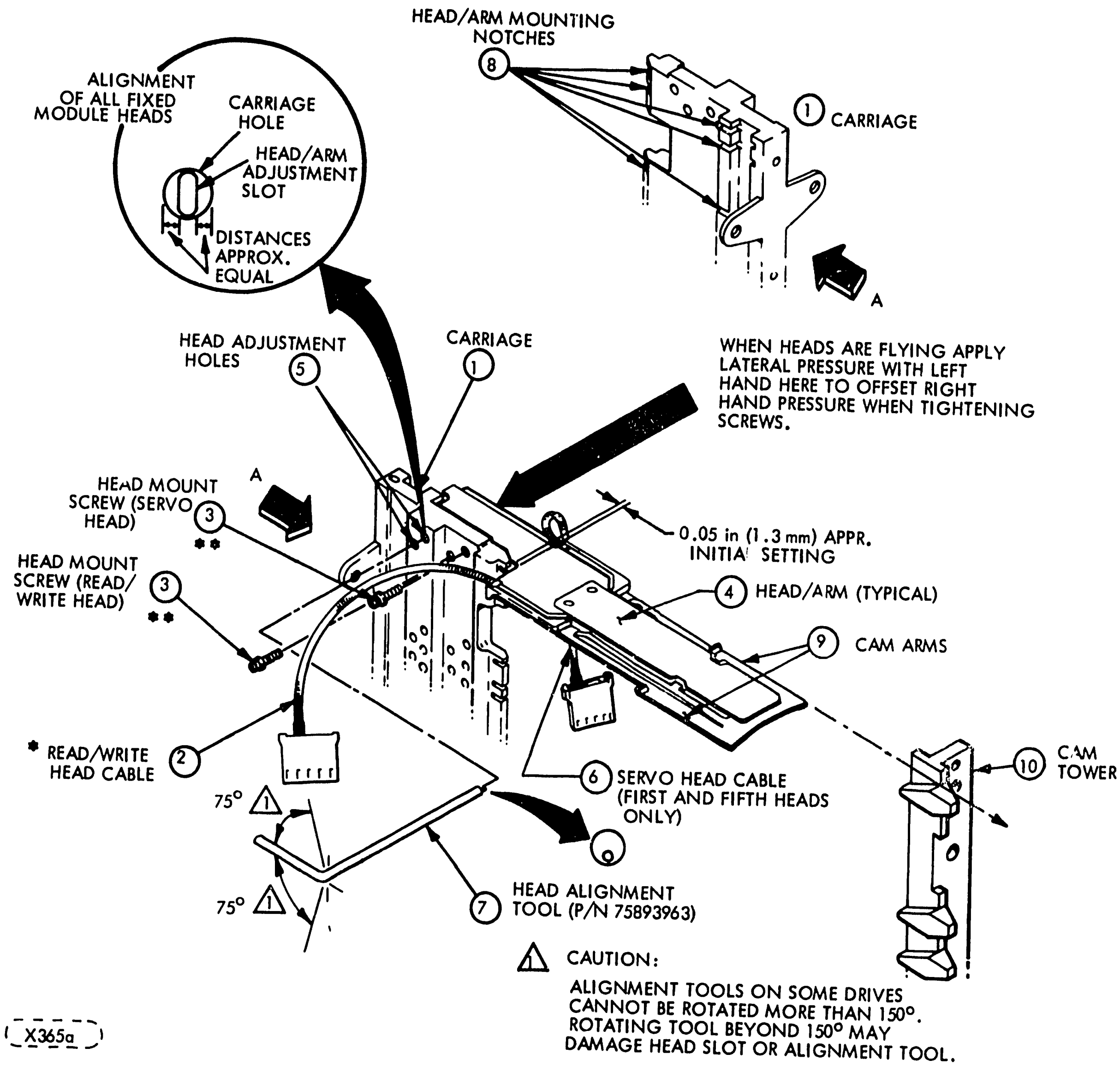
> Do not allow heads to load against themselves. Gimbal springs are extremely delicate and easily damaged. Nothing should contact any head. If head pad is touched, perform head cleaning procedure per paragraph 6.7.11 (finger prints can cause head-to-disk contact).

9. Install replacement head/arm as follows:
    a. From the spindle motor side, slide the head connector and cable [2] through the vacant head/arm slot. Be careful not to let the connector slide across the head of an adjacent head/arm.
    b. With the head cam arm [9] supported by the cam tower [10], move the head/arm toward the carriage until the head/arm is seated in the two notches [8] in the carriage [1] (see Figure 6-10).

c. Using a 3/32 inch hex head-alignment bit (87016704) in the torque driver install the screw [3] which secures the head/arm to the carriage. Retain a hold on the head/arm until the screw is in far enough to prevent the head/arm from coming out of the notches [8] in the carriage. Do not completely tighten the screw at this point in the installation. Torque to 4 1/2 lbf-in (0.40 to 0.51 Nm).

d. Connect the head connector to the Read/Write Preamp Board. Make sure the connector is oriented so that the hole pattern matches the pin pattern, otherwise pins could be bent when an attempt is made to force the connector onto the pins.

10. Replace the head connector retainer ([D] in Figure 6-11).
11. Connect input power cable to external power source.
12. Set AC power circuit breaker to ON.
13. Perform Read/Write Head/Arm Alignment Check and Adjustment procedure (paragraph 6.8.5.4).
14. When alignment is complete torque the head securing screws per paragraph 6.8.5.4.
15. Replace the Electronic Module in the unit with care.
16. Replace unit top cover.
17. Restore power to the unit.



* SHOWN ON FIRST HEAD/ARM FOR ILLUSTRATIVE PURPOSES ONLY.

** USE 3/32 INCH HEX BALL BIT (87016704)

FIGURE 6-10. HEAD/ARM REMOVAL AND REPLACEMENT AND ALIGNMENT

6.7.10 SERVO HEAD/ARM REMOVAL AND REPLACEMENT

1. Press START switch to stop drive motor.
2. Set the AC POWER circuit breaker to OFF.
3. Disconnect the input power cable from external power source.
4. Open the pack access door. The pack need not be removed, however.
5. Remove the top cover.
6. Lift the Electronics Module and swing it to the side of the unit.
7. Remove the two screws [B] which secure the cover to the Servo Preamp Assembly (Figure 6-11).
8. Remove the cover to the Servo Preamp Assembly. Slide toward carriage and then up.
9. Remove the head cable form the cable clamp [C].
10. Remove the head connector retainer [E].
11. Disconnect the Servo Head/Arm Cable connectors from the tie point plate [A] and the Servo Preamp PWA.
12. Replace the Servo Head/Arm as described in steps 7 through 9c of paragraph 6.7.9.
13. Connect the head connectors to the Servo Preamp PWA and the tie point plate. Make sure each connector is oriented such that the hole pattern matches pin pattern, otherwise pins could be bent when an attempt is made to force the connector onto the pins.
14. Replace the Servo Preamp cover. Replace two screws [B]. Insert head cables into cable clamps [C].
15. Replace the head connector retainer [E].
16. Close the pack access door.
17. Connect input power cable to power source.
18. Set AC circuit breaker to ON.
19. Perform Servo Head Alignment Check and Adjustment Procedure (paragraph 6.8.5.4).
20. When alignment is complete torque the head securing screws per paragraph 6.8.5.4.
21. Replace the Electronics Module in the unit with care.
22. Replace the top cover.
23. Restore power to the unit.

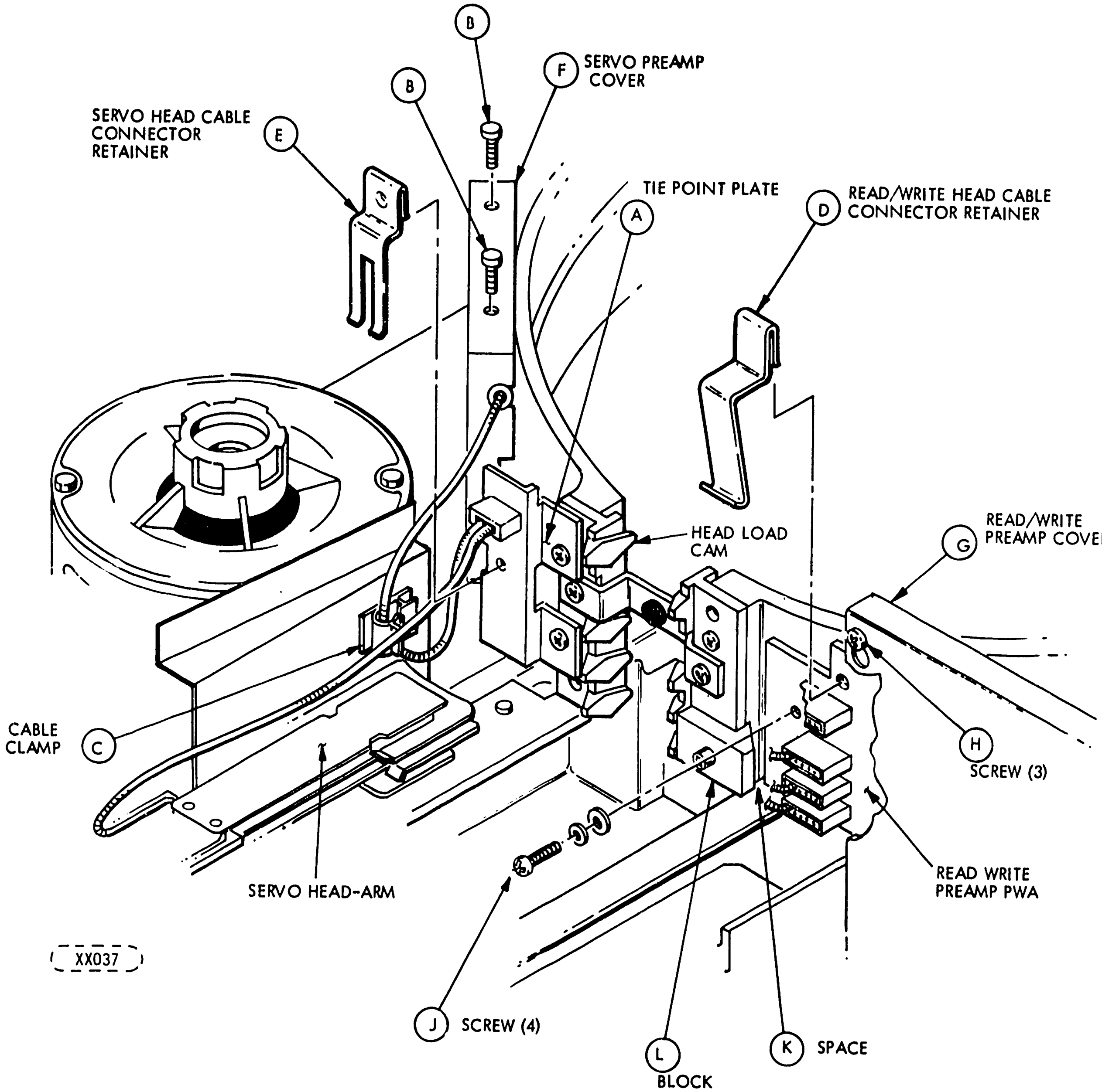


FIGURE 6-11. SERVO HEAD/ARM ASSEMBLY

6.7.11 HEAD INSPECTION AND CLEANING

6.7.11.1 GENERAL

The drive has a positive pressure filtration system that eliminates the need for periodic inspection and cleaning of heads. The heads should be inspected for the following reasons only:

- A problem is traced to a specific head or heads; for example, excessive data errors.

- Head to disk contact is suspected. This may be indicated by an audible ping, scratching noise, or a burning odor when the heads are over the disk area.
- Concentric scratches are observed on the disk surfaces.
- Contamination of pack is suspected (possibly due to improper storage of the pack).
- The pack has been physically damaged (possibly due to dropping or bumping).

CAUTION

Do not attempt to operate the media on another drive until full assurance is made that no damage or contamination has occurred to the media.

Do not attempt to operate the drive with another media until full assurance is made that no damage or contamination has occurred to the drive heads or the shroud area.

6.7.11.2 INSPECTION

The following procedure assumes that the heads to be inspected and cleaned have been removed from the drive.

CAUTION

Place head assemblies on a flat clean surface, with the head pads up and do not place any objects on top of the flying pads. Do not smoke during this procedure.

Do not touch the head pad and/or gimbal spring with fingers or tools.

a. Head Pad Inspection

NOTE

A spotlight and magnifier glass might be helpful during head inspection, however they are not required under adequate light conditions and normal vision of the inspector.

Areas to be checked around the head pad are shown in Figure 6-12a.

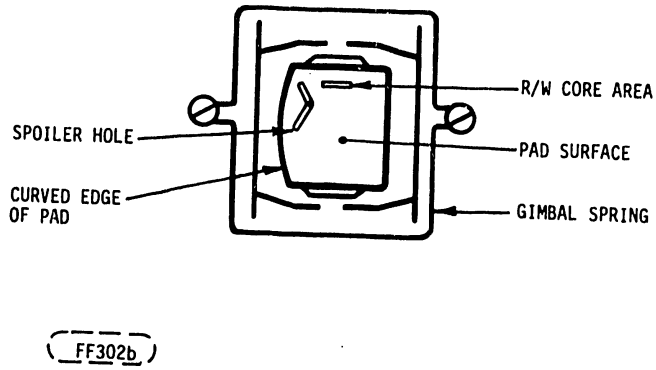


FIGURE 6-12A. HEAD SHOWING AREAS TO BE CHECKED

Hold the head by its rigid arm and direct the pad toward a good light source, such that the light reflects on the pad.

Check the following places for contamination or damage as described:

- Head Pad Surface

  The pad may have one or more of the following marks requiring cleaning in an attempt to save the assembly.

  Oxide streaks in either direction, mainly along the disk rotation path.

  Smear spots, splashes or finger print type of debris anywhere on the pad.

  Marks or spots other than the streaks, scratches or smear.

  NOTE

  If scratches due to head flying are visible without magnification or special lighting, head replacement is recommended.

- READ/WRITE Core Area

  The READ/WRITE Core Area may have:

  Same as listed under head pad surface inspection.
  Damage to the core surrounding bond and the slot it is embedded in.

CAUTION

Damage and/or debris near the READ/WRITE core area is the most critical as this is the point closest to the disk during flying operation.

- Spoiler Hole

Any obvious dust or lint particles in or around the spoiler hole.

NOTE

If heads are inspected from a drive that had head-to-disk contact, special attention should be paid to the spoiler holes of the heads that did not have head to disk contact and appear clean on the pad. The oxide removed during head-to-disk contact tends to accumulate in the spoiler holes of ALL heads in that drive. The oxide is a very fine black powder which must be removed prior to cleaning the head pad on the punch card (described later). Refer to spoiler hole inspection and cleaning.

- Curved Edge of Pad

This is a very sharp edge and cleaning material residue or paperlint may reside there after improper handling or cleaning.

If any of the above contamination is found, perform head cleaning and check again. If the cleaning operation does not successfully remove all contamination, discard head and replace with new one.

b. Head Arm and Mechanical Inspection

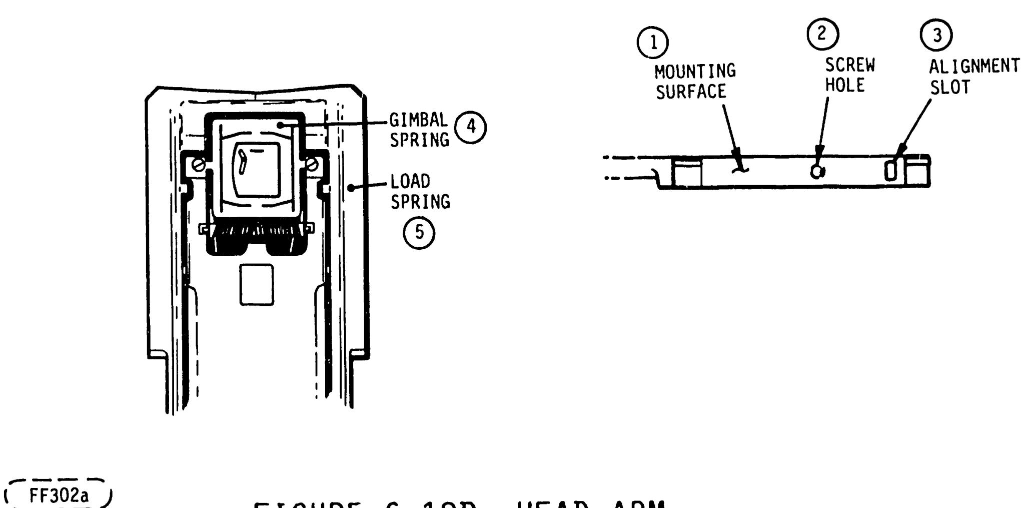


FIGURE 6-12B. HEAD ARM

Areas to be checked on the head arm are shown in Figure 6-12b.

Check the following areas for contamination or damage as described:

Head arm mounting surface [1] that mates to the carriage. Make sure the surface is free of debris, damage and corrosion.

Index to burst problems and heads slipping out of alignment may be indications of an improper head arm mounting surface.

Threaded screw hole [2] used to mount and torque the head arm to the carriage. This hole must be absolutely free of damage or contamination to ensure proper head mounting.

Alignment slot [3] used to shift head arm back and forth. This slot must not be "rounded out". Improper alignment or the inability to align the head at all may be result of a contaminated or damaged alignment slot.

Head gimbal spring [4]. This spring must be clean and free of damage or bends. It must not touch the load spring [5] at any point. Check the head for any obvious damage or contamination of the gimbal spring, or severe damage to head and disk may occur.

If any of the above mentioned problems are found on the head assembly, replacement is strongly recommended.

6.7.11.3 HEAD CLEANING

Refer to list of maintenance tools and materials at the beginning of this chapter for part numbers of media cleaning solution and dry air.

Head cleaning is a delicate procedure and should be performed only by properly trained and/or experienced field personnel.

The following routine assumes that the head has been removed from the drive, properly inspected and cleaning was found necessary in an attempt to save the assembly.

Head cleaning procedure is described in the following paragraphs:

CAUTION

> Throughout the following routine, place the super dry dust remover can on a flat surface, and do not shake it. Give it 1 or 2 shots to clean the spray hose prior to blowing air at the head.
>
> If the can is shaken or not upright, the driving gas will be blown onto the head and severely contaminate it.

1. Dry-blow off all loose material prior to applying cleaning solution.

   Use super dry air to blow off all loose material from the head pad. Have the air can upright on a table and rotate the head pad while blowing the super dry air on it. Hold head about 1 to 2 inches away from nozzle.

   If spoiler hole needs cleaning, perform the following procedure. Otherwise, continue with item 3.

2. Clean spoiler hole first, if found necessary. Refer to Figure 6-13a.

   Wet the edge of a piece of clean, white paper with a drop of media cleaning solution. Insert wet edge carefully into spoiler hole and move it around.

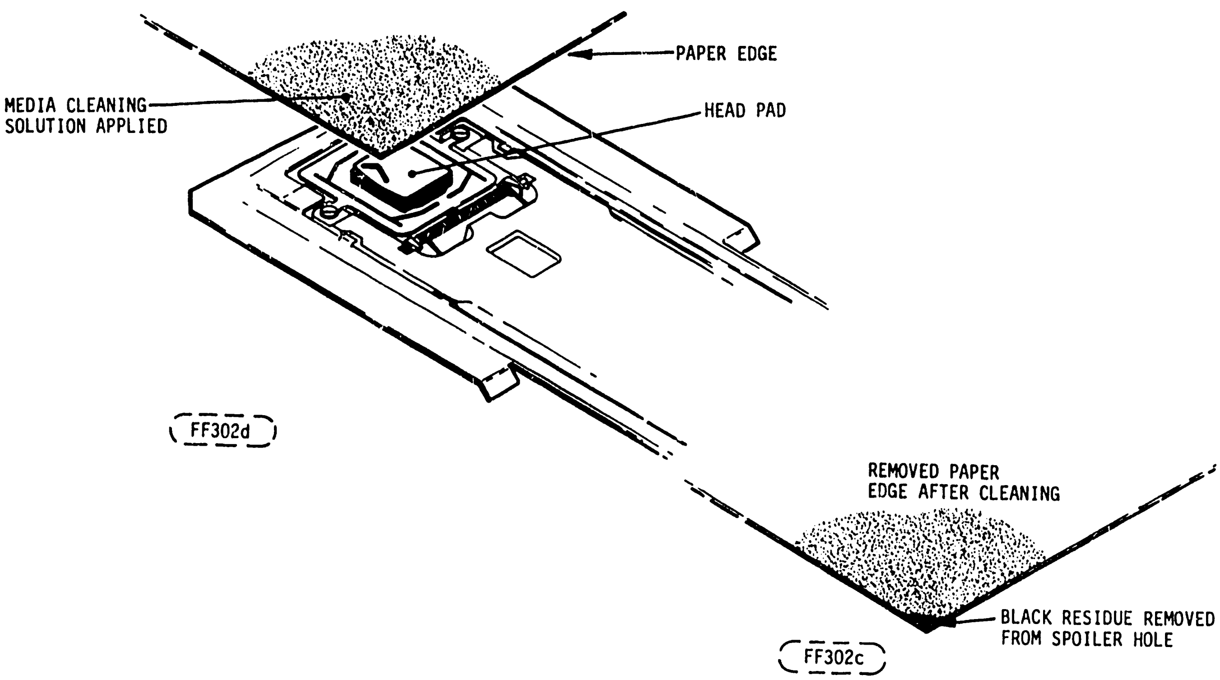


FIGURE 6-13A. CLEANING SPOILER HOLE

If, after inspection, black residue remained on paper edge, repeat this process with a new, clean edge, until it remains clean.

NOTE

Do not soak paper edge with cleaning solution.

3. Wet clean the head pad.

Clean a smooth, flat working surface, for example, a glass or formica table top.

Place a new, unpunched, clean computer card with the back side up (printing down) on the clean flat working surface.

Moisten a small area at the left or right end of the card.

CAUTION

> Care should be taken to avoid excess cleaning solution. Excess solution on the head cable may remove the plasticizer and make the cable stiff. A stiff cable reduces the flexibility of the head pad an could cause broken wires.

Due to two different head configurations, there are two different head arm motions during cleaning. See Figure 6-13b.

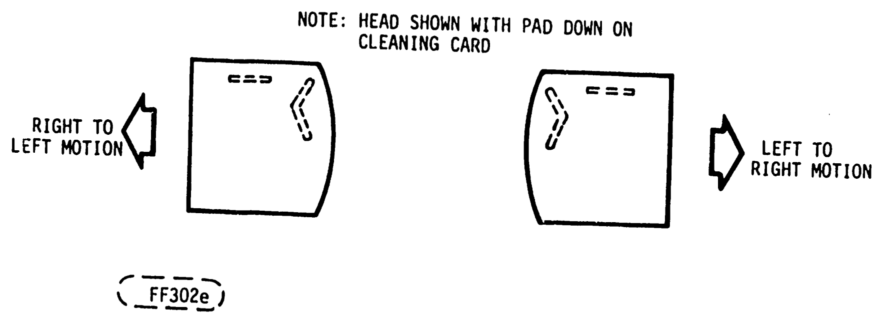


FIGURE 6-13B. HEAD PAD CLEANING MOTION

Always move head pad such that the straight edge is leading.

Very carefully place head pad into moistened spot. With a little downward pressure, move head away from wet spot. preferably in a zig-zag motion for an extended path. See Figure 6-13c.

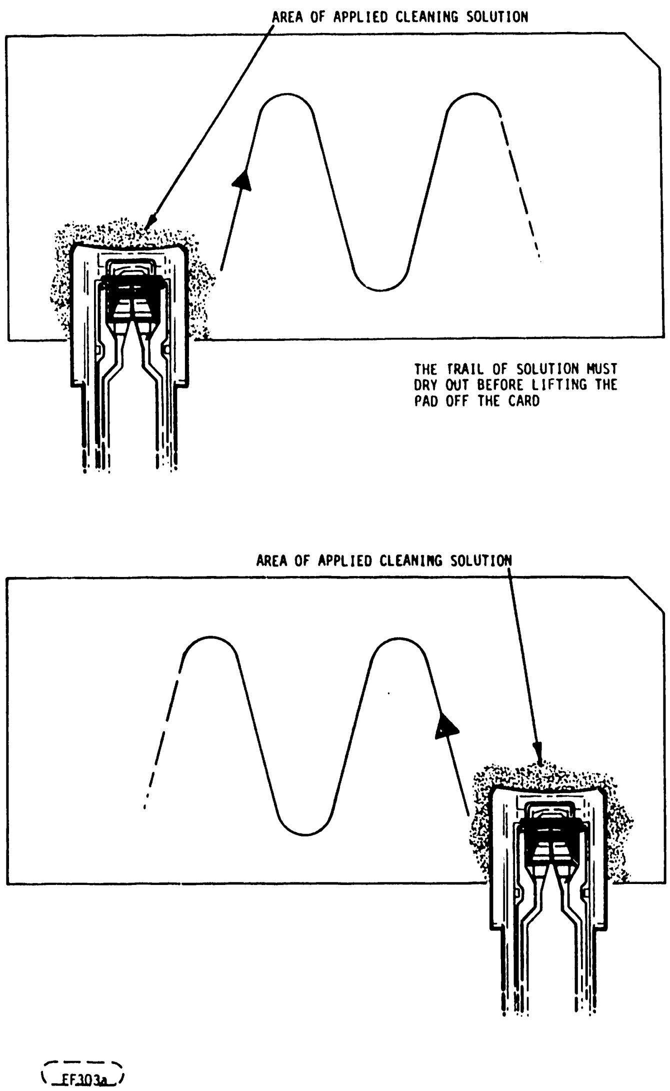


FIGURE 6-13C. CLEANING HEAD PADS

CAUTION

Make sure to move each head in the appropriate direction during cleaning.

If head is moved in wrong direction, the sharp edge of the curved end may cut into the punch card and prevent proper motion and cleaning.

While mounting the head pad over the card, ensure good contact of pad to card by holding the head arm horizontal to the card as shown in Figure 6-13d.

SIDE VIEW

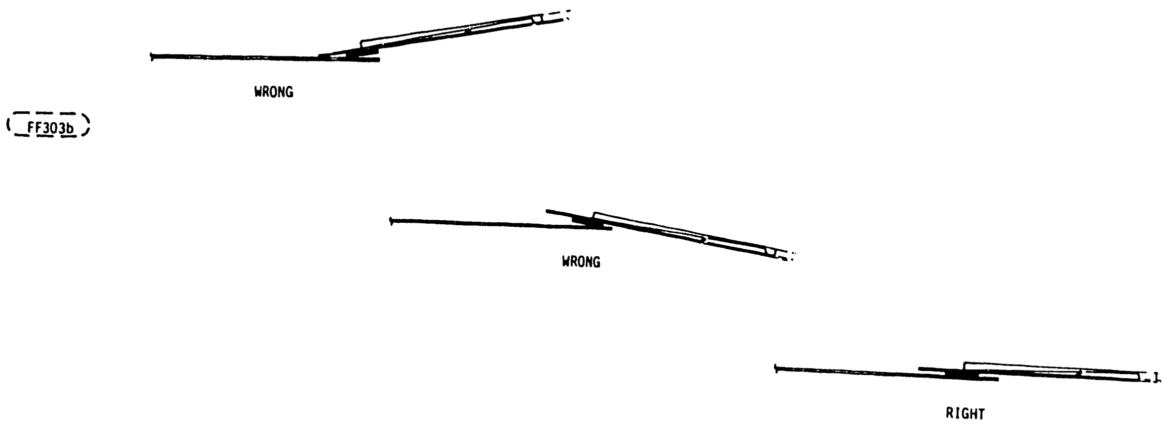


FIGURE 6-13D. PROPER HEAD ARM ANGLE FOR CLEANING HEAD PADS

Discoloration of the media cleaning solution and/or the punch card indicate that oxide particles have been removed from pad flying surface. Do not reuse this card.

The trail of solution must dry out on the card before lifting the pad. If pad is still wet when lifted off card, the solution will evaporate and a layer of residue might be left on the pad.

Repeat wet cleaning of the head pad using a clean computer card and clean media cleaning solution each time until no discoloration on card is present.

After discoloration has ceased, inspect head to determine that oxide deposits were removed. If deposits remain, but show signs of being removed, repeat cleaning procedure until deposits are removed.

4. Dry-Blow Off Heads

   Blow off heads again using super dry dust removed as in Step 1. Be sure all lint and dust are removed.

   If oxide deposits cannot be removed, replace head/arm assembly.

   If oxide deposits were removed and head passes inspection according to the Head/Arm Replacement Criteria, reinstall head.

   Follow head replacement procedure to install cleaned head or a replacement head as required.

5. Check head thoroughly prior to installation.

6.7.11.4 HEAD/ARM REPLACEMENT CRITERIA SUMMARY

A head/arm assembly requires replacement if any of the following conditions exist:

- Consistent oxide buildup on the same head, indicating repeated head to disk contact. It should be noted that a new head should not be installed unless the disk is also replaced, since a new head would not likely fly over a damaged surface.
- Appreciable oxide buildup which cannot be removed.
- Scratches on the head flying surface.
- Imbedded particles in the head pad flying surface.
- Bent or damaged gimbal spring.
- Any apparent physical damage to head/arm assembly.

6.7.12 SPINDLE MOTOR REMOVAL AND REPLACEMENT

Perform the following procedure to remove and replace the spindle motor assembly. Refer to Figure 6-14.

1. Perform the procedures given in paragraphs 6.7.1 and 6.7.2.
2. Disconnect the motor connector which goes to the Relay Control Board. See Figure 6-14 which shows the connector [6] which goes to RCJ4.
3. Remove the spindle drive belt [1].
4. Remove the motor belt drive pulley [3]. To do this loosen the set screw [2] in the pulley collar using a 5/32 inch hex bit in a torque driver wrench.
5. Using a 9/64 inch hex bit in a torque driver wrench remove the four screws [4] which secure motor to the motor base plate. Remove the motor from the unit.
6. Install the new motor. Orient the motor so that the wires exit the motor toward the side of the unit rather than toward the middle from the unit.
7. Secure the motor to the base plate using the screws removed in Step 5. Torque screws to 16 $\pm$1 lbf-in (1.8 $\pm$0.1 Nm).
8. Replace the motor belt pulley. See Figure 6-14. Using a good scale for measurement position the pulley so that it is mounted on the shaft with the edge of the pulley 0.280 inches (7.1 mm) away from the plate surface as shown. Torque the screw in the collar to 64 lbf-in (7.2 Nm).
9. Reconnect the connector as shown in Figure 6-14.
10. Position the smooth side of the drive belt around the spindle pulley. Hold the belt taut around the pulley while performing the next step so the belt does not slip off pulley.
11. While maintaining hand tension on the belt, roll the belt onto motor pulley while manually rotating the spindle pack hub in a counterclockwise direction. Rotate the spindle pulley several revolutions to seat the belt on the pulley.
12. Lower the deck to its normal position. Insert the screws which fasten the unit to the shock mounts at the front of the unit. Swing the Electronics Module back into place carefully.
13. Install the top cover.
14. Install the disk pack.
15. Restore power to the unit.

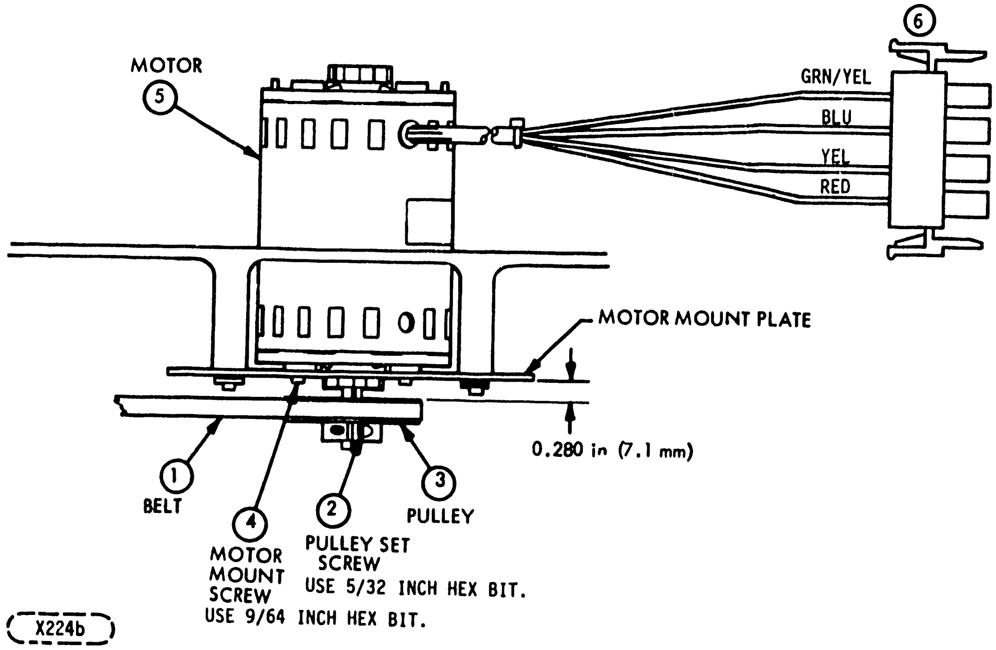


FIGURE 6-14. DRIVE MOTOR ASSEMBLY

6.7.13 BLOWER REMOVAL AND REPLACEMENT

1. Press START switch to stop rotation of motor.
2. Remove AC power plug.
3. Set AC circuit breaker to OFF.
4. Remove top cover. Refer to paragraph 6.7.1.
5. Raise deck assembly to maintenance position per 6.7.2.

CAUTION

Guide deck toward the left when raising or lowering to prevent speed sensor disk contacting blower.

6. Remove screws and washer [1], [2], [3] and [4]. See Figure 6-16.
7. Remove blower electrical connections [5] and [6] in Figure 6-16.
8. Pull the blower toward the side of the unit to dislodge the blower muzzle from the cooling manifold. Remove the blower from the unit.
9. Install the replacement blower assembly in the unit. Orient the electrical lead wires as shown in Figure 6-16.
10. Secure the blower assembly to the intake manifold using the screws and washers removed in step 6.
11. Connect the blower lead wires per Figure 6-16.
12. Lower the deck from the maintenance position. Re-install the screws which secure the deck to the front shock mounts.
13. Replace the Electronics Module in its place in the unit.

14. Replace top cover.
15. Replace AC power cable.
16. Set AC circuit breaker to ON.
17. Restore unit to normal operation.

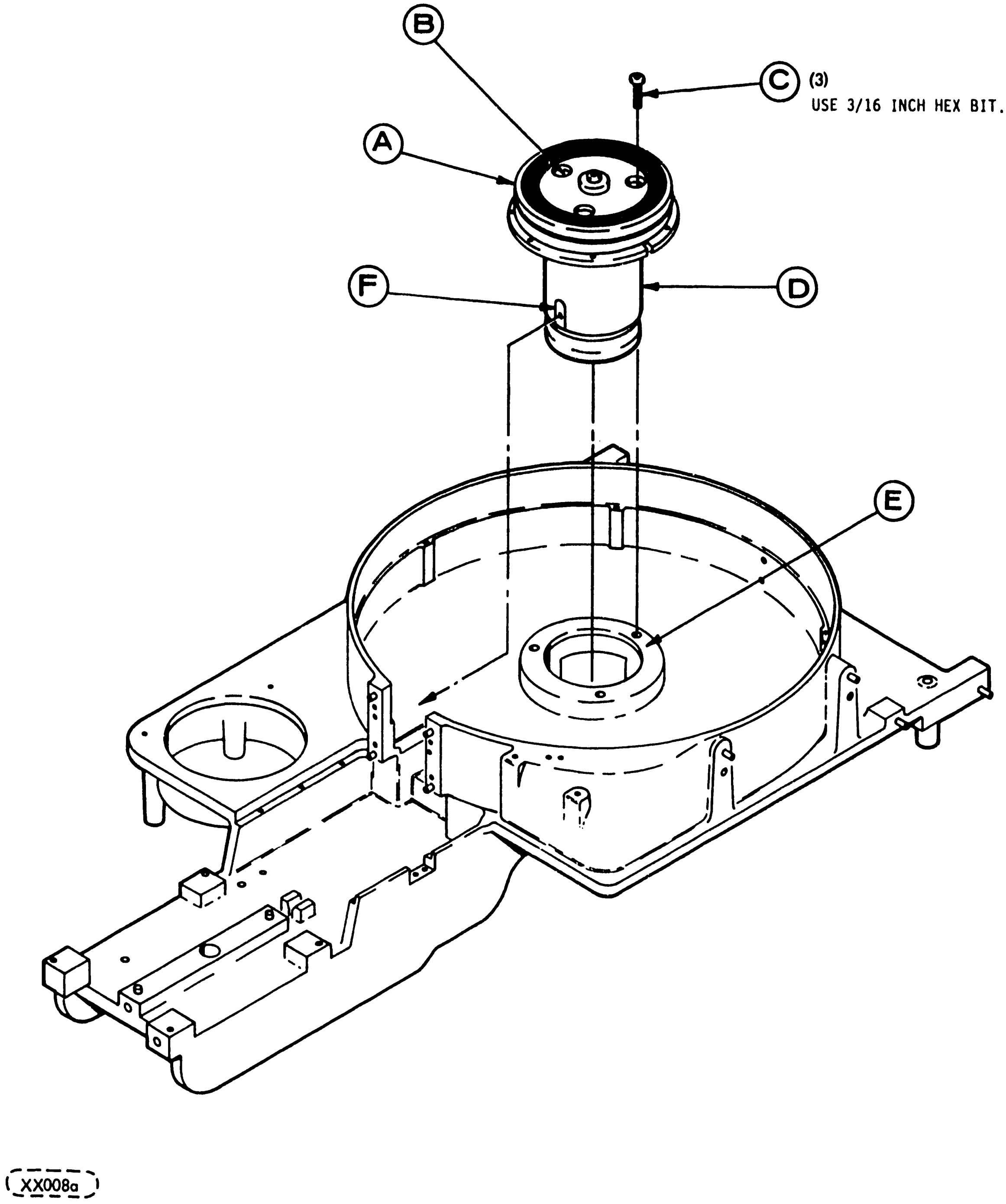


FIGURE 6-15. SPINDLE REMOVAL AND REPLACEMENT

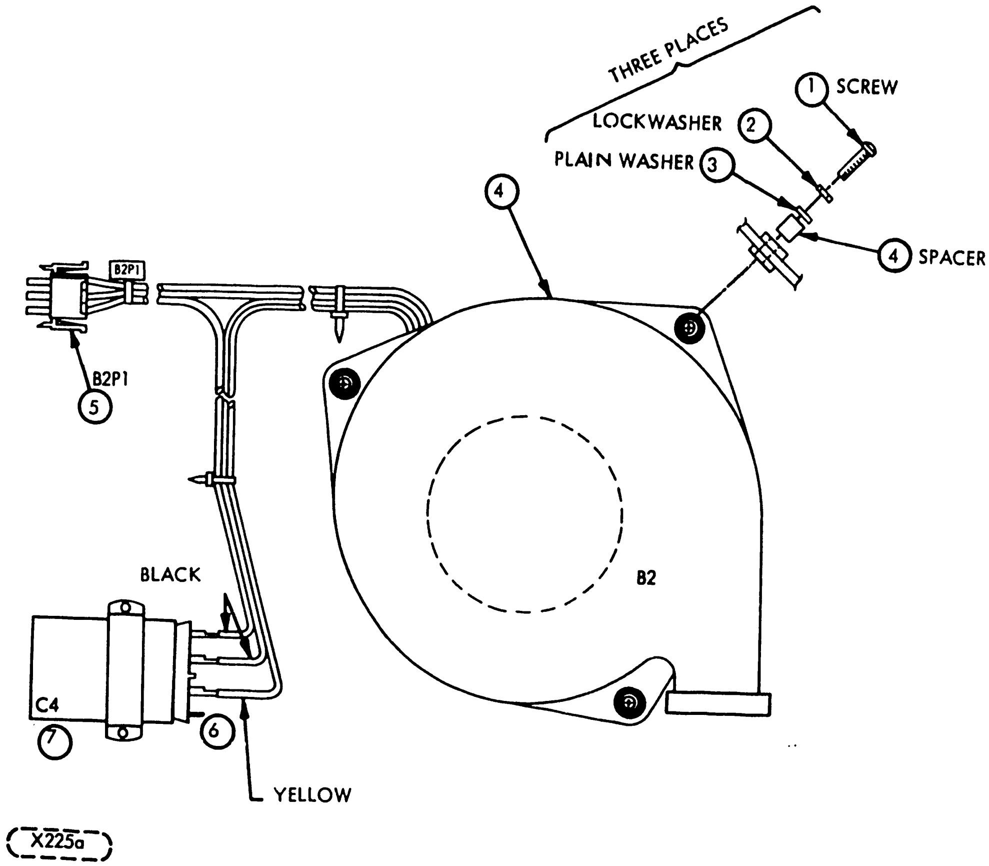


FIGURE 6-16. BLOWER ASSEMBLY

6.7.14 SPINDLE REMOVAL AND REPLACEMENT

Refer to Figure 6-15 as an aid in understanding the following description.

NOTE

> If possible, the information stored on the fixed disks should be retrieved and stored elsewhere before beginning this procedure. If this is not done the information on the fixed module may be lost.

1. Remove AC power from the unit.
2. Remove disk cartridge per Section 2.7.
3. Remove top cover per Section 6.7.1.
4. Remove the receiver assembly per Section 6.7.6.
5. Remove the fixed module per Section 6.7.7, steps 29 through 34. Place the fixed module/alignment tool assembly in a clean shipping canister and cover until reinstallation.
6. Elevate the base deck per Section 6.7.2

7. Remove slotted disk from bottom of spindle pulley. Rotate the spindle by hand and move the belt toward the edge of the pulley until the belt comes off. Remove speed transducer/static ground bracket form Spindle Hub. See Section 6.7.4. Lower the deck to normal position.
8. Rotate the spindle hub [A] by hand until the three holes [B] in the hub line up with the screws [C].
9. Using a size 3/16 inch hex wrench remove the three screws [C].
10. Remove the spindle [D] from the unit.

CAUTION

> The spindle is delicate, precision equipment. Do not drop, bump or jar. Do not touch spindle housing bare metal surfaces as perspiration will etch precision surface.

11. Insert the new spindle in the hole [E] in the base deck and line up the holes in spindle with the holes in the base deck and at the same time insure that the Spin Speed Sensor bracket mounting slot [F] in the spindle housing is oriented toward the drive motor.
12. Install the three screws [C] which secure the spindle to the base deck.
13. Torque the screws to 100 lbf-inch (11.3 Nm). Refer to Table 6-1 for wrench and bit.
14. Raise the base deck assembly per paragraph 6.7.2
15. Install the belt with smooth side toward the pulley. Turn the spindle several revolutions to center the belt on the pulleys.
16. Install the slotted disk and the speed transducer/static ground bracket on the spindle.
17. Lower the deck to its normal position. Insert the screws which fasten the unit to the shock mounts at the front of the unit. Swing the Electronics module back into place carefully so as not to pinch any wires.
18. Reinstall the fixed module saved in step 5 above per paragraph 6.7.7, step 38.
19. Install the disk cartridge.
20. Restore power to the unit.

6.7.15 REMOVAL AND REPLACEMENT OF POWER SUPPLY, PWA BOARDS AND FUSES

Refer to Figure 6-17.

6.7.15.1 PWA REMOVAL AND REPLACEMENT

Proceed as follows to remove the two PWA boards.

1. Stop and power down per 2.3.3 and 2.3.4.
2. Remove the Power Supply from the drive per Section 6.7.15.3.
3. Remove two screws [9] to free the power transistor PWA [10].
4. PWA [10] plugs into a printed circuit board connector mounted on PWA [12]. Remove PWA [10] from this connector.
5. Perform steps 1-3 in reverse order to install new transistor PWA [10].
6. To remove the capacitor mount PWA [12] remove the power transistor PWA [10] as given in steps 1-3.
7. Disconnect the 8 pin connector [13] from PWA [12].
8. Disconnect the three single quick disconnect terminals [16] from PWA [12].
9. Remove screw [15] which secures the end capacitor to the Power Supply chassis.
10. Remove the eight screws [11] which secure the capacitor mount PWA to the Power Supply chassis.
11. Slide the PWA [12] out of the Power Supply.
12. To install Power Supply boards perform the steps 1-10 in reverse order.
13. Replace Power Supply in the drive.
14. Connect drive to power source and restore to normal operation.

6.7.15.2 FUSE REMOVAL AND REPLACEMENT

- Aluminum Chassis Power Supply

Fuses F1, through F8 are mounted in the Power Supply (four in front, four in the side). F1 thru F4 are easily accessible should it be necessary to replace one (see Figure 6-17). Removal of F5 thru F8 requires removal of the Power Supply from the base pan. Some units have F9 and F10 mounted in fuseholders in the wires from CR1 to P5 (in those units which have P5). See Figure 6-17a. To replace follow steps 1-5 and 7-10. To remove and replace a Power Supply fuse proceed as follows.

1. STOP power down drive per 2.3.3 and 2.3.4.
2. Remove AC line cord from power source.
3. Remove top cover. Refer to Paragraph 6.7.1.
4. Raise deck assembly to maintenance position.
5. Remove desired fuse [6] or [8] (or [18] in some units). Replace with good fuse.
6. To remove [5] or [7] remove Power Supply per 6.7.15.3. Replace bad fuse. Replace Power Supply.
7. Lower deck assembly to normal position.
8. Replace top cover.
9. Connect AC cord to power source.
10. Restore unit to normal operation.

- Two Piece Steel Chassis Power Supply

Fuses F1, through F10 are mounted in the Power Supply (six in front, four in the side). F1 thru F4 and F9 and F10 are easily accessible should it be necessary to replace one (see Figure 6-17a). Removal of F5 thru F8 requires removal of the Power Supply from the base pan. To remove and replace a Power Supply fuse proceed as follows.

1. Stop and power down drive per 2.3.3 and 2.3.4.
2. Remove AC line cord from power source.
3. Remove top cover. Refer to Paragraph 6.7.1.
4. Raise deck assembly to maintenance position.
5. Remove desired fuse F1 thru F4 and F9 and F10. Replace with good fuse.
6. To remove F5 thru F8, remove Power Supply per 6.7.15.3 steps 3 thru 7. Remove bad fuse. Replace with good fuse.
7. Replace Power Supply in reverse order as in step 6 above.
8. Lower deck assembly to normal position.
9. Replace top cover.
10. Connect AC cord to power source.
11. Restore unit to normal operation.

6.7.15.3 POWER SUPPLY REMOVAL AND REPLACEMENT

To remove and replace the Power Supply Assembly perform the following procedure.

1. STOP and power down the drive per 2.3.3 and 2.3.4. Remove AC line cord from power source.
2. Remove the top cover. Refer to Paragraph 6.7.1.
3. Remove the four screws [4] which secure the Power Supply to the base pan. These are removed from the under side of the unit. Push Power Supply toward front of unit as far as it will go.
4. Disconnect the frame ground wire [14] at Power Supply end.
5. Raise the deck assembly to maintenance position.
6. Disconnect the four connectors PS1P1 [1], PS1P2 [2], and PS1P3 [3] and PS1P4 [17].
7. Remove the Power Supply from unit.
8. Install Power Supply back into its place in the drive.
9. Perform steps 6 through 1 in reverse.

6.7.16 HEADS LOADED SWITCH REMOVAL AND REPLACEMENT

1. STOP and power down the drive per 2.3.3 and 2.3.4. Remove AC power cord from power source.
2. Remove top cover.
3. Refer to Figure 6-19, item G. Identify (label) heads loaded switch leadwires. Disconnect the lead wires at the switch terminals.
4. Remove the two screws and washers which secure the heads loaded switch to its mounting bracket.

5. Position the replacement switch on mounting bracket (pretravel adjustment bracket must be under switch actuator arm). Loosely secure switch to the bracket using two screws and washers.
6. Perform Heads Loaded Switch Adjustment procedure starting at step 8 (refer to paragraph 6.8.3).

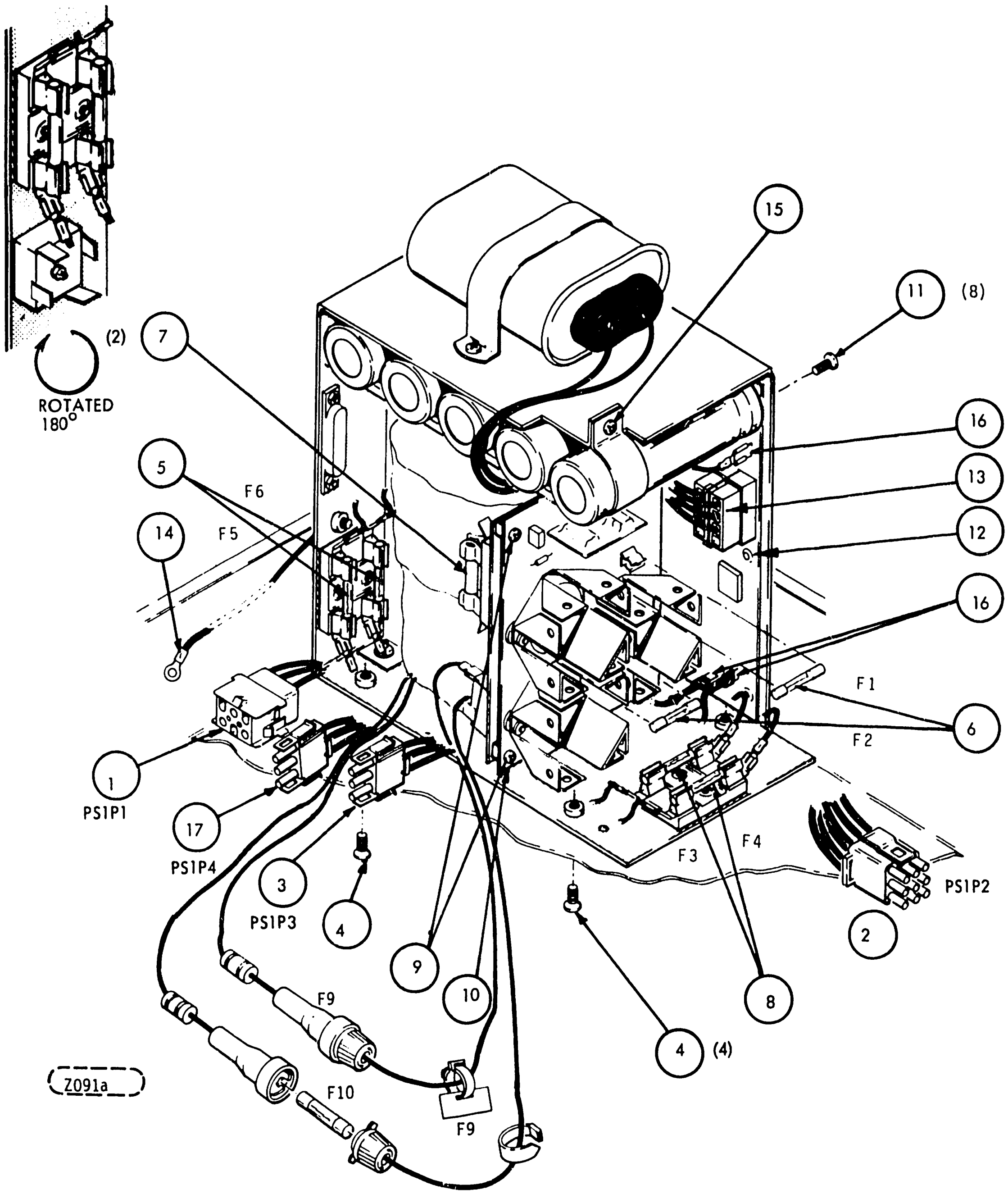


FIGURE 6-17. POWER SUPPLY ASSEMBLY

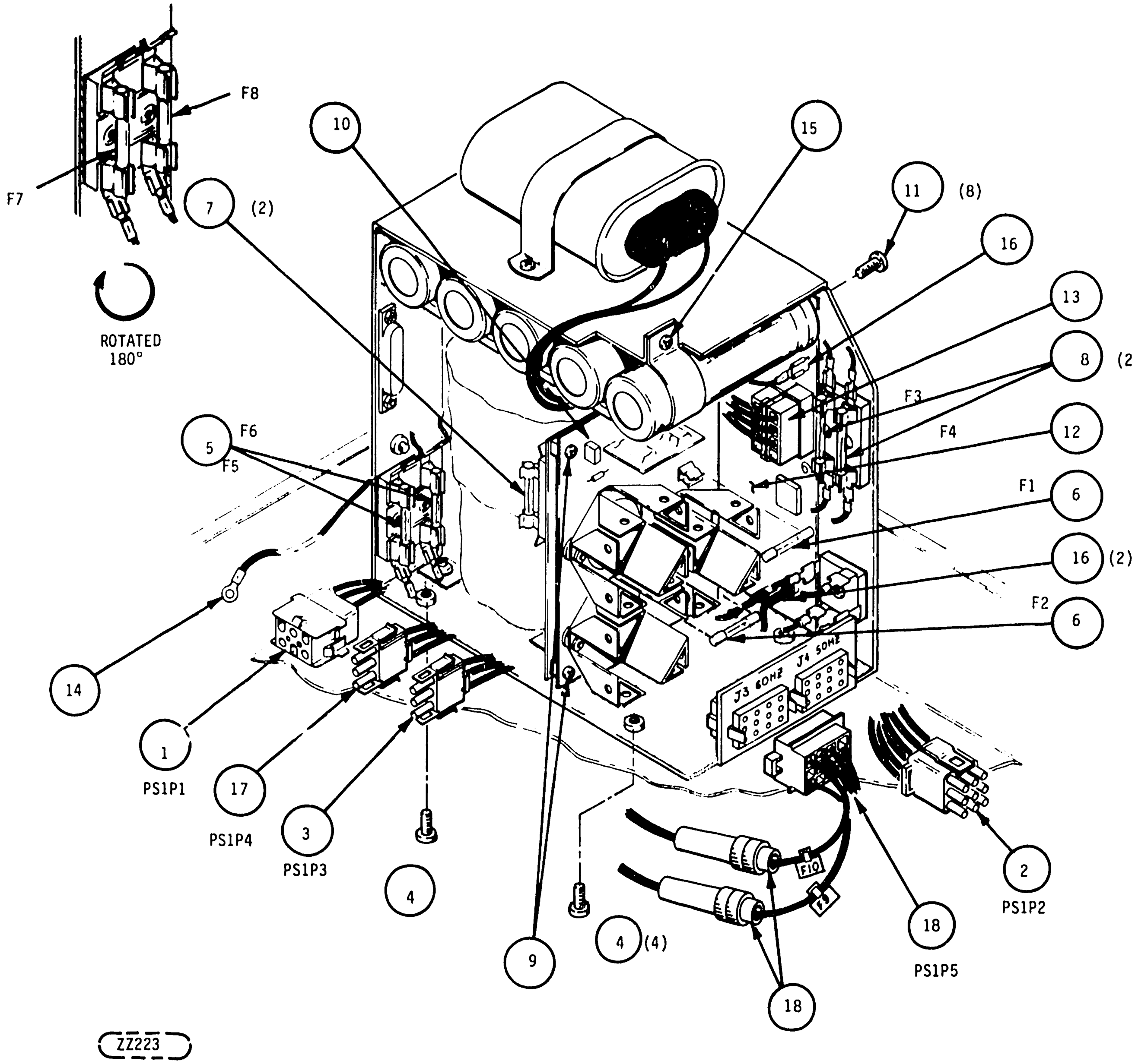


FIGURE 6-17A. 50/60 HZ POWER SUPPLY ASSEMBLY

6.7.17 ACTUATOR MAGNET REMOVAL AND REPLACEMENT

Refer to Figure 6-18 and 6-19 for the following removal and replacement procedure.

a. Position the START/STOP switch to the STOP position and wait for the READY light to stop blinking. Set AC circuit breaker to OFF.
b. Remove the top cover per 6.7.1.

c. Remove the Power Amplifier mounted on top of the actuator magnet. Remove the plastic cover (Figure 6-2) and unplug the connectors. Remove the four screws that secure the PWA and remove PWA.
d. Remove the velocity transducer housing and magnetic core per paragraph 6.7.20.
e. Label heads loaded switch leadwires. Disconnect the lead wires at the switch terminals.
f. If the carriage is not to be removed, the carriage complete with heads shall be secured into its rearmost position prior to removal or replacement of the magnet. This insures that the heads are not unintentionally loaded onto the disks or allowed to slip off the head cam towers. Securing the carriage can best be done by taping the carriage bearing support (see Figure 6-2) to the top of the bearing plate. The Electronics Module side is least obstructed and therefore the most convenient side to tape.
g. Remove the four screws [C] which fasten the actuator magnet to the base deck. This requires a 5/32 inch hex bit.
h. Carefully slide the magnet to the rear of the drive. Be very careful not to damage voice coil.
i. To replace actuator magnet carefully insert the voice coil into the circular slot in the face of the actuator magnet as the magnet is being slid forward.
j. Insert the front locator pin on the base deck into the groove at the front, bottom of the actuator magnet and slide the magnet forward until the rear pin slides into and is firmly seated at the rear of its groove and the four magnet mounting holes line up with the holes in the base deck.
k. Fasten the actuator magnet to the base deck with the four socket head screws removed in step g.
l. Replace the velocity transducer housing and magnetic core per paragraph 6.7.20.
m. If a new magnet is being installed, remove the heads loaded switch bracket, carriage restraint block, tie wrap bracket, carriage locking tool and four stand-offs from the old magnet and install on the new magnet.
n. Install the Power AMP PWA which was removed in step c. Fasten down with four screws. For correct way to install plugs PAP1, PAP2, and PAP3 see Figure 5-11. Replace plastic cover.
o. Reconnect the heads loaded switch lead wires.
p. Adjust the Head Load Switch per paragraph 6.8.3.1.
q. Adjust the carriage restraint blocks per 6.8 6.
r. Set the AC circuit breaker to ON.
s. Start unit and perform Velocity Gain adjustment per paragraph 6.8.5.2
t. Check overshoot by measuring the voltage on test point 10 on the Servo Coarse PWA while performing continuous 822 track seeks (from cylinder 0 to cylinder 822). The signal should not exceed ±1.5 volts on the fixed and not exceed ±2.0 volts on the removable.
u. Replace top cover and restore unit to normal operation.

6.7.18 CARRIAGE ASSEMBLY REMOVAL AND REPLACEMENT

a. Press STOP/START switch to stop the unit operation and remove AC power from the unit when READY lamp has stopped blinking.
b. Remove top cover per 6.7.1.
c. Remove the head arms from the carriage per Sections 6.7.9 and 6.7.10.
d. Remove the velocity transducer housing and actuator magnet as described in Section 6.7.17.
e. Disconnect the voice coil lead connector. See Figure 6-19.
f. Using a screw driver remove the two screws [A] that secure the voice coil lead support bracket to the base deck. Use 5/16 inch nut driver.
g. Remove the tape that was used to secure the carriage while the magnet was removed.
h. Remove the voice coil by moving it to the rear of the unit with the right hand while guiding the voice coil lead support bracket around obstacles on the base deck with the left hand.
i. If a new carriage is to be installed it must be installed without any head arms.
j. Clean the carriage bearings and guide rod per Section 6.6.3.
k. Install the carriage assembly in the unit, guiding the bearings onto the guide rod and under the bearing plates with the right hand while guiding the voice coil lead bracket around obstacles with the left hand.
l. Make sure the carriage moves freely as described in step 3 of Section 6.6.3. Re-clean the bearings and guide rod if necessary.
m. Secure the voice coil lead support bracket with the two screws removed in step c above.
n. Install the actuator magnet and velocity transducer housing per Section 6.7.17.
o. Move the carriage over its full travel several times to insure that the voice coil does not drag or touch the actuator magnet.
p. Install the head arms per Sections 6.7.9 and 6.7.10.
q. Re-connect the voice coil connector.
r. Perform the head alignment as described in Section 6.8.5.4.
s. Replace top cover.
t. Place the unit in operation in the system.

6.7.19 REMOVAL AND REPLACEMENT OF THE CARRIAGE GUIDE ROD AND/OR SIDE BEARING

a. Press STOP/START switch to stop unit operation and remove AC power when READY indicator stops blinking.
b. Remove top cover per Section 6.7.1.

NOTE

If carriage guide rod [A] (Figure 6-20) only is to be replaced perform steps c through k.

c. Remove the velocity transducer housing and actuator magnet per Section 6.7.17.

d. Remove the carriage assembly per Section 6.7.18.
e. Raise the base deck to the maintenance position as described in Section 6.7.2.

To remove the guide rod [A] proceed as follows (see Figure 6-20):

f. Remove screw [B] which secures the carriage guide rod [A].
g. Remove the carriage guide rod [A] from the unit.
h. Before installing the carriage guide rod in the unit inspect to see that the rod, the screw [B] and hole it goes in are clean and free from all contamination. Watch for thread locking cement debris or burrs on the screw or in the hole, as these promote binding resulting in erroneous torque readings. If available, use a new screw and washer. If not available, clean the exicting screw threads and guide rod with a dry, lint free cloth. Thread the screw into the guide rod as far as it will go (tighten with fingers only). The screw should not protrude from the rod more than 1/16 inch (1.7 mm). Remove the screw and verify that the guide rod and screw are clean.
i. Install the carriage guide rod in the unit.
j. When installing the screw which secures the carriage guide rod put thread locking cement on the screw and torque it to 1.25 ±0.25 lbf-inch (0.14 ±0.03 Nm).

NOTE

This torque specification is critical and should be rigidly adhered to. Under no circumstances should it ever exceed 1.5 lbf-inch.

k. Lower the base deck assembly and secure it per Section 6.7.2.

To remove and replace the side bearing plate [F] proceed as follows (see Figure 6-20):

l. Remove screw [C] and remove the air baffle [D] using 3/16 inch nut driver.
m. Remove screws [E] and remove bearing plate [F] using 3/16 inch nut driver.
n. Install new bearing plate and secure with screws [E].
o. Replace the air baffle [D] and secure with screw [C].

To remove and replace the plate assembly [H] proceed as follows (see Figure 6-20):

p. Remove the two screws [G] and remove the plate assembly [H] using 1/4 inch nut driver.
q. Install the new plate assembly [H] and secure it with the two screws [G].
r. Replace carriage assembly per Section 6.7.18.
s. Replace transducer housing and actuator magnet per Section 6.7.17.

6.7.20 REMOVAL AND REPLACEMENT OF VELOCITY TRANSDUCER

For the following procedure refer to Figures 6-18 and 6-19.

a. Position the START/STOP switch to the STOP position and wait for the READY light to stop blinking. Set AC circuit breaker to OFF.
b. Remove the top cover per 6.7.1.
c. Remove the two screws [A] which secure the velocity transducer housing [D] to the voice coil magnet (Figure 6-18). Use 5/16 inch nut driver tool.
d. Unscrew the velocity transducer magnet core [F] from the rear of the carriage using a 3/16 inch open end wrench.
e. Remove the velocity transducer housing and core together.
f. Disconnect the velocity transducer connector.
g. To replace the velocity transducer assembly insert the core and housing together into the hole in the actuator magnet.
h. Screw the core into the hole in the back of the carriage and tighten the core in the hole using a 3/16 inch open end wrench.
i. Replace the top cover.
j. Restore power to the unit and place in operation in the system.

