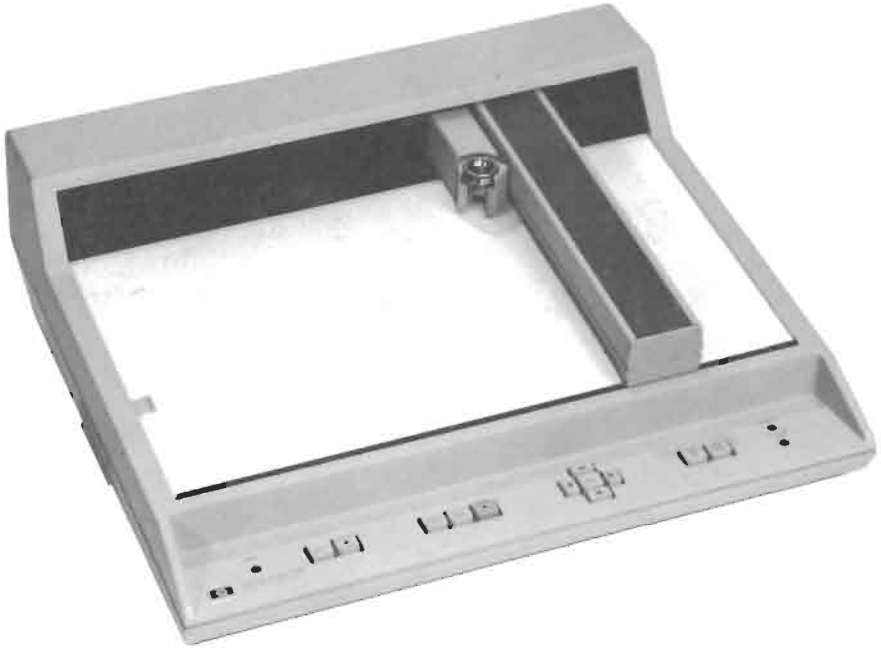
SERVICE MANUAL

GRAPHICS PLOTTER

7225A



HEWLETT PACKARD

HP 7225A

SERVICE MANUAL

7225A GRAPHICS PLOTTER

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Figure 1-1. Model 7225A Graphics Plotter

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This Service Manual contains the necessary information to test, adjust and service the Hewlett-Packard Model 7225A Graphics Plotter, which is shown in Figure 1-1. For ease of reference, this manual has been divided into six sections as follows:

Section I – General Information

Section II – Performance Tests

Section III – Adjustments

Section IV – Replaceable Parts

Section V – Manual Changes

Section VI – Service

1-3. Information on interfacing and operation of the Model 7225A is contained in a separate Operating and Programming Manual. Table 1-1 contains a list of Hewlett-Packard part numbers for the Operating and Programming Manuals related to various system configurations.

1-4. Listed on the title page of this manual is a microfiche part number. This number can be used to order 4 x 6 inch microfiche transparencies of the manual. Each microfiche contains up to 96 photo duplicates of the manual pages. The microfiche package also includes the latest Manual Change supplement as well as any pertinent Service Notes.

1-5. DESCRIPTION.

1-6. The Model 7225A is a microprocessor controlled graphics plotter which produces high quality graphic plots of computer program output data. The 7225A incorporates digital circuitry with a microprocessor to produce stepper-motor functions. Linear stepper motors are utilized to accomplish addressable moves, and accelerometers are incorporated in feedback circuitry to dampen the overall system and improve the line quality.

1-7. The internal microprocessor functions as a servo processor, while its firmware contains instructions to simplify programming such as position and pen commands, point digitizing, and initialization. The processor also contains 64 bytes of "scratch-pad" RAM for performing plotter algorithms and storing various constants. Interrupt capability is employed to generate a confidence test that exercises the plotter mainframe electronics along with the plotter interface PCA.

1-8. SAFETY CONSIDERATIONS.

1-9. Safety information relevant to the service procedure being described is provided in the appropriate sections

Table 1-1. Related Operating and Programming Manuals

I/O PLUG-IN MODULE	FOR USE WITH HP DESKTOP COMPUTER	MODULE OPTION NUMBER	OPERATING AND PROGRAMMING MANUAL HP PART NUMBER
General I/O 17600A	9815A	17600A – 015	17600-90000
General I/O 17600A	9820/21A	17600A – 020 & 021	17600-90001
General I/O 17600A	9825A	17600A – 025	17600-90002
General I/O 17600A	9830A	17600A – 030	17600-90003
HP-IB I/O 17601A	General HP-IB System	17601A – 001/035/045	17601-90000
HP-IB I/O 17601A	9825A	17601A – 025	17601-90001
Parallel I/O 17602A	8, 12 or 16-bit controllers	17602A	17602-90001

of this manual. The Model 7225A and this manual should be reviewed for safety markings and instructions before service work is performed.

1-10. LINE VOLTAGE AND FUSE SELECTION.

1-11. The HP Model 7225A will operate with a voltage source of 100, 120, 220, or 240 Vac +5-10%, 48 to 66 Hz single phase.

CAUTION

Applying 220/240V line voltage to the Plotter when the line voltage selection jumpers are set for 100/120V operation will cause damage to the Plotter circuits and "blow" the AC line fuse.

1-12. When shipped from the factory, the line voltage selectors and fuse are set according to the option number ordered:

Option	Voltage	Fuse
001	100 Vac	1 AT
002	120 Vac	1 AT
003	220 Vac	500 mAT
004	240 Vac	500 mAT

The line voltage identification plate on the rear of the plotter indicates the voltage setting and fuse installed. (See Figure 1-2.)

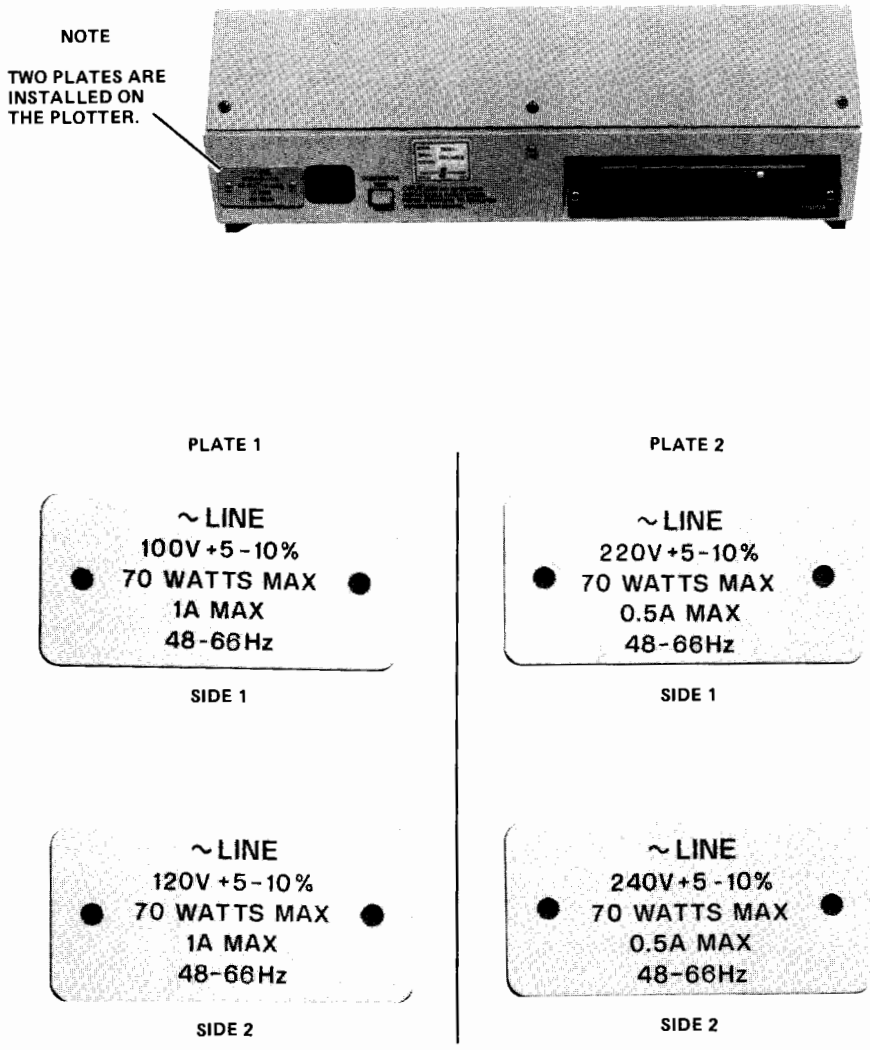


Figure 1-2. Line Voltage Identification Plates

1-13. LINE VOLTAGE SELECTION.

WARNING

The following service procedures should be performed only by service-trained personnel who are aware of the electrical shock hazards involved.

1-14. Three jumpers located on the Main PCA are used to match the plotter input circuitry to the applied line voltage. Before operating the plotter with a different line voltage, change these three jumpers as follows:

a. Switch the plotter off and disconnect the AC line cord.

b. Remove the top cover and upper deck assembly. (See Figure 1-3.)

c. Remove the AC shield. (See Figure 1-4.)

d. Position the jumpers for the desired line voltage according to the legend on the AC shield. This legend is repeated in Figure 1-5. Figure 1-6 illustrates the jumpers positioned for 120 Vac.

e. Install a fuse of the correct type and rating for the new line voltage. (See Figure 1-8.)

f. Replace and secure the AC shield.

g. Remove the line voltage identification plates from the rear of the plotter. (See Figure 1-2).

h. Rearrange and install the line voltage identification plates so that the new line voltage is visible at the rear of the plotter.

i. Replace the upper deck assembly using care to properly seat the electrical connector P1, on the upper deck, to J5, on the main PCA. Secure with 4 screws. (See Figure 1-3C).

j. Replace the top cover. Secure with six screws. (See Figure 1-3A/B).

k. Install the correct line cord for the voltage range used. (See Figure 1-7 for power cord configurations.)

1-15. FUSE SELECTION AND REPLACEMENT.

WARNING

The following service procedures should be performed only by service-trained personnel who are aware of the electrical shock hazards involved.

1-16. The line fuse is internally mounted on the main PCA. To replace the line fuse, proceed as follows:

a. Switch the plotter off and disconnect the line cord.

b. Remove the top cover and upper deck assembly. (See Figure 1-3.)

c. Remove the AC shield. (See Figure 1-4.)

d. Remove the existing fuse and replace it with a fuse of the correct type and rating for the line voltage:

	100 or 120 Vac 1AT HP P/N 2110-0007
European	220 or 240 Vac 500 mAT HP P/N 2110-0458
For US use only	220 or 240 Vac 500 mAT HP P/N 2110-0202 (See Figure 1-8.)

e. Replace and secure the AC shield.

f. Replace the upper deck assembly using care to properly seat the electrical connector P1, on the upper deck, to J5, on the main PCA. Secure with four screws. (See Figure 1-3C.)

g. Replace the top cover. Secure with six screws. (See Figure 1-3A/B.)

h. Connect the line cord and apply AC power.

1-17. INTERFACING THE PLOTTER.

1-18. Interfacing the 7225A Plotter is accomplished by an interface PCA which is physically mounted through the rear panel of the lower deck assembly. (See Figure 1-9.) Table 1-2 contains a listing of the 7225A interface PCA's with their corresponding model numbers.

1-19. Information on the service of the interface PCA may be found in a separate service manual, also designated in Table 1-2.

1-20. PLOTTERS COVERED BY MANUAL.

1-21. Attached to the Plotter is a serial number plate. The first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical plotters; it changes only when a change is made to the plotter. The suffix, however, is assigned sequentially and is different for each plotter. The contents of this manual apply to plotters with the serial number prefix(es) listed under serial numbers on the title page.

1-22. A plotter manufactured after the printing of this manual may have a serial number prefix that is not listed on

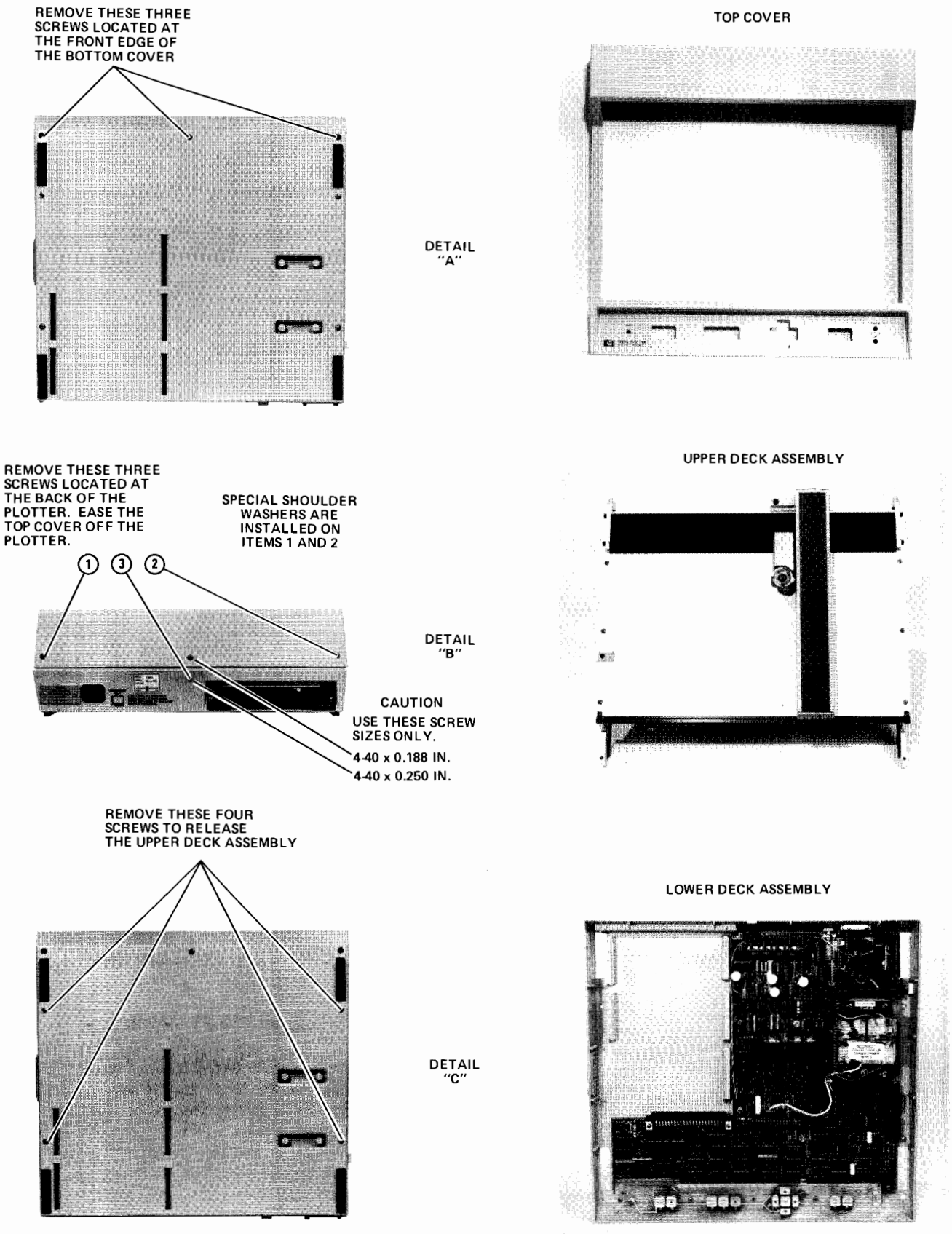


Figure 1-3. Top Cover and Deck Assemblies Identification/Removal

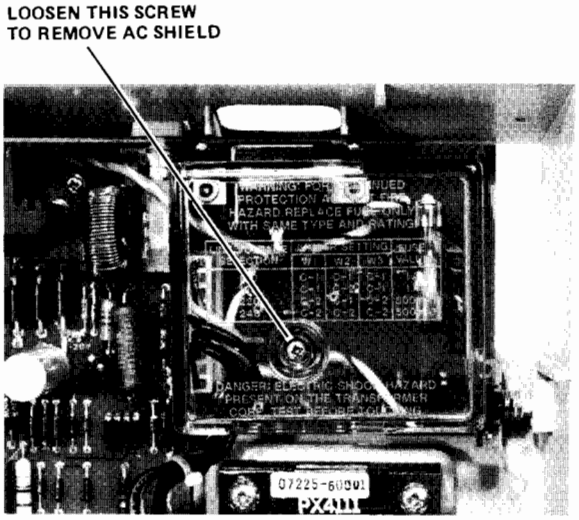


Figure 1-4. AC Shield Removal.

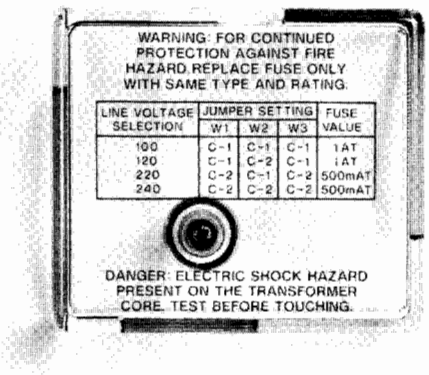


Figure 1-5. AC Shield Legend.

the title page. This unlisted serial number prefix indicates the plotter is different from those described in this manual. The manual for this newer plotter is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer plotter.

1-23. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible,

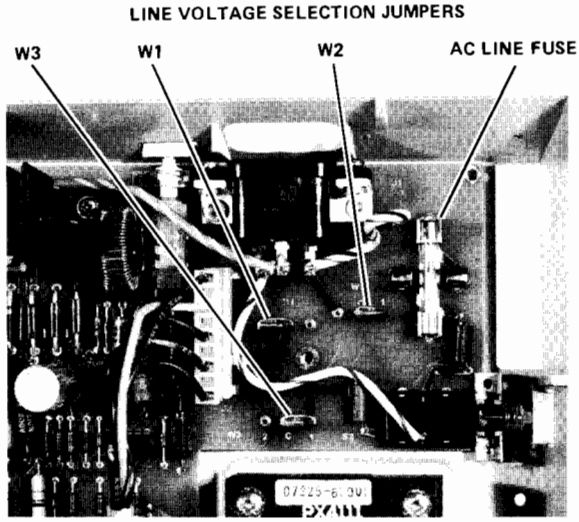


Figure 1-6. Line Voltage Jumper Identification

Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-24. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-25. SPECIFICATIONS.

1-26. Plotter specifications are listed in Table 1-3. These specifications are the performance standards or limits against which the plotter is tested.

1-27. ACCESSORIES SUPPLIED.

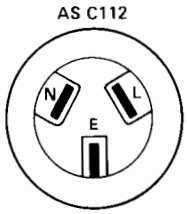
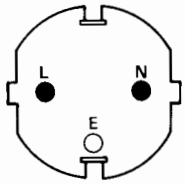
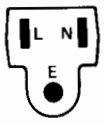
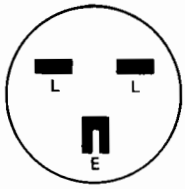
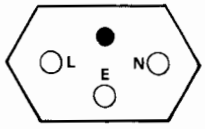
1-28. Accessories supplied with the Model 7225A are listed in Table 1-4.

1-29. SUPPLIES-ACCESSORIES AVAILABLE.

1-30. Supplies and accessories that are available for use with the Model 7225A are listed in Table 1-5.

1-31. TEST EQUIPMENT REQUIRED FOR MAINTENANCE.

1-32. Test equipment recommended to maintain the Model 7225A Graphics Plotter is listed in Table 1-6. Other equipment may be substituted if it meets or exceeds the specifications of the equipment listed in the table.

		Option Number
BS 1363A 	HP Part Number 8120-1351; 250V, 13A, 1ϕ plug rating. (Furnished for use in Great Britain, Cyprus, Nigeria, Rhodesia, Singapore)	900
AS C112 	HP Part Number 8120-1369; 250V, 10A, 1ϕ plug rating. (For use in Australia, New Zealand)	901
CEE 7-VII 	HP Part Number 8120-1389; 250V, 10/16A, 1ϕ plug rating. (Furnished for use in East and West Europe, Saudi Arabia, Egypt)	902
NEMA 5-15P 	HP Part Number 8120-1378; 125V, 15A, 1ϕ plug rating. (UL approved; for use in United States, Canada, Japan, Mexico, Philippines, Tiawan)	903
NEMA 6-15P 	HP Part Number 8120-0698; 250V, 15A, 1ϕ plug rating. (UL approved; for use in United States)	904
SEV 1011 	HP Part Number 8120-2104; 250V, 10A, 1ϕ plug rating. (For use in Switzerland)	906

NOTE: All plugs are viewed from connector end.

- L = Line or Active Conductor (also called "live" or "hot")
- N = Neutral or Identified Conductor
- E = Earth or Safety Ground

Figure 1-7. Power Cord Configurations

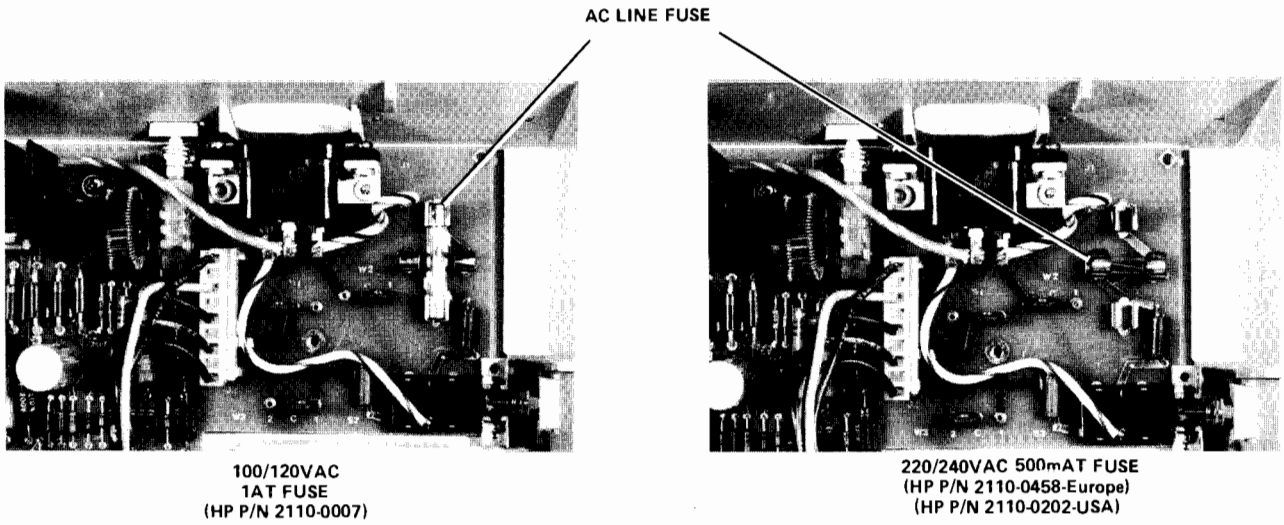


Figure 1-8. Line Fuse Installation

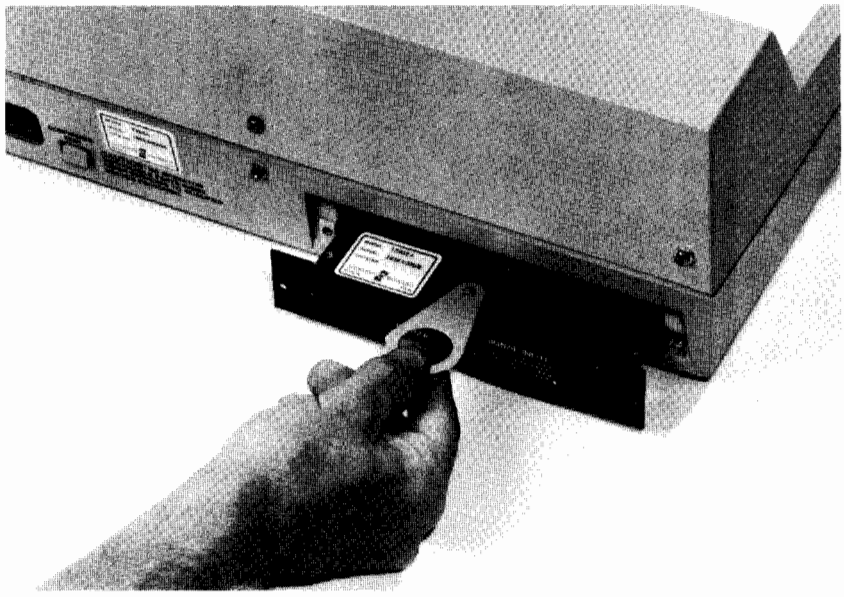


Figure 1-9. Installing an Interface PCA

Table 1-2. Model 7225A Interface PCA Module Service Manuals

MODEL	TITLE	SERVICE MANUAL	PART NUMBER
17600A	General I/O	Model 17600A General I/O	17600-90004
17601A	HP-IB I/O	Model 17601A HP-IB I/O	17601-90003
17602A	Parallel I/O	Model 17602A	17602-90000

Table 1-3. Model 7225A Plotter Specifications

PLOTTING AREA:

X axis: 203 mm (8 in.)

Y axis: 285 mm (11.2 in.)

Accepts up to ISO A4 or 8½ x 11 in. chart paper

PLOTTING ACCURACY: ±0.25 mm (0.01 in.) [includes linearity and repeatability and assumes the plotter has been "zeroed" exactly to the lower left (0.0) coordinates].

REPEATABILITY: 0.1 mm (0.004 in.) from any given point and direction.

ADDRESSABLE STEP SIZE: 0.032 mm (0.0013 in.) smallest addressable step.

PEN VELOCITY:

250 mm/s (10 in./s) in each axis.

350 mm/s (14 in./s) on 45° angle.

VECTOR LENGTH: No limit – any length vector within the plotter's mechanical limits will be plotted.

CHARACTER PLOTTING SPEED: Up to 3 characters/s for 2.5 mm (0.1 in.) characters.

POWER REQUIREMENTS:

Source:	100, 120, 220, 240V –10%, +5% internally selectable
Frequency:	48-66 Hz
Consumption:	70W maximum

ENVIRONMENTAL RANGE:

Temperature:	0°C to 55°C
Relative humidity:	5% to 95% (below 40°C)

SIZE/WEIGHT:

Height:	140 mm (5.5 in.)
Width:	413 mm (16.3 in.)
Depth:	379 mm (14.9 in.)
Net Weight:	8 kg (17.6 lb)
Shipping Weight:	11.4 kg (25 lb) approximately

Table 1-4. Model 7225A Plotter Accessories Supplied

ITEM	QUANTITY	PART NUMBER
Operating and Programming Manual	1	See Table 1-1
Paper – One pad (50 sheets) 8-1/2 x 11 in. blank	1 Pad	9280-0475
Pens – black (package of 5)	1 Package	5060-6787
Pens – package contains a red, blue, green and black pen	1 Package	5060-6810
Dust Cover	1	9222-0635
Power Cord	1	As applicable to the line voltage used.

Table 1-5. Model 7225A Plotter Accessories Available

7225A OPTION NUMBER	ITEM	PART NUMBER
006	Paper/Pen Supplies Kit, A4 paper size	–
007	Paper/Pen Supplies Kit, 8-1/2 x 11 in. paper size	–
009	Dust Cover	9222-0635
010	Vinyl Carrying Case	1540-0560
* –	Digitizing Sight	09872-60066
–	Pens – red (package of 5)	5060-6784
–	Pens – blue (package of 5)	5060-6785
–	Pens – green (package of 5)	5060-6786
–	Pens – black (package of 5)	5060-6787
–	Pens – red, blue, green, black (package of 1 each)	5060-6810
	Plotter Paper:	
	8-1/2 x 11 in., standard grid, English, 100 sheets	9270-1006
	216 x 280 mm, standard grid, Metric, 100 sheets	9270-1023
	8-1/2 x 11 in. blank pad, 50 sheets	9280-0475
	A4 size blank pad, 50 sheets	9280-0476

*Included with supplies kit, Option 007

Table 1-6. Recommended Test Equipment

FOR "ON SITE SERVICE"	
INSTRUMENT TYPE	SUGGESTED MODEL
Service Kit	HP 17215A and 17216A
Digital Multimeter	HP 970A
Logic Probe	HP 10525T
FOR "BENCH SERVICE"	
Oscilloscope	HP 184A or Equivalent
Vertical Plug-In; 2 channel differential input	HP 1806A
Timebase Plug-In; 10 nsec to 1 sec	HP 1820C
Signature Analyzer	HP 5004A
Digital Multimeter	HP 3465A
Logic Probe	HP 10525T
Logic Pulser	HP 10526T
Extender Cable	P/N 07225-60115

SECTION II

PERFORMANCE TESTS

2-1. INTRODUCTION.

2-2. The procedures described in this section provide the user with a simple means of checking the essential functions of the plotter and plug-in module. Note that the confidence test will not verify the performance specifications listed in Table 1-3; however, it will give the user a highly reliable indication that the plotter is functioning properly.

2-3. Plotter repeatability and accuracy tests are contained in the individual service manuals for the plug-in modules. Refer to Section III of the particular I/O Module Service Manual for performance tests.

2-4. CONFIDENCE TEST.

2-5. A pushbutton switch on the rear of the plotter allows the user to initiate the confidence test. (See Figure 2-1.) Pressing this Confidence Test switch causes a test sequence to be initiated in which:

a. All front panel indicators are momentarily turned on.

b. The plotter executes an initialization sequence.

c. A fan shaped test plot is drawn. See Figure 2-2.

d. The Text "END OF TEST" is printed only if a properly operating I/O module is installed in the plotter.

2-6. To perform the confidence test proceed as follows:

a. Apply power to the plotter.

b. Press the CHART LOAD pushbutton. (Indicator is on.)

c. Load chart paper and press the CHART LOAD pushbutton. (Indicator is off.)

d. Load a new pen into the plotter.

e. Press the CONFIDENCE TEST pushbutton.

f. The plotter will complete the test plot and an initialization sequence.

2-7. The fan portion of the confidence test checks the servo processor, motor drive and feedback circuits of the main PCA along with the motors and accelerometers. The text "END OF TEST" verifies the operation of the I/O module and its interface with the plotter.

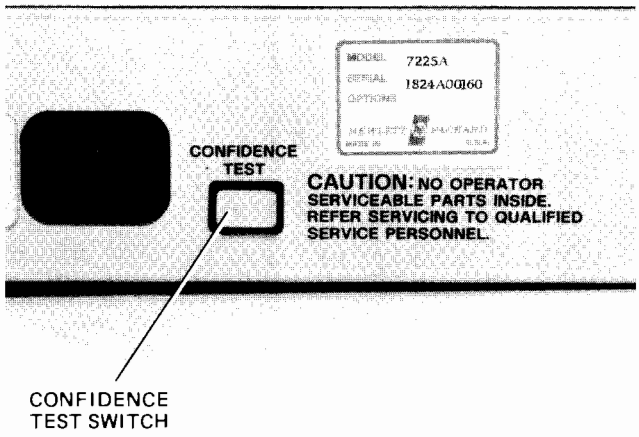


Figure 2-1. Model 7225A Rear Panel Showing Confidence Test Switch

NOTE

The text "END OF TEST" is only printed when a functionally operational I/O Module is installed in the Plotter.

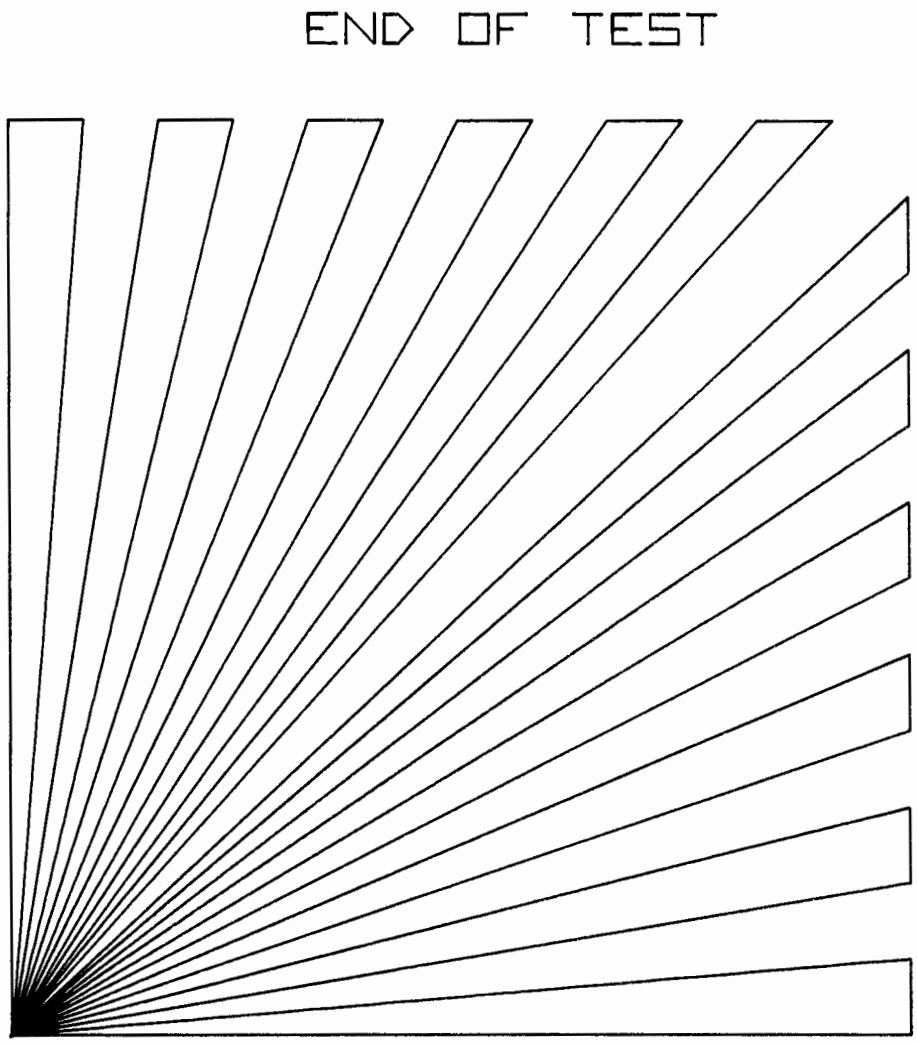


Figure 2-2. Confidence Test Plot

SECTION III

ADJUSTMENTS

3-1. INTRODUCTION.

3-2. This section describes checks and adjustments required to maintain the plotter, or to return it to peak operating condition when repairs have been made.

3-3. Alignment procedures must be performed in sequence, as one step may be interactive with other steps.

3-4. SAFETY REQUIREMENTS.

3-5. This section contains warnings that must be followed for your protection and to avoid damage to the plotter.

WARNING

The following service procedures should be performed only by service-trained personnel who are aware of the electrical shock hazards involved.

Certain adjustments described in this section are performed with power supplied to the plotter while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, or repair of the opened plotter with voltage applied should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

3-6. EQUIPMENT REQUIRED.

3-7. Table 3-1 lists the equipment required to perform the adjustment procedures contained in this section.

3-8. OPENING THE PLOTTER.

3-9. To avoid repetition throughout this Section, the procedure for opening-up the plotter is outlined in this paragraph only. Where an adjustment procedure requires the plotter to be opened-up, this paragraph is referenced.

WARNING

The following service procedures should be performed only by service-trained personnel who are aware of the electrical shock hazards involved.

To open the plotter proceed as follows:

a. Switch the plotter OFF and disconnect the AC line cord.

Table 3-1. Equipment Required for Adjustment Procedures

EQUIPMENT REQUIRED	QUANTITY	HP PART NUMBER OR MODEL NUMBER
Allen Hex-wrench, 7/64 in.	1	8710-0097
Tension Gauge	1	8750-0086
Feeler Gauges	1 set	—
Metric Scale	1	—
Optical Comparator	1	Bausch & Lomb 81-34-35

b. Remove the top cover. (See Figure 3-1 detail "A" and "B".)

c. Remove the four screws shown in Figure 3-1 detail "C" ONLY if it is desired to remove the upper deck assembly.

3-10. ELECTRICAL ADJUSTMENTS.

3-11. No electrical adjustments are required.

3-12. MECHANICAL ADJUSTMENTS.

3-13. X MOTOR STATOR ALIGNMENT.

3-14. This procedure is used to position the X Motor Stator so that the top of Y Stator is 9.90 mm ±0.25 mm (0.39 in. ±0.01 in.) above the platen at all points. This procedure should be performed any time the X Motor Stator is replaced or is out of alignment.

NOTE

After the X Motor Stator alignment has been changed, the PEN DOWN ADJUSTMENT and the PEN LIFT ADJUSTMENT must be checked. (Refer to following procedures.)

3-15. The procedure which is used to align the X Motor Stator requires the use of a metric scale and is performed as follows:

a. Remove the Top Cover and Upper Deck Assembly. (Refer to paragraph 3-9.)

b. Remove the Y stator cover (pen arm) by disengaging the locking tab. (See Figure 3-2 detail A.)

c. Slide the cover off the bottom tab and lift it clear of the stator. (See Figure 3-2 detail B.)

d. Position the Y Stator at the left edge of the platen with the Y motor (pen holder) approximately 5 cm (2.0 in.) up from the bottom of the Y arm.

e. Using the metric scale, measure the distance from the platen to the upper surface of the Y Stator at the top and bottom of the platen surface. (See Figure 3-4.) This should measure 9.90 mm ±0.25 mm (0.39 in. ±0.01 in.).

f. If adjustment is required, use a 7/64 in. hex key (HP P/N 8710-0096) and loosen the X Motor Stator screws. (See Figure 3-3.)

g. With the metric scale placed near the top edge of the platen, raise or lower the X Stator until the upper surface of the Stator is 9.90 mm ±0.25 mm (0.39 in. ±0.01 in.) above the platen. Snug down the hex cup screw nearest the platen. (See Figure 3-4A.)

h. With the metric scale placed near the bottom edge of the platen, lightly twist the X Stator until the upper surface of the Y Stator is 9.90 mm ±0.25 mm (0.39 in. ±0.01 in.) above the platen. Snug down the other hex cup screw. (See Figure 3-4B.)

i. Move the Y Stator to the right end of the platen and repeat steps g. and h.

j. Recheck the measurements at the four points again and tighten all four screws securely.

k. Check pen adjustments. (See following procedures.)

l. Replace covers. This completes the X Stator alignment.

3-16. PEN HOLDER ADJUSTMENT.

3-17. This adjustment sets the pen lift assembly height in relationship to the solenoid plate. To make this adjustment proceed as follows:

a. Remove the top cover. (Refer to paragraph 3-9.)

b. Remove the Y stator cover (pen arm) by disengaging the locking tab. (See Figure 3-2 detail A.)

c. Slide the cover off the bottom tab and lift it clear of the stator. (See Figure 3-2 detail B.)

d. Remove the two 2-56 screws securing the solenoid cover. Lift the cover from the solenoid. See Figure 3-5.

e. Remove the two 2-56 screws securing the solenoid assembly to the Y motor. Remove the solenoid assembly. (See Figure 3-5.)

f. Loosen the two 2-56 screws holding the pen lift assembly to the solenoid plate. (See Figure 3-6.)

g. Position the pen lift assembly to center the screws in the slots of the solenoid plate.

h. Align the pen lift assembly so that it is perpendicular to the solenoid plate. (See Figure 3-7.)

i. Securely tighten the screws making certain that the alignment does not change.

j. Return the solenoid assembly to its position on the Y motor and secure with two 2-56 screws.

k. Perform the following Pen Down Adjustment and Pen Lift Adjustment procedure.

3-18. PEN DOWN ADJUSTMENT.

3-19. This procedure contains the steps to be performed to ensure that when the pen is down it will contact all points

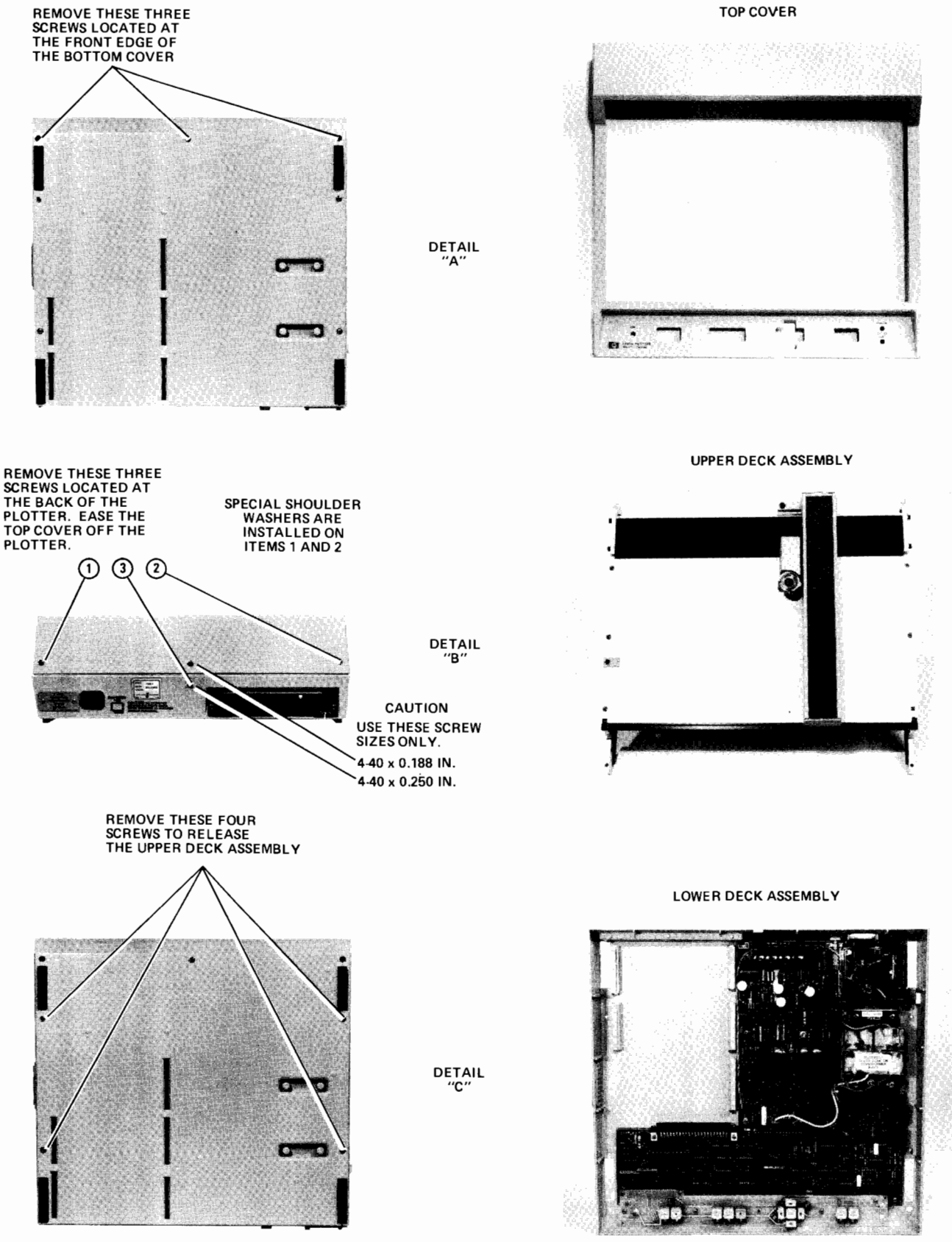


Figure 3-1. Top Cover and Deck Assemblies Identification/Removal

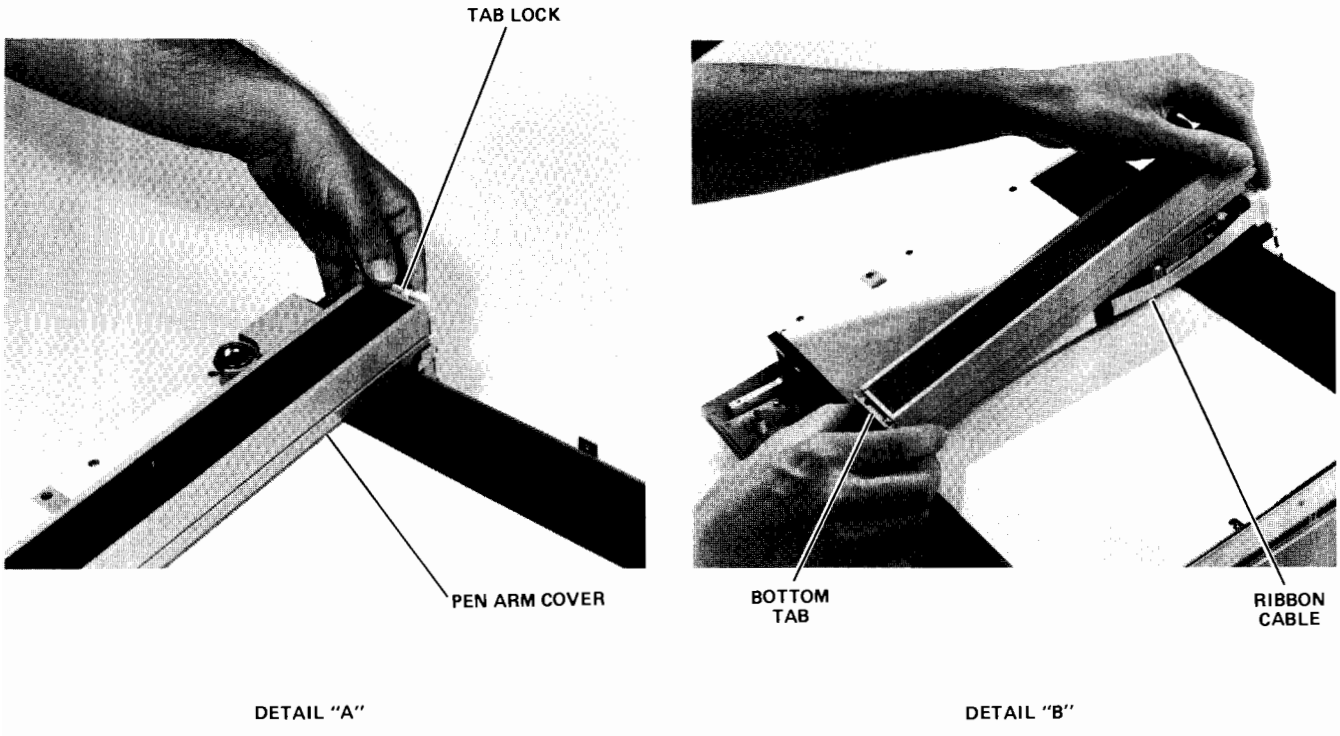


Figure 3-2. Pen Arm Cover Removal

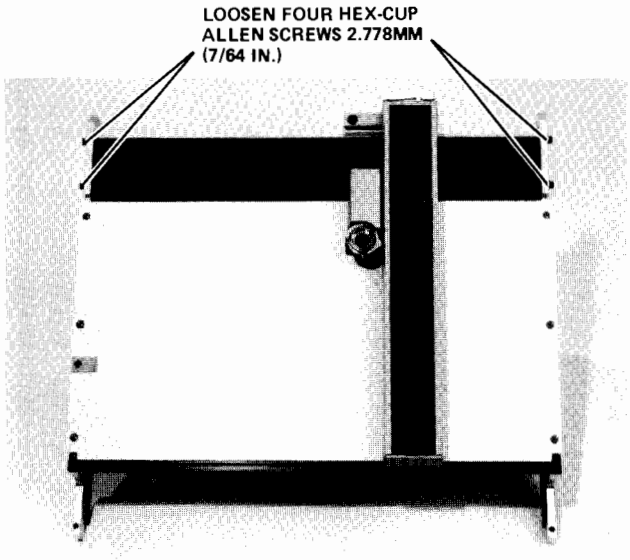


Figure 3-3. X Motor Stator Mounting Screws

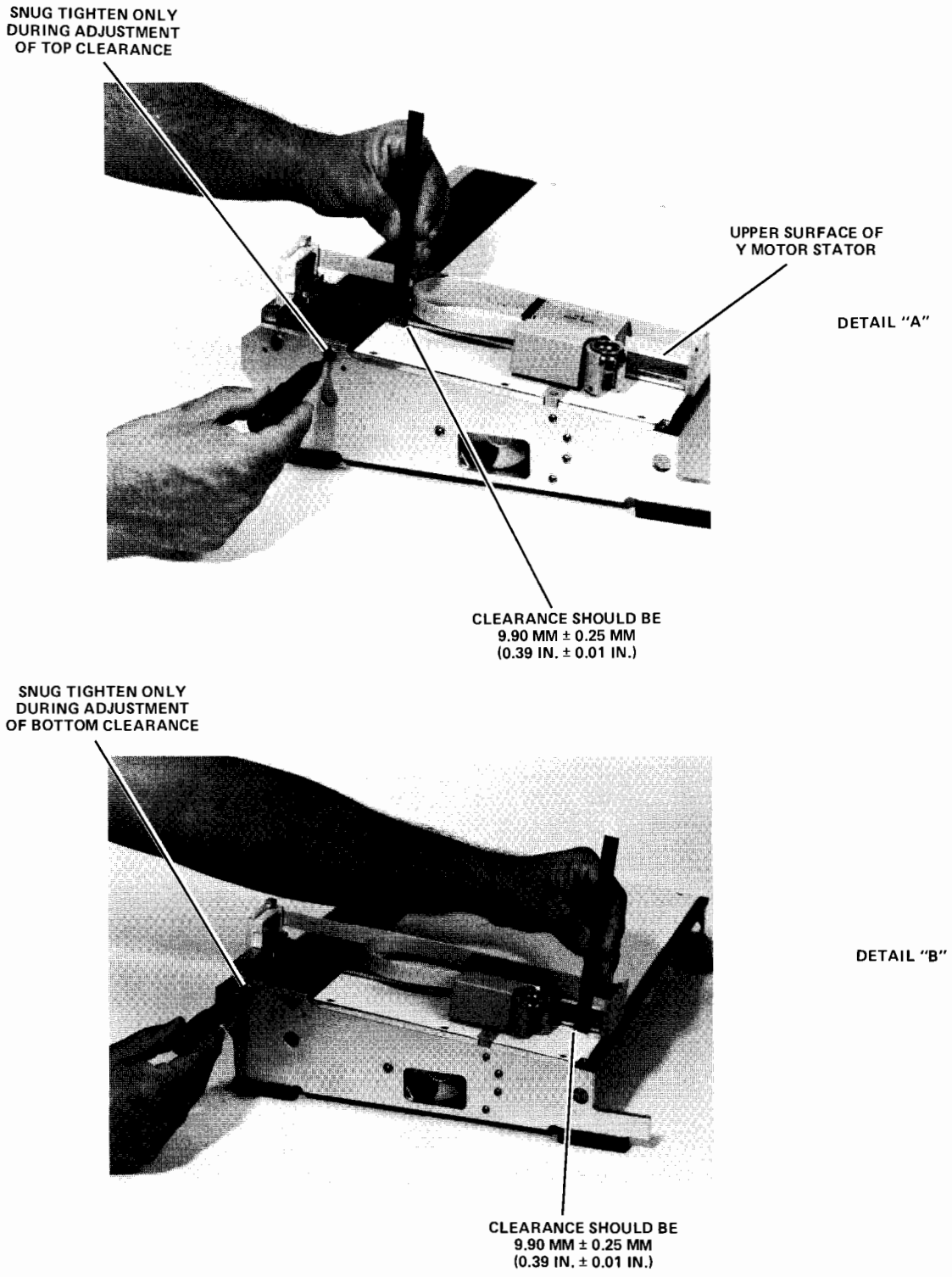


Figure 3-4. X Motor Stator Alignment Using a Metric Scale

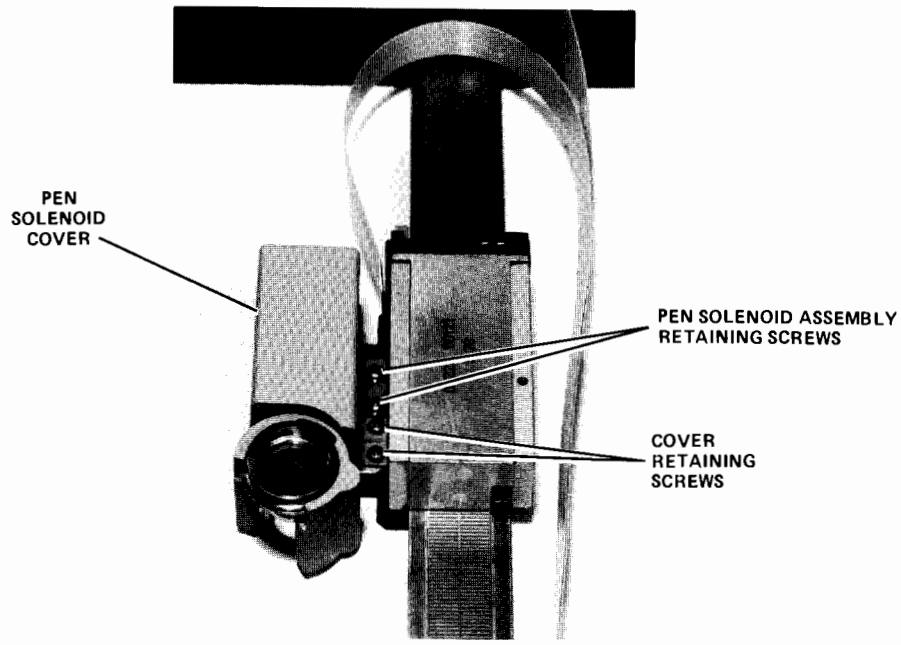


Figure 3-5. Pen Solenoid Assembly

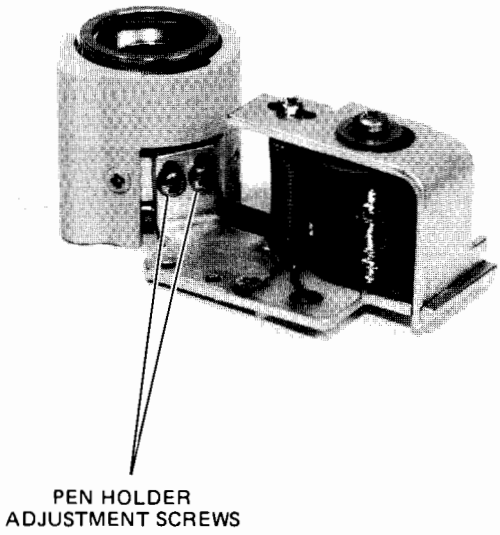


Figure 3-6. Pen Holder Adjustment

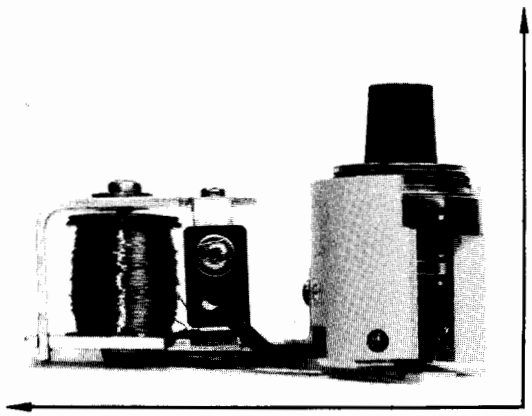


Figure 3-7. Pen Holder to Solenoid Plate Perpendicularity Check

on the chart paper. To perform this alignment proceed as follows:

a. Remove the top cover. (Refer to paragraph 3-9.)

b. Remove the Y stator cover (pen arm) by disengaging the locking tab. (See Figure 3-2 detail A.)

c. Slide the cover off the bottom tab and lift it clear of the stator. (See Figure 3-2 detail B.)

d. Remove the solenoid cover. (See Figure 3-5.)

e. Apply AC power to the plotter.

f. Load chart paper in the plotter.

g. Install a new pen in the pen holder.

h. With the pen positioned at the lower left corner of the platen, press the PEN DOWN button on the front panel. (See Figure 3-8A.)

i. With the pen tip resting on the paper, use a round wire feeler gauge* and check the clearance between the pen slider and the pen-lift extension at each corner of the platen. The clearance should be between 1.0 mm and 1.5 mm (0.04 in. and 0.06 in.). Refer to Figure 3-8B.

*NOTE

If a round feeler gauge is not readily available, a jumbo size paper clip can be straightened out and used as a substitute gauge.

j. To adjust for correct clearance and/or proper pen contact with the paper, loosen the 2-56 screw securing the lift extension to the solenoid top plate. (See Figure 3-8B.)

k. Slide the pen-lift extension up or down to obtain proper clearance and/or pen contact and tighten the lift extension mounting screw.

l. Recheck the clearance and pen to paper contact at each corner of the platen.

m. Repeat steps i. through l. if necessary.

n. Replace covers.

3-20. PEN LIFT ADJUSTMENT.

3-21. With the pen in the UP position, a clearance of between 1.0 mm and 1.5 mm should exist between the pen tip and all points on the chart paper. (See Figure 3-9.) If clearance is incorrect, perform the following pen lift adjustment procedure:

a. Switch the plotter OFF and disconnect the AC line cord.

b. Remove the top cover. (Refer to paragraph 3-9.)

c. Remove the Y stator cover (pen arm) by disengaging the locking tab. (See Figure 3-2 detail A.)

d. Slide the cover off the bottom tab and lift it clear of the stator. (See Figure 3-2 detail B.)

e. Remove the solenoid cover. (See Figure 3-5.)

f. With the pen in the UP position use feeler gauges to measure the clearance between the chart paper and the pen tip. This clearance should measure between 1.0 mm and 1.5 mm (0.04 in. and 0.06 in.).

g. Set for correct pen lift clearance by adjusting the solenoid stop screw which is located on the solenoid top plate. (See Figure 3-9.)

h. Check the clearance at each corner and the center of the chart paper to assure proper overall clearance. Repeat steps f. and g. if necessary.

i. Replace all covers.

3-22. PEN SIDE PLAY ADJUSTMENT.

