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THERMAL-TIP RECORDER

7414A



HEWLETT  PACKARD



MANUAL CHANGES

MODEL 7414A

THERMAL-TIP RECORDER
(MANUAL TITLE)

MANUAL SERIALS PREFIXED 1145A

MANUAL PRINTED MARCH, 1972

MAKE ALL CHANGES IN THIS MANUAL ACCORDING TO THE ERRATA BELOW. ALSO CHECK THE FOLLOWING TABLE FOR YOUR INSTRUMENT SERIAL PREFIX (FIRST THREE DIGITS OF AN EIGHT DIGIT SERIAL NUMBER) AND MAKE ANY LISTED CHANGE(S) IN THE MANUAL.

SERIAL PREFIX	MAKE MANUAL CHANGES	SERIAL PREFIX	MAKE MANUAL CHANGES
ALL INSTRUMENTS	ERRATA		
1202A	CHANGE 1		
1207A	CHANGE 2		

ERRATA

- Page 5-4, Paragraph 5-15, Step g: Change reference to Paragraph 5-57 to Paragraph 5-59.
- Page 5-5, D, 3, Step c: Change Figure 6-15 reference to Figure 5-4.
- Page 5-10, Step a (4): Should read "...by levering from front of top bar..."
- Page 5-23, Paragraph 5-47, Step g: Change step to read "Remove snap ring holding sprocket to drive roller shaft using snap ring pliers."
- Page 5-25, Figure 5-14: C-ring 0510-1017 shown has been changed to snap-ring 0510-1012, which must be removed with snap-ring pliers.
- Page 6-6, Table 6-1: Add on A3MP1, 7124-1605, Label 59-61 (Hz).
Change A3J6, receptacle to 1251-2995, and A3J5 to 9100-3198.
- Page 6-12, Table 6-1: Change A9T1 to 07754-60470.
After A10MP5, add attaching part 0510-1012; Ring, retaining.
- Page 6-14, Table 6-1: A10A1MP26 was changed in error; see Change 1.
- Page 6-16, Table 6-1: Add to Option 008, 7124-1604, Label 49-51 (Hz).

March, 1972

07414-91999

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DATE

MANUAL PART NUMBER

SUPPLEMENT

MANUAL CHANGES, MODEL 7414A (Cont'd)

- CHANGE 1: Page 6-14, Table 6-1:
On A10A1MP26, Add 07754-00880 Spring, Solenoid Adjustment;
Delete (1) 07754-00840 Spacer and (3) 07754-00860 Shim.
- CHANGE 2: Page 6-13, Table 6-1:
Delete A10W1, Cable, interlock.
- Page 6-27, Figure 6-12:
Delete INTERLOCK ASSEMBLY at bottom center of schematic;
Substitute a black jumper across the pins on the Transfer Board A3A1.

0-18937-4
0-18930-6

March, 1972

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MANUAL CHANGES

MODEL 7414A

THERMAL-TIP RECORDER
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SERIAL PREFIX	MAKE MANUAL CHANGES	SERIAL PREFIX	MAKE MANUAL CHANGES
ALL INSTRUMENTS	ERRATA		

△ NEW OR REVISED ITEM

△ ERRATA

Page 5-22, Figure 5-12: On Speed Control Connections, Pin 3 connects to ORANGE wire and Pin 4 connects to YELLOW wire.

Page 5-28, Figure 5-18: In lower right corner, specification for SHAFT END PLAY of gearbox should be 0.007 inch (0.018 mm).

**MODEL
7414A
THERMAL-TIP
RECORDER**

SERIALS PREFIXED: 1145A

This manual applies directly to HP Model 7414A Thermal Tip Recorders having serial numbers prefixed 1145A.

OTHER PREFIXES:

For instruments having prefixes lower than 1145A, refer to Appendix I, Backdating Supplement. For higher prefixes, see the manual change sheets provided.

**OPERATING AND SERVICE MANUAL
07414-91999**

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Hewlett-Packard
Medical Electronics Division
175 Wyman Street
Waltham, Massachusetts 02154

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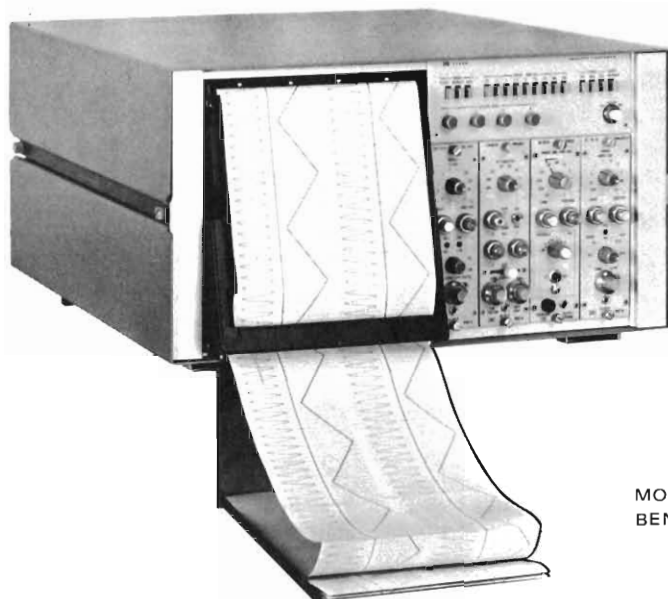
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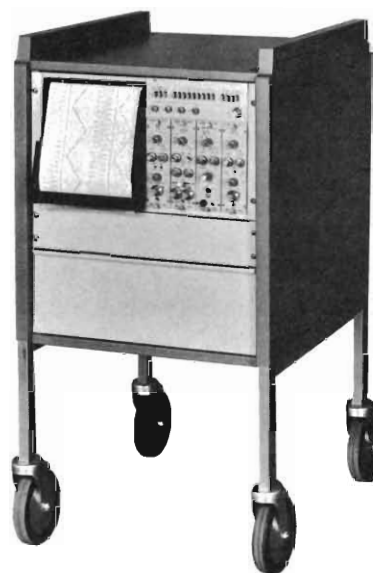
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MODEL 7414A RECORDER IN
BENCHTOP ENCLOSURE



MOBILE CART OPTION 054

Figure 1-1. Model 7414A Recording System and Optional Configurations

SECTION I GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual contains installation, operating, and maintenance instructions for your Hewlett-Packard Model 7414A Recording System, which has four channels, and produces four recorded traces with heated styli on heat-sensitive chart paper Permapaper.® Other manuals, for use with the 8800-Series Preamplifiers, and for other equipment ordered with the 7414A System are provided separately since a variety of preamplifiers, scopes, tape recorders, computer terminals and control units may be used with the recording system.

1-3. FOUR-CHANNEL RECORDER.

1-4. The Model 7414A Recorder (Figure 1-1), at the core of the system, is supplied mounted in a benchtop enclosure. It is optionally available mounted in a mobile cart, or, unenclosed, for mounting in an existing equipment rack.

1-5. The Recorder houses up to four Hewlett-Packard 8800 Series Preamplifiers and supplies them with operating power and signal connections. The preamplifiers, selected for each channel and ordered separately, are installed and tested with the recorder at the factory. It is easy to change the function of any channel by loosening two front panel thumbscrews and replacing the preamplifier with a different model.

1-6. The Model 7414A Recording System records signals monitored from devices, processes, or transducers. To monitor a signal, connect the signal cable to the input connector for the assigned channel on the recorder rear panel. The rear panel inputs are connected to signal conditioning preamplifiers mounted in the recorder. Each preamplifier output is applied to a power amplifier that drives one recording stylus. From the preamplifier output on, all four channels are identical. For ease of maintenance, all electrical adjustments are accessible from the front or top of the recorder, and most assemblies can be removed with the recorder mounted in the enclosure, mobile cart, or equipment rack.

1-7. The recorder uses Z-fold chart paper for convenient access to any part of the recording. The folded paper permits rapid scanning of the record to assess response trends. All pages are numbered to allow insertion in a notebook, or the complete record may be filed in the original flat box (pages are 8 x 12 inches, 20 x 30 cm, approximately). A new pack of chart paper can be loaded quickly, in less than ten seconds, to minimize loss of recording continuity.

1-8. The recorder may be remotely controlled to mark events, start, or go on standby. Two event markers are provided; one permits the user to indicate the start and finish of an event, the second provides time interval marking in minutes or seconds.

1-9. Applications and Specifications.

1-10. A wide selection of transducers and Hewlett-Packard preamplifiers are available for research, laboratory, and industrial applications. The following list gives some typical applications where data can be measured, monitored, and recorded using the recorder and Hewlett-Packard preamplifiers:

- Engine Testing
- Aircraft, Missile, and Space Flight Analysis
- Seismographic Studies
- Environmental Pollution Monitoring
- Telemetry Systems
- Production Control
- Relative Displacement and Velocity Monitoring

1-11. Hewlett-Packard will be glad to cooperate in the selection of transducers and preamplifiers for any particular measurement, and to send you information as additional instruments are developed to provide your recording system with other capabilities. For help in expanding your system, contact the field engineer at any Hewlett-Packard Sales/Service Office listed in the back of this manual.

1-12. Table 1-1 gives the specifications for the Model 7754A Recorder, a part of the Model 7414A Thermal Tip Recording System, and Table 1-2 lists the recorder options available. Preamplifier specifications will be found in the separate preamplifier manuals. Preamplifier frequency response and rise time must be modified by the frequency response and rise time specifications given for the recorder. Recording quality is improved by the recorder's low level of hysteresis distortion. Minor waveform details are not obscured by recorder-contributed distortion.

1-13. 8800 Series Preamplifiers (7414A System).

1-14. The 7414A Recording System is factory assembled for use with the solid-state 8800 Series Preamplifiers (Figure 1-2). They plug in interchangeably from the front of the recorder. Signal connections are made at the rear, but signals can be monitored from the front of the preamplifiers. The general characteristics of each preamplifier are given in the following paragraphs. For complete information see the preamplifier instruction manual.

Table 1-1. Model 7414A Recording System Specifications (7754A Recorder)

SENSITIVITY: ± 2.5 volts (± 0.5 volts) full scale. (Adjustable.)

FREQUENCY RESPONSE: Flat within ± 0.5 dB ($\pm 6\%$), dc to 50 Hz, reference 50 div. at 10 Hz; down less than 3 dB at 100 Hz, reference 10 div. at 10 Hz.

POWER RESPONSE: At 50 Hz: More than 50 divisions (full scale). At 100 Hz: More than 10 divisions.

CHART SPEEDS: 0.25, 0.5, 1.0, 2.5, 10, 25, 50, and 100 mm/sec. Speed Regulation: $\pm 1\%$. Paper Weave: Less than 0.5 mm. (Speeds selected via panel push-buttons.)

INPUT IMPEDANCE: Loading at preamplifier output is 50 kilohms, min.

NOISE: Not discernible with recorder input open or shorted.

GAIN STABILITY: (One hour warmup). Temperature: 0.25 div/ 25°C , from 20°C to 40°C . Line Voltage: 0.25 divisions from 103 to 127 vac.

ZERO DRIFT: (One hour warmup, input shorted). Temperature: 0.25 div/ 25°C , from 20°C to 40°C . Line Voltage: 0.25 divisions from 103 to 127 vac.

OUTPUT LINEARITY: Error less than ± 0.25 divisions at any scale point, including hysteresis (after calibration at center scale and at $+20$ divisions).

With 8808A Log-Audio Preamplifier, error less than 0.5 division at any scale point, including hysteresis (after calibration for zero error at upper and lower scale ends).

RISE TIME: 5 milliseconds over any 20 divisions (10% to 90%), overshoot adjusted for 4% or less.

LIMITING: Stylus limit 1.5 mm over channel edge (adjustable).

MARKERS: Event: Local or remote control (monopolar), located on right side, between channels 3 and 4. Timed: 1 minute or 1 second interval (monopolar), located on left side, between channels 1 and 2.

HYSTERESIS: Less than ± 0.15 divisions (see linearity).

DAMPING: Galvanometer damping set to about 4% overshoot.

CHART PAPER: Four 40 mm wide channels, each with 50 divisions; time lines every 1 mm; heat sensitive Z-fold Permapaper $\text{\textcircled{C}}$ with green grid lines is

available in packs of 500 sheets, each sheet 12 inches (30 cm) long, and numbered for footage and indexing.

Green grid lines and black stylus trace make recording suitable for reproduction.

PAPER LOADING: No threading required. Loading in 10 seconds.

PAPER TAKEUP: On shelf of recorder, or in drawer provided with cart installations.

TRACE WIDTH: 0.020 inches (0.5 mm) nominal; depends upon heat control setting.

REMOTE OPERATION: Rear panel connector J8: Remote operation of chart drive, event marker, optional extra marker. Connector also supplies ± 12 , ± 20 , and -24 vdc.

FRONT PANEL CONTROLS: Power, Chart Drive, Chart Speed selection, Time Marker, Event Marker, Channel Heat controls.

OTHER CONTROLS: Each Channel: Position, Gain, Damping, High Limit, Low Limit, 440 Hz Oscillator Amplitude.

POWER REQUIRED: 115/230 volts ac, ($\pm 10\%$), 60 Hz (50 Hz optional), 300 watts. Warmup time, approximately 15 seconds.

DIMENSIONS: Height: 10.5 inches (29 cm). Width: 19.0 inches (48.3 cm), for standard rack. Depth: 22.75 inches (57.3 cm). Projection: 2.5 inches (6.3 cm) from rack front.

Bench Top Enclosure: Height: 11.87 inches (30.2 cm). Width: 20.25 inches (51 cm). Depth: 24 inches (60.5 cm). Paper Takeup Tray projects 10.5 inches (26.4 cm) from front; hangs down 5.5 inches (13.8 cm).

Mobile Cart (Option 054): Height: 41 inches (105 cm). Width: 23 inches (59 cm). Depth: 31 inches (79 cm).

WEIGHT: Recorder: 76 lbs (34.4 kg). Bench Top Enclosure: 94 lbs (42.5 kg); with paper takeup shelf 95.5 lbs (43.3 kg); with Mobile Cart: 191 lbs (81 kg).

ENVIRONMENT: Maximum ambient temperature (free air circulation): 40°C (104°F). No free air circulation: 25°C (77°F). Location: Free from dust, explosive vapors, corrosive vapors, and extreme cold.

Table 1-2. Model 7414A Recording System, Equipment Options

Option	Part Number	Description
	7414A	Four Channel Thermal Tip Recording System, 60 Hz, 115/230V ac; mint gray front panels, jade green knobs, 440 Hz Oscillator for 8803A High Gain Preamplifier, and 2400 Hz Oscillator for 8805A Carrier Preamplifier; moss gray Bench Top Enclosure 07754-60261.
001	07754-60600	Rack mounting kit (Figure 2-7), with paper take-up tray and panel.
008		For 115/230V ac, 50 Hz operation.
012		Less one channel; right channel No. 4 is deleted, event marker installed between channels 2 and 3, extra marker cannot be installed with this option.
015	07754-60350	Extra monopolar marker installed between channels 2 and 3; this marker cannot be installed with Option 012.
054		Mounted in 1064B Mobile Cart; moss gray, with paper take-up drawer, blank panel.

Note: For a complete System, order up to four 8800 Series Preamplifiers.

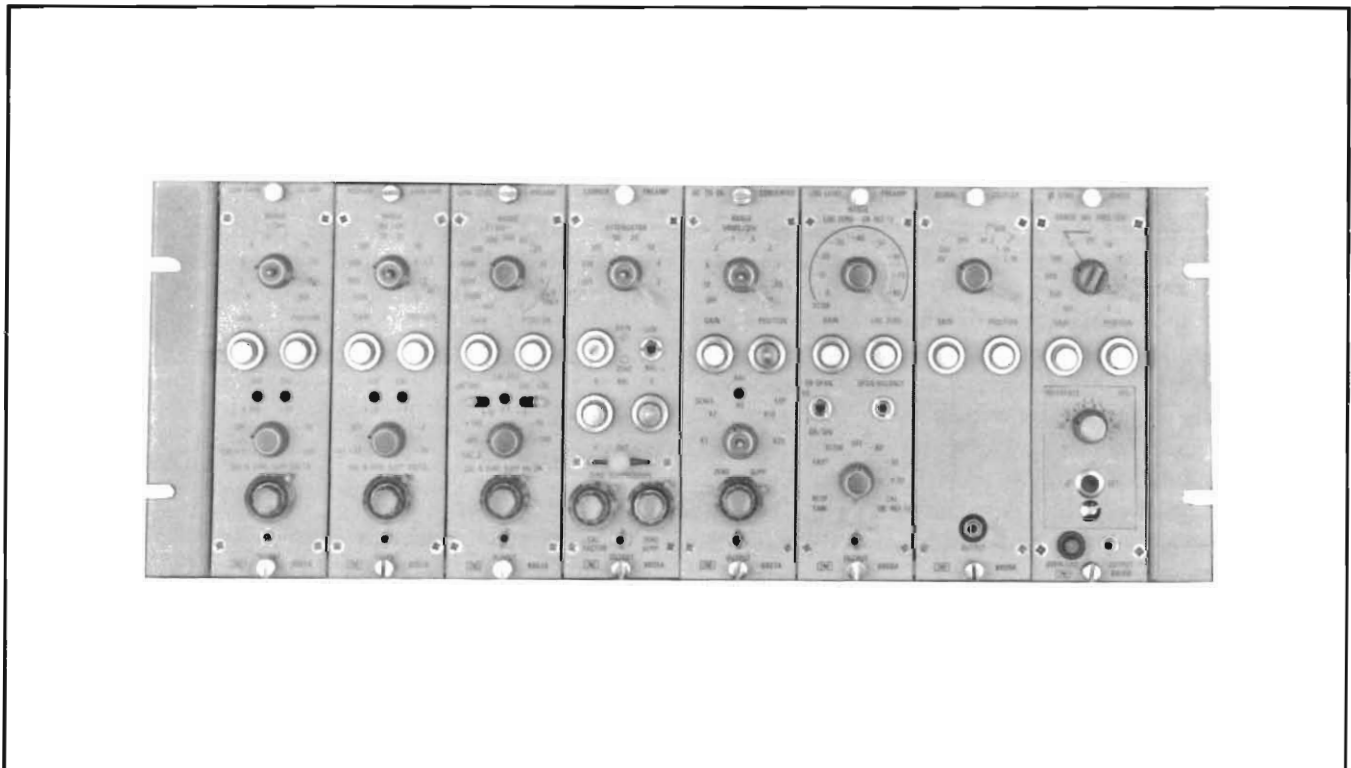


Figure 1-2. 8800 Series Preamplifiers

1-15. MODEL 8801A LOW GAIN DC PREAMPLIFIER. — With a maximum sensitivity of 5 mV/div, the 8801A provides stable and precise amplification from dc to the limit of the recorder's capability, or up to 10 kHz when used with an oscilloscope or other indicator. The 8801A features calibrated zero suppression with limits of ± 10 and ± 100 volts.

1-16. MODEL 8802A MEDIUM GAIN DC PREAMPLIFIER. — The 8802A has a gain that is five times greater than the 8801A and zero suppression to ± 2 and ± 20 volts. Except for the common-mode tolerance, which is smaller by a factor of five on the high sensitivity positions of the RANGE control, the choice between the 8801A and 8802A depends directly on signal input requirements.

1-17. MODEL 8803A LOW LEVEL PREAMPLIFIER. — With a maximum sensitivity of 1 μ V/div, corresponding to a gain of 100,000, the 8803A accommodates a much wider range of signal amplitude (within a bandwidth of dc to 100 Hz) than the 8801A and 8802A. The 8803A features a fully-guarded input circuit, with a floating input and common-mode rejection as high as 160 dB at dc (120 dB at 60 Hz). In addition to a high rejection ratio, the input circuit will tolerate a common-mode voltage as high as ± 300 Vdc at any position of the RANGE control. Calibrated zero suppression is provided in three maximum ranges: ± 1 , ± 10 , and ± 100 volts with resolution to 10^{-3} .

1-18. MODELS 8805A/B CARRIER AMPLIFIER. — The 8805s measure any physical variable that can be coupled to a suitable transducer, i.e., strain gage bridge, resistance or reactance transducer, or differential transformer. A partial listing of physical variables includes: strain, pressure, force, velocity, flow and acceleration. A 2400 Hz oscillator in the recording system provides an excitation voltage which is amplified by a buffer amplifier in the 8805 to a power level appropriate for exciting the external transducer, eliminating the need for an external excitation circuit. The excitation voltage, 5 Vrms at 2400 Hz, can drive a load resistance greater than 100 ohms; the amplifier will operate with sources having an internal impedance up to 5000 ohms at the signal input terminals. Calibrated zero suppression permits analyzing small signals when large static loads are present on the transducer. A calibration factor control allows attenuation and zero suppression to be calibrated in terms of transducer load units.

1-19. MODEL 8806B PHASE-SENSITIVE DEMODULATOR. — The 8806B provides a dc output proportional

to the rms value of an input signal component that is in phase, or 180° out of phase with respect to an external ac reference voltage. For flexibility, the phase-reference voltage can be shifted to any phase angle by three plug-in calibrated phase shifters, available for frequencies of 60, 400, or 5000 Hz. A fourth plug-in phase shifter covers six frequency bands from 50 Hz to 40 kHz and provides for continuous phase shifting from 0° to 360° . Other features include transformer isolation for both the signal and reference voltage circuits, and a maximum calibrated sensitivity of 0.5 mV rms/div, corresponding to a gain of 200 (rms ac to dc).

1-20. MODEL 8807A AC TO DC CONVERTER. — The 8807A provides a dc voltage output proportional to the average value of a full-wave rectified ac input signal. Range sensitivity is calibrated in terms of rms, for sinusoidal waveforms. The input circuit is transformer coupled, floating, and guarded for high common-mode rejection, allowing measurements over a wide range of input signal conditions: 3 mV to 500 Vrms, from 50 Hz to 100 kHz. Calibrated zero suppression and variable scale expansion permit clear analysis of small excursions in large input signals.

1-21. MODEL 8808A LOG LEVEL PREAMPLIFIER. — The 8808A contains compression and full-wave detection circuits that provide an output proportional to the \log_{10} of the ac input signal amplitude, expressed in decibels, where zero decibels is taken as a 1 volt rms sine-wave input voltage. The unit provides for 50 dB and 100 dB ranges, with full-span outputs corresponding to ± 2.5 volts or 0 to +5 volts. Input signals from 3 mv to 300 Vrms may be recorded without changing ranges; a voltage ratio of 100,000 (100 dB).

1-22. MODEL 8809A SIGNAL COUPLER. — The 8809A is a low cost, solid state preamplifier with selectable high or low input impedance and a GAIN control. It is used for simple signal coupling to an HP direct writing recorder, in single and multichannel systems.

1-23. Accessories.

1-24. For a list of recorder accessories, refer to Table 6-1, Assembly A19, Accessories. Order accessories by their individual part numbers. For other system accessories, refer to the separate equipment manuals provided with the recording system.

SECTION II INSTALLATION

2-1. INITIAL INSPECTION.

2-2. Initial inspection consists of a check for physical damage incurred during shipping, and the completion of all performance tests. See Figure 2-1 for Recorder inspection particulars.

2-3. Mechanical Check.

2-4. If damage to the shipping carton is evident, notify the HP Sales/Service Office and unpack the equipment in the presence of the carrier's agent. Upon unpacking, inspect the instrument for mechanical damage such as scratches, dents, broken knobs, or other defects. Also check the cushioning materials for signs of severe stress during handling.

2-5. Performance Tests.

2-6. The electrical and mechanical performance of the Model 7414A Thermal Tip Recording System may be verified upon receipt, using performance tests described in Section V, Maintenance. An 8800-Series Preampfier must be in place for these tests.

2-7. Damage Claims.

2-8. If the instrument is damaged in transit, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately. For your convenience, a list of these offices is located in the rear of this manual. Keep the shipping carton and packaging material for the carrier's inspection. The Sales/Service Office will arrange for repair or replacement of the System without waiting for claim settlements from the carrier.

2-9. STORAGE.

2-10. If the Recording System is to be stored for a period of time, wrap the front panels in protective padding and seal the equipment in a moisture-proof covering. Repackage the System in a container similar to the original factory carton. If the System is installed in a Bench Top Enclosure, leave it mounted in the enclosure. If it is installed in a Mobile Cart or equipment rack, remove it from the cart or rack to facilitate moistureproof packaging. If long-term storage is anticipated, pull the paper table out at the Cart drawer and unlatch it. This will prevent a flat spot from developing on the drive roller from the spring-loaded pressure roller.

2-11. INSTALLATION.

2-12. Recording Systems installed in the Bench Top Enclosure do not require installation instructions. For access to the Recorder, loosen knobs at the front of the case and raise the top cover (see Figure 2-1). If the Recorder is installed in a Mobile Cart, release the four front-panel shipping screws to slide the Recorder out for receiving inspection and performance checks (see Figure 2-1). If the Recorder is installed in an existing equipment rack, the rack slides must be installed before mounting the Recorder (Option 001).

2-13. Preampfier Installation.

2-14. The Recording System is shipped with all preampfiers installed. To change a preampfier, perform the following steps.

- a. Switch off Recorder power.
- b. Loosen the top and bottom front panel screws and pull the preampfier straight out.
- c. Insert the replacement preampfier into the channel guide, push firmly to mate connectors, and tighten screws at the top and bottom of the front panel.

2-15. Power Connections.

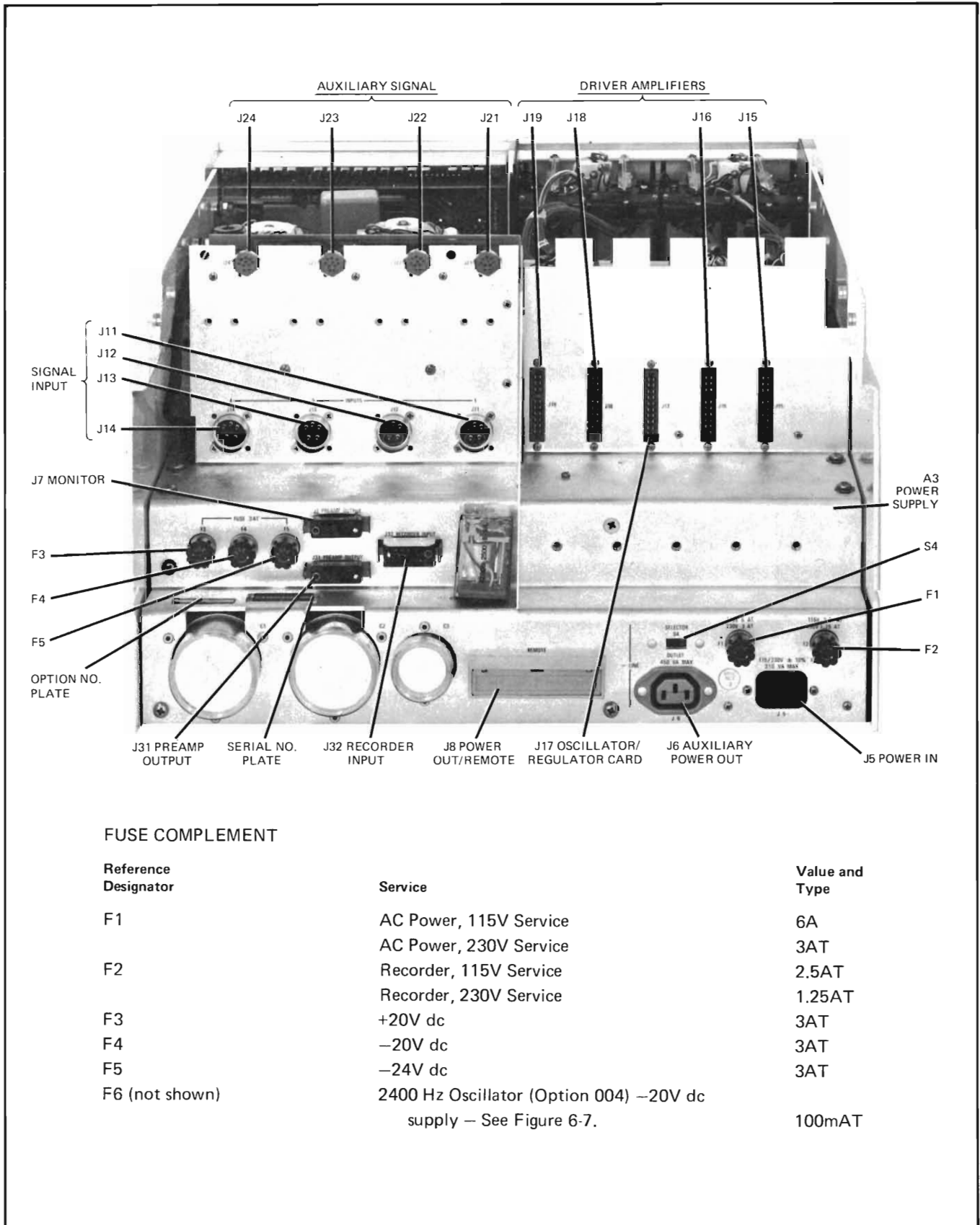
2-16. Check that the power line voltage and frequency is the same as that shown on the Recorder nameplate, located on a shelf at the left side of the rear panel (see Figure 2-2). Note locations of the fuses.

2-17. When making power connections, push the POWER button on the front panel so that it protrudes and a Z-shaped line appears. Otherwise, the recorder will start when the power cord is plugged in. Refer to Figure 2-3 and perform the following steps for Mobile Cart power connections.

- a. Connect a ground wire (as shown) to a good earth ground, such as a cold water pipe.
- b. Check that the paper take-up drawer is grounded with a strap, and that the recorder chassis is grounded to the cart.
- c. Plug the power cord connector into the recorder POWER INPUT jack, and into the line receptacle built into the cart.
- d. Connect the cart power cord to a 3-wire line outlet, completing the power connections.



