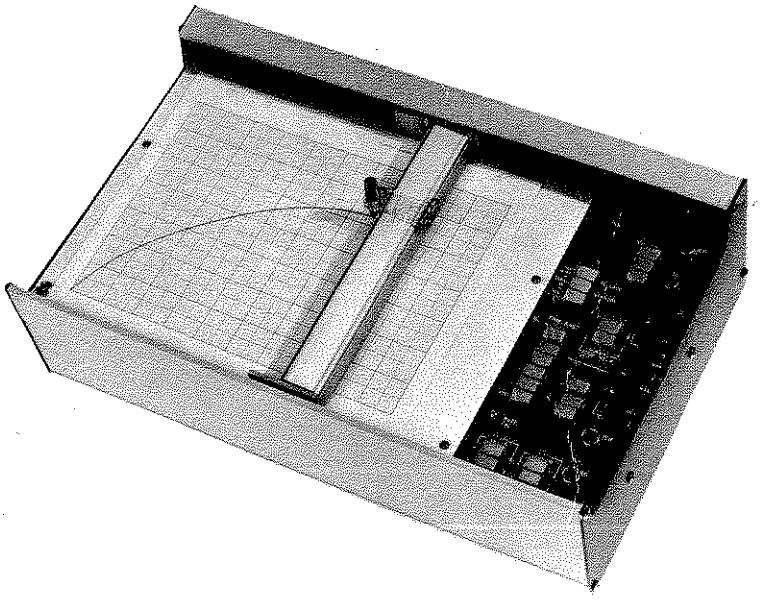
OPERATING AND SERVICE MANUAL

X-Y RECORDER

7015B



HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

7015B X-Y RECORDER

SERIAL PREFIX: 1816A

16399 W. BERNARDO DRIVE, SAN DIEGO, CALIFORNIA 92127

07015-90002
07015-90052 (Microfiche)

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLES

ILLUSTRATIONS

Figure 1-1. Model 7015B X-Y Recorder

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains operating and service instructions for the Hewlett-Packard 7015B X-Y Recorder and is arranged in eight sections as follows: General Information, Installation, Operation, Performance Tests, Adjustments, Replaceable Parts, Manual Changes, and Service. If further information is required, contact the nearest Hewlett-Packard Sales and Service Office. A list of these offices is located at the rear of this manual.

1-3. DESCRIPTION.

1-4. The Hewlett-Packard Model 7015B X-Y Recorder (Figure 1-1) is a one-pen, ISO A4, 8-1/2 X 11 inch instrument designed to plot Cartesian coordinate graphs from dc electrical sources. This instrument completely fulfills the needs of the user seeking reliability, dependability, and versatility. The Model 7015B has a control panel containing lighted power ON/OFF switch, pushbutton range switches (three spans of .01 V/in., .1 V/in., 1.0 V/in., or 5 mV/cm, 50 mV/cm, 500 mV/cm), chart hold, servo on, and pen record lift pushbutton switches, as well as vernier and zero controls. An X-axis timebase is standard with sweep speeds of 0.5, 1, 5, 10, 50 and 100 seconds per inch (.1, .5, 1, 5, 10, and 50 seconds per cm). The 7015B is equipped with an active input filter in each axis. This filter provides an additional 50 dB normal mode attenuation at 60 Hz and 47 dB attenuation at 50 Hz. The 7015B has approximately 20 dB inherent normal mode attenuation at 60 Hz with the active filter switched out.

1-5. Sweep calibration, and X and Y calibration potentiometers can be adjusted from the front control panel. Standard equipment includes electrostatic paper holddown, rear connector, and a universal pen holder which will hold most standard fiber tipped pens. Options for the unit include metric calibration (spans of 5 mV/cm, 50 mV/cm, and 500 mV/cm) (Option 001), carrying case (Option 004), and rack mounting brackets (Option 908).

1-6. SAFETY CONSIDERATIONS.

1-7. This Safety Class I instrument (provided with a protective earth terminal) has been designed and tested according to international safety standards.

WARNING

Before switching on this instrument, the protective earth terminals of this instrument must be connected to the protective conductor of the ac line power cord. The ac line plug shall only be inserted in an outlet provided with a protective earth contact. The protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

WARNING

Use only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) for replacement. The use of repaired fuses and the short-circuiting of fuse holders must be avoided.

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal is likely to make this instrument dangerous. Intentional interruption is prohibited.

WARNING

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when necessary should be carried out only by a skilled person who is aware of the hazard involved.

1-8. INSTRUMENTS COVERED BY MANUAL.

1-9. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number

prefix(es) as listed under SERIAL NUMBERS on the title page.

1-10. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Change supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-11. 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, Hewlett-Packard recommends that you periodically request the newest Manual Change 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. For information concerning a serial number prefix that is not listed on the title page or in the Manual Change supplement, contact your nearest Hewlett-Packard office.

1-12. SPECIFICATIONS.

1-13. Table 1-1 lists the specifications for the Model 7015B.

1-14. OPTIONS.

1-15. Optional features available for the Model 7015B are specified in the following paragraphs and describe features that may be built into or combined with the Model 7015B.

1-16. METRIC CALIBRATION – OPTION 001.

1-17. A metrically calibrated version of the instrument with X and Y input spans of 5 mV/cm, 50 mV/cm and 500 mV/mc and metric Time Base is provided. (May be field installed; order Kit HP Part No. 07015-60013).

1-18. CARRYING CASE – OPTION 004.

1-19. This case (HP Part No. 07010-60039) is used to transport the unit from one area to another. The size and weight of the instrument facilitate portability of the unit. The 7015B is not meant to be shipped in the carrying case. (May be ordered at any time.) See Figure 1-4.

1-20. RACK MOUNTING – OPTION 908.

1-21. Rack mounting enables the user to mount the Model 7015B in a standard 19-inch rack configuration. (May be field installed; order Kit HP Part No. 07010-60008.) See Figure 1-5.

1-22. EXTRA MANUAL – OPTION 910.

1-23. Provides an extra Operating and Service Manual.

1-24. ACCESSORIES SUPPLIED.

1-25. Accessories supplied with the recorder are listed in Table 1-2.

1-26. SUPPLIES/ACCESSORIES AVAILABLE.

1-27. For supplies and accessories available refer to Recorder Consumables Catalog HP Part No. 5952-2834.

1-28. TEST EQUIPMENT REQUIRED.

1-29. Table 1-3 lists the test equipment required to maintain the Model 7015B.

Table 1-1. Specifications, Model 7015B

PERFORMANCE SPECIFICATIONS

Input ranges:	Three ranges – .01 V/in., .1 V/in., 1 V/in. (5 mV/cm, 50 mV/cm, 500 mV/cm). Vernier adjustment overlapping all ranges.
Type of input:	Floating.
Input resistance:	1M ohm constant.
Normal Mode Rejection:	Greater than 50dB at 50 and 60 Hz. (40dB per decade roll-off above 60 Hz.)
Common mode rejection:	100 dB dc and ac from +10°C to +40°C, 0 to 80% R.H. Degrades 20 dB/decade step in attenuator (both ac and dc).
Common mode voltage:	40 Vdc and peak ac maximum.
Connection:	Front panel binding posts or standard rear connector.

Table 1-1. Specifications, Model 7015B (Continued)

PERFORMANCE SPECIFICATIONS (Continued)

Accuracy: ±0.3% of full scale on .01 V/in range (includes linearity and resetability) plus ±0.20% of deflection when on other ranges. Temperature coefficient ±0.02%/°C.

Resetability: 0.2% of full scale.

Overshoot: 2% full scale maximum.

Slewing speed: 20 in./sec (50 cm/sec) minimum.

Frequency Response: See Figure 1-2.

Zero control:

Control ranges – pen may be positioned at any location on chart using 10 T pot +1 full scale zero suppression.

Resolution – pen positioned within +0.005 in. of any point on chart.

Environmental conditions: 0°C to +55°C, 0 to 95% R.H. at 40°C

GENERAL SPECIFICATIONS

Front panel controls: Line ON/OFF, chart hold, servo standby, pen lift, range switches, vernier, zero, and timebase.

Timebase:

Sweep rates – six from 0.5 sec/in. to 100 sec/in. (0.1 sec/cm to 50 sec/cm).

Accuracy – 1.5% at 25°C.

Temperature coefficient – ±0.1% of full scale per °C over a range of 10°C to 40°C.

Controls – Start, reset, actuated from the front panel, remote contact closure or TTL control.

Writing system: Disposable pens and a universal pen holder designed for most fiber tipped pens.

Platen size: Holds 8-1/2 × 11 inch or ISO A4 chart paper.

Writing area: 18 × 25 cm (7 × 10 in.)

Dimensions: 10-15/52 × 17-3/16 × 5-5/16 (266 mm × 437 mm × 145 mm). May be mounted in 19 inch or ISO size equipment rack (see Figure 1-3)

Power: Switch selectable for 100, 120, 220 or 240 Vac +5 -10%, 47.5 – 440 Hz, 70 VA maximum.

Weight: Net 16 pounds (7.2 Kg); shipping 22 pounds (10 Kg).

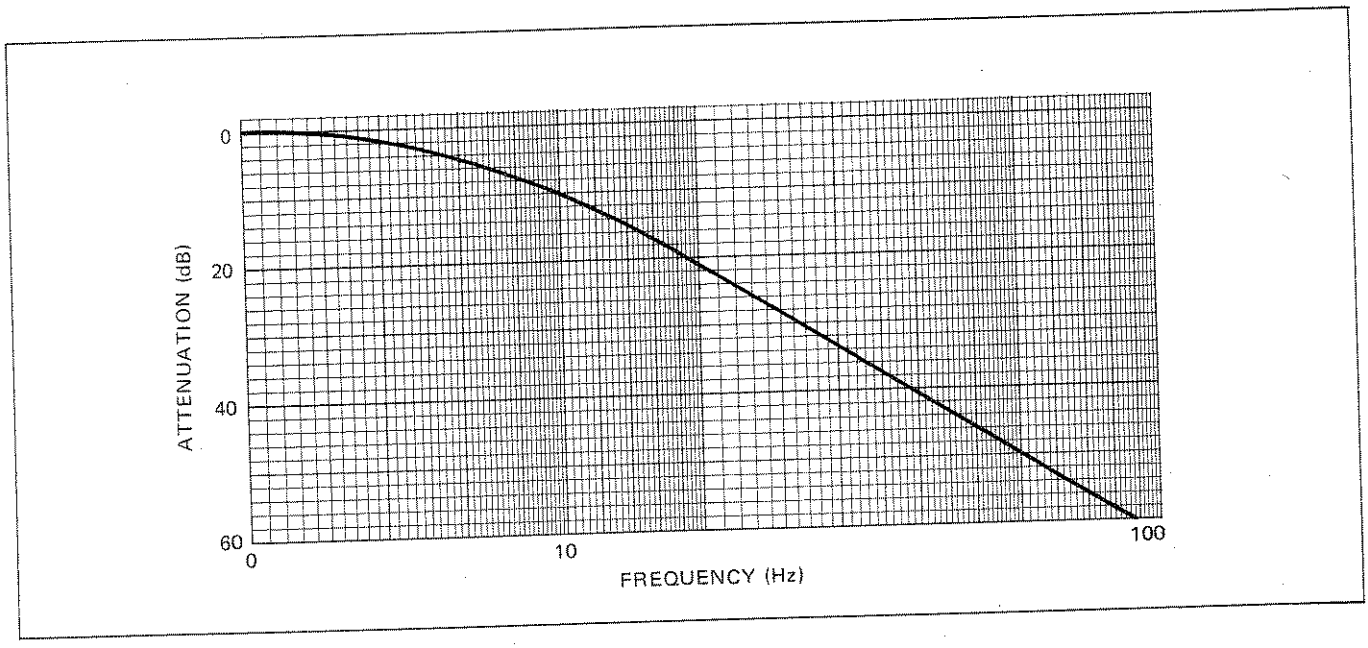


Figure 1-2. Typical Y-Axis Frequency Response

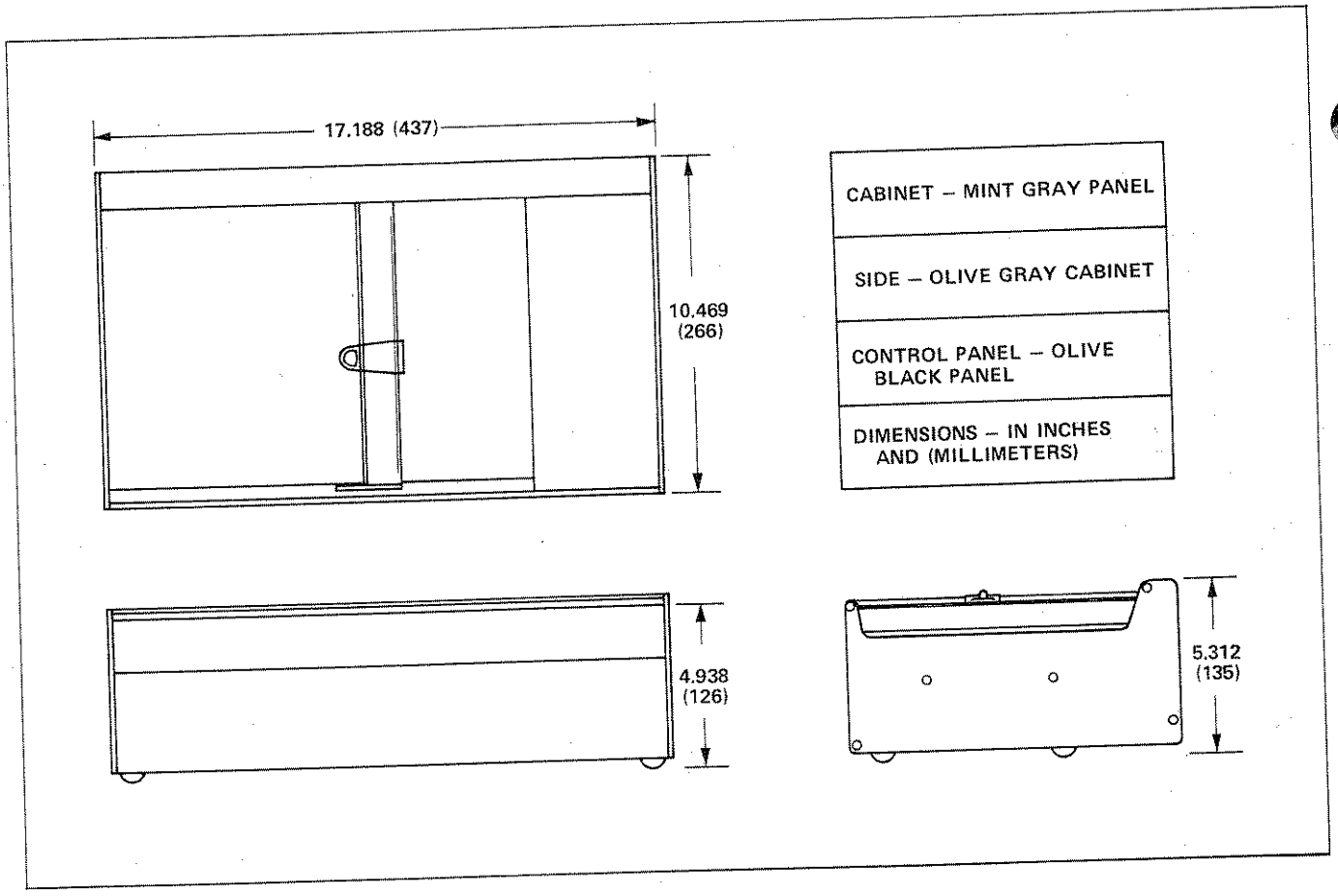


Figure 1-3. Model 7015B Dimension Drawing

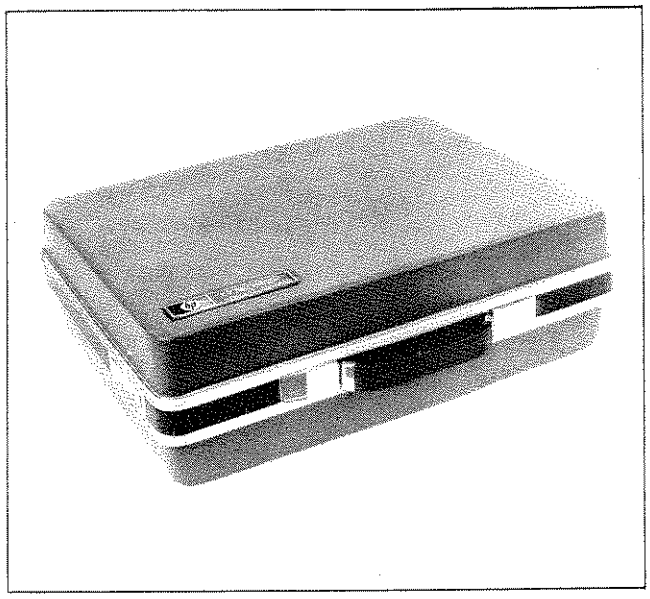


Figure 1-4. Model 7015B Carrying Case

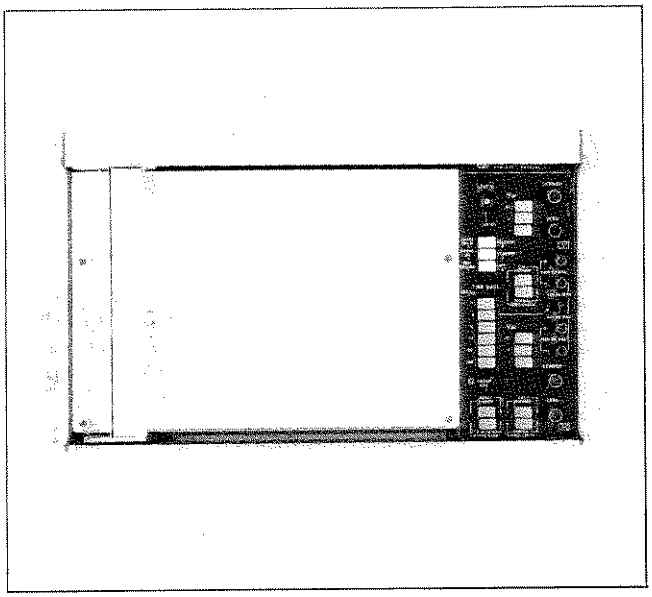


Figure 1-5. Model 7015B with Rack Mounts (Option 908)

Table 1-2. Accessories Supplied

1. Accessory Kit, Part No. 07015-60321

QTY	DESCRIPTION	PART NUMBER
1	Disposable Pen, Red (Package of 5)	5081-1190
1	Disposable Pen, Blue (Package of 5)	5081-1191
1	Can Slidewire Cleaner	5080-3605
2	Rear Connectors	1251-2500 1251-2799
1	Universal Pen Holder Assembly	07010-60034
1	"Your X-Y Recorder" Manual	5955-1233

2.	Operating and Service Manual	07015-90002
3.	Graph Paper, 7 x 10 in., 10 sheets (heavy)	9270-1006
	180 x 250 mm, 10 sheets (OPTION 001)	9270-1023
4.	Graph Paper, 7 x 10 in., 10 sheets (light)	9270-1007
	180 x 250 mm, 10 sheets (OPTION 001)	9270-1027
5.	Power Cord	8120-1378
6.	Dust Cover	4040-0681

Table 1-3. Recommended Test Equipment

1. HP 3465B or 970A Digital Voltmeter Multimeter or equivalent.
2. HP 6202B Power Supply.
3. HP 3310A Function Generator.
4. HP 740B Voltage Standard.
5. HP Model 226A Time Mark Generator.
6. HP 181A Oscilloscope.
7. Bausch & Lomb 81-34-15 Optical Comparator.
8. 1k ohm Resistor (two required).
9. 1M ohm Resistor.
10. Assorted Cables.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Model 7015B X-Y Recorder. This section also includes information about initial inspection and damage claims, preparation for using the X-Y Recorder and packaging, storage, and shipment.

2-3. RECEIVING INSPECTION.

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. RECORDER INSTALLATION.

2-6. The Model 7015B requires no installation. Rack mounted models (Option 908) are designed for installation in a standard 19-inch cabinet. Four screws (two in each side) are used for easy installation of Option 908. See Figure 2-1.

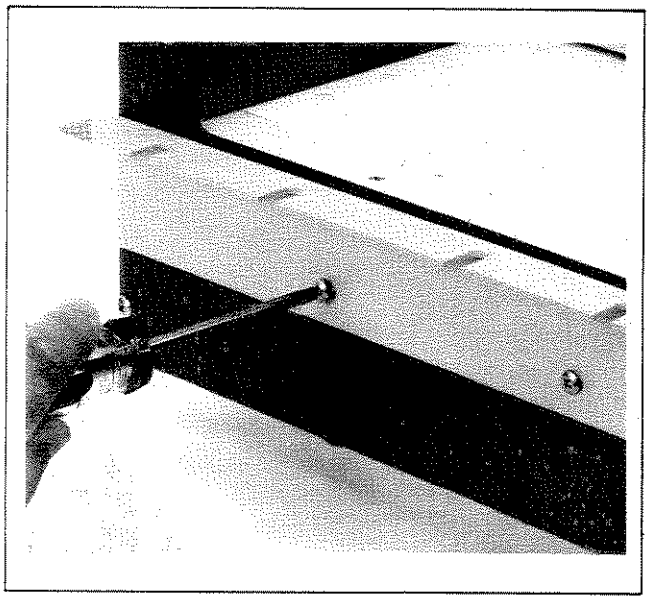


Figure 2-1. Rack Mount Installation (Option 908)

2-7. COOLING.

2-8. Cooling is provided by convection. The location or mounting of the instrument must ensure adequate air circulation.

2-9. LINE VOLTAGE AND FUSE SELECTION.

2-10. The Model 7015B requires a power source of 100, 120, 220, or 240 Vac; 47.5 - 440 Hz; 70 VA maximum. Figure 2-2 shows the Model 7015B power controls and connectors. Figure 2-3 shows the ac voltage switch settings. The ac voltage selector switches located on the rear power bracket should be set to correspond to the available supply voltage. A 1/2 ampere fuse (HP Part No. 2110-0202) is used for 100 to 120 operation; a 1/4 ampere fuse (HP Part No. 2110-0201) is used for 220 to 240 operation.

2-11. POWER CABLE.

2-12. A power cord is supplied to connect the recorder to the power source. The power cord furnished with the instrument complies with National Electric Code requirements only when used for 100 to 120V operation. For 220 to 240 operation, the power cord must be replaced or modified. To modify the cord, replace the male plug with a NEMA configurated plug for 220 to 240V operation. See Figure 2-4.

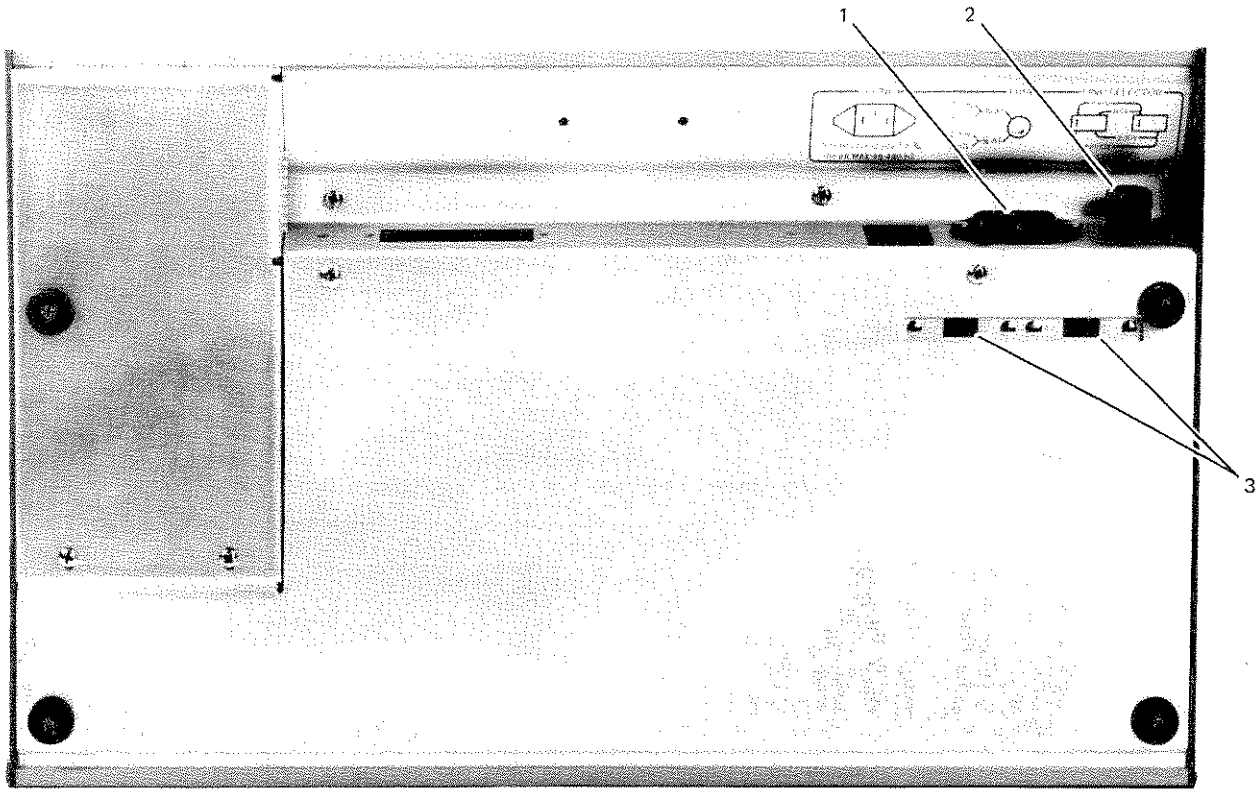
2-13. Power plugs used in the United States and other countries are shown in Figure 2-5. The plug rating and the HP Part Number for the plug and power cord are shown beside each plug. If the correct power cable is not available, notify the nearest Hewlett-Packard Sales and Service Office and a replacement cable will be provided.

2-14. GROUNDING.

WARNING

Do not remove protective grounding conductor. Any intentional interruption of protective (grounding) conductor is likely to make apparatus dangerous.

2-15. For compliance with safety laws and optimum performance, the third prong of the ac power cord must be grounded. When operating from ungrounded power sources, a secondary grounding method is mandatory.



WARNING

Use only the approved three-wire cable supplied with the instrument. Interruption of the grounding conductor is likely to make the instrument hazardous. (See Figure 2-5).

1. AC LINE Receptacle: Accepts the AC line cord.

WARNING

For continued protection against fire hazard, replace fuse only with same type and rating.

WARNING

For protection against shock hazard, remove the AC line cord before replacing fuse.

2. FUSE Holder: Contains the AC line fuse. For 100 or 120 Vac, use 1/2 ampere fuse. For 220 or 240 Vac, use 1/4 ampere fuse.

CAUTION

To prevent damage to the instrument, make the line voltage selection BEFORE connecting the line power. Check line fuse for proper rating any time a voltage change is made.

3. VOLTAGE SELECTOR: Two switches which are set for the available AC line voltage to permit operation from 100, 120, 220, or 240 Vac (see Figure 2-3).

Figure 2-2. Model 7015B Power Controls and Connectors

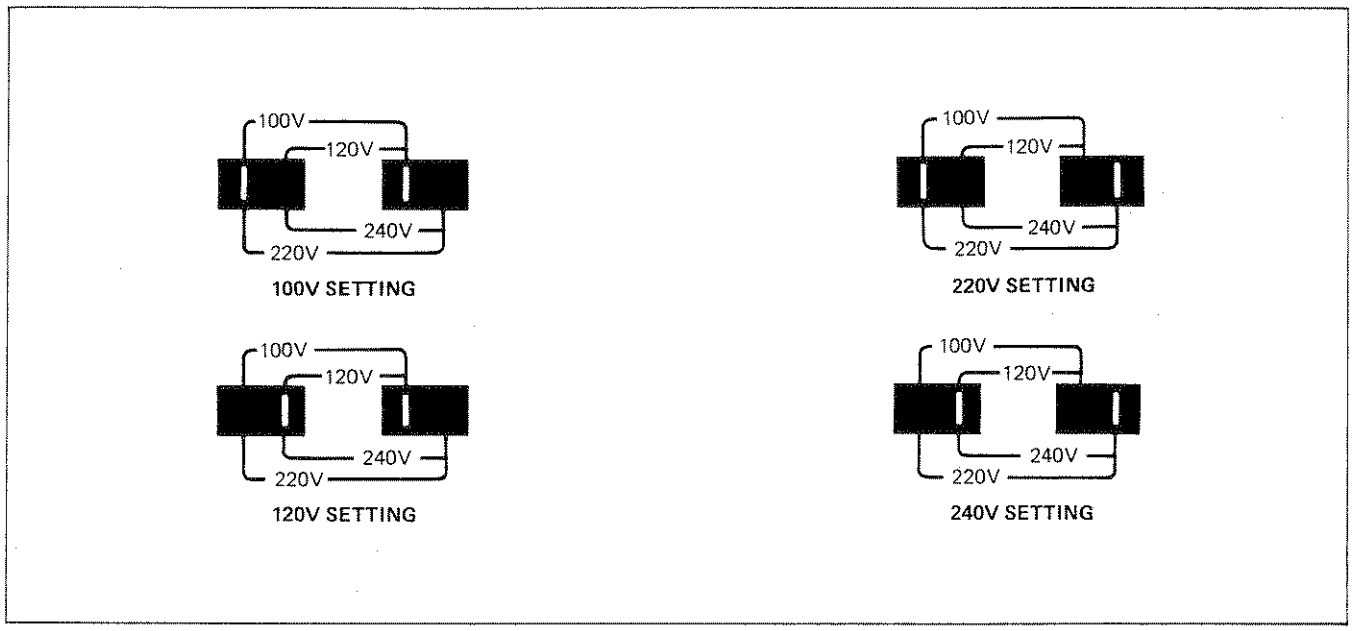


Figure 2-3. AC Voltage Switch Settings

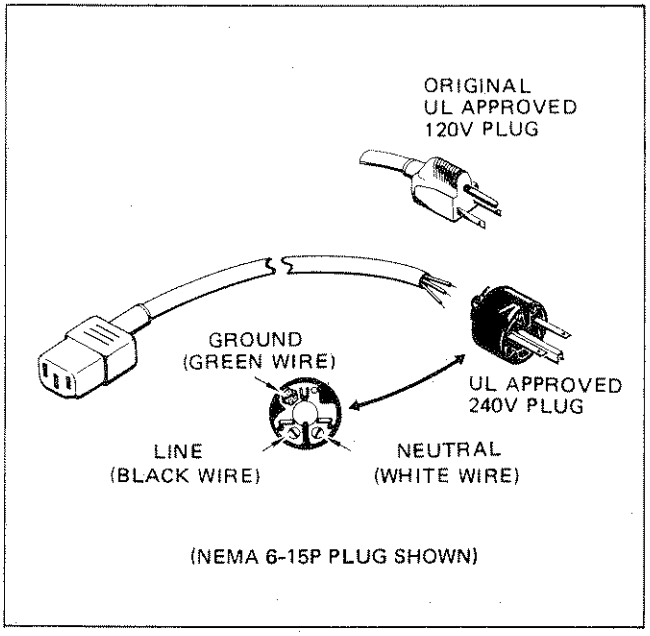


Figure 2-4. Power Cord Modification for 220 – 240 Operation

2-16. CONTROL AND SIGNAL CONNECTIONS.

2-17. The recorder's input terminals (plus, minus, and chassis ground) are located on the front panel. The varying dc signal to be measured is connected between the plus and minus terminals of the front panel. In addition, two rear connectors (one for controls, the other for the input signal) are located under a metal cover at the rear of the instrument. See Figure 2-6. To use the rear connectors, remove the connector cover as shown in Figure 2-7. The input signal should vary at a rate within the response capabilities of the instrument and have amplitudes within the scale ranges or an erroneous recording may result. It is important that the side of the signal with the lowest impedance to ground is connected to the minus input terminal of the instrument.

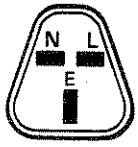
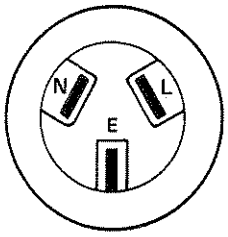
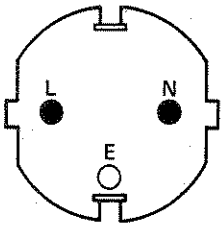
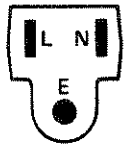
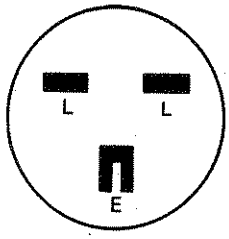
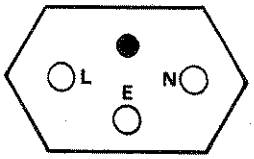
2-18. SHIPMENT.

2-19. Before returning the instrument for any reason, notify the local field sales office of the difficulty encountered, giving the model and serial number of the instrument They will furnish shipping instructions. The following precautions should be taken when repackaging the recorder:

a. Remove disposable pen.

b. Position carriage assembly to the left side of recorder using Y-arm holder shipping bracket (HP Part No. 5001-0325) and foam padding to prevent movement while in transit. Do not ship recorder in carrying case (Option 004).

c. Wrap instrument in heavy paper or plastic and surround with three or four inches of shock absorbing material to cushion and prevent movement inside shipping container. Container should be sufficiently durable to prevent damage to instrument during handling. If in doubt, request a shipping carton from nearest Hewlett-Packard Sales and Service office.

		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 8120-1689; 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; furnished with standard for use in United States, Canada, Japan, Mexico, Philippines, Taiwan)	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; E is earth or safety ground, N is neutral or identified conductor, and L is line or active conductor.

Figure 2-5. Power Plug Configurations and Part Numbers

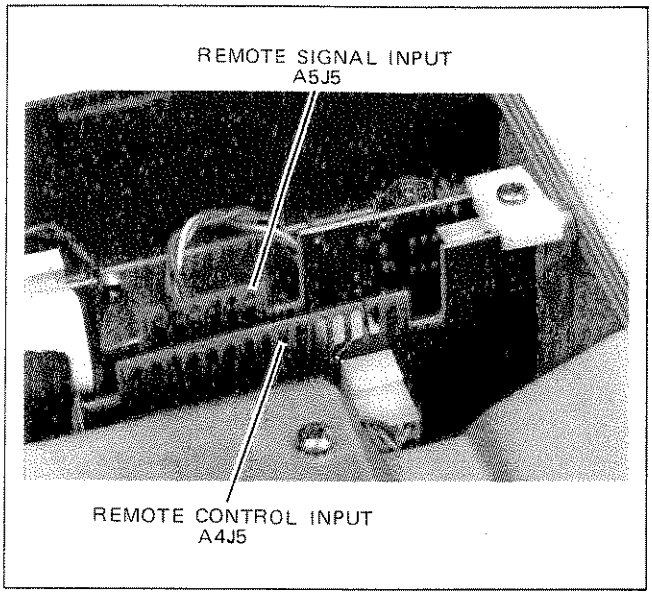


Figure 2-6. Model 7015B Remote Signal and Control Connections

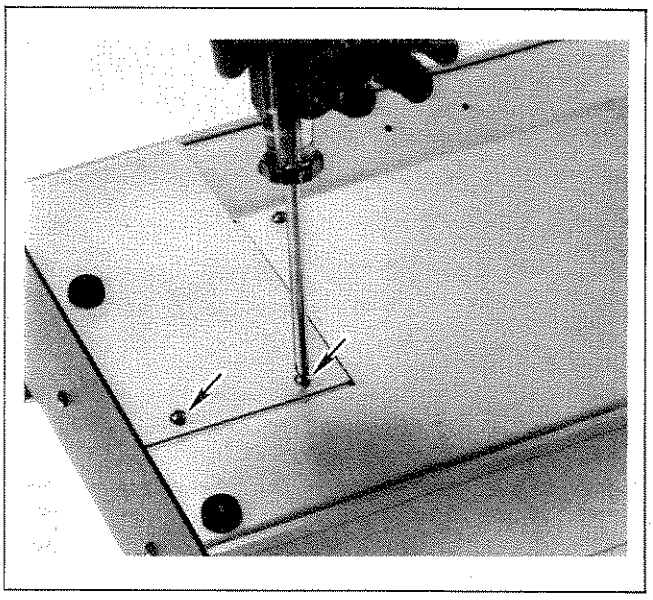


Figure 2-7. Connector Cover Removal

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section provides operating instructions for the Model 7015B X-Y Recorder. Included herein are listings of front and rear panel controls, connectors and indicators, chart and pen loading and operator maintenance.

3-3. PANEL FEATURES.

3-4. Front panel controls, connectors and indicators are illustrated and described in Figure 3-1. Rear panel features are illustrated and described in Figure 3-2.

3-5. OPERATION.

3-6. This portion of the manual outlines the basic procedures used to operate the 7015B.

NOTE

This instrument is designed to operate over an ambient temperature range of +0°C to +55°C. Operation under other conditions may produce inaccurate results and may cause damage to the recorder. In areas with high humidity, graph paper may expand, affecting the accuracy of the grid lines. The area of operation should also be as free as possible of air contamination (soot, smoke, fumes, etc.). Excessive air contamination will require more frequent cleaning.

WARNING

Before switching on the instrument, the protective earth terminals of the instrument must be connected to the protective conductor of the ac line power cord. The ac line plug shall only be inserted in an outlet provided with a protective earth contact. The protective conductor (grounding). Ensure that all devices connected to this instrument are connected to the protective (earth) ground.

CAUTION

Before switching on this instrument:
Make sure the instrument is set to the voltage of the power source.
Make sure that only fuses with the required rated current of the specified type are used.

3-7. CONNECTING POWER.

3-8. Preset the 7015B front panel controls:

a. LINE – OFF

b. CHART HOLD: RELEASE

c. SERVO: STANDBY

d. PEN: LIFT

e. TIMEBASE: X-INPUTS

3-9. Preset the rear panel:

a. VOLTAGE SELECTOR switches: to appropriate line voltage (refer to paragraph 2-9).

b. FUSE: appropriate rating for voltage selected. (Refer to paragraph 2-9).

3-10. Connect an appropriate power cord (see Figure 2-5) between the recorder and the power source.

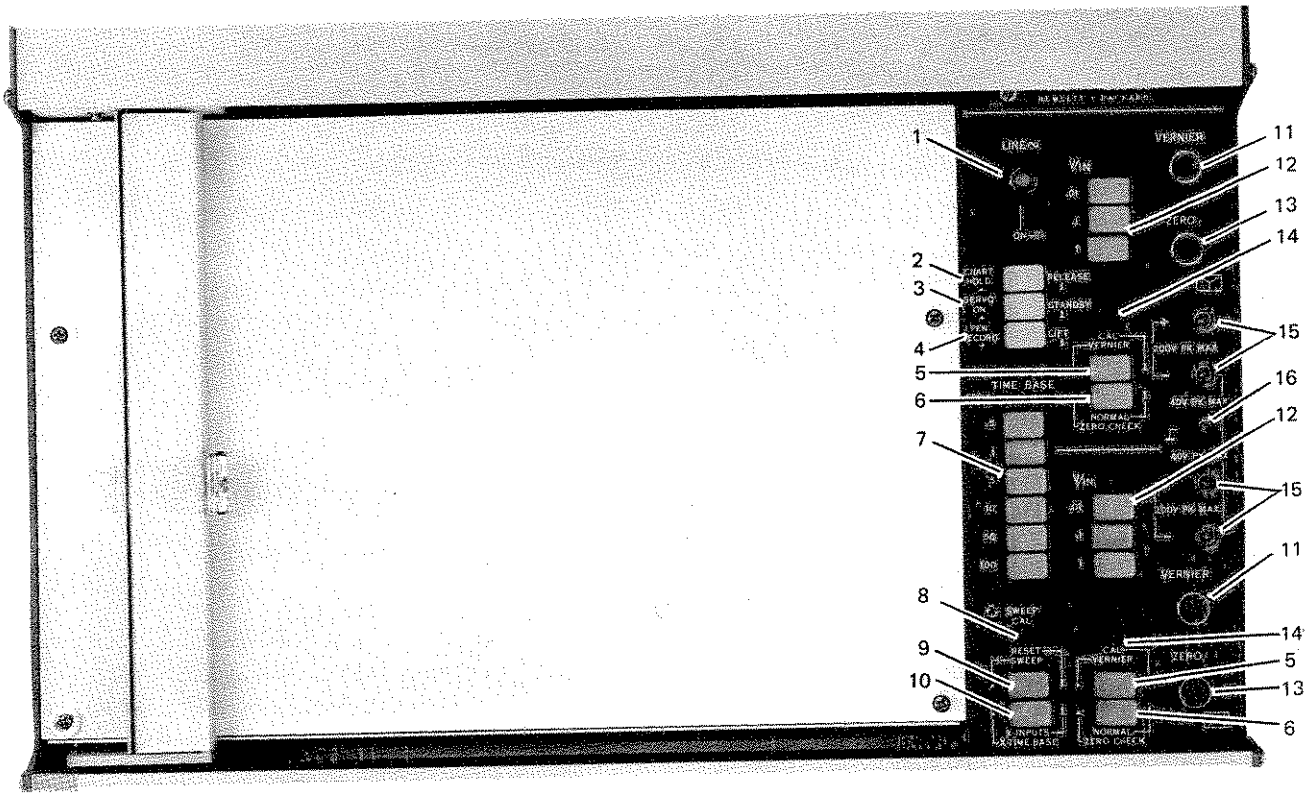
3-11. Press the LINE pushbutton to energize the recorder. The power ON indicator will light.

3-12. CHART LOADING.

3-13. Place chart paper on the recorder platen and align the left edge and the bottom with the paper stop. See Figure 3-5. To energize the electrostatic holddown, press the CHART HOLD button.

3-14. PEN INSTALLATION.

3-15. The disposable pen is inserted into the notched holder located on the carriage arm. Twist the lock in holder. See Figure 3-6.



1. LINE switch. A two position pushbutton switch. When pushed in AC power is applied to the recorder. The ON indicator LED will light when power is applied.

2. CHART HOLD/RELEASE switch. A two position pushbutton switch. When pushed into the HOLD position the electrostatic chart table is activated. When out the chart table is turned off.

3. SERVO ON/STANDBY switch. A two position pushbutton switch. When pushed into the ON position the recorder servos are on. When out the servos are muted.

4. PEN RECORD/LIFT switch. A two position pushbutton switch. When pushed into the RECORD position the pen is lowered on to the chart. When out the pen is raised from the chart.

5. CAL/VERNIER switch. A two position pushbutton switch. When pushed into the VERNIER position the VERNIER potentiometer controls sensitivity. When out the switch is in the CAL position. The sensitivity is controlled by the V/IN switches in this position.

6. NORMAL/ZERO CHECK switch. A two position momentary contact pushbutton switch. When pushed and held this switch removes the input signal to check the zero position of the pen. When released the switch returns to the NORMAL position for signal input.

7. TIME BASE SEC/IN (SEC/CM) switches. Six pushbutton switches. Select one of six sweep rates for Time Base function.

8. SWEEPCAL potentiometer. Screwdriver adjustable potentiometer to calibrate sweep rate.

Figure 3-1. Model 7015B Front Panel Controls, Indicators and Connectors (Sheet 1 of 2)

9. SWEEP/RESET switch. A two-position pushbutton switch. In Time Base mode pressing the switch in to the SWEEP position will lower the pen and start the timed X axis sweep. When in the RESET position the pen is raised and the X axis sweep returns to the zero position.

