WANG

3105

# CONTROL DATA CORPORATION
# CARTRIDGE MODULE DRIVE
# 96 MB BLOCK POINT 4



**Customer Engineering Reprint**
**Product Maintenance Manual**

**741-1063**

# PREFACE

The purpose of this manual is to provide the Wang-trained Customer Engineer (CE) with instructions to operate, troubleshoot and repair the Control Data Corporation CMD 96 MB Block 4.

NOTE: Head Crash information located at the end of Section 6.

Fourth Edition (August 1984)

This reprint is the new converted number for and obsoletes 729-1063-A. Also included is additional information pertaining to head crashes preventive maintenance.  Updates and/or changes to this document will be published as Publications Update Bulletins (PUB's) or subsequent editions.

**CUSTOMER ENGINEERING**

# PUBLICATION UPDATE BULLETIN

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Previous Notice(s):

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REASON FOR CHANGE:

This PUB contains power supply and amplifier isolation procedures pertaining to head home switches for the Control Data Corporation 96 MB Block Point 4 CMD.

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INSTRUCTIONS:

Remove pages and insert attached pages as follows:

| | REMOVE | INSERT |
|---|---|---|
| 1. | Title Page/Page ii | Title Page/Page ii |
| 2. | Page vii/ Page viii | Page vii/ Page viii |

Insert pages 6-113 through 6-117 after page 6-112 of the Control Data Corporation Cartridge Module Drive 96 MB Manual Reorder Number 741-1063.

This page is to be used as a permanent record of revisions; place it directly following the title page.

WANG LABORATORIES, INC
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PRINTED IN U.S.A.

# HARDWARE PRODUCT CONFIGURATOR DOCUMENT PACKAGE AND MANUAL TO EQUIPMENT LEVEL CORRELATION

## SCOPE

The documentation provided in this package supplements the Model 9448 Hardware Maintenance Manual and makes it unique to the equipment described below. This documentation package, when referenced, should be identified by the Hardware Product Configurator (HPC) number, and the title 'HPC Document Package', i.e., 77717013 HPC Document Package.

## EQUIPMENT

| | |
|---|---|
| HPC NUMBER | 77717013 |

## PACKAGE CONTENTS

| | |
|---|---|
| DEVICE SPEC AND SWITCH SELECTION | 77716013 |
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| PWA CNTL/MUX PER SECTION 5 OF HMM | 77666950 |
| PWA OPERATOR CNTL PER SEC 5 OF HMM | 77680700 |
| PWA SERVO COURSE PER SEC 5 OF HMM | 77666801 |
| PWA RELAY CNTL PER SEC 5 OF HMM | 77680650 |
| PWA TERMINATOR PER SEC 5 OF HMM | 75886100 |
| HARDWARE MANUAL OEM Rev. E BP4 | 77683555 |
| NOTE: THE DATA PROVIDED ON THIS HPC SHEET | |
| : IS FOR INFOR. ONLY DO NOT | SUPPLY |
| : MANUAL OR HPC PACK FOR THIS HPC TAB. | |

77717013
BP04-00B

# PARTS DATA
## HARDWARE PRODUCT CONFIGURATOR

SCOPE

This document defines the unique mechanical requirements for the Model 9448 Cartridge Module Drive (CMD) Hardware Product Configurator (HPC) number 77717013.

When used with Section 7 of the Hardware Maintenance Manual, the table below physically describes the above HPC based on customer selected items. This table must be used with Figure 7-1 of Section 7 and it may be desirable to insert this page in front of the Section.

| ITEM | IDENT NO | DESCRIPTION | REMARKS |
|---|---|---|---|
| 500 | 77669983 | TOP LEVEL ASSEMBLY | FIG 7-1 |
| 540 | 75778719 | PWR CORD 60HZ | FIG 7-1 |
| 555 | 75880851 | PACK & HEADS - 96 MB | FIG 7-1 |
| 569 | 75882826 | BRACKET PWB | FIG 7-1 |
| 606 | 75899170 | COVER | FIG 7-1 |
| 624 | 75895046 | SOUND TREATMENT OPT | FIG 7-1 |
| 634 | 75893032 | FRONT PANEL INSTL KIT | FIG 7-1 |
| 637 | 75896141 | ENCODING BUTTON KIT (NOT SHOWN) | FIG 7-1 |
| 680 | 75883739 | DOOR | FIG 7-1 |
| 737 | 77664370 | SIGNAL HARNESS | FIG 7-1 |
| 745 | 24565004 | CABLE CLAMP | FIG 7-1 |
| 746 | 75893902 | E MODULE ASM | FIG 7-1 |
| 807 | 77700036 | POWER KIT 7 | FIG 7-1 |
| 821 | 77700061 | ESD BASE PAN KIT | FIG 7-1 |
| 825 | 77700071 | AIR OPTION KIT | FIG 7-1 |

# DEVICE SPECIFICATIONS AND SWITCH SELECTIONS

## 1.0 SCOPE

This document defines the unique mechanical/electrical requirements and switch adjustment selections for the CMD Disk Storage Drive Hardware Product Configurator (HPC) number 77717013 .

Immediately following the Device Specification Summary, Paragraph 2.0, are the switch selection adjustments for the following Printed Circuit Boards:

| BOARD TITLE (OEM) | SHEET |
|---|---|
| Control Multiplexer Board | 4 |
| Coarse Servo Board | 4 |
| I/O Board | 4 |

# 2.0 DEVICE SPECIFICATION SUMMARY

The following is a summary of customer selected items. This configuration has been prepared to meet the requirements of the HPC specified in paragraph 1.0.

Indicates Selection

1. Input Voltage and Frequency

   120 VOLTS 60 HZ

2. Sectoring

   Number of sectors req. 64

3. Controller Interface

   OEM [X]

   Other ____

4. Air Option

   LANA [ ]

   None [X]

5. Basepan

   STD Basepan [ ]

   ESD Basepan Kit [X]

   Unique ____

6. Color Option

   STD [ ]

   Unique

   Door 77623113

   Panel Insert ____

   None [X]

   Front Panel ____

   None [X]

   Filter Frame ____

   None [X]

7. Power Cord

   220/230/240 V 50 Hz [ ]

   120 V 60 Hz [X]

   Other ____

8. Capacity

   32 MB [ ]

   64 MB [ ]

   96 MB [X]

   32/96 MB [ ]

   64/96 MB [ ]

9. Sound Treatment

   Full [ ]

   Stripped [ ]

   Unique 75895046

10. Terminator

    56 Ohms [X]

    None [ ]

11. Logo STD [ ]

    Unique ____

12. Slides [ ]

13. Manual OEM [ ]

14. Special Options [ ]

15. Standard Options [X]

    75896141 - ID Plugs 1-3

PWA Options

16. I/O - OEM

   a. ON CYL true immediately following seek complete. ☐

   b. ON CYL true when seek is completed following a volume change and First Index Mark. ☒

   c. Seek to present address Automatic following a volume change. ☐

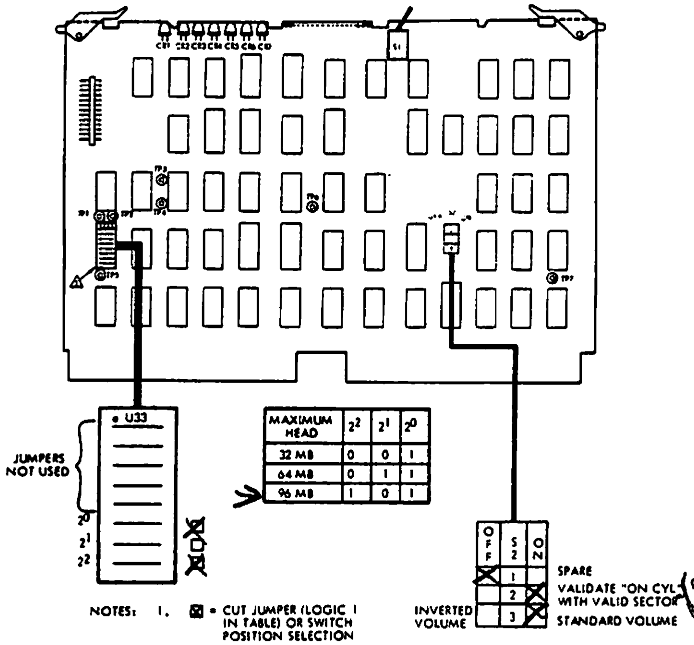
   d. b and c above ☐

   CONTROL/MUX - OEM

   a. SEEK END true for SEEK ERROR or when ON CYL ☐

   b. SEEK END true when seek is completed following a volume change and First Index Mark ☒

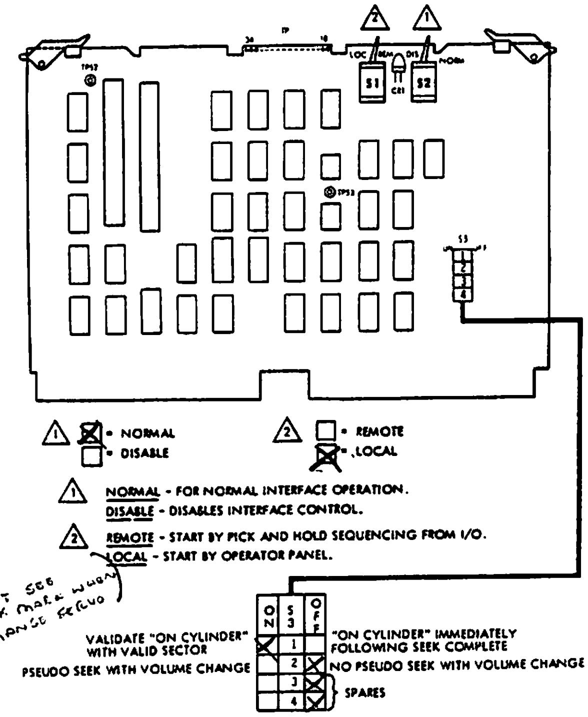
   c. INVERTED VOLUME ☐



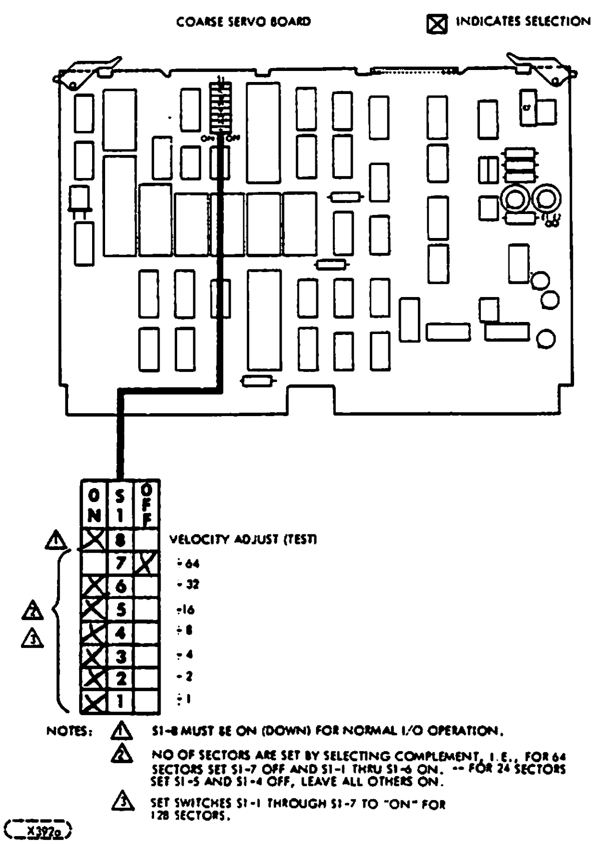

| MAXIMUM HEAD | $2^2$ | $2^1$ | $2^0$ |
|---|---|---|---|
| 32 MB | 0 | 0 | 1 |
| 64 MB | 0 | 1 | 1 |
| 96 MB | 1 | 0 | 1 |

(must see INPCK make when change servo)

OEM CONTROL
MULTIPLEXER BOARD




I/O PWA (OEM)




COARSE SERVO BOARD

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 subsidiary of
CONTROL DATA CORPORATION

HARDWARE MAINTENANCE MANUAL

## REVISION RECORD

| REV | DATE | SHEETS AFFECTED | MANUAL/SECTION REVISION STATUS 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | CHANGE AUTHORITY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | S. Wise 81 OCT 8 | ISSUE | A | A | A | A | A | A | A | A | | | | | Joe Dubue 10/8/81 |
| B | 81 Jack DEC 14 | ii | A | B | B | A | B | B | A | A | | | | | PL 33706 |
| C | 82 Jack JAN 14 | ii | A | B | B | A | C | C | A | A | | | | | PL 33788 |
| D | 82 Jack JAN 21 | ii | A | B | B | B | D | D | A | A | | | | | PL 33803 |
| E | 82 JAN MAR 10 | ii,v and vii | A | C | C | C | E | E | B | B | | | | | PL 33856 |



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:

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| 2 | Operation | 77683557-1 |
| 3 | Installation and Checkout | 77683558-9 |
| 4 | Theory of Operation | 77683559-7 |
| 5 | Diagrams* | 77683560-5 |
| 6 | Maintenance | 77683561-3 |
| 7 | Parts Manual | 77683724-7 |
| 8 | Wire Lists | 77683563-9 |

*In some instances the I/O board documentation 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 naehe des Geraetes montiert ist, einzustecken. Der Netzstecker muss leicht und gefahrlos zugaenglich sein.
2. Zur Inbetriebnahme, sowie zum Ausschalten des Geraetes, wird der Start-Stop Druck Schalter an der Vorderseite betaetigt.
3. Das Geraet darf nur von Fachpersonal nach dem Ziehen des Netzsteckers geoeffnet werden.
4. Im Falle eines technischen Defektes, ist der Netzstecker zu ziehen und der Technische Dienst zu verstaendigen.

## EMI NOTICE

NOTICE: This equipment has been designed as a 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. This equipment is a component supplied without its final enclosure and therefore is not subject to standards imposed by FCC Rules for Electro-Magnetic Interference (EMI). Federal Docket 20780/FCC 80-148 Part 15.

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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 daisy-chain 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 in 16 megabyte increments). See Figure 6-25; Figure 6-25 is guardband waveform.

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

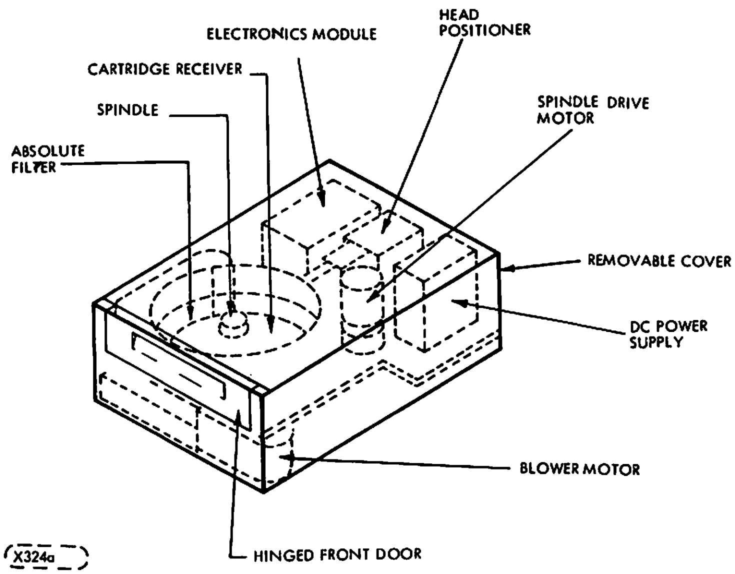
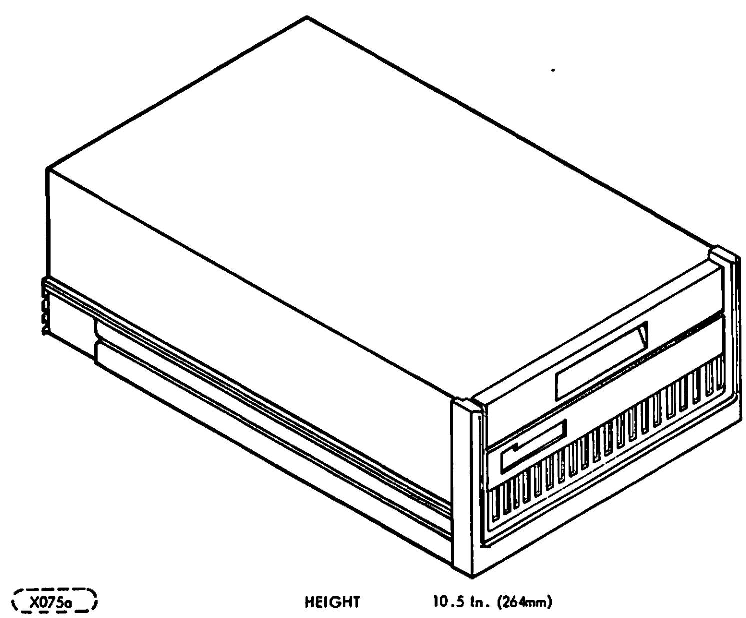



FIGURE 1-1. MAJOR COMPONENTS OF CARTRIDGE MODULE DRIVE




| | |
|---|---|
| HEIGHT | 10.5 In. (264mm) |
| WIDTH | 19.0 In. (483mm) Max. (Panel)<br>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 Logic 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* |
| *Includes 1 data surface on removable disk. | | | |
| UNITS PER CONTROLLER I/O CHAN | 8 (Daisy chain or Star) | | |

## 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 indications. 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 safe guard 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.

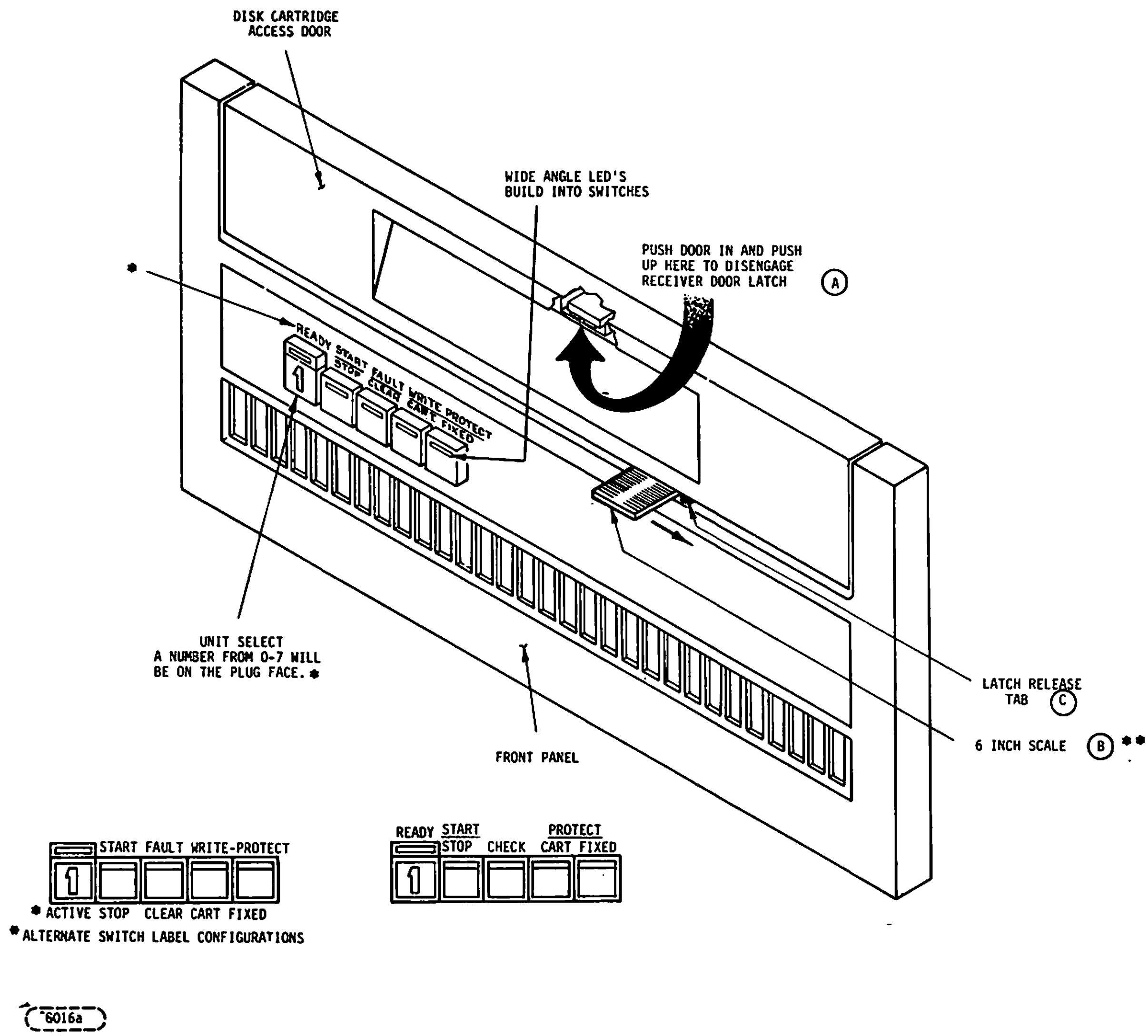



FIGURE 2-1. OPERATOR CONTROLS AND INDICATORS

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

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.

8. 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.

### 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.

*Proper state of PICK, HOLD and/or LOCAL/REMOTE is assumed.

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

| 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:<br>1. The AC Circuit breaker is ON.<br>2. Disk cartridge loading door closed and latched with cartridge in place.<br>3. FAULT light is OFF (indicating certain fault conditions do not exist-see Section 2-9).<br>4. a. Switch S-1 on I/O PWA in "LOCAL" Position (see Figure 3-17).<br>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 unit 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 the 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. |

**Does not indicate Seek Error.

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

| 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. |
| 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 generated 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 numbered plug is installed at installation time. |
| | DISK PACK ACCESS DOOR |
| DISK PACK ACCESS DOOR LATCH | The Disk Pack Access Door is unlatched as follows:<br>1. Press the door <u>in</u> to release the safety latch.<br>2. Lift <u>up</u> on the release lever (A) with the fingers (See Figure 2-1).<br>3. Pull <u>out</u> and <u>down</u> to open the door and unload the cartridge.<br>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. |

## 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.

### 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. Read-out of the causes for faults is described in Section 6.9.

## 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 2-2. 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, or refer to Section 6 of this manual.

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 it s 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.

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.

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

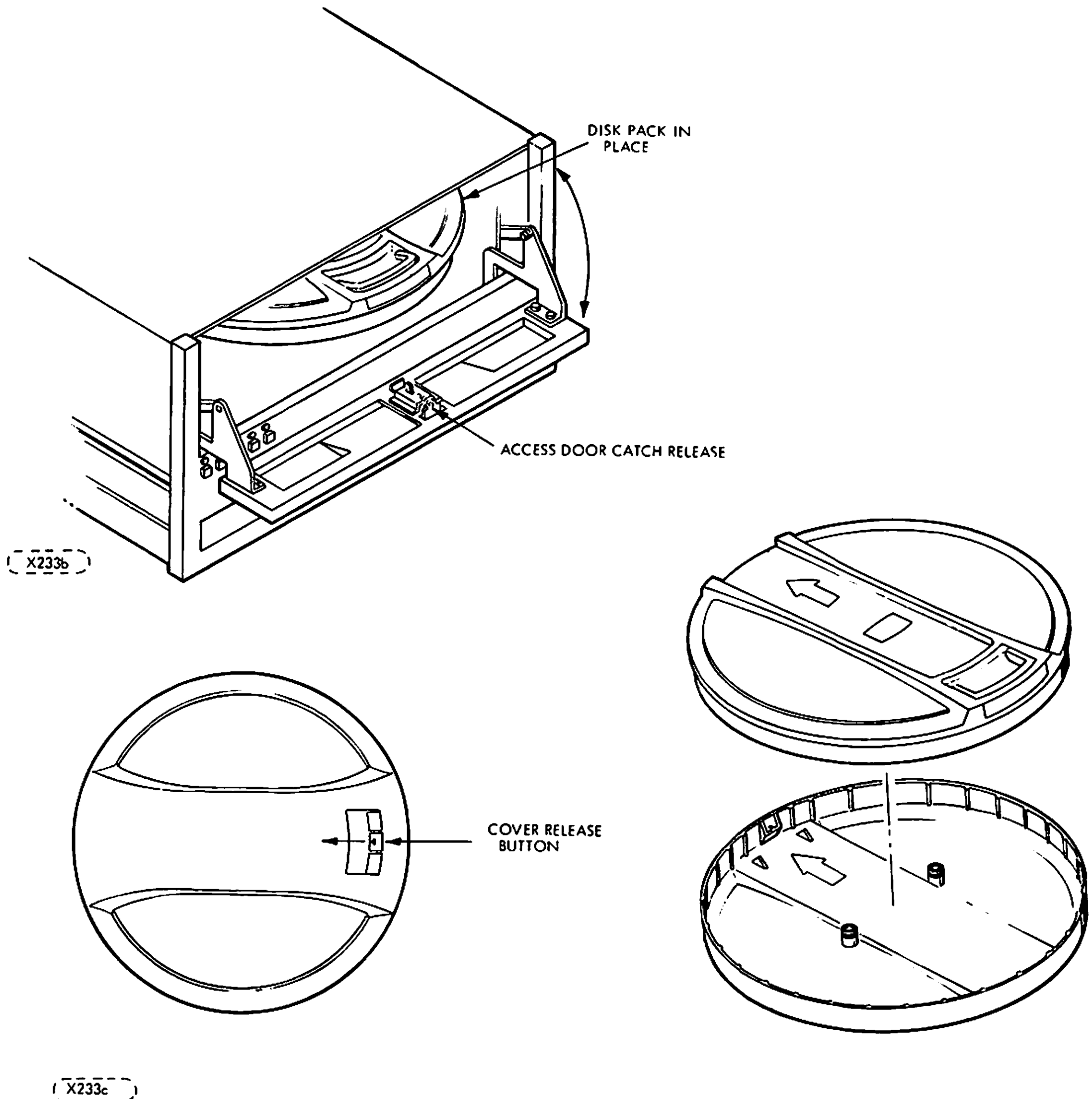



FIGURE 2-2. DISK CARTRIDGE INSTALLATION/REMOVAL

7. Store cartridge cover upside down in some convenient location.
8. 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.

### 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, procced 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 2-9, 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-Course PWA microprocessor (called the Microprocessor Fault Summary). Table 2-4 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 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.

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

TABLE 2-4. FAULT DISPLAY INDICATOR SUMMARY

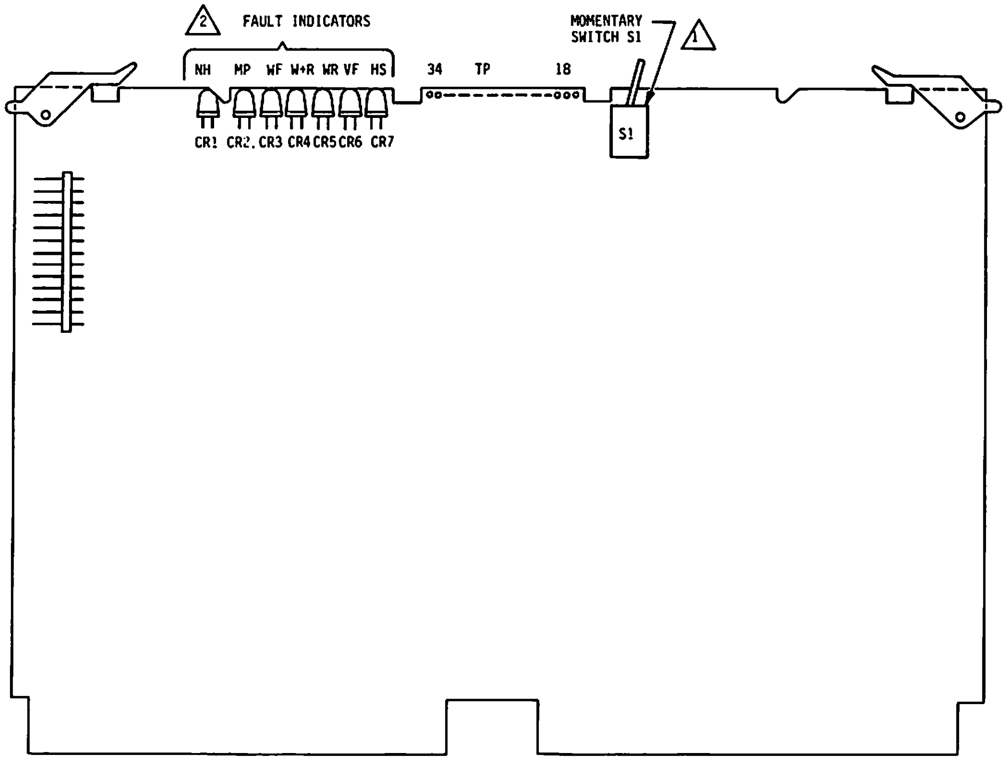
| IND | LOGIC DETECTED FAULT | MICROPROCESSOR DETECTED FAULT |
|---|---|---|
| CR1 | NO HEAD SELECT FAULT (NH) | CR1 not used |
| CR2 | OFF | ON |
| CR3 | WRITE FAULT | HIGHEST ORDER M.P. FLT CODE SUMMARY BIT ($2^4$).* |
| CR4 | WRITE OR READ WHILE OFF CYL. (W-R) | M.P. FAULT CODE BIT $2^3$. |
| CR5 | 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 displayed in serial order first and then all of the fault codes applicable in serial order. See Table 6-7** for more details. Below is a table of phases and faults which may be displayed on CR3 - CR7.

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

**Maintenance Section of the Hardware Maintenance Manual




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.

CAUTION

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.

## 3.1 INTRODUCTION

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

## 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.

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 driver. 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 agains. 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 (Figure 3-3, Sheet 2 of 2) are installed, (customer option) remove and stow them below the deck in the Base Pan together with all the hardware as shown. If the deck hold down bolts were 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.

## 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.

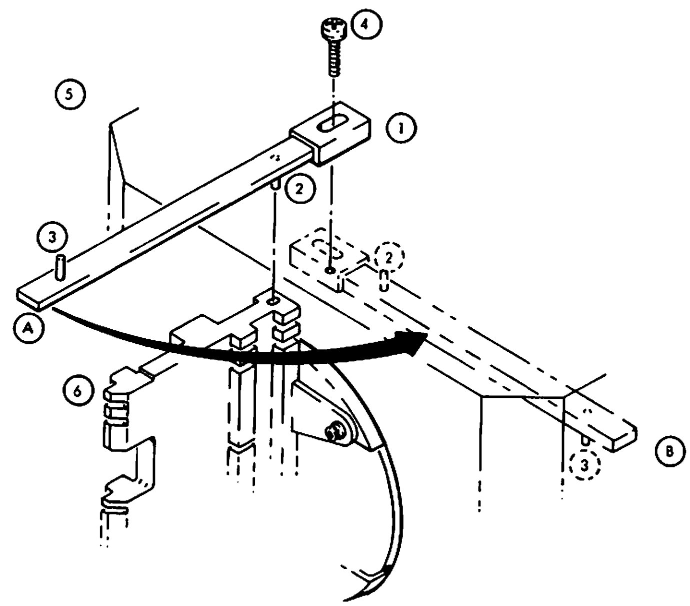
CAUTION

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.

### 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.

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




Ⓐ CARRIAGE LOCK PIN ① IN SHIPPING POSITION
Ⓑ CARRIAGE LOCK PIN ① IN OPERATING POSITION

FIGURE 3-1. CARRIAGE LOCKING TOOL - SHIPPING POSITION

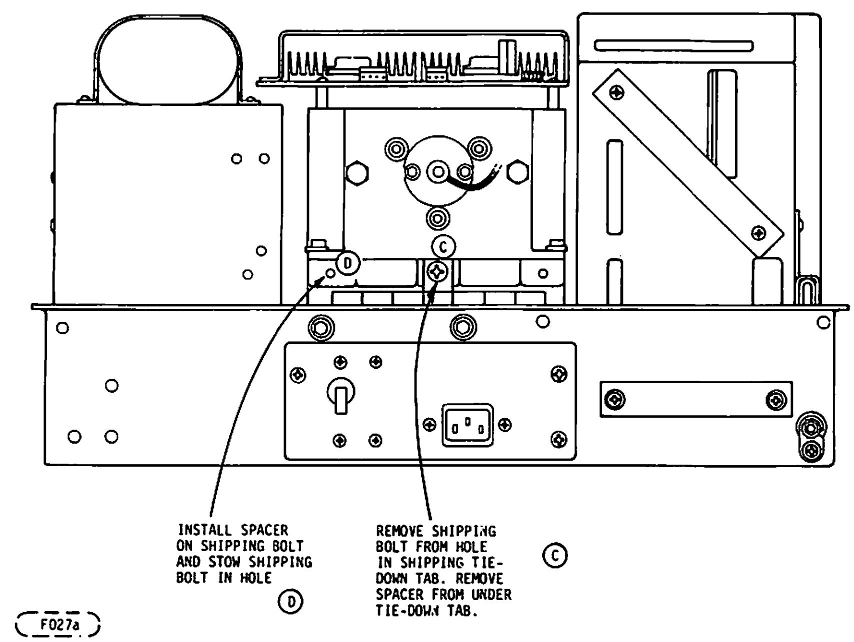



FIGURE 3-2. REAR SHIPPING BOLT LOCATION

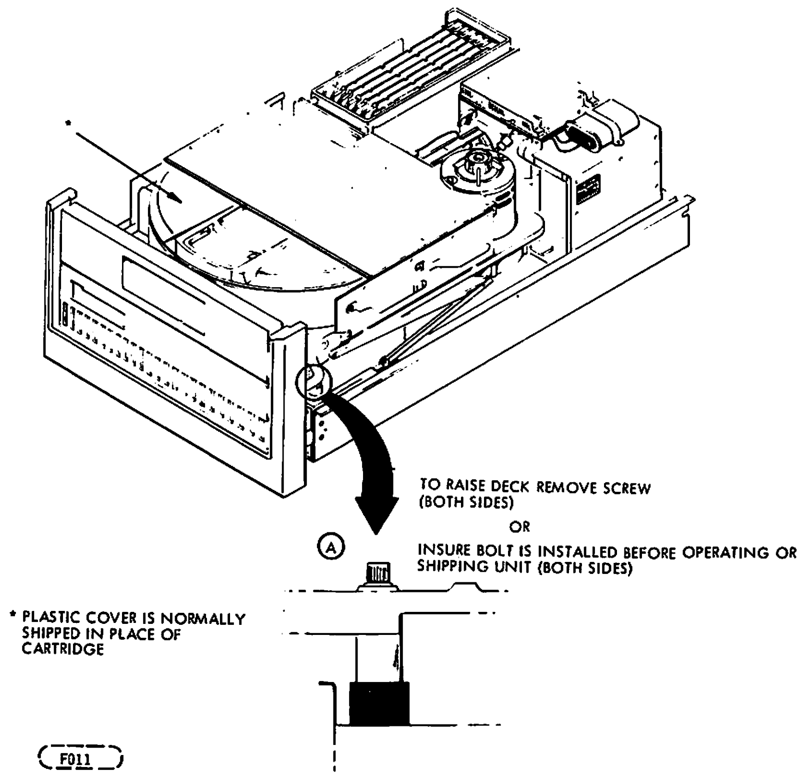



FIGURE 3-3. DECK HOLD DOWN BOLTS (SHEET 1 OF 2)

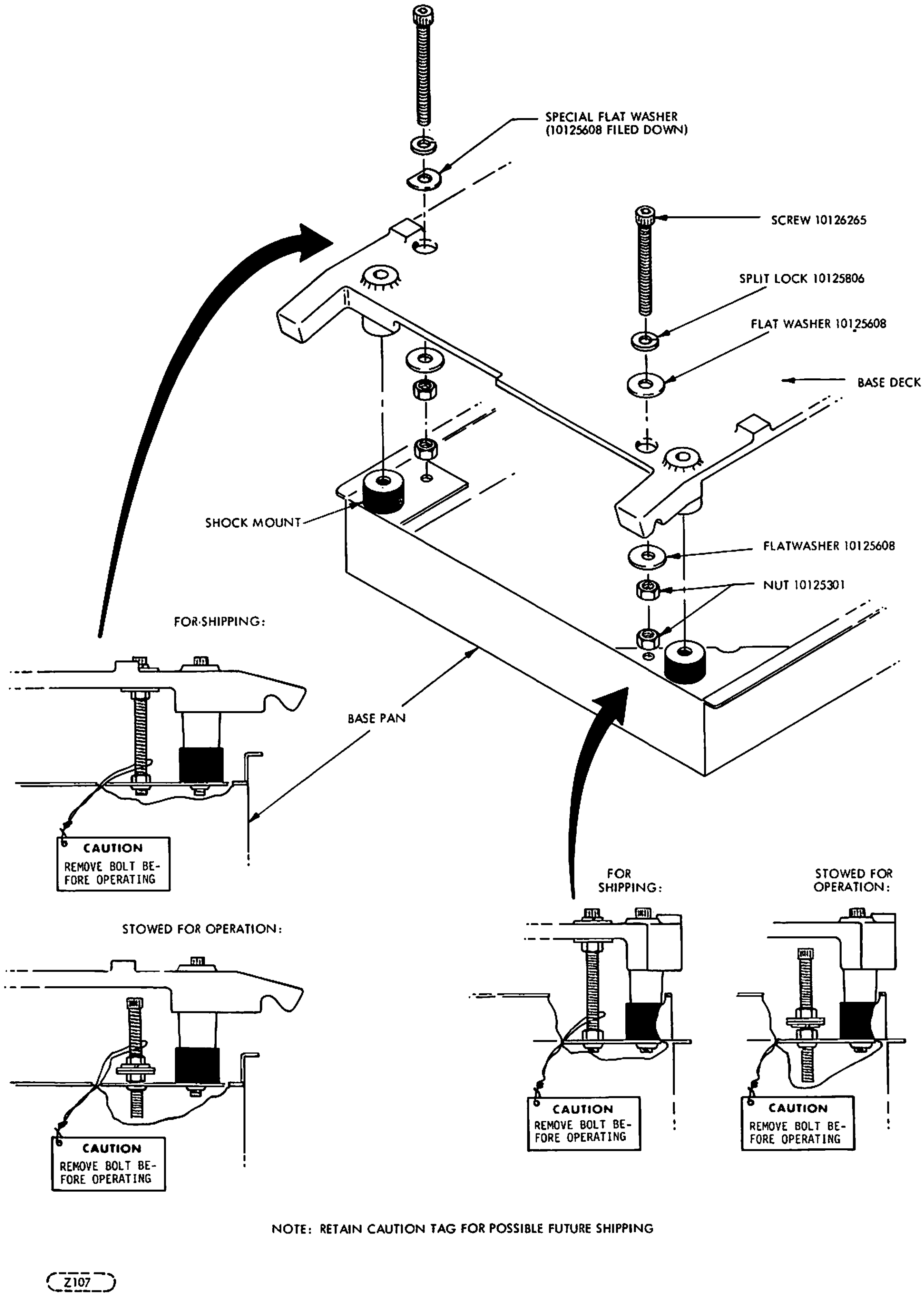
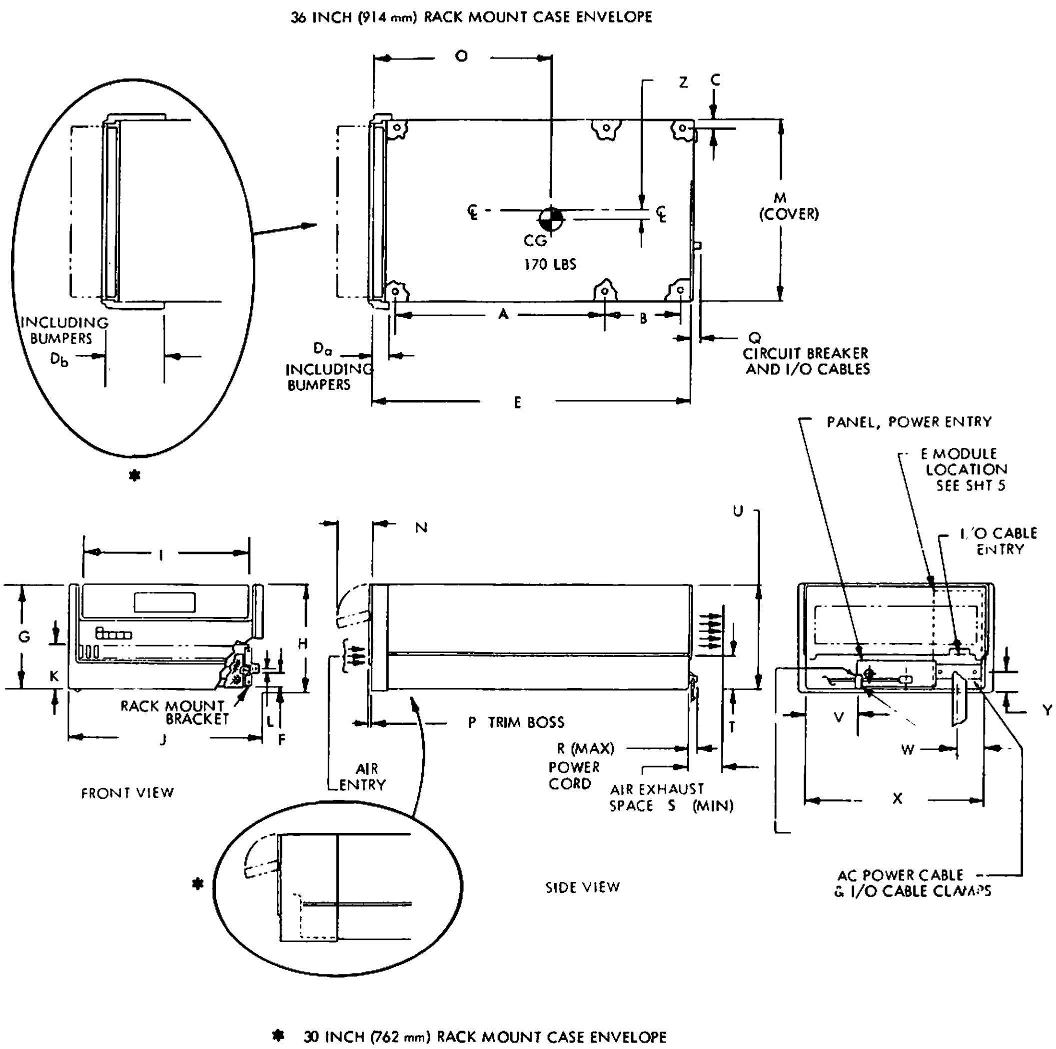


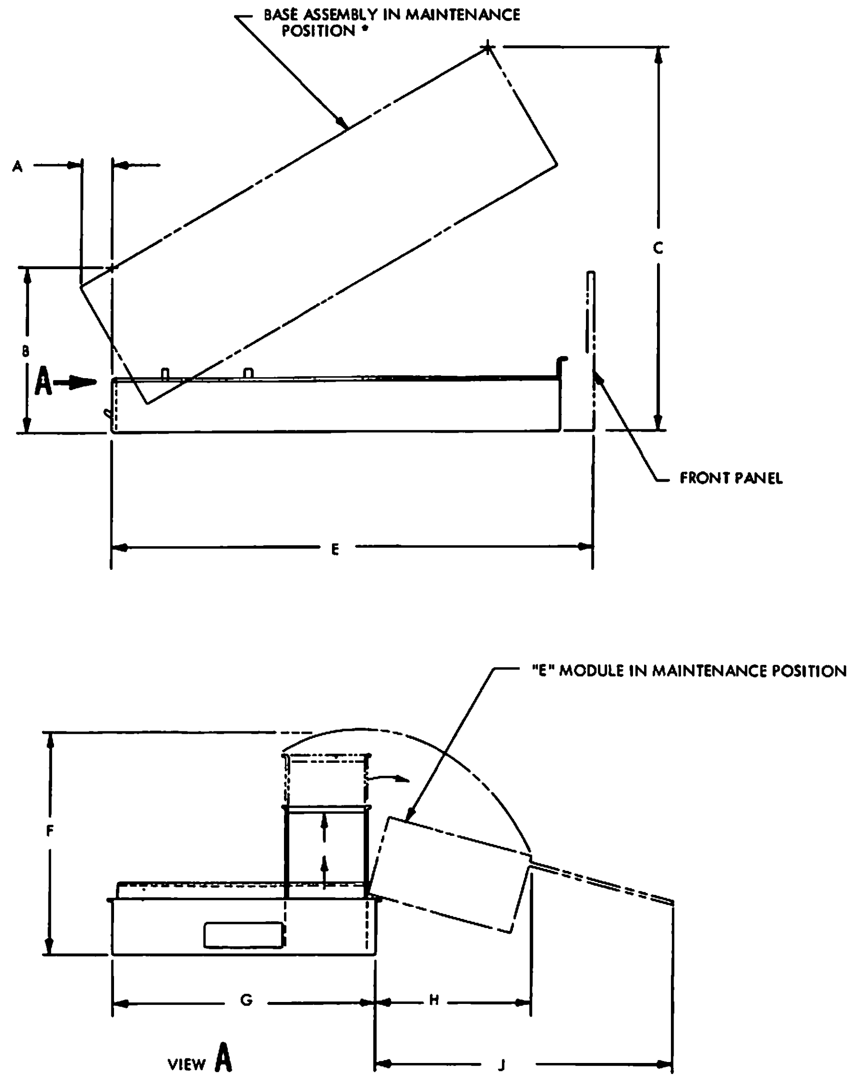

FIGURE 3-3. DECK HOLD DOWN BOLTS (SHEET 2 OF 2)




| 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 | 1.25 | 31.0 |
| 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 | 0.50 | 12.5 |
| 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 |

FIGURE 3-4. DETAILED DIMENSIONS




| 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 |

XX204o

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 dimension 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) attach the chassis mounting rail (4) to the pan (3) of the CMD.
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 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 the 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.

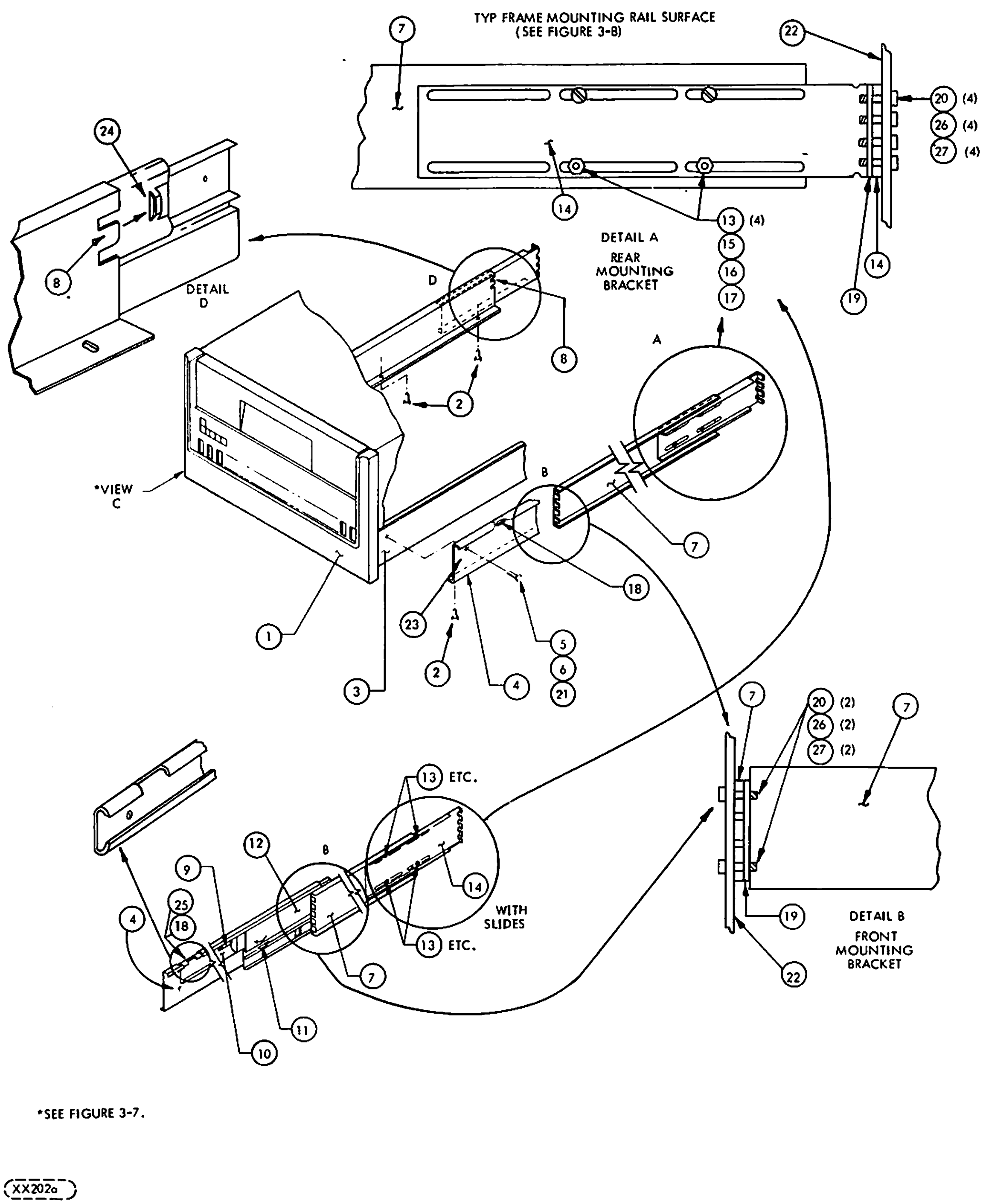
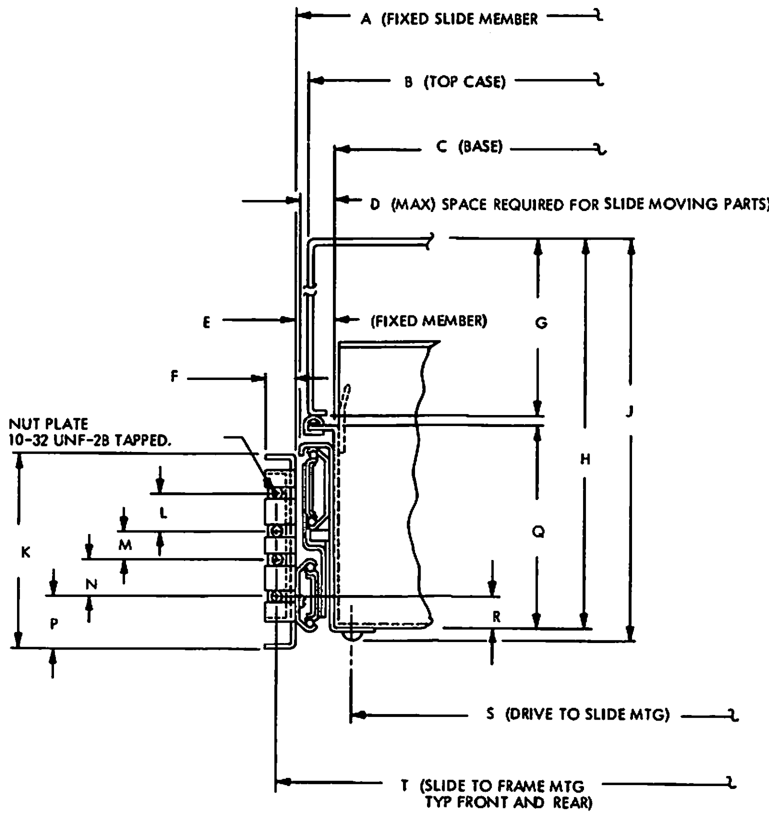



FIGURE 3-6. RACK MOUNTING DETAILS (WITH OR WITHOUT SLIDES)
(SHEET 1 OF 2)

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 & 17. Washers, nut 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. Rach 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

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



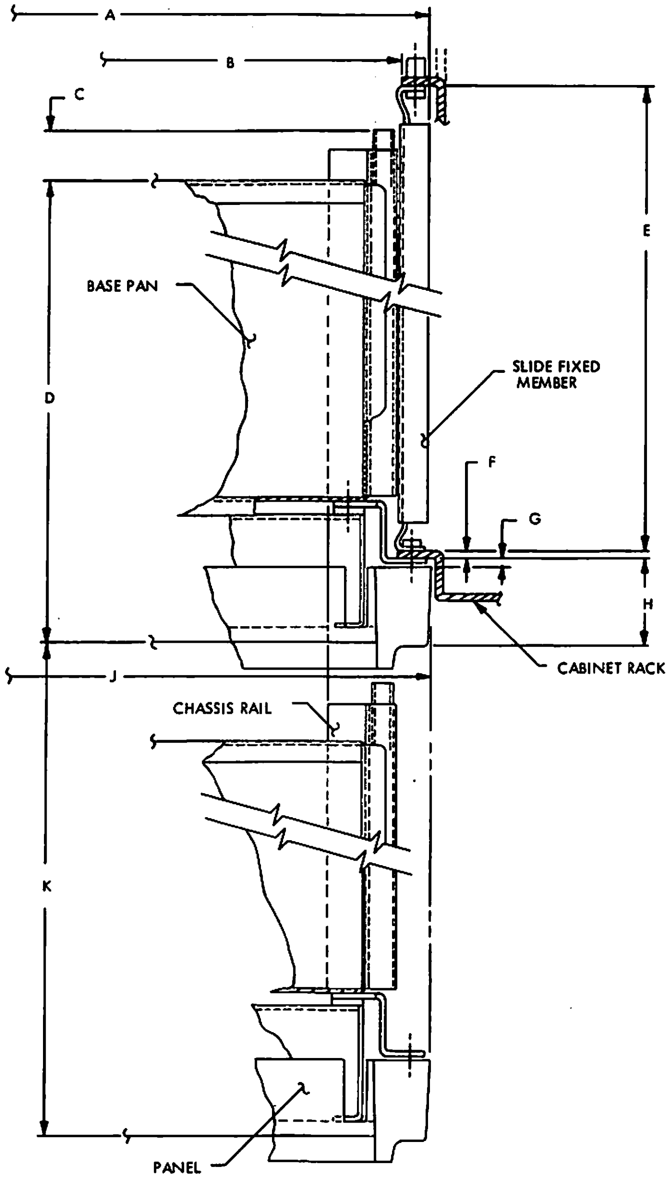

VIEW C
FRONT PANEL REMOVED

| DIMENSION | INCHES | MILLIMETERS | DIMENSION | INCHES | MILLIMETERS |
|---|---|---|---|---|---|
| A | 17.82 | 452.6 | L | 0.625 | 15.9 |
| B | 17.50 | 444.5 | M | 0.500 | 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 | | | |

(XX207a)

*See Figure 3-6

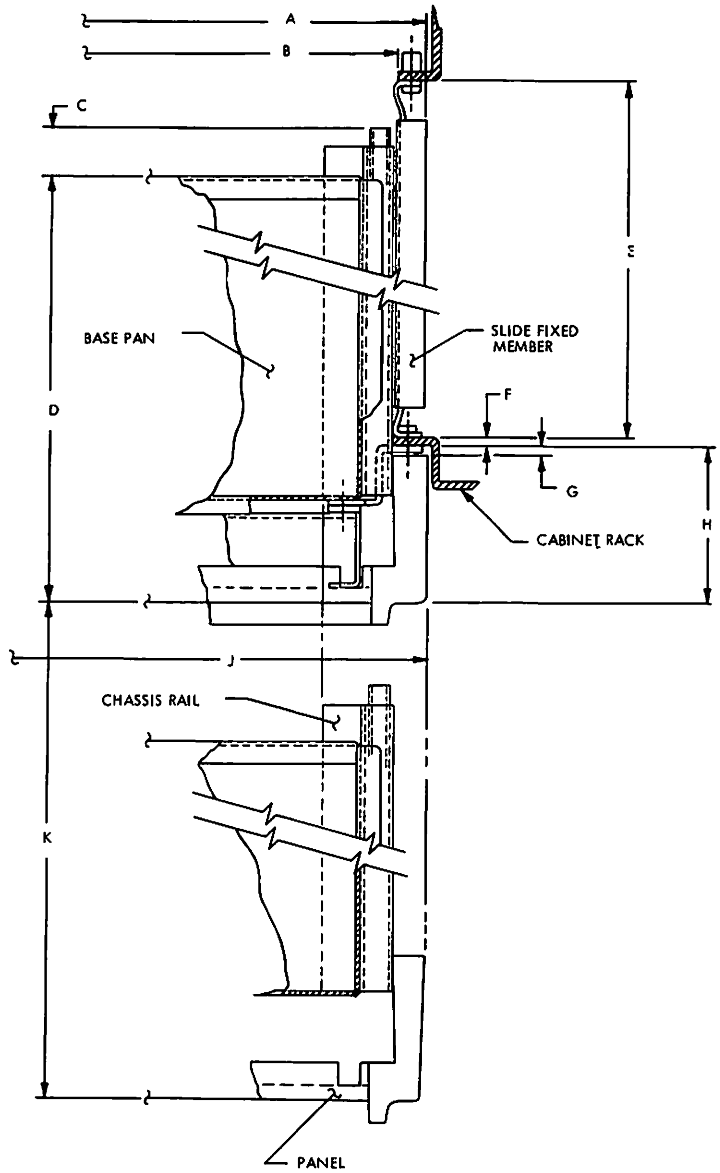
FIGURE 3-7. SLIDE/DRIVE MOUNTING CROSS SECTION




| 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 |

XX206a

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. PREIMARY VOLTAGE REQUIREMENTS

| VOLTAGE (VAC) | TOLERANCE (VAC) | FREQUENCY (Hz) | TOLERANCE (Hz) |
|---|---|---|---|
| 100 | +7, -10 | 60 | +0.6, -1.0 |
| 120 | +8, -18 | 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 |
|---|---|---|---|---|
| | 100/50 | 8.2 | 18.0 | 0.950 |
| Disks and Carriage in Motion | 100/60<br>120/60<br>120/50 | 8.2 | 15.0 | 0.950 |
| | 220/50<br>230/50<br>240/50 | 4.0 | 7.5 | |
| Disks not in motion (standby) | 100/60<br>120/60<br>100/50<br>120/50 | 2.0 | | 0.25 |
| | 220/50<br>230/50<br>240/50 | 1.0 | | |

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

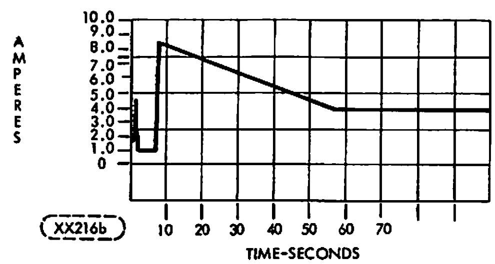



FIGURE 3-9.1A. START UP CURRENT (220-240 V, 50 HZ)

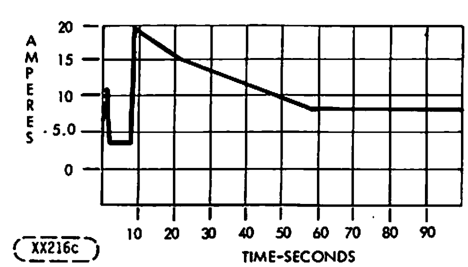



FIGURE 3-9.1B. START UP CURRENT (100 - 120 V, 50/60 HZ)

### 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 |

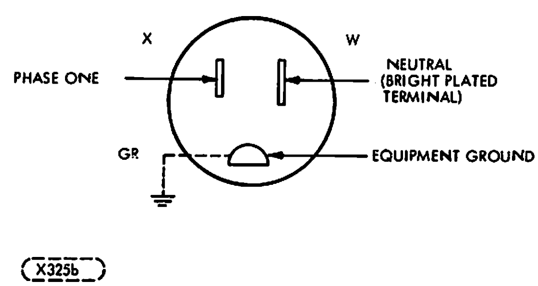



FIGURE 3-10. INPUT POWER CONNECTOR, 120 V 60 HZ (POWER SOURCE PLUG END)

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 Section 3-12 "Accessories" for applicable cable/connector part numbers.

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 2-2. 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 daisy chained 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, ELECTRO-STATIC DISCHARGE OR FIELDS can cause damge 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 susceptable 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 therefor such a device is not offered. Retract Mechanisms can be purchased from a number of different manufacturers.

A note of caution: Additional I/O cable lengths are required to raise the E module to the maintenance position.

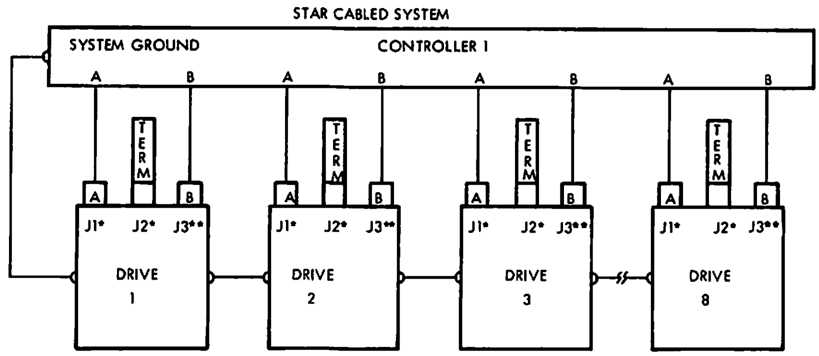
## 3.7 GROUNDING

### 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 3-12) 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.

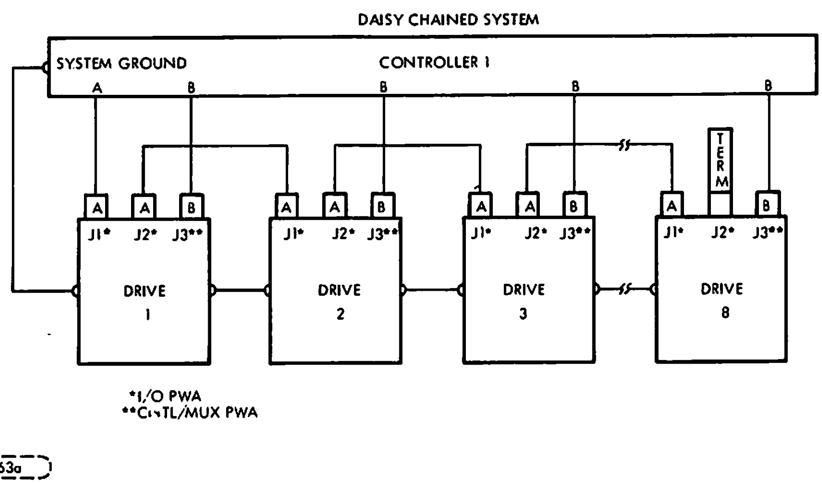
### 3.7.2 FRAME GROUND

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.




NOTES:

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

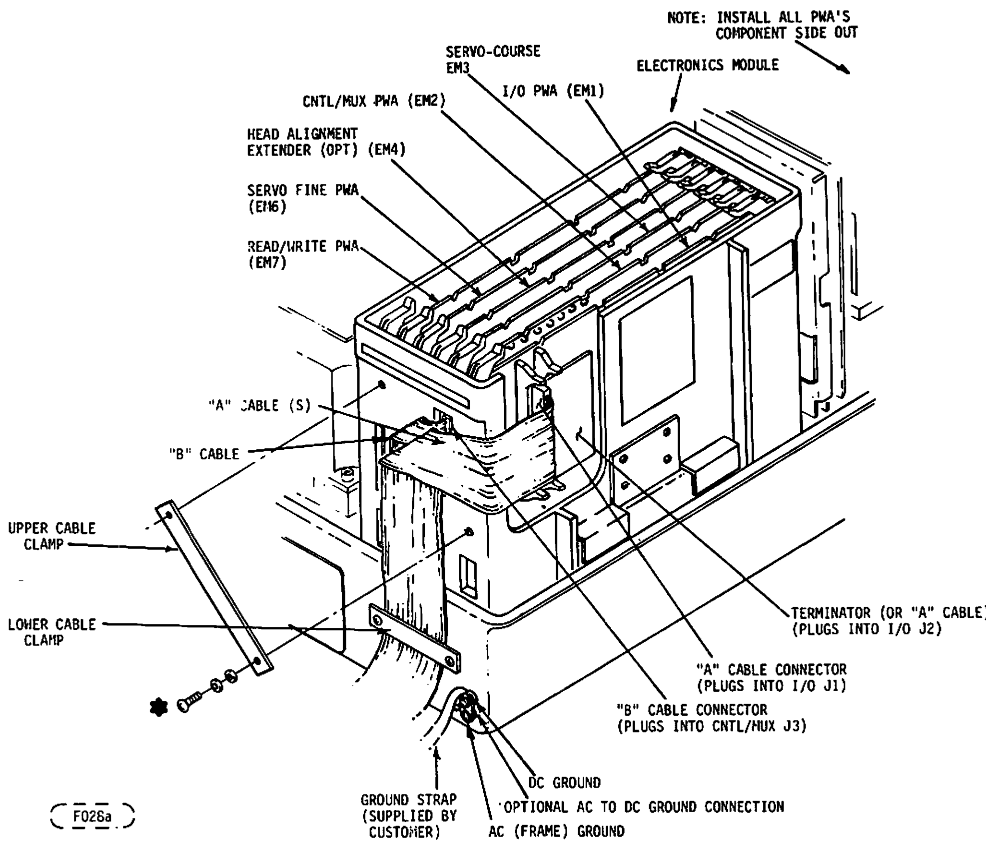



NOTES:

1. Termination of "A" cable lines are required at controller receivers and the last unit of the daisy chain or each unit in a star.
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).

* I/O PWA
** CNTL/MUX PWA

FIGURE 3-11. SINGLE CHANNEL INTERFACE




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

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

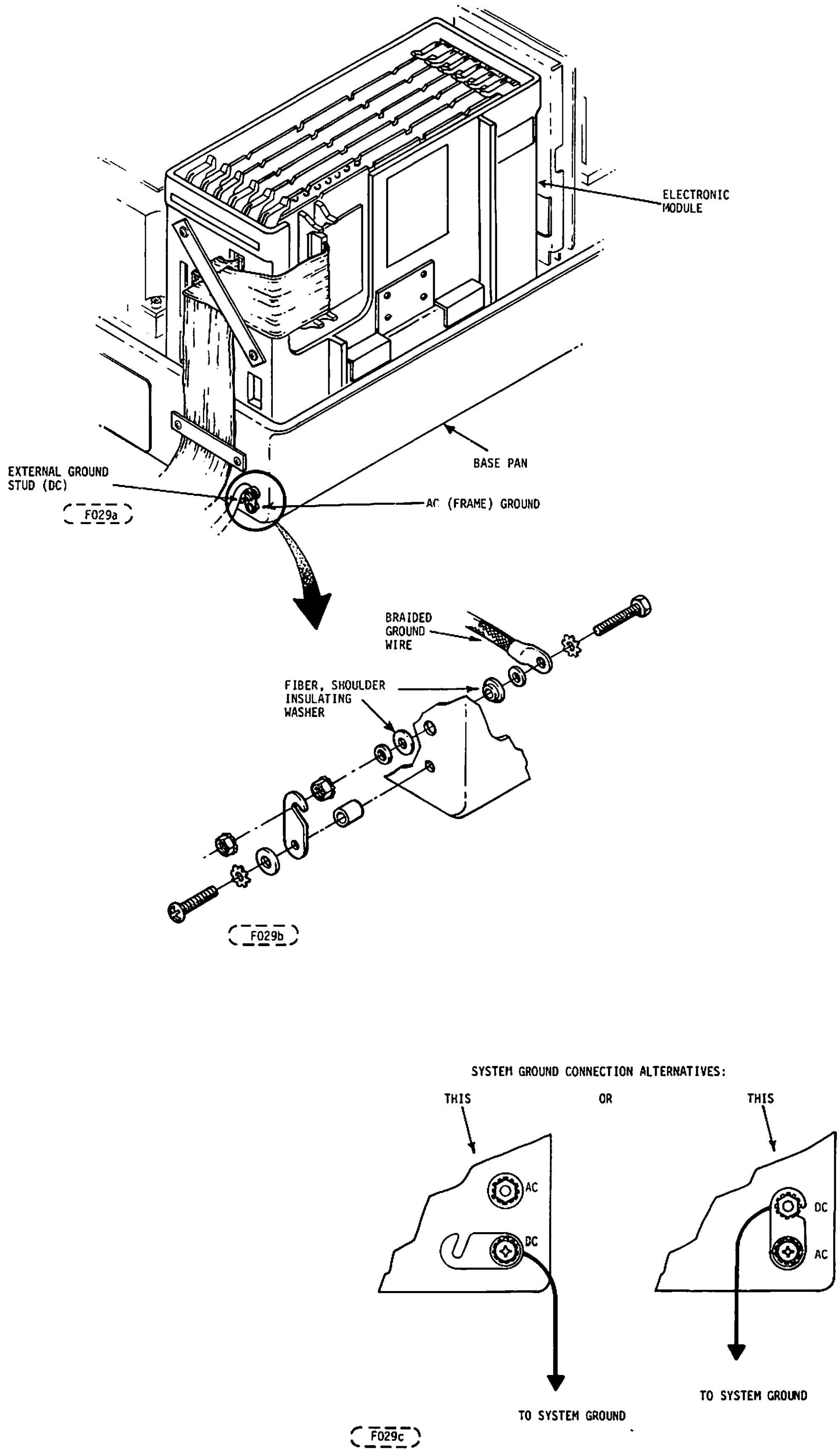



FIGURE 3-13. GROUNDING OPTION

### 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 charge build-up on the frame becomes a problem when frame and DC grounds are separate it may help to connect the two together at one point through a one megohm resistor in parallel with a 0.47 uF capacitor.

## 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 Gredient | 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 (4.4°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 (-40.4°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/1000ft. (1.08°C/305m)

*** Ambient Temperature - Inlet Air can reach 95°F provided the maximum air temperature at the hottest point around the 4 sides (excluding front & 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 3-16. 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.

*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

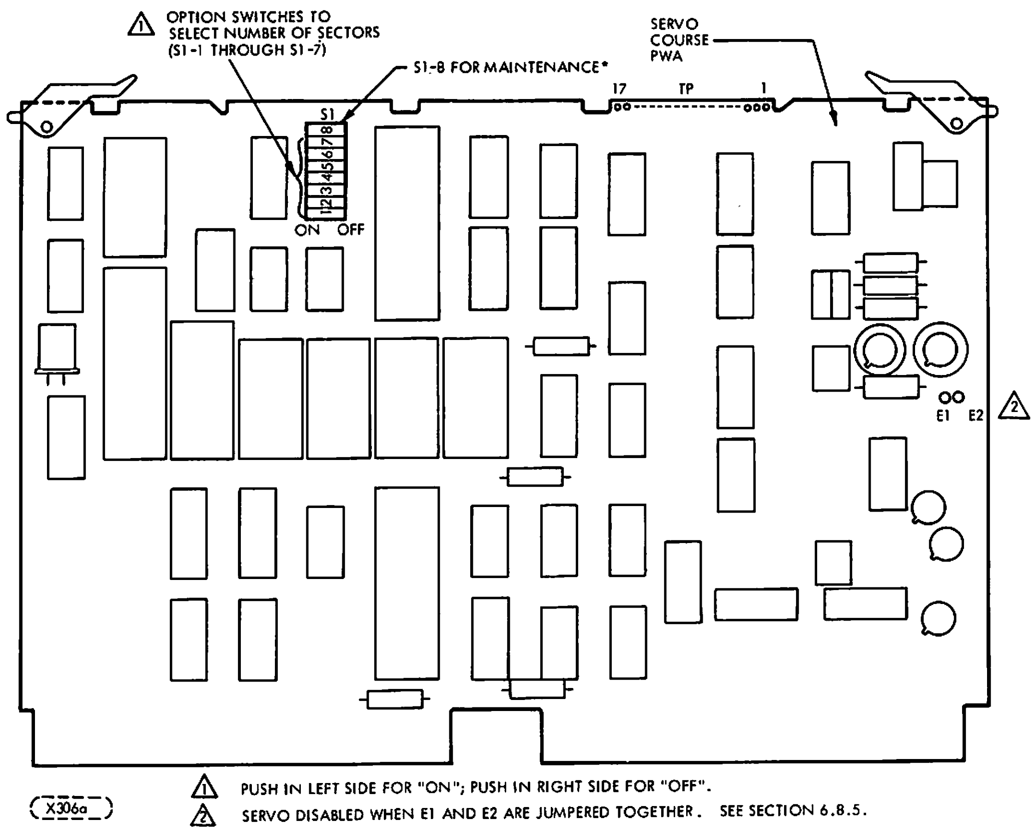
| S1-- 7 | 6 | 5 | 4 | 3 | 2 | 1 | | Number of Sectors (in decimal) | Includes Sector Numbers |
|---|---|---|---|---|---|---|---|---|---|
| 64 | 32 | 16 | 8 | 4 | 2 | 1 | (Binary Weight) | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | | 2 | 0-1 |
| 0 | 0 | 0 | 0 | 0 | 1 | 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.

### 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.

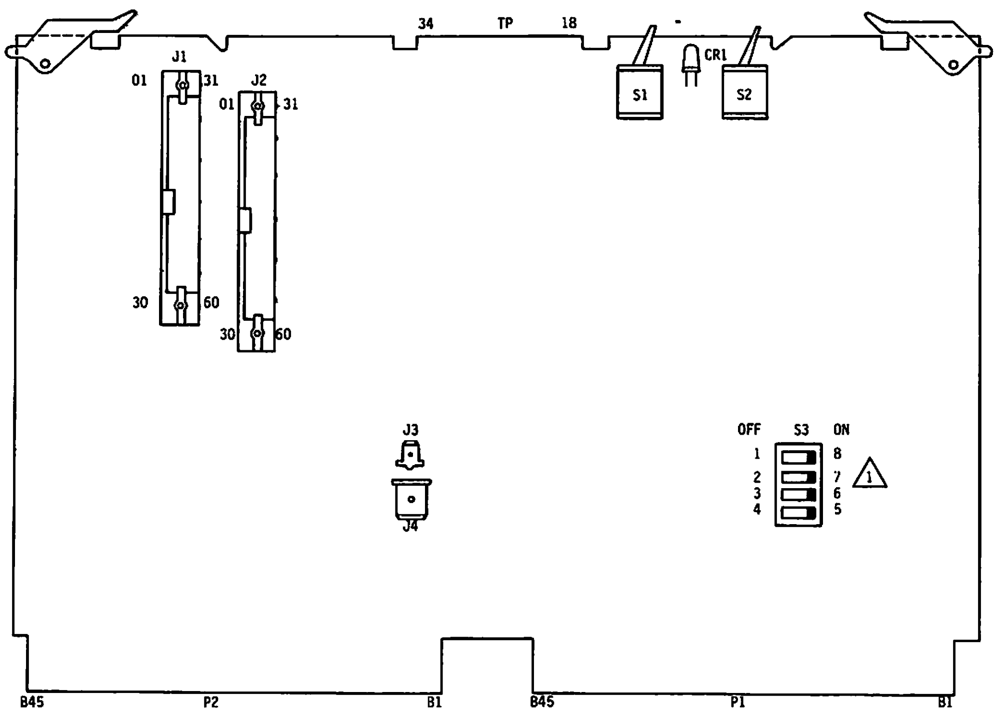



1 PUSH IN LEFT SIDE FOR "ON"; PUSH IN RIGHT SIDE FOR "OFF".

2 SERVO DISABLED WHEN E1 AND E2 ARE JUMPERED TOGETHER. SEE SECTION 6.8.5.

*Section 6.9.1 discusses the use of S1-8.

FIGURE 3-14. SERVO-COARSE OPTION SWITCHES




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 ±5 pounds (4.5 ±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 Daisy chain configurations, the terminator is installed in the last device only.
6. If the plastic bag surrounding the unit was damaged during shipping a 20 minute purge should be performed.
7. If a purge is to be performed, disconnect A1P1 (the voice coil lead).
8. Turn on AC power circuit breaker. Make certain that the blower is operating.
9. Remove Plastic cover shipped in place of a cartridge and install a cartridge per Section 2-7.
10. On the I/O PWA switch the REM/LOC switch to LOC.
11. Operate the START/STOP switch on the operators panel to start the drive.
12. Check to see that the spindle drive motor is operating.
13. (Perform this step only if purge is to be performed).
    With A1P1 disconnected the heads will not load, but the disk will continue to spin. The unit should be allowed to purge for at least 20 minutes.
    a. Operate STOP switch on operator control panel.
    b. When a stopped condition is obtained, turn off AC breaker.
    c. Reconnect A1P1, turn on AC breaker, then operate the START switch to START.
14. Check that the positioner drives the carriage forward to load the read/write heads at track 00 in a maximum of 70 seconds.
15. Operate START/STOP switch to STOP and check to see that the heads FULLY UNLOAD and the spindle stops.
16. 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.
17. Install I/O cables per Section 3.7.
18. Replace top cover.
19. Operate the START/STOP switch to START to start the unit. Wait until 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. 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 daisy chain.
2. Last two digits denote length. (For cable length see Table 305.)

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

TABLE 3-5. 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 3-18)

| ITEM | DESCRIPTION | MPI P/N | BERG P/N | P/N SPECTRA-STRIP |
|---|---|---|---|---|
| 1 | Connector (60 Pos) | 94361115 | 65043-007 | |
| 2 | Flat Cable (twisted-pair 30 pair, 28 AWG | 95043902 | | 3CT-6028-3-05-100 |
| 3 | Contact, Insert | 94245603 | 48048 | ----- |

"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 3-18)

| ITEM | DESCRIPTION | MPI P/N | AMP P/N |
|---|---|---|---|
| 5 | Connector (26 pos.) | 65853402 | 3399-3000 |
| 6 | Connector Pull Tab | 92004801 | 3490-2 |
| 7 | Flat Cable (26 pos.) with ground plane and drain wire. | 95028509 | 3476-26 |

"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

Type: 30 twisted pair, flat-cable
Twists per inch: 2
Impedance: 100 ±10 ohms
Wire size: 28 AWG, 7 strands
Propagation time: 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)

Type: 26 conductor, flat cable with ground plane and drain wire
Impedance: 65 ohms (3M P/M 3476-26)
Wire size: No. 28 AWG, 7 strands
Propagation velocity: 1.65 ns/ft (nominal) (5.41 ns/m)
Maximum cable length: 50 ft (15.24m)
Voltage Rating: 300 V rms

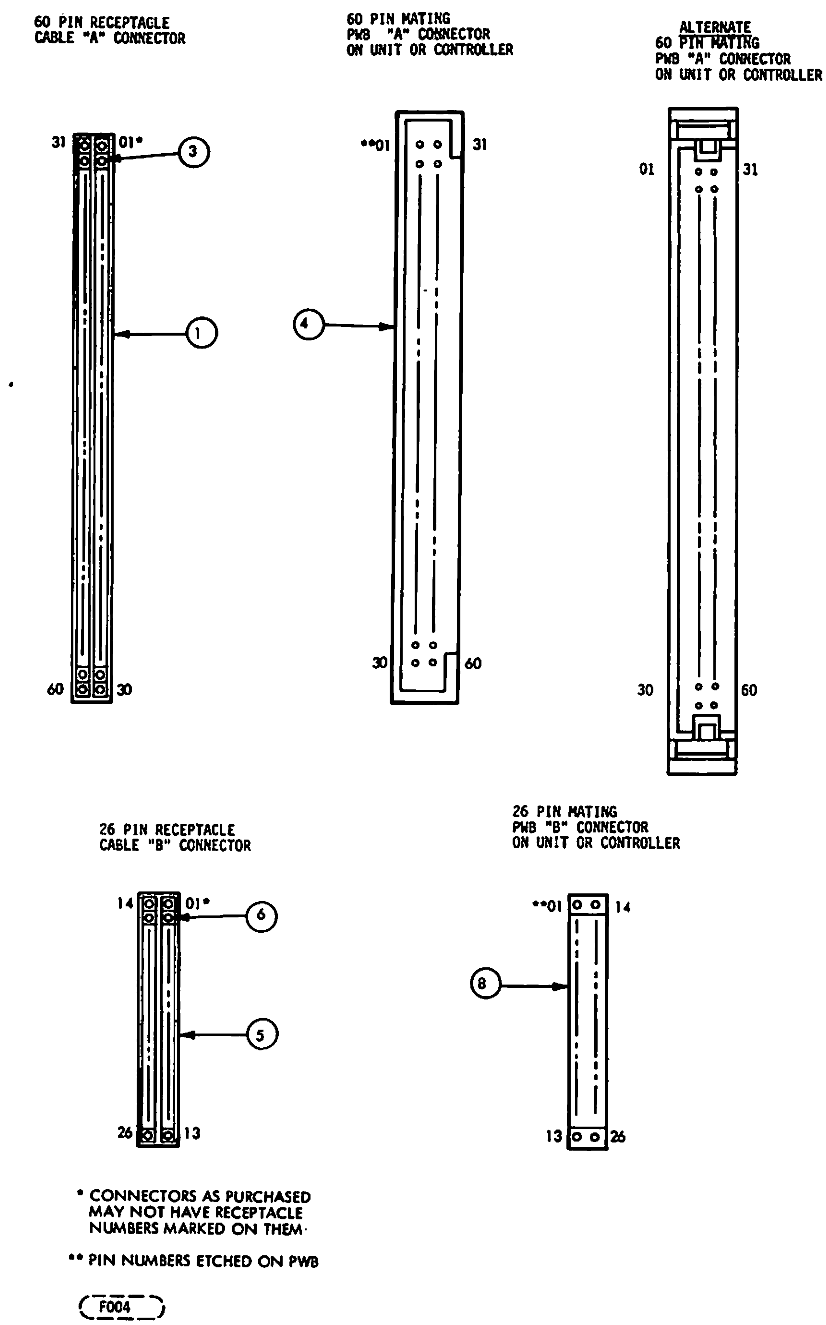



FIGURE 3-16. I/O CONNECTORS - CABLE MOUNT AND PWB MOUNT

### 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 76204000.

## 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 or -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 |
| | No-Air Pressure Transducer |

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 Intracabling 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 intracabling 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.

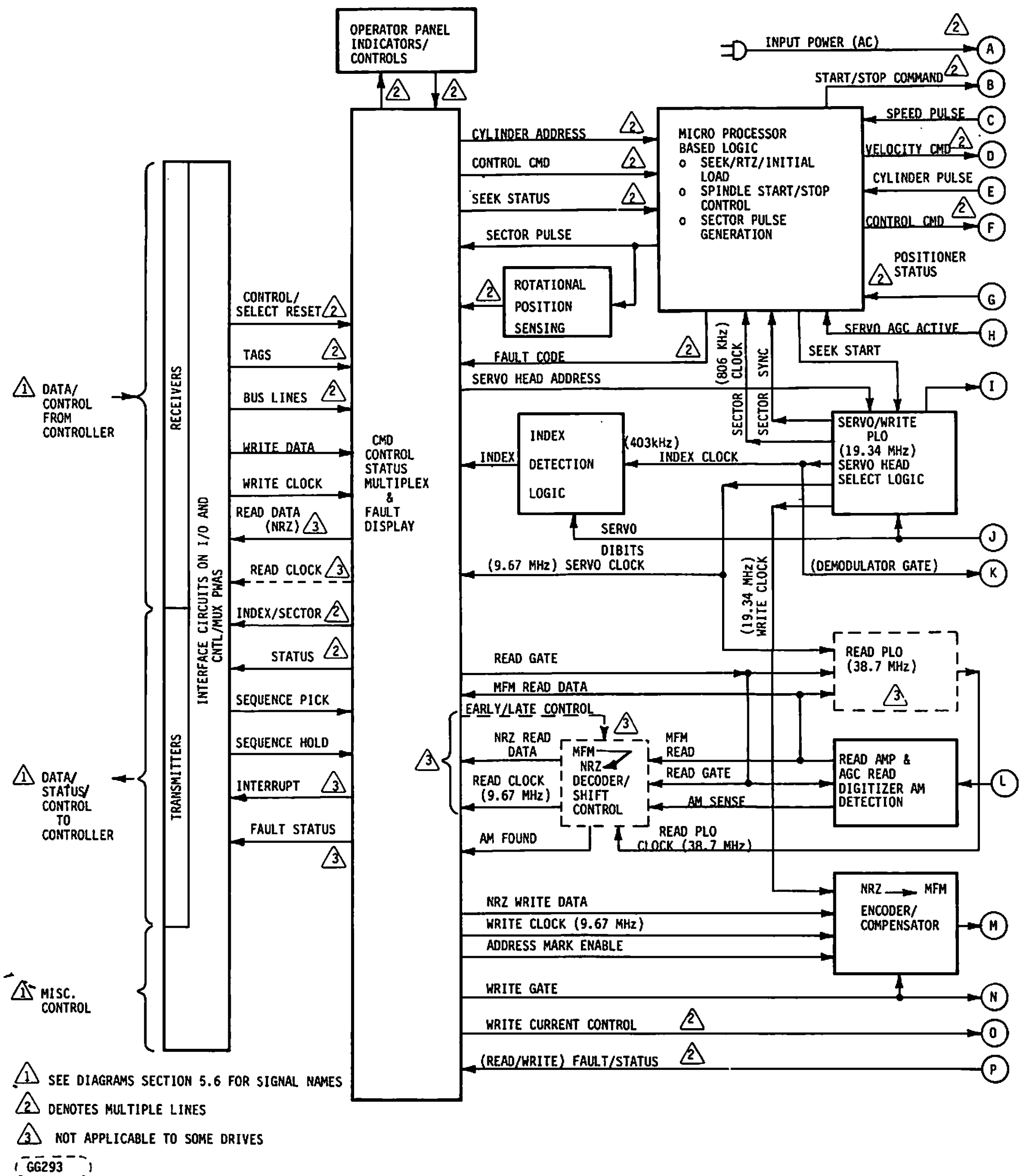



FIGURE 4-1. CMD BLOCK DIAGRAM (SHEET 1 OF 2)

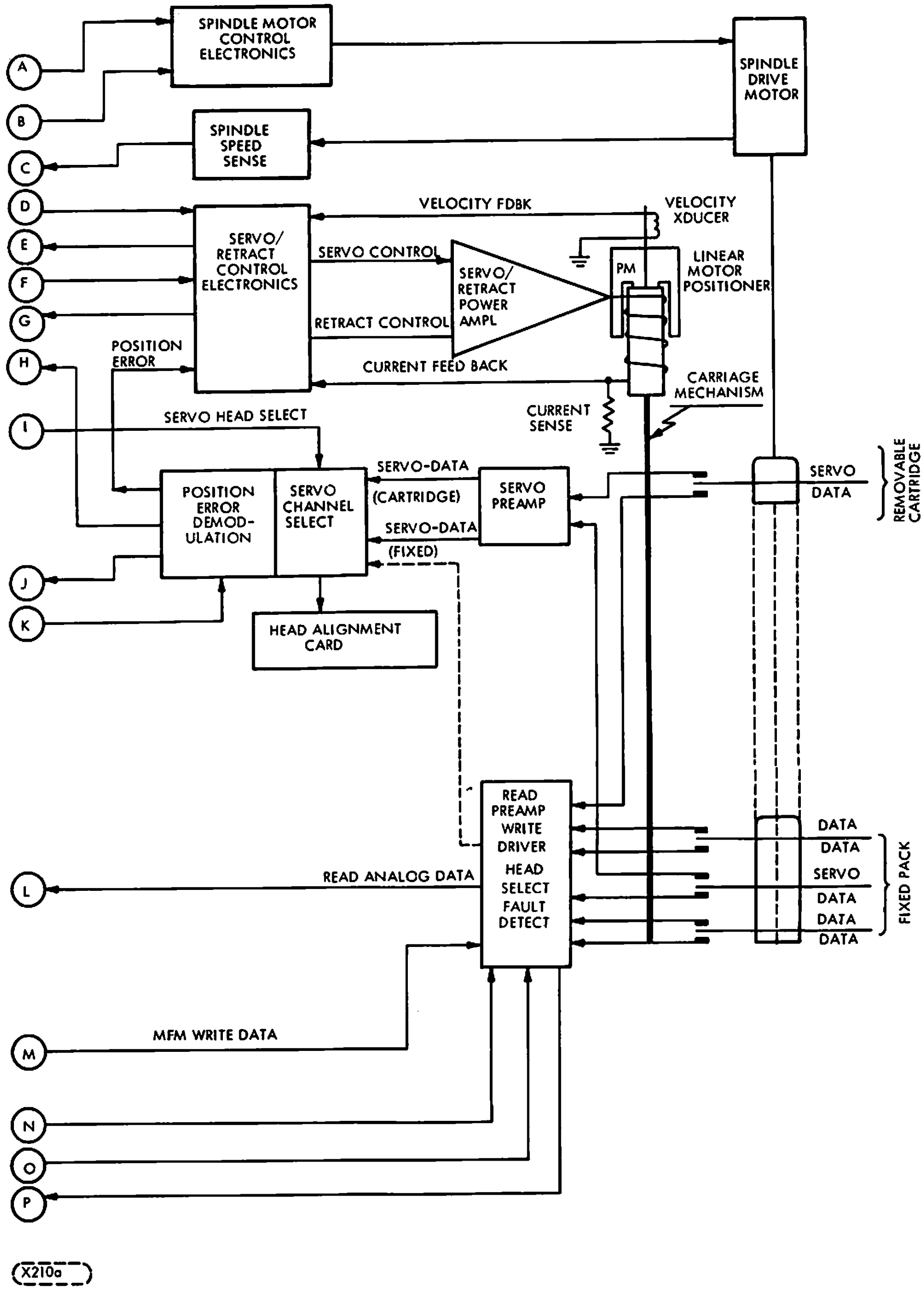



FIGURE 4-1. CMD BLOCK DIAGRAM (SHEET 2 OF 2)

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 501, 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 useage of the cross referencing system discussed briefly here.

Integrated circuit components are designated as follows:

U25 - 12

12 — IC pin number

U25 — 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 pindle motor, assuming that the deck is down, the cartridge is seated and the cartridge access door is closed.

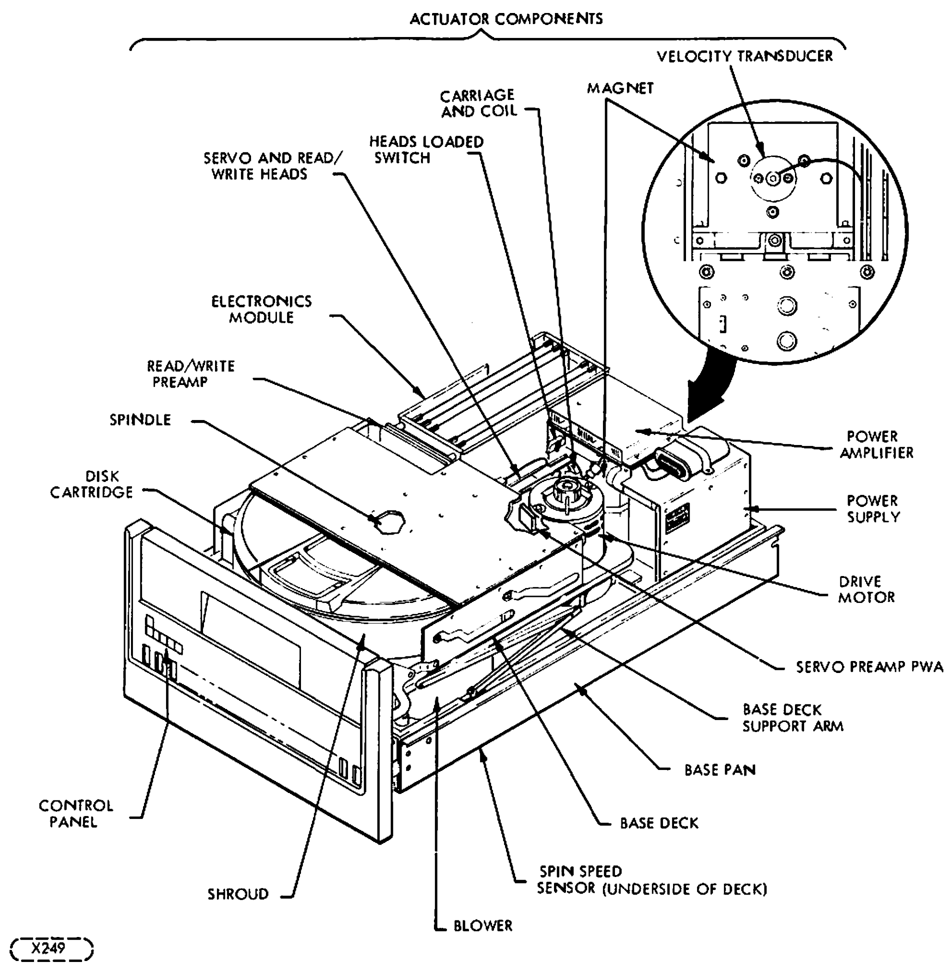



FIGURE 4-2. CMD MAJOR ASSEMBLIES

CAUTION

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.

## 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 form 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 it 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.

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 movable. 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.

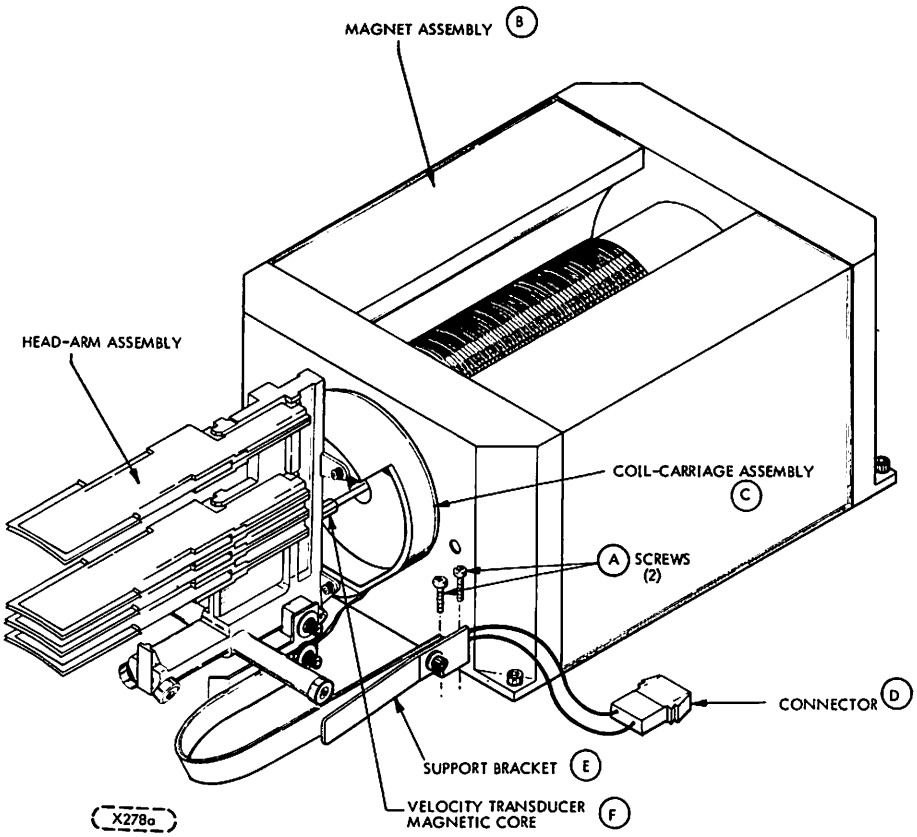



FIGURE 4-3. ACTUATOR ELEMENTS (VOICE COIL SLIGHTLY EXTENDED FROM RETRACTED POSITION)

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 th 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 refelects 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.

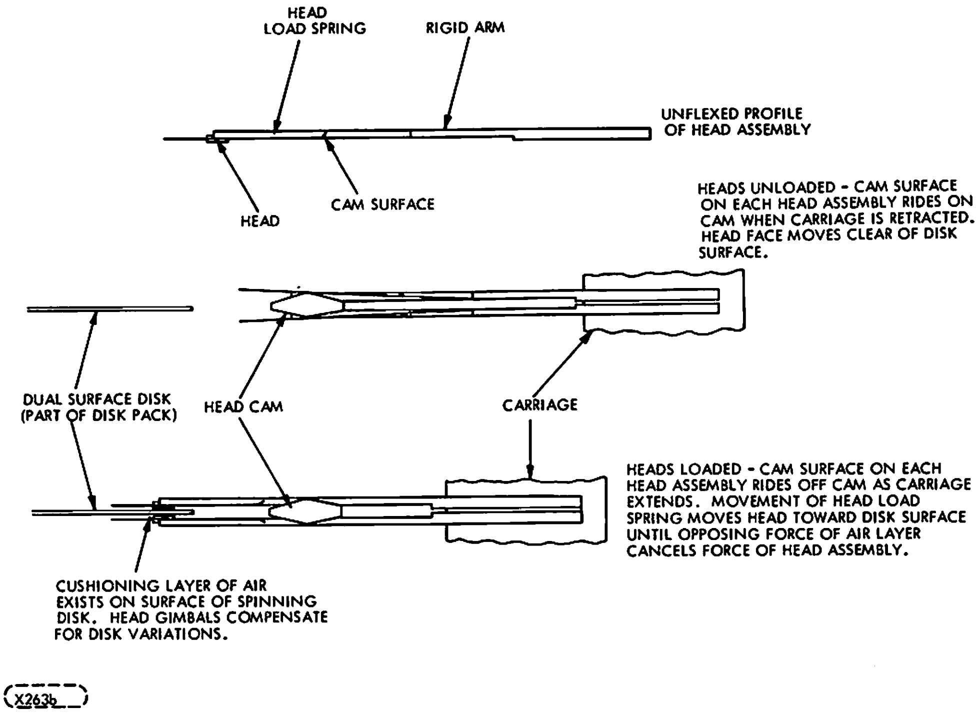



FIGURE 4-4. HEAD LOADING

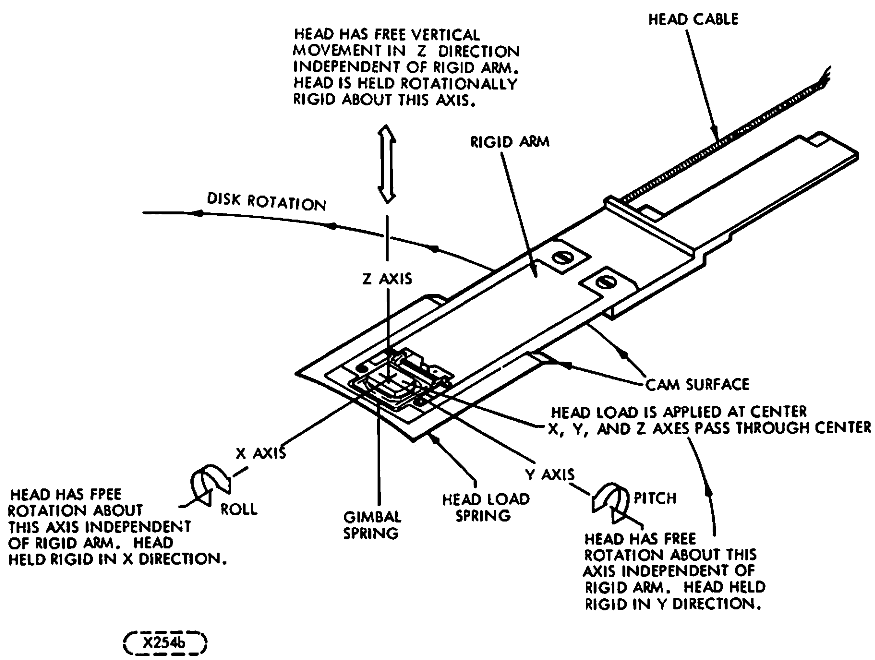



FIGURE 4-5. HEAD/ARM ASSEMBLY MOTION

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 tranducer. These transducers provide signals that are used by the microprocessor to generally control the progression of most machine operations.

The Base Pan Assembly contains one pressure switch transducer. This pressure transducer provides a signal that tells 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 pusles 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 reduced 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 assy. 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

---
*Figure 5-13.

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.

#### 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 switch monitors the output of the absolute filter. The NO-AIR pressure switch is set at a level that indicates the absolute filter has to 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.

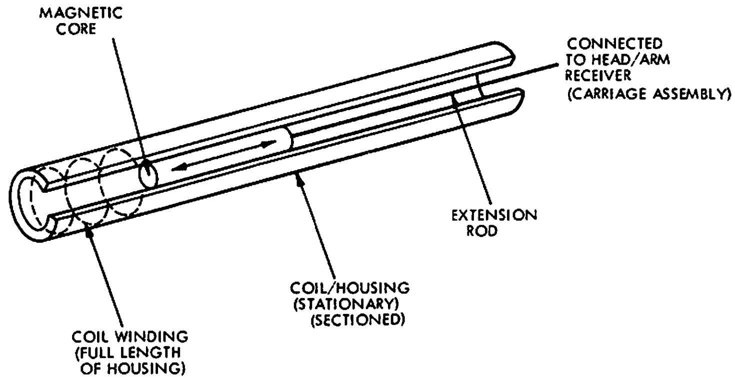
### 4.2.7 DISKS

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

The disk cartridge has a two-piece container. The bottom cover can be removed by simply pushing the cover release button toward 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.



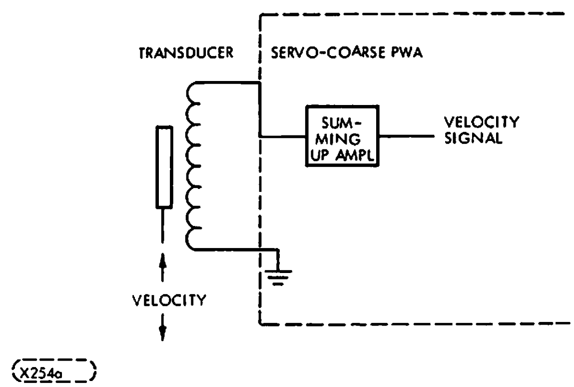




FIGURE 4-6. VELOCITY DETECTION

### 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 removeable 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 PACK 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 V. The open circuit voltage is 5 VDC max.

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

CMDs 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 sequenced 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 U36 on the Servo-Coarse PWA.

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*See Section 4.3.4 for details of the microprocessor components.

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.
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.

### 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 (removes 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 int its internal operations counter which takes 30 seconds to count down to -1. The M.P. de-energies 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.

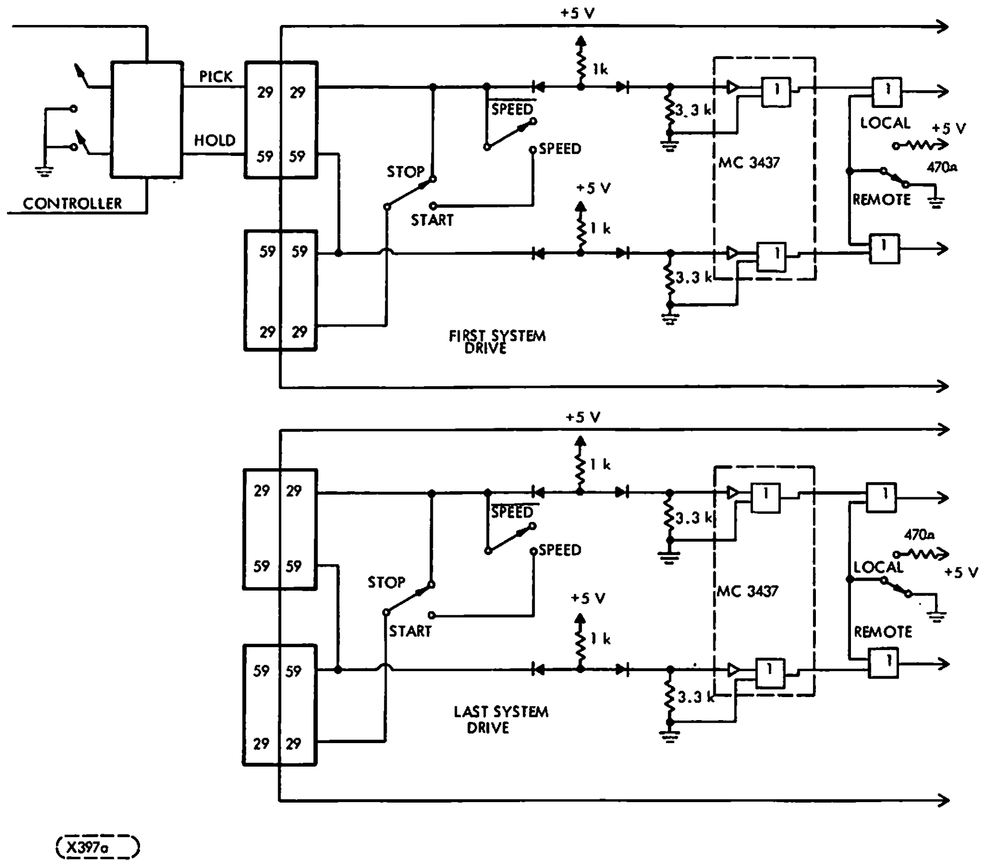



FIGURE 4-7. SEQUENCE POWER LINES - CMD

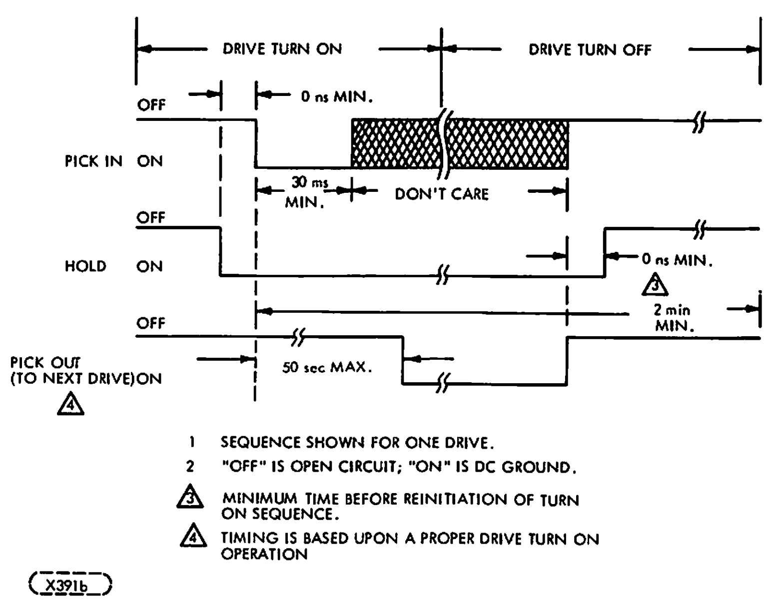



FIGURE 4-8. POWER SEQUENCE TIMING

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.

- 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 pusles from the disk at 3600 r/min is 1042 micro-

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

seconds. 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 Servo to stop moving. Relay K2 is de-energized so that the voice 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.

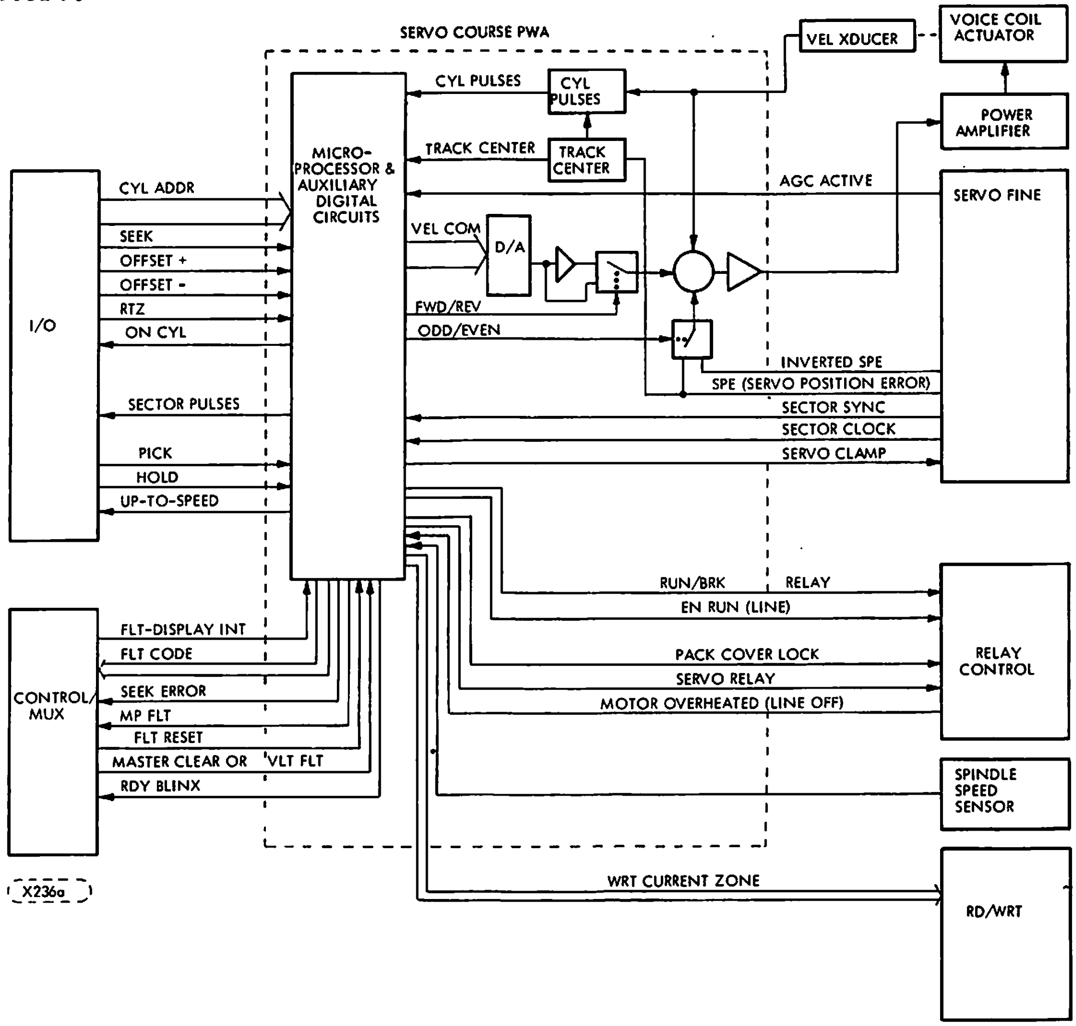



FIGURE 4-9. BLOCK DIAGRAM OF SERVO-COARSE PWA AND SUPPORTING ELEMENTS

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).

### 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 (U2) 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.

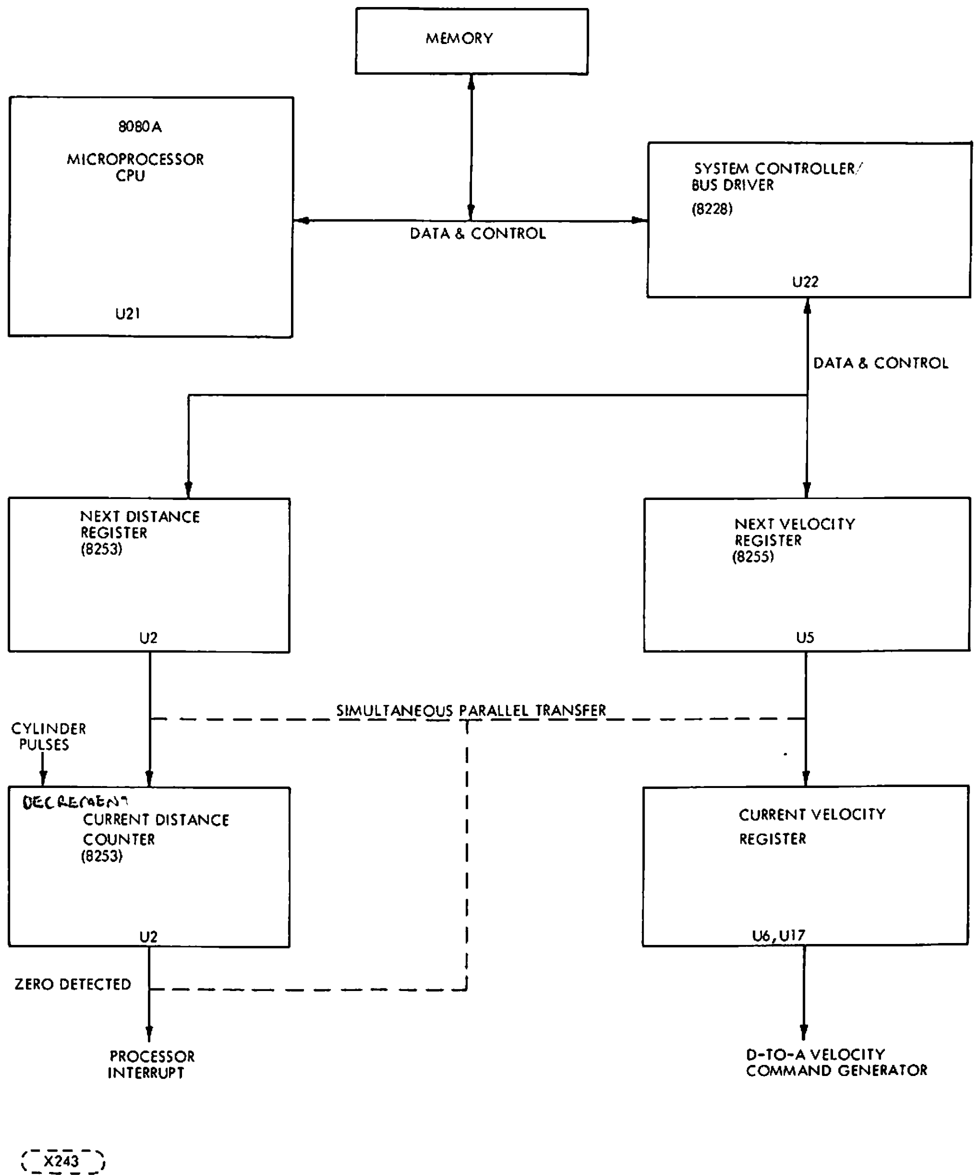



FIGURE 4-10. SEEK CONTROL (DIGITAL PORTION) BLOCK DIAGRAM

| SEEK DIST. | IPS | | |
|---|---|---|---|
| 626-822 | 74 | 33-47 | 23.9 |
| 429-625 | 74 | 18-32 | 17.3 |
| 232-428 | 74 | 12-17 | 11.9 |
| 165-231 | 63.3 | 8-11 | 8.95 |
| 116-164 | 51.9 | 6-7 | 6.92 |
| 74-115 | 41.2 | 4-5 | 4.55 |
| 48-73 | 31.6 | 3 | 3.42 |
| | | 2 | 2.63 |
| | | 1 | 2.11 |

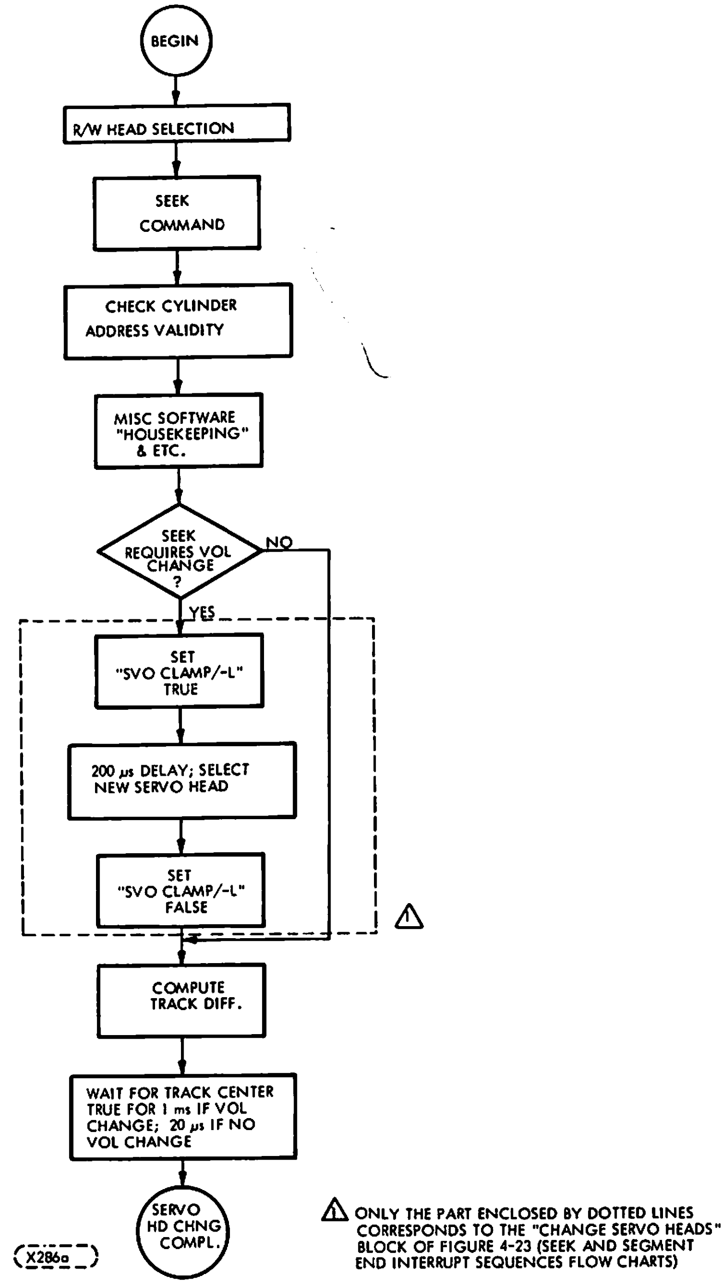



FIGURE 4-11. SERVO HEAD CHANGE OPERATIONAL FLOW CHART

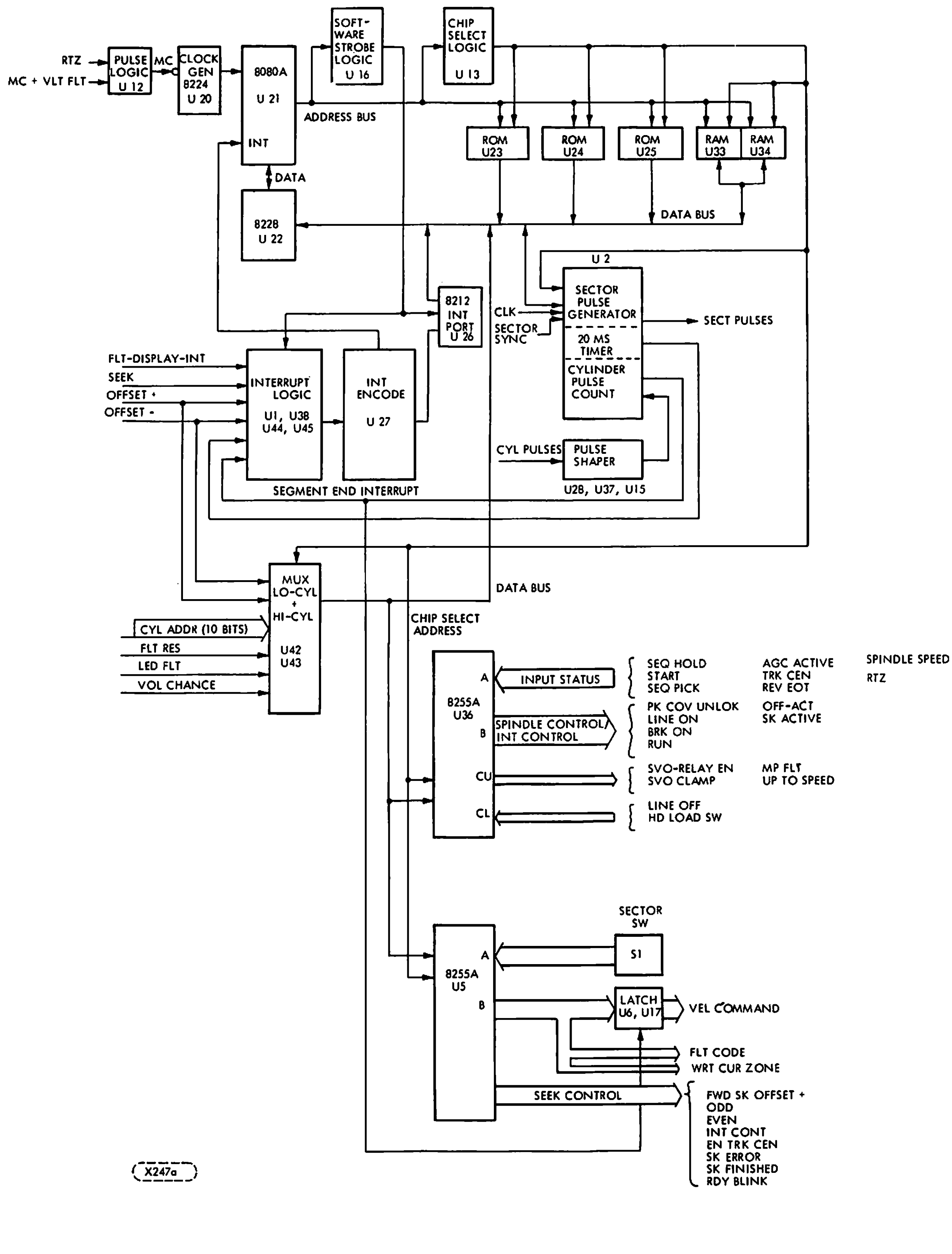



FIGURE 4-12. MICROPROCESSOR HARDWARE BLOCK DIAGRAM

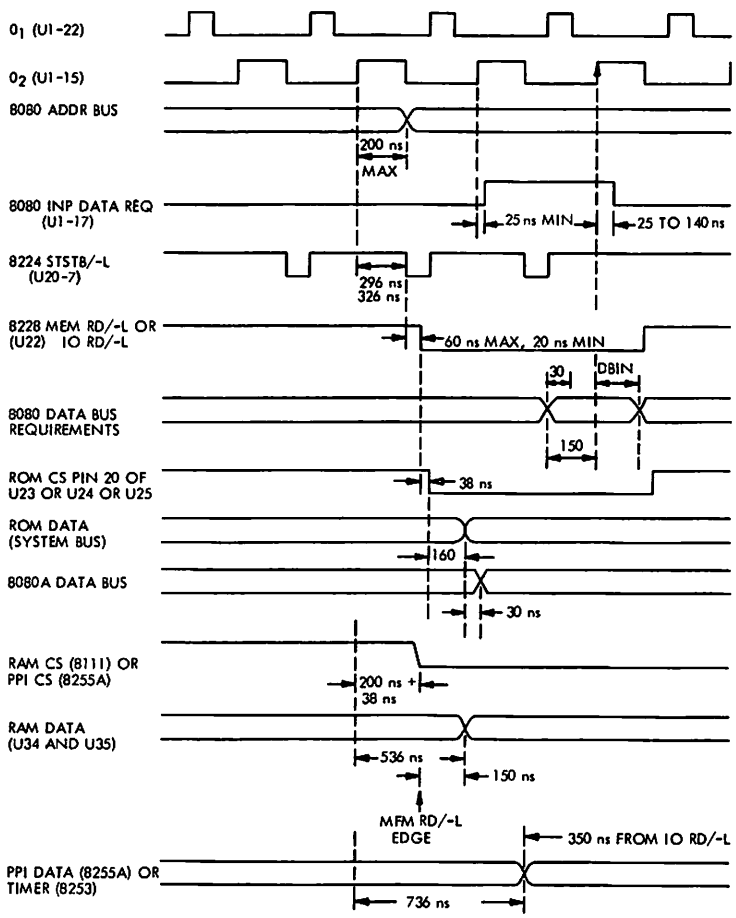
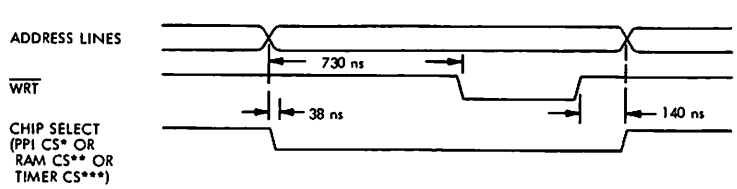



FIGURE 4-13. M.P. READ TIMING




*PPI CS SETUP = 20 ns MIN REQUIRED
**RAM CS SETUP = 150 ns MIN
***REQUIREMENTS SAME AS PPI

XX014b

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 (8708/8308), data memory (8111), 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 U13 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 V = Logic "1"). However, the A, B and C address lines are actually mechanizes as "/-L" logic (nominal 0 V 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 response 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 (U27) 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, U26 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 theinstruction 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 | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | F | E | D | C | B | A | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| External Address (EM4) | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - * |
| Internal Addresses | | | | | | | | | | | | | | | | |
| Memory: ROM U23 | 0 | 0 | 0 | 0 | 0 | 0 | - | - | - | - | - | - | - | - | - | - |
| ROM U24 | 0 | 0 | 0 | 0 | 0 | 1 | - | - | - | - | - | - | - | - | - | - |
| ROM U25 | 0 | 0 | 0 | 0 | 1 | 0 | - | - | - | - | - | - | - | - | - | - |
| RAM U34, U35 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | - | - | - | - | - | - | - | - |
| Input Ports Addressed as Memory (U42, U43) | | | | | | | | | | | | ** | | | | |
| LO-CYL | 0 | 0 | 0 | 1 | 1 | 1 | - | - | x | x | x | x | - | - | - | - |
| HI-CYL | 0 | 0 | 0 | 0 | 1 | 1 | - | - | x | x | x | x | - | - | - | - |
| ***I/O Ports: PPI-1 (U5) | | | | | | | | | | | | | | | | |
| Control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port A | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port B | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port C | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| PPI-2 (U36) | | | | | | | | | | | | | | | | |
| Control | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port A | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port B | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Port C | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| ***Timer: (U2) Mode | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| CNT 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| CNT 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| CNT 2 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| Software Strobes: | | | | | | | | | | | | | | | | |
| LD-VEL-RD-INT | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-SK-INT | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-EXT-INT | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-RTZ | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-OFF-INT | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-SPD-LCH | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |
| RES-SEG-END-INT | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | x | x | x | x | x | x | x | x |
| SET-INT | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | x | x | x | x | x | x | x | x |

* "-" indicates address line is used to address a memory cell within the selected device.
** "x" indicates that the bits are not used.
*** Address qualified by I/O Rd or I/O write.