Figure 2-1. Recorder Access for Receiving Inspection



FUSE COMPLEMENT

Reference Designator	Service	Value and Type
F1	AC Power, 115V Service	6A
	AC Power, 230V Service	3AT
F2	Recorder, 115V Service	2.5AT
	Recorder, 230V Service	1.25AT
F3	+20V dc	3AT
F4	-20V dc	3AT
F5	-24V dc	3AT
F6 (not shown)	2400 Hz Oscillator (Option 004) -20V dc supply - See Figure 6-7.	100mAT

Figure 2-2. Recorder Rear Panel Connections and Fuse Locations

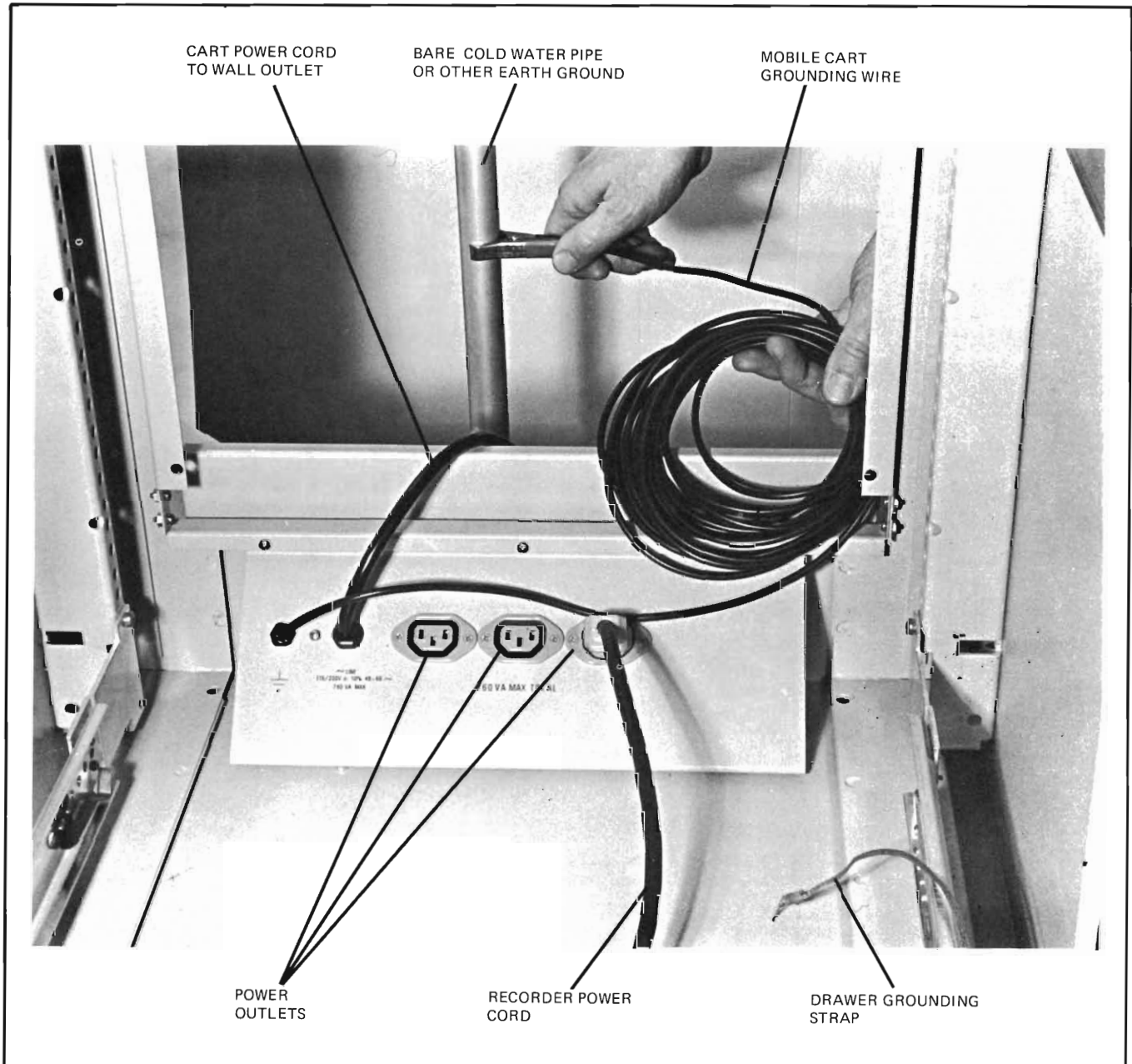


Figure 2-3. Recorder and Mobile Cart Power Connections

2-18. Signal Connections.

2-19. For signal connection information relative to the individual preamplifiers, refer to the preamplifier instruction manuals. Also refer to Figure 2-4 for a description of signal cable preparation for the 8800-Series Preamplifiers.

2-20. Tape System Connections.

2-21. If an instrumentation tape recorder is to be used with the Recording System, the addition of a 4681A or a 4682A

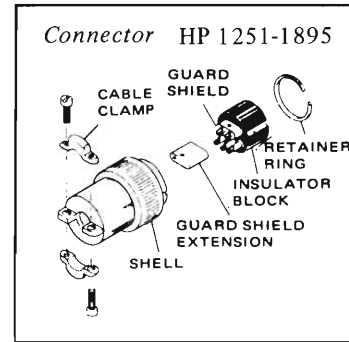
Control Section is recommended. Connections for the Recorder and the Control Sections are shown in Figure 2-5.

2-22. Remote Control and Marker Connections.

2-23. A remote control and marker plug is supplied with the Recorder as an accessory. To make remote control connections for operating the Recorder and the Event Marker, make the cable connections shown in Figure 2-6, using the HP parts noted in the illustration.

SIGNAL CONNECTOR PREPARATION

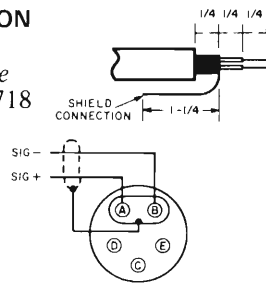
- a. Slide the prepared end of the cable into the cable clamp and through the connector shell. Also slide the end of the cable through the guard shield extension, for guarded input circuits. For non-guarded input circuits, remove and store the guard shield extension.
- b. Wire the connector according to the diagram below, according to preamplifier to be used. For guarded input circuits, slide the guard shield extension into place after soldering the signal leads to terminals A and B.
- c. Press the connector block carefully into the connector shell.
- d. Insert the retaining ring.
- e. Tighten the cable screws.
- f. Check with an ohmmeter to determine that the cable shields are not shorted to the connector shell or to each other.



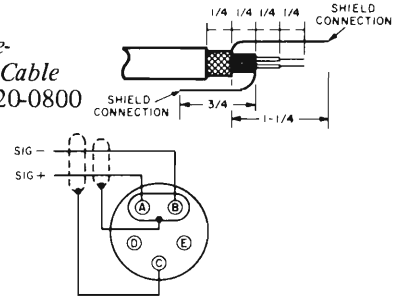
GUARDED CABLE PREPARATION

PREAMPLIFIER MODEL
8803A
8806B *
8807A **

Single-Shield Cable
HP 8120-0718



Double-Shield Cable
HP 8120-0800



NOTES:

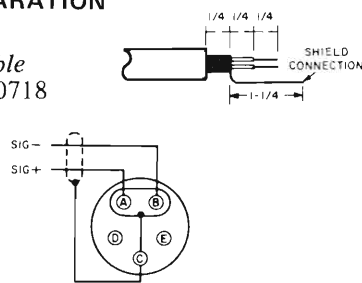
* 1. Connect Ref voltage to pins A and B on auxiliary connector of the power supply.

** 1. AC output available on pin C of auxiliary connector of the power supply.
2. DC input (8807A, Opt 02) available on pins A and B of auxiliary connector of the power supply.

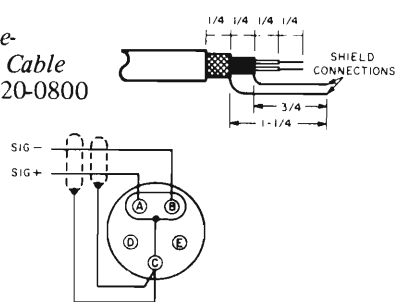
NON-GUARDED CABLE PREPARATION

PREAMPLIFIER MODEL
8801A
8802A
8808A
8809A

Single-Shield Cable
HP 8120-0718



Double-Shield Cable
HP 8120-0800




NOTE:

Single conductor shielded cable can be used by connecting center conductor to pin A and shield to pin B.

CARRIER PREAMPLIFIER CABLE PREPARATION

PREAMPLIFIER MODEL
8805A
8805B

HP Transducers having 5-pin AN connectors (pin pattern ) use Input Adapter 14060B for signal input connections. For other signal sources, connect the input signals as shown. The transducer output leads and transducer excitation leads must be twisted and enclosed in braided shielding.

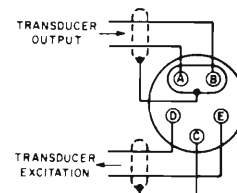
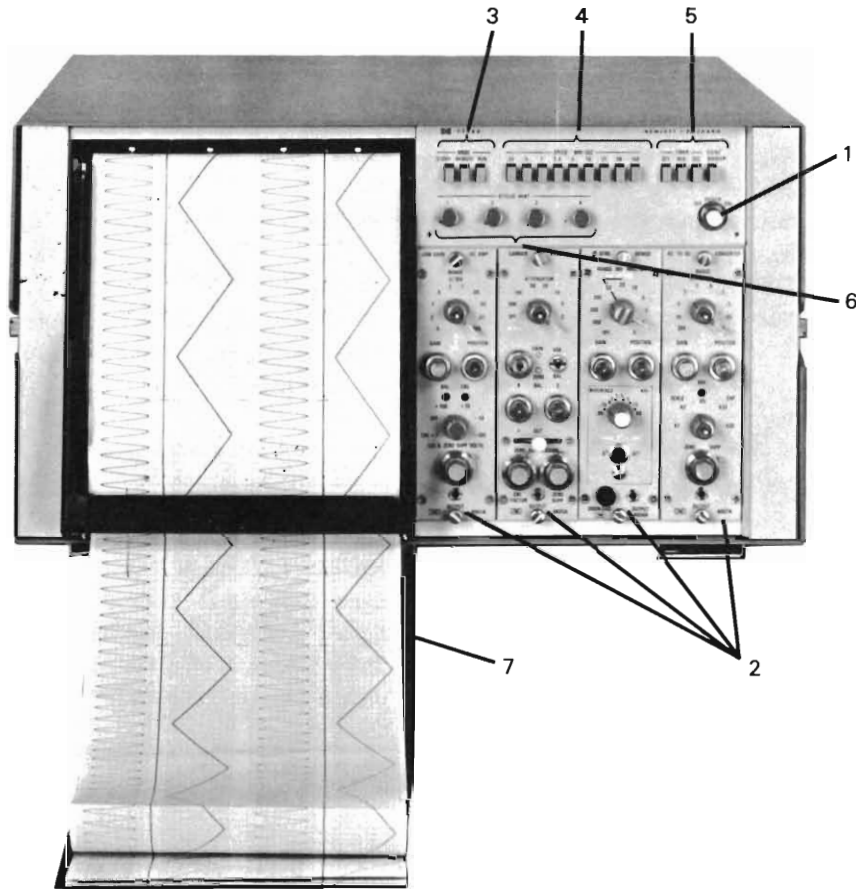


Figure 2-4. 7414A System Input Cable Preparation



1. RECORDER POWER SWITCH: Press to apply power; press to remove power. Back-lighted with power applied.

2. 8800-SERIES PREAMPLIFIERS: Refer to the individual instruction manuals for control information.

3. MODE CONTROL BUTTONS: Pressing the STDBY button holds the styli of all channels at chart center during Recorder operation. The REMOTE button transfers control of the Recorder "run mode" to a remote location. The RUN button starts the chart drive, applies heat to the styli and signals to the recording circuits.

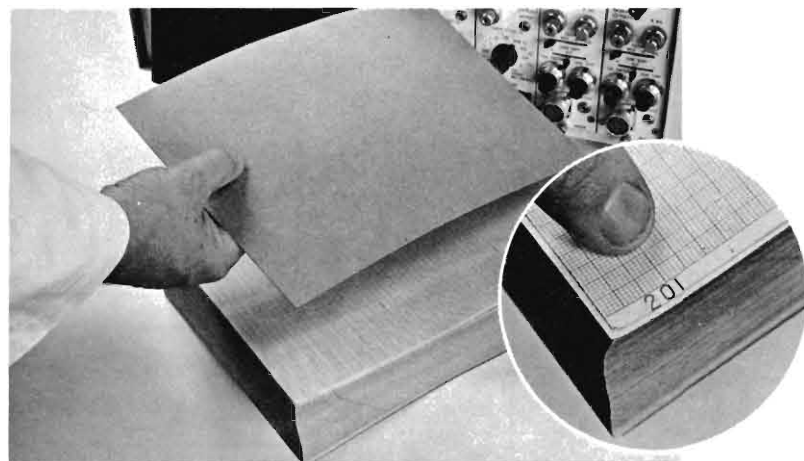
4. SPEED MM/SEC CONTROL BUTTONS: Nine speed selection buttons select standard chart speeds from 0.25 to 100 mm/second. Button remains depressed to indicate selected chart speed.

5. TIMER BUTTONS: The OFF button turns off the interval timing marker. The SEC button selects timing marks at 1-second intervals. The MIN button selects timing marks at 1-minute intervals. The EVENT MARKER button applies a marker pulse when pressed, to mark events in the process being recorded.

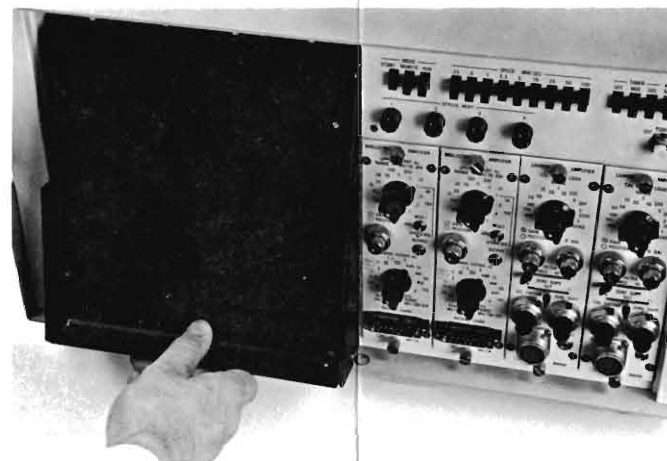
6. STYLUS HEAT CONTROLS: Individual controls adjust the heat at each stylus tip, and thereby the trace width. More stylus heat is generally required for high-frequency signals than low-frequency signals. Once adjusted, stylus heat is automatically regulated to compensate for changes in chart paper speed.

7. PAPER TAKEUP DRAWER (CART): The takeup drawer pulls out to receive used chart paper. For Bench Top Enclosure models, a paper takeup shelf is provided. Install as shown in Figure 3-2.

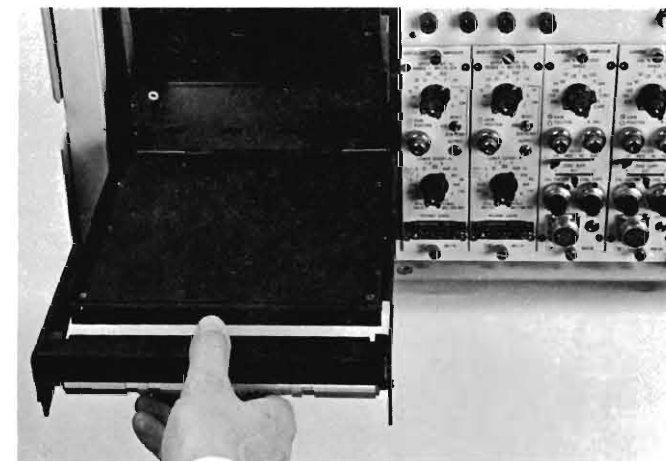
Figure 3-1. 7414A Recording System, Control Locations



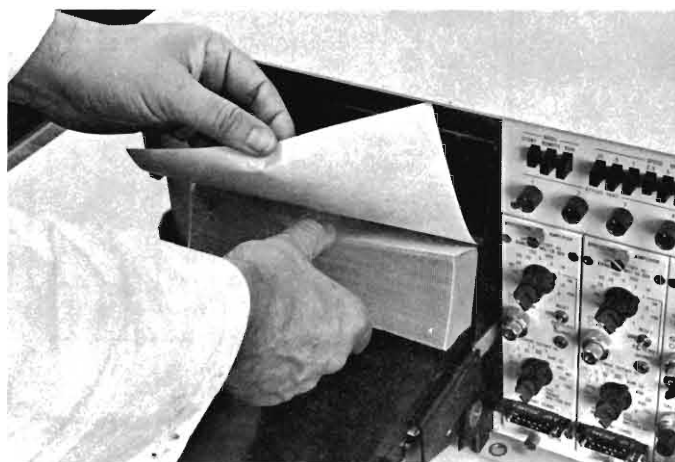
1. UNWRAP PAPER and remove cardboard. Make sure highest odd number is on top of pack.



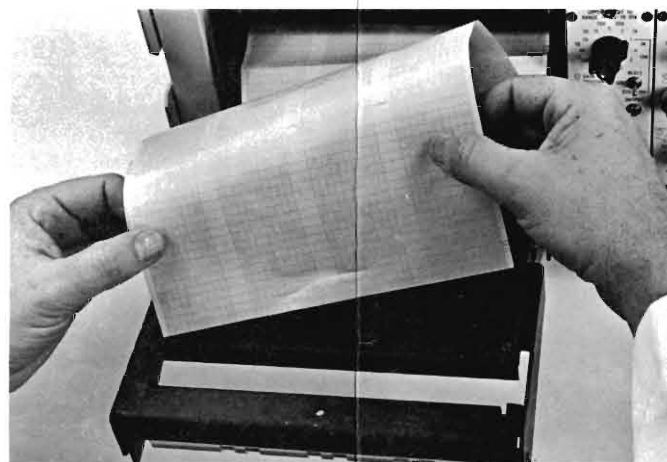
2. PULL PAPER TABLE OUT AT BOTTOM.



3. LOWER IT SLOWLY. It must be fully horizontal.



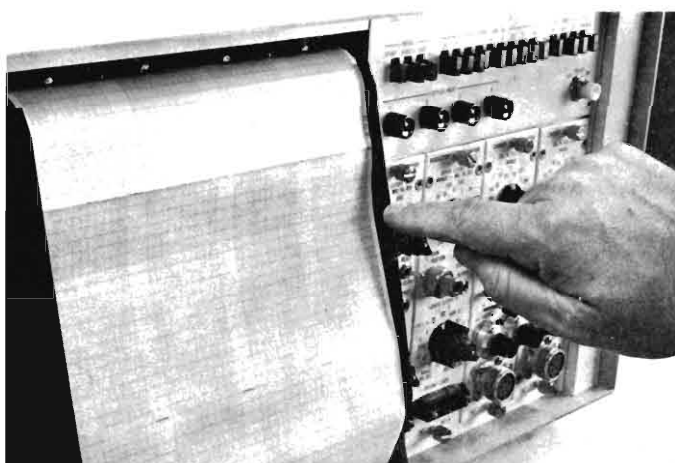
4. SLIDE PAPER PACK INTO FEED TRAY while compressing paper, and pulling top sheet out.



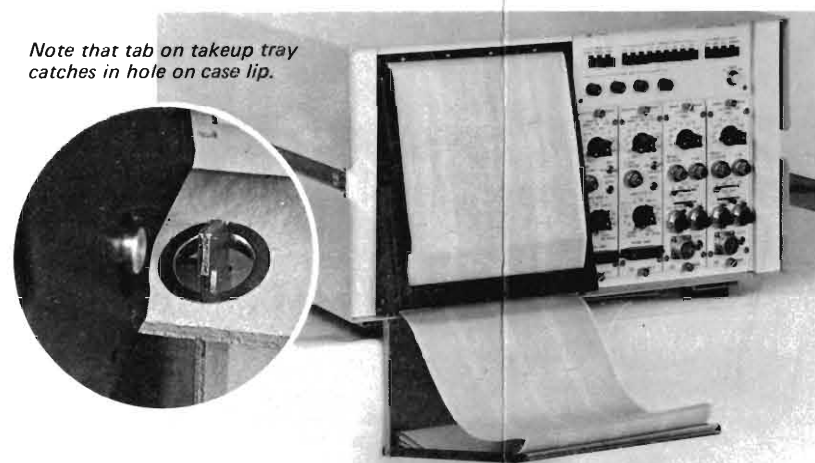
5. INSERT PAPER INTO PAPER TABLE SLOT.



6. CLOSE PAPER TABLE, pulling down slightly on paper. Press table in firmly so it locks in place.

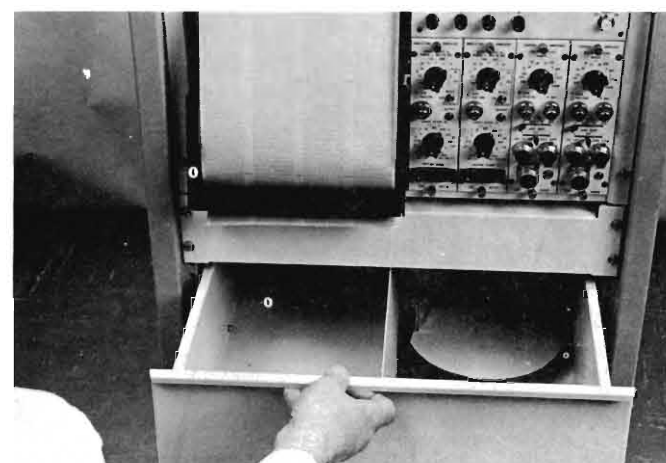


7. PAPER MUST NOT BE SLACK. A slight looseness, as shown, is all right.



Note that tab on takeup tray catches in hole on case lip.

8. IF RECORDER IS IN A CASE, INSTALL TAKEUP TRAY. Note that an odd-numbered sheet should be first onto tray.



9. IF RECORDER IS IN A CART OR A CABINET, PULL OUT PAPER TAKEUP DRAWER. Odd-numbered sheet should be first into drawer.

Figure 3-2. Paper Loading Procedure

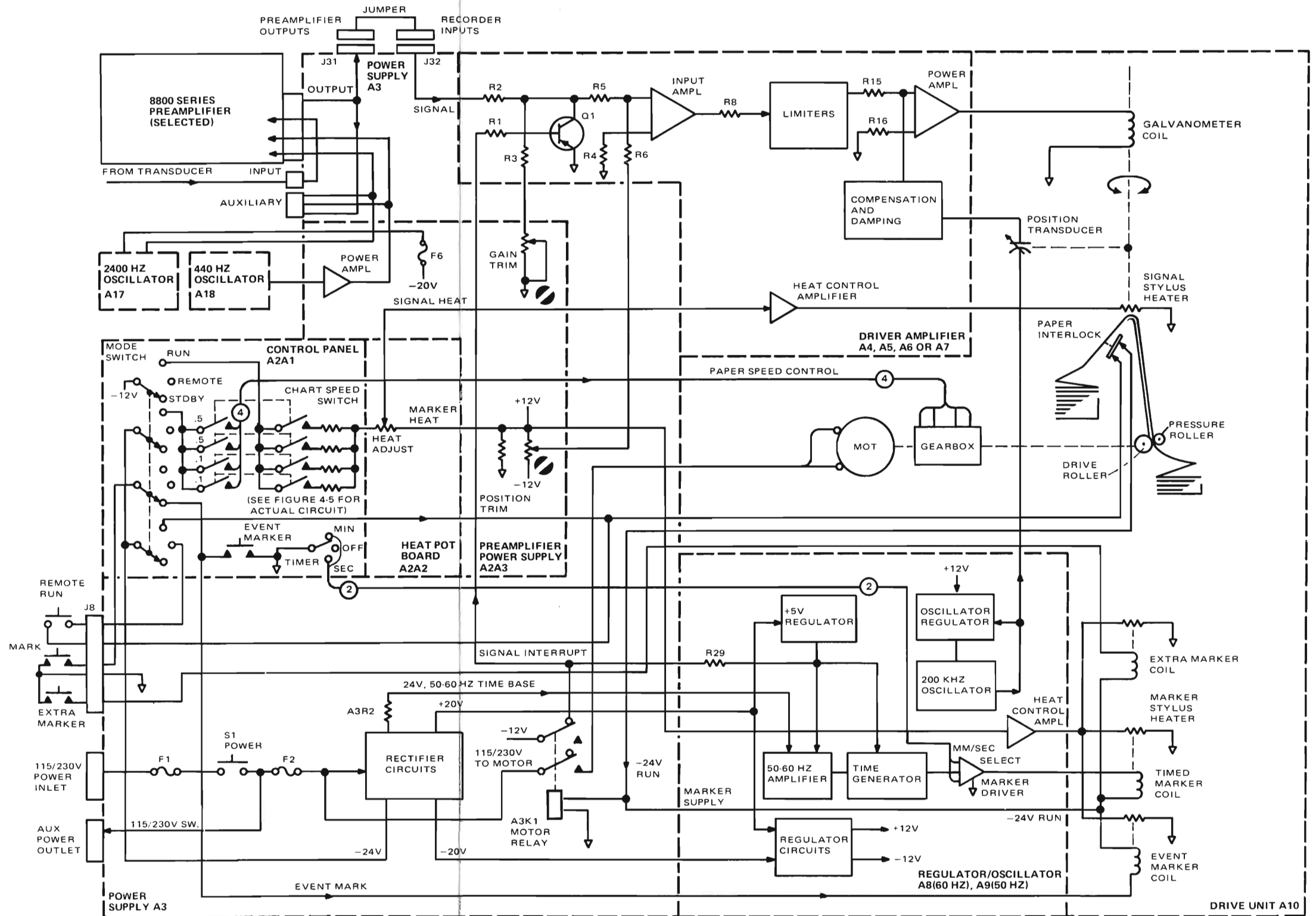


Figure 4-1. Model 7754A Recorder, Block Diagram.

SECTION IV PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section describes the principles of operation of the Thermal Tip Recorder. The Recorder includes signal, power control, and power circuits, and a chart drive mechanism. The signal circuits are described for one channel only, as all channels are identical. The power circuits and chart drive are common to all channels. This section provides functional block and schematic diagrams of the Recorder; for complete schematics, refer to Section VI at the rear of the manual.

4-3. As shown in the Block Diagram, Figure 4-1, the pre-amplifier signal is routed through a jumper cable on the rear panel to the driver amplifier, where it is amplified, limited, and combined with position feedback from the stylus position transducer. It is then amplified further and applied to the galvanometer, which drives the heated signal stylus, producing a trace on the heat-sensitive Permapaper. The Permapaper is pulled through the recorder by a drive roller, which is driven through a variable speed gearbox that is electrically controlled from the front panel. Four solenoids and gear sets are used in various combinations to produce the full range of chart speeds. In conjunction with speed selection, the selector switch varies the stylus heat so it is proportional to the chart speed. Heat adjustment controls on the front panel may be used to further vary the stylus heat to compensate for greater stylus travel caused by increased signal frequency. Other circuits in the recorder include marker, timing, rectifier, regulator, and oscillator circuits. A regulated oscillator provides a 200 kHz excitation signal for the position transducer. The block diagram shows the assembly location of these functional component groups as a troubleshooting aid.

4-4. PREAMPLIFIER POWER SUPPLY CIRCUITS.

4-5. Figure 4-2, a simplified schematic diagram, shows the preamplifier power and signal connections at the top, and, at the bottom, the recorder and preamplifier power supply circuits, including oscillators. The Preamplifier Power Supply board, A2A3, in addition to containing an oscillator fuse and power supply resistors, provides power amplification for the 440 Hz oscillator output, and connects the front panel circuit boards to the transfer board. Refer to the description of the recorder power supply for a description of these circuits.

4-6. Signals from the individual preamplifiers are routed into the power supply, on Transfer Board A3A1, and pass through the rear panel, a jumper cable, and back into the

power supply. From there they are applied to the inputs of the four driver amplifiers, which are discussed next.

4-7. RECORDER SIGNAL CIRCUITS.

4-8. The signal processing circuits consist of the driver amplifiers, one for each channel, and the galvanometers. A simplified schematic diagram of these circuits is presented in Figure 4-3.

4-9. The signal from the preamplifier (or other source that can be connected to the RECORDER INPUT jack) enters the driver amplifier and is applied to a summing junction with the gain control signal and a transistor switch that shorts the junction to ground when the Recorder is in standby mode. The signal is applied through R5 to voltage amplifier U1 input with position control voltage (± 10 mm on chart) and amplifier feedback being applied at the same point. After amplification, the signal and its control components encounter the limiter diodes, which cut the signal off at adjustable high and low levels. The diodes are powered by emitter follower voltage sources (not shown). High, low, left, right, upscale and downscale are defined on the diagram. The signal, applied through R15 to amplifier driver U2, is then current-limited to 600 mA by transistors Q5 and Q8 and further amplified by power amplifier Q4, Q7 (not shown), Q6, Q9. A feedback circuit around the power amplifier and its driver acts as an output voltage limiter (± 12.5 V).

4-10. The galvanometer circuit receives the driver amplifier output signal, and the drive coil rotates a crank attached to the signal stylus, which marks the recording chart. The galvanometer shaft is also attached to a capacitive position transducer, described in Paragraph 4-14.

4-11. Stylus Linkage.

4-12. The linkage system shown in Figure 4-4 provides a linear motion at the stylus tip from the rotary motion of the galvanometer. The galvanometer moves the end of the crank arm through the arc of a circle, and the end of the crank arm moves the center of the stylus through the same arc. But because the inner end of the stylus frame is constrained by a bearing that can move only toward or away from the chart, the stylus tip moves in a straight line.

4-13. Galvanometer Position Feedback.

4-14. The position transducer consists of a capacitor with a split bottom plate, one top plate that excites both bottom

plates, and a grounded rotor with apertures to permit passage of the 200 kHz excitation signal. The rotor is attached to the galvanometer shaft. The bottom plate is divided into four sections, connected diagonally (Figure 4-4) so that the excitation is received differentially. This differential action keeps the load on the excitation oscillator constant, to aid the oscillator regulator in maintaining a constant output current. Excitation signal amplitude is important since it affects position transducer sensitivity.

4-15. The demodulator circuit senses the unbalance between the two portions of the position sensing capacitor, caused by the amount of energy from the oscillator that is coupled through the apertures in the rotor on the galvanometer shaft. If the circuit is balanced, both halves of the position capacitor receive equal amounts of 200 kHz radiation from the oscillator output plate. Refer to Figure 4-4. On the positive excursion of the excitation signal (200 kHz), diode CR2 conducts, turning on transistor Q2 and charging C1. Diode CR1 is back-biased, and keeps Q1 cut off during this period. On the negative excursion of the excitation signal, the opposite current flow takes place, with Q1 cut off during this period. On the negative excursion of the excitation signal, the opposite current flow takes place, with Q1 conducting the same amount as Q2 conducted previously. When the circuit is balanced, C1 thus reflects a net zero voltage output. During an unbalanced condition, either Q1 conducts more or Q2 conducts more to produce an average positive or negative voltage on C1.

4-16. An example of unbalance is shown in Figure 4-4. As the positive signal causes the galvanometer to move the stylus as shown, the rotor moves so that more of the oscillator output is felt on the shaded pair of split capacitor plates. These plates are connected to the CR1-Q1 half of the demodulator, so that more negative voltage is impressed upon C1. The unshaded plates receive proportionately less of the oscillator output, and so CR2-Q2, the positive side of the demodulator, produces less positive output for C1. C1, then, sends a negative feedback voltage to the driver amplifier, which tends to return the stylus toward the center of the chart. The feedback voltage is aided by a torsion spring that facilitates setting of the stylus mechanical center. For maintenance purposes, note that one volt of position voltage corresponds to 10 divisions of stylus movement.

4-17. Galvanometer Damping.

4-18. The position feedback signal is fed back to the driver amplifier through resistor R36. Part of the position voltage is fed back through C6 as velocity information and C4 and C5 as acceleration information. The amount of velocity feedback controls the damping, which is varied with R30.