CAUTION

Excessive tightening of the side play adjustment setscrew can cause binding of the pen lift or damage to the mechanism.

3-23. This adjustment is designed to minimize pen wobble. To perform the side play adjustment proceed as follows:

a. Switch the plotter OFF.

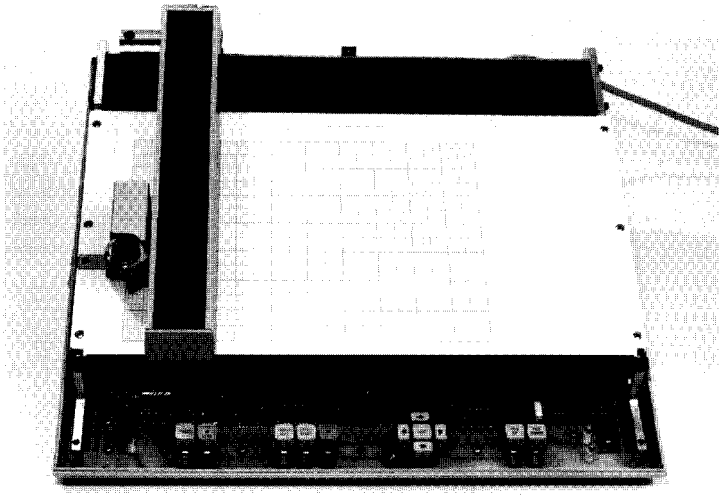
b. Load chart paper to prevent marking the platen and install pen into the pen holder.

c. Using the spring tension gauge, apply a force of 45 grams to the side of the pen tip. Push pen tip to the right (away from the adjustment screw). (See Figure 3-10A.)

d. If pen wobble is observed, tighten the side play adjustment setscrew gradually until no wobble is observed. (See Figure 3-10B.)

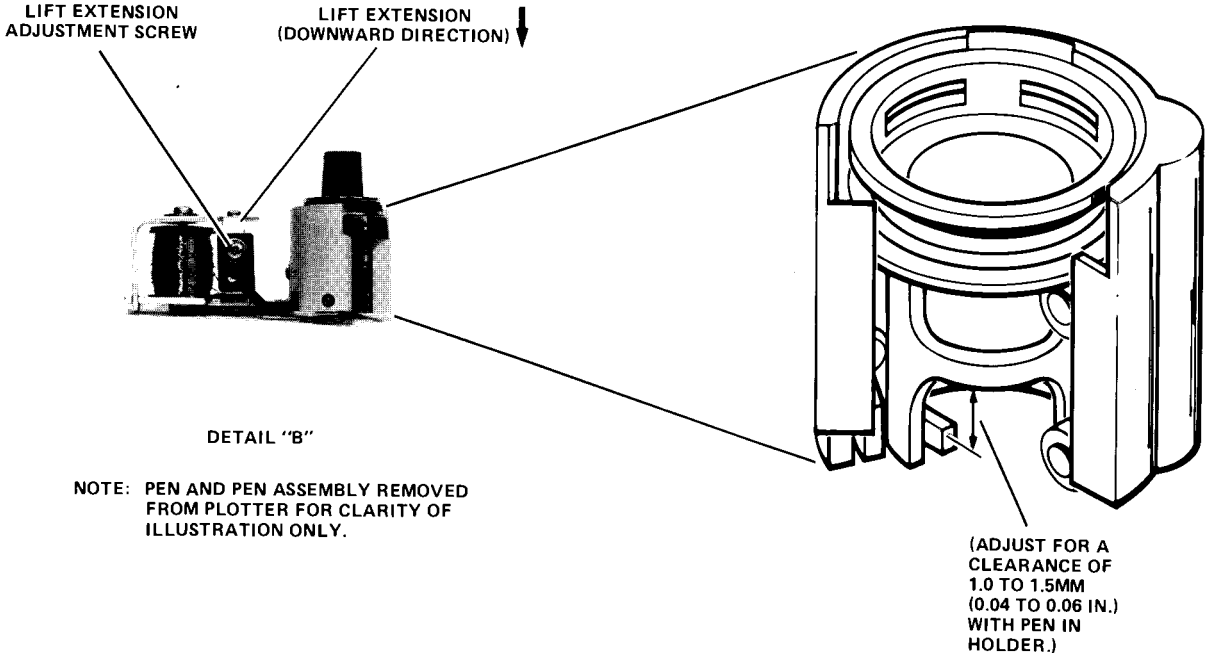
e. Recheck side play with a force of 45 grams from one or two other angles to assure correct adjustment. Note that excessive pressure from the adjusting screw will slow the pen lift up and down response.

f. To verify correct pen side play adjustment, install an I/O module and perform the Confidence Test. The quality of the lettering in the "END OF TEST" text will verify correct adjustment.



DETAIL "A"

POSITION PEN AT
LOWER LEFT



DETAIL "B"

NOTE: PEN AND PEN ASSEMBLY REMOVED FROM PLOTTER FOR CLARITY OF ILLUSTRATION ONLY.

Figure 3-8. Pen Down Adjustment

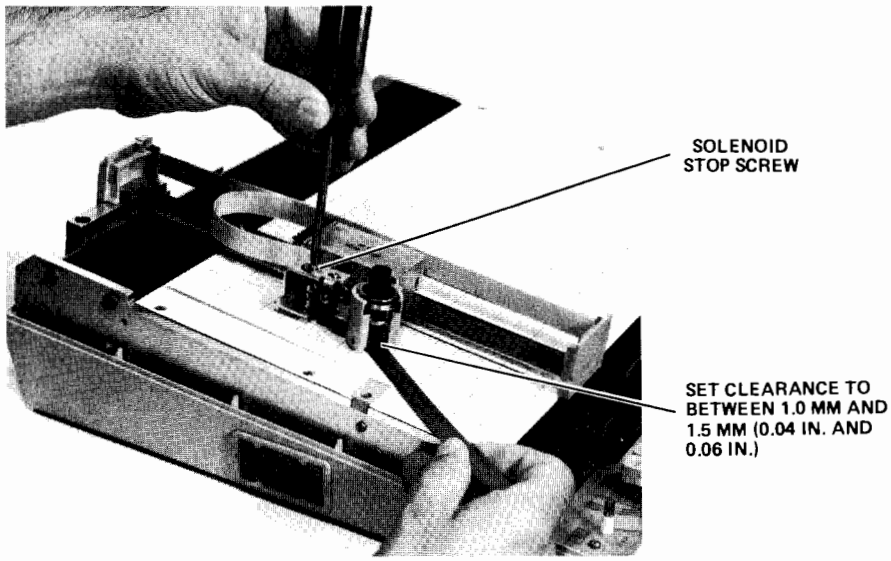


Figure 3-9. Pen Lift Adjustment

3-24. PAPER GUIDE ALIGNMENT

3-25. This procedure contains the steps to be performed in order to align the X grid lines on the graph paper with the horizontal movement of the pen. To perform this alignment, proceed as follows:

a. Remove the top cover. (Refer to paragraph 3-9.)

b. Loosen the paper guide screws and position the guide against the platen edge. (See Figure 3-11.)

c. Tighten the paper guide screws.

d. Apply AC power to the plotter.

e. Carefully load a sheet of lined chart paper onto the plotter (e.g., HP P/N 9270-1023).

f. Install a new pen into the pen holder.

g. Move the pen to the left edge of the graph and position it just below a horizontal grid line. (See Figure 3-12A).

h. Lower the pen onto the graph by pressing the front panel PEN DOWN pushbutton.

i. Plot a horizontal line across the full width of the chart paper by holding down the FAST and the → pushbutton simultaneously. (See Figure 3-12B.)

j. Press the PEN UP and then the UPPER RIGHT pushbutton to move the pen carriage to the upper right area of the graph.

k. Using an optical comparator, measure the distance between the grid line and the plotted line at both the left and right ends. Allowable difference is ±0.13 mm (0.005 in.).

l. If the plotted line goes up on the right end, loosen the paper guide screws and lower the left end of the paper guide slightly more than the error measured in step k. Tighten screws. (See Figure 3-13A).

m. If the plotted line goes down on the right end, loosen the paper guide screws and lower the right end of the paper guide slightly more than the error measured in step k. Tighten screws. (See Figure 3-13B.)

n. Realign the graph paper to the guide and plot another horizontal line to check the paper guide alignment. (Repeat steps i. through m. if necessary.)

o. Replace cover.

p. Pen arm (Y stator) alignment must be checked after paper guide alignment. (See following procedure.)

3-26. PEN ARM (Y STATOR) ALIGNMENT.

3-27. This procedure contains the steps to be performed in order to check/align the pen arm with the vertical grid lines on the graph paper.

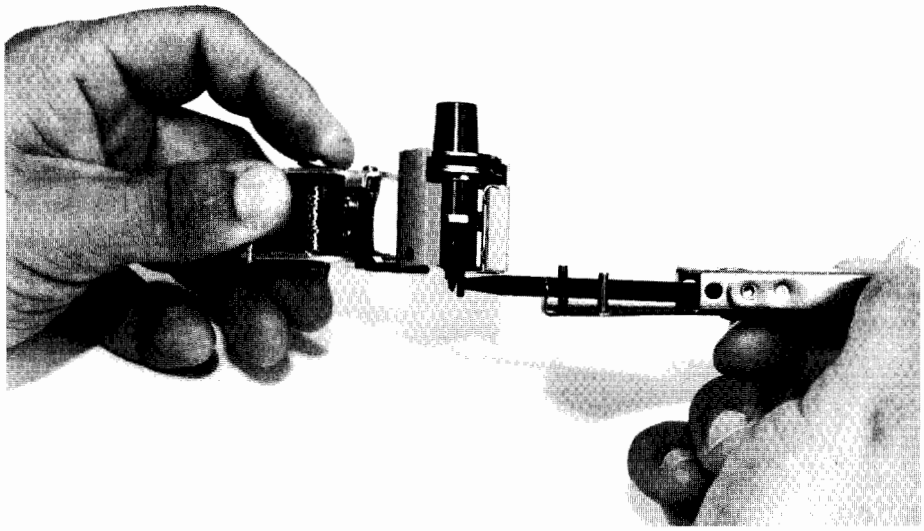
NOTE

Paper guide alignment should always be checked before pen arm alignment is performed.

To check/adjust the pen arm alignment, proceed as follows:

a. Carefully load a sheet of X-Y grid chart paper onto the plotter.

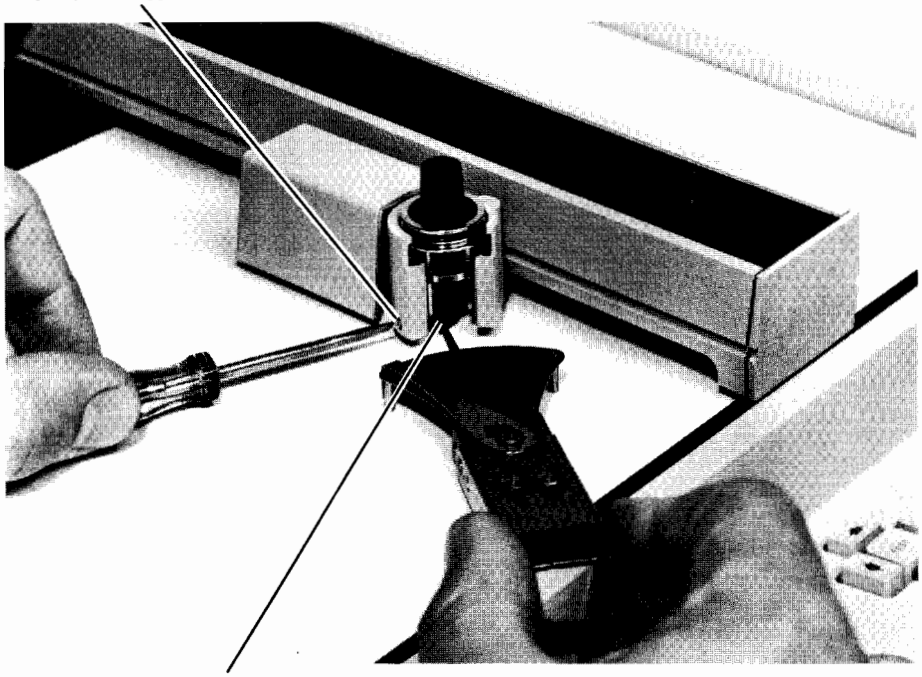
b. Install a new pen in the holder.



DETAIL "A"
SHOWING PLACEMENT
OF TENSION GAUGE
BLADE AGAINST PEN

NOTE
PEN ASSEMBLY REMOVED FROM PLOTTER
FOR CLARITY OF ILLUSTRATION ONLY.

ROTATE SIDE PLAY
ADJUSTMENT SCREW
TO OBTAIN 45 GRAMS
OF SIDE PRESSURE



DETAIL "B"

PLACE TENSION GAUGE
BLADE AGAINST BOTTOM
OF PEN BODY

Figure 3-10. Pen Side Play Adjustment

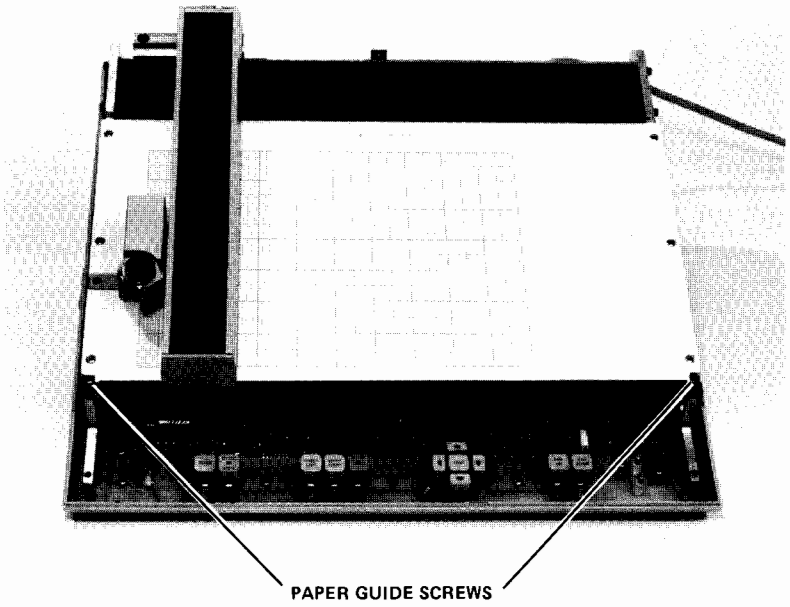


Figure 3-11. Paper Guide Screws Location

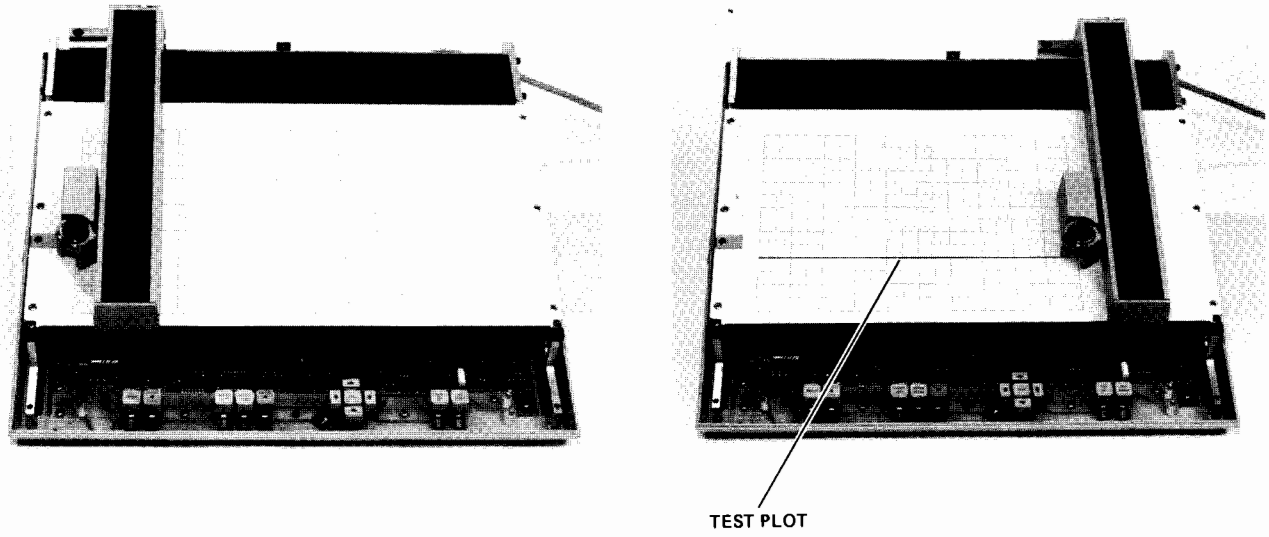
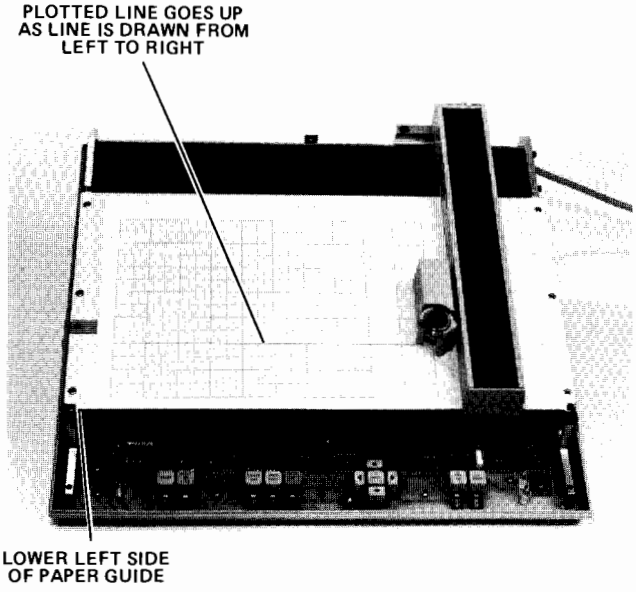


Figure 3-12. Paper Guide Adjustment Test Plot



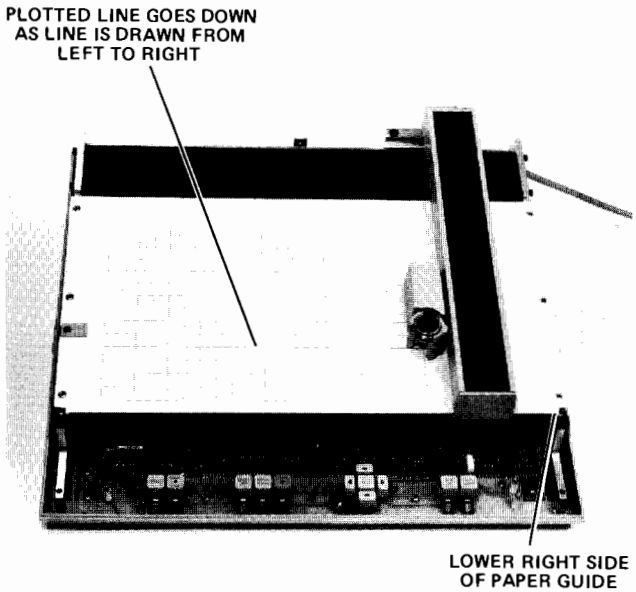


Figure 3-13. Paper Guide Alignment

c. Position the pen at the upper edge of the graph.

d. Move the pen next to a vertical grid line. (See Figure 3-14A.)

e. Lower the pen onto the graph by pressing the front panel PEN DOWN pushbutton.

f. Plot a vertical line to the bottom of the graph by holding down the FAST and the ↓ pushbutton simultaneously. (See Figure 3-14B.)

g. Press the PEN UP and then the UPPER RIGHT pushbutton to move the pen carriage to the upper right area of the graph.

h. Using an optical comparator, measure the distance between the plot line and the grid line at both the top and bottom of the graph. Allowable difference is ±0.13 mm (0.005 in.) or less. (See Figure 3-14.)

i If pen arm alignment is required, remove the top cover. (Refer to paragraph 3-9.)

j. Remove the Y stator cover (pen arm) by disengaging the locking tab. (See Figure 3-2 detail A).

k. Slide the cover off the bottom tab and lift it clear of the stator. (See Figure 3-2 detail B).

l. Using a 7/64 in. (2.778 mm) hex-key wrench (HP P/N 8710-0096) loosen the two hex cup Allen screws on the X motor. (See Figure 3-15A.)

m. Align the Y stator parallel to the graph grid lines. (See Figure 3-15B.)

n. Tighten the two hex cup Allen screws on the X motor. (See Figure 3-15A.)

o. Repeat steps c. through h. to check the alignment.

p. Replace covers.

3-28. X-LIMIT SWITCH ADJUSTMENT

3-29. The X limit switch adjustment references the initial X limits of the pen arm mechanism in relation to the plotting area. This adjustment is factory set and should not require adjustment unless the switch is replaced or otherwise altered.

3-30. To check the X limit switch adjustment, perform the following:

a. Install a sheet of metric chart paper (HP P/N 9270-1023), graph side up.

b. Turn the plotter on.

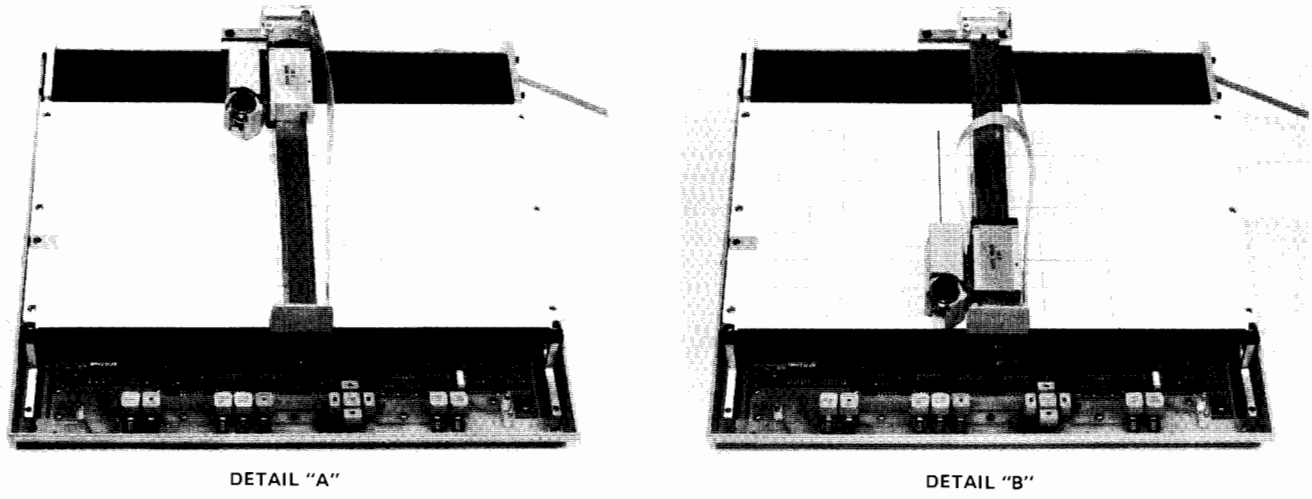


Figure 3-14. Pen Arm Alignment Test Plot

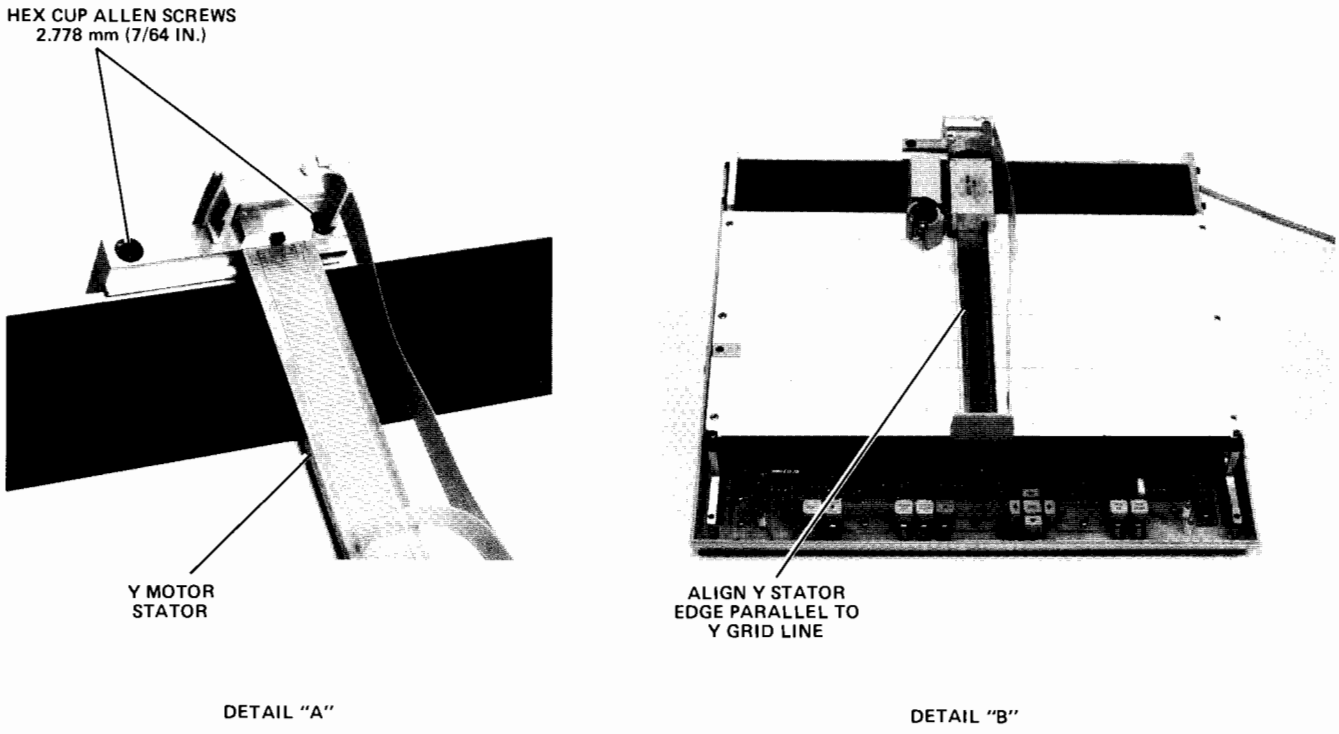


Figure 3-15. Pen Arm/Y Motor Stator Alignment

c. Install a pen in the penholder.

d. Sequentially press ENTER and then RESET pushbuttons on the control panel.

e. Press the UPPER RIGHT pushbutton on the control panel.

f. Press the PEN DOWN pushbutton and then the PEN UP pushbutton so that an ink dot appears on the graph paper. Press the LOWER LEFT pushbutton to allow viewing of the reference mark. The ink dot should be within 0.5 mm to the right and 2.0 mm to the left of the right hand border of the graph paper. If the ink dot is outside the +0.5, -2.0 mm tolerance, adjustment of the X limit switch is necessary.

3-31. To adjust the X limit switch, perform the following:

NOTE

Normal adjustment consists of seating the X limit switch as fully counterclockwise in its mounting bracket holes as possible. Additional adjustment is obtained by carefully bending the X-limit switch actuator arm to obtain the proper setting.

a. Turn the plotter off and disconnect the power cord.

b. Remove the top cover and upper deck assembly. (Refer to paragraph 3-9.)

c. Install the extender cable between the upper and lower deck assemblies observing the caution notice on the extender cable connector. (See Figure 3-16.)

d. Release the X limit switch bracket from the chassis by removing the two bracket mounting screws, then loosen the two X limit switch retaining screws. Seat the X limit switch as fully counterclockwise in its bracket holes as possible and tighten the two switch retaining screws. (See Figure 3-17.)

e. Install X limit switch bracket to chassis.

NOTE

For proper limit switch actuation, make sure that the X limit switch actuator roller is not contacting the flat motor cables, but is contacting the X motor block. If necessary, reposition the cables for clearance.

f. Check the X limit switch adjustment per paragraph 3-30.

g. If further adjustment is not necessary, reassemble the plotter in reverse of disassembly procedure.

3-32. If further adjustment is necessary, perform the following:

a. Very carefully bend the X limit switch actuator arm, either clockwise to move the reference ink dot to the left or counterclockwise to move the reference ink dot to the right.

CAUTION

Excessive bending of the actuator arm can weaken the arm and damage the switch assembly.

b. Check the X limit switch adjustment per paragraph 3-30.

c. Repeat paragraph 3-32 if necessary.

d. Reassemble plotter in reverse order of disassembly.

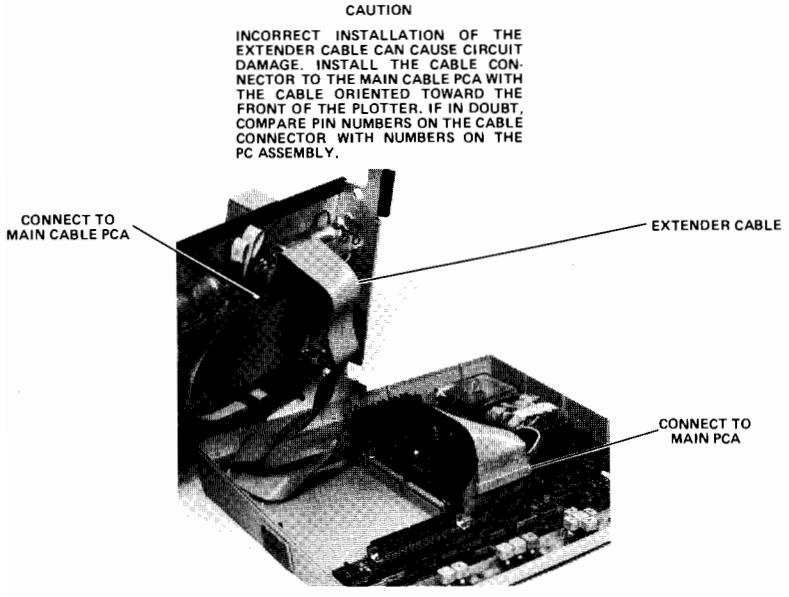


Figure 3-16. Extender Cable Installation

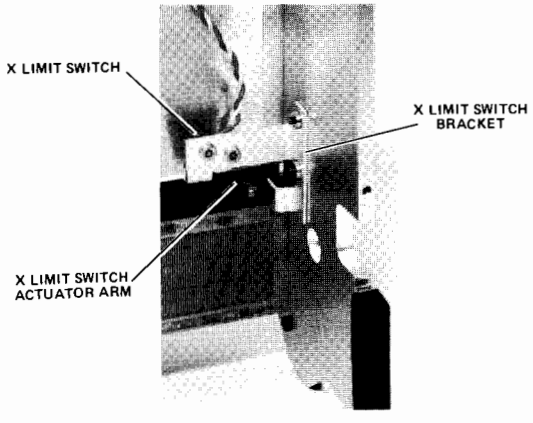


Figure 3-17. X Limit Switch Adjustment

SECTION IV

REPLACEABLE PARTS

4-1. INTRODUCTION.

4-2. This section contains part information for the Model 7225A Plotter. Included herein is a listing of assemblies, replaceable parts and ordering information.

4-3. EXCHANGE ASSEMBLIES.

4-4. Factory rebuilt assemblies that can be exchanged are listed in Table 4-1.

4-5. SPARE PARTS (ACCESSORIES).

4-6. A listing of the plotter accessories supplied is given in Table 1-5 (Section I).

4-7. REPLACEABLE PARTS LIST.

4-8. PRINTED CIRCUIT ASSEMBLY (PCA)

4-9. Parts located on printed circuit assemblies are listed in tabular form in Tables 4-2 through 4-4.

4-10. FRAME MOUNTED PARTS.

4-11. Parts located on the frame assembly are listed in Tables 4-5 through 4-6 and illustrated in Figures 4-1 and 4-2.

4-12. ORDERING INFORMATION.

4-13. To obtain replacement parts or assemblies, address an order or inquiry to the nearest Hewlett-Packard Sales and Service Office. The order should include the part or assembly number, its description and location, the plotter model and serial number. A list of Sales and Service Offices is located at the end of this manual.

4-14. CODE LIST OF MANUFACTURERS.

4-15. Table 4-7 lists the five digit code numbers assigned to the manufacturer of parts in the HP Model 7225A Graphic Plotter. These code numbers appear with the parts in Tables 4-5 through 4-6 as an aid for ordering replacement parts directly from the manufacturer.

4-16. ABBREVIATIONS.

4-17. Table 4-8 lists abbreviations used throughout the manual. Abbreviations in the Parts List are always all capital letters, in other parts of the manual both upper and lower case letter abbreviations are used.

Table 4-1. Exchange Assembly Part Number

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	07225-66105	5	1	MAIN PCA, REBUILT	28480	07225-66105

Table 4-2. Main PCA (A1) Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	07225-60105	3	1	MAIN PCA	28480	07225-60105
A1C1	0180-2141	6	2	CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1C2	0180-1746	5	5	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C3	0180-0650	8	2	CAPACITOR-FXD 390UF+100-10% 20VDC AL	56289	672D397M020DT2C
A1C4	0180-0582	5	2	CAPACITOR-FXD 270UF+100-10% 40VDC AL	56289	672D277M040DT2C
A1C5	0180-0582	5		CAPACITOR-FXD 270UF+100-10% 40VDC AL	56289	672D277M040DT2C
A1C6	0180-0650	8		CAPACITOR-FXD 390UF+100-10% 20VDC AL	56289	672D397M020DT2C
A1C7	0160-0162	5	5	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A1C8	0160-0194	3	2	CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
A1C9	0160-3847	9	33	CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C10	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C11	0160-0194	3		CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
A1C12	0170-0066	9	3	CAPACITOR-FXD .027UF +-10% 200VDC POLYE	28480	0170-0066
A1C13	0160-0154	5	5	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A1C14	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C15	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C16	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C17	0160-4742	5	3	CAPACITOR-FXD 1000PF +-10% 600 VDC POLYE	28480	0160-4742
A1C18	0160-4742	5		CAPACITOR-FXD 1000PF +-10% 600 VDC POLYE	28480	0160-4742
A1C19	0160-4742	5		CAPACITOR-FXD 1000PF +-10% 600 VDC POLYE	28480	0160-4742
A1C20	0160-2204	0	1	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A1C21	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C22	0160-0153	4	8	CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C23	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C24	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A1C25	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C26	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C27	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A1C28	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C29	0180-2141	6		CAPACITOR-FXD 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
A1C30	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C31	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C32	0160-0889	3	1	CAPACITOR-FXD .33UF +-10% 80VDC POLYE	28480	0160-0889
A1C33	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C34	0160-0157	8	5	CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1C35	0170-0040	9	4	CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1C36	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1C37	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C38	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C40	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A1C41	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C42	0160-0162	5		CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A1C43	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C44	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C46	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1C47	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C48	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C49	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C50	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1C51	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1C52	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C53	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C54	0170-0040	9		CAPACITOR-FXD .047UF +-10% 200VDC POLYE	56289	292P47392
A1C55	0170-0066	9		CAPACITOR-FXD .027UF +-10% 200VDC POLYE	28480	0170-0066
A1C56	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1C57	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C58	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C60	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C61	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C62	0160-2200	6	2	CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A1C63	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C64	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C65	0160-2015	1	1	CAPACITOR-FXD 15PF +-5% 500VDC MICA	28480	0160-2015
A1C66	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C67	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A1C68	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C69	0160-0156	7	2	CAPACITOR-FXD 3900PF +-10% 200VDC POLYE	28480	0160-0156
A1C70	0160-2671	5	2	CAPACITOR-FXD .1UF +-5% 80VDC POLYE	28480	0160-2671
A1C71	0160-0127	2	3	CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1C72	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A1C73	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1C74	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A1C75	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A1C76	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C77	0160-0156	7		CAPACITOR-FXD 3900PF +-10% 200VDC POLYE	28480	0160-0156
A1C78	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C79	0180-0229	7	2	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1C80	0180-0309	4	1	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A1C81	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C82	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1C83	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C84	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C85	0160-0127	2		CAPACITOR-FXD 1UF +-20% 25VDC CER	28480	0160-0127
A1C86	0160-2671	5		CAPACITOR-FXD .1UF +-5% 80VDC POLYE	28480	0160-2671
A1C87	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C88	0170-0066	9		CAPACITOR-FXD .027UF +-10% 200VDC POLYE	28480	0170-0066
A1C89	0180-2205	3	1	CAPACITOR-FXD .33UF+-10% 35VDC TA	56289	1500334X9035A2
A1C90	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C91	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C93	0160-0299	9	2	CAPACITOR-FXD 1800PF +-10% 200VDC POLYE	28480	0160-0299
A1C94	0160-0299	9		CAPACITOR-FXD 1800PF +-10% 200VDC POLYE	28480	0160-0299
A1C95	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C96	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C97	0160-0153	4		CAPACITOR-FXD 1000PF +-10% 200VDC POLYE	28480	0160-0153
A1C98	0180-0229	7		CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X9010B2
A1C99	0160-3847	9		CAPACITOR-FXD .01UF +100-0% 50VDC CER	28480	0160-3847
A1C100	0160-2200	6		CAPACITOR-FXD 43PF +-5% 300VDC MICA	28480	0160-2200
A1C101	0160-0157	8		CAPACITOR-FXD 4700PF +-10% 200VDC POLYE	28480	0160-0157
A1CR1	1901-0704	4	10	DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR2	1901-0050	3	26	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR3	1901-1081	2	2	DIODE-PWR RECT 100V 3A	04713	MR501
A1CR4	1901-1081	2		DIODE-PWR RECT 100V 3A	04713	MR501
A1CR5	1901-0691	8	2	DIODE-PWR RECT 100V 3A 200NS	03508	A115A
A1CR6	1901-0691	8		DIODE-PWR RECT 100V 3A 200NS	03508	A115A
A1CR7	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR8	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR10	1902-3092	1	2	DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	28480	1902-3092
A1CR11	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR12	1901-0831	8	2	DIODE-HV RECT 1N4937 600V 1A 200NS DO-41	01928	1N4937
A1CR13	1901-0831	8		DIODE-HV RECT 1N4937 600V 1A 200NS DO-41	01928	1N4937
A1CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR15	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR16	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR17	1901-1065	2	9	DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR18	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR19	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR20	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR21	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR24	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR25	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR26	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR27	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR28	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR29	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR31	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR32	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR33	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR34	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR35	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR36	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR37	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A1CR38	1901-0704	4		DIODE-PWR RECT 1N4002 100V 1A DO-41	01295	1N4002
A1CR39	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR40	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR41	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR42	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR43	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR44	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR45	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR46	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR47	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR48	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR49	1902-3059	0	4	DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
A1CR50	1902-3059	0		DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
A1CR51	1901-1065	2		DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR52	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR53	1902-3059	0		DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
A1CR54	1902-3059	0		DIODE-ZNR 3.83V 5% DO-7 PD=.4W TC=-.051%	28480	1902-3059
A1CR55	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR56	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR57	1902-3077	2	1	DIODE-ZNR 4.42V 2% DO-7 PD=.4W TC=-.031%	28480	1902-3077
A1CR58	1901-0511	1	1	DIODE-PWR RECT 1N3889R 50V 12A 200NS	04713	1N3889R
A1CR61	1902-3105	7	2	DIODE-ZNR 5.62V 2% DO-7 PD=.4W TC=+.016%	28480	1902-3105
A1CR62	1902-3105	7		DIODE-ZNR 5.62V 2% DO-7 PD=.4W TC=+.016%	28480	1902-3105
A1CR63	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A1CR64	1902-3092	1		DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	28480	1902-3092
A1E1	0340-0765	6	9	INSULATOR-XSTR KAPTON	28480	0340-0765
A1E2	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E3	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E4	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E5	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E6	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E7	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E8	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E9	0340-0765	6		INSULATOR-XSTR KAPTON	28480	0340-0765
A1E10	0360-0270	0	1	TERMINAL-SLDR LUG LK-MTG FOR-#10-SCR	28480	0360-0270
A1E11	0360-1514	7	23	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E12	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E13	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E14	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E15	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E16	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E17	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E18	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E19	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E20	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E21	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E22	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E23	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E24	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E25	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E26	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E27	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E28	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E29	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E30	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E31	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E32	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E33	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A1E34	1251-0600	0	8	CONNECTOR-SGL CONT PIN 1.14-MM-8SC-SZ SQ	28480	1251-0600
A1E35	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-8SC-SZ SQ	28480	1251-0600
A1E36	1200-0824	3	1	SOCKET-IC 40-CONT LSI DIP-SLDR	28480	1200-0824
A1E37	1205-0355	5	4	HEAT SINK SGL TO-220-PKG	13103	6043PB
A1E38	1205-0355	5		HEAT SINK SGL TO-220-PKG	13103	6043PB
A1E39	1205-0355	5		HEAT SINK SGL TO-220-PKG	13103	6043PB
A1E40	1205-0355	5		HEAT SINK SGL TO-220-PKG	13103	6043PB
A1E41	1251-2118	9	9	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E42	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E43	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E44	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E45	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E46	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E47	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E48	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E49	1251-2118	9		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-2118
A1E50	2110-0269	0	6	FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
A1E51	2110-0269	0		FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
A1E52	2110-0597	7	2	FUSEHOLDER-CLIP TYPE 10A 250V	28480	2110-0597
A1E53	2110-0597	7		FUSEHOLDER-CLIP TYPE 10A 250V	28480	2110-0597
A1E54	5041-0268	5	1	KEY CAP, HALF, SDL PG	28480	5041-0268
A1E55	5041-0532	6	1	KEY CAP, HALF, SDL SW	28480	5041-0532
A1E56	07225-00017	0	2	BRACKET, PCB CONNECTOR	28480	07225-00017
A1E57	07225-00017	0		BRACKET, PCB CONNECTOR	28480	07225-00017
A1E58	07225-00018	1	1	BRACKET, AC RECEPTACLE	28480	07225-00018
A1E59	07225-20008	1	2	HEAT SINK, LARGE	28480	07225-20008
A1E60	07225-20008	1		HEAT SINK, LARGE	28480	07225-20008
A1E61	07225-20009	2	1	HEAT SINK, SMALL	28480	07225-20009
A1E62	1258-0146	3	3	PLUG-SHORTING .04 IN-DIA .5 IN-LG	28480	1258-0146
A1E63	1258-0146	3		PLUG-SHORTING .04 IN-DIA .5 IN-LG	28480	1258-0146
A1E64	1258-0146	3		PLUG-SHORTING .04 IN-DIA .5 IN-LG	28480	1258-0146
A1E65	2110-0269	0		FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1E66	2110-0269	0		FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
A1E67	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1E68	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1E69	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1E70	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1E71	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1E72	1251-0600	0		CONNECTOR-SGL CONT PIN 1.14-MM-BSC-SZ SQ	28480	1251-0600
A1F1	2110-0007	4	1	FUSE 1A 250V SLO-BLO 1.25X.25 UL IEC (FOR 110V OPERATION)	75915	313001
A1F2	2110-0458	9	1	FUSE .5A 250V SLO-BLO IEC (FOR 220V OPERATION)	28480	2110-0458
A1F3	2110-0083	6	1	FUSE 2.5A 250V FAST-BLO 1.25X.25 UL IEC (FOR 110V OPERATION)	28480	2110-0083
A1H1	2190-0152	8	1	WASHER-FL MTLC NO. 8 .188-IN-ID	28480	2190-0152
A1H2	2190-0476	9	6	WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H3	2190-0476	9		WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H4	2190-0476	9		WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H5	2190-0476	9		WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H6	2190-0476	9		WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H7	2190-0476	9		WASHER-LK 82 CTSK EXT T NO. 4 .116-IN-ID	28480	2190-0476
A1H8	2200-0103	2	1	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H9	2200-0105	4	6	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H10	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H11	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H12	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H13	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H14	2200-0105	4		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A1H15	2200-0169	0	6	SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H16	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H17	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H18	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H19	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H20	2200-0169	0		SCREW-MACH 4-40 .5-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
A1H21	2360-0440	8	9	SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H22	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H23	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H24	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H25	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H26	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H27	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H28	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1H29	2360-0440	8		SCREW-MACH 6-32 .25-IN-LG BDG-HD-PHL	00000	ORDER BY DESCRIPTION
A1J1	1251-4470	0	1	CONNECTOR-AC PWR CEE-22 MALE REC-FLG	28480	1251-4470
A1J2	1251-5565	6	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-5565
A1J3	1251-3192	1	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-3192
A1J4	1251-2225	9	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-2225
A1J5	1251-2026	8	1	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A1J6	1251-5413	3	1	CONNECTOR 25-PIN PRESSURE TYPE	28480	1251-5413
A1L1	9140-0282	7	2	INDUCTOR 500UH 15%	28480	9140-0282
A1L2	9140-0282	7		INDUCTOR 500UH 15%	28480	9140-0282
A1L3	9100-1649	8	10	COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L4	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L5	9100-1665	8	1	COIL-MLD 3.3MH 5% Q=70 .215DX.56LG-NOM	28480	9100-1665
A1L6	9140-0131	5	1	COIL-MLD 10MH 5% Q=80 .24DX.74LG-NOM	28480	9140-0131
A1L7	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L8	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L9	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L10	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L11	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L12	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L13	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L14	9100-1649	8		COIL-MLD 620UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1649
A1L15	9100-1788	6	2	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A1L16	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A1Q1	1853-0444	6	1	TRANSISTOR PNP SI DARL TO-220AB PD=1.67W	28480	1853-0444
A1Q2	1853-0443	5	5	TRANSISTOR PNP SI TO-220AB PD=1.67W	28480	1853-0443
A1Q3	1854-0791	8	5	TRANSISTOR NPN SI TO-220AB PD=1.67W	28480	1854-0791
A1Q4	1853-0271	7	7	TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q5	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q6	1854-0467	5	10	TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q7	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q8	1854-0801	1	1	TRANSISTOR NPN SI TO-39 PD=1W FT=15MHZ	28480	1854-0801
A1Q9	1853-0443	5		TRANSISTOR PNP SI TO-220AB PD=1.67W	28480	1853-0443
A1Q10	1854-0791	8		TRANSISTOR NPN SI TO-220AB PD=1.67W	28480	1854-0791

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1Q11	1853-0443	5		TRANSISTOR PNP SI TO-220AB PD=1.67W	28480	1853-0443
A1Q12	1854-0791	8		TRANSISTOR NPN SI TO-220AB PD=1.67W	28480	1854-0791
A1Q13	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q14	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q15	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q16	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q17	1853-0443	5		TRANSISTOR PNP SI TO-220AB PD=1.67W	28480	1853-0443
A1Q18	1854-0791	8		TRANSISTOR NPN SI TO-220AB PD=1.67W	28480	1854-0791
A1Q19	1853-0443	5		TRANSISTOR PNP SI TO-220AB PD=1.67W	28480	1853-0443
A1Q20	1854-0791	8		TRANSISTOR NPN SI TO-220AB PD=1.67W	28480	1854-0791
A1Q21	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q22	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q23	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q24	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1Q25	1853-0073	7	2	TRANSISTOR PNP SI PD=25W FT=3MHZ	28480	1853-0073
A1Q26	1853-0073	7		TRANSISTOR PNP SI PD=25W FT=3MHZ	28480	1853-0073
A1Q27	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q28	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q29	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q30	1854-0467	5		TRANSISTOR NPN 2N4401 SI TO-92 PD=310MW	04713	2N4401
A1Q31	1853-0271	7		TRANSISTOR PNP 2N4403 SI TO-92 PD=310MW	04713	2N4403
A1R1	0699-0263	8	10	RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R2	0811-1217	4	2	RESISTOR 150 5% 5W PW TC=0+-20	28480	0811-1217
A1R3	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R4	0811-1217	4		RESISTOR 150 5% 5W PW TC=0+-20	28480	0811-1217
A1R5	0757-0984	4	1	RESISTOR 10 1% .5W F TC=0+-100	28480	0757-0984
A1R6	0757-0814	9	1	RESISTOR 511 1% .5W F TC=0+-100	28480	0757-0814
A1R7	0757-0401	0	8	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R8	0811-1662	3	1	RESISTOR .47 5% 2W PW TC=0+-800	75042	BWH2-47/100-J
A1R9	0757-0444	1	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1R10	0698-3153	9	3	RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R11	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R12	0757-0274	5	6	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R13	0698-3159	5	2	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A1R14	0698-3271	2	1	RESISTOR 115K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1153-F
A1R15	0757-0461	2	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A1R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R17	0698-3403	2	2	RESISTOR 348 1% .5W F TC=0+-100	28480	0698-3403
A1R18	0698-8754	6	3	RESISTOR 10M 1% .25W C TC=0+-100	01121	CC1005F
A1R19	0698-8754	6		RESISTOR 10M 1% .25W C TC=0+-100	01121	CC1005F
A1R20	0686-2265	7	2	RESISTOR 22M 5% .5W CC TC=0+1059	01121	EB2265
A1R21	0698-3260	9	2	RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1R22	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R23	0686-1855	9	2	RESISTOR 1.8M 5% .5W CC TC=0+1000	01121	EB1855
A1R24	0686-1855	9		RESISTOR 1.8M 5% .5W CC TC=0+1000	01121	EB1855
A1R25	0757-0477	0	2	RESISTOR 332K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-3323-F
A1R26	0698-8754	6		RESISTOR 10M 1% .25W C TC=0+-100	01121	CC1005F
A1R27	0698-3260	9		RESISTOR 464K 1% .125W F TC=0+-100	28480	0698-3260
A1R29	0686-2265	7		RESISTOR 22M 5% .5W CC TC=0+1059	01121	EB2265
A1R31	0698-3430	5	2	RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1R32	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R33	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R34	0811-1204	9	4	RESISTOR 200 5% 5W PW TC=0+-20	28480	0811-1204
A1R35	0811-1204	9		RESISTOR 200 5% 5W PW TC=0+-20	28480	0811-1204
A1R36	0811-1204	9		RESISTOR 200 5% 5W PW TC=0+-20	28480	0811-1204
A1R37	0811-1204	9		RESISTOR 200 5% 5W PW TC=0+-20	28480	0811-1204
A1R38	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R39	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R40	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R41	0698-3154	0	4	RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R42	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R43	0811-3424	9	2	RESISTOR .5 1% 3W PW TC=0+-90	28480	0811-3424
A1R44	0811-3424	9		RESISTOR .5 1% 3W PW TC=0+-90	28480	0811-3424
A1R45	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R46	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R48	0698-8781	9	4	RESISTOR 5.36K .1% .125W F TC=0+-25	28480	0698-8781
A1R49	0698-8781	9		RESISTOR 5.36K .1% .125W F TC=0+-25	28480	0698-8781
A1R50	0698-8780	8	4	RESISTOR 24.9K .1% .125W F TC=0+-25	28480	0698-8780
A1R51	0698-3452	1	6	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R53	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R54	0813-0051	6	4	RESISTOR 270 5% 3W PW TC=0+-20	28480	0813-0051
A1R55	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263
A1R56	0813-0051	6		RESISTOR 270 5% 3W PW TC=0+-20	28480	0813-0051
A1R57	0813-0051	6		RESISTOR 270 5% 3W PW TC=0+-20	28480	0813-0051
A1R58	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R59	0699-0263	8		RESISTOR 26.1 2% .25W F TC=0+-100	28480	0699-0263

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A1R60	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R61	0813-0051	6		RESISTOR 270 5% 3W PW TC=0+-20	28480	0813-0051
A1R62	0811-2191	5	2	RESISTOR 15 5% 5W PW TC=0+-20	28480	0811-2191
A1R63	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R64	0698-8780	8		RESISTOR 24.9K .1% .125W F TC=0+-25	28480	0698-8780
A1R65	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R66	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A1R67	0698-3153	9		RESISTOR 3.83K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3831-F
A1R68	0811-3510	4	2	RESISTOR .9 1% 3W PW TC=0+-90	28480	0811-3510
A1R69	0811-3510	4		RESISTOR .9 1% 3W PW TC=0+-90	28480	0811-3510
A1R70	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R71	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R73	0698-8781	9		RESISTOR 5.36K .1% .125W F TC=0+-25	28480	0698-8781
A1R74	0698-8780	8		RESISTOR 24.9K .1% .125W F TC=0+-25	28480	0698-8780
A1R75	0698-8780	8		RESISTOR 24.9K .1% .125W F TC=0+-25	28480	0698-8780
A1R76	0698-8781	9		RESISTOR 5.36K .1% .125W F TC=0+-25	28480	0698-8781
A1R77	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4221-F
A1R78	0811-2191	5		RESISTOR 15 5% 5W PW TC=0+-20	28480	0811-2191
A1R81	0698-0085	0	2	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1R82	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A1R83	0757-0317	7	2	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1R84	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A1R85	0757-0349	5	2	RESISTOR 22.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2262-F
A1R86	0757-0349	5		RESISTOR 22.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2262-F
A1R87	0757-0458	7	2	RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R88	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R89	0698-7332	4	2	RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A1R90	0757-0441	8	2	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1R91	0757-0159	5	1	RESISTOR 1K 1% .5W F TC=0+-100	28480	0757-0159
A1R92	0757-0280	3	6	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R93	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R94	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R95	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1R96	0757-0416	7	4	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R97	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R98	0757-0477	0		RESISTOR 332K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-3323-F
A1R99	0698-4519	3	1	RESISTOR 140K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1403-F
A1R100	0698-4515	9	1	RESISTOR 107K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1073-F
A1R101	0757-0458	7		RESISTOR 51.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5112-F
A1R102	0698-3454	3	1	RESISTOR 215K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2153-F
A1R103	0757-0821	8	1	RESISTOR 1.21K 1% .5W F TC=0+-100	28480	0757-0821
A1R104	0698-3159	5		RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A1R105	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R106	0698-3452	1		RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A1R107	0698-3329	1	5	RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R108	0698-5789	1	1	RESISTOR 11.1K .5% .125W F TC=0+-50	28480	0698-5789
A1R109	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A1R110	0698-7332	4		RESISTOR 1M 1% .125W F TC=0+-100	28480	0698-7332
A1R111	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A1R112	0757-0438	3	1	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1R113	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1R114	0757-0405	4	1	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A1R115	0698-3132	4	4	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R116	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R117	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R118	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A1R119	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R120	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1R121	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R122	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1R123	0698-3446	3	1	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A1R124	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R125	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R126	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R127	0698-3329	1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A1R128	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R129	0698-3430	5		RESISTOR 21.5 1% .125W F TC=0+-100	03888	PME55-1/8-T0-21R5-F
A1R130	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1R131	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A1R132	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R133	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R134	0698-3403	2		RESISTOR 348 1% .5W F TC=0+-100	28480	0698-3403
A1R135	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1R136	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F

Table 4-2. Main PCA (A1) Parts List (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1RN1	1810-0279	5	2	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	01121	210A472
A1RN2	1810-0279	5		NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	01121	210A472
A1RN3	1810-0206	8	1	NETWORK-RES 8-PIN-SIP .1-PIN-SPCG	01121	208A103
A1RN4	1810-0277	3	1	NETWORK-RES 10-PIN-SIP .1-PIN-SPCG	01121	210A222
A1S1	3101-0600	5	1	SWITCH-PB DPDT MOM 1A 300VAC	28480	3101-0600
A1S2	3101-0555	9	1	SWITCH-PB DPDT ALTNG 4A 250VAC	28480	3101-0555
A1U1	1826-0147	9	1	IC 7812 V RGLTR TO-220	04713	MC7812CP
A1U2	1826-0311	9	2	OP AMP GP 8-DIP-P	04713	MLM201AP1
A1U3	1826-0311	9		OP AMP GP 8-DIP-P	04713	MLM201AP1
A1U4	1826-0296	9	1	OP AMP GP 8-DIP-P	28480	1826-0296
A1U5	1826-0407	4	3	OP AMP BIMOS TO-99	28480	1826-0407
A1U6	1826-0418	7	1	IC 320T-12 V RGLTR TO-220	07263	UA7912UC
A1U7	1820-0477	6	4	OP AMP GP 8-DIP-P	27014	LM301AN
A1U8	1826-0139	9	2	OP AMP GP DUAL 8-DIP-P	01928	CA1458G
A1U9	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A1U10	1826-0407	4		OP AMP BIMOS TO-99	28480	1826-0407
A1U11	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A1U12	1826-0139	9		OP AMP GP DUAL 8-DIP-P	01928	CA1458G
A1U13	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A1U14	1820-1491	6	3	IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74S367AN
A1U15	1820-1917	1	1	IC BFR TTL LS LINE DRVR OCTL	01295	SN74L8240N
A1U16	1816-1241	5	1	IC TTL 256-BIT ROM 50-NS 3-S	01295	SN74S288N PROGRAMMED
A1U17	1826-0550	8	1	CONV 8-B-D/A 16-DIP-P	07263	UA0801EPC
A1U18	1826-0407	4		OP AMP BIMOS TO-99	28480	1826-0407
A1U19	1820-1546	2	3	MULTIPLXR ANLG DUAL 16-DIP-C	04713	MC14052BCL
A1U20	1826-0410	9	3	OP AMP BIFET 14-DIP-P	01295	TL084CN
A1U21	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74S367AN
A1U22	1820-2152	8	1	IC	07263	3870PC PROGRAMMED
A1U23	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74L886N
A1U24	1820-1197	9	2	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1U25	1820-1212	9	2	IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
A1U26	1820-1438	1	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS257AN
A1U27	1820-1546	2		MULTIPLXR ANLG DUAL 16-DIP-C	04713	MC14052BCL
A1U28	1826-0065	0	1	COMPARATOR PRCN 8-DIP-P	01295	SN72311P
A1U29	1826-0410	9		OP AMP BIFET 14-DIP-P	01295	TL084CN
A1U30	1820-0668	7	1	IC BFR TTL NON-INV HEX 1-INP	01295	SN7407N
A1U31	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
A1U32	1820-1441	6	2	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A1U33	1820-1491	6		IC BFR TTL LS NON-INV HEX 1-INP	01295	SN74S367AN
A1U34	1820-1443	8	3	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A1U35	1826-0410	9		OP AMP BIFET 14-DIP-P	01295	TL084CN
A1U36	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A1U37	1820-1198	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A1U38	1820-1428	9	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
A1U39	1820-1272	1	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS33N
A1U40	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A1U41	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A1U42	1820-1196	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74L8174N
A1U43	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A1U44	1820-1546	2		MULTIPLXR ANLG DUAL 16-DIP-C	04713	MC14052BCL
A1U45	1820-1420	1	1	IC CNTR TTL LS DIV-X-12 ASYNCHRO	01295	SN74LS92N
A1U46	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A1W1	07225-60053	0	1	WIRE ASSEMBLY	28480	07225-60053
A1W2	07225-60054	1	1	WIRE ASSEMBLY	28480	07225-60054
A1W3	07225-60055	2	1	WIRE ASSEMBLY	28480	07225-60055
A1W4	07225-60056	3	1	WIRE ASSEMBLY	28480	07225-60056
A1W5	07225-60057	4	1	WIRE ASSEMBLY	28480	07225-60057
A1Y1	0410-1179	7	1	CRYSTAL-QUARTZ 4.00 MHZ +-50 PPM	28480	0410-1179