10. X TIME BASE/X INPUTS. A two-position pushbutton switch. When pressed into the X TIME BASE position, the Time Base Mode is selected. When out X INPUTS are selected.

11. VERNIER potentiometer. Varies the input sensitivity when VERNIER pushbutton is depressed.

12. V/IN (V/cm) switches. Three 2-position pushbutton switches. Select one of three fixed input sensitivities.

13. ZERO Potentiometer. Varies the zero position of the pen.

14. CAL Potentiometer. Screwdriver adjustable potentiometer. Adjusts the calibration of the recorder.

15. Input Terminals. Binding posts for input signals. Accept open wires or banana plug connectors.

16. Chassis Ground Terminal.

Figure 3-1. Model 7015B Front Panel Controls, Indicators and Connectors (Sheet 2 of 2)

CAUTION

The disposable pen incorporates a precision writing tip. Care must be taken not to damage this tip during pen changing or other handling. Writing by hand on any surface may damage the pen tip. Use pen only in pen holder or recorder.

3-16. A universal pen holder, HP Part No. 07010-60034 is provided in the Accessory Kit, and can be used with most filter-tip pens. Insert pen into universal holder and pull up locking ring to secure. See Figure 3-7.

3-17. SERVO CONTROL.

3-18. To activate the recorder servo system press the SERVO ON pushbutton. When not recording return the SERVO pushbutton to STANDBY. This avoids unnecessary wear on the balance potentiometer and other mechanical parts.

3-19. Servo ON/STANDBY may also be controlled through the Remote Control Connector A4J5. Through the rear connector it is possible to control each axis individually. The X-axis control is pins P and R. The Y-axis control is pins K and L. See Figure 3-3.

3-20. If the input voltage exceeds the range setting, the pen will quickly move to the end on its travel and strike the drive mechanism stop. The motor will stop, protecting the recorder drive mechanism until the input signal returns to an on scale value.

3-21. SET ZERO.

3-22. With no signal applied set the X and Y ZERO controls to position the pen over the desired starting position.

3-23. With input signals applied, the zero position of the pen may be checked by pressing the ZERO CHECK pushbutton for each axis.

3-24. Zero position may also be controlled through the Remote Control Connector A4J5. This is achieved by installing two (2) 10K ohm 10 turn potentiometers as illustrated in Figure 3-3. Front panel ZERO potentiometers are unplugged when using remote zero control.

3-25. INPUT SENSITIVITY.

3-26. Select the appropriate V/IN pushbutton in each axis for the amplitude of the signals to be plotted.

3-27. VERNIER CONTROL.

3-28. If range sensitivities other than the fixed values of the V/IN pushbuttons are desired the VERNIER control potentiometers are used.

3-29. The VERNIER control is activated by pressing the VERNIER pushbutton. With the pushbutton in the VERNIER position the VERNIER potentiometer may be adjusted for the desired sensitivity. To return to a fixed V/IN span the VERNIER pushbutton is returned to the CAL position.

3-30. SIGNAL INPUTS.

3-31. Signal inputs to the recorder are made either through the front panel binding posts or through the remote signal connector A5J5 with the 12 pin connector HP Part No. 1251-2500 supplied with the accessory kit. (See Figure 3-4.)

3-32. For maximum common mode rejection the (-) input should be connected to the side of the input signal with the lowest impedance to ground.

3-33. PLOTTING.

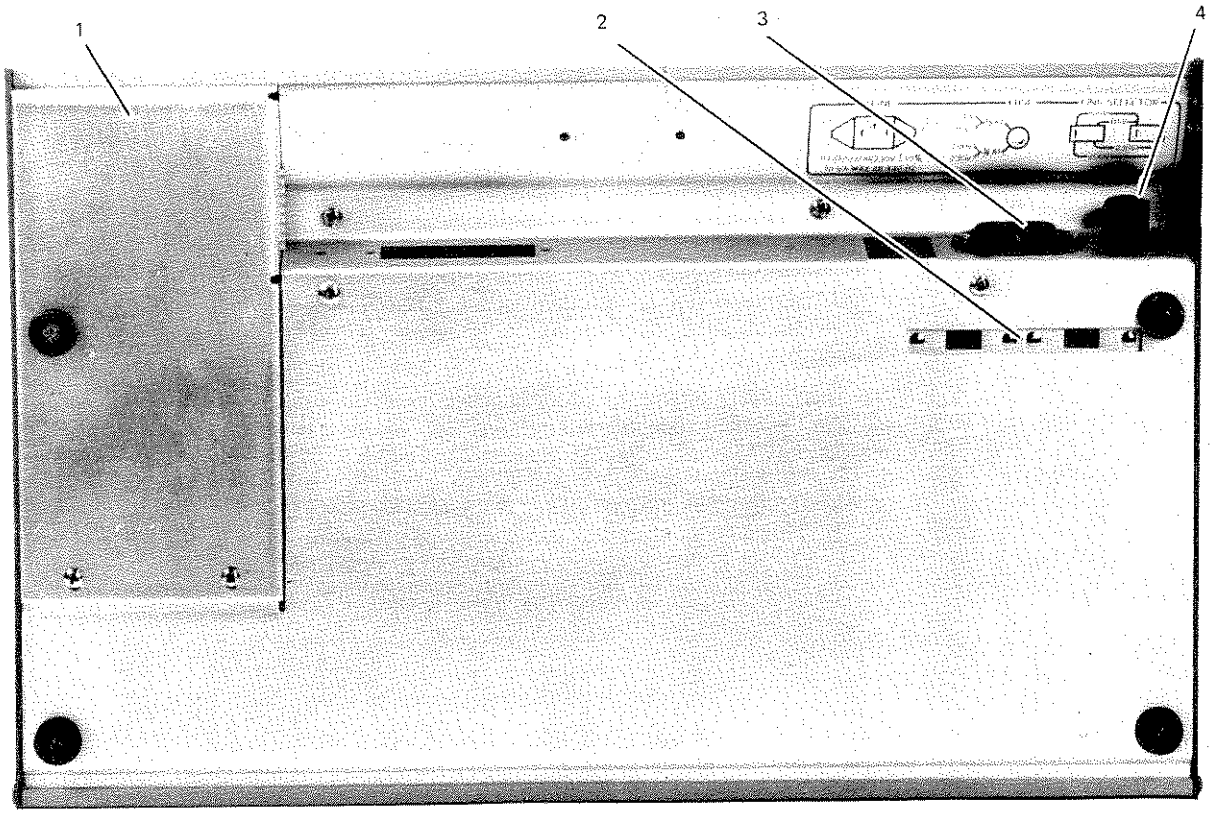
3-34. To lower the pen onto the graph for plotting press the PEN RECORD pushbutton. The PEN RECORD/LIFT may also be controlled remotely through the rear connector A4J5 with the 30 pin connector (HP Part No. 1251-2799) supplied in the accessory kit. See Figure 3-3.

3-35. TIMEBASE.

3-36. The timebase allows the user to plot varying dc signals against an internal timing standard with six selectable sweep times in the X-axis.

3-37. To select timebase proceed as follows:

a. Select the sweep time by pressing the pushbutton beside the desired sec/in. indication.



1. Remote Input Cover. Remote Control Connector and Remote Signal Connector are located underneath cover. For access to connectors remove two screws.

2. LINE SELECTOR Switches. Select one of four line voltages for recorder operation. 100, 120, 220 or 240 Vac may be selected.

3. LINE Cord Receptacle. Use only an approved line cord.

4. FUSE Holder. Contains line fuse. For 100 or 120 Vac use 1/2 ampere fuse (HP Part Number 2110-0202). For 220 or 240 Vac use 1/4 ampere fuse (HP Part Number 2110-0201).

Figure 3-2. Rear Panel Features

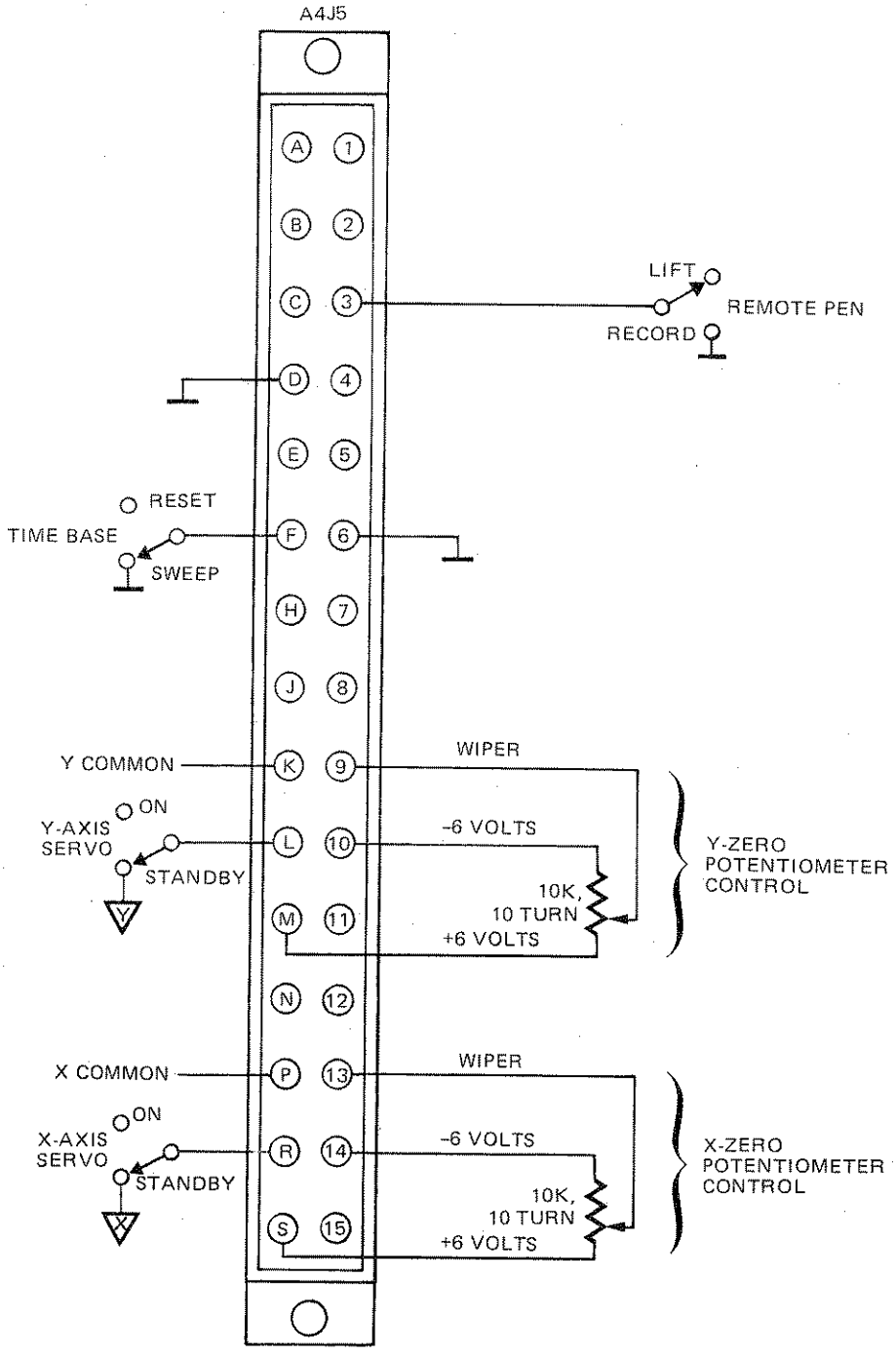


Figure 3-3. Remote Control Connector

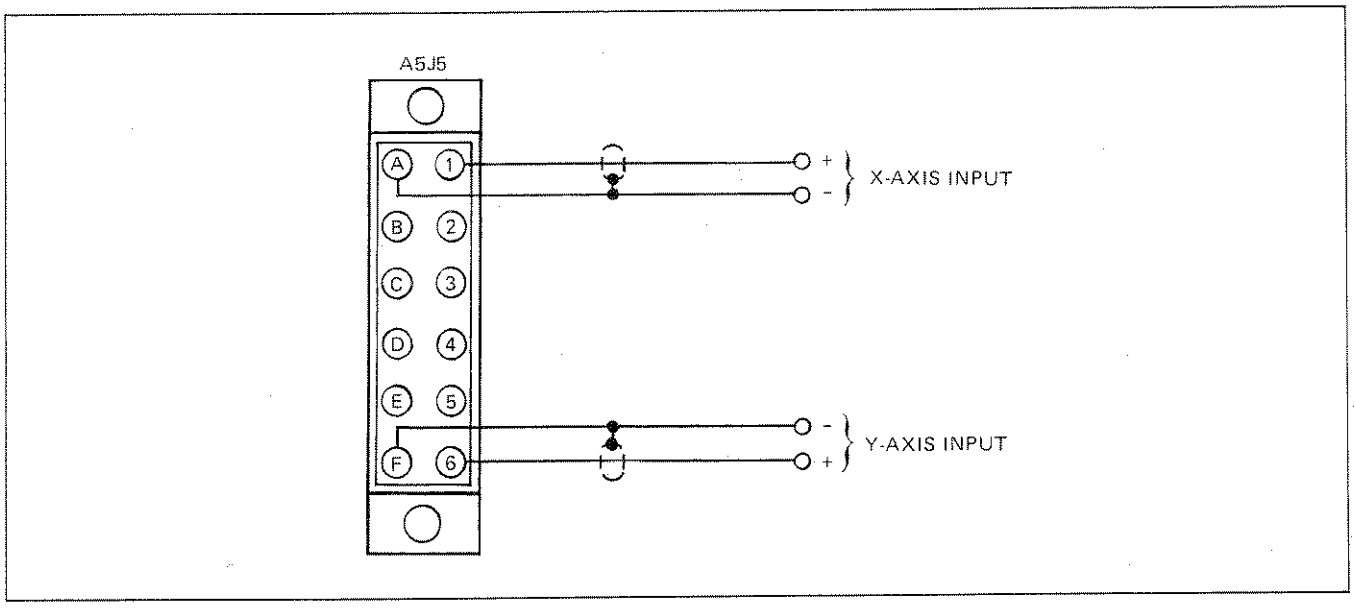


Figure 3-4. Remote Signal Connector

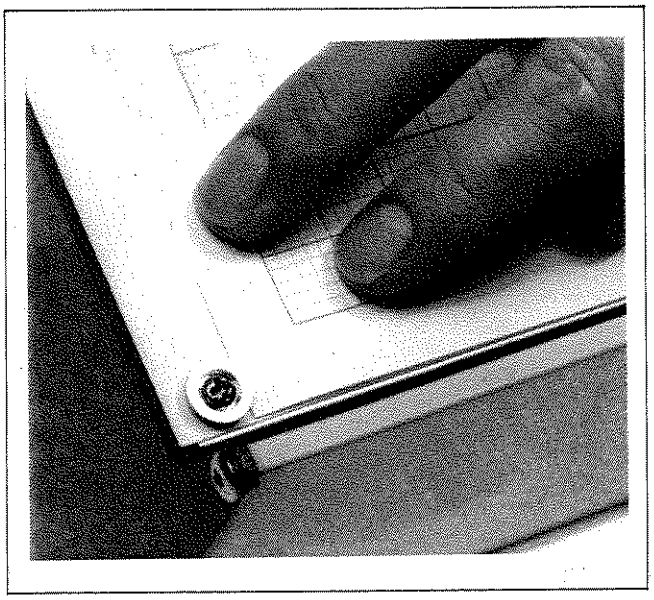


Figure 3-5. Chart Paper Loading

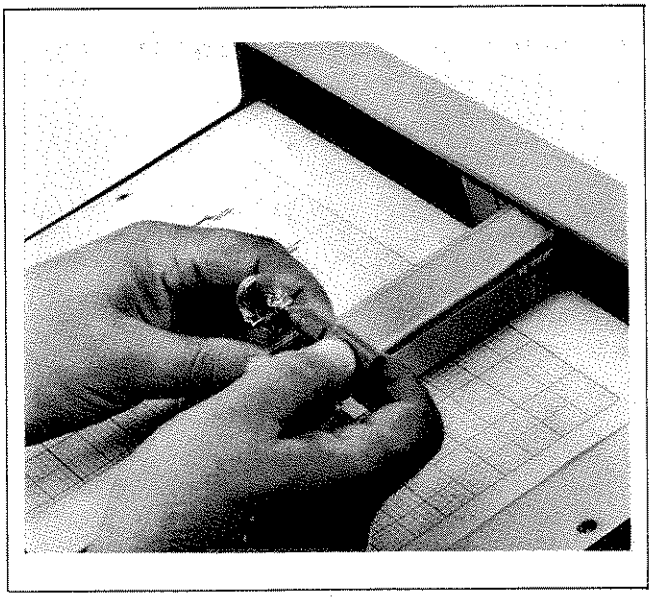


Figure 3-6. Pen Installation

b. Press the X TIMEBASE pushbutton.

c. To start the sweep press the SWEEP pushbutton.

d. At the end of the sweep the pen is returned to the zero position by setting the SWEEP/RESET pushbutton to the RESET position.

3-38. The timebase will automatically lower the pen at the start of the sweep and raise the pen when reset if the PEN switch is in the LIFT position.

3-39. The X-INPUTS/X-TIMEBASE function may be controlled through the remote control connector A4J5 by installation of a double pole double throw switch as illustrated in Figure 3-3. The SWEEP/RESET control may also be controlled remotely by contact closure between pins D and F of the remote control connector.

3-40. X AND Y ACTIVE INPUT FILTERS.

3-41. The X and Y active input filters are equipped with selector switches which allow the user to by-pass the filter

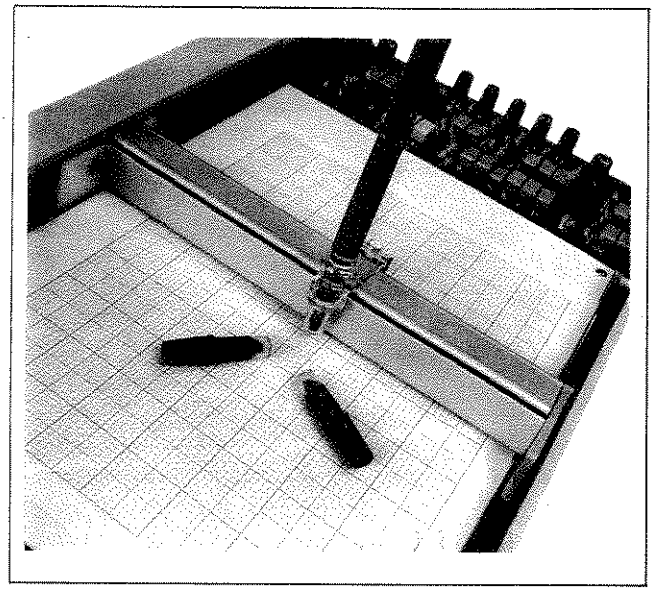


Figure 3-7. Universal Pen Holder

if desired. When shipped from the factory these switches are set IN.

3-42. If it is desired to by-pass these filters refer to paragraph 5-24.

3-43. OPERATOR MAINTENANCE.

3-44. FUSE REPLACEMENT.

3-45. To replace the ac line fuse proceed as follows:

a. Turn off the LINE switch.

b. Remove the ac line cord from the instrument.

c. Remove the fuse holder cap and the defective fuse.

d. Replace the fuse with one of the same type and rating.
110/120 Vac 1/2 amp fuse HP Part No. 2110-0202
220/240 Vac 1/4 amp fuse HP Part No. 2110-0201

e. Install the ac line cord.

f. Turn on the recorder.

3-46. AUTOGRIP TABLE CLEANING.

3-47. Dust and other contaminants on the Autogrip surface will lower the paper holding capability. Although recording ink will not affect Autogrip performance, it may be desirable to remove ink stains as well. NO STRONG CHEMICALS, SILICONE-BASED CLEANERS, OR HARSH ABRASIVE CLEANERS SHOULD BE USED ON THE AUTOGRIP TABLE.

WARNING

Scratches or punctures in the table surface may expose high voltage conductors. Instruments damaged in this manner should NOT BE OPERATED. Apply water using only a Kimwipe® or equivalent, being careful to not allow water to stand on the Autogrip surface or run through openings in the enclosure as it may cause a potential electrical hazard.

WARNING

Turn off the plotter and remove the ac line cord before cleaning the Autogrip table.

a. Cleaning moderate contamination can be accomplished as follows:

1. Prepare a mixture of 75% isopropyl alcohol and 25% water by volume.

2. Apply the alcohol/water mixture to the table using a Kimwipe®. Immediately wipe any moisture from the surface. Never let any liquid stand on Autogrip surface as the surface may become permanently damaged.

b. If the surface cannot be easily cleaned with the alcohol/water mixture, cleaning can be accomplished as follows:

1. Select a clean, lint-free cloth that will not scratch the Autogrip surface.

2. Dampen the cloth with warm water or alcohol and apply a light amount of cleanser (HP Part No. 9310-0515). A commercial cleanser such as Ajax®, Comet®, or Vim® may be used.

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

SECTION IV

PERFORMANCE TESTS

4-1. INTRODUCTION.

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument.

4-3. TEST EQUIPMENT REQUIRED.

4-4. Test equipment required for the performance tests is listed in Table 1-3, Recommended Test Equipment in Section I. Substitutions in test equipment may be made if equivalent equipment is used.

4-5. COMMON MODE REJECTION CHECK.

4-6. DC Common Mode Rejection – X-Axis.

a. To test common mode rejection for X-axis, install a 1k ohm resistor between X-axis plus and minus terminals. (See Figure 4-1).

b. Install chart and pen.

c. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. TIMEBASE – X-INPUT
6. RANGE 0.01 V/in. (5 mV/cm).

d. Connect DC Standard with zero volts output, between X-axis minus terminals and ground. (See Figure 4-1.)

e. Lower recorder pen. Align pen at convenient grid line near center of chart.

f. Switch DC Standard to 40V output.

g. The difference between the final stable pen position and the starting grid line should be not more than 0.040 in. (1.0 mm). This test verifies that recorder meets 100 dB dc common mode rejection specifications.

4-7. DC Common Mode Rejection – Y-Axis.

a. To test Y-axis common mode rejection, repeat 4-6.a through g. for Y-axis.

4-8. AC Common Mode Rejection – X-Axis.

a. To test AC common mode rejection for the X-axis, install a 1k ohm resistor between X-axis plus and minus terminals. (See Figure 4-2.)

b. Install chart and pen.

c. Set recorder controls as follows.

1. LINE ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. TIMEBASE – X INPUTS
6. RANGE 0.01 V/in. (5 mV/cm)

d. Connect an HP3310A Function Generator to the recorder, high to the (–) terminal and low to the (⏚) terminal. (See Figure 4-2.)

e. Set the function generator controls as follows:

1. POWER – ON
2. FREQUENCY – available line frequency – 50 or 60 Hz.
3. Waveform – Sine
4. Amplitude – 10V Peak-to-Peak.

f. The maximum allowable pen deflection is .031 in. (0.25 mm).

4-9. AC Common Mode Rejection – Y-Axis.

a. To test Y-axis common mode rejection repeat 4-8a. through f. with inputs to the Y-axis.

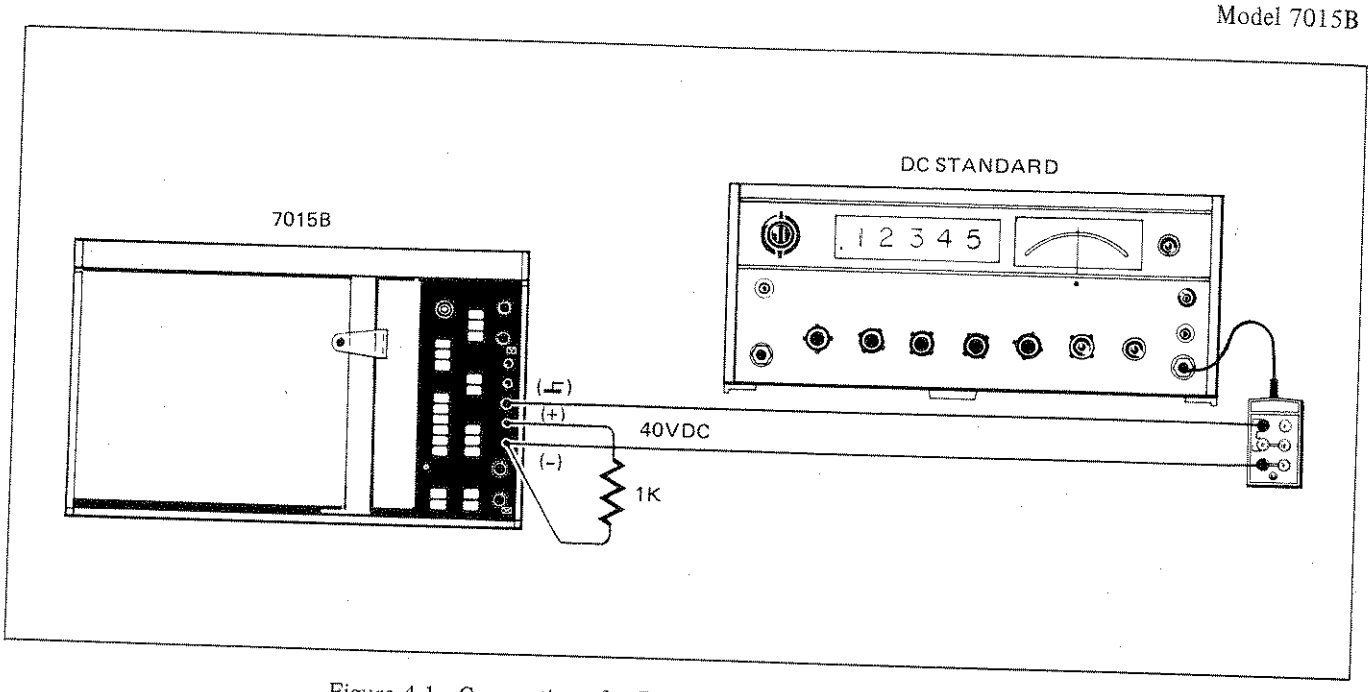


Figure 4-1. Connections for DC Common Mode Rejection Check

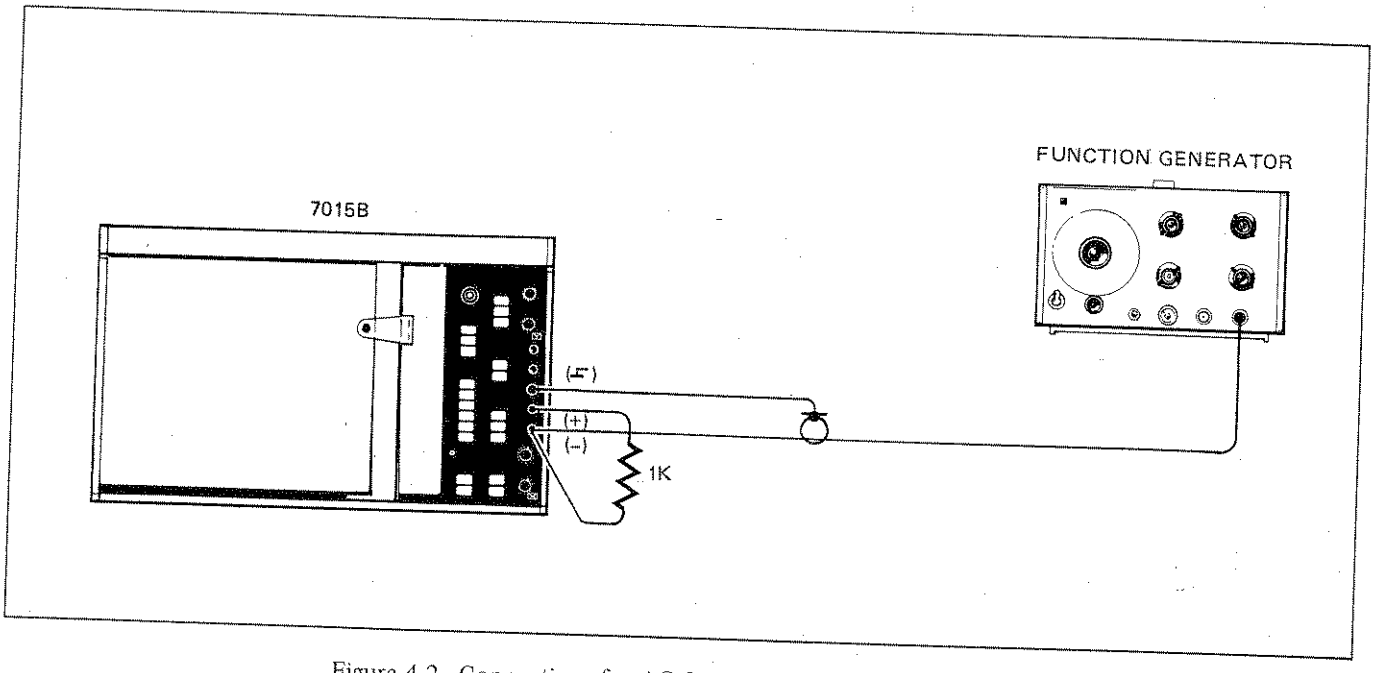


Figure 4-2. Connections for AC Common Mode Rejection Check

4-10. ACCURACY CHECK (INCLUDES LINEARITY AND DEADBAND).

4-11. To make this test for the X- and Y-axis, install chart and pen, then perform the following steps:

a. Set recorder controls as follows:

1. LINE – ON

2. CHART – HOLD

3. SERVO – ON

4. PEN – RECORD

5. TIMEBASE – X-INPUT

6. RANGE switch (X and Y) .01 V/in. (5 mV/cm).

b. X-AXIS CALIBRATION.

1. Apply zero volts from Model 740B DC Standard to X-axis input. (See Figure 4-3.)

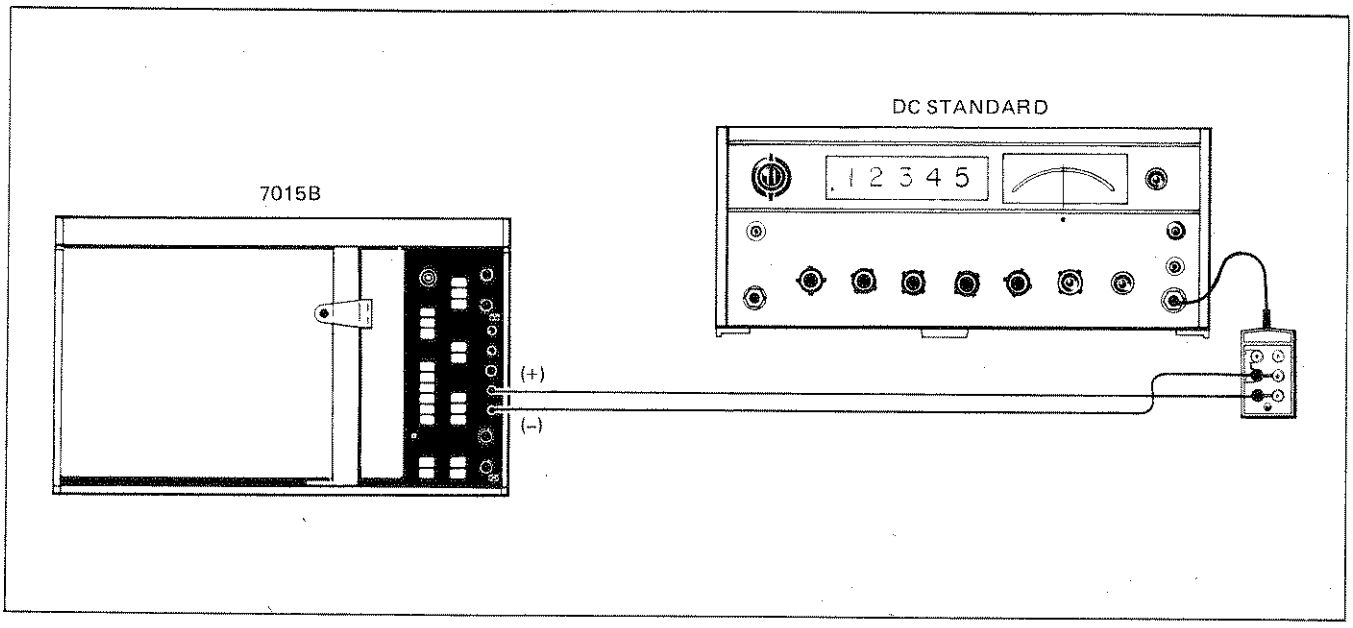


Figure 4-3. Connections for Accuracy Checks

2. Position pen to exactly zero on X-axis using zero control.

3. Set Model 740B to .1V (.125V for metric) and connect it to X-input.

4. Pen should travel to full scale grid line 10 inches ±0.030 in. (25 cm ± 0.75 mm).

5. If calibration is required, refer to paragraph 5-8.

6. Set Model 740B output to zero volts. Pen will move to left side of grid.

7. Set output to 740B from .01V to .1V, in increments of .01V and drop pen at each point to check linearity. (For metric model .01V to .125V) reduce voltage applied in equal .01V increments. Pen should stop at each 1-inch (2 cm) grid line within 0.030 in. (0.75 mm).

c. Y-AXIS CALIBRATION.

1. Apply zero volts from Model 740B DC Standard to Y-axis input. See Figure 4-3.

2. Position pen to exactly zero on Y-axis using zero control.

3. Set Model 740B to .07V (.09V for metric model) and connect it to the Y-axis.

4. Pen should travel to full scale grid line 7 inches ±0.021 in. (18 cm ±0.54 mm).

5. If calibration is required, refer to paragraph 5-8.

6. Set Model 740B output to zero volts. Pen will move to lowest vertical point of grid.

7. Set output of Model 740B to seven increments of .01V and drop pen at each point to check linearity. (For metric model .01V to .09V). Reduce voltage applied in equal .01V increments. Pen should stop at each 1-in. (2 cm) grid line within 0.021 in. (0.54 mm).

d. RANGE-TO-RANGE ACCURACY.

1. Use procedures contained in steps a., b., and c. in paragraph 4-11 to verify accuracy of additional ranges. When comparing ranges, full scale calibration should not vary more than 0.020 inches (0.5 mm).

4-12. SLEWING SPEED AND OVERSHOOT CHECK.

4-13. To check the Y-axis proceed as follows:

a. Connect the recorder as shown in Figure 4-4.

b. Set the HP 3310A Function Generator as follows:

1. Power – ON

2. Frequency – 0.83 Hz

3. Waveform – Triangle

4. Amplitude – fully counterclockwise (minimum).

c. Switch on the HP 6202B Power Supply and set for output of voltage of approximately 0.6V (1.76V for metric model).

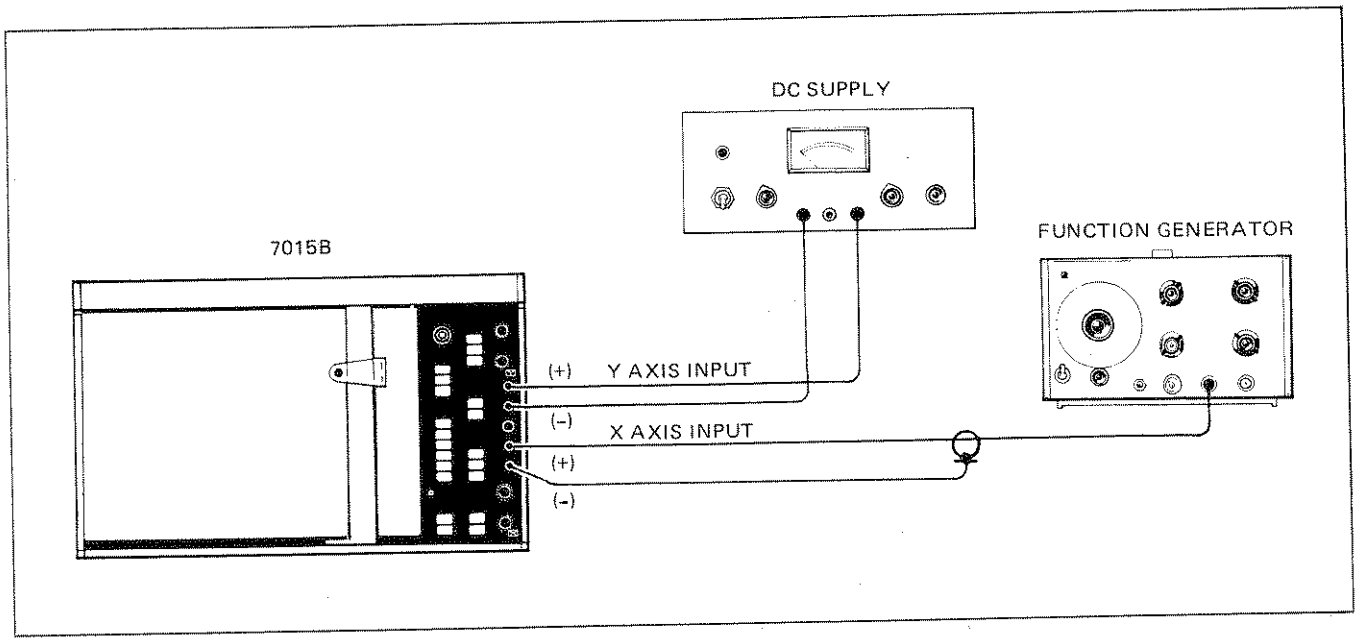


Figure 4-4. Connection for Slewing Test

d. Set the recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – RECORD
5. TIMEBASE – X-INPUT
6. RANGE .1 V/in. (50 mV/cm) (both X and Y).
7. FILTERS – OUT.

e. Zero Y-axis to bottom grid line on graph paper.

f. Apply output from function generator to X-axis input.

g. Set the X-axis for a 6 in. (15.2 cm) peak-to-peak excursion, using the amplitude control on the HP 3310A and the X ZERO control.

h. When the X-axis is near the left hand side of its up-scale travel, insert cable from HP 6202B Power Supply into Y-axis input.

i. Switch the SERVO to STANDBY.

j. The slope of the straight line portion of the plotted curve shall be equal to or greater than two. Maximum overshoot specified is 0.14 in. (0.36 cm). The recorded plot should appear similar to Figure 4-5.

k. ZERO the X-axis at the far left hand grid line.

l. Apply output from function generator to Y-axis input.

m. Set the Y-axis for a 6 in. (15.2 cm) peak-to-peak excursion, using the amplitude control on the HP 3310A, and the Y ZERO control.

n. Adjust the Y-axis ZERO control until the Y-axis is making a 7-inch peak-to-peak excursion.

o. When the Y-axis is near the center of its up-scale travel, insert cable from HP 6202B Power Supply into X-axis input. The recorder plot should appear similar to Figure 4-6.

p. Switch SERVO to STANDBY.

q. The slope of the straight line portion of the plotted curve (towards the right side of the page) should be determined. This slope should be less than one half. Maximum overshoot is 0.2 in. (0.5 cm). (See Figure 4-6.)

4-14. 45 DEGREE RETRACE CHECK.

4-15. To perform the 45 degree retrace check, make connections as shown in Figure 4-7.

a. Set controls on HP 3310A as follows:

1. Power – ON
2. Frequency – 0.071 Hz
3. Waveform – Triangle wave
4. Amplitude – Fully counterclockwise.

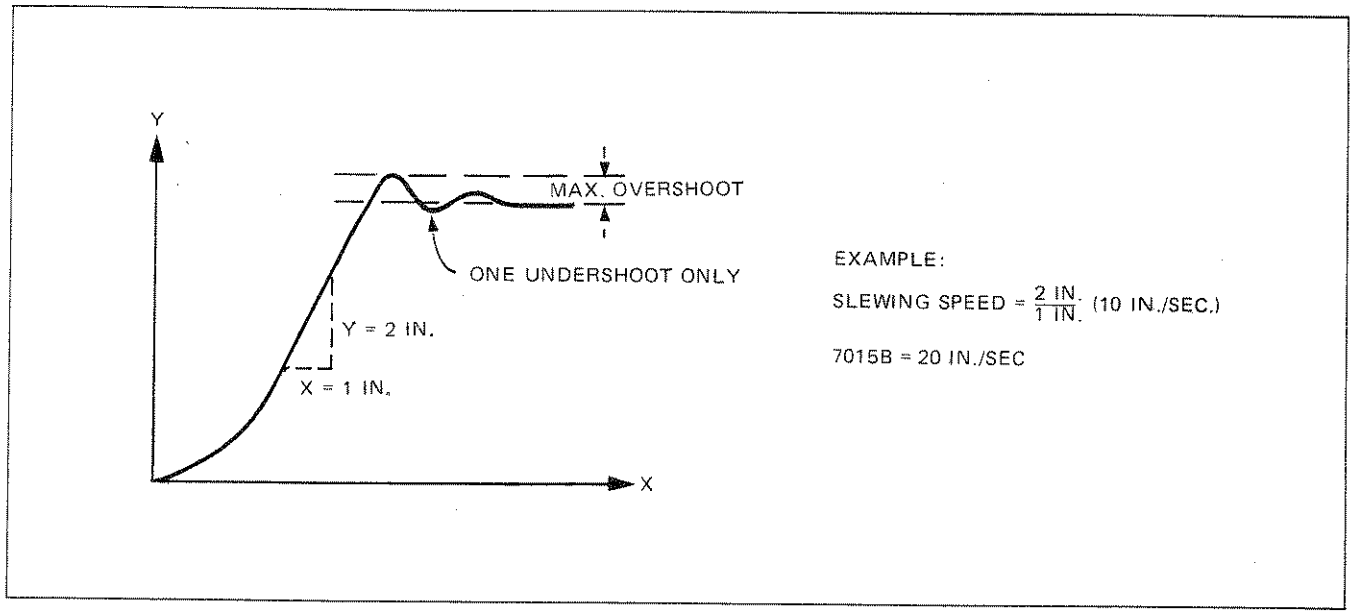


Figure 4-5. Y-Axis Slewing Test Plot

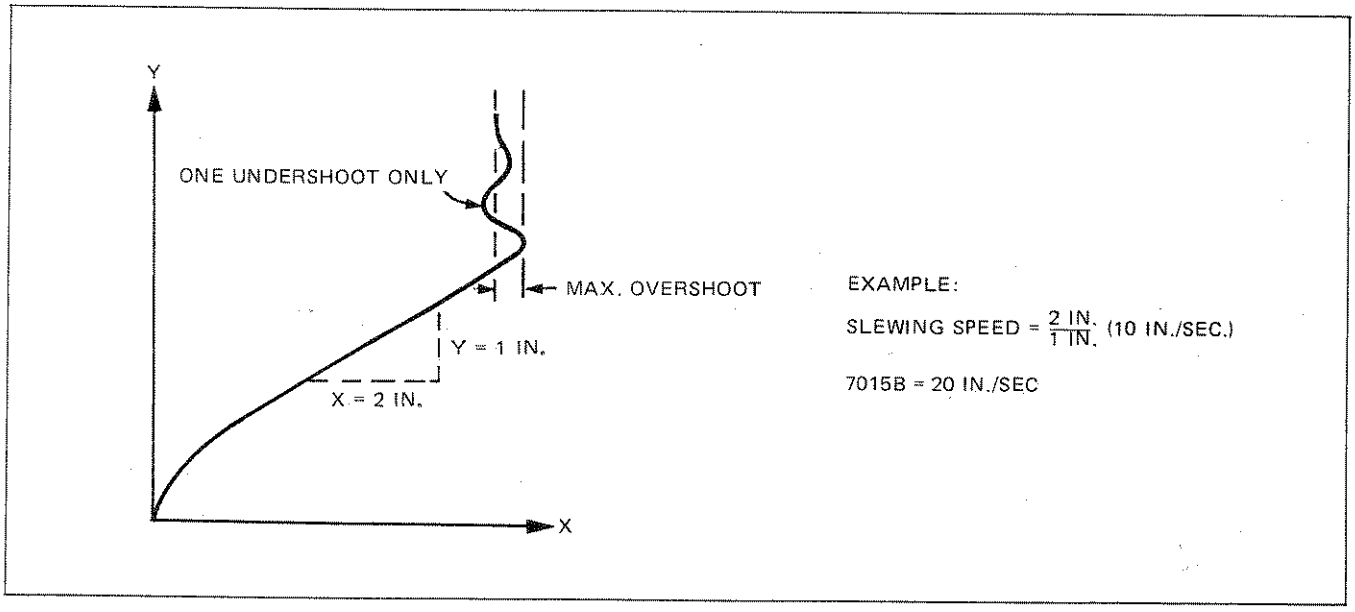


Figure 4-6. X-Axis Slewing Test Plot

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. TIMEBASE – X-INPUT
6. RANGE switch (X and Y) .1 V/in. or 50 mV/cm.

c. Gradually increase amplitude of HP 3310A until both axes of the recorder have a travel of 7 in. (17.8 cm).

e. Allow the pen to draw a single line, then retrace this line once.

f. Next to the retraced line, draw a single line (not retraced).

g. Measure the width of the single line with an optical comparator.