4-19. **DAMPING.** Damping is a force that is (1) propor-

tional to galvanometer velocity and (2) opposite to the direction of pen motor velocity. Figure 4-5 shows the effects of damping on frequency response and transient response, where underdamping produces peaked and oscillatory waveforms, and overdamping diminishes response. Optimum damping leaves about 71% of the original signal strength, so that the frequency response is about 3 dB down at the galvanometer's natural frequency and the response to a square wave (step function) input shows about 4% overshoot.

4-20. Heat Control Circuit.

4-21. Stylus heat is controlled from the Heat Pot Board, A2A2, on the front panel. The heat control voltage is applied to a simple feedback amplifier located on the driver amplifier assembly, Q11, Q12, and Q13, which has a current limiting circuit similar to that used for the galvanometer. The amplifier output drives the resistive stylus heat element. A good stylus should have about 34 ohms resistance.

4-22. Power Control Circuits.

4-23. Power is controlled from the recorder front panel. Figure 4-6 shows recorder power switching and fuses together with chart motor control circuits and speed control solenoid circuit.

4-24. Line common reaches the chart drive motor through S1, the power switch and S4, the voltage selector, whenever S1 is on. The high side of line power is applied to the chart drive motor through motor relay K1, which is actuated by the control switch RUN button through interlock S3 or by a remote run signal (Figure 2-8). The motor is described further in Paragraph 4-29. K1 also turns on stylus heat through the control switch.

4-25. The motor drives the gearbox, the speeds of which are controlled by speed selection solenoids L1, L2, L3, and L4. The speed control action of these solenoids is described in Paragraph 4-31. The segments of the control switch are so arranged that the solenoids are energized in the correct combination for each speed desired (Table 4-1). The switch is shown in the 1mm/sec position. As an example of how the switch works, the -24V supply voltage, applied to the switch via the main feeder line at the top of Figure 4-6 energizes the center contacts of the switch segment. When the pushbutton marked "1" is depressed, -24V is applied to solenoids L1 and L2 through resistors R8 and R7 respectively, selecting the proper gear combination. In speeds of 2.5mm/sec and higher, the heat control voltage is augmented by fixed voltages applied to the heat control potentiometers by the control switch. The heat control poten-

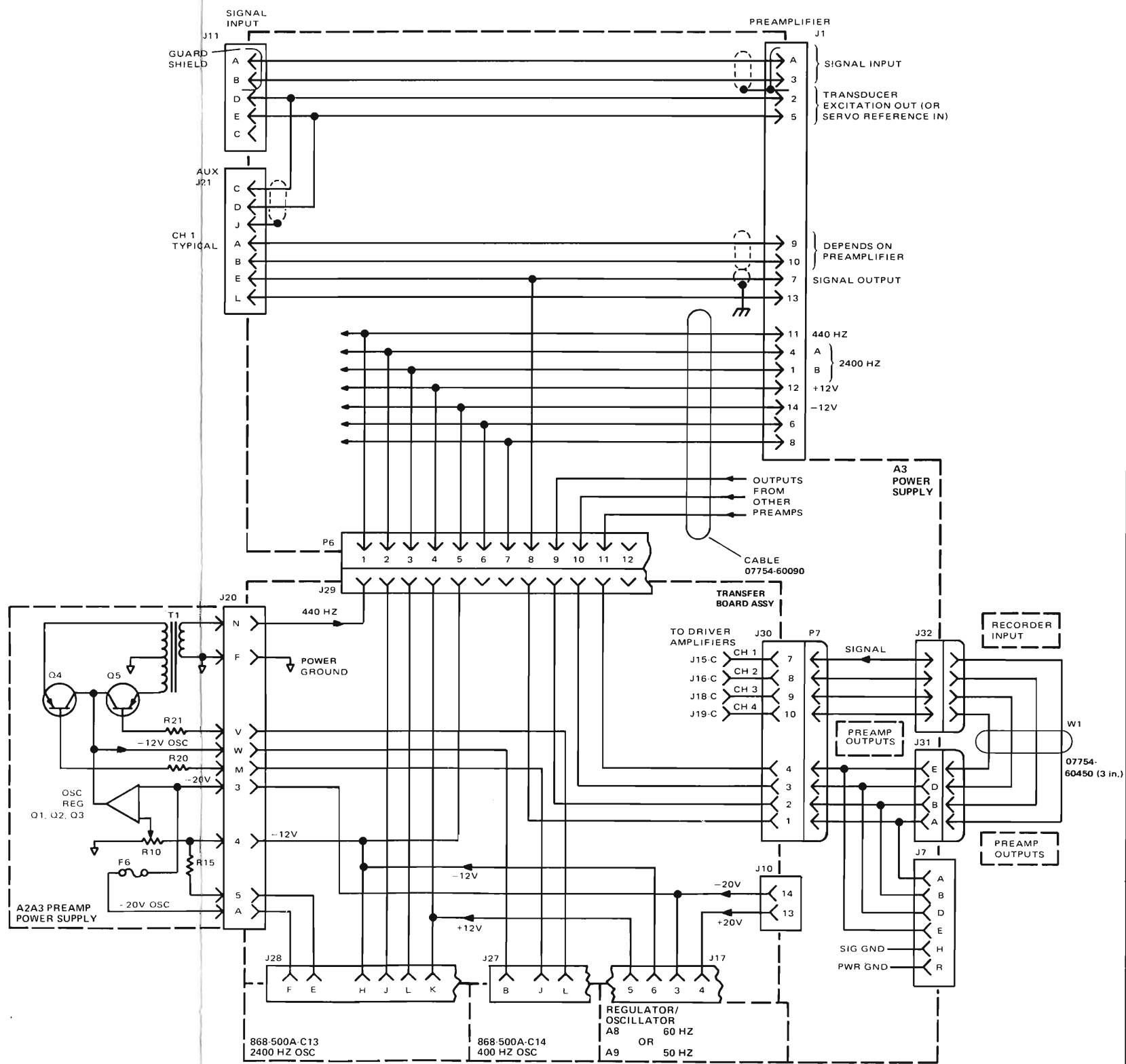


Figure 4-2. Preamplifier Power Supply Circuits, Simplified Diagram.

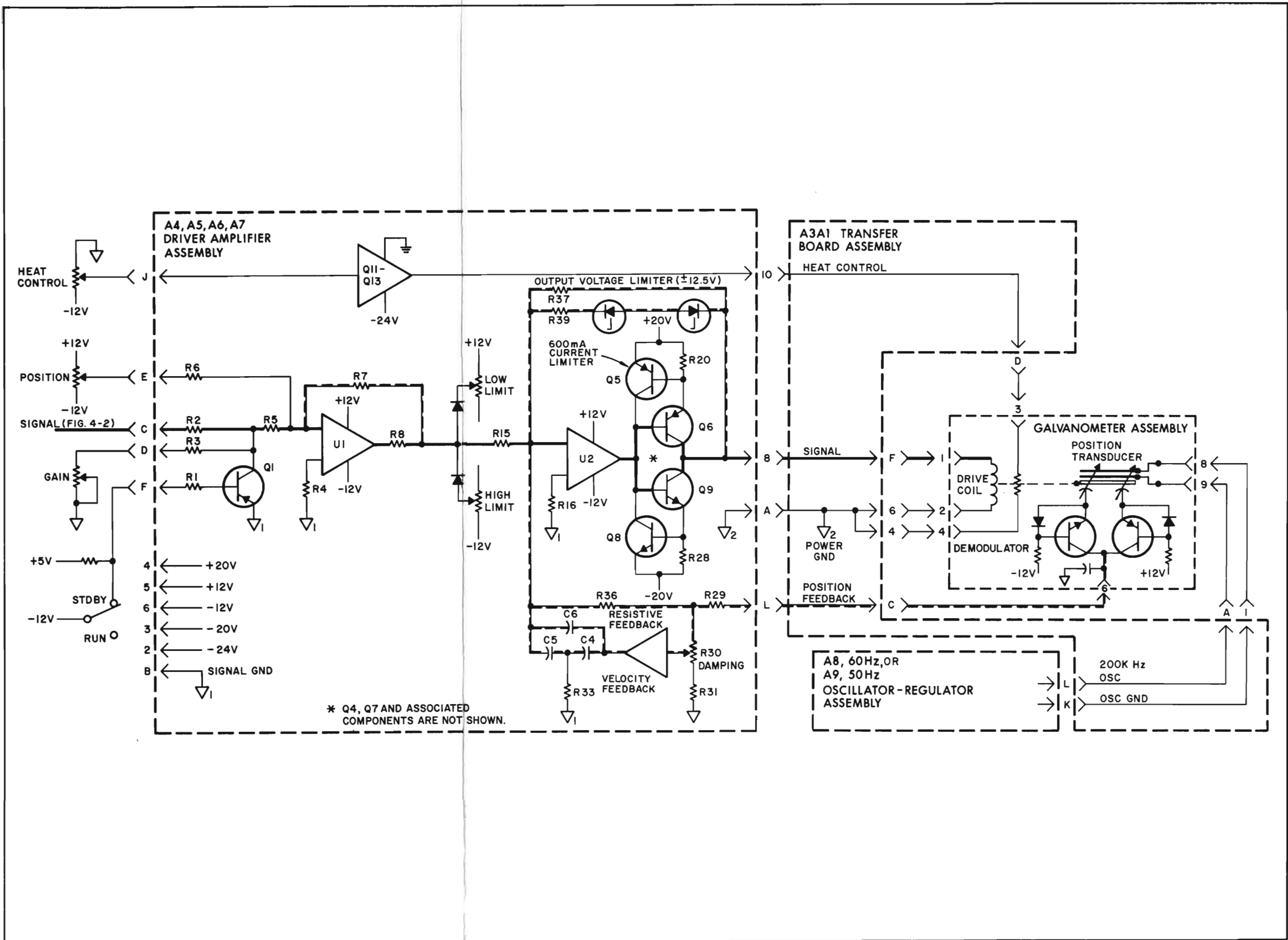


Figure 4-3. Recorder Signal Circuits, Simplified Diagram.

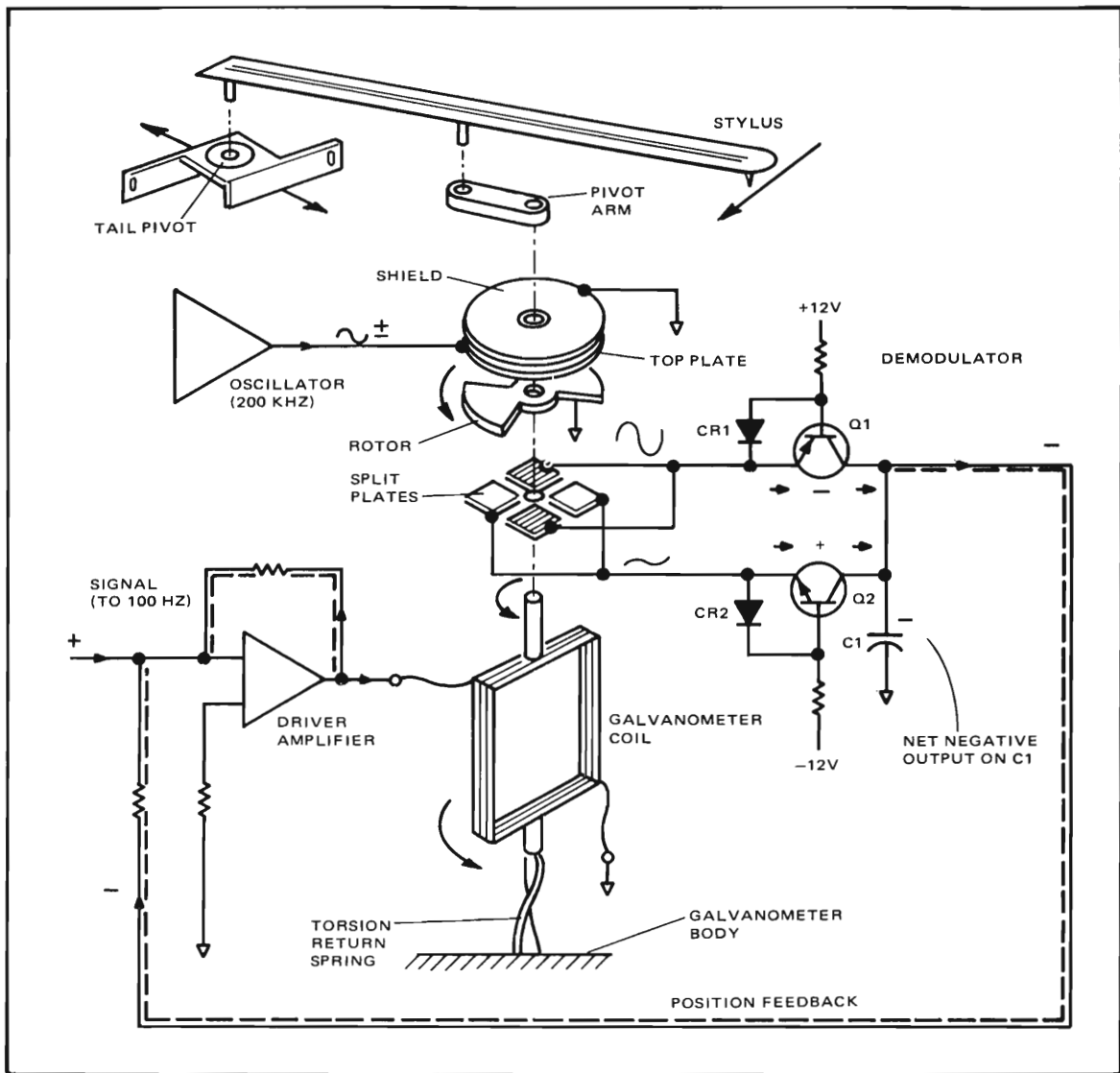


Figure 4-4. Galvanometer Position Feedback Circuit

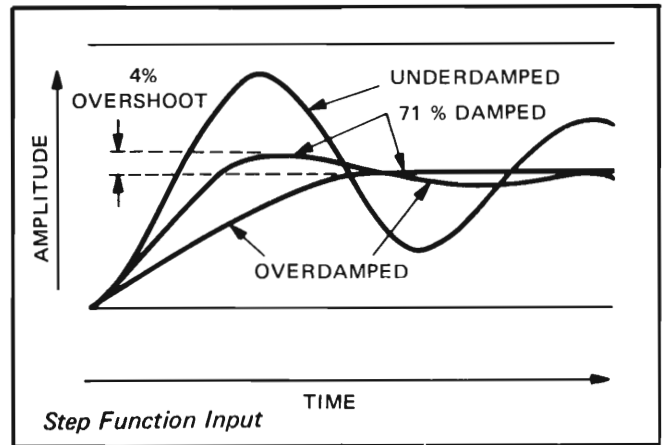
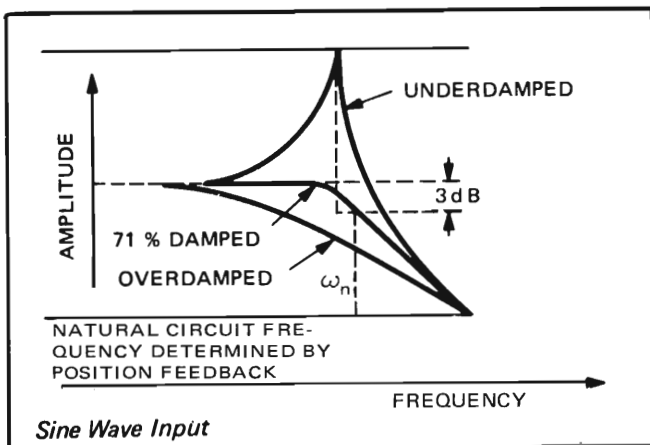


Figure 4-5. Galvanometer Damping

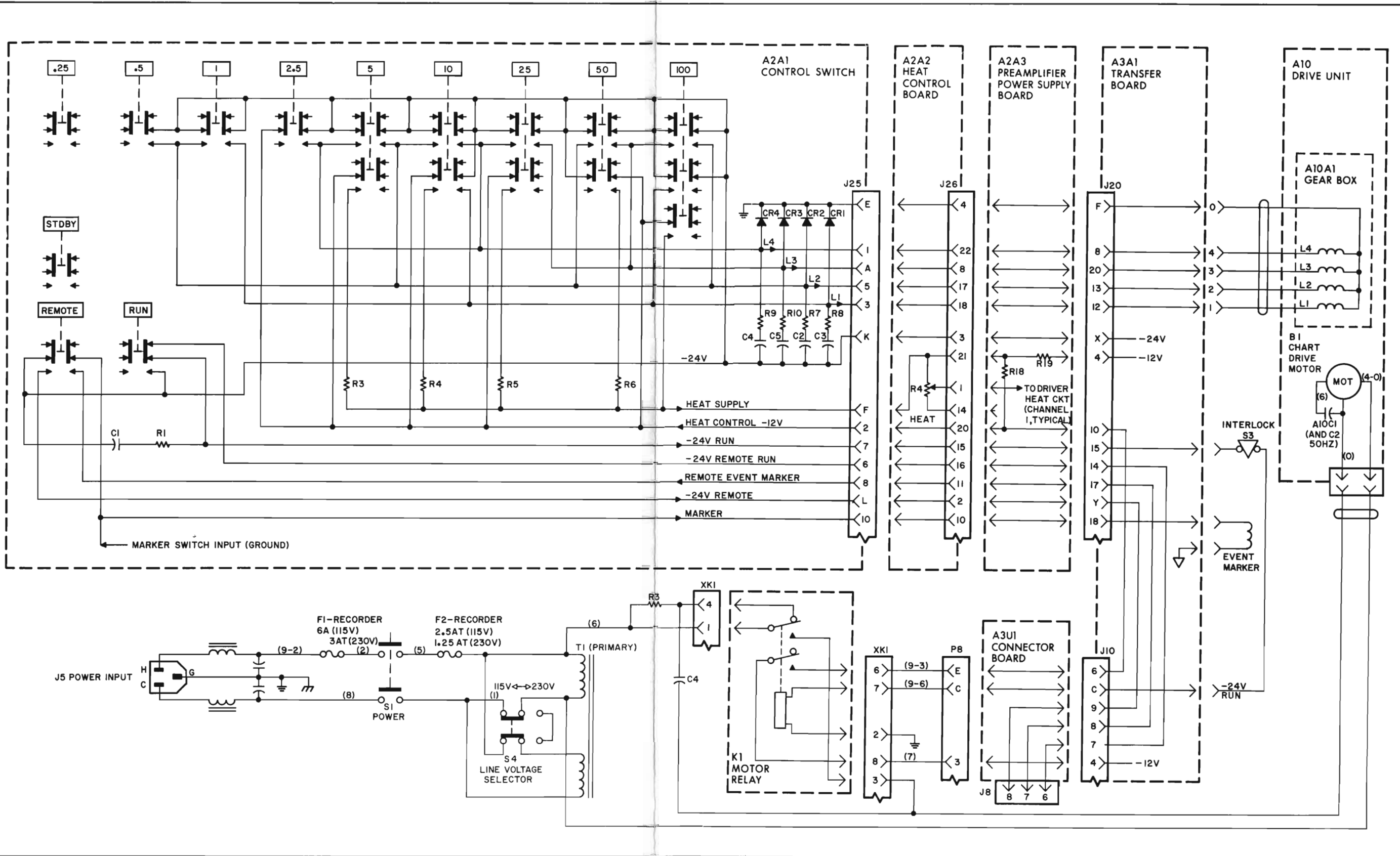


Figure 4-6. Recorder Power Control Circuits, Simplified Diagram.

tiometer setting permits front panel adjustment of the trace density through the heat control circuit in each driver amplifier (Paragraph 4-21).

4-26. CHART DRIVE.

4-27. The recorder chart drive consists of a 115 volt ac motor, a gearbox with four clutches and speed selection solenoids, a pair of paper drive rollers, and a paper brake bar.

4-28. Chart Motor.

4-29. The chart motor is a continuous duty, synchronous motor with a speed of 450 rpm for 60 Hz operation. A sprocket gear on the motor shaft engages a drive chain that transmits power to the gearbox. To provide additional electrical safety, the motor is insulated from the recorder chassis by non-conducting spacers and an insulated sprocket gear at the gearbox input.

4-30. Speed Control.

4-31. Chart paper speed is varied by a gear train consisting of sets of four gears, on two shafts (Figure 4-7). These

shafts are fixed in place and do not rotate. Each set of four gears (A, B, C, and D) either provides a speed reduction with all four gears transmitting power, or no speed reduction, with power bypassing the reduction gears through a spring clutch that links gears A and D on the primary shaft. Gear D is machined together with Gear A of the next set, so power is directly transmitted to the next set of gears.

4-32. When direct drive is desired, the associated solenoid is energized, withdrawing the plunger from the clutch pawls. The clutch then engages, coupling gears A and D. The spring clutch between gears B and C automatically disengages since output gear C, being smaller than input gear B, rotates faster when gears A and D are in direct drive.

4-33. SPEED SELECTION SOLENOIDS. Solenoids L1, L2, L3 and L4 control the speed reduction. They are energized from Control Switch Assembly A2A1. The paper speeds obtained by energizing different combinations of solenoids are presented in Figure 4-8. Remember that as more solenoids are energized, the fewer are the sets of gears that provide speed reduction, and thus the paper goes faster.

4-34. POWER FLOW. The mechanical power flow through the gearbox is diagrammed, for each speed, in Figure 4-8.

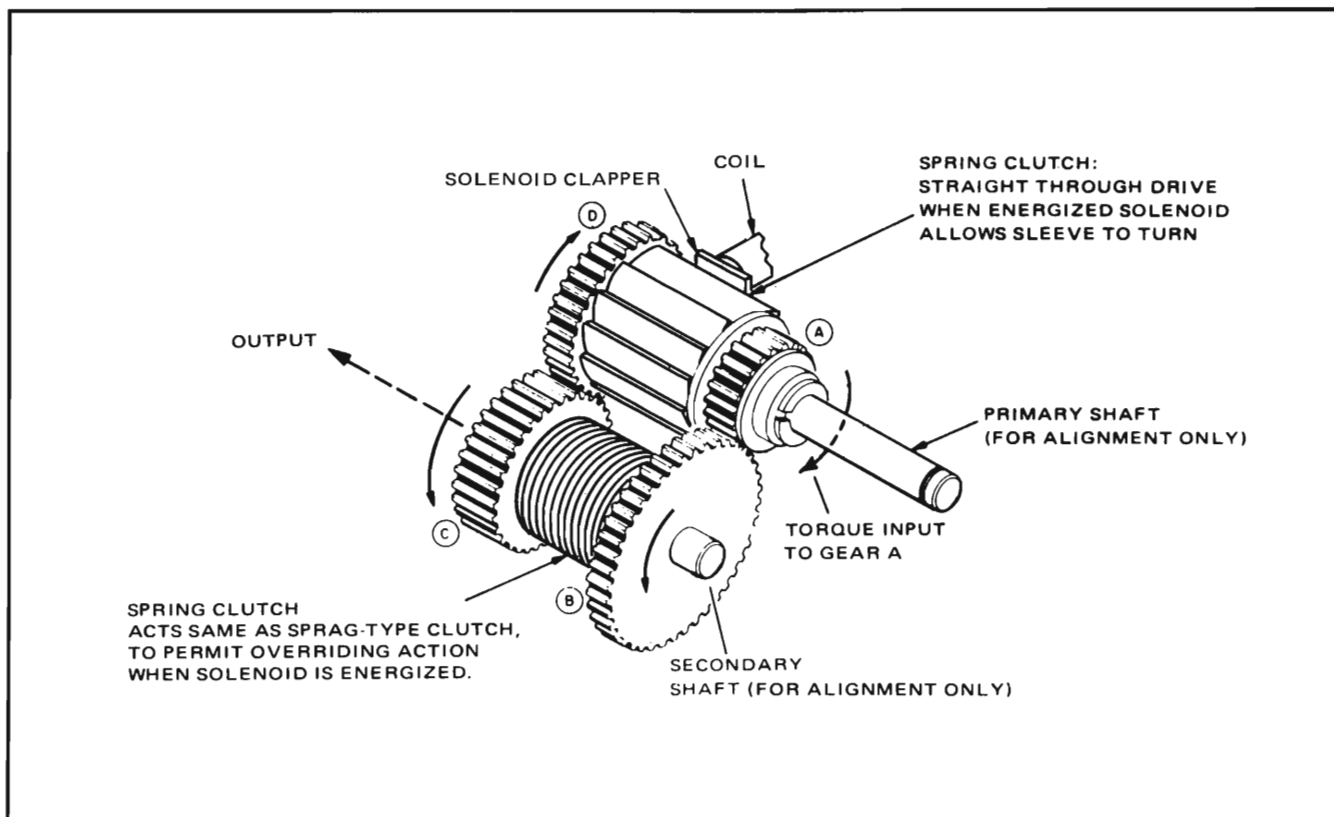
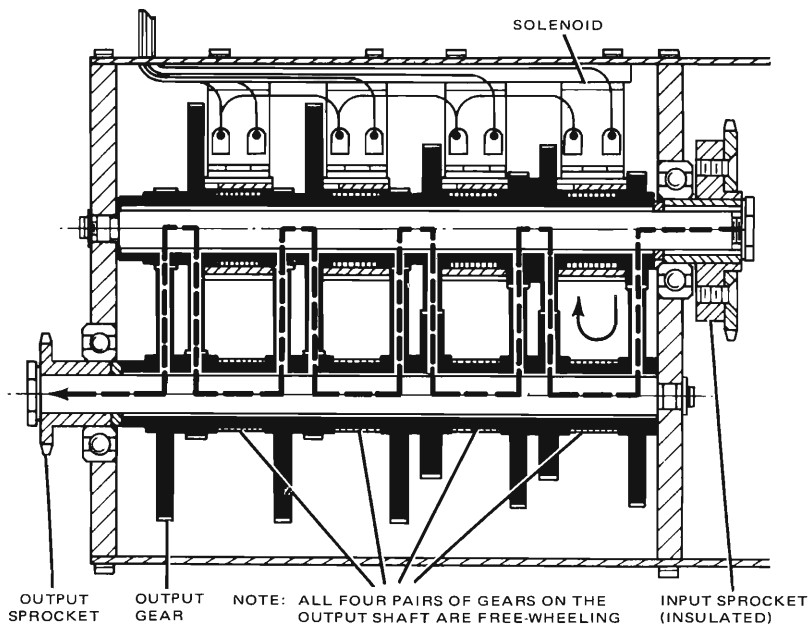
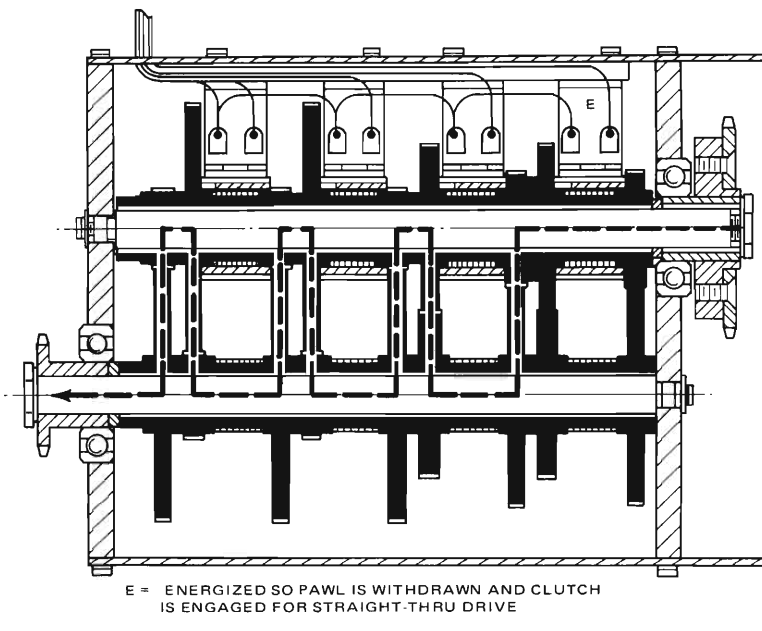