Table 4-3. Front Panel PCA (A2) Parts List

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	07225-60104	2	1	PCA-FRONT PANEL	28480	07225-60104
A2DS1	1990-0521	0	1	LED-VISIBLE LUM-INT=2.2MCD IF=50MA-MAX	28480	5082-4955
A2DS2	1990-0524	3	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4550
A2DS3	1990-0524	3		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4550
A2DS4	1990-0487	7	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A2DS5	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A2E1	09872-40006	8	3	SPACER, LED	28480	09872-40006
A2E2	09872-40006	8		SPACER, LED	28480	09872-40006
A2E3	09872-40006	8		SPACER, LED	28480	09872-40006
A2S1	5060-9436	7	12	PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S2	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S3	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S4	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S5	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S6	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S7	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S8	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S9	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S10	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S11	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
A2S12	5060-9436	7		PUSHBUTTON SWITCH P.C. MOUNT	28480	5060-9436
	5041-0059	2	4	KEY CAP, HALF, ARROW	28480	5041-0059
	5041-0061	6	1	KEY CAP, FULL, PEN DOWN	28480	5041-0061
	5041-0062	7	1	KEY CAP, FULL, PEN UP	28480	5041-0062
	5041-0063	8	1	KEY CAP, FULL, FAST	28480	5041-0063
	5041-0064	9	1	KEY CAP, FULL, LOWER LEFT	28480	5041-0064
	5041-0067	2	1	KEY CAP, FULL, UPPER RIGHT	28480	5041-0067
	5041-0068	3	1	KEY CAP, CHART HOLD	28480	5041-0068
	5041-0069	4	1	KEY CAP, FULL, ENTER	28480	5041-0069
	5041-0936	4	1	KEY CAP, FULL, RESET	28480	5041-0936

Table 4-4. Main Cable PCA (A3) Parts List

Reference Designation	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
A3	07225-60102	0	1	PCA, MAIN CABLE	28480	07225-60102
A3C1	0180-0583	6	2	CAPACITOR-FXD 6000UF+75-10% 30VDC AL	28480	0180-0583
A3C2	0180-0583	6		CAPACITOR-FXD 6000UF+75-10% 30VDC AL	28480	0180-0583
A3CR1	1901-1081	2	4	DIODE-PWR RECT 100V 3A	04713	MR501
A3CR2	1901-1081	2		DIODE-PWR RECT 100V 3A	04713	MR501
A3CR3	1901-1081	2		DIODE-PWR RECT 100V 3A	04713	MR501
A3CR4	1901-1081	2		DIODE-PWR RECT 100V 3A	04713	MR501
A3E1	0360-1514	7	2	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3E2	0360-1514	7		TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
A3E3	0363-0144	3	1	CONTACT-TABLE LONG	28480	0363-0144
A3E4	0363-0145	4	1	CONTACT-TABLE SHORT	28480	0363-0145
A3E5	2110-0269	0	8	FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E6	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E7	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E8	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E9	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E10	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E11	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E12	2110-0269	0		FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A3E13	07225-20007	0	4	SPACER, CABLE, PCB	28480	07225-20007
A3E14	07225-20007	0		SPACER, CABLE, PCB	28480	07225-20007
A3E15	07225-20007	0		SPACER, CABLE, PCB	28480	07225-20007
A3E16	07225-20007	0		SPACER, CABLE, PCB	28480	07225-20007
A3F1	2110-0304	4	2	FUSE 1.5A 250V SLO-BLO 1.25X.25 UL IEC	28480	2110-0304
A3F2	2110-0304	4		FUSE 1.5A 250V SLO-BLO 1.25X.25 UL IEC	28480	2110-0304
A3F3	2110-0360	2	2	FUSE .75A 250V SLO-BLO 1.25X.25 UL IEC	75915	313.750
A3F4	2110-0360	2		FUSE .75A 250V SLO-BLO 1.25X.25 UL IEC	75915	313.750
A3H1	0361-0142	7	2	RIVET-SEMITUB OVH .123 DIA .156 LG	00000	ORDER BY DESCRIPTION
A3H2	0361-0142	7		RIVET-SEMITUB OVH .123 DIA .156 LG	00000	ORDER BY DESCRIPTION
A3H3	1400-0482	3	2	CABLE TIE .062-3-DIA .14-MD NYL	28480	1400-0482
A3H4	1400-0482	3		CABLE TIE .062-3-DIA .14-MD NYL	28480	1400-0482
A3J1	1251-3618	6	1	CONNECTOR 2-PIN M POST TYPE	28480	1251-3618
A3J2	1251-5552	1	2	CONNECTOR 10-PIN F FLEXIBLE CIRCUIT	28480	1251-5552
A3J3	1251-5552	1		CONNECTOR 10-PIN F FLEXIBLE CIRCUIT	28480	1251-5552
A3J4	1251-3192	1	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-3192
A3R1	0686-3355	8	4	RESISTOR 3.3M 5% .5W CC TC=0+1000	01121	EB3355
A3R2	0686-3355	8		RESISTOR 3.3M 5% .5W CC TC=0+1000	01121	EB3355
A3R3	0686-3355	8		RESISTOR 3.3M 5% .5W CC TC=0+1000	01121	EB3355
A3R4	0686-3355	8		RESISTOR 3.3M 5% .5W CC TC=0+1000	01121	EB3355

Table 4-5. Upper and Lower Deck Assemblies Parts List

Item No.	HP Part Number	CD	Qty	Description	Mfr Code	Mfr Part Number
1	7120-1255	2	1	LABEL, PLATE (HP LOGO)	28480	7120-1255
2	07225-60004	1	1	COVER, TUB ASSEMBLY	28480	07225-60004
3	07225-20072	9	2	WASHER, SHOULDERED	28480	07225-20072
4	2200-0111	2	28	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
5	3050-0222	8	11	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0222
6	2200-0103	2	8	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
7	07225-60104	2	1	PCA, FRONT PANEL	28480	07225-60104
8	07225-60001	8	1	TRANSFORMER ASSEMBLY, POWER	28480	07225-60001
9	2510-0148	2	4	SCREW-MACH 6-32 1.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
10	07225-40015	2	4	BUMPER, STOP	28480	07225-40015
11	07225-20055	8	1	SIDE FRAME, LEFT	28480	07225-20055
12	07225-00030	7	1	SHROUD, FAN	28480	07225-00030
13	3160-0314	2	1	FAN BLADE 19-CFM 2.06-OD .125-ID	28480	3160-0314
14	07225-60035	8	1	MOTOR ASSEMBLY, FAN	28480	07225-60035
15	2200-0117	8	5	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
16	07225-60042	7	1	PEN HOLDER ASSEMBLY	28480	07225-60042
17	07225-40044	7	1	COVER, SOLENOID	28480	07225-40044
18	7120-7495	4	1	LABEL, BLANK (Y STATOR TRIM)	28480	7120-7495
19	4040-1485	7	1	COVER, Y STATOR	28480	4040-1485
20	07225-60120	2	1	MOTOR ASSEMBLY, X	28480	07225-60120
21	07225-60008	5	1	SUPPORT, PCB ASSEMBLY	28480	07225-60008
22	07225-60045	0	1	CABLE ASSEMBLY, X LIMIT SWITCH	28480	07225-60045
23	2260-0009	3	1	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
24	0520-0177	6	2	SCREW-MACH 2-56 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
25	3101-2278	7	1	SWITCH, SEN-SPDT (X-LIM. SWITCH)	28480	3101-2278
26	07225-00015	8	1	HOLDER, X-LIMIT SWITCH	28480	07225-00015
27	07225-20004	7	1	GUIDE, PAPER (STOP)	28480	07225-20004
28	07225-00117	1	1	SPACER-TABLE, ALUMINUM	28480	07225-00117
29	07225-60117	7	1	TABLE ASSEMBLY (ALUMINUM)	28480	07225-60117
30	07225-20025	2	1	TRIM-STATOR, X	28480	07225-20025
31	07225-60005	2	1	STATOR ASSEMBLY, X	28480	07225-60005
32	07225-00118	2	1	SPACER-TABLE, FIBER	28480	07225-00118
33	07225-20056	9	1	SIDE FRAME, RIGHT	28480	07225-20056
34	3050-0947	4	4	WASHER-FL MTLC NO. 6 .146-IN-ID	28480	3050-0947
35	0570-0657	2	4	SCREW-SOCKET HD HEX CAP 6-32 .625 IN-LG	28480	0570-0657
36	07225-40005	0	4	FOOT, PLASTIC MOULDED	28480	07225-40005
37	07225-40035	6	1	GUIDE-PAPER, X	28480	07225-40035
38	2200-0107	6	6	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
39	07225-00016	9	2	TUBE-STRAIN RELIEF	28480	07225-00016
40	07225-60102	0	1	PCB, CABLE BOARD	28480	07225-60102
41	07225-40001	6	1	SUPPORT, Y COVER, FRONT	28480	07225-40001
42	07225-60011	0	1	CABLE ASSEMBLY, MOTOR Y	28480	07225-60011
43	07225-60010	9	1	CABLE ASSEMBLY, MOTOR X	28480	07225-60010
44	07225-60049	4	1	SHIELD, AC POWER MODULE	28480	07225-60049
45	2200-0570	7	1	SCREW-MACH 4-40 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
46	2200-0105	4	1	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
47	07225-00064	7	1	BRACKET, TOP COVER	28480	07225-00064
48	07225-60105	3	1	PCA, MAIN	28480	07225-60105
49	0380-0907	2	1	SPACER-RND .25-IN-LG .12-IN-ID .25-IN-OD	00000	ORDER BY DESCRIPTION
50	07225-60003	0	1	TUB ASSEMBLY	28480	07225-60003
51	3150-0348	1	1	FILTER-AIR 30 PORES/IN	28480	3150-0348
52	07225-40050	5	1	FRAME, FILTER-AIR	28480	07225-40050

Table 4-6. Pen Arm (Y Stator) Assembly Parts List

Item No.	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
	07225-60030	3	1	PEN LIFT ASSEMBLY	28480	07225-60030
1	1460-1687	8	1	SPRING-GTR 1.58-MM-OD 47.1-MM-LG-ACT-BDY	28480	1460-1687
2	07225-20091	2	1	SLIDER-PEN	28480	07225-20091
3	1460-1724	4	1	SPRING, EXTENSION	28480	1460-1724
4	07225-40070	9	1	LIFT, SHROUD	28480	07225-40070
5	0570-0656	1	1	SCREW-NYLOK 4-40 10.5 MM-LG	28480	0570-0656
6	07225-20090	1	1	LIFT-BEARING PLATE	28480	07225-20090
	07225-60042	7	1	PEN HOLDER ASSEMBLY	28480	07225-60042
7	0520-0173	2	8	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
8	07225-40044	7	1	COVER, SOLENOID	28480	07225-40044
9	2200-0582	1	1		28480	2200-0582
10				NOT ASSIGNED		
11	07225-40042	5	1	LIFT-EXTENSION	28480	07225-40042
12	07225-00041	0	1	SOLENOID PLATE-TOP	28480	07225-00041
13	2190-0103	9	2	WASHER-LK INTL T NO. 2 .089-IN-ID	28480	2190-0103
14	07225-20049	0	1	GUIDE-SPRING, UPPER	28480	07225-20049
15	1460-1680	1	1	SPRING, COMPRESSION	28480	1460-1680
16	07225-20048	9	1	GUIDE-SPRING	28480	07225-20048
17	3050-0855	3	1	WASHER-FL NM 2.5 MM 3-MM-ID 17-MM-OD	28480	3050-0855
18	07225-60041	6	1	COIL ASSEMBLY, SOLENOID	28480	07225-60041
19	0520-0174	3	3	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
20	07225-20103	7	1	PCB, TERMINATION, SOLENOID	28480	07225-20103
21	07225-00042	1	1	SOLENOID PLATE-BOTTOM	28480	07225-00042
22	2200-0107	6	1	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
23	0520-0128	6	1	SCREW-MACH 2-56 .500-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
24	4040-1458	4	1	SOLENOID MOUNTING PLATE	28480	4040-1458
25	2190-0112	0	2	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0112
26	0520-0130	1	2	SCREW-MACH 2-56 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
27	07225-60121	3	1	MOTOR ASSEMBLY-Y	28480	07225-60121
28	07225-40006	1	1	PLATE, Y MOTOR RETAINING	28480	07225-40006
29	07225-40040	3	2	FRAME, MOUNT, ACCELEROMETER	28480	07225-40040
30	07225-60020	1	2	ACCELEROMETER ASSEMBLY	28480	07225-60020
31	1600-0746	6	1	CLAMP, Y MOTOR	28480	1600-0746
32	0520-0176	5	2	SCREW-MACH 2-56 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
33	07225-40001	6	1	SUPPORT-Y COVER, FRONT	28480	07225-40001
34	07225-60011	0	1	CABLE ASSEMBLY- MOTOR Y	28480	07225-60011
35	07225-60006	3	1	STATOR ASSEMBLY- Y	28480	07225-60006
36	0624-0430	4	2	SCREW-TPG 3-28 .5-IN-LG PAN-HD-POZI	28480	0624-0430
37	7120-7495	4	1	LABEL, BLANK (Y STATOR TRIM)	28480	7120-7495
38	4040-1485	7	1	COVER, Y STATOR	28480	4040-1485
39	07225-20025	2	1	TRIM-STATOR, X	28480	07225-20025
40	07225-60005	2	1	STATOR ASSEMBLY-X	28480	07225-60005
41	0570-0657	2	2	SCREW-SOCKET HD HEX CAP 6-32 .625 IN-LG	28480	0570-0657
42	3050-0959	8	2	WASHER-FL MTLC NO. 6 .148-IN-ID	28480	3050-0959
43	07225-20018	3	1	SUPPORT, Y-ARM	28480	07225-20018
44	07225-40060	7	2	BUMPER, Y-SUPPORT	28480	07225-40060
45	07225-60120	2	1	MOTOR ASSEMBLY-X	28480	07225-60120
46	1600-0736	4	1	CLAMP-CABLE	28480	1600-0736
47	07225-60010	9	1	CABLE ASSEMBLY-MOTOR, X	28480	07225-60010
48	1600-0745	5	1	CLAMP- X MOTOR	28480	1600-0745
49	0520-0185	6	1	SCREW-MACH 2-56 .125-IN-LG PAN-HD-PDZI	00000	ORDER BY DESCRIPTION
50	3050-0946	3	2	WASHER-FL MTLC NO. 5 .122-IN-ID	28480	3050-0946
51	0570-0658	3	2	SCREW-SOCKET HD HEX CAP 6-32 .5 IN-LG	28480	0570-0658
52	07225-40030	1	1	SUPPORT-Y COVER, REAR	28480	07225-40030
53	1600-0765	9	1	HOLDER- Y CABLE	28480	1600-0765
54	07225-60050	7	1	WIRE ASSEMBLY-Y LIMIT SWITCH	28480	07225-60050

Table 4-7. Code List of Manufacturers

Mfr No.	Manufacturer Name	Address	Zip Code
01121	Allen-Bradley Company	Milwaukee, WI	53204
01295	Texas Instruments, Inc., Semiconductor Component Div.	Dallas, TX	75222
0192B	RCA Corporation, Solid State Div.	Somerville, NJ	08876
02114	Ferroxcube Corporation	Saugerties, NY	12477
03508	GE Company, Semiconductor Prod. Dept.	Syracuse, NY	13201
03888	KDI Pyrofilm Corporation	Whippany, NJ	07981
04713	Motorola Semiconductor Products	Phoenix, AZ	85062
07263	Fairchild Semiconductor Div.	Mountain View, CA	94042
13103	Thermalloy Company	Dallas, TX	75234
14936	General Instr. Corporation, Semidon. Prod. Group	Hicksville, NY	11802
19701	Mepco/Electra Corporation	Mineral Wells, TX	76067
24546	Corning Glass Works (Bradford)	Bradford, PA	16701
27014	National Semiconductor Corporation	Santa Clara, CA	95051
28480	Hewlett-Packard Company, Corporate Headquarters	Palo Alto, CA	94304
56289	Sprague Electric Company	North Adams, MA	01247
75042	TRW, Inc., Philadelphia Div.	Philadelphia, PA	19108
75915	Littelfuse, Inc.	Des Plaines, IL	60016

Table 4-8. Reference Designators and Abbreviations

REFERENCE DESIGNATIONS

A . . . . . assembly
B . . . . . fan; motor
C . . . . . capacitor
CR . . . . . diode; diode thyristor; varactor
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
J . . . . electrical connector (stationary portion); jack
L . . . . . coil; inductor
MP . . . . . miscellaneous mechanical part
P . . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RN . . . . . resistor network
S . . . . . switch
T . . . . . transformer
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
W . . . . cable; transmission path; wire
X . . . . . socket
Y . crystal unit (piezoelectric or quartz)

ABBREVIATIONS

A . . . . . ampere
AC . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AL . . . . . aluminum
AMPL . . . . . amplifier
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BKDN . . . . . breakdown
CAL . . . . . calibrate
ccw . . . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
CONN . . . . . connector
COS . . . . . cosine
CP . . . . . cadmium plate
CTL . . . . complementary transistor log
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dc . . . . . direct current
deg . . degree (temperature interval or difference)
. . .° . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DTL . . . . diode transistor logic
DVM . . . . digital voltmeter
DXØ-DX4 . . . X data (bits Ø thru 4)
DYØ-DY4 . . . Y data (bits Ø thru 4)
ECL . . . . emitter coupled logic
EMF . . electromotive force
ELECT . . . . . electrolytic
EN . . . . . enable
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat-head
FIL H . . . . . fillister head
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HI . . . . . high
HP . . . . . Hewlett-Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . integrated circuit
ID . . . . . inside diameter
IMPG . . . . . impregnated
in . . . . . inch
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
I/O . . . . . input/output
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . . . low
LOG . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
LSB . . least significant bit
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . . metallic oxide
MFR . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
MIN . . . . . minimum
min . . . . . minute (time)
. . .′ . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MSB . . most significant bid
MTG . . . . . mounting
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak-to-peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
μA . . . . . microampere
μF . . . . . microfarad
μH . . . . . microhenry
μs . . . . . microsecond
μV . . . . . microvolt
μVac . . . . . microvolt, ac
μVdc . . . . . microvolt, dc
μVpk . . . . microvolt, peak
μVp-p . . . microvolt, peak-to-peak
μVrms . . . . microvolt, rms
μW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NEG . . . . . negative
NI PL . . . . . nickel plate
N/O . . . . . normally open
NOM . . . . . nominal
NORM . . . . . normal
NPN . . . negative-positive-negative
NPO . . . . negative-positive zero (zero temperature coefficient)
NRFR . . not recommended for field replacement
NSR . . . . . not separately replaceable
ns . . . . . nanosecond
OBD . order by description
OD . . . . outside diameter
OH . . . . . oval head
OP AMPL . . . . operational amplifier
OPT . . . . . option
OSC . . . . . oscillator
OX . . . . . oxide
oz . . . . . ounce
Ω . . . . . ohm
P . . . . peak (used in parts list)

NOTE

All abbreviations in the parts list will be in upper-case.

Table 4-8. Reference Designators and Abbreviations (Continued)

PC . . . . . printed circuit
PCA . . . . . printed circuit assembly
pF . . . . . picofarad
PHL . . . . . Phillips
PIV . . . . . peak inverse voltage
pk . . . . . peak
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
POZI . . . . . pozidriv
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PWR . . . . . power
PWV . . . . . peak working voltage
RAM . . . . . random access memory
RC . resistance-capacitance
RECT . . . . . rectifier
REF . . . . . reference
REG . . . . . regulated
REPL . . . . . replaceable
RF . . . . . radio frequency
RFI . . . . radio frequency interference
RH . . . . round head; right hand
RLC . . . . . resistance-inductance-capacitance
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
RWV . . . . reverse working voltage
s . . . . . second (time)
. . . " . . . . . second (plane angle)
S-B . . . . . slow-blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier; screw
SE . . . . . selenium
SECT . . . . . sections
SEMICON . . semiconductor
SI . . . . . silicon
SIN . . . . . sine
SPDT . . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . . single-pole, single-throw
SST . . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SYNC . . . . . synchronize
T . . . . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TSTR . . . . . transistor
TTL . . . . . transistor-transistor logic
U . . . . micro (10^{-6}) (used in parts list)
UF . . . . microfarad (used in parts list)
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VTVM . . . . . vacuum-tube voltmeter
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
Z_o characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
M	mega	10^6
k	kilo	10^3
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

N
M
SY
:IGURE 4-21

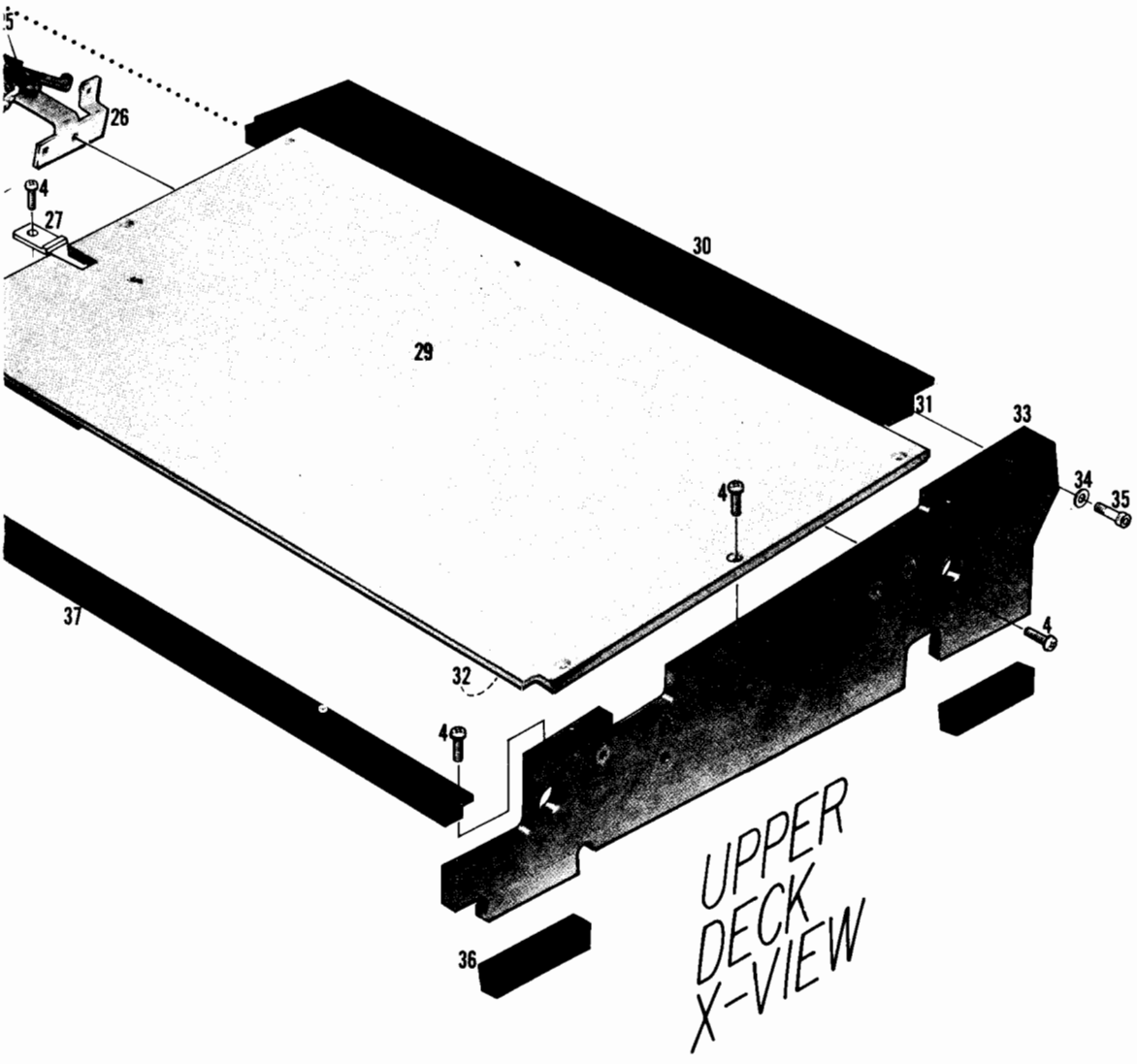
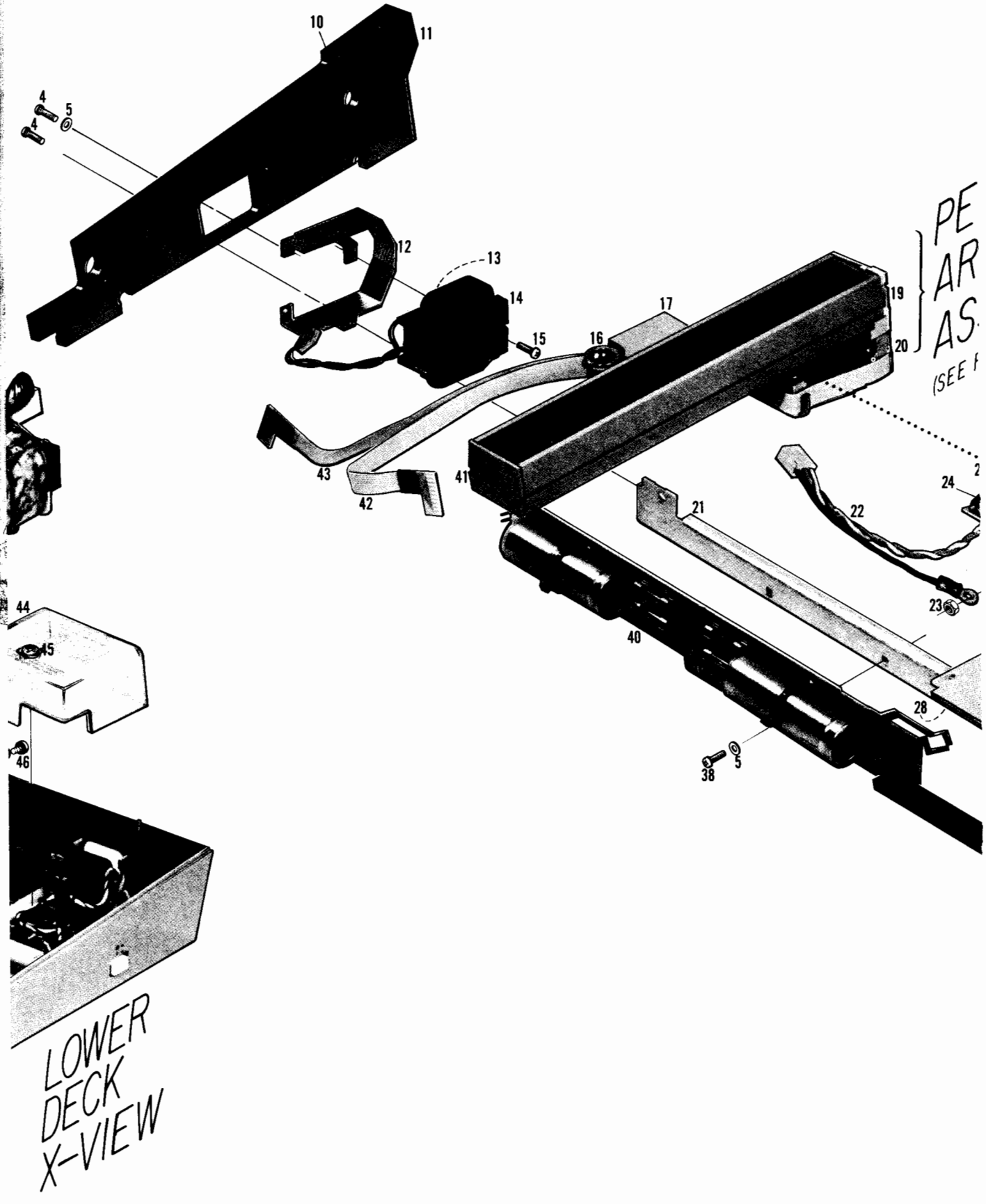


Figure 4-1. Upper and Lower Deck Assembly

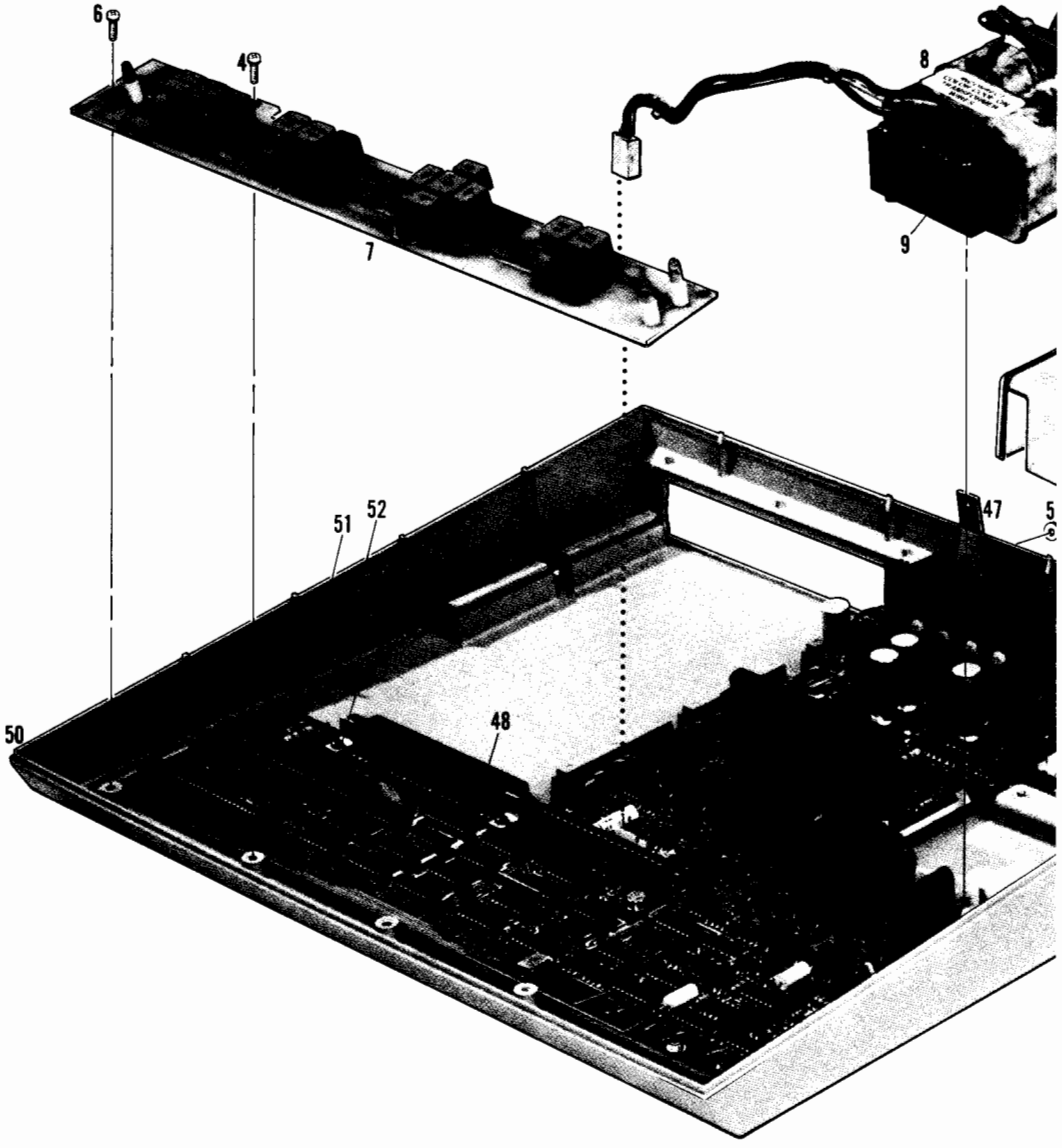


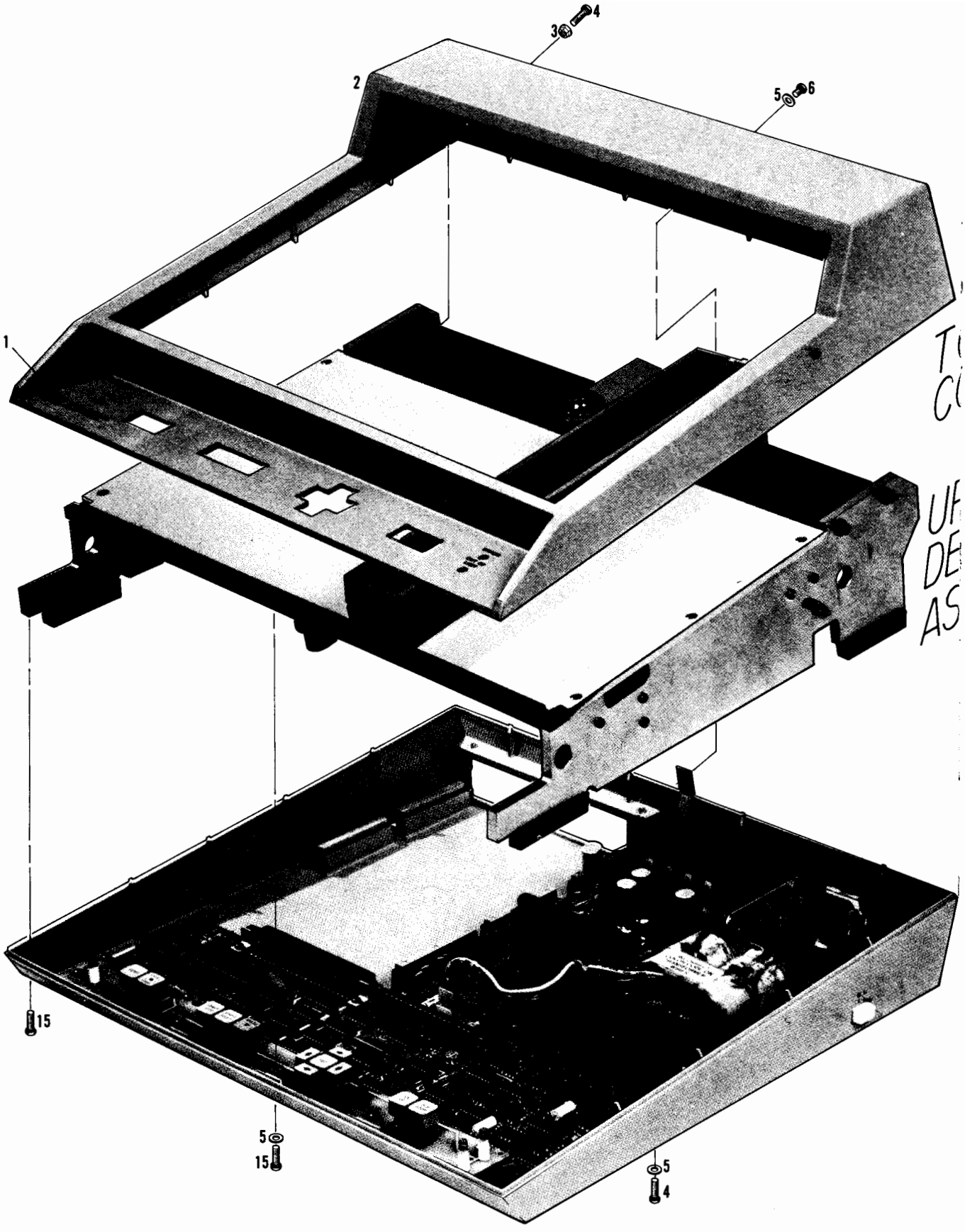
LOWER DECK X-VIEW

OP
OVER

PER
CK
SY

LOWER
DECK
ASSY

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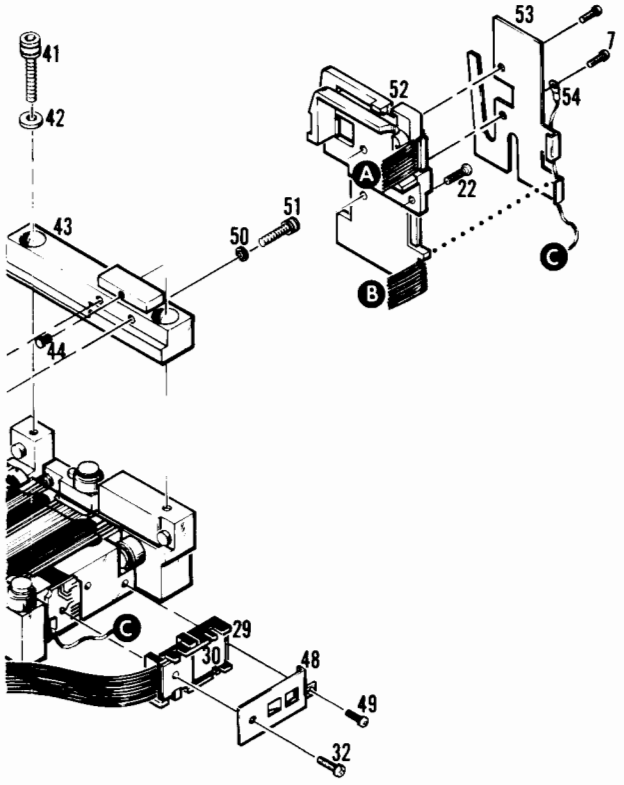
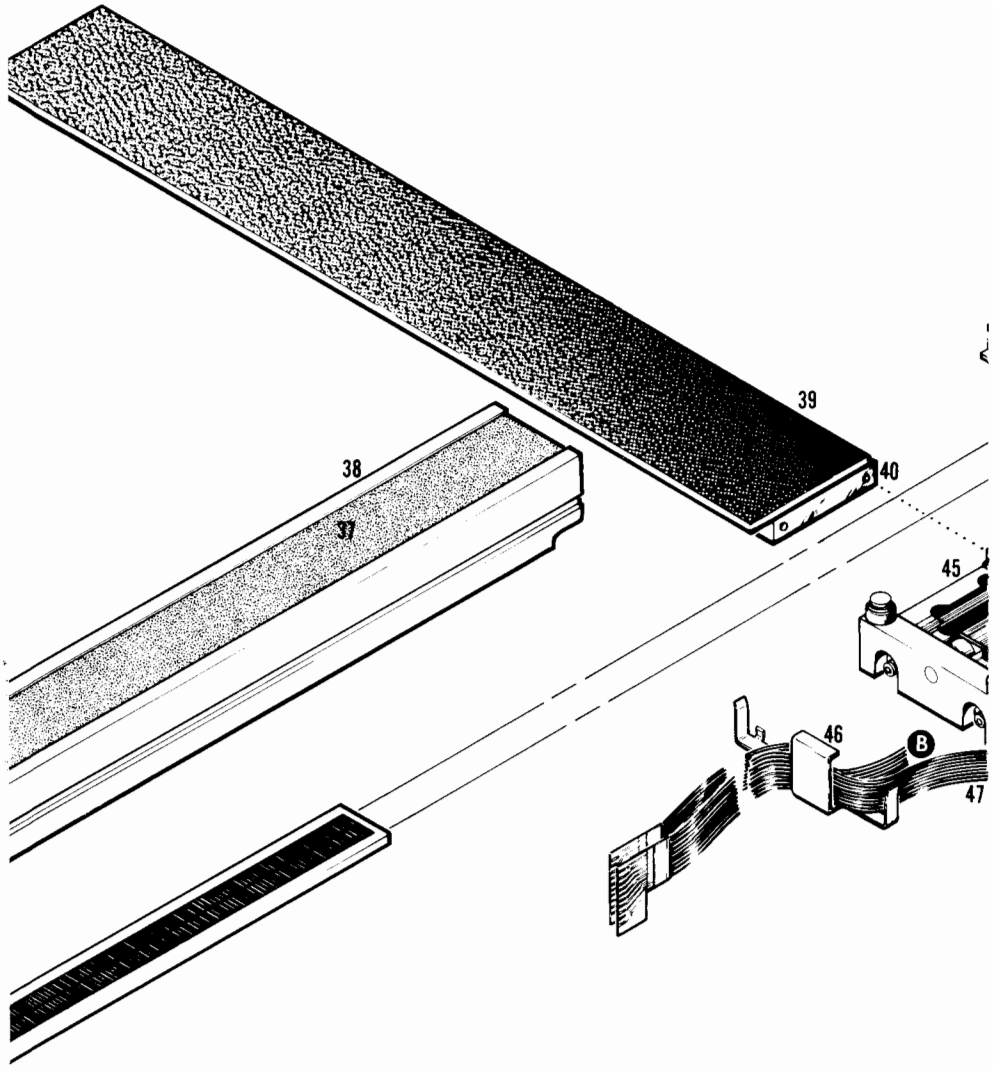
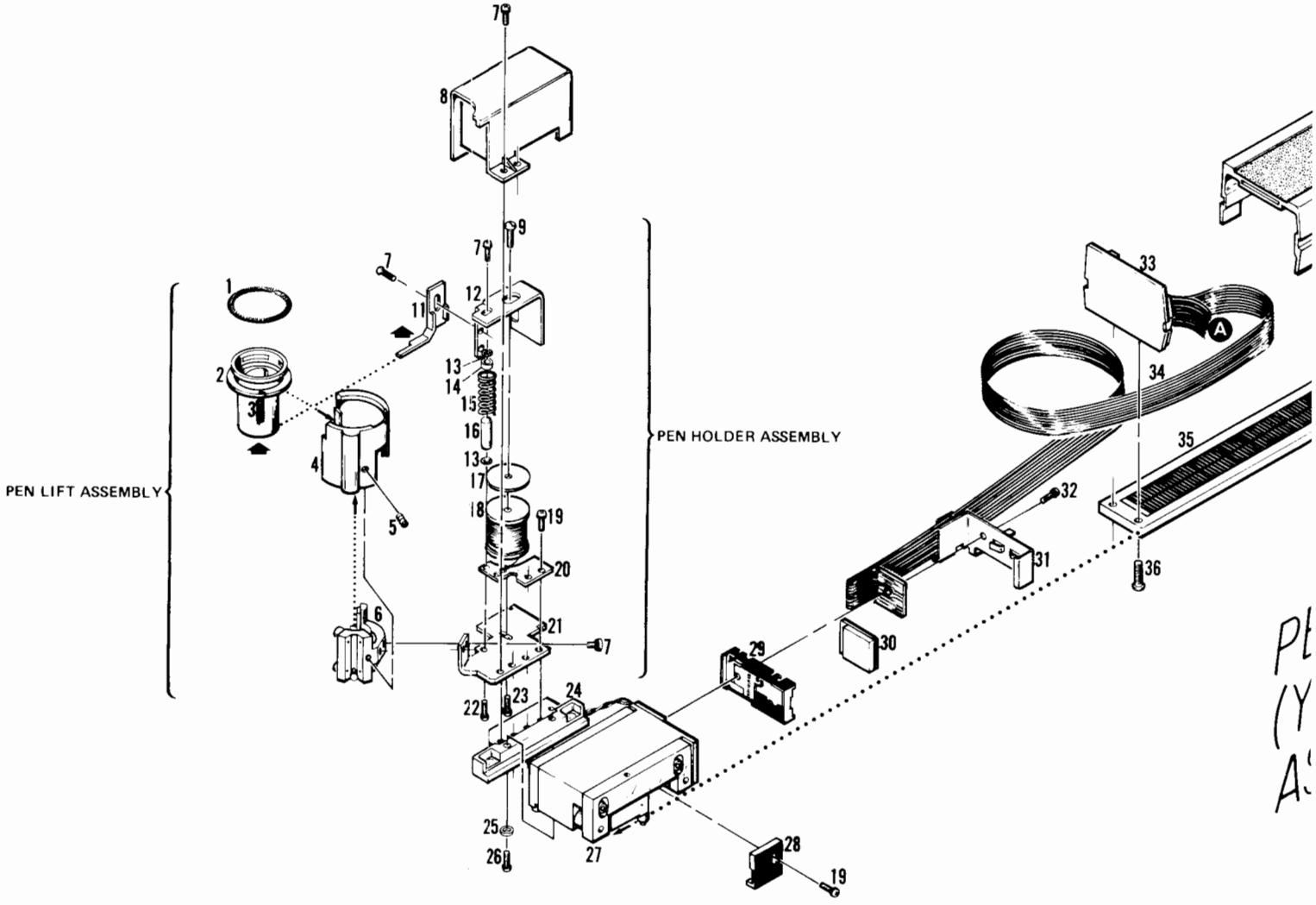


Figure 4-2. Pen Arm (Y Stator) Assembly



EN ARM
STATOR)
SSEMBLY


PEN LIFT ASSEMBLY
PEN HOLDER ASSEMBLY
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SECTION V

MANUAL CHANGES

5-1. INTRODUCTION.

5-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to PLOTTERS COVERED BY MANUAL in Section I for additional important information about serial number coverage.

SECTION VI

SERVICE

6-1. INTRODUCTION.

6-2. This section contains information needed for repair and maintenance of the Model 7225A, including:

Theory of Operation

Preventive Maintenance

Troubleshooting Information

Replacement of Parts

Functional Block Diagram

Schematic Diagrams

Component Location Figures

The circuits are shown on four schematic diagrams, identified as Service Sheet 1 through 4. Each connection between schematics is identified by a signal letter. In addition, a number indicates the service sheet of origin or destination of the connection.

6-3. Service information for the Input/Output modules is contained in separate service manuals.

6-4. BASIC THEORY OF OPERATION.

6-5. The Model 7225A uses microprocessor-based logic to convert digital instructions into a graphic plot. The microprocessor (referred to as the Servo Processor) receives instructions from an external controller through an Input/Output (I/O) module. It then issues data which are converted to analog voltages to drive the X-axis and Y-axis step motors. For each X or Y motor step, the Servo Processor issues a 5-bit binary address to a Read Only Memory (ROM). The ROM output for each address is an 8-bit binary code which is changed by a digital-to-analog converter to an analog voltage that is amplified to drive the motor.

6-6. Because each motor has two windings (sine and cosine), motor drive information must be synchronized through the circuits in four time periods. This synchronization is accomplished by the timing and control circuits, which operate from a crystal-controlled 4 MHz clock.

6-7. Vibration due to motor movement causes accelerometers in the X and Y motor assemblies to produce feedback voltages which are combined with the motor drive signals to smooth the pen movement.

6-8. Front panel pushbuttons may be used to lower and raise the pen, to place the pen in any location within the maximum plotting area, and to enter plotting limits into the Servo Processor memory.

6-9. FUNCTIONAL THEORY OF OPERATION.

6-10. The following information describes the circuits that are shown on the Functional Block Diagram, Figure 6-44, and the schematic diagrams on Service Sheets 1 through 4 in this section of the manual.

6-11. SERVO PROCESSOR.

6-12. The microprocessor (A1U22) on the Main Printed Circuit Assembly is referred to as the Servo Processor. It can be defined primarily by describing its input and output signals, which are grouped as follows:

Input/Output Ports (4 ports, 8 lines each)

External Interrupt

Clock Input

Reset

Table 6-1 lists pin numbers and signal names and gives a brief signal description.

6-13. The Servo Processor has 2048 bytes of Read Only Memory which contain the fixed algorithms required for plotting and labeling. Sixty-four bytes of random access memory serve as "scratch pad" memory for current operation. The input/output ports carry information to and from the servo processor memory.

6-14. RESET INPUT.

6-15. A low (true) signal at this input from the A1Q30/31 circuit (Service Sheet 1) sets the Servo Processor to the proper initial conditions. When the line switch is set from OFF to ON, Q30 and Q31 turn on, connecting reset to common. This condition is maintained until all power supply voltages have stabilized. The front panel RESET pushbutton switch does not connect to this input.

6-16. EXTERNAL INTERRUPT (CONFIDENCE TEST).

6-17. Pressing the rear panel CONFIDENCE TEST pushbutton sets the External Interrupt line low. This initiates a processor routine which produces a prescribed fan-shaped plot to demonstrate that the circuits and motors are operating correctly. If an I/O module is installed in the plotter, it should print "END OF TEST" above the plot at completion of the test. Errors or irregularities in this test may be used to point out a faulty circuit or mechanical assembly.

Pin Designation	Pin No.	Functional Description
$\overline{P0\text{-}0}$	3	$\overline{DX0}$
$\overline{P0\text{-}1}$	4	$\overline{DX1}$
$\overline{P0\text{-}2}$	5	$\overline{DX2}$
$\overline{P0\text{-}3}$	6	$\overline{DX3}$
$\overline{P0\text{-}4}$	19	$\overline{DX4}$ } X motor step address output.
$\overline{P0\text{-}5}$	18	Chart Load input.
$\overline{P0\text{-}6}$	17	Reset input. Low = Reset.
$\overline{P0\text{-}7}$	16	Pen Up/Down input. Low = Down; High = Up.
$\overline{P1\text{-}0}$	37	$\overline{DY0}$
$\overline{P1\text{-}1}$	36	$\overline{DY1}$
$\overline{P1\text{-}2}$	35	$\overline{DY2}$
$\overline{P1\text{-}3}$	34	$\overline{DY3}$
$\overline{P1\text{-}4}$	22	$\overline{DY4}$ } Y motor step address output.
$\overline{P1\text{-}5}$	23	Y limit switch input.
$\overline{P1\text{-}6}$	24	X limit switch input.
$\overline{P1\text{-}7}$	25	Control input from I/O module.
$\overline{P4\text{-}0}$	8	Flag output to I/O module.
$\overline{P4\text{-}1}$	9	Pen control output to pen drive and I/O module. Low = Down.
$\overline{P4\text{-}2}$	10	Enter Light output.
$\overline{P4\text{-}3}$	11	Chart Load output. Low = light on; hold voltage disabled.
$\overline{P4\text{-}4}$	12	Status output to I/O module.
$\overline{P4\text{-}5}$	13	Compensation clock output during acceleration and deceleration.
$\overline{P4\text{-}6}$	14	Front Panel Disable when Low.
$\overline{P4\text{-}7}$	15	No Connection.
$\overline{P5\text{-}0}$	33	Enter input from front panel or I/O module. Pen Status output. Low = Down; High = Up (command or data). Compensation data (Data Bus 0).
$\overline{P5\text{-}1}$	32	Lower Left input. Lower Left or Upper Right changed status. Compensation data (Data Bus 1).
$\overline{P5\text{-}2}$	31	Upper Right input. Digitizer status. Compensation data (Data Bus 2).
$\overline{P5\text{-}3}$	30	Right arrow. Front panel power-on initialize status ("0" = not initialize). Compensation data (Data Bus 3).
$\overline{P5\text{-}4}$	29	Left arrow. Chart Load status ("0" = chart hold activated; "1" = chart hold disabled) Compensation data (Data Bus 4).
$\overline{P5\text{-}5}$	28	Up arrow. Error status (X/Y input position out of range). Compensation Data (Data Bus 5).
$\overline{P5\text{-}6}$	27	Down arrow. Compensation data ("1" = X is fast axis; "0" = Y is fast axis).
$\overline{P5\text{-}7}$	26	Fast. Compensation ("0" = + full scale or + full scale for fast axis; "1" = – full scale or –full scale for fast axis).
External Interrupt	38	Confidence Test Switch input. Initiates execution of confidence test plot subroutine.
XTL 2	2	4 MHz clock input.
$\overline{Reset}$	39	Resets program counter to zero.

6-18. RESPONSE TO FRONT PANEL SWITCHES.

6-19. All of the front panel switches are momentary contact (non-latching). For the PEN DOWN and CHART LOAD commands the Servo Processor provides the latching action by holding an output line low (true). The PEN UP command releases the pen down latching action and the pen is lifted by a spring. Pressing the CHART LOAD switch results in a "toggle" action by the servo processor. The instrument turns on with the chart hold voltage on. Pressing the switch once disables the chart hold high voltage and moves the pen carrier to the initialized position at the upper right. Pressing the same switch a second time turns the chart hold voltage on again. The CHART LOAD indicator is lit when the chart hold voltage is off. The light is enabled by the same processor output that disables the chart hold voltage.

6-20. The ENTER key is used to enter the LOWER LEFT and UPPER RIGHT plot limits into the Servo Processor memory. After these limits have been set, pressing either LOWER LEFT or UPPER RIGHT moves the pen to the position selected. Pressing RESET moves the pen to the initialized position, then returns it to the last previously programmed position. The plotter only resets the pen position without changing any programmed parameters. Pressing ENTER then RESET erases the preset positions from memory and moves the pen to the initialized position. After the ENTER key is pressed, the indicator in the center of the key will flash until any other key (except PEN UP/DOWN) is pressed.

6-21. While any of the directional (arrow) keys is held down the Servo Processor issues the required X or Y data to keep the pen moving in the direction indicated. Pressing an X and Y key at the same time moves the pen at a 45° angle. Pressing the FAST key with a directional key (or keys) increases the rate of travel by increasing the rate that the Servo Processor issues step addresses.

6-22. X/Y STEP MOTOR OPERATION.

6-23. The X and Y pen drive motors are linear step motors, requiring no drive cables, pulleys, or slidewires. The stator is in the form of a bar, and the armature is supported on and guided along the bar by ball bearings. Motor steps are defined by "teeth" on the stator which are spaced at 1.024 mm (0.04 in.) intervals. The motors are capable of 32 steps for each space; consequently, the smallest step length is 0.032 mm (0.0013 in.).

6-24. Movement of the motor armature in relation to the stator is effected by varying the magnitude and direction of currents through two windings on the armature. These are called the sine (SIN) and cosine (COS) windings, and are illustrated in the simplified diagram of Figure 6-1. These currents are controlled primarily by digital step data from the Servo Processor.

6-25. The teeth on the armature are offset in relation to the stator teeth as illustrated in Figure 6-1. Assume that the amplitude of the currents through the SIN and COS windings are equal and in the same direction, equal forces are exerted, and the armature is in the position shown. If the SIN current were then increased and the COS current decreased, the force relationship would change and the armature would move to the right. The changing forces exerted as a result of changes in the amplitude and direction of currents through the two windings cause the armature to move.

6-26. The Servo Processor issues one address for both SIN and COS windings. This address is used for the SIN current and a logic "1" is added to bit 3 of the address for the COS current.

6-27. If the space of one stator tooth is considered to be 360°, each step (32 steps per tooth) is 11.25°. Current in the SIN winding is proportional to the sine of the angle.

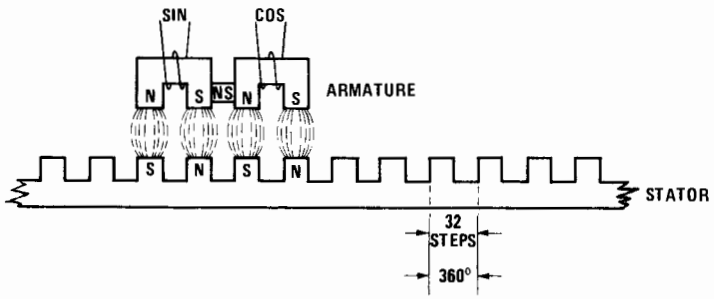


Figure 6-1. Step Motor

For example, maximum negative SIN current would occur at 270° (SIN 270° = -1). The COS current at the same time would be zero (COS 270° = 0). The current at each succeeding step would be in the same relationship (SIN 281.25° = -0.98; COS = 0.20, etc.).

6-28. When the Servo Processor receives a pen movement command, it calculates the number and direction of steps required to move from the last position to the new position, then issues the necessary step addresses. When the plot requires movement in both axes at the same time, the Servo Processor determines which axis requires the most steps and issues these addresses at the normal rate. Addresses for the shorter axis move are issued at a proportionally slower rate. For example, if the X axis required 1000 steps and the Y axis only 250 steps, one Y step would occur for each four X steps.

6-29. TIMING AND CONTROL.

6-30. Because the same circuits are used to process both X and Y motor drive information, timing circuits are required to make sure the information goes to the correct motor and winding. Figure 6-2 is a block diagram of the timing circuit dividers, along with the timing signals. The circled signal numbers identify the same signals in diagrams which follow.

6-31. A 4 MHz crystal-controlled oscillator provides the clock signal for the Servo Processor and for the processor in the Input/Output (I/O) module. The 4 MHz signal also goes to a series of counter circuits which divide it to provide control timing, ultimately producing a 7.8125 kHz square wave which could be called the machine, or X/Y, cycle. X-axis information is handled during one half of this cycle and Y-axis during the other half.

6-32. A 15.625 kHz square wave (two times the X/Y cycle frequency) is used to provide separate periods for motor drive information and velocity feedback data within each X and Y period. Other (higher) frequencies are used as gating and enabling signals for circuits which will be explained later.

6-33. ADDRESS MULTIPLEXER AND ADDER.

