75888415

CONTROL DATA CORPORATION

CONTROL DATA®
CARTRIDGE MODULE DRIVE

GENERAL DESCRIPTION
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

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REVISION RECORD

REV	DATE	SHEETS AFFECTED	MANUAL/SECTION REVISION STATUS 1	2	3	4	5	6	7	8	9	10	11	12	CHANGE AUTHORITY
AA	80 ls May 29	ii(ser.cd 3)	E	G	M	H	U	S	N	F					PL 22968
AB	80 AUG21	ii	E	G	M	H	U	S	P	F					PL 33071
AC	80 Sw. SEP17	ii, vi,x,xi,xii	E	H	N	J	V	T	P	F					PL 33111
AD	80 OCT 17 Sw	ii	F	H	N	J	V	T	P	F					PL 33125
AE	80 DEC 4 Sw	ii thru xiii/xiv	F	H	N	J	V	T	P	F					PL 33203
AF	81 JAN 20 Sw		F	J	P	K	W	U	P	F					PL 33255
AG	81 JAN 27 Sw	ii	F	J	P	K	Y	U	P	F					PL 33282
AH	81 Sw MAR 5	ii	F	J	P	K	Z	U	P	F					PL 33345
AJ	81 Sw MAR 16	ii	F	J	P	K	Z	V	P	F					PL 33362
AK	81 Sw APR 10	ii	F	K	R	L	AA	W	P	F					PL 33397
AL	81 APR29	ii	F	K	R	L	AA	Y	P	F					PL 33444
AM	81 JUN 10 S.Wise	ii, iii	F	K	R	L	AB	Z	P	F					PL 33492
AN	81 AUG 13 S.Wise	ii	F	K	R	L	AB	Z	R	F					PL 33618
AP	81 SEP9	ii	F	K	R	L	AC	AA	R	F					PL 33664

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

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.

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 (75888415). This number, along with the unit HPC number, should be used when making reference to the Cartridge Module Drive Product Manual.

The following table identifies the content of each volume:

	SECTION NUMBER/TITLE	PUBLICATION NUMBER
I	General Description	75888326
II	Operation	75888416
III	Installation and Checkout	75888417
IV	Theory of Operation	75888418
V	Diagrams *	75888419
VI	Maintenance	75888331
VII	Parts Manual	75888332
VIII	Wire Lists	75888333

* In some instances the I/O board documentation is part of the Hardware Product Configuration (HPC) documentation package in the front of this manual.

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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

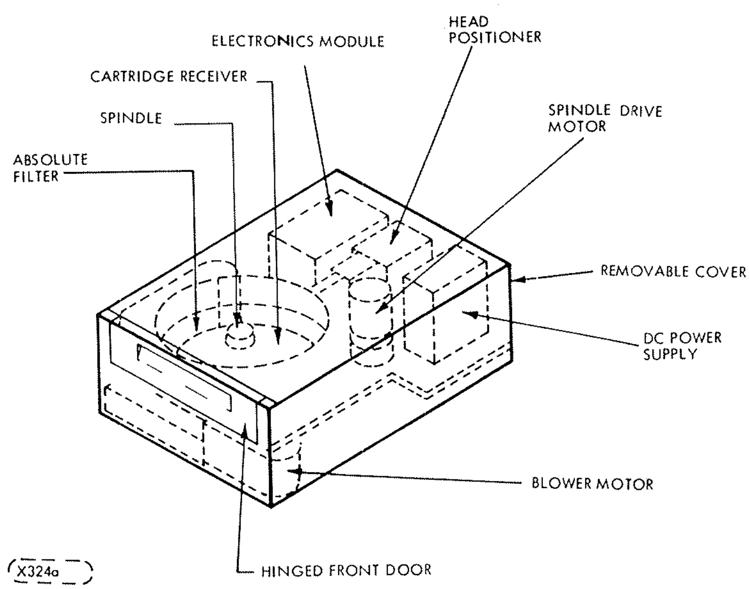
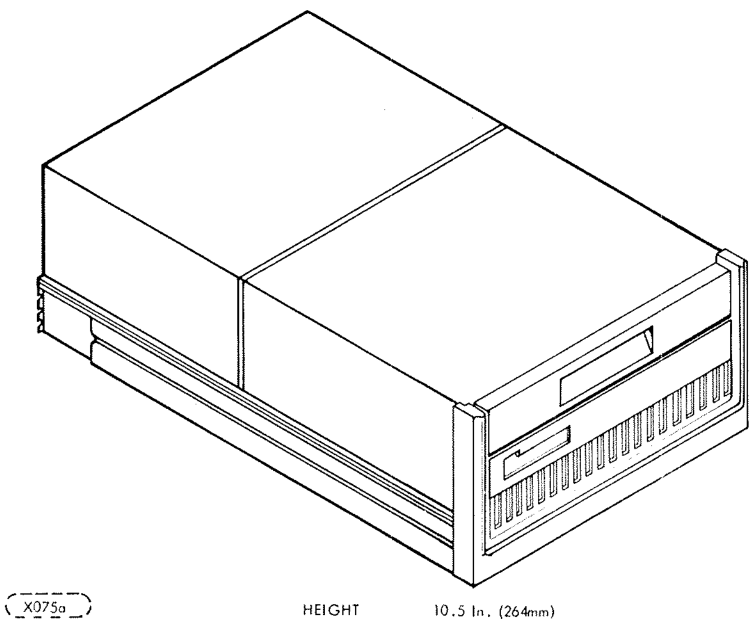


FIGURE 1-1. MAJOR COMPONENTS OF CARTRIDGE MODULE DRIVE



HEIGHT	10.5 In. (264mm)
WIDTH	19.0 In. (483mm) Max. (Panel) 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, 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 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 Maintenance Section.

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 sucking 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 a cartridge in the unit at all times and 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 Maintenance Section 6.7.22.
3. To prevent damage and/or data loss, follow the Disk Cartridge Removal procedure in Section 2.8
4. 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

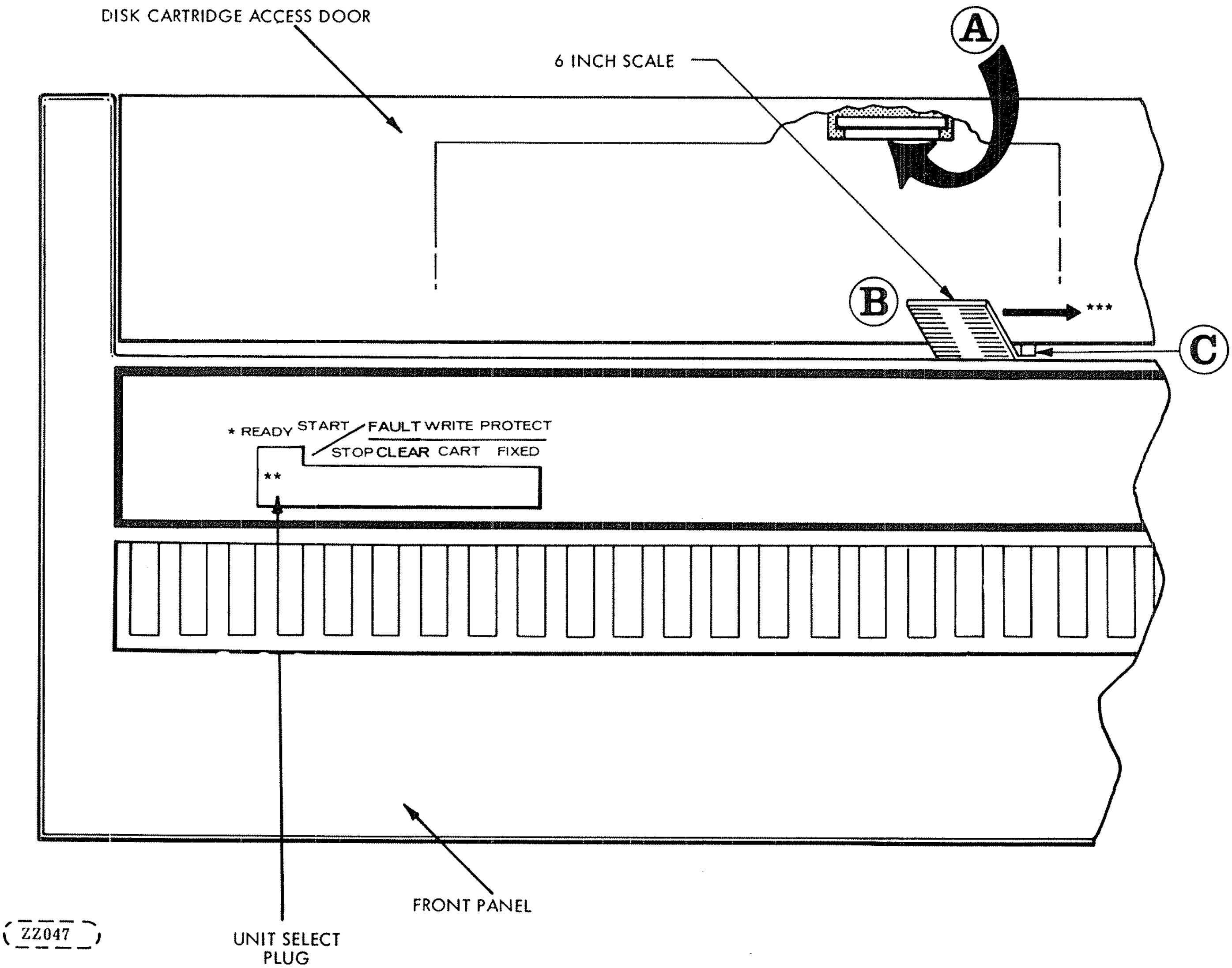
NOTE

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.

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.



* SEE TABLE 2-1 FOR DIFFERENCES IN NAMES FOR THIS INDICATOR.

** A NUMBER FROM 0-7 WILL BE ON THE PLUG FACE.

*** SEE PARAGRAPH 2.8.2.

Figure 2-1. Operator Controls and Indicators

Table 2-1. Controls and Indicators

Control or Indicator	Function
	Control Panel
START/STOP switch/indicator	Start switch energizes spindle motor and initiates the first seek mode provided the following conditions are met: 1. The AC circuit breaker is ON. 2. Disk cartridge loading door closed and latched with cartridge in place. 3. FAULT light is OFF (certain fault conditions do not exist - see Section 4). 4. a. Switch S-1 on I/O PWA in "Local" position (see Figure 3-17). b. If S-1 on I/O PWA is in the "Remote" position, the CMD will start when a 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. Not all units have a START indicator.
READY indicator	Positioned above the unit select plug on units which have START indicator within the Start/Stop Switch. READY indicates unit ready status. READY indicator is illuminated whenever unit is up to speed and heads are loaded and no fault requiring manual intervention exists within the unit. The READY light will blink 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.

Table 2-1. Controls and Indicators (continued)

Control or Indicator	Function
	Control Panel
FAULT switch/indicator	Clears certain fault conditions when operated. Refer to Section 6, Maintenance.
FAULT indicator	Located within the FAULT switch. * Indicates any fault condition when illuminated. Turns OFF when fault condition cleared by operating the FAULT switch.
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 (See Figure 2-1)	The Disk Pack Access Door is unlatched by lifting with the fingers on the latch A that is under the lip of the recess in the access door. 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 will release 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.

*Does not indicate Seek error.

5. Install disk cartridge in accordance with Disk Cartridge Installation procedure.

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.

7. Verify that FAULT indicator remains off.

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. If the START/STOP spindle stop procedure applies.

To stop:

1. Operate START/STOP switch and verify that the READY indicator blinks 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 blinking and has extinguished.

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.

2.4 FAULT OPERATING INSTRUCTION

If FAULT indicator illuminates during operation or power up, proceed as follows:

1. Operate FAULT switch. If lamp extinguishes, normal operation can be resumed. If FAULT lamp remains illuminated, proceed to step 2.

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, proceed to step 3.

3. Power down equipment in accordance with Stop and Power Down procedure. Turn AC circuit breaker off then power up in the normal manner again. If the fault indicator is still on, call customer service engineer.

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 briefly summarized in Table 2-2. A more detailed description is given in Theory of Operation (Section 4.3.1).

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. Cartridges can be stacked on top of one another, but should not be stacked more than four high.

2.7 DISK CARTRIDGE INSTALLATION

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

1. Release latch under lip of access door recess (see Figure 2-1) and pull down cartridge access door.

NOTE

> Power must be on, the Start/Stop switch out, and READY and FAULT lamps must be off to release lock on cartridge door.

2. To separate dust cover from the disk cartridge, push cover release button toward center of cartridge.

* Not including switching of AC power input to the unit.

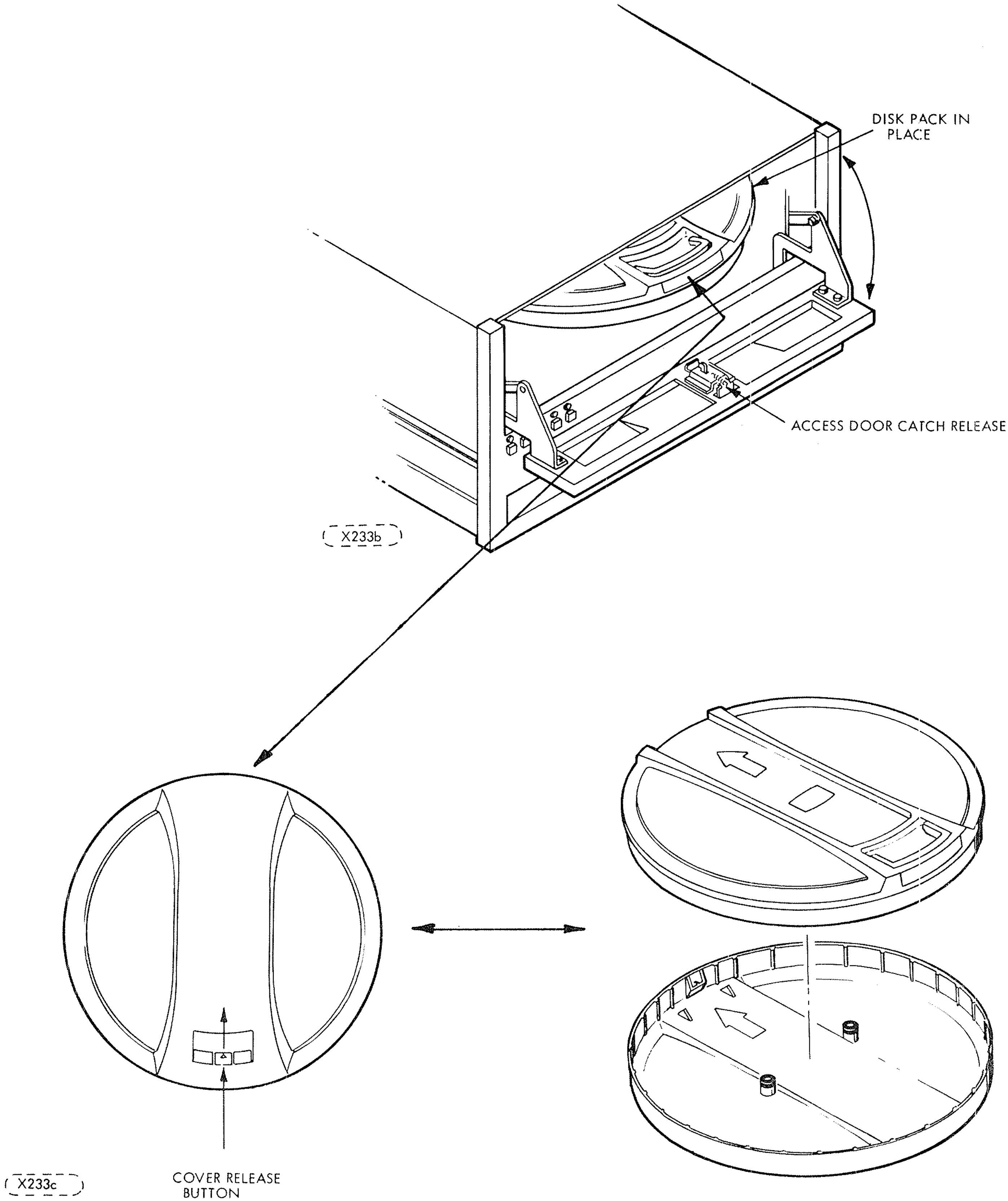


Figure 2-2. Disk Cartridge Installation/ Removal

Table 2-2. 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 causing the carriage to move or a zero distance seek. A carriage offset will result in loss of On Cylinder for a period of 2.75 ms (nominal).
UNIT READY	When active and the device is selected, this line indicates that the device is up to speed, the heads are positioned over the recording tracks and no fault condition exists within the device.
ADDRESS MARK FOUND	Pulse sent following recognition of at least 16 missing transitions and the first zero of the zeros pattern.

*, ** See end of Table

CAUTION

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

Table 2-2. 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 (Bits 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 2-3 lists these control signals.
POWER SEQUENCE PICK 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 2-3) 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 2-3.

*, **, *** See end of Table.

Table 2-2. 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 Signals from the CMD to the Controller
SERVO CLOCK	Phase-locked 9.677 MHz clock generated from the servo track dibits. Returned by the controller to the CMD as WRITE CLOCK.
READ DATA	This line transmits the recovered data in the NRZ form.
READ CLOCK	This clock defines the beginning of the data cell. It is internally derived and is synchronous with the detected data.
SEEK END	This line combines the ON CYLINDER or SEEK ERROR signals indicating that a seek operation has terminated.
UNIT SELECTED	If the code on the three Unit Select lines is equal to the lines coming from the logic plug on the operator panel while UNIT SELECT TAG is true, then the CMD sends UNIT SELECTED to the controller.
INDEX**	Pulse which occurs once per disk revolution; its leading edge being considered the leading edge of the Sector Zero. Pulse width is typically 2.5 us. Index to controller is gated off during volume change and RTZ.
SECTOR**	Pulse derived from the servo track which divides each track into sectors. Up to 127 sector pulses are available per cylinder depending on the setting of sector switches in the CMD. Sector to controller is gated off during volume change and RTZ.

*See Figure 3-7 for interface cabling diagram.

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

***Unit Select 2^3 must be zero.

Table 2-3. 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 Section 4.3.1 for timing. A zero denotes the removable cartridge and a one denotes the fixed disks.

3. Disengage dust cover from disk cartridge. Set cover aside upside down to prevent dust from collecting within the cover.

CAUTION

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

4. Slide disk cartridge into receiver track, ensuring that the head opening is toward rear of the machine.

5. Push handle down. Push cartridge rearward until it stops.

6. 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.

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 blinking and extinguishes entirely.

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. Close the access door if another cartridge is not to be installed.

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 3 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, Maintenance).

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. Close the access door if another cartridge is not to be installed.

CARTRIDGE REMOVAL FOR EMERGENCY CONDITIONS

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

1. Make sure the spindle motor is completely stopped. Either observe the motor with the top cover of the unit off or turn off AC Power and wait a full 5 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 above.
4. Close the door in the normal manner when ready to do so.

2.9 MAINTENANCE SWITCHES AND INDICATORS

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

A set of seven LED fault display indicators are mounted on the top of the Control/Mux PWA in the electronics module. Two types of faults can be displayed on these indicators: non-microprocessor or logic detected faults and error conditions detected by the Servo-Coarse PWA microprocessor (called the Microprocessor Fault Summary). Table 2-4 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. Also, the FAULT CLEAR switch does not operate to place microprocessor faults on the LED fault displays as 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 6-8 and 6-9 in the Maintenance Section.

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 heat 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.

Table 2-4. Fault Display Indicator Summary

IND	LOGIC DETECTED FAULT	MICROPROCESSOR DETECTED FAULT
CR1	NO HEAD SELECT FAULT (NH)	CR 1 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.

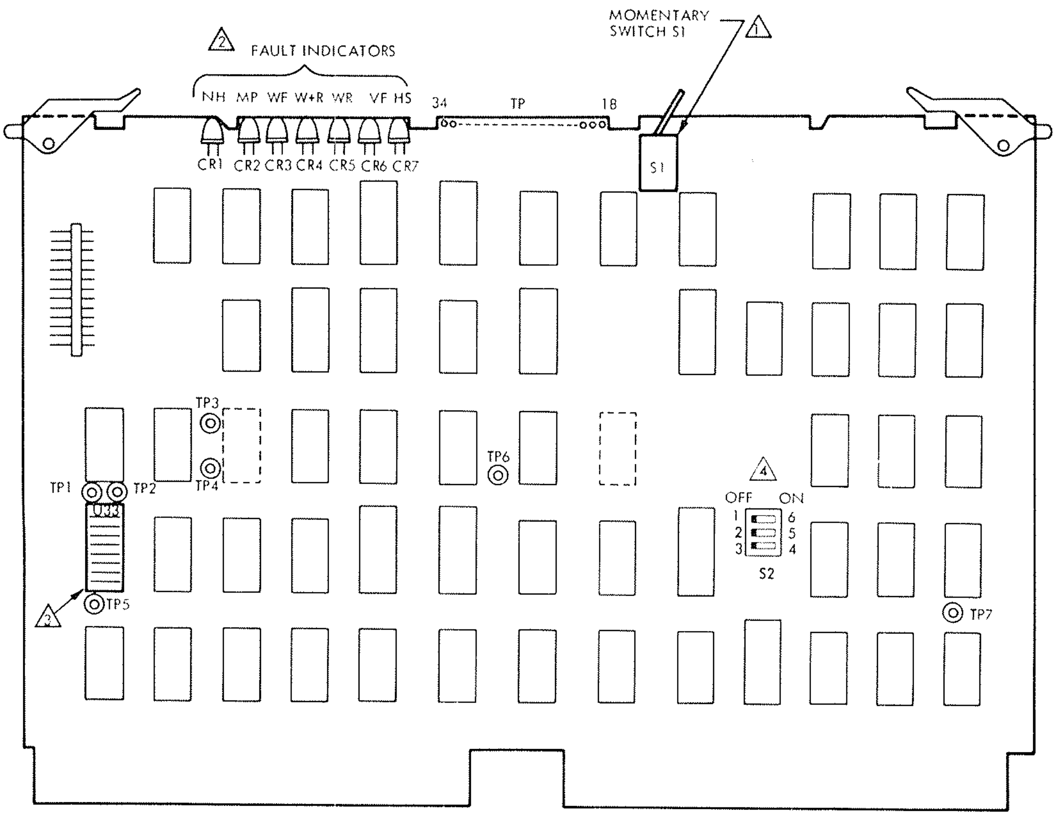
*In the Microprocessor Fault Code Summary mode two types of information are displayed: The phase of operations where the fault occurred and the type fault. From 1 to 12 phases could be displayed and from 1 to 16 faults. All of the applicable phases are displayed in serial order first and then all of 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

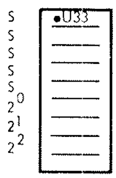
CODE (HEX)	FAULT TYPE
0F	Spindle did not Start/Stop in 2 minutes 10 or 14 was noted
10	Spindle Start GT 70 SEC max
11	No spindle movement or not up to speed in 2 MIN
12	No Drive to Solid State Relay
13	Solid State Relay Failure
14	Stop Timeout
15	Emergency Retract Failure
16	Normal Retract Failure
17	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



1. SHOWN IN "OFF" POSITION

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

3. BINARY WEIGHTS MUST BE PROGRAMMED TO INDICATE DEVICE CAPACITY, BY INSERTING JUMPER (ITEM 62) INTO SOCKET U33 S IS SPACE.



4. SEE SWITCH SETTING SPECIFICATION INCLUDED WITH MANUAL WHEN SHIPPED WITH UNIT. OPTIONS AVAILABLE ARE:

	OFF	S2	ON	
		1		SPARE
		2		VALIDATE "ON CYL" WITH VALID SECTOR
INVERTED VOLUME		3		STANDARD VOLUME

X399a

FIGURE 2-3. CONTROL/MUX (OEM INTERFACE) PWA SHOWING FAULT INDICATORS AND FAULT RESET SWITCH

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 again.

E. If the screws F that secure the electronics module to the base pan are installed, remove and discard.

F. If the deck hold down bolts B (Figure 3-3, Sheet 2 of 2) are installed, remove and stow them below the deck in the Base Pan together with all the hardware as shown. If the deck hold down bolts B were not installed, proceed to the next step.

NOTE

The screws F that secure the electronics module to the Base Pan and the deck hold down bolts B are part of a kit that may be installed as a customer option.

G. 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).

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

I. 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 determing 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.

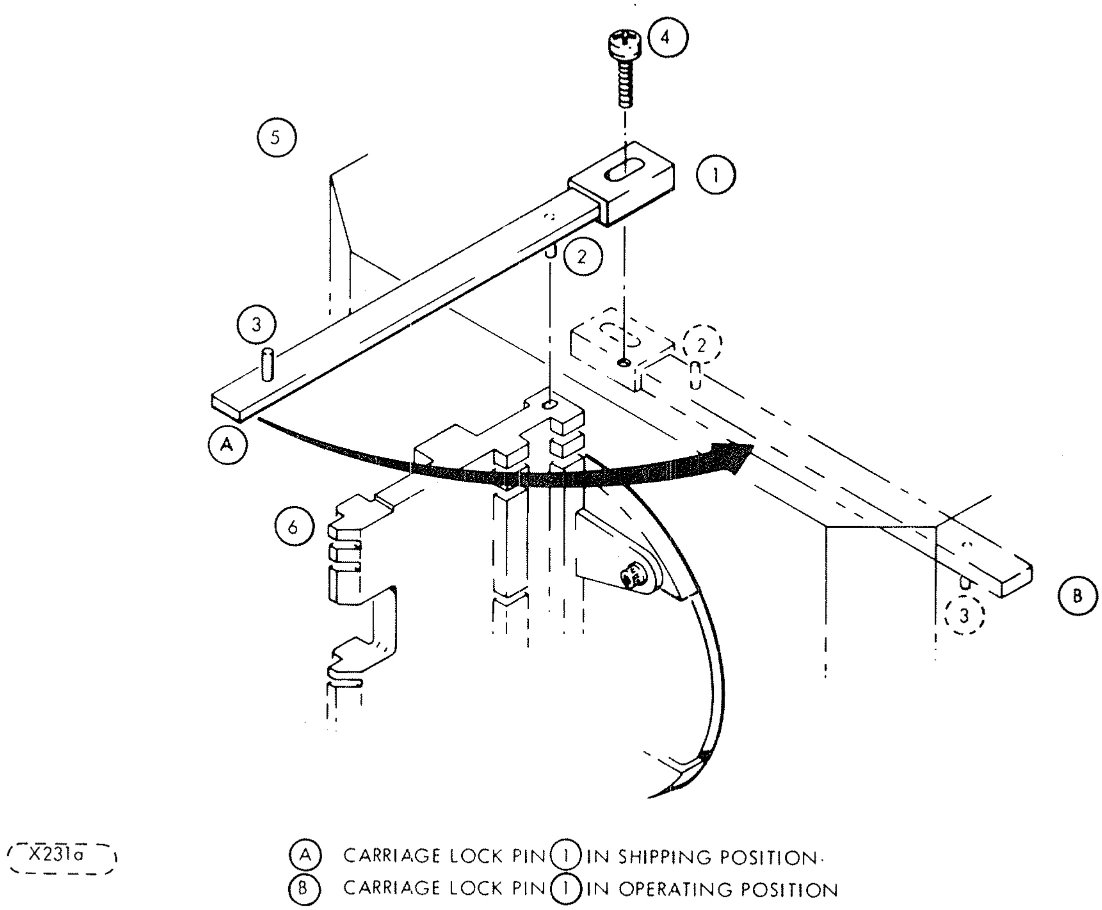


Figure 3-1. Carriage Locking Tool - Shipping Position

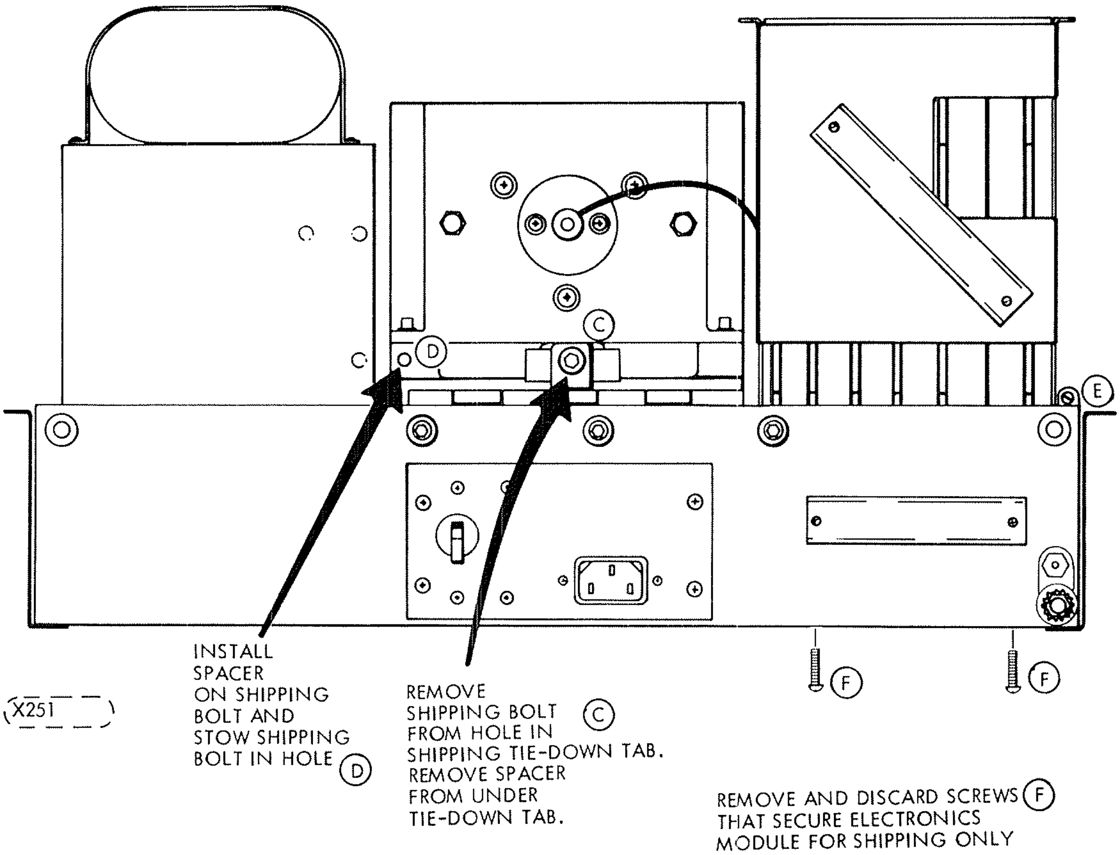


Figure 3-2. Rear Shipping Bolt Location

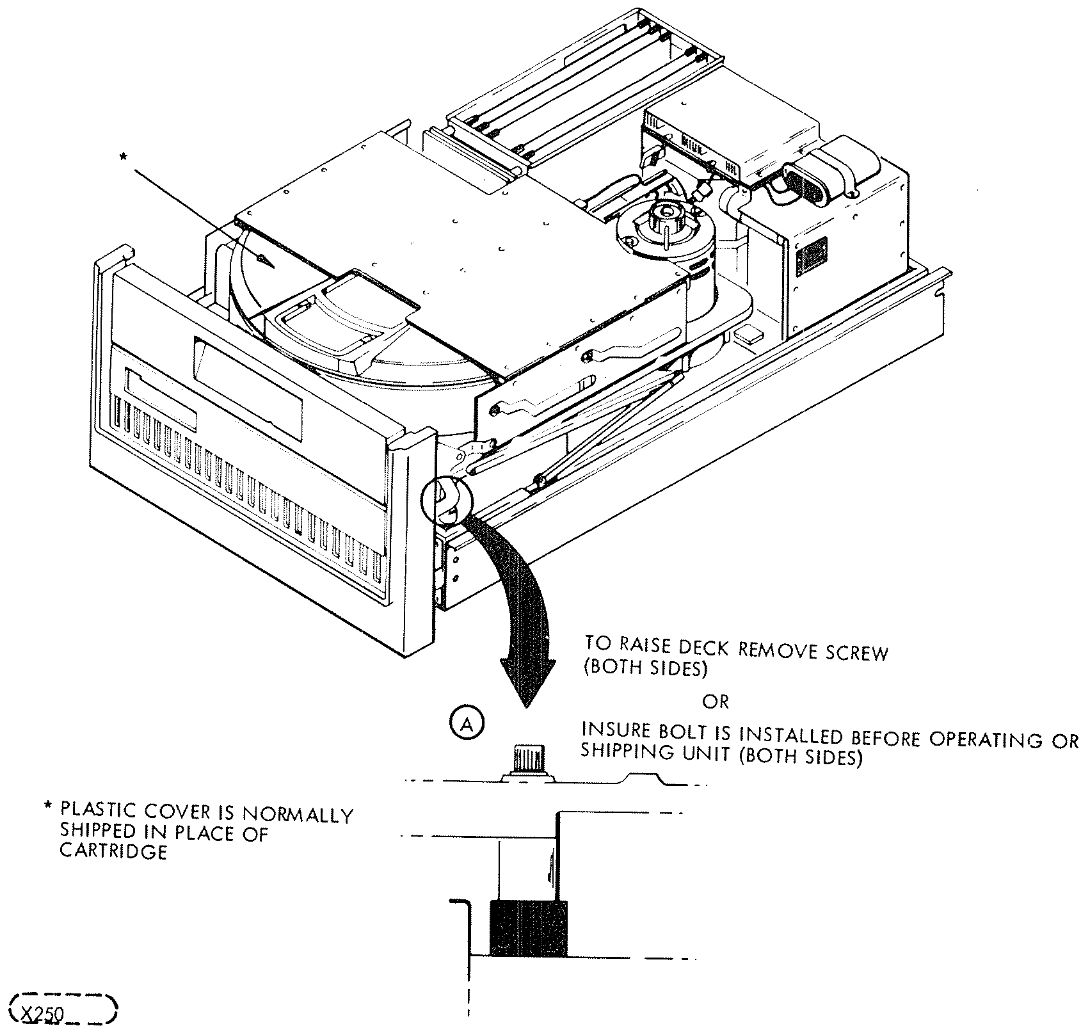


Figure 3-3. Deck Hold down Bolts (Sheet 1 of 2)

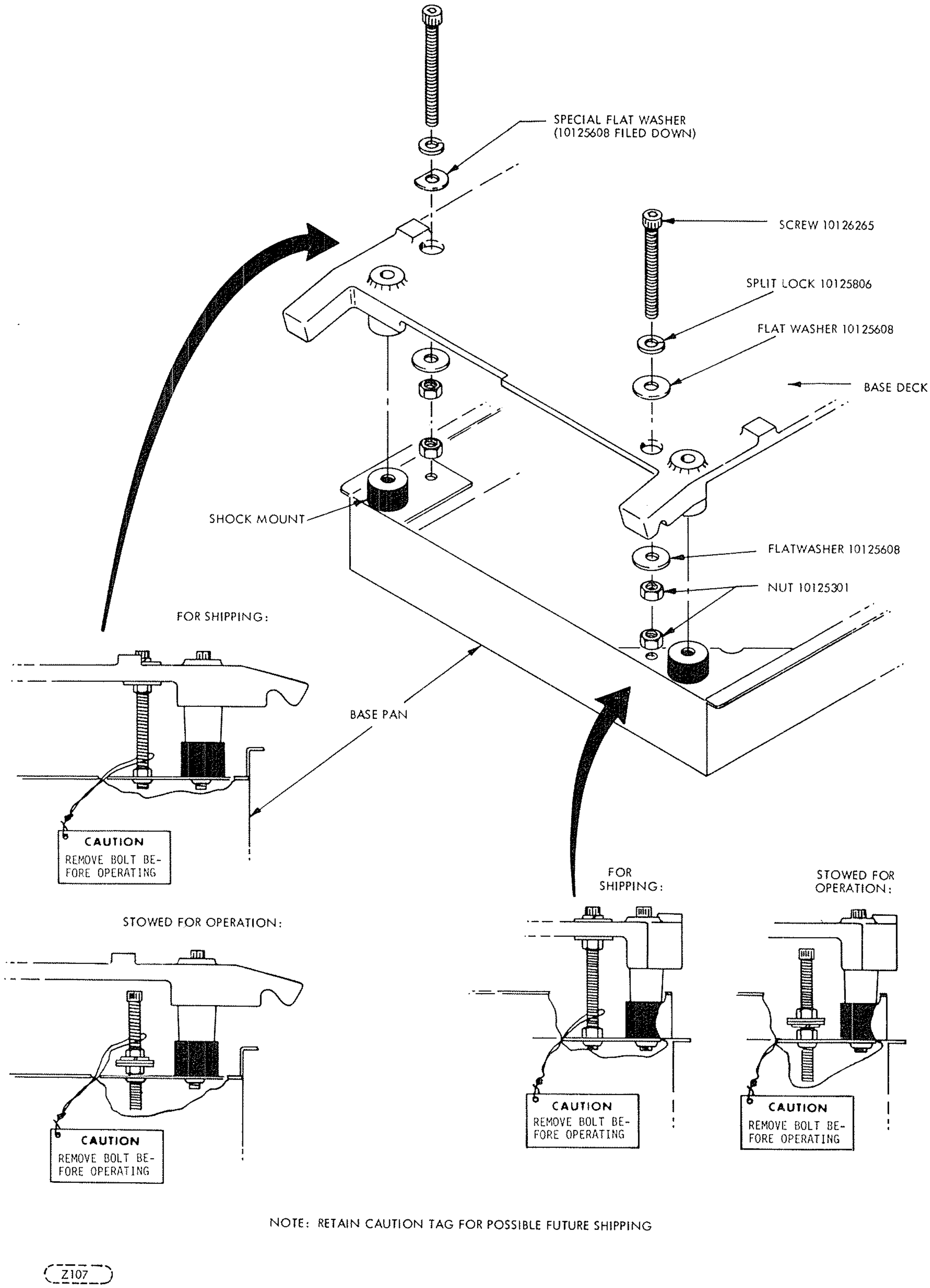
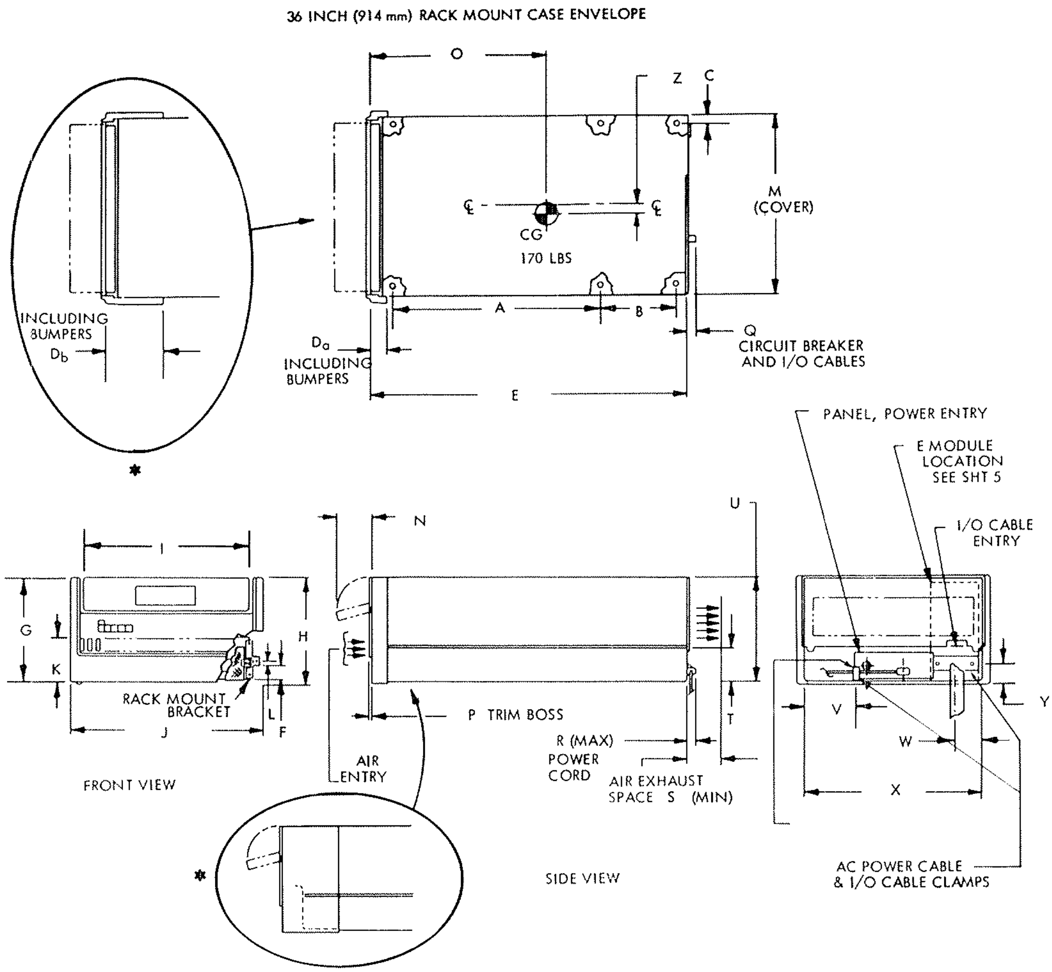


FIGURE 3-3. DECK HOLD DOWN BOLTS (SHEET 2 OF 2)



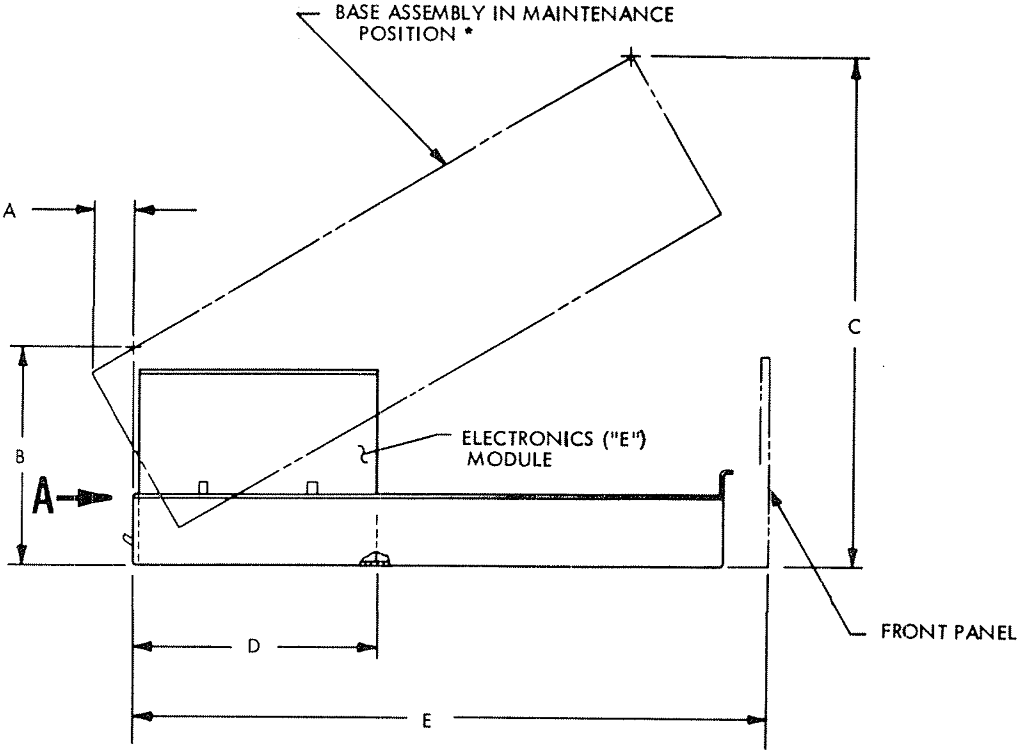
* 30 INCH (762 mm) RACK MOUNT CASE ENVELOPE

DIMENSION	INCHES	MILLIMETERS
A	17.76	451.1
B	10.0	254.0
C	0.38	9.7
D_a	1.50	38.1
D_b	2.53	64.3
E	30.50	774.7
F	1.25	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

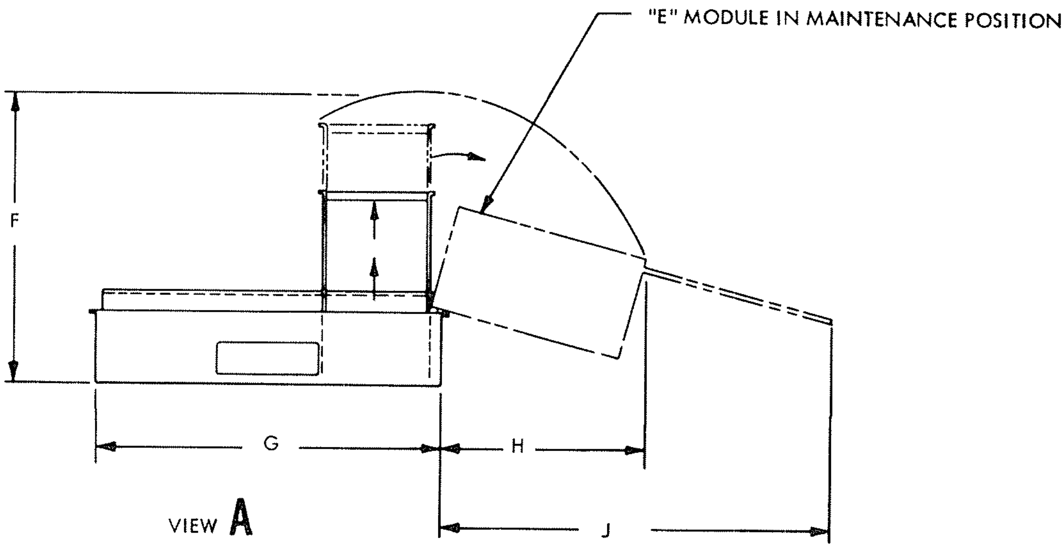
XX215

FIGURE 3-4. DETAILED DIMENSIONS



NOTE:

* "E" MODULE MUST BE IN MAINTENANCE POSITION TO RAISE THE BASE ASSEMBLY



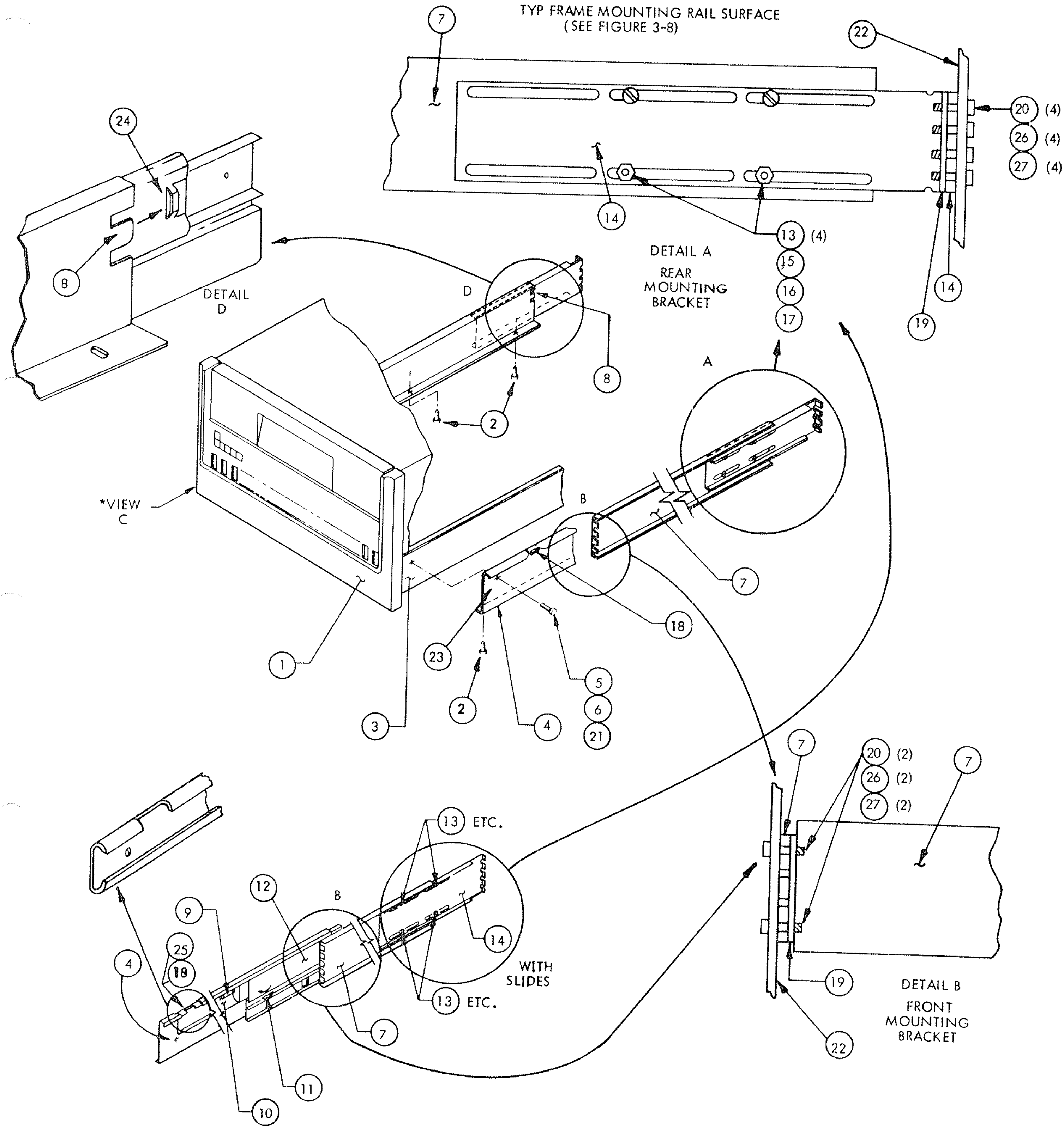
DIMENSION	INCHES	MILLIMETERS	REMARKS
A	2.00 MAX	50.8	
B	10.50 MAX	266.7	
C	24.50	622.3	"E" MODULE RAISED TO MAINTENANCE POSITION
D	12.50	317.5	
E	30.50 REF	774.7	
F	14.20	360.7	
G	16.70 REF	424.2	
H	9.80 MAX	248.9	
J	18.80	477.5	WITH BOARD EXTENSION

XX204a

Figure 3-5. Base Assembly and E Module Maintenance Envelope

3.4.2 INSTALLATION PROCEDURE FOR RACK MOUNTING OF THE CMD

1. Adjust the rack rails (22) front-to-back separation 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 attach the chassis mounting rail (4) to the base 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 washers ((13), (15), (16) and (17)) to adjust the length of the fixed slide number (7). Position the slides so that the inside edges of the fixed slide members are 17.82 in. (452.7 mm) apart. Make sure that the slides are horizontal and equidistant 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 (2). Insert the screw (2) 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 sides. Tighten the screws (20) if they were loosened while adjusting the separation of the slides.
12. With both hands unlock the slides by simultaneously pushing the spring locks (9) inward and pushing the CMD into the rack. If an increase in pressure is required as the CMD is pushed into the rack, loosen the twelve screws (20). Adjust the separation between the sides so that the minimum amount of effort is required to push the CMD all the way into the rack. Slide the CMD into and out of the rack at least three times to check the freedom of travel. Tighten the twelve screws (20).
13. If the CMD is to be secured to the rack to prevent it from being slid out from the rack, refer to Section 6.6.1. Remove the front panel per instructions and install screw (8) in Figure 6-1 which is the same type as (20) in Figure 3-6. Reinstall the front panel.



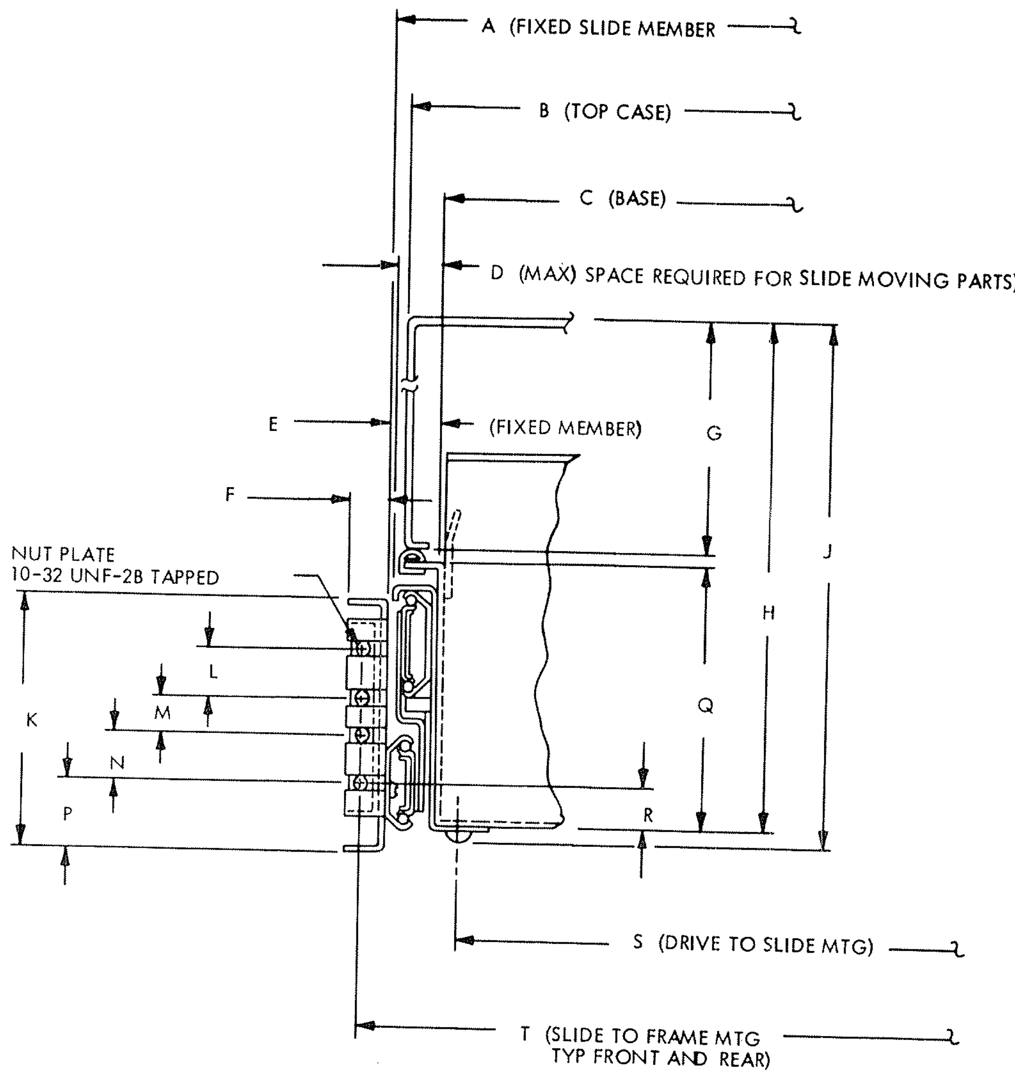
*SEE FIGURE 3-7.

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 rail 4 (fits into item 25).
19. Plate, nut
20. Screw, Mach., Pan Hd 10-32 x 5/8, P/N 10127144
21. Washer, flat #6
22. Rack rail
23. Hole in fixed slide member for screw item #5 above.
24. Mounting slot on end of outer slide member 10
25. Mounting slot on top side of outer slide member 10
26. Washer, lock #10, P/N 10125805
27. Washer, plain, flat, #10, P/N 94279113

Figure 3-6. Rack Mounting Details (Sheet 2 of 2)



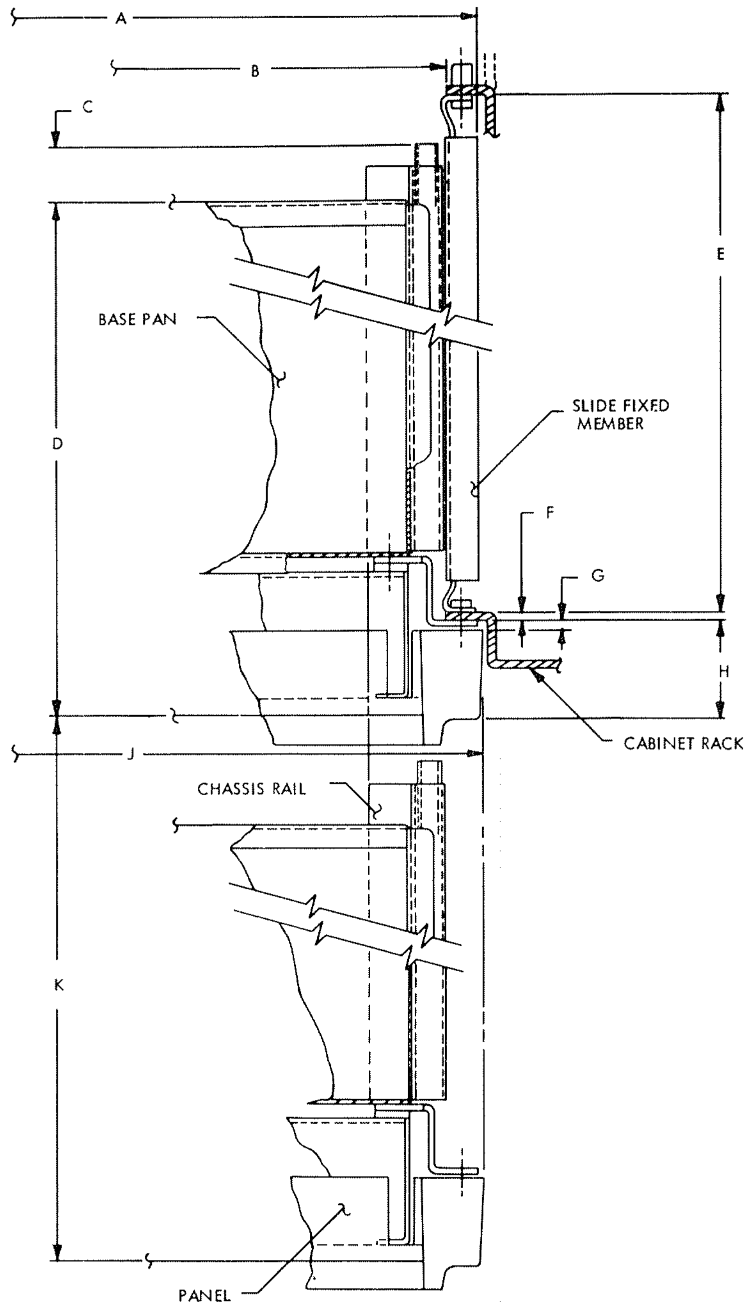
VIEW C
FRONT PANEL REMOVED

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

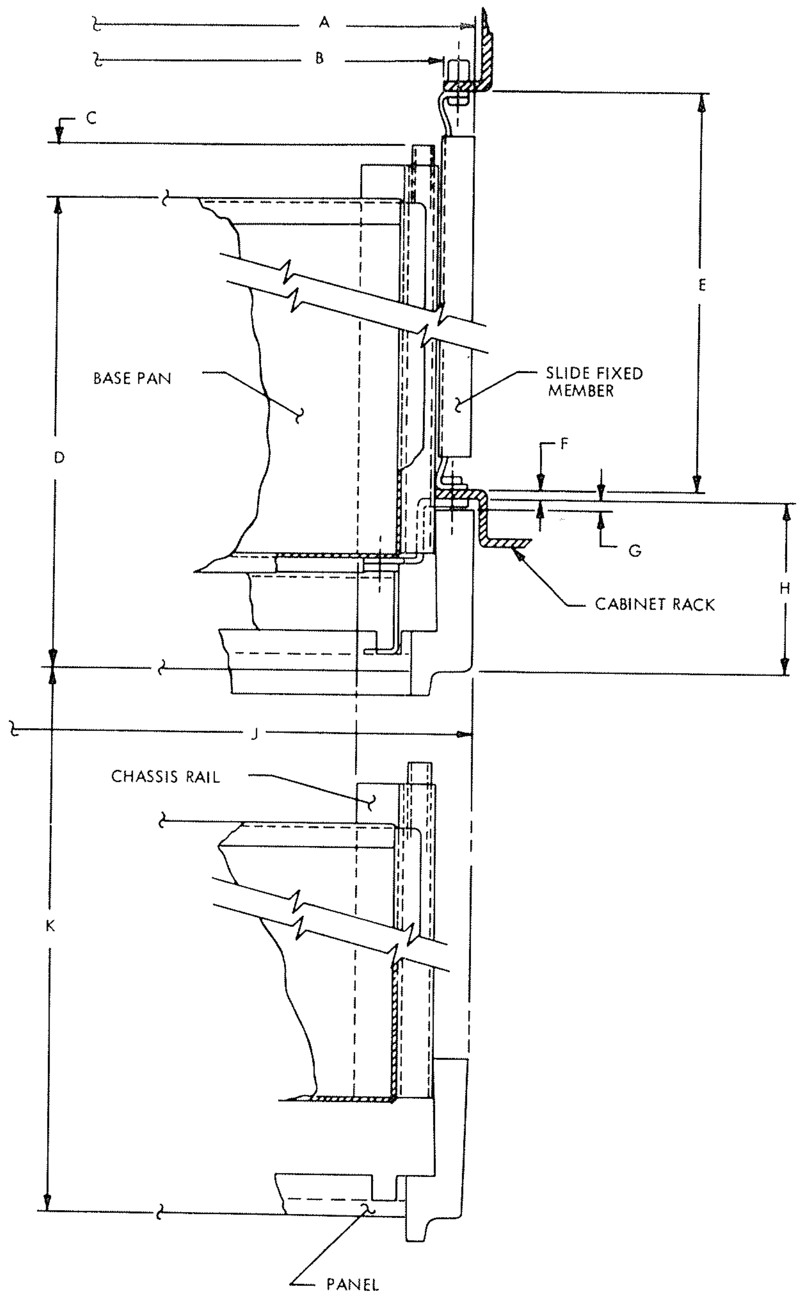
Figure 3-7. Slide/Drive Mounting Cross Section



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. Primary 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
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		

Table 3-2. Primary Current Requirements (Operating)

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

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

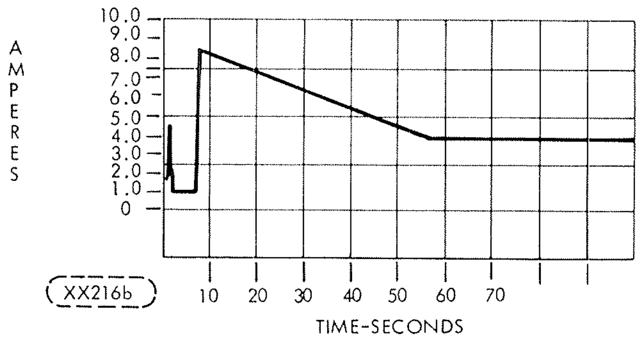


FIGURE 3-9.1A. START UP CURRENT (220-240 V, 50 HZ)

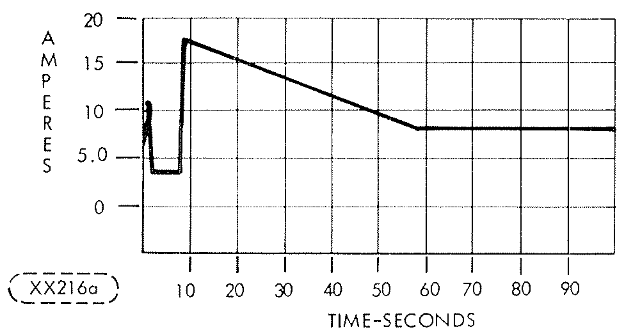


FIGURE 3-9.1B. START UP CURRENT (100 - 120 V, 50/60 HZ)

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.		5-15P

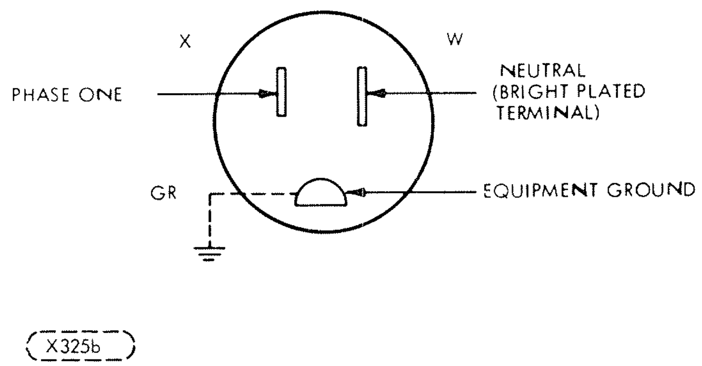


Figure 3-10. INPUT POWER CONNECTOR, 120 V 60 Hz (power source plug end)

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 wirewrap pins. Figure 5-1 shows proper locations for these. See 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.

3.6.2 I/O AND POWER CABLE ROUTING INFORMATION

Rack Mount Drives

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

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

3.7 GROUNDING

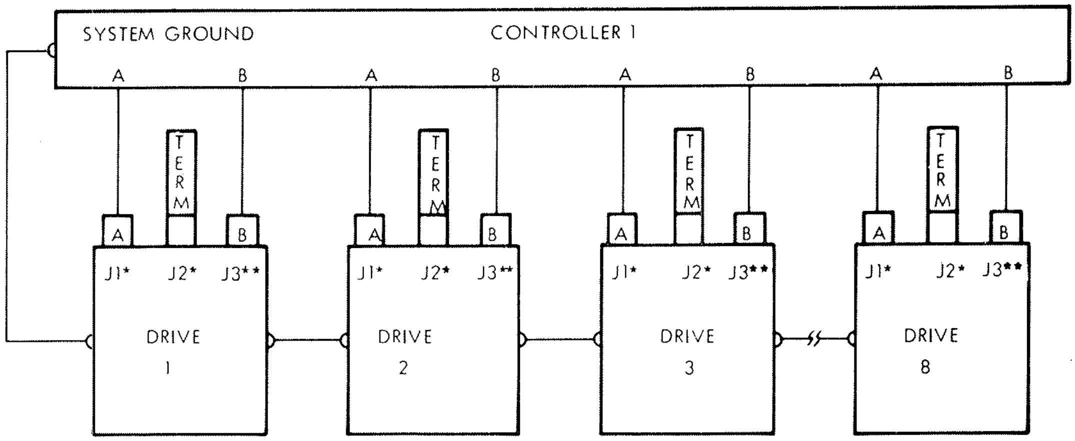
3.7.1 SYSTEM GROUNDING CONNECTIONS

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.

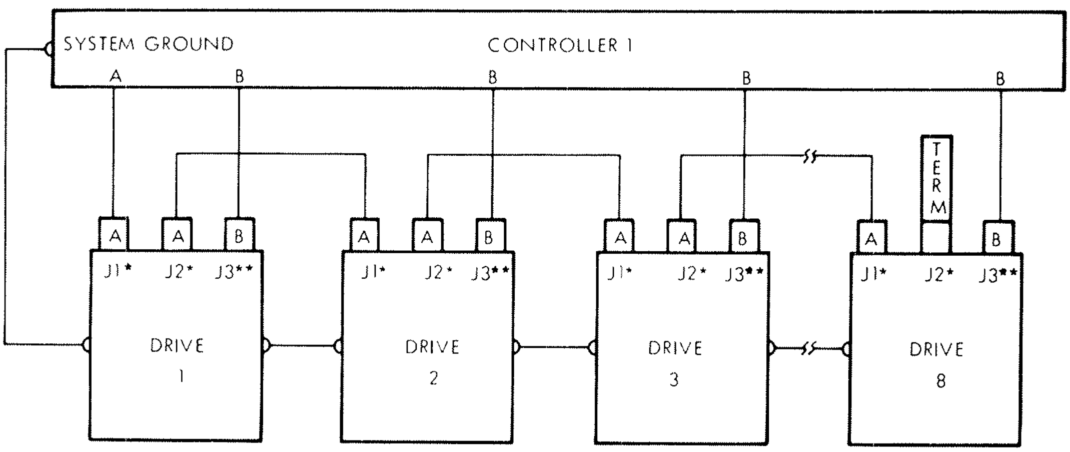
STAR CABLED SYSTEM



NOTES:

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

DAISY CHAINED SYSTEM



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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

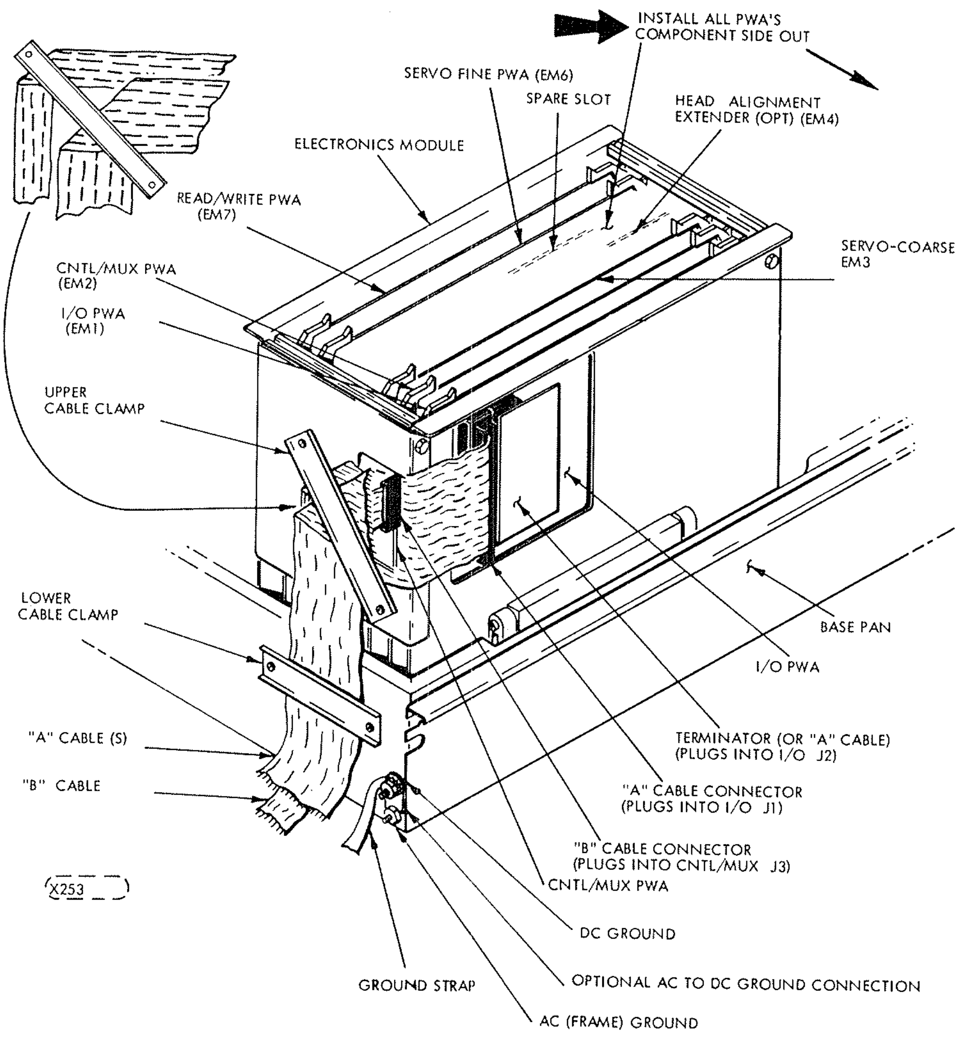
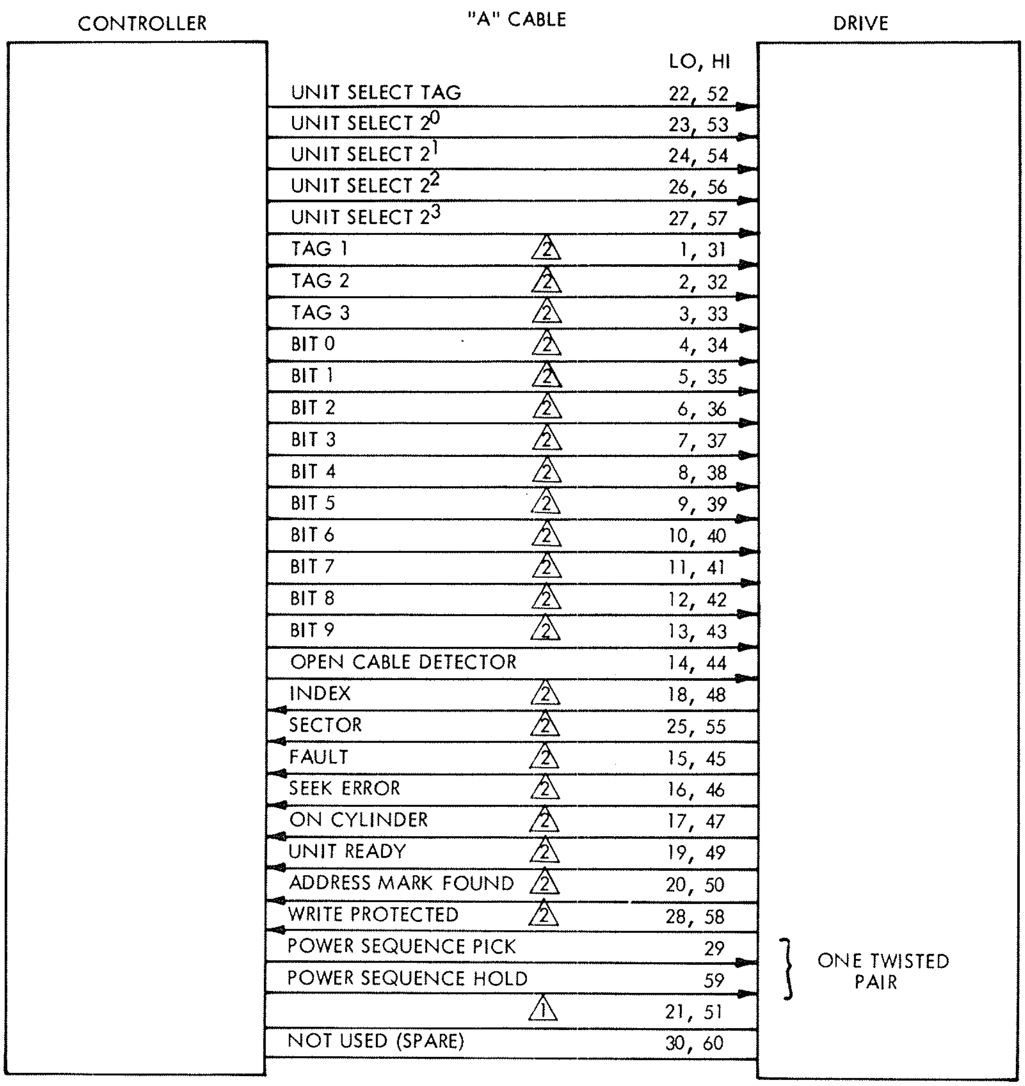


FIGURE 3-12. I/O CABLE INSTALLATION AND PWA NAMES/LOCATIONS



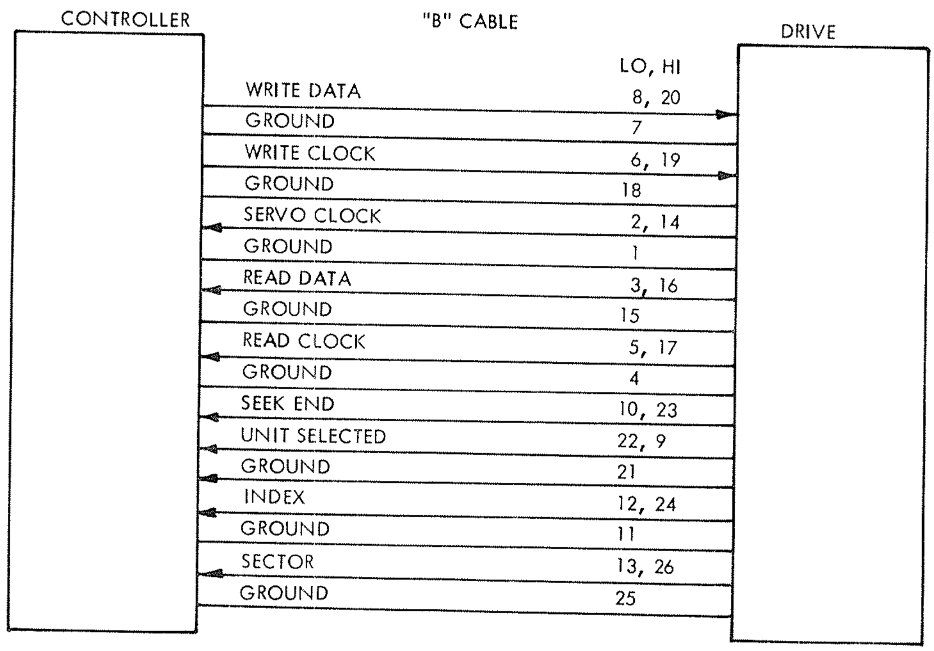
NOTE: 60 POSITION
28 AWG, 30 PAIR, TWISTED-STRAIGHT FLAT CABLE
MAXIMUM LENGTH - 100 FT

1 RESERVED

2 GATED BY UNIT SELECTED

XX020a

Figure 3-13. 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 3-14. TAG BUS I/O INTERFACE, "B" CABLE

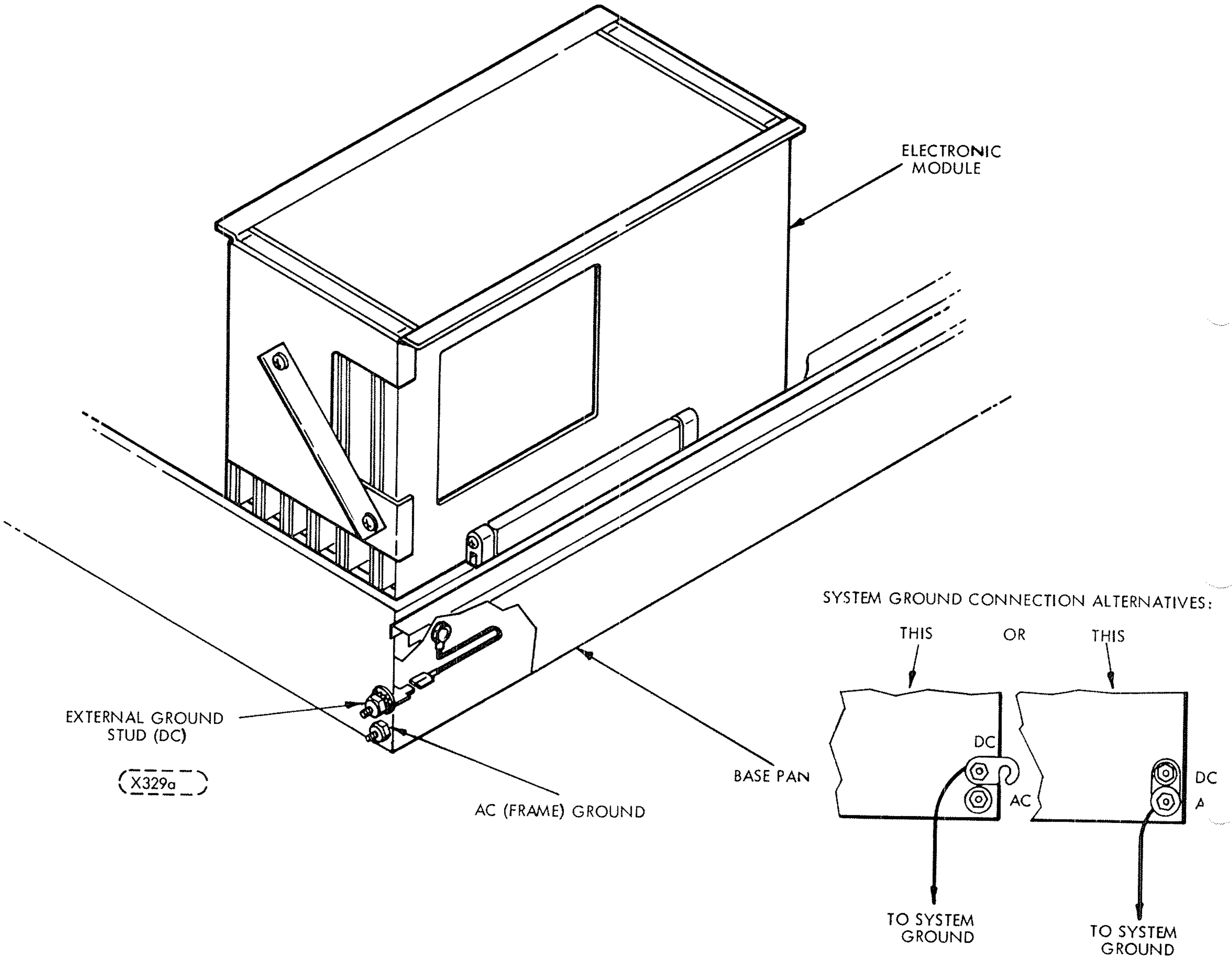


Figure 3-15. Grounding Option

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 μF 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/1000 ft. (1.08°C/305 m)

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

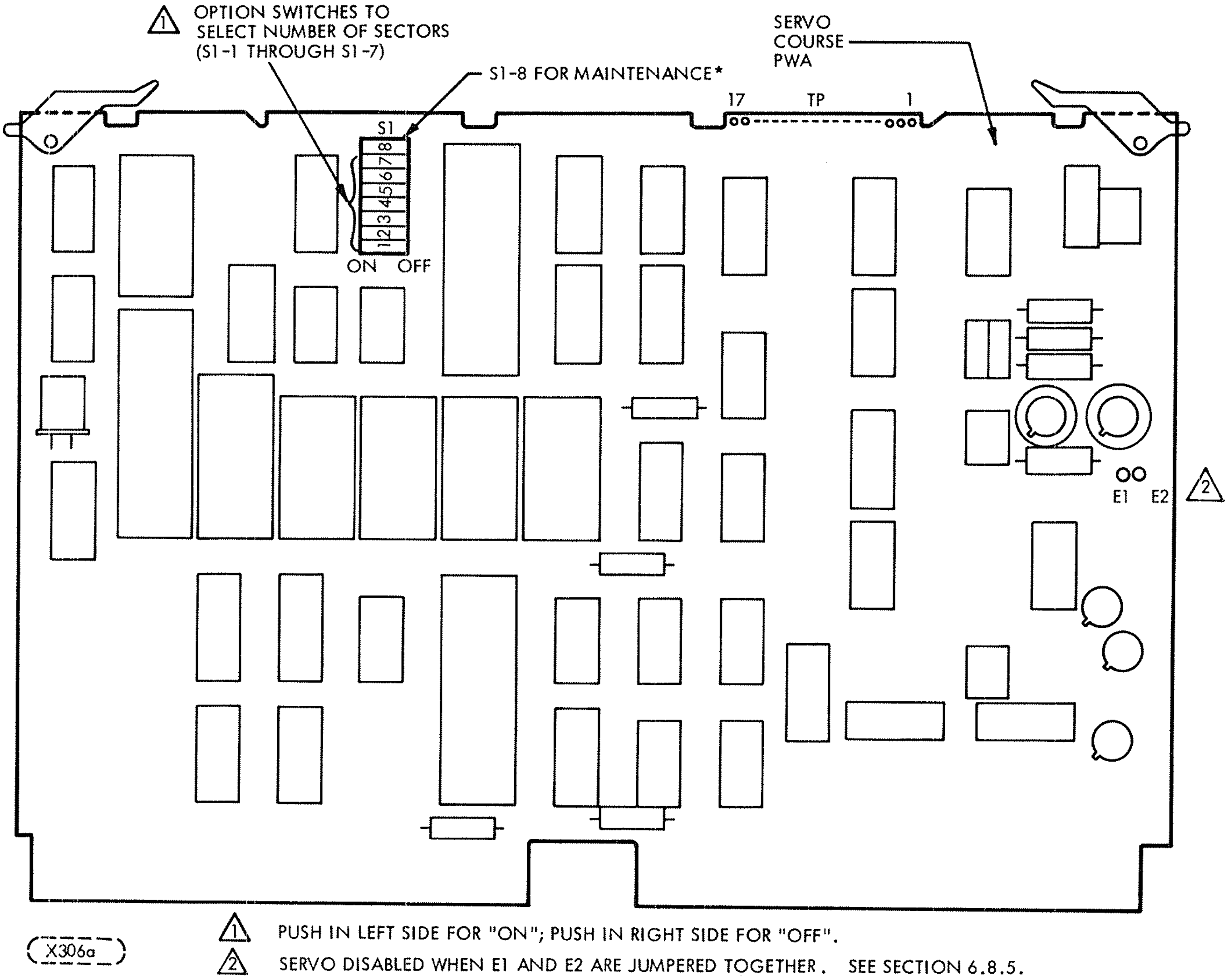
			S1--					Number of Sectors (in decimal)	Includes Sector Numbers
7	6	5	4	3	2	1			
64	32	16	8	4	2	1	(Binary Weight)		
0	0	0	0	0	0	1		1	0
0	0	0	0	0	1	0		2	0-1
0	0	0	0	0	1	1		3	0-2
0	0	0	0	1	0	0		4	0-3
0	0	0	0	1	0	1		5	0-4
			:				— etc.* —		
0	0	0	1	0	0	0		8	0-7
			:				— etc.* —		
0	0	1	0	0	0	0		16	0-15
			:				— 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 3-17).

The third switch is an option selection switch which 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. Figure 3-17 shows what the options are for S3 settings.

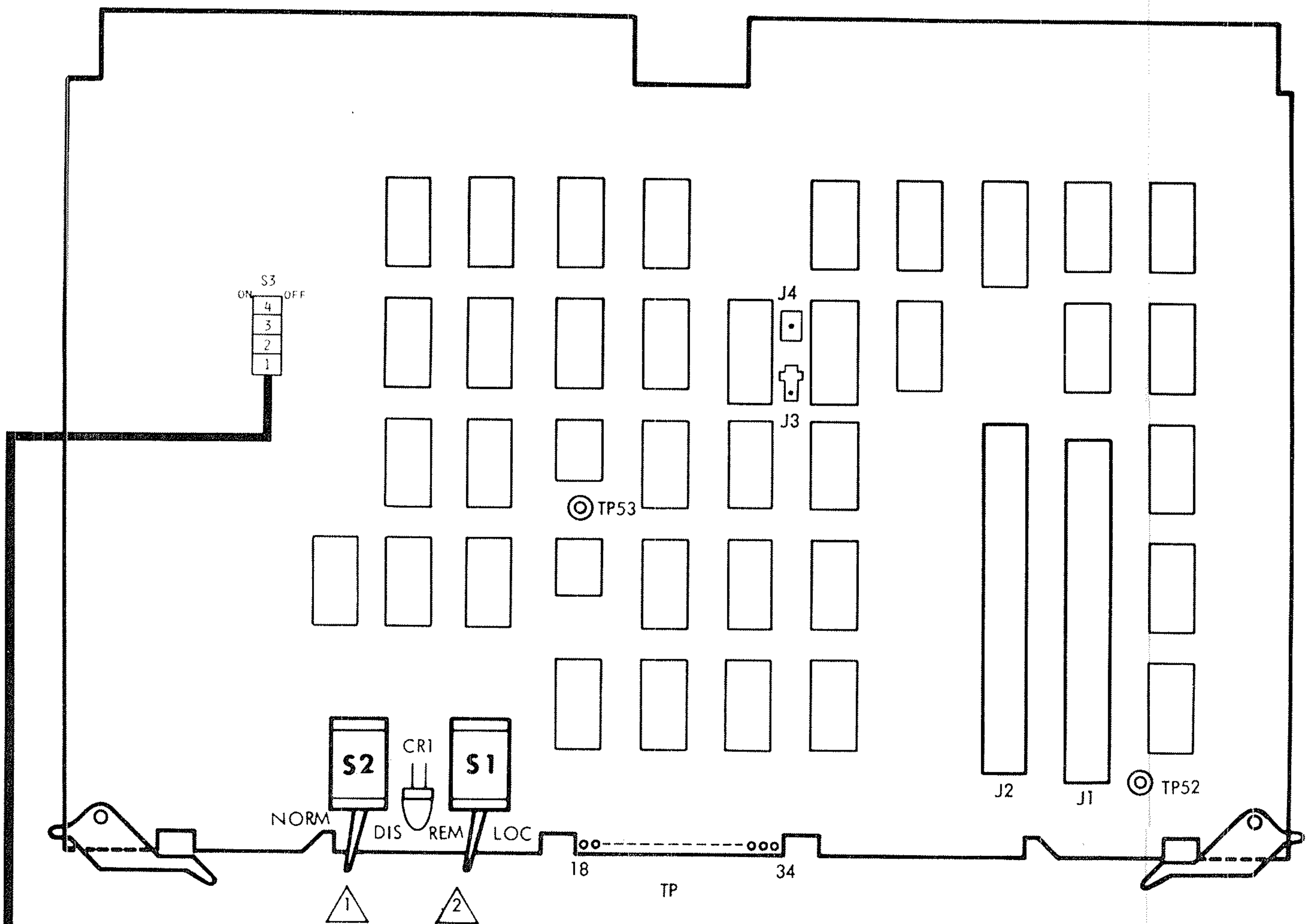


1 PUSH IN LEFT SIDE FOR "ON"; PUSH IN RIGHT SIDE FOR "OFF".

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 3-16. Servo-Coarse Option Switches



1. NORMAL - FOR NORMAL INTERFACE OPERATION (POSITION SHOWN)
   DISABLE - DISABLES INTERFACE CONTROL.

2. REMOTE - START BY PICK AND HOLD SEQUENCING FROM I/O. (POSITION SHOWN)
   LOCAL - START BY OPERATOR PANEL.

3. AN "X" IS MARKED IN "ON" OR "OFF" SQUARES ON SWITCH SPECIFICATION DOCUMENT TO SHOW OPTION SELECTED.

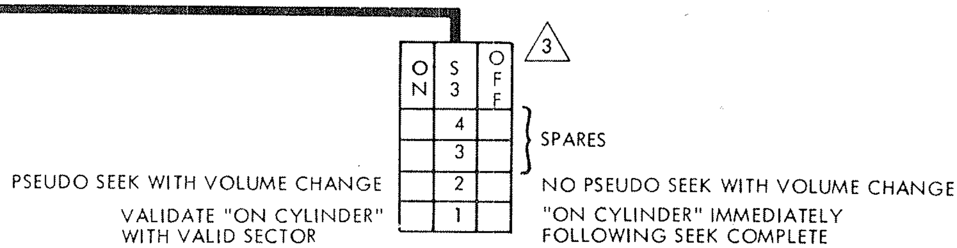


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FIGURE 3-17. I/O PWA SHOWING SWITCHES AND I/O CONNECTOR LOCATION

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 3-5.)

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.	CABLE LENGTH IN $\frac{\text{FEET}}{\text{METERS}}$									
		$\frac{5}{1.52}$	$\frac{6}{1.83}$	$\frac{8}{2.44}$	$\frac{10}{3.05}$	$\frac{15}{4.58}$	$\frac{20}{6.96}$	$\frac{25}{7.63}$	$\frac{30}{9.15}$	$\frac{40}{12.2}$	$\frac{50}{15.24}$
TAB (XX)	"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/N 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 (15.24 m)
Voltage Rating: 300 V rms

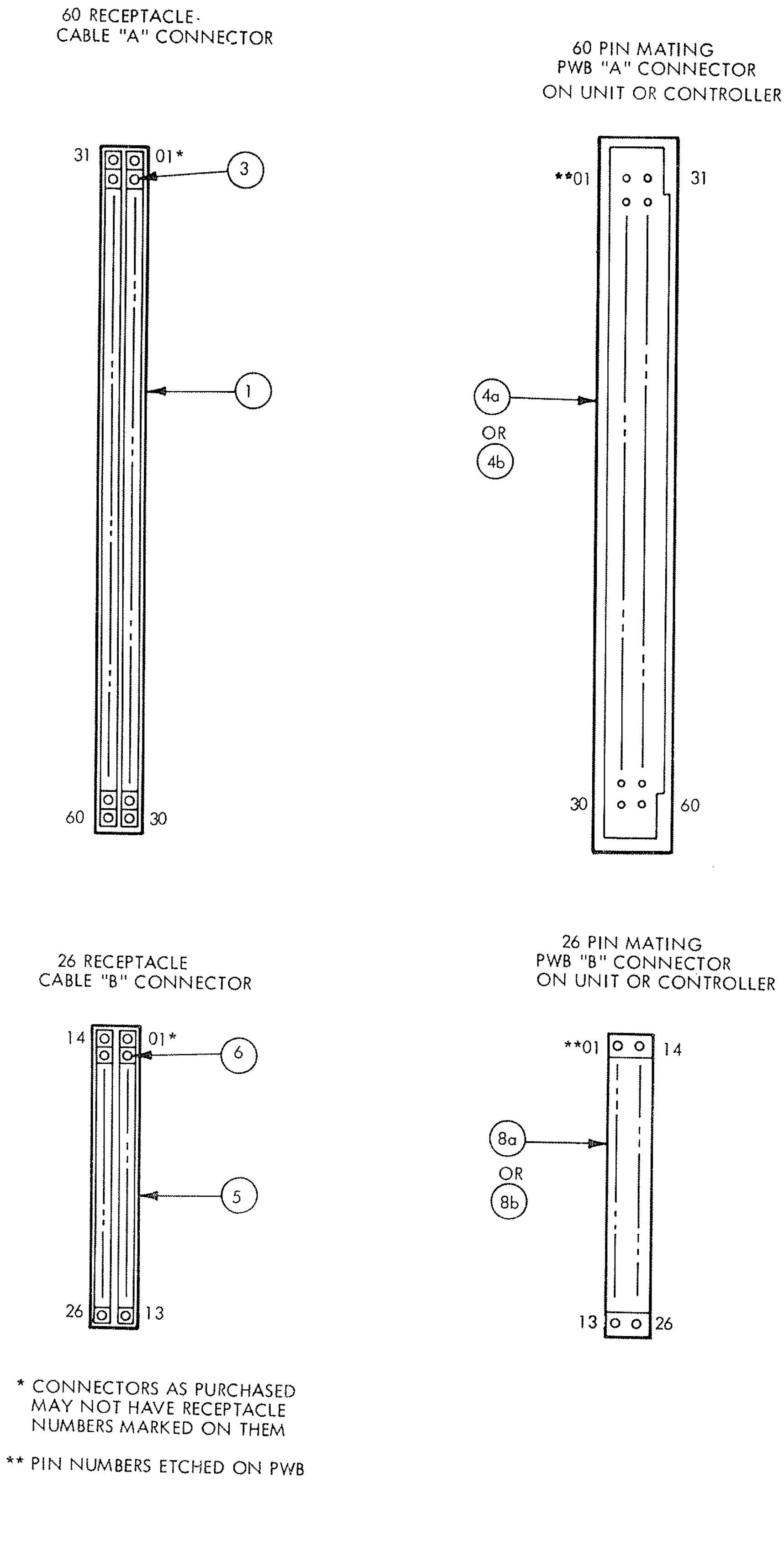


Figure 3-18. I/O Connectors - Cable Mount and PWB Mount

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"). 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
EM5	Spare
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

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 wire wrap 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. 0901) shows "P-DIBIT-REM" going out on J2-01.

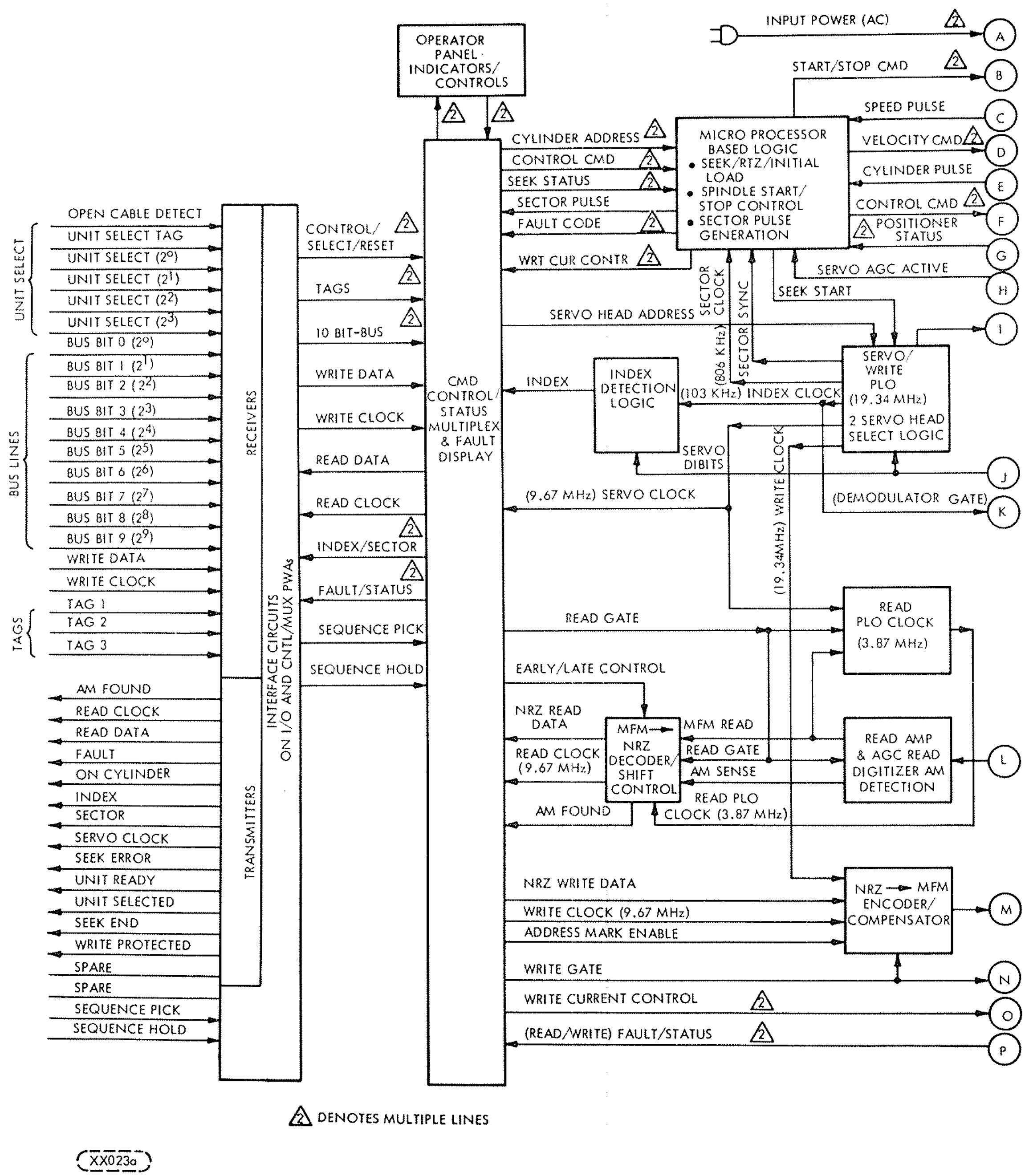


FIGURE 4-1. BLOCK DIAGRAM (SHEET 1 OF 2) (STD-OEM INTERFACE)

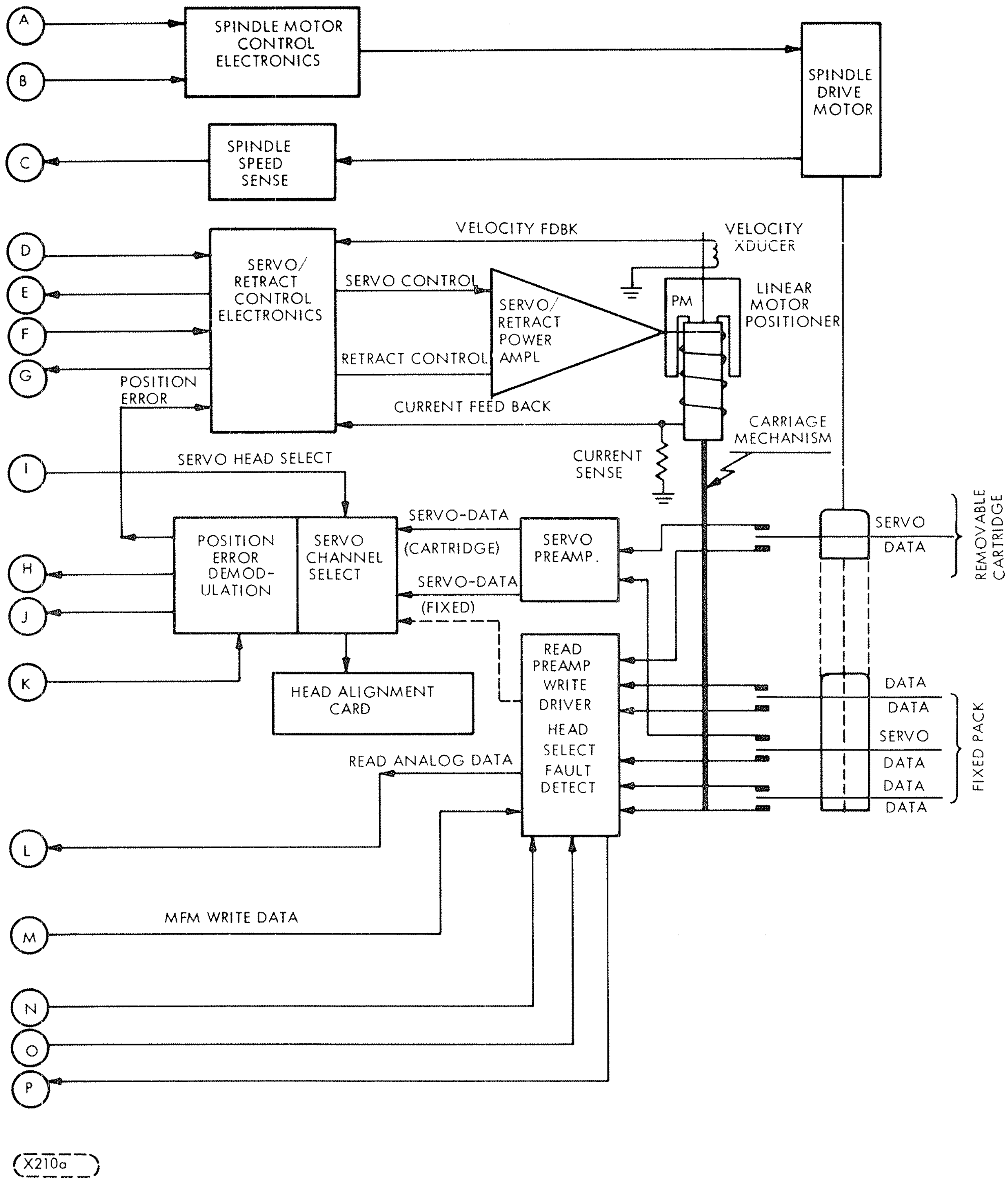


Figure 4-1. CMD Block Diagram (STD-OEM Interface) (Sheet 2 of 2)

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 use-age of the cross referencing system discussed briefly here.

Intergrated 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 illlustrates 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 for use by the motor breaking circuit.

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

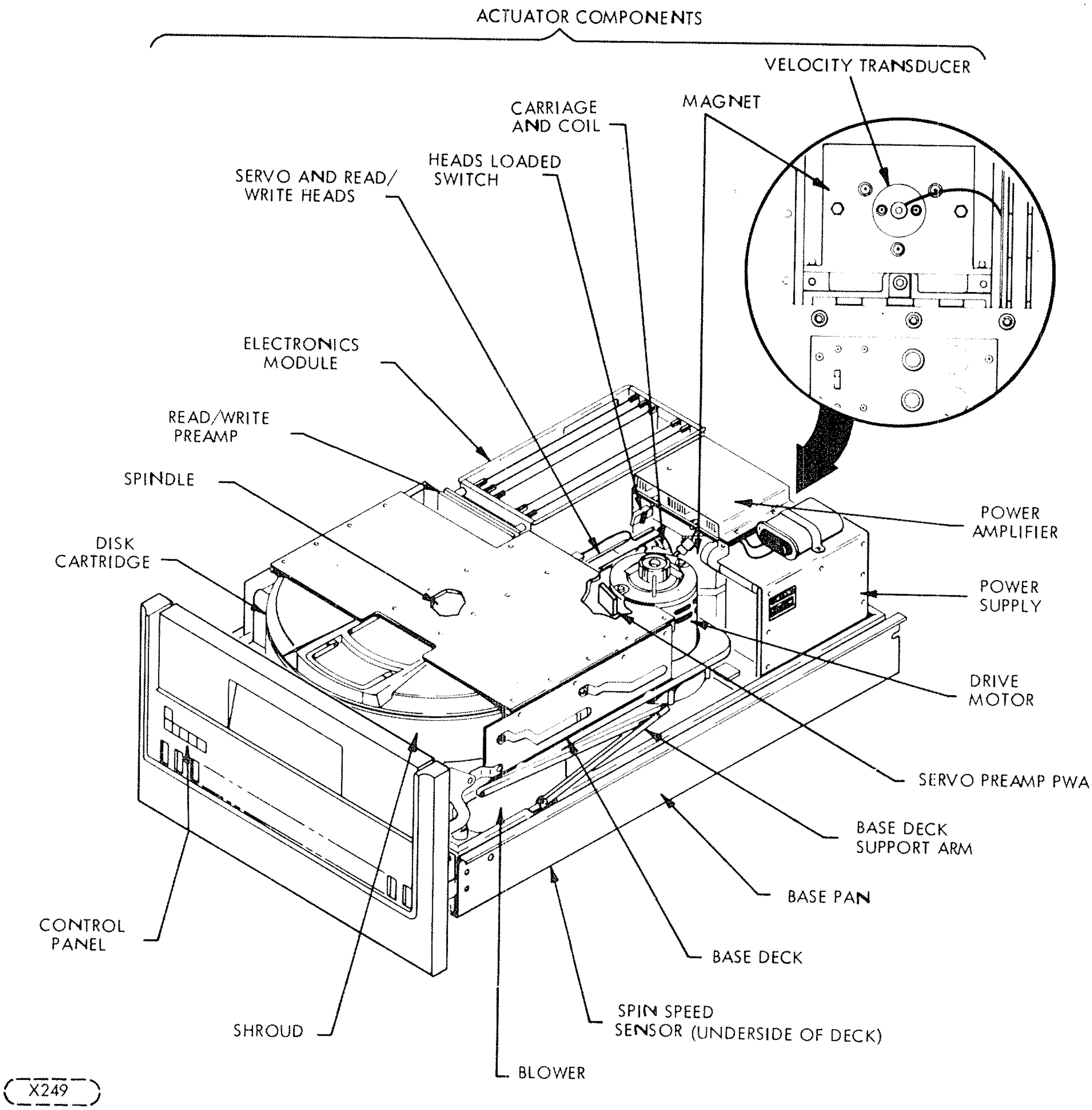


Figure 4-2. CMD Major Assemblies

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.

and the cartridge access door is closed.

4.2.2 DRIVE MOTOR ASSEMBLY

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

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

4.2.3 SPINDLE ASSEMBLY

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

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

A ground spring is mounted at the lower end of the spindle assembly. The ground spring is mounted so that 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 mandril-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 an 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.

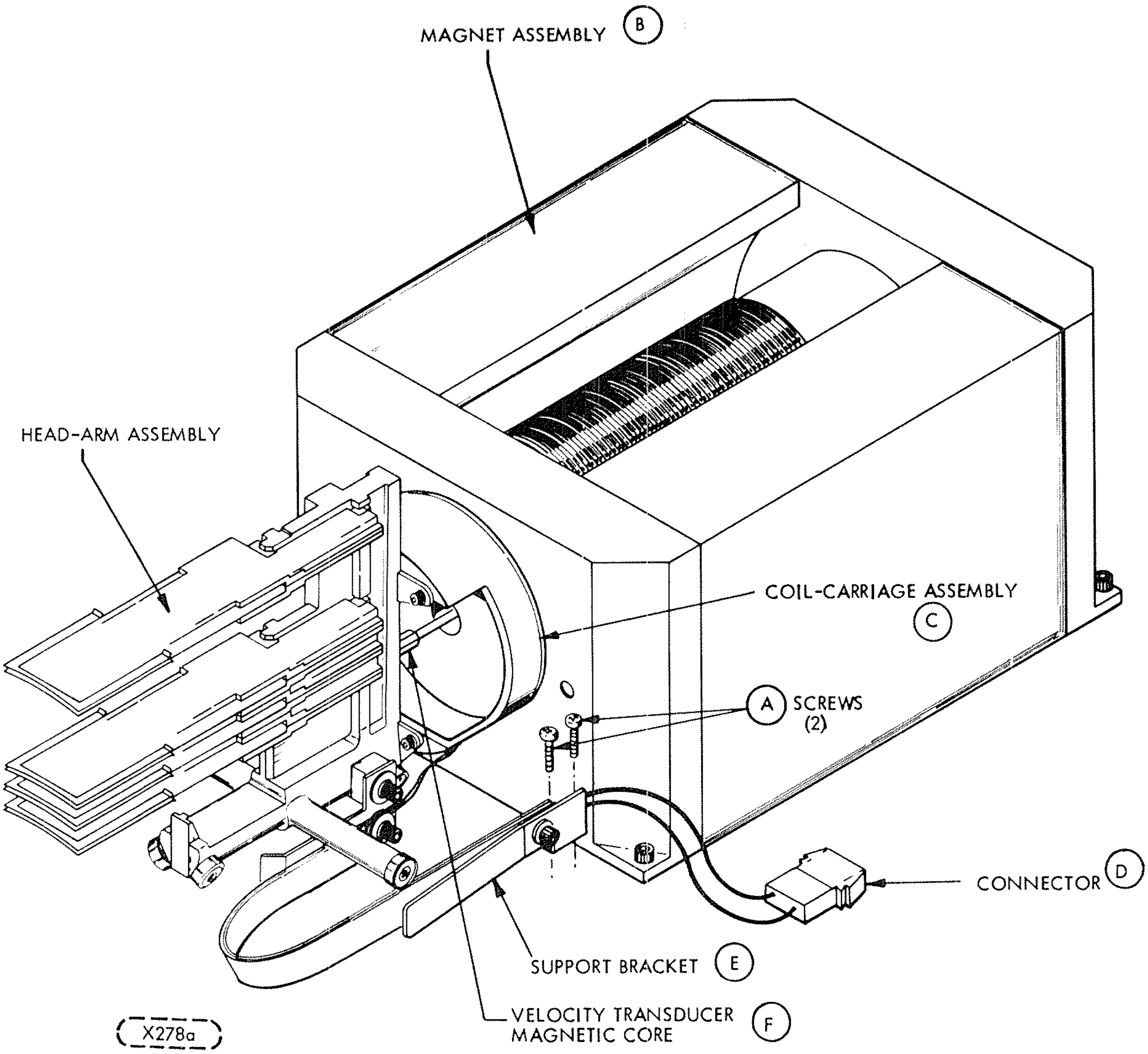


Figure 4-3. Actuator Elements (Voice coil slightly extended from retracted position)

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 the carriage moves forward, the head load spring cam surface rides off the head cam just after the read/write heads move out over the disk surface. The loading force moves the head face toward the air layer on the surface of the spinning disk until the opposing forces balance.

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

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

4.2.4.2 Head/Arm Assemblies

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

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

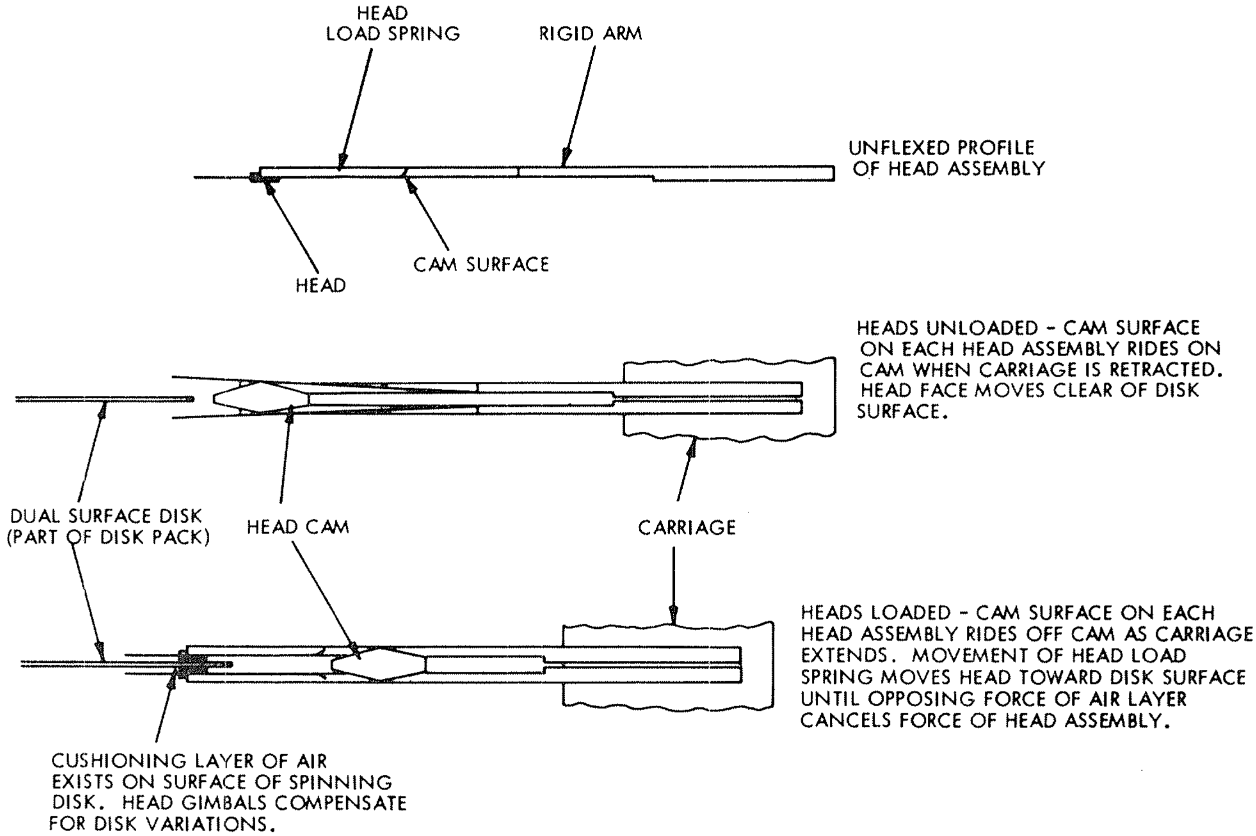


Figure 4-4. Head Loading

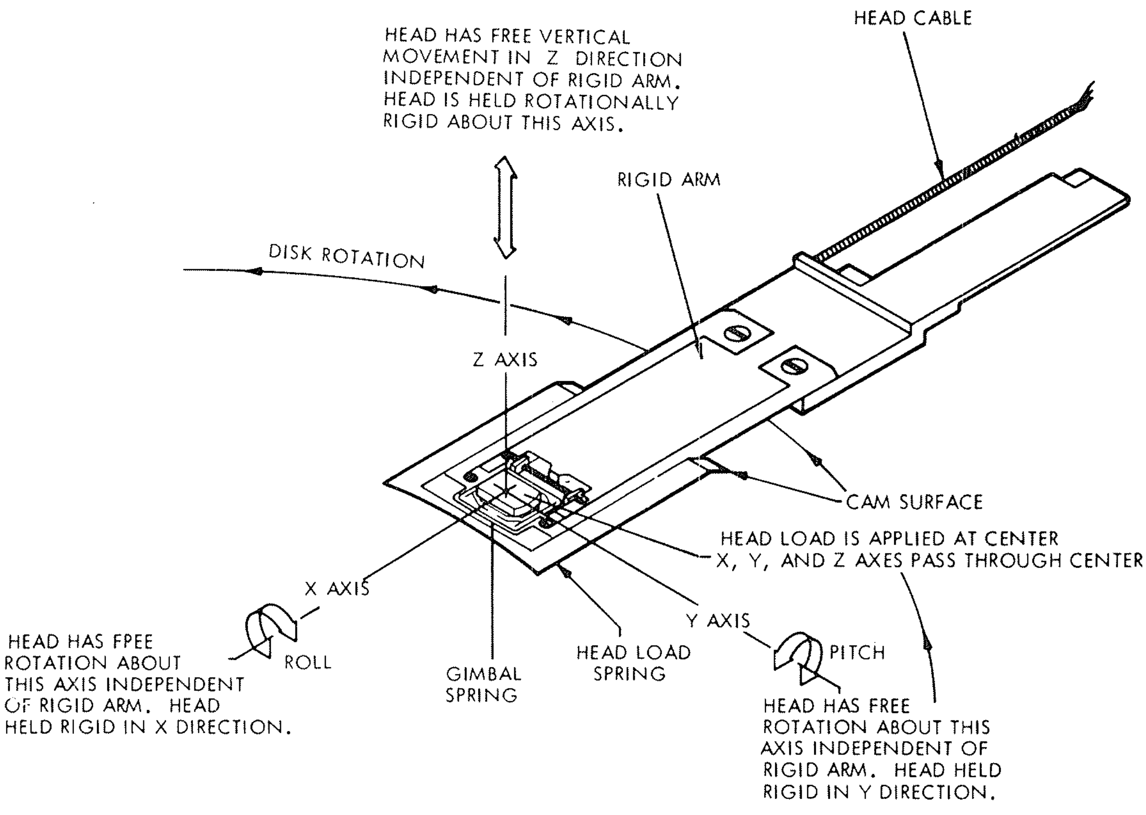


Figure 4-5. Head/Arm Assembly Motion

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

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

4.2.5 TRANSDUCERS

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

4.2.5.1 Spin Speed Sensor

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

*Figure 5-13.

direction of motion by the core (and carriage). The transducer output drives a summing operational amplifier located on the Servo Coarse PWA in the Electronics Module. This signal is used by the servo logic to control acceleration/deceleration and velocity of the carriage during Seek operations.