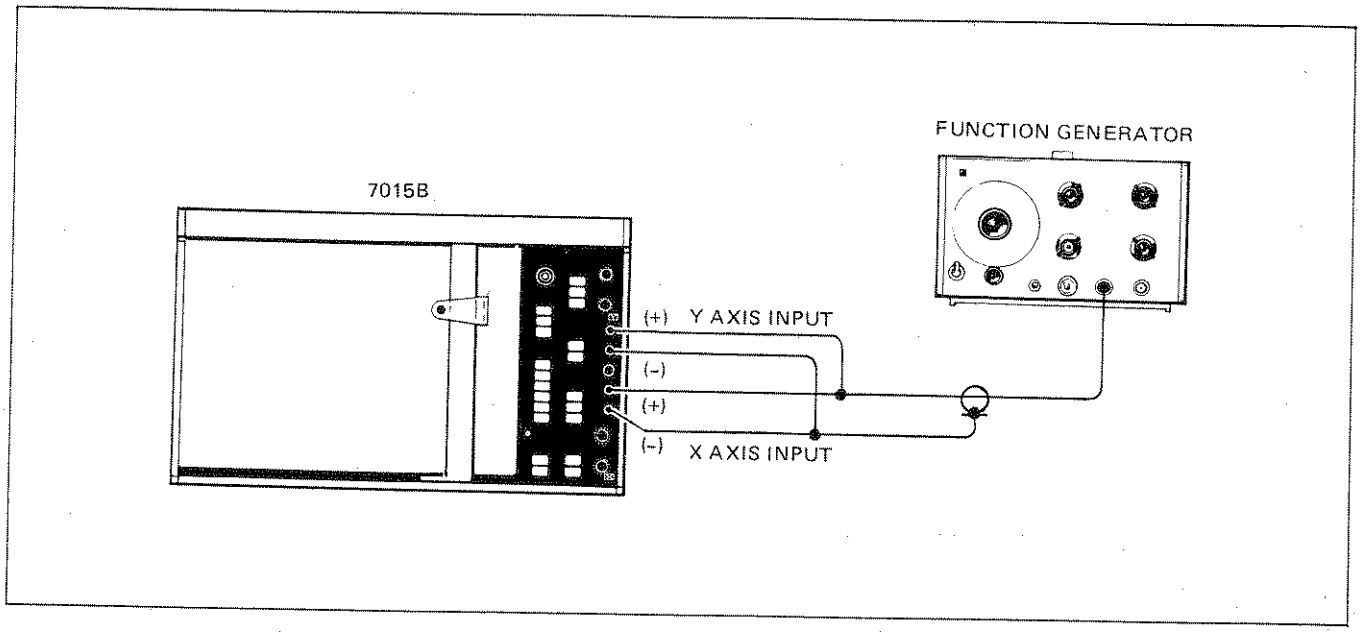


Figure 4-7. Connection for Retrace Check

h. Measure the width of the retraced line from outer edge to outer edge.

i. The width of the retraced line shall be no greater than 0.015 in. (0.38 mm), plus the width of the single line. (See Figure 4-8.)

j. If the recorder fails to meet the Retrace Test, check mechanical freedom (see paragraph 8-45), and Phasing adjustment (refer to paragraph 5-18).

4-16. 75 DEGREE RETRACE CHECK.

4-17. To perform the 75 degree retrace test proceed as follows.

a. Set HP 3310A controls as in 4-15.a.

b. Set recorder controls as in 4-15.b., 1 through 5.

c. Set X-RANGE switch to 1 V/in. (500 mV/cm) and Y-RANGE switch to 0.1 V/in. (50 mV/cm).

d. Perform steps 4-15.c. through h.

e. The recorder will draw a line at a 75 degree angle.

f. If the width of the retraced line is more than .020 in. (0.50 mm) wider than the single line (see Figure 4-8) check mechanical freedom (paragraph 8-45) and refer to X-gain adjustment (paragraph 5-20).

4-18. 15 DEGREE RETRACE TEST.

4-19. To perform the 15 degree retrace test proceed as follows:

a. Set HP 3310A controls as in 4-15.a.

b. Set recorder controls as in 4-15.b., 1 through 5.

c. Set X-RANGE switch to 0.1 V/in. (50 mV/cm) and Y-RANGE switch to 1.0 V/in. (500 mV/cm).

d. Perform steps 4-15.c. through h.

e. The recorder will draw a line at a 15 degree angle.

f. If the width of the retraced line is more than 0.015 in. (0.38 mm) wider than the single line (see Figure 4-8) check mechanical freedom (paragraph 8-45) and Y-gain adjustment (refer to paragraph 5-22).

4-20. TIMEBASE CHECK.

4-21. To check, perform the following steps:

a. Install HP Model 226A Time Mark Generator to Y-axis inputs of recorder per Figure 4-9. This generator will be used as a time reference for checking the sweep. If a time mark generator is not available, a stop-watch may be used as an alternate time reference.

b. Install chart paper and disposable pen in recorder.

c. Set recorder controls as follows:

1. LINE – ON

2. CHART – HOLD

3. SERVO – ON

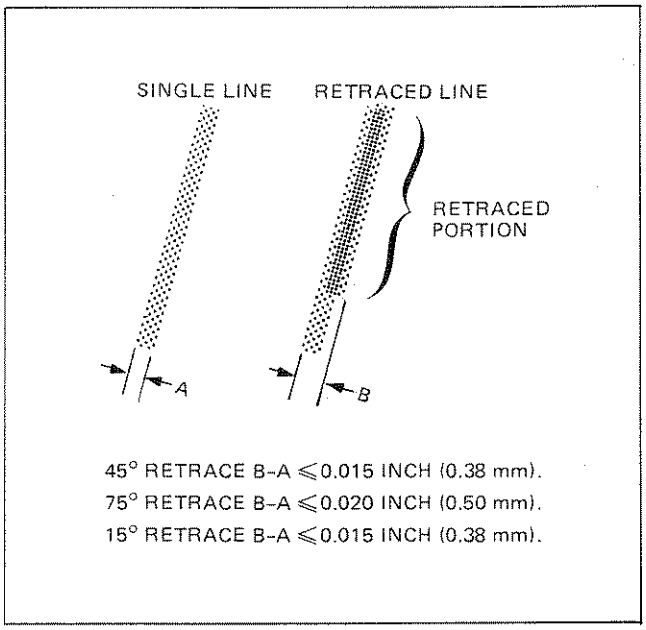


Figure 4-8. Retrace Test Plot

4. PEN – LIFT

5. TIMEBASE – X-TIMEBASE

6. Y-RANGE – 0.1 V/IN. (50 mV/cm)

7. X-TIMEBASE – RESET

8. X-TIMEBASE RANGE – 10 sec/in. (10 sec/cm) or for slowest sweep, if using stopwatch.

d. Set controls of Model 226A Time Mark Generator to 10 seconds per mark.

e. Switch time mark generator ON.

f. ZERO recorder pen to far left grid margin.

g. Switch timebase to SWEEP. (Start stopwatch at same time, if using stopwatch.)

h. Record elapsed time of full scale sweep when stopwatch is used. Accuracy specification is 1.5%.

i. Switch timebase to RESET.

j. Pen should lift and reset to initial starting position.

CAUTION

If pen is in RECORD position, it will not lift on RESET of timebase.

k. Visually inspect chart after test. Timing marks should be spaced equally at 1 inch (1 cm) increments; tolerance ±0.15 in. (±0.38 cm). If out of tolerance, refer to Time Base Calibration Adjustment paragraph 5-14.

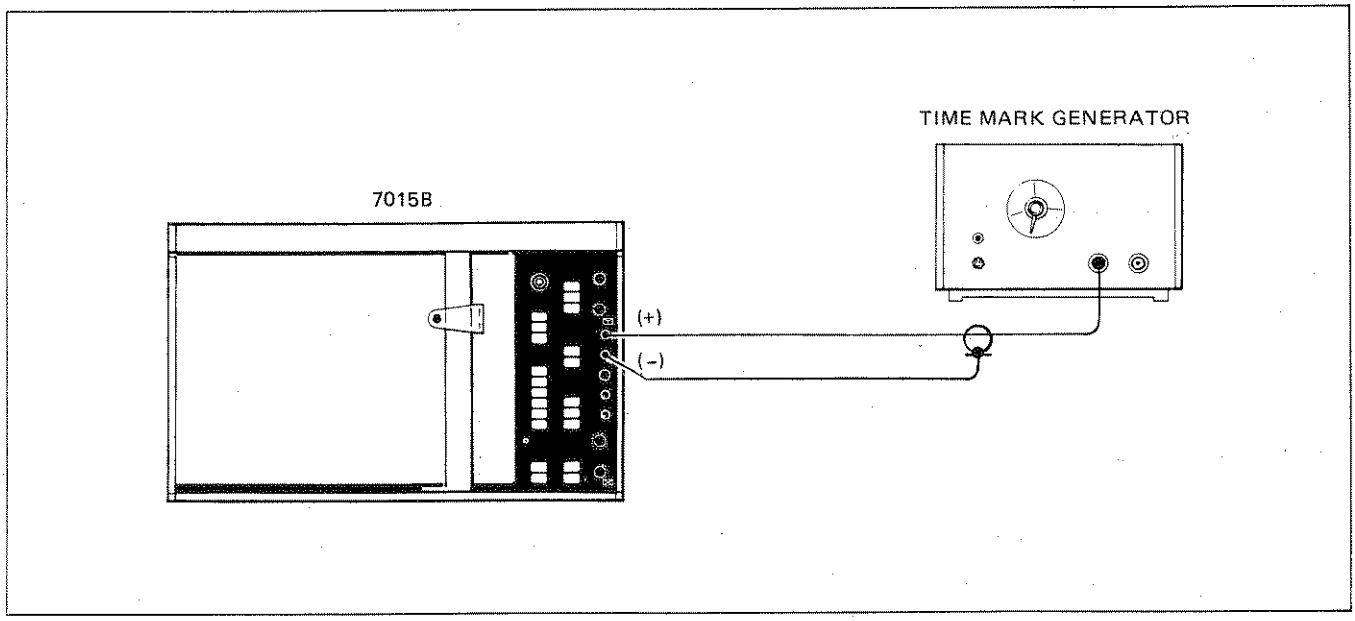


Figure 4-9. Connection for Time Base Check

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the instrument to peak operating capabilities when repairs have been made. Included in this section are test equipment set-ups, electrical and mechanical adjustments.

5-3. SAFETY REQUIREMENTS.

5-4. This section contains information and warnings which must be followed for your protection and to avoid damage to the equipment.

WARNING

Maintenance described herein is performed with protective covers removed and power supplied to the instrument.

WARNING

Maintenance of the opened instrument with power applied should be avoided as much as possible. When necessary it should be performed only by service-trained personnel.

5-5. TEST EQUIPMENT.

5-6. Test equipment required to adjust the 7015B is listed in Table 1-3, Section I. Substitutions in test equipment may be made if equivalent equipment is used.

5-7. ELECTRICAL ADJUSTMENTS.

5-8. CALIBRATION.

5-9. The following paragraph contains information for the calibration of the X- and Y-axes and the timebase sweep rate. These adjustments are made from the front control panel requiring no disassembly of the instrument.

5-10. X-AXIS CALIBRATION.

5-11. To calibrate the X-axis proceed as follows:

a. Load chart and disposable pen into the recorder.

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – RECORD
5. X-AXIS V/IN. – .01 V/IN. (5 mV/cm)
6. X-CAL/VERNIER – CAL
7. TIMEBASE/X-INPUTS – X-Inputs

c. Connect a DC Standard to the X-axis plus and minus input terminals. Set at zero volts. (See Figure 5-1.)

d. Using X-axis ZERO control, position the pen exactly on the left hand zero grid line of the chart.

e. Apply 0.1V (.125V metric) from the DC Standard to the X-axis inputs.

f. Pen should move 10 in. ±0.030 in. (25 cm ±0.75 mm) and be centered exactly over the right hand grid line on the chart.

g. If necessary to meet step f., adjust the X-axis calibration potentiometer A5R35 on the front panel. (See Figure 5-2.)

h. Set DC Standard output to zero. Pen should return to zero grid line.

i. If necessary adjust X-axis ZERO to reposition the pen on the zero line.

j. Repeat steps e. through i. until the X-axis meets specifications, 10 in. ±0.030 in. (25 cm ±0.75 mm).

k. Remove DC Standard inputs from X-axis.

5-12. Y-AXIS CALIBRATION.

5-13. To calibrate the Y-axis proceed as follows:

a. Load chart and disposable pen into the recorder.

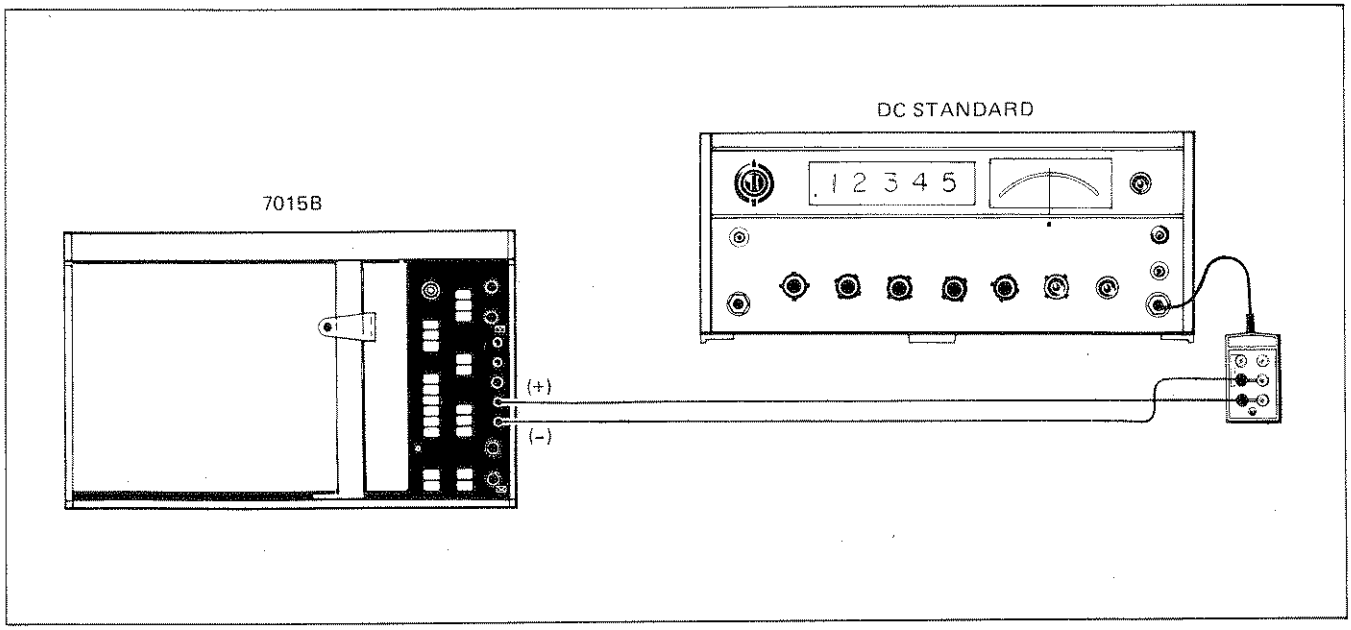


Figure 5-1. Sweep Calibration Connection

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – RECORD
5. Y-AXIS V/IN. = .01V/in. (5 mV/cm)
6. Y-CAL/VERNIER – CAL

c. Connect DC Standard to Y-axis plus and minus input terminals. Set at zero volts. (See Figure 5-1.)

d. Using the Y-axis ZERO control, position the pen exactly over the lower zero grid line of the chart.

e. Apply .07V (.09V metric) to the Y-input terminals.

f. Pen should move 7.0 in. ±0.021 in. (18 cm ±0.54 mm) and be centered exactly over the upper grid line of the chart.

g. If necessary to meet step f., adjust the Y-axis calibration potentiometer.

h. Set DC Standard output to zero. Pen should return to zero grid line.

i. If necessary adjust the Y-axis ZERO control to reposition the pen over the zero grid line.

j. Repeat steps e. through i. until the Y-axis calibration meets specifications 7 in. ±0.021 in. (18 cm ±0.54 mm).

k. Remove DC Standard inputs from the recorder.

5-14. TIMEBASE CALIBRATION ADJUSTMENT.

5-15. To calibrate the timebase, proceed as follows:

a. Install chart and disposable pen into the recorder.

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. Y-AXIS V/IN. – 0.1 V/in. (50 mV/cm)
6. TIMEBASE – 1 sec/in. (.5 sec/cm)
7. X-INPUTS/TIMEBASE – TIMEBASE

c. Connect HP Model 226A Time Mark Generator to Y-axis inputs. (See Figure 5-3.)

d. Set Time Mark Generator for 1.0 second marks.

e. Using X-axis ZERO control position pen over left hand grid line on chart.

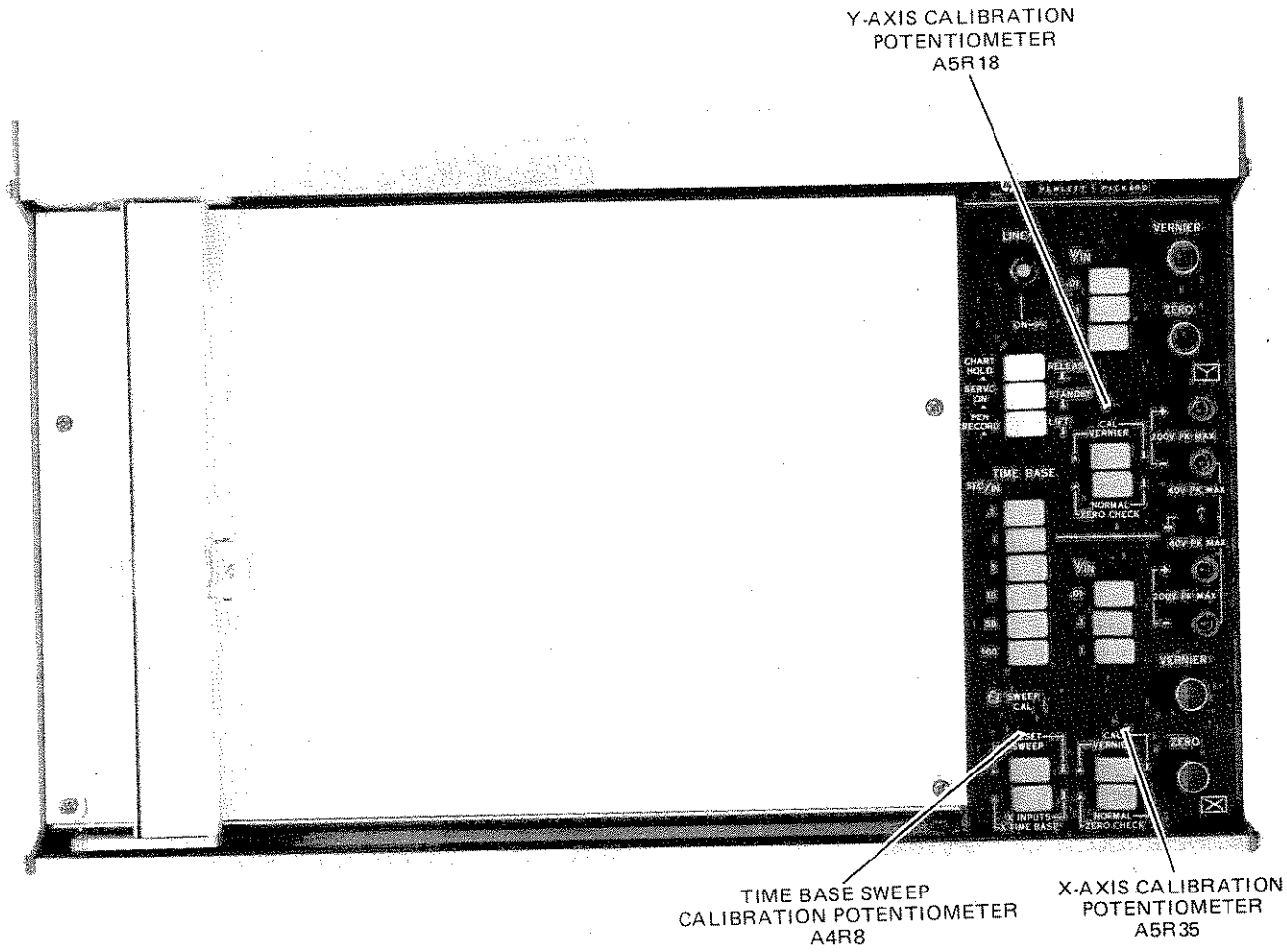


Figure 5-2. Front Panel Calibration Adjustments

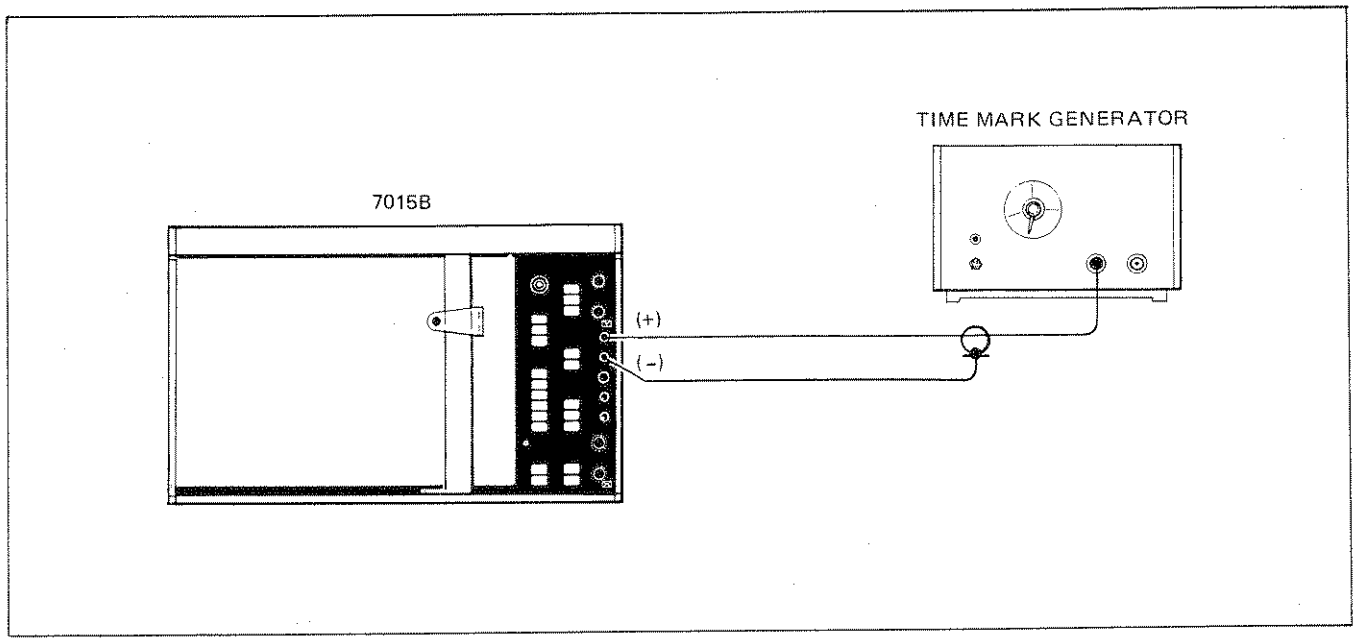


Figure 5-3. Timebase Calibration Connection

f. Press SWEEP pushbutton on front panel. Pen will sweep at 1 in./sec.

g. Timing marks will appear on the sweep at 1 in. ±0.15 in. (2 cm ±0.38 cm).

h. If necessary to meet specification in step g., adjust Timebase Sweep Potentiometer A4R8 on front panel. (See Figure 5-2.)

5-16. INPUT OFFSET ADJUSTMENT.

5-17. To zero out any offset in the X or Y preamplifier channels proceed as follows:

a. Remove both bottom covers. Refer to paragraph 5-28.

b. Place a jumper between the (+) and (–) terminals of each axis.

c. Set X and Y input sensitivity to .01 V/in. (5 mV/cm).

d. Connect an HP Model 3465A Digital Voltmeter between A5TP2 (Y-axis) (+) and A3TP12 (ground) (–). (See Figures 5-4 and 5-5.)

e. Adjust A5R7 (Y-axis offset adjustment) until the digital voltmeter indicates 0V ±1.0 mV. (See Figure 5-4.)

f. Remove the voltmeter lead from A5TP2 and A3TP12.

g. Connect (+) lead to A5TP5. Connect (–) lead to A2TP12.

h. Adjust A5R25 (X-axis offset adjustment) until the digital voltmeter indicates 0V ±0.1 mV. (See Figure 5-4.)

i. Remove meter leads.

5-18. PHASE ADJUSTMENT.

NOTE

For phasing adjustment the filter switches A5S4 and A5S8 must be set to the IN position. Refer to paragraph 5-24.

5-19. To adjust the Y-phasing proceed as follows:

a. Install chart and disposable pen.

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. X-INPUT/TIMEBASE – X-INPUT
6. X and Y V/IN. – .1 V/in. 50 mV/cm

c. Connect HP Model 3310A Function Generator to recorder inputs as shown in Figure 5-6.

d. Set function generator controls as follows:

1. Power – ON
2. Frequency – .071 Hz

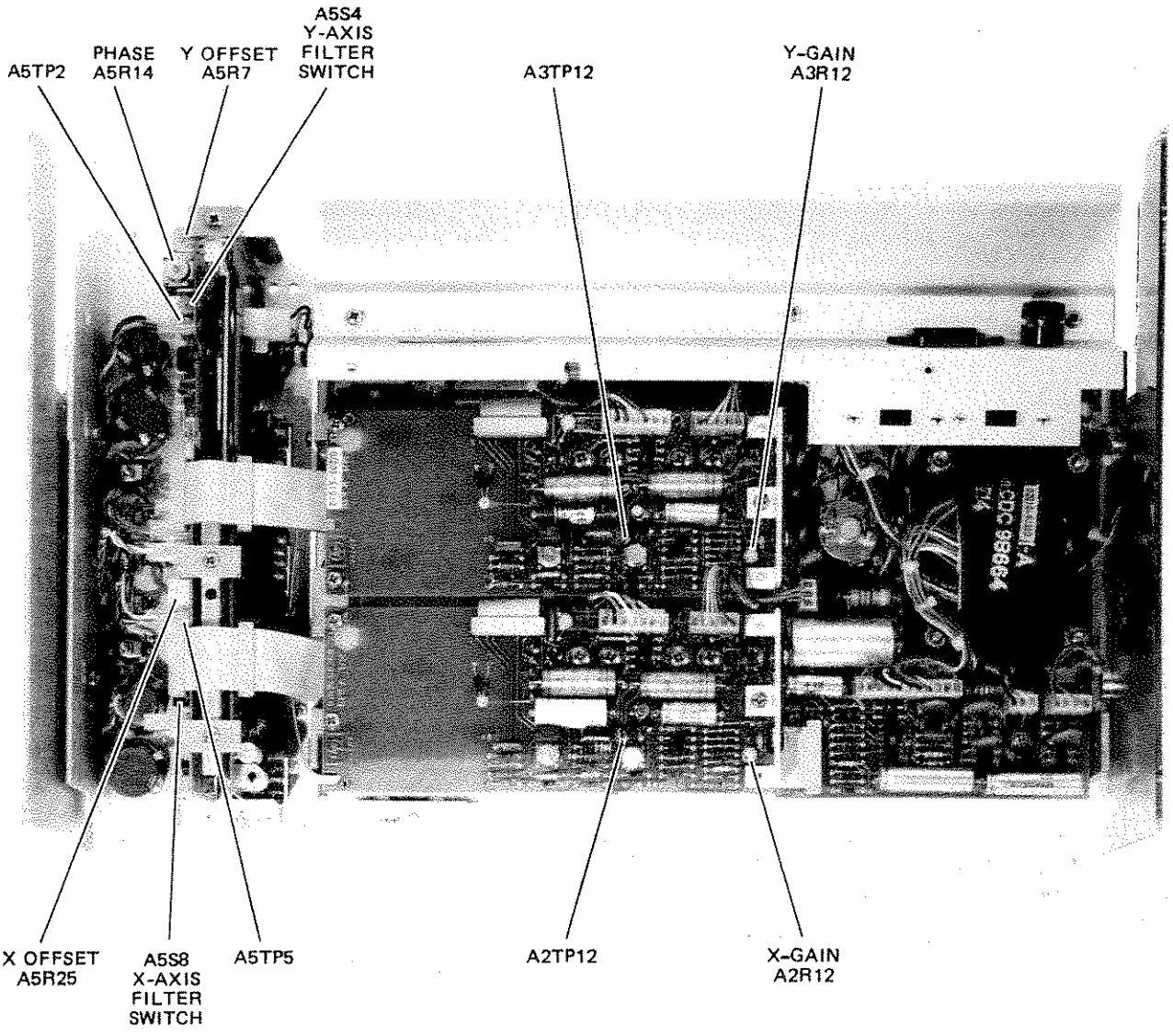


Figure 5-4. Calibration Adjustments and Test Points

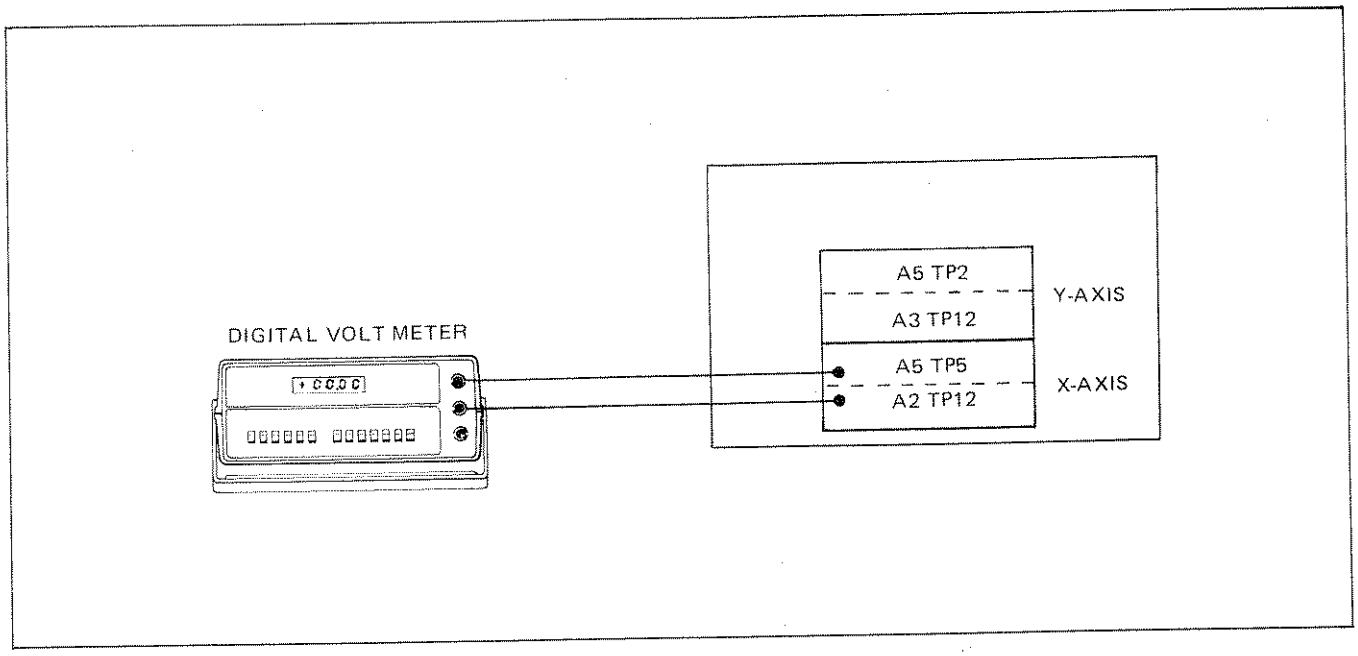


Figure 5-5. Input Offset Adjustment Connections

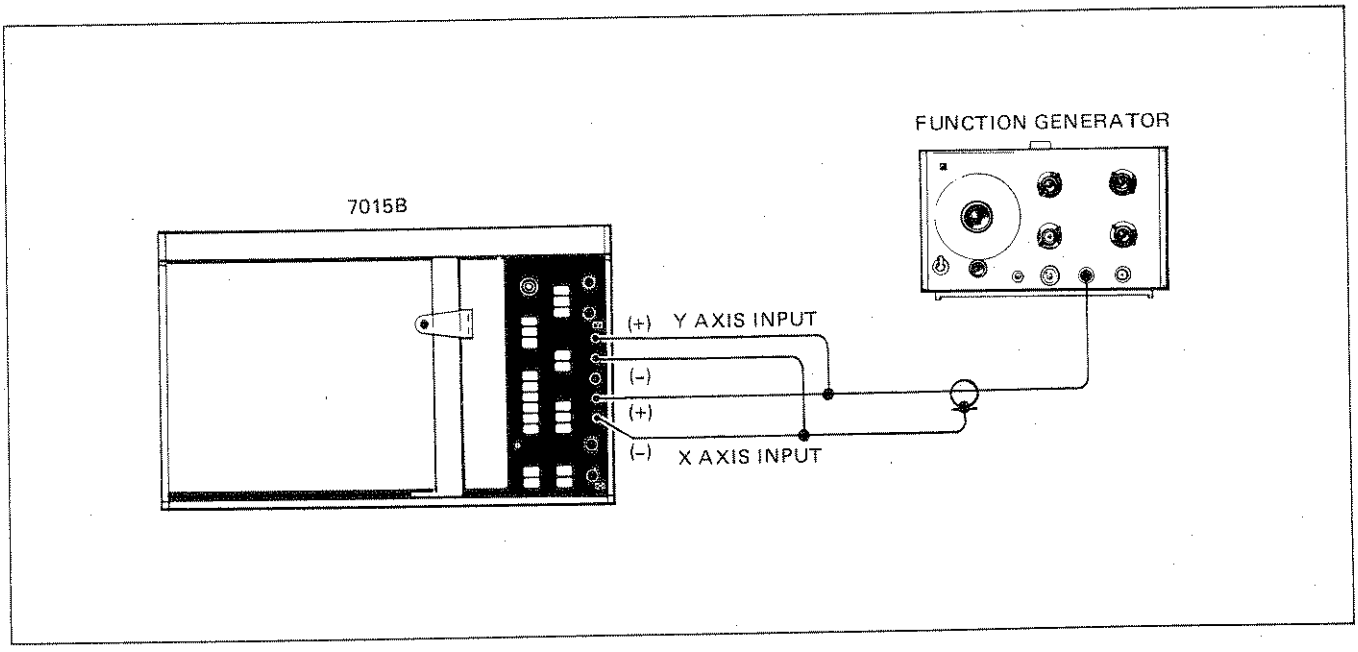


Figure 5-6. Phase Calibration Connection

3. Waveform – Triangle

4. Amplitude – Fully counterclockwise

e. Slowly increase the amplitude of the frequency generator until both axes of the recorder have a travel of approximately 7 inches centered on the graph.

f. Lower the pen allowing the pen to draw one line and retrace the line once.

g. Near this line plot a single line with no retrace.

h. Compare the width of the two lines with an optical comparator.

i. The width of the retraced line shall be no more than 0.015 in. (0.38 mm) wider than the single line. (See Figure 5-7.)

j. If the retraced line is greater than 0.015 in. (0.38 mm) wider, adjust A5R14 Y-phase adjustment for minimum width of the retraced line. (See Figure 5-4.)

k. Repeat steps f. through j. until minimum width is attained.

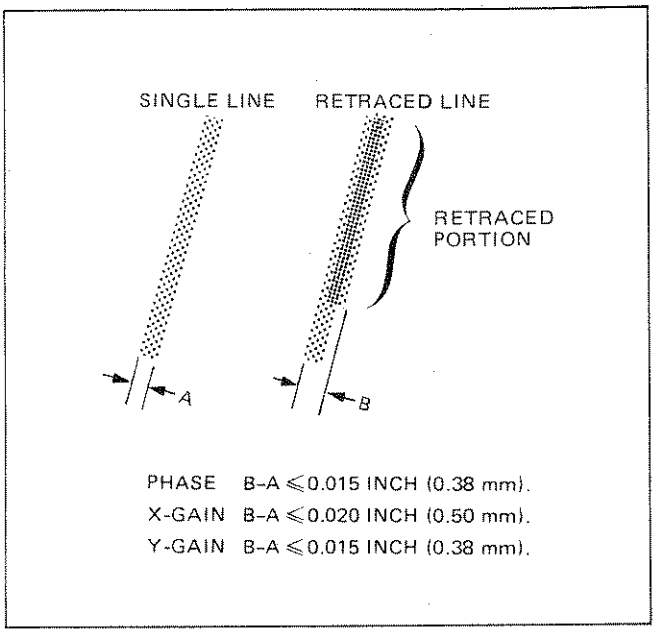


Figure 5-7. Phase and Gain Adjustment

5-20. X-GAIN ADJUSTMENT.

5-21. To adjust the X-axis gain proceed as follows:

a. Install chart and disposable pen.

b. Set recorder controls as follows:

1. LINE – ON
2. CHART – HOLD
3. SERVO – ON
4. PEN – LIFT
5. X-INPUT/TIMEBASE – X-INPUT
6. X V/IN. – 1 V/in. (500 mV/cm)
7. Y V/IN. – 0.1 V/in. (50 mV/cm)

c. Connect HP Model 3310A Function Generator as shown in Figure 5-6.

d. Set function generator controls as follows:

1. Power – ON
2. Waveform – Triangle
3. Frequency – .071 Hz
4. Amplitude – Fully counterclockwise

e. Slowly increase the amplitude of the function generator until the pen has a 7-inch travel.

f. Lower the pen allowing the pen to draw one line and then retrace this line once.

g. Near this line plot another single line with no retrace.

h. Compare the width of the retraced line with the width of the single line.

i. The retraced line shall be no more than 0.02 in. (0.50 mm) wider than the single line. (See Figure 5-7.)

j. Adjust A2R12 X-gain adjustment to meet this specification. (See Figure 5-4.)

k. Repeat steps f. through j. for minimum width of the retraced line with no pen oscillations.

5-22. Y-GAIN ADJUSTMENT.

5-23. To adjust the Y-axis gain proceed as follows:

a. Complete the steps a. through h. as outlined in paragraph 5-20, X-Gain Adjustment, with the following exception.

1. Set X V/IN. – 0.1 V/in. (50 mV/cm)
2. Set Y V/IN. – 1.0 V/in. (500 mV/cm)

b. The retrace line shall be no more than 0.015 in. (0.38 mm) wider than the single line. (See Figure 5-7.)

c. Adjust A3R12 Y-gain adjustment to meet this specification. (See Figure 5-4.)

d. Repeat steps for minimum width of retraced line with no pen oscillations.

5-24. X AND Y FILTER BYPASS.

5-25. The X and Y active input filters are equipped with switches (Y-axis A5S4) (X-axis A5S8) allowing the user to bypass these filters.

5-26. To switch these filters OUT proceed as follows:

a. Set LINE OFF.

b. Remove the ac line cord from the recorder.

c. Remove the back cover from the recorder. Refer to paragraph 5-28.

d. Set switches A5S4 and A5S8 to the OUT position.

e. Reassemble the recorder.

5-27. MECHANICAL MAINTENANCE.

5-28. ACCESS TO COMPONENTS.

5-29. Access to components for mechanical adjustments requires removal of exterior parts first, such as hood, covers, etc. To remove certain parts, perform the following procedures:

NOTE

The majority of the screws in the unit are Pozidriv type. These screws are less likely to deform or strip provided the Pozidriv screwdriver is used. Two models are available, the small model, HP Part No. 8710-0899, and the larger one, HP Part No. 8710-0900.

a. Hood Assembly – remove four screws, two from each side, and lift hood.

b. Bottom Cover – set unit with power receptacle and fuse holder visible (recording surface downwards). Remove four screws and lift off bottom cover.

c. Autogrip Table – set machine on edge. Remove bottom cover and disconnect two red wires (connector A1J5) on the power supply PCA A1 (Part No. 07010-20300) from electrostatic table. (See Figure 5-8). Remove four screws securing the Autogrip table. Slide the pen carriage to the left, and ease platen up and out on the right side.

d. Side Covers – remove six screws. Lift off side cover.

e. Front Cover – remove four screws, two on each side. Lift off front cover.

5-30. MECHANICAL ADJUSTMENTS.

5-31. Any adjustments to the unit are deemed necessary only when it is determined the model is out of adjustment per specifications. If recorder is malfunctioning, repair before attempting adjustment.

5-32. Y-AXIS DRIVE STRING TENSION ADJUSTMENT.

5-33. The tension on the Y-axis string should be enough to stall the Y motor when the pen carriage is driven off-scale. To make Y-axis string tension adjustment, perform the following steps:

a. Remove disposable pen.

b. Remove rear hood assembly. See paragraph 5-28.

c. Lift pen bar and remove pen bar return spring.

d. Push down the following control buttons to set the recorder controls:

1. LINE – ON

2. CHART – HOLD

3. SERVO – ON

e. Turn Y-axis ZERO control potentiometer (on front panel) until pen holder assembly reaches the bottom of the carriage arm.

f. Adjust tension screw in Y-slider block until tension on Y-axis stringing is enough to stall Y-motor. (See Figure 5-9).