6-34. Because the X-axis and Y-axis motors each have a SIN and a COS winding, four drive signals are needed. This dictates that drive information be supplied during four separate time periods. These periods are allocated by signals from the timing and control circuits. Data from the Servo Processor is used in developing a five-bit address to a Read Only Memory (ROM) which produces an eight-bit code. This code is converted to motor drive information by a Digital-to-Analog (D/A) Converter. The ROM address selection process is illustrated in Figure 6-3.

6-35. A Multiplexer (U38) selects address data $\overline{DX0}$ through $\overline{DX3}$ or $\overline{DY0}$ through $\overline{DY3}$ and inverts the Servo Processor negative true logic to positive true logic. These data bits go to an adder (U41) where they are combined with acceleration correction data. Data bit $\overline{DX4}$ or $\overline{DY4}$ is selected by the $\overline{X}/Y$ and $X/\overline{Y}$ signals by means of wired - OR connections. The selected bit is then added in U32 to the carry output from the bit 0 through 3 addition. All five bits are stored in a latch, U42.

6-36. Data bits 0, 1, and 2 go directly from the latch to the ROM. Data bit 3 goes to an adder (U32) where a logic "1" is added to it during each cosine time period. Data bit 4 is added to a logic "1" in U32 to invert it to positive true logic. These five data bits are the ROM address A0 through A4.

6-37. ROM AND D/A CONVERTER.

6-38. Each time it is enabled, the Read Only Memory (see Figure 6-4) issues a predetermined eight-bit byte of binary data for the five-bit address at its input. Because the address is five bits, 32 different address and corresponding output bytes (2^5) are possible. The eight-bit output data byte goes to the Digital-to-Analog (D/A) converter, which produces an output current proportional to its binary input. While the ROM is not enabled its tri-state outputs are in the "don't care" state, permitting the same eight data lines to be used for compensation data input to the Converter. The compensation data is enabled while the ROM is disabled and vice versa.

6-39. The D/A Converter uses a reference voltage to develop an output current to an amplifier, proportional to the eight-bit binary code at the input. The amplifier output goes to both the Motor Drive Demultiplexer and the Compensation Demultiplexer.

6-40. DEMULTIPLEXER AND SAMPLE/HOLD AMPLIFIERS.

6-41. The motor drive control voltage from the D/A Converter is switched by the Demultiplexer (U19) to one of four Sample/Hold Amplifiers. Figure 6-5 shows the timing. The Demultiplexer contains two sets of switches which are connected in parallel for this application. When the Enable input is high all outputs are open circuit, and when any one output is active the other three outputs are open.

6-42. One of the Demultiplexer outputs is active for eight microseconds during each X and Y sine or cosine period. During this time the drive control voltage charges a capacitor at the input to one of the four Sample/Hold Amplifiers. The amplifier has a high input impedance so that when the Demultiplexer output becomes inactive (open) the voltage remains essentially constant (is "held") on the capacitor until it is updated during the next period. The amplifier output is low impedance to provide current to the Motor Driver circuit.

6-43. MOTOR DRIVER CIRCUITS.

6-44. The plotter uses two motors, one motor drives the X-axis and the other motor drives the Y-axis. Each motor has two windings labelled sine and cosine respectively. The

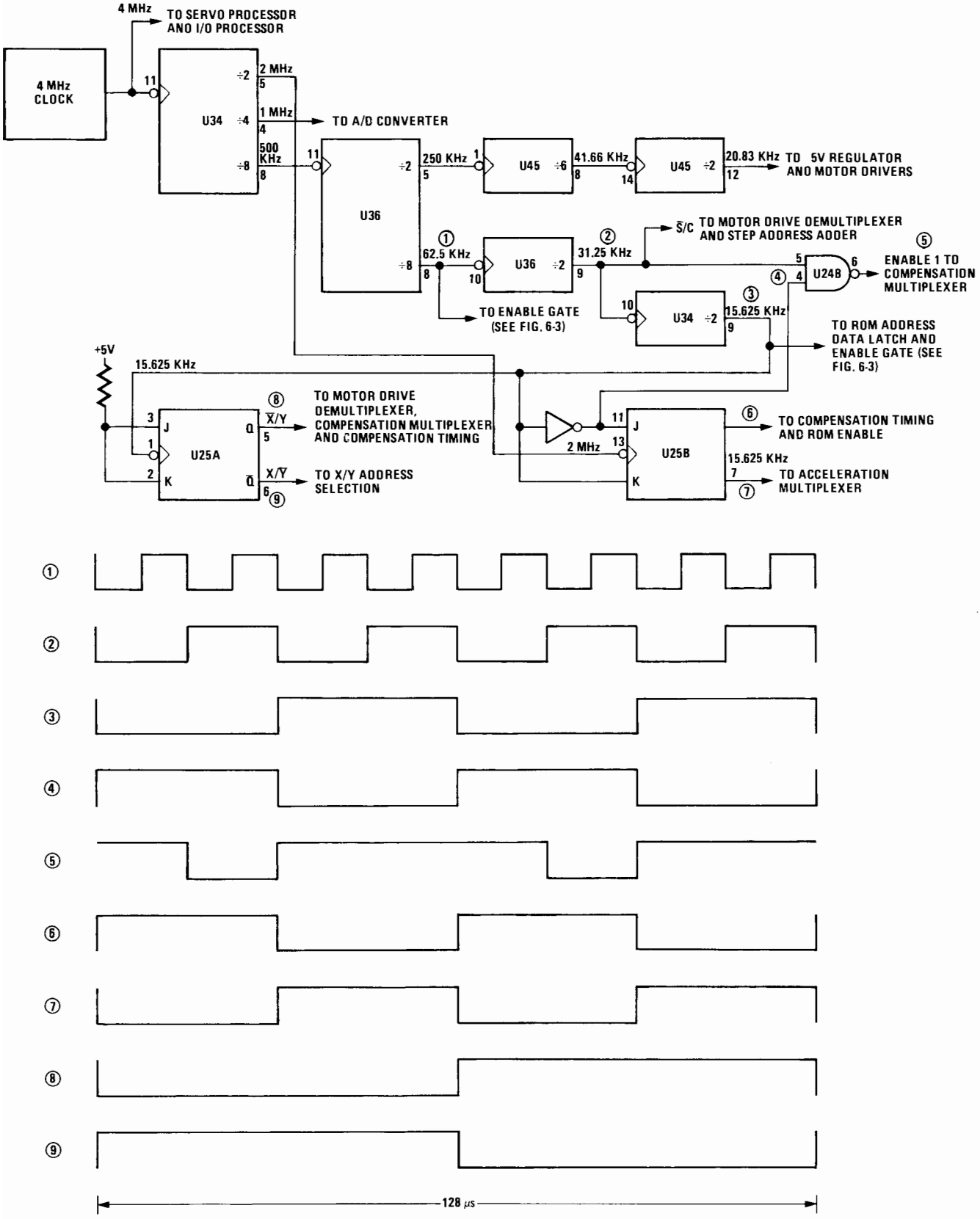


Figure 6-2. Timing Circuit Divider Outputs

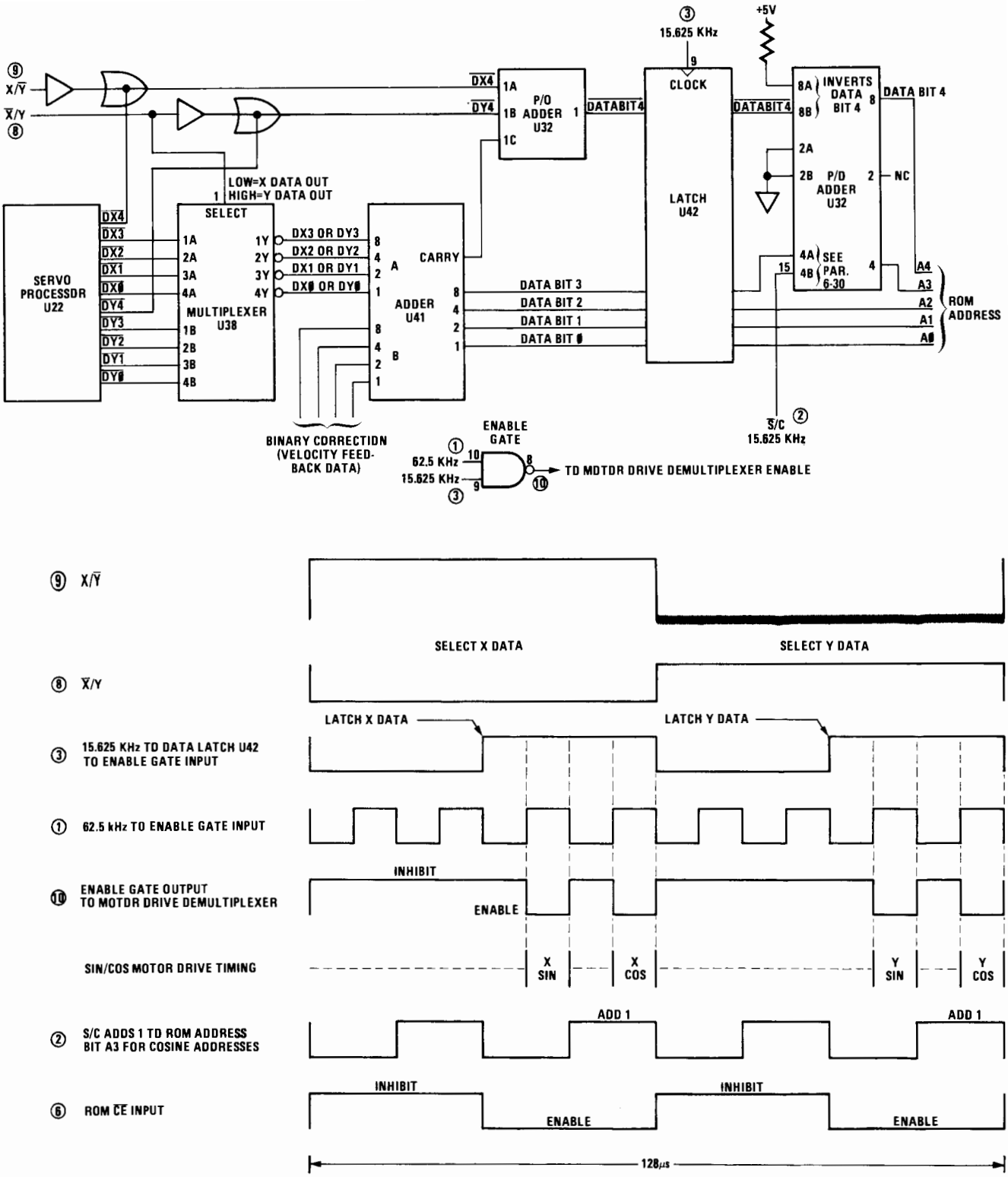


Figure 6-3. ROM Address Timing

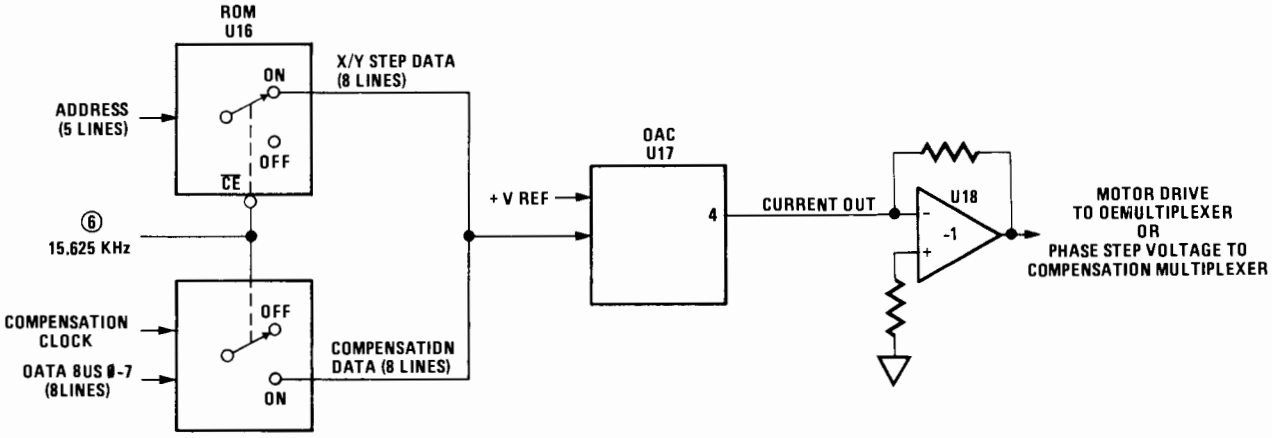


Figure 6-4. Simplified Diagram, Digital-to-Analog Converter Input/Output

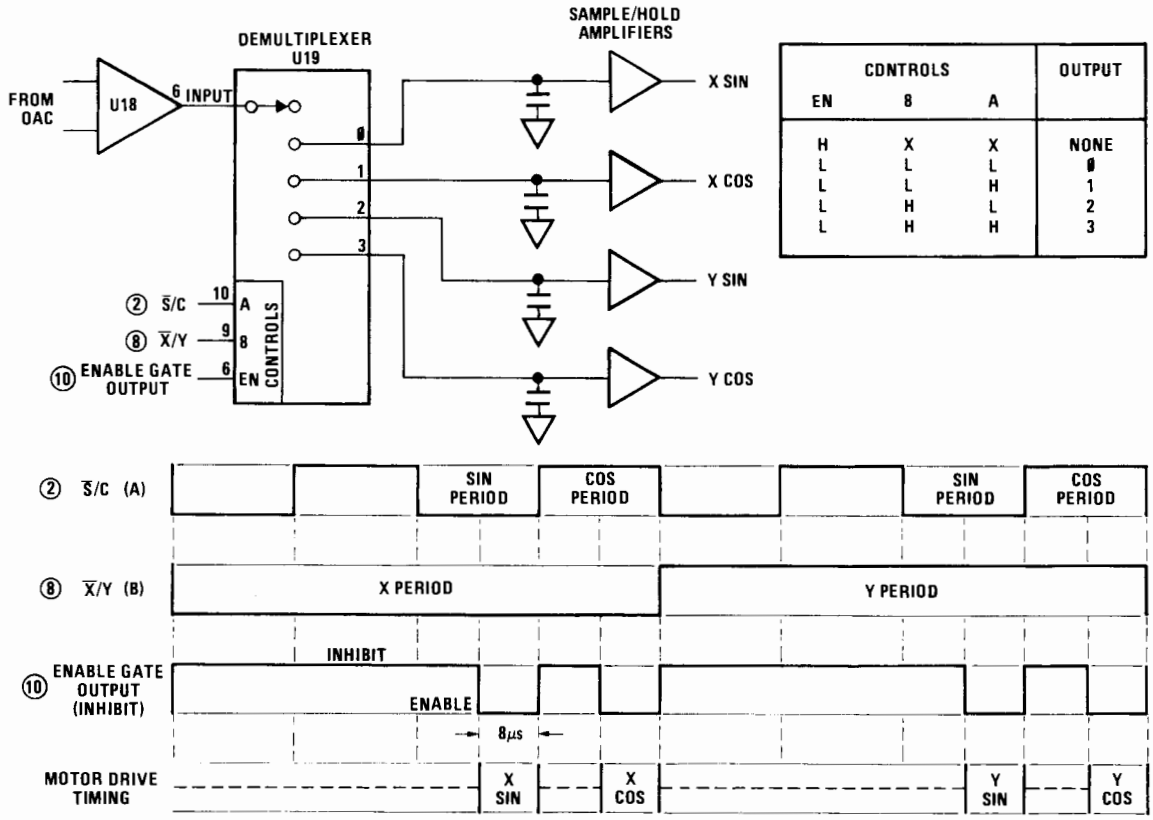


Figure 6-5. Motor Driver Demultiplexer

motor driver circuitry consists of four separate current amplifier circuits, one for each motor phase drive signal (X sine and cosine, Y sine and cosine). Basically, each circuit is a switching amplifier with linear devices that supply a drive current to its respective motor winding.

6-45. As shown on Service Sheet 3, the four amplifier circuits are practically identical; consequently, only the X sine circuit will be described. It is to be understood that all four amplifier circuits function in the same manner.

6-46. The sinusoidal voltage output from the X sine Sample/Hold amplifier U20D-14 (Service Sheet 2) is applied to the non-inverting input of Integrating Amplifier U8A-3 through Resistor R64. Any high frequency noise riding on the sine wave is filtered out by Capacitor C35.

6-47. Motor current sampling resistor R43 provides a negative feedback "sense" voltage to the inverting input of U8A-2. Based on the current through the motor winding, as "sensed" across R43, the drive current to the motor is controlled. The 20.83 KHz oscillator stabilizes the circuit by locking the driver to this reference frequency.

6-48. The output of Integrating Amplifier U8A is an integrated waveform at the oscillator frequency of 20.83 kHz. Diodes CR28 and CR29 protect the circuit from turn-on transient signals by clamping this output signal.

6-49. The integrated (sawtooth) output of U8A is coupled to the non-inverting input of Switching Amplifier U7. With the motor current sense line connected to the inverting input the resultant output of U7 resembles a square-wave signal with a duty cycle that is modulated by the amplitude of the X sine signal.

6-50. During the portion of the switching cycle when the output of U7 is driven high, transistor Q13 is forward biased. Conduction of Q13 provides a controlled turn-on time for transistor Q9 through resistor R34 and inductor L7. With transistor Q9 turned on, diode CR16 is forward biased and a ramp of current flows into the sine motor winding.

6-51. When the output from U8A swings low enough to drive the output of U7 negative, it causes transistors Q13 and Q9 to turn OFF and Q14 to turn ON. After Q9 turns OFF, the built-up current in the motor winding continues to flow, as it decays, through diode CR18. The voltage level of the -20V supply is consequently increased by the current through diode CR18.

6-52. After Q14 turns ON, there is a delayed turn-on of Q10 through R35 and L8. This switching action allows current to be supplied to the X sine motor winding through diode CR19 to the -20V supply.

6-53. Diode CR17 acts as a free-wheeling diode for the motor winding current during the time transistor Q10 is turned off.

6-54. The overall effect of the motor driver circuit is to maintain the feedback voltage from the motor current sampling resistor (R43) at the same level as the input voltage to U8A.

6-55. When the feedback voltage from R43 differs from the level of the input voltage Switching Amplifier U7 causes the duty cycle of the switching driver transistors to change so they will supply the required current to the motor winding to make the inputs at U8A equal.

6-56. ACCELEROMETERS.

6-57. A piezoelectric accelerometer mounted in each motor assembly produces a voltage proportional to the rate of acceleration. Acceleration and deceleration are a necessary part of the programmed motor movement. However, unwanted acceleration (because of imperfections in the stator, for example) could cause irregularities in the line drawn by the pen, particularly if they occur at a rate near the resonant frequency of the mechanical assembly. The accelerometer output signals are used to add "advance" or "retard" data to the motor step address, effectively damping the irregularities in the motor movement.

6-58. COMPENSATION DATA.

6-59. The X and Y accelerometer outputs include voltages resulting from required acceleration and deceleration of the motors. These voltages must be removed from the accelerometer signals. At the same time the Servo Processor issues step data to accelerate the motors it also issues compensation data to prevent the acceleration from being cancelled by feedback from the accelerometer outputs. Figure 6-6 illustrates this cancelling action.

6-60. Maximum plotting velocity in one axis is 10 inches per second. Since motor movement starts at zero velocity, some acceleration time is required to reach maximum velocity. Also, a corresponding deceleration time is needed for the motor to stop. The rate of acceleration (and deceleration) is 200 inches/second/second. Approximately 200 steps (50 ms) are required for the motor to reach maximum velocity. Consequently, if a pen movement requires fewer than 400 steps, the Servo Processor must divide the steps between acceleration and deceleration. Corresponding compensation data must be provided.

6-61. When pen movement is in both axes at the same time, the Servo Processor determines the number of steps required for each motor, then issues step data at maximum acceleration and slewing speed for the motor that has the longest move. Data for the other motor is issued at a proportionately slower rate. Acceleration compensation data must be provided in the same proportions.

6-62. COMPENSATION TIMING AND CONTROL.

6-63. Figure 6-7 shows compensation data paths between the Servo Processor and the D/A Converter. The $\overline{X}$/Y signal directs data into the X and Y periods. The 15.625 kHz

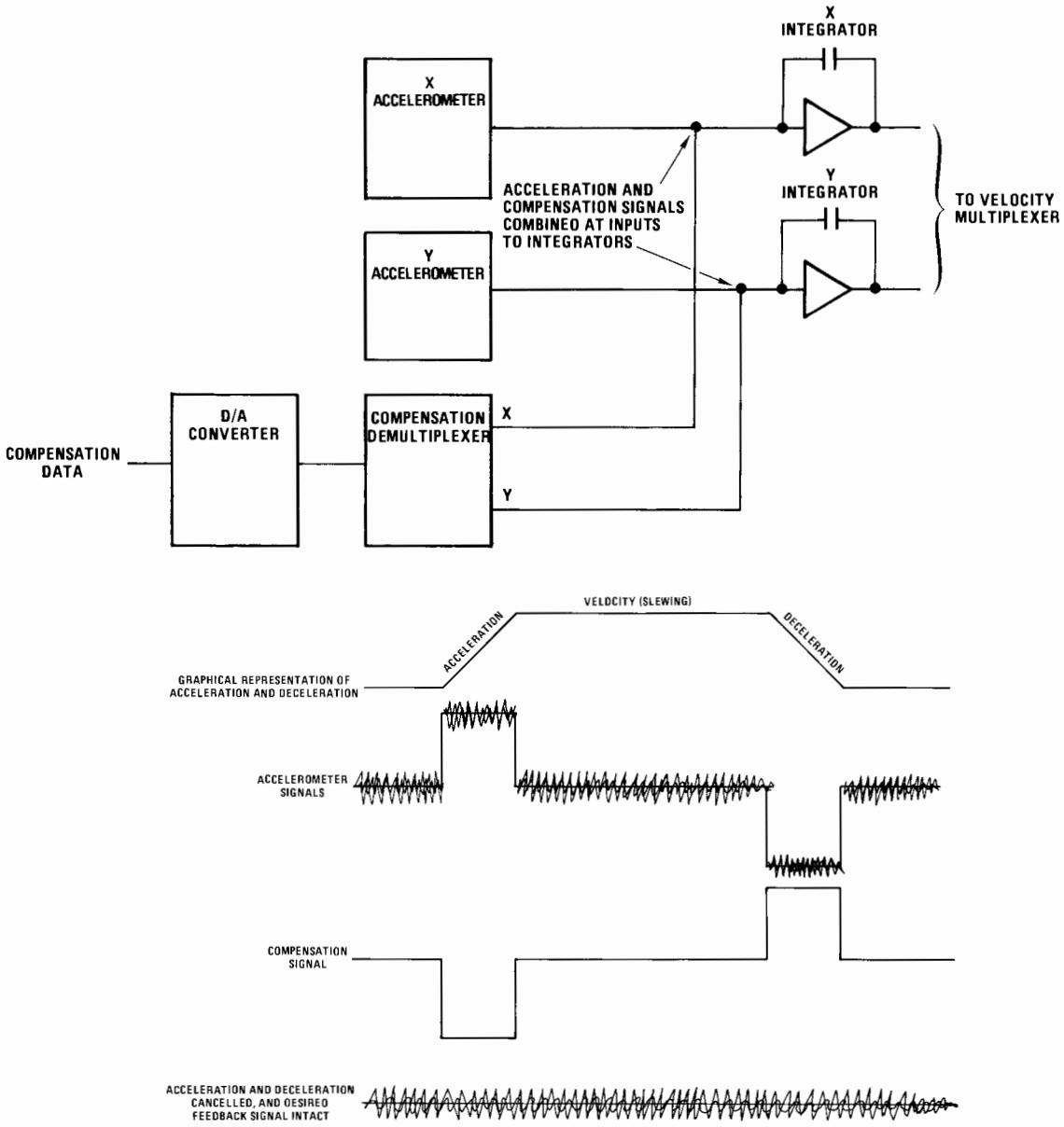


Figure 6-6. Cancellation of Acceleration Signal

signals enable compensation data to be sent to the D/A Converter while it is not being used for motor step data. The logic level of the Data Bus 6 line indicates whether X or Y is the fast axis. Data Bus 7 provides the sign for the fast axis compensation.

6-64. COMPENSATION DEMULTIPLEXER.

6-65. Compensation data is applied to the same Digital-to-Analog converter as the motor step data (see Paragraph 6-37). The X/A Converter output goes through the Compensation Demultiplexer to one of two Sample/Hold Amplifiers (see Figure 6-8). When the demultiplexer is not enabled both outputs are open, and when one output is active the other is open. The demultiplexer is enabled by the Enable 1 signal. The output is switched to either the X or Y Sample/Hold Amplifier by the $\overline{X}$/Y signal.

6-66. VELOCITY FEEDBACK.

6-67. The X and Y accelerometer and compensation signals are summed at the inputs to integrating amplifiers (see Figure 6-6). After the compensation has cancelled the programmed acceleration and deceleration feedback voltages from the feedback signals, the remaining signals are integrated to provide velocity feedback voltages. These voltages are applied through the X/Y Velocity Multiplexer to an Analog-to-Digital (A/D) Converter (see Figure 6-9), which provides binary digital data to the motor step data adder circuits to "advance" or "retard" the motor step address, smoothing the pen movement. The multiplexer is controlled by the $\overline{X}$/Y signal and signals from the A/D Converter control circuits.

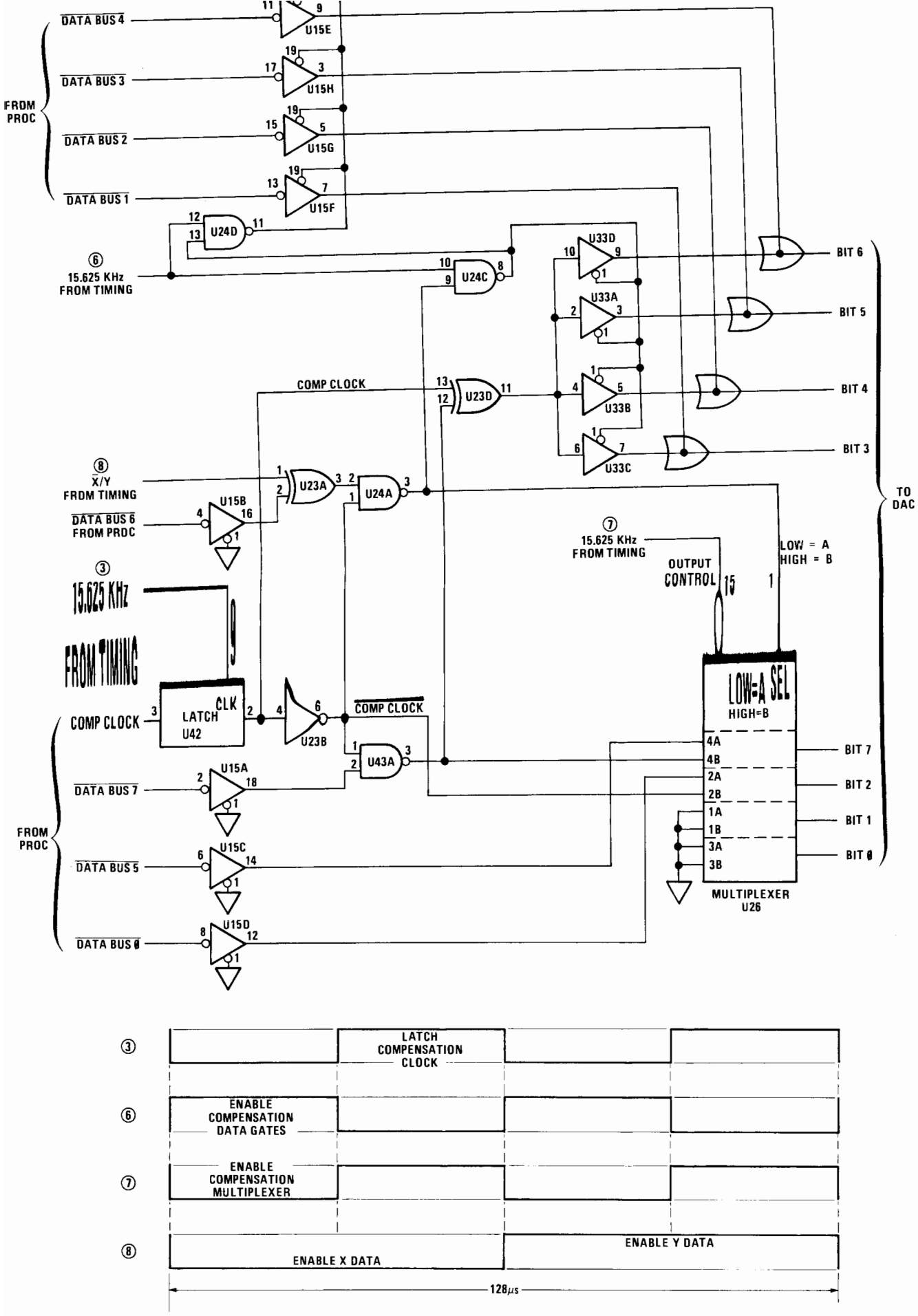


Figure 6-7. Compensation Timing and Control

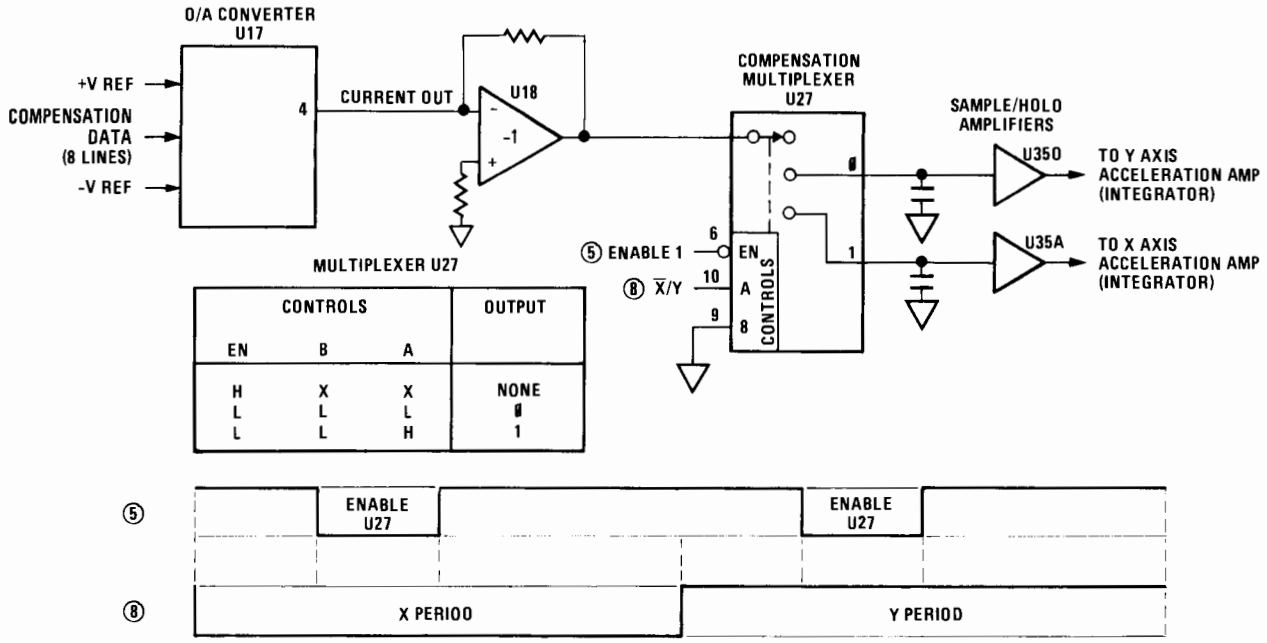


Figure 6-8. Compensation Demultiplexer

6-68. ANALOG-TO-DIGITAL CONVERTER.

6-69. The Analog-to-Digital (A/D) Converter consists of a Dual-Slope Integrator, a Comparator that essentially compares the integrator to ground, and a Binary Counter that is controlled by the Comparator output. The integrator input is the output of the X/Y Velocity Multiplexer.

6-70. DUAL-SLOPE INTEGRATION.

6-71. Figure 6-10 is a simplified drawing of the Dual-Slope Integrator and Comparator. The input to the integrator is either the X or Y velocity feedback voltage, selected by the X/Y Velocity Multiplexer. The integrator charges toward the input voltage for a fixed period of time (16μs); consequently, the charging rate and the resulting charge on the integrating capacitor are proportional to the input voltage. Then the integrator input is switched to a -5.1V reference and the capacitor discharges at a fixed rate determined by the reference voltage. The discharge time, then, is proportional to the charge, which is proportional to the input voltage.

6-72. The Comparator output goes positive when the integrator begins to charge, and returns to zero when the capacitor is discharged. This positive output is used to enable a gate, applying a 1 MHz square wave to a binary counter input. When the comparator output returns to zero and the gate is disabled, the counter output is a binary number proportional to the integrator input voltage (X or Y velocity feedback).

6-73. A/D CONVERSION PROCESS.

6-74. The circuits and signals associated with the A/D conversion process are illustrated in Figure 6-9. Two J-K flip-flops are used in controlling the converter circuits. The Q output from U31A and the $\overline{X}$/Y signal determine whether the multiplexer output is the X velocity, Y velocity, or reference voltage. The following events occur at the points marked A, B, C and D at the bottom of Figure 6-9. This example refers to the X period. The Y period is identical except that the Y velocity voltage is selected.

A. The 15.625 kHz clock signal to U31B sets Q high and $\overline{Q}$ low.

   U31B-Q output resets the Binary Counter outputs to 0000.

   U31B-$\overline{Q}$ output clears U31A, setting its Q output low and $\overline{Q}$ output high.

B. U31A-Q output to the multiplexer, along with $\overline{X}$/Y selects the X velocity voltage.

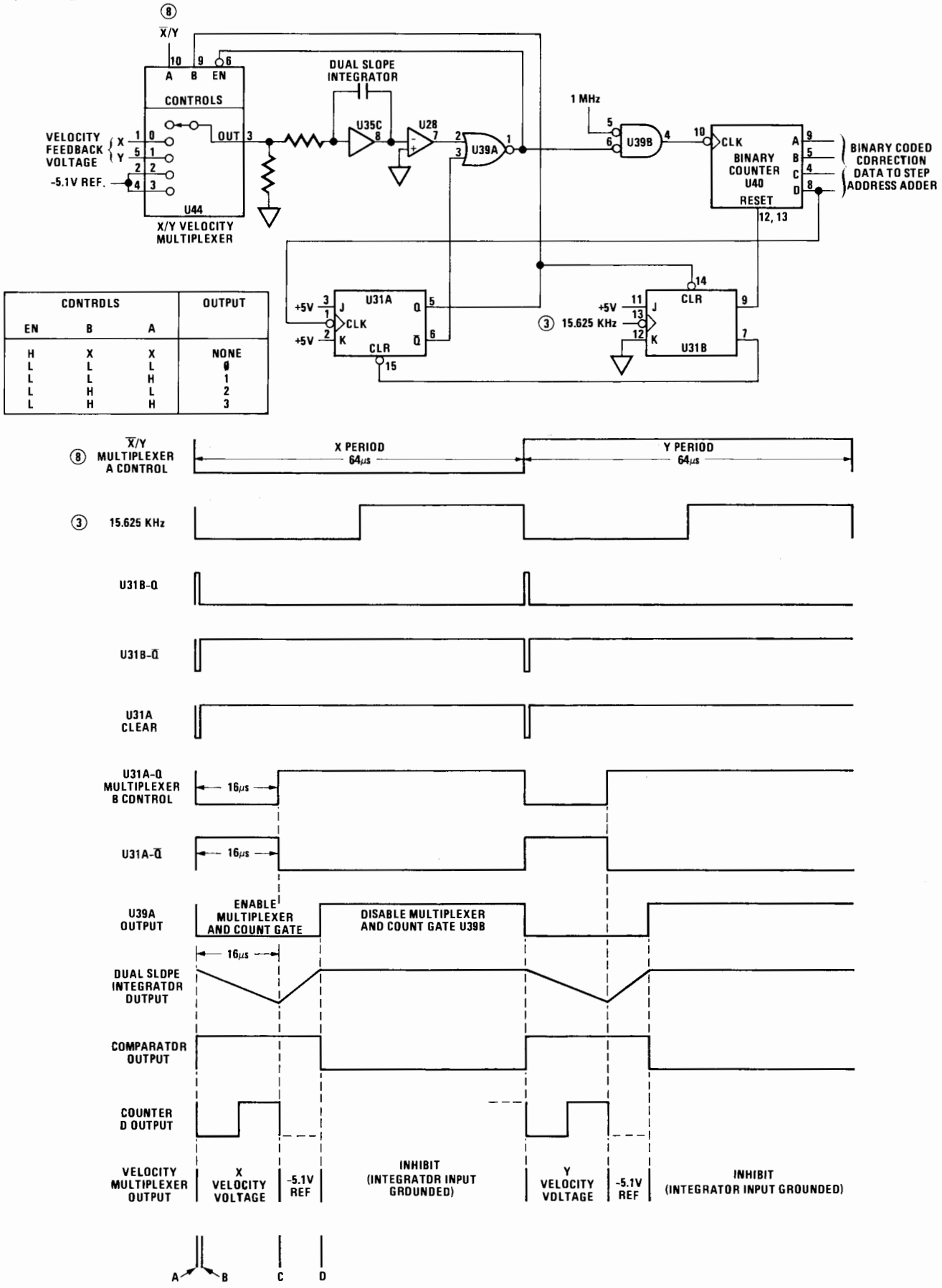


Figure 6-9. A/D Converter

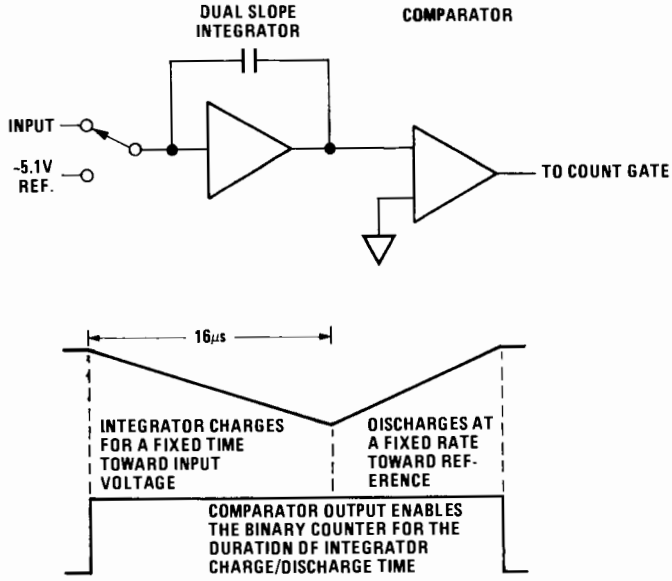


Figure 6-10. Dual-Slope Integration

U31A-$\overline{Q}$ output (high) makes gate U39A output low, enabling count gate U39B, passing the 1 MHz signal to the Binary Counter input.

U31A-Q output resets U31B-Q output to low, removing the reset signal from the Binary Counter.

The Dual Slope Integrator begins charging toward the X velocity voltage.

The Comparator output goes positive.

C. When the Binary Counter counts through to 0000 (16 counts) its low D output toggles U31A. The counter continues to count (through 0000, 0001, etc.) because the Comparator output keeps the gates enabled.

U31A-Q output (high) causes the multiplexer to select the −5.1V reference.

The Integrator begins to discharge toward the reference voltage.

D. When the Integrator is discharged, the Comparator output goes to zero.

Gate U39A output goes high, disabling count gate U39B and the multiplexer.

The count at the Binary Counter outputs A, B, C, and D is a binary number proportional to the X velocity feedback voltage. This binary data goes to the motor step address adder (see Paragraph 6-33).

6-75. POWER SUPPLY CIRCUITS.

6-76. The Power Supply circuitry, illustrated on Service Sheet 4, provides the DC operating voltages listed in Table 6-2 to the Plotter circuits.

6-77. INPUT VOLTAGE.

6-78. The main AC power source is switched into the primary windings of transformer T1 through the POWER ON/OFF switch and the appropriate internal line fuse and line voltage selector jumpers. Inductors L15 and L16 provide radio frequency interference (RFI) filtering for the AC lines.

6-79. Power transformer T1 provides the proper stepped down voltage both to the cooling fan, and to the full wave rectifier diodes CR1-CR4. Radio frequency interference (RFI) filtering is supplied by the combination of capacitors C32, C47 and C48.

Table 6-2. Power Supply Voltages

Power Supply	Type	Voltage Range (DC)	Note
+5V	Regulated	+4.75 to +5.25V	
+12V	Regulated	+11.2 to +12.8V	
-12V	Regulated	-11.2 to -12.8V	
+20V	Balanced	+16 to +25V	The ±20V power supplies are balanced to within 1V of each other.
+475V Chart Hold	Regulated	+270V (Approx.)	Measured voltage levels will vary widely depending upon input impedance of the voltmeter used and normal manufacturing tolerances. Voltages indicated were measured with a 10 megohm input impedance voltmeter.
-420V Chart Hold	Regulated	-190V (Approx.)	

6-80. ±20 VOLT SUPPLY AND VOLTAGE BALANCE CIRCUIT.

6-81. The ±20V unregulated supply is provided by full wave rectifiers CR1-CR4 and is filtered by capacitors C1 and C2. Note that these components are located on the Main Cable PCA.

6-82. As switched by the motor drivers, the X/Y motors form an inductive load across the ±20V lines. This inductive loading with its associated counter-induced voltages will vary with motor operation. The counter-induced voltages are cumulative in effect on the +20V or -20V lines and will cause the charge on capacitor C1 or C2 to increase accordingly.

6-83. To correct these undesired increases that develop in the +20V or -20V lines, a balance circuit is connected between the +20V line and the -20V line. This balance circuit constantly compares the two lines and equalizes any imbalance between the absolute voltage values of the +20V line and the -20V line.

6-84. There are two cases of unbalanced lines: either the +20V is higher than the -20V supply or the -20V is higher than the +20V supply. The voltage balance circuit will sense either of these two conditions and cause current to be drawn from the higher supply and current to be supplied to the lower supply.

6-85. Referring to Service Sheet 4, when the +20V and the -20V supplies are balanced, there is zero voltage drop at the junction of resistors R10 and R11. The 20.83 kHz square wave oscillator input is integrated into a sawtooth at the input to Comparator U2 which is referenced to common.

6-86. During a positive excursion of the oscillator input and with the +20V line high, a positive voltage is developed at the junction of resistors R10 and R11. This positive voltage causes the output of comparator U2 to turn transistor Q6 ON. Resistor R2 and inductor L3 provide a controlled turn-on time for transistor Q2. With the conduction of Q2, diode CR3 is forward biased which completes a current path from the +20V line to common through energy storage inductor L1. Note that the current flow into L1 is a 'ramp' of current.

6-87. During the negative excursion of the 20.83 kHz oscillator input, the output of comparator U2 turns transistors Q4 and Q3 ON. Capacitor C7 provides approximately 3 microseconds of delay in turning transistors Q4 and Q6 ON or OFF. During the delay after turning transistor Q6 OFF and before transistor Q4 is turned ON, the built-up current in energy storage inductor L1 continues to flow through diode CR6 and adds to the charge on capacitor C1. By raising the -20V line, a balance between the +20V and -20V supplies is attained resulting in zero volts at the junction of resistors R10 and R11.

6-88. With the -20V line higher than the +20V line, the balance circuit functions in a similar manner to the preceding description. The "high" -20V supply is now loaded and current in energy storage inductor L1 flows through diode CR5. This L1 current adds to the charge on capacitor C2 thus raising the +20V line. Transistors Q4 and Q3 are activated during nominally one half of the 20.83 kHz oscillator cycle combined with the duration of time that the junction of resistors R10 and R11 is negative.

6-89. The waveshape at Test Point 18, located at one end of inductor L1, approximates a square wave of the same frequency as the oscillator input, 20.83 kHz. However, the duty cycle of this waveform does change a small amount with changing load conditions in order to maintain the ±20V power supply balance within 1V.

6-90. Of the remaining components in the circuit: Resistor R5 and capacitor C11 form a damping circuit which

minimizes the peak power dissipation of transistors Q2 and Q3 and switching capacitor C5, and provides decoupling for the high frequencies.

6-91. ±12 VOLT SUPPLY.

6-92. The +12V and -12V supply is developed by a pair of three-terminal regulators connected across the unregulated +20V and -20V supply lines. The input to each regulator, U1 and U6, is stabilized from high frequency oscillation by capacitors C1 and C29, respectively.

6-93. The +12V output from regulator U1 is stabilized by capacitor C2. Should a loss of input voltage occur, diode CR1 will protect the regulator. Capacitor C23 and diode CR15 perform a similar function for the -12V regulator U6.

6-94. +5V SWITCHING SUPPLY.

6-95. Switching type circuitry is used to develop a +5V supply from the unregulated +20 volt line. The +20 volts is applied to series pass transistor Q1. During the time Q1 is conducting, a ramp of current is developed in inductor L2 which charges capacitor C3 to the output voltage of +5 volts.

6-96. Integrator U4 integrates the 20.83 kHz square-wave oscillator input into a sawtooth wave which forms the input to voltage comparator U3. In addition, the relationship between the output +5 volts and the reference +4.99 volts at the input to integrator U4 causes the mean voltage output of U4 to change.

6-97. The output of voltage comparator U3 switches according to the relationship between the mean voltage output of integrator U4 and the output +5 volts.

6-98. This switching output from voltage comparator U3 turns control transistor Q5 ON and OFF. Switching Q5 ON forward biases series pass (Darlington) transistor Q1 causing a ramp of current flow in inductor L2 and the charging of capacitor C3 to the +5 volt output level. Consequently, when the output +5 volt line is pulled low, the ON time of the output from comparator U3 will increase.

6-99. During the time that series pass transistor Q1 is turned OFF, the current built up in inductor L2 by the ramp current function will continue to flow through diode CR58, but its magnitude decreases. Consequently, the charge on capacitor C3 starts to discharge and the +5 volts output starts to drop. The effect of this drop is a change in the output level of integrator U4 thus causing voltage comparator U3 to switch which turns transistors Q5 and Q1 "ON" starting the cycle over again.

6-100. The additional components involved in the +5 volt switching supply are used to stabilize the switching circuits and shape the loop characteristics as follows:

a. Both resistor R8 with capacitor C6 and resistor R13 with capacitor C12 control the gain and phase of the loop to prevent oscillation.

b. Capacitor C13 allows a square wave to be summed into the integrator stage to generate a linear triangular wave.

c. Transistor Q7 prevents turn-on transients from overdriving comparator U3 by clamping the output of integrator U4 through clamp diode CR9.

d. Inductor L5 and resistor R6 delay the turn-on and reduce peak current in transistor Q1.

6-101. ELECTROSTATIC CHART HOLD CIRCUIT.

6-102. The electrostatic chart hold drive circuit generates high DC voltages to provide electrostatic hold down for the chart paper.

6-103. Activating the front panel CHART LOAD push-button (see Service Sheet 1) causes Microprocessor U22 to simultaneously:

a. Turn the front panel CHART HOLD lamp OFF.

b. Enable the 15.625 kHz clock signal to the autogrip drive circuit.

6-104. Basically, the autogrip drive circuit is a Ringing Circuit which develops a high voltage by charging two capacitor networks in parallel. A regulator maintains the high voltage to the platen at approximately +475 volts and -420 volts. This regulation prevents the high voltage from exceeding the voltage rating of the components used in the circuit.

6-105. Transistor Q8 is turned ON and OFF by the 15.625 kHz Chart Hold signal. The magnitude of Q8's emitter current is set by resistor R22 and its base voltage as controlled by Error Amplifier U5. Turning transistor Q8 ON causes current to ramp up in storage inductor L6. When Q8 is abruptly turned OFF, the current in inductor L6 continues to flow rapidly charging stray capacitance to a high voltage. When this voltage equals the charge on capacitors C17 and C18, diodes CR12 and CR13 conduct, and the energy remaining in inductor L6 charges capacitors C17 and C18. At equilibrium, this charge just replenishes the charge lost during the preceding half-cycle. The resultant high voltage to the platen is current limited by resistors R21 and R27.

6-106. Error amplifier U5 detects any difference between the 4.99 volt reference and the output of the resistive divider R19, R18, R26 and R25. The output of U5 regulates the base reference voltage of transistor Q8 so as to maintain approximately 500 volts peak at inductor L6 (Test Point Q).

6-107. Approximate output voltage readings are noted on the schematic diagram (Service Sheet 4) and as explained in NOTE 1 on the schematic, these readings should be used for reference purposes only.

6-108. PEN DRIVER CIRCUIT.

6-109. The pen is held in the up position by a spring in the pen solenoid assembly. Upon receiving a pen down signal, the pen driver circuit supplies current to the pen

solenoid. Activation of the pen solenoid forces the lift extension down which causes the spring to be compressed thus allowing the pen to drop down.

6-110. A pen down signal may arrive from any one of three sources:

a. From the Interface I/O Module through connector J4 (See Service Sheet 1).

b. From the Servo Processor U22 (Service Sheet 1).

c. From the Front Panel pen down pushbutton control (Service Sheet 1).

6-111. Initially, a higher surge current is necessary to activate the solenoid enough to compress the spring. However, once the spring is compressed and the pen is down it takes less current to sustain the pen down mode. The initial higher surge current is controlled by a one shot IC U46.

6-112. The pen down signal, which is a low (0 volt) level signal, is applied to one shot U46 causing it to trigger. The output of U46 is a single pulse having a duration of 15-20 milliseconds. This single pulse forward biases diode CR52 which causes transistors Q27 and Q26 to turn ON.

6-113. With series pass transistor Q26 turned ON, +20 volts is applied to the pen solenoid through resistor R78 (which is only 15 ohms). Consequently, the solenoid is driven relatively hard for the duration of the one shot pulse.

6-114. The pen down signal also turns transistors Q28 and Q25 ON. After the 15-20 millisecond pulse duration is complete, the +20 volts is applied to the pen solenoid through series pass transistor Q25 and resistors R62 and R78. The drive to the pen solenoid is now reduced while still sustaining the pen down mode.

6-115. A pen up signal, which is a high (+5 volt) level signal, will cause transistors Q28 and Q25 to turn OFF. With the pen solenoid drive removed the spring is allowed to raise the pen.

6-116. MAINTENANCE.

6-117. CLEANING THE CHART TABLE.

WARNING

Scratches or punctures in the chart table surface may expose high voltage conductors. Instruments damaged in this manner should not be operated.

To avoid electrical shock, disconnect the AC power cord from the plotter before cleaning the chart table.

Do not allow water or other liquids to stand on the chart table or enter any openings in the plotter enclosure. This may cause a potential shock hazard.

6-118. Dust and other contaminants on the chart table surface will lower the paper-holding capability. Although recording ink may not affect performance, it may be desirable to remove ink stains as well. Use a soft disposable wiper or lint-free cloth moistened with water. Isopropyl alcohol may also be used if needed.

CAUTION

Do not use strong chemicals, abrasives, or silicone-based cleaners on the chart table, and do not allow any liquid to stand on the surface or it may become permanently damaged.

6-119. If the surface cannot be cleaned with water or isopropyl alcohol, use the following procedure:

a. Select a clean lint-free cloth that will not scratch the table surface.

b. Dampen the cloth with warm water or isopropyl alcohol and apply a small amount of cleanser (HP P/N 9310-0515). A non-abrasive cleanser such as Ajax® or Comet® may be used.

c. Wipe the table surface until it is clean, then rinse the cloth thoroughly and wipe any remaining cleanser from the table. Immediately wipe any moisture from the surface.

6-120. CLEANING THE FILTER.

6-121. The fan filter at the left side of the plotter should be inspected frequently and cleaned or replaced as necessary to allow free flow of air. Remove the plastic foam filter from its holder and wash thoroughly with soapy water, rinse clean, and air dry.

6-122. CLEANING MOTOR BEARING SURFACES.

6-123. Motor cleaning is normally not required or recommended. However, if rough deposits build up on the motor ball-bearings or stator bearing surfaces enough to cause poor line quality, cleaning will be necessary. These surfaces may be cleaned by rubbing the contaminated areas with a clean wiper or cotton swab. Liquid solvents such as contact cleaners are not recommended, but if a solvent is used, do not apply directly to the bearings or stators. Apply sparingly to the wiper or swab, then rub the deposits until the residue is removed.

CAUTION

Do not spray solvent on the bearings or stators, and do not allow solvent to contact the chart table plotting surface. Solvent may damage the bearings or the plastic surface of the chart table.

6-124. TROUBLESHOOTING.

6-125. TEST EQUIPMENT REQUIRED.

6-126. Table 1-7 (in Section I) lists recommended test equipment needed to service the 7225A. Other models may be used if their capabilities and specifications are equivalent.

6-127. ORIENTATION OF COMPONENTS.

6-128. A square pad or dot on the printed circuit board aids in orientation of certain components for replacement and in identification of connections.

Component	Connection	Identification
Integrated Circuit	Pin 1	Square Pad
Transistor	Emitter	Dot
Diode	Cathode	Dot
Light Emitting Diode	Cathode (Flat side on collar)	Dot
Electrolytic Capacitor	Positive	Dot

6-129. OPENING THE PLOTTER.

6-130. To avoid repetition throughout this Section, the procedure for opening the plotter is outlined in this paragraph only. Where a repair or part replacement requires the plotter to be opened, the following paragraph is referenced.

6-131. To open the plotter proceed as follows:

WARNING

THE FOLLOWING SERVICE PROCEDURES SHOULD BE PERFORMED ONLY BY SERVICE-TRAINED PERSONNEL WHO ARE AWARE OF THE ELECTRICAL SHOCK HAZARDS INVOLVED.

a. Switch the plotter OFF, disconnect the AC line cord, and remove the pen.

b. Remove the top cover (see Figure 6-11, Detail "A" and "B").

c. Ease the top cover off the plotter. Reverse steps a through c to reassemble.

CAUTION

When replacing the top cover, make sure that the shortest screw (1/4 in.) is used in the center rear hole on the plotter (Figure 6-11B, Item 3). A longer screw will interfere with plotter arm movement.

6-132. UPPER DECK ASSEMBLY.

6-133. To remove the upper deck assembly, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove the four 4-40 X 1/2 POZI mounting screws. (See Figure 6-11C.)

c. Install in reverse order of removal procedure.

6-134. EXTENDER CABLE (For Power On Troubleshooting Only).

6-135. To insert the extender cable, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Connect extender cable to main PCA and main cable PCA connectors. (See Figure 6-12.)

CAUTION

Incorrect installation of the extender cable can cause circuit damage. Install the cable connector to the Main Cable PCA with the cable oriented toward the front of the plotter. If in doubt, compare pin numbers on the cable connector with numbers on the PC assembly.

6-136. PRELIMINARY TROUBLESHOOTING.

6-137. A good visual inspection may identify some obvious problem. Make sure the microprocessor U22 is seated firmly in its socket and that cable connectors are also seated properly. Screws at the left end of the front panel PCA must be tight to ensure good connection to the main PCA. Verify power supply voltages. (See Table 6-2 for voltages and tolerances.) The power supplies will not operate when the cable PCA under the chart table is disconnected from the main PCA. Use an extender cable (Part No. 07225-60115) to make this connection when the plotter is disassembled. (See Paragraph 6-134.)

6-138. Contamination on a printed circuit board edge connector may cause a malfunction. These connections on the cable PCA, flat cables W1 and W2, and the front panel PCA may be cleaned by rubbing lightly with a soft, nonabrasive pencil eraser.

6-139. VOLTAGE AND COUNTER READINGS.

6-140. DC voltage readings are shown at many points on the schematic diagrams. Notes on the schematics detail the conditions under which readings were taken. Frequency counter readings are also shown in a separate table for many of the digital circuits. Incorrect readings may help identify a faulty circuit.