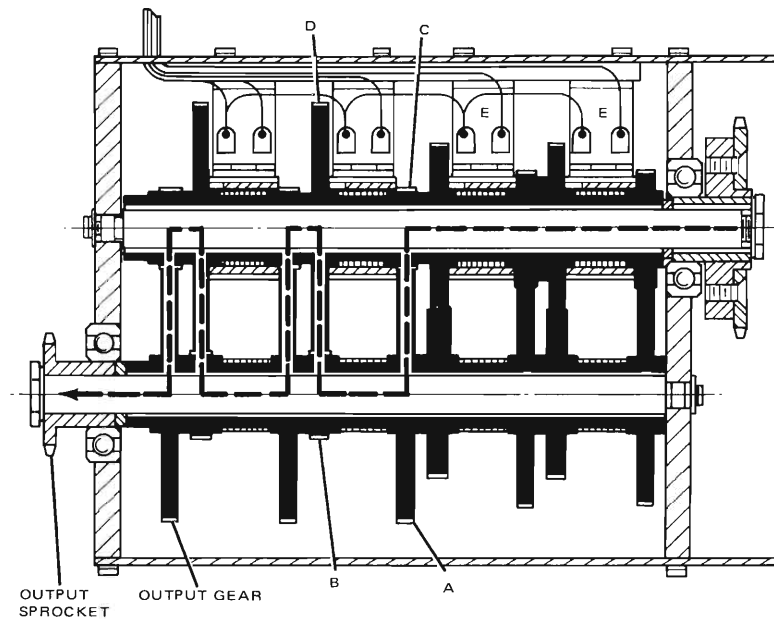
Figure 4-7. Chart Drive Gears



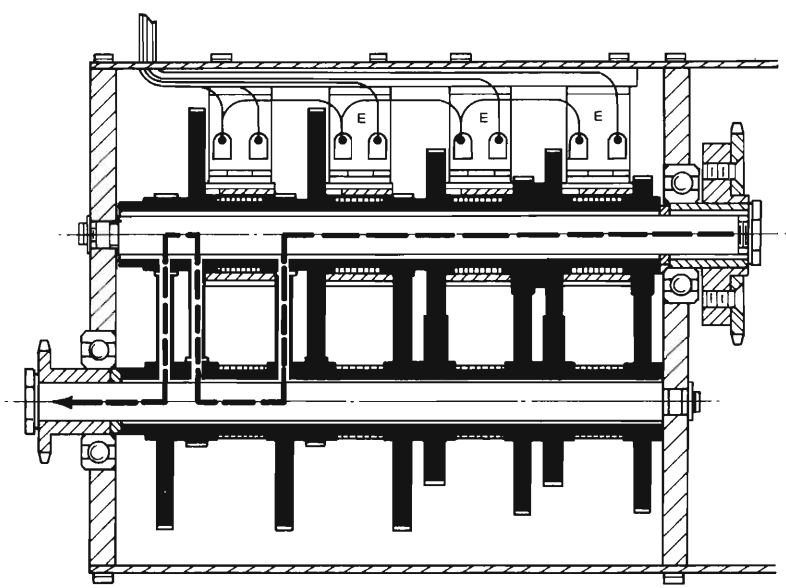
.25 mm/sec



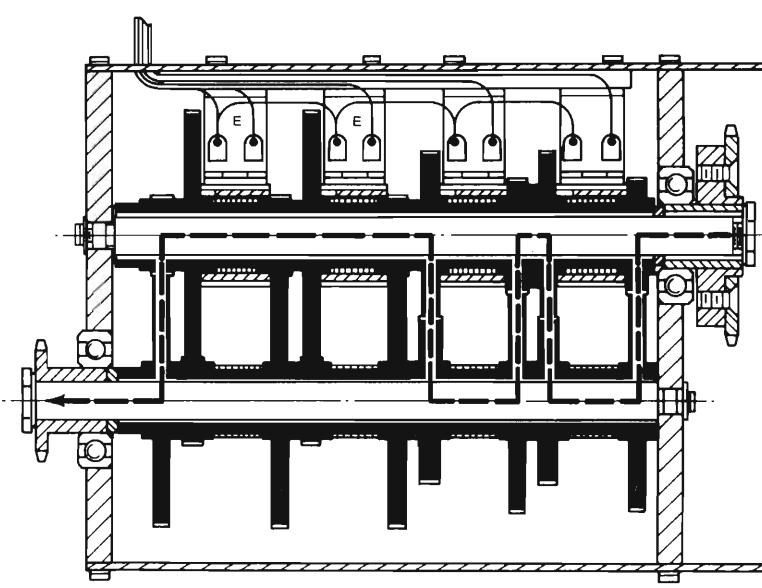
0.5 mm/sec



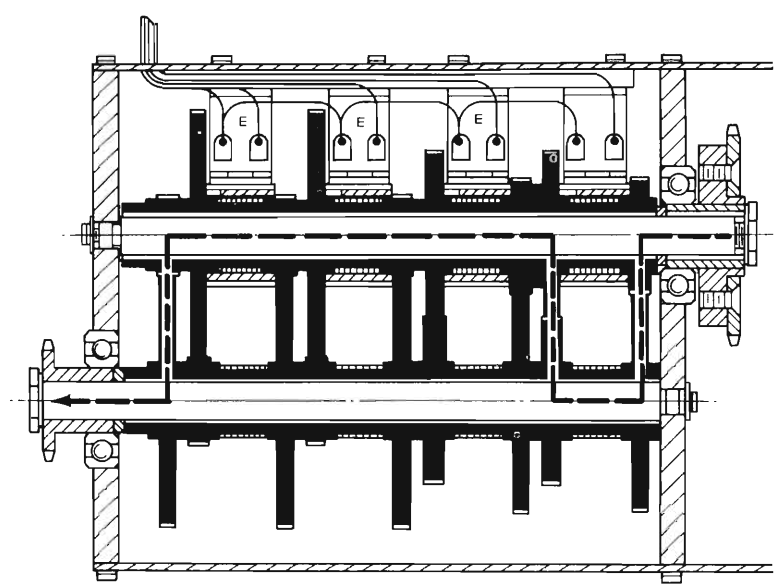
1 mm/sec



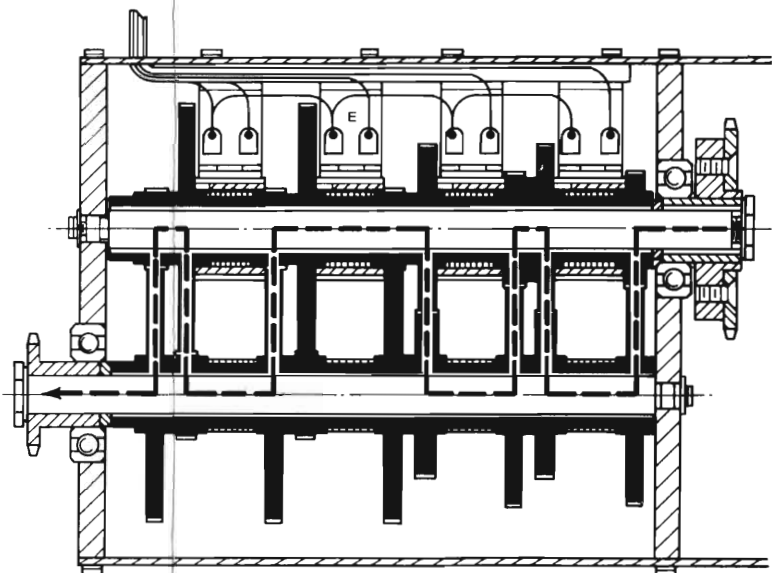
10 mm/sec



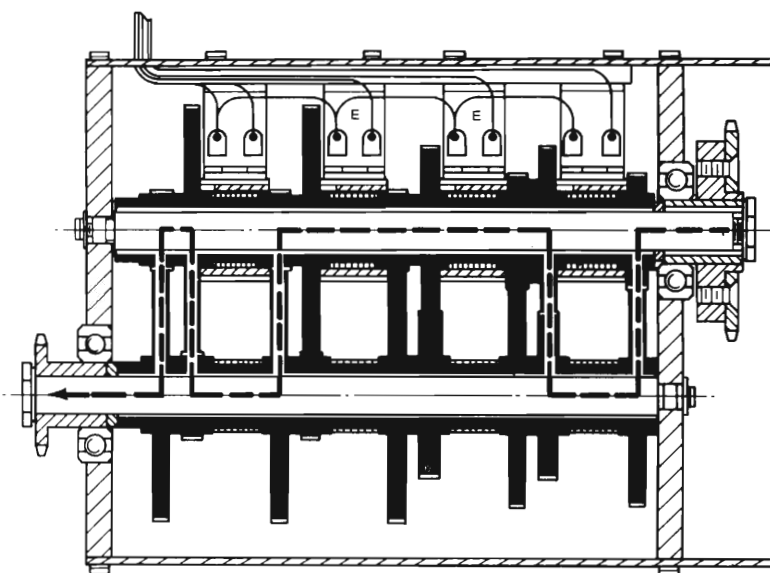
25 mm/sec



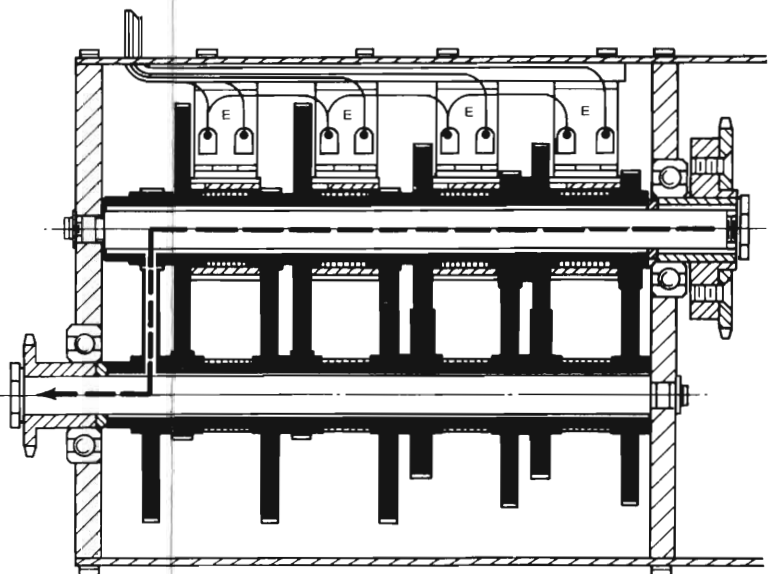
50 mm/sec



2.5 mm/sec



5 mm/sec



100 mm/sec

Energized Solenoids	Paper Speed, MM/SEC								
	0.25	0.5	1	2.5	5	10	25	50	100
L1		X	X			X			X
L2			X		X	X		X	X
L3				X	X	X	X	X	X
L4							X	X	X

Note: When solenoids are deenergized, clutches are disengaged, permitting pairs of primary gears to transmit power. When solenoids are energized (power on), clutches are engaged, causing straight-through drive.

Figure 4-8. Gearbox Power Flow

Take the 1mm/sec speed flow as an example (top row, third from left). Power input from the drive motor enters the gearbox via the input drive sprocket at the right side of the upper (primary) shaft. Since solenoids L1 and L2 are energized, the first two sets of gears are directly coupled to the input sprocket by the spring clutches. The third and fourth sets of gears provide speed reductions since L3 and L4 are deenergized and the associated clutches are kept from rotating by the released plungers. Power thus flows through all the gears in these two gear sets.

4-35. Paper Feed.

4-36. As shown in Figure 4-9, a paper brake arm establishes tension across the felt-covered paper brake bar. From the output of the gearbox, a chain drive runs a rubber drive roller. The drive roller pulls the chart paper at a uniform speed, slippage being prevented by a pressure roller that causes the paper to grip the drive roller. After the Z-fold paper leaves the drive roller, it folds sheet by sheet onto a takeup tray provided with the bench-top enclosure, or into a takeup tray provided with the system cabinet or portable cart. The consecutively numbered chart pages indicate the amount of paper remaining, and can be used as an index for instant access to any part of the recording.

4-37. RECORDER POWER SUPPLY AND REGULATOR CIRCUITS.

4-38. The power supply contains rectifier and regulator circuits, a 200 kHz oscillator for the galvanometer position feedback circuit, and may have transducer-excitation oscillators (2400 Hz or 440 Hz) for the input circuits of some preamplifiers. Connections for these oscillators are shown in Figure 4-2, and the rectifier and regulator circuits are shown in Figure 4-10. In the figures, some elements such as current regulating circuits, bypass and suppression networks, some ground connections, minor feedback loops, filters, and coupling elements are omitted. Refer to Section VI for complete schematic diagrams.

4-39. Recorder DC Power Supplies.

4-40. The Recorder power supply rectifiers provide +20 volts, -20 volts and -24 volts dc as unregulated control and heat supply voltages. The voltages are filtered and fused on the power supply chassis, as shown in Figure 4-10.

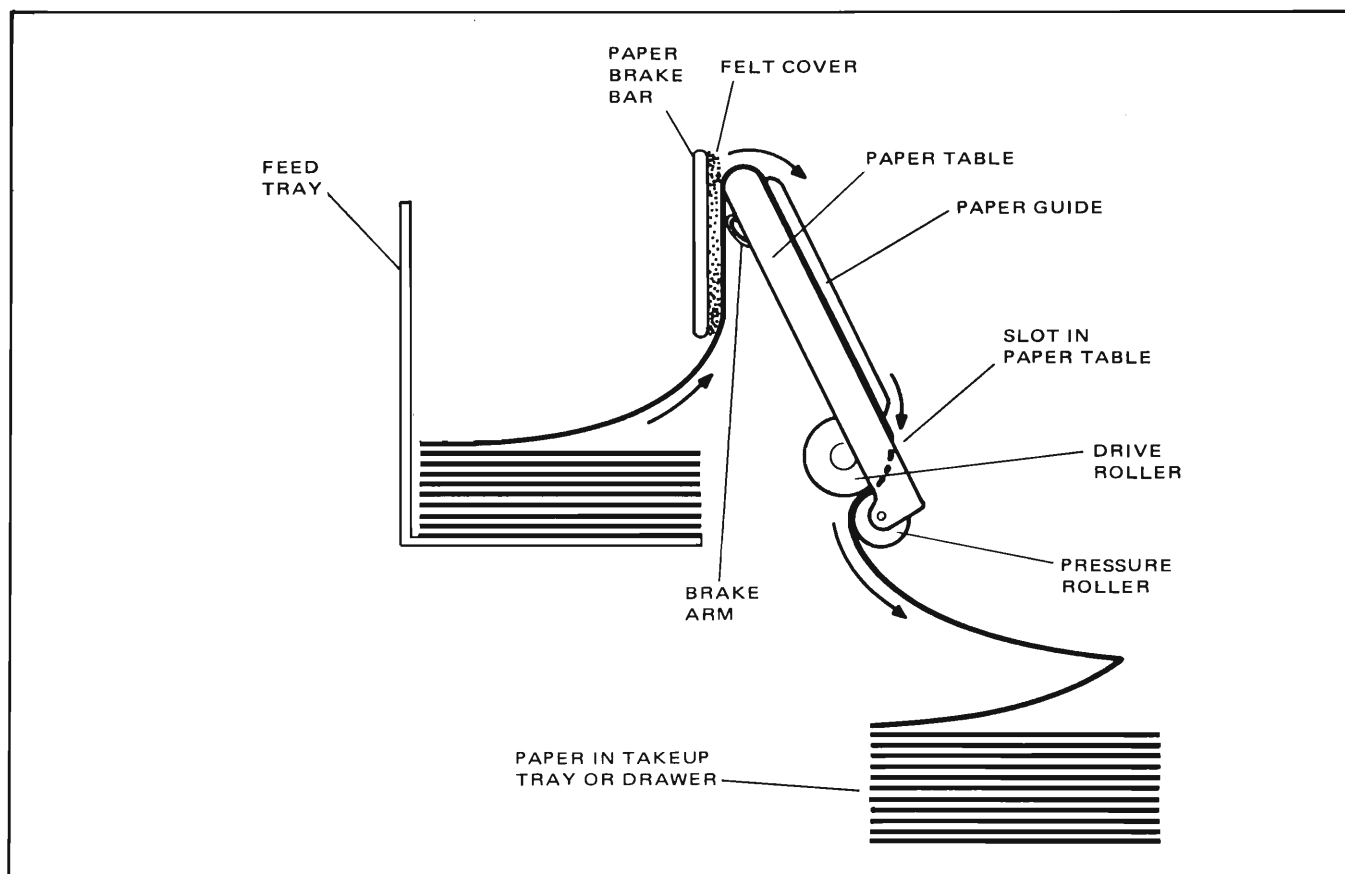


Figure 4-9. Paper Feed Path

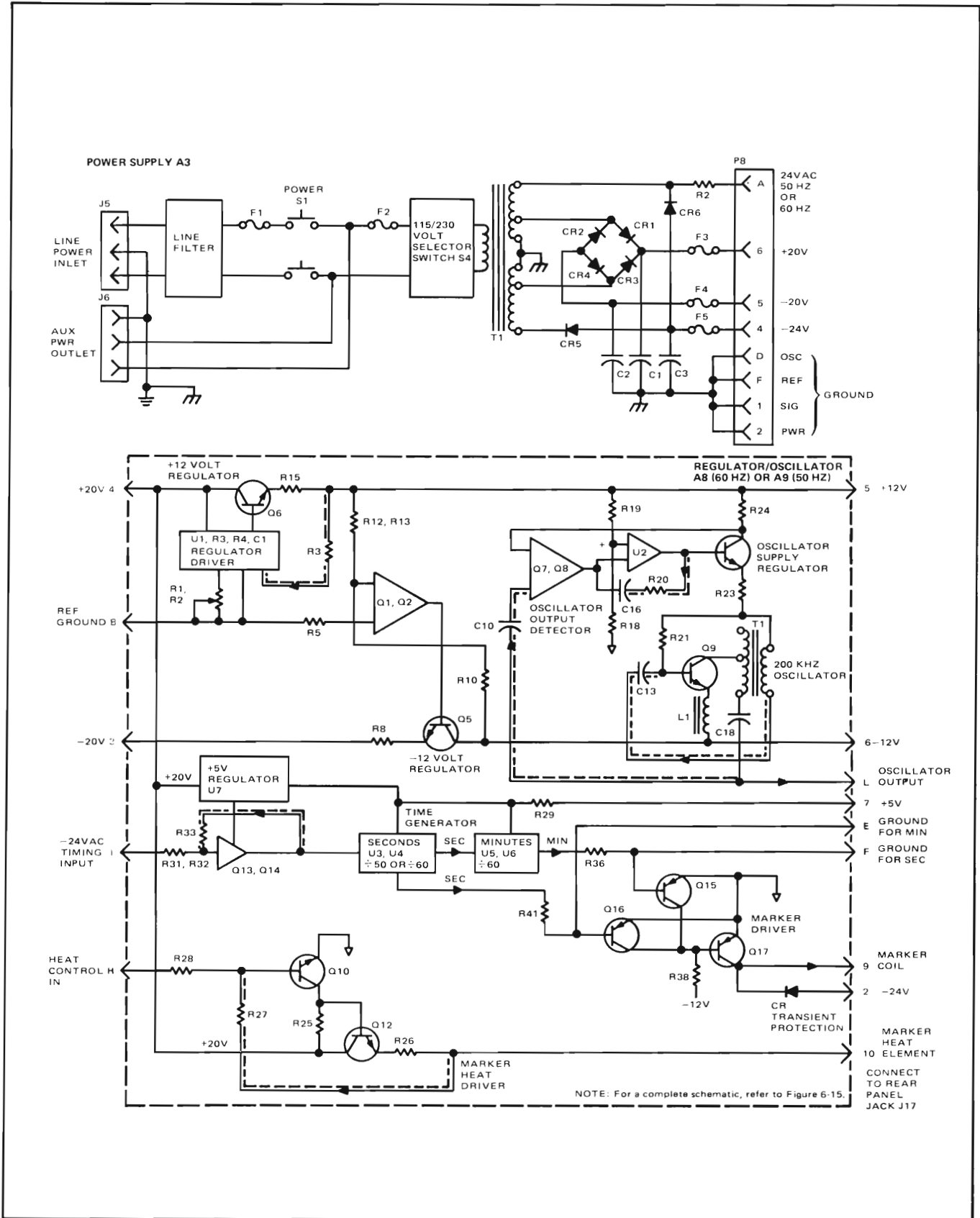


Figure 4-10. Recorder Power Supply and Regulator Circuits, Simplified Circuit

4-41. Regulator/Oscillator.

4-42. The Regulator/Oscillator Assembly includes a +5V, a +12V and a -12V voltage regulator, a 200 kHz oscillator with a stabilizing regulator, and the timing circuits for the timed marker stylus. The relationship of these circuits is shown in Figure 4-10.

4-43. +5-VOLT REGULATOR. The +5 volt regulated supply is used in the timing generator, and in the signal interruption circuit of each driver amplifier. It is derived from the +20 volt unregulated supply with an integrated circuit voltage regulator that has an independent voltage reference. A resistor in series with the regulator absorbs some of the power dissipated in the regulation process, thereby reducing the amount of heat generated in the regulator.

4-44. +12-VOLT REGULATOR. The +12 volt supply is derived from +20 volts with an integrated circuit regulator used as a regulator-driver. Since the IC is not capable of handling the required power, an external power transistor, Q6, acts as the series regulator. The IC regulator incorporates a $\pm 5\%$ voltage reference. To adjust the voltage (within 100 millivolts), the circuit uses potentiometer R2 to reference ground. Resistor R15, one ohm in series with regulating transistor Q6, provides short circuit protection and has a current-sensing function. R4 and C1 form an RC network that improves the stability of the operational amplifier that drives Q6.

4-45. -12 VOLT REGULATOR. The -12 volt supply is derived from the -20 volt unregulated output. The -12 volt regulator is another operational amplifier, with the driven, series regulating element as Q5. Q1 and Q2 are the differential components of the amplifier. Q1 base is returned to ground via R5, and the reference input, derived from -12 volts through R12 and R13, is connected to Q2. The amplifier output drives Q5, and is returned to the reference input via feedback resistor R10. Current limiting is provided by R8 and Q4 (not shown in diagram), and RC network R6, C3 aids stability.

4-46. 200 kHz OSCILLATOR. The high frequency excitation signal, used in the galvanometer position capacitive transducer, is generated by L-C Oscillator Q9 and its associated circuitry. Random conductance in Q9 sets up currents in T1 which are fed back, in phase, to the base of Q9 through C13. Since feedback is greater than unity gain, oscillation amplitude is controlled only by saturation of Q9, and reaches nearly the power supply voltage. Oscillator frequency is determined by C15 and the external loading capacitance across the transformer primary together with T1 inductance. Filter choke L1, with C14 (not shown), decouples the oscillator and its harmonics from the -12

volt supply. A step-up winding, connected to C18, increases the oscillator output voltage by about 7 to 1.

4-47. OSCILLATOR REGULATION CIRCUIT. Since the position transducers are an important factor in recorder accuracy, the 200 kHz oscillator must remain extremely stable in operation. An indication of oscillator stability, both in frequency of oscillation and in amplitude, can be obtained by detecting the product of frequency and output voltage, and comparing the results with a reference voltage. The L-C oscillator circuit, by nature, exhibits frequency changes with variations in load. The oscillator regulation circuit varies the oscillator supply voltage to compensate for loading, which stabilizes the output.

4-48. To do this, the oscillator output detector generates a voltage proportional to frequency and amplitude of the 200 kHz component being removed by C11. This voltage is compared in differential amplifier U2 to a reference voltage (+4.23 volts), derived from the +12 volt supply through voltage divider R18-R19. The comparator output drives a series regulator transistor, part of U2, in such a way that the oscillator will maintain a constant output amplitude, and therefore a constant frequency.

4-49. Marker Circuits.

4-50. The Recorder includes two monopolar markers, one of which is timed, and the other actuated with a front panel or remote pushbutton. The timing circuits for the timed marker are located on the Regulator/Oscillator Assembly, and operate by dividing 50 or 60 Hz ac input to generate one-second pulses, and then dividing these pulses to obtain pulses at one-minute intervals. The selected set of pulses is then amplified to drive the timed marker.

4-51. Line frequency ac voltage at 24 Vac is obtained from the power transformer and filtered to remove transients and high-frequency noise. Then a threshold detector circuit, Q13-Q14, generates a train of spike waveforms at line frequency to drive the divider TTL logic circuitry. Integrated circuit U3 divides by 5 or 6, and then U4 divides by 10 to achieve a 50:1 or 60:1 division. The seconds output is routed to switch Q16, and also to the minutes divider, which divides by 60 in the same way, using IC's U5 and U6. The minutes output is routed to transistor switch Q15.

4-52. MARKER SWITCHES. When the circuit is off, both switches are grounded, stopping conduction in Q15 and Q16 and permitting Q17 to conduct steady-state. When either minute or second marking is selected, the ground is removed from one switch, which conducts and connects the base of Q17 to ground. Once each minute or second, the timing circuit cuts off the switch, thereby restoring the base

drive to Q17 momentarily, so the marker coil is energized and the marker makes a jog on the paper. The diode at the collector of Q17 removes the large transient that results when the marker solenoid stops conducting.

4-53. **MARKER HEAT DRIVER.** The marker heat elements are powered from the -20 volt unregulated line. Heat regulation originates at the heat potentiometer sub-assembly of the front panel, and is applied to the base of Q10, which drives Q12, a series regulator that is similar to the voltage regulator circuits. Circuit feedback is applied for stability, and the circuit is protected against a shorted output by current limiter Q11 (shown in Figure 6-15).

4-54. **440 Hz Oscillator.**

4-55. The 440 Hz oscillator circuit (Figure 4-11) consists of oscillator printed circuit assembly A2 and associated power regulation circuits on the power supply chassis. Power for the oscillator is regulated by Q2 and Q3 from the -20 volt oscillator supply (refer to Figures 2-4 and 6-7) on the Pre-amplifier Power Supply Assembly. The reference voltage is obtained from the -12 volt supply. Voltage divider R11 and R13 senses any change in the output of regulator Q3. The change is sensed by regulator driver Q1 and is applied to the base of Q3 to return the output to its former level.

4-56. Oscillations generated by push-pull oscillator Q12, Q13 are frequency stabilized by capacitor C15 and the primary windings of transformer T4, which together form a tank circuit in the oscillator output. Output from the

secondary of T4 is controlled in amplitude by diodes CR21 and CR22 at a level determined by breakdown diode CR23. Each side of the T4 secondary is connected to half of push-pull power amplifier Q4, Q5 to drive output transformer T1. The output of T1 is distributed to the preamplifier connectors and the auxiliary power output connector as shown in Figure 4-2.

4-57. **2400 Hz Oscillator.**

4-58. The 2400 Hz oscillator furnishes a transducer excitation signal to pressure amplifiers such as the Model 8805A or 8805B. The preamplifier further amplifies the excitation voltage for use with a transducer. Power for the oscillator (Figure 4-12) is provided by the -20 volt oscillator supply through series regulator Q19. The base of Q19 is held at a regulated -12 volts from the preamplifier regulated supply, providing collector voltage to Q20 and Q21 through the primary of T7. This voltage is filtered by capacitor C21.

4-59. Oscillations generated by push-pull oscillator Q20, Q21 are frequency stabilized at 2400 Hz by the primary of oscillation transformer T7, which, with the capacitance of C18 and C19, forms a tank circuit across the oscillator output. Thermistors RT7 and RT8 provide temperature stability. The output of T7 is a 2400 Hz sine wave balanced with respect to ground, with diodes CR25 and CR26 controlling the oscillation amplitude at a level determined by CR24. The differential signal is distributed to all channels and auxiliary power output connector J8.

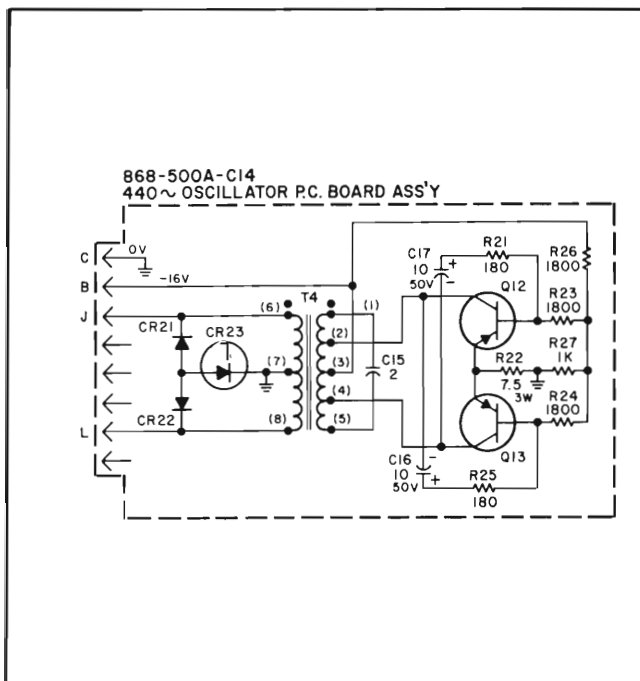


Figure 4-11. 440 Hz Oscillator Circuit

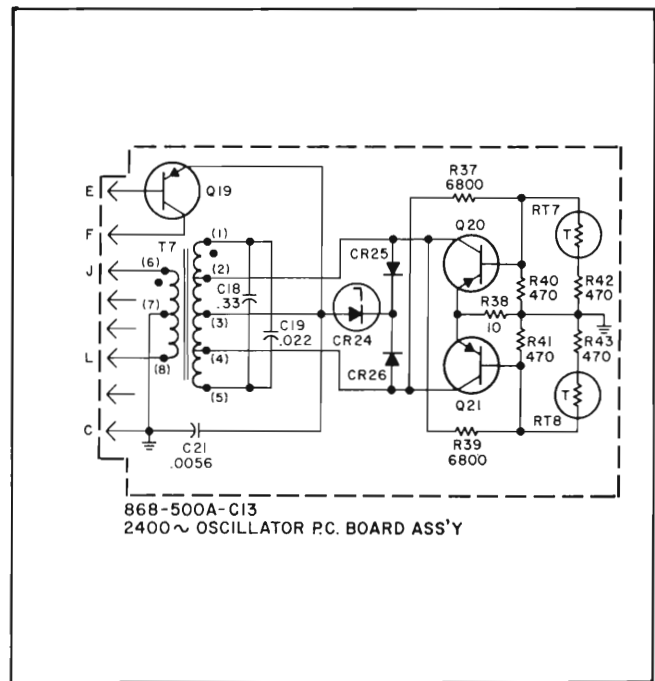


Figure 4-12. 2400 Hz Oscillator Circuit

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Hewlett-Packard 4-Channel Thermal Tip Recorder. Information includes:

Performance Checks	Paragraph 5-5.
Preventive Maintenance	Paragraph 5-10.
Adjustments and Minor Repairs	Paragraph 5-20.
Overhaul and Lubrication (Gearbox)	Paragraph 5-49.

For system troubleshooting information, refer to Table 5-3.

5-3. TEST EQUIPMENT AND LUBRICANTS.

5-4. The test equipment recommended for maintenance is listed in Table 5-1, with the performance characteristics

required. Other test equipment may be used if its specifications equal those listed. For satisfactory performance, use only the lubricants listed in Table 5-2. Lubrication intervals are as follows:

Normal use in upper half of the speed range:	12 months or 2000 hours.
Slow speed use, over extended periods:	6 months or 1000 hours.

For further information, refer to Paragraph 5-49.

5-5. PERFORMANCE CHECKS.

5-6. The performance checks verify specifications and circuit operation, and can be used under the following circumstances:

Table 5-1. Recommended Test Equipment

Instrument Type	Required Characteristics	Model Number of Instrument Recommended
Variable Autotransformer	115 or 230 Vac; 0-130 Vac, 5 amperes; 0-260 Vac, 2.5 amperes	General Radio VARIAC
DC VTVM	1 mV to 1000V full scale, 1 mA to 1 ampere	HP Model 412A or equivalent
Digital Voltmeter (DVM)	Range: 0-999.9V; Accuracy: ±0.05%	HP Model 3440A or equivalent
Function Generator	0.01 Hz - 100 kHz 35V p-p open circuit output; 15V p-p into 600-ohm load	HP Model 3300A with Model 3301A Auxiliary Plug-in. Used with dual-banana to BNC adapter HP 10110A.
Oscilloscope	Sensitivity 5 mV/division or better. Vertical amplifier dc coupled, dc to 400 kHz or better	HP Model 140 with Time Base and any 1400-series Vertical Amplifier.
Stylus Pressure Tester	25 grams maximum	HP Part No. 14023A or equivalent
Test Boards	PC Board Support for Driver and Regulator/Oscillator	07754-00900 (Figure 5-2)
	Driver Amplifier Extender Board	07754-00920
	Regulator/Oscillator Extender Board	07754-00910
Test Cable	For test signals	To be made; see Figure 5-2
Oscillator Load Plug	To load oscillator	To be made; see Figure 5-2

Table 5-2. Lubricants and Solvents Required

Type	Commercial Source or Hewlett-Packard Part No.
MACHINE OIL, No.10	6040-0220
GEAR GREASE	6040-0222
CHAIN GREASE	6040-0223
PENETRATING OIL	Commercial, such as Marvel Mystery Oil
SOLVENT AND CLEANER	DOW Chlorothene (1,1-Inhibited Trichloroethane)

- a. As part of an incoming inspection;
- b. Periodically, where maximum reliability is required;
- c. To troubleshoot malfunctioning circuits; and
- d. After repairs or adjustments.

5-7. To facilitate checking the Driver Amplifiers and the Regulator/Oscillator Assembly, extender boards (Table 5-1) are available as accessories.

5-8. Variable Line Voltage.

5-9. During the performance checks, the Recorder should be connected to the power source through an adjustable autotransformer so the line voltage can be changed $\pm 10\%$ from the nominal 115 or 230 Vac.

CAUTION

TO AVOID DAMAGE, REMOVE POWER FROM THE RECORDER BEFORE DISCONNECTING ASSEMBLIES OR COMPONENTS.

5-10. PREVENTIVE MAINTENANCE

5-11. Preventive maintenance is recommended every six months or 1000 hours of operation and as an aid for minor repairs, adjustments and troubleshooting.