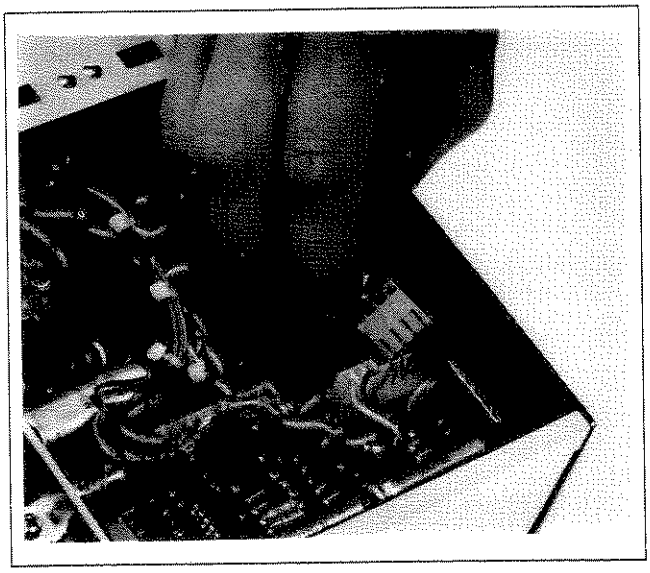


Figure 5-8. Autogrip Table Removal

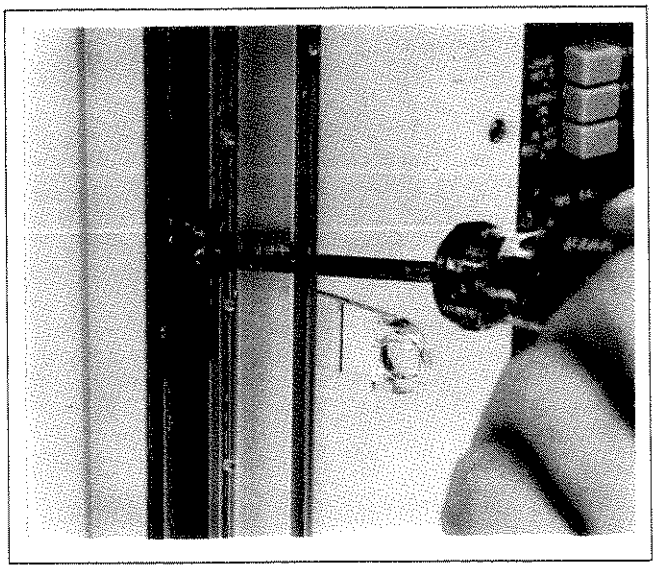


Figure 5-9. Y-Axis Cable Tension Adjustment

5-34. X-AXIS CABLE TENSION ADJUSTMENT.

5-35. The X-axis cable tension should be verified by measuring the force required to displace it a given distance. With the arm at the extreme right, pull up the center of the section of cable to the center of the X-slider rod. The scale should measure 24 ounces ±1 ounce. (682 grams ±28 grams). See Figure 5-10. If the tension does not fall within these limits, loosen or tighten screw on X-axis slider block and perfom Y-axis alignment, paragraph 5-42. (See Figure 5-11).

5-36. Y-GEAR TRAIN BACKLASH ADJUSTMENT.

5-37. The backlash of the pen gear drive system is adjusted as follows:

a. Remove hood assembly and Autogrip table (paragraph 5-28).

b. With Pozidriv screwdriver, loosen screw holding servo motor to slider block (Figure 5-12) while holding nut with a 3/16 inch open end wrench.

c. Gently move pen holder up and down, observing backlash between servo motor pinion gear and mating gear.

d. Rotate servo motor in mounting, observing backlash.

e. Proper adjustment is obtained when only a slight amount of play can be observed between gears.

f. To verify that gears are not too closely adjusted, move pen holder up and down through several inches of travel, feeling for binding. Properly adjusted gears will run smoothly.

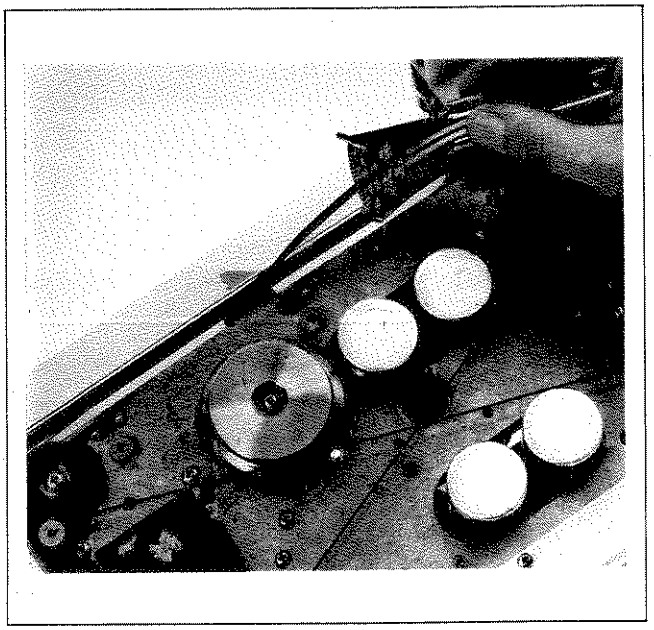


Figure 5-10. X-Axis Cable Tension Check

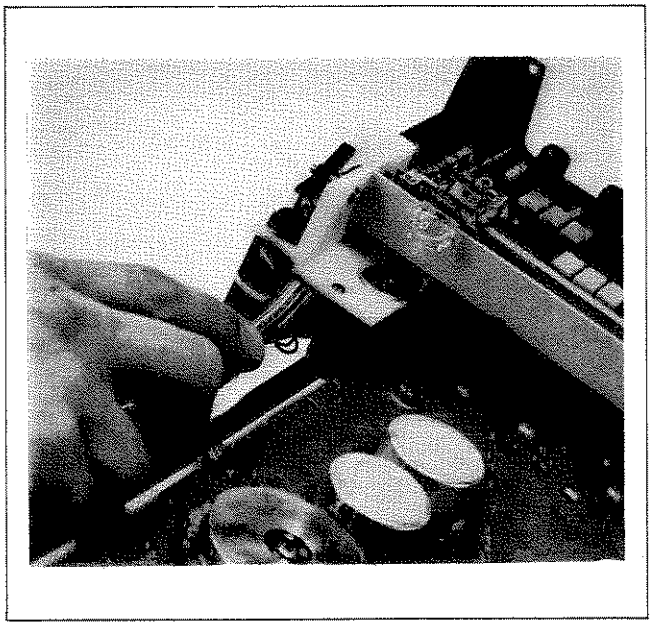


Figure 5-11. X-Axis Cable Tension Adjustment

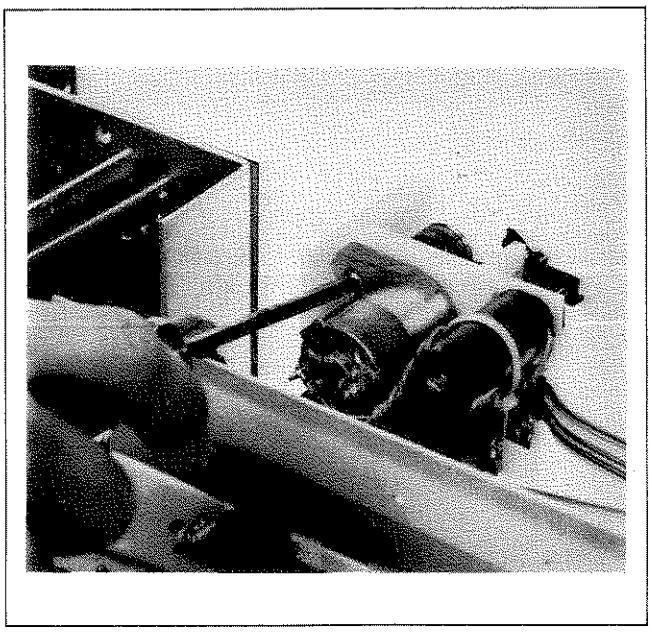
g. Reassemble.

5-38. X-AXIS GEAR TRAIN BACKLASH.

5-39. Backlash of the gear drive system is adjusted as follows:

a. Remove Autogrip table and bottom cover (paragraph 5-28).

b. With 1/4-inch hex driver to rear of machine and driver at front, loose screw retaining servo motor (Figure 5-13).



5-12. Y-Axis Gear Train Backlash Adjustment

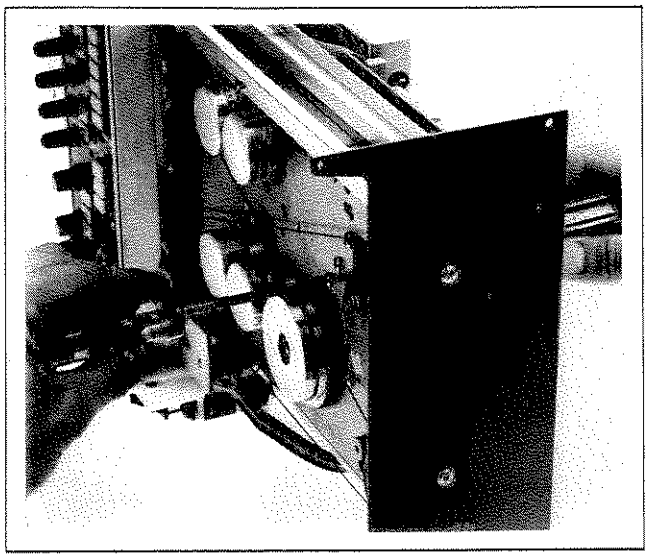


Figure 5-13. X-Axis Gear Train Backlash Adjustment

c. Hold servo motor and recording arm. Move recording arm gently to left and right, observing backlash between gears.

d. Proper adjustment is obtained when only a slight amount of play can be observed between gears.

e. To verify that gears are not too closely adjusted, move recording arm back and forth through several inches of travel, feeling for binding. Properly adjusted gears will run smoothly.

f. Reassemble.

5-40. X-AXIS ALIGNMENT ADJUSTMENT.

5-41. If the horizontal pen trace deviates from correctly aligned paper grid, adjust as follows:

a. Install chart paper.

b. Install disposable pen in holder.

c. Push down the following control buttons to set the recorder controls:

1. LINE – ON

2. CHART – HOLD

3. SERVO – ON

4. PEN – LIFT

d. Align the recording pen to a convenient horizontal grid line using Y-axis ZERO control.

e. Lower recording pen and move pen through the entire horizontal travel by using X-axis ZERO control.

f. Pen should not deviate from the horizontal grid line by more than 0.010 in. (0.25 mm) of pen trace.

g. If specification is not met, align as follows:

1. Record exact deviation distance over approximately 8.25 in. (21 cm) of pen trace.

2. Remove bottom cover and Autogrip table (paragraph 5-28).

3. With 12-inch steel scale and straight-edge ruler, measure difference between straight-edge and trailing edge of paper stop guide on left and right side of chassis.

4. Loose three screws retaining bottom chart paper guide.

5. Reposition guide to compensate for deviation distance recorded in steps g.1. and g.3. (See Figure 5-15.)

6. Reassemble recorder and recheck alignment, steps d. through f.

5-42. Y-AXIS ALIGNMENT ADJUSTMENT.

CAUTION

Do not attempt to perform Y-axis alignment until X-axis alignment has been completed.

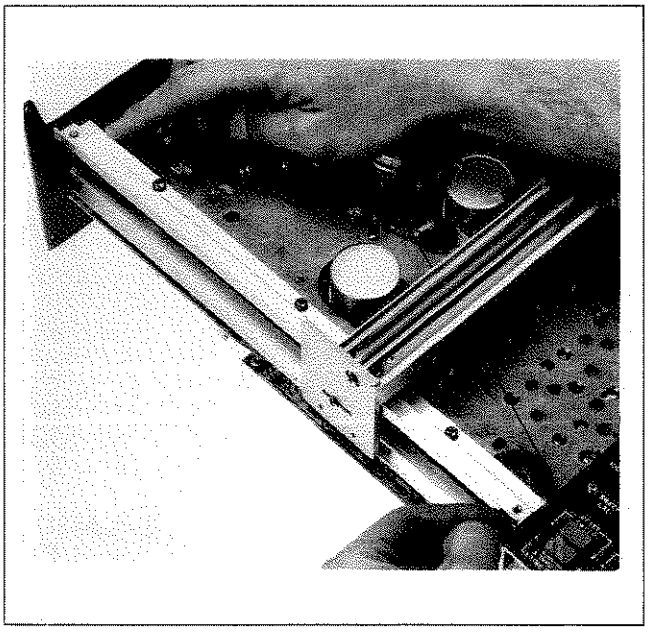


Figure 5-14. X-Axis Alignment Adjustment

5-43. If the vertical pen trace deviates from correctly aligned paper grids, and horizontal alignment is correct, proceed as follows:

a. Install chart paper.

b. Install disposable pen in holder.

c. Set the following controls by pushing down the control button:

1. LINE – ON

2. CHART – HOLD

3. SERVO – ON

4. PEN – LIFT

d. Align recording pen to convenient vertical grid line using X-axis ZERO control.

e. Lower recording pen and move pen through the entire vertical travel by using Y-axis ZERO control.

f. Pen should not deviate from the vertical grid line by more than 0.010 in. (0.25 mm).

g. If specification is not met, align as follows:

1. Remove front cover. Refer to paragraph 5-28.

2. Loosen Y-axis alignment screw located at bottom of recording arm (Figure 5-15).

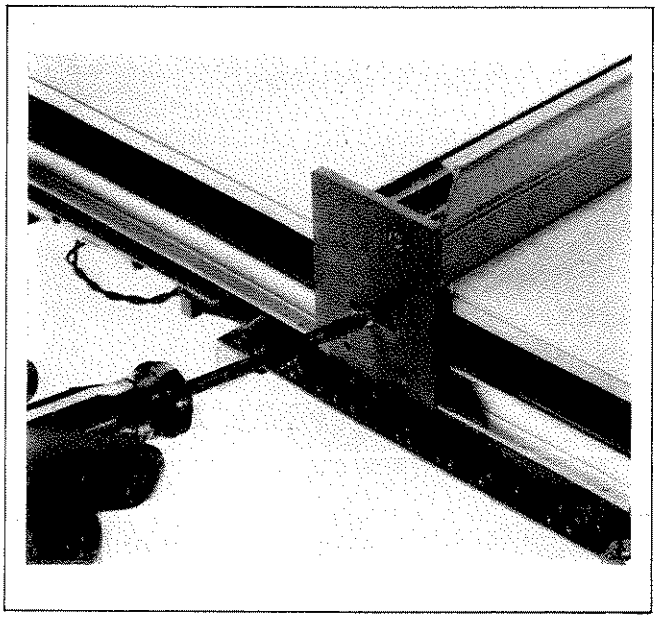


Figure 5-15. Y-Axis Alignment Adjustment

3. Realign recording arm to correct for alignment error. Retighten alignment screw.

4. Recheck alignment (steps d., e. and f.) and realign if necessary.

5. Reassemble recorder.

5-44. X-AXIS WIPER ALIGNMENT.

5-45. If it is necessary to align the X-axis wiper after wiper replacement or when checking for slidewire wear, perform the following steps:

a. Remove bottom cover. Refer to paragraph 5-28. Wiper assembly is visible under the power bracket.

b. Check that the wiper is aligned properly on the slidewire so that the double contacts are on the gold stripe of the slidewire, and the V of the single contact is resting on the mandrel. See Figure 5-16. Move the Y-arm along the length of the X-axis slidewire, checking that proper contact is made between the wiper and slidewire along the entire X-axis.

NOTE

It is important that the single contact is not side loaded. (See Figure 5-16).

c. If the conditions in step b. are not met, note the direction and magnitude of misalignment of contacts.

d. Carefully insert a small piece of heavy paper or a card between the X-wiper contacts and the slidewire to protect the slidewire.

e. With a Pozidriv screwdriver in the notch in the power bracket, loosen the wiper mounting screw, and slide out the wiper assembly. (See Figure 5-17).

f. With smooth jaw needle-nose pliers, gently bend the contacts to proper alignment. Reattach wiper assembly to slider block with screw.

g. Remove the paper from the contacts and make certain the contacts on the slidewire assembly are positioned properly, moving the Y-arm along the length of the X-axis.

h. Reassemble recorder.

5-46. Y-AXIS WIPER ALIGNMENT.

5-47. To align the Y-axis wiper, proceed as follows:

a. Remove disposable pen. Remove rear hood assembly. See paragraph 5-28.

b. Lift up Y pen lift bar and remove spring so pen lift bar stays open.

c. Move slider block toward bottom of recording arm, checking to see that wiper contacts are in proper position on the slidewire. Refer to Figure 5-16 for correct position of wiper on slidewire.

d. Carefully insert small piece of heavy paper or card between Y-wiper contacts and slidewire to protect slidewire.

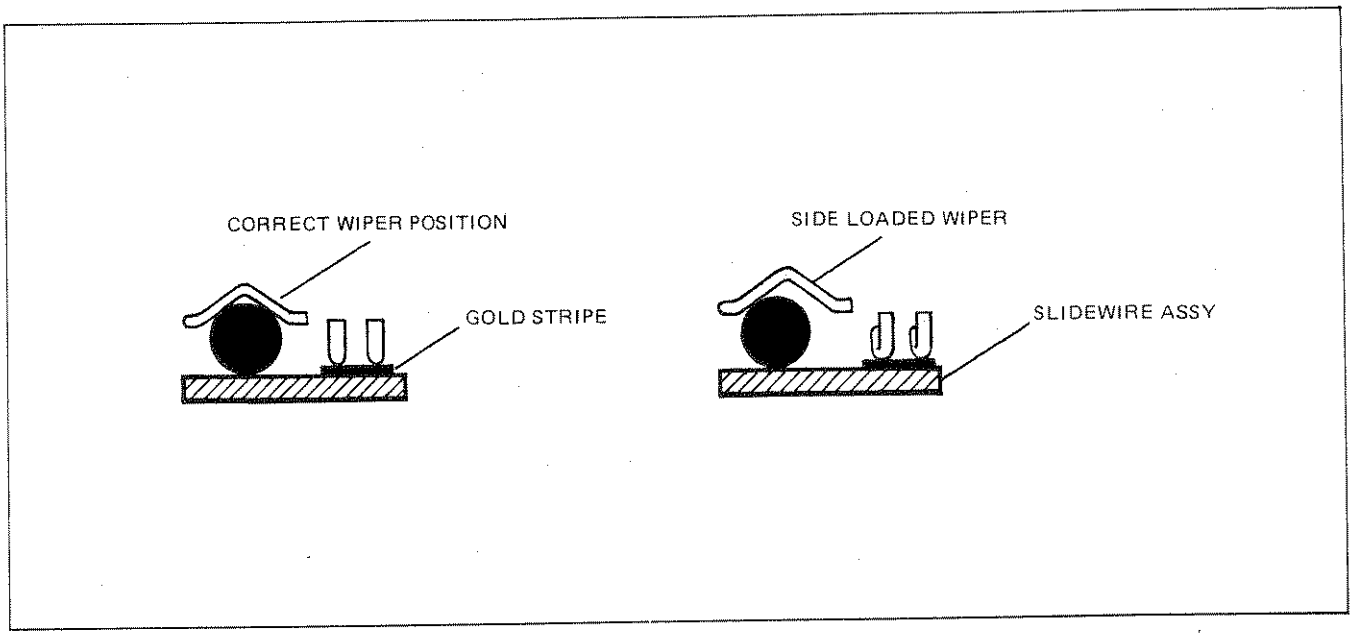


Figure 5-16. Slidewire Wiper Alignment

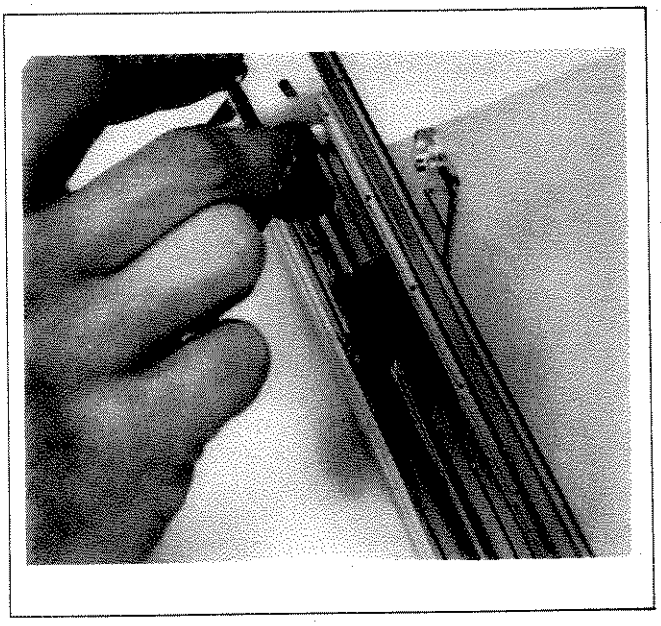


Figure 5-17. X-Axis Wiper Removal

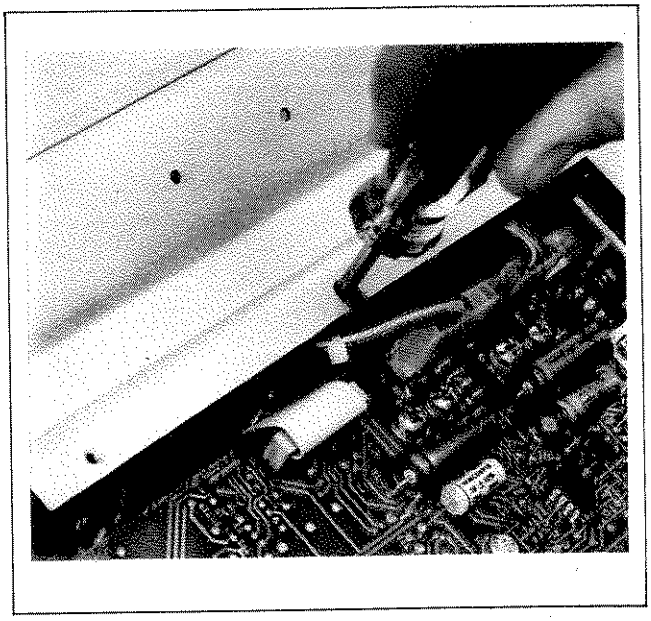


Figure 5-18. Y-Axis Wiper Removal

e. Remove wiper assembly held by one screw. (See Figure 5-18).

f. With smooth jaw needle-noise pliers, gently bend the contacts to proper alignment. Reattach wiper assembly.

g. Reassemble recorder.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains complete information on the 7015B parts list. The list is presented in an alphanumerical and numerical order. The procedure for ordering replacement parts for this instrument is also contained in this section.

6-3. MISCELLANEOUS PARTS

6-4. Table 6-1 lists items not covered in the other tables.

6-5. CHASSIS PARTS.

6-6. Chassis mounted parts for the HP Model 7015B are identified in Figures 6-1 through 6-4 and listed in Tables 6-2 through 6-5.

6-7. CIRCUIT BOARD PARTS.

6-8. Parts located in printed circuit assemblies are identified and listed in Section VII.

6-9. ORDERING INFORMATION.

6-10. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Sales/Service Office (see insert pages at back of manual for address of nearest HP office.) The order should include part number and description of the part, and function and location of the part.

6-11. DIRECT MAIL ORDER SYSTEM.

6-12. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Chassis and electrical parts are available at the Customer Service Center in Mountain View; consumable items (pens, ink, graph paper, slidewire cleaner) can be ordered from the HP San Diego Division. Advantages of using this system are:

a. Direct ordering and shipment from the HP Parts Center in Mountain View California or HP San Diego California Division.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices – to provide these advantages, a check or money order must accompany each order.

6-13. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

6-14. CODE LIST OF MANUFACTURERS.

6-15. Table 6-7 lists the five-digit code number assigned to a specific manufacturer. This table is a cross-reference to Tables 6-2 through 6-5 in that the five-digit number listed in Tables 6-2 through 6-5 is identified by name in Table 6-7.

6-16. ABBREVIATIONS.

6-17. Table 6-6 lists abbreviations used throughout the manual.

Table 6-1. Miscellaneous Parts

QTY	DESCRIPTION	PART NUMBER
	ACCESSORY KIT	
1	Accessory Kit (includes the following):	07015-60321
1	Can Slidewire Cleaner	5080-3605
1	Disposable Pens. Red (Pkg of 5)	5081-1190
1	Disposable Pens, Blue (Pkg of 5)	5081-1191
1	Rear Connector	1251-2500
1	Rear Connector	1251-2799
1	Universal Pen Holder Assembly	07010-60034
	GRAPH PAPER	
	Graph Paper, Heavy, English	9270-1006
	Graph Paper, Light, English	9270-1007
	Graph Paper, Heavy, Metric	9270-1023
	Graph Paper, Light, Metric	9270-1027
	DISPOSABLE PENS (May Be Ordered)	
	Red (Pkg of 5)	5081-1190
	Blue (Pkg of 5)	5081-1191
	Green (Pkg of 5)	5081-1192
	Black (Pkg of 5)	5081-1193
	CABLE ASSEMBLIES	
	Amplifier Cable 20 Conductor	07015-60008
	Power Supply Cable 20 Conductor	07015-60009
	Y-axis Trailing Cable	07010-60190
	X Slidewire Cable	07010-60188
	Autogrip Cable	07010-60290
	PRINTED CIRCUIT ASSEMBLIES	
	Power Supply PCA A1	07010-60300
	X Amplifier PCA A2 (English)	07015-60360
	X Amplifier PCA A2 (Metric)	07015-60361
	Y Amplifier PCA A3 (English)	07015-60370
	Y Amplifier PCA A3 (Metric)	07015-60371
	Control PCA A4 (English)	07015-60350
	Control PCA A4 (Metric)	07015-60351
	Preamplifier PCA A5	07015-60340

Table 6-2. Main Frame Parts List

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			MAIN FRAME PARTS LIST		
1	2360-0358	1	SCREW-MACH 6-32 .375-IN-LG TR-HD-POZI	28480	2360-0358
2	07010-00305	1	SIDE PLATE, LEFT	28480	07010-00305
3	07010-20013	1	HOOD	28480	07010-20013
4	2360-0197		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0197
5	07010-60305	1	SIDE PLATE, RIGHT	28480	07010-60305
6	07010-20005	1	EXTRUSION, FRONT	28480	07010-20005
7	07010-00337	1	COVER, CONNECTOR	28480	07010-00337
8	07010-00339	1	COVER, BOTTOM	28480	07010-00339
9	2360-0115		SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0115
10	0430-0187		FOOT RUBBER	28480	0430-0187
11	2360-0201	1	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	28480	2360-0201
12	07010-20281	1	CASTING	28480	07010-20281
13	07010-60083	1	END CAP ASSEMBLY	28480	07010-60083
14	07010-60200	1	PEN HOLDER ASSEMBLY	28480	07010-60200
15	07010-60196	1	TABLE, AUTOGRIP	28480	07010-60196
16			CONTROL PANEL, REFER TO FIG. 6-3.		

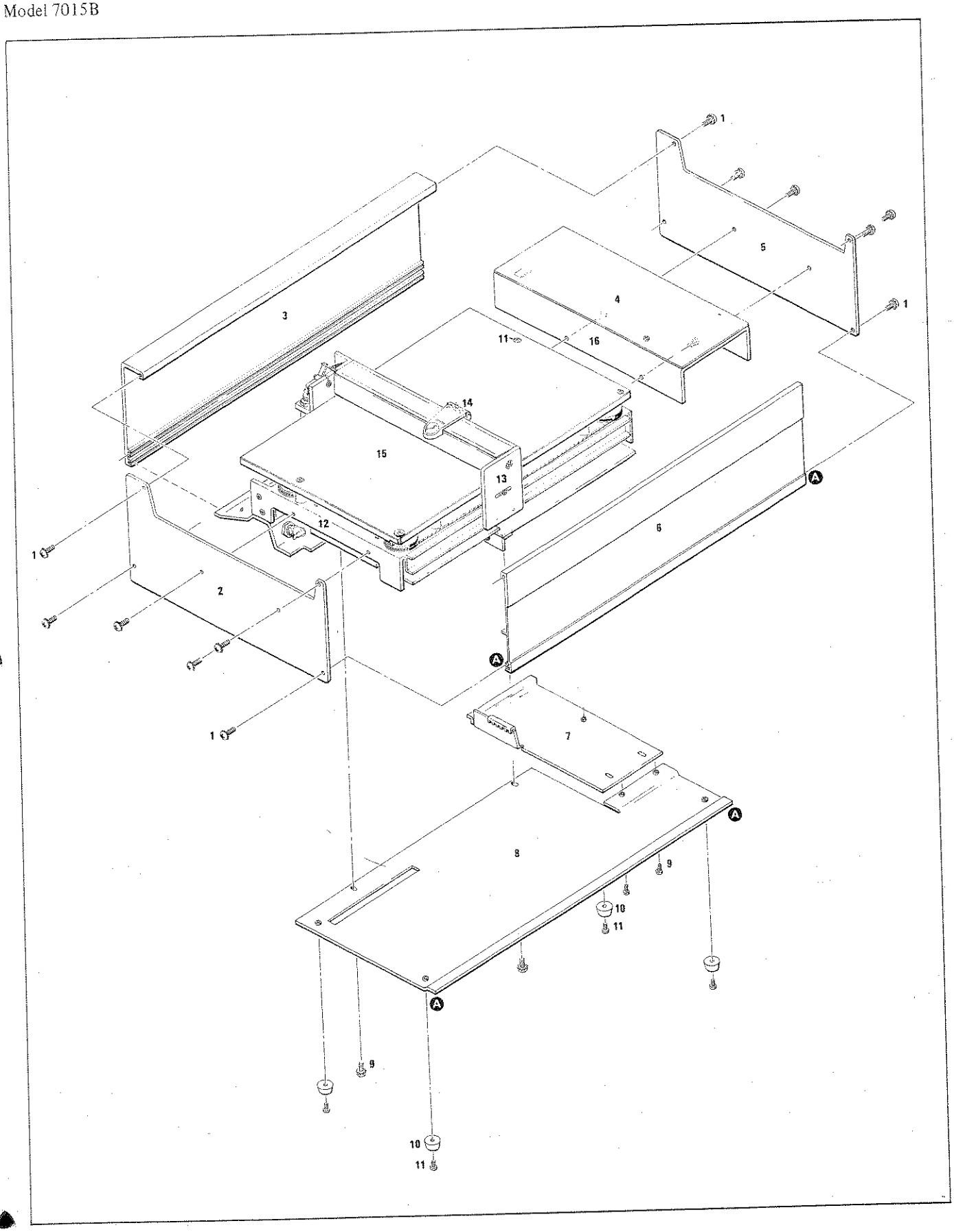


Figure 6-1. Main Frame, Exploded View

Table 6-3. Pen Drive Assembly

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	2200-0151	1	SCREW-MACH 4-40 .75-IN-LG PAN-HD-POZI	28480	2200-0151
2	2190-0108	3	WASHER-LK NM NO. 4 .115-IN-ID .226-IN-OD	28480	2190-0108
3	2190-0416	1	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	2190-0416
4	1410-0277	1	BUSHING, LAMP HOLDER 5/16-32 THREAD	0069C	A-1410-0277-1
5	07010-20011	1	GEAR, Y-DRIVE	28480	07010-20011
6	07010-20003	1	STUD, Y-GEAR	28480	07010-20003
7	7120-6160	1	LABEL-BLANK .73-IN-WD 8.75-IN-LG MYLAR	28480	7120-6160
8	07010-60002	1	PEN LIFT ASSEMBLY	28480	07010-60002
9	1460-1587	1	SPRING EXTENSION	28480	1460-1587
10	2360-0203	1	SCREW-MACH 6-32 .625-IN-LG PAN-HD-POZI	28480	2360-0203
11	2360-0118	1	SCREW-MACH 6-32 .375-IN-LG 82 DEG	28480	2360-0118
12	07010-20008	1	WASHER	28480	07010-20008
13	2190-0185	1	WASHER-FL MTLC 1/4 IN .312-IN-ID	28480	2190-0185
14	0520-0128	1	SCREW-MACH 2-56 .25-IN-LG PAN-HD-POZI	28480	0520-0128
15	2190-0112	1	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0112
16	3050-0230	1	WASHER-FL MTLC NO. 2 .091-IN-ID	28480	3050-0230
17	3050-0222	1	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0222
18	2200-0141	3	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
19	07010-60485	1	Y-MOTOR MOUNT ASSEMBLY	28480	07010-60485
20	07010-20023	1	PIVOT, CAM	28480	07010-20023
21	1460-0664	1	SPRING-TRSN .235-IN-OD .11-IN-LG SST	28480	1460-0664
22	0510-0015	1	RETAINER-RING E-R EXT .125-DIA STL	05738	1000-12-ST-CD
23	07010-40015	1	CAM, PEN LIFT	28480	07010-40015
24	2200-0141		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
25	2190-0108		WASHER-LK NM NO. 4 .115-IN-ID .226-IN-OD	28480	2190-0108
26	0360-0609	1	TERMINAL-SLDR LUG PL-MTG FOR-#1/2-#CR	28480	0360-0609
27	0491-0102	1	SOLENOID, PEN LIFT	28480	0491-0102
28	07010-60080	1	Y-ARM ASSEMBLY	28480	07010-60080
29	0905-0363	1	SEAL-"O" RING, 0.239" ID	7662J	622-705
30	07040-20160	1	STUD, PULLEY	28480	07040-20160
31	1410-0269	1	BALL BEARING	28480	1410-0269
32	07040-20540	1	PULLEY, Y-IDLER	28480	07040-20540
33	3050-0394	1	WASHER-FL MTLC NO. 5 .13-IN-ID .25-IN-OD	28480	3050-0394
34	07010-20007	1	ROD, Y-SLIDER	28480	07010-20007
35	2200-0140	1	SCREW-MACH 4-40 .25-IN-LG 100 DEG	28480	2200-0140
36	5081-1190	1	PEN, DISPOSABLE, RED	28480	5081-1190
37	0516-0005	1	SCREW-MACH 0-80 .188-IN-LG PAN-HD-SLT	28480	0516-0005
38	07010-60200	1	PEN HOLDER ASSEMBLY	28480	07010-60200
39	2200-0179	2	SCREW-MACH 4-40 .125-IN-LG PAN-HD-POZI	28480	2200-0179
40	07010-60012	1	WIPER, Y-AXIS	28480	07010-60012
41	0520-0130	1	SCREW-MACH 2-56 .375-IN-LG PAN-HD-POZI	28480	0520-0130
42	0905-0363	1	"O" RING	28480	0905-0363
43	07010-20016	1	SLIDER, BLOCK Y-AXIS	28480	07010-20016
44	07010-60224	1	Y AXIS CABLE ASSEMBLY	28480	07010-60224
45	07010-60196	1	TABLE, AUTOGRIP	28480	07010-60196
46	2360-0201	1	SCREW-MACH 6-32 .5-IN-LG PAN-HD-POZI	28480	2360-0201
47	07010-20012	1	PAPER GUIDE	28480	07010-20012
48	2360-0117	1	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117
49	07010-60001	1	PAPER STOP	28480	07010-60001
50	07010-20006	1	SLIDER ROD, X-AXIS	28480	07010-20006
51	0340-0135	1	GROMMET, VINYL 3/8" ID	0000J	080
52	07010-00310	1	CLAMP, CABLE	28480	07010-00310
53	2260-0009	2	NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	28480	2260-0009
54	07040-40040	1	CLAMP, MOTOR	28480	07040-40040
55	2260-0009		NUT-HEX-W/LKWR 4-40-THD .094-IN-THK	28480	2260-0009
56	5060-6608	1	MOTOR ASSEMBLY	28480	5060-6608
57	07040-60217	1	PULLEY ASSEMBLY	28480	07040-60217
58	07040-20520	1	SLEEVE, IDLER, PULLEY	28480	07040-20520
59	2430-0004	1	SCREW-MACH 6-32 .5-IN-LG TR-HD-PHL	28480	2430-0004
60	2360-0318	1	SCREW-MACH 6-32 1.875-IN-LG PAN-HD-POZI	28480	2360-0318
61	07010-20035	1	SLIDER BLOCK, X-AXIS	28480	07010-20035
62	07010-40001		TENSION ADJUST, X-CABLE	28480	07010-40001
63	07010-60023	1	WIPER, X-AXIS	28480	07010-60023
64	2200-0179		SCREW-MACH 4-40 .125-IN-LG PAN-HD-POZI	28480	2200-0179
65	2360-0209	1	SCREW-MACH 6-32 1-IN-LG PAN-HD-POZI	28480	2360-0209
66	07040-60710	1	GEAR ASSEMBLY, X-DRIVE	28480	07040-60710
67	5020-6202	1	STUD	28480	5020-6202
68	1530-1754	1	CABLE, X-DRIVE NO. 1	28480	1530-1754
69	07010-40012	1	ADJUSTOR, Y-ARM	28480	07010-40012
70	2260-0001	1	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
71	1530-1755	1	CABLE, X-DRIVE NO. 2	28480	1530-1755
72	07010-60083	1	END CAP ASSEMBLY, Y-ARM	28480	07010-60083
73	2190-0108		WASHER-LK NM NO. 4 .115-IN-ID .226-IN-OD	28480	2190-0108
74	2200-0141		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141

Table 6-3. Pen Drive Assembly (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
75	2200-0145	1	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
76	2190-0008	1	WASHER-LK EXT T NO. 6 .141-IN-ID	0460D	1341
77	07010-20031	1	ROLLER	28480	07010-20031
78	07010-20030	1	BEARING	28480	07010-20030
79	07010-20281	1	CASTING	28480	07010-20281
80	2360-0183	1	SCREW-MACH 6-32 .375-IN-LG 82 DEG	28480	2360-0183
81	2360-0115	1	SCREW-MACH 6-32 .312-IN-LG PAN-HD-POZI	28480	2360-0115
82	07010-20315	1	SUPPORT, Y-ARM	28480	07010-20315
83	0590-0381	1	NUT-HEX-W/LKWR 6-32-THD .12-IN-THK	78189	511-061600-01
84	3050-0399	1	WASHER-FL MTLC NO. 6 .143-IN-ID	28480	3050-0399
85	07040-21020	1	WASHER, SHOULDER	28480	07040-21020
86	07010-40011	1	RING, PEN HOLDER	28480	07010-40011
87	07010-40013	1	BODY, PEN HOLDER	28480	07010-40013
88	07010-60034	1	PEN HOLDER, UNIVERSAL	28480	07010-60034

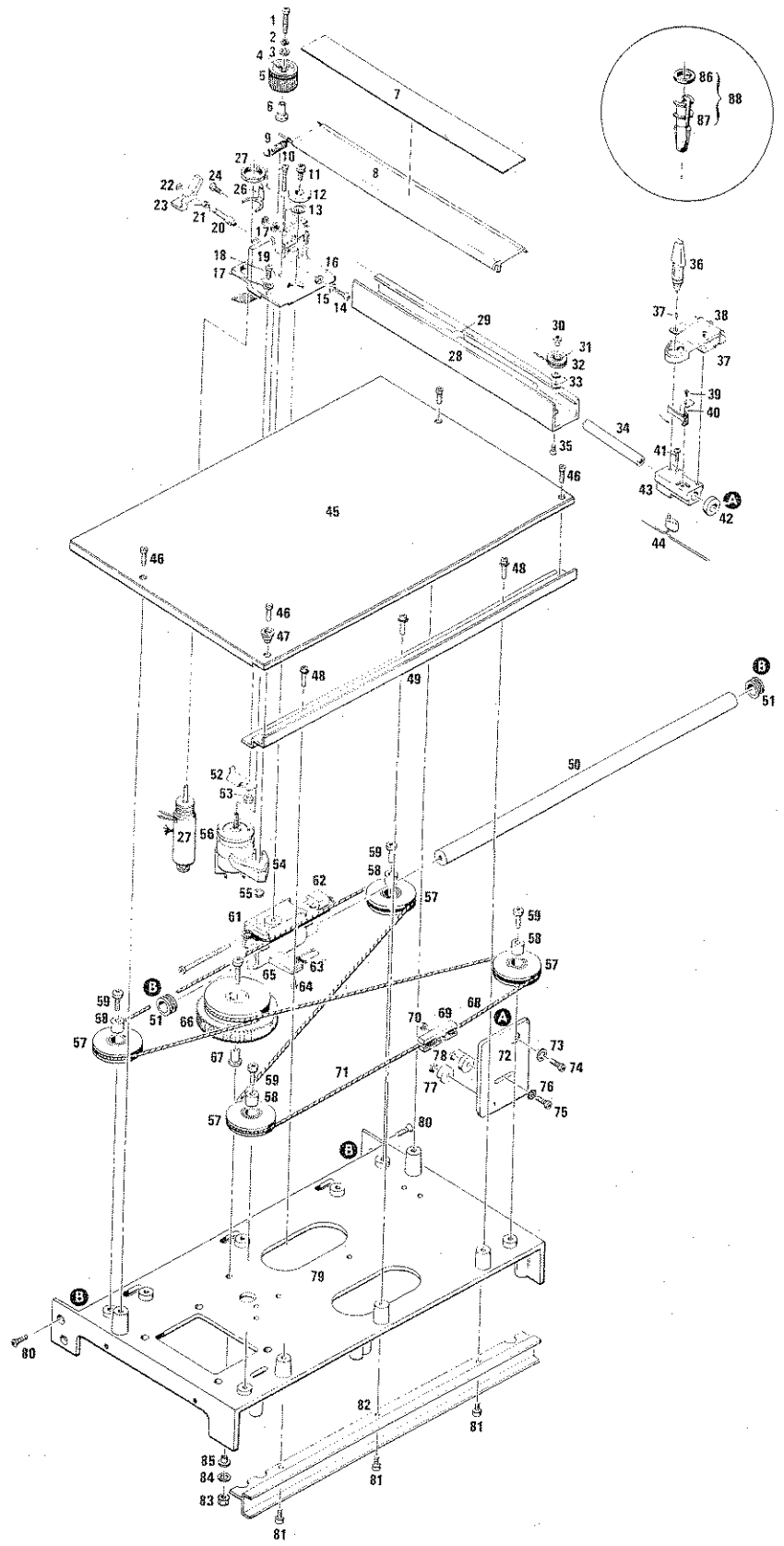


Figure 6-2. Pen Drive Assembly, Exploded View

Table 6-4. Control Panel

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	1510-0094	4	BINDING POST SGL BGL-TOR OBP RED	28480	1510-0094
2	1510-0522	1		28480	1510-0522
3	0370-1095	4	KNOB-BABE 1/2 OBP .25-IN-ID	28480	0370-1095
4	2200-0139	1	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	28480	2200-0139
5	2950-0043	4	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	28480	2950-0043
6	07010-00302	1	PANEL, CONTROL	28480	07010-00302
7	07010-00291	1	PANEL, SUB	28480	07010-00291
8	0360-0365	6	TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	78189	2104-06-00
9	2420-0010	6	NUT-HEX-DBL-CHAM 6-32-THD .125-IN-THK	28480	2420-0010
10	2950-0144	5	NUT-HEX-DBL-CHAM 3/8-32-THD .188-IN-THK	28480	2950-0144
11	0360-0365		TERMINAL-SLDR LUG LK-MTG FOR-#6-SCR	78189	2104-06-00
12	2420-0010		NUT-HEX-DBL-CHAM 6-32-THD .125-IN-THK	28480	2420-0010
13	2190-0163	6	WASHER-LK INTL T 3/8 IN .38-IN-ID	78189	1220-05
14	2100-2682	4	RESISTOR, VARIABLE 10K 10T (R2) Y-VERNIER	28480	2100-2682
15	2100-2682		RESISTOR,VARIABLE 10K 10T (R1) Y-ZERO	28480	2100-2682
16	2100-2682		RESISTOR, VARIABLE 10K 10T (R3) X-VERNIER	28480	2100-2682
17	2100-2682		RESISTOR, VARIABLE 10K 10T (R4) X-ZERO	28480	2100-2682
18	07010-00134	1	SHIELD, INPUT	28480	07010-00134
19	07015-60340	1	(A5) PREAMPLIFIER, PCA	28480	07015-60340
20	07015-60350	1	(A4) CONTROL, PCA	28480	07015-60350
21	07010-40320	3	HOLDER, PCA	28480	07010-40320
22	2190-0008	3	WASHER-LK EXT T NO. 6 .141-IN-ID	04600	1341
23	2360-0205	3	SCREW-MACH 6-32 .75-IN-LG PAN-HD-POZI	28480	2360-0205
24	07010-60203	4	CABLE ASSEMBLY	28480	07010-60203
25	07010-60201	1	CABLE ASSEMBLY, Y	28480	07010-60201
26	07010-60202	1	CABLE ASSEMBLY, X	28480	07010-60202