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.

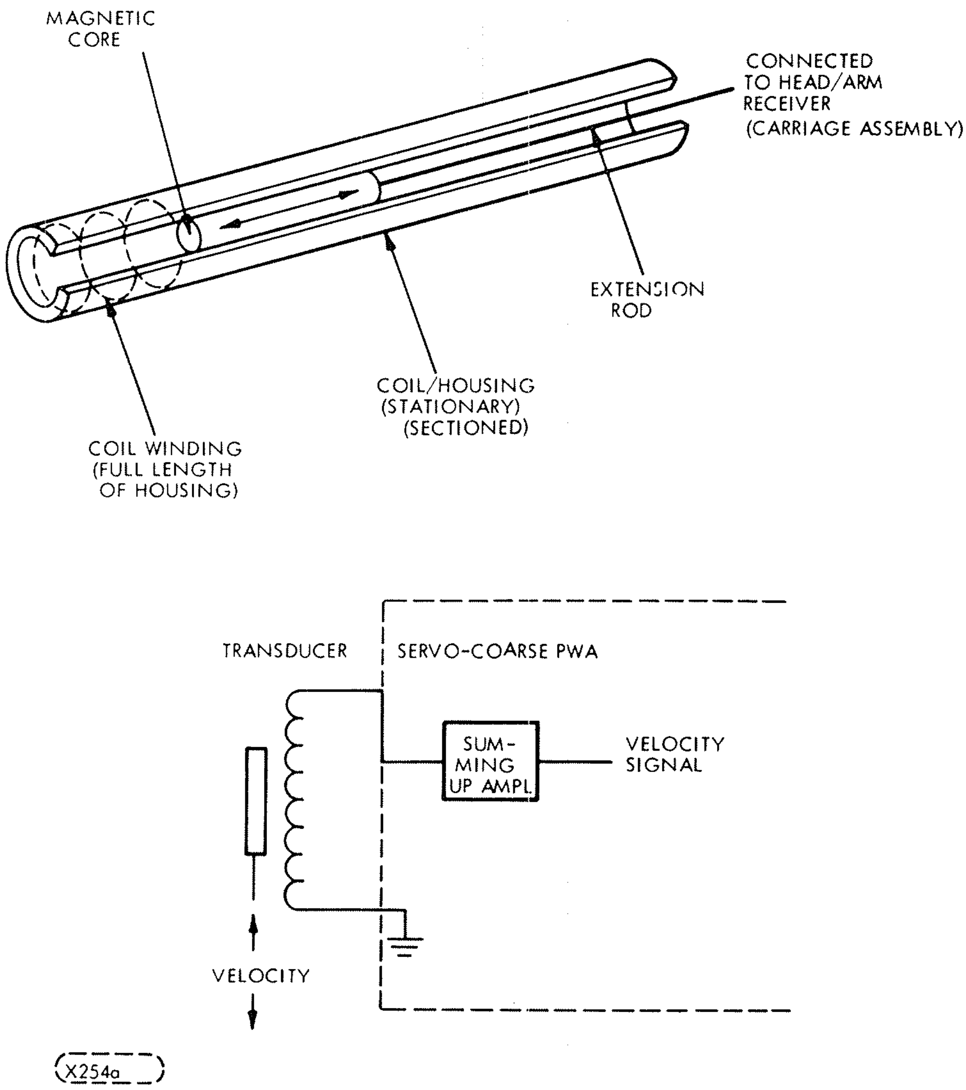


Figure 4-6. Velocity Detection

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.

4.2.8 ELECTRONICS MODULE

The Electronics Module Assembly consists of a "mother board" and seven 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 seven 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 base pan. 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.

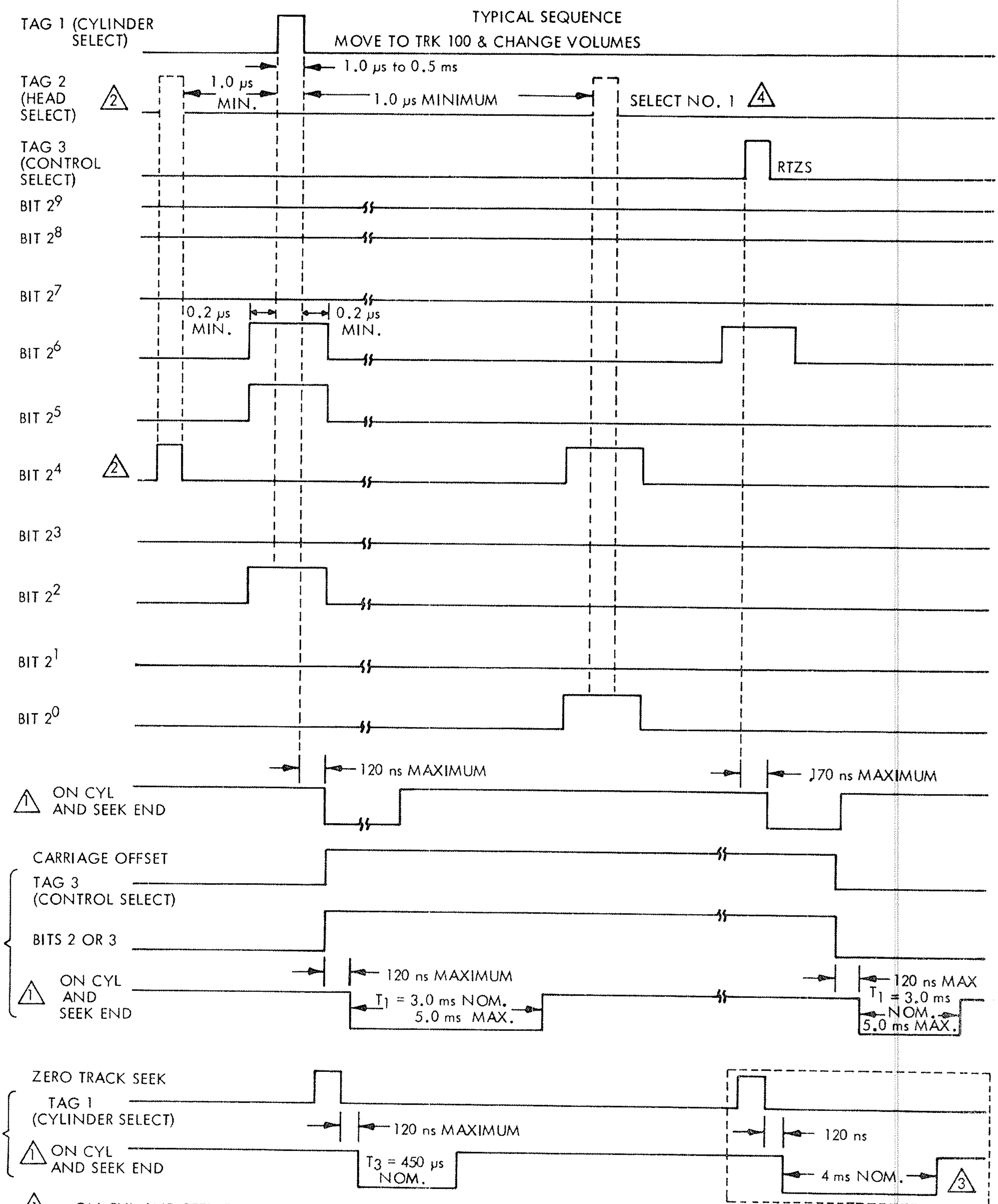
The Electronics Module frame is at "DC" ground and is isolated from frame or AC ground unless a wire at the rear of the unit is connected to the frame ground stud tab at the rear, left side of the frame. See Section 3.7 "Grounding". Connecting AC to DC ground is a customer option.

4.3 FUNCTIONS

4.3.1 I/O OPERATIONS

Input/Output signal definitions are shown in Table 2.2. Pin number assignments are shown in Figures 3-8 and 3-9.

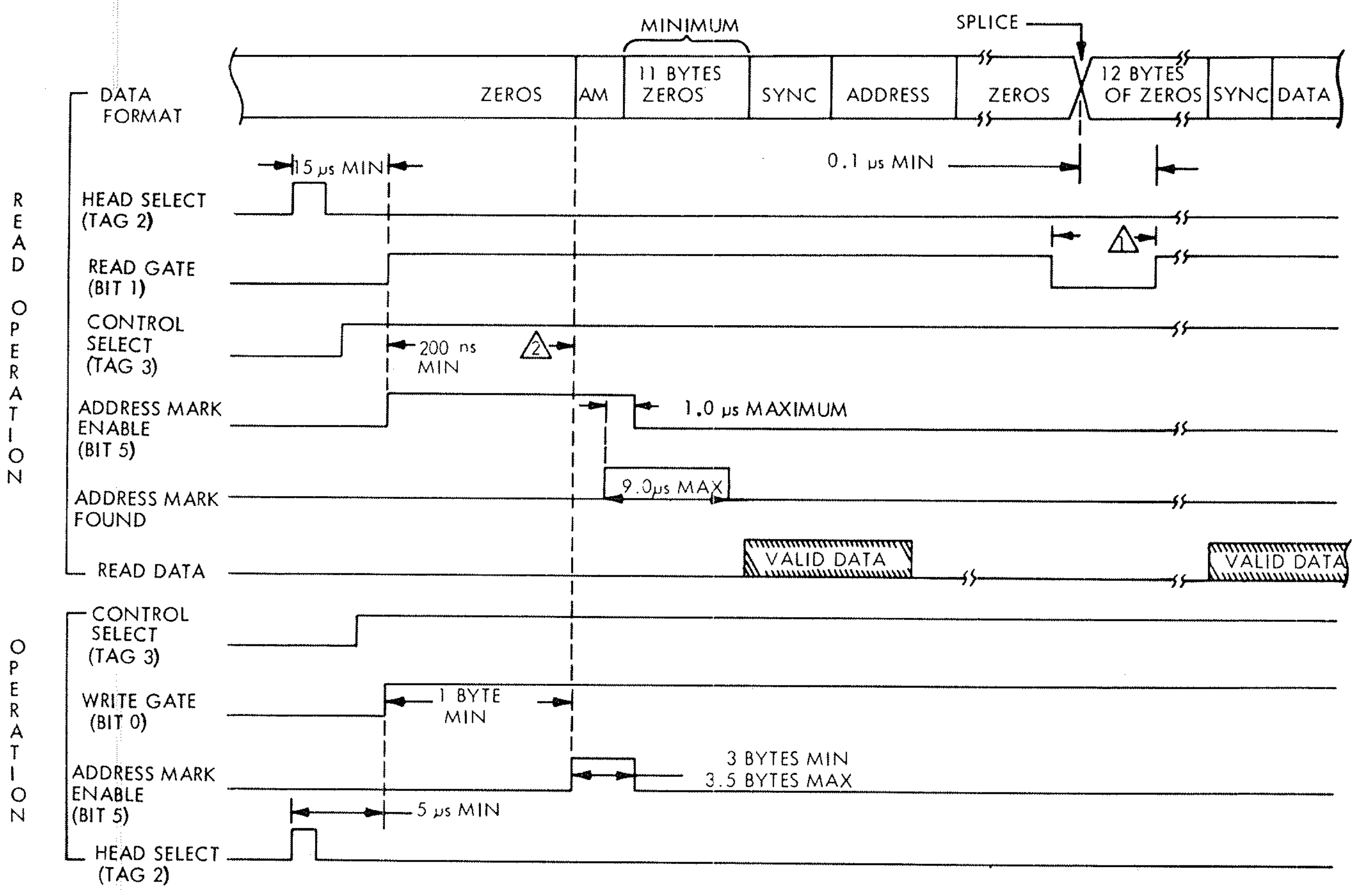
The timing characteristics interface signals are shown in Figures 4-7, 4-8, 4-9, and 4-10.



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 4-7. I/O TAG and BUS Timing



⚠1 READ GATE MUST BE DROPPED PRIOR TO THE WRITE SPLICE. IT MUST BE REINTIATED AT LEAST ONE BIT AFTER THE WRITE SPLICE AND WITH AT LEAST 11 BYTES OF ZERO BITS REMAINING IN THE SYNC FIELD. 12 BYTE (EXAMPLE) CONSISTS OF ONE BYTE FOR WRITE SPLICE AND 11 BYTES FOR PLO SYNC.

⚠2 ADDRESS MARK ENABLE SHOULD OCCUR SIMULTANEOUS WITH READ ENABLE.

XX021a

Figure 4-8. Typical Read/Write Timing with Address Mark

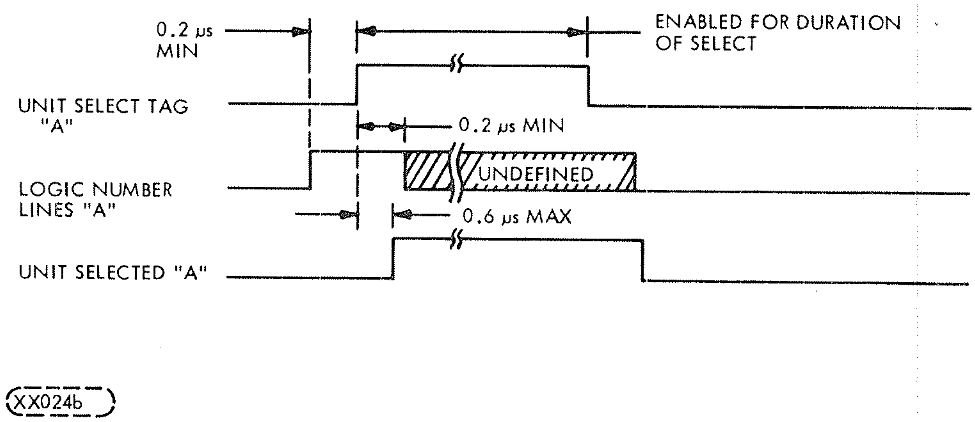


Figure 4-9. Logic Number Select and Timing Diagram

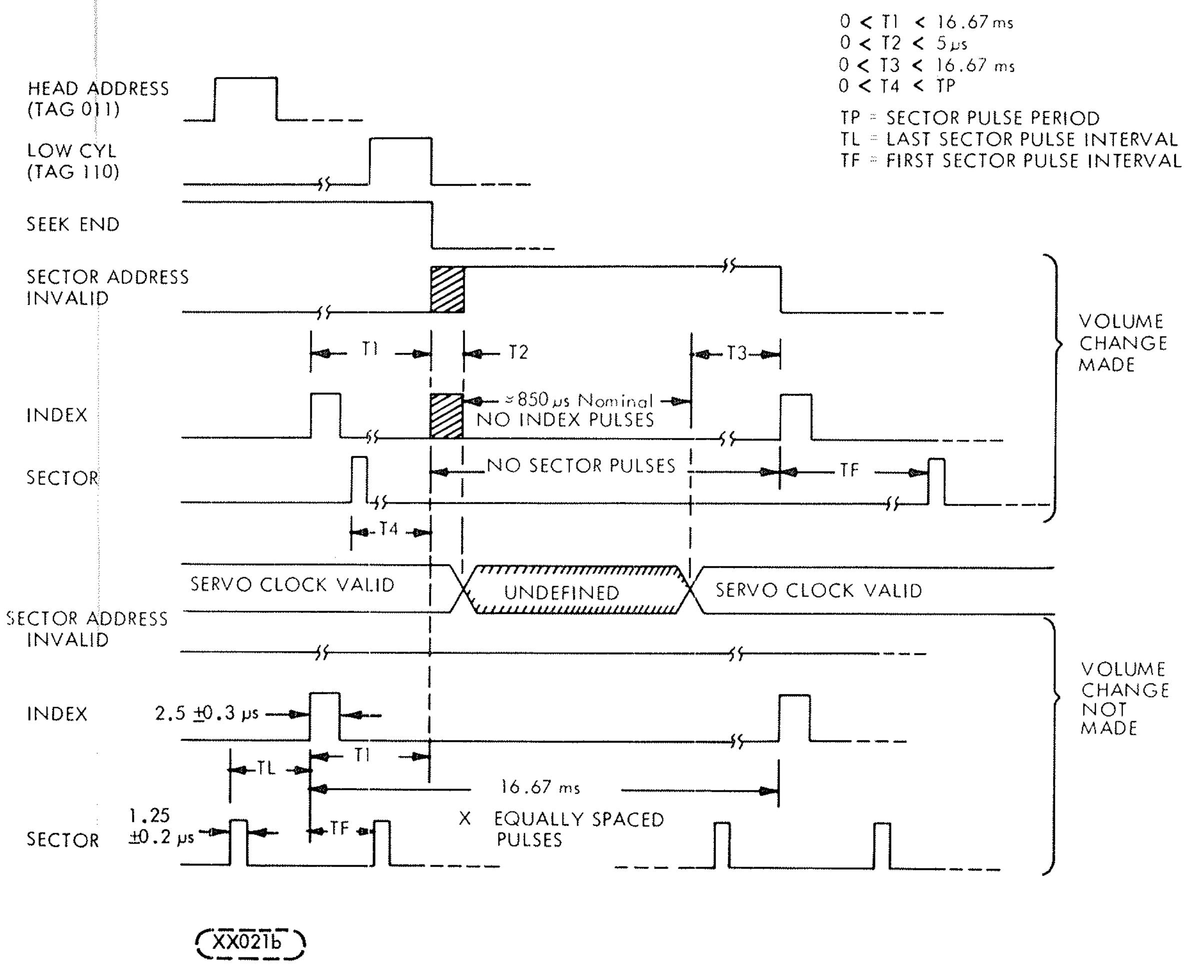


Figure 4-10. Index and Sector During a Seek

4.3.2 POWER ON/OFF AND SPINDLE START/STOP FUNCTIONS

4.3.2.1 Power Sequencing Pick and Hold

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

Interrupting the Hold line will cause all units to unload heads and stop the spindle. Single unit start up can be controlled by momentarily closing the Pick line with the Hold line grounded. Successive units will start each time the Pick line is grounded. Power sequencing circuits and timing are shown in Figures 4.10.1 and 4.10.2.

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 Figure 4-18 and 4-22).

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 three other interlock switches - the deck down, cartridge seated and cartridge access door closed switches - and then goes as START/-L to PPI* port U36 on the Servo-Coarse PWA.

2. The microprocessor continually loops through a routine and as part of the routine it interrogates PPI port U36 and detects that the START/STOP switch is in the START position and that the SEQ-HOLD/-L signal is active low, which it will be with the REM/LOC swtich 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 4-19, 4-20, 4-22 and 4-23 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 4-21 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 in 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.

*See Section 4. 3. 4 for details of the microprocessor components.

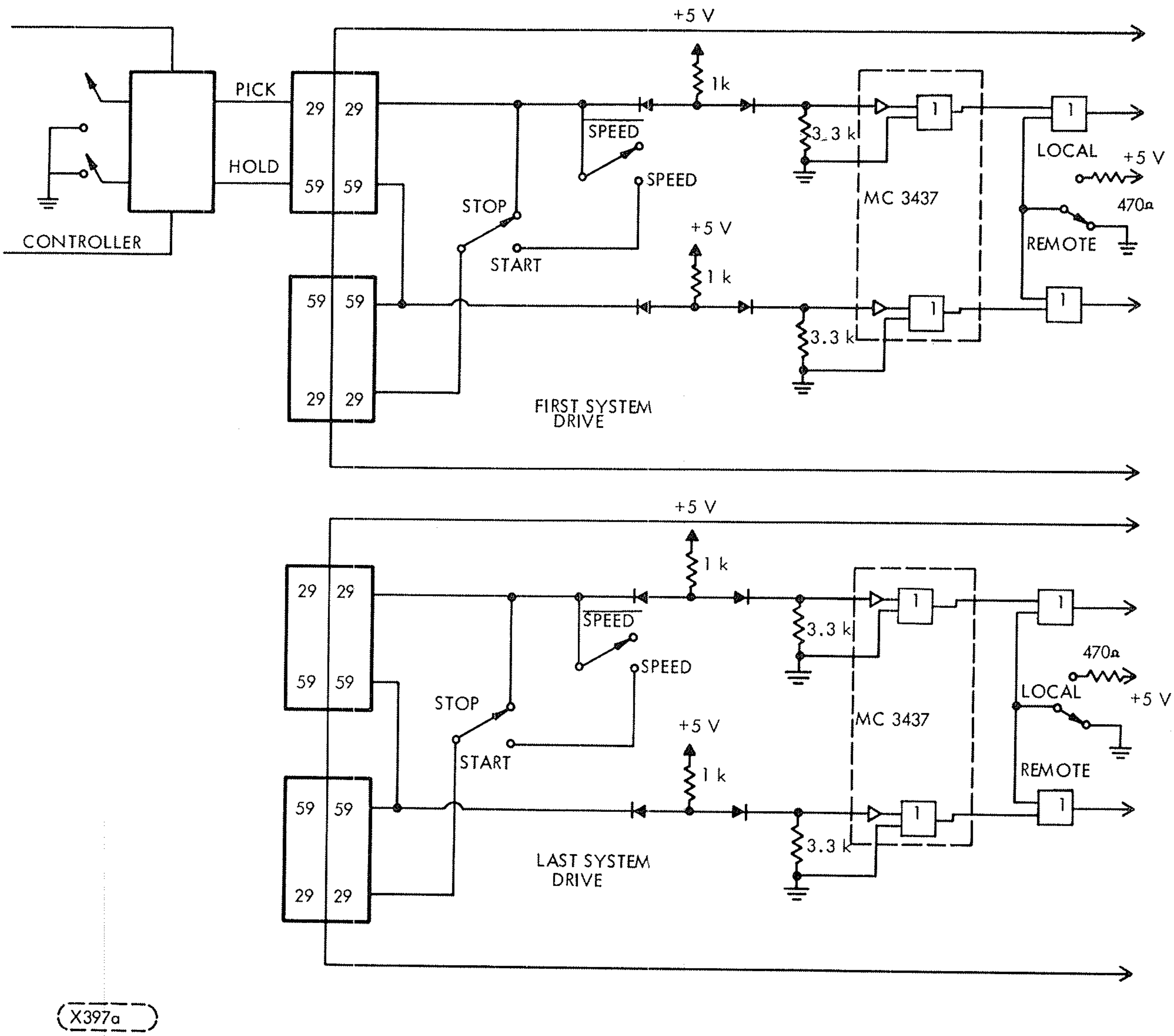
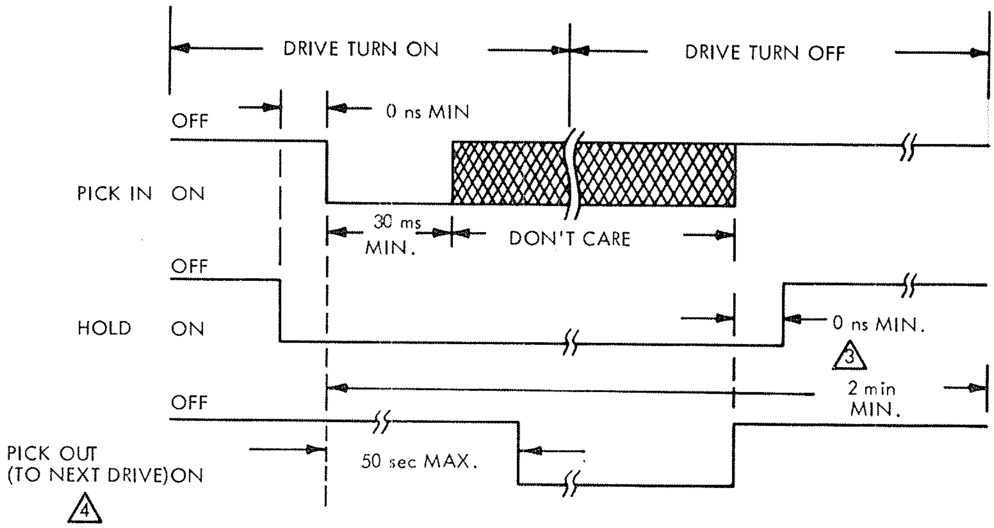


Figure 4-10.1. Sequence Power Lines - CMD



1 SEQUENCE SHOWN FOR ONE DRIVE.

2 "OFF" IS OPEN CIRCUIT; "ON" IS DC GROUND.

3 MINIMUM TIME BEFORE REINITIATION OF TURN ON SEQUENCE.

4 TIMING IS BASED UPON A PROPER DRIVE TURN ON OPERATION

X391b

Figure 4-10.2. 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 time-out. 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 4-29).

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 brake 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 pulses from the disk at 3600 r/min is 1042 microseconds. The worst case mechanical tolerances can introduce an error of about 1%. Thus the total error is about 3%.

*See Table 6-7 for error codes.
**See General Block Diagrams in Figures 4-11 and 4-14.

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 cyclinder. The CMD positioner servo is of the well proven linear motor-tachometer 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 next velocity register from where it is transferred into a current distance counter and current volocity register. Each time "next" information becomes "current" information the microprocessor refills the two "next" registers with "next" information. See Figure 4-12. With each cylinder pulse, the value in the current distance counter is

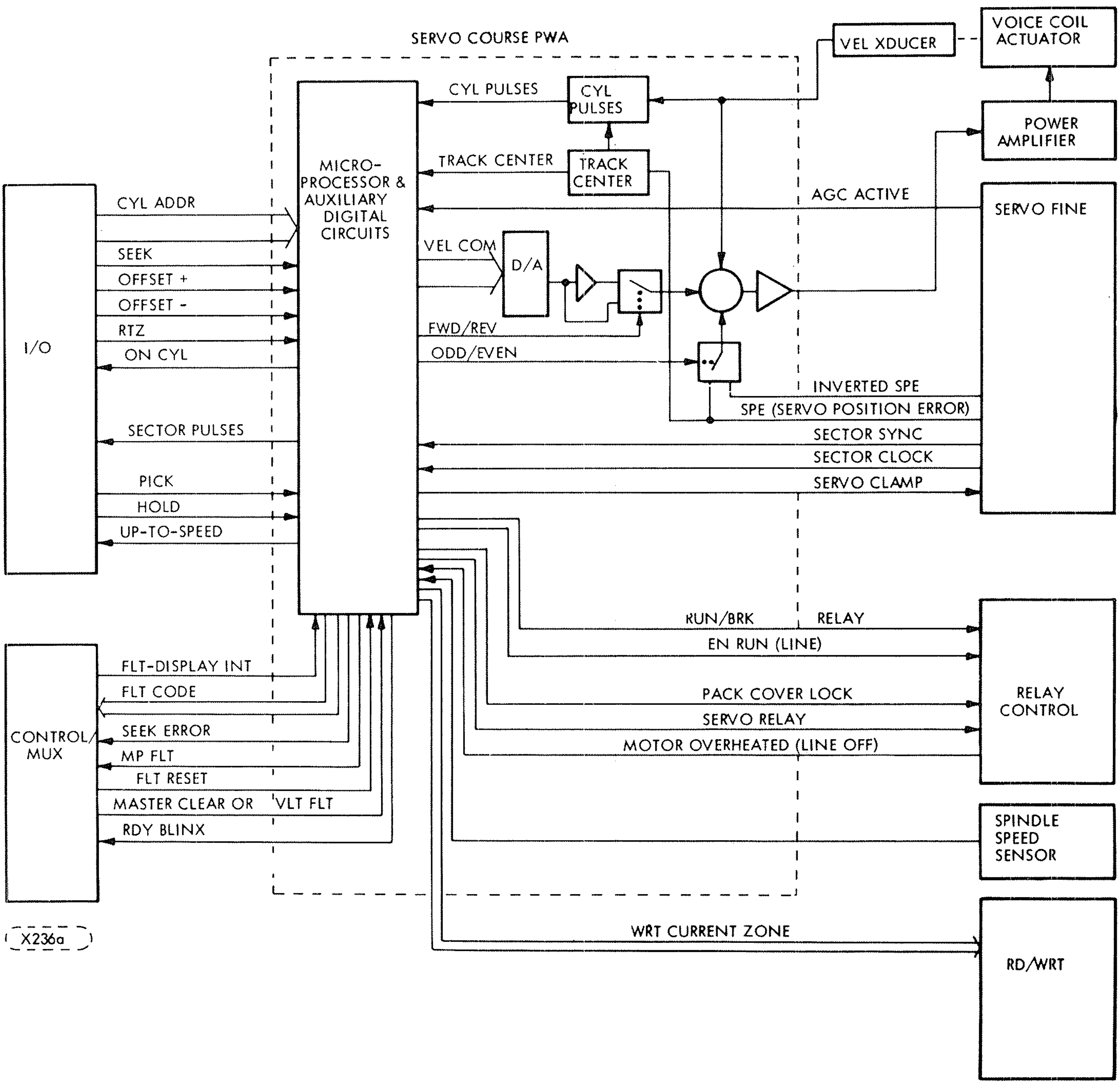


Figure 4-11. Block Diagram of Servo-Coarse PWA and Supporting Elements

decremented. When the counter reaches zero, the value in the next distance register is transferred into the current distance counter, the value in the next velocity register is transferred into the current velocity register and the processor interrupted (see "Interrupt Logic", Section 4.3.4.3) so that new values will be loaded into the "next" registers.

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

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 4-13 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 2.10, 4.3.8 and 6.9 for more details on the microprocessor diagnostics.

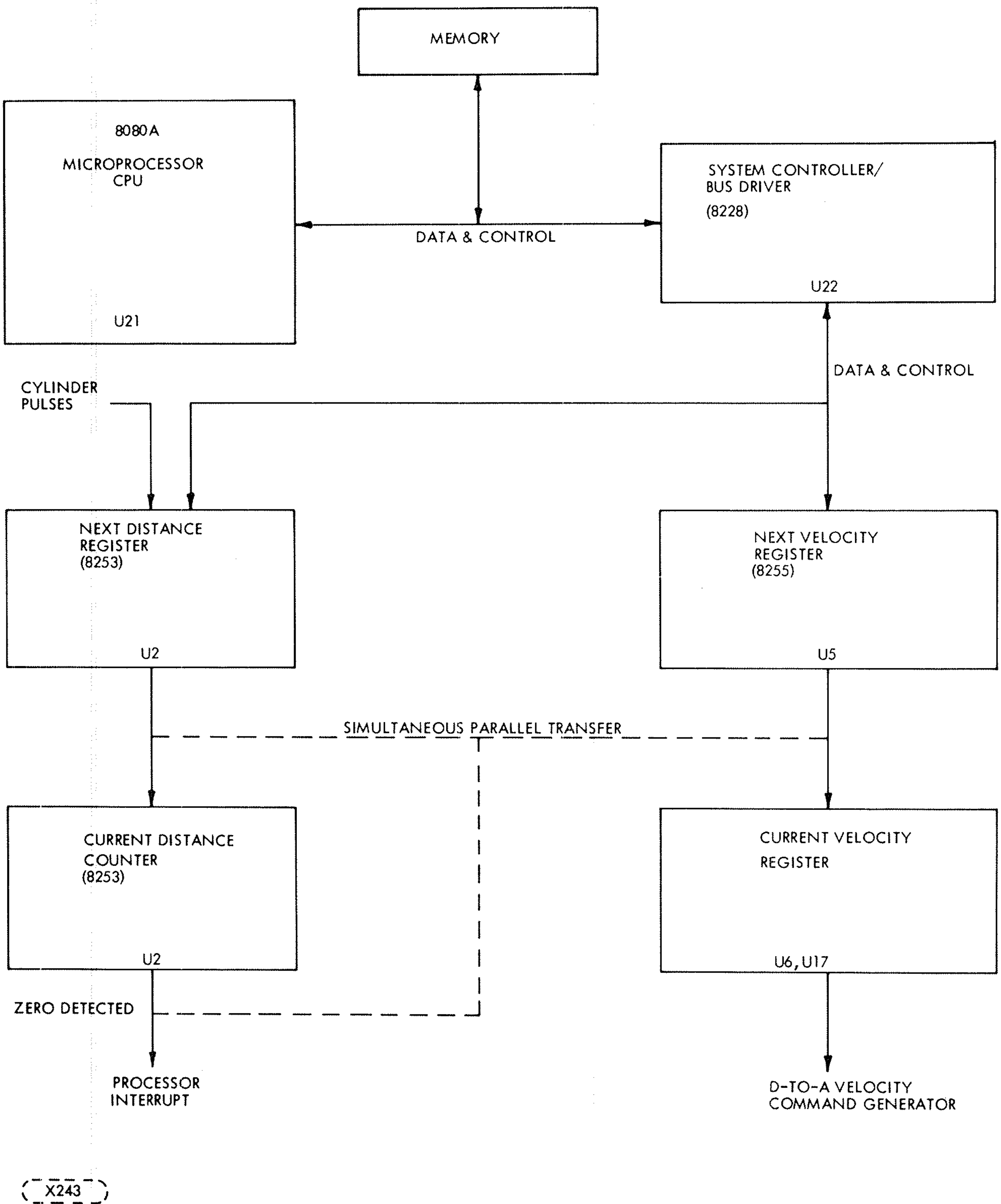
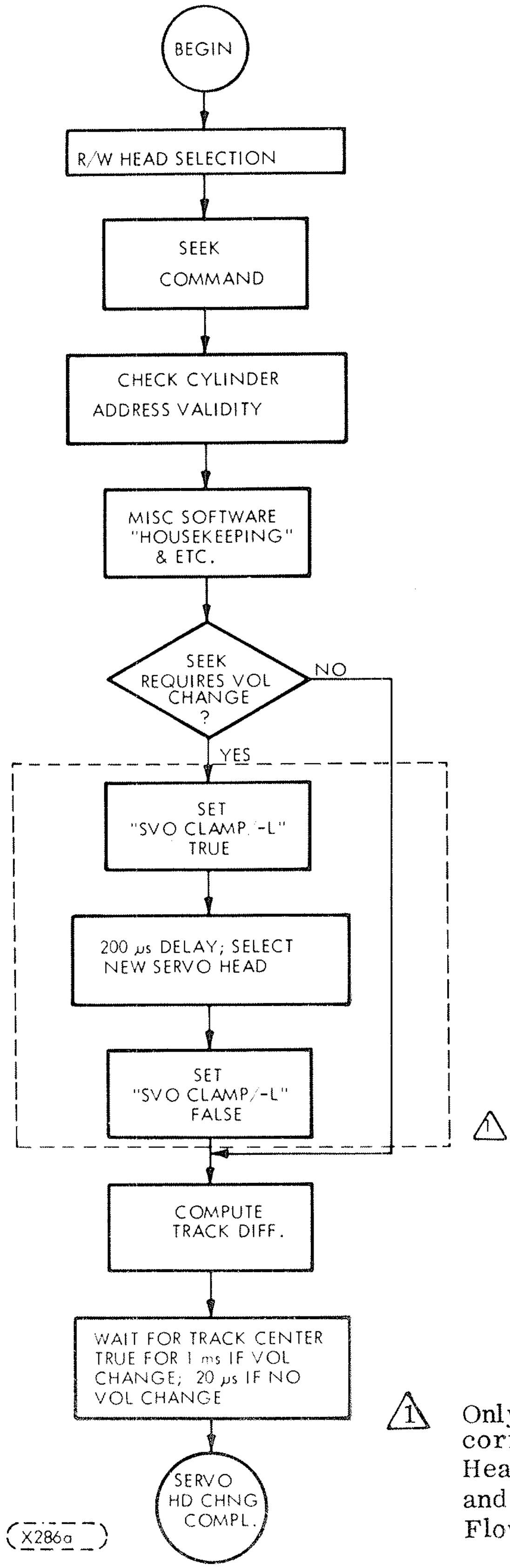


Figure 4-12. Seek Control (Digital Portion) Block Diagram



1 Only the part enclosed by dotted lines corresponds to the "Change Servo Heads" block of Figure 4-25 (Seek and Segment End Interrupt Sequences Flow Charts)

Figure 4-13. Servo Head Change Operational Flow Chart

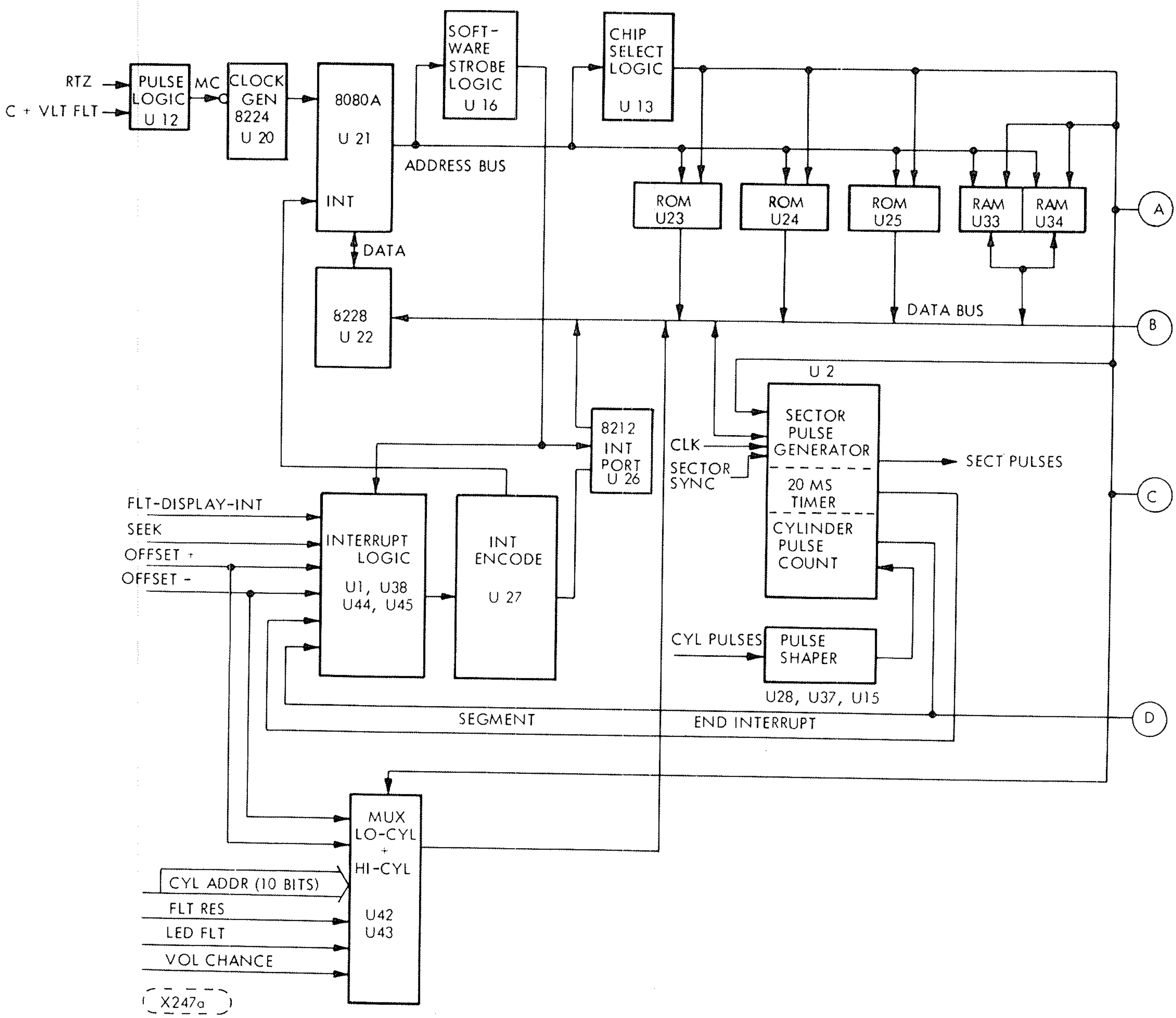


Figure 4-14. Microprocessor Hardware Block Diagram (Sheet 1 of 2)

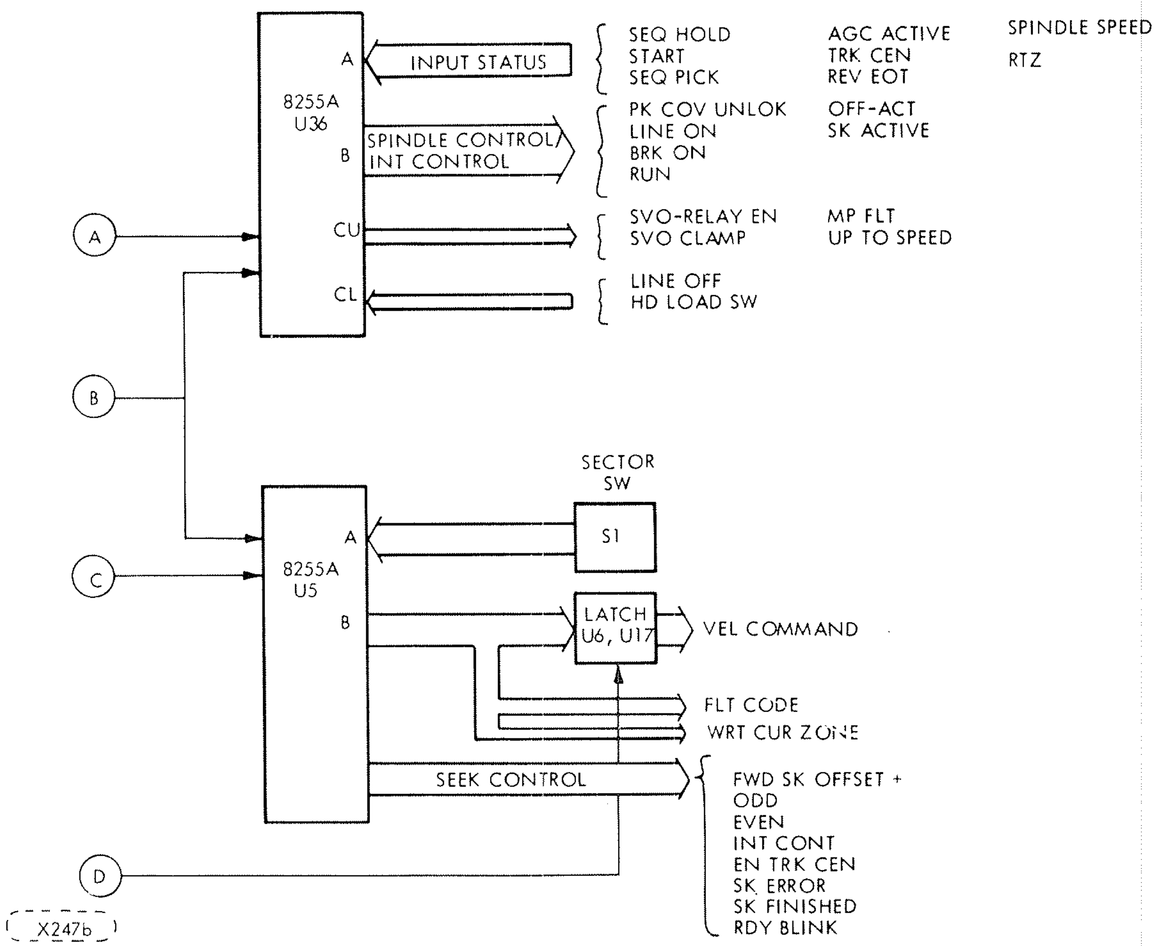


Figure 4-14. Microprocessor Hardware Block Diagram (Sheet 2 of 2)

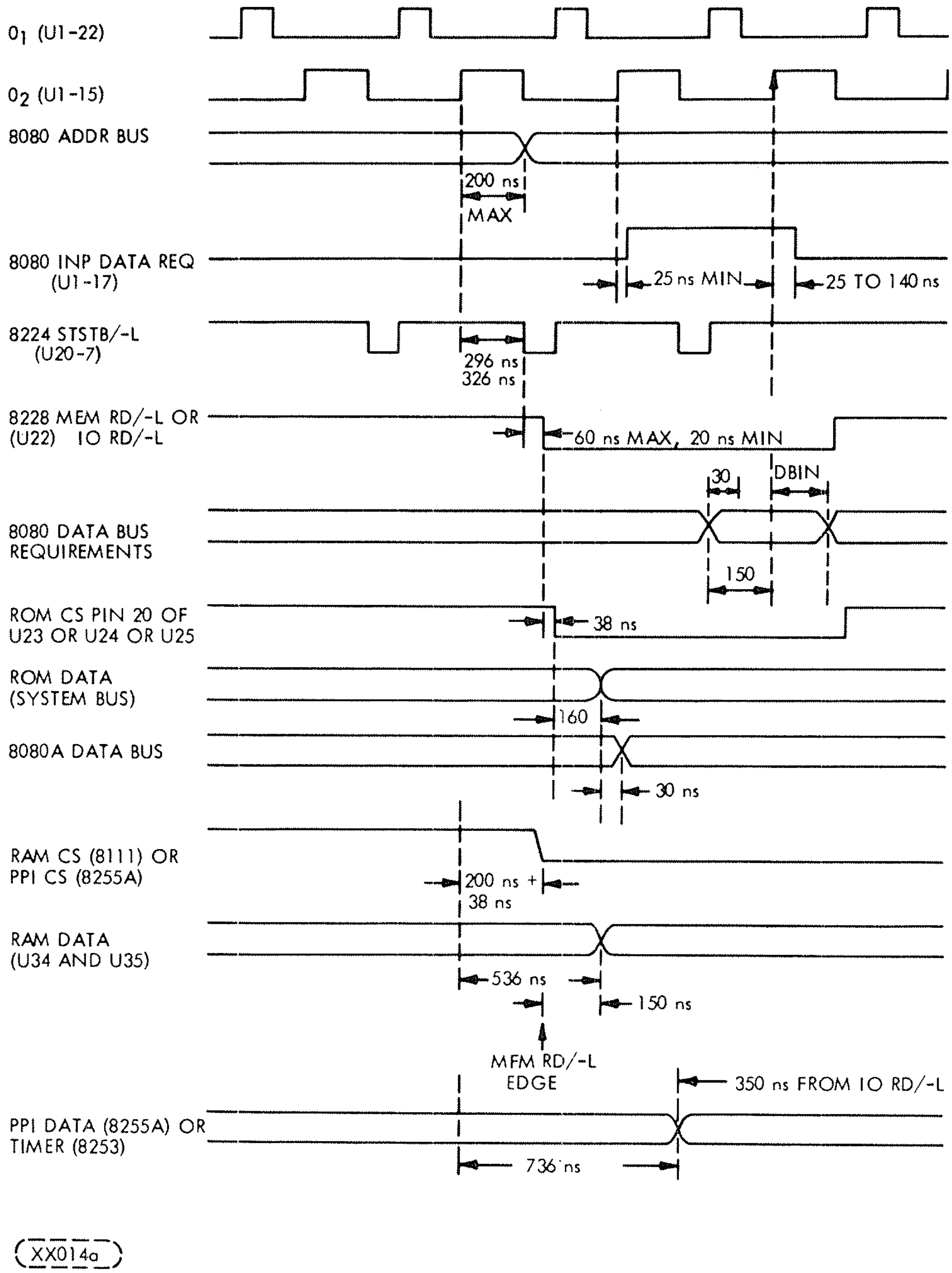


Figure 4-15. MP Read Timing

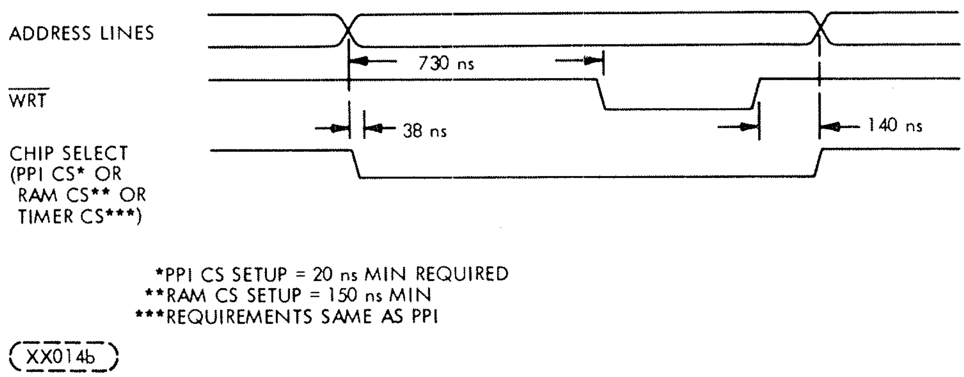


Figure 4-16. Microprocessor Write Timing

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 4-15 and 4-16.

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 mechanized 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 the instruction whose address is eight times the AAA field of the Restart instruction. The new instruction at 8 X AAA is the first instruction in the subroutine that services the requirements of the particular function that caused the interrupt.

Table 4-1. Microprocessor Memory Address Code Assignments

FUNCTION	MEMORY ADDRESS LINES MADR F/+L THRU MADR 0/+L															
	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	(11110111)
			AAA

Clock (20 ms) Interrupt:

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

Segment End Interrupt:

Counter #0 of the 8253 produces the Segment End interrupt when the seek control logic requires the next velocity command as described in Section 4.3.3.2, "Seek Control". Refer also to the timing diagram of Figure 4-17. 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 4-17 illustrates the case where the heads are programmed to travel a one track segment at the "present velocity" at the end of which the "segment end interrupt" occurs.

External Interrupt:

External Interrupt is reserved for later use.

Offset Interrupt:

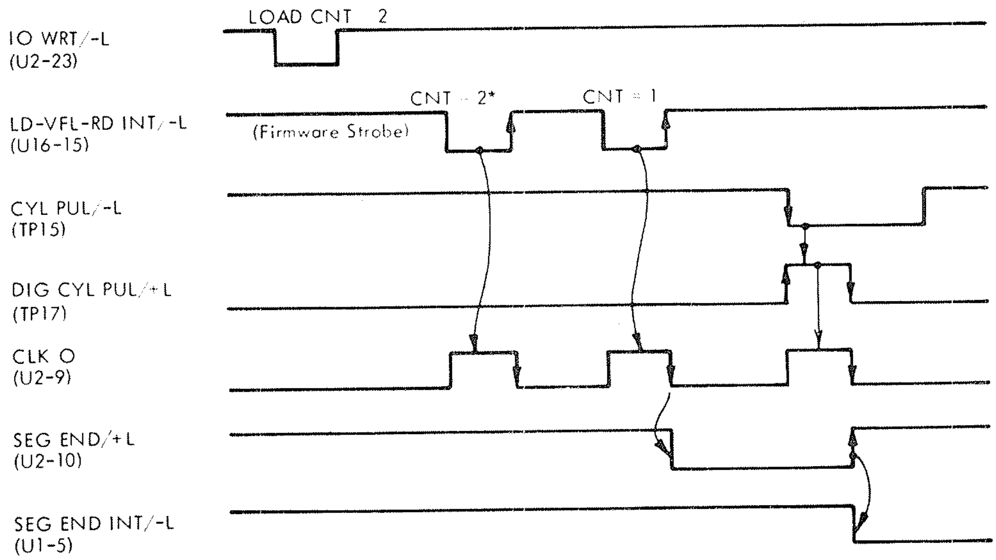
A change in offset command lines detected by an edge detector circuit generates the offset interrupt. The microprocessor then commands an offset position through the velocity command port (PPI-1, Port B) to the D to A converter. In the fine mode (closed loop) the D to A output is a position offset, but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

Maintenance Fault Interrupt:

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

Seek Interrupt:

The Seek Interrupt initiates a seek operation. The flow chart of Figure 4-25 illustrates the Seek and Segment End Interrupts.



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

XX032a

Figure 4-17. 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 & U36; type 8255A) and two multiplex chips (U42 & 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 Figure 4-14. 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-rupt 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 second 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. (contd.)

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. (contd.)

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. (contd.)

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. (contd.)

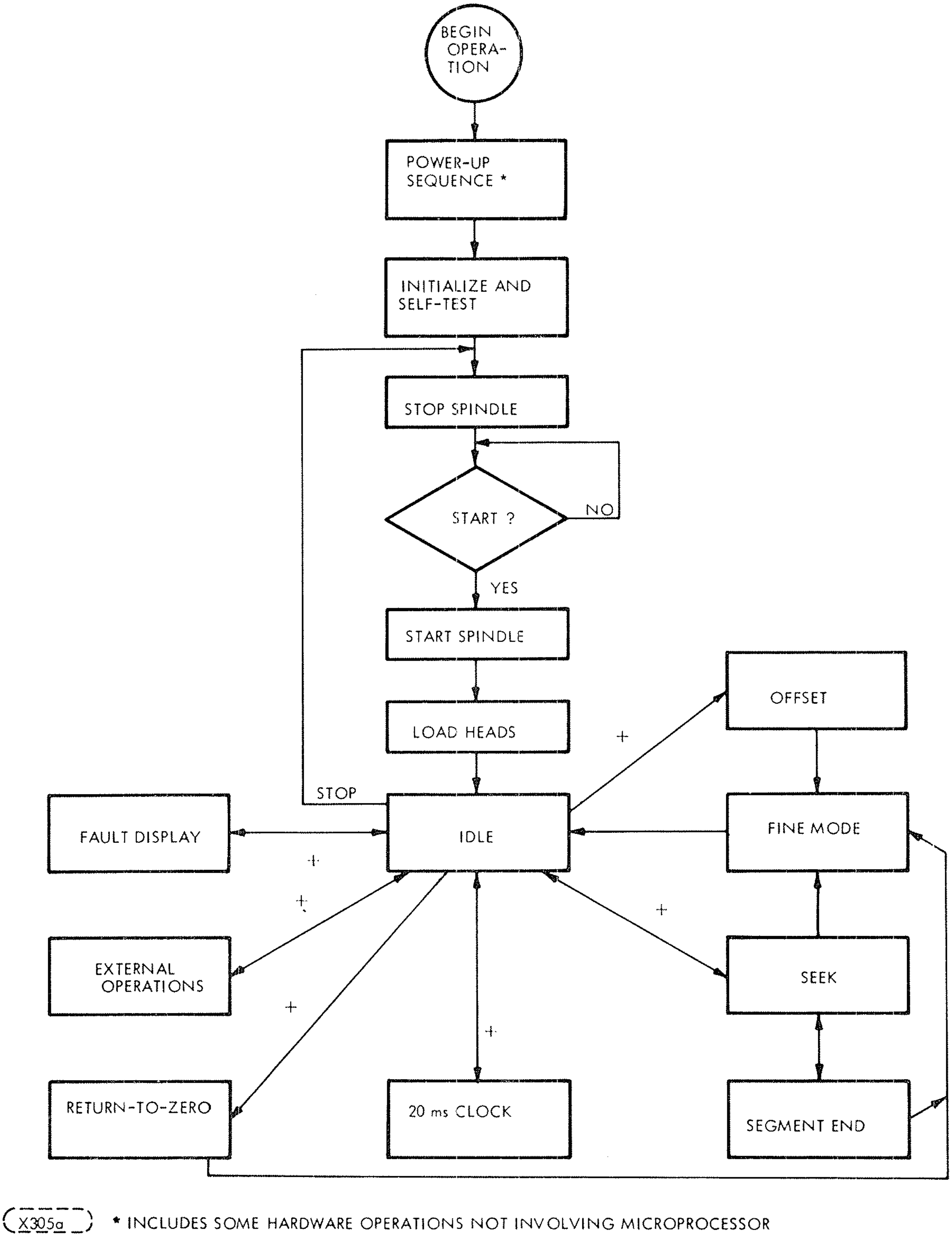
PPI 2 (U36	Source/Destination	Function
U16 Binary/1:8 Decoder		Software strobes decoded from input addresses
U16-15	LD-VEL-RD-INT/-L	Loads contents of velocity port into Velocity Command Registers and strobes the Segment End Counter. Also this strobe allows the reading of the interrupt instruction port 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

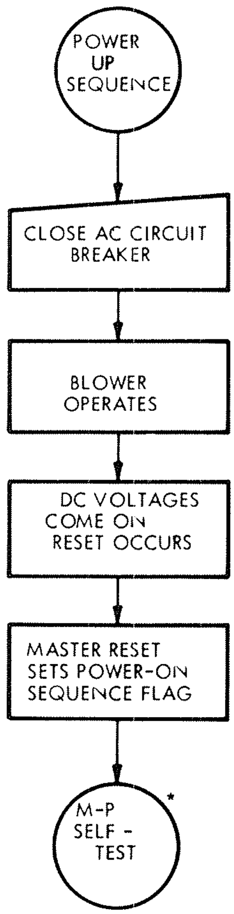
Flow charts illustrating microprocessor operation sequences are given in Figure 4-18 through 4-29.

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 4-18. Microprocessor General Operation Flow Chart



X316b

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

*Figure 4-20.

Figure 4-19. Power-up Hardware Sequences Flow Chart

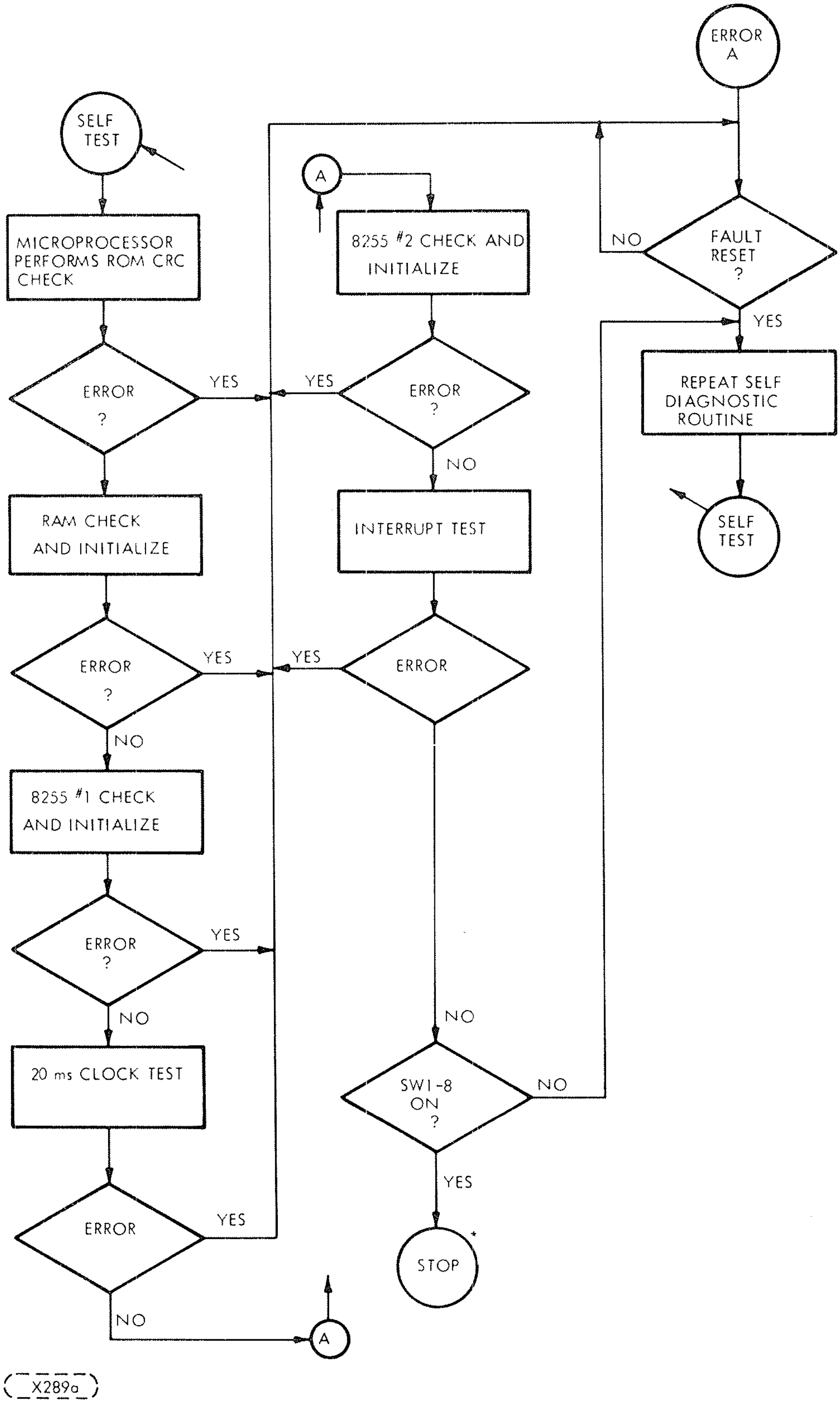
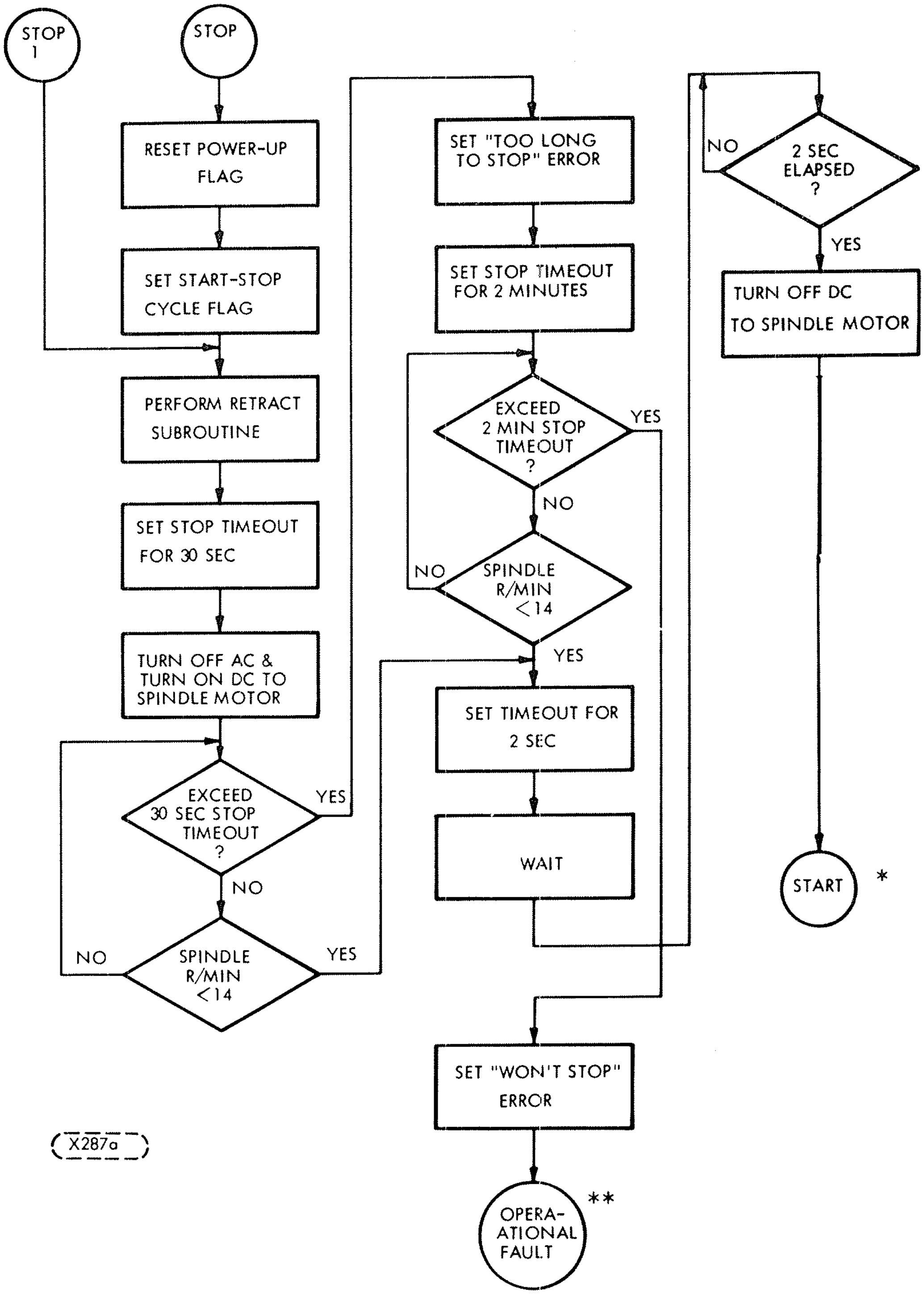


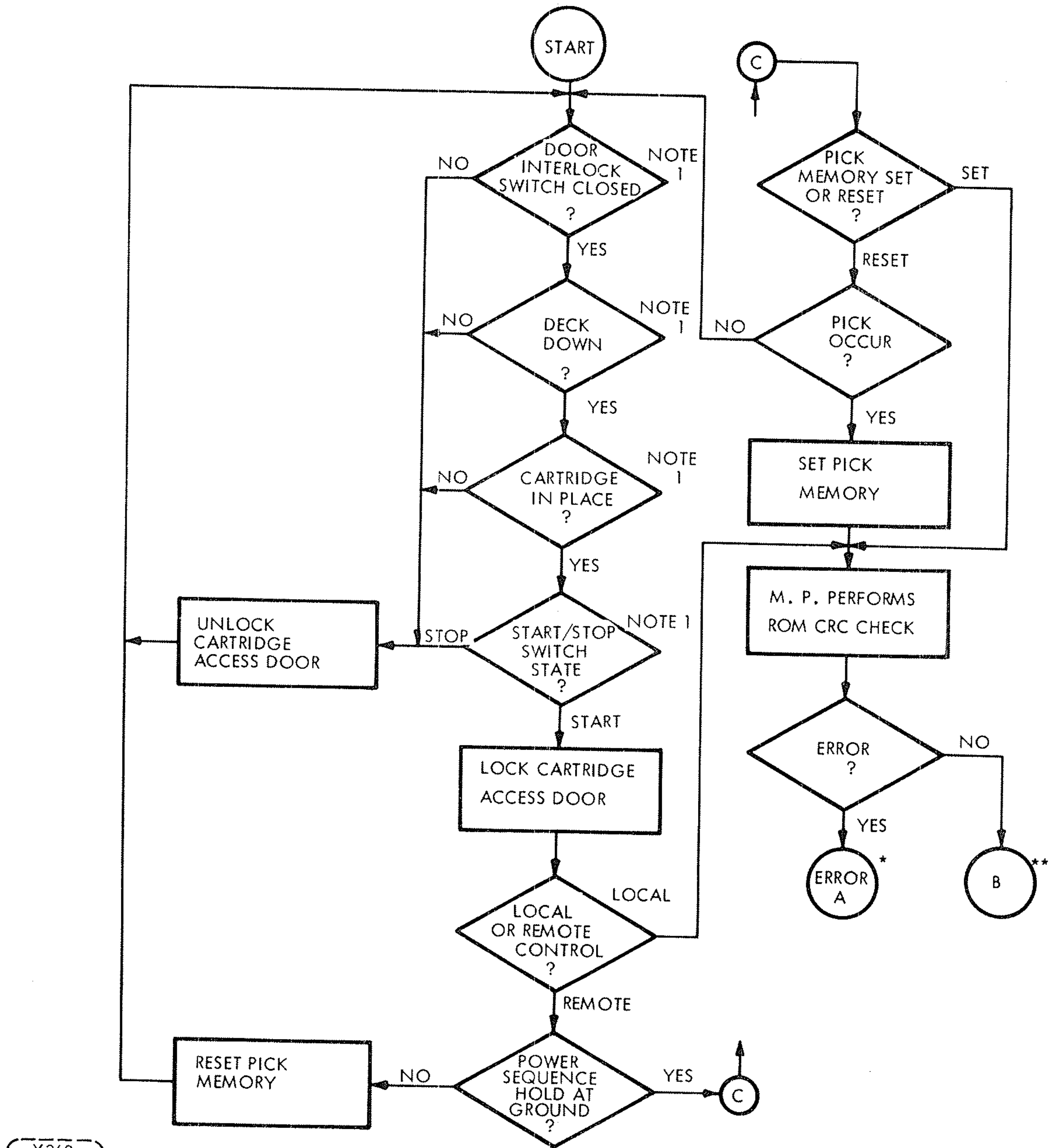
*Figure 4-21

Figure 4-20. Initialization and Self Test Sequence Flow Chart



* Figure 4-22
** Figure 4-29

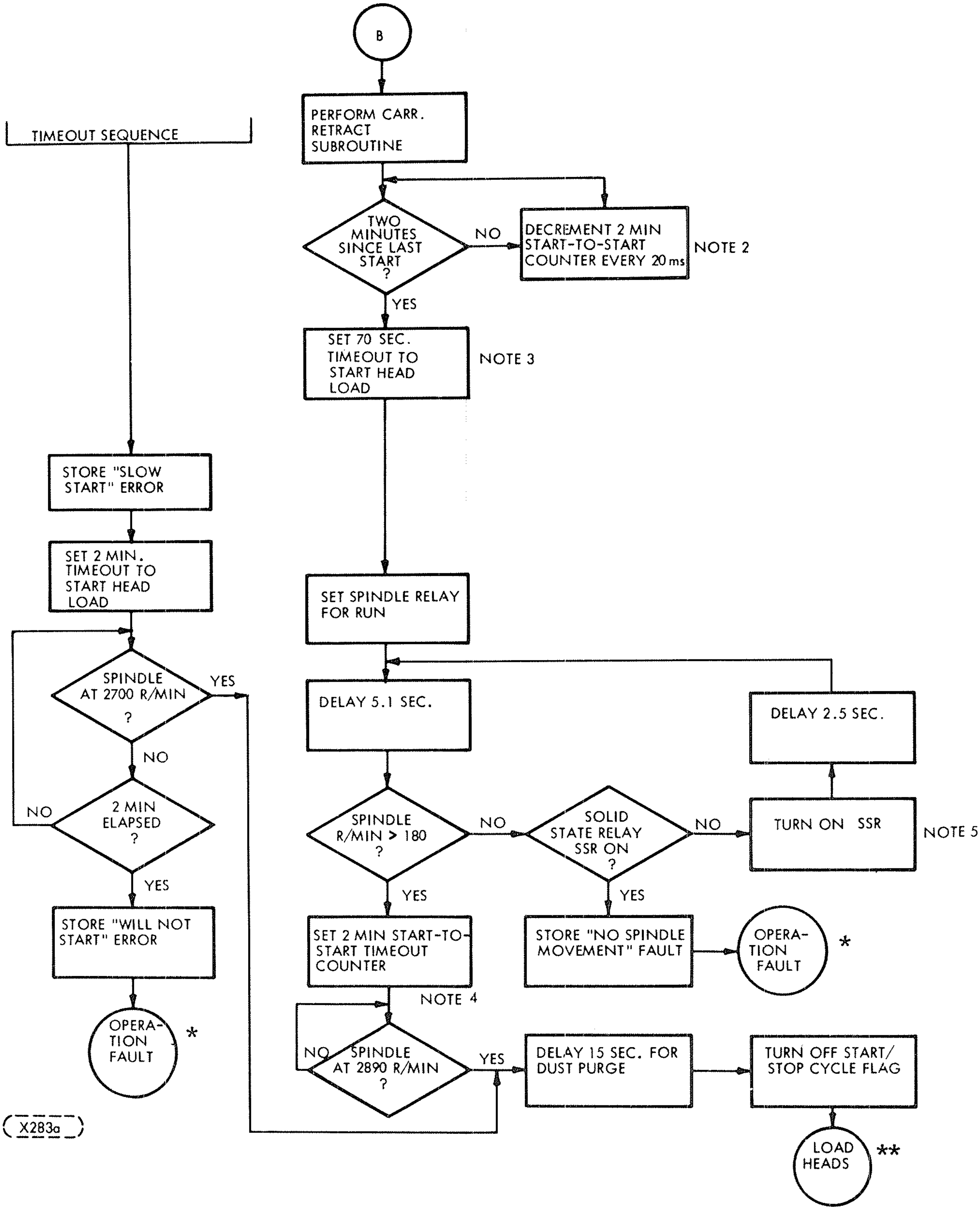
Figure 4-21. Stop Sequence Flow Chart



* FIGURE 4-19

** SHEET 2 OF THIS CHART

Figure 4-22. Microprocessor Start Sequence Flow Chart (Sheet 1 of 3)



* Figure 4-29
** Figure 4-23

Figure 4-22. 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".

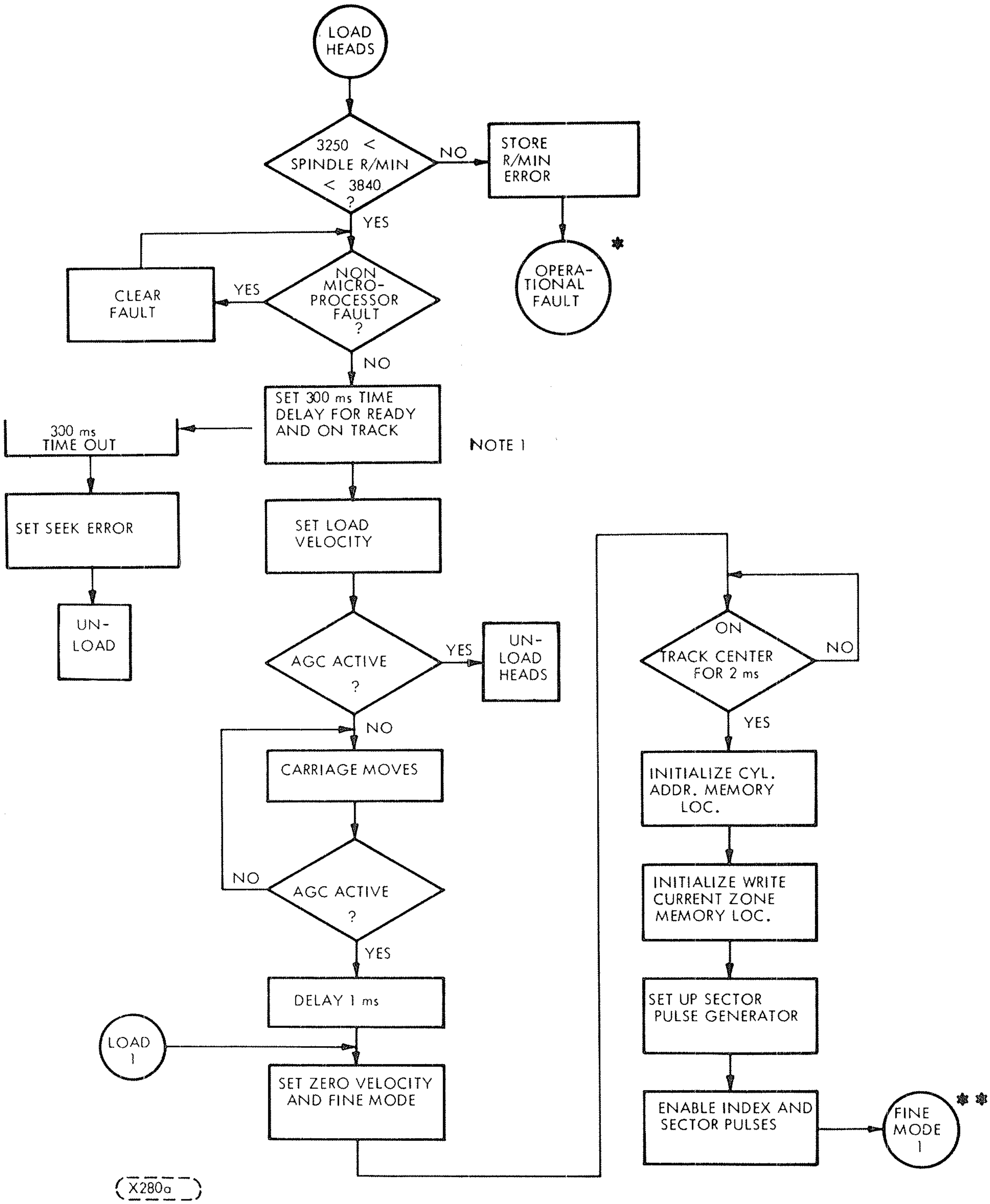
Note 2. A few blocks previous to this point in the flow chart it was found that the START/STOP switch indicates Start. However, a two minute timer will not allow operation to procede until the two minute interval has elapsed. The two minute timer counter is decremented by the 20 ms idle interrupt clock (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 int he 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 4-22. Start Sequence Flow Chart (Sheet 3 of 3)



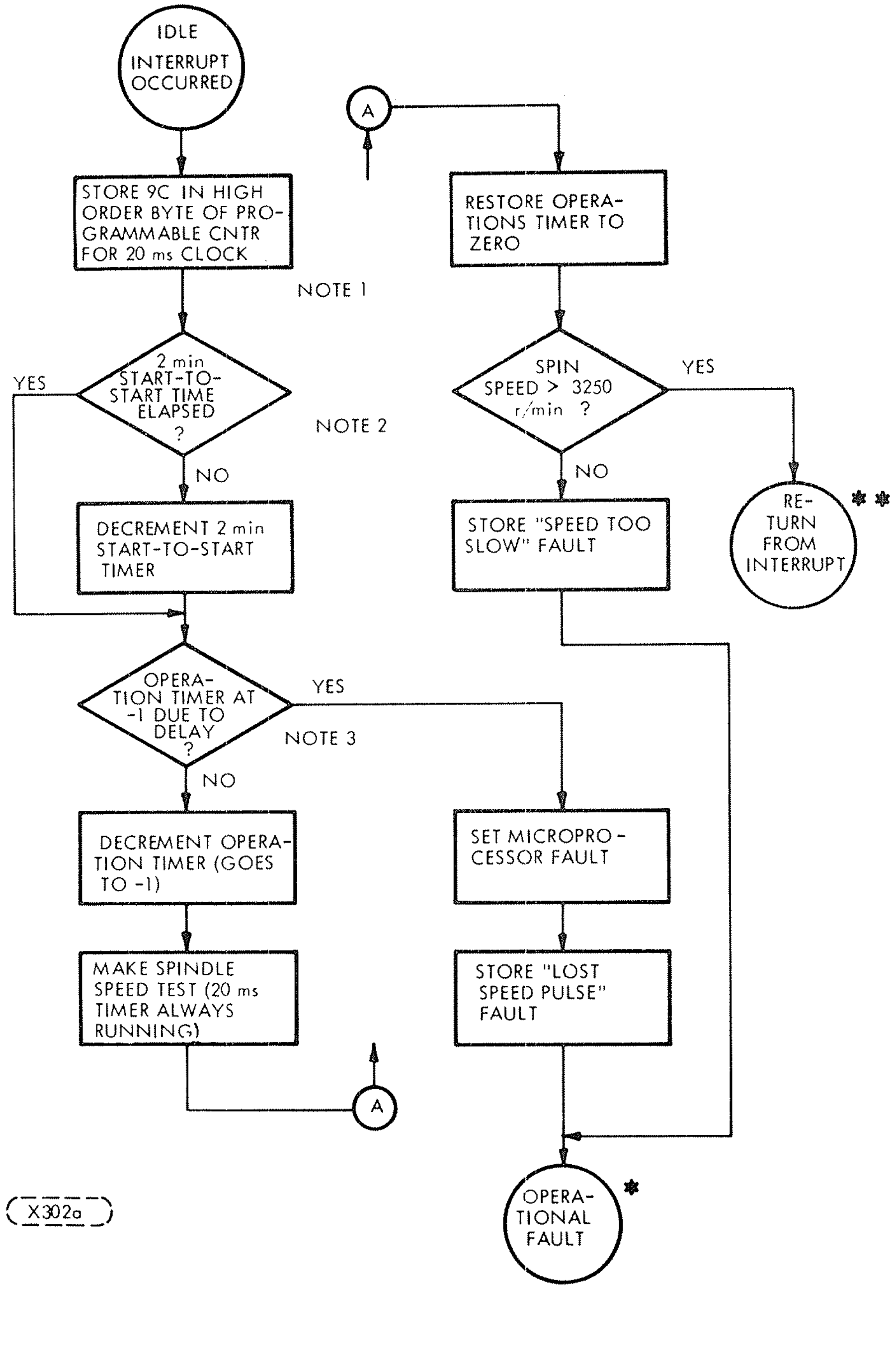
* Figure 4-29
** Figure 4-26

Figure 4-23. Head Load Sequence Flow Chart (Sheet 1 of 2)

Figure 4-23. Load Heads Sequence Flow Chart Supplementary Notes.

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 4-23. Head Load Sequence Flow Chart (Sheet 2 of 2)



* Figure 4-29
** Return to the routine which was interrupted.

Figure 4-24. 20 ms Clock Sequence Flow Chart (Sheet 1 of 2)

20ms 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 count-down.

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

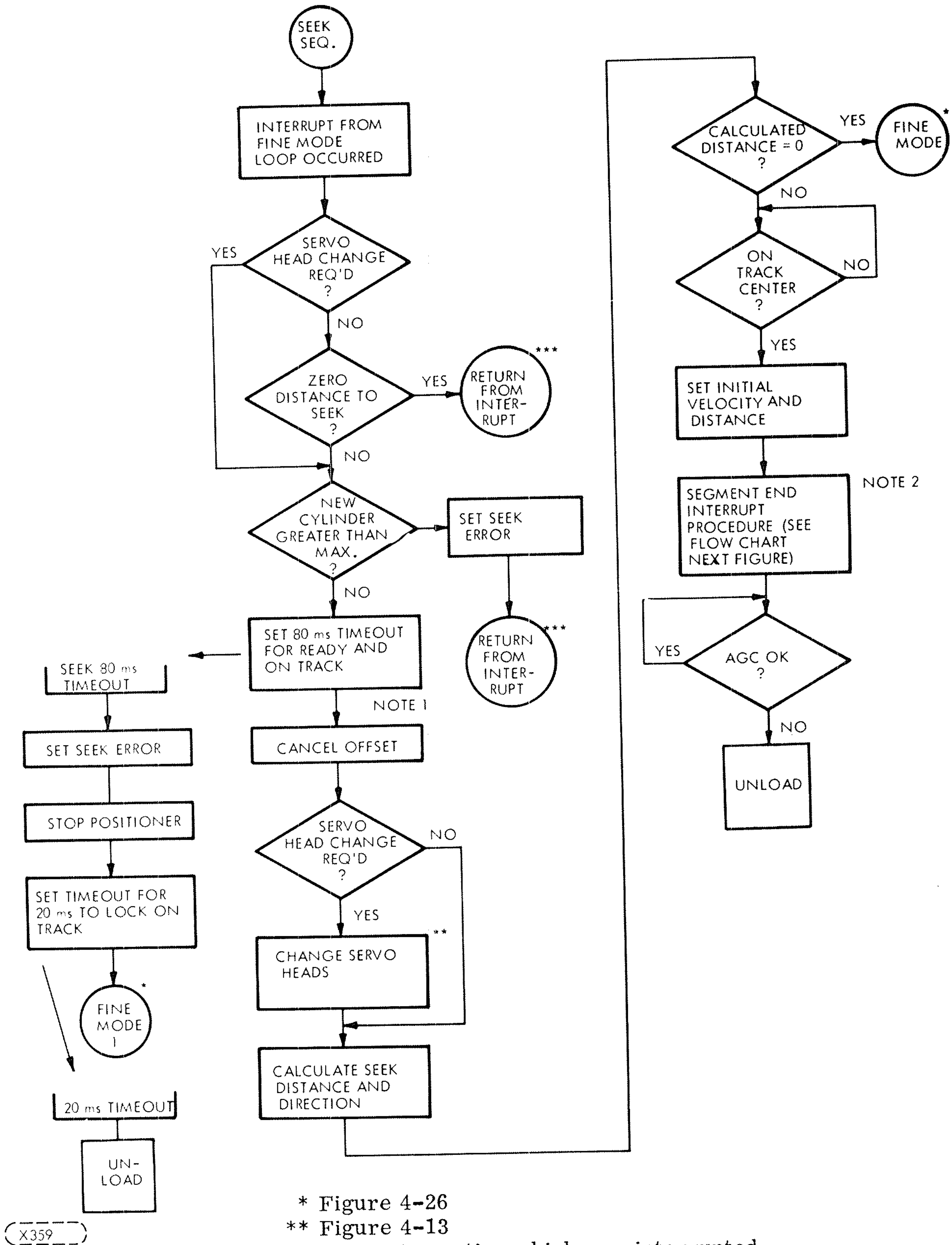
Note 2. To measure off a 2 minute Start-to-Start interval, the CPU loads a 16 bit location in RAM with a number to be decremented by the 20 ms clock (see note 1). When the number has been decremented to -1 (2 minutes elapsed) a new start may be initiated (assuming the power up sequence is complete).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

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

Note 3. There is a location in RAM called the Operations 16 bit Timer which is used for storing some number which will be counted down to provide a time interval for some operation. The number stored there depends on the operation. When this counter location is used in the motor spindle speed check sequence it is loaded with zero. When the 20 ms clock interrupts the CPU the Operations Timer is checked for -1 which it will not be if everything is operating correctly. After the -1 check the timer is decremented to -1 and then the spindle speed check is made. After the spindle speed check is complete the Operations Timer is loaded again with zero. If during the spindle speed check some fault occurs (a CPU interrupt, for example) and the spindle speed check is not completed before 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 4-24. 20 ms Clock Sequence Flow Chart (Sheet 2 of 2)



* Figure 4-26
** Figure 4-13
*** Return to routine which was interrupted

Figure 4-25. Seek and Segment End Interrupt Sequences Flow Charts (Sheet 1 of 3)

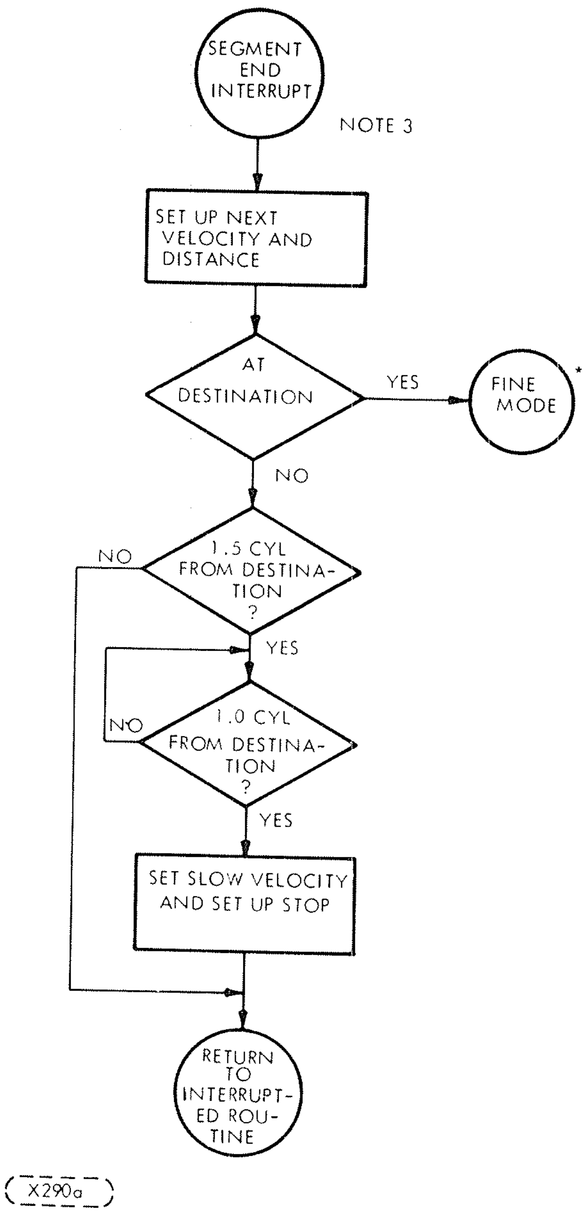


*Figure 4-26

Figure 4-25. Seek and Segment End Interrupt Sequences Flow Charts (Sheet 2 of 3)

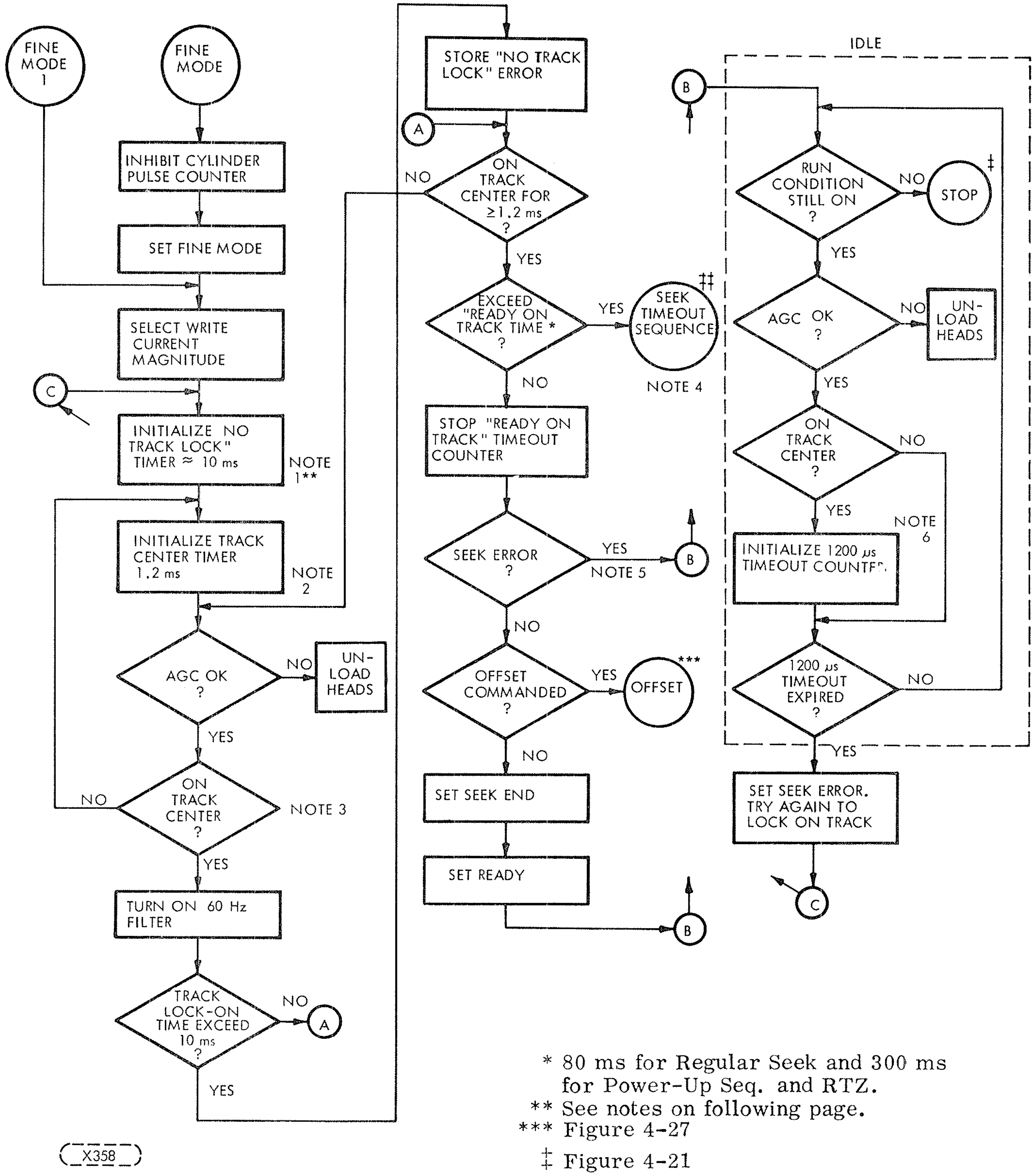
Figure 4-25. Seek Sequence Flow Charts Supplementary Notes

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

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

Note 3. The Segment End Interrupt sets up the next distance/velocity segment. If final distination 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 4-25. 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 4-27

‡ Figure 4-21

‡‡ Figure 4-25

FIGURE 4-26. FINE MODE SEQUENCE FLOW CHART (SHEET 1 OF 2)

Figure 4-26. Fine Mode Flow Chart Supplementary Notes.

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

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

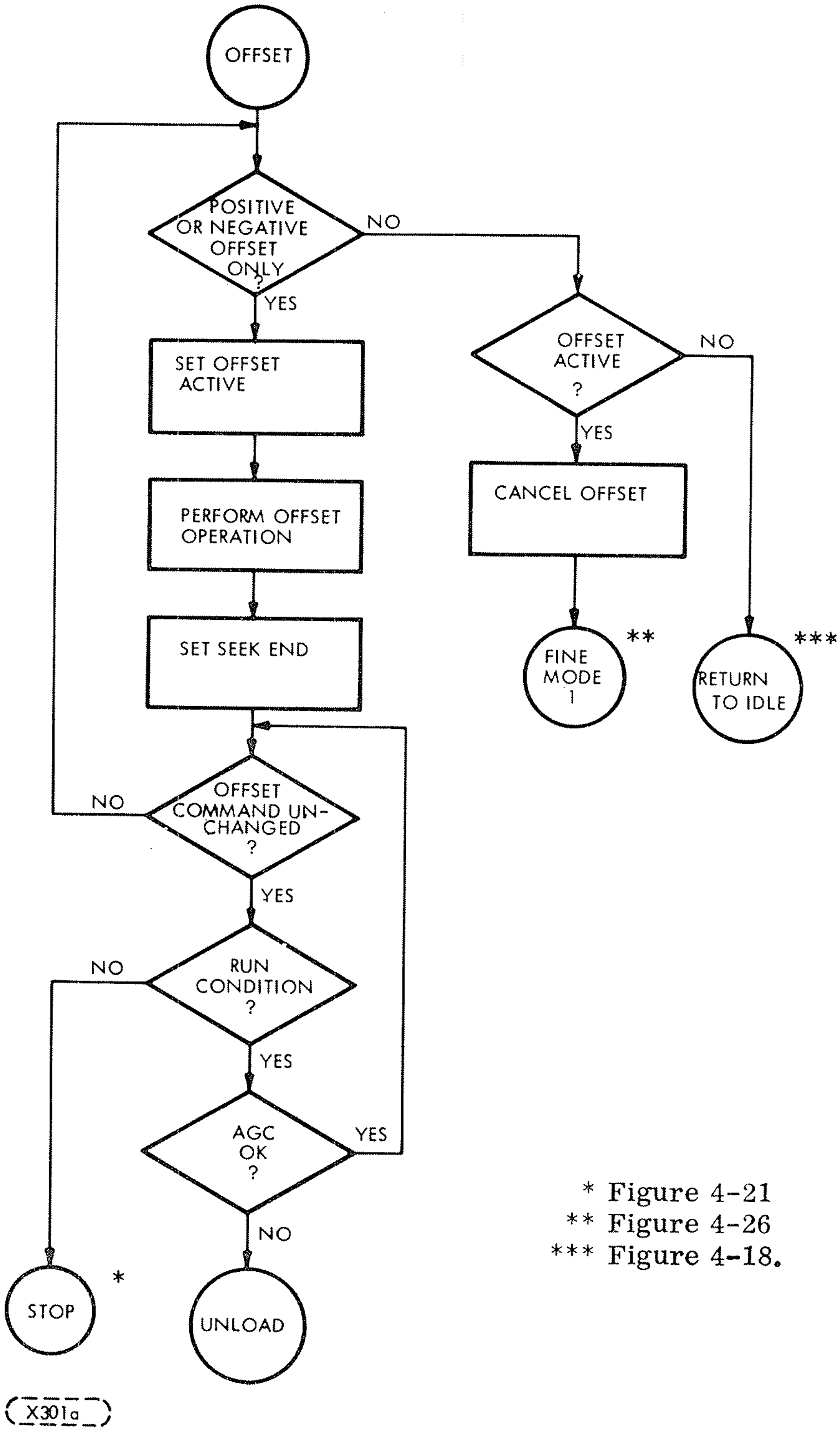
Note 3. In the event of a malfunction affecting the units ability to get and stay on track center, operation could conceivably never get past here, in which case the 80 ms (seek operation) or 300 ms (RTZ or head load operation) timeout could occur. See note 4.

Note 4. Operation must reach this point before the 80 ms (seek) or 300 ms (RTZ or head load) timeout occurs or operation goes to the "Seek Timeout Sequence" in Figure 4-25.

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.

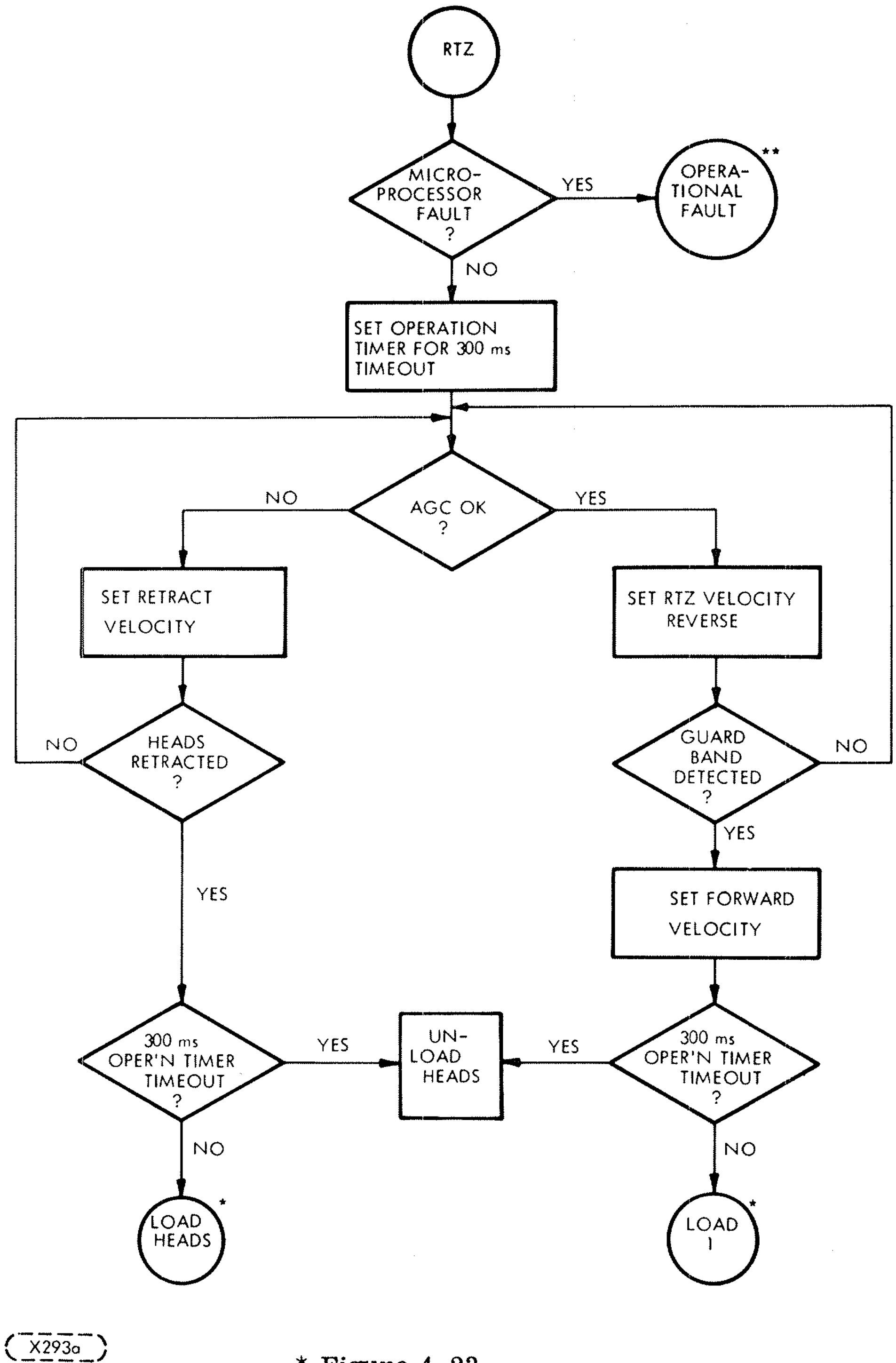
Note 6. The servo system continually works to keep the heads of the selected volume on track center. If the heads stay on track center the 1200 μs counter never times out because the timer is repeatedly initialized before timeout occurs. If the heads get off and don't get back on track center before 1200 μs elapses, a seek error is stored in the M. P. fault storage. The M. P. then goes back to C and tries the 10 ms lock-on sequence again. Operation loops continually in the flow ecnlosed by the dotted lines. This corresponds to the "IDLE" block in Figure 4-18. Operation leaves the Idle phase when an interrupt to the M. P. occurs. The 1200 us counter operation is suspended until operation returns.

Figure 4-26. Fine Mode Sequence Flow Chart (Sheet 2 of 2)



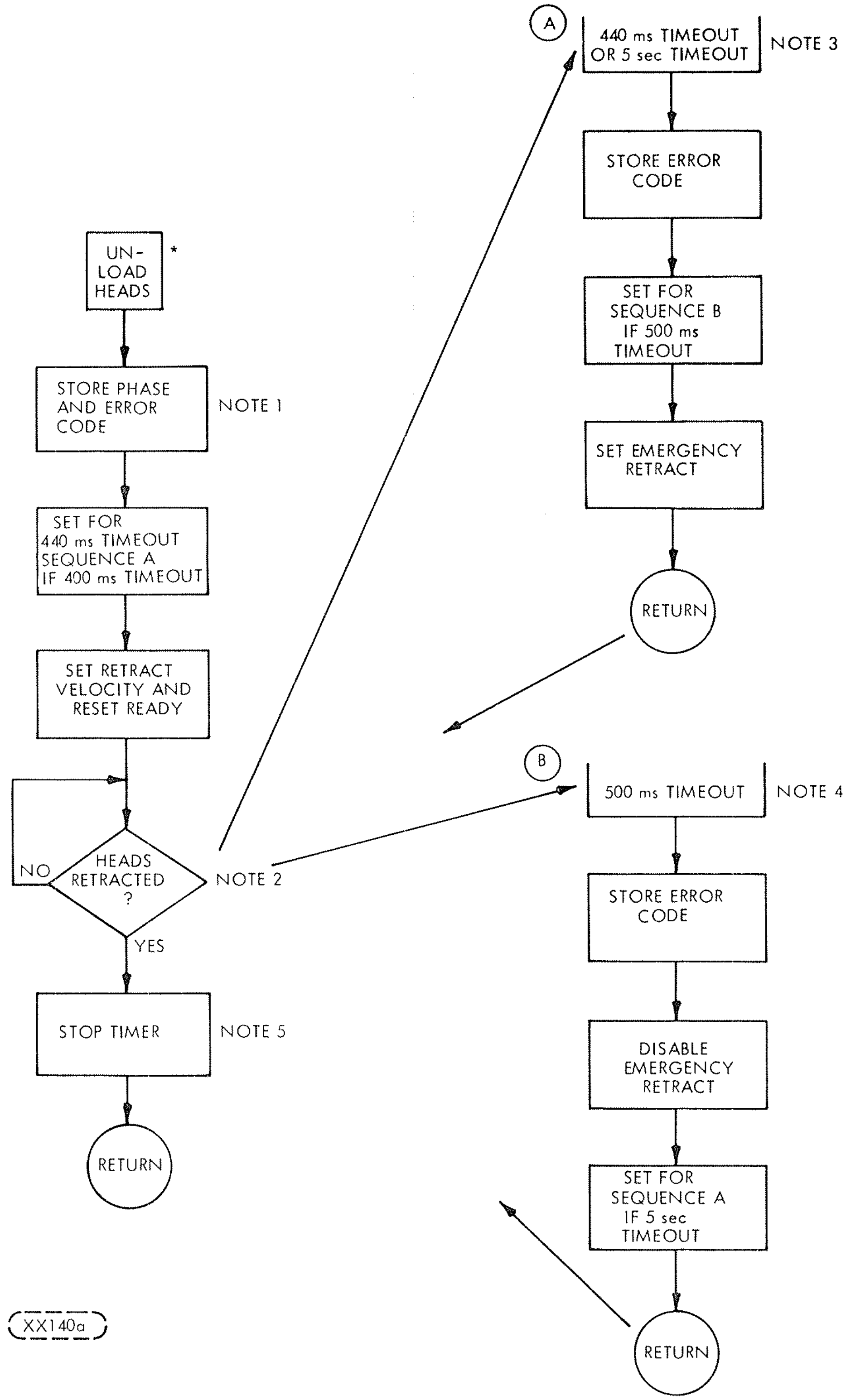
* Figure 4-21
** Figure 4-26
*** Figure 4-18.

Figure 4-27. Offset Sequence Flow Chart



* Figure 4-23
** Figure 4-29

Figure 4-28. RTZ Sequence Flow Chart (Sheet 1 of 3)



*"UNLOAD HEADS" also referred to on Figures 4-23, 25, and 26

Figure 4-28. 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.

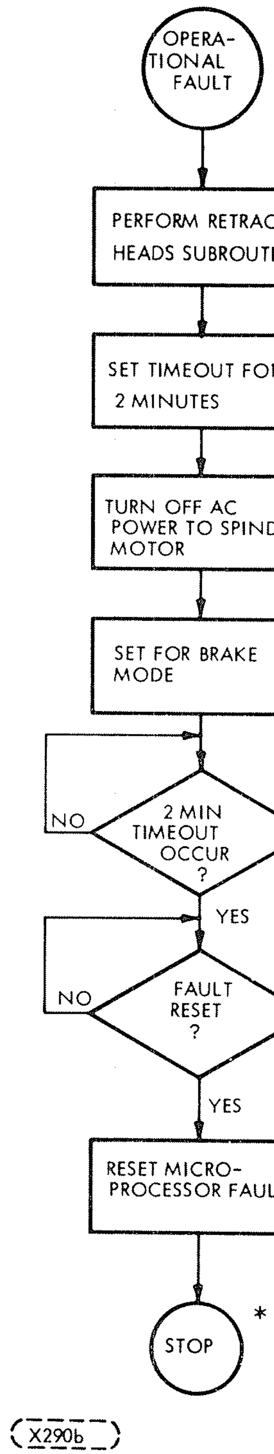
Note 2: During the wait for "Heads Retracted" condition the two time-out sequences "A" and "B" will also occur alternately if retract cannot be accomplished. (See Note 3 and 4 below).

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 4-28. RTZ Sequence Showing Heads Unload Flow (Sheet 3 of 3)



* Figure 4-21

Figure 4-29. 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 4-30 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 4-33) 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 4-31 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.

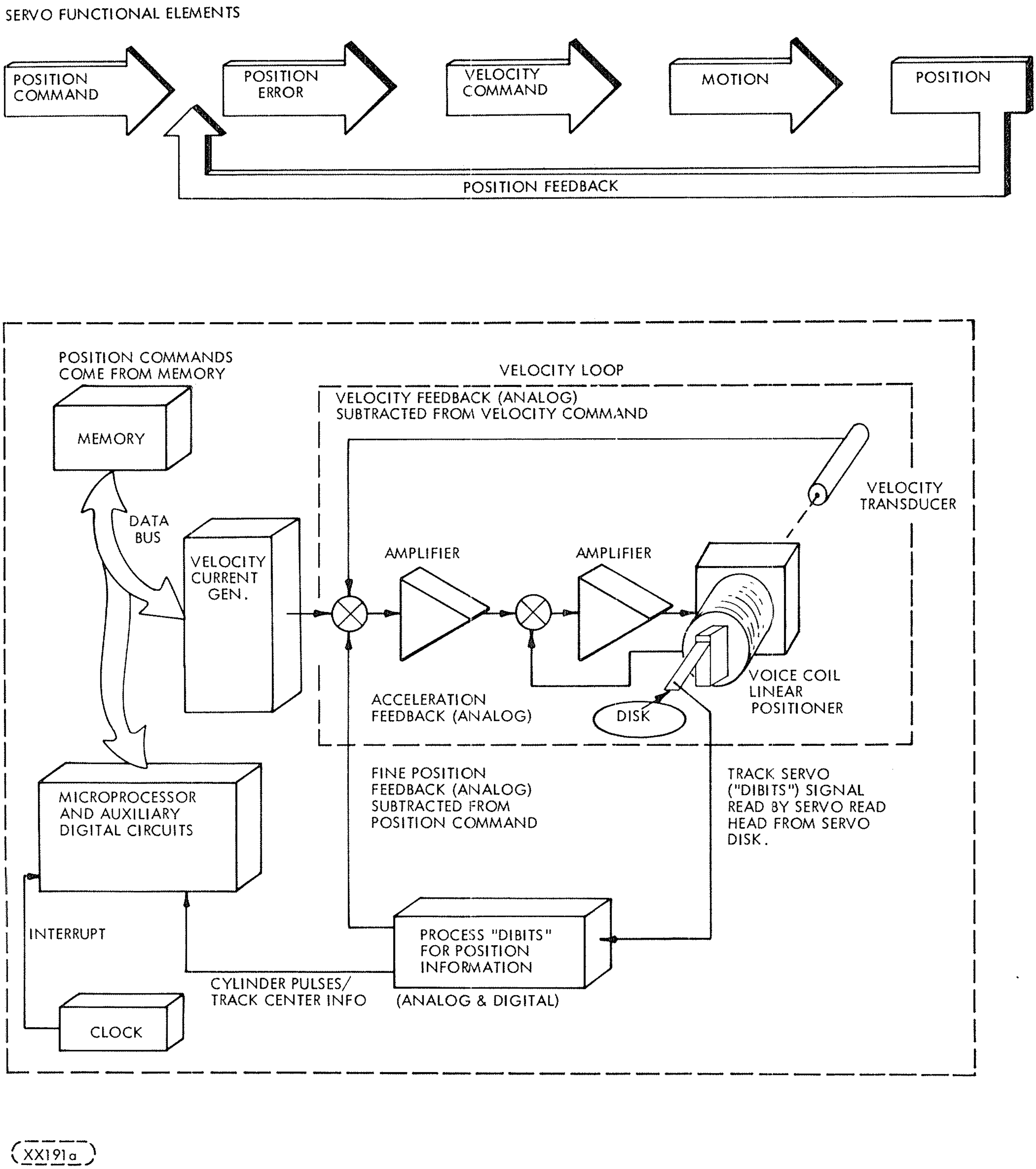


Figure 4-30. Servo System General Block Diagram

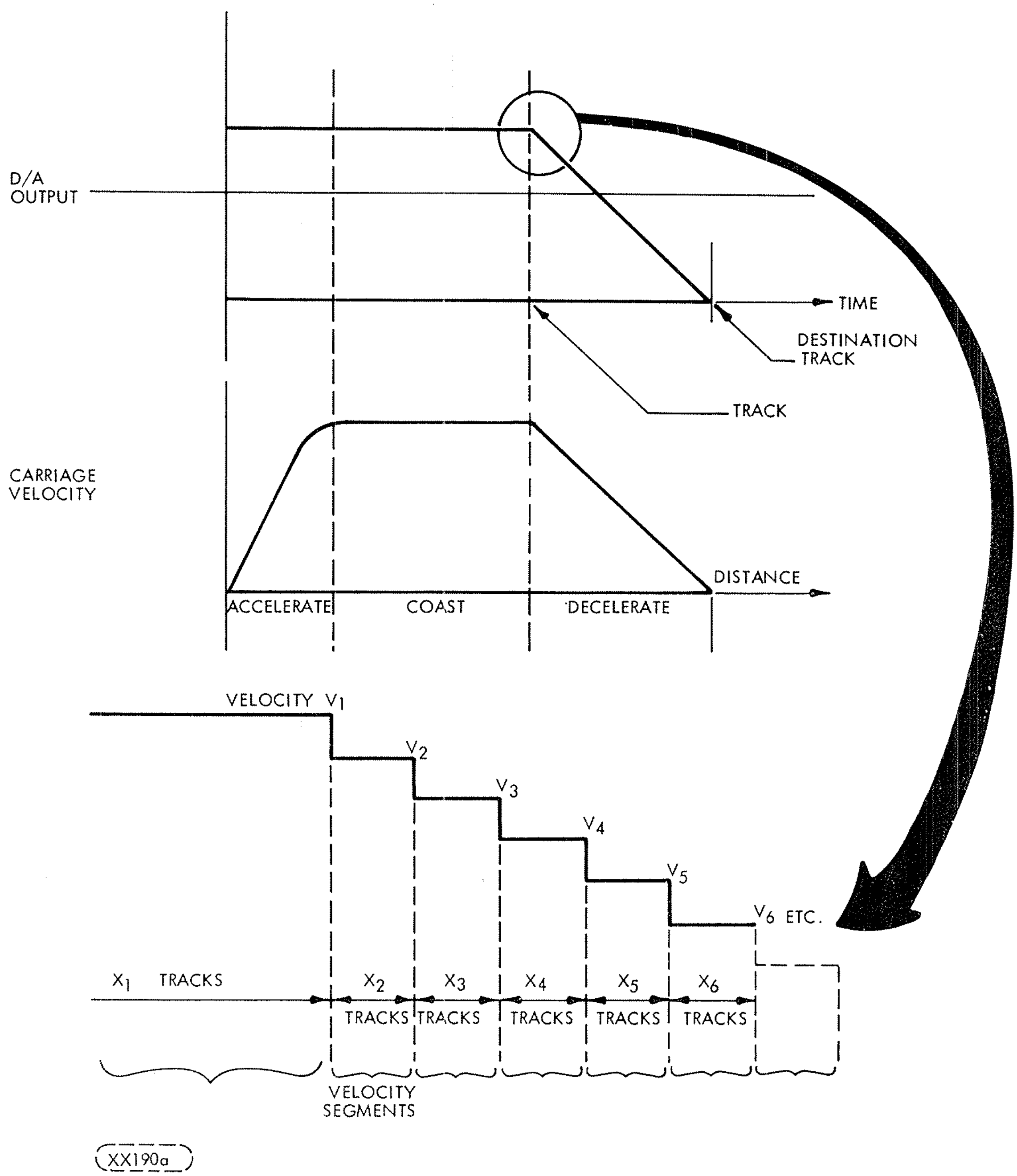


FIGURE 4-31. SEEK VELOCITY PROFILE

4.3.5.3 Detailed Positioning System Theory of Operation

Position Loop Details

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

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

Dibits are the result of the manner in which flux reversals are recorded on the servo tracks. One type of track, known as the Even track, contains negative dibits. The other track, the Odd track, contains positive dibits. A positive dibit consists of a 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 4-32 shows an example of the odd and even dibit waveforms resulting from an "on track" position of the servo head. Figure 4-34 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 position, the amplitude of one dibit component increases while the other decreases. This produces an error voltage used for fine positioning called the track servo signal.

Track Servo Signal

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

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

The track servo signal is applied to the servo circuit and to the cylinder detect circuit. In the servo circuit, it is used to generate the fine position analog signal that controls movement during the last 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 seek. If the servo head drifts off of its centered position, the track servo signal will no longer be at null. The signal, functioning as the fine position analog signal within the servo circuit, will act as a position error signal to drive the positioner back into position.

Circuit gain control is achieved by applying the outputs from the peak detectors to a second summing amplifier. Its output is negative in 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 4-33), 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 siganls which are used in other places within the CMD:

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

For aid in understanding the following description of the Servo-Fine operation refer to Figures 4-32, 4-33 and 4-34 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 4-32 and 4-36.

Input Circuitry

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

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.