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

TABLE 4-2. 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 ($11\underbrace{110}_{AAA}111$) |

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 U6 and U17. 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 reoutine 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.

Seek Interrupt:

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

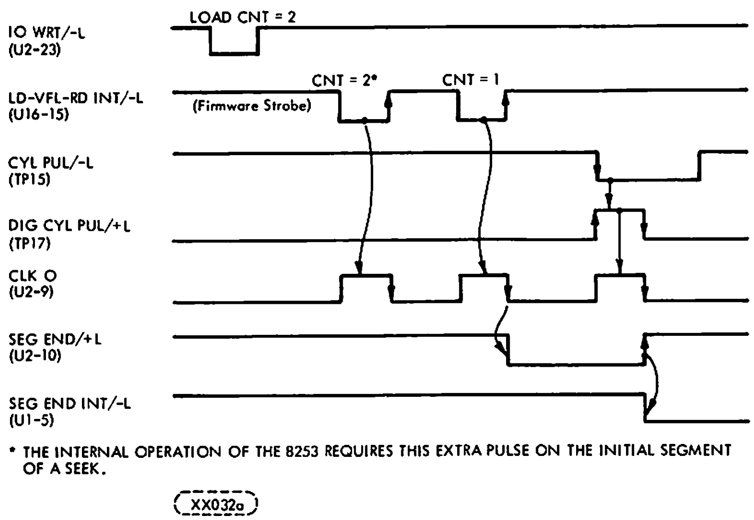



FIGURE 4-15. INITIAL 1 TRACK SEGMENT TIMING (SEEK OPERATION)

## 4.3.4.4 MICROPROCESSOR I/O LOGIC

The input/output logic consists of two programmable peripheral interface PPI chips (U5 and U36; type 8255A) and two multiplex chips (U42 and U43; type 74LS257). A binary 1 of 8 decoder (U16; 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 Figue 4-12. Table 4-3 which follows lists the I/O ports and their functions.

TABLE 4-3. MICROPROCESSOR I/O PORT SIGNAL ASSIGNMENTS

| PPI 1 (U5) | Source/Destination | Function |
|---|---|---|
| PORT A | (Inputs) | |
| PA0 : : : PA6 | Sector Selection Switch S1-1 (LSB) through 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 interr-upt occurs. |
| PORT B | (Outputs) | |
| PB0 : : : : : PB7 | Output Velocity commands to Vel. com. registers or maintenance codes to Fault Displays on CNTL/ MUX PWA | During a seek these signals are servo velocity commands and during execution of a mainte-nance 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 a 1/4 sec. 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 run-out 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 (U5) | 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 (U36) | | |
| PORT A | (Inputs) | Port A is hardware status inputs. |
| PA0 | SEQ PICK | Interface control line for sequencing start of spindle motor. |
| PA1 | Not used | |
| 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 when the positioner is on track (see also Section 4.3.5.3). |
| PA4 | AGC ACTIVE | Signal from servo fine PWA which defines when the positioner is out of the servo recorded zone. |
| PA5 | SPIN PULSE (shrunk) | 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 (U36) | 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 | Not used | |
| PC2 | Not used | |
| 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 (U36) | 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. |
| U42, U43 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 | | |
| 0 | CYL-ADDR-8/+L | Two high order bits of cylinder address. |
| 1 | CYL-ADDR-9/+L | |
| 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. |

*See end of Table for notes.

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

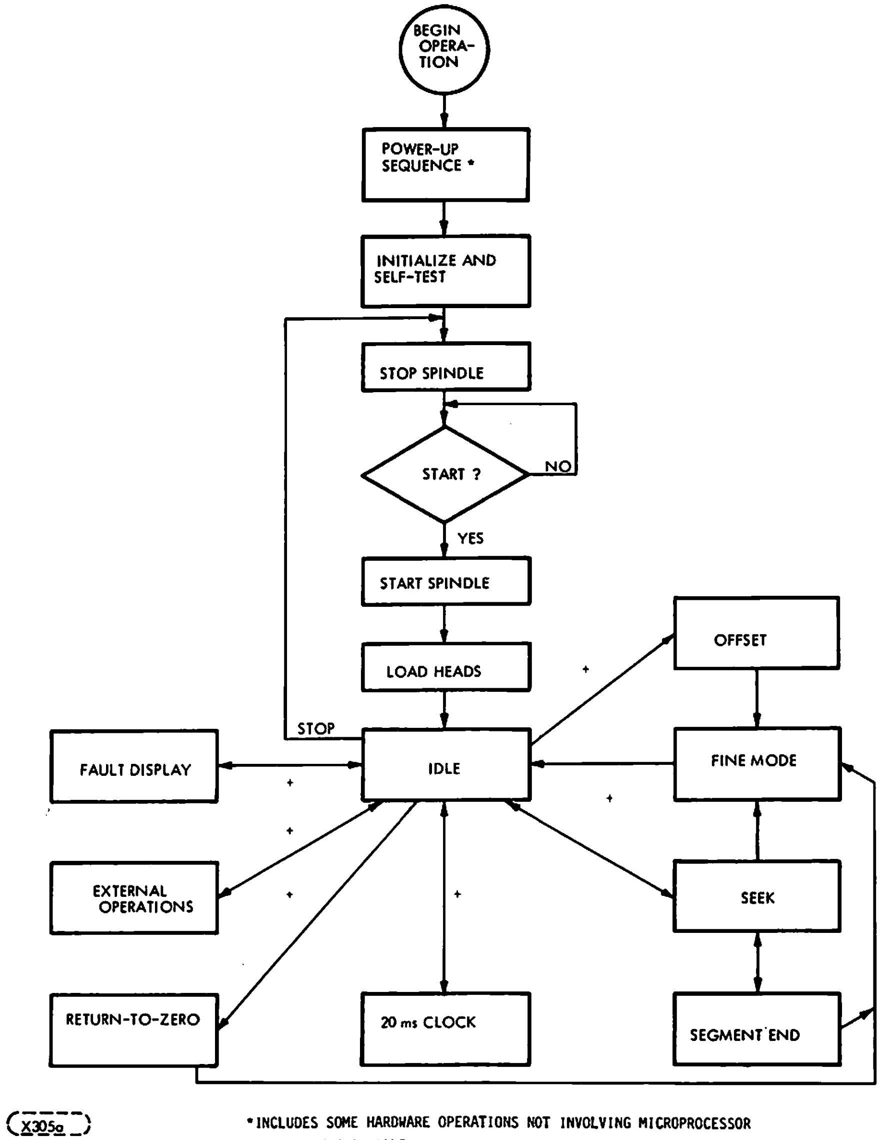
| PPI 2 (U36) | Source/Destination | Function |
|---|---|---|
| Inputs to PPI 2 From U16 Binary/1:8 Decoder | | Software strobes decoded from input addresses |
| U16-15 | LD-VEL-RD-INT/-L | Loads contents of velocity port into Velocity Command Registers and strobes the Segment End Counter. Also this strobe allows the reading of the interrupt instruction port for diagnostic purposes. |
| U16-14 | RES-SK-INT/-L | Resets seek interrupt flip-flop. |
| U16-13 | RES-EXT-INT/-L | Available for later external use. |
| U16-12 | RES-RTZ/-L | Resets RTZ latch and MP-MC latch. |
| U16-11 | RES-OFF-INT/-L | Resets offset interrupt latch. |
| U16-10 | RES-SPD-LCH/-L | Resets speed latch. |
| U16-9 | RES-SEG-END-INT/-L | Resets the segment end interrupt flip-flop. |
| U16-7 | SET-INT/-L | Checks interrupt related hardware for diagnostic purposes. |

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

## 4.3.4.5 MICROPROCESSOR OPERATION FLOW CHARTS

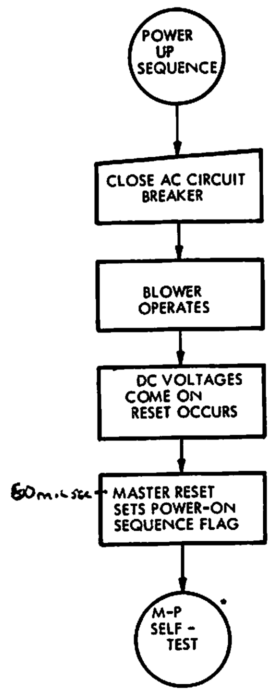
Flow charts illustrating microprocessor operation sequences are given in Figure 4-16 through 4-27.

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




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

*FIGURE 4-18

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

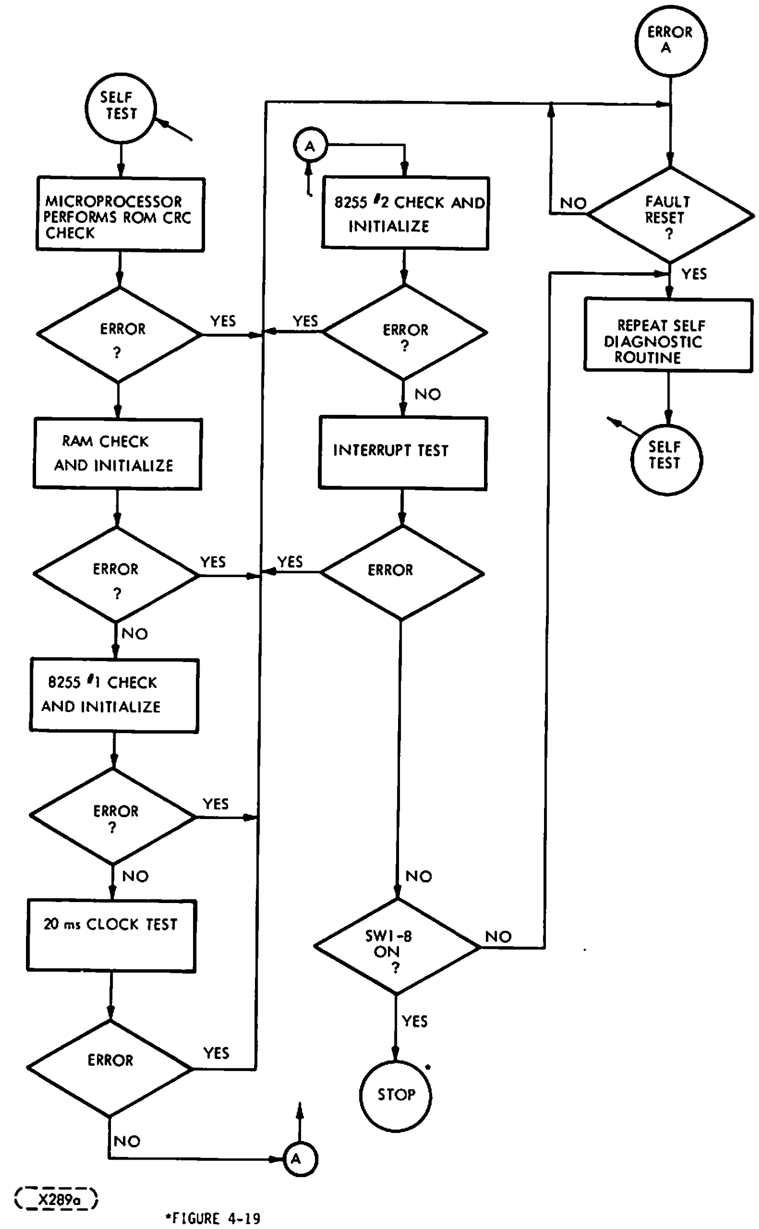



FIGURE 4-18. INITIALIZATION AND SELF TEST SEQUENCE FLOW CHART

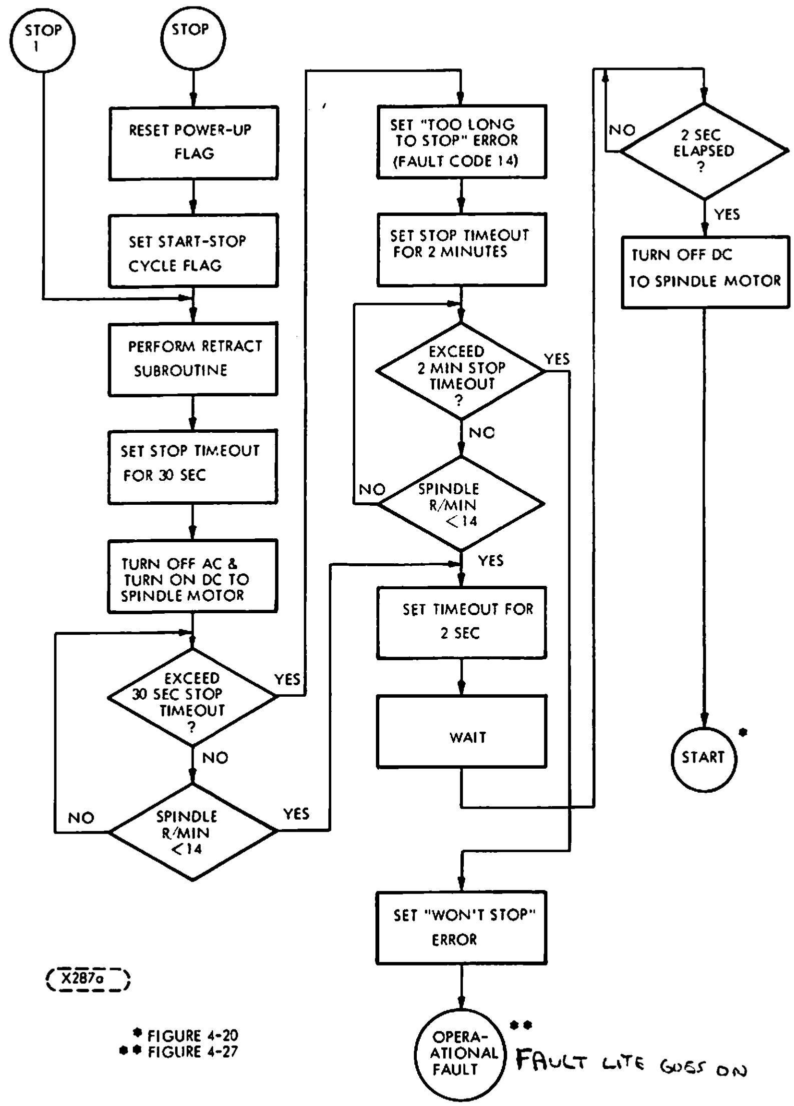



FIGURE 4-19. STOP SEQUENCE FLOW CHART

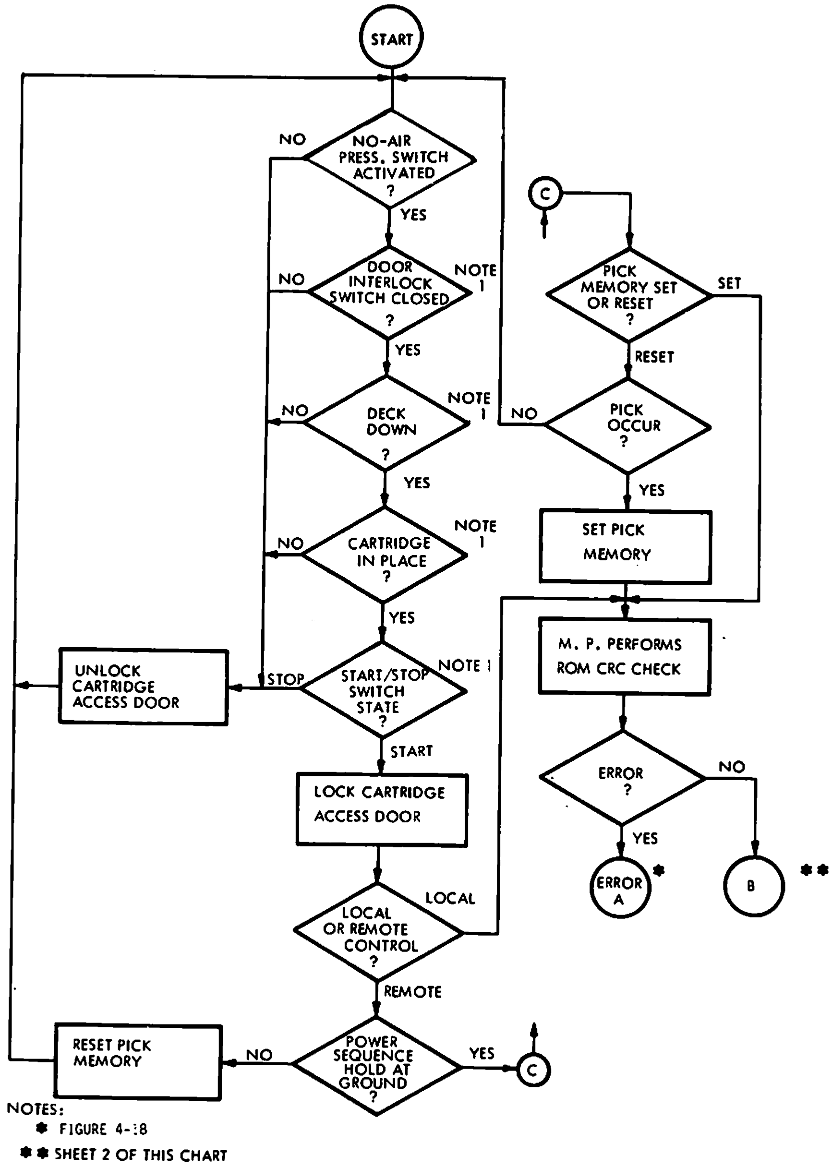
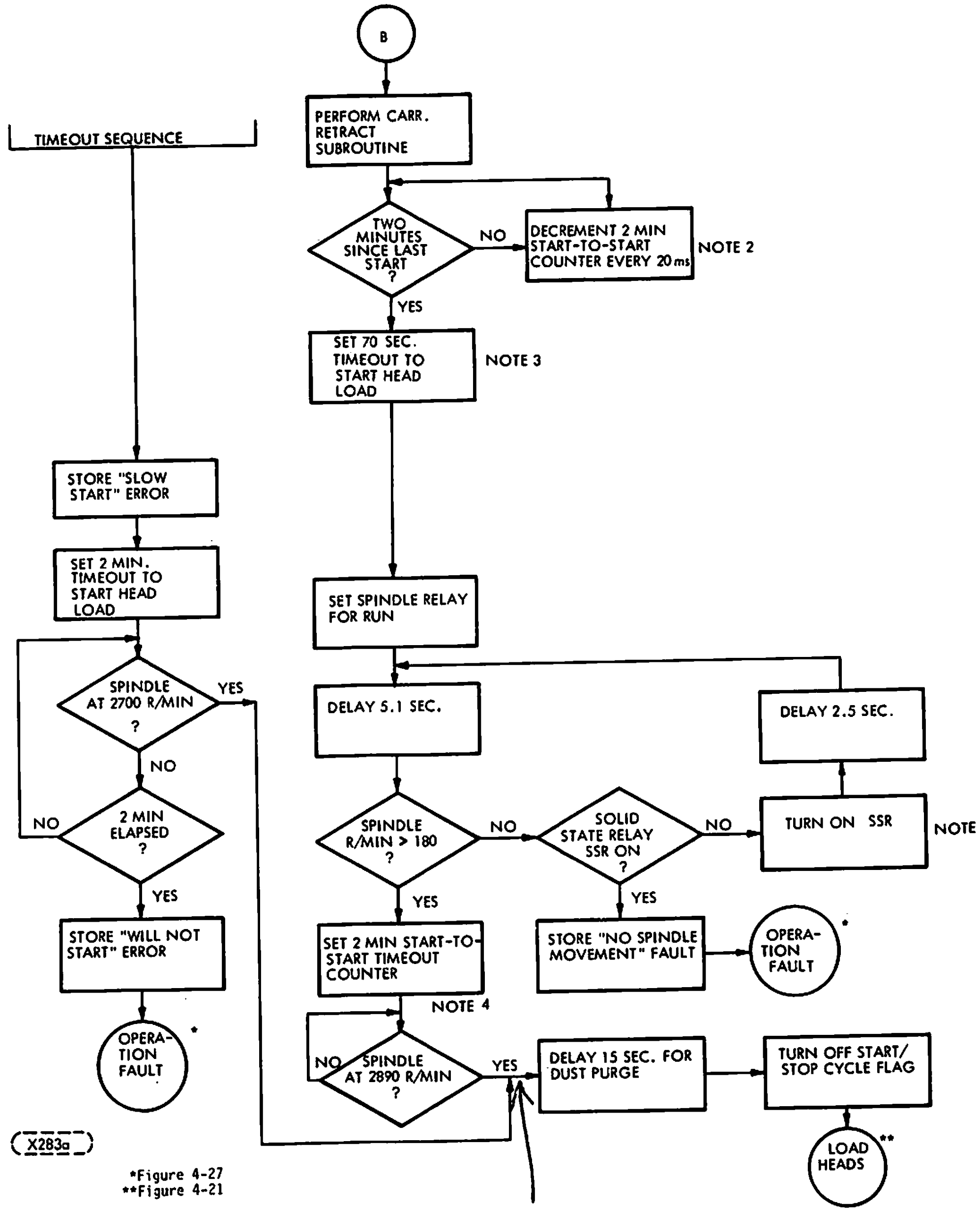



FIGURE 4-20. MICROPROCESSOR START SEQUENCE FLOW CHART (SHEET 1 OF 3)




UP TO SPEED
CANCEL 70 SEC TIMER
SEQUENCE PICK FOR REMOTE POWER UP

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 it was found that the START/STOP switch indicates Start. However, a two minute timer will not allow operation to procede 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)

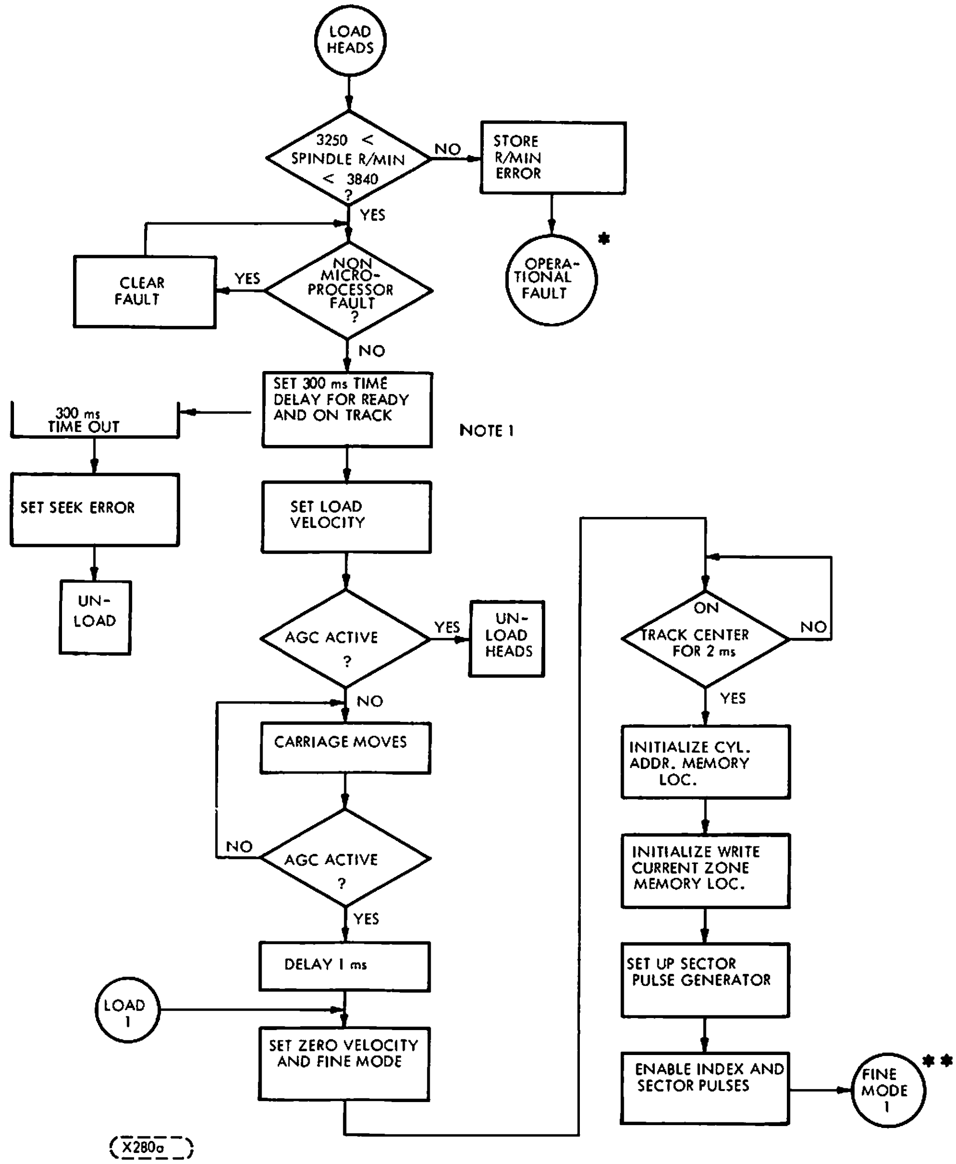



*FIGURE 4-27
**FIGURE 4-24

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 4-21. LOAD HEADS SEQUENCE FLOW CHART SUPPLEMENTARY NOTES

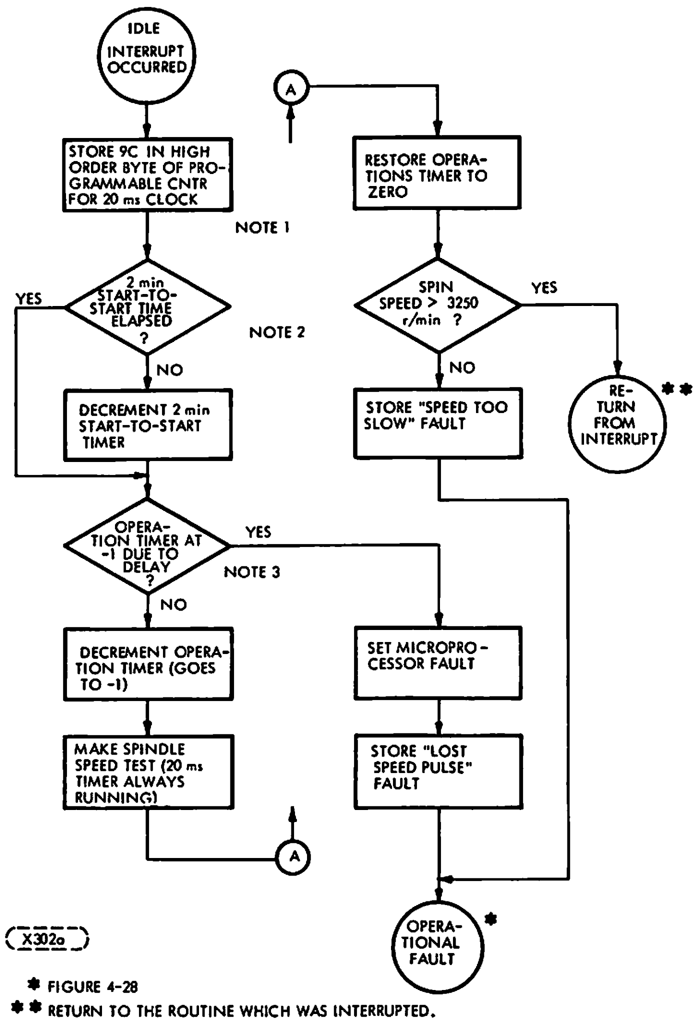



FIGURE 4-22. 20 MS CLOCK SEQUENCE FLOW CHART (SHEET 1 OF 2)

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 Powr-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 times 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 come 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)

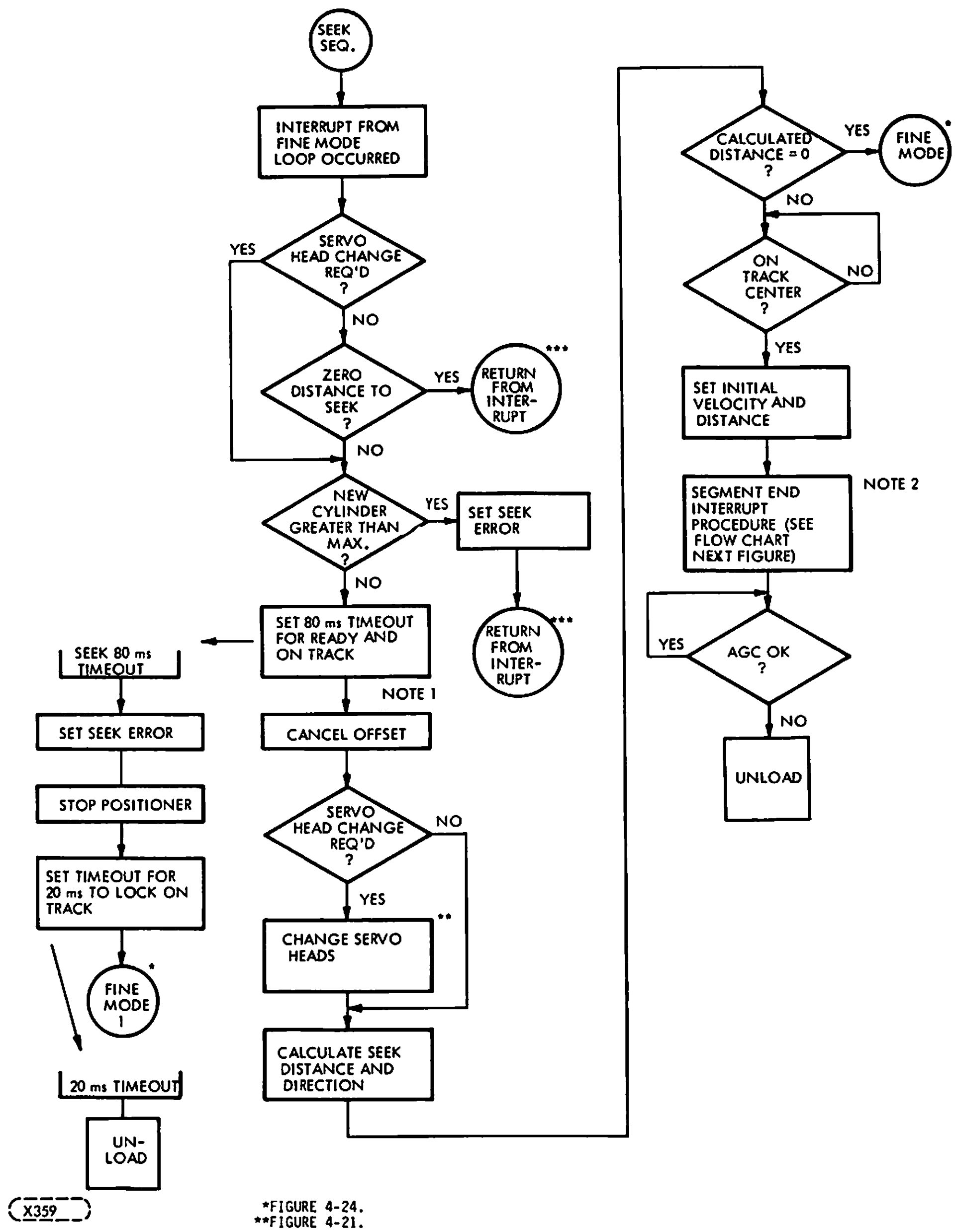



*FIGURE 4-24.
**FIGURE 4-21.
*** RETURN TO ROUTINE WHICH WAS INTERRUPTED

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

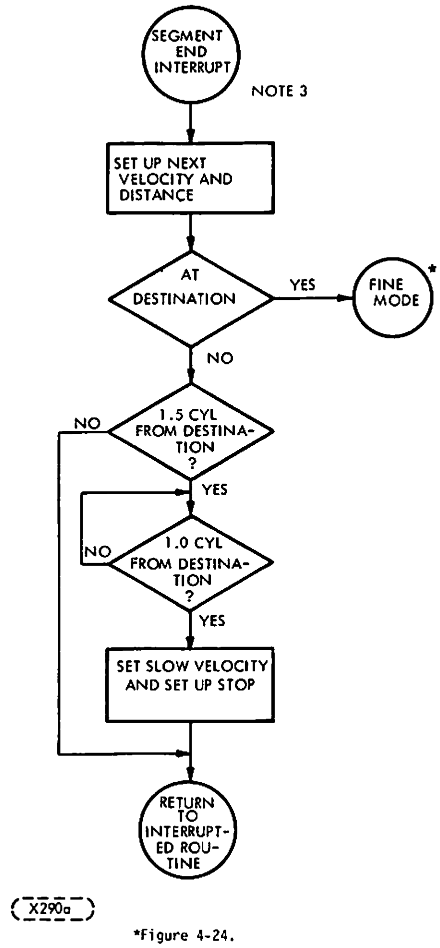



FIGURE 4-23. SEEK AND SEGMENT END INTERRUPT SEQUENCES FLOW CHARTS (SHEET 2 OF 3)

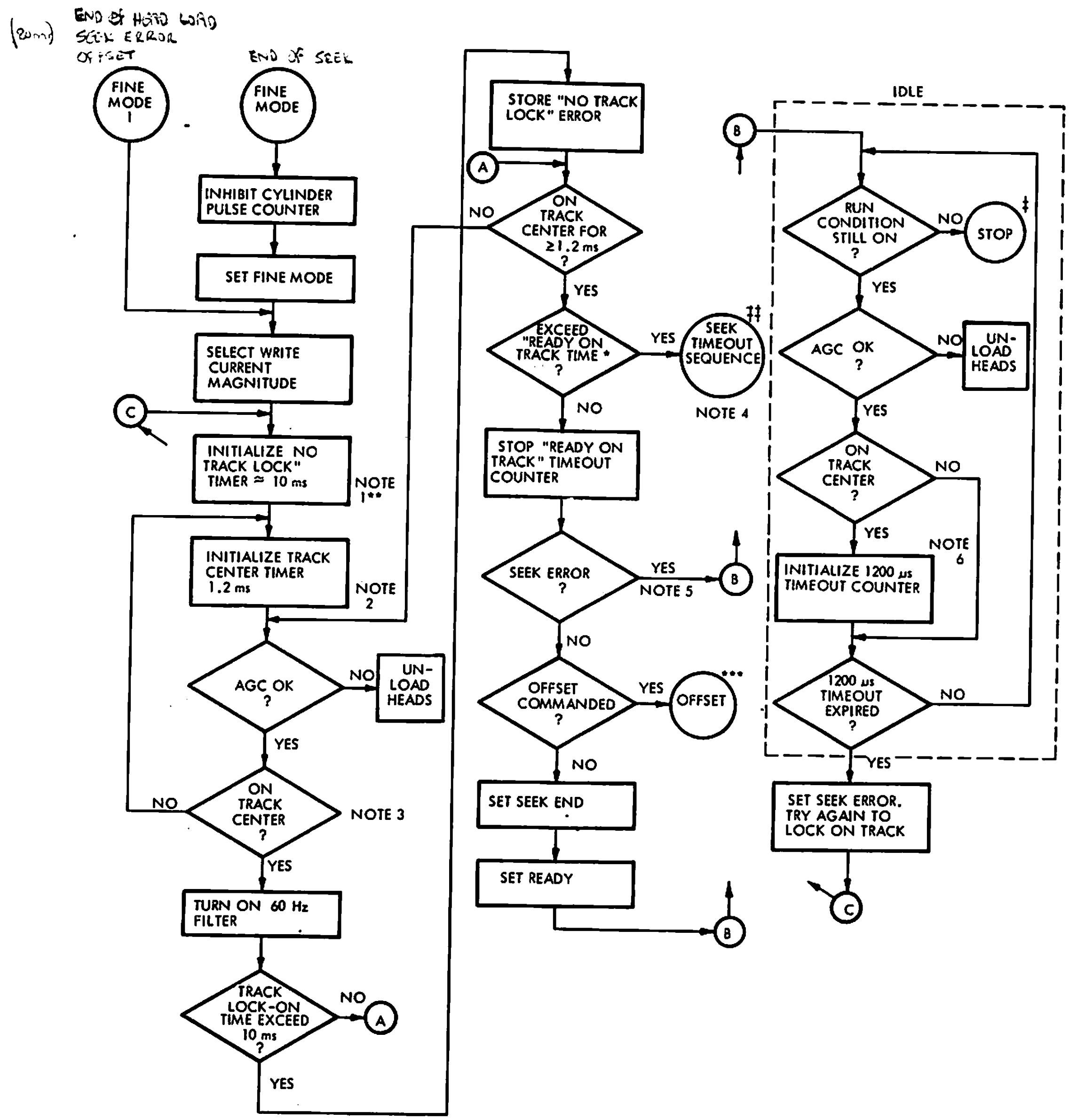
| Figure 4-23. Seek Sequence Flow Charts Supplementary Notes |
|---|

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 Inerrupt" 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 operaton) 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 occured 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 us 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 us 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 us counter operation is suspended until operation returns. |

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

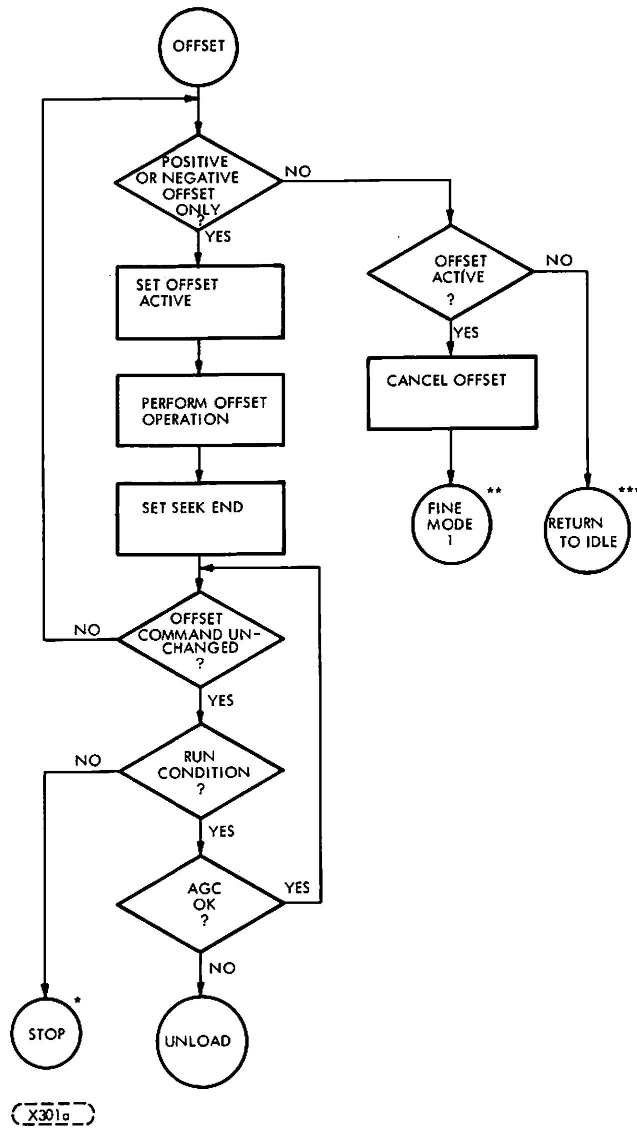



*FIGURE 4-19
**FIGURE 4-24
***FIGURE 4-16

FIGURE 4-25. OFFSET SEQUENCE FLOW CHART

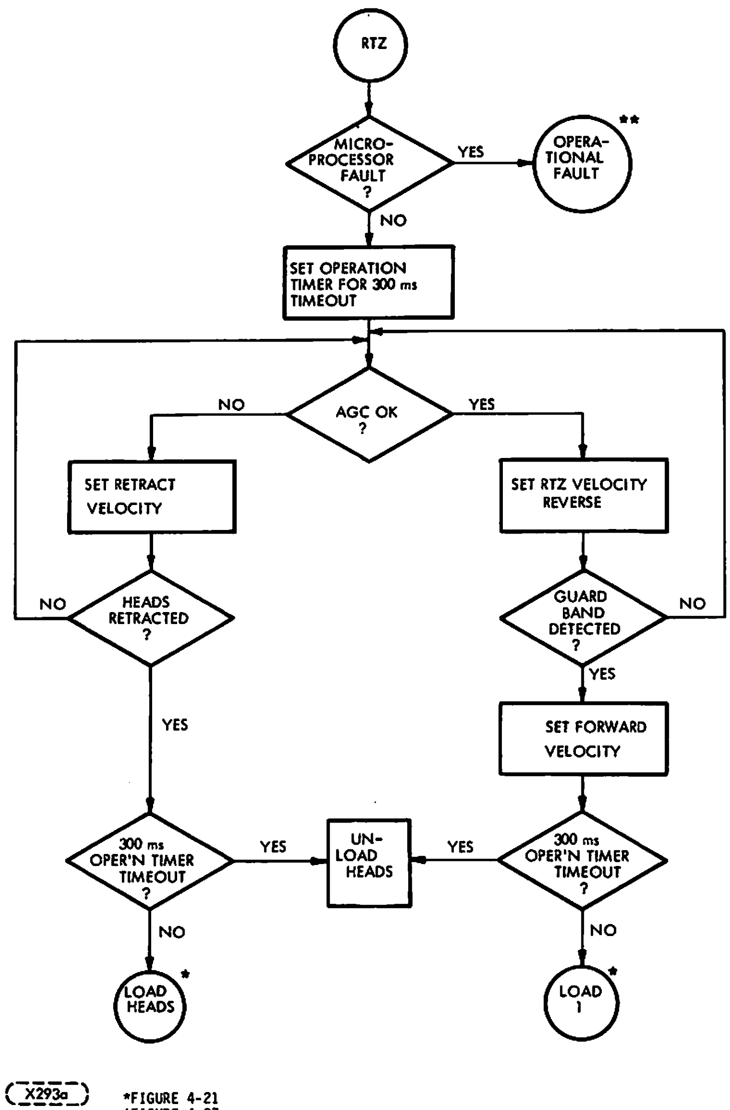
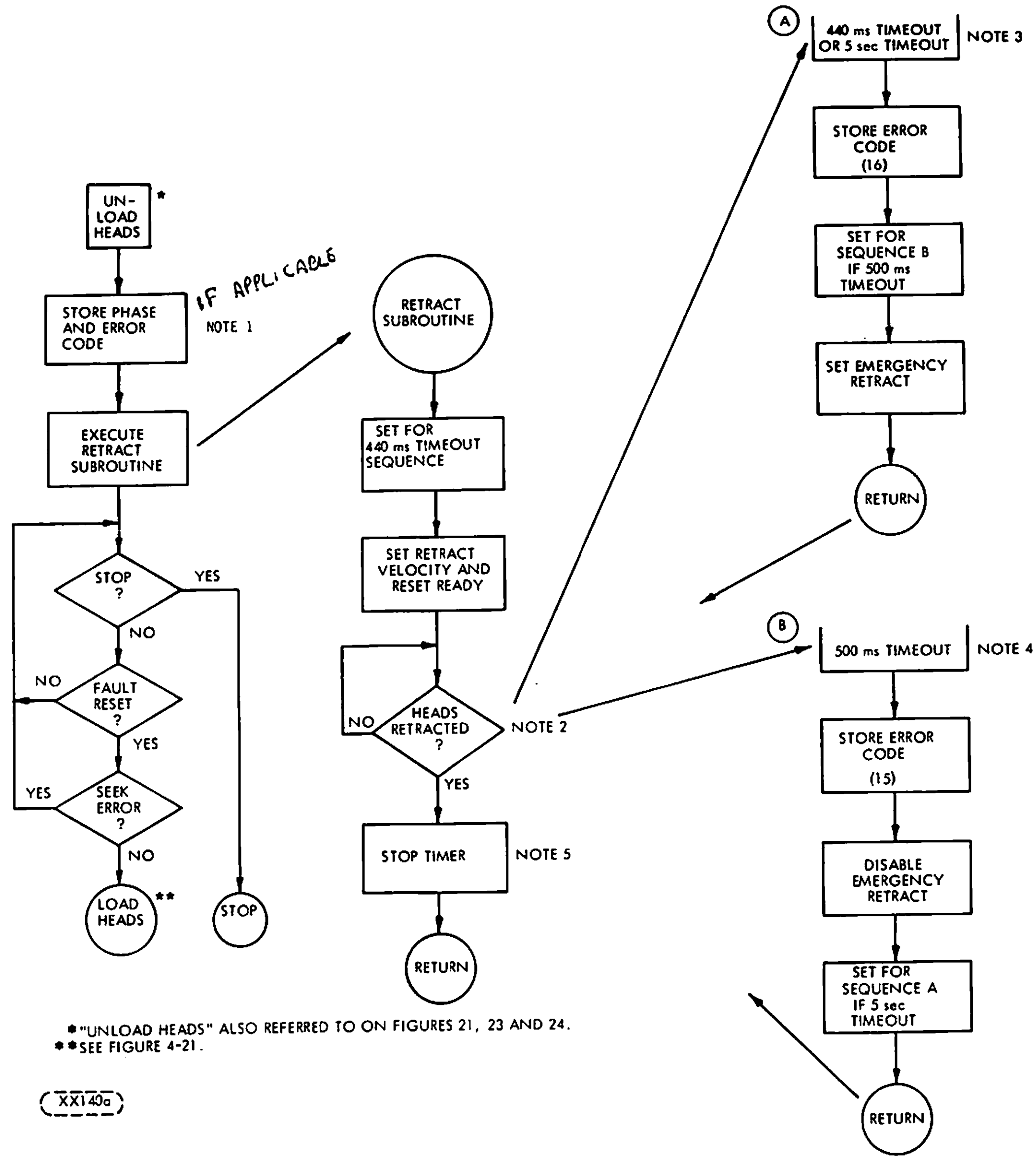



*FIGURE 4-21
**FIGURE 4-27

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




*"UNLOAD HEADS" ALSO REFERRED TO ON FIGURES 21, 23 AND 24.
**SEE FIGURE 4-21.

XX140a

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 Note 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)

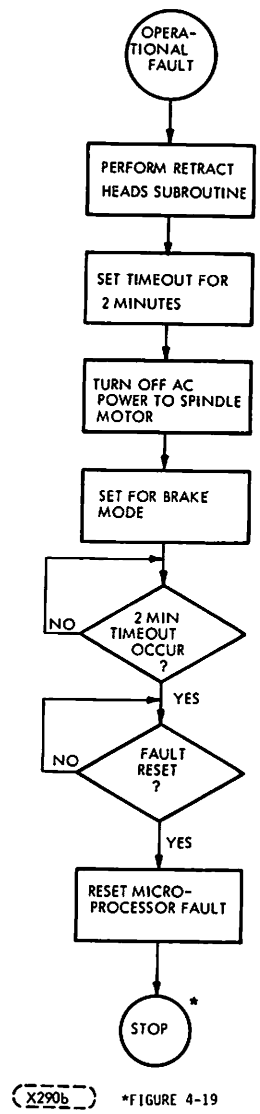



FIGURE 4-27. OPERATIONAL FAULT SEQUENCE FLOW CHART

## 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.

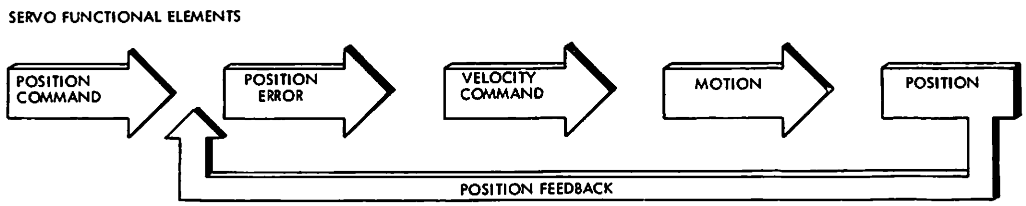
    c. Signals that indicate that the position of the heads is outside of the region of the normal data cylinders.

    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.



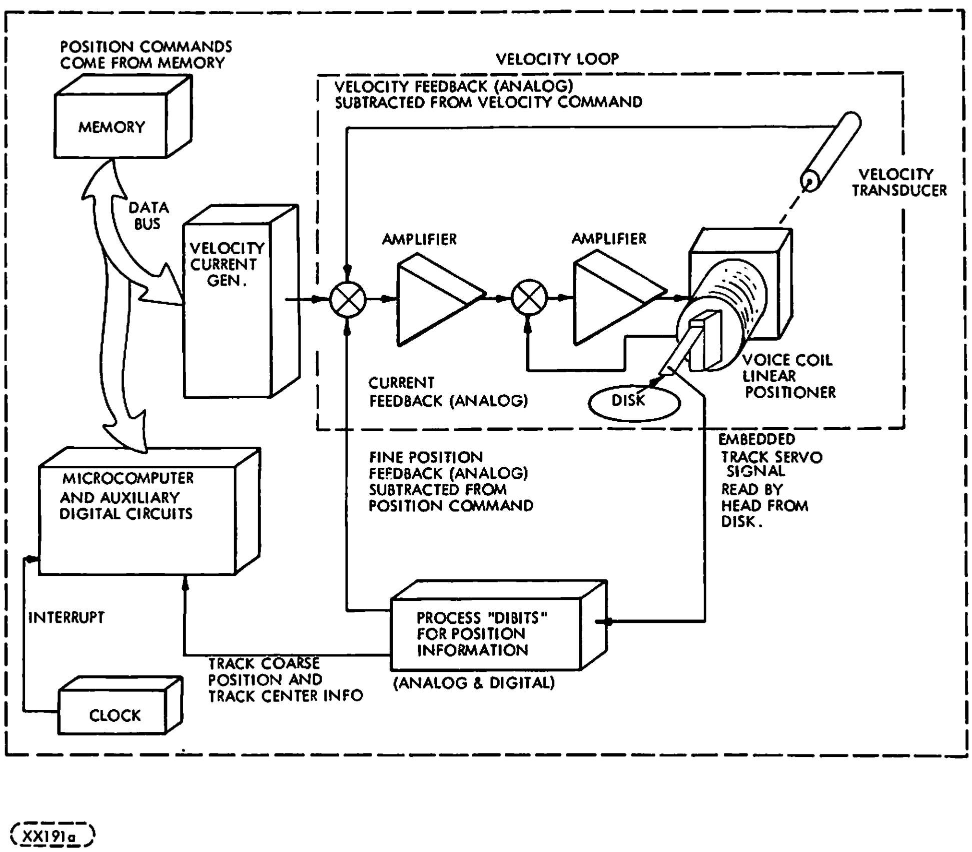




FIGURE 4-28. SERVO SYSTEM GENERAL BLOCK DIAGRAM

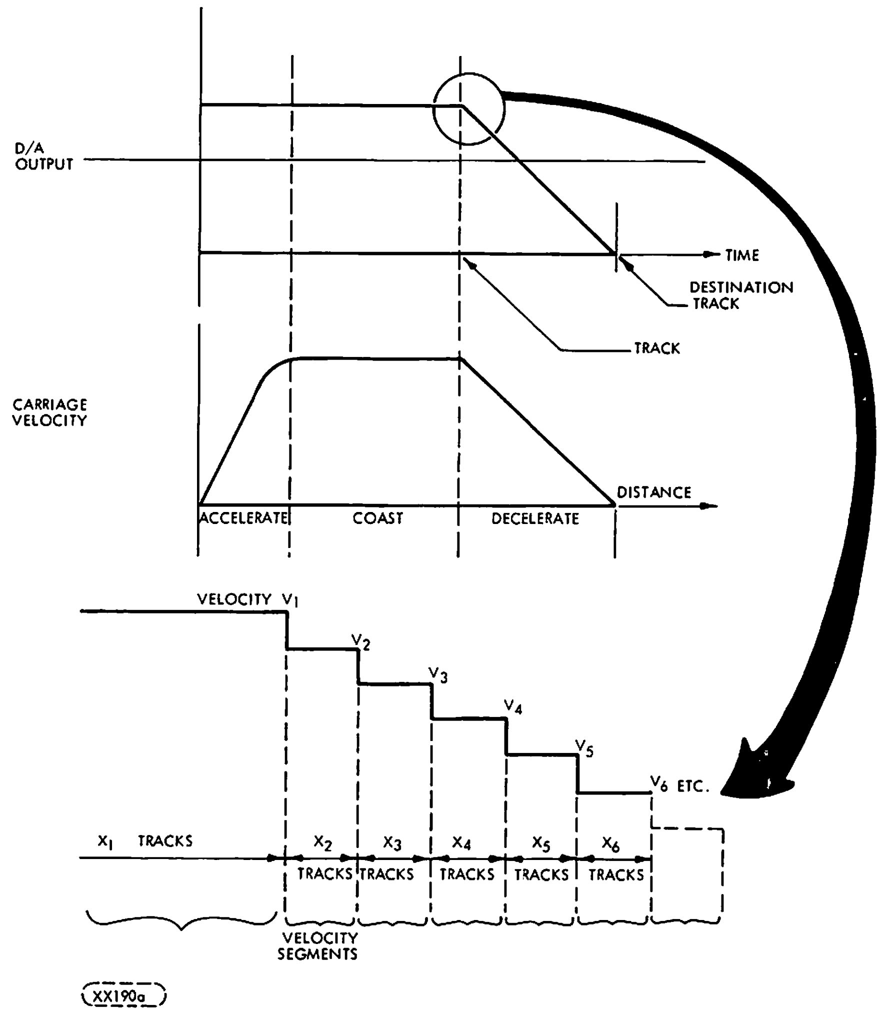



FIGURE 4-29. SEEK VELOCITY PROFILE

## 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. As positive dibit consists of a positive-going 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. This 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 psoition, 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.

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 signals 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 dectector. 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 onehalf track of a seek or during a Load sequence. The cylinder detect circuit generates cylinder pulses as the track servo signal approaches a null.

The track servo circuit remains active following completion of a sek. 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 is proportion to signal strength: the stronger the signal, the less negative the agc voltage. This 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 determines when the heads are positioned outside of the normal data cylinders. This function is used during Load and RTZ sequences and to indicate an error condition during a seek. Reverse EOT indicates that the heads are positioned over the outer guard band. If this condition occurs during regular reverse seeks, the microprocessor is informed and it initiates a sequence to return the actuator to cylinder 000. Loss of the AGC-ACTIVE/-L signal also provides the microprocessor with the information that the heads are positioned outside the normal cylinder area.

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 Schmitt-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 withint 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 opearation refer to Figures 4-30, 4-31 and -432 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 of 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 othe branch provides the reference signal for the Phase Locked Loop (PLL) circuits. The PLL operation will be described first.

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 phaselocked 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.

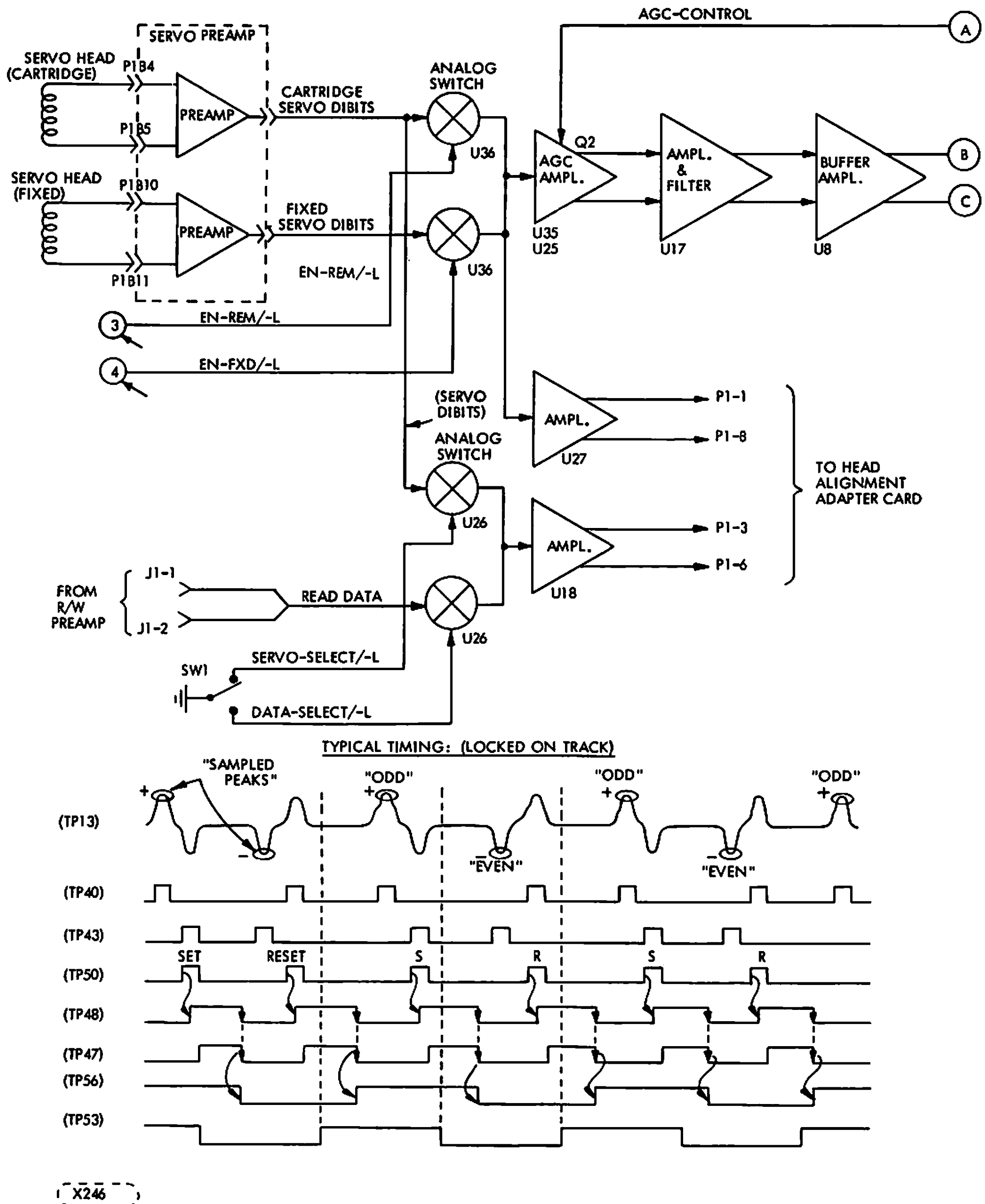



FIGURE 4-30. BLOCK DIAGRAM OF SERVO FINE CIRCUITRY
(SHEET 1 OF 2)

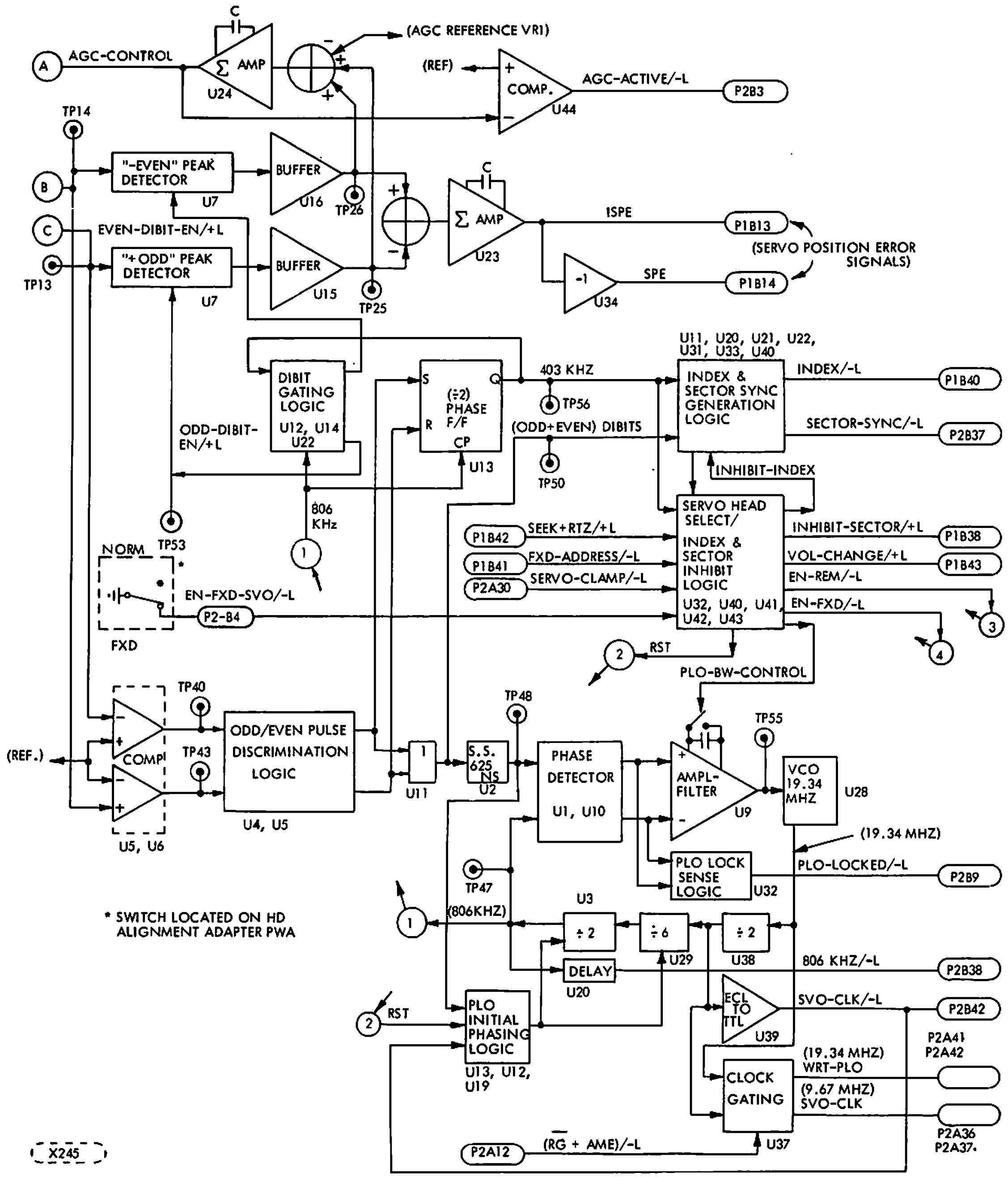



FIGURE 4-30. BLOCK DIAGRAM OF SERVO FINE CIRCUITRY (SHEET 2 OF 2)

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 TP50. 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 increases 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 frequence 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/+l (TP53) and EVEN-DIBIT-EN/+L in the peak detector U7. The peak detector citcuits 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 outpus (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.

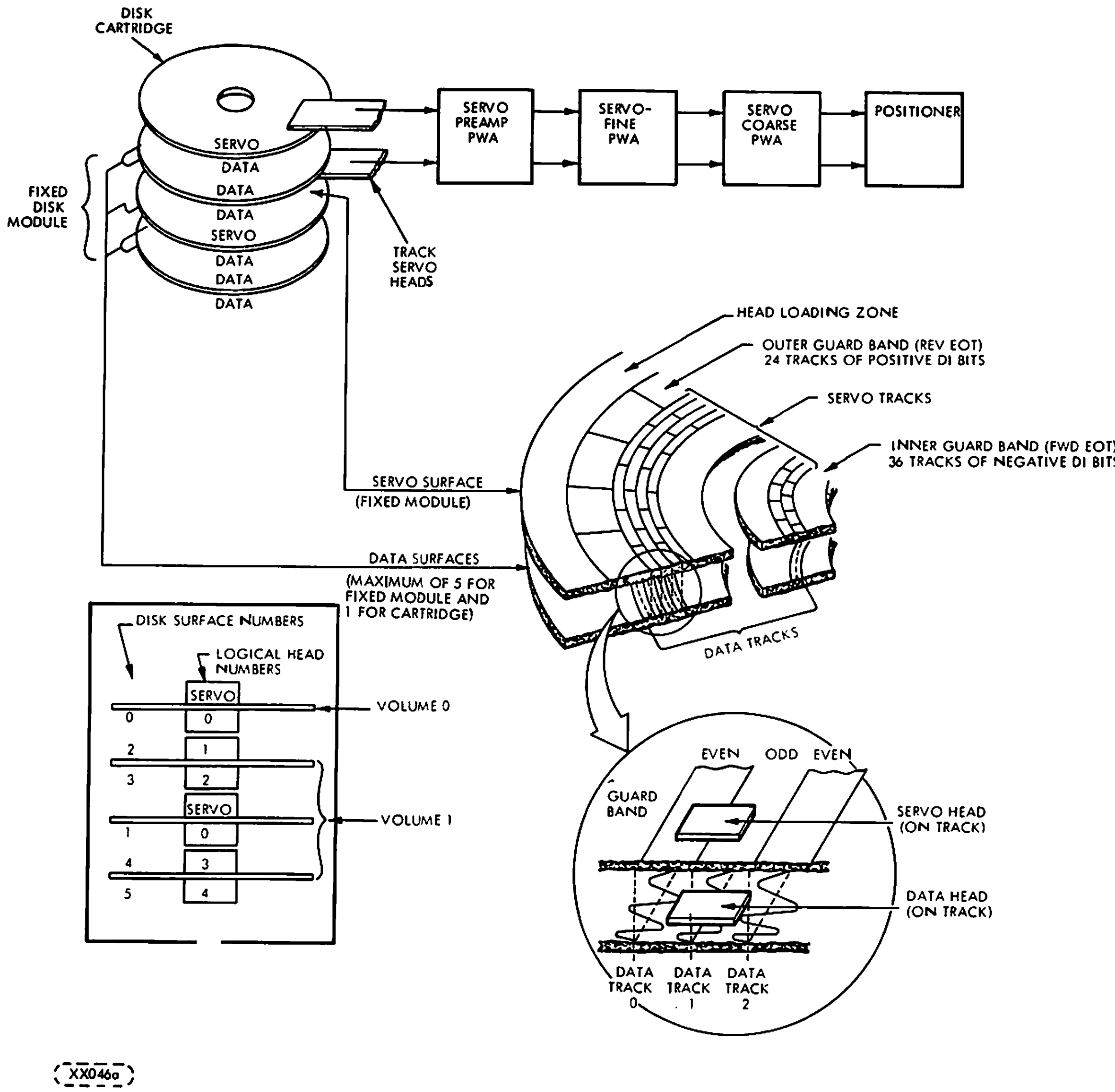



FIGURE 4-31. TRACK AND SERVO DISK LAYOUT

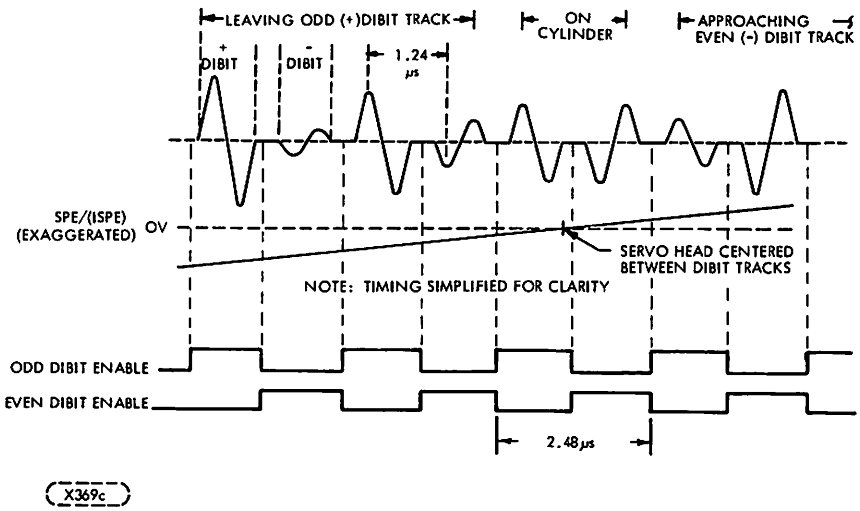



FIGURE 4-32. SERVO SYSTEM WAVEFORMS - POSITIONER IN MOTION

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 3.9 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 U8, two op amps U19, analog switch IC U9 and two gate circuits U7 and U15 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 two different resistances on the U19 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 U9-9, 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 swithc U9-10, 11 to allow a higher range of currents to be input to the summing amplifier U30. 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 (U15-13). A positive offset (U15-13, Low) places the heads closer to the spindle center.

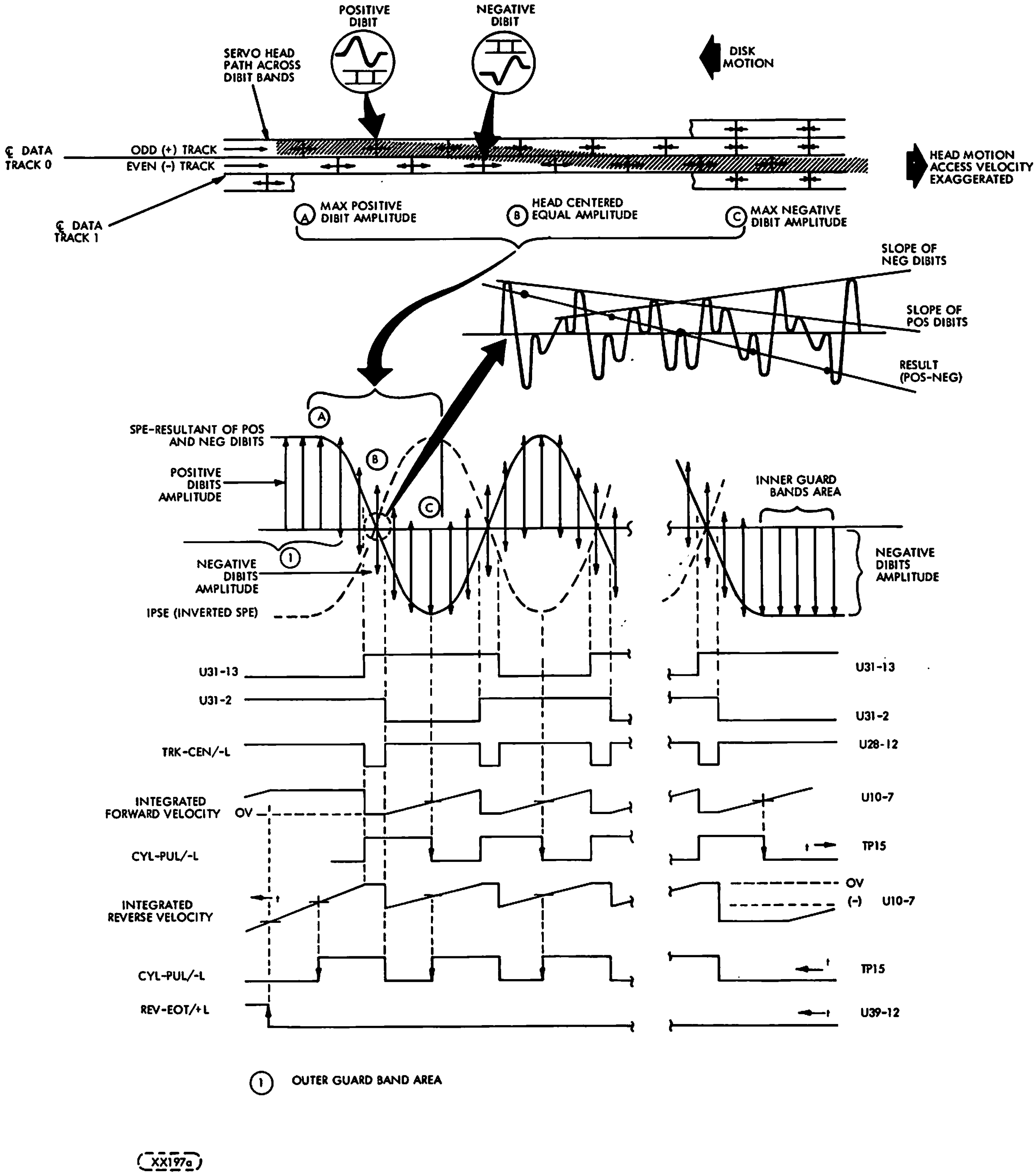



FIGURE 4-33. TRACK CENTER AND CYLINDER PULSE GENERATION

The controller commands this capability in an attempt to recover data that is slightly off track. Analog switches U9-3 and U9-6, operated by FWD-SK-OFFSET+/ -L, decide the input configuration of op amp U19-7: R32 either has ground on it or the output of op amp U19-1. The latter condition provides a positive drive to the summing amplifier U30. U19-7 is a unity gain amplifier which inverts or does not invert the drive signal, depending on whether analog switch U9-3 is open or closed. U9-14 attenuates the drive signal if the +5 volts is lost. Summing Amplifier U30 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 U10-14 supplies current to drive the two transistros Q1 and Q2 which drive the power amplifier on the Power Amp PWA. U10-14 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-RLY/-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 U11 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 U11 feeds back the velocity signal into the actuator drive circuitry at the summing node before amplifier U30. 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 Accelleration 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 U10 and summed in with the actuator drive signal at a summing junction between the 3.9 kHz notch filter and another amplifier, also in U10. 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 U41 controls the retract velocity of the carriage in the following manner. Resistor R98 (on U41 pin 8) programs the quiescent currents within the op amp U41 so that capacitors C69 and C70 can hold enough charge after power is lost to allow retraction to be completed at the proper rate. U41 operates as a velocity reference and compares the velocity signal directly from the Velocity Transducer with the reference voltage at U41-2 and thereby limits the drive current provided to transistor Q4. The amplifier chain Q4 and Q3, and Q1 on the Powr 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 signal 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. Comparator U31 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 +5V logic voltage drops. This will cause an emergency retract before the logic voltage drops completely.

## Compensation Circuitry

The compsensation feedback network around U10, 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 non-linearity of Q1 and Q2.

The U30 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 U30 is an active notch filter, centered at 3.9 kHz. This includes the circuitry from U30-6 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 U19, U28 and U29 essentially produces an increase in gain of 5: 1 for the SPE and ISPe signals (switched by U40-6, 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 ontrack 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.

*SI units, means Revolutions per Minute.

The signal FN-TRK-CEN/+L operates the analog switch U29-6, 7 and U29-14, 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.

Track Center Detection Circuitry

To generate a pulse at the center of each servo track. two comparators (U31) and a schmidt trigger (U28) 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 trough PPI #2. To generate TRK-CEN/-L, comparator U31-13 is driven Low (0V) during most of the positive half of SPE and comparator U31-2 is driven Low (0V) 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 Schmitt trigger circuit U28 squares up the pulses and inverts them, thus creating the TRK-CEN/-L signal. The relationship between SPE and TRK-CEN/-L is shown in Figure 4-33.

Cylinder Pulse Generaion Circuitry

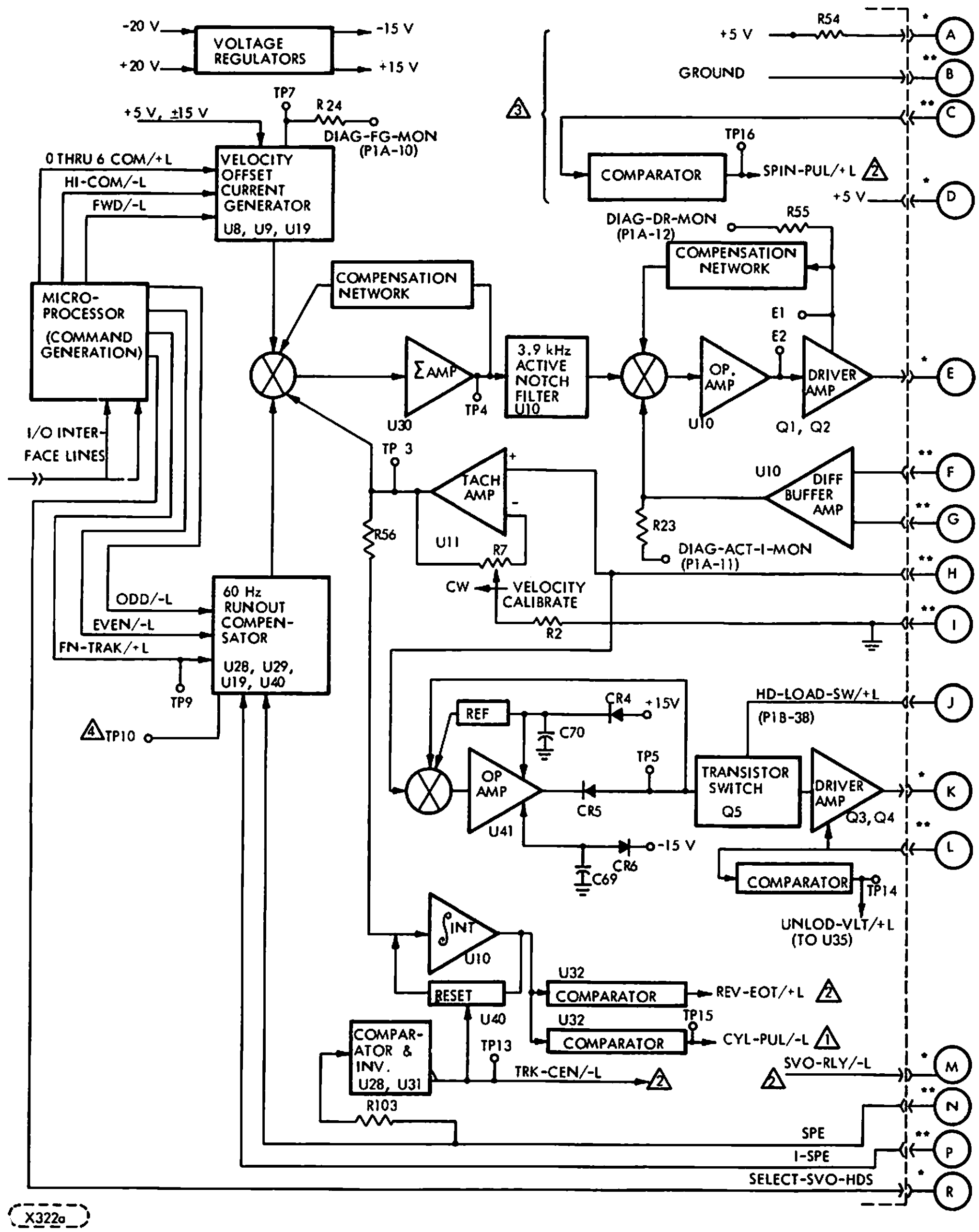
The track center signal TRK-CEN/-L resets integrator U10 by closing analog switch U40-10, 11 and shorts VEL to ground using switch U40-2,3. The integrator U10 integrates the VEL signal (TP3) which represents the head and carriage velocity. Because the inegrator is reset by the track center signal, integrated output U10-7 is proportional to the distance traveled by the heads after the track center signal goes false. Comparators U32-13 and U32-2 compare the integrator output level (U10-7) 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 U10-7. Figure 4-33 shows the timing relationships 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 U10-7 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 at a point representing the data track center.

## 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 loading of the heads and 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 U10-7 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 U32-1 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 (0.061mm) 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 U31-1 squares up the edges of the pulse from the light sensing transistor and sends the pulse (TP16) on to the pulse shrinking circuit made up of U28, U39, U44 and U45 plus the delay filter R110 and C67. This pulse shrinking circuit produces a 1 μsecond negative going pulse at U45-3 at the point in time when the trailing positive going edge of the 120 μsecond 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 U36.




*Notes on Sheet Three

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

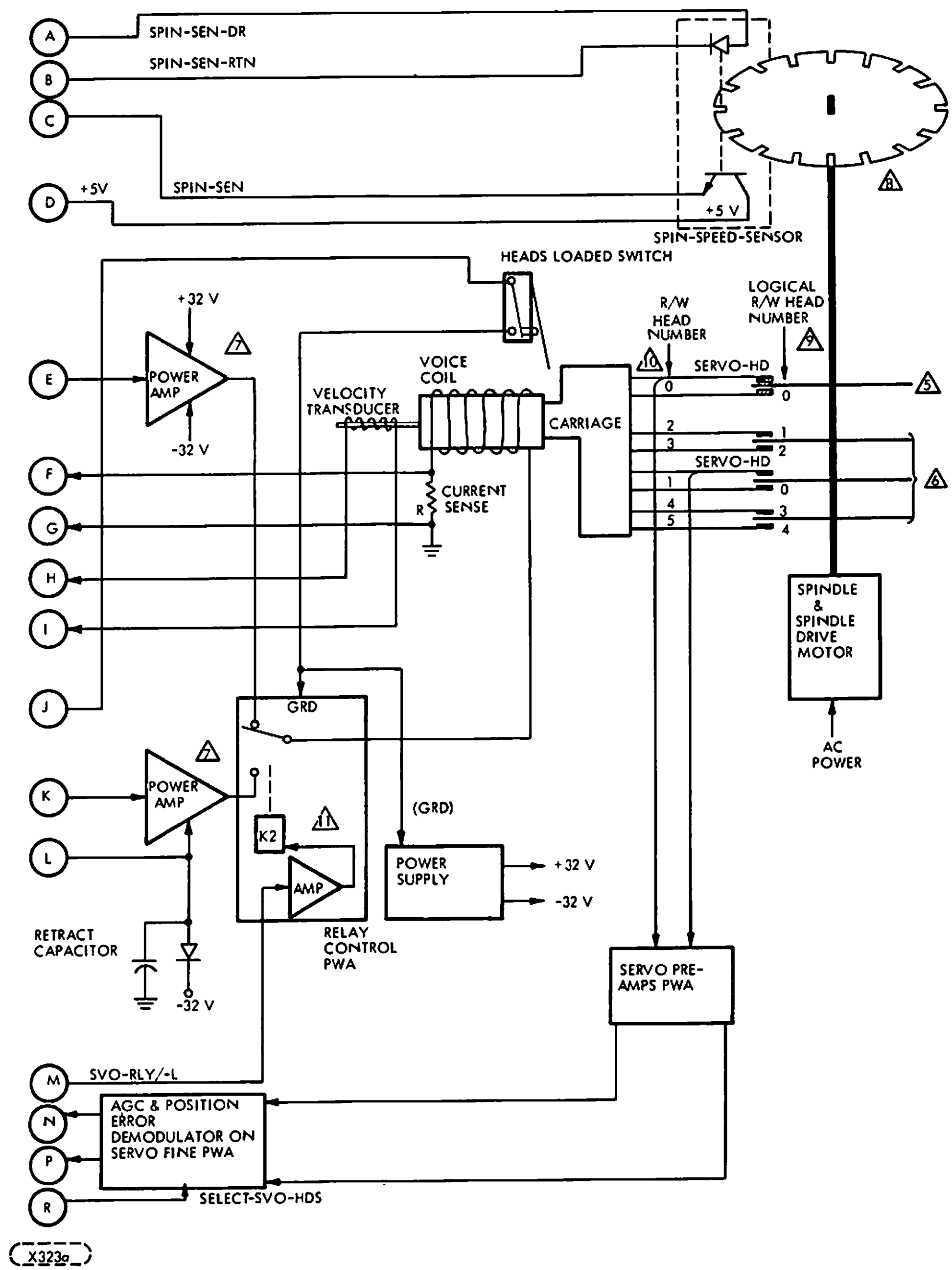



FIGURE 4-34. BLOCK DIAGRAM OF ANALOG PORTIONS OF SERVO SYSTEM (SHEET 2 OF 3)

NOTES:

*Outputs to circuitry external to Servo-Coarse PWA

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

△1 To cylinder pulse shrinker (U28, U37, U15), then to M.P. Programmable Interval Timer U2 (8253).

△2 To M.P. via PPI U36.

△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 description 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 effects 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.

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 compulsary 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.

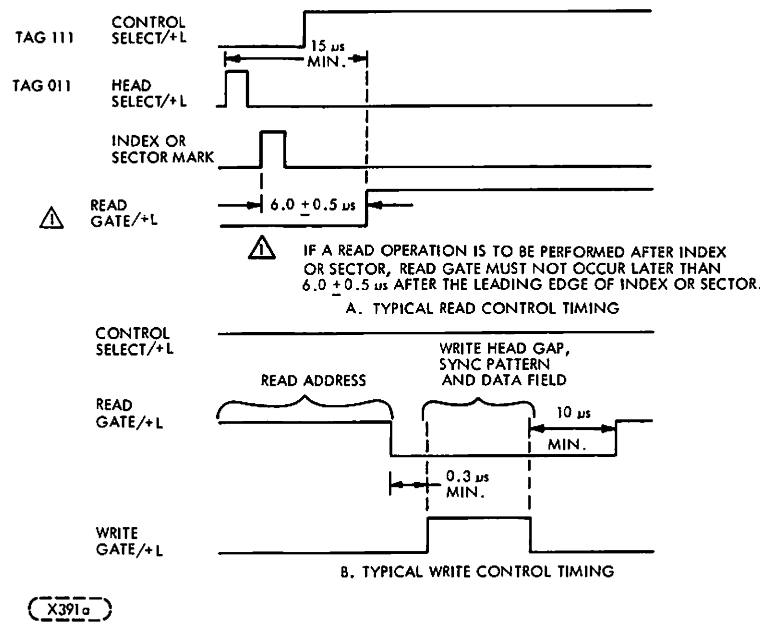



FIGURE 4-35. READ/WRITE CONTROL TIMING

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 ØA, ØB which are used to clock the registers. A specific serial output of the shift register is used along with the ØA 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 labled "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:

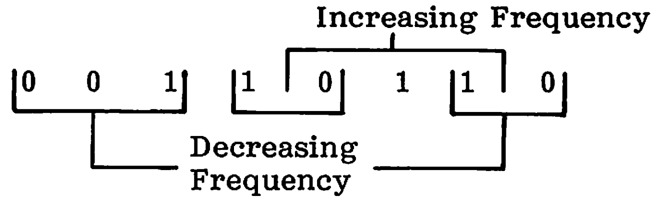
The pattern decode logic analyses the NRZ data and determines if its frequency is constant, increasing or decreasing. This is necessary because if the frequency is increasing or decreasing, problems can occur during subsequent read operations. These problems are eliminated by compensating the data before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




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 interrrupts 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).

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 in ÷ 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 below.

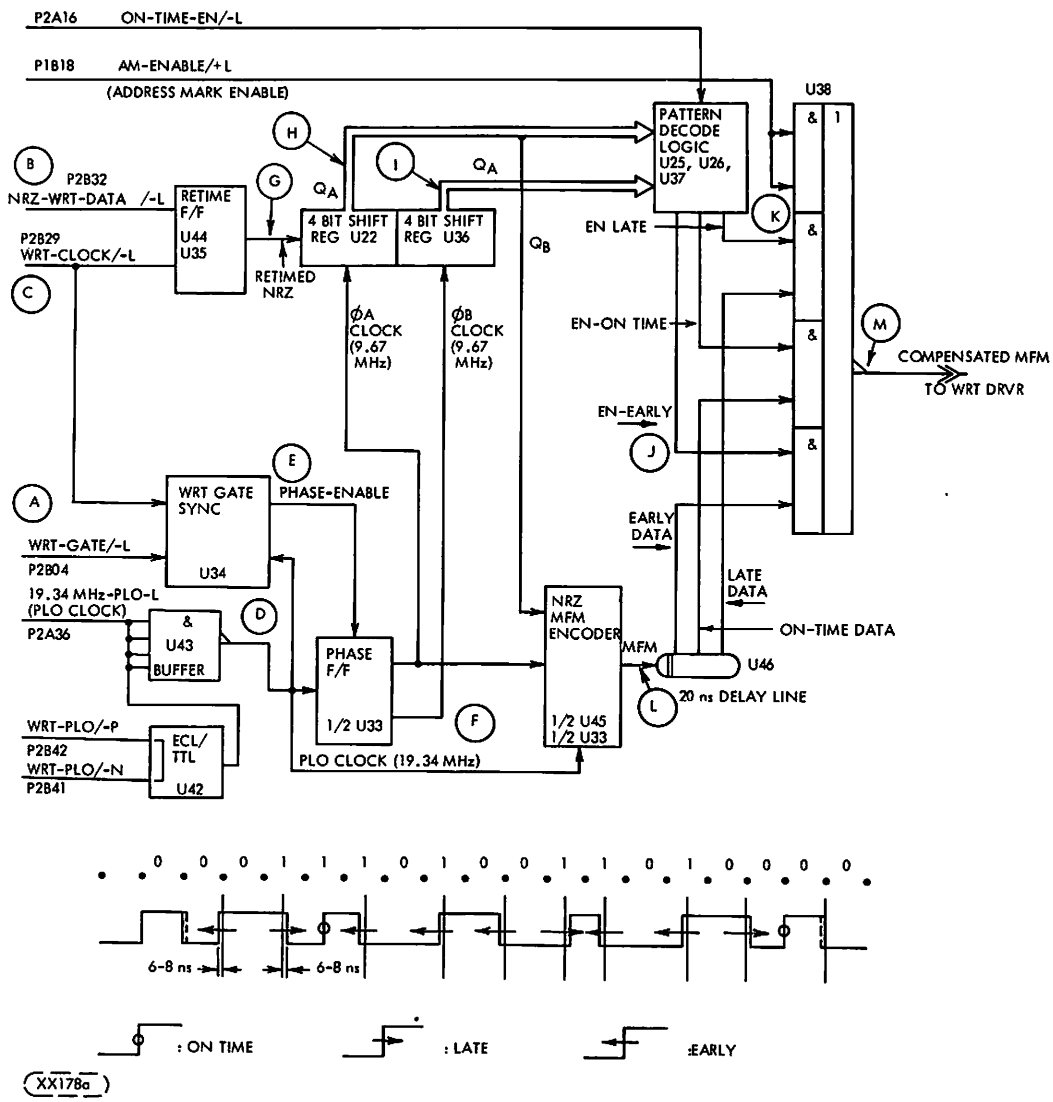



FIGURE 4-36. MFM ENCODER/WRITE COMPENSATOR

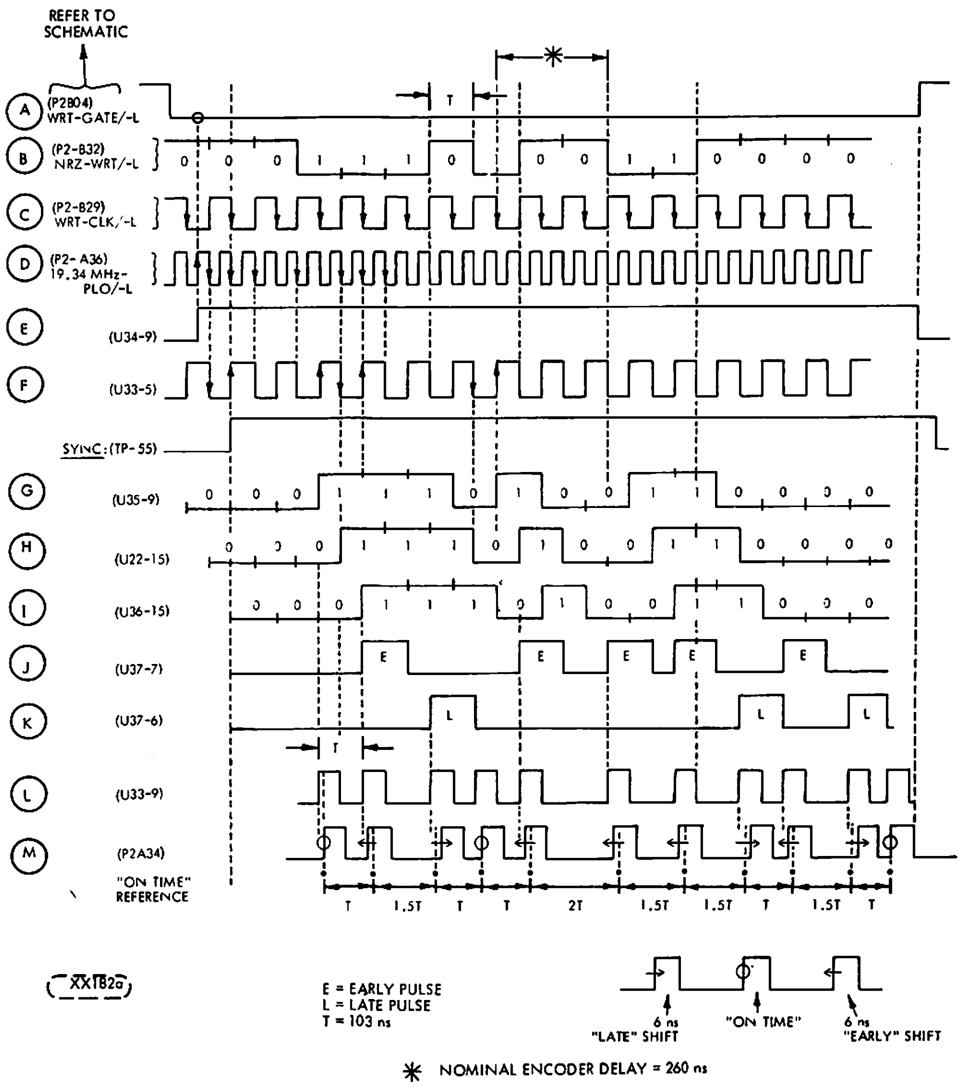



FIGURE 4-37. NRZ TO MFM ENCODER TIMING DIAGRAM

### 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 |

### 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 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 inadvertant write operation to occur while the heads are retracting.

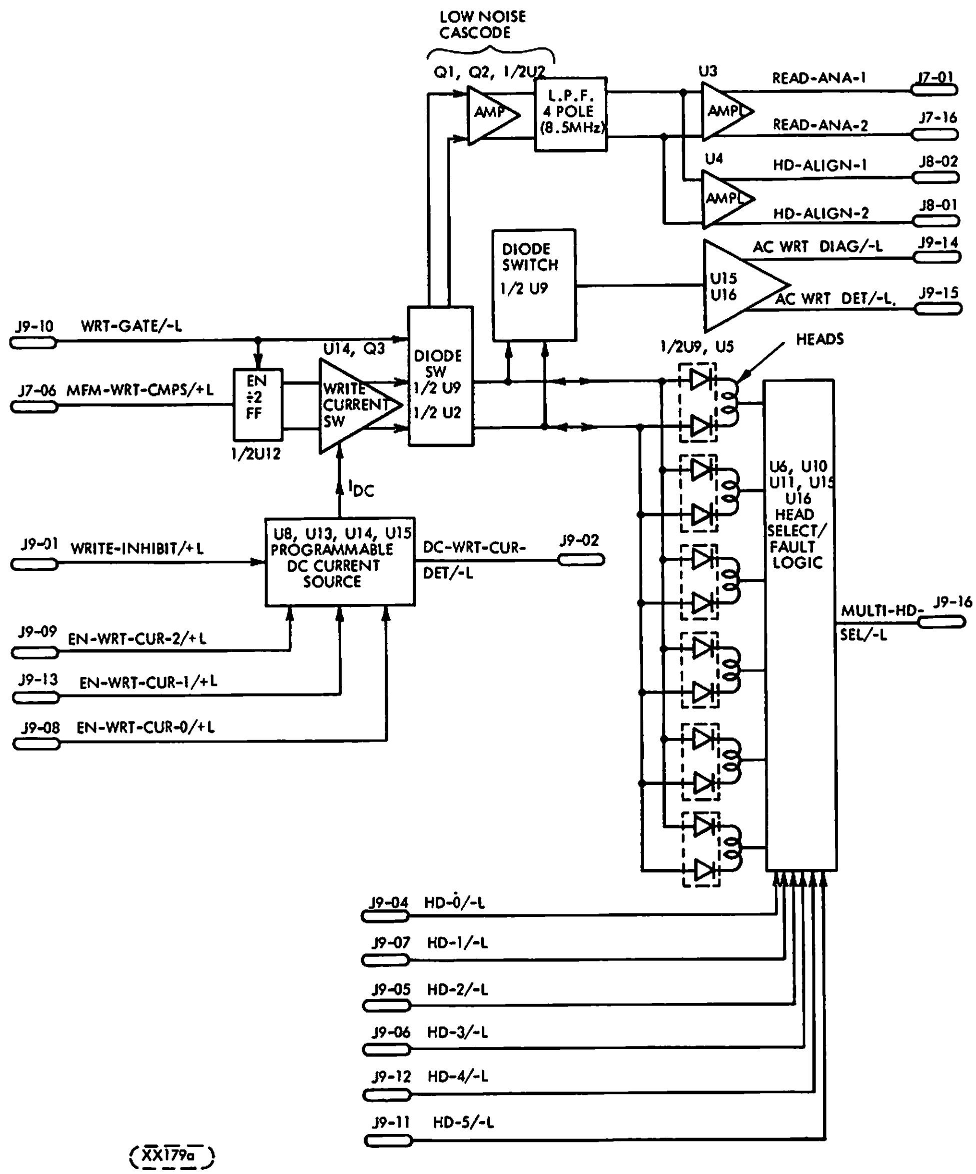



FIGURE 4-38. READ/WRITE PREAMP - BLOCK DIAGRAM

### 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.

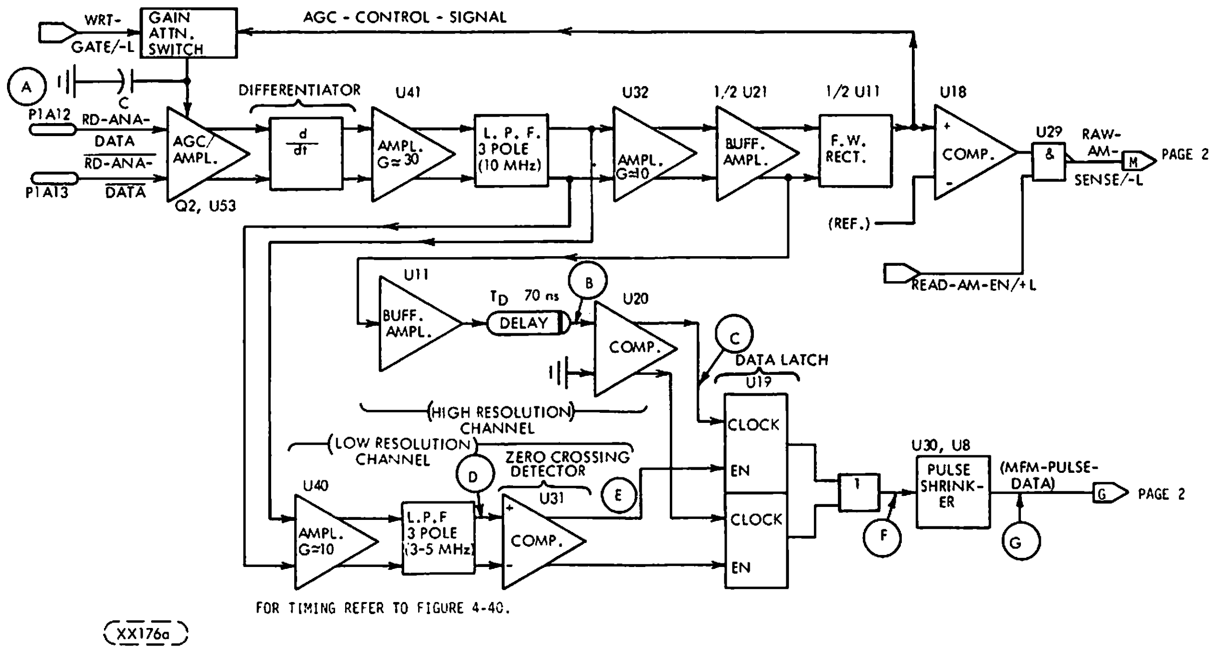



FIGURE 4-39. READ/WRITE - BLOCK DIAGRAM
P. 1/2 (ANALOG)

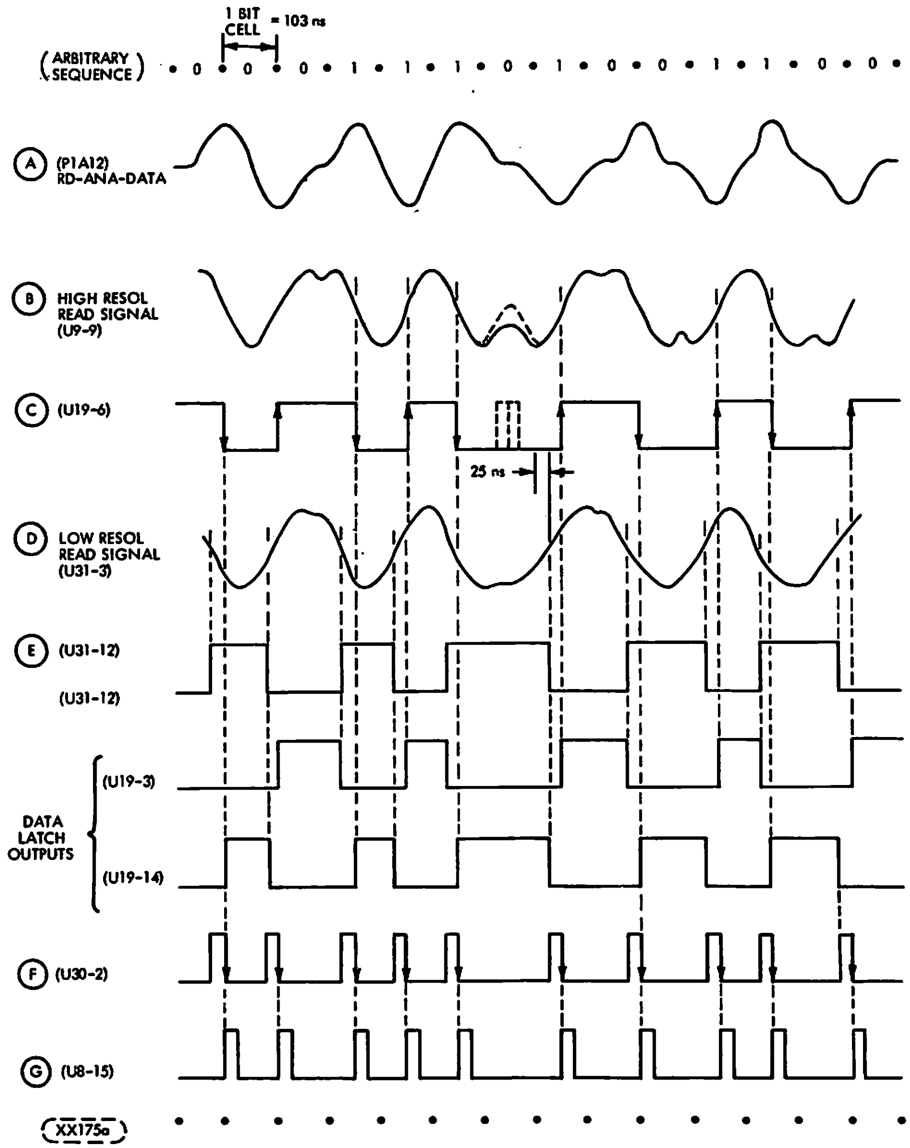



FIGURE 4-40. READ ANALOG/DATA LATCH TIMING DIAGRAM

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 Figures 4-42 and 4-43 and Sector Format diagrams in Figures 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 us max.

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 max 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 immeditately upon detection of leading edge of Read Command and continues for a period of 9 μs max. Data transmission will similarly begin before this time is exhausted, as shown by the Data Enable signal of timing diagram Figure 4-43.

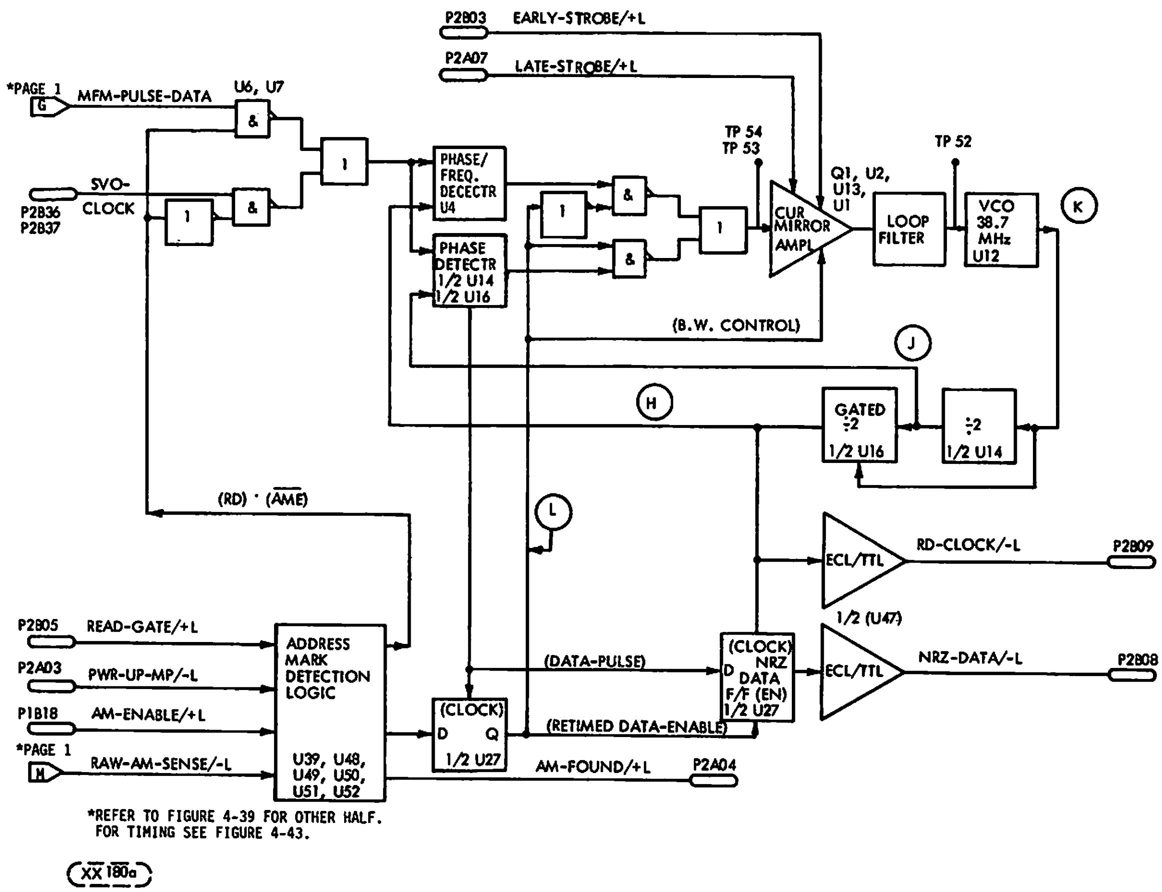



FIGURE 4-41. READ/WRITE - BLOCK DIAGRAM
P. 2/2 (DIGITAL)

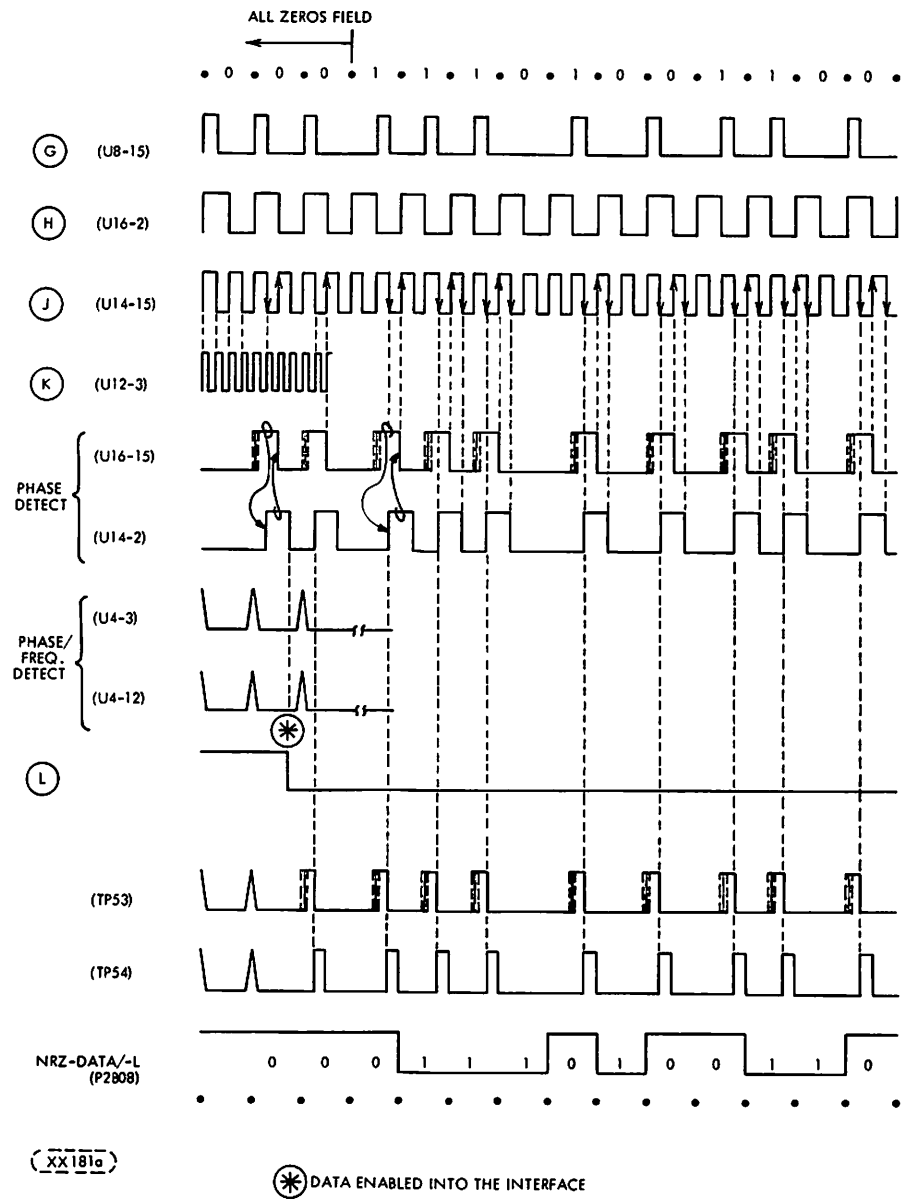



FIGURE 4-42. READ DIGITAL TIMING - PLL LOCKED

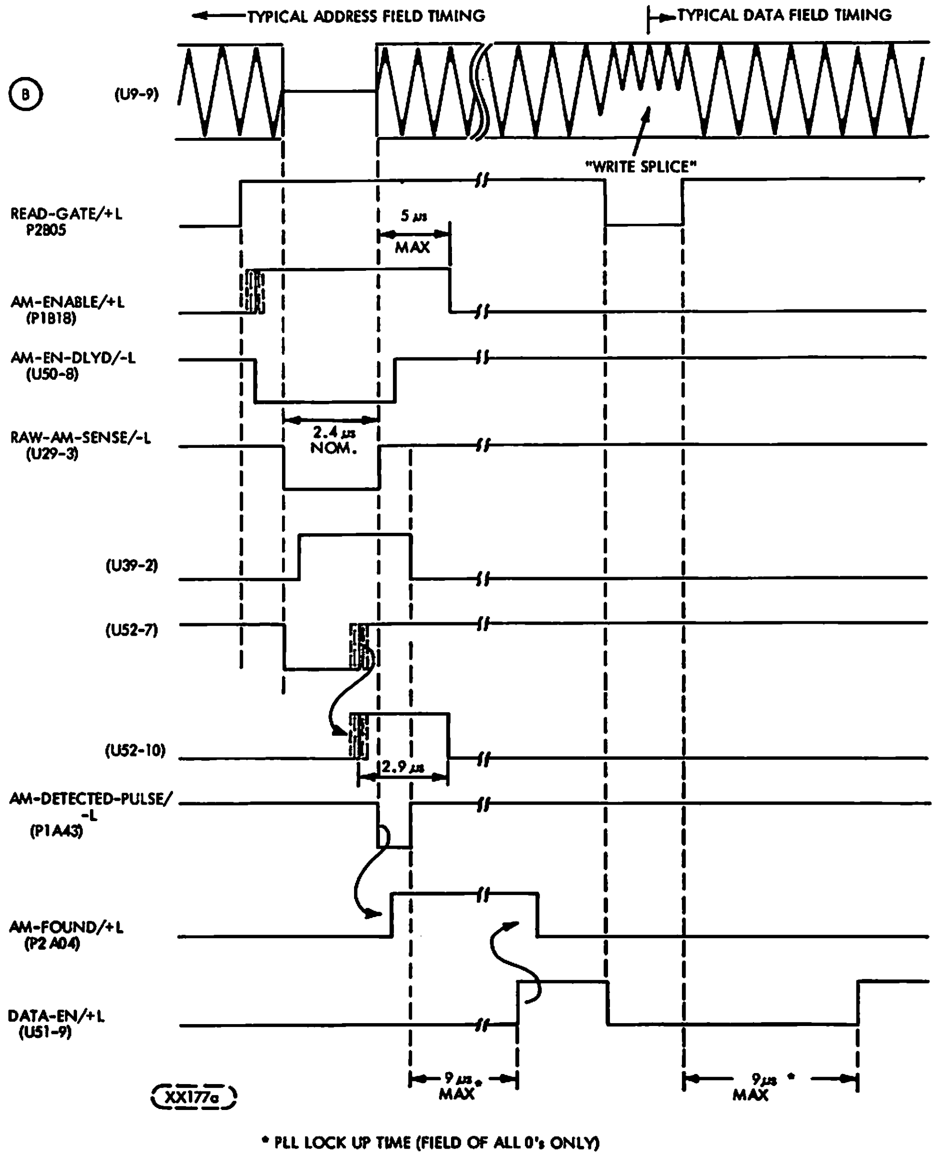
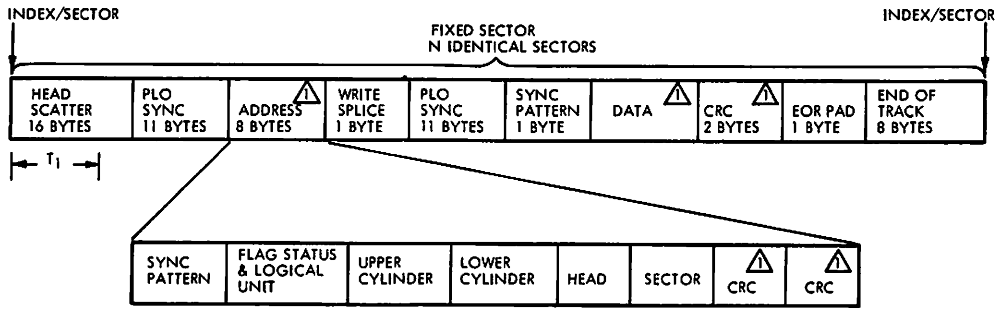



FIGURE 4-43. ADDRESS DETECTION AND DATA ENABLE TIMING DIAGRAM




$T_1$ = 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?

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

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

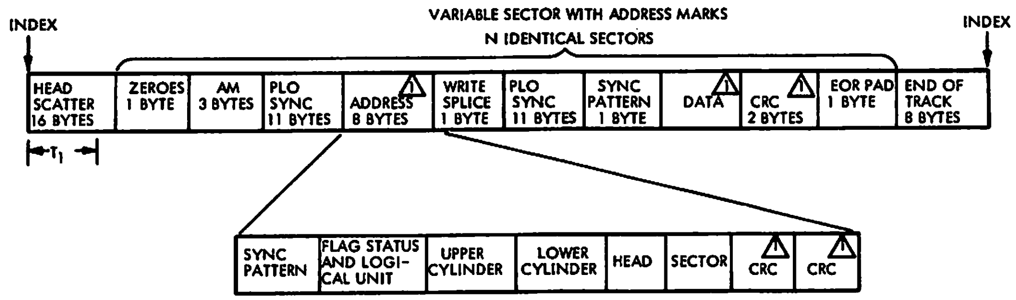
DATA = 256 BYTES/SECTOR

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

⚠ 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?

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

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

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

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

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

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

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

X393a

FIGURE 4-45. VARIABLE SECTOR FORMAT

## 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.

Input/Output (I/O) Board documentation (for boards not listed below) is included in the Hardware Product Configurator (HPC) Document Package located in front of the manual. It may be desirable to insert the I/O Board portion in from of Figure 5-4. 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, Special Printed Circuit Boards, and other customer unique features are included in the HPC package.

## 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.

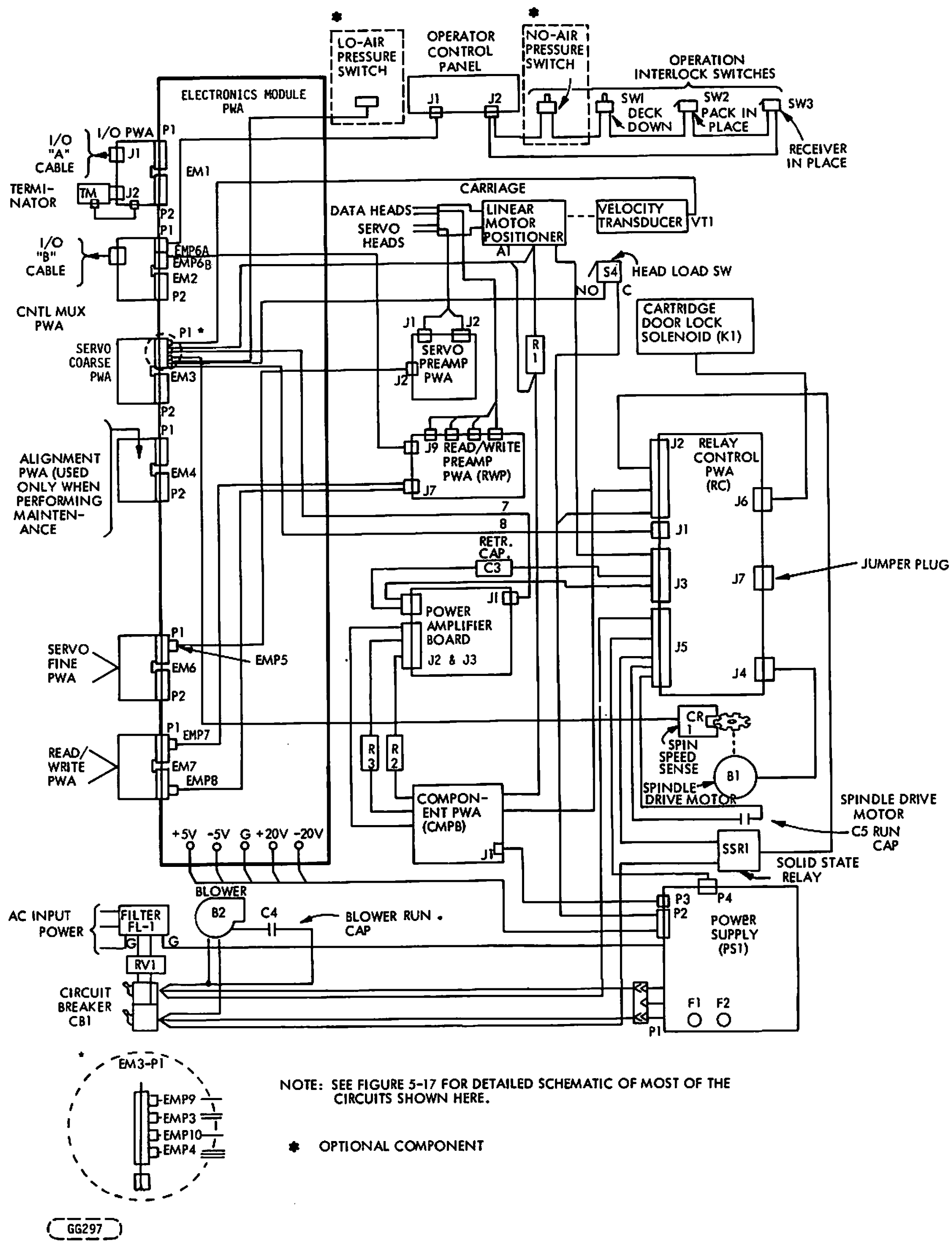
TABLE 5.3-1. CMD CIRCUIT BOARDS

| CKT BD IDENT | SLOT LOC | FIGURE | CROSS REF. NO. | TITLE |
|---|---|---|---|---|
| 77622501 | EM1 | 5-4 | 01XX | I/O CKT BD, OEM |
| 77665650 | EM1 | 5-4 | 01XX | I/O CKT BD, OEM |
| 77667100 | EM1 | 5-4 | 01XX | I/O CKT BD, OEM |
| 77666950 | EM2 | 5-5 | 02XX | CNTL/MUX CKT BD |
| 77624700 | EM2 | 5-5 | 02XX | CNTL/MUX CKT BD |
| 77588000 | EM2 | 5-5 | 02XX | CNTL/MUX CKT BD |
| 77622403 | EM3 | 5-6 | 03XX | SERVO COARSE CKT BD |
| 77666801 | EM3 | 5-6 | 03XX | SERVO COARSE CKT BD |
| 75886300 | EM6 | 5-7 | 06XX | SERVO FINE CKT BD |
| 75886350 | EM7 | 5-8 | 07XX | READ/WRITE CKT BD |
| 75885752 | | 5-9 | 08XX | READ/WRITE PREAMP CKT BD |
| 75885800 | | 5-10 | 09XX | SERVO PREAMP CKT BD |
| 77680500 | | 5-11 | 10XX | POWER AMPLIFIER CKT BD |
| 77624900 | | 5-12 | 11XX | OPERATOR CONTROL CKT BD |
| 77666750 | | 5-12 | 11XX | OPERATOR CONTROL CKT BD |
| 77680700 | | 5-12 | 11XX | OPERATOR CONTROL CKT BD |
| 77680740 | | 5-12 | 11XX | OPERATOR CONTROL CKT BD |
| 77680650 | | 5-13 | 12XX | RELAY CONTROL CKT BD NO-AIR |
| 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 |
| 77648080 | OR | 5-1 | | ELECTRONICS MODULE-PWA (Ref Only) |
| 77648090 | OR | 5-1 | | ELECTRONICS MODULE-PWA (Ref Only) |
| 77648120 | | 5-1 | | ELECTRONICS MODULE-PWA (Ref Only) |

*Not a PWA - Conventional Wiring

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).