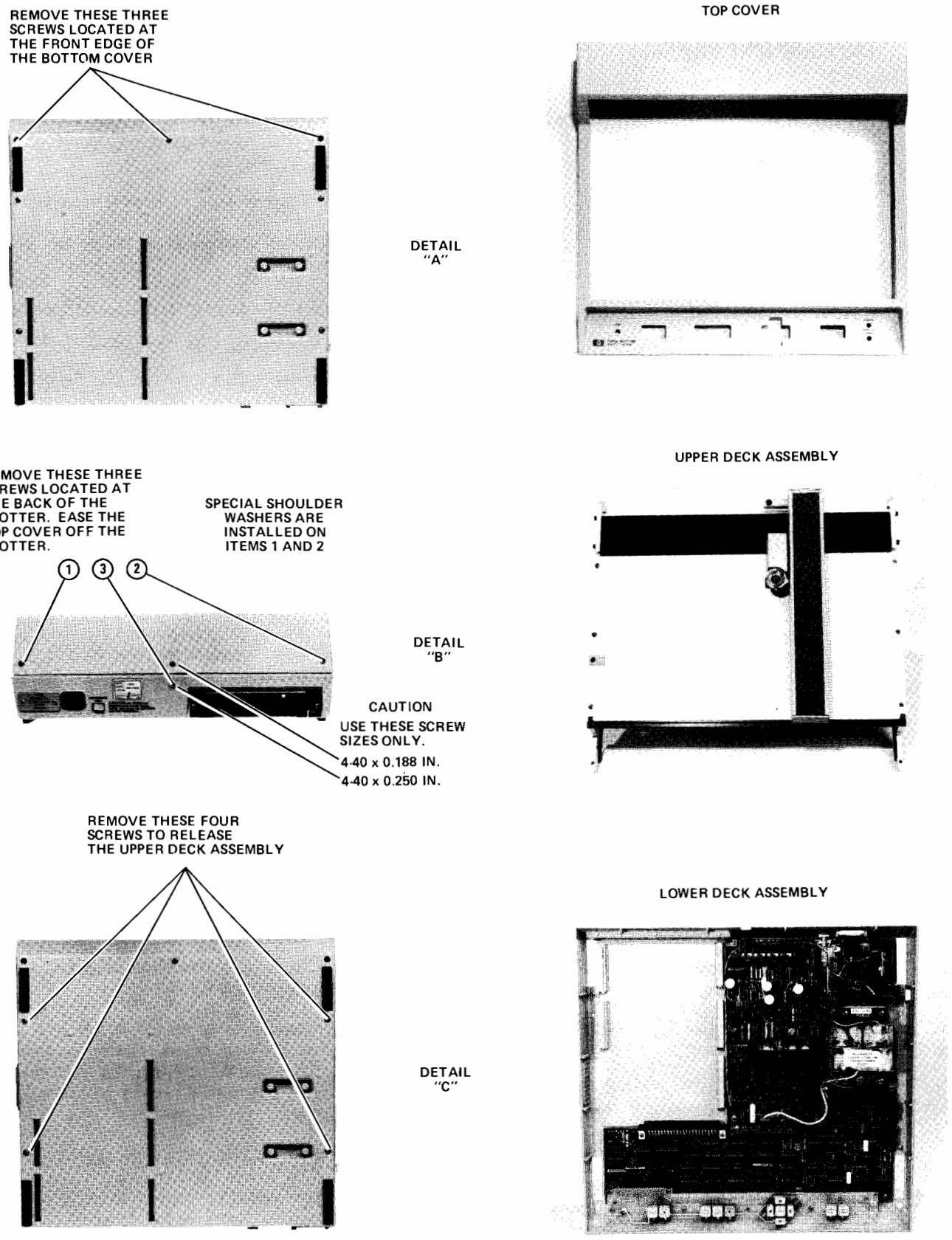


Figure 6-11. Top Cover and Deck Assemblies Identification/Removal

CAUTION

INCORRECT INSTALLATION OF THE EXTENDER CABLE CAN CAUSE CIRCUIT DAMAGE. INSTALL THE CABLE CONNECTOR TO THE MAIN CABLE PCA WITH THE CABLE ORIENTED TOWARD THE FRONT OF THE PLOTTER. IF IN DOUBT, COMPARE PIN NUMBERS ON THE CABLE CONNECTOR WITH NUMBERS ON THE PC ASSEMBLY.

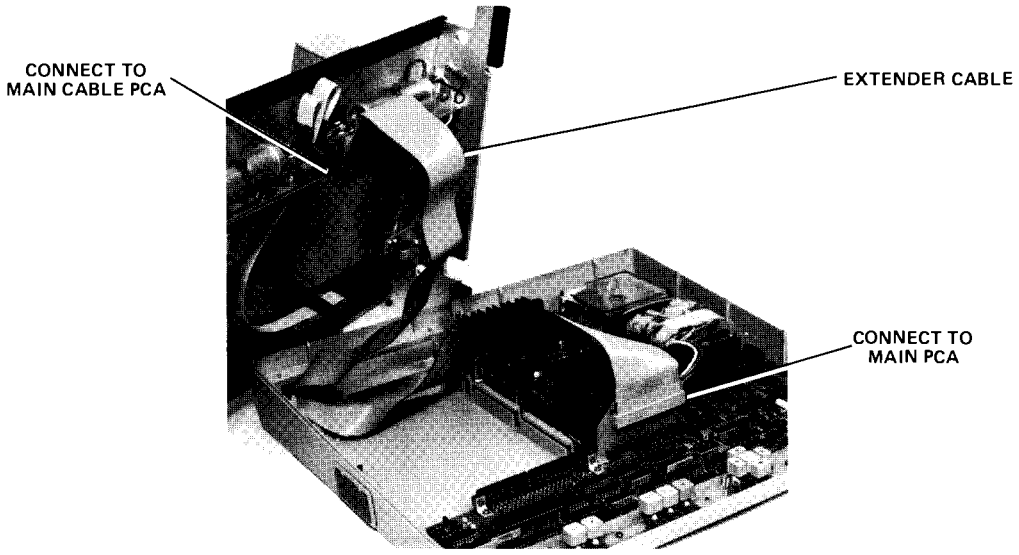


Figure 6-12. Extender Cable Installation

6-141. TROUBLE SYMPTOMS.

6-142. Some trouble symptoms and possible causes are shown in the following tables:

Table 6-3. Turn-on Problems

Table 6-4. Confidence Test Irregularities (see Figure 6-13)

Table 6-5. Pen Lift Problems

Table 6-6. Operating Problems.

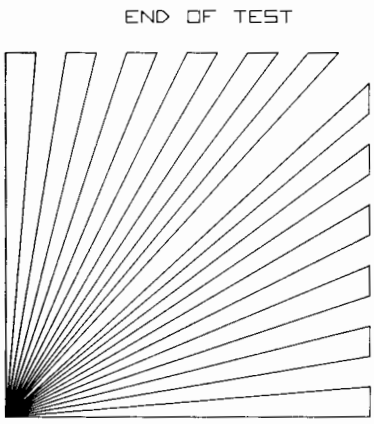
6-143. SIGNATURE ANALYSIS.

6-144. Because of the increased complexity of the logic circuits used to control many instruments, malfunctions in these circuits are very difficult to locate. The concept of signature analysis is based on the fact that a particular point in a circuit, the data bit stream is predictable under specifically programmed conditions. An instrument such as the Hewlett-Packard Model 5004A Signature Analyzer compresses the data at a given point during a controlled time span (window) and displays the resulting four-character signature. The signature indicates whether the correct data was present within the window at the measurement point, and this information can be used to locate a defective component.

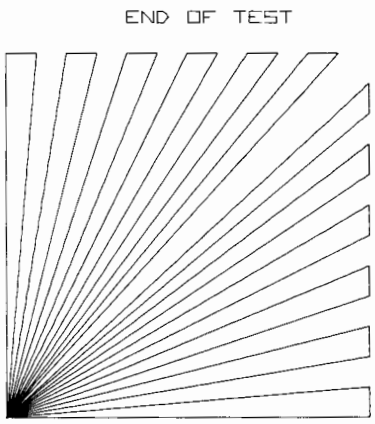
6-145. To troubleshoot the 7225A logic circuits by signature analysis, follow the sequence shown in the flow chart, Figure 6-14. Location of the circuits is shown in Figure 6-15. The signatures shown in Figures 6-16 through 6-21 were obtained with no Input/Output module installed.

Table 6-3. Turn-on Problems

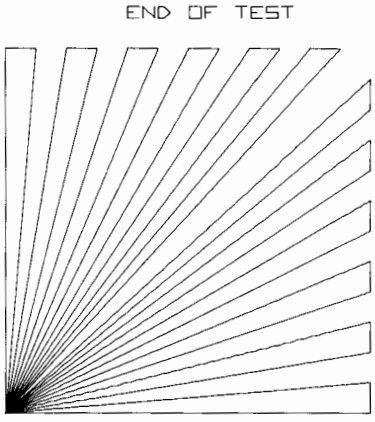
Symptoms	Possible Causes	Suggested Troubleshooting
No indicator lights and no motor response.	a. Line Fuse, F1.	a. Check for cause of blown fuse. Replace F1. Connect plotter to a Variac and beginning at zero, increase voltage slowly while watching for excessive line current. Normal current is approximately 500 mA.
	b. Power supply failure.	b. Check power supply voltages and circuits. +5V supply is fused (F3).
	c. Excessive load on ±20V supply caused by circuit failure.	c. Check for shorted motor driver transistor (A1Q9-12 or 17-20) and/or associated components. Also check ±20V balance circuit.
Line indicator ON but no motor response.	a. Power supply failure.	a. Check power supply voltages and circuits.
	b. Motor drive logic circuits.	b. Frequency counter readings and/or signature analysis.
	c. 4 MHz clock oscillator or timing circuits.	c. Check clock and timing circuits with frequency counter, including 20.83 kHz to power supplies and motor drivers.
Pen carrier moves to upper right but either X or Y motor chatters against stop instead of moving to proper initialized position.	X or Y limit switch circuit.	Check limit switch and continuity through cables to servo processor.
X motor movement erratic; Y motor appears normal.	X SIN or COS drive circuit.	Check fuses A3F1 and F2 on Main Cable PCA A3. Check continuity through cable W1 and X motor windings. Troubleshoot X SIN and COS driver circuits.
No X motor movement; Y motor appears normal.	a. $\overline{X}$/Y signal to Demultiplexer U19 incorrect.	a. Check outputs of U25A. Check timing circuits.
	b. X SIN and COS drive circuits.	b. Check fuses A3F1 and F2 on Main Cable A3. Check continuity through cable W1 and X motor windings. Troubleshoot X SIN and COS driver circuits.
Y motor movement erratic; X motor appears normal.	Y SIN or COS drive circuit.	Check fuses A3F3 and F4 on Main Cable PCA A3. Check continuity through cable W2 and Y motor windings. Troubleshoot Y SIN and COS driver circuits.
No Y Motor movement; X motor appears normal.	a. $\overline{X}$/Y signal to Demultiplexer U19 incorrect.	a. Check outputs of U25A. Check timing circuits.
	b. Y SIN and COS driver circuits.	b. Check fuses A3F3 and F4 on Main Cable A3. Check continuity through cable W2 and Y motor windings. Troubleshoot Y SIN and COS driver circuits.



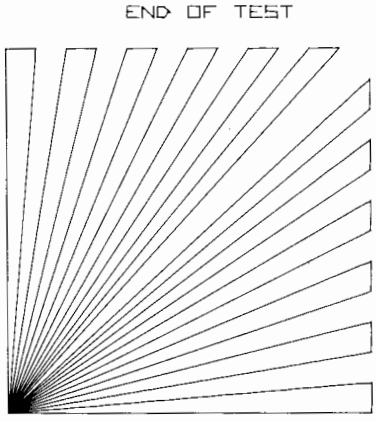
a. Normal Confidence Test Plot



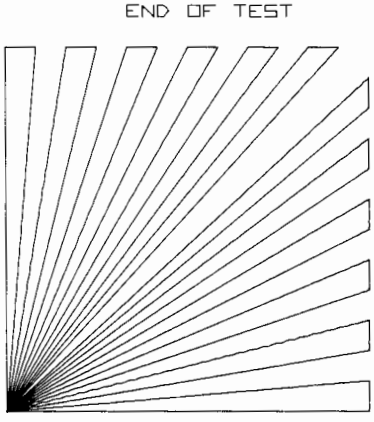
b. X Accelerometer Signal Missing



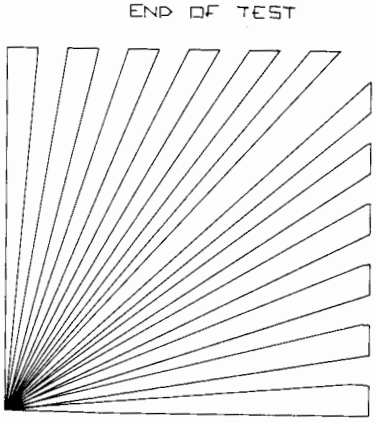
c. Y Accelerometer Signal Missing



d. Compensation Signals Missing



e. No Velocity Feedback to Phase Step Data



f. Pen Side Play Adjustment Loose

NOTE: "END OF TEST" is not printed unless an I/O module is installed.

Figure 6-13. Confidence Test Symptoms

Table 6-4. Confidence Test Irregularities

Symptoms	Possible Causes	Suggested Troubleshooting
Chart paper does not adhere properly to table.	a. Contamination on chart table. b. Open circuit in electrostatic chart hold voltage path. c. Chart hold voltage circuit defective. d. Defective or damaged chart table.	a. Clean table. See Paragraph 6-117. b. Check continuity through Main Cable PCA A3 to chart table. c. Check drive circuit. d. Replace table.
Horizontal lines are straight but other lines are wavy, particularly those 5 to 20° from vertical. See Figure 6-13b.	X accelerometer feedback not correct.	Check waveform at A1TP3 with pen traveling from upper right to lower left. Correct waveform is shown opposite Service Sheet 3. 1. If the waveform is not present, check continuity from the X accelerometer through cable W1 to A1TP3. 2. If the DC offset is greater than 2V or amplitude is less than 1V p-p, replace the accelerometer.
Vertical lines are straight but other lines are wavy, particularly those 5 to 20° from horizontal. See Figure 6-13c.	Y accelerometer feedback not correct.	Check waveform at A1TP4 with pen traveling from upper right to lower left. Correct waveform is shown opposite Service Sheet 3. 1. If the waveform is not present, check continuity from the Y accelerometer through cable W2 to A1TP4. 2. If the DC offset is greater than 2V or amplitude is less than 1V p-p, replace the accelerometer.
Small overshoot or curve at beginning and/or end of straight lines. See Figure 6-13d.	Compensation feedback not correct.	Check compensation demultiplexer U27, multiplexer U26, timing and control circuits U15, U23, U24, U42.
Most plot lines wavy. See Figure 6-13e.	Velocity feedback not correct.	Check X/Y velocity multiplexer U44, A/D converter circuits U35C, U28, U37, U31, U40, adder U41.
Plot line and lettering irregularities as shown in Figure 6-13f.	Pen side play adjustment loose.	Adjust according to procedure in Section III.
Ink trace skips or is too light.	a. Pen running out of ink. b. Pen is too high over all or part of plotting surface.	a. Replace pen. b. Perform pen height adjustment in Section III.
Plotter does not complete fan pattern.	Servo processor memory defective.	Replace servo processor U22.
No response to confidence test switch.	a. Switch defective. b. Servo processor defective.	a. Short across switch momentarily to determine if trouble is in the switch. b. Replace servo processor U22.
I/O module is installed but "END OF TEST" is not printed.	a. I/O module connector not making proper contact. b. I/O module defective.	a. Clean the connector contacts and make sure module is installed properly. b. See I/O module Service Manual for troubleshooting information.

Table 6-5. Pen Lift Problems

Symptoms	Possible Causes	Suggested Troubleshooting
When pen is up, does not clear the paper in some (or all) areas.	a. Paper not adhering properly to chart table.	a. Check for contamination on chart table. Check electrostatic chart hold circuit. Check continuity from chart hold circuit to chart table.
	b. Pen height adjustment not correct.	b. Perform pen height adjustment procedure in Section III.
	c. X motor stator misaligned.	c. Perform alignment procedures in Section III.
When pen is down, skips some areas or trace is too light.	a. Pen running out of ink.	a. Replace pen.
	b. Pen height adjustment not correct.	b. Perform pen height adjustment procedure in Section III.
	c. X motor stator misaligned.	c. Perform alignment procedures in Section III.
Pen does not respond to PEN DOWN key.	a. Pen solenoid open or drive current path open.	a. Check continuity through cable W2 and pen solenoid.
	b. Pen drive circuit defective.	b. Check pen drive circuit U46, Q25 through Q28.
	c. PEN DOWN key switch defective.	c. Replace switch (or front panel PCA A2).
	d. Pen control buffer U30 defective.	d. Replace U30.
Pen does not respond to PEN UP key.	a. Pen carrier return spring broken.	a. Replace pen carrier.
	b. Pen control buffer U30 defective.	b. Replace U30.

is intermittent.	panel PCA A2 and main PCA A1.	screws are tight.
	c. Servo processor or other A1 component faulty.	c. Troubleshoot A1 using voltage readings, counter readings and/or signature analysis.
Plotter does not respond to any front panel key.	a. If an I/O module is installed, PANEL/PEN disable line may be held low.	a. Remove I/O module, then check front panel key operation. If correct, troubleshoot I/O module.
	b. If no I/O module is installed, U37D may be defective.	b. Check logic level at U37D pin 11. Should be low.
Chart paper does not adhere properly to table.	a. Contamination on chart table.	a. Clean table. See Paragraph 6-117.
	b. Open circuit in electrostatic chart hold voltage path.	b. Check continuity through main cable PCA A3 to chart table.
	c. Chart hold voltage circuit defec-	c. Check drive circuit.
	d. Defective or damaged chart table.	d. Replace table.
Wavy or irregular plot lines.	Refer to Table 6-4, Confidence Test Irregularities.	

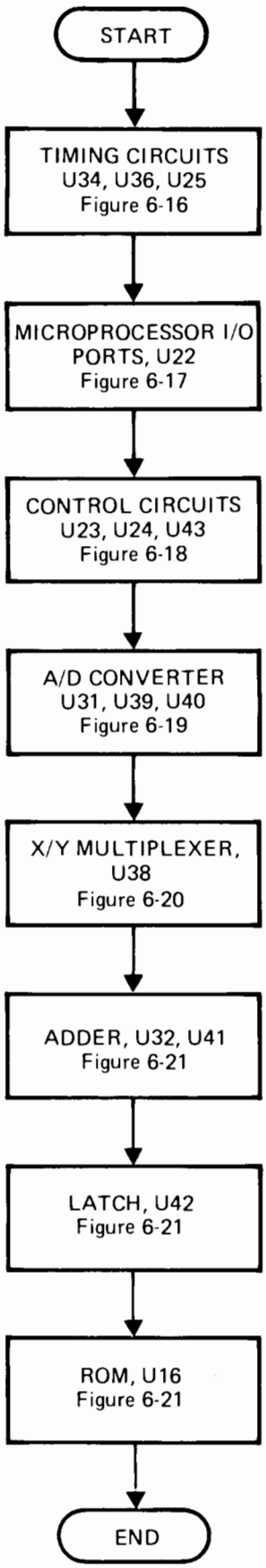


Figure 6-14. Signature Analysis Test Flow Chart

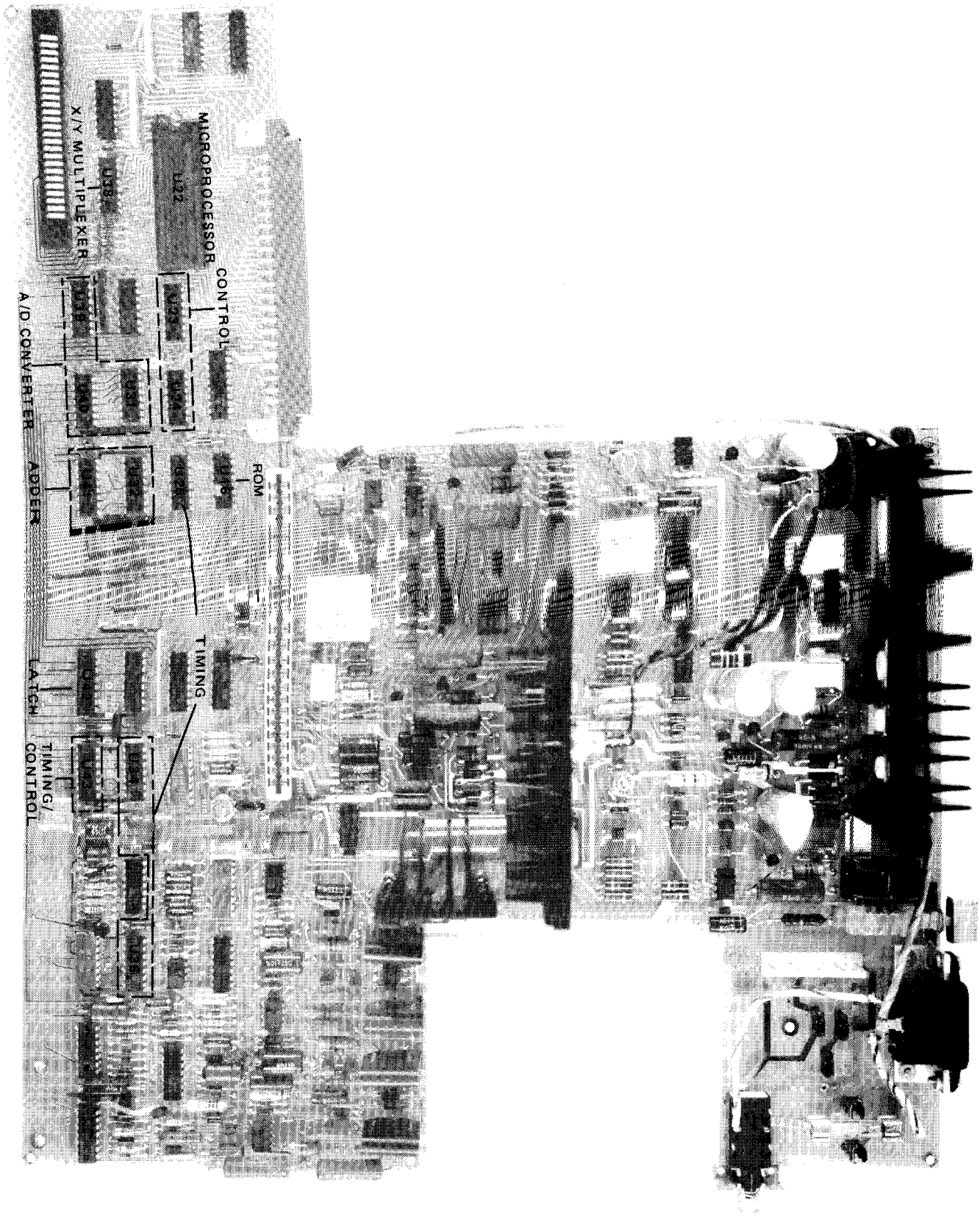


Figure 6-15. Location of Circuits in Signature Analysis Tests

a. Set the signature analyzer controls as follows:

START	⌐	(in)
STOP	⌐	(in)
CLOCK	⌐	(out)

b. Connect the signature analyzer as follows:

START	A1TP11
STOP	A1TP11
CLOCK	A1TP16

c. Compare the signatures observed at U34, U36, and U25 with the correct signatures shown. Also determine that the probe light flashes when connected to U43 pin 6.

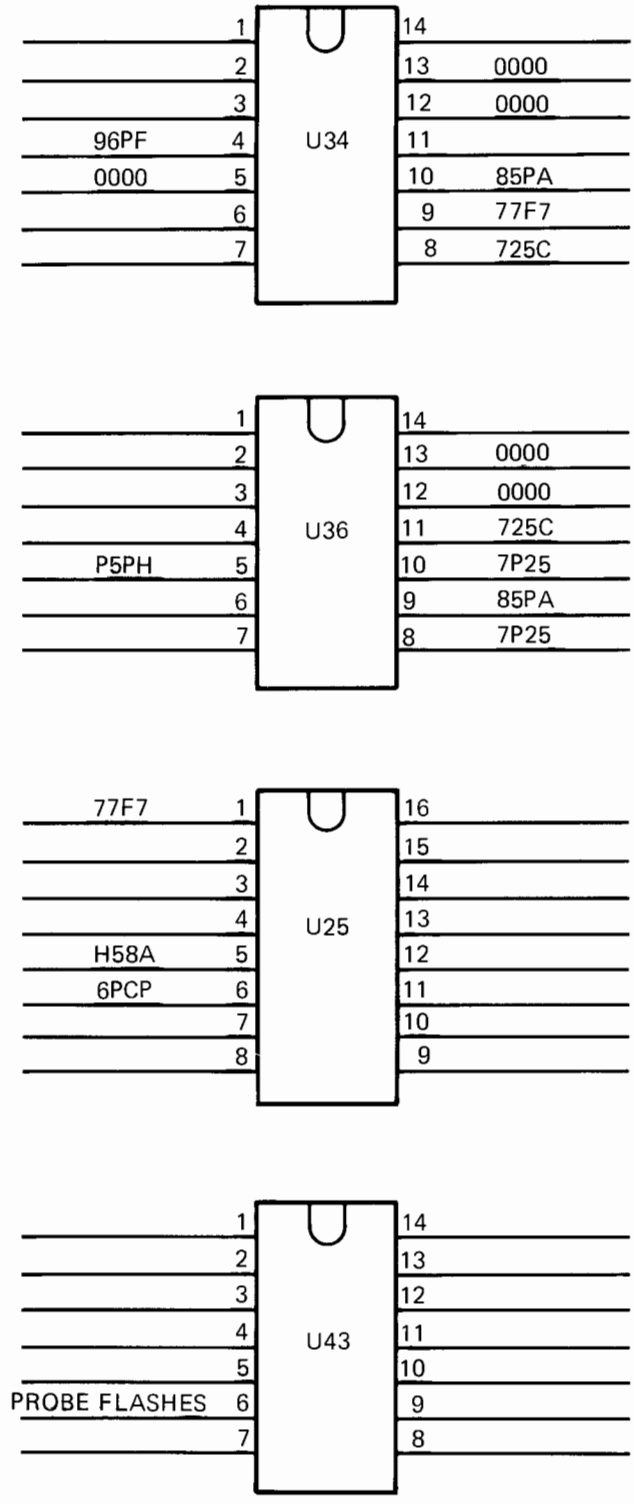


Figure 6-16. Timing Circuit Test

START	A1TP14
STOP	A1TP14
CLOCK	A1TP16

c. Set 7225A power switch to OFF then ON to make sure circuits are set to initial conditions.

d. Press LOWER LEFT key.

e. In the microprocessor tests, two signatures should be observed at each point on U22 indicated. One following pen movement from lower left to upper right and the other following movement from upper right to lower left. The signature analyzer probe must contact the test point during the entire pen movement. Place the signature analyzer probe on a point to be tested, then press UPPER RIGHT and LOWER LEFT as necessary. Compare the signatures observed with the correct signatures shown.

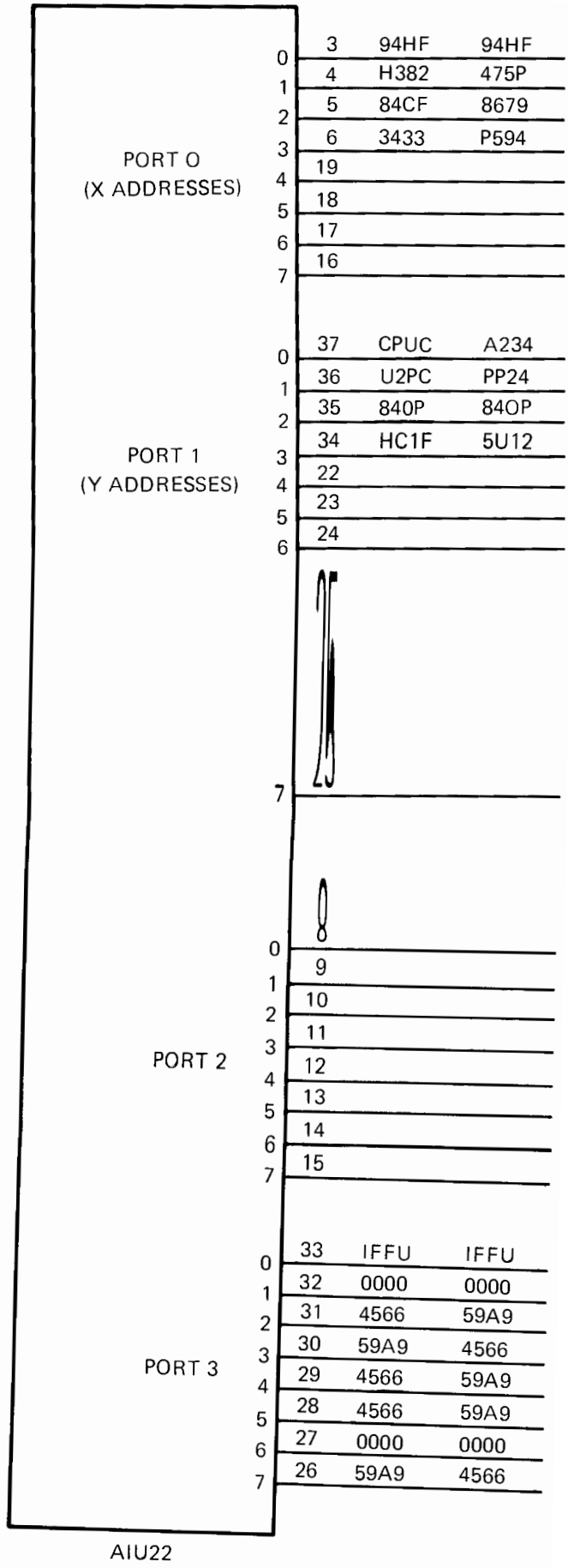


Figure 6-17. Microprocessor Signatures

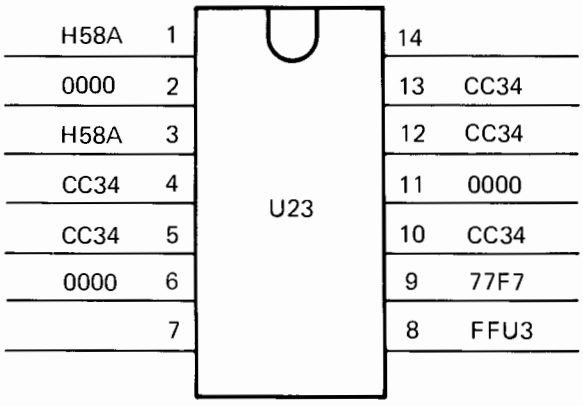
a. Set the signature analyzer controls as follows:

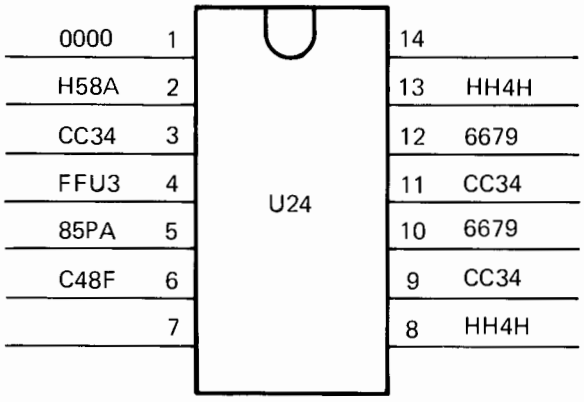
START	⌐	(in)
STOP	⌐	(in)
CLOCK	⌐	(out)

b. Connect the signature analyzer as follows:

START	A1TP11
STOP	A1TP11
CLOCK	A1TP16

c. Compare the signatures observed at U23, U24, and U43 (control circuits) with the correct signatures at the points indicated.





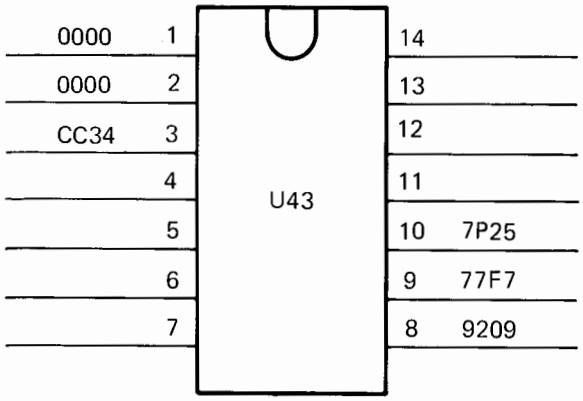


Figure 6-18. Control Circuit Test

a. Set the signature analyzer controls as follows:

START	⌐	(in)
STOP	⌐	(out)
CLOCK	⌐	(out)

b. Connect the signature analyzer controls as follows:

START	A1TP11
STOP	A1TP11
CLOCK	A1TP16

c. Compare signatures observed at U31, U39, and U40 (A/D Converter) with the correct signatues at the points indicated.

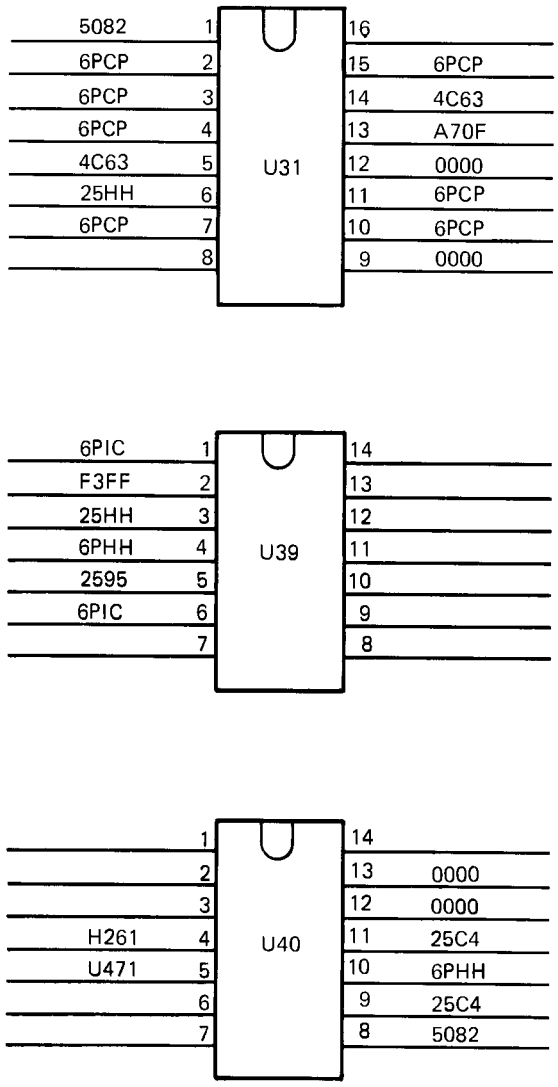


Figure 6-19. A/D Converter Circuit Test

a. Set the signature analyzer controls as follows:

START	⌐	(in)
STOP	⌐	(in)
CLOCK	⌐	(out)

b. Connect the signature analyzer as follows:

START	A1TP11
STOP	A1TP11
CLOCK	A1TP16

c. Set 7225A power switch to OFF then ON to make sure circuits are set to initial conditions.

d. Press LOWER LEFT key. Observe signatures at the points on U38 indicated. Compare with the correct signatures shown under LOWER LEFT PEN POSITION.

e. Press UPPER RIGHT key. Observe signatures at the points indicated and compare with the correct signatures shown under UPPER RIGHT PEN POSITION.

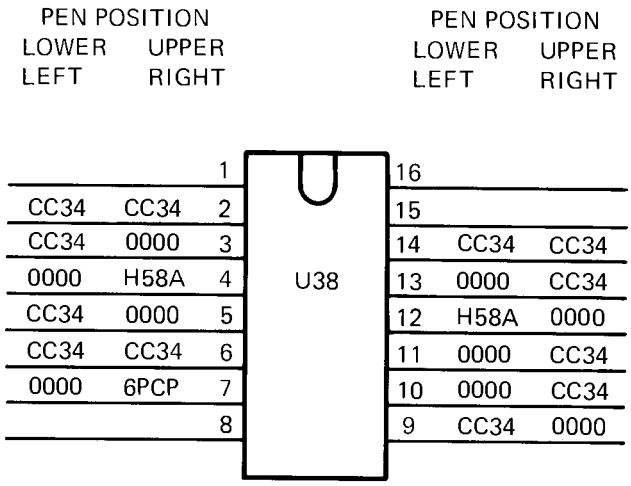


Figure 6-20. X/Y Multiplexer Test

a. Set the signature analyzer controls as follows:

START	⌐	(in)
STOP	⌐	(out)
CLOCK	⌐	(out)

b. Connect the signature analyzer as follows:

START	A1TP11
STOP	A1TP11
CLOCK	A1TP16

c. Set 7225A power switch to OFF then ON to make sure circuits are set to initial conditions.

d. Press LOWER LEFT key. Observe signatures at the points on U32 indicated. Compare with correct signatures shown under LOWER LEFT PEN POSITION.

e. Press UPPER RIGHT key. Observe signatures at the points indicated on U32 and compare with the correct signatures shown.

f. Repeat steps d. and e. for U41.

g. Repeat steps d. and e. for U42.

h. Repeat steps d. and e. for U16.

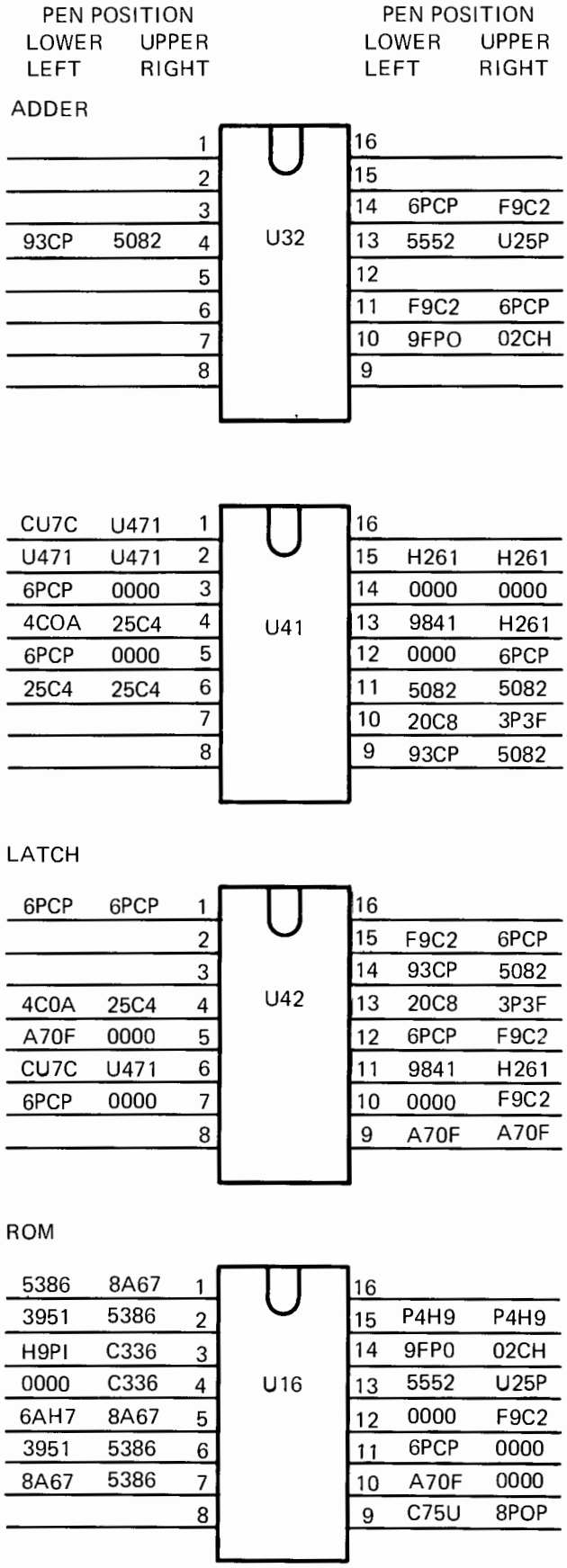


Figure 6-21. Adder, Latch, and ROM Circuit Tests

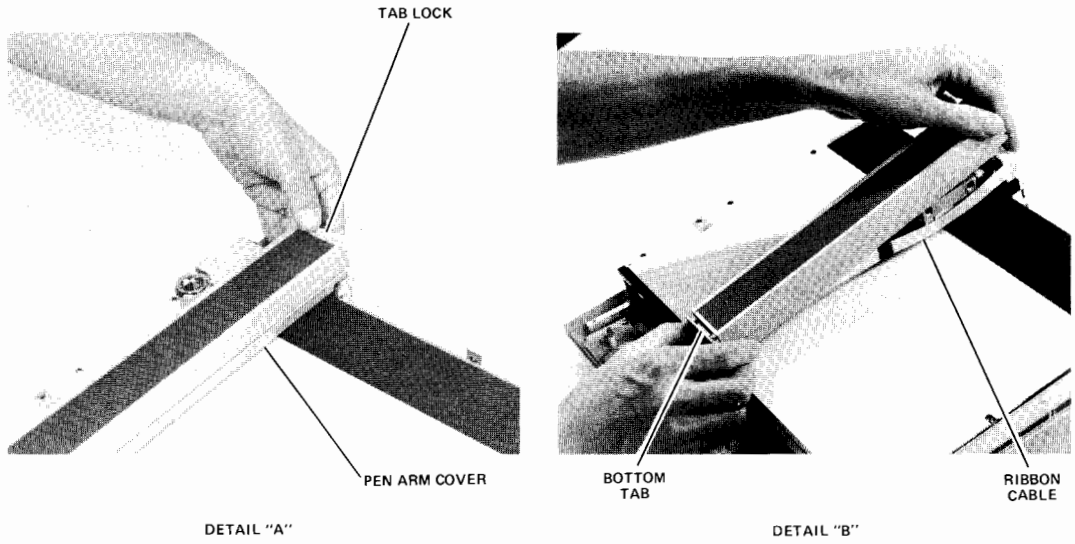


Figure 6-22. Pen Arm (Y Stator) Cover Removal

6-146. PARTS REPLACEMENT.

6-147. PEN ARM (Y STATOR) COVER.

6-148. To remove the pen arm cover, proceed as follows:

a. Remove the top cover. (See Paragraph 6-131.)

b. Remove the pen arm cover by disengaging the tab lock over the back end of the cover and lifting up. (See Figure 6-22A.)

c. Slide the cover off the bottom tab and lift it clear of the Y stator. (See Figure 6-22B.)

d. Install in reverse order of removal procedure. Note that the slotted end of the cover fits over the bottom tab.

6-149. PEN SOLENOID COVER.

6-150. To remove the pen solenoid cover, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove pen arm cover. (See Figure 6-22A/B.)

c. Remove the two 2-56 X 1/4 pen solenoid cover retaining screws. (See Figure 6-23.)

d. Remove pen solenoid cover.

e. Install in reverse order of removal procedure.

6-151. PEN SOLENOID/PEN HOLDER ASSEMBLY.

6-152. To remove the pen solenoid assembly, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove pen arm cover. (See Figure 6-22A/B.)

c. Remove pen solenoid cover. (See Figure 6-23.)

d. Remove the two 2-56 X 3/8 pen solenoid assembly retaining screws. (See Figure 6-23.)

e. Remove pen solenoid assembly. (See Figure 6-23.)

f. Remove the two pen holder assembly retaining screws to release the pen holder assembly. (See Paragraph 6-24.)

g. Install pen solenoid in reverse of removal procedure.

h. Refer to Section III of this manual and check pen adjustments.

6-153. CHART TABLE (PLATEN).

6-154. To remove the chart table, proceed as follows:

a. Remove the top cover. (See Paragraph 6-131.)

b. Remove paper stop. (See Figure 6-25A.)

NOTE

There are two types of chart tables in use, aluminum and plastic. Determine by visual inspection the type of table installed in the plotter, and the type of table that is to be installed.

The aluminum table may be recognized by its bright polished sides and bottom.

If the plotter has an aluminum table and the same type is to be installed, omit step g.

If the plotter has a plastic table and the same type is to be installed, omit steps c. through f.

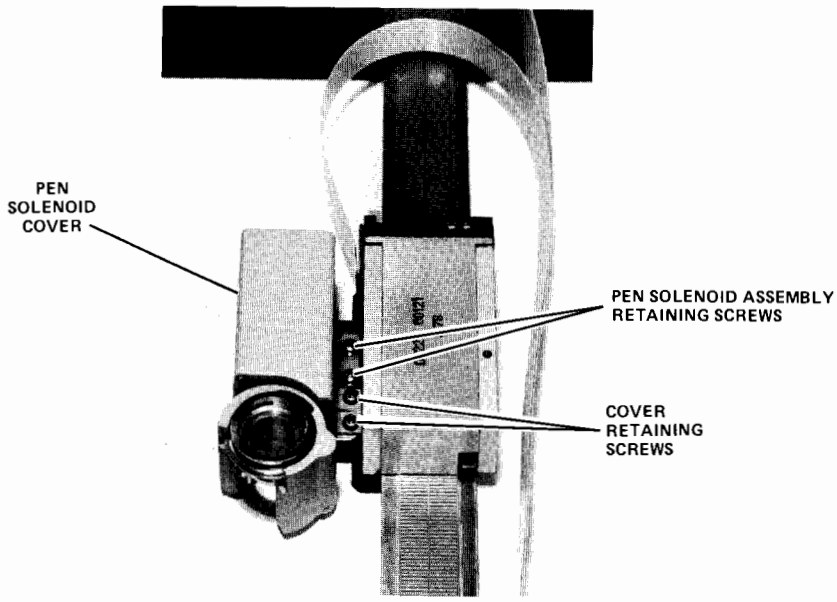


Figure 6-23. Pen Solenoid Cover and Solenoid Assembly Removal

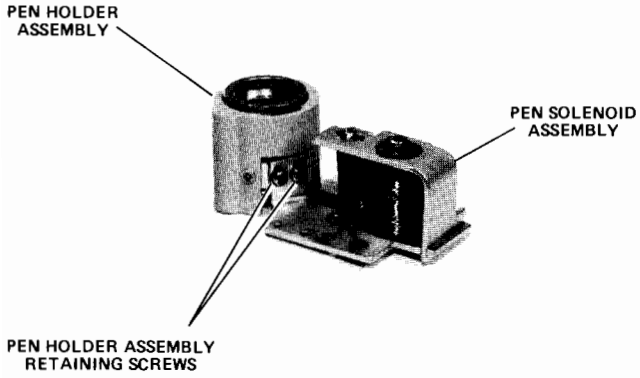


Figure 6-24. Pen Holder Assembly Removal

c. Remove the upper deck assembly. (See Figure 6-11C.)

d. Disconnect the chart table wires from the main cable PCA. (See Figure 6-25B.)

e. Observe the insulator between the bottom surface of the table and the upper deck assembly at the right hand set of mounting screws, and the aluminum spacer at the left hand set of mounting screws.

f. Remove the six 4-40 X 1/2 Pozidriv table mounting screws. (See Figure 6-25A.)

g. Remove the six 4-40 X 1/4 nylon chart table mounting screws. (See Figure 6-25A.)

h. Remove the chart table, exercising caution not to scratch the table surface with the pen arm mechanism.

NOTE

To facilitate ease of table removal, it is suggested that the pen arm mechanism be moved to the left hand edge of the plotter and the table be lifted up and out from the right hand edge.

i. Install table in reverse order of removal procedure.

NOTE

When installing the aluminum table, whether a direct replacement or change from the plastic table, it is necessary to insert the insulator between the table and upper deck assembly at the right hand set of mounting screws, and the aluminum spacer between the table and upper deck assembly at the left hand set of mounting screws.

The fiber insulator and aluminum spacer are deleted when installing a plastic chart table.

j. Check X motor stator alignment for proper pen arm height per Section III of this manual.

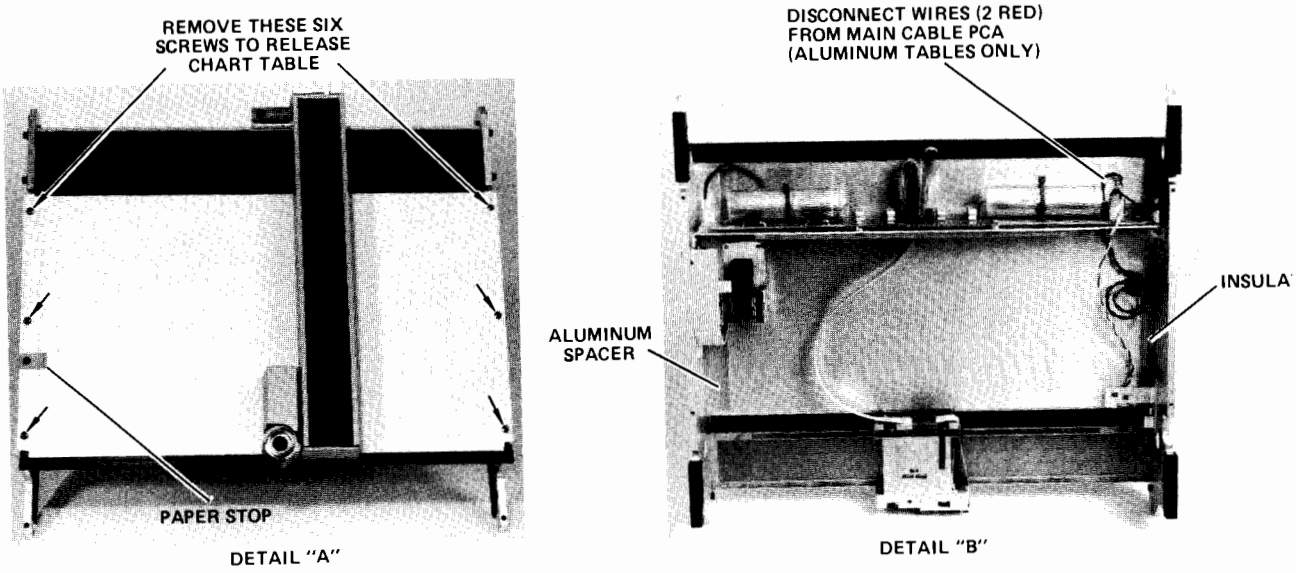


Figure 6-25. Chart Table (Platen) Removal

6-155. FRONT PANEL PCA

6-156. To remove the front panel PCA, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove the three 4-40 X 1/2 Pozidriv and the three 4-40 X 1/4 Pozidriv front panel PCA mounting screws. (See Figure 6-26.)

c. Remove front panel PCA.

d. Install front panel PCA. Make sure contacts on front panel PCA and J6 on main PCA are clean to assure good contact.

e. Replace and secure the front panel PCA mounting screws making sure to center the fiber spacer under the far right hand 4-40 X 1/2 screw between the front panel PCA and main PCA.

f. Replace top cover.

6-157. MAIN PCA.

6-158. To remove the main PCA, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Remove the I/O module mounting screws and slide the I/O module out of the lower deck assembly.

d. Remove the front panel PCA. (See Figure 6-26.)

e. Remove the AC shield. (See Figure 6-27.)

f. Disconnect the transformer lead connectors from the main PCA.

g. Remove the four 4-40 X 1/4 and the two 4-40 X 3/8 main PCA mounting screws. (See Figure 6-27.)

h. Carefully remove the main PCA, exercising caution not to damage the confidence test switch or the power on/off switch located near the right rear corner of the plotter.

NOTE

It may be necessary to press the confidence test switch to remove the main PCA from the lower deck assembly.

i. Install main PCA making sure that the confidence test switch and power on/off switch align with their respective slots in the lower deck assembly.

j. Install in reverse of removal procedure.

6-159. POWER TRANSFORMER.

6-160. To remove the power transformer, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Remove the AC shield. (See Figure 6-27.)

d. Disconnect the transformer lead connectors from the main PCA.

e. Remove the four 8-32 X 1-1/4 transformer mounting screws. (See Figure 6-27.)

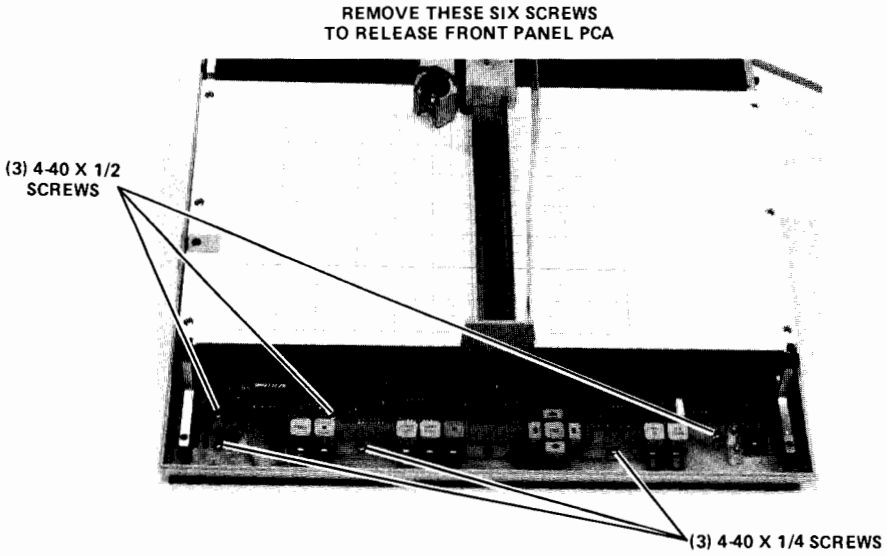


Figure 6-26. Front Panel PCA Removal

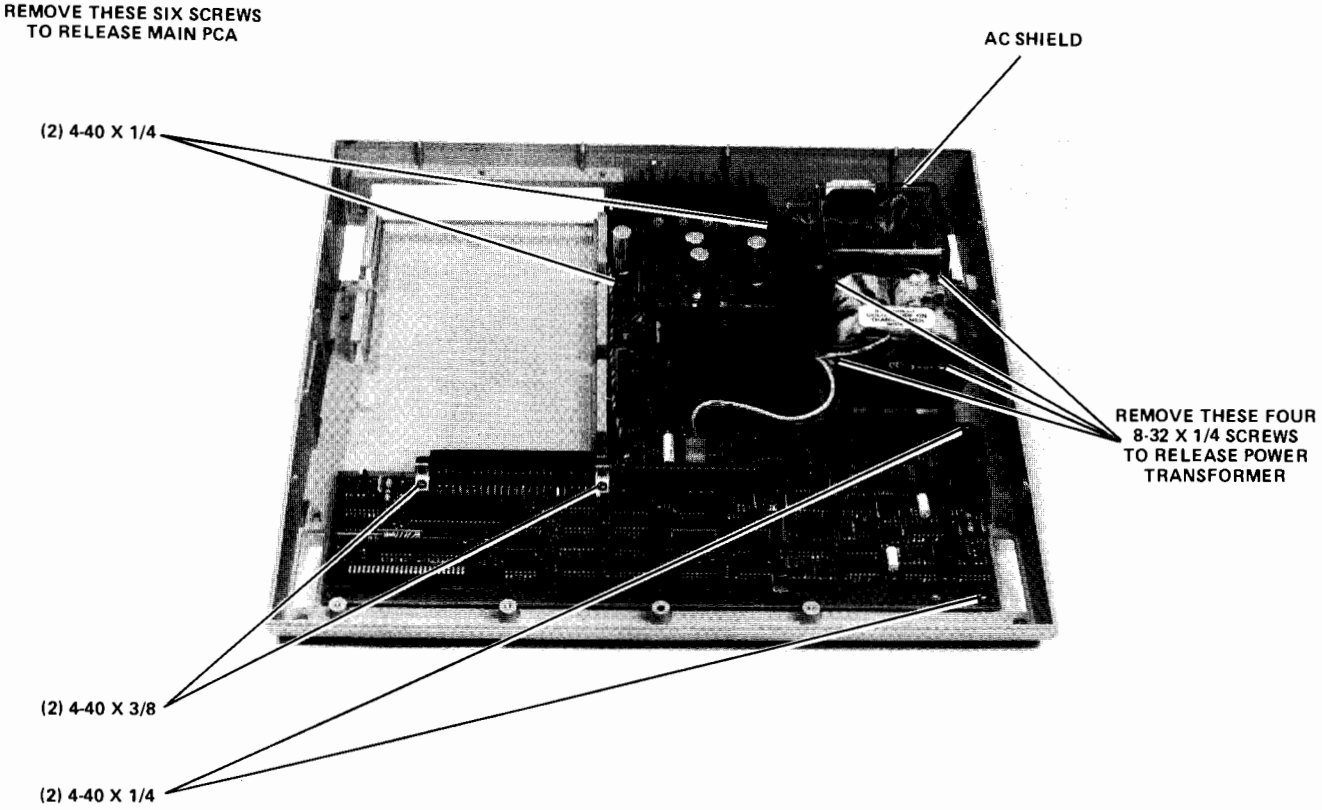


Figure 6-27. Main PCA and Power Transformer Removal

f. Remove power transformer.

g. Install transformer in reverse of removal procedure.

6-161. MAIN CABLE PCA.

6-162. To remove the main cable PCA, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Unplug fan wire connector (J1), X limit switch connector (J4), and chart table wires (Aluminum Tables only) from the main cable PCA located under the upper deck assembly. (See Figure 6-28.)

d. Remove the two 4-40 X 1/2 main cable PCA bracket mounting screws at each end of the main cable PCA bracket. Release the brackets with the PCA from the upper deck assembly. (See Figure 6-28.) Lift the left end of the main cable PCA first to prevent damage to the spring chart table contacts at the right-hand end.

e. Disconnect the X and Y motor cables from their respective connectors and the main cable PCA. (See Figure 6-28.)

f. Remove the four 4-40 X 1/2 Pozi main cable PCA to bracket mounting screws. Remove main cable PCA.

g. Install main cable PCA in reverse of removal procedure.

6-163. MOTOR FUSES.

NOTE

The motor fuses are located on the main cable PCA.

6-164. Main cable PCA motor fuse replacement is accomplished as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove the upper deck assembly to gain access to the motor fuses. (See Figure 6-11C.)

c. Replace fuse(s) and reassemble in reverse order of removal. (See Figure 6-29.)

6-165. AC LINE FUSE.

6-166. To replace the AC line fuse, proceed as follows:

a. Remove the top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Remove AC shield. (See Figure 6-27.)

d. Replace AC line fuse with fuse of proper size and rating. (See Figure 6-30.)

e. Assemble in reverse order of removal.

6-167. X LIMIT SWITCH.

6-168. To remove the X limit switch, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Disconnect X limit switch connector (J4) from main cable PCA and disconnect X limit switch ground wire connected to bottom right side of upper deck chassis near main cable PCA. (See Figure 6-31A.)