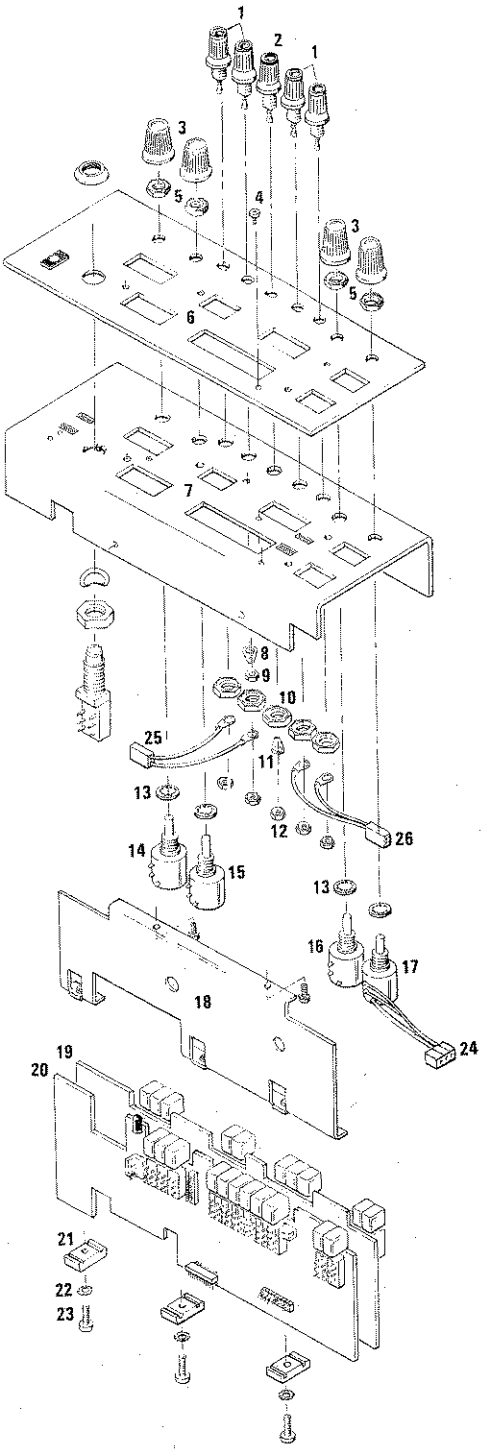


Figure 6-3. Control Panel, Exploded View

Table 6-5. Rear Frame Assembly

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
1	07010-20281	1	CASTING	28480	07010-20281
2	2510-0067	1	SCREW-MACH 6-32 2-IN-LG PAN-HD-POZI	28480	2510-0067
3	1400-0264	20	CABLE TIE, NYLON	28480	1400-0264
4	2100-1574	1	SLIDEWIRE, X-AXIS 13.0K	28480	2100-1574
5	2360-0183	2	SCREW-MACH 6-32 .375-IN-LG 82 DEG	28480	2360-0183
6	0360-0365	1	TERMINAL-SLDR LUG LK-MTG FOR-#6-#8CR	78189	2104-06-00
7	2420-0010	1	NUT-HEX-DBL-CHAM 6-32-THD .125-IN-THK	28480	2420-0010
8	07010-60300	1	(A1) POWER SUPPLY, PCA	28480	07010-60300
9	07015-60009	1	CABLE ASSEMBLY, POWER	28480	07015-60009
10	07015-60370	1	(A3) Y-AMPLIFIER, PCA	28480	07015-60370
11	07015-60360	1	(A2) X-AMPLIFIER, PCA	28480	07015-60360
12	07015-60008	2	CABLE ASSEMBLY, AMPLIFIER	28480	07015-60006
13	07010-00011	2	SUPPORT, POWER BRACKET	28480	07010-00011
14	07010-60317	1	POWER BRACKET ASSEMBLY	28480	07010-60317
15	0510-0790	1	CABLE CLAMP-MFCL .312-DIA .312-WD STL	0093A	CINCH MFG1 858
16	2190-0108	1	WASHER-LK NM NO. 4 .115-IN-ID .226-IN-OD	28480	2190-0108
17	2260-0001	2	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
18	3101-2227	1	SWITCH-PB DPDT ALTNG 4A 250VAC GRN-BTN	28480	3101-2227
19	07010-60289	1	CABLE ASSEMBLY, PRIMARY	28480	07010-60289
20	2360-0225	1	SCREW-MACH 6-32 .375-IN-LG HEX-HD-HEX	28480	2360-0225
21	1400-0090	1	WASHER:RUBBER 5/8" OD	0000J	089
22	2110-0470	1	FUSEHOLDER-EXTR POST 20A 300V UL/IEC	04700	345003-010
23	2110-0465	1	FUSEHOLDER-EXTR POST UL/IEC .25X1.25FUSE	28480	2110-0465
24	07010-60198		CABLE ASSEMBLY, Y-TRAILING	28480	07010-60198
25	07010-40002	1	CLAMP, CABLE	28480	07010-40002
26	2420-0016	2	NUT-HEX-DBL-CHAM 6-32-THD .062-IN-THK	28480	2420-0016
27	07010-00316	1	PLATE, COVER	28480	07010-00316
28	2580-0006	4	NUT-HEX-W/LKWR 8-32-THD .125-IN-THK	78189	KEPS11-081800-00
29	0360-0005	1	TERMINAL-SLDR LUG PL-MTG FOR-#8-8CR	79963	9-H-.169
30	2190-0452	1	WASHER:RECTANGULAR #6	95980	06-140
31	0150-0791	1	CLAMP, CABLE	28480	0150-0791
32	07010-60320	1	(T1) TRANSFORMER	28480	07010-60320
33	2420-0016		NUT-HEX-DBL-CHAM 6-32-THD .062-IN-THK	28480	2420-0016
34	2190-0105	1	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0105
35	3050-0393	1	WASHER-FL MTLC NO. 5 .13-IN-ID	28480	3050-0393
36	07040-40040	1	CLAMP, MOTOR	28480	07040-40040
37	5060-6807	1	MOTOR X	28480	5060-6807
38	07040-40007	1	INSULATOR	28480	07040-40007
39	07040-00010	1	WASHER	28480	07040-00010
40	2200-0145	1	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
41	2190-0311	1	WASHER-SHLDR NO. 10 .195-IN-ID	04941	7860
42	2190-0925	1	WASHER-LK NO. 6 .144-IN-ID .327-IN-OD	0203G	52-200-F002
43	2260-0001		NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
44	2360-0117	2	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117
45	2360-0183		SCREW-MACH 6-32 .375-IN-LG 82 DEG	28480	2360-0183
46	2360-0205	1	SCREW-MACH 6-32 .75-IN-LG PAN-HD-POZI	28480	2360-0205
47	2360-0117		SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117

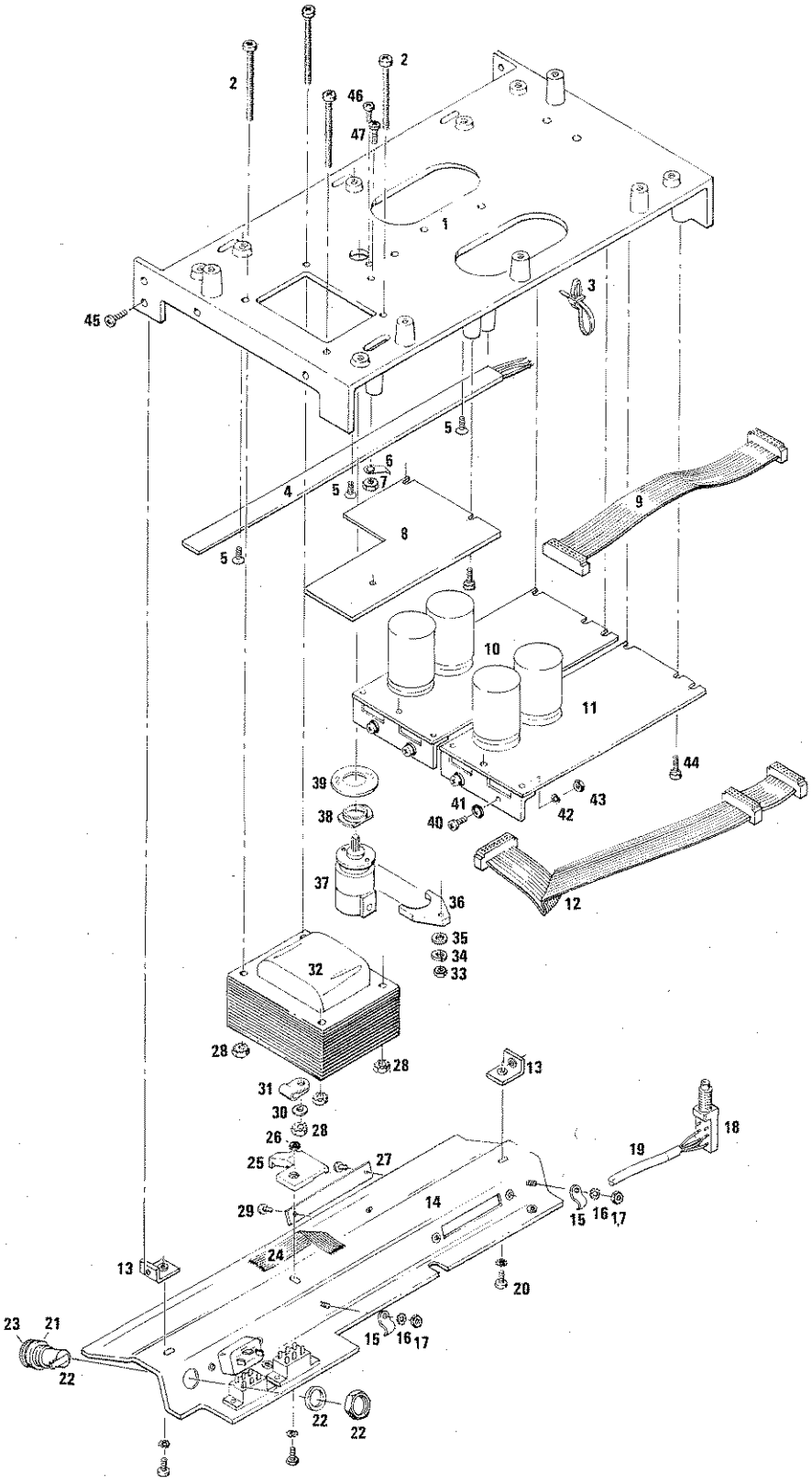


Figure 6-4. Rear Frame Assembly, Exploded View

Table 6-6. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
° . . . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
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
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance-capacitance
LED . . light-emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . . logarithmic taper (used in parts list)
log . . . . . logrithm(ic)
LPF . . . . . low pass filter
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
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time)
. . . ' . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter

NOTE

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

Table 6-6. Reference Designations and Abbreviations (Continued)

MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal-oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
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
μmho . . . . . micromho
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
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
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
nW . . . . . nanowatt
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)
PAM . . . . pulse-amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . . . pulse-duration modulation
pF . . . . . picofarad
PH BRZ phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . . polystyrene
PORC . . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . . position
POT . . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . peak-to-peak (used in parts list)
PPM . . . . pulse-position modulation
PREAMPL . . . preamplifier
PRF . . . . pulse-repetition frequency
PRR . . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . . pulse-time modulation
PWM . . . . . pulse-width modulation
PWV . . . . . peak working voltage
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
RMO . . . rack mount only
rms . . . . root-mean-square
RND . . . . . round
ROM . . read-only memory
R&P . . . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
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
SHF . . . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . . single-pole, single-throw
SSB . . . . . single sideband
SST . . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing-wave ratio
SYNC . . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . . . temperature compensating
TD . . . . . time delay
TERM . . . . . terminal
TFT . . thin-film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . . transistor
TTL . . transistor-transistor logic
TV . . . . . television
TVI television interference
TWT . . traveling wave tube
U . . . . . micro (10^{-6}) (used in parts list)
UF . . . microfarad (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . . voltage-controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . . volts, filtered
VFO . . variable-frequency oscillator
VHF . . . . . very-high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . . voltage-tuned oscillator
VTVM . . . . vacuum-tube voltmeter
V(X) . . . . . volts, switched
W . . . . . watt
W/ . . . . . with
WIV . . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium-iron-garnet
Z_o . . . . . characteristic impedance

NOTE

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

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
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}

Table 6-7. Code List of Manufacturers

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
0093A	Empire Electronic		
0160G	Allen-Bradley Co.	Milwaukee, Wi.	53212
0203G	Motorola Semiconductor Products	Phoenix, Az.	85008
0223G	Fairchild Semiconductor Div.	Mountain View, Ca.	94040
0260H	Thermalloy Co.	Dallas, Tx.	75231
0288C	Siliconix Inc.	Santa Clara, Ca.	95050
0299E	MEPCO/Electra Corp.	Mineral Wells, Tx.	76067
0329B	Corning Glass Works (Bradford)	Bradford, Pa.	16701
0340F	National Semiconductor Corp.	Santa Clara, Ca.	95051
0341B	Corning Glass Works (Wilmington)	Wilmington, N.C.	28401
0374D	Bourns Inc. Trimpot Prod. Div.	Riverside, Ca.	92507
0379D	Advanced Micro Devices Inc.	Sunnyvale, Ca.	94088
03888	KDI Pyrofilm Corp.	Whippany, N.J.	07981
0420J	Sprague Electric Co.	North Adams, Ma.	01247
0449B	Centralab Elek. Div. Globe-Union Inc.	Milwaukee, Wi.	53202
0460D	Federal Screw Products Co.	Chicago, Il.	60618
0470C	Littelfuse Inc.	Des Plaines, Il.	60016
0487F	C-W Industries	Warminster, Pa.	18974
04941	Walsco Electronics Corp.	Rockford, Il.	61101
0552D	Dale Electronics Inc.	Columbus, Ne.	68601
0573B	Industrial Retaining Ring Co.	Irvington, N.J.	07111
08261	Spectra-Strip Corp.	Garden Grove, Ca.	92642
27264	Molex Products Co.	Downers Grove, Il.	60515
28480	HP Div. 00 Corporate Hdq.	Palo Alto, Ca.	94304
31918	IEEE/Shadow Inc.	Minneapolis, Mn.	55426
73138	Beckman Instruments Inc. Helipot Div.	Fullerton, Ca.	92634
78189	Illinois Tool Works Inc. Shakeproof	Elgin, Il.	60126
79963	Zierick Mfg. Co.	Mt. Kisco, N.Y.	10549

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

7-2. This section contains information for adapting this manual to recorders for which the content does not apply directly.

7-3. If your recorder serial number is not listed on the title page of this manual or, in this section, it may be documented in a yellow MANUAL CHANGES supplement. For additional information about serial number coverage refer to INSTRUMENTS COVERED BY MANUAL in Section 1.

7-4. MANUAL CHANGES.

7-5. To adapt this manual to your recorder, refer to Table 7-1 and make all of the manual changes listed opposite your recorder serial number.

Table 7-1. Manual Changes by Serial Number

SERIAL PREFIX NO.	CHANGE NO.
1808A	1, 2
1741A	1, 2, 3

7-6. MANUAL CHANGE INSTRUCTIONS.

7-7. CHANGE 1.

7-8. Page 8-28, Table 8-5. Make the following changes.

	Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
Add:	A5R6	0757-0449	4	Resistor, 20K, 1%, .125W F	0329B	C4-1/8-TO-2002-F
	A5R8	0757-0449		Resistor, 20K, 1%, .125W F	0329B	C4-1/8-TO-2002-F
	A5R24	0757-0449		Resistor, 20K, 1%, .125W F	0329B	C4-1/8-TO-2002-F
	A5R26	0757-0449		Resistor, 20K, 1%, .125W F	0329B	C4-1/8-TO-2002-F
Change To Read:	A5	07015-60340	1	PCA, Preamplifier		
	A5R7	2100-3353	2	Resistor-TRMR-20K, 10%, 1Turn	0374D	3386X-Y46-203
	A5R25	2100-3353		Resistor-TRMR-20K, 10%, 1Turn	0374D	3386X-Y46-203

Page 8-29/30, Figure 8-24. Substitute the following Figure 7-1.

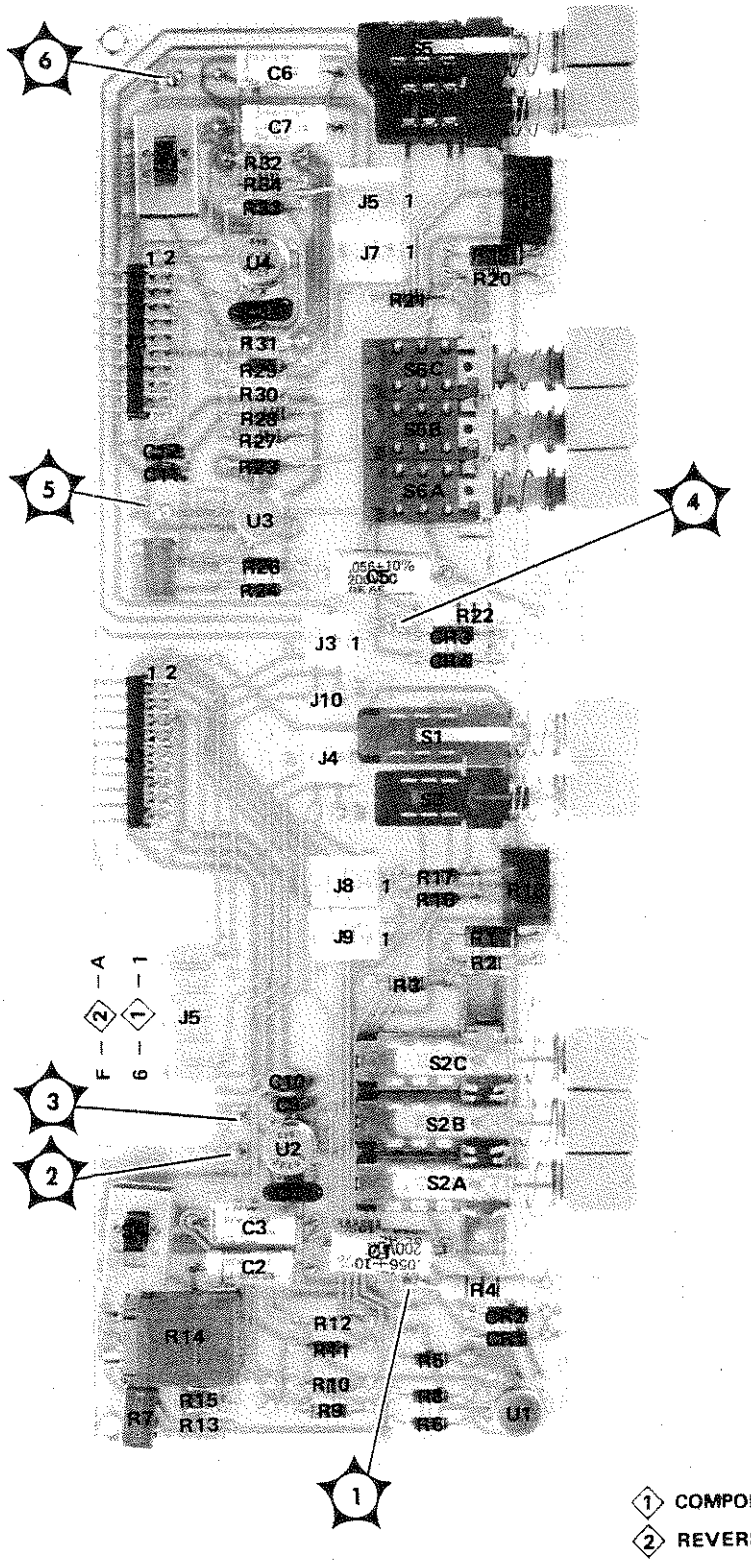


Figure 7-1. Preamplifier PCA A5 Parts Location

Page 8-29/30, Figure 8-25. Change the U1 and U3 circuits to agree with the following Figure 7-2.

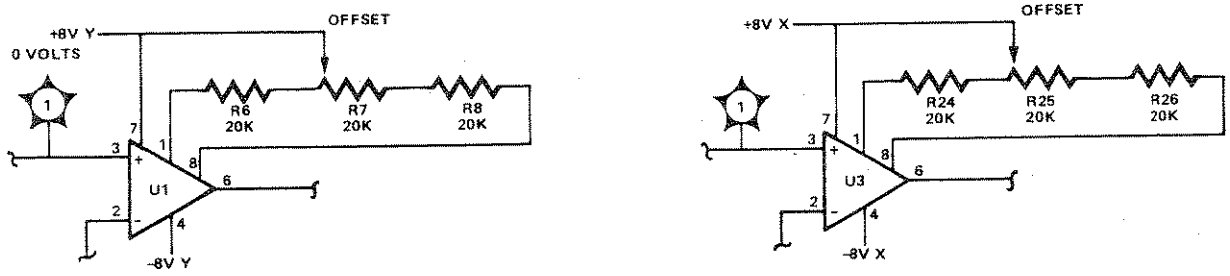


Figure 7-2. X and Y Axis Offset Changes

7-9. CHANGE 2.

7-10. Page 8-22, Table 8-3.

DELETE: A2 and A3C15 0160-0170 1 Capacitor-Fxd, .22μF.

Page 8-24, Figure 8-20. Substitute the following Figure 7-3.

Page 8-25, Figure 8-21. Delete Capacitor C15 (.22/25V) from the feedback loop of the servo amplifier.

7-11. CHANGE 3.

7-12. Page 6-4, Table 6-2. Make the following part number changes:

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
7	07010-00317	1	Cover, Connector	28480	07010-00317
8	07010-00313	1	Cover, Bottom	28480	07010-00313

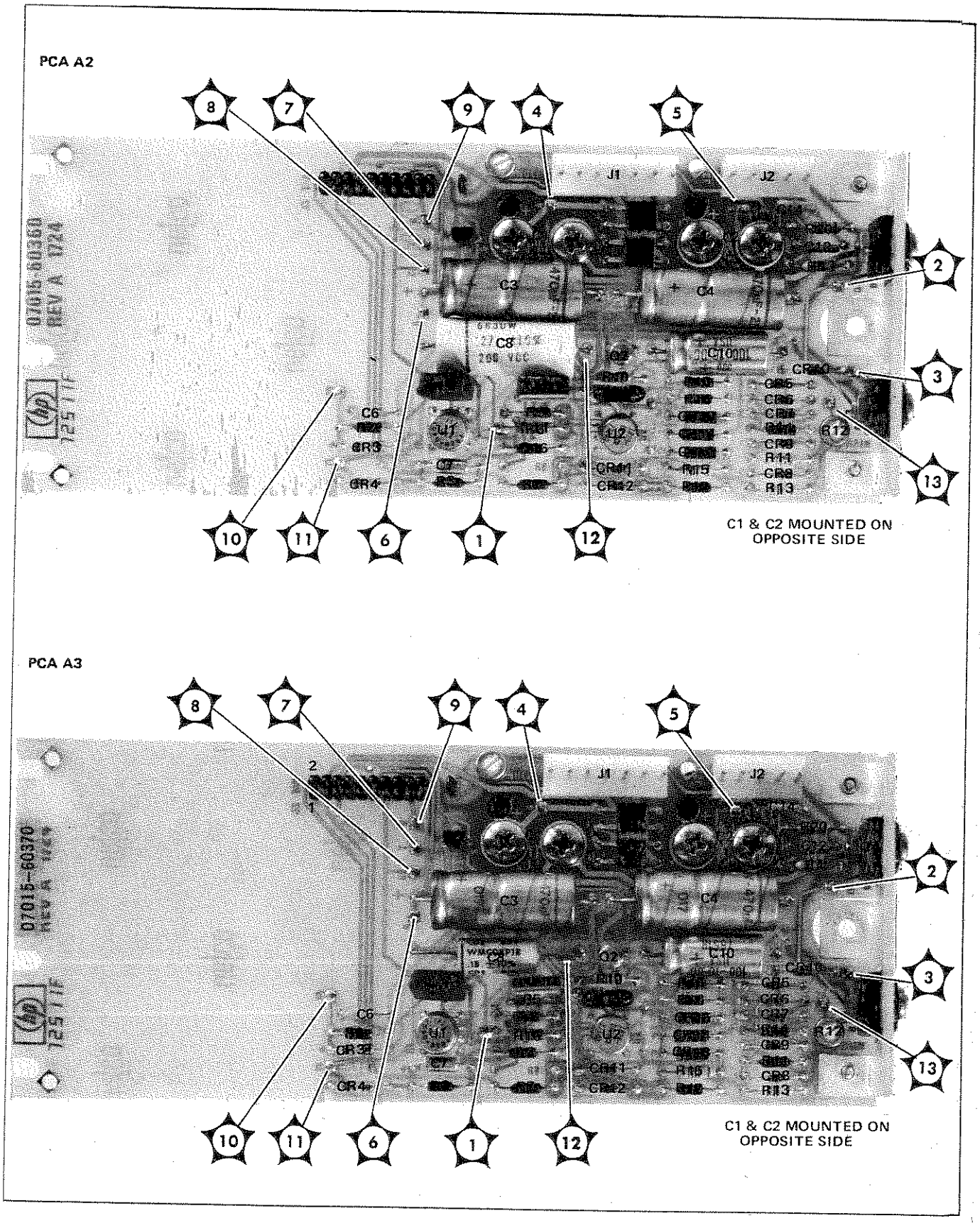


Figure 7-3. X and Y Amplifier PCA A2 and A3 Parts Location

MANUAL CHANGES

MANUAL TITLE: X-Y RECORDER 7015B

MANUAL PART NO. 07015-90002

MANUAL PRINTED: MARCH 1979

CHANGE DATE: MAY 6, 1982

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
1949A	1
2003	1, 2
2008A	1, 2, 3
2016A	1, 2, 3, 4

SERIAL PREFIX	MAKE CHANGE

SERIAL PREFIX	MAKE CHANGE

ERRATA

Page 1-3, Table 1-1. Change the following specifications to read:

Accuracy at 25°C: ±0.3% of full scale on 0.01 V/in. (5 mV/cm) range (includes linearity and resettability) plus ±0.20% of deflection when on other ranges. Temperature coefficient ±0.02% per degree Celsius.

Resettability: 0.2% of full scale.

Timebase:
Accuracy – 1.5% of full scale at 25°C.

Page 1-4, Figure 1-2.
Correct the figure as indicated.

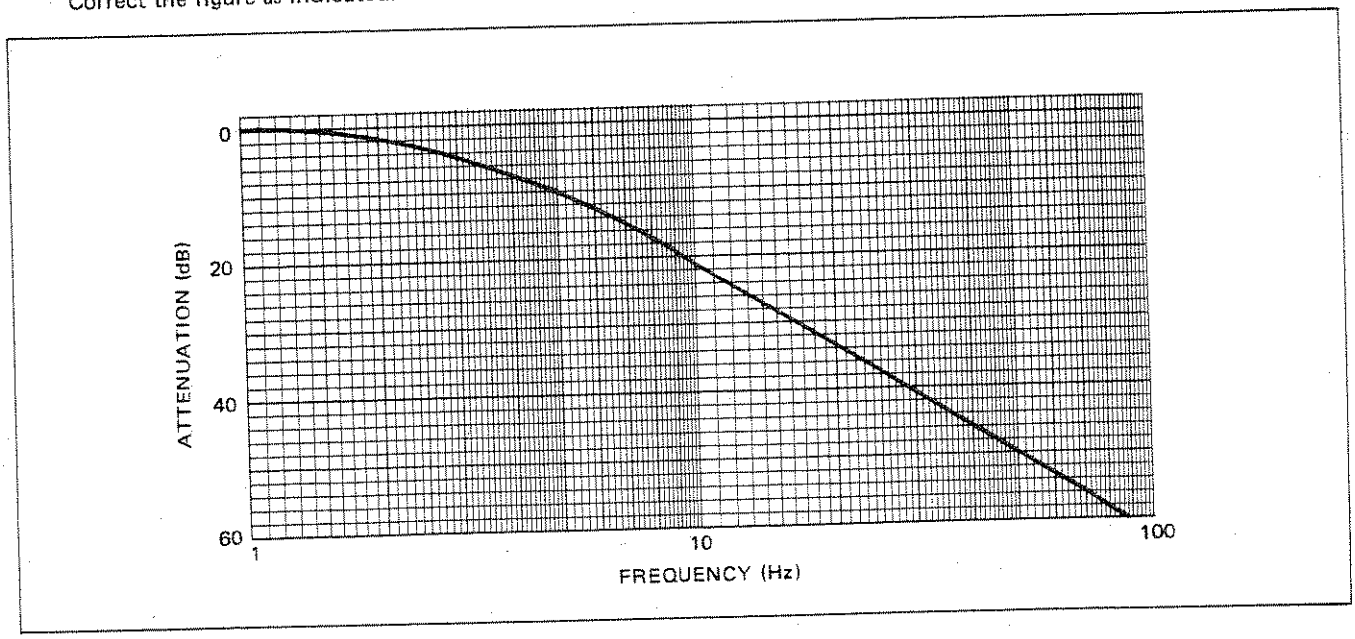


Figure 1-2. Typical Y Axis Frequency Response

▲Page 2-3, paragraph 2-19, step b. Add the following sentence:

To prevent damage to the platen, a plastic washer (P/N 2190-0311) must be placed between the Y-arm clamping bracket and the platen.

Page 3-1, paragraph 3-8. Add step f. as follows:

f. V/in. (V/cm): Press down the 1 V/in. (500 mV/cm) pushbutton switches in both X and Y axis.

Page 3-1. Add the following caution statement between paragraph 3-10 and paragraph 3-11:

CAUTION

One of the three input sensitivity range pushbuttons must be pushed down before power is applied or the X and Y axis will slew to their mechanical limits.

▲Page 3-2, Figure 3-1, item 4. Change to read:

PEN WRITE/LIFT switch. A two position pushbutton switch. When placed in the WRITE position the pen is lowered on to the chart.

Page 4-3, paragraph 4-13, step c., line 2 to read:

. . . an output voltage of approximately 0.6 V (0.76 V for metric model).

Page 4-4, paragraph 4-13, step d., item 7 to read:

7. FILTERS – OUT. (Remove bottom cover for switch access.)

Page 4-4, paragraph 4-13, substitute the following for step n.

n. Set HP 6202B Power Supply for an output voltage of approximately 0.9 V (1.15 V for metric model).

Page 4-6, paragraph 4-17. c. and d. also paragraph 4-19. c. and d. to read:

4-17 . . .

c. Set X-RANGE switch to 1 V/in. (500 mV/cm) and Y-RANGE switch to 0.1 V/in. (50 mV/cm). Gradually increase amplitude of function generator until Y-axis has a travel of 7 in. (17.8 cm).

d. Perform steps 4-15. e. through h.

4-19 . . .

c. Set X-RANGE switch to 0.1 V/in. (50 mV/cm) and Y-RANGE switch to 1.0 V/in. (500 mV/cm). Gradually increase amplitude of function generator until X-axis has a travel of 7 in. (17.8 cm).

d. Perform steps 4-15. e. through h.

Page 5-4, paragraph 5-15. f., line 2, to read:

sweep at 1 in./sec (2 cm/sec).

Page 5-4, paragraph 5-17. step h., line 2 to read:

. . . indicates 0 V ±1.0 mV.

▲Page 5-12, Figures 5-17 and 5-18 are interchanged. Exchange figure numbers and titles.

▲Page 6-3, Table 6-1, Accessory Kit. Add the following item:

Qty 2	POLARIZING KEY-CONNECTOR	1251-1115

Page 6-4, Table 6-2. Make the following change:

Item 10	0403-0187

Page 6-8, Table 6-4. Make the following changes:

Item 9	2420-0003	
Item 12	2420-0003	
Item 13	2190-0056	
Item 23	2360-0121	
Add:	3101-2227	Switch PB DPDT (ac line)

Page 6-10, Table 6-5. Make the following changes:

Item 7	2360-0117
Item 14	07015-60317
Item 26	2420-0003
Item 28	2580-0003
Item 29	2200-0103
Item 30	3050-0001
Item 31	1400-0017
Item 32	5081-1985
Item 40	2360-0199
Item 43	2420-0003

Page 8-1, paragraph 8-7. Make the following changes:

S2 to S6
CR1 and CR2 to CR3 and CR4
R4 to R22
U1 to U3

Page 8-1, paragraph 8-9. Make the following changes:

U1 to U3
R9 and R10 to R27 and R28
R11, R12, R2 to R29, R30, R3
S3 to S7
R7 to R25

Page 8-1, paragraph 8-11. Make the following changes:

U2 to U4
S4 to S8
R16 and R17 to R33 and R34

▲Page 8-1, paragraph 8-14. Make the following changes:

R18 to R35
R7 to R8

Page 8-1, paragraph 8-15. Make the following changes:

R7, R6, R5 to R8, R7, R6
R7 to R8
R6 to R7
R5 to R6

Page 8-2, paragraph 8-17. Make the following changes:

U4 to U2
R13 to R14

Page 8-2, paragraph 8-18. Make the following changes:

R18 to R20

Page 8-2, paragraph 8-20. Make the following changes:

U3 to U1
R5 to R6
R4, C8 to R5, C8

Page 8-2, paragraph 8-22. Make the following changes:

R1 to T1

Page 8-2, paragraph 8-25. Substitute the following:

Placing the PEN switch S3 in the WRITE position pulls pin 8 of U1 low. The output at pin 14 goes high causing Q1 to conduct. The diode CR11 limits the base voltage of Q1. The initial conduction discharges C9 providing a pull-in pulse to the pen solenoid. After C9 discharges, the current through the transistor Q1 is sufficient to hold the solenoid energized.

Page 8-21, Figure 8-19. Change voltage reference at Resistor R13 to read +16 V(C).

Page 8-23, Table 8-3. Make the following changes:

A2 & A3R19 to 0757-0438

Page 8-25, Figure 8-21. Make the following changes:

C14 to 0.1/100V

Page 8-28, Table 8-5. Make the following changes:

A5 Miscellaneous
PUSHBUTTON to 3131-0382

CHANGE 1

Incorporates a new pen holder assembly.

Page 6-4, Table 6-2, Item 14, Pen Holder.
Change the part number to 07010-60354.

Page 6-6, Table 6-3, Item 38, Pen Holder.
Change the part number to 07010-60354.

CHANGE 2

Adds a resistor to X and Y Amplifier PCA's A2 and A3 to prevent oscillations in the emitter-follower output stage.

Page 8-23, Table 8-3, add the following item:

A2 and A3R21	0757-0401	1	Resistor 100 1% .125W F TC=0+-100	03292	C4-1/8-TO-101-F

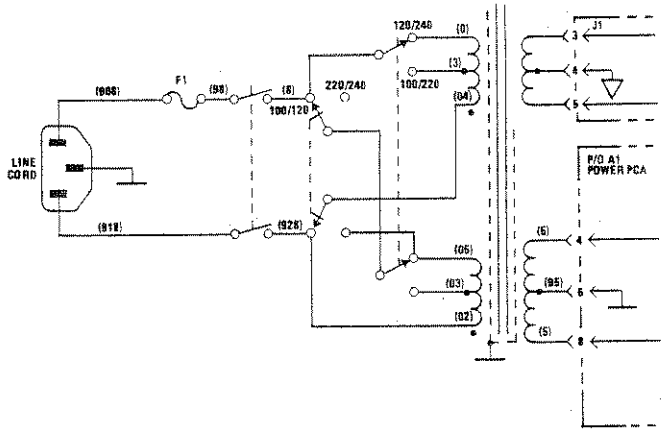
Page 8-25, Figure 8-21, Schematic Diagram. Draw Resistor R21 100 ohms between Pin 6 of U2 and Q3-Q4 base terminals (adjacent to TP2).

NOTE: On some PCA's this resistor will be physically located on the etch side of the board.

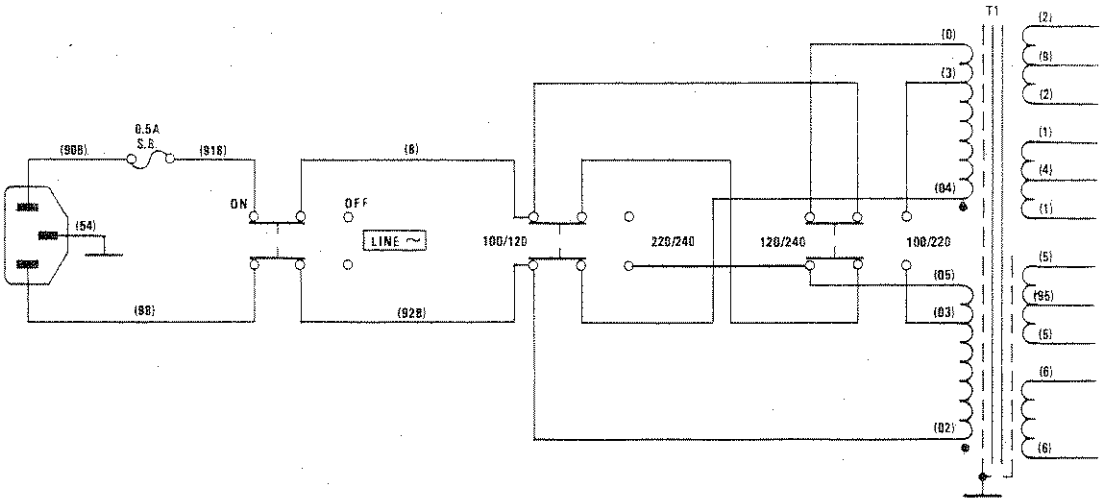
CHANGE 3

Changes wiring on the AC Voltage Select switches to correct the transformer output voltage on the 220V switch position.

Page 8-19, Figure 8-17. Change the ac primary circuit as indicated.



Page 8-31, Figure 8-26. Change the ac primary circuit as indicated.



CHANGE 4

This change adds two reverse biased diodes to the power supply circuitry. These diodes prevent the regulator circuit from latching-up due to a negative biasing of the positive output when power is first applied.

A Capacitor C16 is added which, in conjunction with Resistor R21 (see Change 2) eliminates oscillations in the emitter-follower Transistor circuitry of Q3 and Q4.

Also with this change, Resistor R15 is relocated and two resistors (R22 and R23) are added to the Amplifier PCA's. These three resistors with Capacitor C13 eliminate oscillations in the servo-loop circuitry.

Page 8-22, Table 8-3. Add the following components:

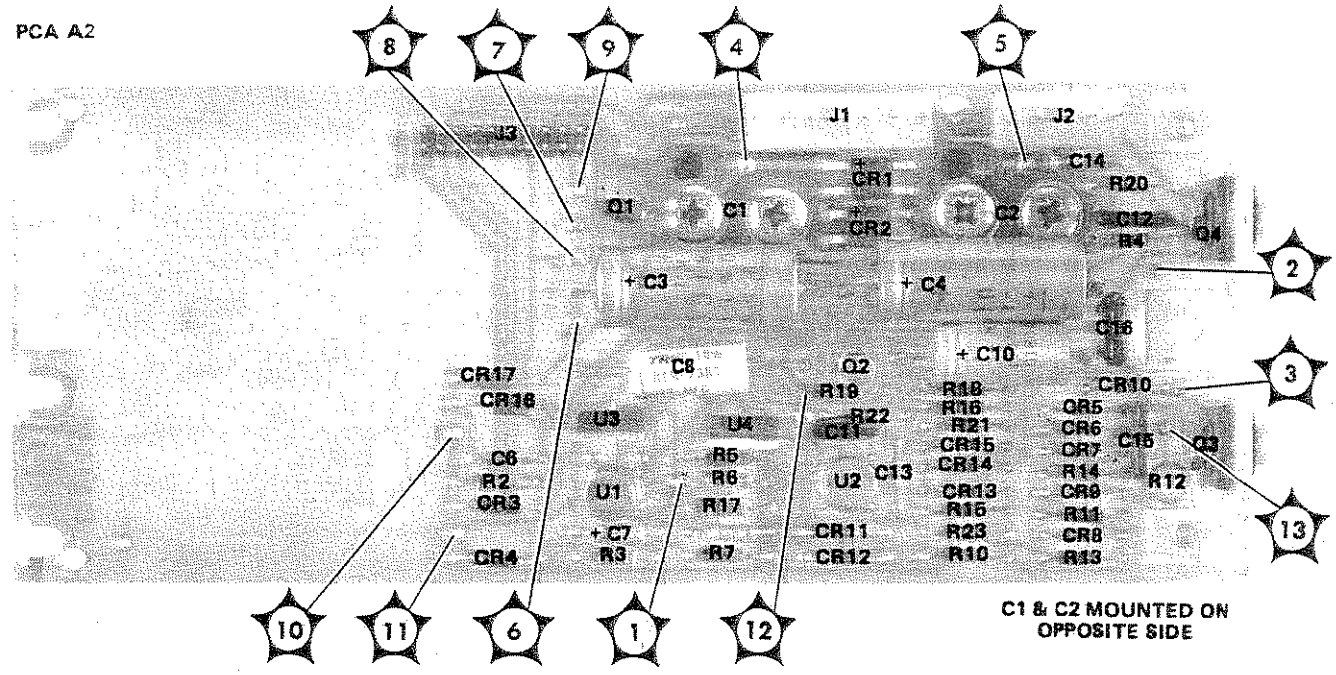
A2+A3C16	0160-2735	1	Capacitor-Fxd .001UF ±5% 100Vdc MICA	28480	0160-2735
A2+A3CR16	1901-0743	2	Diode-Pwr Rect 400V 1A	0223G	1N4004
A2+A3CR17	1901-0743		Diode-Pwr Rect 400V 1A	0223G	1N4004

Page 8-23, Table 8-3. Add the following components:

A2+A3R21,R22,R23	0757-0401	3	Resistor 100 1% .125W TC=0+-100	00746	CRB14

Page 8-24, Figure 8-20. Substitute the following parts location illustration.

Page 8-25, Figure 8-21. Substitute the following partial schematic for the area indicated.