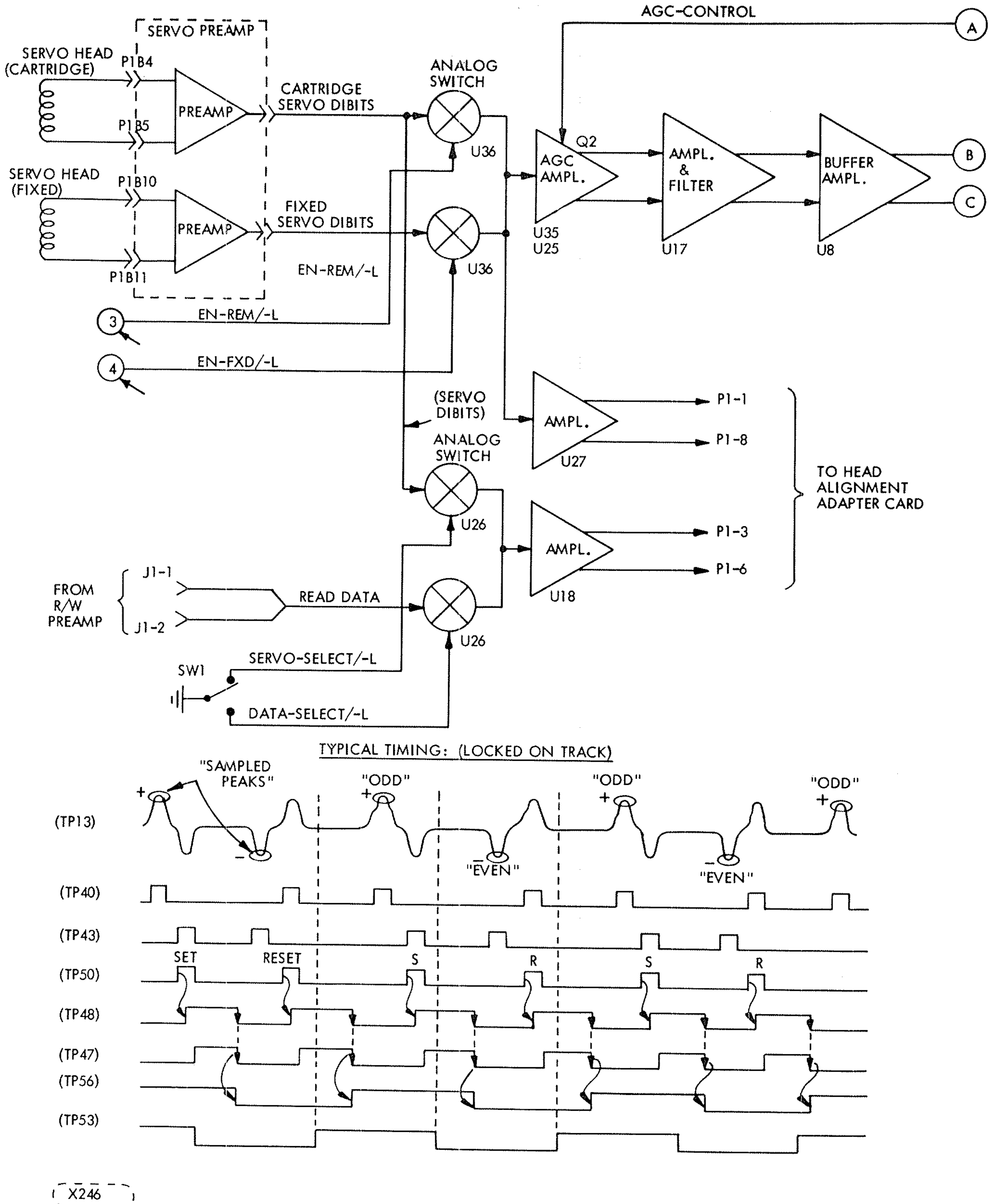


Figure 4-32. Block Diagram of Servo Fine Circuitry (Sheet 1 of 2)

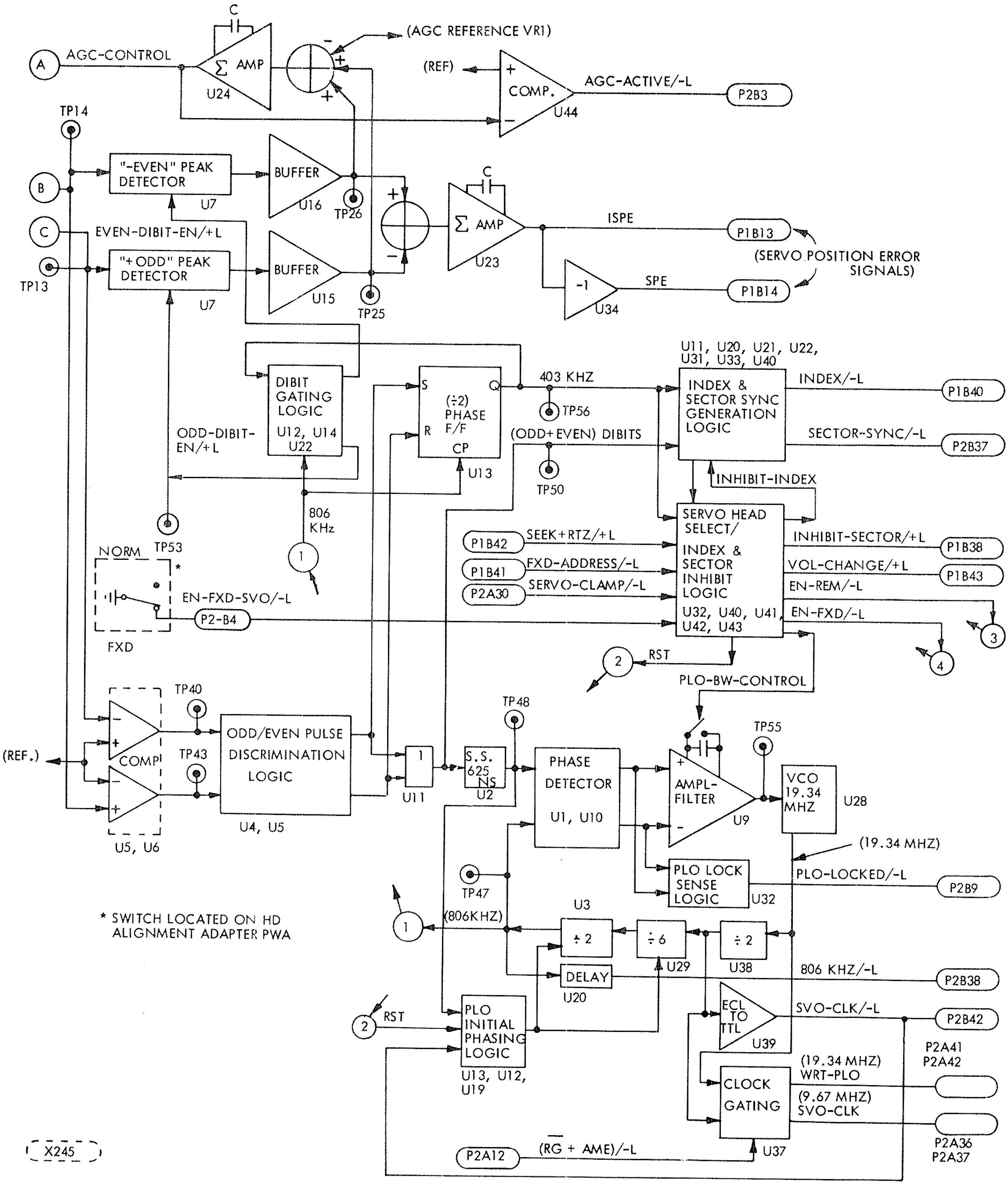


Figure 4-32. Block Diagram of Servo Fine Circuitry (Sheet 2 of 2)

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 4-32. 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 4-32. 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 4-34 illustrates this. The signal at TP50 changes to 403 kHz as alternate dibit pairs fall below the comparator threshold. ODD + EVEN/+L drives the logic which creates the Index and Sector Sync signals and provides the PLL input to which the Phase Lock Oscillator (PLO) U28 must lock.

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

Servo Position Error Signals

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

AGC Control Signals

For AGC control the buffered peak detector outputs (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 detection 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 stablilized. Timing waveforms illustrating these conditions are shown in Figure 4-10.

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.

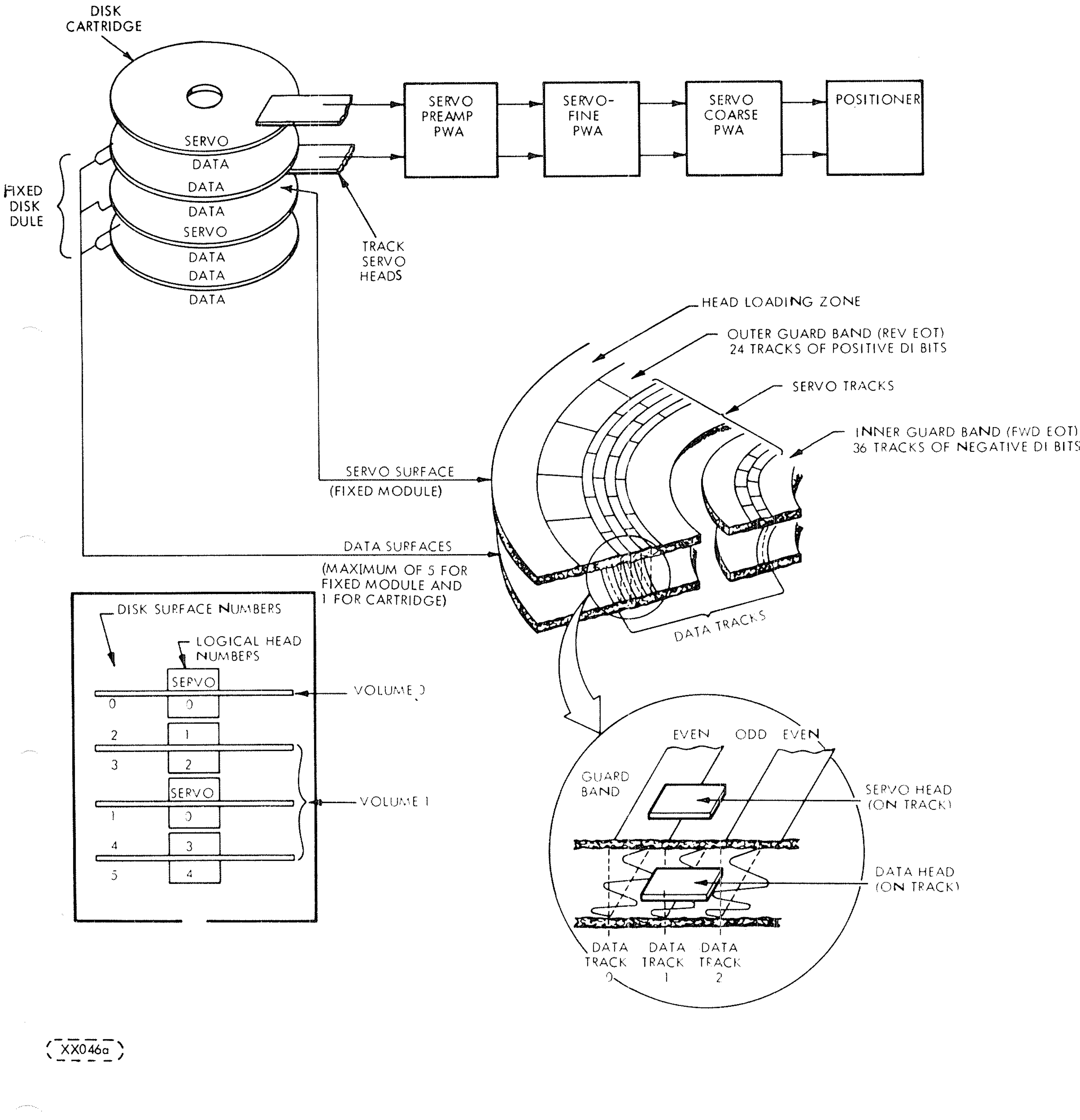


Figure 4-33. Track and Servo Disk Layout

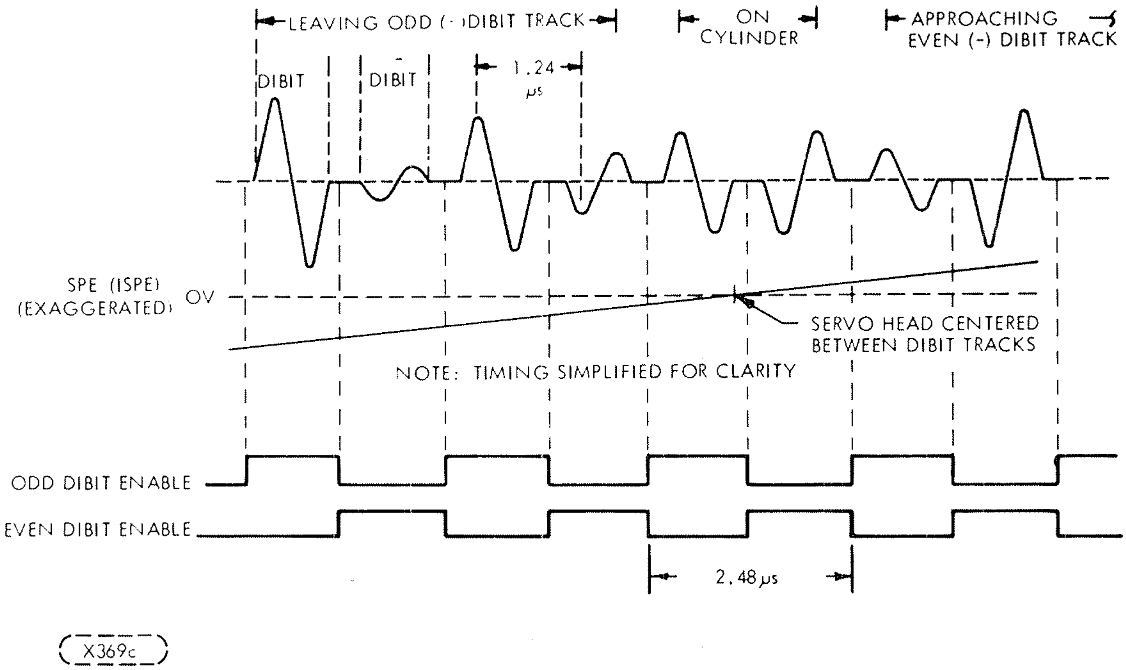


Figure 4-34. Servo System Waveforms - Positioner In Motion

B Servo-Coarse PWA Operation

The Servo-Coarse PWA provides the following circuit functional groups (refer to Figure 4-36):

- 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 Sections 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 4-35, 4-36 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 4-36 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 switch 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.

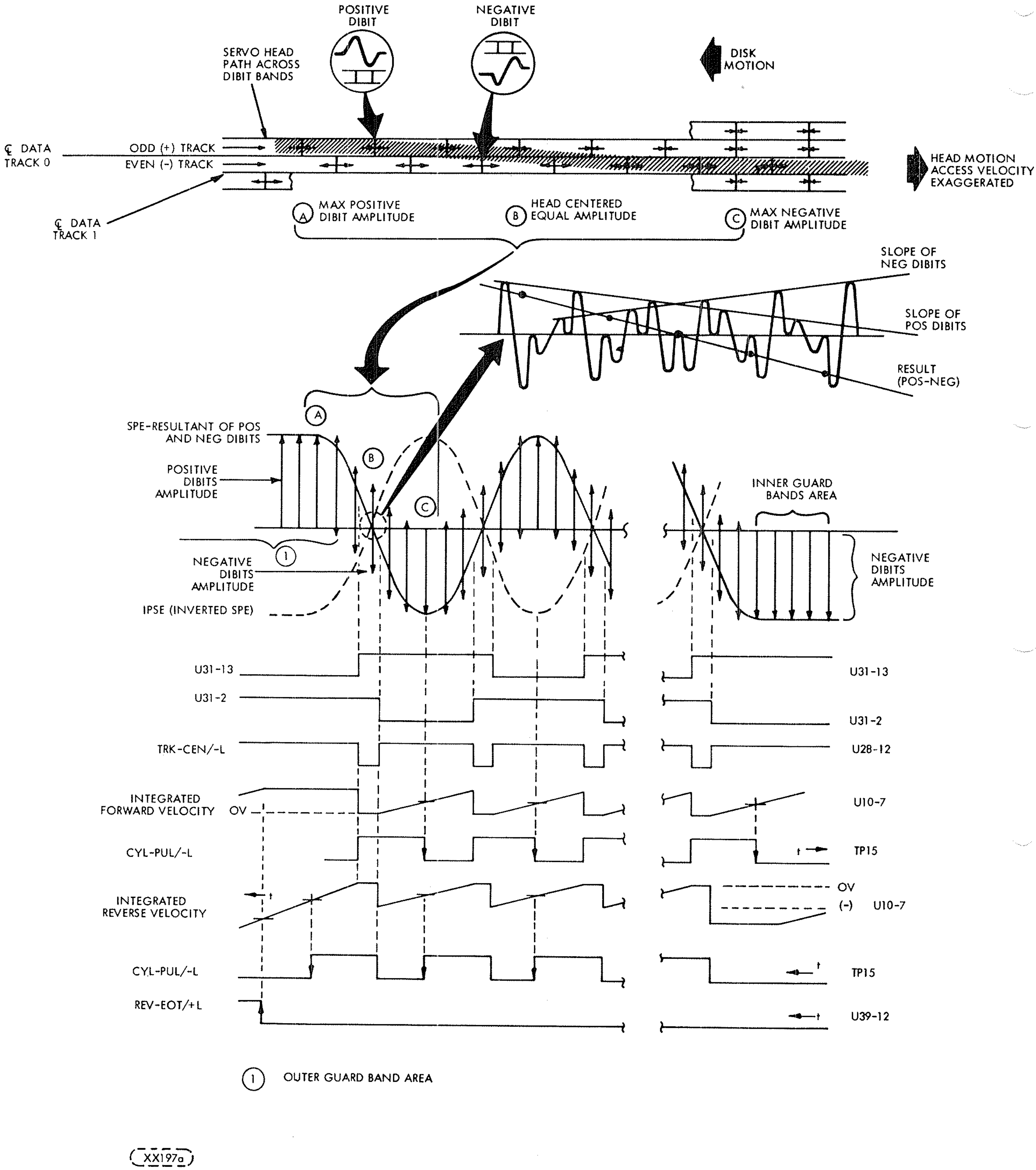


Figure 4-35. Track Center and Cylinder Pulse Generation

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 transistors 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 to it through the contacts of a relay K2 on the Relay Control PWA. The signal 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 non-linearity 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 Power Amp PWA will not drive the actuator beyond the proper velocity, but due to the small amount of current C69 and C70 must furnish, the retract velocity is uniform. The main retract power is supplied to Q1 by the energy stored in a large retract capacitor.

The 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 compensation 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, R43, R124) controls the gain and rolls 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 on track when using a servo signal modulated by an eccentric track caused by mechanical imperfections in disk and spindle. On a machine having a disk rotation of 3600 r/min* eccentricity in the track will pass under the heads 60 times a second, thus causing an amplitude variation in the servo signal that is centered around 60 Hz.

*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 through 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 4-35.

Cylinder Pulse Generation Circuitry

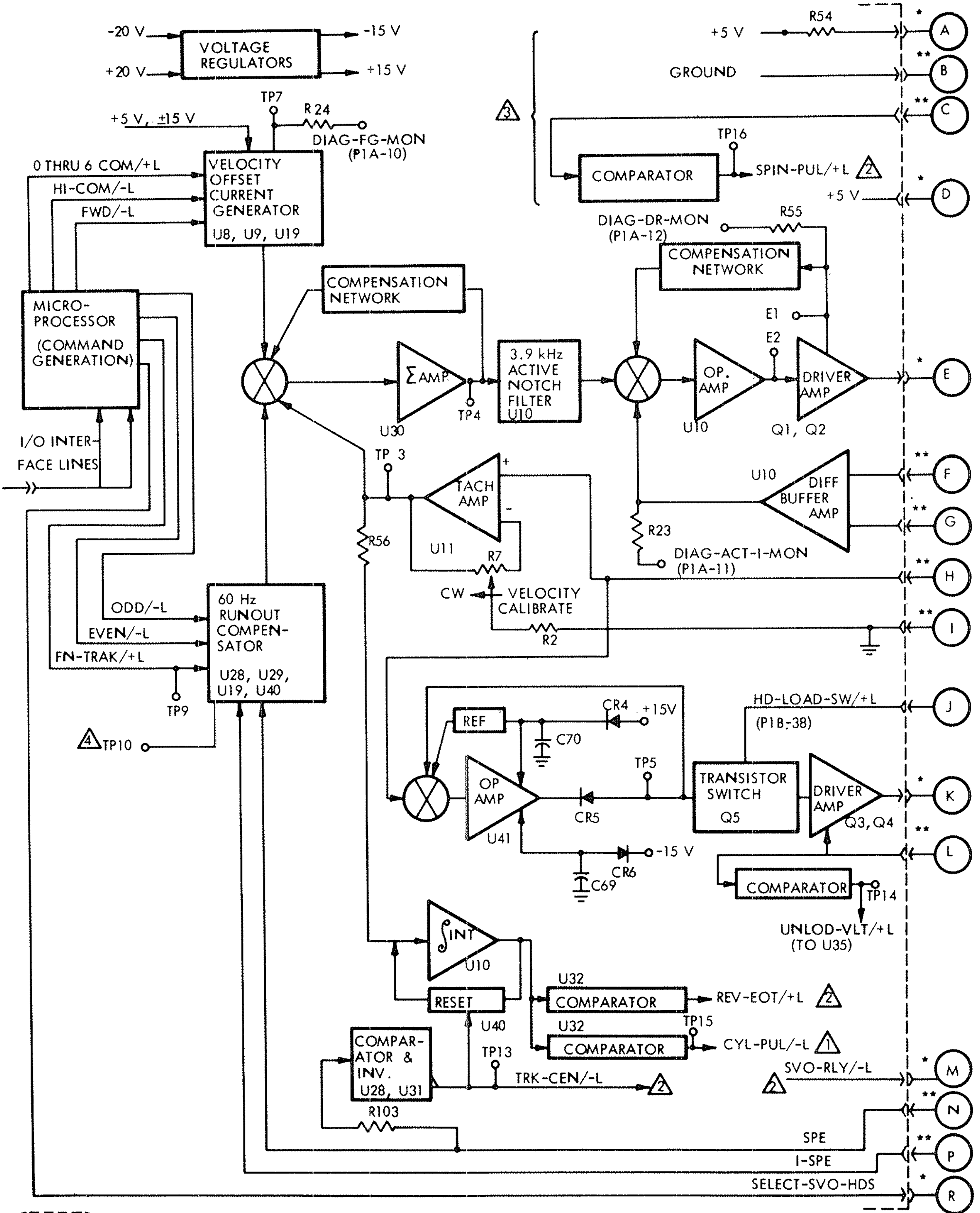
The track center signal TRK-CEN/-L resets integrator U10 by closing analog switch U40-10, 11 and shorts VEL to ground using switch U40-2, 3. The integrator U10 integrates the VEL signal (TP3) which represents the head and carriage velocity. Because the integrator is reset by the track center signal, 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 4-35 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 2.4 mils (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 positvely (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 4-35.

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 drive 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 usecond negative going pulse at U45-3 at the point in time when the trailing positive going edge of the 120 usecond pulse occurs. See Section 6.8.4 for specifications on this pulse. The 1 us pulse is made available for use by the microprocessor through the port U36.



* Notes on Sheet Three

Figure 4-36. Block Diagram of Analog portions of Servo System (Sheet 1 of 3)

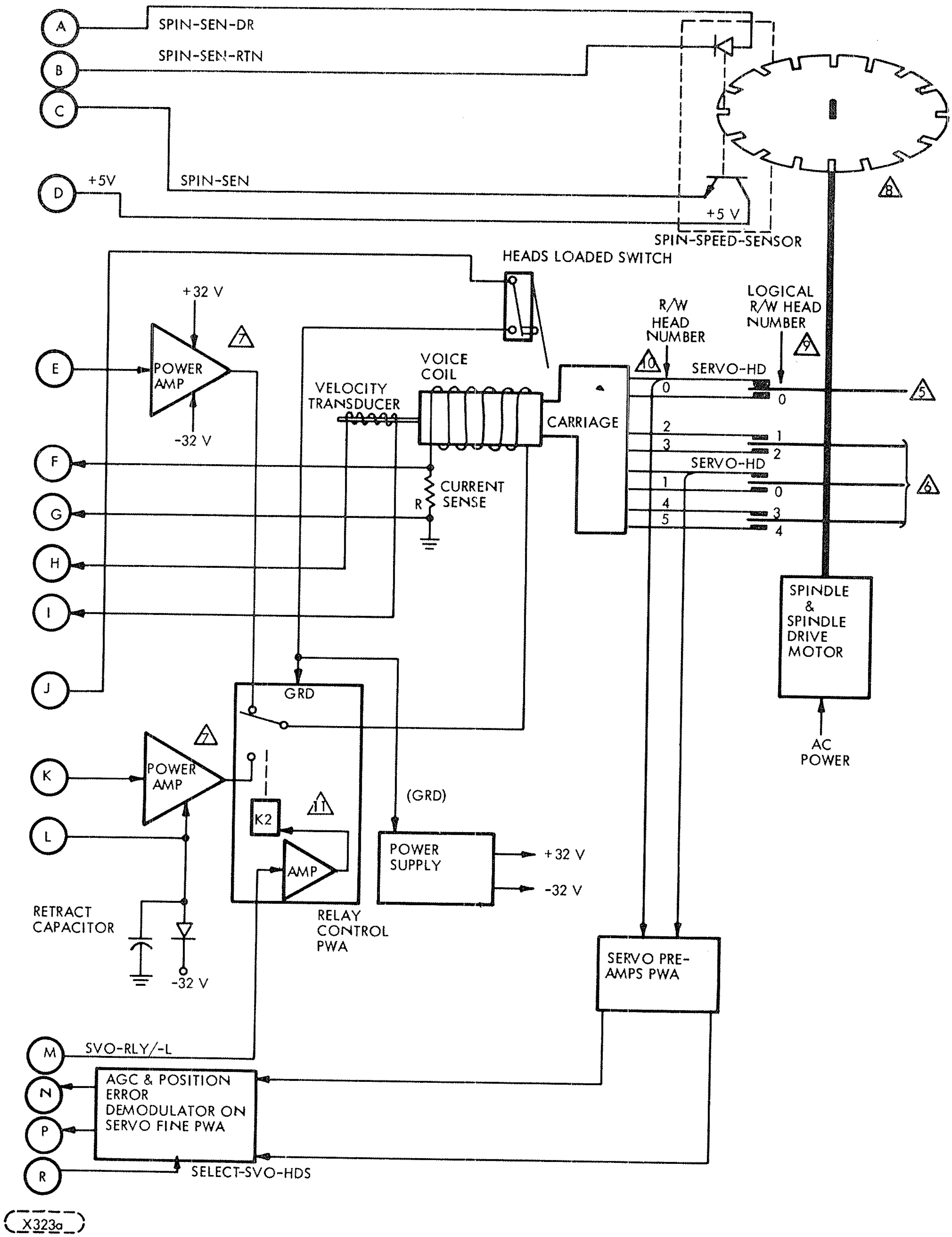


Figure 4-36. Block Diagram of Analog Portions of Servo System (Sheet 2 of 3)

NOTES:

*Outputs to circuitry external to Servo-Course PWA

**Feedback signals from circuits external to Servo-Course 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 adressed by the controller.
10. Use this number when selecting heads on factory tester.
11. Relay shown in energized position.

Figure 4-36. 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 4-37. 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 4-38 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.

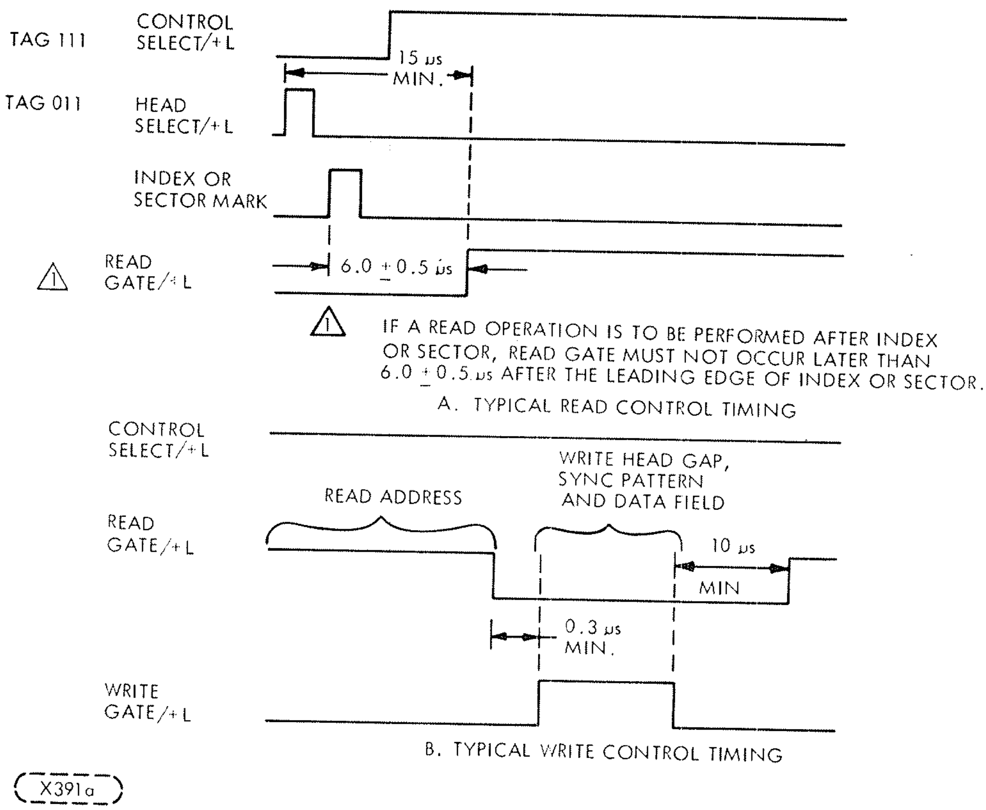


Figure 4-37. Read/Write Control Timing

NRZ to MFM Encoder/Write Compensation

The following functional description is written with reference to Block Diagram Figure 4-38, Timing Diagram of Figure 4-39 and the logic schematic of the PWA (Figure 5-8, Sheet 5).

Figure 4-38 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 4-38). 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 labled "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:

Increasing Frequency

0 0 1 1 0 1 1 0

Decreasing Frequency

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

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

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

An address Mark enable command interrupts the flow of data and produces approximately 3 bytes of erased mark on the disk producing a unique mark which is detected during read of a "soft sector" format (refer to interface format).

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 4-40 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.

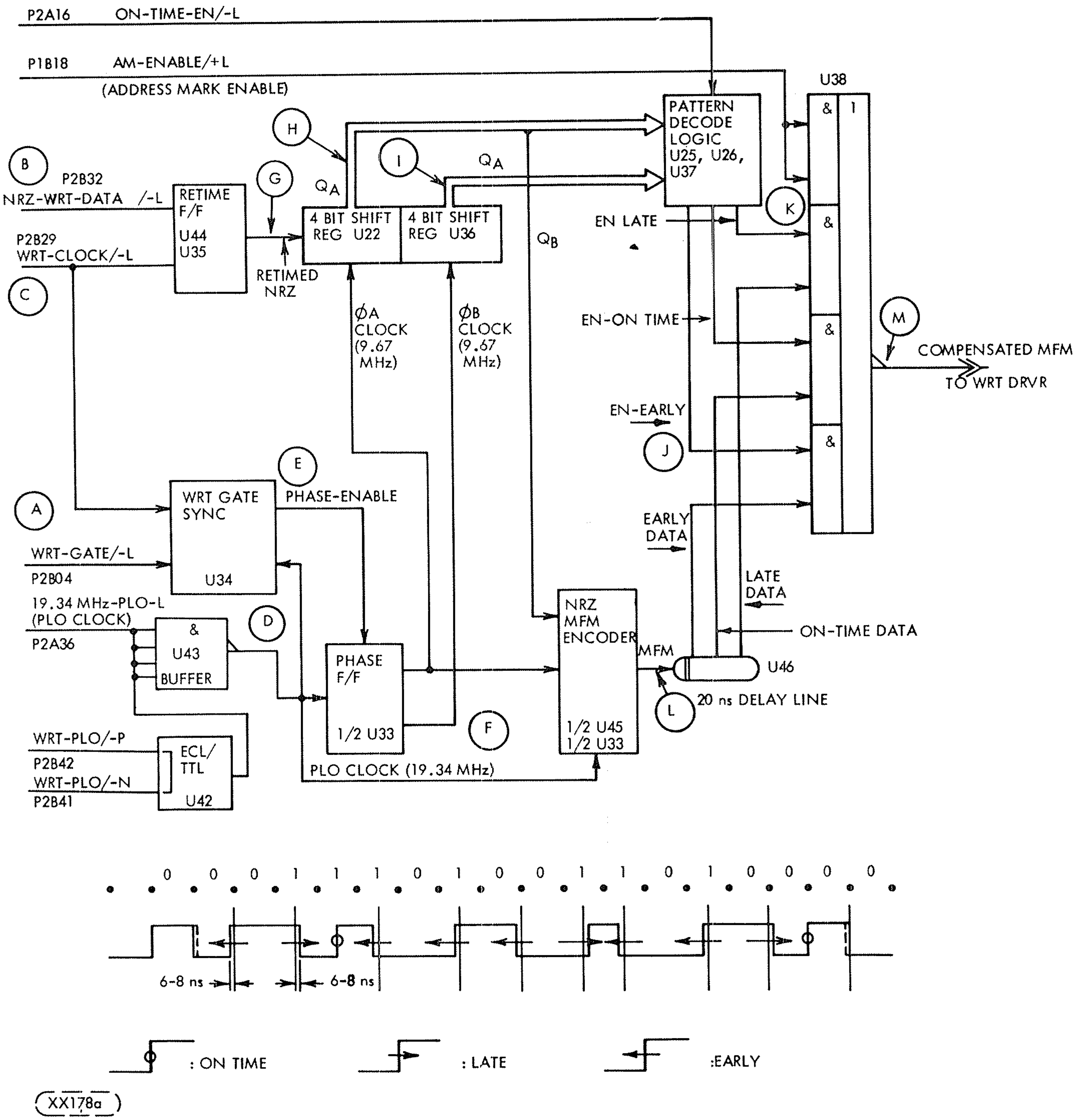


Figure 4-38. MFM Encoder/Write Compensator

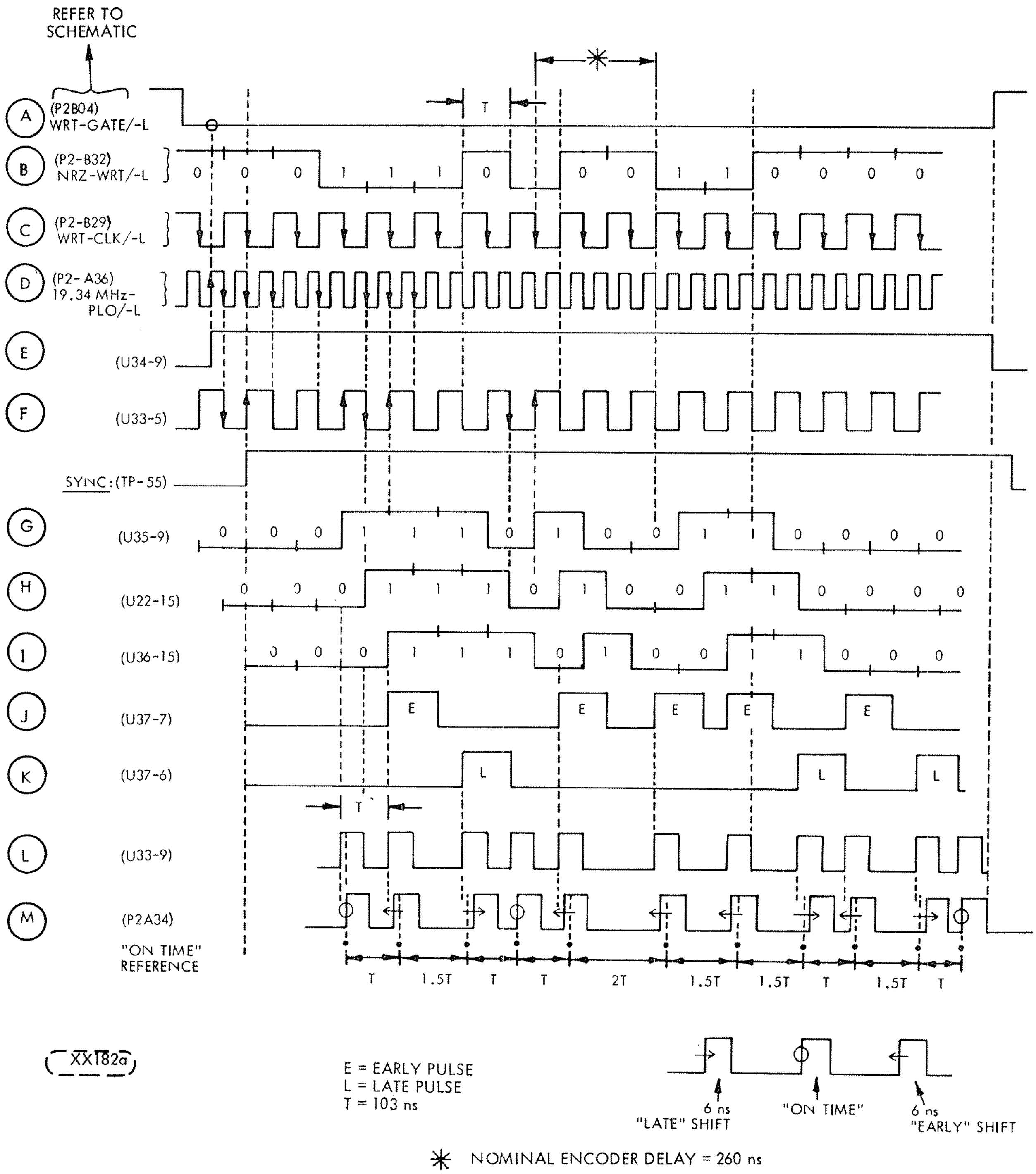


Figure 4-39. NRZ to MFM Encoder Timing Diagram

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 boundary 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.

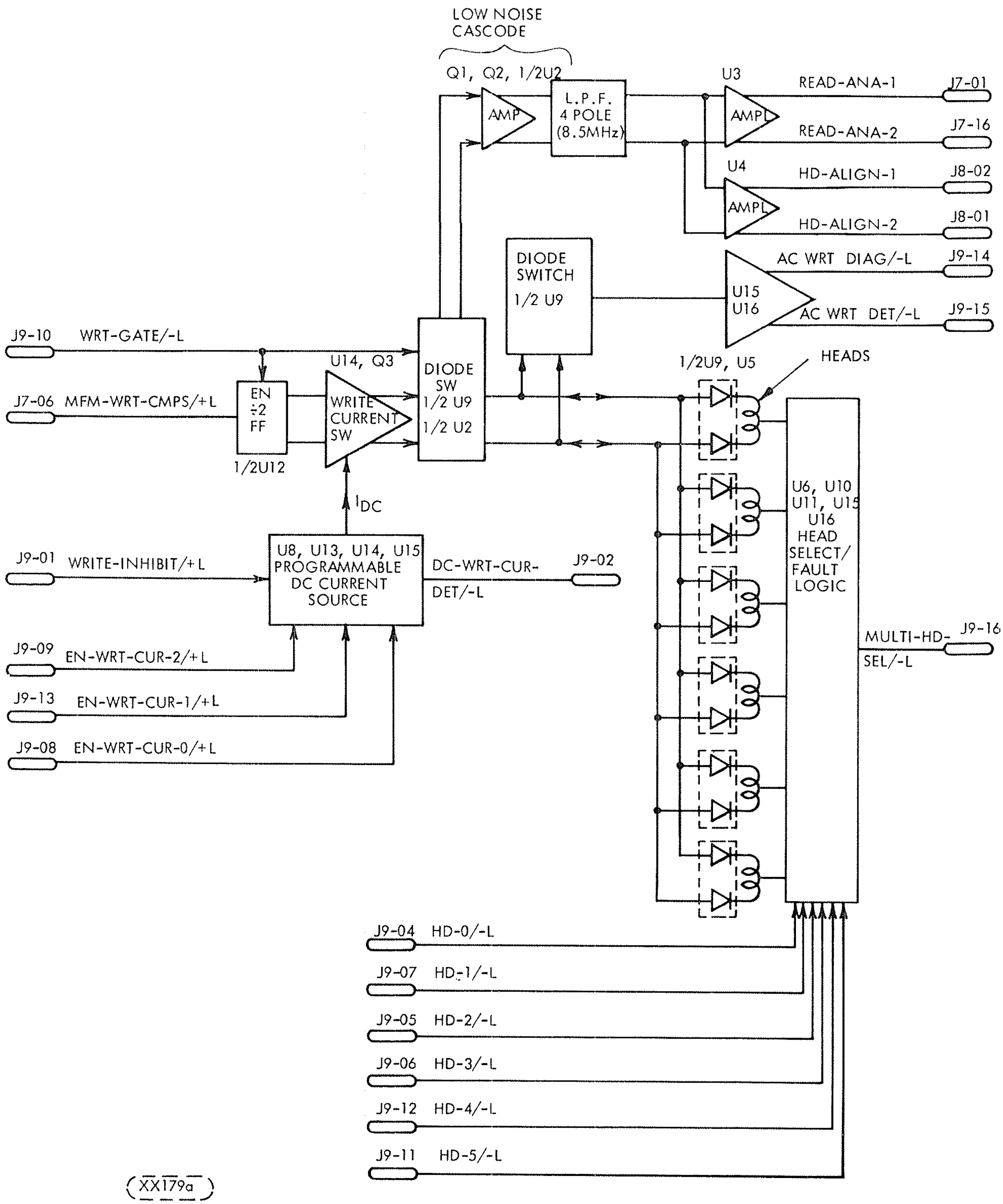


Figure 4-40. Read/Write Preamp - Block Diagram

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 4-40 and 4-41, timing Diagram of Figure 4-42, and Circuit Schematics of Read/Write Preamp Figure 5-9 and Read/Write Figure 5-8.

The read preamp circuit of Figure 4-40 is enabled as soon as the Write enable is turned off, providing the small differential 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 frequencynoise 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 frequency 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 4-42 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.

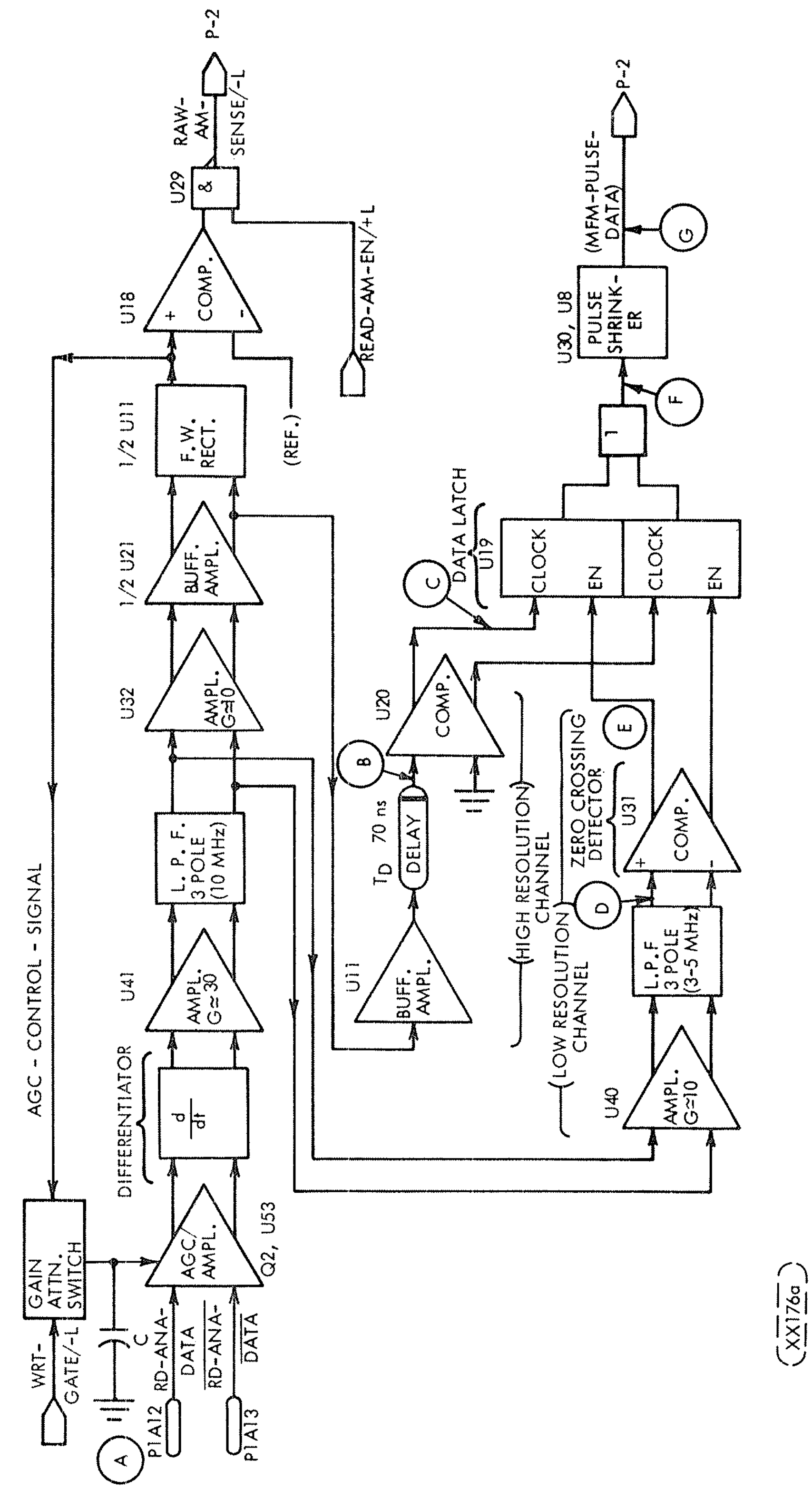


Figure 4-41. Read/Write - Block Diagram - P. 1/2 (Analog)

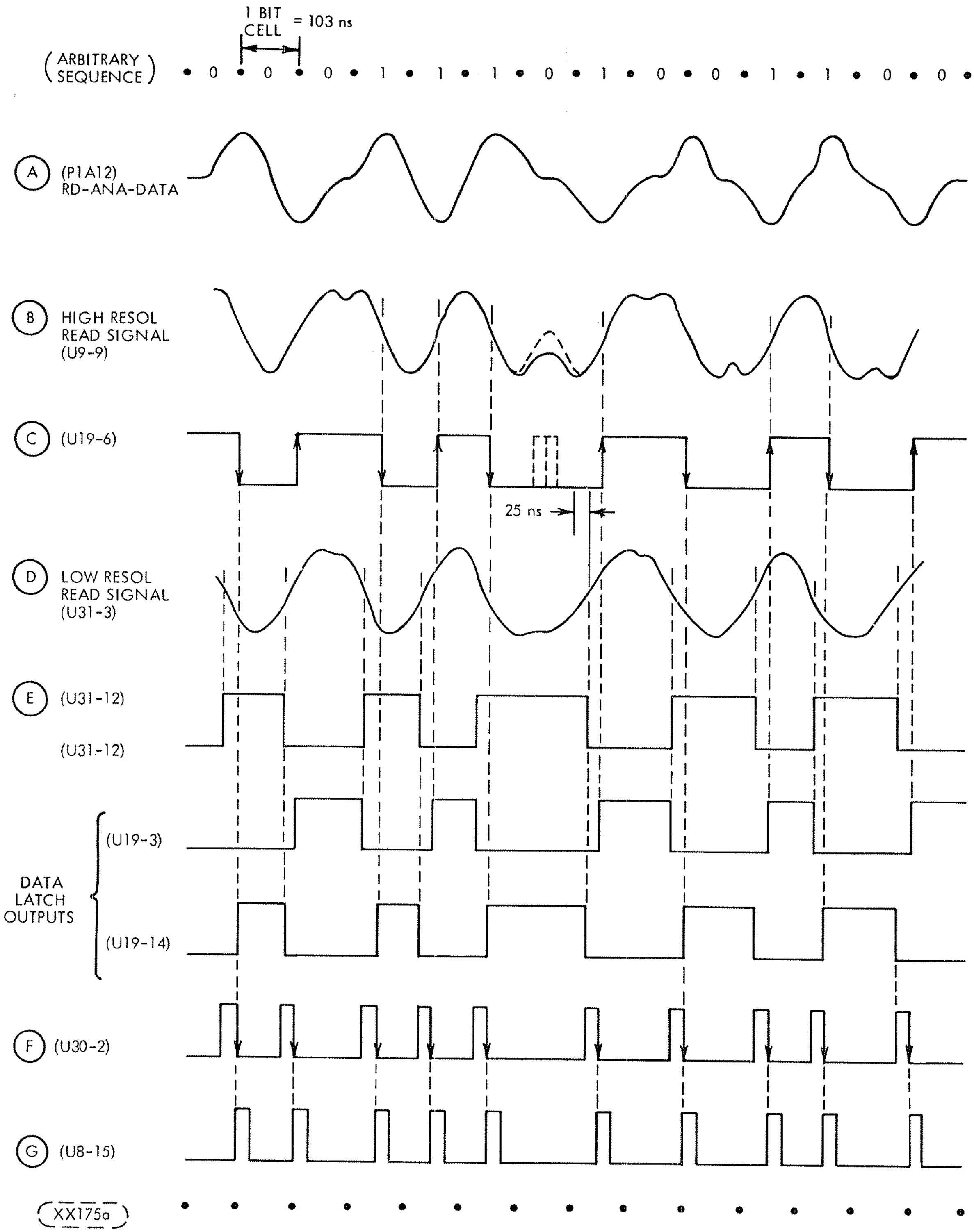


FIGURE 4-42. READ ANALOG/DATA LATCH TIMING DIAGRAM

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 4-43, Timing Diagram Figures 4-44 and 4-45 and Sector Format diagrams in Figures 4-46 and 4-47.

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 4-43. 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 frequency and phase. The VCO nominal frequency of 38.7 MHz is divided by 4 (1/2 U14, 1/2 U16) and fed back 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 4-44 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 4-45 depicts two conditions leading to the start of PLL lock up time of 9 µs 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 immediately 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 4-45.

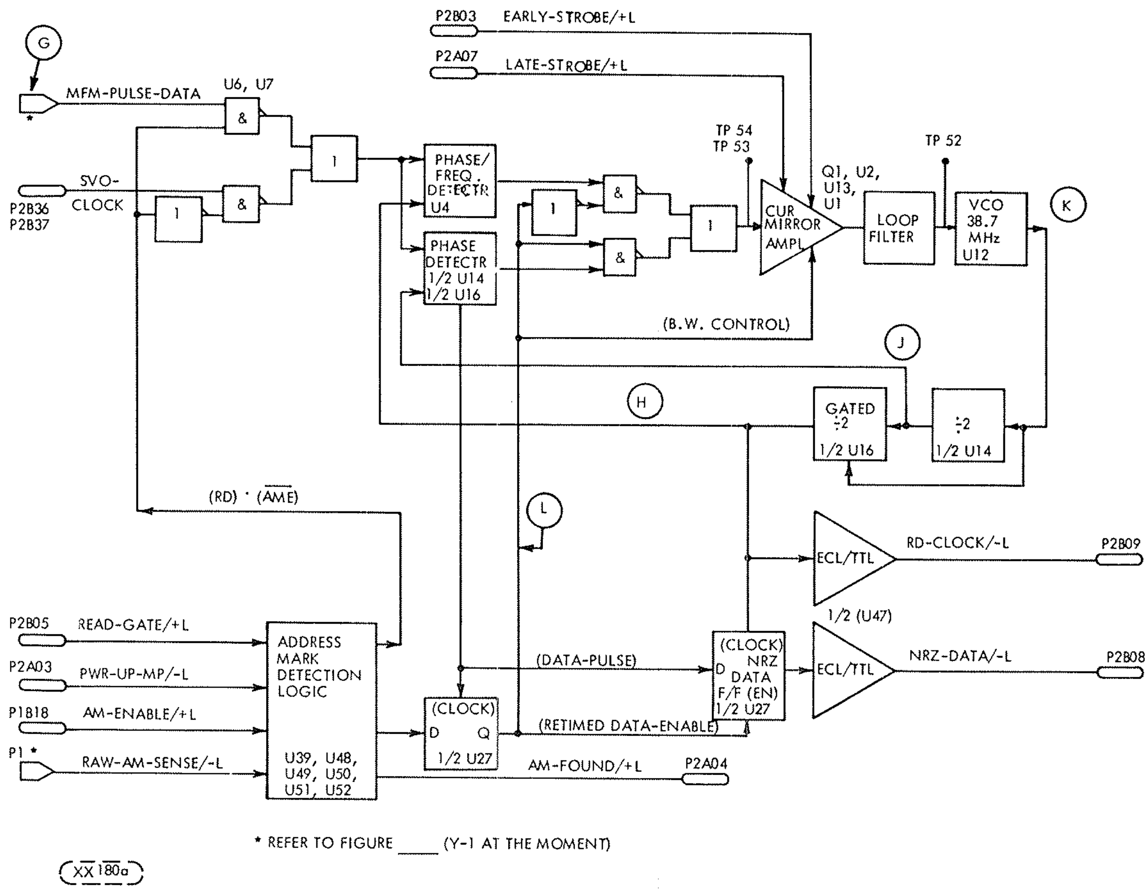


FIGURE 4-43. READ/WRITE - BLOCK DIAGRAM - P.2/2 (DIGITAL)

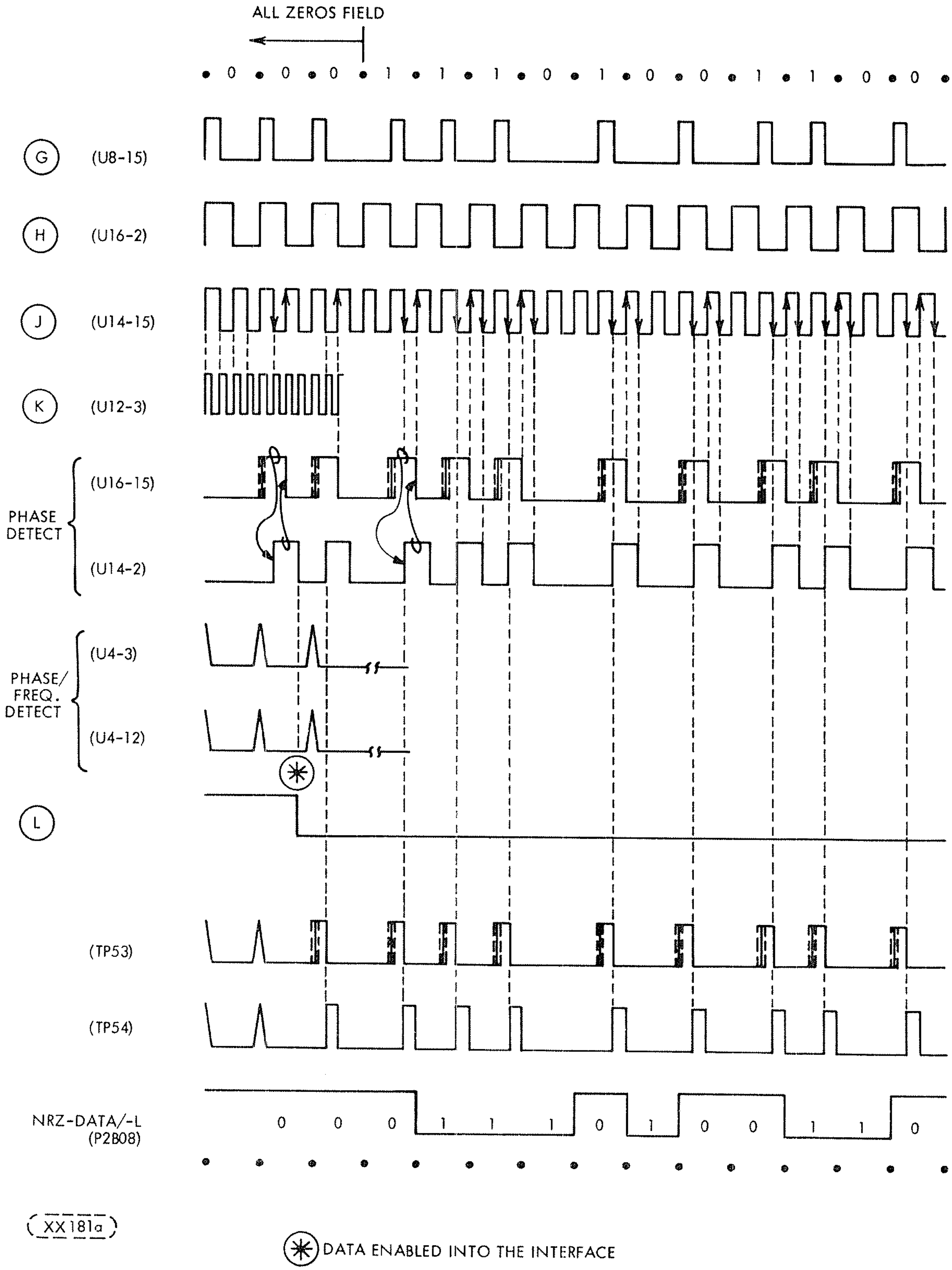


Figure 4-44. Read Digital Timing - PLL Locked

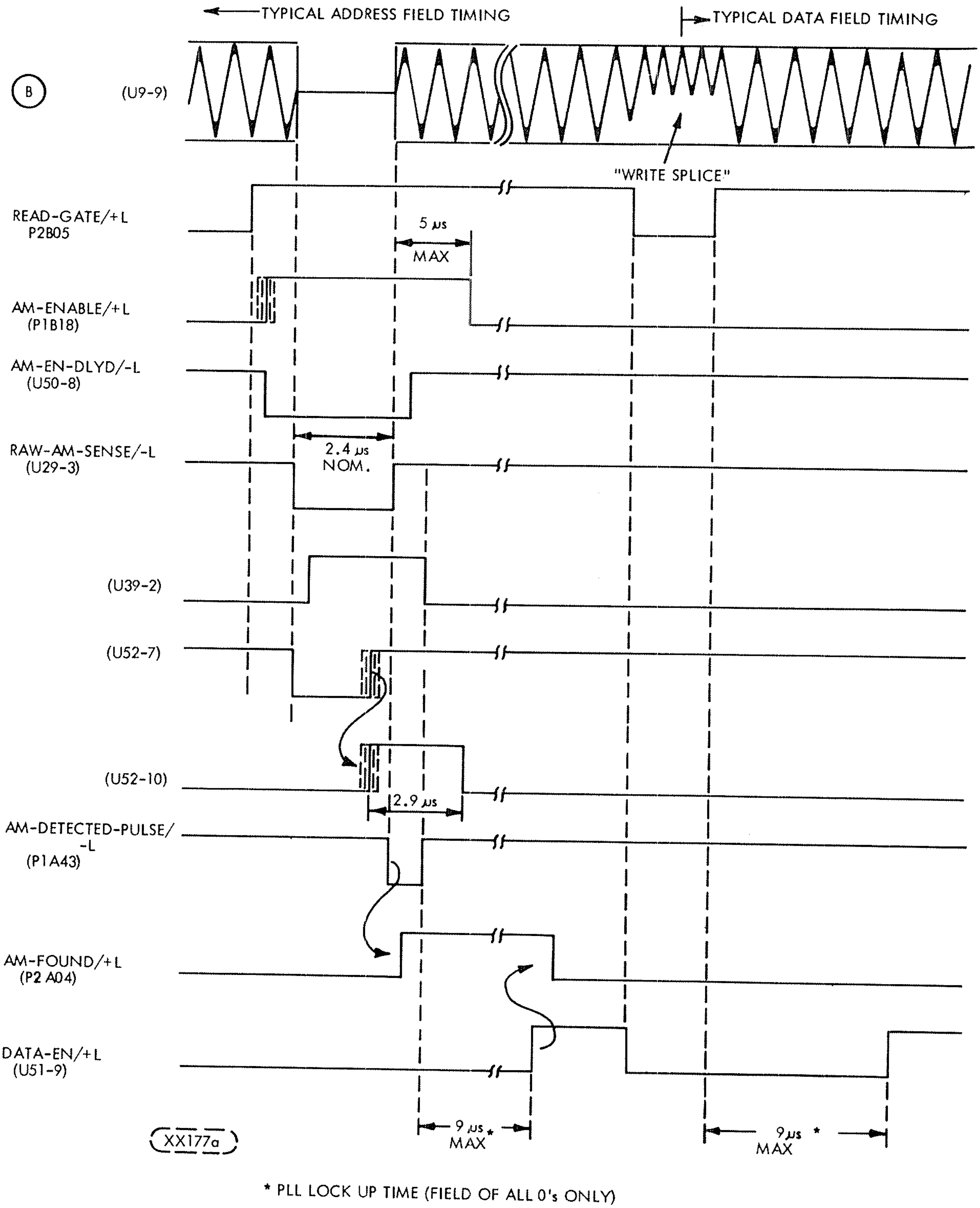
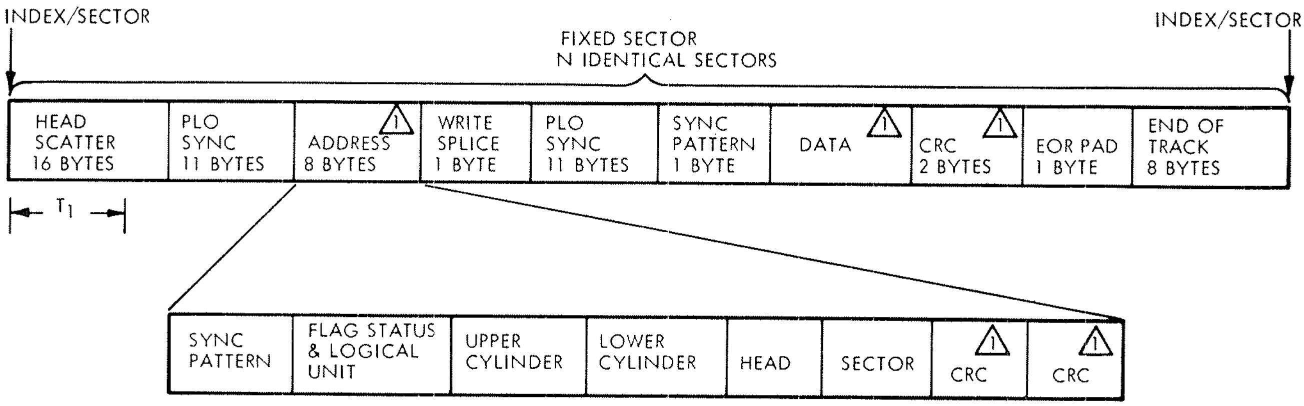


Figure 4-45. Address Detection and Data Enable Timing Diagram



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

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

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

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

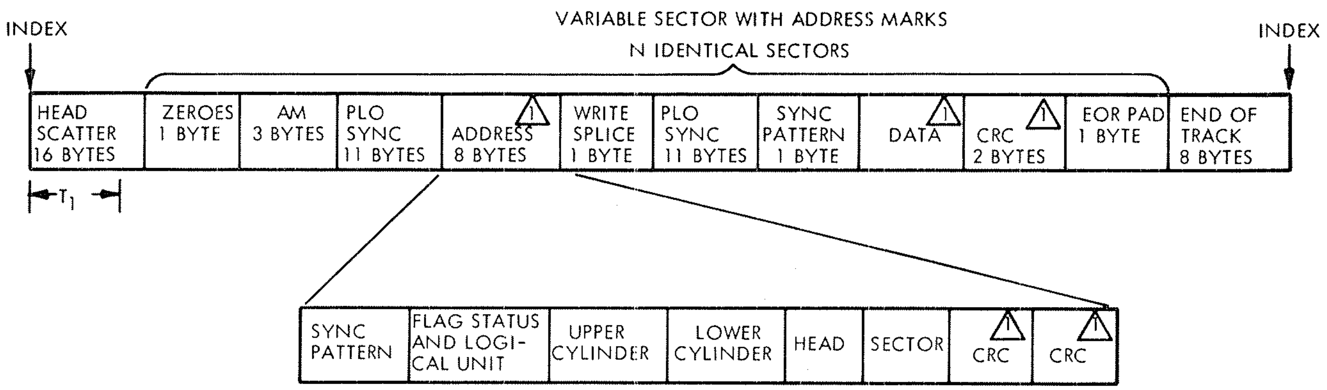
DATA = 256 BYTES/SECTOR

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

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

X388b

Figure 4-46. 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?

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

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

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

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

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

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

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

X393a

*For additional timing constraints see Figure 4-35.

Figure 4-47. 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 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 front of this Section.

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 the Servo Coarse circuit board. 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. The power supply printed circuit boards are listed in Section 5.4.

TABLE 5.3-1. CMD CIRCUIT BOARDS

CKT BD IDENT	SLOT LOC	FIGURE	CROSS REF. NO.	TITLE
77665650	EM1	5-4	01XX	I/O CKT BD, OEM
77522501	EM1	5-4	01XX	I/O CKT BD, OEM
77666950	EM2	5-5	02XX	CNTL/MUX CKT BD
77622402	EM3	5-6	03XX	SERVO COARSE CKT BD
77666800	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
75885950		5-11	10XX	POWER AMPLIFIER CKT BD
77624900		5-12	11XX	OPERATOR CONTROL CKT BD
77680700		5-12	11XX	OPERATOR CONTROL CKT BD
77680740		5-12	11XX	OPERATOR CONTROL CKT BD
77634490		5-13	12XX	RELAY CONTROL CKT BD (50/60 Hz) LO-V
77634450		5-13	12XX	RELAY CONTROL CKT BD (50 Hz) HI-V
77633300		5-13	12XX	RELAY CONTROL CKT BD (60 Hz) LO-V
75886100		5-14	13XX	TERMINATOR CKT BD
75895250		5-15	14XX	COMPONENT BD (32 V FILTER) CKT BD
75886001	EM4	5-16	15XX	HEAD ALIGNMENT EXTENDER CKT BD
75898343*		5-17	16XX	AC AND DC POWER 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
77647920	OR	5-1		ELECTRONICS MODULE - PWA (REF ONLY)
77647925	OR	5-1		ELECTRONICS MODULE - PWA (REF ONLY)
77648080		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.

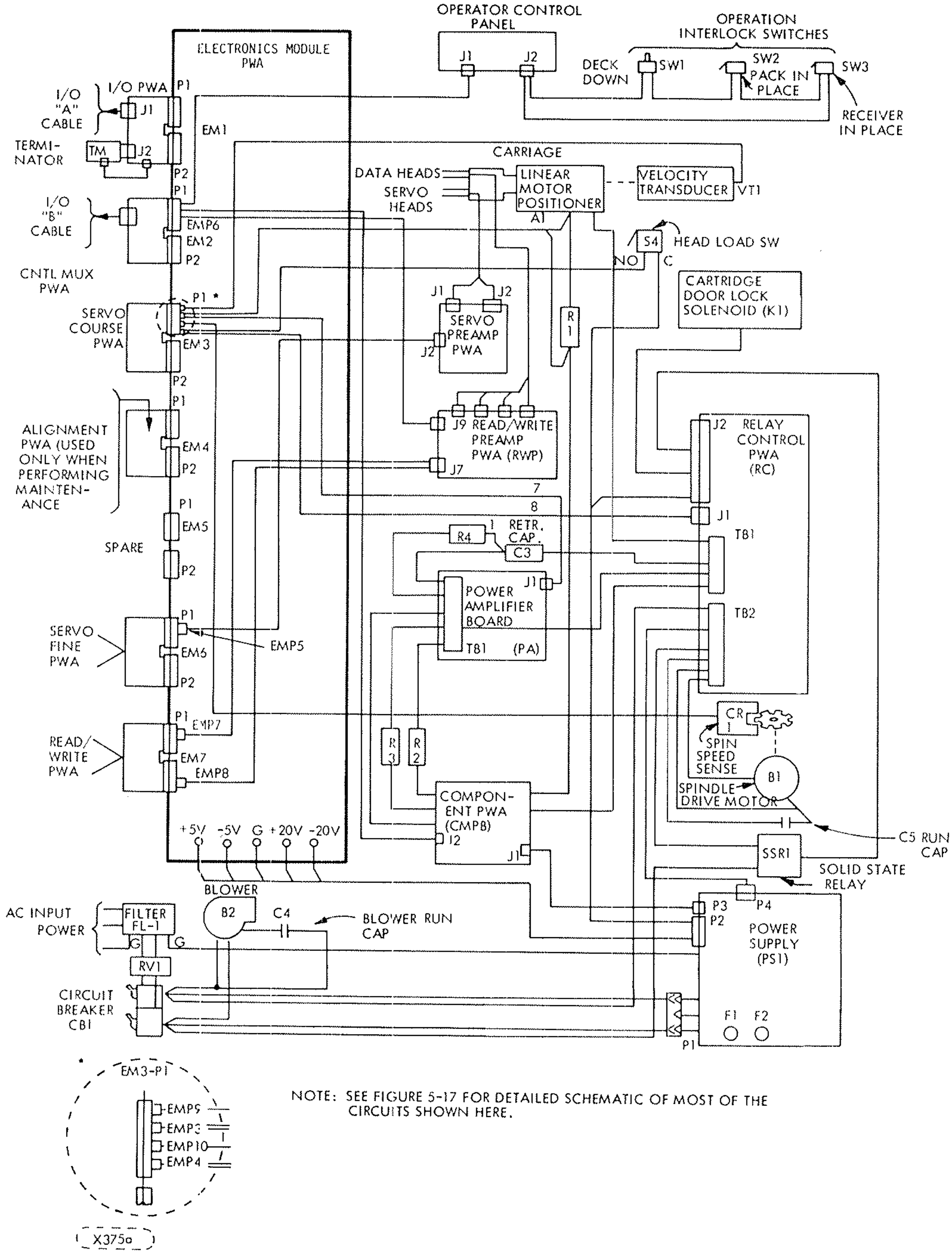
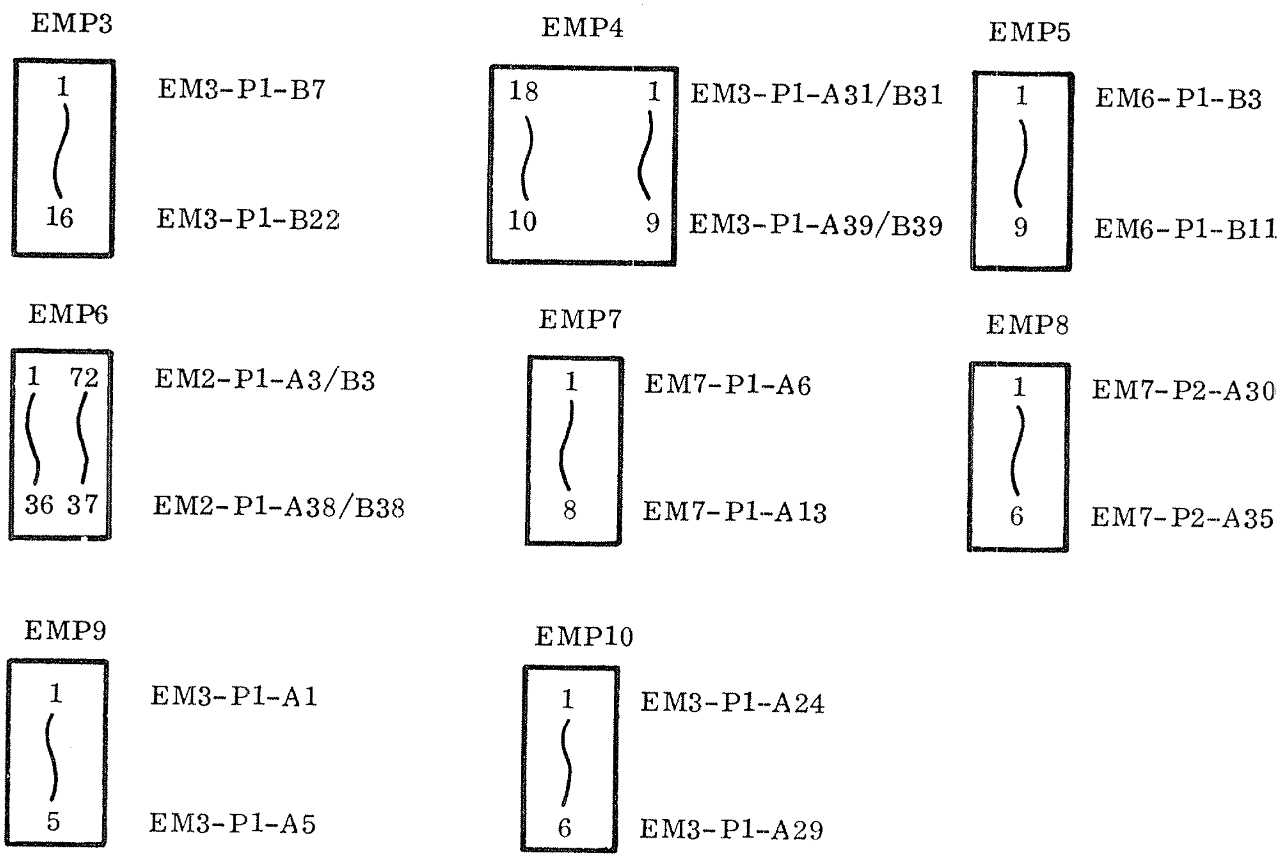


FIGURE 5-1. INTRACABLING DIAGRAM (SHEET 1 OF 2)

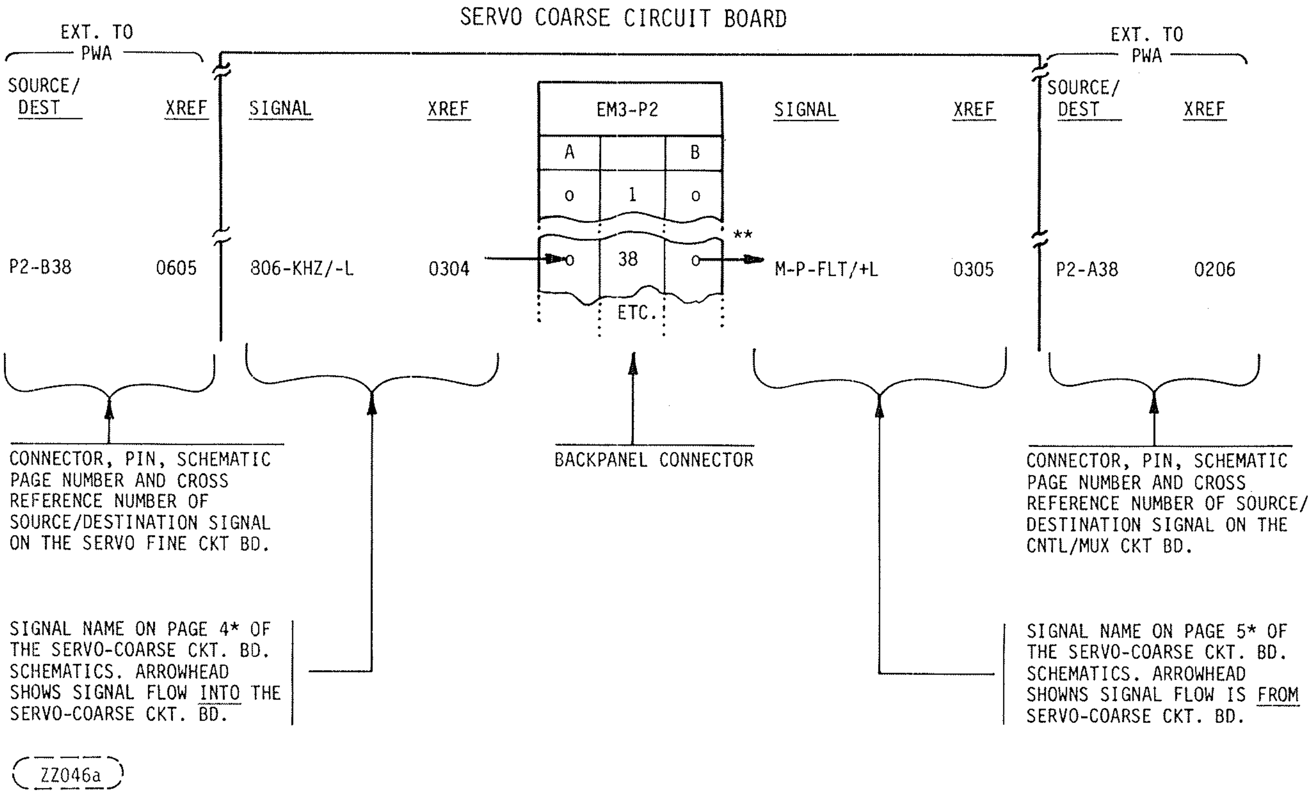


NOTE: Sleeving is used on back panel pins adjacent to connectors as a guide for locating correct pins if connectors are removed.

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.

Figure 5-2a. Typical Interconnection Sheet Entry

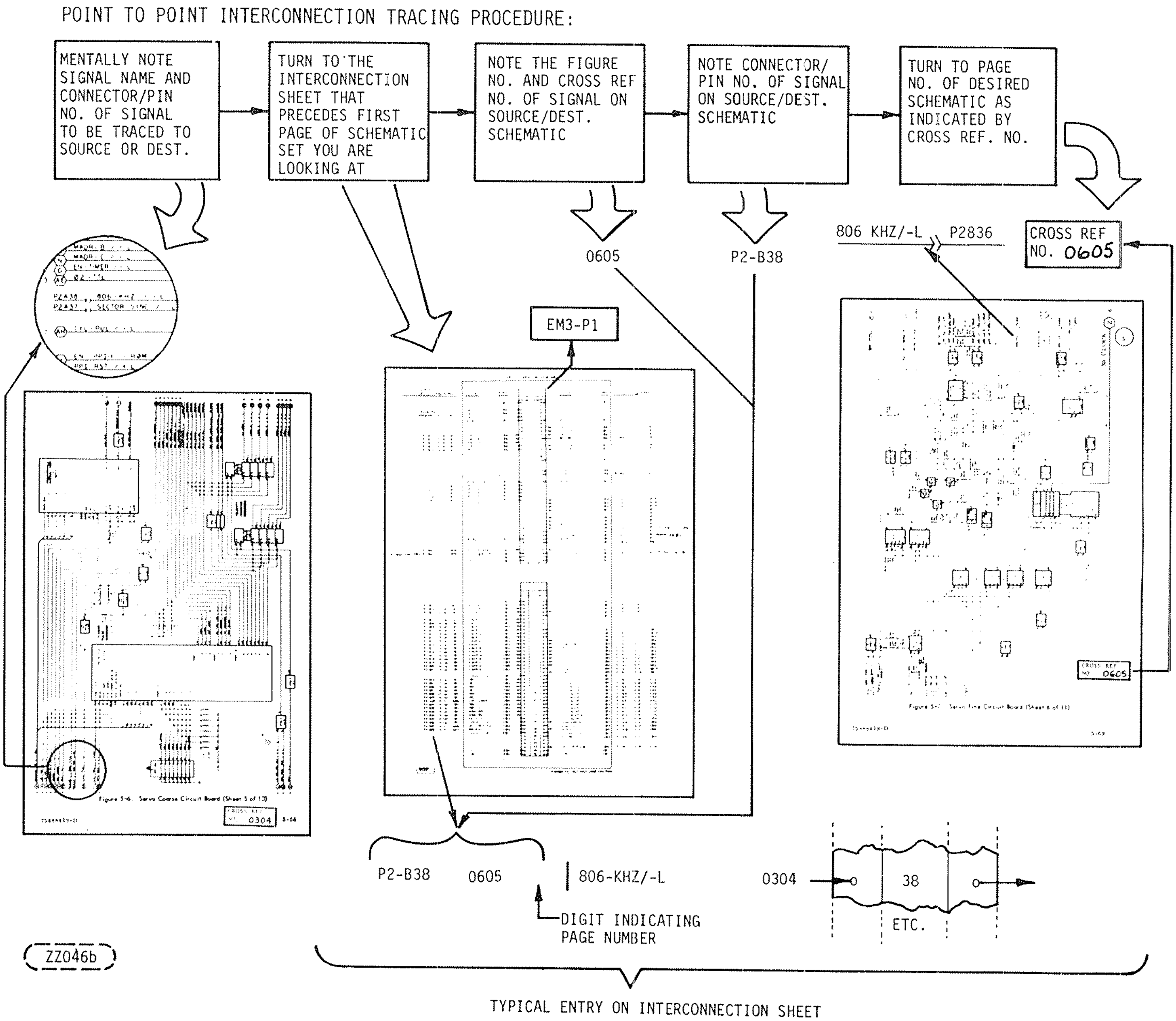
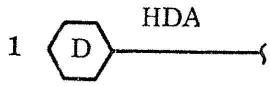


Figure 5-2B. Illustration of Point to Point Interconnection Tracing Procedure

5.3.2 SCHEMATIC DIAGRAM INTERCONNECTION SYMBOLOGY

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

- Sheet to Sheet ON PAGE example:

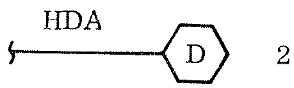


1 = Signal "from" sheet 1 of SET

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

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

- Sheet to Sheet OFF PAGE example:

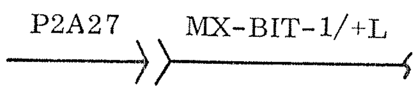


2 = Signal "to" sheet 2 of SET

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

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

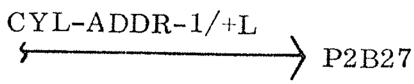
- Board to Board ON PAGE example:



A27 = Pin Location of Board connector (Ref Figure 5-2a)

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

- Board to Board OFF PAGE example:



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

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

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

5.4 MAJOR ELECTRICAL DIAGRAMS

5.5 POWER SUPPLY DIAGRAMS

5.6 LOGIC DIAGRAM SYMBOLOGY

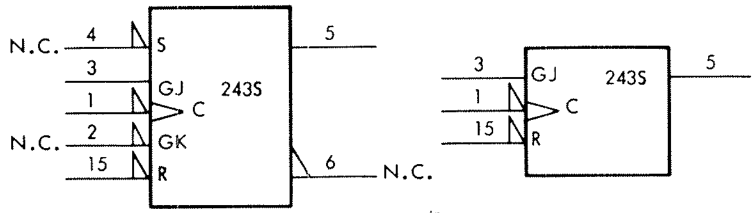
5.6.1 GENERAL INFORMATION

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 (G1, 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 output 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")

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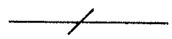
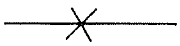
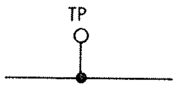
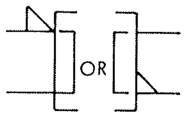
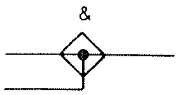
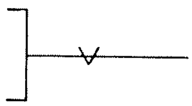
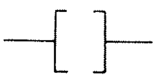
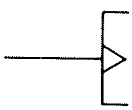
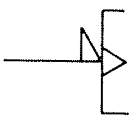
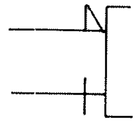
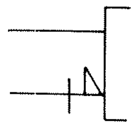
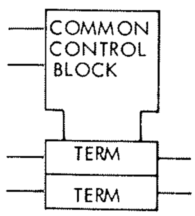
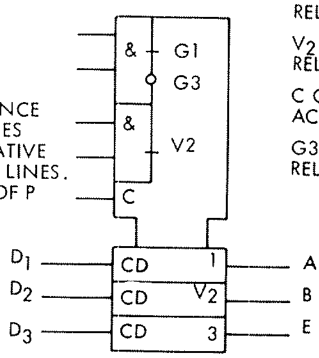
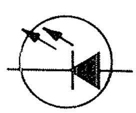
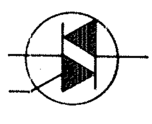
Figure 5-2c. Functionally Equivalent Symbols

5.6.3 SYMBOLOGY

Logic Symbols are as described in Table 5-1.

Table 5-1. Logic Symbology

	INDICATES NON-STANDARD LOGIC LEVELS
	INDICATES NON-LOGIC (ANALOG) SIGNALS
	TEST POINT
	INDICATES TWO OR MORE LINES WHICH CARRY THE SAME INFORMATION (USUALLY DIFFERENTIALLY)
	WIRED "AND" CIRCUIT
	INDICATES NON-SIGNAL CARRYING VOLTAGE REFERENCE OR POWER SUPPLY LINE
	IMPLIED SIGN INDICATOR - ABSENCE OF AN N SIGN INDICATOR IMPLIES A NON-INVERTING SIGNAL RELATIVE TO OTHER IMPLIED SIGN SIGNAL LINES. EFFECT IS THE SAME AS THE USE OF P SIGN INDICATOR INTERNALLY.
	SIGN INDICATOR - USED TO INDICATE INVERSION RELATIVE TO IMPLIED SIGN SIGNAL LINES.
	DYNAMIC INPUT ACTIVE DURING THE TRANSITION FROM LOW TO HIGH STATE
	DYNAMIC INPUT ACTIVE DURING THE TRANSITION FROM HIGH TO LOW STATE
	A HIGH LEVEL ON THE LOWER INPUT "INHIBITS" THE BLOCK OUTPUT FROM ASSUMING ITS ACTIVE STATE
	A LOW LEVEL ON THE LOWER INPUT "INHIBITS" THE BLOCK OUTPUT FROM ASSUMING ITS ACTIVE STATE
	INPUTS TO THE COMMON CONTROL BLOCK AFFECT EVERY TERM IN THE ARRAY. INPUTS TO EACH TERM AFFECT ONLY THAT TERM.
EXAMPLE: 	G1 AFFECTS OUTPUT A WITH AN "AND" RELATION TO THE ACTIVE STATE. V_2 AFFECTS OUTPUT B WITH AN "OR" RELATION TO THE ACTIVE STATE. C CLOCKS DATA INPUTS D1 and D2 DURING ACTIVE PERIOD OF C. G3 AFFECTS OUTPUT E WITH A NAND RELATION TO THE ACTIVE STATE.
	LIGHT EMITTING DIODE
	TRIAC

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5.6.4 FUNCTION SYMBOLOGY

Function symbols are as described in Table 5-2.

Table 5-2. Function Symbols

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

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

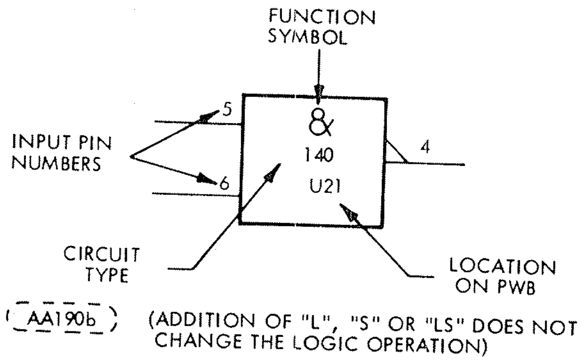

Figure 5-3a. Typical Integrated Circuit

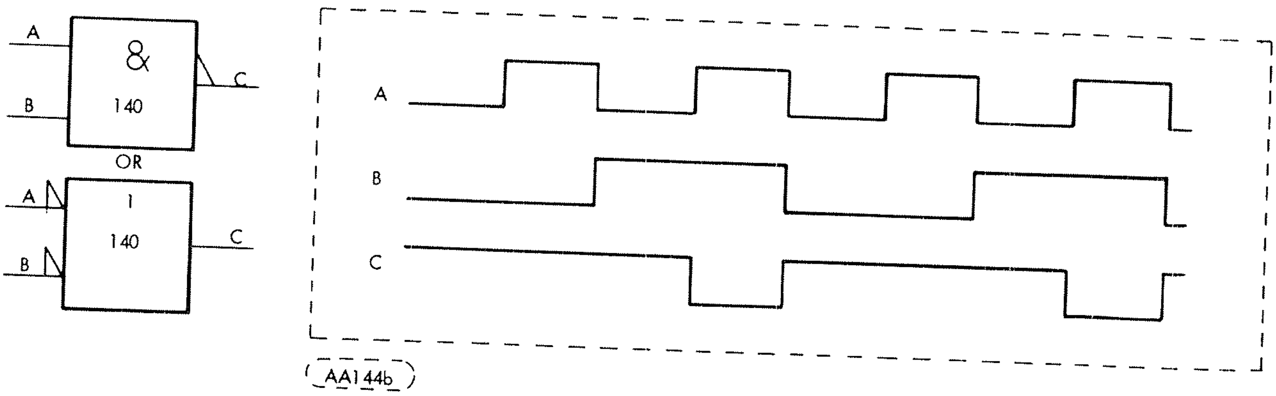

Figure 5-3b. Positive NAND Negative NOR

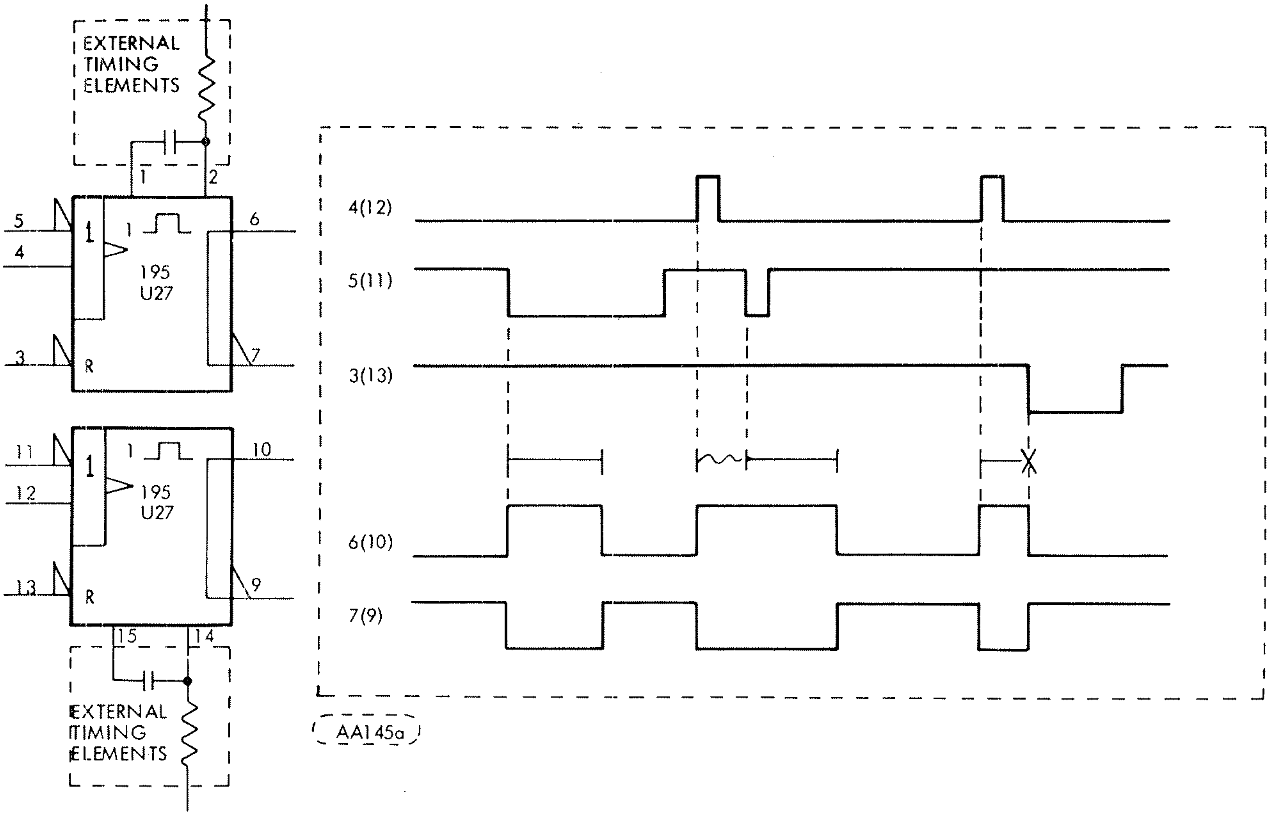

Figure 5-3c. Retriggerable, Resettable, Monostable Multivibrator (One Shot)

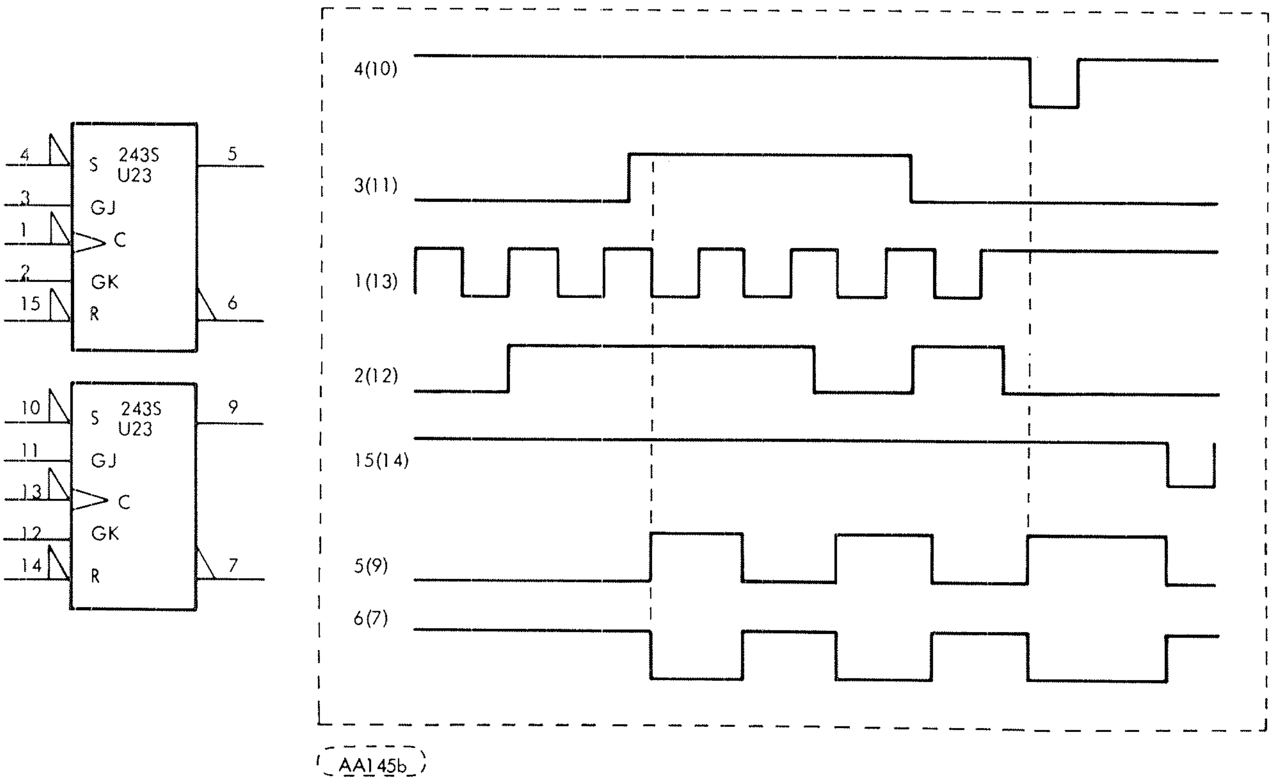

Figure 5-3d. "JK" Negative Edge Triggered Type F/F

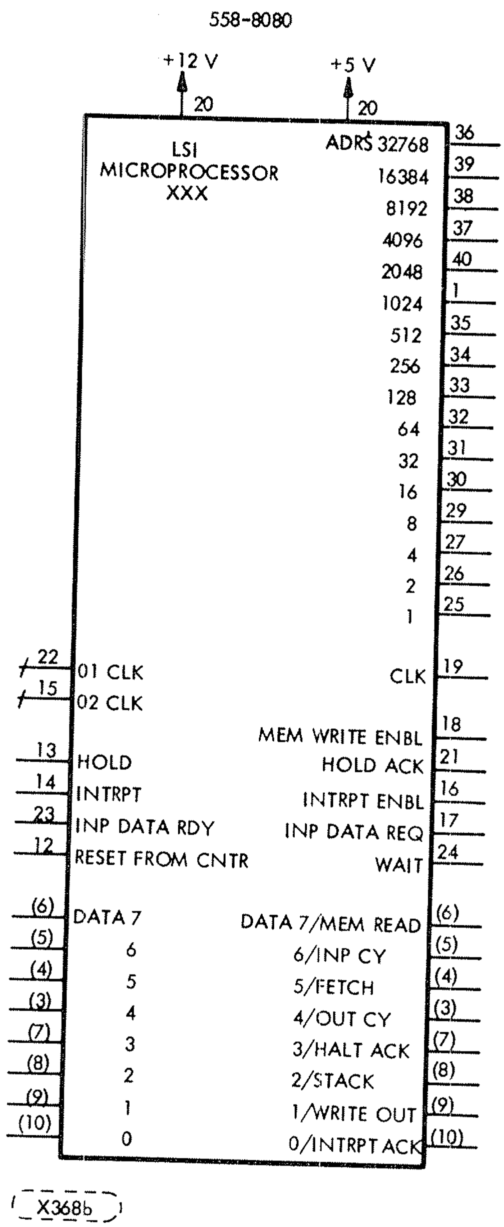

Figure 5-3e. 8080A Microprocessor (Sheet 1 of 2)

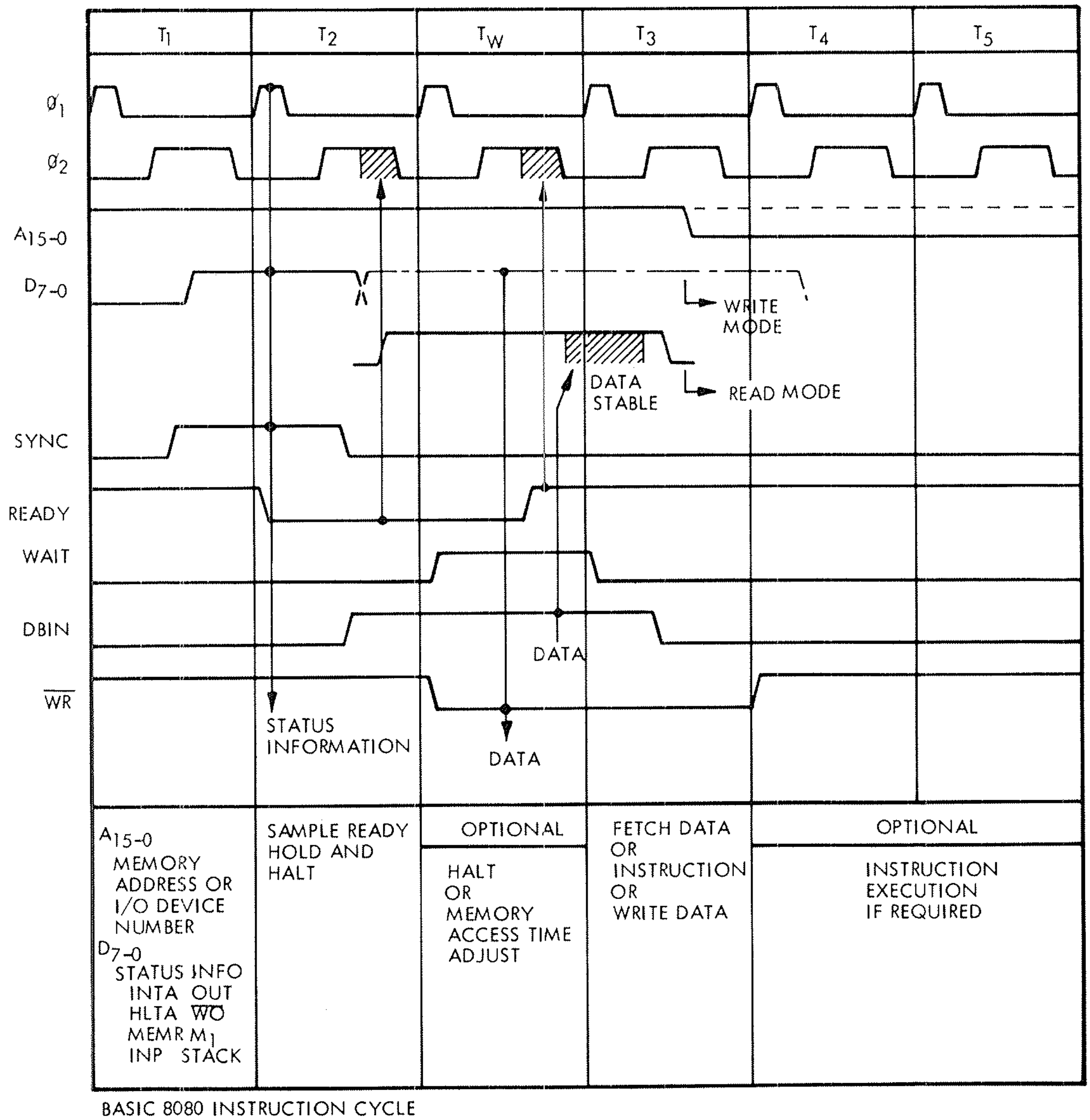

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Figure 5-3e. 8080A Microprocessor (Sheet 2 of 2)

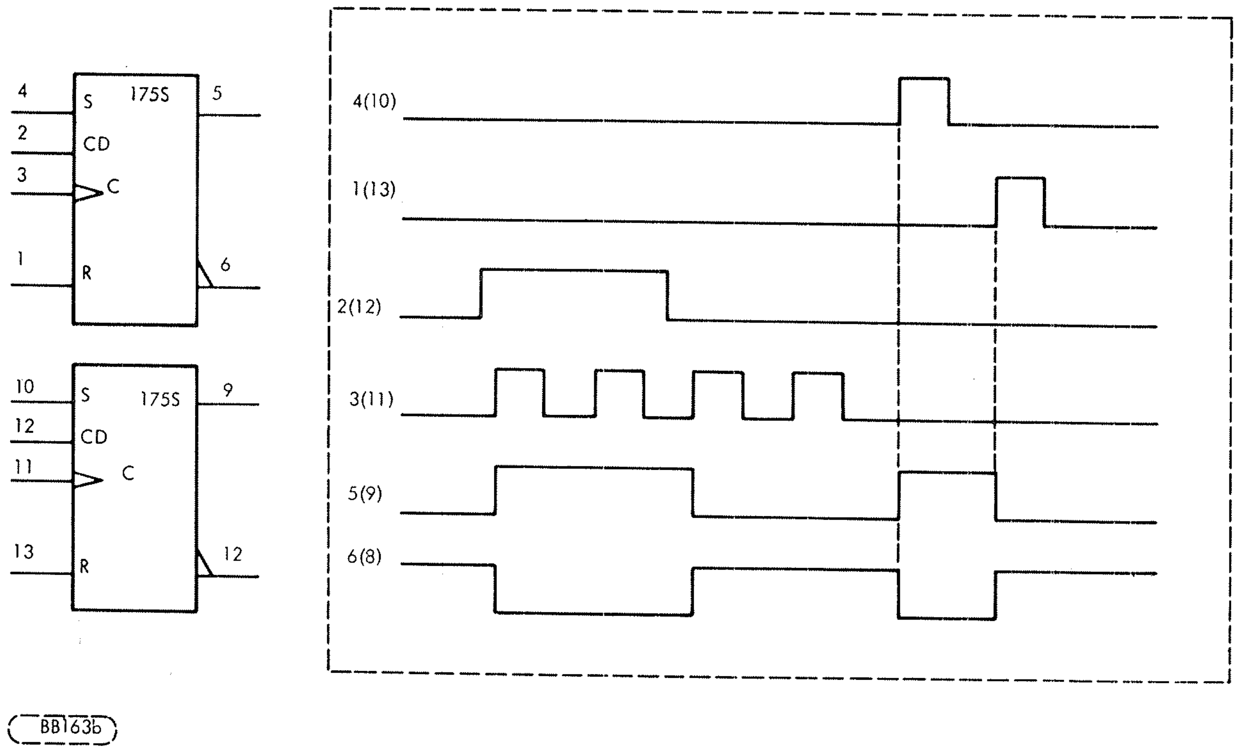


Figure 5-3f. "D" Type F/F

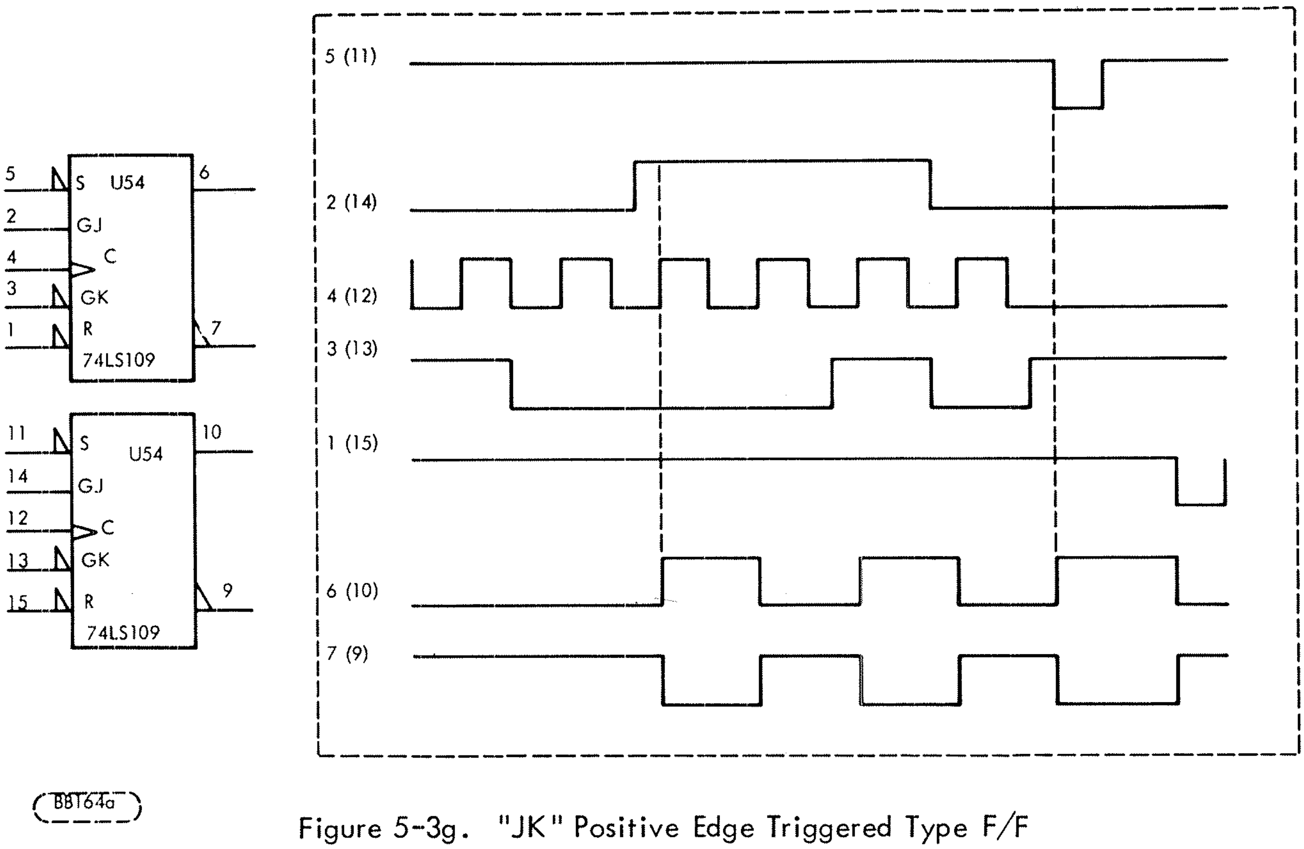


Figure 5-3g. "JK" Positive Edge Triggered Type F/F

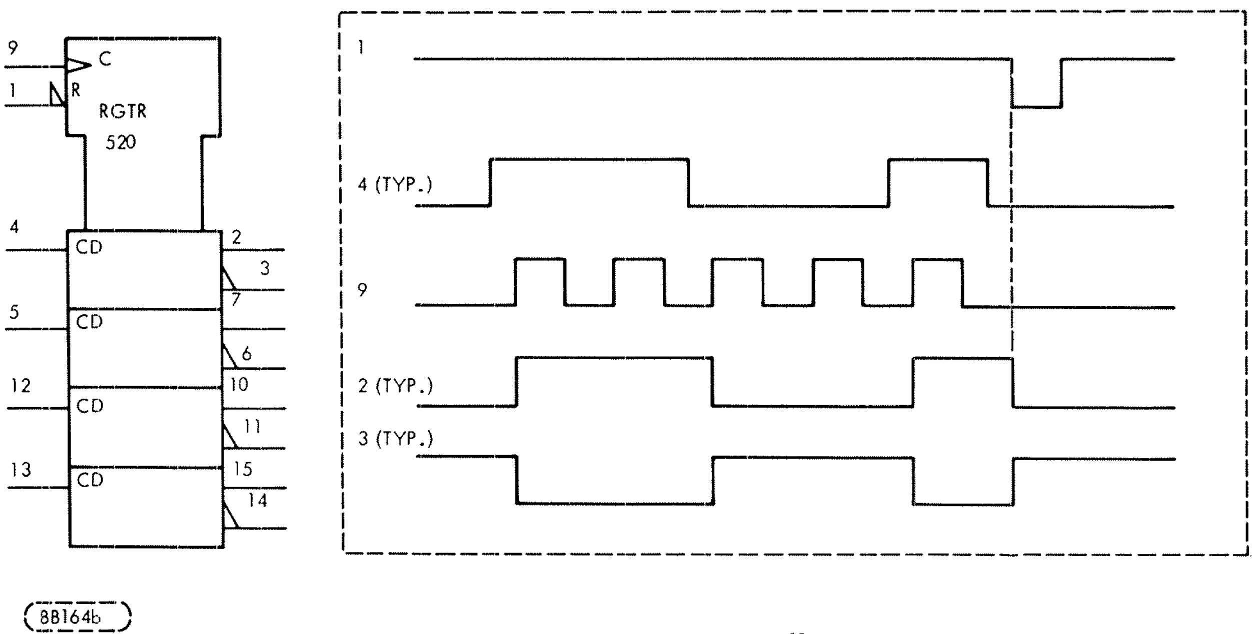
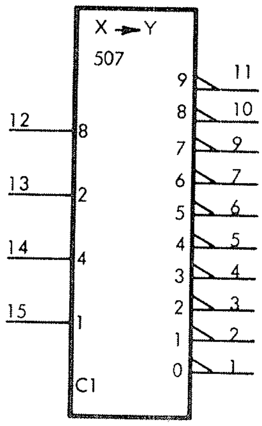


Figure 5-3h. QUAD TTL "D" Type F/F



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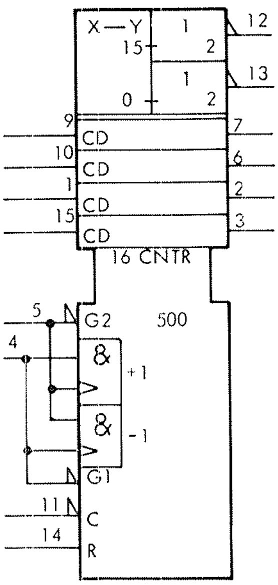
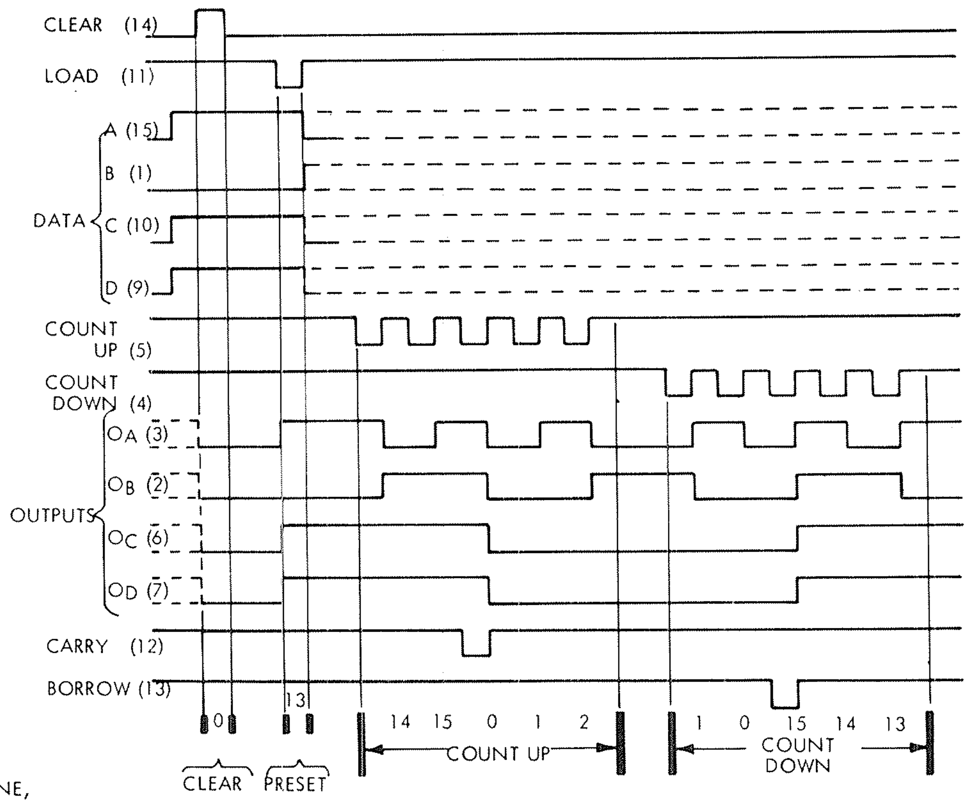
INPUTS 8	4	2	1	OUTPUT COUNT (ONE LOW AT A TIME) 9	8	7	6	5	4	3	2	1	0	
12	13	14	15	11	10	9	7	6	5	4	3	2	1	← PIN
L	L	L	L	H	H	H	H	H	H	H	H	H	L	
L	L	L	H	H	H	H	H	H	H	H	H	L	H	
L	L	H	L	H	H	H	H	H	H	H	L	H	H	
L	L	H	H	H	H	H	H	H	H	L	H	H	H	
L	H	L	L	H	H	H	H	H	L	H	H	H	H	
L	H	L	H	H	H	H	H	L	H	H	H	H	H	
L	H	H	L	H	H	H	L	H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

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

TYPICAL CLEAR, PRESET, COUNT, AND INHIBIT SEQUENCES

ILLUSTRATED BELOW IS THE FOLLOWING SEQUENCE:

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

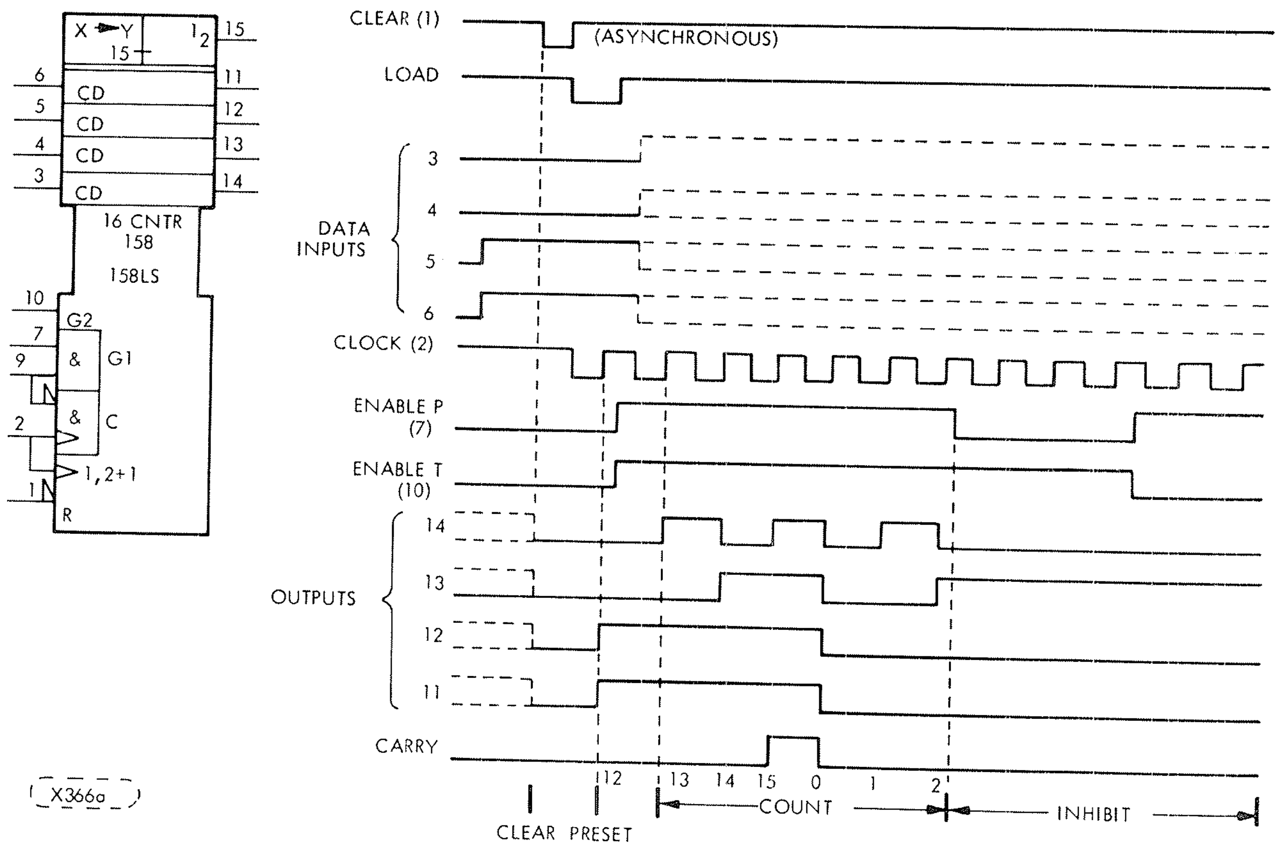


Figure 5-3k. 4-Bit Binary Counter

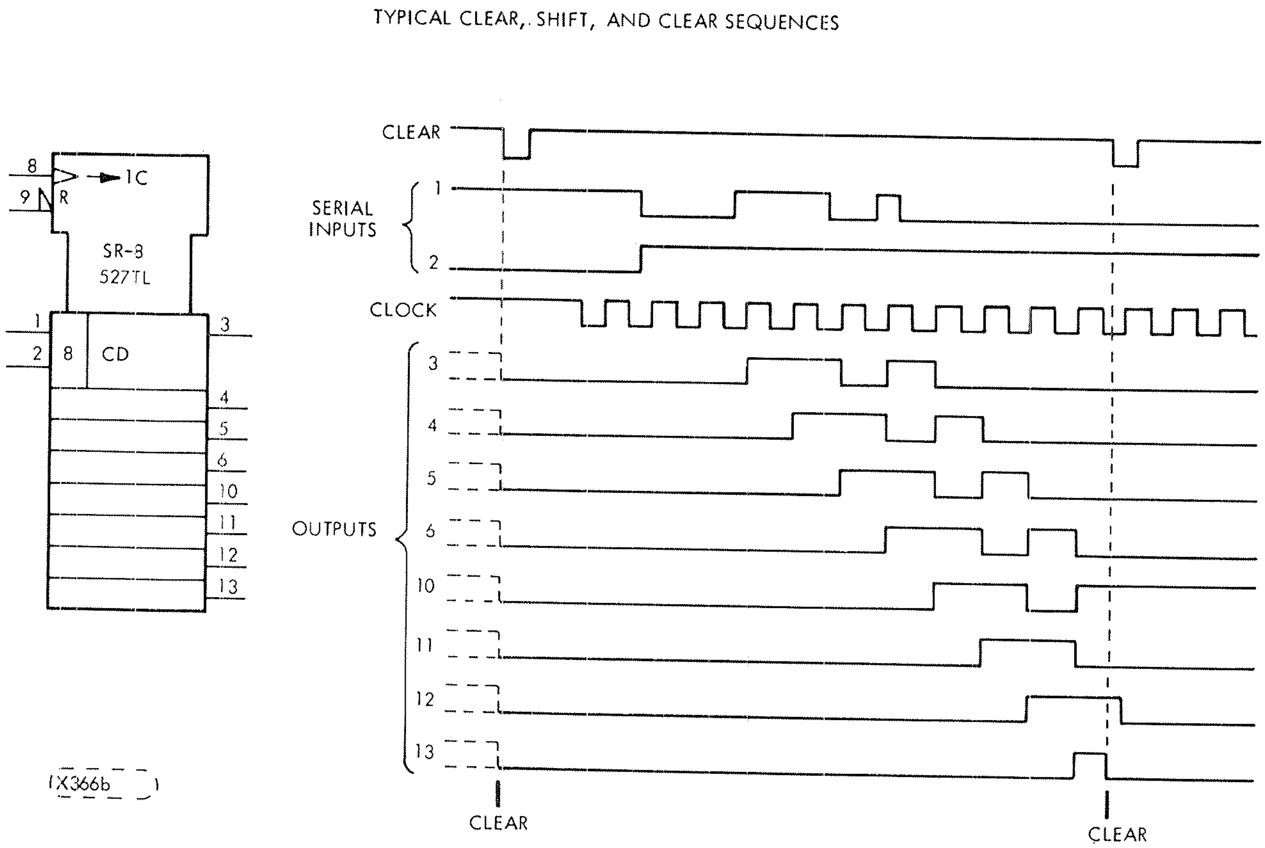


Figure 5-31. Serial In-Parallel Out 8-Bit Register

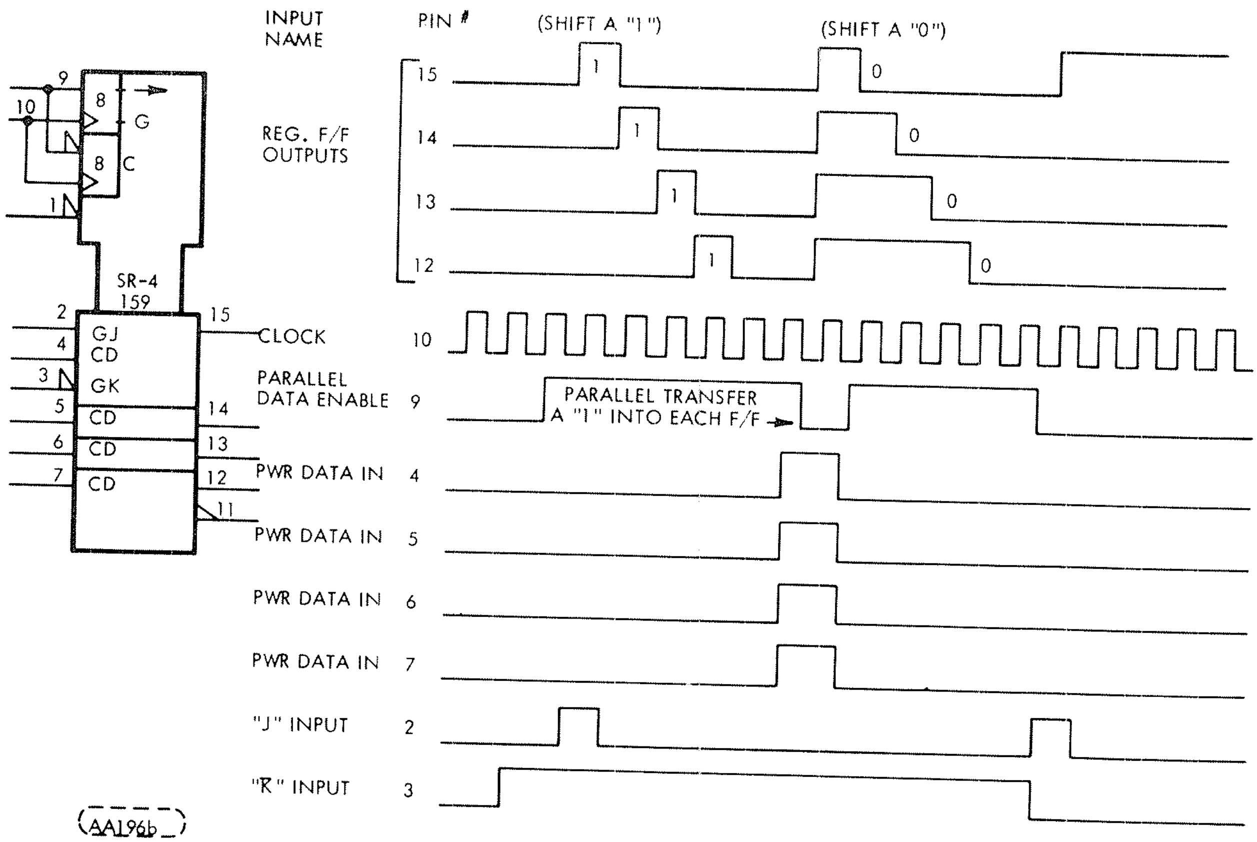
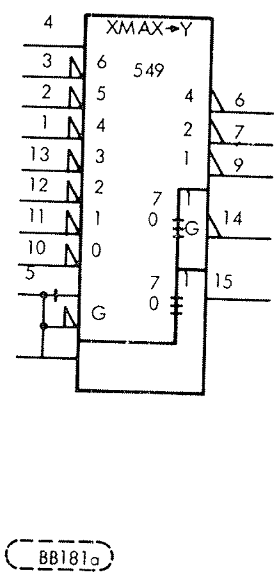


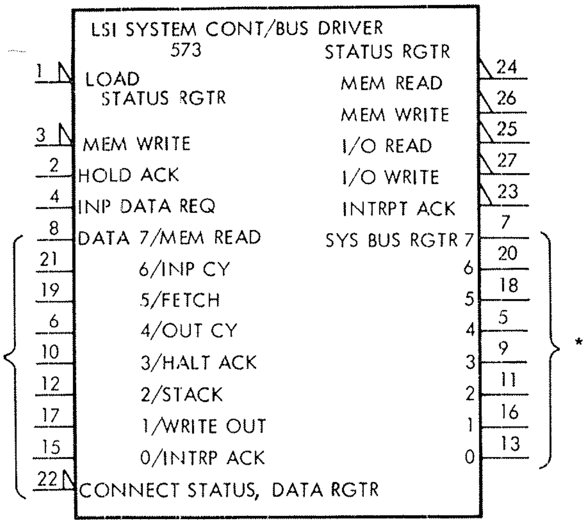
Figure 5-3m. Four FLIP-FLOP Shift Register



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

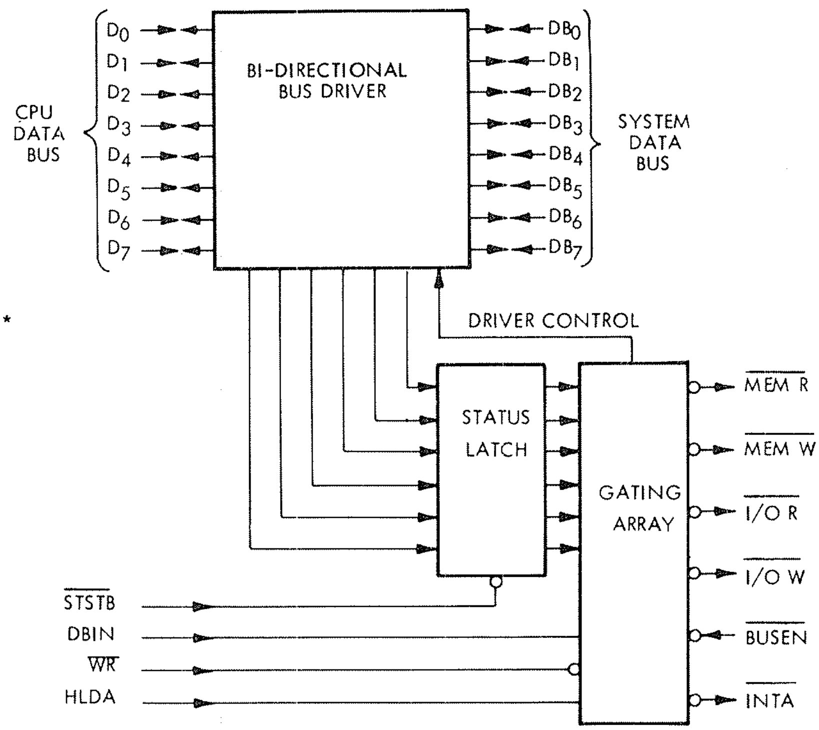
Figure 5-3n. 1 Out of 4 Decoder

Schematic Symbol:



* BI-DIRECTIONAL DATA LINES

8228 Block Diagram



Pin Names

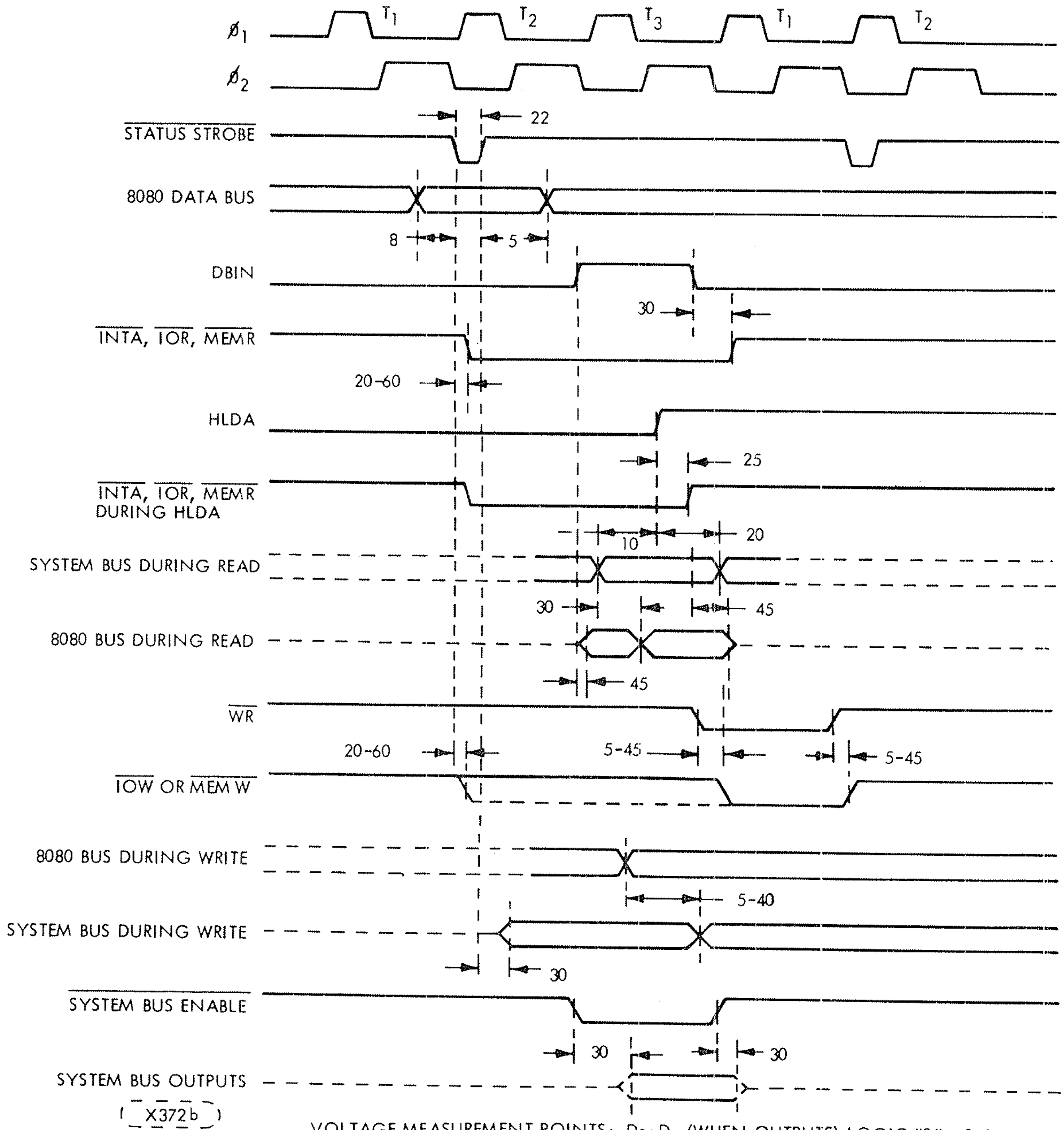
D7-D0	DATA BUS (8080 SIDE)
DB7-DB0	DATA BUS (SYSTEM SIDE)
$\overline{I/OR}$	I/O READ
$\overline{I/OW}$	I/O WRITE
$\overline{MEMR}$	MEMORY READ
$\overline{MEMW}$	MEMORY WRITE
DBIN	DBIN (FROM 8080)

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

X372a

Figure 5-3o. System Controller/ Bus Driver for Microprocessor System
(Sheet 1 of 2)

Typical Timing



VOLTAGE MEASUREMENT POINTS: D_0-D_7 (WHEN OUTPUTS) LOGIC "0" = 0.8 V, LOGIC "1" = 3.0 V.
ALL OTHER SIGNALS MEASURED AT 1.5 V.