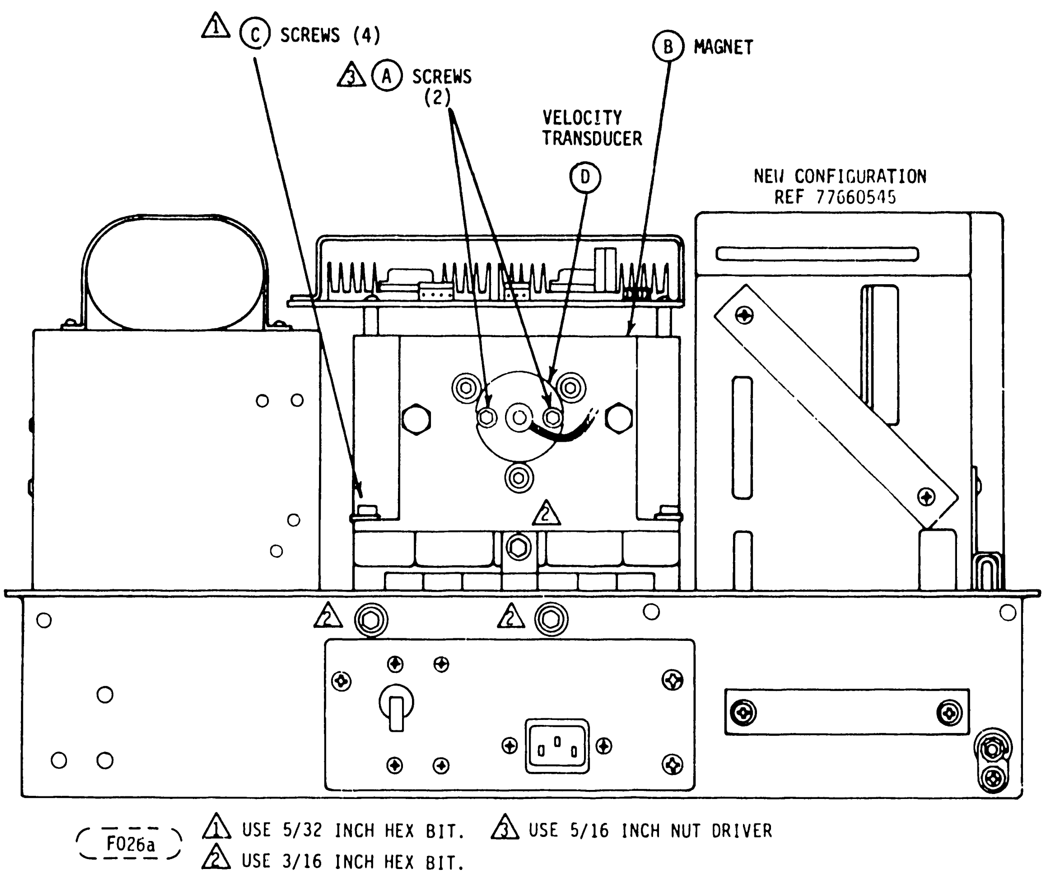


FIGURE 6-18. VELOCITY TRANSDUCER AND ACTUATOR MAGNET REMOVAL

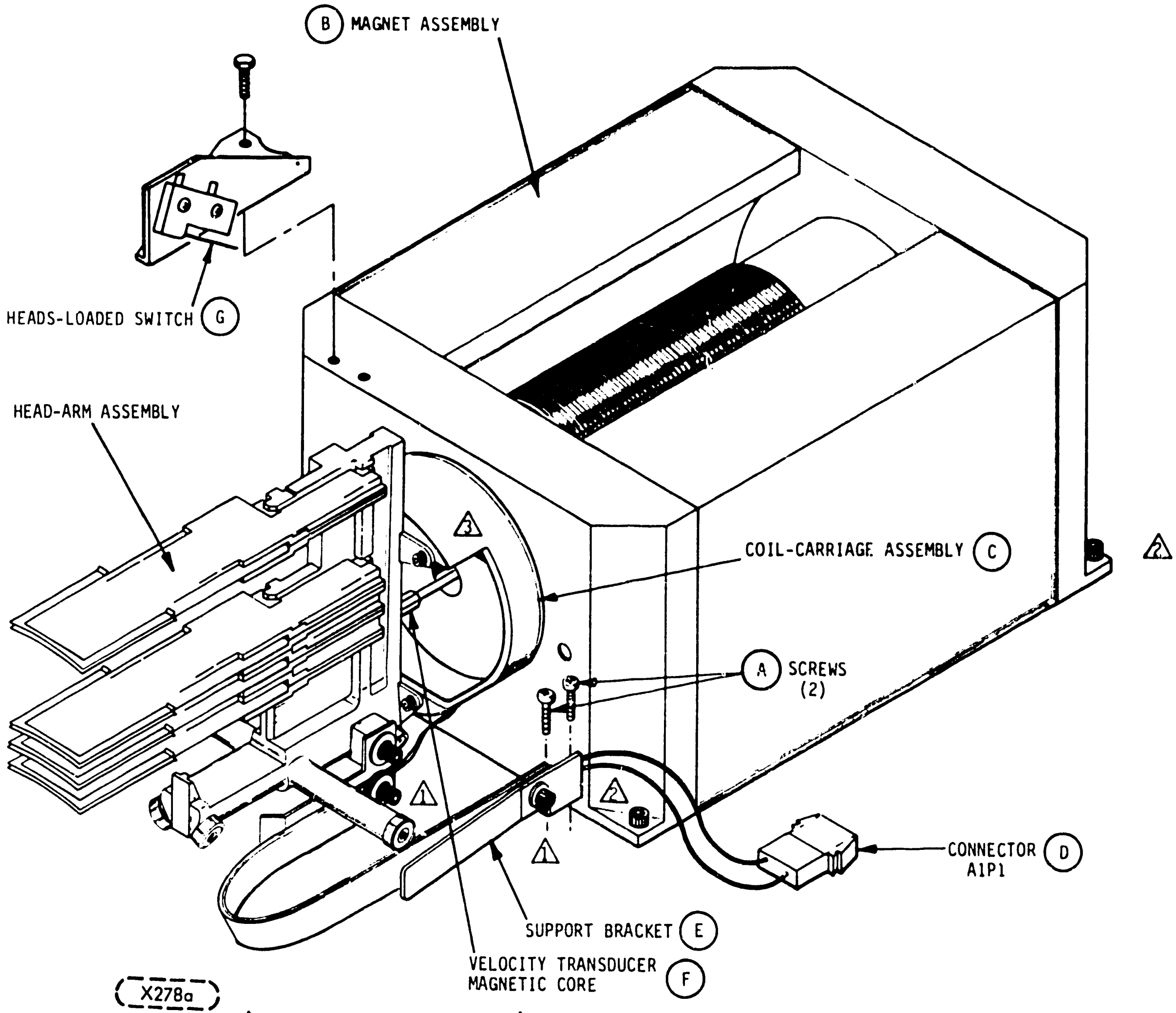


FIGURE 6-19. ACTUATOR ELEMENTS (POWER AMPLIFIER REMOVED)

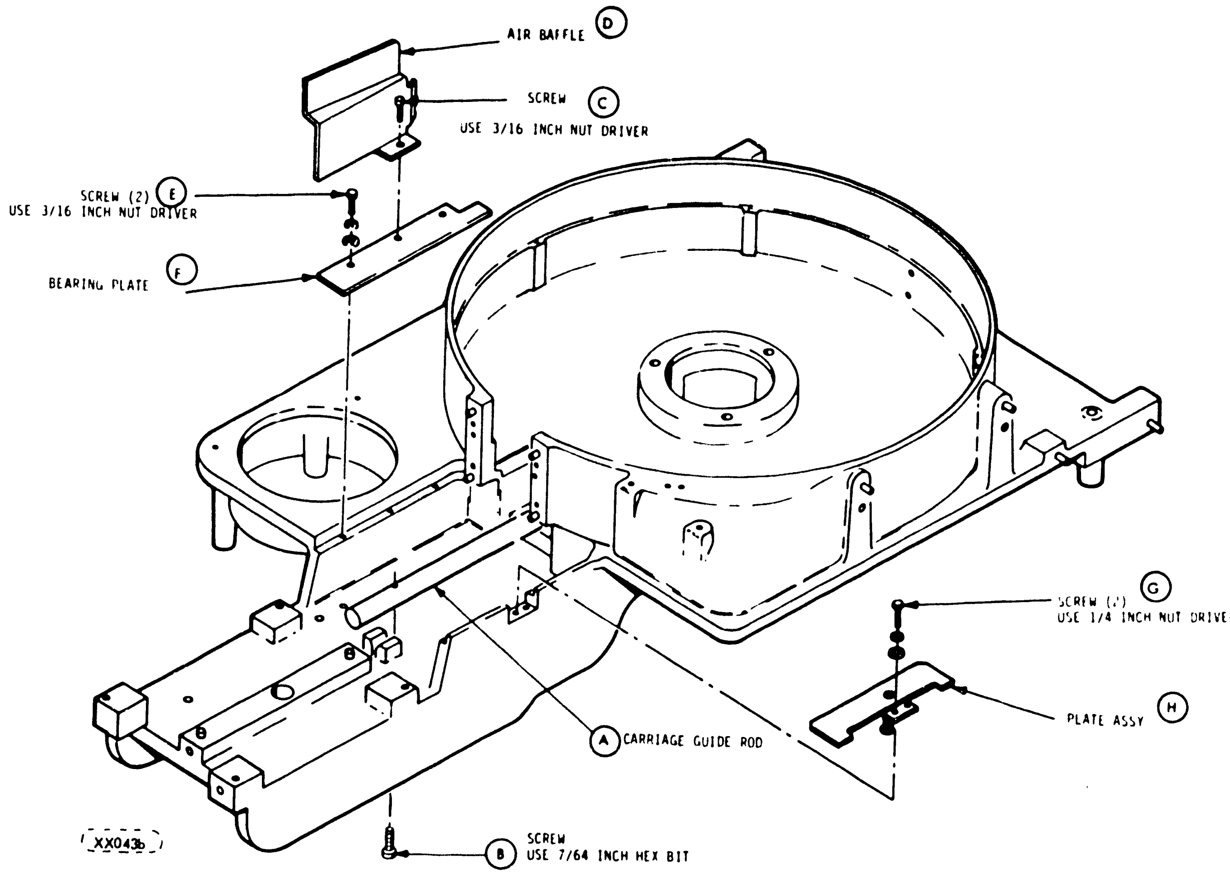


FIGURE 6-20. CARRIAGE GUIDE ROD REMOVAL AND REPLACEMENT

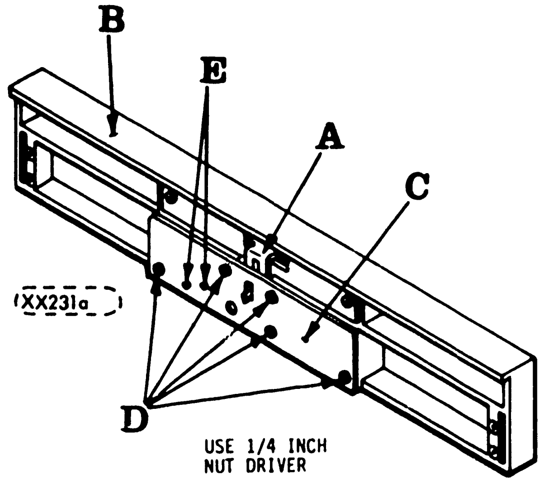
6.7.21 REMOVAL AND REPLACEMENT OF CARTRIDGE ACCESS DOOR LOCK SOLENOID

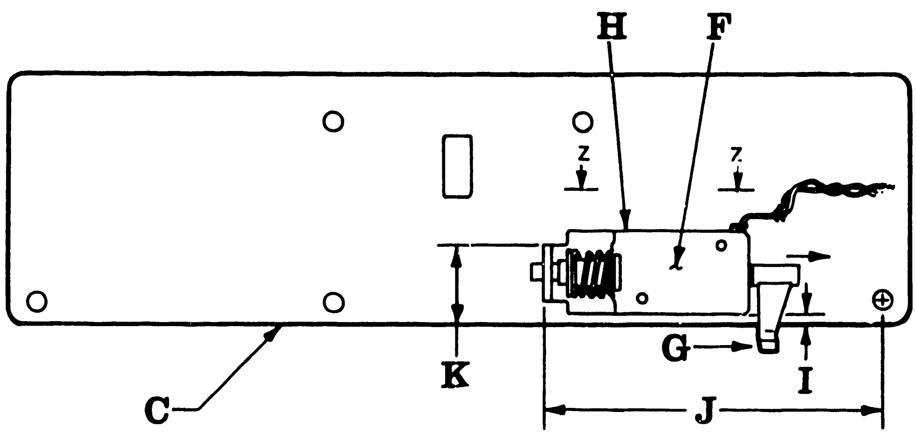
To remove and replace the cartridge access door lock solenoid. Proceed as follows.

Refer to Figure 6-20.1 for visualization of the part names used in the description.

a. Stop the operation of the unit. Wait until the spindle has completely stopped.
b. Do not remove AC power from the unit.
c. Refer to Figure 2-1. Lift on the door release slide [A] and pull open the cartridge access door ([B] in Figure 6-20.1). If door will not open refer to Section 2.8.2. Proceed with next step when the door has been opened and AC power is removed.
d. Remove the five screws [D] using a 1/4 inch nut driver. Save the screws.
e. Move tab [G] in direction shown by arrow in order to retract solenoid plunger.
f. While holding the solenoid plunger retracted, lift latch cover plate [C] from the door [B].

g. Remove the wires from the solenoid [F] electrical connection tabs.
h. Remove the two screws [E] which secure the solenoid [F] to the cover plate. Discard the old solenoid but retain the bracket [H].
i. Install the new solenoid to the cover plate [C] using bracket [H] and secure with the two screws [E].
j. Adjust the positions of the solenoid and bracket to the dimensions I, J and K as shown in Figure 6-20.1. Position the solenoid relative to the bracket so that the plunger does not contact its mounting bracket and so the tip of the plunger extends through the hole in the bracket when not retracted but does not extend beyond the end of the bracket when the plunger is retracted.
k. Tighten the mounting hardware.
l. Connect the two wires which were removed from the old solenoid to the proper tabs as illustrated in View Z - Z in Figure 6-20.1.
m. Install the latch cover plate assembly to the access door. To do this, lift up on the door release slide [A] and pull back the solenoid plunger so it will clear the shoulder at the bottom of the door release, and then let the solenoid plunger return to resting position when the cover plate is properly in place.
n. Install the five screws removed in step d but allow them to remain loose. Position the bottom edge of the cover plate against the protruding edge at the bottom of the access door. Move the cover plate sideways until the solenoid bracket is against the side of the door release slide. This reduces the play in the door release slide.
o. Tighten the cover plate mounting screws.
p. Check to see that the door release slide will operate the release catch properly when the solenoid plunger is pulled back with table [G].
q. Install a cartridge if it was removed at the beginning of this procedure.
r. Close the cartridge access door. The unit is ready for normal operation.
s. Restore AC power to the unit and make sure the access door can be opened.
t. Activate the START switch to operate the unit.

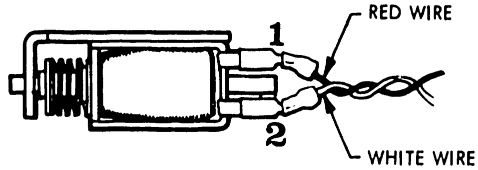




DIMENSION	INCHES	mm
I	0.055 ±0.01*	1.39 ±0.3
J	2.76 ±0.01	70.10 ±0.3
K	0.68 ±0.01	17.27 ±0.3

*DIMENSION APPLIES AT REAR END OF SOLENOID ONLY AS SHOWN

XX231b



VIEW Z - Z

FIGURE 6-20.1. CARTRIDGE ACCESS DOOR SHOWING LATCH LOCK SOLENOID

6.7.22 HEAD-TO-DISK CONTACT RECOVERY PROCEDURE

Head-to-disk contact recovery procedure is described in the flow chart of Figure 6-20.2. Head-to-disk contact recognition procedure is described in Section 2.10 in the operating procedure section. There is nothing in the following procedure that can be accomplished by the operator. A maintenance person is required to perform the recovery procedure.

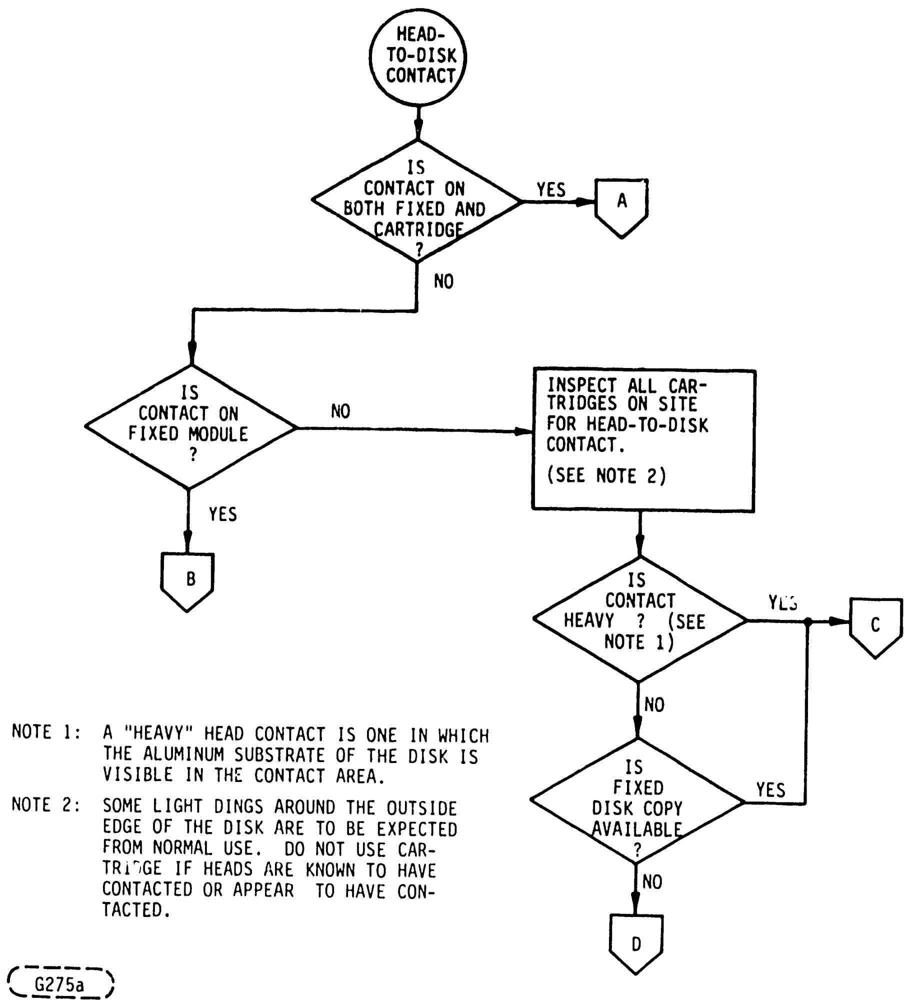


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 1 OF 4)

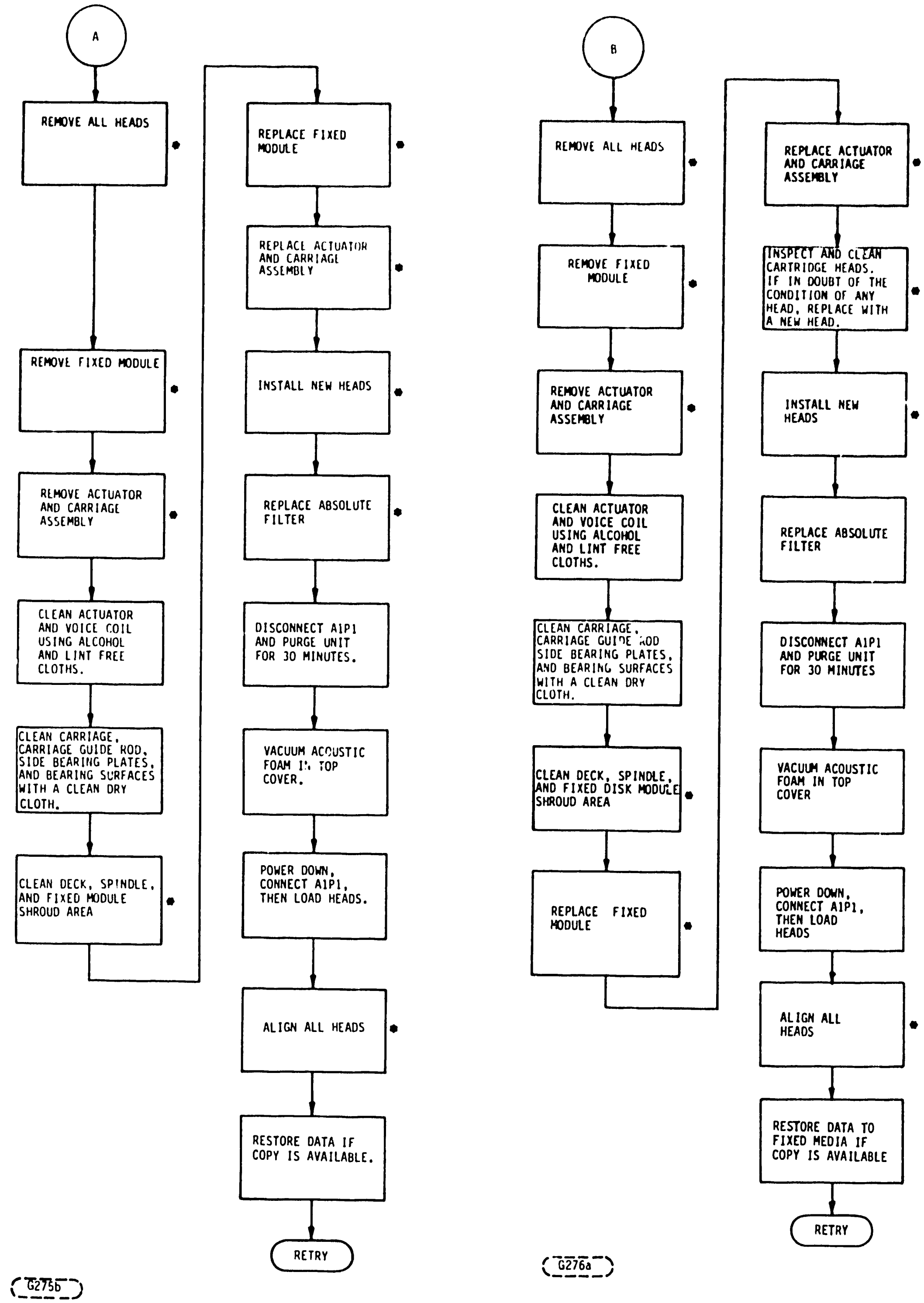
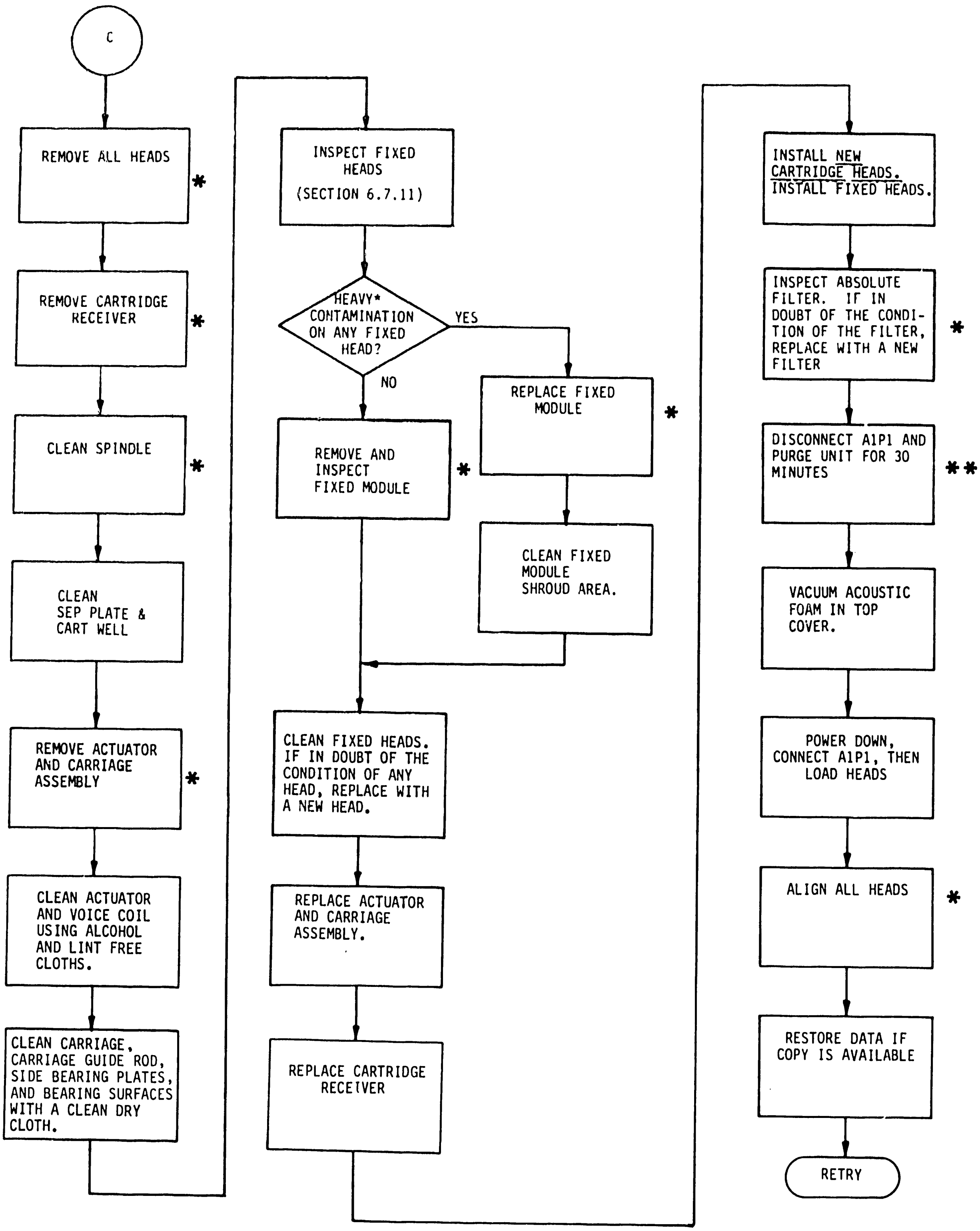


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 2 OF 4)

* See Table 6-3.

** Allow the blower to purge the absolute filter a minimum of 5 minutes with the deck raised and purge the unit a minimum of 25 minutes with the deck lowered. A1P1 disconnected, and disks spinning.



F038a

FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 3 OF 4)

* See Table 6-3.

** Allow the blower to purge the absolute filter a minimum of 5 minutes with the deck raised and purge the unit a minimum of 25 minutes with the deck lowered. A1P1 disconnected and disks spinning.

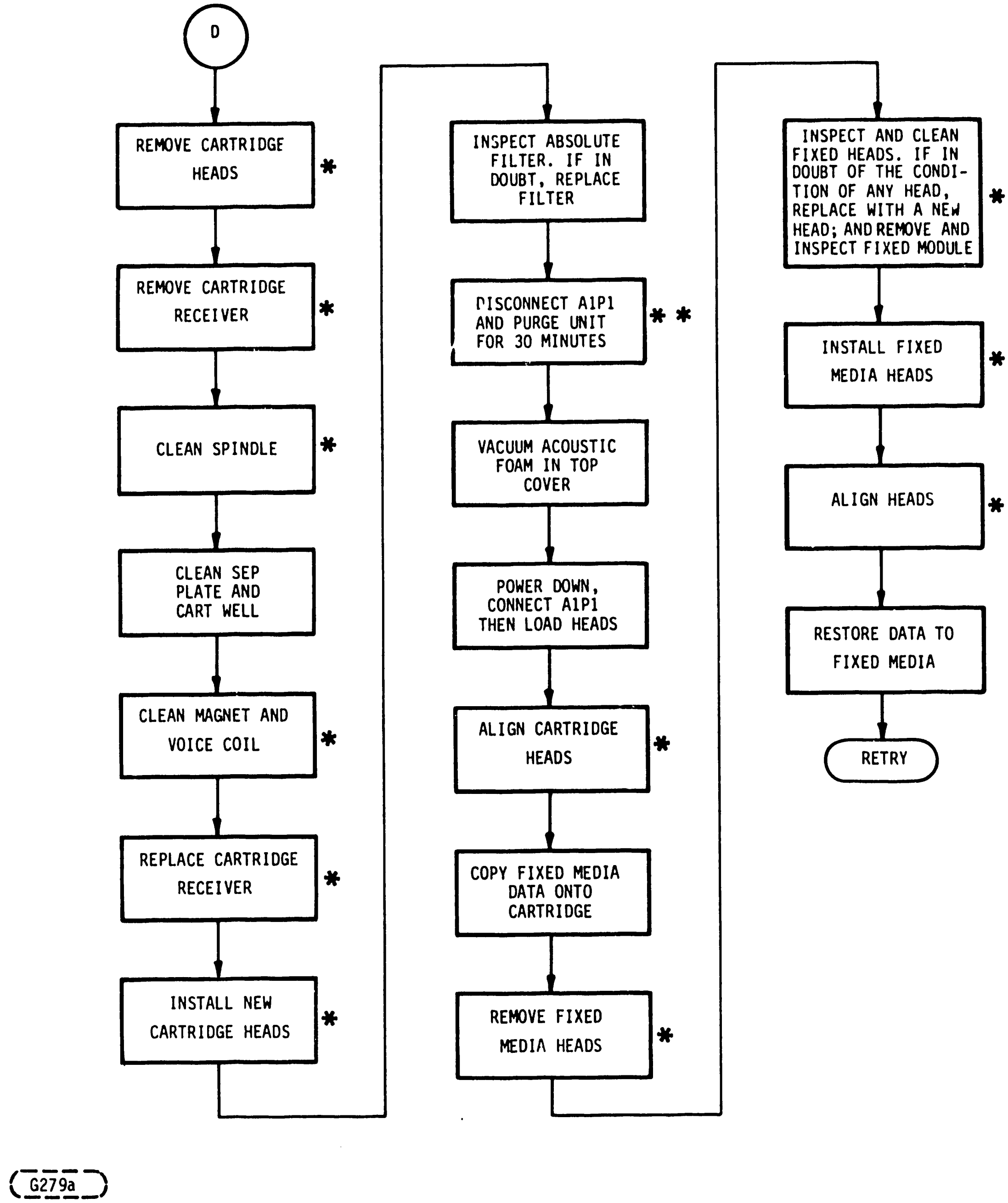


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 4 OF 4)

* See Table 6-3.

** Allow the blower to purge the absolute filter a minimum of 5 minutes with the deck raised and purge the unit a minimum of 25 minutes with deck lowered, A1P1 disconnected, and disks spinning.

6.7.23 REMOVAL AND REPLACEMENT OF AIR PRESSURE SWITCHES

To remove and replace an air pressure switch refer to figure 6-20.3 and perform the following procedure.

1. Press START/STOP switch to stop rotation of motor.
2. Set AC circuit breaker to OFF. Remove AC power cord from power source.
3. Remove top cover. Refer to paragraph 6.7.1.
4. Raise base deck to maintenance position. Refer to paragraph 6.7.2.
5. Remove the absolute filter and cover outlet opening with a clean piece of paper.
6. Disconnect the leadwires [A] at the air pressure switch [E] or [F] terminals.
7. Disconnect air tubing [B] from the air pressure switch [E] or [F].
8. Remove the two screws and hardware [D] which secure the air pressure switch [E] or [F] to the switch bracket [C].
9. Install replacement air pressure switch [E] or [F] on switch bracket [C] using the existing screws and hardware.
10. Reconnect air tubing and leadwires to the switch.
11. Remove cover from absolute filter and re-install in unit.
12. Lower base deck assembly to normal position.
13. Replace top cover.
14. Connect AC cord to power source.
15. Restore unit to normal operation.

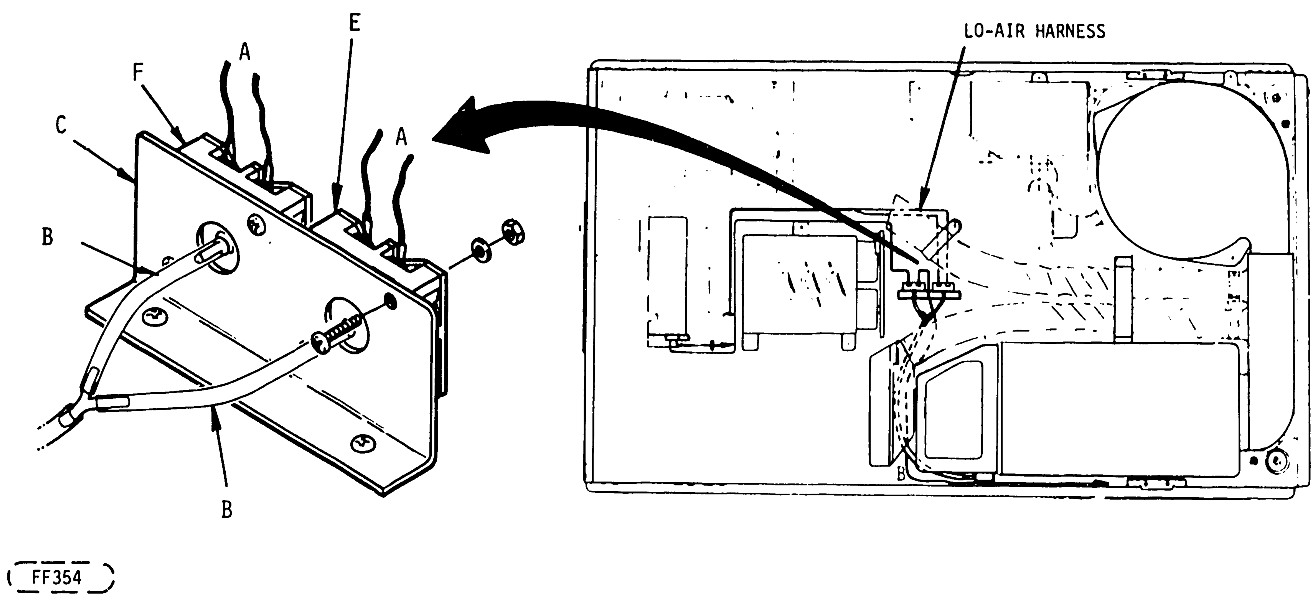


FIGURE 6-20.3. LOCATION OF LO-AIR*/NO-AIR PRESSURE SENSORS

* Optional.

6.7.24. REMOVAL AND REPLACEMENT OF THE COMPONENT BOARD ASSEMBLY

(Mounted next to power resistor mounting bracket near middle of basepan).

1. Press START/STOP switch to stop rotation of motor.
2. Set AC breaker to OFF.
3. Remove top cover. Refer to paragraph 6.7.1.
4. Raise base deck to maintenance position. Refer to paragraph 6.7.2.
5. Disconnect plug P1 and the three quick-disconnect terminals at TB1 on the component board assembly.
6. Remove the deck down sensor from the component board.
7. Remove the screws that secure the resistor mounting bracket.
8. Tilt and lift the bracket to one side and slide the component board assembly from beneath.
9. Insert the new component board assembly under the bracket. Verify that the front edge of the component board is placed against the tab in front of the bracket.
10. Replace the screws to secure the component board assembly.
11. Connect P1 and the three terminals at TB1. Mount the deck down sensor on the new component board.
12. Lower base deck from the maintenance position. Re-install the screws which secure the deck to the front shock mounts.
13. Replace top cover.
14. Restore power to unit.

6.7.25 PROCEDURE FOR REMOVING AND REPLACING THE R/W PREAMP

1. Stop the unit by operating the START/STOP switch to the out position.
2. When the START/STOP switch indicator stops blinking indicating the disk has stopped rotating, remove AC power form the unit.
3. Remove the top cover of the unit per manual Section 6.7.1.
4. Lift and swing the Electronics Module out by performing step 2 in manual Section 6.7.2.
5. Loosen the three screws securing the R/W Preamp shield. Slide the shield up and off. Lay it in the base pan on top of the Electronics Module brace.
6. Carefully unplug RWPP7 and RWPP9, making sure no pins are bent when taken out. Using a flat screw driver to gently pry the plugs loose could help prevent the pin from getting bent.
7. Remove the retainer clip located in front of the head cables and then unplug the head cables from the PWA.
8. Remove the four screws that hold the preamp to its mounting plate, and remove the PWA.
9. If the mounting plate needs adjusting do the following: (See Figure 6-20.4)

    a. Loosen the two plate mounting screws just enough to allow movement of plate.
    b. Push mounting plate toward the rear of the unit to the limit permitted by the slotted mounting holes.
    c. Tighten both mounting screws.

10. Install the new PWA, using the same four screws removed in step 8.
11. Reinstall the head cables back to their original position, and replace the retainer clip.
12. Plug RWPP7 and RWPP9 in their respective places. Replace the R/W preamp shield.
13. Restore the Electronics Module to its normal position.
14. Return the drive to normal operation.

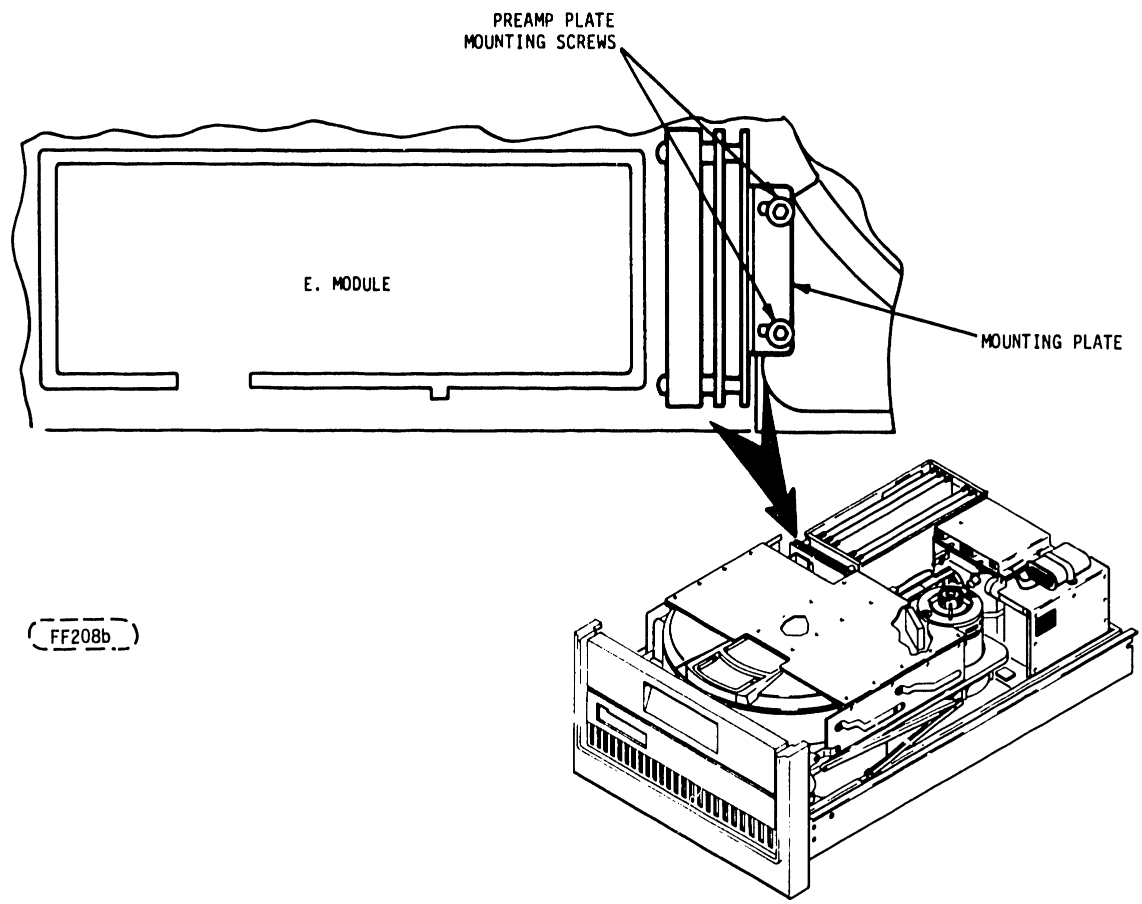


FIGURE 6-20.4. PRE-AMP MOUNTING PLATE, SHOWING LOCATION OF SCREWS TO BE LOOSENED FOR ADJUSTMENT OF MOUNTING PLATE POSITION

6.8 DRIVE TESTS AND ADJUSTMENTS

6.8.1 GENERAL

The tests and adjustments contained in this subsection are those which every drive must pass to be considered operationally acceptable.

If a more detailed test or adjustment procedure is needed to isolate a malfunction, refer to the Trouble Analysis Aids procedures which follow these procedures.

6.8.1.1 MANUAL HEAD POSITIONING

Manual head positioning with spindle not up to proper speed should NEVER be done.

Manual head positioning with power on and disk pack up to speed is not recommended unless required by maintenance procedure or loss of servo control makes it necessary.

1. Should manual loading of the heads be unavoidable, observe the following SAFETY PRECAUTIONS during manual carriage operation.

   - Do not fail to unload heads manually before operating START/STOP switch to power down the unit.
   - If power to drive motor is lost while heads are loaded and voice coil leadwires are disconnected, immediately retract carriage. Otherwise, head-to-disk contact will be made when disk speed is insufficient to enable heads to fly.
   - When positioning heads, do not use excessive downward force on voice coil.
   - Before reconnecting voice coil leadwire connector, make sure fingers and tools are clear of coil and actuator.
   - Do not use CE disk pack unless specifically directed to do so. Use only the type of pack called for in the maintenance procedure.
2. Install a scratch cartridge (refer to disk Cartridge Installation and Removal) and transfer all data from the fixed disks to some other storage location.

CAUTION

> If loss of servo control necessitates manual loading and unloading of heads, observe the following:
>
> Do not load heads unless spindle is up to speed (READY has ceased blinking).
>
> When manually loading or unloading heads, simulate normal load (unload) speed of servo under electrical control.
>
> Disconnect voice coil leadwire connector before attempting to load heads.

3. Press drive START/STOP switch to allow normal spindle start and first seek (if it will).
4. Remove top cover per paragraph 6.7.1.
5. Disconnect voice coil leadwire connector A1P1 (refer to Figure 6-19 and 6-21).

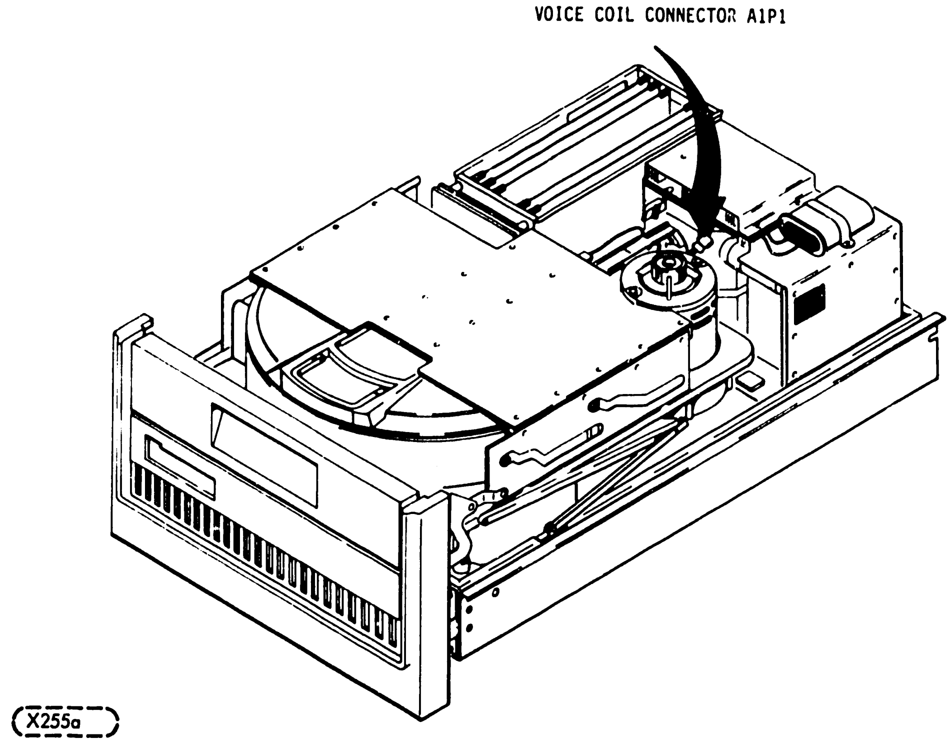


FIGURE 6-21. VOICE COIL LEADWIRE CONNECTOR

6. Very carefully position carriage as required by maintenance procedure by applying a lateral (parallel to carriage) movement pressure to top of the carriage.

WARNING

Keep hands away from actuator.

7. Reconnect voice coil leadwire connector A1P1:
   a. Make sure hands and fingers are clear of heads, carriage or coil.
   b. Touch connector halves together and ensure carriage locks on cylinder or retracts fully. If erratic voice coil movement is notices, remove connection immediately and troubleshoot malfunction.
   c. After carriage locks on cylinder or retracts full, firmly seat voice coil leadwire connector halves.
8. Command an RTZ before any seeks are performed.
9. Replace top cover.

6.8.2 CERTIFICATION OF FIXED MEDIA

After replacement of the fixed media it is necessary to certify each data surface to identify the number and location of flaws in the media which may cause read errors. This can only be done after installation of the fixed module since the precise location of each data track is not determined until the module is installed.

1. Perform the head alignment procedure as defined in paragraph 6.8.5.4.
2. Format each data surface with the format and number of sectors normally used. A single section on each track with one large data field is preferred but not necessary.
3. Read the format with nominal strobe and no offset. If any error is detected, note the track location and re-read. Track locations for which an error is detected more than once must be flagged and excluded from further use. Use spare track locations 808-822 as alternates.
4. Repeat steps 2-3 only for alternate track locations.
5. Write data pattern I in Figure 6-22 in each data field.
6. Read the data pattern written in 5 above using the strobe and offset combinations shown in Figure 6-22. Record the track location of any error detected.
7. Repeat Steps 5 and 6 for data patterns II through IV in Figure 6-22.
8. Examine the record of track locations for which errors were detected in Step 6. Flag all track locations which appear more than once. Exclude these tracks from further use. Use spare track locations 808-822 as alternates.
9. Repeat Steps 2-8 only for alternate track locations.

WRITE DATA PATTERNS

I. $3B63B63B_{16}$
II. $E255FE25_{16}$
III. $FFFFA924_{16}$
IV. $FE254A80_{16}$

READ COMBINATIONS

A - NOM STROBE	1 - NOM OFFSET
B - EARLY STROBE	2 - FWD OFFSET
C - LATE STROBE	3 - REV OFFSET

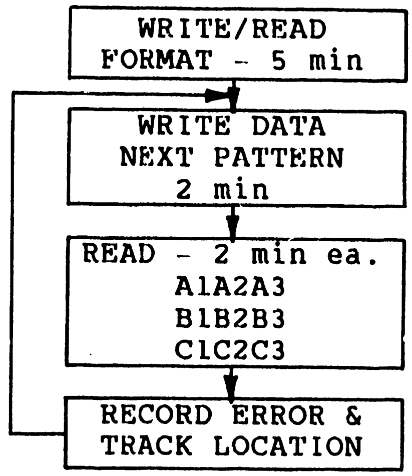


FIGURE 6-22. CERTIFICATION OF FIXED MEDIA

6.8.3 SWITCH ADJUSTMENTS

NOTE

The following definition applies to paragraphs 6.8.3.1 and 6.8.3.2 which follow.

The "Switch Operating Position" is defined as that position of the switch lever at which the switch contact points switch from a normal (switching mechanism at rest, not being stressed) position to operating position (switching mechanism stressed so it wants to return to "normal" position). At the Switch Operating Position the normally open contacts will close (normally closed contacts will open). The Switch Operating Position can be determined by the snap action noise of the switch contacts as they change positions, or by the placing a multimeter (set to RX1 scale) across the switch common (C) and normally open contact (NO). At the Switch Operating Position the multimeter will change indication from infinity to zero ohms.

6.8.3.1 HEADS LOADED SWITCH ADJUSTMENT

1. STOP and power down per 2.3.3 and 2.3.4.
2. Remove top cover.
3. Identify heads loaded switch leadwires.
4. Connect a multimeter (set to RX1) across switch terminals.
5. With carriage retracted, multimeter should indicate zero ohms.

CAUTION

Do not move carriage forward far enough to fall off the cam tower and thus allow heads to load onto the disks.

6. Slowly move carriage towards spindle while observing multimeter. Multimeter must indicate infinite ohms when carriage has traveled 0.07 (±0.04) inch from full retract stop. (Distance is measured from rear edge of carriage to magnet.) If adjustment is needed, proceed to next step. If no adjustment is needed, proceed to step 9.

NOTE

Make certain that carriage is fully retracted while performing next step.

7. Loosen screws securing heads loaded switch to mounting bracket. Adjust switch position until it actuates after 0.07 (±0.04) inch travel from full retract stop. Tighten screws when switch position correctly adjusted.
8. Install top cover.
9. Set AC POWER circuit breaker to ON.
10. Press START switch to operate drive.

6.8.3.2 CARTRIDGE ACCESS DOOR INTERLOCK SWITCH ADJUSTMENT

1. Stop the unit and power down per 2.3.3 and 2.3.4.
2. Remove the cover from the unit per 6.7.1.
3. Remove the front panel per 6.7.3.
4. Refer to Figure 6-22.1 for the following steps. Identify the cartridge access door closed interlock switch and its leadwires.
5. Remove the striker plate mounting screws.
6. Remove the striker plate and spacer(s) and disconnect the leadwires.
7. Loosen the switch mounting hardware.
8. Refer to View "A" in Figure 6-22.1. Adjust the position of the switch until the operating position* is reached at 0.150 ±0.010 inches (3.8 ±0.3 mm) below the striker plate top. This is dimension "Z" in View "A" and is measured coincident with the center line of the striker plate slotted mounting holes.

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* Refer to the NOTE at the beginning of Section 6.8.3 on operating position and test method.

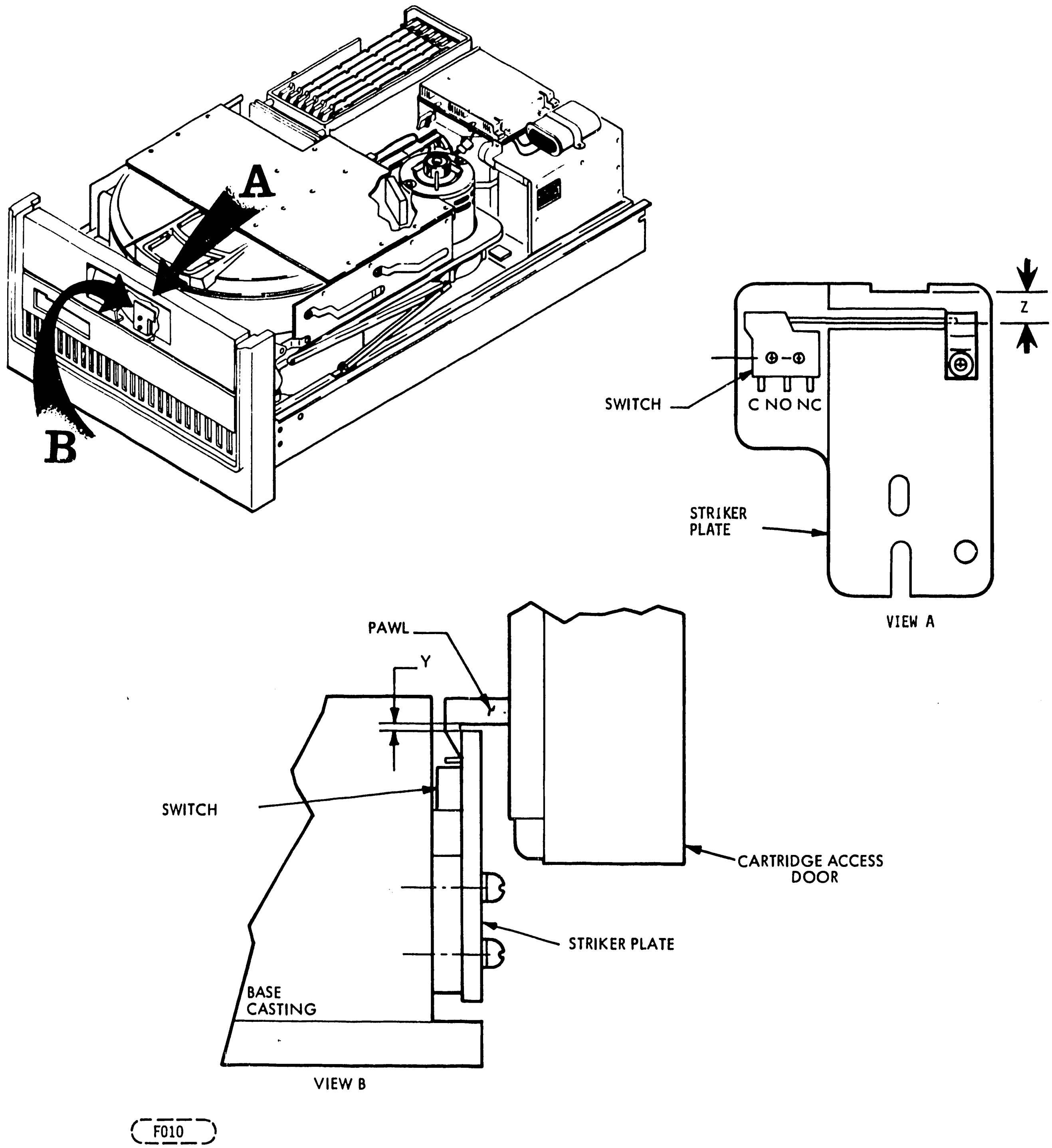


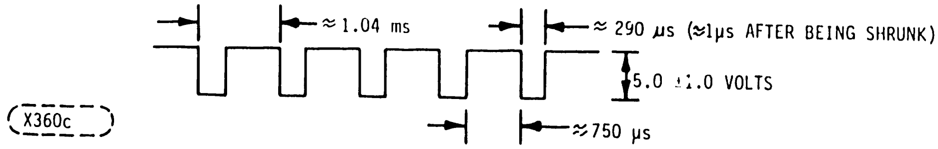
FIGURE 6-22.1. CARTRIDGE ACCESS DOOR INTERLOCK SWITCH AND STRIKER PLATE ADJUSTMENT

9. Tighten the switch mounting hardware and check to see that the operating position* (dimension "Z") has not changed. If the operating position has changed readjust per steps 7 and 8 above.
10. Replace the leadwires, spacer(s), striker plate and mounting hardware. Do not tighten the striker plate mounting screws yet.
11. Close the door to the locked position.
12. While pulling up on door release slide, (do not pull door forward), raise the striker plate such that dimension "Y" in view B is 0.00 +0.01, -0.00 inch (0.00 +0.3 - 0.0 mm).
13. Tighten the striker plate mounting hardware.
14. Verify that door will not open while pulling up on door release slide and pulling door forward with a force of 10 pounds (45 Newtons).
15. Verify that striker pawl goes over striker smoothly.
16. With the door still closed and locked, verify that any movement of the door due to "play" will not allow the switch contacts to open. If the switch contacts open readjust the switch per this procedure.
17. Replace the front panel and top cover.
18. Set AC power circuit breaker to ON.
19. Push START switch to operate the drive.

6.8.4 PULSE CIRCUITS TESTS

6.8.4.1 SPIN SPEED SENSOR TEST

1. STOP and power down per 2.3.3 and 2.3.4. Remove AC line cord from power source.
2. Remove top cover. Remove screw which secure Electronics Module.
3. Lift Electronics Module and swing to side of unit.
4. Connect oscilloscope probe channel A to TP16 on top edge of Servo Coarse PWA (see Figure 3-16).
5. Set oscilloscope vertical sensitivity to 2 Volt/div for channels A & B; horizontal sensitivity to 0.2 or 0.5 ms/div.
6. Set AC POWER circuit breaker to ON. Connect AC line cord to power source. Operate START switch.
7. When READY indicator comes on unit should be up to speed. Pulse width of the spin speed sensor pulses should be approximately 250 µs at Logic 1 (this is not critical) and varies slightly with spindle speed. The width after shrinking is more important (see Step 8). See waveforms shown below.



8. Change horizontal sensitivity to 1 µs per div. and put probe from channel B on TP12 of the Servo-Coarse PWA. The pulse should have been shrunk to about 1 µs in duration (100 ns min, 8.5 µs max).

---

* Refer to the NOTE at the beginning of Section 6.8.3 on operating position and test methods.

6.8.5 SYSTEM ADJUSTMENTS AND DISABLING PROCEDURE

6.8.5.1 GENERAL

There are only two adjustments that are required by field service personnel and these are the velocity gain adjustment and the servo and data read/write head alignment. The procedures for these are given in paragraphs 6.8.5.2 and 6.8.5.4. Misadjustment of these may cause difficulties that appear to be malfunctions of the hardware. If any Servo-Coarse PWA is replaced or swapped between drives and a malfunction appears that wasn't there before, check velocity gain.

6.8.5.2 VELOCITY GAIN ADJUSTMENT

Position switch S1-8 on the Servo-Coarse PWA to the OFF (Open contacts) position (right side down).* Actuate the momentary switch on the Control/Mux PWA (S1) and observe the fault indicators (see Figure 2-3).* Velocity gain is adjusted to the correct value using adjustable resistor R7 on the Servo-Coarse PWA. When S1 on the Control/Mux PWA is actuated, the carriage seeks to track 822 and stops there. LED #2 will be lit constantly when in this mode and one of the LED indicators #3 through #7 will light to indicate the status of the velocity gain. Table 6-4 shows the interpretation of the Fault indicators when S1 is activated and shows which way to turn R7 to bring the velocity gain into proper adjustment. Each time S1 is actuated the drive performs a seek to track 822 and the M.P. calculates the velocity of the carriage and stores it. The value of velocity stored is compared with the correct value in the M.P., and then the M.P. commands one of the indicators #3 through #7 be turned on, depending on the results of the comparison.

TABLE 6-4. VELOCITY GAIN ADJUSTMENT TABLE

INDICATOR #**	INTERPRETATION	SERVO-COARSE R7 ADJUSTMENT
3	Velocity gain very low	Turn Clock-wise coarse
4	Velocity gain low	Fine tune clock-wise
5	Velocity gain all right	No adjustment necessary
6	Velocity gain high	Fine tune counter clock-wise
7	Velocity gain very high	Turn counter clock-wise coarse

** Indicator #2 will be on for the following situations

* See Section 6-9 "Maintenance Aids"

Velocity Gain Adjustment Procedure

NOTE

> To prevent erroneous readings, the unit should be warmed up by doing alternate seek routine for five minutes prior to checking the adjustment.

1. Position switch S1-8 on Servo-Coarse PWA to OFF (right side down).

CAUTION

> Do not actuate S1 on the Control/Mux PWA when the drive is stopped and switch S1-8 (velocity gain adjustment switch) on the Servo-Coarse PWA is off. It is possible in this condition for the motor to start independent of the interlock system and the operator control panel.

2. Toggle S1 on Cntl/Mux PWA ten times and verifying that CR #5 is lit no less than 9 of the 10 times. If the unit does not pass this or if CR4 illuminates during any of the 10 times, then proceed with the adjustment procedure. If the unit passes this test, go to step 5.
3. Adjust R7 on Servo-Coarse PWA so that CR6 lights on each toggle of S1; use Table 6-4 to determine which direction to turn R7. This adjustment should be done in 1/2 turn increments.
4. After adjusting R7 so that CR6 lights for each toggle of S1:
   a. Begin adjusting R7 counter clockwise in 1/4 turn increments until CR6 or CR5 will randomly light. Check several times by toggling S1.
   b. Turn R7 pot 1 full counter clockwise and check the gain setting as in Step 2.
5. Restore switch S1-8 to ON (left side down) and return to normal operation.

6.8.5.3 SERVO DISABLE PROCEDURE

If it should be necessary to disable the servo system for some reason, follow the procedure given below. Use either method.

Jumper Method

- STOP and power down per 2.3.3 and 2.3.4.
- Remove top cover of the unit.
- Remove the Servo-Coarse PWA from the Electronics Module.
- Jumper together Pins E1 and E2 located in the middle, right side (component side) of the Servo-Coarse PWA. Refer to Figure 3-16. A jumper plug is available.
- Replace Servo-Coarse PWA. Apply power as needed.

- Remove jumper on E1 and E2 when it becomes necessary to enable the servo system again.
- Replace top cover and restore to normal operation.

NOTE

On new Servo-Coarse PWAs the servo disable jumper is accessible without removing the card from the Electronics Module.

To disable servo, simply move attached jumper plug from J2-2 and 3 to J2-1 and 2. Refer to Figure 3-16.

Alternate Method

- STOP and power down per paragraph 2.3.3 and 2.3.4.
- Remove top cover of unit per paragraph 6.7.1.
- Disconnect voice coil connector A1P1 (Figure 6-21) from A1J1.
- Servo is now disabled. Power up unit.
- When ready to enable servo system again, power down and reconnect A1J1 to A1P1.
- Replace top cover and power up to restore normal operation.

CAUTION

The difference between the two methods is that the voice coil disconnect totally disables all electronic actuator control of the actuator. (Recommended for manual head positioning.) With the Servo-Coarse PWA jumper method an emergency retract is still possible should the heads be loaded manually and an emergency condition occur. (i.e., power loss, voltage fault, etc.) The jumper servo disable is recommended for any extended purge. For you safety, be aware of the emergency retract possibility should you position the heads manually while jumper servo disable is used.

6.8.5.4 HEAD ALIGNMENT

The Head Alignment section is divided into the following subsections:

1. General
2. Tools and Equipment
3. Head Alignment Purpose and Principle
4. Mechanical Aspects and Precautions
5. Electrical set up and Switch Explanations
6. Head Alignment Offset Calculation
7. General Precautions
8. Preparation
9. Switch and Scope Settings

10. Head Alignment Check
11. Cartridge Servo Head Alignment and Verification
12. Cartridge Data Head Alignment and Verification
13. Operational Check
14. Fixed Module Data Head Alignment

1. General

The following procedures must be followed very carefully and all precautions must be observed in order to ensure proper alignment and to prevent any unnecessary damage to the CMD, its media and heads.

CAUTION

Head alignment should be performed by properly trained and/or experienced field service personnel only.

HEAD ALIGNMENT (OFFSET) SHOULD BE CHECKED

- When the drive shows an increasing read error rate which is not due to head to disk contact or read/write electronics.
- If the drive shows incompatibility on its removable media.
- If the drive has volume change problems (going from cartridge to fixed or vice versa).
- Refer to sub-section 10 for head alignment check.

HEAD ALIGNMENT MUST BE PERFORMED

- On a new drive prior to leaving the factory.
- When the above mentioned checks prove the head(s) are out of tolerance.
- When the fixed media is replaced.
- When any of the drive's servo heads or the cartridge data head is replaced.
- If head screws have been loosened and/or heads have been moved accidentally.
- Refer to sub-sections 11 and 12 for head alignment.

NOTE

If heads are replaced due to head-to-disk contact, both heads and media will have to be replaced, and the drive must be cleaned thoroughly.

NOTE

The fixed data heads are somewhat special as there is no head alignment in the classical sense. Refer to subsection 14 at the end of this section on head alignment.

2. Tools and Equipment Required

- Torque screwdriver (77611696) and bit (87016704)
- Head alignment tool (75893963)
- CE alignment cartridge 1204-51 (76204400)
- Field test unit TB216 or proper system diagnostics
- Oscilloscope, Tektronix 453, 465, 475 or similar

The TB216 FTU includes the following head alignment hardware additionally:

- Head alignment extender card (75886001)
- Head alignment card AZPV (54285300)
- Head alignment cable 8 pin (77612337)
- Head alignment cable 2 pin (75882394)
- A/D converter to read the offset from front panel

NOTE

> If no TB216 is available, these additional items must be purchased as the "Head Alignment Kit", (P/N 75882399 or 75899096). This kit also includes an analog meter to read the offset.

3. Head Alignment Purpose and Principle

PURPOSE

The basic purpose of head alignment is to ensure compatibility between different drives of the same kind and their removable media.

Fixed media drives usually do not require head alignment, as heads and media are never separated. However, the CMD is somewhat special in this case.

As the CMD has two servo heads, one for the cartridge and one for the fixed module, there will be two procedures for head alignment:

1. Align cartridge servo head to fixed servo head.
   This ensures that:
   - Both servo heads are on the same track
   - Both servo heads are within the specified tolerance to each other for volume switching during normal operation.

2. Align cartridge data head to cartridge servo head.
   This ensures that
   - The cartridge data head is at the same position as the servo head for compatibility.

NOTE

Usually there is no alignment in the classical sense for the fixed data heads, however, any change in initial position of the fixed servo head or any of the fixed data heads would affect their alignment or track reference.

Should it be necessary to align one or more fixed data heads after initial alignment, a procedure is given at the end of this section which describes how to "realign" a fixed data head, even though this is more involved than the normal procedure.

PRINCIPLE

A dibit signal read from the media is used to align servo and data heads. The dibit signal is written on the servo surfaces of fixed volume and cartridge, however, the alignment (CE) cartridge in addition has dibit tracks written at specific locations of its alignment (data) surface. Refer to Figure 6-23a.