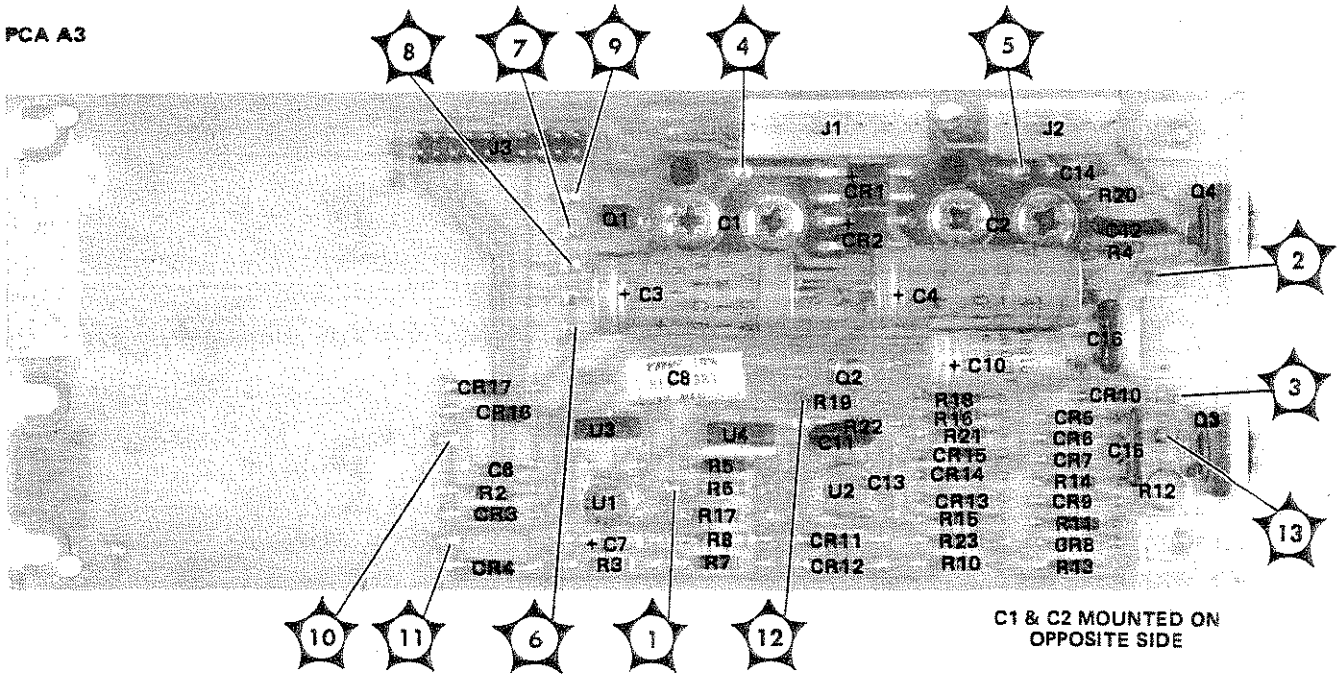


Figure 8-20. X and Y Amplifier PCA's A2 and A3 Parts Location

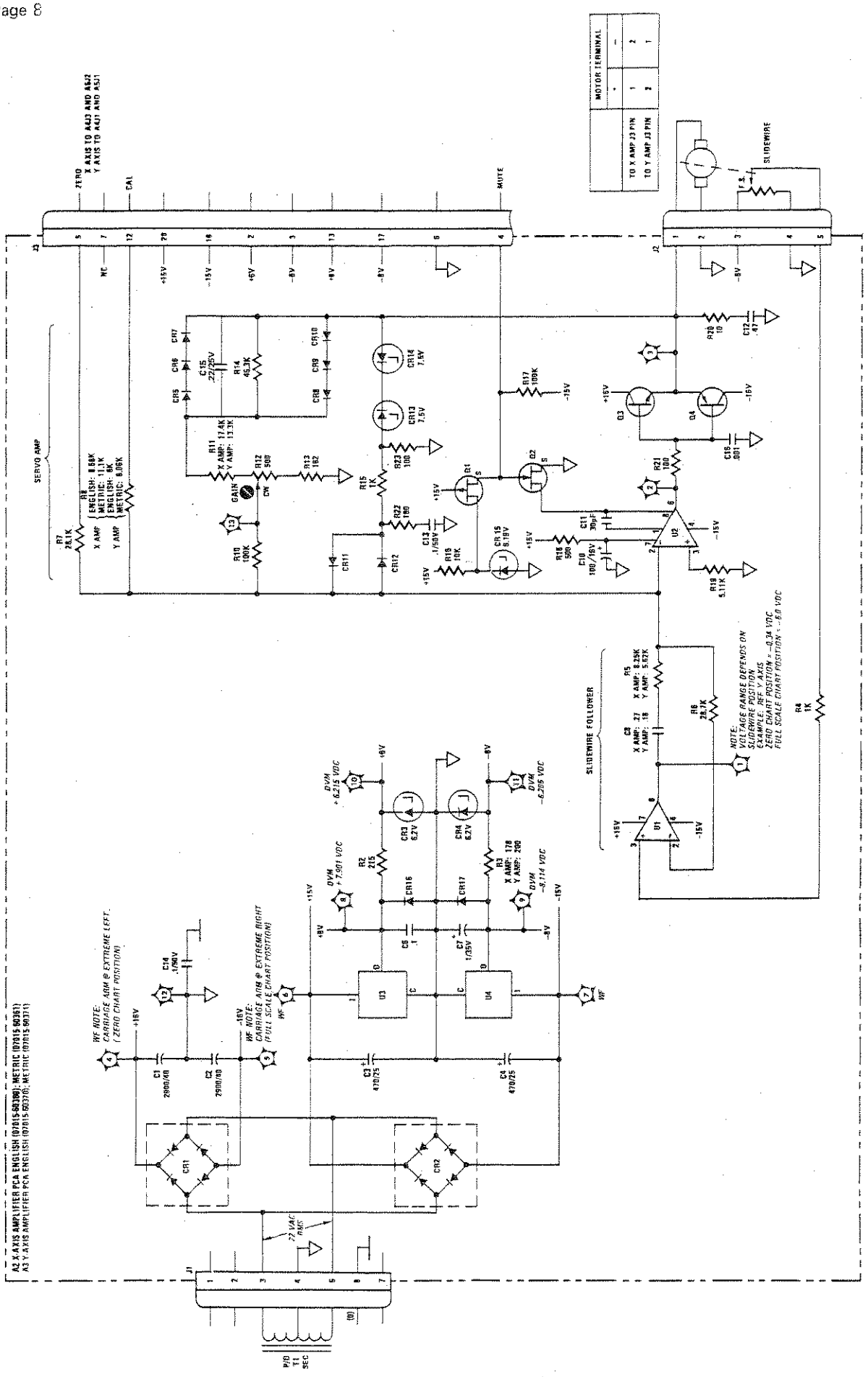


Figure 8-21. X and Y Amplifier PCA's A2 and A3, Schematic Diagram

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section includes the theory of operation; instrument maintenance such as cleaning and lubrication; troubleshooting and repair; as well as schematic diagrams and parts location photos of the printed circuit assemblies.

8-3. The 7015B has the following printed circuit assemblies.

a.	A1 Power Supply PCA	Contains +16V and -16V supply and control circuits for pen lift and time base.
b.	A2 X-Axis Amplifier PCA	Contains 16V, 15V and 6V supplies and the servo and power amplifier circuit for X-axis.
c.	A3 Y-Axis Amplifier PCA	Contains 16V, 15V and 6V supplies and servo and power amplifier circuit for the Y-axis.
d.	A4 Control PCA	Contains the time base sweep rate circuit and recorder function switches.
e.	A5 Preamplifier PCA	Contains the X and Y input circuits, range selector circuits, preamplifier circuits and active filters.

8-4. FUNCTIONAL THEORY OF OPERATION.

8-5. The following paragraphs contain a description of the recorder circuits by function. Included is a functional description using block diagram Figure 8-17, with detailed circuit analysis where necessary.

8-6. INPUT CIRCUIT.

NOTE

The X and Y axis service systems are essentially the same. Threfore only the Y-axis will be discussed here. Any difference between the two axes will be pointed out.

8-7. The input signal, either from the front or rear input connectors, is applied to the three section attenuator switch S2 and the corresponding attenuator resistors. The overvoltage protection circuit consists of zener diodes CR1 and CR2 and resistor R4. This circuit limits the input to U1 to 10V.

8-8. PREAMPLIFIER CIRCUIT.

8-9. The conditioned input signal is applied to the preamplifier U1, R9, R10, the vernier R11, R12, R2 and the offset circuit R6, R7, R8. With the vernier switch S3 in the CAL position the preamplifier gain is fixed by the values of R9 and R10. With switch S3 in the VERNIER position the gain is determined by the setting of the vernier potentiometer R20. Offset potentiometer R7 zeros out any voltage offset in the preamplifier.

8-10. FILTER CIRCUIT.

8-11. From the preamplifier the signal is applied to a two pole active filter U2 and associated components. The filter provides 50db normal mode rejection at 60 hz. Switch S4 is provided to bypass the filter. Gain resistors R16 and R17 set the gain of the stage at 1.24 for minimum response time and minimum overshoot.

8-12. Phase potentiometer R14 is provided in the Y axis only. This provides for phase balancing of the X and Y servo channels.

8-13. SUMMING CIRCUIT.

8-14. The preamplifier output voltage is applied to the Y Cal potentiometer R18 and a series scaling resistor R7. The value of the summing resistor differs between the two axes and with metric calibration (Option 001).

8-15. The junction of R7, R6 and R5 is referred to as the summing node and is maintained at approximately zero volts when the servo is at null. Since the preamplifier output voltage is fixed at a level determined by the input signal and the summing node is maintained at approximately zero volts, a current thru R18 and R7 is generated which is proportional to the input signal. Two other currents are also summed at this point. The zero control potentiometer current enters through R6 and the feedback current from the slidewire follower enters through R5. The sum of the three currents will cancel at servo null to maintain zero volts at the summing node.

8-16. Servo amplifier – Any voltage which appears at the summing node will be amplified by the servo amplifier and applied to the dc servo motor which will change the position of the wiper on the slidewire. This will change the slidewire circuit voltage and return the summing node to null.

8-17. Servo amplifier voltage gain is accomplished by U4 a high gain linear amplifier. The output of U4 is applied to darlingtron power amplifier Q3 and Q4 in an emitter follower configuration. The power amplifier supplies the high current capability drive voltage for the dc servo motor. Zener diodes CR13 and CR14 limit the motor drive voltage. In the servo feedback circuit, the network of CR5 – CR10 and R13 provide for increased gain for small servo error voltages. This compensates for starting friction in the servo motor and associated mechanical parts.

When the diodes reach conduction level R13 is effectively eliminated reducing the gain of the circuit.

8-18. The servo amplifier has maximum stability when driving a resistive load. To compensate for the inductive load of the motor C12 and R18 are added. The combined circuit C12, R18 and B2 "look" like a resistive load to the amplifier.

8-19. SLIDEWIRE CIRCUIT.

8-20. The servo motor drives both the pen and the wiper of the slidewire potentiometer. Any movement of the wiper on the potentiometer will vary the voltage to the slidewire follower U3. U3 is a high impedence unity gain amplifier. The output of U3 is applied to scaling resistor R5 and to the compensation network R4, C8. The compensation network prevents excessive pen overshoot or oscillation as the servo responds to a changing input signal.

8-21. AUTOGRIP POWER SUPPLY.

8-22. The autogrip power supply is a voltage multiplier circuit. The input to the supply is 308 Vac from a secondary winding of power transformer R1. The power supply is current limited by R1, making it impossible to measure the high voltage dc output with a low impedence dc voltmeter.

8-23. PEN LIFT CIRCUIT.

8-24. The electric pen lift circuit is controlled from the front panel switch or remote control connector at the rear of the instrument. Remote control may be either contact closure to ground or TTL level switching.

8-25. Placing the PEN switch S4 in the RECORD position applies -16V to comparator U1C. This causes the output at pin 2 to go high. This high output is applied to the base of the relay driver Q1. The base Q1 goes high, limited by the zener diode CR11. Q1 conducts discharging C9. The discharge of C9 provides an initial pull-in pulse for the pen solenoid. After the discharge of C9 current flow through the solenoid coil maintains the pen in the record position. If the PEN switch is in the RECORD position and the power to the instrument is interrupted, U1D keeps Q1 turned off momentarily by the time delay R13, C8. The delay allows capacitor C9 to charge sufficiently to create the required pull-in pulse when the output of U1D goes high and allows Q1 to conduct.

8-26. X TIMEBASE CIRCUIT.

8-27. The X Time Base circuit may be controlled either from the front panel SWEEP/RESET button or through the remote control connector at the rear of the plotter. Remote control may be achieved either by contact closure to ground or by TTL level control.

8-28. Pen sweep is initiated either by placing switch S5 in the sweep position or by contact closure to ground on the remote control connector. This provides a low to pin 10 of comparator U1A. The output of U1A will go high deenergizing time base relay coil L1. L1 opens switch S7 allowing the sweep integrator to develop the sweep voltage.

8-29. The high output of comparator U1A is also applied to pin 8 of comparator U1B causing the output at pin 14 to go low. This low is applied to comparator U1C of the pen lift circuit. This lowers the pen onto the chart at the start of the sweep.

8-30. The integration voltage charges C1 through the resistor selected by the time base switch S4. The current is kept constant by the feedback of the linear amplifier U1. The output of the sweep integrator is applied to the scaling resistor R11 to provide the current required by the X amplifier circuit. The charging voltage for C1 may be varied by the SWEEP CAL potentiometer R8 to accurately calibrate the sweep time.

8-31. To return the pen to its original position the time base switch S5 is set to the RESET position. This creates a high input at pin 10 of U1A causing the output to go low. This energizes time base relay coil L1 and also causes the pen to lift. When L1 energizes switch S7 closes allowing the discharge of C1 through R10. The zero output signal from U1 is applied to the X-axis amplifier returning the pen to zero.

8-32. SERVO MUTE.

8-33. It is possible to disable the recorder servo system either by placing the front panel SERVO switch in the STANDBY position or remotely through the rear input Remote Control Connector. Remote Control of the servos is by contact closure to circuit common of the axis being switched.

8-34. Switching to STANDBY connects common to the base of FET Q2. Q2 turns on providing a path for current flow from pin 8 of the OP Amp U4 to common, disabling U4.

8-35. FET Q1 disables the servo when power is removed from the recorder. The +15V at the base of Q1 will decay more rapidly than the regulated +6V at the drain of Q1. Q1 will switch on raising the voltage at the base of Q2. This switches Q2 on disabling the servo amplifier. This will eliminate any possible pen movement when power is removed.

8-36. INSTRUMENT CLEANING.

8-37. Thorough cleaning should be performed periodically. Intervals are determined by type of operation, local air contamination, and climatic conditions. Under normal use and conditions, cleaning intervals should be nine to twelve months. Cleaning routine should include the following:

a. Remove platen and bottom cover. See paragraph 8-58 steps b and c.

b. In accessible areas where there is only dust accumulation, cleaning can be accomplished with an air gun. Use slidewire cleaner, part number 5080-3605 to clean circuit boards. Where an air gun cannot remove dirt, dust, or ink accumulation on mechanical parts, clean with a sponge or cloth saturated in mild liquid soap and warm water, and wipe dry.

c. Every twelve months, gears should be cleaned thoroughly with slidewire cleaner, part number 5080-3605, and relubricated. Do not use soap or water on these components.

8-38. AUTOGRIP TABLE CLEANING.

8-39. Dust and other contaminants on the Autogrip surface lower the paper holding capability. Although recording ink will not affect Autogrip performance, it may be desirable to remove ink stains as well. NO STRONG CHEMICALS, SILICONE-BASE CLEANERS, OR HARSH ABRASIVE CLEANERS SHOULD BE USED ON THE AUTOGRIP TABLE.

WARNING

Scratches or punctures in the table surface may expose high voltage conductors. Instruments damaged in this manner should NOT BE OPERATED. For cleaning apply water using only a Kimwipe® or equivalent, being careful to not allow water to stand on the Autogrip surface or run through openings in the enclosure as it may cause a potential electrical hazard.

a. Cleaning moderate contamination can be accomplished as follows:

1. Prepare a mixture of 75% isopropyl alcohol and 25% water by volume.

2. Apply the alcohol/water mixture to the table using a Kimwipe®. Immediately wipe any moisture from the surface. Never let any liquid stand on Autogrip surface as the surface may become permanently damaged.

b. If the surface cannot be easily cleaned with the alcohol/water mixture, cleaning can be accomplished as follows:

1. Select a clean, lint-free cloth that will not scratch the Autogrip surface.

2. Dampen the cloth with warm water or alcohol and apply a light amount of cleanser (HP 9310-0515). A commercial cleanser such as Ajax®, Comet®, or Vim® may be used.

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

4. Allow the table to dry before recording.

8-40. SLIDEWIRE CLEANING.

8-41. Irregular or jumpy recordings produced by smooth signals on a properly adjusted recorder may indicate worn or dirty slidewires or wipers. To clean X-axis slidewire:

a. Place unit in upright position with back of instrument facing forward.

b. Remove hood. See paragraph 8-58 step a.

c. Spray X-axis wiper contacts with slidewire cleaner (HP Part No. 5080-3605). Spray industrial cotton applicator (HP Part No. 5080-5400) with slidewire cleaner and rub along X-axis slidewire. See Figure 8-1.

NOTE

If there is discoloration on cotton applicator, repeat cleaning process until there is no stain.

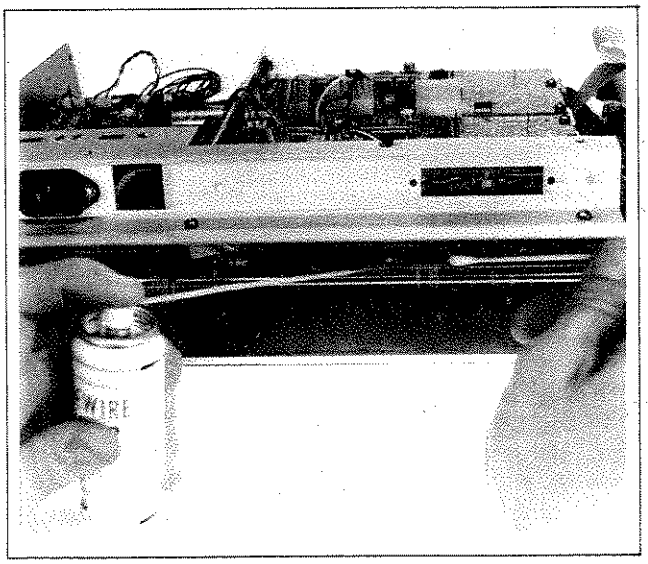


Figure 8-1. Slidewire Cleaning

8-42. To clean Y-axis slidewire:

a. Place unit in upright position with front of instrument facing forward.

b. Remove hood. See paragraph 8-58 step a.

c. Raise pen holder.

d. Raise pen bar to expose Y-axis slidewire.

e. Spray Y-axis wiper contacts with slidewire cleaner (HP Part No. 5080-3605). Spray industrial cotton applicator (HP Part No. 5080-5400) with slidewire cleaner and rub along Y-axis slidewire.

NOTE

If there is discoloration on cotton applicator, repeat cleaning process until there is no stain.

8-43. LUBRICATION.

8-44. This is a precision instrument. Gears and other moving parts have very close tolerances. Intervals between periodic lubrication are determined by the type of operation, local air contamination, and climatic conditions. All ball bearings are pre-lubricated. No lubrication is needed for them. The procedure for periodic lubrication is as follows:

a. Clean balance potentiometers and clean X- and Y-axis slider rod every three months.

NOTE

Do not use slidewire lubricant on plastic-coated X or Y slidewires.

b. Every twelve months or 150 hours, whichever comes first:

1. Clean and lubricate drive gears and guide under Y-axis carriage arm with light grade silicone grease, Part No. 6040-0363. A light film of grease is sufficient.

2. Clean with slidewire cleaner (Part No. 5080-3605) and clean cloth, and lubricate X- and Y-axis slider rod with instrument oil, Part No. 6040-0220.

8-45. VISUAL INSPECTION AND MECHANICAL FREEDOM TEST.

8-46. During periodic cleaning and lubrication, a planned inspection should be performed. The following steps are a general approach:

a. Check both X and Y drive gears for proper adjustment (minimum backlash) and any worn or damaged teeth.

b. Inspect X-axis drive cable pulleys for any binding.

c. Ensure servo motors are mounted securely.

d. Slide pen carriage through several excursions, listening for scrapes, grinding noises, etc., while feeling for any binding in the movement. Repeat procedure for carriage arm. If binding or other problem exists, perform step g.

e. Check cables of both axes for evidence of fraying or rubbing.

f. Check components for evidence of overheating, loose connections, cracked circuit boards, or other defects.

g. Remove bottom cover per paragraph 8-58 step b. Disconnect A2J2 X-Amp motor connector and apply a level of 2.25V from an external dc power supply to the X-servo motor terminals pins (1) and (2). This should drive arm to left or right depending on polarity. If arm stops along travel, mechanical bind may exist. Clean and lubricate slider rod. If situation continues, perform paragraph 5-40 to correct bind, or replace servo motor per paragraph 8-71.

h. Disconnect A3J2 Y-amp motor connector. Apply a level of ±2V from an external dc power supply to the Y-servo motor terminal pins (1) and (2). This should drive the Y carriage pen up or down scale, depending on polarity. If pen carriage stops along travel, a mechanical bind may exist. Clean and lubricate gears and slider rod, and readjust backlash for minimum backlash without binding. Correct all mechanical binds. If problem continues, replace servo motor per paragraph 8-71.

8-47. TROUBLESHOOTING.

8-48. The overall block diagram (Figure 8-17) can be used to isolate a problem to a particular assembly or circuit. After a problem has been thus isolated, use the troubleshooting table (Table 8-1) together with the PCA parts location and schematic for that board to obtain detailed troubleshooting information for the circuit.

8-49. SAFETY CONSIDERATIONS.

8-50. The safety considerations outlined in Section I, paragraph 1-6 apply when troubleshooting the 7015B.

8-51. RECOMMENDED TEST EQUIPMENT.

8-52. Refer to Section I, Table 1-3 for recommended test equipment. Equivalent equipment may be used if the model listed is not available.

8-53. TROUBLESHOOTING PROCEDURES.

8-54. Table 8-1 lists troubleshooting procedures for Model 7015B.

Table 8-1. Troubleshooting

PROBLEM	POSSIBLE CAUSE	CURE
AUTOGRIP		
1. Chart paper does not adhere to table correctly.	a. Improper chart paper.	a. Use HP or equivalent.
	b. Contamination on table.	b. Clean table (paragraph 8-38).
	c. Cable to table not connected or damaged.	c. Correct or repair.
	d. Autogrip table defective.	d. Replace (paragraph 8-56).
	e. Autogrip power supply output voltage too low.	e. Isolate defective component and replace.
	f. Chart switch defective.	f. Replace.
2. Chart paper does not release from table in CHART RELEASE.	a. Chart switch defective.	a. Replace.
	b. A1R2 or A1R3 open 10M.	b. Replace.
ELECTRIC PEN		
1. Pen will not lower in RECORD position.	a. Power supply defective.	a. Check +16, -16V.
	b. Pen solenoid defective.	b. Replace.
	c. Pen switch defective.	c. Replace.
	d. A1 Circuit Board defective.	d. Isolate defective component and replace.
TIME BASE		
1. Recorder will not sweep in SWEEP position but operates correctly with X-signal inputs.	a. Relay not operating.	a. Check contact continuity. Driver A1U1A not switching. Switch A4S4 defective.
	b. Sweep resistor open.	b. Identify and replace resistor.
	c. Defective IC	c. Replace A4U1.
	d. Charging capacitor open.	d. Replace A4C1.
2. Sweep will not calibrate (Refer to paragraph 5-14)	a. -6V X Power Supply defective. PCA A2	a. Repair.
	b. A4R8 CAL potentiometer defective.	b. Replace.

Table 8-1. Troubleshooting (Continued)

PROBLEM	POSSIBLE CAUSE	CURE
TIME BASE (Continued)		
2. (Continued)	c. Sweep charging resistor changed value. d. Sweep IC/A4U1 defective. e. Scaling attenuator R7 and R9 defective.	c. Replace. d. Isolate defective component and replace. e. Replace defective resistor.
3. Sweep will not reset to zero after sweeping to full scale. (Refer to Para. 4-34.)	a. A4S5 defective. b. Reed relay defective.	a. Replace b. Replace.
4. One or more time base range is incorrect.	a. S6 or S5 defective. b. Range resistor changed value.	a. Replace. b. Isolate defective resistor with precision ohmmeter and replace.
5. Pen will not drop when in SWEEP.	a. Pen lift not oper. b. A1U1B defective.	a. Refer to Electric pen. b. Replace.
6. Pen will not lift in RESET.	a. PEN switch is in RECORD position. b. A1U1B defective.	a. Reposition to LIFT b. Replace
SERVO SYSTEM		
1. Pen will not move in X or Y axis with any combination of zero control or input signal.	a. SERVO switches standby. b. Line fuse blown. c. Voltage selector switch is in wrong position. d. Power supply voltages incorrect. e. Defective Servo Amplifier power supplies. f. Defective Servo Motor. g. Servo Voltage Amplifier or Power Amplifier defective.	a. Turn SERVO on. b. Replace fuse. c. Reposition. (See Figure 2-3.) d. Isolate and replace defective components. e. Isolate and replace defective components. f. Replace (Paragraph 8-68). g. Isolate and replace defective components.

Table 8-1. Troubleshooting (Continued)

PROBLEM	POSSIBLE CAUSE	CURE
SERVO SYSTEM (Continued)		
1. (Continued)	h. Slidewire wiper not contacting.	h. Clean and align or replace if necessary (paragraphs 5-46, 5-48, 8-58, 8-64).
	i. Mechanical binding.	i. Locate and repair paragraph 8-45.
2. Pen does not respond to input signal on X or Y-axis but pen can be positioned with zero control.	a. X Time Base X INPUTS in Time Base position.	a. Reposition.
	b. Attenuator switch defective.	b. Replace.
	c. Preamplifier defective.	c. Troubleshoot and repair.
	d. Filter defective.	d. Troubleshoot and repair.
	e. No V/in button depressed.	e. Select V/in range.
3. Pen responds to input signal correctly, but pen does not respond properly to zero control.	a. Zero potentiometer defective.	a. Replace.
	b. + or -6V power supply voltage incorrect.	b. Isolate and replace defective component.
	c. A2R6 or A3R6 defective.	c. Replace.
4. X or Y-axis cannot be calibrated.	a. Switch in Vernier position.	a. Reposition to CAL.
	b. X TIME BASE selected.	b. Reposition to X inputs.
	c. Attenuator resistors incorrect value.	c. Replace incorrect values.
	d. Preamplifier defective.	d. Troubleshoot and repair.
	e. CAL potentiometer defective.	e. Replace.
	f. R7 incorrect value.	f. Replace.
5. Cannot adjust OFFSET properly.	a. A5U1 or A5U3 defective.	a. Replace.
	b. OFFSET potentiometer defective.	b. Replace.
6. Linearity does not meet specifications.	a. Not calibrated properly.	a. Recalibrate (Paragraph 5-8).
	b. Slidewire follower defective.	b. Replace.
	c. Slidewire not linear.	c. Replace (paragraph 8-58, 8-62).
	d. Preamplifier defective.	d. Isolate and replace defective components.

Table 8-1. Troubleshooting (Continued)

PROBLEM	POSSIBLE CAUSE	CURE
SERVO SYSTEM (Continued)		
6. (Continued)	e. Filter defective.	e. Troubleshoot and repair.
7. Retrace does not met specifications.	a. Mechanical binding.	a. Check mechanical freedom. (Paragraph 8-45.)
	b. Servo Motor defective.	b. Replace.
	c. Gear backlash adjusted too tight.	c. Readjust (Paragraph 5-38, 5-40).
	d. Binding in servo.	d. Correct (Paragraph 8-45).
	e. Servo Amplifier gain too low.	e. Replace defective components (voltage gain from slidewire wiper to servo motor drive with motor disconnected should be approximately 380 for X-axis (300 for Y-axis).
8. Input impedance to ground lower than specification (10 Megohm) or Common Mode Rejection does not meet specifications.	a. X-axis servo motor isolating washer damaged.	a. Replace.
	b. Contamination on input terminals, wires, or printed circuit boards.	b. Clean components with Freon or equivalent cleaner.
	c. A5C1 or A5C5 leaky.	c. Replace.
9. Range accuracy does not meet specifications.	a. Attenuator resistor or switch defective.	a. Replace
	b. Preamplifier or input circuit defective.	b. Isolate defective component and replace.
10. Overshoot.	a. Drive cable tension too loose.	a. Readjust (Paragraph 5-34 through 5-36).
	b. Lubricant on drive cable.	b. Clean with slidewire cleaner or Freon type cleaner.
	c. Servo motor defective.	c. Replace (paragraph 8-69).
	d. Power Supply on Servo Amplifier defective.	d. Repair.

Table 8-1. Troubleshooting (Continued)

PROBLEM	POSSIBLE CAUSE	CURE
SERVO SYSTEM (Continued)		
11. Slewing speed too low (specifications 20in./sec.) and acceleration sluggish.	a. Drive cable tension too tight.	a. Readjust (paragraph 5-34 through 5-36).
	b. Servo Motor defective.	b. Replace (paragraph 8-69).
	c. Power Supply or Servo Amplifier defective.	c. Repair.
	d. Mechanical binding.	d. Isolate (paragraph 8-45) and correct.
	e. Line voltage selector switches set incorrectly.	e. Reposition for correct line voltage.
12. Excessive pen jitter.	a. Excessive normal mode noise on input signal.	a. Lower noise by using shielded or twisted wire input cable of minimum length or low pass filter.
	b. Excessive common mode signal.	b. Optimize input signal connection to minimize common mode effects. (See Common Mode Figure 5-16.)
	c. Gain set too high.	c. Readjust and check retrace. (Paragraphs 5-20 and 5-22.)
	d. Slidewire not clean.	d. Clean and lubricate slidewire (Paragraph 5-11).
	e. Slidewire wiper worn.	e. Replace (paragraph 8-60 and 8-64).
	f. Servo gear backlash too close.	f. Adjust backlash. Check mechanical freedom (paragraph 8-45).
	g. Servo Amplifier or Power Supply defective.	g. Isolate defective component and replace.
13. Retrace too wide at 45° slope.	a. Phasing misadjusted.	a. Adjust (paragraph 5-18).
	b. Servo system binding.	b. Correct (paragraph 8-45).
	c. Power Supply or Servo Amplifier defective.	c. Repair.
14. Retrace too wide at 75°.	a. X gain too low.	a. Adjust (paragraph 5-20).
	b. Mechanical binding.	b. Correct.

Table 8-1. Troubleshooting (Continued)

PROBLEM	POSSIBLE CAUSE	CURE
SERVO SYSTEM (Continued)		
14. (Continued)	c. X-axis power supply or amplifier defective.	c. Troubleshoot and repair.
15. Retrace too wide at 15°.	a. Y gain too low. b. Mechanical binding. c. Y-axis power supply or amplifier defective.	a. Adjust (paragraph 5-22). b. Correct. c. Troubleshoot and repair.

8-55. REPAIR.

8-56. DISASSEMBLY OF EXTERIOR PARTS.

8-57. Access to components for replacement of parts requires removal of exterior parts first, such as the hood assembly, covers, etc. To remove certain parts, perform the following procedures:

a. Hood Assembly – remove four screws, two from each side, and lift hood.

b. Bottom Cover – set unit with power receptacle and fuse holder visible (recording surface downwards). Remove screws and lift off bottom cover. The circuit board is visible.

c. Autogrip Table – to perform maintenance on X drive cable assembly, X drive gear, etc., set machine on edge. Remove bottom cover and remove connector A1J5 (has two red wires) from power board (part number 07010-20300). See Figure 8-2. Remove four screws securing the Autogrip table. Slide the pen carriage to the left, and ease platen up and out on the right side.

d. Side Covers – remove six screws. Lift off side cover.

e. Front cover – remove four screws, two on each side. Lift off front cover.

f. Lower Paper Guide – remove Autogrip table. Remove three screws and lift off paper guide.

8-58. X-AXIS POTENTIOMETER REPLACEMENT.

8-59. To remove and replace X-axis balance potentiometer, perform the following steps:

a. Remove disposable pen. Remove connector cover, rear hood assembly and bottom cover. See paragraph 8-56.

b. Place recorder in upright position resting on front side with back of instrument facing forward. Insert heavy paper or card between wiper and slidewire to protect potentiometer. Slide carriage to left so that it aligns with the access slot in the power bracket. Place screwdriver inside access slot and remove screw holding X wiper.

c. With needle-nose pliers, carefully remove wiper from the instrument by lifting up.

d. Remove two screws holding Power Bracket to the casting.

e. Move Power Bracket to one side.

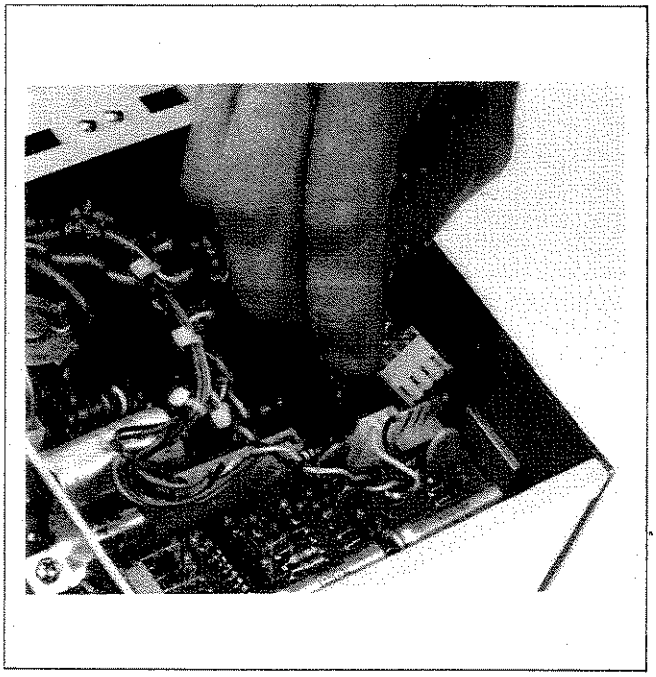


Figure 8-2. Autogrip Table Removal

CAUTION

Power Bracket will still be held to the recorder by cabling.

f. Loosen three screws along side of potentiometer. (See Figure 8-3.)

g. Partially ease out X-axis balance potentiometer. (See Figure 8-3.)

h. Carefully unsolder three wires from potentiometer, and note wire colors.

i. Remove potentiometer.

j. Install new balance potentiometer, Part No. 07010-60010. The new potentiometer should be aligned against the stop on the casting, adjacent to the soldered leads.

k. Reassemble, reversing procedures.

8-60. X-AXIS WIPER REPLACEMENT.

8-61. The wiper assembly is manufactured with very close tolerances necessary for long life and reliability. The wiper is located on the X-axis slider block. To remove, perform steps b and c paragraph 8-59. Install new wiper, Part No. 07010-60023, with the same screw that held the old wiper. See Figure 8-4. Ensure wiper is properly aligned on slidewire.

CAUTION

When installing new wiper, use piece of card or heavy paper between wiper and slidewire to protect slidewire.

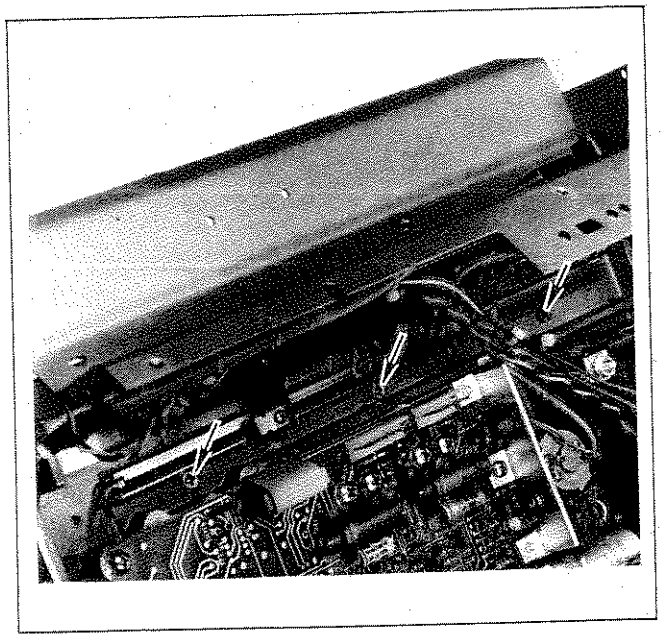


Figure 8-3. X-Axis Potentiometer Replacement

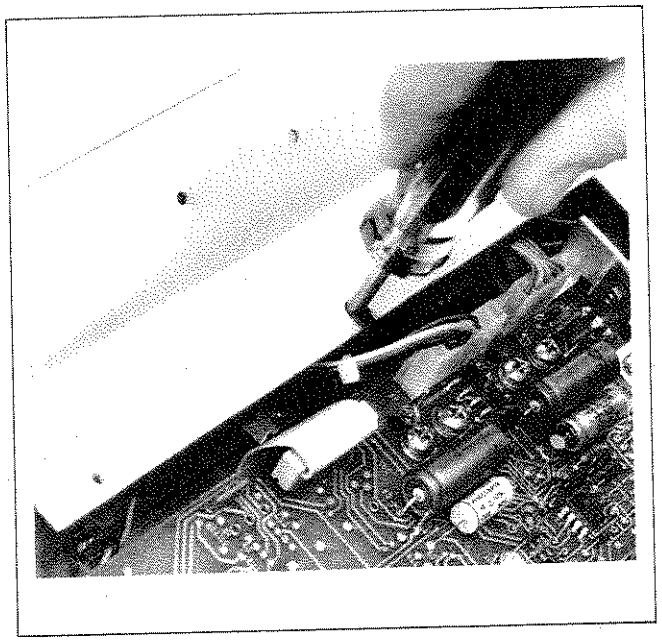


Figure 8-4. X-Axis Wiper Replacement

8-62. Y-AXIS POTENTIOMETER REPLACEMENT.

8-63. To remove and replace Y-axis balance potentiometer:

a. Remove disposable pen. Remove rear hood assembly and front extrusion. See paragraph 8-56.

b. Lift up pen bar; remove pen bar return spring and Y-wiper assembly. See paragraph 8-56.

c. Loosen cable tension by loosening tension screw in Y slider block. See Figure 8-5.

d. Insert small blade screwdriver under drive cable on right side of Y gear drive.

e. Turn gear counterclockwise until stringing is removed from Y gear.

NOTE

Be careful not to damage gears when removing stringing.

f. Remove screw at front end of slider rod. See Figure 8-6.

g. Remove pen bar and pen holder assembly.

h. Ease potentiometer asembly from under slider rod/carriage assembly. See Figure 8-7.

i. Unsolder three wires from potentiometer. Note wire colors.

j. Y-axis balance potentiometer assembly should now be free of recorder. Remove bottom pulley assembly and

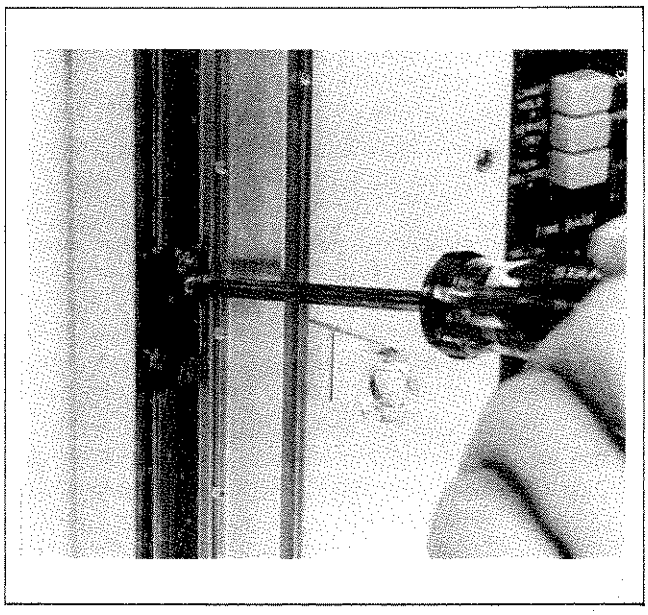


Figure 8-5. Y-Axis Cable Removal

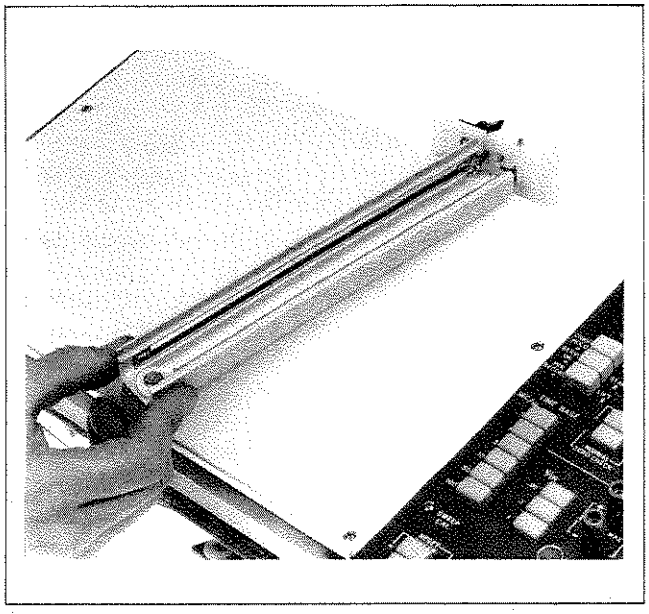


Figure 8-7. Y-Axis Potentiometer Removal

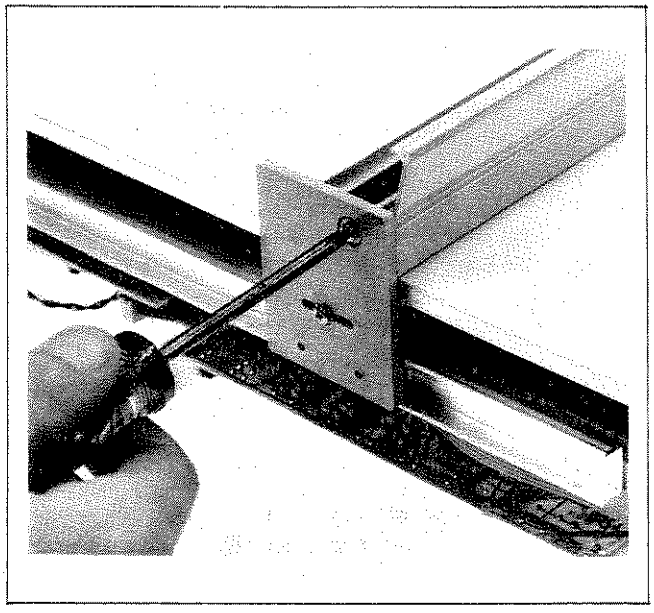


Figure 8-6. Carriage Arm Removal

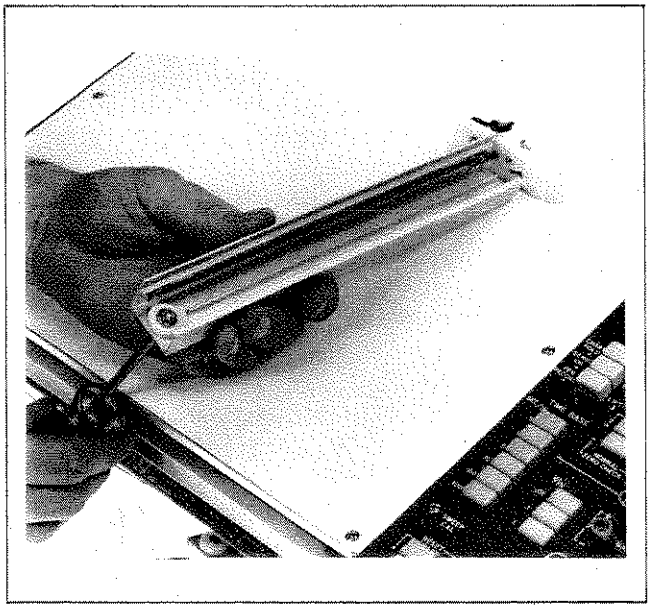


Figure 8-8. Y-Axis Pulley Assembly Removal

install on new potentiometer assembly, Part No. 07010-60011. See Figure 8-8.

k. Restring Y-axis. See paragraph 8-70.

l. Reassemble, reversing procedure.

m. Lubricate slider rod and guide under slider rod. Check wiper alignment.

8-64. Y-AXIS WIPER REPLACEMENT.

8-65. The wiper assembly is located on the Y slider block inside the recording arm. See Figure 8-9. To remove, perform the following steps:

a. Remove disposable pen. Remove rear hood assembly. See Paragraph 8-56.