Figure 5-3o. 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 signals ($\overline{\text{MEM R}}$, $\overline{\text{I/O R}}$ and $\overline{\text{INTA}}$) are derived from the logical combination of the appropriate Status bit (or bits) and the DBIN input from the 8080A CPU.

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

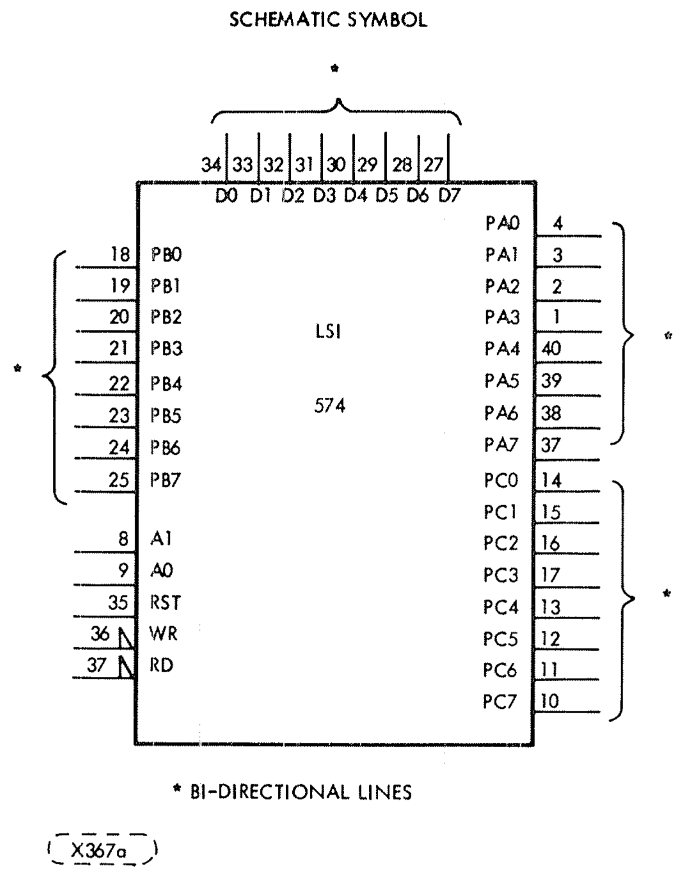
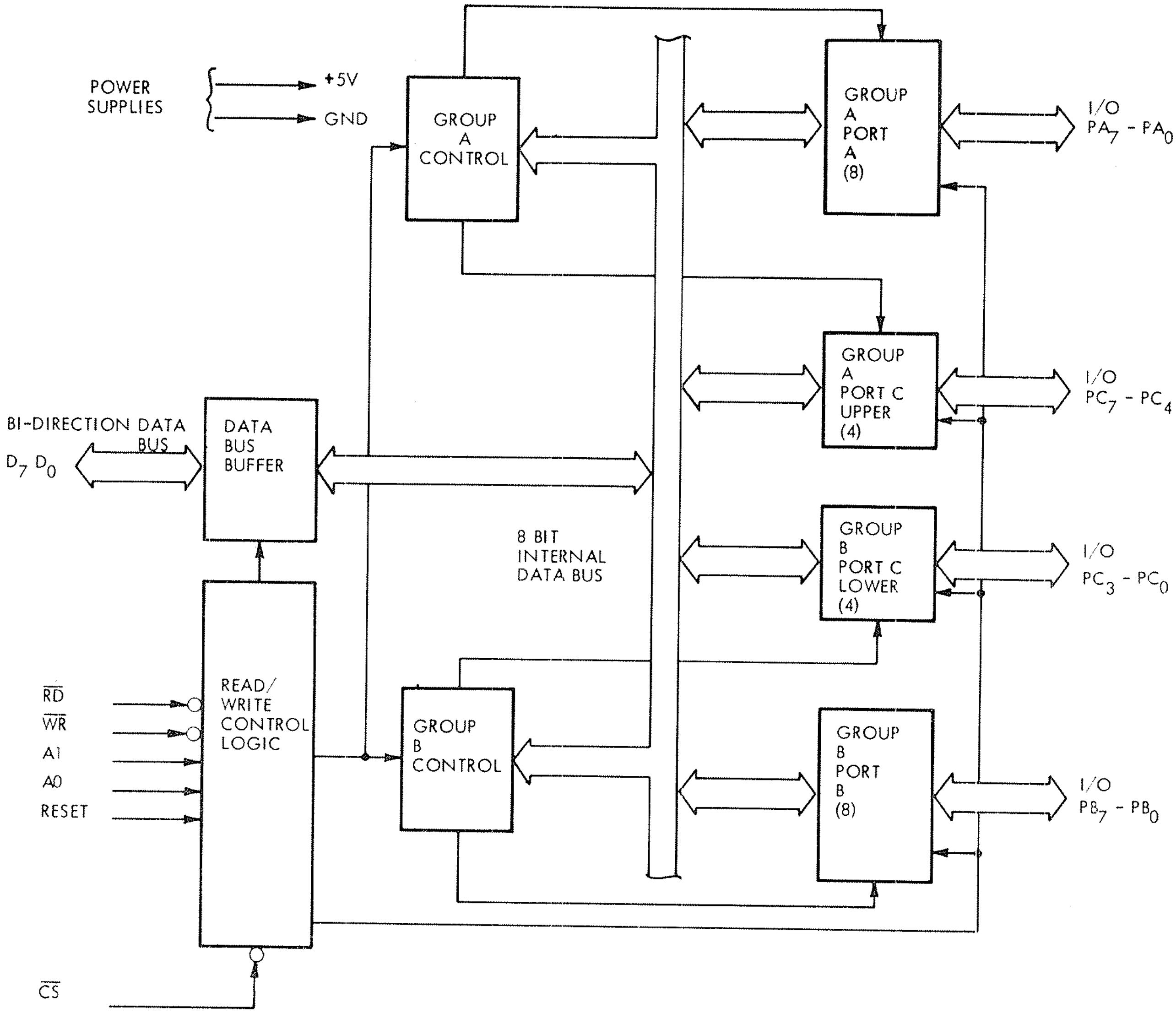


Figure 5-3p. 8255 Programmable Peripheral Interface (PPI) for Microprocessor (Sheet 1 of 3)

Block Diagram



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

AA288a

Figure 5-3p. 8255 Programmable Peripheral Interface (PPI) for Microprocessor (Sheet 2 of 3)

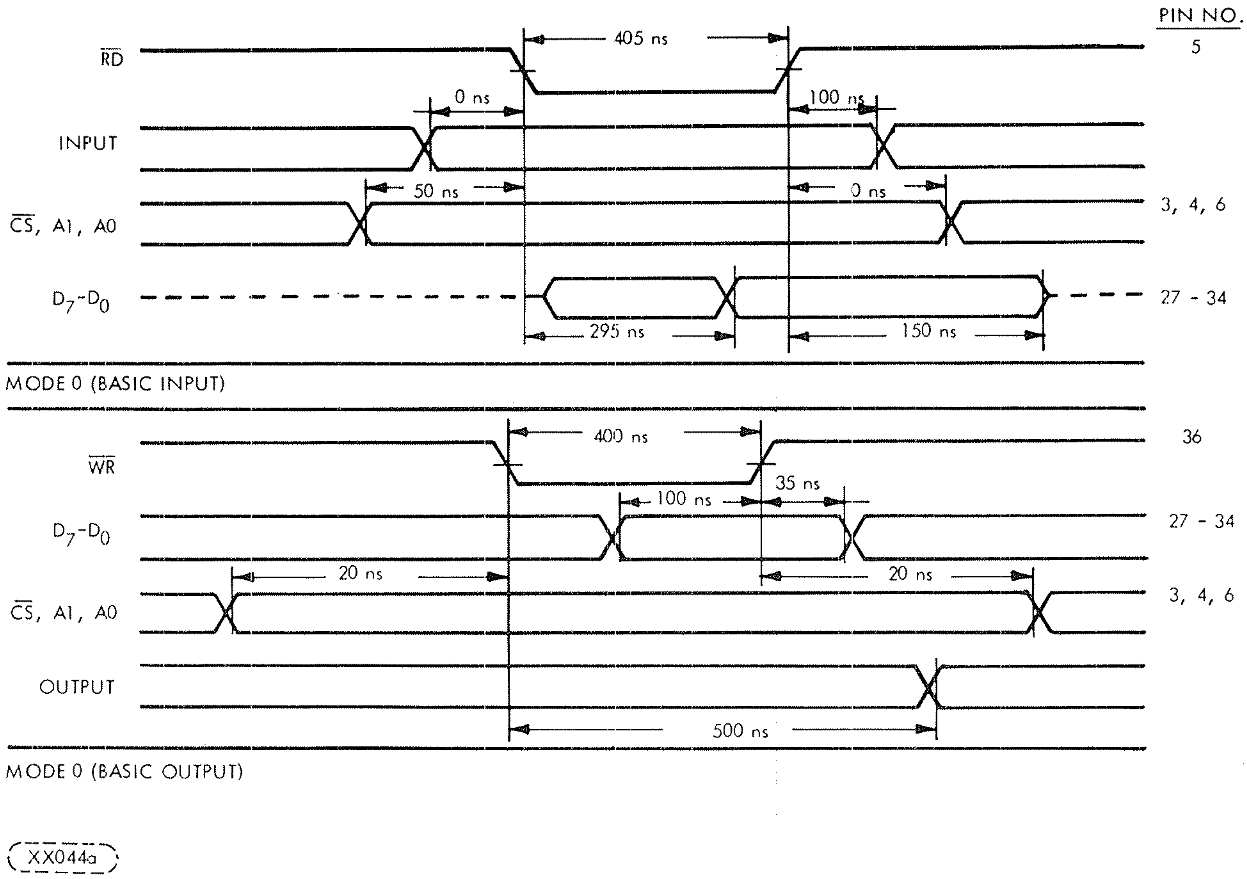


Figure 5-3p. 8255 Progammable Peripheral Interface (PPI) for Microprocessor (Sheet 3 of 3)

8255A Programmable Peripheral Interface Functional Description

General

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

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

- Data Bus Buffer

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

- Read/Write and Control Logic

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

- I/O Ports A, B and C

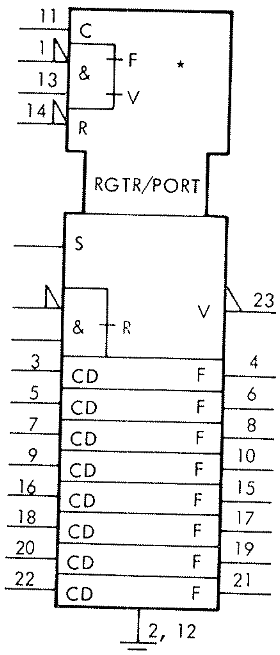
  The 8255A contains three 8-bit ports (A, B, and C). All can be configured in a wide variety of functional characteristics by the 8080A software (or firmware) but each has its own special features or "personality" to further enhance the power and flexibility of the 8255A.

  Port A: One 8-bit data 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 of the desired modes of operation of the 8255A unit. The coding on the memory address lines during the execution of the Output instruction take part in setting up the modes also, in that they define which PPI and which port the coded byte on the data bus lines is intended for. (See table 4-1).

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



* ELEMENT NUMBER NOT ASSIGNED
(8212)

8212

TIMING DIAGRAM

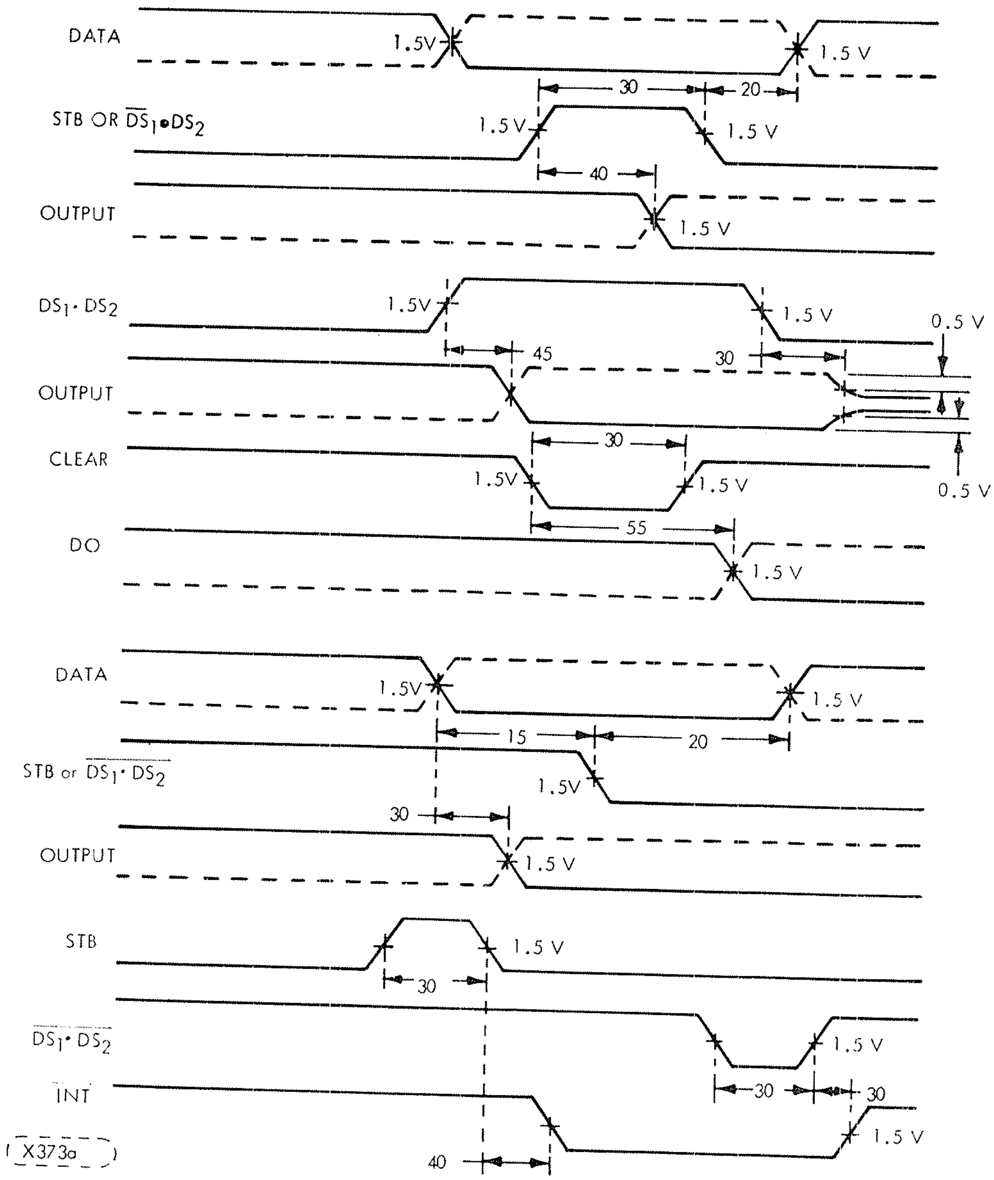


Figure 5-3q. I/O Port 8-Bit Parallel (8212)

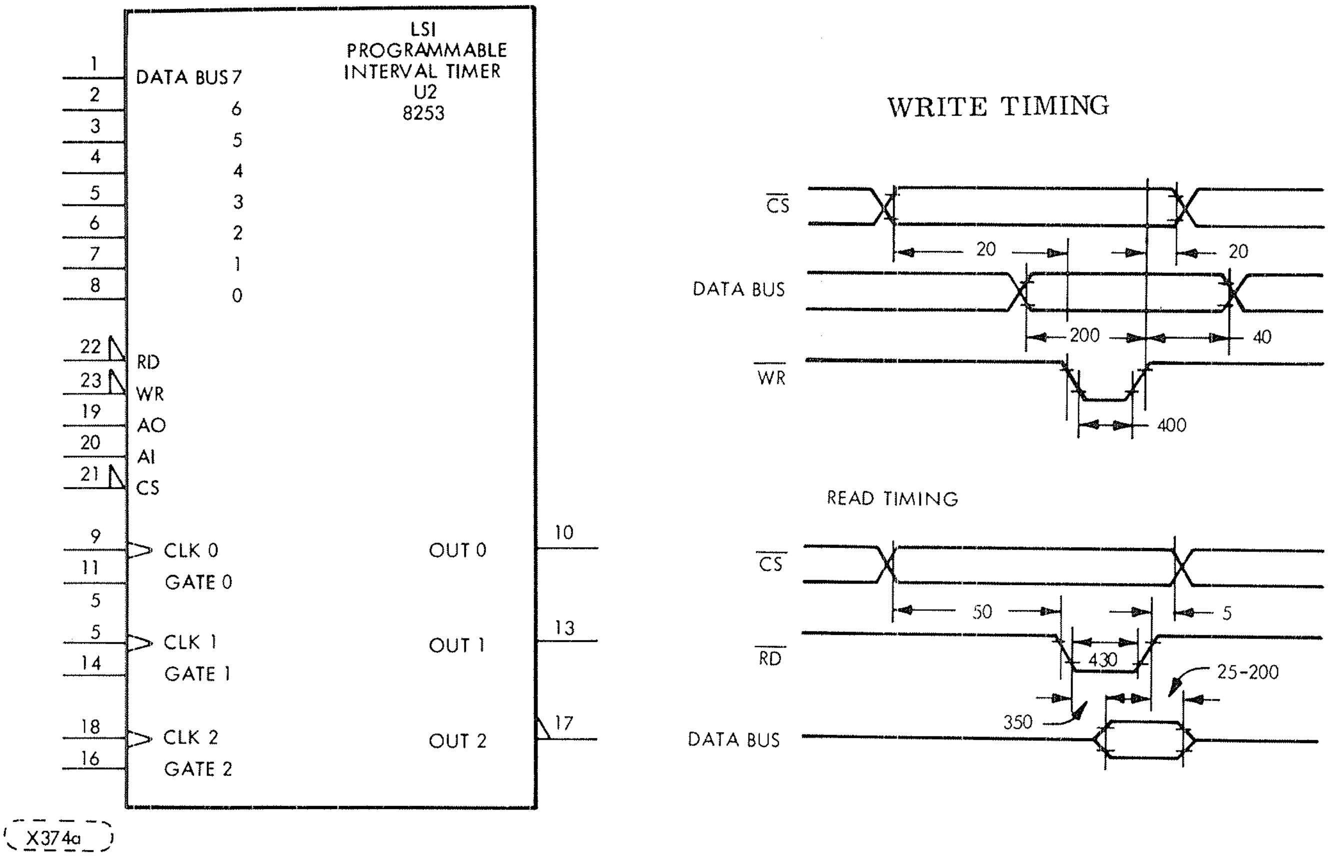


Figure 5-3r. 8253 LSI Programmable Interval Timer for 8080 System
(Sheet 1 of 2)

CONTROL LINE TRUTH TABLE

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

CONTROL WORD FORMAT

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

DEFINITION OF CONTROL FIELDS

SC-SELECT COUNTER

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

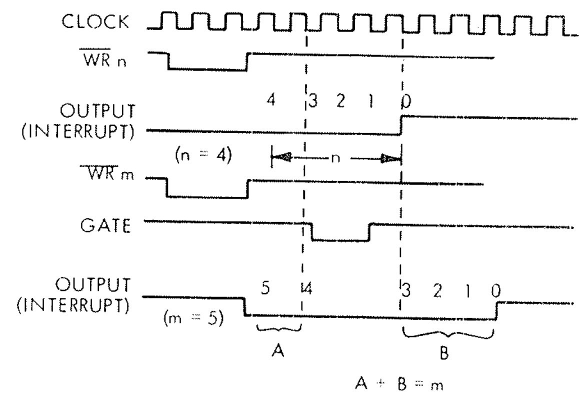
RL-READ/LOAD

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

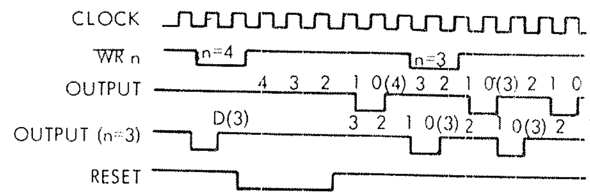
X374b

TYPICAL TIMING FOR MODES USED

MODE 0: INTERRUPT ON TERMINAL COUNT



MODE 2: RATE GENERATOR

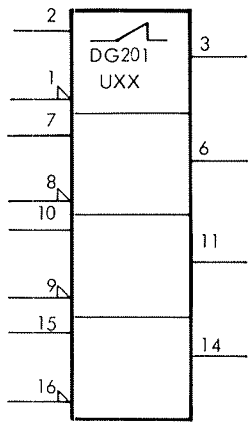


M-MODE

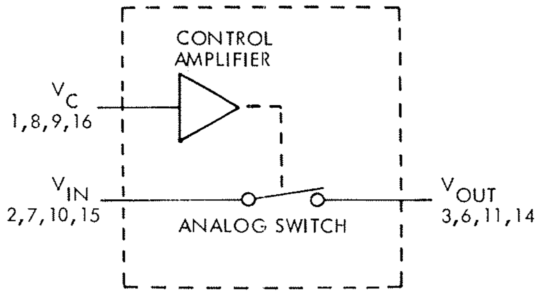
M2	M1	M0		
0	0	0	MODE 0	
0	0	1	MODE 1	*
X	1	0	MODE 2	
X	1	1	MODE 3	*
1	0	0	MODE 4	*
1	0	1	MODE 5	*

* NOT USED

Figure 5-3r. 8253 LSI Programmable Interval Timer for 8080 System (Sheet 2 of 2)

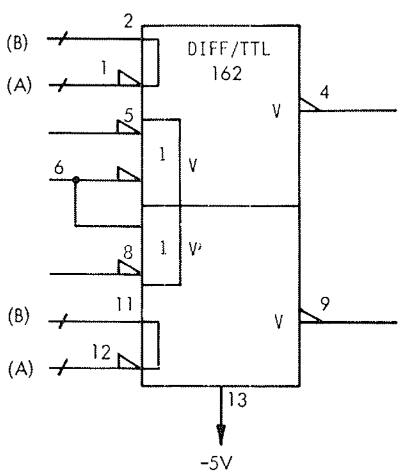


X371a



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

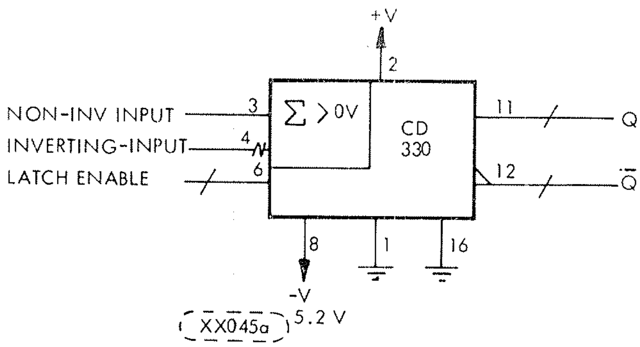


XX033a

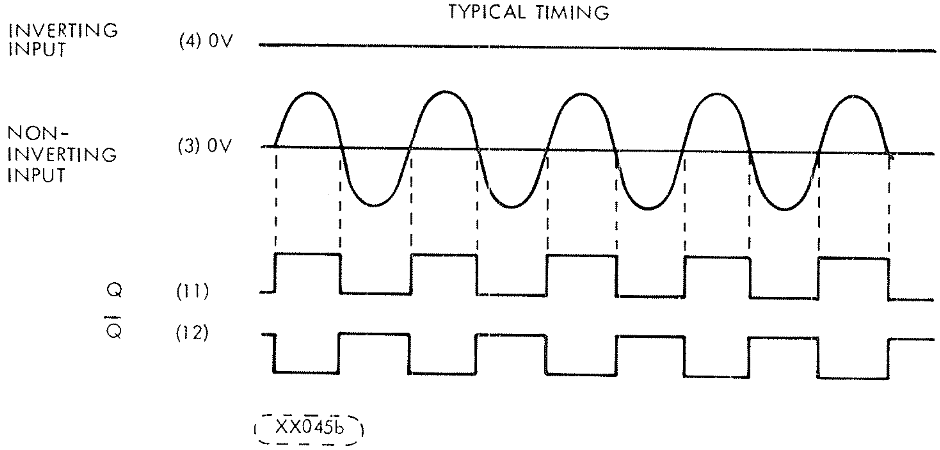
DIFFERENTIAL INPUTS	STROBES		OUTPUT
	G1	G2	
$V_{ID} \geq 25$ MV	L OR H	L OR H	H
$-25MV < V_{ID} < 25MV$	L OR H	L	H
	L	L OR H	H
	H	H	INDETERMINATE
$V_{ID} \leq -25MV$	L OR H	L	H
	L	L OR H	H
	H	H	L

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



TYPICAL TIMING



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

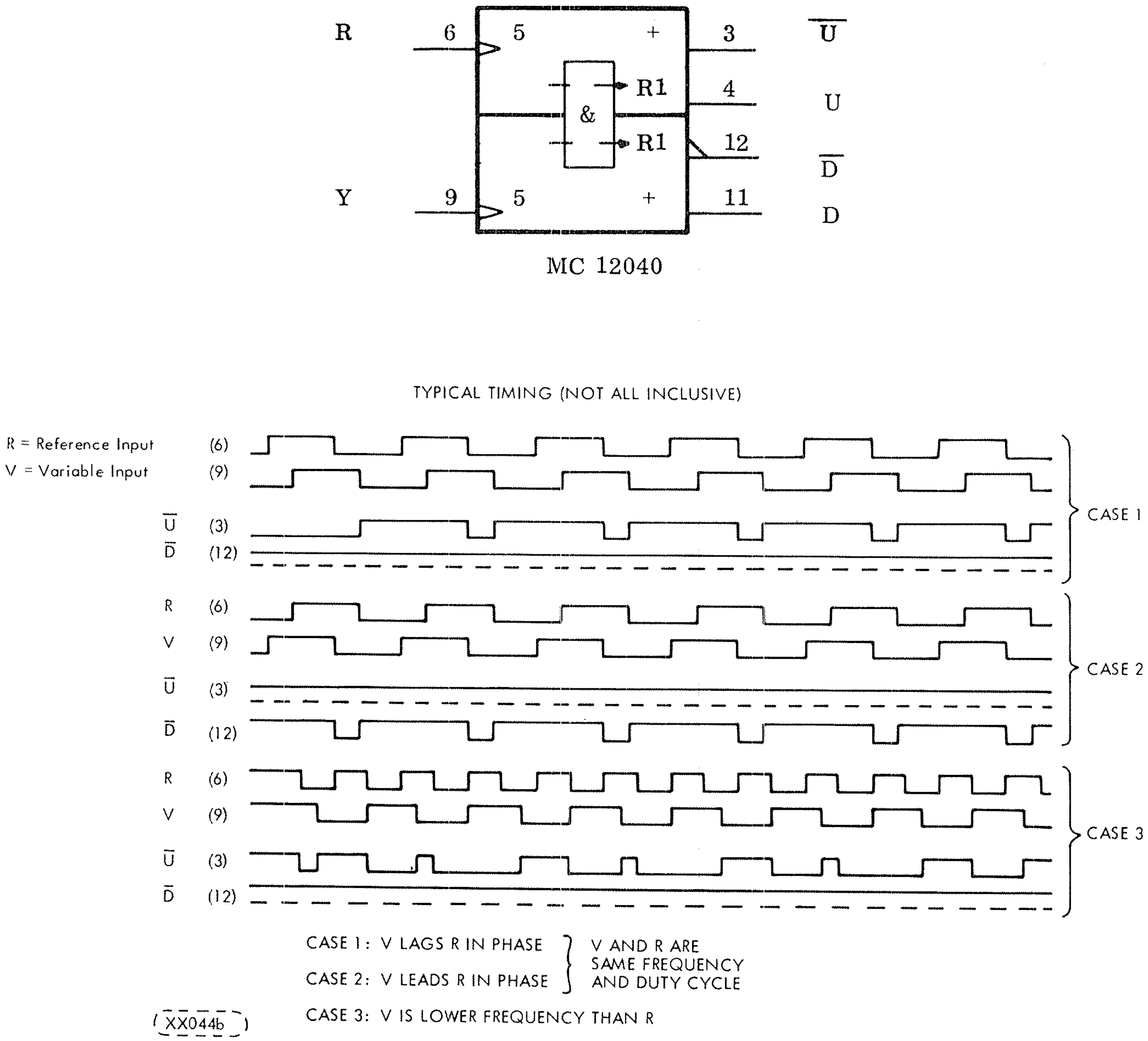


Figure 5-3v. Phase-Frequency Detector

I/O CIRCUIT BOARD (01XX)

EM1-P1 — Side A

SOURCE/ DEST	X-REF	SIGNAL	X-REF.	Pin
		GND	0101	6
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
		GND	0101	23
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
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
		+5 V	0101	44

EM1-P1 — Side B

Pin	SIGNAL	X-REF.	SOURCE/ DEST	X-REF
6	GND	0101		
22	INHIB-SEC/-L	0104	P1-B22	0204
23	GND	0101		
39	GND	0101		
43	VOL-CHANGE/-L	0105	P1-A43	020*, P1-A43 0303
44	+5 V	0101		

EM1-P2 — Side A

SOURCE/ DEST	X-REF	SIGNAL	X-REF.	Pin
		-5 V	0101	2
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
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
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
		GND	0101	23
P2-B24	0203	CLR-FLT-STAT/-L	0103	24
P2-B26	0206	FAULT/-L	0104	26
P2-B27	0204	SK-ERR/-L	0104	27
P2-B28	0205	AM-FND/-L	0104	28
P2-B29	0206	WRT-PROT/-L	0104	29
P2-B30	0205	I/O-AM-ENABLE/+L	0103	30
P2-B35	0205	SEL-0/+L	0103	35
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
		+5 V	0101	44

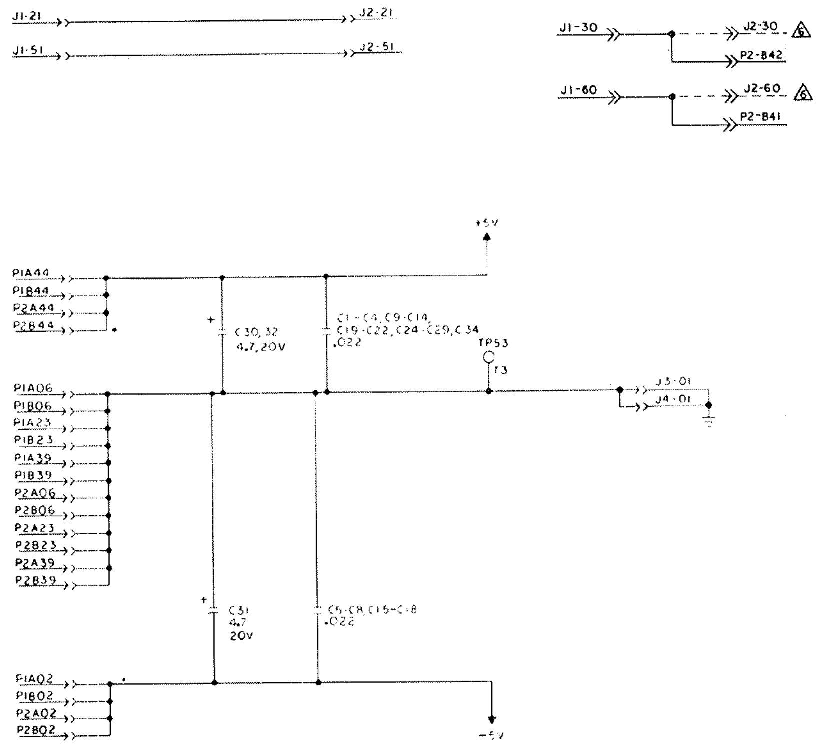
EM1-P2 — Side B

Pin	SIGNAL	X-REF.	SOURCE/ DEST	X-REF
2	-5 V	0101		
6	GND	0101		
12	RTZ/-L	0103	P2-A12	0205
13	ON-CYL	0104	P2-A13	0204
21	SEEK/-L	*	P2-A21	* P2-B21 0305
22	FXD/+L	0103	P2-B22	0205
23	GND	0101		
24	OFFSET -/+L	0102	P2-B24	0305
25	OFFSET +/+L	0102	P2-B25	0305
26	CYL-ADDR-0/+L	0102	P2-B26	0303
27	CYL-ADDR-1/+L	0102	P2-B27	0303
28	CYL-ADDR-2/+L	0102	P2-B28	0303
29	CYL-ADDR-3/+L	0102	P2-B29	0303
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
35	CYL-ADDR-9/+L	0103	P2-B35	0303
39	GND	0101		
43	SECTOR-PULSE/-L	0104	P2-B43	0304
44	+5 V	0101		

XX228

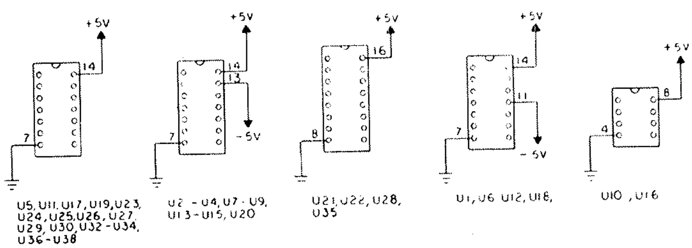
*WIRED TO, BUT NOT USED ON PWA

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



UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
218LS	74LS32	U5	11
943LS	74LS14	U25	4
203LS	74LS05	U11	6, 8, 10, 12
213LS	74LS11	U29	6
19*	9602	U35	[illegible]
146LS	74LS02	U33	[illegible], 4, 10
224LS	74LS27	U3[illegible]	8, 12
146LS	74LS04	U38	10, 12

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



CROSS REF NO. 0101

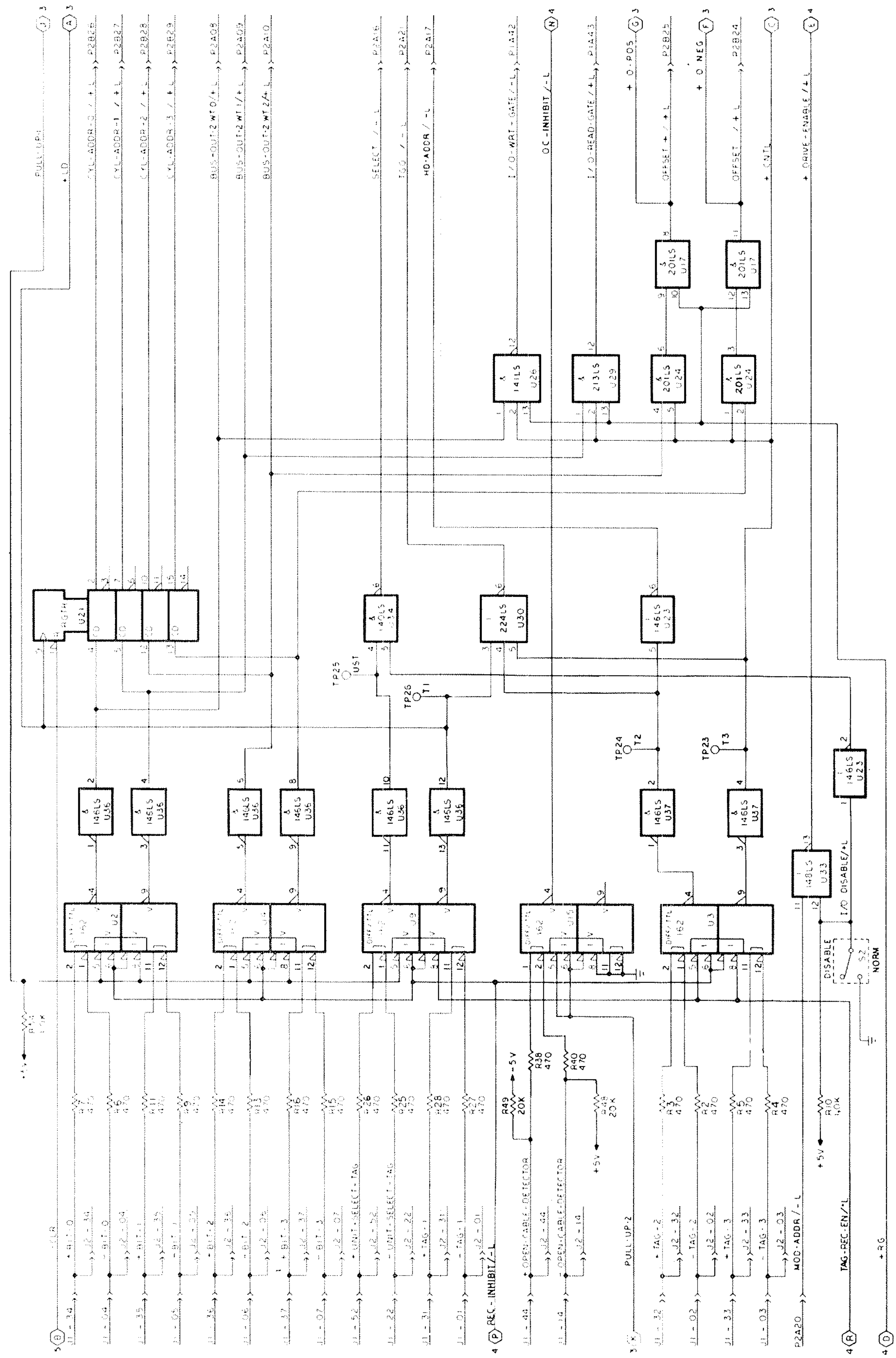
NOTES: UNLESS OTHERWISE SPECIFIED

△ 4. S3-1 VALIDATE ON CYLINDER WITH VALID SECTOR

△ 5. S3-2 PSEUDO SEEK WITH VOLUME CHANGE

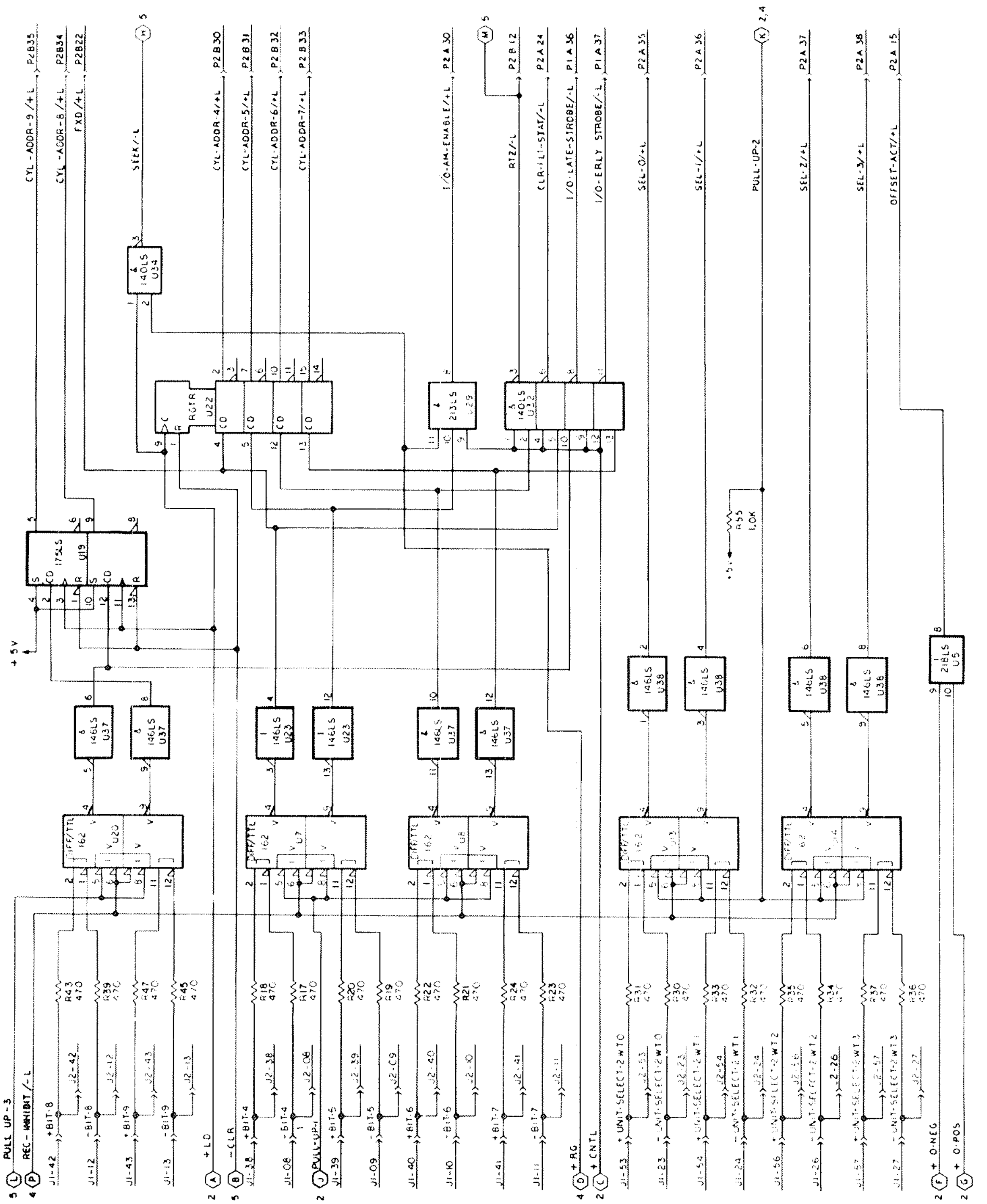
△ 6. NOT CONNECTED ON ASSY. 77667100

Figure 5-4. I/O CKT Board (Sheet 2 of 9)



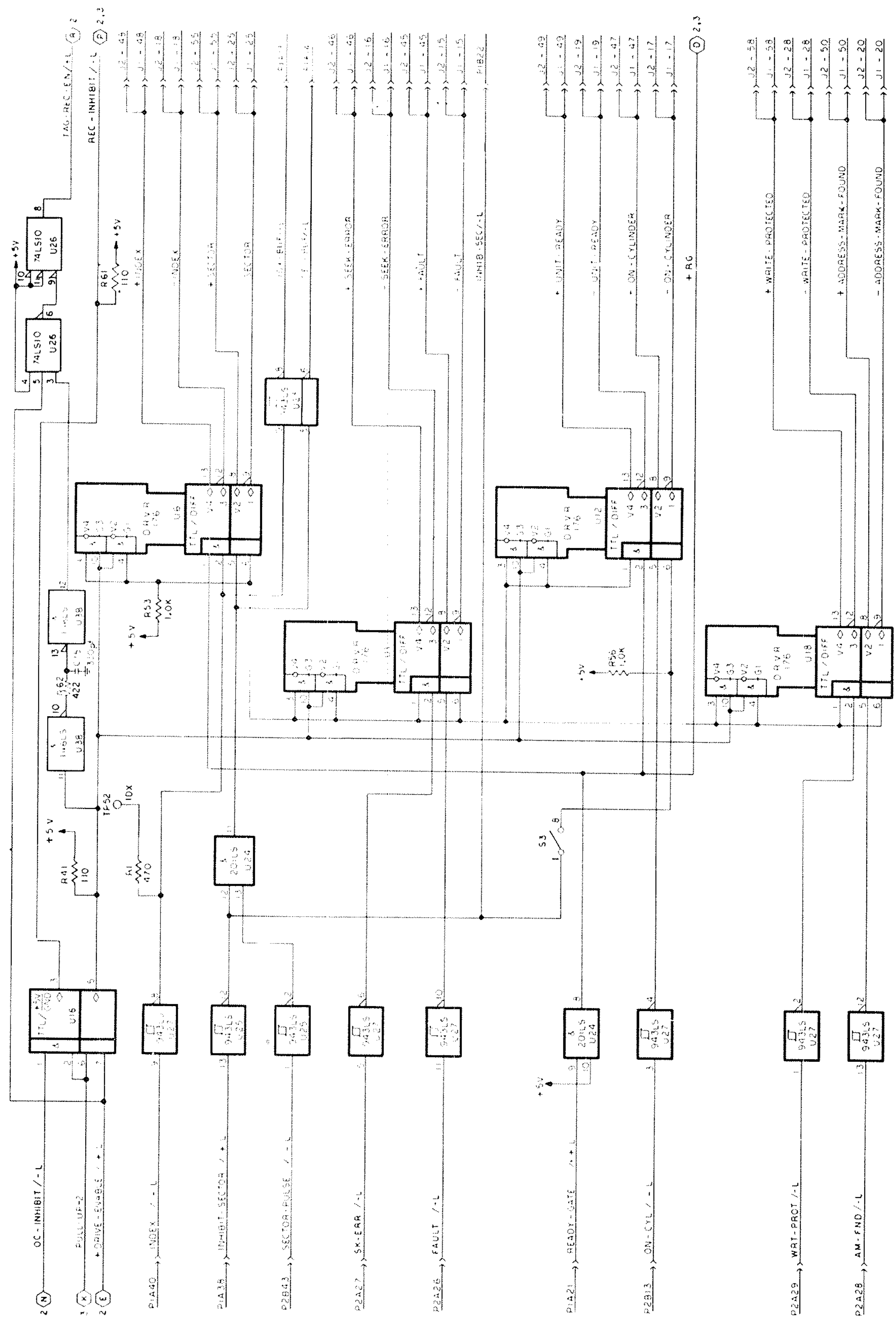
CROSS REF NO. 0102

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)



CROSS REF
NO. 0104

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

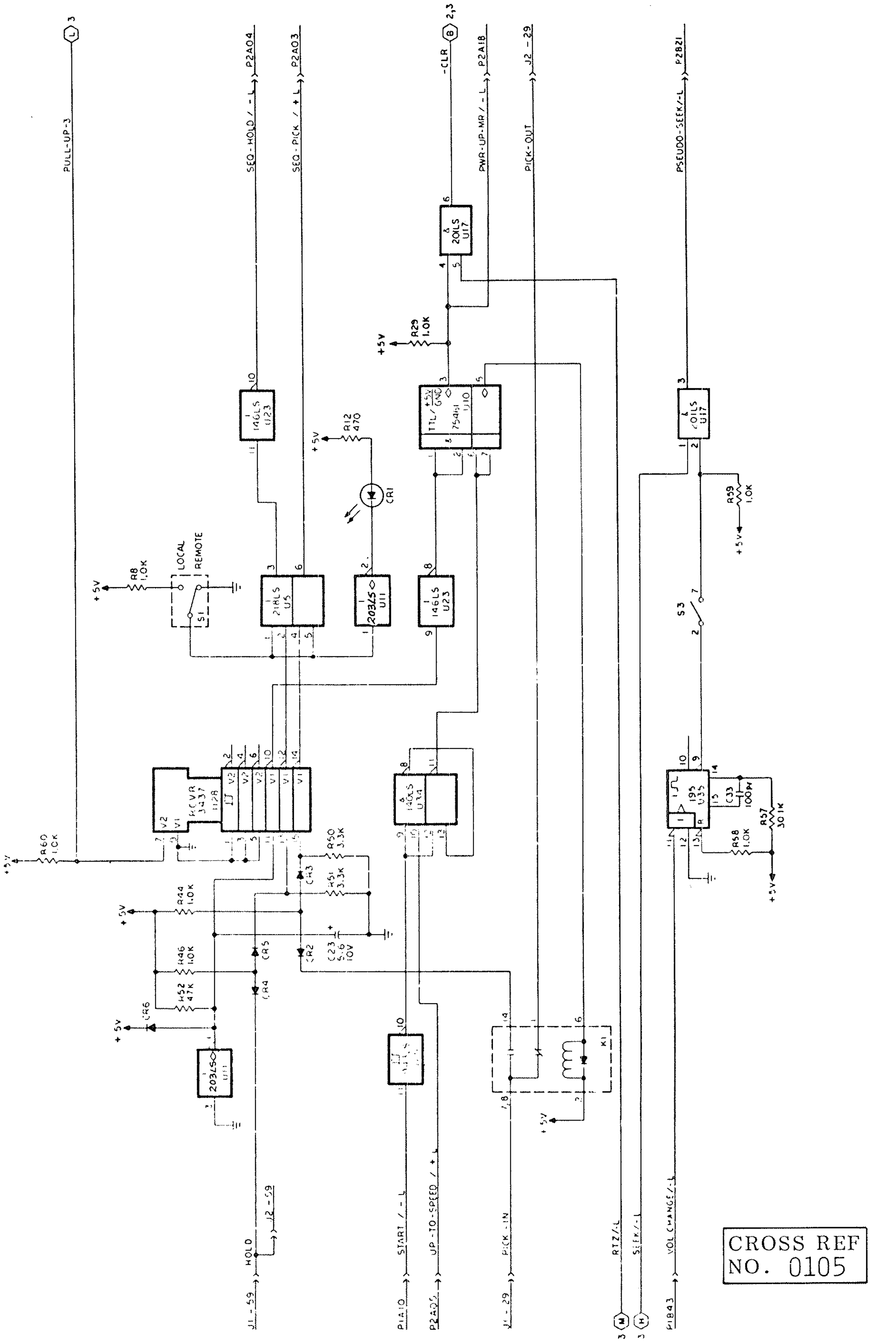
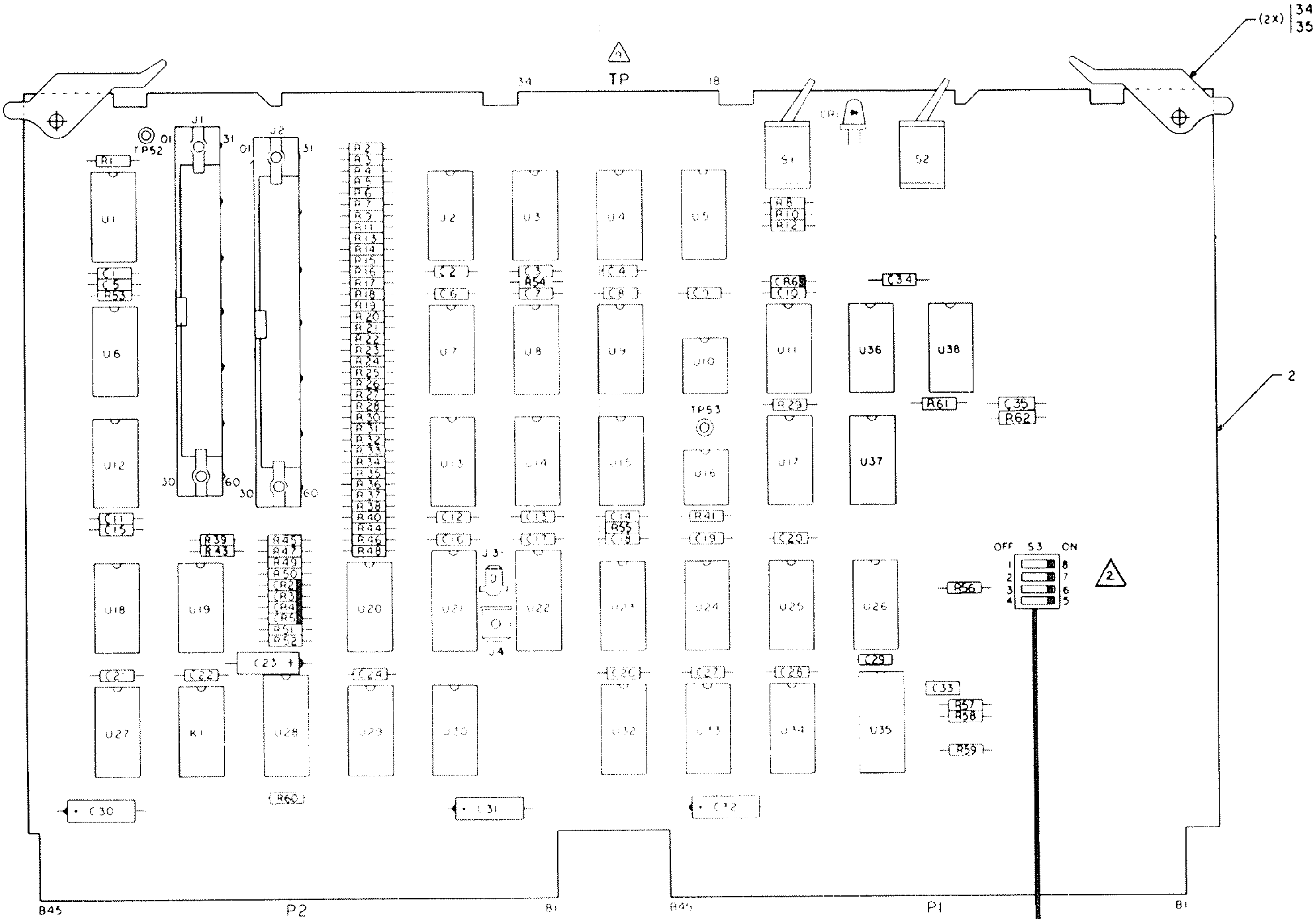


FIGURE 5-4. I/O CKT BOARD (SHEET 6 OF 9) (ASM 77622501 ONLY)



NOTES:

△1. SWITCH SETTING OPTIONS

	OFF	S3	ON	
"ON CYLINDER" IMMEDIATELY FOLLOWING SEEK COMPLETE		1		VALIDATE "ON CYLINDER" WITH VALID SECTOR
NO PSEUDO SEEK WITH VOLUME CHANGE		2		PSEUDO SEEK WITH VOLUME CHANGE
		3		SPARES
		4		SPARES

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

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	22
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	11
U32	7
U33	8
U34	7
U35	42

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	29
R16	28
R17	28
R18	28
R19	28
R20	28
R21	28
R22	28
R23	28
R24	28
R25	28
R26	28
R27	25
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	29
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 △2

RLY	PL ITEM
K1	20

NOTES:

△2. SEE TABLE A FOR JUMPER CONFIGURATION OR OPTION SWITCH SETTING. (SHEET 2) HPC/SWITCH SETTING SPEC DEFINES SETTINGS APPLICABLE FOR THIS PARTICULAR UNIT.

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	77665670	PWB, I/O OEM	
2	77622520	PWB, I/O OEM	
5	50252900-1	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% 470	
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	83452701-3	Switch - 4 Position	
45	94240426-0	Cap 50 V 10% 330 pF	
46	94360260-7	Res 1/4 W 1% 442 ohm	
46*	94360256-5	Res 1/4 W 1% 383 ohm	

*77622501 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 A	PIN	EM2-P1 B	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 A	PIN	EM2-P2 B	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) 010 *, P2-B21	030 *	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					

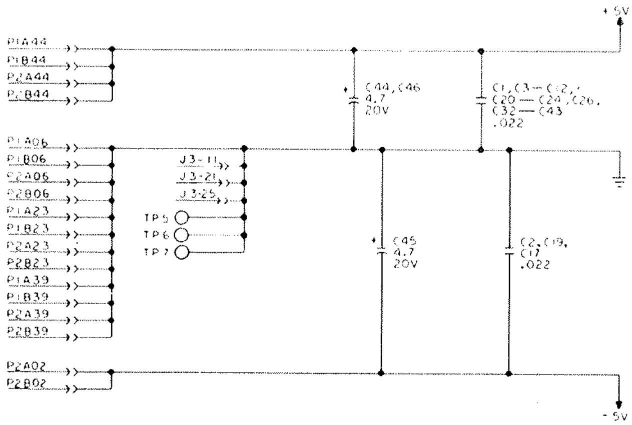
XX226

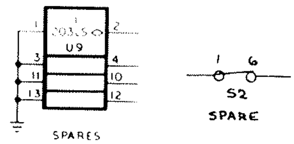
*WIRED TO, BUT NOT USED ON PWA

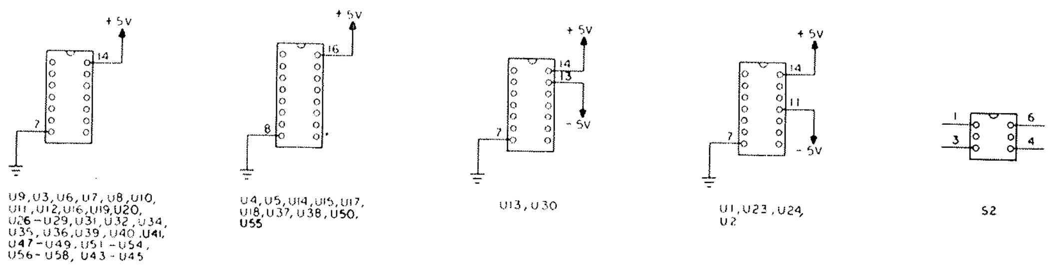
Figure 5-5. CNTL/MUX Circuit Board (Sheet 1 of 11)

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







CROSS REF
NO. 0201

Figure 5-5. CNTL/MUX Circuit Board (Sheet 2 of 11)

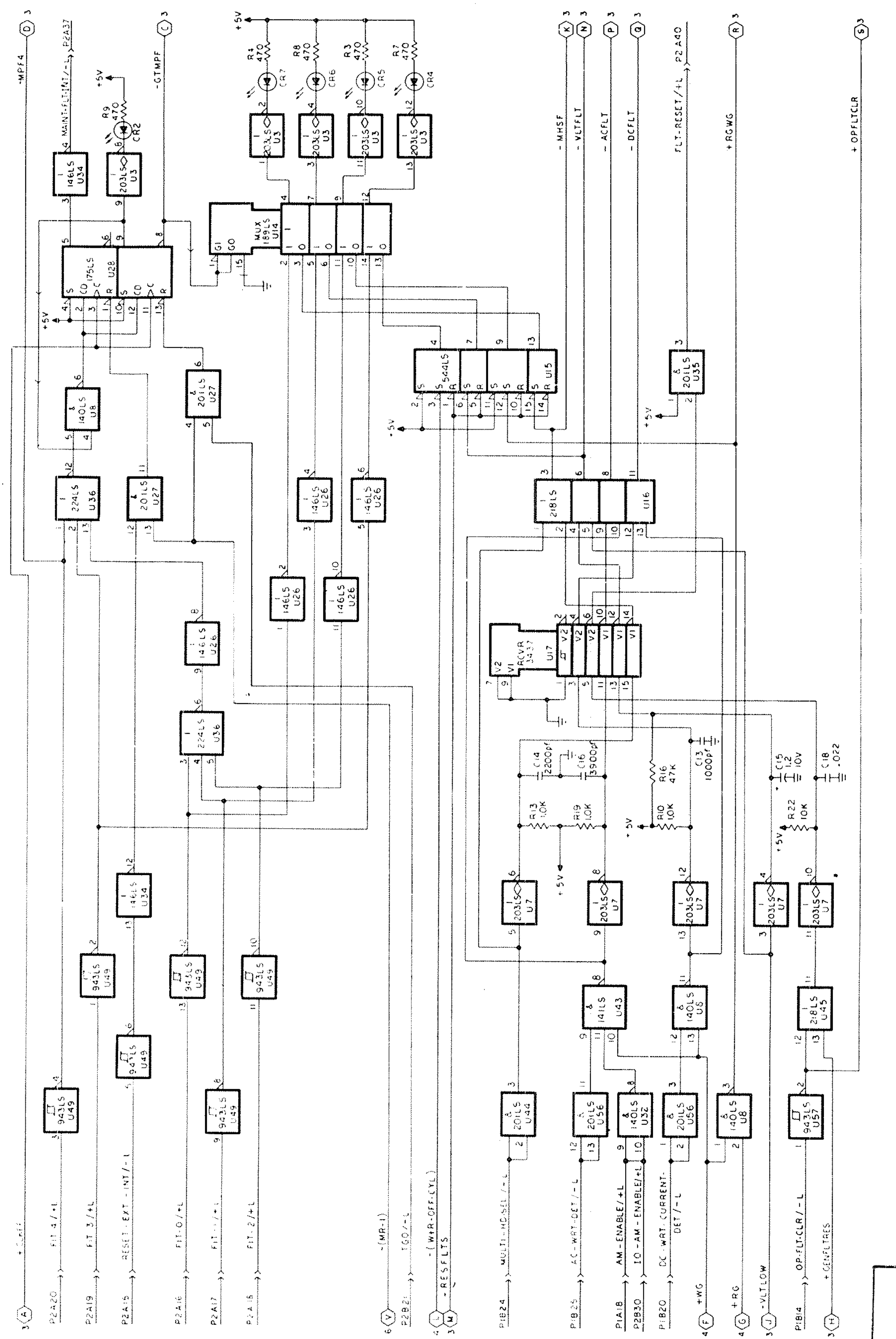


Figure 5-5. CNTL/MUX Circuit Board (Sheet 3 of 11)

CROSS REF
NO. 0202

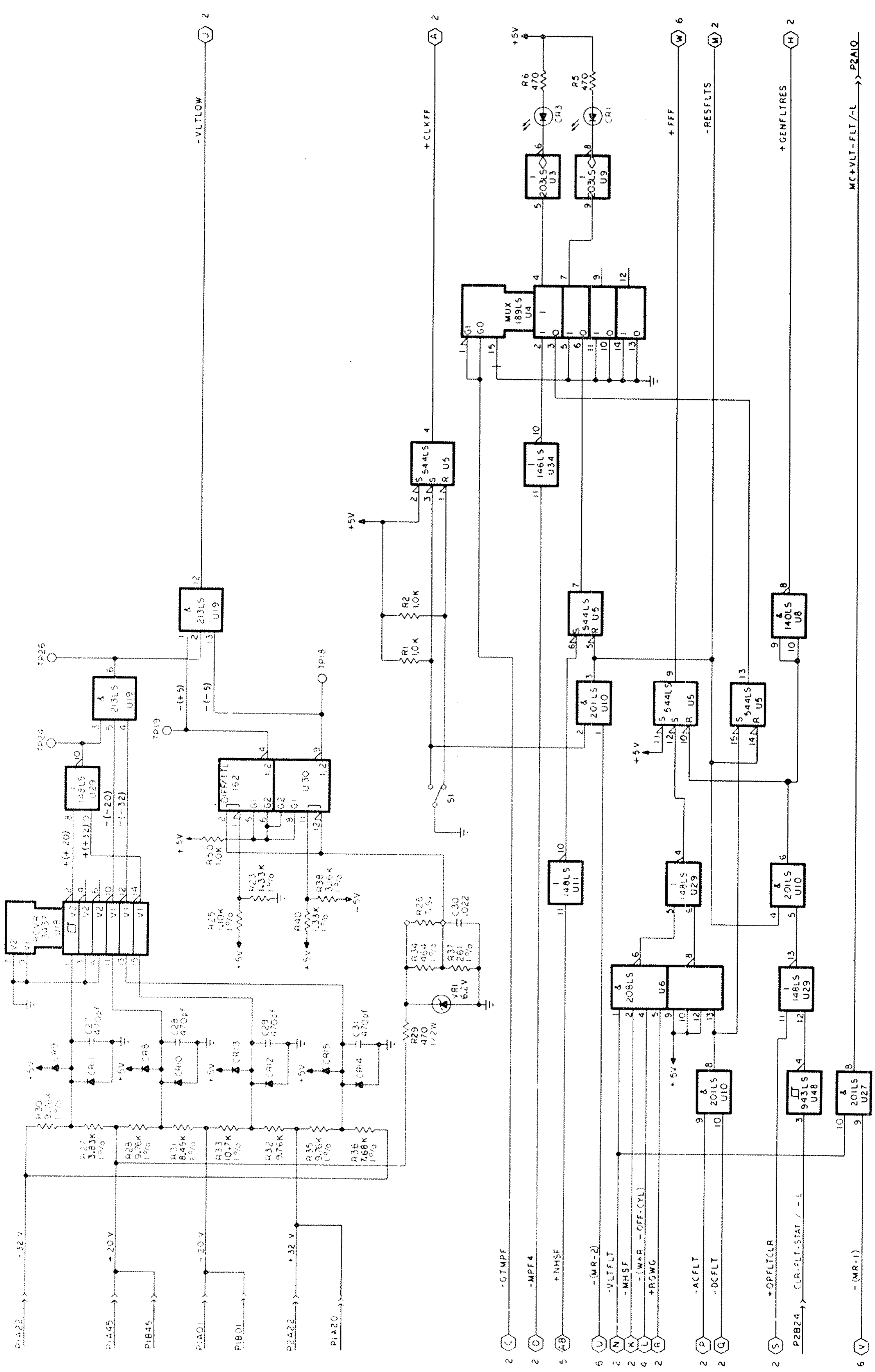
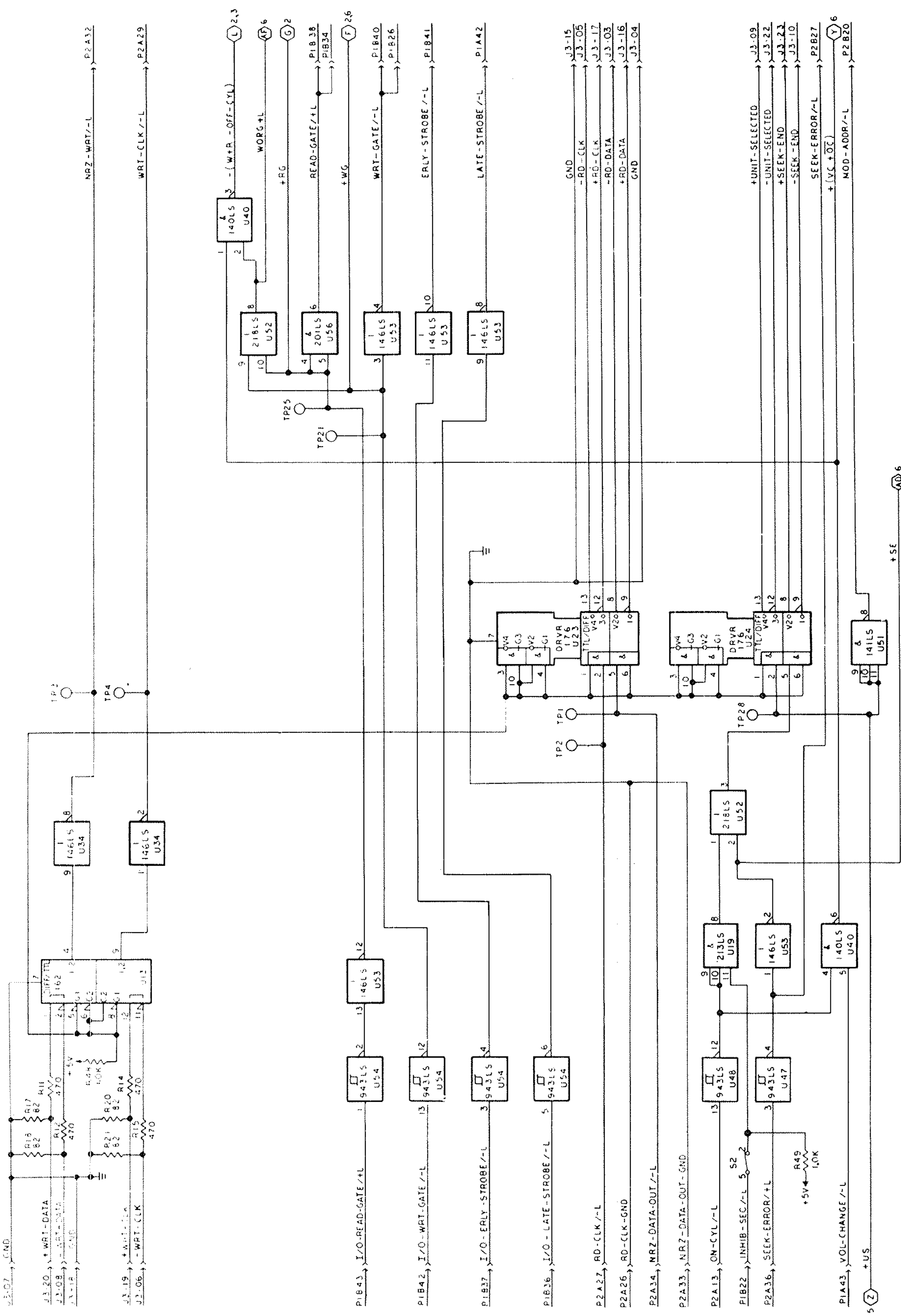


Figure 5-5. CNTL/MUX Circuit Board (Sheet 4 of 11)

CROSS REF
NO. 0203



CROSS REF
NO. 0204

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 5 OF 11)

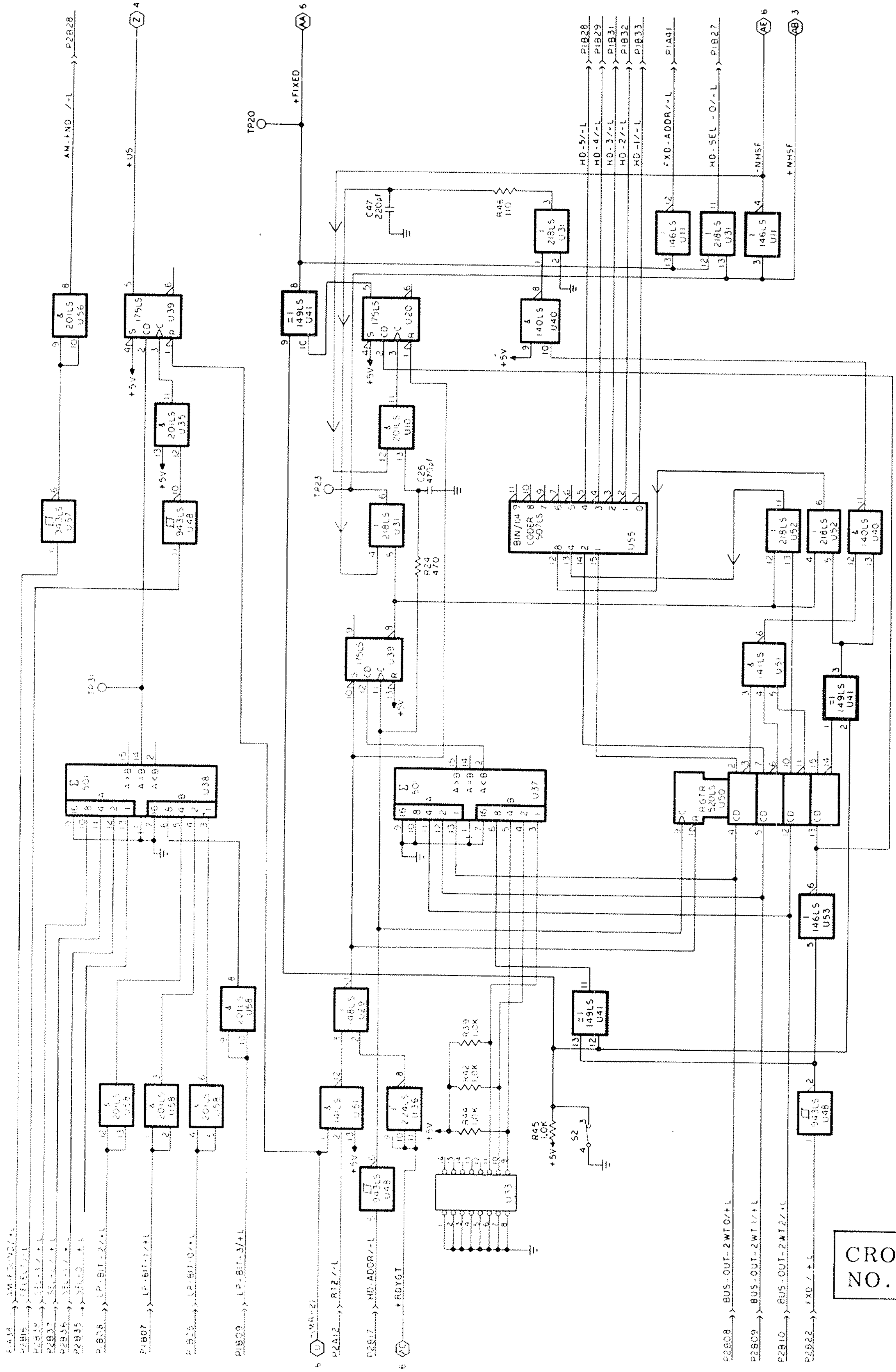
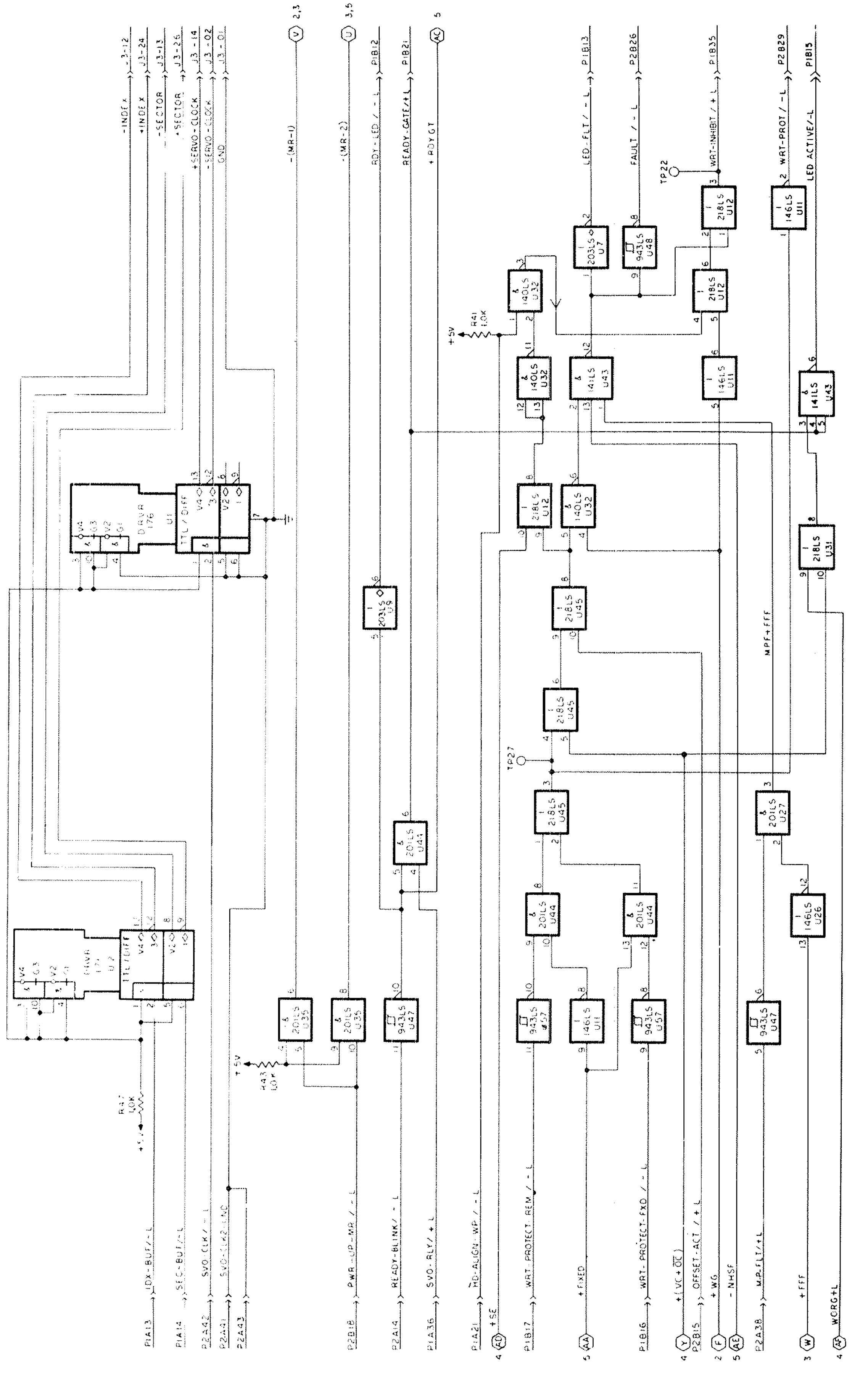


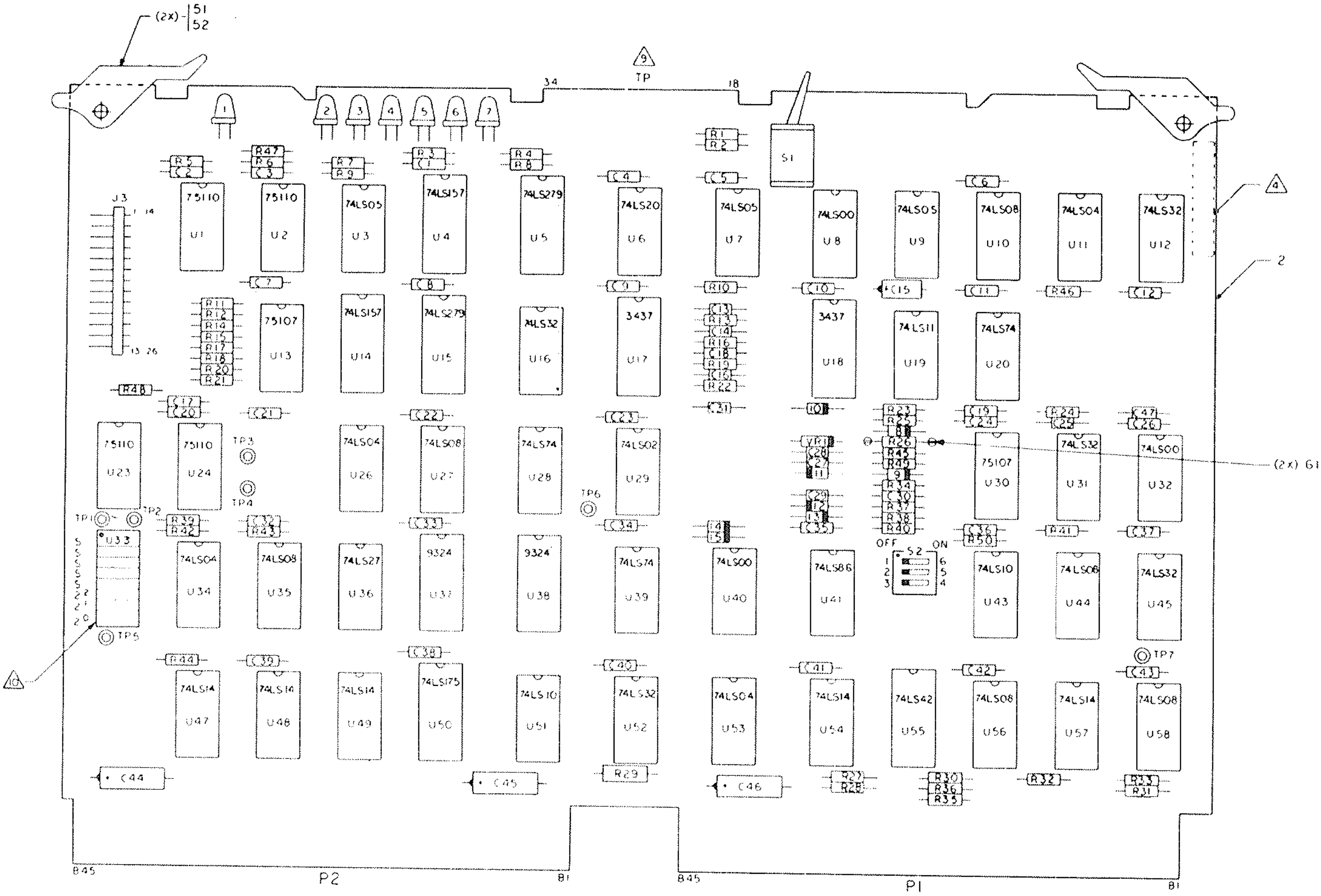
FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 6 OF 11)

CROSS REF
NO. 0205



CROSS REF
NO. 0206

Figure 5-5. CNTL/MUX Circuit Board (Sheet 7 of 11)



NOTE:

6. SOLID BAND ON DIODES & VOLT REGULATORS INDICATES CATHODE END

△ 8. FLAT SIDE OF LED INDICATES CATHODE LEAD

△ 10. S IS SPARE, BINARY WEIGHTS MUST BE PROGRAMMED TO INDICATE DEVICE CAPACITY, BY INSERTING ITEM S2 INTO SOCKET U33 PWA TEST

Figure 5-5. CNTL/MUX Circuit Board (Sheet 8 of 11)

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

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

IC	PL ITEM
U1	6
U2	6
U3	10
U4	21
U5	23
U6	15
U7	10
U8	7
U9	10
U10	11
U11	9
U12	17
U13	5
U14	21
U15	23
U16	17
U17	25
U18	25
U19	13
U20	20
U21	—
U22	—
U23	6
U24	6
U25	—
U26	9
U27	11
U28	20
U29	8
U30	5
U31	17
U32	7
U33	53,62
U34	9
U35	11
U36	16
U37	26
U38	26
U39	20
U40	7
U41	24
U42	—
U43	12
U44	11
U45	17
U46	—

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

VOLT REG	PL ITEM
VR1	33

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

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

SW	PL ITEM
S1	49
S2	60

CONN	PL ITEM
J1	—
J2	—
J3	48

Figure 5-5. CNTL/MUX Circuit Board (Sheet 9 of 11)

ITEM	DRAWING NO.	DESCRIPTION	REMARKS
	77666950	PWA, CNTL/MUX OEM	
2	77666970	PWB, CNTL/MUX OEM	
5	20252900-1	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	
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	75803529-4	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 q/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	24500155-7	Res 1/2 W 5% 470	
44	94402130-2	Res 1/4 W 5% 82	
45	94402180-7	Res 1/4 W 5% 10 K	

FIGURE 5-5. CNTL/MUX CIRCUIT BOARD (SHEET 10 OF 11)

ITEM	DRAWING NO.	DESCRIPTION	REMARKS
46	94402148-4	Res 1/4 W 5% 470	
47	24500063-3	Res 1/4 W 5% 1K	
47	94402156-7	Res 1/4 W 5% 1K	
48	77612196-4	Right Angle Header	
49	41347801-7	Switch Toggle PC Bd	
50	92498021-2	Terminal Swaged	
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	94358500-0	Jumper Wire, Molded	
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 11 OF 11)

SERVO GOARSE CIRCUIT BOARD

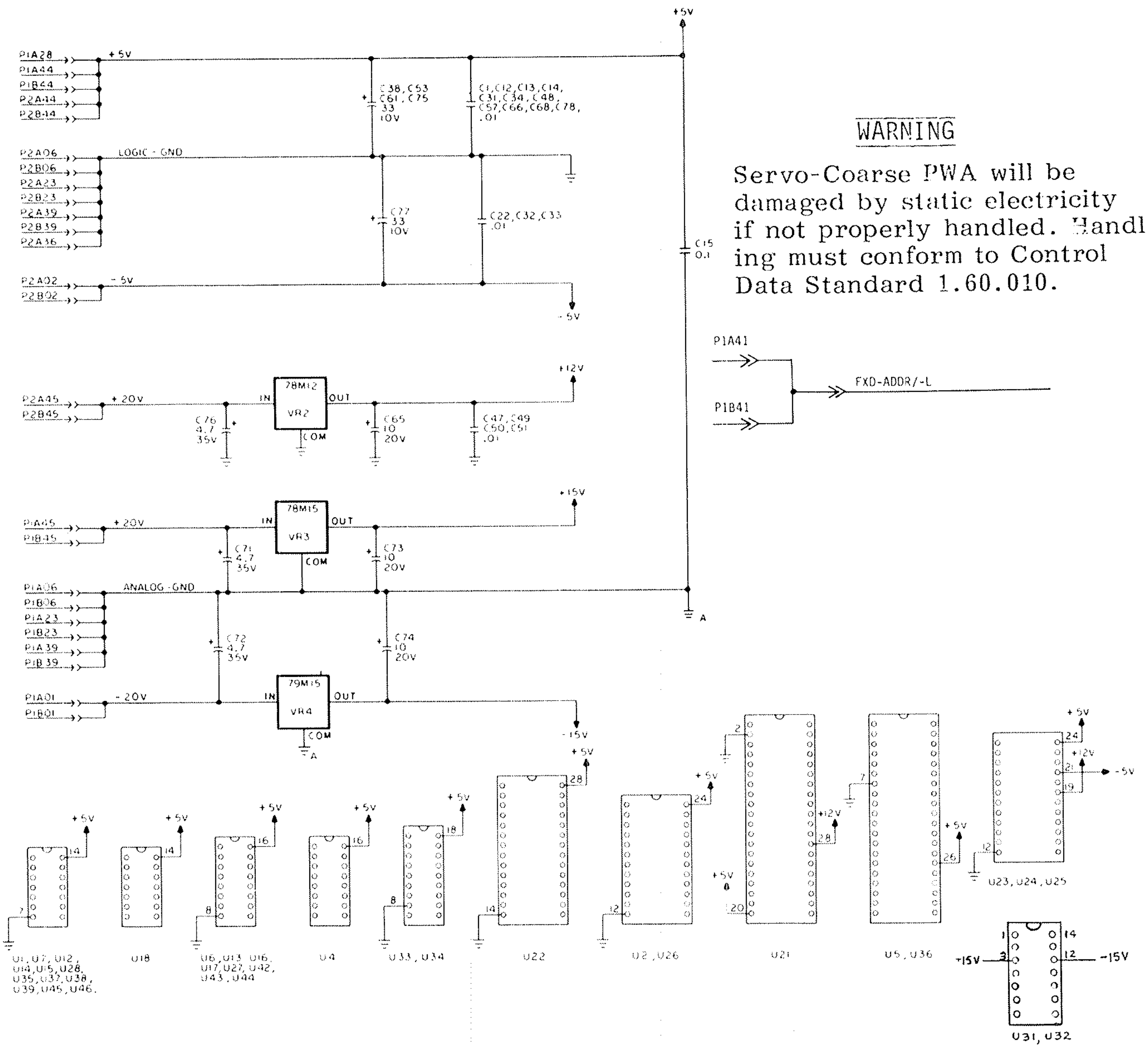
SOURCE/DEST	X-REF	SOURCE/DEST	X-REF	SIGNAL (A)	X-REF.	EM3-P1	SIGNAL (B)	X-REF.	SOURCE/DEST	X-REF	SOURCE/DEST	X-REF
				-20 V	0301	1	-20 V	0301				
						2						
				TACH-SHLD	0306	3						
		VELOCITY XDUCER	1601	TACH	0306	4						
				TACH-RTN		5						
				ANALOG GND	0301	6	ANALOG GND	0301				
						7						
						8	PA-COM-P	0306	J1-08	1001		
						9	UNLOAD-CURR	0307	J1-02	1001		
		P1-B10	150 *	DIAG-FG-MON	0306	10	PA-COM-N	0306	J1-07	1001		
		P1-B11	150 *	DIAG-ACT-I-MON	0306	11	32 V RET	0306	J1-03	1001		
		P1-B12	150 *	DIAG-DR-MON	0306	12						
		P1-B13	150 *	I-SPE	0306	13	UNLOAD-COMMON	0307	J1-04	1001		
		P1-B14	150 *	SPE	0306	14	-31-CAP	0307	J1-05	1001		
						15						
						16						
						17	+5 V RTN	0301				
						18						
						19						
						20	I-FBK-SIG	0306	P1-01 } R1	1601		
						21	I-FBK-RTN	0306	P1-02 }	1601		
						22						
				ANALOG AND	0301	23	ANALOG GND	0301				
		J10-01	1601	SPIN-SEN-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 *		
						32			J1-08	1201		
						33	RUN/+L	0305	J1-02	1201		
						34	LINE-EN/+L	0305	J1-07	1201		
						35	PK-COV-UNLOCK/+L	0305	J1-03	1201		
						36	SVO-RLY/+L	0305	J1-06	1201,	P1-A36	0206
						37	LINE-OFF/+L	0305	J1-04	1201		
						38	HD-LOAD-SW/+L	0305	SW4-N.O.	1601		
				ANALOG GND	0301	39	ANALOG GND	0301	J1-05	1201		
						40	LED-FLT/-L	0303	P1-B13	0206		
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				

SOURCE/DEST	X-REF	SIGNAL (A)	X-REF.	EM3-P2	SIGNAL (B)	X-REF.	SOURCE/DEST	X-REF	SOURCE/DEST	X-REF
				1						
		-5 V	0301	2	-5 V	0301				
P2-B03	0603	AGC ACT/-L	0305	3	SEQ-PICK/+L	0305	P2-A03	0105		
P2-B04	150 *	I/O-WRT/-L	0302	4	SEQ-HOLD/+L	0305	P2-A04	0105		
P2-B05	150 *	I/O-RD/-L	0302	5	UP-TO-SPEED/+L	0305	P2-A05	0105		
		LOGIC GND	0301	6	LOGIC GND	0301				
P2-B07	150 *	MADR-0/+L	0302	7						
P2-B08	150 *	MADR-1/+L	0302	8						
P2-B09	150 *	MADR-2/+L	0302	9						
P2-B10	150 *	MADR-3/+L	0302	10	MC-VLT-FLT/+L	0303	P2-A10	0202		
P2-B11	150 *	MADR-4/+L	0302	11	START/-L	0305	P1-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	102
				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		
				41						
				42						
				43	SECTOR-PULSE/-L	0304	P2-B43	0104		
		+5 V	0301	44	+5 V	0301				
		+20 V	0301	45	+20 V	0301				

XX227

* WIRED TO, BUT NOT USED ON PWA

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



WARNING

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

UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
175LS	74LS74	U1	8 OR 9
202LS	74LS03	U12	11
201LS	74LS08	U37	6
146	7404	U46	4

ASSEMBLY	TABLE A					
	JUMPER CONFIGURATION					
	△5 W1	△6 W2	W3	W4	W5	W6
77622402	–	X	–	X	X	X
77666800	–	△7	–	–	–	–

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

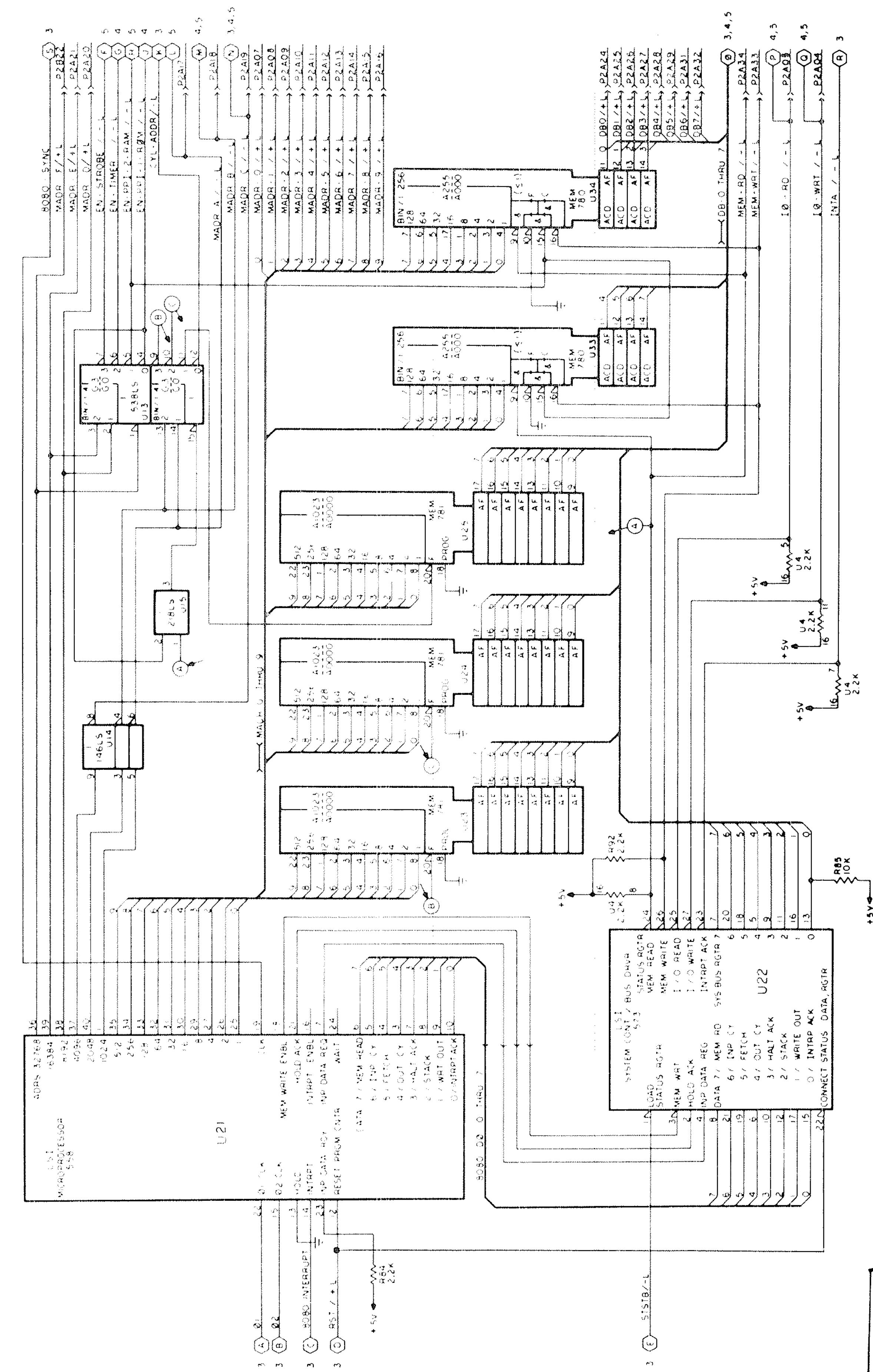
△5. W1 JUMPER CAUSES ON CYLINDER TO BECOME FALSE FOR APPROXIMATELY 1.2 MSEC, WHEN OFFSET IS CHANGED OR TERMINATED

△6. W2 JUMPER KEEPS ON CYLINDER TRUE, WHEN OFFSET IS CHANGED OR TERMINATED

△7. W2 ON THE 77666800 PWA IS AN ETCHED CONNECTION ON THE PWB.