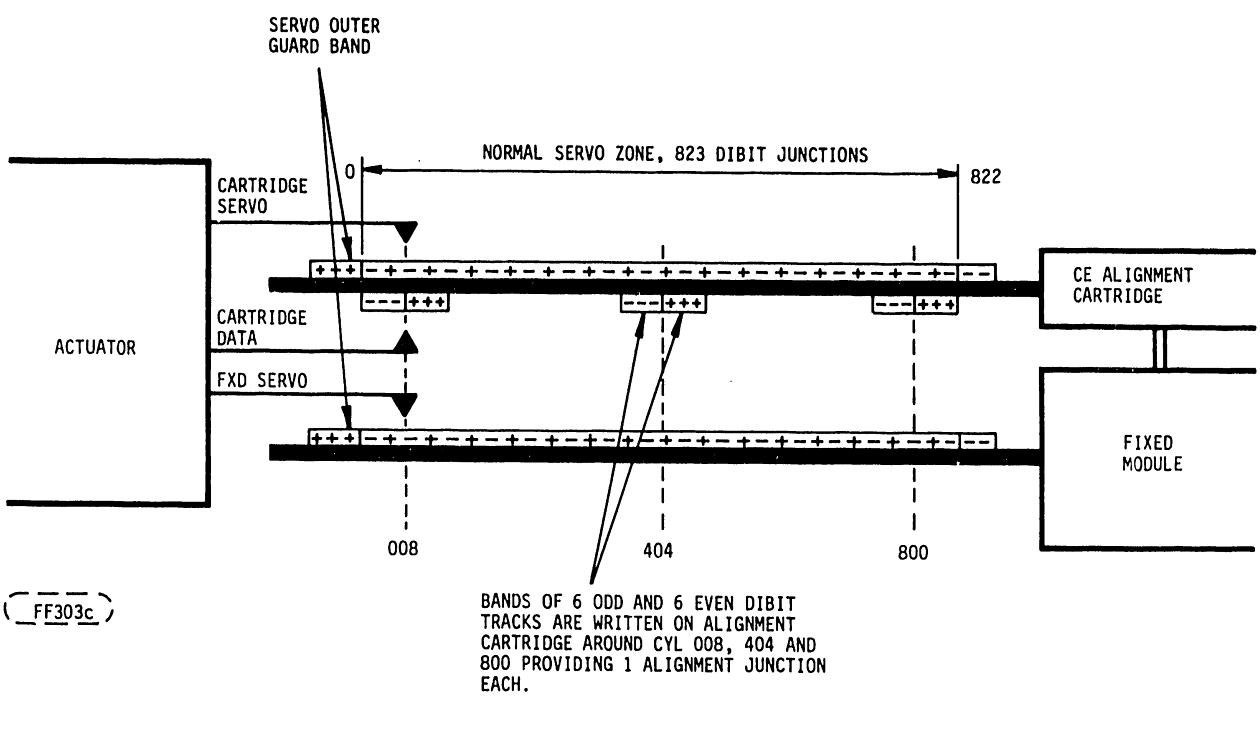
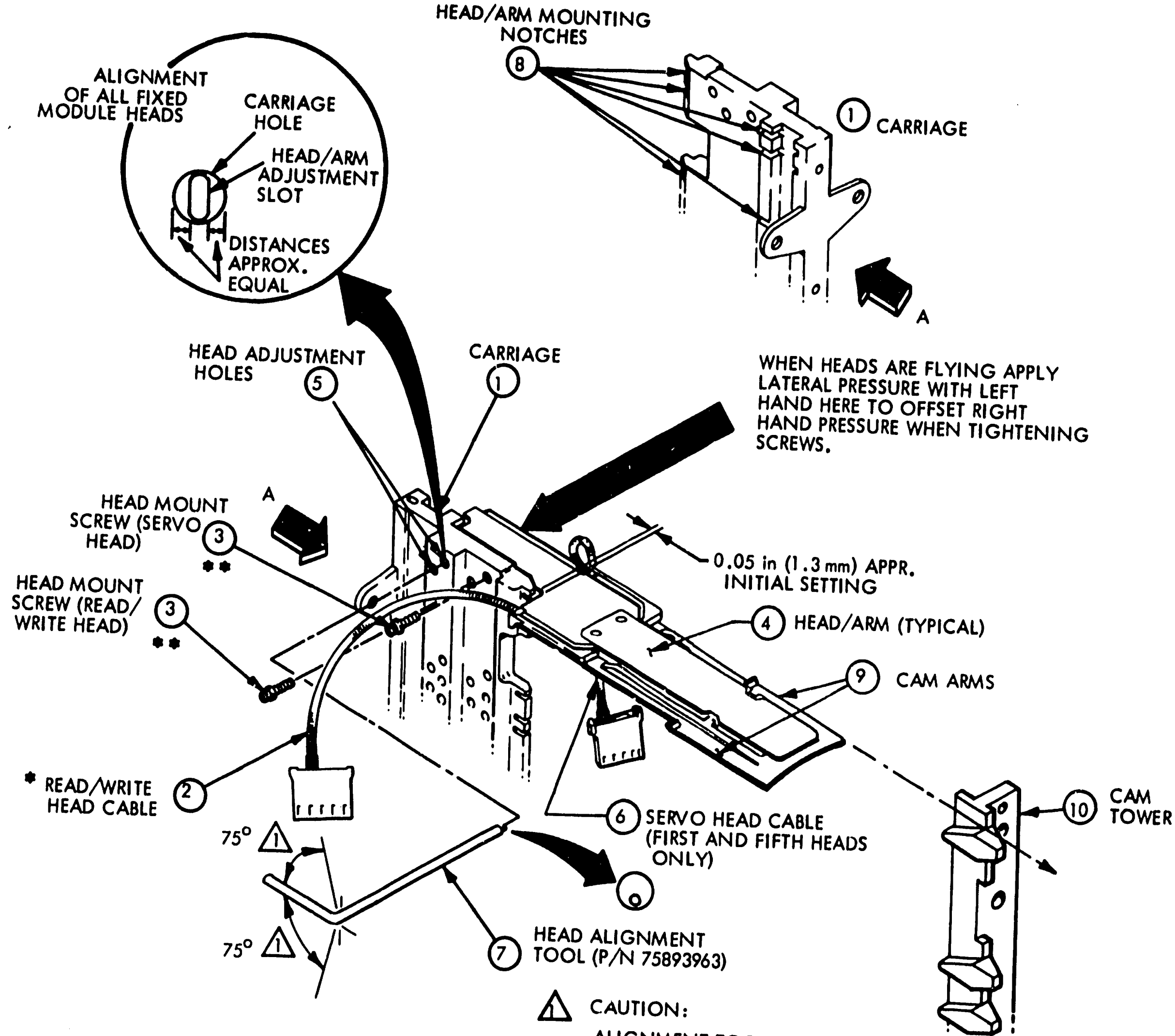


FIGURE 6-23A. DIBIT SIGNAL LOCATIONS



⚠ CAUTION:

ALIGNMENT TOOLS ON SOME DRIVES CANNOT BE ROTATED MORE THAN 150°. ROTATING TOOL BEYOND 150° MAY DAMAGE HEAD SLOT OR ALIGNMENT TOOL.

* SHOWN ON FIRST HEAD/ARM FOR ILLUSTRATIVE PURPOSES ONLY.

** USE 3/32 INCH HEX BALL BIT (87016704)

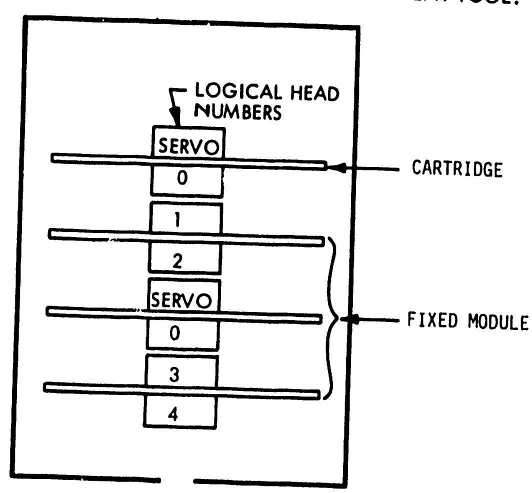


FIGURE 6-23B. MECHANICAL ASPECTS OF HEAD/ARM REMOVAL AND REPLACEMENT AND ALIGNMENT

After seeking to a certain track, the non tracking (non-selected) servo head and the cartridge data head can be moved with the head alignment tool to find a specific odd/even junction. However, trying to move the tracking servo head would result in an actuator movement as the tracking servo head will keep its on track position through the drive's servo electronics.

4. Mechanical Aspects and Precautions

This section describes mechanical aspects of head alignment and notes some very important precautions. Refer to Figure 6-23b for assistance in visualizing the meaning of statements given relating to the mechanics involved.

Use only the specified alignment tool and calibrated torque screwdriver and bit. Ensure the alignment tool is clean and free of damage.

Ensure the head mounting screws are tightened to the specified torque requirement, otherwise damage to tool or head arm could occur.

When inserting the adjustment tool, locate the head arm alignment slot with the tip of the tool prior to applying any turning force.

When turning the tool, enough inward force should be applied on the tool to ensure tool and arm-slot engagement. At the same time, apply counterforce from the other side of the carriage using your free hand. This prevents the carriage from tilting while heads are flying.

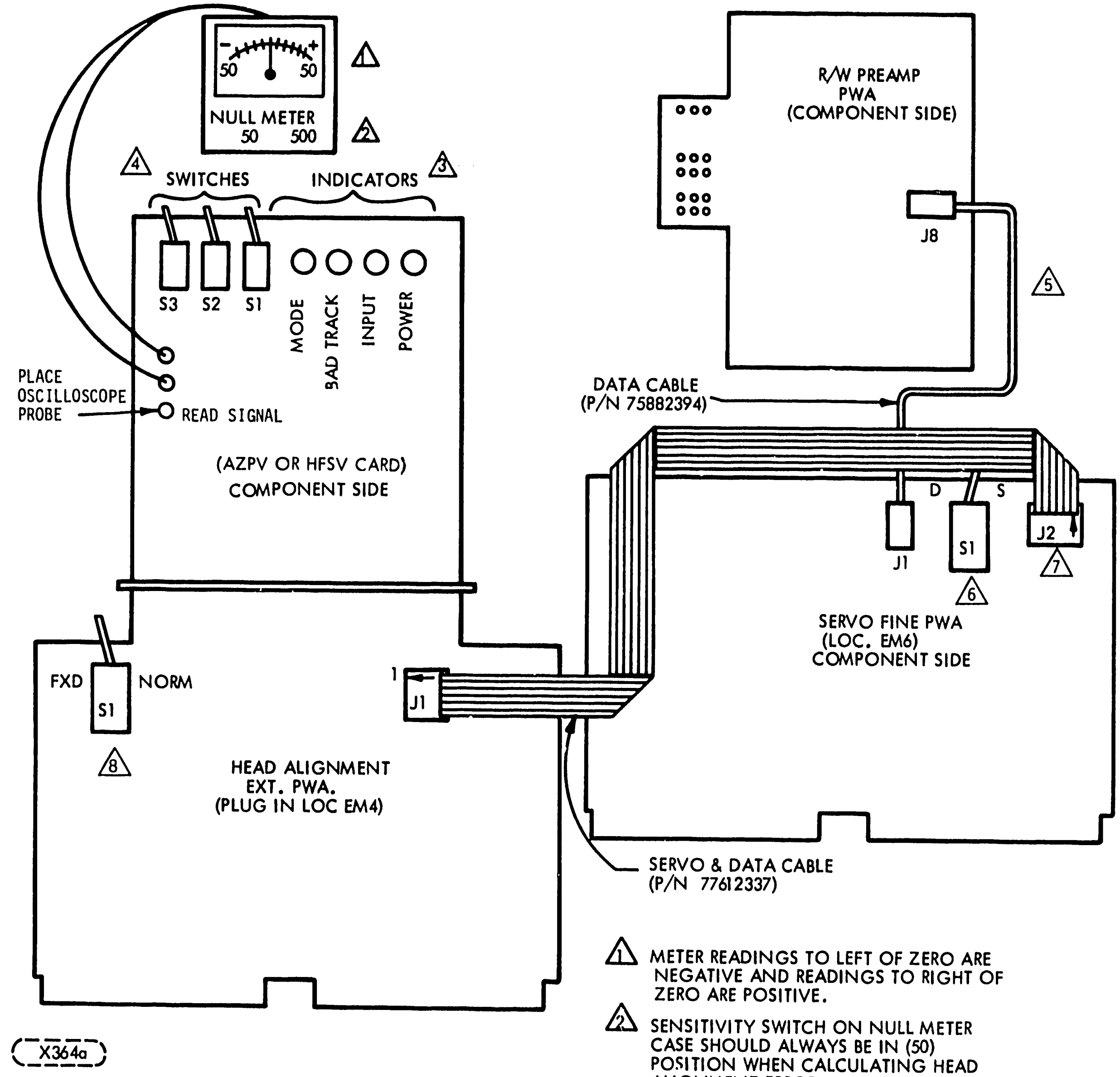
NOTE

"Rounding-out" of the head arm adjustment slot prevents further adjustment of that particular head and it may require replacement.

When torquing the head clamping screw, keep torque driver as perfectly aligned with head screw as possible. If care is not taken, the head arm could be pushed out of alignment again.

CAUTION

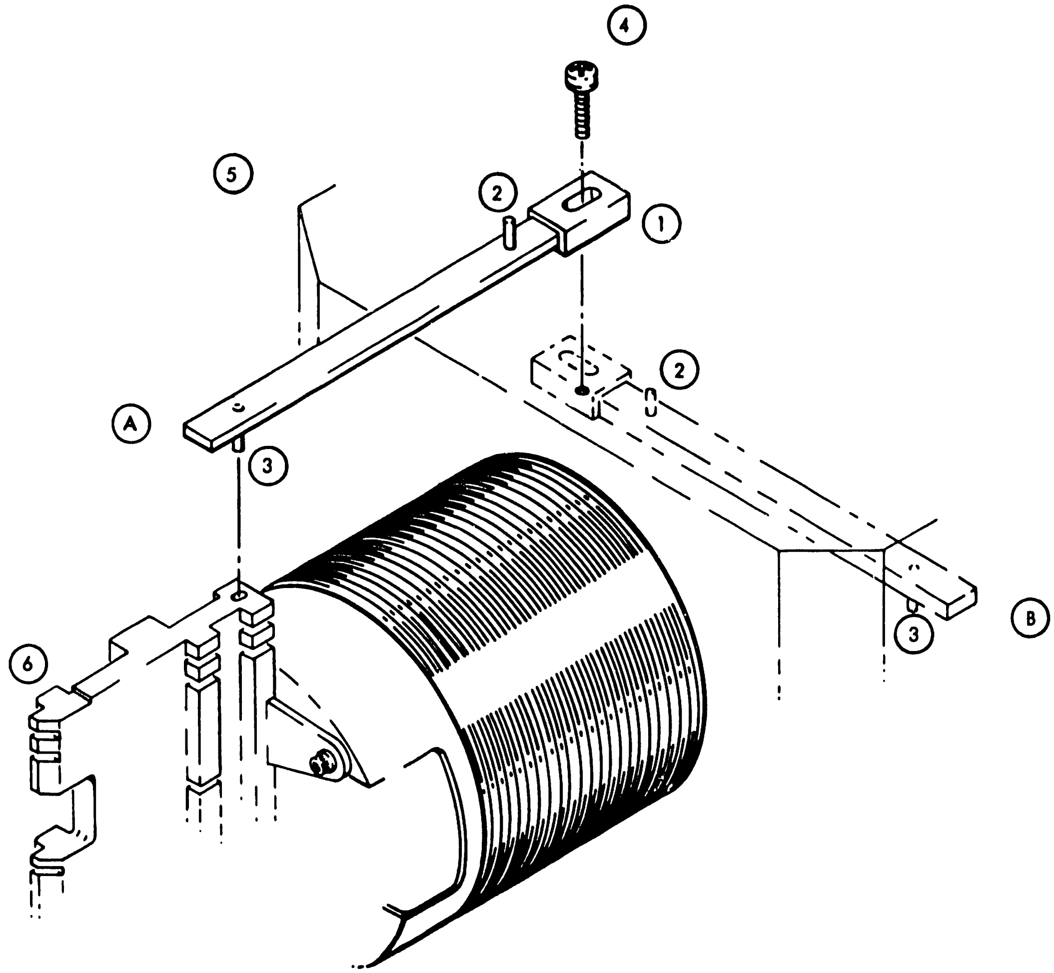
Do not loosen or remove head clamping screws while heads are loaded.



1. METER READINGS TO LEFT OF ZERO ARE NEGATIVE AND READINGS TO RIGHT OF ZERO ARE POSITIVE.
2. SENSITIVITY SWITCH ON NULL METER CASE SHOULD ALWAYS BE IN (50) POSITION WHEN CALCULATING HEAD ALIGNMENT ERROR.
3. AZPV PWA HAS NO INDICATORS.
4. S1: POLARITY SWITCH
   S2: DO NOT MOVE FROM POSITION SHOWN IN ILLUSTRATION.
   S3: METER SENSITIVITY SWITCH. POSITION SHOWN IN ILLUSTRATION IS FOR DVM (XI).

5, 6, 7, 8 SEE TEXT.

FIGURE 6-23C. HEAD ALIGNMENT BLOCK DIAGRAM



Ⓐ CARRIAGE LOCK PIN ① IN HEAD ALIGNMENT POSITION

Ⓑ CARRIAGE LOCK PIN ① IN OPERATING POSITION

FIGURE 6-24. CARRIAGE LOCKING TOOL-HEAD ALIGNMENT POSITION

CAUTION

Whenever the heads are adjusted and the clamping screws are turned while the heads are flying, extreme care should be taken so as not to move the carriage assembly in a lateral direction (right angles to the normal direction of head movement). THE RESULTANT FORCE CAN ROTATE THE CARRIAGE ASSEMBLY AND CAUSE SEVERE DAMAGE TO THE HEADS AND DISKS. This motion can be prevented by applying sufficient counter force on the opposite side of the carriage.

5. Electrical Set-Up

Refer to Figure 6-23c for a diagram of the electrical set-up for the alignment. The numbers in triangles in the following description refer to items in the figure flagged with the same numbers.

Switch/Connection Explanations

During head alignment, the differential analog read signal of the cartridge data head passes through the cable J8-J1 △5 to the Servo-Fine card. The signal will be dibits whenever the head is positioned around the alignment tracks of the CE cartridge. The polarity of J1 and J8 connection does not matter.

Switch S1 △6 switches between dibit signals that go to the alignment card for reading the mV offset. In POS S, it selects the cartridge servo dibits, regardless of which servo head is selected for tracking.In POS D, it selects the signal from the cartridge data head that goes to the preamp via J1.

NOTE 1: The balanced dibit signal of the track servo head is also on the J2 △7 cable to EM4 and can be selected from the analog alignment card.

NOTE 2: Make sure connector J2 is plugged in oriented as shown. Note the arrow on right end of connector.

S1 on EM4 △8 selects the tracking servo head. In POS FXD, the switch selects the fixed servo head to be the tracking one bypassing the unit's volume selection logic.

In POS NRM, the unit's volume selection logic selects the tracking servo head.

After loading heads or an RTZ command ,the cartridge servo head is selected unless:

- Otherwise commanded thru the I/O, or
- The unit has the invert volume option active.

NOTE

If invert volume is selected on those Cntl/Mux cards have that feature and a TB216 FTU is used for head alignment, it is advisable to switch back to standard volume in order to follow this head alignment procedure.

If a system is used for head alignment, make sure to have the right servo head selected for tracking as indicated in this procedure.

The analog alignment card AZPV converts the incoming dibit signal of either servo or data head into a mV reading available at the output jacks A and B (common and +). The testpoint is used to display the dibit signal on the scope for reference.

Switches (see 4, Figure 6-23c):

S3 - This switch connects the offset voltage unchanged (X1) or divided by 10 (X.1) to jacks A and B. Position X.1 is for analog meter protection only. This switch can stay in X1 (true offset volt.)

- if a TB216 A/D converter is used for the mV reading,
- if the volt meter has a range select.

The maximum voltage on jacks A and B is around 1200 mV. Make sure to be in the correct range when taking the final readings. Refer to TB216 FTU manual for how to read the offset voltage from the tester front panel (Digital Read Out).

S2 - POS R/W selects S1 on Servo-Fine as an input. S1 in turn selects either the cartridge servo or cartridge data head signal for display. Throughout the alignment procedure, S2 can stay in position R/W.

POS S selects the balanced dibit signal of the tracking servo head regardless of the positions of other switches.

NOTE

Observing the tracking servo head dibits might be of interest, but it is not required during head alignment.

S1 - POS P (POSITIVE) and N (NEGATIVE) are used to calculate the actual offset of the head under alignment. Both values (P and N) must be noted. Refer to offset calculation for details.

NOTE

Some older analog alignment cards (delivered with the TB304 SMD Tester) could be the HFSV type. They are fully interchangeable with the AZPV card. Ignore the four extra LED's on these cards or refer to the TB304 Tester Manual.

6. Head Offset Calculation

A given dibit signal appearing on the oscilloscope during head alignment may look similar to Figure 6-25a.

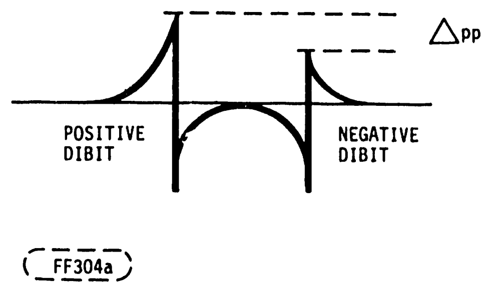


FIGURE 6-25A. UNEVEN DIBIT SIGNAL

NOTE

Dibit signal and peak differential on scope are for reference only. The alignment reading is to be taken from meter.

With S1 in position P the analog card calculates the difference between the positive peaks and in position N the difference between the negative peaks using the inversion of the signal.

The two values will have opposite polarity and may have different absolute values. To get the final head offset, the two values are added algebraically as shown below.

$$(\pm P) - (\pm N)$$

Example 1: P = -30 mV
N = +50 mV

(P) - (N) = (-30) - (+50) = -80 mV

This is called the calculated offset. Compare this offset to the limits given later in the alignment procedure in order to determine if the heads are within tolerance or not.

Example 2: P = +40 mV
N = -15 mV

(P) - (N) = (+40) - (-15) = +55 mV

As 1 mV approximates about 0.5 microinches (12.7 nm) physical offset, the head would be "off" ideal position by about 40 microinches (1016 nm) in example 1 in one direction and about 27 microinches (685 nm) in example 2 in the other direction. See Figure 6-25b.

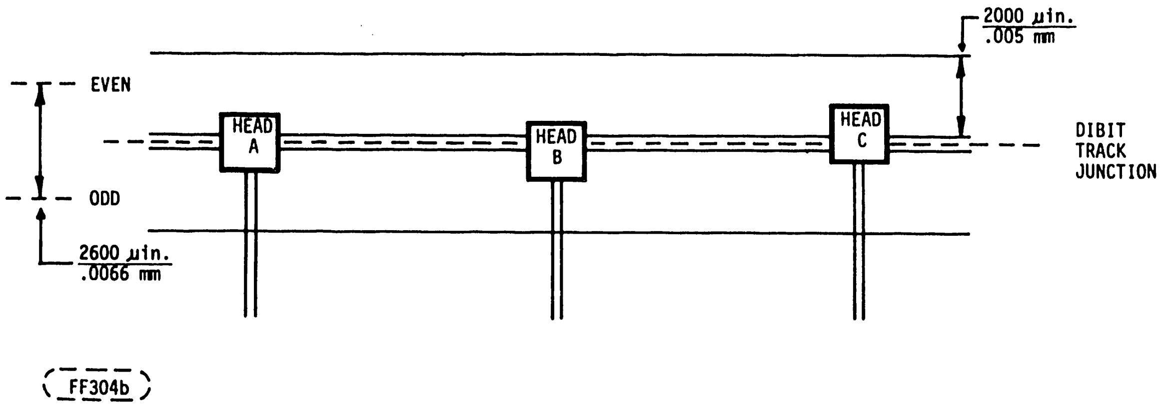


FIGURE 6-25B. HEAD OFFSET EXAMPLES

In Figure 6-25B note that:

Head A has ideal alignment position - offset reading 0 mV,

Head B is offset by XX microinches in one direction.

Head C is offset by XX microinches in the opposite direction.

So, the calculated offset value of ±XX mV indicates by the + or - in which direction the head is offset, and by the absolute value of XX mV the amount of offset. During head alignment, the amount of offset is the important factor, rather than the direction (or polarity).

7. General Precautions

Before starting head alignment, make sure the data on the fixed module is saved, unless the fixed servo head is not moved. Recovery of fixed module data (due to a moved fixed servo head) by "aligning" the fixed data heads is a time consuming process, even though it is possible.

With an alignment cartridge installed, the drive should be in write protect mode to prevent accidental overwriting of alignment tracks, even though an installed alignment card provides an internal write protect.

- Use the alignment cartridge for head alignment and index to burst check only. Remove it immediately upon completion of any of those two procedures.
- Always allow sufficient warm-up time as described later.
- Be extremely careful when manipulating on heads while they are flying. Do not apply any force to heads or carriage other than the force required for proper alignment and torquing.

- Never loosen a head arm screw while heads are flying.
- When on alignment track, install carriage locking tool before moving head arms for alignment. This protects you from personal injury in care of an actuator retract.

NOTE

> In case of a mistake, an attempted seek or RTZ with the locking tool installed will not harm the drive, however, if power is lost, the carriage must be retracted manually as quickly as possible.

- Be careful when swinging the Electronics Module into maintenance position for access to the head and arm screws and alignment slots as there are several cables, wires and the alignment card attached.

8. Preparation for Head Offset Check and/or Head Alignment

a. Press STARt/STOP switch to STOP and wait for ready indicator to cease blinking. Leave existent cartridge in drive.

b. Switch AC breaker off.

c. Remove top cover.

d. Do the electrical set up according to Figure 6-23c.

   1. Plug extender card into EM4 slot of Electronics Module.
   2. Plug analog alignment card into extender card.
   3. Plug 8 pin CBL from EM4 to EM6 (note orientation).
   4. Plug 2 pin CBL from R/W preamp to EM6. Connect the analog card jacks A & B to the alignment input of the TB216 tester or to your analog meter.
   5. Connect oscilloscope CH1 to the testpoint of analog card.

e. Connect TB216 or system I/O to unit.

f. Carefully lift and swing Electronics Module into maintenance position. WATCH CABLES!

g. If head offset has to be checked only, proceed with paragraph 10. If heads are within tolerance, alignment is not necessary.

h. If head alignment has to be performed, proceed as follows:

i. Verify position of fixed servo head arm relative to carriage by checking head alignment slot being centered in the carriage adjustment hole. See Figure 6-25c.

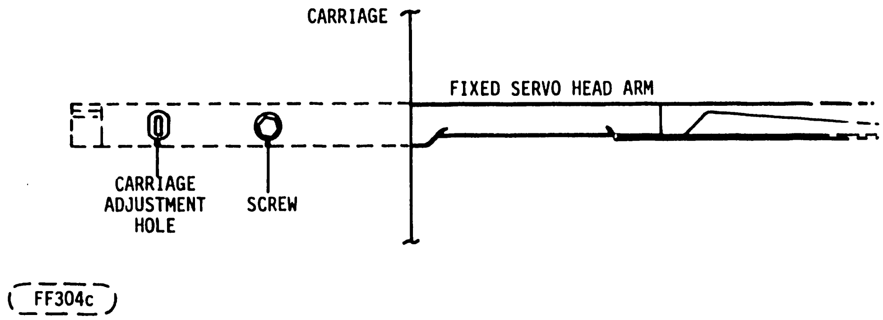


FIGURE 6-25C. CARRIAGE ADJUSTMENT HOLE ALIGNMENT

If slot is not centered, loosen fixed servo head mounting screws and, using head alignment tool, center slot in hole. Then, torque head mounting screw to 12 lbf-in.

NOTE

> Centering of fixed data heads is advisable but not necessary. If desired to do so, perform same routine as used for fixed servo heads.

j. Loosen cartridge servo and data head mounting screws and torque to 4.5 lbf-in.

k. Apply AC to unit, open cartridge door and install CE alignment cartridge, close door.

l. Press START/STOP switch to START and wait for unit to come ready.

m. Perform temperature stabilization by allowing drive to run 60 minutes with heads loaded.

NOTE

> If alignment is done on more than one drive, an adaption period of 15 minutes of a warm CE cartridge in a warm (running) drive is sufficient.

9. Switch and Oscilloscope Settings

- Set the switches on analog alignment card AZPV as follows and retain throughout the alignment and check procedures:

  S3 - In POS X1 (unless meter used requires range X.1)

  S2 - In POS R/W (unless display of the tracking servo head signal is desired)

S1 - Toggle this switch between P and N to obtain offset readings.

- Set S1 on EM4 extender PWA to select the servo head to be used for tracking:

FXD - (Fixed servo head)
NRM - (cartridge servo head) (unless otherwise commanded from TB216 or system controller)

- Set S1 on EM6 (Servo-Fine) PWA to select source of the signal to be from the cartridge servo (POS S) or cartridge date (POS D) head.

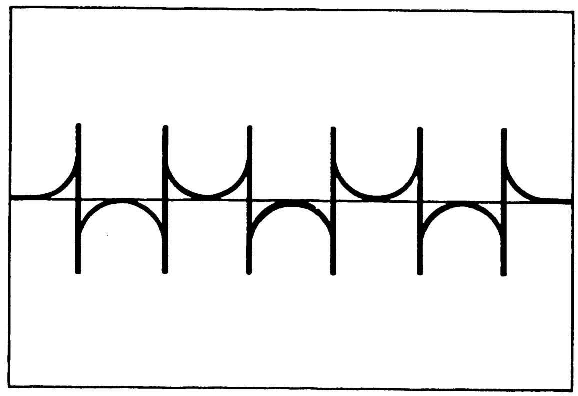
- Make oscilloscope settings for use throughout these procedures as follows:

VERT. 0.5V/DIV

TIME 0.5 μs/DIV

CHAN. 1: TESTPOINT OF AZPV CARD

TRIGG: INT. CHI. POS.



FF305a

FIGURE 6-25D. DIBIT PATTERN SHOWING ON-TRACK PATTERN

10. Head Alignment Check

- Cartridge Servo Head

Refer to Figure 6-26A, view 2 for orientation.

a. Set up the unit by performing paragraph 8, Steps a through f and j through m. Now the unit is ready for alignment check.
b. Set S1 on EM4 to "FXD" and issue RTZ.
c. Set S1 on EM6 to "S".

d. Perform direct seek to the following cylinders and verify the calculated offset being within tolerance:

- CYL 404_{10} $\leq \pm 300$ mV
- CYL 8_{10} & 800_{10} $\leq \pm 600$ mV
- CYL 0 & 822_{10} $\longrightarrow$ No guardband reading

If the above listed parameters are met, cartridge servo head alignment is not necessary.

- Data Head

Refer to Figure 6-26A, view 3 for orientation.

a. Set up unit by performing paragraph 8, Steps a through f and j through m (same as for servo head check).
b. Set S1 on EM4 to "NRM" and issue RTZ (selects REM. SERVO head for tracking).
c. Set S1 on EM6 to "D".
d. Perform direct seek to CYL $\leq 404_{10}$ and verify the calculated offset (P-N) being $\leq \pm 300$ mV.

If this parameter is met, cartridge data head adjustment is not necessary. If the calculated offset is greater than ± 600 mV, all ON-SITE cartridge data should be transferred to a temporary storage media before cartridge data head alignment is performed.

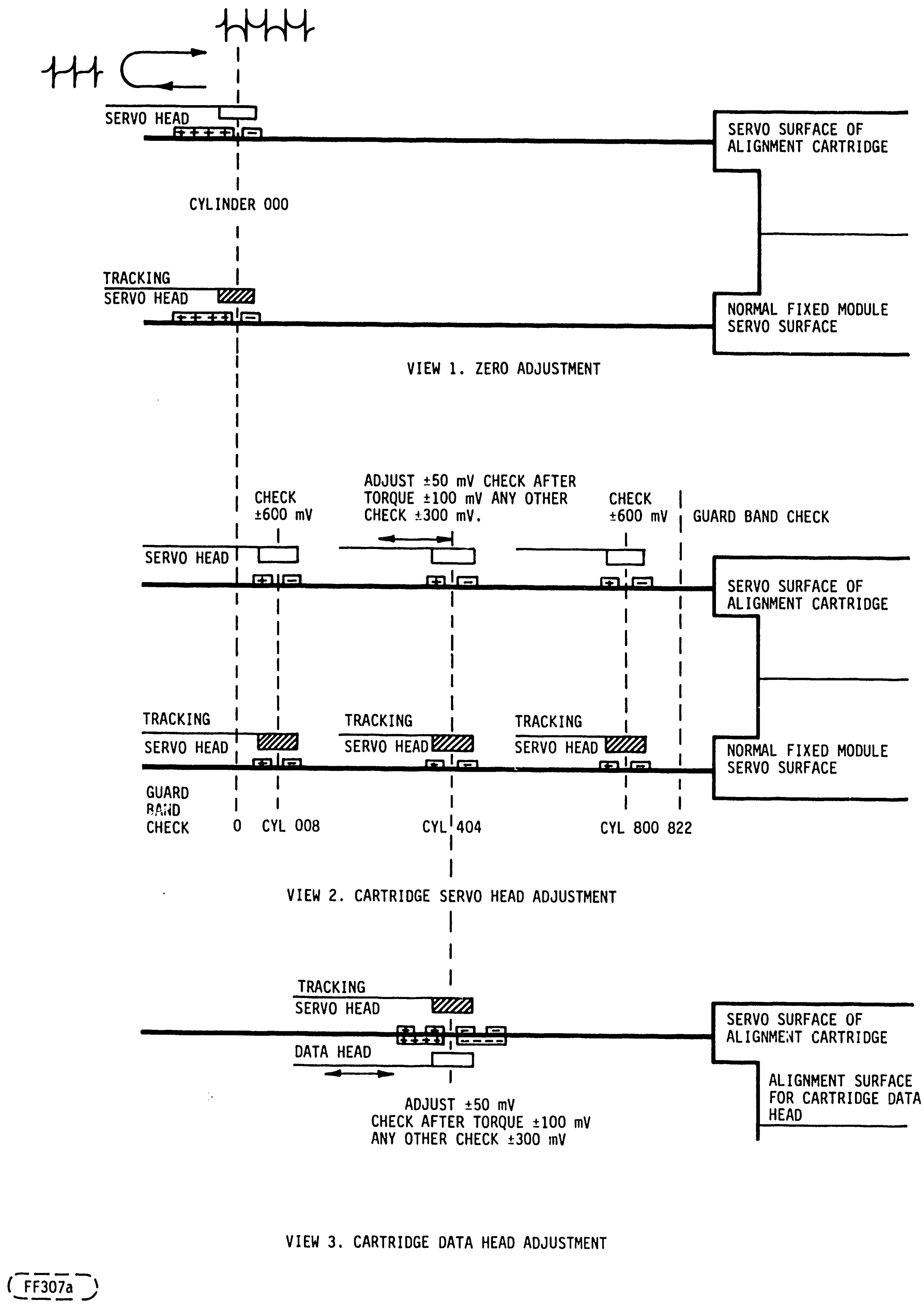
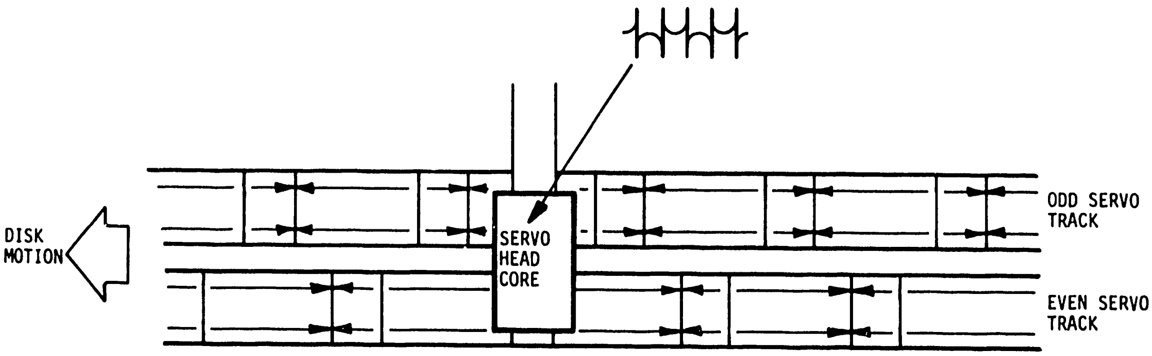
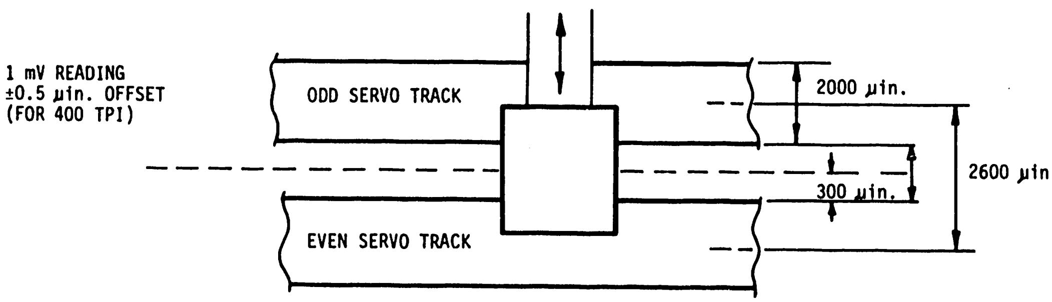


FIGURE 6-26A. DIAGRAMS SUMMARIZING HEAD ALIGNMENT REFERENCES (SHEET 1 OF 2)





VIEW 4. RELATION BETWEEN SERVO HEAD POSITION
AND (1) DIBIT PATTERN, (2) OFFSETS ALLOWED

FF308a

FIGURE 6-26A. DIAGRAMS SUMMARIZING HEAD ALIGNMENT REFERENCES
(SHEET 2 OF 2)

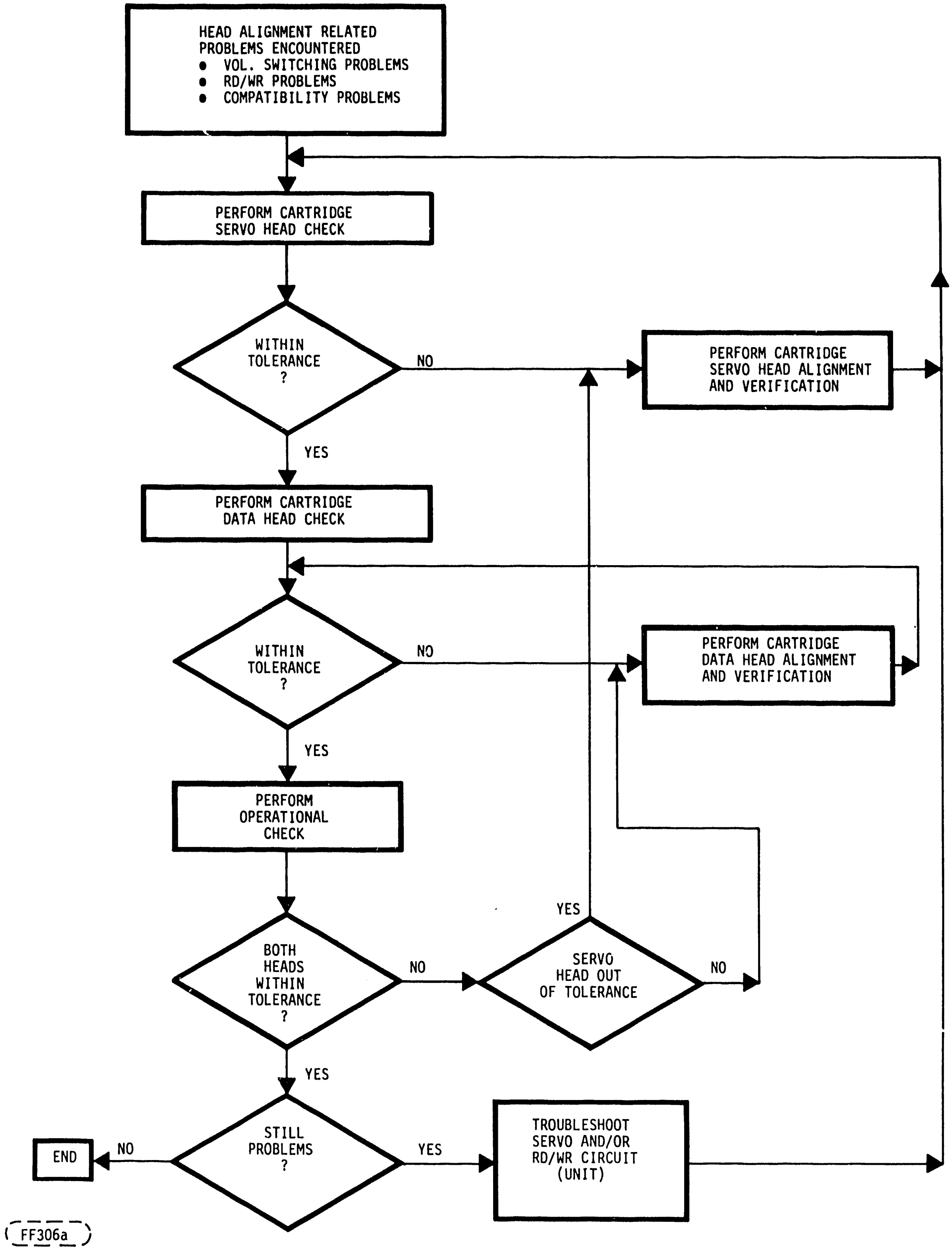


FIGURE 6-26B. HEAD ALIGNMENT AND CHECK FLOWCHART

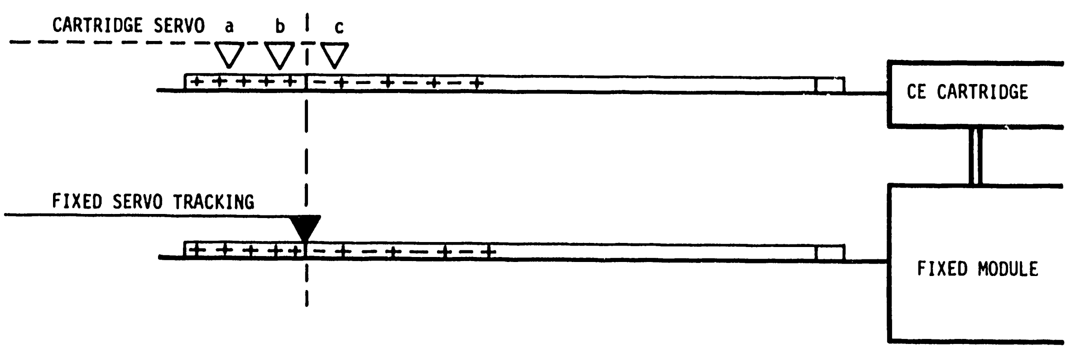
11. Cartridge Servo Head Alignment and Check

Use Figure 6-26a, views 1 and 2 as reference. See note at end of routine for "Fixed Servo Head Alignment".

a. Set S1 on EM4 to POS "FXD" and perform an RTZ command. The unit will recalibrate the fixed servo head to fixed volume cyl 0.

b. With S1 on EM6 card in POS S, the oscilloscope will display the read signal of the cartridge servo head. As the two servo heads are in any undefined relation to each other, the display could be:

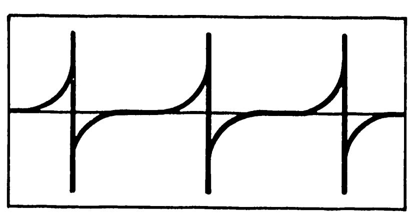
1. Noise (servo head out of any recorded zone)
2. Odd dibits (servo head placed in outer guard band of disk)
3. Odd and even dibits (servo head placed anywhere in servo zone). Refer to Figure 6-26c.



FF305b

FIGURE 6-26C. RELATIVE SERVO HEAD POSITIONING

c. Carefully place alignment tool into alignment hole of cartridge servo head and engage in head arm alignment slot.



FF305c

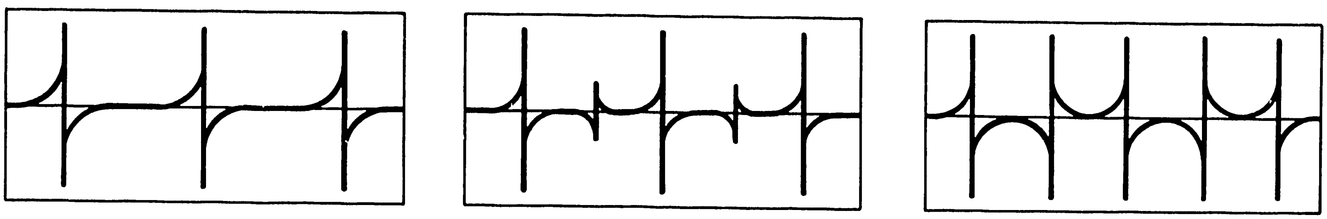
FIGURE 6-26D. GUARD BAND DIBITS

d. Move cartridge servo head in appropriate direction by turning the tool until the oscilloscope indicates outer guard band dibits as shown in Figure 6-26d.

NOTE

Signal polarity shown is with P/N switch in Pos. N. Polarity is not important at this point in the procedure.

e. From the position reached in Step d, carefully and slowly move cartridge servo head forward until oscilloscope changes into a balanced dibit pattern as shown in the three views shown in Figure 6-26e.



FF305d

FIGURE 6-26E. DIBIT PATTERNS FOR GUARD BAND THROUGH TRACK 0

This indicates that the cartridge servo head is placed on cartridge track 0. No voltage readings are taken at this point. Now perform direct seek to CYL 822_{10} and verify that head does not read inner guard band information. If it does, repeat Step d, if not, continue.

f. Perform a direct seek to CYL 404_{10} and allow temperature stabilization for 5 minutes. Oscilloscope display should be similar to Figure 6-26d, view 3.

g. Make note of the mV offset reading in Pos. P and N and calculate total offset. Calculated offset must be within ±50 mV. If not, insert alignment tool and carefully move head arm until the calculated offset meets the ±50 mV specification, and then issue an RTZ command.

h. Carefully torque cartridge servo head to 12 lbf. in. Seek direct to 404_{10} again.

Calculated offset must be within ±100 mV. Otherwise, unload heads, loosen cartridge servo head, re-torque to 4.5 lbf-in., start unit, wait for "READY" and repeat cartridge servo head alignment until the ±100 mV calculated offset limit is met.

i. Perform direct seeks to CYL 0 and 822 and ensure the oscilloscope reads an odd and even dibit pattern. This proves that the cartridge servo head is at the same CYL as the tracking fixed servo head.

If guardband is observed in ether case, unload heads, loosen cartridge servo head screw, re-torque to 4.5 lbf. in., start unit, wait for READY and repeat cartridge servo head alignment.

j. Seek to CYL 8_{10} and 800_{10}; let heads stabilize on each CYL for 5 minutes and calculate offset. Cartridge servo head offset must not exceed $\pm$600 mV on either track.

This completes the cartridge servo head alignment.

NOTE

> In case the fixed servo head only has to be replaced, for any reason other than head to disk contact, there is a way of reversing this procedure and align the replaced fixed servo head to the undisturbed, aligned cartridge servo. Simply have the cartridge servo head tracking, and perform Steps 3 thru 10 of the preceding procedure for the fixed servo head. However, this procedure should be used as an exception for fixed servo head replacements only.

12. Cartridge Data Head Adjustment and Check

Use Figure 6-26a, view for reference.

- After the cartridge servo head is properly aligned, tightened and checked to be within tolerance, set S1 on EM4 extender card to Pos. "NRM" and S1 on servo fine card to Pos. "D".

- Now perform an RTZ command. This will select the cartridge servo head for tracking and recalibrate it to CYL 0. The scope will display the read signal of the cartridge data head, which is of no concern at track 0.

- Do a direct seek to CYL 404_{10} and allow 5 minutes for temperature stabilization. Track 404_{10} on the alignment cartridge data surface is an odd and even dibit junction, which is guarded by 2 bands of odd and even tracks.

- After seeking to 404_{10}, the oscilloscope would display one of the following:
  a. Noise - Cartridge data head placed out of alignment area.
  b. Odd or even dibits only - cartridge data head is placed in one of the bands.
  c. Balanced or imbalanced dibits - Cartridge data head is at, or close to alignment junction.

- Using the head alignment tool, carefully move the cartridge data head until a balanced dibit pattern is observed on the oscilloscope.

- After taking "P" and "N" readings, calculate offset. Adjust head arm until calculated offset is ± 50 mV or less.

- Perform RTZ and carefully torque cartridge data head to 12 lbf. in.

- Seek direct to CYL 404_{10} and check for the head to be within calculated offset of ± 100 mV.

- If the checking limit of ± 100 mV is exceeded, unload heads (stop unit), loosen cartridge data head screw and re-torque to 4.5 lbf. in.

  Start unit, wait for ready and repeat steps 11.d through 11.h.

This completes the cartridge data head alignment.

13. Operational Check

- After proper alignment and check of both cartridge servo and data head, it is necessary to perform the following safety routine to ensure that the heads stay within tolerance under normal operating conditions.

- Perform continuous seeks between CYL 0 and CLY 300_{10} for two minutes. Then, stop unit, wait for spindle to stop, restart and wait for head load and ready.

- Verify that the calculated offset of cartridge servo and data head does not exceed the following limits:

  Cartridge Servo Head:

  a. ± 100 mV on CYL 404_{10}
  b. ± 600 mV on CYL 008_{10} and 800_{10}
  c. No guardband reading on either CYL 0 or 822_{10}

  Cartridge Data Head:

  ± 100 mV on CYL 404_{10}

- Proceed with index to burst check or
  power down unit, remove alignment cartridge and head alignment hardware, and, if desired, checkout drive for proper operation and compatibility using systems diagnostics or TB216 FTU.

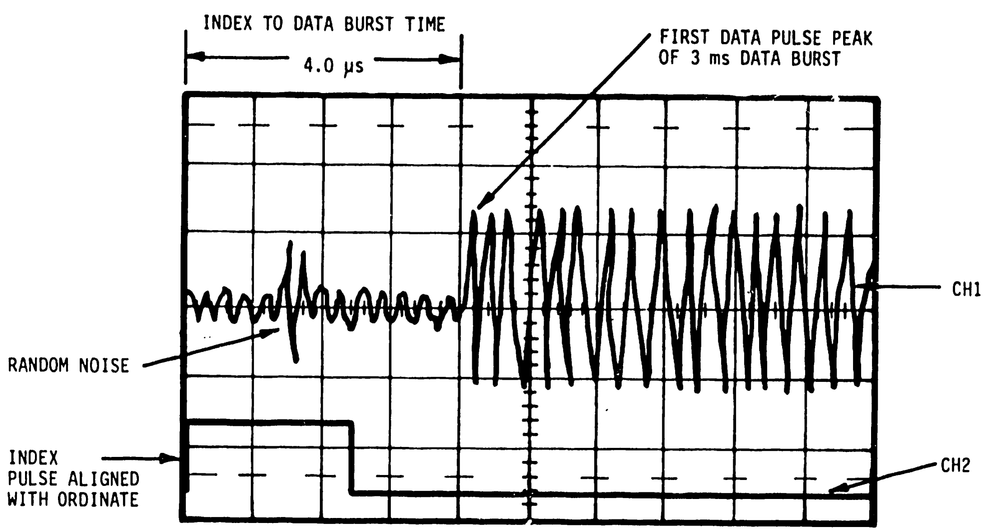
14. **Index to Burst Check**

Seek to cylinder 15.

Observe waveform on oscilloscope. It should be similar to Figure 6-27. The Index leading edge to data burst time is to be 4 ±2.9 µs.

Seek to Cylinder 793.

Observe waveform on the oscilloscope. Index to data burst time is to be 4 ±2.9 µs.



OSCILLOSCOPE SETTINGS:

VOLTS/DIV: CHAN. 1 -1 V; CHAN. 2 -5 V
TIME/DIV: A - 1 µs; B - NOT USED
TRIGGERING: A - INTERNAL POSITIVE (CHAN 2); B - NOT USED

PROBE CONNECTIONS:

CHAN. 1 - TO READ SIGNAL OF HEAD ALIGNMENT PWA
CHAN. 2 - TO INDEX (TP52) OF I/O PWA

ZZ069b

FIGURE 6-27. INDEX TO BURST FORMAT

When head alignment is satisfactorily completed press the STOP/START switch to stop the drive and wait until the spindle drive motor has stopped. Remove the CE cartridge and install the cartridge into its protective cover. Write Protect switches on the operators panel can be released if desired. Set the AC circuit breaker (rear of drive) to the OFF position. Remove the head alignment kit from drive:

a. Meter
b. AZPV or HFSV PWA and extender PWA
c. Cable from R/W preamp PWA to Servo Fine PWA
d. Cable from extender PWA to Servo Fine PWA

Return the Electronics Module to its normal position and install locking screw.

CAUTION

USE EXTREME CAUTION when setting the Electronics Module down into its normal position. Cables that are in the close proximity of the Electronics Module will be damaged if caution is not used.

Store the carriage locking tool in its normal operating position.

Install top cover and return unit to normal operation.

15. Fixed Disk Module Data Read/Write Head Alignment Procedure

The procedure for aligning a newly replaced fixed disk module data read/write head is given in the following paragraphs.

CAUTION

Use only head alignment tool P/N 75893963. Use of a different tool can cause permanent damage to head/arm and carriage.

Inspect head adjustment tool for damage (nicked, scratched, etc.) at adjustment end. The end should have a polished surface where it enters carriage. Polish end with crocus cloth if aluminum deposits are present, and wipe clean. Do not use emery cloth, sandpaper, or files, which can permanently damage tool, and subsequently damage heads and carriage holes. Do not use a defective tool. Repair or replace tool if damage exists.

Use care when using the head alignment tool. The tool should slip easily through the alignment hole (in the carriage) and into the slot in the head/arm. When adjusting the head, the tool should turn freely in the hole. If anything more than a small amount of force is required to adjust the head/arm, the tool is probably binding in the hole (in the carriage).

NOTE

In order to remove data when changing a fixed disk module data read/write head, the host system must be utilized in order to read the formatted surface involved.

- Allow the drive to stabilize by running with heads loaded for a minimum of 15 minutes.
- Seek to and attempt to read from the replaced head at cylinder 404 (a continuous loop read and error print-out is desired).
- Install the carriage locking tool in the head alignment position as shown in Figure 6-24.
- Connect an oscilloscope so as to be able to look at the read analog differential voltage across TP1 and TP2 of the read/write preamp PWA. Move the newly replaced head slowly in the forward and reverse directions with the head alignment tool while watching the read voltage and listening to the error print-out. Adjust initially for maximum read voltage. Continue adjusting until no error is printed by the host system.
- Remove carriage locking tool, issue RTZ and torque the head clamping screw to 12 $\pm 1/2$ lbf. in. (1.26 to 1.38 Nm). Seek to 404_{10} again and readjust the head for zero error printout if necessary.
- Repeat the fine tune adjustment step with the head alignment tool until the drive will read error free.
- Remove the head alignment tool.

NOTE

It should be noted that although the above procedure is designed to recover as much of the customer data as possible, the error rate performance cannot be guaranteed over the range of environmental extremes normally specified for the drive. Therefore, it is recommended that all of the data be recovered from the media, and the media be reformatted and data rewritten.

- Operate the STOP/START switch to the STOP position and wait for the drive to stop turning.
- Set the AC circuit breaker to OFF.
- Install top cover assembly, turn on AC circuit breaker and start the drive.

6.8.6 CARRIAGE RESTRAINT BLOCK ADJUSTMENT

The carriage restraint blocks limit the carriage roll movement during head adjustment. Re-adjustment of these blocks is necessary when (a) The actuator magnet is removed and replaced. (b) The carriage is replaced. (c) The carriage guide rod and or side bearing plates are replaced.

NOTE

> Block G (Figure 6-28) must be adjusted with the carriage fully extended. This can be done only with the spindle up to speed and heads at track 822 or when the heads and/or all disks have been removed from the drive.

1. Position carriage forward until outrigger arm bearing is underneath the set screw to check and adjust dimension [C] (front end).
2. Check dimension [C] to insure that it is between 0.001 and 0.003 inches (0.025 -0.08 mm). This measurement should be done by sliding a 0.001 and a 0.003 inch thick shim (0.03 and 0.08 mm shims) between the adjustment screw [J] and the bearing plate [K].
3. To adjust dimension [C], slide a 0.003 inch (0.08 mm) shim between the bearing plate [K] and the adjustment screw [J]. Adjust screw [J] until shim fits snugly between the bearing plate [K] and the adjustment screw [J].
4. Repeat step 2.
5. If this spacing is not correct, repeat steps 3 and 4 above.

NOTE

> Block H (Figure 6-28) must be adjusted with the carriage fully retracted.

1. Position carriage in retracted position to check or adjust dimension [D] (rear end).
2. Check dimension [D] to insure that it is between 0.001 and 0.003 inches (0.025 and 0.08 mm). This measurement should be done by sliding a 0.001 and 0.003 inch shim (0.03 and 0.08 mm shims) between the adjustment screw [L] and the bearing plate [K].
3. To adjust dimension [D], slide a 0.003 inch (0.08 mm) shim between the bearing plate [K] and the adjustment screw [L]. Adjust screw [L] until the shim fits snugly between bearing plate [K] and adjustment screw [L].
4. Repeat step 2.
5. If this spacing is not correct, repeat steps 3 and 4 above.

6.8.7 AIR PRESSURE SWITCH TEST

1. Prepare gage 77732543 for use according to procedure 6.8.8.
2. Operate the START/STOP switch to STOP position and wait for spindle to stop rotating.
3. Turn OFF power at AC circuit breaker (CB-1).
4. Remove top cover per paragraph 6.7.1.
5. Clean or replace prefilter per paragraph 6.6.1.
6. Connect gage tube to filter fitting located on absolute filter outlet plenum (see Figure 6-28.1). Two types of fittings are used (a and b as shown in Figure 6-28.1).

   If unit uses type (a) fitting, remove tee assembly A from gage (Figure 6-28.2). Remove cap from fitting and attach gage tube. If type (b) fitting is used, leave tee assembly attached to gage tube. Remove unit air tube from fitting (b) and attach this tube to tee assembly. Attach remaining tube from tee assembly to filter fitting.
7. Turn on unit AC power.
8. Operate START/STOP switch to START position.
9. After heads load, gradually block the pre-filter using strips of paper approximately 4 x 12 inches.

   Two gage readings are required: One at the point where flashing of fault lamp on the operator panel begins (Low-Air). The second just before heads unload (No-Air). Several trials will be necessary to obtain these readings. The gage scale is calibrated in inches of water (IOW) with 0.02 IOW subdivisions.

	LOW-AIR	NO-AIR
Acceptable Range	0.65 to 0.80 IOW	0.30 to 0.40 IOW

   Conditional exceptions to these limits are permissible -- Low-Air less than 0.65 IOW or No-Air greater than 0.40 IOW with the condition that the difference between the Low-Air and No-air readings is greater than 0.29 IOW.

   Examples of acceptable combinations:

LOW-AIR		0.60 IOW	0.75 IOW
NO-AIR		0.30	0.45
	Difference	0.30	0.30

WARNING

The value of NO-AIR must never be less than 0.30 inches of water.

10. Disconnect gage from filter fitting.
11. Restore unit to operational condition.

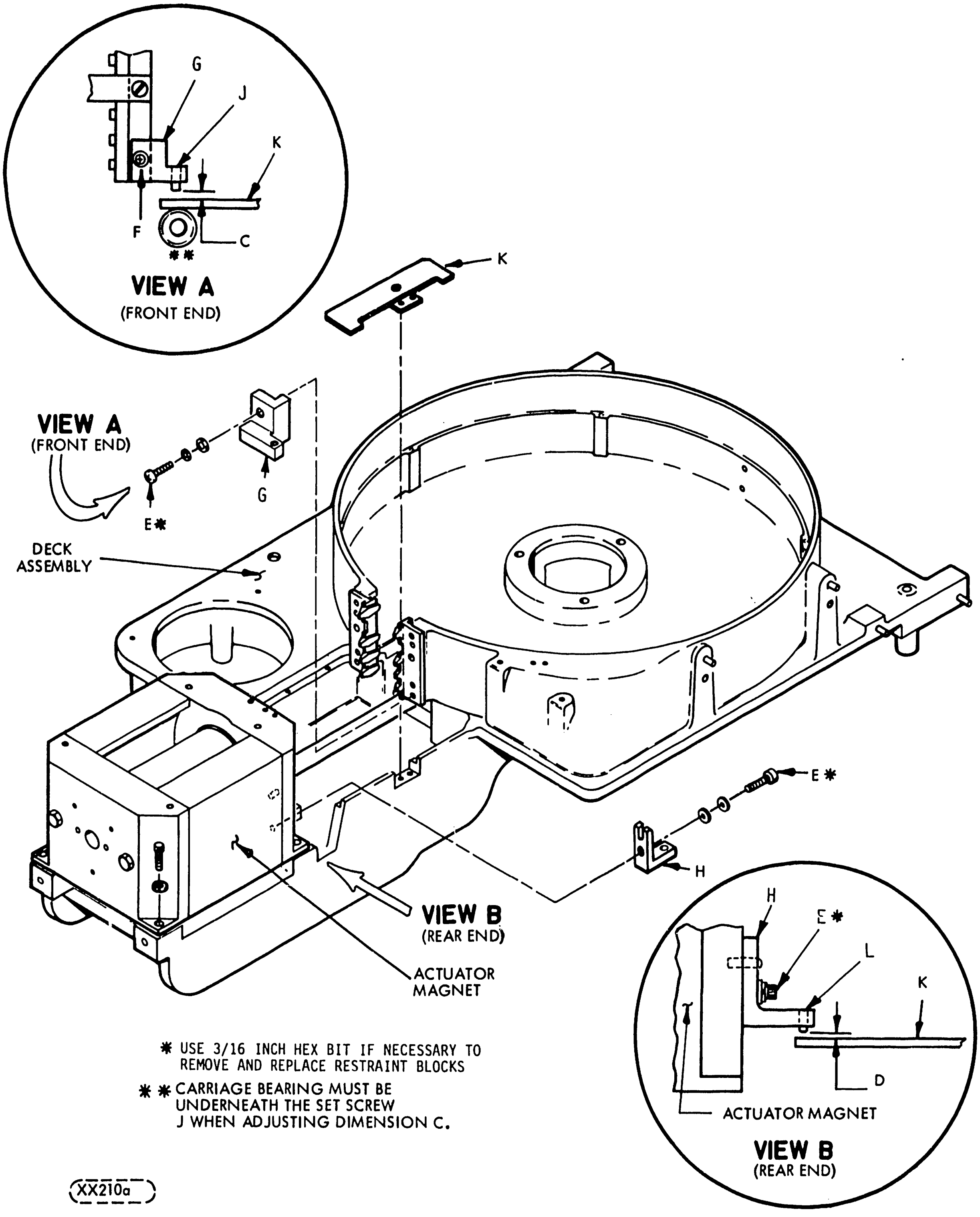


FIGURE 6-28. CARRIAGE RESTRAINT BLOCK ADJUSTMENT

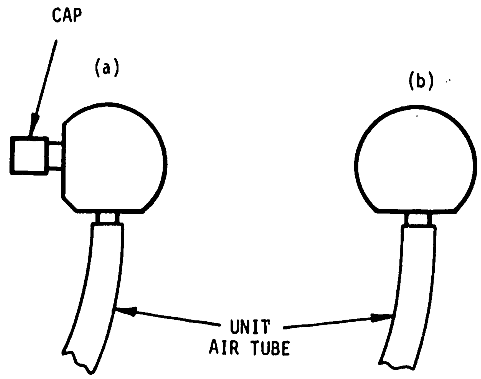
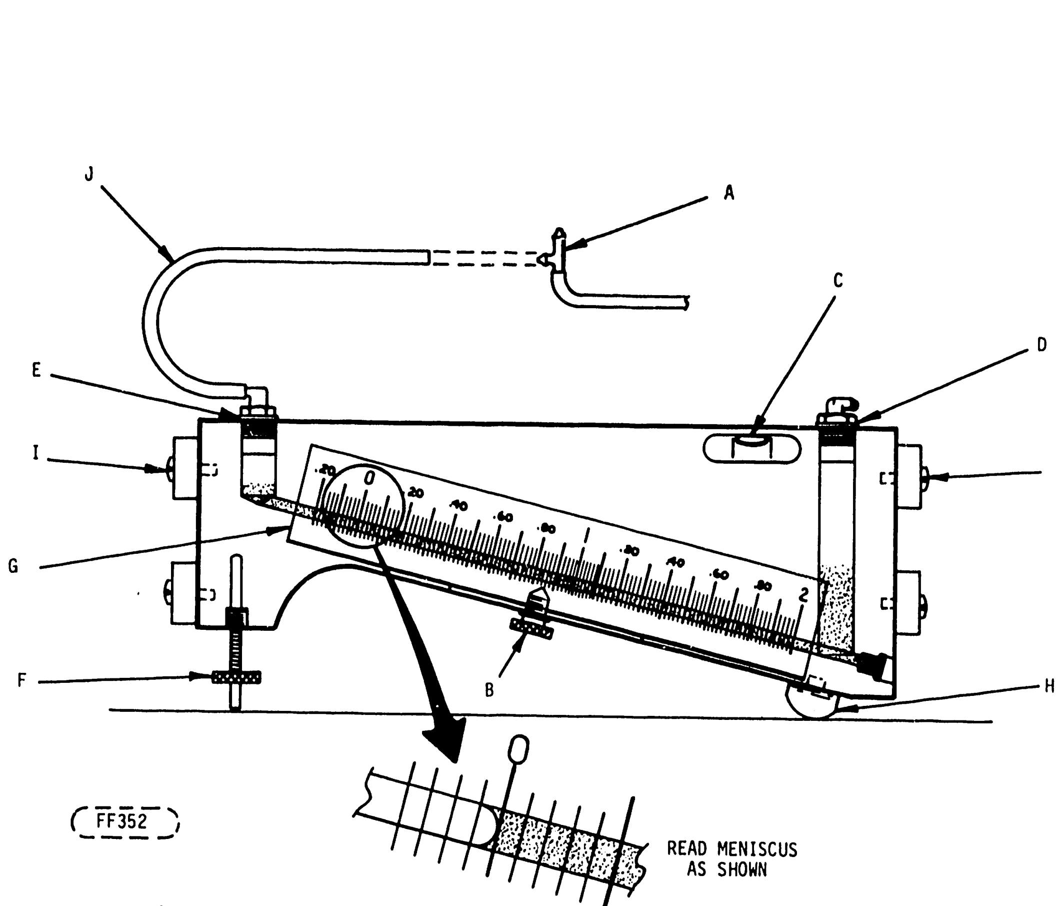


FIGURE 6-28.1. FILTER FITTING FOR PRESSURE SENSING TUBE

6.8.8 AIR GAGE PREPARATION FOR USE

1. Place gage on a stable horizontal surface using gage stand; or mount gage on a vertical steel surface using magnaclips.
2. Open connectors (counterclockwise) 1 1/2 turns.
3. Push gage tube on filter connector.
4. Level gage while viewing level from the top. Adjust leveling screw or slide gage on magnaclips as required to center bubble.
5. Loosen scale screw and slide scale so zero is directly behind meniscus as shown (Figure 6-28.2). Retighten scale screw.
6. Gage is ready for use.
7. When stowing gage be sure to turn connectors clockwise to stops. Gage oil spill will result if this is not done.