NOTE: SEE FIGURE 5-17 FOR DETAILED SCHEMATIC OF MOST OF THE CIRCUITS SHOWN HERE.

* OPTIONAL COMPONENT

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

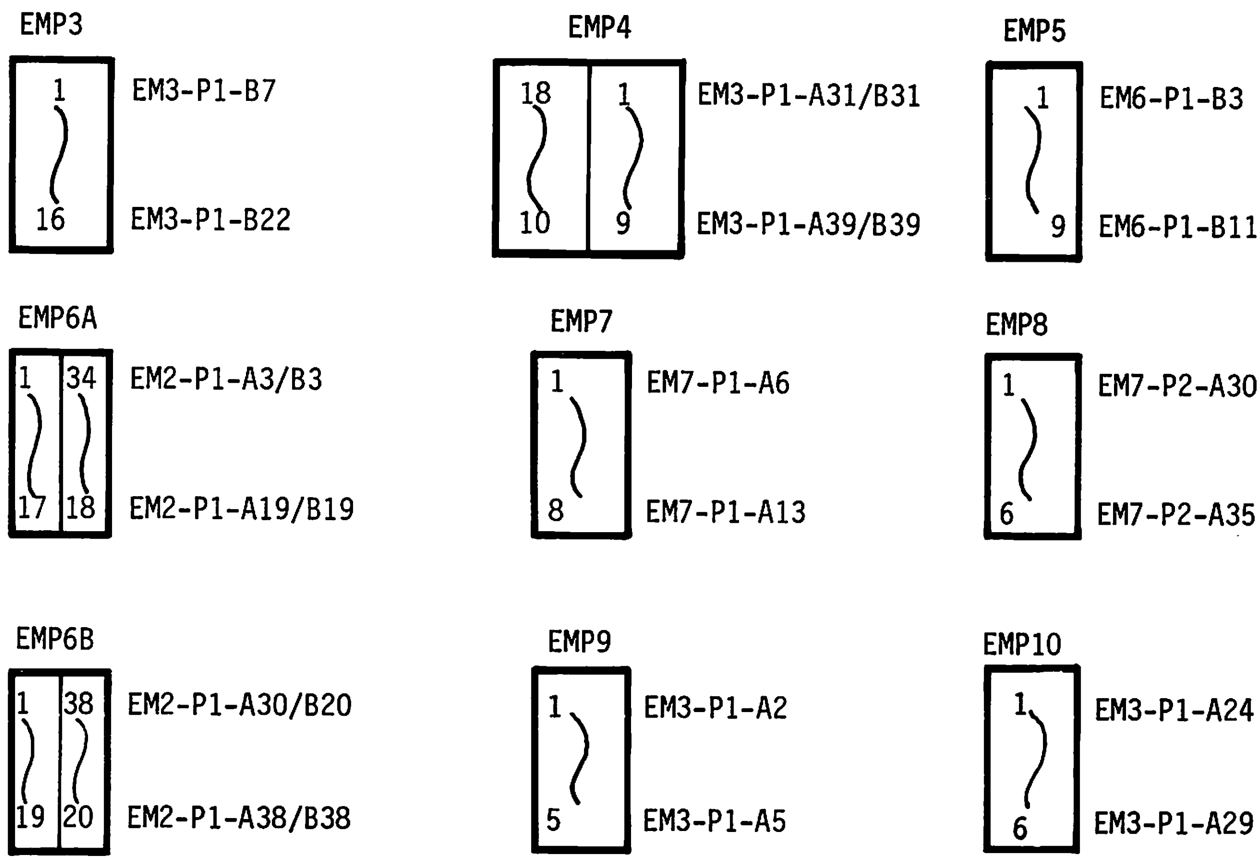
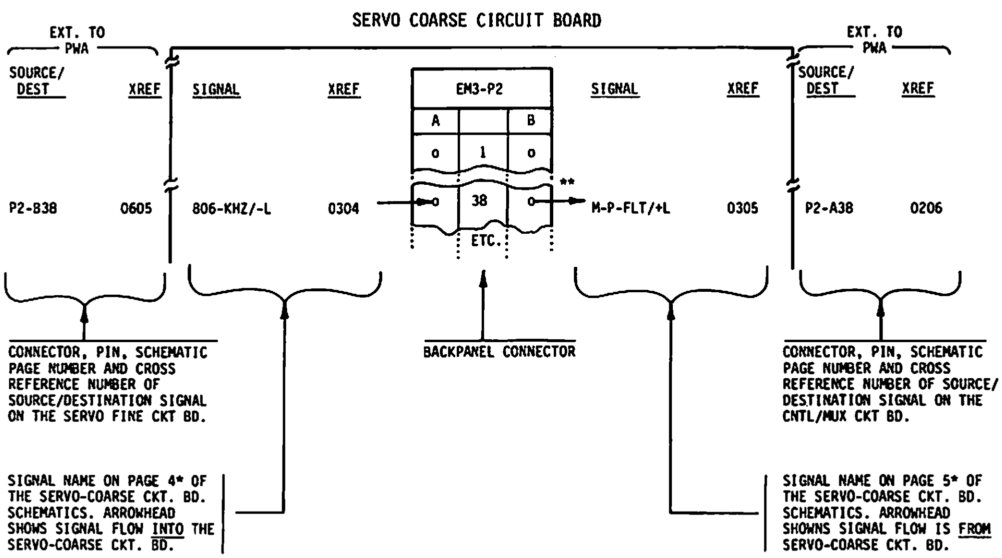



FIGURE 5-1. LOCATION OF CONNECTORS ON BACK PANEL (SHEET 2 OF 2)

## 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).

** 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.

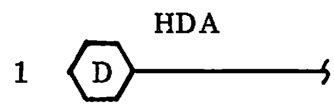
Z2046a

FIGURE 5-2A. TYPICAL INTERCONNECTION SHEET ENTRY

## 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 left-hand corner of each schematic sheet using the last (right-most) digit of the corss reference number. Symbology for Sheet to sheet connections and board to board connections are as follows:

- Sheet to Sheet ON PAGE example:

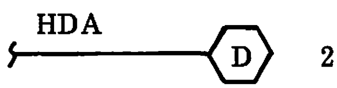



1 = Signal "from" sheet 1 of SET

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:

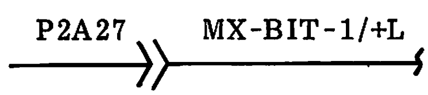



2 = Signal "to" sheet 2 of SET

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

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

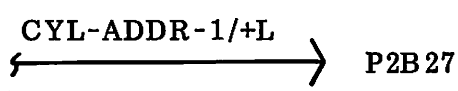
- Board to Board ON PAGE example:




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 corss reference number.

## 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.

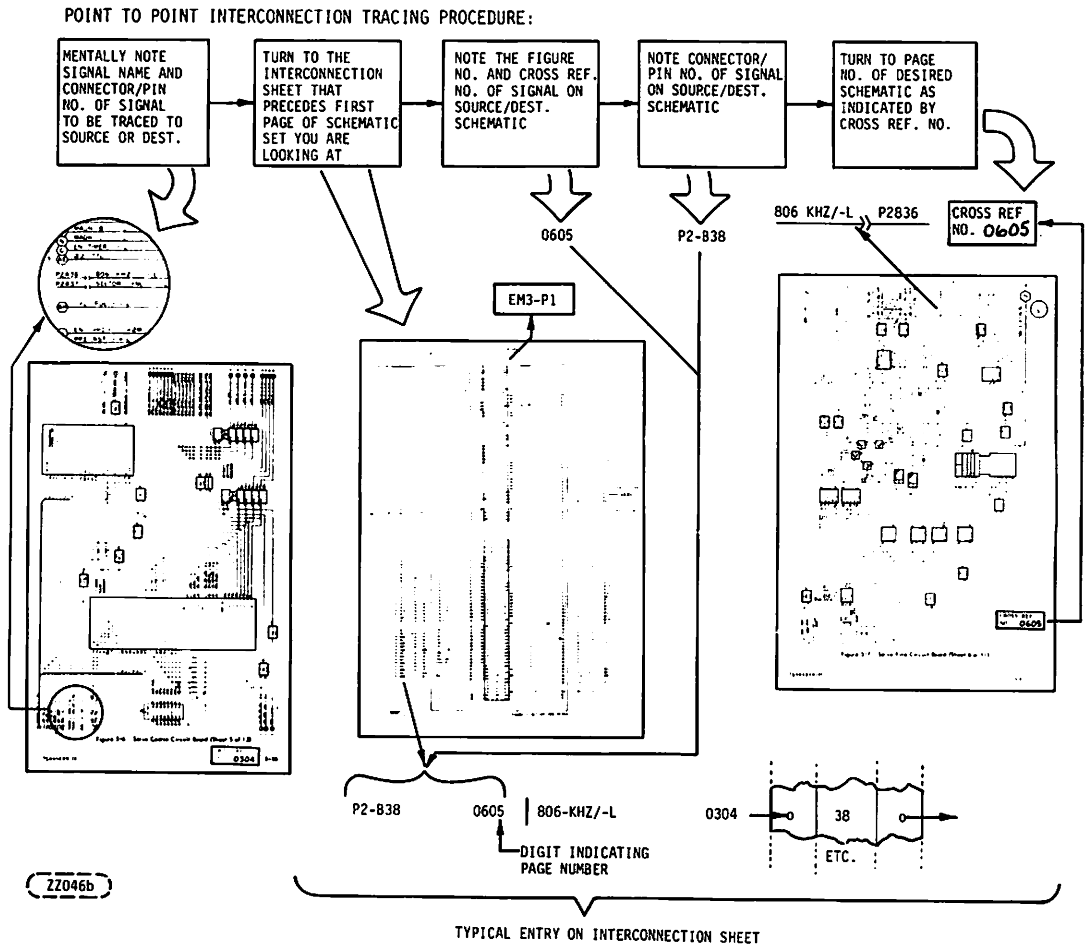



FIGURE 5-2B. ILLUSTRATION OF POINT TO POINT TRACING PROCEDURE

## 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

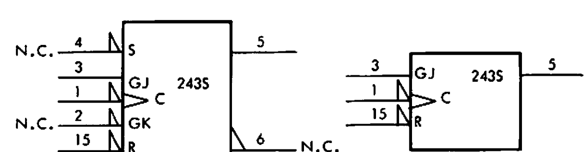
### 5.6.1 GENERAL INFORMATION

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

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 5-2c 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.




BOTH SYMBOLS REPRESENT A BI-STABLE JK F/F CIRCUIT WITH SOME OF THE PINS UNUSED. (N.C. INDICATES "NOT CONNECTED")

X370b

FIGURE 5-2C. FUNCTIONALLY EQUIVALENT SYMBOLS

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.

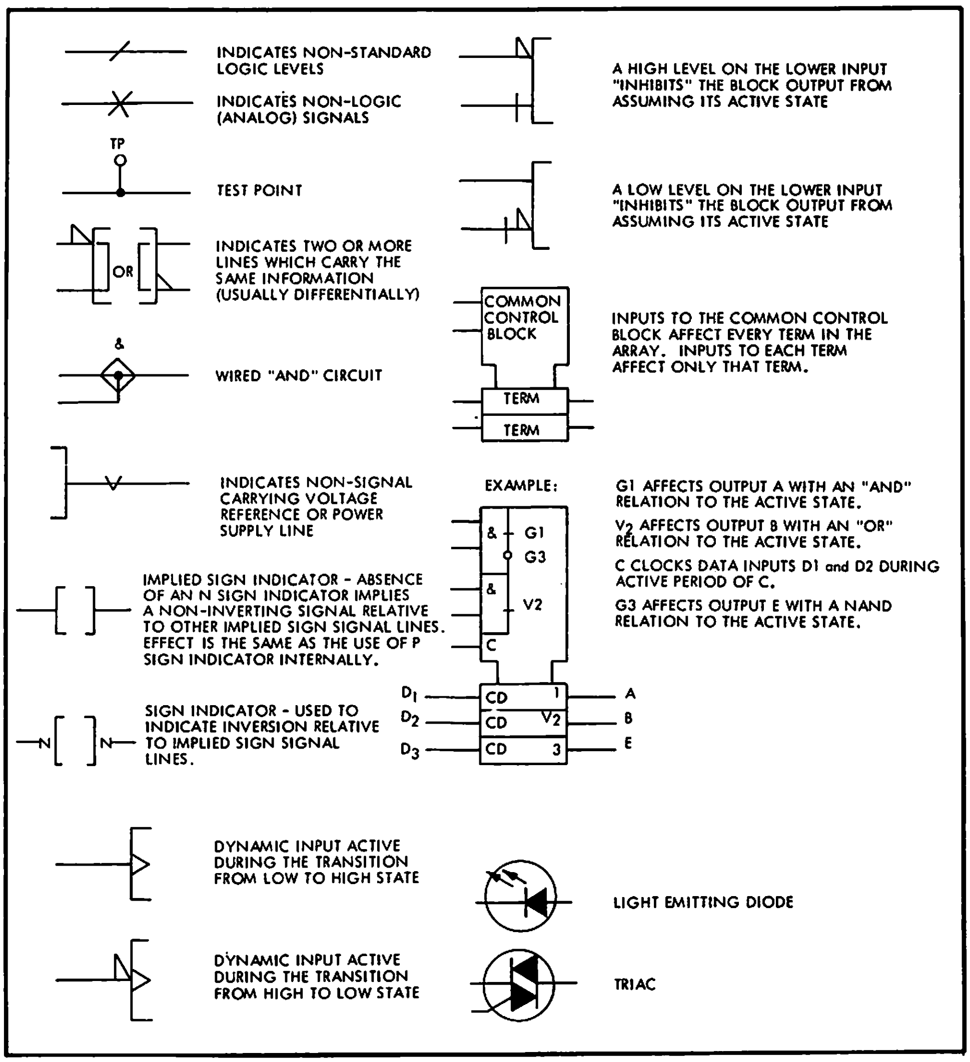
The signal MEM-RD /-L will be "Hi" much of the time but when the microprocessor memory is to be accessed (read out) MEM-RD/-L will go "Active-Lo" (to Logic 0) for a brief instant while the contents of some memory location is accessed (read).

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/$\frac{+5\ V}{GND}$ 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: ( ≤ 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.

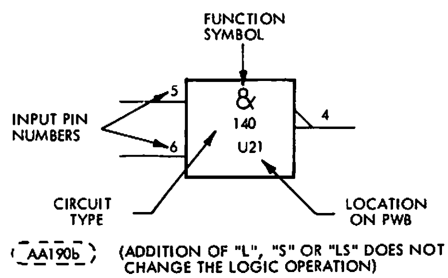



FIGURE 5-3A. TYPICAL INTEGRATED CIRCUIT

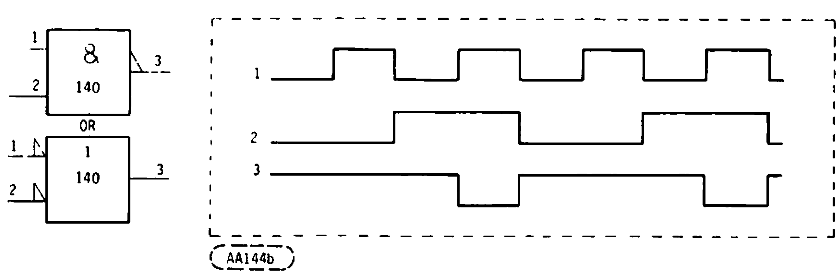



FIGURE 5-3B. POSITIVE NAND NEGATIVE NOR

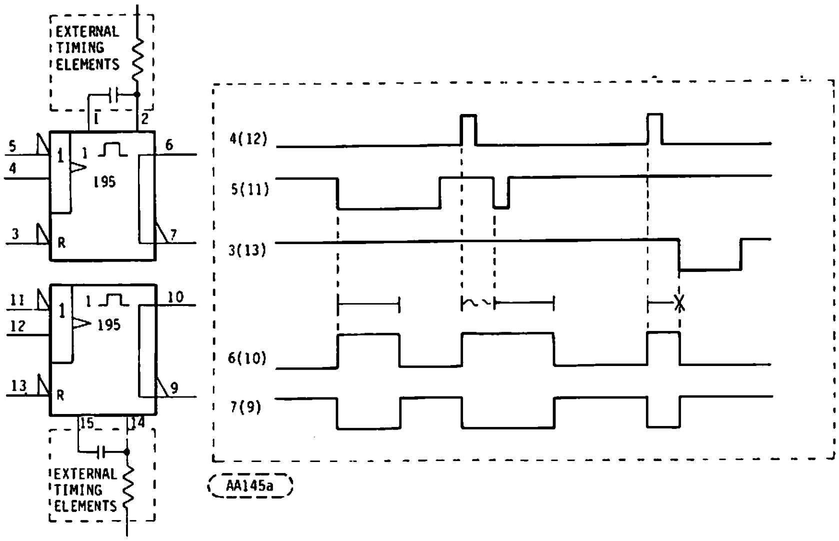



FIGURE 5-3C. RETRIGGERABLE, RESETTABLE, MONOSTABLE MULTIVIBRATOR (ONE SHOT)

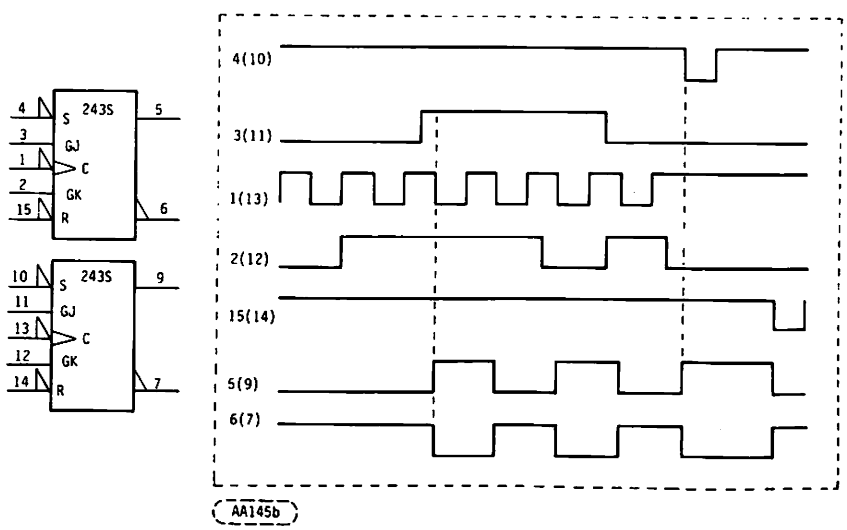



FIGURE 5-3D. "JK" NEGATIVE EDGE TRIGGERED TYPE F/F

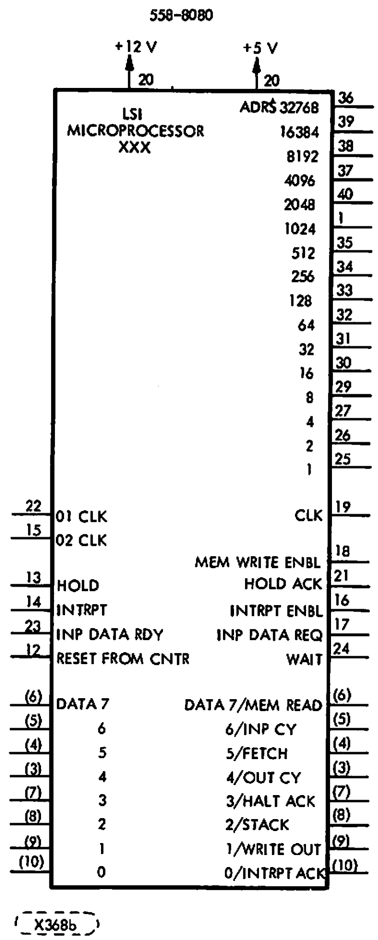



FIGURE 5-3E. 8080A MICROPROCESSOR (SHEET 1 OF 2)

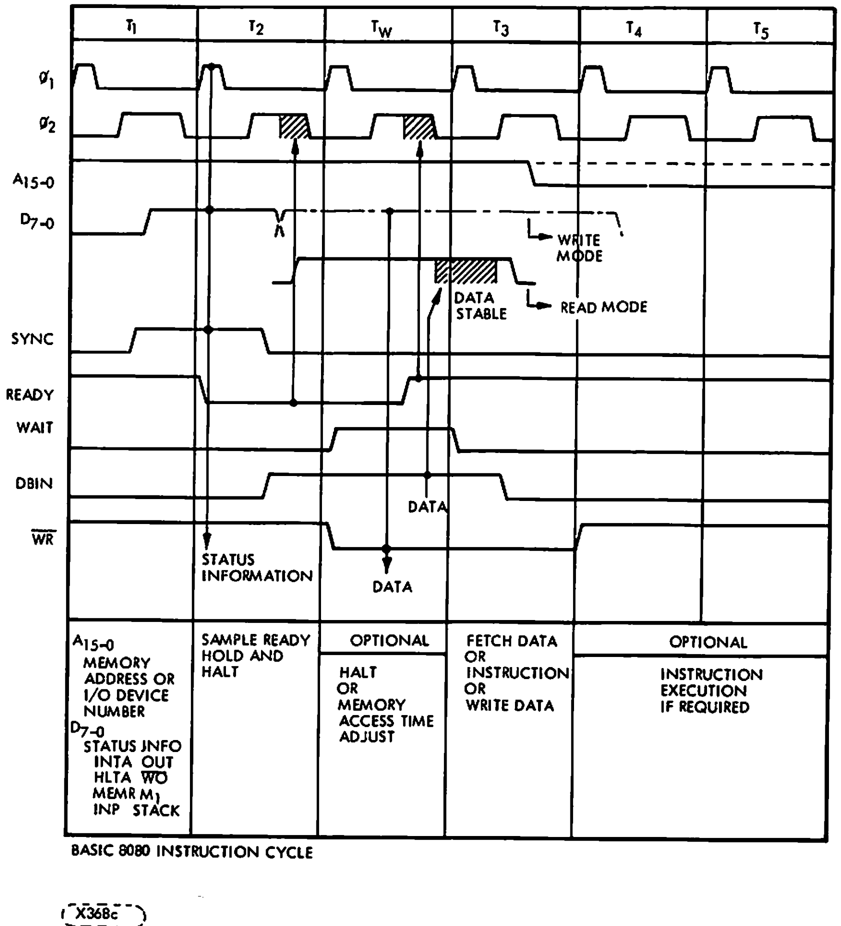



FIGURE 5-3E. 8080A MICROPROCESSOR (SHEET 2 OF 2)

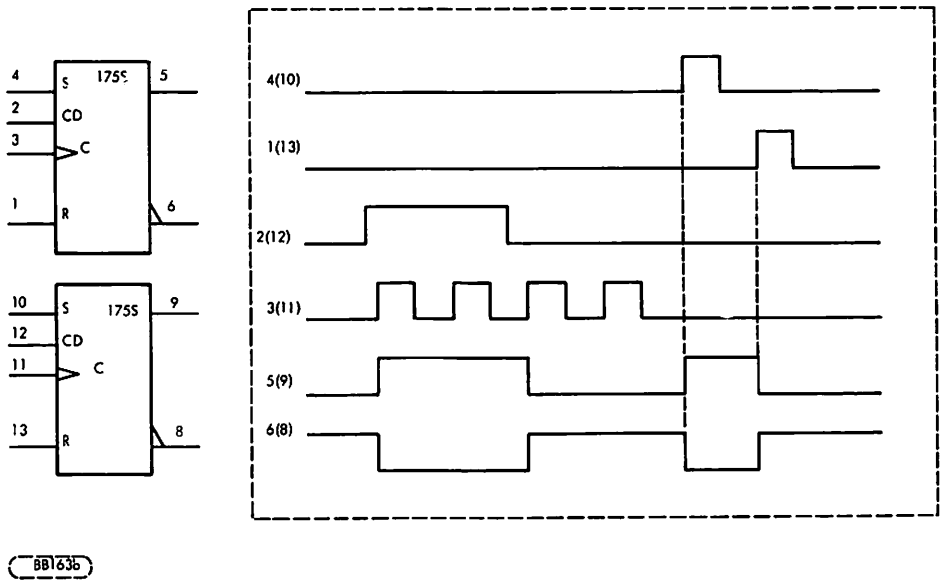



FIGURE 5-3F. "D" TYPE F/F

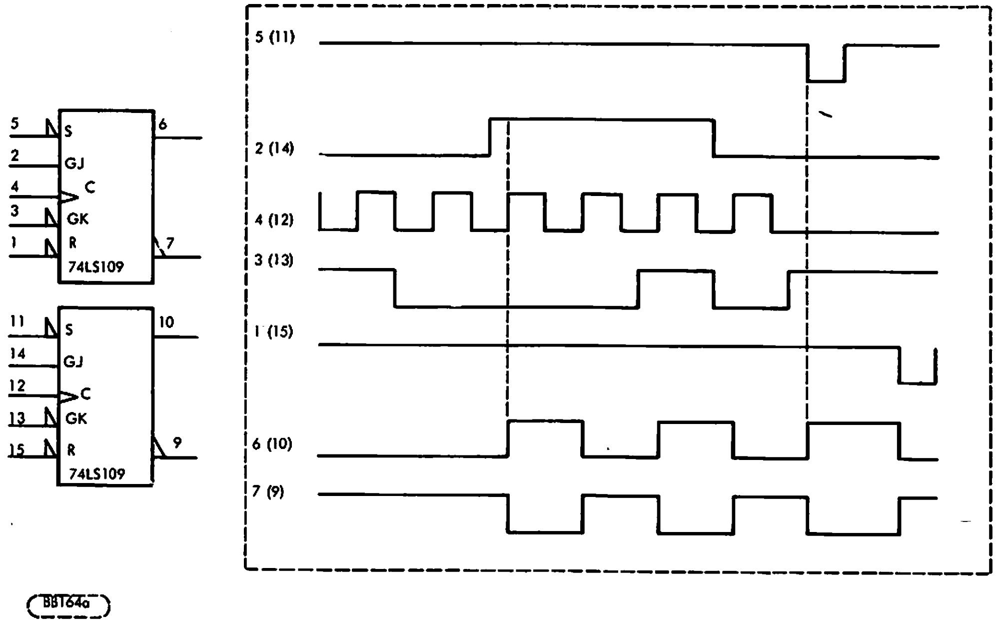



FIGURE 5-3G. "JK" POSITIVE EDGE TRIGGERED TYPE F/F

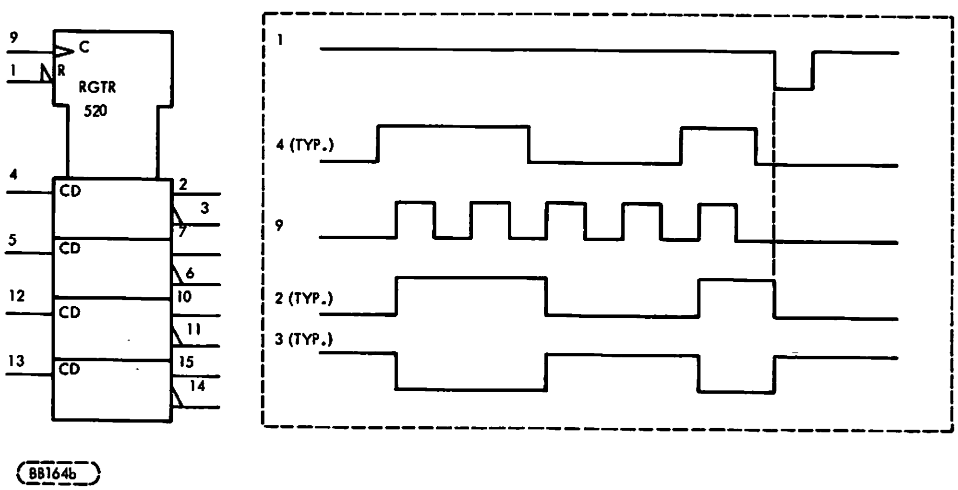
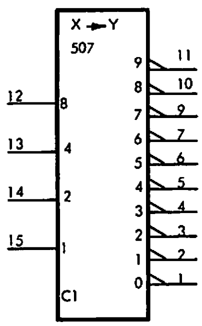


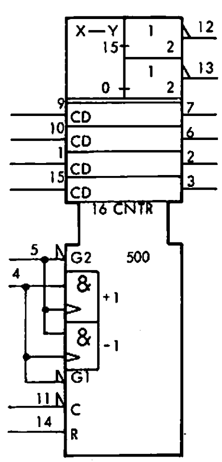

FIGURE 5-3H. QUAD TTL "D" TYPE F/F

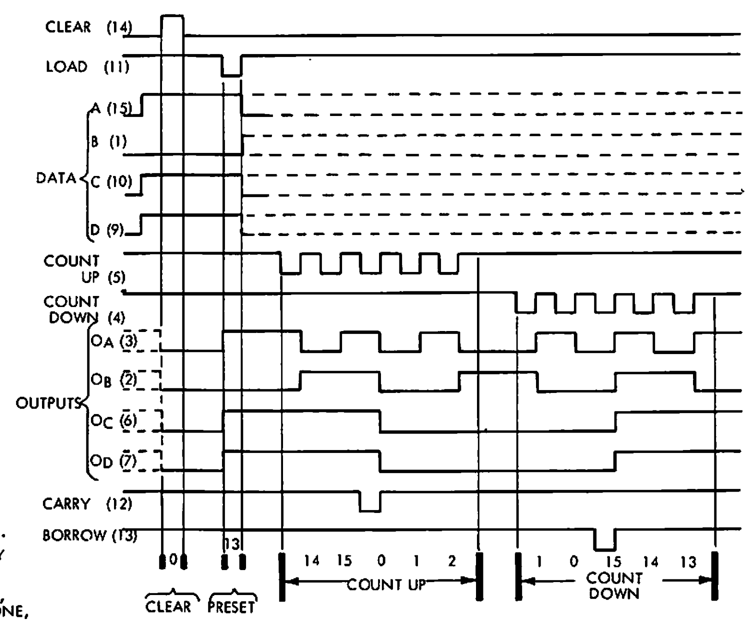



| INPUTS | | | | OUTPUT COUNT (ONE LOW AT A TIME) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 4 | 2 | 1 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | |
| 12 | 13 | 14 | 15 | 11 | 10 | 9 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | ← PIN |
| L | L | L | L | H | H | H | H | H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

(AA196a)

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.

(AA198b)

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

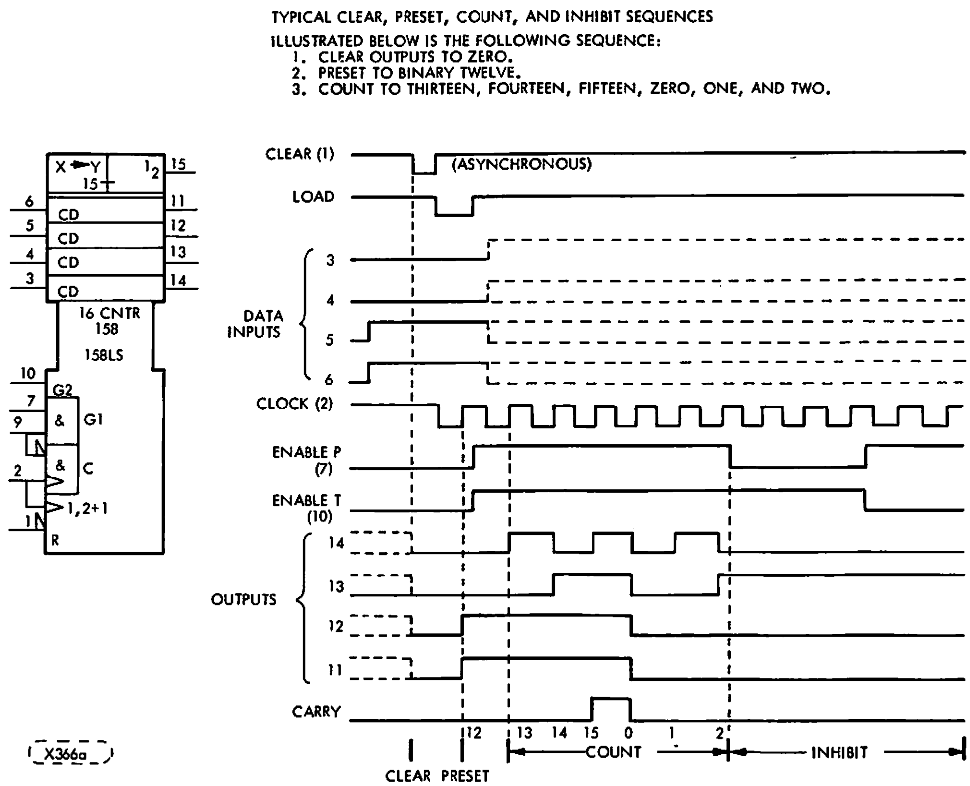



FIGURE 5-3K. 4-BIT BINARY COUNTER

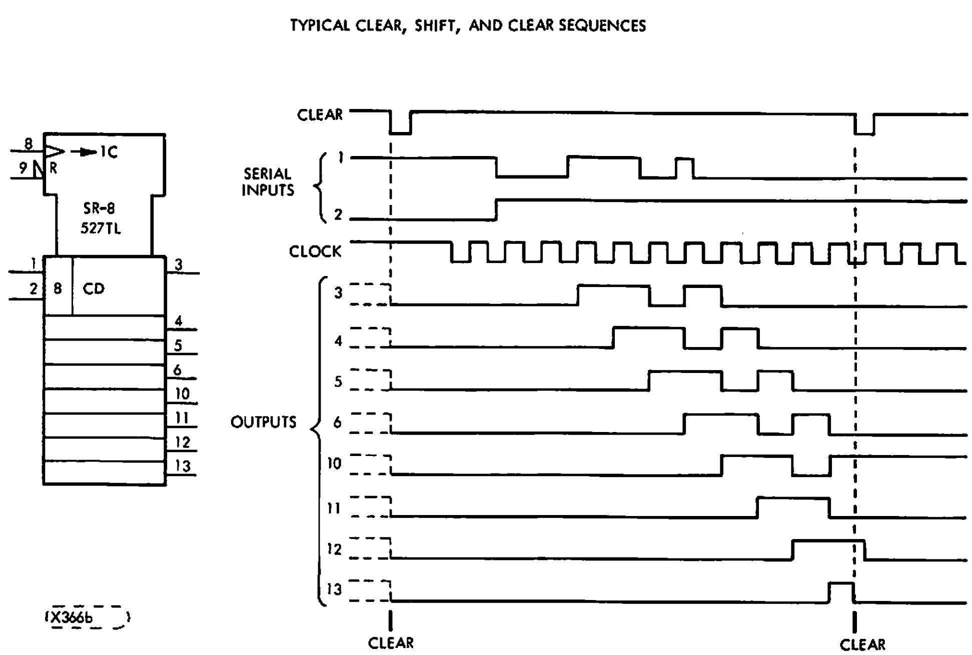



FIGURE 5-3L. SERIAL IN-PARALLEL OUT 8-BIT REGISTER

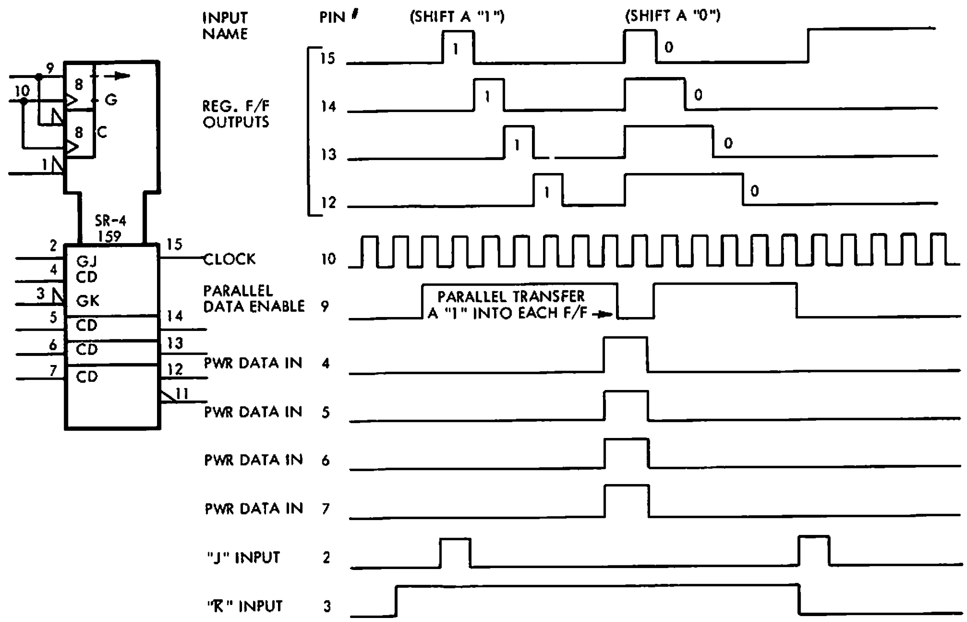



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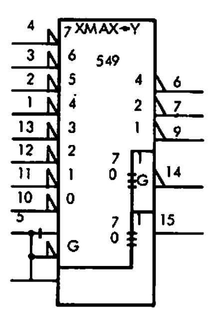
FIGURE 5-3M. FOUR FLIP-FLOP SHIFT REGISTER




| 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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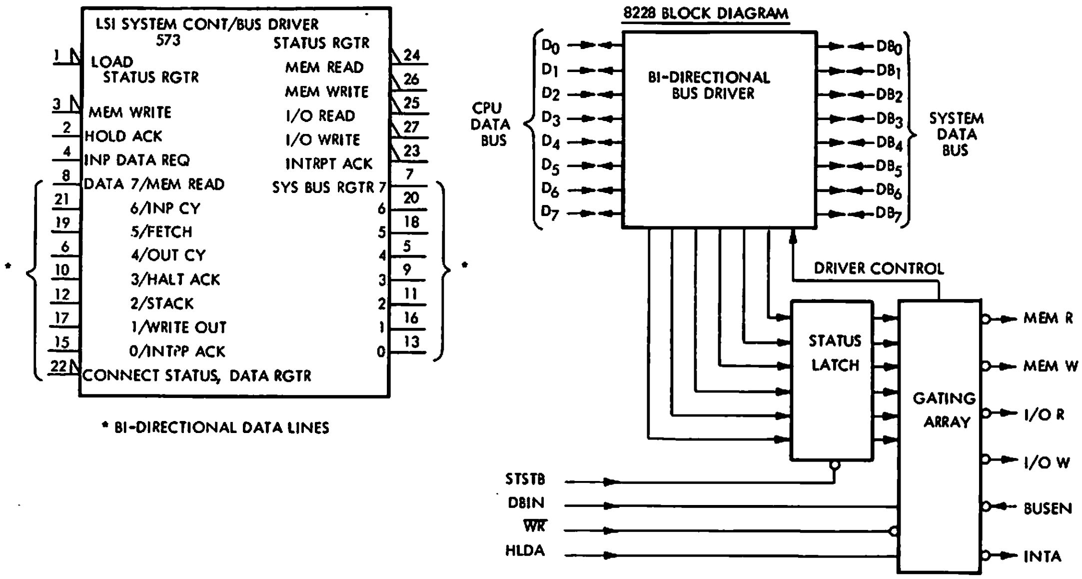
FIGURE 5-3N. 1 OUT OF 4 DECODER




PIN NAMES

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

| | |
|---|---|
| INTA | INTERRUPT ACKNOWLEDGE |
| HLDA | HLDA (FROM 8080) |
| $\overline{WR}$ | WR (FROM 8080) |
| $\overline{BUSEN}$ | BUS ENABLE INPUT |
| $\overline{STSTB}$ | 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)

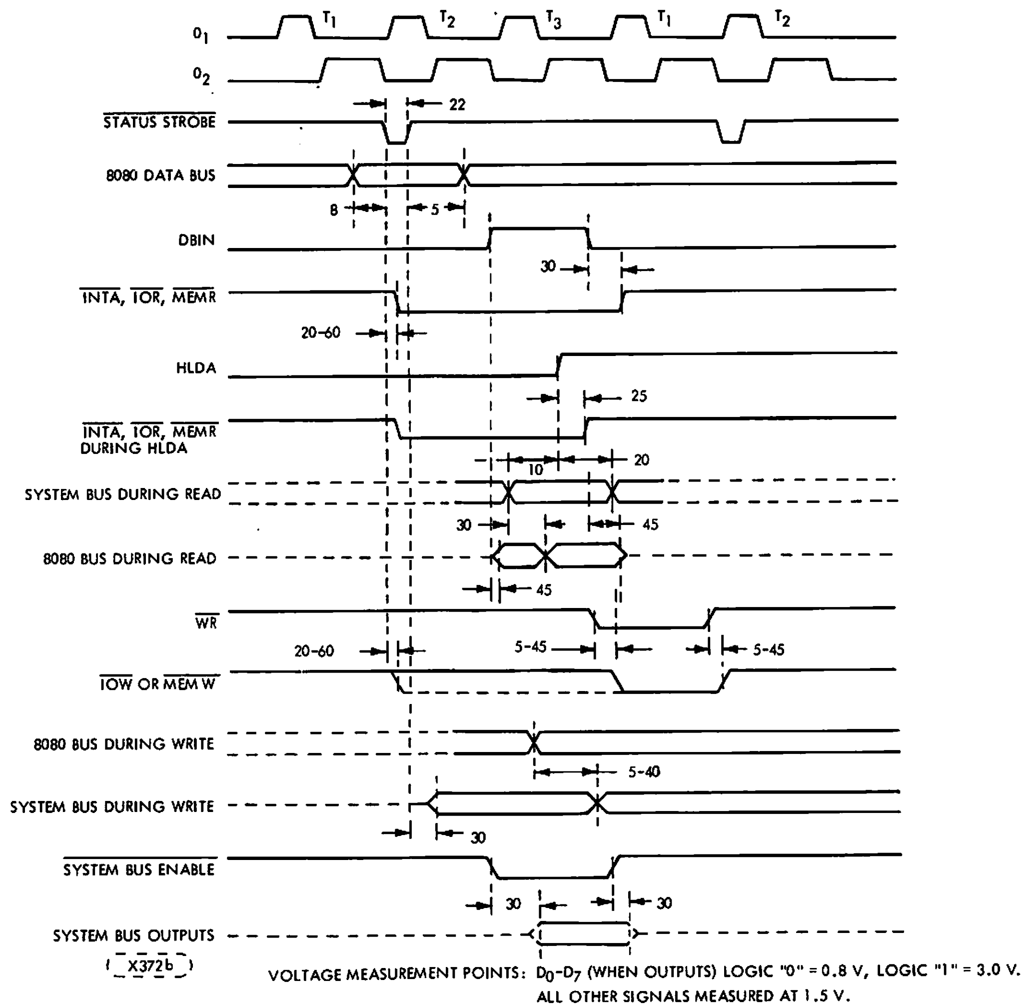



FIGURE 5-30. SYSTEM CONTROLLER/BUS DRIVER FOR MICROPROCESSOR SYSTEM (SHEET 2 OF 2)

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, $\overline{\text{WR}}$, and HLDA).

The "read" control signas ($\overline{\text{MEM R}}$, $\overline{\text{I/O R}}$ 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 $\overline{\text{WR}}$ 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 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.

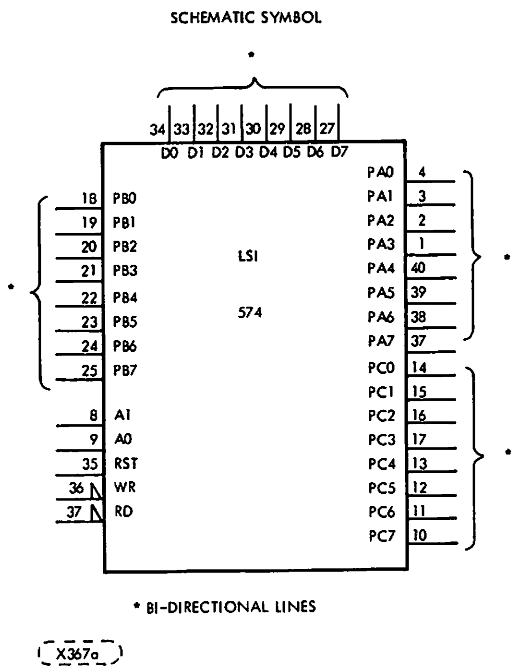
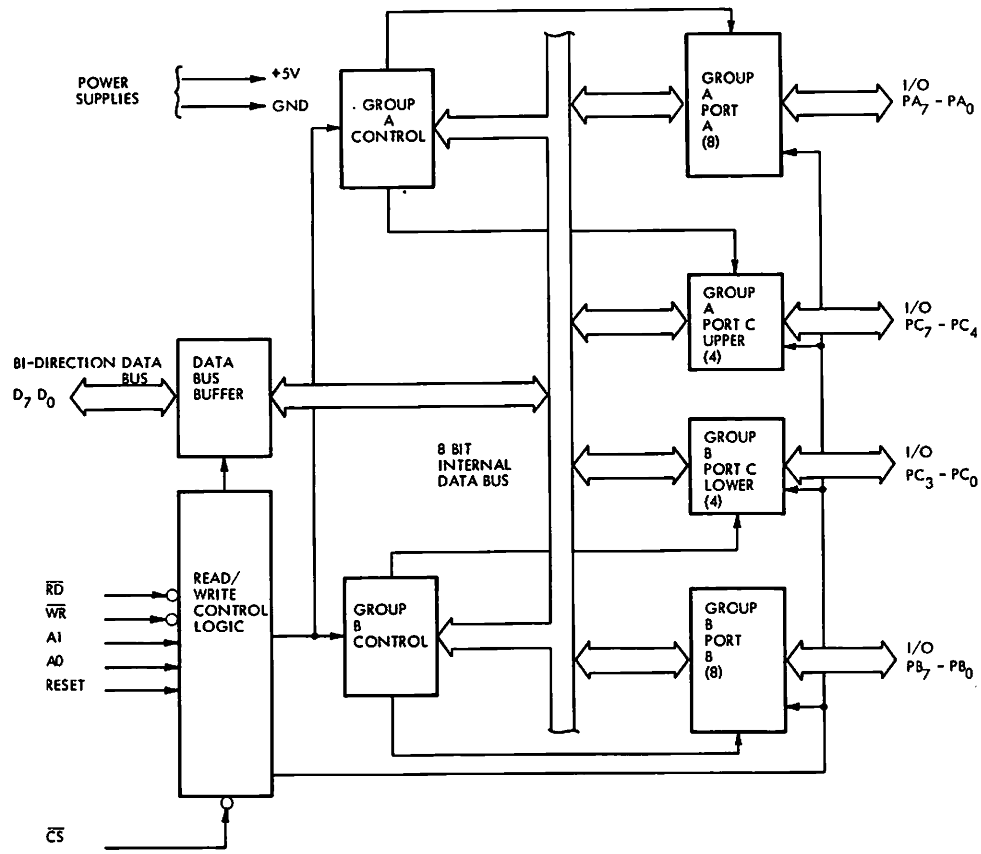



FIGURE 5-3P. 8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI) FOR MICROPROCESSOR (SHEET 1 OF 3)




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)

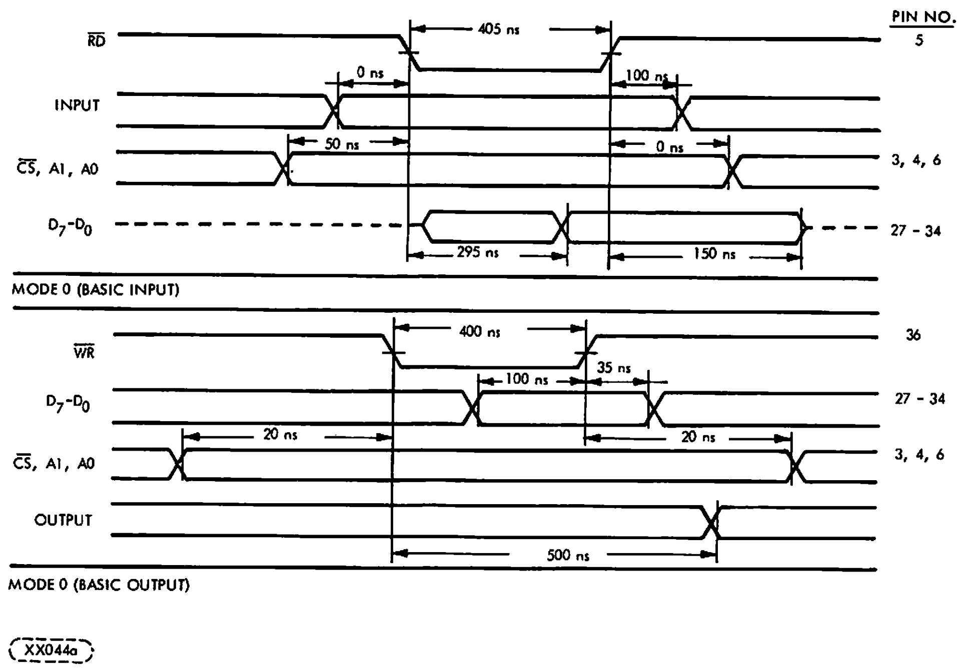



FIGURE 5-3P. 8255 PROGRAMMABLE PERIPHERAL INTERFACE (PPI) FOR MICROPROCESSOR (SHEET 3 OF 3)

## 8255A Programmable Peripheral Interface Functional Description

General

The 8255A is a Programmable Peripheral Interface (PPI) device designed for used 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

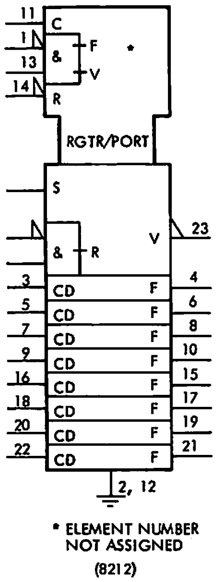
  The 8255A contains three 8-bit ports (A, B and C). All can be configured in a wide variety of functional characteristics by the 8080A software (or firmware) but each has its own special features or "personality" to further enhance the power and flexibility of the 8255A.

  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 Poart 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 ines for "handshaking" and Mode 2 provides a bi-directional bus (with Port Con 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 808-A I/O timing. This is shown in the timing diagrams in Figures 5-3p, 4-15 and 4-16.



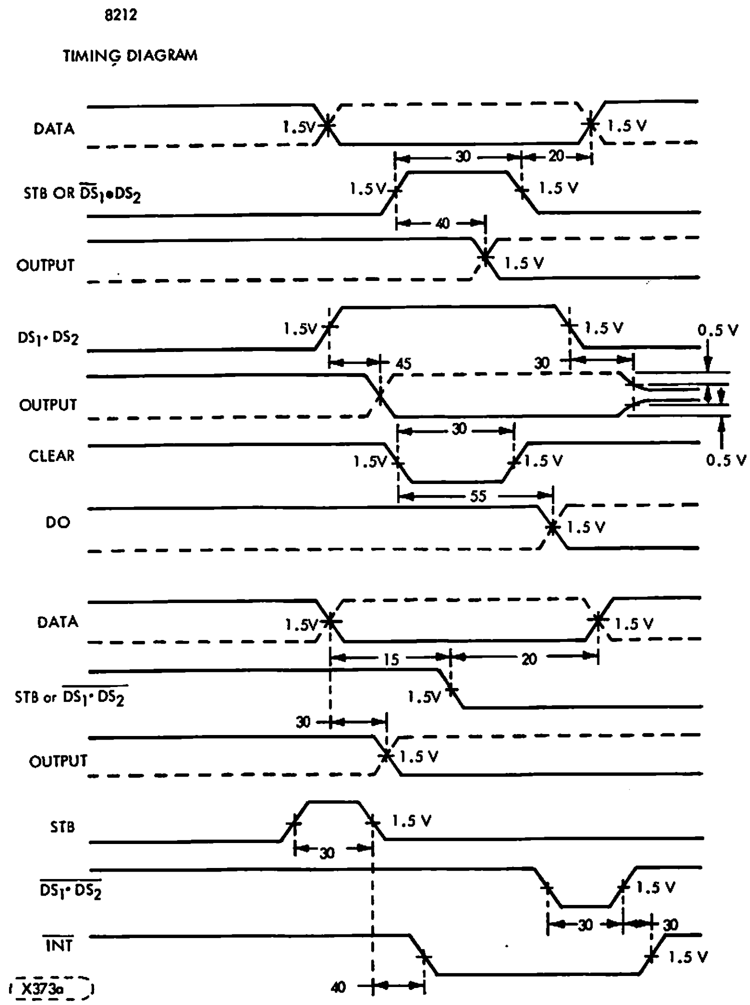




FIGURE 5-3Q. I/O PORT 8-BIT PARALLEL (8212)

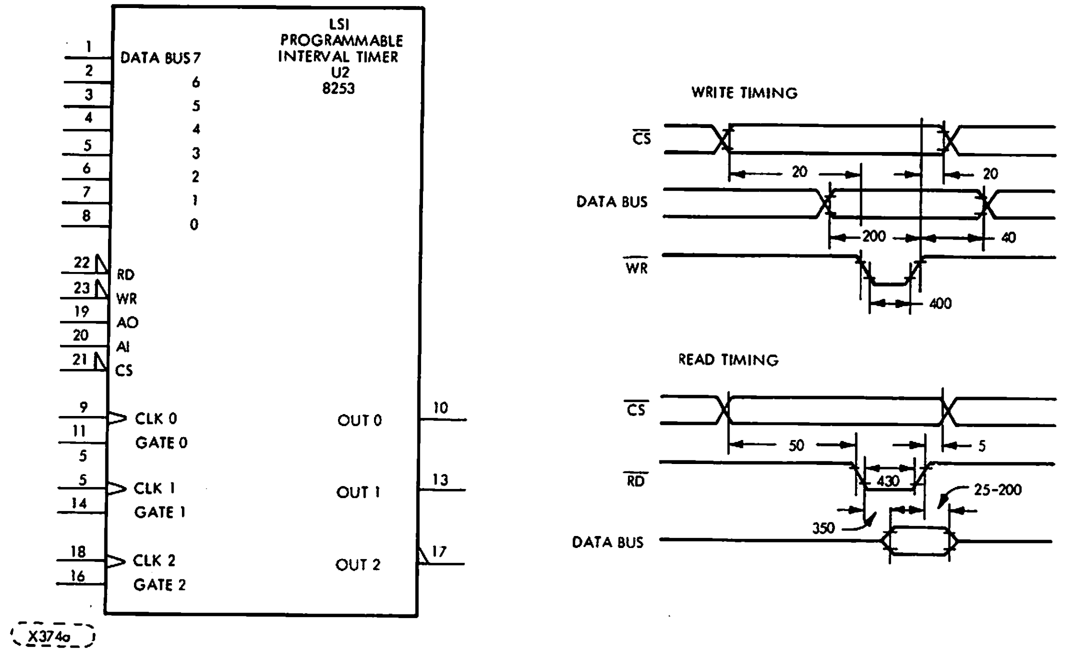



FIGURE 5-3R. 8253 LSI PROGRAMMABLE INTERVAL TIMER FOR 8080 SYSTEM (SHEET 1 OF 2)

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 |

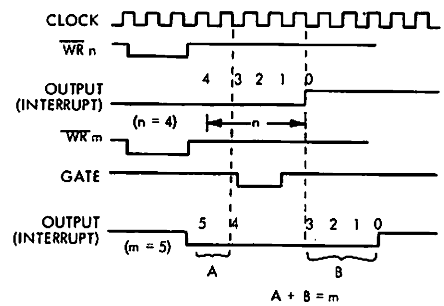
RL-READ/LOAD

| 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. |

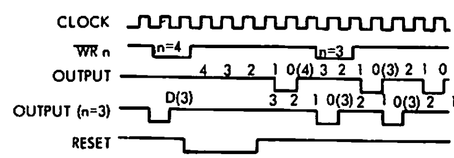
X374b

TYPICAL TIMING FOR MODES USED

MODE 0: INTERRUPT ON TERMINAL COUNT




MODE 2: RATE GENERATOR

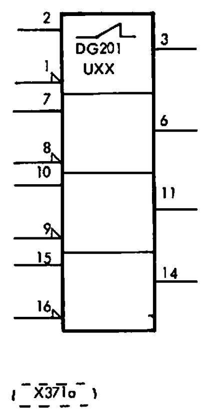


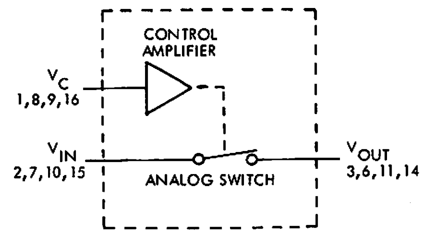

M-MODE

| 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

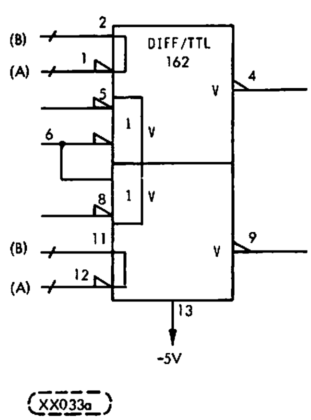
FIGURE 5-3R. 8253 LSI PROGRAMMABLE INTERVAL TIMER FOR 8080 SYSTEM (SHEET 2 OF 2)




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

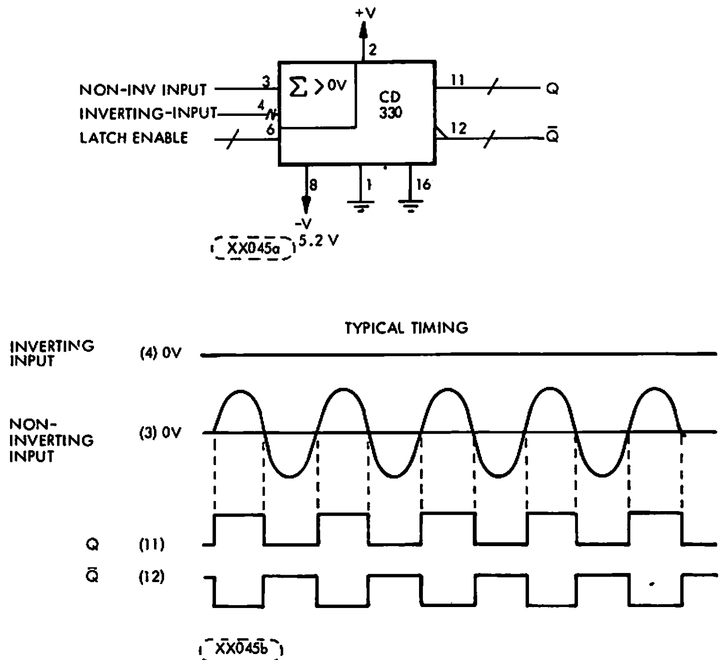
FIGURE 5-3S. ANALOG SWITCH




| 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-HOLD 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

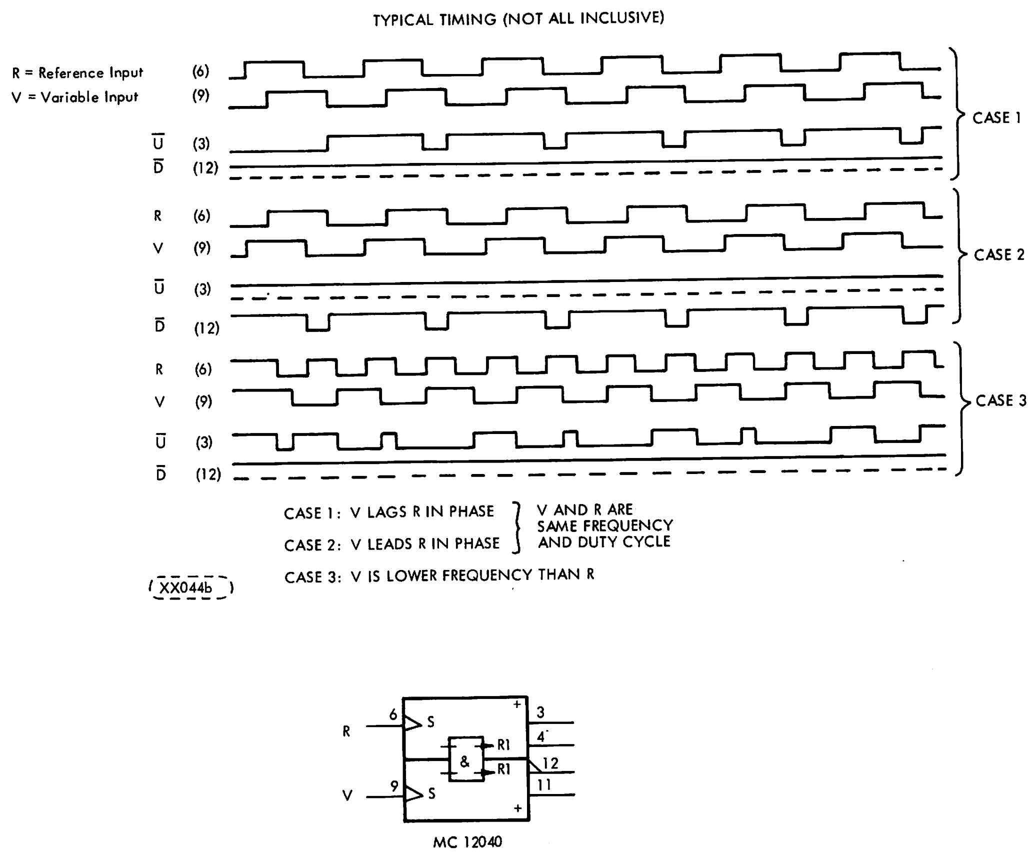



FIGURE 5-3V. PHASE-FREQUENCY DETECTOR

I/O CIRCUIT BOARD (01XX)

EM1-P1

| SOURCE/DEST | X-REF | SIGNAL | X-REF | PIN | SIGNAL | X-REF | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|
| | | GND | 0101 | 6 | GND | 0101 | | |
| P1-B10 | * | 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‚04 | 21 | | | | |
| | | | | 22 | INHIB-SEC/-L | 0104 | P1-B22 | 0204 |
| | | GND | 0101 | 23 | GND | 0101 | | |
| 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 | 1501 | 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 | 020*, P1-A43 0303 |
| | | +5 V | 0101 | 44 | +5 V | 0101 | | |

EM1-P2

| SOURCE/DEST | X-REF | SIGNAL | X-REF | PIN | SIGNAL | 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 | | |

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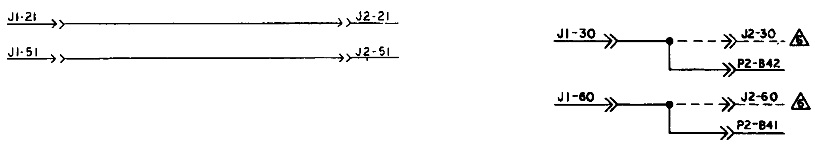
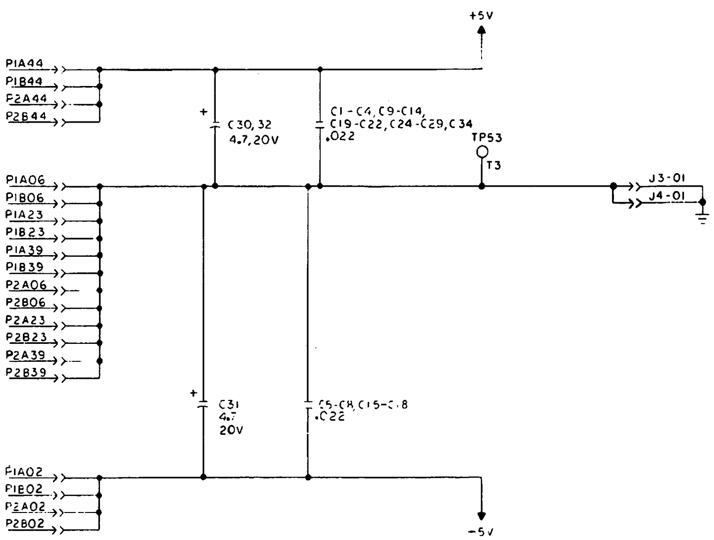
*WIRED TO, BUT NOT USED ON PWA

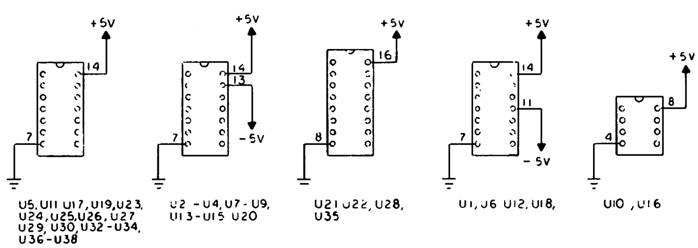
FIGURE 5-4. I/O CKT BOARD (SHEET 1 OF 9)




| 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 |
| 195 | 9602 | U35 | 6 OR 7 |
| 148LS | 74LS02 | U33 | 1,4,10 |
| 224LS | 74LS27 | U30 | 8,12 |
| 146LS | 74LS04 | U38 | 10,12 |

| TABLE A | | |
|---|---|---|
| SWITCH CONFIGURATION | | FUNCTION |
| S3-1 | S3-2 | |
| OFF | OFF | STANDARD |
| ON | — | 4 |
| | ON | 5 |



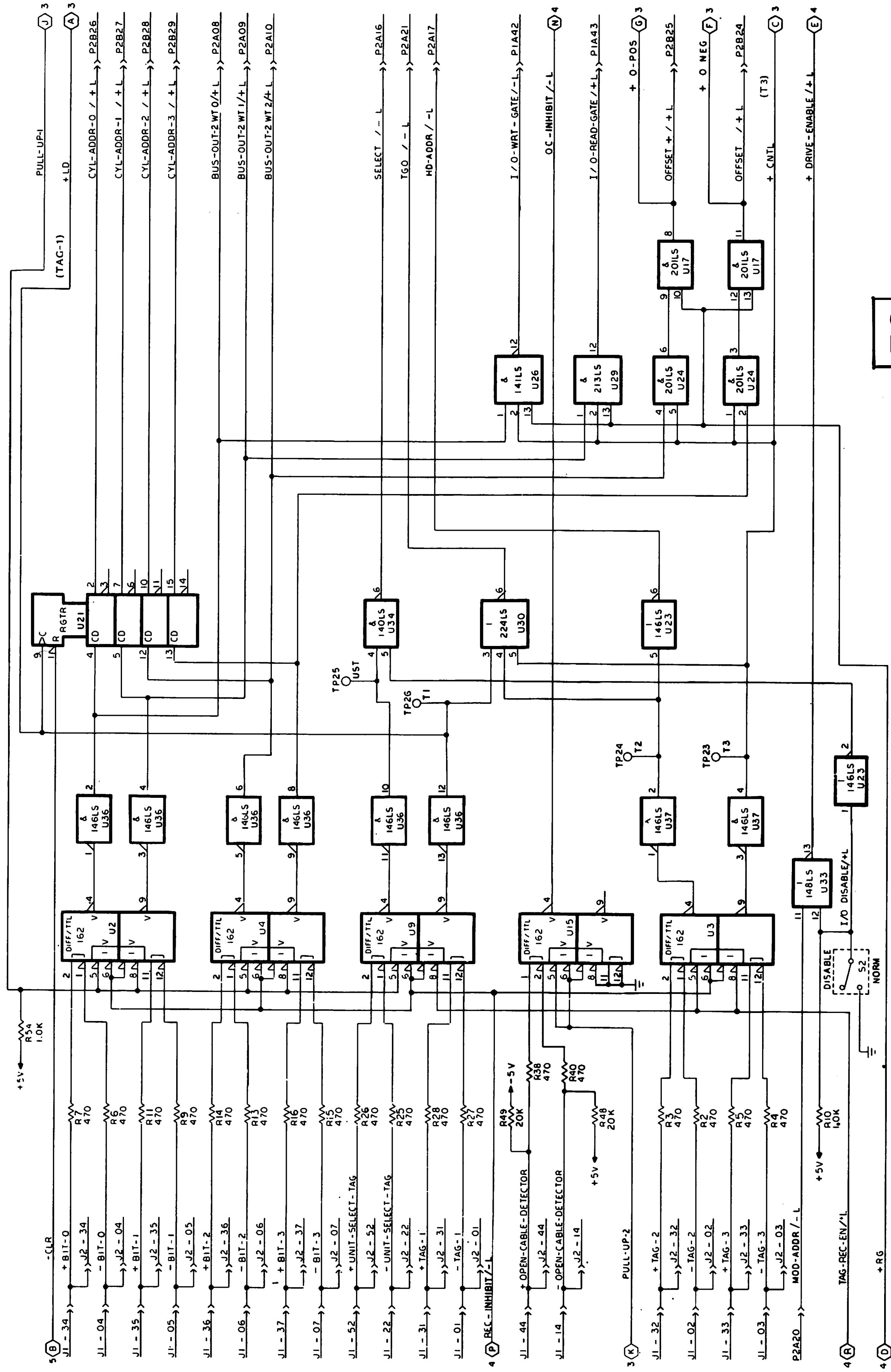

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS, 1/4 W, ±5%
2. CAPACITANCE VALUES ARE IN MICROFARADS
△ 3. SEE TABLE A FOR JUMPER CONFIGURATION
△ 4. S3-1: VALIDATE ON CYLINDER WITH VALID SECTOR
△ 5. S3-2: PSEUDO SEEK WITH VOLUME CHANGE
△ 6. NOT CONNECTED ON ASSY. 77667100

**WARNING**

**PWAs can be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).**

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

CROSS REF NO. 0101



CROSS REF
NO. 0102

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

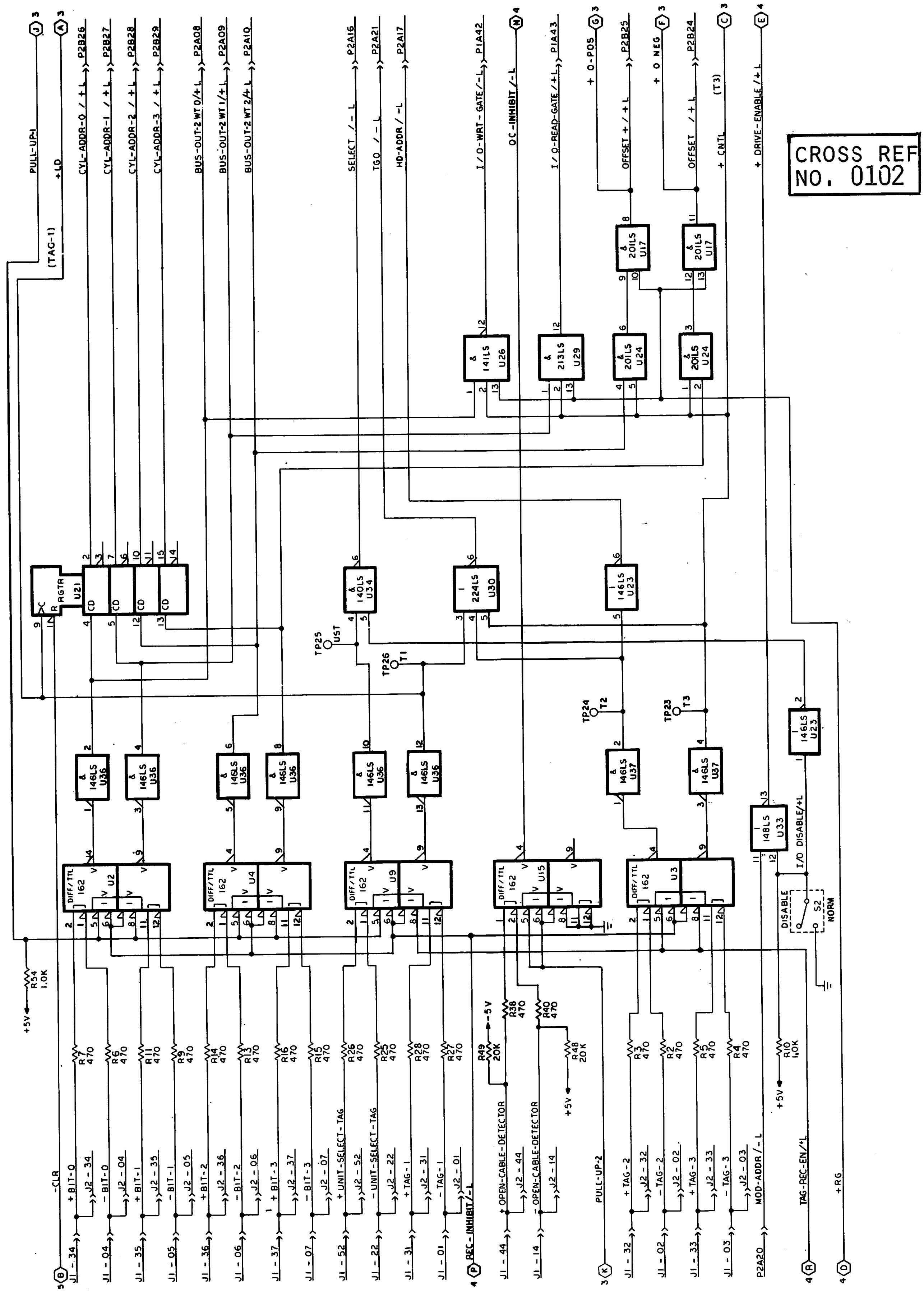
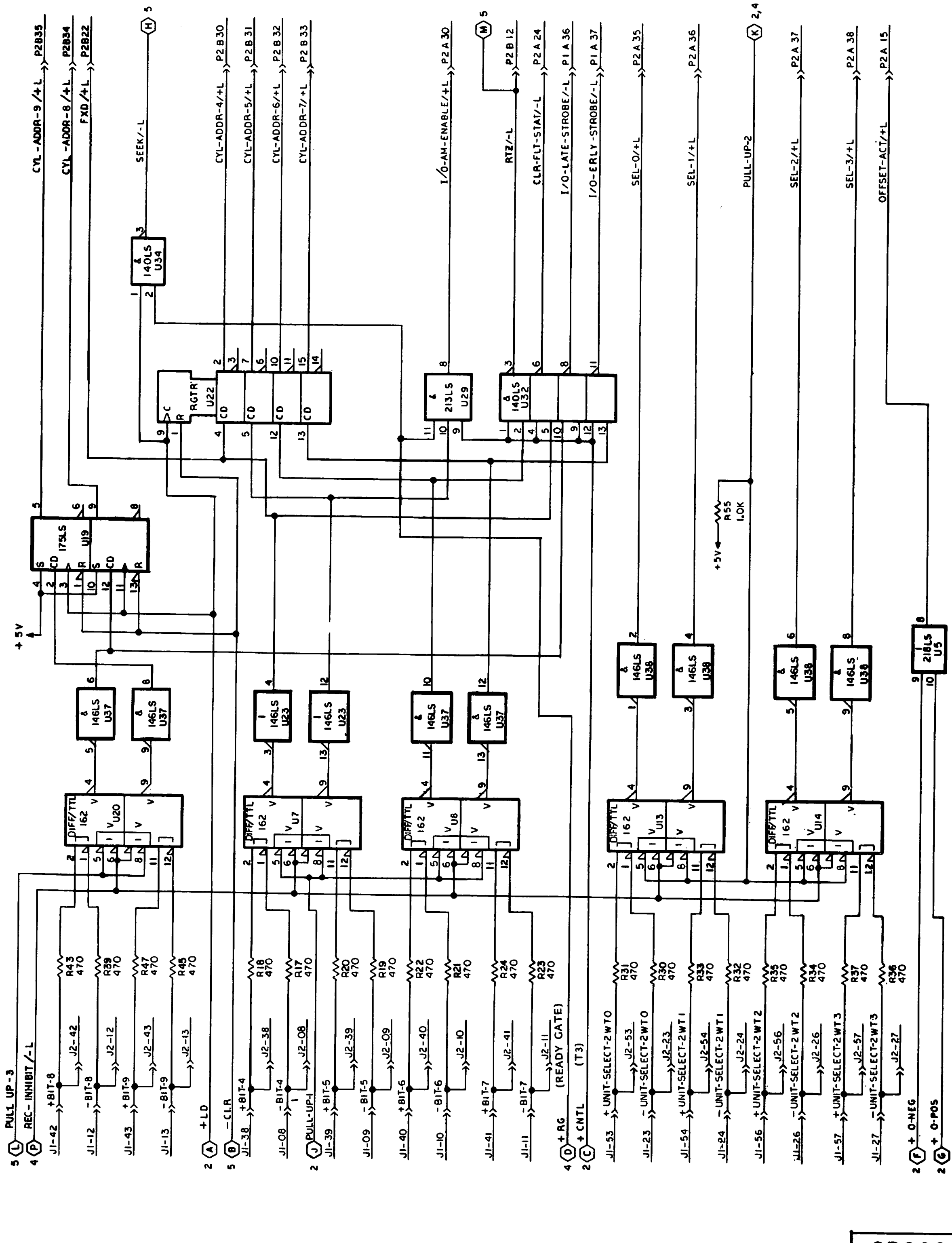



FIGURE 5-4. I/O CKT BOARD (SHEET 3 OF 9) (ASM 77622501 ONLY)




CROSS REF NO. 0103

FIGURE 5-4. I/O CKT BOARD (SHEET 4 OF 9) (ASM 77622501 ONLY)

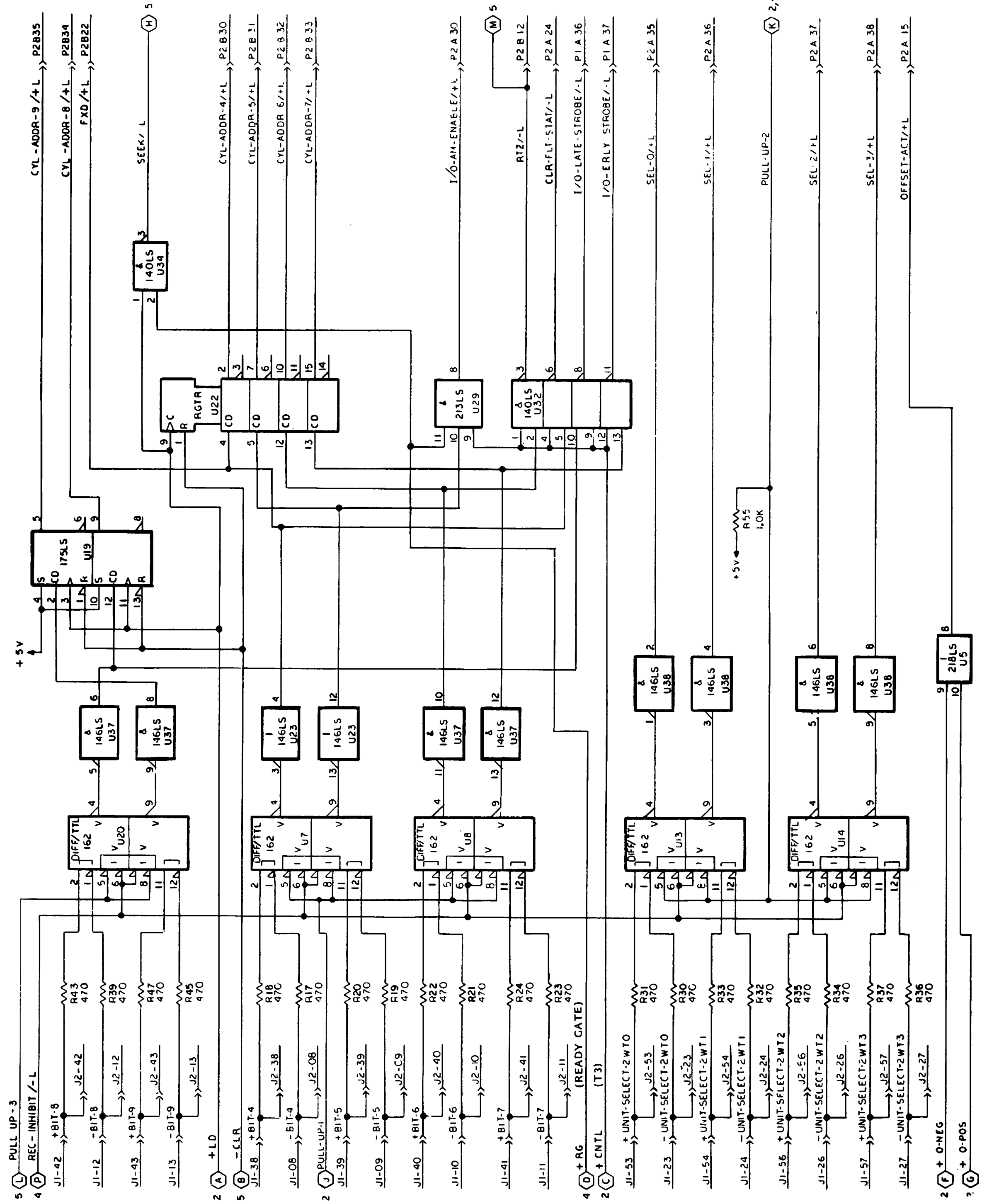
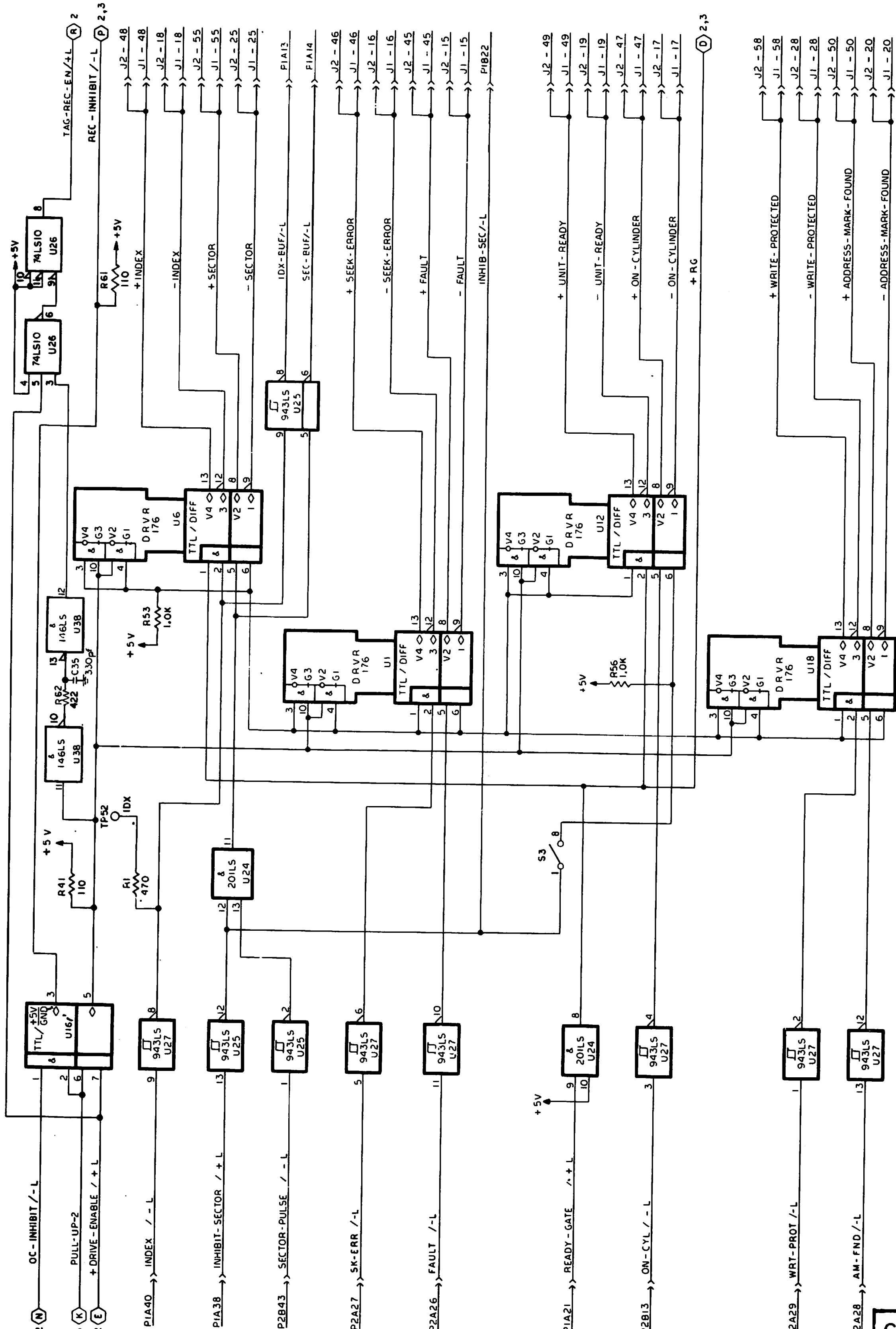


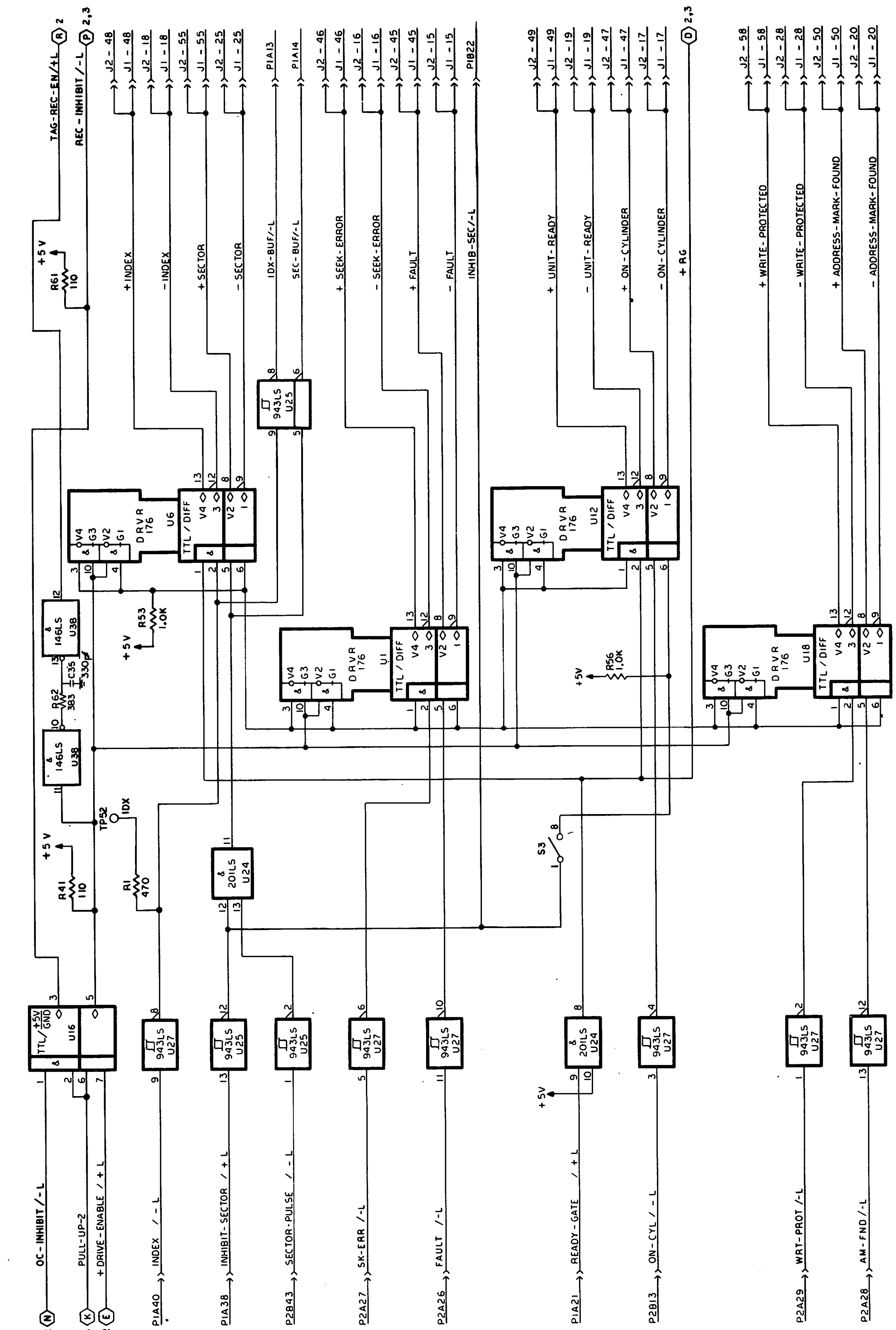
FIGURE 5-4. I/O CKT BOARD (SHEET 4 OF 9)

CROSS REF
NO. 0103



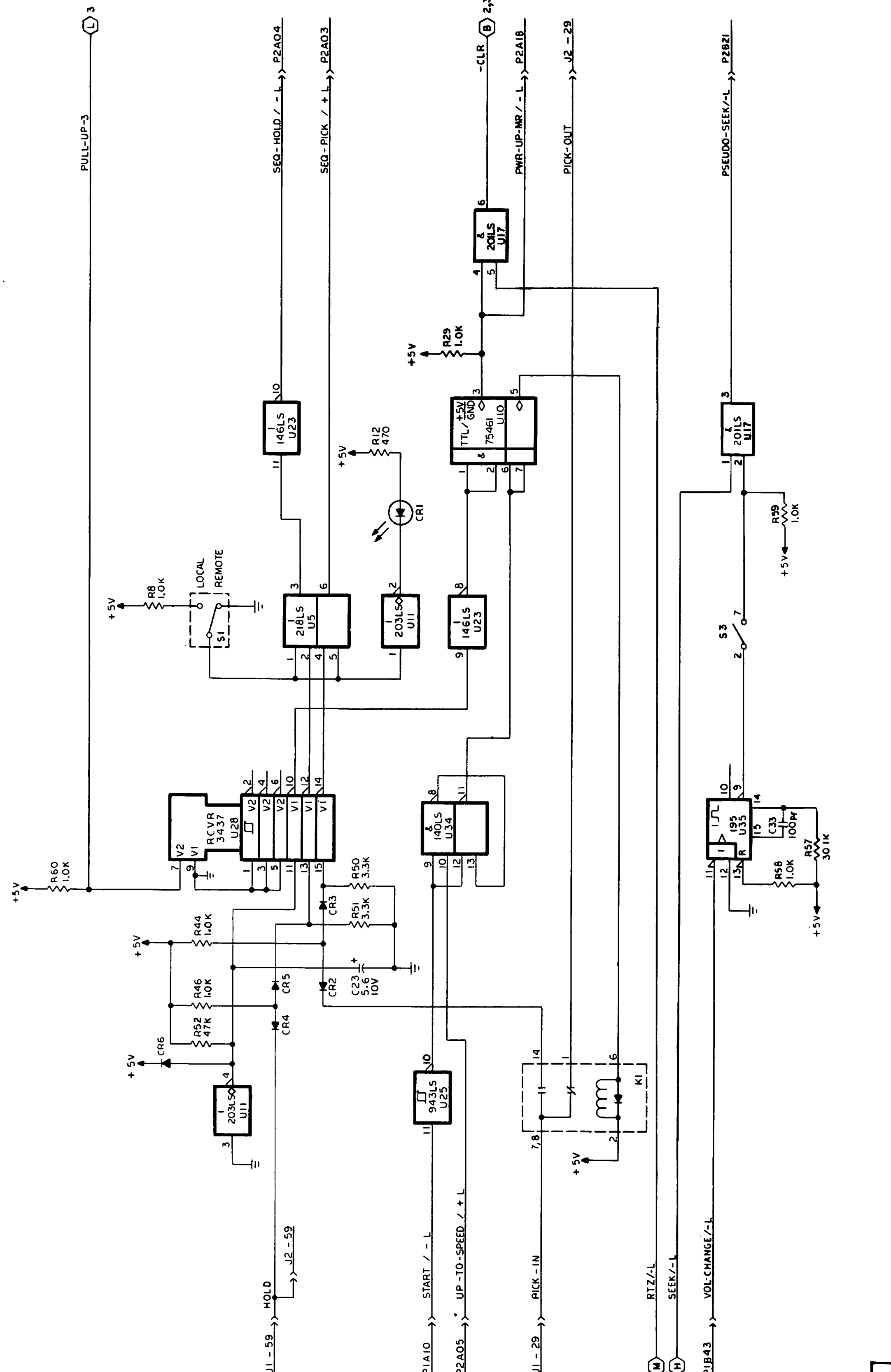

CROSS REF
NO. 0104

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



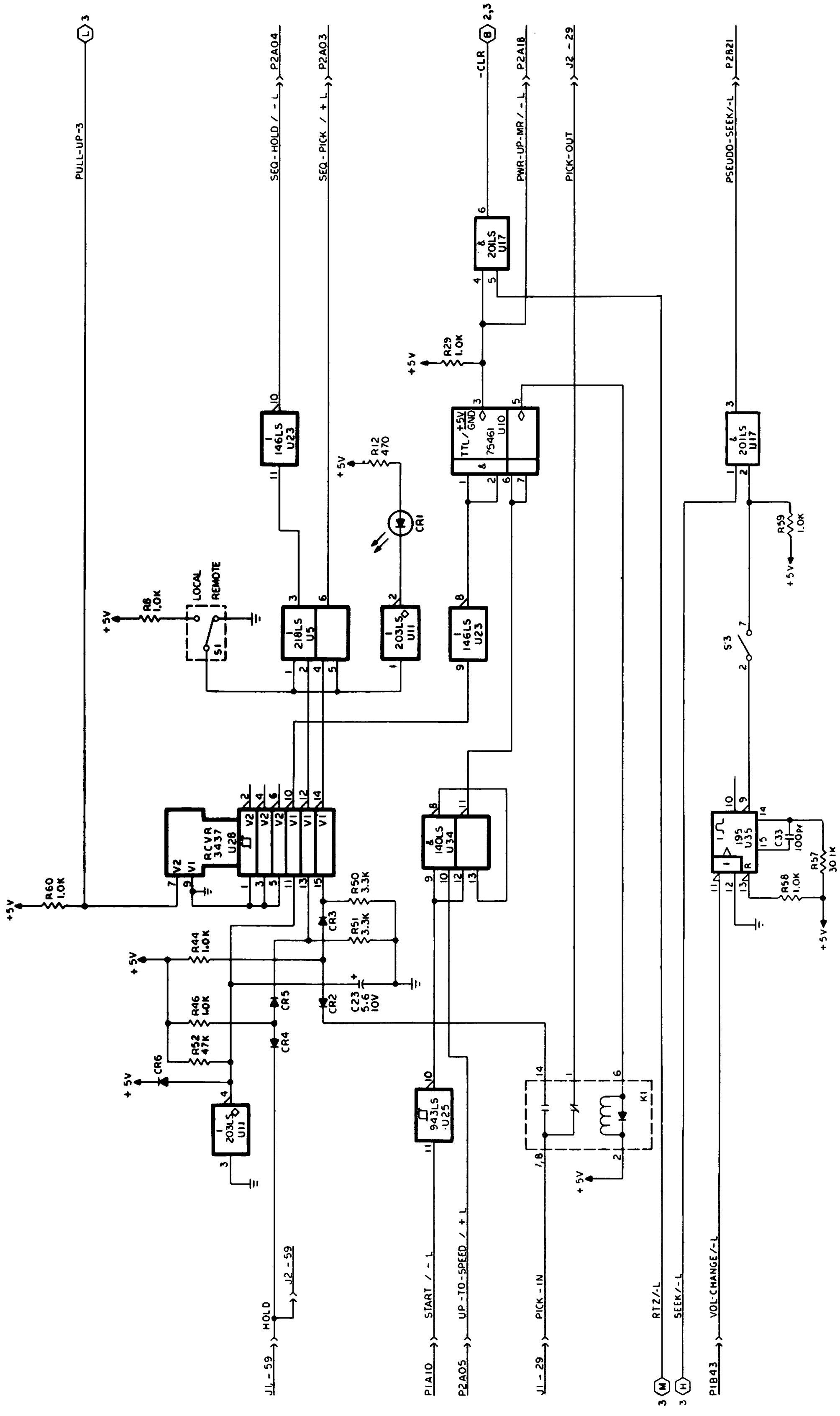

CROSS REF
NO. 0104

FIGURE 5-4. I/O CKT BOARD (SHEET 5 OF 9) (ASM 77622501 ONLY)



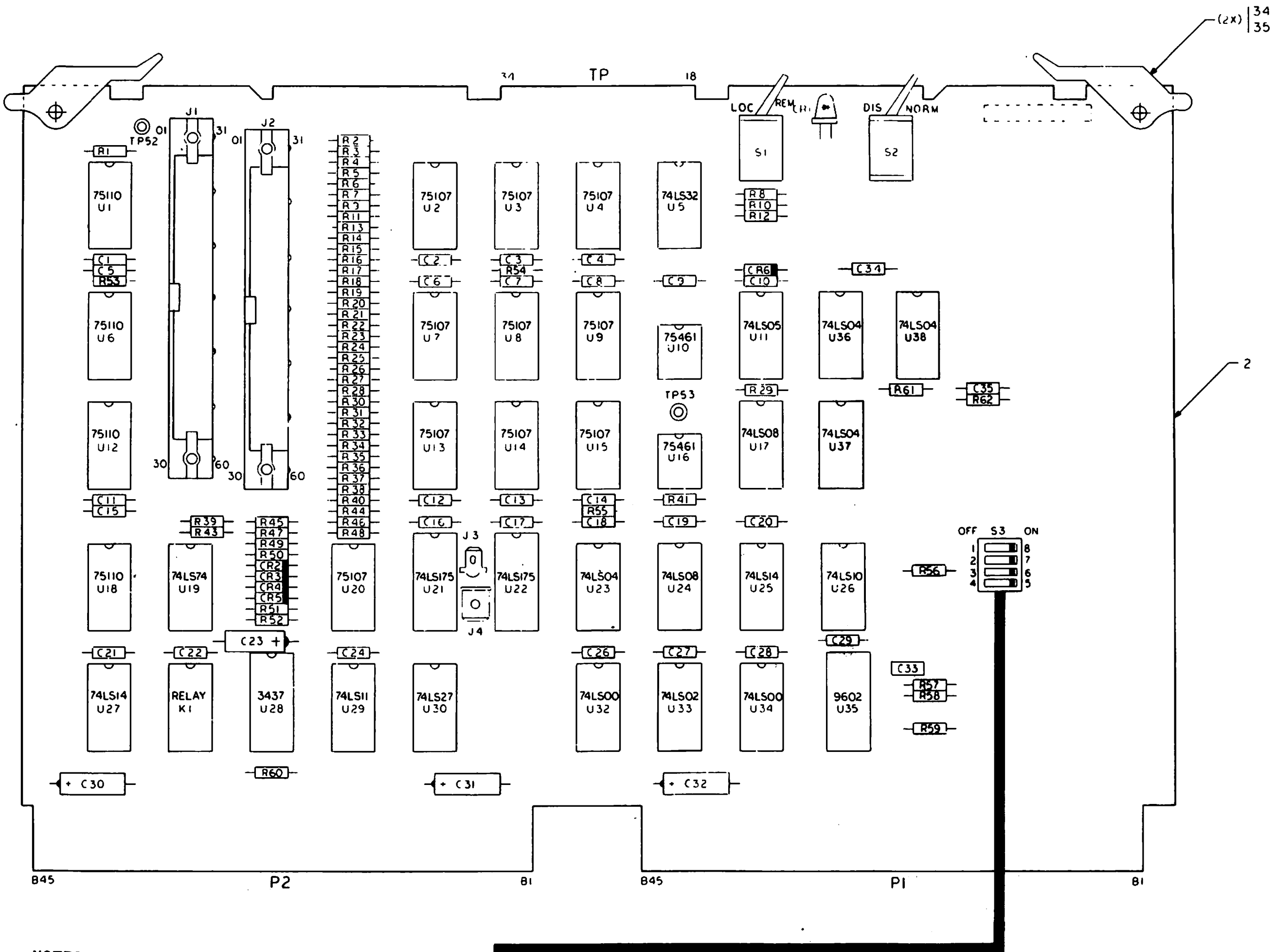

CROSS REF
NO. 0105

FIGURE 5-4. I/O CKT BOARD (SHEET 6 OF 9) (ASM 77622501 ONLY)




CROSS REF
NO. 0105

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




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 | 15 |
| 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 | 13 |
| 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 | 46 |

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

| TERM | PL ITEM |
|---|---|
| TP52 | 38 |
| TP53 | 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 | |
| | 77622501 | PWA, I/O OEM | |
| 2 | 77622520-3 | PWB, 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 | 17706709-7 | Cap 10 V 10% 5.6 uF | |
| 22 | 94361416-4 | Cap 50 V +80 -20% 0.022 uF | |
| 23 | 24504380-7 | Cap 20 V 20% 4.7 uF | |
| 24 | 51706300-4 | Diode IN4454 | |
| 25 | 41347800-9 | Switch Toggle | |
| 26 | 91904653-2 | Header, Solder Tail | |
| 26* | 77834360-8 | Conn Header Assy | |
| 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 | 95538300-4 | 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* | 94360256-5 | Res 1/4 W 1% 383 ohm | |
| 46 | 94360260-7 | Res 1/4 W 1% 422 ohm | |

*Used on Asm 7622501 only.

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

CNTL/MUX CIRCUIT BOARD

| SOURCE/DEST | X-REF | SIGNAL | X-REF. | EM2-P1 | SIGNAL | X-REF. | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|
| | | -20 V | 0203 | 1 | -20 V | 0203 | | |
| | | -5 V | 0201 | 2 | -5 V | 0201 | | |
| P1-B03 | 1501 | DIAG-HD-0/+L | 0205 | 3 | +5 V | 0201 | P1-B19 | 0201, J1-01 (5-12) 1101 |
| P1-B04 | 1501 | DIAG-HD-1/+L | 0205 | 4 | GND | 0201 | P1-B06 | 0201, J1-16 (5-12) 1101 |
| P1-B05 | 1501 | DIAG-HD-2/+L | 0205 | 5 | LP-BIT-0/+L | 0205 | J1-02 | 1101 |
| | | GND | 0201 | 6 | GND | 0201 | P1-B04 | 0201, P1-B18 (5-5) 0201 |
| P1-B07 | 1501 | DIAG-HD-4/+L | 0205 | 7 | LP-BIT-1/+L | 0205 | J1-15 | 1101 |
| P1-B08 | 1501 | DIAG-LATE-STROBE/+L | 0204 | 8 | LP-BIT-2/+L | 0205 | J1-03 | 1101 |
| P1-B09 | 1501 | DIAG-ERLY-STROBE/+L | 0204 | 9 | LP-BIT-3/+L | 0205 | J1-14 | 1101 |
| P1-A10 | 1501 | DIAG-AC-WRTCUR/+L | 020 * | 10 | START -L | | P1-A10 | 0101, P2-B11 (5-6) 0305, J1-04 (5-12) 1101 |
| P1-A11 | 1501 | DIAG-RD-GATE/+L | 0204 | 11 | | | | |
| P1-A12 | 1501 | DIAG-WRT-GATE/+L | 0204 | 12 | RDY-LED/-L | 0206 | J1-05 | 1101 |
| P1-A13 | 0104 | IDX-BUF-/L | 0206 | 13 | LED-FLT -L | 0206 | P1-B40 | 0303, J1-12 (5-12) 1101 |
| P1-A14 | 0104 | SEC-SEC/-L | 0206 | 14 | OP-FLT-CLR/-L | 0202 | J1-06 | 1101 |
| P1-B15 | 1501 | DIAG-ENABLE/+L | 0204 | 15 | LED-ACTIVE/-L | | J1-11 | 1101 |
| | | | | 16 | WRT-PROTECT-FXD/-L | 0206 | J1-07 | 1101 |
| P1-B17 | 1501 | DIAG-AM-EN/+L | 0205 | 17 | WRT-PROTECT-REM/-L | 0206 | J1-10 | 1101 |
| P1-B18 | 0704 | AM-ENABLE/+L | 0205 | 18 | GND | 0201 | P1-B06 | 0201, J1-08 (5-12) 1101 |
| | | | | 19 | +5 V | 0201 | P1-B03 | 0201, P1-B44 (5-5) 0201, J1-09 (5-12) 1101 |
| | | +32V | 0203 | 20 | DC-WRT-CUR-DET -L | 0202 | J09-02 | 0801 |
| P1-B22 | 1501 | HD-ALIGN-WP/-L | 0206 | 21 | READY-GATE/+L | 0206 | P1-A21 | 0104 |
| | | -32 V | 0203 | 22 | INHIB-SEC/-L | 0204 | P1-B22 | 0104 |
| | | GND | 0201 | 23 | GND | 0201 | | |
| J9-08 0801, P1-B28 | 0306 | EN-WRT-CUR-0 +L | 020 * | 24 | MULTI-HD-SEL/-L | 0202 | J9-16 | 0802 |
| J9-13 0801, P1-B29 | 0306 | EN-WRT-CUR-1 +L | 020 * | 25 | AC-WRT-DET -L | 0202 | J9-15 | 0801 |
| J9-09 0801, P1-B30 | 0306 | EN-WRT-CUR-2 +L | 020 * | 26 | WRT-GATE -L | 0204 | J9-10 | 0801 |
| | | | | 27 | HD-SEL-0/-L | 0205 | J9-04 | 0802 |
| P1-B28 | 1501 | DIAG-WRT-DATA -L | 0204 | 28 | HD-5/-L | 0205 | J9-11 | 0802 |
| P1-B29 | 1501 | DIAG-WRT-DATA-GND | 0204 | 29 | HD-4/-L | 0205 | J9-12 | 0802 |
| P1-B30 | 1501 | DIAG-WRT-CLK -L | 0204 | 30 | | | | |
| P1-B31 | 1501 | DIAG-WRT-CLK-GND | 0204 | 31 | HD-3/-L | 0205 | J9-06 | 0802 |
| P1-B32 | 1501 | DIAG-RD-DATA -L | 0204 | 32 | HD-2/-L | 0205 | J9-05 | 0802 |
| P1-B33 | 1501 | DIAG-RD-DATA-GND | 0204 | 33 | HD-1/-L | 0205 | J9-07 | 0802 |
| P1-B34 | 1501 | DIAG-RD-CLK/-L | 0204 | 34 | READ-GATE/+L | 0204 | | |
| P1-B35 | 1501 | DIAG-RD-CLK GND | 0204 | 35 | WRT-INHIBIT +L | 0206 | J9-01 | 0801 |
| P1-B36 | 0305 | SVO-RLY/+L | 0206 | 36 | I/O LATE STROBE -L | 0204 | P1-A36 | 0103 |
| P2-A37 | 070 * | ON-TIME-EN/-L | 020 * | 37 | I/O ERLY STROBE/-L | 0204 | P1-A37 | 0103 |
| P2-A04 0705, P1-B38 | 1501 | AM-FOUND +L | 0205 | 38 | READ GATE/+L | 0204 | P2-B05 | 0705 |
| | | GND | 0201 | 39 | GND | 0201 | | |
| P1-B38 P2-B18 0206, P2-A03 | 0705 | PWR-UP-MR -L | 0206 | 40 | WRT GATE -L | 0204 | P2-B04 | 0704 |
| P1-B41 | 0606 | FXD-ADDR/-L | 0205 | 41 | ERLY-STROBE/-L | 0204 | P2-B03 | 0703 |
| P2-A07 | 0703 | LATE-STROBE/-L | 0204 | 42 | I/O WRT-GATE/-L | 0204 | P1-A42 | 0102 |
| P1-B43 0303, P1-B43 | 010 * | VOL-CHANGE/-L | 020 * | 43 | I/O READ-GATE +L | 0204 | P1-A43 | 0102 |
| | | +5 V | 0201 | 44 | +5 V | 0201 | P1-B19 | 0201 |
| | | +20 V | 0203 | 45 | +20 V | 0203 | | |

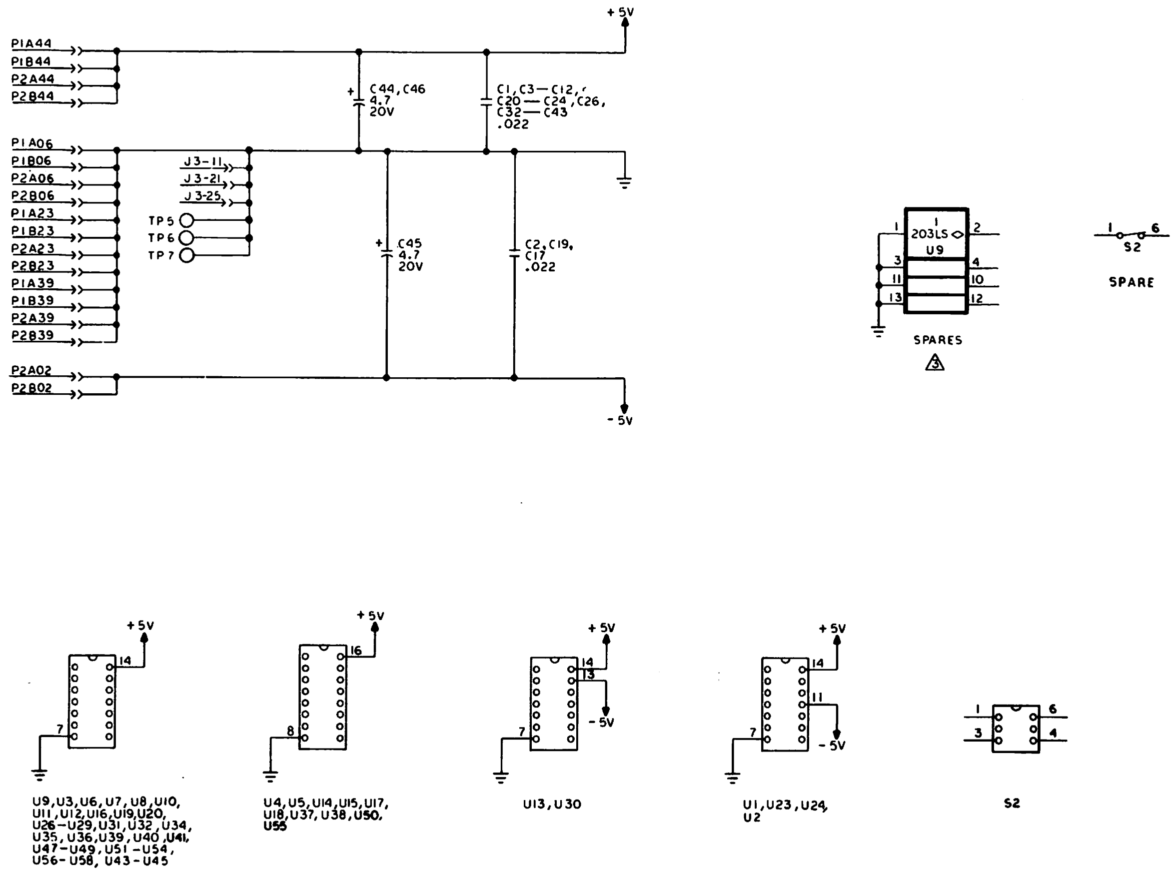
| SOURCE/DEST | X-REF | SIGNAL | X-REF. | EM2-P2 | SIGNAL | X-REF. | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | | | |
| | | -5 V | 0201 | 2 | -5 V | 0201 | | |
| | | | | 3 | | | | |
| | | | | 4 | | | | |
| | | | | 5 | | | | |
| | | GND | 0201 | 6 | GND | 0201 | | |
| | | | | 7 | BUS-OUT-2WT7/+L | 020 * | P2-A07 | 0102 |
| | | | | 8 | BUS-OUT-2WT0/+L | 0205 | P2-A08 | 0102 |
| | | | | 9 | BUS-OUT-2WT1/+L | 0205 | P2-A09 | 0102 |
| P2-B10 | 0303 | MC+VLT-FLT/-L | 0203 | 10 | BUS-OUT-2WT2/+L | 0205 | P2-A10 | 0102 |
| | | | | 11 | | | | |
| P2-B12 (5-6) 0305, P2-B12 | 0103 | RTZ/-L | 0205 | 12 | | | | |
| P2-B13 (5-6) 0305, P2-B13 | 0104 | ON-CYL/-L | 0204 | 13 | | | | |
| P2-B14 | 0304 | READY-BLINK/-L | 0206 | 14 | | | | |
| P2-B15 | 0305 | RESET-EXT-INT/-L | 0202 | 15 | OFFSET - ACT/+L | 0206 | P2-A15 | 0103 |
| P2-B16 | 0304 | FLT-0/+L | 0202 | 16 | SELECT/-L | 0205 | P2-A16 | 0102 |
| P2-B17 | 0304 | FLT-1/+L | 0202 | 17 | HD-ADDR/-L | 0205 | P2-A17 | 0102 |
| P2-B18 | 0304 | FLT-2/+L | 0202 | 18 | PWR-UP-MR/-L | 0206 | P2-A18 | 0105, P1-A40 (5-5) 0206 |
| P2-B19 | 0304 | FLT-3/+L | 0202 | 19 | | | | |
| P2-B20 | 0304 | FLT-4/+L | 0202 | 20 | MOD-ADDR/-L | 0204 | P2-A20 | 0102 |
| P2-B21 (5-4) 0105, P2-B21 | 0305 | SEEK/-L | 020 * | 21 | TGO/-L | 0202 | P2-A21 | 0102 |
| | | +32 V | 0203 | 22 | FXD/+L | 0205 | P2-B22 | 0103 |
| | | GND | 0201 | 23 | GND | 0201 | | |
| | | | | 24 | CLR-FLT-STAT/-L | 0203 | P2-A24 | 0103 |
| | | | | 25 | | | | |
| P2-B10 | 0703 | RD-CLK-GND | 0204 | 26 | FAULT/-L | 0206 | P2-A26 | 0104 |
| P2-B09 | 0703 | RD-CLK-GND | 0204 | 27 | SEEK-ERROR/-L | 0204 | P2-A27 | 0104 |
| P2-B28 | 0704 | WRT-CLK-GND | 0204 | 28 | AM-FND/-L | 0205 | P2-A28 | 0104 |
| P2-B29 | 0704 | WRT-CLK/-L | 0204 | 29 | WRT-PROT/-L | 0206 | P2-A29 | 0104 |
| | | | | 30 | I/O-AM-ENABLE/+L | 0205 | P2-A30 | 0103 |
| P2-B31 | 0704 | NRZ-WRT-GND | 0204 | 31 | | | | |
| P2-B32 | 0704 | NRZ-WRT/-L | 0204 | 32 | | | | |
| P2-B07 | 0703 | NRZ-DATA-OUT-GND | 0204 | 33 | | | | |
| P2-B08 | 0703 | NRZ-DATA-OUT/-L | 0204 | 34 | | | | |
| | | | | 35 | SEL-0/+L | 0205 | P2-A35 | 0103 |
| P2-B36 | 0305 | SEEK ERROR/+L | 0204 | 36 | SEL-1/+L | 0205 | P2-A36 | 0103 |
| P2-B37 | 0303 | MAIN-FLT-INT/-L | 0202 | 37 | SEL-2/+L | 0205 | P2-A37 | 0103 |
| P2-B38 | 0305 | M-P-FLT/+L | 0206 | 38 | SEL-3/+L | 0205 | P2-A38 | 0103 |
| | | GND | 0201 | 39 | GND | 0201 | | |
| P2-B40 | 0303 | FLT-RESET/+L | 0202 | 40 | | | | |
| P2-B41 | 0605 | SVO-CLK2-GND | 0206 | 41 | | | | |
| P2-B42 | 0605 | SVO-CLK/-L | 0206 | 42 | | | | |
| P2-B43 | 0605 | SVO-CLK2-GND | 0206 | 43 | | | | |
| | | +5 V | 0201 | 44 | +5 V | 0201 | | |
| | | | | 45 | | | | |

XX226

*WIRED TO, BUT NOT USED ON PWA

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

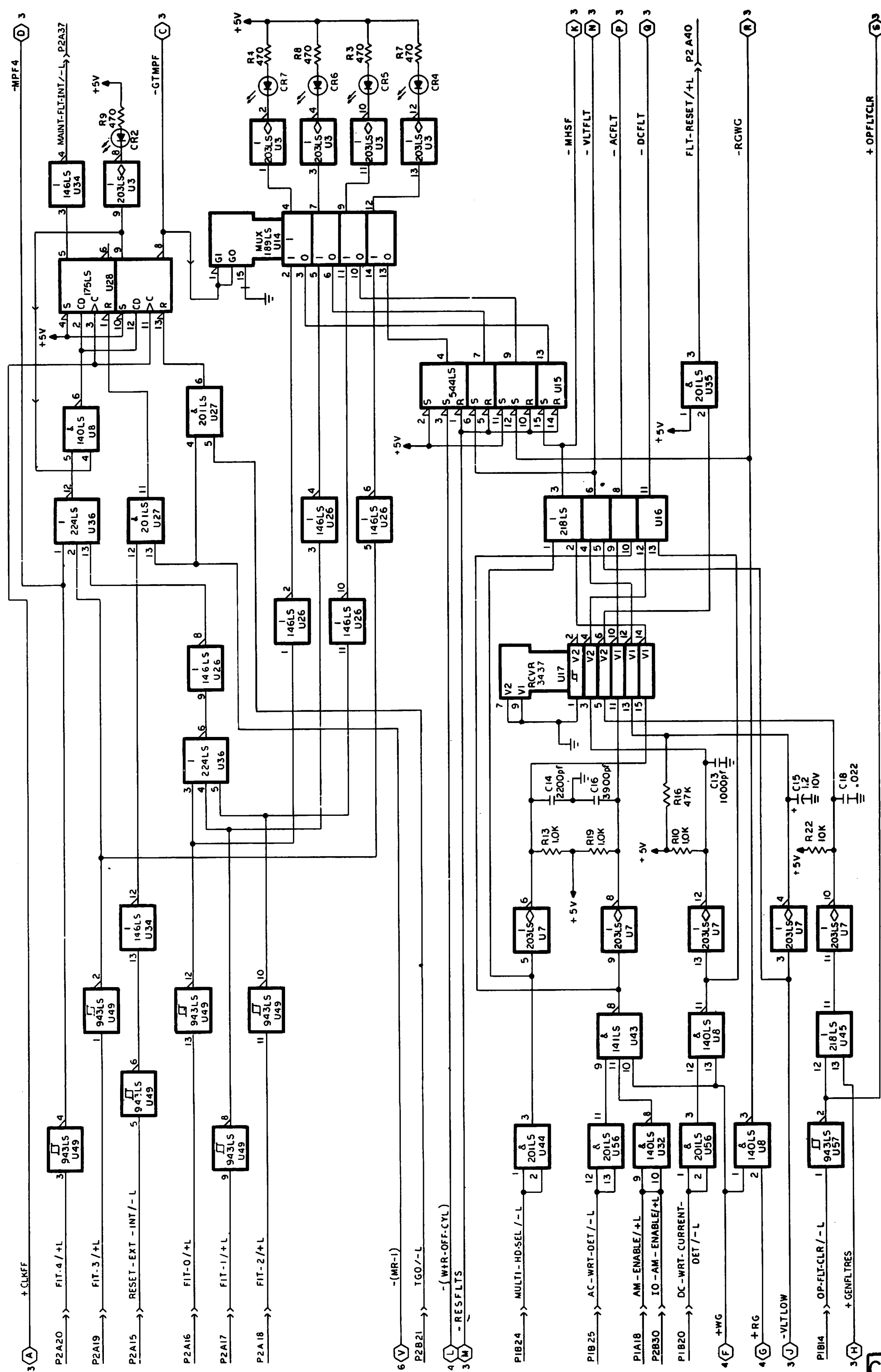
1. RESISTORS VALUES ARE IN OHMS, 1/4W, ±5%
2. CAPACITANCE VALUES ARE IN MICROFARADS
3. △ INPUT PINS ON U9 SPARES TIED TO GROUND TO REDUCE POWER DISSIPATION.
4. △ S2-2 USED TO VALIDATE ON CYLINDER WITH VALID SECTOR.