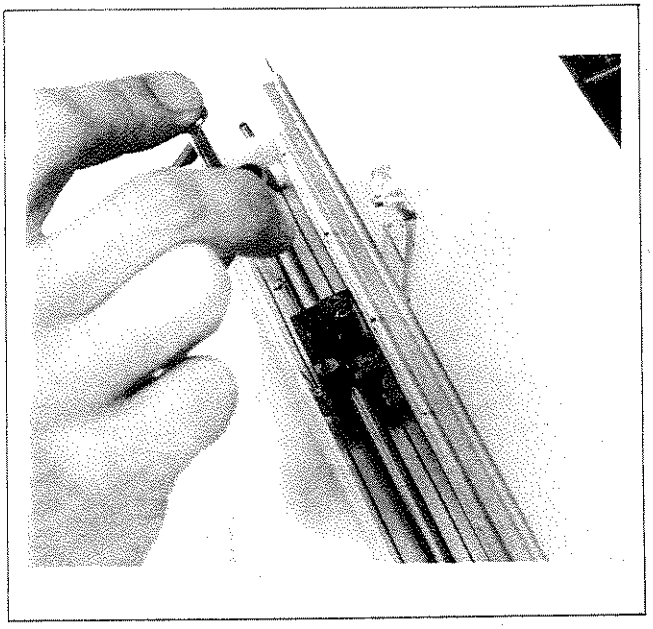


Figure 8-9. Y-Axis Wiper Replacement

b. Lift up Y pen lift bar and remove spring so pen lift bar stays open.

c. Move Y slider block toward bottom of recording arm.

d. Carefully insert small piece of heavy paper or card between Y wiper contacts and slidewire to protect potentiometer.

e. Remove wiper assembly. Wiper assembly held by one screw. See Figure 8-9.

f. Install new wiper, Part No. 07010-60012, in reverse. Clean potentiometer, see paragraph 8-40.

g. Check to ensure wiper is properly aligned with slidewire.

8-66. X-AXIS DRIVE GEAR REPLACEMENT.

8-67. To replace the X-axis drive gear, perform the following procedures:

a. Remove disposable pen. Remove rear hood, platen and bottom cover. See paragraph 8-56.

b. Remove X-axis motor wires. Remove four screws holding amplifier board in place to facilitate access to nut securing drive gear.

c. Stand recorder on front side.

d. Loosen X-axis stringing by loosening screw on slider block. See Figure 8-10. Remove stringing from drive gear. Use masking tape to hold string in place.

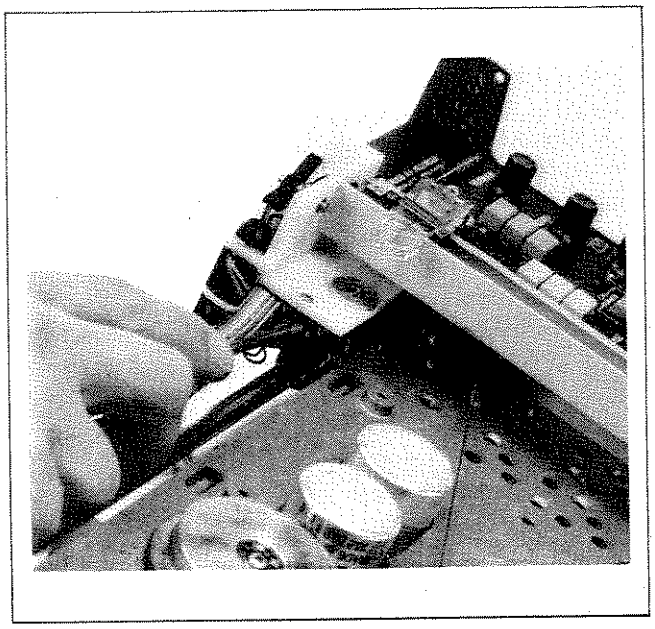


Figure 8-10. X-Axis Stringing Removal

e. Stand recorder on front side. Remove No. 6-32 screw mounting gear holding nut on reverse side. Remove gear (see Figure 8-11A and 8-11B).

f. Replace with new gear assembly, Part No. 07040-60710.

g. Reassembly in reverse. Restring per paragraph 8-72.

h. Adjust gear backlash per paragraph 5-40.

8-68. SERVO MOTOR MAINTENANCE.

8-69. The servo motors are basically free from maintenance. The high thermal mass aluminum frames and all ball-bearing construction provide long life. Do not disassemble a servo motor as this will result in weakening the magnetic field strength and produce substandard performance. If it becomes necessary, however, to replace either the X- or the Y-axis servo motor, perform the procedure indicated in the following steps:

a. X-Axis Servo Motor.

1. Remove disposable pen. Remove platen and bottom cover. See paragraph 8-56.

2. Stand recorder on front side. Unsolder two wires from feedthrough capacitors. Note wire colors.

CAUTION

Use care not to break off feedthrough capacitors when unsoldering leads as this will result in irreparable damage to the motor.

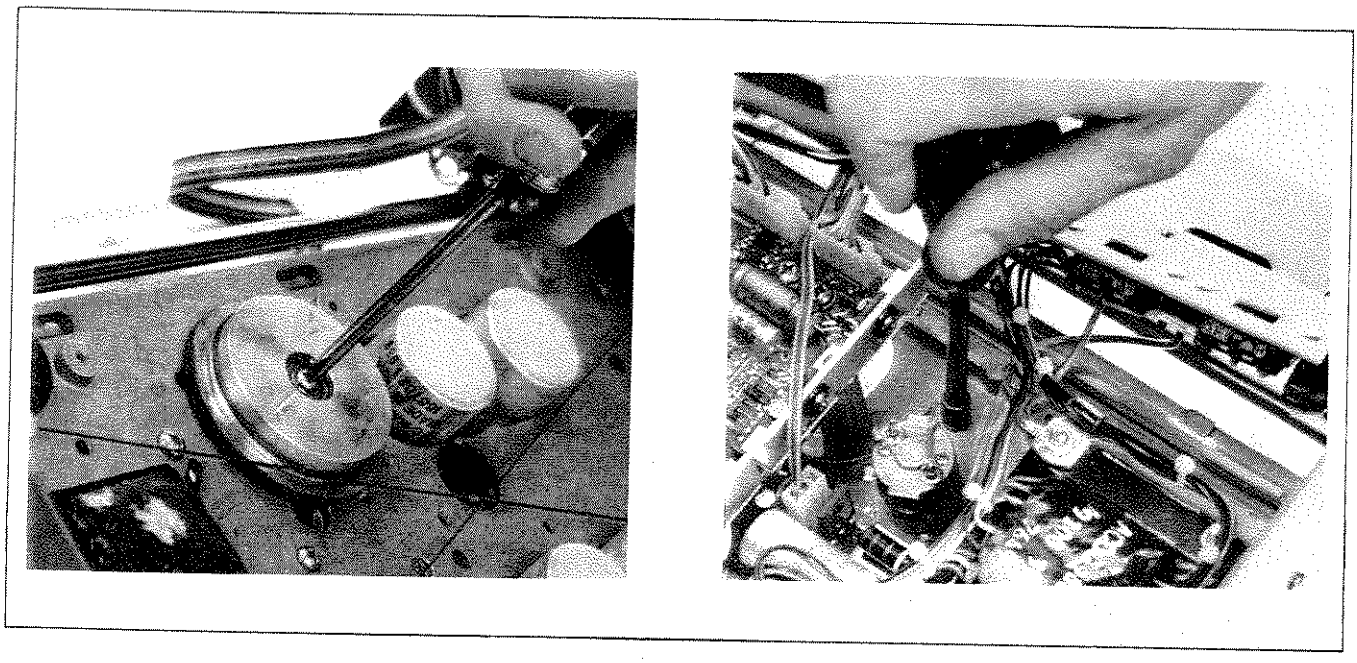


Figure 8-11. X-Axis Drive Gear Removal

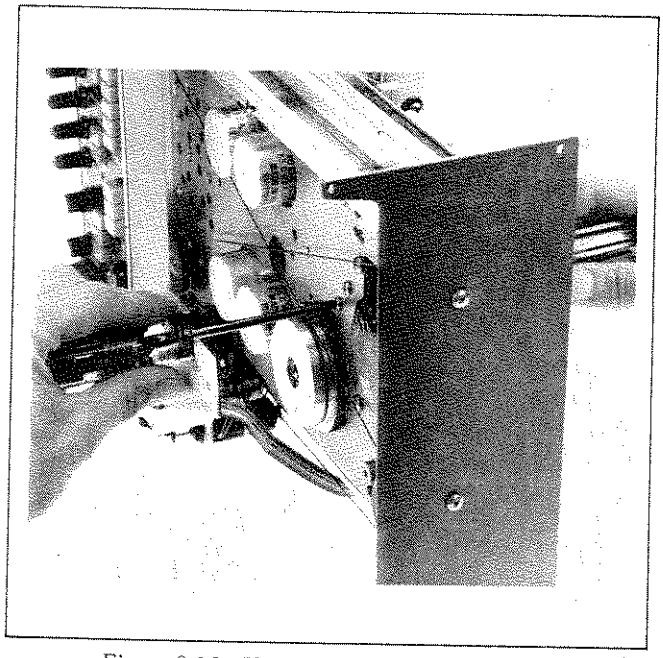


Figure 8-12. X-Axis Servo Motor Removal

3. Remove screw and nut holding servo motor casting on unit (See Figure 8-12.) Replace with new X-axis servo motor, Part No. 5060-6608.

4. Adjust gear backlash per paragraph 5-40.

b. Y-Axis Servo Motor.

1. Remove disposable pen. Remove rear hood assembly and platen. See Paragraph 8-56.

2. Stand recorder on front side.

3. Unsolder two wires from feedthrough capacitors.

CAUTION

Use care not to break off feedthrough capacitors when unsoldering leads as this will result in irreparable damage to the motor.

4. Remove screw holding servo motor mounting clamp to motor. (See Figure 8-13.)

5. Connect wires to new Y-axis servo motor, Part No. 5060-6608.

6. Install Y-axis servo motor.

7. Adjust Y-axis gear train backlash per paragraph 5-38.

8-70. Y-AXIS RESTRINGING.

8-71. To restring, using Y-axis cable assembly, Part No. 07010-60224, perform the following procedure:

a. Remove disposable pen. Remove rear hood assembly, front cover assembly, and pen bar return spring. See paragraph 8-56.

b. Loosen cable tension screw in Y slider block. See Figure 8-5.

c. Insert small blade screwdriver under drive cable on right side of Y gear drive.

d. Turn gear counterclockwise until stringing is removed from Y gear.

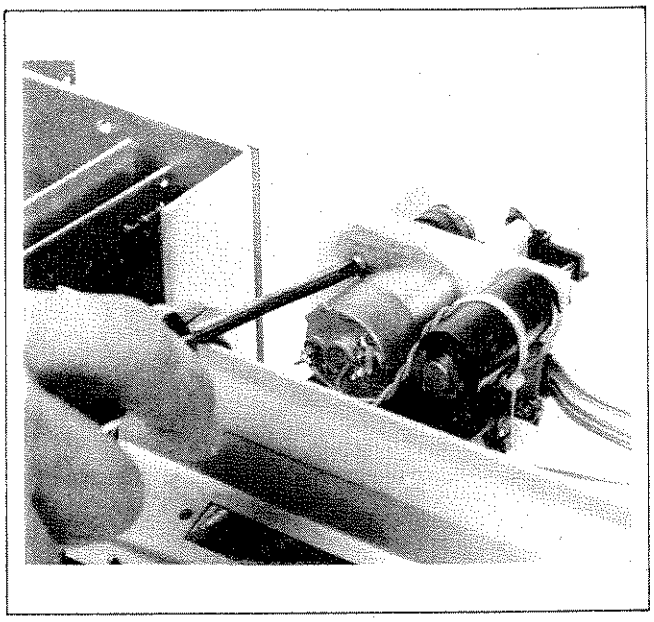


Figure 8-13. Y-Axis Servo Motor Removal

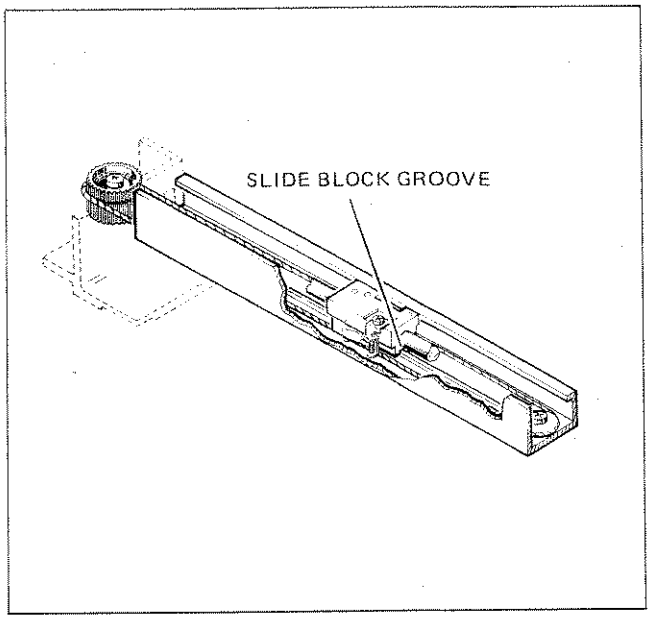


Figure 8-14. Cable Alignment Grooves

NOTE

Be careful not to damage gears when removing stringing.

e. Remove screw at front end of slider rod. See Figure 8-6.

f. Carefully raise bottom of slider rod while twisting slider block to allow wipers to face upward.

g. Remove slider block.

h. Install new drive cable assembly in adjuster block.

i. Reassemble carriage arm, making sure cable is between pen block and slidewire. Care should be taken not to damage wiper.

j. Loop cord around upper and lower pulleys.

k. Reassemble cable.

l. Check wiper tracking. Minor adjustments can be made by twisting metal wiper base with force from small screwdriver. Make sure cable is in cable alignment grooves. See Figure 8-14.

m. Reset cable tension with cable tension screw so no slippage can occur. See Figure 8-6.

8-72. X-AXIS RESTRINGING.

a. Remove front cover, Autogrip table, and lower paper guide. See paragraph 8-56, steps c., e., and f.

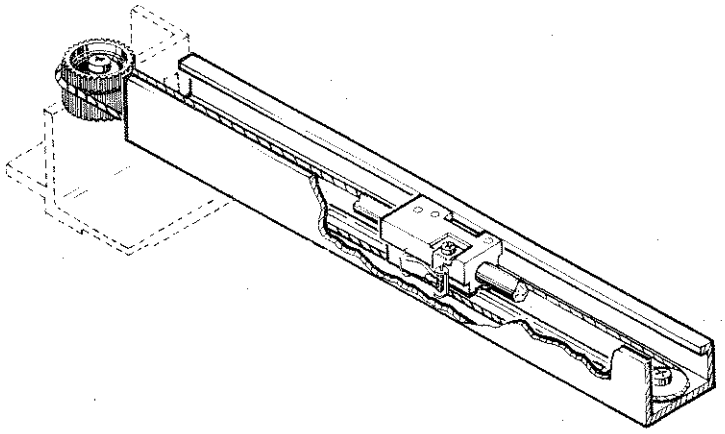
b. Remove old stringing by removing screw on slider block and screw that holds alignment block to end cap. Block slides out to expose loop part of stringing. Unwind. See Figure 8-11.

c. Reassemble cable using X-axis cable assemblies, Part Numbers 1530-1754 and 1530-1755, and secure to recording arm end cap with screw. Refer to Figure 8-15. Insert long cable adjustment screw into end loop of cable assembly No. 1, 1530-1755, at point A. Route cable from slider block to pulley (point F). Route cable in a clockwise direction around pulley (point F), continuing around pulley G in a counterclockwise direction; secure cable assembly No. 1 to alignment block point E. Route cable assembly No. 2 1530-1754 (with white plastic adjustment block attached) under cable assembly No. 1 near point A. Insert into slot on slider block, point H, securing with approximately two turns of cable around adjustment screw. Route cable counterclockwise around pulley (point B). Proceed to drive gear pulley (point C) and route cable two turns counterclockwise. Continue clockwise around pulley (point D). Secure cable assembly No. 2 to alignment block point E.

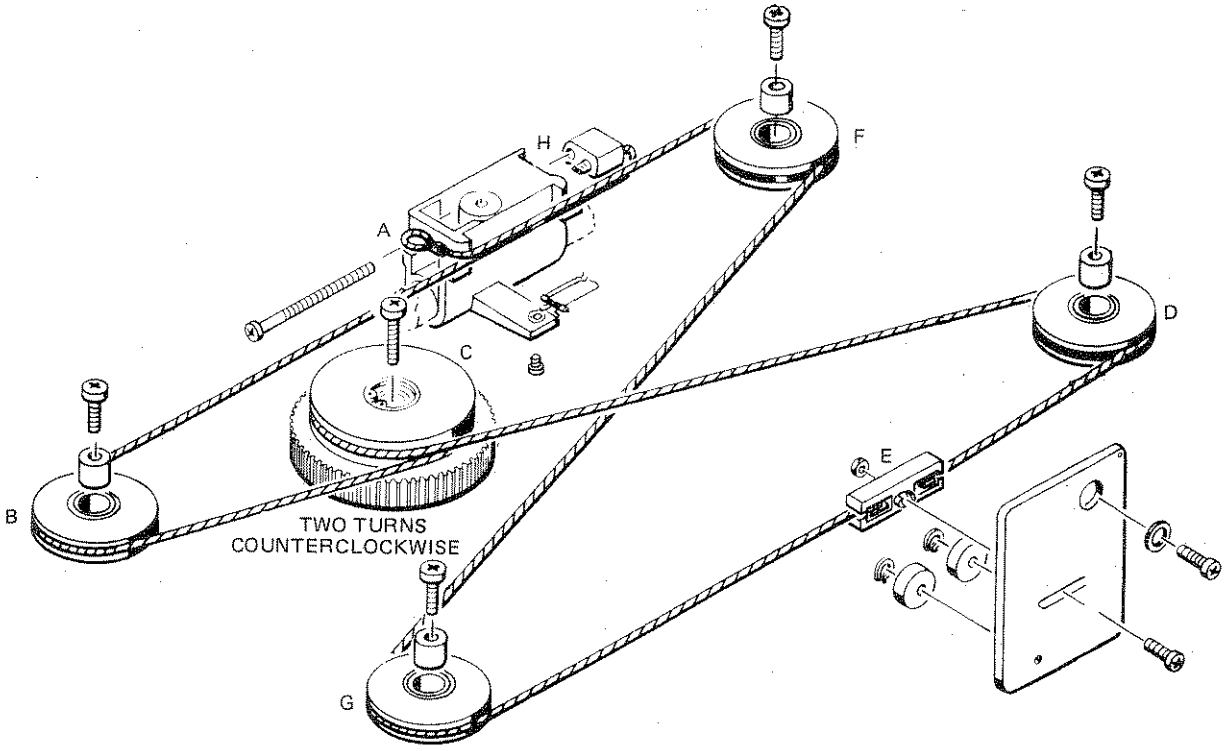
d. Tighten screw at point A until stringing is taut. See Figure 8-16.

e. Perform X-axis cable tension adjustment, paragraph 5-36. X-axis alignment adjustment, paragraph 5-42 and Y-axis alignment adjustment, paragraph 5-44.

f. Reassemble.



Y-AXIS



X-AXIS

Figure 8-15. X- and Y-Axis Restringing

SCHEMATIC DIAGRAM NOTES

Resistance in ohms, capacitance in microfarads, inductance in millihenries unless otherwise noted.

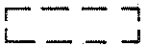
* Asterisk denotes a factory-selected value. Value shown in typical. Part might be omitted.

Indicates a NOTE on the schematic diagram.

Tool-aided adjustment.

Manual control.

Encloses a front-panel or circuit assembly silkscreened designator.



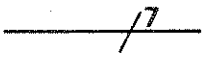
Encloses a rear-panel silkscreened designator.

Circuit assembly borderline.

Other assembly borderline. Also used to indicate mechanical interconnection (ganging) and RF shielding.

Heavy line with arrows indicates path and direction of main signal.

Heavy dashed line with arrows indicates path and direction of main feedback.



Indicates cable run with seven lines.

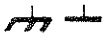
Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).

Numbered Test point. Measurement aid (metal post, circuit pad, etc.) provided.

Lettered Test point. No measurement aid provided.

( ) Encloses wire color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider stripe, third number identifies the narrower stripe (e.g., (947) denotes white base, yellow wide stripe, violet narrow stripe).

A direct conducting connection to the earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).



A conducting connection to a chassis or frame.

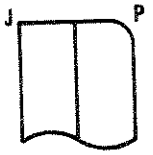
Common connections. All like-designated points are connected. When accompanied by a letter, indicates the type common (i.e., A = Analog, D = Digital, F = Floating).

Figure 8-16. Schematic Diagram Symbols (Sheet 1 of 2)

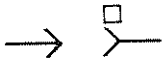
SCHEMATIC DIAGRAM NOTES (Continued)

Light Emitting Diode (LED).

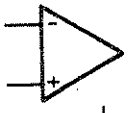
Photo-Transistor.



Cable and circuit assembly connectors.



Circuit assembly square-pin connectors.



Operational Amplifier (integrated circuit).

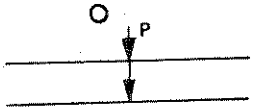
Voltage regulator (breakdown diode).

Denotes Field Effect transistor (FET) with N-type base.

Denotes FET with P-type base.

Denotes Silicon Controlled Rectifier (SCR).

Denotes spring-loaded switch.



Indicates twisted pair.

Identifies service sheet for quick reference.

Signal line identification.

Combined service sheet and signal line identification.

Figure 8-16. Schematic Diagram Symbols (Sheet 2 of 2)

8-73. AFTER SERVICE CHECKS.

8-74. After the Model 7015B has been serviced, it is necessary to carry out performance tests as described in Section IV.

8-75. SCHEMATIC DIAGRAM NOTES.

8-76. Schematic Diagram Notes are shown in Figure 8-16. Included are symbols for outlines, variable resistors, test points, wire colors, grounds, etc.

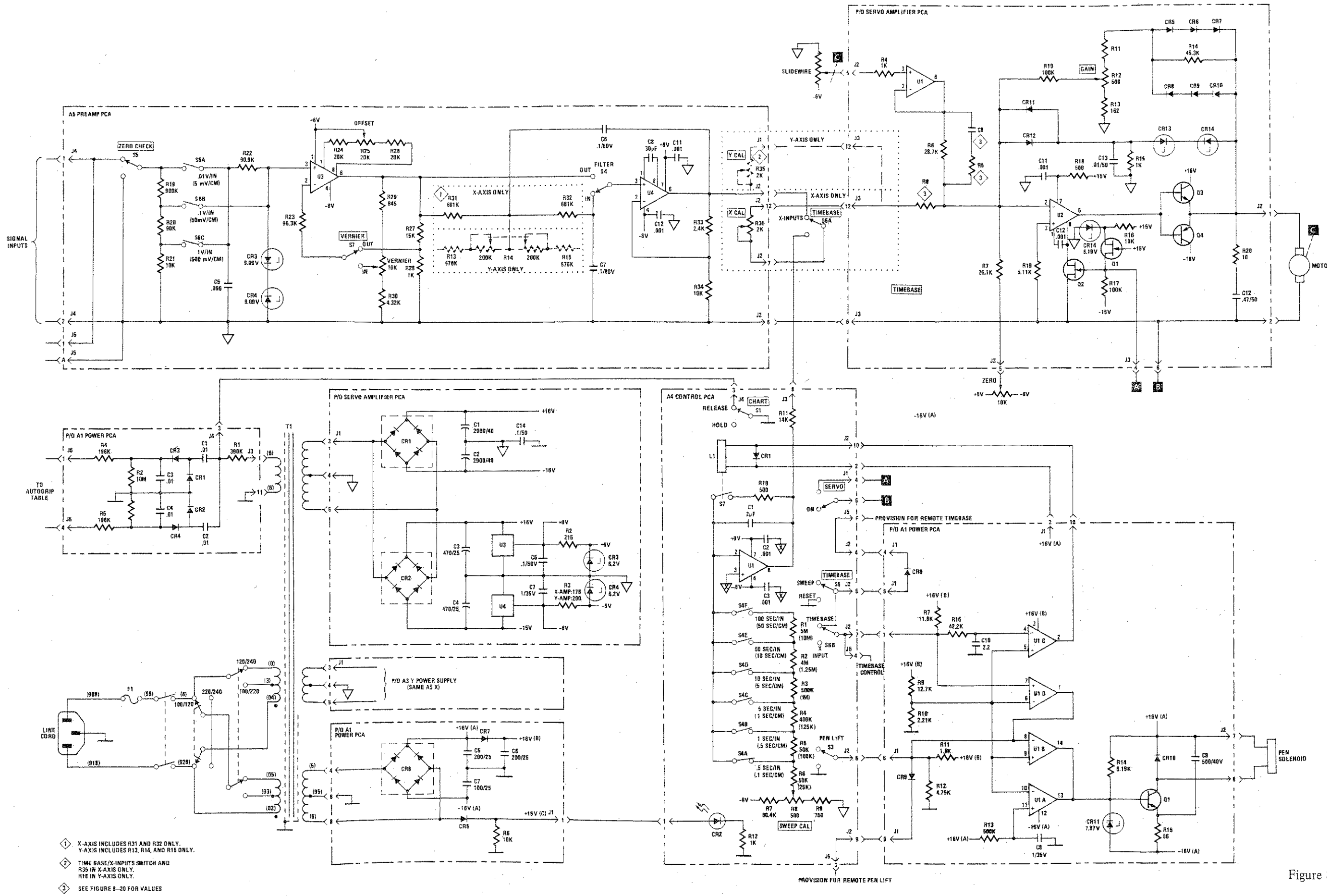


Figure 8-17. Model 7015B Functional Block Diagram

Table 8-2. Power Supply PCA A1 Parts List

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	07010-60300	1	PCA, POWER	28480	07010-60300
A1C1	0150-0012	4	CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
A1C2	0150-0012		CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
A1C3	0150-0012		CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
A1C4	0150-0012		CAPACITOR-FXD .01UF +-20% 1KVDC CER	0420J	C023A102J103M838
A1C5	0180-2144	2	CAPACITOR-FXD 200UF+75-10% 25VDC AL	0420J	30D207G025DH9
A1C6	0180-2144		CAPACITOR-FXD 200UF+75-10% 25VDC AL	0420J	30D207G025DH9
A1C7	0180-0094	1	CAPACITOR-FXD 100UF+75-10% 25VDC AL	0420J	30D107G025DD2
A1C8	0180-0291	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	0420J	150D105X9035A2
A1C9	0180-0633	1	CAPACITOR-FXD 500UF+75-10% 40VDC AL	0420J	39D507G040GJ4
A1C10	0180-0197	1	CAPACITOR-FXD 2.2 UF +-10% 20 VDC TA	0420J	150D225X9020A
A1CR1	1901-0470	4	DIODE-HV RECT 1KV 600MA DO-41	02039	BR1358-14
A1CR2	1901-0470		DIODE-HV RECT 1KV 600MA DO-41	02039	BR1358-14
A1CR3	1901-0470		DIODE-HV RECT 1KV 600MA DO-41	02039	BR1358-14
A1CR4	1901-0470		DIODE-HV RECT 1KV 600MA DO-41	02039	BR1358-14
A1CR5	1901-0025	5	DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1CR6	1901-0364	1	DIODE-FW BRDG 200V 1A	02039	BDA 10185-4
A1CR7	1901-0025		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1CR8	1901-0025		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1CR9	1901-0025		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1CR10	1901-0025		DIODE-GEN PRP 100V 200MA DO-7	28480	1901-0025
A1CR11	1902-3134	1	DIODE-ZNR 7.87V 5% DO-7 PD=.4W TC=+.051%	02235	FZ7250
A1J1	1251-4212	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-4212
A1J2	1251-3192	2	CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031(2403-03A)
A1J3	1251-4885	1	CONNECTOR 11-PIN M POST TYPE	27264	09-60-1111
A1J4	1251-3192		CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031(2403-03A)
A1J5	1251-3195	1	CONNECTOR 4-PIN M POST TYPE	27264	09-60-1041(2403-04A)
A1Q1	1854-0558	1	TRANSISTOR NPN SI DARL PD=70W FT=1MHZ	28480	1854-0558
A1R1	0686-3945	1	RESISTOR 390K 5% .5W CC TC=0+682	01607	EB3945
A1R2	0698-8754	2	RESISTOR 10M 1% .25W C TC=0+-100	01607	CC1005F
A1R3	0698-8754		RESISTOR 10M 1% .25W C TC=0+-100	01607	CC1005F
A1R4	0698-3453	2	RESISTOR 196K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1963-F
A1R5	0698-3453		RESISTOR 196K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1963-F
A1R6	0757-0442	1	RESISTOR 10K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002-F
A1R7	0698-3264	2	RESISTOR 11.8K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1182-F
A1R8	0757-0437	2	RESISTOR 4.75K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4751-F
A1R9	0698-3359	1	RESISTOR 12.7K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1272-F
A1R10	0757-0430	1	RESISTOR 2.21K 1% .125W F TC=0+-100	03298	C4-1/8-T0-2211-F
A1R11	0698-3264		RESISTOR 11.8K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1182-F
A1R12	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4751-F
A1R13	0698-3263	1	RESISTOR 500K 1% .125W F TC=0+-100	0552D	CMF-55-1
A1R14	0757-0290	1	RESISTOR 6.19K 1% .125W F TC=0+-100	0299E	MF4C1/8-T0-6191-F
A1R15	0764-0013	1	RESISTOR 56 5% 2W MO TC=0+-200	03418	FP-42
A1R16	0698-3450	1	RESISTOR 42.2K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4222-F
A1U1	1826-0138	1	IC COMPARATOR	0340F	LM339N
			A1 MISCELLANEOUS		
	0360-1514	8	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514

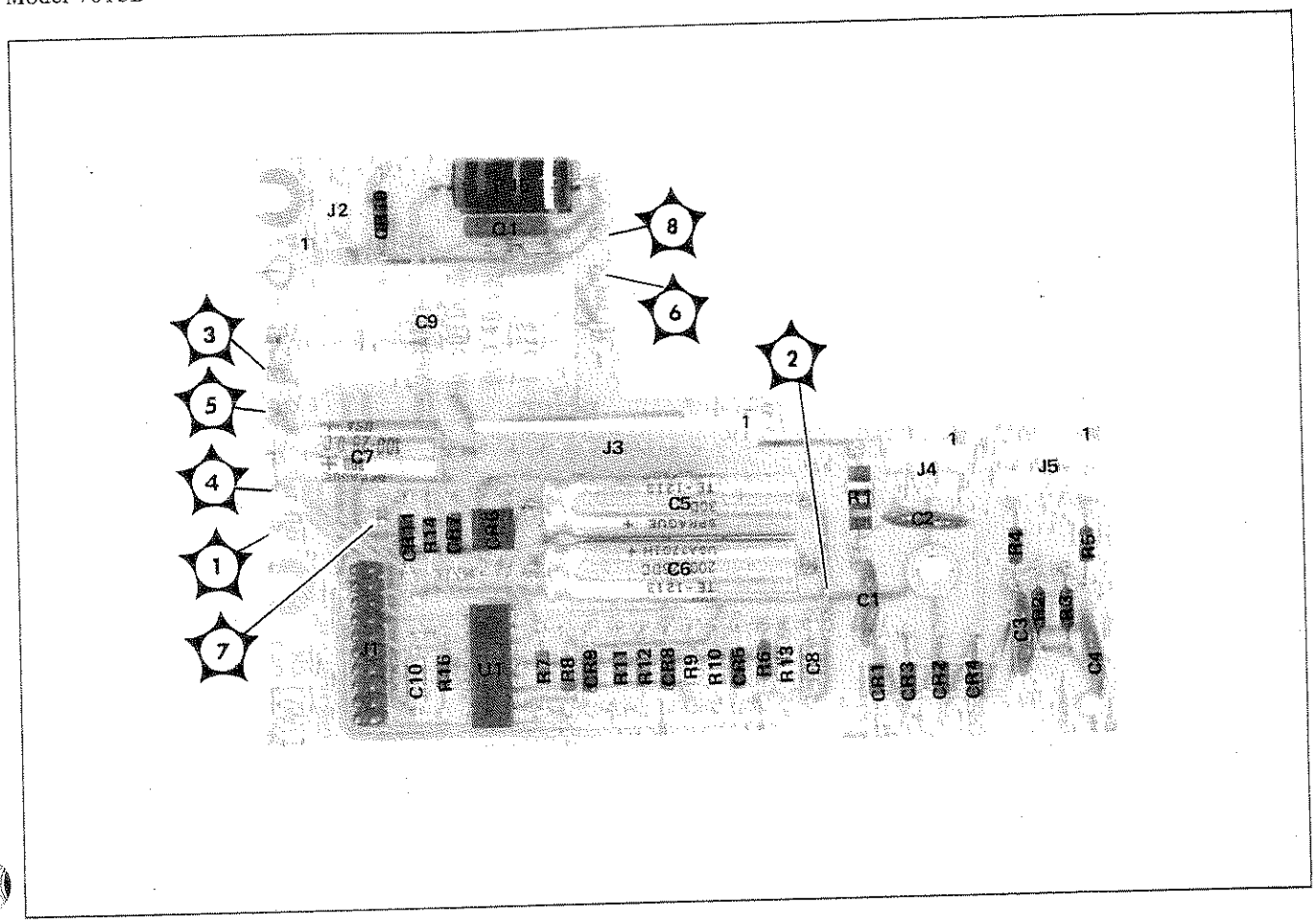
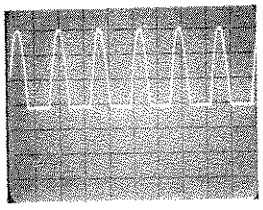
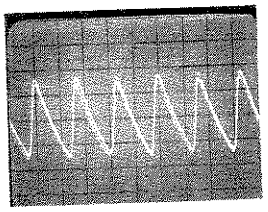


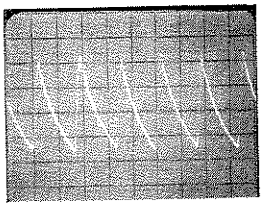
Figure 8-18. Power Supply PCA A1, Parts Location



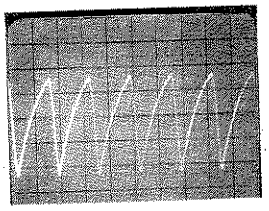
Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 10 m sec/div.
Vert. Amp.: 5.0 V/div. DC



Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp.: 0.1 V/div. AC



Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp.: 0.1 V/div. AC



Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp.: 0.1 V/div. AC

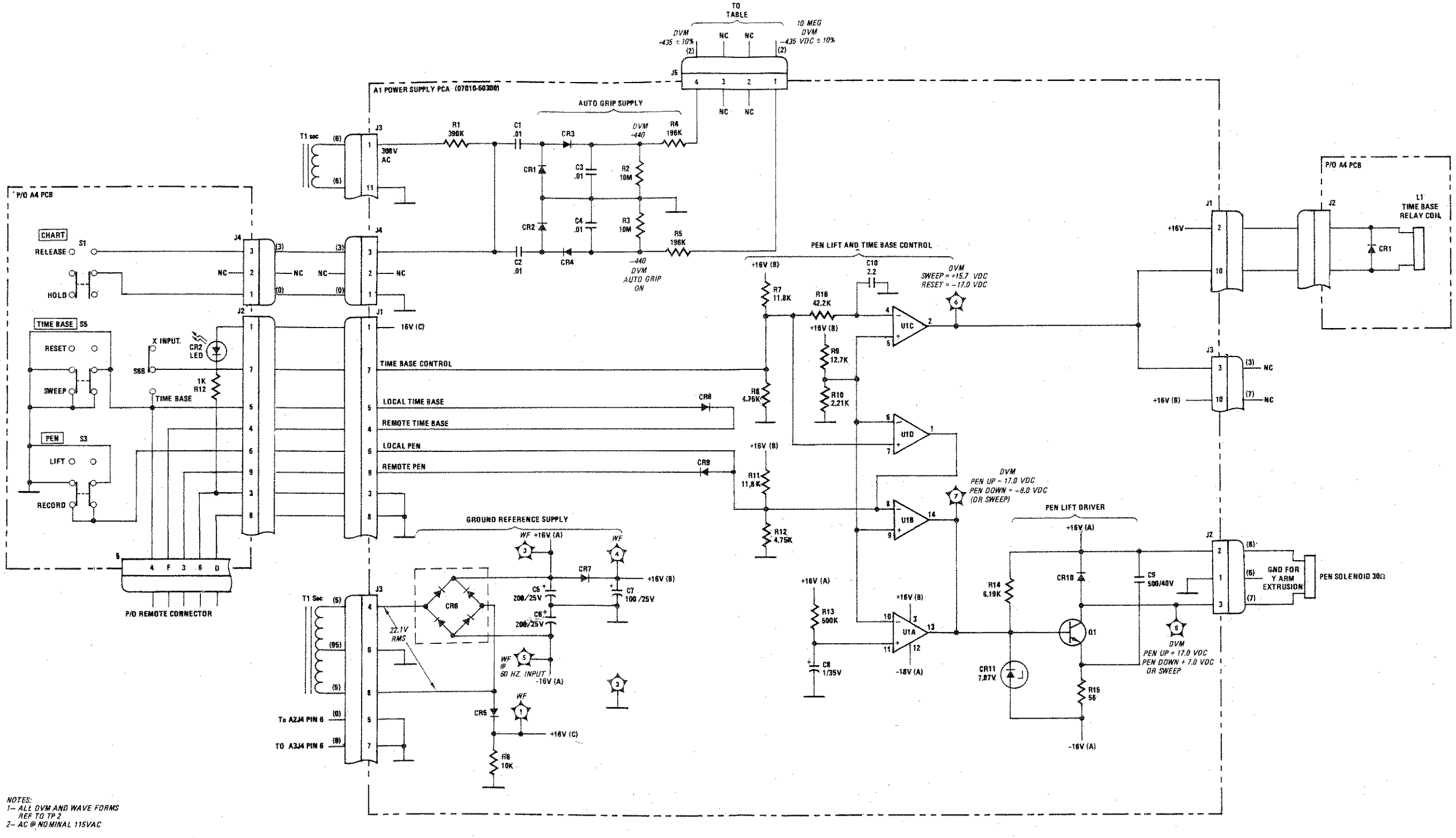


Figure 8-19. Power Supply PCA A1 Schematic Diagram

Table 8-3. X and Y Amplifier PCA's A2 and A3 Parts List

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2	07015-60360		PCA, X-AXIS	28480	07015-60360
A3	07015-60370	1	PCA, Y-AXIS	28480	07015-60370
A2&A3C1	0180-2414	2	CAPACITOR-FXD 2900UF+75-10% 40VDC AL	0420J	36D292G040AA2A
A2&A3C2	0180-2414		CAPACITOR-FXD 2900UF+75-10% 40VDC AL	0420J	36D292G040AA2A
A2&A3C3	0180-2506	2	CAPACITOR-FXD 470UF+50-10% 25VDC AL	28480	0180-2506
A2&A3C4	0180-2506		CAPACITOR-FXD 470UF+50-10% 25VDC AL	28480	0180-2506
A2&A3C6	0150-0121	3	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A2&A3C7	0180-0291	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	0420J	150D105X9035A2
A2C8	0160-0039	1	CAPACITOR-FXD .27UF +-10% 200VDC POLYE (X)	0420J	160P27492
A3C8	0160-2291	1	CAPACITOR-FXD .18UF +-10% 80VDC POLYE (Y)	0420J	292P1849R8
A2&A3C10	0180-0061	1	CAPACITOR-FXD 100UF+75-10% 16VDC AL	0420J	30D107G016DC2
A2&A3C11	0160-2199	1	CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A2&A3C12	0160-3097	1	CAPACITOR-FXD .47UF+80-20% 50VDC CER	28480	0160-3097
A2&A3C13	0150-0121		CAPACITOR-FXD, .1UF+80-20% 50VDC CER	28480	0150-0121
A2&A3C14	0150-0121		CAPACITOR-FXD, .1UF+80-20% 50VDC CER	28480	0150-0121
A2&A3C15	0160-0170	1	CAPACITOR-FXD, .22UF+80-20% 25VDC CER	28480	0160-0170
A2&A3CR1	1901-0364	2	DIODE-FW BRDG 200V 1A	0203G	SDA 10185-4
A2&A3CR2	1901-0364		DIODE-FW BRDG 200V 1A	0203G	SDA 10185-4
A2&A3CR3	1902-0686	2	DIODE-ZNR 1N825 6.2V 2% DO-7 PD=.4W	0203G	IN825
A2&A3CR4	1902-0686		DIODE-ZNR 1N825 6.2V 2% DO-7 PD=.4W	0203G	IN825
A2&A3CR5	1901-0040	8	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR6	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR7	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR8	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR9	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR10					
A2&A3CR11	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR12	1901-0040		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2&A3CR13	1902-3129	2	DIODE-ZNR 7.5V 2% DO-7 PD=.4W TC=+.05%	0223G	FZ7448
A2&A3CR14	1902-3129		DIODE-ZNR 7.5V 2% DO-7 PD=.4W TC=+.05%	0223G	FZ7448
A2&A3CR15	1902-0049		DIODE-ZENER 6.19V 5%		
A2&A3U1	1826-0407	1	IC 308 OP AMP	28480	1826-0407
A2&A3U2	1820-0478	1	IC 7806 V RGLTR	0379D	LM308
A2&A3U3	1826-0146	1	IC V RGLTR	0223G	7806UC
A2&A3U4	1826-0449	1		28480	1826-0449
A2&A3J1	1251-3767	1	CONNECTOR 7-PIN M POST TYPE	27264	09-60-1071
A2&A3J2	1251-0513	1	CONNECTOR 5-PIN M POST TYPE	27264	09-60-1051
A2&A3J3	1251-4212	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-4212
A2&A3Q1	1855-0082	1	TRANSISTOR MOSFET P-CHAN D-MODE SI	28480	1855-0082
A2&A3Q2	1855-0341	1	TRANSISTOR J-FET 2N4338 N-CHAN D-MODE	0288C	2N4338
A2&A3Q3	1854-0558	1	TRANSISTOR NPN SI DARL PD=700W FT=1MHZ	28480	1854-0558
A2&A3Q4	1853-0334	1	TRANSISTOR PNP SI DARL PD=700W FT=1MHZ	28480	1853-0334
A2&A3R2	0698-3441	1	RESISTOR 215 1% .125W F TC=0+-100	03298	C4-1/8-T0-215R-F
A2R3	0698-3439	1	RESISTOR 178 1% .125W F TC=0+-100 (X)	03298	C4-1/8-T0-178R-F
A3R3	0757-0407	1	RESISTOR 200 1% .125W F TC=0+-100 (Y)	03298	C4-1/8-T0-201-F
A2&A3R4	0757-0280	2	RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A2R5	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100 (X)	03298	C4-1/8-T0-8251-F
A3R5	0757-0200	1	RESISTOR 5.62K 1% .125W F TC=0+-100 (Y)	03298	C4-1/8-T0-5621-F
A2&A3R6	0698-7880	1	RESISTOR 28.7K 1% .125W F TC=0+-25	0299E	MF4C1/8-T9-2872-F
A2&A3R7	0698-7842	1	RESISTOR 26.1K 1% .125W F TC=0+-25	0299E	MF4C1/8-T9-2612-F
A2R8	0698-8076	1	RESISTOR 8.66K 1% .125W F TC=0+-25 (X ENGLISH)	0299E	MF4C1/8-T9-8661-F
A3R8	0698-5789	1	RESISTOR 11.1K .5% .125W F TC=0+-50 (X METRIC)	03888	PME55B
A2&A3R6	0698-6940	1	RESISTOR 6K 1% .125W F TC=0+-25 (Y ENGLISH)	03298	NE55
A2&A3R8	0698-6488	1	RESISTOR 8.06K 1% .125W F TC=0+-25 (Y METRIC)	03298	NE55
A2&A3R10	0757-0465	2	RESISTOR 100K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1003-F
A2R11	0698-4482	1	RESISTOR 17.4K 1% .125W F TC=0+-100 (X)	73138	73138
A3R11	0757-0289	1	RESISTOR 13.3K 1% .125W F TC=0+-100 (Y)	03298	C4-1/8-T0-1742-F
A2&A3R12	2100-1788	1	RESISTOR VARIABLE 500 10%	0299E	MF4C1/8-T0-1332-F
				28480	2100-1788