5-12. Operational Checks and Inspection

5-13. Switch Recorder power OFF. Inspect the Recorder for evidence of mechanical or electrical overload, dents, rust, and corrosion. Check that all components are securely mounted, including the cable connectors. Also check external connecting cables for strain, breaks, and frayed insulation. If the Recorder is installed in a cart or cabinet, the cables should be free when the Recorder is moved in and out.

WARNING

TO PREVENT PERSONAL INJURY IF RECORDER SHOULD SLIDE PARTLY OUT, KEEP RECORDER ATTACHED TO CART OR CABINET WITH SCREWS IN FRONT PANEL AT ALL TIMES EXCEPT DURING MAINTENANCE.

5-14. Operate the Recorder in all speed ranges, and perform the operating procedure, using all controls listed in Figure 3-1.

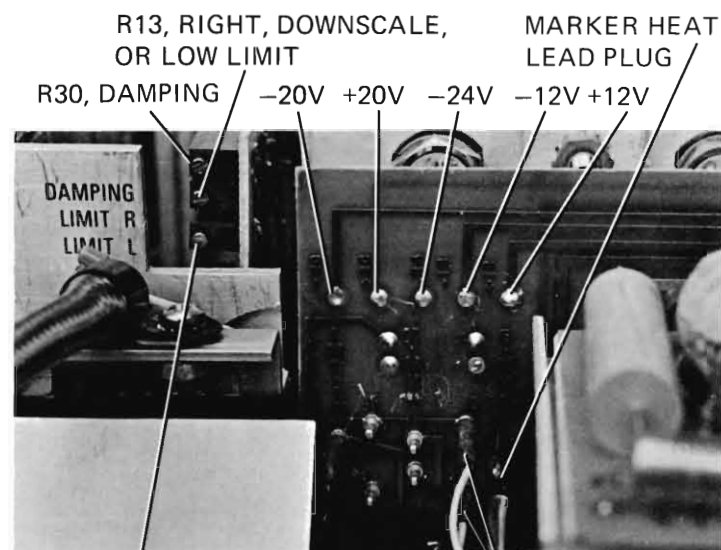
5-15. The following steps check operation of the Recorder:

- a. **Recorder slides:** Check that the slides roll in and out smoothly and that they lock in the full open position (Figure 2-1).

- b. **Paper tension:** Run the Recorder at the highest speed, and inspect paper travel over the platen at the paper table (See Figure 4-9). The paper should travel snugly over the paper table. Adjust the paper brake (Paragraph 5-24) if necessary, or clean or replace the brake felt (Paragraph 5-27).

- c. **Paper tracking:** The paper brake should be slightly tighter at one side or the other so the paper will track consistently to the right and not weave back and forth. Run approximately 5 feet of the chart at 25 mm/sec. Marker styli are normally in a fixed position between channels. Remove the record and measure the distance between the marker trace and the edge of the chart paper. The measurement should be consistent within ± 0.5 mm all along the length of the record. Repeat this procedure at the 100 mm/sec speed. If the paper weave exceeds the limit, loosen the left paper brake adjustment screw slightly (Figure 5-1). If adjustment is difficult or if tracking problems persist, see Paragraph 5-24.

- d. **Galvanometer to Paper Parallax:** So that all channels will have the same time reference with respect to the paper, all stylus tips must fall on the same time reference line of the paper, ± 0.25 division. To check parallax, apply power to the Recorder, and set to STANDBY mode. With finger pressure, gently move the stylus off center full scale, in the



R9, LEFT, UPSCALE, OR HIGH LIMIT
 MARKER COIL LEADS (TYPICAL) +12V ADJUSTMENT

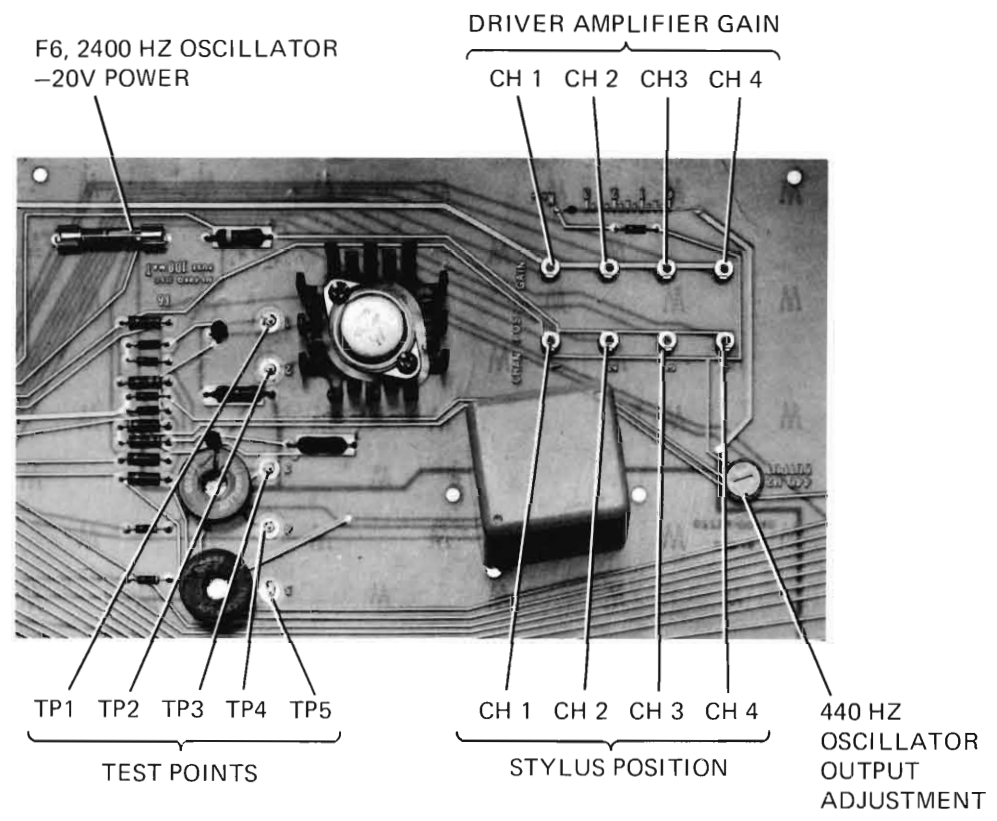
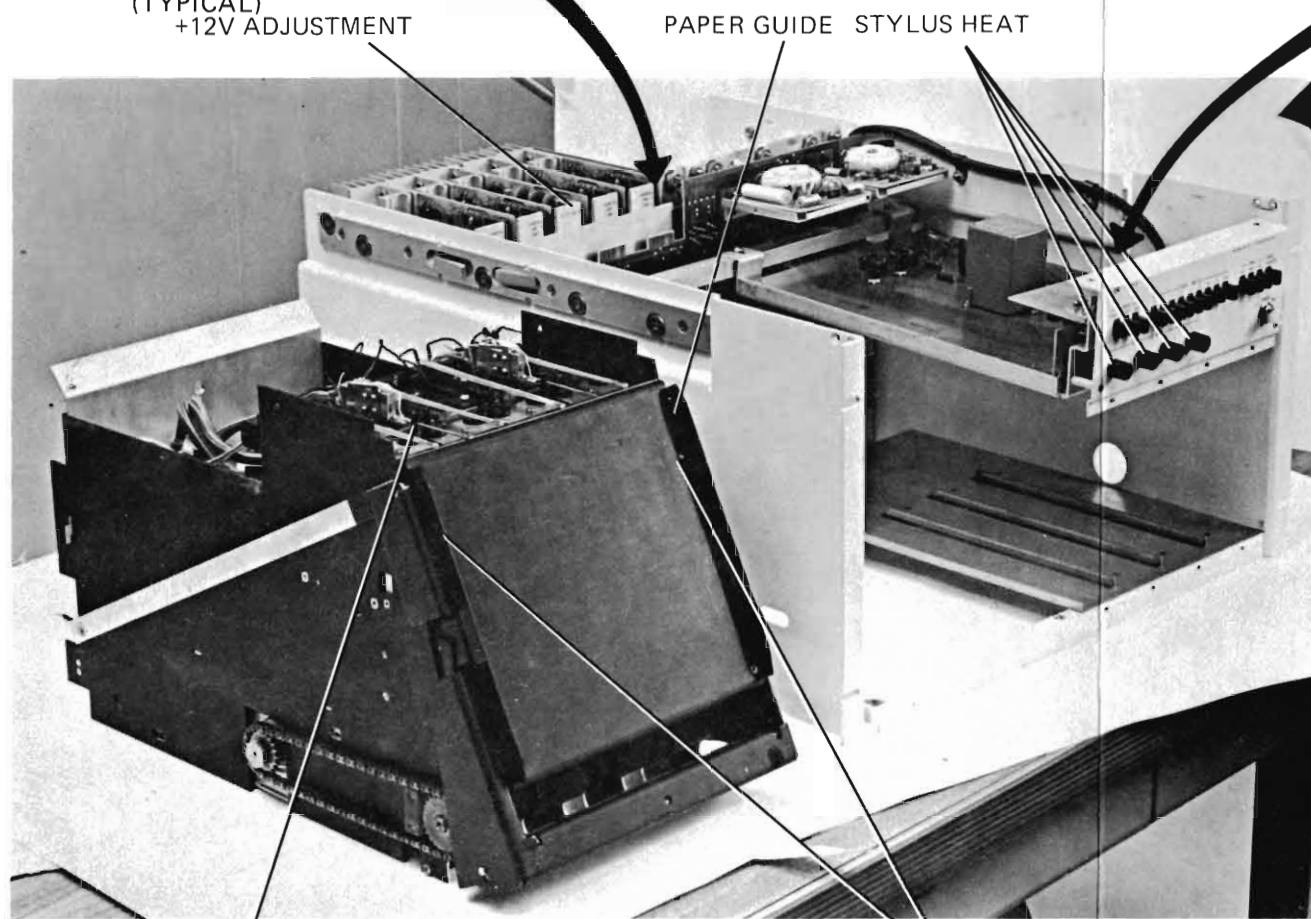


Figure 5-1. Test and Adjustment Points

positive and negative directions. The trace line over the width of each channel should be ± 0.25 mm; if not, see Paragraph 5-33 to adjust stylus parallax. The time reference with respect to paper (full chart width or four channels) should be within ± 0.25 mm. If not, refer to Paragraph 5-34 for the channel time synchronization procedure, which is used to adjust galvanometer parallax.

e. **Signal Styli:** Inspect each signal stylus for cleanliness and condition. If a stylus is bent or twisted, replace it (Paragraph 5-35).

f. **Stylus Pressure:** When stylus pressure is too light, the trace lacks definition, but when pressure is too heavy, friction causes noticeable non-linearity and hysteresis. Refer to Paragraph 5-31 for stylus pressure adjustments.

g. **Marker Styli:** Inspect each marker stylus and solenoid for cleanliness and condition. Run a few feet of paper at 100 mm/sec while pressing the EVENT MARKER button,

and with the timed marker in SEC mode. If the recording is unsatisfactory, check the marker stylus electrical connections and pressure (Paragraph 5-57). Recheck marker performance. If still unsatisfactory, troubleshoot the marker heat circuit, or replace the marker stylus.

h. **Stylus Heat:** Turn Recorder power ON, set SPEED to 25 mm/sec, and adjust STYLUS HEAT controls for best trace definition. Unlatch the Recorder (or raise the portable case lid), and rotate each preamplifier POSITION potentiometer (Figure 5-1) from one extreme to the other. Trace definition should remain the same over the whole channel width. If not, first check for an unlapped stylus. Then check for defects, improper clamping (Paragraph 5-29), or poor stylus pressure.

i. **Electrical Checks:** The electrical checks include adjustment of the electrical and mechanical limiting of stylus deflection. See Table 5-3.

Table 5-3. Electrical Performance Checks and Adjustments

<p>A. UNREGULATED POWER SUPPLY CHECK</p>	<p>Pin 11 of J8, and observe following voltages on DVM:</p>
<p>a. Push recorder POWER ON-OFF switch so it pops out (OFF).</p>	<p>(1) All styli at top of chart, about -20 volts.</p>
<p>b. Remove protective cover from J8 REMOTE to gain access to PC board connections.</p>	<p>(2) All styli at bottom of chart, about -18 volts.</p>
<p>c. Insert connector body 1251-1190 into J8 to provide test points.</p>	<p>n. Set MODE switch to STDBY.</p>
<p>d. Remove jumper cable (07754-60450) from J31-J32.</p>	<p>o. Lower paper table.</p>
<p>e. Connect function generator (Table 5-1) to RECORDER INPUT connector J32 through signal test cable.</p>	<p>p. Set MODE switch to RUN and SPEED switch to 100 MM/SEC.</p>
<p>f. Connect system to variable autotransformer (VARIAC). Set dial to 115 Vac, and push recorder POWER switch to it stays in (ON).</p>	<p>q. Connect DVM between Pin E (-24 volts) and Pin 11 of J8. DVM should read -24 volts dc.</p>
<p>g. Set function generator for 0.1 Hz square wave. Set amplitude dial fully counterclockwise (CCW).</p>	<p>r. Set Function Generator amplitude control fully CW.</p>
<p>h. Rotate all stylus heat controls fully clockwise (CW).</p>	<p>s. Press interlock switch (Figure 5-14), located under paper table. DVM should read about -22.5 volts.</p>
<p>i. Set Recorder speed to 2.5 MM/SEC.</p>	<p>t. Set MODE switch to STDBY.</p>
<p>j. Set MODE switch to RUN.</p>	<p>u. Push paper table up and in at bottom so it locks into place.</p>
<p>k. Adjust function generator amplitude control so stylus motion covers complete chart width.</p>	<p>B. 440 HZ OSCILLATOR ADJUSTMENT. This procedure is to be performed only if the Option 005 Oscillator is installed.</p>
<p>l. Connect digital voltmeter (DVM) between Pin 1 ($+20$ volts) and Pin 11 (Power ground) of J8, and observe the following voltages on DVM:</p>	<p>a. Push Recorder POWER switch so it pops out (OFF).</p>
<p>(1) All styli at top of chart, about $+18$ volts.</p>	<p>b. Connect oscillator load plug, to one of four preamplifier connectors, <i>inside</i> the preamplifier housing (J1, J2, J3 or J4).</p>
<p>(2) All styli at bottom of chart, about $+20$ volts.</p>	<p>c. Push POWER switch so it stays in (ON).</p>
<p>Note:</p>	<p>d. Connect scope between Pin A (440Hz) and Pin 11 of J8.</p>
<p>Top of chart is to left.</p>	<p>e. Adjust 440 Hz voltage output control R10</p>
<p>m. Connect DVM between Pin D (-20 volts) and</p>	

Table 5-3. Electrical Performance Checks and Adjustments (cont.)

(Figure 5-1) for an output of 14.0 volts p-p on scope.

C. 2400 HZ OSCILLATOR CHECK

- a. Connect scope between Pin 2 (OSC "B") and Pin 11 of J8; scope should read about 17.0 volts p-p.
- b. Connect scope between Pin 3 (OSC "A") and Pin 11 of J8; scope should read about 17.0 volts p-p.
- c. Set Recorder POWER switch to OFF.
- d. Remove input cable from function generator, oscillator load plug, scope leads, and remove connector body from J8 REMOTE. Reinsert protective cover into J8.
- e. Reconnect jumper cable on recorder rear panel.

D. REGULATOR/OSCILLATOR BOARD CHECK AND ADJUSTMENT.

Note:

Regulated voltages under test are loaded with preamplifiers installed in the recorder.

1. +12 Volt Regulator Check and Adjustment.

- a. Set Recorder POWER switch to OFF.
- b. Remove Oscillator/Regulator Assembly.
- c. Install extender board 07754-00910 and test fixture 07754-00900 on the assembly, as shown in Figure 5-3.
- d. Install extender board with regulator/oscillator and test fixture into Recorder J17.
- e. Set Recorder SPEED switch to 2.5 MM/SEC, MODE switch to STDBY, and POWER switch ON.
- f. Connect DVM between TP1 (+12 volts dc) and power ground.
- g. Set MODE switch to RUN.
- h. Position all styli to center scale with POSITION control on each preamplifier.
- i. Set MODE switch to STDBY.
- j. Check DVM for reading of +12.0 volts dc ± 30 mV. If reading is beyond tolerance, adjust potentiometer R2 (Figure 5-4) for +12.0 volts dc ± 30 mV.
- k. Change input voltage with Variac (Table 5-1) to 103 Vac and 127 Vac. DVM reading must not vary more than ± 30 mV.
- l. Return Variac to 115 Vac setting.
- m. Disconnect test cable at DVM and connect it to scope.
- n. Set scope INPUT to AC, SWEEP to 5 MSEC/CM, and SENS to 5 mV/CM.
- o. Ripple observed on scope must not exceed 5 mV p-p.

- p. Disconnect cable from scope and reconnect cable to DVM.

2. -12 Volt Regulator Check.

Note

Only the +12 volt regulator circuit is adjustable. The -12 volt regulator uses +12 volts as a reference.

- a. Connect DVM between TP2 -12V dc and power ground. The DVM must read -12.0 volts dc ± 0.1 volt.
- b. Change input voltage with Variac to 103 Vac and 127 Vac. Reading on DVM must not exceed tolerance.
- c. Return Variac to 115 Vac.
- d. Disconnect cable at DVM, and connect it to scope.
- e. Set scope INPUT to AC, SWEEP to 5 MSEC/CM, and SENS to 5 mV/CM.
- f. Ripple observed on scope must not exceed 5 mV p-p.

3. 200 kHz Oscillator Measurements.

- a. Remove standard probe (1:1 probe) from scope, and connect 10:1 probe.
- b. Set scope controls as follows:

Switch	Position
INPUT	AC
SWEEP	2 uSEC/cm
SENS	10V/cm

- c. Connect scope between TP3 (200 kHz) and oscillator ground. There are other TP3's on other boards; this one is shown in Figure 6-15.
- d. Scope must show a pattern as in the following photograph.
- e. Remove 10:1 probe from TP3 and from scope.

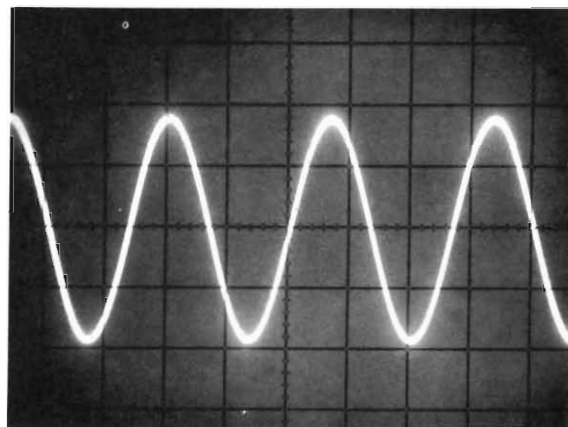
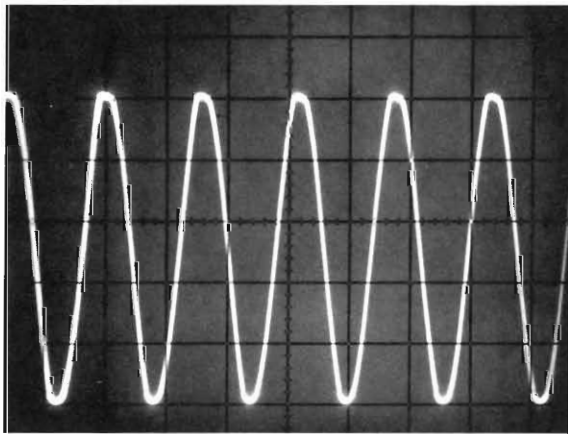


Table 5-3. Electrical Performance Checks and Adjustments (cont.)

4. *Input to Timing Generator.*

- a. Reinstall 1:1 probe on scope in place of 10:1 probe.
- b. Set scope controls same as in Step 3 except SWEEP to 10 mSEC/cm.
- c. Connect scope between TP4 (24 Vac, 50 Hz or 60 Hz), and power ground.
- d. Scope must show pattern as in following photograph.
- e. Remove scope probe from TP4.

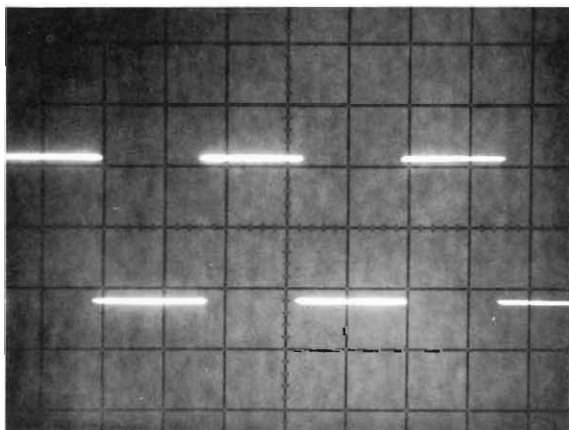


5. *Output of Timing Generator.*

- a. Set scope controls as follows:

Switch	Position
INPUT	DC
SWEEP	5 mSEC/cm
SENS	2V/cm

- b. Connect scope (1:1 probe) between TP5 (collector of Q14) and power ground.
- c. Scope must show a pattern as in following photograph:



- d. Connect scope between TP6 and power ground.

- e. Set scope controls as follows:

Switch	Position
INPUT	AC
SWEEP	1 SEC/CM
SENS	2V/CM

- f. One pulse should appear on the scope every second (centimeter on the scale), of about +3.0V p-p.
- g. Connect scope between TP7 (Figure 5-4) and power ground.
- h. Set scope SWEEP switch to 5 SEC/CM.
- i. One pulse should appear every minute on scope, +3.0V p-p.
- j. Set recorder POWER switch to OFF.
- k. Remove extender board, Regulator/Oscillator board and support from Recorder. Remove extender and support from board.
- l. Reinstall Regulator/Oscillator board into Recorder J17 if satisfactory, otherwise make necessary repairs and retest.

E. **PREAMPLIFIER POWER SUPPLY ASSEMBLY ADJUSTMENTS (07754-60140)**

1. *Position Control Adjustments.*

Note

CHAN POS controls are only for trimming channels. To position stylus during operation, use preamplifier POSITION control.

- a. Remove small cable from rear panel of Recorder (07754-60450), to disconnect preamplifier signals from Recorder input.
- b. Set Recorder SPEED switch to 2.5 MM/SEC.
- c. Set MODE switch to RUN.
- d. Adjust Channel 1 position (CHAN POS 1) control on preamplifier power supply board to its complete range. Stylus 1 should be able to be positioned over ± 10 divisions each side of center.
- e. Position stylus 1 to center of chart Channel 1.
- f. Repeat steps d and e for Channels 2, 3, and 4.
- g. Set MODE switch to STDBY position.

2. *Gain Control Adjustments.*

- a. Reconnect signal test cable (shown in Figure 5-2) to J32, and connect the dual banana plug to DC Standard 741 (Table 5-1), OUTPUT.
- b. Set output of dc standard to 0 volts.
- c. Set MODE switch to RUN, on 7754A Recorder.

Table 5-3. Electrical Performance Checks and Adjustments (cont.)

- d. Set dc standard output to +2.5V dc. All styli should move upscale (to left).
- e. Adjust all GAIN controls on Preamplifier Power Supply board to set all styli accurately to 25 divisions deflection (top line on chart).
- f. Reset dc standard output to 0 volts.
- g. Repeat steps c, d, e, and f until an accurate 0 to 25 divisions gain is obtained.
- h. Set Recorder MODE switch to STDBY.
- i. Disconnect dual banana plug from dc standard.

F. STYLUS MECHANICAL LIMIT ADJUSTMENT

- a. Connect dual banana plug on RECORDER INPUT TEST CABLE to Function Generator through HP dual to BNC adapter 10110A.
- b. Set Function Generator frequency to 1 Hz, and output to triangular waveform. Set amplitude control to 5.0V p-p.
- c. Set Recorder MODE switch to RUN.
- d. Adjust LIMIT controls (R9 and R13, Figure 5-1 inset) on each Driver Amplifier board fully clockwise, to cause all styli to travel at least 2.5 divisions beyond chart channel edge.
- e. Adjust Channel 1 right and left bumpers to limit travel of stylus to 2.5 divisions beyond top and bottom line of chart channel.
- f. Repeat Step e for Channels 2, 3, and 4.

Note

Stylus travel beyond the edge of the channel grid must not interfere with any adjacent channel stylus or marker stylus when styli are at maximum excursion toward each other.

G. DRIVER AMPLIFIER ASSEMBLY ADJUSTMENTS

1. Electrical Limiting Adjustment.

- a. Adjust Channel 1 LIMIT L control (R9, Figure 5-1) to limit stylus travel to 1.5 divisions beyond top line of chart (turn ccw).
- b. Adjust Channel 2 LIMIT R control (R13, Figure 5-1) to limit stylus travel to 1.5 divisions beyond bottom line of chart (turn ccw).
- c. Repeat Steps a and b for Channels 2, 3, and 4.
- d. Turn amplitude control of Function Generator ccw so stylus travel stops at last grid line of chart top and bottom. Triangular waveform must not limit at either top or bottom of chart.
- e. Set MODE switch to STDBY.

2. Damping Adjustments.

- a. Push Recorder SPEED button for 10 MM/SEC speed.
- b. Adjust Function Generator output to 1 Hz square wave.
- c. Set Recorder MODE switch to RUN.
- d. Adjust Function Generator amplitude control to produce a 20 division deflection on Recorder chart.
- e. Adjust Channel 1 DAMPING control (R30, Figure 5-1 inset) so overshoot on chart does not exceed 0.8 division.
- f. Set MODE switch to STDBY.
- g. Set Function Generator output to 5 Hz sine wave.
- h. Set MODE switch to RUN.
- i. Adjust Function Generator amplitude control to produce full-scale (50 division) deflection on chart.
- j. Set Function Generator output to 50 Hz sine wave; stylus deflection must be no less than 45 divisions.
- k. Set MODE switch to STDBY.
- l. Repeat steps b through k for Channels 2, 3, and 4.

3. Frequency Response Check.

- a. Set Function Generator to 10 Hz sine wave.
- b. Push Recorder SPEED button for 10 MM/SEC speed.
- c. Set MODE switch to RUN.
- d. Adjust Function Generator amplitude control for a 10 division stylus deflection.
- e. Set Function Generator output to 100 Hz sine wave.
- f. Stylus must deflect 7.07 divisions (3 dB down) on chart.
- g. Set MODE switch to STDBY.
- h. Repeat steps a through g for Channels 2, 3, and 4.

4. Linearity Check.

- a. Set Function Generator output to 0.1 Hz triangular waveform.
- b. Push Recorder SPEED button for 10 MM/SEC speed.
- c. Set MODE switch to RUN.
- d. Adjust Function Generator amplitude for full-scale stylus deflection.
- e. Stylus must show less than ± 0.25 division deviation from straight line.
- f. Set MODE switch to STDBY.

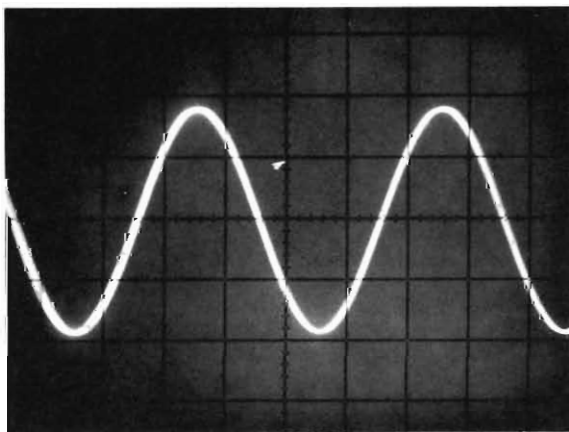
Table 5-3. Electrical Performance Checks and Adjustments (cont.)

5. Signal Waveform Measurements.

- a. Press Recorder POWER switch to remove power (OFF).
- b. Remove Driver Amplifier Assembly (07754-60170) from channel to be tested.
- c. Install extender board (07754-00920) and plastic support (07754-00900) on Driver Amplifier Assembly.
- d. Install extender board, with Driver attached, to Recorder connector from which Driver was removed.
- e. Press Recorder POWER switch to apply power (ON).
- f. Adjust Function Generator output to 50 Hz sine wave.
- g. Set scope controls as follows:

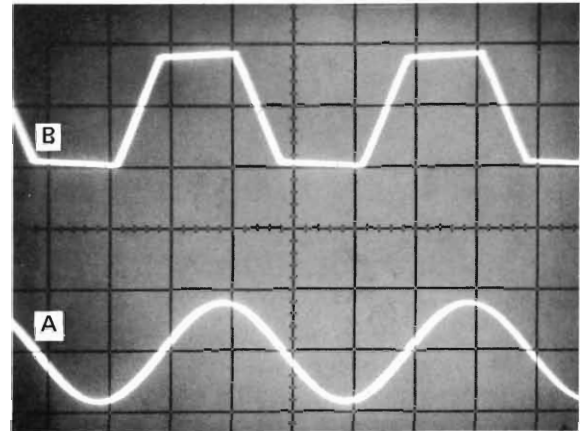
Switch	Position
INPUT	AC
SWEEP	5 MSEC/CM
SENS	0.5V/CM

- h. Connect scope between TP1 (Figure 5-5) and signal ground.
- i. Push Recorder SPEED button for 2.5 MM/SEC.
- j. Set MODE switch to RUN.
- k. Adjust Function Generator amplitude for full scale stylus deflection.
- l. Scope must show a pattern as in the following photograph:



- m. Connect scope between TP2 and signal ground.
- n. Set scope SENS control to 10V/CM.
- o. Scope must show pattern same as "A" in following photo.
- p. Turn Function Generator amplitude control clockwise to cause limiters to limit signal.