CROSS REF
NO 0201

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

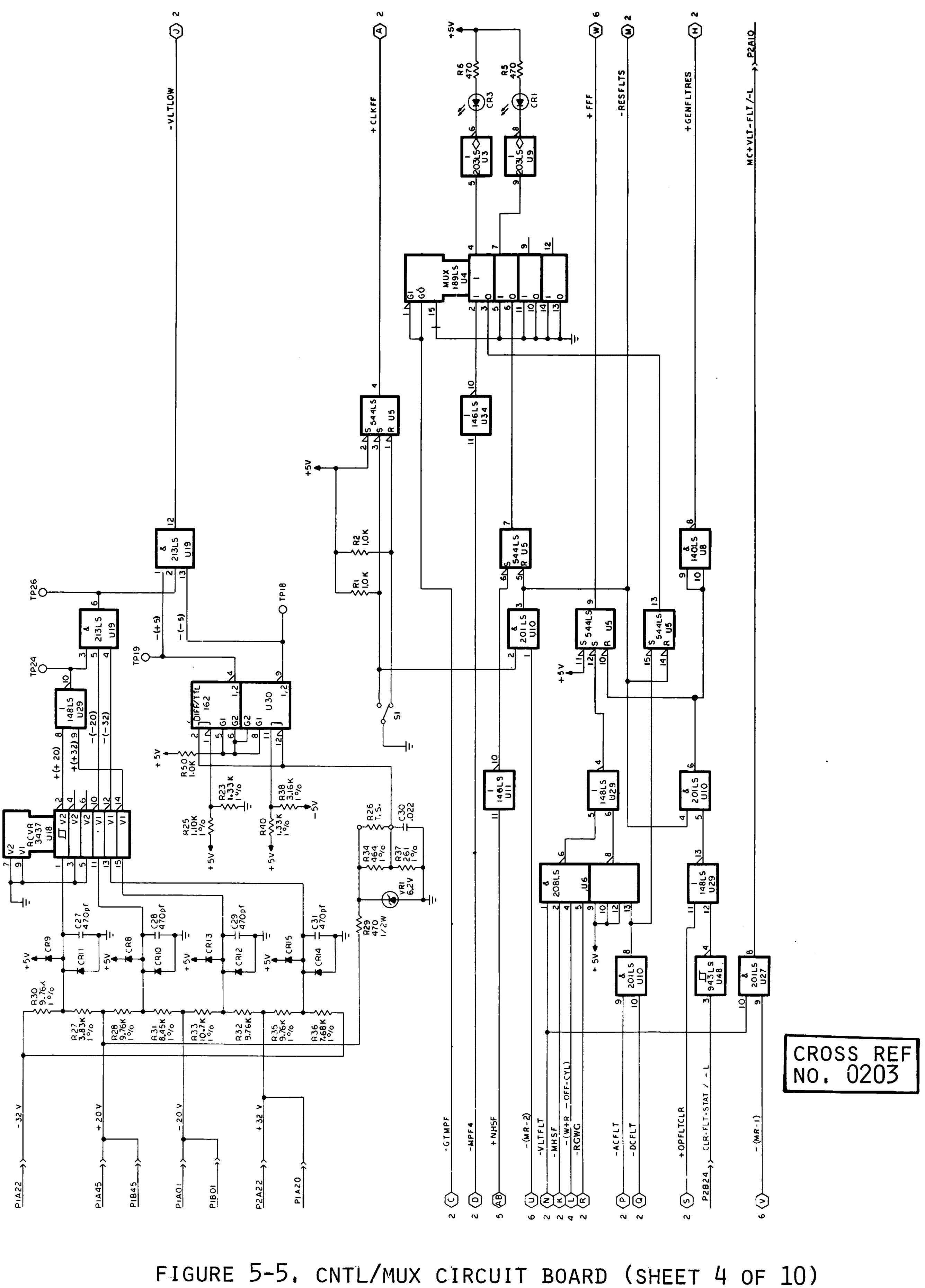
**WARNING**

**PWAs can be damaged by static electrictiy if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).**



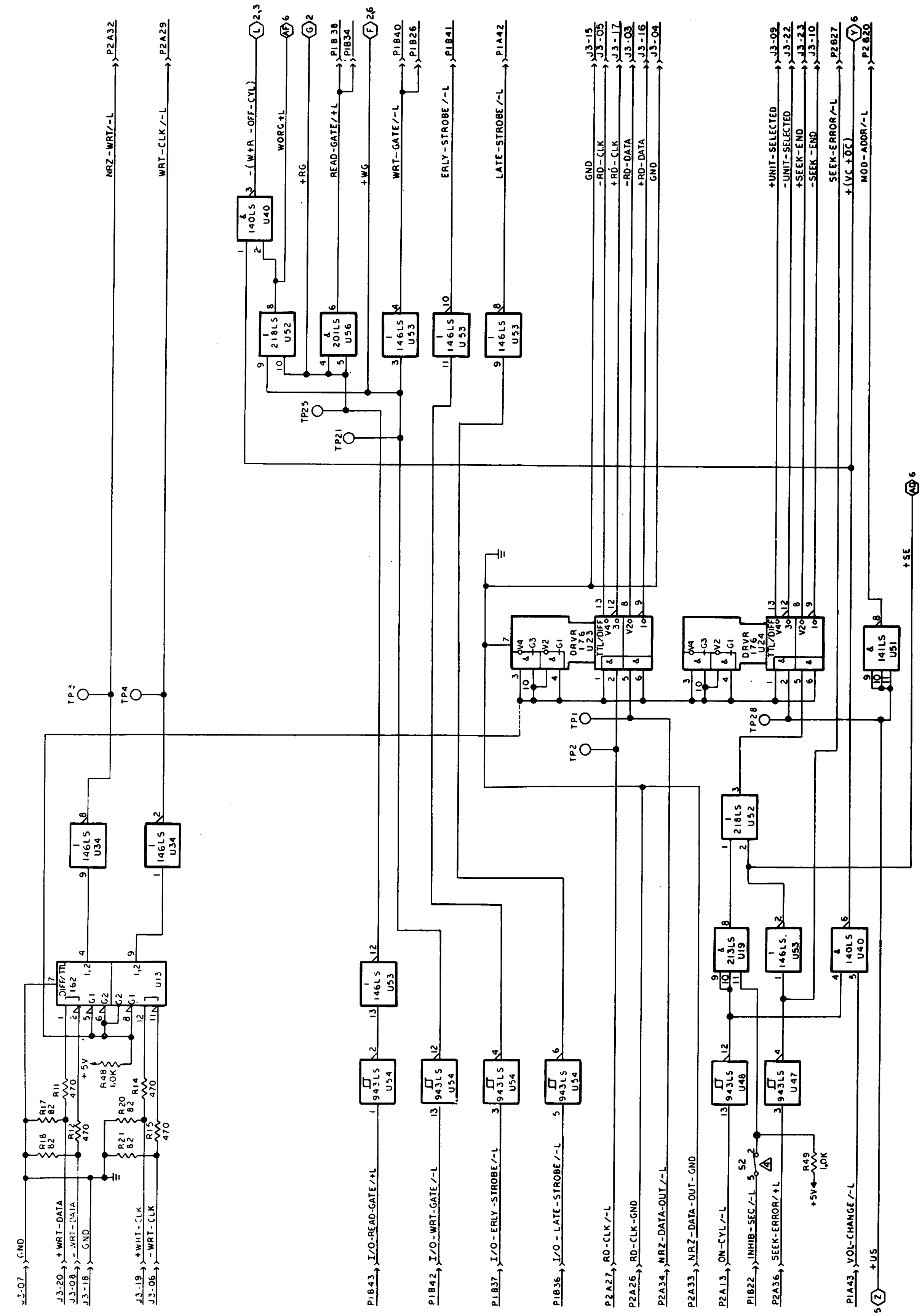

CROSS REF
No. 0202

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



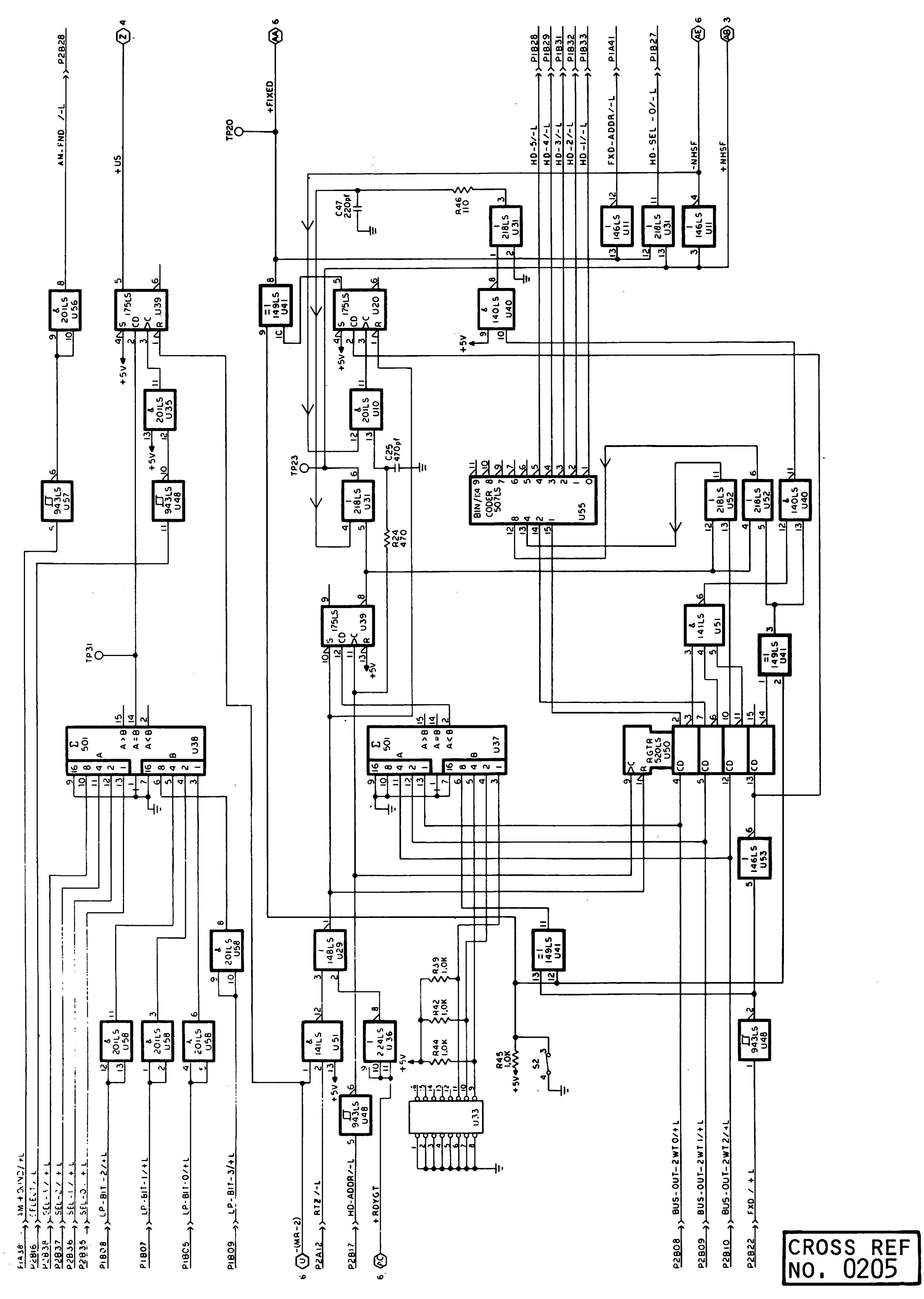

CROSS REF
NO. 0203

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



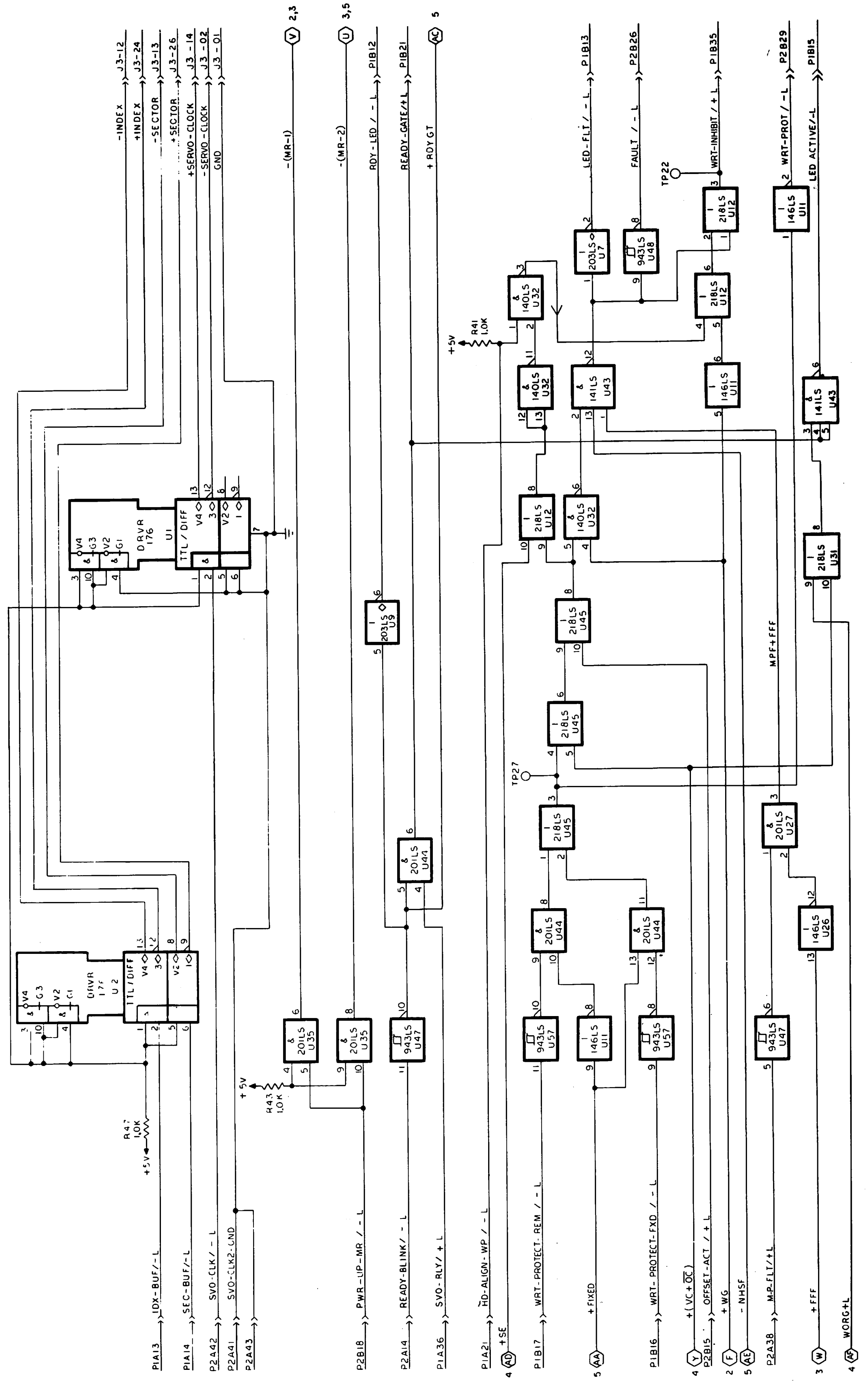

CROSS REF
NO. 0204

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



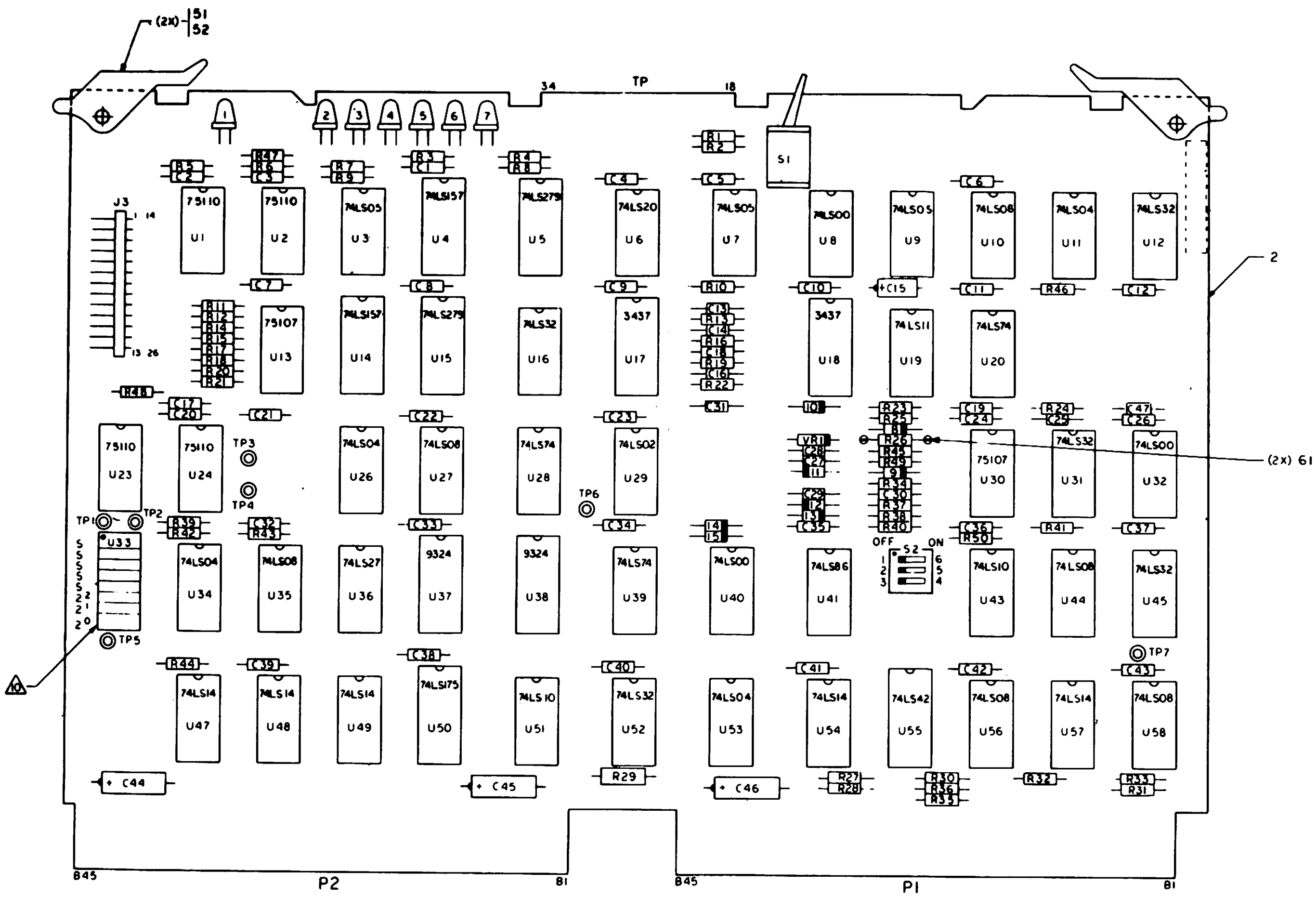
CROSS REF
NO. 0205

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




CROSS REF
NO. 0206

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




△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)

| ITEM | DRAWING NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| | 77624700 | PWA, CNTL/MUX OEM | |
| | 77588000 | PWA, CNTL/MUX OEM | |
| | 77666950 | PWA, CNTL/MUX OEM | |
| | 77666970 | PWB, CNTL/MUX OEM | |
| 2 | 77588020 | 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 uF | |
| 31 | 24504380-7 | Cap 20 V 20% 4.7 uf | |
| 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% 1.10 K | |
| 38 | 94360312-6 | Res 1/4 W 1% 1.33 K | |
| 39 | 94360348-0 | Res 1/4 W 1% 3.16 K | |
| 40 | 94360356-3 | Res 1/4 W 1% 3.83 K | |
| 41 | 94360403-3 | Res 1/4 W 1% 10.7 K | |
| 42 | 94360395-1 | Res 1/4 W 1% 9.76 K | |
| 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% 10 K | |
| 46 | 94402148-4 | Res 1/4 W 5% 470 | |
| 47 | 94402156-7 | Res 1/4 W 5% 1 K | |
| 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 | 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% 47 K | |
| 56 | 94360389-4 | Res 1/4 W 1% 8.45 K | |
| 57 | 94360385-2 | Res 1/4 W 1% 7.68 K | |
| 58 | 17706701-4 | Cap 10 V 10% 1.2 uF | |
| 59 | 94240407-0 | Cap 50 V 10% 220 | |
| 60 | 83452211-2 | Switch, Dual-In-Line | |
| 61 | 77612165-9 | 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)

ETCH — SERVO COARSE CIRCUIT BOARD — COMPONENT

### EM3-P1

| SOURCE/DEST | X-REF | SOURCE/DEST | X-REF | SIGNAL (A) | X-REF. | PIN | SIGNAL (B) | X-REF. | SOURCE/DEST | X-REF | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | -20 V | 0301 | 1 | -20 V | 0301 | | | | |
| | | VELOCITY XDUCER | 1601 | TACH-SHLD | 0306 | 3 | | | | | | |
| | | | | TACH | 0306 | 4 | | | | | | |
| | | | | TACH-RTN | | 5 | | | | | | |
| | | | | ANALOG GND | 0301 | 6 | ANALOG GND | 0301 | | | | |
| | | | | | | 8 | PA-COM-P | 0306 | J1-01 | 1001 | | |
| | | | | | | 9 | UNLOAD-CURR | 0307 | J1-02 | 1001 | | |
| | | P1-B10 | 150* | DIAG-FG-MON | 0306 | 10 | PA-COM-N | 0306 | J1-03 | 1001 | | |
| | | P1-B11 | 150* | DIAG-ACT-I-MON | 0306 | 11 | 32 V RET | 0306 | J1-04 | 1001 | | |
| | | P1-B12 | 150* | DIAG-DR-MON | 0306 | 12 | | | | | | |
| | | P1-B13 | 150* | I-SPE | 0306 | 13 | UNLOAD-COMMON | 0307 | J1-05 | 1001 | | |
| | | P1-B14 | 150* | SPE | 0306 | 14 | -31-CAP | 0307 | J1-06 | 1001 | | |
| | | | | | | 17 | +5 V RTN | 0301 | | | | |
| | | | | | | 20 | I-FBK-SIG | 0306 | P1-01 R1 | 1601 | | |
| | | | | | | 21 | I-FBK-RTN | 0306 | P1-02 R1 | 1601 | | |
| | | | | ANALOG AND | 0301 | 23 | ANALOG GND | 0301 | | | | |
| | | J10-01 | 1601 | SPIN-SEN-DR | 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 | 0307 | 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 |
| | | | | | | 31 | BRK-PUL/+L | 0305 | J1-01 | 1201 | | |
| | | | | | | 33 | RUN/+L | 0305 | J1-03 | 1201 | | |
| | | | | | | 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 | 030*,P1-B41 | | 030* | FXD-ADDR/-L | 030* | 41 | FXD-ADDR/-4 | 030* | P1-A41 | 030* | | |
| | | 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 | 0208 ,P1-A43 | | 0303 |
| | | | | +5 V | 0301 | 44 | +5 V | 0301 | | | | |
| | | | | +20 V | 0301 | 45 | +20 V | 0301 | | | | |

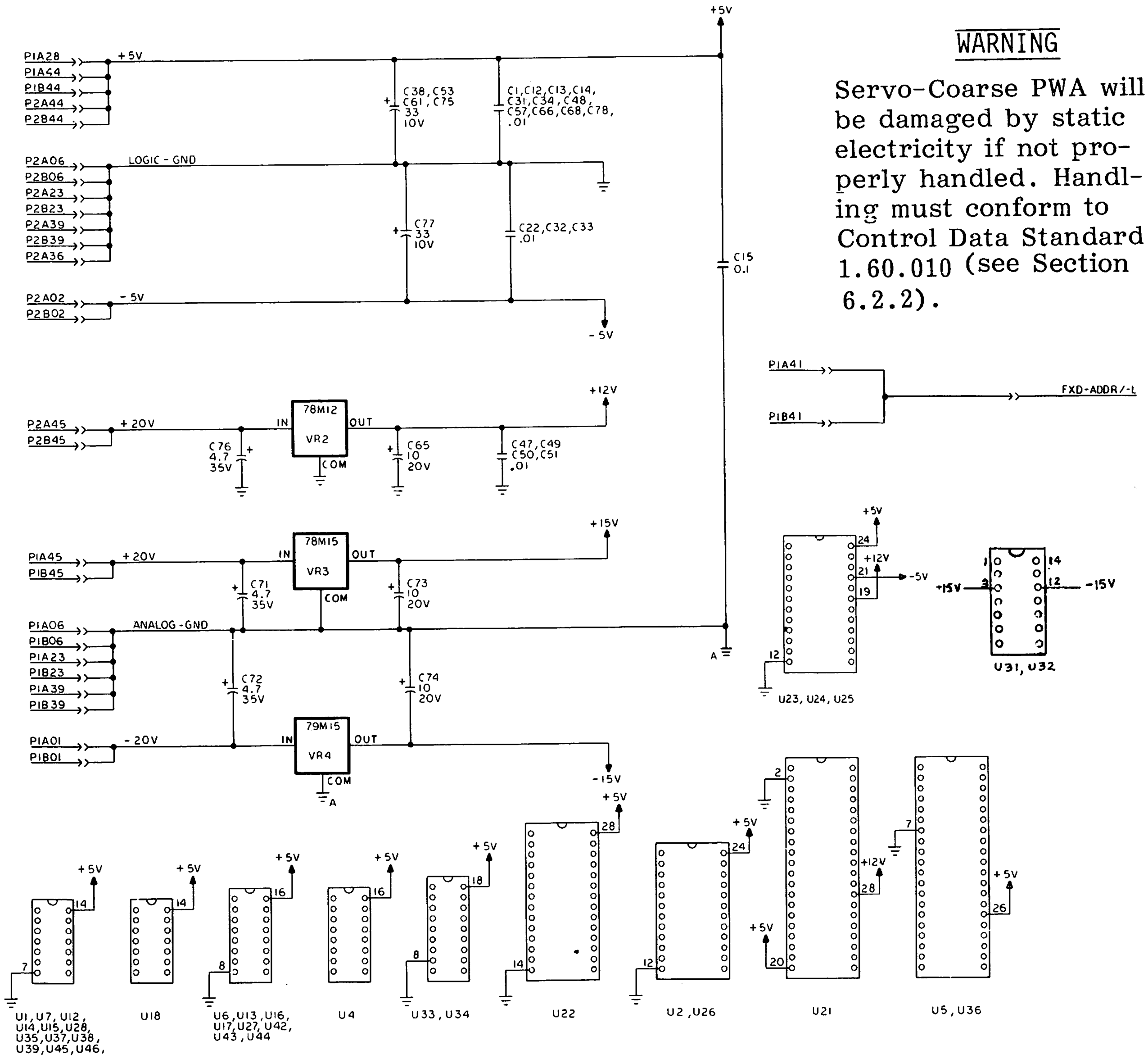
### EM3-P2

| SOURCE/DEST | X-REF | SIGNAL (A) | X-REF. | PIN | SIGNAL (B) | X-REF. | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|
| | | -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-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 | 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-REST/+L | 0303 | P2-A40 | 0202 |
| | | | | 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)




## WARNING

Servo-Coarse PWA will be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).

| UNUSED LOGIC ELEMENTS | | | |
|---|---|---|---|
| ELEMENT | VENDOR NO. | LOCATION | OUTPUT PIN |
| 202LS | 74LS03 | U12 | 11 |

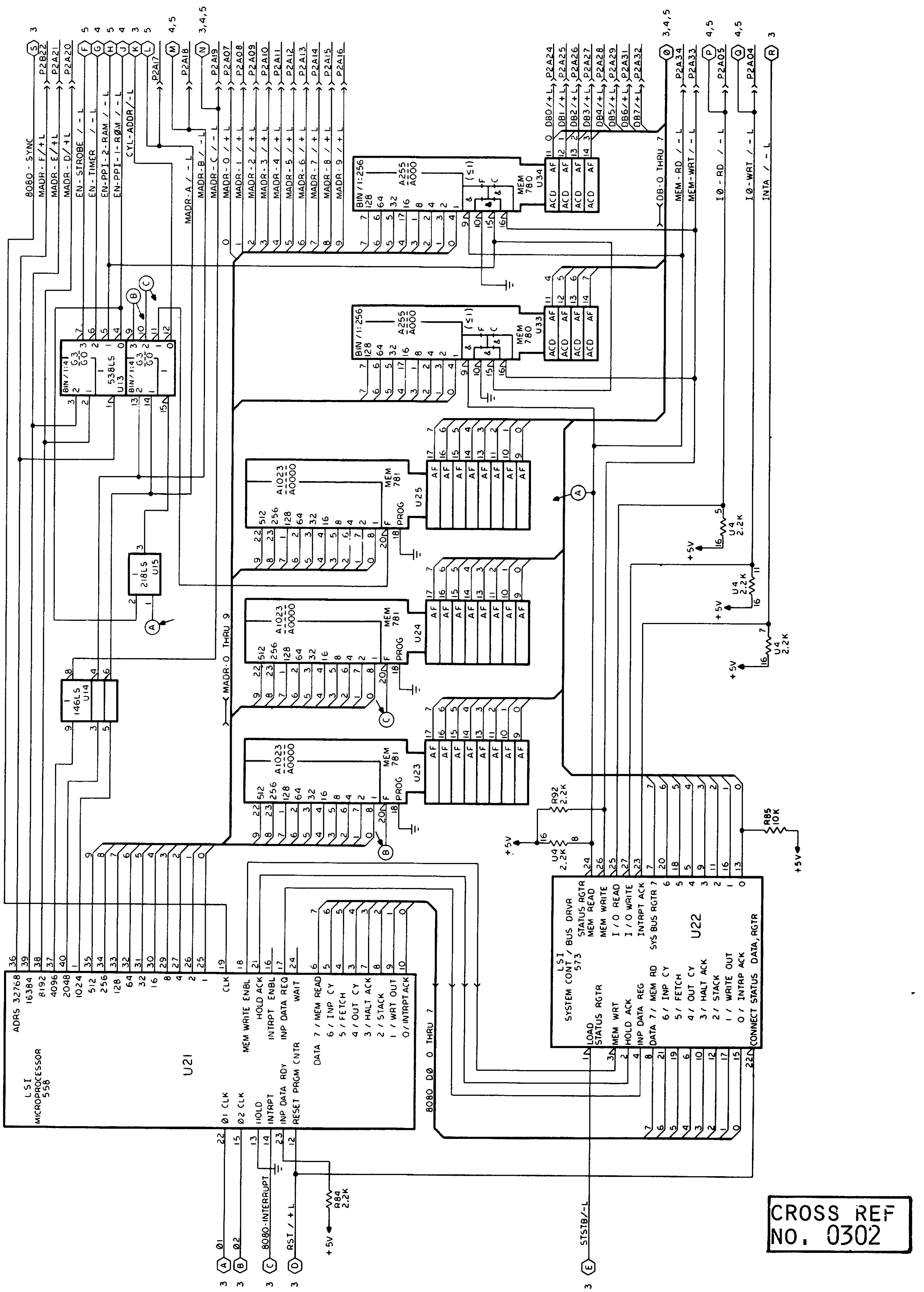
| ASSEMBLY | JUMPER CONFIGURATION | | | | | |
|---|---|---|---|---|---|---|
| | △5 W1 | △6 W2 | W3 | W4 | W5 | W6 |
| 77622402-4 | – | X | – | X | X | X |
| 77622440-4 | X | – | – | X | X | X |

TABLE A

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTORS VALUES ARE IN OHMS, 1/4W, ±5%
2. CAPACITANCE VALUES ARE IN MICROFARADS
3. SWITCHES 1 THRU 7 ARE THE NUMBER OF SECTORS PER REV SELECTION. SWITCH 8 IS VELOCITY MEASUREMENT MODE
△4 SEE TABLE A FOR JUMPER CONFIGURATION
△5. W1 JUMPER CAUSES ON CYLINDER TO BECOME FALSE FOR APPROXIMATELY 1.2 MSEC. WHEN OFFSET IS CHANGED OR TERMINATED
△6. W2 JUMPER KEEPS ON CYLINDER TRUE, WHEN OFFSET IS CHANGED OR TERMINATED

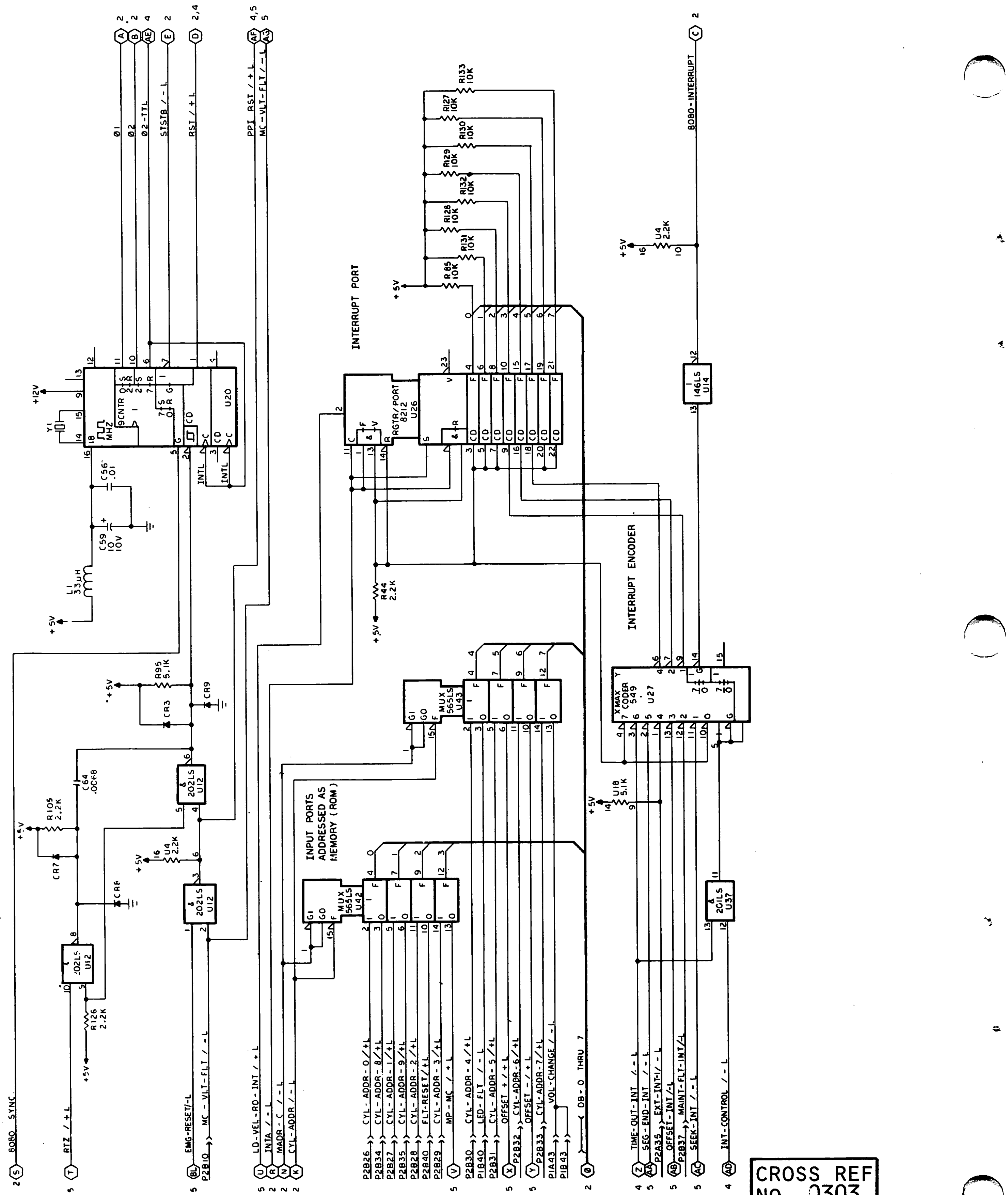
CROSS REF NO. 0301

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



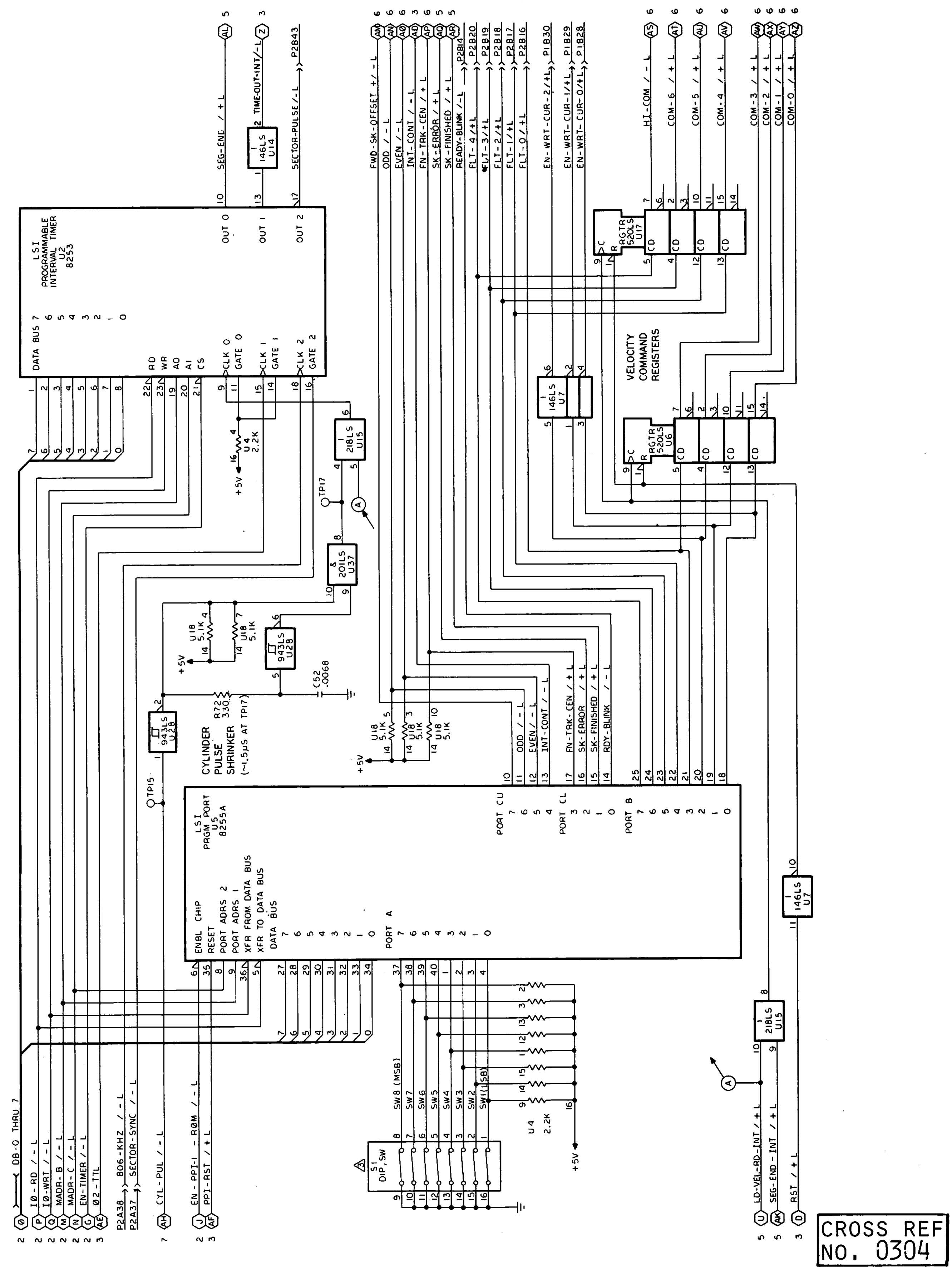
CROSS REF
NO. 0302

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



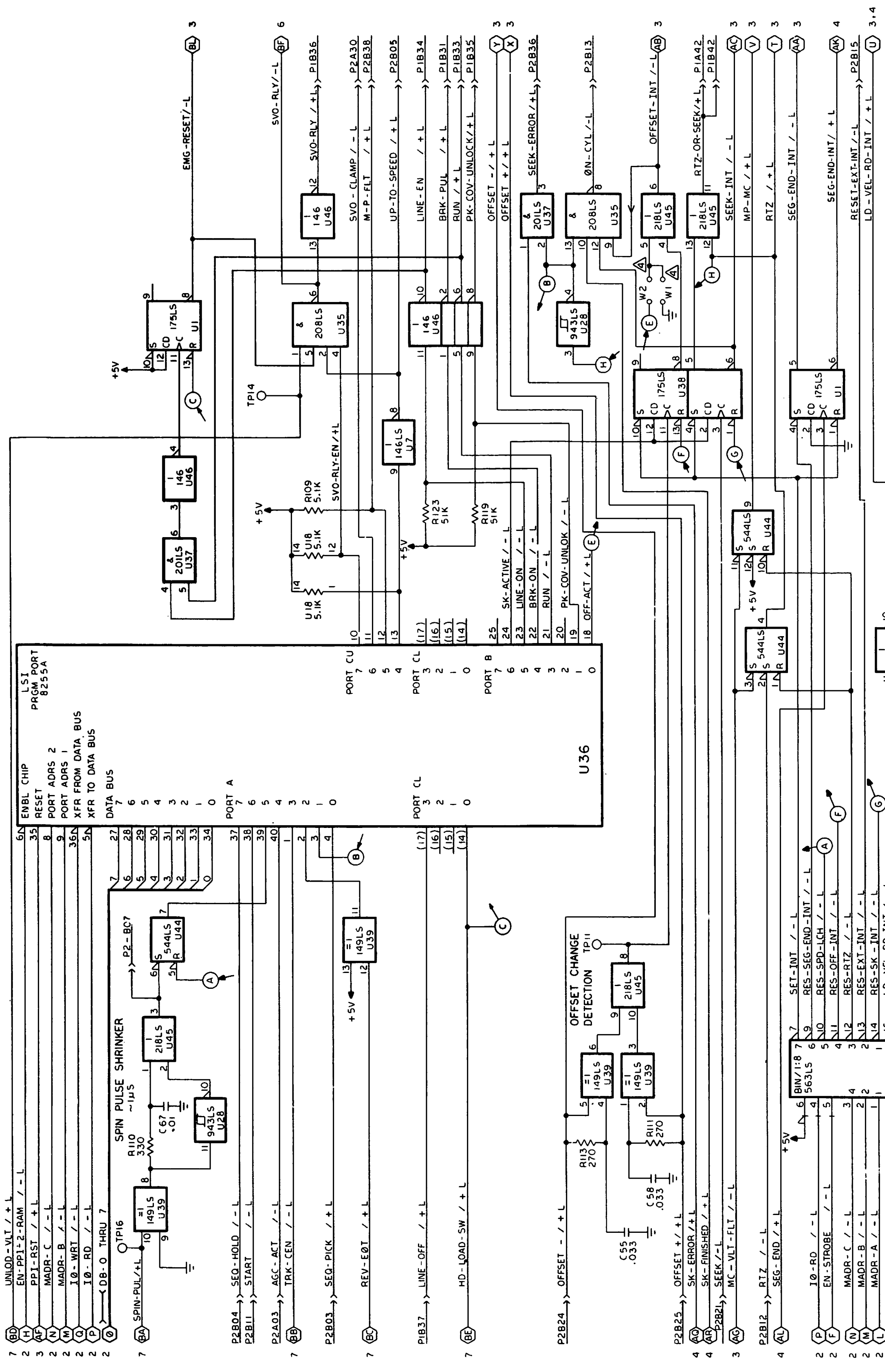

CROSS REF NO. 0303

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



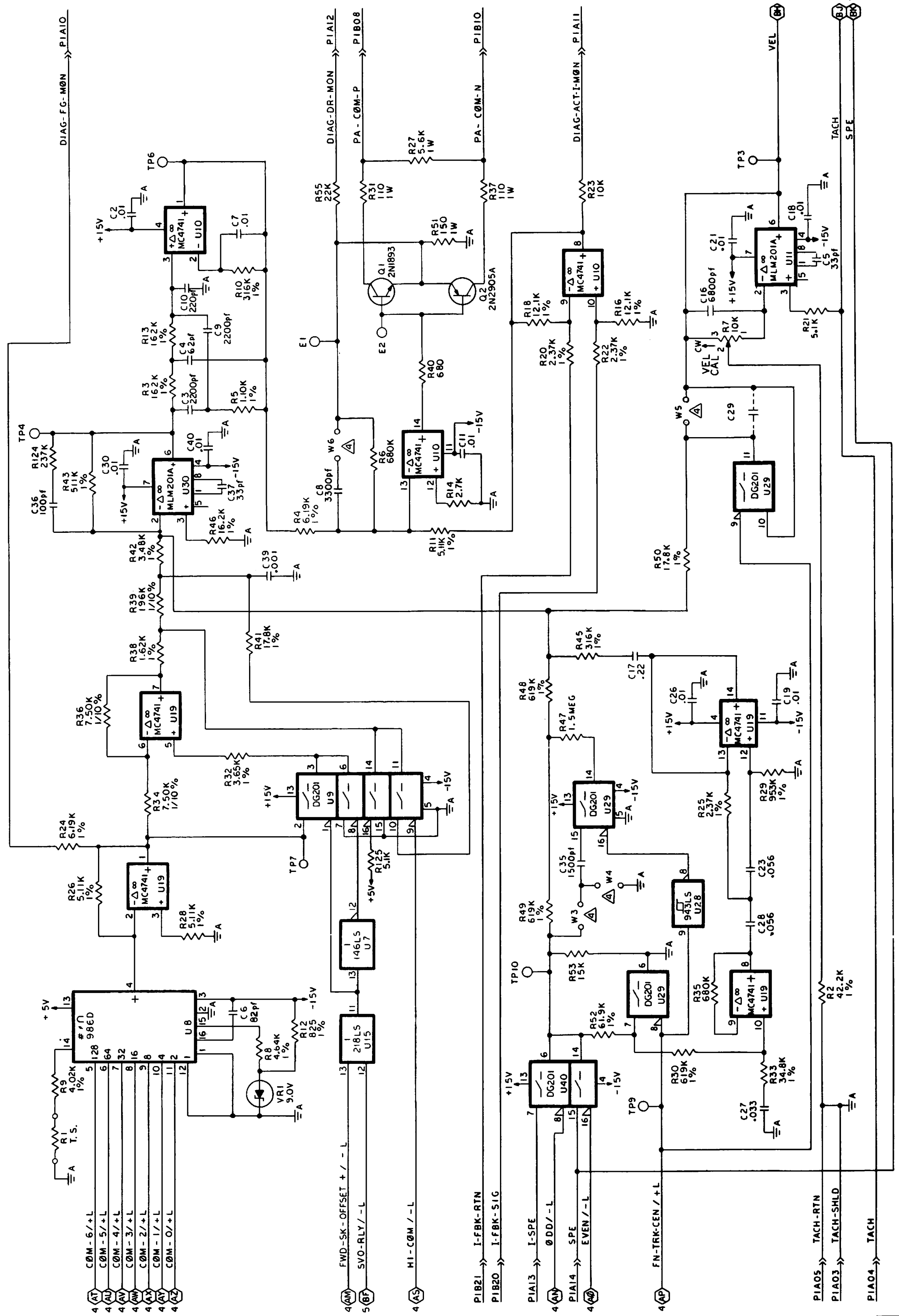

CROSS REF
NO. 0304

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



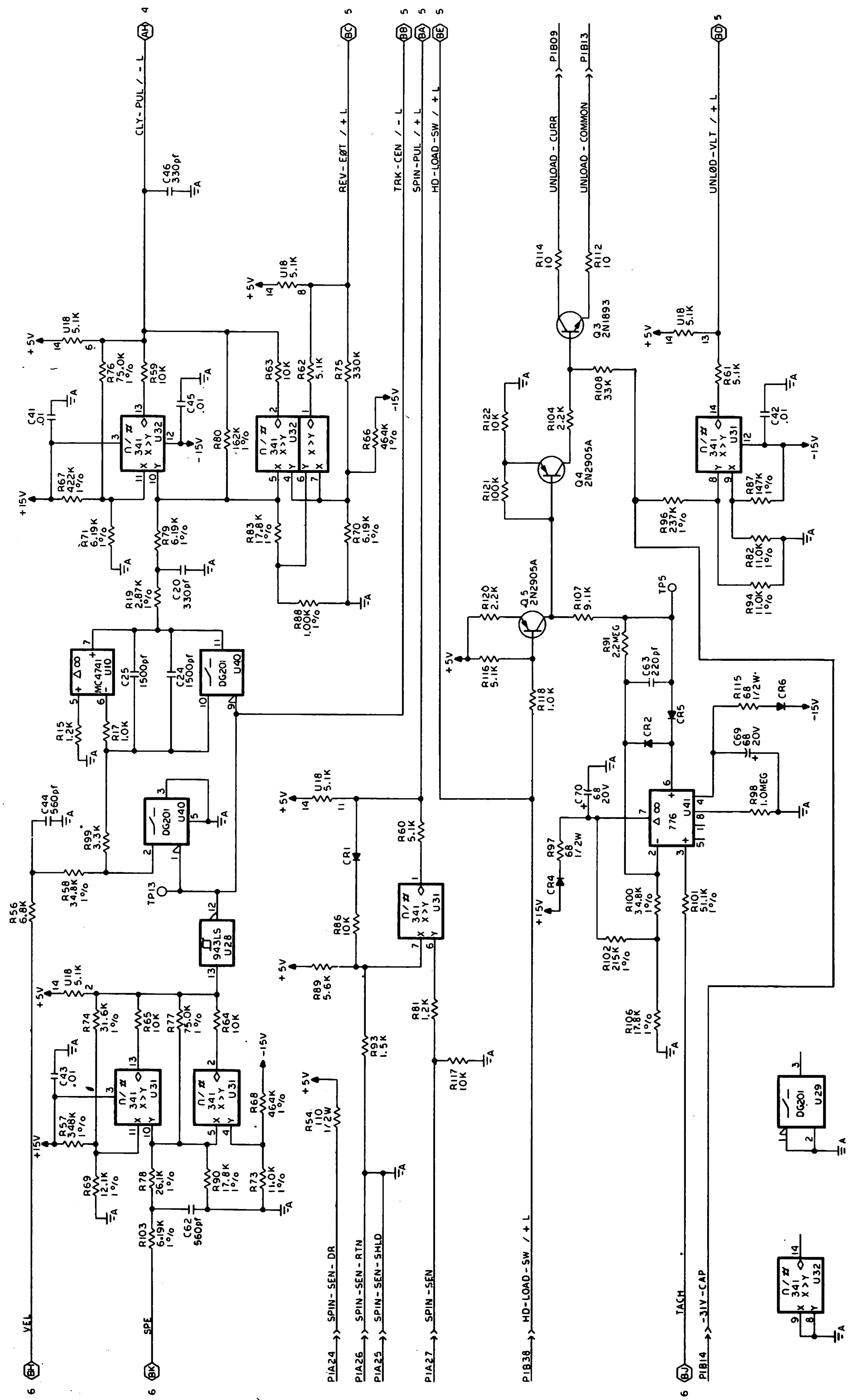

CROSS REF
NO. 0305

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



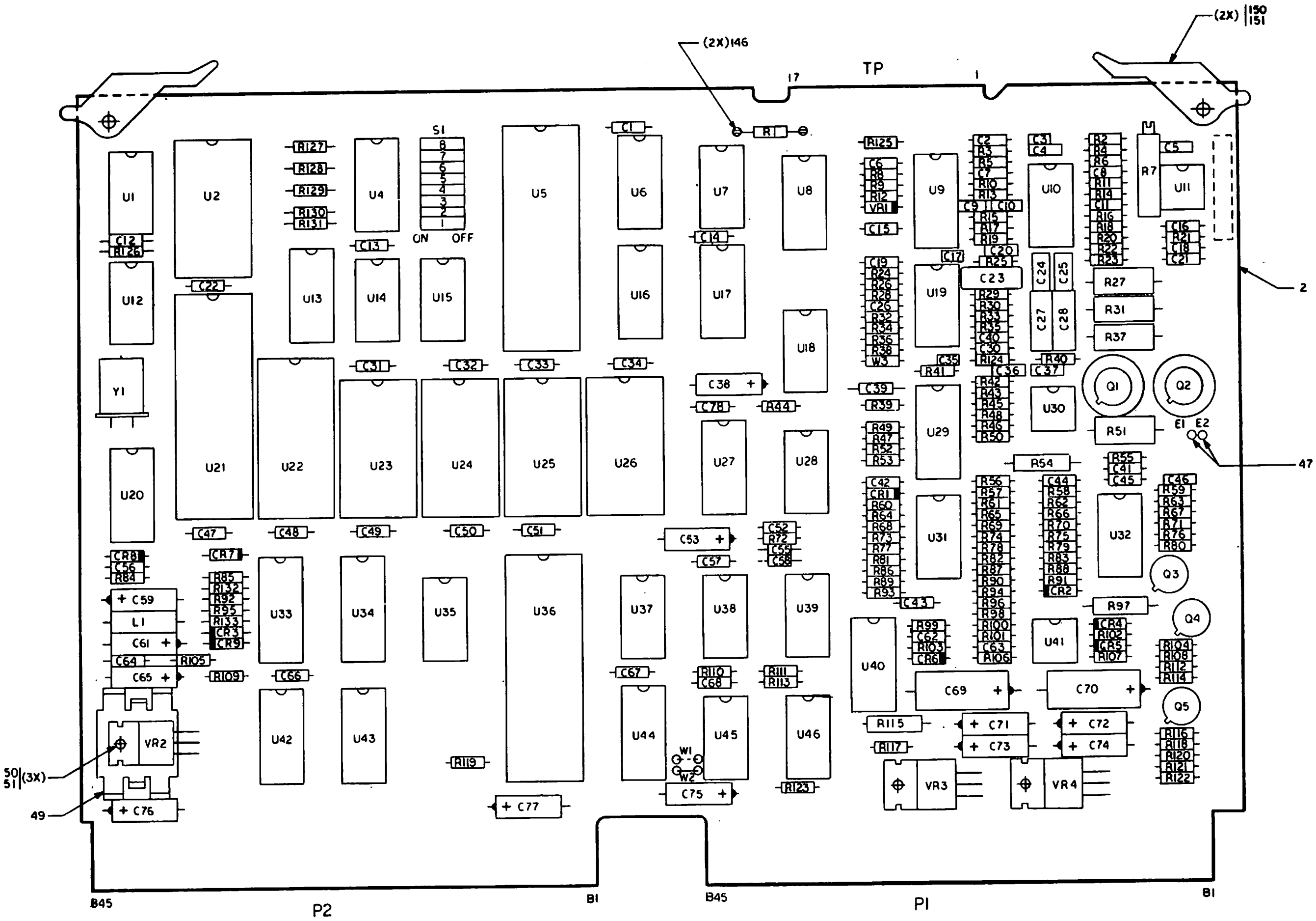

CROSS REF
NO. 0306

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




CROSS REF
NO. 0307

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




| CAP | PL ITEM |
|---|---|
| C53 | 58 |
| C54 | — |
| C55 | 76 |
| C56 | 80 |
| C57 | 80 |
| C58 | 76 |
| C59 | 57 |
| C60 | — |
| C61 | 58 |
| C62 | 62 |
| C63 | 118 |
| C64 | 75 |
| C65 | 54 |
| C66 | 80 |
| C67 | 80 |
| C68 | 80 |
| C69 | 56 |
| C70 | 56 |
| C71 | 55 |
| C72 | 55 |
| C73 | 54 |
| C74 | 54 |
| C75 | 58 |
| C76 | 55 |
| C77 | 58 |
| C78 | 80 |
| C79 | — |

| IND | PL ITEM |
|---|---|
| L1 | 53 |

| JMPR | PL ITEM |
|---|---|
| W1 | — |
| W2 | — |
| W3 | — |

| DIO | PL ITEM |
|---|---|
| CR1 | 43 |
| CR2 | ←→ |
| CR3 | ←→ |
| CR4 | ←→ |
| CR5 | ←→ |
| CR6 | 43 |
| CR7 | 43 |
| CR8 | 43 |
| CR9 | 43 |

| CAP | PL ITEM |
|---|---|
| C1 | 80 |
| C2 | 80 |
| C3 | 70 |
| C4 | 60 |
| C5 | 59 |
| C6 | 72 |
| C7 | 80 |
| C8 | 78 |
| C9 | 70 |
| C10 | 61 |
| C11 | 80 |
| C12 | 80 |
| C13 | 80 |
| C14 | 80 |
| C15 | 73 |
| C16 | 75 |
| C17 | 63 |
| C18 | 80 |
| C19 | 80 |
| C20 | 64 |
| C21 | 80 |
| C22 | 80 |
| C23 | 68 |
| C24 | 65 |
| C25 | 65 |
| C26 | 80 |
| C27 | 67 |
| C28 | 68 |
| C29 | — |
| C30 | 80 |
| C31 | ←→ |
| C32 | ←→ |
| C33 | ←→ |
| C34 | 80 |
| C35 | 66 |
| C36 | 117 |
| C37 | 59 |
| C38 | 58 |
| C39 | 77 |
| C40 | 80 |
| C41 | 80 |
| C42 | 80 |
| C43 | 80 |
| C44 | 62 |
| C45 | 80 |
| C46 | 64 |
| C47 | 80 |
| C48 | ←→ |
| C49 | ←→ |
| C50 | ←→ |
| C51 | 80 |
| C52 | 75 |

| IC | PL ITEM |
|---|---|
| U1 | 19 |
| U2 | 12 |
| U3 | — |
| U4 | 27 |
| U5 | 11 |
| U6 | 17 |
| U7 | 16 |
| U8 | 33 |
| U9 | 32 |
| U10 | 29 |
| U11 | 30 |
| U12 | 111 |
| U13 | 26 |
| U14 | 16 |
| U15 | 18 |
| U16 | 15 |
| U17 | 17 |
| U18 | 28 |
| U19 | 29 |
| U20 | 6,38 |
| U21 | 5,37 |
| U22 | 7 |
| U23 | 156,35 |
| U24 | 157,35 |
| U25 | 158,35 |
| U26 | 10 |
| U27 | 24 |
| U28 | 25 |
| U29 | 32 |
| U30 | 30 |
| U31 | 31 |
| U32 | 31 |
| U33 | 9 |
| U34 | 9 |
| U35 | 22 |
| U36 | 11 |
| U37 | 23 |
| U38 | 19 |
| U39 | 21 |
| U40 | 32 |
| U41 | 148 |
| U42 | 13 |
| U43 | 13 |
| U44 | 20 |
| U45 | 18 |
| U46 | 14 |

| SW | PL ITEM |
|---|---|
| S1 | 34 |

| XTAL | PL ITEM |
|---|---|
| Y1 | 52 |

| RES | PL ITEM |
|---|---|
| R105 | 124 |
| R106 | 100 |
| R107 | 126 |
| R108 | 134 |
| R109 | 127 |
| R110 | 120 |
| R111 | 119 |
| R112 | 116 |
| R113 | 119 |
| R114 | 116 |
| R115 | 143 |
| R116 | 127 |
| R117 | 131 |
| R118 | 121 |
| R119 | 136 |
| R120 | 124 |
| R121 | 138 |
| R122 | 131 |
| R123 | 136 |
| R124 | 112 |
| R125 | 127 |
| R126 | 124 |
| R127 | 131 |
| R128 | 131 |
| R129 | 131 |
| R130 | 131 |
| R131 | 131 |
| R132 | 131 |
| R133 | 131 |

| VOLT REG | PL ITEM |
|---|---|
| VR1 | 42 |
| VR2 | 39 |
| VR3 | 40 |
| VR4 | 41 |

| TSTR | PL ITEM |
|---|---|
| Q1 | 44,48,46 |
| Q2 | 45,48,46 |
| Q3 | 44,48 |
| Q4 | 45,48 |
| Q5 | 45,48 |

| RES | PL ITEM |
|---|---|
| R53 | 132 |
| R54 | 142 |
| R55 | 133 |
| R56 | 129 |
| R57 | 160 |
| R58 | 103 |
| R59 | 131 |
| R60 | 127 |
| R61 | 127 |
| R62 | 127 |
| R63 | 131 |
| R64 | 131 |
| R65 | 131 |
| R66 | 113 |
| R67 | 74 |
| R68 | 113 |
| R69 | 96 |
| R70 | 104 |
| R71 | 104 |
| R72 | 120 |
| R73 | 94 |
| R74 | 161 |
| R75 | 79 |
| R76 | 85 |
| R77 | 85 |
| R78 | 101 |
| R79 | 104 |
| R80 | 155 |
| R81 | 122 |
| R82 | 94 |
| R83 | 100 |
| R84 | 124 |
| R85 | 131 |
| R86 | 131 |
| R87 | 95 |
| R88 | 92 |
| R89 | 128 |
| R90 | 100 |
| R91 | 135 |
| R92 | 124 |
| R93 | 123 |
| R94 | 94 |
| R95 | 127 |
| R96 | 112 |
| R97 | 143 |
| R98 | 141 |
| R99 | 125 |
| R100 | 103 |
| R101 | 106 |
| R102 | 93 |
| R103 | 104 |
| R104 | 124 |

| RES | PL ITEM |
|---|---|
| R1 | 144 |
| R2 | 105 |
| R3 | 155 |
| R4 | 104 |
| R5 | 86 |
| R6 | 139 |
| R7 | 145 |
| R8 | 90 |
| R9 | 89 |
| R10 | 154 |
| R11 | 91 |
| R12 | 84 |
| R13 | 155 |
| R14 | 97 |
| R15 | 122 |
| R16 | 96 |
| R17 | 121 |
| R18 | 96 |
| R19 | 87 |
| R20 | 147 |
| R21 | 127 |
| R22 | 147 |
| R23 | 131 |
| R24 | 104 |
| R25 | 147 |
| R26 | 91 |
| R27 | 108 |
| R28 | 91 |
| R29 | 115 |
| R30 | 114 |
| R31 | 83 |
| R32 | 88 |
| R33 | 103 |
| R34 | 81 |
| R35 | 139 |
| R36 | 81 |
| R37 | 83 |
| R38 | 137 |
| R39 | 110 |
| R40 | 130 |
| R41 | 100 |
| R42 | 82 |
| R43 | 99 |
| R44 | 124 |
| R45 | 154 |
| R46 | 98 |
| R47 | 140 |
| R48 | 114 |
| R49 | 114 |
| R50 | 100 |
| R51 | 109 |
| R52 | 107 |

F057

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

| Item No. No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| | 77622403 | PWA, Servo Coarse | |
| | 77666801 | PWA, Servo Coarse | |
| 2 | 77622770 | PWB, Servo | |
| 2 | 77622420-6 | PWB, Servo | |
| 5 | 15138300-7 | IC 8080A | |
| 6 | 15153500-2 | IC 8224 | |
| 7 | 15153400-5 | IC 8228 | |
| 9 | 15151600-2 | IC 8111 | |
| 10 | 15155400-3 | IC 8212 | |
| 11 | 15153300-7 | IC 8255 | |
| 12 | 15164419-2 | IC 8253 | |
| 13 | 15164402-8 | IC 74LS257 | |
| 14 | 36187100-7 | IC 7404 | |
| 15 | 15147400-4 | IC 74LS138 | |
| 16 | 15145100-2 | IC 74LS04 | |
| 17 | 15146900-4 | IC 74LS175 | |
| 18 | 15146200-9 | IC 74LS32 | |
| 19 | 15146300-7 | IC 74LS74 | |
| 20 | 15148300-5 | IC 74LS279 | |
| 21 | 15146400-5 | IC 74LS86 | |
| 22 | 15145900-5 | IC 74LS20 | |
| 23 | 15145400-6 | IC 74LS08 | |
| 24 | 15162200-8 | IC 74148 | |
| 25 | 15148500-0 | IC 74LS14 | |
| 26 | 15146600-0 | IC74LS139 | |
| 27 | 75738661-0 | Res Pac 2% 2.2K (15) | |
| 28 | 75009935-0 | Res Pac 2% 5.1K (13) | |
| 29 | 15164404-4 | IC MC4741C | |
| 30 | 15156600-7 | IC 201A | |
| 31 | 95794600-7 | IC LM339 | |
| 32 | 15164438-2 | IC 201 | |
| 33 | 15164442-4 | 1408L-8 | |
| 34 | 83452205-4 | Switch-8 Position | |
| 35 | 51858100-4 | Socket 24 Pin | |
| 37 | 51858103-8 | Socket 40 Pin | |
| 38 | 94260301-0 | Socket 16 Pin | |
| 39 | 15161100-1 | Volt Reg 78M12 | |
| 40 | 15161102-7 | Volt Reg 78M15 | |
| 41 | 15137902-1 | Volt Reg 79M15 | |
| 42 | 50241502-9 | Volt Reg 9.0V | |
| 43 | 51706300-4 | Diode IN4454 | |
| 44 | 51751900-5 | Trans, Silicon, 2N1893 | |
| 45 | 51585100-4 | Tstr 2N2905A (PNP) | |
| 46 | 77832363-4 | Heat Sink | |
| 47 | 94245412-9 | Terminal, Wire Wrap | |
| 48 | 94335900-0 | Pad-Transistor MTG | |
| 49 | 77832299-0 | Heat Sink | |
| 50 | 95683702-9 | Stud, Press | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 51 | 92583002-8 | Nut Lock | |
| 52 | 39465705-0 | Crystal 18 MHZ | |
| 53 | 94233930-0 | Inductor 33 uH | |
| 54 | 17706766-7 | Cap 20V 10% 10 uF | |
| 55 | 24505237-8 | Cap 35V 10% 4.7 uF | |
| 56 | 77612232-7 | Cap 20V +150-10% 68uF | |
| 57 | 24504350-0 | Cap 10V 20% 10 uF | |
| 58 | 24504353-4 | Cap 10V 20% 33uF | |
| 59 | 94227214-7 | Cap 500V +1PF 33 | |
| 60 | 94227221-2 | Cap 500V 2% 62 | |
| 61 | 94227234-5 | Cap 300V 2% 220 | |
| 62 | 94240428-6 | Cap 50V 10% 560 | |
| 63 | 77830576-3 | Cap 50V +80-20% 0.22uF | |
| 64 | 94227238-6 | Cap 100V 2% 330 | |
| 65 | 94227254-3 | Cap 100V 2% 1500 | |
| 66 | 75887697-3 | Cap 50V 5% 1500 | |
| 67 | 75888014-0 | Cap 200V 5% 0.033 uF | |
| 68 | 75888017-3 | Cap 200V 5% .056 uF | |
| 69 | | | |
| 70 | 75887699-9 | Cap 50V 5% 2200 | |
| 71 | | | |
| 72 | 94240421-1 | Cap 50V 10% 82 | |
| 73 | 94361400-8 | Cap 50V +80-20% 0.10uF | |
| 74 | 94360560-0 | Res 1/4W 1% 422K | |
| 75 | 94240410-4 | Cap 50V 10% 6800 | |
| 76 | 94240442-7 | Cap 50V 10% 0.033uF | |
| 77 | 94240401-3 | Cap 50V 10% 1000 | |
| 78 | 94240433-6 | Cap 50V 10% 3300 | |
| 79 | 17705924-3 | Res 1/4W 5% 0.33MEG | |
| 80 | 94361401-6 | Cap 50V 80-20% 0.01uF | |
| 81 | 75721503-3 | Res 1/8W 0.1% 7.5K | |
| 82 | 94360352-2 | Res 1/4W 1% 3.48K | |
| 83 | 24507126-1 | Res 1W 5% 110 | |
| 84 | 94360288-8 | Res 1/4W 1% 825 | |
| 85 | 94360484-3 | Res 1/4W 1% 75.0K | |
| 86 | 94360304-3 | Res 1/4W 1% 1.10K | |
| 87 | 94360344-9 | Res 1/4W 1% 2.87K | |
| 88 | 94360354-8 | Res 1/4W 1% 3.65K | |
| 89 | 94360358-9 | Res 1/4W 1% 4.02K | |
| 90 | 94360364-7 | Res 1/4W 1% 4.64K | |
| 91 | 94360368-8 | Res 1/4W 1% 5.11K | |
| 92 | 94360300-1 | Res 1/4W 1% 1.00K | |
| 93 | 94360532-9 | Res 1/4W 1% 215K | |
| 94 | 94360404-1 | Res 1/4W 1% 11.0K | |
| 95 | 94360516-2 | Res 1/4W 1% 147K | |
| 96 | 94360408-2 | Res 1/4W 1% 12.1K | |
| 97 | 24500073-2 | Res 1/4W 5% 2.7K | |
| 98 | 94360420-7 | Res 1/4W 1% 16.2K | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 99 | 94360568-3 | Res 1/4W 1% 511K | |
| 100 | 94360424-9 | Res 1/4W 1% 17.8K | |
| 101 | 94360440-5 | Res 1/4W 1% 26.1K | |
| 102 | | | |
| 103 | 94360452-0 | Res 1/4W 1% 34.8K | |
| 104 | 94360376-1 | Res 1/4W 1% 6.19K | |
| 105 | 94360460-3 | Res 1/4W 1% 42.2K | |
| 106 | 94360468-6 | Res 1/4W 1% 51.1K | |
| 107 | 94360476-9 | Res 1/4W 1% 61.9K | |
| 108 | 24507181-6 | Res 1W 5% 5.6K | |
| 109 | 24507129-5 | Res 1W 5% 150 | |
| 110 | 75721506-6 | Res 1/8W, 0.1%, 196K | |
| 111 | 15145200-0 | IC 74LS03 | |
| 112 | 94360536-0 | Res 1/4W 1% 237K | |
| 113 | 94360564-2 | Res 1/4W 1% 464K | |
| 114 | 94360576-6 | Res 1/4W 1% 619K | |
| 115 | 94360594-9 | Res 1/4W 1% 953K | |
| 116 | 24500015-3 | Res 1/4W 5% 10 | |
| 117 | 94227226-1 | Cap 300V 2% 100 | |
| 118 | 94240407-0 | Cap 50V 10% 220 | |
| 119 | 24500049-2 | Res 1/4W 5% 270 | |
| 120 | 24500051-8 | Res 1/4W 5% 330 | |
| 121 | 24500063-3 | Res 1/4W 5% 1K | |
| 122 | 24500065-8 | Res 1/4W 5% 1.2K | |
| 123 | 24500067-4 | Res 1/4W 5% 1.5K | |
| 124 | 24500071-6 | Res 1/4W 5% 2.2K | |
| 125 | 24500075-7 | Res 1/4W 5% 3.3K | |
| 126 | 24500086-4 | Res 1/4W 5% 9.1K | |
| 127 | 24500080-7 | Res 1/4W 5% 5.1K | |
| 128 | 24500081-5 | Res 1/4W 5% 5.6K | |
| 129 | 24500083-1 | Res 1/4W 5% 6.8K | |
| 130 | 24500059-1 | Res 1/4W 5% 680 | |
| 131 | 24500087-2 | Res 1/4W 5% 10K | |
| 132 | 24500091-4 | Res 1/4W 5% 15K | |
| 133 | 24500095-5 | Res 1/4W 5% 22K | |
| 134 | 24500099-7 | Res 1/4W 5% 33K | |
| 135 | 17705944-1 | Res 1/4W 5% 2.2MEG | |
| 136 | 17705905-2 | Res 1/4W 5% 51K | |
| 137 | 94360320-9 | Res 1/4W 1% 1.62K | |
| 138 | 17705912-8 | Res 1/4W 5% .10MEG | |
| 139 | 17705932-6 | Res 1/4W 5% .68MEG | |
| 140 | 17705940-9 | Res 1/4W 5% 1.5MEG | |
| 141 | 17705936-7 | Res 1/4W 5% 1.0MEG | |
| 142 | 24500140-9 | Res 1.2W 5% 110 | |
| 143 | 24500135-9 | Res 1/2W 5% 68 | |
| 144 | 94357500-1 | Resistor Test Select | |
| 145 | 77612039-6 | Res Var-3/4W, 10%, 10K | |
| 146 | 92498021-2 | Terminal Swaged | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 147 | 94360336-5 | Res 1/4W 1% 2.37K | |
| 148 | 15164425-9 | IC MC1776 | |
| 149 | 18748600-6 | Compound 340 | |
| 150 | 82311900-3 | Inject/Eject-Card | |
| 151 | 93533118-1 | Pin, Rolled | |
| 152 | 83409902-0 | Jumper PWB Solid Con | |
| 153 | 94358500-0 | Jumper Wire, Molded | |
| 154 | 94360548-5 | Res 1/4W 1% 316K | |
| 155 | 94360520-4 | Res 1/4W 1% 162K | |
| 156 | 77611804-4 | IC Prom BNPF #1 | |
| 157 | 77611808-5 | IC Prom BNPF #2 | |
| 158 | 77611809-3 | IC Prom BNPF #3 | |
| 160 | 94360552-7 | Res 1/4W 1% 348K | |
| 161 | 94360448-8 | Res 1/4W 1% 31.6K | |
| 162 | 75808519-5 | Cap 100V 10% 330 | |

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

SERVO FINE CIRCUIT BOARD

EM6-P1

| SOURCE/DEST | X-REF | SIGNAL | X-REF | A | PIN | B | SIGNAL | X-REF | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -20 V | 0601 | | 1 | | -20 V | 0601 | | |
| | | | | | 4 | | P-DIBIT-REM | 0602 | J2-01 | 0901 |
| | | | | | 5 | | N-DIBIT-REM | 0602 | J2-08 | 0901 |
| | | ANALOG GND | 0601 | | 6 | | ANALOG GND | 0601 | | |
| | | +6 V | 0601 | | 7 | | +6 V | 0601 | | |
| | | SP-GND-2 | 0601 | | 8 | | SP-GND-2 | 0601 | J2-03 | 0901 |
| | | -6 V | 0601 | | 9 | | -6 V | 0601 | | |
| | | | | | 10 | | P-DIBIT-FXD | 0602 | J2-04 | 0901 |
| | | | | | 11 | | N-DIBIT-FXD | 0602 | J2-05 | 0901 |
| | | | | | 13 | | I-SPE | 0603 | P1-A13 | 150 * |
| | | | | | 14 | | SPE | 0603 | P1-A14 | 150 * |
| | | ANALOG GND | 0601 | | 23 | | ANALOG GND | 0601 | | |
| | | | | | 38 | | INHIBIT-SECTOR/+L | 0606 | P1-A38 | 0104 |
| | | ANALOG GND | 0601 | | 39 | | ANALOG GND | 0601 | | |
| | | | | | 40 | | INDEX/-L | 0606 | P1-A40 | 0104 |
| | | | | | 41 | | FXD-ADDR/-L | 0606 | P1-A41 | 0207 |
| | | | | | 42 | | RTZ-OR-SEEK/+L | 0606 | P1-A42 | 0305 |
| | | | | | 43 | | VOL-CHANGE/-L | 0606 | P1-A43 | 0303 |
| | | +5 V | 0601 | | 44 | | +5 V | 0601 | | |
| | | +20 V | 0601 | | 45 | | +20 V | 0601 | | |

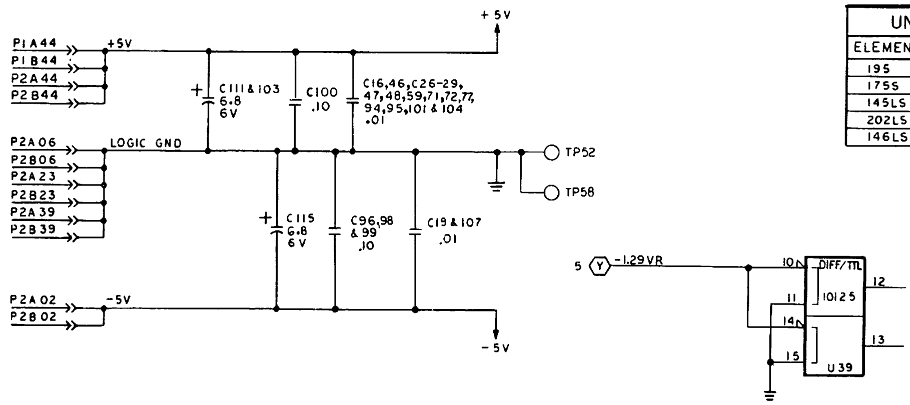
EM6-P2

| SOURCE/DEST | X-REF | SIGNAL | X-REF | A | PIN | B | SIGNAL | X-REF | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -5 V | 0601 | | 2 | | -5 V | 0601 | | |
| | | | | | 3 | | AGC-ACTIVE/-L | 0603 | P2-A03 | 0305 |
| | | | | | 4 | | EN-FXD-SVO/-L | 0606 | P2-A04 | 1501 |
| | | LOGIC GND | 0601 | | 6 | | LOGIC GND | 0601 | | |
| | | | | | 9 | | PLO-LOCKED/-L | 0603 | P2-A09 | 150 * |
| P2-B12 | 0703 | WRT-CLOCK-ENABLF/-L | 0605 | | 12 | | | | | |
| | | LOGIC GND | 0601 | | 23 | | LOGIC GND | 0601 | | |
| P2-A30 | 0305 | SVO-CLAMP/-L | 0606 | | 30 | | | | | |
| P2-B35 | 0703 | SVO-CLK-GND | 0605 | | 35 | | | | | |
| P2-B36 | 0703 | SVO-CLK-N | 0605 | | 36 | | | | | |
| P2-B37 | 0703 | SVO-CLK-P | 0605 | | 37 | | SECTOR-SYNC/-L | 0606 | P2-A37 | 0304 |
| P2-B38 | 0703 | SVO-CLK-P-GND | 0605 | | 38 | | 806-KHZ/-L | 0605 | P2-A38 | 0304 |
| | | LOGIC GND | 0601 | | 39 | | LOGIC GND | 0601 | | |
| P2-B40 | 0704 | WRT-PLO-N-GND | 0605 | | 40 | | | | | |
| P2-B41 | 0704 | WRT-PLO-N | 0605 | | 41 | | SVO-CLK2-GND | 0605 | P2-A41 | 0209 |
| P2-B42 | 0704 | WRT-PLO-P | 0605 | | 42 | | SVO-CLK/-L | 0605 | P2-A42 | 0209 |
| P2-B43 | 0704 | WRT-PLO-P-GND | 0605 | | 43 | | SVO-CLK2-GND | 0605 | P2-A43 | 0209 |
| | | +5 V | 0601 | | 44 | | +5 V | 0601 | | |

* WIRED TO, BUT NOT USED ON PWA

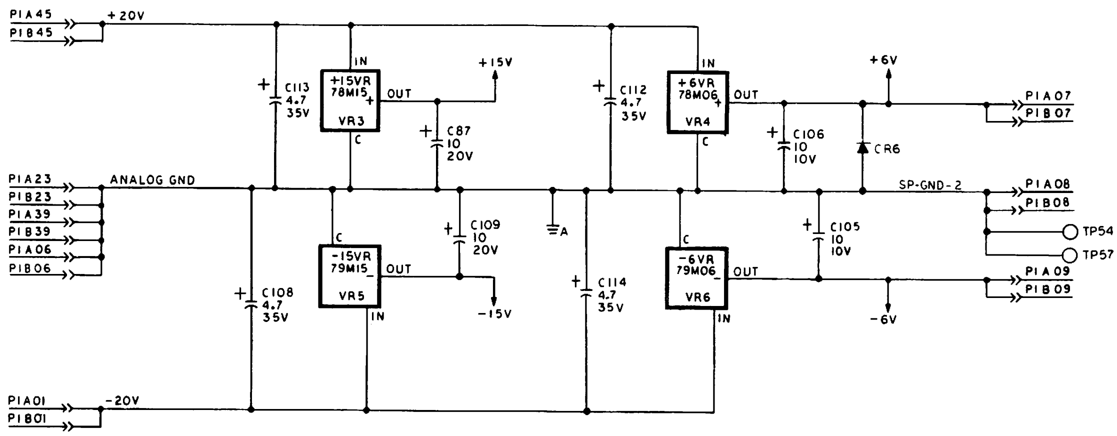
XX230

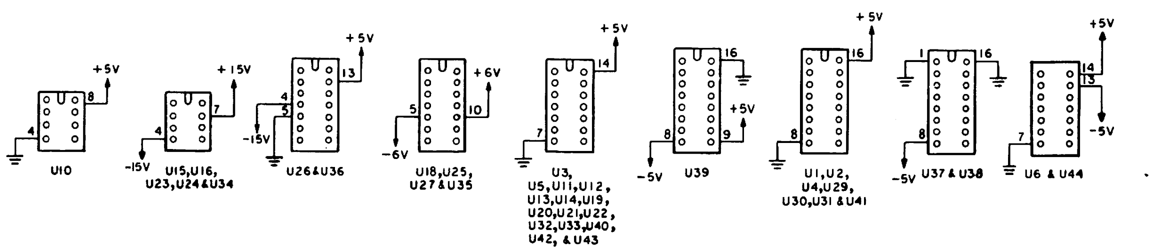
FIGURE 5-7. SERVO FINE CIRCUIT BOARD (SHEET 1 OF 11)




| UNUSED LOGIC ELEMENTS | | | |
|---|---|---|---|
| ELEMENT | VENDOR NO. | LOCATION | OUTPUT PIN |
| 195 | 9602 | U2 | 9 OR 10 |
| 175S | 74S74 | U3 | 8 OR 9 |
| 145LS | 74LS02 | U12 | 13 |
| 202LS | 74LS03 | U14 | 8,11 |
| 146LS | 74LS04 | U43 | 8 |

NOTS: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS, ± 1%, 1/4 W
2. CAPACITANCE VALUES ARE IN MICROFARADS



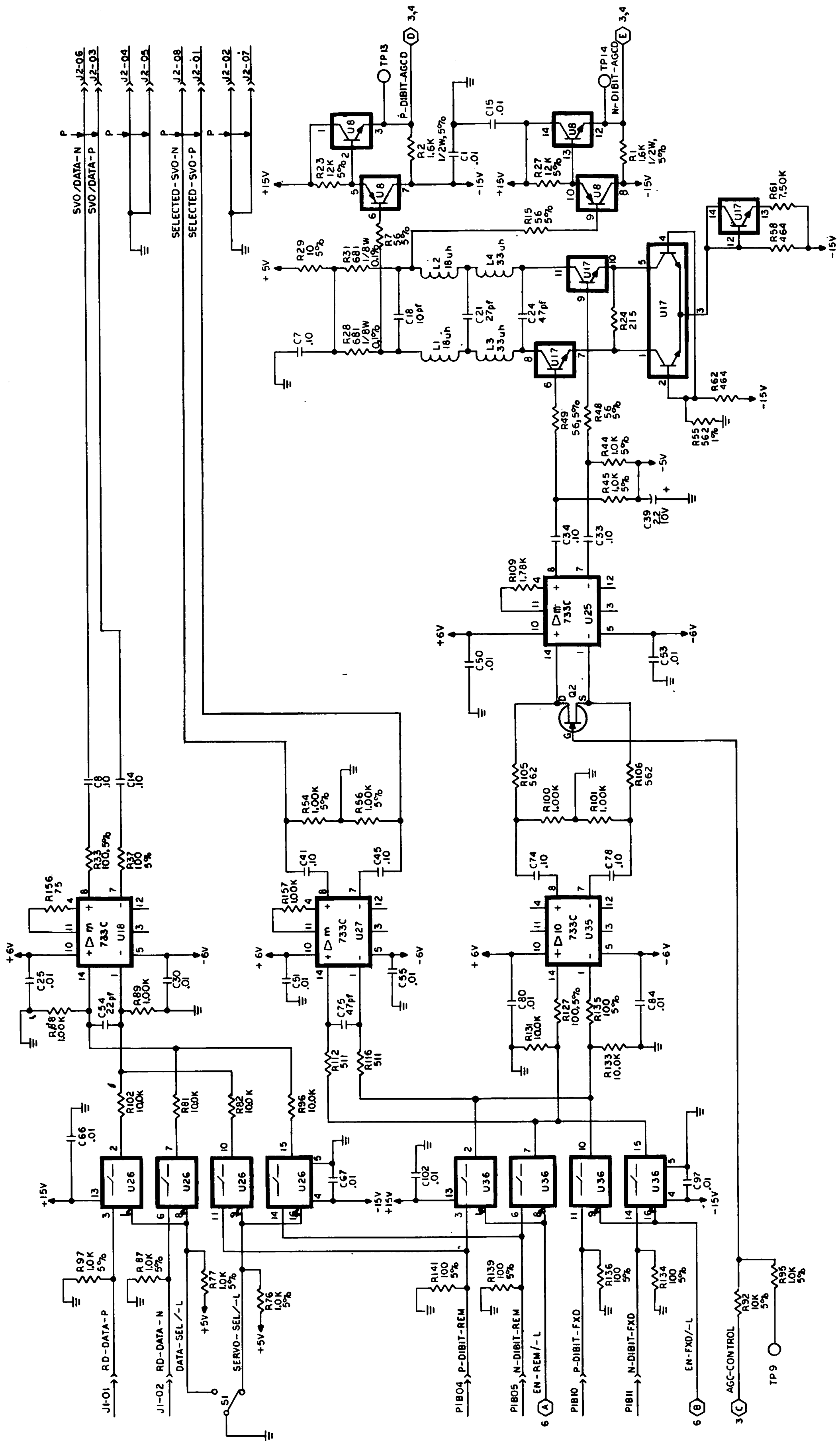

| | | SIGNAL | SH. NO. | SOURCE/DEST | XREF |
|---|---|---|---|---|---|
| | 01 | RD-DATA-PE | (2) | J8-01 | 0801 |
| | 02 | RD-DATA-N | (2) | J8-02 | 0801 |
| J1 | 01 | SELECTED-SVO-P | (2) | J1-D1 | 1501 |
| J1 | 02 | GND | (2) | | |
| J1 | 03 | SVO/DATA-N | (2) | J1-03 | 1501 |
| J1 | 04 | GND | (2)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

WARNING

Servo Fine PWA will be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010. (see Section 6.2.2).

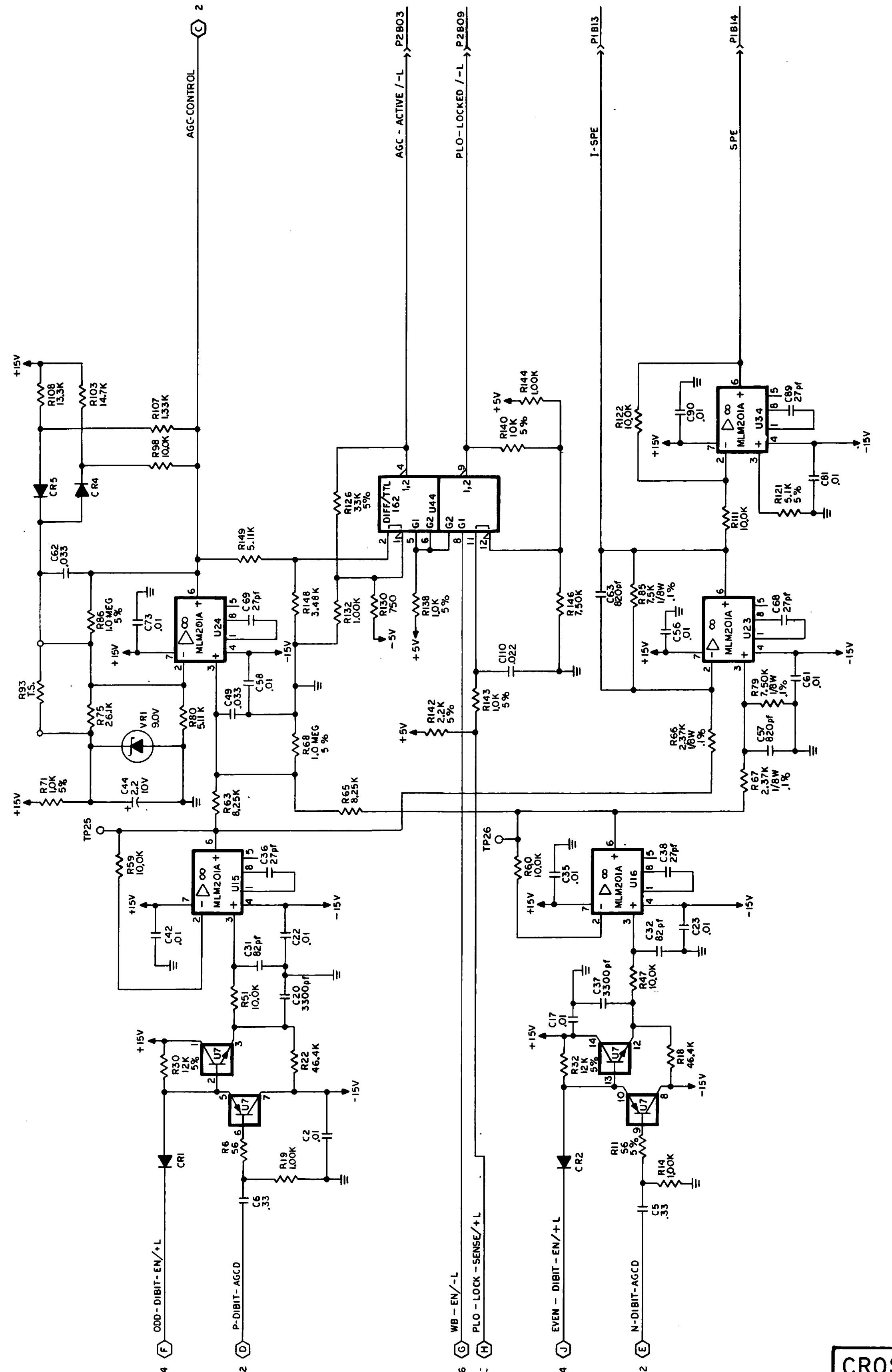
CROSS REF NO. 0601

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



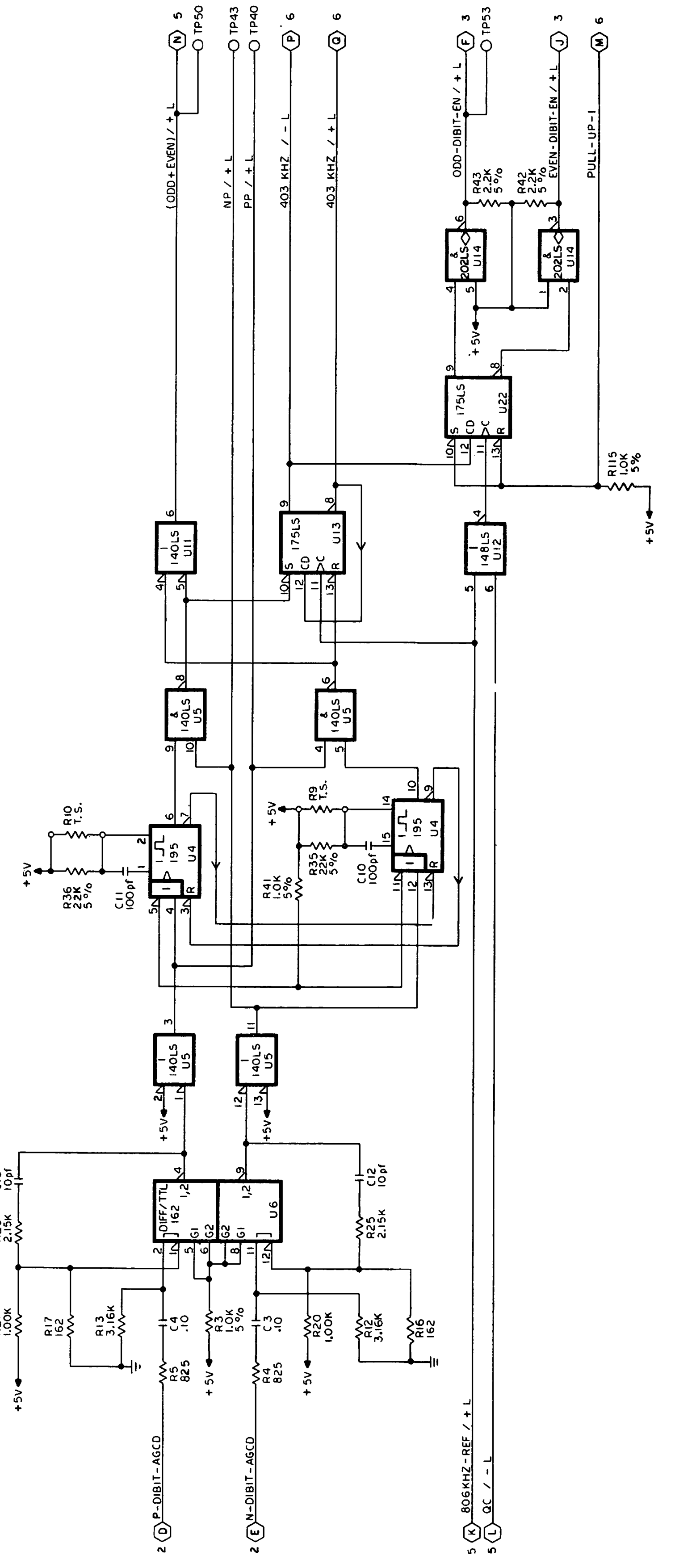

CROSS REF
NO. 0602

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



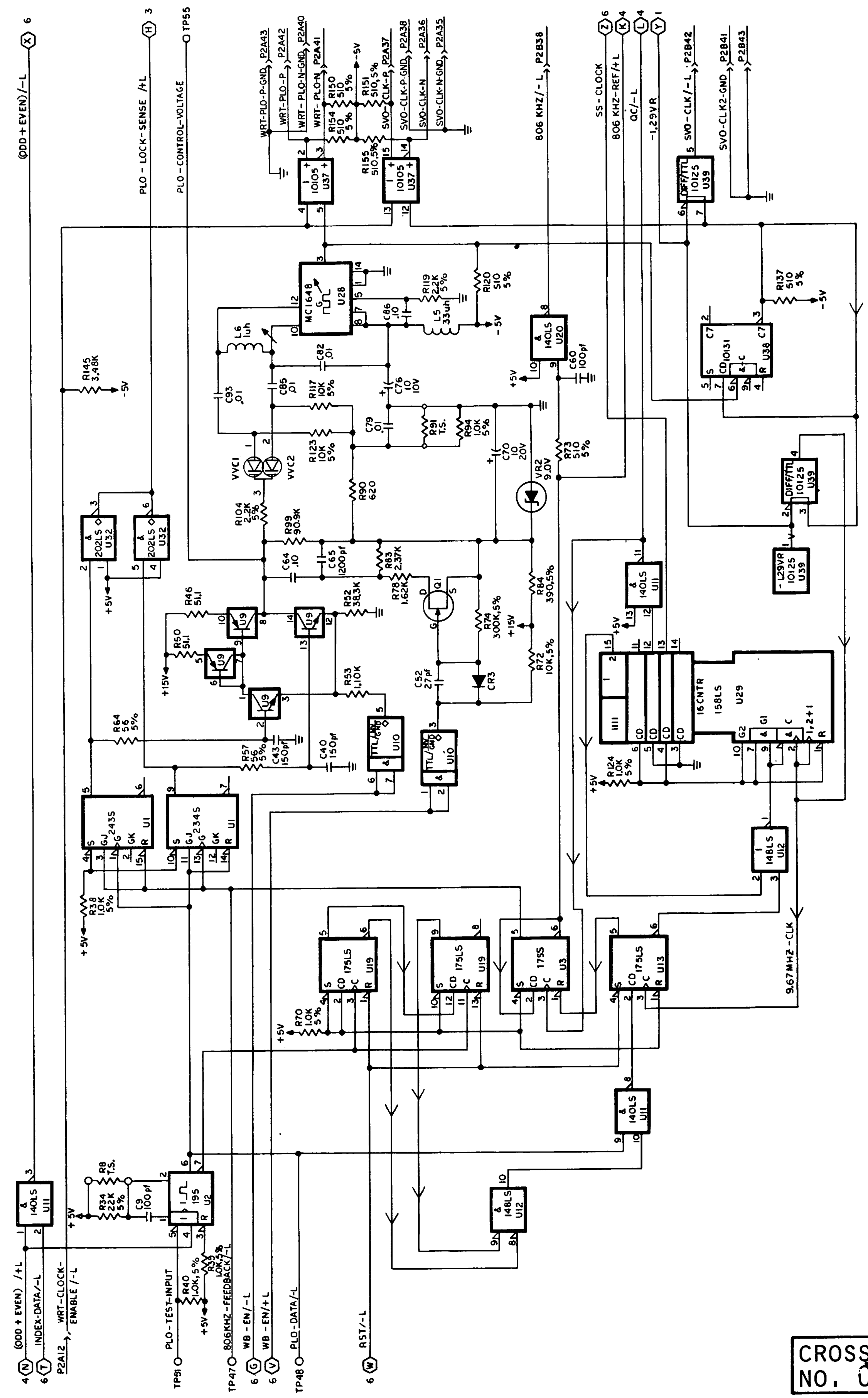

CROSS REF
NO. 0603

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



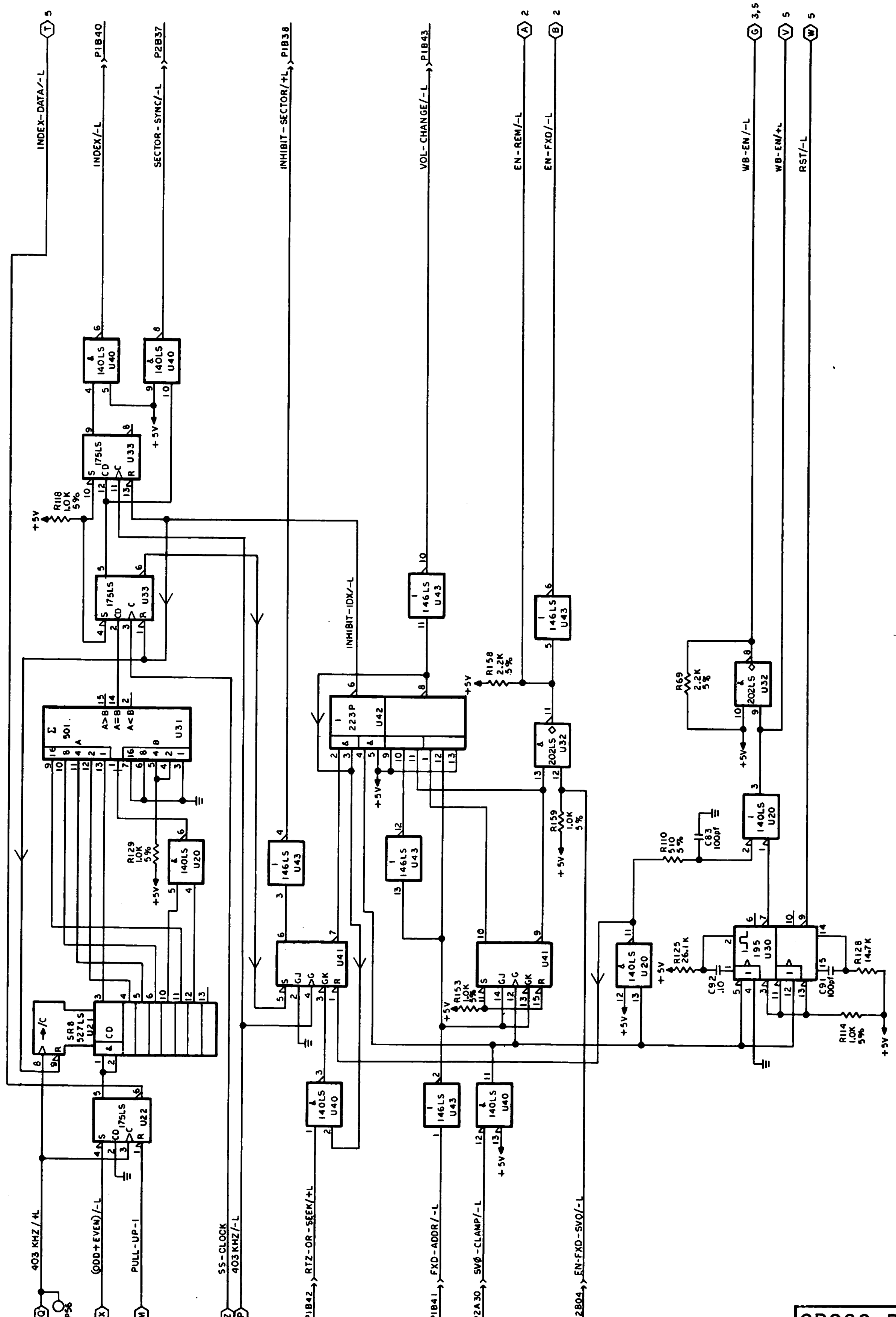

CROSS REF
NO. 0604

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



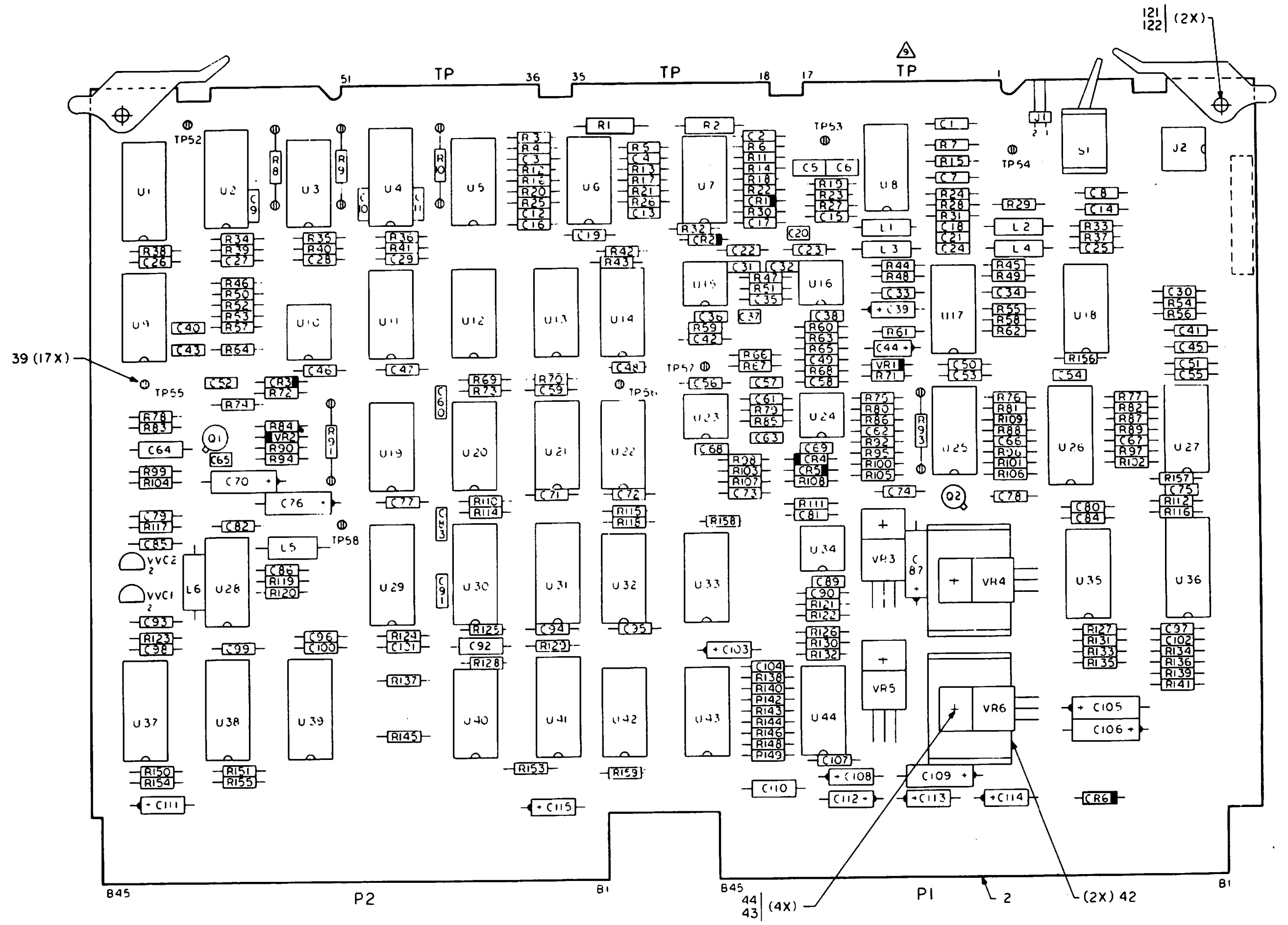

CROSS REF
NO. 0605

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




CROSS REF
NO. 0606

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




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

| DIODE | CR1 | CR2 | CR3 | CR4 | CR5 | CR6 |
|---|---|---|---|---|---|---|
| PL ITEM | 36 | 36 | 36 | 36 | 36 | 124 |

| TSTR | Q1 | Q2 |
|---|---|---|
| PL ITEM | 32 | 32 |

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

| VARI CAP DIODE | VVC1 | VVC2 |
|---|---|---|
| PL ITEM | 46 | 46 |

| SW | S1 |
|---|---|
| PL ITEM | 120 |

| CONN | J1 | J2 |
|---|---|---|
| PL ITEM | 40 | 41 |

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

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

| 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 | C25 | C26 | C27 | C28 | C29 | C30 | C31 | C32 | C33 | C34 | C35 | C36 | C37 | C38 | C39 | C40 | C41 | C42 | C43 | C44 | C45 | C46 | C47 | C48 | C49 | C50 | C51 | C52 | C53 | C54 | C55 | C56 | C57 | C58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | 66 | 66 | 67 | 67 | 68 | 68 | 67 | 67 | 57 | 57 | 57 | 52 | 52 | 67 | 66 | 66 | 66 | 52 | 66 | 60 | 54 | 66 | 66 | 55 | 66 | 66 | 66 | 66 | 66 | 66 | 56 | 56 | 67 | 67 | 66 | 54 | 60 | 54 | 51 | 58 | 67 | 66 | 58 | 51 | 67 | 66 | 66 | 66 | 63 | 66 | 66 | 54 | 66 | 53 | 66 | 66 | 59 | 66 |

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

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

| 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 | 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 | R51 | R52 | R53 | R54 | R55 | R56 | R57 | R58 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | 69 | 69 | 109 | 84 | 84 | 104 | 104 | 119 | 119 | 119 | 104 | 88 | 88 | 85 | 104 | 74 | 74 | 97 | 85 | 85 | 85 | 97 | 113 | 77 | 82 | 82 | 113 | 70 | 101 | 113 | 70 | 113 | 105 | 114 | 114 | 114 | 105 | 109 | 109 | 109 | 109 | 110 | 110 | 109 | 109 | 75 | 93 | 104 | 104 | 75 | 93 | 99 | 76 | 109 | 81 | 109 | 104 | 79 |

F058

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| | 75886300-5 | PWA, Servo Fine | |
| 2 | 75886320-3 | PWB, Servo Fine | |
| 5 | 15118500-6 | IC ECL 10131 | |
| 6 | 15161600-0 | IC 75461 | |
| 7 | 15163100-9 | IC 733C | |
| 8 | 15164438-2 | IC 201 | |
| 9 | 15156600-7 | IC 201A | |
| 10 | 15164426-7 | IC 75107 | |
| 11 | 15104301-5 | IC 9602 | |
| 12 | 15119500-5 | IC ECL 10125 | |
| 13 | 15118100-5 | IC ECL 10105 | |
| 14 | 15158600-5 | IC 74S112 | |
| 15 | 15164422-6 | IC ECL 1648 | |
| 16 | 15146800-6 | IC 74LS161 | |
| 17 | 15146300-7 | IC 74LS74 | |
| 18 | 15148000-1 | IC 74LS109 | |
| 19 | 15124700-4 | IC 74LS51 | |
| 20 | 15163303-9 | IC 74LS164 | |
| 21 | 51783500-5 | IC 9324 | |
| 22 | 15145200-0 | IC 74LS03 | |
| 23 | 15145000-4 | IC 74LS02 | |
| 24 | 15145100-2 | IC 74LS04 | |
| 25 | 15144900-6 | IC 74LS00 | |
| 26 | 94675200-3 | IC CA3046/CA3346 | |
| 27 | 75889250-9 | IC 6600-1 | |
| 28 | 15161102-7 | Volt Reg 78M15 | |
| 29 | 15161101-9 | Volt Reg 78M06 | |
| 30 | 15137902-1 | Volt Reg 79M15 | |
| 31 | 15137901-3 | Volt Reg 79M06 | |
| 32 | 75888005-8 | Transistor 2N4860A | |
| 33 | 50241502-9 | Volt Reg 9.0V | |
| 34 | 88923000-9 | IC 74S74 | |
| 35 | 50241500-3 | Volt Reg 6.2V | |
| 36 | 51706300-4 | Diode IN4454 | |
| 47 | 94233927-6 | Inductor 18 uH | |
| 38 | 94233930-0 | Inductor 33uH | |
| 39 | 92498021-2 | Terminal Swaged | |
| 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 | 18748600-6 | Compound 340 | |
| 46 | 77612970-2 | MVAM2 | |
| 47 | 24505259-2 | Cap 6V 10% 6.8 uF | |
| 48 | 17706712-1 | Cap 10V 10% 10 uF | |
| 49 | 17706766-7 | Cap 20V 10% 10 uF | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 50 | 24505237-8 | Cap 35V 10% 4.7 uF | |
| 51 | 17706704-8 | Cap 10V 10% 2.2 uF | |
| 52 | 94227205-5 | Cap 500V +1PF 10 | |
| 53 | 94227210-5 | Cap 500V 5% 22 | |
| 54 | 94227212-1 | Cap 500V +1pF 27 | |
| 55 | 94227218-8 | Cap 500V +/-1PF 47 | |
| 56 | 94227224-6 | Cap 300V 2% 82 | |
| 57 | 94227226-1 | Cap 300V 2% 100 | |
| 58 | 94227230-3 | Cap 500V 2% 150 | |
| 59 | 94227248-5 | Cap 100V 2% 820 | |
| 60 | 75887701-3 | Cap 50V 5% 3300 | |
| 61 | 94240448-4 | Cap 50V 10% 10uF | |
| 62 | 75887696-5 | Cap 50V 5% 1200 | |
| 63 | 94240442-7 | Cap 50V 10% .033uF | |
| 64 | 94240440-1 | Cap 50V 10% .022uF | |
| 66 | 94361401-6 | Cap 50V 8-20% .01uF | |
| 67 | 94361400-8 | Cap 50V +80-20%, 0.10 uF | |
| 68 | 94354816-4 | Cap 50V 20% .33uF | |
| 69 | 24500168-0 | Res 1/2W 5% 1.6K | |
| 70 | 75721504-1 | Res 1/8W .1% 681 | |
| 71 | 75721502-5 | Res 1/8W .1% 2.37K | |
| 72 | 75721503-3 | Res 1/8W .1% 7.5K | |
| 73 | 94360324-1 | Res 1/4W 1% 1.78K | |
| 74 | 94360220-1 | Res 1/4W 1% 162 | |
| 75 | 94360168-2 | Res 1/4W 1% 51.1 | |
| 76 | 94360304-3 | Res 1/4W 1% 1.10K | |
| 77 | 94360232-6 | Res 1/4W 1% 215 | |
| 78 | 94360320-9 | Res 1/4W 1% 1.62K | |
| 79 | 94360264-9 | Res 1/4W 1% 464 | |
| 80 | 94360268-0 | Res 1/4W 1% 511 | |
| 81 | 94360272-2 | Res 1/4W 1% 562 | |
| 82 | 94360332-4 | Res 1/4W 1% 2.15K | |
| 83 | 94360284-7 | Res 1/4W 1% 750 | |
| 84 | 94360288-8 | Res 1/4W 1% 825 | |
| 85 | 94360300-1 | Res 1/4W 1% 1.00K | |
| 86 | 94360312-6 | Res 1/4W 1% 1.33K | |
| 87 | 94360336-5 | Res 1/4W 1% 2.37K | |
| 88 | 94360348-0 | Res 1/4W 1% 3.16K | |
| 89 | 94360352-2 | Res 1/4W 1% 3.48K | |
| 90 | 94360184-9 | Res 1/4W 1% 75.0 | |
| 91 | 94360368-8 | Res 1/4W 1% 5.11K | |
| 92 | 94360388-6 | Res 1/4W 1% 8.25K | |
| 93 | 94360400-9 | Res 1/4W 1% 10.0K | |
| 94 | 94360412-4 | Res 1/4W 1% 13.3K | |
| 95 | 94360416-5 | Res 1/4W 1% 14.7K | |
| 96 | 94360440-5 | Res 1/4W 1% 26.1K | |
| 97 | 94360464-5 | Res 1/4W 1% 46.4K | |
| 98 | 94360492-6 | Res 1/4W 1% 90.9K | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 99 | 94360456-1 | Res 1/4W 1% 38.3K | |
| 100 | 94360384-5 | Res 1/4W 1% 7.50K | |
| 101 | 24500015-3 | Res 1/4W 5% 10 | |
| 103 | 24500065-8 | Res 1/4W 5% 1.2K | |
| 104 | 24500033-6 | Res 1/4W 5% 56 | |
| 105 | 24500039-3 | Res 1/4W 5% 100 | |
| 106 | 24500053-4 | Res 1/4W 5% 390 | |
| 107 | 24500058-3 | Res 1/4W 5% 620 | |
| 108 | 24500056-7 | Res 1/4W 5% 510 | |
| 109 | 24500063-3 | Res 1/4W 5% 1K | |
| 110 | 24500071-6 | Res 1/4W 5% 2.2K | |
| 111 | 24500080-7 | Res 1/4W 5% 5.1K | |
| 112 | 24500087-2 | Res 1/4W 5% 10K | |
| 113 | 24500089-8 | Res 1/4W 5% 12K | |
| 114 | 24500095-5 | Res 1/4W 5% 22K | |
| 115 | 24500099-7 | Res 1/4W 5% 33K | |
| 116 | 17705923-5 | Res 1/4W 5% .30MEG | |
| 118 | 17705936-7 | Res 1/4W 5% 1.0MEG | |
| 119 | 94357500-1 | Resistor Test Select | |
| 120 | 41347800-9 | Switch Toggle | |
| 121 | 82311900-3 | Inject/Eject-Card | |
| 122 | 93533118-1 | Pin, Rolled | |
| 123 | 75887583-5 | Inductor 5% 1.0uH | |

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 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ANALOG -5 V | 0701 | A | 2 | B | ANALOG -5 V | 0701 | | |
| J1-05 | 0801 | ANALOG GND | 0701 | A | 6 | B | ANALOG GND | 0701 | | |
| J7-15 | 0801 | -5 V | | | 7 | | | | | |
| J7-12 | 0801 | +20 V | | | 8 | | | | | |
| J7-02 | 0801 | +5 V | | | 9 | | | | | |
| J7-07 | 0801 | ANALOG GND | 0701 | A | 10 | B | ANALOG GND | 0701 | | |
| | | ANALOG GND | 0701 | A | 11 | B | ANALOG GND | 0701 | | |
| J7-01 | 0801 | RD-ANA-DATA | 0702 | A | 12 | B | ANALOG GND | 0701 | | |
| J7-16 | 0801 | RD-ANA-DATA | 0702 | A | 13 | B | ANALOG GND | 0701 | | |
| | | ANALOG GND | 0701 | A | 14 | B | ANALOG GND | 0701 | | |
| | | ANALOG GND | 0701 | A | 15 | B | ANALOG GND | 0701 | | |
| | | | | | 16 | B | DIAG-RD-AGC | 0702 | P1-A16 | 150* |
| | | | | | 18 | B | AM-ENABLE/+L | 0704 | P1-A18 | 0205 |
| | | ANALOG GND | 0701 | A | 23 | B | ANALOG GND | 0701 | | |
| | | GND | 0701 | A | 39 | B | GND | 0701 | | |
| | | +5 V | 0701 | A | 44 | B | +5 V | 0701 | | |
| | | +20 V | 0701 | A | 45 | B | +20 V | 0701 | | |

EM7-P2

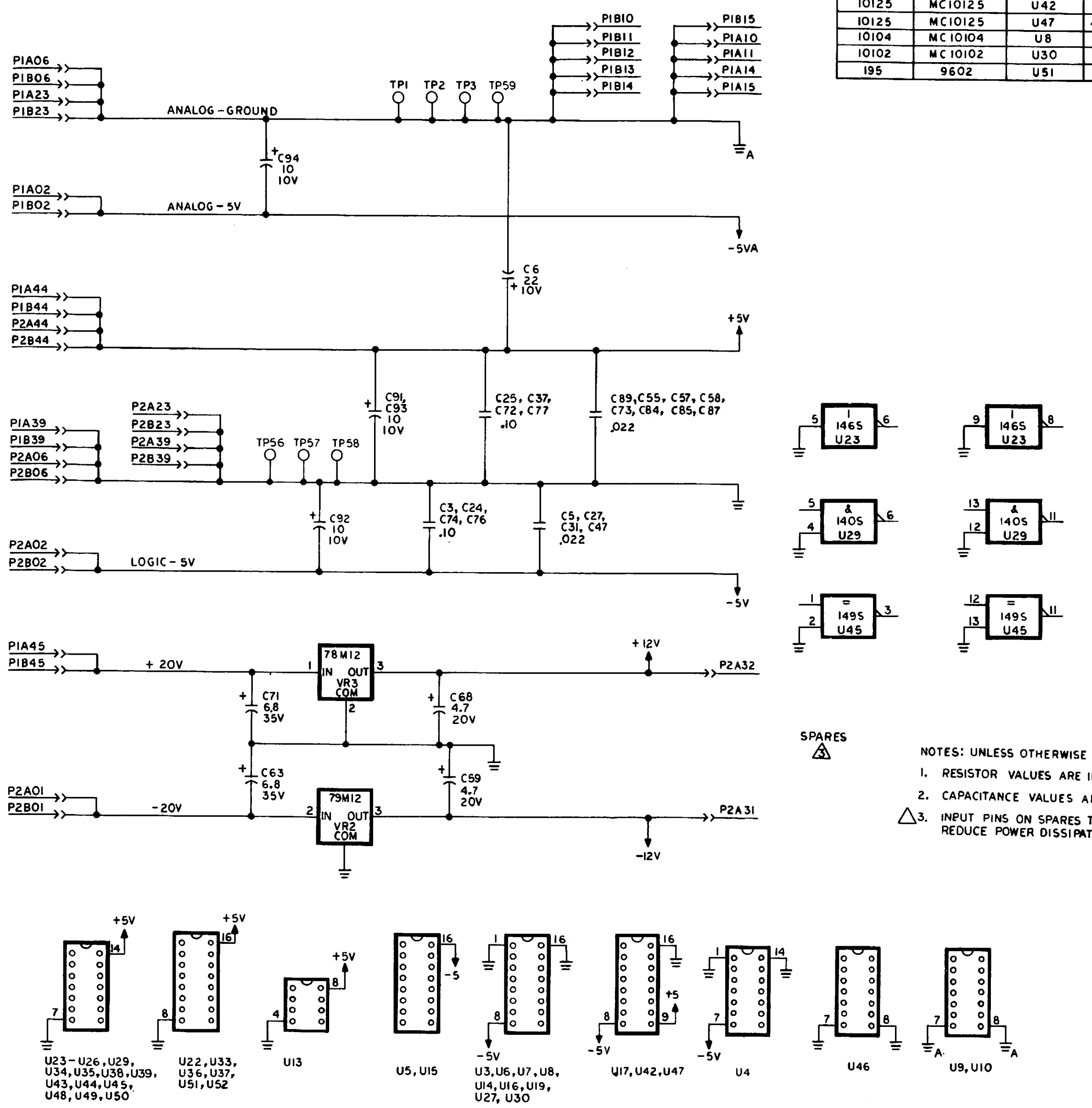
| SOURCE/DEST | X-REF | SIGNAL | X-REF. | A | PIN | B | SIGNAL | X-REF. | SOURCE/DEST | X-REF |
|---|---|---|---|---|---|---|---|---|---|---|
| | | -20 V | 0701 | A | 1 | B | -20 V | 0701 | | |
| | | LOGIC -5 | 0701 | A | 2 | B | LOGIC -5 V | 0701 | | |
| P1-A40 | 0209 | PWR-UP-MR/-L | 0705 | A | 3 | B | ERLY-STROBE/-L | 0703 | P1-B41 | 0208 |
| P1-A38 | 0204 | AM-FOUND/+L | 0705 | A | 4 | B | WRT-GATE/-L | 0704 | P1-B40 | 0208 |
| | | | | | 5 | B | READ-GATE/+L | 0705 | P1-B38 | 0208 |
| | | GND | 0701 | A | 6 | B | GND | 0701 | | |
| P1-A42 | 0208 | LATE STROBE/-L | 0703 | A | 7 | B | NRZ-DATA-OUT-GND | 0703 | P2-A33 | 0208 |
| | | | | | 8 | B | NRZ-DATA-OUT | 0703 | P2-A34 | 0208 |
| | | | | | 9 | B | RD-CLK/-L | 0703 | P2-A27 | 0208 |
| | | | | | 10 | B | RD-CLK-GND | 0703 | P2-A26 | 0208 |
| | | | | | 12 | B | WRT-CLOCK-ENABLE/-L | 0703 | P2-A12 | 0605 |
| P1-A37 | 020 * | ON-TIME-EN/-L | 0704 | A | 16 | | | | | |
| | | GND | 0701 | A | 23 | B | GND | 0701 | | |
| | | | | | 25 | B | DIAG-RD-PLO-LOCK/+L | 070 * | P2-A25 | 150* |
| | | | | | 28 | B | WRT-CLK-GND | 0704 | P2-A28 | 0208 |
| | | | | | 29 | B | WRT-CLK/-L | 0704 | P2-A29 | 0208 |
| J7-13 | 0801 | -12 V | 0701 | A | 31 | B | NRZ-WRT-GND | 0704 | P2-A31 | 0208 |
| J7-04 | 0801 | +12 V | 0701 | A | 32 | B | NRZ-WRT/-L | 0704 | P2-A32 | 0208 |
| J7-06 | 0801 | MFM-WRT-CMPS/+L | 0704 | A | 34 | | | | | |
| J7-11 | 0801 | MFM-WRT-GND | 0704 | A | 35 | B | SVO-CLK-N-GND | 0703 | P2-A35 | 0605 |
| | | | | | 36 | B | SVO-CLK-N | 0703 | P2-A36 | 0605 |
| | | | | | 37 | B | SVO-CLK-P | 0703 | P2-A37 | 0605 |
| | | | | | 38 | B | SVO-CLK-P-GND | 0703 | P2-A38 | 0605 |
| | | GND | 0701 | A | 39 | B | GND | 0701 | | |
| | | | | | 40 | B | WRT-PLO-N-GND | 0704 | P2-A40 | 0605 |
| | | | | | 41 | B | WRT-PLO-N | 0074 | P2-A41 | 0605 |
| | | | | | 42 | B | WRT-PLO-P | 0704 | P2-A42 | 0605 |
| | | | | | 43 | B | WRT-PLO-P-GND | 0704 | P2-A43 | 0605 |
| | | +5 V | 0701 | A | 44 | B | +5 V | 0701 | | |

XX229

* 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 | MC 10104 | U8 | 2 OR 5, 3 |
| 10102 | MC 10102 | U30 | 3, 14 |
| 195 | 9602 | U51 | 6 OR 7 |




NOTES: UNLESS OTHERWISE SPECIFIED.

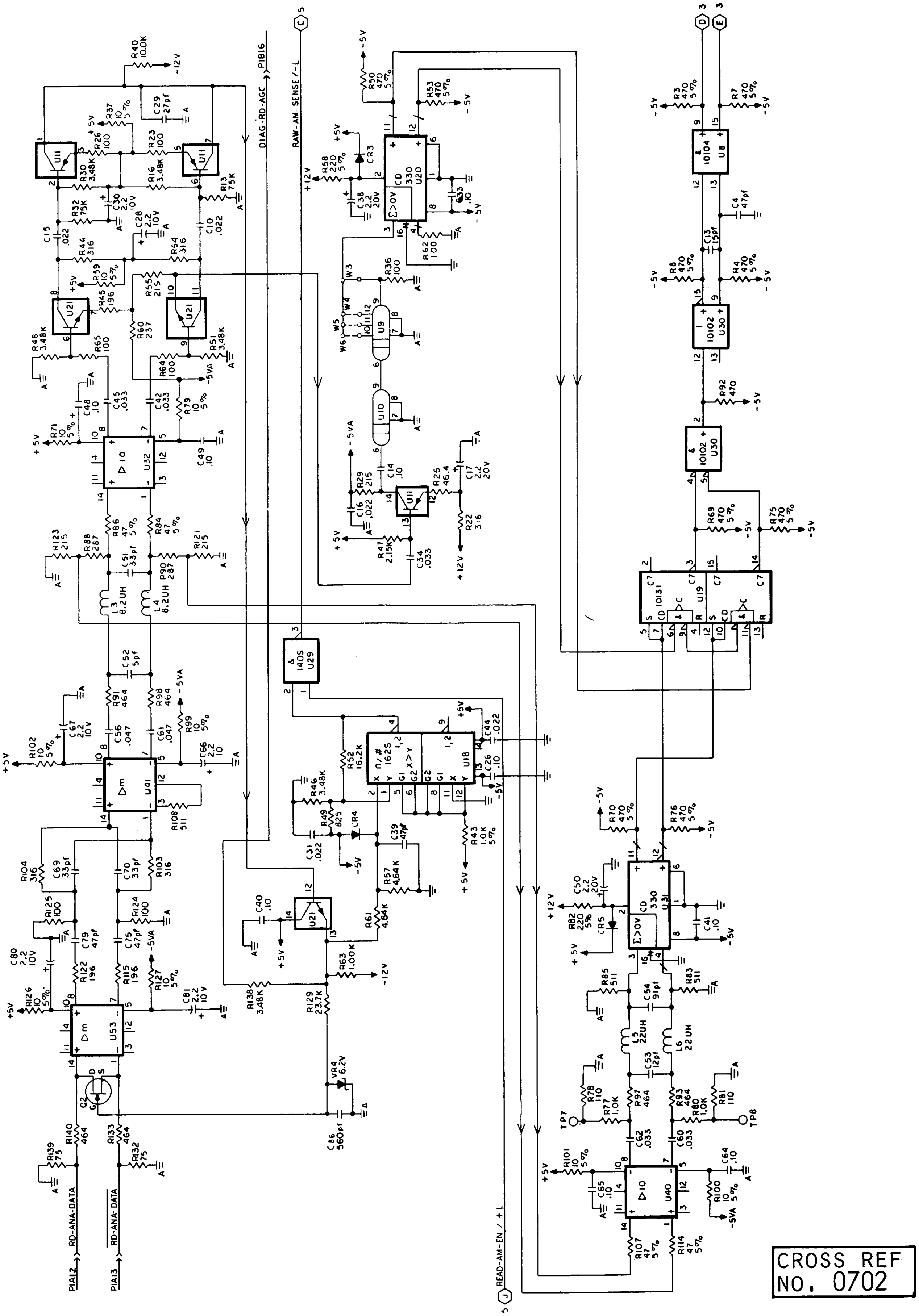
1. RESISTOR VALUES ARE IN OHMS, 1/4 W, ±1%.
2. CAPACITANCE VALUES ARE IN MICROFARADS.
3. (△) INPUT PINS ON SPARES TIED TO GROUND TO REDUCE POWER DISSIPATION.