A TEE Assembly (removable)
B Scale Screw
C Level
D Connector, Atmosphere
E Connector, Filler
F Leveling Screw
G Scale
H Gage Stand
I Magneclip
J Gage Tube

CAUTION

When connectors D and E are open, gage must be kept upright to prevent oil spill.

FIGURE 6-28.2. AIR GAGE

6.8.9 FIXED MODULE INSPECTOR PREPARATION FOR USE AND OPERATING PROCEDURE

This procedure describes the set-up and operation of the DML 1204 FMD Fixed Module Inspector (referred to as Inspector below). Refer to Figure 6-28.3.

1. The Inspector must be used in a clean area. Locate the inspector on a stable, level surface at a comfortable viewing height.
2. Open the carrying case and remove the cover.
3. Carefully remove the optics assembly from its storage position. Before plugging in the optics assembly light power connector, check that AC voltage select switch in the storage well is in the correct position for line voltage that will be applied.
4. Center the speed and volume controls in mid range. Turn the disk rotation switch to off.
5. Remove the optics mast from its storage position and assembly it to the deck. Hand tighten securely.

6. With the optics assembly in hand (removed in step 3 above), turn optics thumb screw counterclockwise to limit and slip the optics onto the mast to the first detent. Be sure the red dot on the optics assembly is aligned with the mast slot. Plug the connector into the lamp power socket.
7. Remove the AC power cord from the inspector case lid and connect the Inspector to AC wall power.
8. If the inspector has a gage assembly, rotate it clear of the red lined area.
9. The inspector is now ready for installation of a Fixed Module/Alignment Tool Assembly.

<u>CAUTION</u>

Insure that optics (and gages if included) are clear of the red lines area before proceeding.

10. For installation of module onto Inspector refer to paragraph 6.7.7, step 36.
11. Slowly rotate optics assembly into the top fixed disk to be inspected and hand tighten the thumb screw. Be careful to avoid contact with the disk.
12. Press main AC power switch.
13. Press lamp switch and observe image of disk surface through eye piece.
14. Rotate disk using direction switch and speed control while observing disk surface. Apply media rejection guidelines given in paragraph 6.7.7, step 37.
15. Adjust volume control for audible level of tone signifying one turn of disk.
16. After top disk inspection, be sure to loosen thumb screw and rotate optics clear of disk before lowering optics, then lower the optics assembly to next detent.
17. After inspection is finished, turn off lamp and AC power. Return inspector components to storage locations and close the carrying case.

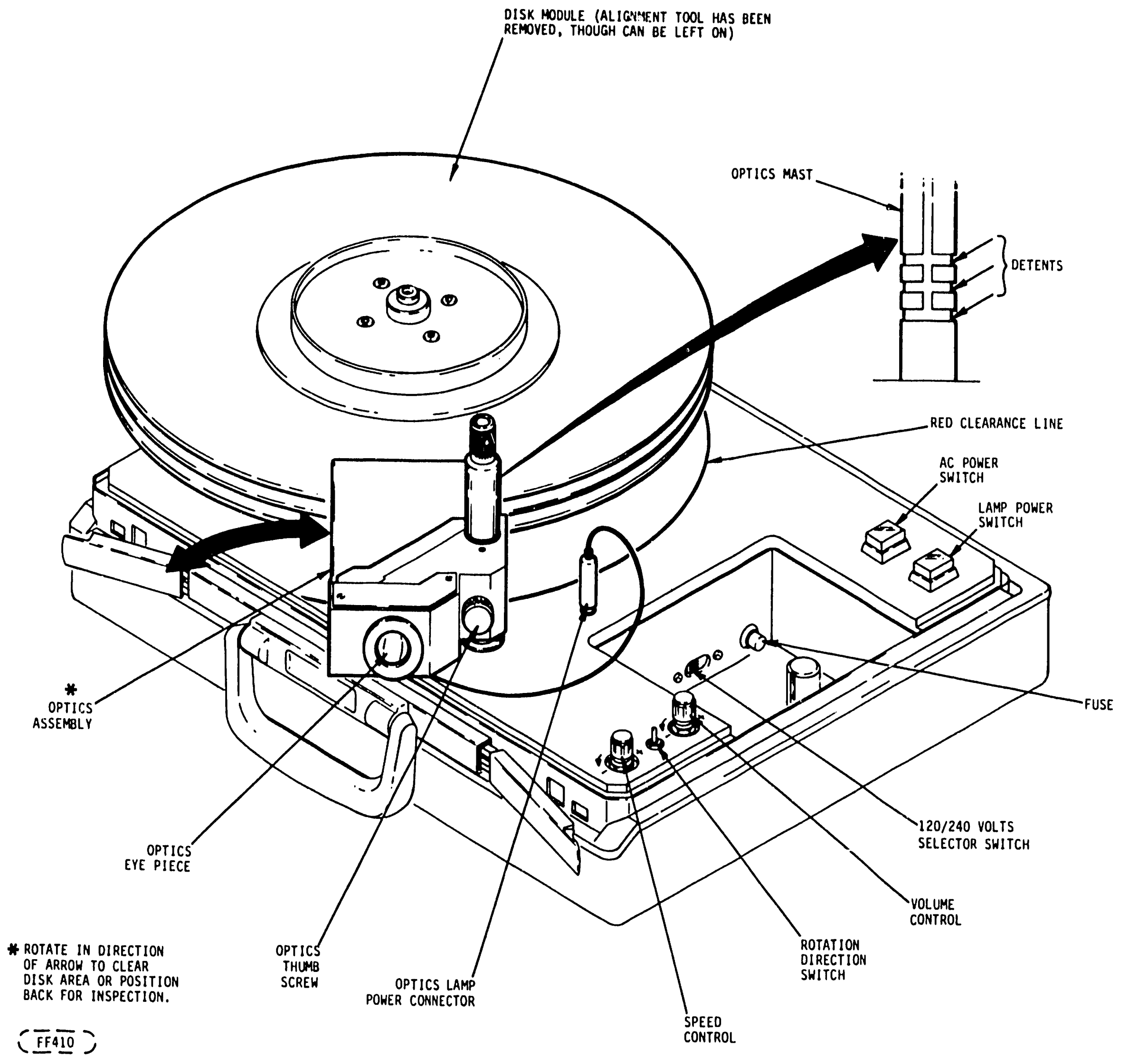


FIGURE 6-28.3. FIXED MODULE INSPECTOR WITH MODULE INSTALLED FOR INSPECTION

6.9 MAINTENANCE AIDS

6.9.1 MAINTENANCE SWITCHES AND INDICATORS

Maintenance switches and indicators are listed with a brief functional description in Tables 6-5 and 6-6. These switches and indicators are located on the Control/Mux, I/O Servo Coarse and Servo Fine PWAs in the Electronics Module and should only be accessed by the Field Service Engineer. Although the indicator on the operators panel on the front of the unit have some value for maintenance purposes, they are discussed in Section 2 so their use need not be discussed here. Those switches and indicators which are intended solely for maintenance purposes are discussed in this section. The switches and indicators can be seen on the component layout drawings which accompany each schematic diagram in Section 5. See page 5-1 for page number of the various schematics.

On the Control/Mux PWA (see Figure 2-3) is a bank of seven LED maintenance indicators numbered CR1 through CR7 which have four different uses. They are used for 1) displaying non-Microprocessor detected faults, 2) displaying the present cylinder address held in the Microprocessor, 3) displaying Microprocessor-detected faults, and 4) assisting in velocity gain adjustment. As viewed from the component side of the PWA. CR1 is leftmost and CR7 is rightmost, with a separation between CR1 and CR2 that is slightly wider than that between the rest of the indicators. This space is to separate CR1 from CR2 and the other indicators which have multiple meanings, with the meaning depending on the settings of switches. The normal situation is with S1-#8 on the Servo Coarse PWA in the ON position and S1 on the Control/Mux PWA in the OFF position.* Under the indicators CR1-CR7 are abbreviations which represent the non-Microprocessor-detected faults. Following a master Reset of the unit electronics, as long as S1 on the Control/Mux PWA is not positioned to the ON position, operation of the fault indicators remains in Mode 1. This is shown in Figure 5-5. Table 6-6 shows the meanings of the abbreviations. For example "NH" means "NO HEAD SELECTED FAULT", "MP" means "MICROPROCESSOR FAULT CODE ACTIVE", "WF" means "WRITE FAULT", and so on.

Table 6-6 charts the different ways in which the indicators CR1-CR7 are used (called "Display Modes"), and Figure 6-29 contains a flow chart which may aid in the understanding of how the indicators are used. Paragraph 6.9.1.1 describes in more detail the 5 Display Modes listed in Table 6-6.

*S1 is a momentary action switch and remains OFF until manually actuated.

TABLE 6-5. DESCRIPTION OF MAINTENANCE SWITCHES AND THEIR FUNCTIONS (SHEET 1 OF 2)

SWITCH	NAME	LOCATION	FUNCTION
S1*	Fault Clear	Cntl/Mux PWA	Momentary toggle switch which performs several functions in conjunction with the Maintenance Display Indicators CR1-CR7 as follows: 1. Resets the fault latches when in the non-microprocessor fault display mode.** 2. The same actuation of S1 that resets fault latches (#1 above) also initiates the present cylinder address display mode and causes the two highest order binary bits of the present address to be displayed on CR6 and CR7. Subsequent S1 actuaions display remainder of the cylinder addresses and a separator state. 3. After the separator state following cylinder address display, actuations of S1 cause Microprocessor-detected error conditions to be displayed on CR3-CR7, resets the M.P. fault store and sets fault code into the fault latches for display on CR3-CR7. 4. When CR3-CR7 are used to aid velocity gain adjustment, actuation of S1 causes the drive to execute a seek to maximum cylinder number, after which the status of the velocity is displayed.

* See also Table 6-6 where the use of this switch is explained further.

** The display modes of the CR1-CR7 indicators are explained in Table 6-6 and paragraphs 6.9.1.1.

TABLE 6-5. DESCRIPTION OF MAINTENANCE SWITCHES AND THEIR FUNCTIONS (SHEET 2 OF 2)

SWITCH	NAME	LOCATION	FUNCTION
S1	Remote/ Local	I/O PWA	Toggle switch provides manual override of power sequence lines or when remote spindle start is used.
S2	On Line/ Off Line	I/O PWA	Provides manual capability of inhibiting drive transmitted signals except for Read/Write or servo dibits for use in aligning the read/write or servo heads. Positioning this switch has no effect unless the Head Alignment Extender PWA is plugged into EM4 and a special cable is connected from J2 of the Servo Fine PWA to J1 on the extender. Section 6.8.5.4 discusses the use of this switch and switches on the extender.
S1-#8	Velocity Gain Adj	Servo-Coarse PWA	When S1-#8 is in the OFF position, it enables the use of the fault latches and fault indicators CR3-CR7 (on the Control/Mux PWA) to display the status of the servo system velocity gain adjust ment. The switches S1-#1 through S1-#8 are OFF when pressed down on the right side of the switch. When S1-#8 is in the ON position, it enables the displaying of faults on the fault indicators. See Figure 6-2 and refer to Table 6-6 for more information on the use of this switch.
S1-#1*** through S1-#7	Sector Number Select	Servo-Coarse PWA	The voltages on the seven outputs of this switch are interpreted as seven digit binary number by the microprocessor. It is used by the M.P. to generate the number of sector pulses per revolution required by the drive user. See paragraph 3.10.1 for more details.

*** Not used normally for maintenance, but mentioned here to complete the description of switch S1 on the Servo-Coarse PWA.

TABLE 6-6. INTERPRETATION OF CONTROL/MUX FAULT DISPLAY INDICATORS (SHEET 1 OF 4)

MODE	SWITCH/INDICATOR									DESCRIPTION OF INDICATOR MEANING/FUNCTION
	S1-#8	CONTROL/MUX PWA								
		S1**	1	2	3	4	5	6	7	
1	0	0	1 (NH)	0	*	*	*	*	*	NO-HEAD-SELECTED FLT. Indicates that an attempt has been made to select a non-existent head.
1	0	0	*	0 (MP)	*	*	*	*	*	CR3 lights only when M.P. is active..
1	0	0	*	0	1 (WF)	*	*	*	*	WRITE FAULT. Indicates that a loss of AC or DC write current has occurred.
1	0	0	*	0	*	1 (W+R)	*	*	*	WRITE OR READ OFF CYL. Indictates that an attempt was made to write or read during a seek, RTZ or volume change.
1	0	0	*	0	*	*	1 (WR)	*	*	WRITE AND READ FLT. Indicates an attempt to write and read simultaneously.
1	0	0	*	0	*	*	*	1 (VF)	*	VOLTAGE FLT. Indictates a below normal voltage.
1	0	0	*	0	*	*	*	*	1 (HS)	HEAD SELECT FLT. Indicates a multiple head select (2 or more heads selected).

SEE NOTES AT END OF TABLE.

TABLE 6-6. INTERPRETATION OF CONTROL/MUX FAULT DISPLAY INDICATORS (SHEET 2 OF 4)

	SWITCH/INDICATOR									
		CONTROL/MUX PWA								DESCRIPTION OF INDICATOR MEANING/FUNCTION
MODE	S1-#8	S1**	1	2	3	4	5	6	7	
2	0	1A	0	1	+	0	0	C_9	C_8	The two highest order bits of the present cylinder address displayed by first S1 actuation. Resets mode 1 fault.
2	0	2A	0	1	+	C_7	C_6	C_5	C_4	The next high order four bits of present cylinder address displayed by second S1 actuation.
2++	0	3A	0	1	+	C_3	C_2	C_1	C_0	The lowest order four bits of the present cylinder address displayed by third S1 actuation.
3++	0	4A	0	1	0	0	0	0	0	Separator state between cylinder address display mode and Microprocessor Fault Summary display mode.

SEE NOTES AT END OF TABLE.

TABLE 6-6. INTERPRETATION OF CONTROL/MUX FAULT DISPLAY INDICATORS (SHEET 3 OF 4)

MODE	SWITCH/INDICATOR									DESCRIPTION OF INDICATOR MEANING/FUNCTION
	S1-#8	CONTROL/MUX PWA								
		S1**	1	2	3	4	5	6	7	
4	0	A	0	1	M_4	M_3	M_2	M_1	M_0	A hexidecimal coded, binary no. (M4--M0) is displayed which indicates a microprocessor detected error condition. The actuation of S1 displays the code from the first fault store location that contains an error code. Subsequent actuations of S1 displays all other error codes stored, displaying one at a time until all have been displayed.
4 4	0 0	XA A	0 0	1 1	M_4 1	M_3 1	M_2 1	M_1 1	M_0 1	Table 6-7 lists all error codes and meaning of each. 0111111 indicates all M.P. Fault Summary Codes have been displayed.
5	1	A	0	1	1	0	0	0	0	Servo velocity gain adjust display. CR3 on indicates velocity is very slow during seek to max cyl.***
5	1	A	0	1	0	1	0	0	0	CR4 ON indicates velocity slow during seek to max cyl.

SEE NOTES AT END OF TABLE.

TABLE 6-6. INTERPRETATION OF CONTROL/MUX FAULT DISPLAY INDICATORS (SHEET 4 OF 4)

MODE	SWITCH/INDICATOR									DESCRIPTION OF INDICATOR MEANING/FUNCTION
		CONTROL/MUX PWA								
	S1-#8	S1**	1	2	3	4	5	6	7	
5	1	A	0	1	0	0	1	0	0	CR5 ON indicates velocity all right during seek to max cyl.
5	1	A	0	1	0	0	0	1	0	CR6 ON indicates velocity fast during seek to max cyl.
5	1	A	0	1	0	0	0	0	1	CR7 ON indicates velocity very fast during seek to max cyl.

NOTES:

"1" means switch OFF or indicator "ON"; "0" means switch ON or indicator "OFF".

S1-#8 is on the Servo-Coarse PWA.

* Any or all of these indicators could be on at the same time except CR2 which has no meaning in mode 1. The fault description defines the meaning of that indicator in whose column the "1" appears.

** "A" means a momentary actuation of this switch. (Its output goes to ground) "1A" means first actuation of the switch; "2A" means second actuation, etc.

*** A seek is made to maximum cylinder number with each S1 actuation.

\+ Always "0" except when cyl. address is zero, then it is "1".

++ Display modes 2 and 3 could be skipped under certain conditions. See explanatory text following in 6.9.1.1.

6.9.1.1 MAINTENANCE INDICATOR DISPLAY MODES

Display Mode 1: Display of Non-Microprocessor Detected Faults. As shown in Table 6-6, this display mode occurs only when M.P. detects switch S1-#8 on the Servo-Coarse PWA being in the ON position and S1 on the Control/Mux PWA being in the OFF position.* One or more of the fault indicates CR1 and CR3-CR7 can be turned on after a non-Microprocessor detected fault occurs, so more than one at a time could be ON. The fault latches that drive the CR1-CR7 indicators directly can be reset only by S1 (on Cntl/Mux) or Power-ON Master Reset. However, the non-Microprocessor detected faults are also stored in another register whose outputs go across the interface. See Table 2-3 if applicable. (This feature applies only to the "Standard" interface - it does not apply to the "multiplexed" interface). This latter register is reset from the interface or front panel CLEAR switch or S1 (but only if the fault conditions are gone). Actuating S1 to reset the fault latches also starts Display Mode 2 or 4.

Display Mode 2: Display of the Present Cylinder Address. When S2 on the Control/Mux PWA is actuated in display mode 1, the fault latches are reset, CR2 indicator is turned ON, and indicators CR6 and CR7 display the highest order two binary bits of the present cylinder address (the address used by the drive in performing the last seek operation). S1 need only be actuated momentarily. When S1 is actuated a second time the information displayed by CR6 and CR7 will be cleared and CR4 through CR7 will then display the next four high order binary bits of the present cylinder address. The third actuation of S1 will change the information displayed on CR4-CR7 to the low order four binary bits of the present cylinder address. CR3 will always be zero except when the cylinder address digit displayed on CR4-CR7 is zero which time CR3 will turn ON. The ten bits displayed as described above are to be interpreted as three hexidecimal numbers representing the address of the last seek performed by the drive. At the time the cylinder address bits are displayed the location storing the address is cleared.

Therefore, before a new present cylinder address could be displayed a new seek to a different volume or different cylinder would have to be performed.

Display Mode 3: The next (fourth) actuation of switch S1 after the three actuations of Display Mode 2 turns off CR3-CR7 leaving only CR2 ON. This is a separator state between Display Mode 2 and Display Mode 4. The only way Display Mode 3 can be entered is through Display Mode 2, but Display Mode 4 can be entered through Display Modes 1 or 3. Display Mode 3 does not occur if Display Mode 2 does not occur. If Display Mode 3 does not occur it should be recognized that the first three actuations of S1 constituted the first three M.P. Fault Summary codes in Display Mode 4.

---

* Even though S1-#8 is ON no faults will be displayed unless the Microprocessor causes them to be displayed.

Therefore, the first three codes should be written down as one cannot be sure what the code represents until the fourth S1 actuation which will be either the separator code (Display Mode 3) or a fault code of Display Mode 4.

Display Mode 4: Assuming that Display Modes 2 and 3 occurred first, the fifth actuation of S1 places operation in Display Mode 4 which is called the "Microprocessor Fault Summary" mode. This is the mode that displays the Microprocessor-detected errors. The Microprocessor has a fault store area in its RAM where it stores a different binary code number for each error detected.

The fifth actuation of S1 as mentioned above will display on CR3-CR7 the code in the first fault store location where an error code is stored. Those locations in the fault store where no error code has been stored will not be displayed.

Subsequent actuations of S1 displays all other error codes stored, displaying them one at a time until all error codes have been displayed. Table 6-7 lists all the error codes and the meaning of each. The next S1 actuation after the last error code has been displayed displays all ones on CR2-CR7 (all lights ON). The next actuation after all ones displays all zeros (all lights OFF but CR2). Subsequent actuations of S1 jumps the displays back and forth between ones and zeros on CR2-CR7 until some operation is performed by the drive (i.e., seek, read or write, RTZ, etc.). After the drive gets back in the idle mode of operation after an operation it will be in Display Mode 1 again. Display Mode 4 could directly follow Mode 1 in some situations. A typical situation would be after a seek was commanded but the ready and "ON-track" condition was never reached. Any time the cylinder address is cleared and a new seek is not completed, Modes 2 and 3 would be skipped.

If the fault readout process is somewhere in Mode 4 when a seek is performed, operation returns to Mode 1. The M.P. error codes still stored in the M.P. fault store (i.e., those which hadn't been displayed before the seek occurred) remain there and will be displayed the next time Mode 4 is in process. Any new faults which may be stored before operation returns to Mode 4 through subsequent actuations of S1 in the normal manner will be displayed with the remaining faults.

Display Mode 5: When S1-#8 on the Servo-Coarse PWA is placed in the OFF position, (right side of switch depressed when facing switch from component side of PWA), the servo system velocity can be displayed on CR3-CR7. Paragraph 6.8.5.2 describes the use of this display mode in adjusting the servo velocity gain.

TABLE 6-7. MICROPROCESSOR FAULT CODES AND MEANINGS

Codes 01 through 0D represent the 13 phases of operation that are checked by the microprocessor. Codes 0F through 1E represent the fault types that could have occurred in one of the phases. In display Mode 4 the phase codes are read out in order first and then the fault codes in order. Code hex 1F is read after the last fault code is read out.

HEX CODE	BINARY CODE*	PHASE OF OPERATION
01	00001	RETURN TO TRACK CENTER
02	00010	WAIT FOR COARSE SEEK COMPLETION
03	00011	AFTER SEEK SETTLING
04	00100	IDLE LOOP
05	00101	RETURN TO ZERO MOTION
06	00110	END OF VELOCITY TABLE
07	00111	HEAD LOAD
08	01000	AWAIT AGC DURING HEAD LOAD
09	01001	AWAIT TRACK CENTER-LOAD OR RTZ
0A	01010	SETTLING-LOAD OR RTZ
0B	01011	OFFSET ACTIVE
0C	01100	CLEAR OFFSET SETTLING
0D	01101	RESUME SETTLING AFTER FALSE TERMINATION
		FAULT TYPE
0F	01111	SPINDLE DID NOT START/STOP IN 2 MINUTES AFTER ERSLO/ERSTP WAS NOTED (100000/10100)
10	10000	SPINDLE START GREATER THAN 70 SEC
11	10001	NO SPINDLE MOVEMENT
12	10010	NO DRIVE TO SOLID STATE RELAY
13	10011	SOLID STATE RELAY FAILURE
14	10100	STOP TIMEOUT
15	10101	EMERGENCY RETRACT FAILURE
16	10110	NORMAL RETRACT FAILURE
17	10111	CYLINDER ADDRESS GREATER THAN 822
18	11000	OFF TRACK GREATER THAN 1.2 ms
19	11001	UNEXPECTED AGC IN HEAD LOAD
1A	11010	LOST AGC
1B	11011	RPM FAULT
1C	11100	LOST SPEED PULSES
1D	11101	ALLOWED TIME EXPIRED
1E	11110	NO TRACK LOCK IN SETTLING
1F	11111	MICROPROCESSOR FAULT CODE SUMMARY READOUT IS COMPLETE

*CR3-CR7. "1" means light on. "0"L means light OFF.

6.9.1.2 TABLES OF FAULT TYPES VS. OPERATION PHASES

Table 6-8A through 6-8E shows the different fault codes that could show up for various phases of drive operation monitored by the Microprocessor. For example in Table 6-8B, "Seek Operation", an error in phase 03 (AFTER SEEK SETTLING) would also show one or more the fault types 11010, 11101 and 11110 (see Table 6-7).

TABLE 6-8A. SPINDLE START AND STOP

	ERROR					
PHASE	10000	10001	10010	10011	10100	01111
STOP					X △1	X △2
START	X △3	X	X	X		X △4

△1 30 SEC TIME LIMIT

△2 MAY OCCUR ONLY 2 MIN AFTER 10100 CODE

△3 70 SEC TIME LIMIT

△4 MAY OCCUR ONLY 2 MIN AFTER 10000 CODE

TABLE 6-8B. SEEK OPERATION △1

	ERROR				
PHASE	10111	11010	11101	11110	11011
01			X		
02		X	X		
03		X	X	X	
06		X	X		
NO PHASE CODE STORED	X				X

△1 80 MS TIME LIMIT

TABLE 6-8C. RTZ 1 AND HEAD LOAD 2

ERROR

PHASE	11001	11010	11011	11100	11101	11110
05					X	
07	X				X	
08					X	
0A		X			X	X
09					X	
NO PHASE CODE STORED						

1 500 ms TIME LIMIT

2 300 ms TIME LIMIT

TABLE 6-8D. HEAD RETRACT

ERROR

PHASE	11101 1	10101 2
NO PHASE CODE STORED	X	X

1 440 ms TIME LIMIT

2 500 ms TIME LIMIT (MAY OCCUR ONLY AFTER ERROR CODE 1)

TABLE 6-8E. IDLE AND OFFSET

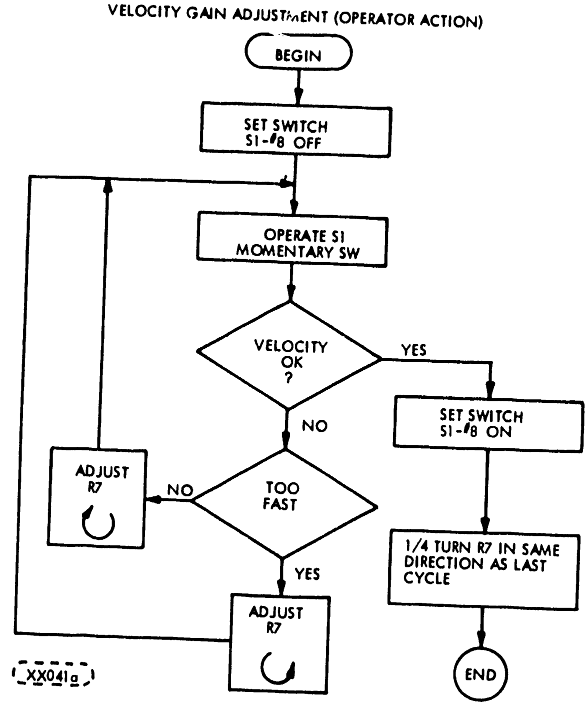
PHASE	11010	11110	11101	11000	11100	11011
04	X	X 1		X		
0B	X					
0C	X	X	X 2			
NO PHASE CODE STORED					X	X

1 ONLY IF 11000 ALSO PRESENT

2 20 ms TIME LIMIT

6.9.2 TEST POINTS

The test points on each of the printed wiring assembly boards are shown in Figure 5-4 through 5-9 (Section 5). Most of the small holes along the top edge of the boards which are called out on the figures as test points do not actually connect to any circuitry. All test points that do connect to circuitry are shown on the schematic drawings in Section 5.



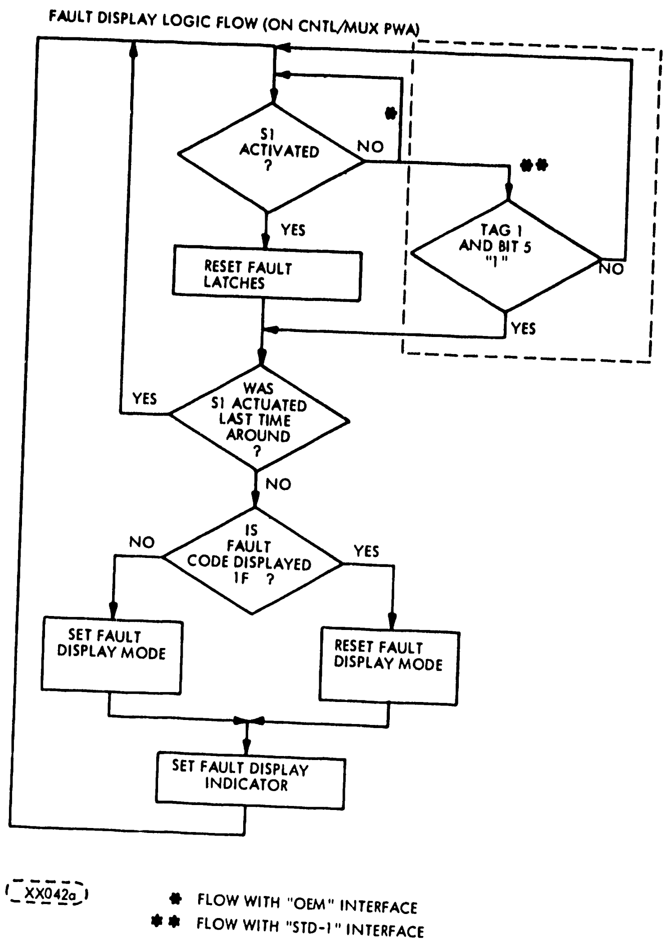


FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC (SHEET 1 OF 2)

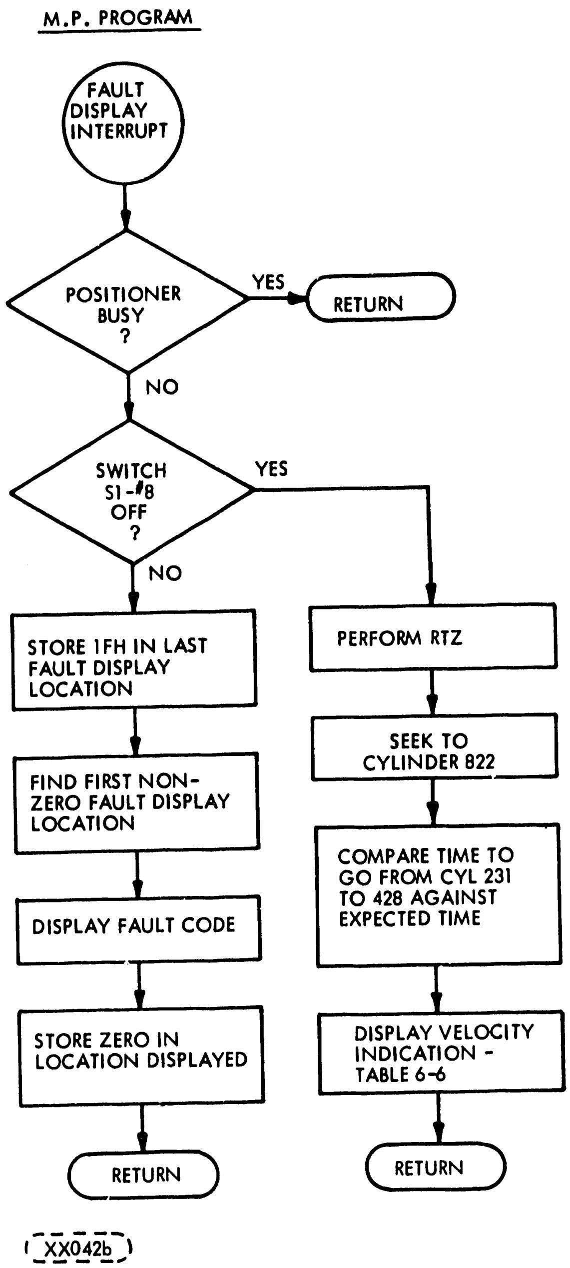


FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC (SHEET 2 OF 2)

6.9.3 CONVERSION OF CMD UNIT FROM 60 HZ TO 50 HZ

To convert from 60 Hz to 50 Hz when unit contains Power Supply Assembly as shown in Figure 6-17.1. Perform the following procedure.

1. Stop and power down the drive per Paragraph 2.3.3 and 2.3.4.
2. Remove AC line cord from power source.
3. Remove the top cover. Refer to Paragraph 6.7.1.
4. Raise the deck assembly to maintenance position. Refer to Paragraph 6.7.2 steps 1 thru 4.

5. Remove PS1P5 from J3 and install PS1P5 into J4 as shown in Figure 6-17.1.
6. On connector PS1J1 remove wire from pin 2 position and install it in pin 3 position. (See Figure 6-30). Figure 6-31 shows PS1J1 to CB1 connections for various frequency/voltage combinations.
7. Remove the spindle drive belt [1]. See Figure 6-14.
8. Remove the motor belt drive pulley [3]. To do this loosen the set screw [2] in the pulley collar using a 5/32 inch Allen screw driver. See Figure 6-14.
9. Install the 50 Hz pulley on drive motor shaft. See Figure 6-14. Using a good scale for measurement, position the pulley so that it is mounted on the shaft with the edge of the pulley 0.280 inches (7.1 mm) away from the plate surface as shown. Torque the screw in collar to 64 lbf. in. (7.2 Nm).
10. Position the smooth side of the drive belt around the spindle pulley. Hold the belt taut around the pulley while performing the next step so that the belt does not slip off pulley.
11. While maintaining hand tension on the belt, roll the belt onto motor pulley while manually rotating the spindle pack hub in a counterclockwise direction. Rotate the spindle pulley several revolutions to seat the belt on pulley.
12. Replace the 60 Hz blower with the 50 Hz blower per paragraph 6.7.13.
13. Lower the deck to its normal position. Refer to paragraph 6.7.2, steps 5 thru 10.
14. Connect AC line cord to 50 Hz power source.
15. Power up drive per paragraph 2.3.1.
16. Restore unit to normal operation.

6.9.4 CONVERSION OF CMD UNIT FROM 50 HZ TO 60 HZ

To convert from 50 Hz to 60 Hz when unit contains Power Supply Assembly as shown in Figure 6-17.1. Perform the following procedure.

1. Stop and power down the drive per paragraph 2.3.3 and 2.3.4.
2. Remove AC line cord from power source.
3. Remove the top cover. Refer to paragraph 6.7.1.
4. Raise the deck assembly to maintenance position. Refer to paragraph 6.7.2 steps 1 thru 4.
5. Remove PS1P5 from J4 and install PS1P5 into J3 as shown in Figure 6-17.1.
6. On connector PS1J1 remove wire from pin 3 position and install it in pin 2 position. (See Figure 6-30.) Figure 6-31 shows PS1J1 to CB1 connections for various frequency/voltage combinations.
7. Remove the spindle drive belt [1]. See Figure 6-14.
8. Remove the motor belt drive pulley [3]. To do this loosen the set screw [2] in the pulley collar using a 5/32 inch Allen screw driver. See Figure 6-14.

9. Install the 60 Hz pulley on drive motor shaft. See Figure 6-14. Using a good scale for measurement, position the pulley so that it is mounted on the shaft with the edge of the pulley 0.280 inches (7.1 mm) away from the plate surface as shown. Torque the screw in collar to 64 lbf. in. (7.2 Nm).
10. Position the smooth side of the drive belt around the spindle pulley. Hold the belt taut around the pulley while performing the next step so that the belt does not slip off pulley.
11. While maintaining hand tension on the belt, roll the belt onto motor pulley while manually rotating the spindle pack hub in a counterclockwise direction. Rotate the spindle pulley several revolutions to seat the belt on pulley.
12. Replace the 50 Hz blower with the 60 Hz blower per paragraph 6.7.13.
13. Lower the deck to its normal position. Refer to paragraph 6.7.2, steps 5 thru 10.
14. Connect AC line cord to 60 Hz power source.
15. Power up drive per paragraph 2.3.1.
16. Restore unit to normal operation.

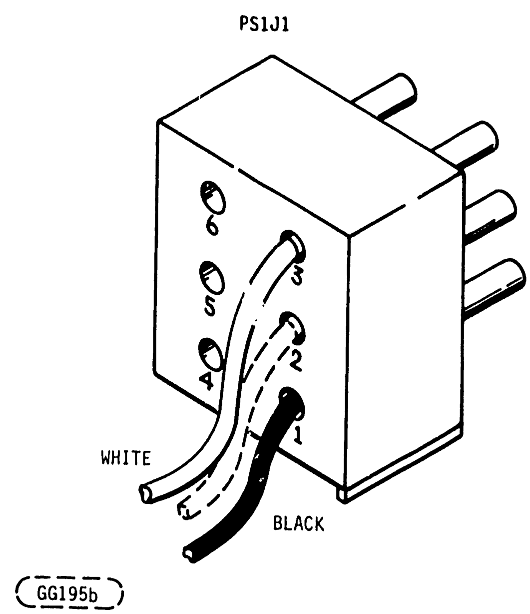


FIGURE 6-30. WIRE CHANGE TO PLUG PS1-J1

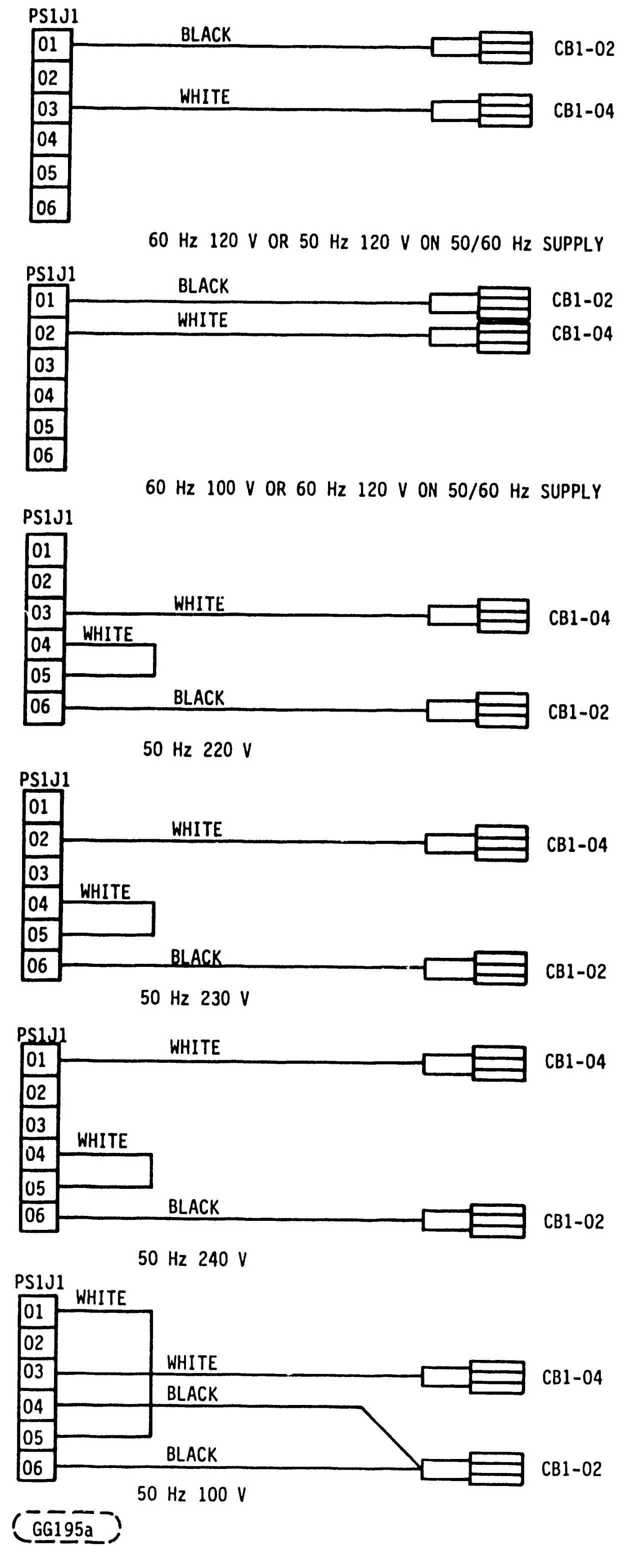


FIGURE 6-31. POWER SUPPLY TO CIRCUIT BREAKER HOOK UP

6.10 HEAD CRASH PREVENTIVE MAINTENANCE

The 2280, 6580, Phoenix Cartridge Module Drive is a high density Disk drive used across the complete Wang product line (VS, OIS, VP, MVP). This drive, like the Storage Module Drive, is extremely sensitive to its operating conditions and environment. Therefore, proper installation procedures and preventive maintenance as well as corrective maintenance procedures must be followed. The level of technical experience to install, maintain, and repair is at the same level as with the 2265V1 and 2265V2 storage module drives. However, extra care should be exercised, particularly with respect to preventing head crashes. It is to this end that this section will be geared to.

Some causes noted involve customer discipline in handling of cartridges. Most notably these are:

A. Damaged Cartridge Migration (movement from one drive to another)

This is extremely important. After any head crash, whether on the fixed module and/or the removable cartridge. All cartridges which could be involved should be inspected. A large amount of repeat crashes are caused by improper or inadequate cleaning, or by installation of damaged cartridges into a good drive.

B. Proper Cartridge Handling

Handling damage by operators is a prime problem source contributing to many incidences of head crashes. Acclimating the cartridge to the ambiance of the drives environment, storing the cartridge cover improperly, and storing of the cartridges more than 3-high, are all contributors that operators should be aware of.

There are various other reasons contributing to head crashes, but the two above cases are directly under customer control and are considered extremely important. Therefore, extra time and care should be spent alerting customers to the sensitivity of these items.

6.10.1 HEAD DESCRIPTION

A head is an electro-magnetic device that records data on and reads it from a disk coated with a magnetizable material. It is mounted at the end of a supporting arm. The head and arm together are part of a head-arm assembly which mounts on the carriage in the drive actuator assembly. Information is sent to and from the heads via head-arm cables.

There are two types of heads: (1) servo head, and (2) read/write head. There are two servo heads per CMD drive. These are used to read position information from the servo surface on one of the disks. There is one read/write head for each of the data surfaces on the disks. These are used to record data and read it from these surfaces.

Each head-arm assembly consists of a rigid arm, head load spring, head gimbal spring, and the head (refer to Figure 6-32). The rigid arm, mounted on the carriage transmits carriage motion to the heads. The action required to load and unload the heads and to allow the heads to follow the disk surface is provided by the springs. When the heads are loaded they do not contact the disk but actually fly on a cushion of air created by the spinning of the disk pack. The air cushion pressure varies directly with disk speed. For the disk operating at the desired speed, the head load spring is designed to develop a force which exactly balances the air cushion force at the desired flying distance between the head and the disk.

If the disk speed drops below the desired speed, the cushion pressure decreases and the head load spring forces the head closer to the disk. Sufficent loss of speed causes the head to stop flying and to contract the rotating disk surface.

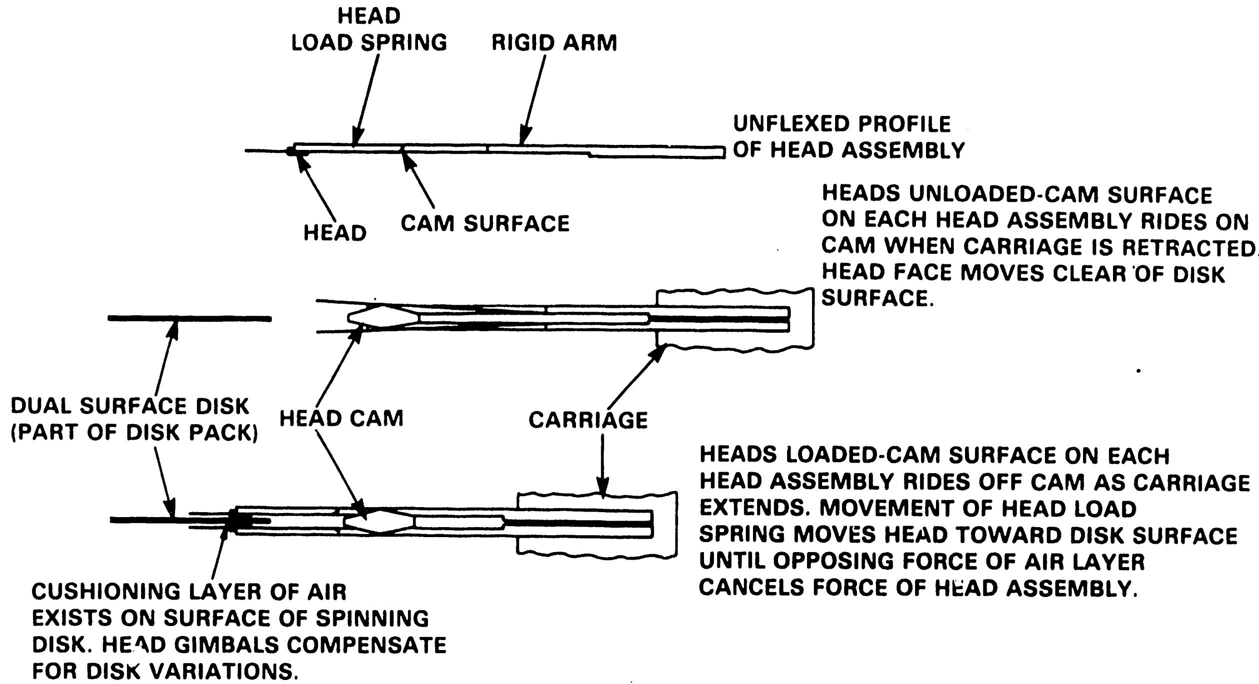
6.10.2 MEDIA DESCRIPTION

The data storage for the Phoenix drive consists of a removeable cartridge, with one data surface and one servo surface, and a fixed module with five data surfaces and one servo surface. The cartridge is portable and interchangeable between equivalent drives. Both the disk internal to the cartridge and the ensuring disks of the fixed module are each coated on both surfaces with a layer of magnetic oxide and related binders and adhesives. The servo surface of both the cartridge and fixed module contain information pre-recorded at the factory. These surfaces are used by the drive to generate position information and various timing signals. The remaining surfaces are available for data storage.

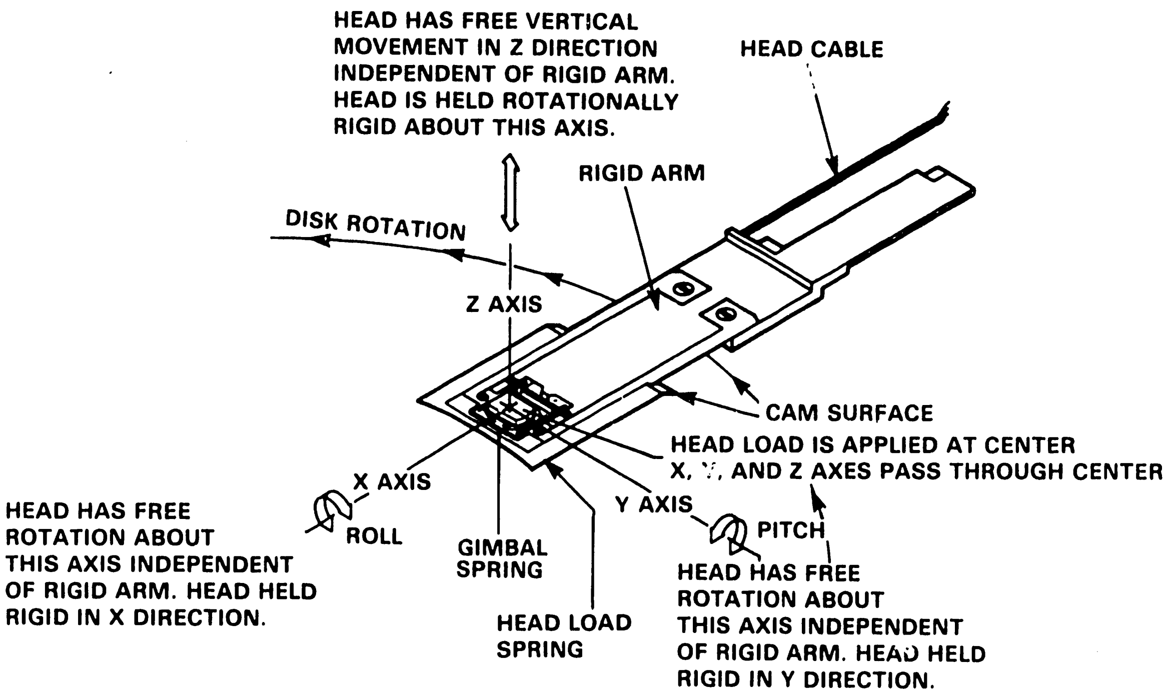
6.10.3 FLYING HEIGHT AND THE EFFECTS OF CONTAMINATION

Data is written on the coated disk by passing a current through the read/write head coil which generates a magnetic flux field across the head gap. This magnetizes the iron oxide particles on the disk directly beneath the gap. Ideally, to assure the maximum accuracy of reproduction of the signal recorded, the distance between the head gap and the disk surface would be infinitesimally small. However, due to disk imperfections and disk assembly and mounting tolerances, the head must fly far enough away from the disk to prevent head/disk contact.

Disk surface smoothness is currently approximately one microinch, arithmetic average. CMD head flying distances range between 32 and 35 microinches. On the other hand, airborne and air driven particles, including dust, smoke, lint and numerous other particles under the general name of dirt can find their way into the drive unless strict precautionery measures are taken. These particles can have diameters several orders of magnitude larger than head to disk flying height. This relationship is shown in Figure 6-33. Such contaminants, when squeezed between a head and a rotating disk, can disrupt the action of the cushion of air between the two and lead to data errors and eventual head crash.



HEAD LOADING



HEAD/ARM ASSEMBLY

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FIGURE 6-32. HEAD LOADING AND HEAD/ARM ASSEMBLY

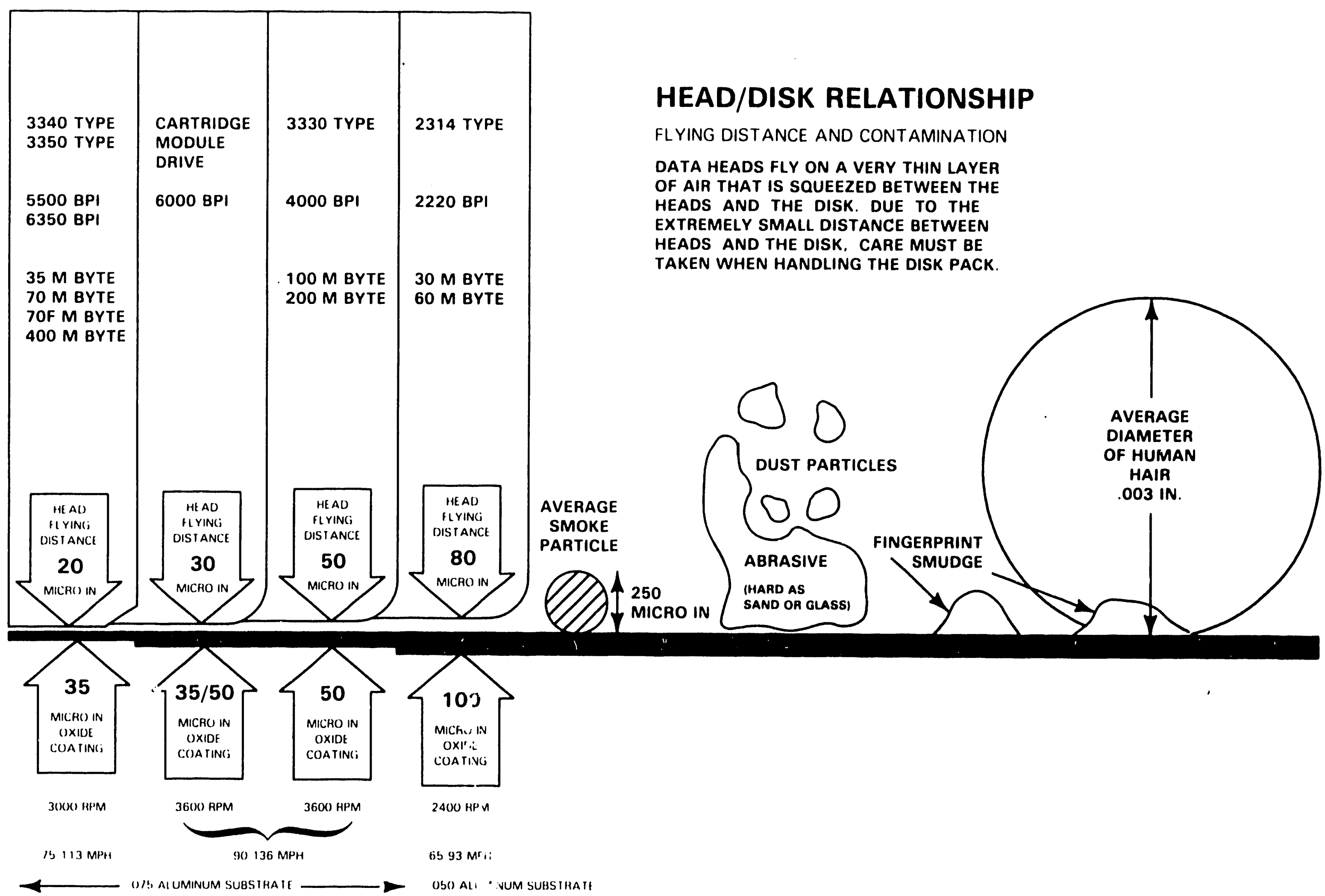

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FIGURE 6-33. HEAD/DISK RELATIONSHIP

6.10.4 PRECAUTIONS

Keep in mind that the great majority of head crashes can be traced to cartridge handling damage, swapping damaged cartridges between drives, or to contamination in the head/disk gap. Therefore, it is necessary that all actions which involve the drive and its environment be examined for these possibilities. Fortunately, the occurrence of head crashes due to these causes can be minimized through the observance and practice of common sense.

The cartridge itself is a high precision assembly. Particular effort is made during manufacturing to provide not only a disk surface smooth enough to form a uniform and reliable air cushion for the normal flying height, but also flat enough to keep variations in flying height to a small percentage of the nominal value. Both of these conditions are necessary for reliable signal recording and playback. It is, therefore, very important that great care be taken in handling the disk cartridge to avoid subjecting it to any unnecessary physical stress.

It is important that the cartridge involved in a head crash be carefully inspected before that cartridge is used again. A cartridge with disk surface damage, a bent disk, or mounting surface damages can cause head crashes to occur on each drive on which it is used if it is allowed to move from one drive to another.

Remember also that particles of contamination, measuring only a few microinches, are enemies of crash free operation. Another enemy is time, during which tiny particles can build up in critical areas to dimensions large enough to cause a head crash.

Although procedures may vary depending upon the application, some of the precautionary measures that some drive users have taken to keep contaminants out of their machines and to avoid damage to cartridges are covered in the following paragraphs.

<u>General Environment and Equipment Handling Precautions</u>

A. Install the drive in a room which is kept carefully dusted, with particular attention given to maintaining a smooth floor mopped and a carpeted floor vacuumed. Carpeted floors can be particularly troulbesome because of the dirt and dust they trap and the amount of lint they generate. Traffic in the room housing the disk drive should be kept to a minimum.

B. Maintain as much separation as possible between the disk drive and printers and tape and card punch equipment. These machines can generate a lot of paper, dust, and other airborne debris.

C. Eliminate smoking in the disk drive are if at all possible. Smoke particles have a sticky characteristic. The absolute filter on the disk drive can clog more rapidly in such an environment.

D. Maintain the relative humidity in the disk drive operating room at 40 to 50% if at all possible. Low relative humidity levels can lead to particle attraction and accumulation by static electricity.

Blower System

The blower system (Figure 6-34) provides positive pressure in the disk area The presence of this elevated pressure results in an outward dispersion of air preventing ingestion of contaminated air. This air flow greatly reduces possible contamination and resulting damage to the disk surfaces and the read/write heads.

Power to the blower motor is available whenever the AC POWER circuit breaker is on. It is recommended to leave the AC Power on and have the blower running continuously if possible.

Cartridge Handling and Storage

1. When handling or storing a disk cartridge. The cartridge dust cover should be on the cartridge while it is out of the disk receiver. This will immobilize the disk inside and insure a positive dust seal.

2. Cartridges can be stored flat but never on the edge. They can be stacked on top of one another, but never more than three high.

Disk Cartidge Installation (See Figure 6-35)

This disk cartridge must be stored in the same environment as the CMD for 60 minutes immediately preceding its use. Make certain disk cartridge has been cleaned and maintained in accordance with accepted preventive maintenance procedures.

1. Press the door in to release the safety latch.

2. Lift up on the release lever with the fingers.

3. Pull out and down to open the door and unload the cartridge.

NOTE: Power must be on, the START/STOP switch out, and READY and FAULT lamps must be off to release lock on cartridge door.

4. To seperate dust cover from the disk cartridge, push cover release button toward center of cartridge.

5. Disengage dust cover from disk cartridge. Set cover aside upside down to prevent dust from collecting within the cover.

   CAUTION: Make certain that the read/write heads are fully retracted.

6. Slide disk cartridge into receiver track, ensuring that the head opening is toward rear of the machine.

7. Push handle down. Push cartridge toward the rear until it stops.

8. Close cartridge access door and press the door closed until it is latched. The cartridge slides into place on the spindle automatically as the access door is closed.

9. Store cartridge cover upside down in some convenient location.

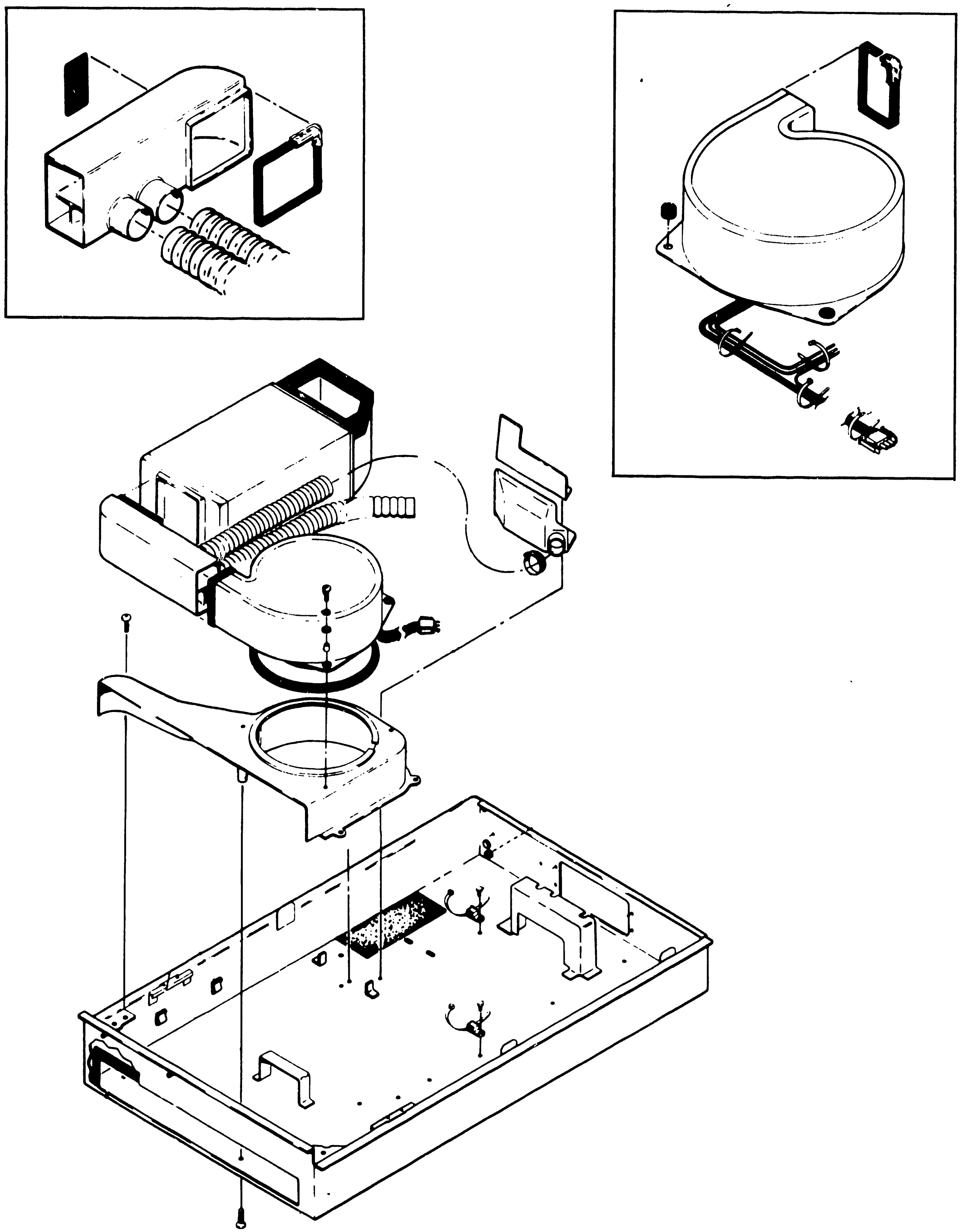

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FIGURE 6-34. BLOWER SYSTEM

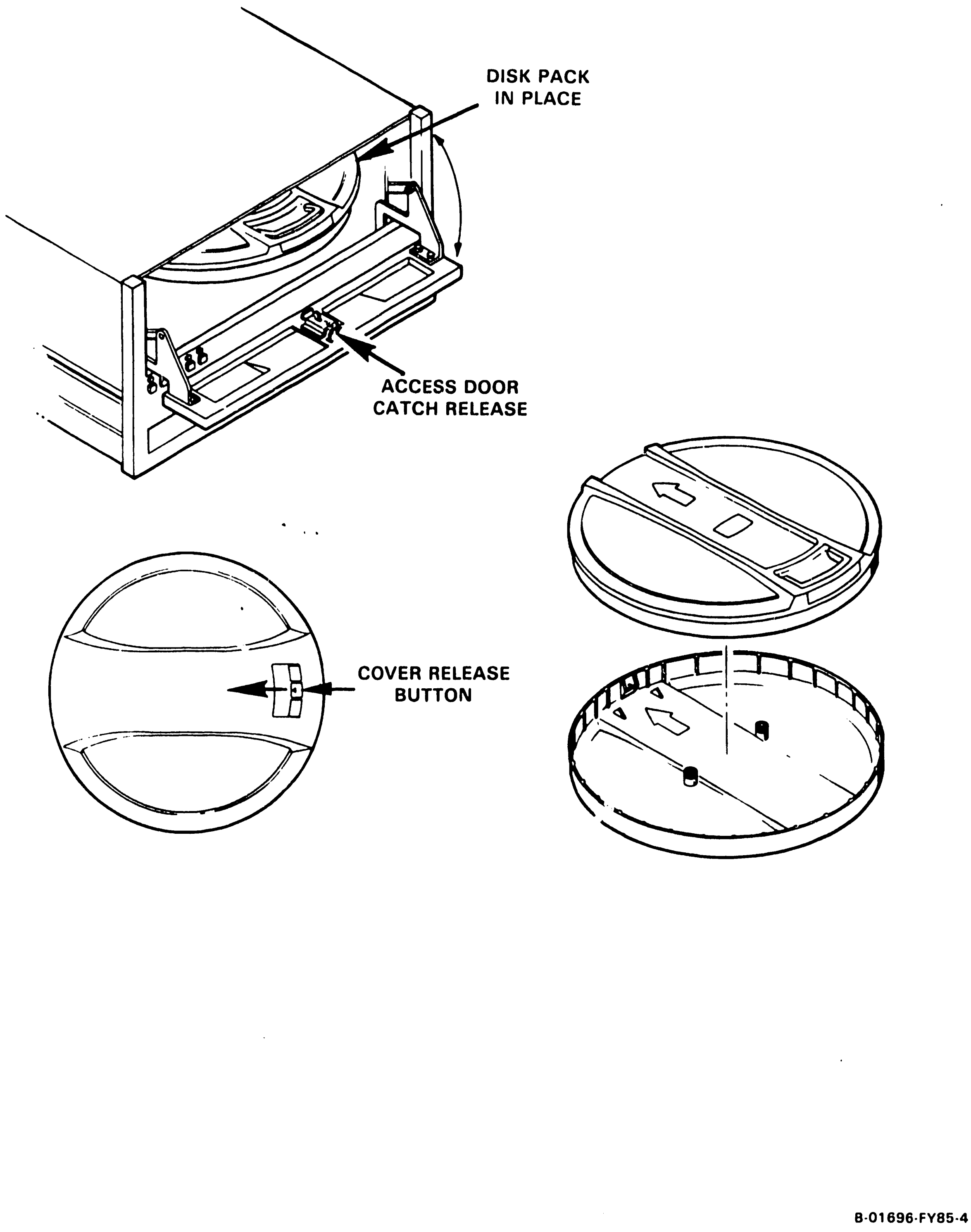


FIGURE 6-35. DISK CARTRIDGE INSTALATION

10. Depress START/STOP switch to apply power to spindle motor.

NOTE: If the spindle motor will not rotate, disk cartridge access door may not be completely closed, the cartridge may not be properly seated on the spindle chuck, or the cartridge receiver/base may not be all the way down on the lower chassis.