Table 8-3. X and Y Amplifier PCA's A2 and A3 Parts List (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2&A3R13	0757-0405	1	RESISTOR 162 1% .125W F TC=0+-100	03298	C4-1/8-T0-162R-F
A2&A3R14	0698-4496	1	RESISTOR 45.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4532-F
A2&A3R15	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1001-F
A2&A3R16	0757-0442	1	RESISTOR 10 K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1002 -F
A2&A3R17	0757-0465	1	RESISTOR 100K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1003-F
A2&A3R18	0698-5852	1	RESISTOR 500 1% .125W F TC=0+-100	03298	C4-1/8-T0-500R -F
A2&A3R19	0757-0483	1	RESISTOR5.11K1% .125W F TC=0+-100	03298	C4-1/8-T0-5111 -F
A2&A3R20	0757-0346	1	RESISTOR 10 1% .125 WF TC=0 + -100	03298	CR-1/8-TO-10R0-F
			A2,A3 MISCELLANEOUS		
	0340-0511	2	INSULATOR-XSTR KAPTON	0260H	43-77-2
	0360-1514	12	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	0361-0266	2	RIVET, AD 42 ABS DOMED HEAD, ALUM.	7707E	AD 42AB8
	2190-0068	4	WASHER-LK INTL 7 NO. 10 .195-IN-ID	78189	1210-00
	2190-0311	2	WASHER-SHLDR NO. 10 .195-IN-ID	04941	7860
	2190-0925	2	WASHER-LK NO. 6 .144-IN-ID .327-IN-OD	02035	52-200-F002
	2200-0145	2	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
	2260-0001	2	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
	2680-0099	4	SCREW-MACH 10-32 .25-IN-LG PAN-HD-POZI	28480	2680-0099
	07010-00304	1	HEAT SINK	28480	07010-00304

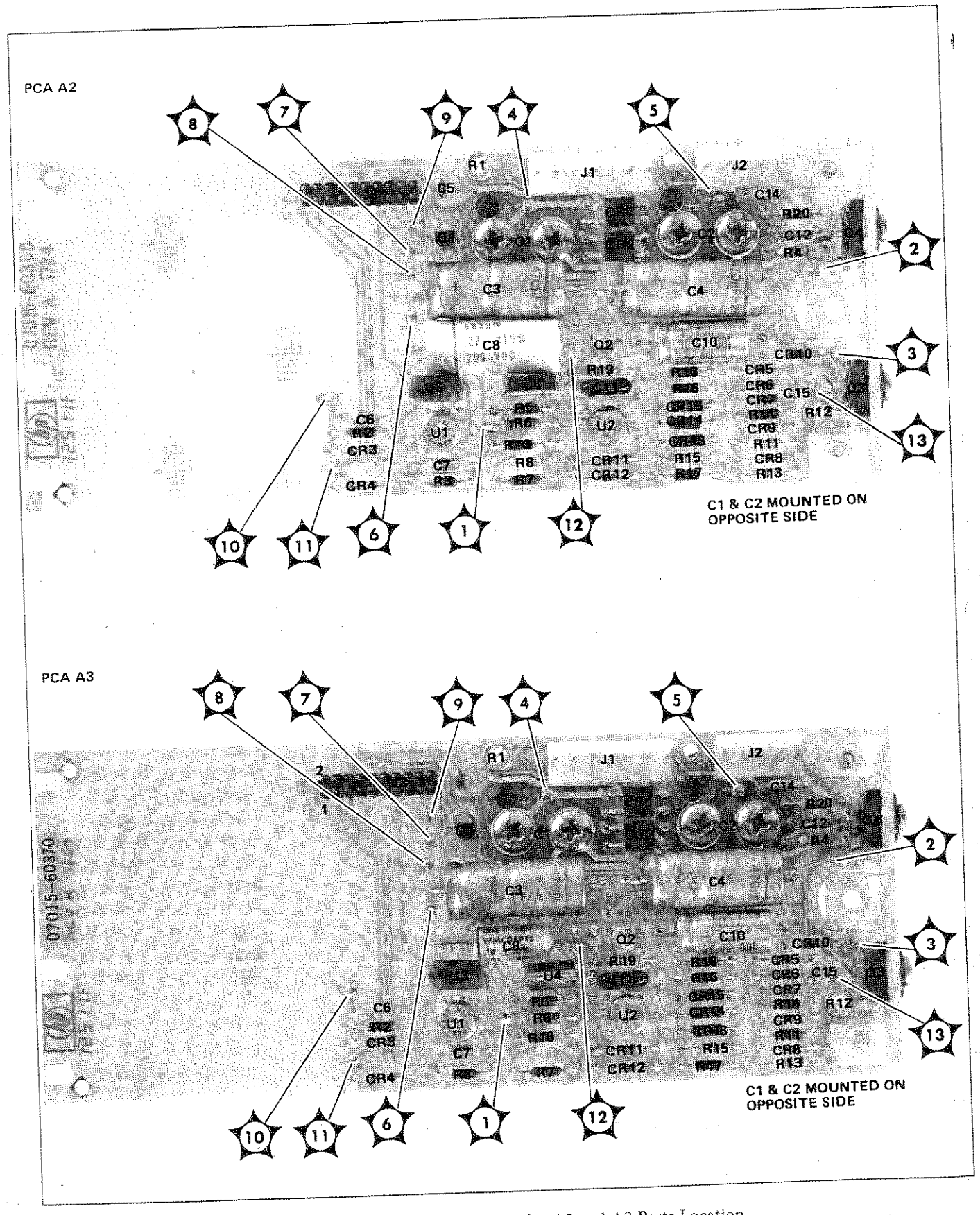
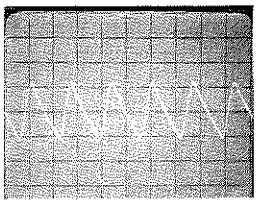


Figure 8-20. X and Y Amplifier PCA A2 and A3 Parts Location

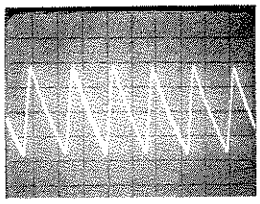
PCA A2 WAVEFORMS

4



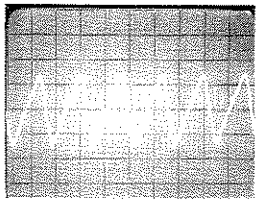
Recorder Settings: Carriage Arm @ Extreme Left (Zero Position).
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp.: 1.0 V/div. AC

6



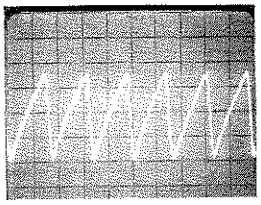
Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert Amp.: 0.1 V/div. AC

5



Recorder Settings: Carriage Arm @ Extreme Right (Full Scale Position)
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp. 1.0 V/div. AC

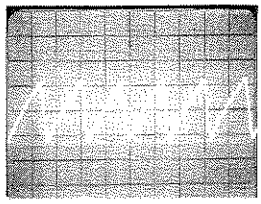
8



Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert Amp.: 0.1 V/div. AC

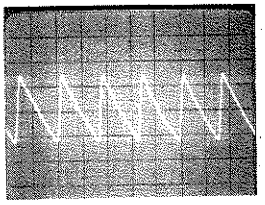
PCA A3 WAVEFORMS

6

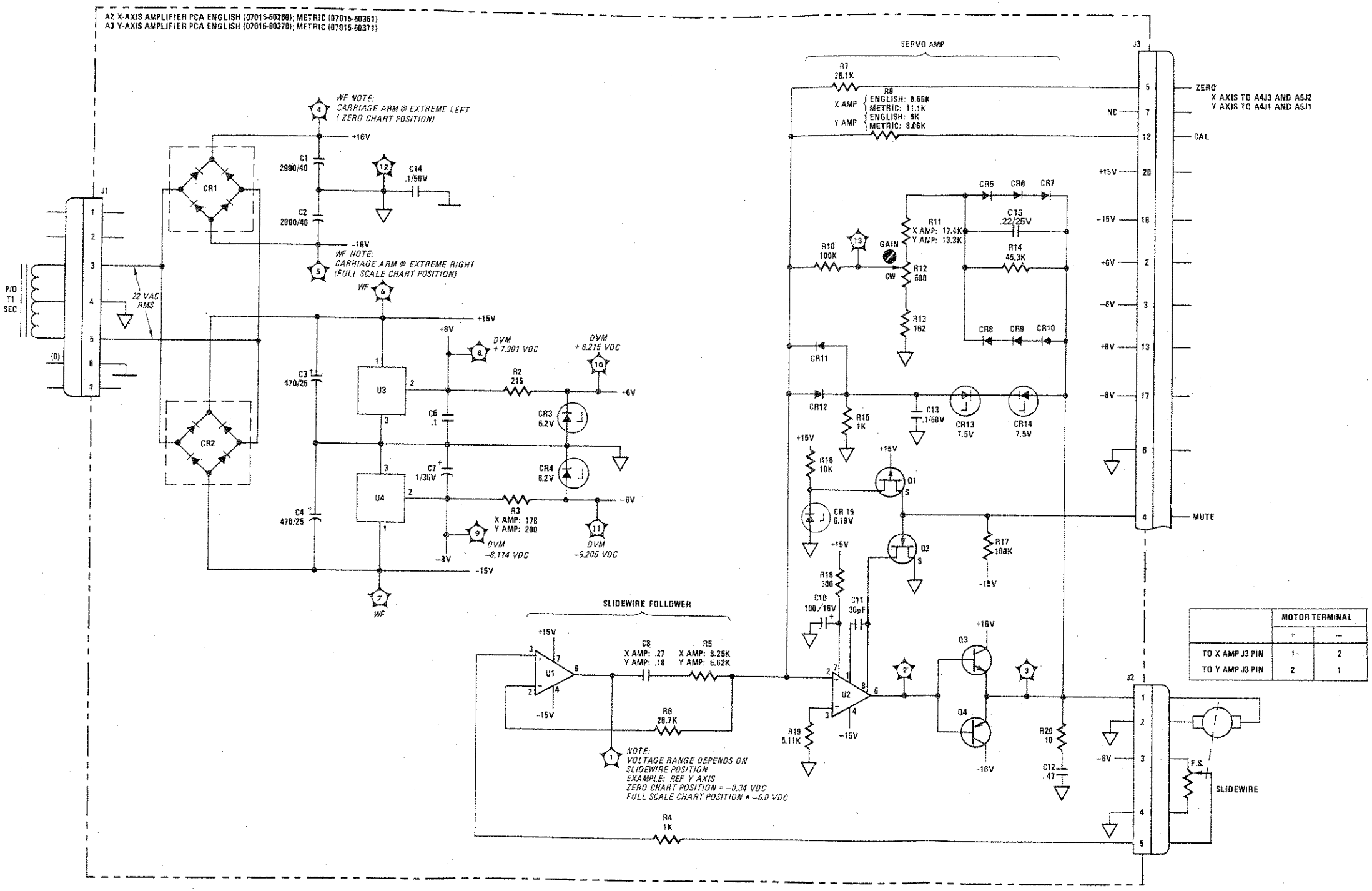


Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert Amp.: 0.1 V/div. AC

8



Recorder Settings: Null, Pen Up
Oscilloscope Settings: HP 181A
Time: 50 m sec/div.
Vert. Amp.: 0.1 V/div. AC



	MOTOR TERMINAL	
	+	–
TO X AMP J3 PIN	1	2
TO Y AMP J3 PIN	2	1

NOTES:
1- ALL DVM AND WAVE FORMS REF TO TP12
2- AC @ NOMINAL 115VAC

Figure 8-21. X and Y Amplifier PCA's A2 and A3 Schematic Diagram

Table 8-4. Control PCA A4 Parts List

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4	07015-60350	1	PCA, CONTROL	28480	07015-60350
A4C1	0160-3405	1	CAPACITOR-FXD 2UF +-10% 50VDC MET-POLYC	28480	0160-3405
A4C2	0150-0050	2	CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A4C3	0150-0050		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A4CR1	1901-0191	1	DIODE-PWR RECT 100V 750MA DO-41	02036	SR1358-2
A4CR2	1990-0521	1	LED-VISIBLE LUM-INT=2.2MCD IF=50MA-MAX	28480	1990-0521
A4J1	1251-4524	2	CONNECTOR 20-PIN M POST TYPE	06261	SB-801-082
A4J2	1251-4212	1	CONNECTOR 20-PIN M POST TYPE	28480	1251-4212
A4J3	1251-4524		CONNECTOR 20-PIN M POST TYPE	06261	SB-801-082
A4J4	1251-3192	1	CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031(2403-03A)
A4L1	0490-1131	1	COIL, RELAY	28480	0490-1131
A4R1	0698-3587	1	RESISTOR 5M 1% 1W F TC=0+-100 (ENGLISH)	03888	PME708
A4R1	0698-8754	1	RESISTOR 10M 1% .25W C TC=0+-100 (METRIC)	0160G	CC1005F
A4R2	0698-3586	1	RESISTOR 4M 1% 1W F TC=0+-100 (ENGLISH)	03888	PME708
A4R2	0698-5916	1	RESISTOR 1.25M 1% .5W F TC=0+-100 (METRIC)	05520	CMF-65-2
A4R3	0698-3263	1	RESISTOR 500K 1% .125W F TC=0+-100 (ENGLISH)	05520	CMF-55-1
A4R3	0698-7332	2	RESISTOR 1M 1% .125W F TC=0+-100 (METRIC)	0209E	MF5C1/8-T0-1004-F
A4R4	0698-3573	1	RESISTOR 400K 1% .125W F TC=0+-25 (ENGLISH)	03298	NE55
A4R4	0698-6292	1	RESISTOR 125K .5% .125W F TC=0+-100 (METRIC)	03298	C4, T=0
A4R5	0698-4009	2	RESISTOR 50K 1% .125W F TC=0+-100 (ENGLISH)	03298	C4-1/8-T0-5002-F
A4R5	0757-0465	1	RESISTOR 100K 1% .125W F TC=0+-100 (METRIC)	03298	C4-1/8-T0-1003-F
A4R6	0698-4009		RESISTOR 50K 1% .125W F TC=0+-100 (ENGLISH)	03295	C4-1/8-T0-5002-F
A4R6	0698-6650	1	RESISTOR 24K 1% .12W (METRIC)	28480	0698-6650
A4R7	0698-3572	1	RESISTOR 60.4K 1% .125W F TC=0+-100	03298	C4-1/8-T0-6042-F
A4R8	2100-1757	1	RESISTOR-TRMR 500 5% WW SIDE-ADJ 1-TRN	03740	3348W-W50-501
A4R9	0757-0420	1	RESISTOR 750 1% .125W F TC=0+-100	03298	C4-1/8-T0-751-F
A4R10	0698-5852	1	RESISTOR 500 1% .125W F TC=0+-100	03298	C4-1/8-T0-500R-F
A4R11	0698-4479	1	RESISTOR 14K 1% .125W F TC=0+-100	03298	C4-1/8-T0-1402-F
A4R12	0687-1021	1	RESISTOR 1K 10% .5W CC TC=0+647	0160G	EB1021
A4S1	3101-1658	2	SWITCH-PB DPDT ALTNG 1A 300VAC	31918	F-2U-EE
A4S2	3101-2099	1	SWITCH-PB DPDT ALTNG .5A 100VAC	28480	3101-2099
A4S3	3101-1658		SWITCH-PB DPDT ALTNG 1A 300VAC	31918	F-2U-EE
A4S4	3101-2226	1	SWITCH-PB 6-STATION 10MM C-C SPACING	28480	3101-2226
A4S5	3101-2225	2	SWITCH-PB DPDT ALTNG .5A 100VAC	28480	3101-2225
A4S6	3101-2225		SWITCH-PB DPDT ALTNG .5A 100VAC	28480	3101-2225
A4S7	0490-0401	1	SWITCH-REED 1A DRY 3V A 100MA 250V	28480	0490-0401
A4U1	1826-0407	1		28480	1826-0407
			A4 MISCELLANEOUS		
	0360-1514	1	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	3131-0382	3	BUTTON-PB-SW BUTTERSCOTCH GOLD) .398-IN W	04498	J52312 BUTTERSCOTCH GOLD
	3131-0383	8	BUTTON-PB-SW HARVEST GOLD) .398-IN W	04498	J52312 HARVEST GOLD

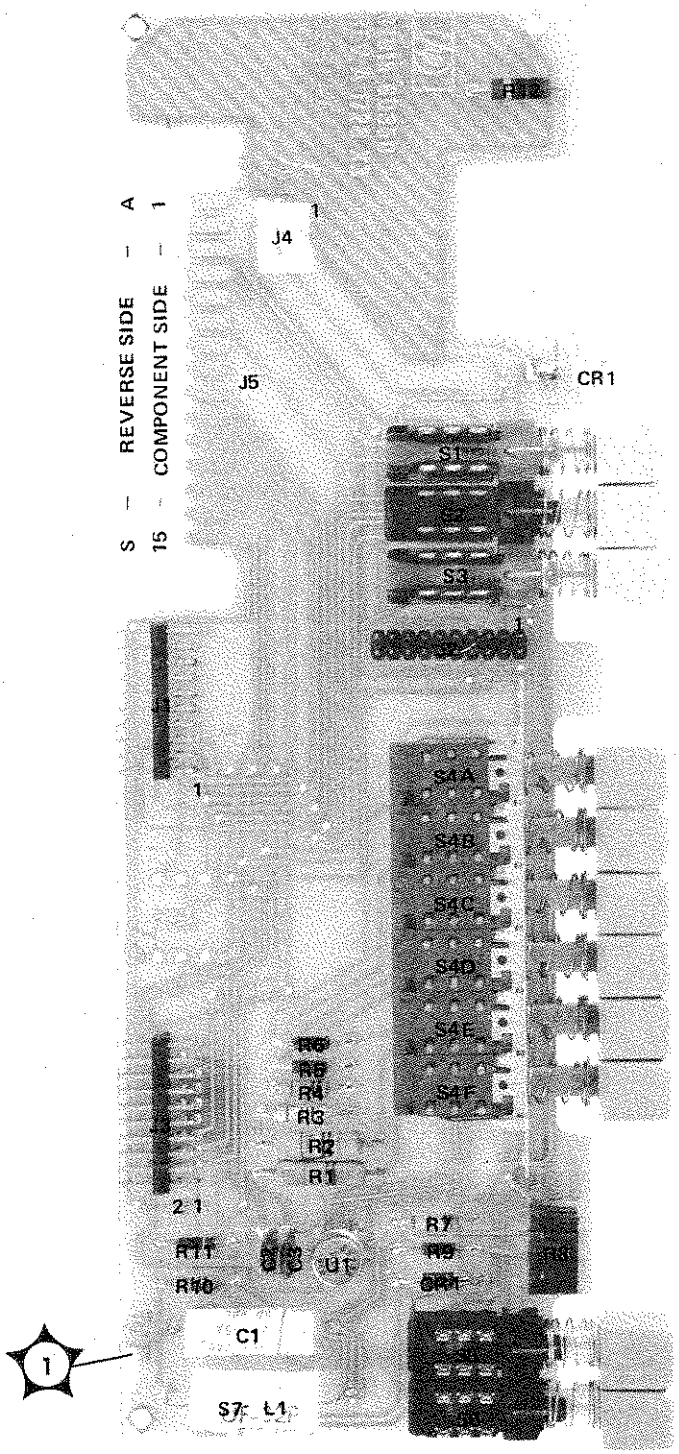


Figure 8-22. Control PCA A4 Parts Location

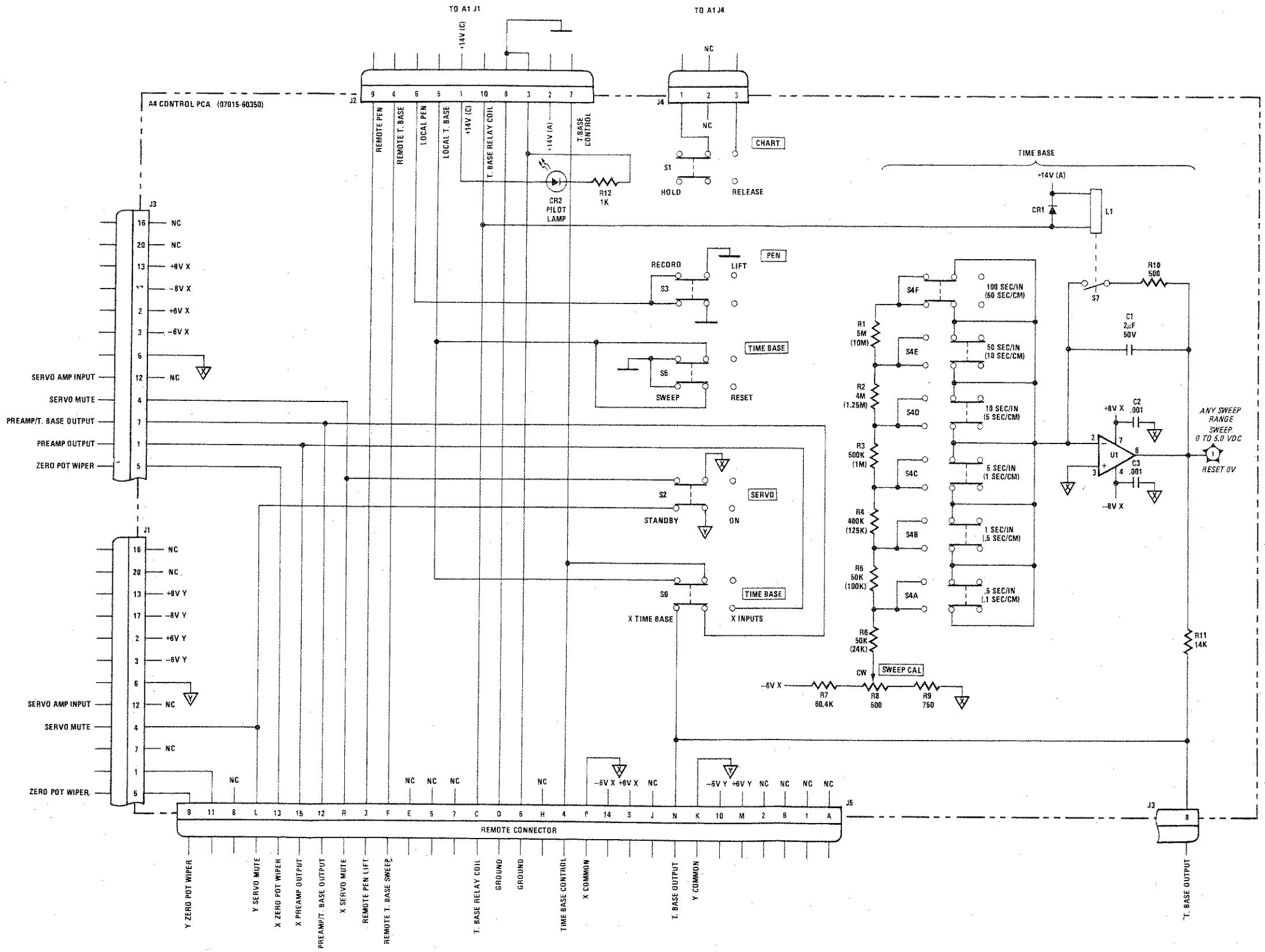


Figure 8-23. Control PCA A4 Schematic Diagram

Table 8-5. Preamplifier PCA A5 Parts List

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5	07015-60345	1	PCA, PREAMPLIFIER	28480	07015-60340
A5C1	0160-0165	2	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	0420J	292P56392
A5C2	0160-2671	4	CAPACITOR-FXD .1UF +-5% 50VDC POLYE	0420J	292P1045R8
A5C3	0160-2671		CAPACITOR-FXD .1UF +-5% 50VDC POLYE	0420J	292P1045R8
A5C4	0160-2199	2	CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A5C5	0160-0165		CAPACITOR-FXD .056UF +-10% 200VDC POLYE	0420J	292P56392
A5C6	0160-2671		CAPACITOR-FXD .1UF +-5% 50VDC POLYE	0420J	292P1045R8
A5C7	0160-2671		CAPACITOR-FXD .1UF +-5% 50VDC POLYE	0420J	292P1045R8
A5C8	0160-2199		CAPACITOR-FXD 30PF +-5% 300VDC	28480	0160-2199
A5C9	0150-0050	4	CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A5C10	0150-0050		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A5C11	0150-0050		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A5C12	0150-0050		CAPACITOR-FXD 1000PF +80-20% 1KVDC CER	28480	0150-0050
A5CR1	1902-0037	4	DIODE-ZNR 9.09V 10% DO-7 PD=.4W	0223G	FZ7057
A5CR2	1902-0037		DIODE-ZNR 9.09V 10% DO-7 PD=.4W	0223G	FZ7057
A5CR3	1902-0037		DIODE-ZNR 9.09V 10% DO-7 PD=.4W	0223G	FZ7057
A5CR4	1902-0037		DIODE-ZNR 9.09V 10% DO-7 PD=.4W	0223G	FZ7057
A5J1	1251-0524	2		28480	1251-0524
A5J2	1251-0524			28480	1251-0524
A5J3	1251-3618	2	CONNECTOR 2-PIN M POST TYPE	27264	09-60-1021
A5J4	1251-3618		CONNECTOR 2-PIN M POST TYPE	27264	09-60-1021
A5J6	1251-3192	4	CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031 (2403-03A)
A5J7	1251-3192		CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031 (2403-03A)
A5J8	1251-3192		CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031 (2403-03A)
A5J9	1251-3192		CONNECTOR 3-PIN M POST TYPE	27264	09-60-1031 (2403-03A)
A5R1	0698-6305	2	RESISTOR 900K ,1% ,25W F TC=0+-25	03298	NE60
A5R2	0698-6342	2	RESISTOR 90K ,1% ,125W F TC=0+-25	03298	NE55
A5R3	0698-6360	2	RESISTOR 10K ,1% ,125W F TC=0+-25	03298	NE55
A5R4	0757-0858	2	RESISTOR 90.9K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-9092-F
A5R5	0757-0978	2	RESISTOR 95.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-9532-F
A5R7	2100-2642	4 2	RESISTOR VAR 100K 10% 15T	28480	2100-2642
A5R9	0698-5552	2	RESISTOR 1K 1% .125W F TC=0+-25	03298	NE55
A5R10	0698-6719	2	RESISTOR 15K 1% .125W F TC=0+-25	03298	NE55
A5R11	0757-0436	2	RESISTOR 4.32K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4321-F
A5R12	0698-6329	2	RESISTOR 845 1% .125W F TC=0+-25	03298	NE55
A5R13	0698-7803	2	RESISTOR 576K 1% .125W F TC=0+-100	0299E	MF5C1/8-T0-5763-F
A5R14	2100-3657	1	RESISTOR 576K 1% .125W F TC=0+-100	28480	2100-3657
A5R15	0698-7803			0299E	MF5C1/8-T0-5763-F
A5R16	0698-5553	2	RESISTOR 2.4K 1% .125W F TC=0+-25	03298	NE55
A5R17	0698-3274	2	RESISTOR 10K 1% .125W F TC=0+-25	03298	NE55
A5R18	2100-1759	2	RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	0374D	3345W-W50-202
A5R19	0698-6305		RESISTOR 900K ,1% ,25W F TC=0+-25	03298	NE60
A5R20	0698-6342		RESISTOR 90K ,1% ,125W F TC=0+-25	03298	NE55
A5R21	0698-6360		RESISTOR 10K ,1% ,125W F TC=0+-25	03298	NE55
A5R22	0757-0858		RESISTOR 90.9K 1% .5W F TC=0+-100	0299E	MF7C1/2-T0-9092-F
A5R23	0757-0978		RESISTOR 95.3K 1% .125W F TC=0+-100	03298	C4-1/8-T0-9532-F
A5R25	2100-2642		RESISTOR VAR 100K 10% 15T	28480	2100-2642
A5R27	0698-6719		RESISTOR 15K 1% .125W F TC=0+-25	03298	NE55
A5R28	0698-5552		RESISTOR 1K 1% .125W F TC=0+-25	03298	NE55
A5R29	0757-0436		RESISTOR 4.32K 1% .125W F TC=0+-100	03298	C4-1/8-T0-4321-F
A5R30	0698-6329		RESISTOR 845 1% .125W F TC=0+-25	03298	NE55
A5R31	0757-0485	2	RESISTOR 681K 1% .125W F TC=0+-100	05520	CMF-55-1
A5R32	0757-0485		RESISTOR 681K 1% .125W F TC=0+-100	05520	CMF-55-1
A5R33	0698-5553		RESISTOR 2.4K 1% .125W F TC=0+-25	03298	NE55
A5R34	0698-3274		RESISTOR 10K 1% .125W F TC=0+-25	03298	NE55
A5R35	2100-1759		RESISTOR-TRMR 2K 5% WW SIDE-ADJ 1-TRN	0374D	3345W-W50-202
A5S1	3101-2226	2	SWITCH-PB DPDT MOM ,5A 100VAC	28480	3101-2226
A5S2	3101-2229	2	SWITCH-PB 3-STATION 10MM C-C SPACING	28480	3101-2229
A5S3	3101-2225	2	SWITCH-PB DPDT ALTNG ,5A 100VAC	28480	3101-2225
A5S4	3101-1162	2	SWITCH-SL SPDT-NS MINTR ,5A 125VAC/DC PC	0487F	GF124-0008
A5S5	3101-2226		SWITCH-PB DPDT MOM ,5A 100VAC	28480	3101-2226
A5S6	3101-2229		SWITCH-PB 3-STATION 10MM C-C SPACING	28480	3101-2229
A5S7	3101-2225		SWITCH-PB DPDT ALTNG ,5A 100VAC	28480	3101-2225
A5S8	3101-1162		SWITCH-SL SPDT-NS MINTR ,5A 125VAC/DC PC	0487F	GF124-0008
A5U1	1826-0102	2	IC OP AMP	0340F	LM312H
A5U2	1826-0407	2	IC OP AMP	28480	1826-0407
A5U3	1826-0102			0340F	LM312H
A5U4	1826-0407			28480	1826-0407
			A5 MISCELLANEOUS		
	0360-1514	6	TERMINAL-STUD SGL-PIN PRESS-MTG	28480	0360-1514
	3131-0383	10	BUTTON-PB-SW HARVEST GOLD .398-IN W	04498	J52312 HARVEST GOLD

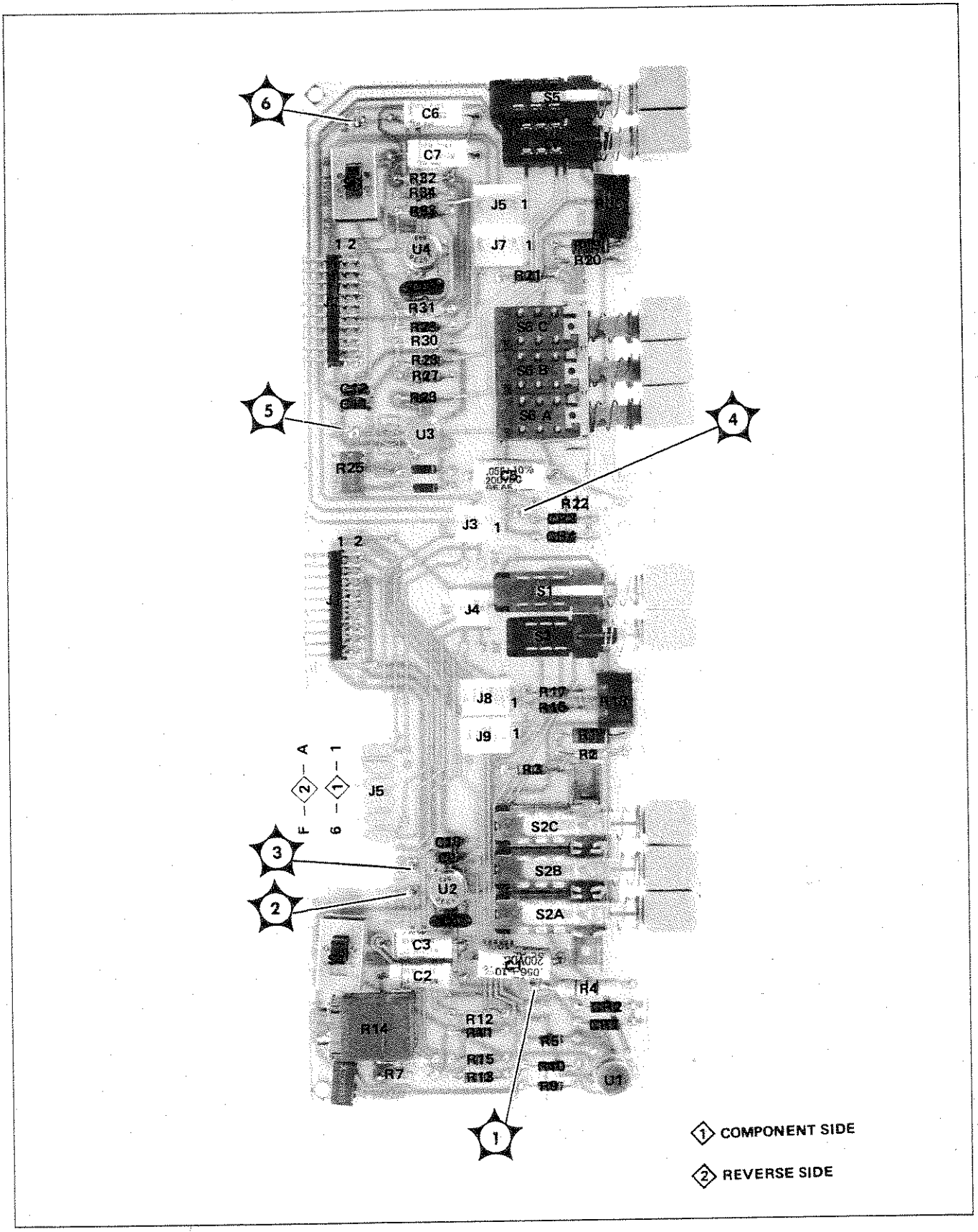


Figure 8-24. Preamplifier PCA A5 Parts Location

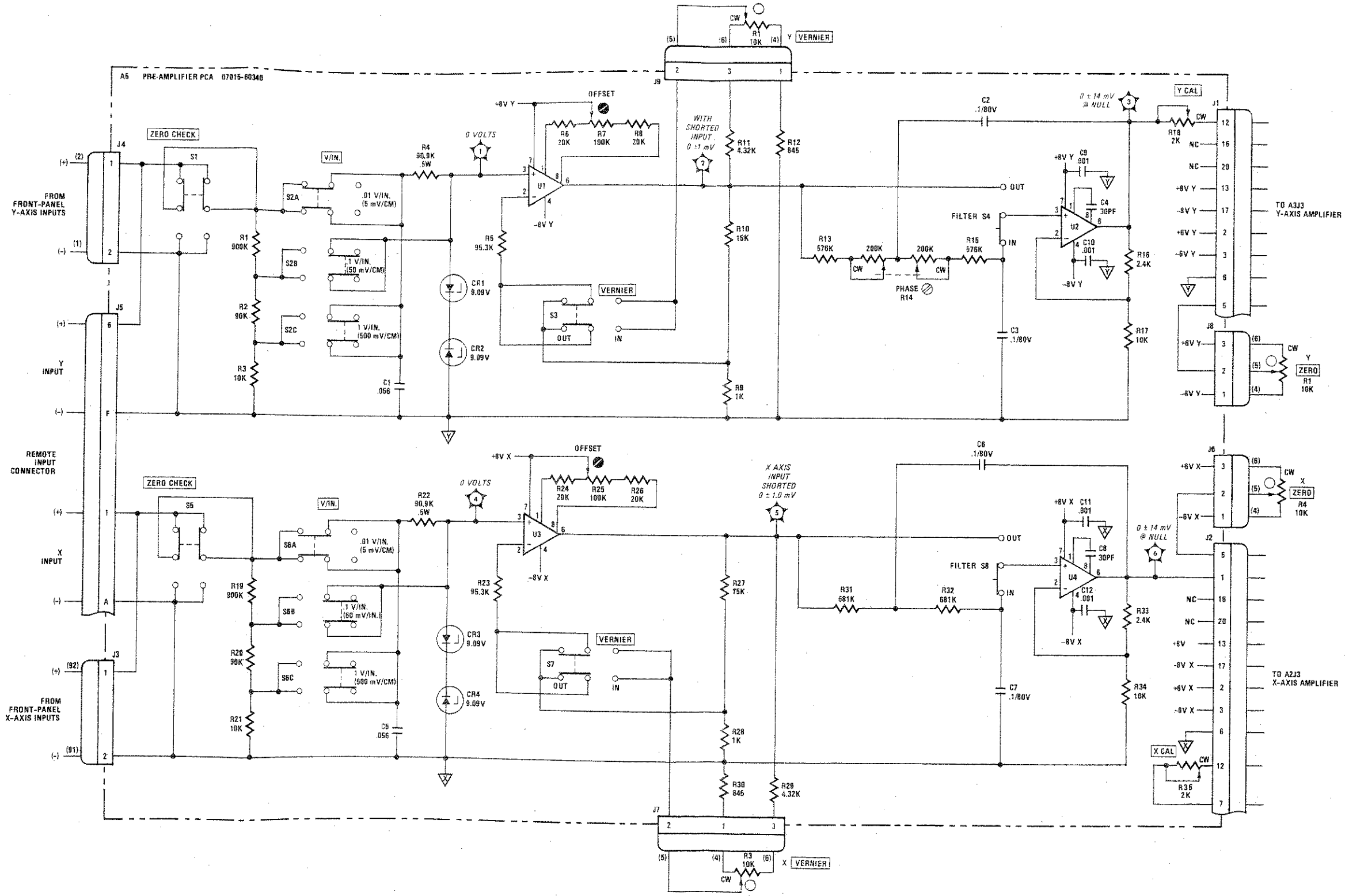
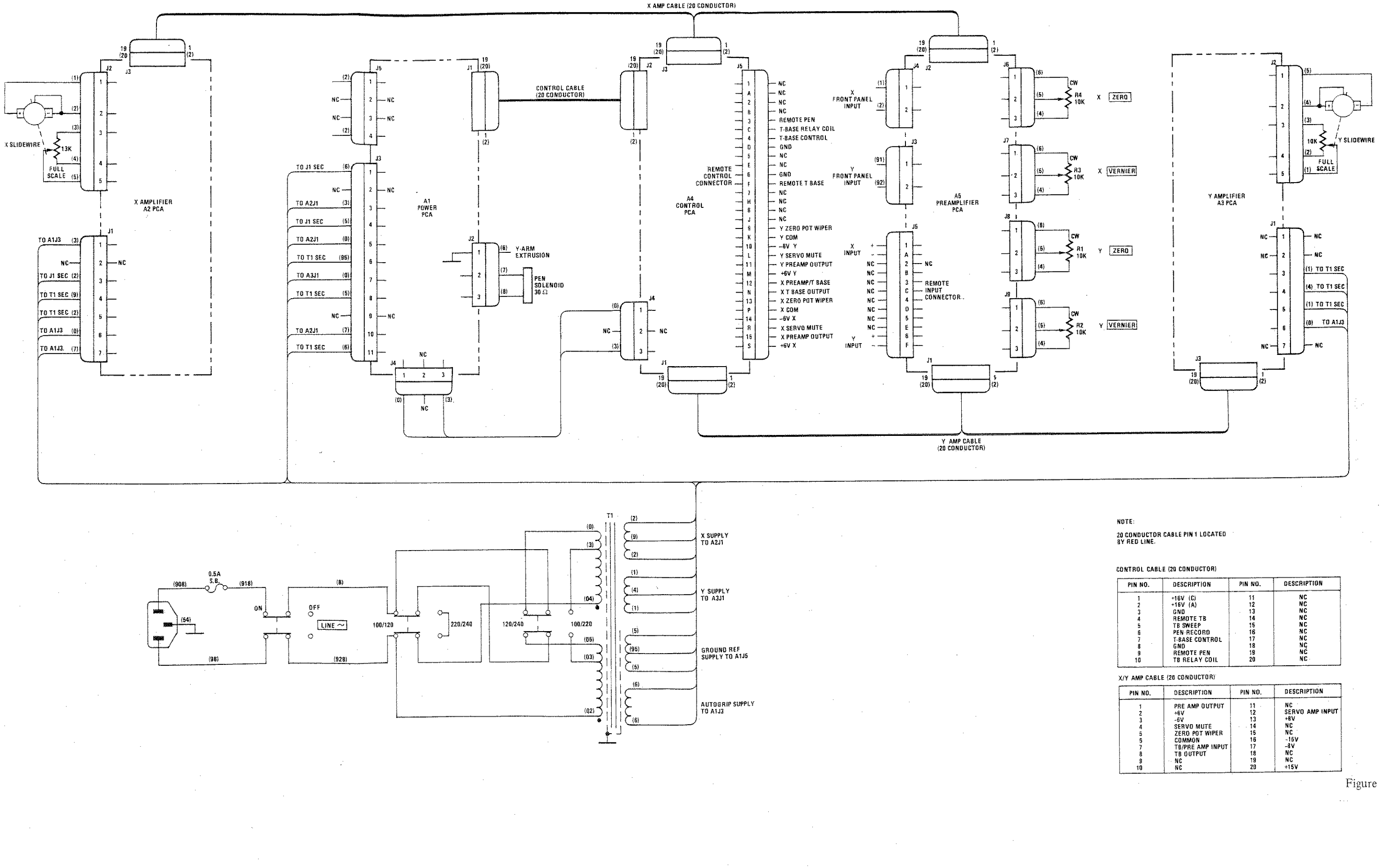


Figure 8-25. Preamplifier PCA A5 Schematic Diagram



NOTE:

20 CONDUCTOR CABLE PIN 1 LOCATED BY RED LINE.

CONTROL CABLE (20 CONDUCTOR)

PIN NO.	DESCRIPTION	PIN NO.	DESCRIPTION
1	+16V (C)	11	NC
2	+16V (A)	12	NC
3	GND	13	NC
4	REMOTE TB	14	NC
5	TB SWEEP	15	NC
6	PEN RECORD	16	NC
7	T-BASE CONTROL	17	NC
8	GND	18	NC
9	REMOTE PEN	19	NC
10	TB RELAY COIL	20	NC

X/Y AMP CABLE (20 CONDUCTOR)

PIN NO.	DESCRIPTION	PIN NO.	DESCRIPTION
1	PRE AMP OUTPUT	11	NC
2	+6V	12	SERVO AMP INPUT
3	-6V	13	+8V
4	SERVO MUTE	14	NC
5	ZERO POT WIPER	15	NC
6	COMMON	16	-15V
7	TB/PRE AMP INPUT	17	-8V
8	TB OUTPUT	18	NC
9	NC	19	NC
10	NC	20	+15V

Figure 8-26. Model 7015B Wiring Diagram