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

CROSS REF
NO. 0701

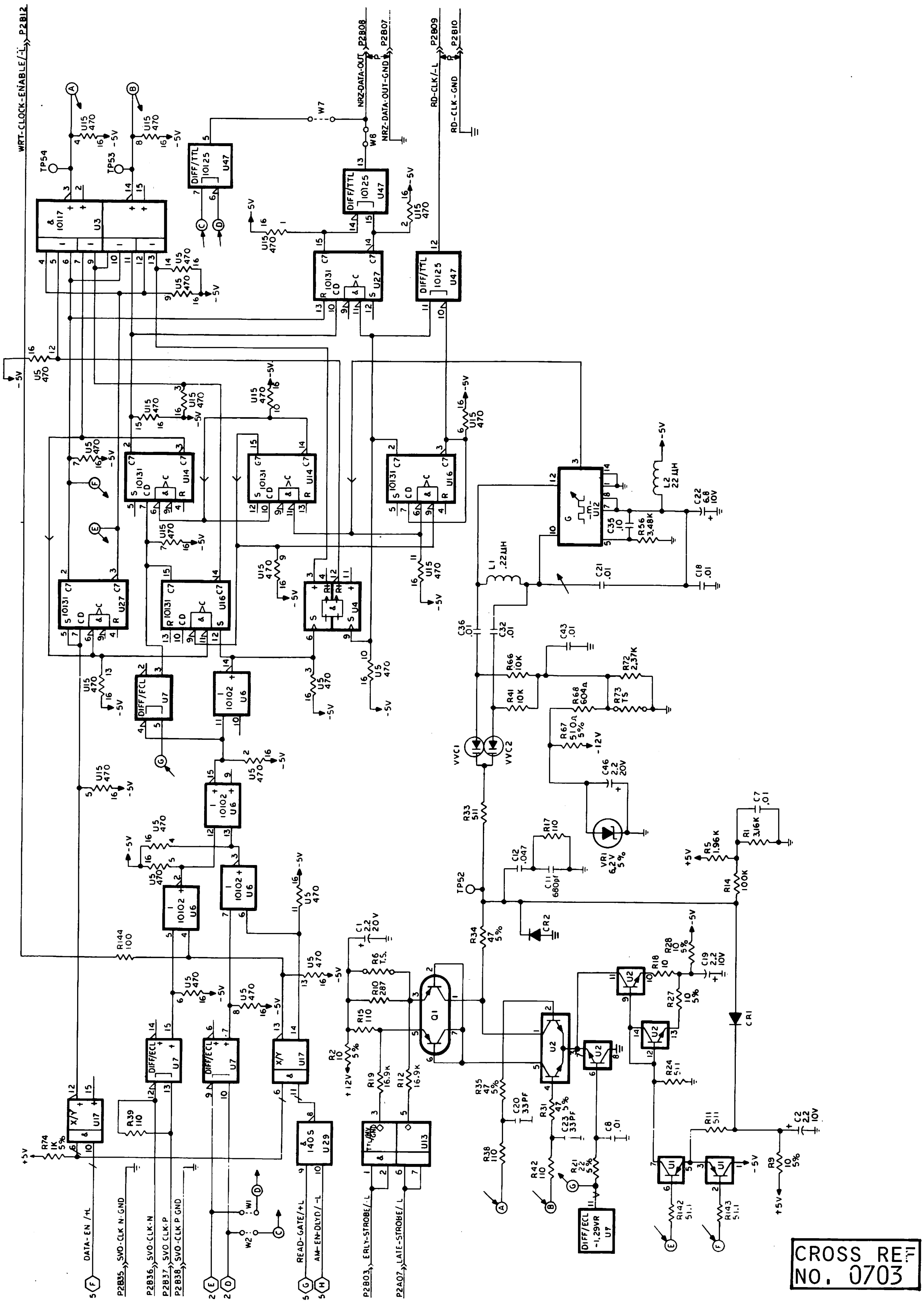
WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).



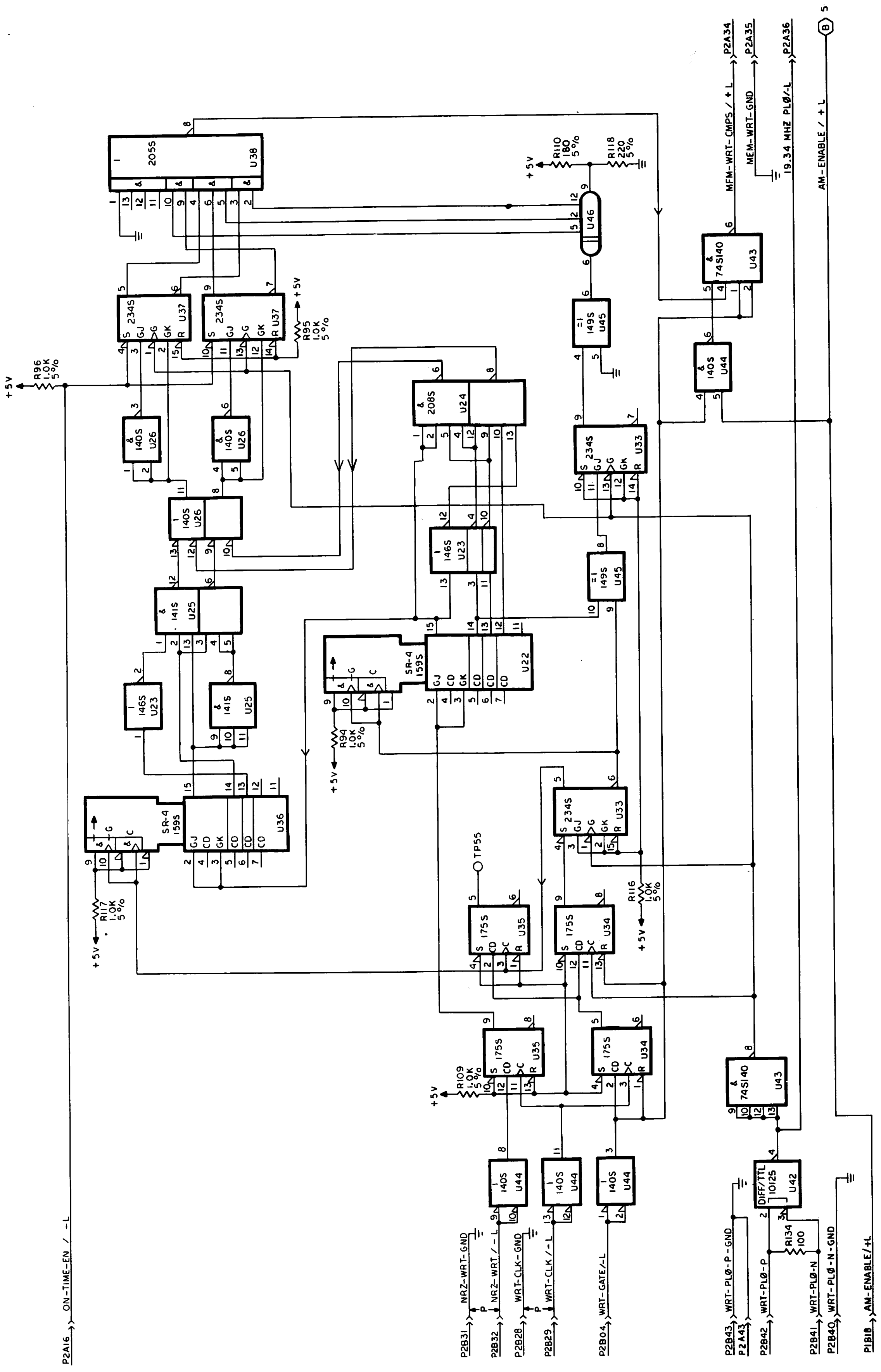

CROSS REF
NO. 0702

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



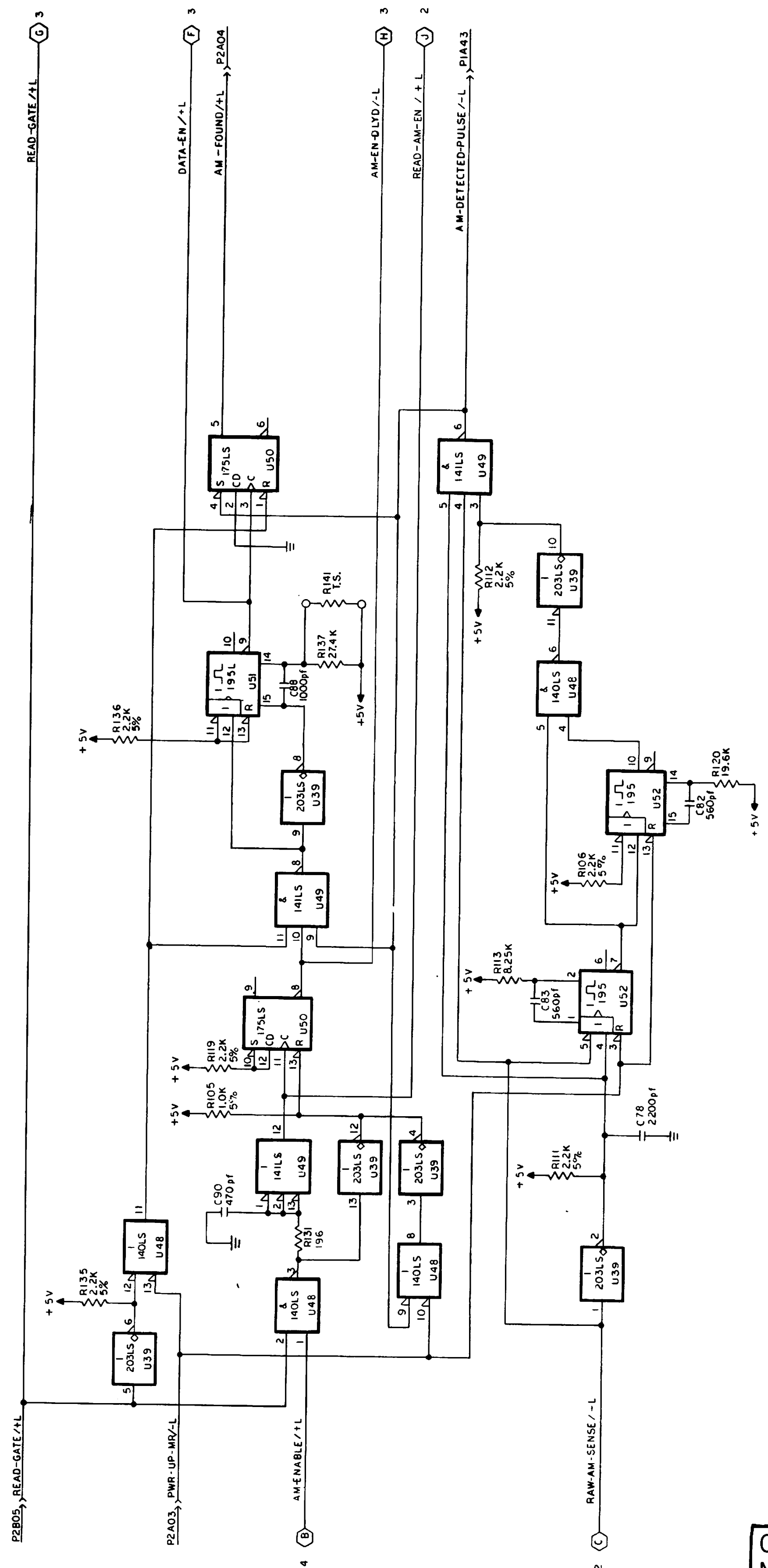

CROSS REF NO. 0703

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



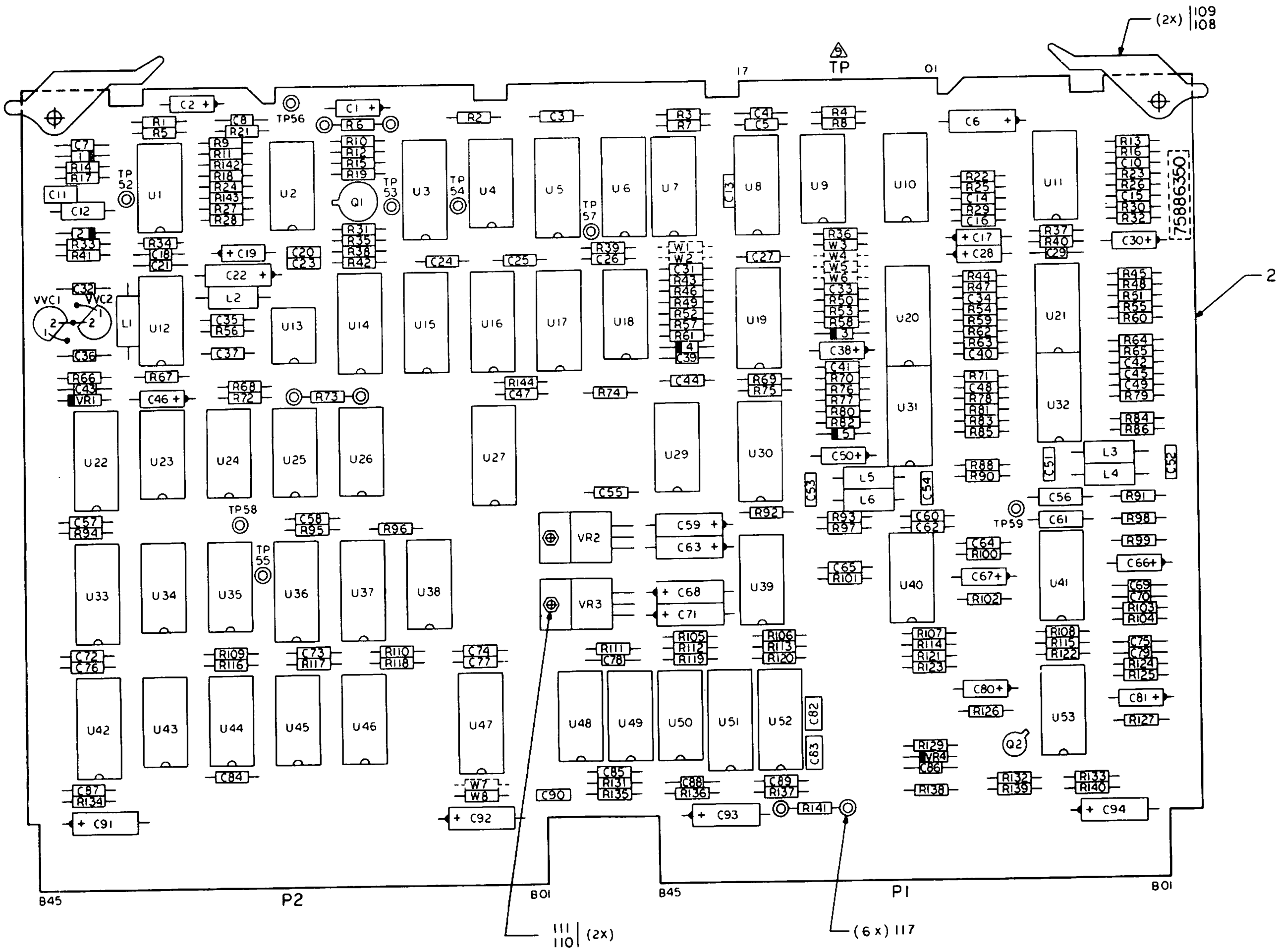

CROSS REF
NO. 0704

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




CROSS REF
NO. 0705

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




| 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 | — |

| TSTR | PL ITEM |
|---|---|
| Q1 | 38 |
| Q2 | 40 |

| VOLT REG | PL ITEM |
|---|---|
| VR1 | 118 |
| VR2 | 81 |
| VR3 | 82 |
| VR4 | 118 |

| VARI CAP DIODE | PL ITEM |
|---|---|
| VVC1 | 84 |
| VVC2 | 84 |

| JMPR | PL ITEM |
|---|---|
| W1 | — |
| W2 | — |
| W3 | 42 |
| W4 | — |
| W5 | — |
| W6 | — |
| W7 | — |
| W8 | 42 |

| IC | PL ITEM |
|---|---|
| U1 | 37 |
| U2 | 36 |
| U3 | 13 |
| U4 | 17 |
| U5 | 39 |
| U6 | 10 |
| U7 | 12 |
| U8 | 11 |
| U9 | 35 |
| U10 | 35 |
| U11 | 37 |
| U12 | 9 |
| U13 | 32 |
| U14 | 16 |
| U15 | 39 |
| U16 | 16 |
| U17 | 14 |
| U18 | 5 |
| U19 | 16 |
| U20 | 6 |
| U21 | 36 |
| U22 | 31 |
| U23 | 20 |
| U24 | 24 |
| U25 | 23 |
| U26 | 19 |
| U27 | 16 |
| U28 | — |
| U29 | 19 |
| U30 | 10 |
| U31 | 6 |
| U32 | 7 |
| U33 | 29 |
| U34 | 27 |
| U35 | 27 |
| U36 | 31 |
| U37 | 29 |
| U38 | 25 |
| U39 | 21 |
| U40 | 7 |
| U41 | 7 |
| U42 | 15 |
| U43 | 30 |
| U44 | 19 |
| U45 | 28 |
| U46 | 34 |
| U47 | 15 |
| U48 | 18 |
| U49 | 22 |
| U50 | 26 |
| U51 | 122 |
| U52 | 33 |
| U53 | 7 |

| CAP | PL ITEM |
|---|---|
| C59 | 106 |
| C60 | 101 |
| C61 | 102 |
| C62 | 101 |
| C63 | 112 |
| C64 | 103 |
| C65 | 103 |
| C66 | 104 |
| C67 | 104 |
| C68 | 106 |
| C69 | 91 |
| C70 | 91 |
| C71 | 112 |
| C72 | 103 |
| C73 | 100 |
| C74 | 103 |
| C75 | 92 |
| C76 | 103 |
| C77 | 103 |
| C78 | 98 |
| C79 | 92 |
| C80 | 104 |
| C81 | 104 |
| C82 | 96 |
| C83 | 96 |
| C84 | 100 |
| C85 | 100 |
| C86 | 95 |
| C87 | 100 |
| C88 | 97 |
| C89 | 100 |
| C90 | 94 |
| C91 | 113 |
| C92 | 113 |
| C93 | 113 |
| C94 | 113 |

| CAP | PL ITEM |
|---|---|
| C1 | 105 |
| C2 | 104 |
| C3 | 103 |
| C4 | 92 |
| C5 | 100 |
| C6 | 114 |
| C7 | 99 |
| C8 | 99 |
| C9 | — |
| C10 | 100 |
| C11 | 116 |
| C12 | 102 |
| C13 | 89 |
| C14 | 103 |
| C15 | 100 |
| C16 | 100 |
| C17 | 105 |
| C18 | 99 |
| C19 | 104 |
| C20 | 90 |
| C21 | 99 |
| C22 | 107 |
| C23 | 90 |
| C24 | 103 |
| C25 | 103 |
| C26 | 103 |
| C27 | 100 |
| C28 | 104 |
| C29 | 115 |
| C30 | 104 |
| C31 | 100 |
| C32 | 99 |
| C33 | 103 |
| C34 | 101 |
| C35 | 103 |
| C36 | 99 |
| C37 | 103 |
| C38 | 105 |
| C39 | 92 |
| C40 | 103 |
| C41 | 103 |
| C42 | 101 |
| C43 | 99 |
| C44 | 100 |
| C45 | 101 |
| C46 | 105 |
| C47 | 100 |
| C48 | 103 |
| C49 | 103 |
| C50 | 105 |
| C51 | 90 |
| C52 | 88 |
| C53 | 89 |
| C54 | 93 |
| C55 | 100 |
| C56 | 102 |
| C57 | 100 |
| C58 | 100 |

| RES | PL ITEM |
|---|---|
| R117 | 50 |
| R118 | 48 |
| R119 | 51 |
| R120 | 79 |
| R121 | 59 |
| R122 | 58 |
| R123 | 59 |
| R124 | 56 |
| R125 | 56 |
| R126 | 44 |
| R127 | 44 |
| R128 | — |
| R129 | 52 |
| R130 | — |
| R131 | 58 |
| R132 | 55 |
| R133 | 64 |
| R134 | 56 |
| R135 | 51 |
| R136 | 51 |
| R137 | 121 |
| R138 | 71 |
| R139 | 55 |
| R140 | 64 |
| R141 | 43 |
| R142 | 73 |
| R143 | 73 |
| R144 | 56 |

| TERM | PL ITEM |
|---|---|
| TP52 | 117 |
| TP53 | 117 |
| TP54 | 117 |
| TP55 | 117 |
| TP56 | 119 |
| TP57 | 119 |
| TP58 | 119 |
| TP59 | 119 |

| RES | PL ITEM |
|---|---|
| R59 | 44 |
| R60 | 60 |
| R61 | 74 |
| R62 | 56 |
| R63 | 67 |
| R64 | 56 |
| R65 | 56 |
| R66 | 77 |
| R67 | 41 |
| R68 | 54 |
| R69 | 49 |
| R70 | 49 |
| R71 | 44 |
| R72 | 70 |
| R73 | 43 |
| R74 | 50 |
| R75 | 49 |
| R76 | 49 |
| R77 | 67 |
| R78 | 57 |
| R79 | 44 |
| R80 | 67 |
| R81 | 57 |
| R82 | 48 |
| R83 | 65 |
| R84 | 45 |
| R85 | 65 |
| R86 | 45 |
| R87 | — |
| R88 | 61 |
| R89 | — |
| R90 | 61 |
| R91 | 64 |
| R92 | 49 |
| R93 | 64 |
| R94 | 50 |
| R95 | 50 |
| R96 | 50 |
| R97 | 64 |
| R98 | 64 |
| R99 | 44 |
| R100 | 44 |
| R101 | 44 |
| R102 | 44 |
| R103 | 62 |
| R104 | 62 |
| R105 | 51 |
| R106 | 51 |
| R107 | 45 |
| R108 | 65 |
| R109 | 50 |
| R110 | 47 |
| R111 | 51 |
| R112 | 51 |
| R113 | 76 |
| R114 | 45 |
| R115 | 58 |
| R116 | 50 |

| RES | PL ITEM |
|---|---|
| R1 | 72 |
| R2 | 44 |
| R3 | 49 |
| R4 | 49 |
| R5 | 68 |
| R6 | 43 |
| R7 | 49 |
| R8 | 49 |
| R9 | 44 |
| R10 | 61 |
| R11 | 65 |
| R12 | 120 |
| R13 | 75 |
| R14 | 80 |
| R15 | 57 |
| R16 | 71 |
| R17 | 57 |
| R18 | 44 |
| R19 | 120 |
| R20 | — |
| R21 | 46 |
| R22 | 62 |
| R23 | 56 |
| R24 | 65 |
| R25 | 53 |
| R26 | 56 |
| R27 | 44 |
| R28 | 44 |
| R29 | 59 |
| R30 | 71 |
| R31 | 45 |
| R32 | 75 |
| R33 | 65 |
| R34 | 45 |
| R35 | 45 |
| R36 | 56 |
| R37 | 44 |
| R38 | 57 |
| R39 | 57 |
| R40 | 77 |
| R41 | 77 |
| R42 | 57 |
| R43 | 50 |
| R44 | 62 |
| R45 | 58 |
| R46 | 71 |
| R47 | 69 |
| R48 | 71 |
| R49 | 66 |
| R50 | 49 |
| R51 | 71 |
| R52 | 78 |
| R53 | 49 |
| R54 | 62 |
| R55 | 59 |
| R56 | 71 |
| R57 | 74 |
| R58 | 48 |

F059

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 7 OF 10)

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| | 75886350-0 | PWA Read/Write | |
| 2 | 75886370-8 | PWB, Read/Write | |
| 5 | 15123100-8 | IC NE521FH | |
| 6 | 15164430-9 | IC AM685 | |
| 7 | 15163100-9 | IC 733C | |
| 9 | 15164422-6 | IC ECL 1648 | |
| 10 | 15118000-7 | IC ECL 10102 | |
| 11 | 15120900-4 | IC ECL 10104 | |
| 12 | 15121100-0 | IC ECL 10116 | |
| 13 | 15118600-4 | IC ECL 10117 | |
| 14 | 15119400-8 | IC ECL 10124 | |
| 15 | 15119500-5 | IC ECL 10125 | |
| 16 | 15118500-6 | IC ECL 10131 | |
| 17 | 15126400-9 | IC ECL 12040 | |
| 18 | 15144900-6 | IC 74LS00 | |
| 19 | 88884500-5 | IC 74S00 | |
| 20 | 88883700-2 | IC 74S04 | |
| 21 | 15145300-8 | IC 74LS05 | |
| 22 | 15145600-1 | IC 74LS10 | |
| 23 | 88884200-2 | IC 74S10 | |
| 24 | 88885300-9 | IC 74S20 | |
| 25 | 15164407-7 | IC 74S64 | |
| 26 | 15146300-7 | IC 74LS74 | |
| 27 | 88923000-9 | IC 74S74 | |
| 28 | 88922900-1 | IC 74S86 | |
| 29 | 15158600-5 | IC 74S112 | |
| 30 | 15158700-3 | IC 74S140 | |
| 31 | 15164418-4 | IC 74S195 | |
| 32 | 15161600-0 | IC 75461 | |
| 33 | 15104301-5 | IC 9602 | |
| 34 | 94262301-8 | Delay Line 20 ns | |
| 35 | 94262302-6 | Delay Line 50 ns | |
| 36 | 94675202-9 | IC CA3046/CA3346 | |
| 37 | 77832298-2 | IC MPZ 1500 | |
| 38 | 77612002-4 | Tstr Dual 2N5583 | |
| 39 | 75738656-0 | Res Pac 2% 470 (15) | |
| 40 | 75888005-8 | Transistor 2N4860A | |
| 41 | 24500056-7 | Res 1/4W 5% 510 | |
| 42 | 94358500-0 | Jmpr Wire, Molded | |
| 43 | 94357500-1 | Resistor Test Select | |
| 44 | 24500015-3 | Res 1/4W 5% 10 | |
| 45 | 24500031-0 | Res 1/4W 5% 47 | |
| 46 | 24500023-7 | Res 1/4W 5% 22 | |
| 47 | 24500045-0 | Res 1/4W 5% 180 | |
| 48 | 24500047-6 | Res 1/4W 5% 220 | |
| 49 | 24500055-9 | Res 1/4W 5% 470 | |

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

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 50 | 24500063-3 | Res 1/4W 5% 1K | |
| 51 | 24500071-6 | Res 1/4W 5% 2.2K | |
| 52 | 94360436-3 | Res 1/4W 5% 23.7K | |
| 53 | 94360164-1 | Res 1/4W 1% 46.4 | |
| 54 | 94360275-5 | Res 1/4W 1% 604 | |
| 55 | 94360184-9 | Res 1/4W 1% 75.0 | |
| 56 | 94360200-3 | Res 1/4W 1% 100 | |
| 57 | 94360204-5 | Res 1/4W 1% 110 | |
| 58 | 94360228-4 | Res 1/4W 1% 196 | |
| 59 | 94360232-6 | Res 1/4W 1% 215 | |
| 60 | 94360236-7 | Res 1/4W 1% 237 | |
| 61 | 94360244-1 | Res 1/4W 1% 287 | |
| 62 | 94360248-2 | Res 1/4W 1% 316 | |
| 64 | 94360264-9 | Res 1/4W 1% 464 | |
| 65 | 94360268-0 | Res 1/4W 1% 511 | |
| 66 | 94360288-8 | Res 1/4W 1% 825 | |
| 67 | 94360300-1 | Res 1/4W 1% 1.00K | |
| 68 | 94360328-2 | Res 1/4W 1% 1.96K | |
| 69 | 94360332-4 | Res 1/4W 1% 2.15K | |
| 70 | 94360336-5 | Res 1/4W 1% 2.37K | |
| 71 | 94360352-2 | Res 1/4W 1% 3.48K | |
| 72 | 94360348-0 | Res 1/4W 1% 3.16K | |
| 73 | 94360168-2 | Res 1/4W 1% 51.1 | |
| 74 | 94360364-7 | Res 1/4W 1% 4.64K | |
| 75 | 94360484-3 | Res 1/4W 1% 75.0K | |
| 76 | 94360388-6 | Res 1/4W 1% 8.25K | |
| 77 | 94360400-9 | Res 1/4W 1% 10.0K | |
| 78 | 94360420-7 | Res 1/4W 1% 16.2K | |
| 79 | 94360428-0 | Res 1/4W 1% 19.6K | |
| 80 | 94360500-6 | Res 1/4W 1% 100K | |
| 81 | 15137903-9 | Volt Reg 79M12 | |
| 82 | 15161100-1 | Volt Reg 78M12 | |
| 83 | 51706300-4 | Diode IN4454 | |
| 84 | 77612970-2 | MVA M2 | |
| 85 | 75887594-2 | Inductor 5% 8.2uH | |
| 86 | 75887599-1 | Inductor 5% 22 uH | |
| 87 | 75887575-1 | Inductor 5% .22uH | |
| 88 | 94227201-4 | Cap 500V +1PF 5 | |
| 89 | 94227207-1 | Cap 500V +1PF 15 | |
| 90 | 94227214-7 | Cap 500V +1PF 33 | |
| 91 | 94240417-9 | Cap 50V 10% 33 | |
| 92 | 94240419-5 | Cap 50V 10% 47 | |
| 93 | 94227225-3 | Cap 300V 2% 91 | |
| 94 | 94227242-8 | Cap 100V 2% 470 | |
| 95 | 94240428-6 | Cap 50V 10% 560 | |
| 96 | 94227244-4 | Cap 100V 2% 560 | |
| 97 | 94240409-6 | Cap 50V 10% 1500 | |
| 98 | 94240402-1 | Cap 50V 10% 2200 | |
| 99 | 94240411-2 | Cap 50V 10% .01uF | |

FIGURE 5-8. READ/WRITE CIRCUIT BOARD (SHEET 9 OF 10)

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 100 | 94361416-4 | Cap 50V +80-20% .022uF | |
| 101 | 94240442-7 | Cap 50V 10% .033uF | |
| 102 | 94240444-3 | Cap 50V 10% .047uF | |
| 103 | 94361400-8 | Cap 50V +80-20% 10uF | |
| 104 | 24504342-7 | Cap 10V 20% 2.2uF | |
| 105 | 24504378-1 | Cap 20V 20% 2.2uF | |
| 106 | 24504380-7 | Cap 20V 20% 4.7uF | |
| 107 | 24504348-4 | Cap 10V 20% 6.8uF | |
| 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 35V 20% 6.8uF | |
| 113 | 24504350-0 | Cap 10V 20% 10uF | |
| 114 | 24504352-6 | Cap 10V 20% 22uF | |
| 115 | 94240416-1 | Cap 50V 10% 27 | |
| 116 | 94227246-9 | Cap 100V 2% 680 | |
| 117 | 77612165-9 | Terminal, Slotted | |
| 118 | 50241500-3 | Volt Reg 6.2V | |
| 119 | 92498021-2 | Terminal Swaged | |
| 120 | 94360422-3 | Res 1/4 W 1% 16.9 K | |
| 121 | 94360442-1 | Res 1/4 1% 27.4K | |
| 122 | 15150700-1 | IC 96L02 | |

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 Control Data Standard 1.60.010 (see Section 6.2.2).

R/W PREAMP CKT BOARD

| Pin | SIGNAL | X-REF. | SOURCE/DEST/ | X-REF | | |
|---|---|---|---|---|---|---|
| J8 | | | | | | |
| 01 | HD-ALIGN-2 | 0801 | J1-01 | 0602 | | |
| 02 | HD-ALIGN-1 | 0801<br>0802 | J1-02 | 0602 | | |
| J9 | | | | | | |
| 01 | WRT-INHIBIT/+L | 0801 | P1-B35 | 0206 | | |
| 02 | DC-WRT-CUR-DET/-L | 0801 | P1-B20 | 0202 | | |
| 04 | HD-SEL-0/-L | 0802 | P1-B27 | 0205 | CNTL MUX | |
| 05 | HD-2/-L | 0802 | P1-B32 | 0205 | | |
| 06 | HD-3/-L | 0802 | P1-B31 | 0205 | | |
| 07 | HD-1/-L | 0802 | P1-B33 | 0205 | | |
| 08 | EN-WRT-CUR-0/+L | 0801 | P1-A24 | 020* | P1-B28 | 0304 |
| 09 | EN-WRT-CUR-2/+L | 0801 | P1-A26 | 020* | P1-B30 | 0304 |
| 10 | WRT-GATE/-L | 0801 | P1-B26 | 0204 | | |
| 11 | HD-5/-L | 0802 | P1-B28 | 0205 | | |
| 12 | HD-4/-L | 0802 | P1-B29 | 0205 | | |
| 13 | EN-WRT-CUR-1/-L | 0801 | P1-A25 | 020* | P1-B29 | 0304 |
| 14 | AC-WRT-DIAG/-L | 0801 | | * | | |
| 15 | AC-WRT-DET/-L | 0801 | P1-B25 | 0202 | | |
| 16 | MULT-HD-SEL/-L | 0802 | P1-B24 | 0202 | | |
| 21 | MFM-WRT-GND | 0801 | P2-A35 | 0704 | | |
| 22 | MFM-WRT-CMPS/+L | 0801 | P2-A34 | 0704 | | |

* WIRED TO, BUT NOT USED ON PWA LISTED

R/W PREAMP CKT BOARD

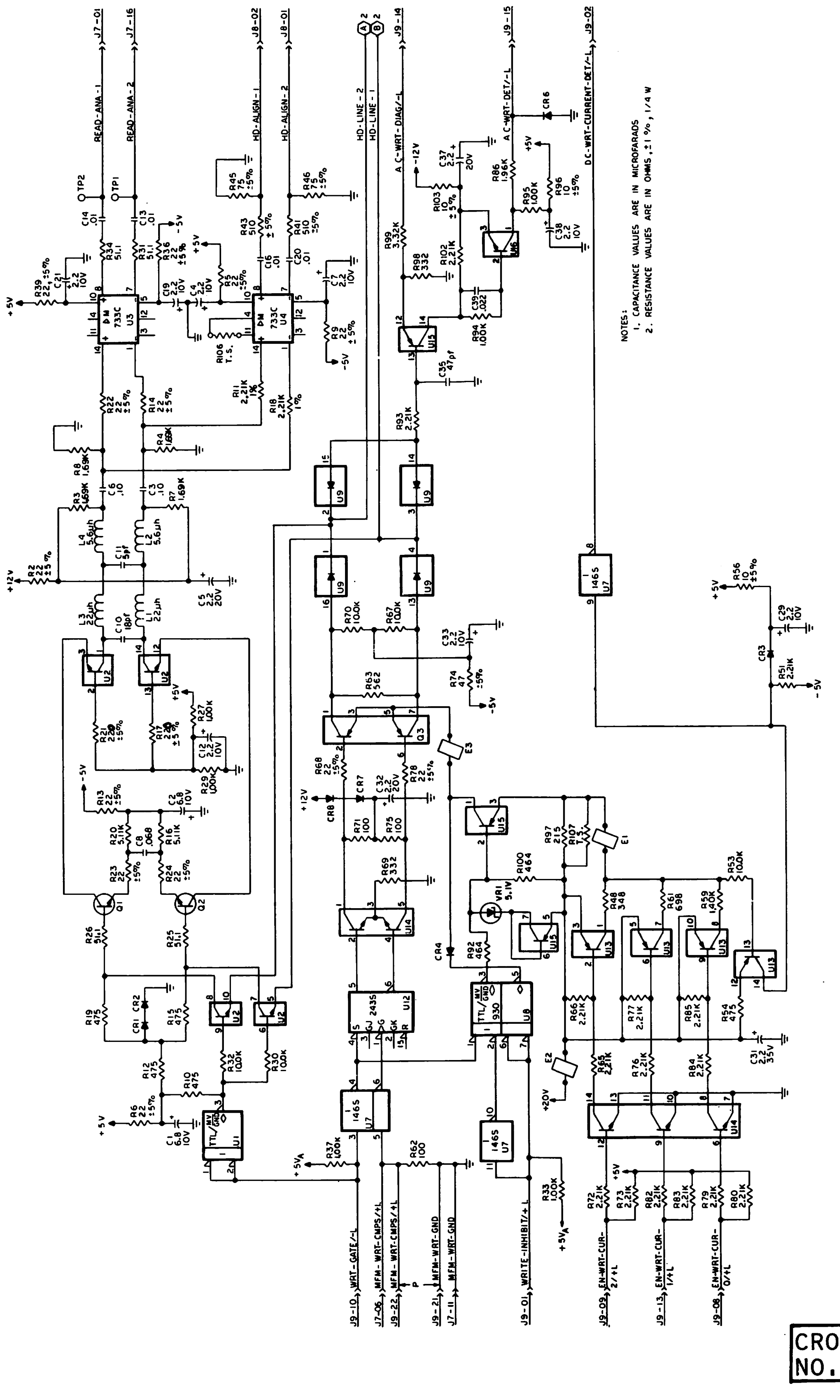
| Pin | SIGNAL | X-REF. | SOURCE DEST | X-REF |
|---|---|---|---|---|
| J1 | | | | |
| 01, 02, 03 | | | UP HD #0, REMOVABLE DISK (SEE NOTE) | |
| J2 | | | | |
| 01, 02, 03 | | | DWN HD #1, FIXED DISK | |
| J3 | | | | |
| 01, 02, 03 | | | UP HD #2, FIXED DISK | |
| J4 | | | | |
| 01, 02, 03 | | | UP HD #0, FIXED DISK | |
| J5 | | | | |
| 01, 02, 03 | | | DWN HD #3, FIXED DISK | |
| J6 | | | | |
| 01, 02, 03 | | | UP HD #4, FIXED DISK | |
| J7 | | | | |
| 01 | RD-ANA-DATA | 0901 | P1-A12 | 0702 |
| 02 | +5 V | 0902 | P1-A09 | 0701 |
| 04 | +12 V | 0902 | P2-A32 | 0701 |
| 05 | ANALOG GND | | P1-A06 | 0704 |
| 06 | MFM-WRT-CMPS/+L | 0901 | P2-A34 | 0704 |
| 07 | ANALOG GND | 0902 | P1-A10 | 0704 |
| 11 | MFM-WRT-GND | 0901,0902 | P2-A35 | 0704 |
| 12 | +20 V | 0902 | P1-A08 | 0701 |
| 13 | -12 V | 0902 | P2-A31 | 0701 |
| 15 | -5 V | 0902 | P1-A07 | 0701 |
| 16 | $\overline{\text{RD-ANA-DATA}}$ | 0901 | P1-A13 | 0702 |

R/W BRD

NOTE" "LOGICAL" HEAD NUMBERS USED HERE (SEE FIGURE 4-36)

ZZ158a

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 1 OF 6)

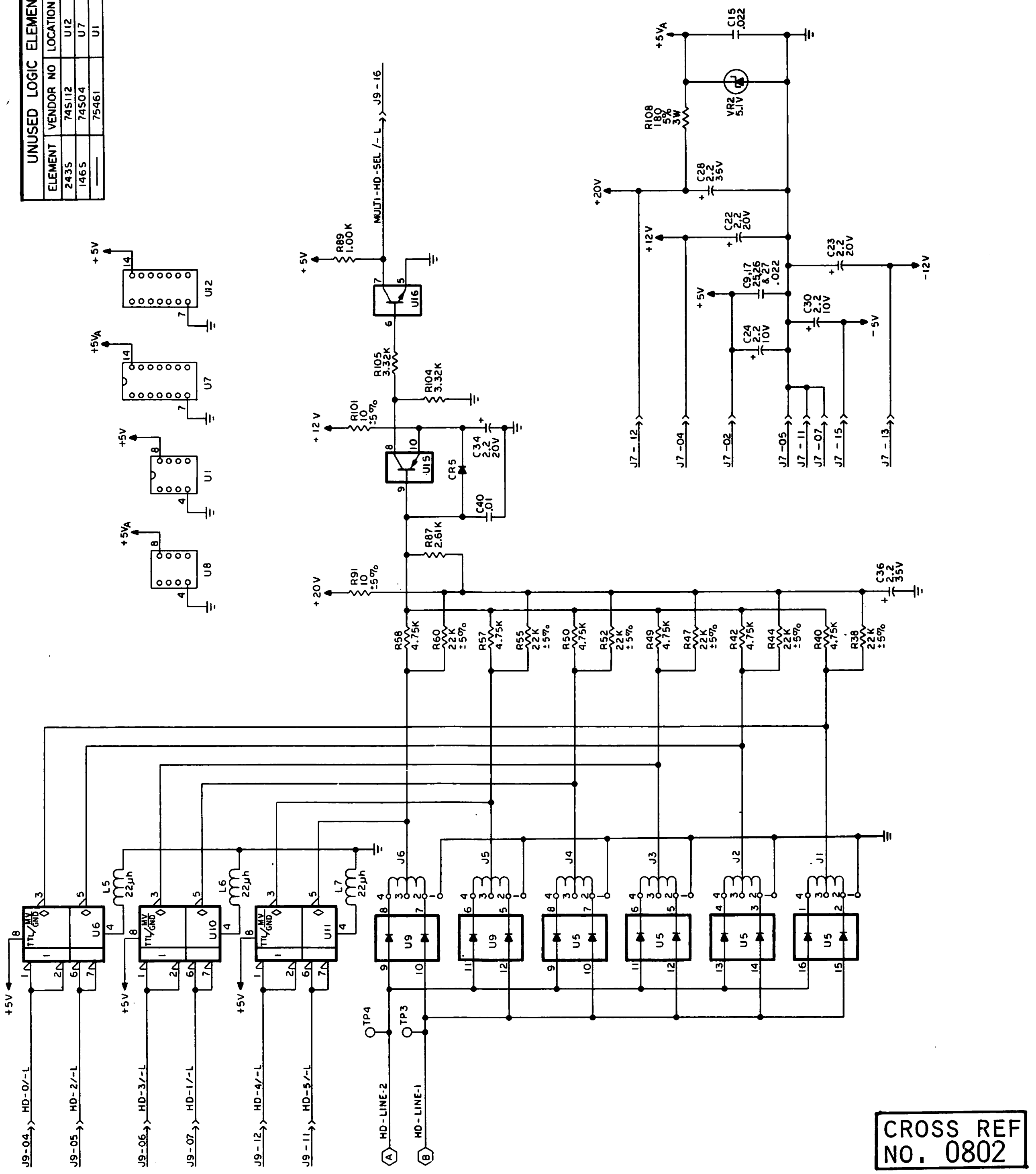



CROSS REF
NO. 0801

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 2 OF 6)

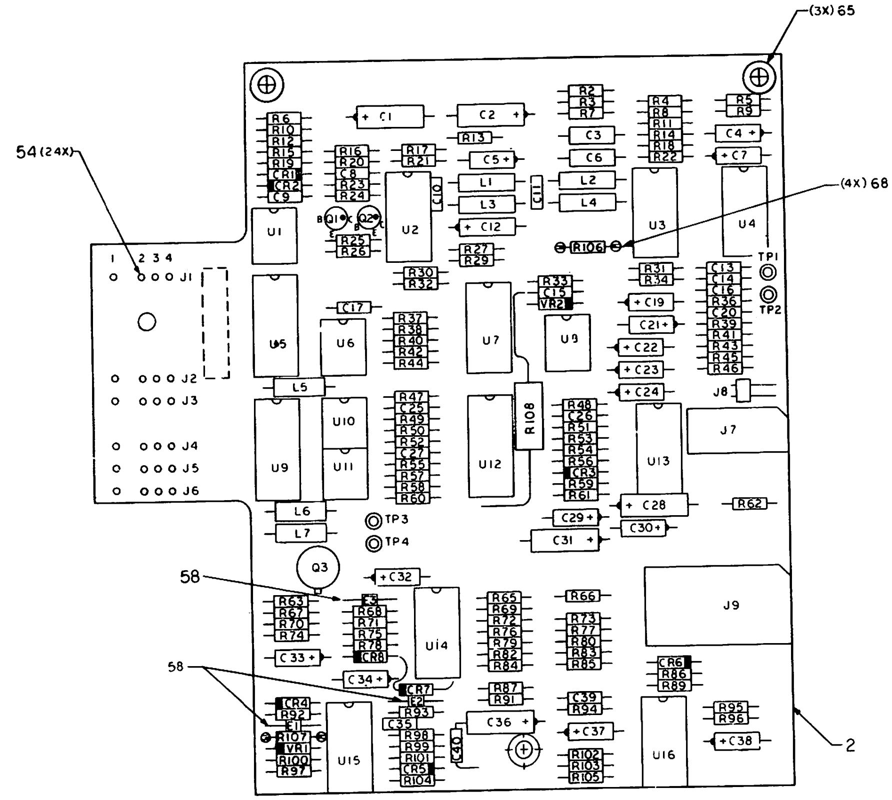
UNUSED LOGIC ELEMENTS

| ELEMENT | VENDOR NO | LOCATION | OUTPUT PIN |
|---|---|---|---|
| 2435 | 74S112 | U12 | 7,9 |
| 1465 | 74S04 | U7 | 2,12 |
| —— | 75461 | U1 | 5 |




CROSS REF NO. 0802

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 3 OF 6)




| IND | L1 | L2 | L3 | L4 | L5 | L6 | L7 |
|---|---|---|---|---|---|---|---|
| PL ITEM | 16 | 17 | 16 | 17 | 16 | 16 | 16 |

| DIO | CR1 | CR2 | CR3 | CR4 | CR5 | CR6 | CR7 | CR8 |
|---|---|---|---|---|---|---|---|---|
| PL ITEM | 18 | ← | | | | | → | 18 |

| TERM | TP 1 | TP 2 | TP 3 | TP 4 |
|---|---|---|---|---|
| PL ITEM | 59 | 59 | 59 | 59 |

| IC | U1 | U2 | U3 | U4 | U5 | U6 | U7 | U8 | U9 | U10 | U11 | U12 | U13 | U14 | U15 | U16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | 9 | 11 | 5 | 5 | 10 | 9 | 8 | 7 | 10 | 9 | 9 | 6 | 13 | 12 | 13 | 11 |

| TSTR | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| PL ITEM | 15 | 15 | 14 | — |

| CONN | J7 | J8 | J9 |
|---|---|---|---|
| PL ITEM | 57 | 55 | 56 |

| 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 | C25 | C26 | C27 | C28 | C29 | C30 | C31 | C32 | C33 | C34 | C35 | C36 | C37 | C38 | C39 | C40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | 29 | 29 | 24 | 26 | 27 | 24 | 26 | 67 | 20 | 23 | 22 | 26 | 25 | 25 | 20 | 25 | 20 | — | 26 | 25 | 26 | 27 | 27 | 26 | 20 | 20 | 20 | 28 | 26 | 26 | 28 | 27 | 26 | 27 | 21 | 28 | 27 | 26 | 20 | 25 |

| RES | R54 | R55 | R56 | R57 | R58 | R59 | R60 | R61 | R62 | R63 | R64 | R65 | R66 | R67 | R68 | R69 | R70 | R71 | R72 | R73 | R74 | R75 | R76 | R77 | R78 | R79 | R80 | R81 | R82 | R83 | R84 | R85 | R86 | R87 | R88 | R89 | R90 | R91 | R92 | R93 | R94 | R95 | R96 | R97 | R98 | R99 | R100 | R101 | R102 | R103 | R104 | R105 | R106 | R107 | R108 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | 43 | 36 | 33 | 50 | 50 | 66 | 36 | 69 | 38 | 42 | — | 48 | 48 | 52 | 34 | 41 | 52 | 38 | 48 | 48 | 35 | 38 | 48 | 48 | 34 | 48 | 48 | — | 48 | 48 | 48 | 48 | 60 | 61 | — | 45 | — | 33 | 44 | 48 | 45 | 45 | 33 | 39 | 41 | 49 | 44 | 33 | 48 | 33 | 49 | 49 | 62 | 62 | 70 |

| 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 | 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 | R51 | R52 | R53 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PL ITEM | — | 34 | 46 | 46 | 34 | 34 | 46 | 46 | 34 | 43 | 48 | 43 | 34 | 34 | 43 | 51 | 71 | 48 | 43 | 51 | 71 | 34 | 34 | 34 | 37 | 37 | 45 | — | 45 | 52 | 37 | 52 | 45 | 37 | — | 34 | 45 | 36 | 34 | 50 | 63 | 50 | 63 | 36 | 64 | 64 | 36 | 40 | 50 | 50 | 48 | 36 | 52 |

| VOLT REG | VR1 | VR2 |
|---|---|---|
| PL ITEM | 19 | 19 |

F060

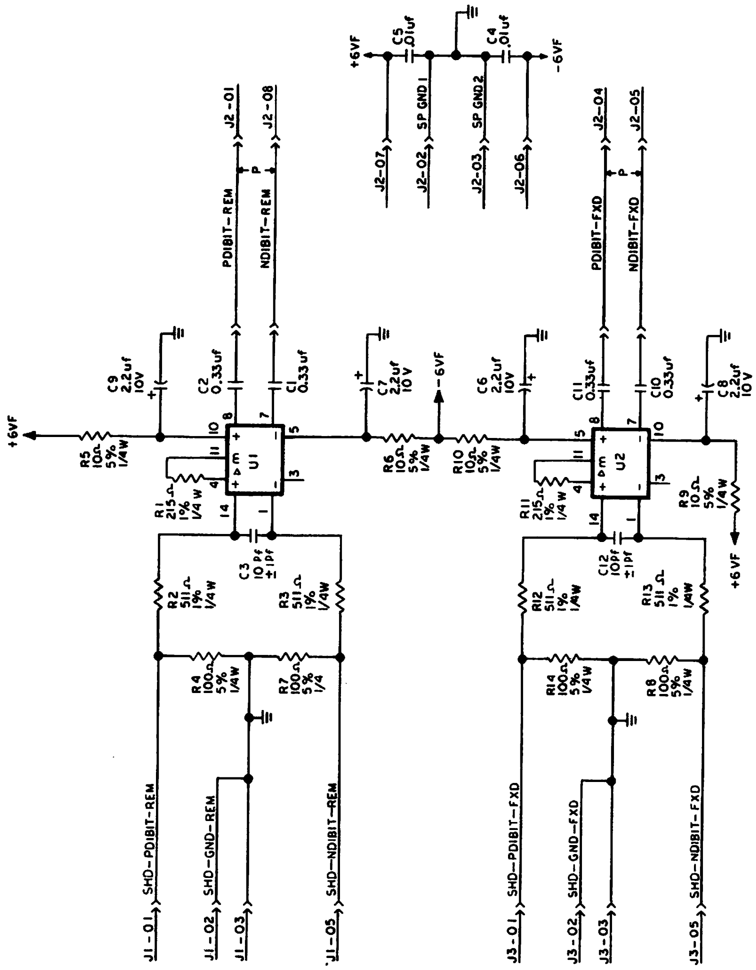
FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 4 OF 6)

| Item No. | Drawing No. | Description | Remarks |
| --- | --- | --- | --- |
| | 75885752-8 | PWA Read/Wrt Preamp | |
| 2 | 75885772-6 | PWB Read/Write Preamp | |
| 5 | 15163100-9 | IC 733C | |
| 6 | 15158600-5 | IC 74S112 | |
| 7 | 15113000-2 | IC 75452 | |
| 8 | 88883700-2 | IC 74S04 | |
| 9 | 15161600-0 | IC 75461 | |
| 10 | 50241802-3 | Diode Array, 8, D1C16 | |
| 11 | 77832297-4 | IC MPQ 1000 | |
| 12 | 94675200-3 | IC CA3046/CA3346 | |
| 13 | 77832298-2 | IC MPQ 1500 | |
| 14 | 77612002-4 | Tstr Dual 2N5583 | |
| 15 | 77612004-0 | Transistor BFR91 | |
| 16 | 75887599-1 | Inductor 5% 22uH | |
| 17 | 75887592-6 | Inductor 5% 5.6uH | |
| 18 | 51706300-4 | Diode IN4454 | |
| 19 | 95818110-9 | Volt Reg 5.1V IN5231 | |
| 20 | 94240440-1 | Cap 50V 10% .022uF | |
| 21 | 94227218-8 | Cap 500V +/-1PF 47 | |
| 22 | 94227201-4 | Cap 500V +1PF 5 | |
| 23 | 94227208-9 | Cap 500V 1% 18 | |
| 24 | 94240448-4 | Cap 50V 10% .10uF | |
| 25 | 94240411-2 | Cap 50V 10% .01uF | |
| 26 | 24504342-7 | Cap 10V 20% 2.2uF | |
| 27 | 24504378-1 | Cap 20V 20% 2.2uF | |
| 28 | 24504333-6 | Cap 35V 20% 2.2uF | |
| 29 | 24504348-4 | Cap 10V 20% 6.8uF | |
| 33 | 24500015-3 | Res 1/4W 5% 10 | |
| 34 | 24500023-7 | Res 1/4W 5% 22 | |
| 35 | 24500031-0 | Res 1/4W 5% 47 | |
| 36 | 24500095-5 | Res 1/4W 5% 22K | |
| 37 | 94360168-2 | Res 1/4W 1% 51.1 | |
| 38 | 94360200-3 | Res 1/4W 1% 100 | |
| 39 | 94360232-6 | Res 1/4W 1% 215 | |
| 40 | 94360252-4 | Res 1/4W 1% 348 | |
| 41 | 94360250-8 | Res 1/4W 1% 332 | |
| 42 | 94360272-2 | Res 1/4W 1% 562 | |
| 43 | 94360265-6 | Res 1/4W 1% 475 | |
| 44 | 94360264-9 | Res 1/4W 1% 464 | |
| 45 | 94360300-1 | Res 1/4W 1% 1.00K | |
| 46 | 94360322-5 | Res 1/4W 1% 1.69K | |
| 48 | 94360333-2 | Res 1/4W 1% 2.21K | |
| 49 | 94360350-5 | Res 1/4W 1% 3.32K | |
| 50 | 94360365-4 | Res 1/4W 1% 4.75K | |
| 51 | 94360368-8 | Res 1/4W 1% 5.11K | |

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 5 OF 6)

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 52 | 94360400-9 | Res 1/4W 1% 10.0K | |
| 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 1/4W 1% 1.96K | |
| 61 | 94360340-7 | Res 1/4W 1% 2.61K | |
| 62 | 94357500-1 | Resistor Test Select | |
| 63 | 24500056-7 | Res 1/4W 5% 510 | |
| 64 | 24500036-9 | Res 1/4W 5% 75 | |
| 65 | 77612307-7 | Standoff, PWB | |
| 66 | 94360314-2 | Res 1/4W 1% 1.40 K | |
| 67 | 94240446-8 | Cap 50V 10% .068uF | |
| 68 | 77612165-9 | Terminal Slotted | |
| 69 | 94360281-3 | Res 1/4 W 1% 698 | |
| 70 | 92222041-3 | Res 3W 5% 180 | |
| 71 | 94402140-1 | Res 1/4W 5% 220 | |

FIGURE 5-9. READ/WRITE PREAMP CIRCUIT BOARD (SHEET 6 OF 6)




CROSS REF
NO. 0901

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 | |

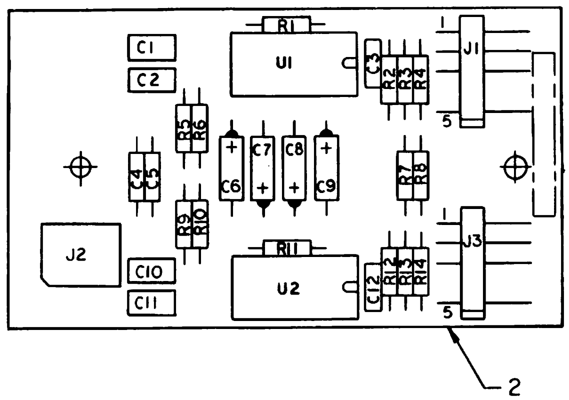
| J2 | SIGNAL | SOURCE/DEST | XREF |
|---|---|---|---|
| 01 | → PDIBIT-REM | P1-B04 | 0602 |
| 02 | ← SP GND 1 | P1-B06 | 0601 |
| 03 | ← SP GND 2 | P1-B08 | 0601 |
| 04 | → P-DIBIT-FXD | P1-B10 | 0602 |
| 05 | → N-DIBIT-FXD | P1-B11 | 0602 |
| 06 | ← -6VF | P1-B09 | 0601 |
| 07 | ← +6VF | P1-B07 | 0601 |
| 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 | |

FIGURE 5-10. SERVO PREAMP CIRCUIT BOARD (SHEET 1 OF 3)

WARNING

PWAs can be damaged by static electricity if not properly handled.
Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).




| 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 |

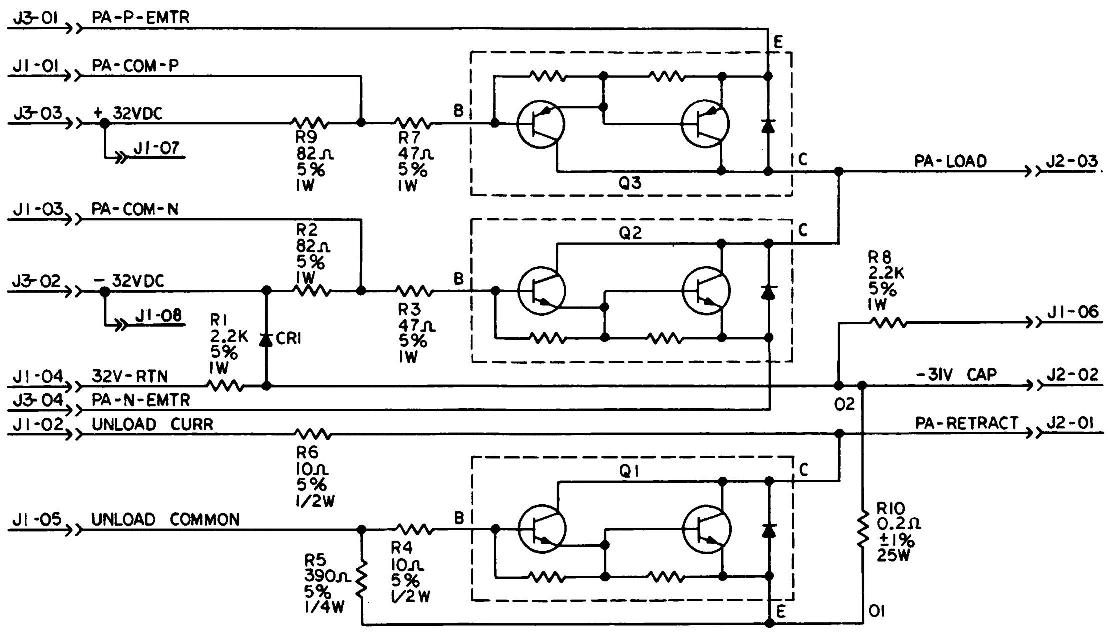
| IC | PL ITEM |
|---|---|
| U1 | 5 |
| U2 | 5 |

| 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 uF | |
| 12 | 94354816-4 | Cap 50 V 20% .33 uF | |
| 13 | 75808537-7 | Cap 100 V 10% .01 uF | |
| 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

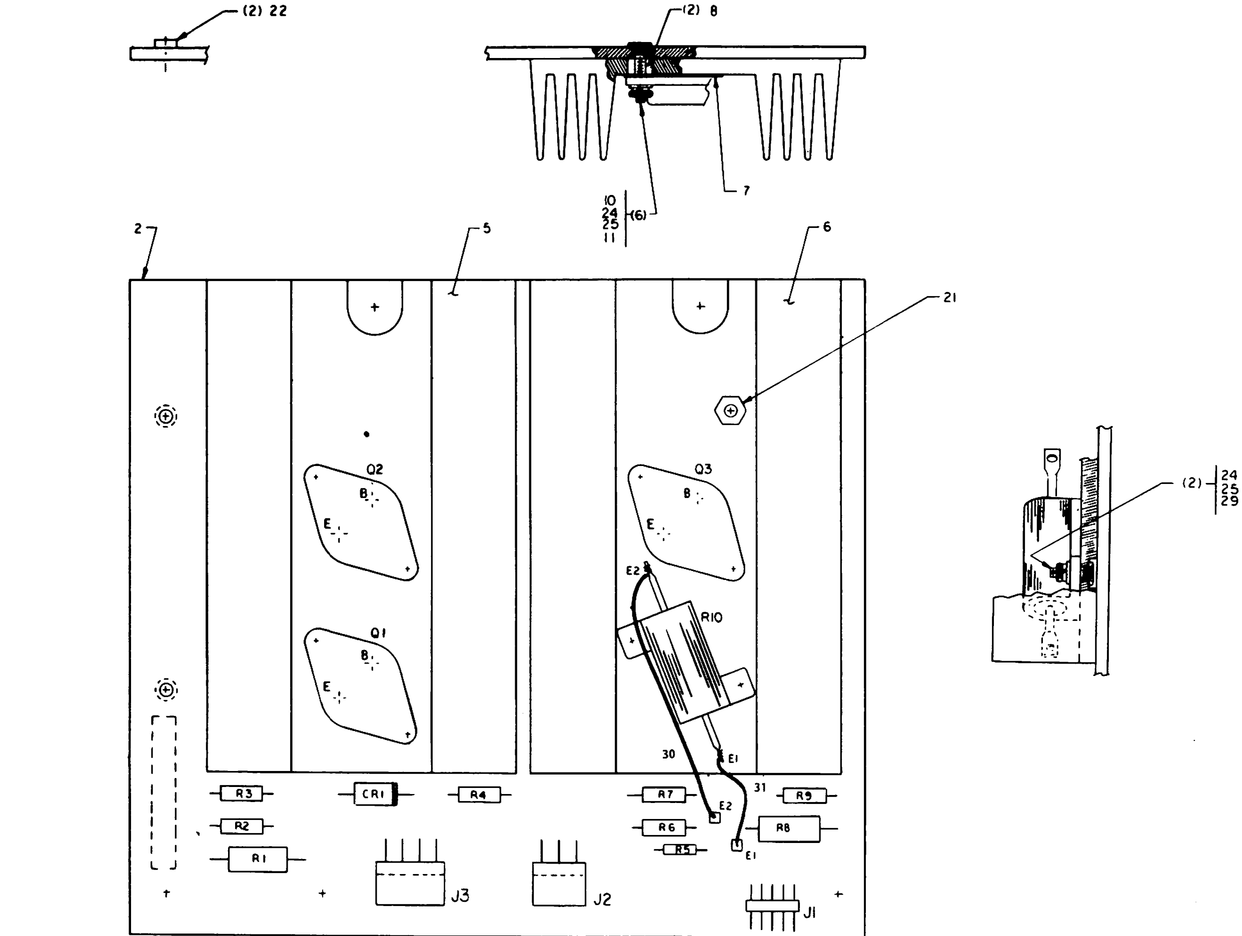
| J1 | SIGNAL | SOURCE/DEST | XREF |
|---|---|---|---|
| 01 | → PA-COM-P | P1-B08 | 0306 |
| 02 | ← UNLOAD CURR | P1-B09 | 0307 |
| 03 | ← PA-COM-N | P1-B10 | 0306 |
| 04 | ← 32V RET | P1-B11 | 0306 |
| 05 | ← UNLOAD COMMON | P1-B13 | 0307 |
| 06 | → -31-CAP | P1-B14 | 0307 |
| 07 | → +32 VDC | P1-A20 | 0203 |
| 08 | → -32 VDC | 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 VDC | CMPB-TB1-03T | 1401 |
| 03 | ← +32 VDC | CMPB-TB1-01T | 1401 |
| 04 | ← PA-N-EMTR | R3-01 | 1601 |

CROSS REF NO. 1001

FIGURE 5-11. POWER AMP CIRCUIT BOARD (SHEET 1 OF 3)



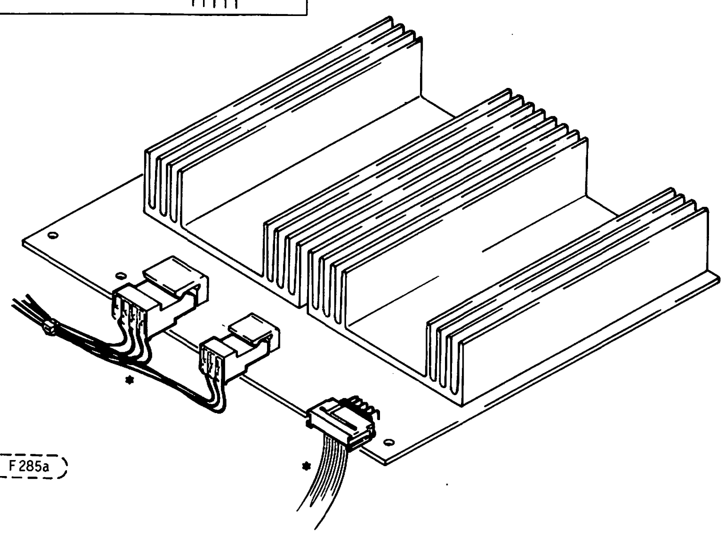

| RES | PL ITEM |
|---|---|
| R1 | 17 |
| R2 | 18 |
| R3 | 16 |
| R4 | 15 |
| R5 | 20 |
| R6 | 15 |
| R7 | 16 |
| R8 | 17 |
| R9 | 18 |
| R10 | 19 |

| TSTR | PL ITEM |
|---|---|
| Q1 | 12 |
| Q2 | 23 |
| Q3 | 13 |

| ITEM | FROM | TO PWB |
|---|---|---|
| 30 | R10 - E2 | E2 |
| 31 | R10 - E1 | E1 |

| CONN | PL ITEM |
|---|---|
| J1 | 26 |
| J2 | 27 |
| J3 | 28 |

| DIODE | PL ITEM |
|---|---|
| CR1 | 14 |



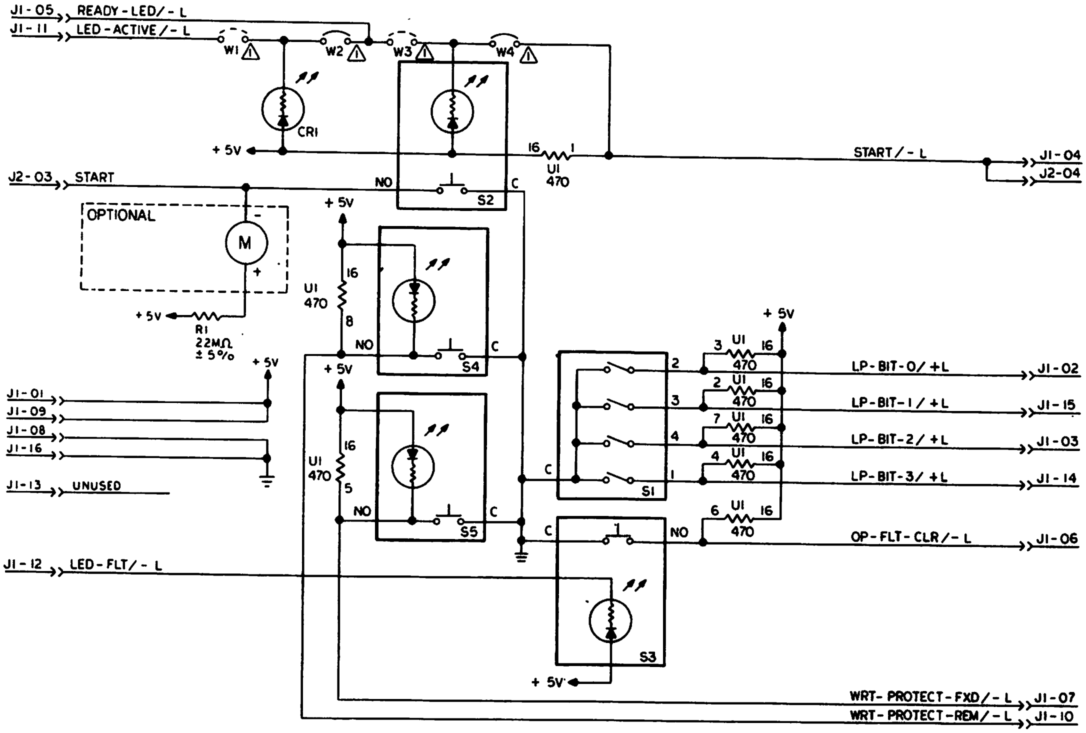

F285a

* 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 |
|---|---|---|---|
| | 77680500 | 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 | 18748600-6 | Compound 340 | |
| 10 | 95683505-2 | Stud, Press | |
| 11 | 10125103-1 | Nut Lock | |
| 12 | 75887208-9 | Transistor, Darlington Pwr | |
| 13 | 15165549-5 | 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% 2.2K | |
| 18 | 94389170-5 | Res 2 W 5% 82 | |
| 19 | 75888776-4 | Res wirewound 0.2 ohm | |
| 20 | 94402145-0 | Res 1/4 W 5% 390 | |
| 21 | 51885504-4 | Standoff, male-female | |
| 22 | 94375501-7 | Insert - PC Bd. | |
| 23 | 15165550-3 | TRSTR-Darlington Pair | |
| 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) | |

FIGURE 5-11. POWER AMP CIRCUIT BOARD (SHEET 3 OF 3)




| TABLE A | | | | |
|---|---|---|---|---|
| ASSEMBLY | JUMPER CONFIGURATION | | | |
| | W1 | W2 | W3 | W4 |
| 77680700 | – | X | – | X |
| 77624900 | – | X | – | X |
| 77680740 | X | – | X | – |

NOTES:
△ 1. SEE TABLE "A" FOR JUMPER CONFIGURATION

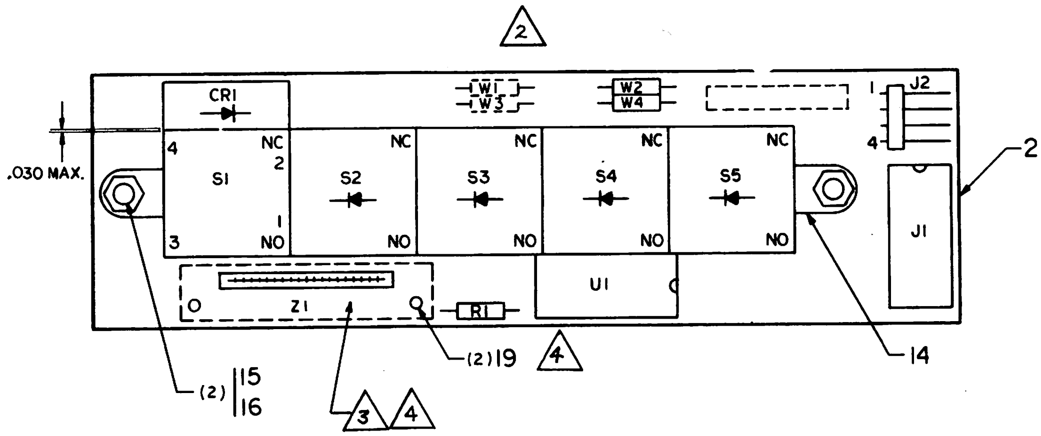
OPR CNTL CKT BD

| J1 | | SIGNAL | SOURCE/DEST | XREF |
|---|---|---|---|---|
| 01 | ← | +5V | P1-B03 | 0201 |
| 02 | → | LP-BIT-0/+L | P1-B04 | 0205 |
| 03 | → | LP-BIT-2/+L | P1-B08 | 0205 |
| 04 | → | START/-L | P1-B10 | 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 | 0201 |
| 09 | ← | +5V | P1-B19 | 0201 |
| 10 | → | WRT-PROTECT-REM/-L | P1-B17 | 0206 |
| 11 | ← | LED-ACTIVE/-L | P1-B11 | 020* |
| 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 | 0201 |
| **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)




| SW | PL ITEM |
|---|---|
| S1 | 5,18 |
| S2 | 6,17 |
| S3 | 7,17 |
| S4 | 8,17 |
| S5 | 8,17 |

| JMPR | PL ITEM |
|---|---|
| W1 | — |
| W2 | 10 |
| W3 | — |
| W4 | 10 |

| CONN | PL ITEM |
|---|---|
| J1 | 11 |
| J2 | 12 |

| DIODE | PL ITEM |
|---|---|
| CR1 | 9 |

| IC | PL ITEM |
|---|---|
| U1 | 13 |

| RES | PL ITEM |
|---|---|
| R1 | 21 |

| METR | PL ITEM |
|---|---|
| Z1 | — |

TABLE "A"

| JMPR | PL ITEM | ASSEMBLY P/N |
|---|---|---|
| W1 | 10 | 77680740 |
| W2 | 10 | 77624900, 77680700 |
| W3 | 10 | 77680740 |
| W4 | 10 | 77624900, 77680700 |

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
4. NOT USED ON 77624900

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 | |
| | 77624900 | 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 | 94398800 | Encoding Button "0" | |
| 19 | 65832104 | Socket-Mini Spring | 4 |
| 21 | 17705968 | RES 1/4 W 5% 22 meg | 4 |

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 | 0303 |
| 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 VDC | 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 VDC | CMPB-TB1-03T | 1401 |
| 08 | ← | +32 VDC | 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 |

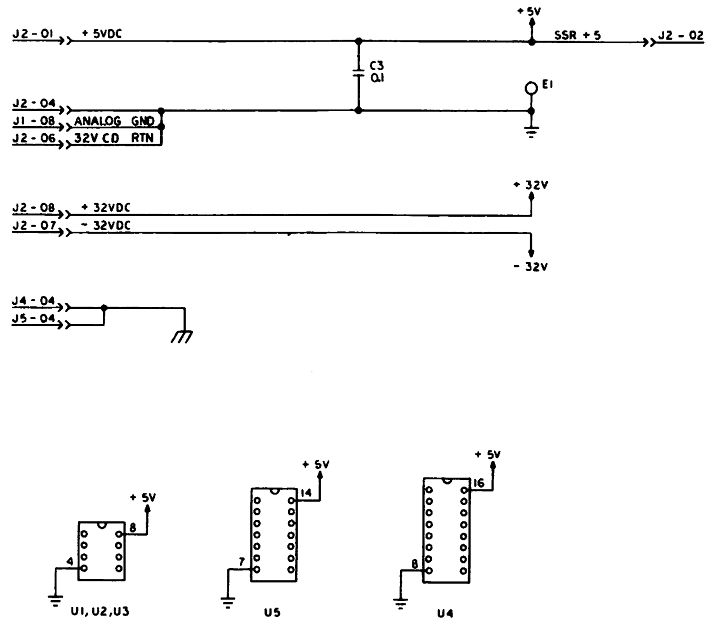
| J4 | | SIGNAL | SOURCE/DEST. | XREF |
|---|---|---|---|---|
| 01 | → | SP-MOT-AUX | | |
| 02 | → | SP-MOT-COM | SPINDLE DRIVE | |
| 03 | → | SP-MOT-MAIN | MOTOR | |
| 04 | → | CASE GROUND | See Figure 5-17 | 1601 |

| 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 | |
| 02 | → | PK-COV-SOL | SOLENOID | 1601 |

| J7 | | SIGNAL | SOURCE/DEST. | XREF |
|---|---|---|---|---|
| 01 | ← | | | |
| 02 | ← | | | |
| 03 | → | | JUMPER PLUG FOR | |
| 04 | ← | | VOLTAGE | |
| 05 | — | SPARE | SEE FIGURE 5-17 | |

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 1 OF 6)




NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTOR VALUES ARE IN OHMS, 1/4W, ± 5%
2. CAPACITOR VALUES ARE IN MICROFARADS

△4. CONNECTIONS DEPEND ON RELAY SUPPLIED

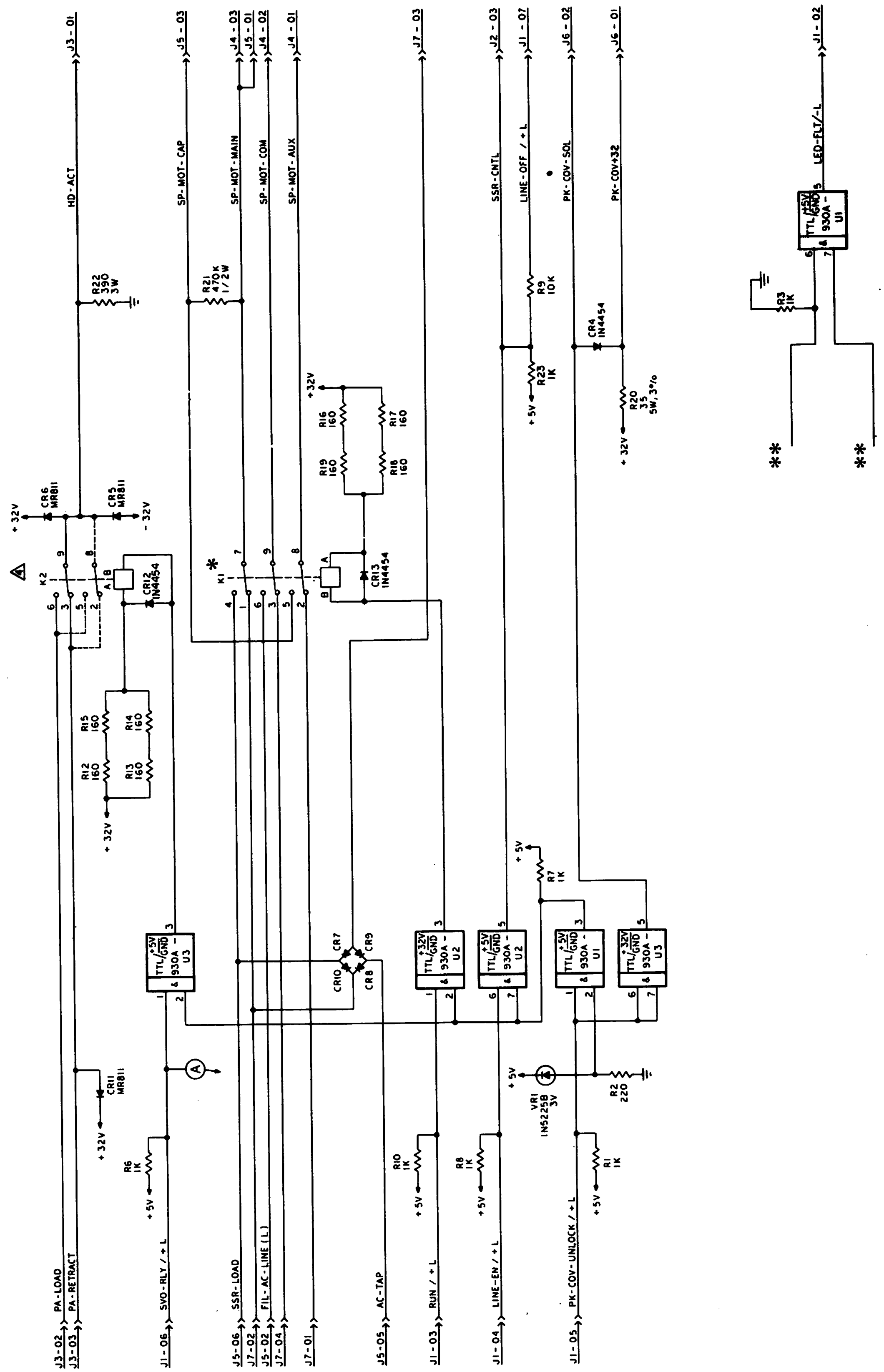
Relays shown in de-energized position.

CROSS REF NO. 1201

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 2 OF 6)

WARNING

PWAs can be damaged by static electricity if not properly handled. Handling must conform to Control Data Standard 1.60.010 (see Section 6.2.2).

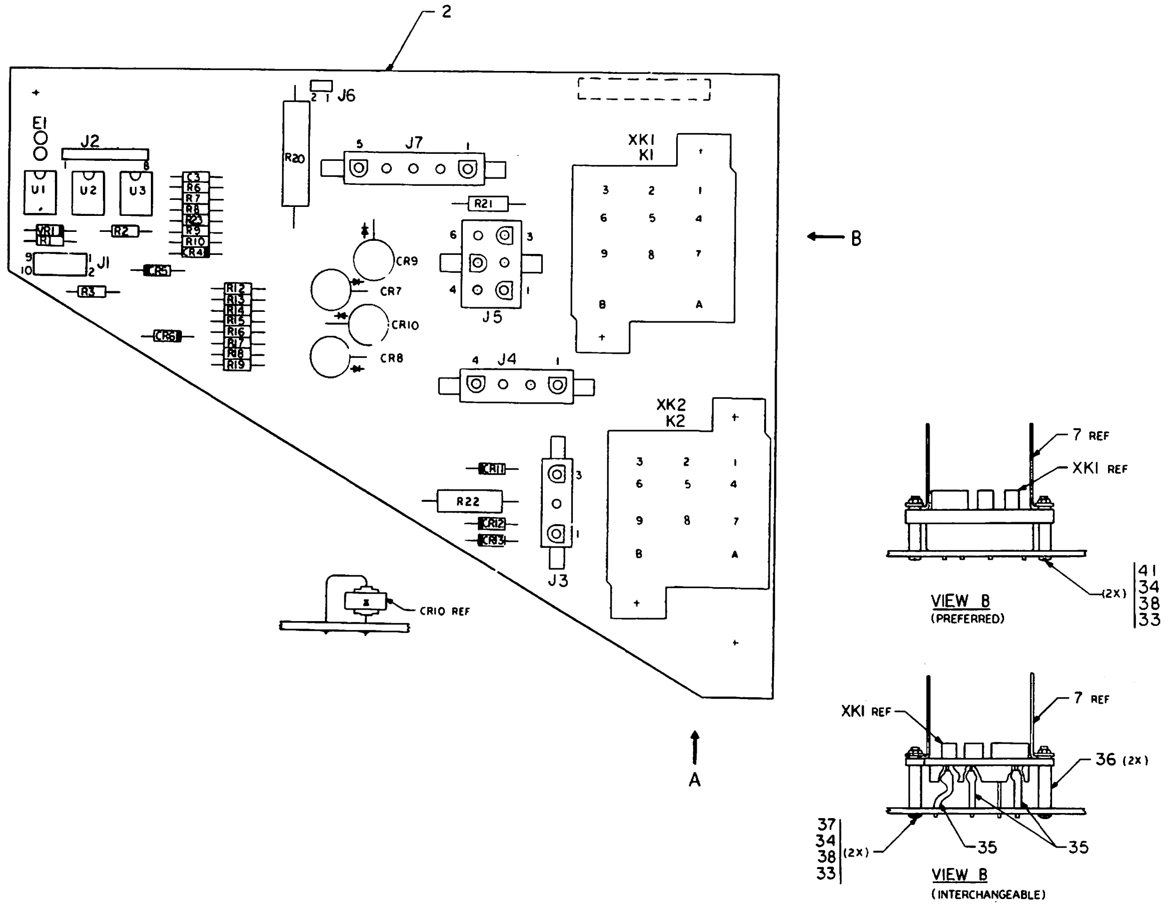


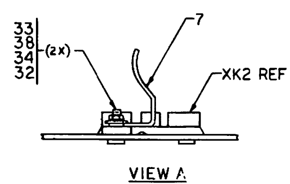

*Relay shown in de-energized position.

** No Connection.

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 3 OF 6)

CROSS REF NO. 1202




| RES | PL ITEM |
|---|---|
| R1 | 24 |
| R2 | 28 |
| R3 | 24 |
| R4 | — |
| R5 | — |
| R6 | 24 |
| R7 | 24 |
| R8 | 24 |
| R9 | 29 |
| R10 | 24 |
| R11 | — |
| R12 | 30 |
| R13 | |
| R14 | |
| R15 | |
| R16 | |
| R17 | |
| R18 | |
| R19 | 30 |
| R20 | 15 |
| R21 | 39 |
| R22 | 23 |
| R23 | 24 |

| SOCKET | PL ITEM |
|---|---|
| XK1 | 40 |
| XK2 | 6 |

| DIODE | PL ITEM |
|---|---|
| CR1 | — |
| CR2 | — |
| CR3 | — |
| CR4 | 20 |
| CR5 | 18 |
| CR6 | 18 |
| CR7 | 19 |
| CR8 | 19 |
| CR9 | 19 |
| CR10 | 19 |
| CR11 | 18 |
| CR12 | 20 |
| CR13 | 20 |

| CONN | PL ITEM |
|---|---|
| J1 | 22 |
| J2 | 16 |
| J3 | 9 |
| J4 | 10 |
| J5 | 14 |
| J6 | 8 |
| J7 | 13 |
| E1 | 25 |

| IC | PL ITEM |
|---|---|
| U1 | 5 |
| U2 | 5 |
| U3 | 5 |
| U4 | — |
| U5 | — |

| CAP | PL ITEM |
|---|---|
| C1 | — |
| C2 | — |
| C3 | 21 |

| RELAY | PL ITEM |
|---|---|
| K1 | 11 |
| K2 | 12 |

| VOLT REG. | PL ITEM |
|---|---|
| VR1 | 17 |

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 4 OF 6)
(ASSEMBLY 77680650, NO AIR)

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| | 77680650 | PWA Relay Control - No Air | |
| 2 | 77680670-5 | PWB, Relay Control | |
| 5 | 15164423-4 | I. C. 75472 | |
| 6 | 22940901-6 | Relay Socket | |
| 7 | 22940903-2 | Relay Retainer | |
| 8 | 76379300-7 | Header Straight 2 pin | |
| 9 | 83435452-4 | Connector, Plug/Cap | |
| 10 | 83435453-2 | Connector, Plug/Cap | |
| 11 | 77612660-9 | Relay | |
| 12 | 22940808-3 | Relay 15 AMP | |
| 13 | 83435458-1 | Connector, Plug/Cap | |
| 14 | 83435454-0 | Connector, Plug/Cap | |
| 15 | 38846808-4 | Res 5 W 3% 35 | |
| 16 | 75743608-4 | Header 8 Pos | |
| 17 | 95818104-2 | Volt Reg 3V 1N52258 | |
| 18 | 77612650-0 | PWR Rectifier MR811 | |
| 19 | 95575001-3 | Rectifier-Sil | |
| 20 | 51706300-4 | Diode 1N4454 | |
| 21 | 94361400-8 | Cap 50 V +80-20% 10uF | |
| 22 | 51860818-7 | Connector, PC | |
| 23 | 92222046-2 | Res 3 W 5% 390 | |
| 24 | 94402156-7 | Res 1/4 W 5% 1K | |
| 24 | 24500063-3 | Res 1/4 W 5% 1K | |
| 25 | 95524700-2 | Terminal, .250 | |
| 28 | 94402140-1 | Res 1/4 W 5% 220 | |
| 28 | 24500047-6 | Res 1/4 W 5% 220 | |
| 29 | 94402180-7 | Res 1/4 W 5% 10K | |
| 29 | 24500087-2 | Res 1/4 W 5% 10K | |
| 30 | 94402137-7 | Res 1/4 W 5% 160 | |
| 30 | 24500044-3 | Res 1/4 W 5% 160 | |
| 32 | 95683505-2 | Stud, Press | |
| 33 | 10125103-1 | Scr Nut-Hex Mach 4-4 | |
| 34 | 10125603-0 | Washer Plain | |
| 35 | 24534709-1 | Sleeving Heat Shrink | |
| 36 | 51760006-0 | Spacer | |
| 37 | 10127109-6 | Screw Pan Hd Mach | |
| 38 | 10125801-0 | Spring Lock Washer 4 | |
| 39 | 17720528-3 | Res-Fix Comp, 1/2 W 5% | |
| 40 | 22940904-0 | Relay Socket/Retainer | |
| 40 | 75889891-0 | Socket Assy | |

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 5 OF 6)

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| 41 | 10127107-0 | Scr 4-40 X 3/4 | |

FIGURE 5-13. RELAY CONTROL CIRCUIT BOARD (SHEET 6 OF 6)

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

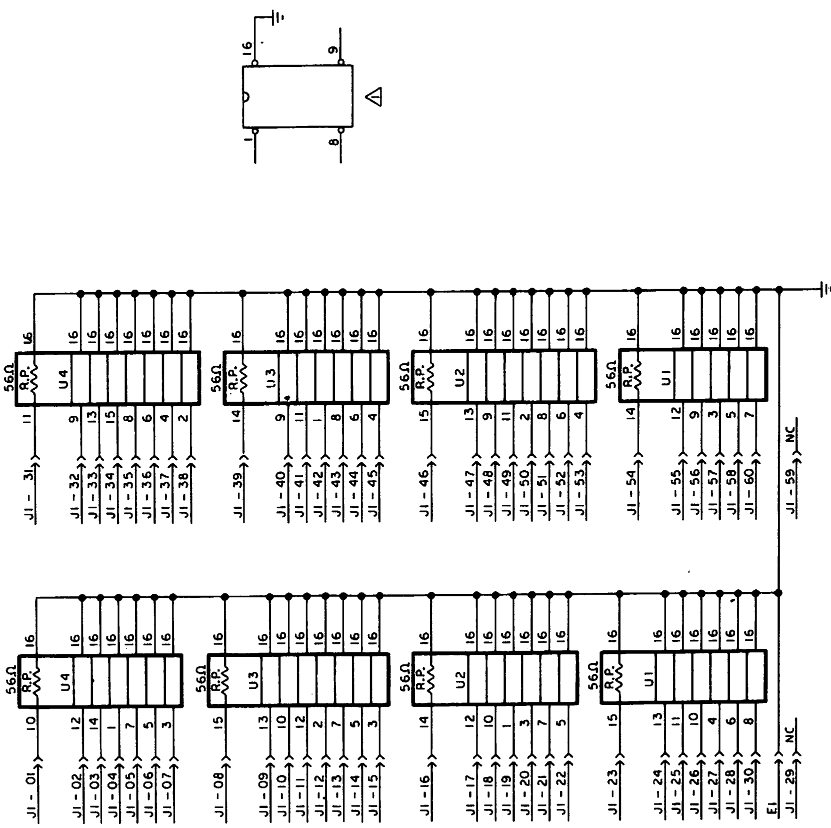
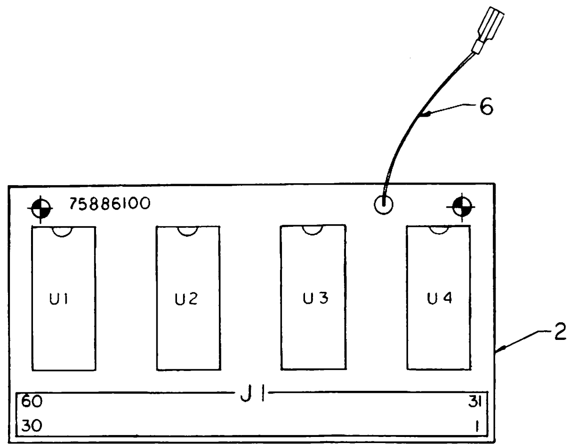



FIGURE 5-14. TERMINATOR CIRCUIT BOARD (SHEET 1 OF 2)

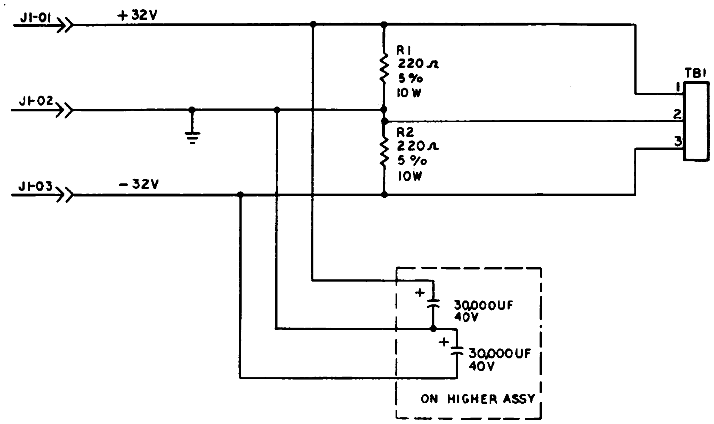


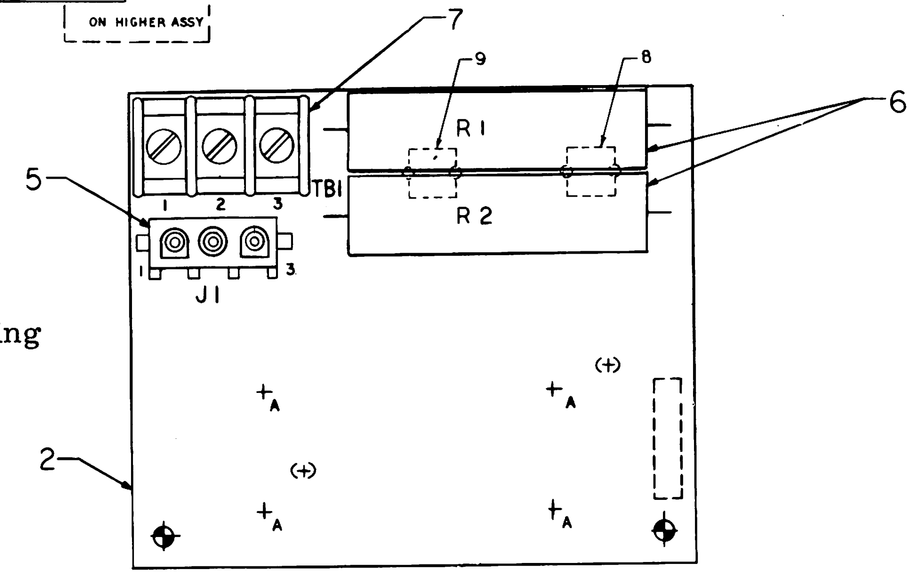

| IC | PL ITEM |
|---|---|
| U1 | 8 |
| U2 | ↑ |
| U3 | ↓ |
| U4 | 8 |

| CONN | PL ITEM |
|---|---|
| J1 | 5 |

| Item No. | Drawing No. | Description | Remarks |
|---|---|---|---|
| | 75886100-9 | PWA Terminator | |
| 2 | 75886120-7 | PWB Terminator | |
| 5 | 75887431-7 | 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 Comp. Bd. 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 | 51830521 | Res 10 W 5% 220 | |
| 7 | 94792383 | Term Strip 3 Pos | |
| 8 | 95588405 | Fuse Clip | |
| 9 | 95588400 | Fuse Clip | |

FIGURE 5-15. COMPONENT BOARD (32V FILTER)

CROSS REF NO. 1401

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 | o | 1 | o | -20 V | 1501 | | | | |
| | | | | | | o | 2 | o | | | | | | |
| | | | | | | o | 3 | o | DIAG-HD-0 | * | P1-A3 | 0205 | | |
| | | | | | | o | 4 | o | DIAG-HD-1 | * | P1-A4 | 0205 | | |
| | | | | | | o | 5 | o | DIAG-HD-2 | * | P1-A5 | 20s | | |
| | | | | GND | 1501 | o | 6 | o | GND | 1501 | | | | |
| | | | | | | o | 7 | o | DIAG-HD-4 | * | P1-A7 | 0205 | | |
| | | | | | | o | 8 | o | DIAG-LATE-STROBE/+L | * | P1-A8 | 0204 | | |
| | | | | | | o | 9 | o | DIAG-ERLY-STROBE/+L | * | P1-A9 | 0204 | | |
| | | P1-A10 | 02* | DIAG-AC-WRTCUR/ | * | o | 10 | o | DIAG-F.G.-MON/+L | * | P1-A10 | 0306 | | |
| | | P1-A11 | 0204 | DIAG-RD-GATE | * | o | 11 | o | DIAG-ACT-I-MON/+L | * | P1-A11 | 0306 | | |
| | | P1-A12 | 0204 | DIAG-WRT-GATE | * | o | 12 | o | DIAG-DR-MON/+L | * | P1-A12 | 0306 | | |
| P1-B13 | 0603, | P1-B13 | 150* | I-SPE | * | o | 13 | o | I-SPE/+L | * | P1-A13 | 150* | P1-A13 | 0306 |
| P1-B14 | 0603, | P1-B14 | 150* | SPE | * | o | 14 | o | SPE/+L | * | P1-A14 | 150* | P1-A14 | 0306 |
| | | | | | | o | 15 | o | DIAG-ENABLE/+L | * | P1-A15 | 0204 | | |
| | | P1-B16 | 0702 | DIAG-RD-AGC | * | o | 16 | o | | | | | | |
| | | | | | | o | 17 | o | DIAG-AM-EN | * | P1-A17 | 0205 | | |
| | | | | | | o | 18 | o | | | | | | |
| | | | | | | o | 19 | o | | | | | | |
| | | | | | | o | 20 | o | | | | | | |
| | | | | | | o | 21 | o | | | | | | |
| | | | | | | o | 22 | o | HD-ALIGN-WP/-L | 1501 | P1-A21 | 0206 | | |
| | | | | GND | 1501 | o | 23 | o | GND | 1501 | | | | |
| | | | | | | o | 24 | o | | | | | | |
| | | | | | | o | 25 | o | | | | | | |
| | | | | | | o | 26 | o | | | | | | |
| | | | | | | o | 27 | o | | | | | | |
| | | | | | | o | 28 | o | | | P1-A28 | 0204 | | |
| | | | | | | o | 29 | o | | | P1-A29 | 0204 | | |
| | | | | | | o | 30 | o | DIAG-WRT-CLK | * | P1-A30 | 0204 | | |
| | | | | | | o | 31 | o | DIAG-WRT-CLK-GND | * | P1-A31 | 0204 | | |
| | | | | | | o | 32 | o | | | P1-A32 | 0204 | | |
| | | | | | | o | 33 | o | | | P1-A33 | 0204 | | |
| | | | | | | o | 34 | o | DIAG-RD-CLK | * | P1-A34 | 0204 | | |
| | | | | | | o | 35 | o | DIAG-RD-CLK-GND | * | P1-A35 | 0204 | | |
| | | | | | | o | 36 | o | | | | | | |
| | | | | | | o | 37 | o | | | | | | |
| | | | | | | o | 38 | o | AM-FOUND/+L | * | P1-A38 | 0205 | | |
| | | | | GND | 1501 | o | 39 | o | GND | 1501 | | | | |
| | | P1-B40 | 0606 | INDEX/-L | * | o | 40 | o | INDEX/-L | * | P1-A40 | 0104 | | |
| | | | | | | o | 41 | o | | | | | | |
| | | | | | | o | 42 | o | | | | | | |
| | | | | | | o | 43 | o | | | | | | |
| | | | | +5 V | 1501 | o | 44 | o | +5 V | 1501 | | | | |
| | | | | +20 V | 1501 | o | 45 | o | +20 V | 1501 | | | | |

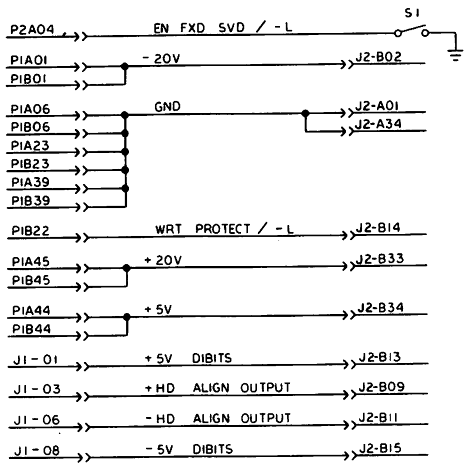
EM4-P2

| SOURCE/DEST | X-REF | SIGNAL | X-REF. | A | PIN | B | SIGNAL | X-REF. | SOURCE/DEST | XREF |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | o | 1 | o | | | | |
| | | | | o | 2 | o | | | | |
| | | | | o | 3 | o | | | | |
| P2-B04 | 0606 | EN-FXD-SVO/-L | 1501 | o | 4 | o | I/O WRT/-L | * | P2-A04 | 0302 |
| | | | | o | 5 | o | I/O RD/-L | * | P2-A05 | 0302 |
| | | | | o | 6 | o | | | | |
| | | | | o | 7 | o | MADR-0/+L | * | P2-A07 | 0302 |
| | | | | o | 8 | o | MADR-1/+L | * | P2-A08 | 0302 |
| P2-B09 | 0603 | PLO-LOCKED/-L | * | o | 9 | o | MADR-2/+L | * | P2-A09 | 0302 |
| | | | | o | 10 | o | MADR-3/+L | * | P2-A10 | 0302 |
| | | | | o | 11 | o | MADR-4/+L | * | P2-A11 | 0302 |
| | | | | o | 12 | o | MADR-5/+L | * | P2-A12 | 0302 |
| | | | | o | 13 | o | MADR-6/+L | * | P2-A13 | 0302 |
| | | | | o | 14 | o | MADR-7/+L | * | P2-A14 | 0302 |
| | | | | o | 15 | o | MADR-8/+L | * | P2-A15 | 0302 |
| | | | | o | 16 | o | MADR-9/+L | * | P2-A16 | 0302 |
| | | | | o | 17 | o | MADR-A/+L | * | P2-A17 | 0302 |
| | | | | o | 18 | o | MADR-B/+L | * | P2-A18 | 0302 |
| | | | | o | 19 | o | MADR-C/+L | * | P2-A19 | 0302 |
| | | | | o | 20 | o | MADR-D/+L | * | P2-A20 | 0302 |
| | | | | o | 21 | o | MADR-E/+L | * | P2-A21 | 0302 |
| | | | | o | 22 | o | MADR-F/+L | * | P2-A22 | 0302 |
| | | | | o | 23 | o | | | | |
| | | | | o | 24 | o | DB0/+L | * | P2-A24 | 0302 |
| P2-B25 | 0901 | DIAG-RD-PLO-LOCK/+L | * | o | 25 | o | DB1/+L | * | P2-A25 | 0302 |
| | | | | o | 26 | o | DB2/+L | * | P2-A26 | 0302 |
| | | | | o | 27 | o | DB3/+L | * | P2-A27 | 0302 |
| | | | | o | 28 | o | DB4/+L | * | P2-A28 | 0302 |
| | | | | o | 29 | o | DB5/+L | * | P2-A29 | 0302 |
| | | | | o | 30 | o | | | | |
| | | | | o | 31 | o | DB6/+L | * | P2-A31 | 0302 |
| | | | | o | 32 | o | DB7/+L | * | P2-A32 | 0302 |
| | | | | o | 33 | o | MEM-WRT/-L | * | P2-A33 | 0302 |
| | | | | o | 34 | o | MEM-RD/-L | * | P2-A34 | 0302 |
| | | | | o | 35 | o | EXT-INT-1/-L | * | P2-A35 | 0303 |
| | | | | o | 36 | o | GND | 1501 | P2-A36 | 0301 |
| | | | | o | 37 | o | | | | |
| | | | | o | 38 | o | | | | |
| | | | | o | 39 | o | | | | |
| | | | | o | 40 | o | | | | |
| | | | | o | 41 | o | | | | |
| | | | | o | 42 | o | | | | |
| | | | | o | 43 | o | | | | |
| | | | | o | 44 | o | | | | |
| | | | | o | 45 | o | | | | |

* WIRED TO, BUT NOT USED ON PWA

XX218

FIGURE 5-16. DIAGNOSTIC/HD ALIGNMENT CKT BOARD (SHEET 1 OF 4)

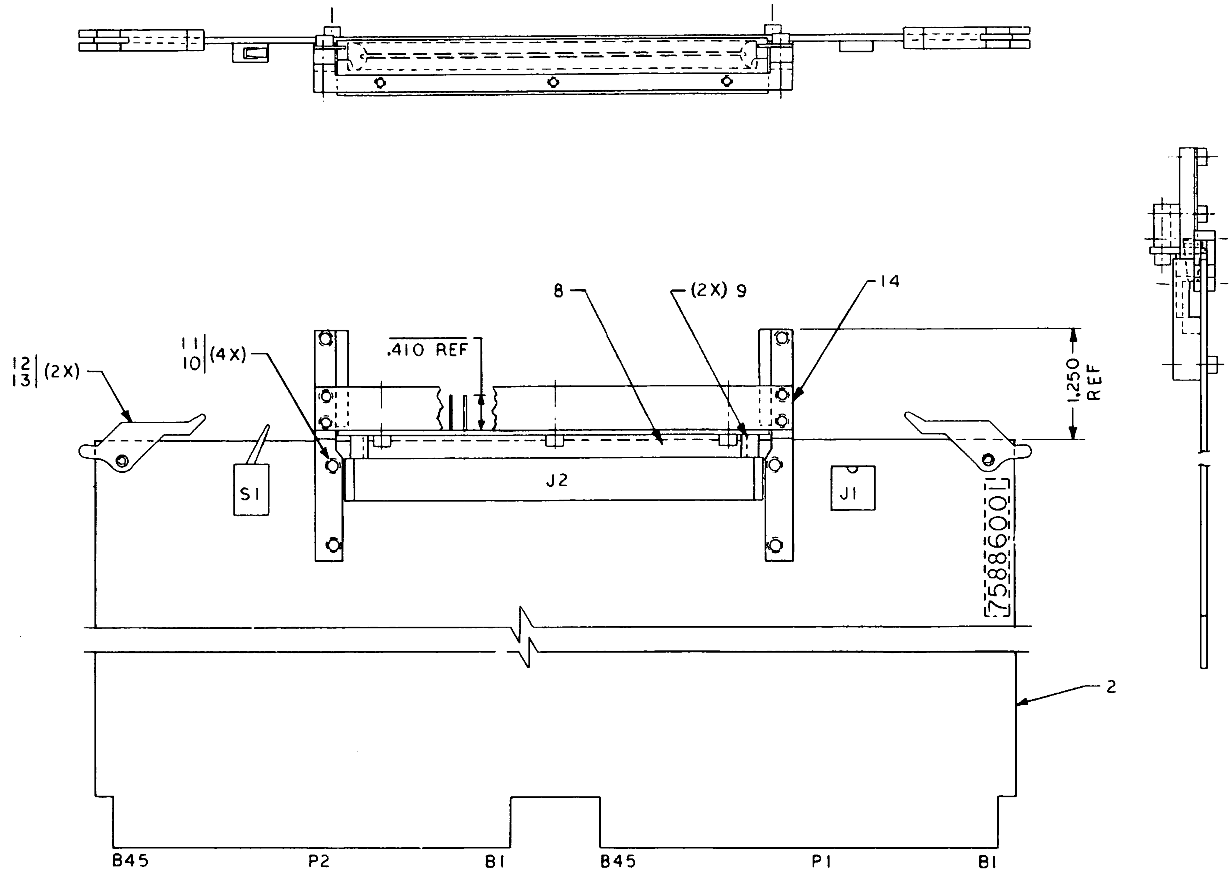



DIAG/Hd ALIGN CKT BD

| 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)



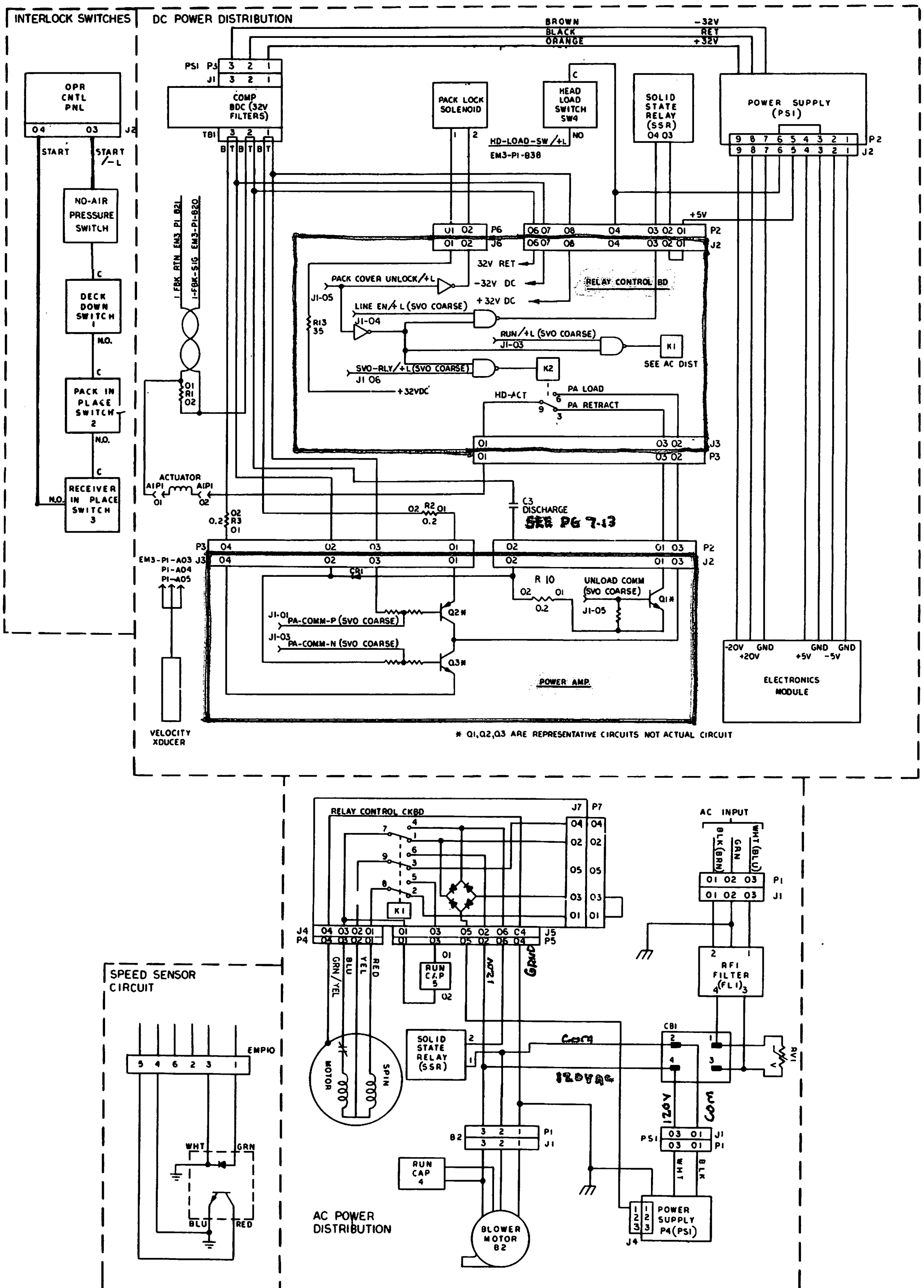

| CONN | PL ITEM |
|---|---|
| J1 | 6 |
| J2 | 5 |

| SW | PL ITEM |
|---|---|
| S1 | 7 |
| | |

FIGURE 5-16. DIAGNOSTIC/HEAD ALIGNMENT C.B. (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 62SOCK | |
| 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 | |

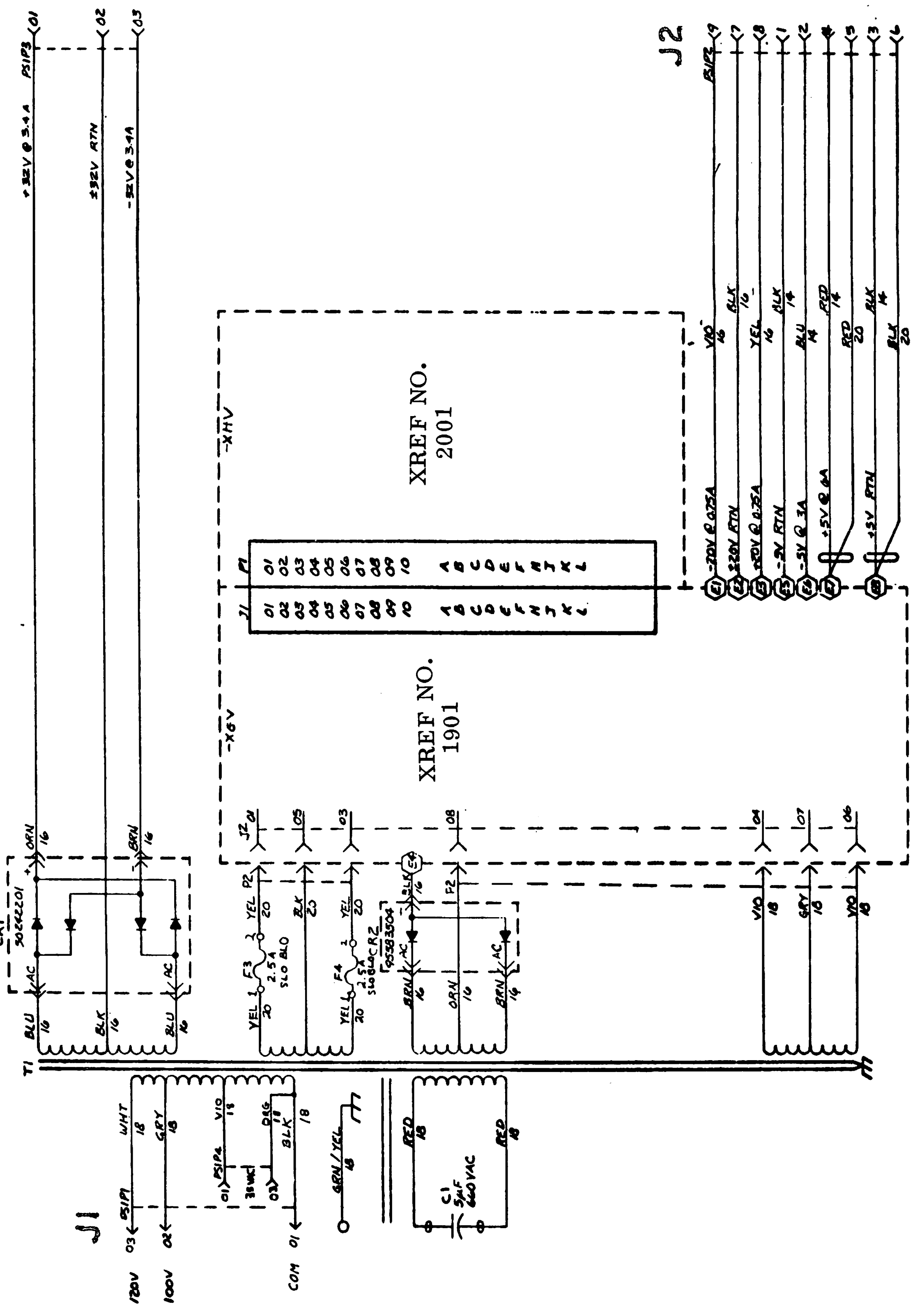
FIGURE 5-16. DIAGNOSTIC/HEAD ALIGNMENT C.B. (SHEET 4 OF 4)




NOTES: 1. THIS HOOK UP IS FOR 120V 60 HZ POWER.
2. RELAY K1 SHOWN IN DE-ENERGIZED POSITION.

CROSS REF NO. 1601

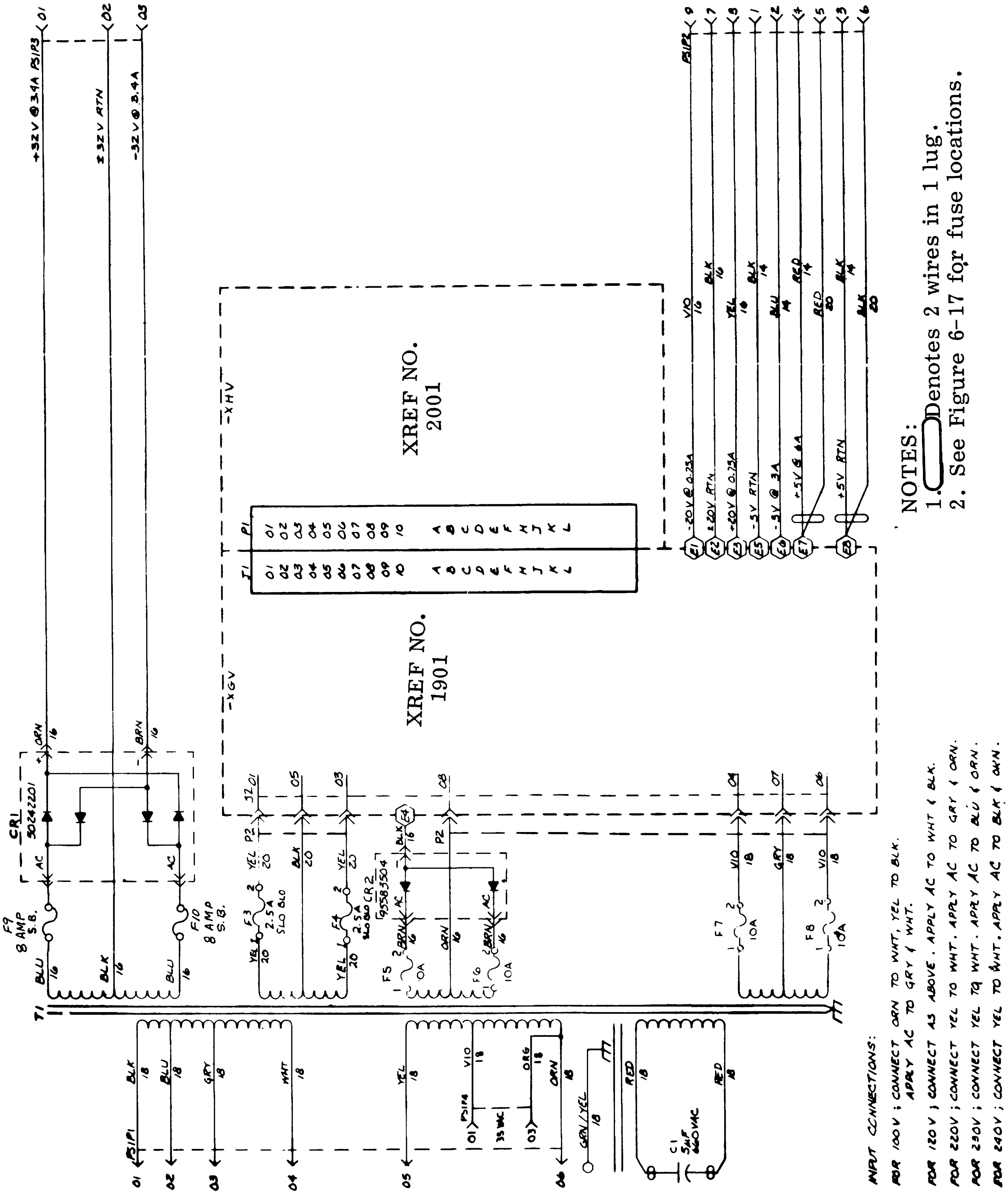
FIGURE 5-17. AC POWER AND DC POWER DISTR. INTERLOCK SWITCHES AND SPEED SENSOR CKT DIAGRAM




NOTES: 1. ⬭ Denotes two wires in one lug.
2. See Figure 6-17 for fuse locations.

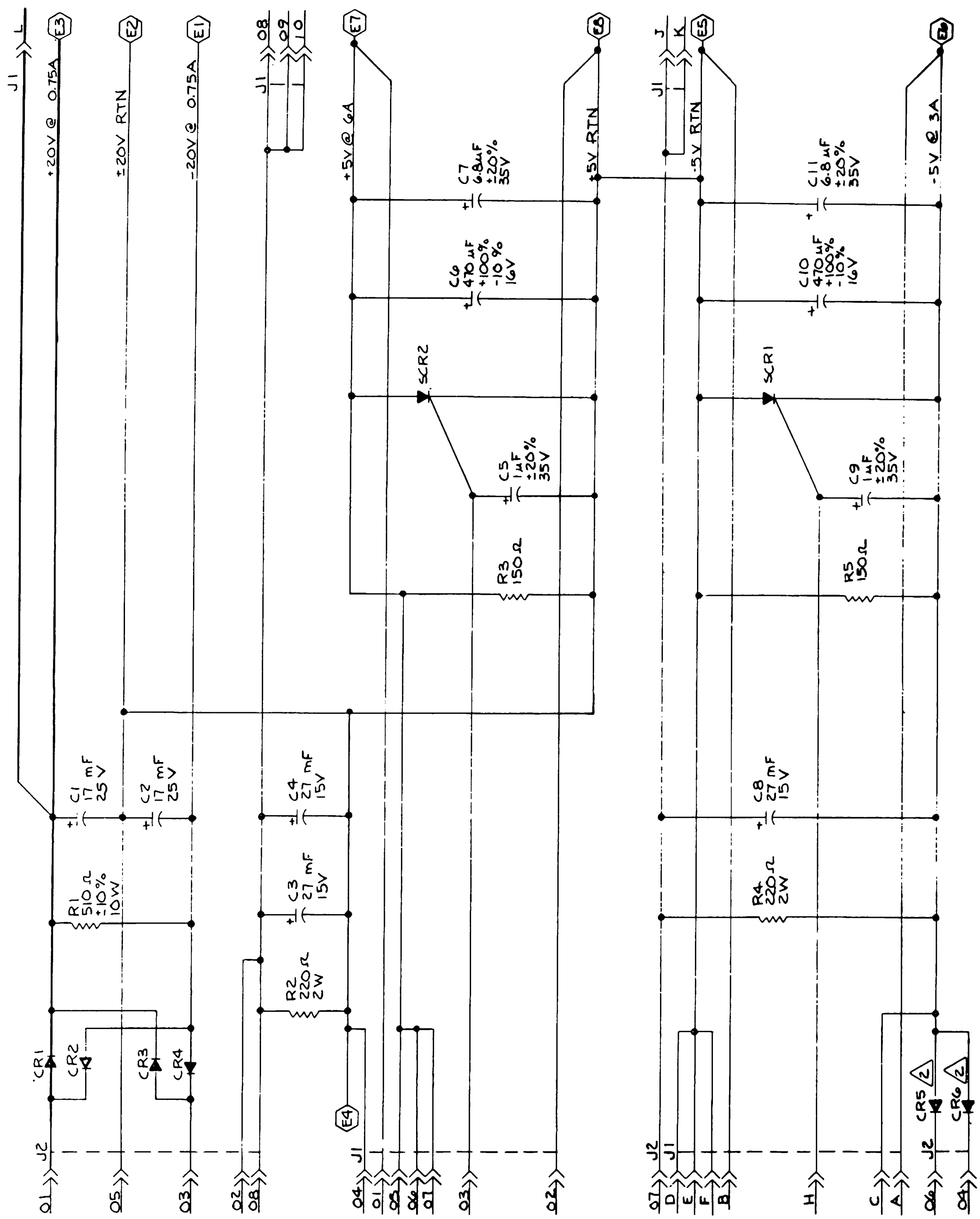
CROSS REF
NO. 1701

FIGURE 5-18. POWER SUPPLY WIRING DIAGRAM (60 Hz)




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.