6.10.5 DISK CARTRIDGE REMOVAL

<u>Normal Removal (See Figure 6-35)</u>

1. Depress START/STOP switch to STOP (out).

2. Pull down the cartridge access door after the READY indicator ceases flashing and extinguishes entirely. READY indicator may be either above UNIT SELECT plug or inside the START/STOP switch.

3. Pull the cartridge out of the receiver with sufficent force to overcome the detent action.

4. Place the dust cover in position on the cartridge and fold over top handle.

<u>NOTE</u>: The handle may be swung out to carry the cartridge but do not push the cover release button.

5. Place another cartridge into the receiver and close cartridge access door. The CMD shall contain a cartridge at all times to insure proper sealing of shroud area.

<u>Power Failure or Emergency Stop Removal</u>

1. Wait approximately 8 minutes for cartridge to stop spinning.

2. Open cartridge access door. This automatically removes cartridge from spindle chuck. Door will not open if a problem exists. Power must be ON and START/STOP switch out retract door latch solenoid.

   AC Power should not be turned OFF while heads are loaded or disks rotating. If AC must be turned off, do not allow it to stay off if emergency retract fails to retract heads. Retract the heads by hand before removing AC power again.

<u>NOTE</u>: If heads have not retracted, FAULT indicator will remain OFF but spindle will continue to rotate until heads can be manually retracted (in the case where AC power is still applied). Top cover of unit must be removed to manually retract heads.

3. With light downward pressure at the front edge of the cartridge (to release from detent) pull cartridge out from receiver.

4. Place cartridge cover in position on bottom of cartridge.

5. Place another cartridge into the receiver and close the cartridge access door (This insures a proper seal of the shroud area).

6.10.6 HEAD CRASH PREVENTIVE MAINTENANCE

Potential drive problems and head crashes can be averted by strict adherence to the preventive maintenance schedule.

These procedures generally assume the reader is familiar with the maintenance section of the drive maintenance manual which contains information on safety and accessing the various components of the drive.

The following table provides the preventive maintenance schedule. Perform these actions in accordance to time or calendar schedule as specified. Actual intervals are dependent upon the environment.

Pre-filter Clean/replace	weekly or 150 hours
Absolute fileter inspection/replacement	six months or sooner if necessary
Actuator inspection w/fixed module in place	six months or 3000 hours
Spindle Hub inspection	six months or 3000 hours

Pre-Filter Clean

The prefilter removes large particles of dust and debris. It must be kept clean to allow sufficient air flow for drive cooling. If the prefilter cannot be cleaned as follows or is damaged, it must be replaced. If in doubt, replace it.

1. The prefilter is secured at right and left edge by a bracket at each edge. Remove the screw holding each bracket and remove brackets. Remove the prefilter. Do not attempt to loosen the brackets and slide the prefilter downward. This will damaged the prefilter jacket (foam gasket).

2. Clean prefilter by agitation in mild detergent solution.

3. Rinse thoroughly with clean water.

4. Blow in reverse direction with a low pressure nozzle until dry.

Absolute Filter Pressure Check

An adequate supply of clean air to the disks is essential to proper operation of the drive. Checking the filter on a quarterly basis is recommended. However, depending on the environment, a check of the airflow may be necessary more often.

1. Connect gauge to absolute filter outlet plemum.

2. Turn on drive AC power.

3. Press start.

4. When heads are loaded at track zero, read the gauge. If the pressure is below .75 inches of water, replace the absolute filter.

Absolute Filter Replacement

1. At this time it is advisable to clean the cartridge receiver bearings and tracks with a lint free cloth. Also check that they are operating properly and not binding.

2. Raise deck to maintenance position.

3. To remove the absolute filter, lift it at its rear end enough to allow it to be pulled toward the rear of the unit. This should free the front end from the hold in the manifold.

4. With filter removed inspect and clean the base pan. Check for any loose connections or other visible signs of potential problems.

   A. Vaccuum and wipe clean with lint free cloth the complete base pan including the absolute filter area.

   B. If the drive is in an excessively dusty area, remove the hoses and wash in a mild detergent solution. Rinse with clean water. Dry hoses thoroughly before reinstalling.

   C. Remove and inspect the manifold. If it has heavy dust buildup, clean it with a lint free cloth. Check the gasket to insure it is not losing its adhesiveness. If the gasket does not appear that it will make a good seal, replace it; if necessary, replace the manifold.

   D. Inspect the gasket on the blower assembly where it joins the manifold. It should not be loose, inhibiting airflow, or cracking and flaking. It should make a good tight seal. Replace gasket if necessary.

NOTE: When the absolute filter is replaced through either normal preventive maintenance or if the deck is raised to the corrective maintenance position, the filter must be purged for 30 minutes with the deck down prior to operation of the drive.

5. Remove power to the voice coil by disconnecting A1P1. Lower the deck, turn "on" AC breaker (CB-1)

6. Depress start/stop switch and allow the drive to purge for the minimum of 30 minutes with deck lowered, A1P1 diconnected, and disks spinning.

7. Depress start/stop switch to stop position when spindle has stopped; turn AC breaker "OFF" and reconnect A1P1.

8. Drive may be returned to normal operation or continue preventive maintenance.

Spindle: Inspection and Cleaning

In order to prevent head-to-disk contact, it is imperative that the spindle be kept clean, to include the cone, magnet, magnetic chuck. (See Figure 6-36)

1. Remove the cartridge receiver assembly.

2. Vacuum the spindle hub and cone. Use a cotton swab to break loose particles while vacuum cleaning.

3. Wipe the magnetic chuck and magnet clean using a lint free cloth dampened with media cleaning solution. Also, wipe all surfaces with a clean lint free cloth.

Spindle Height Measurement (See Figure 6-37)

It is generally recommended to check stack height at six month intervals. However, adverse conditions such as heavy usage or a recent move may require more frequent measurements.

1. Remove the cartridge receiver assembly and place the bar guage on the spindle so that the ends overlap the edge of the deck assembly.

2. Place the dial guage on the bar guage. While holding it steady, depress the top plunger and check that it calibrates to zero. If not, loosen thumb screw on the dial guage and rotate the face until it does.

3. Position the dial gauge on the bar so that it will penetrate the end hole and touches the drive casting.

4. Again, while holding the dial gauge steady, depress the plunger and take measurements at the following locations

   a. Head load area
   b. Front door latch area
   c. Left side
   d. Right side

All readings should be $.313 \pm .004$

5. If any readings was out of spec, the spindle should be replaced.

   A. If spindle was just installed, check measurements again without the drive belt in place. If the reading changes, spindle may have to be replaced again.

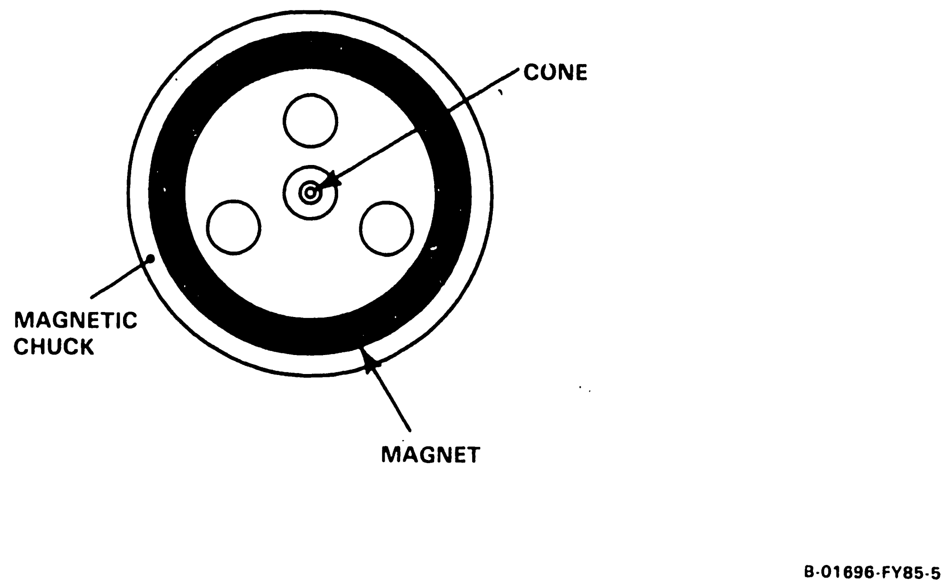


FIGURE 6-36. SPINDLE HUB

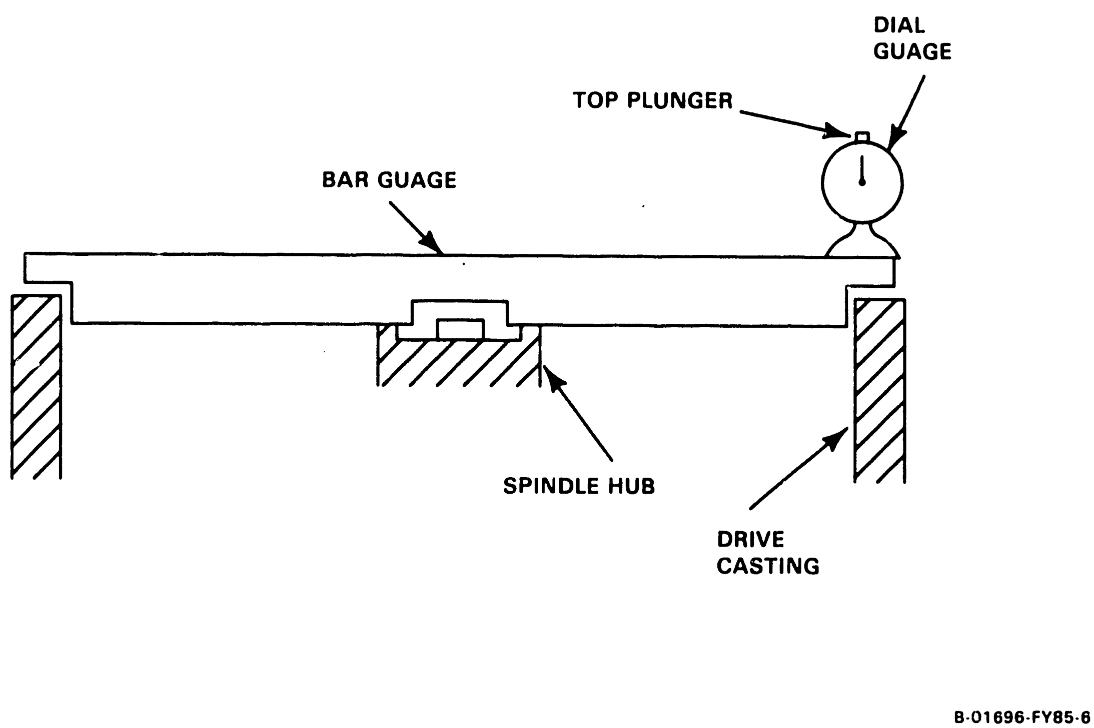


FIGURE 6-37. SPINDLE HEIGHT MEASUREMENT

6.11 PHOENIX POWER SUPPLY AND AMPLIFIER PROBLEM ISOLATION PROCEDURE

6.11.1 INTRODUCTION

The Phoenix CMD has power supply anomalies that may appear on the surface to be a power supply failure but are in fact power amplifier problems caused by faulty heads home switches. In some cases, this particular condition will damage a power amplifier. If it appears that during troubleshooting the power supply has failed without any fuses being blown, then the 32 volt load (the power amplifier circuitry) might have caused the problem. (See Figures 6-38 and 6-39 Basic Block for AC-DC and Power Circuitry Schematics).

6.11.2 DESCRIPTION

If the Power Amplifier of the CMD fails, it usually means that one or more of the darlington pairs are shorted. As a rule, the power amplifier will not fail by itself. If a condition exists where the heads home switch is defective and the microprocessor does not know that a move to the me position was complete, the reverse drive command for the voice coil will not shut off. An excessive power amplifier duty cycle will develop that can result in a power amplifier burn out.

Further insight into this anomaly can be explained in this manner. When a darlington circuit shorts out, it causes the 32 volts in the power supply to load down the input transformer which in turn causes an inoperative power supply. The proper procedure to prevent a power supply failure is to:

a. Insure that the heads home switch is working properly.
b. Identify and replace any shorted components.
c. Observe if the power supply becomes operative.

6.11.3 ISOLATION PROCEDURE

The procedure for the isolation of the 32 volt network from the power supply is as follows:

A. Disconnect the plug from the power supply to the 32 volt filter at the filter end of the harness. The filter is located in the center of the base pan where the blower is mounted. (J1/P1 of the filter, Figure 6-39).

NOTE

When the 32 volt load is taken off the power supply at this point, power is removed from the power amplifier, the relay control board and the logic rack. (See Figure 6-38).
If the other voltages of the power supply do come up with the plug removed, the problem has been isolated to the 32 volt load.

B. Observe if the other voltages of the power supply are present.

C. Observe for the presence of a fault light on the operators panel.

D. Observe that the CR6 indicator is illuminated on the control multiplexer printed circuit board.

Successful completion of these steps indicates the power supply is capable of functioning properly, but the drive is reporting a missing 32 volts. If during this procedure any of the other supplies are inoperative, the problem is with either another power supply load or with that particular power supply itself. It will then be necessary to do one of the following after checking the power supply fuses.

a. Replace the regulator on the power supply.

b. Replace the power supply.

C A U T I O N

> At this point it is not known if the 32 volt output of the power supply is present. This is because it is disconnected from the voltage sense circuits on EM2. If the other voltages of the power supply are present, check to make sure that there is a plus 32 voltage present and a minus 32 voltage present at the end of the 32 volt plug. A cross check of this type will prevent further power amplifier damage. Remember that the power amplifier has to have both plus and minus 32 volts at the right terminals for the correct bias on the darlington circuits or else they will short out again as soon as power is applied.

E.1 (Pre-Block Point IV Drives) Connect all of the 32 volt load except for the power amplifier as follows:

a. Turn off the power.

b. Disconnect terminals 1, 3, 8 & 10 from the power amplifier. (See Figure 6-40)

c. Reconnect the input to the 32 volt filter.

d. Turn on the power.

On Pre-Block Point IV drives, the 32 volt sense was connected to the 32 volt filter. If the power amplifier was the only problem left to be repaired, the front door lock will open (audible click) and the ready light will flash once. Also the fault light will be off and CR6 on EM2 will not be illuminated.

E.2 (Block Point IV Drives) Connect all of the 32 volt load except for the power amplifier as follows:

a. Turn off the power.

b. Disconnect the connectors on the power amplifier. (See Figure 6-40)

c. Reconnect the input to the 32 volt filter.

d. Turn on the power.

On block IV drives, the 32 volt is sensed at the power amplifier. It will be necessary to measure all of the voltages to insure that they are all present even though there is an indication of a voltage fault.

F. If the 32 volt short is corrected and the power supplies are operating do one of the following.

a. Replace the power amplifier or

b. Replace the determined defective transistors using the power amplifier schematic and resistance chart, (See Figures 6-40 and 6-41)

For information, the darlington amplifiers WLI numbers are as follows:

Q1 726-5769
Q2 726-5629
Q3 726-5630

HHSW (heads home switch)
726-5767

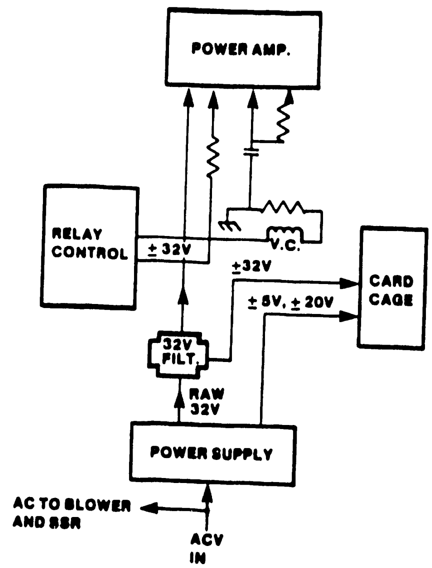


Figure 6-38 Basic Block for AC-DC

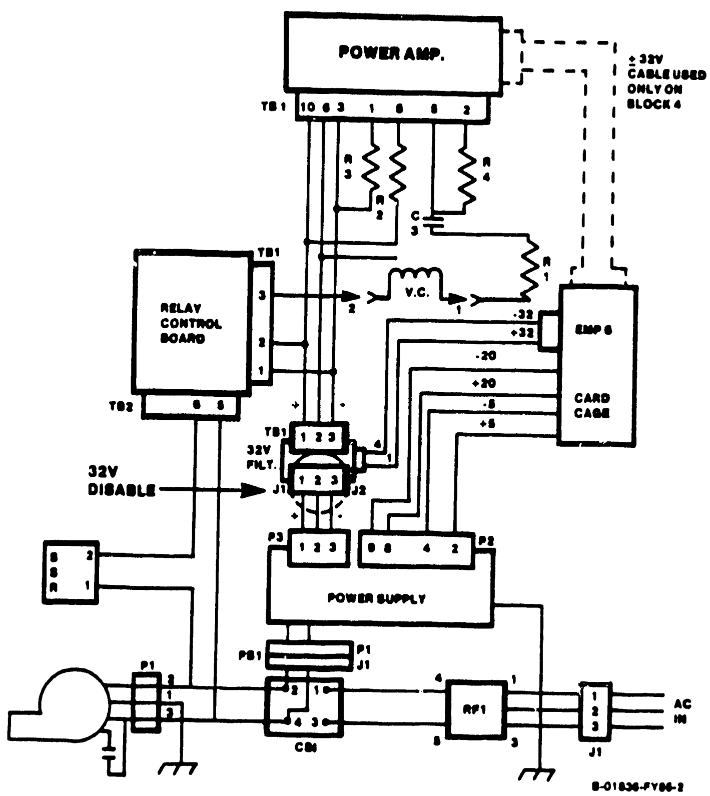


Figure 6-39 Power Circuitry Schematic

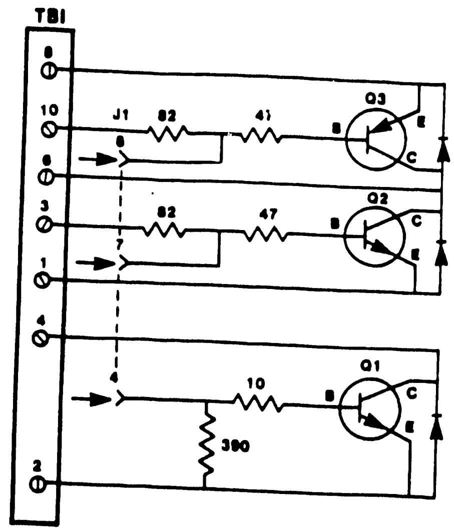


Figure 6-40 Represeentive Power Amplifier Schematic

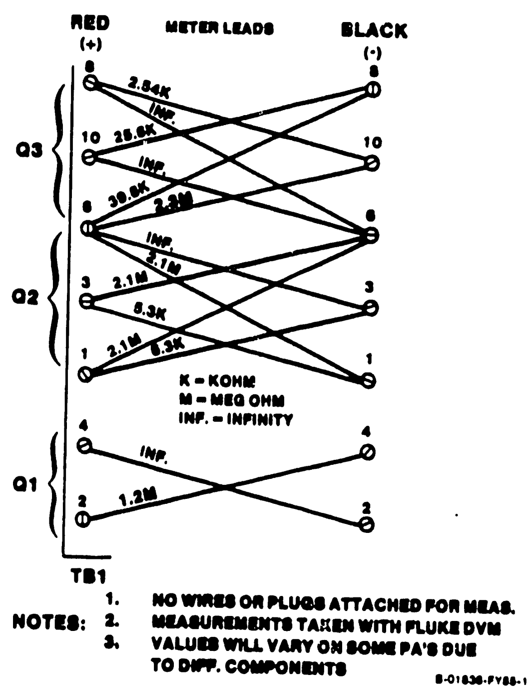


Figure 6-41 Power Amplifier Resistance Chart

SECTION
7
PARTS MANUAL

SECTION 7
PARTS MANUAL

7.1 ILLUSTRATED PARTS CATALOGUE.............................. 7-1

7.1 INTRODUCTION

This section contains an illustrated parts breakdown that describes and illustrates the Cartridge Module Drive (CMD) (Model 9448). In general, parts are in disassembly sequence but do not necessarily indicate the maximum recommended disassembly of parts in the field.

7.2 ILLUSTRATIONS

Item numbers within a circle 1 indicate an assembly (group of parts). Item numbers without a circle, 1, indicate a single part; a group of parts that are pinned or press fitted together; or a group of parts which is normally replaced as an assembly. Disassembly of certain assemblies is not reommended, however, and replacement of parts should be at the assembly level. These will be identified throughout the section.

7.3 PARTS LIST

In addition to the accompanying parts list on each illustration, two additional Parts Lists are available; the Top-Down Assembly/Component Parts List and the Cross Reference Index. Instruction for the use of all Parts Lists in paragraph 7.7.

7.4 ASSEMBLY BREAKDOWN

7.4.1 PRODUCT UNIQUE PARTS

Figure 7-1 illustrates the unique customer selected items defined by the Parts Data Hardware Product Configurator (HPC) sheet. The Parts Data HPC sheet is included in the HPC package located in front of the manual. It may be desirable to insert the Parts Data HPC sheet in front of this section.

7.4.2 TOP LEVEL ASSEMBLY

Figure 7-2 identifies device hardware mounting and the Final Mechanical Assembly.

7.4.3 FINAL MECHANICAL ASSEMBLY

The Final Mechanical Assembly is a detailed breakdown of the CMD device. It also identifies by sheet number, the location of all major assemblies not detailed in Figures 7-1 and 7-2.

7.5 REPLACEMENT PARTS

When ordering replacement parts for the CMD, the inclusion of the Model No., the figure, item and part identification numbers for each part ordered will ensure positive identification of parts.

Before ordering parts, refer to paragraph 7.6.

7.6 SPARE PARTS (SP)

This Illustrated Parts Breakdown is complete to the extent that all parts and assemblies are depicted and identified. Replacement part availability however, depends on the materials and provisioning operation of the supplier.

To assist the service representative in selecting replacement parts with minimum requisitioning lead times, engineering recommended spare parts which reflect the intended service level of the device are identified with the letters SP adjacent to the item number on the face of each illustration. Replaceable non-spared items will require longer requisitioning lead times.

7.7 PARTS LIST INSTRUCTIONS

7.7.1 ILLUSTRATION PARTS LISTS

The parts list for each illustration is an extract from the Top-Down Assembly/Component Parts List and contains only those parts depicted. Refer to paragraph 7.7.2 for explanation of parts list.

7.7.2 TOP-DOWN ASSEMBLY/COMPONENT PARTS LIST

a. Starts at TLA level and lists all parts in Item Number sequence.
b. Correlates Item Numbers with Part Identification Numbers and the Description of each.
c. Indicates where each part is used (used column) within the device by listing the item number(s) of the next higher assembly.
d. Defines the location of each part by listing the sheet number(s) where depicted.

NOTE
The same part may be used in any number of assemblies or sheet locations.

7.7.3 CROSS REFERENCE INDEX

o Lists all parts in numeric sequence (by Identification Number), in conjunction with the referenced sheet number (third column) and illustrations.
o Defines the physical locations of each item identified.

7.4.4 SHEET NUMBER REFERENCING

Sheet number references of Parts Lists and Illustrations refers to sheet locations in this section. Example: Sheet reference 4 represents sheet 7-4, sheet 5 represents sheet 7-5, ect.

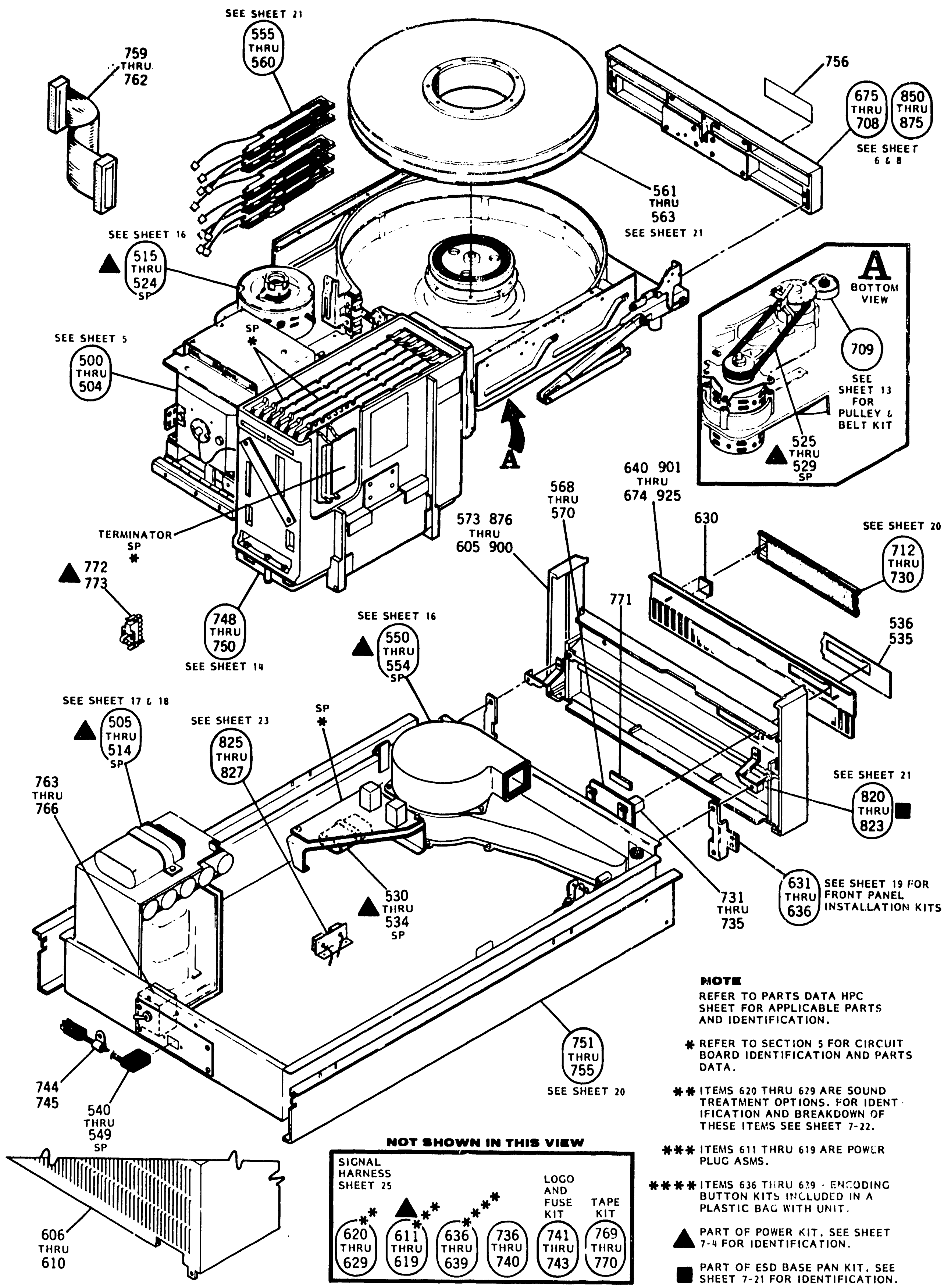
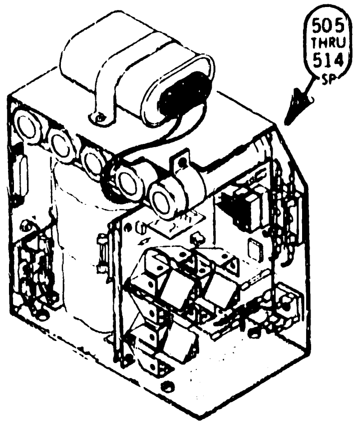
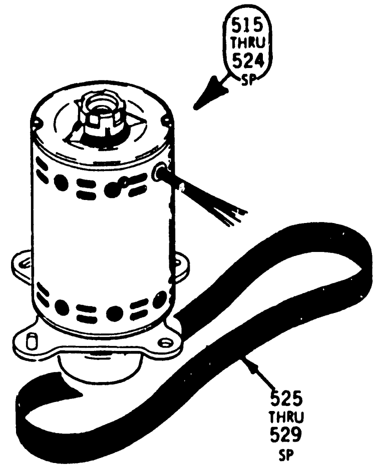
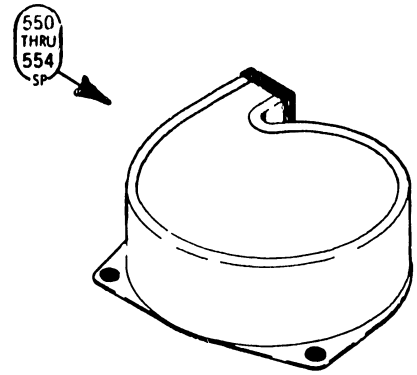


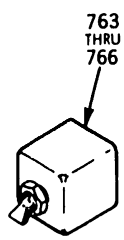
FIGURE 7-1. HARDWARE PRODUCT CONFIGURATION

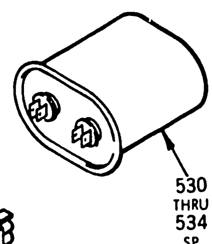
POWER KIT NO.	DESCRIPTION		505 thru 514	515 thru 524	525 thru 529	530 thru 534	550 thru 554	610 thru 619	763 thru 766	772 thru 773
1	50 Hz 100 V		512	520	526	530	551	617	763	773
2	50 Hz 120 V		512	519	526	530	551	619	764	773
3	50 Hz 220 V		512	516	526	531	552	614	764	772
4	50 Hz 230 V		512	516	526	531	552	615	764	772
5	50 Hz 240 V		512	516	526	531	552	618	764	772
6	60 Hz 100 V		511	521	525	530	550	616	763	773
7	60 Hz 120 V		513	515	525	530	550	610	764	773
8	60 Hz 120 V	50/60 Pwr Supply	514	515	525	532	550	616	764	773
9	50 Hz 120 V	50/60 Pwr Supply	514	519	526	532	551	610	764	773

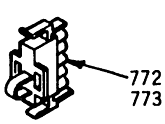


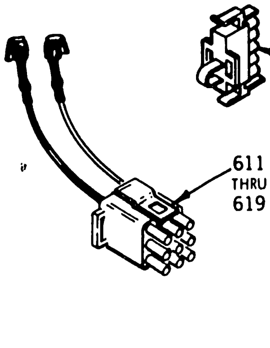






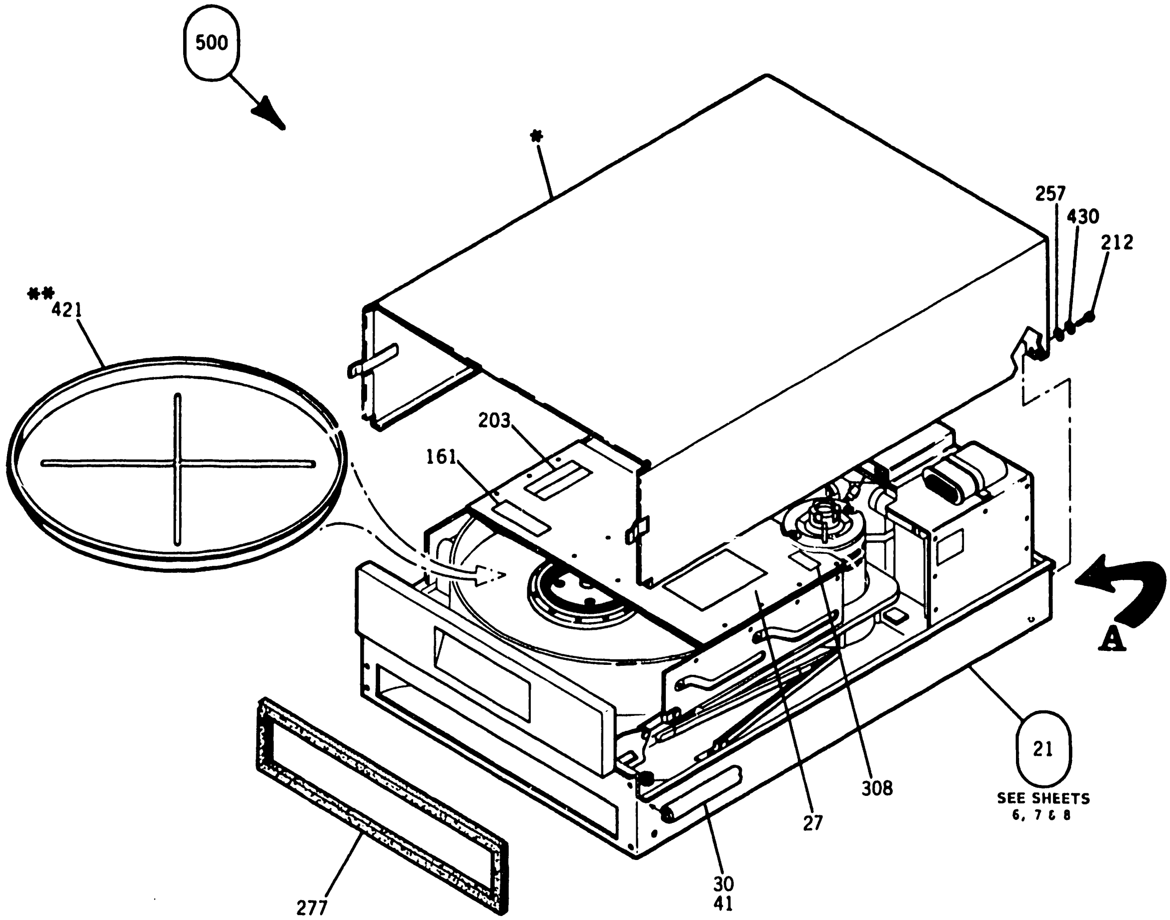






ITEM	IDENT NO.	DESCRIPTION	WHERE USED
509	77610705	POWER SUPPLY 60 HZ	HPC
510	75887884	POWER SUPPLY	HPC
511	77610707	POWER SUPPLY 50 HZ	HPC
512	76867300	POWER SUPPLY	HPC
513	76879400	POWER SUPPLY	HPC
514	76879500	POWER SUPPLY	HPC
515	77638604	DRIVE MTR ASM 60 HZ 120V	HPC
516	77638605	DRV MTR ASM 220-240V	HPC
519	77638603	DRV MTR ASM 50 HZ 120V	HPC
520	77638601	DRV MTR ASM 50 HZ 120V	HPC
521	77638602	DRV MTR ASM 60 HZ 100V	HPC
525	92314113	DRIVE BELT 60 HZ	HPC
526	92314127	DRIVE BELT 50 HZ	HPC
530	75738414	CAPACITOR 60 HZ	HPC
531	76879006	CAPACITOR 50 HZ	HPC
532	77612915	CAPACITOR 50/60 HZ	HPC
550	75889886	BLOWER ASM 60 HZ	HPC
551	75889888	BLOWER ASM 50 HZ	HPC
552	75889889	BLOWER ASM 50 HZ	HPC
611	75899076	POWER PLUG ASM 50 HZ	HPC
614	75899085	POWER PLUG ASM	HPC
615	75899086	POWER PLUG ASM	HPC
616	75899082	POWER PLUG ASM	HPC
617	75899083	POWER PLUG ASM	HPC
618	75899087	POWER PLUG ASM	HPC
763	15165898	CIRCUIT BREAKER	HPC
764	15165895	CIRCUIT BREAKER	HPC
772	77644690	JUMPER PLUG ASM	HPC
773	77644691	JUMPER PLUG ASM	HPC
801	77700030	POWER KIT 1	HPC
802	77700031	POWER KIT 2	HPC
803	77700032	POWER KIT 3	HPC
804	77700033	POWER KIT 4	HPC
805	77700034	POWER KIT 5	HPC
806	77700035	POWER KIT 6	HPC
807	77700036	POWER KIT 7	HPC
808	77700037	POWER KIT 8	HPC
809	77700038	POWER KIT 9	HPC

FIGURE 7-2. POWER KIT ASSEMBLIES



ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
072	75893357	INSTR LABEL	500
021	77665750	FINAL MECHANICAL ASM	500
027	75893356	INSTRUCTION LABEL	500
030	77662086	GASKET EXTRUSION	500
041	95033900	ADHESIVE	500
074	75880242	LABEL	500
086	77686131	GND LABEL	500
157	10127177	SCREW	500
161	75893358	INSTRUCTION LABEL	500
203	75893355	LABEL	500
212	77617049	SCREW	500
254	10125804	WASHER	500
257	10125605	WASHER	500
258	10125606	WASHER	500
277	83410518	GASKETSTRIP	500
308	75790000	DECAL	500
421	90603300	CLOSURE	500
430	10126401	WASHER	500
500	77669983	TOP LEVEL ASM	HPC

* REFERENCE - SEE FIGURE 7 - 1 FOR IDENTIFICATION

** ITEM 421 IS A DUST COVER FOR USE IN CARTRIDGE AREA WHENEVER A CARTRIDGE IS NOT PRESENT

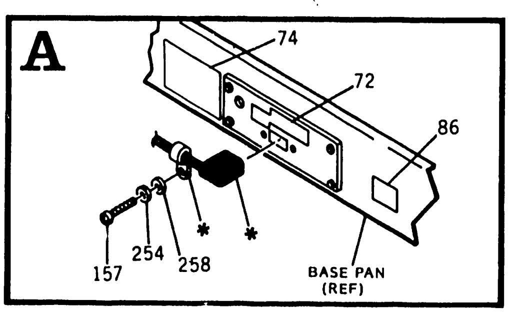
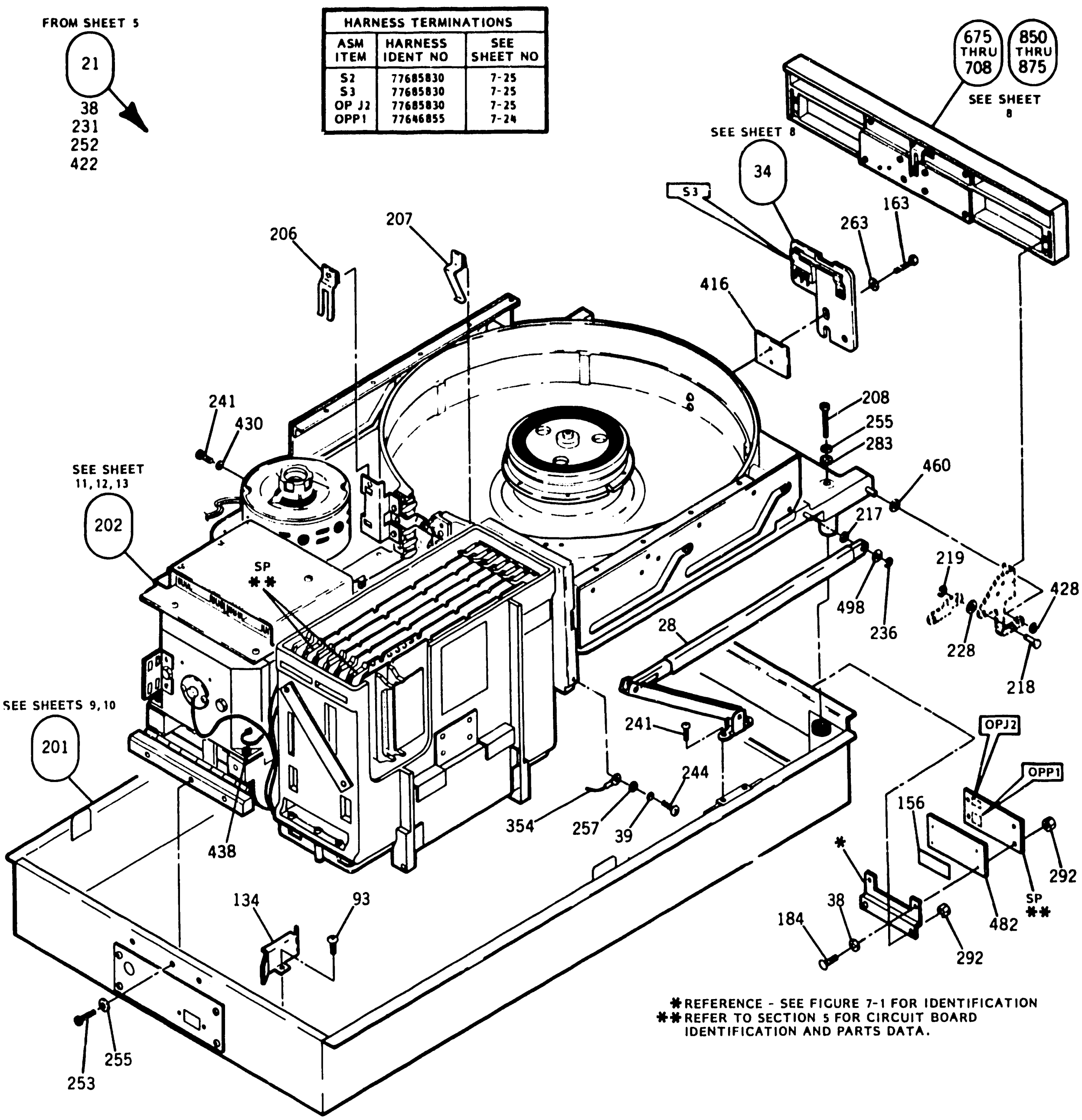


FIGURE 7-3. TOP LEVEL ASSEMBLY

HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
S2	77685830	7-25
S3	77685830	7-25
OP J2	77685830	7-25
OPP1	77646855	7-24

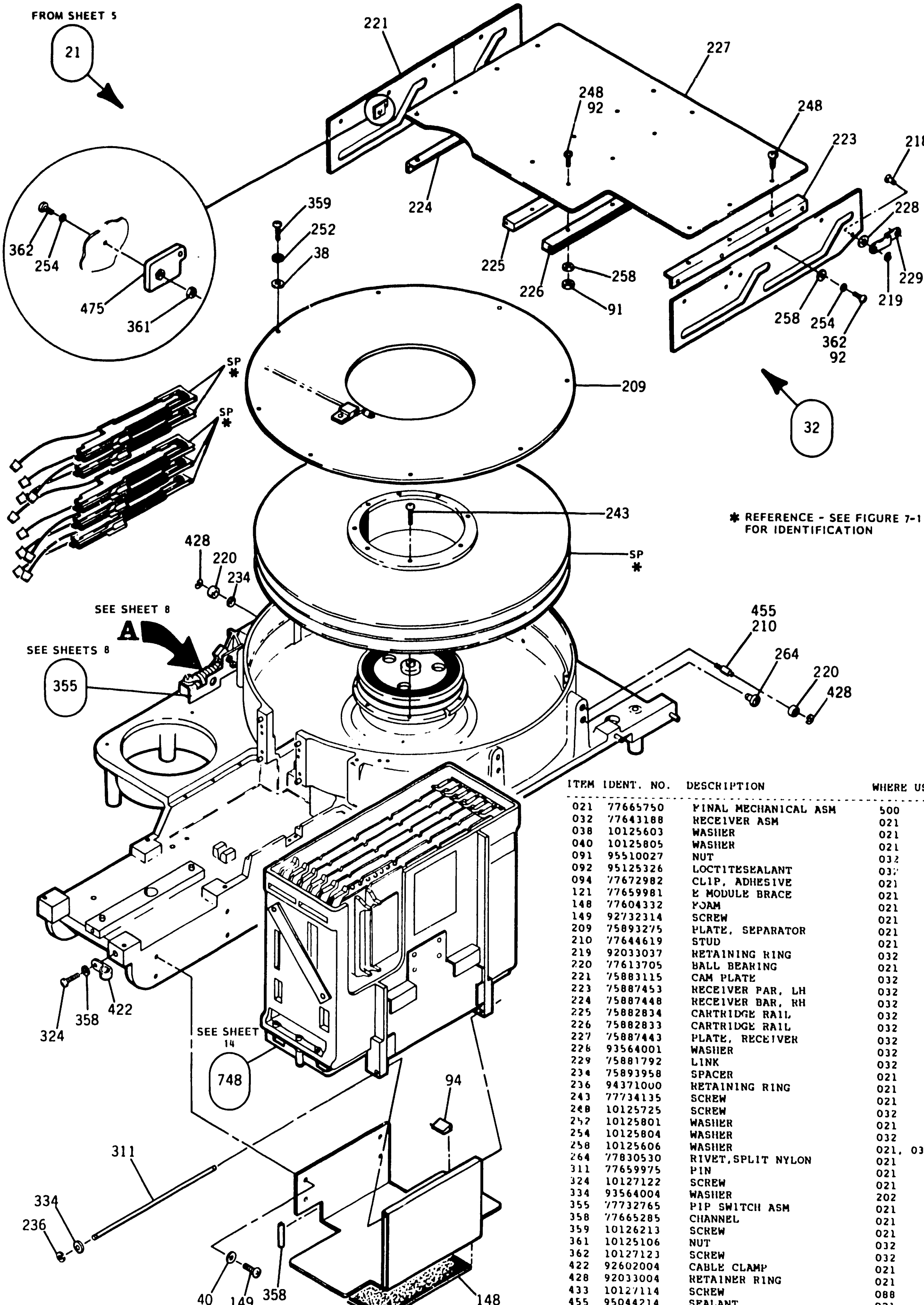


*REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION
**REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
021	77665750	FINAL MECHANICAL ASM	500
028	75881128	DECKSUPPORT LH	021
029	75881129	DECKSUP RH (NOT SHOWN)	021
034	77667396	STRIKER ASM	021
038	10125603	WASHER	021
039	10125803	WASHER	021
093	93749196	SCREW	021
134	77713965	CABLE GUARD	021
152	93749200	SCREW	021
156	77647108	ACOUSTIC FOAM	021
163	93749202	SCREW	021
184	10127322	SCREW	021
201	77665760	BASE PAN ASM	021
202	77665770	DECK ASM	021
206	77681510	CLAMP, SERVO LEAD	021
207	77681505	RETAINER, HEAD CONN	021
208	10126263	SCREW	021
217	75892811	WASHER	021
218	75892221	PIN	021
219	92033037	RETAINING RING	021
228	93564001	WASHER	021
230	16402506	CABLE CLAMP	021
231	10127104	SCREW	021
236	94371000	RETAINING RING	021

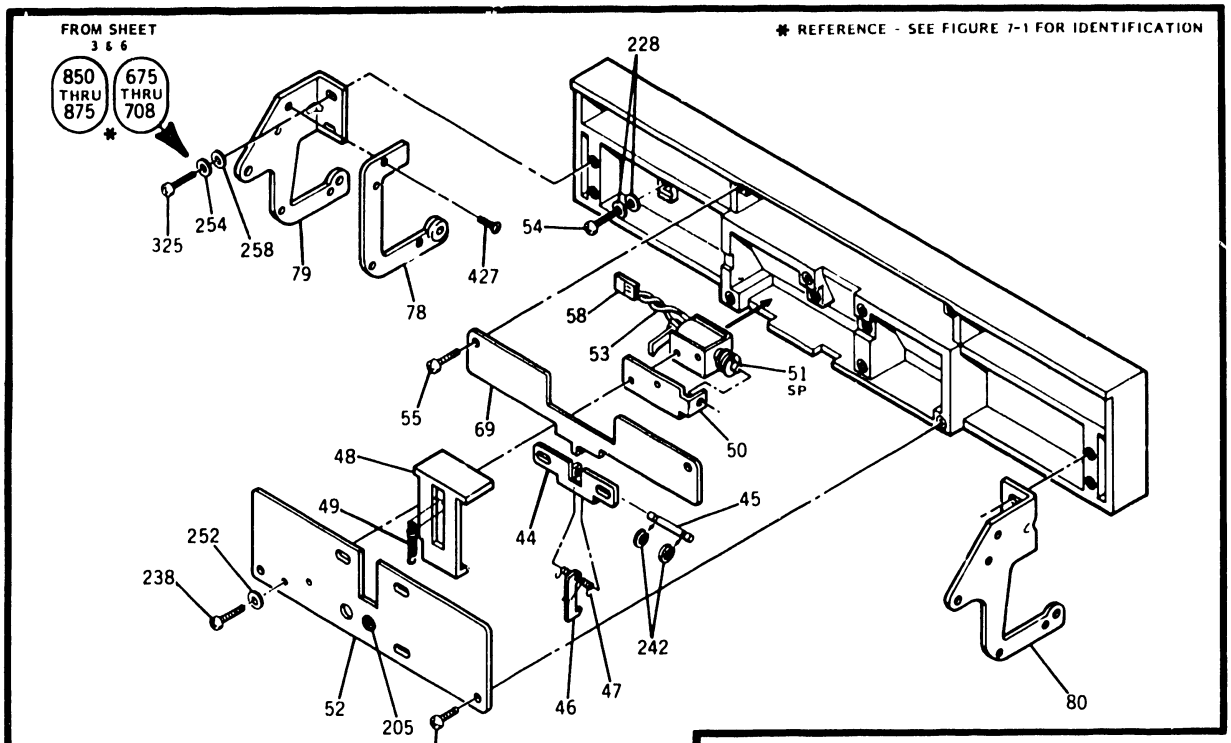
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
241	93592158	SCREW	021
244	10127113	SCREW	021
253	10126253	SCREW	021
255	10125806	WASHER	021
256	10125602	WASHER	021
257	10125605	WASHER	021
261	53777902	NUT & WASHER	021
263	75806504	WASHER	021
283	77619805	WASHER	021
292	53777900	NUT	021
354	75882357	JUMPER WIRE	021
355	77732765	PIP SWITCH ASM	021
416	75882106	SHIM, STRIKER	021
422	92602004	CABLE CLAMP	021
428	92033004	RETAINER RING	021
429	10127112	SCREW	021
430	10126401	WASHER	021
438	74277400	CABLE TIE	021
460	75883025	SPACER, NYLON	021
482	75803804	INSULATOR, FISHPAPER	021
498	75887251	WASHER	021

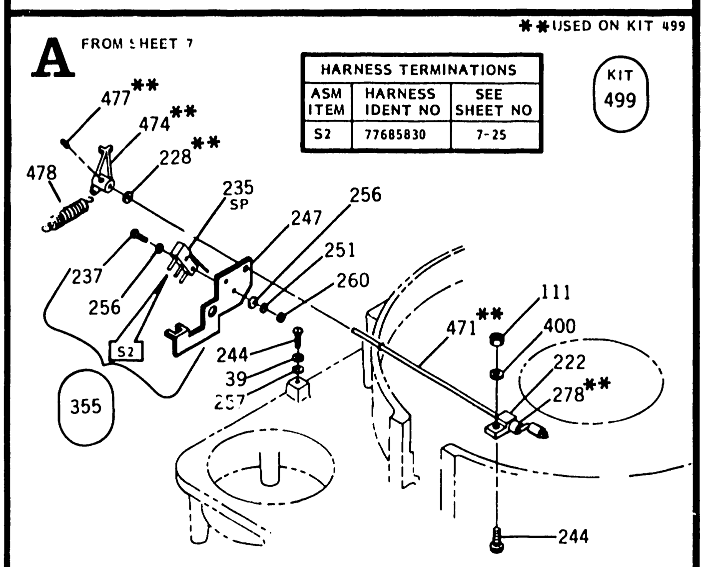
FIGURE 7-4. FINAL MECHANICAL ASM (1 OF 3)

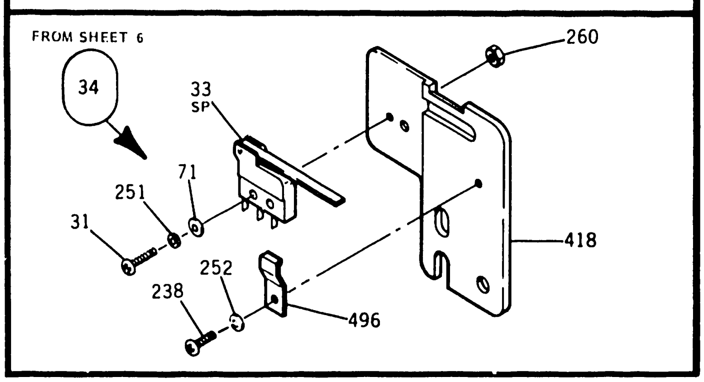


ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
021	77665750	FINAL MECHANICAL ASM	500
032	77643188	RECEIVER ASM	021
038	10125603	WASHER	021
040	10125805	WASHER	021
091	95510027	NUT	032
092	95125326	LOCTITESEALANT	032
094	77672982	CLIP, ADHESIVE	021
121	77659981	E MODULE BRACE	021
148	77604332	FOAM	021
149	92732314	SCREW	021
209	75893275	PLATE, SEPARATOR	021
210	77644619	STUD	021
219	92033037	RETAINING RING	032
220	77613705	BALL BEARING	021
221	75883115	CAM PLATE	032
223	75887453	RECEIVER PAR, LH	032
224	75887448	RECEIVER BAR, RH	032
225	75882834	CARTRIDGE RAIL	032
226	75882833	CARTRIDGE RAIL	032
227	75887443	PLATE, RECEIVER	032
228	93564001	WASHER	032
229	75881792	LINK	032
234	75893958	SPACER	021
236	94371000	RETAINING RING	021
243	77734135	SCREW	021
248	10125725	SCREW	032
252	10125801	WASHER	021
254	10125804	WASHER	032
258	10125606	WASHER	021, 032
264	77830530	RIVET,SPLIT NYLON	021
311	77659975	PIN	021
324	10127122	SCREW	021
334	93564004	WASHER	202
355	77732765	PIP SWITCH ASM	021
358	77665285	CHANNEL	021
359	10126213	SCREW	021
361	10125106	NUT	032
362	10127123	SCREW	032
422	92602004	CABLE CLAMP	021
428	92033004	RETAINER RING	021
433	10127114	SCREW	088
455	95044214	SEALANT	021
475	75893245	BLOCK, LINKAGE	032
748	77660545	E MODULE ASM	HPC

FIGURE 7-4. FINAL MECHANICAL ASM (2 OF 3)

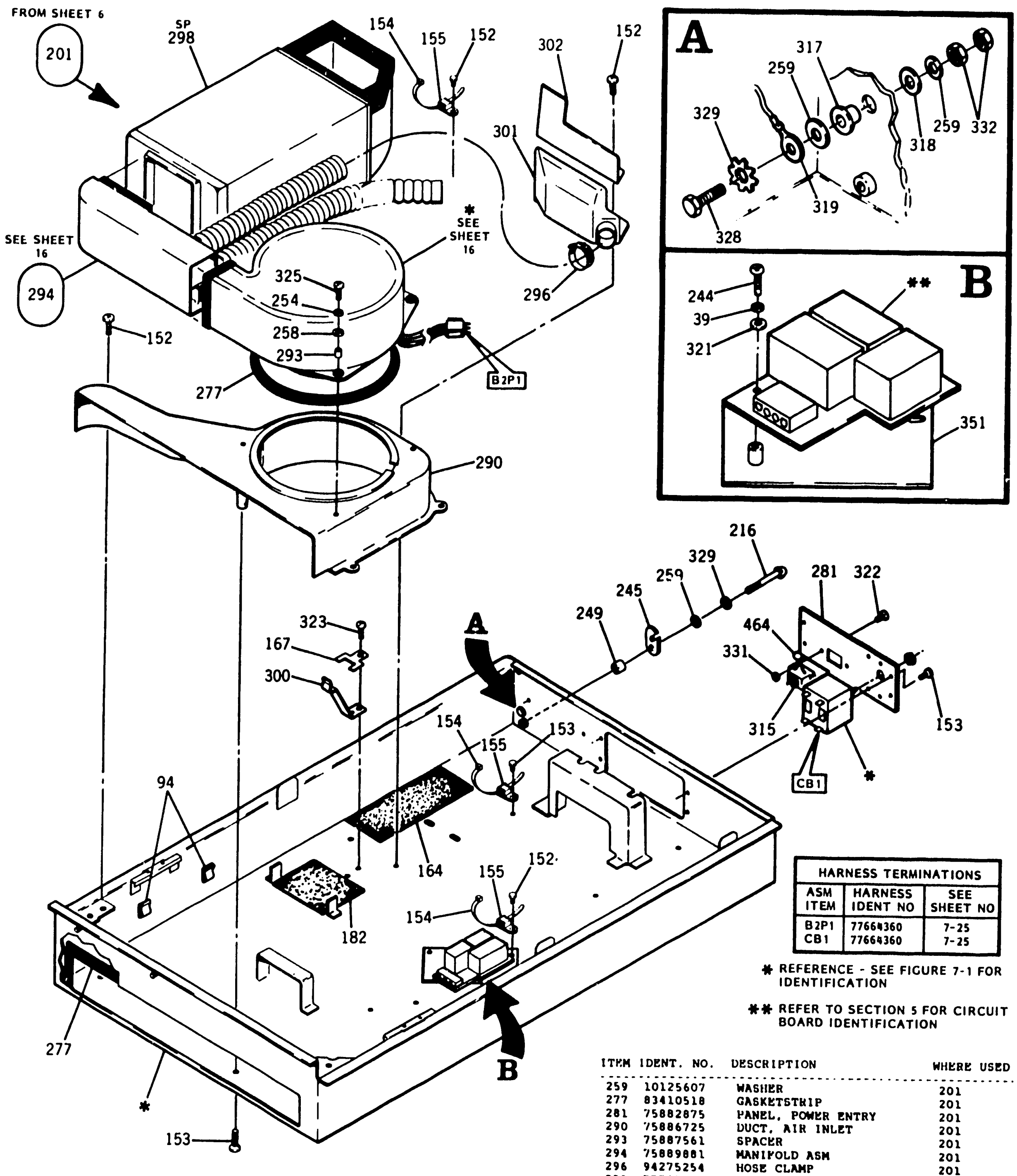






ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
021	77665750	FINAL MECHANICAL ASM	500
031	92742011	SCREW	034
033	94364401	SWITCH	034
034	77667396	STRIKER ASM	021
039	10125803	WASHER	021
044	77641805	LATCH PLATE	043
045	75881840	PIN PAWL	043
046	75881731	PAWL	043
047	75881770	SPRING PAWL	043
048	75882694	SLIDE, LATCH	043
049	75883310	TENSION SPRING	043
050	75883642	SOLENOID BRACKET	043
051	75883056	SOLENOID ASM	043
052	75882691	LATCH COVER	043
053	75883466	JUMPER WIRE ASM	043
054	94376917	SCREW	043
055	94376918	SCREW	043
058	51870302	HOUSING CONN	043
069	77641810	COVER, DOOR	043
071	75806501	FLAT WASHER	034
078	75892737	WIRE GUARD	043
079	75894833	HINGE	043
080	75894832	HINGE	043
205	95523400	BUMPER	043
222	75889492	SUPPORT SHAFT	021
228	93564001	WASHER	499, 043
235	77610146	SW INTEGRAL LEVER	355
237	92745012	SCREW	355
238	10127102	SCREW	034, 043
242	92033033	RETAINING RING	043
244	10127113	SCREW	021
247	77666820	SWITCH PLATE	355
251	10125800	WASHER	355
252	10125801	WASHER	034, 043
254	10125804	WASHER	043
256	10125602	WASHER	355
257	10125605	WASHER	021, 043
258	10125606	WASHER	021
260	10125102	NUT	355, 034
278	75880482	BEARING	499
325	10127124	SCREW	043
355	77732765	PIP SWITCH ASM	021
400	77830611	WASHER	021
418	77653103	STRIKER AND TAPE ASSM	034
427	10125702	SCREW	043
471	77732764	SHAFT ASM	499
472	75880481	BEARING	499
473	75882455	SPACER	499
474	75894896	LEVER, CAM	499
477	77670257	SET SCREW	499
478	77610461	SPRING	021
496	75893211	BRACKET	034
499	77736891	KIT, CART RELEASE	021

FIGURE 7-4. FINAL MECHANICAL ASM (3 OF 3)



HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
B2P1	77664360	7-25
CB1	77664360	7-25

* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION

** REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION

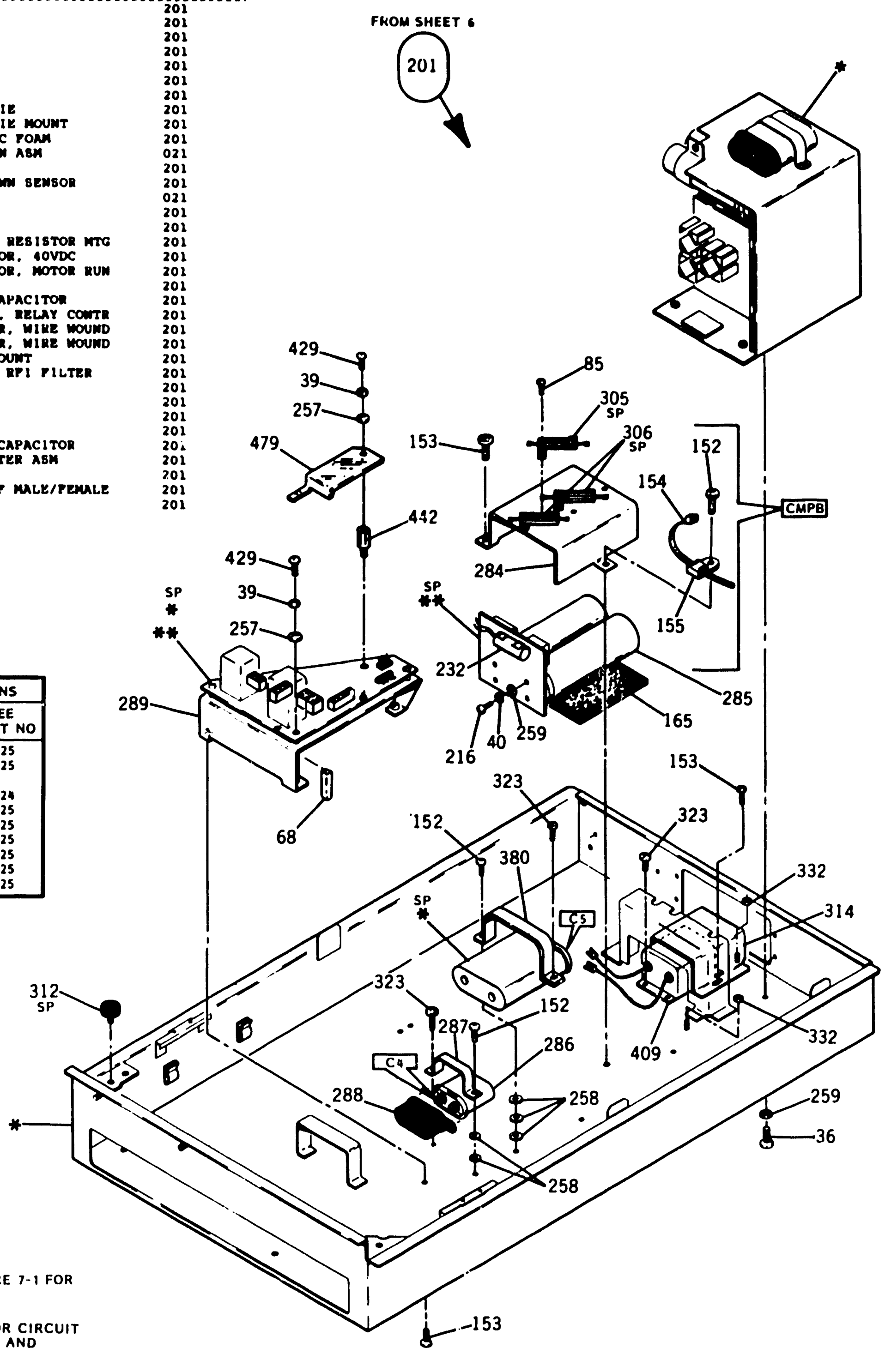
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
039	10125803	WASHER	201
094	77672932	CLIP, ADHESIVE	201
152	93749200	SCREW	201
153	93749198	SCREW	201
154	94277401	CABLE TIE	201
155	94343210	CABLE TIE MOUNT	201
164	77611463	TAPE	201
167	77681338	RETAINER	201
182	77604334	FOAM	201
201	77665760	BASE PAN ASM	021
216	10127143	SCREW	201
244	10127113	SCREW	201
245	75883475	GROUNDSTRAP	201
249	95694202	SPACER	201
254	10125804	WASHER	201
258	10125606	WASHER	201

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
259	10125607	WASHER	201
277	83410518	GASKETSTRIP	201
281	75882875	PANEL, POWER ENTRY	201
290	75886725	DUCT, AIR INLET	201
293	75887561	SPACER	201
294	75889881	MANIFOLD ASM	201
296	94275254	HOSE CLAMP	201
298	77761951	SPARE FILTER KIT	201
300	77647101	SPRING, FILTER RET	201
301	75881265	DEFLECTOR, AIR	201
302	75891005	COVER, AIR DEFLECTOR	201
315	51870400	AC PWR RECEPTACLE	201
317	75062803	WASHER	201
318	75062400	WASHER	201
319	75883453	WIRE JUMPER	201
321	94047067	WASHER	201
322	10127103	SCREW	201
323	93749196	SCREW	201
324	10127122	SCREW	201
325	10127124	SCREW	201
328	10125066	SCREW	201
329	10126403	WASHER	201
331	53777900	NUT	201
332	53777905	NUT	201
351	77737800	BRACKET	201
464	75883007	VARISTOR	201

FIGURE 7-5. BASE PAN ASSEMBLY (1 OF 2)

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
036	77610249	SCREW	201
039	10125803	WASHER	201
040	10125805	WASHER	201
068	77665286	CHANNEL	201
085	17901501	SCREW	201
152	93749200	SCREW	201
153	93749198	SCREW	201
154	94277401	CABLE TIE	201
155	94343210	CABLE TIE MOUNT	201
165	77604333	ACOUSTIC FOAM	201
201	77665760	BASE PAN ASM	021
216	10127143	SCREW	201
232	77685805	DECK DOWN SENSOR	201
257	10125605	WASHER	021
258	10125606	WASHER	201
259	10125607	WASHER	201
284	75881350	BRACKET RESISTOR MTG	201
285	95645628	CAPACITOR, 40VDC	201
286	76878900	CAPACITOR, MOTOR RUN	201
287	92826001	BRACKET	201
288	75772500	BOOT, CAPACITOR	201
289	75888159	BRACKET, RELAY CONTR	201
305	75888775	RESISTOR, WIRE WOUND	201
306	75888776	RESISTOR, WIRE WOUND	201
312	77610156	SHOCK MOUNT	201
314	75882870	SHIELD, RFI FILTER	201
322	10127103	SCREW	201
323	93749196	SCREW	201
329	10126403	WASHER	201
332	53777905	NUT	201
380	95643601	CLAMP, CAPACITOR	201
409	75893326	RFI FILTER ASM	201
429	10127112	SCREW	201
442	51885504	STANDOFF MALE/FEMALE	201
479	77686490	COVER	201

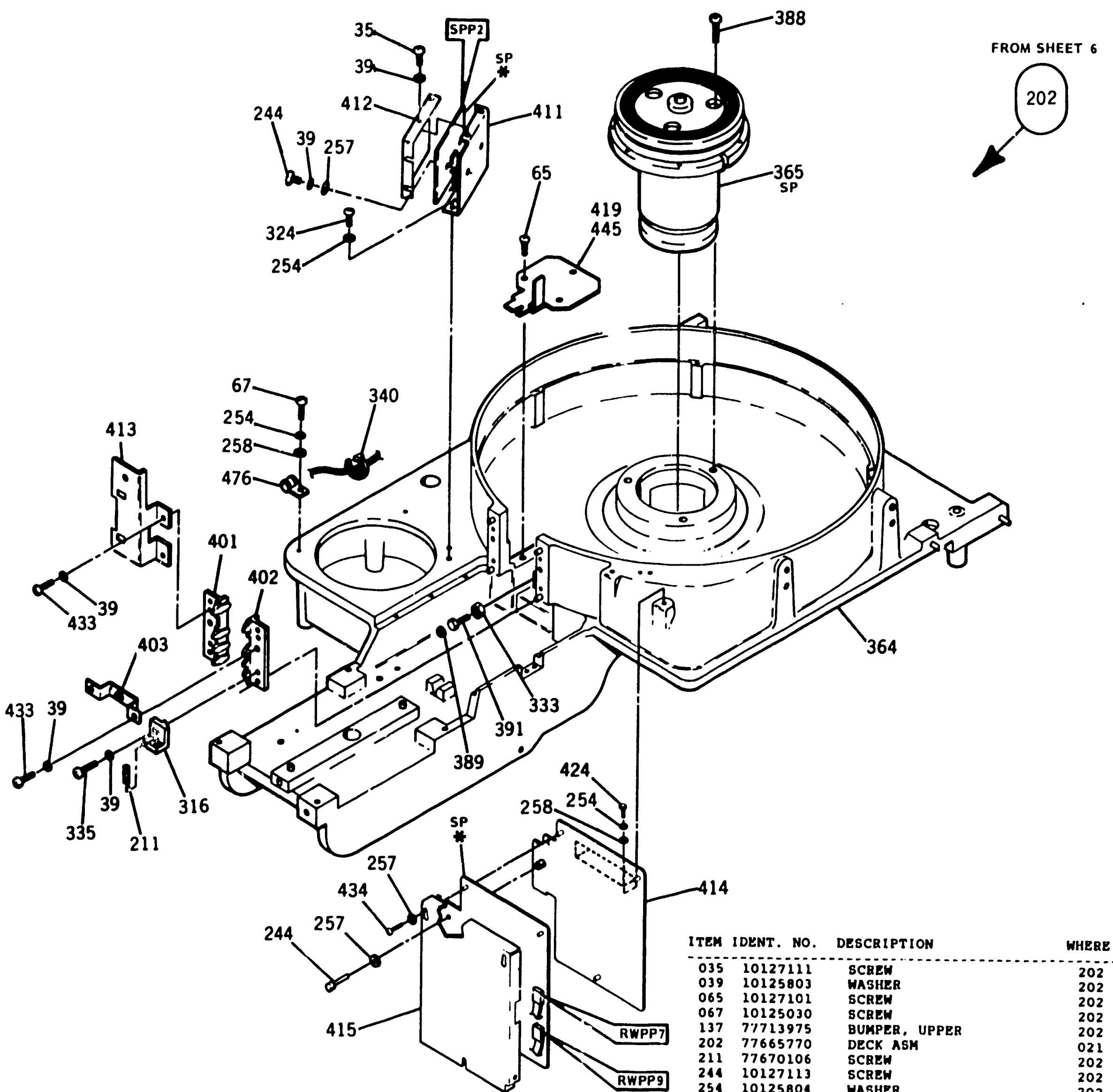
HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
S1	77685830	7-25
CMPB	77685830	7-25
RCJ1	77646835	7-24
RCJ3	77685830	7-25
RCJ2	77685830	7-25
	77685830	7-25
RCJ5	77664360	7-25
	77685830	7-25
C5	77685830	7-25



* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION.

** REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

FIGURE 7-5. BASE PAN ASSEMBLY (2 OF 2)

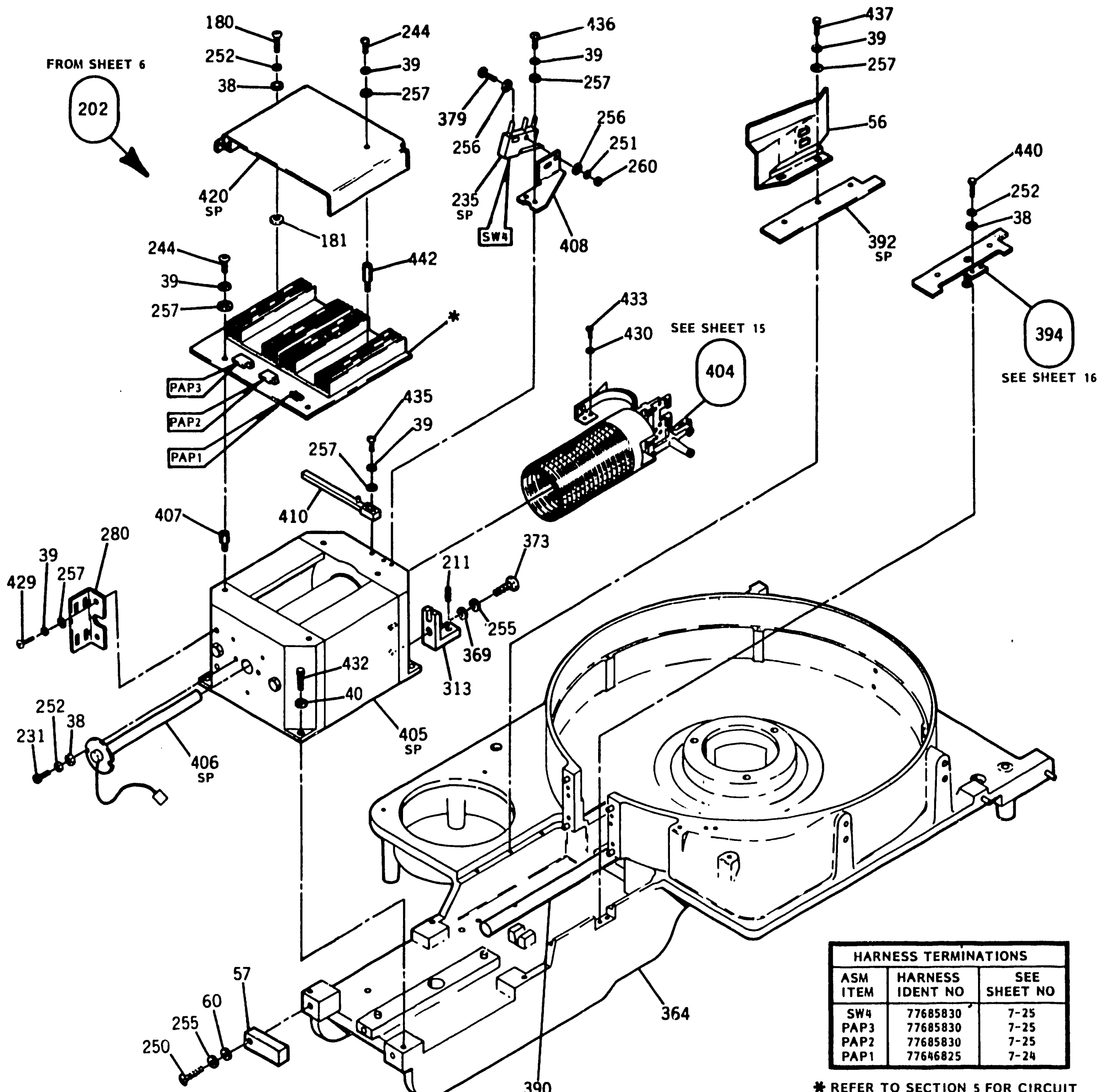


HARNESS TERMINATIONS		
ASM ITEM	HAR''ESS IDENT NO	SEE SHEET NO
SPP2	77646845	7-24
RWPP7	77646865	7-24
RWPP9	77646856	7-24

* REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
035	10127111	SCREW	202
039	10125803	WASHER	202
065	10127101	SCREW	202
067	10125030	SCREW	202
137	77713975	BUMPER, UPPER	202
202	77665770	DECK ASM	021
211	77670106	SCREW	202
244	10127113	SCREW	202
254	10125804	WASHER	202
257	10125605	WASHER	202
258	10125606	WASHER	202
316	75899547	BLK	202
324	10127122	SCREW	202
333	10125301	NUT	202
335	92815166	SCREW	202
340	94277400	STRAP, CABLE TIE	202
364	75880044	BASE PLATE ASM	202
365	75886281	SPINDLE	202
388	92720396	BUTTON SCREW	202
389	77832429	BUMPER	202
391	75893682	BUMPER MOUNT, LOWER	202
401	75888746	CAM-TOWER	202
402	75888747	CAM-TOWER	202
403	77713975	BUMPER MT, UPPER	202
411	75893943	MTG BRACKET	202
412	75893953	SERVO PREAMP SHIELD	202
413	77681500	CONNECTOR PLATE	202
414	75881385	MTG PLATE	202
415	77666850	SHIELD, RD/WR PREAMP	202
419	77732437	COVER	202
424	10125029	SCREW	202
433	10127114	SCREW	202
434	77610221	SCREW	202
445	18440201	SILICONE RUBBER	202
476	92602003	CABLE CLAMP	202
038	10125603	WASHER	202

FIGURE 7-6. DECK ASSEMBLY (1 OF 3)



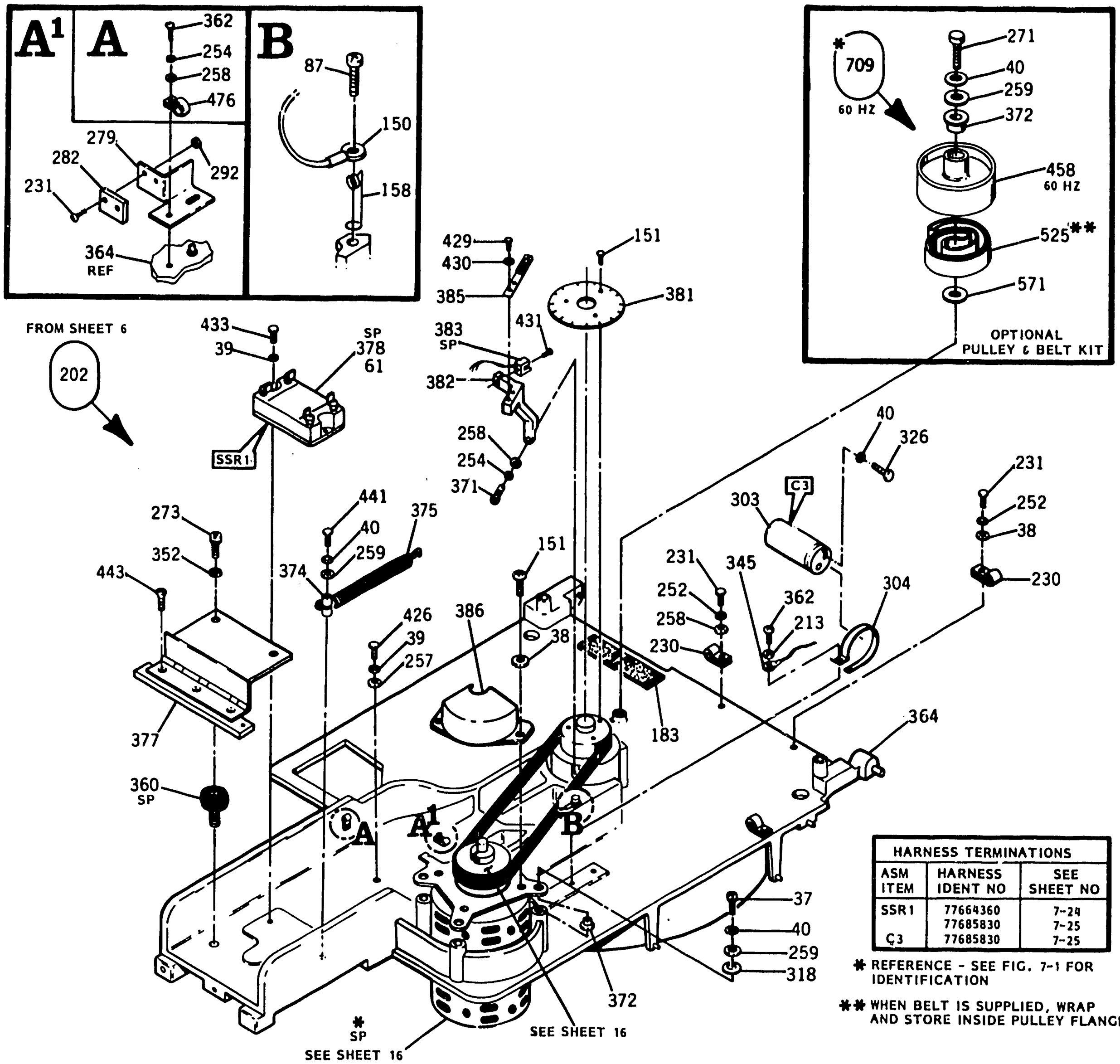
HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
SW4	77685830	7-25
PAP3	77685830	7-25
PAP2	77685830	7-25
PAP1	77646825	7-24

* REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
039	10125803	WASHER	202
040	10125805	WASHER	202
056	77658265	AIR BAFFLE	202
057	75882675	SPACER	202
060	10125608	WASHER	202
180	10127105	SCREW	202
181	75887830	SPACER	202
202	77665770	DECK ASM	021
211	77670106	SCREW	202
231	10127104	SCREW	202
235	77610146	SW INTEGRAL LEVER	202
244	10127113	SCREW	202
244	10127113	SCREW	202
250	92815290	SCREW	202
251	10125800	WASHER	202
252	10125801	WASHER	202
255	10125806	WASHER	202
256	10125602	WASHER	202
257	10125605	WASHER	202
260	10125102	NUT	202
280	77681649	BRACKET, TIE WRAP	202
313	75899543	BLK	202
364	75880044	BASE PLATE ASM	202

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
369	92009012	WASHER	202
373	10126255	SCREW	202
379	10127170	SCREW	202
390	75886286	ROD-GUIDE	202
392	75886037	PLATE BEARING - FIXED	202
394	75891681	PLATE ASM	202
404	75880135	CARRIAGE & COIL ASM	202
405	75886513	MAGNET ASM	202
406	75894102	VEL XDUCER-CONN ASM	202
407	51885515	STANDOFF, MALE-FEMALE	202
408	75891011	BRACKET SWITCH	202
410	75891573	CARRIAGE LKG TOOL	202
420	75883211	COVER, POWER AMP ASM	202
429	10127112	SCREW	202
430	10126401	WASHER	202
432	92805257	SCREW	202
433	10127114	SCREW	202
435	10127115	SCREW	202
436	10125016	SCREW	202
437	10125018	SCREW	202
440	10125006	SCREW	202
442	51885504	STANDOFF, MALE-FEMALE	202
037	92805259	SCREW	202

FIGURE 7-6. DECK ASSEMBLY (2 OF 3)



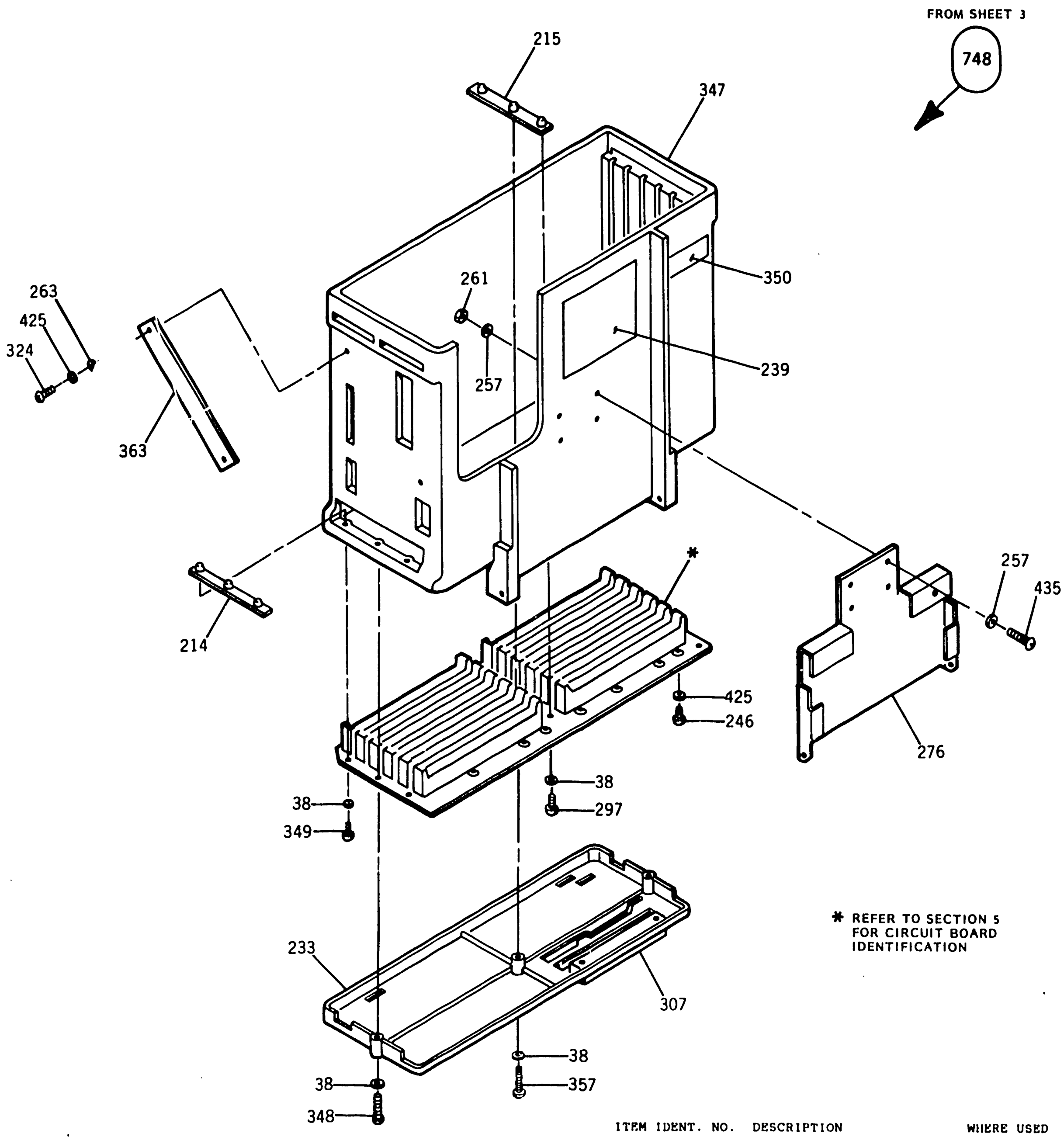
HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
SSR1	77664360 77685830	7-24 7-25
C3	77685830	7-25

* REFERENCE - SEE FIG. 7-1 FOR IDENTIFICATION

** WHEN BELT IS SUPPLIED, WRAP AND STORE INSIDE PULLEY FLANGE.

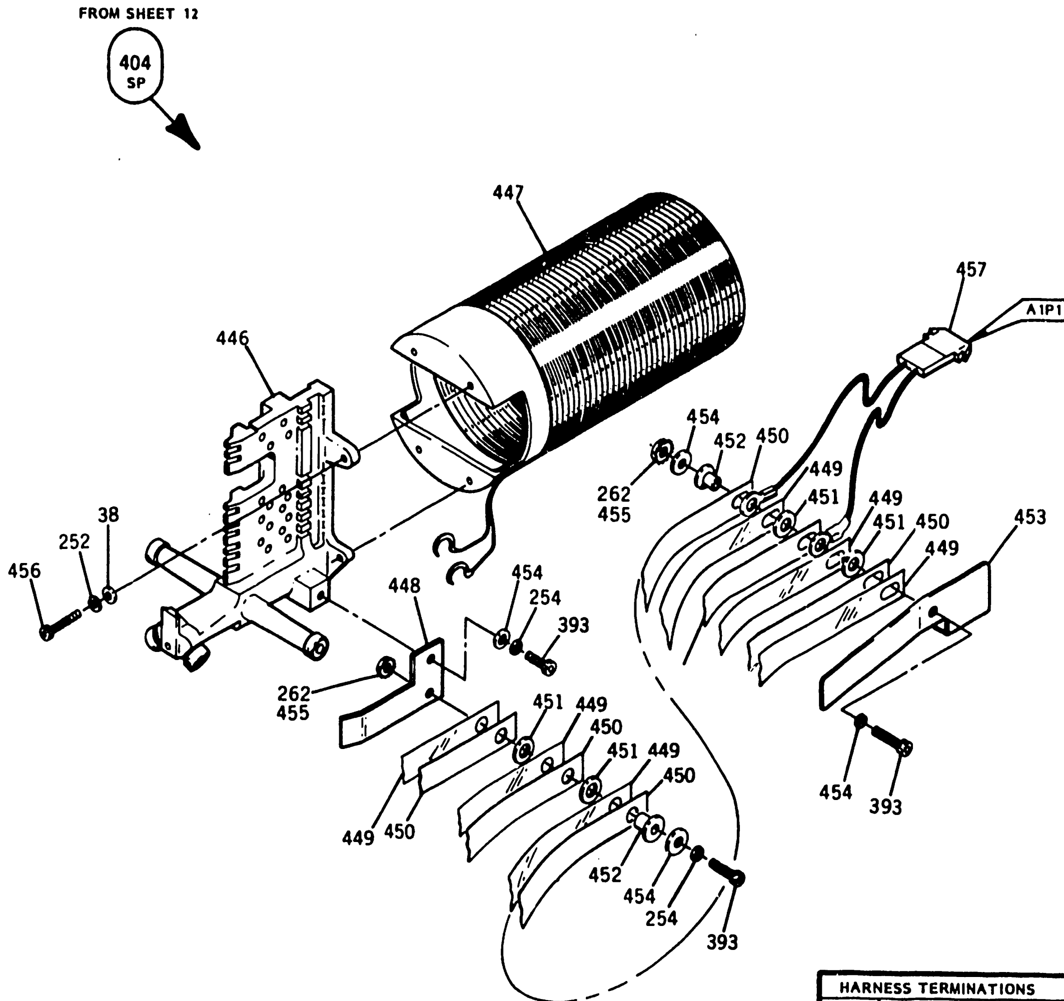
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
038	10125603	WASHER	202
039	10125803	WASHER	202
040	10125805	WASHER	202, 709
061	18748600	COMPOUND 340	202
087	93749198	SCREW	202
150	75883455	JUMPER WIRE	202
151	93749084	SCREW	202
158	77681599	RETAINER	202
183	75881250	GASKET	202
202	77665770	DECK ASM	021
213	10126104	WASHER	202
230	16402506	CABLE CLAMP	202
231	10127104	SCREW	202
252	10125801	WASHER	202
254	10125804	WASHER	202
257	10125605	WASHER	202
258	10125606	WASHER	202
259	10125607	WASHER	202, 709
271	92805266	SCREW	709
273	92815284	SCREW	202
279	77685535	BRACKET, ACTIVATOR	021
282	77670412	ACTIVATOR	202
292	53777900	NUT	202
303	75774471	CAPACITOR	202
304	77681647	CLAMP, CAPACITOR	202
318	75062400	WASHER	202
345	77883454	JUMPER WIRE	202
352	10126106	WASHER	202
360	77610157	SHOCK MOUNT	202
362	10127123	SCREW	202
364	75880044	BASE PLATE ASM	202
371	10126226	SCREW	202
372	75062805	WASHER	202, 709
374	75881537	POST, MOTORSPRING	202
375	75887539	SPRING, TENSION	202
376	75891524	HINGE	202
377	75887975	SPACER, HINGE	202
378	77610051	P.A.C. RELAY (SSR)	202
381	75887791	DISC, SPEEDSENSOR	202
382	75893920	SUPPORT, SPEEDSENSOR	202
383	75880046	SPEEDSENSOR	202
385	77736731	GROUND SPRING ASM	202
386	75883481	PULLEY COVER	202
423	10127119	SCREW	202
426	10126222	SCREW	202
429	10127112	SCREW	202
430	10126401	WASHER	202
431	10125760	SCREW	202
433	10127114	SCREW	202
441	10127148	SCREW	202
443	10125747	SCREW	202
458	75899707	PULLEY	709
476	92602003	CABLE CLAMP	202
525	92314113	DRIVE BELT 60 HZ	709
571	75883026	SPACER	709
709	75883073	PULLEY & BELT KIT (60 HZ)	HPC

FIGURE 7-6. DECK ASSEMBLY (3 OF 3)



ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
038	10125603	WASHER	748
214	77668612	NUT BAR	748
215	77668613	NUT BAR	748
233	77659992	E MODULE SHIELD	748
239	72959302	LABEL	748
246	10127121	SCREW	748
257	10125605	WASHER	748
261	53777902	NUT & WASHER	748
263	75806504	WASHER	748
276	77666815	STOP PLATE	748
297	93749096	SCREW	748
307	44675380	CABLE CLAMP	748
324	10127122	SCREW	748
347	77736865	E MODULE	748
348	93749098	SCREW	748
349	93749092	SCREW	748
350	24547590	WARNING LABEL	748
357	93749100	SCREW	748
363	77633800	CLAMP	748
425	10126402	WASHER	748
433	10127114	SCREW	748
435	10127115	SCREW	748
748	77660545	E MODULE ASM	HPC

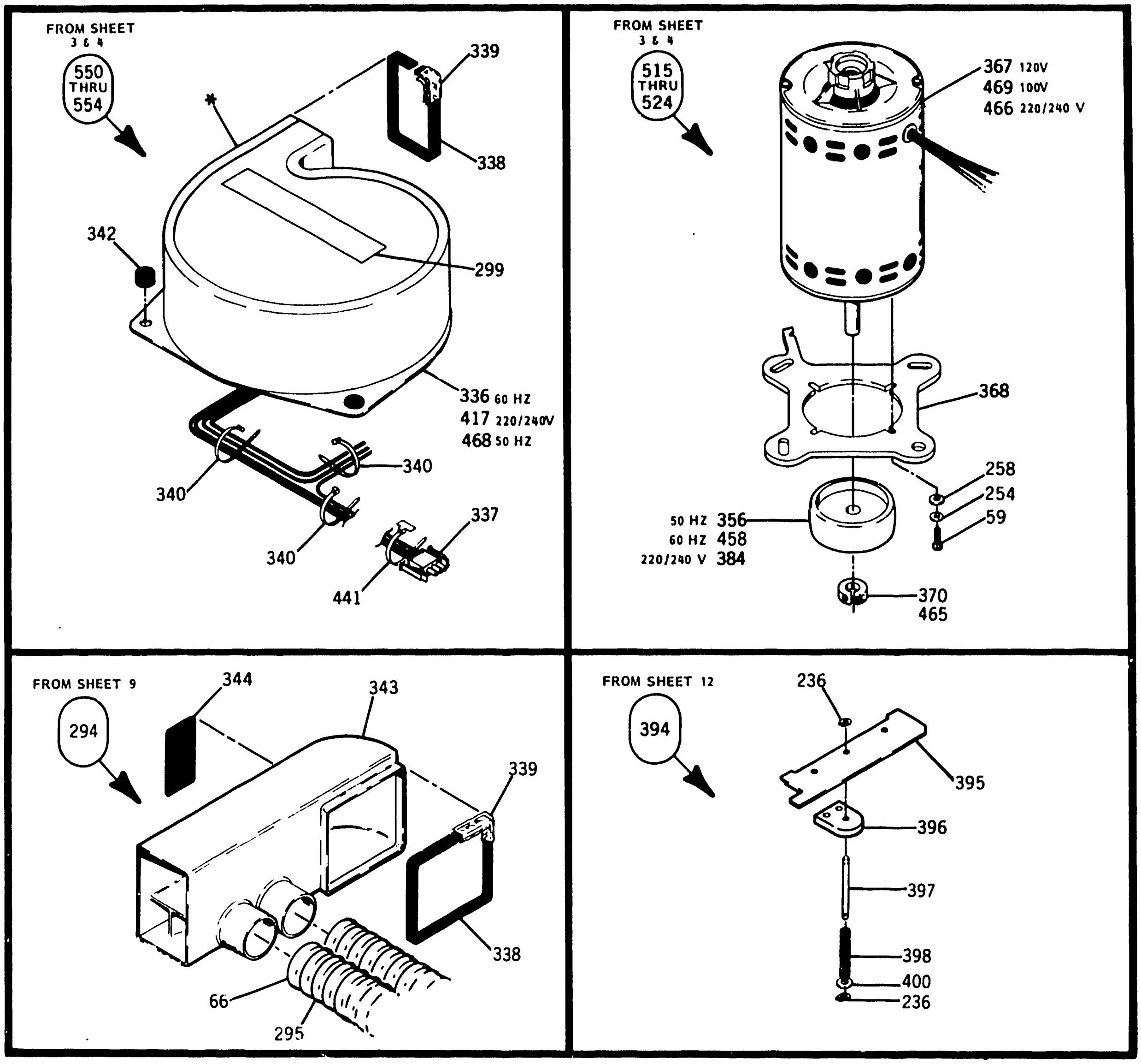
FIGURE 7-7. E MODULE ASSEMBLY



HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
A1P1	77685830	7-25

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
038	10125603	WASHER	404
252	10125801	WASHER	404
254	10125804	WASHER	404
262	53777903	NUT & WASHER	404
393	10126227	SCREW	404
404	75880135	CARRIAGE & COIL ASM	202
446	75880140	CARRIAGE & BEARINGS	404
447	75885981	COIL ASM	404
448	75889435	PLATE, COIL	404
449	75886540	LEAD FLEX, COIL	404
450	75886191	INSULATOR, FLEX LEAD	404
451	75276101	WASHER, PHENOLIC	404
452	75276204	SPACER, PHENOLIC	404
453	75888690	BRACKET, STRAP	404
454	77830612	WASHER	404
455	95044214	SEALANT	404
456	77617025	SCREW	404
457	75881921	ACTUATOR WIRING ASM	404

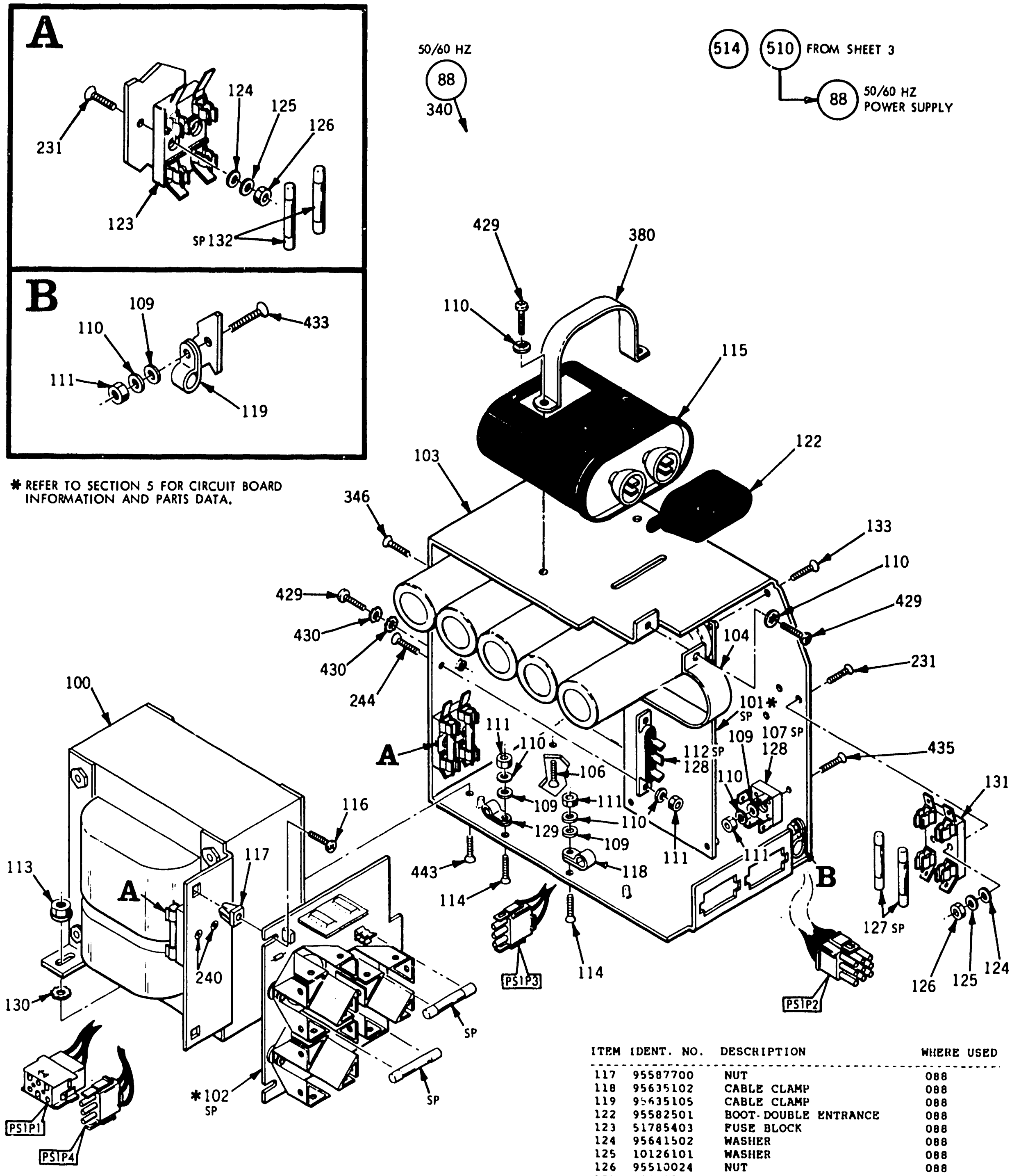
FIGURE 7-8. CARRIAGE AND COIL ASSEMBLY



* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
059	92815193	SCREW	515, 516
059	92815193	SCREW	519, 520
059	92815193	SCREW	521
066	77611448	ADHESIVE	294
236	94371000	RETAINING RING	394
254	10125804	WASHER	515, 516
254	10125804	WASHER	519
258	10125606	WASHER	515-521
294	75889881	MANIFOLD ASM	201
295	75889165	HOSE, PLASTIC AIR	294
299	75893358	LABEL	550-552
336	75887510	BLOWER CENTRIF	550
337	83435302	CONNECTOR, PLUG/CAP	550-552
338	94276600	FOAM TAPE	294
338	94276600	FOAM TAPE	550-552
339	95105900	TAPE, POLY FILM, INSUL	294
339	95105900	TAPE, POLY FILM, INSUL	550-552
340	94277400	STRAP, CABLE TIE	550-552
341	94277409	STRAP, CABLE TIE	550-552
342	75887520	GROMMET,SQSHOULDER	550-552
343	75885931	MANIFOLD	294
344	75881250	GASKET	294
356	75899706	PULLEY	519, 520
367	77658460	MOTOR ASM	515, 519
368	75887776	PLATE, MOTOR MTG	515, 516
368	75887776	PLATE, MOTOR MTG	517, 518
368	75887776	PLATE, MOTOR MTG	519
370	77613626	COLLAR,SHAFT	515, 516
370	77613626	COLLAR,SHAFT	520
370	77613626	COLLAR,SHAFT	521, 519
384	75899703	PULLEY	516
394	75891681	PLATE ASM	202
395	75886033	PLATE BEARING	394
396	75888191	BLOCK, SPRING SUPPORT	394
397	75887557	PIN-SPRING, GUIDE	394
398	75881536	SPRING	394
400	77830611	WASHER	394
417	75887513	BLOWER CENTRIF	552
458	75899707	PULLEY	515, 521
465	80625400	LUBRICANT	515, 516
465	80625400	LUBRICANT	517, 518
466	77658465	MOTOR ASM	516
468	75887512	BLOWER CENTRIF	551
469	77658461	MOTOR ASM	520, 521
515	77638604	DRIVE MTR ASM 60 HZ 120V	HPC
516	77638605	DRV MTR ASM 220-240V	HPC
519	77638603	DRV MTR ASM 50 HZ 120V	HPC
520	77638601	DRV MTR ASM 50 HZ 120V	HPC
521	77638602	DRV MTR ASM 60 HZ 100V	HPC
550	75889886	BLOWER ASM 60 HZ	HPC
551	75889888	BLOWER ASM 50 HZ	HPC
552	75889889	BLOWER ASM 50 HZ	HPC

FIGURE 7-9. MISCELLANEOUS SUB-ASSEMBLIES

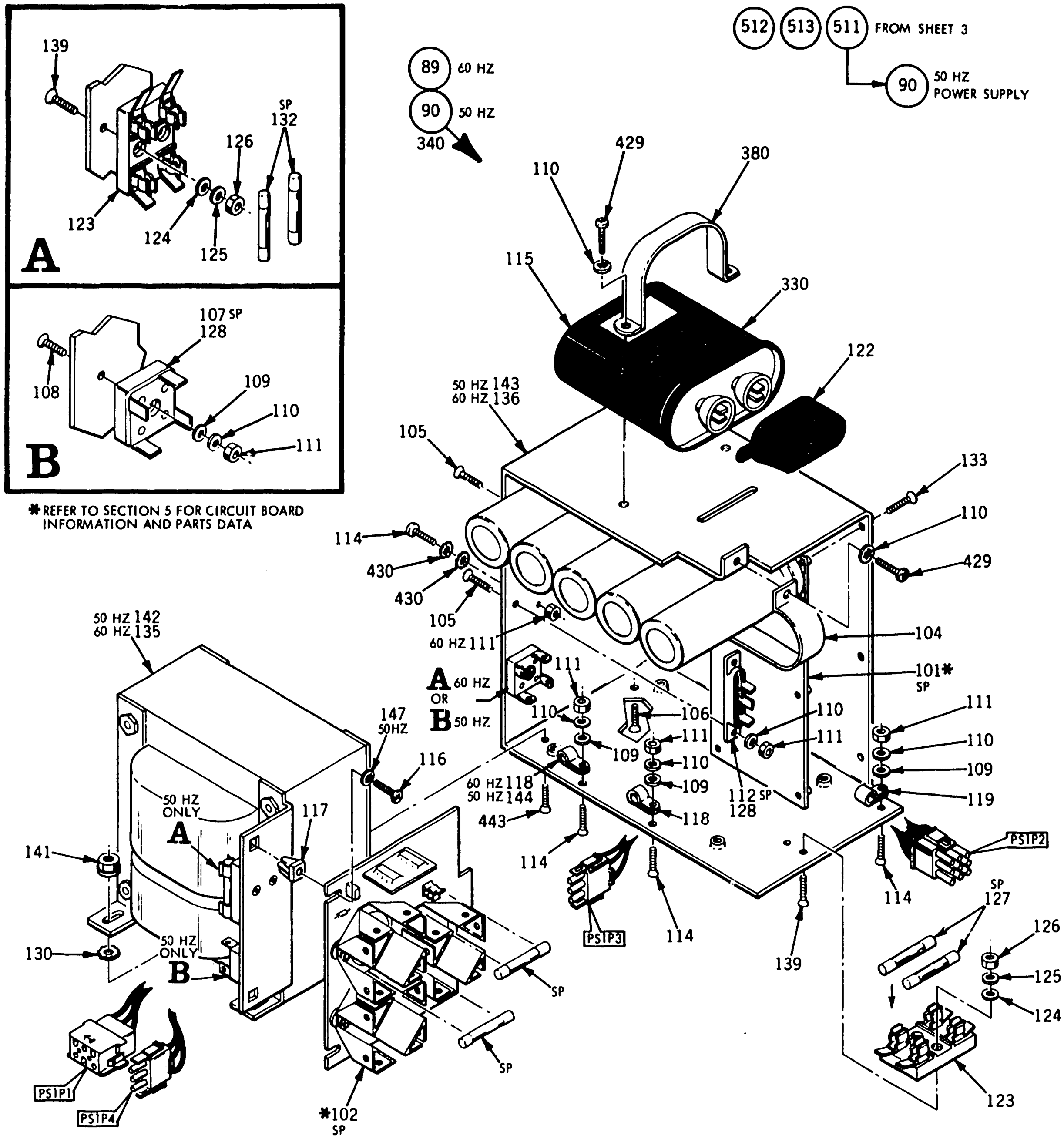


✱ REFER TO SECTION 5 FOR CIRCUIT BOARD INFORMATION AND PARTS DATA.

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
088	70100300	POWERSUPPLY 50/60 HZ	510
100	76867600	TRANSFORMER 50/60 HZ	088
101	75832500	AXGV COMPONENT ASM	088
102	75832900	AXHV COMPONENT ASM	088
103	76876400	CHASSIS	088
104	76873100	CAP MOUNTING BRACKET	088
106	10125746	SCREW	088
107	50242201	RECTIFIER BRIDGE	088
108	10125912	SCREW	088
109	10125613	WASHER	088
110	10126103	WASHER	088
111	95510026	NUT	088
112	95583504	RECTIFIER BLOCK	088
113	92376014	NUT	088
114	10125715	SCREW	088
115	76879005	CAPACITOR	088
116	95655530	SCREW	088

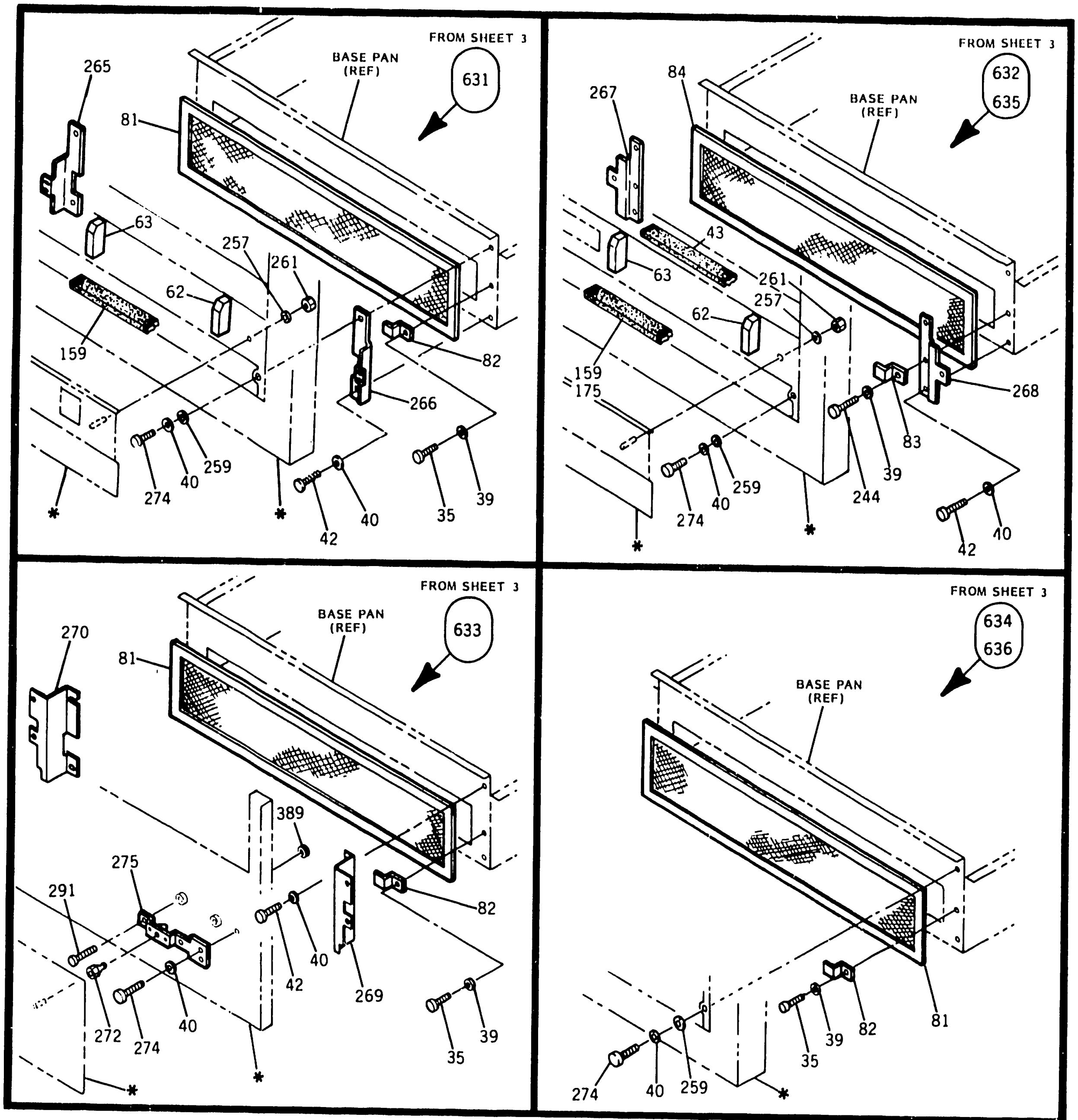
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
117	95587700	NUT	088
118	95635102	CABLE CLAMP	088
119	95635105	CABLE CLAMP	088
122	95582501	BOOT-DOUBLE ENTRANCE	088
123	51785403	FUSE BLOCK	088
124	95641502	WASHER	088
125	10126101	WASHER	088
126	95510024	NUT	088
127	93419228	FUSE, 125 V	088
128	95533601	GREASE	088
129	95635103	CABLE CLAMP	088
130	10126404	WASHER	088
131	94399501	FUSE BLOCK	088
132	95647607	FUSE	088
133	10125909	SCREW	088
231	10127104	SCREW	088
240	10125704	SCREW	510
244	10127113	SCREW	088
340	94277400	STRAP, CABLE TIE	510
346	93749160	SCREW	088
380	95643601	CLAMP, CAPACITOR	510
429	10127112	SCREW	510
430	10126401	WASHER	510
435	10127115	SCREW	088
443	10125747	SCREW	510
510	75887884	POWER SUPPLY	HPC
514	76879500	POWER SUPPLY	HPC

FIGURE 7-10. POWER SUPPLY ASSEMBLY (1 OF 2)



ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
089	76869502	POWERSUPPLY 60 HZ	509
090	70116400	POWERSUPPLY 50 HZ	511
101	75832500	AXGV [illegible]ENT ASM	089, 090
102	75832900	AXHV COMPONENT ASM	089, 090
104	76873100	CAP MOUNTING BRACKET	089, 090
105	10125714	SCREW	089, 090
106	10125746	SCREW	089, 090
107	50242201	RECTIFIER BRIDGE	089, 090
108	10125912	SCREW	089, 090
109	10125613	WASHER	089, 090
110	10126103	WASHER	089, 090
111	95510026	NUT	021
111	95510026	NUT	089, 090
112	95583504	RECTIFIER BLOCK	089, 090
114	10125715	SCREW	089, 090
115	76879005	CAPACITOR	089, 090
116	95655530	SCREW	089, 090
117	95587700	NUT	089, 090
118	95635102	CABLE CLAMP	089, 090
119	95635105	CABLE CLAMP	089, 090
122	95582501	BOOT-DOUBLE ENTRANCE	089, 090
123	51785403	FUSE BLOCK	089, 090
124	95641502	WASHER	089, 090
125	10126101	WASHER	089, 090
126	95510024	NUT	089, 090
127	93419228	FUSE, 125 V	089, 090
128	95533601	GREASE	089
130	10126404	WASHER	089, 090
132	95647607	FUSE	089
133	10125909	SCREW	089, 090
135	70112900	TRANSFORMER 60 HZ	089
136	76873002	CHASSIS	089
138	76873401	WIRE HARNESS ASM	089
139	10125777	SCREW	089, 090
140	93564044	WASHER	089
141	92376014	NUT	089, 090
142	70113000	TRANSFORMER 50 HZ	090
143	70116500	CHASSIS	090
144	95635104	CABLE CLAMP	090
146	70117900	WIRE HARNESS ASM	090
147	93564034	WASHER	090
330	24534729	SLEEVING	089, 090
340	94277400	STRAP, CABLE TIE	508,509
380	95643601	CLAMP, CAPACITOR	508, 509
429	10127112	SCREW	508, 509
430	10126401	WASHER	508, 509
443	10125747	SCREW	508, 509
509	77610705	POWER SUPPLY 60 HZ	HPC
511	77610707	POWER SUPPLY 50 HZ	HPC
512	76867300	POWER SUPPLY	HPC
513	76879400	POWER SUPPLY	HPC

FIGURE 7-10. POWER SUPPLY ASSEMBLY (2 OF 2)



* REFERENCE - SEE FIG 7-1 FOR IDENTIFICATION

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
042	10126244	SCREW	633, 635
042	10126244	SCREW	631, 636
043	77736733	GASKETSTRIP	632
062	77732750	FOAM BLOCK	632, 631
062	77732750	FOAM BLOCK	635
063	77732751	FOAM BLOCK	632, 631
063	77732751	FOAM BLOCK	635
081	94364903	FILTER-AIR	631, 633
081	94364903	FILTER-AIR	636, 634
082	75881845	CLIP	634, 636
082	75881845	CLIP	631, 633
083	77641830	CLIP	632, 635
084	94364906	FILTER-AIR	632, 635
159	83410501	GASKETSTRIP	632, 631
159	83410501	GASKETSTRIP	635
175	77736732	GASKETSTRIP	632
244	10127113	SCREW	635, 632
257	10125605	WASHER	631, 632
257	10125605	WASHER	635
259	10125607	WASHER	631, 632
259	10125607	WASHER	635, 636
261	53777902	NUT & WASHER	635

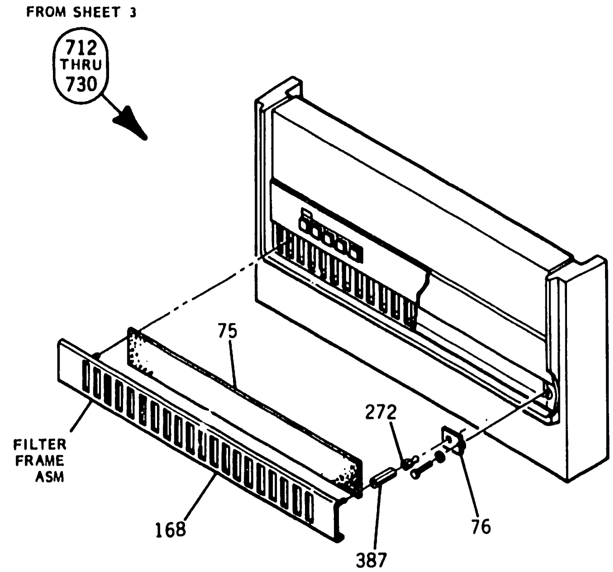
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
261	53777902	NUT & WASHER	631, 632
265	75881906	BRACKET	631
266	75881907	BRACKET	631
267	77641837	ZEE BRACKET	632, 635
268	77641838	ZEE BRACKET	632, 635
269	77666375	BRACKET RH	633
270	77666376	BRACKET L H	633
272	93326006	STUD BALL	633
274	10126252	SCREW	635, 636
274	10126252	SCREW	631 633
275	77648135	CATCH ASM	633
291	94376910	SCREW	633
389	77832429	BUMPER	633
631	75893030	FRONT PANEL INSTL KIT	HPC
632	75893031	FRONT PANEL INSTL KIT	HPC
633	75893035	FRONT PANEL INSTL KIT	HPC
634	75893032	FRONT PANEL INSTL KIT	HPC
635	75893033	FRONT PANEL INSTL KIT	HPC
636	75893034	FRONT PANEL INSTL KIT	HPC
035	10127111	SCREW	636, 634
035	10127111	SCREW	633
039	10125803	WASHER	631-632
040	10125805	WASHER	631, 632

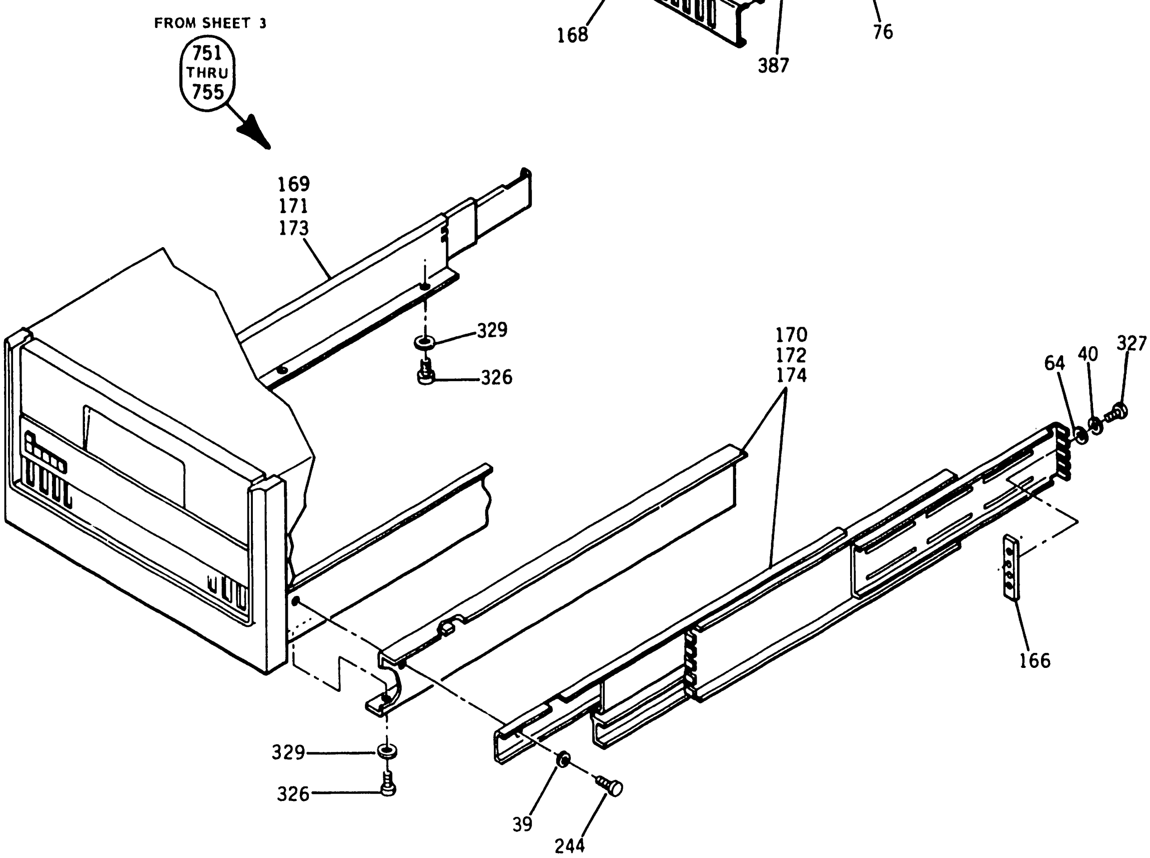
FIGURE 7-11. FRONT PANEL INSTALLATION KITS

PREFILTER KIT		FILTER FRAME ASM
77773209	USES	77773109
77773226	USES	77773126
77773236	USES	77773136
77773243	USES	77773143
77773245	USES	77773145
77773246	USES	77773146
77773250	USES	77773166
77773291	USES	77773191
77773253	USES	77773153
77773266	USES	77773166

NOTE

LAST 2 DIGITS OF PREFILTER KIT (777732XX) ARE IDENTICAL TO THE LAST 2 DIGITS OF THE PANEL INSERT (SEE HPC). LAST 2 DIGITS DETERMINE PAINT COLOR.

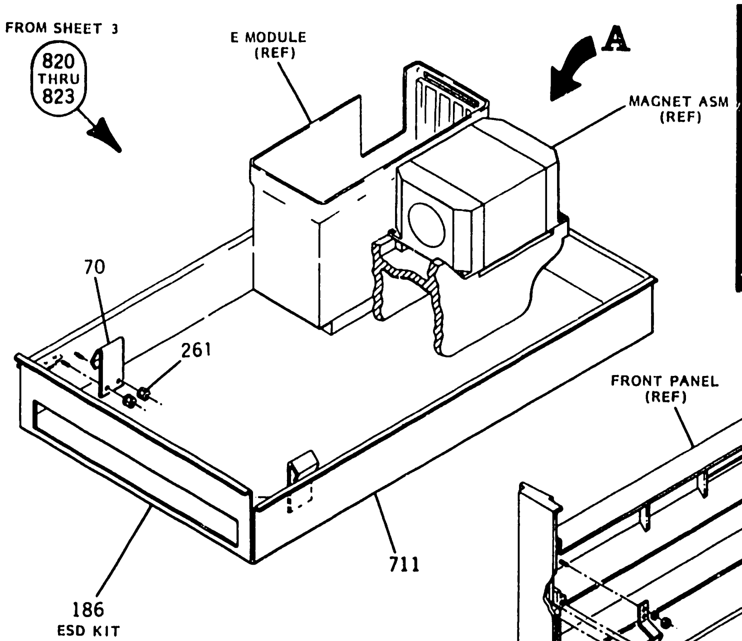


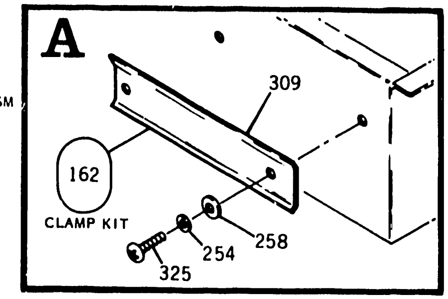


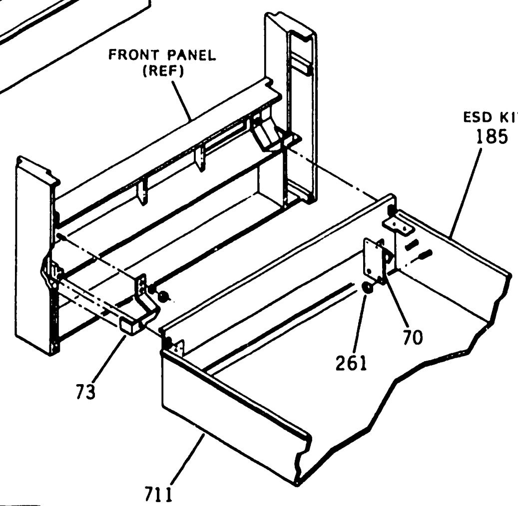
ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
039	10125803	WASHER	751-753
040	10125805	WASHER	751-753
064	94279113	WASHER	751-753
075	77604002	PRE-FILTER-FILTER	712-729
076	77648130	CATCH ASM	712-729
077	77641785	FILTER FRAME ASM	729
166	77668614	NUT BAR	751-753
168	77730195	FRONT PANEL ASM	730
169	75890937	DRAWER EXTSLIDE	751
170	75890938	DRAWER EXT SLIDE	751
171	75890947	DRAWER EXT SLIDE	752
172	75890948	DRAWER EXT SLIDE	752
173	75890949	DRAWER EXT SLIDE	753
174	75890950	DRAWER EXT SLIDE	753
244	10127113	SCREW	751-753
272	93326006	STUD BALL	712-729
326	10127141	SCREW	751-753
327	10127144	SCREW	751-753
329	10126403	WASHER	752

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
329	10126403	WASHER	751-753
387	93109084	SPACER	712-729
713	77773243	PREFILTER KIT	HPC
714	77773226	PREFILTER KIT	HPC
715	77773250	PREFILTER KIT	HPC
716	77773253	PREFILTER KIT	HPC
717	77773266	PREFILTER KIT	HPC
720	77773293	PREFILTER KIT	HPC
721	77773291	PREFILTER KIT	HPC
722	77773236	PREFILTER KIT	HPC
723	77773246	PREFILTER KIT	HPC
724	77773245	PREFILTER KIT	HPC
725	77773209	PREFILTER KIT	HPC
726	77773262	PREFILTER KIT	HPC
727	77773260	PREFILTER KIT	HPC
730	77730238	PREFILTER KIT	HPC
751	75897340	SLIDE KIT	HPC
752	75897701	SLIDE KIT	HPC
753	75899182	SLIDE KIT	HPC

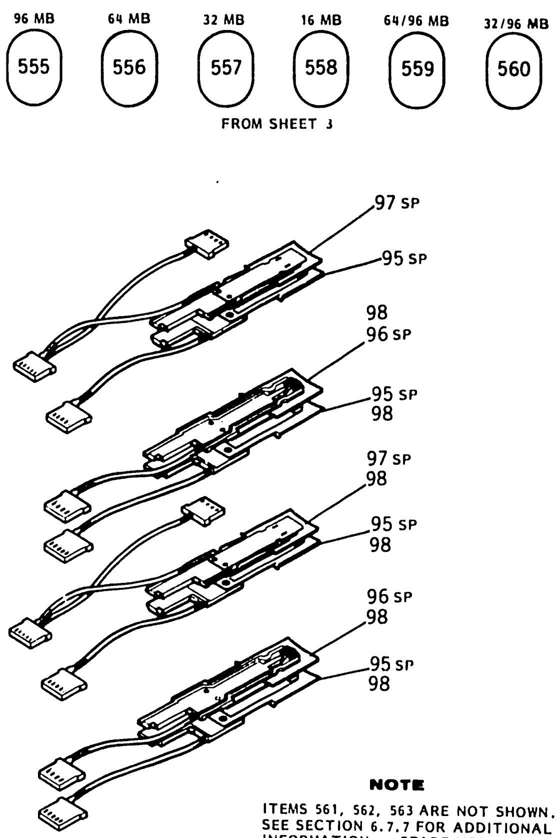
FIGURE 7-12. SLIDE KITS AND PRE-FILTER KIT







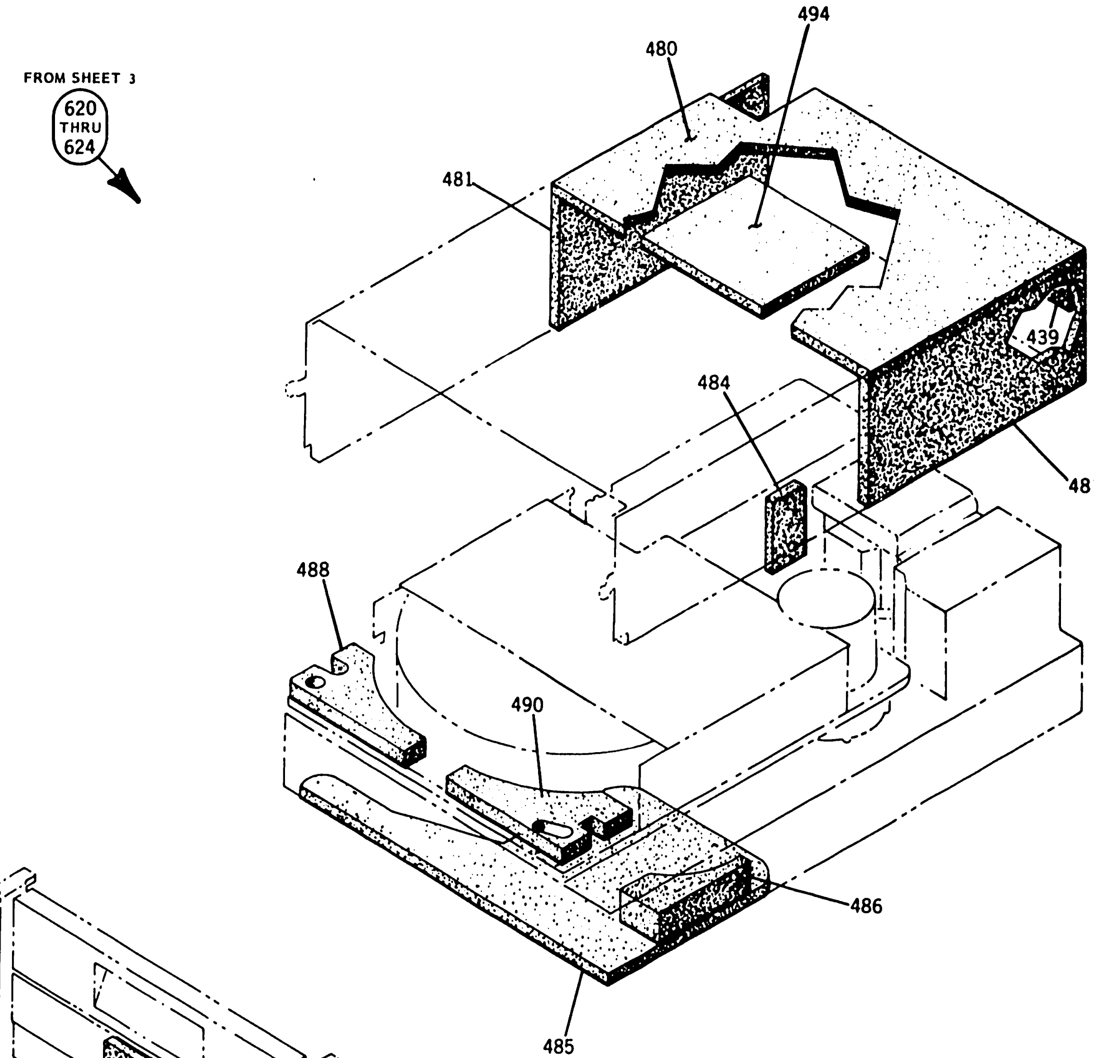
NOTE
710 STANDARD BASE PAN ASSY
NOT SHOWN

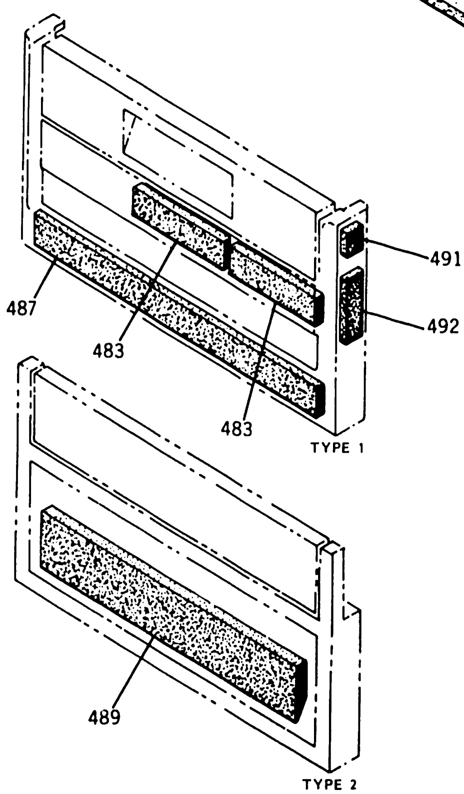


NOTE
ITEMS 561, 562, 563 ARE NOT SHOWN. SEE SECTION 6.7.7 FOR ADDITIONAL INFORMATION on SPARE MODULE AND ALIGNMENT TOOL.

ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
038	10125603	WASHER	556, 557
038	10125603	WASHER	558, 559
038	10125603	WASHER	560
070	75882550	GROUND WIPER	716, 717
073	75884877	GROUND FLEXIBLE	716
095	75010102	HEAD ARM ASM, LOWER	555, 556
095	75010102	HEAD ARM ASM, LOWER	557, 558
095	75010102	HEAD ARM ASM, LOWER	559, 560
096	75010103	HEAD ARM ASM, UPPER	555, 556
096	75010103	HEAD ARM ASM, UPPER	559
097	75010105	HEAD ARM ASM, SERVO	555, 556
097	75010105	HEAD ARM ASM, SERVO	557, 558
097	75010105	HEAD ARM ASM, SERVO	559, 560
098	75883031	WEIGHT HEAD	556, 557
098	75883031	WEIGHT HEAD	558, 559
098	75883031	WEIGHT HEAD	560
099	10126215	SCREW	556, 557
099	10126215	SCREW	558, 559
099	10126215	SCREW	560
120	10126214	SCREW	556, 557
120	10126214	SCREW	558, 559
120	10126214	SCREW	560
162	77714333	CLAMP KIT	820.822
185	75894105	ESD KIT	821, 823
186	75894106	ESD KIT	822
252	10125801	WASHER	556, 557
252	10125801	WASHER	558, 559
252	10125801	WASHER	560
254	10125804	WASHER	162
258	10125606	WASHER	162
261	53777902	NUT & WASHER	716, 717
309	75893762	CLAMP	162
325	10127124	SCREW	162
561	76204655	SPARE MODULE 96 M	HPC
562	76204656	SPARE MODULE 64 M	HPC
563	76204657	SPARE MODULE 32 M	HPC
710	77646344	BASE PAN	820
711	77646345	BASE PAN	821, 822
711	77646345	BASE PAN	823
820	77700060	STD BASE PAN KIT	HPC
821	77700061	ESD BASE PAN KIT	HPC
822	77700062	ESD BASE PAN KIT UNIQ	HPC
823	77700063	ESD BASE PAN KIT UNIQ	HPC

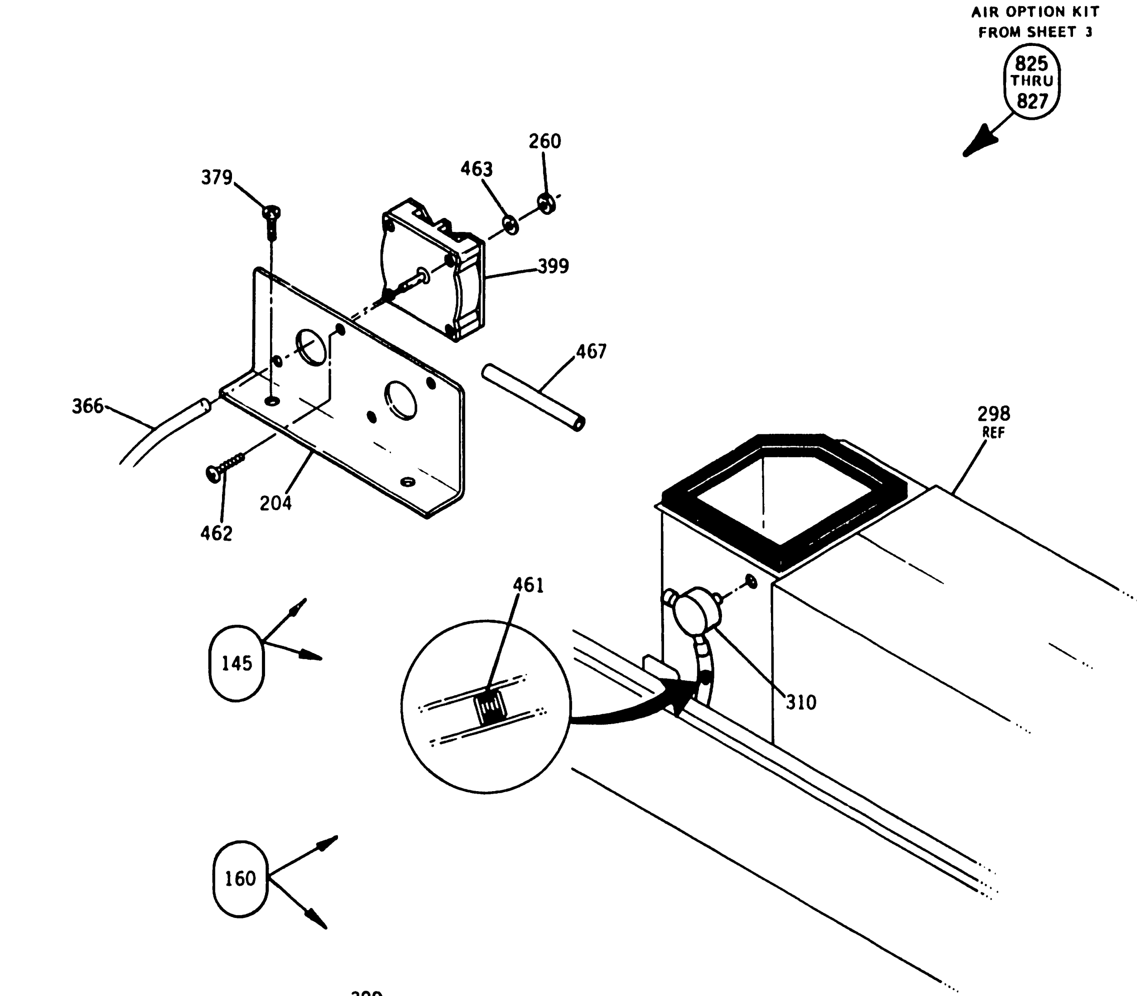
FIGURE 7-13. ESD KITS AND HEADS

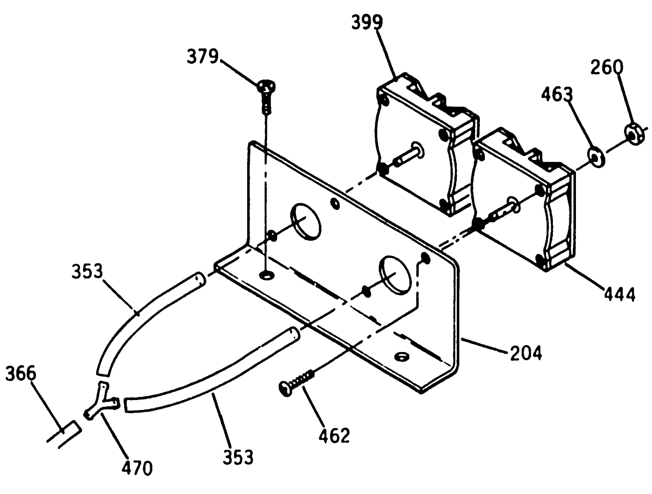




ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
439	77647107	PANEL ACOUSTIC FOAM	620, 621
439	77647107	PANEL ACOUSTIC FOAM	622, 623
480	77647109	PANEL ACOUSTIC FOAM	621, 622
480	77647109	PANEL ACOUSTIC FOAM	623
481	75894326	PANEL ACOUSTIC FOAM	621, 622
481	75894326	PANEL ACOUSTIC FOAM	623
483	75894328	PANEL ACOUSTIC FOAM	621, 623
484	77647105	PANEL ACOUSTIC FOAM	620, 621
484	77647105	PANEL ACOUSTIC FOAM	622, 623
484	77647105	PANEL ACOUSTIC FOAM	624
485	75894330	PANEL ACOUSTIC FOAM	621, 622
485	75894330	PANEL ACOUSTIC FOAM	623, 624
486	75894331	PANEL ACOUSTIC FOAM	621, 622
486	75894331	PANEL ACOUSTIC FOAM	623, 624
487	75894332	PANEL ACOUSTIC FOAM	621, 623
488	77658253	PANEL ACOUSTIC FOAM	621, 622
488	77658253	PANEL ACOUSTIC FOAM	623
489	75894341	PANEL ACOUSTIC FOAM	622
490	77658254	PANEL ACOUSTIC FOAM	621, 622
490	77658254	PANEL ACOUSTIC FOAM	623
491	75894338	PANEL ACOUSTIC FOAM	621
492	75894339	PANEL ACOUSTIC FOAM	621
494	75894336	PANEL ACOUSTIC FOAM	620, 624
620	75895042	SOUND TREATMENT OPT	HPC
621	75895040	SOUND TREATMENT OPT	HPC
622	75895044	SOUND TREATMENT OPT	HPC
623	75895045	SOUND TREATMENT OPT	HPC
624	75895046	SOUND TREATMENT OPT	HPC

FIGURE 7-14. SOUND TREATMENT OPTION





ITEM	IDENT. NO.	DESCRIPTION	WHERE USED
145	77638864	NO AIR-96 MB	825, 826
160	77668539	LO AIR-NO AIR	827
204	77646363	BRACKET	145, 160
260	10125102	NUT	145, 160
310	77732610	FILTER FITTING ASM	145, 160
353	77668545	AIR TUBING	160
366	77668544	AIR TUBING	145, 160
379	10127170	SCREW	145, 160
399	77619634	SENSOR	145, 160
444	77619636	SENSOR	160
461	92006029	SET SCREW	145, 160
462	93749198	SCREW	145, 160
463	10126100	WASHER	145, 160
467	95643257	QUICK CONNECTOR	145
470	94933215	FITTING	160
825	77700071	AIR OPTION KIT	HPC
826	77700072	AIR OPTION KIT	HPC
827	77700070	AIR OPTION KIT	HPC

FIGURE 7-15. AIR OPTION KIT

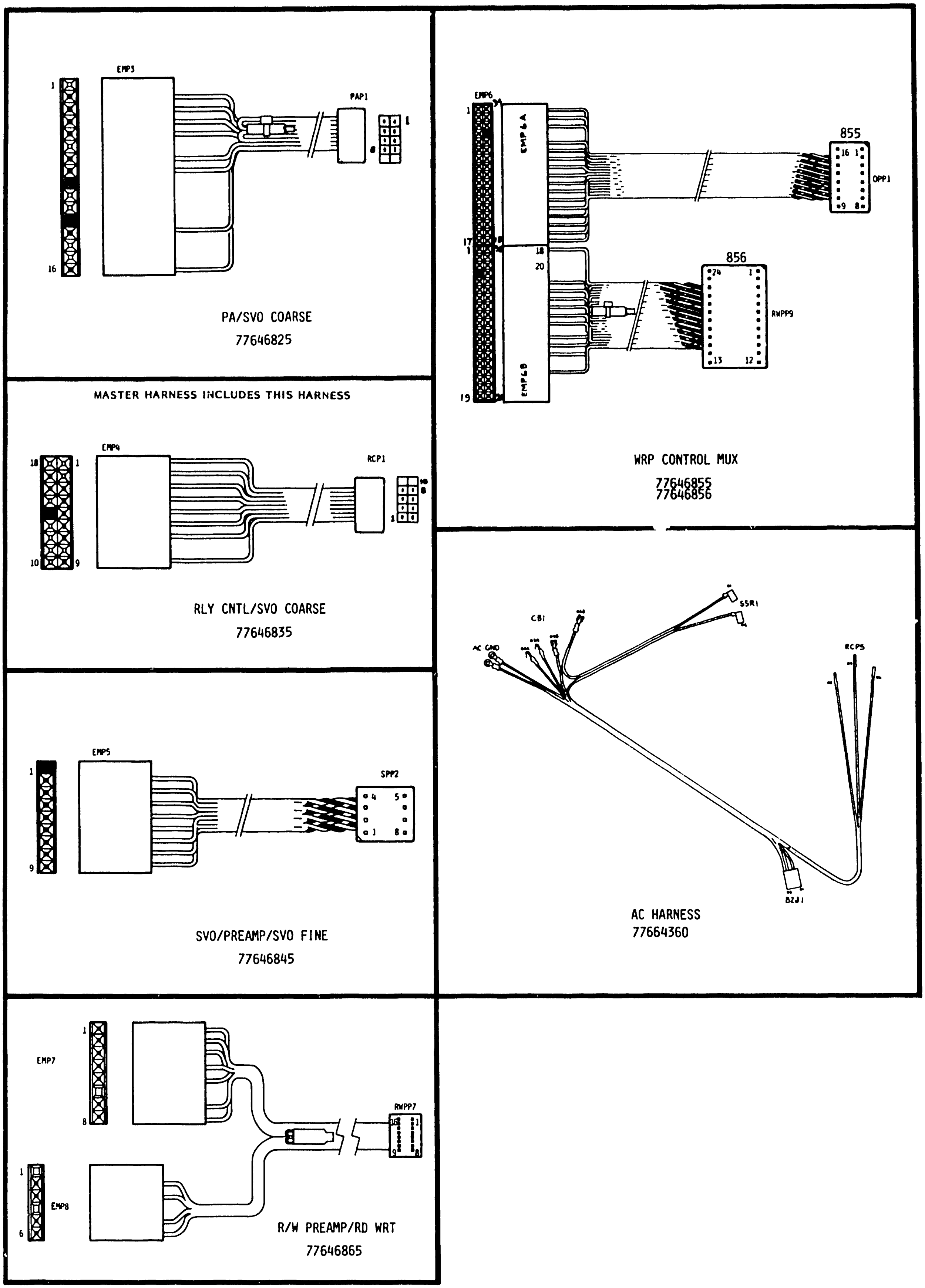


FIGURE 7-16. CMD HARNESS (1 OF 2)

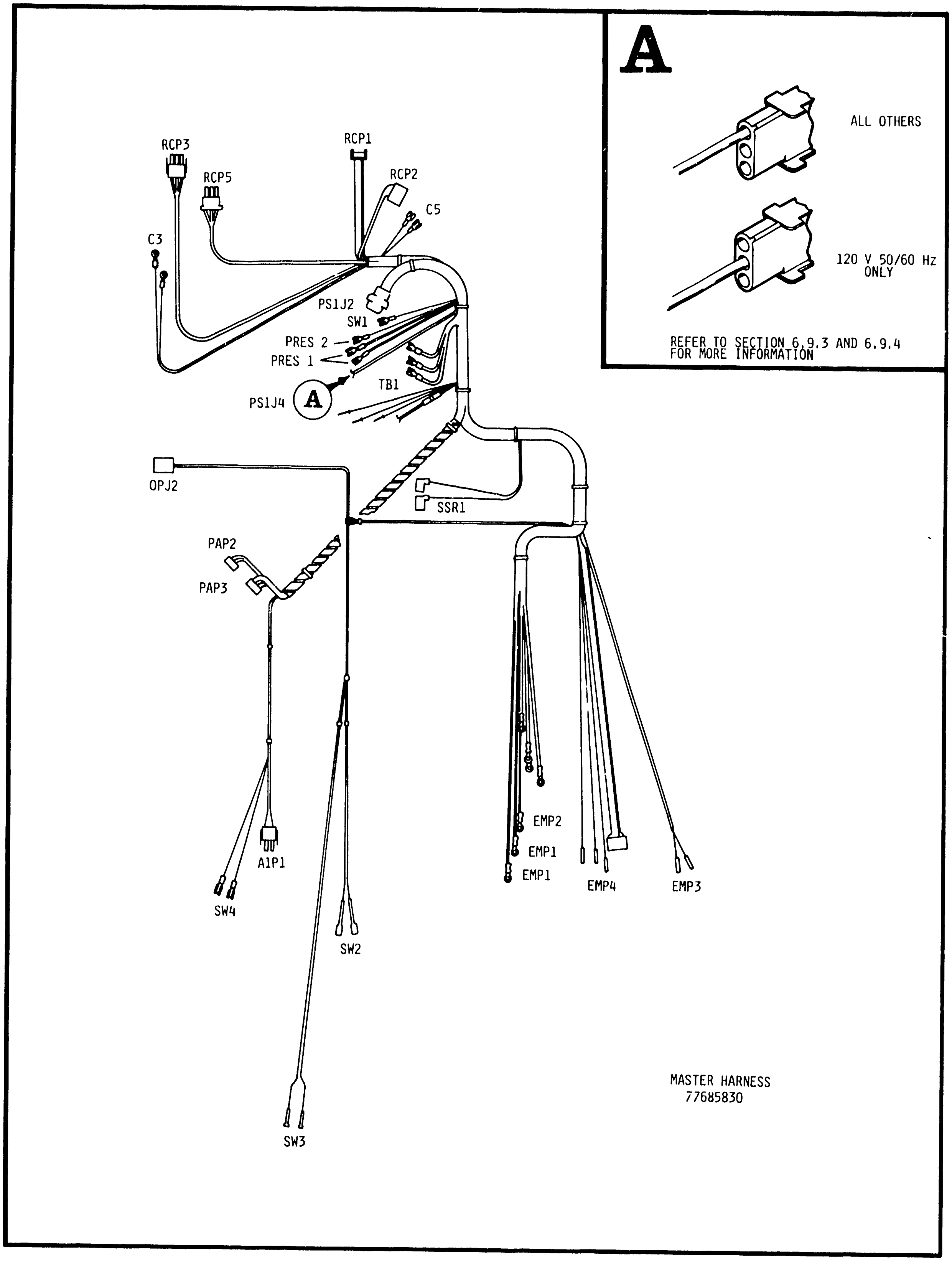


FIGURE 7-16. CMD HARNESS (2 OF 2)

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
021	77665750	FINAL MECHANICAL ASM	500	S5
021	77665750	FINAL MECHANICAL ASM	500	S6
021	77665750	FINAL MECHANICAL ASM	500	S7
021	77665750	FINAL MECHANICAL ASM	500	S8
027	75893356	INSTRUCTION LABEL	500	S5
028	75881128	DECKSUPPORT LH	021	S6
029	75881129	DECKSUP RH (NOT SHOWN)	021	S6
030	77662086	GASKET EXTRUSION	500	S5
031	92742011	SCREW	034	S8
032	77643188	RECEIVER ASM	021	S7
033	94364401	SWITCH	034	S8
034	77667396	STRIKER ASM	021	S6
034	77667396	STRIKER ASM	021	S8
035	10127111	SCREW	202	S11
035	10127111	SCREW	636, 634	S19
035	10127111	SCREW	633	S19
036	77610249	SCREW	201	S10
037	92805259	SCREW	202	S13
038	10125603	WASHER	202	S12
038	10125603	WASHER	202	S13
038	10125603	WASHER	748	S14
038	10125603	WASHER	404	S15
038	10125603	WASHER	560	S21
038	10125603	WASHER	556, 557	S21
038	10125603	WASHER	558, 559	S21
038	10125603	WASHER	021	S6
038	10125603	WASHER	021	S7
039	10125803	WASHER	201	S10
039	10125803	WASHER	202	S11
039	10125803	WASHER	202	S12
039	10125803	WASHER	202	S13
039	10125803	WASHER	631-632	S19
039	10125803	WASHER	751-753	S20
039	10125803	WASHER	021	S6
039	10125803	WASHER	021	S8
039	10125803	WASHER	201	S9
040	10125805	WASHER	201	S10
040	10125805	WASHER	202	S12
040	10125805	WASHER	202, 709	S13
040	10125805	WASHER	631, 632	S19
040	10125805	WASHER	751-753	S20
040	10125805	WASHER	021	S7
041	95033900	ADHESIVE	500	S5
042	10126244	SCREW	633, 635	S19
042	10126244	SCREW	631, 636	S19
043	77736733	GASKETSTRIP	632	S19
044	77641805	LATCH PLATE	043	S8
045	75881840	PIN PAWL	043	S8
046	75881731	PAWL	043	S8
047	75881770	SPRING PAWL	043	S8
048	75882694	SLIDE, LATCH	043	S8
049	75883310	TENSION SPRING	043	S8
050	75883642	SOLENOID BRACKET	043	S8
051	75883056	SOLENOID ASM	043	S8
052	75882691	LATCH COVER	043	S8
053	75883466	JUMPER WIRE ASM	043	S8
054	94376917	SCREW	043	S8
055	94376918	SCREW	043	S8
056	77658265	AIR BAFFLE	202	S12
057	75882675	SPACER	202	S12
058	51870302	HOUSING CONN	043	S8
059	92815193	SCREW	515, 516	S16
059	92815193	SCREW	519, 520	S16
059	92815193	SCREW	521	S16
060	10125608	WASHER	202	S12
061	18748600	COMPOUND 340	202	S13
062	77732750	FOAM BLOCK	632, 631	S19
062	77732750	FOAM BLOCK	635	S19
063	77732751	FOAM BLOCK	632, 631	S19
063	77732751	FOAM BLOCK	635	S19
064	94279113	WASHER	751-753	S20
065	10127101	SCREW	202	S11
066	77611448	ADHESIVE	294	S16
067	10125030	SCREW	202	S11
068	77665286	CHANNEL	201	S10
069	77641810	COVER, DOOR	043	S8
070	75882550	GROUND WIPER	716, 717	S21
071	75806501	FLAT WASHER	034	S8
072	75893357	INSTR LABEL	500	S5
073	75884877	GROUND FLEXIBLE	716	S21
074	75880242	LABEL	500	S5
075	77604002	PRE-FILTER-FILTER	712-729	S20
076	77648130	CATCH ASM	712-729	S20
077	77641785	FILTER FRAME ASM	729	S20
078	75892737	WIRE GUARD	043	S8
079	75894833	HINGE	043	S8
080	75894832	HINGE	043	S8
081	94364903	FILTER-AIR	631, 633	S19
081	94364903	FILTER-AIR	636, 634	S19
082	75881845	CLIP	634, 636	S19
082	75881845	CLIP	631, 633	S19
083	77641830	CLIP	632, 635	S19
084	94364906	FILTER-AIR	632, 635	S19
085	17901501	SCREW	201	S10
086	77686131	GND LABEL	500	S5
087	93749198	SCREW	202	S13
088	70100300	POWERSUPPLY 50/60 HZ	510	S17
089	76869502	POWERSUPPLY 60 HZ	509	S18
090	70116400	POWERSUPPLY 50 HZ	511	S18
091	95510027	NUT	032	S7
092	95125326	LOCTITESEALANT	032	S7
093	93749196	SCREW	021	S6
094	77672982	CLIP, ADHESIVE	021	S7
094	77672982	CLIP, ADHESIVE	201	S9
095	75010102	HEAD-ARM ASM, LOWER	559, 560	S21
095	75010102	HEAD-ARM ASM, LOWER	557, 558	S21
095	75010102	HEAD-ARM ASM, LOWER	555, 556	S21
096	75010103	HEAD-ARM ASM, UPPER	559	S21
096	75010103	HEAD-ARM ASM, UPPER	555, 556	S21
097	75010105	HEAD-ARM ASM,SERVO	555, 556	S21
097	75010105	HEAD-ARM ASM,SERVO	557, 558	S21
097	75010105	HEAD-ARM ASM, SERVO	559, 560	S21
098	75883031	WEIGHT HEAD	558, 559	S21
098	75883031	WEIGHT HEAD	560	S21
098	75883031	WEIGHT HEAD	556, 557	S21
099	10126215	SCREW	558, 559	S21
099	10126215	SCREW	560	S21
099	10126215	SCREW	556, 557	S21
100	76867600	TRANSFORMER 50/60 HZ	088	S17
101	75832500	AXGV COMPONENT ASM	088	S17
101	75832500	AXGV COMPONENT ASM	089, 090	S18
102	75832900	AXHV COMPONENT ASM	088	S17
102	75832900	AXHV COMPONENT ASM	089, 090	S18
103	76876400	CHASSIS	088	S17
104	76873100	CAP MOUNTING BRACKET	088	S17
104	76873100	CAP MOUNTING BRACKET	089, 090	S18
105	10125714	SCREW	089, 090	S18
106	10125746	SCREW	088	S17
106	10125746	SCREW	089, 090	S18
107	50242201	RECTIFIER BRIDGE	088	S17
107	50242201	RECTIFIER BRIDGE	089, 090	S18
108	10125912	SCREW	088	S17
108	10125912	SCREW	089, 090	S18
109	10125613	WASHER	088	S17
109	10125613	WASHER	089, 090	S18
110	10126103	WASHER	088	S17
110	10126103	WASHER	089, 090	S18
111	95510026	NUT	088	S17
111	95510026	NUT	089, 090	S18
111	95510026	NUT	021	S18
112	95583504	RECTIFIER BLOCK	088	S17
112	95583504	RECTIFIER BLOCK	089, 090	S18
113	92376014	NUT	088	S17
114	10125715	SCREW	088	S17
114	10125715	SCREW	089, 090	S18
115	76879005	CAPACITOR	088	S17
115	76879005	CAPACITOR	089, 090	S18
116	95655530	SCREW	088	S17
116	95655530	SCREW	089, 090	S18
117	95587700	NUT	088	S17
117	95587700	NUT	089, 090	S18
118	95635102	CABLE CLAMP	088	S17
118	95635102	CABLE CLAMP	089, 090	S18
119	95635105	CABLE CLAMP	088	S17
119	95635105	CABLE CLAMP	089, 090	S18
120	10126214	SCREW	556, 557	S21
120	10126214	SCREW	558, 559	S21
120	10126214	SCREW	560	S21
121	77659981	E MODULE BRACE	021	S7
122	95582501	BOOT-DOUBLE ENTRANCE	088	S17
122	95582501	BOOT-DOUBLE ENTRANCE	089, 090	S18
123	51785403	FUSE BLOCK	088	S17
123	51785403	FUSE BLOCK	089, 090	S18
124	95641502	WASHER	088	S17
124	95641502	WASHER	089, 090	S18
125	10126101	WASHER	088	S17
125	10126101	WASHER	089, 090	S18
126	95510024	NUT	088	S17
126	95510024	NUT	089, 090	S18
127	93419228	FUSE, 125 V	088	S17
127	93419228	FUSE, 125 V	089, 090	S18
128	95533601	GREASE	088	S17
128	95533601	GREASE	089	S18
129	95635103	CABLE CLAMP	088	S17
130	10126404	WASHER	088	S17
130	10126404	WASHER	089, 090	S18
131	94399501	FUSE BLOCK	088	S17
132	95647607	FUSE	088	S17
132	95647607	FUSE	089	S18
133	10125909	SCREW	088	S17
133	10125909	SCREW	089, 090	S18
134	77713965	CABLE GUARD	021	S6
135	70112900	TRANSFORMER 60 HZ	089	S18
136	76873002	CHASSIS	089	S18
137	77713975	BUMPER, UPPER	202	S11
138	76873401	WIRE HARNESS ASM	089	S18
139	10125777	SCREW	089, 090	S18
140	93564044	WASHER	089	S18
141	92376014	NUT	089, 090	S18
142	70113000	TRANSFORMER 50 HZ	090	S18
143	70116500	CHASSIS	090	S18
144	95635104	CABLE CLAMP	090	S18
145	77638864	NO AIR-96 MB	825, 826	S23
146	70117900	WIRE HARNESS ASM	090	S18
147	93564034	WASHER	090	S18
148	77604332	FOAM	021	S7
149	92732314	SCREW	021	S7
150	75883455	JUMPER WIRE	202	S13
151	93749084	SCREW	202	S13
152	93749200	SCREW	201	S10
152	93749200	SCREW	021	S6
152	93749200	SCREW	201	S9
153	93749198	SCREW	201	S10
153	93749198	SCREW	201	S9
154	94277401	CABLE TIE	201	S10
154	94277401	CABLE TIE	201	S9
155	94343210	CABLE TIE MOUNT	201	S10
155	94343210	CABLE TIE MOUNT	201	S9
156	77647108	ACOUSTIC FOAM	021	S6
157	10127177	SCREW	500	S5
158	77681599	RETAINER	202	S13
159	83410501	GASKETSTRIP	632, 631	S19

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
159	83410501	GASKETSTRIP	635	S19
160	77668539	LO AIR-NO AIR	827	S23
161	75893358	INSTRUCTION LABEL	500	S5
162	77714333	CLAMP KIT	820-822	S21
163	93749202	SCREW	021	S6
164	77611463	TAPE	201	S9
165	77604333	ACOUSTIC FOAM	201	S10
166	77668614	NUT BAR	751-753	S20
167	77681338	RETAINER	201	S9
168	77730195	FRONT PANEL ASM	730	S20
169	75890937	DRAWER EXTSLIDE	751	S20
170	75890938	DRAWER EXT SLIDE	751	S20
171	75890947	DRAWER EXT SLIDE	752	S20
172	75890948	DRAWER EXT SLIDE	752	S20
173	75890949	DRAWER EXT SLIDE	753	S20
174	75890950	DRAWER EXT SLIDE	753	S20
175	77736732	GASKETSTRIP	632	S19
180	10127105	SCREW	202	S12
181	75887830	SPACER	202	S12
182	77604334	FOAM	201	S9
183	75881250	GASKET	202	S13
184	10127322	SCREW	021	S6
185	75894105	ESD KIT	821, 823	S21
186	75894106	ESD KIT	822	S21
201	77665760	BASE PAN ASM	021	S10
201	77665760	BASE PAN ASM	021	S6
201	77665760	BASE PAN ASM	021	S9
202	77665770	DECK ASM	021	S11
202	77665770	DECK ASM	021	S12
202	77665770	DECK ASM	021	S13
202	77665770	DECK ASM	021	S6
203	75893355	LABEL	500	S5
204	77646363	BRACKET	145, 160	S23
205	95523400	BUMPER	043	S8
206	77681510	CLAMP, SERVO LEAD	021	S6
207	77681505	RETAINER, HEAD CONN	021	S6
208	10126263	SCREW	021	S6
209	75893275	PLATE, SEPARATOR	021	S7
210	77644619	STUD	021	S7
211	77670106	SCREW	202	S11
211	77670106	SCREW	202	S12
212	77617049	SCREW	500	S5
213	10126104	WASHER	202	S13
214	77668612	NUT BAR	748	S14
215	77668613	NUT BAR	748	S14
216	10127143	SCREW	201	S10
216	10127143	SCREW	201	S9
217	75892811	WASHER	021	S6
218	75892221	PIN	021	S6
219	92033037	RETAINING RING	021	S6
219	92033037	RETAINING RING	032	S7
220	77613705	BALL BEARING	021	S7
221	75883115	CAM PLATE	032	S7
222	75889492	SUPPORT SHAFT	021	S8
223	75887453	RECEIVER BAR, LH	032	S7
224	75887448	RECEIVER BAR, RH	032	S7
225	75882834	CARTRIDGE RAIL	032	S7
226	75882833	CARTRIDGE RAIL	032	S7
227	75887443	PLATE, RECEIVER	032	S7
228	93564001	WASHER	021	S6
228	93564001	WASHER	032	S7
228	93564001	WASHER	499 043	S8
229	75881792	LINK	032	S7
230	16402506	CABLE CLAMP	202	S13
230	16402506	CABLE CLAMP	021	S6
231	10127104	SCREW	202	S12
231	10127104	SCREW	202	S13
231	10127104	SCREW	088	S17
231	10127104	SCREW	021	S6
232	77685805	DECK DOWN SENSOR	201	S10
233	77659992	E MODULE SHIELD	748	S14
234	75893958	SPACER	021	S7
235	77610146	SW INTEGRAL LEVER	202	S12
235	77610146	SW INTEGRAL LEVER	355	S8
236	94371000	RETAINING RING	394	S16
236	94371000	RETAINING RING	021	S6
236	94371000	RETAINING RING	021	S7
237	92745012	SCREW	355	S8
238	10127102	SCREW	034, 043	S8
239	72959302	LABEL	748	S14
240	10125704	SCREW	510	S17
241	93592158	SCREW	021	S6
242	92033033	RETAINING RING	043	S8
243	77734135	SCREW	021	S7
244	10127113	SCREW	202	S11
244	10127113	SCREW	202	S12
244	10127113	SCREW	202	S12
244	10127113	SCREW	088	S17
244	10127113	SCREW	635, 632	S19
244	10127113	SCREW	751-753	S20
244	10127113	SCREW	021	S6
244	10127113	SCREW	021	S8
244	10127113	SCREW	201	S9
245	75883475	GROUNDSTRAP	201	S9
246	10127121	SCREW	748	S14
247	77666820	SWITCH PLATE	355	S8
248	10125725	SCREW	032	S7
249	95694202	SPACER	201	S9
250	92815290	SCREW	202	S12
251	10125800	WASHER	202	S12
251	10125800	WASHER	355	S8
252	10125801	WASHER	202	S12
252	10125801	WASHER	202	S13
252	10125801	WASHER	404	S15
252	10125801	WASHER	556, 557	S21
252	10125801	WASHER	558, 559	S21

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
252	10125801	WASHER	560	S21
252	10125801	WASHER	021	S7
252	10125801	WASHER	034, 043	S8
253	10126253	SCREW	021	S6
254	10125804	WASHER	202	S11
254	10125804	WASHER	202	S13
254	10125804	WASHER	404	S15
254	10125804	WASHER	515, 516	S16
254	10125804	WASHER	519	S16
254	10125804	WASHER	162	S21
254	10125804	WASHER	500	S5
254	10125804	WASHER	032	S7
254	10125804	WASHER	043	S8
254	10125804	WASHER	201	S9
255	10125806	WASHER	202	S12
255	10125806	WASHER	021	S6
256	10125602	WASHER	202	S12
256	10125602	WASHER	021	S6
256	10125602	WASHER	355	S8
257	10125605	WASHER	021	S10
257	10125605	WASHER	202	S11
257	10125605	WASHER	202	S12
257	10125605	WASHER	202	S13
257	10125605	WASHER	748	S14
257	10125605	WASHER	631, 632	S19
257	10125605	WASHER	635	S19
257	10125605	WASHER	500	S5
257	10125605	WASHER	021	S6
257	10125605	WASHER	021, 043	S8
258	10125606	WASHER	201	S10
258	10125606	WASHER	202	S11
258	10125606	WASHER	202	S13
258	10125606	WASHER	515-521	S16
258	10125606	WASHER	162	S21
258	10125606	WASHER	500	S5
258	10125606	WASHER	021, 032	S7
258	10125606	WASHER	021	S8
258	10125606	WASHER	201	S9
259	10125607	WASHER	201	S10
259	10125607	WASHER	202, 709	S13
259	10125607	WASHER	631, 632	S19
259	10125607	WASHER	635, 635	S19
259	10125607	WASHER	201	S9
260	10125102	NUT	202	S12
260	10125102	NUT	145, 160	S23
260	10125102	NUT	355, 034	S8
261	53777902	NUT & WASHER	748	S14
261	53777902	NUT & WASHER	635	S19
261	53777902	NUT & WASHER	631, 632	S19
261	53777902	NUT & WASHER	716, 717	S21
261	53777902	NUT & WASHER	021	S6
262	53777903	NUT & WASHER	404	S15
263	75806504	WASHER	748	S14
263	75806504	WASHER	021	S6
264	77830530	RIVET,SPLIT NYLON	021	S7
265	75881906	BRACKET	631	S19
266	75881907	BRACKET	631	S19
267	77641837	ZEE BRACKET	632, 635	S19
268	77641838	ZEE BRACKET	632, 635	S19
269	77666375	BRACKET RH	633	S19
270	77666376	BRACKET L H	633	S19
271	92805266	SCREW	709	S13
272	93326006	STUD BALL	633	S19
272	93326006	STUD BALL	712-729	S20
273	92815284	SCREW	202	S13
274	10126252	SCREW	635, 636	S19
274	10126252	SCREW	631-633	S19
275	77648135	CATCH ASM	633	S19
276	77666815	STOP PLATE	748	S14
277	83410518	GASKETSTRIP	500	S5
277	83410518	GASKETSTRIP	201	S9
278	75880482	BEARING	499	S8
279	77685535	BRACKET, ACTIVATOR	021	S13
280	77681649	BRACKET, TIE WRAP	202	S12
281	75882875	PANEL, POWER ENTRY	201	S9
282	77670412	ACTIVATOR	202	S13
283	77619805	WASHER	021	S6
284	75881350	BRACKET RESISTOR MTG	201	S10
285	95645628	CAPACITOR, 40VDC	201	S10
286	76878900	CAPACITOR, MOTOR RUN	201	S10
287	92826001	BRACKET	201	S10
288	75772500	BOOT, CAPACITOR	201	S10
289	75888159	BRACKET, RELAY CONTR	201	S10
290	75886725	DUCT, AIR INLET	201	S9
291	94376910	SCREW	633	S19
292	53777900	NUT	202	S13
292	53777900	NUT	021	S6
293	75887561	SPACER	201	S9
294	75889881	MANIFOLD ASM	201	S16
294	75889881	MANIFOLD ASM	201	S9
295	75889165	HOSE, PLASTIC AIR	294	S16
296	94275254	HOSE CLAMP	201	S9
297	93749096	SCREW	748	S14
298	77761951	SPARE FILTER KIT	201	S9
299	75893358	LABEL	550-552	S16
300	77647101	SPRING, FILTER RET	201	S9
301	75881265	DEFLECTOR, AIR	201	S9
302	75891005	COVER, AIR DEFLECTOR	201	S9
303	75774471	CAPACITOR	202	S13
304	77681647	CLAMP, CAPACITOR	202	S13
305	75888775	RESISTOR, WIRE WOUND	201	S10
306	75888776	RESISTOR, WIRE WOUND	201	S10
307	44675380	CABLE CLAMP	748	S14
308	75790000	DECAL	500	S5
309	75893762	CLAMP	162	S21
310	77732610	FILTER FITTING ASM	145, 160	S23

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
311	77659975	PIN	021	S7
312	77610156	SHOCK MOUNT	201	S10
313	75899543	BLK	202	S12
314	75882870	SHIELD, RFI FILTER	201	S10
315	51870400	AC PWR RECEPTACLE	201	S9
316	75899547	BLK	202	S11
317	75062803	WASHER	201	S9
318	75062400	WASHER	202	S13
318	75062400	WASHER	201	S9
319	75883453	WIRE JUMPER	201	S9
321	94047067	WASHER	201	S9
322	10127103	SCREW	201	S10
322	10127103	SCREW	201	S9
323	93749196	SCREW	201	S10
323	93749196	SCREW	201	S9
324	10127122	SCREW	202	S11
324	10127122	SCREW	748	S14
324	10127122	SCREW	021	S7
324	10127122	SCREW	201	S9
325	10127124	SCREW	162	S21
325	10127124	SCREW	043	S8
325	10127124	SCREW	201	S9
326	10127141	SCREW	751-753	S20
327	10127144	SCREW	751-753	S20
328	10125066	SCREW	201	S9
329	10126403	WASHER	201	S10
329	10126403	WASHER	752	S20
329	10126403	WASHER	751-753	S20
329	10126403	WASHER	201	S9
330	24534729	SLEEVING	089, 090	S18
331	53777900	NUT	201	S9
332	53777905	NUT	201	S10
332	53777905	NUT	201	S9
333	10125301	NUT	202	S11
334	93564004	WASHER	202	S7
335	92815166	SCREW	202	S11
336	75887510	BLOWER CENTRIF	550	S16
337	83435302	CONNECTOR, PLUG/CAP	550-552	S16
338	94276600	FOAM TAPE	294	S16
338	94276600	FOAM TAPE	550-552	S16
339	95105900	TAPE, POLY FILM, INSUL	294	S16
339	95105900	TAPE, POLY FILM, INSUL	550-552	S16
340	94277400	STRAP, CABLE TIE	202	S11
340	94277400	STRAP, CABLE TIE	550-552	S16
340	94277400	STRAP, CABLE TIE	510	S17
340	94277400	STRAP, CABLE TIE	508,509	S18
341	94277409	STRAP, CABLE TIE	550-552	S16
342	75887520	GROMMET,SQSHOULDER	550-552	S16
343	75885931	MANIFOLD	294	S16
344	75881250	GASKET	294	S16
345	77883454	JUMPE RE	202	S13
346	93749160	SCREW	088	S17
347	77736865	E MODU	748	S14
348	93749098	SCREW	748	S14
349	93749092	SCREW	748	S14
350	24547590	WARNING LABEL	748	S14
351	77737800	BRACKET	201	S9
352	10126106	WASHER	202	S13
353	77668545	AIR TUBING	160	S23
354	75882357	JUMPER WIRE	021	S6
355	77732765	PIP SWITCH ASM	021	S7
355	77732765	PIP SWITCH ASM	021	S8
356	75899706	PULLEY	519, 520	S16
357	93749100	SCREW	748	S14
358	77665285	CHANNEL	021	S7
359	10126213	SCREW	021	S7
360	77610157	SHOCK MOUNT	202	S13
361	10125106	NUT	032	S7
362	10127123	SCREW	202	S13
362	10127123	SCREW	032	S7
363	77633800	CLAMP	748	S14
364	75880044	BASE PLATE ASM	202	S11
364	75880044	BASE PLATE ASM	202	S12
364	75880044	BASE PLATE ASM	202	S13
365	75886281	SPINDLE	202	S11
366	77668544	AIR TUBING	145, 160	S23
367	77658460	MOTOR ASM	515, 519	S16
368	75887776	PLATE, MOTOR MTG	519	S16
368	75887776	PLATE, MOTOR MTG	517, 51[illegible]	S16
368	75887776	PLATE, MOTOR MTG	515, 51[illegible]	S16
369	92009012	WASHER	202	S12
370	77613626	COLLAR,SHAFT	520	S16
370	77613626	COLLAR,SHAFT	521, 519	S16
70	77613626	COLLAR,SHAFT	515, 516	S16
371	10126226	SCREW	202	S13
372	75062805	WASHER	202, 709	S13
373	10126255	SCREW	202	S12
374	75881537	POST, MOTORSPRING	202	S13
375	75887539	SPRING, TENSION	202	S13
376	75891524	HINGE	202	S13
377	75887975	SPACER, HINGE	202	S13
378	77610051	P.A.C. RELAY (SSR)	202	S13
379	10127170	SCREW	202	S12
379	10127170	SCREW	145, 160	S23
380	95643601	CLAMP, CAPACITOR	201	S10
380	95643601	CLAMP, CAPACITOR	510	S17
380	95643601	CLAMP, CAPACITOR	508, 509	S18
381	75887791	DISC,SPEEDSENSOR	202	S13
382	75893920	SUPPORT,SPEEDSENSOR	202	S13
383	75880046	SPEEDSENSOR	202	S13
384	75899703	PULLEY	516	S16
385	77736731	GROUND SPRING ASM	202	S13
386	75883481	PULLEY COVER	202	S13
387	93109084	SPACER	712-729	S20
388	92720396	BUTTON SCREW	202	S11
389	77832429	BUMPER	202	S11
389	77832429	BUMPER	633	S19
390	75886286	ROD-GUIDE	202	S12
391	75893682	BUMPER MOUNT, LOWER	202	S11
392	75866037	PLATE BEARING - FIXED	202	S12
393	10126227	SCREW	404	S15
394	75891681	PLATE ASM	202	S12
394	75891681	PLATE ASM	202	S16
395	75886033	PLATE BEARING	394	S16
396	75888191	BLOCK, SPRING SUPPORT	394	S16
397	75887557	PIN-SPRING, GUIDE	394	S16
398	75881536	SPRING	394	S16
399	77619634	SENSOR	145, 160	S23
400	77830611	WASHER	394	S16
400	77830611	WASHER	021	S8
401	75888746	CAM-TOWER	202	S11
402	75888747	CAM-TOWER	202	S11
403	77713975	BUMPER MT, UPPER	202	S11
404	75880135	CARRIAGE & COIL ASM	202	S12
404	75880135	CARRIAGE & COIL ASM	202	S15
405	75886513	MAGNET ASM	202	S12
406	75894102	VEL XDUCER-CONN ASM	202	S12
407	51885515	STANDOFF, MALE-FEMALE	202	S12
408	75891011	BRACKET SWITCH	202	S12
409	75893326	RFI FILTER ASM	201	S10
410	75891573	CARRIAGE LKG TOOL	202	S12
411	75893943	MTG BRACKET	202	S11
412	75893953	SERVO PREAMP SHIELD	202	S11
413	77681500	CONNECTOR PLATE	202	S11
414	75881385	MTG PLATE	202	S11
415	77666850	SHIELD, RD/WR PREAMP	202	S11
416	75882106	SHIM,STRIKER	021	S6
417	75867513	BLOWER CENTRIF	552	S16
418	77653103	STRIKER AND TAPE ASSM	034	S8
419	77732437	COVER	202	S11
420	75883211	COVER, POWER AMP ASM	202	S12
421	90603300	CLOSURE	500	S5
422	92602004	CABLE CLAMP	021	S6
422	92602004	CABLE CLAMP	021	S7
423	10127119	SCREW	202	S13
424	10125029	SCREW	202	S11
425	10126402	WASHER	748	S14
426	10126222	SCREW	202	S13
427	10125702	SCREW	043	S8
428	92033004	RETAINER RING	021	S6
428	92033004	RETAINER RING	021	S7
429	10127112	SCREW	201	S10
429	10127112	SCREW	202	S12
429	10127112	SCREW	202	S13
429	10127112	SCREW	510	S17
429	10127112	SCREW	508, 509	S18
429	10127112	SCREW	021	S6
430	10126401	WASHER	202	S12
430	10126401	WASHER	202	S13
430	10126401	WASHER	510	S17
430	10126401	WASHER	508, 509	S18
430	10126401	WASHER	500	S5
430	10126401	WASHER	021	S6
431	10125760	SCREW	202	S13
432	92805257	SCREW	202	S12
433	10127114	SCREW	202	S11
433	10127114	SCREW	202	S12
433	10127114	SCREW	202	S13
433	10127114	SCREW	748	S14
433	10127114	SCREW	088	S7
434	77610221	SCREW	202	S11
435	10127115	SCREW	202	S12
435	10127115	SCREW	748	S14
435	10127115	SCREW	088	S17
436	10125016	SCREW	202	S12
437	10125018	SCREW	202	S12
438	74277400	CABLE TIE	021	S6
439	77647107	PANEL ACOUSTIC FOAM	622, 623	S22
439	77647107	PANEL ACOUSTIC FOAM	620, 621	S22
440	10125006	SCREW	202	S12
441	10127148	SCREW	202	S13
442	51885504	STANDOFF MALE/FEMALE	201	S10
442	51885504	STANDOFF, MALE-FEMALE	202	S12
443	10125747	SCREW	202	S13
443	10125747	SCREW	510	S17
443	10125747	SCREW	508, 509	S18
444	77619636	SENSOR	160	S23
445	18440201	SILICONE RUBBER	202	S11
446	75880140	CARRIAGE & BEARINGS	404	S15
447	75885981	COIL ASM	404	S15
448	75889435	PLATE, COIL	404	S15
449	75896540	· LEAD FLEX, COIL	404	S15
450	75886191	INSULATOR, FLEX LEAD	404	S15
451	75276101	WASHER, PHENOLIC	404	S15
452	75276204	SPACER, PHENOLIC	404	S15
453	75888690	BRACKET, STRAP	404	S15
454	77830612	WASHER	404	S15
455	95044214	SEALANT	404	S15
455	95044214	SEALANT	021	S7
456	77617025	SCREW	404	S15
457	75881921	ACTUATOR WIRING ASM	404	S15
458	75899707	PULLEY	709	S13
458	75899707	PULLEY	515, 521	S16
460	75883025	SPACER, NYLON	021	S6
461	92006029	SET SCREW	145, 160	S23
462	93749198	SCREW	145, 160	S23
463	10126100	WASHER	145, 160	S23
464	75883007	VARISTOR	201	S9
465	80625400	LUBRICANT	515, 516	S16
465	80625400	LUBRICANT	517, 518	S16

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
466	77658465	MOTOR ASM	516	S16
467	95643257	QUICK CONNECTOR	145	S23
468	75887512	BLOWER CENTRIF	551	S16
469	77658461	MOTOR ASM	520, 521	S16
470	94933215	FITTING	160	S23
471	77732764	SHAFT ASM	499	S8
472	75880481	BEARING	499	S8
473	75882455	SPACER	499	S8
474	75894896	LEVER, CAM	499	S8
475	75893245	BLOCK, LINKAGE	032	S7
476	92602003	CABLE CLAMP	202	S11
476	92602003	CABLE CLAMP	202	S13
477	77670257	SET SCREW	499	S8
478	77610461	SPRING	021	S8
479	77686490	COVER	201	S10
480	77647109	PANEL ACOUSTIC FOAM	621, 622	S22
480	77647109	PANEL ACOUSTIC FOAM	623	S22
481	75894326	PANEL ACOUSTIC FOAM	621, 622	S22
481	75894326	PANEL ACOUSTIC FOAM	623	S22
482	75803804	INSULATOR, FISHPAPER	021	S6
483	75894328	PANEL ACOUSTIC FOAM	621, 623	S22
484	77647105	PANEL ACOUSTIC FOAM	620, 621	S22
484	77647105	PANEL ACOUSTIC FOAM	624	S22
484	77647105	PANEL ACOUSTIC FOAM	622, 623	S22
485	75894330	PANEL ACOUSTIC FOAM	621, 622	S22
485	75894330	PANEL ACOUSTIC FOAM	623, 624	S22
486	75894331	PANEL ACOUSTIC FOAM	623, 624	S22
486	75894331	PANEL ACOUSTIC FOAM	621, 622	S22
487	75894332	PANEL ACOUSTIC FOAM	621, 623	S22
488	77658253	PANEL ACOUSTIC FOAM	621, 622	S22
488	77658253	PANEL ACOUSTIC FOAM	623	S22
489	75894341	PANEL ACOUSTIC FOAM	622	S22
490	77658254	PANEL ACOUSTIC FOAM	621, 622	S22
490	77658254	PANEL ACOUSTIC FOAM	623	S22
491	75894338	PANEL ACOUSTIC FOAM	621	S22
492	75894339	PANEL ACOUSTIC FOAM	621	S22
494	75894336	PANEL ACOUSTIC FOAM	620, 624	S22
496	75893211	BRACKET	034	S8
498	75887251	WASHER	021	S6
499	77736891	KIT, CART RELEASE	021	S8
500	77669983	TOP LEVEL ASM	HPC	S3
500	77669983	TOP LEVEL ASM	HPC	S5
509	77610705	POWER SUPPLY 60 HZ	HPC	S18
509	77610705	POWER SUPPLY 60HZ	HPC	S3
509	77610705	POWER SUPPLY 60 HZ	HPC	S4
510	75887884	POWER SUPPLY	HPC	S17
510	75887884	POWER SUPPLY	HPC	S3
510	75887884	POWER SUPPLY	HPC	S4
511	77610707	POWER SUPPLY 50 HZ	HPC	S18
511	77610707	POWER SUPPLY 50 HZ	HPC	S3
511	77610707	POWER SUPPLY 50 HZ	HPC	S4
512	76867300	POWER SUPPLY	HPC	S18
512	76867300	POWER SUPPLY	HPC	S3
512	76867300	POWER SUPPLY	HPC	S4
513	76879400	POWER SUPPLY	HPC	S18
513	76879400	POWER SUPPLY	HPC	S3
513	76879400	POWER SUPPLY	HPC	S4
514	76879500	POWER SUPPLY	HPC	S17
514	76879500	POWER SUPPLY	HPC	S3
514	76879500	POWER SUPPLY	HPC	S4
515	77638604	DRIVE MTR ASM 60 HZ 120V	HPC	S16
515	77638604	DRIVE MTR ASM 60 HZ 120V	HPC	S3
515	77638604	DRIVE MTR ASM 60 HZ 120V	HPC	S4
516	77638605	DRV MTR ASM 220-240V	HPC	S16
516	77638605	DRIVE MTR ASM 220-240V	HPC	S3
516	77638605	DRV MTR ASM 220-240V	HPC	S4
519	77638603	DRV MTR ASM 50 HZ 120V	HPC	S16
519	77638603	DRV MTR ASM 50 HZ 120V	HPC	S3
519	77638603	DRV MTR ASM 50 HZ 120V	HPC	S4
520	77638601	DRV MTR ASM 50 HZ 120V	HPC	S16
520	77638601	DRV MTR ASM 50 HZ 120V	HPC	S3
520	77638601	DRV MTR ASM 50 HZ 120V	HPC	S4
521	77638602	DRV MTR ASM 60 HZ 100V	HPC	S16
521	77638602	DRV MTR ASM 60 HZ 100V	HPC	S3
521	77638602	DRV MTR ASM 60 HZ 100V	HPC	S4
525	92314113	DRIVE BELT 60 HZ	709	S13
525	92314113	DRIVE BELT 60 HZ	HPC	S3
525	92314113	DRIVE BELT 60 HZ	HPC	S4
526	92314127	DRIVE BELT 50 HZ	HPC	S3
526	92314127	DRIVE BELT 50 HZ	HPC	S4
530	75738414	CAPACITOR 60 HZ	HPC	S3
530	75738414	CAPACITOR 60 HZ	HPC	S4
531	76879006	CAPACITOR 50 HZ	HPC	S3
531	76879006	CAPACITOR 50 HZ	HPC	S4
532	77612915	CAPACITOR 50/60 HZ	HPC	S3
532	77612915	CAPACITOR 50/60 HZ	HPC	S4
535	77666012	FRONT PANEL OVERLAY	HPC	S3
540	75778719	POWER CORD 60 HZ	HPC	S3
541	75778718	POWER CORD 50 HZ	HPC	S3
542	75778725	POWER CORD	HPC	S3
543	75892988	POWER CORD	HPC	S3
544	75892987	POWER CORD	HPC	S3
545	77622695	POWER CORD	HPC	S3
546	15165431	POWER CORD	HPC	S3
547	77622696	POWER CORD	HPC	S3
550	75889886	BLOWER ASM 60 HZ	HPC	S16
550	75889886	BLOWER ASM 60 HZ	HPC	S3
550	75889886	BLOWER ASM 60 HZ	HPC	S4
551	75889888	BLOWER ASM 50 HZ	HPC	S16
551	75889888	BLOWER ASM 50 HZ	HPC	S3
551	75889888	BLOWER ASM 50 HZ	HPC	S4
552	75889889	BLOWER ASM 50 HZ	HPC	S16
552	75889889	BLOWER ASM 50 HZ	HPC	S3
552	75889889	BLOWER ASM 50 HZ	HPC	S4
555	75880851	HEAD KIT - 96 MB	HPC	S3
556	75880852	HEAD KIT - 64 MB	HPC	S3
557	75880853	HEAD KIT - 32 MB	HPC	S3
558	75880854	HEAD KIT - 16 MB	HPC	S3
559	75880856	HEAD KIT - 64/96 MB	HPC	S3
560	75880857	HEAD KIT - 32/96 MB	HPC	S3
561	76204655	SPARE MODULE 96 M	HPC	S21
561	76204655	SPARE MODULE 96 M	HPC	S3
562	76204656	SPARE MODULE 64 M	HPC	S21
562	76204656	SPARE MODULE 64 M	HPC	S3
563	76204657	SPARE MODULE 32 M	HPC	S21
563	76204657	SPARE MODULE 32 M	HPC	S3
568	75893021	SWITCH BRACKET	HPC	S3
569	75882826	PWB BRACKET	HPC	S3
570	75893020	BRACKET, OPR CNTL	HPC	S3
571	75883026	SPACER	709	S13
572	75883027	SPACER	HPC	S3
573	75883845	FRONT PANEL	HPC	S3
574	75899641	FRONT PANEL	HPC	S3
575	75883833	FRONT PANEL	HPC	S3
576	75883935	FRONT PANEL	HPC	S3
577	75883849	FRONT PANEL	HPC	S3
578	75883832	FRONT PANEL	HPC	S3
579	75883830	FRONT PANEL	HPC	S3
580	75883828	FRONT PANEL	HPC	S3
581	75899648	FRONT PANEL	HPC	S3
582	75883827	FRONT PANEL	HPC	S3
583	75883825	FRONT PANEL	HPC	S3
584	75883822	FRONT PANEL	HPC	S3
585	75883821	FRONT PANEL	HPC	S3
586	75883817	FRONT PANEL	HPC	S3
587	75883815	FRONT PANEL	HPC	S3
588	75883814	FRONT PANEL	HPC	S3
589	75883808	FRONT PANEL	HPC	S3
590	75883887	FRONT PANEL	HPC	S3
591	75883850	FRONT PANEL	HPC	S3
592	75899681	FRONT PANEL	HPC	S3
593	75883893	FRONT PANEL	HPC	S3
594	75883851	FRONT PANEL	HPC	S3
595	75883992	FRONT PANEL	HPC	S3
596	75883853	FRONT PANEL	HPC	S3
597	75883855	FRONT PANEL	HPC	S3
598	75883801	FRONT PANEL	HPC	S3
599	75883803	FRONT PANEL	HPC	S3
600	75883813	FRONT PANEL	HPC	S3
601	75883811	FRONT PANEL	HPC	S3
602	75883837	FRONT PANEL	HPC	S3
603	75883842	FRONT PANEL	HPC	S3
604	75883847	FRONT PANEL	HPC	S3
605	75883844	FRONT PANEL	HPC	S3
606	75899186	COVER	HPC	S3
609	75899185	COVER	HPC	S3
610	75899171	COVER	HPC	S3
611	75899076	POWER PLUG ASM 50 HZ	HPC	S3
611	75899076	POWER PLUG ASM 50 HZ	HPC	S4
612	75899077	POWER PLUG ASM 50 HZ	HPC	S3
613	75899080	POWER PLUB ASM	HPC	S3
614	75899085	POWER PLUG ASM	HPC	S3
614	75899085	POWER PLUG ASM	HPC	S4
615	75899086	POWER PLUG ASM	HPC	S3
615	75899086	POWER PLUG ASM	HPC	S4
616	75899082	POWER PLUG ASM	HPC	S3
616	75899082	POWER PLUG ASM	HPC	S4
617	75899083	POWER PLUG ASM	HPC	S3
617	75899083	POWER PLUG ASM	HPC	S4
618	75899087	POWER PLUG ASM	HPC	S3
618	75899087	POWER PLUG ASM	HPC	S4
620	75895042	SOUND TREATMENT OPT	HPC	S22
620	75895042	SOUND TREATMENT OPT	HPC	S3
621	75895040	SOUND TREATMENT OPT	HPC	S22
621	75895040	SOUND TREATMENT OPT	HPC	S3
622	75895044	SOUND TREATMENT OPT	HPC	S22
622	75895044	SOUND TREATMENT OPT	HPC	S3
623	75895045	SOUND TREATMENT OPT	HPC	S22
623	75895045	SOUND TREATMENT OPT	HPC	S3
624	75895046	SOUND TREATMENT OPT	HPC	S22
624	75895046	SOUND TREATMENT OPT	HPC	S3
630	94397002	PRODUCT IDENT EMBLEM	HPC	S3
631	75893030	FRONT PANEL INSTL KIT	HPC	S19
631	75893030	FRONT PANEL INSTL KIT	HPC	S3
632	75893031	FRONT PANEL INSTL KIT	HPC	S19
632	75893031	FRONT PANEL INSTL KIT	HPC	S3
633	75893035	FRONT PANEL INSTL KIT	HPC	S19
633	75893035	FRONT PANEL INSTL KIT	HPC	S3
634	75893032	FRONT PANEL INSTL KIT	HPC	S19
634	75893032	FRONT PANEL INSTL KIT	HPC	S3
635	75893033	FRONT PANEL INSTL KIT	HPC	S19
635	75893033	FRONT PANEL INSTL KIT	HPC	S3
636	75893034	FRONT PANEL INSTL KIT	HPC	S19
636	75893034	FRONT PANEL INSTL KIT	HPC	S3
637	75896141	ENCODING BUTTON KIT	HPC	S3
638	75896140	ENCODING BUTTON KIT	HPC	S3
642	75896853	PANEL INSERT	HPC	S3
643	75896854	PANEL INSERT	HPC	S3
644	75896857	PANEL INSERT	HPC	S3
645	75896846	PANEL INSERT	HPC	S3
646	77624540	PANEL INSERT	HPC	S3
647	75896843	PANEL INSERT	HPC	S3
648	75896838	PANEL INSERT	HPC	S3
649	75896834	PANEL INSERT	HPC	S3
650	75896847	PANEL INSERT	HPC	S3
651	75896844	PANEL INSERT	HPC	S3
652	75896829	PANEL INSERT	HPC	S3
653	75896826	PANEL INSERT	HPC	S3
654	75896827	PANEL INSERT	HPC	S3
655	75896849	PANEL INSERT	HPC	S3
656	75896823	PANEL INSERT	HPC	S3
657	75896850	PANEL INSERT	HPC	S3
658	75896820	PANEL INSERT	HPC	S3