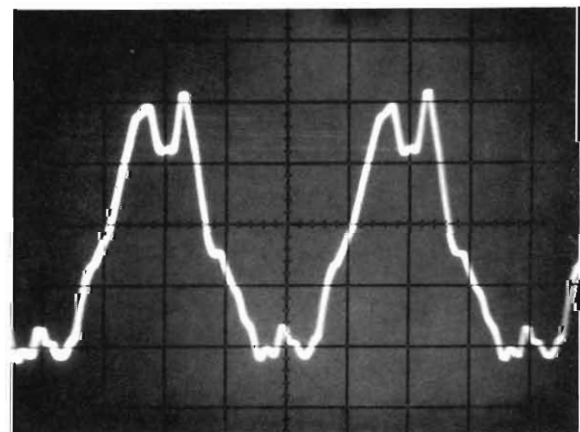
Scope must show pattern same as "B" in following photo:



- q. Turn Function Generator amplitude control to produce full scale deflection on chart without limiting.
- r. Set Recorder MODE switch to STDBY.
- s. Connect scope between TP3 of Driver Amplifier and signal ground, and set Scope controls as follows:

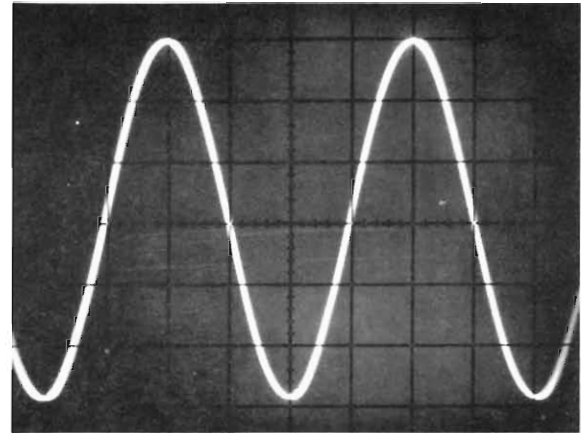
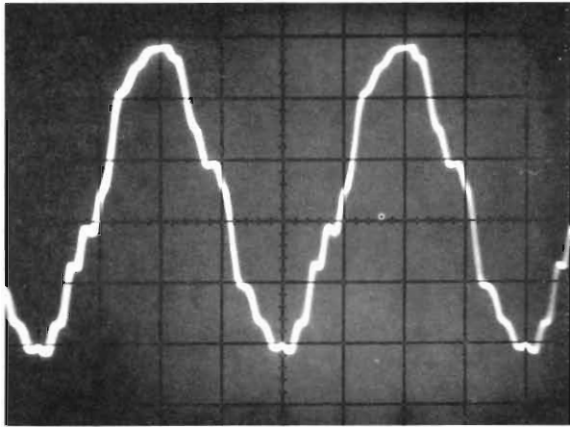
Switch	Position
INPUT	AC
SWEEP	5 MSEC/CM
SENS	1V/CM

Scope should show pattern as in following photo:



- t. Connect scope between TP4 and signal ground, and set scope SENS to 5V/CM. Scope must show pattern as in following photo:

Table 5-3. Electrical Performance Checks and Adjustments (cont.)



- u. Connect Scope between TP5 and signal ground, and set scope SENS control to 1V/CM. Scope must show pattern as in following photo:
- v. Set MODE switch to STDBY and remove test cable from J32 on rear of Recorder. Reconnect jumper cable 07754-60450 to J31 and J32.

- and set MODE switch to RUN.
- d. Push Recorder SPEED buttons in sequence, and observe following readings on DVM; return MODE switch to STDBY for last reading:

6. Driver Heat Control Amplifier Check

- a. Connect Digital Voltmeter (DVM) between TP6 (Figure 6-13) and power ground.
- b. Set all Recorder STYLUS HEAT controls fully clockwise.
- c. Push Recorder SPEED button for .25 MM/SEC

SPEED MM/SEC	DVM	SPEED MM/SEC	DVM
.25	-6.4 Vdc	10	- 8.4 Vdc
.5	-6.4 Vdc	25	- 9.8 Vdc
1	-6.4 Vdc	50	-11.0 Vdc
2.5	-6.4 Vdc	100	-11.9 Vdc
5	-7.7 Vdc	STDBY	- 5.7 Vdc

5-16. Cleaning.

5-17. Depending on environmental conditions, cleaning may be required at much shorter intervals than the regular maintenance intervals:

- a. Unplug Recorder power cord. Remove chart paper. Expose top and rear of Recorder, and remove dust with a vacuum hose.
- b. Clean Recorder and Preamplifier front panels and controls with a soft, lint-free cloth or a wax-impregnated polishing cloth.

CAUTION

IF A SOLVENT IS NECESSARY TO CLEAN THE PANEL, USE ONLY CHLOROTHENE OR ETHYL ALCOHOL. OTHER SOLVENTS, SUCH AS ACETONE OR ISO-PROPYL ALCOHOL, MAY REMOVE PANEL PAINT OR MARKINGS. IF THE PANEL MUST BE MARKED, FOR INSTANCE WITH CHANNEL IDENTITY, USE ONLY CHINA MARKING WAX CRAYON, OR COLOR-CODED EMBOSING TAPE. DO NOT USE

FELT, NYLON, OR BAMBOO-TIPPED MARKERS ON THE INSTRUMENT PANEL OR THE MARKING MAY DISCOLOR THE PANEL PAINT PERMANENTLY.

- c. Pull the paper table out at the bottom (Figure 3-2, Step 2). Clean the black surface of the paper table with Chlorothene solvent. On the rear surface of the table, clean the metal pressure roller and the metal paper brake arm with Chlorothene. At the bottom front of the Drive Unit, clean the rubber drive roller with Chlorothene (Figures 5-13, 5-14).
- d. Carefully clean the writing and marker styli with Chlorothene. Do not use steel wool or abrasive cleaning compounds.

5-18. Lubrication.

5-19. Minor lubrication should be performed during preventive maintenance. Major lubrication (minor lubrication plus gearbox) is done at overhaul and at regular intervals of 12 months or 2000 hours operation, if used mostly in the upper half of the speed range. If the Recorder is used mostly for low speed operation, more clutches are engaged and

more reduction gears are used. Thus, a more frequent lubrication may be required, typically every 6 months or 1000 hours. To help assure uninterrupted service if an extended period of recording is anticipated, overhaul and lubricate the Recorder before placing it on line. Lubricants are listed in Table 5-2. Lubrication points are shown in Figure 5-6.

5-20. ELECTRICAL CHECKS.

5-21. For electrical performance checks and adjustments, refer to the procedures in Table 5-3. To remove and replace the Driver Amplifier, Regulator, and Power Supply Assemblies, see Figure 5-2 and 5-3. Driver Amplifier Board test points are shown in Figure 5-4. Regulator/Oscillator Board test points are shown in Figure 5-5.

5-22. ADJUSTMENTS AND MINOR REPAIRS.

5-23. Mechanical adjustments are confined to the paper drive and galvanometer assemblies. Paper drive minor repair and troubleshooting information is presented in Table 5-4. If necessary, galvanometer superficial parts may be replaced only to the extent indicated in the Replaceable Parts List. Do not attempt to disassemble the Galvanometer, but return it to HP for service.

5-24. Paper Drive Adjustments.

5-25. The rubber drive roller pulls paper over the paper table, where it is aligned by the paper guide. The paper is kept snug on the table by the paper brake pad, which presses the paper against a felt-covered plate. The paper is kept from slipping on the drive roller by a spring-loaded pressure roller. To set up the Recorder so that styli run on the channel centerlines, the paper is first adjusted to run at the right edge of the paper guide, which is fixed in location. Then the stylus position for each channel is adjusted (see Table 5-3), the mechanical limit stops are adjusted, and the electrical limiters are adjusted.

5-26. PAPER BRAKE ADJUSTMENT. The paper brake may have to be adjusted occasionally as the felt compacts and wears. In all cases, the Recorder should pull the paper snugly, but not tightly, over the paper table. If adjustment is difficult, refer to Paragraph 5-27 and renovate or replace the felt backing. Load paper into the Recorder (Figure 3-2), and run it at 25 mm/second. The paper should settle at the right edge of the paper guide (Figure 5-1). If not, lower the paper table and attempt one of the following adjustments:

- a. If paper climbs or wrinkles against right edge, loosen left adjustment screw by turning it *clockwise* (Figure 5-1).
- b. If paper climbs against left edge, loosen right screw by turning *clockwise*.

- c. If paper weaves, or alternately moves from side to side, tighten left screw slightly by turning it counterclockwise.

Allow paper travel so paper feed and possible paper weave can be observed. Make further corrections as needed. If the paper brake arm has been replaced, take up on the adjustment screws all the way (CW), then release them *equally* until braking action is correct, by checking paper speed, and paper snugness over the platen. The paper may weave slightly. To correct this weaving, adjust the paper brake arm slightly at the left by tightening the left screw (CCW) so drag will be greater at the left. Adjust arm progressively until the paper settles to the right.

5-27. PAPER BRAKE FELT RENOVATION. If the paper brake adjustment is difficult or "touchy", the paper brake felt may be worn out or compressed. If the paper weave cannot be corrected, the felt may be compressed more on one side than the other, or be misadjusted. Renovate the felt as follows:

- a. Lower paper table and inspect felt. If it is worn badly, replace it. If it is coated with plastic from Permapaper, renovate it (below) and turn it inside out so fresh surface is exposed. If it is not excessively coated, clean and expand felt as follows:

- (1) Using a flat-blade screwdriver as a lever, pry retaining rod from top of felt, as shown in Figure 5-7.

- (2) Lower felt and remove retaining strip at bottom of felt.

- (3) Wash felt in Chloroethene solvent with stiff brush to remove all traces of chart paper plastic residue. While it is still wet, uniformly fluff it with compressed air (aerosol can or air hose), or let it dry and then brush it again.

- (4) Reinstall felt with retaining strip at bottom, and retaining rod at top, by levering from back of top bar as shown in Figure 5-7.

- b. Readjust paper brake (Paragraph 5-24), but not so tightly as to affect paper timing.

5-28. PAPER TIMING CHECK. The timed marker is used to check the paper speed accuracy. Since this marker is timed from line frequency and the paper drive motor is a synchronous type operating at a multiple of line frequency, the two should coincide exactly. This test therefore checks for mechanical slippage and stretched paper or incorrect paper brake adjustment.

- a. Set the TIMER to SEC, the SPEED to 25 MM/SEC, and MODE to RUN. Turn on Recorder power. Run a few feet of paper and set MODE to STDBY.

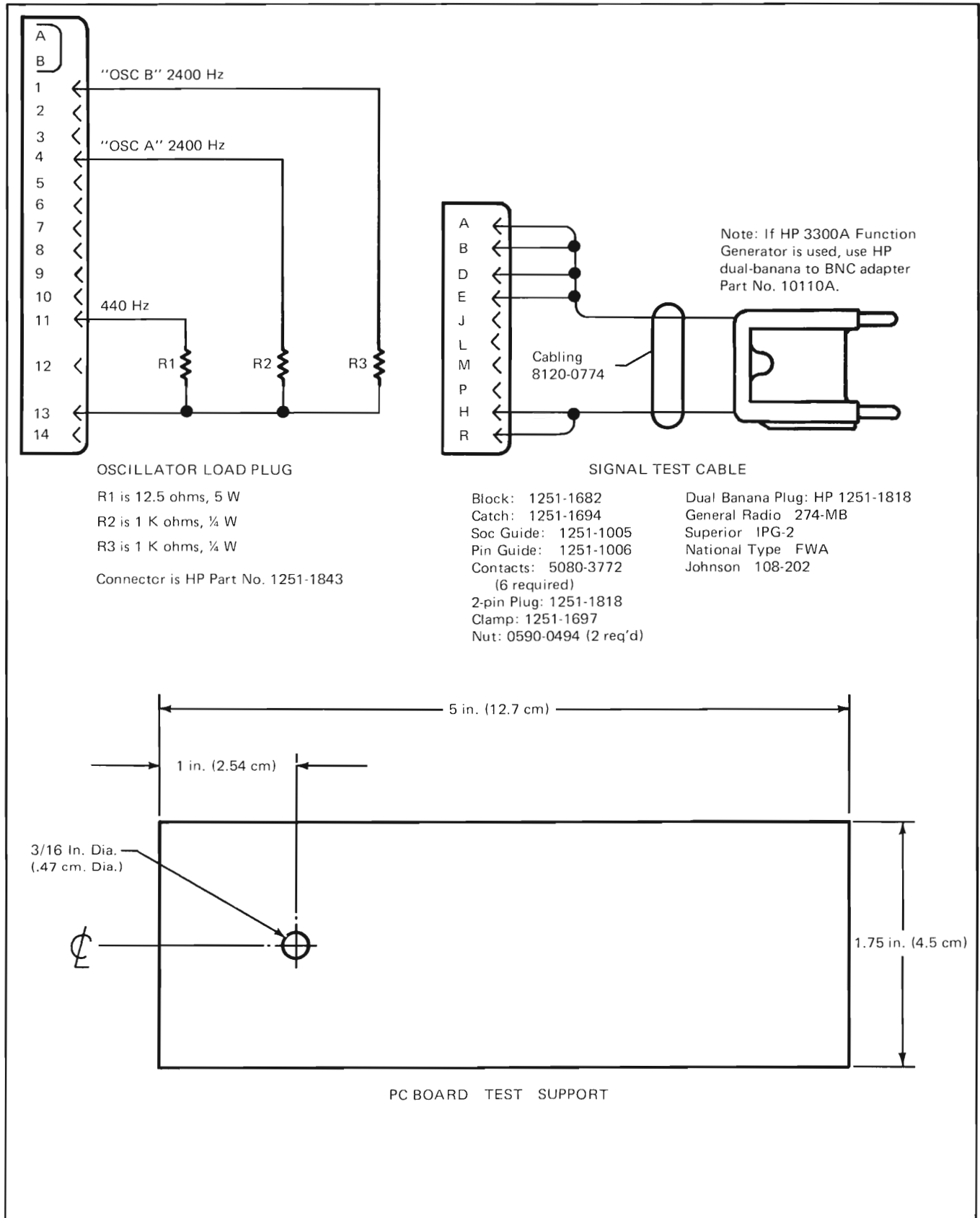


Figure 5-2. Test Cable, Plug and Fixtures

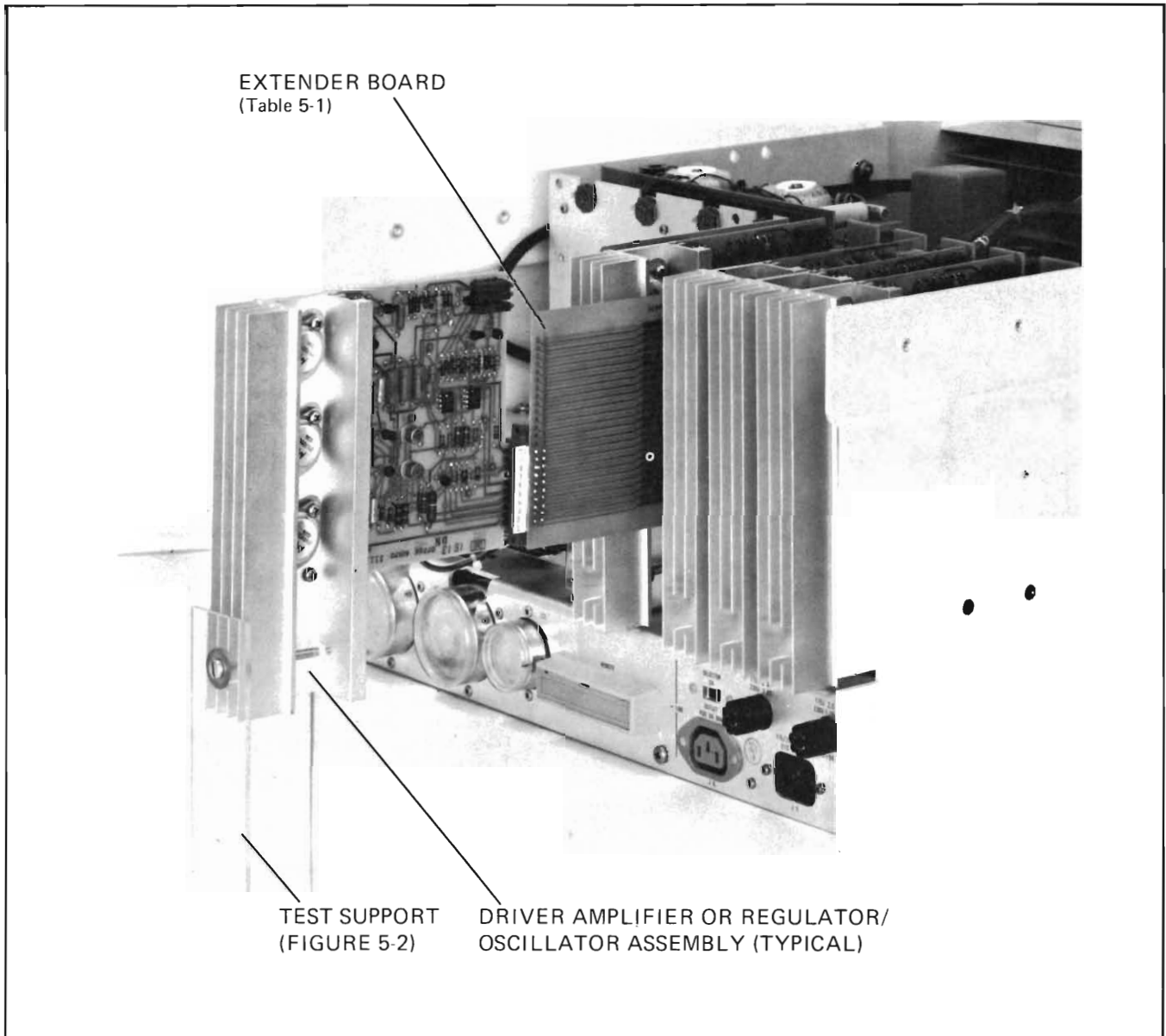


Figure 5-3. Driver Amplifier and Regulator/Oscillator Test

b. Check the spacing of the timing marks with a millimeter scale. They should be $25 \text{ mm} \pm 1\%$. Check again at 100 MM/SEC and 5 MM/SEC speeds, allowing a maximum error of 1%.

Under certain humid conditions, if the paper brake is set too tightly, the paper will stretch slightly on the paper table, resulting in false timing.

5-29. Stylus Adjustments.

5-30. The stylus pressure, mechanical centering and parallax may be adjusted. Mechanical stops are adjusted as part of the electrical maintenance procedures, as is galvanometer sensitivity, but the galvanometer itself has no adjustments.

5-31. **STYLUS PRESSURE ADJUSTMENT.** Stylus pressure must be checked at the *tip* of the stylus only, for accurate readings. For access to the stylus tips, four holes are provided in the front top bar. See Figure 5-8 and proceed as follows:

- Gain access to top of Recorder and remove painted metal cross bar cover to expose four holes for stylus pressure tester.
- Run Recorder at 5 mm/sec. Hook tip of accessory Stylus Pressure Tester 14023A under edge of stylus under test.
- Lift tester and stylus. When stylus stops writing,

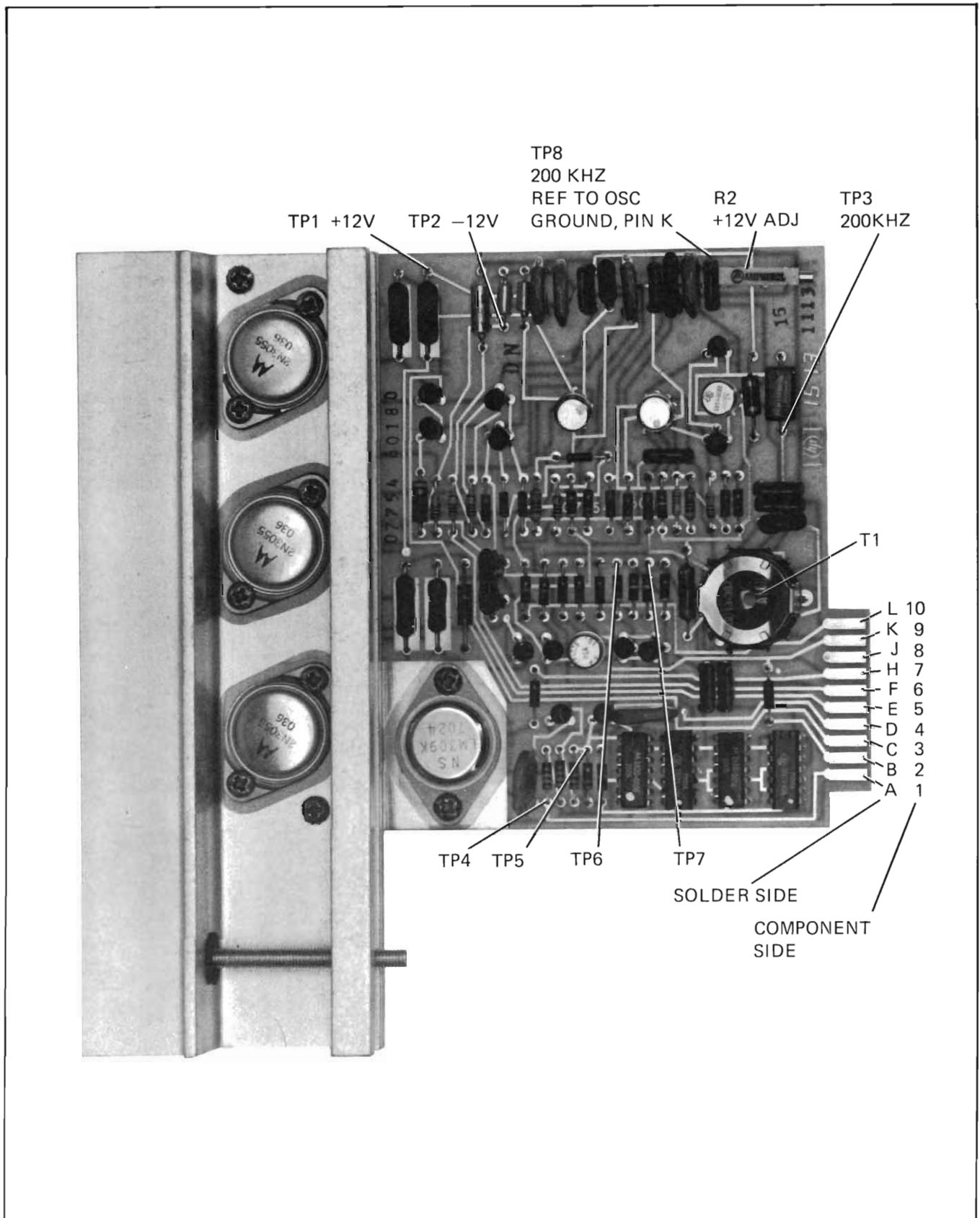


Figure 5-4. Regulator/Oscillator Board Test Points

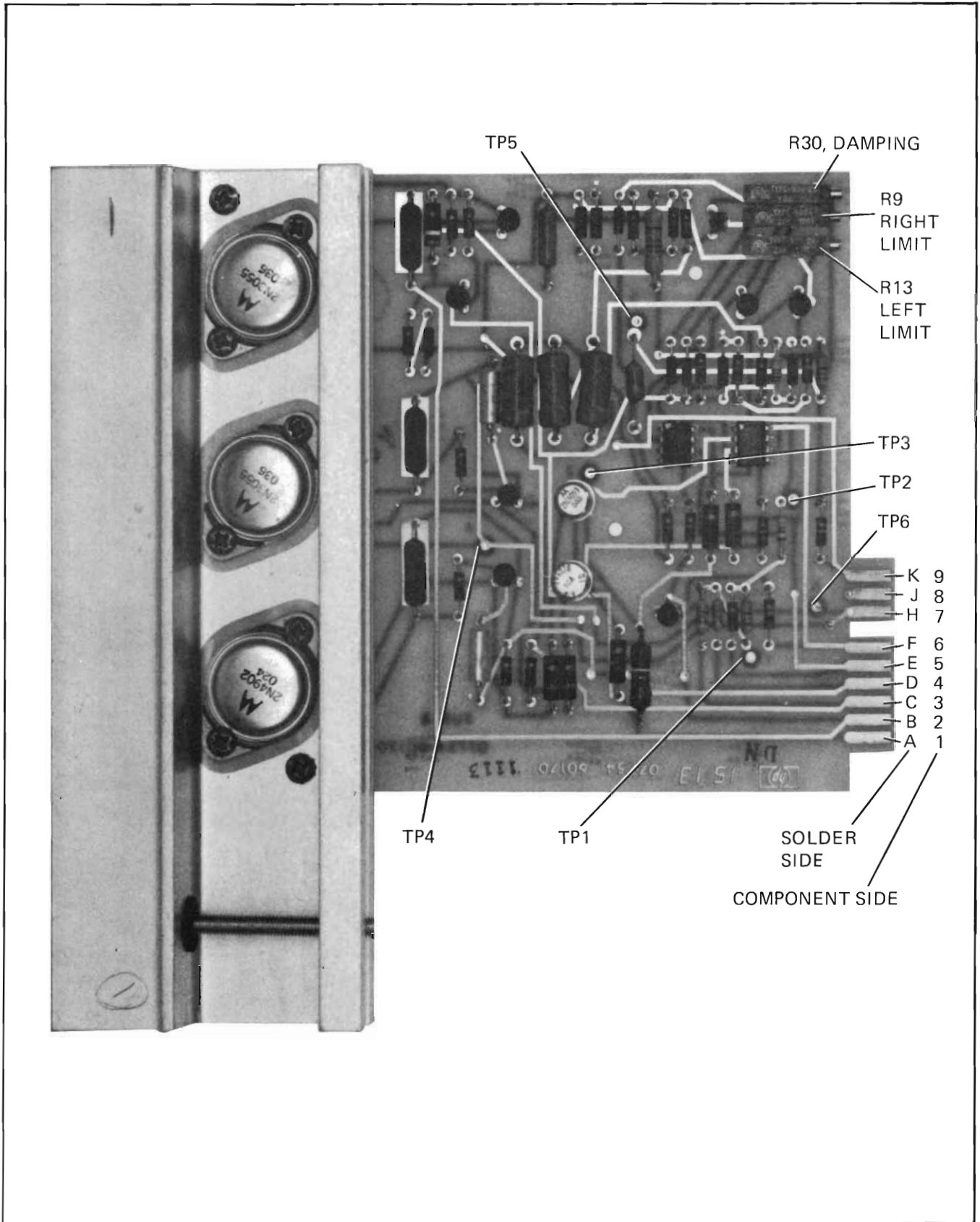


Figure 5-5. Driver Amplifier Board Test Points

Table 5-4. Paper Drive Troubleshooting

Trouble	Probable Cause	Solution and Paragraph
IMPROPER PAPER TRACKING (paper moves to one side or the other)	Worn brake felt or bent paper guide. Uneven tension on paper brake arm adjustment screws.	Replace worn part; 5-27. Establish even paper tension, slightly more on left side; Paragraph 5-24.
PAPER TEARS AT Z-FOLD	Excessive brake pad pressure. Also see next item.	Adjust both brake adjustment screws clockwise; 5-24.
PAPER JAMS IN PRESSURE ROLLER	One pressure roller spring is weaker than the other.	Replace both springs.
PAPER WEAVES FROM SIDE TO SIDE	Paper brake arm tension not adjusted or arm is dirty. Slick or dirty drive roll.	Establish slightly more pressure on left; 5-24. Clean or replace; 5-28.
IRREGULAR PAPER SPEED	Slick or dirty drive roll.	Clean or replace; 5-28.
INCORRECT PAPER SPEED	Solenoid wires to Transfer Board loose or misconnected. Solenoid coil or lead open.	Check for bad connections, open solenoid coils, leads.
NO PAPER DRIVE	Defective drive motor.	Check drive motor fuse and cable from power supply.
NO SIGNAL ON PAPER	Galvanometer circuit problem. CAUTION: GALVANOMETER IS NOT FIELD REPAIRABLE. REPLACE ONLY PARTS SHOWN IN FIGURE 6-18.	Refer to Table 5-3 for Driver troubleshooting, and see Paragraphs 5-29 to 5-34 for galvanometer adjustments.

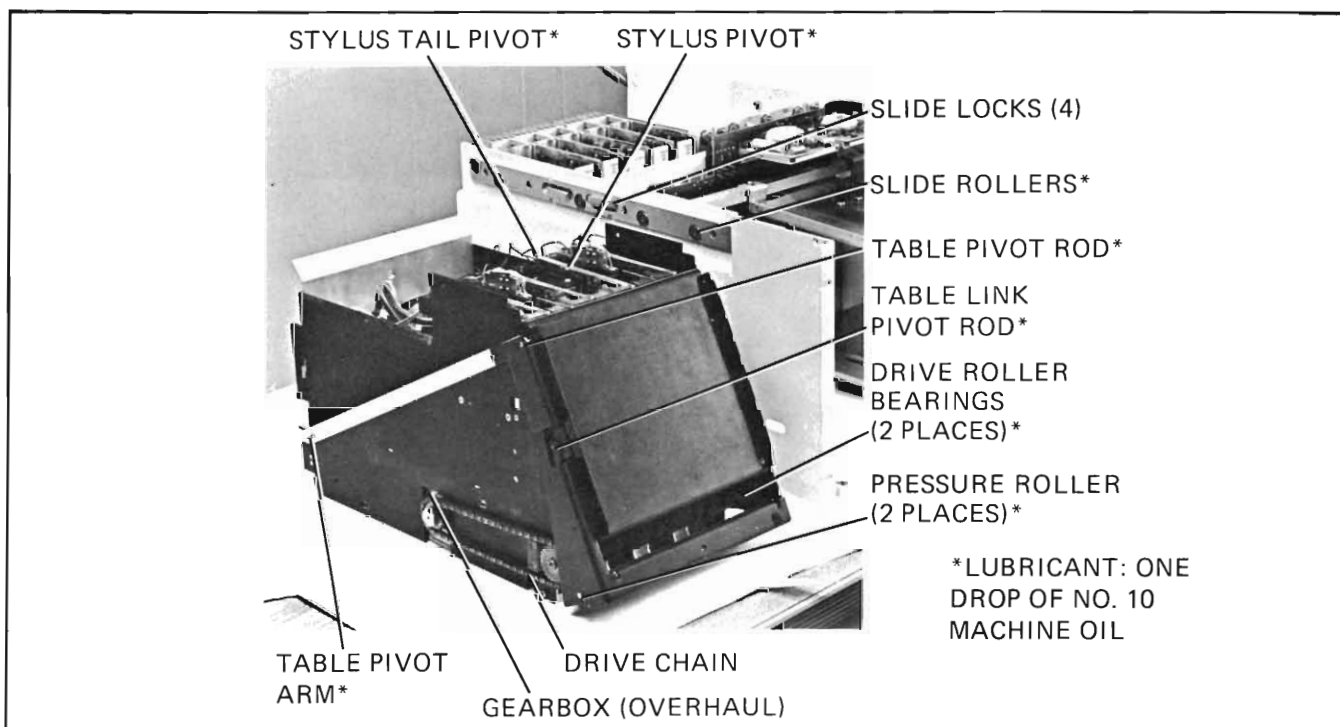
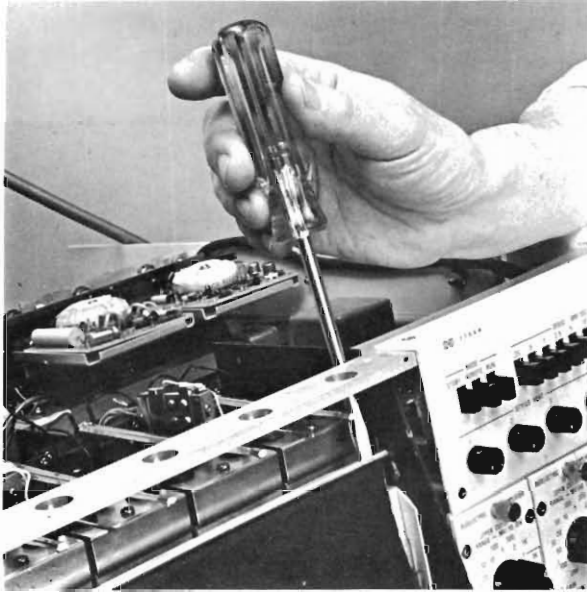
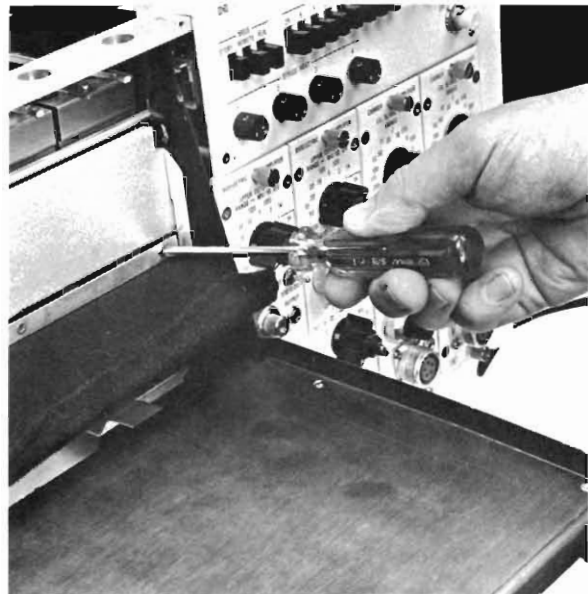


Figure 5-6. Recorder Lubrication Points

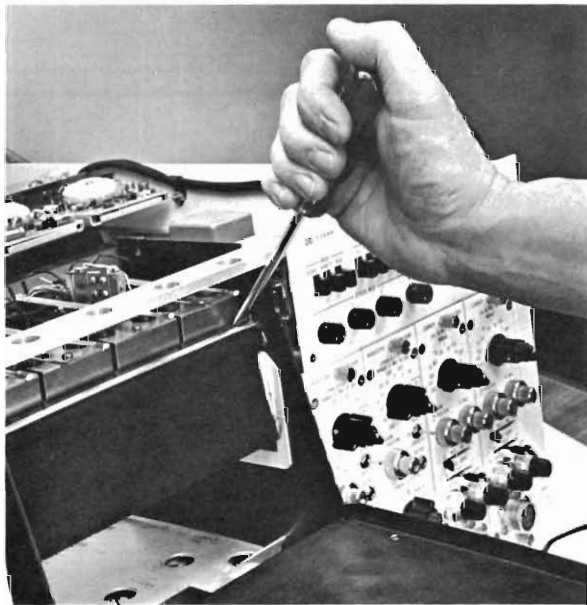
REMOVING FELT
STEP 1



REMOVING FELT
STEP 2



REPLACING FELT



GALVANOMETER MOUNTING
SCREW ACCESS HOLES (4)

Figure 5-7. Paper Brake Felt Cover Removal and Replacement

tester should read 20 grams, ± 2 grams. Read tester with respect to top of fluted ring (Figure 5-8).

d. If pressure adjustment is required, turn adjusting screw (Figure 5-8).