CROSS REF NO. 1901

FIGURE 5-20. POWER SUPPLY MOTHER BOARD (SHEET 1 OF 3)

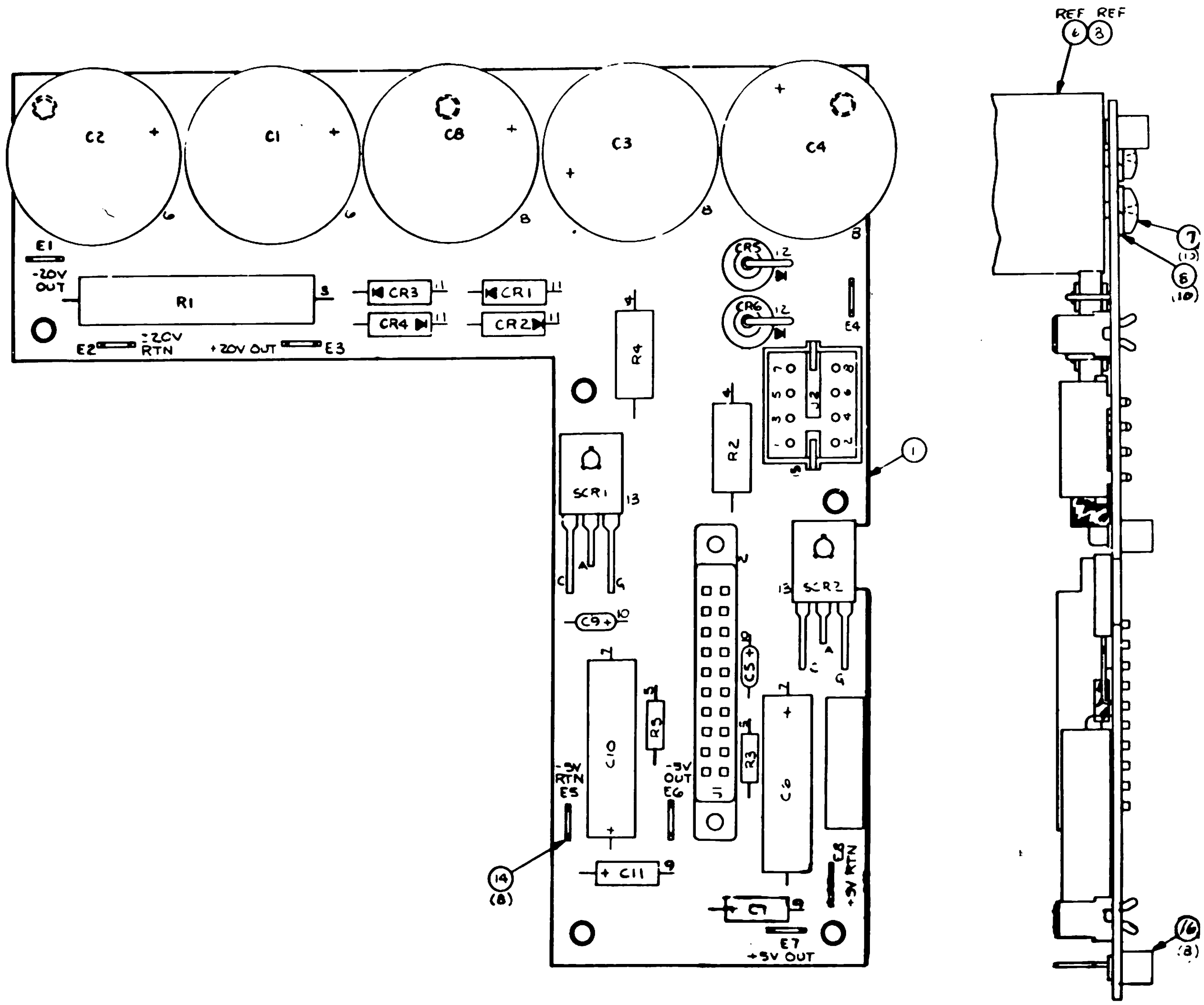
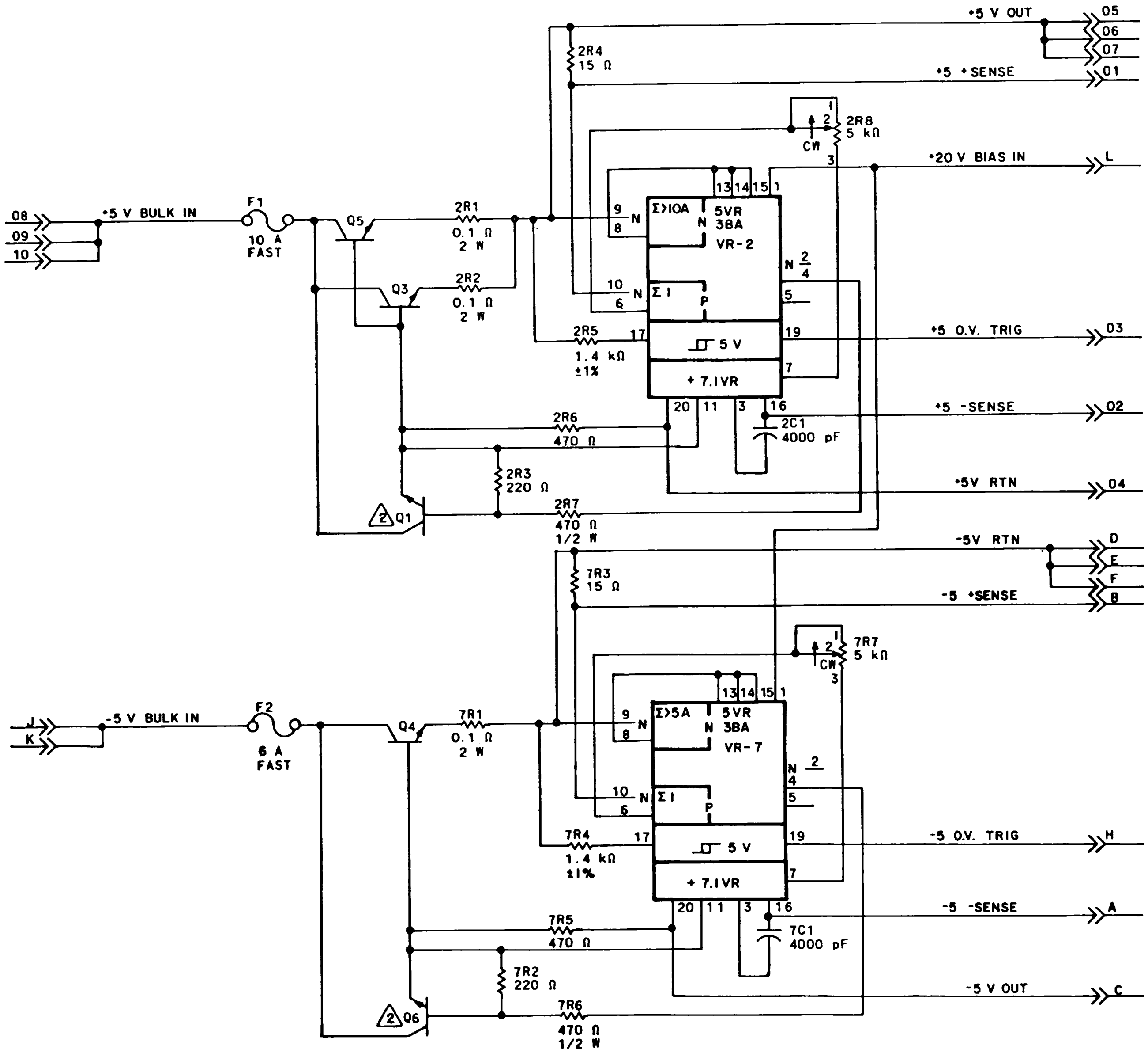



FIGURE 5-20. POWER SUPPLY MOTHER BOARD (SHEET 2 OF 3)

CROSS REF
NO. 1901

| 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 10W 510 Ohms | |
| 4 | 92512571-8 | Resistor 2W 220 Ohms | |
| 5 | 92512809-2 | Res 1/2W 150 Ohm | |
| 6 | 95642426-1 | Cap, Electro 30 V DC | |
| 7 | 92427153-9 | Cap, Electro 470 uF 16 V | |
| 8 | 95661328-5 | Cap 18 V DC 27,000 uF | |
| 9 | 92427039-0 | Cap Electro 6.8MF 35V | |
| 10 | 92427023-4 | Cap Electro 1uF 35V | |
| 11 | 95588200-6 | Rect Sil 3 Amp 100 V | |
| 12 | 95575000-5 | Rectifier-Silicon, Hi-Current | |
| 13 | 94825900-7 | Rectifier, Silicon Controlled | |
| 14 | 95524700-2 | Terminal .250 Quick Connect | |
| 15 | 95882801-4 | Pin Header Assy (Double Row) | |
| 16 | 94363101-0 | Standoff-Threaded Swage | |
| 17 | 93234236-3 | Scr, Mach Pan Hd PH-10-32X5/16 | |
| 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 ±107.
3. All Transistors, NPN, 95689901.

FIGURE 5-21. REGULATOR BOARD (SHEET 1 OF 3)

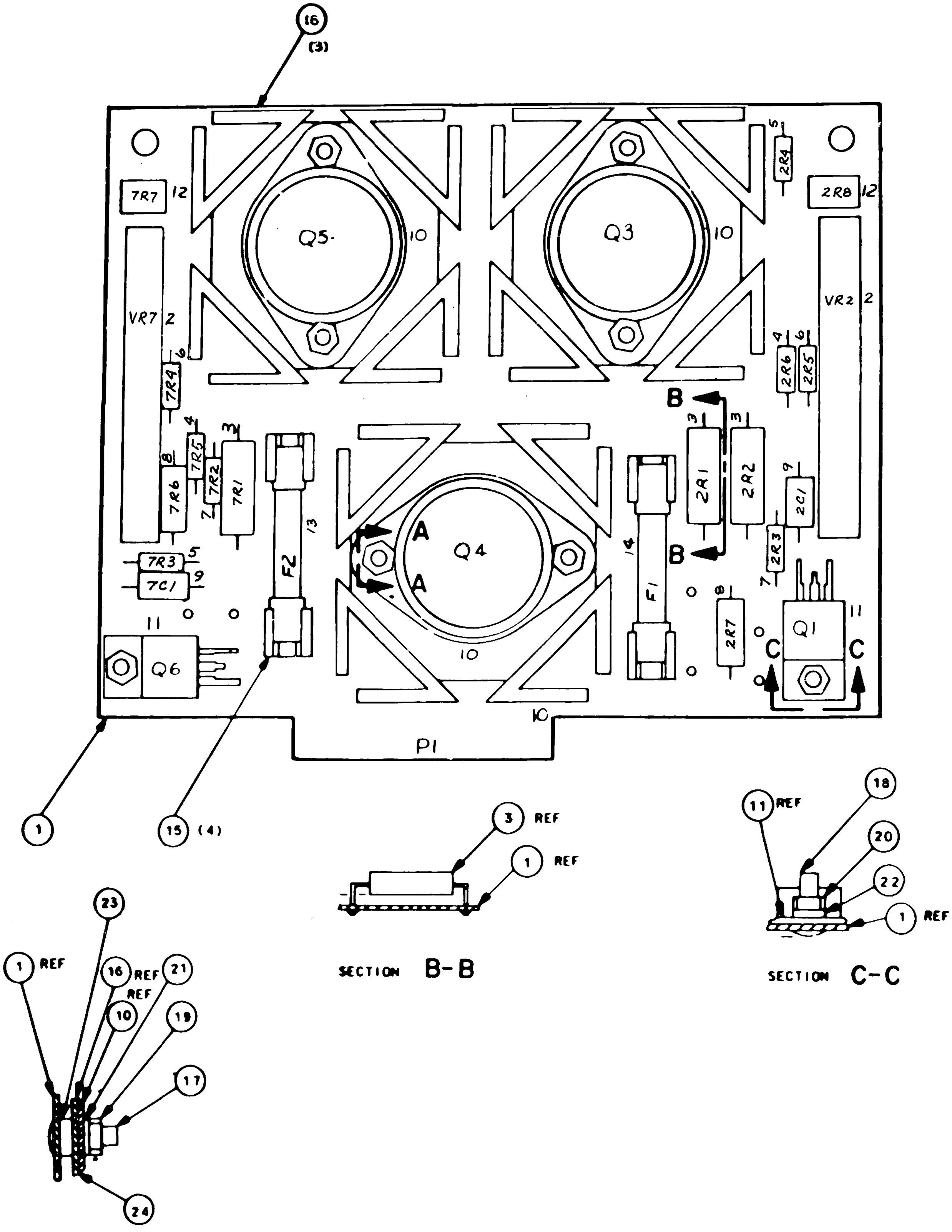



FIGURE 5-21. REGULATOR BOARD (SHEET 2 OF 3)

| 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 2W 0.10 Ohms | |
| 4 | 92512157-6 | Resistor 1/4W 470 Ohms | |
| 5 | 92512242-6 | Resistor 1/4W 15 Ohms | |
| 6 | 94360314-2 | Res 1400 Ohms | |
| 7 | 92512155-0 | Resistor 1/4W 220 Ohms | |
| 8 | 92512817-5 | Res 1/2W 470 Ohm | |
| 9 | 92496369-7 | Cap Non-Electro 4000pF 80 V | |
| 10 | 94791000-6 | Tstr Sil NPN 150W 40 V 2N3771 | |
| 11 | 95689901-7 | Transistor 7 Amp | |
| 12 | 94391208-9 | Potentiometer, Cermet, Trimmer | |
| 13 | 93418334-4 | Fuse 1/4X1 1/4 Glass 6A | |
| 14 | 93418239-5 | Fuse 1/4X/ 1/4 Glass 10A | |
| 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)

## 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)*

| 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 2-4 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. |
| 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 cuasing 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. |

*, ** See end of Table

CAUTION

Do not connect or disconnect I/O Cables when power is on the unit.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE) (CONTINUED)

| 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 (Bite 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. |
| POWER SEQUENCE PICK<br>POWER SEQUENCE 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. |

$\left.\begin{array}{r}*\\ **\\ ***\end{array}\right\}$ See end of Table.

TABLE 5-3. INPUT/OUTPUT LINES (OEM INTERFACE) (CONTINUED)

| SIGNAL | FUNCTION |
|---|---|
| | "A" CABLE SIGNALS FROM THE CMD TO THE CONTROLLER* |
| 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. |
| | "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. |
| | "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 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. |

* See Figure 3-7 for interface cabling diagram.

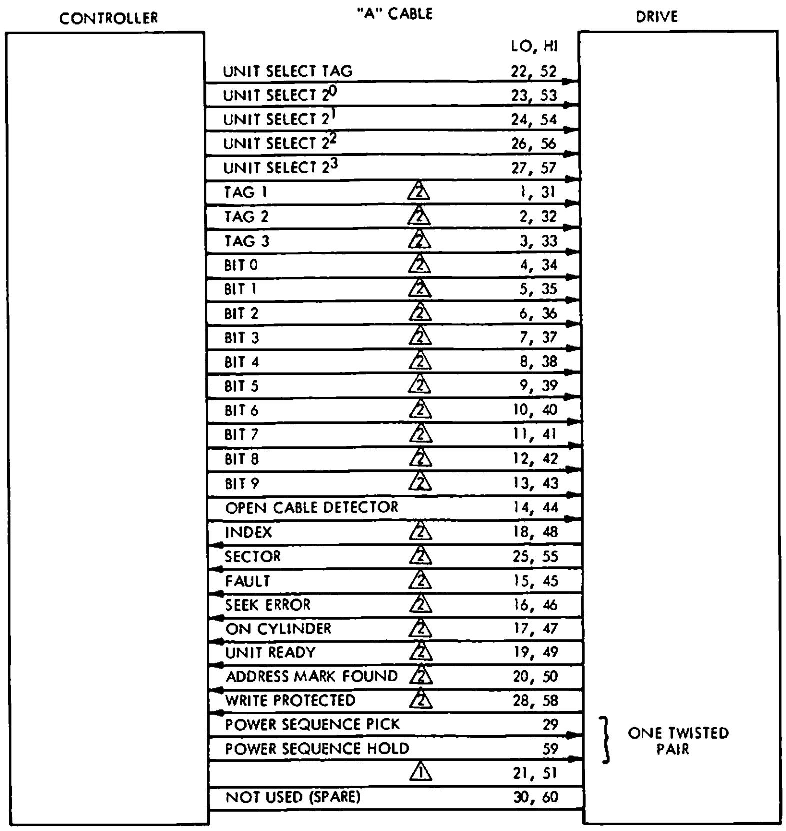
** Both Index and Sector pulses are inhibited during selection of a data head on the other volume until the first index detected after initiation of a seek, and during an RTZ.

*** 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.



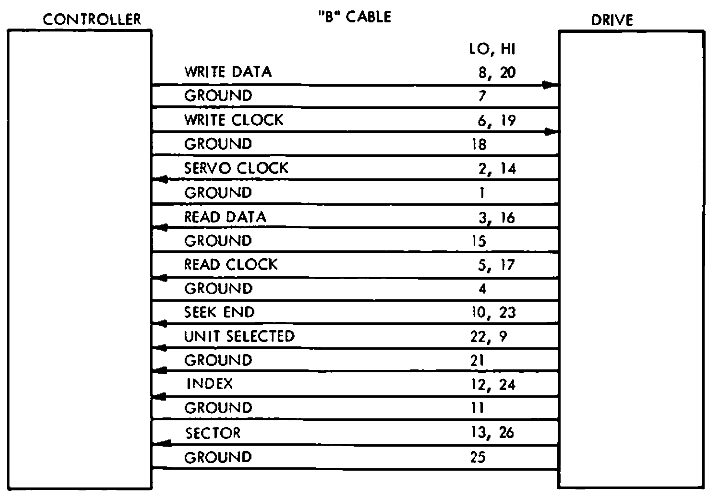

NOTE: 60 POSITION
28 AWG, 30 PAIR, TWISTED-STRAIGHT FLAT CABLE
MAXIMUM LENGTH - 100 FT

⚠1 RESERVED

⚠2 GATED BY UNIT SELECTED

XX020a

FIGURE 5.7-1. TAG BUS I/O INTERFACE, "A" CABLE

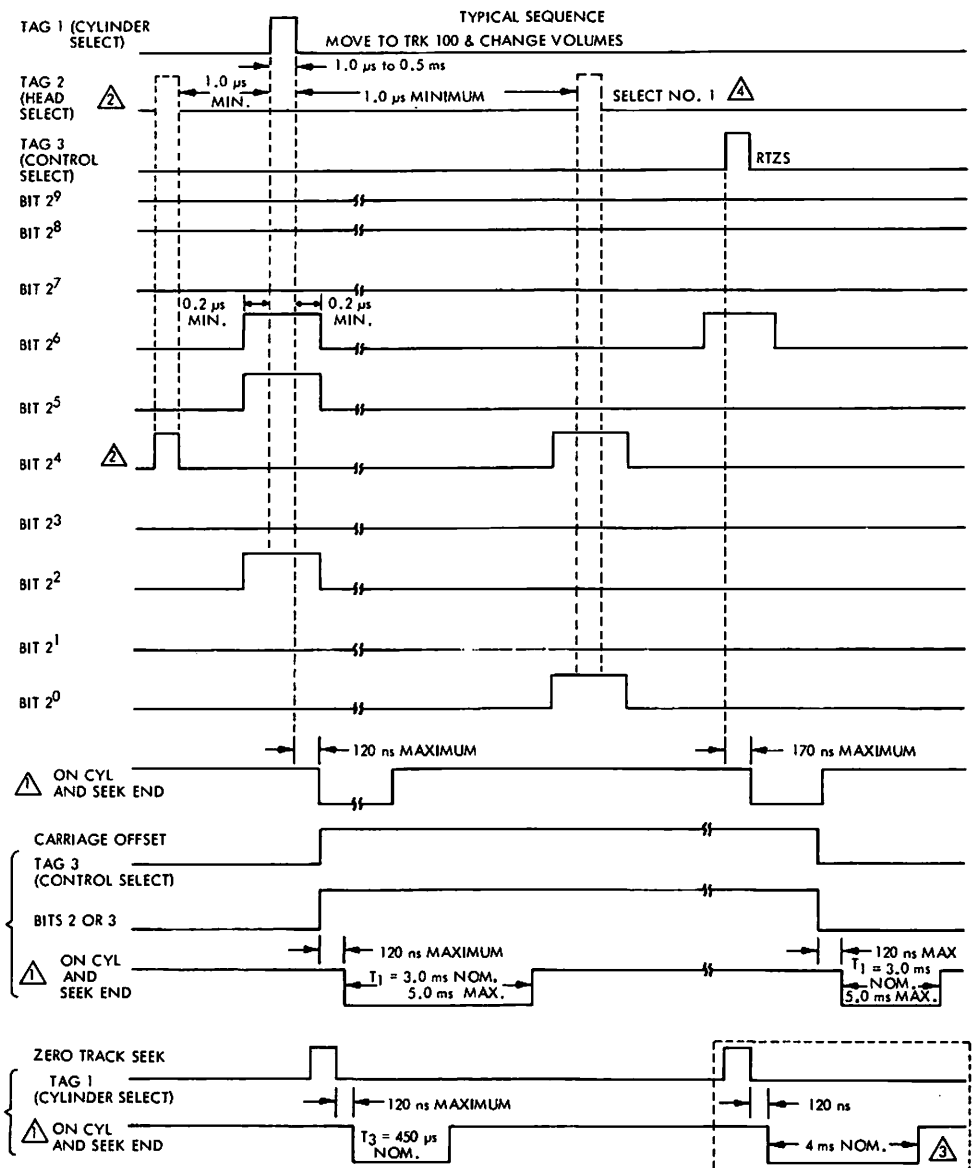



NOTES: 1. 26 CONDUCTOR FLAT CABLE. MAXIMUM LENGTH - 50 FT.

2. NO SIGNALS GATED BY UNIT SELECTED.

XX020b

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

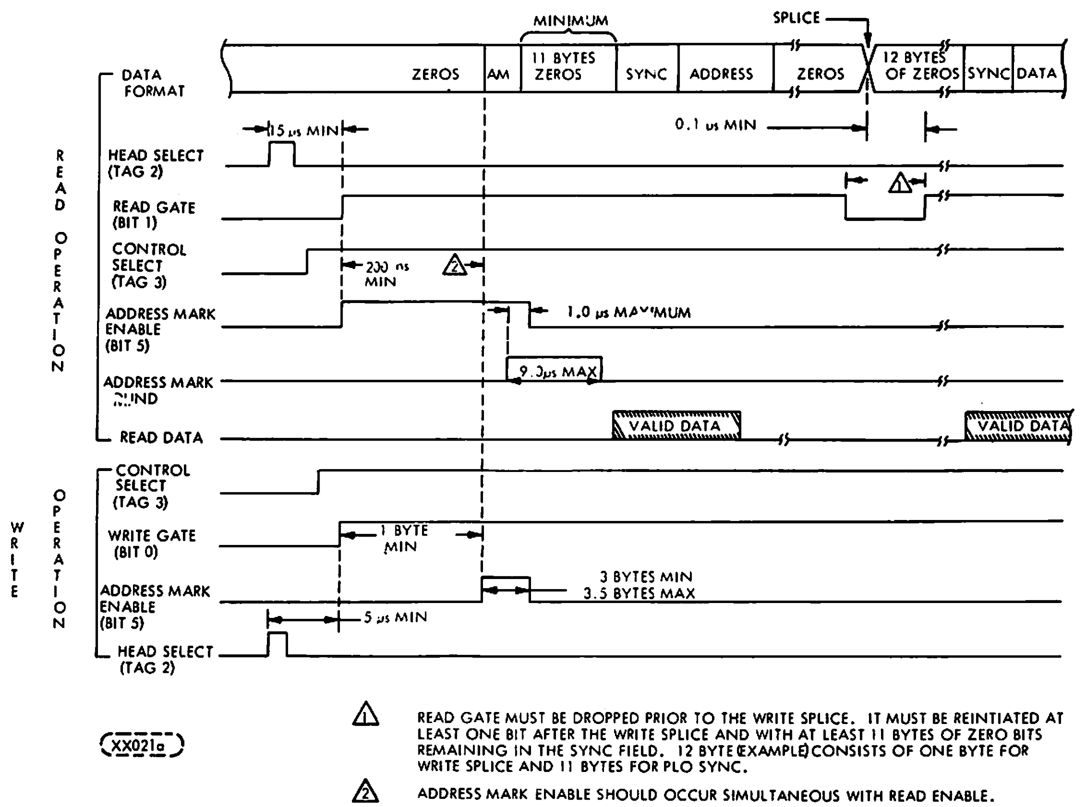



FIGURE 5.7-4. TYPICAL READ/WRITE TIMING WITH ADDRESS MARK

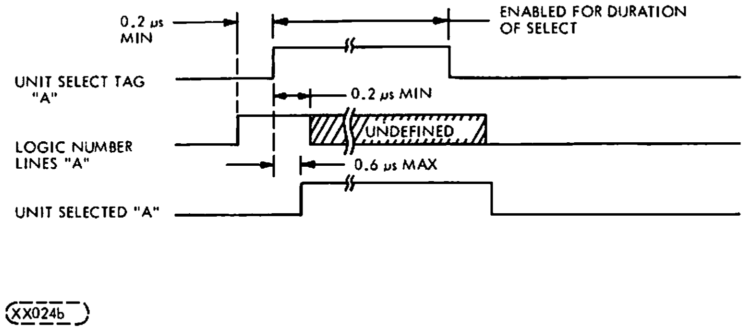



FIGURE 5.7-5. LOGIC NUMBER SELECT AND TIMING DIAGRAM

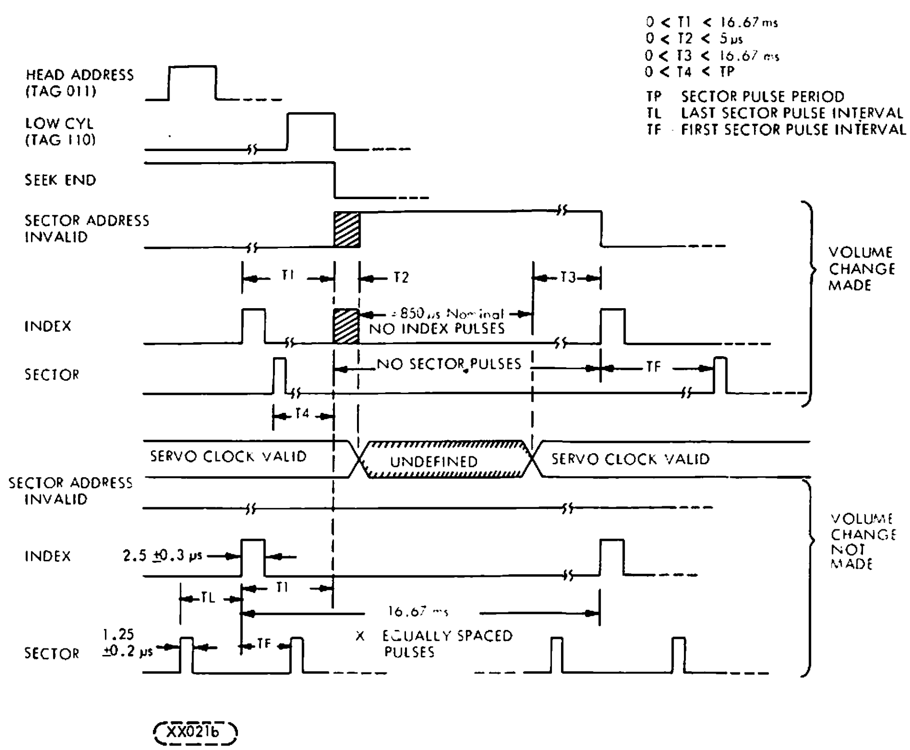



FIGURE 5.7-6. INDEX AND SECTOR DURING A SEEK

## 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 inury.

### 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 sucking 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 environmental contaminants.

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, ELECTRO-STATIC 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/reliabile 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 susceptable 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.

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 heads will crash 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 heads manually when spindle is not up to speed. It is recommended that the heads not be loaded manually though they are up to speed.

## 6.3 MAINTENANCE TOOLS

The special tools required to maintain the disk drive are listed in Table 6-1.

TABLE 6-1. MAINTENANCE TOOLS

| DESCRIPTION | PART NUMBER |
|---|---|
| Head Adjusting Tool | 75893963 |
| Model 1204-51 CE Disk Cartridge | 76204400*** |
| Bit, 1/4 Hex (For Head Alignment) | 87016700-04 |
| PWA Extender Board | 75882560 or 77643160 |
| Head Alignment Kit | 75899096** |
| Torque Driver Wrench | 77611696 |
| Jumper Connector* | 77612622 |
| Bit, 1/4 Hex (For Fixed Mod. Installation) | 87016703 |
| Bit, 1/4 Hex (For Fixed Mod. Installation) | 87016705 |

*Used to Jumper E1 to E2 on Servo Coarse PWA to Defeat Servo Amp.

**See Table 6-1a for Kit Parts List.

***This should not be used as a "scratch" disk for use in troubleshooting. A regular M1204 data disk Part No. 76204000 should be used. Use a disk that does not contain valuable data.

TABLE 6-1A.

| 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 Assy AZPV |
| 4 | 77612337 | Cable Asm 8 Pin 20 in |
| 5 | 75882394 | Hd Align Cable Assy |
| 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 |

## 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 the 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.

### 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 elctronics.

NOTE

For the correct way to install the plugs (PAP1, PAP2, PAP3) onto the power amp board refer to Figure 5-11.

I/O cables should absolutely NOT be removed or replaced when AC power is applied to the unit.

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 locations of the Printed Wiring Assemblies.

* 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.

TABLE 6-3. MAINTENANCE INDEX AND SCHEDULE

| PREVENTIVE MAINTENANCE | PARA. | SCHEDULE |
|---|---|---|
| Pre-Filter Removal and Replacement | 6.6.1 | 4* |
| Inspect Actuator Assembly (Disks in) | 6.6.2 | 4 |
| Check Power Supply Outputs | 6.6.4 | 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.** | |
| 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 Spindle and Fixed Disk Module Receiver Area | 6.7.8 | |
| Head Removal and Replacement (Read/Write 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 | |
| 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 Assembly | 6.7.24 | |
| 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 | |
| DC Voltage Measurements | 6.6.4 | |

*Maximum times. Preventive maintenance may be required more frequently depending on dust contamination level of operation area.

**When the NO-AIR option is present it will indicate need of filter replacement by not allowing the unit to power up.

## 6.6 PREVENTIVE MAINTENANCE

### 6.6.1 PREFILTER AND ABSOLUTE FILTER 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. 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) .
4. 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.
5. Reinstall the prefilter by reversing steps 1, 2 and 3.
6. Remove top cover and raise deck per procedure given in paragraph 6.7.
7. Refer to Figure 6-1. Remove filter fitting (9) from absolute filter by pressing on the fitting from the inside of the filter opening. 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 hold in the manifold. Lift the filter out of the unit. 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 during the course of repair, the filter should be purged prior to operation of the drive.

8. Remove power to the voice coil by disconnecting A1P1. With the deck still in the raised position, turn AC breaker (CB-1) "ON". Visually observe the START/STOP switch LED does not illuminate. (Interlock switch will prevent operation of the operator controls).
9. If the absolute filter is dated June 12, 1981, or later, and is opened at the time of installation, allow the blower to purge the filter for a minimum of five (5) minutes with the deck in the raised position.

   If the filter is undated or opened prior to installation, allow the blower to purge the filter for a minimum of twenty (20) minutes with the deck in the raised position.
10. Turn AC breaker "OFF", lower the deck, turn AC breaker "ON".
11. Depress the START switch, verify the spindle comes up to speed. Allow the unit to purge for a minimum of five (5) minutes with the spindle turning if the filter is dated June 12, 1981, or later, and was not opened prior to installation.
12. Depress the start switch to stop the spindle. When the spindle has stopped, turn AC breaker "OFF" and reconnect A1P1.
13. Restore drive to normal operating condition.

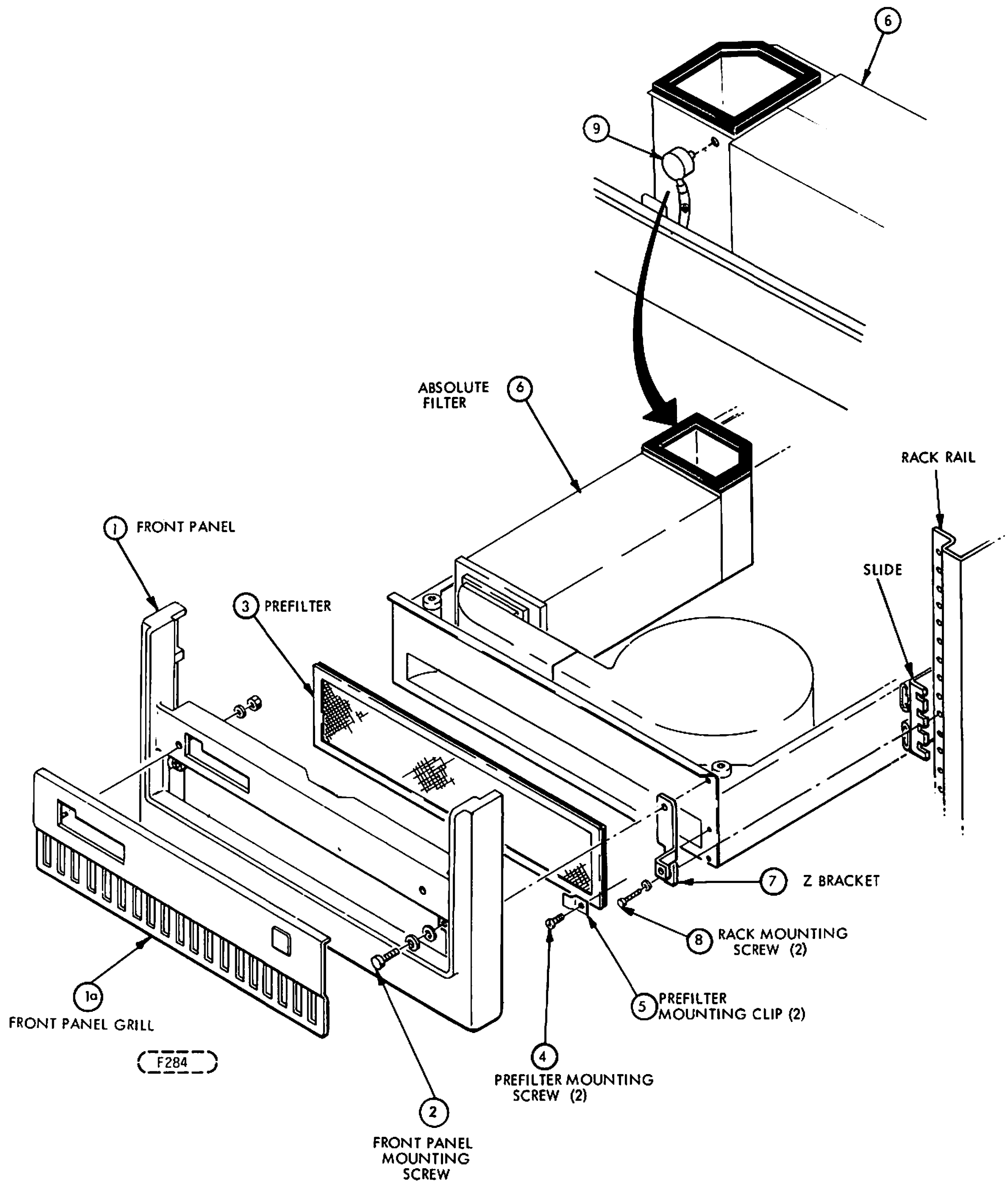
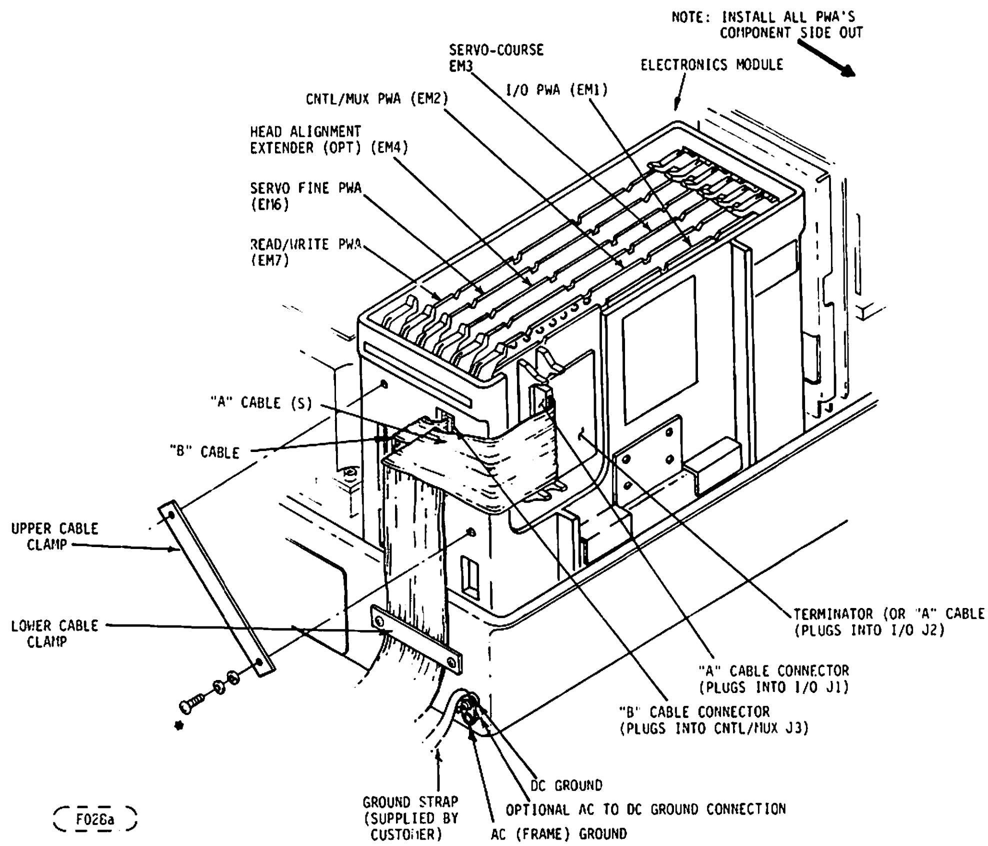



FIGURE 6-1. FILTER REMOVAL AND REPLACEMENT




* Protrusion beyond inner wall surface not to exceed 0.12 inches (3mm). Select proper length screw from accesssory carton.

FIGURE 6-1A. I/O CABLE INSTALLATION AND PWA NAMES/LOCATIONS

## 6.6.2 ACATUATOR 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.
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 rail 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 rail 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 RAILS AND BEARINGS WITH BOTH DISK MODULES REMOVED FROM THE DRIVE

To ensure that the carriage moves freely along the rails, it is essential that the rail and bearing and bearing plate surfaces be kept clean. Any obstruction to free movement of the carriage may cause cylinder address errors. This procedure assumes that both the disk cartridge and the fixed disk module have been removed from the spindle. This cleaning procedure is not to be done with the disks on the spindle. It is recommended that cleaning of the carriage rails and bearings be done whenever the fixed disk module is removed, or whenever the carriage is removed. However, when replacing the carriage the heads will not be on it, so the carriage can be moved back and forth along the rails as described in step 3 below. If there are no heads on the carriage the disk modules need not be removed.

1. Lift the electronics module and swing it out to the side.
2. Carefully and slowly push the coil forward to extend the heads.
3. Once head arms have cleared cams, 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 rails or bearings. Do not confuse pressure of flex leads and head leads with a sudden irregularity in motion. Pressure from leads is a smooth change.
4. 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 heads unloaded position (fully retracted).

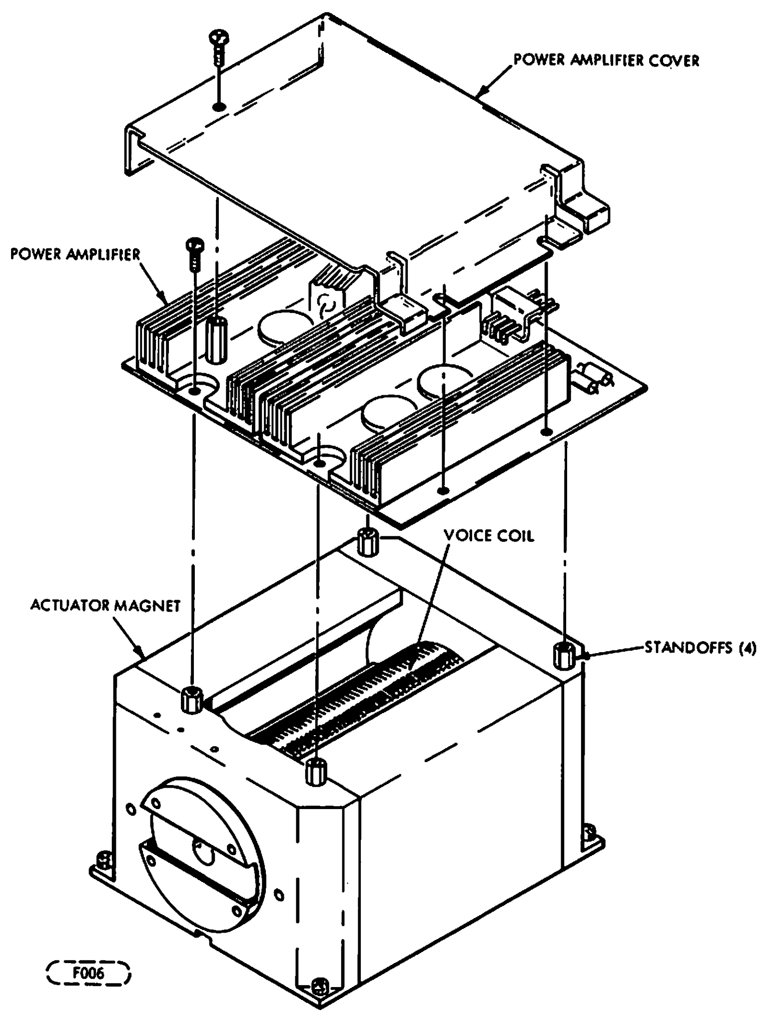



FIGURE 6-2. REMOVAL OF POWER AMPLIFIER FOR ACCESS TO VOICE COIL

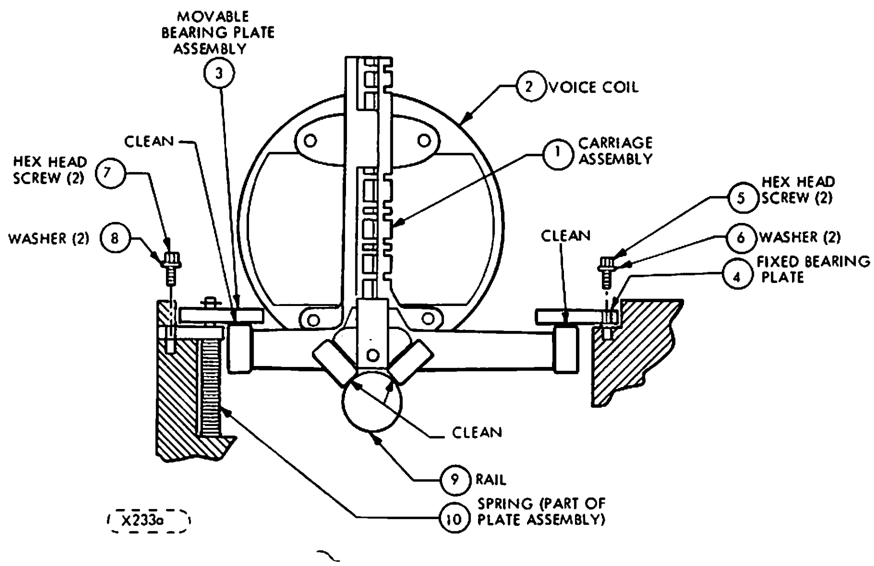



FIGURE 6-3. CARRIAGE RAILS AND BEARINGS

5. Using a clean dry cloth, clean rail, side bearing plate and bearing surfaces. Move carriage back and forth carefully to insure all surfaces are reached. See Figure 6-3.

CAUTION

Do not use media cleaning solution or alcohol when cleaning rails, side bearing plate, or bearing surfaces.

6. When rail, 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 rail and bearings using a strong light. Look for deterioration of rail or bearing surfaces. If no problems can be seen, remove the side bearing plates and inspect them for deterioration. Surface deterioration requires replacement of defective part.
7. Return carriage heads to unloaded position (fully retracted).
8. Install the head arms if they are not on the carriage. See Section 6.7.9 and 6.7.10. Align the heads per Section 6.8.5.4.
9. Replace Electronics Module into unit. Lower deck to normal position if it was raised to aid in the cleaning and inspection procedure.
10. Install new disk module, and disk cartridge if applicable see Section 6.7.6.
11. Replace top cover.
12. 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.

## 6.7 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 deterent to contaminants entering the unit. Operating the drive with the top cover removed during troubleshooting or adjustments is expected. The storing of or operation of the unit for extended lengths of time with the top cover removed may possibly 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 E 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. 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. 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.
6. Reinstall the two screws which secure the deck to the shock mounts.
7. 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.
8. Replace the front panel and secure it with the two screws removed in Step 3.
9. Replace the top cover per 6.7.1.
10. 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 stowage hole (Figure 3-2).

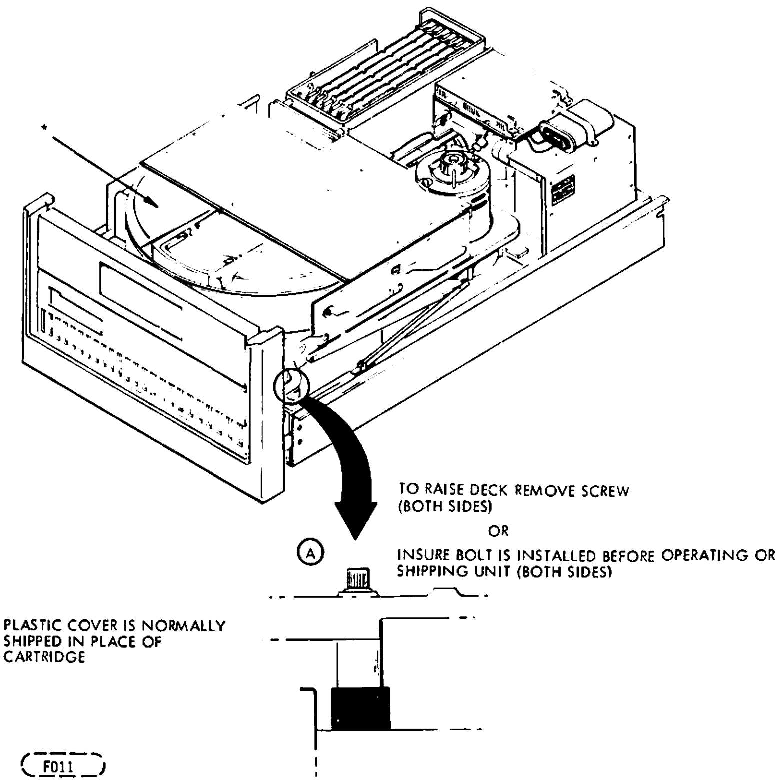



FIGURE 6-4. DECK HOLD DOWN BOLT LOCATION

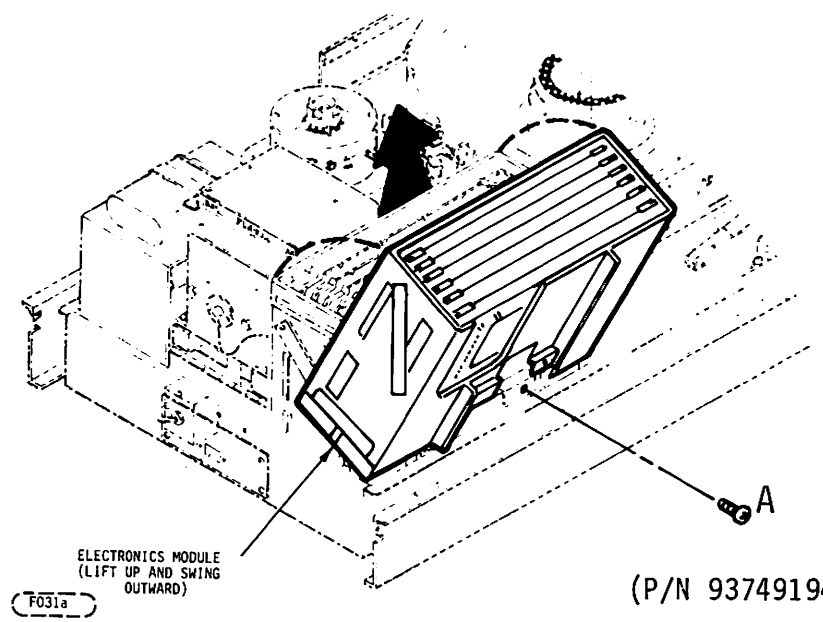
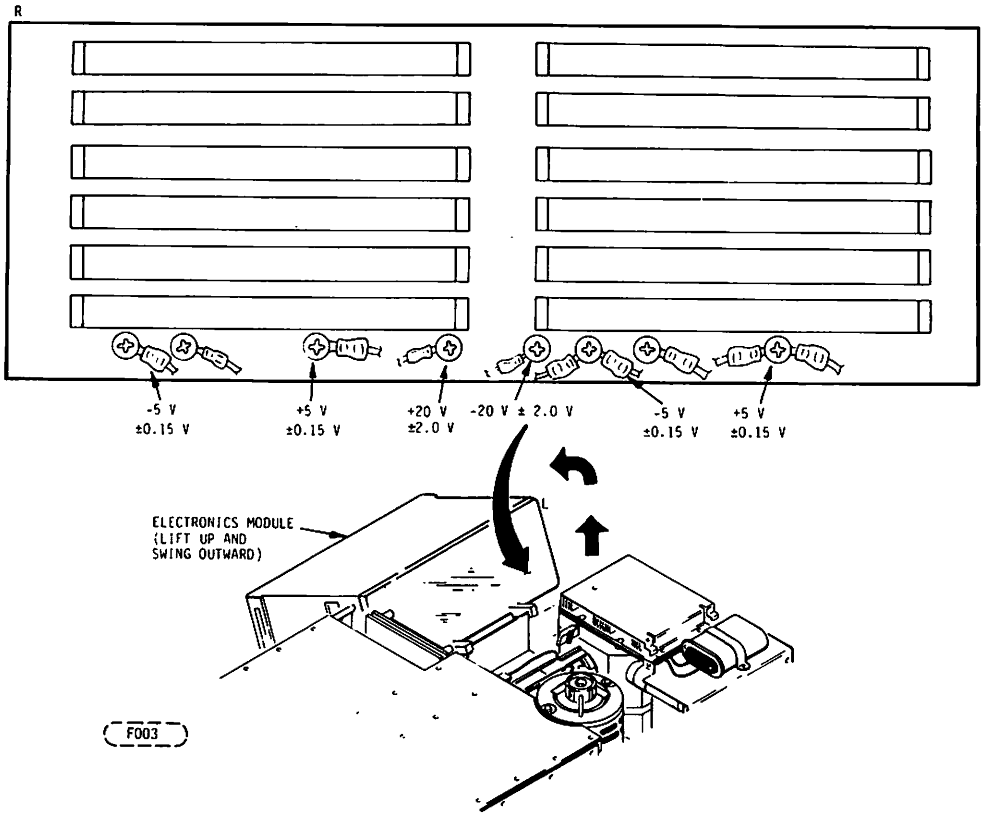
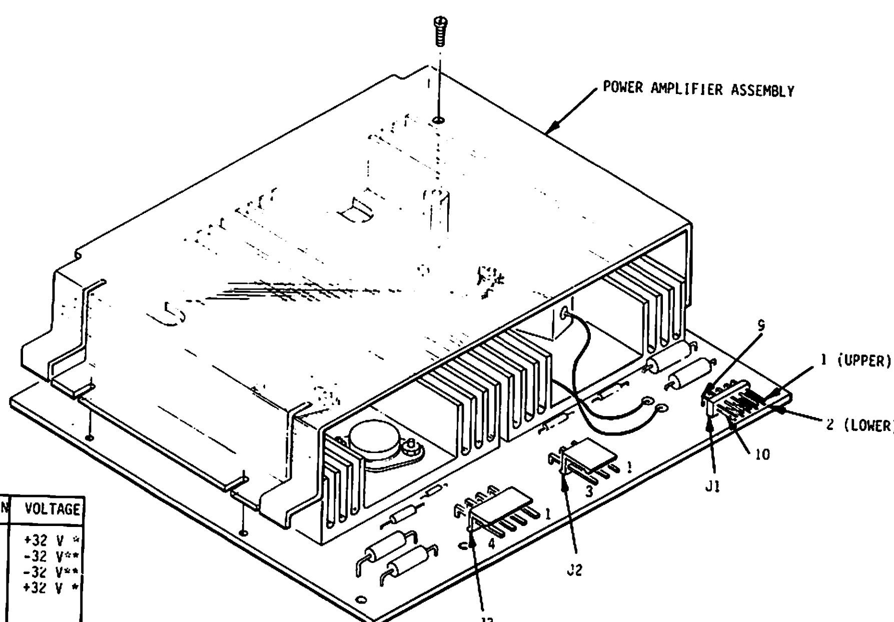



FIGURE 6-5. ACCESSING UNDERSIDE OF ELECTRONICS MODULE




| 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 Allen 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 (EMP10) 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 brakcet 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, EMP10) 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.

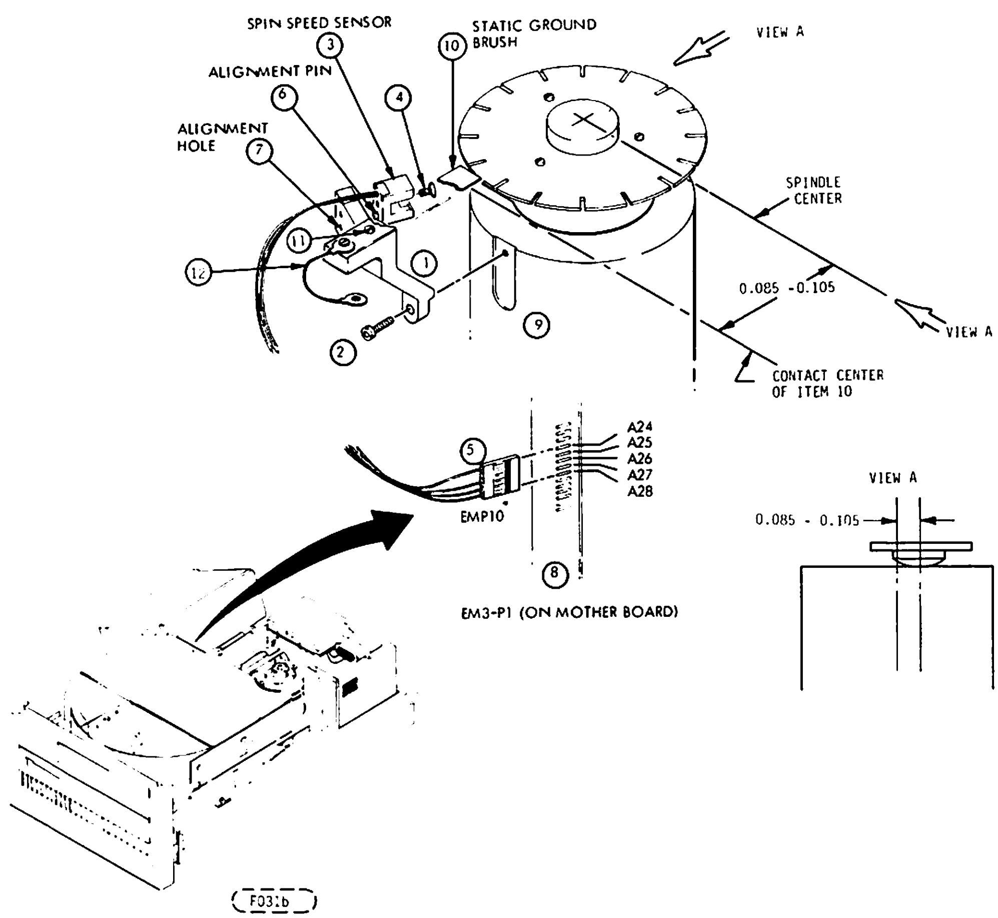



FIGURE 6-7. REMOVAL AND REPLACEMENT OF SPIN SPEED SENSOR ASSEMBLY

## 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) (0.31 in or 7.6 mm across hex flats).
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.
7. Disconnect the spring (R) from the cam lever (Q).
8. Loosen set screw (P).
9. Remove cam lever (Q) from shaft Assembly (T).
10. Disconnect S2 leads, thread leads through hole in cam lever plate (W).
11. Remove cam lever plate (W) and nylon washer (S) from shaft Assembly (T).

### 6.7.6.2 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 the nylon washer (S) onto the shaft.
3. Slide cam lever plate (W) onto shaft (T).
4. Thread S2 leads from the inside, through hole in cam lever plate (W) and reconnect to S2.
5. Slide cam lever (Q) onto shaft assembly (T) with set screw (P) positioned over flat of shaft (tighten screw to 12 ±1 lbf-in (1.32 ±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 cam lever plate (W) to eliminate any axial looseness of shaft assembly when the set screw is tightened.

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).

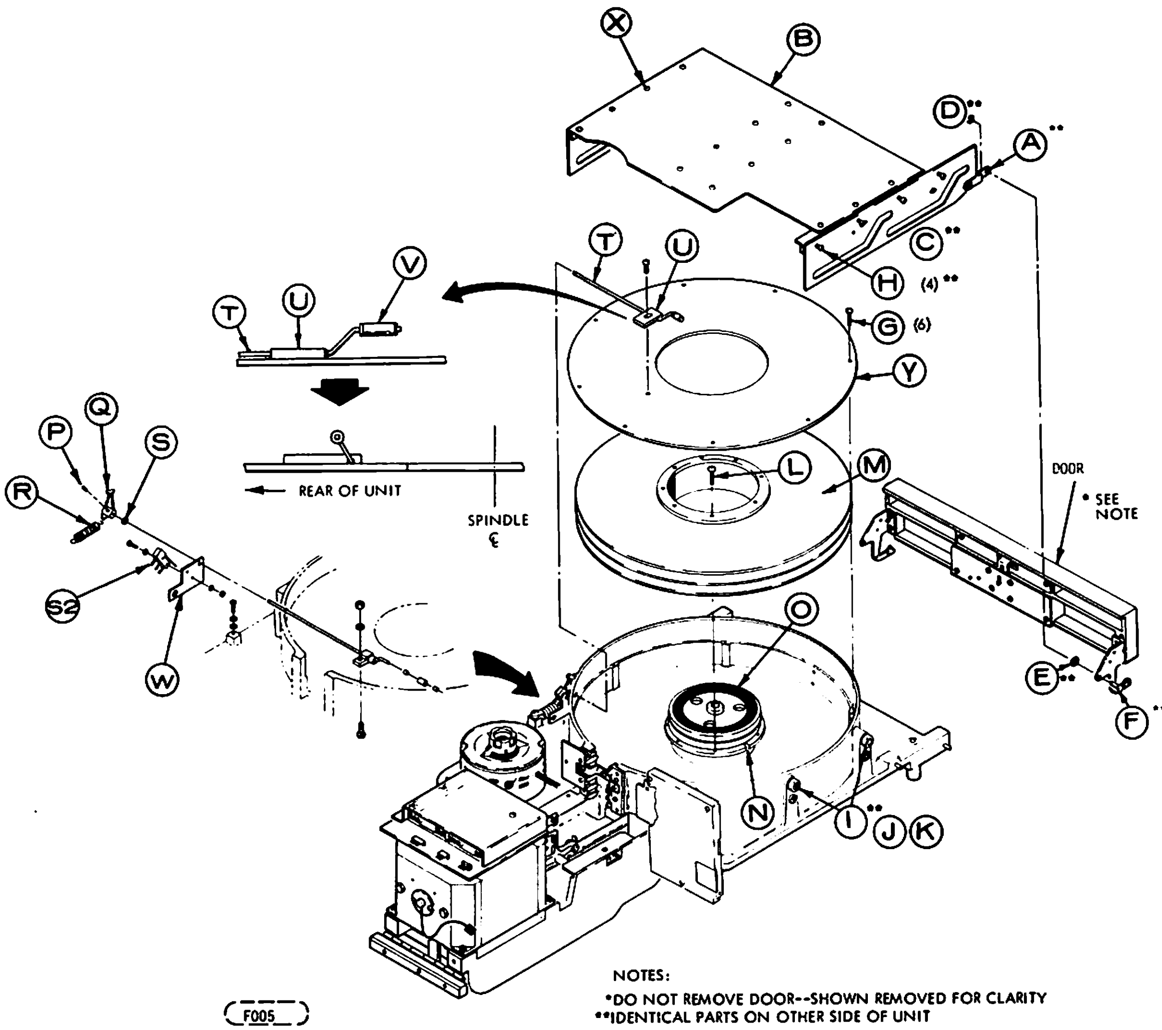



FIGURE 6-8. REMOVAL OF RECEIVER PLATE ASSEMBLY AND FIXED DISK PACK

13. Close the cartridge access door and watch the pin on cam level 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 K and ends up 0.540 ±0.005 inches (1.37 ±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.

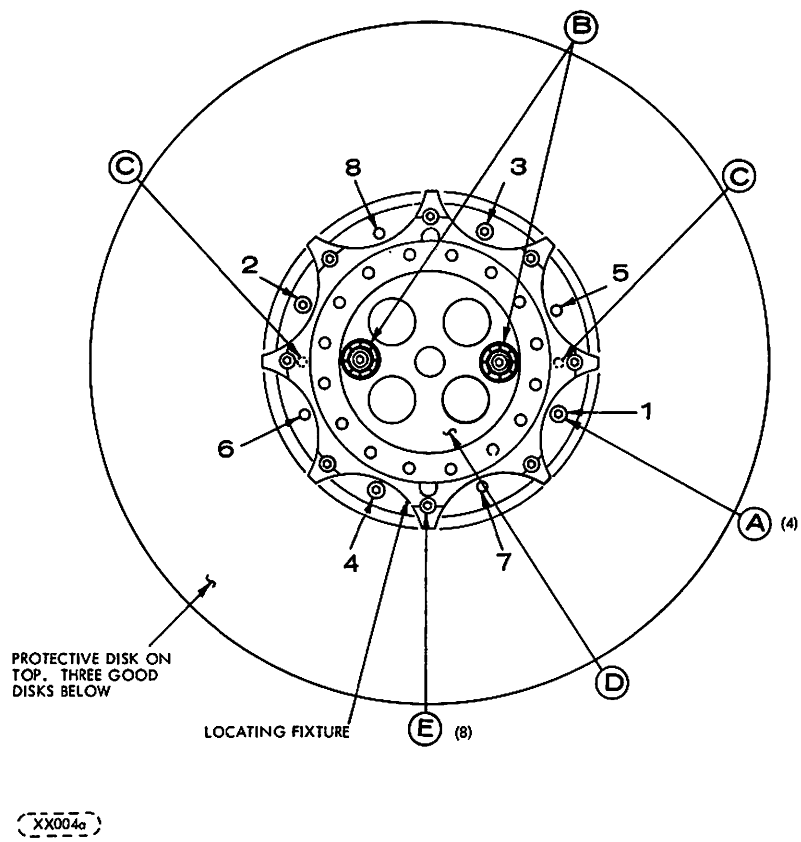



FIGURE 6-9. FIXED DISK PACK LOCATING FIXTURE AND PROTECTIVE DISK

## 6.7.7 FIXED DISK MODULE REMOVAL AND REPLACEMENT

The fixed disk module is replaceable in the field only by adequately trained personnel using the proper procedure and in an environment that is as clean as possible. Minimum conditions shall be a typical clean office type area where there is no smoking allowed during the replacement procedure. Better than this is preferable. The fixed disk module must be replaced as an assembly using a special locating fixture which provides the required locating accuracy for installing the pack on the spindle. The special locating fixture* that comes with the new pack* must be returned for reuse.

CAUTION

The special locating fixture that comes attached to the fixed module CANNOT be reused on the same pack at the drive site. If the fixed module servo disks have too much "runout" the fixture CANNOT be reinstalled to properly center the fixed module. Both the fixed module and the special locating fixture must be returned to the factory and a new fixed module and fixture set* must be obtained.

The following procedure should be followed meticulously when replacing the fixed disk module. Refer to Figures 6-8 and 6-9 for aid in locating parts mentioned in the procedure.

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 K.
4. Remove the separator plate K.
5. Remove the 8 screws L which fasten the fixed module M to the spindle P.
6. Lift the fixed module up and out.
7. Clean and inspect the spindle and fixed disk module area as detailed in section 6.7.8. If there has been mechanical damage to the removed fixed module or if the carriage rail and bearings are dirty, clean and inspect per section 6.6.3.
8. Lift the Velcro fasteners which secure the fixed module shipping container lid to the container base and remove the lid.

CAUTION

Extreme care must be taken in handling of the fixed module to insure that it is not damaged or contaminated by body contact or dirty environment. If fixed module is dropped it must not be used but must be returned.

9. Refer to Figure 6-9. To remove the Fixed disk module and locating fixture assembly* from the shipping container, remove the four screws at A and lift the fixture/disk module assembly out using the fixture body as a hand hold.
10. Carefully inspect the bottom of the disk module for contamination on the mounting surface. 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 fixture/fixed pack 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 fixture at B (Figure 6-9) are also aligned. The fixed module hub shall fit firmly against the spindle hub.

*Called "Fixed Pack/Alginment Tool" in parts catalog in Section 7, Figure 6-9 shows top view of pack and alignment tool.

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 place D is kept level relative to locating fixture. Tighten the screws and torque them to 4 lbf-in (0.45 Nm). Rotate the fixture and fixed module and inspect for any large observable radial or axial runout on the fixed 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.
13. If any excessive runout is observed loosen the two screws B and re-seat the locating fixture/fixed module assembly on the spindle. When the ball on the bottom of the fixed pack 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.
14. Install the 8 screws L (Figure 6-8) which were removed in step 8. Install these in the holes marked 1 through 8 in Figure 6-9. Tighten these 8 screws in numerical order and in the torque steps specified. Torque the 8 screws in numerical order using 4 lbf-in (0.45 Nm). Repeat the sequence using 7 lbf-in (0.8 Nm) and then again using 10 lbf-in (1.13 Nm).
15. The fixed module is now located to the unit spindle. Rotate the fixed module to insure that there are no large observable radial or axial runouts on the fixed module. If there are, remove the 8 screws and the two captive screws and start over from step 12.
16. When the fixed module is located on the spindle, the locating fixture must be removed from the fixed module and spindle.
17. Disengage the two captive screws B (Figure 6-9).
18. Remove the 8 screws E which fasten the fixture to the fixed module (Figure 6-9).
19. The fixture is now free and can be lifted up and out of the unit. One disk which is a protective disk comes off with the fixture. The remaining 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 fixed module.
20. Replace the separator plate K (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-in (0.9 ±0.1 Nm).
21. Carefully vacuum locating fixture hones at B. Rotate fixed module mounting flange and vacuum through one of the three holes in flange face to remove any loose debris.
22. Install the locating fixture to the removed fixed module if available using the 8 screws at E (Figure 6-9).
23. Install the fixture and removed fixed module into the container and secure using the 4 screws at A (Figure 6-9).
24. If the fixed module is not to be returned with the locating fixture, fasten the fixture plate to the shipping container at two "E" hole locations using two screws supplied in the container.
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 6.7.6.2. However, do not replace the top cover as called out in that section.

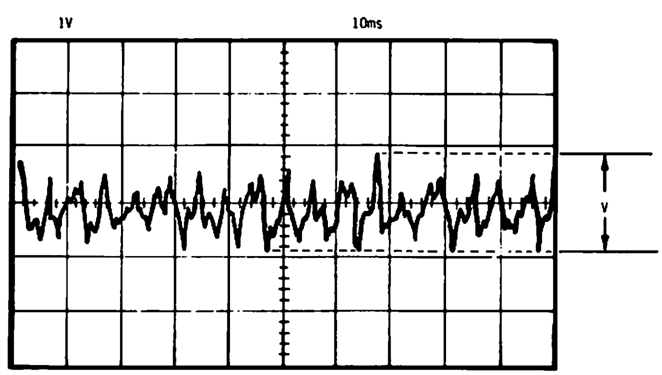
---

*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.

27. Check fixed disk module runout:

- Disable servo per Section 6.8.5.3.
- Connect the input cable to external power source.
- Install the AZPV or HFSV Head Alignment PWA (P/N 54226509) into the Head Alignment Extender PWA (see Figure 6-28) and install the entire assembly in the Electronics Module location EM4.
- Set AC power circuit breaker to ON.
- Install the "CE" cartridge (P/N 76204400) and activate Write Protect switches located on the operator control panel.
- Press START switch to start the drive and load the heads.
- Run The unit for 30 minutes with heads unloaded to purge fixed disk module of any contaminants.
- Re-enable servo per Section 6.8.5.3 and load heads.
- Connect the oscilloscope to TP10 of the Servo-Coarse PWA. Refer to Figure 6-1A.
- Using a suitable jumper, ground TP9 of the Servo-Coarse PWA.
- Using either a field tester or the Head Alignment Extender PWA. Select the fixed Servo (select a head greater than 0).
- Observe the waveform on the oscilloscope. Peak to peak voltage should be 2 Volts or less (see V in Figure 6-9.1).
- Remove the jumper.
- If the above specified 2 Volt limit is exceeded, the fixed disk module should be replaced.

28. Perform the Initial Head Alignment Procedure given in Section 6.8.5.4. Perform the Certification of Fixed Media Procedure given in Section 6.8.2.
29. Replace the top cover per Section 6.7.1.




OSCILLOSCOPE SETTINGS:

VOLT/DIV: 1 VOLT
TIME/DIV: 10 ms
TRIGGERING: INTERNAL POSITIVE
PROBE CONNECTIONS: TP10 ON SERVO-COARSE PWA

Z2069a

FIGURE 6-9.1. VOLTAGE INDICATING AMOUNT OF FIXED DISK MODULE RUNOUT

## 6.7.8 PROCEDURE FOR CLEANING SPINDLE AND FIXED DISK MODULE AREA

In order to prevent head to disk contact, it is imperative that the disk module area 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 spindle, giving particular attention to the reference surfaces to which the fixed disk module and cartridge are mounted. Clean the receiver plate (Item K Figure 6-8) and wipe all surfaces of the shroud clean of dirt and smudges.

## 6.7.9 READ/WRITE HEAD REMOVAL AND REPLACEMENT

Head/Arm replacement criteria are given in paragraph 6.7.9c.

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 Ball Allen screwdriver. Hold the head arm with one hand while removing the screw because the arm easily slips out of its mounting grooves and it could fall 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 (finger prints can cause head crashes).

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 Ball Allen screwdriver 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 (para. 6.8.5.4).
14. When alignment is complete torque the head securing screws per para 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.

## 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 the up.
9. Remove the head cable from the cable calmp 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. Remove the Servo Head/Arm as described in steps 7 through 9 c 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 cource.
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 para. 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.

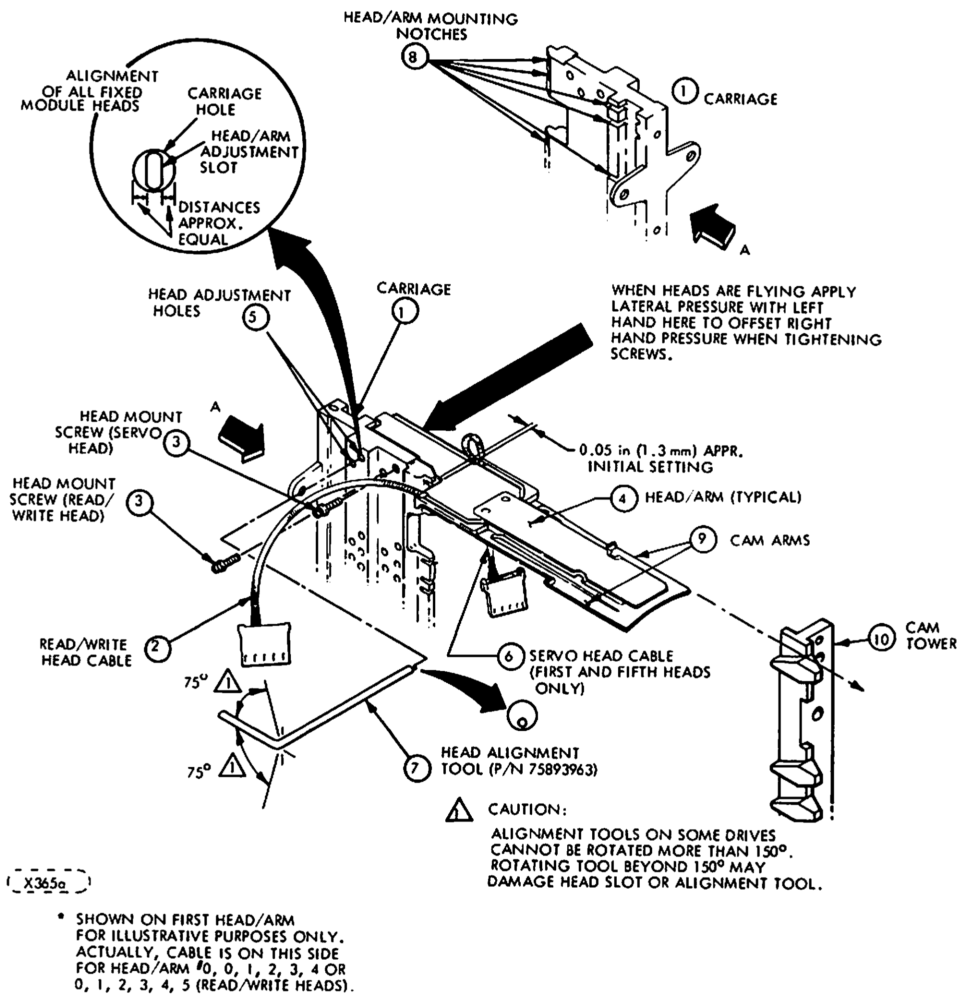



FIGURE 6-10. HEAD/ARM REMOVAL AND REPLACEMENT AND ALIGNMENT

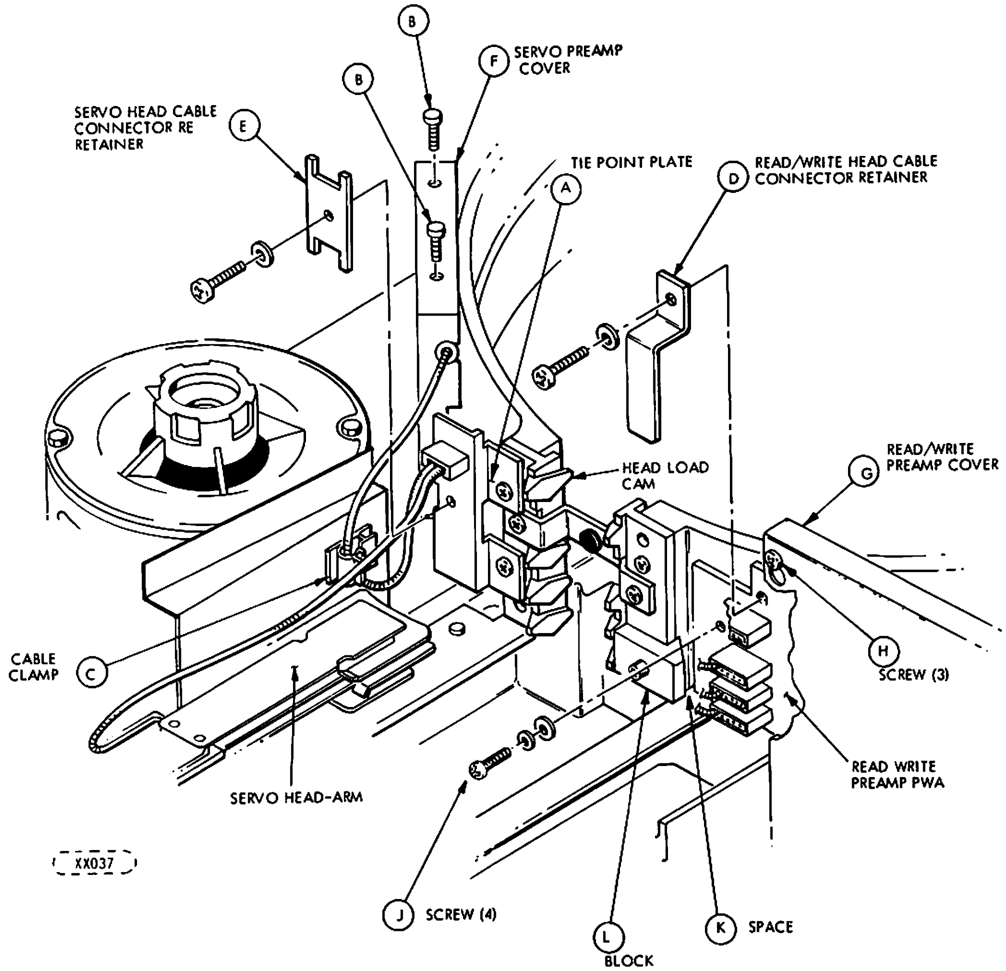



FIGURE 6-11. SERVO HEAD/ARM ASSEMBLY

### 6.7.11 HEAD INSPECTION AND CLEANING

General

The drive has a positive pressure filteration system that eliminates the need for periodic inspection and cleaning of heads. The heads should be inspected for the following reasons only:

1. A problem is traced to a specific head or heads; for example, excessive data errors.
2. 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.
3. Concentric scratches are observed onthe disk surfaces.
4. Contamination of pack is suspected (possibly due to improper storage of the pack).
5. 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 to the shroud area.

a. Head Inspection

CAUTION

Do not smoke when inspecting or cleaning heads. Use extreme care not to damage the head.

Do not touch the head pad or gimbal spring with fingers or tools.

If head must be laid down, do not allow the head pad or gimbal spring to touch anything.

Prior to removing head from inspection, use a bright directional light to inspect pack while it is mounted on drive spindle. If pack shows signs of concentric scratches or any surface damage in data zone, reject pack. (Small tick marks in the head loading zone are not cause for pack rejection).

Remove suspected head as described in the Head Removal and Replacement procedure. Refer to Figure 6-12 observe the head/arm, and perform the suggested remedy as follows:

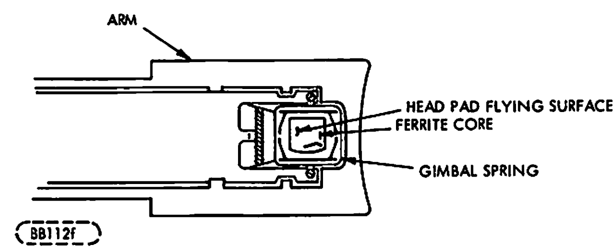



FIGURE 6-12. TYPICAL HEAD/ARM COMPONENTS

1. If reddish-brown oxide deposits exist on the head, replace or clean the head/arm assembly.
2. If head appears scratched, replace or clean the head/arm assembly.
3. If head appears damaged, replace the head/arm assembly.
4. If the gimbal spring (it holds the head pad to the arm) is bent or damaged, replace the head/arm assembly.

b. Head Cleaning

CAUTION

Head cleaning is a delicate procedure which is not recommended. It should not be undertaken unless it is absolutely necessary and then it should be performed by properly trained personnel only.

Refer to Figure 6-13 if head cleaning is required and perform the following procedure. Use care not to damage any part of the head/arm assembly.

CAUTION

In the following step, hold the can of dust remover upright (vertical). If the can is not held upright, liquid propellant will be sprayed on the head.

1. Use super dry dust remover (see list of Maintenance Tools and Materials) to blow off all loose particles from the head pad (flying surface), from the edge of the head pad, and from the holes in the head pad. Hold the nozzle one-fourth to one-half inch (6 to 12 mm) from the head pad. Spray with a back and forth motion across the head pad, making certain to hold the can only in a vertical position.

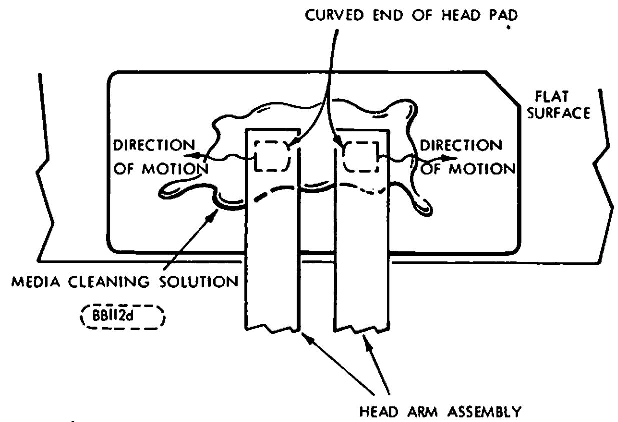



FIGURE 6-13. HEAD CLEANING MOTION

2. Clean a smooth, flat working surface, for example, a glass or formica table top.
3. Place a new, unpunched, clean computer card with the back side up (printing down) on the clean flat working surface as shown in Figure 6-13.

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 and could cause broken wires.

4. Moisten a small area in the center of the card with media cleaning solution. (Refer to the list of Maintenance Tools and Materials).

CAUTION

Inspect the media cleaning solution for contamination, rust, dirt, etc. Do not use contaminated solution.

5. Very carefully place the head pad flying surface on moistened area and move head pad from moistened area to dry area in a zig-zag motion as shown in Figure 6-13. Move head in a direction away from curved end of head pad. If it is moved in the opposite direction the sharp edge of the curved end will cut into the computer card and prevent movement and proper cleaning.

NOTE

Discoloration of media cleaning solution and computer card indicate that oxide particles are being removed from head pad flying surface.

6. Repeat steps, 3, 4, and 5 using a clean computer card and clean media cleaning solution each time until no discoloration on card is present.
7. After discoloration has ceased, inspect head to determine that oxide deposits were removed. If deposits remain but show signs of being removed, repeat cieaning procedure until deposits are removed.
8. Blow OFF heads again using super dry dust removed as in step 1. Be sure all lint and dust are removed.
9. If oxide deposits cannot be removed, replace head/arm assembly.
10. If oxide deposits were removed and head passes inspection according to the Head/Arm Replacement Criteria, reinstall head.
11. Follow head Replacement procedure to install cleaned head or a replacement head as required.

c. Head/Arm Replacement Criteria

A head/arm assembly requires replacement if any of the following conditions exist:

1. 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 sufrace.
2. Appreciable oxide buildup which cannot be removed.
3. Scratches on the head flying surface.
4. Imbedded particles in the head pad flying surface.
5. Bent or damaged gimbal spring.
6. 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 Allen screw driver.
5. Using a 9/64 inch Allen screw driver 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 ±1 lbs-in (1.8 ±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.

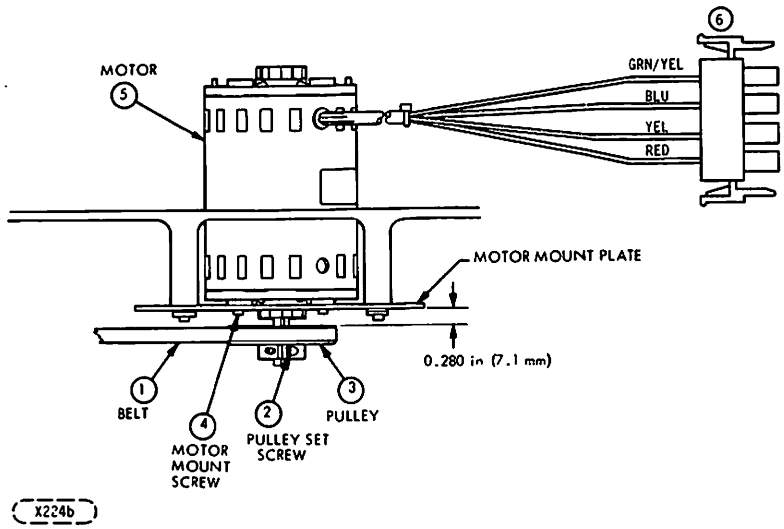



FIGURE 6-14. DRIVE MOTOR ASSEMBLY

## 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.
6. Remove screws and washers 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 mount.
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.

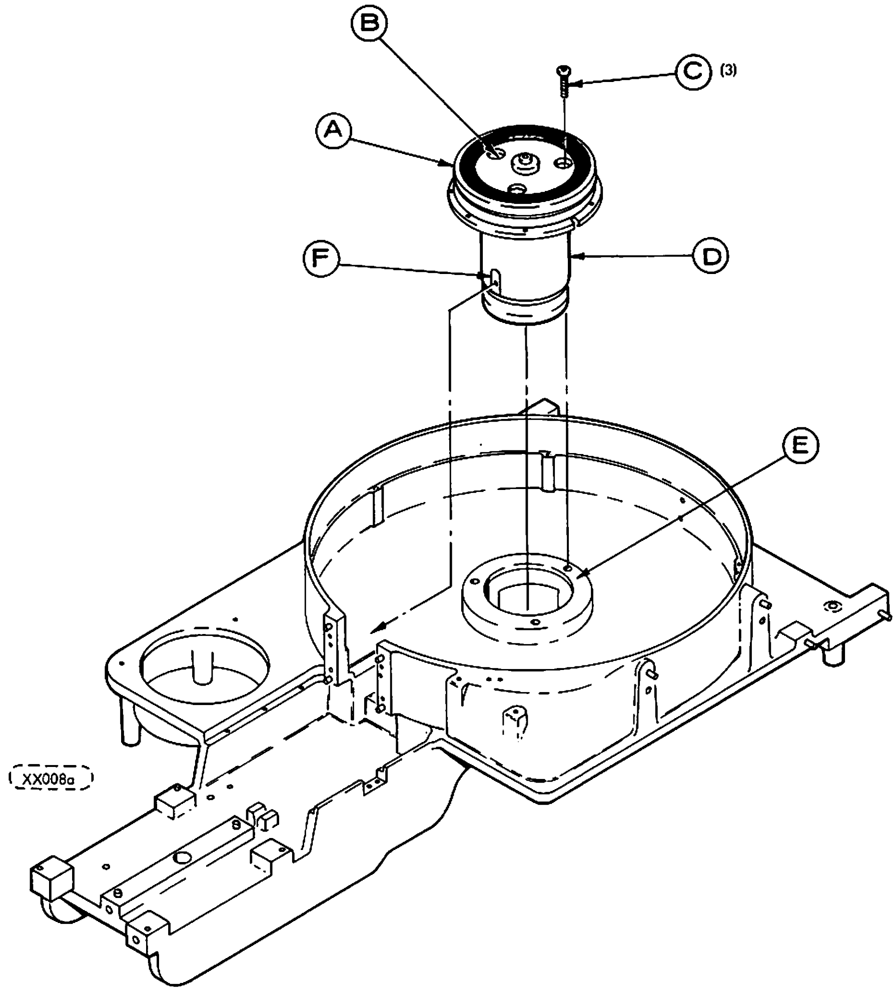



FIGURE 6-15. SPINDLE REMOVAL AND REPLACEMENT

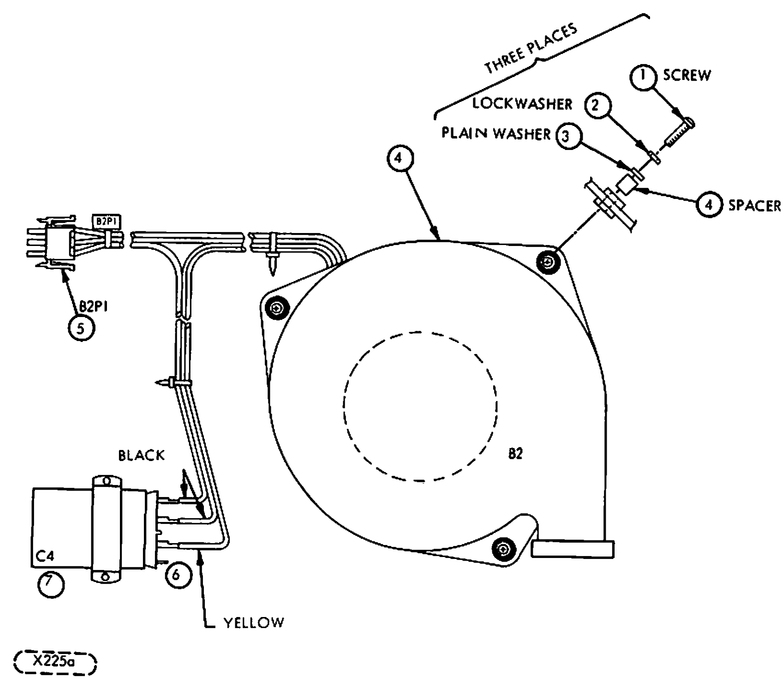



FIGURE 6-16. BLOWER ASSEMBLY

## 6.7.14 SPINDLE REMOVAL AND REPLACEMENT

Refer to Figure 6-15 as an aid in understanding the following description.

NOTE

The fixed disks are removed and replaced with a new disk pack as part of this procedure. 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 disks will 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 disk module per Section 6.7.7 and perform cleaning and inspection as outlined in Sections 6.7.7 and 6.7.8.
6. Elevate the base deck per Section 6.7.2.
7. 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 from Spindle Hub. Remove slotted disk from bottom of spindle pulley. 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-in (11.3 Nm). A torque wrench which accepts a 3/16 inch hex driver wrench is required.
14. Raise the base deck assembly per Section 6.7.2.
15. Reinstall the slotted disk and the speed transducer/static ground bracket (including the Spin Speed Sensor) on the spindle.
16. 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 the pulley.
17. While maintaining hand tension on the belt, roll the belt onto the 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.
18. 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.
19. Install the new fixed pack per Section 6.7.7.
20. Install the disk cartridge.
21. 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 perfrom 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 accessable 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 6-17.1. 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 accessable should it be necessary to replace one (see Figure 6-17.2). 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 in 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. 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).

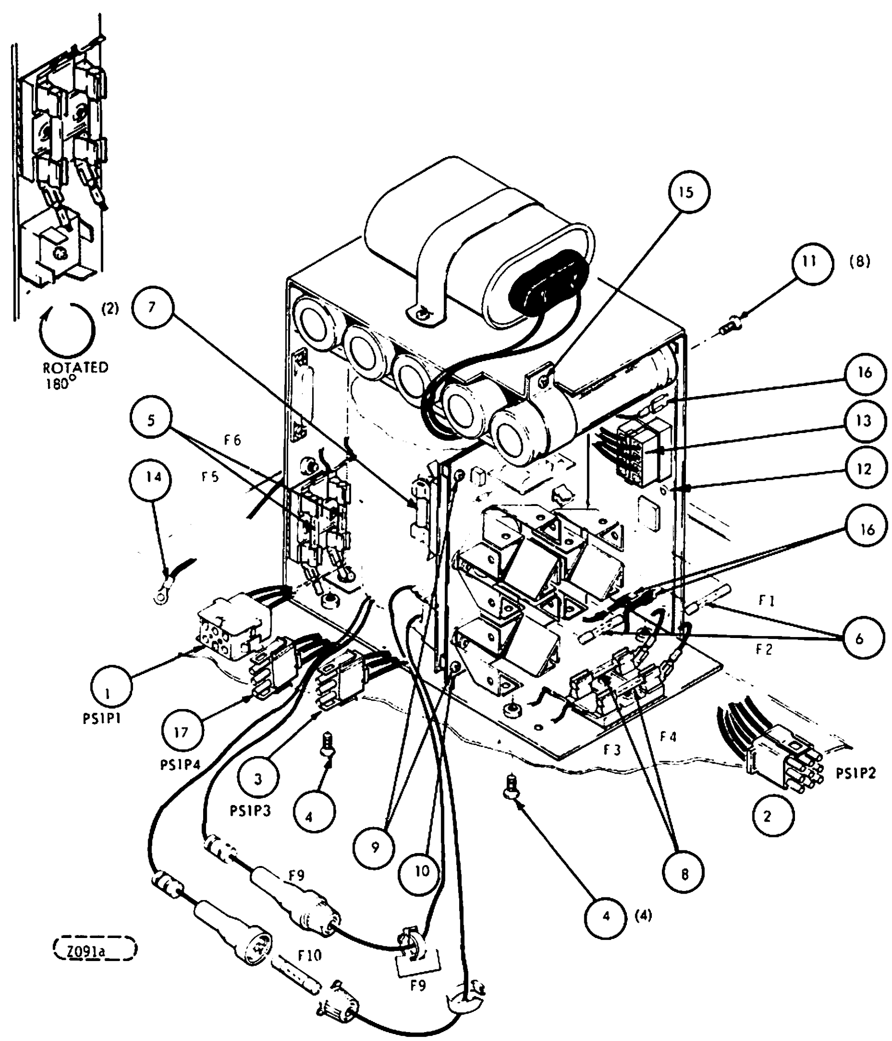



FIGURE 6-17. POWER SUPPLY ASSEMBLY

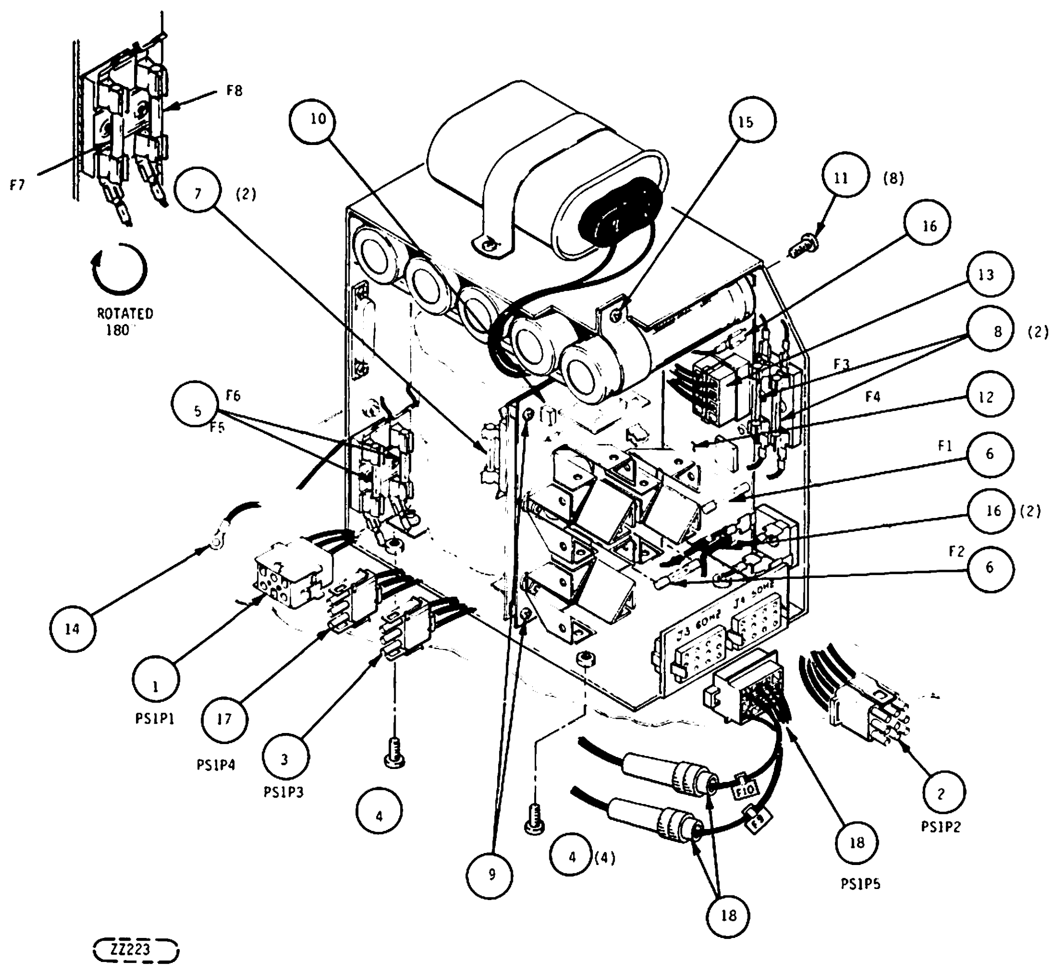



FIGURE 6-17.1. 50/60 HZ POWER SUPPLY ASSEMBLY

## 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 then remove the four screws and four stand-offs that fasten it and move it aside being careful not to excessively kink the wires connected to it.
d. Remove the Velocity transducer as described in paragraph 6.7.20.
e. If the carriage is not to be removed, the carriage complete with heads shall be secured in 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.
f. Remove the four screws C which fasten the actuator magnet to the base deck. This requires a 4/32 in hex driver tool.
g. Carefully slide the magnet to the rear of the drive. Be very careful not to damage voice coil or the velocity transducer magnet core ( F , Figure 6-19) which is attached to the carriage and protrudes through the velocity transducer hole in the actuator magnet.
h. To replace the actuator magnet carefully insert the velocity transducer magnetic core ( F , Figure 6-19) into the velocity transducer hole to the actuator magnet.
i. 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 hex head screws removed in step 3.
l. Insert the Velocity Transducer housing into its hole in the Actuator Magnet while guiding the core into its hole in the transducer housing.
m. Replace the Velocity Transducer housing and secure it to the Actuator Magnet using the two screws removed in step c.
n. Install the Power Amp PWA which was removed in step b. Fasten down with four screws. For correct way to install plugs PAP1, PAP2, and PAP3 see Figure 5-11.
o. Fasten the Head Load Switch bracket to the Actuator Magnet using the two screws removed in step e. Reconnect the switch lead wires.
p. Adjust the Head Load Switch per paragraph 6.8.3.
q. Adjust the carriage restraint blocks per 6.8.6.
r. If a new magnet is being installed remove the carriage lock pin from the old magnet and install it on the new magnet.
s. Set the AC circuit breaker to ON.
t. Start the spindle and return the unit to the system for testing using system diagnostic routines.

## 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.
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. Remove the Velocity Transducer Magnet Core from the removed carriage and install it on the new carriage per Section 6.7.20.
k. Clean the carriage bearings and rails per Section 6.7.20.
l. Install the carriage assembly in the unit, guiding the bearings onto the rail and under the bearing plates with the right hand while guiding the voice coil lead bracket around obstacles with the left hand. Be careful not to bend the Velocity Transducer Magnet Core.
m. Make sure the carriage moves freely as described in step 3 of Section 6.6.3. Re-clean the bearings and rails if necessary.
n. Secure the voice coil lead support bracket with the two screws removed in step c above.
o. Install the actuator magnet and velocity transducer housing per Section 6.7.17.
p. Move the carriage over its full travel several times to insure that the voice coil does not drag or touch the actuator magnet.
q. Install the head arms per Sections 6.7.9 and 6.7.10.
r. Re-connect the voice coil connector.
s. Perform the head alignment as described in Section 6.8.5.4.
t. Replace top cover.
u. Place the unit in operation in the system.

## 6.7.19 REMOVAL AND REPLACEMENT OF THE CARRIAGE CENTER RAIL 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 center rail A (Figure 6-2) 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.
3. Raise the base deck to the maintenance position as described in Section 6.7.2.

To remove the center rail (A) proceed as follows (see Figure 6-20):

f. Remove screw (B) which secures the carriage rail (A)
g. Remove the carriage rail (A) from the unit.
h. Before installing the carriage rail in the unit inspect to see that it is clean and free from all contamination.
i. Install the carriage rail in the unit.
j. When installing the screw which secures the carriage rail put thread locking cement on the screw and torque it to 1.25 ±0.25 lbf-in (0.14 ±0.03 Nm).

NOTE

This torque specification is critical and should be rigidly adhered to.

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).
m. Remove screws (E) and remove bearing plate (F).
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).
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 REMOVE 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).
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 the 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.

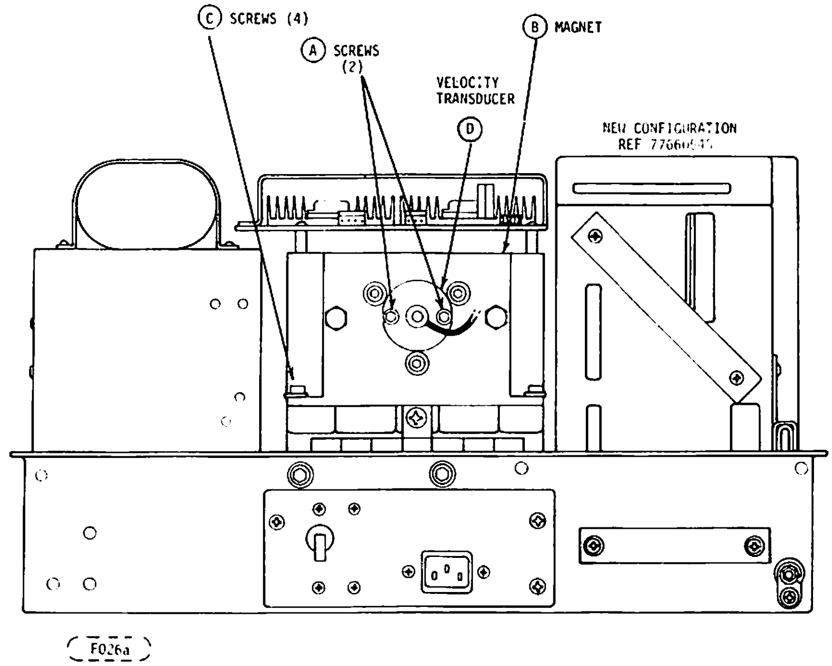



FIGURE 6-18. VELOCITY TRANSDUCER AND ACTUATOR MAGNET REMOVAL

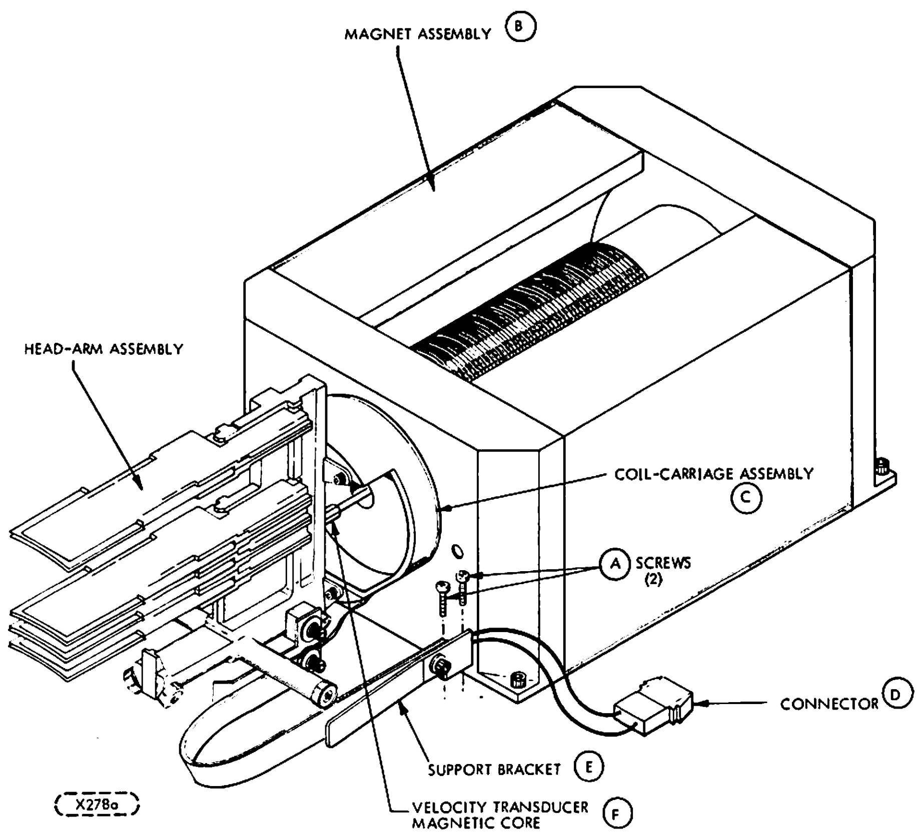



FIGURE 6-19. ACTUATOR ELEMENTS (POWER AMPLIFIER REMOVED)

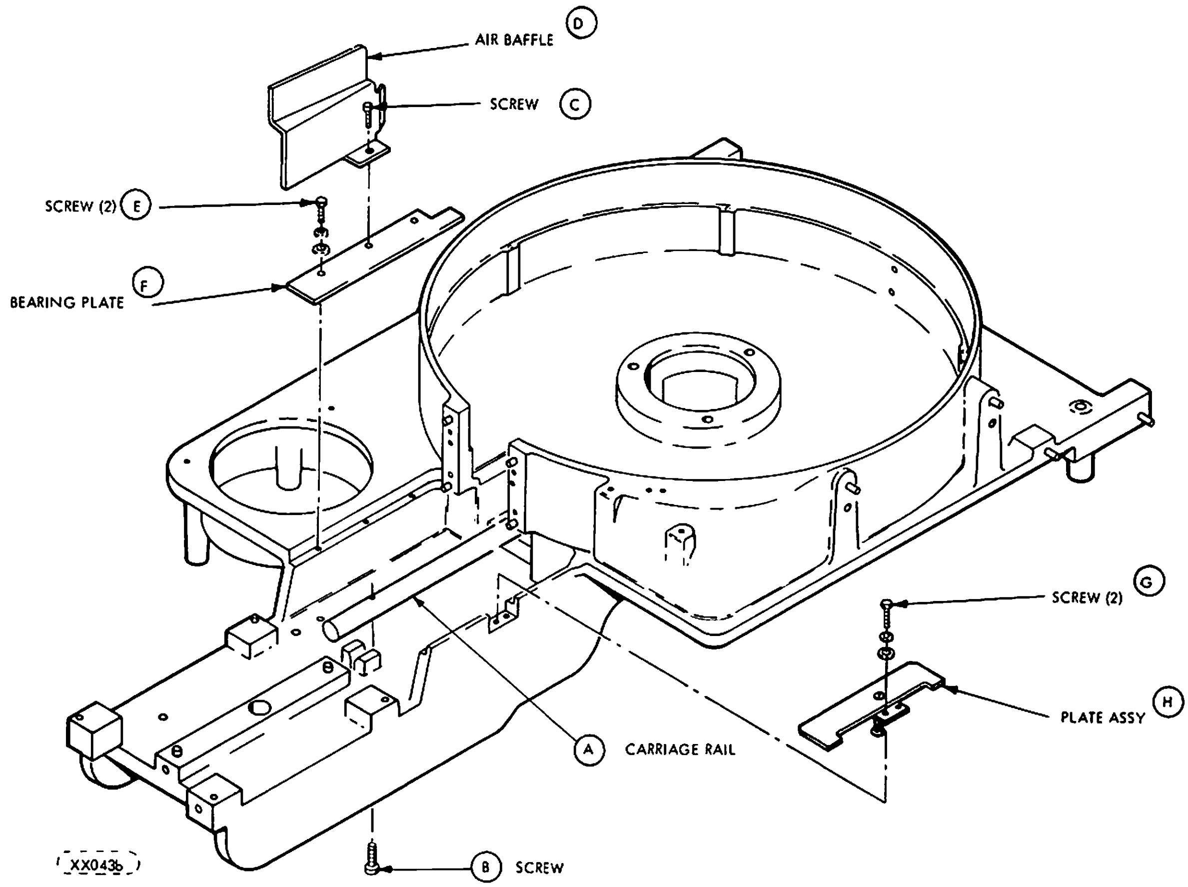



FIGURE 6-20. CARRIAGE RAIL REMOVAL AND REPLACEMENT

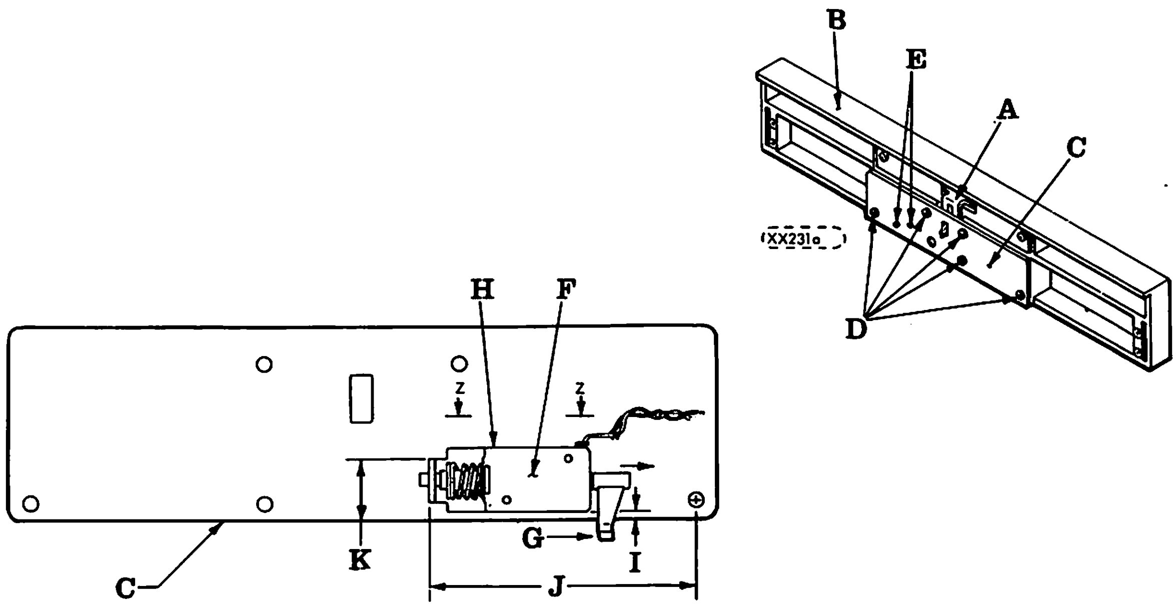
## 6.7.21 REMOVAL AND REPLACEMENT OF CARTRIDGE ACCESS DOOR LOCK SOLENOID

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.

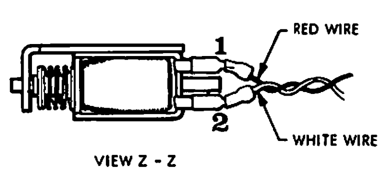
k. Tighten the mounting hardware.
l. Connect the two wires which were removed from the old solenoid to the proper tabls as illustrated in View Z - Z in Figure 6-20.1.
m. Install the latch cover plate assembly to the access door. To do this, lift up on the door release slide (A) and pull back the solenoid 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.

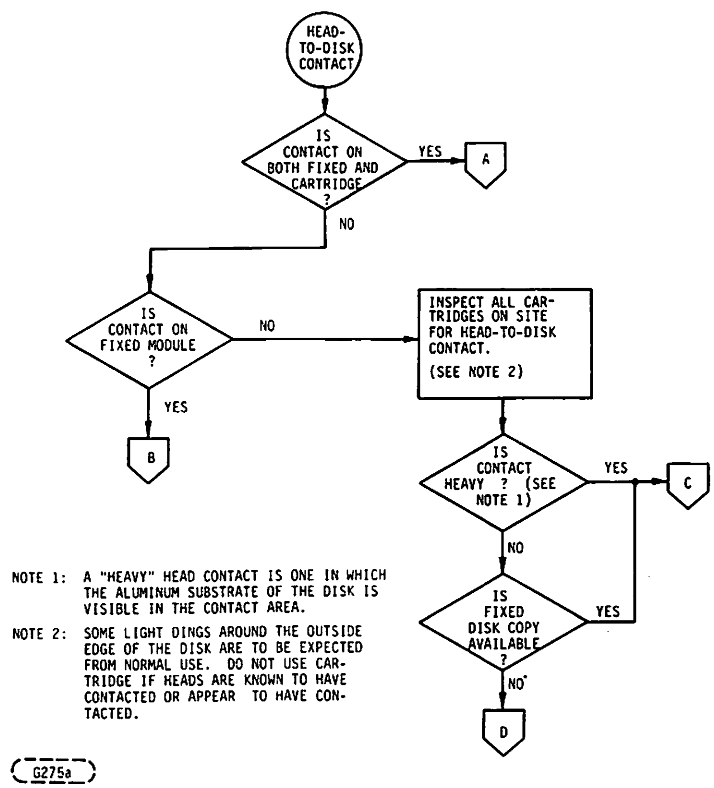
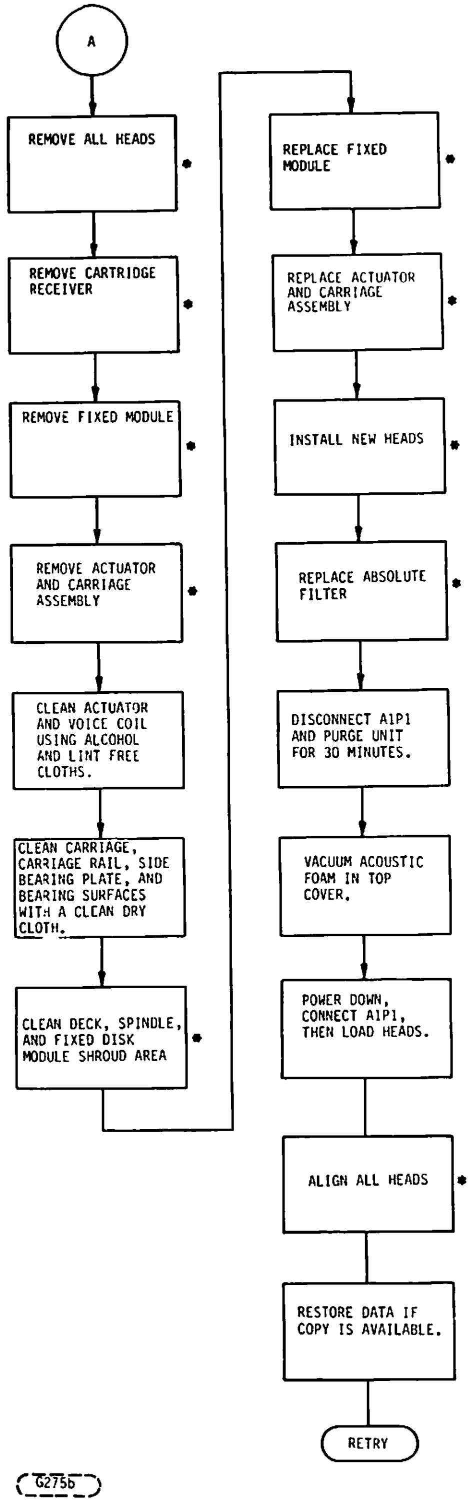



FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 1 OF 4)



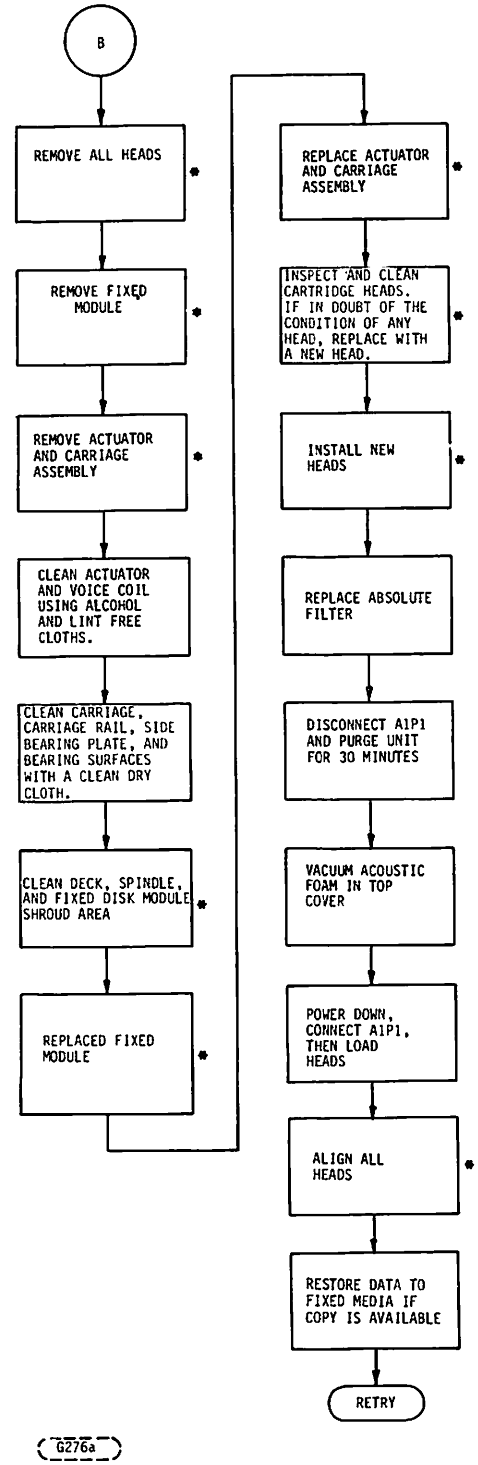




FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 2 OF 4)

*See Table 6-3.

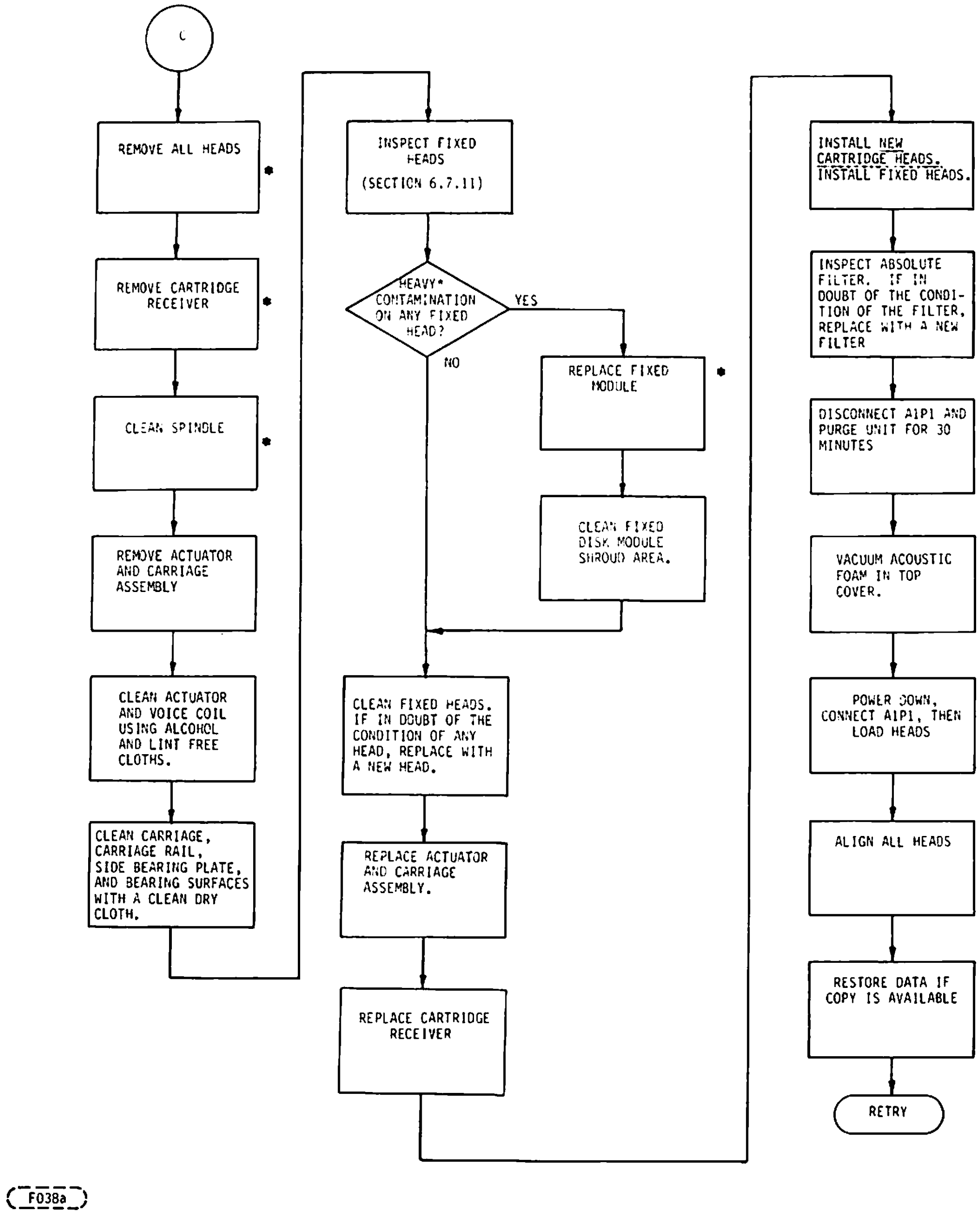



FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 3 OF 4)

*See Table 6-3.

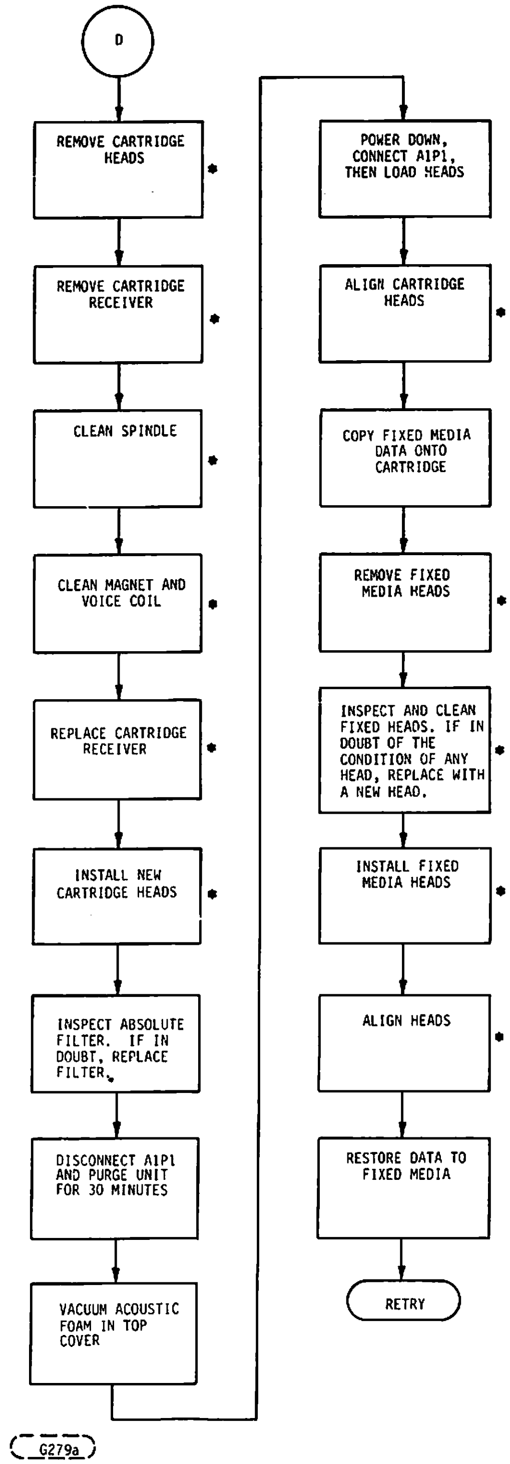



FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 4 OF 4)

*See Table 6-3.