Figure 5-6. Servo Coarse Circuit Board (Sheet 2 of 13)

CROSS REF NO. 0301



CROSS REF
NO. 0302

Figure 5-6. Servo Coarse Circuit Board (Sheet 3 of 13)

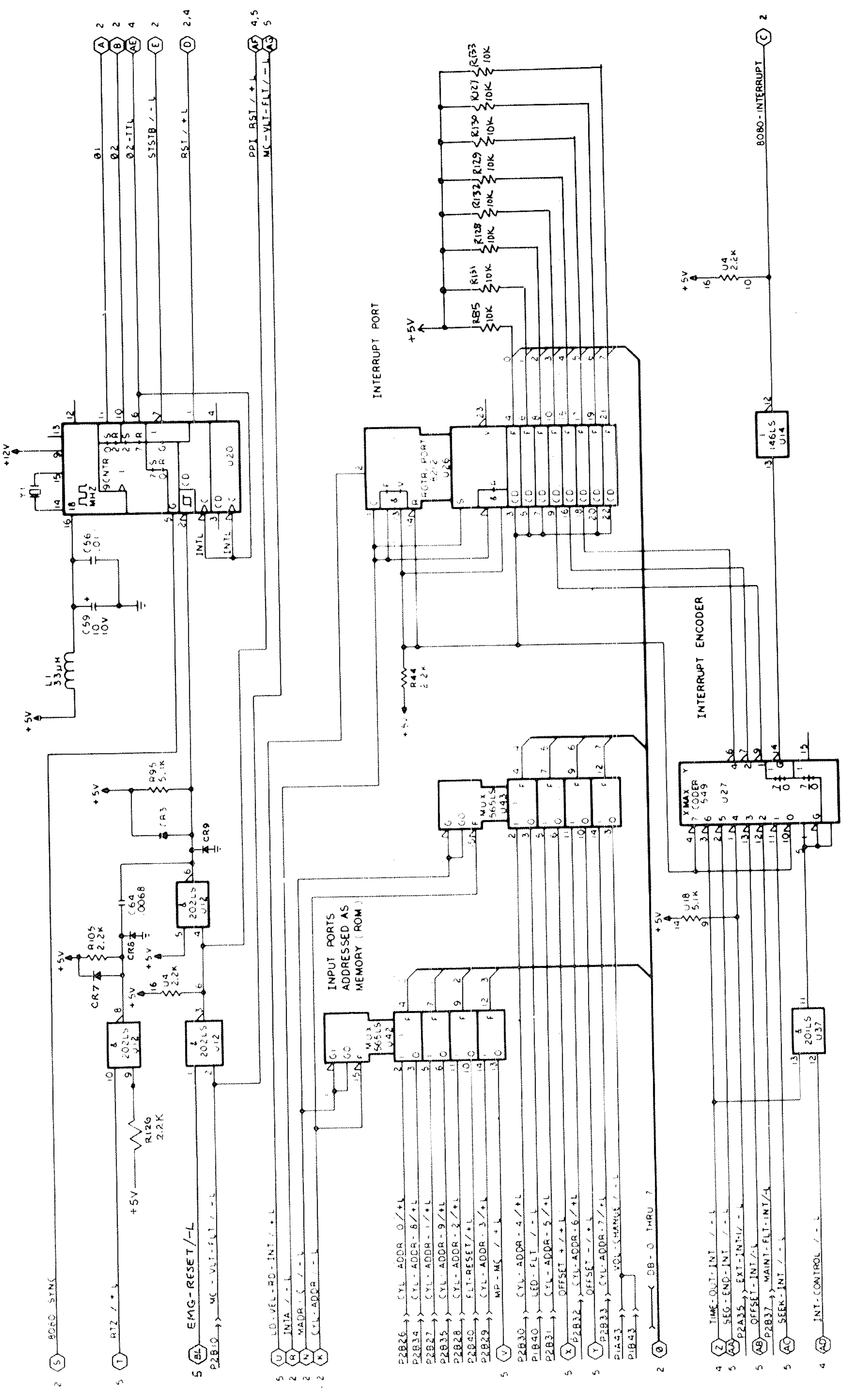


Figure 5-6. Servo Coarse Circuit Board (Sheet 4 of 13)

CROSS REF
NO. 0303

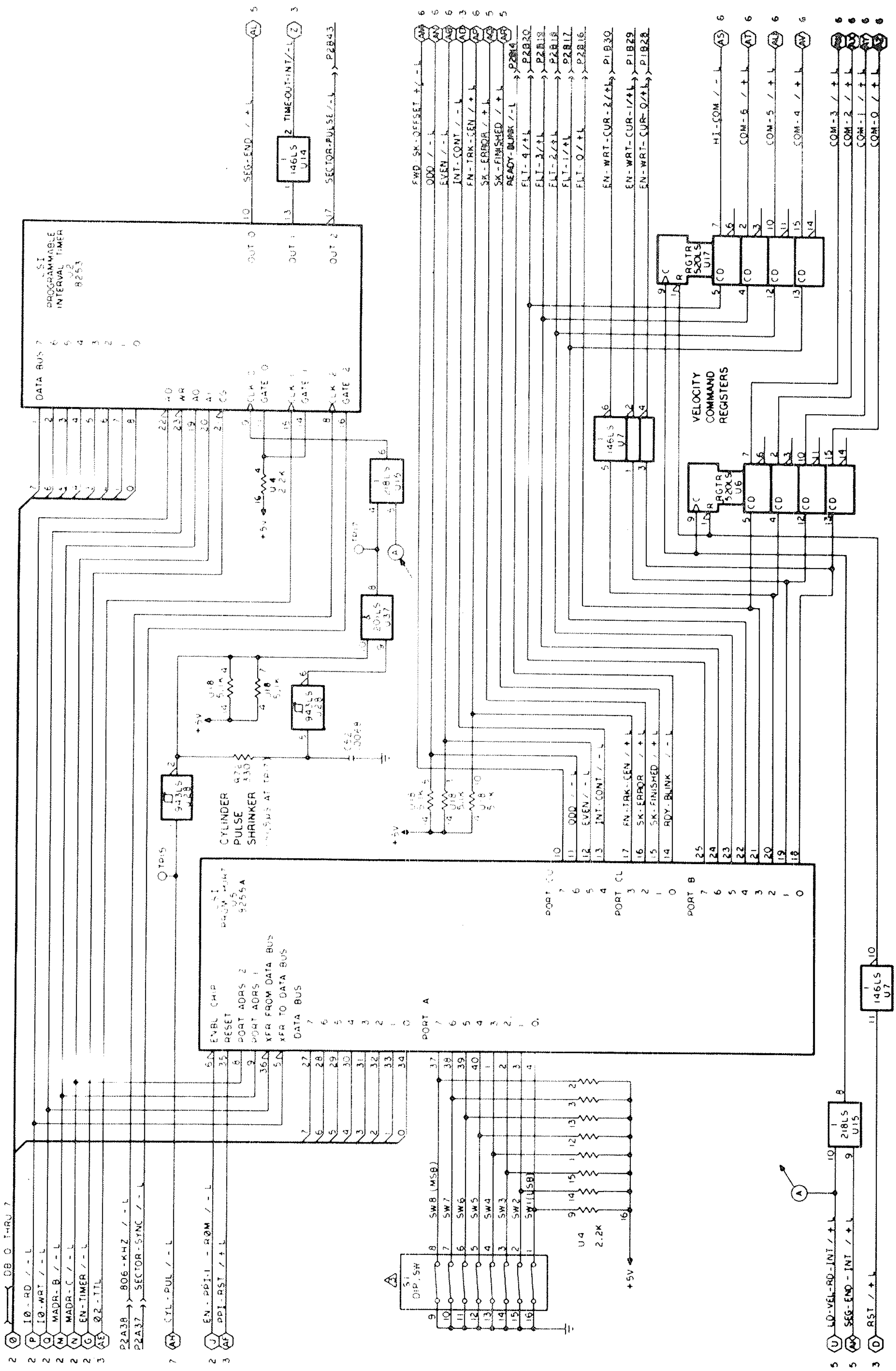


Figure 5-6. Servo Coarse Circuit Board (Sheet 5 of 13)

CROSS REF
NO. 0304

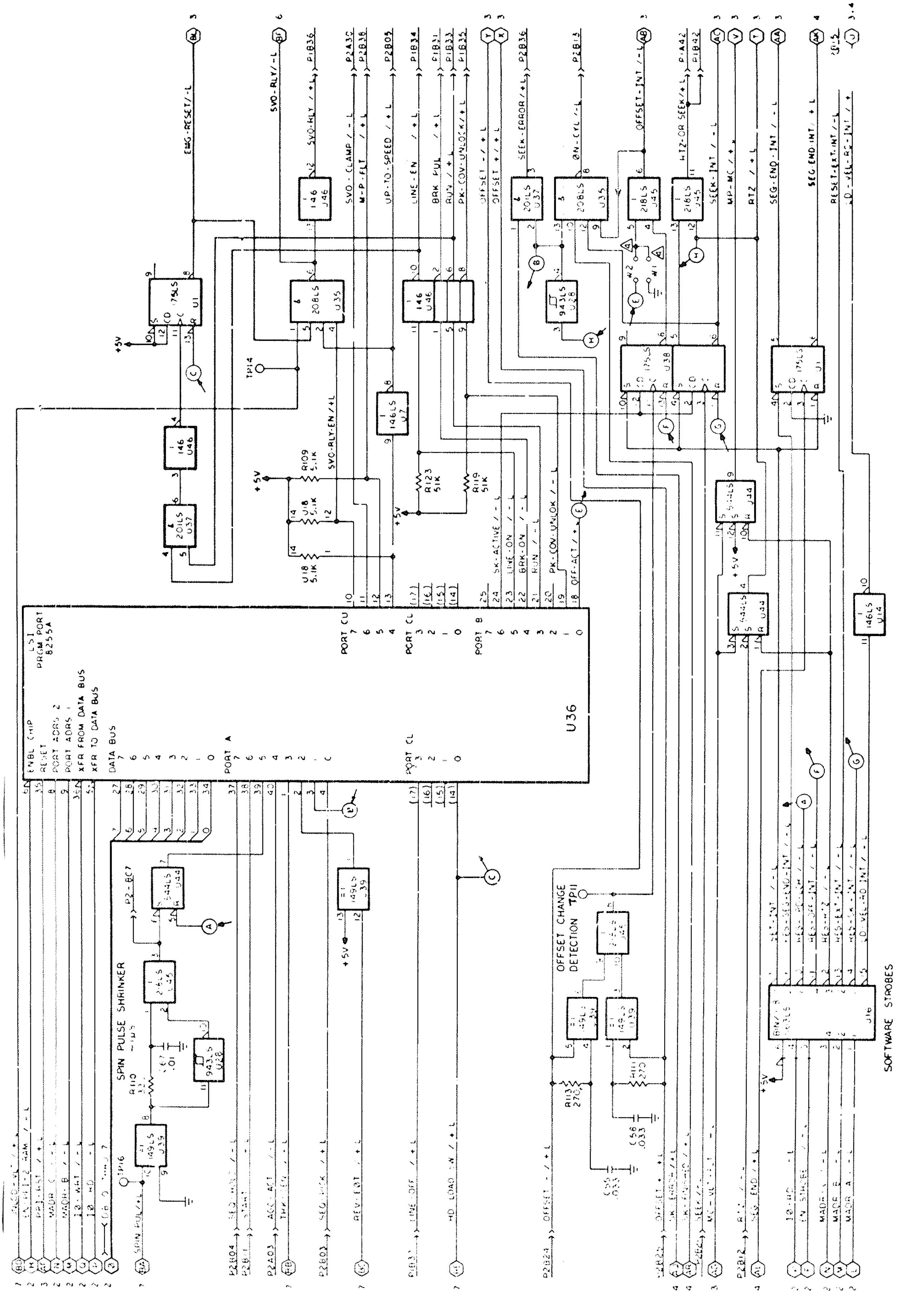


Figure 5-6. Servo Coarse Circuit Board (sheet 6 of 13)

CROSS REF
NO. 0305

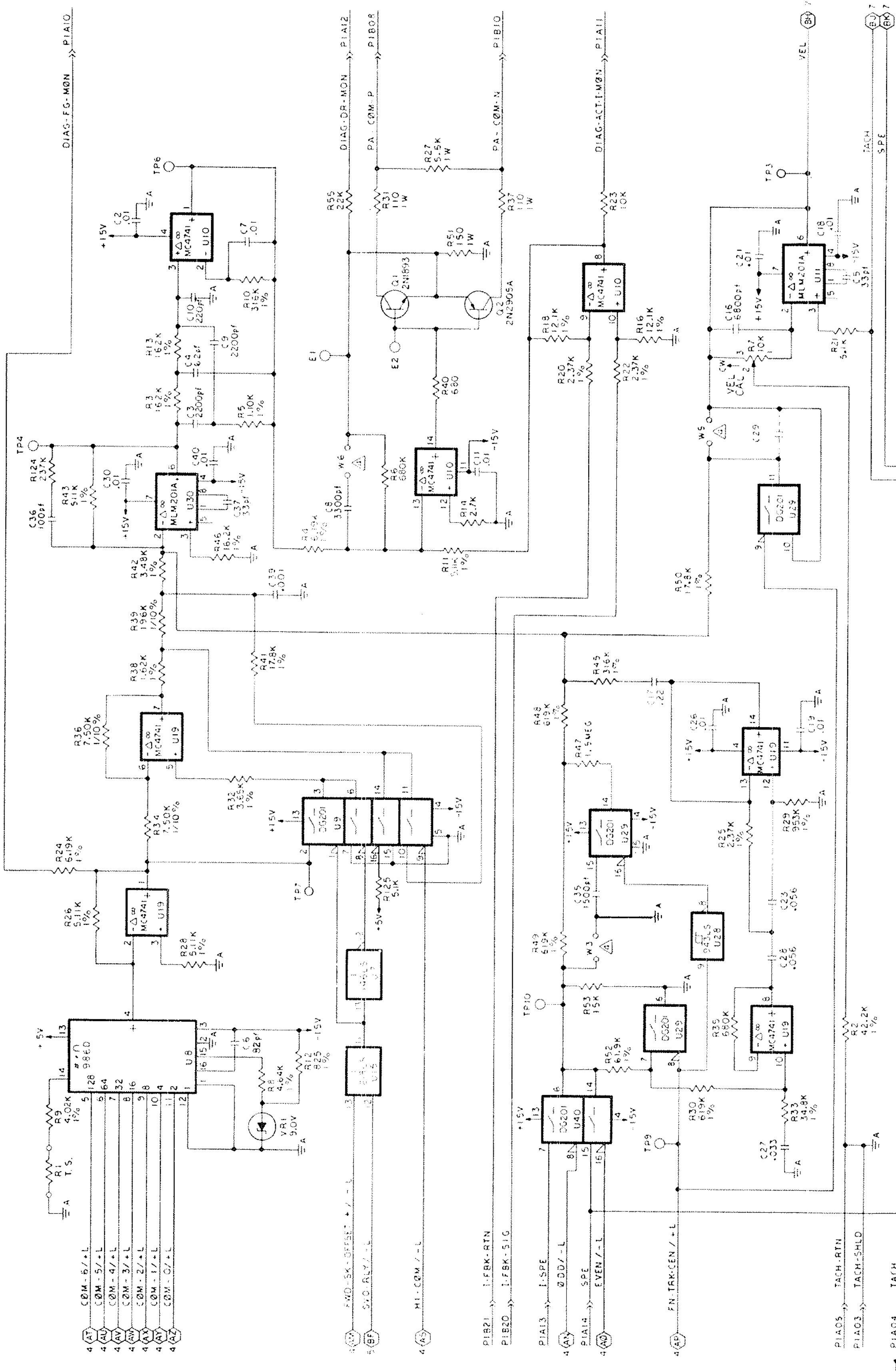
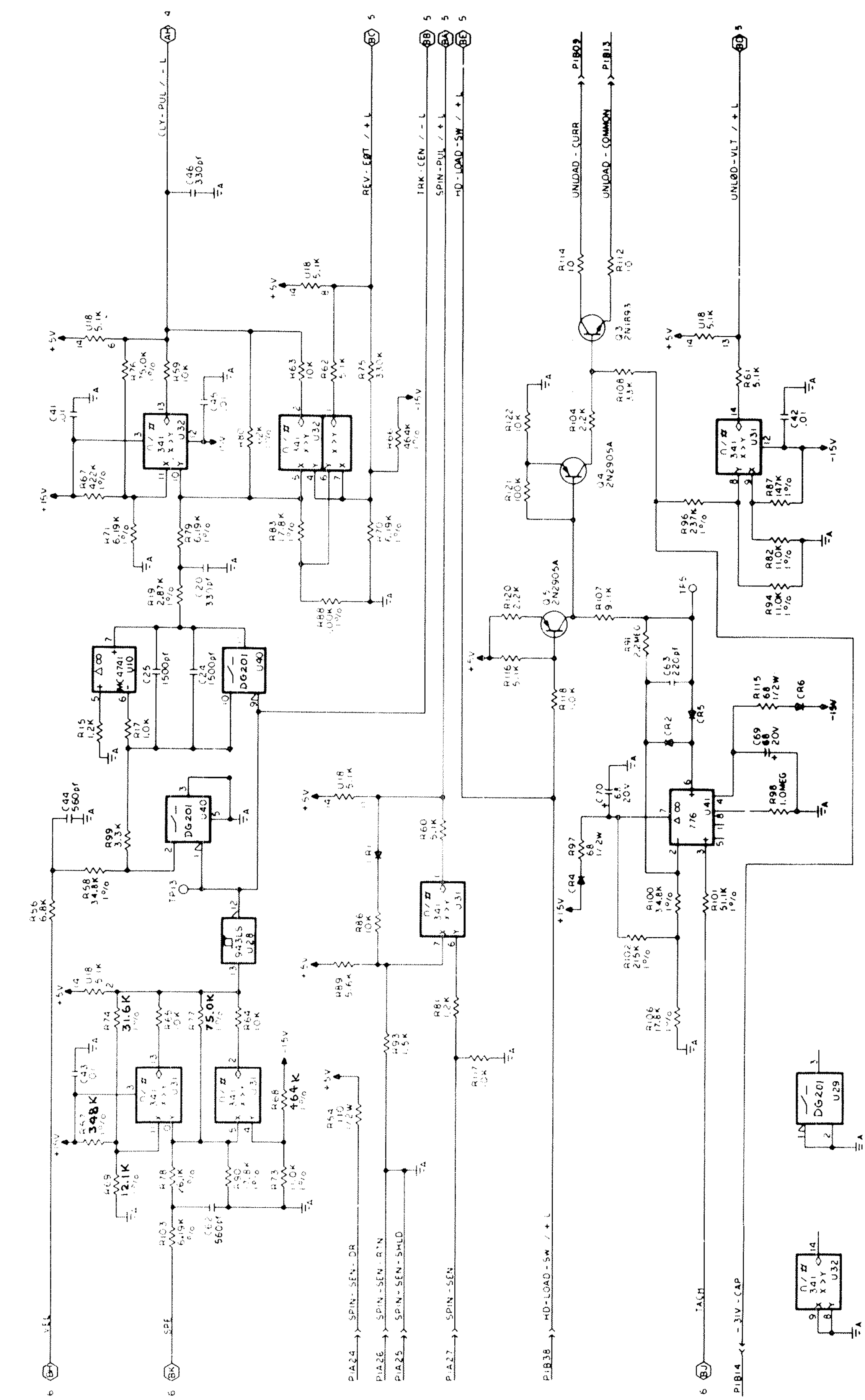


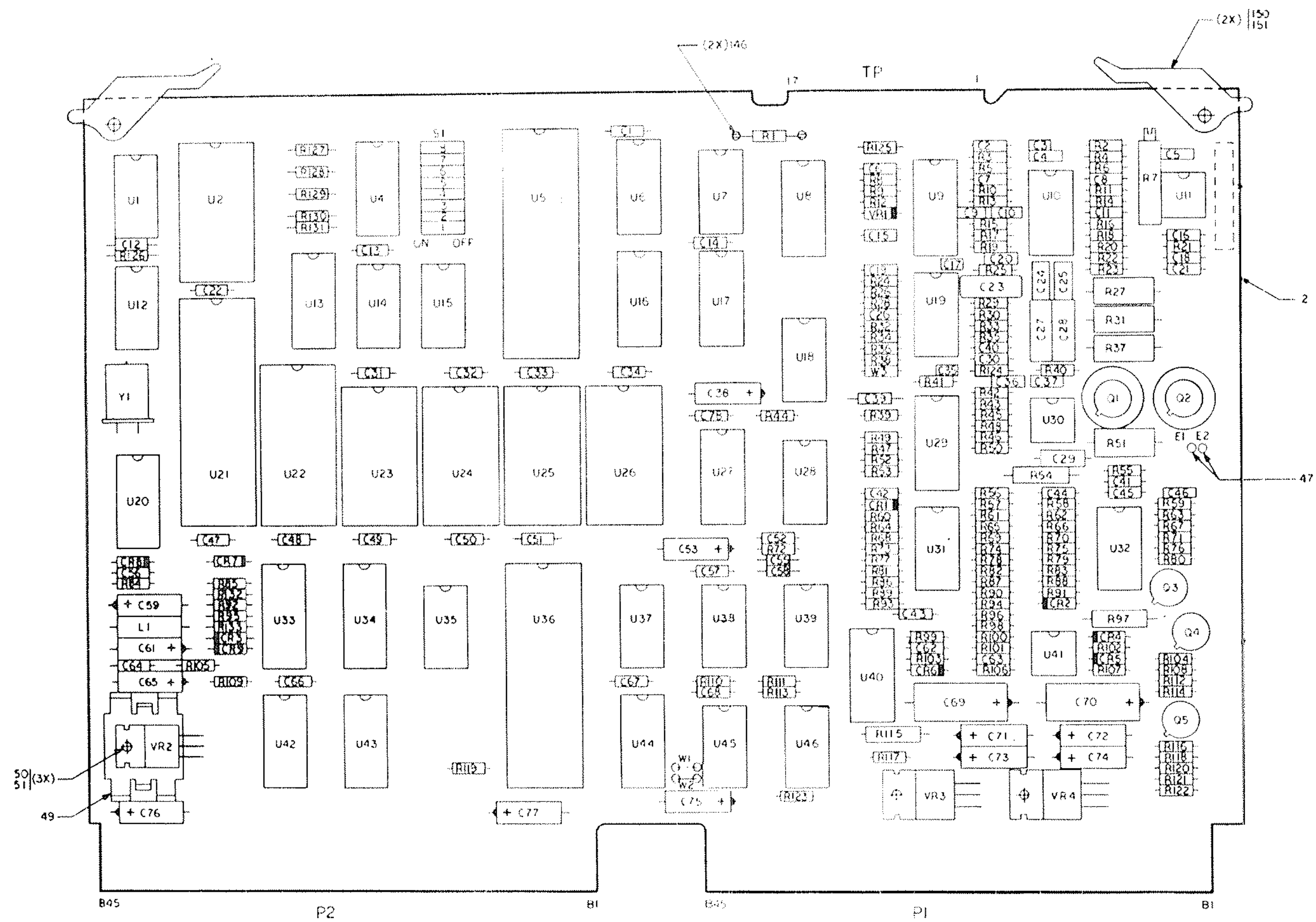
FIGURE 5-6. SERVO COARSE CIRCUIT BOARD (SHEET 7 OF 13)

CROSS REF
NO. 0306



CROSS REF
NO. 0307

Figure 5-6. Servo Coarse Circuit Board (Sheet 8 of 13)



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	95
R17	121
R18	96
R19	87
R20	147
R21	127
R22	147
R23	131
R24	104
R25	147
R26	91
R27	108
R28	[illegible]
R29	[illegible]
R30	[illegible]
R31	[illegible]
R32	[illegible]
R33	[illegible]
R34	91
R35	139
R36	9
R37	63
R38	137
R39	110
R40	130
R41	100
R42	82
R43	99
R44	124
R45	54
R46	98
R47	140
R48	114
R49	114
R50	100
R51	109
R52	107

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	13
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	[illegible]
R81	122
R82	94
R83	100
R84	124
R85	13
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
R105	124
R106	100
R107	126
R108	134
R109	127
R110	120
R111	119
R112	16
R113	119
R114	16
R115	143
R116	127
R117	131
R118	21
R119	136
R120	124
R121	138
R122	131
R123	136
R124	112
R125	127
R126	124

RES	PL ITEM
R127	131
R128	131
R129	131
R130	131
R131	131
R132	131
R133	131

XTAL	PL ITEM
Y	52

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

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

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	17
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

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

IND	PL ITEM
L1	53

4

7

JMPR	PL ITEM
W1	152
W2	—
W3	—
W4	153
W5	153
W6	153

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

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

Item No. No.	Drawing No.	Description	Remarks
	77622402	PWA, Servo Coarse	
	77666800	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 8255A	
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
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	77611806-9	IC Prom BNPF #3	
160	94360552-7	Res 1/4W 1% 348K	
161	94360448-8	Res 1/4 W 1% 31.6K	
162	75808519-5	Cap 100V 10% 330 pF	

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	EM6-P1	B	SIGNAL	X-REF.	SOURCE/DEST	X-REF
		-20 V	0601		1		-20 V	0601		
					2					
					3					
					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
					12					
					13		I-SPE	0603	P1-A13	150 *
					14		SPE	0603	P1-A14	150 *
					15					
					16					
					17					
					18					
					19					
					20					
					21					
					22					
		ANALOG GND	0601		23		ANALOG GND	0601		
					24					
					25					
					26					
					27					
					28					
					29					
					30					
					31					
					32					
					33					
					34					
					35					
					36					
					37					
					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	0205
					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		

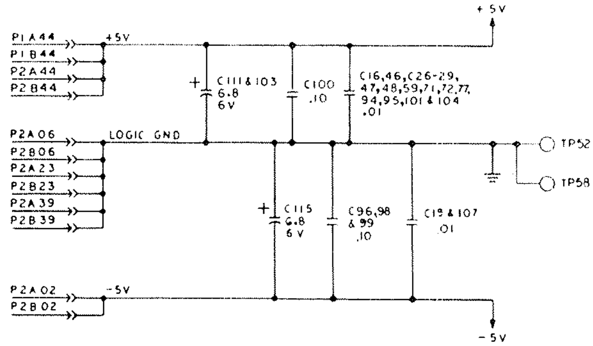
EM6-P2

SOURCE/DEST	X-REF	SIGNAL	X-REF.	A	EM6-P2	B	SIGNAL	X-REF.	SOURCE/DEST	X-REF
					1					
		-5 V	0601		2		-5 V	0601		
					3		AGC-ACTIVE/-L	0603	P2-A03	0305
					4		EN-FXD-SVO/-L	0606	P2-A04	1501
					5					
		LOGIC GND	0601		6		LOGIC GND	0601		
					7					
					8					
					9		PLO-LOCKED/-L	0603	P2-A09	150 *
					10					
					11					
P2-B12	0703	WRT-CLOCK-ENABLE/-L	0605		12					
					13					
					14					
					15					
					16					
					17					
					18					
					19					
					20					
					21					
					22					
		LOGIC GND	0601		23		LOGIC GND	0601		
					24					
					25					
					26					
					27					
					28					
					29					
P2-A30	0305	SVO-CLAMP/-L	0606		30					
					31					
					32					
					33					
					34					
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		
					45					

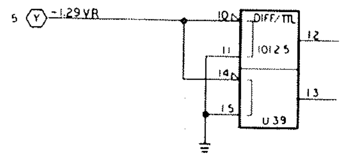
* WIRED TO, BUT NOT USED ON PWA

XX230

Figure 5-7. Servo Fine Circuit Board (Sheet 1 of 11)

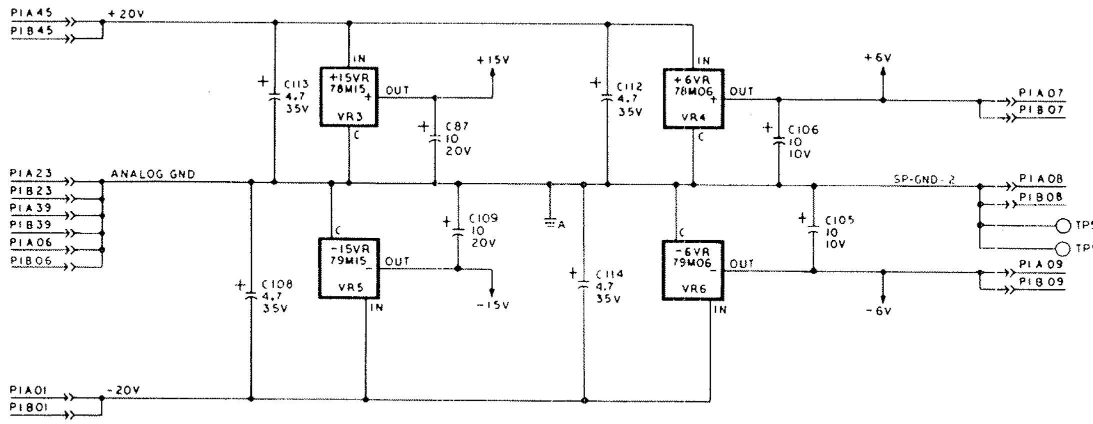


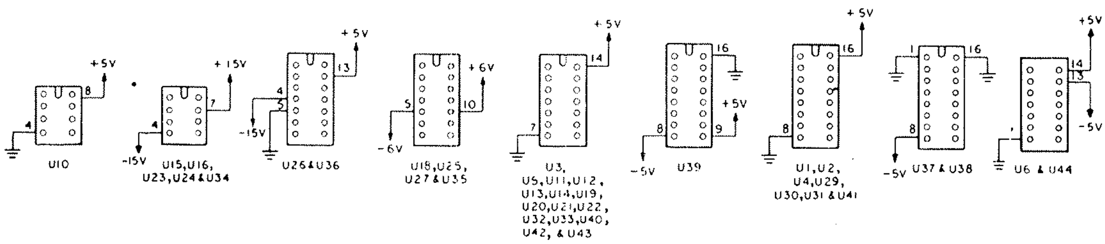
UNUSED LOGIC ELEMENTS			
ELEMENT	VENDOR NO.	LOCATION	OUTPUT PIN
19S	9602	U2	9 OR 10
175S	74S74	U3	8 OR 9
145LS	74LS02	U12	13
202LS	74LS03	U14	8, 11
146LS	74LS04	U43	8



NOTS: UNLESS OTHERWISE SPECIFIED

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





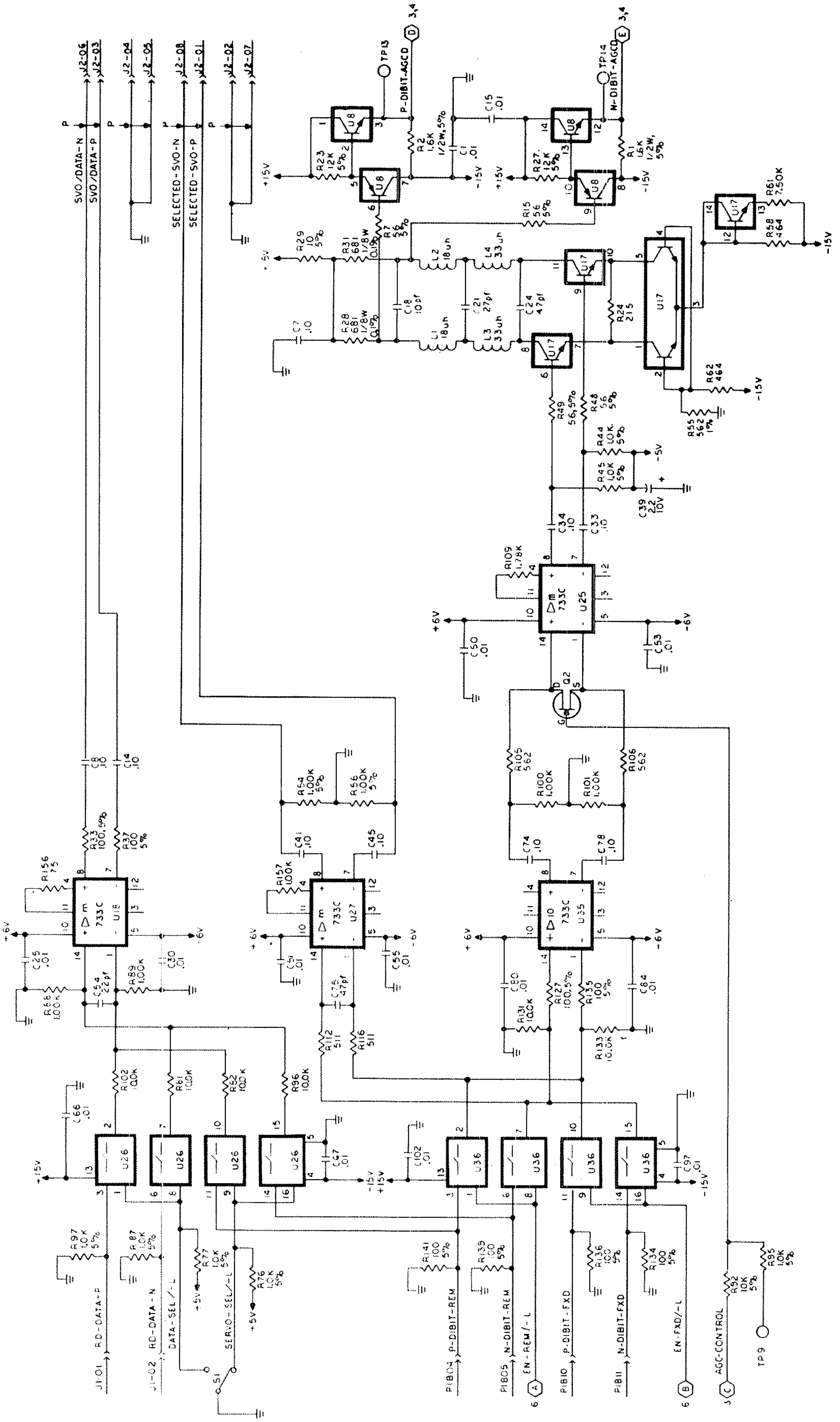
	SIGNAL	SH. NO.	SOURCE/DEST	XREF
	01 RD-DATA-PE	(2)	J8-01	0801
	02 RD-DATA-N	(2)	J8-02	0801
J1	01 SELECTED-SVO-P	(2)	J1-D1	1501
J1	02 GND	(2)		
J1	03 SVO/DATA-N	(2)	J1-03	1501
J1	04 GND	(2)		
J1	05 GND	(2)		
J1	06 SVO/DATA-N	(2)	J1-06	1501
J1	07 GND	(2)		
J1	08 SELECTED-SVO-N	(2)	J1-08	1501

CROSS REF NO. 0601

WARNING

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

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)

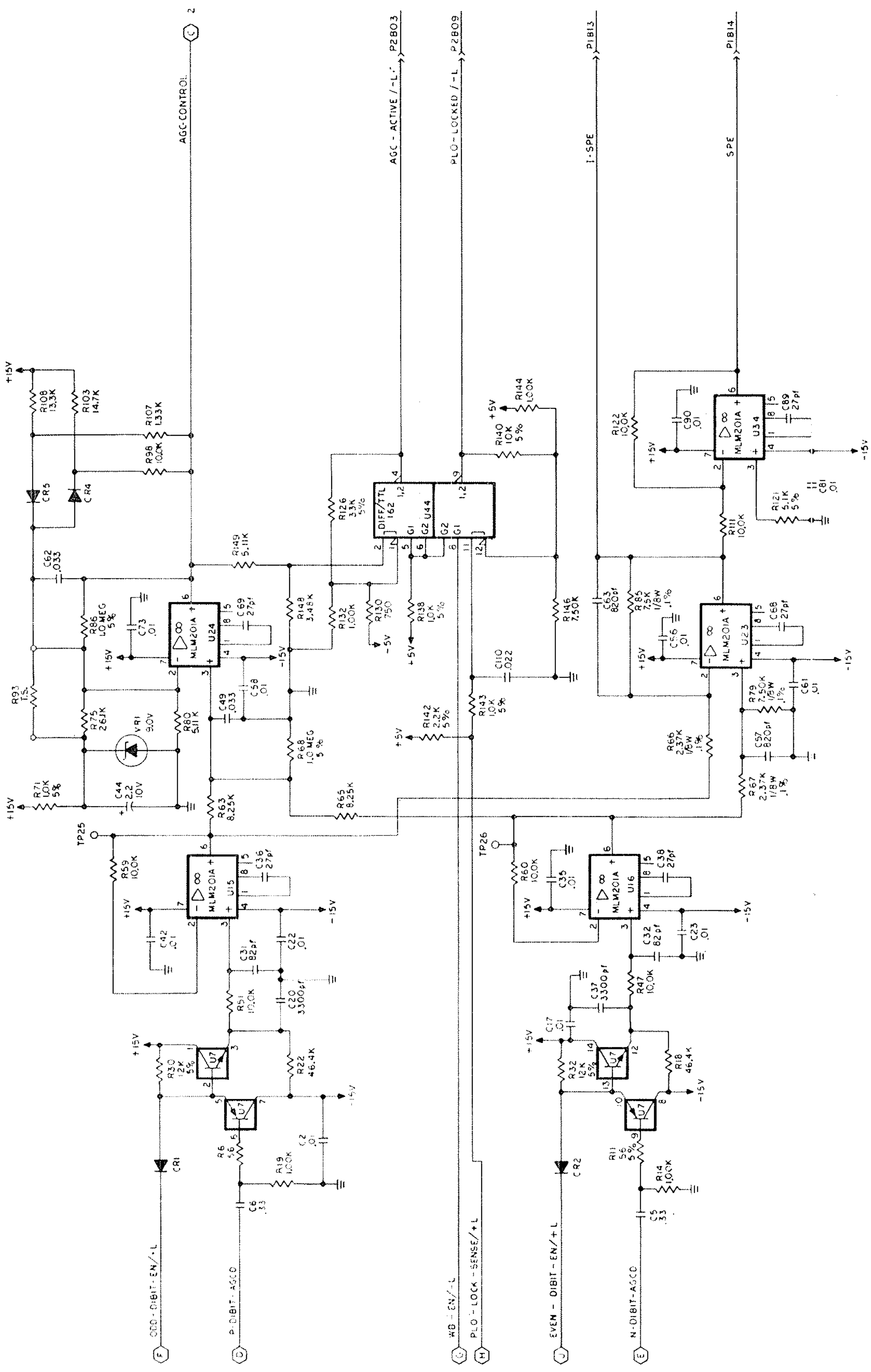
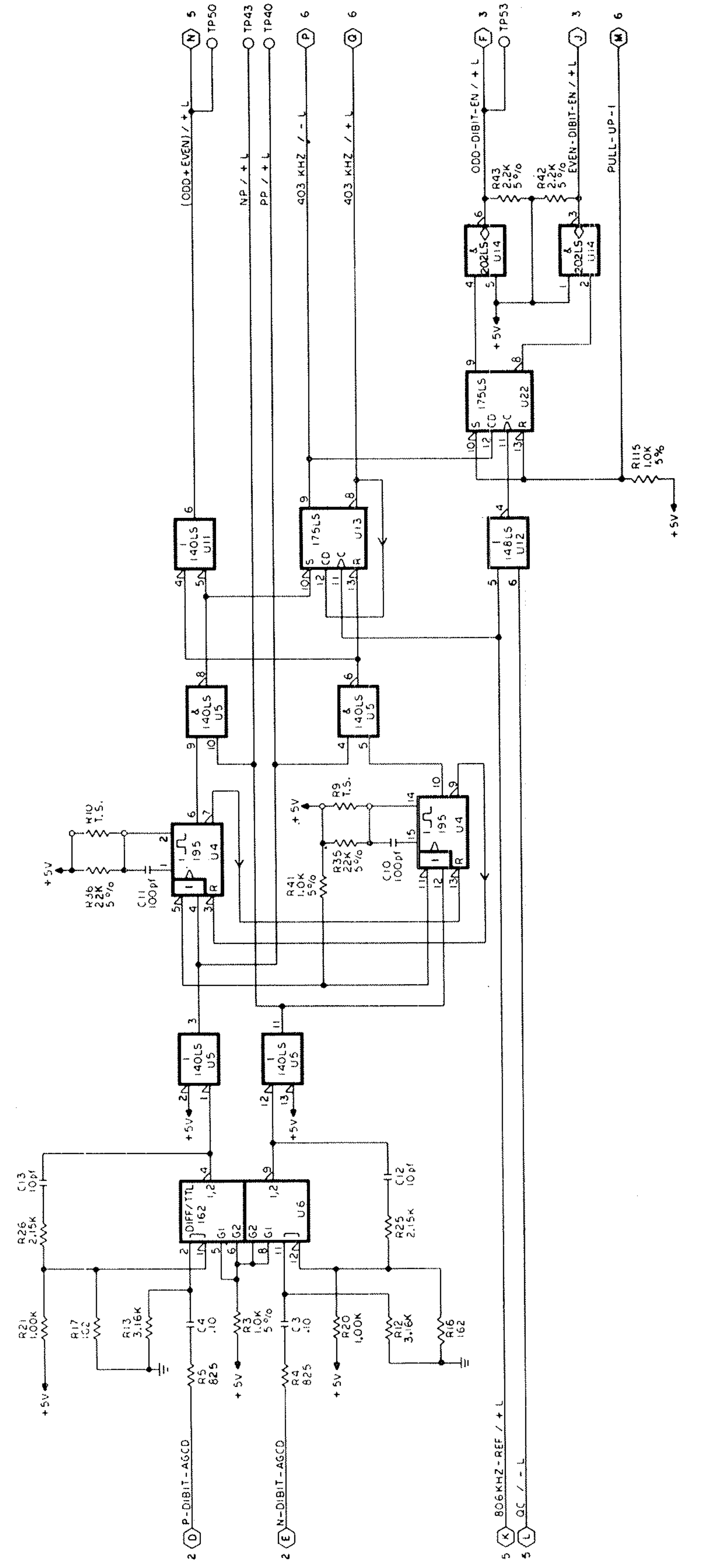


Figure 5-7. Servo Fine Circuit Board (Sheet 4 of 11)

CROSS REF
NO. 0603



CROSS REF
NO. 0604

Figure 5-7. Servo Fine Circuit Board (Sheet 5 of 11)

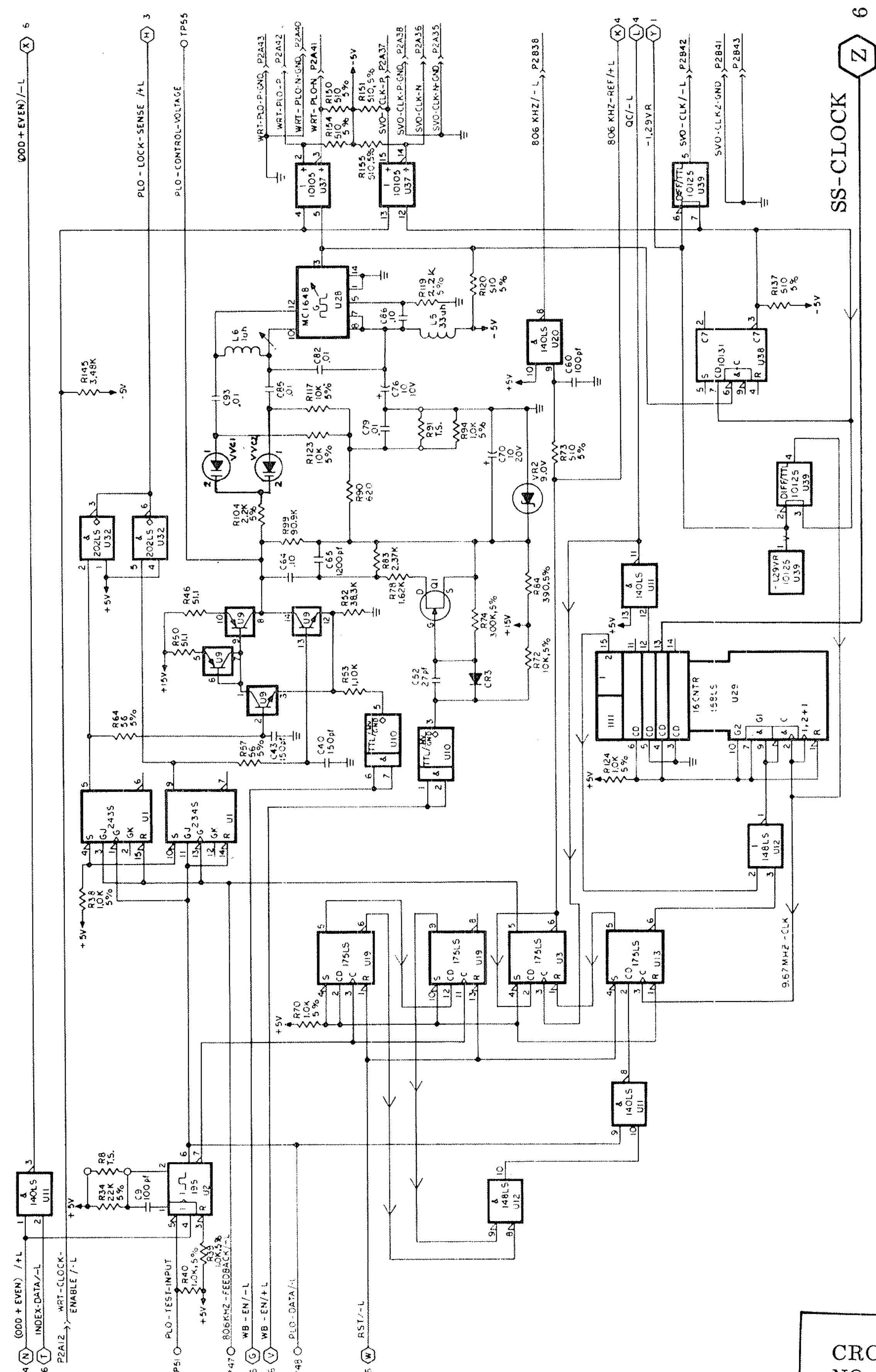


Figure 5-7. Servo Fine Circuit Board (Sheet 6 of 11)

CROSS REF
NO. 0605

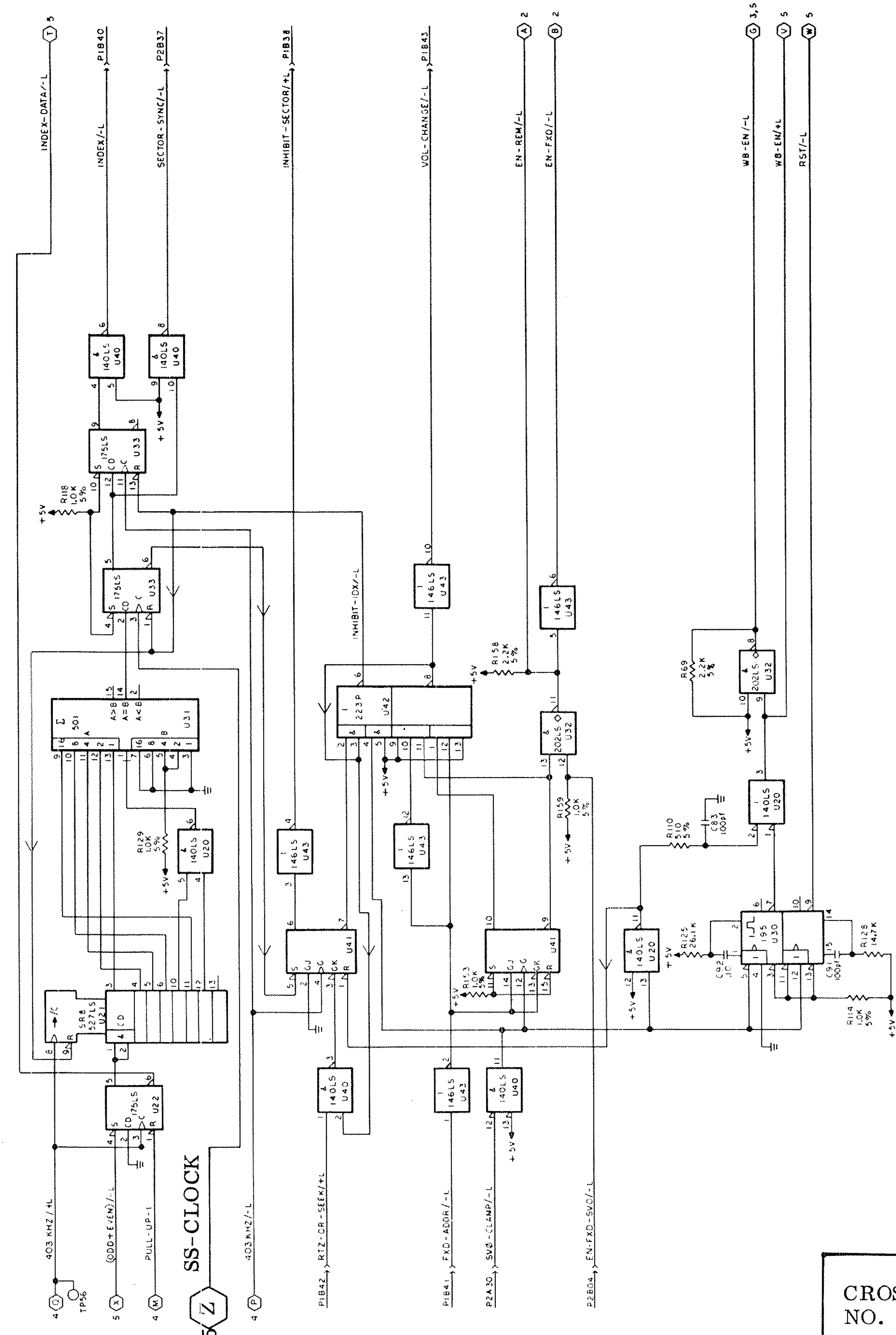
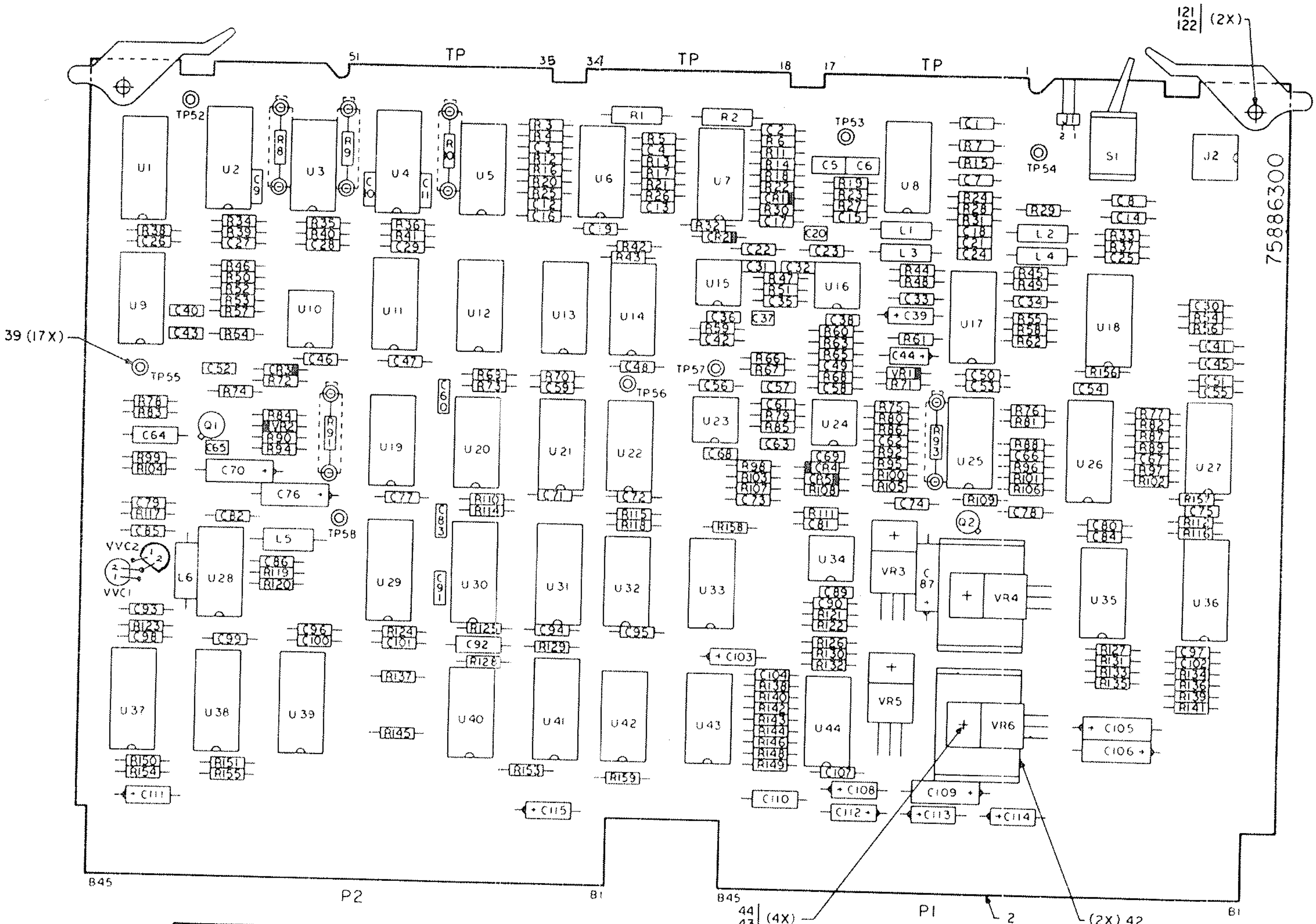


Figure 5-7. Servo Fine Circuit Board (Sheet 7 of 11)

CROSS REF
NO. 0606



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

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

TSTR	PL ITEM
Q1	32
Q2	32

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

VARI CAP DIODE	PL ITEM
VVC1	46
VVC2	46

SW	PL ITEM
S1	120

CONN	PL ITEM
J1	40
J2	41

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

CAP	PL ITEM
C59	66
C60	57
C61	66
C62	63
C63	59
C64	61
C65	62
C66	66
C67	65
C68	54
C69	54
C70	49
C71	66
C72	66
C73	66
C74	67
C75	55
C76	48
C77	66
C78	67
C79	66
C80	66
C81	66
C82	66
C83	57
C84	66
C85	66
C86	57
C87	49
C88	—
C89	54
C90	66
C91	57
C92	61
C93	66
C94	66
C95	66
C96	67
C97	66
C98	67
C99	67
C100	67
C101	66
C102	66
C103	47
C104	66
C105	48
C106	48
C107	66
C108	50
C109	49
C110	64
C111	47
C112	50
C113	50
C114	50
C115	47

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

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

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

RES	PL ITEM
R1	69
R2	69
R3	109
R4	84
R5	84
R6	104
R7	104
R8	119
R9	119
R10	119
R11	104
R12	88
R13	88
R14	85
R15	104
R16	74
R17	74
R18	97
R19	85
R20	85
R21	85
R22	97
R23	113
R24	77
R25	82
R26	82
R27	113
R28	70
R29	101
R30	113
R31	70
R32	113
R33	105
R34	114
R35	114
R36	114
R37	105
R38	109
R39	109
R40	109
R41	109
R42	110
R43	110
R44	109
R45	109
R46	75
R47	93
R48	104
R49	104
R50	75
R51	93
R52	99
R53	76
R54	109
R55	81
R56	109
R57	104
R58	79

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	50252900-1	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.	PIN (A)
		ANALOG -5 V	0701	2
J1-05	0801	ANALOG GND	0701	6
J7-15	0801	-5 V		7
J7-12	0801	+20 V		8
J7-02	0801	+5 V		9
J7-07	0801	ANALOG GND	0701	10
		ANALOG GND	0701	11
J7-01	0801	RD-ANA-DATA	0702	12
J7-16	0801	RD-ANA-DATA	0702	13
		ANALOG GND	0701	14
		ANALOG GND	0701	15
		ANALOG GND	0701	23
		GND	0701	39
		+5 V	0701	44
		+20 V	0701	45

PIN (B)	SIGNAL	X-REF.	SOURCE/DEST	X-REF.
2	ANALOG -5 V	0701		
6	ANALOG GND	0701		
10	ANALOG GND	0701		
11	ANALOG GND	0701		
12	ANALOG GND	0701		
13	ANALOG GND	0701		
14	ANALOG GND	0701		
15	ANALOG GND	0701		
16	DIAG-RD-AGC	0702	P1-A16	1501
18	AM-ENABLE/+L	0704	P1-A18	5
23	ANALOG GND	0701		
39	GND	0701		
44	+5 V	0701		
45	+20 V	0701		

EM7-P2

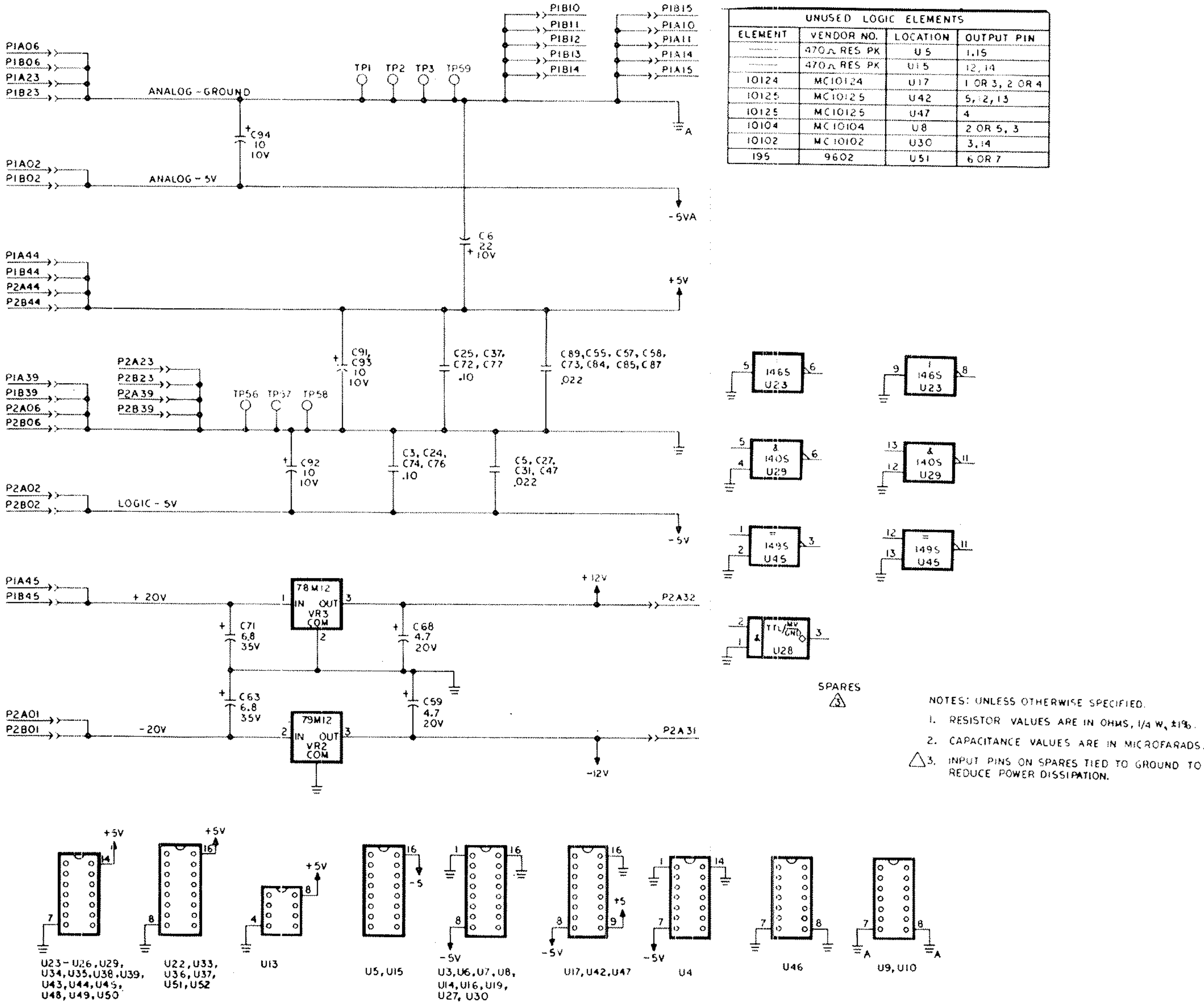
SOURCE/DEST	X-REF.	SIGNAL	X-REF.	PIN (A)
		-20 V	0701	1
		LOGIC -5	0701	2
P1-A40	0206	PWR-UP-MR/-L	0705	3
P1-A38	0205	AM-FOUND/+L	0705	4
		GND	0701	6
P1-A42	0204	LATE STROBE/-L	0703	7
P1-A37	020 *	ON-TIME-EN/-L	0704	16
		GND	0701	23
J7-13	0801	-12 V	0701	31
J7-04	0801	+12 V	0701	32
J7-06	0801	MFM-WRT-CMPS/+L	0704	34
J7-11	0801	MFM-WRT-GND	0704	35
		GND	0701	39
		+5 V	0701	44

PIN (B)	SIGNAL	X-REF.	SOURCE/DEST	X-REF.
1	-20 V	0701		
2	LOGIC -5 V	0701		
3	ERLY-STROBE/-L	0703	P1-B41	0204
4	WRT-GATE/+L	0704	P1-B40	0204
5	READ-GATE/+L	0705	P1-B38	0204
6	GND	0701		
7	NRZ-DATA-OUT-GND	0703	P2-A33	0204
8	NRZ-DATA-OUT	0703	P2-A34	0204
9	RD-CLK/-L	0703	P2-A27	0204
10	RD-CLK-GND	0703	P2-A26	0204
12	WRT-CLOCK-ENABLE/-L	0703	P2-A12	0605
23	GND	0701		
25	DIAG-RD-PLO-LOCK/+L	070 *	P2-A25	1501
28	WRT-CLK-GND	0704	P2-A28	0204
29	WRT-CLK/-L	0704	P2-A29	0204
31	NRZ-WRT-GND	0704	P2-A31	0204
32	NRZ-WRT/-L	0704	P2-A32	0204
35	SVO-CLK-N-GND	0703	P2-A35	0605
36	SVO-CLK-N	0703	P2-A36	0605
37	SVO-CLK-P	0703	P2-A37	0605
38	SVO-CLK-P-GND	0703	P2-A38	0605
39	GND	0701		
40	WRT-PLO-N-GND	0704	P2-A40	0605
41	WRT-PLO-N	0074	P2-A41	0605
42	WRT-PLO-P	0704	P2-A42	0605
43	WRT-PLO-P-GND	0704	P2-A43	0605
44	+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	MC10104	U8	2 OR 5, 3
10102	MC10102	U30	3,14
195	9602	U51	6 OR 7

NOTES: UNLESS OTHERWISE SPECIFIED.
1. RESISTOR VALUES ARE IN OHMS, 1/4 W, ±1%.
2. CAPACITANCE VALUES ARE IN MICROFARADS.
3. INPUT PINS ON SPARES TIED TO GROUND TO REDUCE POWER DISSIPATION.

Figure 5-8. Read/Write Circuit Board (Sheet 2 of 10)

CROSS REF NO. 0701

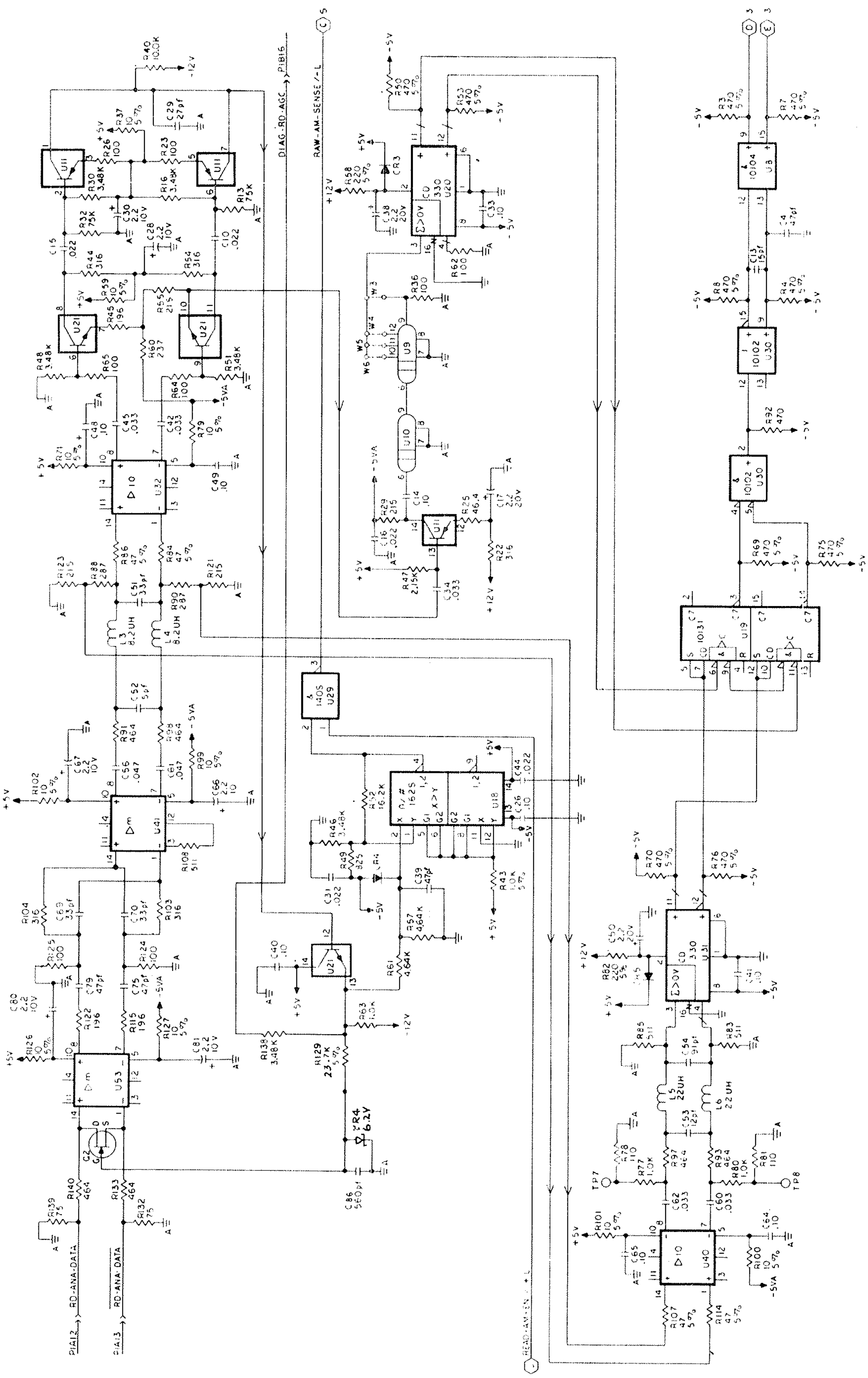


Figure 5-8. Read/Write Circuit Board (Sheet 3 of 10)

CROSS REF
NO. 0702

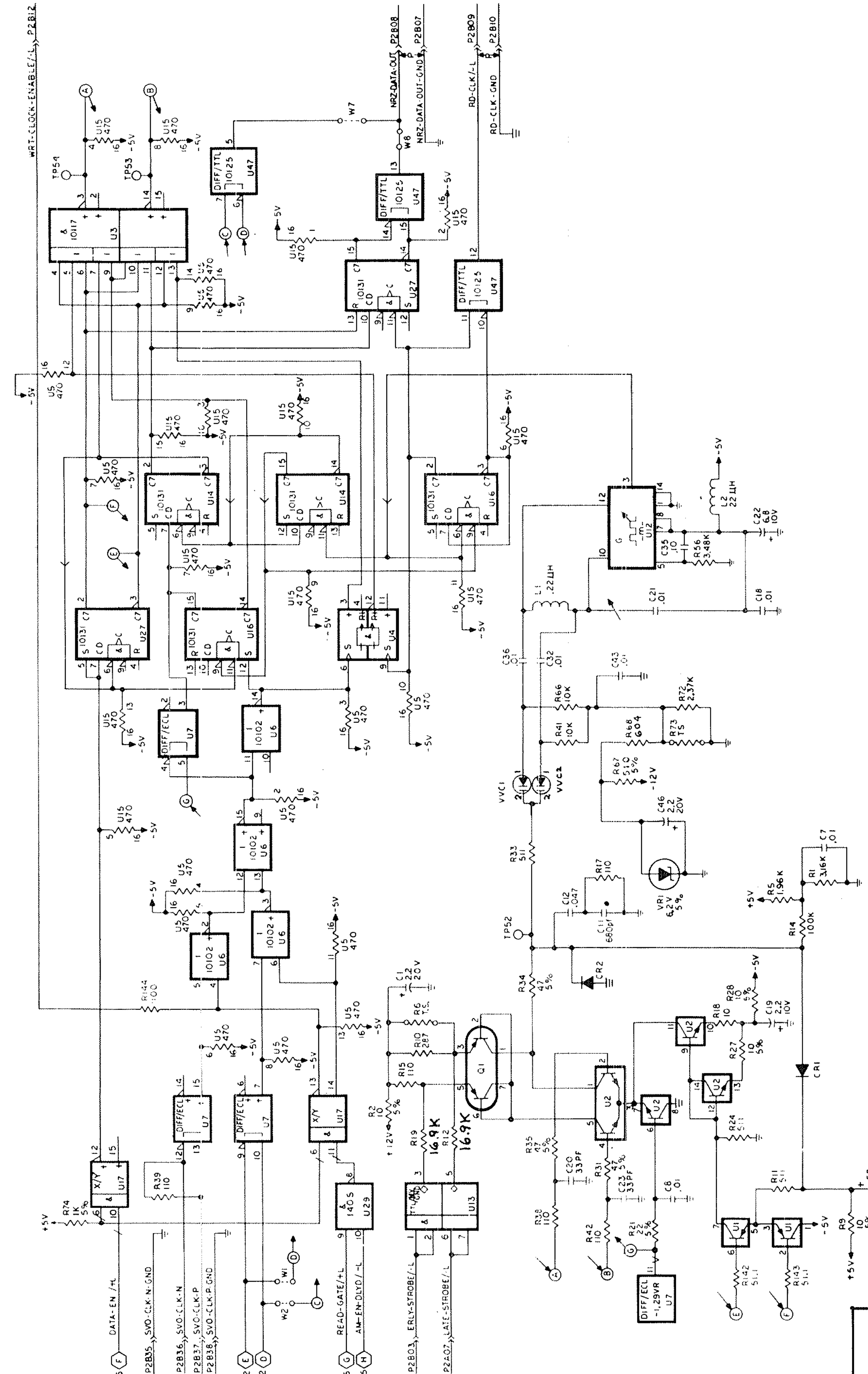


Figure 5-8. Read/Write Circuit Board (Sheet 4 of 10)

CROSS REF
NO. 0703

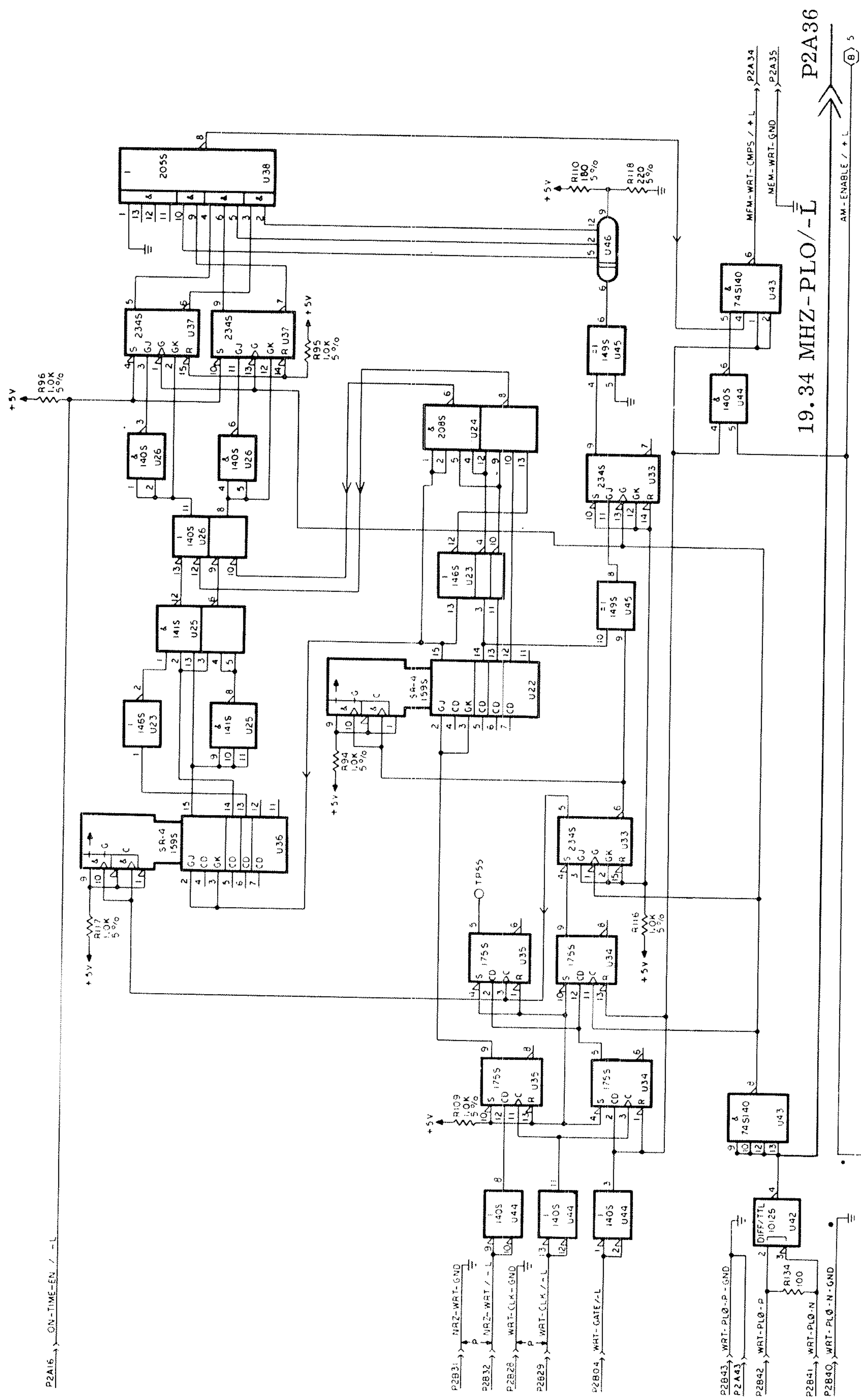


Figure 5-8. Read/Write Circuit Board (Sheet 5 of 10)

CROSS REF
NO. 0704

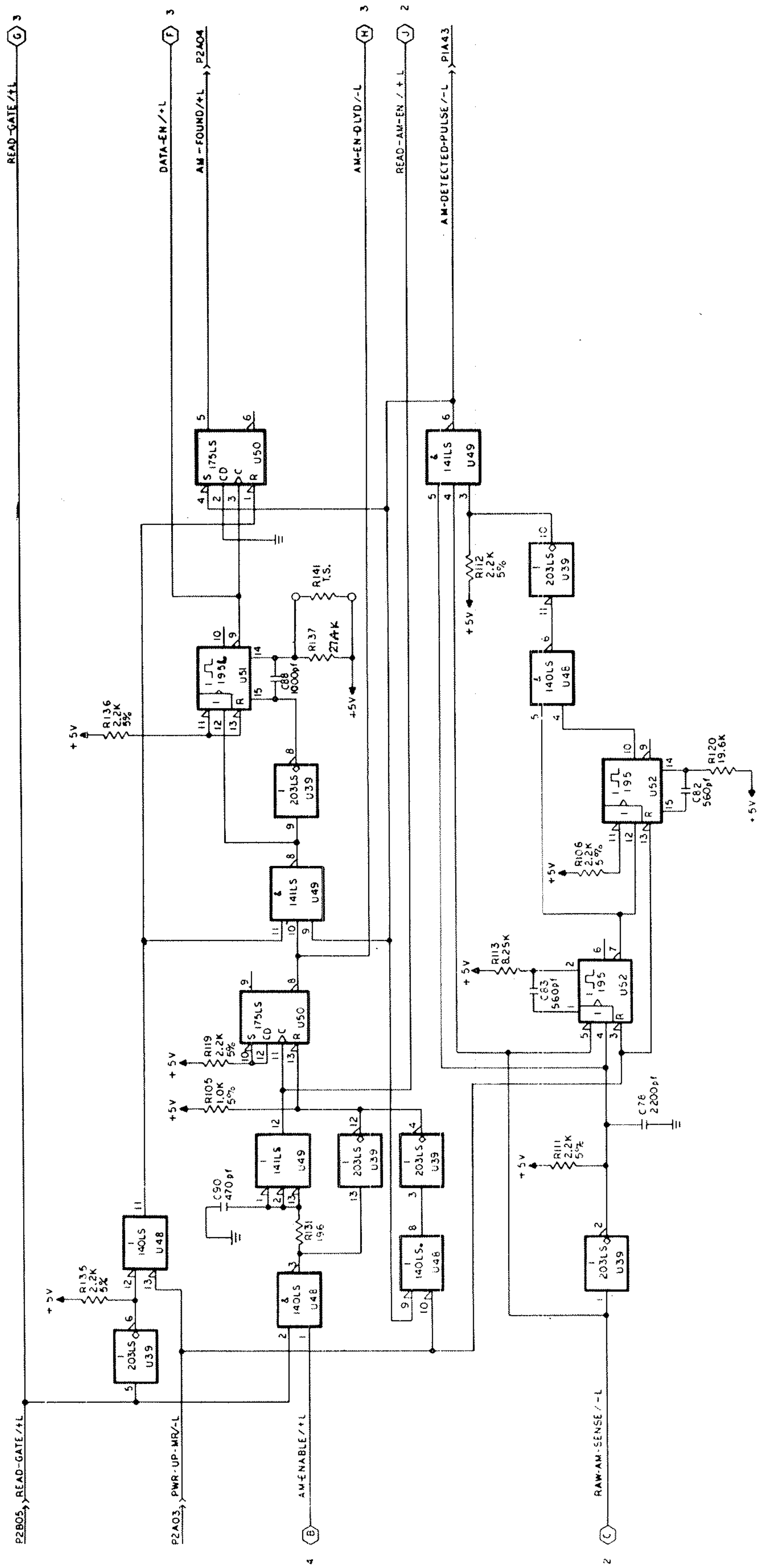
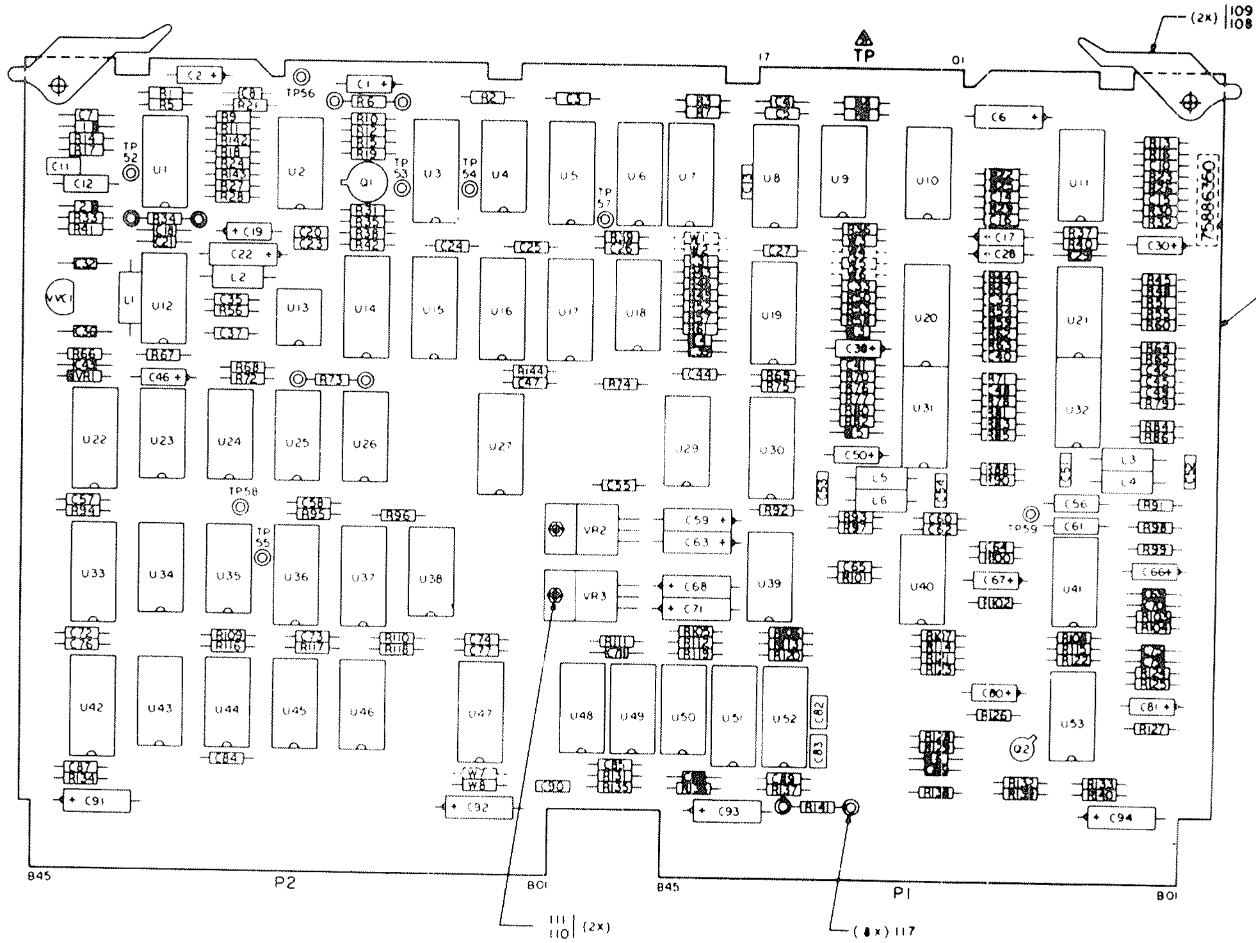


Figure 5-8. Read/Write Circuit Board (Sheet 6 of 10)

CROSS REF
NO. 0705



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	2
U8	1
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	5
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	9
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	[illegible]
R131	58
R132	55
R133	64
R134	56
R135	51
R136	51
R137	121
R138	71
R139	55
R140	64
R141	43
R142	[illegible]
R143	[illegible]
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	71
R67	41
R68	54
R69	49
R70	49
R71	44
R72	70
R73	43
R74	50
R75	49
R76	49
R77	67
R78	51
R79	44
R80	67
R81	57
R82	48
R83	65
R84	45
R85	65
R86	45
R87	—
R88	61
R89	—
R90	51
R91	64
R92	49
R93	54
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

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	MVAM2	
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)

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 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		
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

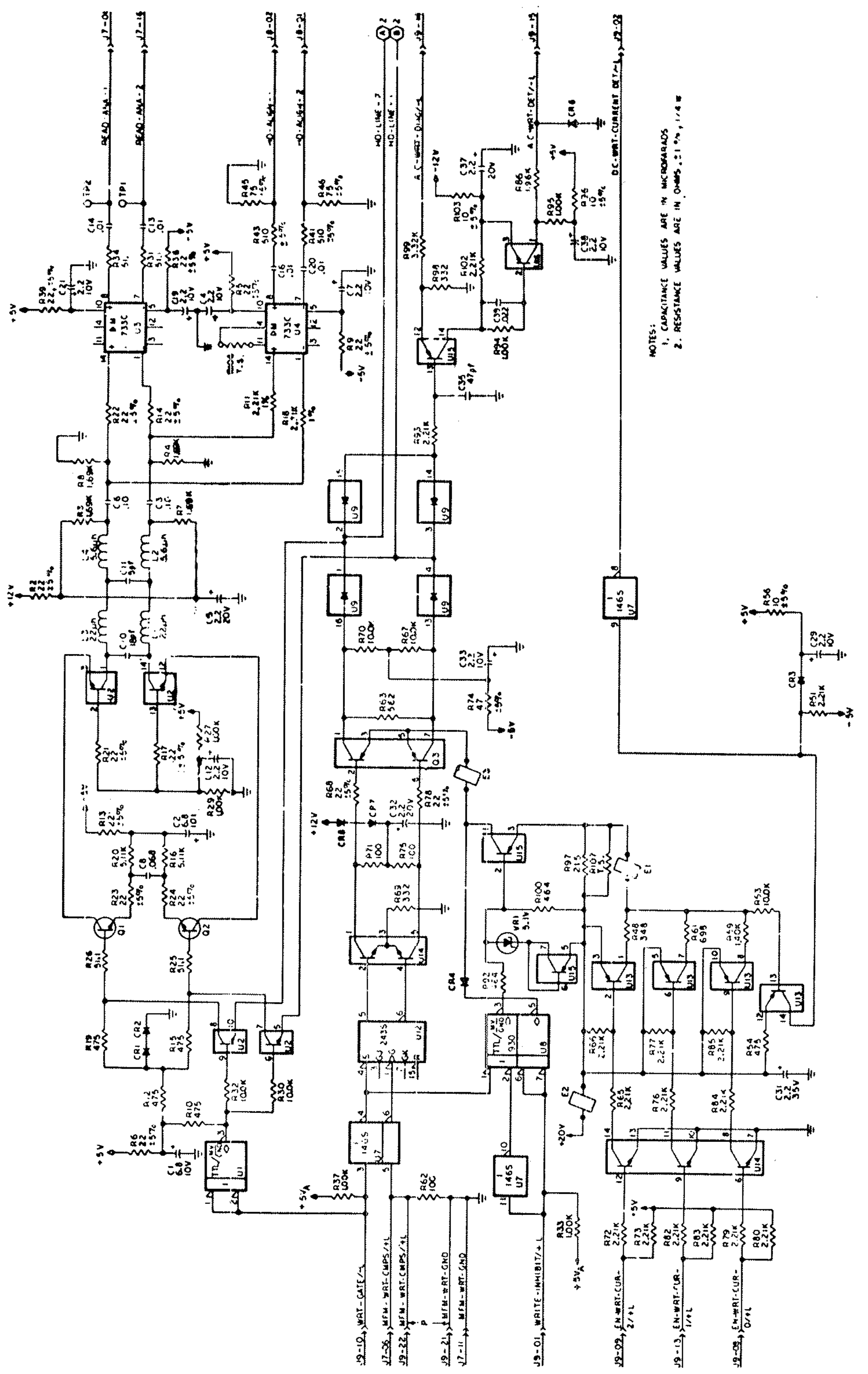
R/W PREAMP CKT BOARD

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

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

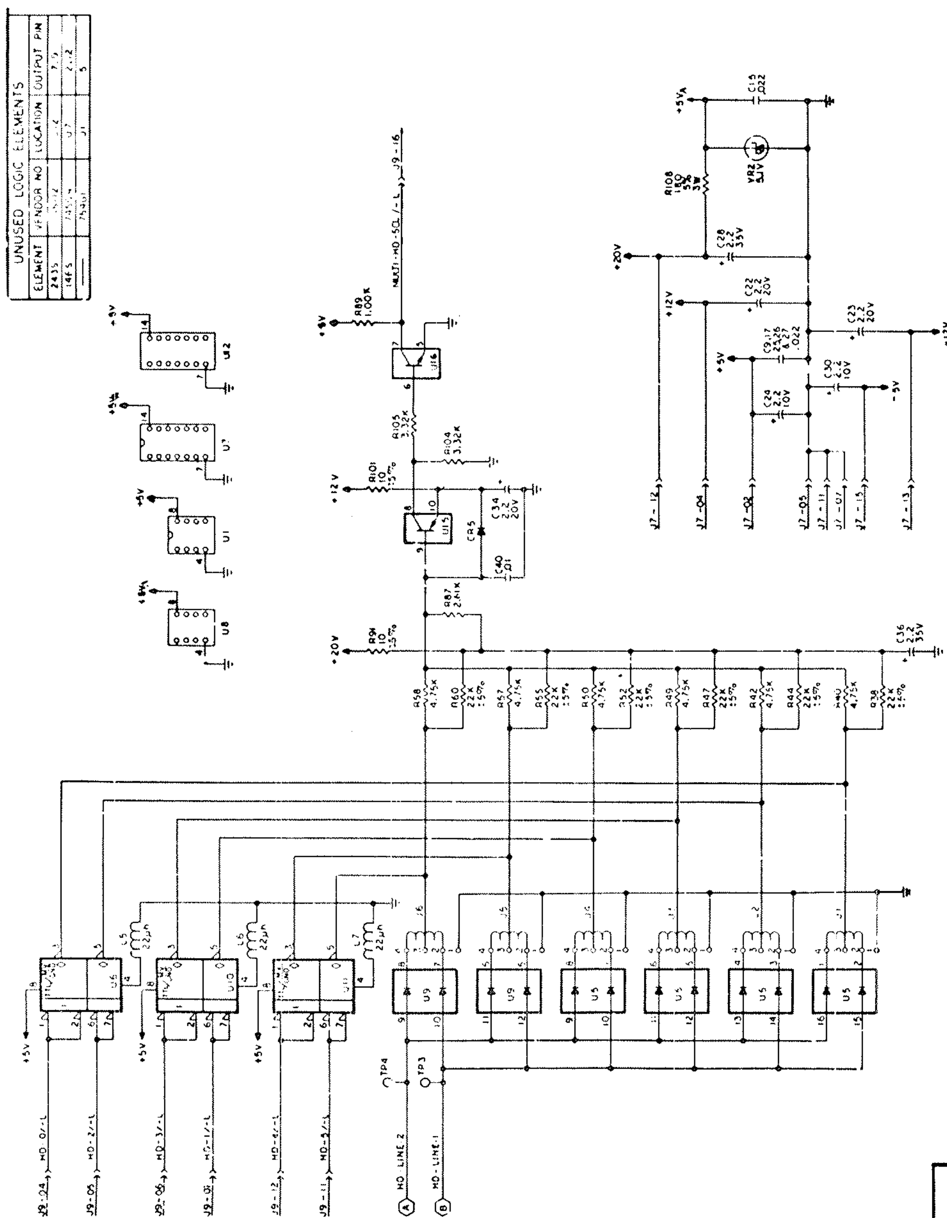
ZZ158a

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)



CROSS REF NO. 0802

Figure 5-9. Read/Write Preamp Circuit Board (Sheet 3 of 6)

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

TSTR	PL ITEM
Q1	15
Q2	15
Q3	14
Q4	—

CONN	PL ITEM
J7	57
J8	55
J9	56

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

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

TERM	PL ITEM
TP1	59
TP2	59
TP3	59
TP4	59

CAP	PL ITEM
C1	29
C2	29
C3	24
C4	26
C5	27
C6	24
C7	26
C8	67
C9	20
C10	23
C11	22
C12	26
C13	25
C14	25
C15	20
C16	25
C17	20
C18	—
C19	25
C20	25
C21	[illegible]
C22	27
C23	27
C24	26
C25	20
C26	20
C27	20
C28	26
C29	26
C30	[illegible]
C31	28
C32	27
C33	26
C34	27
C35	21
C36	28
C37	27
C38	26
C39	20
C40	25

BEAD	PL ITEM
E1	53
E2	53
E3	53

RES	PL ITEM
R54	43
R55	36
R56	33
R57	50
R58	50
R59	66
R60	36
R61	69
R62	38
R63	42
R64	—
R65	48
R66	48
R67	52
R68	34
R69	41
R70	52
R71	38
R72	48
R73	48
R74	35
R75	38
R76	48
R77	48
R78	34
R79	48
R80	48
R81	—
R82	48
R83	48
R84	48
R85	48
R86	60
R87	61
R88	—
R89	45
R90	—
R91	33
R92	44
R93	48
R94	45
R95	45
R96	33
R97	39
R98	41
R99	49
R100	44
R101	33
R102	48
R103	33
R104	49
R105	49
R106	62
R107	67
R108	70

RES	PL ITEM
R1	—
R2	34
R3	46
R4	46
R5	34
R6	34
R7	46
R8	46
R9	34
R10	43
R11	48
R12	43
R13	34
R14	34
R15	43
R16	51
R17	34
R18	48
R19	43
R20	51
R21	34
R22	←
R23	→
R24	34
R25	37
R26	37
R27	45
R28	—
R29	45
R30	52
R31	37
R32	52
R33	45
R34	37
R35	—
R36	34
R37	45
R38	36
R39	34
R40	50
R41	63
R42	50
R43	63
R44	36
R45	64
R46	64
R47	36
R48	40
R49	50
R50	50
R51	48
R52	35
R53	52

VOLT REG	PL ITEM
VR1	19
VR2	19

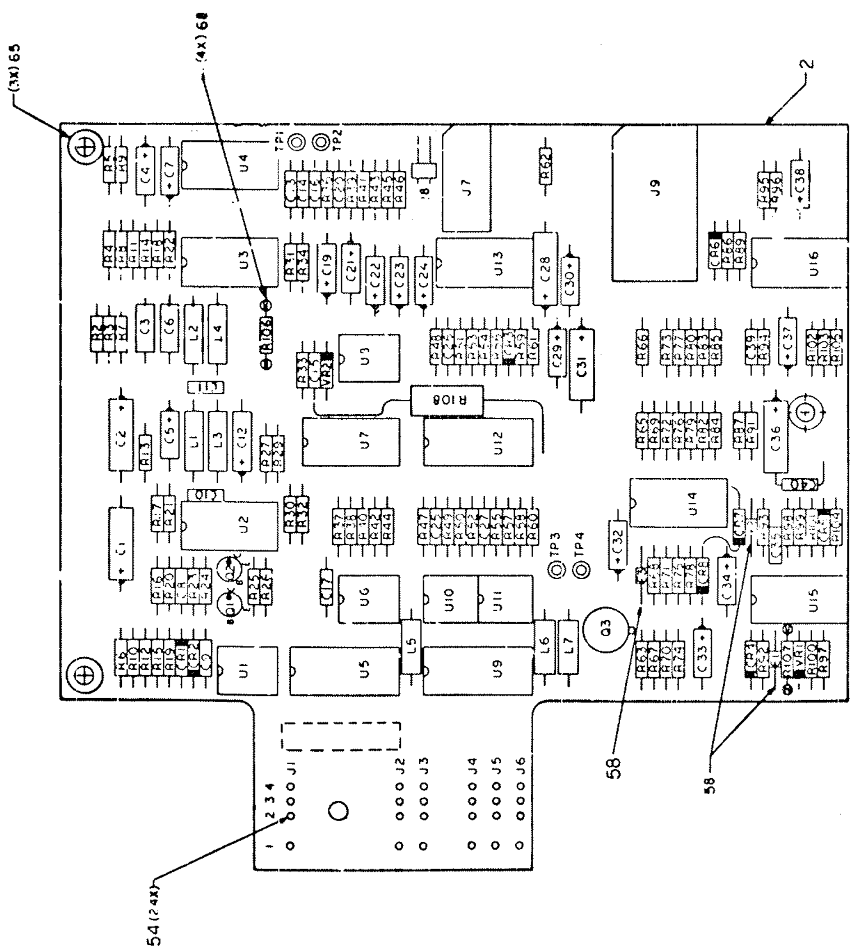


Figure 5-9. Read/Write Preamp Circuit Board (Sheet 4 of 6)

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	

Figure 5-9. Read/Write Preamp Circuit Board (Sheet 6 of 6)

SERVO PREAMP CKT BD

J1		SIGNAL	SOURCE/DEST
01	←	SHD-PDIBIT-REM	TO REM SERVO HEAD
02	←	SHD-GND-REM	
03	←	SHD-GND-REM	
05	←	SHD-NDIBIT-REM	

J2		SIGNAL	SOURCE/DEST	XREF
01	→	PDIBIT-REM	P1-B04	0602
02	←	SP GND 1	P1-B06	0601
03	←	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 4)

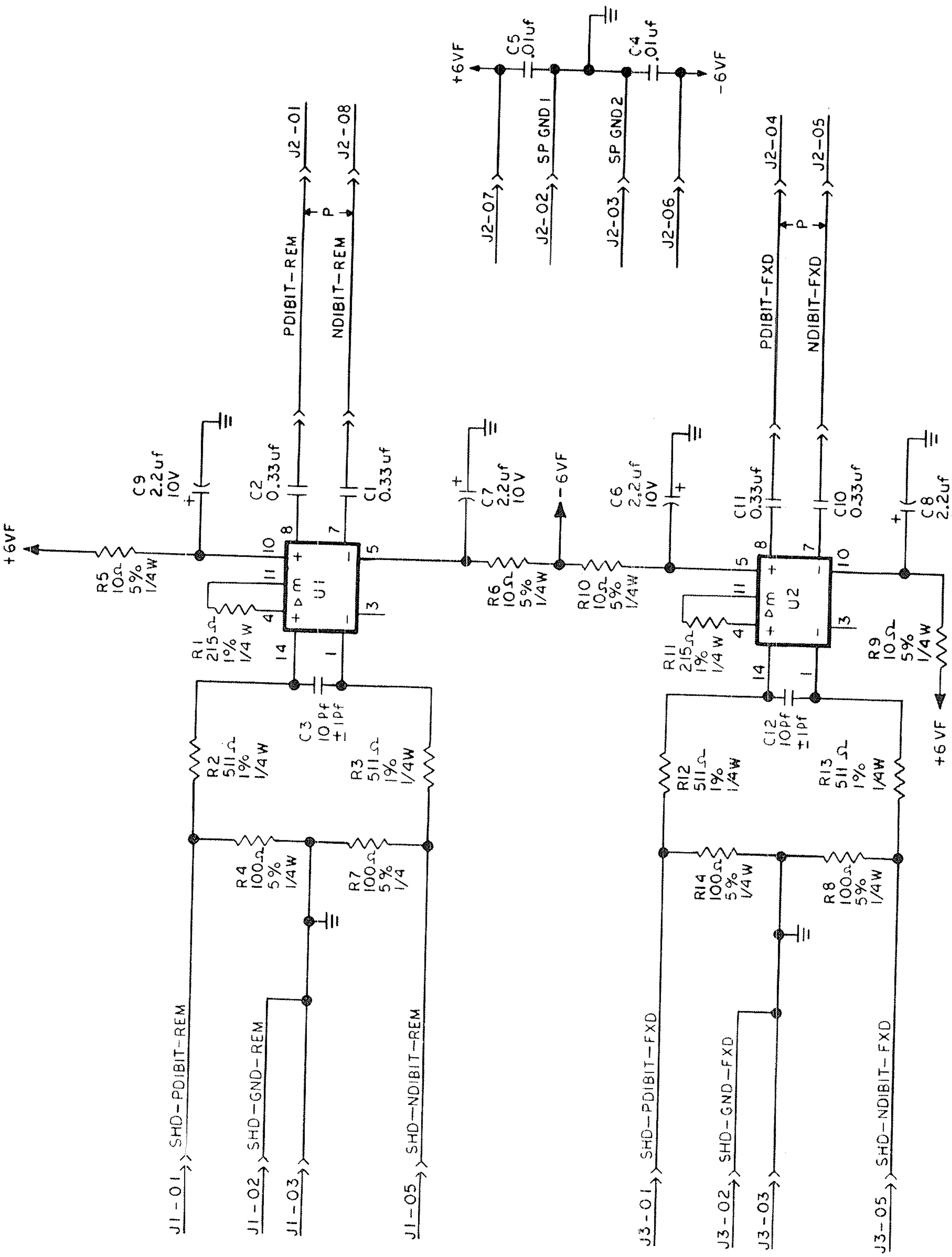
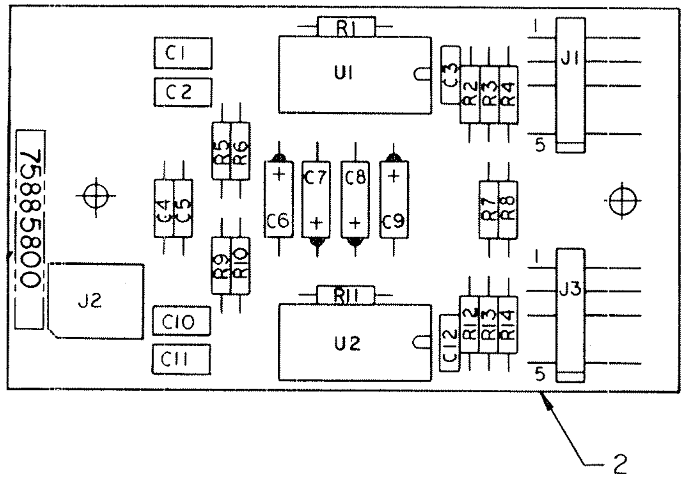


Figure 5-10. Servo Preamp Circuit Board (Sheet 2 of 4)

CROSS REF
NO. 0901



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

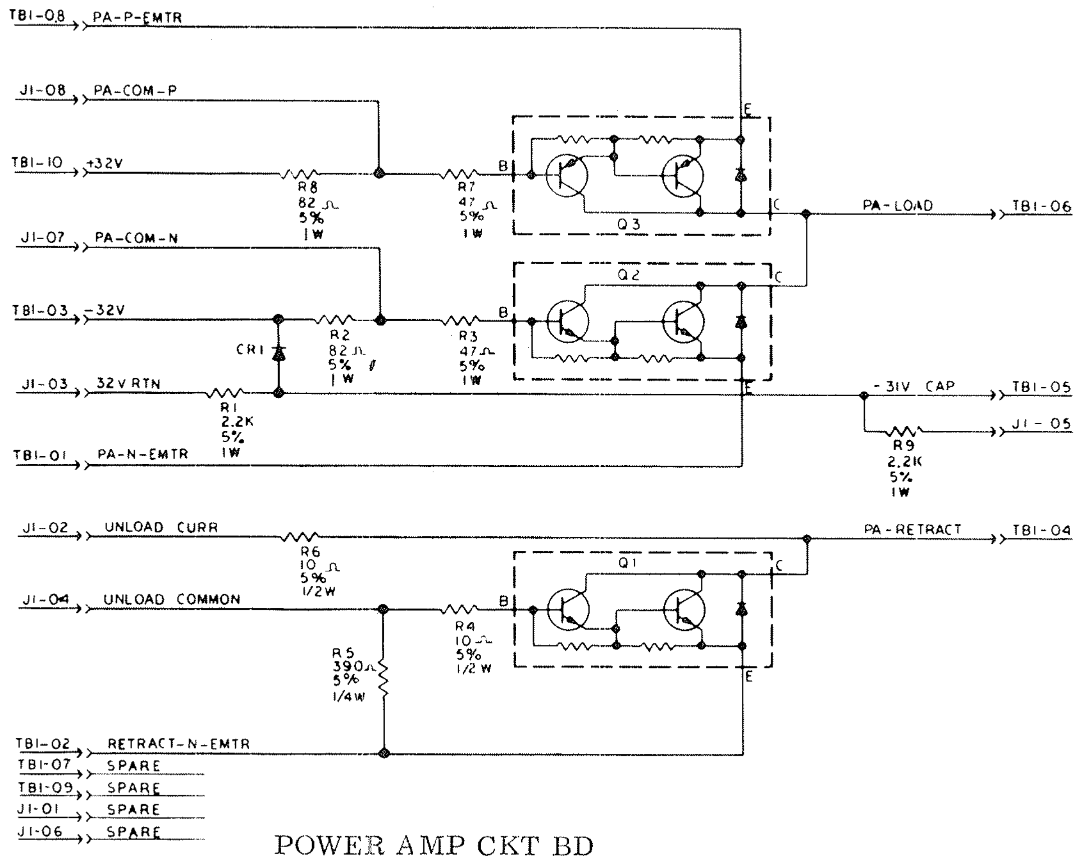
IC	PL ITEM
U1	5
U2	5

CONN	PL ITEM
J1	14
J2	15
J3	14

Figure 5-10. Servo Preamp Circuit Board (Sheet 3 of 4)

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 1/4W 5% 100	
7	94360268-0	Res 1/4W 1% 511	
8	94360232-6	Res 1/4W 1% 215	
9	24500015-3	Res 1/4W 5% 10	
10	94227205-5	Cap 500V +1PF 10	
11	24504342-7	Cap 10V 20% 2.2uF	
12	94354816-4	Cap 50V 20% .33uF	
13	75808537-7	Cap 100V 10% .01uF	
14	75772401-8	Connector Hdr	
15	77832292-5	Socket, 8 Pin	

Figure 5-10. Servo Preamp Circuit Board (Sheet 4 of 4)

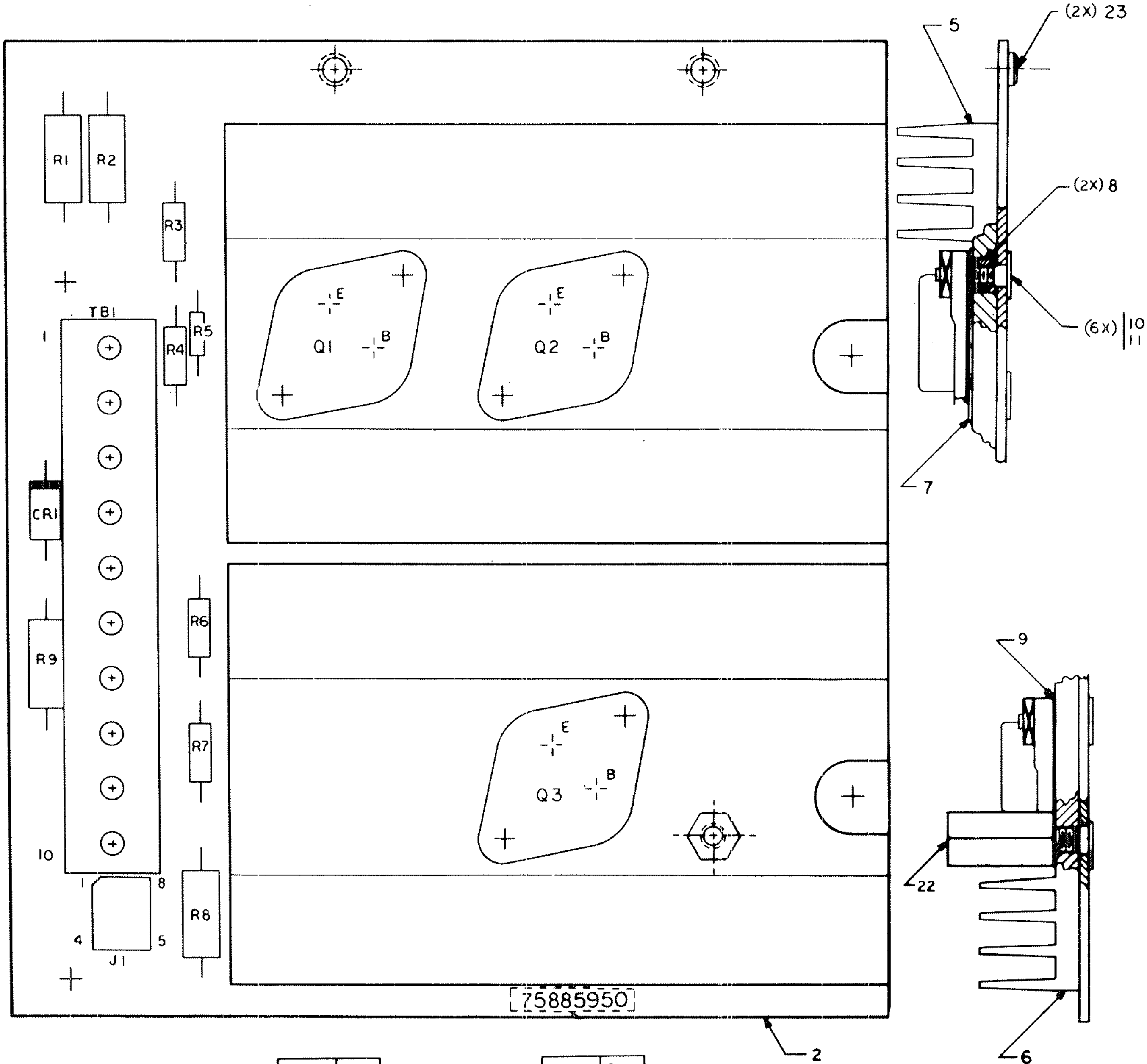


POWER AMP CKT BD

J1		SIGNAL	SCH. SH. NO.	SOURCE/DEST	XREF
01		SPARE			
02	←	UNLOAD CURR		P1-B09	0307
03	←	32V RET		P1-B11	0307
04	←	UNLOAD COMMON		P1-B13	0307
05	→	-31-CAP		P1-B14	0307
06		SPARE			
07	←	PA-COM-N		P1-B10	0306
08	←	PA-COM-P		P1-B08	0306

Figure 5-11. Power Amp Circuit Board (Sheet 1 of 3)

CROSS REF NO. 1001



RES	PL ITEM
R1	17
R2	21
R3	16
R4	15
R5	20
R6	15
R7	16
R8	21
R9	17

CONN	PL ITEM
J1	19

TSTR	PL ITEM
Q1	12
Q2	24
Q3	13

TERM BD	PL ITEM
TB1	18

DIO	PL ITEM
CR1	14

Figure 5-11. Power Amp Circuit Board (Sheet 2 of 3)

Item No.	Drawing No.	Description	Remarks
	75885950-8	PWA, Power Amp	
2	75885970-6	PWB, Power Amp	
5	75886735-2	Heat Sink	
6	75886736-0	Heat Sink	
7	16798707-2	Wafer	
8	77832275-0	Spacer, Fibre	
9	18748600-6	Compound 340	
10	95683505-2	Stud, Press	
11	92583002-8	Nut Lock	
12	75887208-9	Transistor, Darlington Pwr	
13	15165549-5	Transistor	
14	75887484-6	Pwr Rectifier MR500	
15	24500115-1	Res 1/2W 5% 10	
16	77612864-7	Res 1W 5% 47	
17	24507171-7	Res 1W 5% 2.2K	
18	77832259-4	Terminal Strip	
19	77832292-5	Socket, 8 Pin	
20	24500053-4	Res 1/4W 5% 390	
21	24507123-8	Res 1W 5% 82	
22	51885504-4	Standoff, Male-Female	
23	94375501-7	Insert-PC Bd	
24	75165550-3	TRSTR, Darlington Pwr	

Figure 5-11. Power Amp Circuit Board (Sheet 3 of 3)

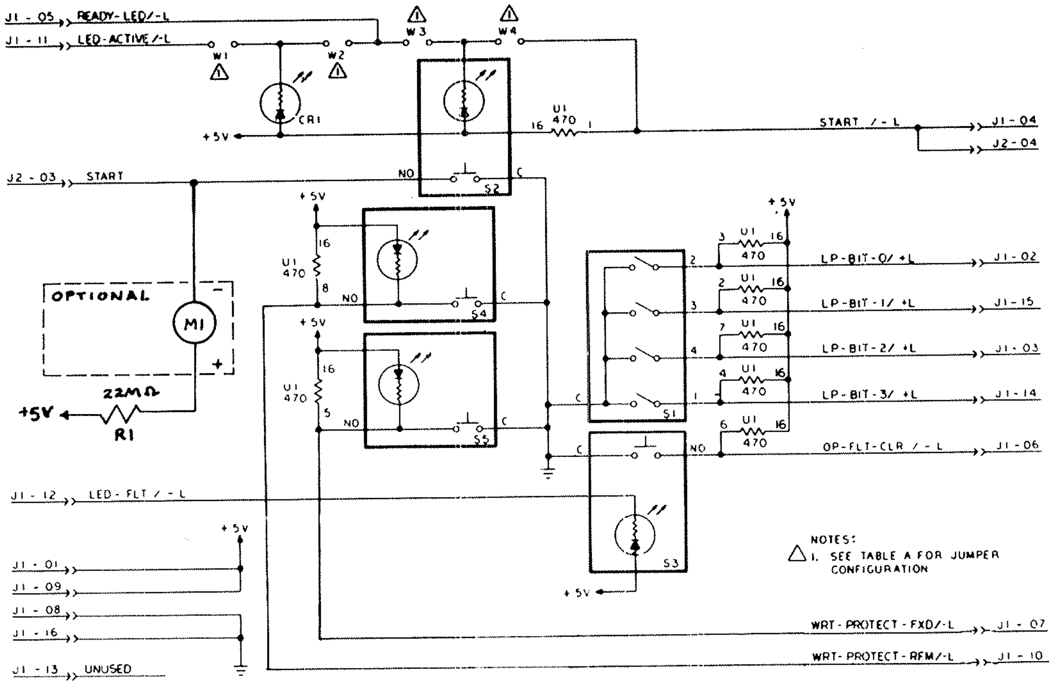


TABLE A

ASSEMBLY	JUMPER CONFIGURATION W1	W2	W3	W4
77680700	—	X	—	X
77624900	—	X	—	X
77680740	X	—	X	—

UNUSED LOGIC ELEMENTS

ELEMENT NO.	VENDOR NO.	LOCATION	OUTPUT PIN
—	470Ω RES PAC	U1	9,10,11,12, 13,14 & 15

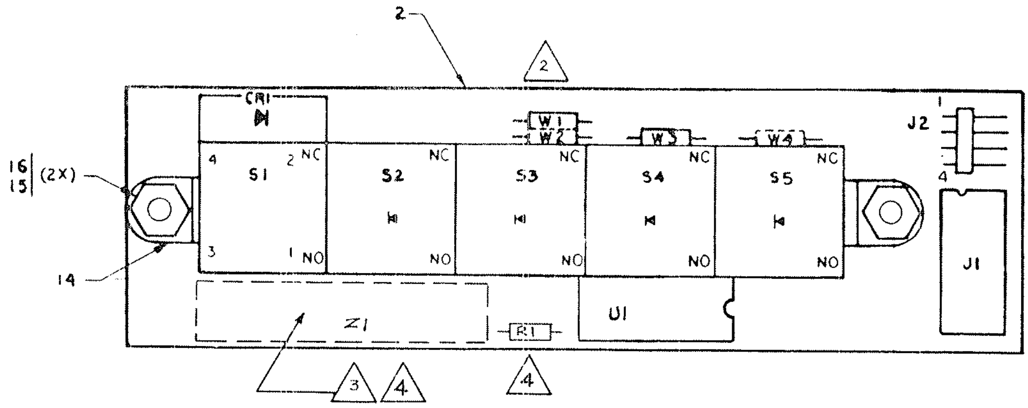
OPR CNTL CKT BD

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	020*
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)



CONN	PL ITEM
J1	11
J2	12

DIO	PL ITEM
CR1	9

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

METR	PL ITEM
Z1	—

IC	PL ITEM
U1	13

RES	PL ITEM
R1	21

TABLE "A"

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"

TABLE B

JMPR	P. L. ITEM	ASSEMBLY P/N
W1	10	77680740
W2	10	77624900, 77680700
W3	10	77680740
W4	10	77624900, 77680700

NOTES:

1. IF OTHER THAN "0" PLUG IS REQUIRED ORDER REPLACEMENT FROM TABLE "A"
2. SEE TABLE "B" FOR JUMPER CONFIGURATION
3. OPTIONAL RUNNING 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)

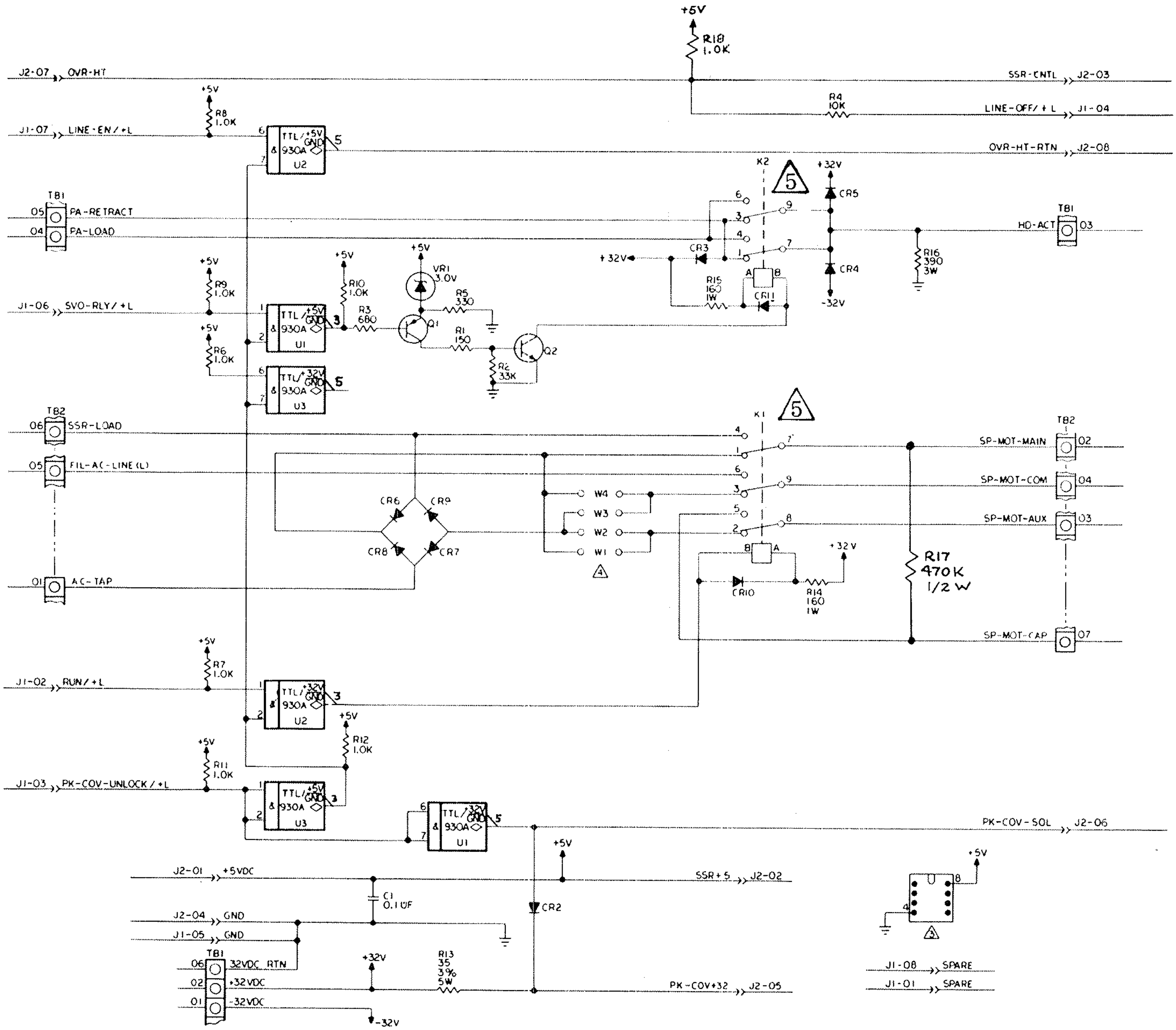
RELAY CONTROL BD

J1		SIGNAL	SOURCE/DEST.	XREF
01	←	SPARE		
02	←	RUN/+L	P1-B33	0305
03	←	PK-COV-UNLOCK/+L	P1-B35	0305
04	→	LINE-OFF/+L	P1-B37	0305
05	←	ANALOG GND	P1-B39	0305
06	←	SVO-RLY/+L	P1-B36	0305
07	←	LINE-EN/+L	P1-B34	0305
08	←	SPARE		

J2		SIGNAL	SOURCE/DEST.	XREF
01	←	+5VDC	See Figure 5-17	1601
02	→	SSR+5		
03	→	SSR-CNTL		
04	←	GND		
05	→	PK-COV +32		
06	→	PK-COV-SOL		
07				
08				

NOTE: FOR TB1 AND TB2 WIRING SEE FIGURE 5-17.

Figure 5-13. Relay Control Circuit Board (Sheet 1 of 4)



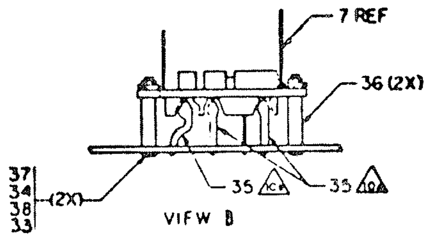
NOTES:

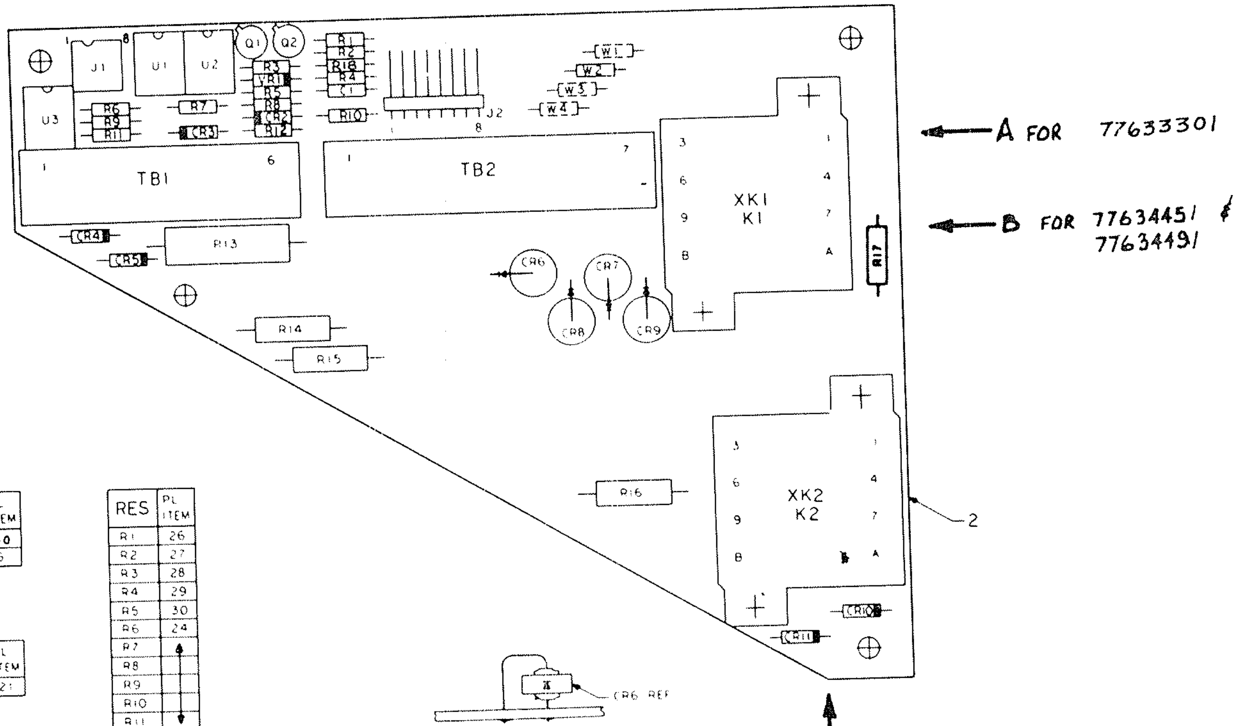
1. DRAWING INTERPRETATION PER 900
2. RESISTORS ARE IN OHMS, 1/4W, ±5%
3. TYPICAL POWER CONNECTIONS FOR 8 PIN INT CKTS
4. SEE TABLE A FOR JUMPER CONFIGURATION
5. Relays shown in de-energized position.

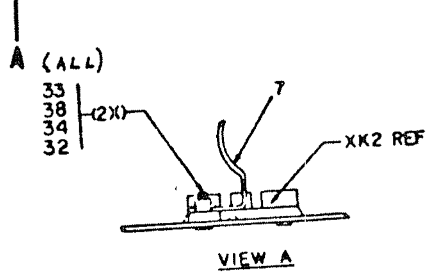
TABLE A ASSEMBLY	JUMPER CONFIGURATION			
	W1	W2	W3	W4
75898851	-	X	-	-
75899121	X	-	X	-
77634451	X	-	X	-
77634491	-	X	-	-
77633301	-	X	-	-

CROSS REF NO. 1201

Figure 5-13. Relay Control Circuit Board (Sheet 2 of 4)







SOC	PL ITEM
XK1	40
XK2	6

RES	PL ITEM
R1	26
R2	27
R3	28
R4	29
R5	30
R6	24
R7	↑
R8	
R9	
R10	
R11	↓
R12	24
R13	15
R14	22
R15	22
R16	23
R17	39
R18	24

CAP	PL ITEM
C1	21

VOLT REG	PL ITEM
VR1	17

RELAY	PL ITEM
K1	11
K2	12

TSTR	PL ITEM
Q1	13
Q2	4

TABLE A

JMPR	PL ITEM	ASSEMBLY NUMBER
W1	31	77634451
W2	31	77634491
W3	31	77634451, 77633301
W4	-	---------

DIO	PL ITEM
CR1	—
CR2	20
CR3	18
CR4	18
CR5	18
CR6	19
CR7	19
CR8	19
CR9	19
CR10	20
CR11	20

CONN	PL ITEM
J1	10
J2	6

TERM BD	PL ITEM
TB1	8
TB2	9

IC	PL ITEM
U1	5
U2	5
U3	5

NOTES:
1. SEE TABLE A FOR JUMPER CONFIGURATION.