CAUTION

DO NOT ATTEMPT TO BEND STYLUS.

e. If stylus pressure cannot be adjusted, replace stylus (Paragraph 5-35), but only after observing whether stylus is properly mounted, and that pivot arm and retaining clip are locked on.

5-32. **STYLUS CENTER ADJUSTMENT.** Use the following procedure to center the writing stylus in its chart channel:

a. Run chart paper at 25 mm/sec to find correct position on table. Unplug galvanometer cable to permit true mechanical centering.

b. Loosen pivot arm clamp screw (Figure 5-10), but only enough so pivot arm moves on galvanometer upper suspension with a little resistance.

c. Position stylus on channel mechanical center. Run chart paper to check stylus position, and correct if necessary.

d. Slide pivot arm so its upper surface is flush with top of upper coil shaft (Figure 5-10). Tighten pivot arm clamp screw firmly.

CAUTION

USE A SHARP-CORNERED ALLEN WRENCH THAT WILL STAY IN SET SCREW HOLE WITHOUT APPLYING SIDE PRESSURE. DO NOT APPLY EXCESSIVE SIDE PRESSURE.

e. Reconnect galvanometer cable to transfer board assembly.

5-33. **STYLUS PARALLAX ADJUSTMENT.** When the stylus has proper parallax, the tail pivot and the stylus tip are on the same line as the chart channel centerline, with the result that square waves drawn by the stylus are exactly parallel to the chart time lines. To adjust the stylus parallax:

a. Loosen two screws indicated in Figure 5-8 and move stylus tail pivot into proper position. Tighten both screws snug but not tight.

b. Test for parallax by moving stylus gently with finger

pressure, upscale and downscale, and observing whether stylus markings are parallel to time lines, ± 0.1 mm across width of each channel.

c. When adjustment is complete, tighten tail pivot screws.

5-34. **CHANNEL TIME SYNCHRONIZATION.** When all channels are synchronized with respect to time, all styli fall on the same time line of the recording chart, ± 0.25 mm over the width of the entire recording chart. Stylus parallax may have to be readjusted (Paragraph 5-33) after synchronizing channels since galvanometer adjusting screws may have some side play. If necessary, the galvanometers can be lined up as follows:

a. Remove chart paper.

b. With a long Pozidriv screwdriver, loosen 2 galvanometer hold-down screws in each misaligned channel just enough so galvanometer can be moved with adjustment screw (Figure 5-9).

c. Adjust with adjustment screws until traces all fall on same time line. This adjustment is by trial and error since chart paper will interfere with adjustment.

5-35. **STYLUS REMOVAL AND REPLACEMENT.** The stylus is attached to the galvanometer pivot arm with a sliding retainer.

CAUTION

CONSIDERABLE CAUTION IS REQUIRED IN REMOVING STYLUS SINCE IT IS EASILY BENT IN VERTICAL PLANE ALTHOUGH IT IS EXTREMELY STIFF HORIZONTALLY.

To remove the stylus, perform the following procedure (Figure 5-10):

a. Using long nosed pliers and *obtaining some leverage to limit travel of the pull*, remove two heater wires from pins on galvanometer.

b. Push retaining clip on pivot arm forward, toward Recorder front, as shown.

c. Grip stylus between center attaching pin and tail pivot.

d. Carefully lift stylus free of pivot arm and tail pivot while rocking stylus from side to side.

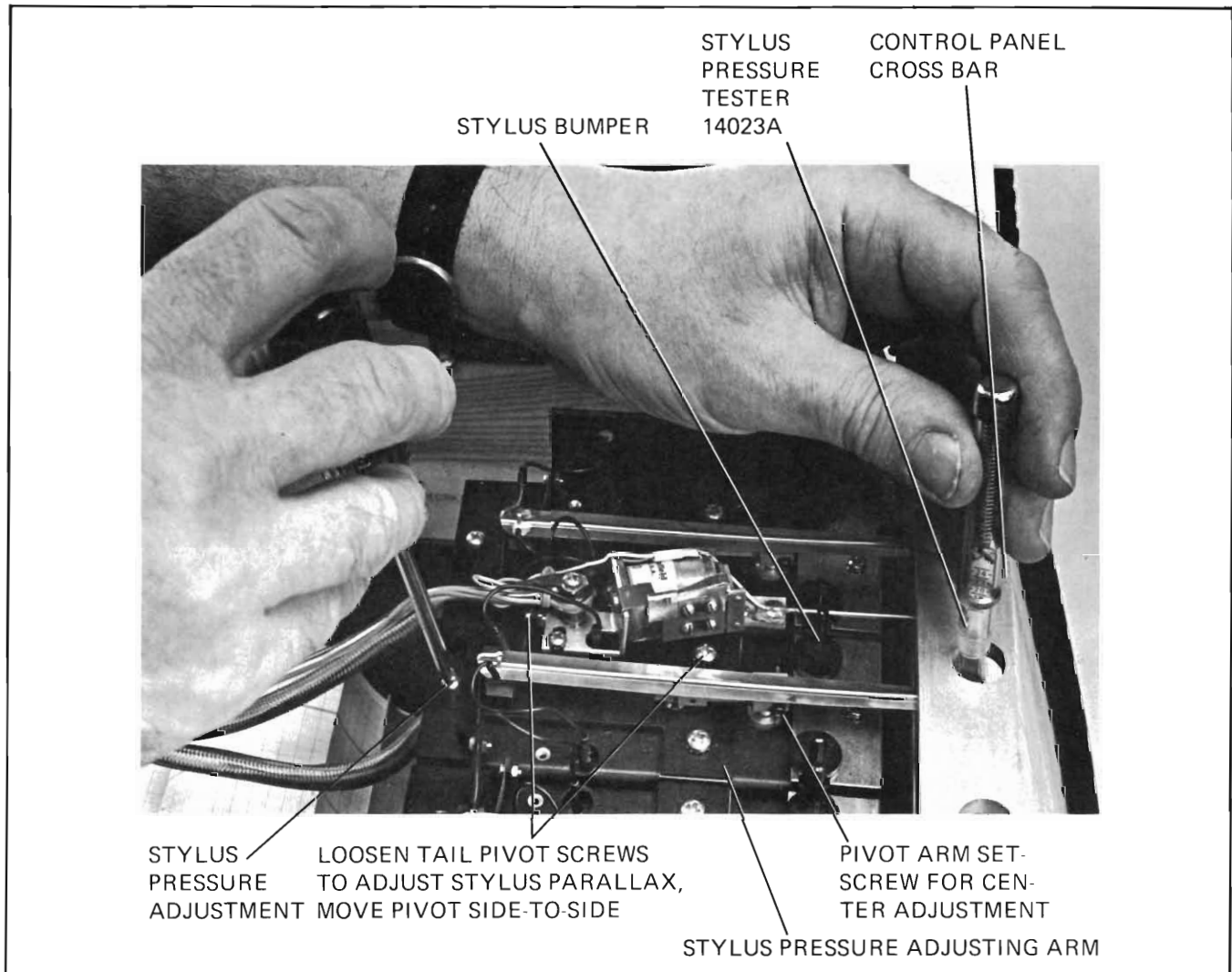


Figure 5-8. Stylus Adjustments

5-36. After stylus replacement, the tip of the new stylus must be made to conform with the exact angle of the paper surface. This angle varies slightly from stylus to stylus. Styli therefore should never be replaced without lapping.

NOTE: The new stylus tip should be on the same time line as the other styli, ± 0.25 mm, otherwise adjust channel time synchronization, Paragraph 5-34.

5-37. **STYLUS LAPPING.** A new or replacement stylus must be lapped so it will have a uniform trace width as it moves across the paper.

a. Connect 30 Hz sine wave signal to input of channel. Run recorder at .25 mm/sec speed, and adjust signal amplitude for about 10 divisions deflection. Stop recorder.

b. Place a piece of lapping paper (07850-01520) under

stylus tip so it spans center 10 divisions. Hold lapping paper with one finger on each side of stylus so paper is exactly flat. (Figure 5-11.)

c. Run recorder at .25 mm/sec, slowly moving paper under the stylus tip. Lapping time should be about 15 seconds. Turn off recorder and remove lapping paper.

d. Lapping is complete when stylus leaves uniform trace across entire channel width. Check stylus pressure, as described in Paragraph 5-31. *Do not lap excessively since the stylus tip is tapered and will leave a progressively wider trace.*

5-38. CORRECTIVE MAINTENANCE.

5-39. Instructions for removing and replacing Power Supply Assembly A3 and Driver Amplifier Assemblies A4, A5, A6

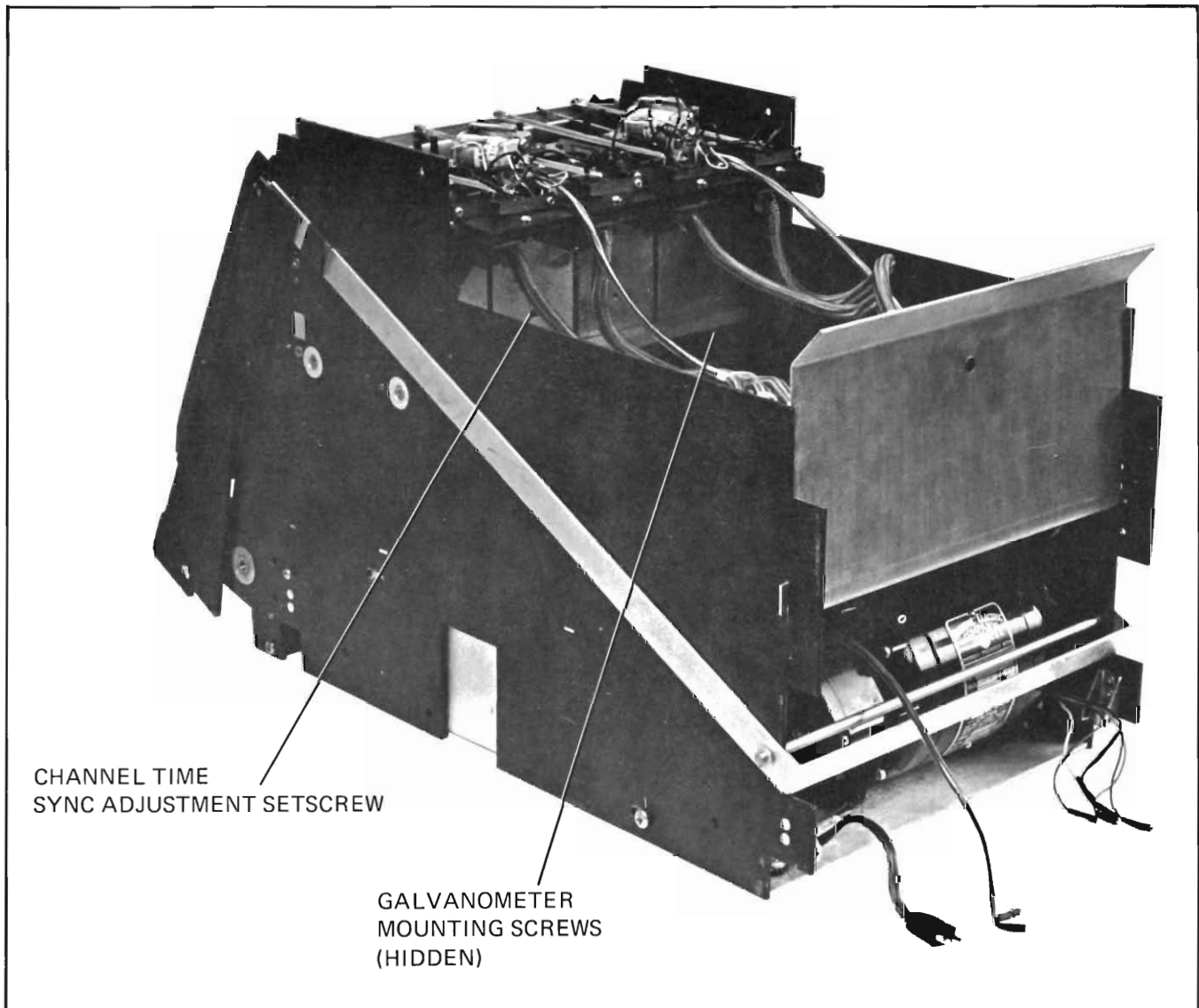


Figure 5-9. Channel Time Synchronization Adjustment

and A7 are given in the electrical performance test in Table 5-3. Corrective maintenance procedures cover:

- Galvanometer Removal and Replacement
- Drive Unit Removal and Replacement
- Paper Table Removal and Replacement
- Gearbox Removal, Lubrication and Replacement
- Marker Assembly and Adjustment.

5-40. Galvanometer Removal and Replacement.

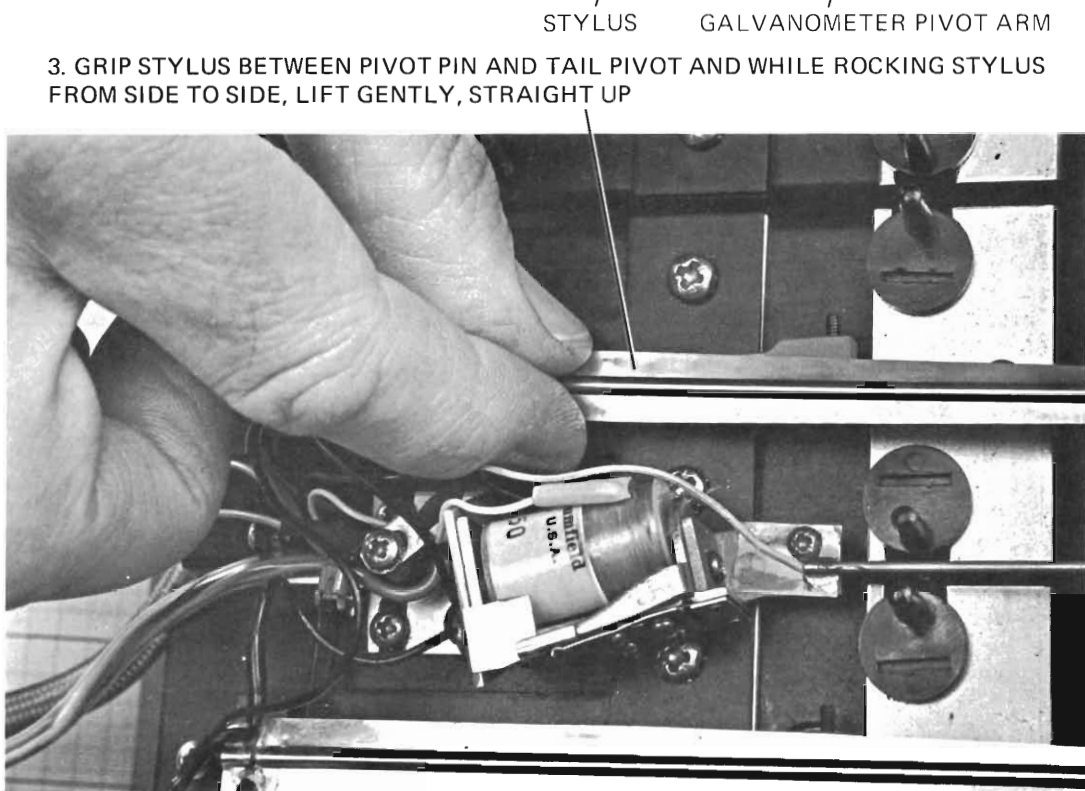
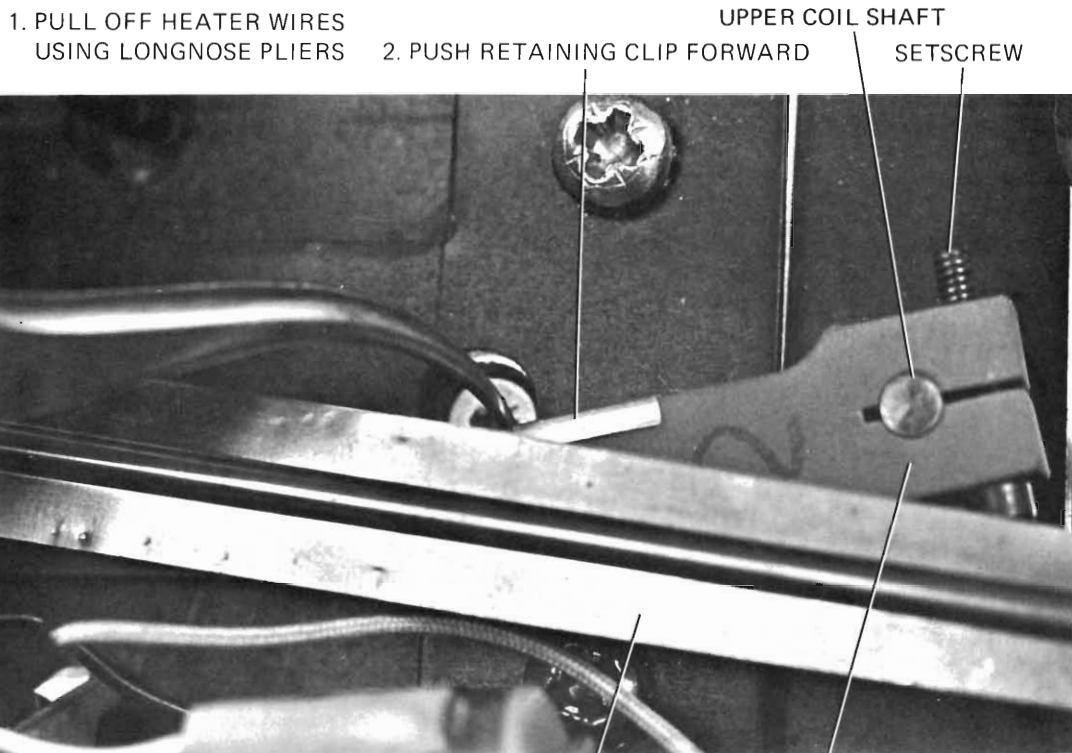
5-41. To remove a Galvanometer, perform the following procedure:

- a. Remove any marker assemblies attached to Galvanometer, following procedures in Paragraph 5-57.
- b. Remove galvanometer cable W1 from PC edge con-

ductor on Transfer Board Assembly.

- c. Pull out paper table at bottom, open fully.
- d. Remove pack of paper from feed tray.
- e. Remove stylus from Galvanometer (Paragraph 5-35).
- f. Pass a screwdriver up through galvanometer mounting screw access holes (Figures 5-7, 5-12) and unfasten two galvanometer mounting screws (Figure 5-9). Do not change timing sync setscrew adjustment.
- g. Carefully lift Galvanometer free of mounting.

5-42. Replacement of the Galvanometer is the reverse of the removal procedure. Always check the Galvanometer synchronization (position) with respect to the chart timing



4. CAREFULLY LIFT STYLUS FREE OF TAIL PIVOT

Figure 5-10. Stylus Removal and Replacement

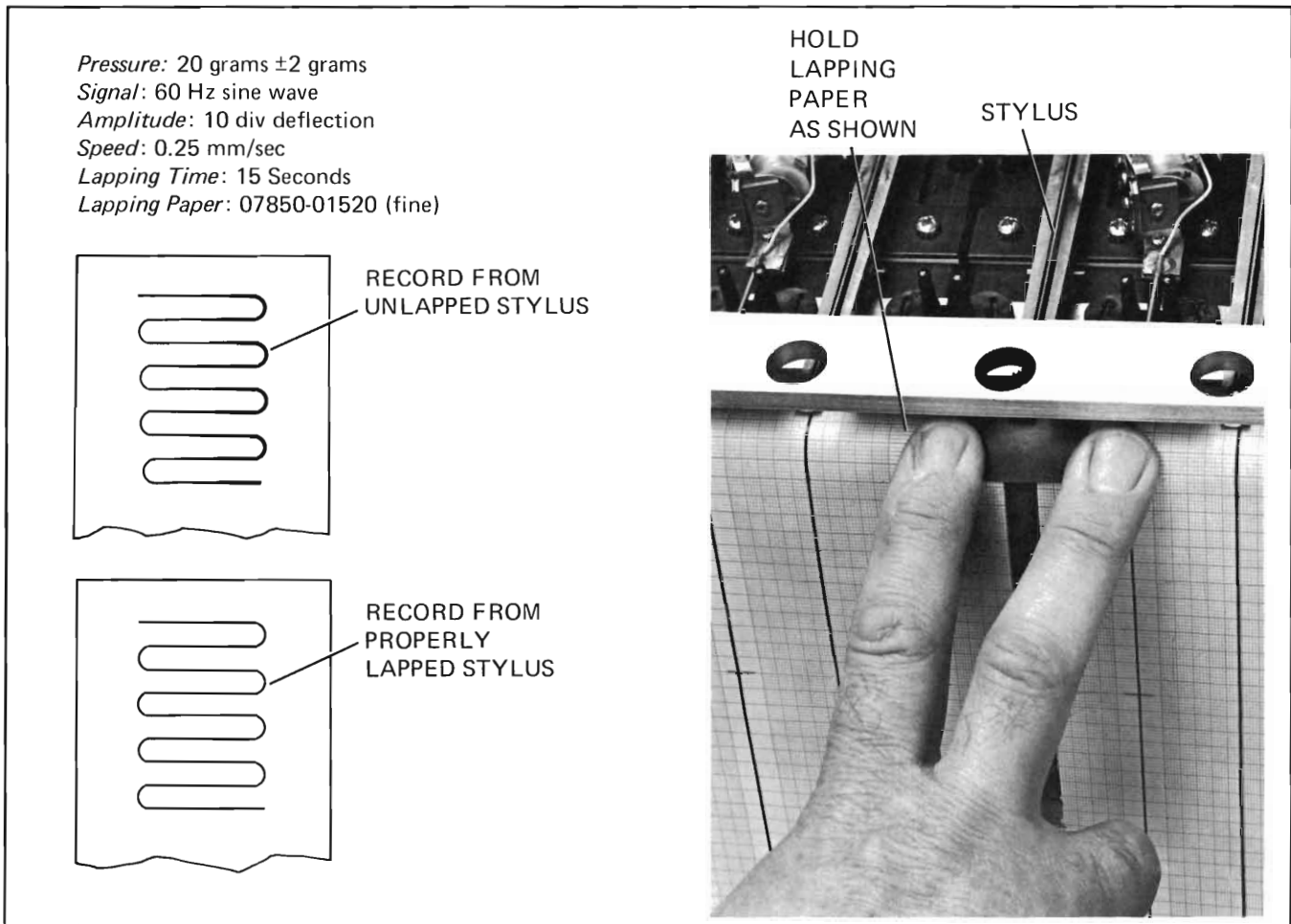


Figure 5-11. Stylus Lapping Procedure

lines (Timing Sync, Paragraph 5-15, part d) after replacement. Faulty parallax may be corrected with the time synchronization procedure in Paragraph 5-34.

5-43. Drive Unit Removal and Replacement.

5-44. The Drive Unit can be removed from the main chassis for maintenance. It is not necessary to remove the drive unit to gain access to the gearbox or galvanometer assemblies, which can be removed separately. To remove the Drive Unit, first remove the Recorder from the Case (Figure 2-11). To remove it from the Case, unfasten the screws shown and lift out the Recorder. The Recorder need not be removed from the Cabinet or the Cart, but a table should be placed under the drive unit before the drive unit is removed.

CAUTION

TO PREVENT ACCIDENTALLY UNBALANCING THE RECORDER, ALWAYS TIP IT ONTO THE HEAVY SIDE THAT CONTAINS THE DRIVE UNIT.

- Tip the Recorder onto its left side (facing the front panel).
- Refer to Figure 5-12 and disconnect the drive motor plug and speed control wires (inset). Remove four screws from the front and rear bottom cross bars. Two typical screws are shown in the illustration.
- Carefully return the Recorder to a level position, on a flat surface.
- Remove the control switch cover bracket and the control panel cross bar (Figure 5-8). Unplug galvanometer, interlock and marker cables.
- Remove one flat-head Pozidriv screw from upper rear center portion of paper feed tray on Drive Unit (Figure 5-12, lower illustration).
- Carefully lift the Drive Unit up and out of the main chassis (Unit Housing Assembly).

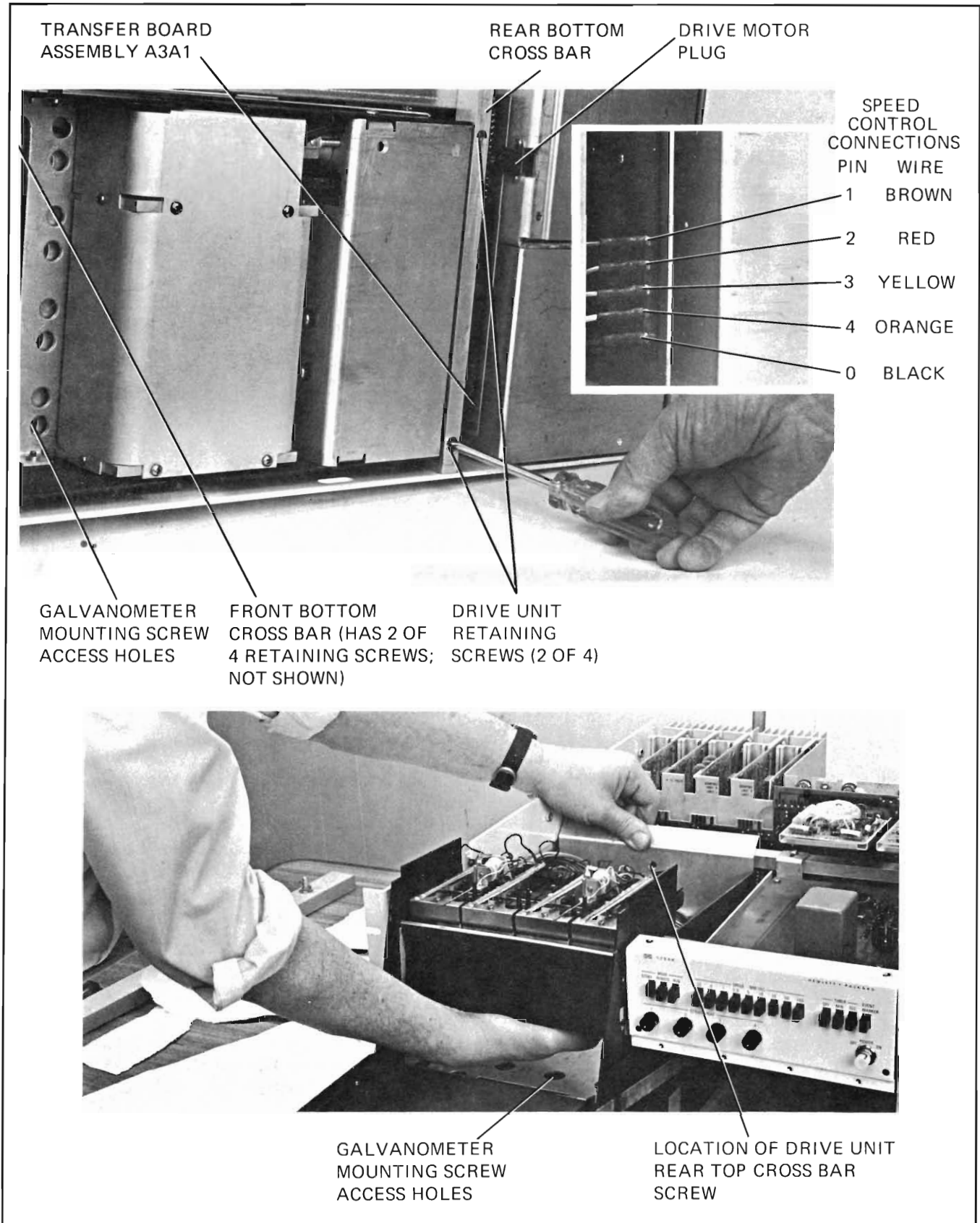


Figure 5-12. Drive Unit Removal

5-45. Reinstallation of the Drive Unit is the reverse of the removal procedure.

5-46. Paper Table Disassembly for Drive Roller Replacement.