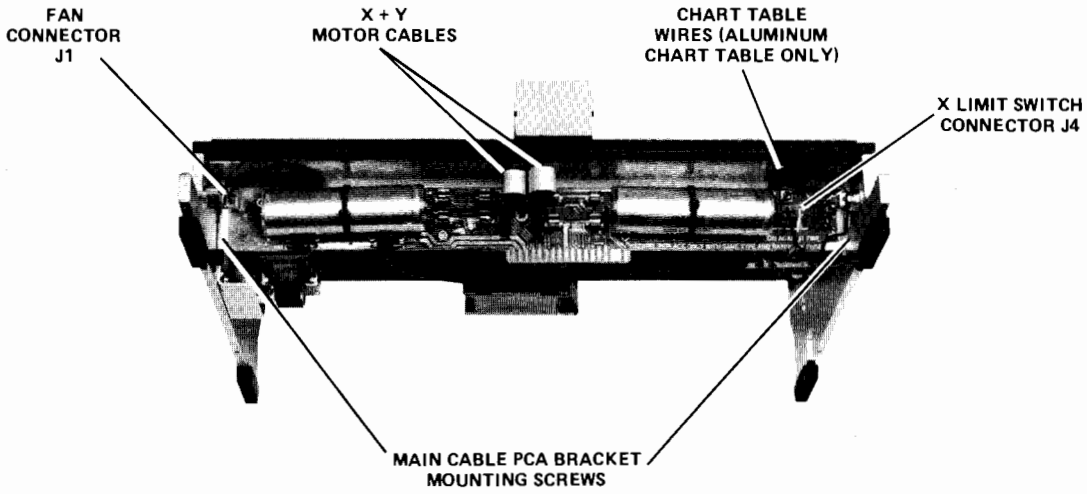


Figure 6-28. Main Cable PCA Removal

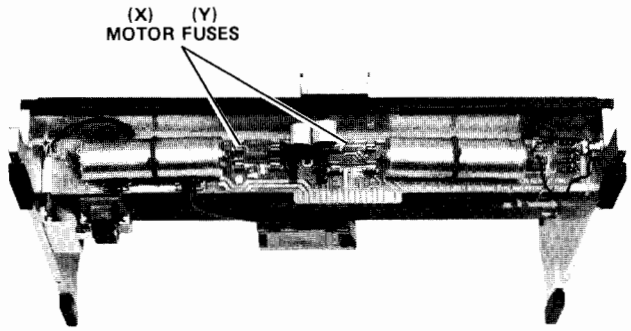


Figure 6-29. Motor Fuses, Located on the Main Cable PCA

d. Remove the two 4-40 X 1/2 Pozi screws that hold the X limit switch bracket to the chassis to release X limit switch assembly. (See Figure 6-31B.)

e. Remove the two 2-56 X 7/16 from the X limit switch to release X limit switch from bracket. (See Figure 6-31B.)

f. Install X limit switch assembly in reverse of removal procedure.

g. Refer to Section III of this manual for X limit switch adjustment procedure.

6-169. Y LIMIT SWITCH.

NOTE

The Y limit switch is a two part mechanism comprised of the Y motor accelerometer cover cable clamp and the rear Y stator cover support cable clamp.

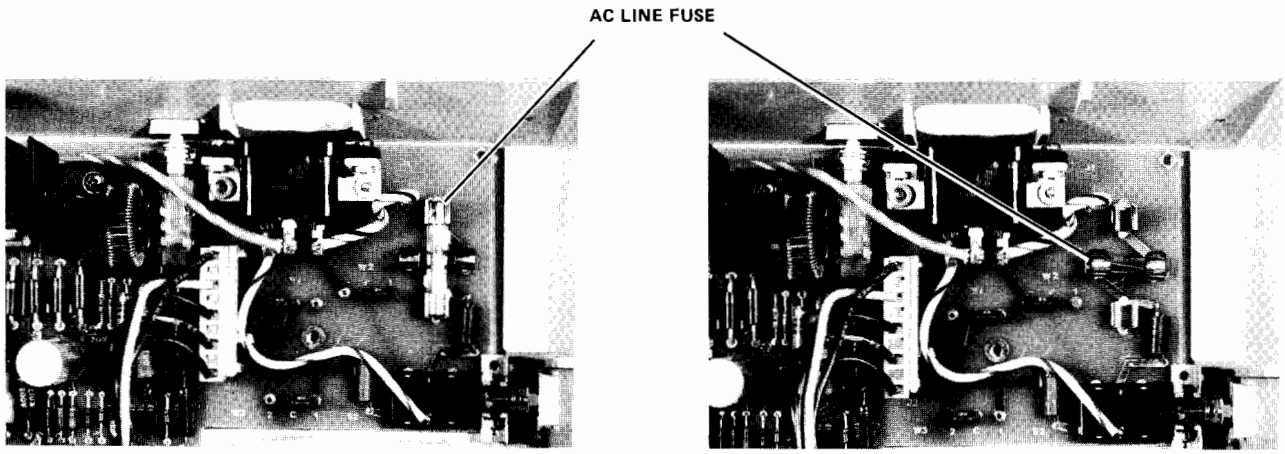


Figure 6-30. AC Line Fuse Replacement

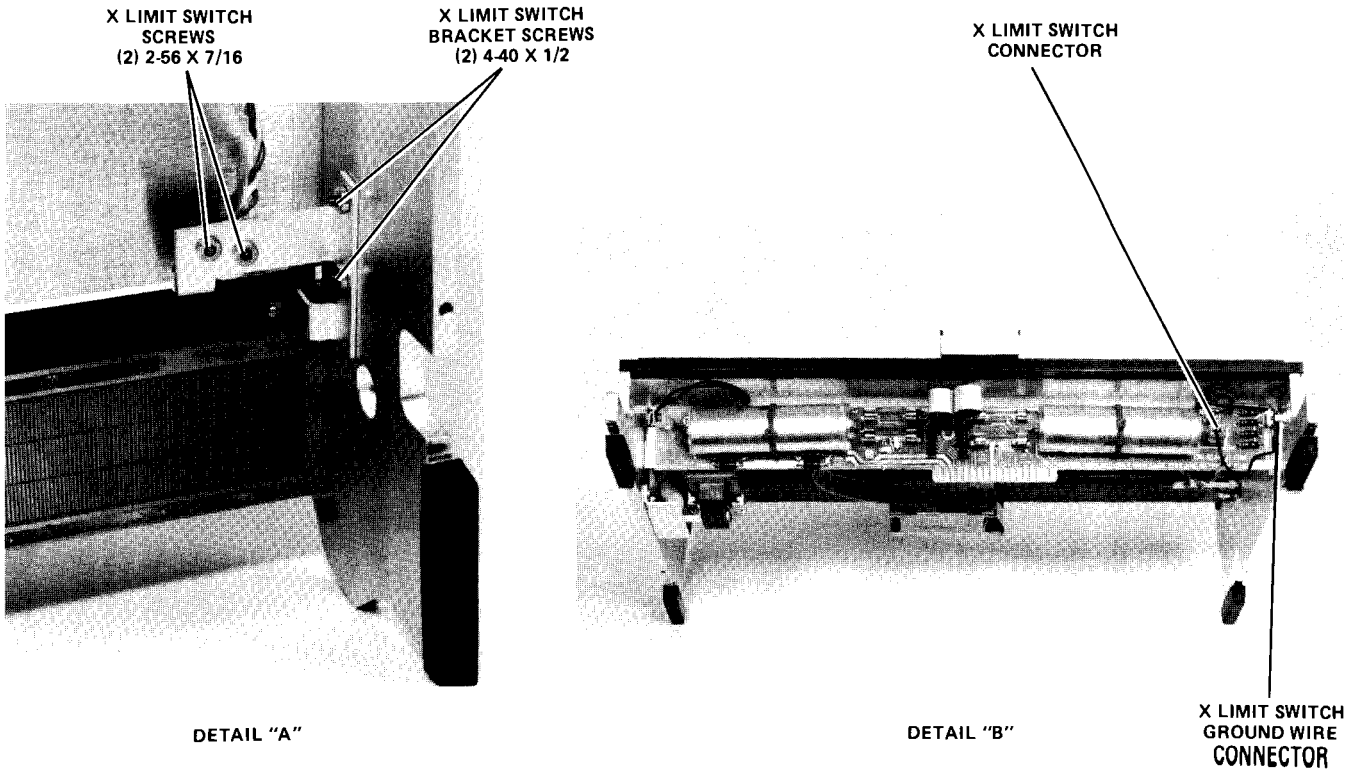


Figure 6-31. X Limit Switch Removal

6-170. To remove the Y motor accelerometer cover cable clamp portion of the Y limit switch mechanism proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove pen arm (Y stator) cover. (See Figure 6-22A/B.)

c. Rotate the plotter so that the back side faces forward.

d. Remove the 2-56 X 3/8 Pozi Y motor accelerometer cover cable clamp retaining screw to release the clamp. (See Figure 6-32A.) Observe the position of the cable and accelerometer to the clamp.

e. Install Y motor accelerometer cover cable clamp in reverse of removal procedure.

6-171. To remove the rear Y stator cover support cable clamp portion of the Y limit switch mechanism, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove the two 2-56 X 3/16 rear Y stator cover support cable clamp screws to release the clamp. (See Figure 6-32B.) Observe the lead dress of the Y limit switch wire.

c. Install rear Y stator cover cable clamp in reverse order of removal procedure.

6-172. FAN ASSEMBLY.

6-173. To remove the fan assembly, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Disconnect fan connector (J1) from main cable PCA.

d. Remove the three 4-40 X 1/2 fan shroud mounting screws (see Figure 6-33), and slide the fan wire connector through the slot between the main cable PCA bracket and the left side of the upper deck chassis, so that the wire and connector are below the main cable PCA. If necessary, loosen the main cable PCA bracket.

e. Remove fan assembly.

f. Install fan assembly in reverse order of removal procedure.

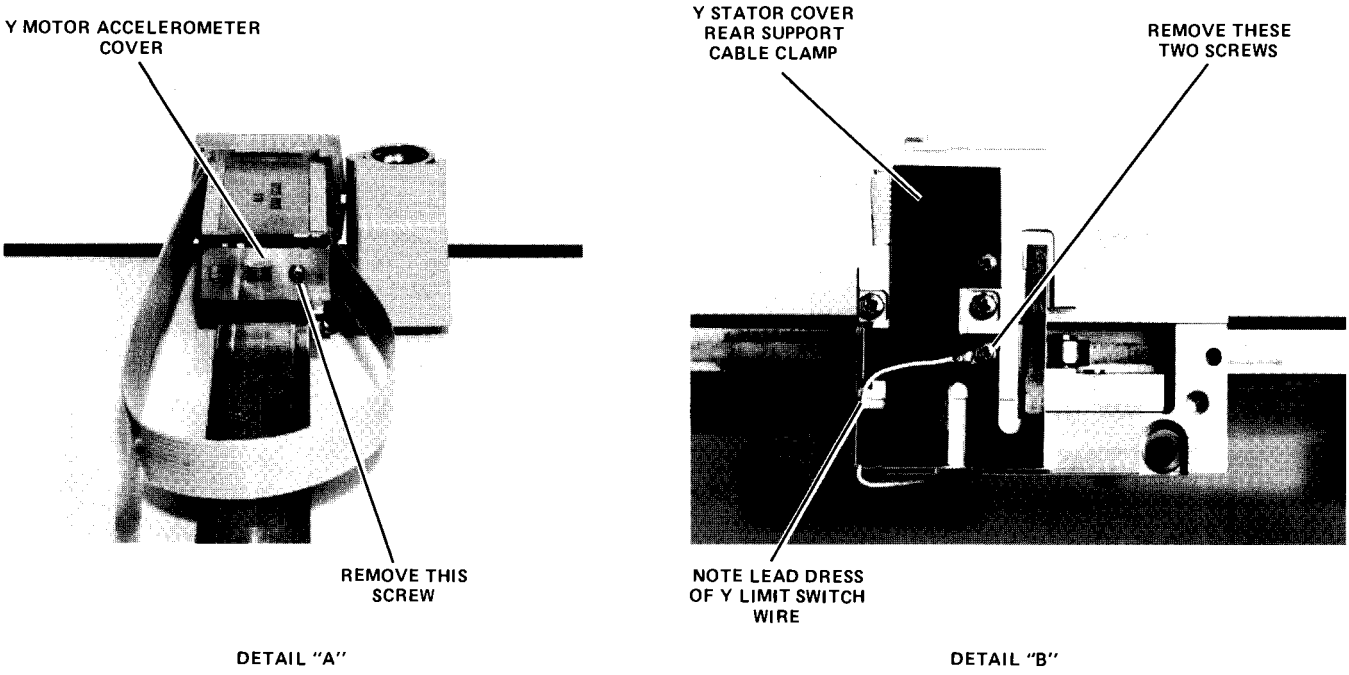


Figure 6-32. Y Limit Switch Removal

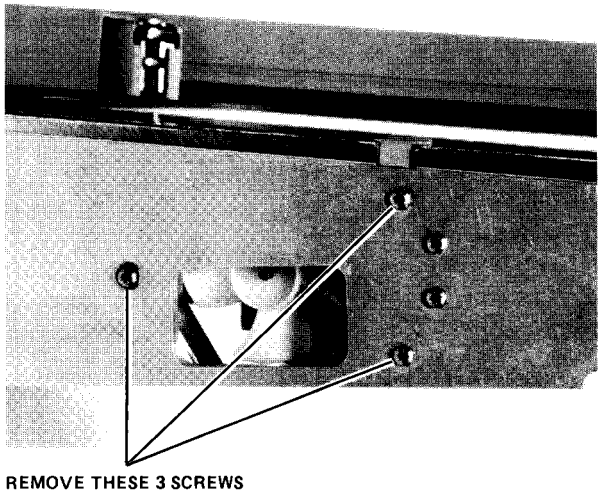


Figure 6-33. Fan Assembly Removal

6-174. X MOTOR CABLE

6-175. To remove the X motor cable, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Carefully pry off the X motor cable clamp. (See Figure 6-34B.)

d. Remove the 2-56 X 3/8 and 2-56 X 1/8 X accelerometer cover and cable clamp mounting screws and remove clamp. (See Figure 6-34B.)

e. Carefully pry out the X cable termination from the accelerometer cover. (See Figure 6-35.)

f. Remove the two 4-40 X 1/2 main cable PCA bracket screws at each end of the main cable PCA. Release the bracket with the main cable PCA, but do not remove.

g. Gently pull the X motor cable from the connector in the main cable PCA and remove the X cable. (See Figure 6-34A.)

h. Install X motor cable in reverse of removal procedure.

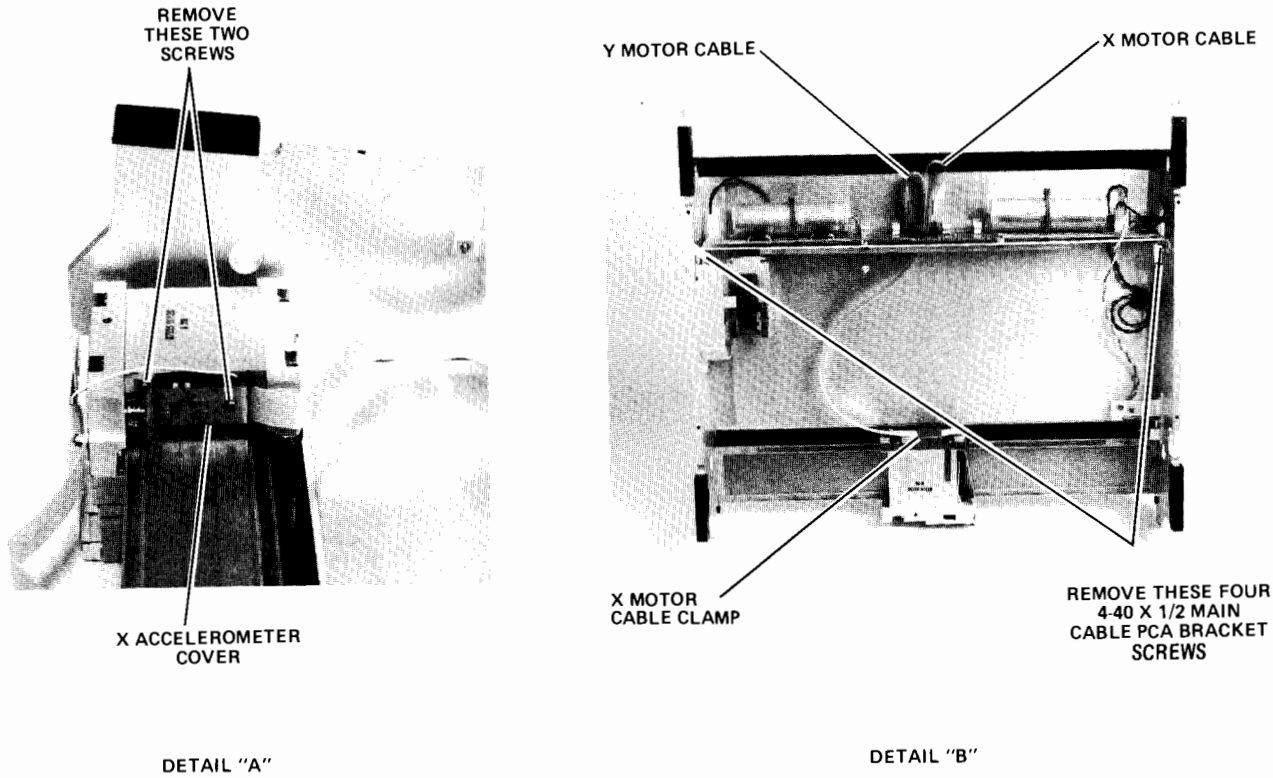


Figure 6-34. X Motor Cable Removal

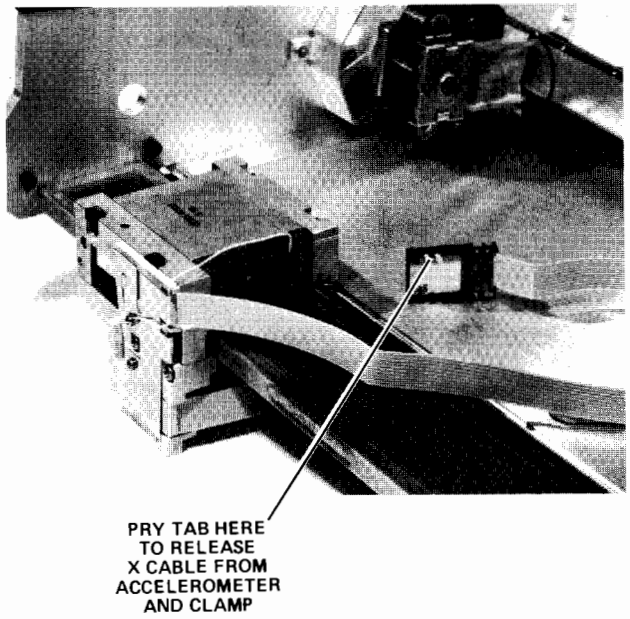


Figure 6-35. X Cable Termination Removal

6-176. X ACCELEROMETER.

6-177. To remove X accelerometer, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Carefully pry off the X motor cable clamp. (See Figure 6-23A.)

d. Remove the 2-56 X 3/8 and 2-56 X 1/8 X accelerometer cover and cable clamp mounting screws and remove clamp. (See Figure 6-34B.)

e. Carefully pry out the accelerometer from its cover. (See Figure 6-36.).

f. Install X accelerometer in reverse order of removal procedure.

6-178. Y MOTOR CABLE.

6-179. To remove the Y motor cable, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Remove pen arm cover. (See Figure 6-22 A/B.)

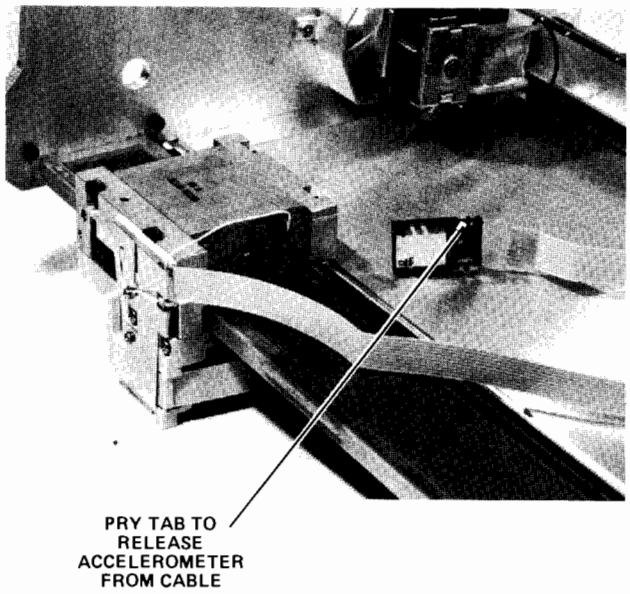


Figure 6-36. X Accelerometer Removal

d. Remove the two 2-56 X 3/16 Y cable to rear support clamp mounting screws and remove clamp. (See Figure 6-37A.) Note the position of the Y limit switch wire to the rear support Y cable clamp.

e. Slide the Y motor cable from the slots in the Y cover front and rear supports. (See Figure 6-34A.)

f. Remove the Y accelerometer cover screw and cable clamp. (See Figure 6-37B.)

g. Remove the X motor cable clamp and release the Y motor cable.

h. Carefully pry out the Y cable termination from the accelerometer cover. (See Figure 6-38.)

i. Remove the two 4-40 X 1/2 main cable PCA bracket screws at each end of the main cable PCA. Release the main cable PCA, but do not remove. (See Figure 6-28A.)

j. Gently pull the Y motor cable from the connector on the main cable PCA and remove the Y cable.

k. Install Y motor cable in reverse of removal procedure.

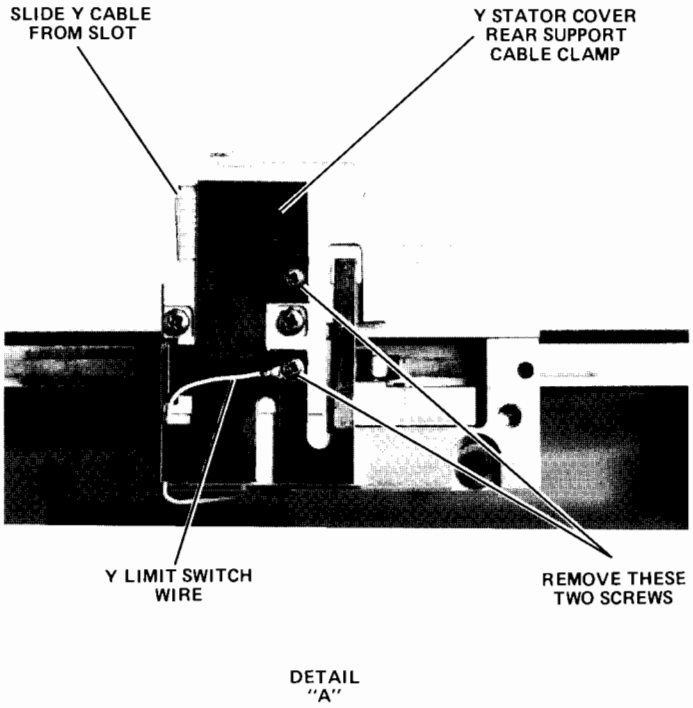


Figure 6-37. Y Motor Cable Removal

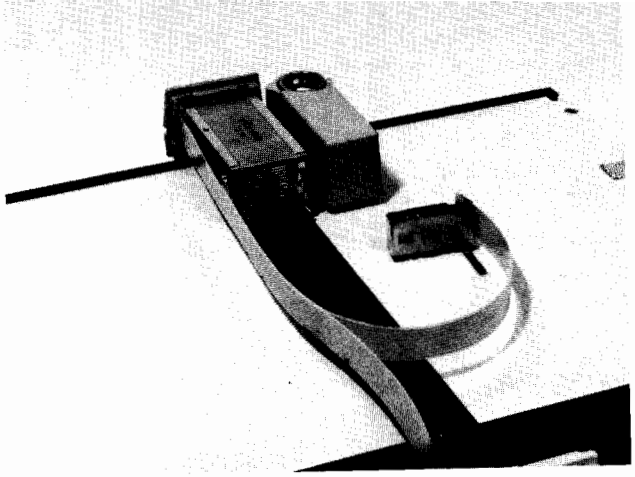


Figure 6-38. Y Cable Termination Removal

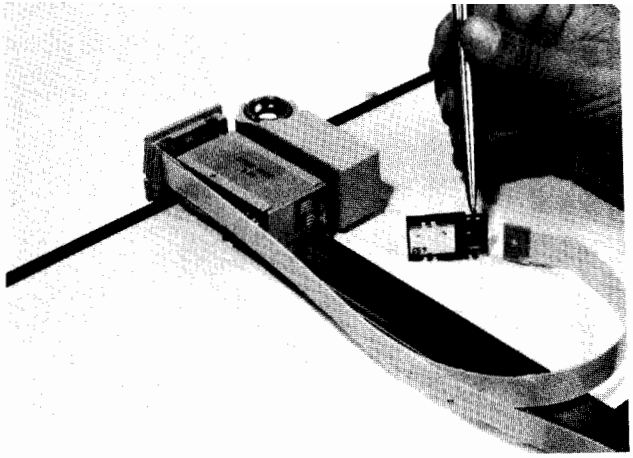


Figure 6-39. Y Accelerometer Removal

6-180. Y ACCELEROMETER

6-181. To remove the Y accelerometer, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

c. Remove pen arm cover. (See Figure 6-22A/B.)

d. Remove the Y accelerometer cover screw and cable clamp. (See Figure 6-37B.)

e. Carefully pry out the accelerometer from its cover. (See Figure 6-39.)

f. Install Y accelerometer in reverse order of removal procedure.

6-182. PEN ARM (Y STATOR).

6-183. To remove the pen arm (Y stator) assembly, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove pen arm cover. (See Figure 6-11A/B.)

c. Remove the two 2-56 X 3/16 Y cable to rear support clamp mounting screws and remove clamp. (See Figure 6-37A.) Note the position of the Y limit switch wire to the rear support Y cable clamp.

d. Carefully slide the Y motor cable up out of the slot in the Y cover front support assembly located at the front end of the pen arm assembly. (See Figure 6-40A.)

e. Remove the two 4-40 X 1/2 Y cover rear support screws and remove the Y cover rear support. (See Figure 6-40C.)

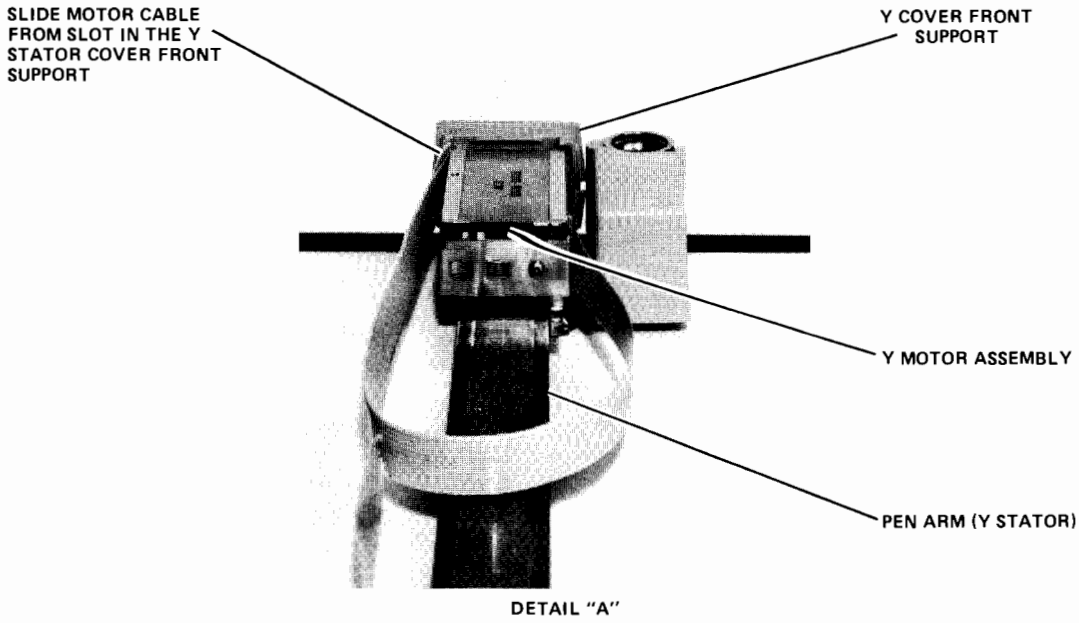
f. Remove the two 4-40 X 1/2 hex, Y stator to arm support screws to release the pen arm assembly. A 3/32 in. Allen wrench (HP P/N 8710-0896) can be used. (See Figure 6-40B.)

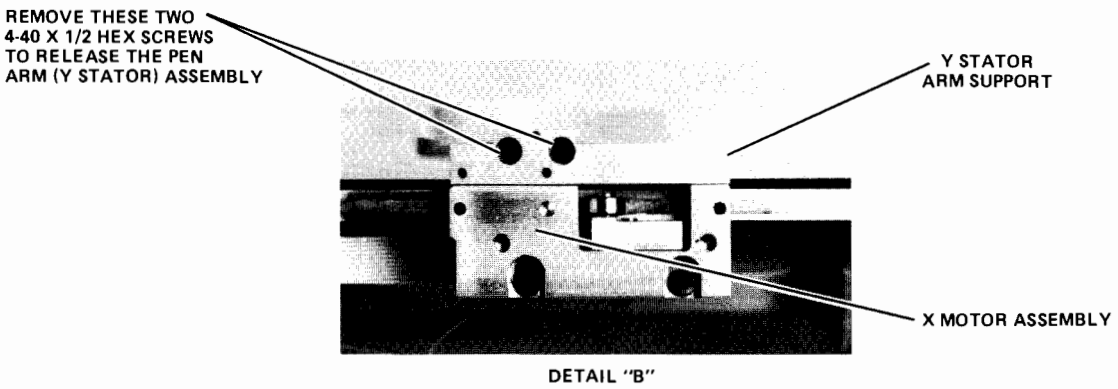
g. Lift the pen arm and slide the Y motor off the stator.

h. Remove the two #3 self-tapping screws that mount the Y cover front support assembly to the pen arm assembly and remove the Y cover front support.

i. Install pen arm (Y stator) in reverse order of removal procedure.

j. Check X motor stator and pen arm (Y stator) alignment per Section III of this manual.





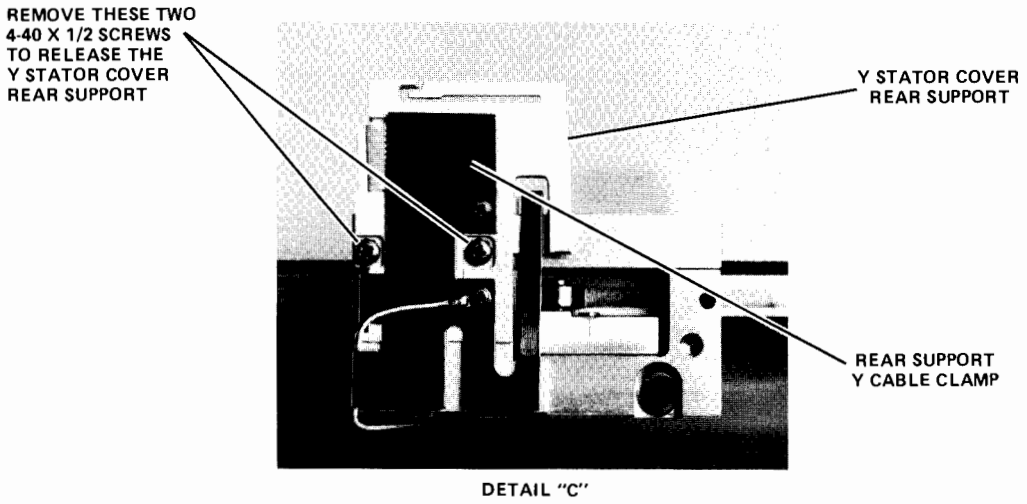


Figure 6-40. Pen Arm (Y Stator) Removal

b. Remove pen arm cover. (See Figure 6-11A/B.)

c. Remove pen solenoid assembly. (See Figure 6-23.)

d. Remove plastic clamp from right side of Y motor. (See Figure 6-41A.)

e. Remove Y accelerometer cover and cable clamp screw and gently slide clamp and accelerometer cover to top of Y motor and off the motor assembly. (See Figure 6-37.)

f. Remove Y motor by pushing on the motor bearing spring while lifting the Y motor from the stator. (See Figure 6-41B.) Note that a flange retains the motor on its left side; the motor will lift up on its right side with an applied twisting motion once the magnetic holding force is overcome. (See Figure 6-41C.)

g. Install Y motor in reverse of removal procedure.

NOTE

The Y accelerometer clamp must slide into slot on right side of Y motor in order to retain accelerometer assembly to the Y motor.

6-186. X MOTOR STATOR.

6-187. To remove the X motor stator, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove the four 4-40 X 5/8 hex X stator mounting screws using a 7/64 in. Allen wrench such as HP P/N 8710-0096. (See Figure 6-42.)

c. Carefully lift X motor, X stator, and pen arm assembly as unit and slide X stator from X motor.

d. Install X motor stator in reverse of removal procedure.

e. Perform X motor stator alignment per Section III of this manual.

6-188. X MOTOR.

6-189. To remove the X motor, proceed as follows:

a. Remove top cover. (See Paragraph 6-131.)

b. Remove upper deck assembly. (See Figure 6-11C.)

e. Remove the two 2-56 X 3/16 Y cable to rear support clamp mounting screws and remove clamp. (See Figure 6-37.) Note the position of the Y limit switch wire to the clamp.

f. Remove the Y stator cover rear support. (See Figure 6-40C.)

g. Remove the pen arm assembly. (See Figure 6-40.)

h. Remove the X motor from the X motor stator by pushing on the motor bearing spring while applying a firm twisting motion. Note that a firm pull is required to overcome the magnetic holding force. (See Figure 6-43A/B.)

i. Install X motor in reverse of removal procedure.

j. Check X motor stator and pen arm (Y stator) alignment per Section III of this manual.

6-190. DIAGRAMS.

6-191. FUNCTIONAL BLOCK DIAGRAM.

6-192. The 7225A circuits are grouped according to function in the functional block diagram. Operation of the circuits is described in the Theory of Operation beginning with Paragraph 6-9. The heavy dotted lines on the block diagram indicate the schematic diagram location of the circuits.

6-193. SCHEMATIC DIAGRAMS.

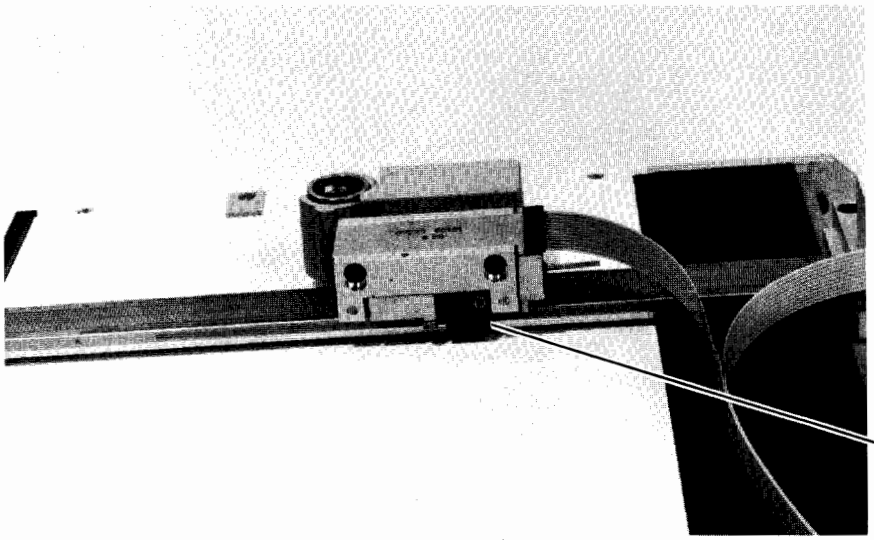
6-194. The circuits are shown on four schematic diagrams printed on foldout sheets designated as Service Sheets 1 through 4. DC voltage readings are shown at a number of points. Notes on the schematic diagrams state the conditions under which the voltage readings were taken.

6-195. WAVEFORMS.

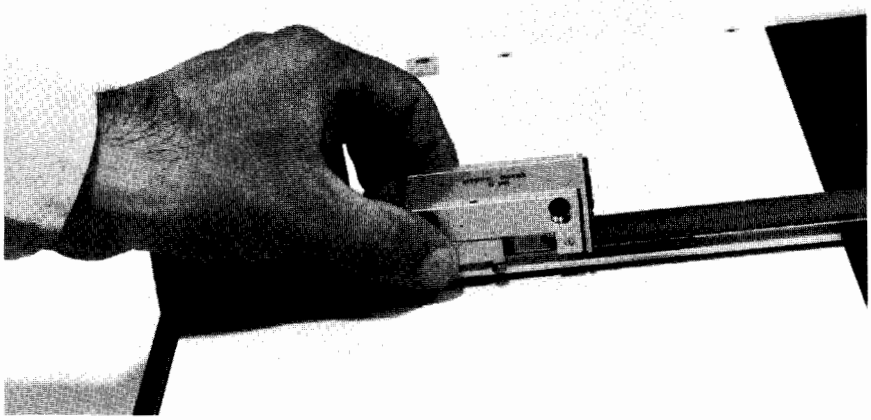
6-196. Waveforms are shown in conjunction with each schematic diagram as a troubleshooting aid. They were obtained with all circuits operating normally. An incorrect waveform may help identify a malfunctioning circuit.

6-197. FREQUENCY COUNTER READINGS.

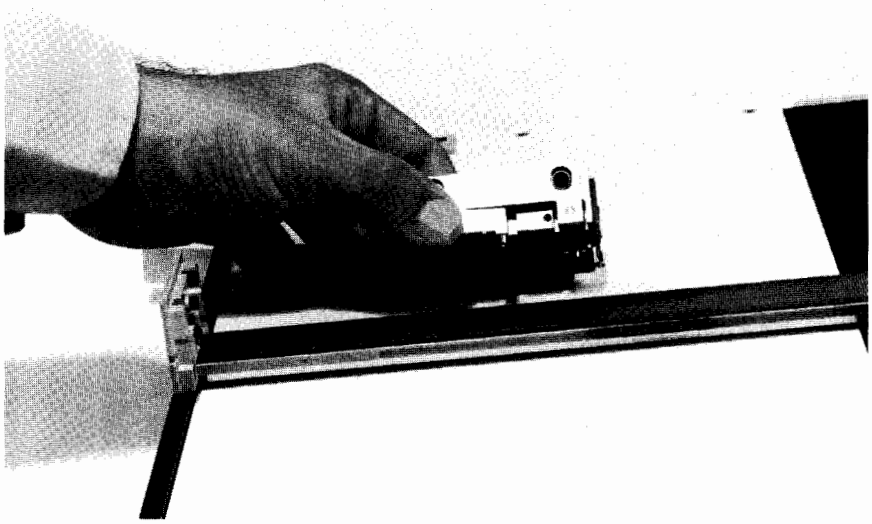
6-198. Table 6-7 lists correct frequency counter readings taken at a number of points in the digital circuits. These points are indicated on the schematic diagrams by asterisks (*), usually next to the DC voltage reading at the same point.



DETAIL "A"



DETAIL "B"



DETAIL "C"

Figure 6-41. Y Motor Removal

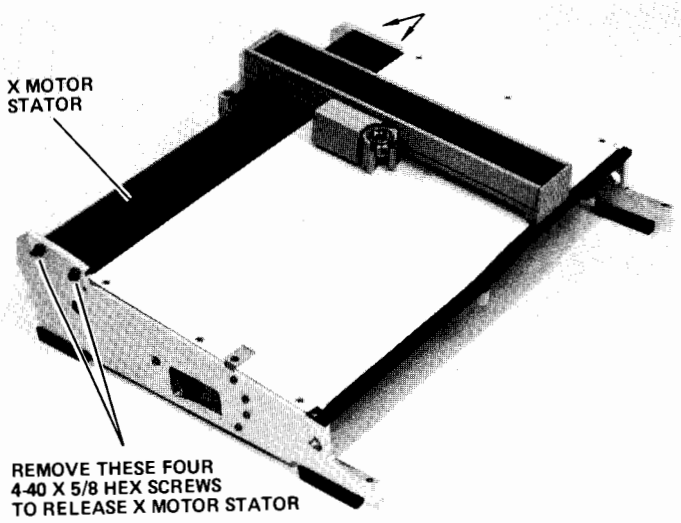
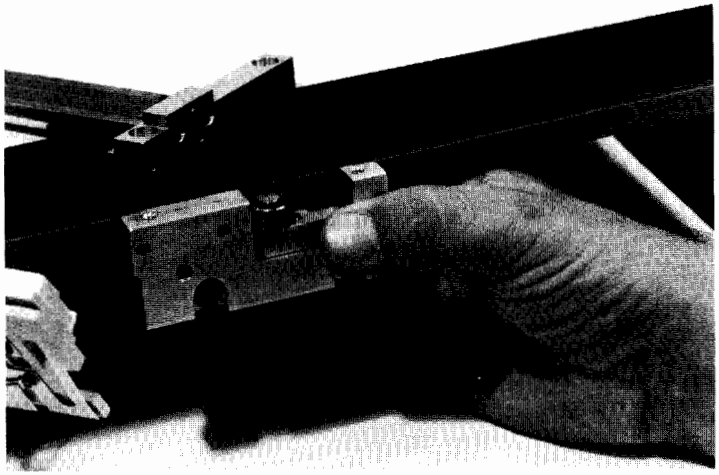
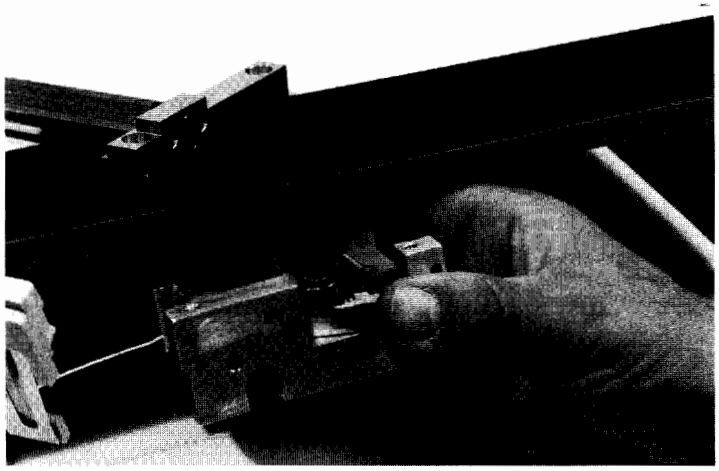


Figure 6-42. X Motor Stator Removal



PRESS IN TO
RELEASE BEARING
TENSION

DETAIL "A"



PULL DOWN TO
RELEASE X
MOTOR FROM
STATOR

DETAIL "B"

Figure 6-43. X Motor Removal

Table 6-7. Frequency Counter Readings

IC	Pin No.	Counter Reading	Service Sheet #	IC	Pin No.	Counter Reading	Service Sheet #
U2	3	20.83 kHz	4	U23A	1	7.81 kHz	2
U2	6	20.83 kHz	4	U23A	3	7.81 kHz	2
				U23C	8	15.62 kHz	2
U3	2	20.83 kHz	4	U23C	9	15.62 kHz	2
U4	8	20.83 kHz	4	U24A	2	7.81 kHz	2
				U24A	4	15.62 kHz	2
U7	6	20.83 kHz	3	U24B	5	31.24 kHz	2
				U24B	6	15.62 kHz	2
U9	6	20.83 kHz	3	U24C	8	15.62 kHz	2
				U24C	10	15.62 kHz	2
U10	6	20.83 kHz	2	U24D	12	15.62 kHz	2
				U24D	13	15.62 kHz	2
U11	6	20.83 kHz	3				
				U25A	1	15.62 kHz	2
U13	6	20.83 kHz	3	U25A	5	7.81 kHz	2
				U25A	6	7.81 kHz	2
U15G	5	31.25 kHz	1	U25B	7	15.62 kHz	2
				U25B	9	15.62 kHz	2
U15H	3	31.25 kHz	1	U25B	11	15.62 kHz	2
				U25B	12	15.62 kHz	2
U16	1	31.24 kHz	2	U25B	13	2.0 MHz	2
U16	2	31.24 kHz	2				
U16	5	31.24 kHz	2	U26	4	31.24 kHz	2
U16	6	31.24 kHz	2	U26	9	31.24 kHz	2
U16	7	31.24 kHz	2	U26	12	15.62 kHz	2
U16	9	15.62 kHz	2	U26	15	15.62 kHz	2
U16	13	31.24 kHz	2				
U16	14	31.24 kHz	2	U27	3	15.62 kHz	3
				U27	6	15.62 kHz	3
U17	5	15.62 kHz	2	U27	10	7.81 kHz	3
U17	6	31.24 kHz	2	U27	13	15.62 kHz	3
U17	7	31.24 kHz	2				
U17	8	31.24 kHz	2	U30A	1	7.81 kHz	1
U17	11	31.24 kHz	2	U30A	2	7.81 kHz	1
U17	12	31.24 kHz	2	U30B	3	7.81 kHz	1
				U30B	4	7.81 kHz	1
U18	6	15.62 kHz	2	U30D	9	15.62 kHz	2
U18	8	15.62 kHz	2				
				U31B	13	15.62 kHz	3
U19	3	15.62 kHz	2				
U19	6	31.24 kHz	2	U32	5	7.81 kHz	2
U19	9	7.81 kHz	2	U32	6	7.81 kHz	2
U19	10	31.24 kHz	2	U32	10	31.24 kHz	2
U19	13	15.62 kHz	2	U32	13	31.24 kHz	2
				U32	15	31.24 kHz	2
U22	2	4.0 MHz	1				
U22	19	7.81 MHz	1	U33A	3	31.24 kHz	2
U22	22	7.81 kHz	1	U33B	5	31.24 kHz	2

Table 6-7. Frequency Counter Readings (Continued)

IC	Pin No.	Counter Reading	Service Sheet #
U33D	9	31.24 kHz	2
U33E	11	7.81 kHz	2
U33E	12	7.81 kHz	2
U33F	13	31.24 kHz	2
U33F	14	31.24 kHz	2
U34	4	1.0 MHz	2
U34	5	2.0 MHz	2
U34	8	500 kHz	2
U34	9	15.62 kHz	2
U34	10	31.24 kHz	2
U34	11	4.0 MHz	2
U36	4	125 kHz	2
U36	5	249.96 kHz	2
U36	8	62.49 kHz	2
U36	9	31.24 kHz	2
U36	10	62.49 kHz	2
U36	11	500 kHz	2
U37B	5	15.62 kHz	2
U37B	6	15.62 kHz	2
U39B	5	1.0 MHz	3
U41	1	93.73 kHz	2
U41	2	93.73 kHz	2
U41	4	187.47 kHz	2
U41	6	187.47 kHz	2
U41	10	31.24 kHz	2
U41	11	15.62 kHz	2
U41	13	46.87 kHz	2
U41	15	46.87 kHz	2
U42	4	187.47 kHz	2
U42	6	93.73 kHz	2
U42	9	15.62 kHz	2
U42	11	46.87 kHz	2
U42	13	31.24 kHz	2
U43B	5	4.0 MHz	2
U43B	5	4.0 MHz	2
U43C	8	31.24 kHz	2
U43D	11	4.0 MHz	2
U43D	12	4.0 MHz	2
U43D	13	4.0 MHz	2
U44	3	15.62 kHz	3
U45	1	249.96 kHz	2
U45	8	41.66 kHz	2
U45	9	83.32 kHz	2
U45	11	83.32 kHz	2
U45	12	20.83 kHz	2
U45	14	41.66 kHz	2

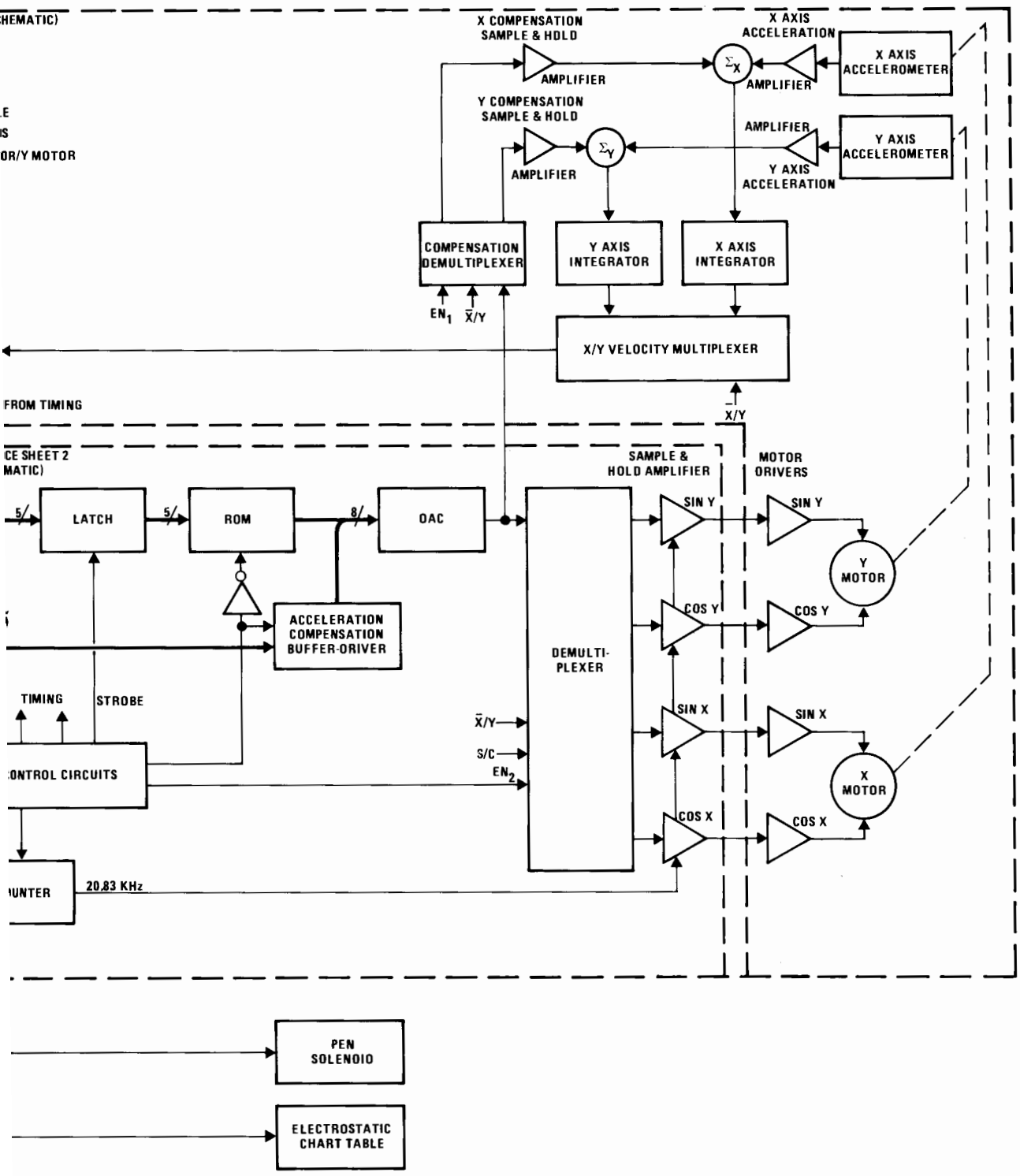
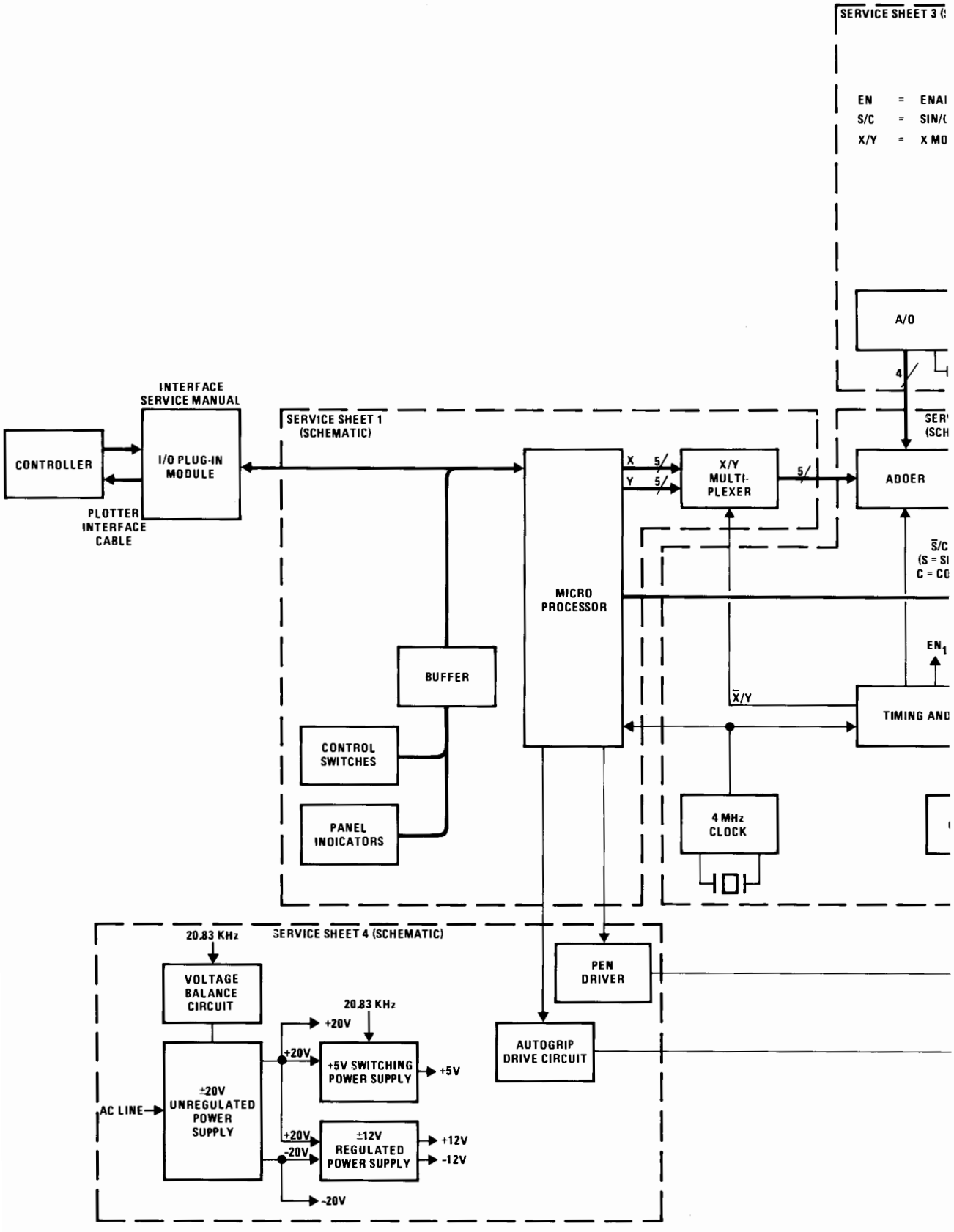
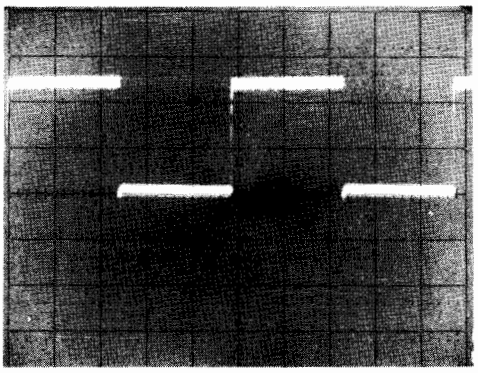


Figure 6-44. Functional Block Diagram

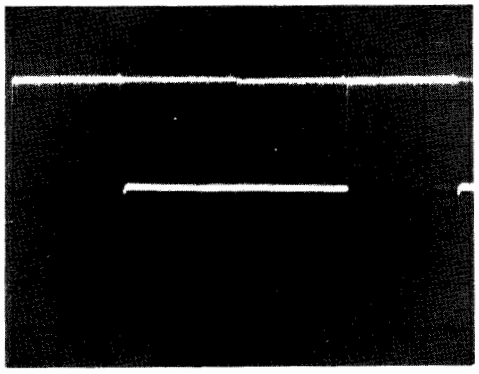

SERVICE SHEET 3 (S
EN = ENAI
S/C = SIN/(
X/Y = X MO
A/O
4
INTERFACE
SERVICE MANUAL
CONTROLLER
I/O PLUG-IN
MODULE
PLOTTER
INTERFACE
CABLE
SERVICE SHEET 1
(SCHEMATIC)
SER
(SCH
X
Y
5
X/Y
MULTI-
PLEXER
ADDER
S/C
(S = SI
C = CO
MICRO
PROCESSOR
BUFFER
CONTROL
SWITCHES
PANEL
INDICATORS
EN1
X/Y
TIMING AND
4 MHz
CLOCK
20.83 KHz
SERVICE SHEET 4 (SCHEMATIC)
VOLTAGE
BALANCE
CIRCUIT
PEN
DRIVER
20.83 KHz
+20V
AUTOGRIP
DRIVE CIRCUIT
+20V
+5V SWITCHING
POWER SUPPLY
+5V
AC LINE
±20V
UNREGULATED
POWER
SUPPLY
+20V
-20V
±12V
REGULATED
POWER SUPPLY
+12V
-12V
-20V



12 X STP

X/Y MOTOR MOVEMENT FROM LOWER LEFT TO UPPER RIGHT VIA PUSHBUTTON CONTROL

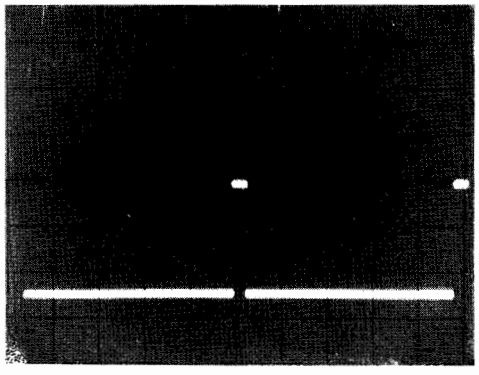
DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 5μs/div
TRIGGER: POSITIVE, AUTO



13 Y STP

X/Y MOTOR MEVEMENT FROM LOWER LEFT TO UPPER RIGHT VIA PUSHBUTTON CONTROL

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 50μs/div
TRIGGER' POSITIVE, AUTO