Figure 5-13. Relay Control Circuit Board (Sheet 3 of 4)

Item No.	Drawing No.	Description	Remarks
	77634451	Relay Control PWA	
	77634491	Relay Control PWA	
	77633301	Relay Control PWA	
2	77634470	Relay Control PWB	
5	15164423	I.C. 75472	
6	22940901	Relay Socket	
7	22940903	Relay Retainer	
8	77832263	Terminal Strip	
9	77832262	Terminal Strip	
10	77832292	Socket, 8 Pin	
11	77612660	Relay	
12	22940808	Relay 15 Amp	
13	72035901	TSTR 2N2907A (PNP)	
14	51795600	TSTR 2N2222A (NPN)	
15	38846808	Res 5W 3% 35 Ohm	
16	75743608	Header-Right Angle	
17	95818104	Volt Reg 3.0 V 1N5225	
18	77612650	PWR Rectifier MR811	
19	95575000	Rectifier-Sil	
20	51706300	Diode 1N4454	
21	94361400	Cap 50 V +80-20% .01 uF	
22	24507130	Res 1W 5% 160 Ohm	
23	92222046	Res 3W 5% 390 Ohm	
24	24500063	Res 1/4W 5% 1K	
26	24500043	Res 1/4W 5% 150 Ohm	
27	24500099	Res 1/4W 5% 33K	
28	24500059	Res 1/4W 5% 680 Ohm	
29	24500087	Res 1/4W 5% 10K	
30	24500051	Res 1/4W 5% 330 Ohm	
31	94358500	Jumper Wire, Molded	
32	95683505	Stud, Press	
33	92583002	Nut Lock	
34	10125603	Washer Plain	
39	17720528	Res 1/2W 5% 470K	

Figure 5-13. Relay Control Circuit Board (Sheet 4 of 4)

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

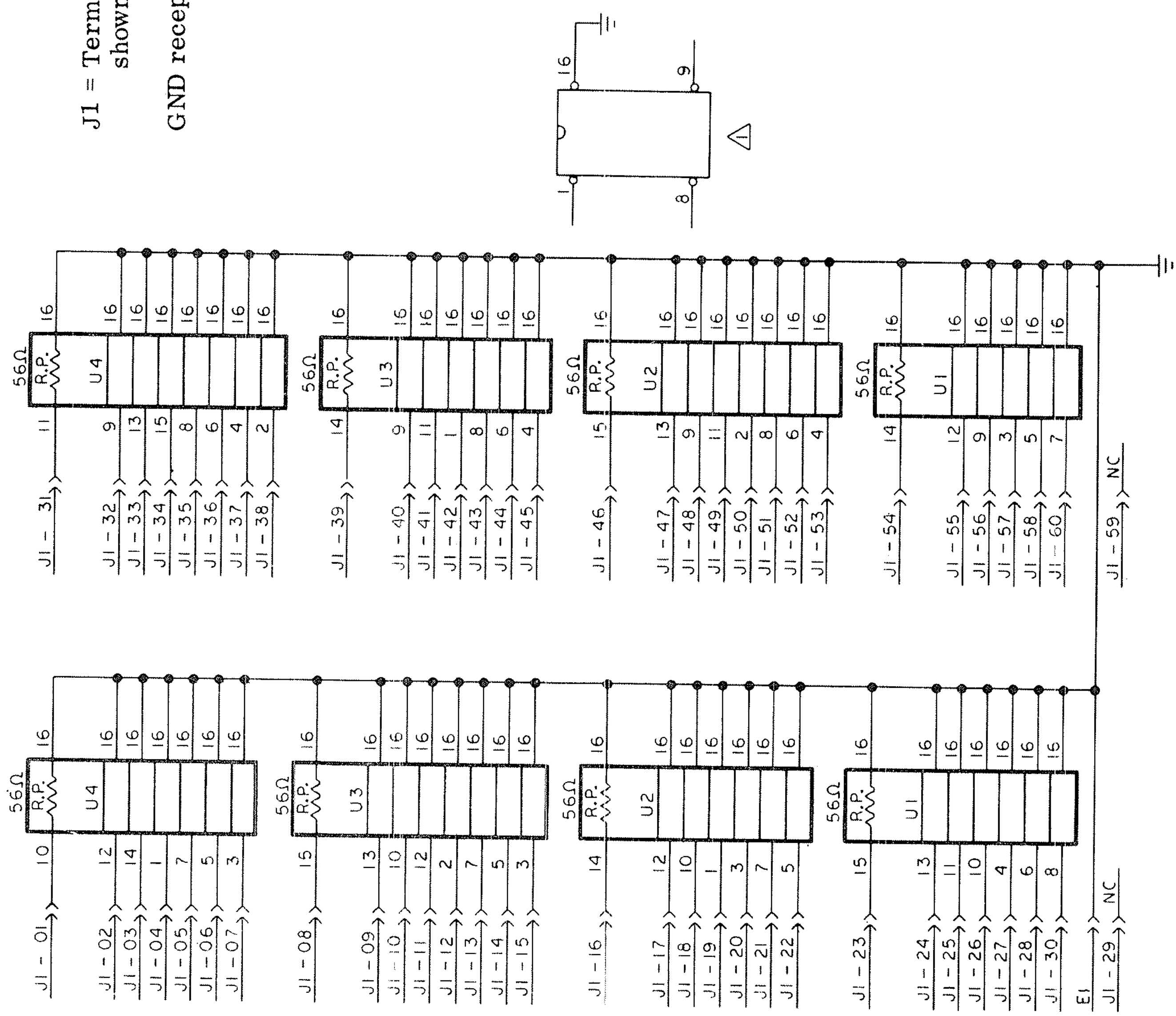
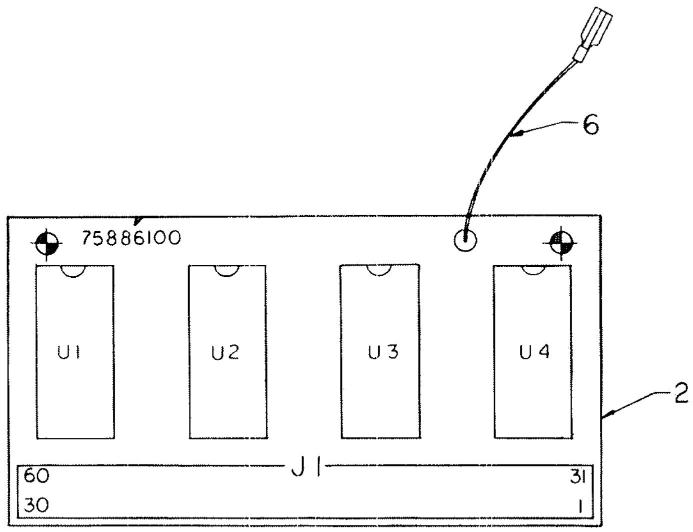


Figure 5-14. Terminator Circuit Board (Sheet 1 of 2)

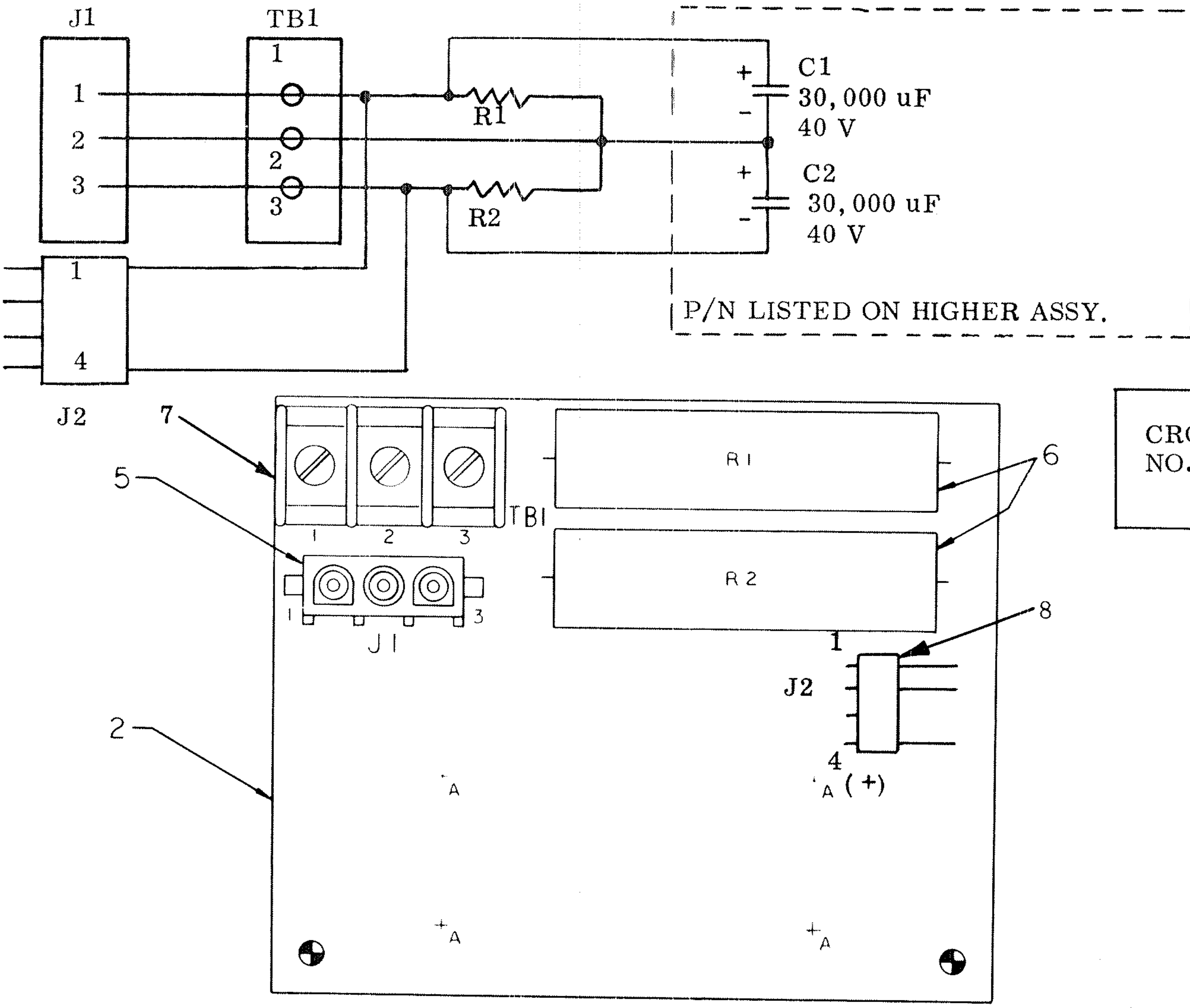
IC	PL ITEM
U1	8
U2	↑
U3	↓
U4	8

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)

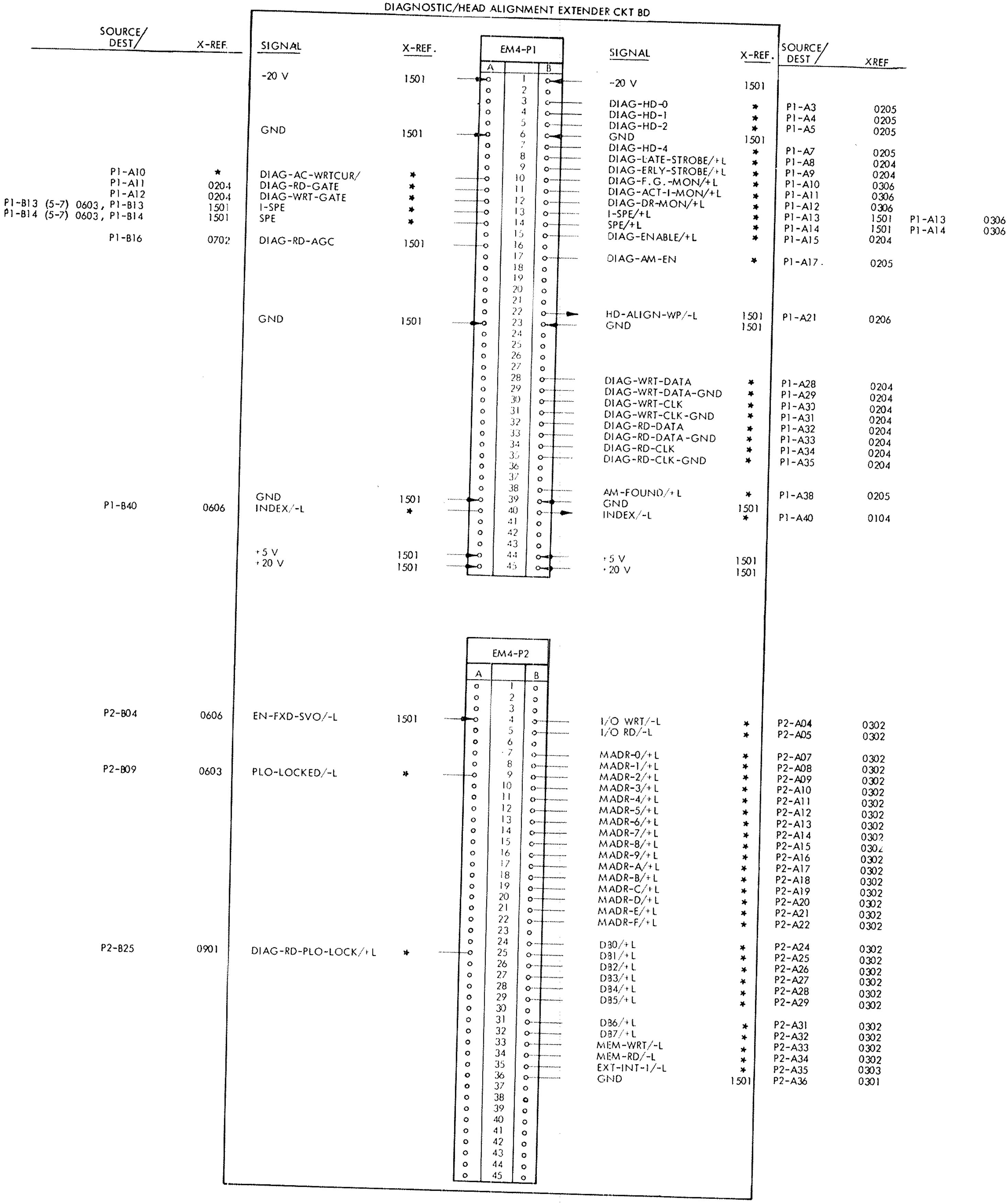


CROSS REF NO. 1401

NOTE: For Comp. BD. interconnections see Figure 5-17.

Item No.	Drawing No.	Description	Remarks
	75895250-1	PWA, Component Board	
2	75895270-9	PWB, Component Board	
5	83435452-4	Connector, Plug/Cap	
6	51830521-4	Res 10W 5% 220	
7	94792383-5	Term Strip 3 Pos	
8.	75743604-3	Header 4 pos	

Figure 5-15. Component Board (32V Filter)



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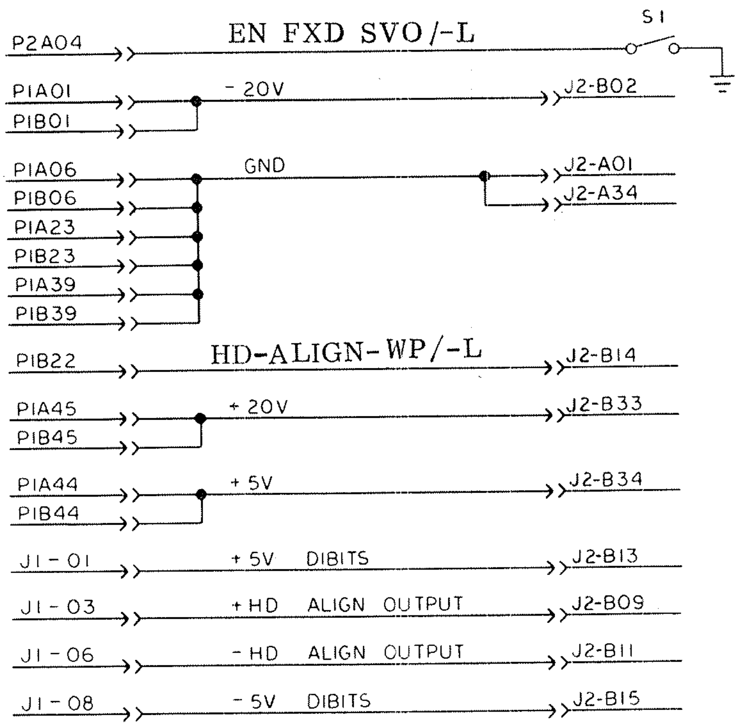
* WIRED TO, BUT NOT USED ON PWA

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

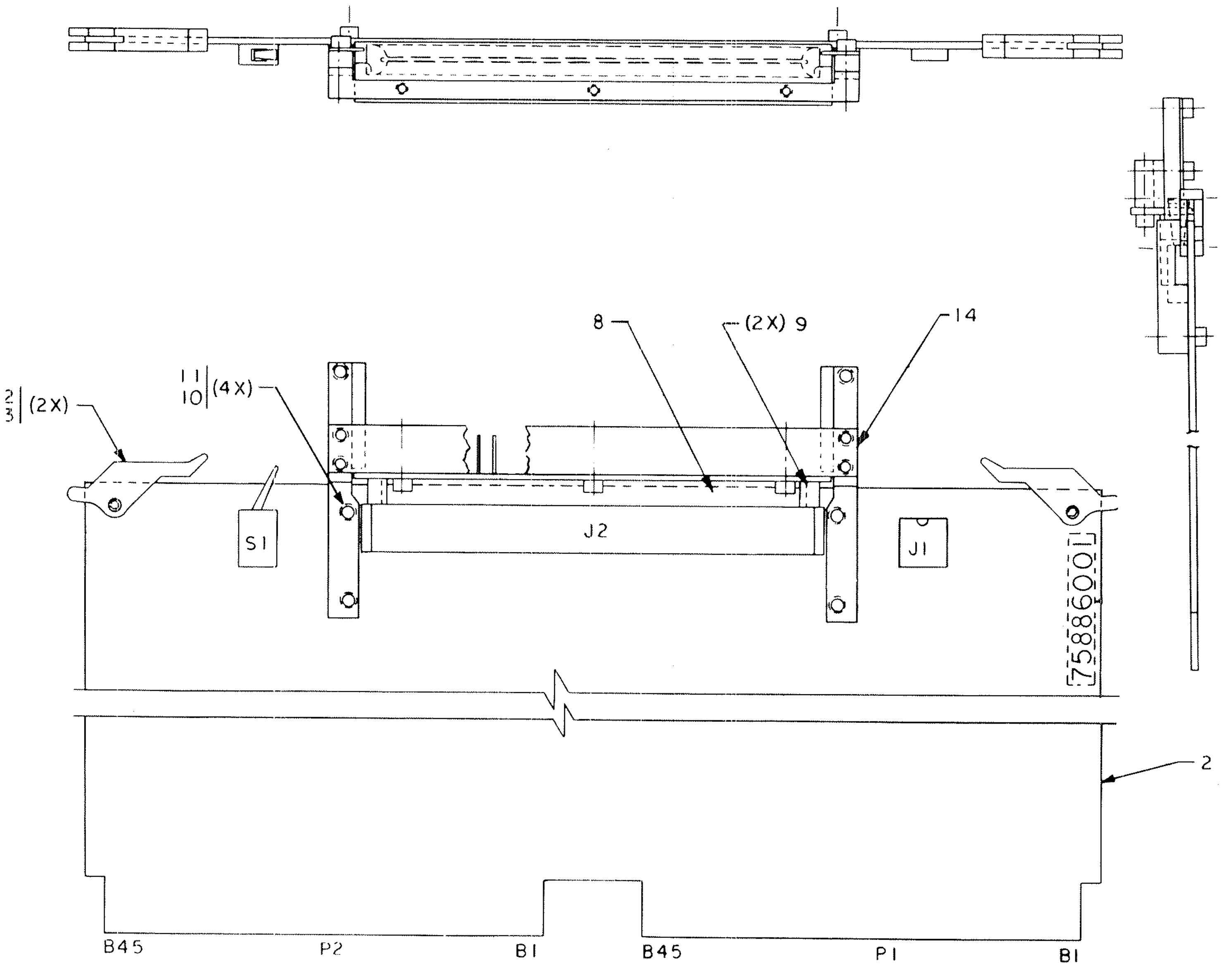
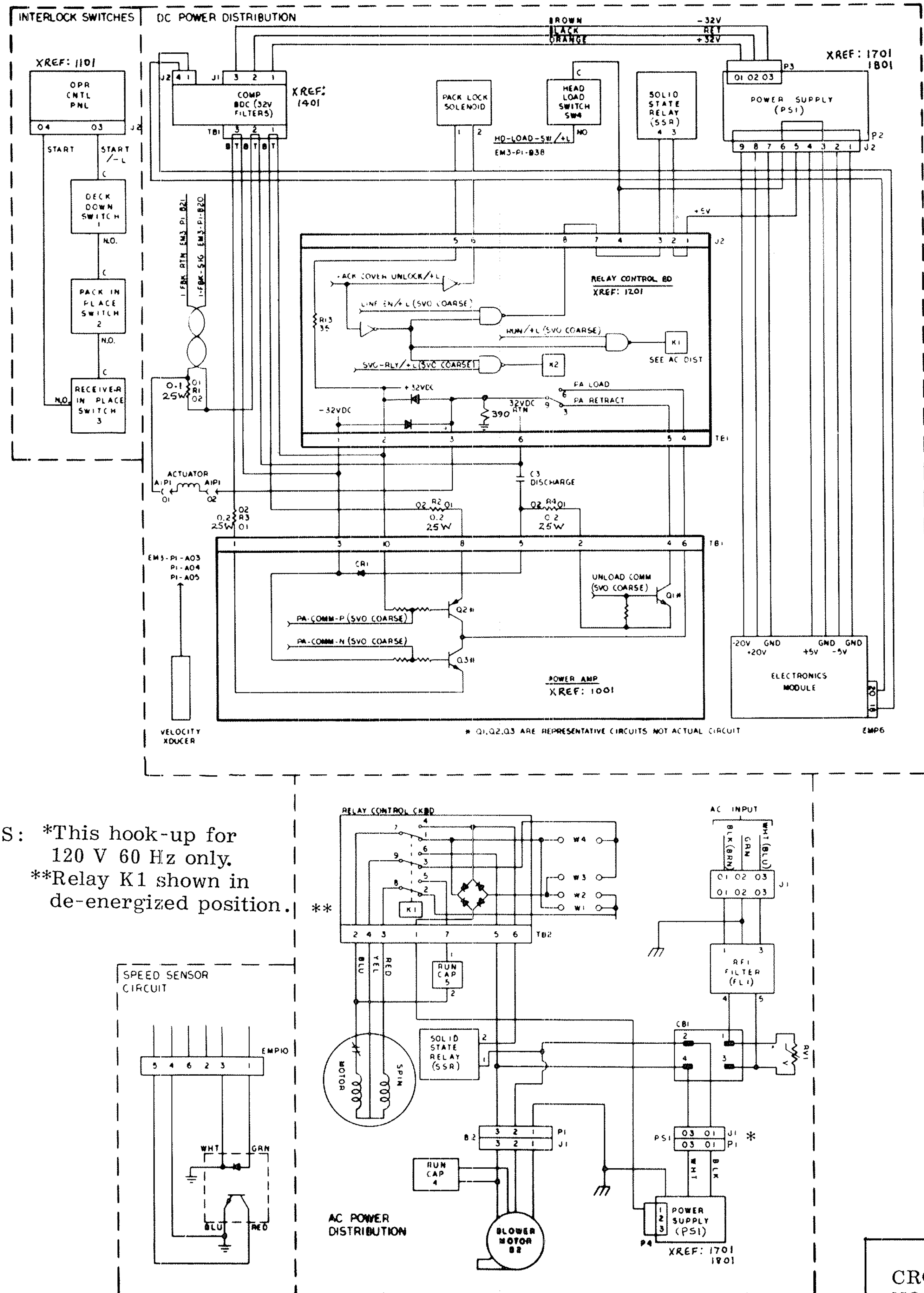


Figure 5-16. Diagnostic/Head Alignment C.B. (Sheet 3 of 4)

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	

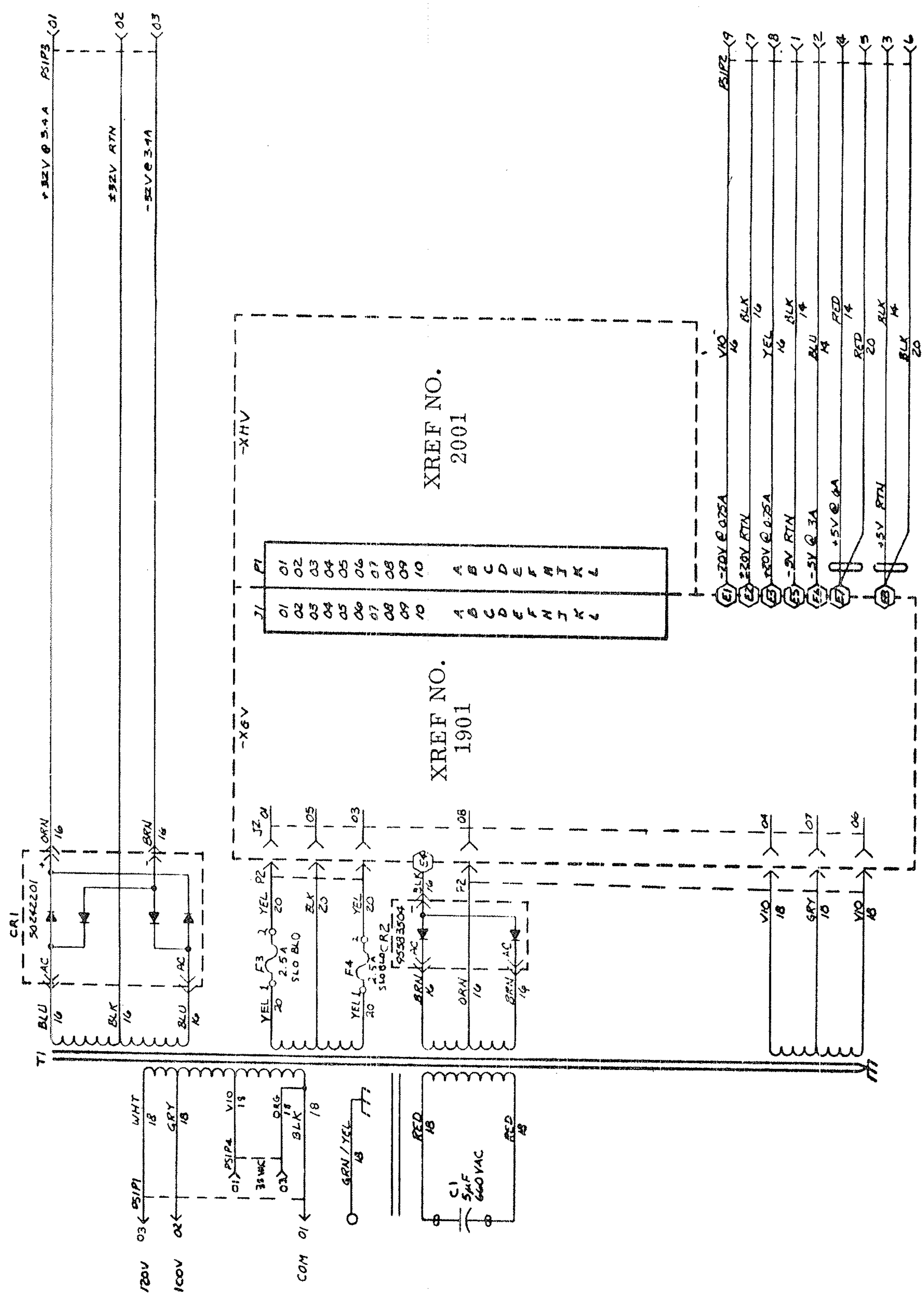
Figure 5-16. Diagnostic/Head Alignment C.B. (Sheet 4 of 4)



NOTES: *This hook-up for 120 V 60 Hz only.
**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.

Figure 5-18. Power Supply Wiring Diagram (60 Hz)

CROSS REF NO. 1701

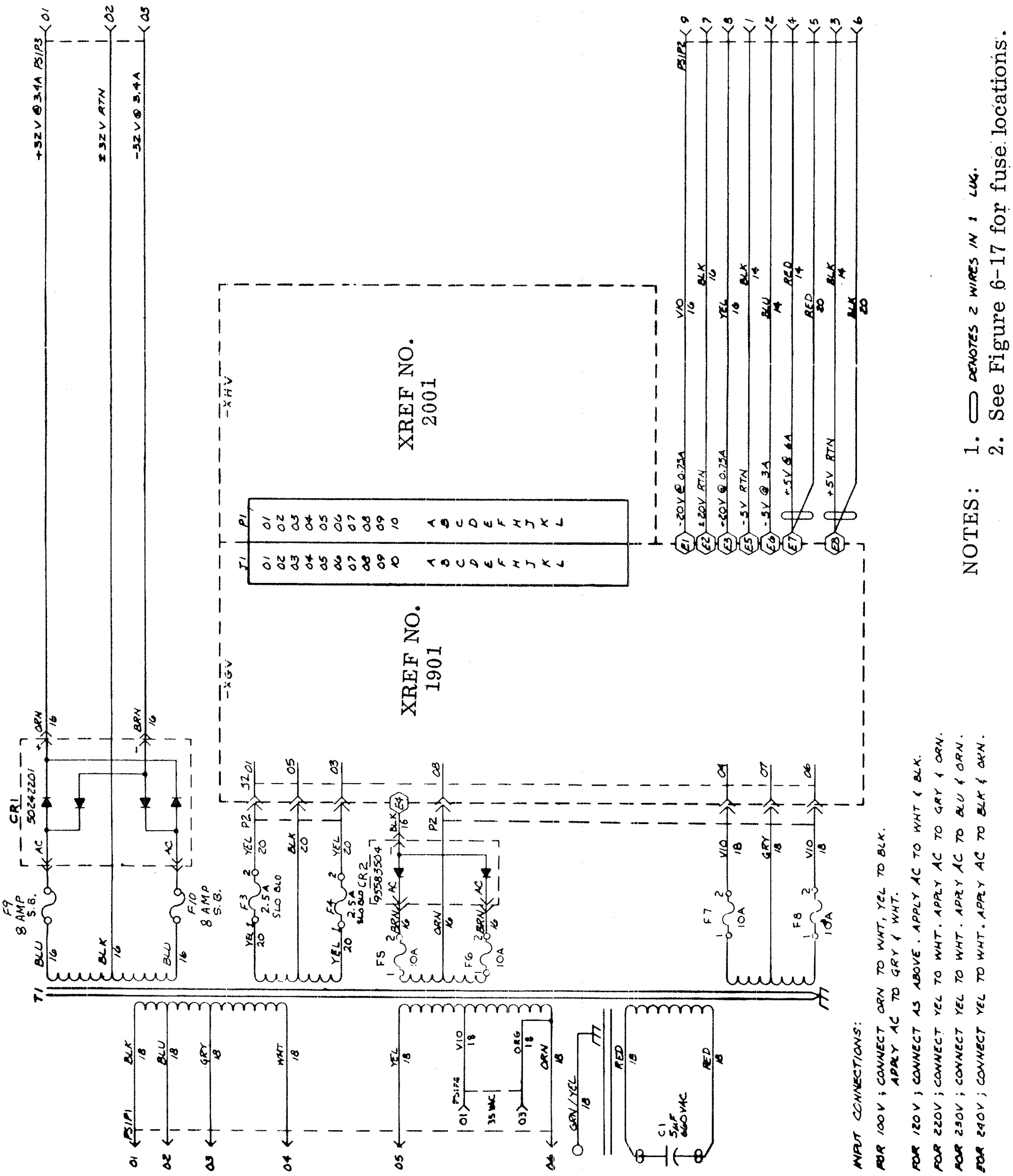
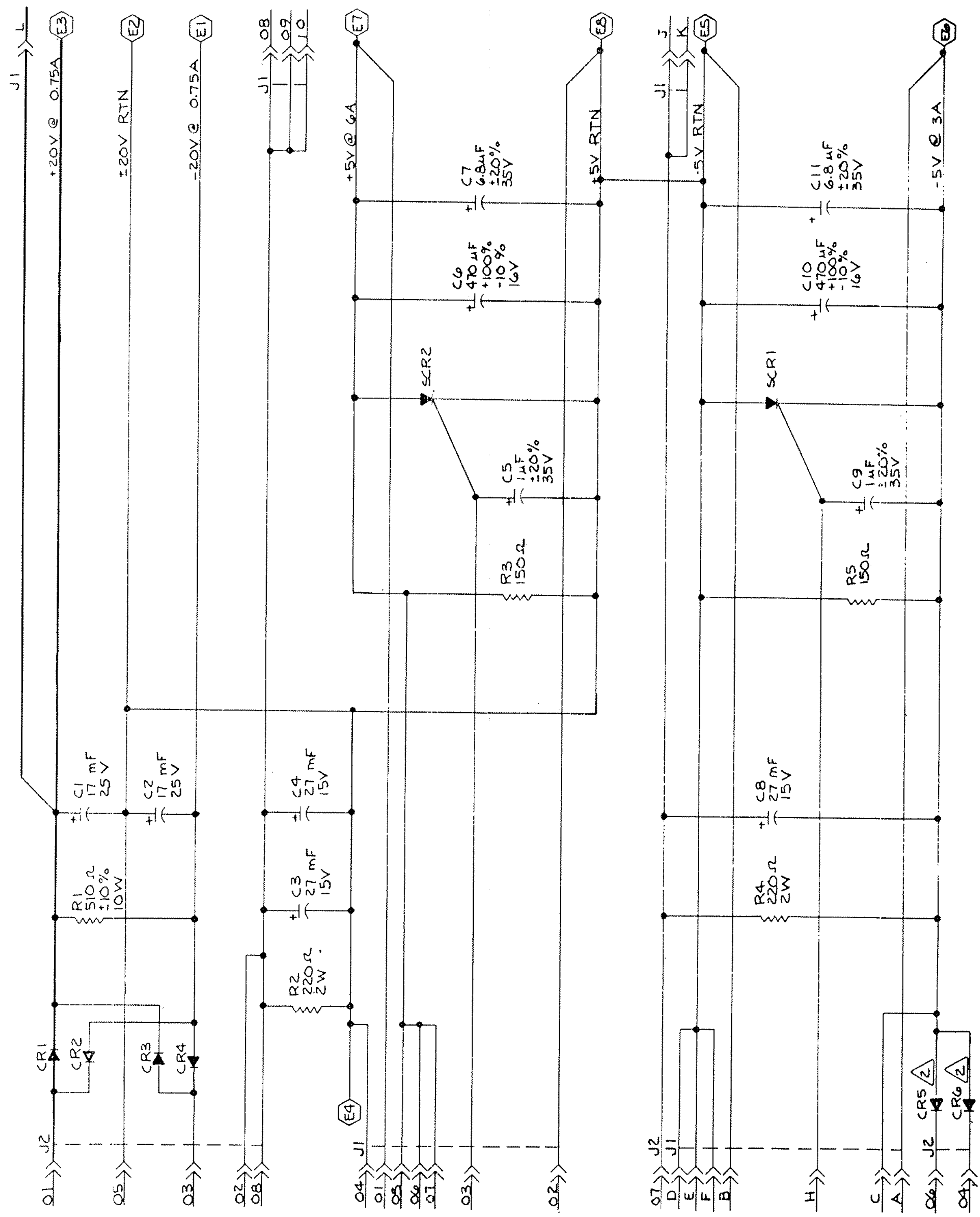


Figure 5-19. Power Supply Wiring Diagram (50 Hz)

CROSS REI
NO. 1801



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)

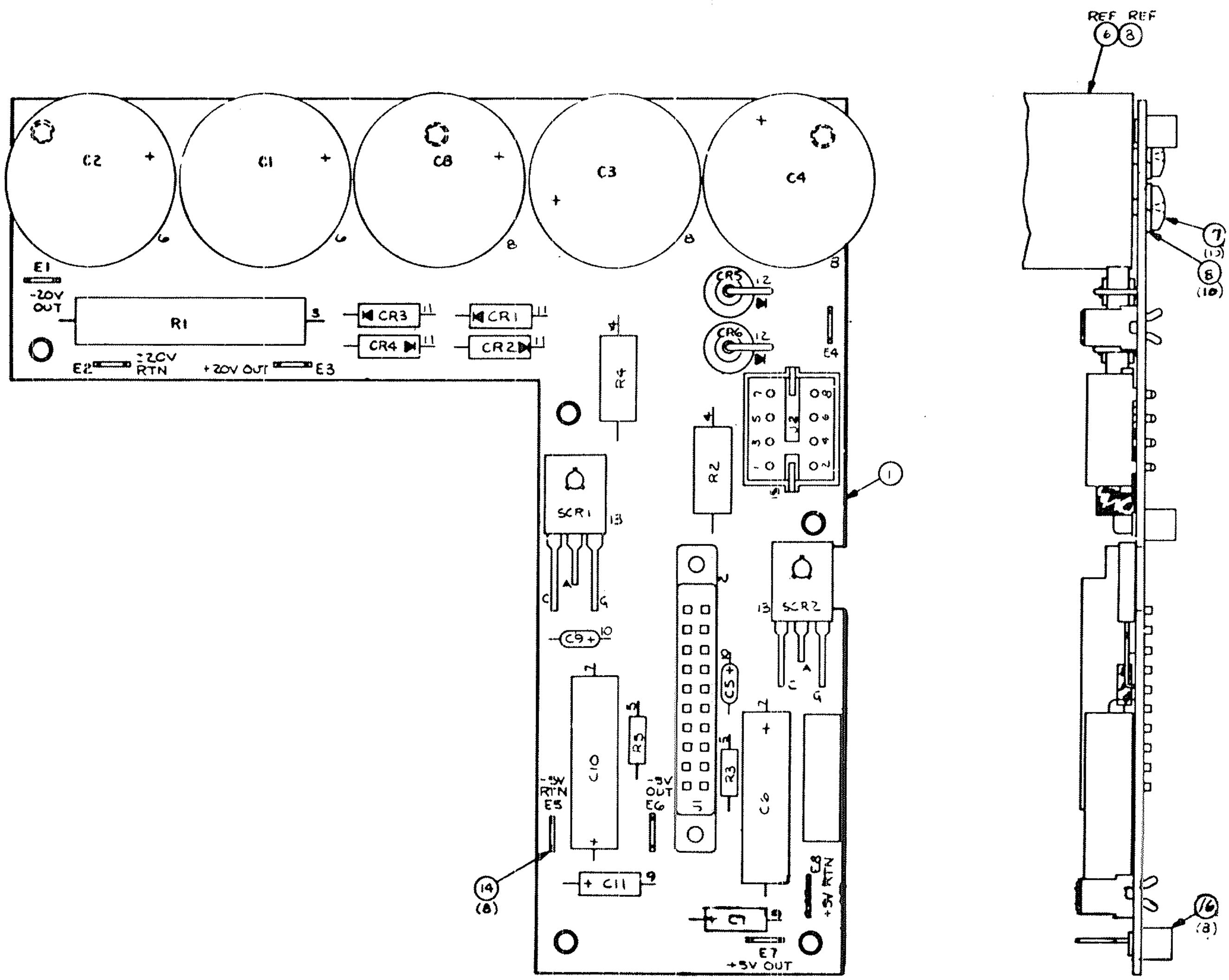
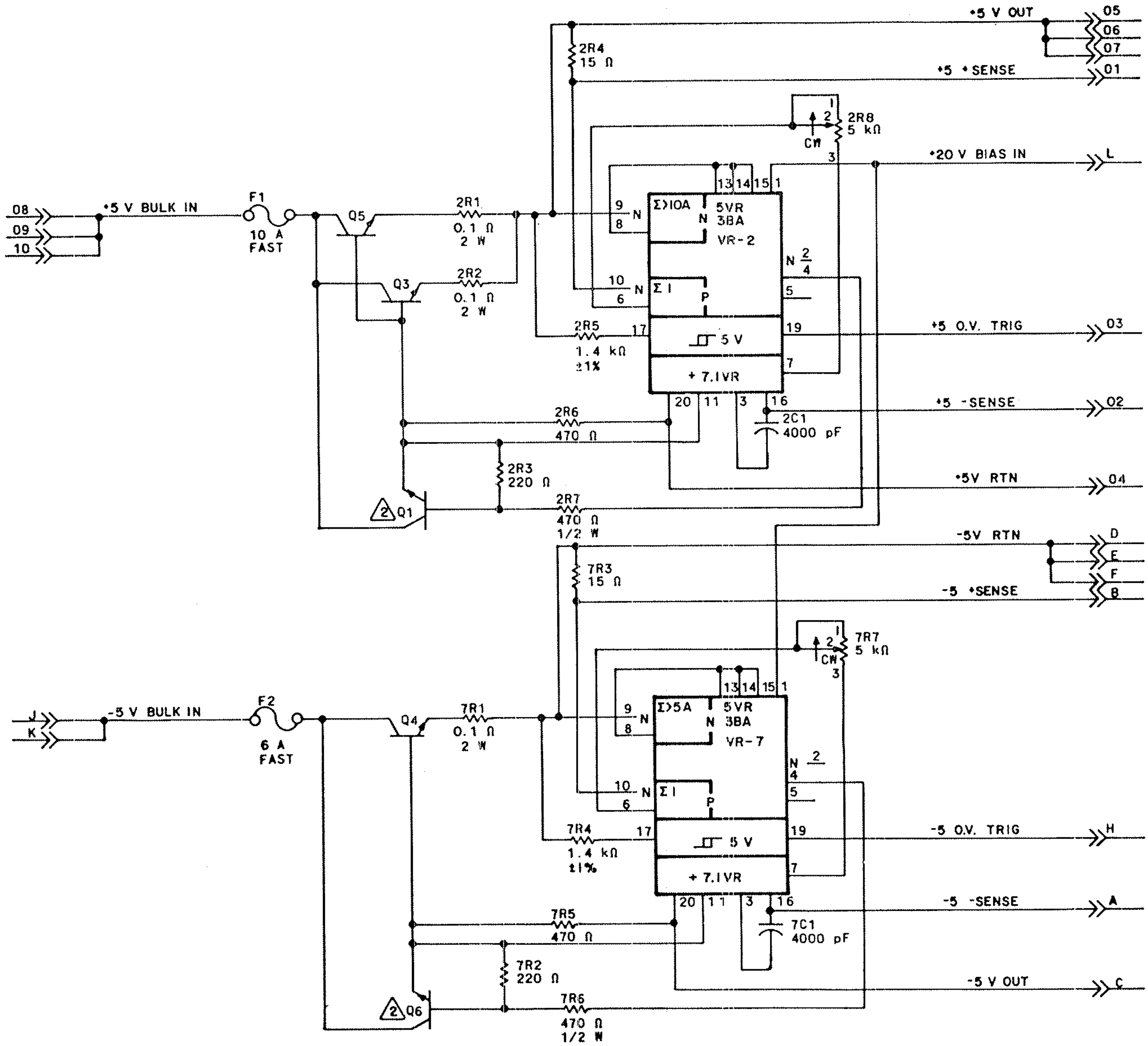


Figure 5-20. Mother Board (Sheet 2 of 3)

Item No.	Drawing No.	Description	Remarks
	75832500	Mother Board	
1	75832400-8	AXGV Board Blank	
2	95595301-3	Connector, P.C. Mount	
3	95594119-0	Resistor, Fixed 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. Mother Board (Sheet 3 of 3)



NOTES:

1. All Transistors, 2N3771, 94791000
2. All Potentiometers 1/2W ±107.
3. All Transistors, NPN, 95689901

Figure 5-21. Regulator Board (Sheet 1 of 3)

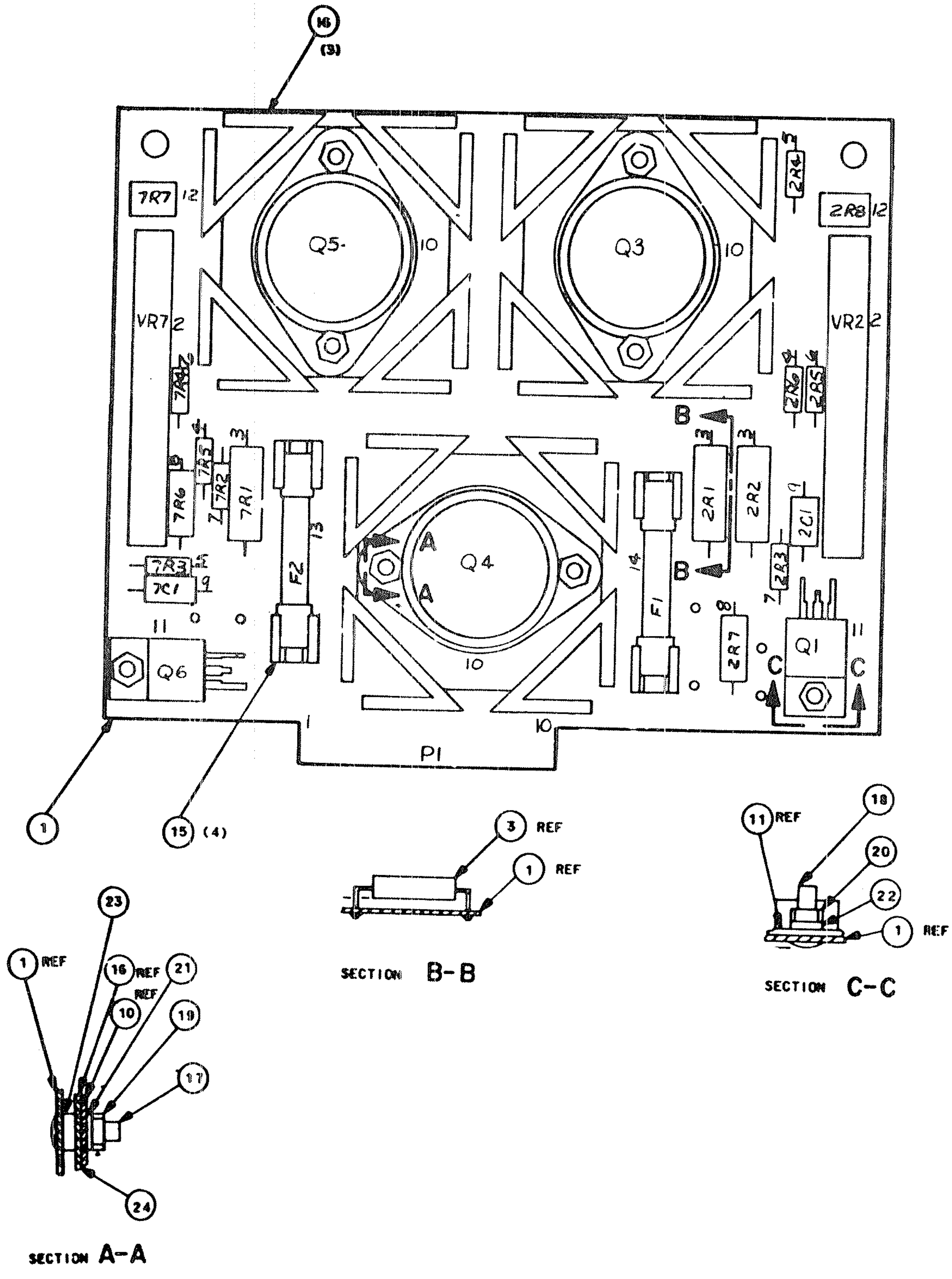


Figure 5-21. Regulator Board (Sheet 2 of 3)

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	956835111-0	Stud, Press	
18	956835037-7	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)

6.1 INTRODUCTION

This section contains the instructions required to maintain the Cartridge Model Drive (CMD). The information is provided in the form of preventive maintenance and corrective maintenance. All maintenance should be performed by qualified and trained service personnel, using the procedures specified in this section.

In general, before performing any drive adjustments or maintenance procedures, install a scratch pack or its equivalent on the drive and switch the drive to an "Off-Line" mode of operation to prevent system interference.

NOTE

The paragraphs following safety precautions describe, in general terms, the methods used for gaining access to the various servicing areas of the drive. Once these procedures have been described, they will not be repeated in subsequent maintenance instructions. Therefore, maintenance personnel are urged to read through the general procedures at least once to become familiar with these standard procedures.

6.2 SAFETY AND SPECIAL MAINTENANCE PRECAUTIONS

Before proceeding with any maintenance, maintenance personnel should become familiar with the precautions given in paragraphs 6.2.1 and 6.2.2. Failure to practice these precautions may result in equipment damage and/or personal injury.

6.2.1 SAFETY PRECAUTIONS

- Use care when power is applied to the unit. Various voltages are present on the terminal block (TB1) 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.

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.

WARNING

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

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 maintenace 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 electronics.

I/O cables should absolutely <u>NOT</u> 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.

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 RE-PLACEMENT 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
Fixed Pack Certification	6.8.2
Interlock Switch Adjustments	6.8.3
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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.

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. 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. Allow blower to purge the absolute filter for a minimum of twenty (20) minutes with the deck in the raised position. This purge will insure that all loose residue and debris from the filter manufacturing process has been removed.
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 ten (10) minutes with the spindle turning.
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.

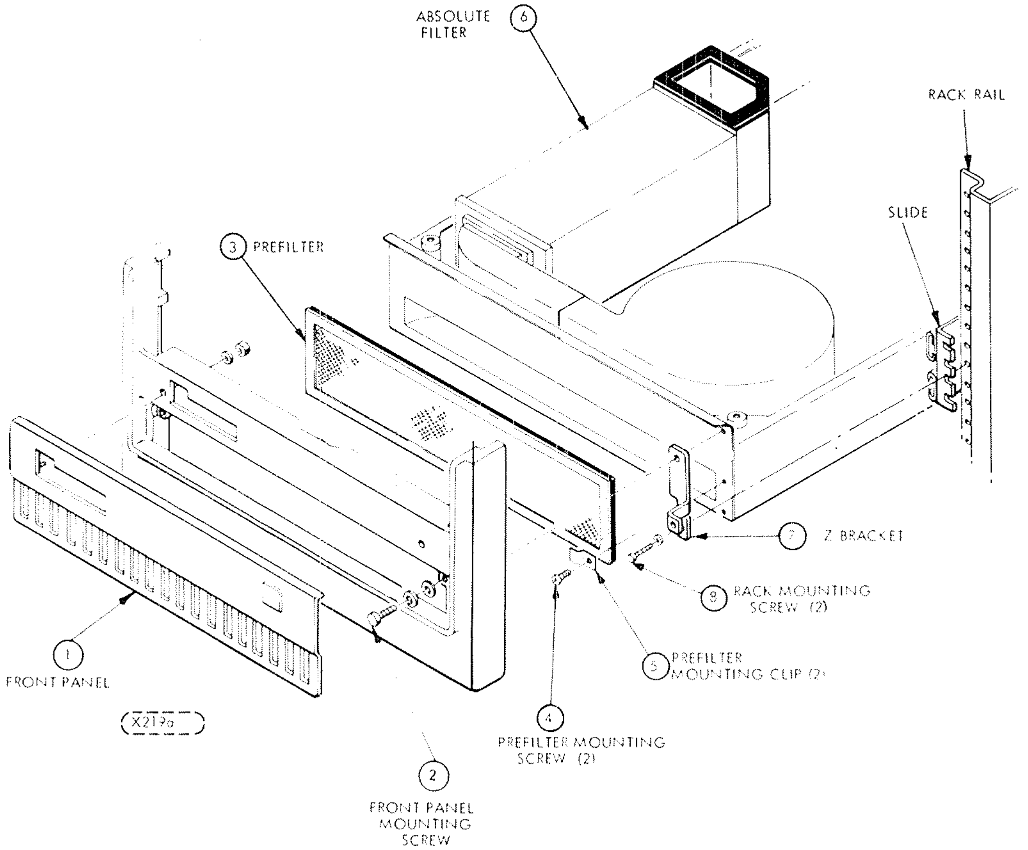


FIGURE 6-1. FILTER REMOVAL AND REPLACEMENT

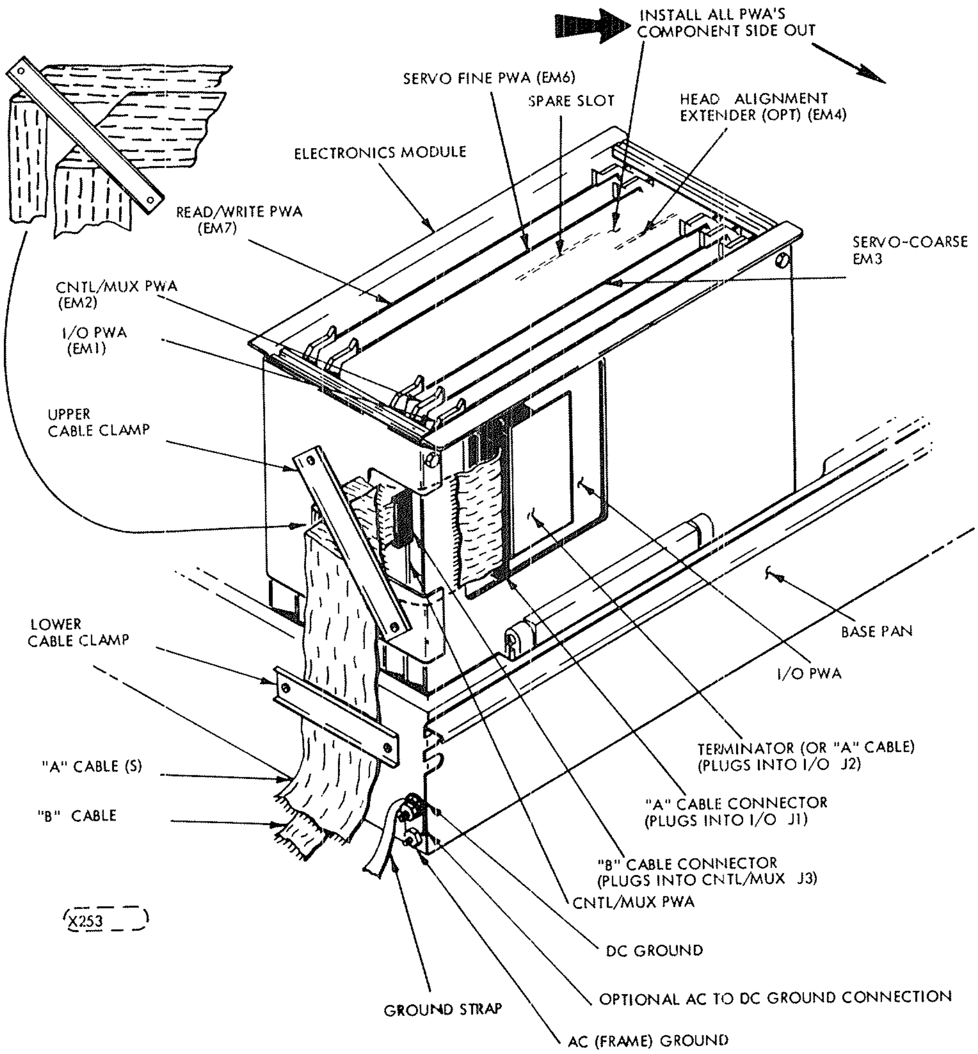


FIGURE 6-1A. I/O CABLE INSTALLATION AND PWA NAMES/LOCATIONS

6.6.2 ACTUATOR ASSEMBLY INSPECTION AND CLEANING WITH FIXED DISK MODULE STILL IN THE DRIVE

1. Set AC POWER circuit breaker to OFF.
2. Remove top cover per paragraph 6.7.
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 attracted particles.
6. Push the carriage back into the fully retracted position.
7. Restore drive to normal operating condition.

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 <u>not</u> 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).

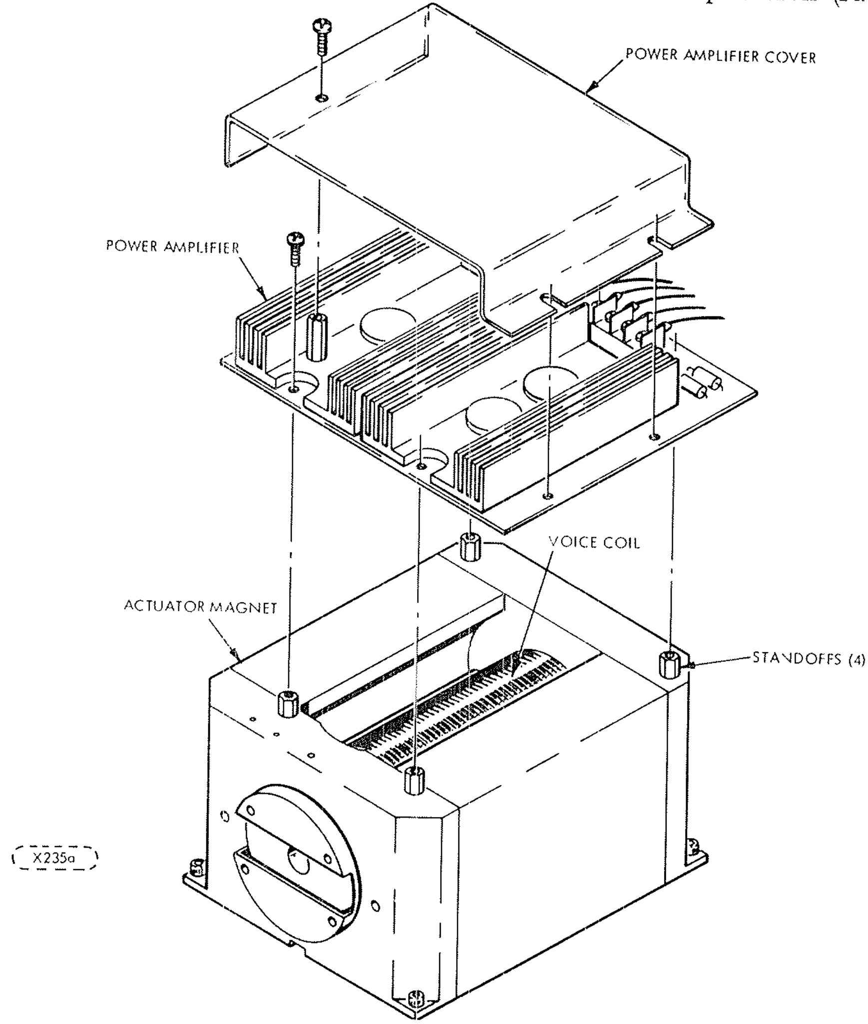


FIGURE 6-2. REMOVAL OF POWER AMPLIFIER FOR ACCESS TO VOICE COIL

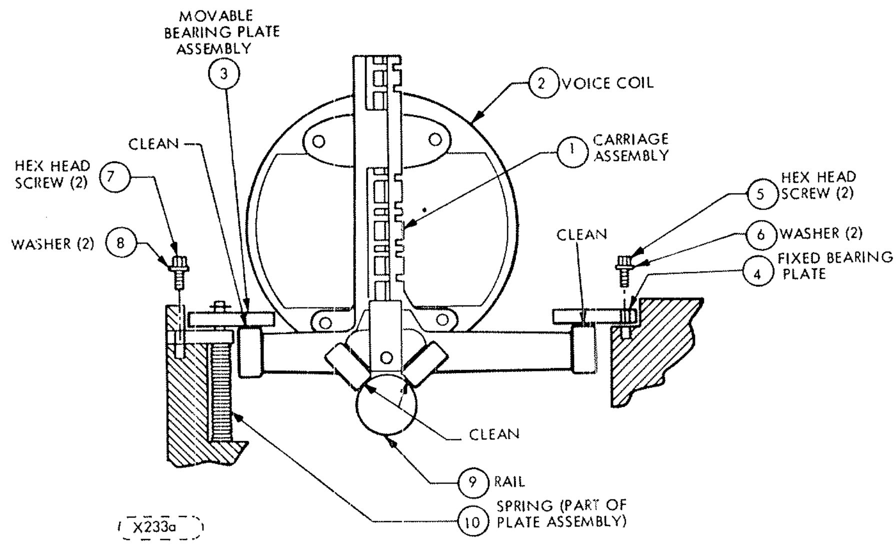


FIGURE 6-3. CARRIAGE RAILS AND BEARINGS

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.
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. Remove the two screws (A) (Figure 6-5) which secure the Electronics Module and loosen or remove the lower I/O cable clamp by loosening or removing one or both of the screws securing it. These screws may be stored in the top of the plastic hinge block. For those units which have the electro-static discharge option installed (ESD), the copper strap (C) must be disconnected from the E-module. To do so, loosen screw (B) and pull the strap to the side before lifting the E-module out. If access is required to the lower part of the Electronics Module or head area, lift the Electronics Module and swing it out to the side (Figure 6-5). Be careful not to allow the cables attaching to the module to catch or chaff on anything.
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 two screws (A) to secure the Electronics Module and secure the I/O cable clamp by tightening the two screws which secure it. If the unit has the ESD option, slip the slot of the copper strap (C) under the washers on screw (B) and tighten screw (B) .
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).

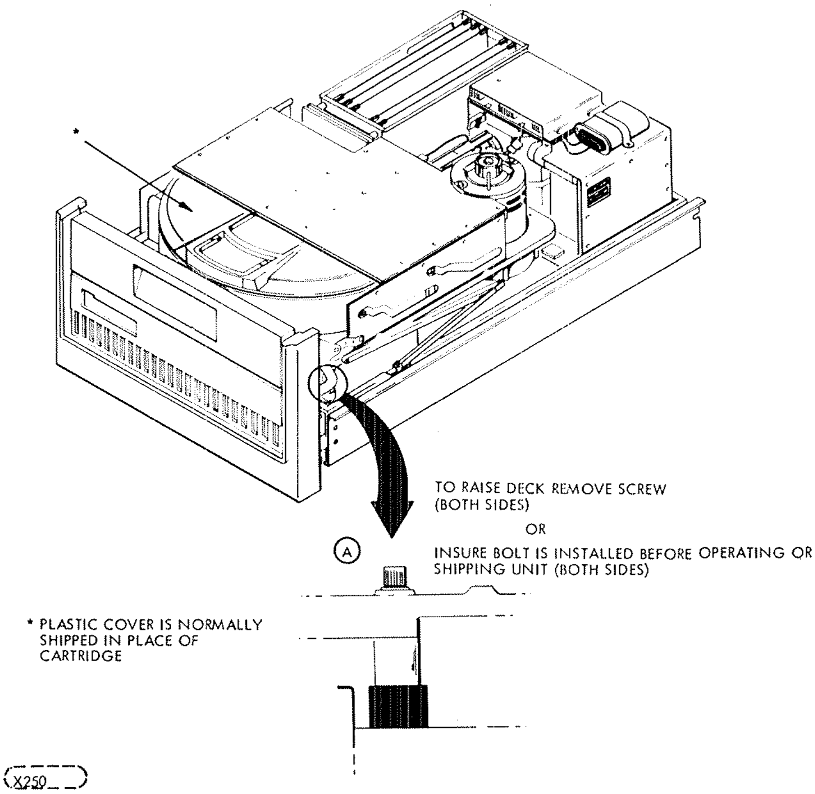


FIGURE 6-4. DECK HOLD DOWN BOLT LOCATION

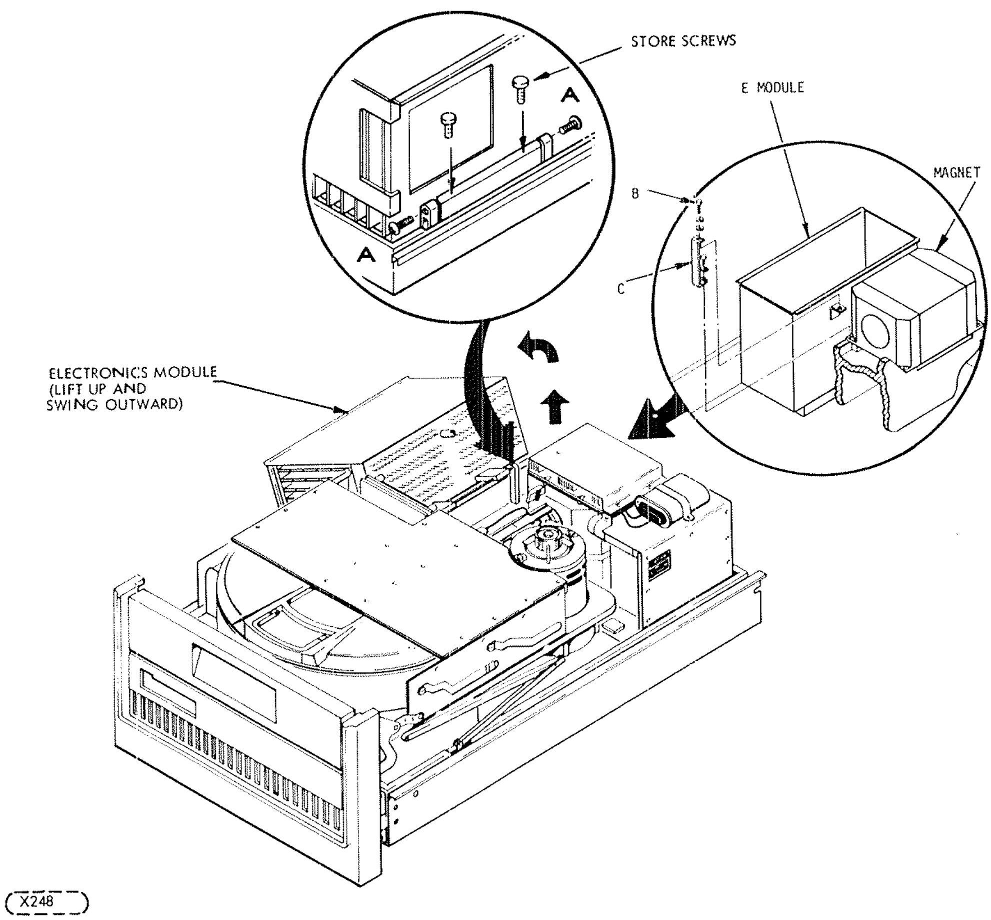
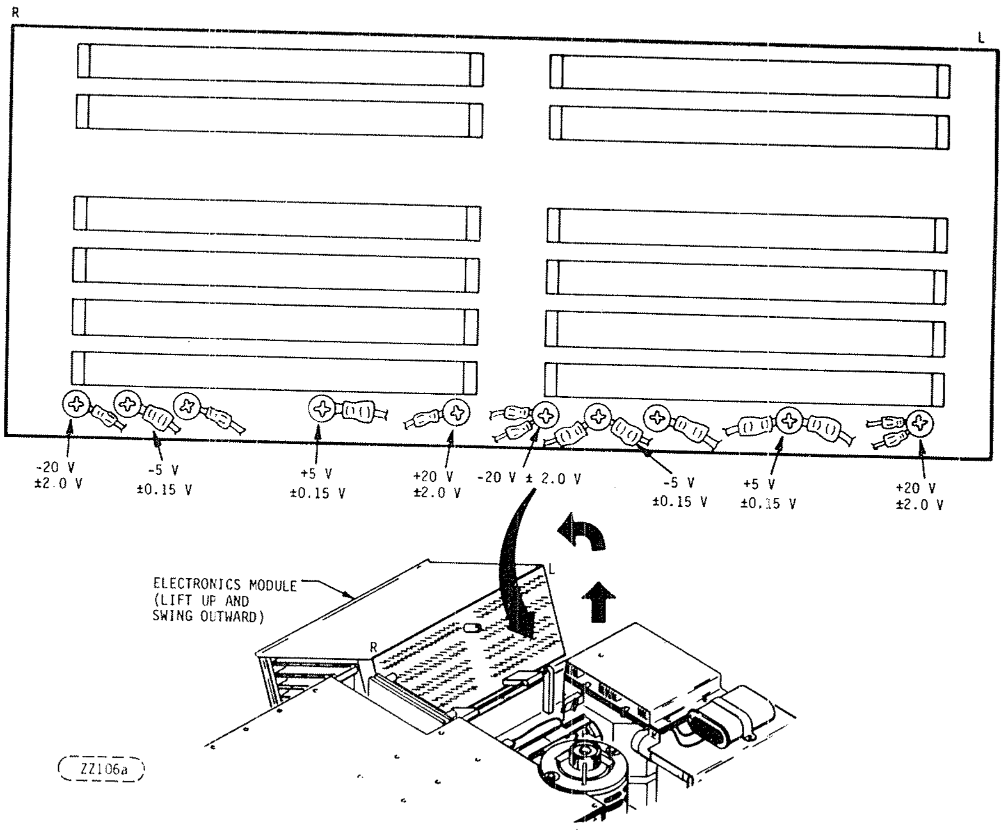


FIGURE 6-5. ACCESSING UNDERSIDE OF ELECTRONICS MODULE



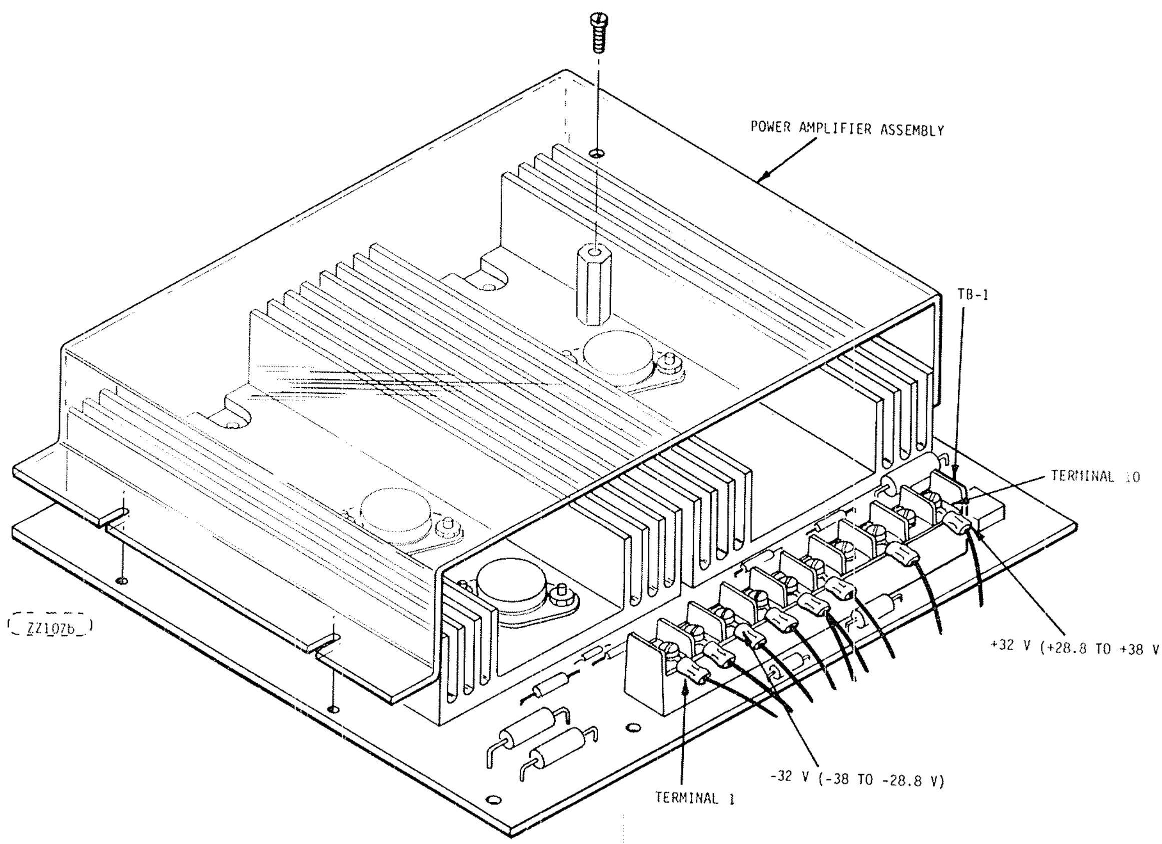


FIGURE 6-6. DC POWER MEASUREMENTS

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 bracket alignment hole (7). Secure with the flat head screw (4) removed in step 7.
9. Connect the connector on the Spin Speed Sensor Cable ((5) 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).

<u>NOTE</u>

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) which retain the Static Ground Brush (10).
6. Remove and replace the Static Ground Bruse. 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 (11) which retain the brush to the Spin Speed Sensor bracket (1).
8. Perform steps 1-4 in reverse order.

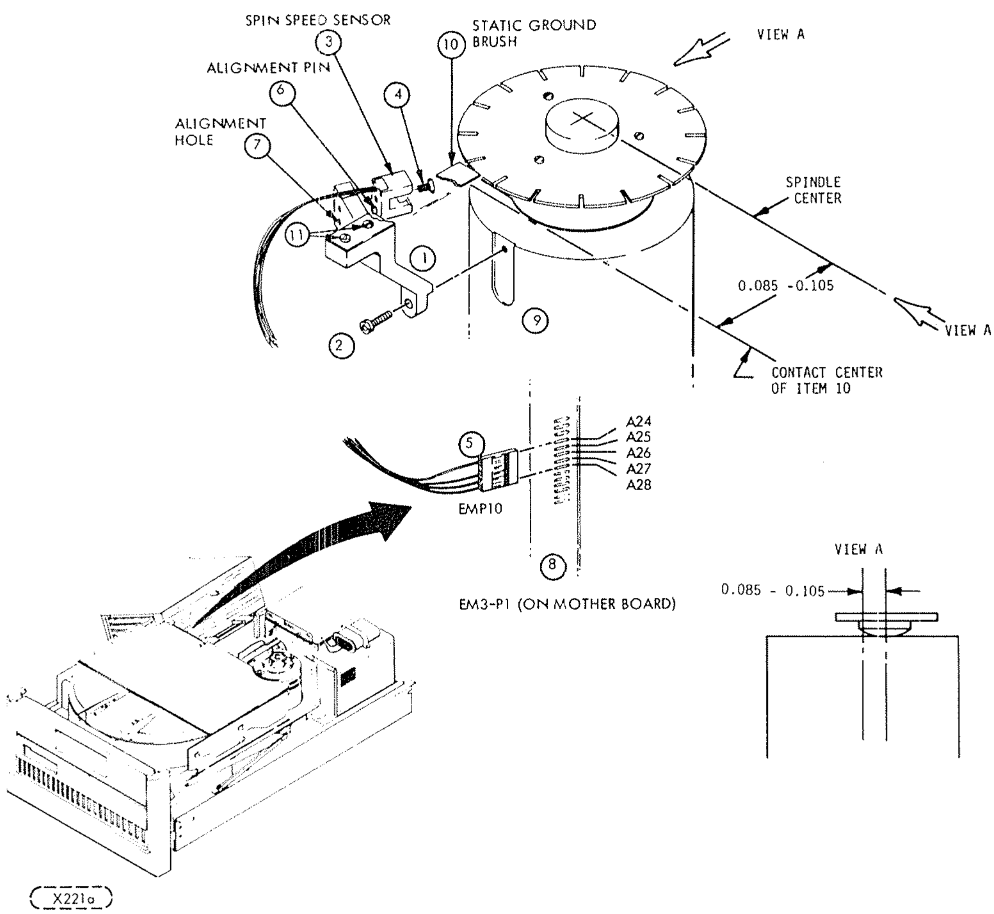


FIGURE 6-7. REMOVAL AND REPLACEMENT OF SPIN SPEED SENSOR ASSEMBLY

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. Loosen the four screws X enough to allow the cam plate C to clear the bearings I on one side.
5. Lift the receiver plate B on the side where the cam plate grooves have cleared the bearings and shift it to the other side such that the cam plate on the other side clears the bearings also. Lift the receiver assembly from the unit.
6. Disconnect the spring R from the cam lever Q.
7. Loosen the two set screws P .
8. Remove cam lever Q and nylon washer S from shaft assembly T .
9. Carefully slide the shaft assembly T out of the bearing support U if shaft assembly is to be replaced. If it is desired to remove the separator plate, it is only necessary to slide the shaft assembly T in the shaft support bearing U until the shaft assembly clears the support bearing.

6.7.6.2 REPLACEMENT OF CARTRIDGE RECEIVER ASSEMBLY

1. Carefully slide the shaft assembly T into the shaft support bearing U and though the hole in the side of the base deck wall.
2. Slide the nylon washer S onto the shaft.
3. Slide the cam lever Q onto the shaft.
4. With the cam lever resting forward against the stop on the outside of the fixed pack receiver wall, adjust the roller V height to 0.540 ±0.005 inch (1.37 ±0.01 mm) from the separator plate surface, with the roller oriented away from the spindle center rather than towards the spindle center.

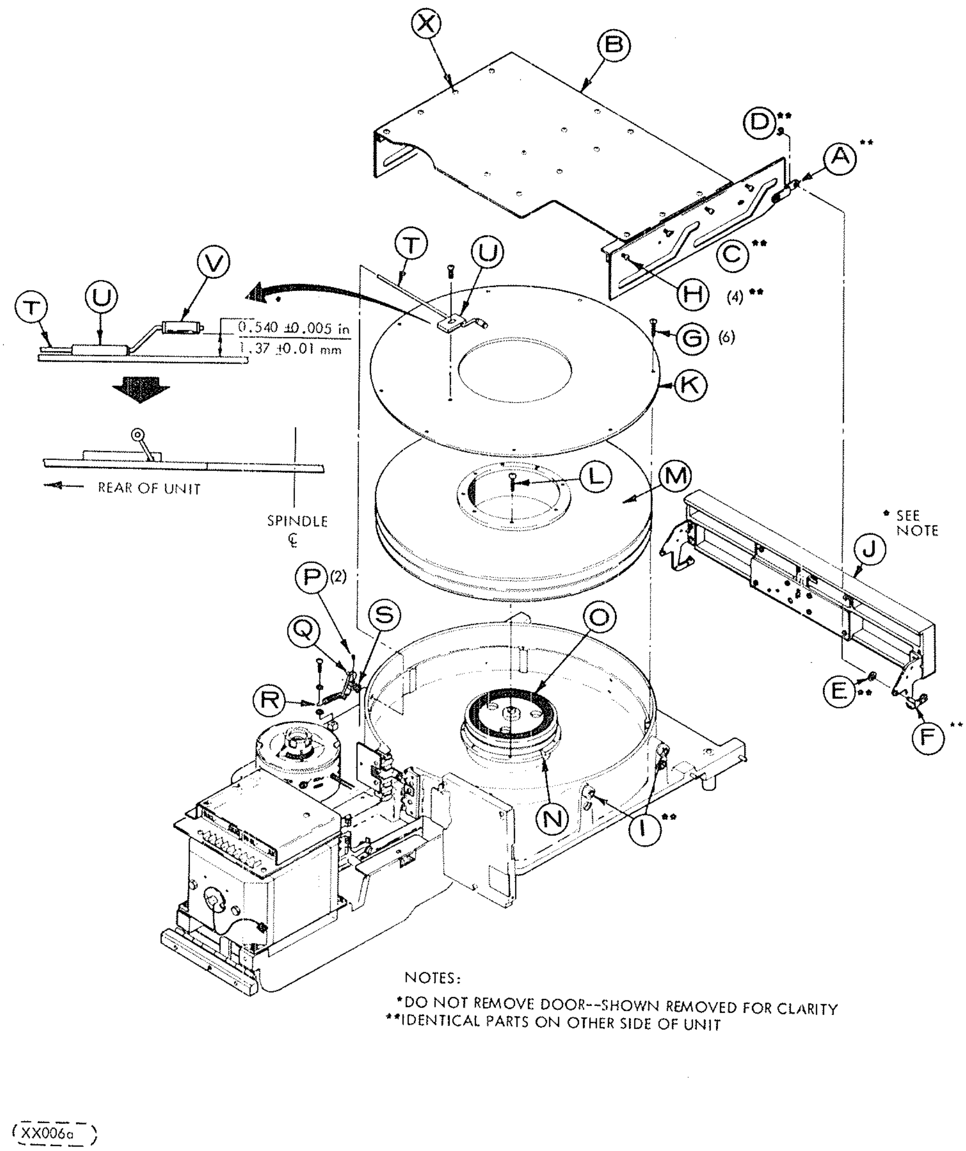


FIGURE 6-8. REMOVAL OF RECEIVER PLATE ASSEMBLY AND FIXED DISK PACK

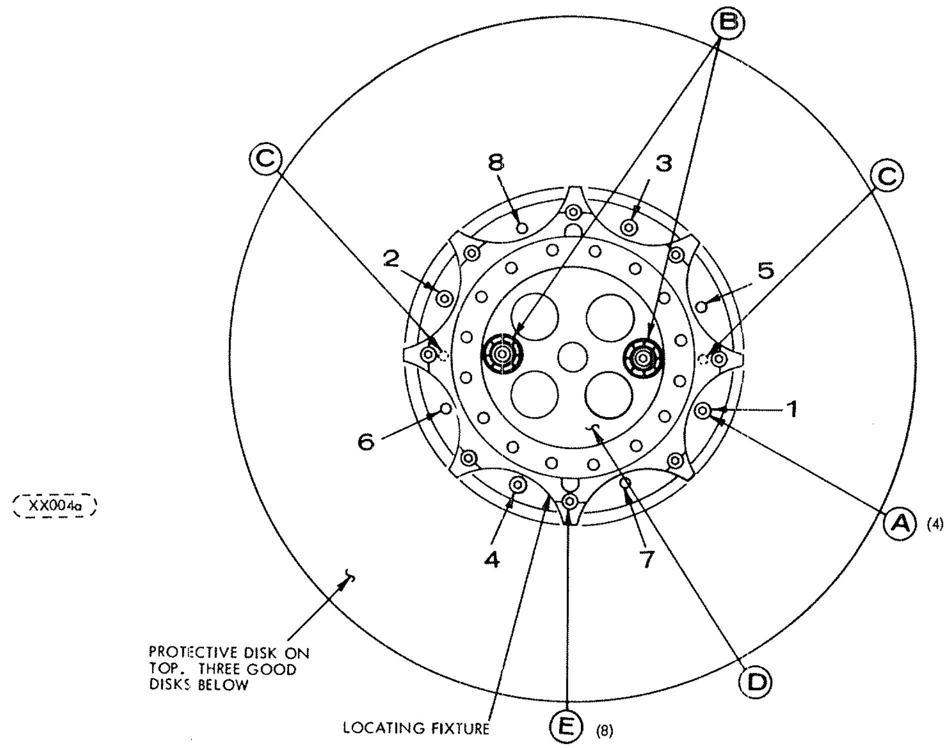


FIGURE 6-9. FIXED DISK PACK LOCATING FIXTURE AND PROTECTIVE DISK

5. Tighten the two set screws (P) 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 bushing to eliminate any axial looseness of shaft assembly when the set screws are tightened.

6. Re-attach the spring (R) to the cam lever (Q).
7. Re-install the receiver assembly in its forward-most position by placing the bearing wheels (I) in their respective cam plate slots at the rear end of the slots. Install the side with the non-loose cam plate first and then the side with the loose cam plate (its four retaining screws were loosened in step 4 of 6.7.6.1).
8. Tighten the four screws (X) which fasten the cam plate to the receiver top plate.
9. On each side re-attach the front access door to the linkage to the cam plate using the pin (F), the nylon bushing (E) and the clip (D).
10. Close the cartridge access door and watch the pin on cam lever (Q). Make sure that the pin on the cam lever goes into the groove in a nylon cam block mounted on the inside of the right (as viewed from the front of the unit) cam plate. Make sure that as the access door is opened roller (V) lifts off the surface of the separator plate (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.
11. Replace the top cover per section 6.7.1.
12. Replace the cartridge in the unit.

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.

NOTE

> 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.

NOTE

> 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 located 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.
12. Start the two screws (B) by hand making certain that they engage correctly with the threads of the corresponding hole in the spindle. Advance the two screws alternately to insure that the plate (D) is kept level relative to 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

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

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. Install the locating fixture to the removed fixed module if available using the 8 screws at (E) (Figure 6-9).
22. Install the fixture and removed fixed module into the container and secure using the 4 screws at (A) (Figure 6-9).
23. 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.
24. Replace the cover on the container and place back into the shipping box.
25. 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.
26. 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.

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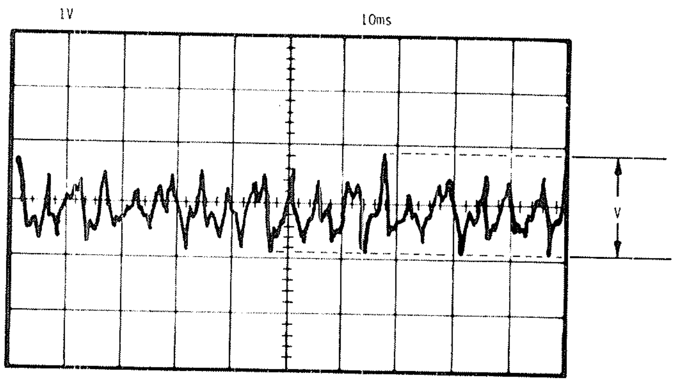
*These values cannot be actually measured but are given as a guide to show the order of magnitude of the acceptable runout. Except in very rare instances, unacceptable runout will be so great that it will be easy to discern when compared with the 0.01 and 0.005 values given here.

- 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.

27. 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.
28. 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

ZZ069a

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 Electronics 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 then up.
9. Remove the head cable from the cable clamp C .
10. Remove the head connector retainer E .
11. Disconnect the Servo Head/Arm Cable connectors from the tie point plate A and the Servo Preamp PWA.
12. 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 source.
18. Set AC circuit breaker to ON.
19. Perform Servo Head Alignment Check and Adjustment Procedure (paragraph 6.8.5.4).
20. When alignment is complete torque the head securing screws per 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.

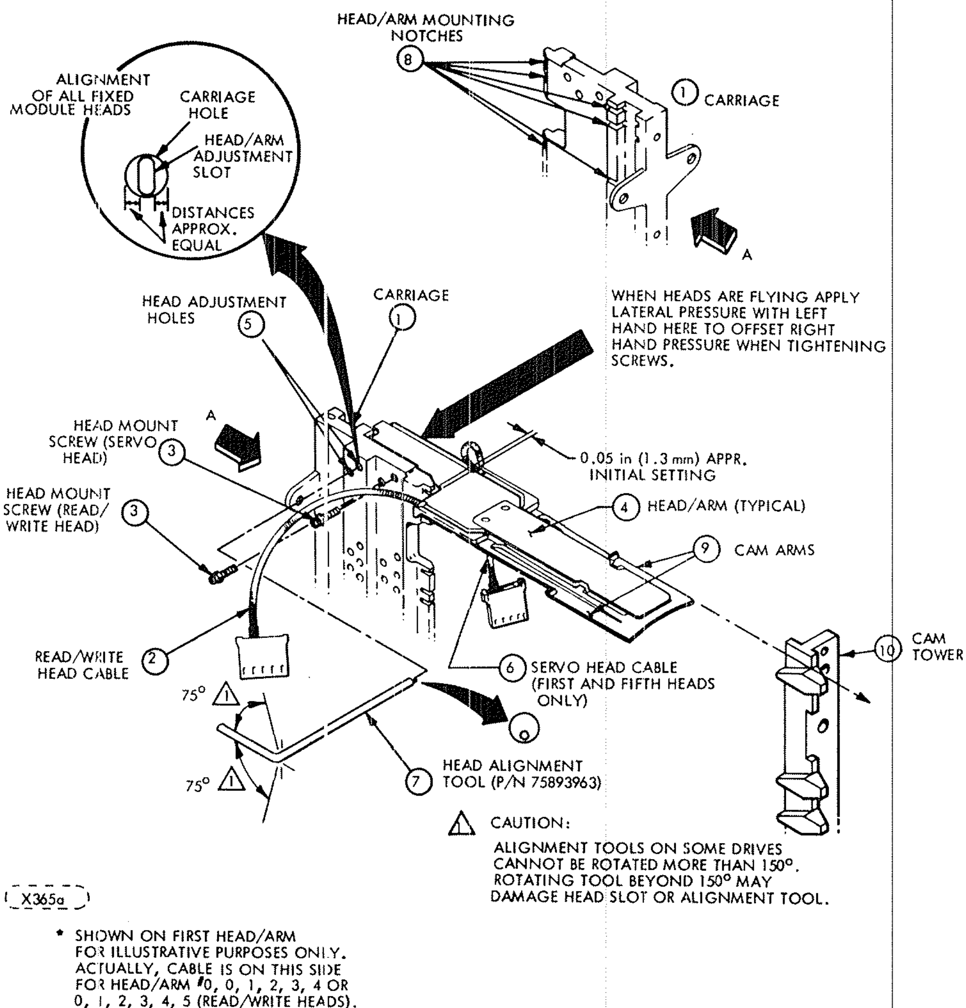


FIGURE 6-10. HEAD/ARM REMOVAL AND REPLACEMENT AND ALIGNMENT

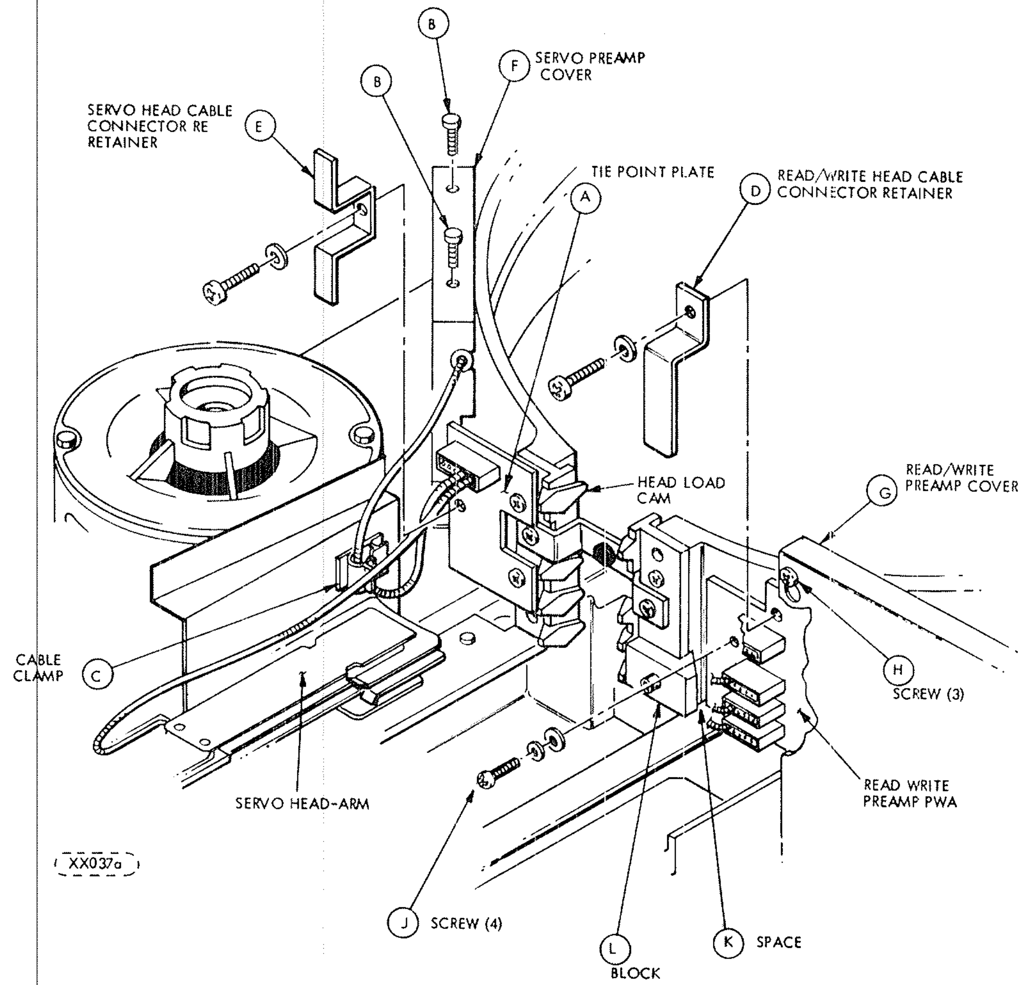


FIGURE 6-11. SERVO HEAD/ARM ASSEMBLY

6.7.11 HEAD INSPECTION AND CLEANING

General

The drive has a positive pressure filtration 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 on the 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 to gimbal spring to touch anything.

Prior to removing head for 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:

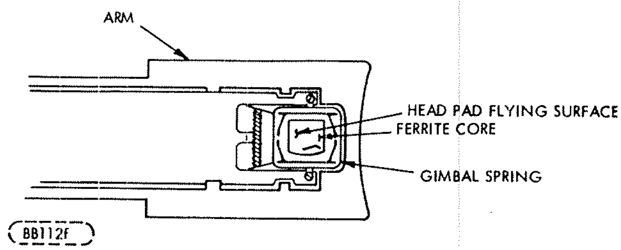


FIGURE 6-12. TYPICAL HEAD/ARM COMPONENTS

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.

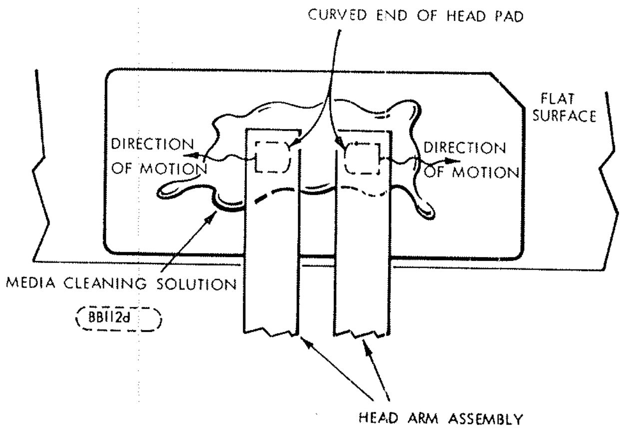


FIGURE 6-13. HEAD CLEANING MOTION

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 cleaning procedure until deposits are removed.
8. Blow OFF heads again using super dry dust remover 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 surface.
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 7.7.2.
2. Disconnect the motor wires which go to the Relay Control Board. See Figure 6-14 which shows the three wires 6 which go to RCTB2.
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 lbf-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 wires 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.

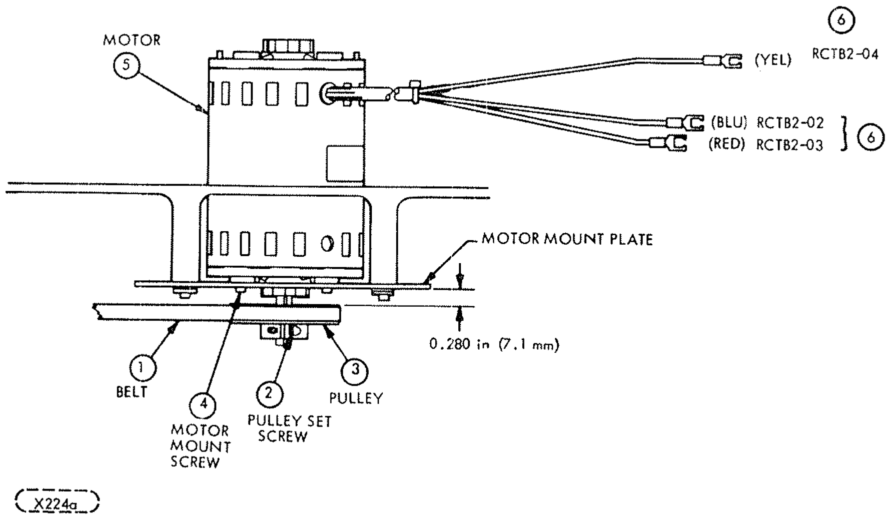


FIGURE 6-14. DRIVE MOTOR ASSEMBLY

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 colling 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.

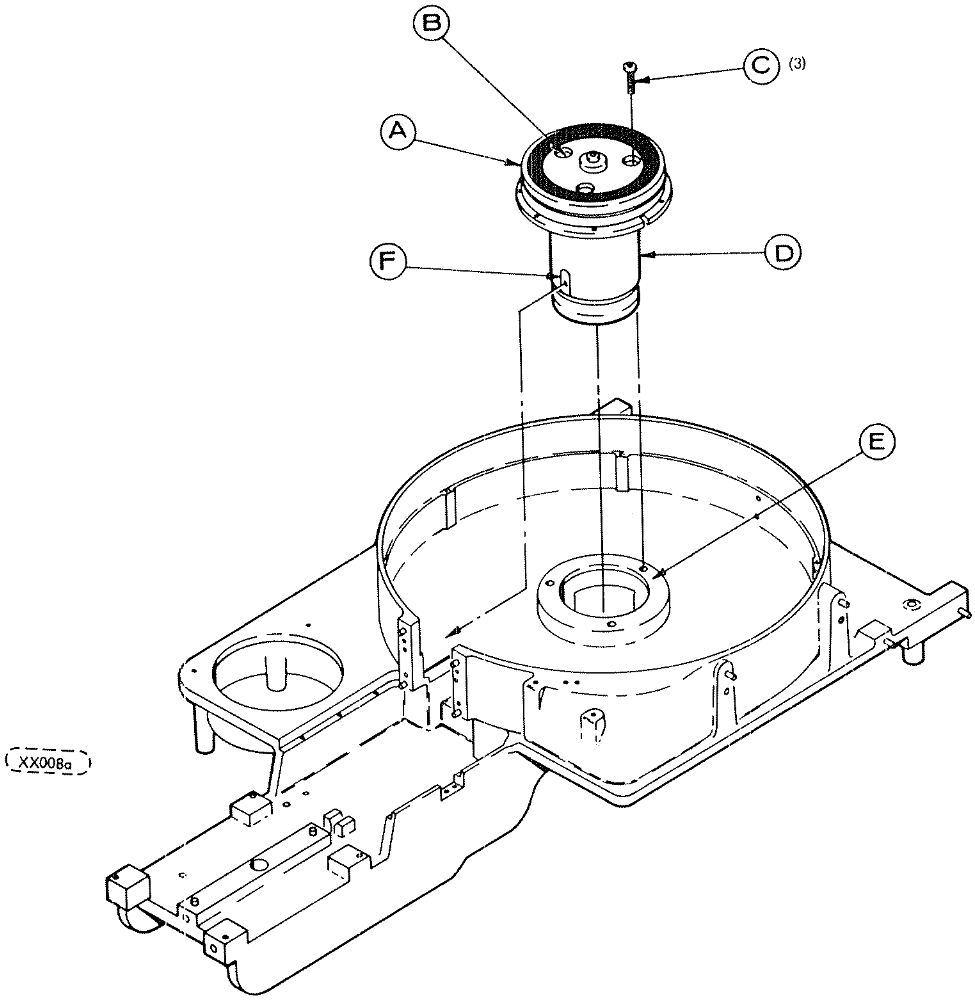


FIGURE 6-15. SPINDLE REMOVAL AND REPLACEMENT

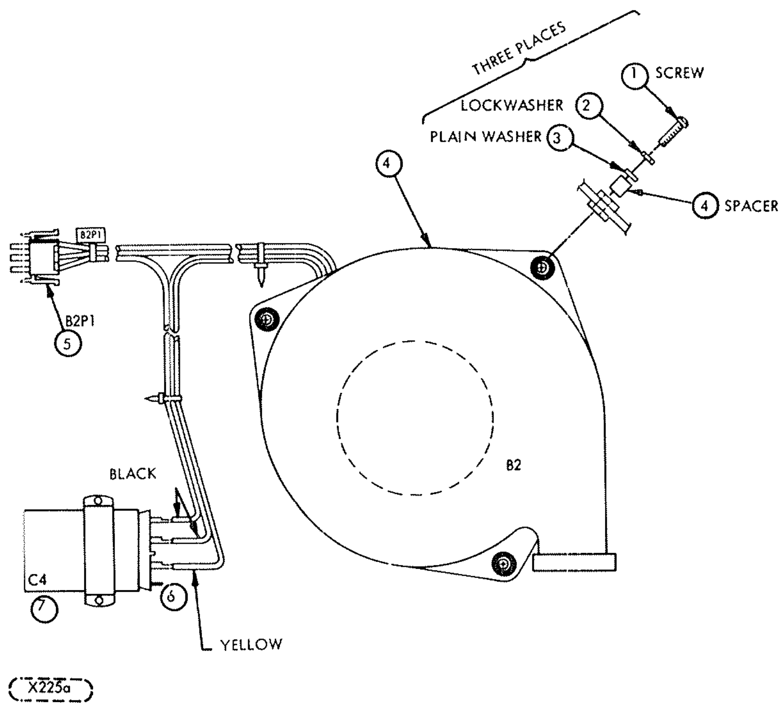


FIGURE 6-16. BLOWER ASSEMBLY

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 81pin connector 13 from PWA 12.
8. Disconnect the three single quick disconnect terminals 16 from PWA 13.
9. Remove screw 15 which secures the end capacitor to the power supply chassis.
10. Remove the eight screws 11 which secure the capacitor mount PWA to the power supply chassis.
11. Slide the PWA 12 out of the power supply.
12. To install Power supply boards perform the steps 1 - 10 in reverse order.
13. Replace Power Supply in the drive.
14. Connect drive to power source and restore to normal operation.

6.7.15.2 FUSE REMOVAL AND REPLACEMENT

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 (para. 6.7.15.3). 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 1-6 and 8-12. 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.
4. Swing Electronics Module out to Allow deck to be raised.
5. Raise deck assembly to maintenance position.
6. Remove desired fuse 6 or 8 (or 18 in some units). Replace with good fuse.
7. To remove 5 or 7 remove power supply per 6.7.15.3. Replace bad fuse. Replace Power Supply.
8. Lower deck assembly to normal position.
9. Swing Electronics Module back into place.
10. Replace top cover.
11. Connect AC cord to power source.
12. 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. Swing out the Electronics Module to allow deck to be raised. Refer to paragraph 6.7.2.
6. Raise the deck assembly to maintenance position.

7. Disconnect the four connectors PS1P1 (1) , PS1P2 (2), and PS1P3 (3) and PS1P4 (17) .
8. Remove the power supply from unit.
9. Install power supply back in its place in the drive.
10. Perform steps 7 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).

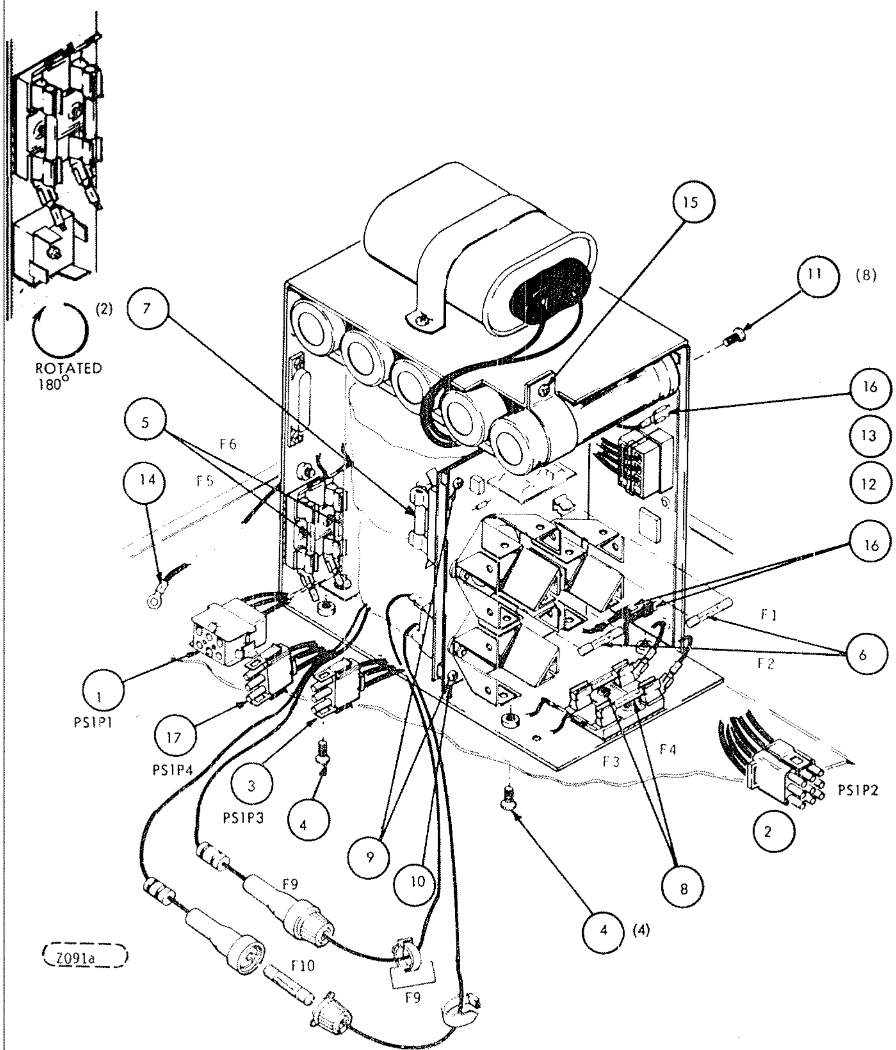


FIGURE 6-17. POWER SUPPLY ASSEMBLY

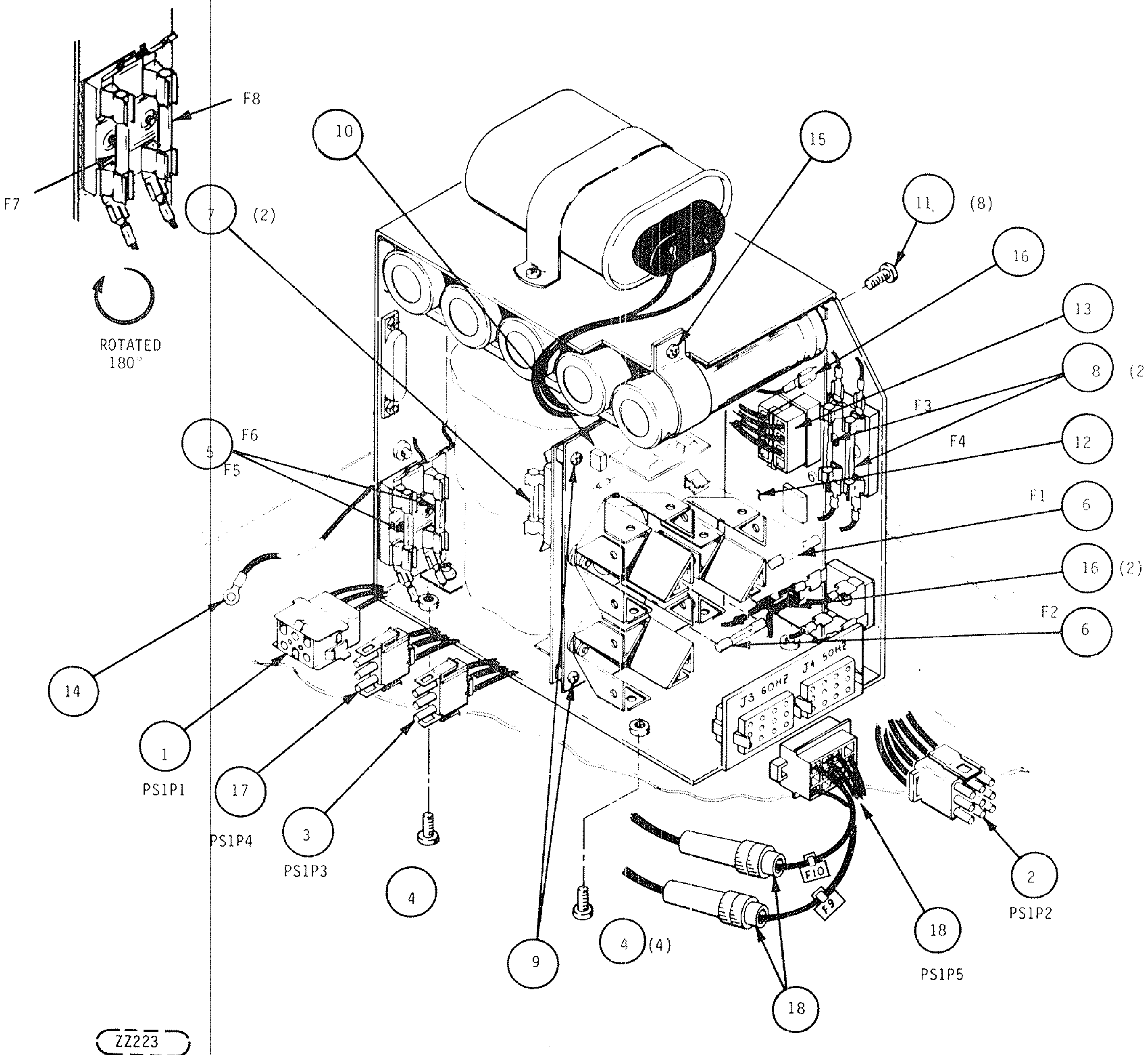


FIGURE 6-17.1. 50/60 HZ POWER SUPPLY ASSEMBLY

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 two screws (A) which fasten the Velocity transducer housing (D) to the voice coil magnet (B).
e. Slide the Velocity Transducer housing out of the Actuator Magnet.
f. Remove the Heads Loaded switch per paragraph 6.7.17.
g. 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 tope of the bearing plate. The Electronics Module side is least obstructed and therefore the most convenient side to tape.
h. Remove the four screws (C) which fasten the actuator magent to the base deck. This requires a 4/32 in. hex driver tool.
i. Carefully slide the magent 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 magent.
j. To replace the actuator magent carefully insert the velocity transducer magnetic core ((F), Figure 6-19) into the velocity transducer hole in the actuator magnet.
k. Carefully insert the voice coil into the circular slot in the face of the actuator magnet as the magnet is being slide forward.
l. Insert the front locator pin on the base deck into the groove at the front, bottom of the actuator magent and slide the magent 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.
m. Fasten the actuator magnet to the base deck with the four hex head screws removed in step e.
n. Insert the Velocity Transducer housing into its hole in the Actuator Magnet while guiding the core into its hole in the transducer housing.
o. Replace the Velocity Transducer housing and secure it to the Actuator Magnet using the two screws removed in step c.
p. Install the Power Amp PWA which was removed in step b. Fasten down with four screws.
q. Fasten the Head Load Switch bracket to the Actuator Magnet using the two screws removed in step e. Reconnect the switch lead wires.
r. Adjust the Head Load Switch per paragraph 6.8.3.
s. Adjust the carriage restraint blocks per 6.8.6.

t. If a new magnet is being installed remove the carriage lock pin from the old magnet and install it on the new magnet.
u. Set the AC circuit breaker to ON.
v. 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.
e. 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.

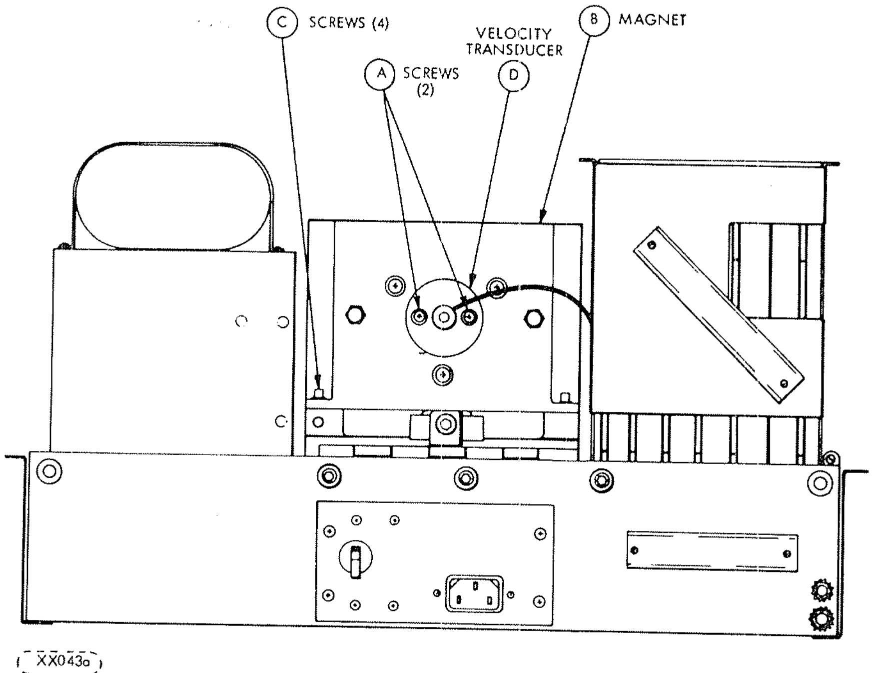


FIGURE 6-18. VELOCITY TRANSDUCER AND ACTUATOR MAGNET REMOVAL

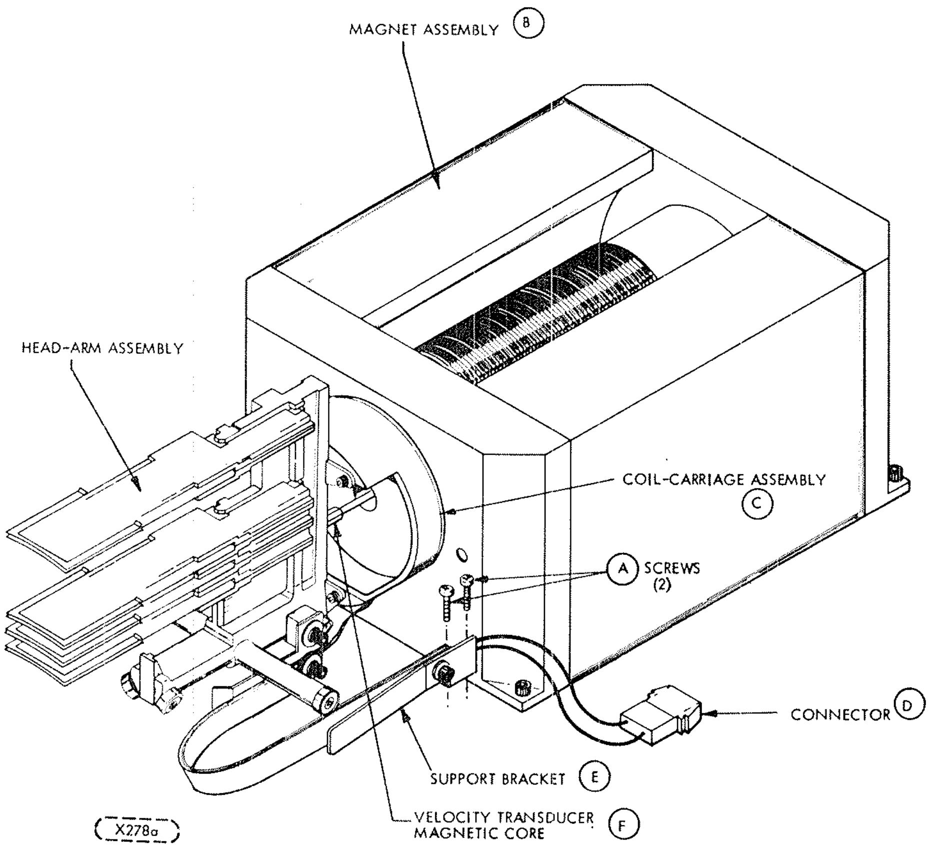


FIGURE 6-19. ACTUATOR ELEMENTS (POWER AMPLIFIER REMOVED)

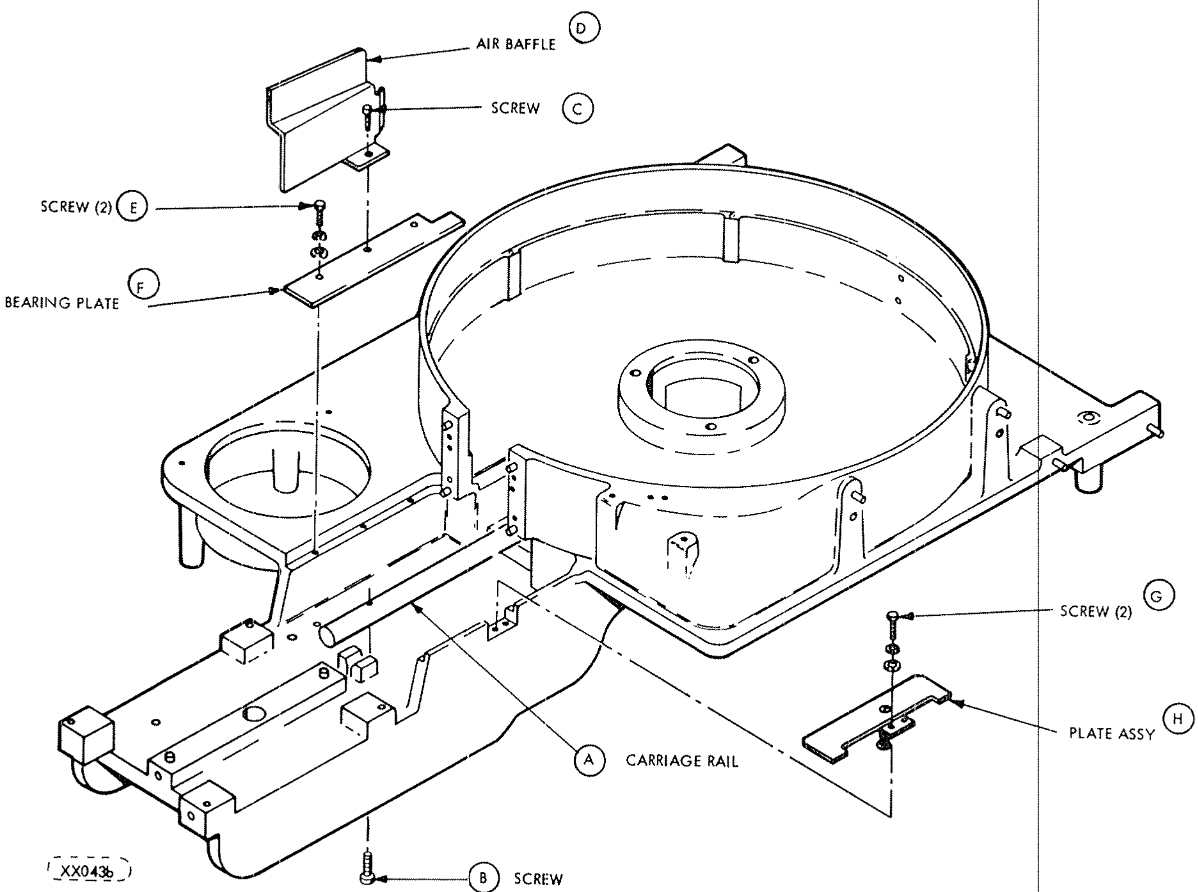


FIGURE 6-20. CARRIAGE RAIL REMOVAL AND REPLACEMENT

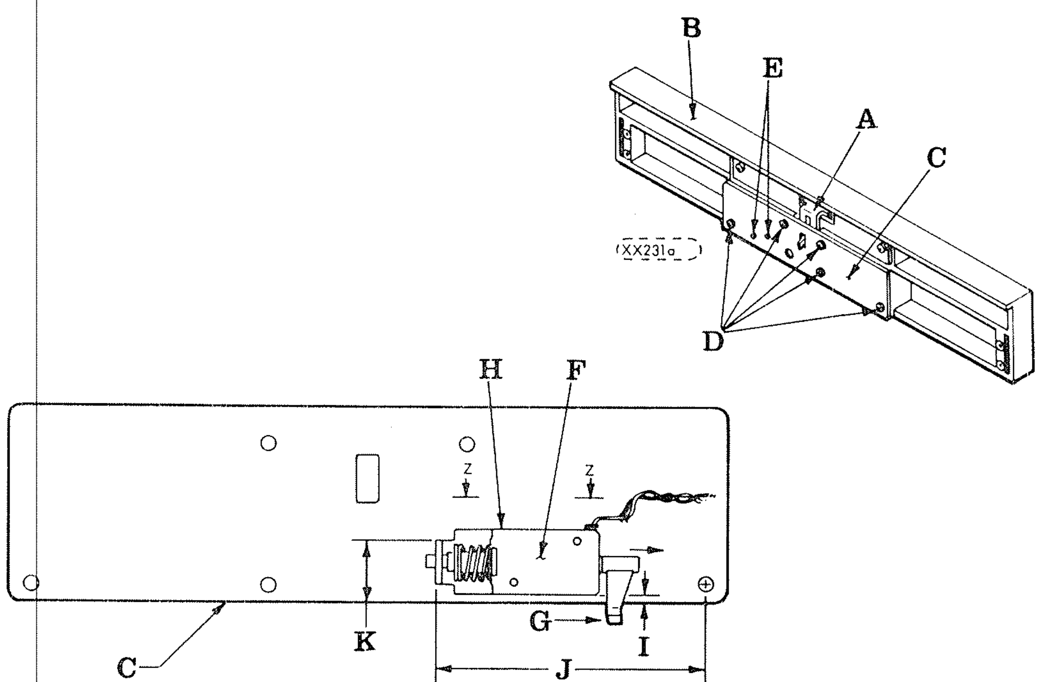
6.7.21 REMOVAL AND REPLACEMENT OF CARTRIDGE ACCESS DOOR LOCK SOLENOID

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.

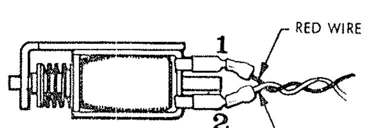
k. Tighten the mounting hardware.
l. Connect the two wires which were removed from the old solenoid to the proper tabs as illustrated in View Z - Z in Figure 6-20.1.
m. Install the latch cover plate assembly to the access door. To do this, lift up on the door release slide (A) and pull back the solenoid plunger so it will clear the shoulder at the bottom of the door release, and then let the solenoid plunger return to resting position when the cover plate is properly in place.
n. Install the five screws removed in step d but allow them to remain loose. Position the bottom edge of the cover plate against the protruding edge at the bottom of the access door. Move the cover plate sideways until the solenoid bracket is against the side of the door release slide. This reduces the play in the door release slide.
o. Tighten the cover plate mounting screws.
p. Check to see that the door release slide will operate the release catch properly when the solenoid plunger is pulled back with tab (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.