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
659	75896818	PANEL INSERT	HPC	S3
660	75896809	PANEL INSERT	HPC	S3
661	77624581	PANEL INSERT	HPC	S3
662	75896893	PANEL INSERT	HPC	S3
663	77624548	PANEL INSERT	HPC	S3
664	75896805	PANEL INSERT	HPC	S3
665	77632391	PANEL INSERT	HPC	S3
666	75896802	PANEL INSERT	HPC	S3
667	75896804	PANEL INSERT	HPC	S3
668	75896810	PANEL INSERT	HPC	S3
669	77644392	PANEL INSERT	HPC	S3
670	75896812	PANEL INSERT	HPC	S3
671	77646493	PANEL INSERT	HPC	S3
672	75896836	PANEL INSERT	HPC	S3
673	77646714	PANEL INSERT	HPC	S3
674	75896816	PANEL INSERT	HPC	S3
675	77773387	PAINT DOOR ASM KIT	HPC	S3
675	77773387	PAINT DOOR ASM KIT	HPC	S6
675	77773387	PAINT DOOR ASM KIT	HPC	S8
676	77773381	PAINT DOOR ASM KIT	HPC	S3
676	77773381	PAINT DOOR ASM KIT	HPC	S6
676	77773381	PAINT DOOR ASM KIT	HPC	S8
677	77773393	PAINT DOOR ASM KIT	HPC	S3
677	77773393	PAINT DOOR ASM KIT	HPC	S6
677	77773393	PAINT DOOR ASM KIT	HPC	S8
678	77773347	PAINT DOOR ASM KIT	HPC	S3
678	77773347	PAINT DOOR ASM KIT	HPC	S6
678	77773347	PAINT DOOR ASM KIT	HPC	S8
679	77773392	PAINT DOOR ASM KIT	HPC	S3
679	77773392	PAINT DOOR ASM KIT	HPC	S6
679	77773392	PAINT DOOR ASM KIT	HPC	S8
680	77773339	PAINT DOOR ASM KIT	HPC	S3
680	77773339	PAINT DOOR ASM KIT	HPC	S6
680	77773339	PAINT DOOR ASM KIT	HPC	S8
681	77773344	PAINT DOOR ASM KIT	HPC	S3
681	77773344	PAINT DOOR ASM KIT	HPC	S6
681	77773344	PAINT DOOR ASM KIT	HPC	S8
682	77773306	PAINT DOOR ASM KIT	HPC	S3
682	77773306	PAINT DOOR ASM KIT	HPC	S6
682	77773306	PAINT DOOR ASM KIT	HPC	S8
683	77773301	PAINT DOOR ASM KIT	HPC	S3
683	77773301	PAINT DOOR ASM KIT	HPC	S6
683	77773301	PAINT DOOR ASM KIT	HPC	S8
684	77773303	PAINT DOOR ASM KIT	HPC	S3
684	77773303	PAINT DOOR ASM KIT	HPC	S6
684	77773303	PAINT DOOR ASM KIT	HPC	S8
685	77773313	PAINT DOOR ASM KIT	HPC	S3
685	77773313	PAINT DOOR ASM KIT	HPC	S6
685	77773313	PAINT DOOR ASM KIT	HPC	S8
686	77773311	PAINT DOOR ASM KIT	HPC	S3
686	77773311	PAINT DOOR ASM KIT	HPC	S6
686	77773311	PAINT DOOR ASM KIT	HPC	S8
687	77773307	PAINT DOOR ASM KIT	HPC	S3
687	77773307	PAINT DOOR ASM KIT	HPC	S6
687	77773307	PAINT DOOR ASM KIT	HPC	S8
688	77773314	PAINT DOOR ASM KIT	HPC	S3
688	77773314	PAINT DOOR ASM KIT	HPC	S6
688	77773314	PAINT DOOR ASM KIT	HPC	S8
689	77773315	PAINT DOOR ASM KIT	HPC	S3
689	77773315	PAINT DOOR ASM KIT	HPC	S6
689	77773315	PAINT DOOR ASM KIT	HPC	S8
690	77773349	PAINT DOOR ASM KIT	HPC	S3
690	77773349	PAINT DOOR ASM KIT	HPC	S6
690	77773349	PAINT DOOR ASM KIT	HPC	S8
691	77773317	PAINT DOOR ASM KIT	HPC	S3
691	77773317	PAINT DOOR ASM KIT	HPC	S6
691	77773317	PAINT DOOR ASM KIT	HPC	S8
692	77773321	PAINT DOOR ASM KIT	HPC	S3
692	77773321	PAINT DOOR ASM KIT	HPC	S6
692	77773321	PAINT DOOR ASM KIT	HPC	S8
693	77773322	PAINT DOOR ASM KIT	HPC	S3
693	77773322	PAINT DOOR ASM KIT	HPC	S6
693	77773322	PAINT DOOR ASM KIT	HPC	S8
694	77773325	PAINT DOOR ASM KIT	HPC	S3
694	77773325	PAINT DOOR ASM KIT	HPC	S6
694	77773348	PAINT DOOR ASM KIT	HPC	S6
694	77773325	PAINT DOOR ASM KIT	HPC	S8
694	77773348	PAINT DOOR ASM KIT	HPC	S8
695	77773348	PAINT DOOR ASM KIT	HPC	S3
696	77773326	PAINT DOOR ASM KIT	HPC	S3
697	77773328	PAINT DOOR ASM KIT	HPC	S3
697	77773328	PAINT DOOR ASM KIT	HPC	S6
697	77773328	PAINT DOOR ASM KIT	HPC	S8
698	77773330	PAINT DOOR ASM KIT	HPC	S3
698	77773330	PAINT DOOR ASM KIT	HPC	S6
698	77773330	PAINT DOOR ASM KIT	HPC	S8
699	77773332	PAINT DOOR ASM KIT	HPC	S3
699	77773332	PAINT DOOR ASM KIT	HPC	S6
699	77773332	PAINT DOOR ASM KIT	HPC	S8
700	77773336	PAINT DOOR ASM KIT	HPC	S3
700	77773336	PAINT DOOR ASM KIT	HPC	S6
700	77773336	PAINT DOOR ASM KIT	HPC	S8
701	77773333	PAINT DOOR ASM KIT	HPC	S3
701	77773333	PAINT DOOR ASM KIT	HPC	S6
701	77773333	PAINT DOOR ASM KIT	HPC	S8
702	77773337	PAINT DOOR ASM KIT	HPC	S3
702	77773337	PAINT DOOR ASM KIT	HPC	S6
702	77773337	PAINT DOOR ASM KIT	HPC	S8
703	77773342	PAINT DOOR ASM KIT	HPC	S3
703	77773342	PAINT DOOR ASM KIT	HPC	S6
703	77773342	PAINT DOOR ASM KIT	HPC	S8
704	77773341	PAINT DOOR ASM KIT	HPC	S3
704	77773341	PAINT DOOR ASM KIT	HPC	S6
704	77773341	PAINT DOOR ASM KIT	HPC	S8
705	77773345	PAINT DOOR ASM KIT	HPC	S3
705	77773345	PAINT DOOR ASM KIT	HPC	S6
705	77773345	PAINT DOOR ASM KIT	HPC	S8
706	77773350	PAINT DOOR ASM KIT	HPC	S3
706	77773350	PAINT DOOR ASM KIT	HPC	S6
706	77773350	PAINT DOOR ASM KIT	HPC	S8
707	77773351	PAINT DOOR ASM KIT	HPC	S3
707	77773351	PAINT DOOR ASM KIT	HPC	S6
707	77773351	PAINT DOOR ASM KIT	HPC	S8
708	77773353	PAINT DOOR ASM KIT	HPC	S3
708	77773353	PAINT DOOR ASM KIT	HPC	S6
708	77773353	PAINT DOOR ASM KIT	HPC	S8
709	75883073	PULLEY & BELT KIT (60 HZ)	HPC	S13
709	75883073	PULLEY & BELT KIT (60 HZ)	HPC	S3
710	77646344	BASE PAN	820	S21
710	77646344	BASE PAN	820	S3
711	77646345	BASE PAN	821, 822	S21
711	77646345	BASE PAN	823	S21
711	77646345	BASE PAN	821, 822	S3
711	77646345	BASE PAN	823	S3
713	77773243	PREFILTER KIT	HPC	S20
713	77773243	PREFILTER KIT	HPC	S3
714	77773226	PREFILTER KIT	HPC	S20
714	77773226	PREFILTER KIT	HPC	S3
715	77773250	PREFILTER KIT	HPC	S20
715	77773250	PREFILTER KIT	HPC	S3
716	77773253	PREFILTER KIT	HPC	S20
716	77773253	PREFILTER KIT	HPC	S3
717	77773266	PREFILTER KIT	HPC	S20
717	77773266	PREFILTER KIT	HPC	S3
720	77773293	PREFILTER KIT	HPC	S20
720	77773293	PREFILTER KIT	HPC	S3
721	77773291	PREFILTER KIT	HPC	S20
721	77773291	PREFILTER KIT	HPC	S3
722	77773236	PREFILTER KIT	HPC	S20
722	77773236	PREFILTER KIT	HPC	S3
723	77773246	PREFILTER KIT	HPC	S20
723	77773246	PREFILTER KIT	HPC	S3
724	77773245	PREFILTER KIT	HPC	S20
724	77773245	PREFILTER KIT	HPC	S3
725	77773209	PREFILTER KIT	HPC	S20
725	77773209	PREFILTER KIT	HPC	S3
726	77773262	PREFILTER KIT	HPC	S20
726	77773262	PREFILTER KIT	HPC	S3
727	77773260	PREFILTER KIT	HPC	S20
727	77773260	PREFILTER KIT	HPC	S3
730	77730238	PREFILTER KIT	HPC	S20
730	77730238	PREFILTER KIT	HPC	S3
731	94398801	ENCODING BUTTON "1"	HPC	S3
732	75896141	ENCODING BUTTON	HPC	S3
733	75896140	ENCODING BUTTON	HPC	S3
736	77664371	SIGNAL HARNESS	HPC	S3
737	77664370	SIGNAL HARNESS	HPC	S3
741	75892524	LOGO & FUSE KIT	HPC	S3
744	24565002	CABLE CLAMP	HPC	S3
745	24565004	CABLE CLAMP	HPC	S3
748	77660545	E MODULE ASM	HPC	S14
748	77660545	E MODULE ASM	HPC	S3
748	77660545	E MODULE ASM	HPC	S7
751	75897340	SLIDE KIT	HPC	S20
751	75897340	SLIDE KIT	HPC	S3
752	75897701	SLIDE KIT	HPC	S20
752	75897701	SLIDE KIT	HPC	S3
753	75899182	SLIDE KIT	HPC	S20
753	75899182	SLIDE KIT	HPC	S3
758	75890937	DRAWER EXT SLIDE	HPC	S3
759	77664125	JUMPER CABLE	HPC	S3
763	15165898	CIRCUIT BREAKER	HPC	S3
763	15165898	CIRCUIT BREAKER	HPC	S4
764	15165895	CIRCUIT BREAKER	HPC	S3
764	15165895	CIRCUIT BREAKER	HPC	S4
769	77732536	TAPE INSTL KIT	HPC	S3
770	77665277	TAPE INSTL KIT	HPC	S3
771	94257605	RUN TIME METER	HPC	S3
772	77644690	JUMPER PLUG ASM	HPC	S3
772	77644690	JUMPER PLUG ASM	HPC	S4
773	77644691	JUMPER PLUG ASM	HPC	S3
773	77644691	JUMPER PLUG ASM	HPC	S4
801	77700030	POWER KIT 1	HPC	S3
801	77700030	POWER KIT 1	HPC	S4
802	77700031	POWER KIT 2	HPC	S3
802	77700031	POWER KIT 2	HPC	S4
803	77700032	POWER KIT 3	HPC	S3
803	77700032	POWER KIT 3	HPC	S4
804	77700033	POWER KIT 4	HPC	S3
804	77700033	POWER KIT 4	HPC	S4
805	77700034	POWER KIT 5	HPC	S3
805	77700034	POWER KIT 5	HPC	S4
806	77700035	POWER KIT 6	HPC	S3
806	77700035	POWER KIT 6	HPC	S4
807	77700036	POWER KIT 7	HPC	S3
807	77700036	POWER KIT 7	HPC	S4
808	77700037	POWER KIT 8	HPC	S3
808	77700037	POWER KIT 8	HPC	S4
809	77700038	POWER KIT 9	HPC	S3
809	77700038	POWER KIT 9	HPC	S4
820	77700060	STD BASE PAN KIT	HPC	S21
820	77700060	STD BASE PAN KIT	HPC	S3
821	77700061	ESD BASE PAN KIT	HPC	S21
821	77700061	ESD BASE PAN KIT	HPC	S3
822	77700062	ESD BASE PAN KIT UNIQ	HPC	S21
822	77700062	ESD BASE PAN KIT UNIQ	HPC	S3
823	77700063	ESD BASE PAN KIT UNIQ	HPC	S21
823	77700063	ESD BASE PAN KIT UNIQ	HPC	S3
825	77700071	AIR OPTION KIT	HPC	S23
825	77700071	AIR OPTION KIT	HPC	S3
826	77700072	AIR OPTION KIT	HPC	S23
826	77700072	AIR OPTION KIT	HPC	S3
827	77700070	AIR OPTION KIT	HPC	S23

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET
827	77700070	AIR OPTION KIT	HPC	S3
850	77773355	PAINT DOOR ASM KIT	HPC	S3
850	77773355	PAINT DOOR ASM KIT	HPC	S6
850	77773355	PAINT DOOR ASM KIT	HPC	S8
851	77773357	PAINT DOOR ASM KIT	HPC	S3
851	77773357	PAINT DOOR ASM KIT	HPC	S6
851	77773357	PAINT DOOR ASM KIT	HPC	S8
852	77773359	PAINT DOOR ASM KIT	HPC	S3
852	77773359	PAINT DOOR ASM KIT	HPC	S6
852	77773359	PAINT DOOR ASM KIT	HPC	S8
853	77773360	PAINT DOOR ASM KIT	HPC	S3
853	77773360	PAINT DOOR ASM KIT	HPC	S6
853	77773360	PAINT DOOR ASM KIT	HPC	S8
854	77773361	PAINT DOOR ASM KIT	HPC	S3
854	77773361	PAINT DOOR ASM KIT	HPC	S6
854	77773361	PAINT DOOR ASM KIT	HPC	S8
855	77773319	PAINT DOOR ASM KIT	HPC	S3
855	77773319	PAINT DOOR ASM KIT	HPC	S6
855	77773319	PAINT DOOR ASM KIT	HPC	S8
856	77773363	PAINT DOOR ASM KIT	HPC	S3
856	77773363	PAINT DOOR ASM KIT	HPC	S6
856	77773363	PAINT DOOR ASM KIT	HPC	S8
857	77773365	PAINT DOOR ASM KIT	HPC	S3
857	77773365	PAINT DOOR ASM KIT	HPC	S6
857	77773365	PAINT DOOR ASM KIT	HPC	S8
876	75883856	FRONT PANEL	HPC	S3
877	75883859	FRONT PANEL	HPC	S3
878	75883960	FRONT PANEL	HPC	S3
879	75883861	FRONT PANEL	HPC	S3
880	75883863	FRONT PANEL	HPC	S3
881	75883865	FRONT PANEL	HPC	S3
882	75883866	FRONT PANEL	HPC	S3
901	75896858	PANEL INSERT	HPC	S3
902	77731376	PANEL INSERT	HPC	S3
903	75896862	PANEL INSERT	HPC	S3
904	75896864	PANEL INSERT	HPC	S3
905	75896865	PANEL INSERT	HPC	S3
906	75896866	PANEL INSERT	HPC	S3

ITEM	IDENT NO.	DESCRIPTION	WHERE USED	SHEET

CROSS REFERENCE

ITEM	IDENT. NO.	SHEET
440	10125006	S12
436	10125016	S12
437	10125018	S12
424	10125029	S11
067	10125030	S11
328	10125066	S9
260	10125102	S12
260	10125102	S23
260	10125102	S8
361	10125106	S7
333	10125301	S11
256	10125602	S12
256	10125602	S6
256	10125602	S8
038	10125603	S12
038	10125603	S13
038	10125603	S14
038	10125603	S15
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038	10125603	S6
038	10125603	S7
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259	10125607	S9
060	10125608	S12
109	10125613	S17
109	10125613	S18
427	10125702	S8
240	10125704	S17
105	10125714	S18
114	10125715	S17
114	10125715	S18
248	10125725	S7
106	10125746	S17
106	10125746	S18
443	10125747	S13
443	10125747	S17
443	10125747	S18
431	10125760	S13
139	10125777	S18
251	10125800	S12
251	10125800	S8
252	10125801	S12
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255	10125806	S12
255	10125806	S6
133	10125909	S17
133	10125909	S18
108	10125912	S17
108	10125912	S18
463	10126100	S23
125	10126101	S17
125	10126101	S18
110	10126103	S17
110	10126103	S18
213	10126104	S13
352	10126106	S13
359	10126213	S7
120	10126214	S21
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099	10126215	S21
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099	10126215	S21
426	10126222	S13
371	10126226	S13
393	10126227	S15
042	10126244	S19
042	10126244	S19
274	10126252	S19
274	10126252	S19
253	10126253	S6
373	10126255	S12
208	10126263	S6
430	10126401	S12
430	10126401	S13
430	10126401	S17
430	10126401	S18
430	10126401	S5
430	10126401	S6
425	10126402	S11
329	10126403	S10
329	10126403	S20
329	10126403	S20
329	10126403	S9
130	10126404	S17
130	10126404	S18
065	10127101	S11
238	10127102	S8
322	10127103	S10
322	10127103	S9
231	10127104	S12
231	10127104	S13
231	10127104	S17
231	10127104	S6
180	10127105	S12
035	10127111	S11
035	10127111	S19
035	10127111	S19
429	10127112	S10
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433	10127114	S11
433	10127114	S12
433	10127114	S13
433	10127114	S14
433	10127114	S7
435	10127115	S12
435	10127115	S14
435	10127115	S17
423	10127119	S13
246	10127121	S14
324	10127122	S11
324	10127122	S14
324	10127122	S7
324	10127122	S9
362	10127123	S13
362	10127123	S7
325	10127124	S21
325	10127124	S8
325	10127124	S9
326	10127141	S20
216	10127143	S10
216	10127143	S9
327	10127144	S20
441	10127148	S13
379	10127170	S12
379	10127170	S23
157	10127177	S5
184	10127322	S6
546	15165431	S3
764	15165895	S3
764	15165895	S4
763	15165898	S3
763	15165898	S4
230	16402506	S13
230	16402506	S6
085	17901501	S10
445	18440201	S11
061	18748600	S13
330	24534729	S18
350	24547590	S14
744	24565002	S3
745	24565004	S3
307	44675380	S14
107	50242201	S17
107	50242201	S18
123	51785403	S17
123	51785403	S18
058	51870302	S8
315	51870400	S9
442	51885504	S10
442	51885504	S12
407	51885515	S12
292	53777900	S13
292	53777900	S6
331	53777900	S9
261	53777902	S14
261	53777902	S19
261	53777902	S19
261	53777902	S21
261	53777902	S6
262	53777903	S15
332	53777905	S10
332	53777905	S9
088	70100300	S17
135	70112900	S18
142	70113000	S18
090	70116400	S18
143	70116500	S18
146	70117900	S18
239	72959302	S14
438	74277400	S6
095	75010102	S21
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095	75010102	S21
096	75010103	S21
096	75010103	S21
097	75010105	S21
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097	75010105	S21
318	75062400	S13
318	75062400	S9
317	75062803	S9
372	75062805	S13
451	75276101	S15
452	75276204	S15
530	75738414	S3
530	75738414	S4
288	75772500	S10
303	75774471	S13
541	75778718	S3
540	75778719	S3
542	75778725	S3
308	75790000	S5
482	75803804	S6
071	75806501	S8
263	75806504	S14
263	75806504	S6
101	75832500	S17
101	75832500	S18
102	75832900	S17
102	75832900	S18
364	75880044	S11
364	75880044	S12
364	75880044	S13
383	75880046	S13
404	75880135	S12
404	75880135	S15
446	75880140	S15
074	75880242	S5
472	75880481	S8
278	75880482	S8
555	75880851	S3
556	75880852	S3
557	75880853	S3
558	75880854	S3
559	75880856	S3
560	75880857	S3
028	75881128	S6
029	75881129	S6
183	75881250	S13
344	75881250	S16
301	75881265	S9
284	75881350	S10
414	75881385	S11
398	75881536	S16
374	75881537	S13
046	75881731	S8
047	75881770	S8
229	75881792	S7
045	75881840	S8
082	75881845	S19
082	75881845	S19
265	75881906	S19
266	75881907	S19
457	75881921	S15
416	75882106	S6
354	75882357	S6
473	75882455	S8
070	75882550	S21
057	75882675	S12
052	75882691	S8
048	75882694	S8
569	75882826	S3
226	75882833	S7
225	75882834	S7
314	75882870	S10
281	75882875	S9
464	75883007	S9
460	75883025	S6
571	75883026	S13
572	75883027	S3
098	75883031	S21
098	75883031	S21
098	75883031	S21
051	75883056	S8
709	75883073	S13
709	75883073	S3
221	75883115	S7
420	75883211	S12
049	75883310	S8
319	75883453	S9
150	75883455	S13
053	75883466	S8
245	75883475	S9
386	75883481	S13
050	75883642	S8
598	75883801	S3
599	75883803	S3
589	75883808	S3
601	75883811	S3
600	75883813	S3
588	75883814	S3
587	75883815	S3
586	75883817	S3
585	75883821	S3
584	75883822	S3
583	75883825	S3
582	75883827	S3
580	75883828	S3
579	75883830	S3
578	75883832	S3
575	75883833	S3
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882	75883866	S3
590	75883887	S3
593	75883893	S3
576	75883935	S3
878	75883960	S3
595	75883992	S3
073	75884877	S21
343	75885931	S16
447	75885981	S15
395	75886033	S16
392	75886037	S12
450	75886191	S15
365	75886281	S11
390	75886286	S12
405	75886513	S12
449	75886540	S15
290	75886725	S9
498	75887251	S6
227	75887443	S7
224	75887448	S7
223	75887453	S7
336	75887510	S16
468	75887512	S16
417	75887513	S16
342	75887520	S16
375	75887539	S13
397	75887557	S16
293	75887561	S9
368	75887776	S16
368	75887776	S16
368	75887776	S16
381	75887791	S13
181	75887830	S12
510	75887884	S17
510	75887884	S3
510	75887884	S4
377	75887975	S13
289	75888159	S10
396	75888191	S16
453	75888690	S15
401	75888746	S11
402	75888747	S11
305	75888775	S10
306	75888776	S10
295	75889165	S16
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222	75889492	S8
294	75889881	S16
294	75889881	S9
550	75889886	S16
550	75889886	S3
550	75889886	S4
551	75889888	S16
551	75889888	S3
551	75889888	S4
552	75889889	S16
552	75889889	S3
552	75889889	S4
169	75890937	S20
758	75890937	S3

CROSS REFERENCE

ITEM	IDENT. NO.	SHEET
170	75890938	S20
171	75890947	S20
172	75890948	S20
173	75890949	S20
174	75890950	S20
302	75891005	S9
408	75891011	S12
376	75891524	S13
410	75891573	S12
394	75891681	S12
394	75891681	S16
218	75892221	S6
741	75892524	S3
078	75892737	S8
217	75892811	S6
544	75892987	S3
543	75892988	S3
570	75893020	S3
568	75893021	S3
631	75893030	S19
631	75893030	S3
632	75893031	S19
632	75893031	S3
634	75893032	S19
634	75893032	S3
635	75893033	S19
635	75893033	S3
636	75893034	S19
636	75893034	S3
633	75893035	S19
633	75893035	S3
496	75893211	S8
475	75893245	S7
209	75893275	S7
409	75893326	S10
203	75893355	S5
027	75893356	S5
072	75893357	S5
161	75893358	S5
299	75893358	S16
391	75893682	S11
309	75893762	S21
382	75893920	S13
411	75893943	S11
412	75893953	S11
234	75893958	S7
406	75894102	S12
185	75894105	S21
186	75894106	S21
481	75894326	S22
481	75894326	S22
483	75894328	S22
485	75894330	S22
485	75894330	S22
486	75894331	S22
486	75894331	S22
487	75894332	S22
494	75894336	S22
491	75894338	S22
492	75894339	S22
489	75894341	S22
080	75894832	S8
079	75894833	S8
474	75894896	S8
621	75895040	S22
621	75895040	S3
620	75895042	S22
620	75895042	S3
622	75895044	S22
622	75895044	S3
623	75895045	S22
623	75895045	S3
624	75895046	S22
624	75895046	S3
638	75896140	S3
733	75896140	S3
637	75896141	S3
732	75896141	S3
666	75896802	S3
667	75896804	S3
664	75896805	S3
660	75896809	S3
668	75896810	S3
670	75896812	S3
674	75896816	S3
659	75896818	S3
658	75896820	S3
656	75896823	S3
653	75896826	S3
654	75896827	S3
652	75896829	S3
649	75896834	S3
672	75896836	S3
648	75896838	S3
647	75896843	S3
651	75896844	S3
645	75896846	S3
650	75896847	S3
655	75896849	S3
657	75896850	S3
642	75896853	S3
643	75896854	S3
644	75896857	S3
901	75896858	S3
903	75896862	S3
904	75896864	S3

ITEM	IDENT. NO.	SHEET
905	75896865	S3
906	75896866	S3
662	75896893	S3
751	75897340	S20
751	75897340	S3
752	75897701	S20
752	75897701	S3
611	75899076	S3
611	75899076	S4
612	75899077	S3
613	75899080	S3
616	75899082	S3
616	75899082	S4
617	75899083	S3
617	75899083	S4
614	75899085	S3
614	75899085	S4
615	75899086	S3
615	75899086	S4
618	75899087	S3
618	75899087	S4
610	75899171	S3
753	75899182	S20
753	75899182	S3
609	75899185	S3
606	75899186	S3
313	75899543	S12
316	75899547	S11
574	75899641	S3
581	75899648	S3
592	75899681	S3
384	75899703	S16
356	75899706	S16
458	75899707	S13
458	75899707	S16
561	76204655	S21
561	76204655	S3
562	76204656	S21
562	76204656	S3
563	76204657	S21
563	76204657	S3
512	76867300	S18
512	76867300	S3
512	76867300	S4
100	76867600	S17
089	76869502	S18
136	76873002	S18
104	76873100	S17
104	76873100	S18
138	76873401	S18
103	76876400	S17
286	76878900	S10
115	76879005	S17
115	76879005	S18
531	76879006	S3
531	76879006	S4
513	76879400	S18
513	76879400	S3
513	76879400	S4
514	76879500	S17
514	76879500	S3
514	76879500	S4
075	77604002	S20
148	77604332	S7
165	77604333	S10
182	77604334	S9
378	77610051	S13
235	77610146	S12
235	77610146	S8
312	77610156	S10
360	77610157	S13
434	77610221	S11
036	77610249	S10
478	77610461	S8
509	77610705	S18
509	77610705	S3
509	77610705	S4
511	77610707	S18
511	77610707	S3
511	77610707	S4
066	77611448	S16
164	77611463	S9
532	77612915	S3
532	77612915	S4
370	77613626	S16
370	77613626	S16
370	77613626	S16
220	77613705	S7
456	77617025	S15
212	77617049	S5
399	77619634	S23
444	77619636	S23
283	77619805	S6
545	77622695	S3
547	77622696	S3
646	77624540	S3
663	77624548	S3
661	77624581	S3
665	77632391	S3
363	77633800	S14
520	77638601	S16
520	77638601	S3
520	77638601	S4
521	77638602	S16
521	77638602	S3
521	77638602	S4
519	77638603	S16

ITEM	IDENT. NO.	SHEET
519	77638603	S3
519	77638603	S4
515	77638604	S16
515	77638604	S3
515	77638604	S4
516	77638605	S16
516	77638605	S3
516	77638605	S4
145	77638864	S23
077	77641785	S20
044	77641805	S8
069	77641810	S8
083	77641830	S19
267	77641837	S19
268	77641838	S19
032	77643188	S7
669	77644392	S3
210	77644619	S7
772	77644690	S3
772	77644690	S4
773	77644691	S3
773	77644691	S4
710	77646344	S21
710	77646344	S3
711	77646345	S21
711	77646345	S21
711	77646345	S3
711	77646345	S3
204	77646363	S23
671	77646493	S3
673	77646714	S3
300	77647101	S9
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484	77647105	S22
439	77647107	S22
439	77647107	S22
156	77647108	S6
480	77647109	S22
480	77647109	S22
076	77648130	S20
275	77648135	S19
418	77653103	S8
488	77658253	S22
488	77658253	S22
490	77658254	S22
490	77658254	S22
056	77658265	S12
367	77658460	S16
469	77658461	S16
466	77658465	S16
311	77659975	S7
121	77659981	S7
233	77659992	S14
748	77660545	S14
748	77660545	S3
748	77660545	S7
030	77662086	S5
759	77664125	S3
737	77664370	S3
736	77664371	S3
770	77665277	S3
358	77665285	S7
068	77665286	S10
021	77665750	S5
021	77665750	S6
021	77665750	S7
021	77665750	S8
201	77665760	S10
201	77665760	S6
201	77665760	S9
202	77665770	S11
202	77665770	S12
202	77665770	S13
202	77665770	S6
535	77666012	S3
269	77666375	S19
270	77666376	S19
276	77666815	S14
247	77666820	S8
415	77666850	S11
034	77667396	S6
034	77667396	S8
160	77668539	S23
366	77668544	S23
353	77668545	S23
214	77668612	S14
215	77668613	S14
166	77668614	S20
500	77669983	S3
500	77669983	S5
211	77670106	S11
211	77670106	S12
477	77670257	S8
282	77670412	S13
094	77672982	S7
094	77672982	S9
167	77681338	S9
413	77681500	S11
207	77681505	S6
206	77681510	S6
158	77681599	S13
304	77681647	S13
280	77681649	S12
279	77685535	S13
232	77685805	S10
086	77686131	S5
479	77686490	S10

ITEM	IDENT. NO.	SHEET
801	77700030	S3
801	77700030	S4
802	77700031	S3
802	77700031	S4
803	77700032	S3
803	77700032	S4
804	77700033	S3
804	77700033	S4
805	77700034	S3
805	77700034	S4
806	77700035	S3
806	77700035	S4
807	77700036	S3
807	77700036	S4
808	77700037	S3
808	77700037	S4
809	77700038	S3
809	77700038	S4
820	77700060	S21
820	77700060	S3
821	77700061	S21
821	77700061	S3
822	77700062	S21
822	77700062	S3
823	77700063	S21
823	77700063	S3
827	77700070	S23
827	77700070	S3
825	77700071	S23
825	77700071	S3
826	77700072	S23
826	77700072	S3
134	77713965	S6
137	77713975	S11
403	77713975	S11
162	77714333	S21
168	77730195	S20
730	77730238	S20
730	77730238	S3
902	77731336	S3
419	77732437	S11
769	77732536	S3
310	77732610	S23
062	77732750	S19
062	77732750	S19
063	77732751	S19
063	77732751	S19
471	77732764	S8
355	77732765	S7
355	77732765	S8
243	77734135	S7
385	77736731	S13
175	77736732	S19
043	77736733	S19
347	77736865	S14
499	77736891	S8
351	77737800	S9
298	77761951	S9
725	77773209	S20
725	77773209	S3
714	77773226	S20
714	77773226	S3
722	77773236	S20
722	77773236	S3
713	77773243	S20
713	77773243	S3
724	77773245	S20
724	77773245	S3
723	77773246	S20
723	77773246	S3
715	77773250	S20
715	77773250	S3
716	77773253	S20
716	77773253	S3
727	77773260	S20
727	77773260	S3
726	77773262	S20
726	77773262	S3
717	77773266	S20
717	77773266	S3
721	77773291	S20
721	77773291	S3
720	77773293	S20
720	77773293	S3
683	77773301	S3
683	77773301	S6
683	77773301	S8
684	77773303	S3
684	77773303	S6
684	77773303	S8
682	77773306	S3
682	77773306	S6
682	77773306	S8
687	77773307	S3
687	77773307	S6
687	77773307	S8
686	77773311	S3
686	77773311	S6
686	77773311	S8
685	77773313	S3
685	77773313	S6
685	77773313	S8
688	77773314	S3
688	77773314	S6
688	77773314	S8
689	77773315	S3
689	77773315	S6
689	77773315	S8
691	77773317	S3

CROSS REFERENCE

ITEM	IDENT. NO.	SHEET
691	77773317	S6
691	77773317	S8
855	77773319	S3
855	77773319	S6
855	77773319	S8
·92	77773321	S3
692	77773321	S6
692	77773321	S8
693	77773322	S3
693	77773322	S6
693	77773322	S8
694	77773325	S3
694	77773325	S6
694	77773325	S8
696	77773326	S3
697	77773328	S3
697	77773328	S6
697	77773328	S8
698	77773330	S3
698	77773330	S6
698	77773330	S8
699	77773332	S3
699	77773332	S6
699	77773332	S8
701	77773333	S3
701	77773333	S6
701	77773333	S8
700	77773336	S3
700	77773336	S6
700	77773336	S8
702	77773337	S3
702	77773337	S6
702	77773337	S8
680	77773339	S3
680	77773339	S6
680	77773339	S8
704	77773341	S3
704	77773341	S6
704	77773341	S8
703	77773342	S3
703	77773342	S6
703	77773342	S8
681	77773344	S3
681	77773344	S6
681	77773344	S8
705	77773345	S3
705	77773345	S6
705	77773345	S8
678	77773347	S3
678	77773347	S6
678	77773347	S8
694	77773348	S6
694	77773348	S8
695	77773348	S3
690	77773349	S3
690	77773349	S6
690	77773349	S8
706	77773350	S3
706	77773350	S6
706	77773350	S8
707	77773351	S3
707	77773351	S6
707	77773351	S8
708	77773353	S3
708	77773353	S6
708	77773353	S8
850	77773355	S3
850	77773355	S6
850	77773355	S8
851	77773357	S3
851	77773357	S6
851	77773357	S8
852	77773359	S3
852	77773359	S6
852	77773359	S8
853	77773360	S3
853	77773360	S6
853	77773360	S8
854	77773361	S3
854	77773361	S6
854	77773361	S8
856	77773363	S3
856	77773363	S6
856	77773363	S8
857	77773365	S3
857	77773365	S6
857	77773365	S8
676	77773381	S3
676	77773381	S6
676	77773381	S8
675	77773387	S3
675	77773387	S6
675	77773387	S8
679	77773392	S3
679	77773392	S6
679	77773392	S8
677	77773393	S3
677	77773393	S6
677	77773393	S8
264	77830530	S7
400	77830611	S16
400	77830611	S8
454	77830612	S15
389	77832429	S11
389	77832429	S19
345	77883454	S13
465	80625400	S16
465	80625400	S16
159	83410501	S19
159	83410501	S19
277	83410518	S5
277	83410518	S9
337	83435302	S16
421	90603300	S5
461	92006029	S23
369	92009012	S12
428	92033004	S6
428	92033004	S7
242	92033033	S8
219	92033037	S6
219	92033037	S7
525	92314113	S13
525	92314113	S3
525	92314113	S4
526	92314127	S3
526	92314127	S4
113	92376014	S17
141	92376014	S18
476	92602003	S11
476	92602003	S13
422	92602004	S6
422	92602004	S7
388	92720396	S11
149	92732314	S7
031	92742011	S8
237	92745012	S8
432	92805257	S12
037	92805259	S13
271	92805266	S13
335	92815166	S11
059	92815193	S16
059	92815193	S16
059	92815193	S16
273	92815284	S13
250	92815290	S12
287	92826001	S10
387	93109084	S20
272	93326006	S19
272	93326006	S20
127	93419228	S17
127	93419228	S18
228	93564001	S6
228	93564001	S7
228	93564001	S8
334	93564004	S7
147	93564034	S18
140	93564044	S18
241	93592158	S6
151	93749084	S13
349	93749092	S14
297	93749096	S14
348	93749098	S14
357	93749100	S16
346	93749160	S17
093	93749196	S6
323	93749196	S10
323	93749196	S9
087	93749198	S13
153	93749198	S10
153	93749198	S9
462	93749198	S23
152	93749200	S10
152	93749200	S6
152	93749200	S9
163	93749202	S6
321	94047067	S9
771	94257605	S3
296	94275254	S9
338	94276600	S16
338	94276600	S16
340	94277400	S11
340	94277400	S16
340	94277400	S17
340	94277400	S18
154	94277401	S10
154	94277401	S9
341	94277409	S16
064	94279113	S20
155	94343210	S10
155	94343210	S9
033	94364401	S8
081	94364903	S19
081	94364903	S19
084	94364906	S19
236	94371000	S16
236	94371000	S6
236	94371000	S7
291	94376910	S19
054	94376917	S8
055	94376918	S8
630	94397002	S3
731	94398801	S3
131	94399501	S17
470	94933215	S23
041	95033900	S5
455	95044214	S15
455	95044214	S7
339	95105900	S16
339	95105900	S16
092	95125326	S7
126	95510024	S17
126	95510024	S18
111	95510026	S17
111	95510026	S18
111	95510026	S18
091	95510027	S7
205	95523400	S8
128	95533601	S17
128	95533601	S18
122	95582501	S17
122	95582501	S18
112	95583504	S17
112	95583504	S18
117	95587700	S17
117	95587700	S18
118	95635102	S17
118	95635102	S18
129	95635103	S17
144	95635104	S18
119	95635105	S17
119	95635105	S18
124	95641502	S17
124	95641502	S18
467	95643257	S23
380	95643601	S10
380	95643601	S17
380	95643601	S18
285	95645628	S10
132	95647607	S17
132	95647607	S18
116	95655530	S17
116	95655530	S18
249	95694202	S9

ITEM	IDENT. NO.	SHEET

SECTION
8
WIRE LISTS

SECTION 8
WIRE LISTS

8.1 INTRODUCTION.. 8-1

8.2 SYMBOLOGY DEFINITION................................ 8-1

8.3 WIRE LISTS.. 8-1

8.1 INTRODUCTION

This section contains the logic load list for the etched circuit board backpanel used on all units.

8.2 SYMBOLOGY DEFINITION

Definitions of the symbology used in the wire list are as follows:

a. NETNAM - Signal nomenclature used on circuit board schematics. Enclosed Netname () indicates signal nomenclature applies to OEM CMD only.

b. FLOC FPIN - Slot and pin location from which wire or etch run originates.

c. TLOC TPIN - Slot and pin location to which wire or etch run connects.

d. BK - In the case of wire-wrapped backpanels, the BK column indicates wrap level of wire on pin. E1 indicates single (or first) level wrap; E2 indicates second level wrap. In the case of the etched backpanel ET indicates etched wire runs; TP indicates twisted pair wires.

A "Slot-to-Figure" cross reference is provided below as a quick reference to aid in locating the desired circuit board diagram in Section V.

SLOT	FIGURE
EM1	5-4
EM2	5-5
EM3	5-6
EM4	5-16
EM6	5-7
EM7	5-8

8.3 WIRE LISTS

Section 8.3 gives the etched circuit board backpanel logic load list.

8.3.1 ETCHED BACK PANEL

LOGIC - SORTED LOADLIST*

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
806-KHZ/-L	EM6P2B	38	EM3P2A	38	ET
AGC-ACT/-L	EM6P2B	03	EM3P2A	03	ET
AM-ENABLE/+L	EM2P1A	18	EM7P1B	18	ET
AM-FOUND/+L	EM2P1A	38	EM7P2A	04	ET
AM-FOUND/+L	EM4P1B	38	EM2P1A	38	ET
BUS-OUT-2WT0/+L	EM1P2A	08	EM2P2B	08	ET
BUS-OUT-2WT1/+L	EM1P2A	09	EM2P2B	09	ET
BUS-OUT-2WT2/+L	EM1P2A	10	EM2P2B	10	ET
BUS-OUT-2WT3/+L	EM1P2A	11	EM2P2B	11	ET
BUS-OUT-2WT6/+L(FXD/+L)	EM1P2B	22	EM2P2B	22	ET
BUS-OUT-2WT7/+L	EM1P2A	07	EM2P2B	07	ET
CLR-ATN/-L	EM1P1A	30	EM2P1B	30	ET
CLR-CHK-DIAG/-L	EM1P2A	25	EM2P2B	25	ET
CLR-FLT-STAT/-L	EM1P2A	24	EM2P2B	24	ET
CYL-ADDR-0/+L	EM1P2B	26	EM3P2B	26	ET
CYL-ADDR-1/+L	EM1P2B	27	EM3P2B	27	ET
CYL-ADDR-2/+L	EM1P2B	28	EM3P2B	28	ET
CYL-ADDR-3/+L	EM1P2B	29	EM3P2B	29	ET
CYL-ADDR-4/+L	EM1P2B	30	EM3P2B	30	ET
CYL-ADDR-5/+L	EM1P2B	31	EM3P2B	31	ET
CYL-ADDR-6/+L	EM1P2B	32	EM3P2B	32	ET
CYL-ADDR-7/+L	EM1P2B	33	EM3P2B	33	ET
CYL-ADDR-8/+L	EM1P2B	34	EM3P2B	34	ET

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NETNAM	FLOC	FPIN	TLOC	TPIN	BK
CYL-ADDR-9/+L	EM1P2B	35	EM3P2B	35	ET
DB-0/+L	EM3P2A	24	EM4P2B	24	ET
DB-1/+L	EM3P2A	25	EM4P2B	25	ET
DB-2/+L	EM3P2A	26	EM4P2B	26	ET
DB-3/+L	EM3P2A	27	EM4P2B	27	ET
DB-4/+L	EM3P2A	28	EM4P2B	28	ET
DB-5/+L	EM3P2A	29	EM4P2B	29	ET
DB-6/+L	EM3P2A	31	EM4P2B	31	ET
DB-7/+L	EM3P2A	32	EM4P2B	32	ET
DIAG-AC-WRTCUR/	EM4P1A	10	EM2P1A	10	ET
DIAG-ACT-I-MON	EM3P1A	11	EM4P1B	11	ET
DIAG-AM-EN/+L	EM4P1B	17	EM2P1A	17	ET
DIAG-DR-MON	EM3P1A	12	EM4P1B	12	ET
DIAG-ENABLE/-L	EM4P1B	15	EM2P1A	15	ET
DIAG-ERLY-STROBE/+L	EM4P1B	09	EM2P1A	09	ET
DIAG-F.G.-MON	EM3P1A	10	EM4P1B	10	ET
DIAG-HD-0/+L	EM4P1B	03	EM2P1A	03	ET
DIAG-HD-1/+L	EM4P1B	04	EM2P1A	04	ET
DIAG-HD-2/+L	EM4P1B	05	EM2P1A	05	ET
DIAG-HD-4/+L	EM4P1B	07	EM2P1A	07	ET
DIAG-LATE-STROBE/+L	EM4P1B	08	EM2P1A	08	ET
DIAG-RD-AGC	EM7P1B	16	EM4P1A	16	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
DIAG-RD-GATE/+L	EM4P1A	11	EM2P1A	11	ET
DIAG-RD-PLO-LOCK/+L	EM7P2B	25	EM4P2A	25	ET
DIAG-WRT-GATE/+L	EM4P1A	12	EM2P1A	12	ET
EN-FXD-SVO/-L	EM6P2B	04	EM4P2A	04	ET
EN-WRT-CUR-0/+L	EM3P1B	28	EM2P1A	24	ET
EN-WRT-CUR-1/+L	EM3P1B	29	EM2P1A	25	ET
EN-WRT-CUR-2/+L	EM3P1B	30	EM2P1A	26	ET
ERLY-STROBE/-L	EM2P1B	41	EM7P2B	03	ET
EXT-INT-1/-L	EM4P2B	35	EM3P2A	35	ET
FLT-0/+L	EM3P2B	16	EM2P2A	16	ET
FLT-1/+L	EM3P2B	17	EM2P2A	17	ET
FLT-2/+L	EM3P2B	18	EM2P2A	18	ET
FLT-3/+L	EM3P2B	19	EM2P2A	19	ET
FLT-4/+L	EM3P2B	20	EM2P2A	20	ET
FLT-RESET/+L	EM2P2A	40	EM3P2B	40	ET
FXD-ADDR/-L	EM3P1A	41	EM3P1B	41	ET
FXD-ADDR/-L	EM2P1A	41	EM6P1B	41	ET
GND	EM-P1-	GND	EM1P1B	23	ET
GND	EM1P1B	23	EM1P1A	23	ET
GND	EM1P1A	23	EM2P1B	23	ET
GND	EM2P1B	23	EM2P1A	23	ET
GND	EM2P1A	23	EM3P1B	23	ET
GND	EM3P1B	23	EM3P1A	23	ET
GND	EM3P1A	23	EM4P1B	23	ET
GND	EM4P1B	23	EM4P1A	23	ET
GND	EM4P1A	23	EM6P1B	23	ET
GND	EM6P1B	23	EM6P1A	23	ET
GND	EM6P1A	23	EM7P1B	23	ET
GND	EM7P1B	23	EM7P1A	23	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
GND	EM7P1A	23	EM7P1A	10	ET
GND	EM7P1A	10	EM7P1A	06	ET
GND	EM7P1A	06	EM7P1B	06	ET
GND	EM7P1B	06	EM6P1A	06	ET
GND	EM6P1A	06	EM6P1B	06	ET
GND	EM6P1B	06	EM4P1A	06	ET
GND	EM4P1A	06	EM4P1B	06	ET
GND	EM4P1B	06	EM3P1A	06	ET
GND	EM3P1A	06	EM3P1B	06	ET
GND	EM3P1B	06	EM2P1A	06	ET
GND	EM2P1A	06	EM2P1B	06	ET
GND	EM2P1B	06	EM1P1A	06	ET
GND	EM1P1A	06	EM1P1B	06	ET
GND	EM1P1B	06	EM2P1B	04	ET
GND	EM2P1B	06	EM3P1B	11	ET
GND	EM1P1A	06	EM2P1B	18	ET
GND	EM3P1B	06	EM7P1A	39	ET
GND	EM7P1A	39	EM7P1B	39	ET
GND	EM7P1B	39	EM6P1A	39	ET
GND	EM6P1A	39	EM6P1B	39	ET
GND	EM6P1B	39	EM4P1A	39	ET
GND	EM4P1A	39	EM4P1B	39	ET
GND	EM4P1B	39	EM3P1A	39	ET
GND	EM3P1A	39	EM3P1B	39	ET
GND	EM3P1B	39	EM2P1A	39	ET
GND	EM2P1A	39	EM2P1B	39	ET
GND	EM2P1B	39	EM1P1A	39	ET
GND	EM1P1A	39	EM1P1B	39	ET
GND	EM1P1B	39	EM1P2B	06	ET
GND	EM1P2B	06	EM1P2A	06	ET
GND	EM1P2A	06	EM2P2B	06	ET
GND	EM2P2B	06	EM2P2A	06	ET
GND	EM2P2A	06	EM3P2B	06	ET
GND	EM3P2B	06	EM3P2A	06	ET
GND	EM3P2A	06	EM4P2B	06	ET
GND	EM4P2B	06	EM4P2A	06	ET
GND	EM4P2A	06	EM6P2B	06	ET
GND	EM6P2B	06	EM6P2A	06	ET
GND	EM6P2A	06	EM7P2B	06	ET
GND	EM7P2B	06	EM7P2A	06	ET
GND	EM7P2A	06	EM1P2B	23	ET
GND	EM1P2B	23	EM1P2A	23	ET
GND	EM1P2A	23	EM2P2B	23	ET
GND	EM2P2B	23	EM2P2A	23	ET
GND	EM2P2A	23	EM3P2B	23	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
GND	EM3P2B	23	EM3P2A	23	ET
GND	EM3P2A	23	EM4P2B	23	ET
GND	EM4P2B	23	EM4P2A	23	ET
GND	EM4P2A	23	EM6P2B	23	ET
GND	EM6P2B	23	EM6P2A	23	ET
GND	EM6P2A	23	EM7P2B	23	ET
GND	EM7P2B	23	EM7P2A	23	ET
GND	EM7P2A	23	EM7P2A	39	ET
GND	EM7P2A	39	EM7P2B	39	ET
GND	EM7P2B	39	EM6P2A	39	ET
GND	EM6P2A	39	EM6P2B	39	ET
GND	EM6P2B	39	EM4P2A	39	ET
GND	EM4P2A	39	EM4P2B	39	ET
GND	EM4P2B	39	EM3P2A	39	ET
GND	EM3P2A	39	EM3P2B	39	ET
GND	EM3P2B	39	EM2P2A	39	ET
GND	EM2P2A	39	EM2P2B	39	ET
GND	EM2P2B	39	EM1P2A	39	ET
GND	EM1P2A	39	EM1P2B	39	ET
HD-ADDR/-L	EM1P2A	17	EM2P2B	17	ET
HD-ALIGN-WP/-L	EM4P1B	22	EM2P1A	21	ET
INDEX/-L	EM4P1A	40	EM4P1B	40	ET
INDEX/-L	EM4P1B	40	EM1P1A	40	ET
INDEX/-L	EM6P1B	40	EM4P1A	40	ET
INHIBIT-SECTOR/+L	EM6P1B	38	EM1P1A	38	ET
INTERRUPT/-L	EM1P2A	19	EM2P2B	19	ET
I-SPE	EM4P1A	13	EM4P1B	13	ET
I-SPE	EM4P1B	13	EM3P1A	13	ET
I-SPE	EM6P1B	13	EM4P1A	13	ET
I/O-AM-ENABLE/+L	EM1P2A	30	EM2P2B	30	ET
I/O-ERLY-STROBE/-L	EM1P1A	37	EM2P1B	37	ET
I/O-LATE-STROBE/-L	EM1P1A	36	EM2P1B	36	ET
I/O-RD/-L	EM3P2A	05	EM4P2B	05	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
I/O-READ-GATE/+L	EM1P1A	43	EM2P1B	43	ET
I/O-WRT-GATE/-L	EM1P1A	42	EM2P1B	42	ET
I/O-WRT/-L	EM3P2A	04	EM4P2B	04	ET
LATE-STROBE/-L	EM2P1A	42	EM7P2A	07	ET
LATE-STROBE/-L	EM4P1A	43	EM4P1B	43	ET
LATE-STROBE/-L	EM2P1A	42	EM4P1A	43	ET
LED-FAULT/-L(SEC-BUF/-L)	EM1P1A	14	EM2P1A	14	ET
LED-FLT/-L	EM2P1B	13	EM3P1B	40	ET
LED-FLT/-L	EM2P1B	13	EM3P1A	33	ET
LED-FLT/-L	EM4P1B	33	EM3P1A	33	ET
LOGIC-GND	EM4P2B	36	EM3P2A	36	ET
MADR-0/+L	EM3P2A	07	EM4P2B	07	ET
MADR-1/+L	EM3P2A	08	EM4P2B	08	ET
MADR-2/+L	EM3P2A	09	EM4P2B	09	ET
MADR-3/+L	EM3P2A	10	EM4P2B	10	ET
MADR-4/+L	EM3P2A	11	EM4P2B	11	ET
MADR-5/+L	EM3P2A	12	EM4P2B	12	ET
MADR-6/+L	EM3P2A	13	EM4P2B	13	ET
MADR-7/+L	EM3P2A	14	EM4P2B	14	ET
MADR-8/+L	EM3P2A	15	EM4P2B	15	ET
MADR-9/+L	EM3P2A	16	EM4P2B	16	ET
MADR-A/-L	EM3P2A	17	EM4P2B	17	ET
MADR-B/-L	EM3P2A	18	EM4P2B	18	ET
MADR-C/-L	EM3P2A	19	EM4P2B	19	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
MADR-D/+L	EM3P2A	20	EM4P2B	20	ET
MADR-E/+L	EM3P2A	21	EM4P2B	21	ET
MADR-F/+L	EM3P2B	22	EM4P2B	22	ET
MAINT-FLT-INT/-L	EM2P2A	37	EM3P2B	37	ET
MC+VLT-FLT/-L	EM2P2A	10	EM3P2B	10	ET
MC+VLT-FLT/-L	EM3P2B	10	EM4P2A	07	ET
MEM-RD/-L	EM3P2A	34	EM4P2B	34	ET
MEM-WRT/-L	EM3P2A	33	EM4P2B	33	ET
MOD-ADDR/-L	EM2P2B	20	EM1P2A	20	ET
M-P-FLT/+L	EM3P2B	38	EM2P2A	38	ET
MX-BIT-0/+L(FAULT/-L)	EM2P2B	26	EM1P2A	26	ET
MX-BIT-1/+L(SK-ERR/-L)	EM2P2B	27	EM1P2A	27	ET
MX-BIT-2/+L(AM-FND/-L)	EM2P2B	28	EM1P2A	28	ET
MX-BIT-3/+L(WRT-PROT/-L)	EM2P2B	29	EM1P2A	29	ET
MX-BIT-4/+L	EM2P2B	31	EM1P2A	31	ET
MX-BIT-5/+L	EM2P2B	32	EM1P2A	32	ET
MX-BIT-6/+L	EM2P2B	33	EM1P2A	33	ET
MX-BIT-7/+L	EM2P2B	34	EM1P2A	34	ET
NRZ-DATA-OUT/-L	EM2P2A	34	EM7P2B	08	ET
NRZ-WRT/-L	EM2P2A	32	EM7P2B	32	ET
OFFSET-ACT/+L	EM2P2B	15	EM1P2A	15	ET
OFFSET-/+L	EM1P2B	24	EM3P2B	24	ET
OFFSET+/+L	EM1P2B	25	EM3P2B	25	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
ON-CYL/-L	EM3P2B	13	EM2P2A	13	ET
ON-CYL/-L	EM2P2A	13	EM1P2B	13	ET
ON-TIME-EN/-L	EM2P1A	37	EM7P2A	16	ET
PLO-LOCKED/-L	EM6P2B	09	EM4P2A	09	ET
PRES-SW/+L	EM6P1A	31	EM3P1A	32	ET
PRES-SW/+L	EM4P1B	32	EM3P1A	32	ET
PRES-SW/+L	EM3P1A	31	EM1P1B	30	ET
PWR-UP-MR/-L	EM2P2B	18	EM1P2A	18	ET
PWR-UP-MR/-L	EM2P2B	18	EM7P2A	03	ET
RD-CLK/-L	EM2P2A	27	EM7P2B	09	ET
READ-GATE/+L	EM2P1B	38	EM7P2B	05	ET
READY-BLINK/-L	EM3P2B	14	EM2P2A	14	ET
READY-GATE/+L	EM2P1B	21	EM1P1A	21	ET
RESET-EXT-INT/-L	EM3P2B	15	EM2P2A	15	ET
RTZ-OR-SEEK/+L	EM3P1A	42	EM6P1B	42	ET
RTZ/-L	EM1P2B	12	EM2P2A	12	ET
RTZ/-L	EM2P2A	12	EM3P2B	12	ET
-20V	EM-P2-	-20	EM1P2B	01	ET
-20V	EM1P2B	01	EM1P2A	01	ET
-20V	EM1P2A	01	EM2P2B	01	ET
-20V	EM2P2B	01	EM2P2A	01	ET
-20V	EM2P2A	01	EM3P2B	01	ET
-20V	EM3P2B	01	EM3P2A	01	ET
-20V	EM3P2A	01	EM4P2B	01	ET
-20V	EM4P2B	01	EM4P2A	01	ET
-20V	EM4P2A	01	EM6P2B	01	ET
-20V	EM6P2B	01	EM6P2A	01	ET
-20V	EM6P2A	01	EM7P2B	01	ET
-20V	EM7P2B	01	EM7P2A	01	ET
-20V	EM7P2A	01	EM7P1A	01	ET
-20V	EM7P1A	01	EM7P1B	01	ET
-20V	EM7P1B	01	EM6P1A	01	ET
-20V	EM6P1A	01	EM6P1B	01	ET
-20V	EM6P1B	01	EM4P1A	01	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
-20V	EM4P1A	01	EM4P1B	01	ET
-20V	EM4P1B	01	EM3P1A	01	ET
-20V	EM3P1A	01	EM3P1B	01	ET
-20V	EM3P1B	01	EM2P1A	01	ET
-20V	EM2P1A	01	EM2P1B	01	ET
-20V	EM2P1B	01	EM1A1A	01	ET
-20V	EM1P1A	01	EM1P1B	01	ET
-32V	EM2P1A	22	EM3P1B	22	ET
-5V	EM-P1-	-5V	EM1P1B	02	ET
-5V	EM-P2-	-5V	EM1P2B	02	ET
-5V	EM1P1B	02	EM1P1A	02	ET
-5V	EM1P2B	02	EM1P2A	02	ET
-5V	EM1P1A	02	EM2P1B	02	ET
-5V	EM1P2A	02	EM2P2B	02	ET
-5V	EM2P1B	02	EM2P1A	02	ET
-5V	EM2P2B	02	EM2P2A	02	ET
-5V	EM2P1A	02	EM3P1B	02	ET
-5V	EM2P2A	02	EM3P2B	02	ET
-5V	EM3P1B	02	EM3P1A	02	ET
-5V	EM3P2B	02	EM3P2A	02	ET
-5V	EM3P1A	02	EM4P1B	02	ET
-5V	EM3P2A	02	EM4P2B	02	ET
-5V	EM4P1B	02	EM4P1A	02	ET
-5V	EM4P2B	02	EM4P2A	02	ET
-5V	EM4P1A	02	EM6P1B	02	ET
-5V	EM4P2A	02	EM6P2B	02	ET
-5V	EM6P1B	02	EM6P1A	02	ET
-5V	EM6P2B	02	EM6P2A	02	ET
-5V	EM6P1A	02	EM7P1B	02	ET
-5V	EM6P2A	02	EM7P2B	02	ET
-5V	EM7P1B	02	EM7P1A	02	ET
-5V	EM7P2B	02	EM7P2A	02	ET
-5V	EM7P1A	02	EM7P1A	07	ET
+20V	EM-P1-	+20	EM1P1B	45	ET
+20V	EM1P1B	45	EM1P1A	45	ET
+20V	EM1P1A	45	EM2P1B	45	ET
+20V	EM2P1B	45	EM2P1A	45	ET
+20V	EM2P1A	45	EM3P1B	45	ET
+20V	EM3P1B	45	EM3P1A	45	ET
+20V	EM3P1A	45	EM4P1B	45	ET
+20V	EM4P1B	45	EM4P1A	45	ET
+20V	EM4P1A	45	EM6P1B	45	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
+20V	EM6P1B	45	EM6P1A	45	ET
+20V	EM6P1A	45	EM7P1B	45	ET
+20V	EM7P1B	45	EM7P1A	45	ET
+20V	EM7P1A	45	EM7P1A	08	ET
+20V	EM7P1A	08	EM7P2A	45	ET
+20V	EM7P2A	45	EM7P2B	45	ET
+20V	EM7P2B	45	EM6P2A	45	ET
+20V	EM6P2A	45	EM6P2B	45	ET
+20V	EM6P2B	45	EM4P2A	45	ET
+20V	EM4P2A	45	EM4P2B	45	ET
+20V	EM4P2B	45	EM3P2A	45	ET
+20V	EM3P2A	45	EM3P2B	45	ET
+20V	EM3P2B	45	EM2P2A	45	ET
+20V	EM2P2A	45	EM2P2B	45	ET
+20V	EM2P2B	45	EM1P2A	45	ET
+20V	EM1P2A	45	EM1P2B	45	ET
+32V	EM2P1A	20	EM3P1B	19	ET
+5V	EM-P1-	+5V	EM1P1B	44	ET
+5V	EM-P2-	+5V	EM1P2B	44	ET
+5V	EM1P1B	44	EM1P1A	44	ET
+5V	EM1P2B	44	EM1P2A	44	ET
+5V	EM1P1A	44	EM2P1B	44	ET
+5V	EM1P2A	44	EM2P2B	44	ET
+5V	EM2P1B	44	EM2P1A	44	ET
+5V	EM2P2B	44	EM2P2A	44	ET
+5V	EM2P1A	44	EM3P1B	44	ET
+5V	EM2P2A	44	EM3P2B	44	ET
+5V	EM3P1B	44	EM3P1A	44	ET
+5V	EM3P2B	44	EM3P2A	44	ET
+5V	EM3P1A	44	EM4P1B	44	ET
+5V	EM3P2A	44	EM4P2B	44	ET
+5V	EM4P1B	44	EM4P1A	44	ET
+5V	EM4P2B	44	EM4P2A	44	ET
+5V	EM4P1A	44	EM6P1B	44	ET
+5V	EM4P2A	44	EM6P2B	44	ET
+5V	EM6P1B	44	EM6P1A	44	ET
+5V	EM6P2B	44	EM6P2A	44	ET
+5V	EM6P1A	44	EM7P1B	44	ET
+5V	EM6P2A	44	EM7P2B	44	ET
+5V	EM7P1B	44	EM7P1A	44	ET
+5V	EM7P2B	44	EM7P2A	44	ET
+5V	EM7P1A	44	EM7P1A	09	ET
+5V	EM7P1A	09	EM2P1B	03	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
+5V	EM2P1B	03	EM2P1B	19	ET
SECTOR-PULSE/-L	EM1P2B	43	EM3P2B	43	ET
SECTOR-SYNC/-L	EM6P2B	37	EM3P2A	37	ET
SEEK-ERROR/+L	EM3P2B	36	EM2P2A	36	ET
SEEK/-L	EM1P2B	21	EM2P2A	21	ET
SEEK/-L	EM2P2A	21	EM3P2B	21	ET
SELECT/-L	EM1P2A	16	EM2P2B	16	ET
SEQ-HOLD/+L	EM1P2A	04	EM3P2B	04	ET
SEQ-PICK/+L	EM1P2A	03	EM3P2B	03	ET
SHIELD-GND	EM2P2A	28	EM2P2A	33	ET
SHIELD-GND	EM2P2A	33	EM7P2B	07	ET
SHIELD-GND	EM7P2B	07	EM7P2B	10	ET
SHIELD-GND	EM7P2B	10	EM7P2B	28	ET
SHIELD-GND	EM7P2B	28	EM7P2B	30	ET
SHIELD-GND	EM7P2B	30	EM7P2B	31	ET
SK-ERROR/+L(IDX-BUF/-L)	EM1P1A	13	EM2P1A	13	ET
SPE	EM4P1A	14	EM4P1B	14	ET
SPE	EM4P1B	14	EM3P1A	14	ET
SPE	EM6P1B	14	EM4P1A	14	ET
START/-L	EM2P1B	10	EM3P2B	11	ET
START/-L	EM2P1B	10	EM1P1A	10	ET
SVO-CLAMP/-L	EM3P2A	30	EM6P2A	30	ET
SVO-CLK2-GND	EM6P2B	41	EM2P2A	41	ET
SVO-CLK2-GND	EM6P2B	43	EM2P2A	43	ET
SVO-CLK-N	EM6P2A	36	EM7P2B	36	ET
SVO-CLK-N-GND	EM6P2A	35	EM7P2B	35	ET
SVO-CLK-P	EM6P2A	37	EM7P2B	37	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
SVO-CLK-P-GND	EM6P2A	38	EM7P2B	38	ET
SVO-CLK/-L	EM6P2B	42	EM2P2A	42	ET
SVO-RLY/+L	EM3P1B	36	EM2P1A	36	ET
SVO-RLY/+L	EM3P1B	36	EM4P1B	35	ET
TAG-1/+L	EM1P2A	12	EM2P2B	12	ET
TAG-2/+L	EM1P2A	13	EM2P2B	13	ET
TAG-3/+L	EM1P2A	14	EM2P2B	14	ET
TGO/-L	EM1P2A	21	EM2P2B	21	ET
TGRG-2WT0/+L(SEL-0/+L)	EM1P2A	35	EM2P2B	35	ET
TGRG-2WT1/+L(SEL-1/+L)	EM1P2A	36	EM2P2B	36	ET
TGRG-2WT2/+L(SEL-2/+L)	EM1P2A	37	EM2P2B	37	ET
TGRG-2WT3/+L(SEL-3/+L)	EM1P2A	38	EM2P2B	38	ET
TGRG-2WT4/+L	EM1P2A	40	EM2P2B	40	ET
TGRG-2WT5/+L	EM1P2A	41	EM2P2B	41	ET
TGRG-2WT6/+L	EM1P2A	42	EM2P2B	42	ET
TGRG-2WT7/+L	EM1P2A	43	EM2P2B	43	ET
UNSTABLE-SECT/+L	EM2P1B	22	EM1P1B	22	ET
UNUSED-A	EM1P1A	16	EM2P1B	16	ET
UNUSED-B	EM1P1A	17	EM2P1B	17	ET
UP-TO-SPEED/+L	EM3P2B	05	EM1P2A	05	ET
VOL-CHANGE/-L	EM3P1A	43	EM3P1B	43	ET
VOL-CHANGE/-L	EM3P1B	43	EM2P1A	43	ET
VOL-CHANGE/-L	EM6P1B	43	EM3P1A	43	ET
VOL-CHANGE/-L	EM2P1A	43	EM1P1B	43	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
WRT-CLK/-L	EM2P2A	29	EM7P2B	29	ET
WRT-CLOCK-ENABLE/-L	EM7P2B	12	EM6P2A	12	ET
WRT-GATE/-L	EM2P1B	40	EM7P2B	04	ET
WRT-PLO-N	EM6P2A	41	EM7P2B	41	ET
WRT-PLO-N-GND	EM6P2A	40	EM7P2B	40	ET
WRT-PLO-P	EM6P2A	42	EM7P2B	42	ET
WRT-PLO-P-GND	EM6P2A	43	EM7P2B	43	ET
XFER-CHAR/+L	EM1P2B	09	EM2P2A	09	ET
XFER-ZERO/+L	EM1P2B	08	EM2P2A	08	ET

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