14 COMP CLK

X/Y MOTOR MOVEMENT FROM UPPER RIGHT TO LOWER LEFT VIA PUSHBUTTON CONTROL

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 200 ms/div
TRIGGER: SINGLE SWEEP

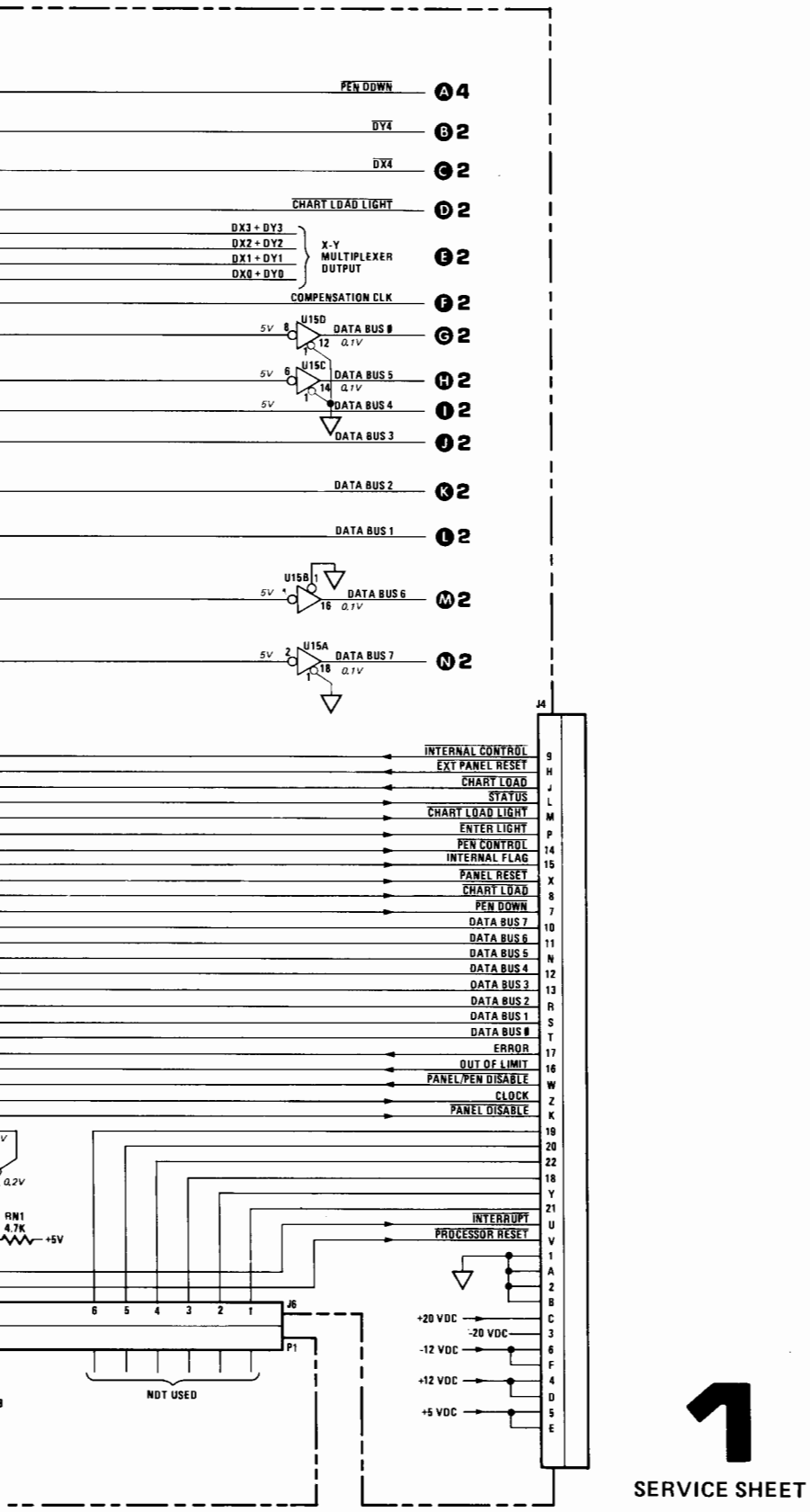
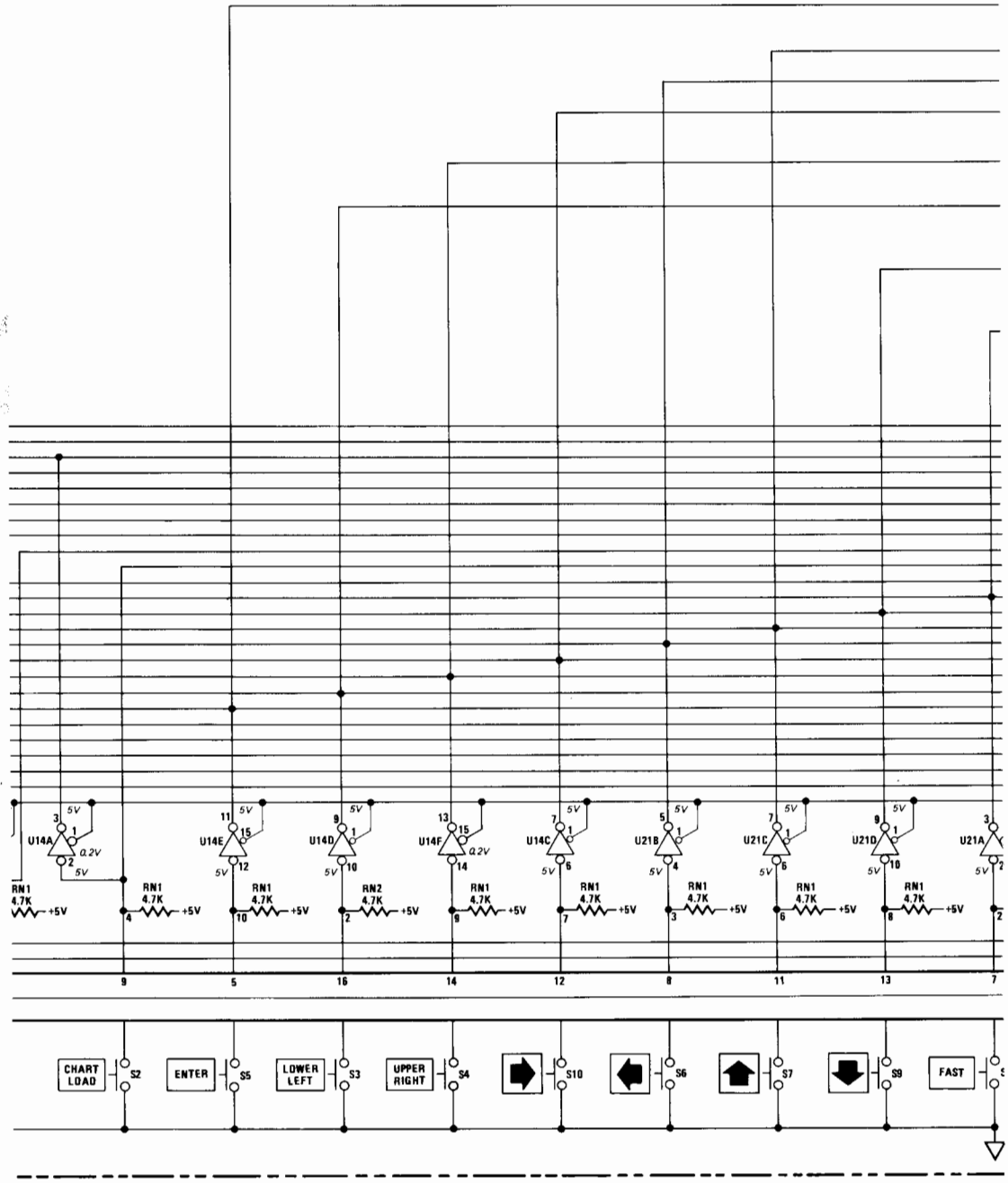
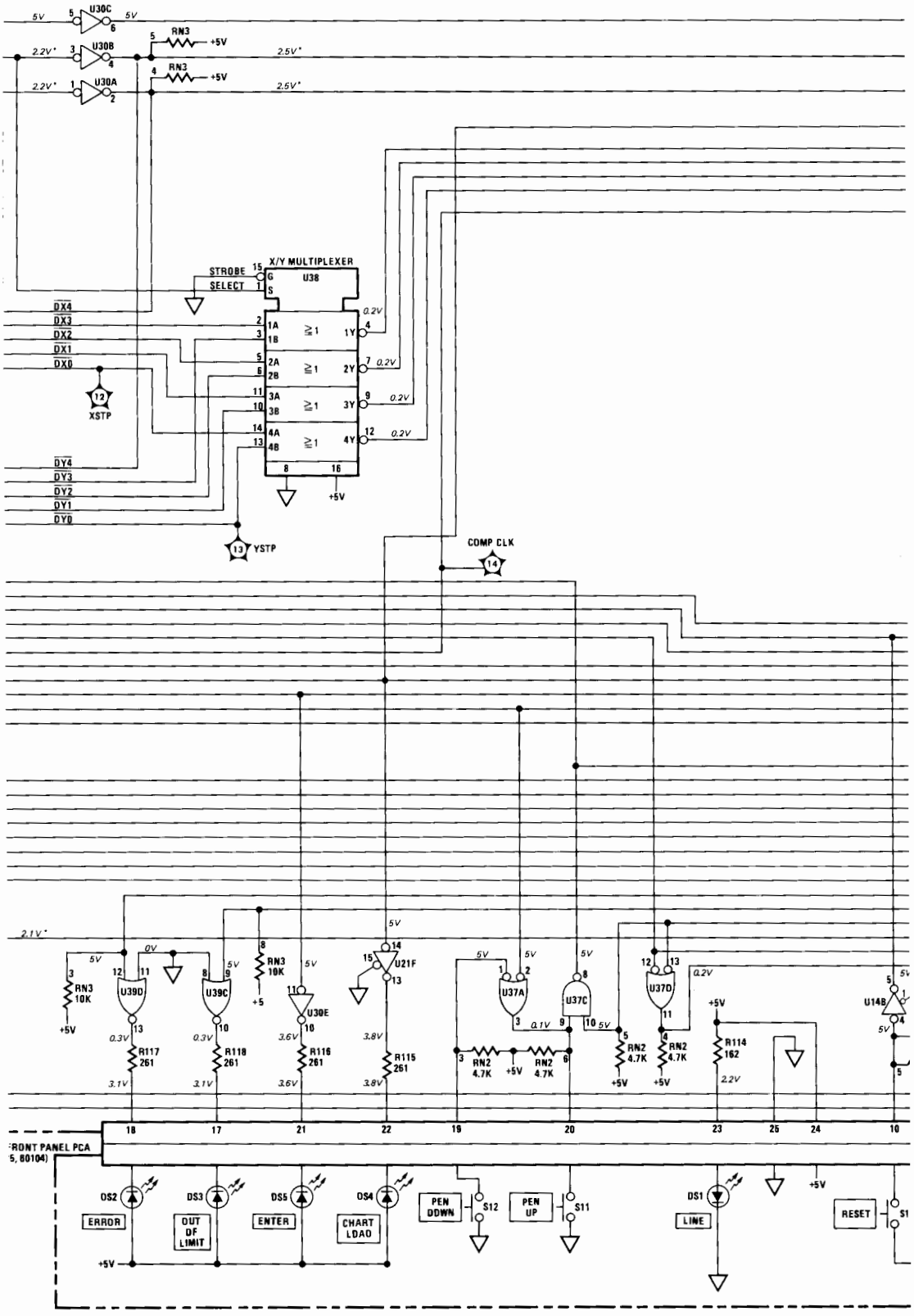
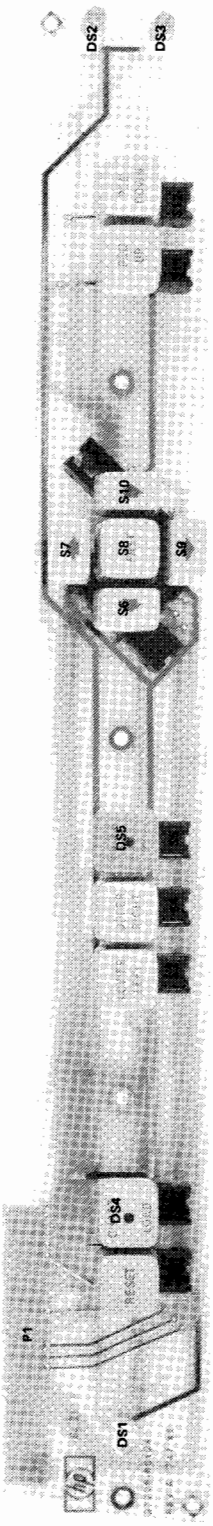


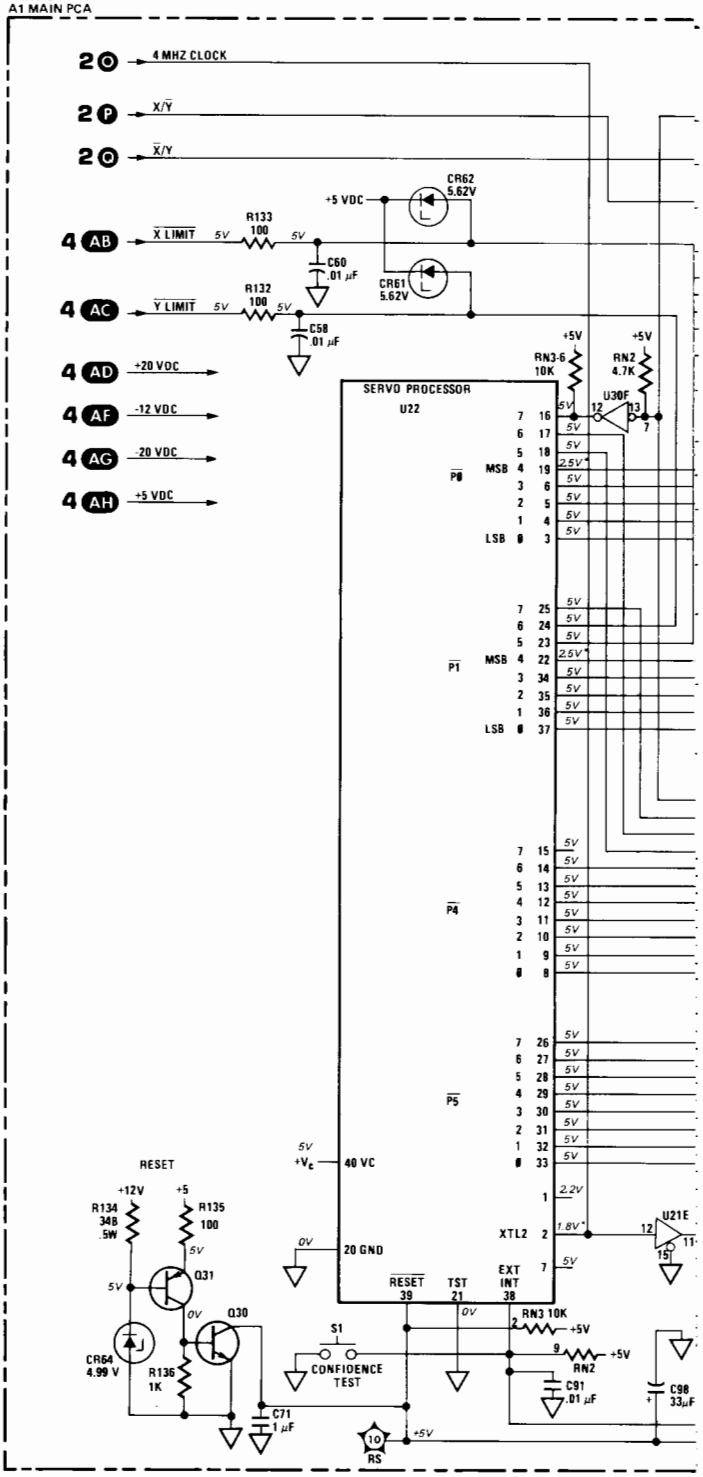
Figure 6-45. Processor and Front Panel Circuits Schematic Diagram


U14A
U14E
U14D
U14F
U14C
U21B
U21C
U21D
U21A
5V
0.2V
RN1
4.7K
RN2
4.7K
+5V
CHART LOAD
S2
ENTER
S5
LOWER LEFT
S3
UPPER RIGHT
S4
S10
S6
S7
S9
FAST


U30C
U30B
U30A
RN3
+5V
2.2V*
2.5V*
5V
X/Y MULTIPLEXER
STROBE
SELECT
U38
DX4
DX3
DX2
DX1
DX0
DY4
DY3
DY2
DY1
DY0
0.2V
XSTP
YSTP
COMP CLK
RN3 10K
U39D
U39C
U30E
U21F
U37A
U37C
U37D
U14B
RN2 4.7K
R117 261
R118 261
R116 261
R115 261
R114 162
0.3V
3.6V
3.8V
0.1V
2.2V
2.1V*
0V
FRONT PANEL PCA
OS2
OS3
OS5
OS4
ERROR
OUT OF LIMIT
ENTER
CHART LOAD
PEN DOWN
PEN UP
S12
S11
DS1
LINE
RESET



PART OF
A1 MAIN PCA

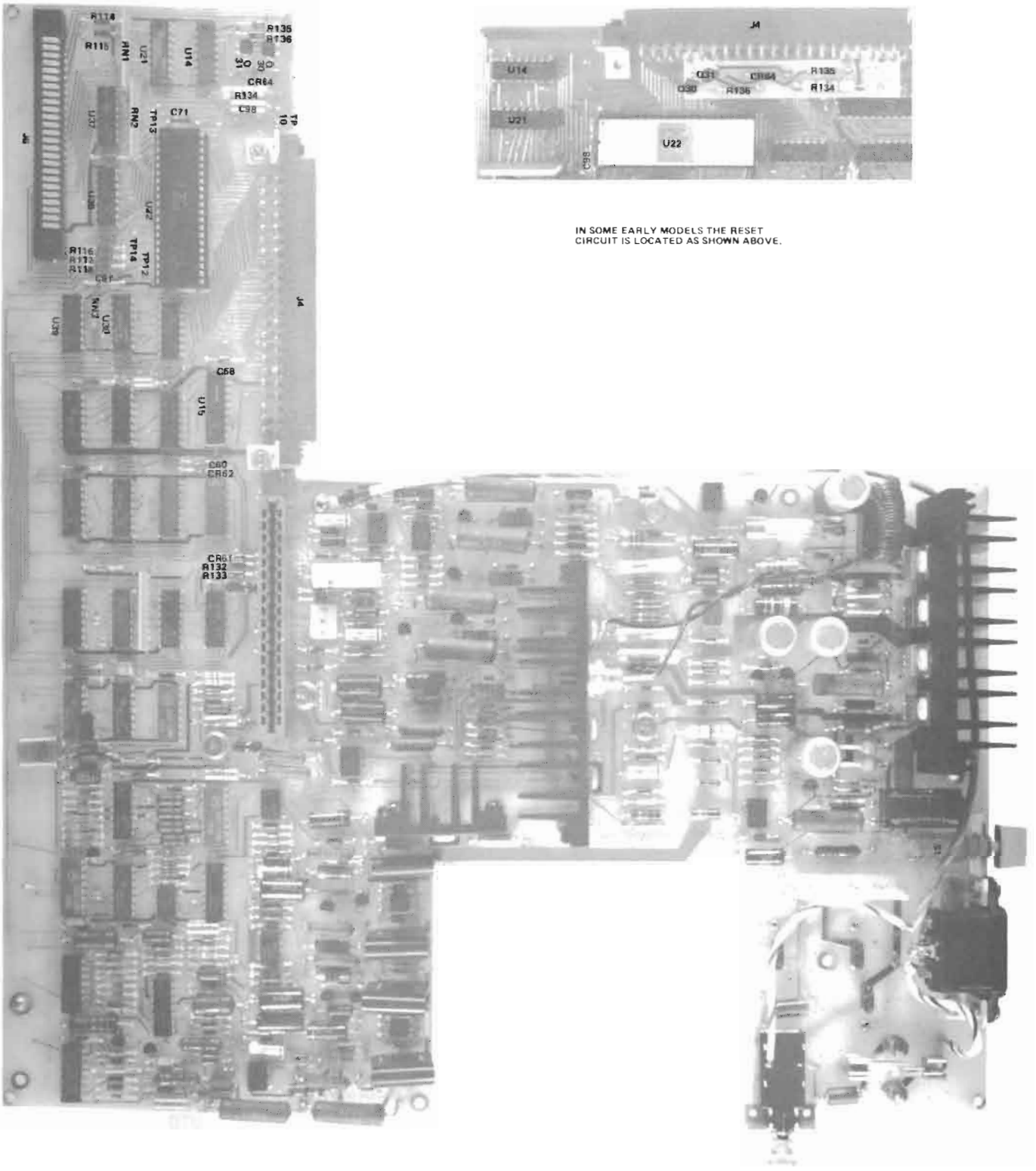


NOTE: VOLTAGE READINGS TAKEN USING HP 3486A OMM WITH I/O PLUG-IN MODULE REMOVED, LINE VOLTAGE AND JUMPERS SET AT 120V; "ERROR" AND "LIMIT" INDICATORS ARE 'ON' AND "CHART LOAD" INDICATOR IS 'OFF'.

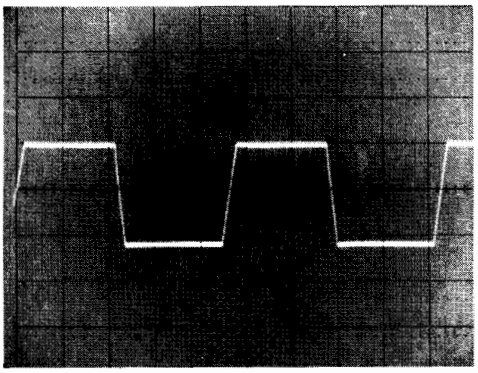
▽ = ANALOG COMMON. ▽ = DIGITAL COMMON

*FREQUENCY COUNTER READING TAKEN AT THIS POINT – REFER TO CHART.

A2 F
(722

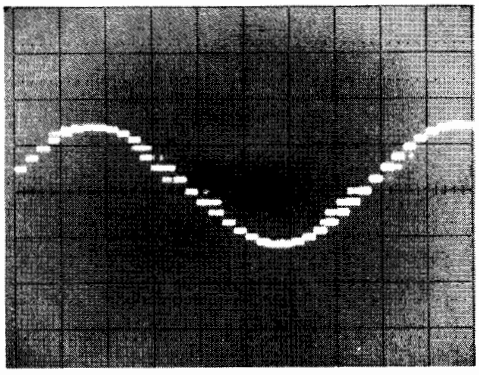


IN SOME EARLY MODELS THE RESET CIRCUIT IS LOCATED AS SHOWN ABOVE.



2 OSC. OUT (20.83kHz)

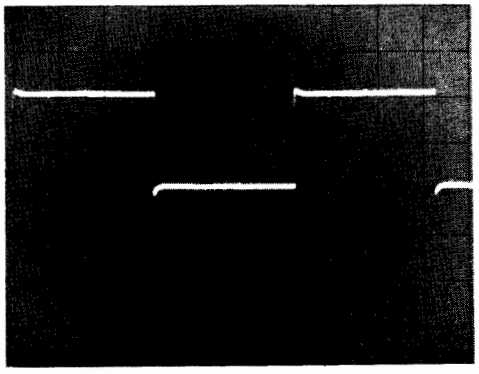
DC INPUT REFERENCE SCOPE CENTER
10:1 PORBE
VERTICAL: 1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO



5 6 7 8 X SIN, X COS, Y SIN, Y COS

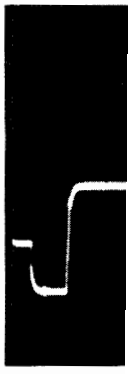
FAST "X" PUSHBUTTONS DEPRESSED

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 2ms/div
TRIGGER: POSITIVE, AUTO



11 $X/\bar{Y}$

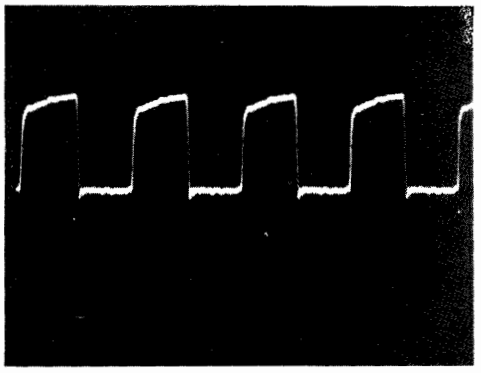
DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 20μs/div
TRIGGER: POSITIVE, AUTO



0.83kHz)

CE SCOPE CENTER

div
AUTO



16 CLK (2 MHz)

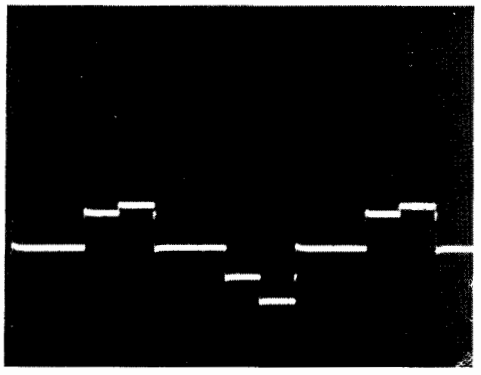
PEN IN UPPER RIGHT VIA UPPER RIGHT PUSHBUTTON

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: .2μs/div
TRIGGER: POSITIVE, AUTO

8 X SIN, X COS, Y SIN, Y COS

ONS DEPRESSED
CE SCOPE CENTER

liv
AUTO



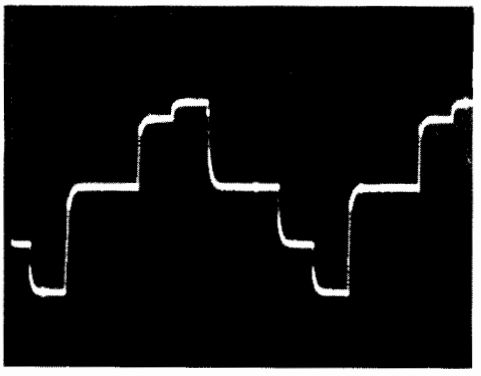
F DAC OUTPUT

PEN IN LOWER LEFT POSITION

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 20μs/div
TRIGGER: POSITIVE, AUTO

E SCOPE CENTER

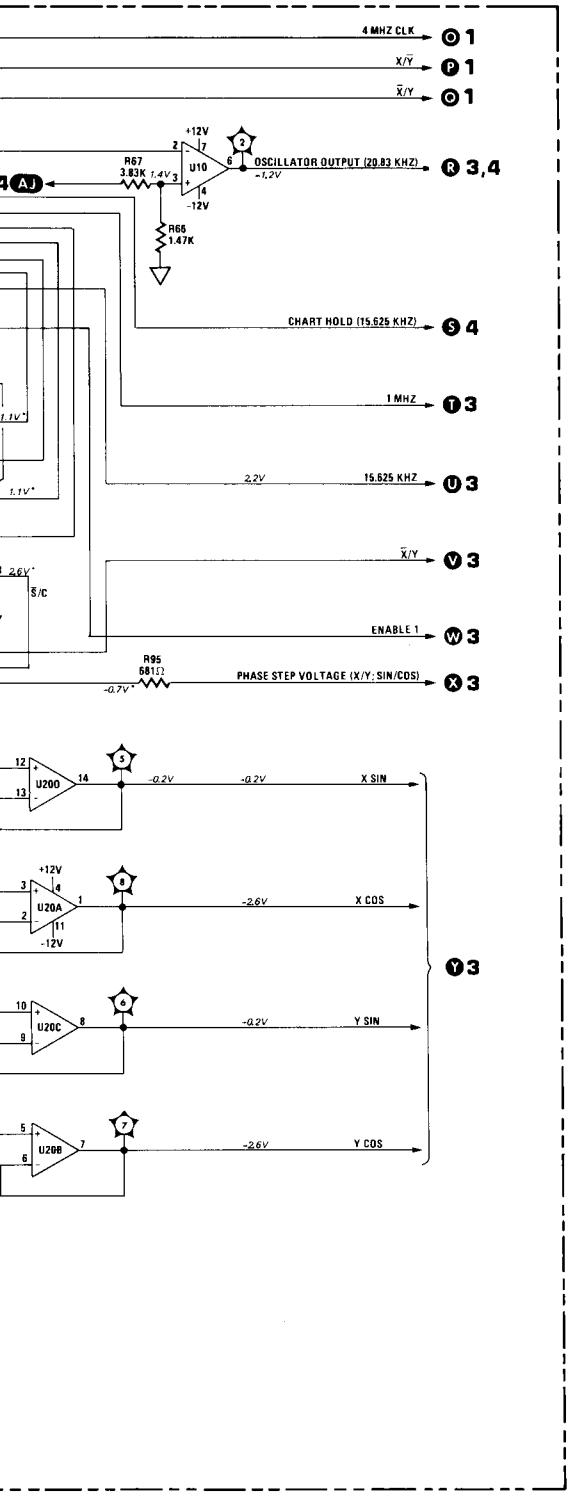
liv
AUTO



G AMP OUTPUT (PHASE STEP VOLTAGE)

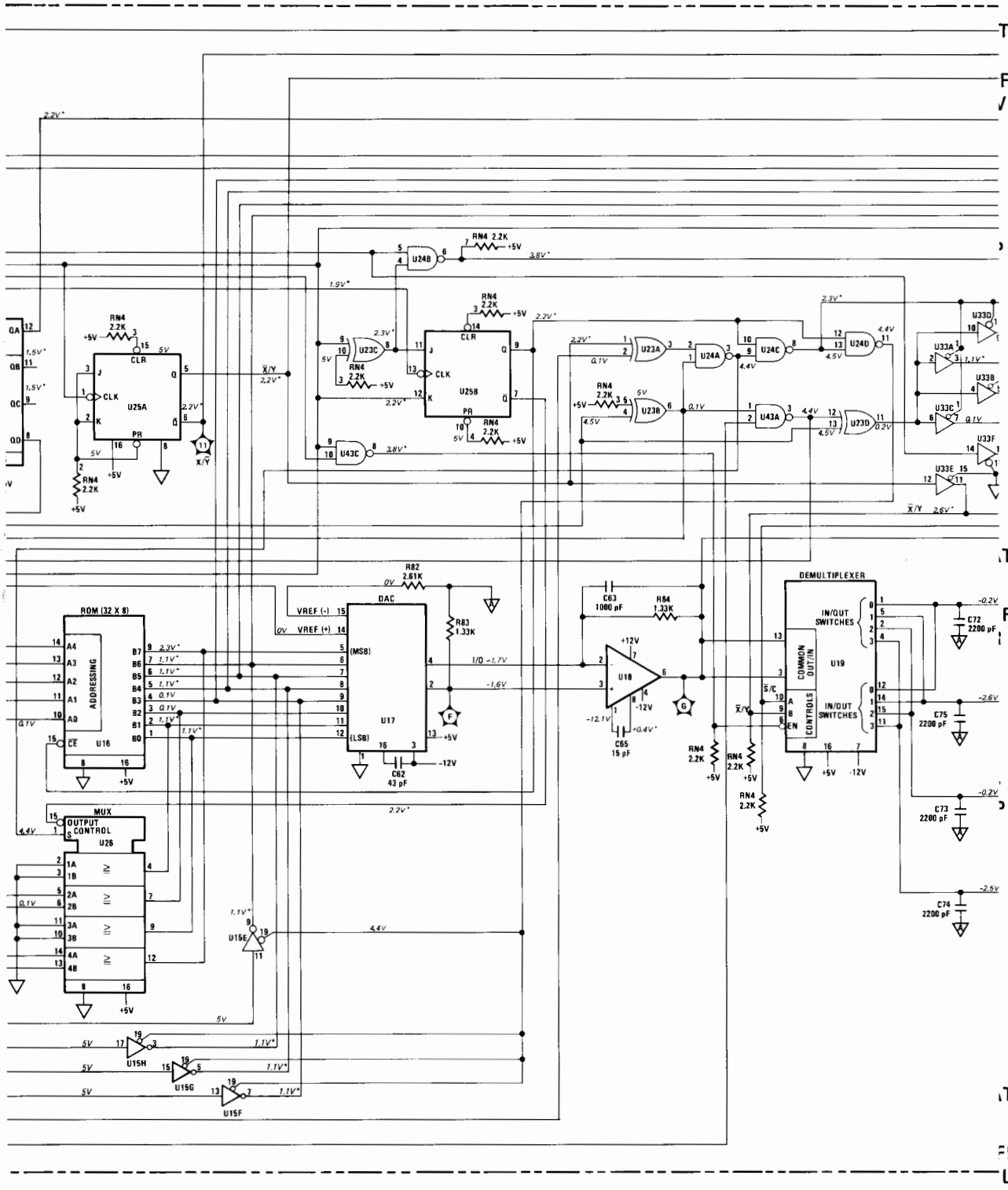
PEN IN LOWER LEFT POSITION

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 20μs/div
TRIGGER: POSITIVE, AUTO

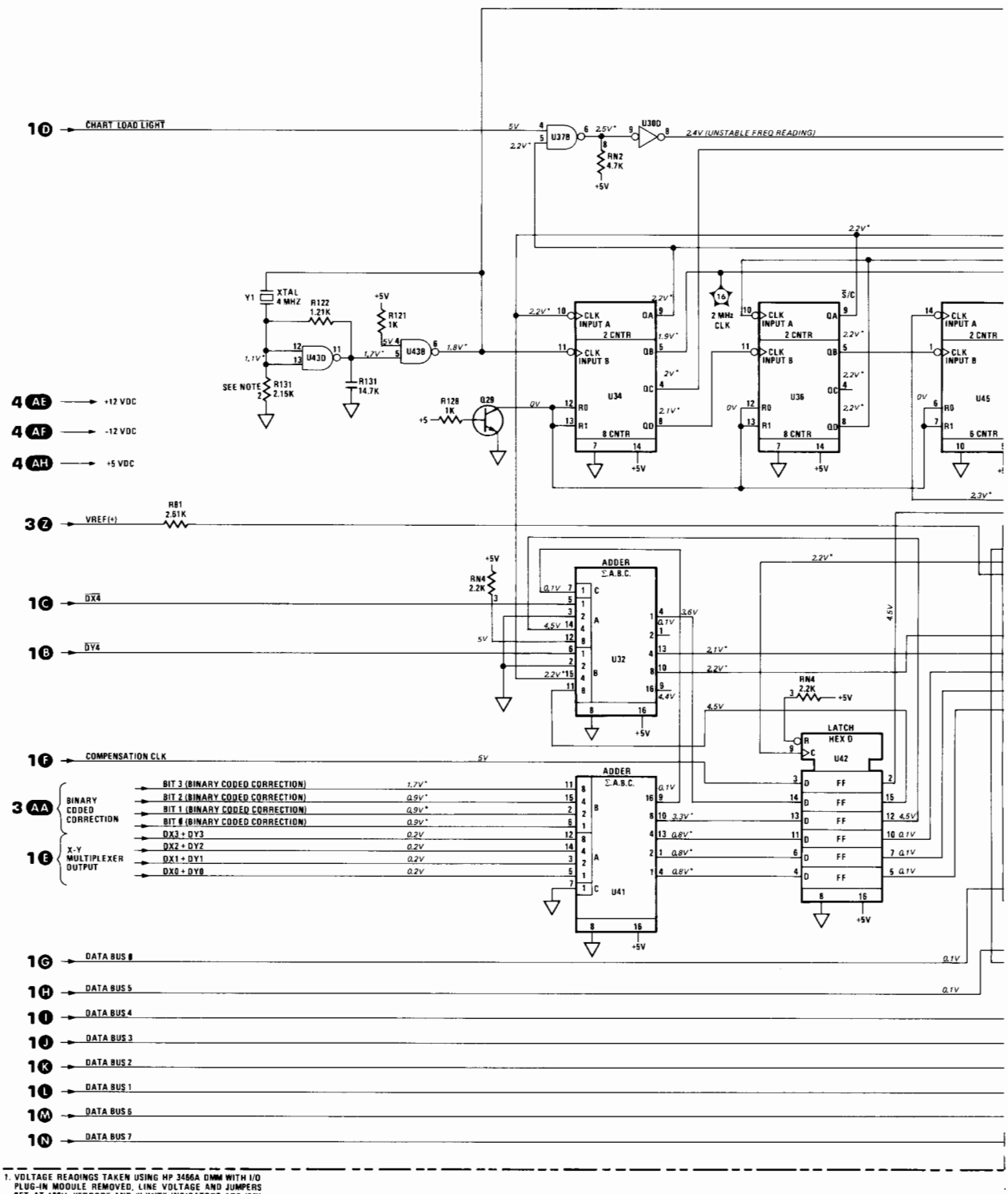


SERVICE SHEET

Figure 6-46. Timing, Control and Phase Step Motor Circuits Schematic Diagram


TION)
FROM UPPER
VIA PUSHBUTTON
TOR OUT
FROM
LEFT
TOR OUT
FROM
LEFT
U25A
U23C
U24B
U25B
U23A
U24A
U24C
U24D
U23B
U43A
U23D
U43C
U33A
U33B
U33C
U33D
U33F
U33E
X/Y
ROM (32 X 8)
ADDRESSING
U16
DAC
VREF (-)
VREF (+)
(MSB)
(LSB)
U17
R82
2.61K
R83
1.33K
C62
43 pF
MUX
OUTPUT CONTROL
U26
U15E
U15H
U15G
U15F
C63
1000 pF
R84
1.33K
U18
C65
15 pF
DEMULTIPLEXER
IN/OUT SWITCHES
COMMON OUT/IN
CONTROLS
U19
C72
2200 pF
C75
2200 pF
C73
2200 pF
C74
2200 pF
RN4
2.2K
+5V
-12V

OF
IN PCA

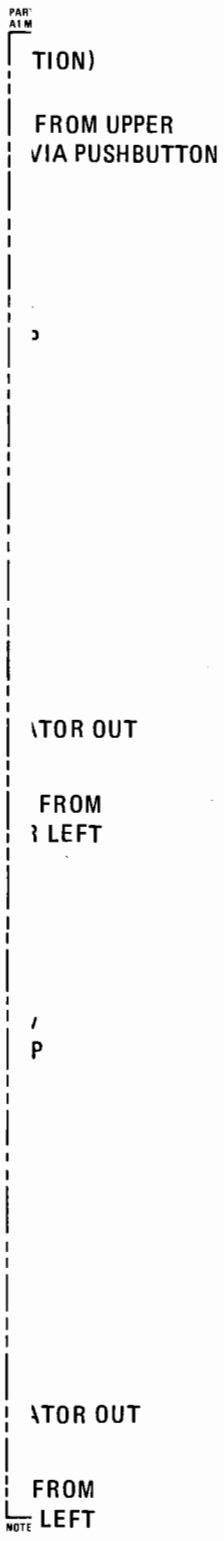


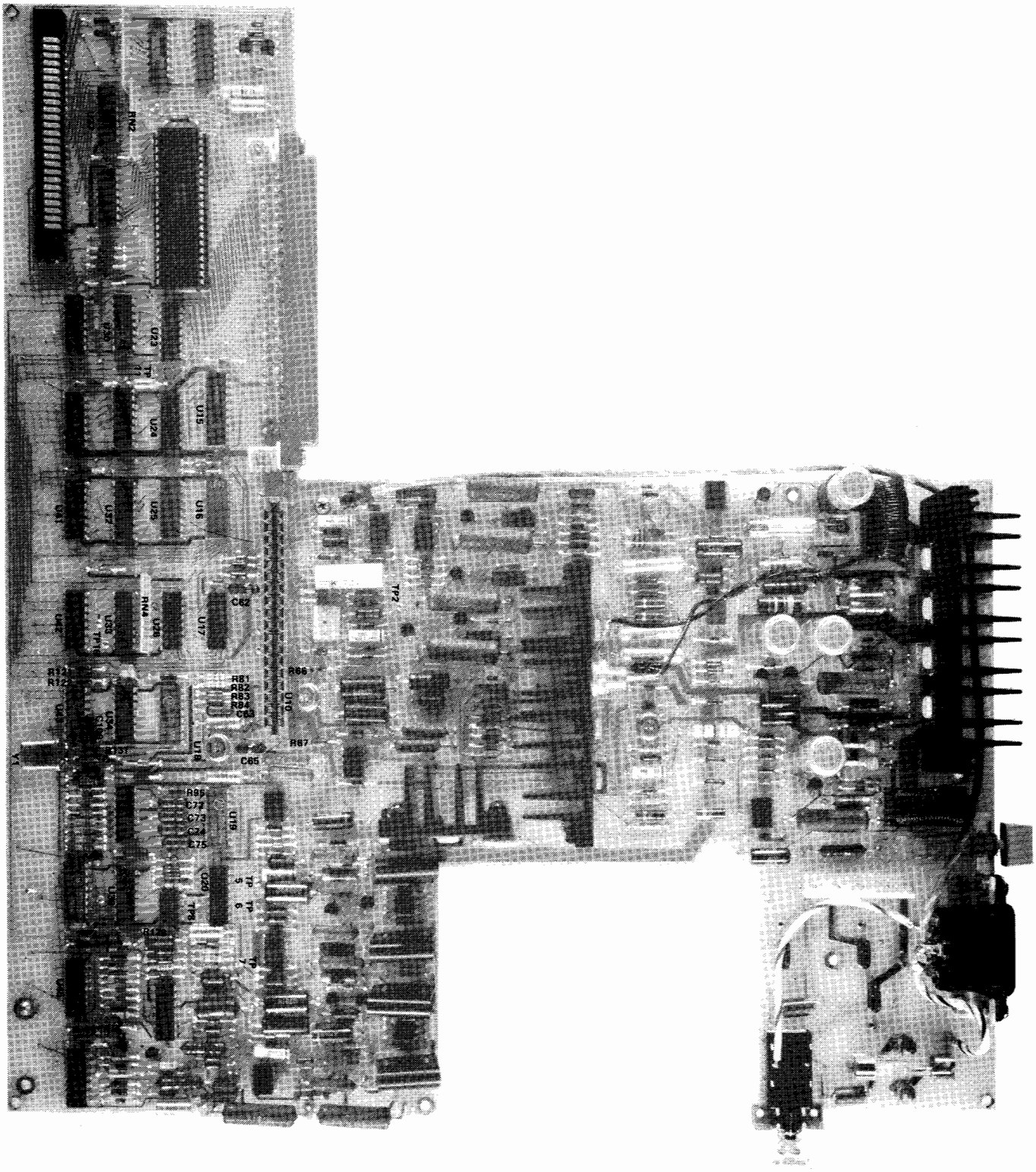
1. VOLTAGE READINGS TAKEN USING HP 3456A DMM WITH I/O PLUG-IN MODULE REMOVED, LINE VOLTAGE AND JUMPERS SET AT 120V; "ERROR" AND "LIMIT" INDICATORS ARE 'ON' AND "CHART LOAD" INDICATOR IS 'OFF'.

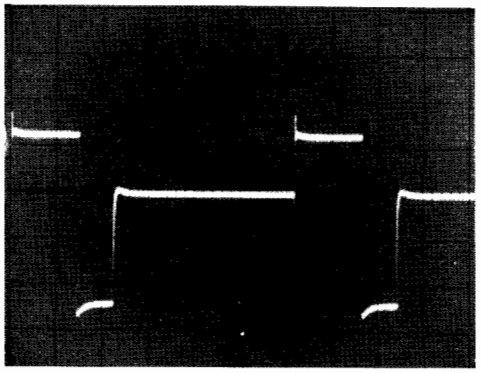
2. IN UNITS WITH SERIAL PREFIX BELOW 1841A, R131 IS 2.15K.

= ANALOG COMMON. ▽ = DIGITAL COMMON.

UENCY COUNTER READING TAKEN
IS POINT – REFER TO CHART.


TION)
FROM UPPER
VIA PUSHBUTTON
ATOR OUT
FROM
LEFT
P
ATOR OUT
FROM
LEFT


R82
U23
U24
U15
U25
U16
U17
C62
RN4
U26
R81
R82
R83
R84
C63
R66
U10
R67
C65
R95
C77
C73
C74
C75
U19
C20
TP4
TP5
TP6
TP7
TP2

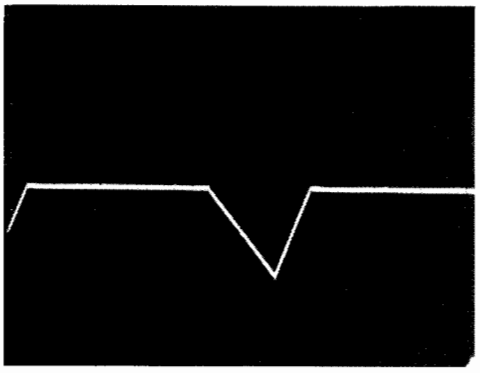


C X/Y VELOCITY MUX OUT

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

TION)

FROM UPPER
VIA PUSHBUTTON

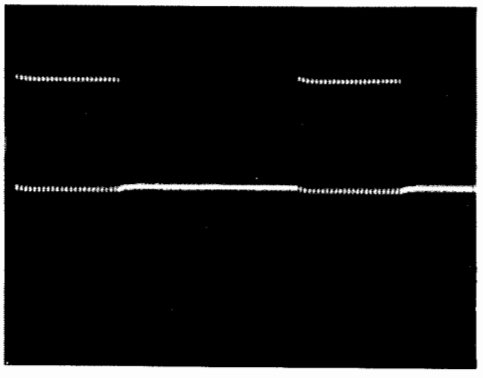


D DUAL SLOPE INT. OUT
(U35-8 AND U28-3)

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL 10μs/div
TRIGGER: POSITIVE, AUTO

TOR OUT

FROM
LEFT



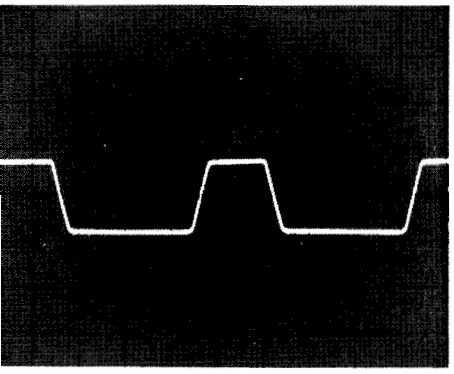
E A/D CONVERTOR
GATED CLOCK

PEN IN UPPER RIGHT POSITION

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

TOR OUT

FROM
LEFT

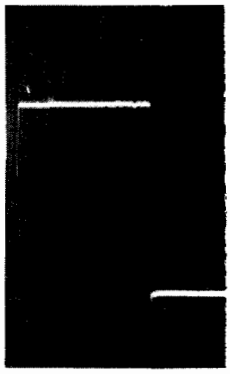


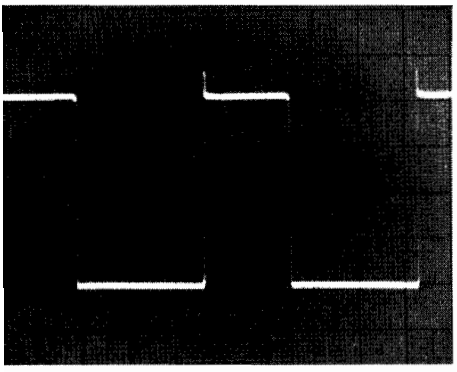
R X SIN MOTOR DRIVER IN

T X COS MOTOR DRIVER IN

PEN IN UPPER RIGHT POSITION

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO



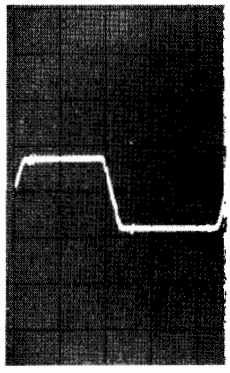


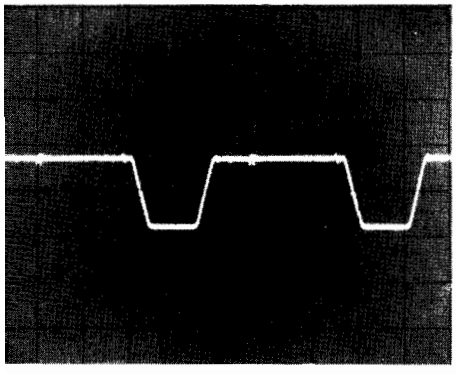
S X SIN MOTOR DRIVE OUT

U X COS MOTOR DRIVE OUT

PEN IN UPPER RIGHT POSITION

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

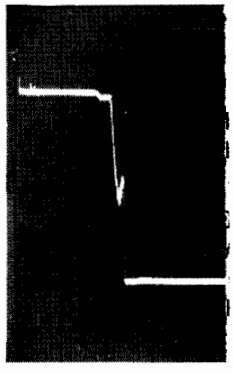


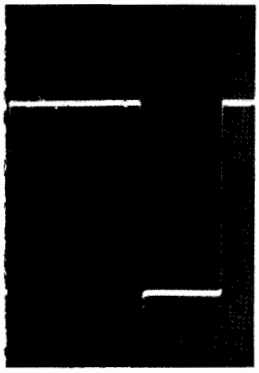


V Y SIN MOTOR DRIVER IN

PEN IN UPPER RIGHT POSITION

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

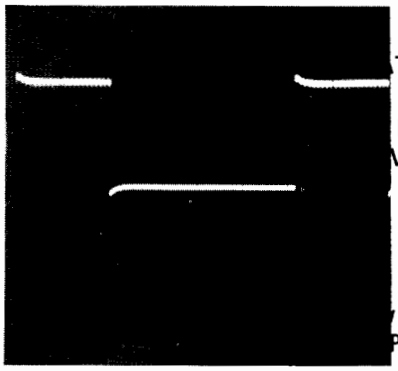




W Y SIN MOTOR DRIVE OUT

PEN IN UPPER RIGHT POSITION

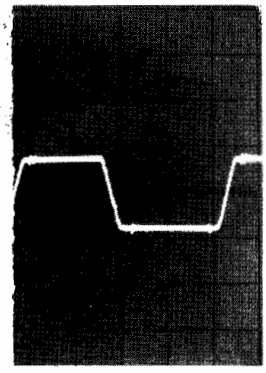
DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: 1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO



TION)

FROM UPPER
VIA PUSHBUTTON

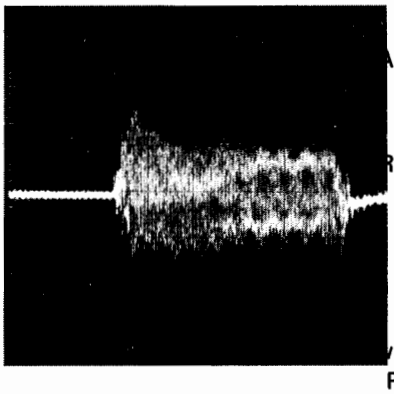
P



X Y COS MOTOR DRIVER IN

PEN IN UPPER RIGHT POSITION

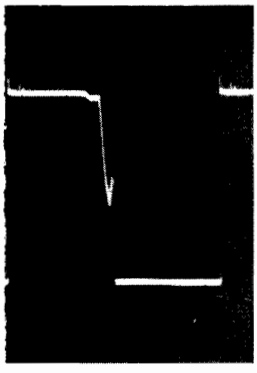
DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO



TOR OUT

FROM
LEFT

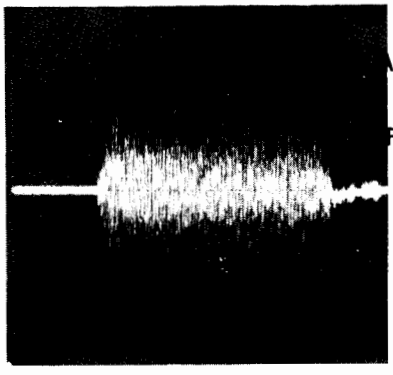
P



Y Y COS MOTOR DRIVE OUT

PEN IN UPPER RIGHT POSITION

DC INPUR REFERENCE
SCOPE CENTER
10:1 PROVE
VERTICAL: 1V/div
HORIZONTAL: 10μs/div
TRIGGER: OPSITIVE, AUTO

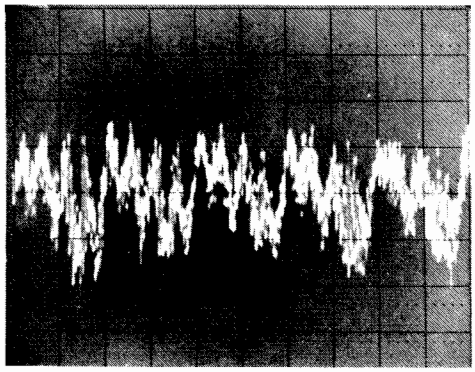


TOR OUT

FROM
LEFT

Z COMPARATOR OUTPUT

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO



3

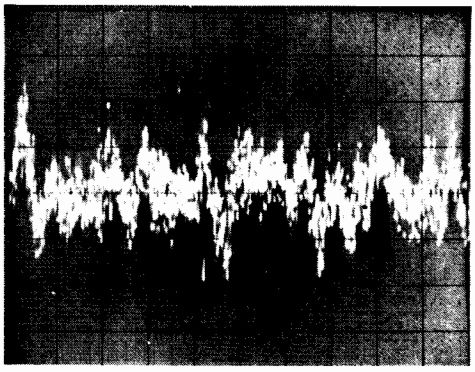
X/Y MO
TO LOW

DC INPU
10:1 PR
VERTIC
HORIZC
TRIGGE

AA X AXIS ACCEL. AMP.

X/Y MOTOR MOVEMENT FROM
UPPER RIGHT TO LOWER LEFT
VIA PUSHBUTTONS

DC INPUR REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 200ms/div
TRIGGER: SINGLE SWEEP



4

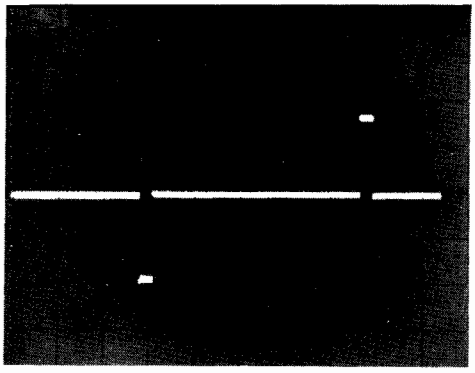
X/Y MO
TO LOW

DC INPU
10:1 PR
VERTIC
HORIZC
TRIGGE

AB Y AXIS ACCEL. AMP.