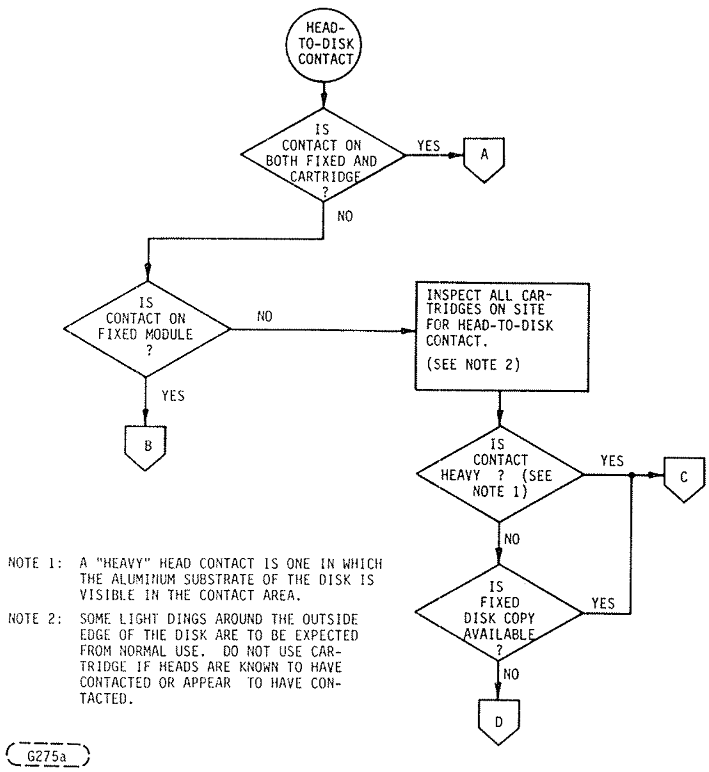


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 1 OF 3)

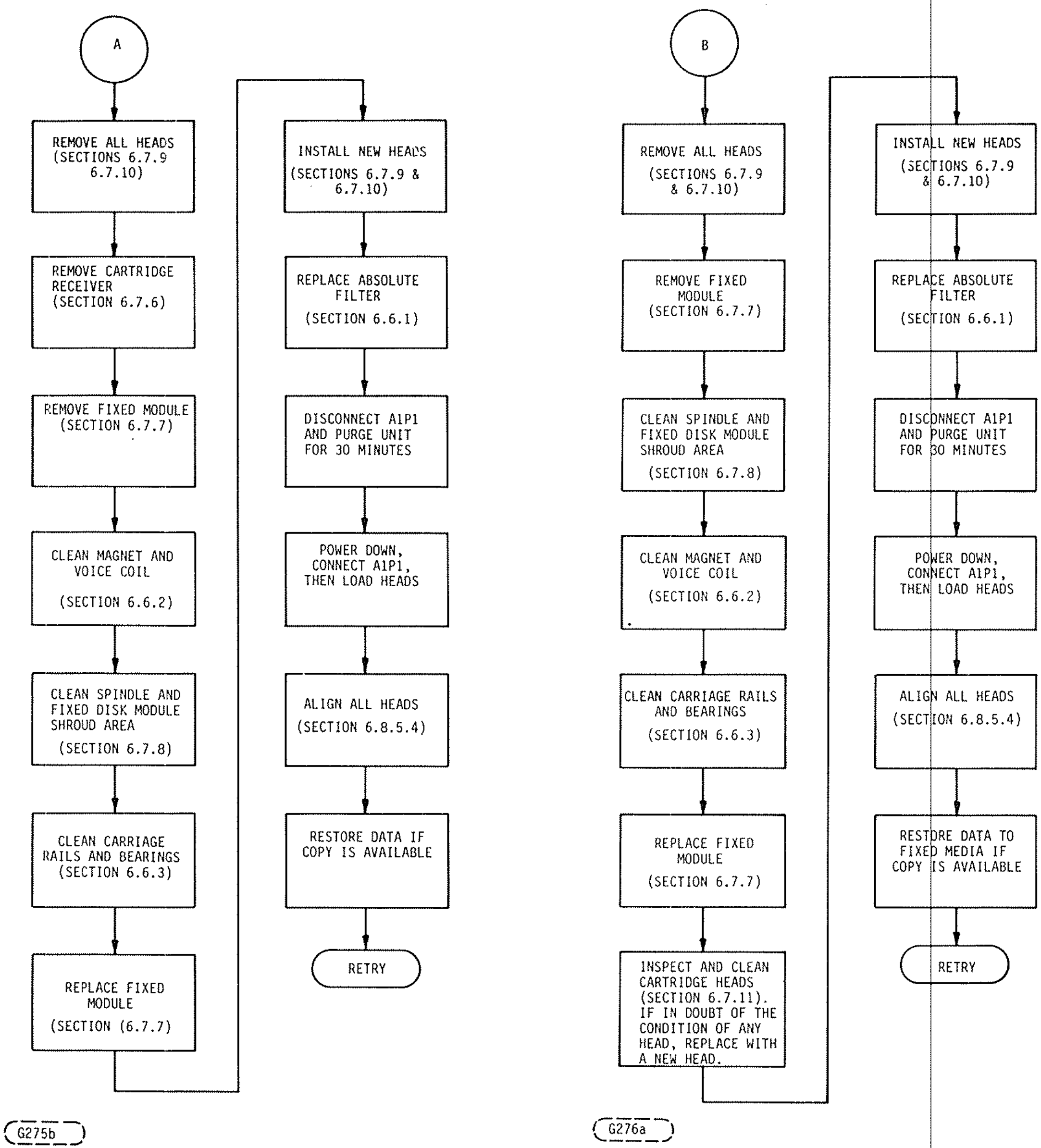


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 2 OF 3)

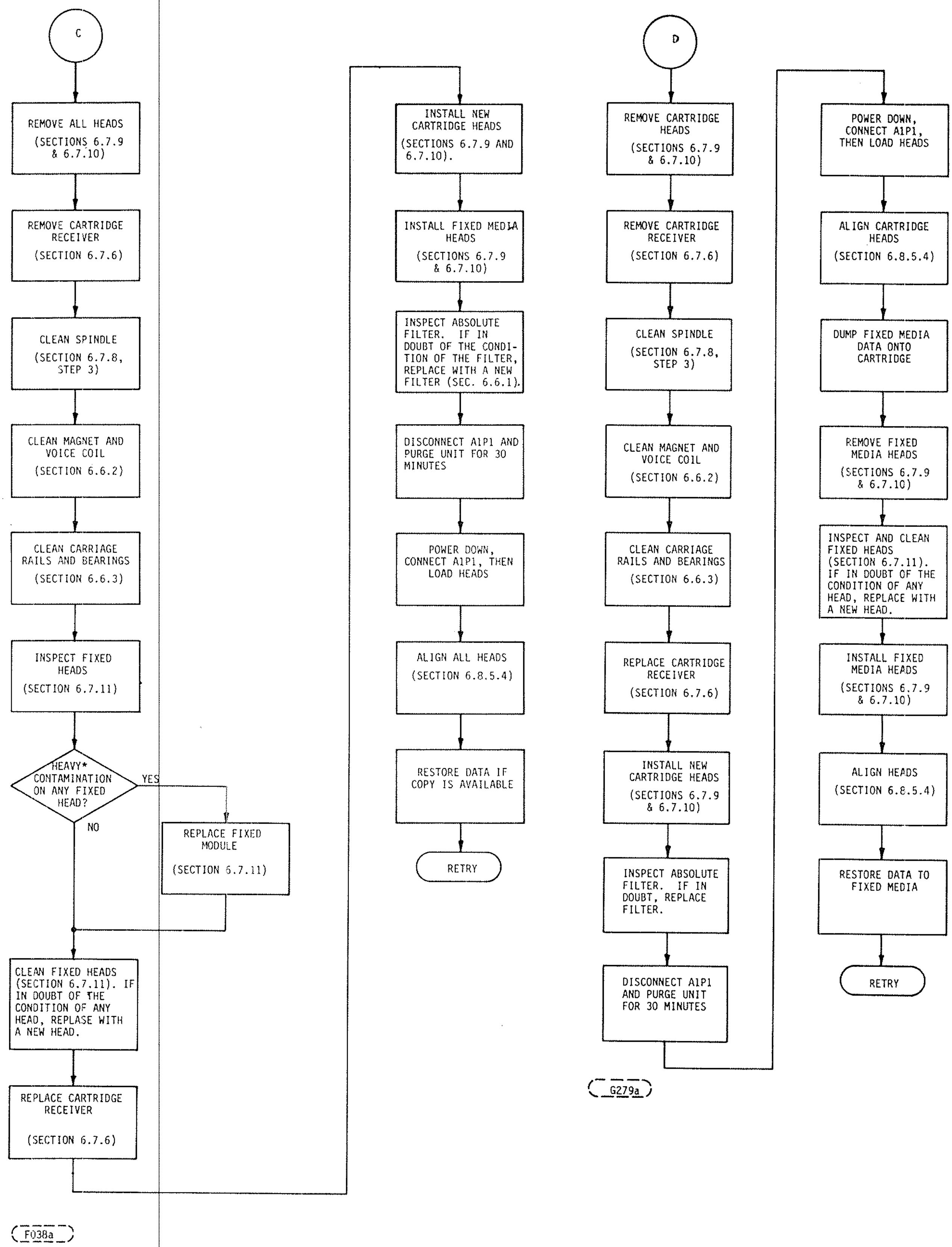


FIGURE 6-20.2. HEAD-TO-DISK CONTACT RECOVERY PROCEDURE (SHEET 3 OF 3)

6.8 DRIVE TESTS AND ADJUSTMENTS

6.8.1 GENERAL

The tests and adjustments contained in this subsection are those which every drive must pass to be considered operationally acceptable.

If a more detailed test or adjustment procedure is needed to isolate a malfunction, refer to the Trouble Analysis Aids procedures which follow these procedures.

6.8.1.1 MANUAL HEAD POSITIONING

Manual head positioning with spindle not up to proper speed should NEVER be done.

Manual head positioning with power on and disk pack up to speed is not recommended unless required by maintenance procedure or loss of servo control makes it necessary.

1. Should manual loading 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).

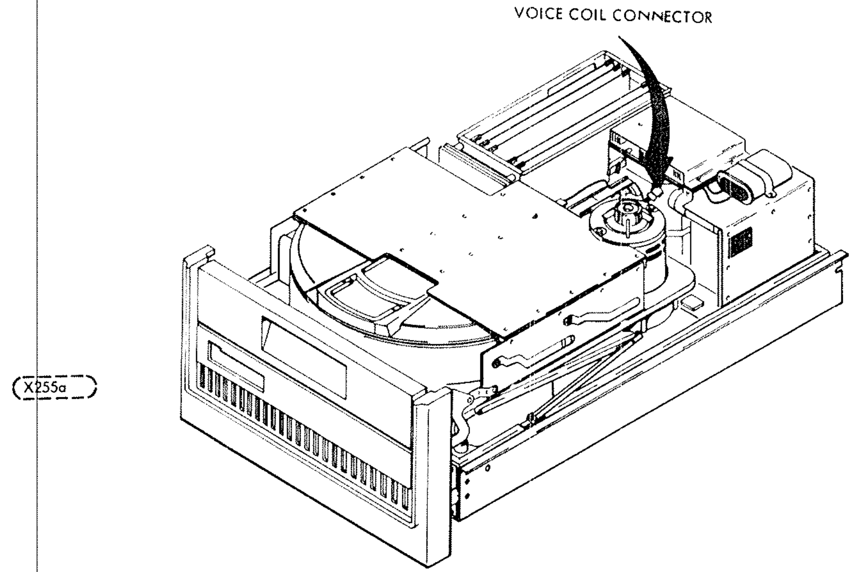


FIGURE 6-21. VOICE COIL LEADWIRE CONNECTOR

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 halves:
   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 cause read errors. This can only be done after installation of the fixed module since the precise location of each data track is not determined until the module is installed.

1. Perform the head alignment procedure as defined in para. 6.8.5.4.
2. Format each data surface with the format and number of sectors normally used. A single sector on each track with one large data field is preferred but not necessary.
3. Read the format with nominal strobe and no offset. If any error is detected, note the track location and re-read. Track locations for which an error is detected more than once must be flagged and excluded from further use. Use spare track locations 808 - 822 as 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

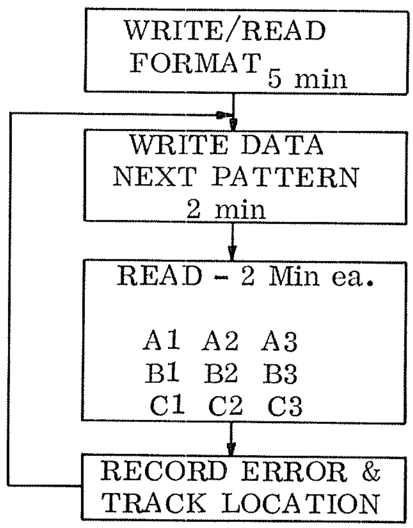


FIGURE 6-22. CERTIFICATION OF FIXED MEDIA

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 RX1) across switch terminals.
5. With carriage retracted, multimeter should indicate zero ohms.

CAUTION

Do not move carriage forward far enough to fall off the cam tower and thus allow heads to load onto the disks.

6. Slowly move carriage towards spindle while observing multimeter. Multimeter must indicate infinite ohms when carriage has traveled 0.07 (±0.04) inch from full retract stop. (Distance is measured from rear edge of carriage to magnet.) If adjustment is needed, proceed to next step. If no adjustment is needed, proceed to step 9.

NOTE

Make certain that carriage is fully retracted while performing next step.

7. Loosen screws securing heads loaded switch to mounting bracket. Adjust switch position until it actuates after 0.07 (±0.04) inch travel from full retract stop. Tighten screws when switch position correctly adjusted.
8. Install top cover.
9. Set AC POWER circuit breaker to ON.
10. Press START switch to operate drive.

6.8.3.2 CARTRIDGE-IN-PLACE SWITCH ADJUSTMENT

1. Stop the spindle and power down per paragraphs 2.3.3 and 2.3.4.
2. Remove the disk cartridge.
3. Remove the cover per 6.7.1.
4. Identify the switch and leadwires. See Figure 6-22a.
5. Measure the distance "X" between the casting edge and the switch lever when the switch is at the operating position. See Note at beginning of Section 6.8.3. Dimension "X" as shown in Figure 6-22a should be 0.15 ±.01 inch (3.8 ±0.3 mm).

6. If the switch does not operate within the specified measurement, loosen the hardware that secures the switch to the mounting bracket and adjust the switch p position.
7. When adjustment is correct, check hardware for adequate tightness and replace leadwires to the common and normally open switch terminals.
8. Install top cover.
9. Install disk cartridge.
10. Set AC power circuit breaker to ON.
11. Press START switch to operate the drive.

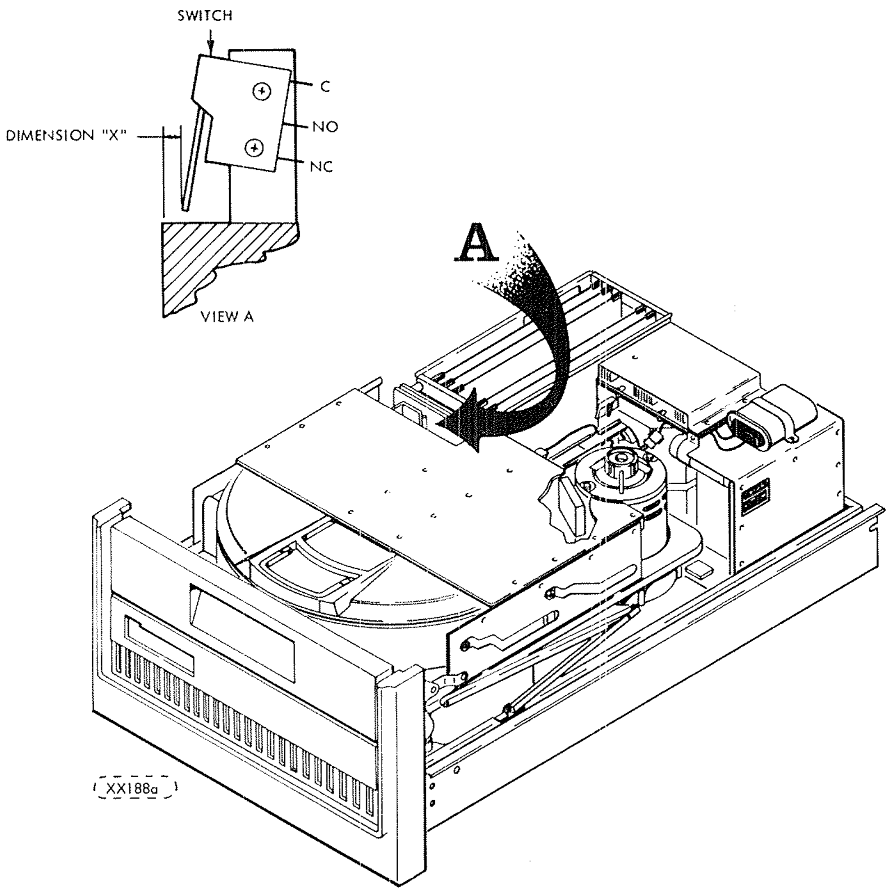


FIGURE 6-22A. CARTRIDGE-IN-PLACE SWITCH ADJUSTMENT

6.8.3.3 DECK DOWN INTERLOCK SWITCH ADJUSTMENT

1. STOP and power down per 2.3.3 and 2.3.4.
2. Remove cover per 6.7.1.
3. Swing Electronics Module to the maintenance position per 6.7.2. Do not raise the Base Deck Assembly.
4. Locate the switch and switch leadwires (see Figure 6-22b).
5. With Base Deck in the normal (down) position the switch should be in the operating position (see NOTE at beginning of Section 6.8.3 on operating position and test method) and the normally open contacts should be closed.
6. If the switch is not in the operating position, loosen the hardware that secures the switch mounting bracket to the Deck support bracket and adjust the switch upward such that the Base Deck casting will contact the switch lever and operate the switch.
7. When adjustment is complete, check that the mounting hardware is adequately tight and replace the leadwires to the common (C) and normally open (NO) switch terminals.
8. Replace the Electronics Module to normal position.
9. Replace the top cover.
10. Set the AC power circuit breaker to ON.
11. Push the START switch to operate the drive.

6.8.3.4 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 ±0.3mm) 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.

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

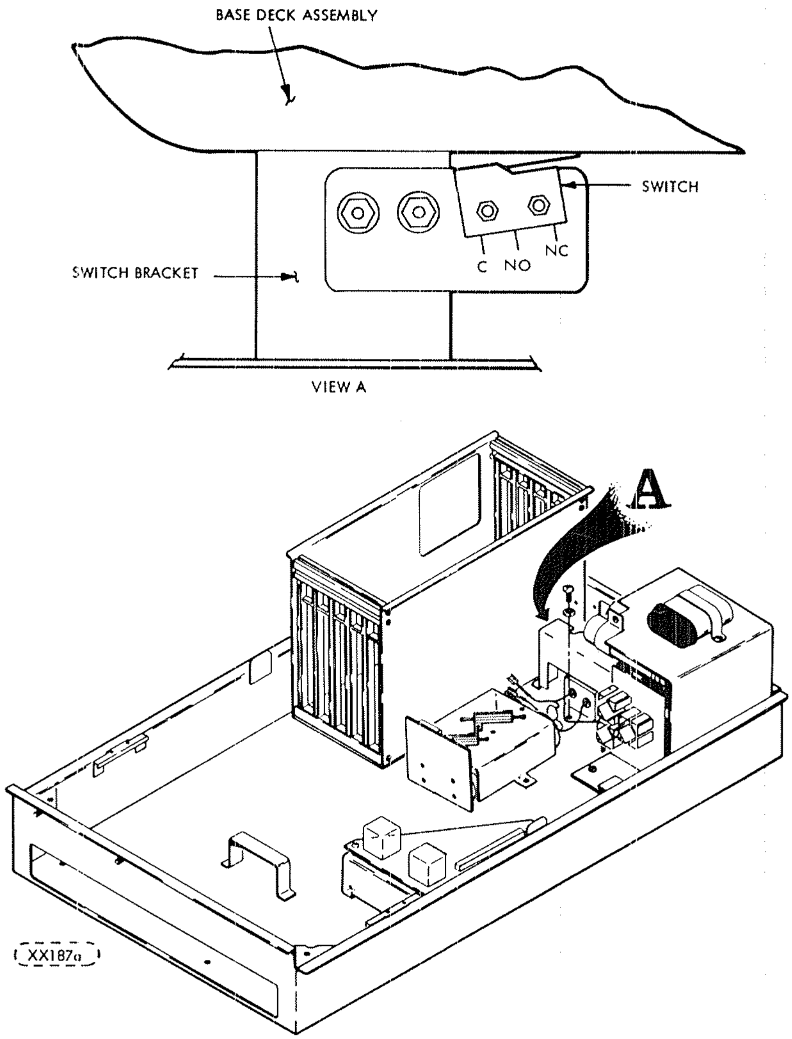


FIGURE 6-22B. DECK DOWN INTERLOCK SWITCH ADJUSTMENT

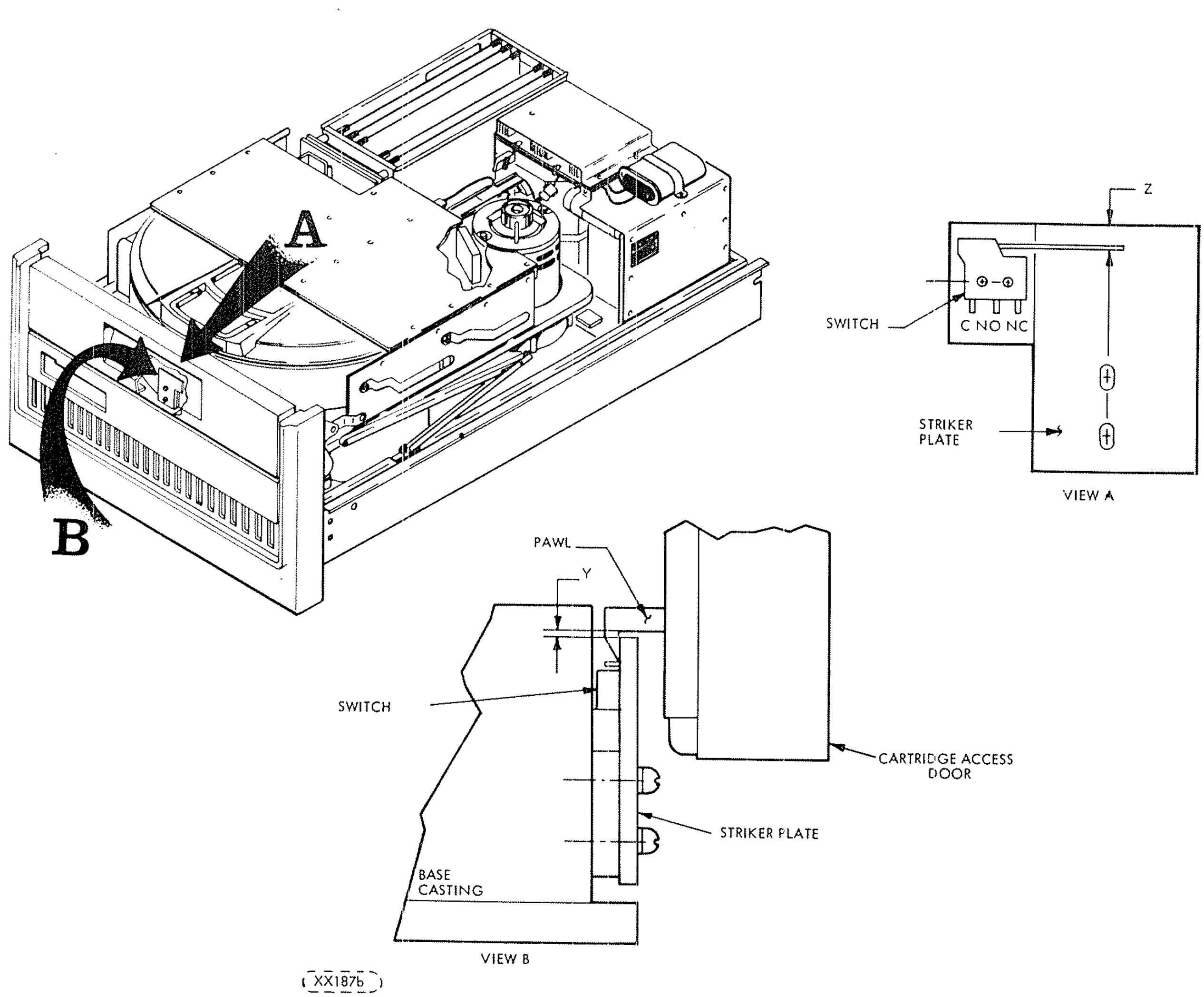


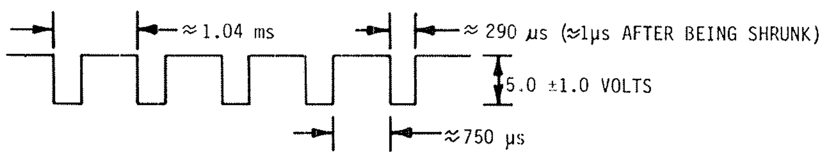
FIGURE 6-22C. CARTRIDGE ACCESS DOOR INTERLOCK SWITCH AND STRIKER PLATE ADJUSTMENT

9. Tighten the switch mounting hardware and check to see that the operating position (dimension "Z") has not changed. If the operating position has changed readjust per steps 7 and 8 above.
10. Replace the leadwires, spacer(s), Striker Plate and mounting hardware. Do not tighten the Striker Plate mounting screws yet.
11. Close the door to the locked position.
12. While pulling up on door release slide, (do not pull door forward), raise the Striker Plate such that dimension "Y" in view B is 0.00 + 0.01, - 0.00 inch (0.00 + 0.3 - 0.0 mm).
13. Tighten the Striker Plate mounting hardware.
14. Verify that door will not open while pulling up on Door Release Slide and pulling door forward with a force of 10 pounds (45 Newtons).
15. Verify that striker pawl goes over striker smoothly.
16. With the door still closed and locked, verify that any movement of the door due to "play" will not allow the switch contacts to open. If the switch contacts open readjust the switch per this procedure.
17. Replace the front panel and top cover.
18. Set AC power circuit breaker to ON.
19. Push START switch to operate the drive.

6.8.4 PULSE CIRCUITS TESTS

6.8.4.1 SPIN SPEED SENSOR TEST

1. STOP and power down per 2.3.3 and 2.3.4. Remove AC line cord from power source.
2. Remove top cover. Remove 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 Velicity gain. Table 6-4 shows the interpretation of the Fault indicators when S1 is activated and

*See Section 6-9 "Maintenance Aids"

shows which way to turn R7 to bring the Velicity 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.

4. After adjusting R7 so that CR6 lights for each toggle of S1:

   a. Being 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:

- 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.

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 A ZPV 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 power 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 light 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 calbes 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 screws 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.

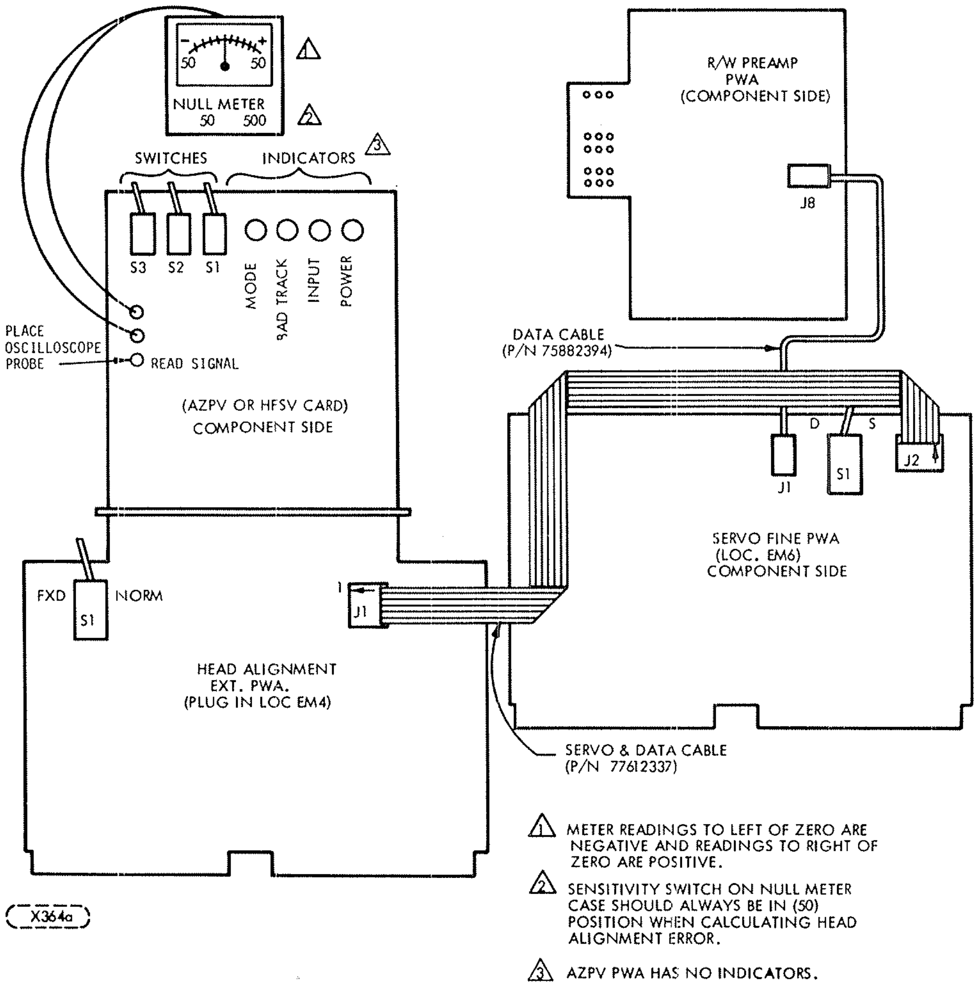
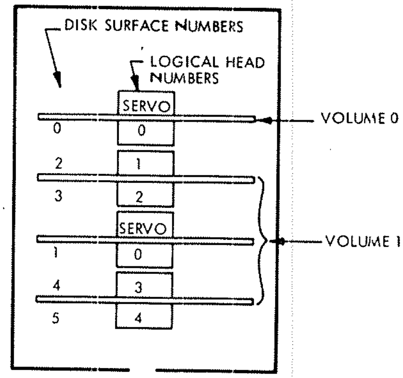
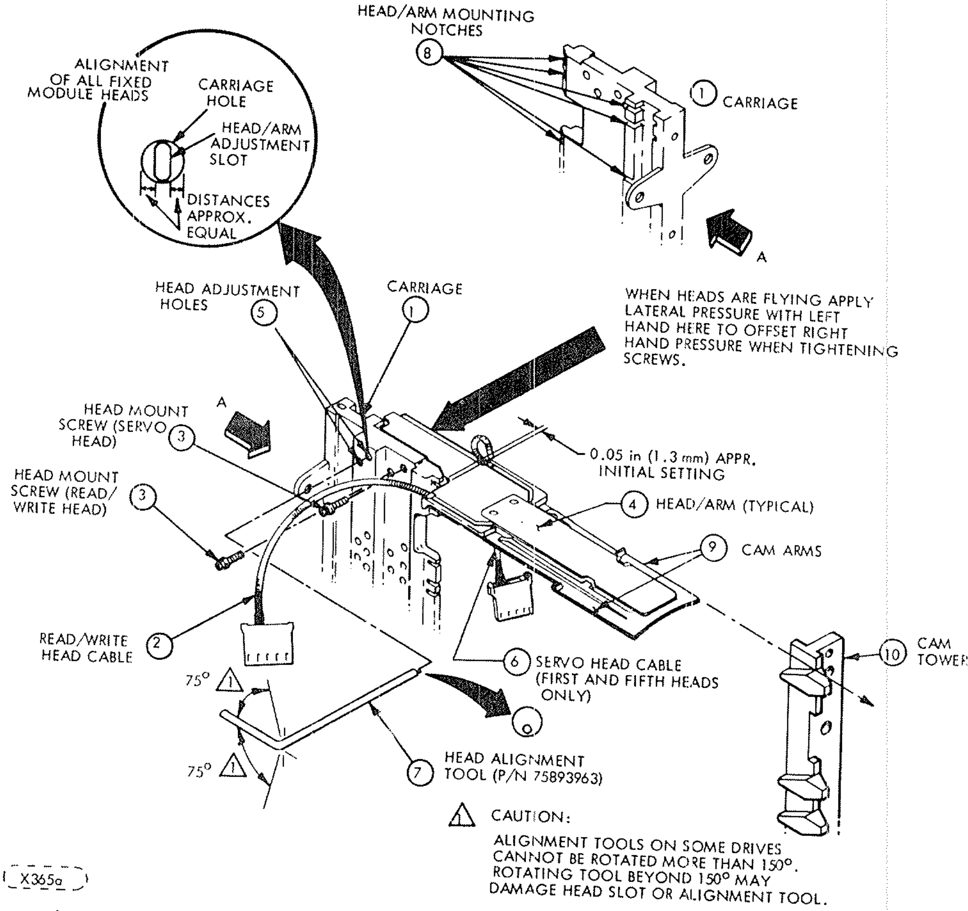


FIGURE 6-23. HEAD ALIGNMENT BLOCK DIAGRAM



X325a



X365a

* 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

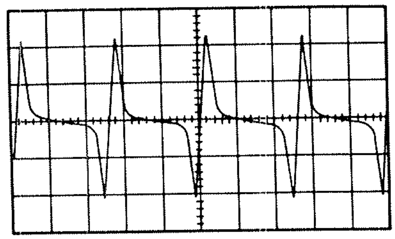
A - 0.5 μs
B - NOT USED

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

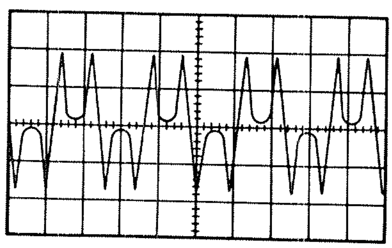
A - 0.5 μs
B - NOT USED

TRIGGERING

A - INTERNAL POSITIVE
B - NOT USED

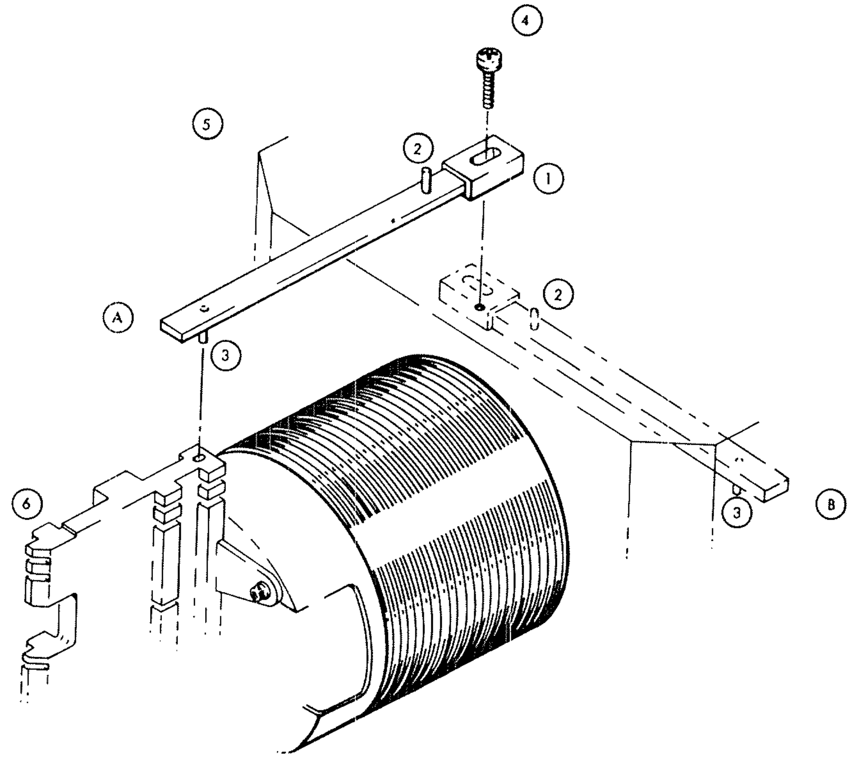
PROBE CONNECTIONS (USE X10 PROBE)

CH 1 TO FTU DIBITS JACK
CH 2 - NOT USED



X369b

FIGURE 6-26. BALANCED DIBIT PATTERN



X231b

(A) CARRIAGE LOCK PIN (1) IN HEAD ALIGNMENT POSITION

(B) CARRIAGE LOCK PIN (1) IN OPERATING POSITION

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 taken so as not to move the carriage assembly in a lateral direction (right angles to the normal direction of head movement). THE RESULTANT FORCE CAN ROTATE THE CARRIAGE ASSEMBLY AND CAUSE SEVERE DAMAGE TO THE HEADS AND DISKS. This motion can be prevented by applying sufficient counter force on the opposite side of the carriage 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 servo 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 waveforms 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.

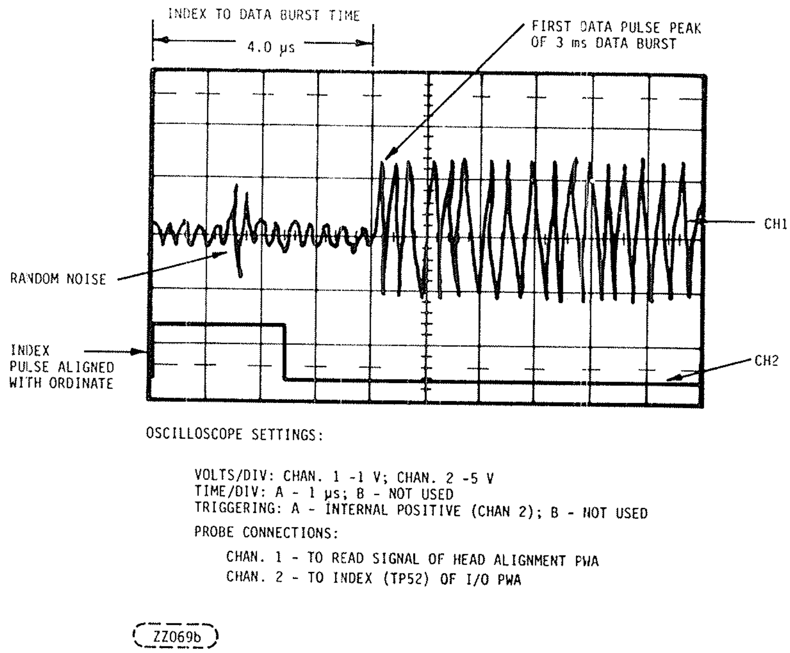


FIGURE 6-27.1. INDEX TO BURST FORMAT

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 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 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 readjust 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, 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).

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 <u>fixed disk module servo head</u>.
e. Perform steps 15 through 33 for the <u>fixed disk module servo head</u>.
f. Perform steps 37, 38 and 40 for the <u>fixed disk module servo head</u>.

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 and 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 is is between 0.001 and 0.003 inches (0.025 - 0.08 mm). This measurement should be done by sliding a 0.001 and a 0.003 inch thick shim (0.03 and 0.08 mm shims) between the adjustment screw J and the bearing plate K .
3. To adjust dimension C , slide a 0.003 inch (0.08 mm) shim between the bearing plate K and the adjustment screw J . Adjust screw J until shim fits snugly between the bearing plate K and the adjustment screw J.
4. Repeat step 2.
5. If this spacing is not correct, repeat steps 3 and 4 above.

NOTE

Block H (Figure 6-28) must be adjusted with the carriage fully retracted.

1. Position carriage in retracted position to check or adjust dimension D .
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.

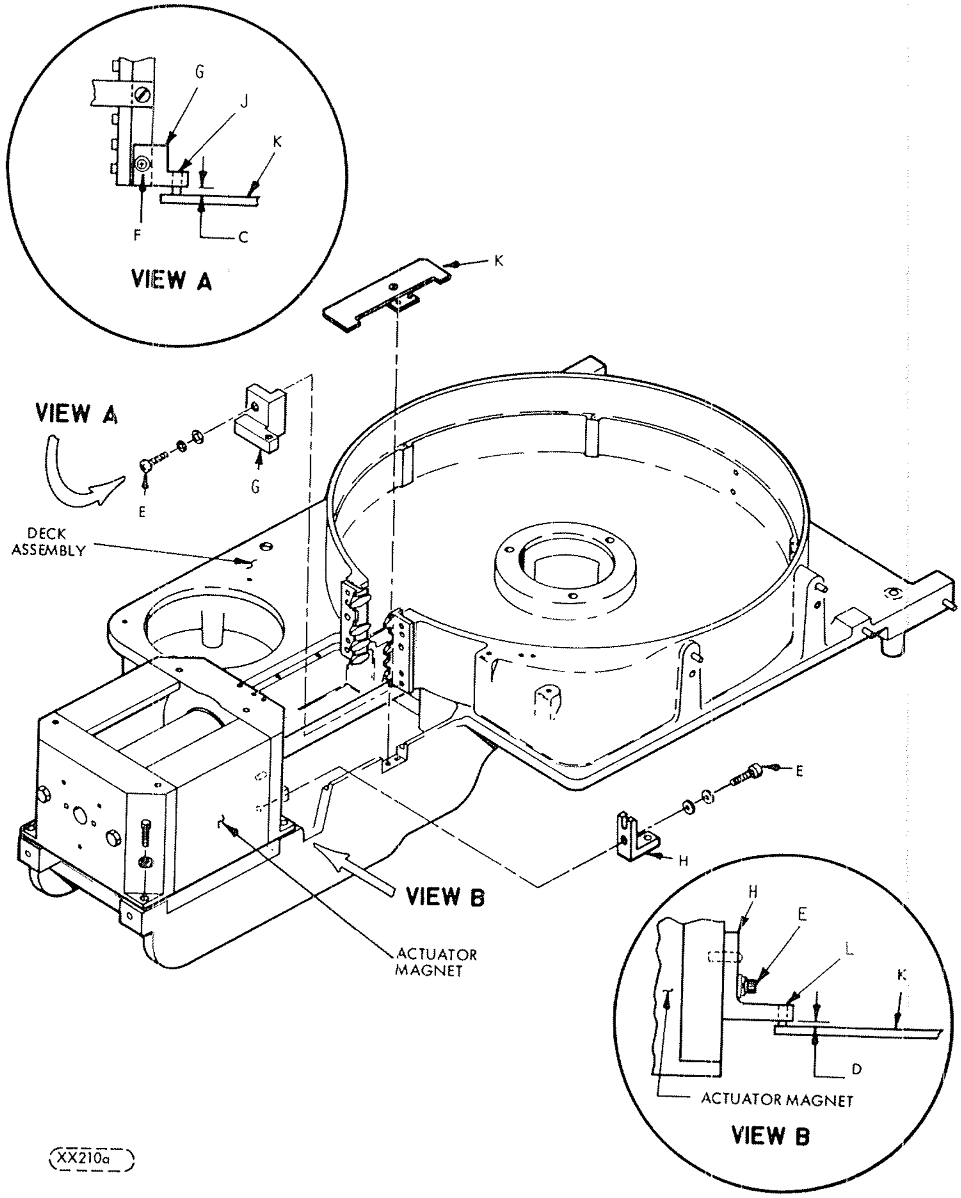


FIGURE 6-28. CARRIAGE RESTRAINT BLOCK ADJUSTMENT

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: 1. Resets the fault latches when in the non-microprocessor fault display mode.** 2. The same actuation of S1 that resets fault latches (#1 above) also initiates the present cylinder address display mode and causes the two highest order binary bits of the present address to be displayed on CR6 and CR7. Subsequent S1 actuations display remainder of the cylinder addresses and a separator state. 3. After the separator state following cylinder address display, Actuations of S1 cause microprocessor-detected error conditions to be displayed on CR3-CR7. Resets the M.P. fault store and sets fault code into the fault latches for display on CR3-CR7. 4. When CR3-CR7 are used to aid velocity gain adjustment, actuation of S1 causes the drive to execute a seek to maximum cylinder number, after which the status of the velocity is displayed.
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 a 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 paragraph 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									DESCRIPTION OF INDICATOR MEANING/FUNCTION
	S1-#8 (SVO-CRSE)	CONTROL/MUX PWA								
		S1 (SWITCH)**	CR1	CR2	CR3	CR4	CR5	CR6	CR7	
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.
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.	.	.	.	.	.	.	.	.	.	
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	S1-#8 (SVO-CRSE)	S1 (SWITCH)**	CR1	CR2	CR3	CR4	CR5	CR6	CR7	DESCRIPTION OF INDICATOR MEANING/FUNCTION
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.

Display Mode 2: Display of the Present Cylinder Address
When S1 on the Control/Mux PWA is actuated in display mode 1, the fault latches are reset, CR2 indicator is turned ON, and indieators CR6 and CR7 display the highest order two binary bits of the present cylinder address (the address used by the drive

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

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 CR 4 through CR7 will then display the next four high order binary bits of the Present cylinder address. The third actuation of S1 will change the information displayed on CR4 - CR7 to the low order four binary bits of the present cylinder address. CR3 will always be zero except when the cylinder address digit displayed on CR4-CR7 is zero which time CR3 will turn ON. The ten bits displayed as described above are to be interpreted as three hexidecimal numbers representing the address of the last seek performed by the drive. At the time the cylinder address bits are displayed the location storing the address is cleared.

Therefore, before a new present cylinder address could be displayed a new seek to a different volume or different cylinder would have to be performed.

Display Mode 3:

The next (fourth) actuation of switch S1 after the three actuations of Display Mode 2 turns off CR3 - CR7 leaving only CR2 ON. This is a separator state between Display Mode 2 and Display Mode 4. The only way Display Mode 3 can be entered is through Display Mode 2, but display mode 4 can be entered through Display Modes 1 or 3. Display Mode 3 does not occur if display mode 2 does not occur. If display mode 3 does not occur it should be recognized that the first three actuations of S1 constituted the first three M.P. Fault Summary codes in display mode 4. Therefore, the first three codes should be written down as one cannot be sure what the code represents until the fourth S1 actuation which will be either the separator code (display mode 3) or a fault code of display mode 4.

Display Mode 4:

Assuming that display modes 2 and 3 occurred first, the fifth actuation of S1 places operation in Display Mode 4 which is called the "microprocessor Fault Summary" mode. This is the mode that displays the Microprocessor-detected errors. The Microprocessor has a fault store area in its RAM where it stores a different binary code number for each error detected.

The fifth actuation of S1 as mentioned above will display on CR3-CR7 the code in the first fault store location where an error code is stored. Those locations in the fault store where no error code has been stored will not be displayed.

Subsequent actuations of S1 displays all other error codes stored, displaying them one at a time until all error codes have been displayed. Table 6-7 lists all the error codes and the meaning of each. The next S1 actuation after the last error code has been displayed displays all ones on CR2 - CR7 (all lights ON). The next actuation after all ones displays all zeros (all lights OFF but CR2). Subsequent actuations of S1 jumps the displays back and forth between ones and zeros on CR2 - CR7 until some operation is performed by the drive (i.e., seek, read or write, RTZ, etc.). After the drive gets back in the idle mode of operation after an operation it will be in Display Mode 1 again. Display mode 4 could directly follow mode 1 in some situations. A typical situation would be after a seek was commanded but the ready and "ON-track" condition was never reached. Any time the cylinder address is cleared and a new seek is not completed, modes 2 and 3 would be skipped.

If the fault readout process is somewhere in mode 4 when a seek is performed, operation returns to mode 1. The M.P. error codes still stored in the M.P. fault store (i.e., those which hadn't been displayed before the seek occurred) remain there and will be displayed the next time mode 4 is in process. Any new faults which may be stored before operation returns to mode 4 through subsequent actuations of S1 in the normal manner will be displayed with the remaining faults.

Display Mode 5:

When S1-#8 on the Servo-Coarse PWA is placed in the OFF position. (right side of switch depressed when facing switch from component side of PWA), the servo system velocity can be displayed on CR3-CR7. Paragraph 6.8.5.2 describes the use of this display mode in adjusting the servo velocity gain.

TABLE 6-7. MICROPROCESSOR FAULT CODES AND MEANINGS

Codes 01 through 0C represent the 12 phases of operation that are checked by the microprocessor. Codes 0F through 1E represent the fault types that could have occurred in one of the phases. In display mode 4 the phase codes are read out in order first and then the fault codes in order. Code hex 1F is read after the last fault code is read out.

HEX CODE	BINARY CODE*	PHASE OF OPERATION
01	00001	RETURN TO TRACK CENTER
02	00010	WAIT FOR COARSE SEEK COMPLETION
03	00011	AFTER SEEK SETTLING
04	00100	IDLE LOOP
05	00101	RETURN TO ZERO MOTION
06	00110	END OF VELOCITY TABLE
07	00111	HEAD LOAD
08	01000	AWAIT AGC DURING HEAD LOAD
09	01001	AWAIT TRACK CENTER-LOAD OR RTZ
0A	01010	SETTLING-LOAD OR RTZ
0B	01011	OFFSET ACTIVE
0C	01100	CLEAR OFFSET SETTLING
0D	01101	RESUME SETTLING AFTER FALSE TERMINATION
		FAULT TYPE
0F	01111	SPINDLE DID NOT START/STOP IN 2 MINUTES AFTER ERSLO/ERSTP WAS NOTED (100000/10100)
10	10000	SPINDLE START GREATER THAN 70 SEC
11	10001	NO SPINDLE MOVEMENT
12	10010	NO DRIVE TO SOLID STATE RELAY
13	10011	SOLID STATE RELAY FAILURE
14	10100	STOP TIMEOUT
15	10101	EMERGENCY RETRACT FAILURE
16	10110	NORMAL RETRACT FAILURE
17	10111	CYLINDER ADDRESS GREATER THAN 822
18	11000	OFF TRACK GREATER THAN 1200 USEC
19	11001	UNEXPECTED AGC IN HEAD LOAD
1A	11010	LOST AGC
1B	11011	RPM FAULT
1C	11100	LOST SPEED PULSES
1D	11101	ALLOWED TIME EXPIRED
1E	11110	NO TRACK LOCK IN SETTLING
1F	11111	MICROPROCESSOR FAULT CODE SUMMARY READOUT IS COMPLETE

*CR3-CR7. "1" means light on. "0" 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 of the fault types 11010, 11101 and 11110 (see Table 6-7).

TABLE 6-8A. SPINDLE START AND STOP

	ERROR					
PHASE	10000	10001	10010	10011	10100	01111
STOP					X △1	X △2
START	X △3	X	X	X		X △4

△1 30 SEC TIME LIMIT

△2 MAY OCCUR ONLY 2 MIN AFTER 10100 CODE

△3 70 SEC TIME LIMIT

△4 MAY OCCUR ONLY 2 MIN AFTER 10000 CODE

TABLE 6-8B. SEEK OPERATION △1

	ERROR				
PHASE	10111	11010	11101 △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

PHASE	ERROR 11001	11010	11011	11100	11101	11110
05					X	
07	X				X	
08					X	
0A		X			X	X
09					X	
No Phase Code Stored						

△1 500 ms TIME LIMIT

△2 300 ms TIME LIMIT

TABLE 6-8D. HEAD RETRACT

PHASE	ERROR 11101 △1	10101 △2
No phase Code Stored	X	X

△1 440 ms TIME LIMIT

△2 500 ms TIME LIMIT (MAY OCCUR ONLY AFTER ERROR CODE △1)

TABLE 6-8E. IDLE AND OFFSET

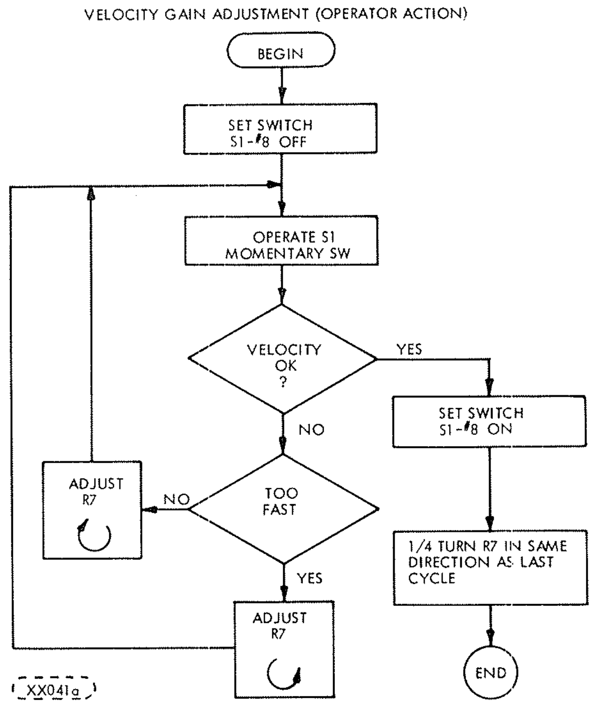
PHASE	ERROR 11010	11110	11101	11000	11100	11011
04	X	X △1		X		
0B	X					
0C	X	X	X △2			
No Phase Code Stored					X	X

△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.



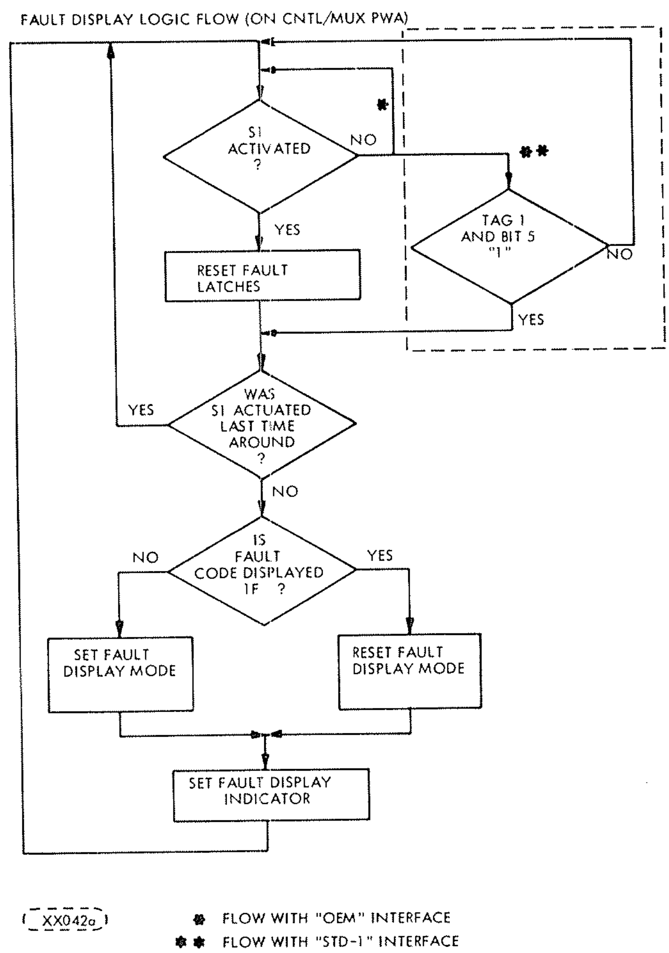


FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC
(SHEET 1 OF 2)

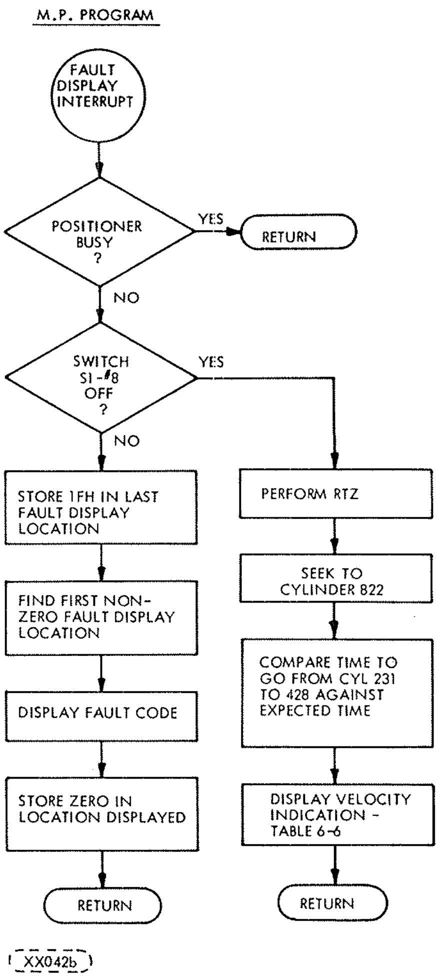


FIGURE 6-29. FLOW CHART OF FAULT DISPLAY LOGIC (SHEET 2 OF 2)

6.9.3 CONVERSION OF CMD UNIT FROM 60 Hz TO 50 Hz

To convert from 60 Hz to 50 Hz when unit contains Power Supply Assembly as shown in Figure 6-17.1. Perform the following procedure.

1. Stop and Power down the drive per Paragraph 2.3.3 and 2.3.4.
2. Remove AC line cord from power source.
3. Remove the top cover. Refer to Paragraph 6.7.1.
4. Raise the deck assembly to maintenance position. Refer to Paragraph 6.7.2 Steps 1 thru 4.
5. Remove PS1P5 from J3 and install PS1P5 into J4 as shown in Figure 6-17.1.
6. On connector PS1J1 remove wire from pin 2 position and install it in pin 3 position. (See Figure 6-30). Figure 6-31 shows PS1J1 to CB1 connections for various frequency/voltage combinations.
7. Remove the spindle drive belt (1). See Figure 6-14.
8. Remove the motor belt drive pulley (3). To do this loosen the set screw (2) in the pulley collar using a 5/32 inch Allen screw driver. See Figure 6-14.
9. Install the 50 Hz pulley on drive motor shaft. See Figure 6-14. Using a good scale for measurement, position the pulley so that it is mounted on the shaft with the edge of the pulley 0.280 inches (7.1 mm) away from the plate surface as shown. Torque the screw in collar to 64 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 Paragraph 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 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 J4 and install PS1P5 into J3 as shown in Figure 6-17.1.
6. On connector PS1J1 remove wire from pin 3 position and install it in pin 2 position. (See Figure 6-30). Figure 6-31 shows PS1J1 to CB1 connections for various frequency/voltage combinations.
7. Remove the spindle drive belt (1). See Figure 6-14.
8. Remove the motor belt drive pulley (3). To do this loosen the set screw (2) in the pulley collar using a 5/32 inch Allen screw driver. See Figure 6-14.
9. Install the 60 Hz pulley on drive motor shaft. See Figure 6-14. Using a good scale for measurement, position the pulley so that it is mounted on the shaft with the edge of the pulley 0.280 inches (7.1 mm) away from the plate surface as shown. Torque the screw in collar to 64 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 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.

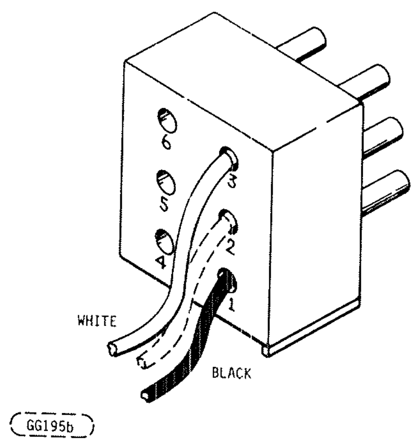


FIGURE 6-30. WIRE CHANGE TO PLUG PS1-J1.

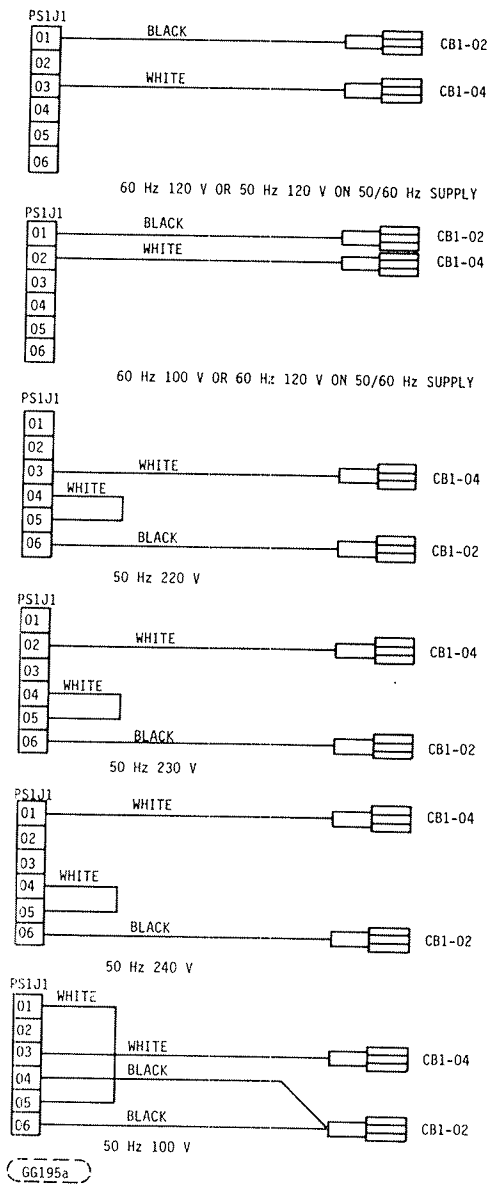


FIGURE 6-31. POWER SUPPLY TO CIRCUIT BREAKER HOOK UP.

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

a. Lists all parts in numeric sequence (by Identification Number), in conjunction with the referenced sheet number (third column) and illustrations.
b. Defines the physical location 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.

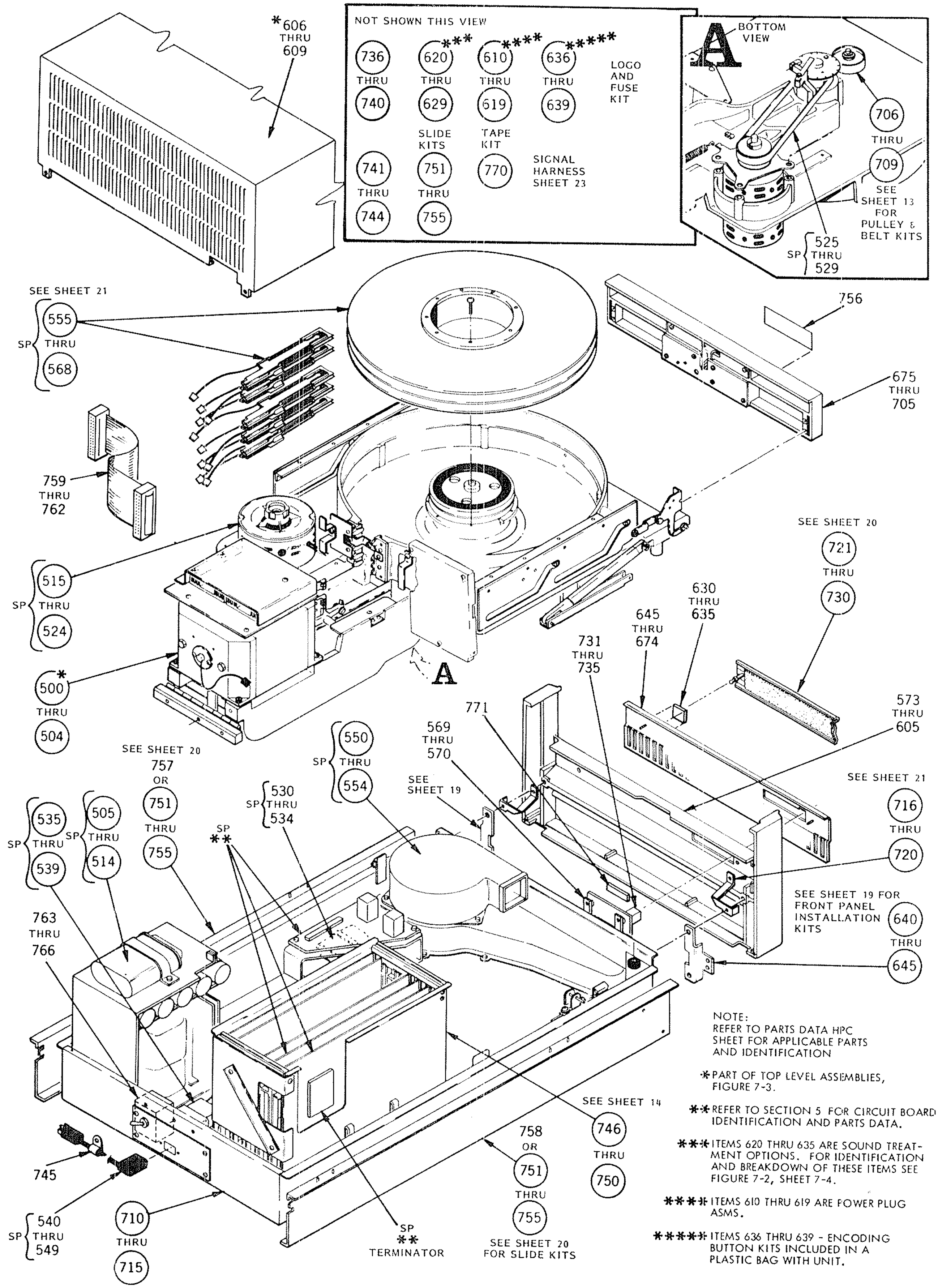
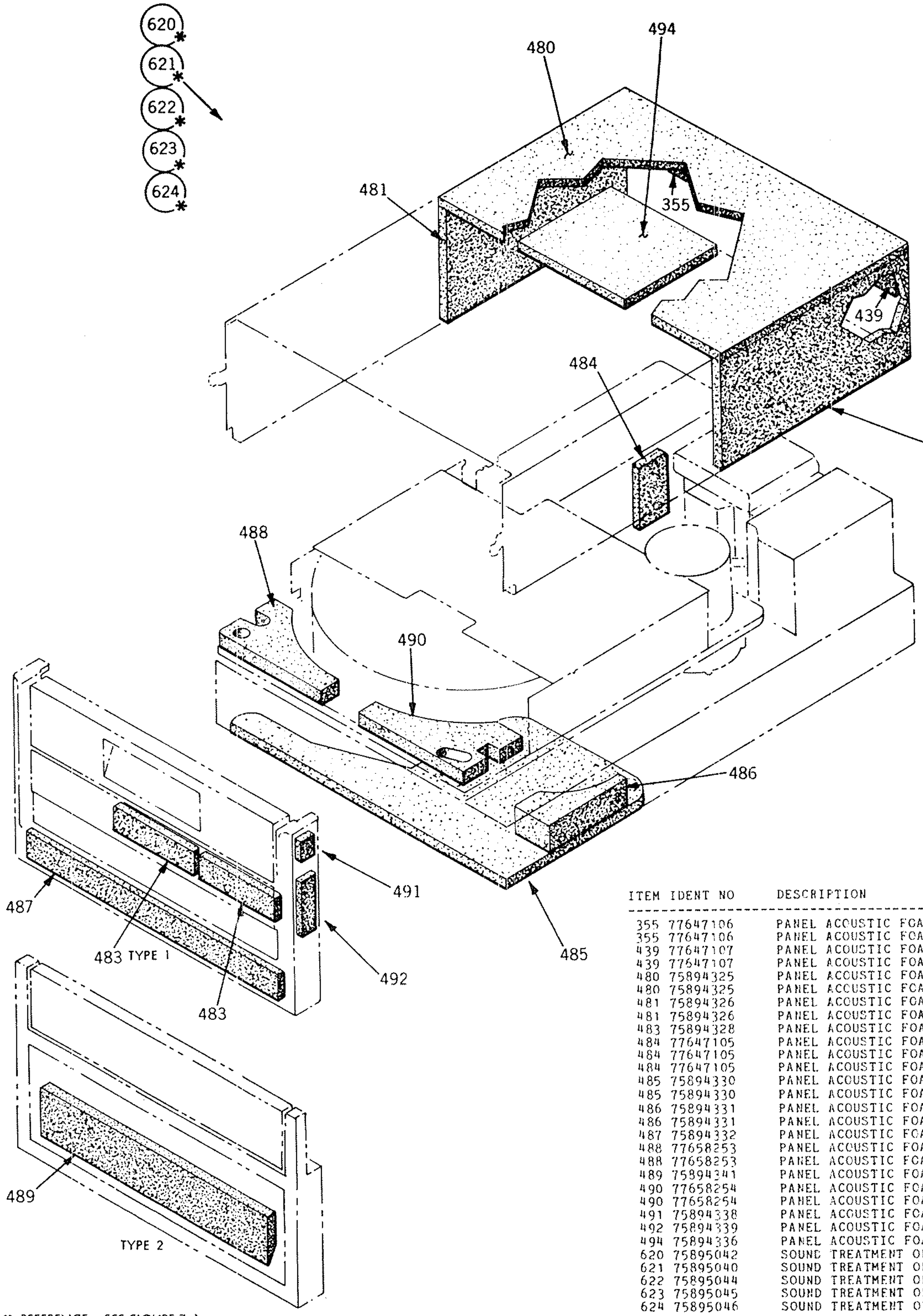


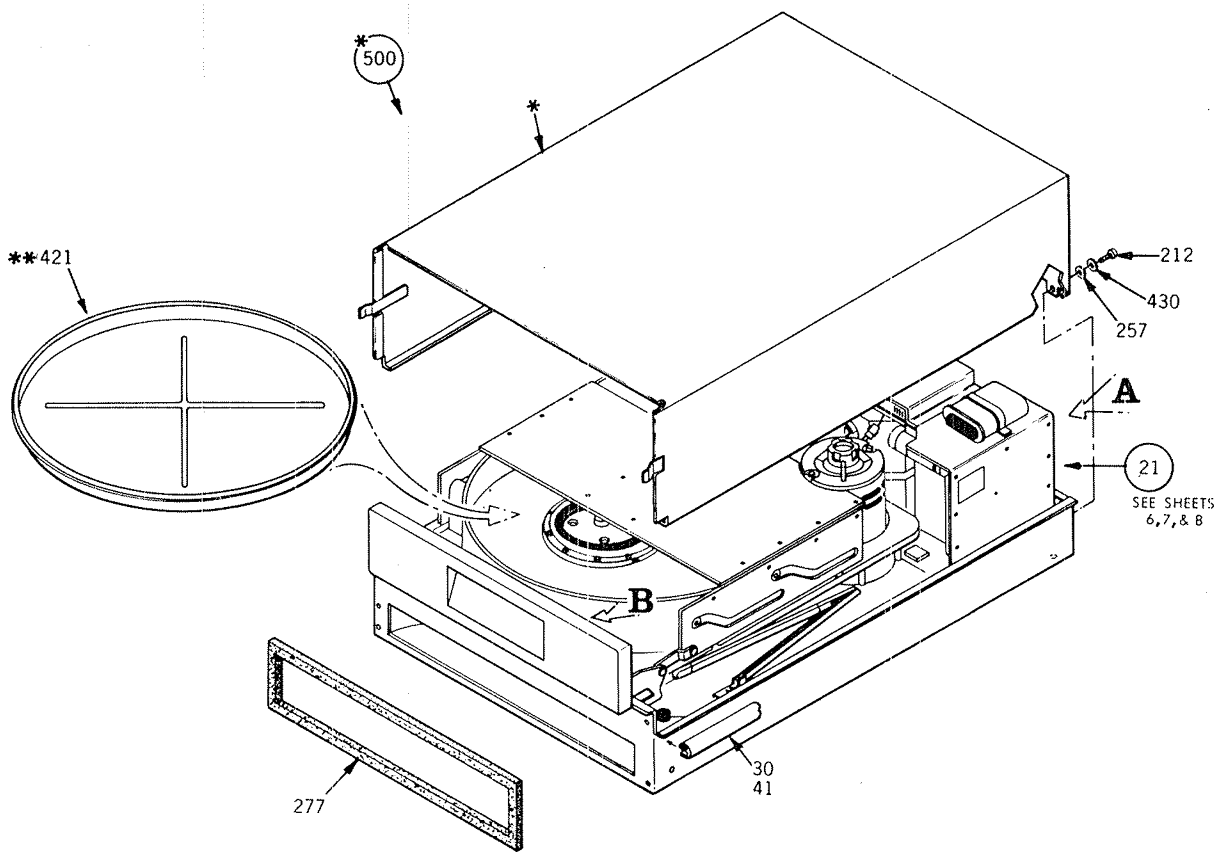
FIGURE 7-1. PRODUCT CONFIGURATION



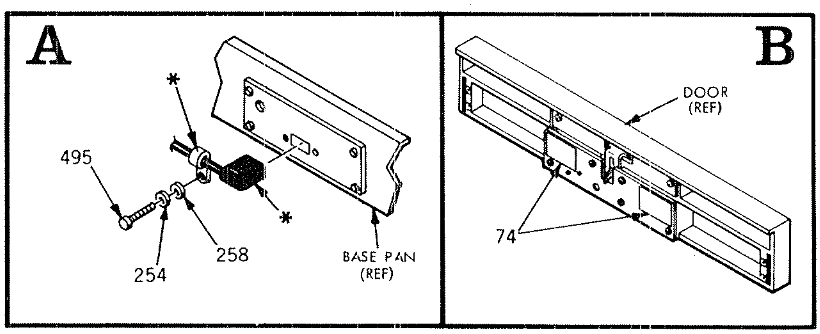
ITEM	IDENT NO	DESCRIPTION	WHERE USED
355	77647106	PANEL ACOUSTIC FOAM	620, 621
355	77647106	PANEL ACOUSTIC FOAM	622, 623
439	77647107	PANEL ACOUSTIC FOAM	620, 621
439	77647107	PANEL ACOUSTIC FOAM	622, 623
480	75894325	PANEL ACOUSTIC FOAM	623
480	75894325	PANEL ACOUSTIC FOAM	621, 622
481	75894326	PANEL ACOUSTIC FOAM	623
481	75894326	PANEL ACOUSTIC FOAM	621, 622
483	75894328	PANEL ACOUSTIC FOAM	621, 623
484	77647105	PANEL ACOUSTIC FOAM	620, 621
484	77647105	PANEL ACOUSTIC FOAM	622, 623
484	77647105	PANEL ACOUSTIC FOAM	624
485	75894330	PANEL ACOUSTIC FOAM	621, 622
485	75894330	PANEL ACOUSTIC FOAM	623, 624
486	75894331	PANEL ACOUSTIC FOAM	621, 622
486	75894331	PANEL ACOUSTIC FOAM	623, 624
487	75894332	PANEL ACOUSTIC FOAM	621, 623
488	77658253	PANEL ACOUSTIC FOAM	623
488	77658253	PANEL ACOUSTIC FOAM	621, 622
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



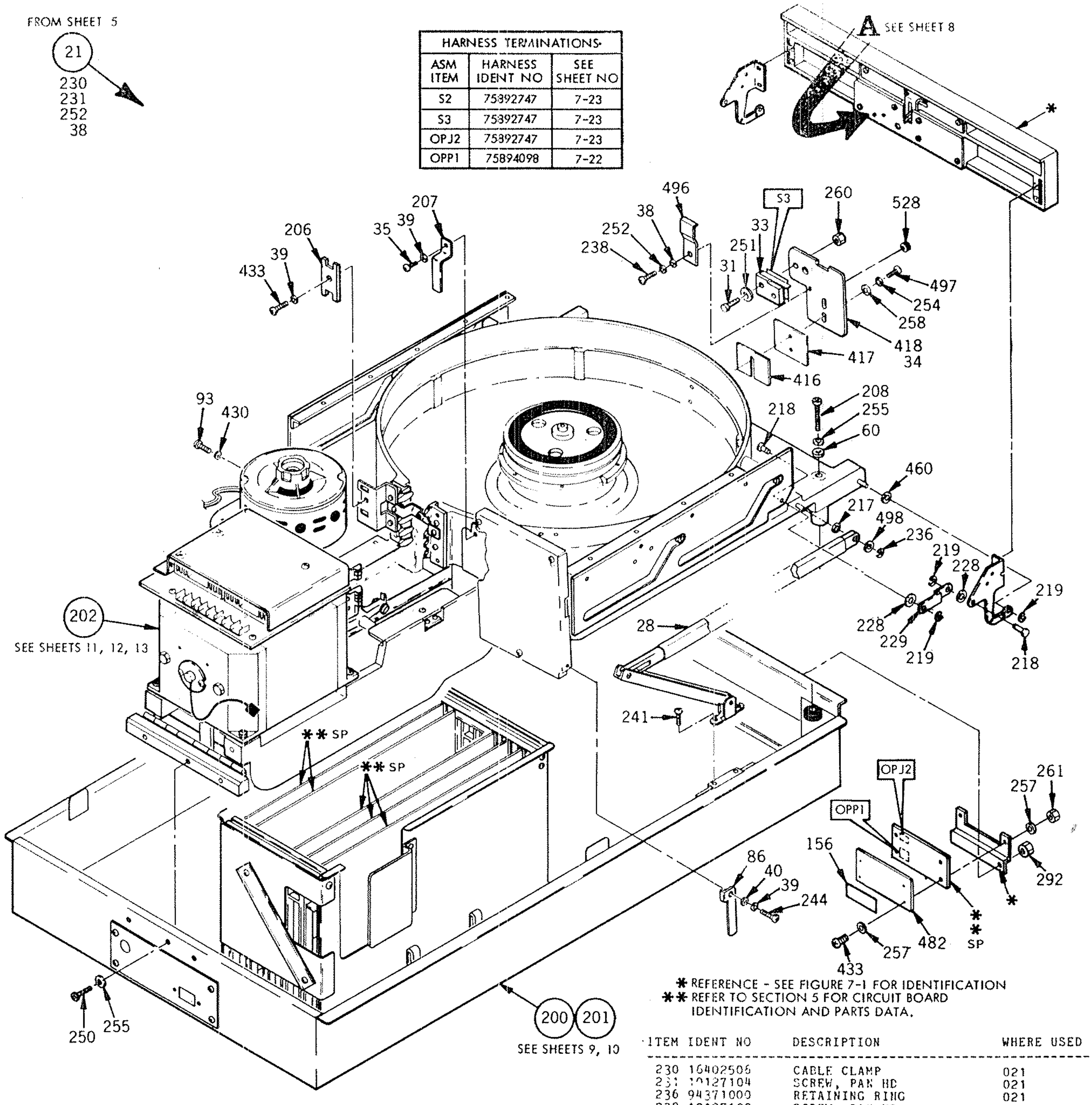
*REFERENCE - SEE FIGURE 7 - 1 FOR IDENTIFICATION
**ITEM 421 IS A DUST COVER FOR USE IN CARTRIDGE AREA WHENEVER A CARTRIDGE IS NOT PRESENT



ITEM	IDENT NO	DESCRIPTION	WHERE USED
021	75880900	FINAL MECHANICAL ASM	500
030	75883045	GASKET	500
041	95033900	ADHESIVE	500
074	77615990	LABEL	500, 501
212	77617049	SCREW, PAN HD	500
254	10125804	WASHER, SPR LOCK	500
257	10125605	WASHER, PLAIN	500
258	10125606	WASHER, PLAIN	500
277	83410518	GASKET STRIP	500
421	90603300	CLOSURE	500, 501
430	10126401	WASHER, EXT TOOTH LK	500, 501
495	10127129	SCREW, PAN HD	500
500	75881025	TOP LEVEL ASM	HPC

FIGURE 7-3. TOP LEVEL ASSEMBLY

HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
S2	75892747	7-23
S3	75892747	7-23
OPJ2	75892747	7-23
OPP1	75894098	7-22

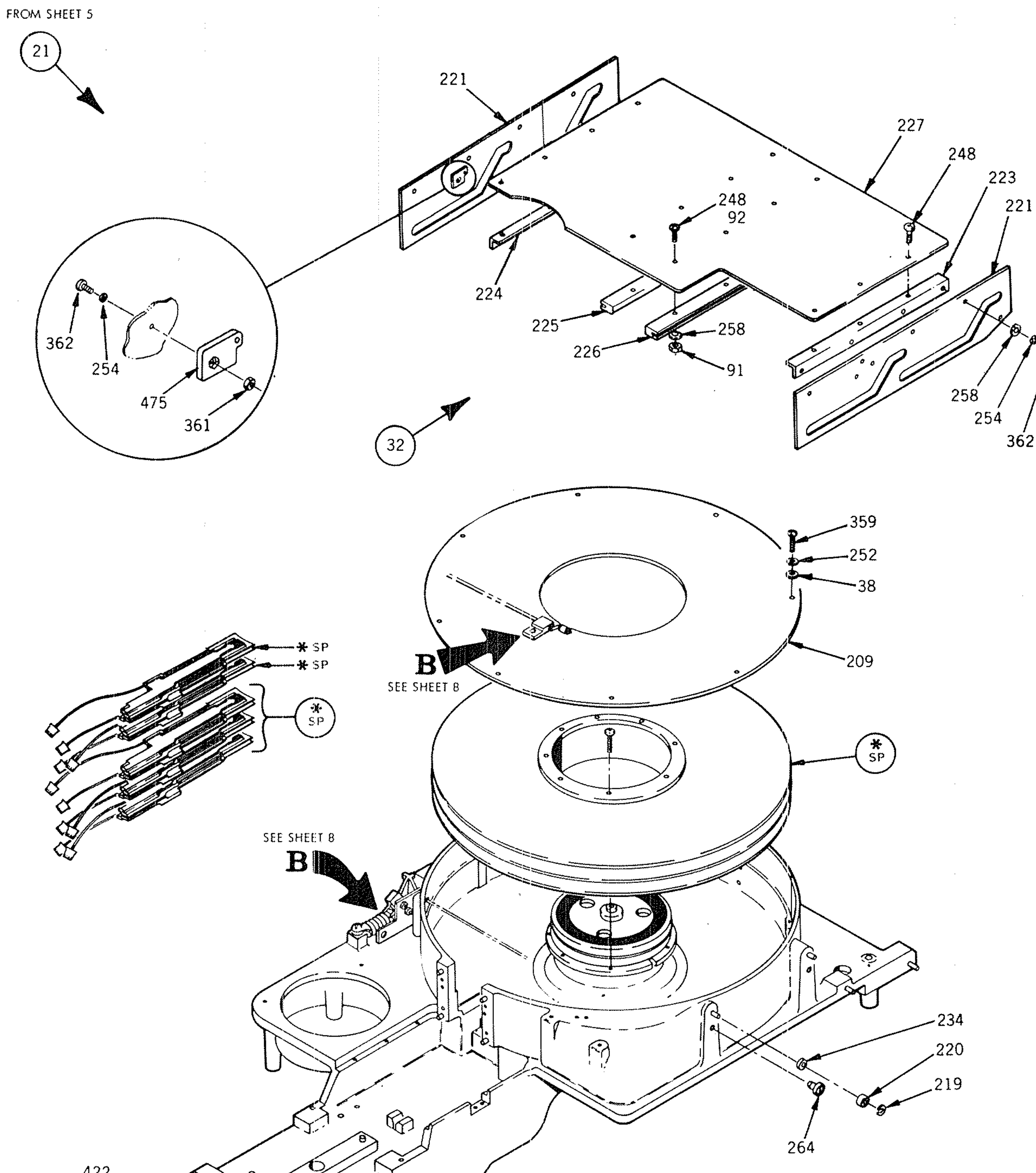


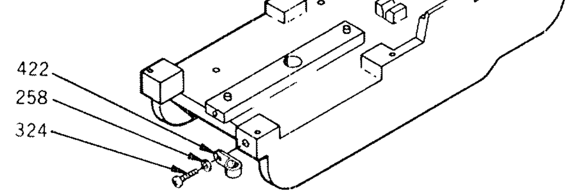
* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION
** REFER TO SECTION 5 FOR CIRCUIT BOARD IDENTIFICATION AND PARTS DATA.

ITEM	IDENT NO	DESCRIPTION	WHERE USED
021	75880900	FINAL MECHANICAL ASM	500
028	75881128	DECK SUPPORT LH	021
029	75881129	DECK SUP RH (NOT SHOWN)	021
031	10127168	SCREW, PAN HD	021
033	94364401	SWITCH	021
034	95105904	POLYESTER TAPE	021
035	10127111	SCREW, PAN HD	021
038	10125603	WASHER, PLAIN	021
039	10125803	WASHER, SPR LOCK	021
040	10125805	WASHER, SPR LOCK	021
060	10125608	WASHER, PLAIN	021
086	75882597	CABLE GUIDE	021
093	17901508	SCREW	021
156	77647108	ACOUSTIC FOAM	021
201	75880814	BASE PAN ASM	021
202	75880120	DECK ASM	021
206	75893107	RETAINER, HEAD CONN	021
207	75881395	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
229	75881790	LINK	021

ITEM	IDENT NO	DESCRIPTION	WHERE USED
230	16402506	CABLE CLAMP	021
231	10127104	SCREW, PAN HD	021
236	94371000	RETAINING RING	021
238	10127102	SCREW, PAN HD	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
254	10125804	WASHER, SPR LOCK	021
256	10125602	WASHER, PLAIN	021
257	10125605	WASHER, PLAIN	021
258	10125606	WASHER, PLAIN	021
260	10125102	NUT-HEX	021
261	53777902	NUT & WASHER	021
292	53777900	NUT & CAPTIVE WASHER	021
416	75882106	SHIM, STRIKER	021
417	75882105	BLOCK, SPACER, STRIKER	021
418	75895214	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
497	10127125	SCREW, PAN HD	021
498	75887251	WASHER, NYLON	021
528	95523400	BUMPER	021

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

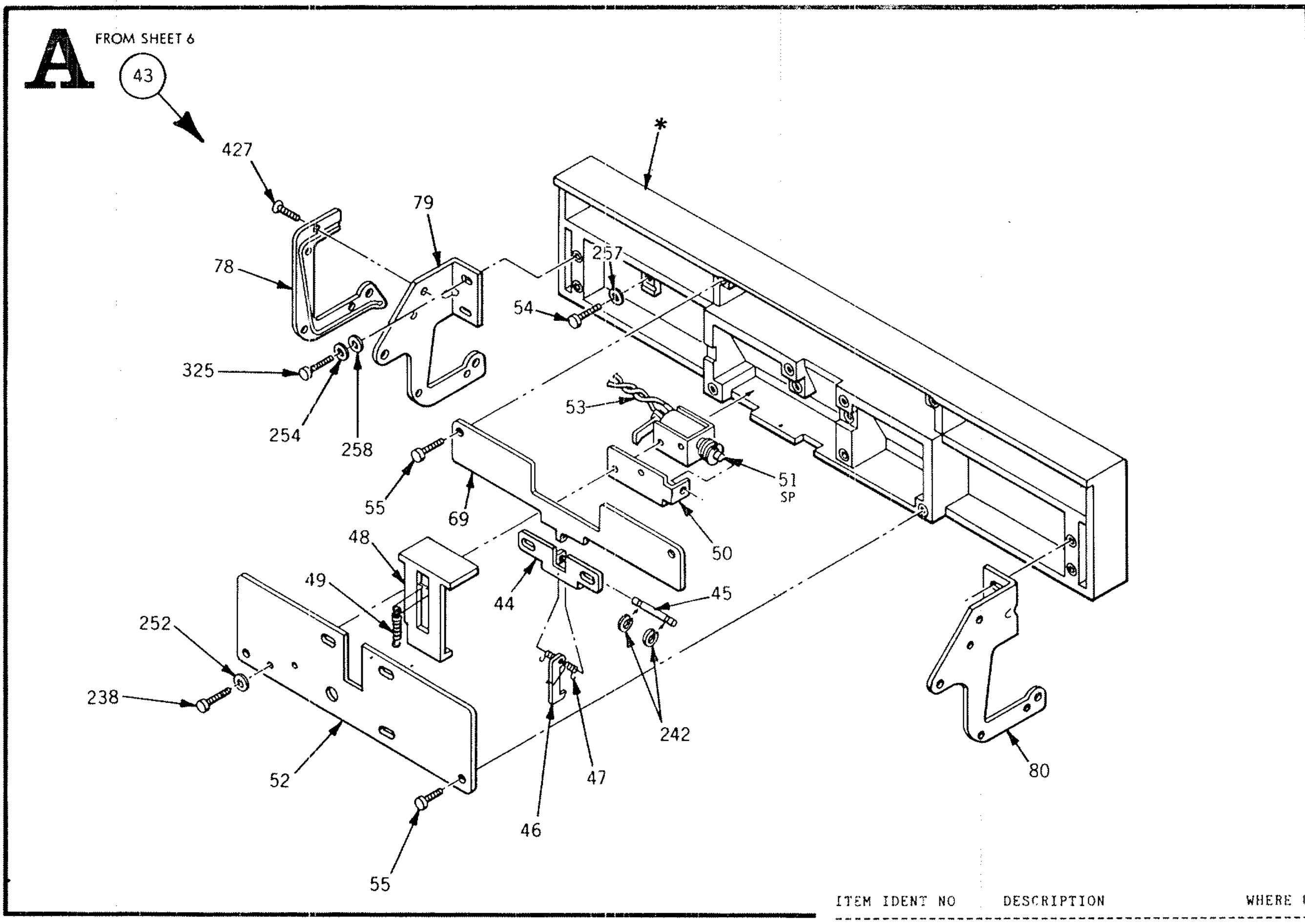


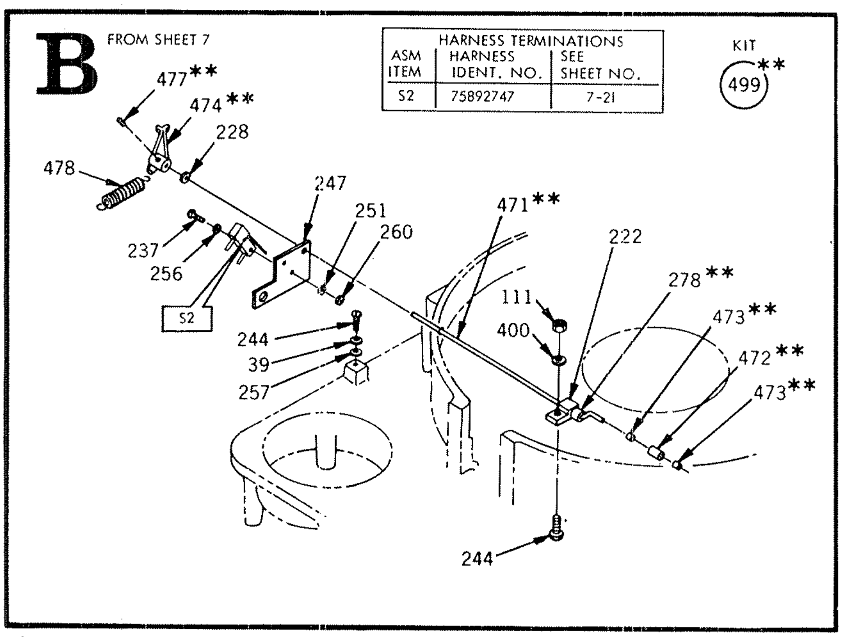


ITEM	IDENT NO	DESCRIPTION	WHERE USED
021	75880900	FINAL MECHANICAL ASM	500
032	77643187	RECEIVER ASM	021
038	10125603	WASHER, PLAIN	021
091	95510027	NUT, HEX	032
092	95125326	LOCTITE SEALANT	032
209	75893275	PLATE, SEPARATOR	021
219	92033037	RETAINING RING	021
220	92054223	BALL BEARING	021
221	75883115	CAM PLATE	032

ITEM	IDENT NO	DESCRIPTION	WHERE USED
223	75887453	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
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
324	10127122	SCREW, PAN HD	021
359	10126213	SCREW	021
362	10127123	SCREW, PAN HD	032
422	92602004	CABLE CLAMP	021
475	75893245	BLOCK, LINKAGE	032

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





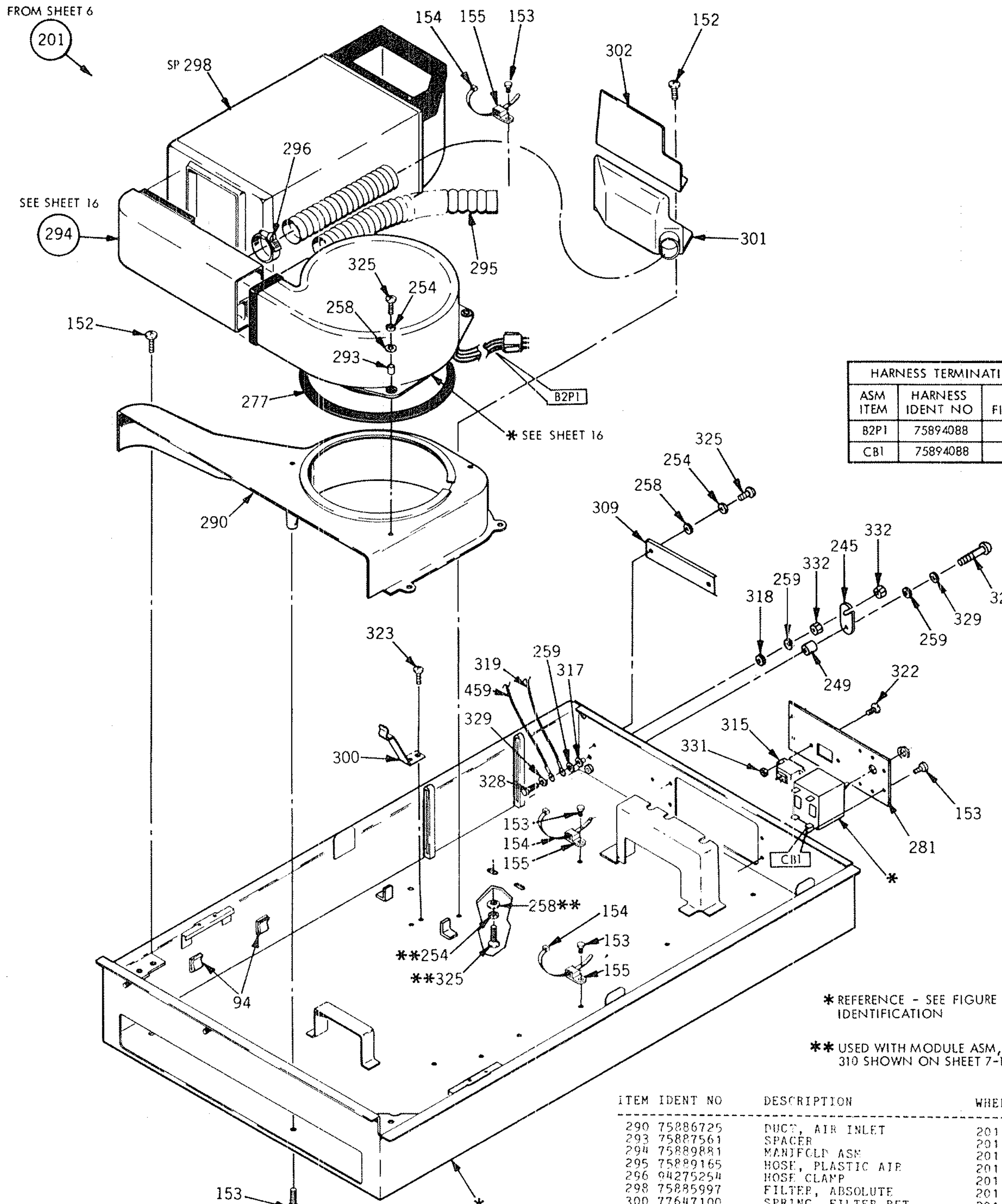
HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT. NO.	SEE SHEET NO.
S2	75892747	7-21

ITEM	IDENT NO	DESCRIPTION	WHERE USED
021	75880900	FINAL MECHANICAL ASM	500
039	10125803	WASHER, SPR LOCK	021
043	75382866	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	75883056	SOLENOID ASM	043
052	75882690	LATCH COVER	043
053	75883465	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
237	92745012	SCREW, PAN HD	021
238	10127102	SCREW, PAN HD	043
242	92033033	RETAINING RING	043
244	10127113	SCREW, PAN HD	021
247	77666818	SWITCH PLATE	021
251	10125800	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
361	10125106	NUT, HEX	032
400	77830611	WASHER, PLAIN STEELE	021
427	10125702	SCREW, FLAT HD	043
471	75883111	SHAFT	499
472	75880481	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

* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION

** USED ON KIT 499

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



HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE FIG NO
B2P1	75894088	7-23
CB1	75894088	7-23

* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION

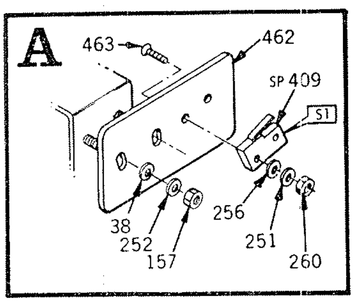
** USED WITH MODULE ASM, ITEM 310 SHOWN ON SHEET 7-10

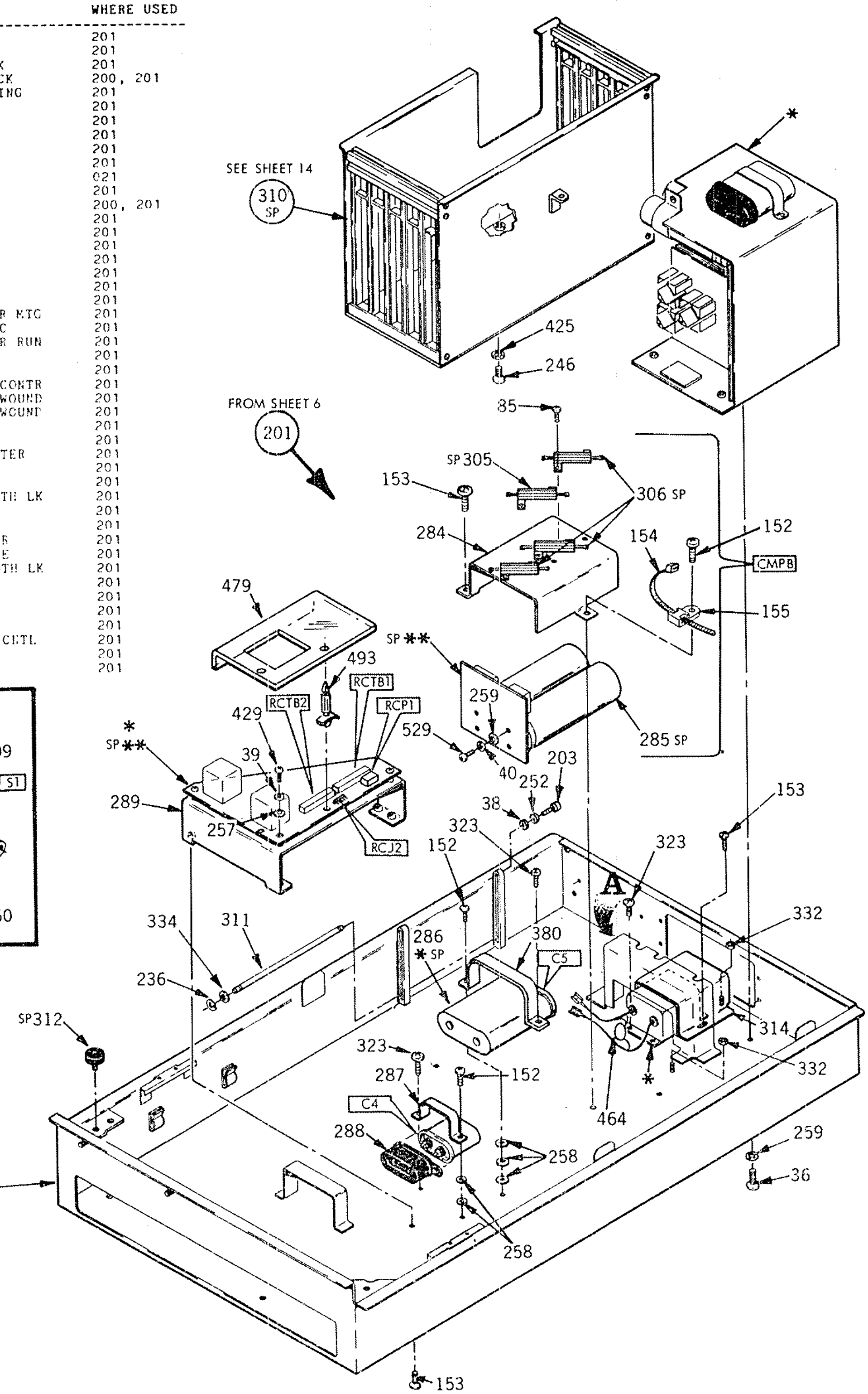
ITEM	IDENT NO	DESCRIPTION	WHERE USED
094	91930600	CLIP, ADHESIVE	201
152	93749200	SCREW	201
153	93749198	SCREW	201
154	94277401	CABLE TIE	201
155	94343210	CABLE TIE MOUNT	201
201	75880814	BASE PAN ASM	021
245	75883475	GROUND STRAP	201
249	95694202	SPACER	201
252	10125801	WASHER SPR LOCK	201
254	10125804	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	200, 201
325	10127124	SCREW, PAN HD	201
327	10127144	SCREW, PAN HD	201
328	10125066	SCREW, HEX HD	201
329	10126403	WASHER, EXT TOOTH LK	201
331	53777900	NUT-HEX	201
459	75882351	JUMPER WIRE	201

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

ITEM	IDENT NO	DESCRIPTION	WHERE USED
036	77610247	SCREW	201
038	10126246	SCREW CAP	201
039	10125803	WASHER, SPR LOCK	201
040	10125805	WASHERS, SPR LOCK	200, 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
157	10125103	NUT-HEX	201
201	75880814	BASE PAN ASM	021
203	10127106	SCREW	201
236	94371000	RETAINING RING	200, 201
246	10127121	SCREW, PAN HD	201
251	10125800	WASHER SPR	201
252	10125801	WASHER SPR LOCK	201
256	10125602	WASHER, PLAIN	201
257	10125605	WASHER, PLAIN	201
259	10125607	WASHER, PLAIN	201
260	10125102	NUT-HEX	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	75888155	BRACKET, RELAY CONTR	201
305	75888775	RESISTOR, WIRE WOUND	201
306	75888776	RESISTOR, WIRE WOUND	201
311	75893755	PIN	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
334	93564004	WASHER, NYLON	201
380	95643601	CLAMP, CAPACITOR	201
409	77610143	SW, SUBMINIATURE	201
425	10126402	WASHER, EXT TOOTH LK	201
429	10127112	SCREW, PAN HD	201
462	75883067	PLATE SW MTG	201
463	92932054	SCREW	201
464	75883006	VARISTOR	201
479	75883418	COVER, PWA RLY CNTL	201
493	51777344	SUPPORT - C.P.	201
529	10127143	SCREW	201



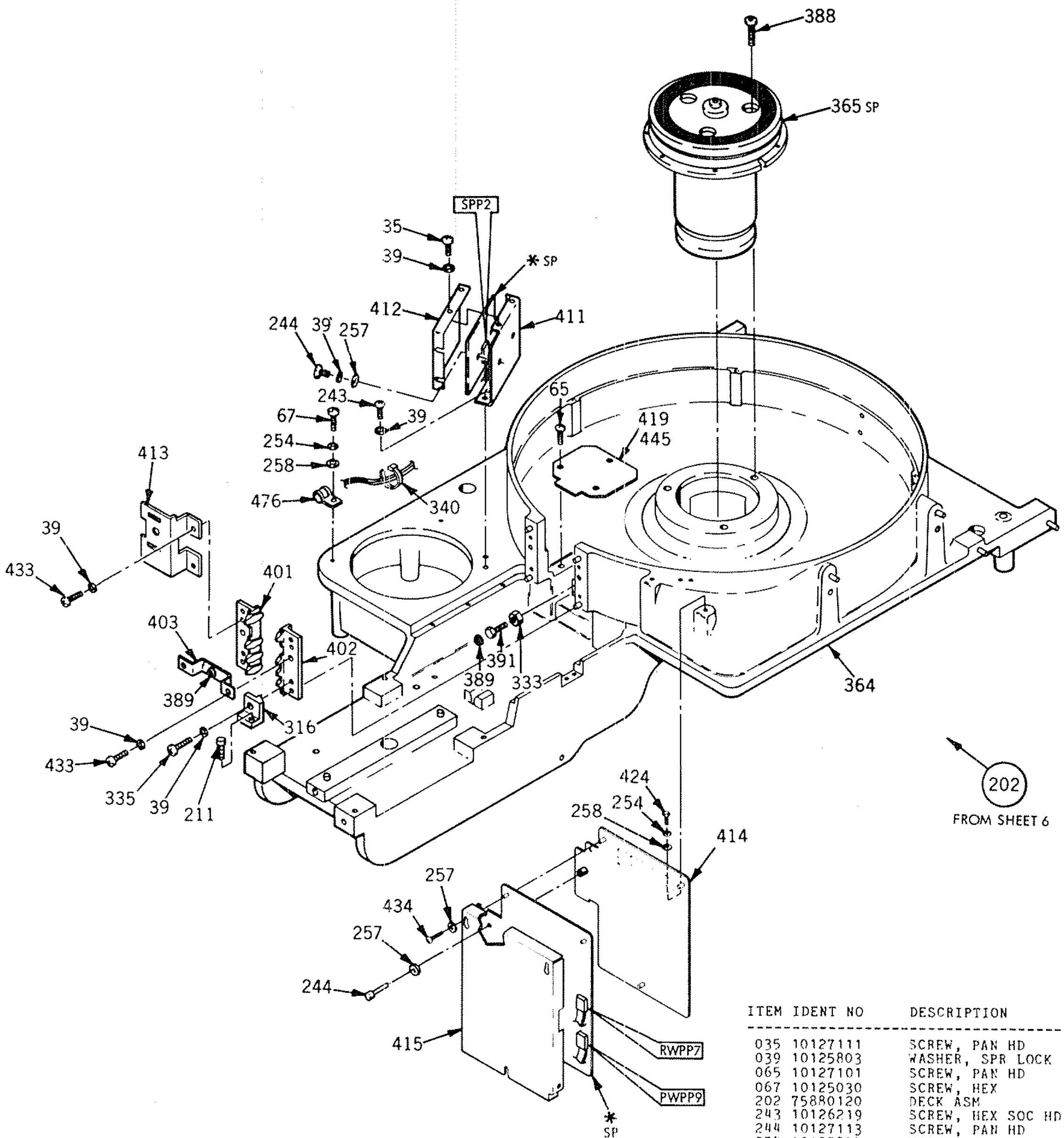


* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION.

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

HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
S1	75892747	7-23
CMPB	75894086	7-23
CMPB	75894098	7-22
RCP1	75894094	7-22
RCTB1	75894086	7-23
RCJ2	75894090	7-23
	75894086	7-23
RCTB2	75894088	7-23
	75894086	7-23
C5	75894086	7-23

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

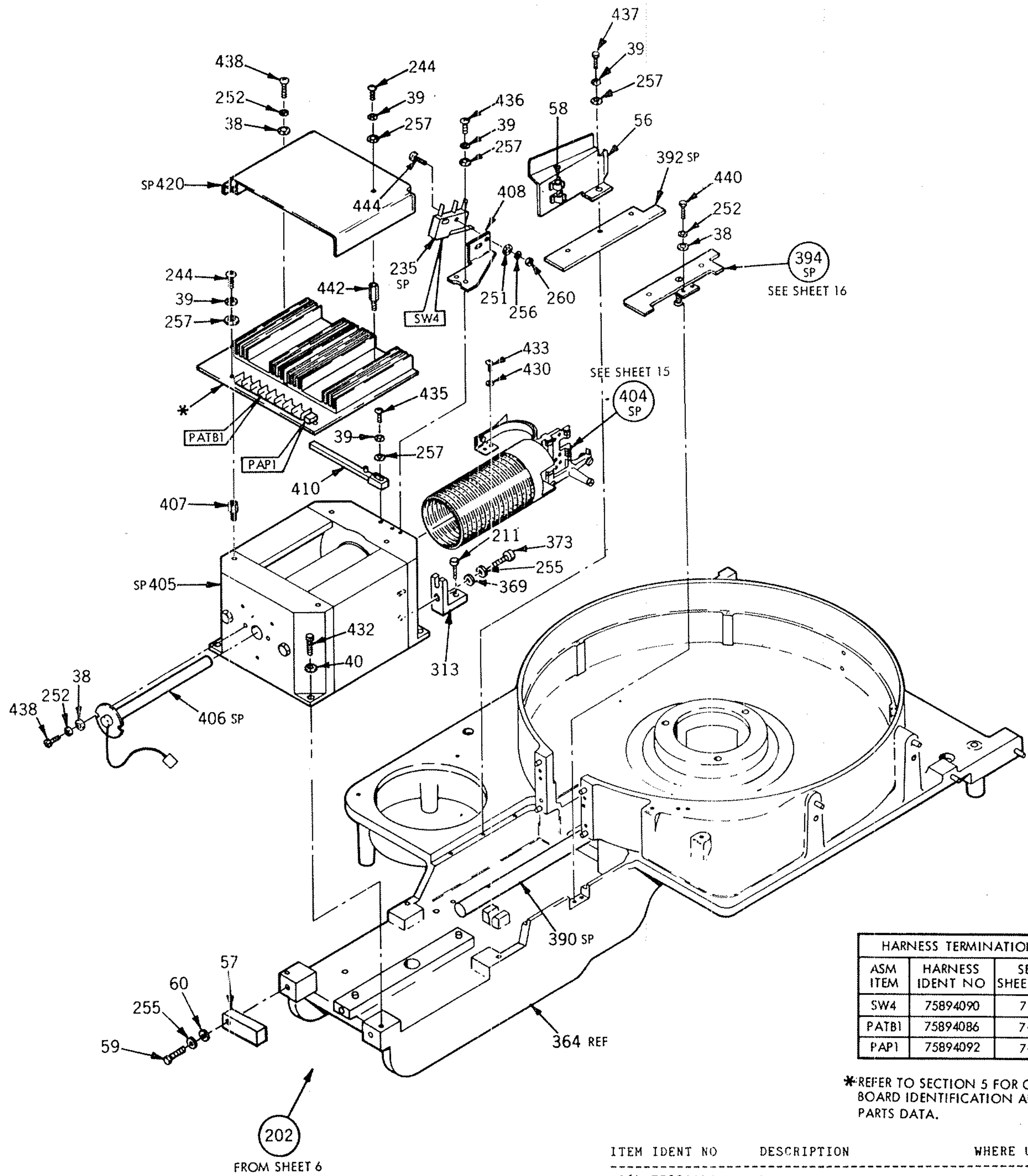


ITEM	IDENT NO	DESCRIPTION	WHERE USED
035	10127111	SCREW, PAN HD	202
039	10125803	WASHER, SPR LOCK	202
065	10127101	SCREW, PAN HD	202
067	10125030	SCREW, HEX	202
202	75880120	DECK ASM	021
243	10126219	SCREW, HEX SOC HD CAP	202
244	10127113	SCREW, PAN HD	202
254	10125804	WASHER, SPR LOCK	202
257	10125605	WASHER, PLAIN	202
258	10125606	WASHER, PLAIN	202
316	75899547	BLK	202
333	10125301	NUT, HEX	202
335	10126221	SCREW	202
340	94277400	STRAP, CABLE TIE	202
364	75880040	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

HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
SPP2	75894096	7-22
RWPP7	75894100	7-22
PWPP9	75894098	7-22

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

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



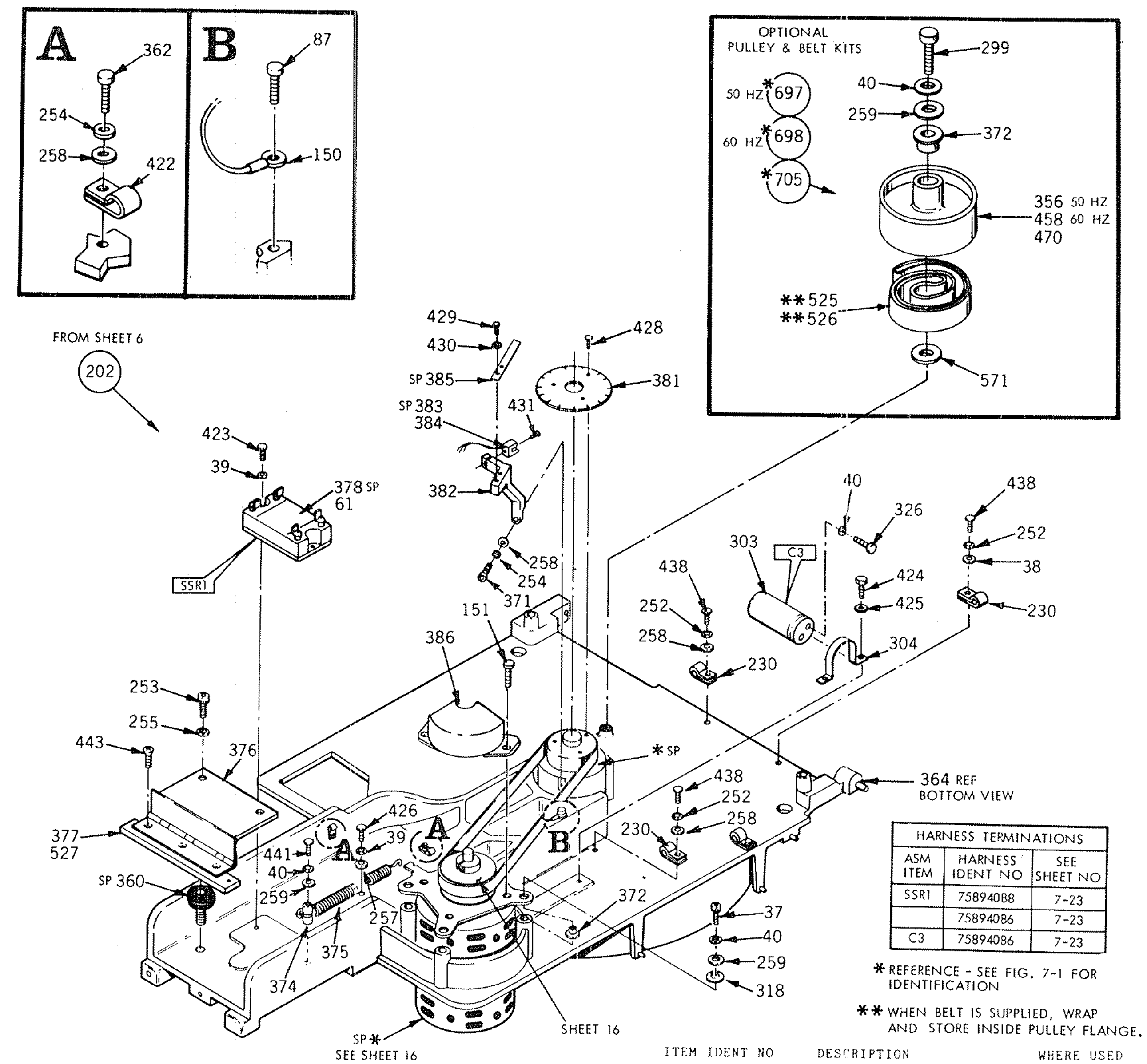
HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
SW4	75894090	7-23
PATB1	75894086	7-23
PAP1	75894092	7-22

*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	WASHERS, 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	75880120	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	75899543	BLK	202

ITEM	IDENT NO	DESCRIPTION	WHERE USED
364	75880040	BASE PLATE ASM	202
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	75894088	7-23
	75894086	7-23
C3	75894086	7-23

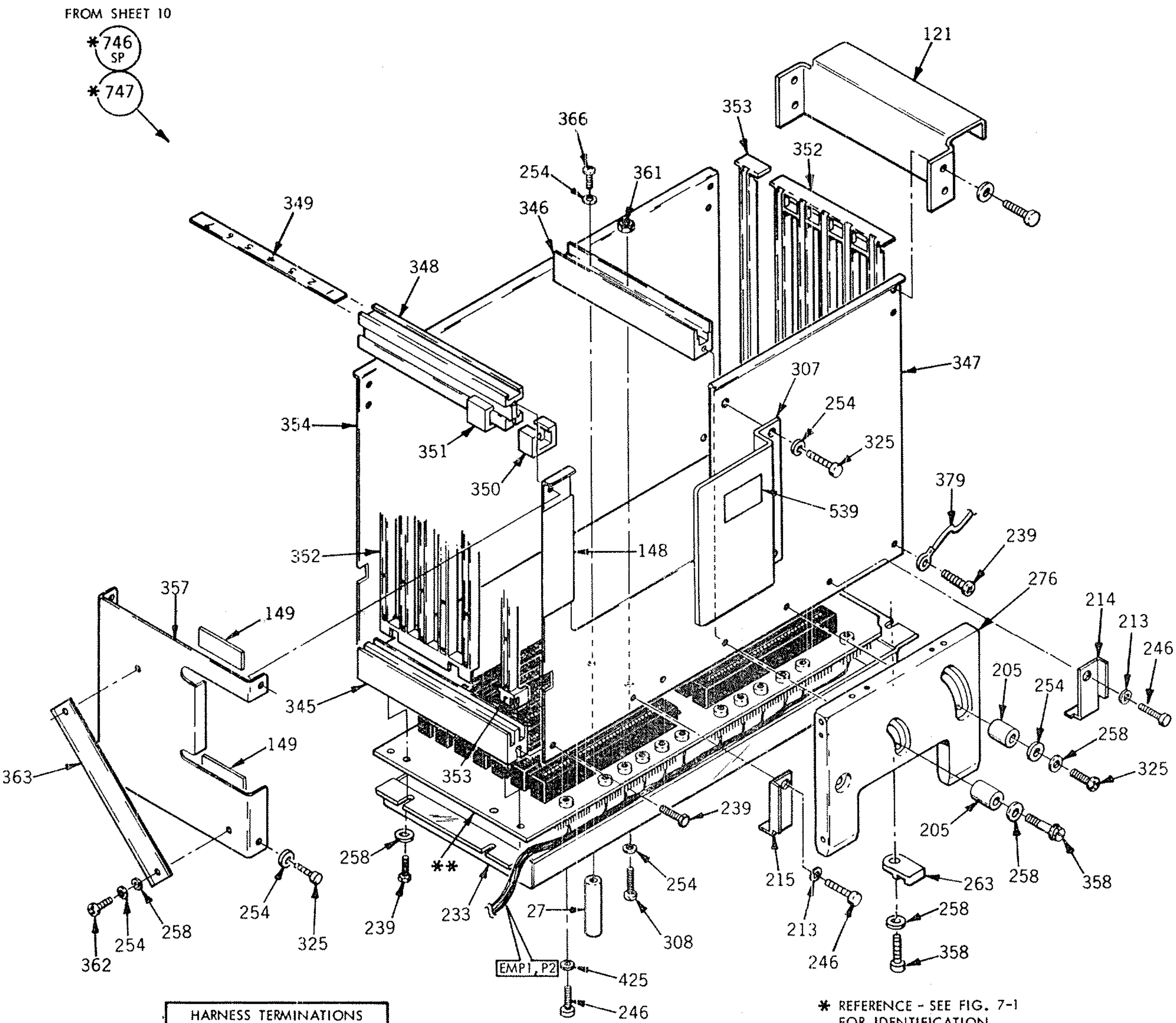
* REFERENCE - SEE FIG. 7-1 FOR IDENTIFICATION

** 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, SPP LOCK	202
040	10125805	WASHERS, SPR LOCK	202, 705
040	10125805	WASHERS, SPR LOCK	697, 698
061	18748600	COMPOUND 340	202
087	93748198	SCREW	202
150	75883455	JUMPER WIRE	202
151	93749082	SCREW	202
202	75880120	DECK ASM	021
213	10126104	WASHER	202
230	16402506	CABLE CLAMP	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	697, 698
259	10125607	WASHER, PLAIN	202, 705
299	10126250	SCREW, CAP	705
299	10126250	SCREW, CAP	697, 698
303	75774471	CAPACITOR	202
304	75881270	CLAMP, CAPACITOR	202
318	75062400	WASHER, INSULATOR	202
356	75899706	PULLEY	697
360	77610157	SHOCK MOUNT	202
362	10127123	SCREW, PAN HD	202
364	75880040	BASE PLATE ASM	202

ITEM	IDENT NO	DESCRIPTION	WHERE USED
371	10126226	SCREW, SOCKET HD	202
372	75062805	WASHER, SHOULDER	697, 698
372	75062805	WASHER, SHOULDER	202, 705
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	75887791	DISC, SPEED SENSOR	202
382	75893920	SUPPORT, SPEED SENSOR	202
383	75880045	SPEED SENSOR	202
384	75885407	OPTICAL SWITCH	383
385	75887871	GROUND SPRING	202
386	75883481	PULLEY COVER	202
422	92602004	CABLE CLAMP	202
423	10127119	SCREW PAN HD	202
424	10125029	SCREW, HEX	202
425	10126402	WASHER, EXT TOOTH LK	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	698
470	75899703	MOTOR PULLEY	705
525	92314113	DRIVE BELT 60 HZ	698
526	92314127	DRIVE BELT 50 HZ	697
527	95125322	SEALANT	202
571	75883026	SPACER	705
571	75883026	SPACER	697, 698

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



HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
EMP1 P2	75894090	7-23

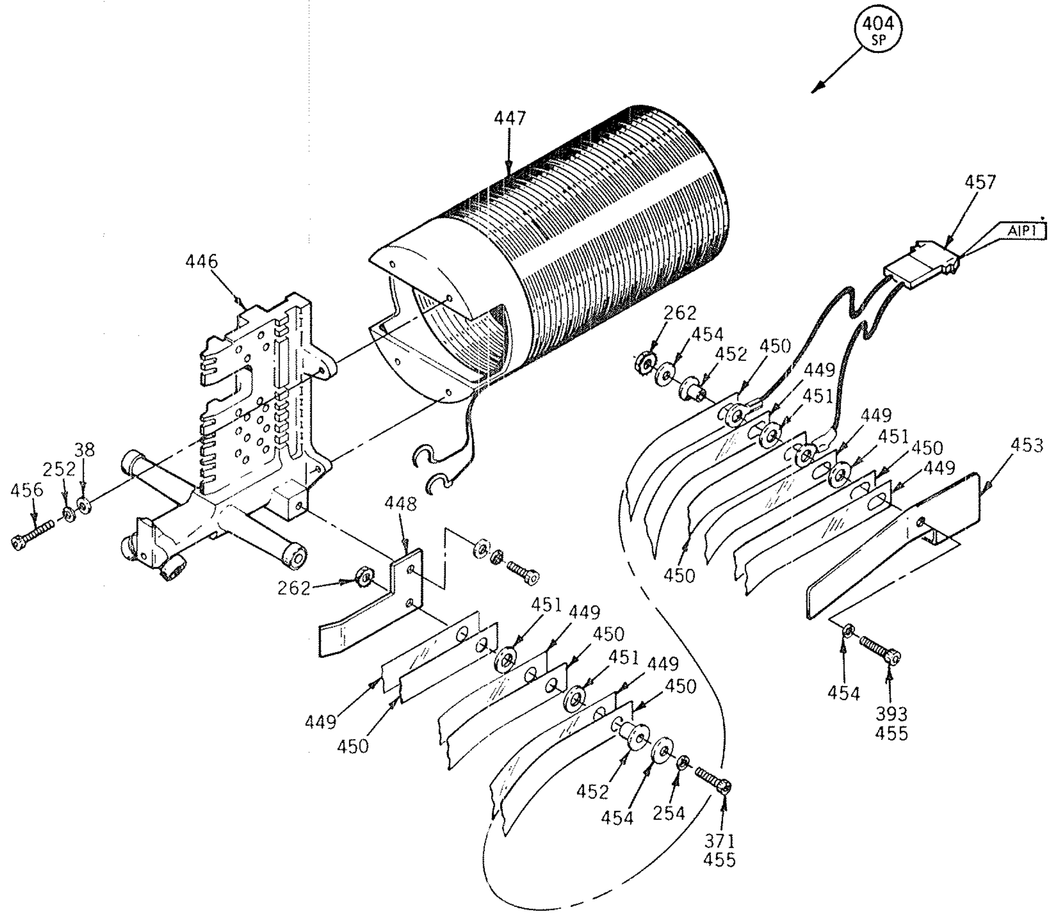
* REFERENCE - SEE FIG. 7-1 FOR IDENTIFICATION.