## 6.7.23 REMOVAL AND REPLACEMENT OF AIR PRESSURE SWITCH

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. Cover the absolute filter opening with a piece of paper.
6. Disconnect the leadwires (A) at the air pressure switch terminals (E) .
7. Disconnect air tubing (B) from the air pressure switch (E) .
8. Remove the two screws and hardware (D) which secure the air pressure switch (E) to the switch bracket (C) .
9. Install replacement air pressure switch (E) 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.
12. Lower base deck assembly to normal position.
13. Replace topcover.
14. Connect AC cord to power source.
15. Restore unit to normal operation.

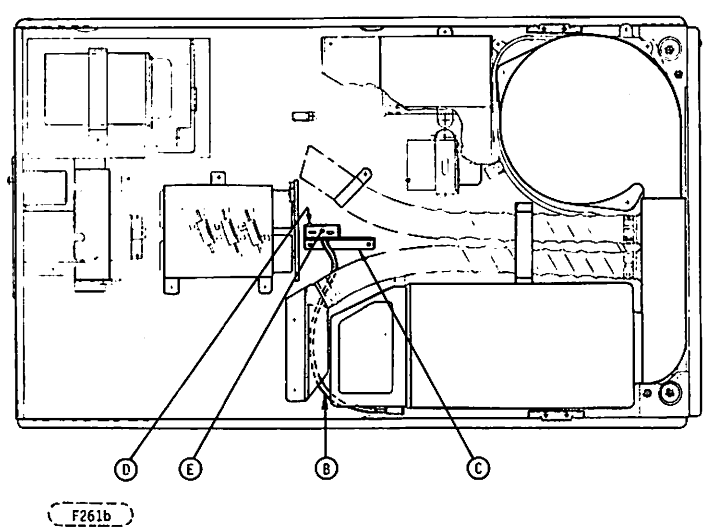



FIGURE 6-20.3. LOCATION OF NO-AIR PRESSURE SENSOR.

### 6.7.24 CORRECTIVE MAINTENANCE

Removal and replacement of the component board assembly:

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 mount.
13. Replace top cover.
14. Restore power to unit.

## 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 Adis 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 at the heads be unavoidable, observe the following safety precautions during manual carriage operation.
   - Make certain that heads will unload or are unloaded before turning power off.
   - If power to drive motor is lost while heads are loaded and voice coil leadwires are disconnected, immediately retract carriage. Otherwise, heads crash 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 (refer to Figure 6-18).

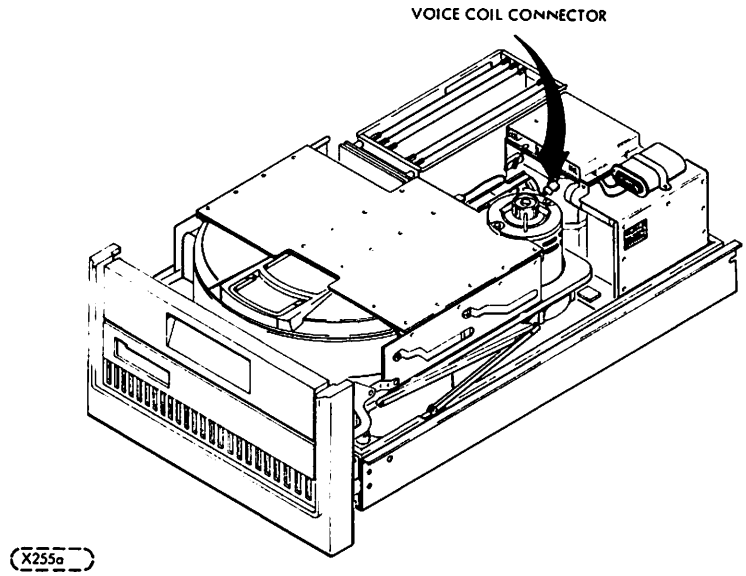



FIGURE 6-21. VOICE COIL LEADWIRE CONNECTOR

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 havles:
   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 noticed, 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 cuase 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 para. 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 by 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 alternatives.
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 1. 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
B - EARLY STROBE
C - LATE STROBE

1 - NOM OFFSET
2 - FWD OFFSET
3 - REV OFFSET

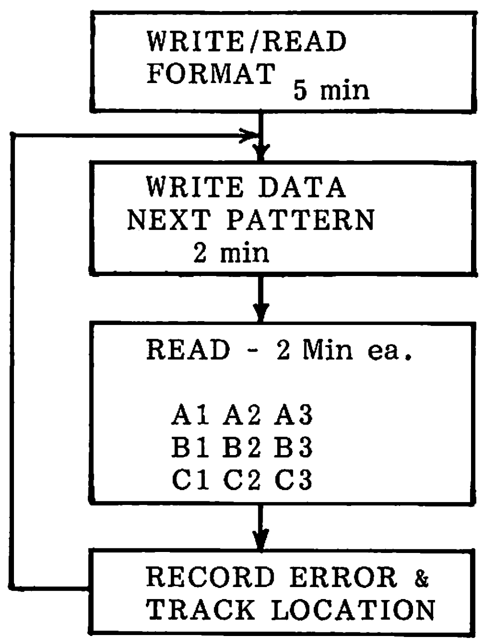



FIGURE 6-22. CERTIFICATION OF FIXED MEDIA

### 6.8.3 SWITCH ADJUSTMENTS

NOTE

The following definition applies to paragraphs 6.8.3.2, 6.8.3.3 and 6.8.3.4 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 contacts (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 RS1) 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 6-22c 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 6-22c. Adjust the position of the switch until the operating position* is reached at 0.150 ±0.010 inches (3.8 10.3 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.
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 foreard), 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).

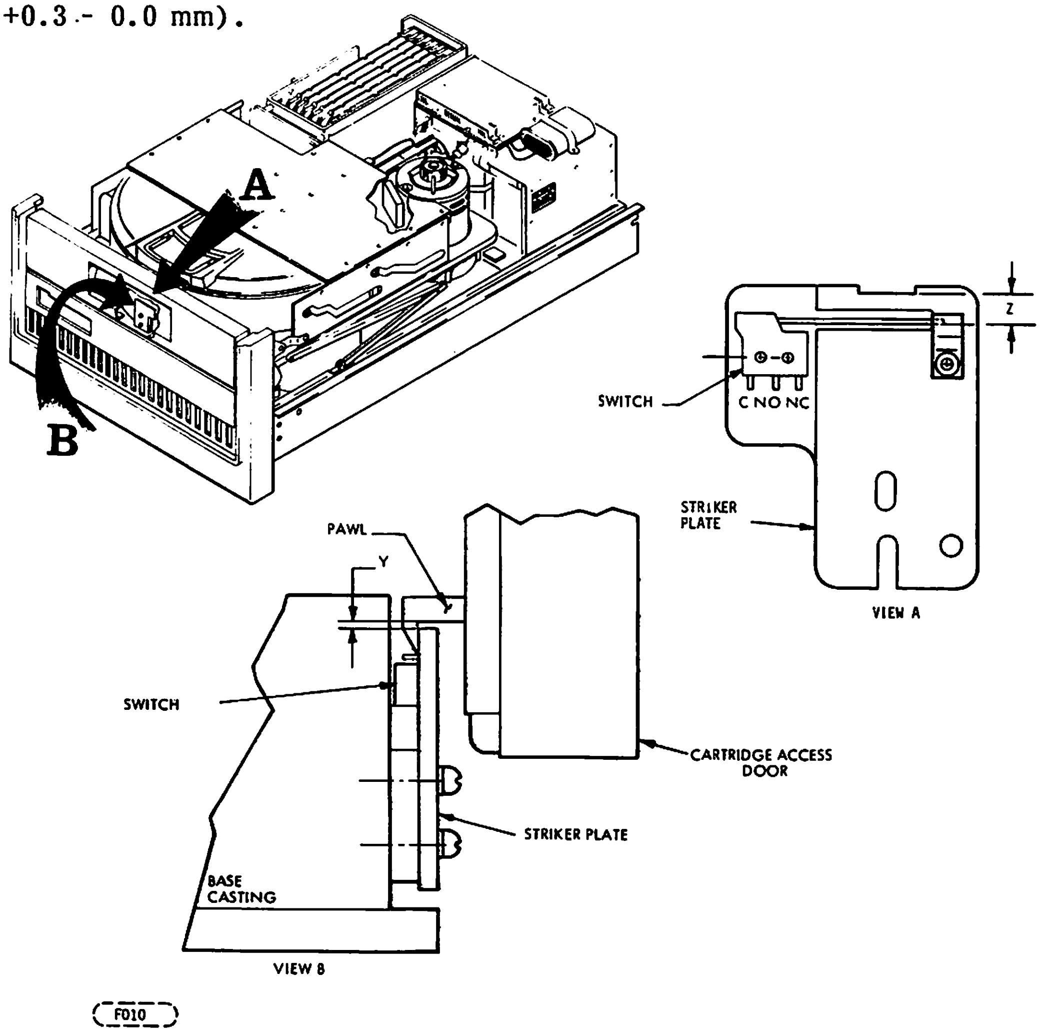



FIGURE 6-22C. CARTRIDGE ACCESS DOOR INTERLOCK SWITCH AND STRIKER PLATE ADJUSTMENT

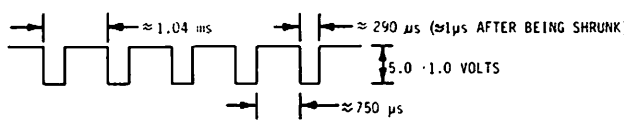
13. Tighten the Striker Plate mounting hardware.
14. Verify that door will not open while pulling up on Door Release Slide and pulling door forward with a force of 10 pounds (45 Newtons).
15. Verify that striker pawl goes over striker smoothly.
16. With the door still closed and locked, verify that any 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.

*Refer to the NOTE at the beginning of Section 6.8.3 on operating position and test method.

## 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 Screws 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.




X360c

8. Change horizontal sensitivity to 1 µs per div. and put probe from channel B on EM3P2-B7 of the Servo-Coarse PWA. The pulse should have been shrunk to about 1 µs in duration (100 ns min, 8.5 µs max).

## 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 6.7.5.2 and 6.8.5.4. Misadjustment of these may cause difficulties that appear to be malfunctions of the hardware. If any servo 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 monentary 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 trun 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

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. Joggle 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.

*See Section 6-9 "Maintenance Adis"

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 turn 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.

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.

### 6.8.5.4 CMD HEAD ARM ALIGNMENT

General

This section describes the procedure which should be used to align the heads of the Cartridge Module Drive (CMD) and describes the operation of some of the equipment used.

CAUTION

The maintenance manual specifically instructs field personnel to utilize correct tools and procedures when performing "Head Arm Alignment".

This CAUTION is intended to emphasize the critical nature of this procedure and hopefully prevent any further head arm or alignment tool damage due to unfamiliarity.

1. Read and understand the "Head Arm Alignment" procedure as explained in the maintenance manual.
2. Use only the specified alignment tool and calibrated torque screwdriver/bit.
3. Ensure the alignment tool is clean and free of damage.
4. Ensure the head mounting screws are tightened to the specified torque requirement. (Damage to the tool or head arm can occur if adjustment is attempted on a head that has been tightened excessively.)

5. When inserting the adjustment tool, locate the head arm slot with the tip of the tool, prior to applying any turning force.
6. When turning the tool, enough inward force should be applied on the tool, so as to prevent the tip of the tool from disengaging from the adjustment slot.
   NOTE: "Rounding-out" of the head arm adjustment slot prevents further adjustment of that particular head and may ultimately require replacement.
   Steps 4, 5 and 6 are especially intended to prevent "Rounding-out" of the head arm adjustment slot and/or damage to the adjustment tool.

The equipment required for the head arm alignment procedure is listed below.

- Field Test Exerciser (FTU) or system controller
- CMD Alignment Kit P/N 75882399 or 75899096
- Carriage Locking Tool P/N 75891573 (stowed on actuator magnet)
- Head Alignment Tool P/N 75893963
- C.E. Cartridge P/N 76204400

Head alignment procedures described in this section are listed below in order of their presentation in this section:

a. General CMD Alignment Principles.
b. Initial Head Alignment Procedure.
c. Cartridge Read/Write Data Head Alignment Procedure.
d. Cartridge Servo Head Alignment Procedure.
e. Fixed Disk Module Data Read/Write Head Alignment Procedure.
f. Fixed Disk Module Servo Head Alignment Procedure.

GENERAL CMD ALIGNMENT PRINCIPLES

NOTE

Each CMD is aligned at the factory and should not need any additional alignment at the customer's site. Due to the differences in CE cartridges, thermal stability and mechanical tolerances, it is possible to exceed the standards of this procedure when checking alignment with a different CE cartridge other than the one used for initial alignment. The only time alignment would become necessary is if data recovery becomes a problem (data error or seek errors.) Alignment should then be accomplished as per this procedure to minimize these accumulative differences.

In general the head alignment is accomplished on all heads by first mechanically aligning each of the fixed disk module heads when the module is first installed. Figure 6-24 shows how the oblong slot in the side of the head arm is "eyeball" aligned in the center of the round hole 5 in the carriage. An RTZ command then positions the fixed servo head on track zero, and with that carriage position as a reference the cartridge servo head is aligned. Once the cartridge servo head is aligned it is used as a reference for aligning the cartridge data head.

NOTE

Any change in initial position of the fixed disk module servo head affects the alignment of all the fixed disk module data heads. Since there are no alignment tracks on or available to the fixed disk module data heads these heads are not normally adjusted. However, should it be necessary to align one or more of the fixed disk module heads after the initial alignment a procedure is given at the end of this section which describes the means of realignment of a fixed disk module servo or data head, though it is more involved than the normal procedure.

Head alignment on the CMD requires an alignment extender PWA to adapt the CMD Head Alignment PWA (AZPV or HFSV PWA one of which is part of the kit P/N (75882399) (75899096) for use with the CMD electronics module. The AZPV or HFSV Head Alignment PWA operates as described in the following paragraphs.

The Head Alignment PWA (called AZPV or HFSV hereafter) develops an alignment voltage derived from a voltage the Servo and Read/Write Preamplifiers produce from read head signals. When reading from a C.E. cartridge the voltage from the AZPV or HFSV PWA will be proportional to the distance that the cartridge servo (or data) head is offset from the track centerline. The drive actuator should have been positioned to the track zero centerline as defined by the fixed disk module servo head when aligning the cartridge servo head or to the centerline as defined by the cartridge servo head when aligning the cartridge data head. To measure the voltage proportional to the offset which is produced by the AZPV or HFSV PWA connect a null meter to the AZPV or HFSV PWA as shown in Figure 6-23.

There are three toggle switches on the AZPV or HFSV PWA which control the AZPV or HFSV PWA operation. These are shown in Figure 6-23 and their operation is described below.

- S1 This switch changes the polarity of the alignment voltage produced on the AZPV or HFSV PWA. This switch is used when null meter readings are taken for the purpose of calculating the offset of the head being aligned.
- S2 This switch selects the head output which will be used as an input to the AZPV or HFSV PWA. Position "S" selects the tracking servo head as an input to the AZPV or HFSV PWA (the tracking servo head is the one selected by S1 on the Head Alignment Extender PWA). Position "R/W" selects whichever of the cartridge heads (servo or data) that have been selected by the BUS OUT interface lines or by S1 on the Servo Fine PWA located in EM6.
- S3 This switch selects the sensitivity range of the AZPV or HFSV PWA. In the "X.1" position the alignment voltage is attenuated by a factor of 10. Head alignment error cannot be accurately measured with S3 in this position. In the "X1" position the alignment voltage is not attenuated and the head alignment error can be accurately measured.

Four indicators are provided on the HFSV PWA (but not on AZPV) to ensure that the PWA is operating properly and is receiving the proper data. These indicators are described as follows:

- POWER - When lighted it indicates that powr is applied to the PWA.
- INPUT - When lighted it indicates that the voltage levels of the input signals are too low for the alignment PWA to operate.

- BAD TRACK - When lighted it indicates a short duration loss of input to the HFSV PWA. A one-shot circuit maintains the lighted condition for at least four seconds. When S1 is switched from P to N or N to P the indicator will ight for its four second cycle each time the switch is moved.
- MODE - When lighted it indicates that either S2 is in the "S" (servo) position or S3 is in the "X.1" position. When either of these conditions exist (light on) read/write head alignment error cannot be measured.

Head alignment is required on a new drive before leaving the factory, when a used drive has a fixed disk module replaced, and when any of the drive servo or data heads are replaced. If a head replacement is required because of contact between the disk and the head, the disk module involved should also be replaced, as a new head would not fly over a damaged disk.

INITIAL HEAD ALIGNMENT PROCEDURE

Following is a description of the initial head alignment procedure; that is, the procedure to be used when aligning the heads for the first time on a new unit or when the fixed disk module is replaced.

1. Operate the START switch to the STOP position to stop the drive motor. Wait until the motor has stopped. That is, when the READY indicator has stopped blinking.
2. Set AC circuit breaker in the rear of the unit to OFF position.
3. Install the "C.E." cartridge (P/N 76204400) and activate the write protect switches located on the operator control panel.
4. Raise the case cover assembly.
5. Install the AZPV or HFSV Head Alignment PWA (P/N 54226509) into the Head Alignment Extender PWA (see Figure 6-23) and install the entire assembly in the electronics module location EM4.
6. Install the two head alignment cables between the Head Alignment Extender PWA, the Servo-Fine PWA (located in EM6) and the Read/Write Preamp PWA as illustrated in Figure 6-23.

   NOTE

   Make sure the arrow on the connector head lines-up with pin 1 of both connectors J1 and J2 on the Head Alignment Extender PWA and the Servo-Fine PWA.

7. Set switch S1 on the Head Alignment Extender PWA to "FXD" position.
8. Connect the null meter leads to test points Z and X on the AZPV or HFSV PWA (red wire to "+").
9. Connect FTU to drive. Refer to FTU maintenance manual for installation instructions.

   NOTE

   The FTU meter can be used instead of the alignment kit meter (P/N 73576400). However, if the FTU meter is used ignore the bottom scale. Refer to the FTU maintenance manual.

10. Connect oscilloscope to ground and dibit test points (marked "Read Signal") on the Head Alignment PWA (AZPV or HFSV).
11. Remove the screw which secure the electronics module (A Figure 6-5) to the hinge bracket and carefully lift the module directly up and slowly swing it out to the side and leave in the rest position.

CAUTION

Use only head alignment tool P/N 75893963, (7 in Figure 6-24). 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. 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 7 (refer to Figure 6-24). 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).

12. Center the alignment slot of all heads (read/write data and servo) associated with the fixed disk module (see 5 in Figure 6-24).

CAUTION

While torquing the head clamping screws 3 (Figure 6-24) use only straight allen wrench and keep it as perfectly aligned as possible with head mounting screw. If care is not taken during this operation head/arm may be pushed out of alignment.

13. Torque all fixed pack head clamping screws 3 to 12 ±1/2 lbf-in (1.26 to 1.38 Nm) while observing the centering 5.
14. Torque the head clamping screws of the removable cartridge heads to 4 ±1/2 lbf-in (0.40 to 0.51 Nm).
15. Set AC power circuit breaker to ON.
16. Press START switch to start drive motor and load heads.
17. Perform thermal stabilization: Allow drive to run with heads loaded for a minimum of 60 minutes. If head/arm alignment check is being performed on more than one drive, the CE disk pack needs only a 15 minute purge per drive after head/arm alignment check has been performed on the preceding drive (provided drive under test has been running for 60 minutes immediately preceding check).

CAUTION

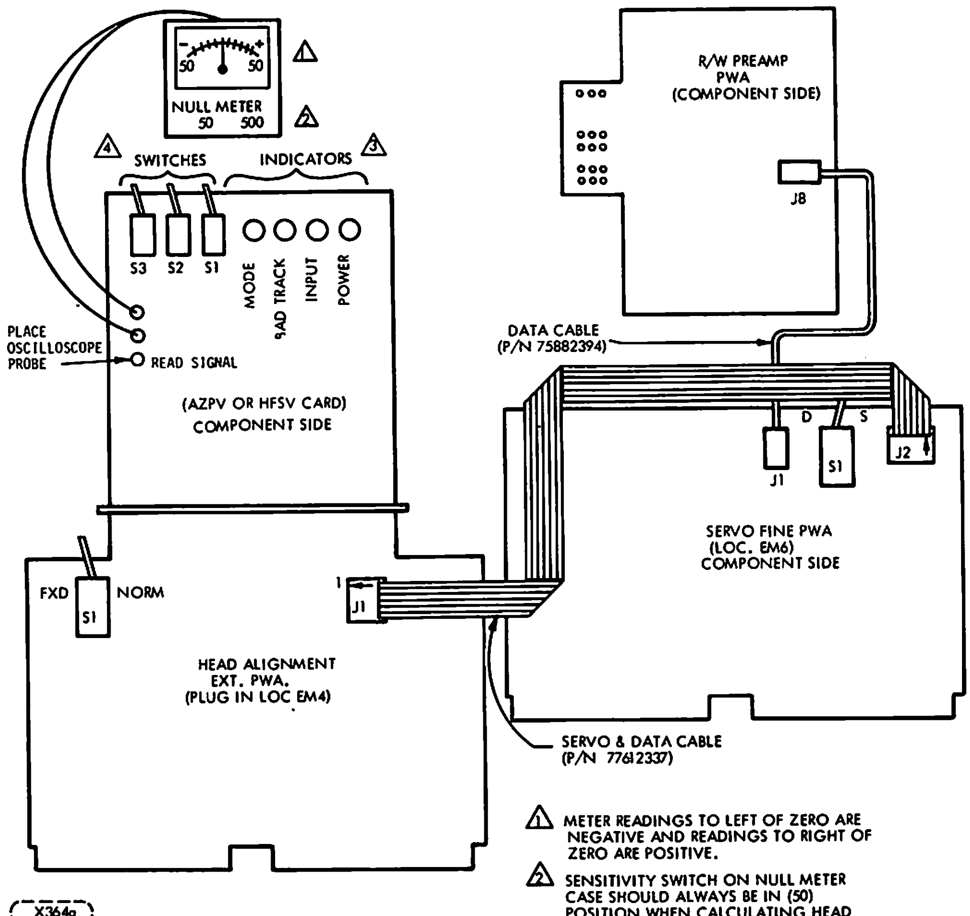
MAKE CERTAIN THAT NO ELECTRICAL CONDUCTORS SUCH AS THE CARRIAGE LOCKING TOOL, HEAD ALIGNMENT TOOL, SCREW DRIVER OR OTHER SUCH TOOLS COME IN CONTACT WITH THE HEAT SINKS MOUNTED ON TOP OF THE VOICE COIL ACTUATOR.

18. Insure the following switches are set in the positions given:

- S1 of Servo-fine in "SERVO" position.
- S1 of Head Alignment Extender PWA in "FXD" position.
- S1 of AZPV or HFSV PWA in "N" position.
- S2 of AZPV or HFSV PWA in "RW" position.
- S3 of AZPV or HFSV PWA in "X1" position.

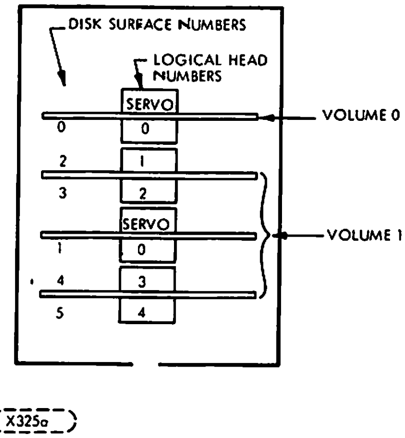
NOTE

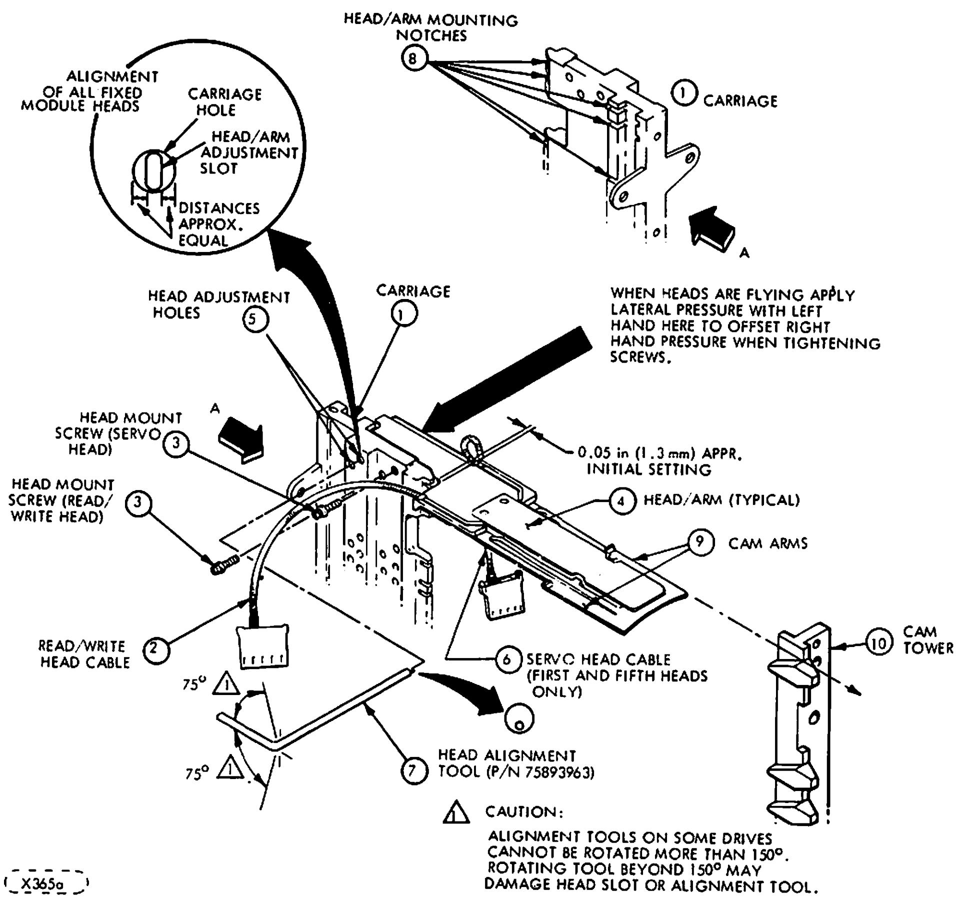
All AZPV or HFSV PWA switches are positioned toward the rear of the drive.




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 (X1).

FIGURE 6-23. HEAD ALIGNMENT BLOCK DIAGRAM




• SHOWN ON FIRST HEAD/ARM FOR ILLUSTRATIVE PURPOSES ONLY. ACTUALLY, CABLE IS ON THIS SIDE FOR HEAD/ARM #0, 0, 1, 2, 3, 4 OR 0, 1, 2, 3, 4, 5 (READ/WRITE HEADS).

FIGURE 6-24. HEAD/ARM REMOVAL AND REPLACEMENT AND ALIGNMENT

OSCILLOSCOPE SETTINGS

LOGIC GROUND TO SCOPE GROUND

VOLTS/DIV

- CH 1 - 0.5 V
- CH 2 - NOT USED

TIME/DIV

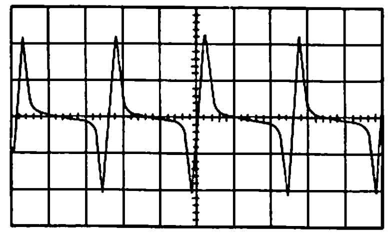
- A - 0.5 μs
- B - NOT USED

TRIGGERING

- A - INTERNAL POSITIVE
- B - NOT USED

PROBE CONNECTIONS (USE X10 PROBE)

- CH 1 TO FTU DIBITS JACK
- CH 2 NOT USED



X369a

FIGURE 6-25. GUARD-BAND WAVEFORM PATTERN

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS/DIV

- CH 1 - 0.2 V
- CH 2 - NOT USED

TIME/DIV

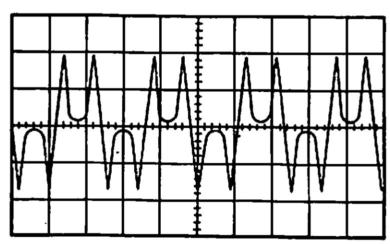
- A - 0.5 μs
- B - NOT USED

TRIGGERING

- A - INTERNAL POSITIVE
- B - NOT USED

PROBE CONNECTIONS (USE X10 PROBE)

- CH 1 TO FTU DIBITS JACK
- CH 2 - NOT USED



X369b

FIGURE 6-26. BALANCED DIBIT PATTERN

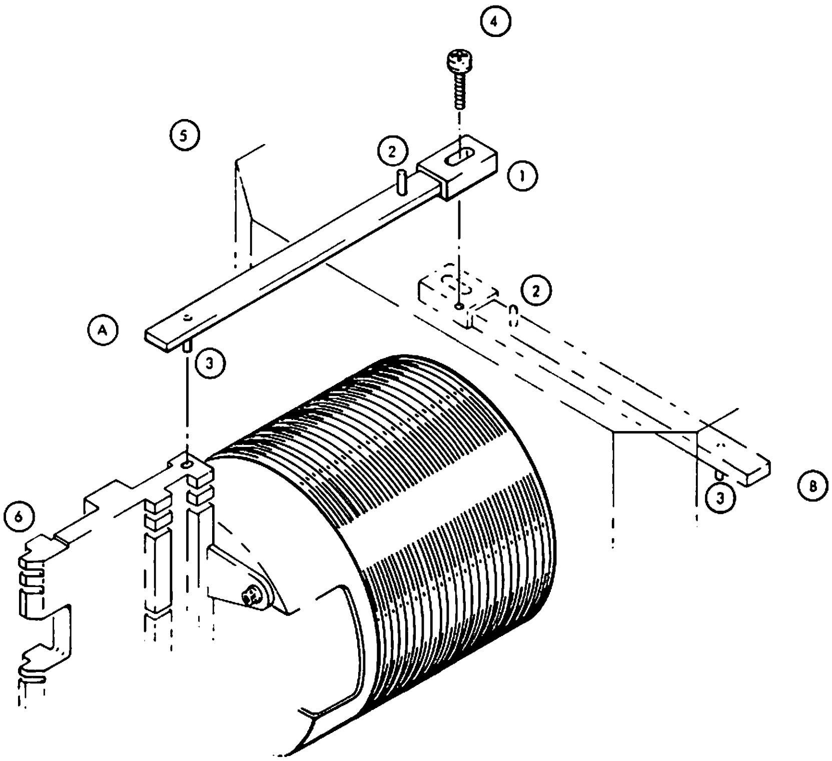



FIGURE 6-27. CARRIAGE LOCKING TOOL-HEAD ALIGNMENT POSITION

19. Issue an RTZ command. This command is necessary to initialize the servo on track "0" of the fixed pack.

CAUTION

Whenever the heads are adjusted and the clamping screws are turned while the heads are flying, extreme care should be tkane 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 as shown by the large arrow in Figure 6-24.

20. Assuming the head alignment tool is to be manipulated with the right hand, place the left hand with the side of the pointer finger against the carriage assembly on the opposite side from where the head alignment tool is inserted. Apply pressure with the left hand only when the right hand applies pressure and then try to apply equal pressure with both hands (see step 21 below).
21. Using a head alignment tool (P/N 75893963) move the cartridge servo head toward the rear of the drive until the outer guard-band is reached. The outer guard band can be located by observing the waveform on the oscilloscope (see Figure 6-25). The waveform shape and amplitude remains constant throughout the guard-band.
22. Once the guard band has been located use the tool to move the cartridge servc head toward the disk center until cylinder number zero is reached. This can be determined by the meter reading of null (centered) and a scope waveform as shown in Figure 6-26. Remove the head alignment tool.

NOTE

Steps 21 and 22 should be repeated to insure that cylinder zero is captured.

23. Perform a seek to cylinder 404. Null meter should be set to its least sensitive range.
24. Install Carriage Locking Tool P/N 75891573. See Figure 6-27.
    a. Allow drive temperature to stabilize for 5 minutes at this cylinder.
25. Calculate the offset using the following procedure:
    - Oscilloscope waveform should be similar to Figure 6-26.
    - Set null meter to its least sensitive range (switch S3 of AZPV or HFSV PWA must be on "X1").
    - Move S1 of AZPV or HFSV PWA to "P" and record meter reading.
    - Calculate the offset as described below.

      (P) - (N) = OFFSET

      P is the meter reading with the POS/NEG switch in the POS position. N is the meter reading with the POS/NEG switch in the NEG position. Meter readings to the right of zero are positive. Meter readings to the left of zero are negative.

      EXAMPLE 1: P=+20, N=_15; (P) - (N) = (20) - (15) = 5
      EXAMPLE 2: P=+20, N=-15; (P) - (N) = (20) - (-15) = 35
      EXAMPLE 3: P=-20, N=+15; (P) - (N) = (-20) - (+15) = -35

26. Insert the head alignment tool again and remembering to offset any force applied by the tool hand with the other hand, adjust the cartridge servo head position to obtain a calculated offset of less than ±50 mV.
27. Torque the servo head clamping screw to 12 ±1/2 lbf-in (1.26 to 1.38 Nm).
28. Re-calculate the offset and make any minor (only) adjustment required if the offset calculates to be greater than ±50 mV. A minor (but only minor) adjustment can be made after the clamping screw has been tightened.
29. REMOVE THE CARRIAGE LOCKING TOOL, BEING CAREFUL TO KEEP HANDS OUT OF THE WAY OF THE CARRIAGE IN CASE IT SHOULD RETRACT.

29a. Perform a seek to Cylinder 0 and insure that the waveform is similar to Figure 6-26.

29b. Perform a seek to Cylinder 822 and insure that the waveform is similar to Figure 6-26.

NOTE

If either Cylinder 0 or Cylinder 822 displays a waveform similar to Figure 6-25, guard band, repeat steps 18 through 29b.

30. Perform a seek to cylinder 8. Allow drive to stabilize five minutes at this cylinder.
31. Calculate the offset as in step 25. Record the offset calculated for later reference.
32. Seek to cylinder 800. Allow drive to stabilize for five minutes at this cylinder.
33. Calculate the offset as in step 25 and record the offset for later reference.

NOTE

Oscilloscope waveforms at cylinders 8 and 800 should be similar to Figure 6-26. Calculated offset should be less than ±600 mV. If either cylinder offset is greater than ±600 mV, repeat steps 23 through 33. Minor compensatory adjustments can be made at cylinder 404 in an attempt to effect the offset at cylinders 8 and 800. However, the final calculated offset can not exceed ±100 mV at cylinder 404.

34. Set the following switches to the positions given:
    - S1 of Servo Fine to "DATA".
    - S1 of Head Alignment Extender PWA to "NORMAL".
    - S1 of AZPV or HFSV PWA to "N".
    - S2 of AZPV or HFSV PWA to "R/W".
    - S3 of AZPV or HFSV PWA to "X1".
35. Command RTZ.

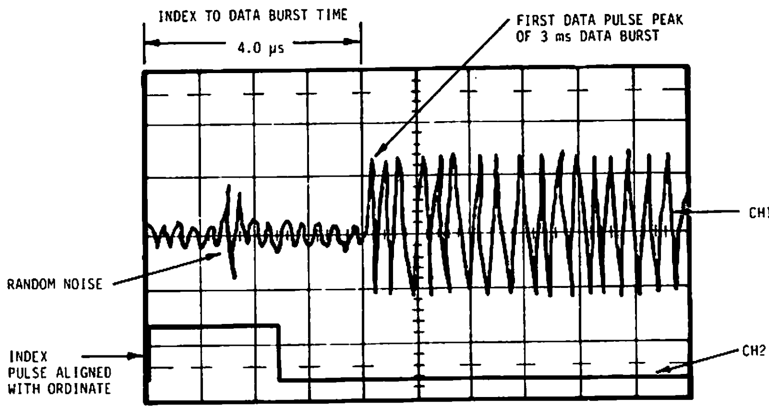
NOTE

This insures that the drive will servo on the cartridge servo and select data head 0.

36. Repeat Steps 23 through 33 for the cartridge data head.
37. Command an alternate seek between cylinders 257 and 512 for a minimum of 30 seconds.
38. Check the cartridge servo head alignment. To do this set the following switches to the positions given:
    - S1 of the Servo Fine PWA to "SERVO".
    - S1 of the Head Alignment Extender PWA to "FXD".
    - S1 of AZPV or HFSV PWA to "N".
    - S2 of AZPV or HFSV PWA to "R/W".
    - S3 of AZPV or HFSV PWA to "X1".

    Seek to cylinder 404, allow drive to stabilize 5 minutes and calculate the offset as in step 25 for the cartridge servo head. If the calculated offset is greater than 300 mV repeat steps 23 through 33 and then 37 and 38.
39. Check the cartridge data head alignment. To do this set the following switches to the positions given and perform the other operations as specified:
    - S1 of the Servo Fine PWA to "DATA".
    - S1 of the Head Alignment Extender PWA to "NORM".
    - Select head 0 (i.e., issue RTZ command).
    - Seek to cylinder 404, allow drive to stabilize for 5 minutes and calculate the offset for the cartridge data head as described in step 25. If the calculated offset exceeds 300 mV at any of these alignment cylinders repeat steps 34 through 39.

39a. Check index to burst for cartridge data head:
- Seek to cylinder 15.
- Observe waveform on oscilloscope. It should be similar to Figure 6-27.1. 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 6-27.1 INDEX TO BURST FORMAT

40. When head alignment is satisfactorily completed press the STOP/START switch to stop the drive and wait until the spindle drive motor has stopped.
41. Remove the CE cartridge and install the cartridge into its protective cover.
42. Write Protect switches on the operators panel can be released if desired.
43. Set the AC circuit breaker (rear of drive) to the OFF position.
44. Remove the head alignment kit from drive:
    - Meter
    - AZPV or HFSV PWA and extender PWA
    - Cable from R/W preamp PWA to Servo Fine PWA
    - Cable from extender PWA to Servo Fine PWA
45. Return the electronics Module to its normal position and install locking screws (Figure 6-5).

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.

46. Store the carriage locking tool in its normal operating position as shown in Figure 6-27.
47. Install the drive cover assembly.

CARTRIDGE DATA HEAD ALIGNMENT PROCEDURE

The procedure for aligning a newly replaced (per section 6.7.5) cartridge data read/write head is given in the following paragraphs.

CAUTION

Use only head alignment tool P/N 75893963 (7 in Figure 6-24). 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. End should have a polished surface where it enters the 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 7 (refer to Figure 6-24). The tool should slip easily through the alignment hold (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).

Refer to "INITIAL HEAD ALIGNMENT PROCEDURE" in performing the following steps for the CARTRIDGE DATA HEAD.

A. Perform steps 1 through 11.
B. Perform steps 14 through 17.
C. Perform steps 34 through 37.
D. Perform steps 39 through 47.

CARTRIDGE SERVO HEAD ALIGNMENT PROCEDURE

The procedure for aligning a newly replaced (per section 6.7.6) cartridge servo head is given in the following paragraphs.

CAUTION

Use only head alignment tool P/N 75893963 ( 7 in Figure 6-24). 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. 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 7 (refer to Figure 6-24). 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).

Refer to "INITIAL HEAD ALIGNMENT PROCEDURE" in performing the following steps for the CARTRIDGE SERVO HEAD.

A. Perform steps 1 through 11.
B. Perform steps 14 through 47.

FIXED DISK MODULE DATA READ/WRITE HEAD ALIGNMENT PROCEDURE

The procedure for aligning a newly replaced (per Section 6.7.7) fixed disk module data read/write head is given in the following paragraphs.

CAUTION

Use only head alignment tool P/N 75893963 (7 in Figure 6024). 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. 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 7 (refer to Figure 6-24). 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 recover 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.

a. Allow the drive to stabilize by running with heads loaded for a minimum of 15 minutes.
b. Seek to and attempt to read from the replaced head at cylinder 404 (a continuous loop read and error print-out is desired).
c. Install the carriage locking tool in the head alignment position as shown in Figure 6-27.
d. Connect an oscilloscope so as to be able to lock 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.
e. Torque the head clamping screw to 12 ±1/2 lbf-in (1.26 to 1.38 Nm) and re-adjust the head for zero error printout if necessary.
f. Repeat the fine tune adjustment step with the head alignment tool until the drive will read error free.
g. Remove the head alignment tool.
h. Remove carriage locking tool (see step 29). 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 and be rewritten on the surface covered by the newly replaced head.

i. Operate the STOP/START switch to the STOP position and wait for the drive to stop turning.
j. Set the AC circuit breaker to OFF.
k. Install case cover assembly.
l. Turn on AC circuit breaker and start the drive.

FIXED MODULE SERVO HEAD ALIGNMENT PROCEDURE

The procedure for aligning a newly replaced (per Section 6.7.8) fixed servo head is given in the following paragraphs.

CAUTION

Use only head alignment tool P/N 75893863 ( 7 in Figure 6-24). Use of a different tool can cause permanent damage to head/arm and carriage.

Inspect head adjustment tool for damage (nicked, scrateched, etc.) at adjustment end. 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 7 (refer to Figure 6-24). 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).

a. The fixed disk module servo head clamping screw should have been torqued to 4 1/2 lbf-in (0.4 Nm) when installed.
b. Plug the cartridge servo head connector into J3 (bottom header) of the Servo Preamp PWA.
c. Plug the fixed disk module servo head connector into J1 (top header).

Refer to "INITIAL ALIGNMENT PROCEDURE" in performing the following steps.
d. Perform steps 5 through 11 for the fixed disk module servo head.
e. Perform steps 15 through 33 for the fixed disk module servo head.
f. Perform steps 37, 38 and 40 for the fixed disk module servo head.

CAUTION

Make sure adjustment is on the fixed disk module servo head.

g. Set CB1 to the OFF position.
h. Plug the Cartridge servo head connector into header J1 of the Servo Preamp PWA.
i. Plug the fixed disk module servo head connector into header J3 of the Servo Preamp PWA.

NOTE

It is recommended that the data on the fixed disk module be recovered is re-formatted subsequent to completion of the alignment procedure involving a fixed pack servo.

j. Set AC circuit breaker to the ON Position.
k. Start the Drive.
l. Recover and reformat the fixed disk module data.
m. Stop the Drive.
n. Perform steps 43 through 47.

### 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 center rail 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 at inner track to check or adjust dimension C.
2. Check dimension C to insure that it is between 0.001 and 0.003 inches (0.25 - 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.
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 thick shim (0.003 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.

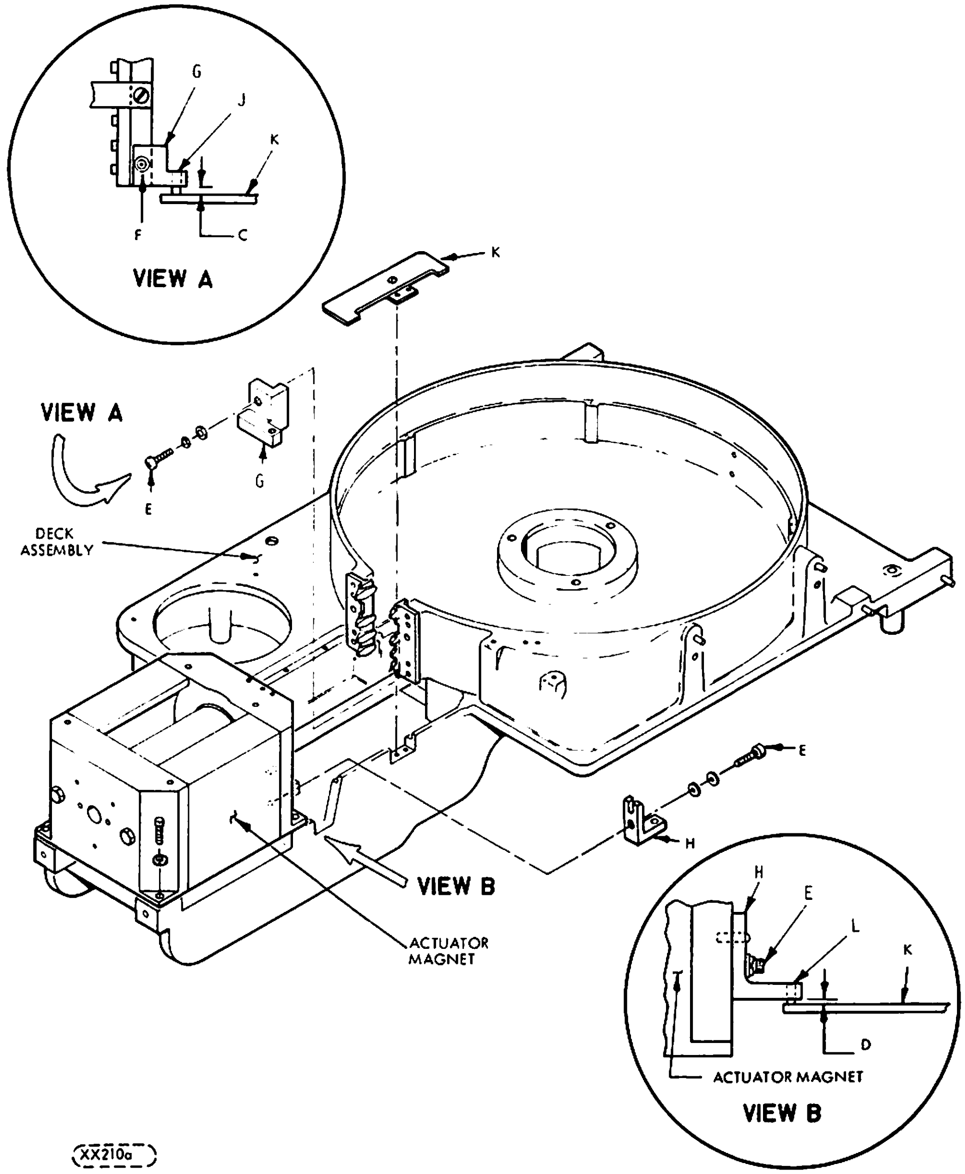



FIGURE 6-28. CARRIAGE RESTRAINT BLOCK ADJUSTMENT

## 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:<br>1. Resets the fault latches when in the non-microprocessor fault display mode.**<br>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 actuations display remainder of the cylinder addresses and a separator state.<br>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.<br>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. |
| 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 Clocks and Data. |
| S1 | Data/Servo Select | Servo Fine PWA | Used for head alignment. Selects either read data 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. |

TABLE 6-5. DESCRIPTION OF MAINTENANCE SWITCHES AND THEIR FUNCTIONS (SHEET 2 OF 2)

| SWITCH | NAME | LOCATION | FUNCTION |
|---|---|---|---|
| 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 adjustment. 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. |

*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.

***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 2)

| DISPLAY MODE | SWITCH/INDICATOR S1-#8 (SVO-CRSE) | CONTROL/MUX PWA S1 (SWITCH)** | CR1 | CR2 | CR3 | CR4 | CR5 | CR6 | CR7 | DESCRIPTION OF INDICATOR MEANING/FUNCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 1 (NH) | 0 | * | * | * | * | * | NO-HEAD-SELECTED FLT. Indicates that an attempt has been made to select a non-existant head. |
| 1 | 0 | 0 | * | 0 (MP) | * | * | * | * | * | CRs light 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. Indicates 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. Indicates a below normal voltage. |
| 1 | 0 | 0 | * | 0 | * | * | * | * | 1 (HS) | HEAD SELECT FLT. Indicates a multiple head select (2 or more heads selected). |
| 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. |
| 4 | 0 | A | 0 | 1 | $M_4$ | $M_3$ | $M_2$ | $M_1$ | $M_0$ | A hexidecimal coded, binary number (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. Table 6-7 lists all error codes and meaning of each. 0111111 indicates all M.P. Fault Summary Codes have been displayed. |
| . | . | . | . | . | . | . | . | . | . | |
| . | . | . | . | . | . | . | . | . | . | |
| . | . | | | ETC. | | | ETC. | | | |
| . | . | . | . | . | . | . | . | . | . | |
| . | . | . | . | . | . | . | . | . | . | |
| . | . | . | . | . | . | . | . | . | . | |
| . | . | . | . | . | . | . | . | . | . | |
| 4 | 0 | XA | 0 | 1 | $M_4$ | $M_3$ | $M_2$ | $M_1$ | $M_0$ | |
| 4 | 0 | A | 0 | 1 | 1 | 1 | 1 | 1 | 1 | |

TABLE 6-6. INTERPRETATION OF CONTROL/MUX FAULT DISPLAY INDICATORS (SHEET 2 OF 2)

| DISPLAY MODE | SWITCH/INDICATOR | | | | | | | | | DESCRIPTION OF INDICATOR MEANING/FUNCTION |
|---|---|---|---|---|---|---|---|---|---|---|
| | S1-#8 (SVO-CRSE) | CONTROL/MUX PWA | | | | | | | | |
| | | S1 (SWITCH)** | CR1 | CR2 | CR3 | CR4 | CR6 | CR7 | | |
| 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. |
| 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".

*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's "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 on the ON position and S1 on the Control/Mux PWA being in the OFF position. *One or more of the fault indicators 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.

*Even though S1-#8 is ON no faults will be displayed unless the Microprocessor causes them to be displayed.

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 abofe 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. 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 acutation 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 ofS1 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 Srvo-Coarse PWA is place 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 START/STOP | 01111 | SPINDLE DID NOT START/STOP IN 2 MINUTES AFTER ERSLO/ERSTP WAS NOTED (10000/10100) |
| 10 START ~~STOP~~ | 10000 | SPINDLE START GREATER THAN 70 SEC |
| 11 START | 10001 | NO SPINDLE MOVEMENT |
| 12 START | 10010 | NO DRIVE TO SOLID STATE RELAY |
| 13 START | 10011 | SOLID STATE RELAY FAILURE |
| 14 STOP | 10100 | STOP TIMEOUT |
| 15 HEAD RETRACT | 10101 | EMERGENCY RETRACT FAILURE |
| 16 | 10110 | NORMAL RETRACT FAILURE |
| 17 SEEK NO PHASE CODE | 10111 | CYLINDER ADDRESS GREATER THAN 822 |
| 18 IDLE + OFFSET 4 | 11000 | OFF TRACK GREATER THAN 1200 USEC |
| 19 RTZ/HEAD LOAD PHASE 7 | 11001 | UNEXPECTED AGC IN HEAD LOAD |
| 1A SEEK 2/3/6 | 11010 | RTZ/HEAD LOAD 0A LOST AGC (DIBITS) IDLE + OFFSET 4/B/C |
| 1B SEEK NO PHASE CODE | 11011 | IDLE + OFFSET RPM FAULT |
| 1C IDLE + OFFSET | 11100 | LOST SPEED PULSES |
| 1D SEEK 1/2/3/6 | 11101 | HEAD RETRACT ALLOWED TIME EXPIRED RTZ/HEAD LOAD 5/7/8/A/9 IDLE + OFFSET C |
| 1E SEEK 3 | 11110 | RTZ/HEAD LOAD 0A NO TRACK LOCK IN SETTLING IDLE + OFFSET 4/C |
| 1F | 11111 | MICROPROCESSOR FAULT CODE SUMMARY READOUT IS COMPLETE |

*CR3-CR7. "1" means light on. "0" 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

| | 10 | 11 | 12 ERROR | 13 | 14 | F |
|---|---|---|---|---|---|---|
| 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

| | 17 | 1A | 1D ERROR | 1E | 1B |
|---|---|---|---|---|---|
| PHASE | 10111 | 11010 | 11101 △1 | 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

| | 19 | 1A | 1B ERROR | 1C | 1D | 1E |
|---|---|---|---|---|---|---|
| PHASE | 11001 | 11010 | 11011 | 11100 | 11101 | 11110 |
| 05 | | | | | X | |
| 07 | X | | | | X | |
| 08 | | | | | X | |
| 0A | | X | | | X | X |
| 09 | | | | | X | |
| No Phase Code Sotred | | | | | | |

△1 500 ms TIME LIMIT

△2 300 ms TIME LIMIT

## TABLE 6-8D. HEAD RETRACT

| | 1D ERROR | 15 |
|---|---|---|
| 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

| | 1A | 1E | 1D | 18 | 1C | 1B |
|---|---|---|---|---|---|---|
| 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 |

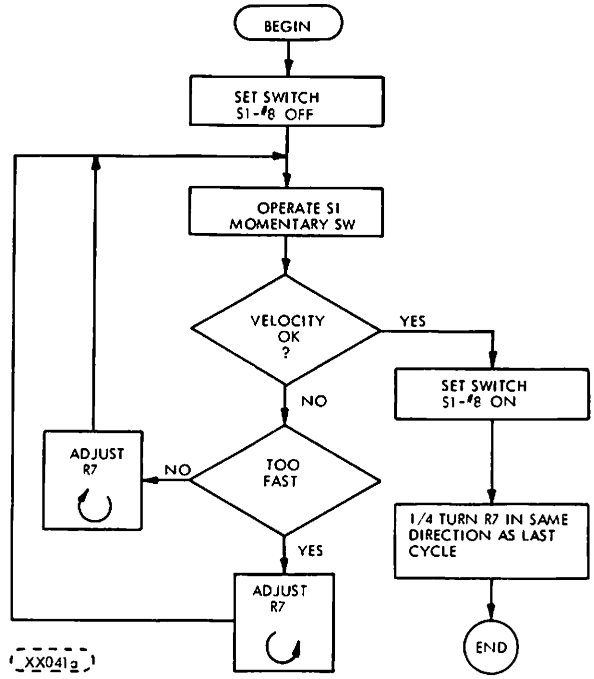
△1 ONLY IF 11000 ALSO PRESENT

△2 20 ms TIME LIMIT

### 6.9.2 TEST POINTS

The test points on each of the printed wiring assembly boards are shown in Figures 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.

VELOCITY GAIN ADJUSTMENT (OPERATOR ACTION)




FAULT DISPLAY LOGIC FLOW (ON CNTL/MUX PWA)

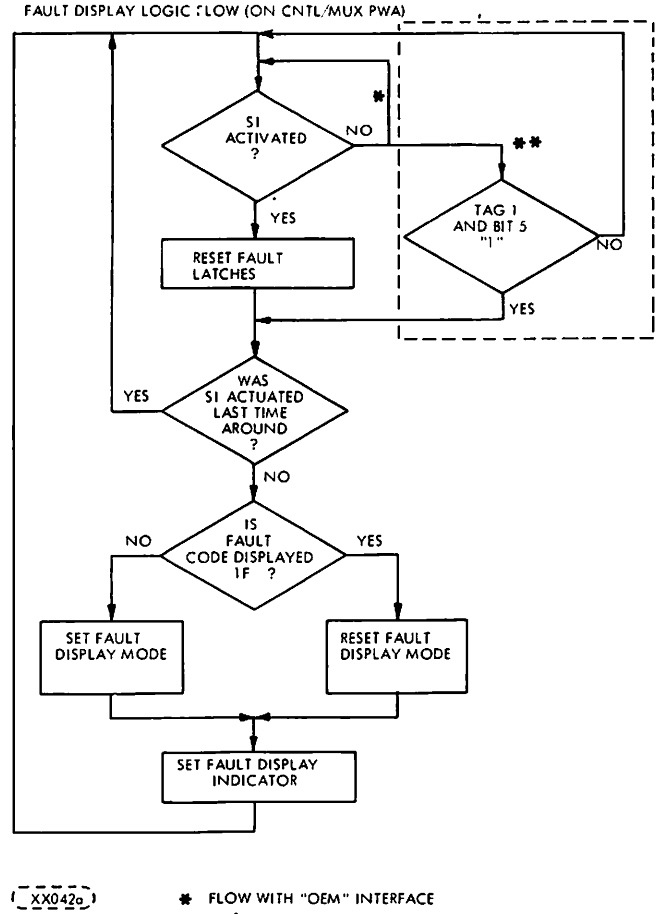



FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC
(SHEET 1 OF 2)

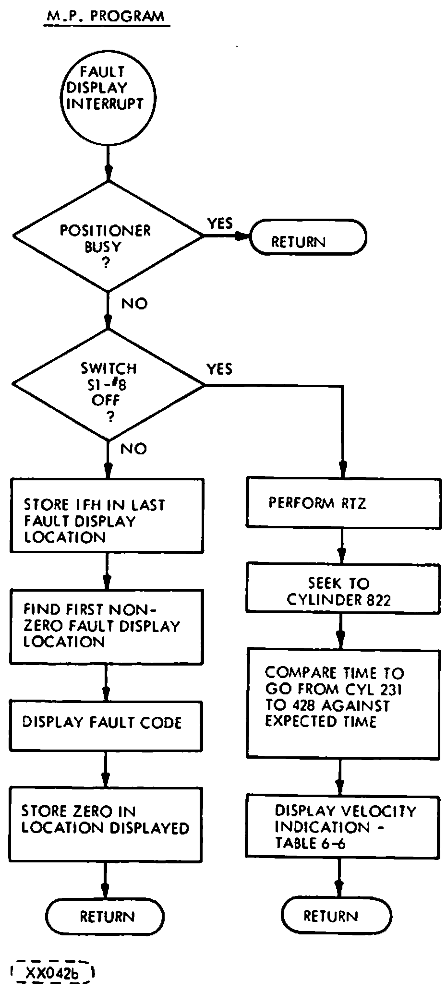



FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC (SHEET 2 OF 2)

## 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 postion. (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 lbs-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. Lower the deck to its normal position. Refer to Paragrqph 6.7.2, Steps 5 thru 10.
13. Connect AC line cord to 50 Hz power source.
14. Power up drive per Paragraph 2.3.1.
15. Restore unit to normal operation.

## 6.9.4 CONVERSION OF CMD UNIT FROM 50 Hz TO 60 Hz

To convert form 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 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 colllar 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 lbs-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 rotatiang the spindle pack hub in a counterclockwise direction. Rotate the spindle pulley several revolutions to seat the belt on pulley.
12. Lower the deck to its normal position. Refer to Paragraph 6.7.2, Steps 5 thru 10.
13. Connect AC line cord to 60 Hz power source.
14. Power up drive per Paragraph 2.3.1.
15. Restore unit to normal operation.

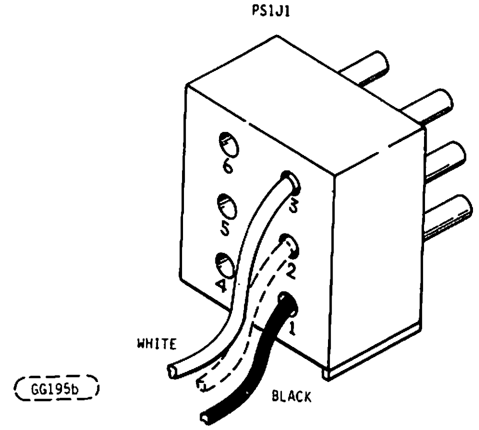



FIGURE 6-30. WIRE CHANGE TO PLUG PS1-J1.

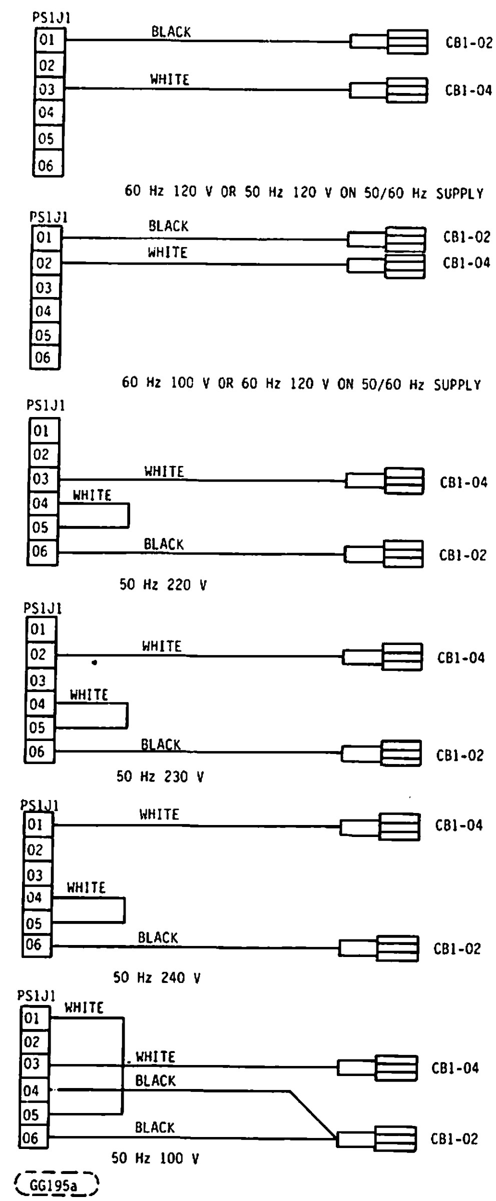



FIGURE 6-31. POWER SUPPLY TO CIRCUIT BREAKER HOOK UP

## 6.11 PHOENIX POWER SUPPLY AND AMPLIFIER PROBLEM ISOLATION PROCEDURE

### 6.11.1 INTRODUCTION

The Phoenix CMD has power supply anomolies 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 case, this particular condition will damage a power amplifier. If it appears that during troubleshooting that 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 exist where the heads home switch is defective and the microprocessor does not know that a move to the home 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 anomoly 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.

CAUTION

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 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 4 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

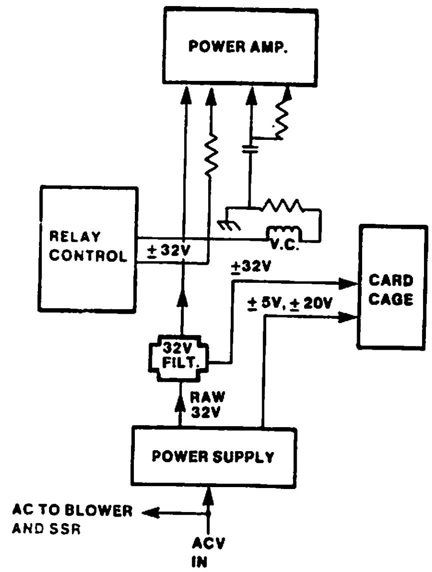



Figure 6-38 Basic Block for AC-DC

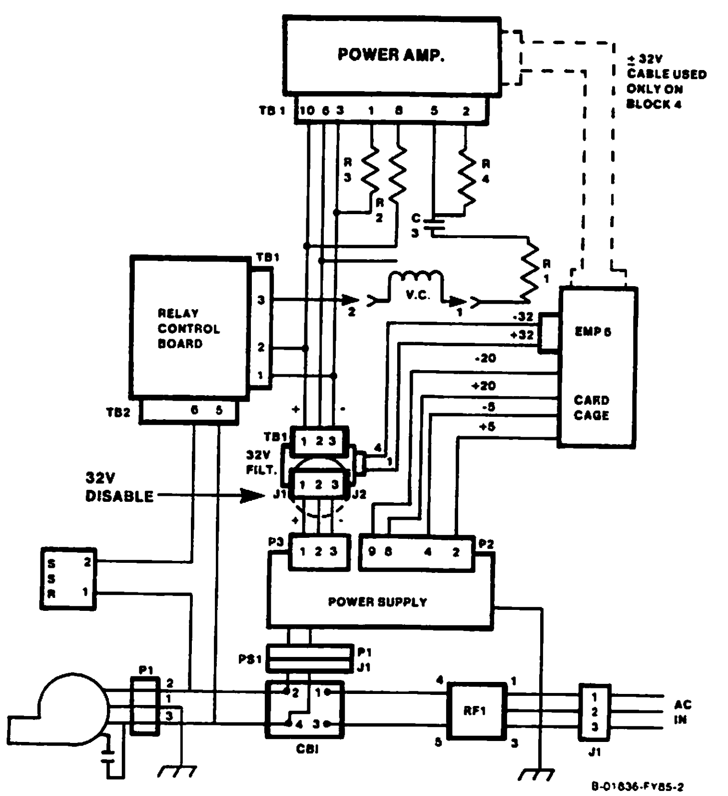



Figure 6-39 Power Circuitry Schematic

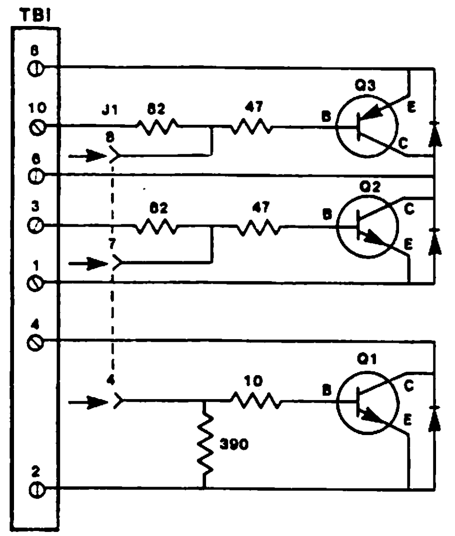



Figure 6-40 Representive Power Amplifier Schematic

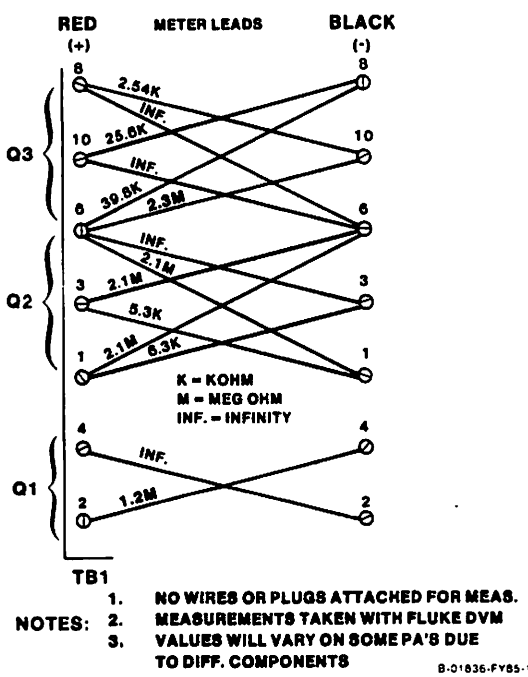



Figure 6-41 Power Amplifier Resistance Chart

## 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 recommended, 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

- Lists all parts in numeric sequence (by Identification Number), in conjunction with the referenced sheet number (third column) and illustrations.
- Defines the physical locations of each item identified.

### 7.7.4 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, etc.

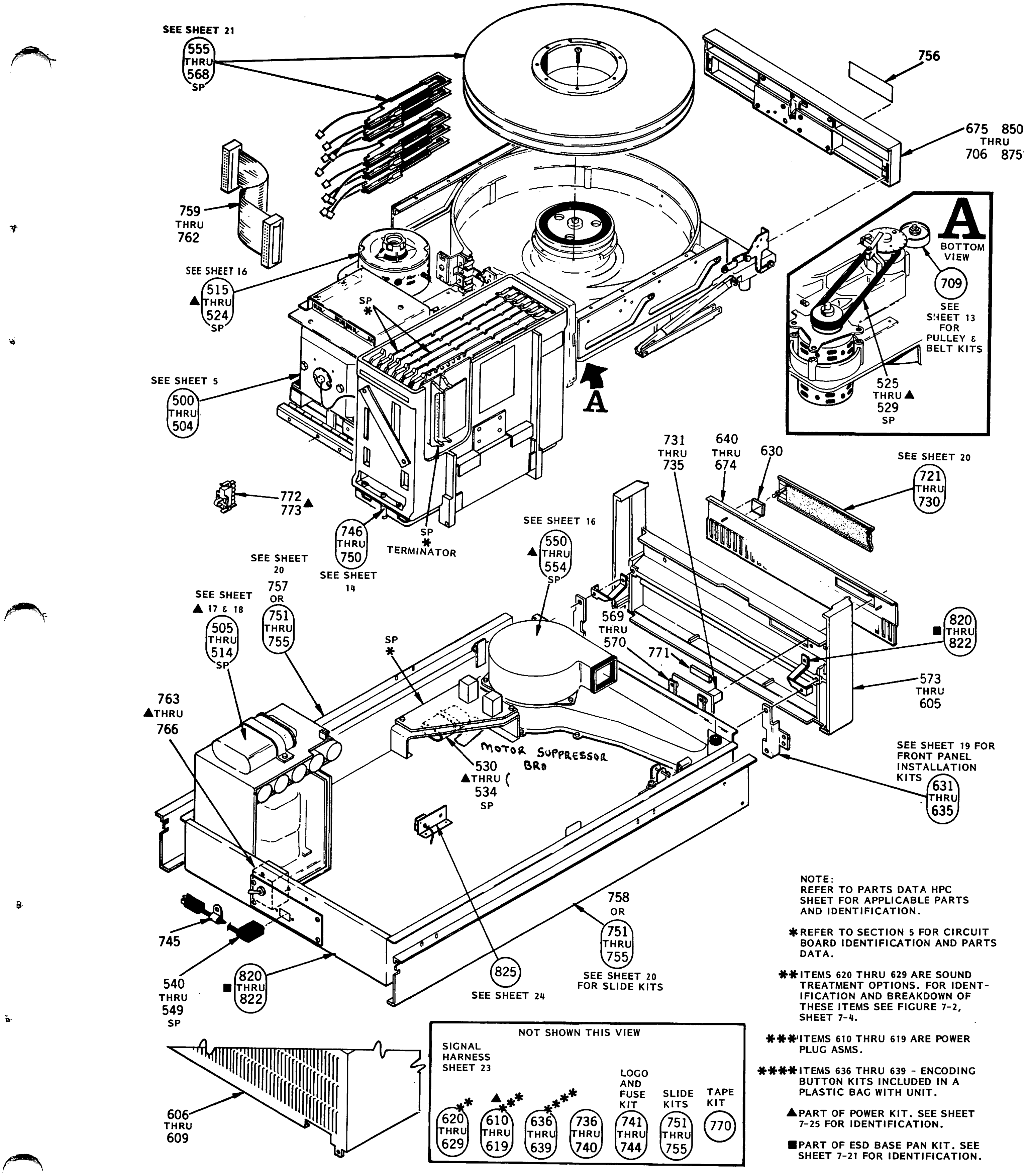
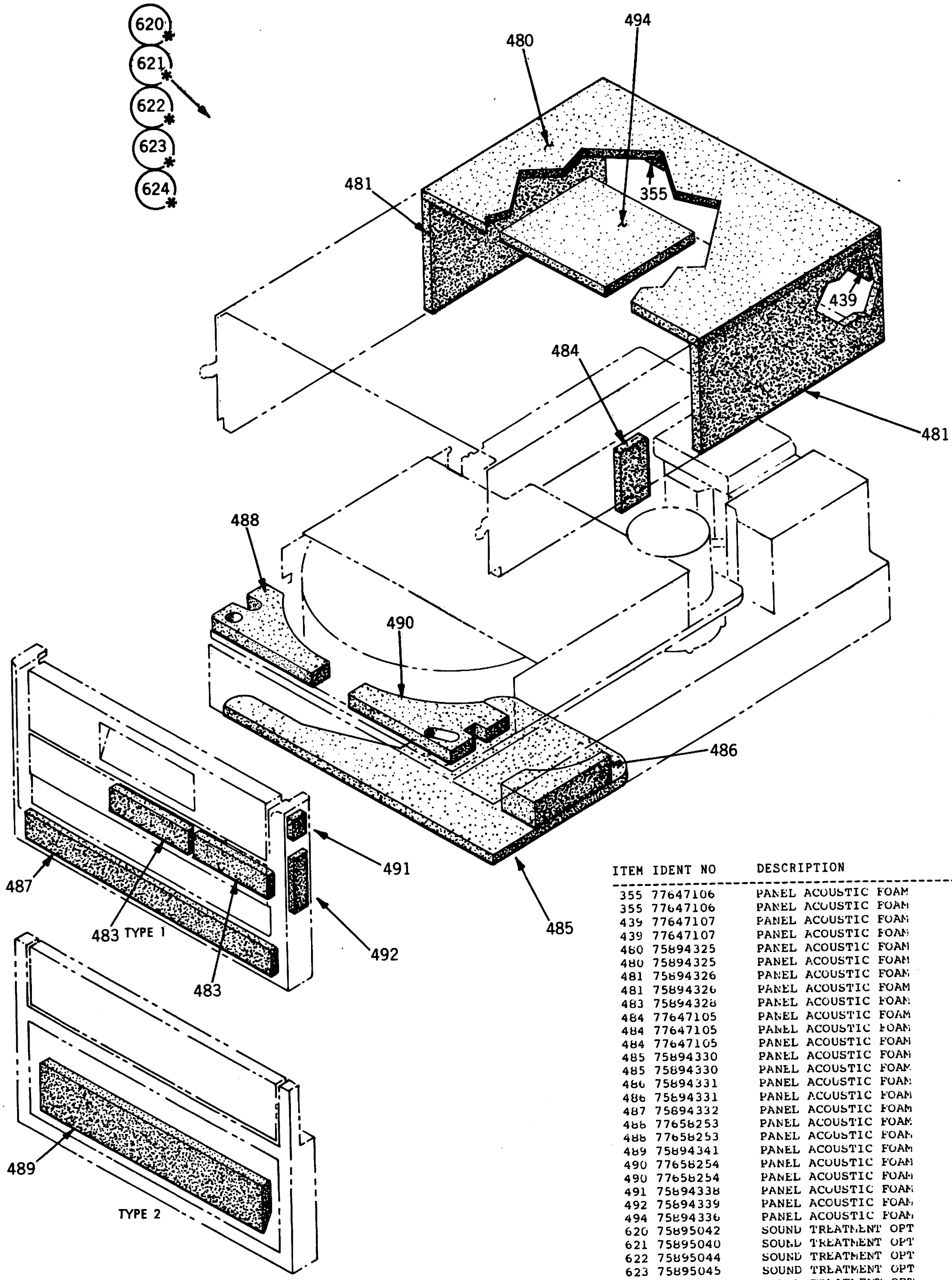


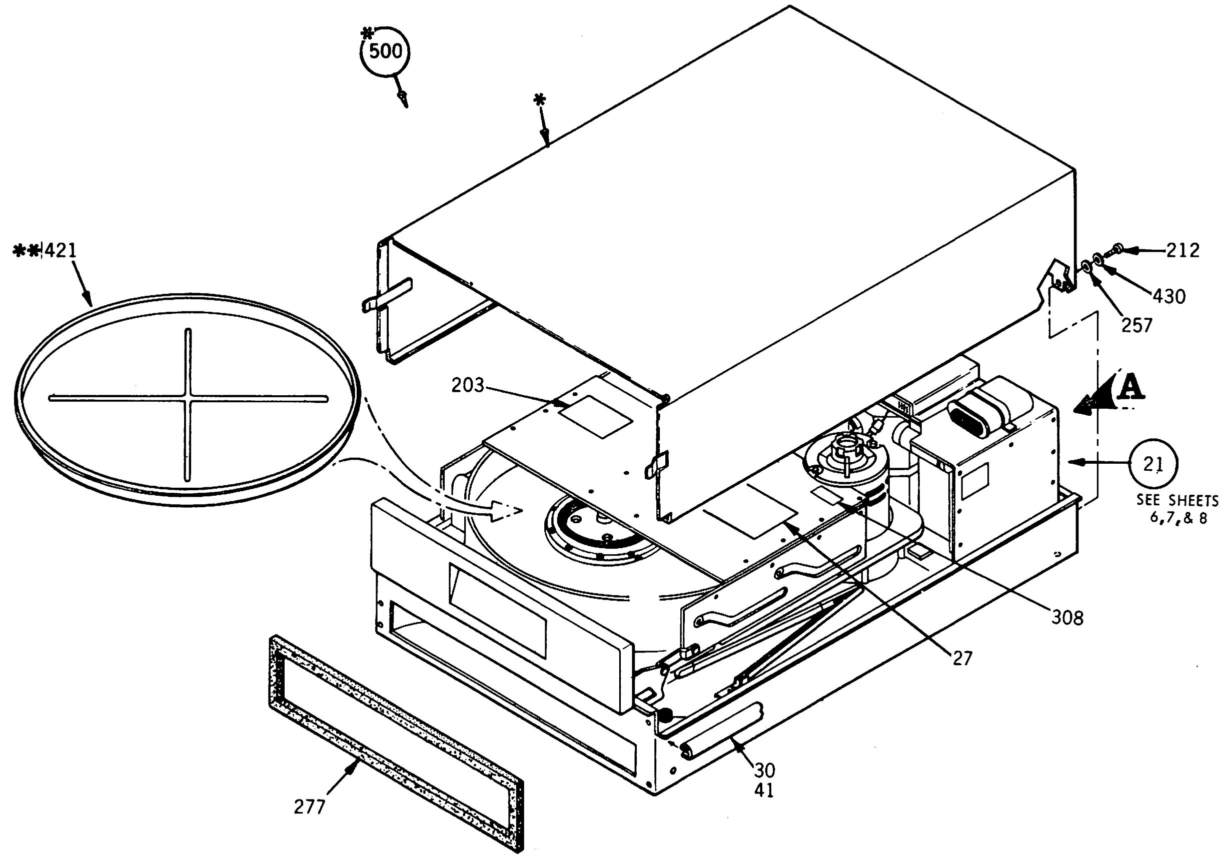

FIGURE 7-1. PRODUCT CONFIGURATION



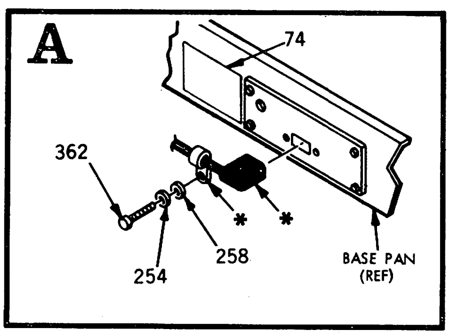

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 355 | 77647106 | PANEL ACOUSTIC FOAM | 622, 623 |
| 355 | 77647106 | PANEL ACOUSTIC FOAM | 620, 621 |
| 439 | 77647107 | PANEL ACOUSTIC FOAM | 622, 623 |
| 439 | 77647107 | PANEL ACOUSTIC FOAM | 620, 621 |
| 480 | 75894325 | PANEL ACOUSTIC FOAM | 621, 622 |
| 480 | 75894325 | 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 | 624 |
| 484 | 77647105 | PANEL ACOUSTIC FOAM | 622, 623 |
| 485 | 75894330 | PANEL ACOUSTIC FOAM | 621, 622 |
| 485 | 75894330 | PANEL ACOUSTIC FOAM | 623, 624 |
| 486 | 75894331 | PANEL ACOUSTIC FOAM | 623, 624 |
| 486 | 75894331 | PANEL ACOUSTIC FOAM | 621, 622 |
| 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 |

* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION

FIGURE 7-2. SOUND TREATMENT OPTION

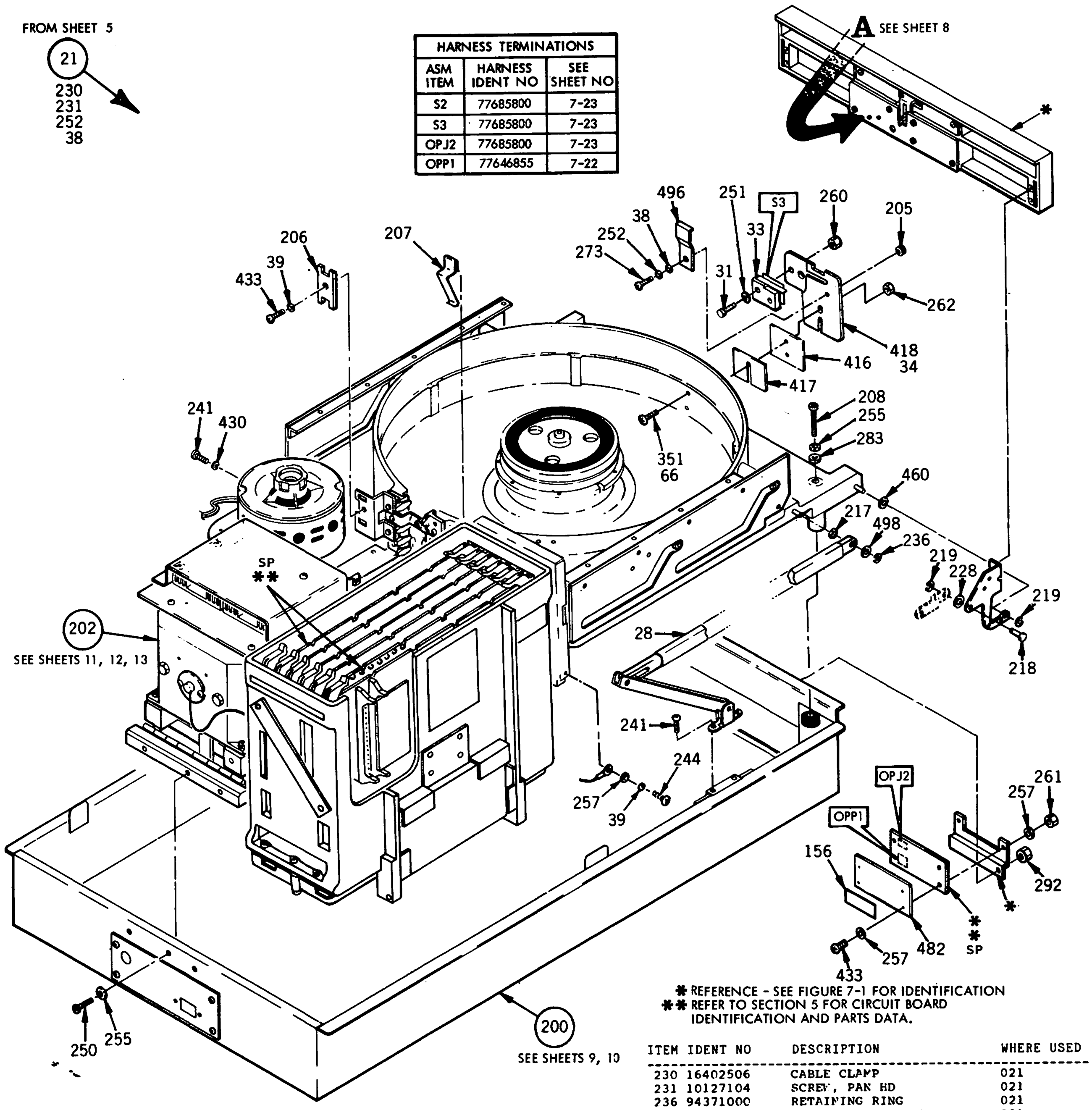



*REFERENCE - SEE FIGURE 7 - 1 FOR IDENTIFICATION
**ITEM 421 IS A DUST COVER FOR USE IN CARTRIDGE AREA WHENEVER A CARTRIDGE IS NOT PRESENT




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 021 | 77665750 | FINAL MECHANICAL ASM | 500 |
| 027 | 75893356 | INSTRUCTION LABEL | 500 |
| 030 | 76423600 | GASKET | 500 |
| 041 | 95033900 | ADHESIVE | 500 |
| 074 | 75880242 | LABEL | 500 |
| 203 | 75893355 | LABEL | 500 |
| 212 | 77617049 | SCREW, PAN HD | 500 |
| 254 | 10125804 | WASHER, SPR LOCK | 500 |
| 257 | 10125605 | WASHER, PLAIN | 500 |
| 258 | 10125606 | WASHER, PLAIN | 500 |
| 277 | 63410516 | GASKET STRIP | 500 |
| 308 | 75790000 | DECAL | 500 |
| 362 | 10127123 | SCREW | 500 |
| 421 | 90603300 | CLOSURE | 500 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 500 |
| 500 | 77669983 | TOP LEVEL ASM | HPC |

FIGURE 7-3. TOP LEVEL ASSEMBLY



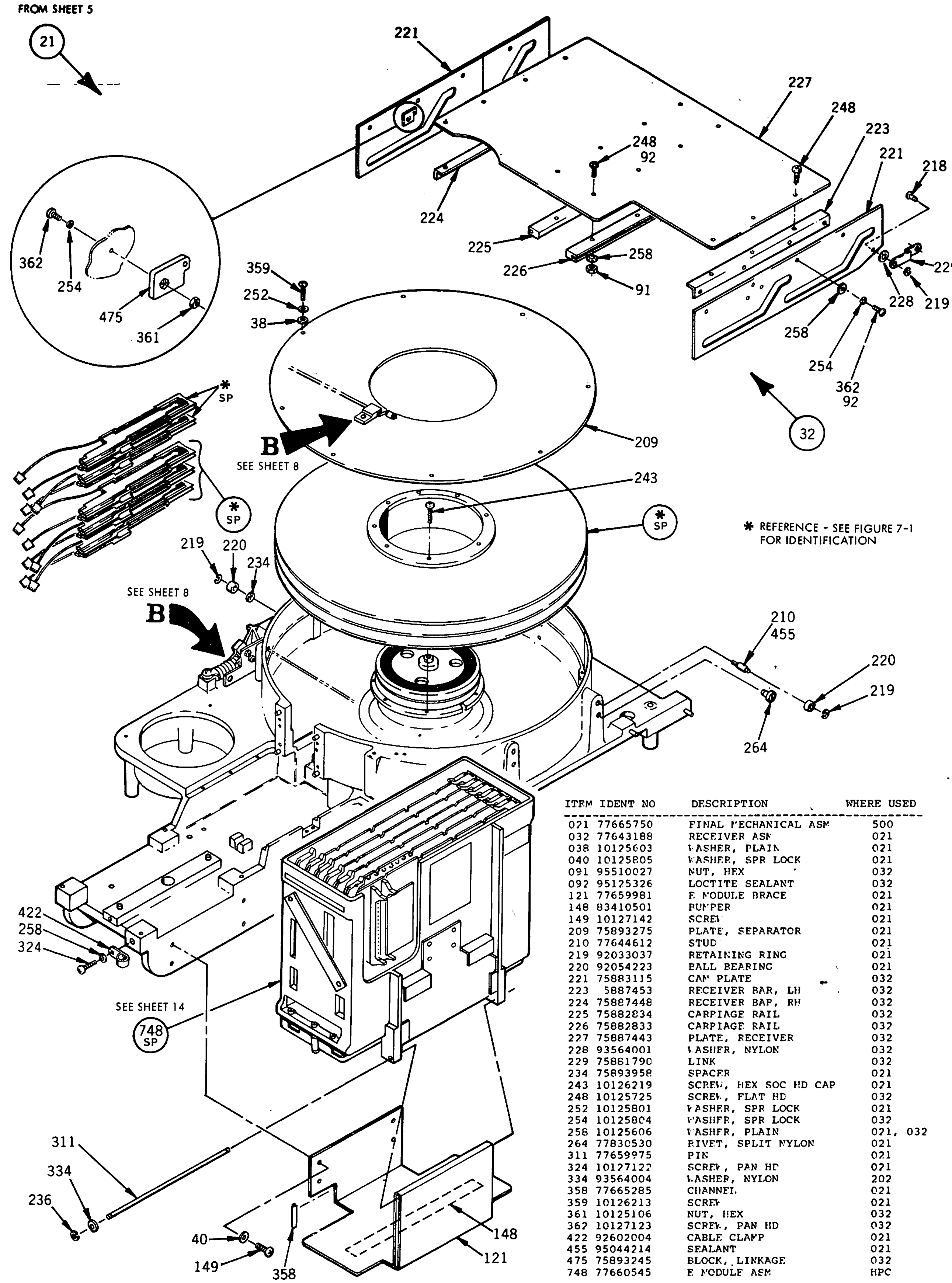

| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| S2 | 77685800 | 7-23 |
| S3 | 77685800 | 7-23 |
| OPJ2 | 77685800 | 7-23 |
| OPP1 | 77646855 | 7-22 |

* 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 | DECK SUPPORT LH | 021 |
| 029 | 75881129 | DECK SUP RH (NOT SHOWN) | 021 |
| 031 | 92742011 | SCREW, PAN HD | 021 |
| 033 | 94364401 | SWITCH | 021 |
| 034 | 95105904 | POLYESTER TAPE | 021 |
| 038 | 10125603 | WASHER, PLAIN | 021 |
| 039 | 10125803 | WASHER, SPR LOCK | 021 |
| 066 | 77611448 | ADHESIVE | 043 |
| 071 | 75806501 | FLAT WASHER | 021 |
| 156 | 77647108 | ACOUSTIC FOAM | 021 |
| 201 | 77665760 | BASE PAN ASM | 021 |
| 202 | 77665770 | DECK ASM | 021 |
| 205 | 95523400 | BUMPER | 021 |
| 206 | 75893107 | RETAINER, HEAD CONN | 021 |
| 207 | 77681505 | RETAINER, HEAD CONN | 021 |
| 208 | 10126263 | SCREW, SOCKET HEAD | 021 |
| 217 | 75892811 | WASHER, SHOULDER | 021 |
| 218 | 75892221 | PIN | 021 |
| 219 | 92033037 | RETAINING RING | 021 |
| 228 | 93564001 | WASHER, NYLON | 021 |

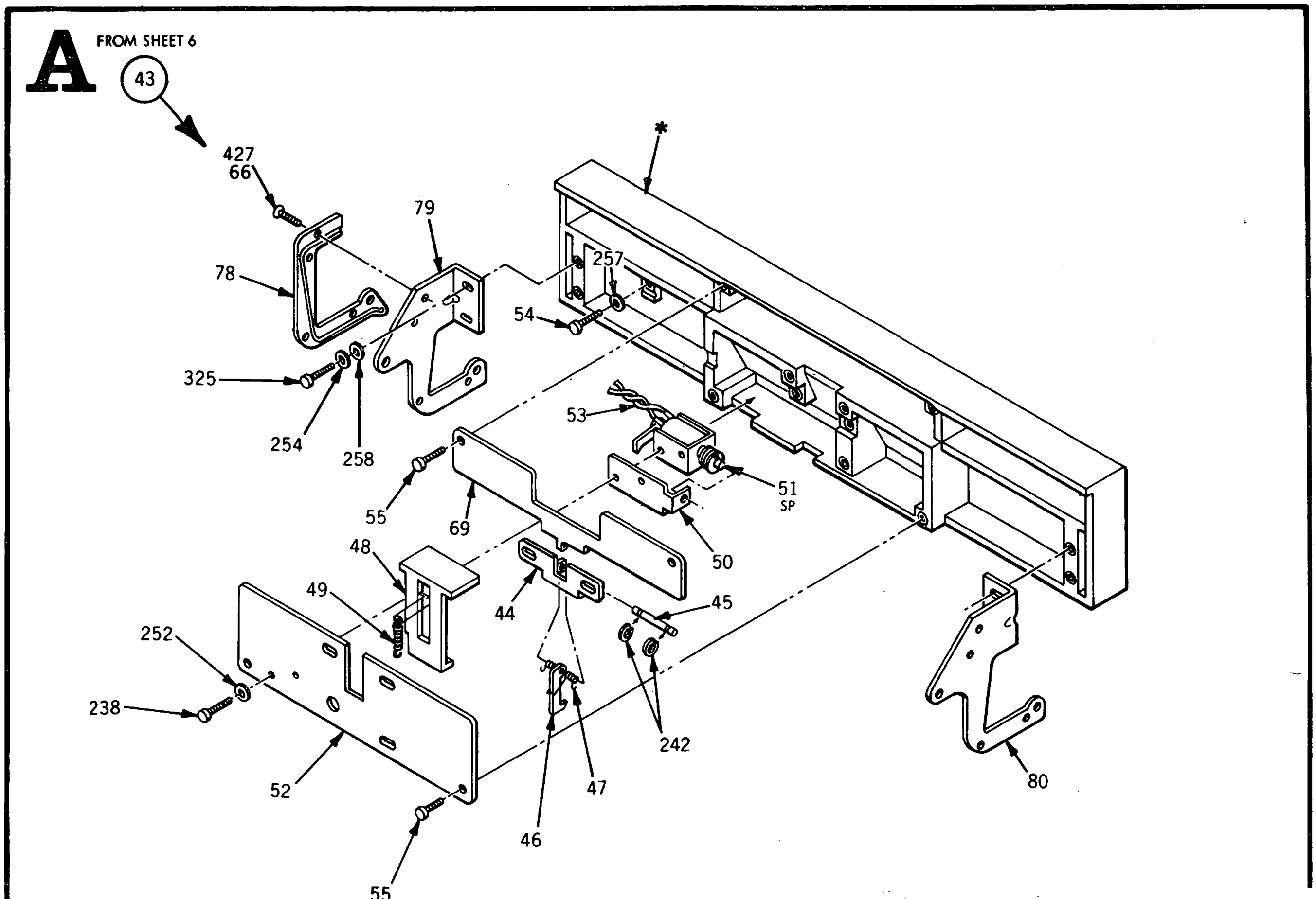
| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 230 | 16402506 | CABLE CLAMP | 021 |
| 231 | 10127104 | SCREW, PAN HD | 021 |
| 236 | 94371000 | RETAINING RING | 021 |
| 241 | 93592158 | SCREW, HEX ASH HD | 021 |
| 244 | 10127113 | SCREW, PAN HD | 021 |
| 250 | 10126253 | SCREW, HEX SOC HD CAP | 021 |
| 251 | 10125800 | WASHER, SPR | 021 |
| 252 | 10125801 | WASHER, SPR LOCK | 021 |
| 256 | 10125602 | WASHER, PLAIN | 021 |
| 257 | 10125605 | WASHER, PLAIN | 021 |
| 260 | 10125102 | NUT-HEX | 021 |
| 261 | 53777902 | NUT & WASHER | 021 |
| 262 | 53777903 | NUT & WASHER | 021 |
| 273 | 92745011 | SCREW | 021 |
| 283 | 77619805 | WASHER | 021 |
| 292 | 53777900 | NUT & CAPTIVE WASHER | 021 |
| 351 | 10127127 | SCREW | 021 |
| 416 | 75882106 | SHIM, STRIKER | 021 |
| 417 | 75882105 | BLOCK, SPACER, STRIKER | 021 |
| 418 | 75895215 | STRIKER | 021 |
| 429 | 10127112 | SCREW, PAN HD | 021 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 021 |
| 433 | 10127114 | SCREW, PAN HD | 021 |
| 460 | 75883025 | SPACER, NYLON | 021 |
| 482 | 75803804 | INSULATOR, FISHPAPER | 021 |
| 496 | 75893211 | BRACKET | 021 |
| 498 | 75887251 | WASHER, NYLON | 021 |

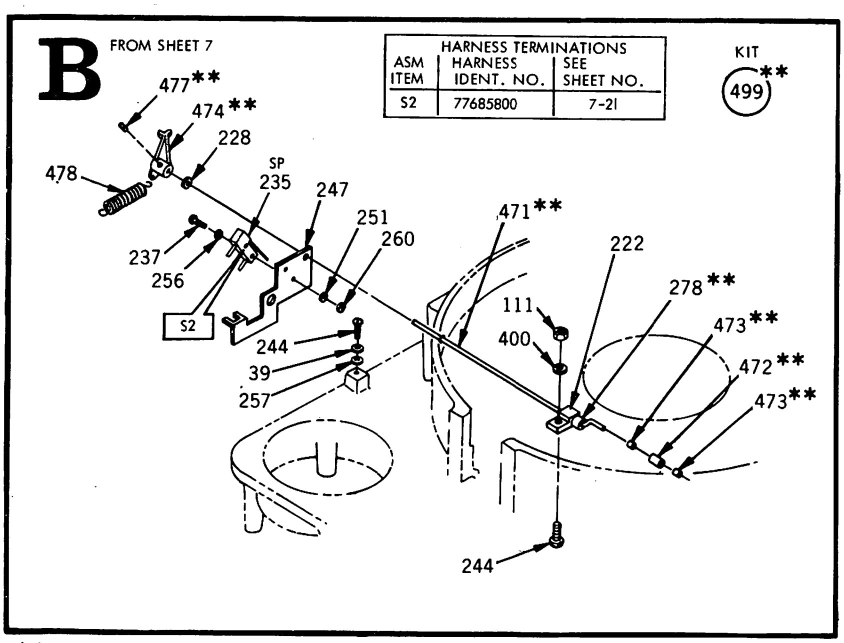
FIGURE 7-4. FINAL MECHANICAL ASM (SHEET 1 of 3)




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 021 | 77665750 | FINAL MECHANICAL ASM | 500 |
| 032 | 77643188 | RECEIVER ASM | 021 |
| 038 | 10125603 | WASHER, PLAIN | 021 |
| 040 | 10125805 | WASHER, SPR LOCK | 021 |
| 091 | 95510027 | NUT, HEX | 032 |
| 092 | 95125326 | LOCTITE SEALANT | 032 |
| 121 | 77659981 | E MODULE BRACE | 021 |
| 148 | 83410501 | BUMPER | 021 |
| 149 | 10127142 | SCREW | 021 |
| 209 | 75893275 | PLATE, SEPARATOR | 021 |
| 210 | 77644612 | STUD | 021 |
| 219 | 92033037 | RETAINING RING | 021 |
| 220 | 92054223 | BALL BEARING | 021 |
| 221 | 75883115 | CAM PLATE | 032 |
| 223 | 5887453 | RECEIVER BAR, LH | 032 |
| 224 | 75887448 | RECEIVER BAR, RH | 032 |
| 225 | 75882834 | CARRIAGE RAIL | 032 |
| 226 | 75882833 | CARRIAGE RAIL | 032 |
| 227 | 75887443 | PLATE, RECEIVER | 032 |
| 228 | 93564001 | WASHER, NYLON | 032 |
| 229 | 75881790 | LINK | 032 |
| 234 | 75893958 | SPACER | 021 |
| 243 | 10126219 | SCREW, HEX SOC HD CAP | 021 |
| 248 | 10125725 | SCREW, FLAT HD | 032 |
| 252 | 10125801 | WASHER, SPR LOCK | 021 |
| 254 | 10125804 | WASHER, SPR LOCK | 032 |
| 258 | 10125606 | WASHER, PLAIN | 021, 032 |
| 264 | 77830530 | RIVET, SPLIT NYLON | 021 |
| 311 | 77659975 | PIN | 021 |
| 324 | 10127122 | SCREW, PAN HD | 021 |
| 334 | 93564004 | WASHER, NYLON | 202 |
| 358 | 77665285 | CHANNEL | 021 |
| 359 | 10126213 | SCREW | 021 |
| 361 | 10125106 | NUT, HEX | 032 |
| 362 | 10127123 | SCREW, PAN HD | 032 |
| 422 | 92602004 | CABLE CLAMP | 021 |
| 455 | 95044214 | SEALANT | 021 |
| 475 | 75893245 | BLOCK, LINKAGE | 032 |
| 748 | 77660545 | E MODULE ASM | HPC |

FIGURE 7-5. FINAL MECHANICAL ASM (SHEET 2 of 3)



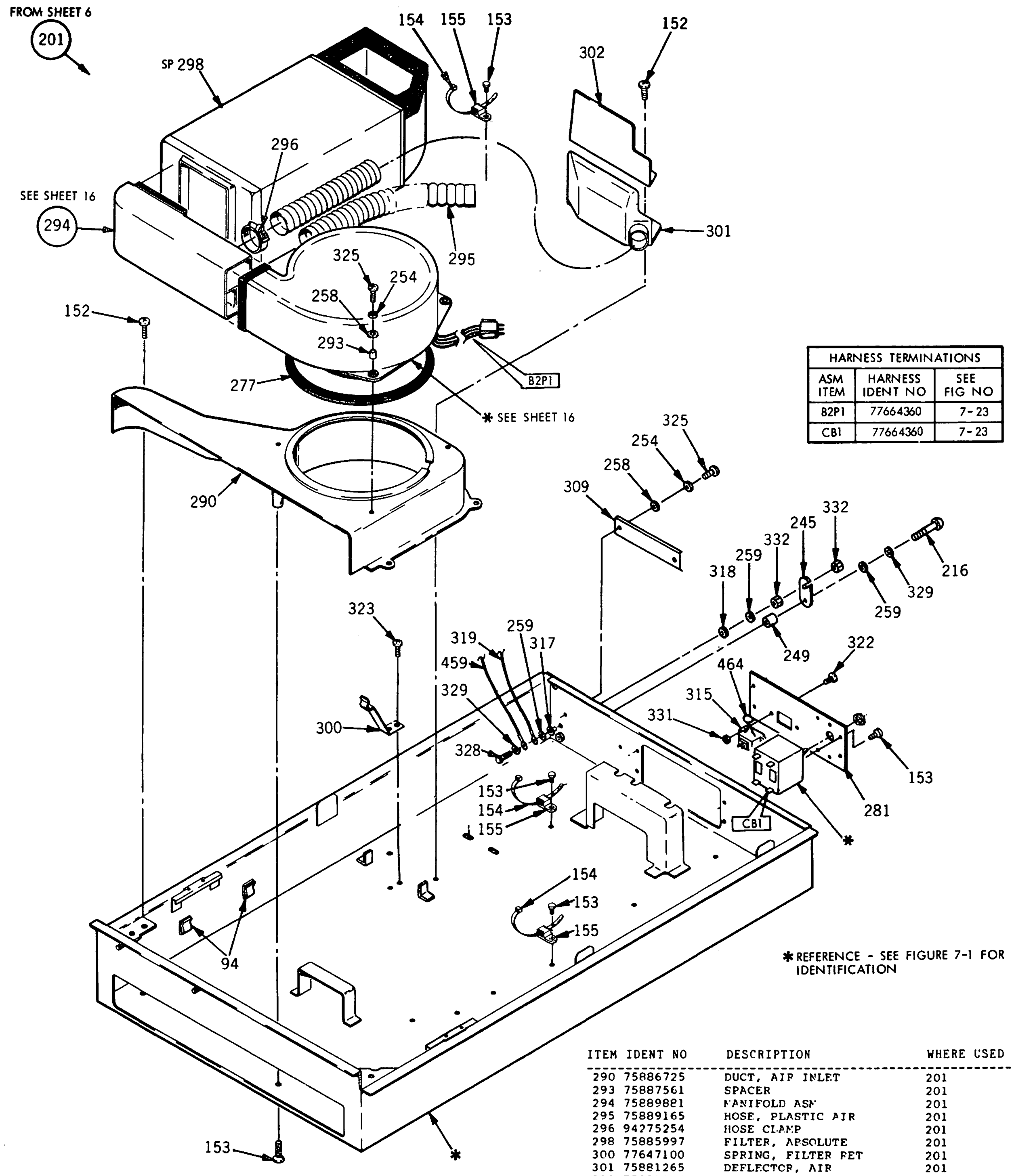




* REFERENCE - SEE FIGURE 7-I FOR IDENTIFICATION

** USED ON KIT 499

| ITEM | IDENT NO | DESCRIPTION | WHERE USED | |
|---|---|---|---|---|
| 021 | 77665750 | FINAL MECHANICAL ASM | 500 | |
| 039 | 10125803 | WASHER, SPR LOCK | 021 | |
| 043 | 75882667 | DOOR ASM | 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 | 75863056 | SOLENOID ASM | 043 | |
| 052 | 75882690 | LATCH COVER | 043 | |
| 053 | 75883466 | JUMPER WIRE ASM | 043 | |
| 054 | 94376917 | SCREW | 043 | |
| 055 | 94376918 | SCREW | 043 | |
| 066 | 77611448 | ADHESIVE | 043 | |
| 069 | 77641810 | COVER, DOOR | 043 | |
| 078 | 75892737 | WIRE GUARD | 043 | |
| 079 | 75894831 | HINGE | 043 | |
| 080 | 75894830 | HINGE | 043 | |
| 111 | 95510026 | NUT, HEX | 021 | |
| 222 | 75889492 | SUPPORT SHAFT | 021 | |
| 228 | 93564001 | WASHER, NYLON | 021 | |
| 235 | 77610140 | SW INTEGRAL LEVER | 021 | |
| 237 | 92745012 | SCREW, PAN HD | 021 | |
| 238 | 10127102 | SCREW, PAN HD | 043 | |
| 242 | 92033033 | RETAINING RING | 043 | |
| 244 | 10127113 | SCREW, PAN HD | 021 | |
| 247 | 77666619 | SWITCH PLATE | 021 | |
| 251 | 10125600 | WASHER, SPR | 021 | |
| 252 | 10125801 | WASHER, SPR LOCK | 043 | |
| 254 | 10125804 | WASHER, SPR LOCK | 043 | |
| 256 | 10125602 | WASHER, PLAIN | 201 | |
| 257 | 10125605 | WASHER, PLAIN | 021 | 043 |
| 258 | 10125606 | WASHER, PLAIN | 021 | 043 |
| 260 | 10125102 | NUT-HEX | 021 | |
| 278 | 75880482 | BEARING | 499 | |
| 325 | 10127124 | SCREW, PAN HD | 043 | |
| 400 | 77830611 | WASHER, PLAIN STEELE | 021 | |
| 427 | 10125702 | SCREW, FLAT HD | 043 | |
| 471 | 75883111 | SHAFT | 499 | |
| 472 | 75880482 | BEARING | 499 | |
| 473 | 75882455 | SPACER | 499 | |
| 474 | 75894895 | LEVER, CAM | 499 | |
| 477 | 77670257 | SET SCREW | 499 | |
| 478 | 77610461 | SPRING | 021 | |
| 499 | 75899599 | KIT, CART RELEASE | 021 | |

FIGURE 7-6. FINAL MECHANICAL ASM DETAILS (SHEET 3 of 3)



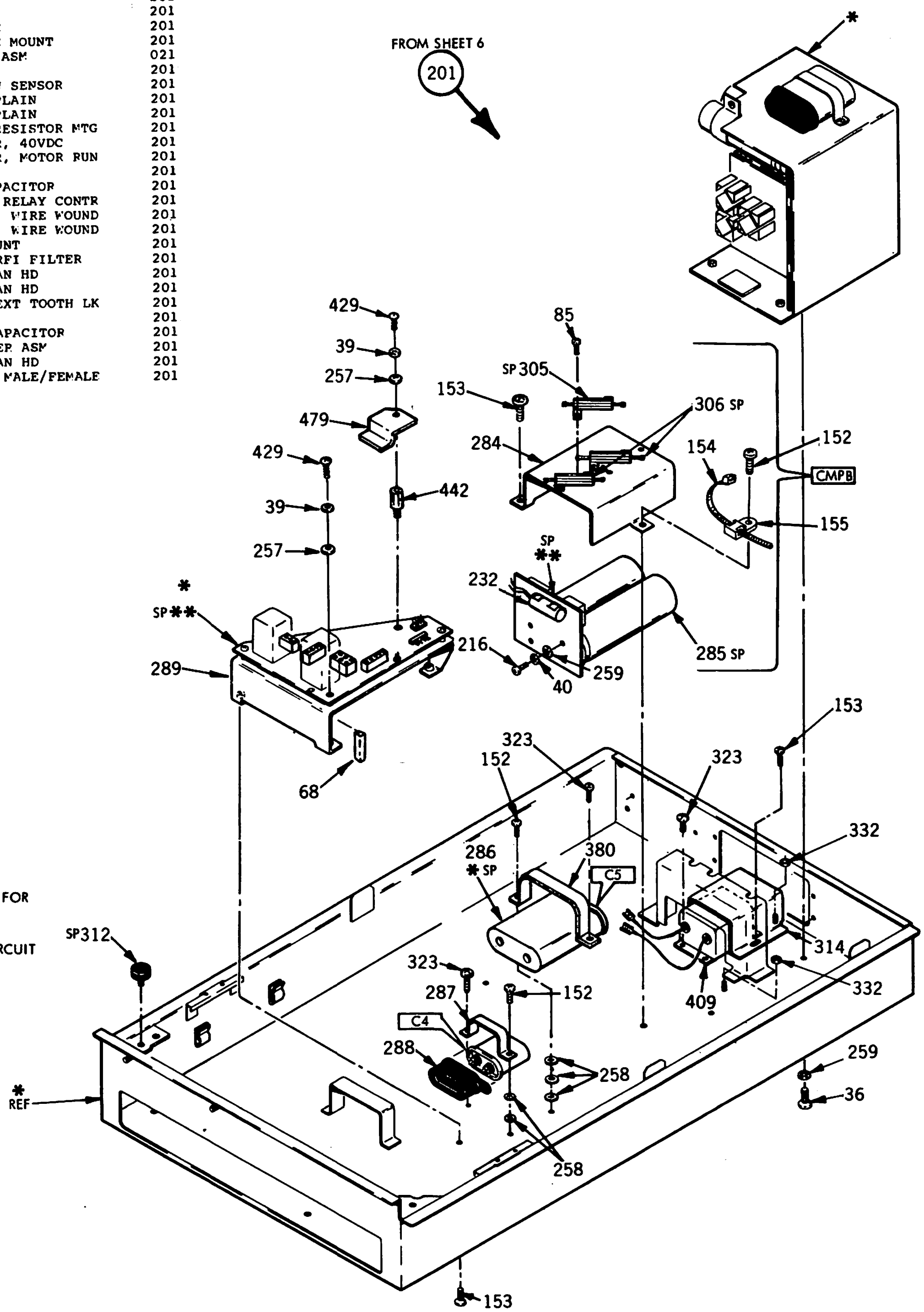

| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE FIG NO |
| B2P1 | 77664360 | 7-23 |
| CB1 | 77664360 | 7-23 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 094 | 91930600 | CLIP, ADHESIVE | 201 |
| 152 | 93749200 | SCREW | 201 |
| 153 | 93749198 | SCREW | 201 |
| 154 | 94277401 | CABLE TIE | 201 |
| 155 | 94343210 | CABLE TIE MOUNT | 201 |
| 201 | 77665760 | BASE PAN ASM | 021 |
| 216 | 10127143 | SCREW | 201 |
| 245 | 75883475 | GROUND STRAP | 201 |
| 249 | 95694202 | SPACER | 201 |
| 254 | 10125804 | WASHER, SPR LOCK | 201 |
| 258 | 10125606 | WASHER, PLAIN | 201 |
| 259 | 10125607 | WASHER, PLAIN | 201 |
| 277 | 83410518 | GASKET STRIP | 201 |
| 281 | 75882875 | PANEL, POWER ENTRY | 201 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 290 | 75886725 | DUCT, AIR INLET | 201 |
| 293 | 75887561 | SPACER | 201 |
| 294 | 75889881 | MANIFOLD ASM | 201 |
| 295 | 75889165 | HOSE, PLASTIC AIR | 201 |
| 296 | 94275254 | HOSE CLAMP | 201 |
| 298 | 75885997 | FILTER, ABSOLUTE | 201 |
| 300 | 77647100 | SPRING, FILTER RET | 201 |
| 301 | 75881265 | DEFLECTOR, AIR | 201 |
| 302 | 75891004 | COVER, AIR DEFLECTOR | 201 |
| 309 | 75893762 | CLAMP | 201 |
| 315 | 51870400 | AC PWR RECEPTACLE | 201 |
| 317 | 75062803 | WASHER, SHOULDER | 201 |
| 318 | 75062400 | WASHER, INSULATOR | 201 |
| 319 | 75883453 | WIRE JUMPER | 201 |
| 322 | 10127103 | SCREW, PAN HD | 201 |
| 323 | 93749196 | SCREW, PAN HD | 201 |
| 324 | 10127122 | SCREW, PAN HD | 201 |
| 325 | 10127124 | SCREW, PAN HD | 201 |
| 328 | 10125066 | SCREW, HEX HD | 201 |
| 329 | 10126403 | WASHER, EXT TOOTH LK | 201 |
| 331 | 53777900 | NUT-HEX | 201 |
| 332 | 53777905 | NUT, HEX | 201 |
| 459 | 75882351 | JUMPER WIRE | 201 |
| 464 | 75883007 | VARISTOR | 201 |

FIGURE 7-7. BASE PAN ASSEMBLY (SHEET 1 of 2)

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 036 | 77610247 | SCREW | 201 |
| 039 | 10125803 | WASHER, SPR LOCK | 201 |
| 040 | 10125805 | WASHER, SPR LOCK | 201 |
| 068 | 77665286 | CHANNEL | 201 |
| 085 | 17901501 | SCREW, THD FORMING | 201 |
| 152 | 93749200 | SCREW | 201 |
| 153 | 93749198 | SCREW | 201 |
| 154 | 94277401 | CABLE TIE | 201 |
| 155 | 94343210 | CABLE TIE MOUNT | 201 |
| 201 | 77665760 | BASE PAN ASM | 021 |
| 216 | 10127143 | SCREW | 201 |
| 232 | 77685805 | DECK DOWN SENSOR | 201 |
| 257 | 10125605 | WASHER, PLAIN | 201 |
| 259 | 10125607 | WASHER, PLAIN | 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, PAN HD | 201 |
| 323 | 93749196 | SCREW, PAN HD | 201 |
| 329 | 10126403 | WASHER, EXT TOOTH LK | 201 |
| 332 | 53777905 | NUT, HEX | 201 |
| 380 | 95643601 | CLAMP, CAPACITOR | 201 |
| 409 | 75893326 | RFI FILTER ASM | 201 |
| 429 | 10127112 | SCREW, PAN HD | 201 |
| 442 | 51885504 | STANDOFF MALE/FEMALE | 201 |

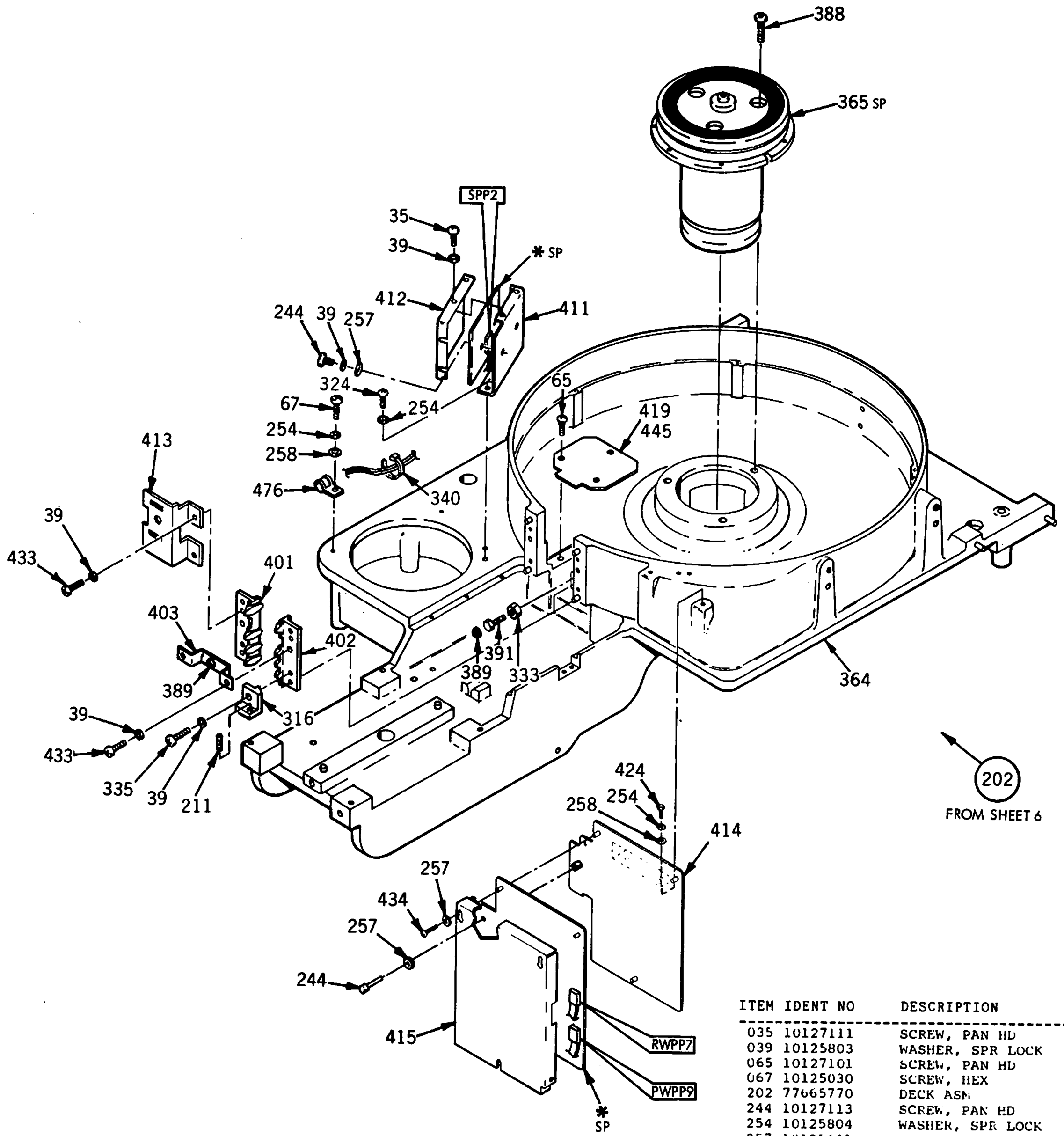



* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION.

** REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| S1 | 77685800 | 7-23 |
| CMPB | 77664370 | 7-23 |
| CMPB | 77646855 | 7-22 |
| RCJ1 | 77646835 | 7-22 |
| RCJ3 | 77664370 | 7-23 |
| RCJ2 | 77664130 | 7-23 |
| | 77664370 | 7-23 |
| RCJ5 | 77664360 | 7-23 |
| | 77664370 | 7-23 |
| C5 | 77664370 | 7-23 |

FIGURE 7-8. BASE PAN ASSEMBLY (SHEET 2 of 2)

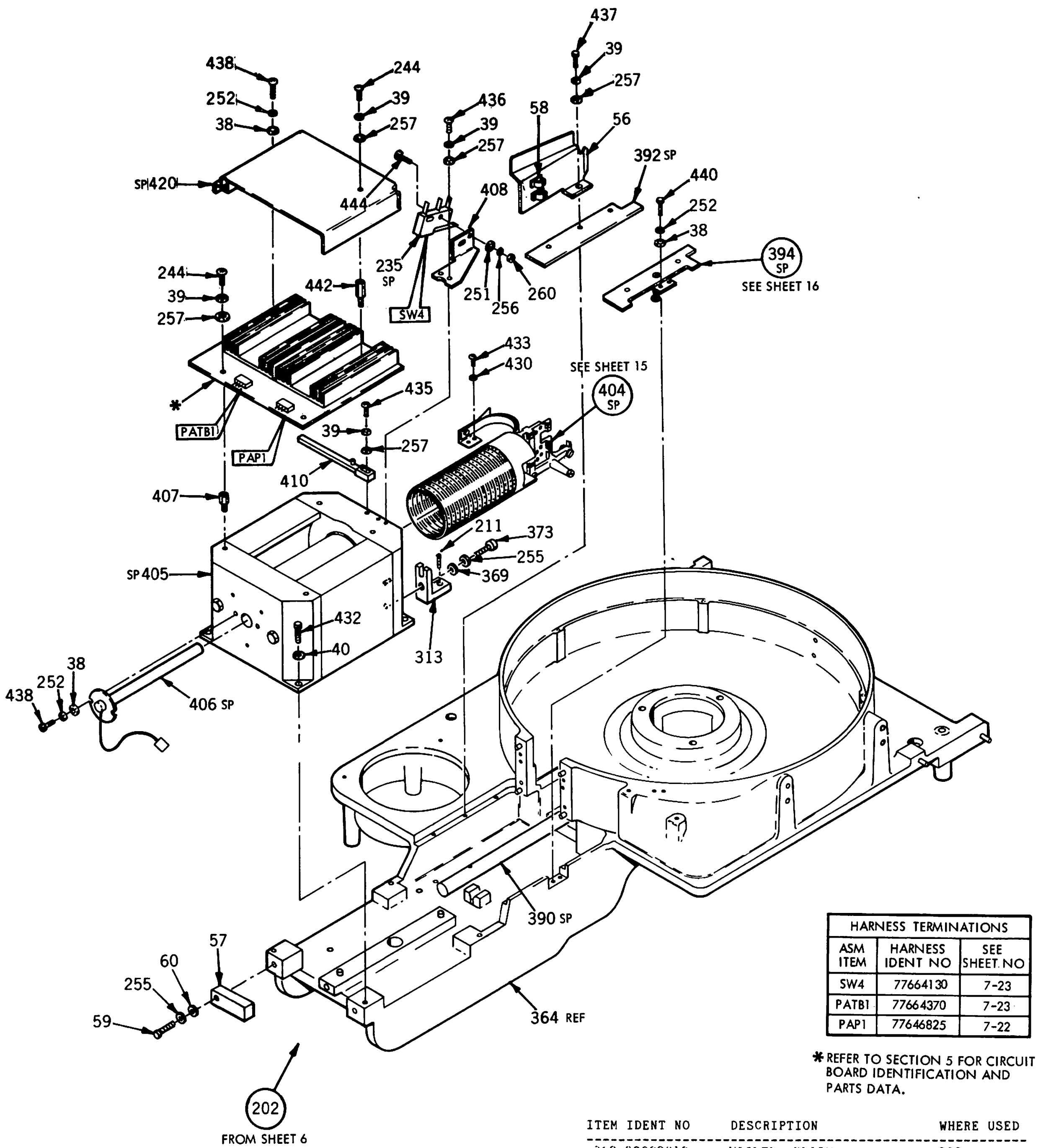



| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| SPP2 | 77646845 | 7-22 |
| RWPP7 | 77646865 | 7-22 |
| PWPP9 | 77646856 | 7-22 |

* REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 035 | 10127111 | SCREW, PAN HD | 202 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 |
| 065 | 10127101 | SCREW, PAN HD | 202 |
| 067 | 10125030 | SCREW, HEX | 202 |
| 202 | 77665770 | DECK ASM | 021 |
| 244 | 10127113 | SCREW, PAN HD | 202 |
| 254 | 10125804 | WASHER, SPR LOCK | 202 |
| 257 | 10125605 | WASHER, PLAIN | 202 |
| 258 | 10125606 | WASHER, PLAIN | 202 |
| 316 | 75899547 | BLK | 202 |
| 324 | 10127122 | SCREW, PAN HD | 202 |
| 333 | 10125301 | NUT, HEX | 202 |
| 335 | 10126221 | SCREW | 202 |
| 340 | 94277400 | STRAP, CABLE TIE | 202 |
| 364 | 75880041 | 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 | 75889469 | BUMPER MT, UPPER | 202 |
| 411 | 75893943 | MTG BRACKET | 202 |
| 412 | 75893953 | SERVO PREAMP SHIELD | 202 |
| 413 | 75893110 | CONNECTOR PLATE | 202 |
| 414 | 75881385 | MTG PLATE | 202 |
| 415 | 77666850 | SHIELD, RD/WR PREAMP | 202 |
| 419 | 75893915 | COVER | 202 |
| 424 | 10125029 | SCREW, HEX | 202 |
| 433 | 10127114 | SCREW, PAN HD | 202 |
| 434 | 77610221 | SCREW, PAN HD | 202 |
| 438 | 10125004 | SCREW, HEX HD | 202 |
| 445 | 18440201 | SILICONE RUBBER | 202 |
| 476 | 92602003 | CABLE CLAMP | 202 |

**FIGURE 7-9. DECK ASSEMBLY (SHEET 1 of 3)**



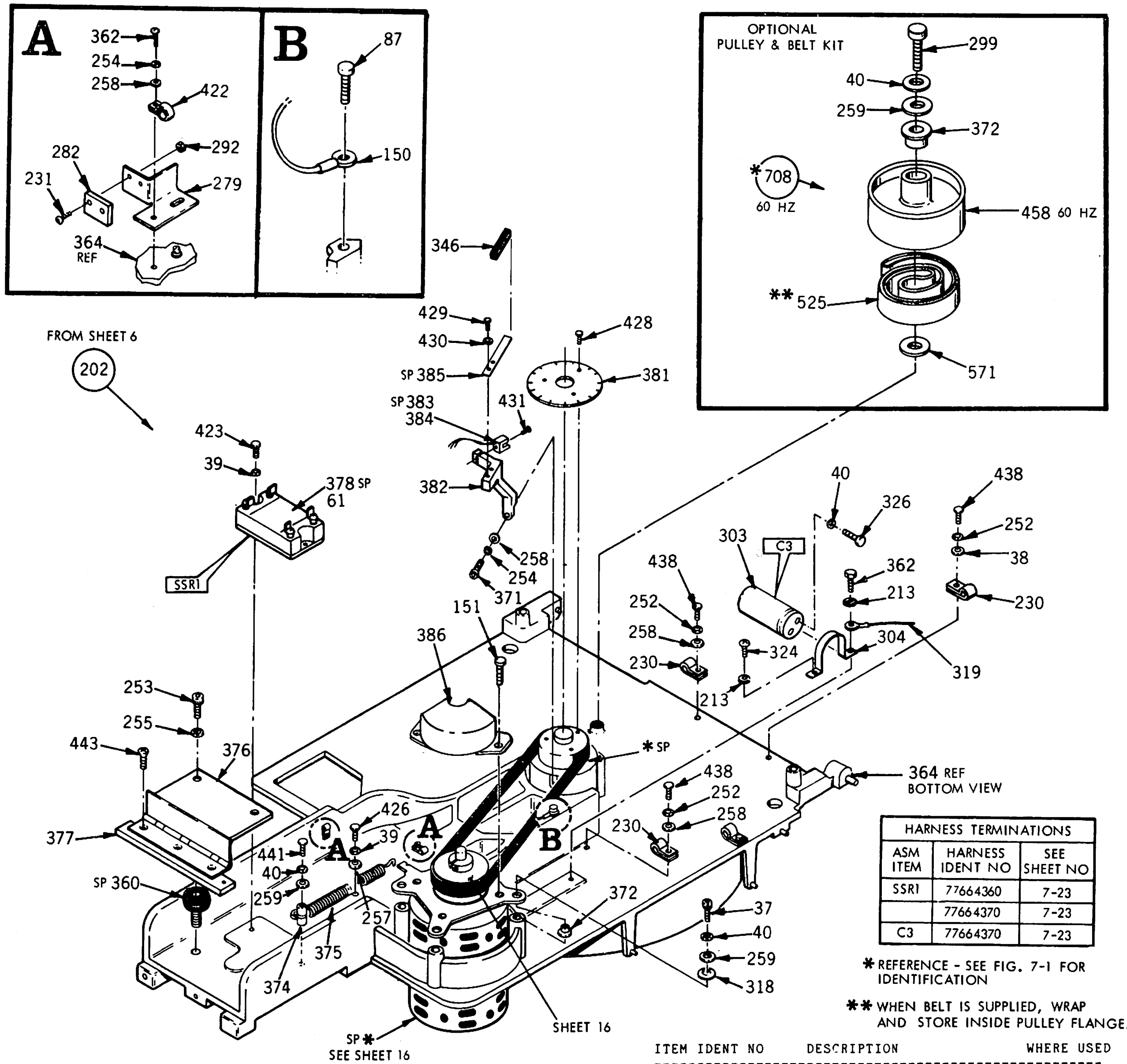

| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| SW4 | 77664130 | 7-23 |
| PATB1 | 77664370 | 7-23 |
| PAP1 | 77646825 | 7-22 |

* REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 038 | 10125603 | WASHER, PLAIN | 202 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 |
| 040 | 10125805 | WASHER, SPR LOCK | 202 |
| 056 | 75881020 | AIR BAFFLE | 202 |
| 057 | 75882675 | SPACER | 202 |
| 058 | 51853015 | CLAMP | 202 |
| 059 | 10126256 | SCREW | 202 |
| 060 | 10125608 | WASHER, PLAIN | 202 |
| 202 | 77665770 | DECK ASM | 021 |
| 211 | 77670106 | SCREW | 202 |
| 235 | 77610140 | SW INTEGRAL LEVER | 202 |
| 244 | 10127113 | SCREW, PAN HD | 202 |
| 251 | 10125800 | WASHER, SPR | 202 |
| 252 | 10125801 | WASHER, SPR LOCK | 202 |
| 255 | 10125806 | WASHER, SPR LOCK | 202 |
| 256 | 10125602 | WASHER, PLAIN | 202 |
| 257 | 10125605 | WASHER, PLAIN | 202 |
| 260 | 10125102 | NUT-HEX | 202 |
| 313 | 75699543 | BLK | 202 |
| 364 | 75880041 | BASE PLATE ASM | 202 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 369 | 92009012 | WASHER, PLAIN | 202 |
| 373 | 10126255 | 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 | 75886512 | 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 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 202 |
| 432 | 10126245 | SCREW, HEX SOC HD | 202 |
| 433 | 10127114 | SCREW, PAN HD | 202 |
| 435 | 10127115 | SCREW, PAN HD | 202 |
| 436 | 10125016 | SCREW, HEX HD | 202 |
| 437 | 10125018 | SCREW, HEX HD | 202 |
| 438 | 10125004 | SCREW, HEX HD | 202 |
| 440 | 10125006 | SCREW, HEX HD | 202 |
| 442 | 51885504 | STANDOFF, MALE-FEMALE | 202 |
| 444 | 10127169 | SCREW, PAN HD | 202 |

FIGURE 7-10. DECK ASSEMBLY (SHEET 2 of 3)




| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| SSR1 | 77664360 | 7-23 |
| | 77664370 | 7-23 |
| C3 | 77664370 | 7-23 |

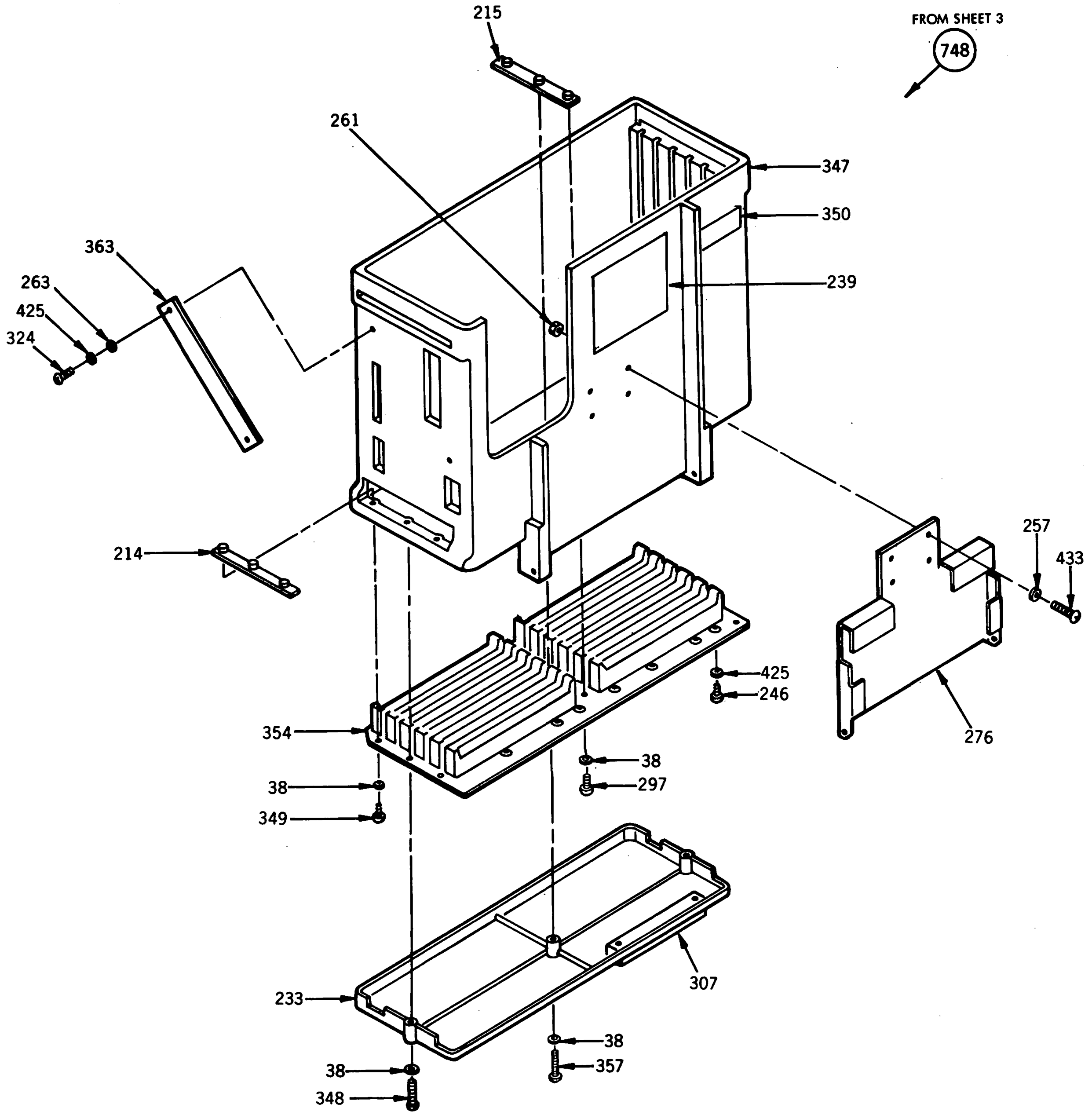
* REFERENCE - SEE FIG. 7-1 FOR IDENTIFICATION

** WHEN BELT IS SUPPLIED, WRAP AND STORE INSIDE PULLEY FLANGE.

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 037 | 10126246 | SCREW CAP | 202 |
| 038 | 10125603 | WASHER, PLAIN | 202 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 |
| 040 | 10125805 | WASHER, SPR LOCK | 202, 708 |
| 061 | 18748600 | COMPOUND 340 | 202 |
| 087 | 93748198 | SCREW | 202 |
| 150 | 75883455 | JUMPER WIRE | 202 |
| 151 | 93749082 | SCREW | 202 |
| 202 | 77665770 | DECK ASM | 021 |
| 213 | 10126104 | WASHER | 202 |
| 230 | 16402506 | CABLE CLAMP | 202 |
| 231 | 10127104 | SCREW, PAN HD | 202 |
| 252 | 10125801 | WASHER, SPR LOCK | 202 |
| 253 | 10126254 | SCREW, SOCKET HD | 202 |
| 254 | 10125804 | WASHER, SPR LOCK | 202 |
| 255 | 10125806 | WASHER, SPR LOCK | 202 |
| 257 | 10125605 | WASHER, PLAIN | 202 |
| 258 | 10125606 | WASHER, PLAIN | 202 |
| 259 | 10125607 | WASHER, PLAIN | 202, 708 |
| 279 | 77685533 | BRACKET, ACTIVATOR | 021 |
| 282 | 77670412 | ACTIVATOR | 202 |
| 292 | 53777900 | NUT & CAPTIVE WASHER | 202 |
| 299 | 10126250 | SCREW, CAP | 708 |
| 303 | 75774471 | CAPACITOR | 202 |
| 304 | 75881270 | CLAMP, CAPACITOR | 202 |
| 318 | 75062400 | WASHER, INSULATOR | 202 |
| 319 | 75883453 | WIRE JUMPER | 202 |

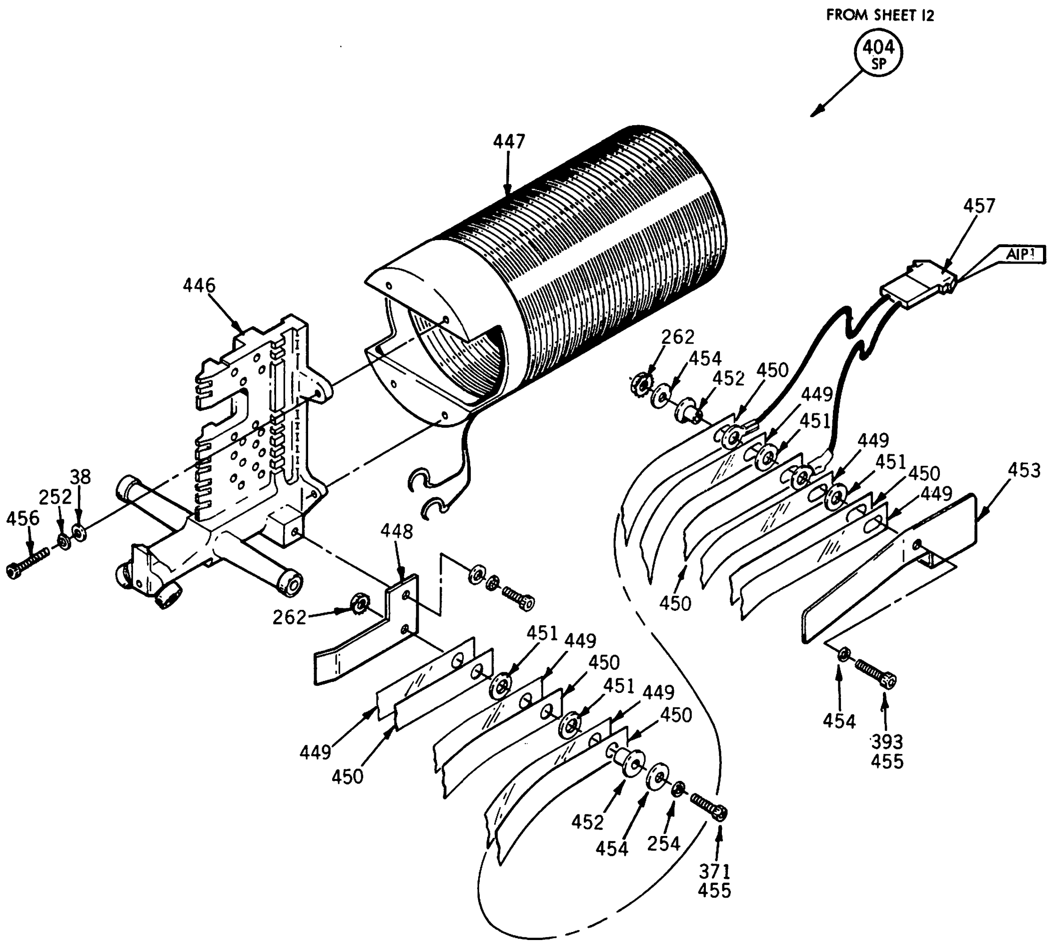
| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 324 | 10127122 | SCREW, PAN HD | 202 |
| 346 | 77604331 | FOAM | 202 |
| 360 | 77610157 | SHOCK MOUNT | 202 |
| 362 | 10127123 | SCREW, PAN HD | 202 |
| 364 | 75880041 | BASE PLATE ASM | 202 |
| 371 | 10126226 | SCREW, SOCKET HD | 202 |
| 372 | 75062805 | WASHER, SHOULDER | 202, 708 |
| 374 | 75881537 | POST, MOTOR SPRING | 202 |
| 375 | 75887539 | SPRING, TENSION | 202 |
| 376 | 75891524 | HINGE | 202 |
| 377 | 75893280 | SPACER, HINGE | 202 |
| 378 | 77610051 | P.A.C. RELAY (SSR) | 202 |
| 381 | 75867791 | DISC, SPEED SENSOR | 202 |
| 382 | 75893920 | SUPPORT, SPEED SENSOR | 202 |
| 383 | 75880046 | SPEED SENSOR | 202 |
| 384 | 75885407 | OPTICAL SWITCH | 383 |
| 385 | 75887872 | GROUND SPRING | 202 |
| 386 | 75863481 | PULLEY COVER | 202 |
| 422 | 92602004 | CABLE CLAMP | 202 |
| 423 | 10127119 | SCREW PAN HD | 202 |
| 426 | 10126222 | SCREW, HEX SOC HD | 202 |
| 428 | 93788082 | SCREW, SELF LOCKING | 202 |
| 429 | 10127112 | SCREW, PAN HD | 202 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 202 |
| 431 | 10125760 | SCREW, FLAT HD | 202 |
| 438 | 10125004 | SCREW, HEX HD | 202 |
| 441 | 10127148 | SCREW, PAN HD | 202 |
| 443 | 10125747 | SCREW, FLAT HD | 202 |
| 458 | 75899707 | PULLEY | 708 |
| 525 | 92314113 | DRIVE BELT 60 HZ | 708 |
| 571 | 75883026 | SPACER | 708 |

## FIGURE 7-11. DECK ASSEMBLY, BOTTOM VIEW (SHEET 3 of 3)




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 038 | 10125603 | WASHER, PLAIN | 748 |
| 214 | 77668612 | NUT BAR | 748 |
| 215 | 77668613 | NUT BAR | 748 |
| 233 | 77659990 | E MODULE SHIELD | 748 |
| 239 | 72959302 | LABEL | 748 |
| 246 | 10127121 | SCREW, PAN HD | 748 |
| 257 | 10125605 | WASHER, PLAIN | 748 |
| 261 | 53777902 | NUT & WASHER | 748 |
| 263 | 75806504 | WASHER | 748 |
| 276 | 77666815 | STOP PLATE | 748 |
| 297 | 93749096 | SCREW | 748 |
| 307 | 44675360 | CABLE CLAMP | 748 |
| 324 | 10127122 | SCREW, PAN HD | 748 |
| 347 | 77622490 | E MODULE | 748 |
| 348 | 93749098 | SCREW | 748 |
| 349 | 93749092 | SCREW | 748 |
| 350 | 77834781 | WARNING LABEL | 748 |
| 354 | 77648090 | BACKPANEL ETCH | 748 |
| 357 | 93749100 | SCREW | 748 |
| 363 | 77633800 | CLAMP | 748 |
| 425 | 10126402 | WASHER, EST TOOTH LK | 748 |
| 433 | 10127114 | SCREW, PAN HD | 748 |
| 748 | 77660545 | E MODULE ASM | HPC |

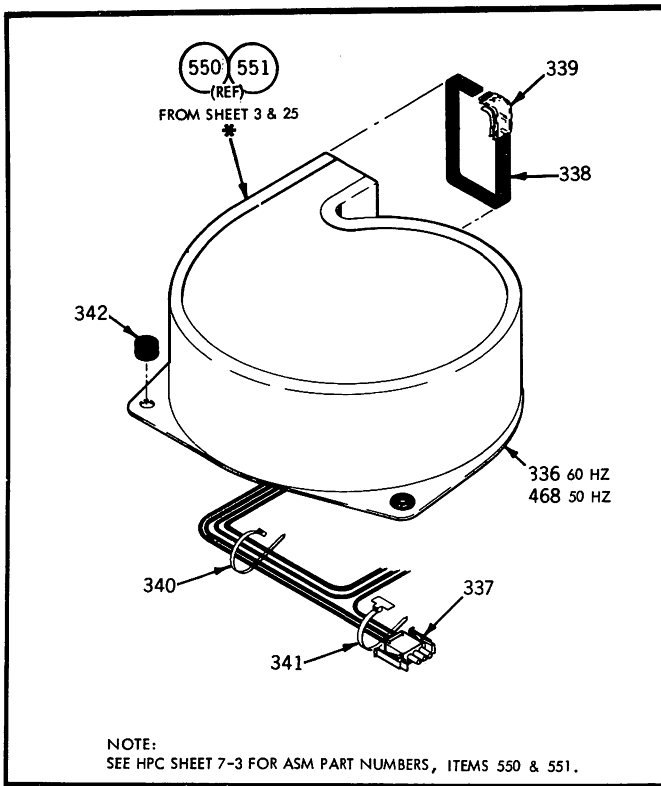
**FIGURE 7-12. E MODULE ASSEMBLY**

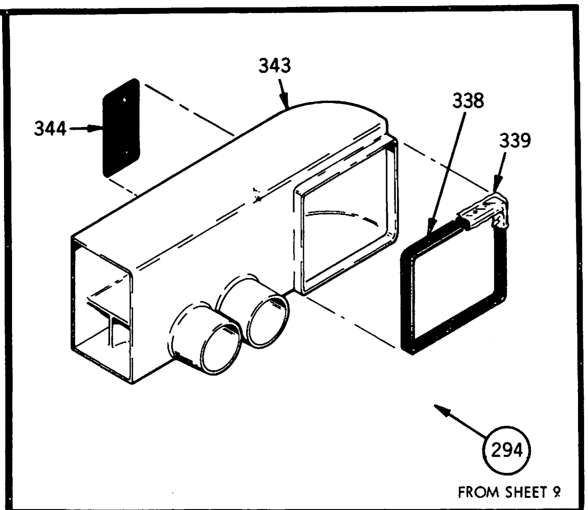


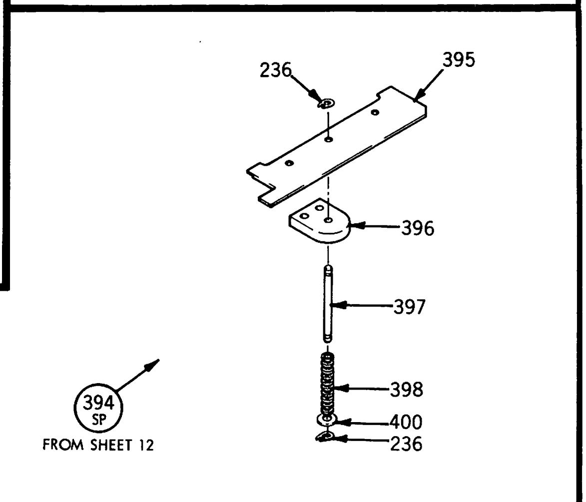

| HARNESS TERMINATIONS | | |
|---|---|---|
| ASM ITEM | HARNESS IDENT NO | SEE SHEET NO |
| AIP1 | 77664370 | 7-23 |

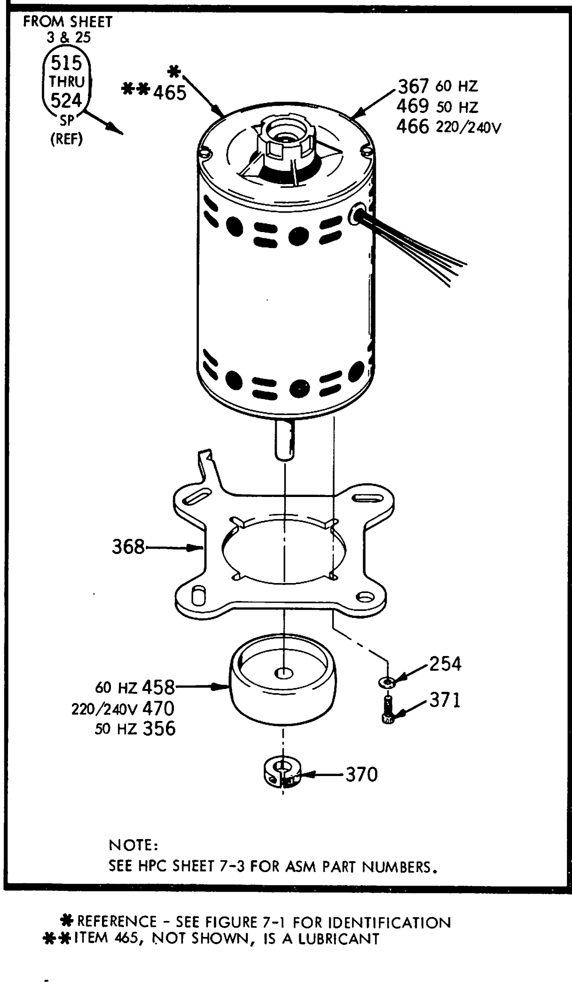
| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 038 | 10125603 | WASHER, PLAIN | 404 |
| 252 | 10125801 | WASHER, SPR LOCK | 404 |
| 254 | 10125804 | WASHER, SPR LOCK | 404 |
| 262 | 53777903 | NUT & WASHER | 404 |
| 371 | 10126226 | SCREW, SOCKET HD | 404 |
| 393 | 10126227 | SCREW, HEX SOC HD | 404 |
| 404 | 75880135 | CARRIAGE & COIL ASM | 202 |
| 446 | 75880140 | CARRIAGE & BEARINGS | 404 |
| 447 | 75865981 | 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 | 77630612 | WASHER, PLAIN | 404 |
| 455 | 95044214 | SEALANT | 404 |
| 456 | 92615099 | SCREW, SOCKET HD CAP | 404 |
| 457 | 75881921 | ACTUATOR WIRING ASM | 404 |

FIGURE 7-13. CARRIAGE AND COIL ASSEMBLY



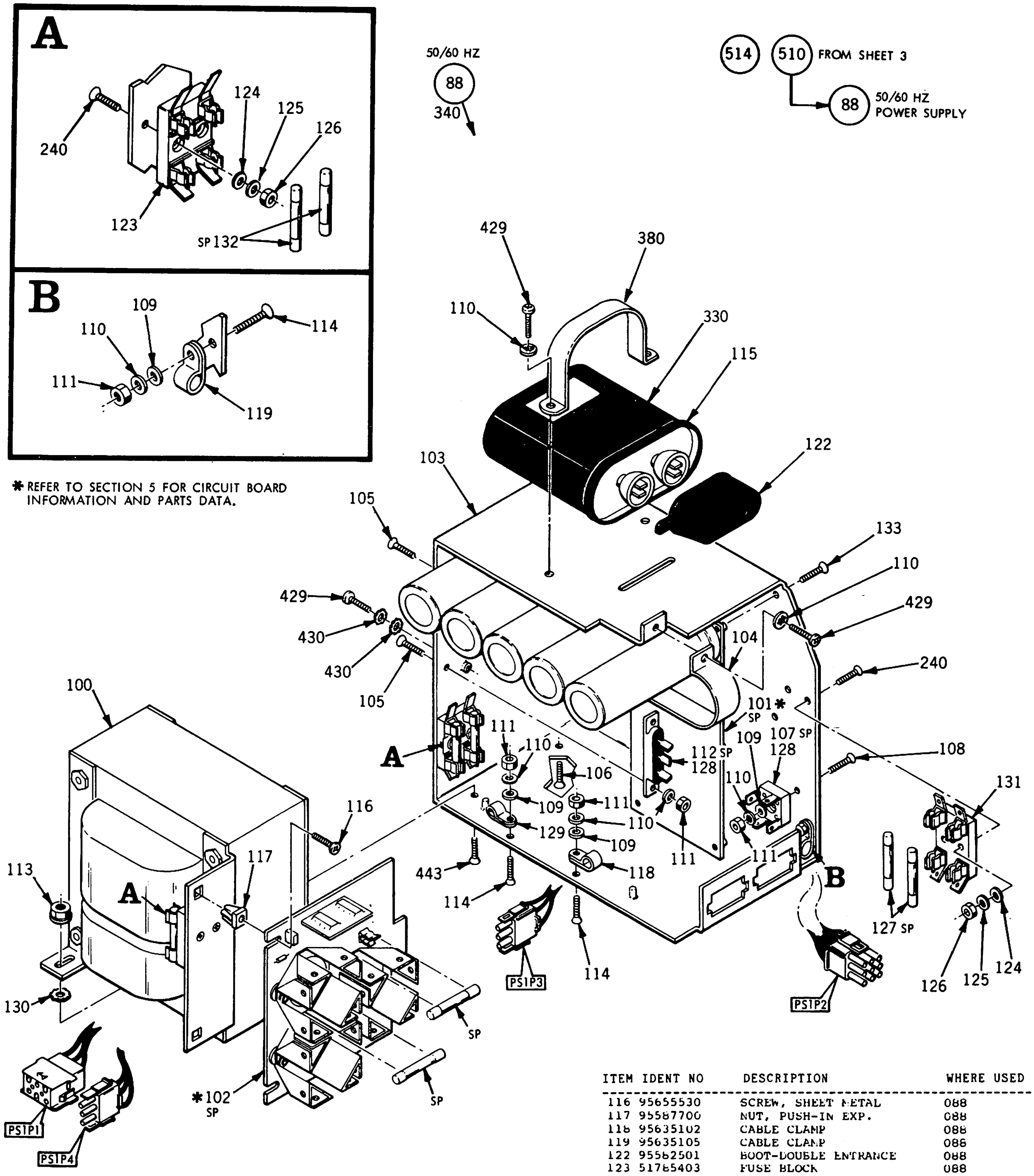




* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION
** ITEM 465, NOT SHOWN, IS A LUBRICANT

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 236 | 94371000 | RETAINING RING | 394 |
| 254 | 10125804 | WASHER, SPR LOCK | 520, 521 |
| 254 | 10125804 | WASHER, SPR LOCK | 515, 516 |
| 254 | 10125804 | WASHER, SPR LOCK | 519 |
| 294 | 75889881 | MANIFOLD ASM | 201 |
| 336 | 75887510 | BLOWER CENTRIF | 550 |
| 337 | 83435302 | CONNECTOR, PLUG/CAP | 550, 551 |
| 338 | 94276600 | FOAM TAPE | 294 |
| 338 | 94276600 | FOAM TAPE | 550, 551 |
| 339 | 95105900 | TAPE, POLY FILM, INSUL | 294 |
| 339 | 95105900 | TAPE, POLY FILM, INSUL | 550, 551 |
| 340 | 94277400 | STRAP, CABLE TIE | 550, 551 |
| 341 | 94277409 | STRAP, CABLE TIE | 550, 551 |
| 342 | 75887520 | GROMMET, SQ SHOULDER | 550, 551 |
| 343 | 75885931 | MANIFOLD | 294 |
| 344 | 75881250 | GASKET | 294 |
| 356 | 75899706 | PULLEY | 519, 520 |
| 367 | 77658460 | MOTOR ASM | 515, 519 |
| 368 | 75887776 | PLATE, MOTOR MTG | 519 |
| 368 | 75887776 | PLATE, MOTOR MTG | 517, 518 |
| 368 | 75887776 | PLATE, MOTOR MTG | 515, 516 |
| 370 | 77613626 | COLLAR, SHAFT | 520 |
| 370 | 77613626 | COLLAR, SHAFT | 521, 519 |
| 370 | 77613626 | COLLAR, SHAFT | 515, 516 |
| 371 | 10126226 | SCREW, SOCKET HD | 520, 521 |
| 371 | 10126226 | SCREW, SOCKET HD | 519 |
| 371 | 10126226 | SCREW, SOCKET HD | 515, 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, PLAIN STEELE | 394 |
| 458 | 75899707 | PULLEY | 515, 521 |
| 465 | 80625400 | LUBRICANT | 515, 516 |
| 465 | 80625400 | LUBRICANT | 517, 518 |
| 466 | 77658465 | MOTOR ASM | 516 |
| 468 | 75887511 | BLOWER CENTRIF 50 HZ | 466 |
| 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 |

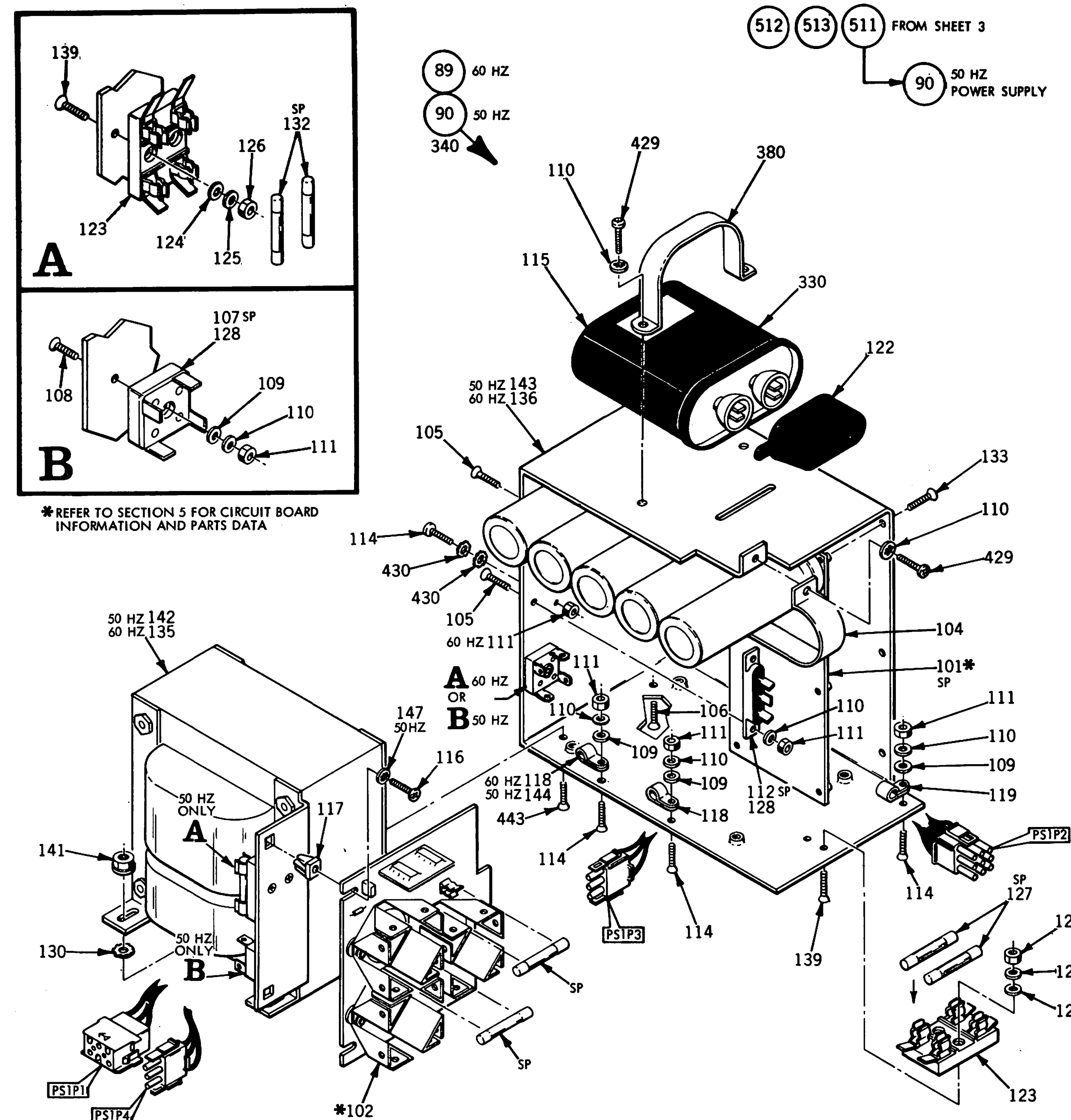
FIGURE 7-14. MISCELLANEOUS SUB-ASSEMBLIES




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 088 | 70100300 | POWER SUPPLY 50/60 HZ | 510 |
| 100 | 70104300 | TRANSFORMER 50/60 HZ | 088 |
| 101 | 75832500 | AXGV COMPONENT ASM | 088 |
| 102 | 75832900 | AXHV COMPONENT ASM | 088 |
| 103 | 70110102 | CHASSIS | 088 |
| 104 | 76873100 | CAP MOUNTING BRACKET | 088 |
| 105 | 10125714 | SCREW, SLAT HD | 088 |
| 106 | 10125746 | SCREW, FLAT HD | 088 |
| 107 | 50242201 | RECTIFIER BRIDGE | 088 |
| 108 | 10125912 | SCREW FLAT HD | 088 |
| 109 | 10125613 | WASHER, PLAIN | 088 |
| 110 | 10126103 | WASHER, INT TH LK | 088 |
| 111 | 95510026 | NUT, HEX | 088 |
| 112 | 95563504 | RECTIFIER BLOCK | 088 |
| 113 | 92376014 | NUT | 088 |
| 114 | 10125715 | SCREW, FLAT HD | 088 |
| 115 | 76879005 | CAPACITOR | 088 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 116 | 95655530 | SCREW, SHEET METAL | 088 |
| 117 | 95587700 | NUT, PUSH-IN EXP. | 088 |
| 118 | 95635102 | CABLE CLAMP | 088 |
| 119 | 95635105 | CABLE CLAMP | 088 |
| 122 | 95562501 | BOOT-DOUBLE ENTRANCE | 088 |
| 123 | 51765403 | FUSE BLOCK | 088 |
| 124 | 95641502 | WASHER, FLAT | 088 |
| 125 | 10126101 | WASHER, INT TH LK | 088 |
| 126 | 95510024 | NUT, HEX | 088 |
| 127 | 93419228 | FUSE, 125 V | 088 |
| 128 | 95533601 | GREASE | 088 |
| 129 | 95635103 | CABLE CLAMP | 088 |
| 130 | 10126404 | WASHERS | 088 |
| 131 | 94399501 | FUSE BLOCK | 088 |
| 132 | 95647607 | FUSE | 088 |
| 133 | 10125909 | SCREW, FLAT HD | 088 |
| 240 | 10125704 | SCREW, FLAT HD | 510 |
| 330 | 24534729 | SLEEVING | 088 |
| 340 | 94277400 | STRAP, CABLE TIE | 510 |
| 380 | 95643601 | CLAMP, CAPACITOR | 510 |
| 429 | 10127112 | SCREW, PAN HD | 510 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 510 |
| 443 | 10125747 | SCREW, FLAT HD | 510 |
| 510 | 75887884 | POWER SUPPLY | HPC |
| 514 | 76879500 | POWER SUPPLY | HPC |

FIGURE 7-15. POWER SUPPLY ASSEMBLY

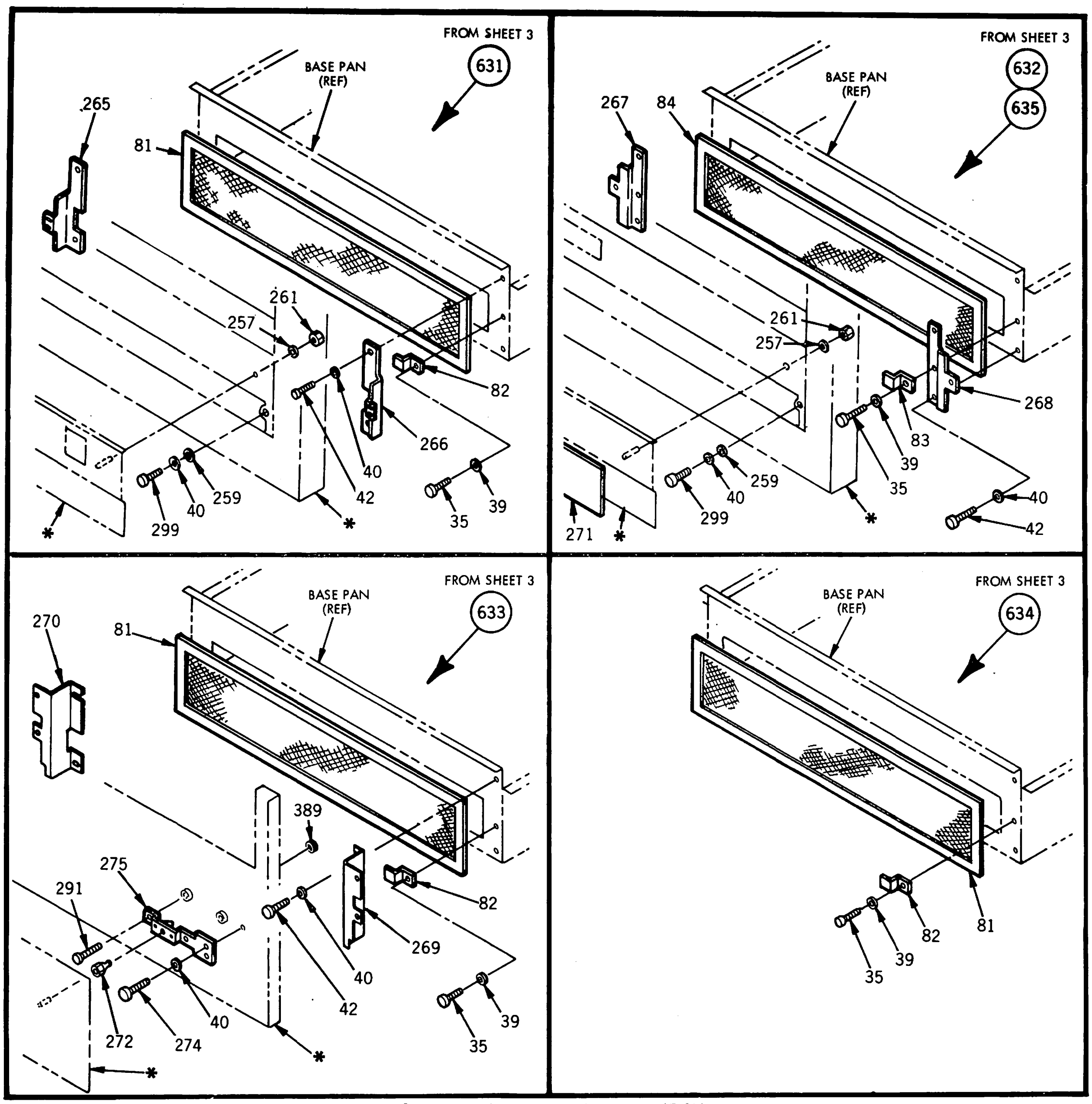



*REFER TO SECTION 5 FOR CIRCUIT BOARD INFORMATION AND PARTS DATA

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 089 | 76869502 | POWER SUPPLY 60 HZ | 509 |
| 090 | 70116400 | POWER SUPPLY 50 HZ | 511 |
| 101 | 75832500 | AXGV COMPONENT ASM | 089, 090 |
| 102 | 75832900 | AXHV COMPONENT ASM | 089, 090 |
| 104 | 76873100 | CAP MOUNTING BRACKET | 089, 090 |
| 105 | 10125714 | SCREW, FLAT HD | 089, 090 |
| 106 | 10125746 | SCREW, FLAT HD | 089, 090 |
| 107 | 50242201 | RECTIFIER BRIDGE | 089, 090 |
| 108 | 10125912 | SCREW FLAT HD | 089, 090 |
| 109 | 10125613 | WASHER, PLAIN | 089, 090 |
| 110 | 10126103 | WASHER, INT TH LK | 089, 090 |
| 111 | 95510026 | NUT, HEX | 089, 090 |
| 112 | 95583504 | RECTIFIER BLOCK | 089, 090 |
| 114 | 10125715 | SCREW, FLAT HD | 089, 090 |
| 115 | 76879005 | CAPACITOR | 089, 090 |
| 116 | 95655530 | SCREW, SHEET METAL | 089, 090 |
| 117 | 95587700 | NUT, PUSH-IN EXP. | 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, FLAT | 089, 090 |
| 125 | 10126101 | WASHER, INT TH LK | 089, 090 |
| 126 | 95510024 | NUT, HEX | 089, 090 |
| 127 | 93419228 | FUSE, 125 V | 089, 090 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 128 | 95533601 | GREASE | 089 |
| 130 | 10126404 | WASHERS | 089, 090 |
| 132 | 95647607 | FUSE | 089 |
| 133 | 10125909 | SCREW, FLAT HD | 089, 090 |
| 135 | 70112900 | TRANSFORMER 60 HZ | 089 |
| 136 | 76873002 | CHASSIS | 089 |
| 138 | 76873401 | WIRE HARNESS ASM | 089 |
| 139 | 10125777 | SCREW, FLAT HD | 089, 090 |
| 140 | 93564044 | WASHER, NYLON | 089 |
| 141 | 92376014 | NUT, SELF-LOCKING | 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, NYLON | 090 |
| 330 | 24534729 | SLEEVING | 089, 090 |
| 340 | 94277400 | STRAP, CABLE TIE | 508,509 |
| 380 | 95643601 | CLAMP, CAPACITOR | 508, 509 |
| 429 | 10127112 | SCREW, PAN HD | 508, 509 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 508, 509 |
| 443 | 10125747 | SCREW, FLAT HD | 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 7-16. POWER SUPPLY ASSEMBLY

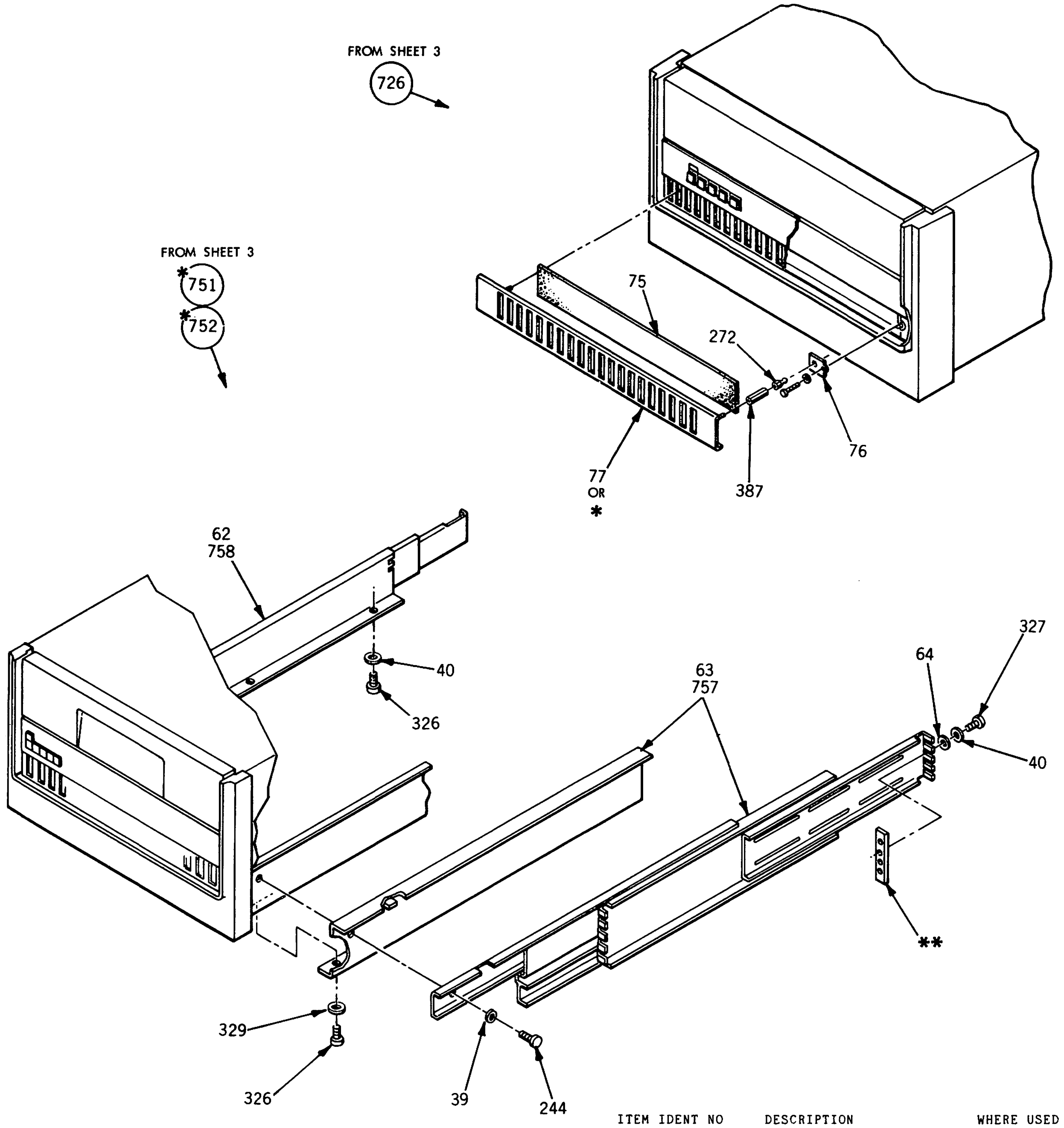



* REFERENCE - SEE FIG 7-1 FOR IDENTIFICATION

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 035 | 10127111 | SCREW, PAN HD | 633, 634 |
| 035 | 10127111 | SCREW, PAN HD | 635 |
| 035 | 10127111 | SCREW, PAN HD | 631, 632 |
| 039 | 10125803 | WASHER, SPR LOCK | 631, 632 |
| 039 | 10125803 | WASHER, SPR LOCK | 635 |
| 039 | 10125803 | WASHER, SPR LOCK | 633, 634 |
| 040 | 10125805 | WASHER, SPR LOCK | 633, 635 |
| 040 | 10125805 | WASHER, SPR LOCK | 631, 632 |
| 042 | 10126244 | SCREW, HEX SOC HD CAP | 633, 635 |
| 042 | 10126244 | SCREW, HEX SOC HD CAP | 631, 632 |
| 081 | 94364903 | FILTER-AIR | 631 |
| 081 | 94364903 | FILTER-AIR | 633, 634 |
| 082 | 75881845 | CLIP | 634 |
| 082 | 75881845 | CLIP | 631, 633 |
| 083 | 77641830 | CLIP | 632, 635 |
| 084 | 94364906 | FILTER-AIR | 632, 635 |
| 257 | 10125605 | WASHER, PLAIN | 631, 632 |
| 257 | 10125605 | WASHER, PLAIN | 635 |
| 259 | 10125607 | WASHER, PLAIN | 631, 632 |
| 259 | 10125607 | WASHER, PLAIN | 635 |
| 261 | 53777902 | NUT & WASHER | 635 |

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 261 | 53777902 | NUT & WASHER | 631, 632 |
| 265 | 75861906 | BRACKET | 631 |
| 266 | 75861907 | BRACKET | 631 |
| 267 | 77641835 | ZEE BRACKET | 632, 635 |
| 268 | 77641836 | ZEE BRACKET | 632, 635 |
| 269 | 77666375 | BRACKET RH | 633 |
| 270 | 77666376 | BRACKET L H | 633 |
| 271 | 77666011 | LABEL | 635 |
| 272 | 93326006 | STUD BALL | 633 |
| 274 | 10126252 | SCREW, SOCKET HEAD | 633 |
| 275 | 77648135 | CATCH ASM | 633 |
| 291 | 94376910 | SCREW | 633 |
| 299 | 10126250 | SCREW, CAP | 635 |
| 299 | 10126250 | SCREW, CAP | 631, 632 |
| 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 |

FIGURE 7-17. FRONT PANEL INSTALLATION KITS

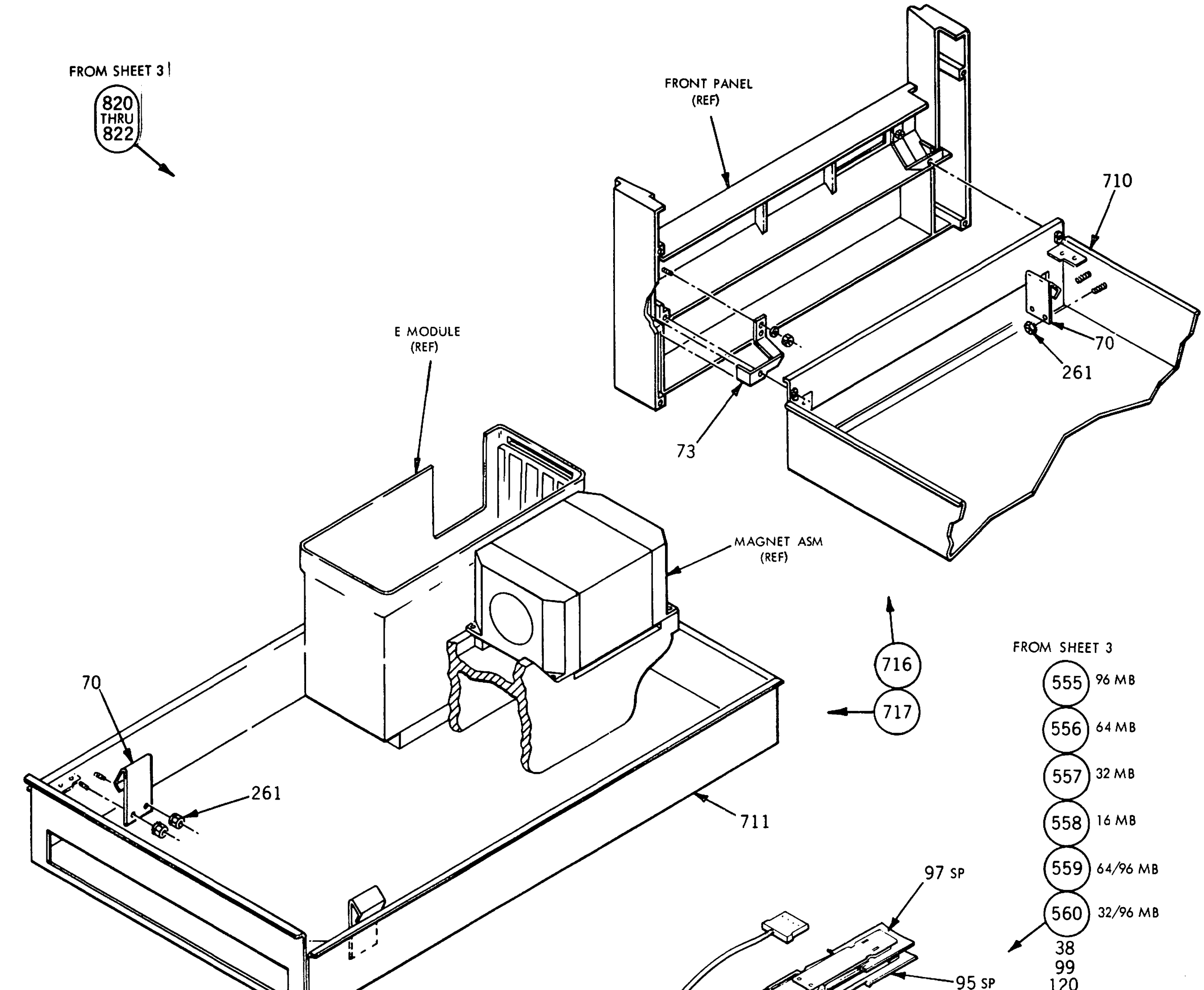



| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 039 | 10125803 | WASHER, SPR LOCK | 751, 752 |
| 040 | 10125805 | WASHER, SPR LOCK | 751, 752 |
| 062 | 75890947 | DRAWER EXT SLIDE | 752 |
| 063 | 75890948 | DRAWER EXT SLIDE | 752 |
| 064 | 94279113 | WASHER, PLAIN | 751, 752 |
| 075 | 77604002 | PRE-FILTER-FILTER | 726 |
| 076 | 77648130 | CATCH ASM | 726 |
| 077 | 77641785 | FILTER FRAME ASM | 726 |
| 244 | 10127113 | SCREW, PAN HD | 751, 752 |
| 272 | 93326006 | STUD BALL | 077 |
| 326 | 10127141 | SCREW, PAN HD | 751, 752 |
| 327 | 10127144 | SCREW, PAN HD | 751, 752 |
| 329 | 10126403 | WASHER, EXT TOOTH LK | 751, 752 |
| 387 | 93109084 | SPACER | 077 |
| 726 | 77641795 | FILTER KIT | HPC |
| 751 | 75897340 | SLIDE KIT | HPC |
| 752 | 75897701 | SLIDE KIT | HPC |
| 757 | 75890936 | DRAWER EXT SLIDE | 751 |
| 758 | 75890937 | DRAWER EXT SLIDE | 751 |

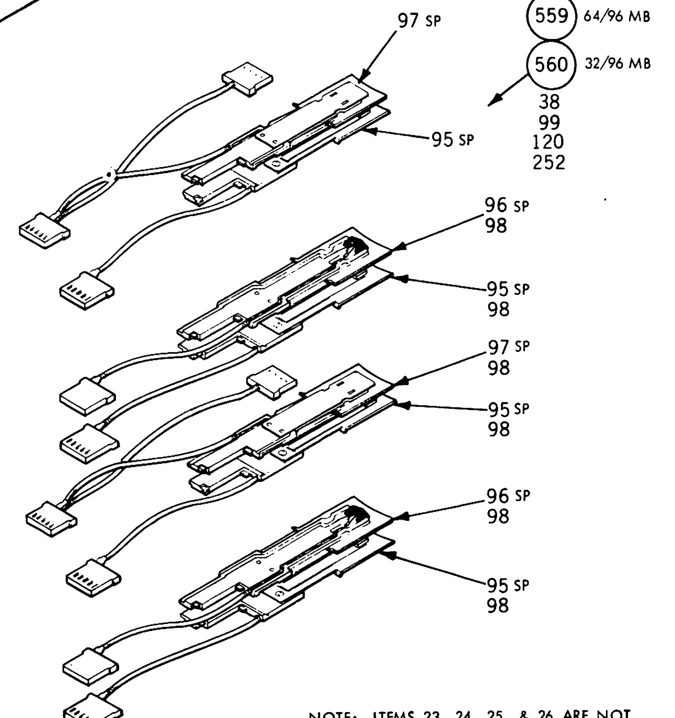
* REFERENCE - SEE FIG. 7 - 1 FOR IDENTIFICATION.

** NUT PLATES ARE FURNISHED WITH SLIDE ASSEMBLIES ITEMS 573 AND 574 OR ITEMS 62 AND 63.

FIGURE 7-18. SLIDE KITS & PREFILTER KIT




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 023 | 76204650 | FIXED PACK/MOD ALIGN TOOL | 555 559 |
| 023 | 76204650 | FIXED PACK/MOD ALIGN TOOL | 560 |
| 024 | 76204651 | FIXED PACK/MOD ALIGN TOOL | 556 |
| 025 | 76204652 | FIXED PACK/MOD ALIGN TOOL | 557 |
| 026 | 76204653 | FIXED PACK/MOD ALIGN TOOL | 558 |
| 038 | 10125603 | WASHER, PLAIN | 560 |
| 038 | 10125603 | WASHER, PLAIN | 556, 557 |
| 038 | 10125603 | WASHER, PLAIN | 558, 559 |
| 070 | 75682550 | GROUND WIPER | 716, 717 |
| 073 | 75684677 | GROUND FLEXIBLE | 716 |
| 095 | 75010102 | HEAD-ARM ASM, LOWER | 559, 560 |
| 095 | 75010102 | HEAD-ARM ASM, LOWER | 557, 558 |
| 095 | 75010102 | HEAD-ARM ASM, LOWER | 555, 556 |
| 096 | 75010103 | HEAD-ARM ASM, UPPER | 559 |
| 096 | 75010103 | HEAD-ARM ASM, UPPER | 555, 556 |
| 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 | 558, 559 |
| 098 | 75883031 | WEIGHT HEAD | 560 |
| 098 | 75883031 | WEIGHT HEAD | 556, 557 |
| 099 | 10126215 | SCREW, HEX SOC HD CAP | 558, 559 |
| 099 | 10126215 | SCREW, HEX SOC HD CAP | 560 |
| 099 | 10126215 | SCREW, HEX SOC HD CAP | 556, 557 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 556, 557 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 558, 559 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 560 |
| 252 | 10125801 | WASHER, SPR LOCK | 556, 557 |
| 252 | 10125801 | WASHER, SPR LOCK | 558, 559 |
| 252 | 10125801 | WASHER, SPR LOCK | 560 |
| 261 | 53777902 | NUT & WASHER | 716, 717 |
| 710 | 77646342 | BASE PAN | 820 |
| 711 | 77646343 | BASE PAN | 821, 822 |
| 716 | 75894105 | ESD KIT | 821 |
| 717 | 75894106 | ESD KIT | 822 |
| 820 | 77700060 | STD BASE PAN KIT | HPC |
| 821 | 77700061 | ESD BASE PAN KIT | HPC |
| 822 | 77700062 | ESD BASE PAN KIT UNIC | HPC |




NOTE: ITEMS 23, 24, 25, & 26 ARE NOT SHOWN. SEE SECTION 6.7.7 FOR ADDITIONAL INFORMATION ON FIXED PACK/MODULE ALIGNMENT TOOL.

FIGURE 7-19. ESD KITS & HEADS

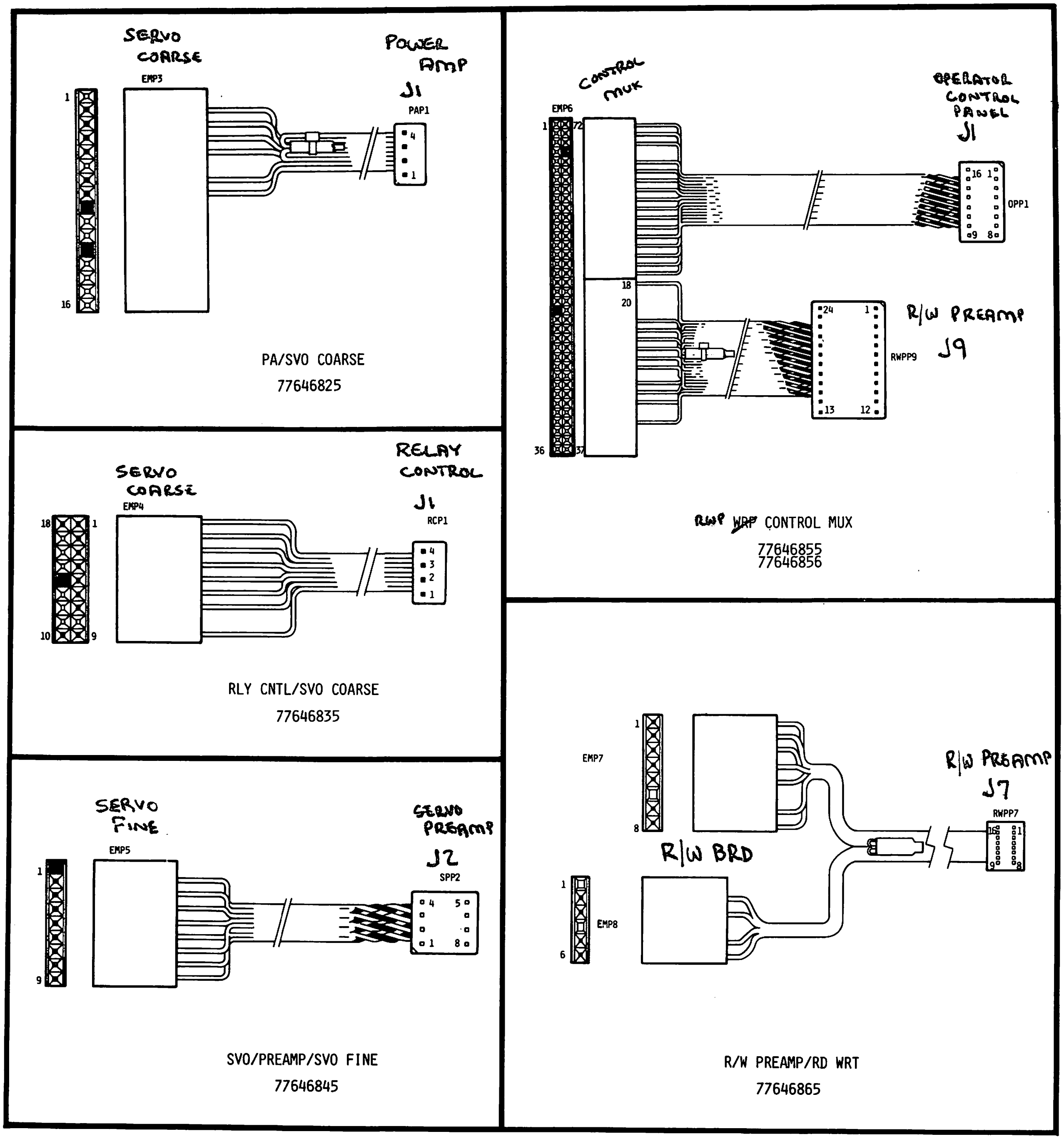



FIGURE 7-20. CMD HARNESSES (SHEET 1 of 2)

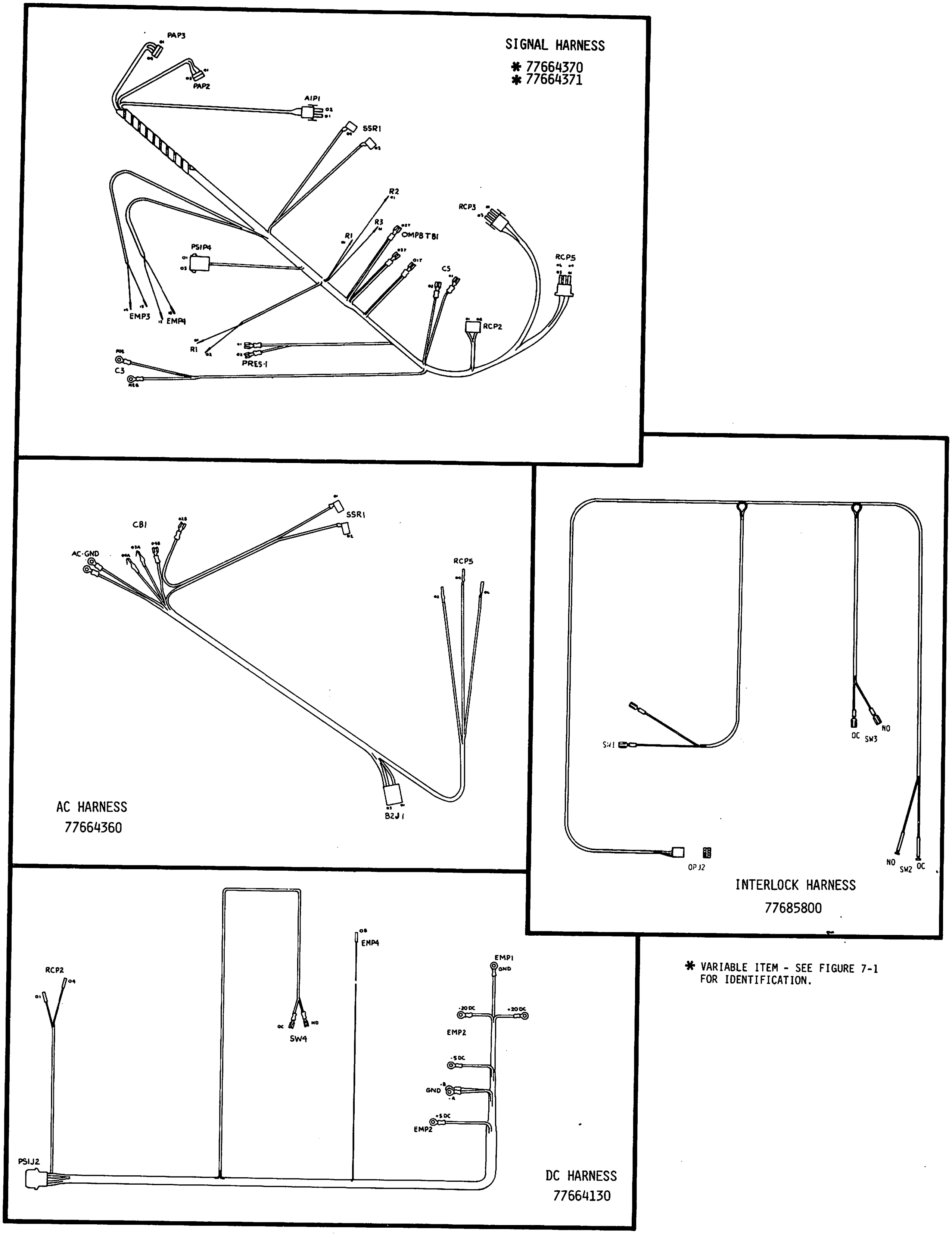
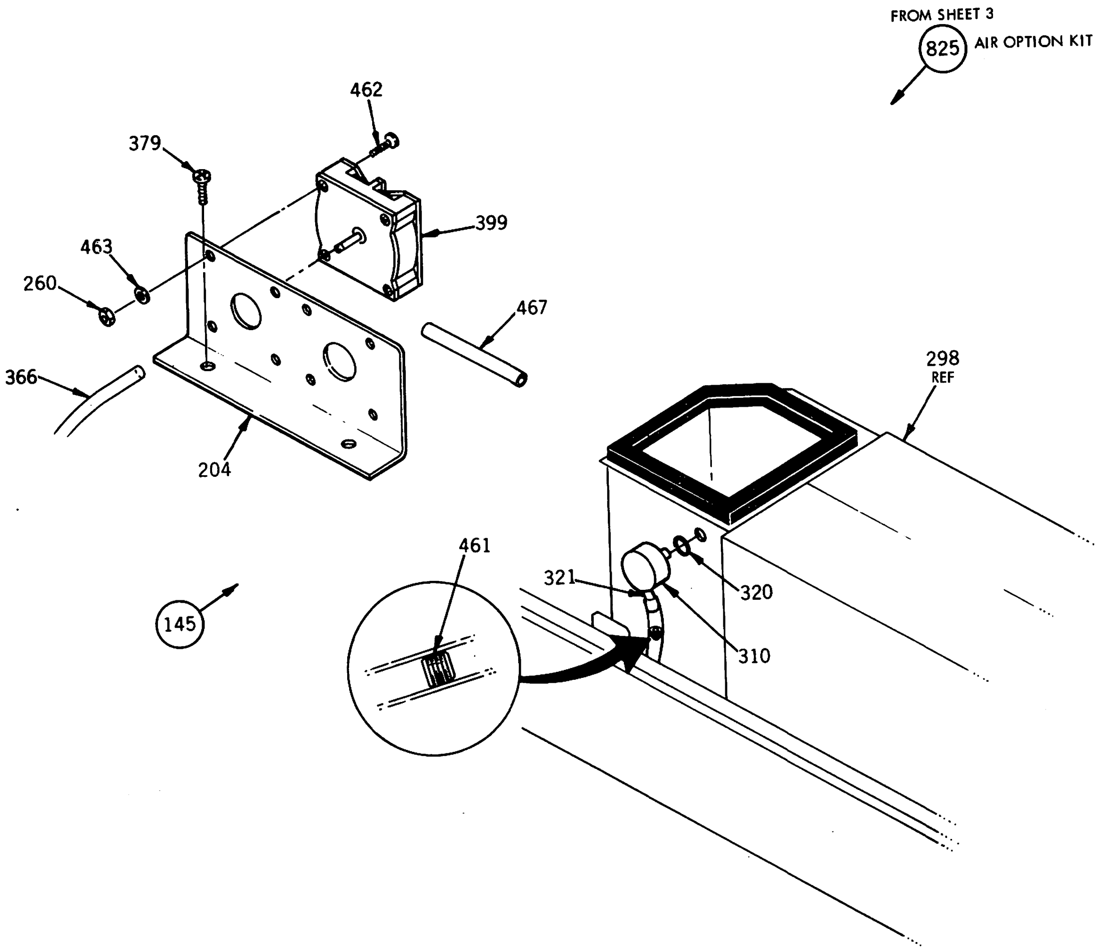


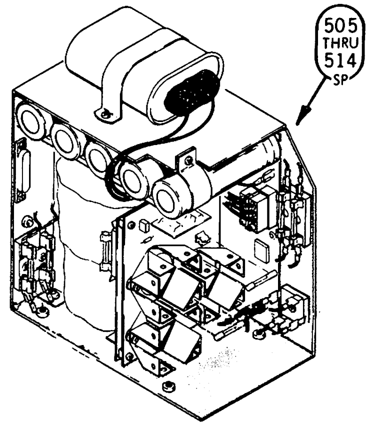

FIGURE 7-21. CMD HARNESSES (SHEET 2 OF 2)

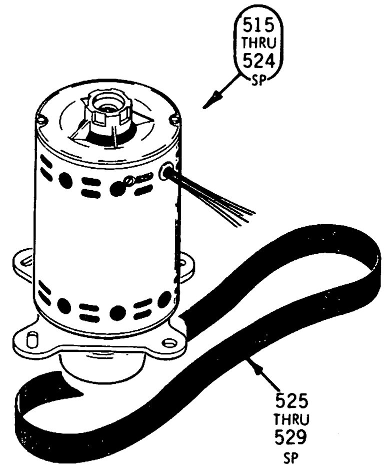


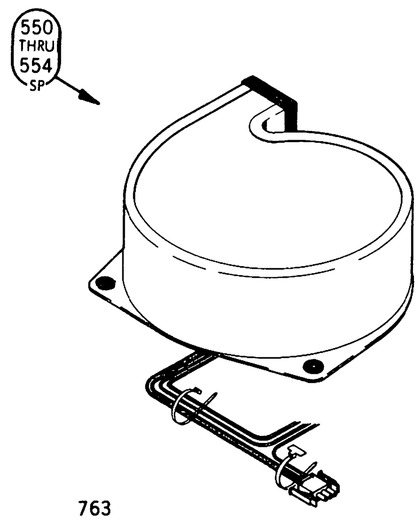

| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 145 | 77668536 | NO AIR-96 MB | 825 |
| 204 | 77646363 | BRACKET | 145 |
| 260 | 10125102 | NUT-HEX | 145 |
| 310 | 75899165 | FILTER FITTING | 145 |
| 320 | 92074007 | O-RING | 145 |
| 321 | 77649250 | AIR TUBE | 145 |
| 366 | 77668546 | AIR TUBING | 145 |
| 379 | 10127170 | SCREW | 145 |
| 399 | 77619634 | SENSOR | 145 |
| 461 | 92006029 | SET SCREW | 145 |
| 462 | 93749198 | SCREW | 145 |
| 463 | 10126100 | WASHER | 145 |
| 467 | 95643257 | QUICK CONNECTOR | 145 |

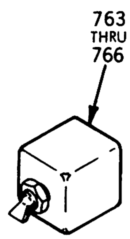
FIGURE 7-22. AIR OPTION KIT

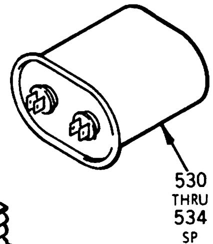
| POWER KIT NO. | DESCRIPTION | | 505 thru 514 | 515 thru 524 | 525 thru 529 | 530 thru 534 | 550 thru 554 | 610 thru 619 | 763 thru 766 | 772 thru 773 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50 Hz 100 V | | 512 | 520 | 526 | 530 | 550 | 617 | 763 | 773 |
| 2 | 50 Hz 120 V | | 512 | 519 | 526 | 530 | 550 | 619 | 764 | 773 |
| 3 | 50 Hz 220 V | | 512 | 516 | 526 | 531 | 551 | 614 | 764 | 772 |
| 4 | 50 Hz 230 V | | 512 | 516 | 526 | 531 | 551 | 615 | 764 | 772 |
| 5 | 50 Hz 240 V | | 512 | 516 | 526 | 531 | 551 | 618 | 764 | 772 |
| 6 | 60 Hz 100 V | | 513 | 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 | 550 | 610 | 764 | 773 |

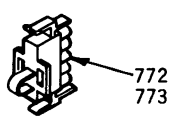


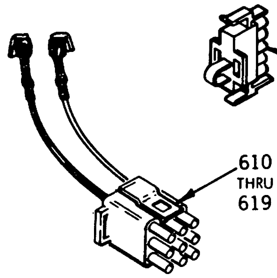




| ITEM | IDENT NO | DESCRIPTION | WHERE USED |
|---|---|---|---|
| 509 | 77610705 | POWER SUPPLY 60 HZ | HPC |
| 510 | 75887684 | POWER SUPPLY | HPC |
| 511 | 77610707 | POWER SUPPLY 50 HZ | HPC |
| 512 | 76867300 | POWER SUPPLY | HPC |
| 513 | 76879400 | POWER SUPPLY | HPC |
| 514 | 76879500 | POWER 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 | 95125322 | 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 | 75889887 | BLOWER ASM 50 HZ | HPC |
| 610 | 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 7-23. POWER KIT ASSEMBLIES

# 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 |
| 023 | 76204650 | FIXED PACK/MOD ALIGN TOOL | 555, 559 | S21 |
| 023 | 76204650 | FIXED PACK/MOD ALIGN TOOL | 560 | S21 |
| 024 | 76204651 | FIXED PACK/MOD ALIGN TOOL | 556 | S21 |
| 025 | 76204652 | FIXED PACK/MOD ALIGN TOOL | 557 | S21 |
| 026 | 76204653 | FIXED PACK/MOD ALIGN TOOL | 558 | S21 |
| 027 | 75893356 | INSTRUCTION LABEL | 500 | S5 |
| 028 | 75881128 | DECK SUPPORT LH | 021 | S6 |
| 029 | 75881129 | DECK SUP RH (NOT SHOWN) | 021 | S6 |
| 030 | 76423600 | GASKET | 500 | S5 |
| 031 | 92742011 | SCREW, PAN HD | 021 | S6 |
| 032 | 77643188 | RECEIVER ASM | 021 | S7 |
| 033 | 94364401 | SWITCH | 021 | S6 |
| 034 | 95105904 | POLYESTER TAPE | 021 | S6 |
| 035 | 10127111 | SCREW, PAN HD | 633, 634 | S19 |
| 035 | 10127111 | SCREW, PAN HD | 635 | S19 |
| 035 | 10127111 | SCREW, PAN HD | 631, 632 | S19 |
| 035 | 10127111 | SCREW, PAN HD | 202 | S11 |
| 036 | 77610247 | SCREW | 201 | S10 |
| 037 | 10126246 | SCREW CAP | 202 | S13 |
| 038 | 10125603 | WASHER, PLAIN | 021 | S6 |
| 038 | 10125603 | WASHER, PLAIN | 202 | S12 |
| 038 | 10125603 | WASHER, PLAIN | 748 | S14 |
| 038 | 10125603 | WASHER, PLAIN | 560 | S21 |
| 038 | 10125603 | WASHER, PLAIN | 202 | S13 |
| 038 | 10125603 | WASHER, PLAIN | 404 | S15 |
| 038 | 10125603 | WASHER, PLAIN | 021 | S7 |
| 038 | 10125603 | WASHER, PLAIN | 556, 557 | S21 |
| 038 | 10125603 | WASHER, PLAIN | 558, 559 | S21 |
| 039 | 10125803 | WASHER, SPR LOCK | 201 | S10 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 | S11 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 | S12 |
| 039 | 10125803 | WASHER, SPR LOCK | 202 | S13 |
| 039 | 10125803 | WASHER, SPR LOCK | 751, 752 | S20 |
| 039 | 10125803 | WASHER, SPR LOCK | 631, 632 | S19 |
| 039 | 10125803 | WASHER, SPR LOCK | 635 | S19 |
| 039 | 10125803 | WASHER, SPR LOCK | 633, 634 | S19 |
| 039 | 10125803 | WASHER, SPR LOCK | 021 | S6 |
| 039 | 10125803 | WASHER, SPR LOCK | 021 | S8 |
| 040 | 10125805 | WASHER, SPR LOCK | 633, 635 | S19 |
| 040 | 10125805 | WASHER, SPR LOCK | 751, 752 | S20 |
| 040 | 10125805 | WASHER, SPR LOCK | 202 | S12 |
| 040 | 10125805 | WASHER, SPR LOCK | 202, 708 | S13 |
| 040 | 10125805 | WASHER, SPR LOCK | 201 | S10 |
| 040 | 10125805 | WASHER, SPR LOCK | 021 | S7 |
| 040 | 10125805 | WASHER, SPR LOCK | 631, 632 | S19 |
| 041 | 95033900 | ADHESIVE | 500 | S5 |
| 042 | 10126244 | SCREW, HEX SOC HD CAP | 633, 635 | S19 |
| 042 | 10126244 | SCREW, HEX SOC HD CAP | 631, 632 | S19 |
| 043 | 75882867 | DOOR ASM | 021 | S6 |
| 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 | 75882690 | LATCH COVER | 043 | S8 |
| 053 | 75883466 | JUMPER WIRE ASM | 043 | S8 |
| 054 | 94376917 | SCREW | 043 | S8 |
| 055 | 94376918 | SCREW | 043 | S8 |
| 056 | 75881020 | AIR BAFFLE | 202 | S12 |
| 057 | 75882675 | SPACER | 202 | S12 |
| 058 | 51853015 | CLAMP | 202 | S12 |
| 059 | 10126256 | SCREW | 202 | S12 |
| 060 | 10125608 | WASHER, PLAIN | 202 | S12 |
| 061 | 16748600 | COMPOUND 340 | 202 | S13 |
| 062 | 75890947 | DRAWER EXT SLIDE | 752 | S20 |
| 063 | 75890948 | DRAWER EXT SLIDE | 752 | S20 |
| 064 | 94279113 | WASHER, PLAIN | 751, 752 | S20 |
| 065 | 10127101 | SCREW, PAN HD | 202 | S11 |
| 066 | 77611448 | ADHESIVE | 043 | S8 |
| 066 | 77611448 | ADHESIVE | 043 | S6 |
| 067 | 10125030 | SCREW, HEX | 202 | S11 |
| 068 | 77665286 | CHANNEL | 201 | S10 |
| 069 | 77641810 | COVER, DOOR | 043 | S8 |
| 070 | 75682550 | GROUND WIPER | 716, 717 | S21 |
| 071 | 75806501 | FLAT WASHER | 021 | S6 |
| 073 | 75884677 | GROUND FLEXIBLE | 716 | S21 |
| 074 | 75880242 | LABEL | 500 | S5 |
| 075 | 77604002 | PRE-FILTER-FILTER | 726 | S20 |
| 076 | 77648130 | CATCH ASM | 726 | S20 |
| 077 | 77641785 | FILTER FRAME ASM | 726 | S20 |
| 078 | 75892737 | WIRE GUARD | 043 | S8 |
| 079 | 75894831 | HINGE | 043 | S8 |
| 080 | 75894830 | HINGE | 043 | S8 |
| 081 | 94364903 | FILTER-AIR | 631 | S19 |
| 081 | 94364903 | FILTER-AIR | 633, 634 | S19 |
| 082 | 75881845 | CLIP | 634 | S19 |
| 082 | 75881845 | CLIP | 631, 633 | S19 |
| 083 | 77641830 | CLIP | 632, 635 | S19 |
| 084 | 94364906 | FILTER-AIR | 632, 635 | S19 |
| 085 | 17901501 | SCREW, THD FORMING | 201 | S10 |
| 087 | 93748198 | SCREW | 202 | S13 |
| 088 | 70100300 | POWER SUPPLY 50/60 HZ | 510 | S17 |
| 089 | 76869502 | POWER SUPPLY 60 HZ | 509 | S16 |
| 090 | 70116400 | POWER SUPPLY 50 HZ | 511 | S18 |
| 091 | 95510027 | NUT, HEX | 032 | S7 |
| 092 | 95125326 | LOCTITE SEALANT | 032 | S7 |
| 094 | 91930600 | 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, HEX SOC HD CAP | 558, 559 | S21 |
| 099 | 10126215 | SCREW, HEX SOC HD CAP | 560 | S21 |
| 099 | 10126215 | SCREW, HEX SOC HD CAP | 556, 557 | S21 |
| 100 | 70104300 | TRANSFORMER 50/60 HZ | 088 | S17 |
| 101 | 75832500 | AXGV COMPONENT ASM | 089, 090 | S18 |
| 101 | 75832500 | AXGV COMPONENT ASM | 088 | S17 |
| 102 | 75832900 | AXHV COMPONENT ASM | 089, 090 | S18 |
| 102 | 75832900 | AXHV COMPONENT ASM | 088 | S17 |
| 103 | 70110102 | CHASSIS | 088 | S17 |
| 104 | 76873100 | CAP MOUNTING BRACKET | 088 | S17 |
| 104 | 76873100 | CAP MOUNTING BRACKET | 089, 090 | S18 |
| 105 | 10125714 | SCREW, FLAT HD | 089, 090 | S18 |
| 105 | 10125714 | SCREW, SLAT HD | 088 | S17 |
| 106 | 10125746 | SCREW, FLAT HD | 088 | S17 |
| 106 | 10125746 | SCREW, FLAT HD | 089, 090 | S18 |
| 107 | 50242201 | RECTIFIER BRIDGE | 089, 090 | S18 |
| 107 | 50242201 | RECTIFIER BRIDGE | 088 | S17 |
| 108 | 10125912 | SCREW FLAT HD | 089, 090 | S18 |
| 108 | 10125912 | SCREW FLAT HD | 088 | S17 |
| 109 | 10125613 | WASHER, PLAIN | 088 | S17 |
| 109 | 10125613 | WASHER, PLAIN | 089, 090 | S18 |
| 110 | 10126103 | WASHER, INT TH LK | 089, 090 | S18 |
| 110 | 10126103 | WASHER, INT TH LK | 088 | S17 |
| 111 | 95510026 | NUT, HEX | 089, 090 | S18 |
| 111 | 95510026 | NUT, HEX | 088 | S17 |
| 111 | 95510026 | NUT, HEX | 021 | S6 |
| 112 | 95583504 | RECTIFIER BLOCK | 089, 090 | S18 |
| 112 | 95583504 | RECTIFIER BLOCK | 088 | S17 |
| 113 | 92376014 | NUT | 088 | S17 |
| 114 | 10125715 | SCREW, FLAT HD | 089, 090 | S18 |
| 114 | 10125715 | SCREW, FLAT HD | 088 | S17 |
| 115 | 76879005 | CAPACITOR | 089, 090 | S18 |
| 115 | 76879005 | CAPACITOR | 088 | S17 |
| 116 | 95655530 | SCREW, SHEET METAL | 089, 090 | S18 |
| 116 | 95655530 | SCREW, SHEET METAL | 088 | S17 |
| 117 | 95587700 | NUT, PUSH-IN EXP. | 089, 090 | S18 |
| 117 | 95587700 | NUT, PUSH-IN EXP. | 088 | S17 |
| 118 | 95635102 | CABLE CLAMP | 089, 090 | S18 |
| 118 | 95635102 | CABLE CLAMP | 088 | S17 |
| 119 | 95635105 | CABLE CLAMP | 089, 090 | S18 |
| 119 | 95635105 | CABLE CLAMP | 088 | S17 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 556, 557 | S21 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 558, 559 | S21 |
| 120 | 10126214 | SCREW, HEX SOC HD CAP | 560 | S21 |
| 121 | 77659981 | E MODULE BRACE | 021 | S7 |
| 122 | 95582501 | BOOT-DOUBLE ENTRANCE | 089, 090 | S18 |
| 122 | 95582501 | BOOT-DOUBLE ENTRANCE | 088 | S17 |
| 123 | 51785403 | FUSE BLOCK | 089, 090 | S18 |
| 123 | 51785403 | FUSE BLOCK | 088 | S17 |
| 124 | 95641502 | WASHER, FLAT | 089, 090 | S18 |
| 124 | 95641502 | WASHER, FLAT | 088 | S17 |
| 125 | 10126101 | WASHER, INT TH LK | 088 | S17 |
| 125 | 10126101 | WASHER, INT TH LK | 089, 090 | S18 |
| 126 | 95510024 | NUT, HEX | 089, 090 | S18 |
| 126 | 95510024 | NUT, HEX | 088 | S17 |
| 127 | 93419228 | FUSE, 125 V | 089, 090 | S18 |
| 127 | 93419228 | FUSE, 125 V | 088 | S17 |
| 128 | 95533601 | GREASE | 088 | S17 |
| 128 | 95533601 | GREASE | 089 | S18 |
| 129 | 95635103 | CABLE CLAMP | 088 | S17 |
| 130 | 10126404 | WASHERS | 088 | S17 |
| 130 | 10126404 | WASHERS | 089, 090 | S18 |
| 131 | 94399501 | FUSE BLOCK | 088 | S17 |
| 132 | 95647607 | FUSE | 088 | S17 |
| 132 | 95647607 | FUSE | 089 | S18 |
| 133 | 10125909 | SCREW, FLAT HD | 088 | S17 |
| 133 | 10125909 | SCREW, FLAT HD | 089, 090 | S18 |
| 135 | 70112900 | TRANSFORMER 60 HZ | 089 | S18 |
| 136 | 76873002 | CHASSIS | 089 | S18 |
| 138 | 76873401 | WIRE HARNESS ASM | 089 | S18 |
| 139 | 10125777 | SCREW, FLAT HD | 089, 090 | S18 |
| 140 | 93564044 | WASHER, NYLON | 089 | S18 |
| 141 | 92376014 | NUT, SELF-LOCKING | 089, 090 | S18 |
| 142 | 70113000 | TRANSFORMER 50 HZ | 090 | S18 |
| 143 | 70116500 | CHASSIS | 090 | S18 |
| 144 | 95635104 | CABLE CLAMP | 090 | S18 |
| 145 | 77668536 | NO AIR-96 MB | 825 | S24 |
| 146 | 70117900 | WIRE HARNESS ASM | 090 | S18 |
| 147 | 93564034 | WASHER, NYLON | 090 | S18 |
| 148 | 83410501 | BUMPER | 021 | S7 |
| 149 | 10127142 | SCREW | 021 | S7 |
| 150 | 75883455 | JUMPER WIRE | 202 | S13 |
| 151 | 93749082 | SCREW | 202 | S13 |
| 152 | 93749200 | SCREW | 201 | S9 |
| 152 | 93749200 | SCREW | 201 | S10 |
| 153 | 93749198 | SCREW | 201 | S9 |
| 153 | 93749198 | SCREW | 201 | S10 |
| 154 | 94277401 | CABLE TIE | 201 | S9 |
| 154 | 94277401 | CABLE TIE | 201 | S10 |
| 155 | 94343210 | CABLE TIE MOUNT | 201 | S9 |

# TOP DOWN ASSEMBLY COMPONENT PARTS LIST

| ITEM | IDENT NO | DESCRIPTION | WHERE USED | SHEET |
|---|---|---|---|---|
| 155 | 94343210 | CABLE TIE MOUNT | 201 | S10 |
| 156 | 77647108 | ACOUSTIC FOAM | 021 | S6 |
| 201 | 77665760 | BASE PAN ASM | 021 | S9 |
| 201 | 77665760 | BASE PAN ASM | 021 | S6 |
| 201 | 77665760 | BASE PAN ASM | 021 | S10 |
| 202 | 77665770 | DECK ASM | 021 | S12 |
| 202 | 77665770 | DECK ASM | 021 | S6 |
| 202 | 77665770 | DECK ASM | 021 | S11 |
| 202 | 77665770 | DECK ASM | 021 | S13 |
| 203 | 75893355 | LABEL | 500 | S5 |
| 204 | 77646363 | BRACKET | 145 | S24 |
| 205 | 95523400 | BUMPER | 021 | S6 |
| 206 | 75893107 | RETAINER, HEAD CONN | 021 | S6 |
| 207 | 77681505 | RETAINER, HEAD CONN | 021 | S6 |
| 208 | 10126263 | SCREW, SOCKET HEAD | 021 | S6 |
| 209 | 75893275 | PLATE, SEPARATOR | 021 | S7 |
| 210 | 77644612 | STUD | 021 | S7 |
| 211 | 77670106 | SCREW | 202 | S12 |
| 212 | 77617049 | SCREW, PAN HD | 500 | S5 |
| 213 | 10126104 | WASHER | 202 | S13 |
| 214 | 77668612 | NUT BAR | 748 | S14 |
| 215 | 77668613 | NUT BAR | 748 | S14 |
| 216 | 10127143 | SCREW | 201 | S9 |
| 216 | 10127143 | SCREW | 201 | S10 |
| 217 | 75892811 | WASHER, SHOULDER | 021 | S6 |
| 218 | 75892221 | PIN | 021 | S6 |
| 219 | 92033037 | RETAINING RING | 021 | S6 |
| 219 | 92033037 | RETAINING RING | 021 | S7 |
| 220 | 92054223 | BALL BEARING | 021 | S7 |
| 221 | 75883115 | CAM PLATE | 032 | S7 |
| 222 | 75889492 | SUPPORT SHAFT | 021 | S6 |
| 223 | 75887453 | RECEIVER BAR, LH | 032 | S7 |
| 224 | 75887448 | RECEIVER BAR, RH | 032 | S7 |
| 225 | 75882834 | CARRIAGE RAIL | 032 | S7 |
| 226 | 75882833 | CARRIAGE RAIL | 032 | S7 |
| 227 | 75887443 | PLATE, RECEIVER | 032 | S7 |
| 228 | 93564001 | WASHER, NYLON | 021 | S8 |
| 228 | 93564001 | WASHER, NYLON | 032 | S7 |
| 228 | 93564001 | WASHER, NYLON | 021 | S6 |
| 229 | 75881790 | LINK | 032 | S7 |
| 230 | 16402506 | CABLE CLAMP | 021 | S6 |
| 230 | 16402506 | CABLE CLAMP | 202 | S13 |
| 231 | 10127104 | SCREW, PAN HD | 202 | S13 |
| 231 | 10127104 | SCREW, PAN HD | 021 | S6 |
| 232 | 77685805 | DECK DOWN SENSOR | 201 | S10 |
| 233 | 77659990 | E MODULE SHIELD | 748 | S14 |
| 234 | 75893958 | SPACER | 021 | S7 |
| 235 | 77610140 | SW INTEGRAL LEVER | 202 | S12 |
| 235 | 77610140 | SW INTEGRAL LEVER | 021 | S8 |
| 236 | 94371000 | RETAINING RING | 394 | S16 |
| 236 | 94371000 | RETAINING RING | 021 | S6 |
| 237 | 92745012 | SCREW, PAN HD | 021 | S8 |
| 238 | 10127102 | SCREW, PAN HD | 043 | S8 |
| 239 | 72959302 | LABEL | 748 | S14 |
| 240 | 10125704 | SCREW, FLAT HD | 510 | S17 |
| 241 | 93592158 | SCREW, HEX ASH HD | 021 | S6 |
| 242 | 92033033 | RETAINING RING | 043 | S8 |
| 243 | 10126219 | SCREW, HEX SOC HD CAP | 021 | S7 |
| 244 | 10127113 | SCREW, PAN HD | 021 | S8 |
| 244 | 10127113 | SCREW, PAN HD | 021 | S6 |
| 244 | 10127113 | SCREW, PAN HD | 202 | S11 |
| 244 | 10127113 | SCREW, PAN HD | 202 | S12 |
| 244 | 10127113 | SCREW, PAN HD | 751, 752 | S20 |
| 245 | 75883475 | GROUND STRAP | 201 | S9 |
| 246 | 10127121 | SCREW, PAN HD | 748 | S14 |
| 247 | 77666619 | SWITCH PLATE | 021 | S8 |
| 248 | 10125725 | SCREW, FLAT HD | 032 | S7 |
| 249 | 95694202 | SPACER | 201 | S9 |
| 250 | 10126253 | SCREW, HEX SOC HD CAP | 021 | S6 |
| 251 | 10125800 | WASHER, SPR | 021 | S8 |
| 251 | 10125800 | WASHER, SPR | 021 | S6 |
| 251 | 10125800 | WASHER, SPR | 202 | S12 |
| 252 | 10125801 | WASHER, SPR LOCK | 021 | S6 |
| 252 | 10125801 | WASHER, SPR LOCK | 404 | S15 |
| 252 | 10125801 | WASHER, SPR LOCK | 021 | S7 |
| 252 | 10125801 | WASHER, SPR LOCK | 556, 557 | S21 |
| 252 | 10125801 | WASHER, SPR LOCK | 558, 559 | S21 |
| 252 | 10125801 | WASHER, SPR LOCK | 202 | S13 |
| 252 | 10125801 | WASHER, SPR LOCK | 043 | S8 |
| 252 | 10125801 | WASHER, SPR LOCK | 202 | S12 |
| 252 | 10125801 | WASHER, SPR LOCK | 560 | S21 |
| 253 | 10126254 | SCREW, SOCKET HD | 202 | S13 |
| 254 | 10125804 | WASHER, SPR LOCK | 520, 521 | S16 |
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| 429 | 10127112 | SCREW, PAN HD | 202 | S13 |
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| 430 | 10126401 | WASHER, EXT TOOTH LK | 021 | S6 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 202 | S12 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 500 | S5 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 510 | S17 |
| 430 | 10126401 | WASHER, EXT TOOTH LK | 508, 509 | S18 |
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| 433 | 10127114 | SCREW, PAN HD | 202 | S11 |
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| 435 | 10127115 | SCREW, PAN HD | 202 | S12 |
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| 442 | 51865504 | STANDOFF MALE/FEMALE | 201 | S10 |
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| 458 | 75899707 | PULLEY | 708 | S13 |
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| 473 | 75882455 | SPACER | 499 | S8 |
| 474 | 75894895 | LEVER, CAM | 499 | S8 |
| 475 | 75893245 | BLOCK, LINKAGE | 032 | S7 |
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| 477 | 77670257 | SET SCREW | 499 | S8 |

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| 480 | 75894325 | PANEL ACOUSTIC FOAM | 623 | S4 |
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| 484 | 77647105 | PANEL ACOUSTIC FOAM | 624 | S4 |
| 484 | 77647105 | PANEL ACOUSTIC FOAM | 622, 623 | S4 |
| 485 | 75894330 | PANEL ACOUSTIC FOAM | 621, 622 | S4 |
| 485 | 75894330 | PANEL ACOUSTIC FOAM | 623, 624 | S4 |
| 486 | 75894331 | PANEL ACOUSTIC FOAM | 623, 624 | S4 |
| 486 | 75894331 | PANEL ACOUSTIC FOAM | 621, 622 | S4 |
| 487 | 75894332 | PANEL ACOUSTIC FOAM | 621, 623 | S4 |
| 488 | 77658253 | PANEL ACOUSTIC FOAM | 621, 622 | S4 |
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| 489 | 75894341 | PANEL ACOUSTIC FOAM | 622 | S4 |
| 490 | 77658254 | PANEL ACOUSTIC FOAM | 621, 622 | S4 |
| 490 | 77658254 | PANEL ACOUSTIC FOAM | 623 | S4 |
| 491 | 75894338 | PANEL ACOUSTIC FOAM | 621 | S4 |
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| 500 | 77669983 | TOP LEVEL ASM | HPC | S3 |
| 509 | 77610705 | POWER SUPPLY 60 HZ | HPC | S18 |
| 509 | 77610705 | POWER SUPPLY 60 HZ | HPC | S25 |
| 509 | 77610705 | POWER SUPPLY 60 HZ | HPC | S3 |
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| 510 | 75887884 | POWER SUPPLY | HPC | S17 |
| 510 | 75887884 | POWER SUPPLY | HPC | S3 |
| 511 | 77610707 | POWER SUPPLY 50 HZ | HPC | S25 |
| 511 | 77610707 | POWER SUPPLY 50 HZ | HPC | S3 |
| 511 | 77610707 | POWER SUPPLY 50 HZ | HPC | S18 |
| 512 | 76867300 | POWER SUPPLY | HPC | S18 |
| 512 | 76867300 | POWER SUPPLY | HPC | S3 |
| 512 | 76867300 | POWER SUPPLY | HPC | S25 |
| 513 | 76879400 | POWER SUPPLY | HPC | S25 |
| 513 | 76879400 | POWER SUPPLY | HPC | S3 |
| 513 | 76879400 | POWER SUPPLY | HPC | S18 |
| 514 | 76879500 | POWER SUPPLY | HPC | S3 |
| 514 | 76879500 | POWER SUPPLY | HPC | S17 |
| 514 | 76879500 | POWER SUPPLY | HPC | S25 |
| 515 | 77638604 | DRIVE MTR ASM 60 HZ 120V | HPC | S3 |
| 515 | 77638604 | DRIVE MTR ASM 60 HZ 120V | HPC | S25 |
| 515 | 77638604 | DRIVE MTR ASM 60 HZ 120V | HPC | S16 |
| 516 | 77638605 | DRIVE MTR ASM 220-240V | HPC | S3 |
| 516 | 77638605 | DRV MTR ASM 220-240V | HPC | S25 |
| 516 | 77638605 | DRV MTR ASM 220-240V | HPC | S16 |
| 519 | 77638603 | DRV MTR ASM 50 HZ 120V | HPC | S3 |
| 519 | 77638603 | DRV MTR ASM 50 HZ 120V | HPC | S25 |
| 519 | 77638603 | 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 | S25 |
| 520 | 77638601 | DRV MTR ASM 50 HZ 120V | HPC | S16 |
| 521 | 77638602 | DRV MTR ASM 60 HZ 100V | HPC | S16 |
| 521 | 77638602 | DRV MTR ASM 60 HZ 100V | HPC | S25 |
| 521 | 77638602 | DRV MTR ASM 60 HZ 100V | HPC | S3 |
| 525 | 92314113 | DRIVE BELT 60 HZ | 708 | S13 |
| 525 | 92314113 | DRIVE BELT 60 HZ | HPC | S25 |
| 525 | 92314113 | DRIVE BELT 60 HZ | HPC | S3 |
| 526 | 95125322 | DRIVE BELT 50 HZ | HPC | S25 |
| 526 | 92314127 | DRIVE BELT 50 HZ | HPC | S3 |
| 530 | 75738414 | CAPACITOR 60 HZ | HPC | S25 |
| 530 | 75738414 | CAPACITOR 60 HZ | HPC | S3 |
| 531 | 76879006 | CAPACITOR 50 HZ | HPC | S25 |
| 531 | 76879006 | CAPACITOR 50 HZ | HPC | S3 |
| 532 | 77612915 | CAPACITOR 50/60 HZ | HPC | S25 |
| 532 | 77612915 | CAPACITOR 50/60 HZ | 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 |
| 550 | 75889866 | BLOWER ASM 60 HZ | HPC | S3 |
| 550 | 75889886 | BLOWER ASM 60 HZ | HPC | S25 |
| 551 | 75889887 | BLOWER ASM 50 HZ | HPC | S3 |
| 551 | 75889887 | BLOWER ASM 50 HZ | HPC | S25 |
| 555 | 75880851 | PACK & HEADS - 96 MB | HPC | S3 |
| 556 | 75880852 | PACK & HEADS - 64 MB | HPC | S3 |
| 557 | 75880853 | PACK & HEADS - 32 MB | HPC | S3 |
| 558 | 75880854 | PACK & HEADS - 16 MB | HPC | S3 |
| 559 | 75880856 | PACK & HEADS - 64/96 MB | HPC | S3 |
| 560 | 75880857 | PACK & HEADS - 32/96 MB | HPC | S3 |
| 569 | 75882826 | PWB BRACKET | HPC | S3 |
| 570 | 75893020 | BRACKET, OPR CNTL | HPC | S3 |
| 571 | 75883026 | SPACER | 708 | 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 | 75899168 | COVER | HPC | S3 |
| 607 | 75899184 | COVER | HPC | S3 |
| 608 | 75899169 | COVER | HPC | S3 |
| 609 | 75899185 | COVER | HPC | S3 |
| 610 | 75899076 | POWER PLUG ASM 50 HZ | HPC | S3 |
| 610 | 75899076 | POWER PLUG ASM 50 HZ | HPC | S25 |
| 612 | 75899077 | POWER PLUG ASM 50 HZ | HPC | S3 |
| 613 | 75899080 | POWER PLUG ASM | HPC | S3 |
| 614 | 75899085 | POWER PLUG ASM | HPC | S25 |
| 614 | 75899085 | POWER PLUG ASM | HPC | S3 |
| 615 | 75899086 | POWER PLUG ASM | HPC | S3 |
| 615 | 75899086 | POWER PLUG ASM | HPC | S25 |
| 616 | 75899082 | POWER PLUG ASM | HPC | S3 |
| 616 | 75899082 | POWER PLUG ASM | HPC | S25 |
| 617 | 75899083 | POWER PLUG ASM | HPC | S3 |
| 617 | 75899083 | POWER PLUG ASM | HPC | S25 |
| 618 | 75899087 | POWER PLUG ASM | HPC | S3 |
| 618 | 75899087 | POWER PLUG ASM | HPC | S25 |
| 620 | 75895042 | SOUND TREATMENT OPT | HPC | S3 |
| 620 | 75895042 | SOUND TREATMENT OPT | HPC | S4 |
| 621 | 75895040 | SOUND TREATMENT OPT | HPC | S3 |
| 621 | 75895040 | SOUND TREATMENT OPT | HPC | S4 |
| 622 | 75895044 | SOUND TREATMENT OPT | HPC | S3 |
| 622 | 75895044 | SOUND TREATMENT OPT | HPC | S4 |
| 623 | 75895045 | SOUND TREATMENT OPT | HPC | S3 |
| 623 | 75895045 | SOUND TREATMENT OPT | HPC | S4 |
| 624 | 75895046 | SOUND TREATMENT OPT | HPC | S4 |
| 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 | S3 |
| 634 | 75893032 | FRONT PANEL INSTL KIT | HPC | S19 |
| 635 | 75893033 | FRONT PANEL INSTL KIT | HPC | S19 |
| 635 | 75893033 | FRONT PANEL INSTL KIT | HPC | S3 |
| 636 | 75896140 | ENCODING BUTTON KIT | HPC | S3 |
| 637 | 75896141 | ENCODING BUTTON KIT | HPC | S3 |
| 642 | 75896853 | PANEL INSERT | HPC | S3 |
| 643 | 75896854 | 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 |
| 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 | 75896605 | PANEL INSERT | HPC | S3 |
| 665 | 77632391 | PANEL INSERT | HPC | S3 |
| 666 | 75896802 | PANEL INSERT | HPC | S3 |
| 667 | 75896804 | PANEL INSERT | HPC | S3 |
| 666 | 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 | 75883787 | DOOR | HPC | S3 |
| 676 | 77615881 | DOOR | HPC | S3 |
| 677 | 75883793 | DOOR | HPC | S3 |

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| ITEM | IDENT NO | DESCRIPTION | WHERE USED | SHEET |
|---|---|---|---|---|
| 678 | 75883747 | DOOR | HPC | S3 |
| 679 | 75883792 | DOOR | HPC | S3 |
| 680 | 75883739 | DOOR | HPC | S3 |
| 681 | 75883744 | DOOR | HPC | S3 |
| 682 | 75883706 | DOOR | HPC | S3 |
| 683 | 75883701 | DOOR | HPC | S3 |
| 684 | 75883703 | DOOR | HPC | S3 |
| 685 | 75883713 | DOOR | HPC | S3 |
| 686 | 75883711 | DOOR | HPC | S3 |
| 687 | 75883707 | DOOR | HPC | S3 |
| 688 | 75883714 | DOOR | HPC | S3 |
| 689 | 75883715 | DOOR | HPC | S3 |
| 690 | 75883749 | DOOR | HPC | S3 |
| 691 | 75883717 | DOOR | HPC | S3 |
| 692 | 75883721 | DOOR | HPC | S3 |
| 693 | 75883722 | DOOR | HPC | S3 |
| 694 | 75883725 | DOOR | HPC | S3 |
| 695 | 77615848 | DOOR | HPC | S3 |
| 696 | 75883726 | DOOR | HPC | S3 |
| 697 | 75883728 | DOOR | HPC | S3 |
| 698 | 75883730 | DOOR | HPC | S3 |
| 699 | 75883732 | DOOR | HPC | S3 |
| 700 | 75883736 | DOOR | HPC | S3 |
| 701 | 75883733 | DOOR | HPC | S3 |
| 702 | 75883737 | DOOR | HPC | S3 |
| 703 | 75883742 | DOOR | HPC | S3 |
| 704 | 77615841 | DOOR | HPC | S3 |
| 705 | 75883745 | DOOR | HPC | S3 |
| 706 | 75883750 | DOOR | HPC | S3 |
| 707 | 75883751 | DOOR | HPC | S3 |
| 708 | 75883753 | DOOR | HPC | S3 |
| 709 | 75883073 | PULLEY & BELT KIT (60 HZ) | HPC | S3 |
| 710 | 77646342 | BASE PAN | 820 | S21 |
| 710 | 77646342 | BASE PAN | 820 | S3 |
| 711 | 77646343 | BASE PAN | 821, 822 | S3 |
| 711 | 77646343 | BASE PAN | 821, 822 | S21 |
| 716 | 75894105 | ESD KIT | 821 | S3 |
| 716 | 75894105 | ESD KIT | 821 | S21 |
| 717 | 75894106 | ESD KIT | 822 | S3 |
| 717 | 75894106 | ESD KIT | 822 | S21 |
| 721 | 77647291 | FILTER FRAME | HPC | S3 |
| 722 | 77647236 | FILTER FRAME | HPC | S3 |
| 723 | 77647246 | FILTER FRAME | HPC | S3 |
| 724 | 77647245 | FILTER FRAME | HPC | S3 |
| 725 | 77647209 | FILTER FRAME | HPC | S3 |
| 726 | 77641795 | FILTER KIT | HPC | S20 |
| 726 | 77641795 | FILTER 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 |
| 745 | 24565004 | CABLE CLAMP | HPC | S3 |
| 748 | 77660545 | E MODULE ASM | HPC | S14 |
| 748 | 77660545 | E MODULE ASM | HPC | S7 |
| 748 | 77660545 | E MODULE ASM | HPC | S3 |
| 751 | 75897340 | SLIDE KIT | HPC | S20 |
| 751 | 75897340 | SLIDE KIT | HPC | S3 |
| 752 | 75897701 | SLIDE KIT | HPC | S3 |
| 752 | 75897701 | SLIDE KIT | HPC | S20 |
| 756 | 75886347 | IDENT PLATE | HPC | S3 |
| 757 | 75890938 | DRAWER EXT SLIDE | 751 | S20 |
| 757 | 75890938 | DRAWER EXT SLIDE | HPC | S3 |
| 758 | 75890937 | DRAWER EXT SLIDE | HPC | S3 |
| 758 | 75890937 | DRAWER EXT SLIDE | 751 | S20 |
| 759 | 77664125 | JUMPER CABLE | HPC | S3 |
| 763 | 15165898 | CIRCUIT BREAKER | HPC | S3 |
| 763 | 15165898 | CIRCUIT BREAKER | HPC | S25 |
| 764 | 15165895 | CIRCUIT BREAKER | HPC | S25 |
| 764 | 15165895 | CIRCUIT BREAKER | HPC | S3 |
| 770 | 77665277 | TAPE INSTL KIT | HPC | S3 |
| 771 | 94257605 | RUN TIME METER | HPC | S3 |
| 772 | 77644690 | JUMPER PLUG ASM | HPC | S25 |
| 772 | 77644690 | JUMPER PLUG ASM | HPC | S3 |
| 773 | 77644691 | JUMPER PLUG ASM | HPC | S25 |
| 773 | 77644691 | JUMPER PLUG ASM | HPC | S3 |
| 801 | 77700030 | POWER KIT 1 | HPC | S3 |
| 801 | 77700030 | POWER KIT 1 | HPC | S25 |
| 802 | 77700031 | POWER KIT 2 | HPC | S25 |
| 802 | 77700031 | POWER KIT 2 | HPC | S3 |
| 803 | 77700032 | POWER KIT 3 | HPC | S25 |
| 803 | 77700032 | POWER KIT 3 | HPC | S3 |
| 804 | 77700033 | POWER KIT 4 | HPC | S3 |
| 804 | 77700033 | POWER KIT 4 | HPC | S25 |
| 805 | 77700034 | POWER KIT 5 | HPC | S25 |
| 805 | 77700034 | POWER KIT 5 | HPC | S3 |
| 806 | 77700035 | POWER KIT 6 | HPC | S25 |
| 806 | 77700035 | POWER KIT 6 | HPC | S3 |
| 807 | 77700036 | POWER KIT 7 | HPC | S25 |
| 807 | 77700036 | POWER KIT 7 | HPC | S3 |
| 808 | 77700037 | POWER KIT 8 | HPC | S25 |
| 808 | 77700037 | POWER KIT 8 | HPC | S3 |
| 809 | 77700038 | POWER KIT 9 | HPC | S3 |
| 809 | 77700038 | POWER KIT 9 | HPC | S25 |
| 820 | 77700060 | STD BASE PAN KIT | HPC | S21 |
| 820 | 77700060 | STD BASE PAN KIT | HPC | S3 |
| 821 | 77700061 | ESD BASE PAN KIT | HPC | S3 |
| 821 | 77700061 | ESD BASE PAN KIT | HPC | S21 |
| 822 | 77700062 | ESD BASE PAN KIT UNIQ | HPC | S3 |
| 822 | 77700062 | ESD BASE PAN KIT UNIQ | HPC | S21 |
| 825 | 77700071 | AIR OPTION KIT | HPC | S3 |
| 850 | 75883755 | DOOR | HPC | S3 |

# CROSS REFERENCE

| ITEM | IDENT NO | SHEET |
|---|---|---|
| 438 | 10125004 | S13 |
| 438 | 10125004 | S11 |
| 438 | 10125004 | S12 |
| 440 | 10125006 | S12 |
| 436 | 10125016 | S12 |
| 437 | 10125018 | S12 |
| 424 | 10125029 | S11 |
| 067 | 10125030 | S11 |
| 328 | 10125066 | S9 |
| 260 | 10125102 | S6 |
| 260 | 10125102 | S12 |
| 260 | 10125102 | S8 |
| 260 | 10125102 | S24 |
| 361 | 10125106 | S7 |
| 333 | 10125301 | S11 |
| 256 | 10125602 | S6 |
| 256 | 10125602 | S8 |
| 256 | 10125602 | S12 |
| 038 | 10125603 | S21 |
| 038 | 10125603 | S21 |
| 038 | 10125603 | S7 |
| 038 | 10125603 | S15 |
| 038 | 10125603 | S13 |
| 038 | 10125603 | S21 |
| 038 | 10125603 | S14 |
| 038 | 10125603 | S12 |
| 038 | 10125603 | S6 |
| 257 | 10125605 | S19 |
| 257 | 10125605 | S8 |
| 257 | 10125605 | S10 |
| 257 | 10125605 | S6 |
| 257 | 10125605 | S13 |
| 257 | 10125605 | S12 |
| 257 | 10125605 | S5 |
| 257 | 10125605 | S14 |
| 257 | 10125605 | S11 |
| 257 | 10125605 | S19 |
| 258 | 10125606 | S8 |
| 258 | 10125606 | S5 |
| 258 | 10125606 | S11 |
| 258 | 10125606 | S9 |
| 258 | 10125606 | S7 |
| 258 | 10125606 | S13 |
| 259 | 10125607 | S13 |
| 259 | 10125607 | S10 |
| 259 | 10125607 | S19 |
| 259 | 10125607 | S19 |
| 259 | 10125607 | S9 |
| 060 | 10125608 | S12 |
| 109 | 10125613 | S18 |
| 109 | 10125613 | S17 |
| 427 | 10125702 | S8 |
| 240 | 10125704 | S17 |
| 105 | 10125714 | S17 |
| 105 | 10125714 | S18 |
| 114 | 10125715 | S17 |
| 114 | 10125715 | S18 |
| 248 | 10125725 | S7 |
| 106 | 10125746 | S17 |
| 106 | 10125746 | S18 |
| 443 | 10125747 | S18 |
| 443 | 10125747 | S17 |
| 443 | 10125747 | S13 |
| 431 | 10125760 | S13 |
| 139 | 10125777 | S18 |
| 251 | 10125800 | S12 |
| 251 | 10125800 | S6 |
| 251 | 10125800 | S8 |
| 252 | 10125801 | S6 |
| 252 | 10125801 | S15 |
| 252 | 10125801 | S8 |
| 252 | 10125801 | S21 |
| 252 | 10125801 | S12 |
| 252 | 10125801 | S13 |
| 252 | 10125801 | S21 |
| 252 | 10125801 | S21 |
| 252 | 10125801 | S7 |
| 039 | 10125803 | S10 |
| 039 | 10125803 | S12 |
| 039 | 10125803 | S11 |
| 039 | 10125803 | S8 |
| 039 | 10125803 | S6 |
| 039 | 10125803 | S19 |
| 039 | 10125803 | S19 |
| 039 | 10125803 | S19 |
| 039 | 10125803 | S20 |
| 039 | 10125803 | S13 |
| 254 | 10125804 | S15 |
| 254 | 10125804 | S8 |
| 254 | 10125804 | S16 |
| 254 | 10125804 | S16 |
| 254 | 10125804 | S5 |
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| 254 | 10125804 | S7 |
| 254 | 10125804 | S13 |
| 254 | 10125804 | S16 |
| 254 | 10125804 | S11 |
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| 040 | 10125805 | S10 |
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| 040 | 10125805 | S12 |
| 040 | 10125805 | S20 |
| 255 | 10125806 | S12 |
| 255 | 10125806 | S13 |
| 133 | 10125909 | S18 |
| 133 | 10125909 | S17 |
| 108 | 10125912 | S17 |
| 108 | 10125912 | S18 |
| 463 | 10126100 | S24 |
| 125 | 10126101 | S18 |
| 125 | 10126101 | S17 |
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| 359 | 10126213 | S7 |
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| 120 | 10126214 | S21 |
| 120 | 10126214 | S21 |
| 099 | 10126215 | S21 |
| 099 | 10126215 | S21 |
| 099 | 10126215 | S21 |
| 243 | 10126219 | S7 |
| 335 | 10126221 | S11 |
| 426 | 10126222 | S13 |
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| 371 | 10126226 | S16 |
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| 432 | 10126245 | S12 |
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| 299 | 10126250 | S13 |
| 299 | 10126250 | S19 |
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| 250 | 10126253 | S6 |
| 253 | 10126254 | S13 |
| 373 | 10126255 | S12 |
| 059 | 10126256 | S12 |
| 208 | 10126263 | S6 |
| 430 | 10126401 | S5 |
| 430 | 10126401 | S18 |
| 430 | 10126401 | S17 |
| 430 | 10126401 | S12 |
| 430 | 10126401 | S13 |
| 430 | 10126401 | S6 |
| 425 | 10126402 | S14 |
| 329 | 10126403 | S10 |
| 329 | 10126403 | S20 |
| 329 | 10126403 | S9 |
| 130 | 10126404 | S18 |
| 130 | 10126404 | S17 |
| 065 | 10127101 | S11 |
| 238 | 10127102 | S8 |
| 322 | 10127103 | S9 |
| 322 | 10127103 | S10 |
| 231 | 10127104 | S13 |
| 231 | 10127104 | S6 |
| 035 | 10127111 | S11 |
| 035 | 10127111 | S19 |
| 035 | 10127111 | S19 |
| 035 | 10127111 | S19 |
| 429 | 10127112 | S6 |
| 429 | 10127112 | S17 |
| 429 | 10127112 | S13 |
| 429 | 10127112 | S10 |
| 429 | 10127112 | S18 |
| 244 | 10127113 | S6 |
| 244 | 10127113 | S8 |
| 244 | 10127113 | S12 |
| 244 | 10127113 | S11 |
| 244 | 10127113 | S20 |
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| 277 | 83410518 | S5 |
| 337 | 83435302 | S16 |
| 421 | 90603300 | S5 |
| 094 | 91930600 | S9 |
| 461 | 92006029 | S24 |
| 369 | 92009012 | S12 |
| 242 | 92033033 | S8 |
| 219 | 92033037 | S7 |
| 219 | 92033037 | S6 |
| 220 | 92054223 | S7 |
| 320 | 92074007 | S24 |
| 525 | 92314113 | S13 |
| 525 | 92314113 | S25 |
| 525 | 92314113 | S3 |
| 526 | 92314127 | S3 |
| 113 | 92376014 | S17 |
| 141 | 92376014 | S18 |
| 476 | 92602003 | S11 |
| 422 | 92602004 | S7 |
| 422 | 92602004 | S13 |
| 388 | 92720396 | S11 |
| 031 | 92742011 | S6 |
| 273 | 92745011 | S6 |
| 237 | 92745012 | S8 |
| 456 | 92815099 | S15 |
| 287 | 92826001 | S10 |
| 387 | 93109084 | S20 |
| 272 | 93326006 | S19 |
| 272 | 93326006 | S20 |
| 127 | 93419228 | S18 |
| 127 | 93419228 | S17 |
| 228 | 93564001 | S8 |
| 228 | 93564001 | S6 |
| 228 | 93564001 | S7 |
| 334 | 93564004 | S7 |
| 147 | 93564034 | S18 |
| 140 | 93564044 | S18 |
| 241 | 93592158 | S6 |
| 087 | 93748198 | S13 |
| 151 | 93749082 | S13 |
| 349 | 93749092 | S14 |
| 297 | 93749096 | S14 |
| 348 | 93749098 | S14 |
| 357 | 93749100 | S14 |
| 323 | 93749196 | S10 |
| 323 | 93749196 | S9 |
| 153 | 93749198 | S10 |
| 153 | 93749198 | S9 |
| 462 | 93749198 | S24 |
| 152 | 93749200 | S10 |
| 152 | 93749200 | S9 |
| 428 | 93788082 | S13 |
| 771 | 94257605 | S3 |
| 296 | 94275254 | S9 |
| 338 | 94276600 | S16 |
| 338 | 94276600 | S16 |
| 340 | 94277400 | S17 |
| 340 | 94277400 | S16 |
| 340 | 94277400 | S11 |
| 340 | 94277400 | S18 |
| 154 | 94277401 | S9 |

| ITEM | IDENT NO | SHEET |
|---|---|---|
| 154 | 94277401 | S10 |
| 341 | 94277409 | S16 |
| 064 | 94279113 | S20 |
| 155 | 94343210 | S9 |
| 155 | 94343210 | S10 |
| 033 | 94364401 | S6 |
| 081 | 94364903 | S19 |
| 081 | 94364903 | S19 |
| 084 | 94364906 | S19 |
| 236 | 94371000 | S16 |
| 236 | 94371000 | S6 |
| 291 | 94376910 | S19 |
| 054 | 94376917 | S8 |
| 055 | 94376918 | S8 |
| 630 | 94397002 | S3 |
| 731 | 94398801 | S3 |
| 131 | 94399501 | S17 |
| 041 | 95033900 | S5 |
| 455 | 95044214 | S15 |
| 455 | 95044214 | S7 |
| 339 | 95105900 | S16 |
| 339 | 95105900 | S16 |
| 034 | 95105904 | S6 |
| 526 | 95125322 | S25 |
| 092 | 95125326 | S7 |
| 126 | 95510024 | S17 |
| 126 | 95510024 | S18 |
| 111 | 95510026 | S8 |
| 111 | 95510026 | S17 |
| 111 | 95510026 | S18 |
| 091 | 95510027 | S7 |
| 205 | 95523400 | S6 |
| 128 | 95533601 | S17 |
| 128 | 95533601 | S18 |
| 122 | 95582501 | S18 |
| 122 | 95582501 | S17 |
| 112 | 95583504 | S17 |
| 112 | 95583504 | S18 |
| 117 | 95587700 | S18 |
| 117 | 95587700 | S17 |
| 118 | 95635102 | S18 |
| 118 | 95635102 | S17 |
| 129 | 95635103 | S17 |
| 144 | 95635104 | S18 |
| 119 | 95635105 | S18 |
| 119 | 95635105 | S17 |
| 124 | 95641502 | S18 |
| 124 | 95641502 | S17 |
| 467 | 95643257 | S24 |
| 380 | 95643601 | S17 |
| 380 | 95643601 | S10 |
| 380 | 95643601 | S18 |
| 285 | 95645628 | S10 |
| 132 | 95647607 | S18 |
| 132 | 95647607 | S17 |
| 116 | 95655530 | S17 |
| 116 | 95655530 | S18 |
| 249 | 95694202 | S9 |

## 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. Inclosed 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 |
|---|---|
| EM | 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 |

*77648060

| 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 | EM3P1A | 31 | EM3P1A | 32 | ET |
| PRES-SW/+L | EM4P1B | 32 | EM3P1A | 32 | 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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