X/Y MOTOR MOVEMENT FROM
UPPER RIGHT TO LOWER LEFT
VIA PUSHBUTTONS

DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 200ms/div



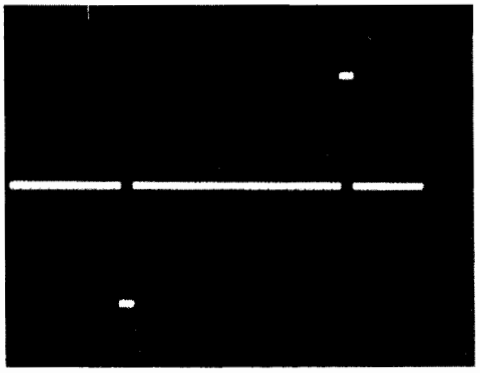
9

X/Y MOT
TO LOWI

DC INPU
10:1 PRC
VERTIC/
HORIZO
TRIGGEI

X ACC (ACCELEROMETER)

OR MOVEMENT FROM UPPER RIGHT
R LEFT VIA PUSHBUTTON
T REFERENCE SCOPE CENTER
BE
L: .1V/div
NTAL: 2ms/div
: SINGLE SWEEP

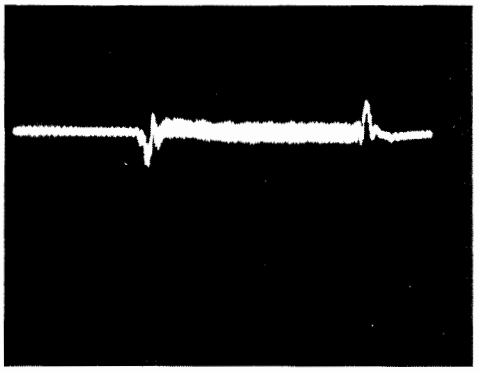


17 XCP (COMPENSATION)

X/Y MOTOR MOVEMENT FROM UPPER RIGHT TO LOWER LEFT VIA PUSHBUTTON
DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .1V/div
HORIZONTAL: 200ms/div
TRIGGER: SINGLE SWEEP

Y ACC (ACCELEROMETER)

OR MOVEMENT FROM UPPER RIGHT
R LEFT VIA PUSHBUTTON
T REFERENCE SCOPE CENTER
BE
L: .1V/div
NTAL: 2ms/div
: SINGLE SWEEP

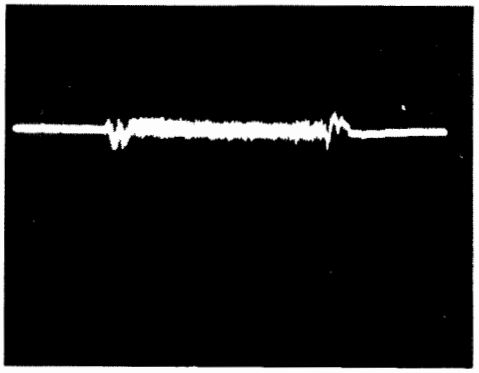


A X AXIS INTEGRATOR OUT

X/Y MOTOR MOVEMENT FROM UPPER RIGHT TO LOWER LEFT VIA PUSHBUTTON
DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 200ms/div
TRIGGER: SINGLE SWEEP

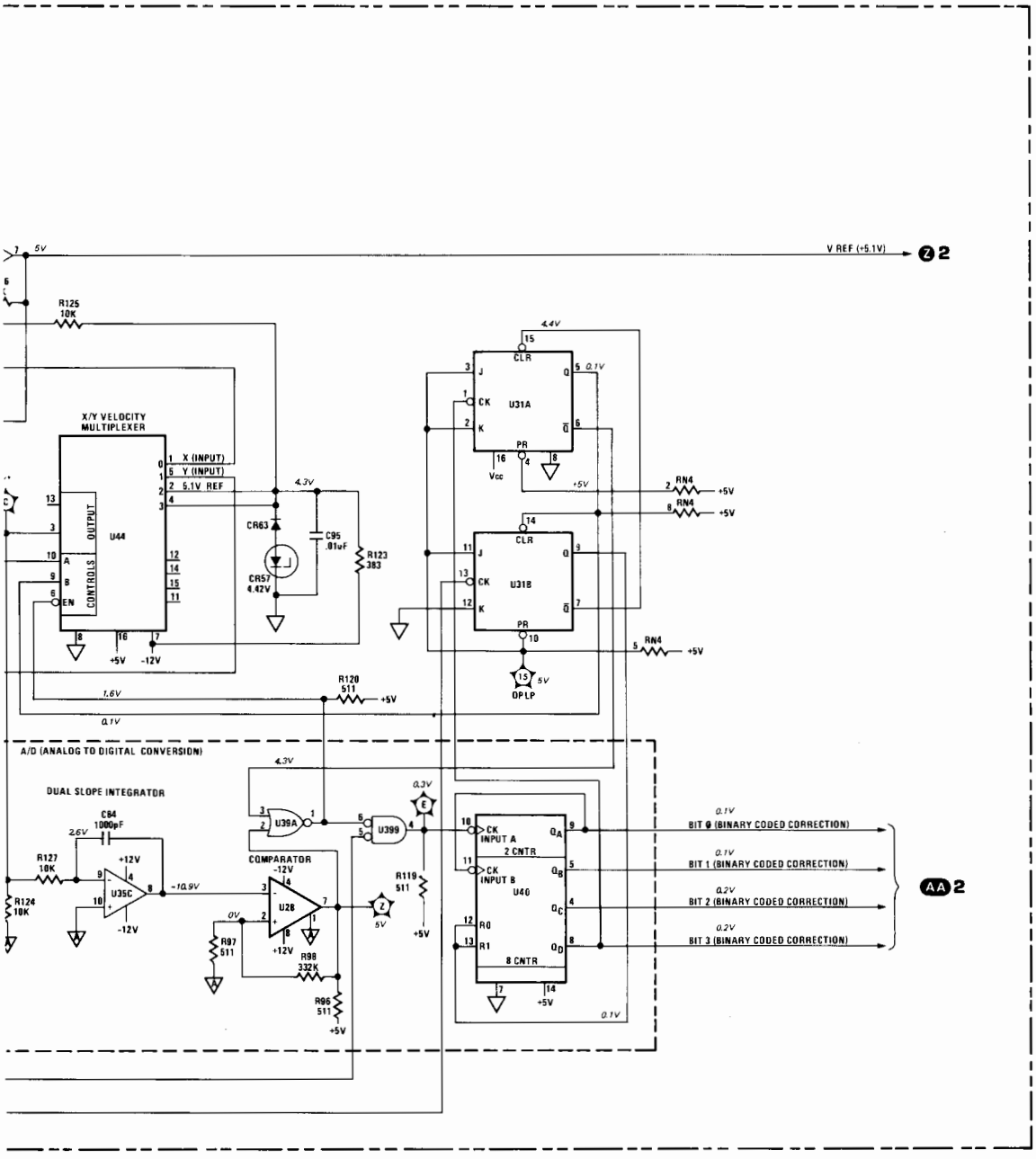
CP (COMPENSATION)

OR MOVEMENT FROM UPPER RIGHT
R LEFT VIA PUSHBUTTON
REFERENCE SCOPE CENTER
BE
L: .1V/div
TAL: 200ms/div
SINGLE SWEEP



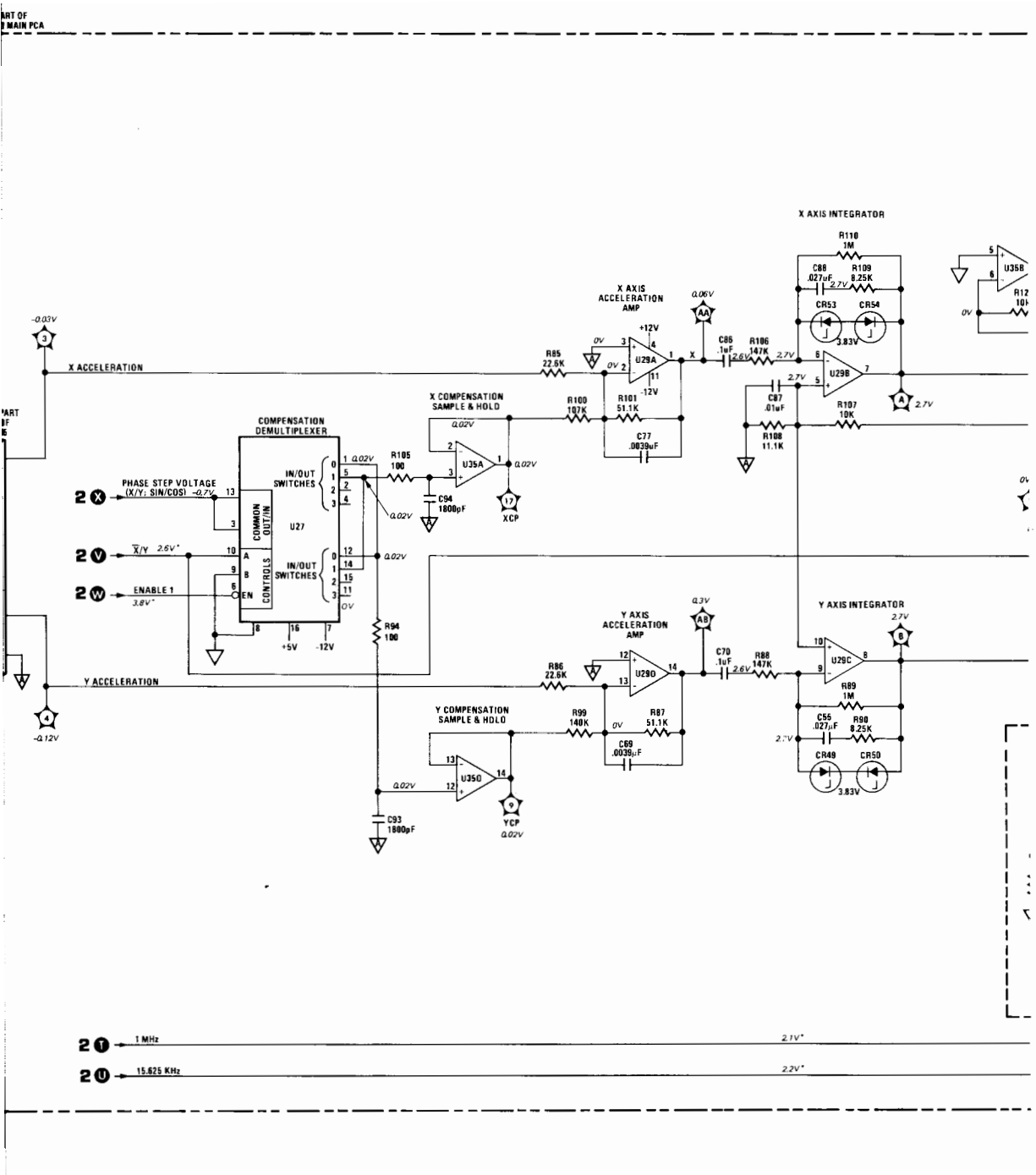
B Y AXIS INTEGRATOR OUT

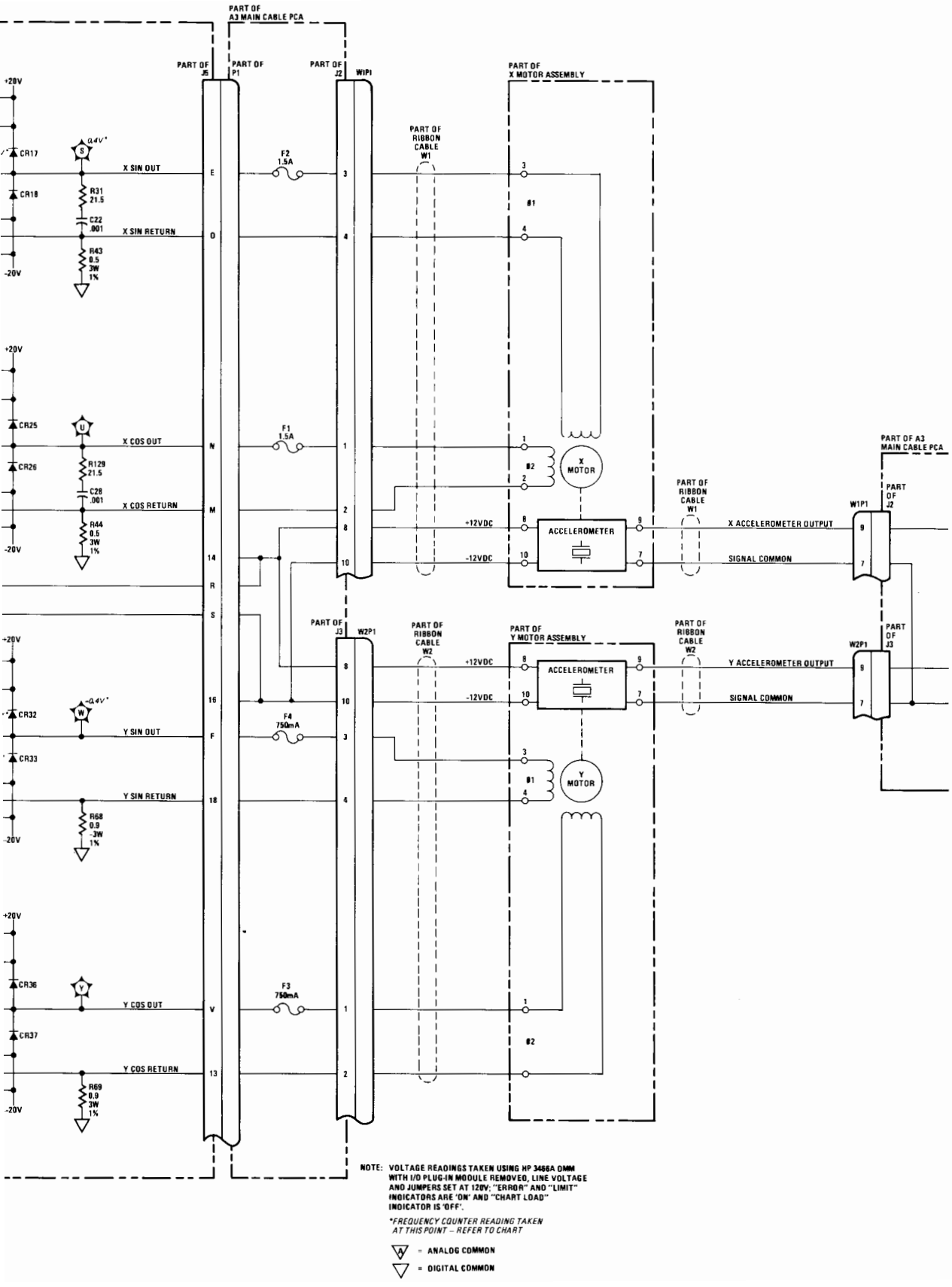
X/Y MOTOR MOVEMENT FROM UPPER RIGHT TO LOWER LEFT VIA PUSHBUTTON
DC INPUT REFERENCE
SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 200ms/div
TRIGGER: SINGLE SWEEP



3
SERVICE SHEET

Figure 6-47. Motor Driver and Accelerometer Circuits Schematic Diagram


X AXIS INTEGRATOR
X AXIS ACCELERATION AMP
X COMPENSATION SAMPLE & HOLD
COMPENSATION DEMULTIPLEXER
X ACCELERATION
PHASE STEP VOLTAGE (X/Y; SIN/COS)
X/Y
ENABLE 1
IN/OUT SWITCHES
COMMON OUT/IN
CONTROLS
U27
+5V
-12V
R85 22.6K
R100 107K
R101 51.1K
C77 .0039uF
R105 100
C94 1800pF
U29A
U35A
XCP
R110 1M
C88 .027uF
R109 8.25K
CR53
CR54
3.83V
C86 .1uF
R106 147K
C87 .01uF
R108 11.1K
U29B
R107 10K
Y AXIS ACCELERATION AMP
Y AXIS INTEGRATOR
Y ACCELERATION
R86 22.6K
R99 140K
R87 51.1K
C69 .0039uF
R94 100
C93 1800pF
U29D
U35D
YCP
C70 .1uF
R88 147K
U29C
R89 1M
C55 .027uF
R90 8.25K
CR49
CR50
1 MHz
15.625 KHz

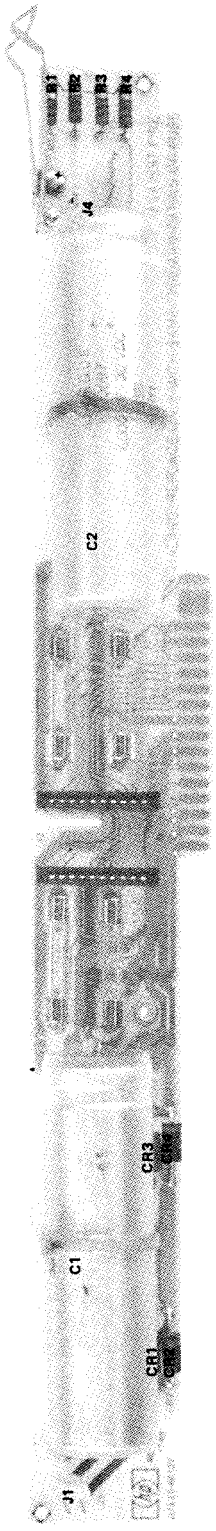


NOTE: VOLTAGE READINGS TAKEN USING HP 3466A DMM WITH I/O PLUG-IN MODULE REMOVED, LINE VOLTAGE AND JUMPERS SET AT 120V; "ERROR" AND "LIMIT" INDICATORS ARE 'ON' AND "CHART LOAD" INDICATOR IS 'OFF'.

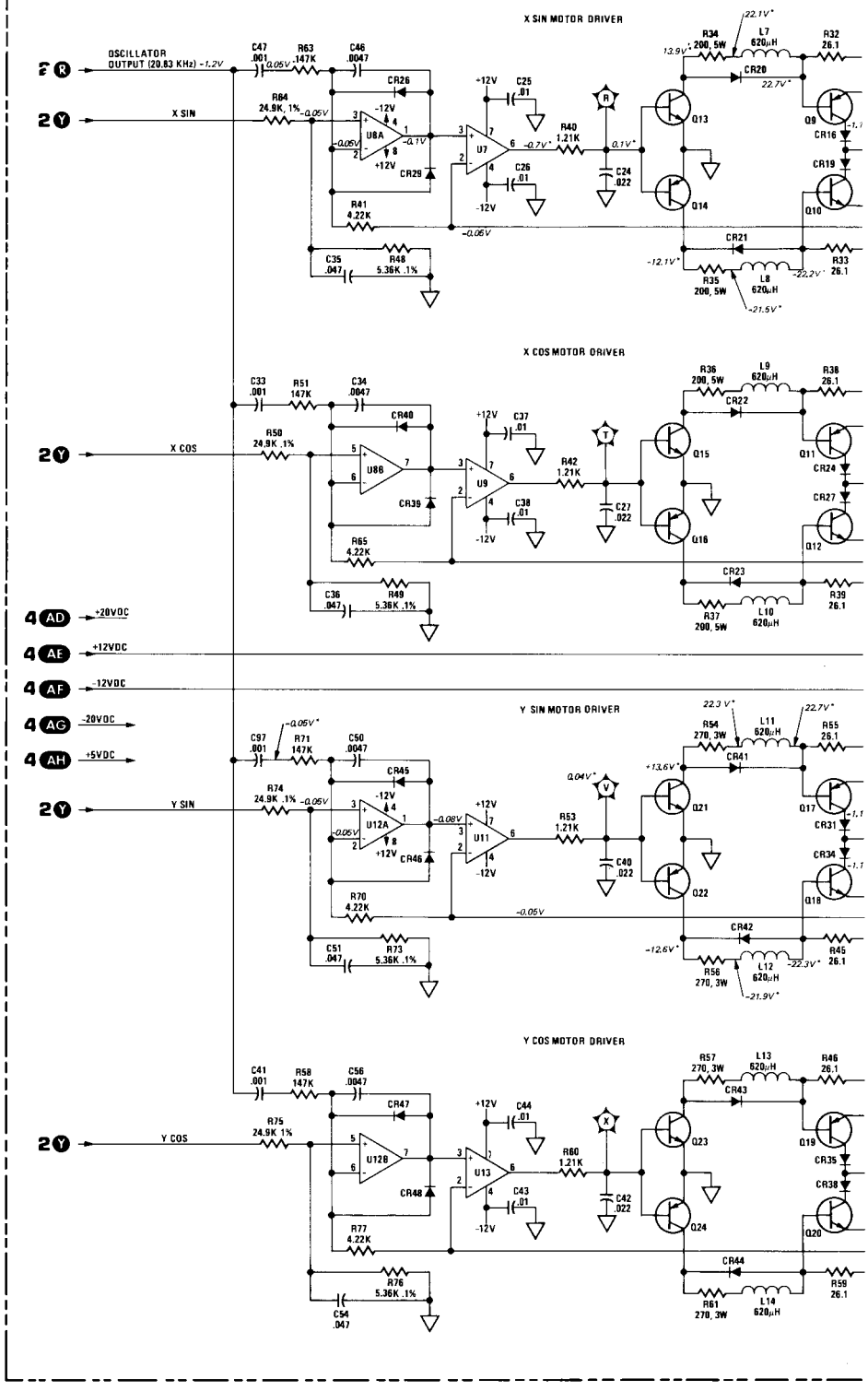
*FREQUENCY COUNTER READING TAKEN AT THIS POINT – REFER TO CHART

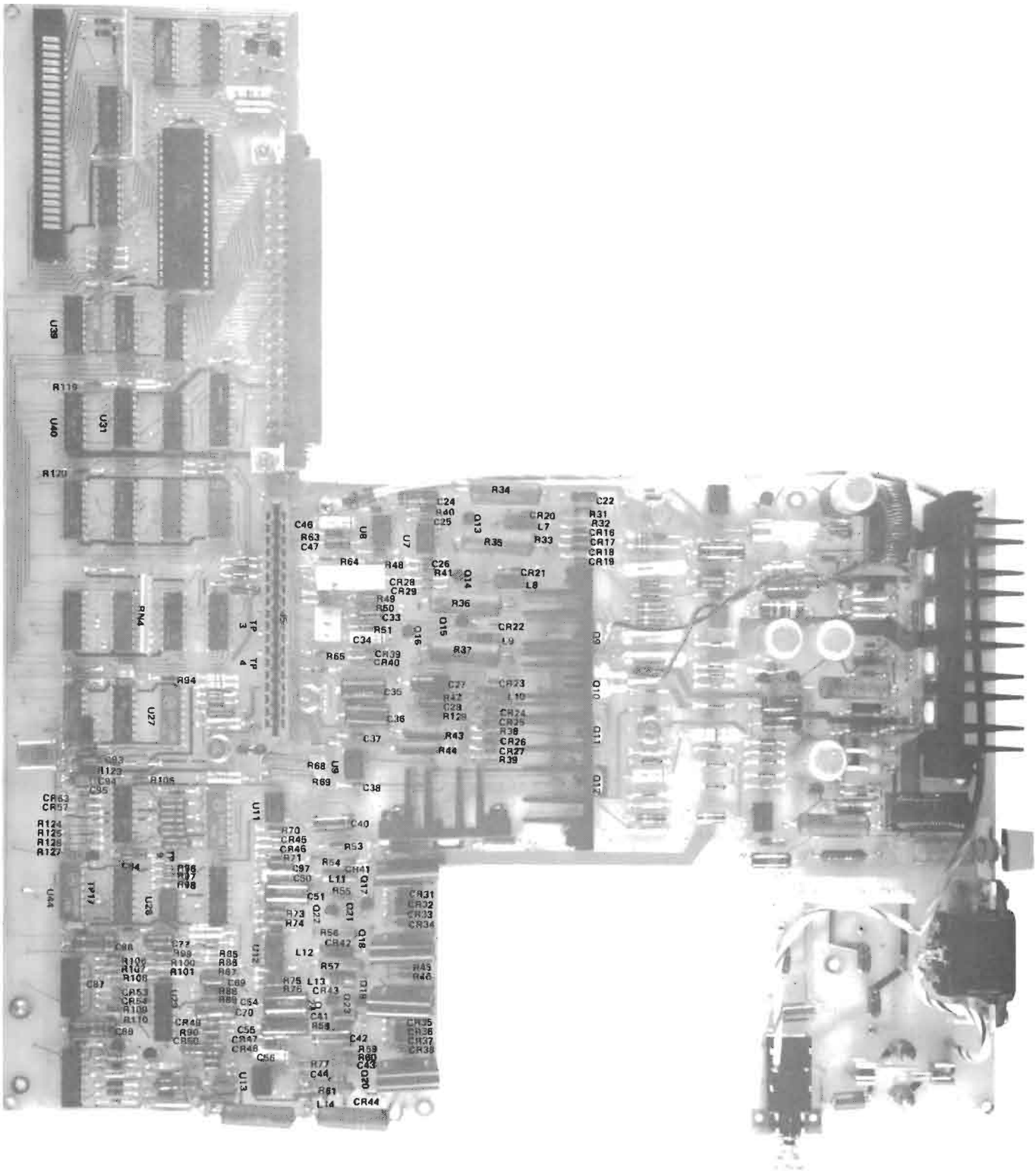
= ANALOG COMMON

= DIGITAL COMMON



PART OF
A1 MAIN PCA

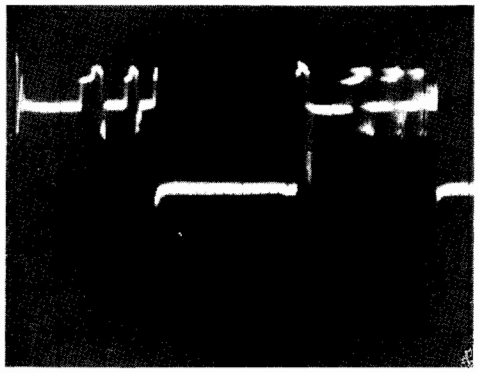



U29
R119
U30
U31
R120
R34
C24
R40
C25
Q13
CR20
L7
R33
C22
R31
R32
CR16
CR17
CR18
CR19
C46
R63
C47
U8
U7
R64
R48
C26
R41
Q14
CR21
L8
CR28
CR29
R49
R50
C33
R36
RN4
TP 3
TP 4
R51
Q16
Q15
CR22
L9
C34
R65
CR39
CR40
R37
Q9
R94
C27
R47
C28
R129
CR23
L10
Q10
C35
C36
CR24
CR25
R38
Q11
U27
C37
R43
R44
CR26
CR27
R39
Q12
R68
U9
R69
C38
R93
R123
C94
C95
R105
CR63
CR57
U11
R124
R125
R126
R127
C40
R70
CR45
CR46
R71
R53
R54
C97
C50
L11
CR41
Q17
C34
R96
R97
R98
TP1
U44
U28
C51
R55
Q22
Q21
CR31
CR32
CR33
CR34
R73
R74
R56
CR42
Q18
C88
C77
R99
R100
R101
R85
R88
R87
L12
R57
R45
R46
C87
R103
R104
R106
R75
R76
L13
CR43
Q19
C89
R86
R89
C54
C70
C41
R58
Q23
R110
C88
R90
CR50
CR48
C55
CR47
CR49
C56
C42
R59
R60
C43
CR35
CR36
CR37
CR38
R77
C44
U13
Q20
R61
L14
CR44

' SUPPLY OUTPUT

)UPLED

5mV/div
L: .5μs/div
OSITIVE, AUTO



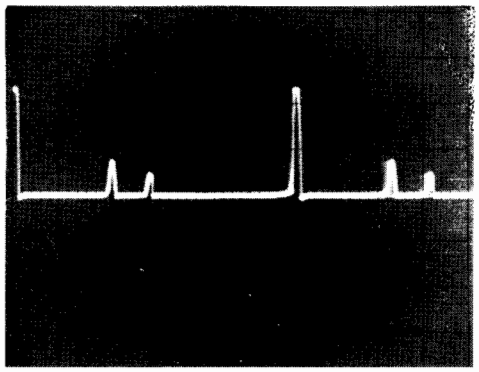
P CHART HOLD INPUT

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: .2V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

DRIVER CIRCUIT

ER DOWN SWITCH
EFERENCE SCOPE CENTER

1V/div
L: 2ms/div
NGLE SWEEP



Q CHART HOLD CIRCUIT

CHART HOLD ACTIVATED
DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: 20V/div
HORIZONTAL: 10μs/div
TRIGGER: POSITIVE, AUTO

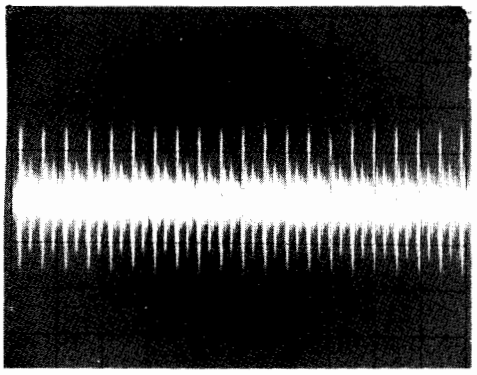
DRIVER OUTPUT

EN DOWN SWITCH
EFERENCE BOTTOM LINE

.5V/div
L: 5ms/div
INGLE SWEEP

J ±20V BALANCE CIRCUIT

: INPUT REFERENCE SCOPE CENTER
:1 PROBE
ERTICAL: .05V/div
ORIZONTAL: 10μs/div
IGGER: POSITIVE, AUTO

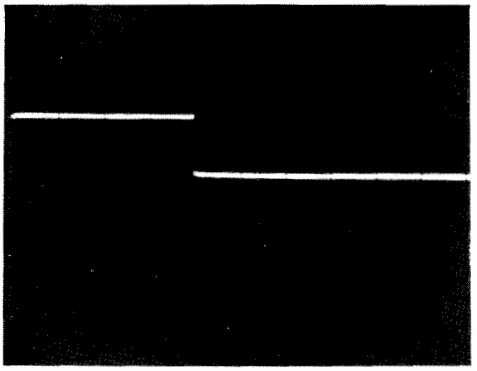


M +5\

INPUT AC C(
10:1 PROBE
VERTICAL:
HORIZONTA
TRIGGER: P

18 ±20V BALANCE CIRCUIT

INPUT REFERENCE SCOPE CENTER
1 PROBE
RTICAL: 1V/div
RIZONTAL: 10μs/div
IGGER: POSITIVE, AUTO

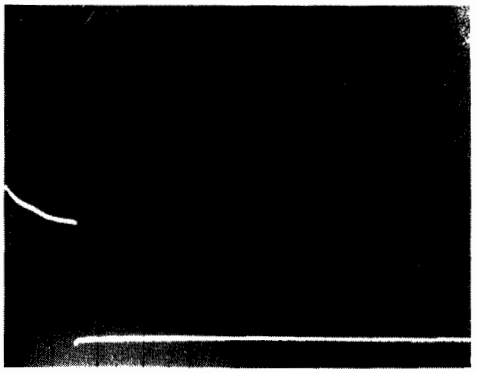


N PEI

ACTIVATE F
DC INPUT RI
10:1 PROBE
VERTICAL:
HORIZONTA
TRIGGER: SI

L +5V SUPPLY (SWITCH QI)

INPUT REFERENCE SCOPE CENTER
1 PROBE
RTICAL: 1V/div
RIZONTAL: 10μs/div
IGGER: POSITIVE, AUTO

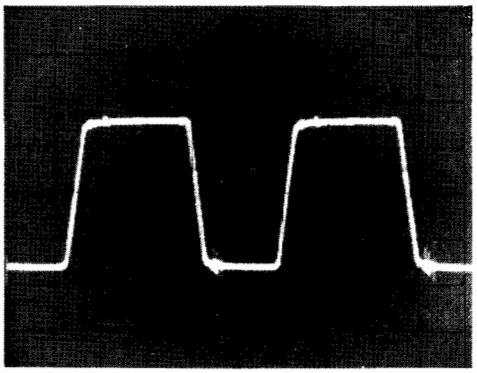


O PEI

ACTIVATE F
DC INPUT R
10:1 PROBE
VERTICAL:
HORIZONTA
TRIGGER: S

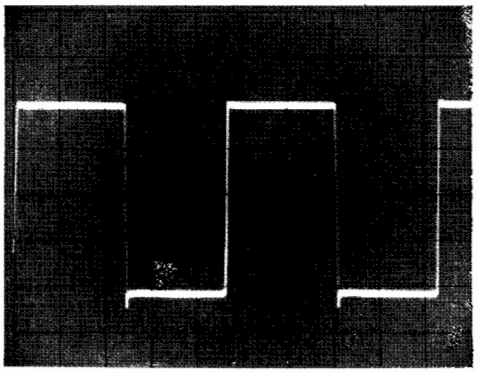
1 AC LINE

DC INPUT REFERENCE SCOPE CENTER
10:1 PROBE
VERTICAL: 10 V/div
HORIZONTAL: 5ms/div
TRIGGER: POSITIVE, AUTO



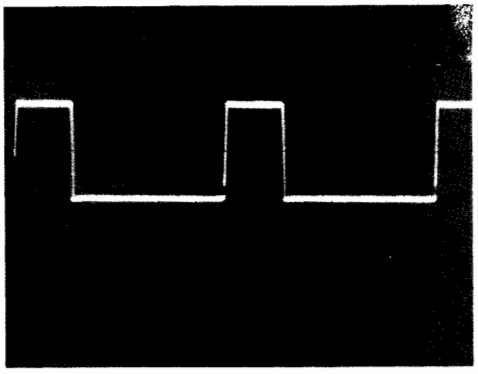
H +20V (RIPPLE)

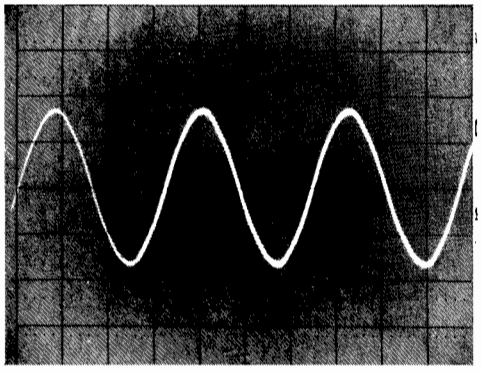
INPUT AC COUPLED
10:1 PROBE
VERTICAL: 20mV/div
HORIZONTAL: 5ms/div
TRIGGER: POSITIVE, AUTO

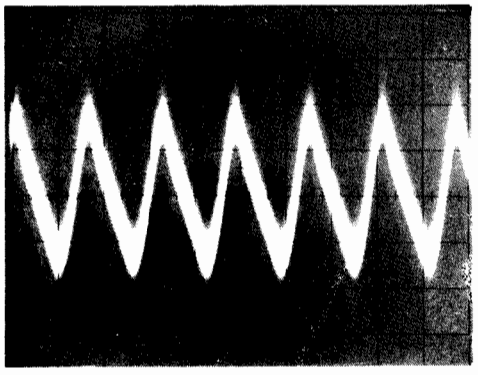


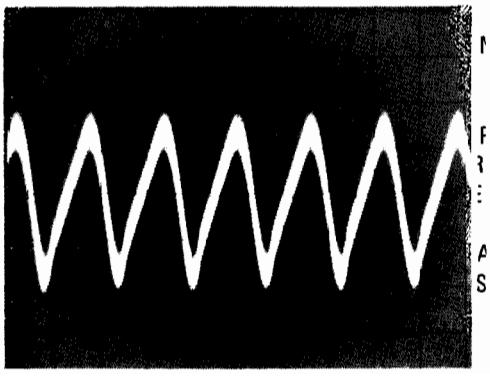
I -20V (RIPPLE)

INPUT AC COUPLED
10:1 PROBE
VERTICAL: 20mV/div
HORIZONTAL: 5ms/div
TRIGGER: POSITIVE, AUTO









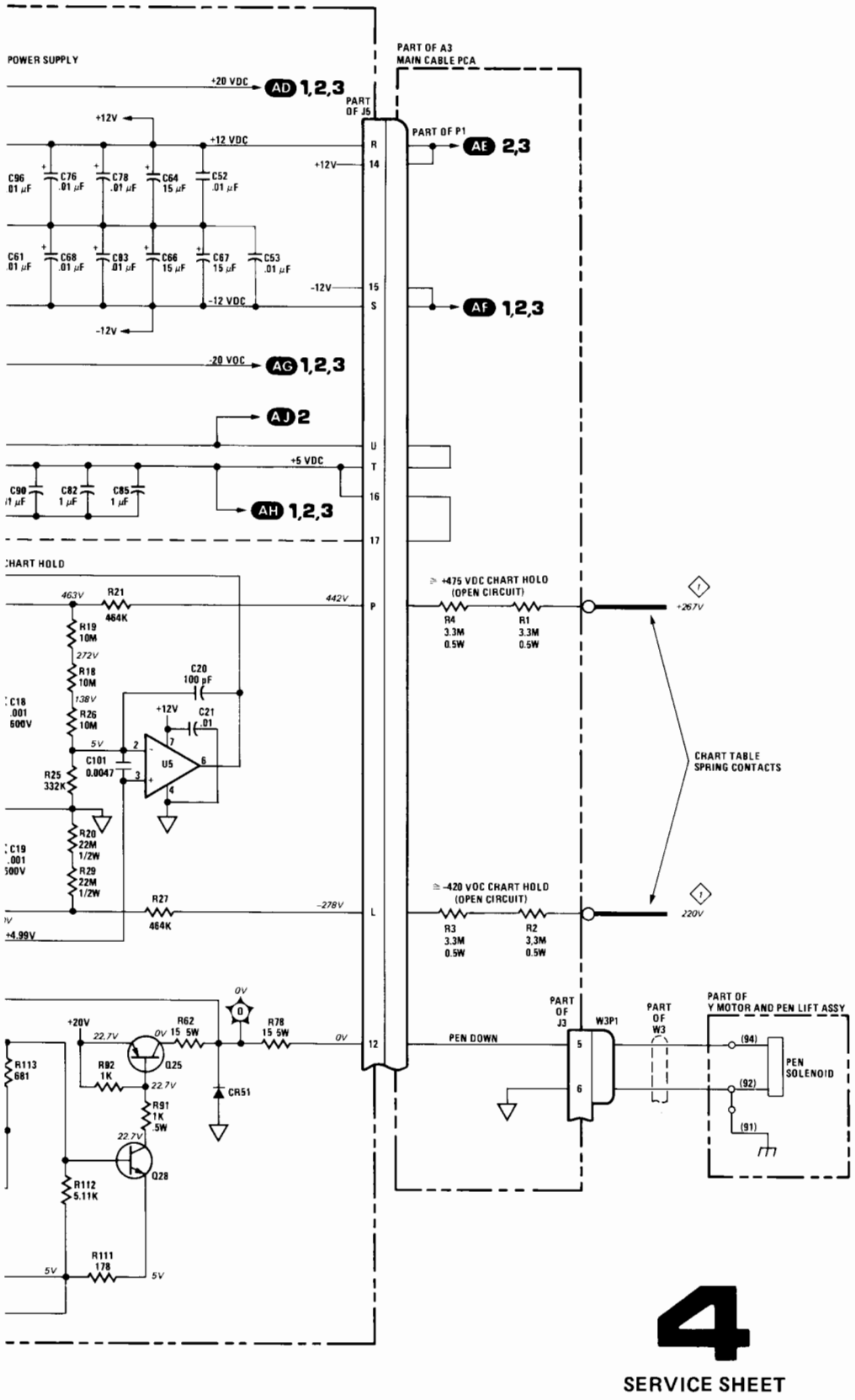
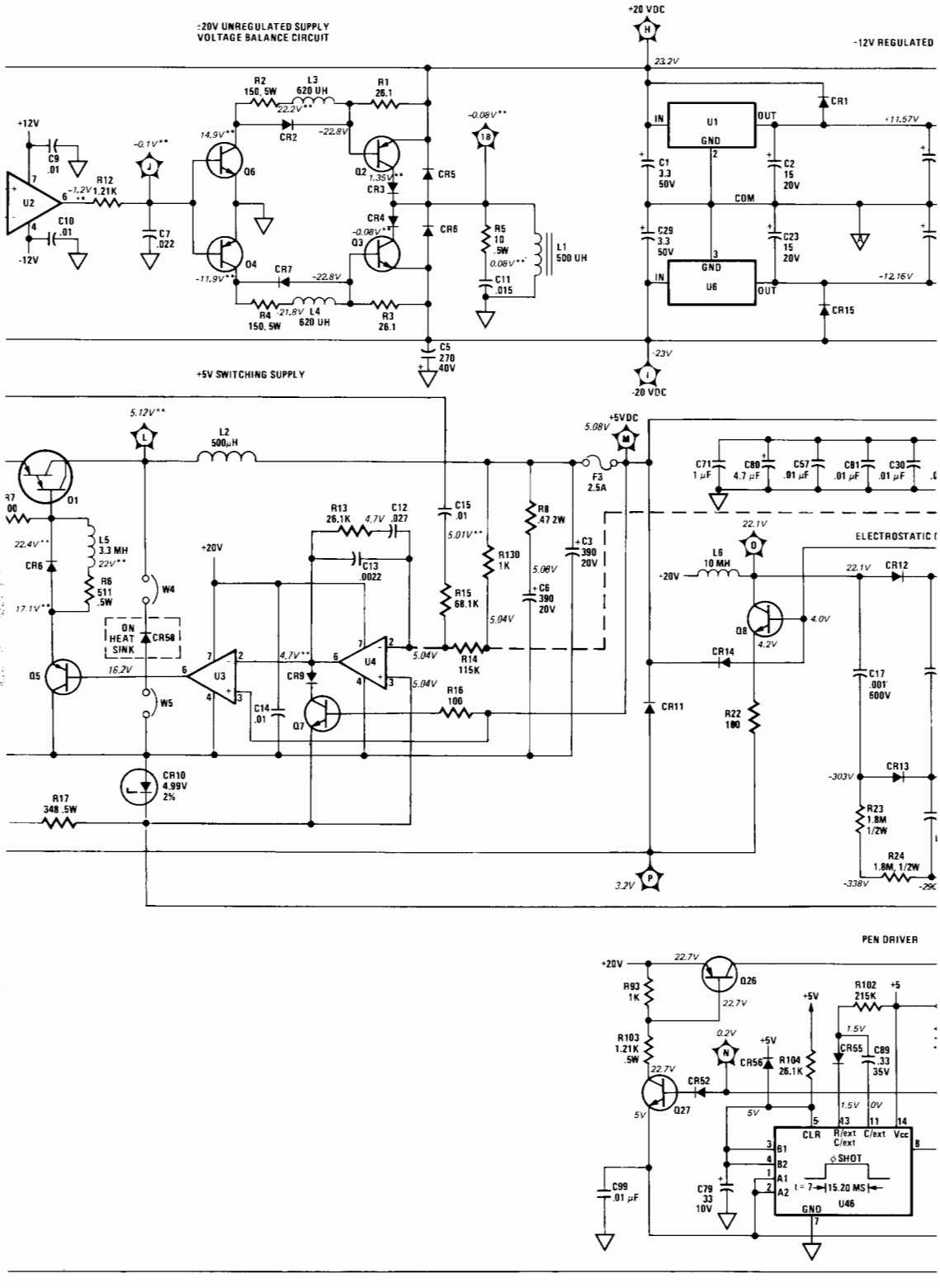
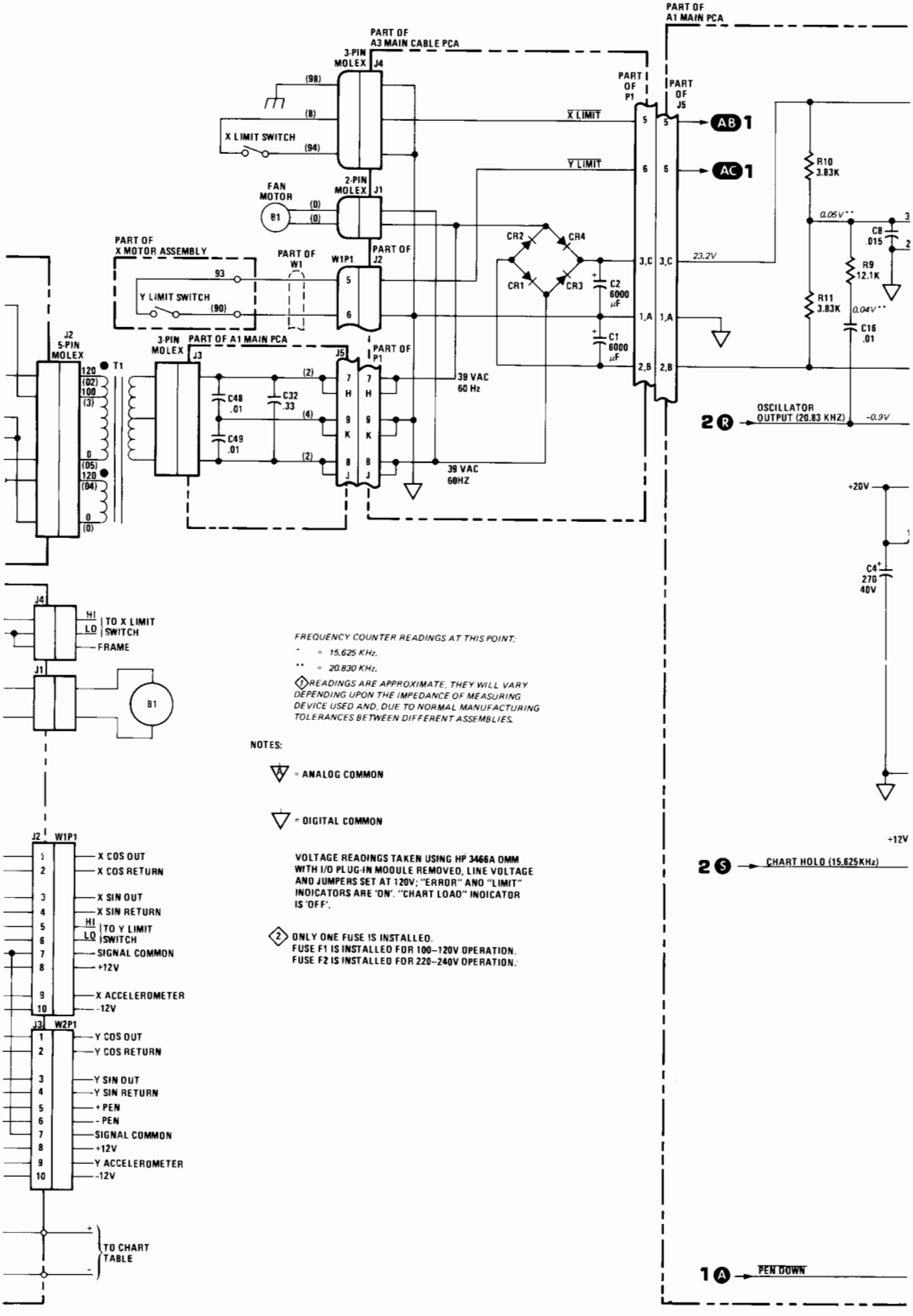
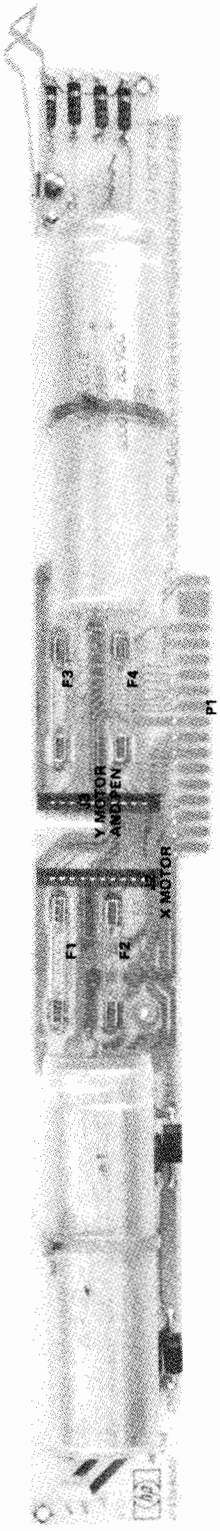
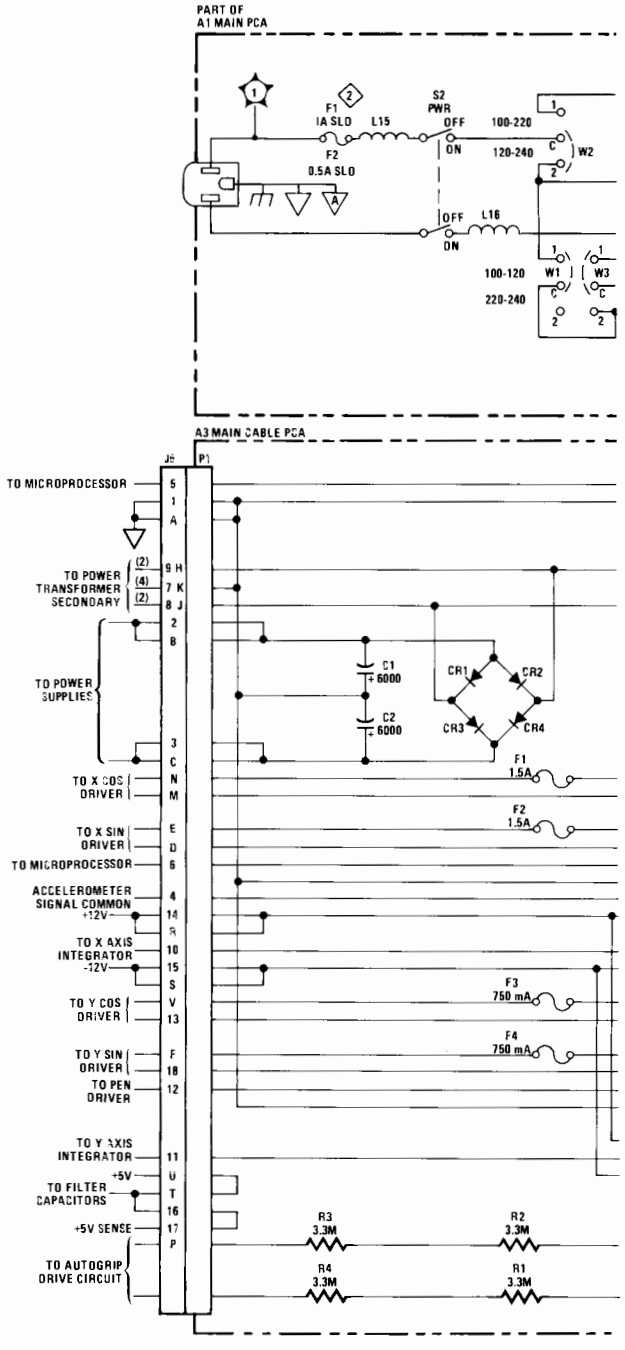


Figure 6-48. Power Supply/Chart Hold/Pen Lift Circuits Schematic Diagram


±20V UNREGULATED SUPPLY
VOLTAGE BALANCE CIRCUIT
+20 VDC
-12V REGULATED
+12V
-12V
U2
R12 1.21K
C9 .01
C10 .01
C7 .022
R2 150, 5W
L3 620 UH
R1 26.1
CR2
Q6
Q4
Q2
Q3
CR3
CR4
CR5
CR6
CR7
R4 150, 5W
L4 620 UH
R3 26.1
R5 10 .5W
L1 500 UH
C11 .015
C5 270 40V
U1
GND
OUT
IN
C1 3.3 50V
C2 15 20V
COM
C29 3.3 50V
C23 15 20V
U6
CR1
CR15
-20 VDC
+5V SWITCHING SUPPLY
L2 500µH
Q1
L5 3.3 MH
CR6
R6 511 .5W
W4
W5
ON HEAT SINK
CR58
Q5
U3
U4
Q7
CR9
C14 .01
R13 26.1K
C12 .027
C13 .0022
C15 .01
R15 68.1K
R130 1K
R14 115K
R16 100
R8 .47 2W
+C3 390 20V
+C6 390 20V
F3 2.5A
+5VDC
CR10 4.99V 2%
R17 348 .5W
C71 1 µF
C80 4.7 µF
C57 .01 µF
C81 .01 µF
C30 .01 µF
L6 10 MH
Q8
CR12
CR14
CR11
R22 180
C17 .001 600V
CR13
R23 1.8M 1/2W
R24 1.8M, 1/2W
ELECTROSTATIC
PEN DRIVER
Q26
Q27
R93 1K
R103 1.21K .5W
CR52
CR56
R104 26.1K
R102 215K
CR55
C89 .33 35V
C99 .01 µF
C79 33 10V
U46
CLR
R/ext C/ext
C/ext
Vcc
B1
B2
A1
A2
GND
SHOT
t = 7→15.20 MS


PART OF A1 MAIN PCA
PART OF A3 MAIN CABLE PCA
3-PIN MOLEX J4
(98)
(8)
X LIMIT SWITCH
(94)
X LIMIT
Y LIMIT
PART OF P1
PART OF J5
AB 1
AC 1
FAN MOTOR
B1
2-PIN MOLEX J1
(0)
(0)
PART OF X MOTOR ASSEMBLY
PART OF W1
W1P1
PART OF J2
93
Y LIMIT SWITCH
(90)
CR2
CR4
CR1
CR3
C2 6000 µF
C1 6000 µF
3,C
1,A
2,B
23.2V
R10 3.83K
0.05V**
C8 .015
R9 12.1K
R11 3.83K
0.04V**
C16 .01
J2 5-PIN MOLEX
T1
120
(02)
100
(3)
0
(05)
120
(04)
0
(0)
3-PIN MOLEX J3
PART OF A1 MAIN PCA
J5
PART OF P1
C48 .01
C32 .33
C49 .01
(2)
(4)
(2)
7 H
9 K
8 J
39 VAC 60 Hz
39 VAC 60HZ
2R OSCILLATOR OUTPUT (20.83 KHZ)
-0.9V
+20V
C4 270 40V
J4
HI
LO
TO X LIMIT SWITCH
FRAME
J1
B1
FREQUENCY COUNTER READINGS AT THIS POINT:
* = 15.625 KHz.
** = 20.830 KHz.
1 READINGS ARE APPROXIMATE, THEY WILL VARY DEPENDING UPON THE IMPEDANCE OF MEASURING DEVICE USED AND, DUE TO NORMAL MANUFACTURING TOLERANCES BETWEEN DIFFERENT ASSEMBLIES.
NOTES:
A = ANALOG COMMON
D = DIGITAL COMMON
VOLTAGE READINGS TAKEN USING HP 3466A DMM WITH I/O PLUG-IN MODULE REMOVED, LINE VOLTAGE AND JUMPERS SET AT 120V; "ERROR" AND "LIMIT" INDICATORS ARE 'ON'. "CHART LOAD" INDICATOR IS 'OFF'.
2 ONLY ONE FUSE IS INSTALLED.
FUSE F1 IS INSTALLED FOR 100–120V OPERATION.
FUSE F2 IS INSTALLED FOR 220–240V OPERATION.
J2 W1P1
1 X COS OUT
2 X COS RETURN
3 X SIN OUT
4 X SIN RETURN
5 HI
6 LO
TO Y LIMIT SWITCH
7 SIGNAL COMMON
8 +12V
9 X ACCELEROMETER
10 -12V
J3 W2P1
1 Y COS OUT
2 Y COS RETURN
3 Y SIN OUT
4 Y SIN RETURN
5 + PEN
6 - PEN
7 SIGNAL COMMON
8 +12V
9 Y ACCELEROMETER
10 -12V
+
-
TO CHART TABLE
+12V
2S CHART HOLD (15,625KHz)
1A PEN DOWN


F3
F4
P1
J3
Y MOTOR
ANDPEN
X MOTOR
J2
F1
F2


PART OF
A1 MAIN PCA
F1
1A SLO
L15
S2
PWR
OFF
ON
100-220
120-240
W2
F2
0.5A SLO
L16
100-120
220-240
W1
W3
A3 MAIN CABLE PCA
J6
P1
TO MICROPROCESSOR
TO POWER TRANSFORMER SECONDARY
TO POWER SUPPLIES
C1
6000
C2
6000
CR1
CR2
CR3
CR4
F1
1.5A
F2
1.5A
TO X COS DRIVER
TO X SIN DRIVER
TO MICROPROCESSOR
ACCELEROMETER SIGNAL COMMON
+12V
TO X AXIS INTEGRATOR
-12V
TO Y COS DRIVER
TO Y SIN DRIVER
TO PEN DRIVER
F3
750 mA
F4
750 mA
TO Y AXIS INTEGRATOR
+5V
TO FILTER CAPACITORS
+5V SENSE
TO AUTOGRIP DRIVE CIRCUIT
R3
3.3M
R2
3.3M
R4
3.3M
R1
3.3M

IN SOME EARLY MODELS F3 IS LOCATED AND SOLDERED INTO PCA AS SHOWN ABOVE

HEWLETT PACKARD

MANUAL CHANGES

MANUAL TITLE: 7225 GRAPHICS PLOTTER SERVICE MANUAL

MANUAL PART NO. 07225-90000

MANUAL PRINTED: April 1979

CHANGE DATE: August 27, 1980

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual. To use this supplement:

Make all ERRATA corrections.

Make all appropriate serial number related changes indicated in the tables below.

▲ Indicates new item.

SERIAL PREFIX	MAKE CHANGE
1939	I
2002	I, II

SERIAL PREFIX	MAKE CHANGE

SERIAL PREFIX	MAKE CHANGE

ERRATA

Page 1-3, Paragraph 1-14 (d), delete the last line "positioned for 120V ac".

Page 4-5, Table 4-2, make the following changes:

Change quantity for item A1E11 from 23 to 20.
Delete items A1E31 through A1E35.
Change heat sink part number: A1E37-A1E40 from 1205-0355 to 1205-0386.
Change quantity for item A1E50 from 6 to 4.

Page 4-6, Table 4-2, add quantity 6 to item A1E67.

Pages 4-6 and 4-7, Table 4-2, change transistor part numbers as follows:

A1Q1 from 1853-0444 to 1853-0479

A1Q2
A1Q9
A1Q11 from 1853-0443 to 1853-0480
A1Q17
A1Q19

A1Q3
A1Q10
A1Q12 from 1854-0791 to 1854-0856
A1Q18
A1Q20

Page 4-11, Table 4-4, delete the following items:

A3E3	Contact – Table Long
A3E4	Contact – Table Short
A3H1 and A3H2	Rivet – Semitub

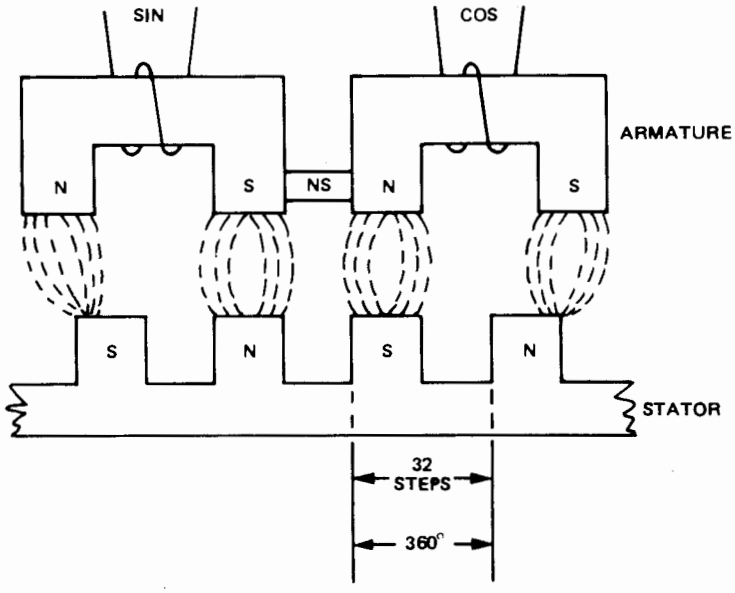
Page 4-12, Table 4-5. The part numbers for item 27 and item 37 are transposed. Change to read:

Item 27 P/N 07225-40035
Item 37 P/N 07225-20004
The descriptions are correct as printed.

Page 4-13, Table 4-6. Item 23 change part number and description to read:

0520-0174 Screw-Mach 2-56, .25-in-lg, pan-head-pozi

Page 6-3, Figure 6-1, substitute the following figure:



CHANGE I

This change adds a velocity select feature to the servo processor IC and plotter. The new processor IC is a direct replacement for IC P/N 1820-2152.

Page 4-2, Table 4-1, change the rebuilt PCA part number from 07225-66105 to 07225-66082.

Page 4-3, Table 4-2, change the Main PCA part number from 07225-60105 to 07225-60082.

Page 4-9, Table 4-2, change the part number of A1U22 from 1820-2152 to 1820-2471 and add the description IC SERVO PROCESSOR.

CHANGE II

This change removes the fan assembly.

Page 4-12, Table 4-5, delete items 12, 13 and 14, and change quantity for item 15 from 5 to 2.

Page 4-17/4-18, Figure 4-1. Delete fan shroud (item 12), fan blade (item 13), fan motor (item 14) and screw (item 15) adjacent to item 14 from the drawing.

Page 6-57, Figure 6-48. Delete fan motor (B1) from schematic diagram.

07225-90000

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