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

ITEM	IDENT NO	DESCRIPTION	WHERE USED
027	75880244	SPACER	746, 747
121	77646195	LIFT BKT E MOD	747
148	24534714	HEAD SHRINK SLEEVE	746, 747
149	75287700	DOOR GASKET	746, 747
205	93109267	SPACER	747
213	10126104	WASHER	746, 747
214	75894320	BRACKET, RIGHT	746, 747
215	75894321	BRACKET, LEFT	746, 747
216	10125723	SCREW, FLAT HD	746, 747
233	77641825	SHIELD, E MODULE	746, 747
239	93592207	SCREW	746, 747
246	10127121	SCREW, PAN HD	746, 747
254	10125804	WASHER, SPR LOCK	746, 747
258	10125606	WASHER, PLAIN	746, 747
263	94343210	CABLE TIE MOUNT	746, 747
276	77647611	HINGE BLK ASM	746, 747
307	75883485	E-MODULE BRACKET	746, 747
308	92745208	SCREW, PAN HD	746, 747
325	10127124	SCREW, PAN HD	746, 747
345	75865836	SPRT BAR-CARD GUIDE	746, 747
346	75885832	MTG BAR-GUIDE CTR	746, 747
347	75886293	PANEL, LEFT SIDE	746, 747
348	75885841	MTG BAR-CARD GUIDE	746, 747
349	75885791	STRIP-CARD LOCATION	746, 747
350	77633806	SPACER	746, 747
351	77633805	SPACER	746, 747
352	82312001	GUIDE, CIRCUIT CARD	746, 351
352	82312001	GUIDE, CIRCUIT CARD	747
353	82311701	GUIDE, CIRCUIT CARD	746, 747
354	75885694	PANEL, RIGHT SIDE	746, 747
357	75893775	BRACKET, I/O CABLE	746, 747
358	93592204	SCREW, HEX WASHER	746, 747
361	10125106	NUT, HEX	746, 747
363	77633800	CLAMP	746, 747
366	92745211	SCREW, PAN HD	746, 747
379	75882357	GND WIRE	746, 747
425	10126402	WASHER, EST TOOTH LK	746, 747
497	10127125	SCREW, PAN HD	746, 747
539	77834781	LABEL	746, 747
746	75893902	E MODULE ASM	HPC
747	77647616	E MODULE ASM	HPC

FIGURE 7-12. E MODULE ASSEMBLY

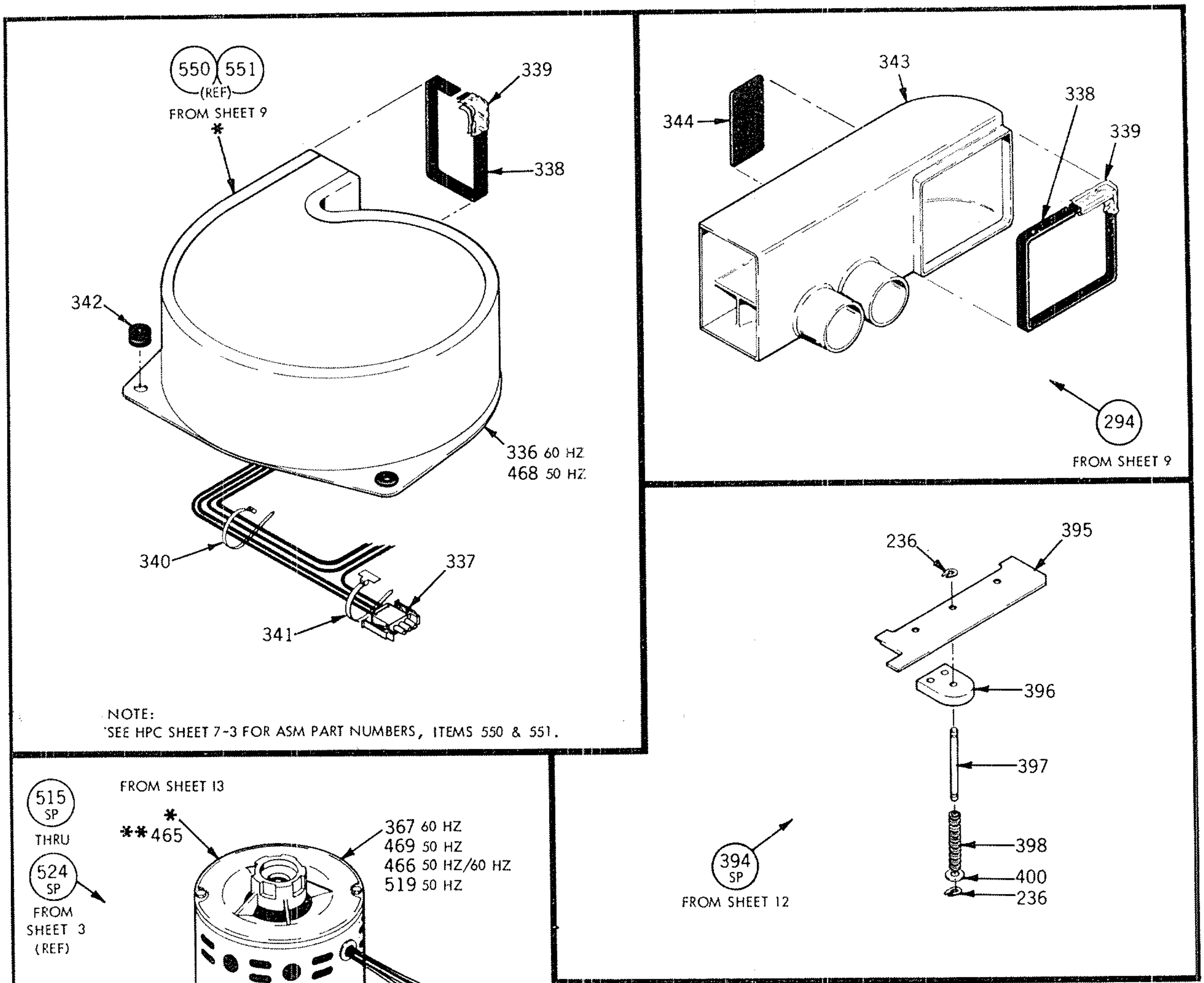
FROM SHEET 12

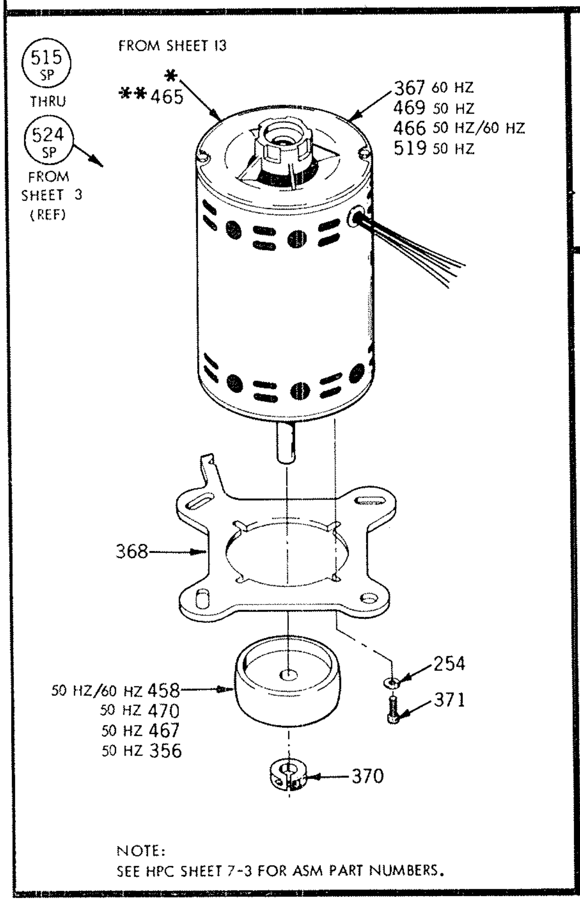


HARNESS TERMINATIONS		
ASM ITEM	HARNESS IDENT NO	SEE SHEET NO
A1P1	75894086	7-23

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	75885981	COIL ASM	404
448	75889435	PLATE, COIL	404
449	75886540	LEAD FLEX, COIL	404
450	75886191	INSULATOR, FLEX LEAD	404
451	75276101	WASHER, PHENOLIC	404
452	75276204	SPACER, PHENOLIC	404
453	75888690	BRACKET, STRAP	404
454	77830612	WASHER, PLAIN	404
455	95044214	SEALANT	404
456	92815099	SCREW, SOCKET HD CAP	404
457	75881921	ACTUATOR WIRING ASM	404

FIGURE 7-13. CARRIAGE AND COIL ASSEMBLY

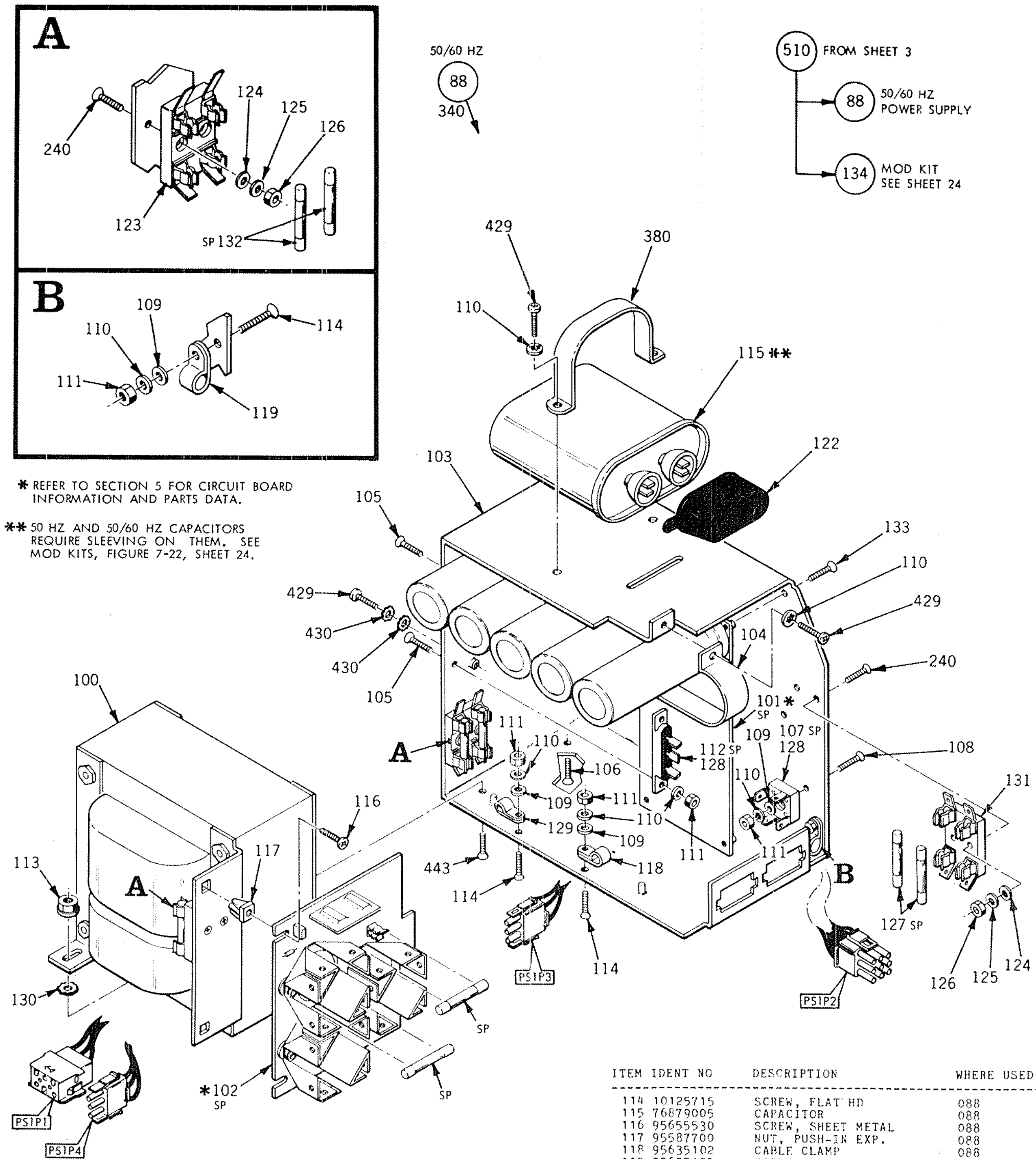




* REFERENCE - SEE FIGURE 7-1 FOR IDENTIFICATION
** ITEM 465, NOT SHOWN, IS A LUBRICANT

ITEM	IDENT NO	DESCRIPTION	WHERE USED
236	94371000	RETAINING RING	394
254	10125804	WASHER, SPR LOCK	515, 516
254	10125804	WASHER, SPR LOCK	517, 518
294	75839881	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
367	75880125	MOTOR ASM	515
368	75887776	PLATE, MOTOR MTG	515, 516
368	75887776	PLATE, MOTOR MTG	517, 518
370	77613626	COLLAR, SHAFT	517, 518
370	77613626	COLLAR, SHAFT	515, 516
371	10126226	SCREW, SOCKET HD	517, 518
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	518
458	75899707	PULLEY	515
465	80625400	LUBRICANT	515, 516
465	80625400	LUBRICANT	517, 518
466	75880127	MOTOR ASM	518
467	75899704	PULLEY	517
468	75887511	BLOWER CENTRIF 50 HZ	466
469	75880126	MOTOR ASM 50 HZ	516
470	75899703	MOTOR PULLEY	516

FIGURE 7-14. MISCELLANEOUS SUB-ASSEMBLIES



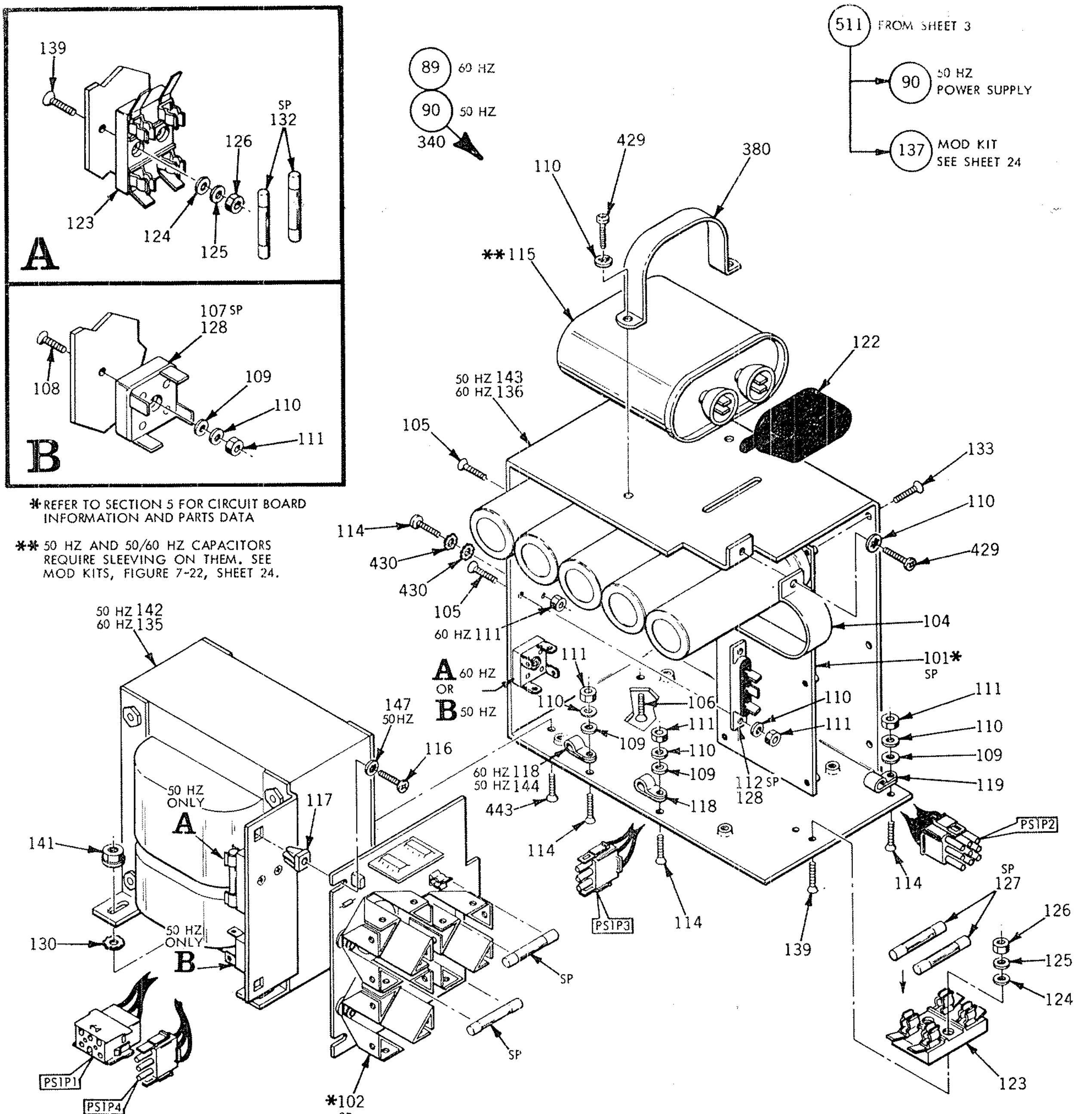
* REFER TO SECTION 5 FOR CIRCUIT BOARD INFORMATION AND PARTS DATA.

** 50 HZ AND 50/60 HZ CAPACITORS REQUIRE SLEEVING ON THEM. SEE MOD KITS, FIGURE 7-22, SHEET 24.

ITEM	IDENT NO	DESCRIPTION	WHERE USED
088	70100300	POWER SUPPLY 50/60 HZ	507
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	95583504	RECTIFIER BLOCK	088
113	92376014	NUT	088

ITEM	IDENT NO	DESCRIPTION	WHERE USED
114	10125715	SCREW, FLAT HD	088
115	76879005	CAPACITOR	088
116	95655530	SCREW, SHEET METAL	088
117	95587700	NUT, PUSH-IN EXP.	088
118	95635102	CABLE CLAMP	088
119	95635105	CABLE CLAMP	088
122	95582501	BOOT-DOUBLE ENTRANCE	088
123	51785403	FUSE BLOCK	088
124	95641502	WASHER, 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
134	75894024	P.S. MOD KIT	510
240	10125704	SCREW, FLAT HD	507
340	94277400	STRAP, CABLE TIE	507
380	95643601	CLAMP, CAPACITOR	507
429	10127112	SCREW, PAN HD	507
430	10126401	WASHER, EXT TOOTH LK ,	507
443	10125747	SCREW, FLAT HD	507
510	75887884	POWER SUPPLY	HPC

FIGURE 7-15. POWER SUPPLY ASSEMBLY



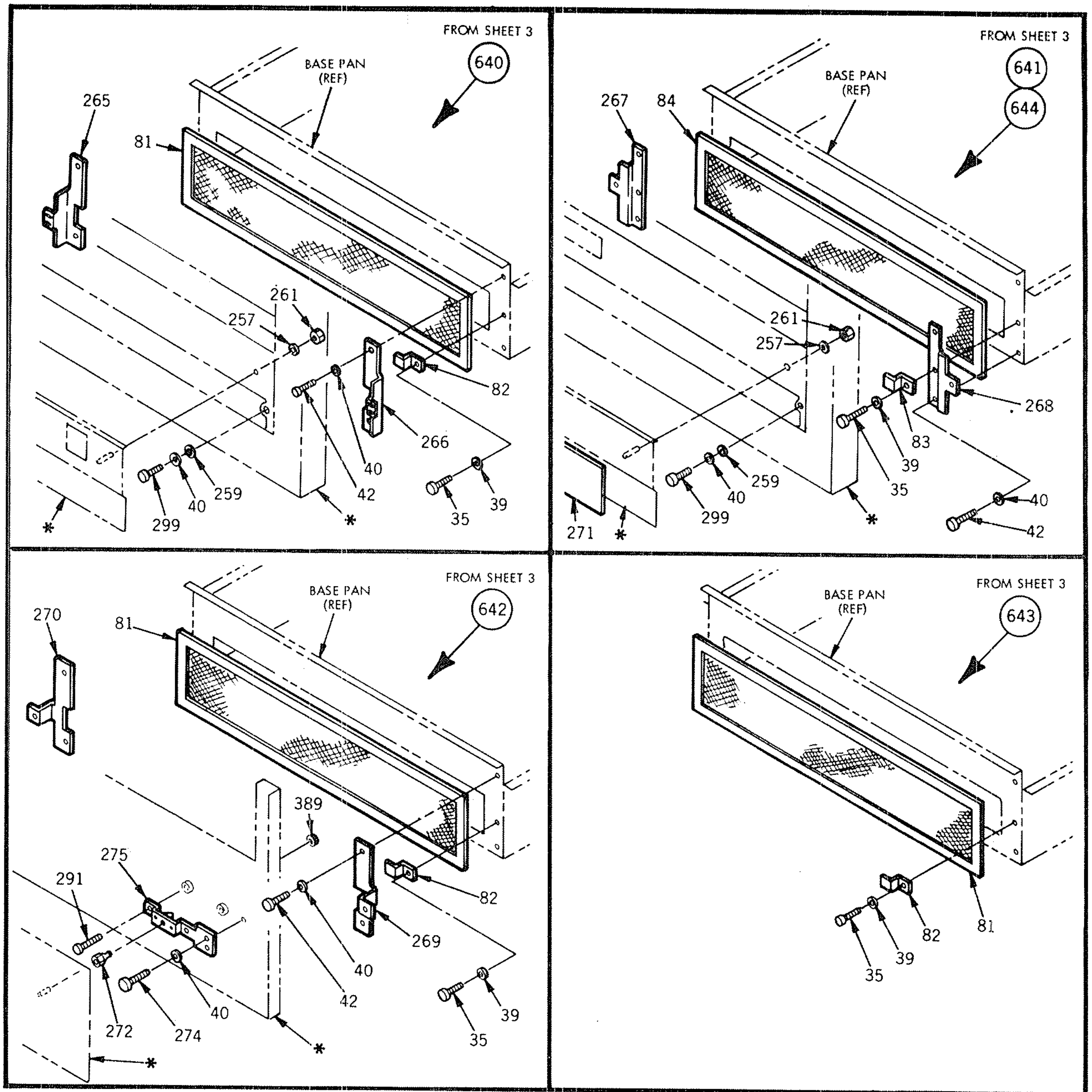
*REFER TO SECTION 5 FOR CIRCUIT BOARD INFORMATION AND PARTS DATA

** 50 HZ AND 50/60 HZ CAPACITORS REQUIRE SLEEVING ON THEM. SEE MOD KITS, FIGURE 7-22, SHEET 24.

ITEM	IDENT NO	DESCRIPTION	WHERE USED
089	76869502	POWER SUPPLY 60 HZ	509
090	70116400	POWER SUPPLY 50 HZ	508
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
137	75895349	P.S. MOD KIT	511
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
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

FIGURE 7-16. POWER SUPPLY ASSEMBLY

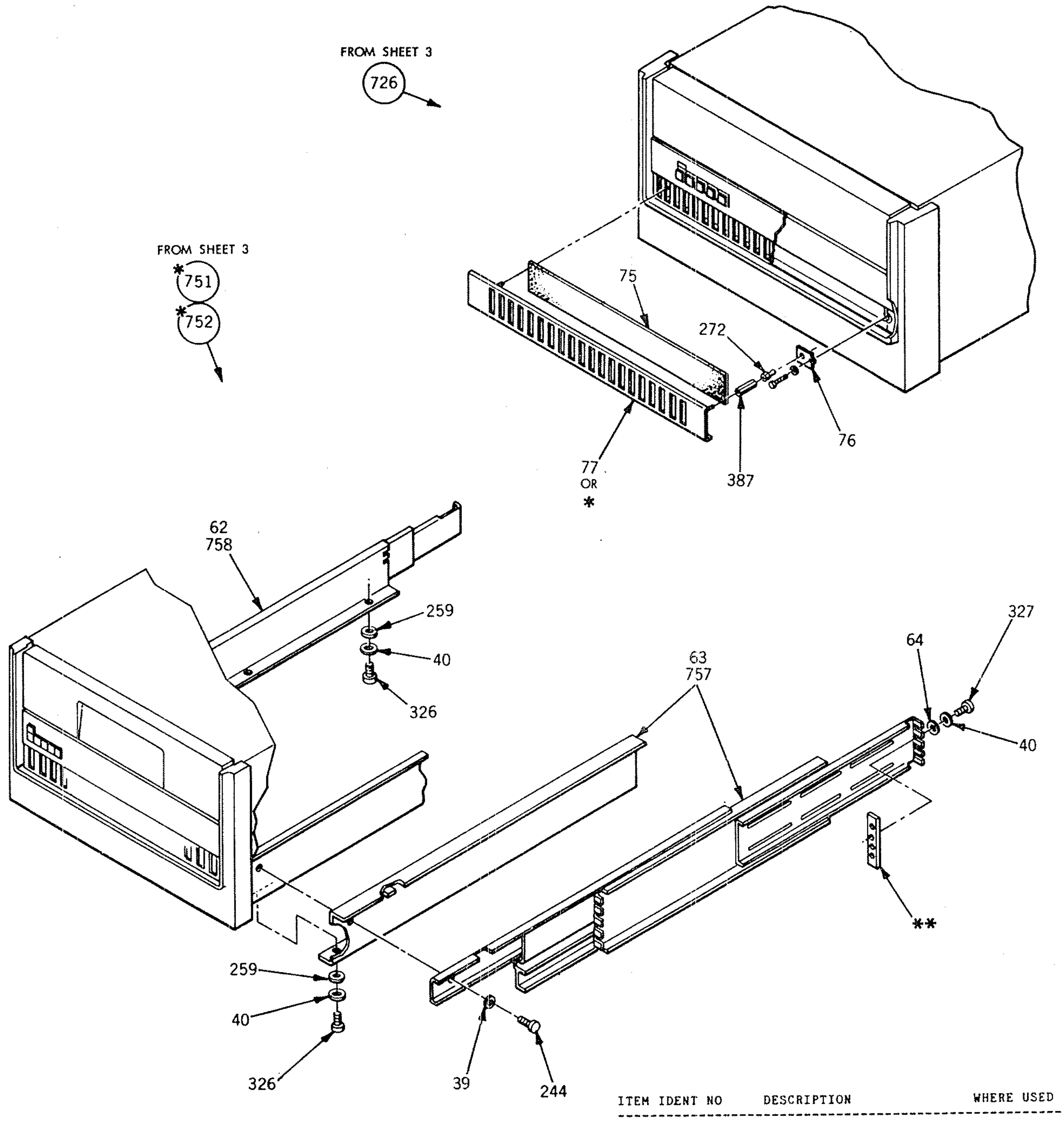


* REFERENCE - SEE FIG 7-1 FOR IDENTIFICATION

ITEM	IDENT NO	DESCRIPTION	WHERE USED
035	10127111	SCREW, PAN HD	640, 641
035	10127111	SCREW,PAN HD	644
035	10127111	SCREW, PAN HD	642, 643
039	10125803	WASHER, SPR LOCK	642, 643
039	10125803	WASHER, SPR LOCK	644
039	10125803	WASHER, SPR LOCK	640, 641
040	10125805	WASHER, SPR LOCK	642, 644
040	10125805	WASHER, SPR LOCK	640, 641
042	10126244	SCREW, HEX SOC HD CAP	642, 644
042	10126244	SCREW, HEX SOC HD CAP	640, 641
081	94364903	FILTER-AIR	640
081	94364903	FILTER-AIR	642, 643
082	75881845	CLIP	640, 642
082	75881845	CLIP	643
083	77641830	CLIP	641, 644
084	94364906	FILTER-AIR	641, 644
257	10125605	WASHER, PLAIN	640, 641
257	10125605	WASHER, PLAIN	644
259	10125607	WASHER, PLAIN	640, 641
259	10125607	WASHER, PLAIN	644
261	53777902	NUT & WASHER	640, 641

ITEM	IDENT NO	DESCRIPTION	WHERE USED
261	53777902	NUT & WASHER	644
265	75881906	BRACKET	640
266	75881907	BRACKET	640
267	77641835	ZEE BRACKET	641, 644
268	77641836	ZEE BRACKET	641, 644
269	77680300	BRACKET	642
270	77680301	BRACKET	642
271	77666011	LABEL	644
272	93326006	STUD BALL	642
274	10126252	SCREW, SOCKET HEAD	642
275	77648135	CATCH ASM	642
291	94376910	SCREW	642
299	10126250	SCREW, CAP	640, 641
299	10126250	SCREW, CAP	644
389	77832429	BUMPER	642
640	75893030	FRONT PANEL INSTL KIT	HPC
641	75893031	FRONT PANEL INSTL KIT	HPC
642	75893035	FRONT PANEL INSTL KIT	HPC
643	75893032	FRONT PANEL INSTL KIT	HPC
644	75893033	FRONT PANEL INSTL KIT	HPC

FIGURE 7-17. FRONT PANEL INSTALLATION KITS

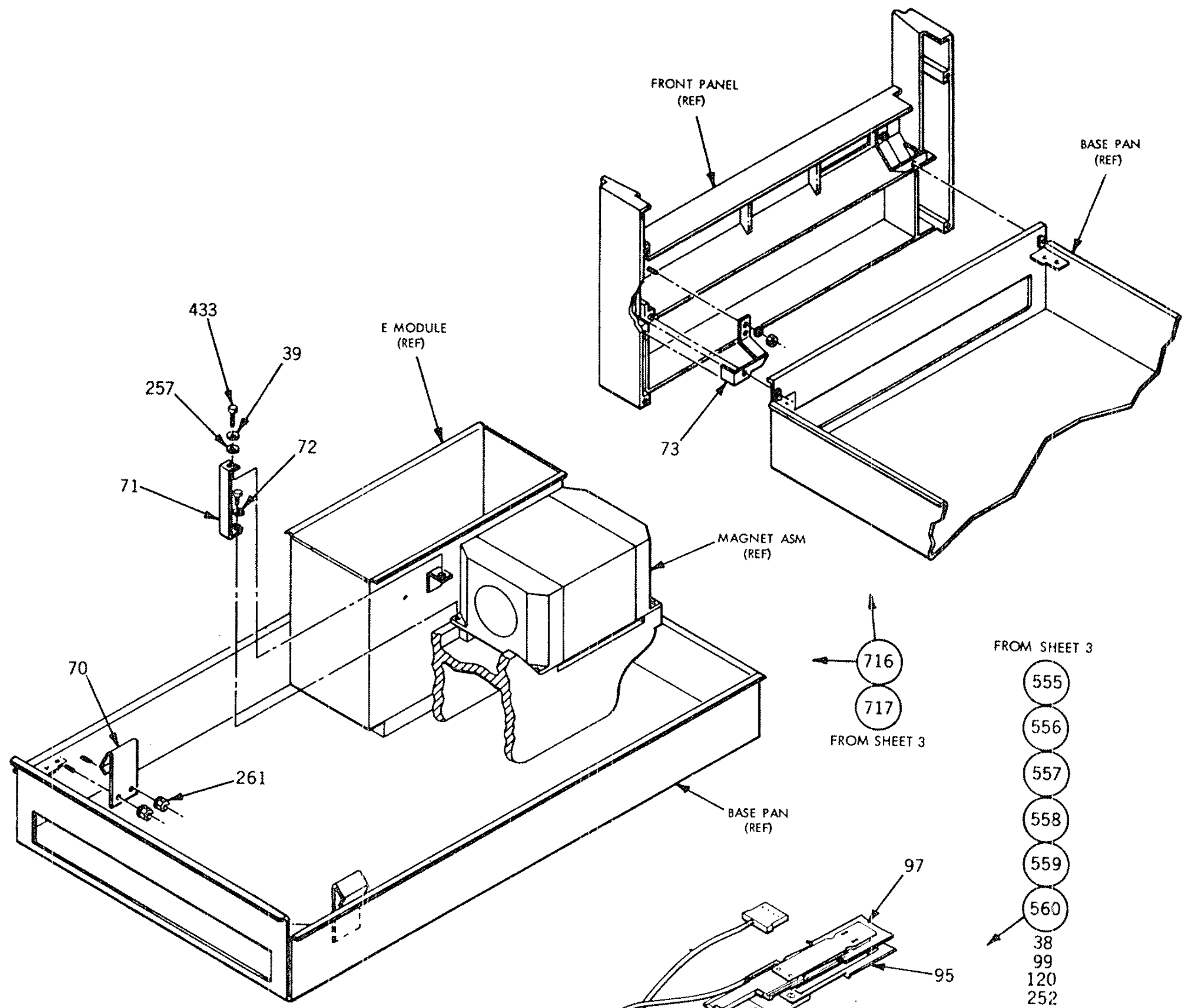


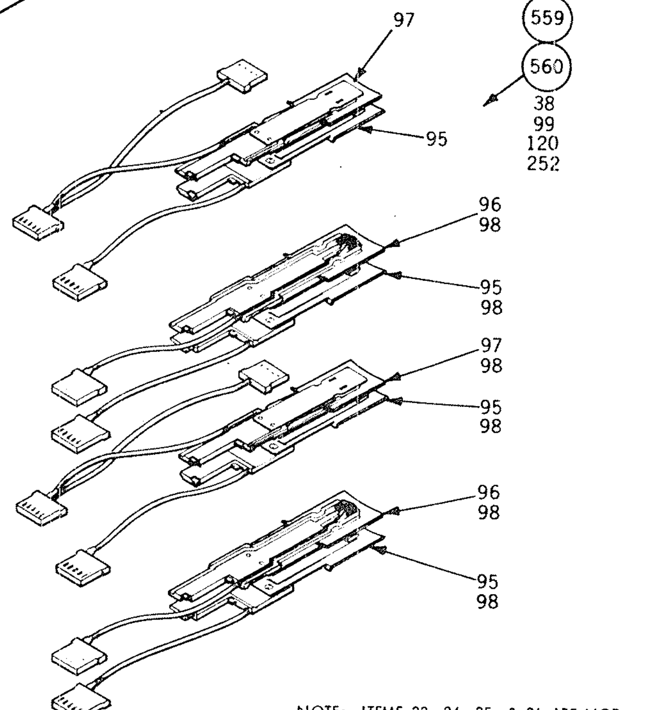
ITEM	IDENT NO	DESCRIPTION	WHERE USED
039	10125803	WASHER, SPR LOCK	751, 752
040	10125805	WASHER, SPR LOCK	751, 752
062	75890947	DRAWER EXT SLIDE	752
063	75890948	DRAWER EXT SLIDE	752
064	94279113	WASHER, PLAIN	751, 752
075	77604002	PRE-FILTER-FILTER	726
076	77648130	CATCH ASM	726
077	77641785	FILTER FRAME ASM	726
244	10127113	SCREW, PAN HD	751, 752
259	10125607	WASHER, PLAIN	751, 752
272	93326006	STUD BALL	077
326	10127141	SCREW, PAN HD	751, 752
327	10127144	SCREW, PAN HD	751, 752
387	93109084	SPACER	077
726	77641795	FILTER KIT	HPC
751	75897340	SLIDE KIT	HPC
752	75897701	SLIDE KIT	HPC
757	75890938	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	PLAIN WASHER	560
038	10125603	PLAIN WASHER	558, 559
038	10125603	PLAIN WASHER	556, 557
039	10125803	WASHER, SPR LOCK	716, 717
070	75882550	GROUND WIPER	716, 717
071	75882555	GROUND STRAP	716, 717
072	10126105	WASHER INT TH LK	716, 717
073	75884877	GROUND FLEXIBLE	716
095	75010102	HEAD-ARM ASM, LOWER	555, 556
095	75010102	HEAD-ARM ASM, LOWER	559, 560
095	75010102	HEAD-ARM ASM, LOWER	557, 558
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	559, 560
097	75010105	HEAD-ARM ASM, SERVO	557, 558
098	75883031	WEIGHT HEAD	556, 557
098	75883031	WEIGHT HEAD	560
098	75883031	WEIGHT HEAD	558, 559
099	10126215	SCREW, HEX SOC HD CAP	558, 559
099	10126215	SCREW, HEX SOC HD CAP	556, 557
099	10126215	SCREW, HEX SOC HD CAP	560
120	10126214	SCREW, HEX SOC HD CAP	560
120	10126214	SCREW, HEX SOC HD CAP	558, 559
120	10126214	SCREW, HEX SOC HD CAP	556, 557
252	10125801	SPRING LK WASHER	556, 557
252	10125801	SPRING LK WASHER	560
252	10125801	SPRING LK WASHER	558, 559
257	10125605	WASHER, PLAIN	716, 717
261	53777902	NUT & WASHER	716, 717
433	10127114	SCREW, PAN HD	716, 717

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

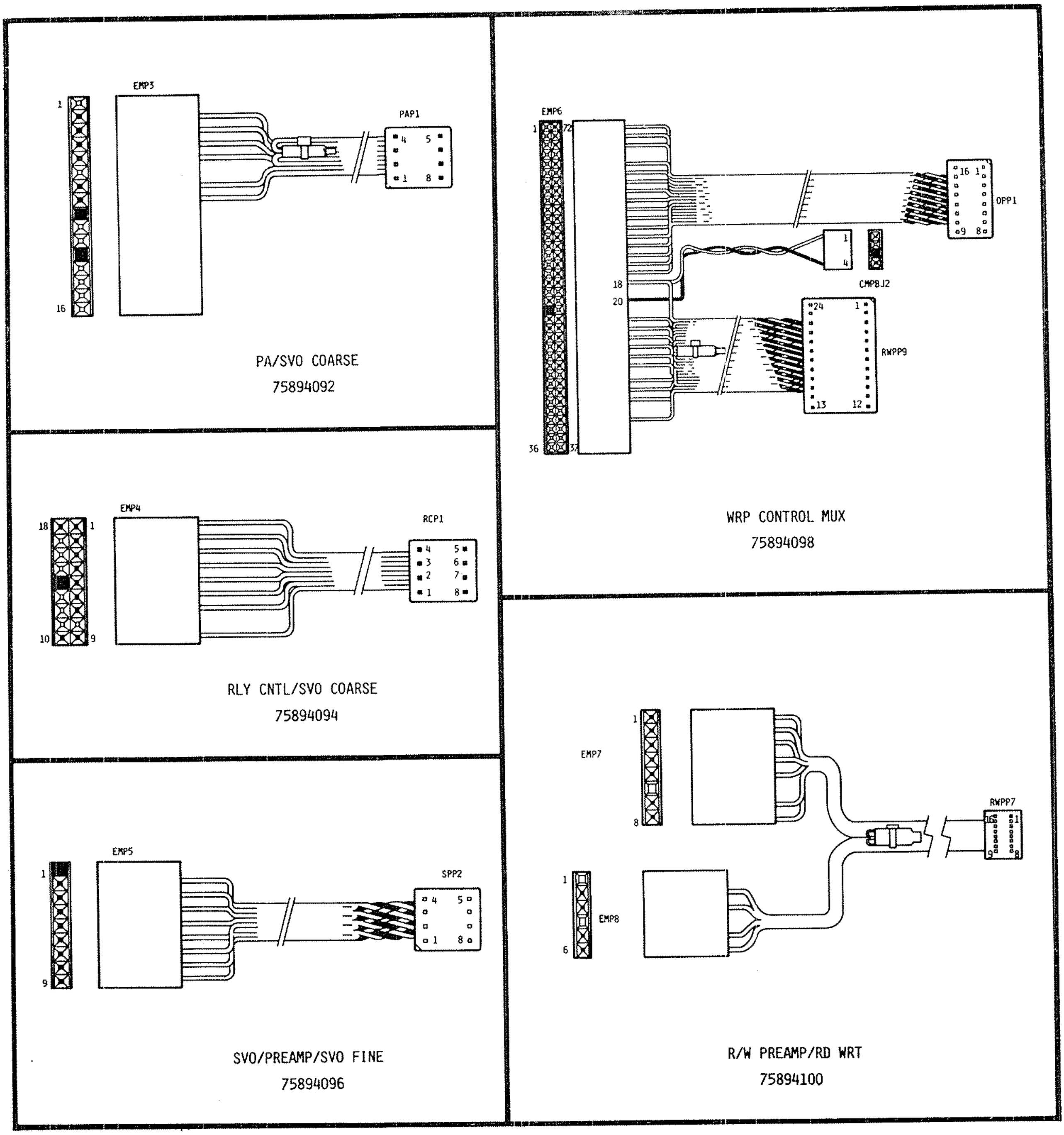
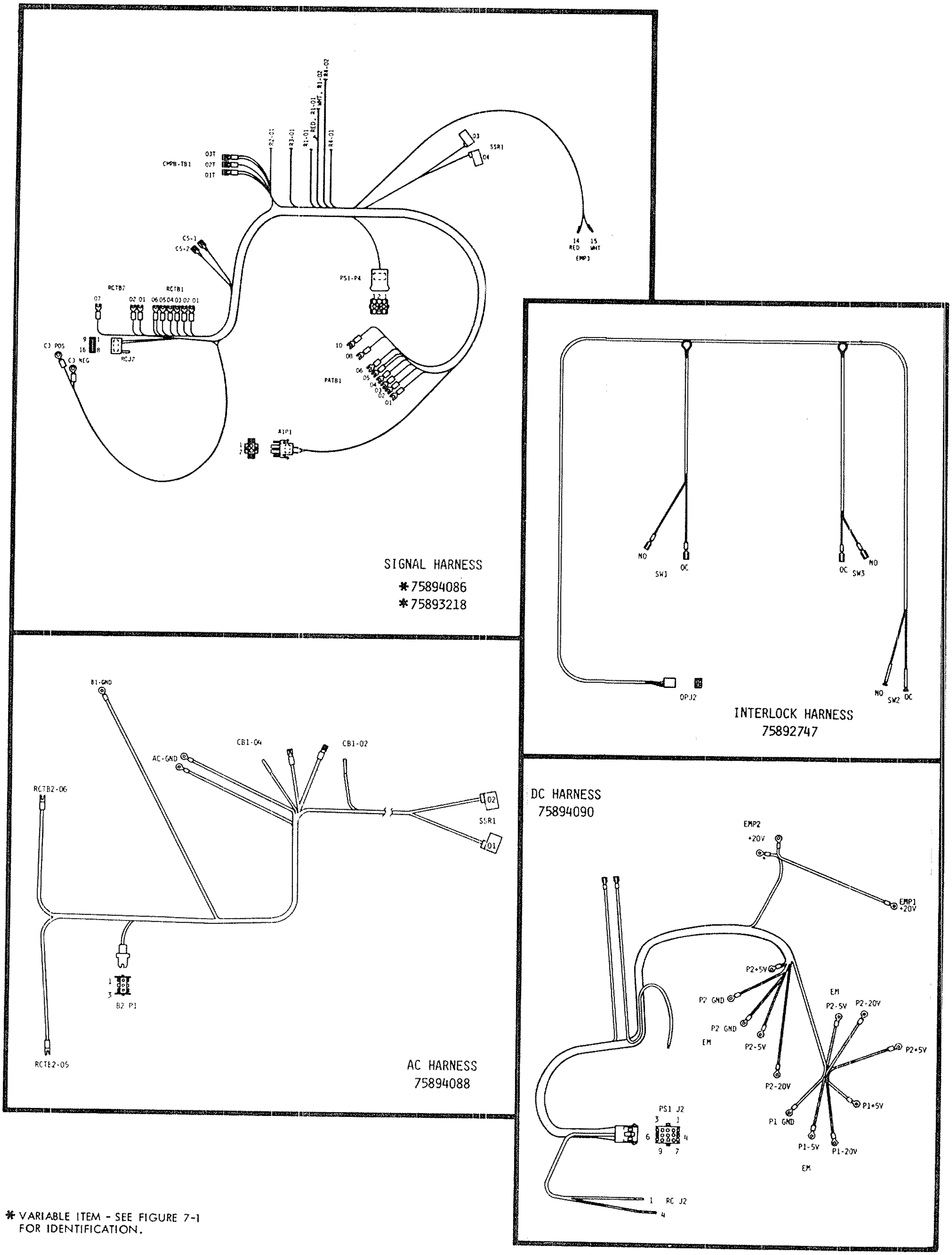
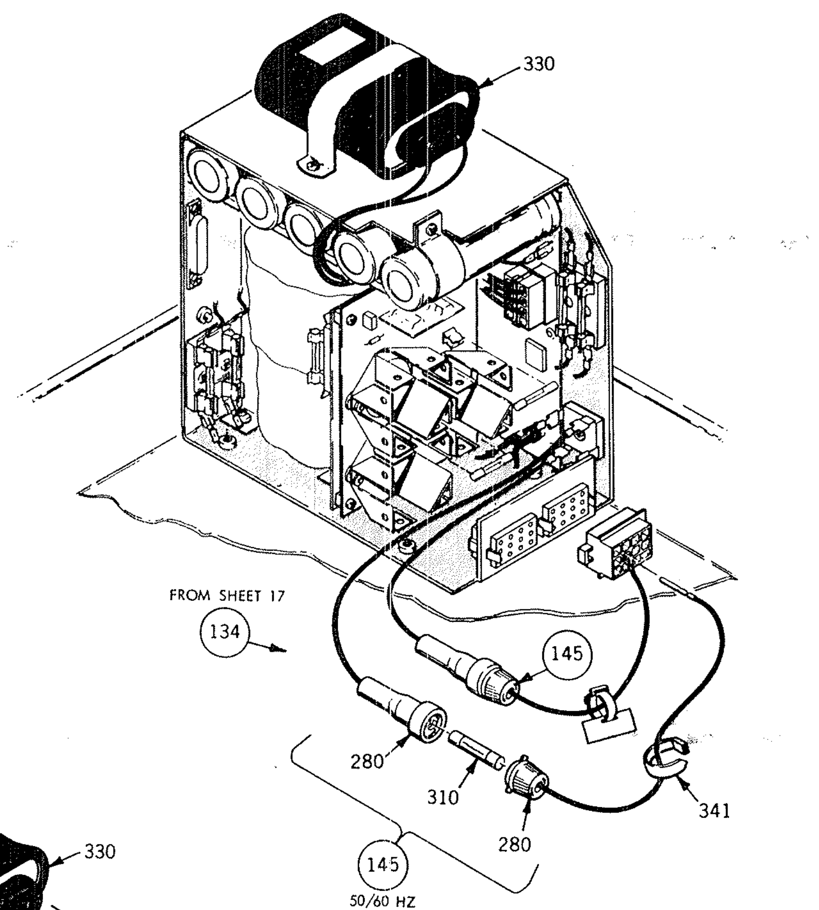


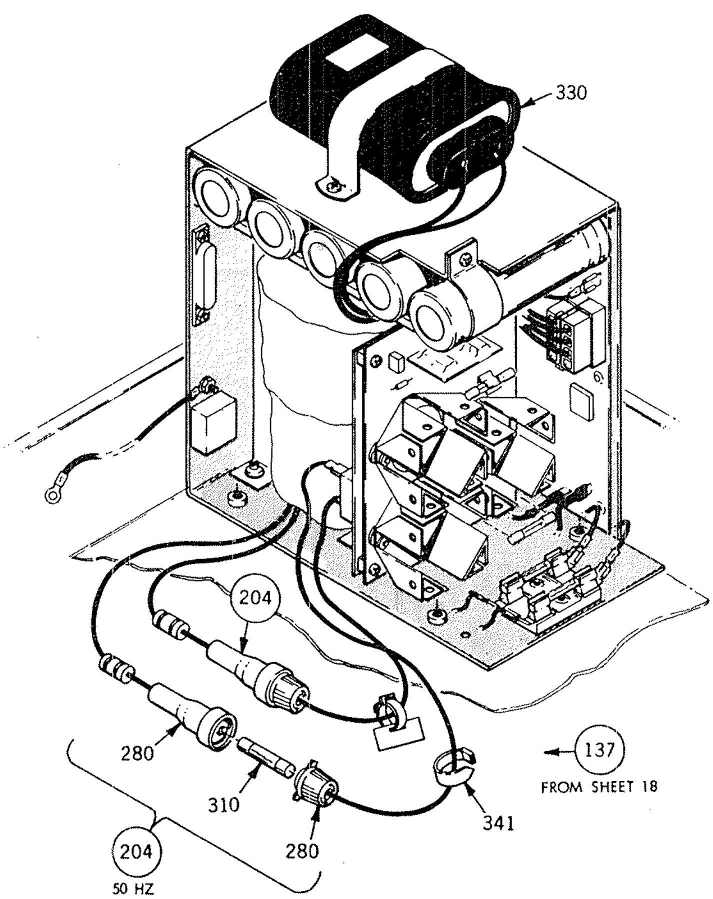
FIGURE 7-20. CMD HARNESSES (SHEET 1 of 2)



* VARIABLE ITEM - SEE FIGURE 7-1
FOR IDENTIFICATION.

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





ITEM	IDENT NO	DESCRIPTION	WHERE USED
134	75894024	P.S. MOD KIT	510
137	75895349	P.S. MOD KIT	511
145	77631967	FUSE HOLDER ASM 50/60 HZ	134
204	77631968	FUSE HOLDER ASM 50 HZ	137
280	94881402	FUSEHOLDER	145, 204
310	51650232	FUSE, CARTRIDGE	145, 204
330	24534729	SLEEVING	134, 137
341	94277409	STRAP, CABLE TIE	145, 204

FIGURE 7-22. POWER SUPPLY MOD KITS

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
021	75880900	FINAL MECHANICAL ASM	500	S5
021	75880900	FINAL MECHANICAL ASM	500	S7
021	75880900	FINAL MECHANICAL ASM	500	S6
021	75880900	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	75880244	SPACER	746, 747	S14
028	75881128	DECK SUPPORT LH	021	S6
029	75881129	DECK SUP RH (NOT SHOWN)	021	S6
030	75883045	GASKET	500	S5
031	10127168	SCREW, PAN HD	021	S6
032	77643187	RECEIVER ASM	021	S7
033	94364401	SWITCH	021	S6
034	95105904	POLYESTER TAPE	021	S6
035	10127111	SCREW, PAN HD	640, 641	S19
035	10127111	SCREW,PAN HD	644	S19
035	10127111	SCREW, PAN HD	021	S6
035	10127111	SCREW, PAN HD	642, 643	S19
035	10127111	SCREW, PAN HD	202	S11
036	77610247	SCREW	201	S10
037	10126246	SCREW CAP	202	S13
038	10126246	SCREW CAP	201	S10
038	10125603	WASHER, PLAIN	202	S12
038	10125603	WASHER, PLAIN	021	S6
038	10125603	WASHER, PLAIN	021	S7
038	10125603	WASHER, PLAIN	404	S15
038	10125603	WASHER, PLAIN	202	S13
038	10125603	PLAIN WASHER	560	S21
038	10125603	PLAIN WASHER	558, 559	S21
038	10125603	PLAIN WASHER	556, 557	S21
039	10125803	WASHER, SPR LOCK	642, 643	S19
039	10125803	WASHER, SPR LOCK	644	S19
039	10125803	WASHER, SPR LOCK	640, 641	S19
039	10125803	WASHER, SPR LOCK	751, 752	S20
039	10125803	WASHER, SPR LOCK	202	S13
039	10125803	WASHER, SPR LOCK	202	S12
039	10125803	WASHER, SPR LOCK	202	S11
039	10125803	WASHER, SPR LOCK	201	S10
039	10125803	WASHER, SPR LOCK	021	S8
039	10125803	WASHER, SPR LOCK	021	S6
039	10125803	WASHER, SPR LOCK	716, 717	S21
040	10125805	WASHERS, SPR LOCK	200, 201	S10
040	10125805	WASHERS, SPR LOCK	202, 705	S13
040	10125805	WASHERS, SPR LOCK	202	S12
040	10125805	WASHER, SPR LOCK	751, 752	S20
040	10125805	WASHER, SPR LOCK	642, 644	S19
040	10125805	WASHER, SPR LOCK	640, 641	S19
040	10125805	WASHERS, SPR LOCK	697, 698	S13
040	10125805	WASHER, SPR LOCK	021	S6
041	95033900	ADHESIVE	500	S5
042	10126244	SCREW, HEX SOC HD CAP	642, 644	S19
042	10126244	SCREW, HEX SOC HD CAP	640, 641	S19
043	75882866	DOOR ASM	021	S8
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	75883465	JUMPER WIPE 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
060	10125608	WASHER, PLAIN	021	S6
061	18748600	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
067	10125030	SCREW, HEX	202	S11
069	77641810	COVER, DOOR	043	S8
070	75882550	GROUND WIPER	716, 717	S21
071	75882555	GROUND STRAP	716, 717	S21
072	10126105	WASHER INT TH LK	716, 717	S21
073	75884877	GROUND FLEXIBLE	716	S21
074	77615990	LABEL	500, 501	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	640	S19
081	94364903	FILTER-AIR	642, 643	S19
082	75881845	CLIP	640, 642	S19
082	75881845	CLIP	643	S19
083	77641830	CLIP	641, 644	S19
084	94364906	FILTER-AIR	641, 644	S19
085	17901501	SCREW, THD FORMING	201	S10
086	75882597	CABLE GUIDE	021	S6
088	70100300	POWER SUPPLY 50/60 HZ	507	S17
087	93748198	SCREW	202	S13
089	76869502	POWER SUPPLY 60 HZ	509	S18
090	70116400	POWER SUPPLY 50 HZ	508	S18
091	95510027	NUT, HEX	032	S7

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
092	95125326	LOCTITE SEALANT	032	S7
093	17901508	SCREW	021	S6
094	91930600	CLIP, ADHESIVE	201	S9
095	75010102	HEAD-ARM ASM, LOWER	555, 556	S21
095	75010102	HEAD-ARM ASM, LOWER	559, 560	S21
095	75010102	HEAD-ARM ASM, LOWER	557, 558	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	559, 560	S21
097	75010105	HEAD-ARM ASM, SERVO	557, 558	S21
098	75883031	WEIGHT HEAD	556, 557	S21
098	75883031	WEIGHT HEAD	560	S21
098	75883031	WEIGHT HEAD	558, 559	S21
099	10126215	SCREW, HEX SOC HD CAP	558, 559	S21
099	10126215	SCREW, HEX SOC HD CAP	556, 557	S21
099	10126215	SCREW, HEX SOC HD CAP	560	S21
100	70104300	TRANSFORMER 50/60 HZ	088	S17
101	75832500	AXGV COMPONENT ASM	088	S17
101	75832500	AXGV COMPONENT ASM	089, 090	S18
102	75832900	AXHV COMPONENT ASM	088	S17
102	75832900	AXHV COMPONENT ASM	089, 090	S18
103	70110102	CHASSIS	088	S17
104	76873100	CAP MOUNTING BRACKET	089, 090	S18
104	76873100	CAP MOUNTING BRACKET	088	S17
105	10125714	SCREW, SLAT HD	088	S17
105	10125714	SCREW, FLAT HD	089, 090	S18
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	089, 090	S18
109	10125613	WASHER, PLAIN	088	S17
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	S8
112	95583504	RECTIFIER BLOCK	089, 090	S18
112	95583504	RECTIFIER BLOCK	088	S17
113	92376014	NUT	088	S17
114	10125715	SCREW, FLAT HD	088	S17
114	10125715	SCREW, FLAT HD	089, 090	S18
115	76879005	CAPACITOR	089, 090	S18
115	76879005	CAPACITOR	088	S17
116	95655530	SCREW, SHEET METAL	088	S17
116	95655530	SCREW, SHEET METAL	089, 090	S18
117	95587700	NUT, PUSH-IN EXP.	088	S17
117	95587700	NUT, PUSH-IN EXP.	089, 090	S18
118	95635102	CABLE CLAMP	088	S17
118	95635102	CABLE CLAMP	089, 090	S18
119	95635105	CABLE CLAMP	088	S17
119	95635105	CABLE CLAMP	089, 090	S18
120	10126214	SCREW, HEX SOC HD CAP	560	S21
120	10126214	SCREW, HEX SOC HD CAP	558, 559	S21
120	10126214	SCREW, HEX SOC HD CAP	556, 557	S21
121	77646195	LIFT BKT E MOD	747	S14
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	089, 090	S18
125	10126101	WASHER, INT TH LK	088	S17
126	95510024	NUT, HEX	088	S17
126	95510024	NUT, HEX	089, 090	S18
127	93419228	FUSE, 125 V	088	S17
127	93419228	FUSE, 125 V	089, 090	S18
128	95533601	GREASE	089	S18
128	95533601	GREASE	088	S17
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	089	S18
132	95647607	FUSE	088	S17
133	10125909	SCREW, FLAT HD	089, 090	S18
133	10125909	SCREW, FLAT HD	088	S17
134	75894024	P.S. MOD KIT	510	S17
134	75894024	P.S. MOD KIT	510	S24
135	70112900	TRANSFORMER 60 HZ	089	S18
136	76873002	CHASSIS	089	S18
137	75895349	P.S. MOD KIT	511	S18
137	75895349	P.S. MOD KIT	511	S24
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	77631967	FUSE HOLDER ASM 50/60 HZ	134	S24
146	70117900	WIRE HARNESS ASM	090	S18
147	93564034	WASHER, NYLON	090	S18
148	24534714	HEAD SHRINK SLEEVE	746, 747	S14
149	75287700	DOOR GASKET	746, 747	S14
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
155	94343210	CABLE TIE MOUNT	201	S10

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
156	77647108	ACOUSTIC FOAM	021	S6
157	10125103	NUT-HEX	201	S10
201	75880814	BASE PAN ASM	021	S6
201	75880814	BASE PAN ASM	021	S10
201	75880814	BASE PAN ASM	021	S9
202	75880120	DECK ASM	021	S13
202	75880120	DECK ASM	021	S12
202	75880120	DECK ASM	021	S11
202	75880120	DECK ASM	021	S6
203	10127106	SCREW	201	S10
204	77631968	FUSE HOLDER ASM 50 HZ	137	S24
205	93109267	SPACER	747	S14
206	75893107	RETAINER, HEAD CONN	021	S6
207	75881395	RETAINER, HEAD CONN	021	S6
208	10126263	SCREW, SOCKET HEAD	021	S6
209	75893275	PLATE, SEPARATOR	021	S7
211	77670106	SCREW	202	S12
212	77617049	SCREW, PAN HD	500	S5
213	10126104	WASHER	202	S13
213	10126104	WASHER	746, 747	S14
214	75894320	BRACKET, RIGHT	746, 747	S14
215	75894321	BRACKET, LEFT	746, 747	S14
216	10125723	SCREW, FLAT HD	746, 747	S14
217	75892811	WASHER, SHOULDER	021	S6
218	75892221	PIN	021	S6
219	92033037	RETAINING RING	021	S7
219	92033037	RETAINING RING	021	S6
220	92054223	BALL BEARING	021	S7
221	75883115	CAM PLATE	032	S7
222	75889492	SUPPORT SHAFT	021	S8
223	75887453	RECEIVER BAR, LH	032	S7
224	75887448	RECEIVER BAR, RH	032	S7
225	75882834	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	021	S6
229	75881790	LINK	021	S6
230	16402506	CABLE CLAMP	021	S6
230	16402506	CABLE CLAMP	202	S13
231	10127104	SCREW, PAN HD	021	S6
233	77641825	SHIELD, F MODULE	746, 747	S14
234	75893958	SPACER	021	S7
235	77610140	SW INTEGRAL LEVER	202	S12
236	94371000	RETAINING RING	021	S6
236	94371000	RETAINING RING	394	S16
236	94371090	RETAINING RING	200, 201	S10
237	92745012	SCREW, PAN HD	021	S8
238	10127102	SCREW, PAN HD	021	S6
238	10127102	SCREW, PAN HD	043	S8
239	93592207	SCREW	746, 747	S14
240	10125704	SCREW, FLAT HD	507	S17
241	93592158	SCREW, HEX ASH HD	021	S6
242	92033033	RETAINING RING	043	S8
243	10126219	SCREW, HEX SOC HD CAP	021	S7
243	10126219	SCREW, HEX SOC HD CAP	202	S11
244	10127113	SCREW, PAN HD	021	S6
244	10127113	SCREW, PAN HD	751, 752	S20
244	10127113	SCREW, PAN HD	202	S12
244	10127113	SCREW, PAN HD	202	S11
244	10127113	SCREW, PAN HD	021	S8
245	75883475	GROUND STRAP	201	S9
246	10127121	SCREW, PAN HD	201	S10
246	10127121	SCREW, PAN HD	746, 747	S14
247	77666818	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	201	S10
251	10125800	WASHER SPR	021	S6
251	10125800	WASHER SPR	021	S8
251	10125800	WASHER SPR	202	S12
252	10125801	WASHER SPR LOCK	021	S6
252	10125801	WASHER SPR LOCK	021	S7
252	10125801	WASHER SPR LOCK	201	S9
252	10125801	WASHER SPR LOCK	404	S15
252	10125801	WASHER SPR LOCK	043	S8
252	10125801	WASHER SPR LOCK	202	S13
252	10125801	WASHER SPR LOCK	202	S12
252	10125801	WASHER SPR LOCK	201	S10
252	10125801	SPRING LK WASHER	556, 557	S21
252	10125801	SPRING LK WASHER	560	S21
252	10125801	SPRING LK WASHER	558, 559	S21
253	10126254	SCREW, SOCKET HD	202	S13
254	10125804	WASHER, SPR LOCK	021	S6
254	10125804	WASHER, SPR LOCK	032	S7
254	10125804	WASHER, SPR LOCK	515, 516	S16
254	10125804	WASHER, SPR LOCK	404	S15
254	10125804	WASHER, SPR LOCK	202	S13
254	10125804	WASHER, SPR LOCK	202	S11
254	10125804	WASHER, SPR LOCK	746, 747	S14
254	10125804	WASHER, SPR LOCK	201	S9
254	10125804	WASHER, SPR LOCK	043	S8
254	10125804	WASHER, SPR LOCK	500	S5
254	10125804	WASHER, SPR LOCK	517, 518	S16
255	10125806	WASHER, SPR LOCK	202	S12
255	10125806	WASHER, SPR LOCK	202	S13
256	10125602	WASHER, PLAIN	021	S6
256	10125602	WASHER, PLAIN	202	S12
256	10125602	WASHER, PLAIN	201	S8
256	10125602	WASHER, PLAIN	201	S10
257	10125605	WASHER, PLAIN	021	S6
257	10125605	WASHER, PLAIN	201	S10
257	10125605	WASHER, PLAIN	021, 043	S8
257	10125605	WASHER, PLAIN	640, 641	S19
257	10125605	WASHER, PLAIN	644	S19

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
257	10125605	WASHER, PLAIN	202	S13
257	10125605	WASHER, PLAIN	202	S12
257	10125605	WASHER, PLAIN	202	S11
257	10125605	WASHER, PLAIN	500	S5
257	10125605	WASHER, PLAIN	716, 717	S21
258	10125606	WASHER, PLAIN	021	S6
258	10125606	WASHER, PLAIN	021, 032	S7
258	10125606	WASHER, PLAIN	202	S11
258	10125606	WASHER, PLAIN	201	S9
258	10125606	WASHER, PLAIN	021, 043	S8
258	10125606	WASHER, PLAIN	500	S5
258	10125606	WASHER, PLAIN	746, 747	S14
258	10125606	WASHER, PLAIN	202	S13
259	10125607	WASHER, PLAIN	201	S9
259	10125607	WASHER, PLAIN	640, 641	S19
259	10125607	WASHER, PLAIN	644	S19
259	10125607	WASHER, PLAIN	697, 698	S13
259	10125607	WASHER, PLAIN	202, 705	S13
259	10125607	WASHER, PLAIN	201	S10
259	10125607	WASHER, PLAIN	751, 752	S20
260	10125102	NUT-HEX	021	S6
260	10125102	NUT-HEX	201	S10
260	10125102	NUT-HEX	202	S12
260	10125102	NUT-HEX	021	S8
261	53777902	NUT & WASHER	021	S6
261	53777902	NUT & WASHER	716, 717	S21
261	53777902	NUT & WASHER	640, 641	S19
261	53777902	NUT & WASHER	644	S19
262	53777903	NUT & WASHER	404	S15
263	94343210	CABLE TIE MOUNT	746, 747	S14
264	77830530	RIVET, SPLIT NYLON	021	S7
265	75881906	BRACKET	640	S19
266	75881907	BRACKET	640	S19
267	77641835	ZEE BRACKET	641, 644	S19
268	77641836	ZEE BRACKET	641, 644	S19
269	77680300	BRACKET	642	S19
270	77680301	BRACKET	642	S19
271	77666011	LABEL	644	S19
272	93326006	STUD BALL	077	S20
272	93326006	STUD BALL	642	S19
274	10126252	SCREW, SOCKET HEAD	642	S19
275	77648135	CATCH ASM	642	S19
276	77647611	HINGE BLK ASM	746, 747	S14
277	83410518	GASKET STRIP	201	S9
277	83410518	GASKET STRIP	500	S5
278	75880482	BEARING	499	S8
280	94881402	FUSEHOLDER	145, 204	S24
281	75882875	PANEL, POWER ENTRY	201	S9
284	75881350	BRACKET RESISTOR MTG	201	S10
285	95645628	CAPACITOR, 40VDC	201	S10
286	76878900	CAPACITOR, MOTOR RUN	201	S10
287	92826001	BRACKET	201	S10
288	75772500	BOOT, CAPACITOR	201	S10
289	75888155	BRACKET, RELAY CONTR	201	S10
290	75886725	DUCT, AIR INLET	201	S9
291	94376910	SCREW	642	S19
292	53777900	NUT & CAPTIVE WASHER	021	S6
293	75887561	SPACER	201	S9
294	75889881	MANIFOLD ASM	201	S9
294	75889881	MANIFOLD ASM	201	S16
295	75889165	HOSE, PLASTIC AIR	201	S9
296	94275254	HOSE CLAMP	201	S9
298	75885997	FILTER, ABSOLUTE	201	S9
299	10126250	SCREW, CAP	640, 641	S19
299	10126250	SCREW, CAP	644	S19
299	10126250	SCREW, CAP	705	S13
299	10126250	SCREW, CAP	697, 698	S13
300	77647100	SPRING, FILTER RET	201	S9
301	75881265	DEFLECTOR, AIR	201	S9
302	75891004	COVER, AIR DEFLECTOR	201	S9
303	75774471	CAPACITOR	202	S13
304	75881270	CLAMP, CAPACITOR	202	S13
305	75888775	RESISTOR, WIRE WOUND	201	S10
306	75888776	RESISTOR, WIRE WOUND	201	S10
307	75883485	E-MODULE BRACKET	746, 747	S14
308	92745208	SCREW, PAN HD	746, 747	S14
309	75893762	CLAMP	201	S9
310	51650232	FUSE, CARTRIDGE	145, 204	S24
311	75893755	PIN	201	S10
312	77610156	SHOCK MOUNT	201	S10
313	75899543	BLK	202	S12
314	75882870	SHIELD, RFI FILTER	201	S10
315	51870400	AC PWR RECEPTACLE	201	S9
316	75899547	BLK	202	S11
317	75062803	WASHER, SHOULDER	201	S9
318	75062400	WASHER, INSULATOR	201	S9
318	75062400	WASHER, INSULATOR	202	S13
319	75883453	WIRE JUMPER	201	S9
322	10127103	SCREW, PAN HD	201	S10
322	10127103	SCREW, PAN HD	201	S9
323	93749196	SCREW, PAN HD	201	S10
323	93749196	SCREW, PAN HD	201	S9
324	10127122	SCREW, PAN HD	021	S7
324	10127122	SCREW, PAN HD	200, 201	S9
325	10127124	SCREW, PAN HD	043	S8
325	10127124	SCREW, PAN HD	201	S9
325	10127124	SCREW, PAN HD	746, 747	S14
326	10127141	SCREW, PAN HD	751, 752	S20
327	10127144	SCREW, PAN HD	201	S9
327	10127144	SCREW, PAN HD	751, 752	S20
328	10125066	SCREW, HEX HD	201	S9
329	10126403	WASHER, EXT TOOTH LK	201	S10
329	10126403	WASHER, EXT TOOTH LK	201	S9
330	24534729	SLEEVING	134, 137	S24
331	53777900	NUT-HEX	201	S9
332	53777905	NUT, HEX	201	S9
332	53777905	NUT, HEX	201	S10
333	10125301	NUT, HEX	202	S11
334	93564004	WASHER, NYLON	201	S10
335	10126221	SCREW	202	S11
336	75887510	BLOWER CENTRIF	550	S16
337	83435302	CONNECTOR, PLUG/CAP	550, 551	S16
338	94276600	FOAM TAPE	294	S16

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
338	94276600	FOAM TAPE	550, 551	S16
339	95105900	TAPE, POLY FILM, INSUL	294	S16
339	95105900	TAPE, POLY FILM, INSUL	550, 551	S16
340	94277400	STRAP, CABLE TIE	202	S11
340	94277400	STRAP, CABLE TIE	550, 551	S16
340	94277400	STRAP, CABLE TIE	508,509	S18
340	94277400	STRAP, CABLE TIE	507	S17
341	94277409	STRAP, CABLE TIE	550, 551	S16
341	94277409	STRAP, CABLE TIE	145, 204	S24
342	75887520	GROMMET, SQ SHOULDER	550, 551	S16
343	75885931	MANIFOLD	294	S16
344	75881250	GASKET	294	S16
345	75885836	SPRT BAR-CARD GUIDE	746, 747	S14
346	75885832	MTG BAR-GUIDE CTR	746, 747	S14
347	75886293	PANEL, LEFT SIDE	746, 747	S14
348	75885841	MTG BAR-CARD GUIDE	746, 747	S14
349	75885791	STRIP-CARD LOCATION	746, 747	S14
350	77633806	SPACER	746, 747	S14
351	77633805	SPACER	746, 747	S14
352	82312001	GUIDE, CIRCUIT CARD	746, 351	S14
352	82312001	GUIDE, CIRCUIT CARD	747	S14
353	82311701	GUIDE, CIRCUIT CARD	746, 747	S14
354	75885694	PANEL, RIGHT SIDE	746, 747	S14
355	77647106	PANEL ACOUSTIC FOAM	620, 621	S4
355	77647106	PANEL ACOUSTIC FOAM	622, 623	S4
356	75899706	PULLEY	697	S13
357	75893775	BRACKET, I/O CABLE	746, 747	S14
358	93592204	SCREW, HEX WASHER	746, 747	S14
359	10126213	SCREW	021	S7
360	77610157	SHOCK MOUNT	202	S13
361	10125106	NUT, HEX	746, 747	S14
361	10125106	NUT, HEX	032	S8
362	10127123	SCREW, PAN HD	202	S13
362	10127123	SCREW, PAN HD	032	S7
363	77633800	CLAMP	746, 747	S14
364	75880040	BASE PLATE ASM	202	S11
364	75880040	BASE PLATE ASM	202	S13
364	75880040	BASE PLATE ASM	202	S12
365	75886281	SPINDLE	202	S11
366	92745211	SCREW, PAN HD	746, 747	S14
367	75880125	MOTOR ASM	515	S16
368	75887776	PLATE, MOTOR MTG	515, 516	S16
368	75887776	PLATE, MOTOR MTG	517, 518	S16
369	92009012	WASHER, PLAIN	202	S12
370	77613626	COLLAR, SHAFT	517, 518	S16
370	77613626	COLLAR, SHAFT	515, 516	S16
371	10126226	SCREW, SOCKET HD	404	S15
371	10126226	SCREW, SOCKET HD	517, 518	S16
371	10126226	SCREW, SOCKET HD	515, 516	S16
371	10126226	SCREW, SOCKET HD	202	S13
372	75062805	WASHER, SHOULDER	697, 698	S13
372	75062805	WASHER, SHOULDER	202, 705	S13
373	10126255	SCREW	202	S12
374	75881537	POST, MOTOR SPRING	202	S13
375	75887539	SPRING, TENSION	202	S13
376	75891524	HINGE	202	S13
377	75893280	SPACER, HINGE	202	S13
378	77610051	P.A.C. RELAY (SSR)	202	S13
379	75882357	GND WIRE	746, 747	S14
380	95643601	CLAMP, CAPACITOR	201	S10
380	95643601	CLAMP, CAPACITOR	508, 509	S18
380	95643601	CLAMP, CAPACITOR	507	S17
381	75887791	DISC, SPEED SENSOR	202	S13
382	75893920	SUPPORT, SPEED SENSOR	202	S13
383	75880045	SPEED SENSOR	202	S13
384	75885407	OPTICAL SWITCH	383	S13
385	75887871	GROUND SPRING	202	S13
386	75883481	PULLEY COVER	202	S13
387	93109084	SPACER	077	S20
388	92720396	BUTTON SCREW	202	S11
389	77832429	BUMPER	642	S19
389	77832429	BUMPER	202	S11
390	75886286	ROD-GUIDE	202	S12
391	75893682	BUMPER MOUNT, LOWER	202	S11
392	75886037	PLATE BEARING - FIXED	202	S12
393	10126227	SCREW, HEX SOC HD	404	S15
394	75891681	PLATE ASM	202	S16
394	75891681	PLATE ASM	202	S12
395	75886033	PLATE BEARING	394	S16
396	75888191	BLOCK, SPRING SUPPORT	394	S16
397	75887557	PIN-SPRING, GUIDE	394	S16
398	75881536	SPRING	394	S16
400	77830611	WASHER, PLAIN STEELE	394	S16
400	77830611	WASHER, PLAIN STEELE	021	S8
401	75888746	CAM-TOWER	202	S11
402	75888747	CAM-TOWER	202	S11
403	75889469	BUMPER MT, UPPER	202	S11
404	75880135	CARRIAGE & COIL ASM	202	S12
404	75880135	CARRIAGE & COIL ASM	202	S15
405	75886512	MAGNET ASM	202	S12
406	75894102	VEL XDUCER-CONN ASM	202	S12
407	51885515	STANDOFF, MALE-FEMALE	202	S12
408	75891011	BRACKET SWITCH	202	S12
409	77610143	SW, SUBMINIATURE	201	S10
410	75891573	CARRIAGE LKG TOOL	202	S12
411	75893943	MTG BRACKET	202	S11
412	75893953	SERVO PREAMP SHIELD	202	S11
413	75893110	CONNECTOR PLATE	202	S11
414	75881385	MTG PLATE	202	S11
415	77666850	SHIELD, RD/WR PREAMP	202	S11
416	75882106	SHIM, STRIKER	021	S6
417	75882105	BLOCK, SPACER, STRIKER	021	S6
418	75895214	STRIKER	021	S6
419	75893915	COVER	202	S11
420	75883211	COVER, POWER AMP ASM	202	S12
421	90603300	CLOSURE	500, 501	S5

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
422	92602004	CABLE CLAMP	202	S13
422	92602004	CABLE CLAMP	021	S7
423	10127119	SCREW PAN HD	202	S13
424	10125029	SCREW, HEX	202	S11
424	10125029	SCREW, HEX	202	S13
425	10126402	WASHER, EXT TOOTH LK	201	S10
425	10126402	WASHER, EXT TOOTH LK	202	S13
425	10126402	WASHER, EST TOOTH LK	746, 747	S14
426	10126222	SCREW, HEX SOC HD	202	S13
427	10125702	SCREW, FLAT HD	043	S8
428	93788082	SCREW, SELF LOCKING	202	S13
429	10127112	SCREW, PAN HD	202	S13
429	10127112	SCREW, PAN HD	021	S6
429	10127112	SCREW, PAN HD	201	S10
429	10127112	SCREW, PAN HD	508, 509	S18
429	10127112	SCREW, PAN HD	507	S17
430	10126401	WASHER, EXT TOOTH LK	202	S12
430	10126401	WASHER, EXT TOOTH LK	202	S13
430	10126401	WASHER, EXT TOOTH LK	508, 509	S18
430	10126401	WASHER, EXT TOOTH LK	507	S17
430	10126401	WASHER, EXT TOOTH LK	500, 501	S5
430	10126401	WASHER, EXT TOOTH LK	021	S6
431	10125760	SCREW, FLAT HD	202	S13
432	10126245	SCREW, HEX SOC HD	202	S12
433	10127114	SCREW, PAN HD	202	S11
433	10127114	SCREW, PAN HD	021	S6
433	10127114	SCREW, PAN HD	202	S12
433	10127114	SCREW, PAN HD	716, 717	S21
434	77610221	SCREW, PAN HD	202	S11
435	10127115	SCREW, PAN HD	202	S12
436	10125016	SCREW, HEX HD	202	S12
437	10125018	SCREW, HEX HD	202	S12
438	10125004	SCREW, HEX HD	202	S11
438	10125004	SCREW, HEX HD	202	S13
438	10125004	SCREW, HEX HD	202	S12
439	77647107	PANEL ACOUSTIC FOAM	620, 621	S4
439	77647107	PANEL ACOUSTIC FOAM	622, 623	S4
440	10125006	SCREW, HEX HD	202	S12
441	10127148	SCREW, PAN HD	202	S13
442	51885504	STANDOFF, MALE-FEMALE	202	S12
443	10125747	SCREW, FLAT HD	508, 509	S18
443	10125747	SCREW, FLAT HD	507	S17
443	10125747	SCREW, FLAT HD	202	S13
444	10127169	SCREW, PAN HD	202	S12
445	18440201	SILICONE RUBBER	202	S11
446	75880140	CARRIAGE & BEARINGS	404	S15
447	75885981	COIL ASM	404	S15
448	75889435	PLATE, COIL	404	S15
449	75886540	LEAD FLEX, COIL	404	S15
450	75886191	INSULATOR, FLEX LEAD	404	S15
451	75276101	WASHER, PHENOLIC	404	S15
452	75276204	SPACER, PHENOLIC	404	S15
453	75888690	BRACKET, STRAP	404	S15
454	77830612	WASHER, PLAIN	404	S15
455	95044214	SEALANT	404	S15
456	92815099	SCREW, SOCKET HD CAP	404	S15
457	75881921	ACTUATOR WIRING ASM	404	S15
458	75899707	PULLEY	698	S13
458	75899707	PULLEY	518	S16
458	75899707	PULLEY	515	S16
459	75882351	JUMPER WIRE	201	S9
460	75883025	SPACER, NYLON	021	S6
462	75883067	PLATE SW MTG	201	S10
463	92932054	SCREW	201	S10
464	75883006	VARISTOR	201	S10
465	80625400	LUBRICANT	515, 516	S16
465	80625400	LUBRICANT	517, 518	S16
466	75880127	MOTOR ASM	518	S16
467	75899704	PULLEY	517	S16
468	75887511	BLOWER CENTRIF 50 HZ	466	S16
469	75880126	MOTOR ASM 50 HZ	516	S16
470	75899703	MOTOR PULLEY	516	S16
470	75899703	MOTOR PULLEY	705	S13
471	75883111	SHAFT	499	S8
472	75880481	BEARING	499	S8
473	75882455	SPACER	499	S8
474	75894895	LEVER, CAM	499	S8
475	75893245	BLOCK, LINKAGE	032	S7
476	92602003	CABLE CLAMP	202	S11
477	77670257	SET SCREW	499	S8
478	77610461	SPRING	021	S8
479	75883418	COVER, PWA RLY CNTL	201	S10
480	75894325	PANEL ACOUSTIC FOAM	623	S4
480	75894325	PANEL ACOUSTIC FOAM	621, 622	S4
481	75894326	PANEL ACOUSTIC FOAM	623	S4
481	75894326	PANEL ACOUSTIC FOAM	621, 622	S4
482	75803804	INSULATOR, FISHPAPER	021	S6
483	75894328	PANEL ACOUSTIC FOAM	621, 623	S4
484	77647105	PANEL ACOUSTIC FOAM	620, 621	S4
484	77647105	PANEL ACOUSTIC FOAM	622, 623	S4
484	77647105	PANEL ACOUSTIC FOAM	624	S4
485	75894330	PANEL ACOUSTIC FOAM	621, 622	S4
485	75894330	PANEL ACOUSTIC FOAM	623, 624	S4
486	75894331	PANEL ACOUSTIC FOAM	621, 622	S4
486	75894331	PANEL ACOUSTIC FOAM	623, 624	S4
487	75894332	PANEL ACOUSTIC FOAM	621, 623	S4
488	77658253	PANEL ACOUSTIC FOAM	623	S4
488	77658253	PANEL ACOUSTIC FOAM	621, 622	S4
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
492	75894339	PANEL ACOUSTIC FOAM	621	S4
493	51777344	SUPPORT - C.B.	201	S10
494	75894336	PANEL ACOUSTIC FOAM	620, 624	S4
495	10127129	SCREW, PAN HD	500	S5
496	75893211	BRACKET	021	S6
497	10127125	SCREW, PAN HD	021	S6
497	10127125	SCREW, PAN HD	746, 747	S14

TOP DOWN ASSEMBLY COMPONENT PARTS LIST

ITEM	IDENT NO	DESCRIPTION	WHERE USED	SHEET
498	75887251	WASHER, NYLON	021	S6
499	75899599	KIT, CART RELEASE	021	S8
500	75881025	TOP LEVEL ASM	HPC	S3
500	75881025	TOP LEVEL ASM	HPC	S5
509	77610705	POWER SUPPLY 60 HZ	HPC	S3
509	77610705	POWER SUPPLY 60 HZ	HPC	S18
510	75887884	POWER SUPPLY	HPC	S3
510	75887884	POWER SUPPLY	HPC	S17
511	77610707	POWER SUPPLY 50 HZ	HPC	S3
511	77610707	POWER SUPPLY 50 HZ	HPC	S18
515	75891693	DRIVE MOTOR ASM 60 HZ	HPC	S3
516	75891690	DRIVE MOTOR ASM 50 HZ	HPC	S3
517	75891692	DRIVE MOTOR ASM 50 HZ	HPC	S3
518	75891694	DRV MOT ASM 50/60 HZ	HPC	S3
519	75891691	DRIVE MOTOR ASM	HPC	S3
525	92314113	DRIVE BELT 60 HZ	698	S13
525	92314113	DRIVE BELT 60 HZ	HPC	S3
526	92314127	DRIVE BELT 50 HZ	697	S13
526	92314127	DRIVE BELT 50 HZ	HPC	S3
527	95125322	SEALANT	202	S13
528	95523400	BUMPER	021	S6
529	10127143	SCREW	201	S10
530	75738414	CAPACITOR 60 HZ	HPC	S3
531	76879006	CAPACITOR 50 HZ	HPC	S3
532	77612915	CAPACITOR 50/60 HZ	HPC	S3
535	75893325	FILTER ASM, RFI	HPC	S3
536	75893326	FILTER ASM, RFI	HPC	S3
539	77834781	LABEL	746, 747	S14
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
546	15165431	POWER CORD	HPC	S3
550	75889886	BLOWER ASM 60 HZ	HPC	S3
551	75889887	BLOWER ASM 50 HZ	HPC	S3
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	705	S13
571	75883026	SPACER	697, 698	S13
572	75883027	SPACER	HPC	S3
573	75883845	FRONT PANEL	HPC	S3
574	75899641	FRONT PANEL	HPC	S3
577	75883849	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	75893020	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
595	75883992	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
607	75899184	COVER	HPC	S3
608	75899169	COVER	HPC	S3
609	75899185	COVER	HPC	S3
610	75899076	POWER PLUG ASM 50 HZ	HPC	S3
614	75899085	POWER PLUG ASM	HPC	S3
615	75899086	POWER PLUG ASM	HPC	S3
616	75899082	POWER PLUG ASM	HPC	S3
618	75899087	POWER PLUG ASM	HPC	S3
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	S3
624	75895046	SOUND TREATMENT OPT	HPC	S4
630	94397002	PRODUCT IDENT EMBLEM	HPC	S3
636	75896140	ENCODING BUTTON KIT	HPC	S3
637	75896141	ENCODING BUTTON KIT	HPC	S3
639	94398801	ENCODING BUTTON "1"	HPC	S3
640	75893030	FRONT PANEL INSTL KIT	HPC	S19
640	75893030	FRONT PANEL INSTL KIT	HPC	S3
641	75893031	FRONT PANEL INSTL KIT	HPC	S19
641	75893031	FRONT PANEL INSTL KIT	HPC	S3
642	75893035	FRONT PANEL INSTL KIT	HPC	S19
642	75893035	FRONT PANEL INSTL KIT	HPC	S3
643	75893032	FRONT PANEL INSTL KIT	HPC	S3
643	75893032	FRONT PANEL INSTL KIT	HPC	S19
644	75893033	FRONT PANEL INSTL KIT	HPC	S3
644	75893033	FRONT PANEL INSTL KIT	HPC	S19
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	75896805	PANEL INSERT	HPC	S3
665	77632391	PANEL INSERT	HPC	S3
666	75896802	PANEL INSERT	HPC	S3
667	75896804	PANEL INSERT	HPC	S3
668	75896810	PANEL INSERT	HPC	S3
670	75896812	PANEL INSERT	HPC	S3
671	77646493	PANEL INSERT	HPC	S3
673	77646714	PANEL INSERT	HPC	S3
674	75896816	PANEL INSERT	HPC	S3
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704	77615841	DOOR	HPC	S3
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707	75883072	PULLEY & BELT KIT (50 HZ)	HPC	S3
708	75883073	PULLEY & BELT KIT (60 HZ)	HPC	S3
710	75897343	BASE PAN	HPC	S3
711	75897346	BASE PAN	HPC	S3
716	75894103	ESD KIT STD	HPC	S3
717	75894104	ESD KIT SPL	HPC	S3
721	77647291	FILTER FRAME	HPC	S3
722	77647236	FILTER FRAME	HPC	S3
723	77647246	FILTER FRAME	HPC	S3
726	77641795	FILTER KIT	HPC	S3
726	77641795	FILTER KIT	HPC	S20
731	94398801	ENCODING BUTTON "1"	HPC	S3
732	75896141	ENCODING BUTTON	HPC	S3
733	75896140	ENCODING BUTTON	HPC	S3
736	75893218	SIGNAL HARNESS	HPC	S3
737	75894086	SIGNAL HARNESS	HPC	S3
741	75892524	LOGO & FUSE KIT	HPC	S3
745	24565002	CABLE CLAMP	HPC	S3
746	75893902	E MODULE ASM	HPC	S3
746	75893902	E MODULE ASM	HPC	S14
747	77647616	E MODULE ASM	HPC	S3
747	77647616	E MODULE ASM	HPC	S14
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752	75897701	SLIDE KIT	HPC	S20
756	75886347	IDENT PLATE	HPC	S3
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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
764	15165895	CIRCUIT BREAKER	HPC	S3
770	77665277	TAPE INSTL KIT	HPC	S3

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348	75885841	S14
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447	75885981	S15

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370	77613626	S16
704	77615841	S3
695	77615848	S3
676	77615881	S3
074	77615990	S5
212	77617049	S5
646	77624540	S3
663	77624548	S3
661	77624581	S3
145	77631967	S24
204	77631968	S24
665	77632391	S3
363	77633800	S14
351	77633805	S14
350	77633806	S14
077	77641785	S20

CROSS REFERENCE

ITEM	IDENT NO	SHEET
726	77641795	S3
726	77641795	S20
044	77641805	S8
069	77641810	S8
233	77641825	S14
083	77641830	S19
267	77641835	S19
268	77641836	S19
032	77643187	S7
121	77646195	S14
671	77646493	S3
673	77646714	S3
300	77647100	S9
484	77647105	S4
484	77647105	S4
484	77647105	S4
355	77647106	S4
355	77647106	S4
439	77647107	S4
439	77647107	S4
156	77647108	S6
722	77647236	S3
723	77647246	S3
721	77647291	S3
276	77647611	S14
747	77647616	S14
747	77647616	S3
076	77648130	S20
275	77648135	S19
488	77658253	S4
488	77658253	S4
490	77658254	S4
490	77658254	S4
759	77664125	S3
770	77665277	S3
271	77666011	S19
247	77666818	S8
415	77666850	S11
211	77670106	S12
477	77670257	S8
269	77680300	S19
270	77680301	S19
264	77830530	S7
400	77830611	S16
400	77830611	S8
454	77830612	S15
389	77832429	S19
389	77832429	S11
539	77834781	S14
465	80625400	S16
465	80625400	S16
353	82311701	S14
352	82312001	S14
352	82312001	S14
277	83410518	S5
277	83410518	S9
337	83435302	S16
421	90603300	S5
094	91930600	S9
369	92009012	S12
242	92033033	S8
219	92033037	S6
219	92033037	S7
220	92054223	S7
525	92314113	S3
525	92314113	S13
526	92314127	S13
526	92314127	S3
113	92376014	S17
141	92376014	S18
476	92602003	S11
422	92602004	S13
422	92602004	S7
388	92720396	S11
237	92745012	S8
308	92745208	S14
366	92745211	S14
456	92815099	S15
287	92826001	S10
463	92932054	S10
387	93109084	S20
205	93109267	S14
272	93326006	S19
272	93326006	S20
127	93419228	S18
127	93419228	S17
228	93564001	S6
228	93564001	S8
334	93564004	S10
147	93564034	S18
140	93564044	S18
241	93592158	S6
358	93592204	S14
239	93592207	S14
087	93748198	S13
151	93749082	S13
323	93749196	S9
323	93749196	S10
153	93749198	S10
153	93749198	S9
152	93749200	S10
152	93749200	S9
428	93788082	S13
296	94275254	S9
338	94276600	S16
338	94276600	S16
340	94277400	S11
340	94277400	S16
340	94277400	S17
340	94277400	S18
154	94277401	S10
154	94277401	S9
341	94277409	S24
341	94277409	S16
064	94279113	S20

ITEM	IDENT NO	SHEET
155	94343210	S10
155	94343210	S9
263	94343210	S14
033	94364401	S6
081	94364903	S19
081	94364903	S19
084	94364906	S19
236	94371000	S10
236	94371000	S16
236	94371000	S6
291	94376910	S19
054	94376917	S8
055	94376918	S8
630	94397002	S3
639	94398801	S3
731	94398801	S3
131	94399501	S17
280	94881402	S24
041	95033900	S5
455	95044214	S15
339	95105900	S16
339	95105900	S16
034	95105904	S6
527	95125322	S13
092	95125326	S7
126	95510024	S18
126	95510024	S17
111	95510026	S8
111	95510026	S17
111	95510026	S18
091	95510027	S7
528	95523400	S6
128	95533601	S17
128	95533601	S18
122	95582501	S17
122	95582501	S18
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	S17
124	95641502	S18
380	95643601	S17
380	95643601	S18
380	95643601	S10
285	95645628	S10
132	95647607	S17
132	95647607	S18
116	95655530	S18
116	95655530	S17
249	95694202	S9

8.1 INTRODUCTION

This section contains the wire list for the CMD Electronics Module wirewrapped backpanel, and the logic load list for the etched circuit board backpanel used on some 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
EM1	5-4
EM2	5-5
EM3	5-6
EM6	5-7
EM7	5-8

8.3 WIRE LISTS

Section 8.3.1 gives the etched circuit board backpanel logic load list.

Section 8.3.2 gives the wire-wrapped backpanel wire 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
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

*P/N 75881860

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
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
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
EMER-RET-CAP/GND	EM3P1B	11	EM3P1B	06	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	EM2P1A	41	EM6P1B	41	ET
FXD-ADDR/-L	EM3P1A	41	EM3P1B	42	ET
GND	EM2P1B	04	EM2P1B	06	ET
GND	EM2P1B	06	EM2P1B	18	ET
GND	EM4P2B	36	EM3P2A	36	ET
GND	EM7P1A	06	EM7P1A	10	ET
HD-ADDR/-L	EM1P2A	17	EM2P2B	17	ET
HD-ALIGN-WP/-L	EM4P1B	22	EM2P1A	21	ET

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
IDX-BUF/-L	EM1P1A	13	EM2P1A	13	ET
INDEX/-L	EM4P1A	40	EM4P1B	40	ET
INDEX/-L	EM4P1B	40	EM1P1A	40	ET
INDEX/-L	EM6P1B	40	EM4P1A	40	ET
INHIBIT-SECTØR/+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/Ø-AM-ENABLE/+L	EM1P2A	30	EM2P2B	30	ET
I/Ø-ERLY-STRØBE/-L	EM1P1A	37	EM2P1B	37	ET
I/Ø-LATE-STRØBE/-L	EM1P1A	36	EM2P1B	36	ET
I/Ø-RD/-L	EM3P2A	05	EM4P2B	05	ET
I/Ø-READ-GATE/+L	EM1P1A	43	EM2P1B	43	ET
I/Ø-WRT-GATE/-L	EM1P1A	42	EM2P1B	42	ET
I/Ø-WRT/-L	EM3P2A	04	EM4P2B	04	ET
LATE-STRØBE/-L	EM2P1A	42	EM7P2A	07	ET
LATE-STRØBE/-L	EM4P1A	43	EM4P1B	43	ET
LATE-STRØBE/-L	EM2P1A	42	EM4P1A	43	ET
LATE-STRØBE/-L	EM5P1A	43	EM5P1B	43	ET
LATE-STRØBE/-L	EM5P1B	43	EM7P2A	07	ET
LED-FLT/-L	EM2P1B	13	EM3P1B	40	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
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

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
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-GND	EM2P2A	33	EM7P2B	07	TP
NRZ-DATA-OUT/-L	EM2P2A	34	EM7P2B	08	TP
NRZ-WRT-GND	EM2P2A	31	EM7P2B	31	TP
NRZ-WRT/-L	EM2P2A	32	EM7P2B	32	TP
OFFSET-ACT/+L	EM2P2B	15	EM1P2A	15	ET
OFFSET-/+L	EM1P2B	24	EM3P2B	24	ET
OFFSET+/+L	EM1P2B	25	EM3P2B	25	ET
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
PWR-UP-MR/-L	EM2P2B	18	EM1P2A	18	ET
PWR-UP-MR/-L	EM1P2A	18	EM7P2A	03	ET
PWR-UP-MR/-L	EM7P2A	03	EM2P2B	18	ET
RD-CLK-GND	EM2P2A	26	EM7P2B	10	TP
RD-CLK/-L	EM2P2A	27	EM7P2B	09	TP
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

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
RTZ-OR-SEEK/+L	EM3P1A	42	EM6P1B	42	ET
RTZ/-L	EM1P2B	12	EM2P2A	12	ET
RTZ/-L	EM2P2A	12	EM3P2B	12	ET
-5V	EM7P1A	02	EM7P1A	07	ET
+20V	EM7P1A	45	EM7P1A	08	ET
+5V	EM2P1B	03	EM2P1B	19	ET
+5V	EM2P1B	19	EM2P1B	44	ET
+5V	EM7P1A	44	EM7P1A	09	ET
SEC-BUF/-L	EM1P1A	14	EM2P1A	14	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
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
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
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

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
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
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
WRT-CLK-GND	EM2P2A	28	EM7P2B	28	TP
WRT-CLK/-L	EM2P2A	29	EM7P2B	29	TP
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
WRT-PROTECT-FXD/-L	EM1P1A	16	EM2P1B	16	ET
WRT-PROTECT-REM/-L	EM1P1A	17	EM2P1B	17	ET

8.3.2 WIRE-WRAPPED BACKPANEL WIRE LIST*

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
806-KHZ/-L	EM6P2B	38	EM3P2A	38	E1
AGC-ACT/-L	EM6P2B	03	EM3P2A	03	E1
AM-ENABLE/+L	EM2P1A	18	EM7P1B	18	E1
AM-FOUND/+L	EM2P1A	38	EM7P2A	04	E1
AM-FOUND/+L	EM4P1B	38	EM2P1A	38	E2
BUS-OUT-2WT0/+L	EM1P2A	08	EM2P2B	08	E1
BUS-OUT-2WT1/+L	EM1P2A	09	EM2P2B	09	E1
BUS-OUT-2WT2/+L	EM1P2A	10	EM2P2B	10	E1
BUS-OUT-2WT3/+L	EM1P2A	11	EM2P2B	11	E1
BUS-OUT-2WT6/+L(FXD/+L)	EM1P2B	22	EM2P2B	22	E1
BUS-OUT-2WT7/+L	EM1P2A	07	EM2P2B	07	E1
CLR-ATN/-L	EM1P1A	30	EM2P1B	30	E1
CLR-CHK-DIAG/-L	EM1P2A	25	EM2P2B	25	E1
CLR-FLT-STAT/-L	EM1P2A	24	EM2P2B	24	E1
CYL-ADDR-0/+L	EM1P2B	26	EM3P2B	26	E1
CYL-ADDR-1/+L	EM1P2B	27	EM3P2B	27	E1
CYL-ADDR-2/+L	EM1P2B	28	EM3P2B	28	E1
CYL-ADDR-3/+L	EM1P2B	29	EM3P2B	29	E1
CYL-ADDR-4/+L	EM1P2B	30	EM3P2B	30	E1
CYL-ADDR-5/+L	EM1P2B	31	EM3P2B	31	E1
CYL-ADDR-6/+L	EM1P2B	32	EM3P2B	32	E1
CYL-ADDR-7/+L	EM1P2B	33	EM3P2B	33	E1
CYL-ADDR-8/+L	EM1P2B	34	EM3P2B	34	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
CYL-ADDR-9/+L	EM1P2B	35	EM3P2B	35	E1
DB-0/+L	EM3P2A	24	EM4P2B	24	E1
DB-1/+L	EM3P2A	25	EM4P2B	25	E1
DB-2/+L	EM3P2A	26	EM4P2B	26	E1
DB-3/+L	EM3P2A	27	EM4P2B	27	E1
DB-4/+L	EM3P2A	28	EM4P2B	28	E1
DB-5/+L	EM3P2A	29	EM4P2B	29	E1
DB-6/+L	EM3P2A	31	EM4P2B	31	E1
DB-7/+L	EM3P2A	32	EM4P2B	32	E1
DIAG-AC-WRTCUR/	EM4P1A	10	EM2P1A	10	E1
DIAG-ACT-I-MON	EM3P1A	11	EM4P1B	11	E1
DIAG-AM-EN/+L	EM4P1B	17	EM2P1A	17	E1
DIAG-DR-MON	EM3P1A	12	EM4P1B	12	E1
DIAG-ENABLE/-L	EM4P1B	15	EM2P1A	15	E1
DIAG-ERLY-STROBE/+L	EM4P1B	09	EM2P1A	09	E1
DIAG-F.G.-MON	EM3P1A	10	EM4P1B	10	E1
DIAG-HD-0/+L	EM4P1B	03	EM2P1A	03	EE
DIAG-HD-1/+L	EM4P1B	04	EM2P1A	04	EE
DIAG-HD-2/+L	EM4P1B	05	EM2P1A	05	EE
DIAG-HD-4/+L	EM4P1B	07	EM2P1A	07	E1
DIAG-LATE-STROBE/+L	EM4P1B	08	EM2P1A	08	E1
DIAG-RD-AGC	EM7P1B	16	EM4P1A	16	E1

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NETNAM	FLOC	FPIN	TLOC	TPIN	BK
DIAG-RD-CLK-GND	EM2P1A	35	EM4P1B	35	TP
DIAG-RD-CLK/-L	EM2P1A	34	EM4P1B	34	TP
DIAG-RD-GATE/+L	EM4P1A	11	EM2P1A	11	E1
DIAG-RD-PLO-LOCK/+L	EM7P2B	25	EM4P2A	25	E1
DIAG-WRT-CLK-GND	EM4P1B	31	EM2P1A	31	TP
DIAG-WRT-CLK/-L	EM4P1B	30	EM2P1A	30	TP
DIAG-WRT-GATE/+L	EM4P1A	12	EM2P1A	12	E1
EMER-RET-CAP/GND	EM3P1B	06	EM3P1B	11	E1
EN-FXD-SVO/-L	EM6P2B	04	EM4P2A	04	E1
EN-WRT-CUR-0/+L	EM3P1B	28	EM2P1A	24	E1
EN-WRT-CUR-1/+L	EM3P1B	29	EM2P1A	25	E1
EN-WRT-CUR-2/+L	EM3P1B	30	EM2P1A	26	E1
ERLY-STROBE/-L	EM2P1B	41	EM7P2B	03	E1
EXT-INT-1/-L	EM4P2B	35	EM3P2A	35	E1
FLT-0/+L	EM3P2B	16	EM2P2A	16	E1
FLT-1/+L	EM3P2B	17	EM2P2A	17	E1
FLT-2/+L	EM3P2B	18	EM2P2A	18	E1
FLT-3/+L	EM3P2B	19	EM2P2A	19	E1
FLT-4/+L	EM3P2B	20	EM2P2A	20	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
FLT-RESET/+L	EM2P2A	40	EM3P2B	40	E1
FXD-ADDR/-L	EM2P1A	41	EM6P1B	41	E1
GND	EM2P1B	04	EM2P1B	06	E1
GND	EM2P1B	06	EM2P1B	18	E2
GND	EM4P2B	36	EM3P2A	36	E1
GND	EM7P1A	06	EM7P1A	10	E2
HD-ADDR/-L	EM1P2A	17	EM2P2B	17	E1
HD-ALIGN-WP/-L	EM4P1B	22	EM2P1A	21	E1
IDX-BUF/-L	EM1P1A	13	EM2P1A	13	E1
INDEX/-L	EM4P1A	40	EM4P1B	40	E1
INDEX/-L	EM4P1B	40	EM1P1A	40	E2
INDEX/-L	EM6P1B	40	EM4P1A	40	E2
INHIBIT-SECTOR/+L	EM6P1B	38	EM1P1A	38	E1
INTERRUPT/-L	EM1P2A	19	EM2P2B	19	E1
I-SPE	EM4P1A	13	EM4P1B	13	E1
I-SPE	EM4P1B	13	EM3P1A	13	E2
I-SPE	EM6P1B	13	EM4P1A	13	E2
I/O-AM-ENABLE/+L	EM1P2A	30	EM2P2B	30	E1
I/O-ERLY-STROBE/-L	EM1P1A	37	EM2P1B	37	E1
I/O-LATE-STROBE/-L	EM1P1A	36	EM2P1B	36	E1
I/O-RD/-L	EM3P2A	05	EM4P2B	05	E1
I/O-READ-GATE/+L	EM1P1A	43	EM2P1B	43	E1
I/O-WRT-GATE/-L	EM1P1A	42	EM2P1B	42	E1
I/O-WRT/-L	EM3P2A	04	EM4P2B	04	E1
LATE-STROBE/-L	EM2P1A	42	EM7P2A	07	E1
LED-FLT/-L	EM2P1B	13	EM3P1B	40	E1
MADR-0/+L	EM3P2A	07	EM4P2B	07	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
MADR-1/+L	EM3P2A	08	EM4P2B	08	E1
MADR-2/+L	EM3P2A	09	EM4P2B	09	E1
MADR-3/+L	EM3P2A	10	EM4P2B	10	E1
MADR-4/+L	EM3P2A	11	EM4P2B	11	E1
MADR-5/+L	EM3P2A	12	EM4P2B	12	E1
MADR-6/+L	EM3P2A	13	EM4P2B	13	E1
MADR-7/+L	EM3P2A	14	EM4P2B	14	E1
MADR-8/+L	EM3P2A	15	EM4P2B	15	E1
MADR-9/+L	EM3P2A	16	EM4P2B	16	E1
MADR-A/-L	EM3P2A	17	EM4P2B	17	E1
MADR-B/-L	EM3P2A	18	EM4P2B	18	E1
MADR-C/-L	EM3P2A	19	EM4P2B	19	E1
MADR-D/+L	EM3P2A	20	EM4P2B	20	E1
MADR-E/+L	EM3P2A	21	EM4P2B	21	E1
MADR-F/+L	EM3P2B	22	EM4P2B	22	E1
MAINT-FLT-INT/-L	EM2P2A	37	EM3P2B	37	E1
MC+VLT-FLT/-L	EM2P2A	10	EM3P2B	10	E1
MC+VLT-FLT/-L	EM3P2B	10	EM4P2A	07	E2
MEM-RD/-L	EM3P2A	34	EM4P2B	34	E1
MEM-WRT/-L	EM3P2A	33	EM4P2B	33	E1
MOD-ADDR/-L	EM2P2B	20	EM1P2A	20	E1
M-P-FLT/+L	EM3P2B	38	EM2P2A	38	E1
MX-BIT-0/+L(FAULT/-L)	EM2P2B	26	EM1P2A	26	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
MX-BIT-1/+L(SK-ERR/-L)	EM2P2B	27	EM1P2A	27	E1
MX-BIT-2/+L(AM-FND/-L)	EM2P2B	28	EM1P2A	28	E1
MX-BIT-3/+L(WRT-PROT/-L)	EM2P2B	29	EM1P2A	29	E1
MX-BIT-4/+L	EM2P2B	31	EM1P2A	31	E1
MX-BIT-5/+L	EM2P2B	32	EM1P2A	32	E1
MX-BIT-6/+L	EM2P2B	33	EM1P2A	33	E1
MX-BIT-7/+L	EM2P2B	34	EM1P2A	34	E1
NRZ-DATA-OUT-GND	EM2P2A	33	EM7P2B	07	TP
NRZ-DATA-OUT/-L	EM2P2A	34	EM7P2B	08	TP
NRZ-WRT-GND	EM2P2A	31	EM7P2B	31	TP
NRZ-WRT/-L	EM2P2A	32	EM7P2B	32	TP
OFFSET-ACT/+L	EM2P2B	15	EM1P2A	15	E1
OFFSET-/+L	EM1P2B	24	EM3P2B	24	E1
OFFSET+/+L	EM1P2B	25	EM3P2B	25	E1
ON-CYL/-L	EM3P2B	13	EM2P2A	13	E1
ON-CYL/-L	EM2P2A	13	EM1P2B	13	E2
ON-TIME-EN/-L	EM2P1A	37	EM7P2A	16	E1
PLO-LOCKED/-L	EM6P2B	09	EM4P2A	09	E1
PWR-UP-MR/-L	EM2P2B	18	EM1P2A	18	E1
PWR-UP-MR/-L	EM2P1A	40	EM7P2A	03	E1
PWR-UP-MR/-L	EM2P1A	40	EM2P2B	18	E2
RD-CLK-GND	EM2P2A	26	EM7P2B	10	TP
RD-CLK/-L	EM2P2A	27	EM7P2B	09	TP
READ-GATE/+L	EM2P1B	38	EM7P2B	05	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
READY-BLINK/-L	EM3P2B	14	EM2P2A	14	E1
READY-GATE/+L	EM2P1B	21	EM1P1A	21	E1
RESET-EXT-INT/-L	EM3P2B	15	EM2P2A	15	E1
RTZ-OR-SEEK/+L	EM3P1A	42	EM6P1B	42	E1
RTZ/-L	EM1P2B	12	EM2P2A	12	E1
RTZ/-L	EM2P2A	12	EM3P2B	12	E2
-5V	EM7P1A	02	EM7P1A	07	E1
+20V	EM7P1A	45	EM7P1A	08	E1
+5V	EM2P1B	03	EM2P1B	19	E1
+5V	EM2P1B	19	EM2P1B	44	E2
+5V	EM7P1A	44	EM7P1A	09	E1
SEC-BUF/-L	EM1P1A	14	EM2P1A	14	E1
SECTOR-PULSE/-L	EM1P2B	43	EM3P2B	43	E1
SECTOR-SYNC/-L	EM6P2B	37	EM3P2A	37	E1
SEEK-ERROR/+L	EM3P2B	36	EM2P2A	36	E1
SEEK/-L	EM1P2B	21	EM2P2A	21	E1
SEEK/-L	EM2P2A	21	EM3P2B	21	E2
SELECT/-L	EM1P2A	16	EM2P2B	16	E1
SEQ-HOLD/+L	EM1P2A	04	EM3P2B	04	E1
SEQ-PICK/+L	EM1P2A	03	EM3P2B	03	E1
SPE	EM4P1A	14	EM4P1B	14	E1
SPE	EM4P1B	14	EM3P1A	14	E2
SPE	EM6P1B	14	EM4P1A	14	E2
START/-L	EM2P1B	10	EM3P2B	11	E1
START/-L	EM2P1B	10	EM1P1A	10	E2
SVO-CLAMP/-L	EM3P2A	30	EM6P2A	30	E1
SVO-CLK2-GND	EM6P2B	41	EM2P2A	41	E1
SVO-CLK2-GND	EM6P2B	43	EM2P2A	43	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
SVO-CLK-N	EM6P2A	36	EM7P2B	36	E1
SVO-CLK-N-GND	EM6P2A	35	EM7P2B	35	E1
SVO-CLK-P	EM6P2A	37	EM7P2B	37	E1
SVO-CLK-P-GND	EM6P2A	38	EM7P2B	38	E1
SVO-CLK/-L	EM6P2B	42	EM2P2A	42	E1
SVO-RLY/+L	EM3P1B	36	EM2P1A	36	E1
TAG-1/+L	EM1P2A	12	EM2P2B	12	E1
TAG-2/+L	EM1P2A	13	EM2P2B	13	E1
TAG-3/+L	EM1P2A	14	EM2P2B	14	E1
TGO/-L	EM1P2A	21	EM2P2B	21	E1
TGRG-2WT0/+L(SEL-0/+L)	EM1P2A	35	EM2P2B	35	E1
TGRG-2WT1/+L(SEL-1/+L)	EM1P2A	36	EM2P2B	36	E1
TGRG-2WT2/+L(SEL-2/+L)	EM1P2A	37	EM2P2B	37	E1
TGRG-2WT3/+L(SEL-3/+L)	EM1P2A	38	EM2P2B	38	E1
TGRG-2WT4/+L	EM1P2A	40	EM2P2B	40	E1
TGRG-2WT5/+L	EM1P2A	41	EM2P2B	41	E1
TGRG-2WT6/+L	EM1P2A	42	EM2P2B	42	E1
TGRG-2WT7/+L	EM1P2A	43	EM2P2B	43	E1
UNSTABLE-SECT/+L	EM2P1B	22	EM1P1B	22	E1
UP-TO-SPEED/+L	EM3P2B	05	EM1P2A	05	E1
VOL-CHANGE/-L	EM3P1A	43	EM3P1B	43	E1
VOL-CHANGE/-L	EM3P1B	43	EM2P1A	43	E2
VOL-CHANGE/-L	EM6P1B	43	EM3P1A	43	E2
VOL-CHANGE/-L	EM2P1A	43	EM1P1B	43	E1

NETNAM	FLOC	FPIN	TLOC	TPIN	BK
WRT-CLK-GND	EM2P2A	28	EM7P2B	28	TP
WRT-CLK/-L	EM2P2A	29	EM7P2B	29	TP
WRT-CLOCK-ENABLE/-L	EM7P2B	12	EM6P2A	12	E1
WRT-GATE/-L	EM2P1B	40	EM7P2B	04	E1
WRT-PLO-N	EM6P2A	41	EM7P2B	41	E1
WRT-PLO-N-GND	EM6P2A	40	EM7P2B	40	E1
WRT-PLO-P	EM6P2A	42	EM7P2B	42	E1
WRT-PLO-P-GND	EM6P2A	43	EM7P2B	43	E1
WRT-PROTECT-FXD/-L	EM1P1A	16	EM2P1B	16	E1
WRT-PROTECT-REM/-L	EM1P1A	17	EM2P1B	17	E1
XFER-CHAR/+L	EM1P2B	09	EM2P2A	09	E1
XFER-ZERO/+L	EM1P2B	08	EM2P2A	08	E1

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