5-47. The Drive Unit must be removed from the Recorder if the paper table is to be disassembled, to gain access to the drive roller if it is to be replaced. To disassemble the paper table, proceed as follows:

- a. Pull out the paper table at the bottom and lower it to a horizontal position (Figure 5-13).
- b. Remove two flat head screws that mount paper guide plate through a strip nut (bar of metal with two tapped holes) at back of paper table (Figure 5-13).
- c. Remove paper guide plate.
- d. Remove rod retainer exposed at upper right corner of table, slide pivot rod to left to disengage pivot arm.
- e. Spring one of center table link pivots outward gently to disengage table from pivot rod.
- f. Loosen 4 gearbox retaining screws to slacken drive chain on table sprocket.
- g. Using small, flat-blade screwdriver, pry off snap ring holding sprocket to drive roller shaft (Figure 5-14). *Pry only at center of C-shaped ring*, as shown, using keyway for access to ring.
- h. Remove sprocket gear and key from shaft.
- i. Remove screw at bottom right edge of drive unit (Figure 5-15).
- j. Spring drive unit side plate outward *with finger pressure only*, and pull table link and drive roller out as shown in Figure 5-15 (1, 2).
- k. Remove bearing at each end of drive roller (3).
- l. Remove right side of drive roller by springing table link outward (4) and pulling drive roller up and to right (5).
- m. Reverse disassembly procedures to reassemble paper table.

NOTE: Paper interlock switch and wires may not be present in some units.

5-48. Gearbox Removal and Overhaul.

5-49. The gearbox may be removed for service without removing the drive unit from the main recorder chassis (unit housing assembly). To remove the gearbox, perform the following steps:

- a. Remove all preamplifiers from preamplifier rack.
- b. Remove speed control wires and motor cable from transfer board assembly (Figure 5-18 inset).
- c. Remove four screws shown in Figure 5-16, as follows:
 - (1) Remove Screw A, located on the Drive Unit inside the preamplifier rack.
 - (2) Tip the Recorder up at the preamplifier side. Under the preamplifier rack, toward the rear, locate and remove Screw B from the Drive Unit.
 - (3) Remove Screw C through the Recorder side plate.
 - (4) Remove Screw D through the Recorder side plate.
- d. The gearbox will drop away from the Drive Unit. If necessary, press in on the hex nut shown in Figure 5-16 to clear side plate.
- e. Elevate the front of the Recorder with a wooden block about 3.5 inches (7 or 8 cm) high. Lift the output chain away from the output sprocket as shown in Figure 5-17. NOTE: The gearbox should be lubricated whenever the recorder is overhauled, in addition to the normal lubrication at 12 months or 2000 hours of operation at varying speeds. Under continued low speed operation, the gearbox should be lubricated every 6 months or 1000 hours. Whenever an extended period of recording is anticipated, that is, for 30, 60 or 90 days continuous duty, a lubrication and inspection before the recording period will help to assure uninterrupted service. For a list of the recommended lubricants, see Table 5-2.

5-50. GEARBOX INSPECTION. With the gearbox separated from the Drive Unit, set it up for test running. This test run is the same as the run-in performed after lubrication. Connect the motor cable and speed control cable to the Transfer Board Assembly with extender cables as shown in Figure 5-18. Remove the inspection plate to expose the gear train. Inspect for brass particles from the gears. If any are found, move the gears by hand and inspect the gear teeth for excessive wear or damage. Run the gearbox in all chart speeds (selected from the recorder control panel), and

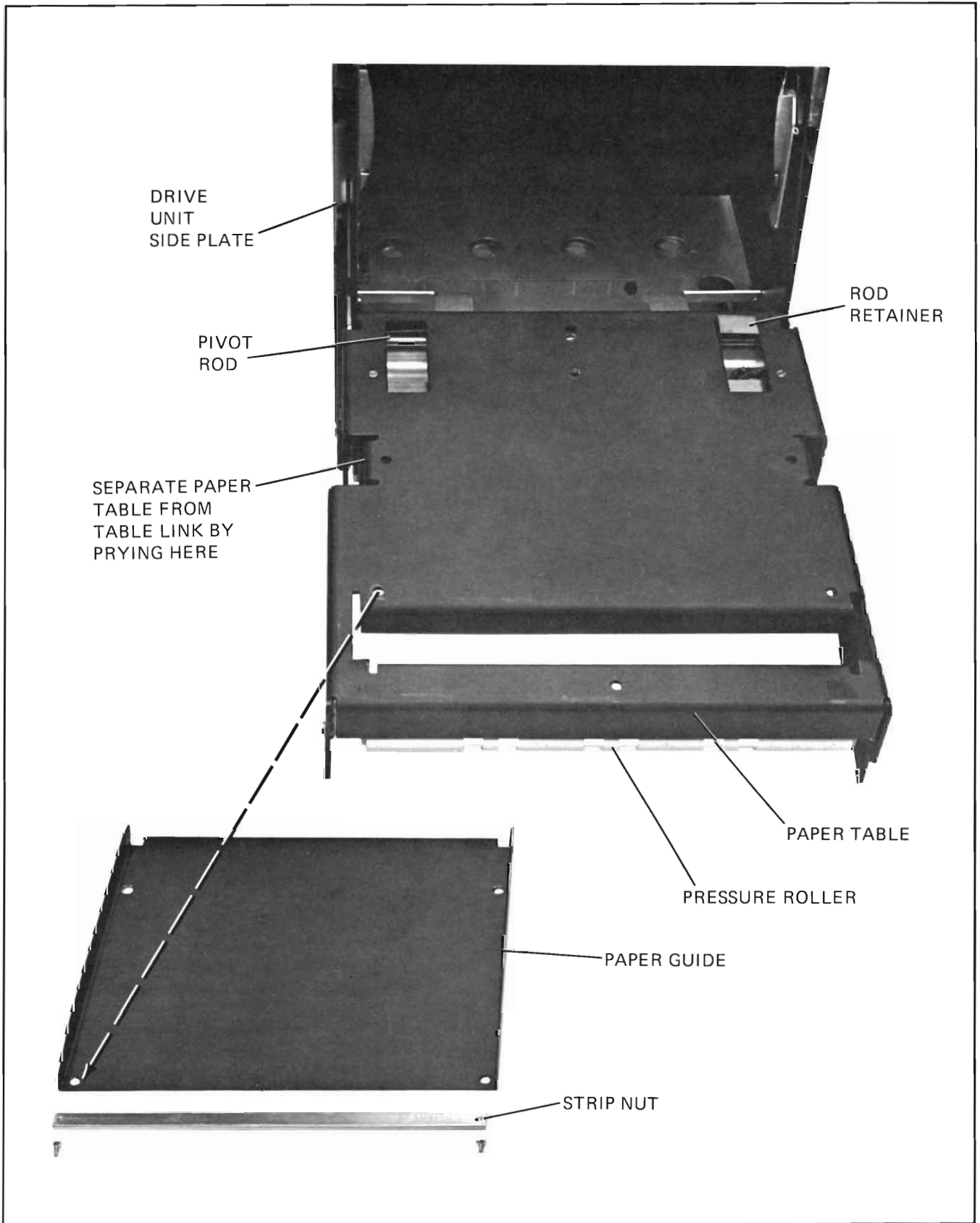


Figure 5-13. Paper Table Removal

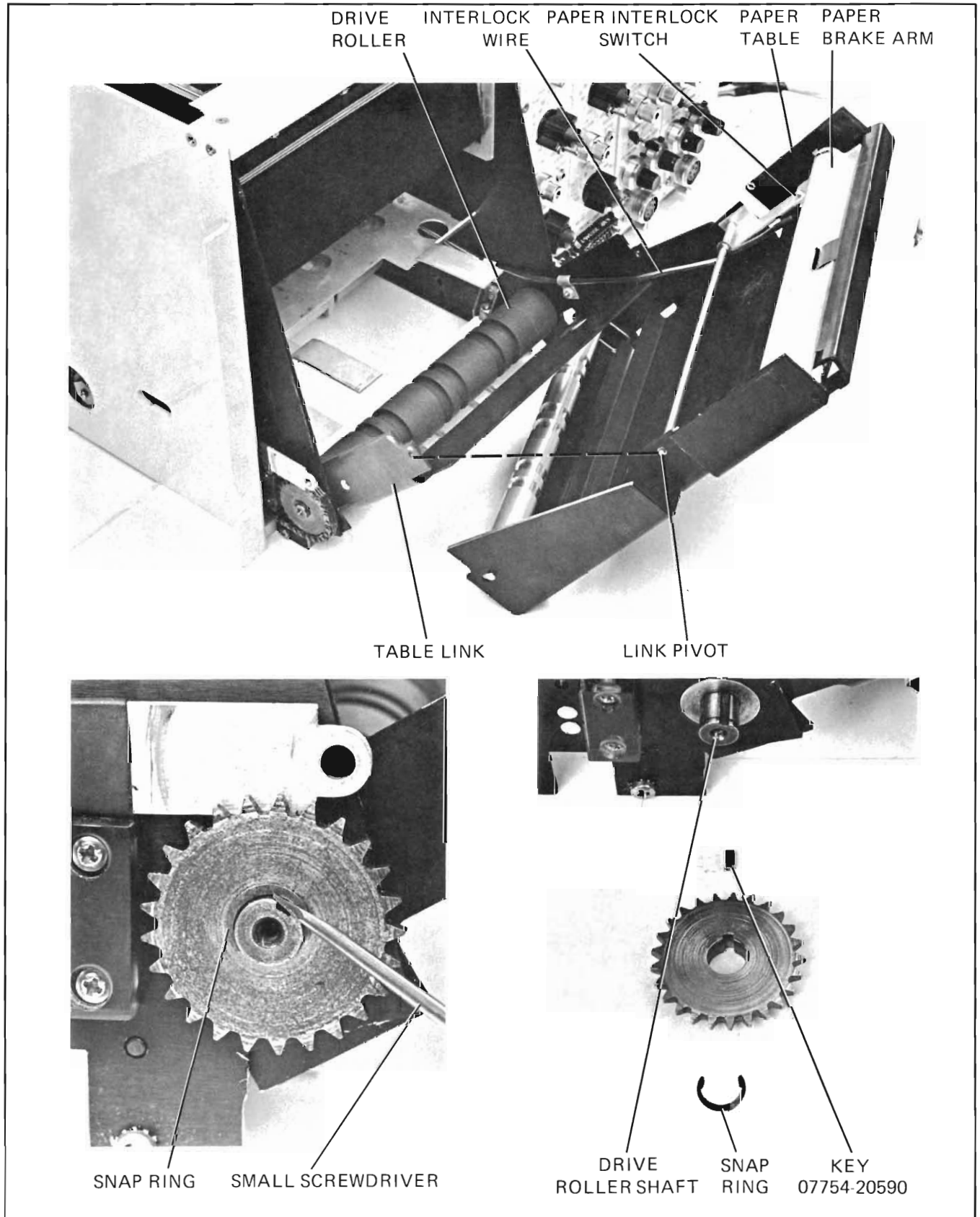


Figure 5-14. Drive Roller and Table Link Removal (Part 1)

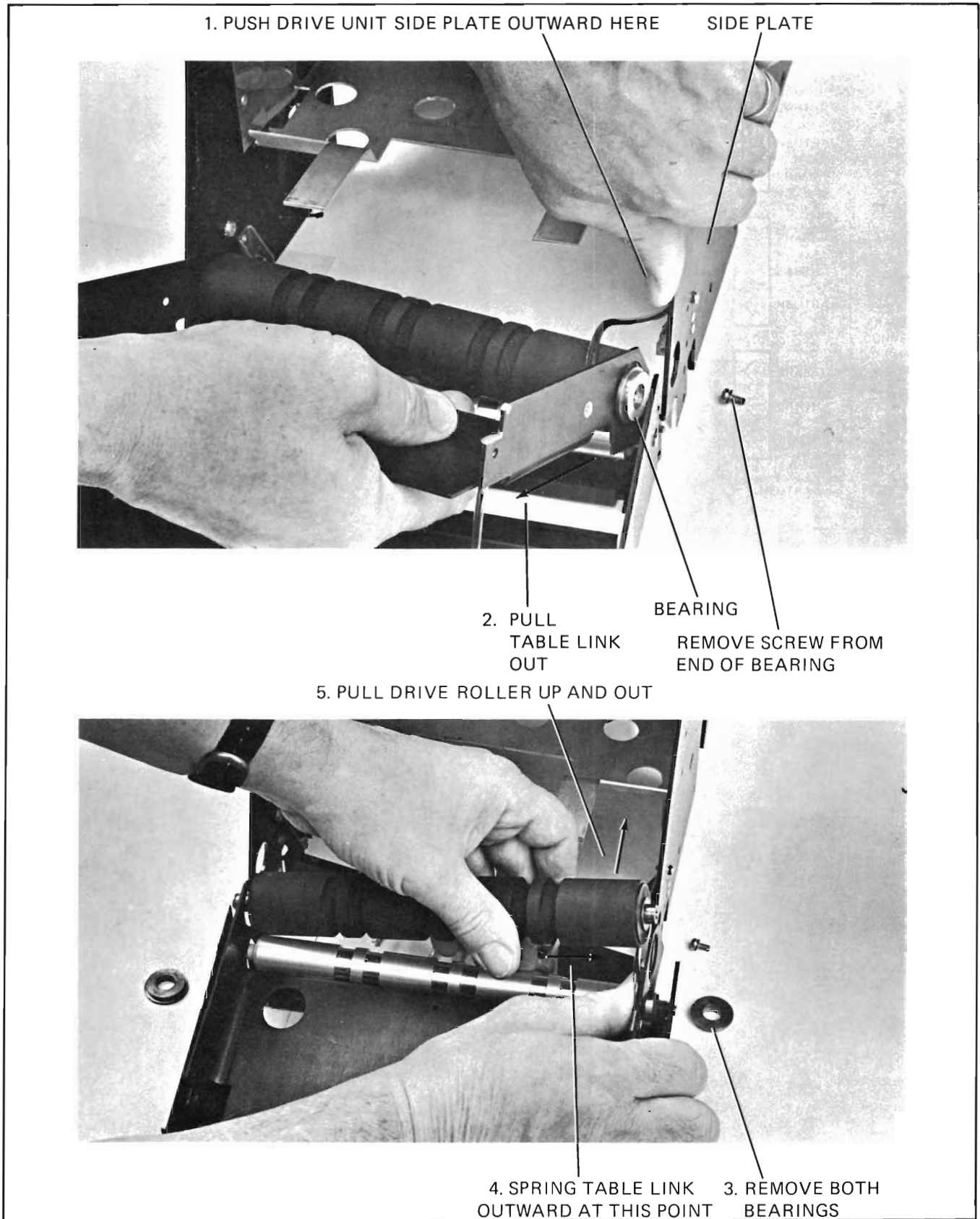
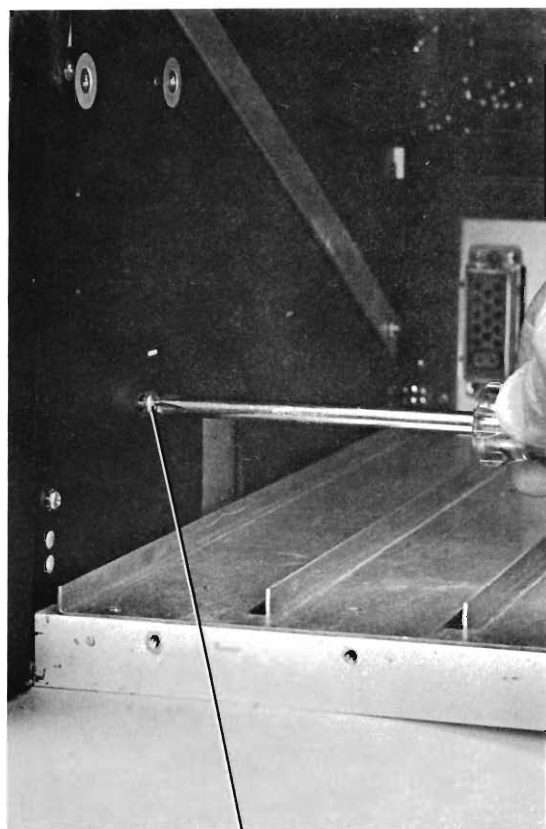
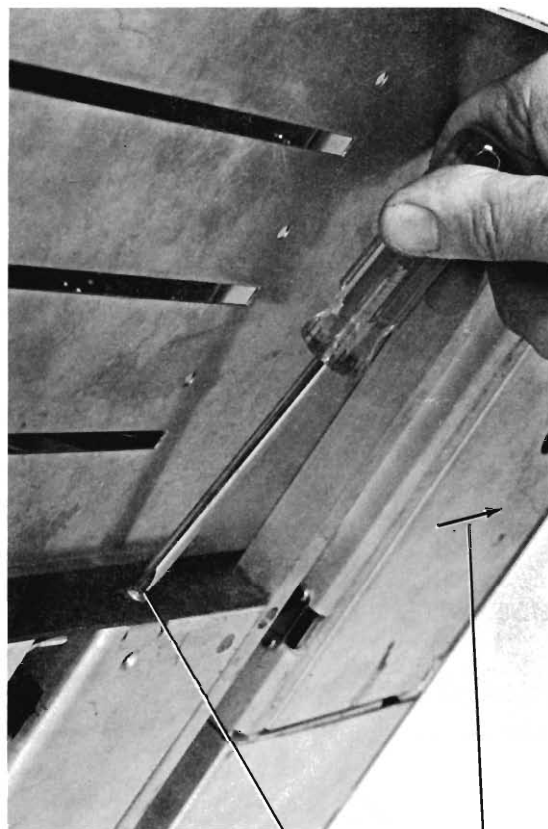


Figure 5-15. Drive Roller and Table Link Removal (Part 2)

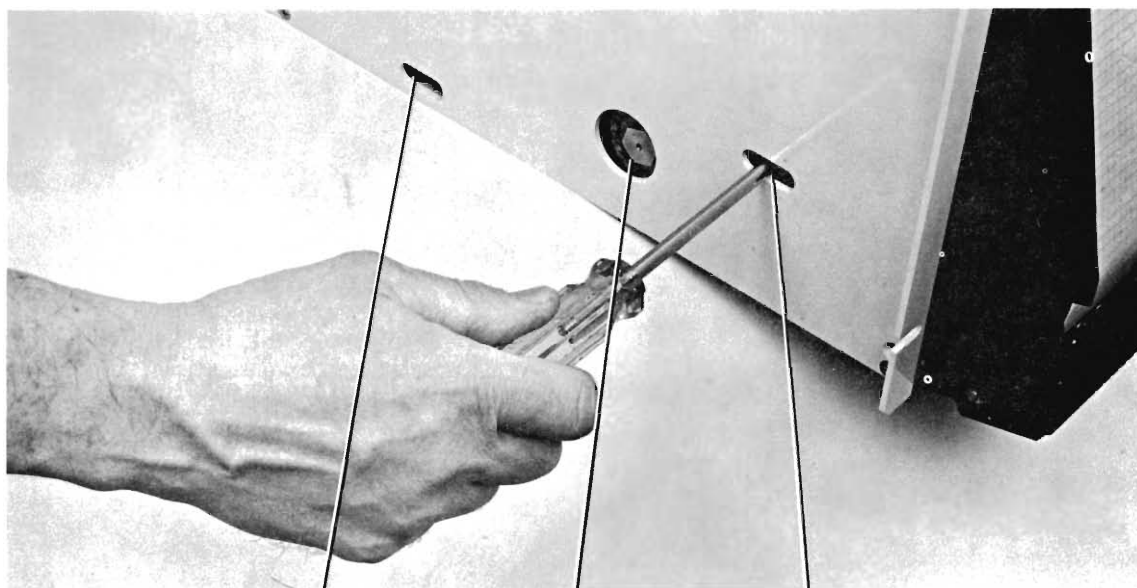


SCREW A



SCREW B

REAR



SCREW C

SPROCKET HEX NUT

SCREW D

Figure 5-16. Gearbox Removal

SPEED CONTROL CABLE CONNECTION

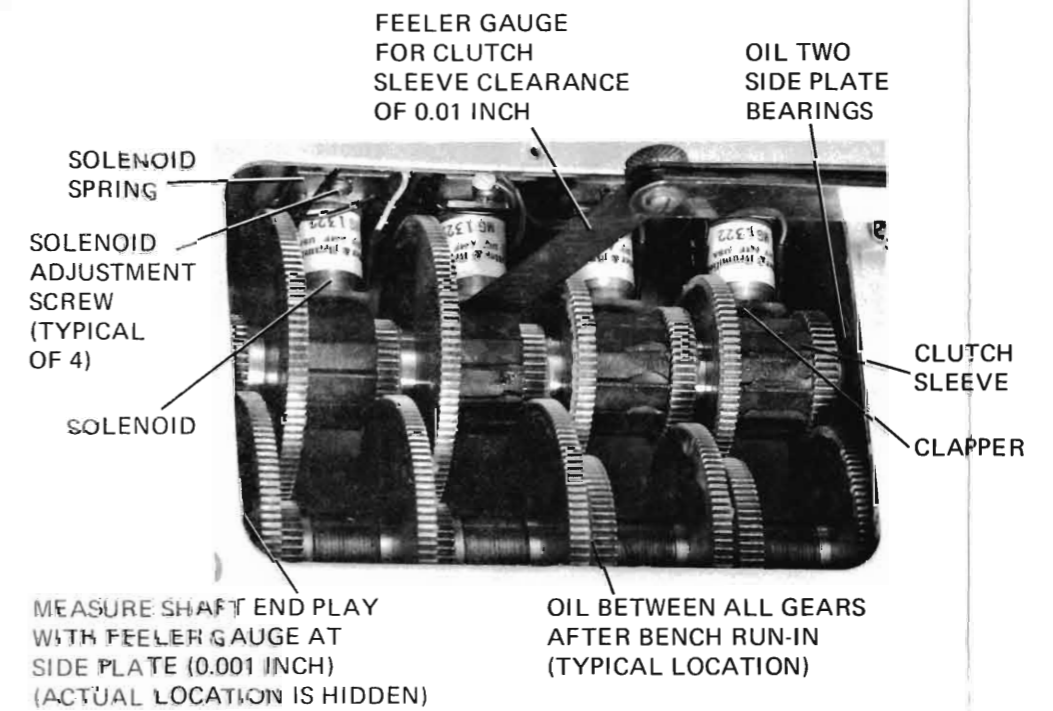
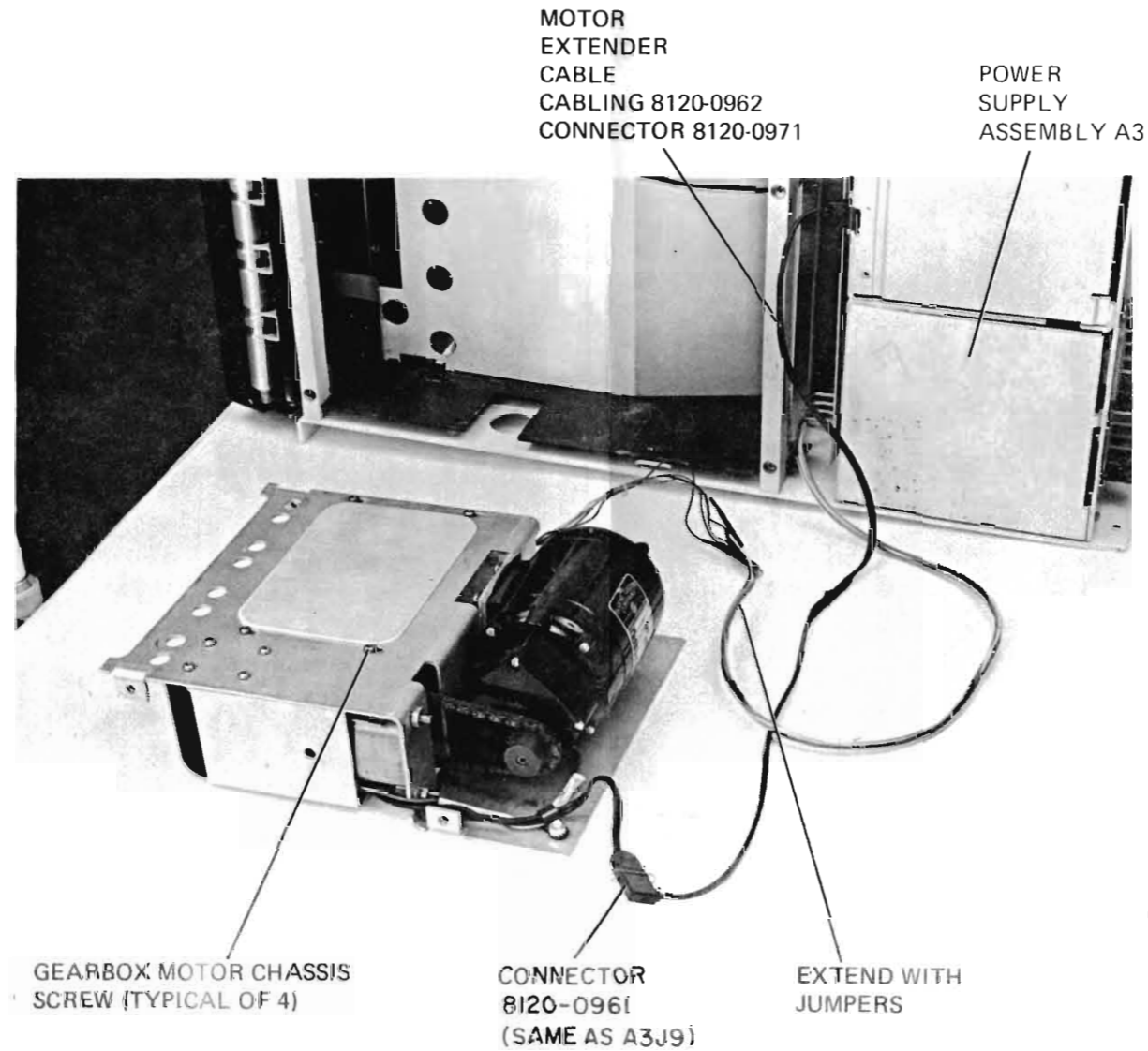
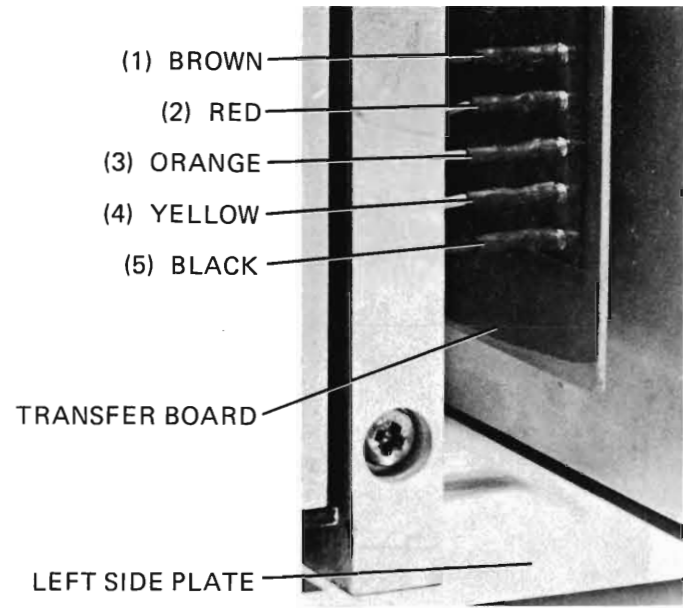
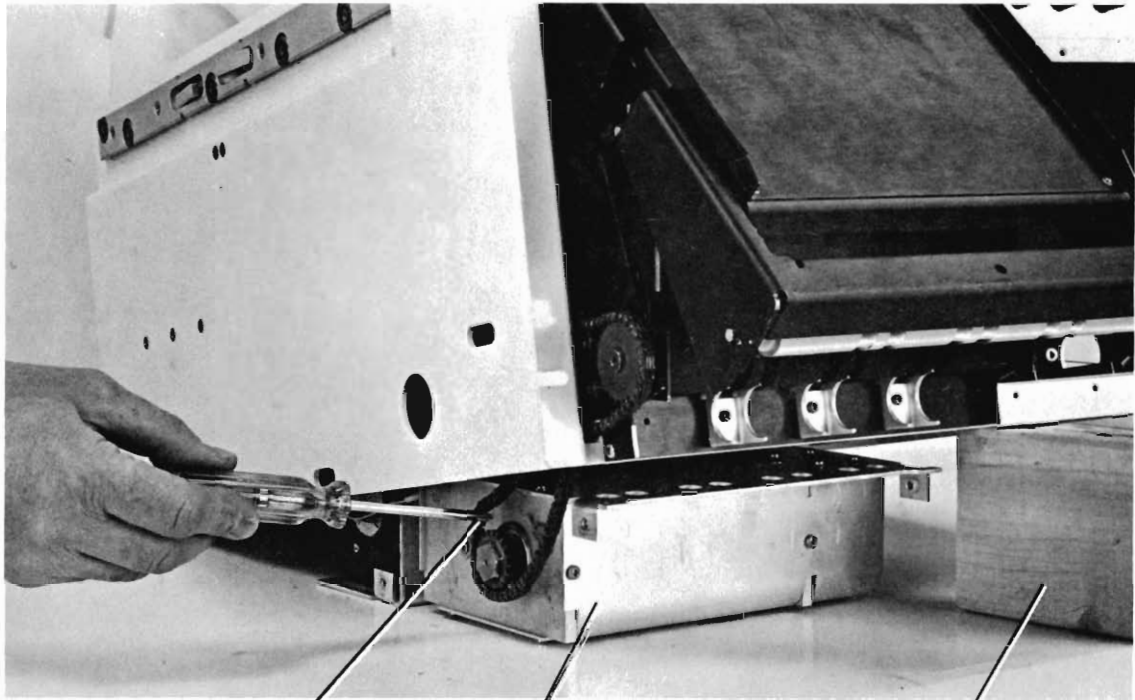


Figure 5-18. Gearbox Inspection and Solenoid Adjustment



LIFT CHAIN TO
REMOVE

GEARBOX A10A1

WOOD BLOCK (SEE TEXT)

Figure 5-17. Drive Chain Removal

listen for chattering of clutch springs, which indicates either a need for lubrication or replacement of the clutch spring or replacement of a gear if the gear hub is worn. Parts that are obviously faulty, such as a twisted spring jamming the gearbox, should be replaced during overhaul.

5-51. **GEARBOX DISASSEMBLY.** Use the following procedure to disassemble the gearbox, and to inspect for clutch wear.

- a. Remove four screws holding the motor chassis and drive motor (Figure 5-18).
- b. Tip the chassis, toward the drive motor as shown in Figure 5-19, removing the chain, cover, and motor as a unit.
- c. Turn the gearbox upside down and remove eight screws holding the bottom cover and solenoids.
- d. Remove the bottom cover by lifting it upward (Figure 5-19).

NOTE: If gears are to be replaced or components lubricated, remove only one shaft at a time to preserve the order of the gears on the shaft for best wear characteristics.

- e. Remove one screw holding the primary shaft to the end plate, and pull out the shaft by the large output gear (Figure 5-20). Lift the entire primary gear train out as one unit. Note the orientation and position of each component.
- f. Remove the parts from the gear train one at a time, and clean each part by brushing it with Chlorothene solvent. Wipe plastic clutch sleeves with Chlorothene-dampened cloth.

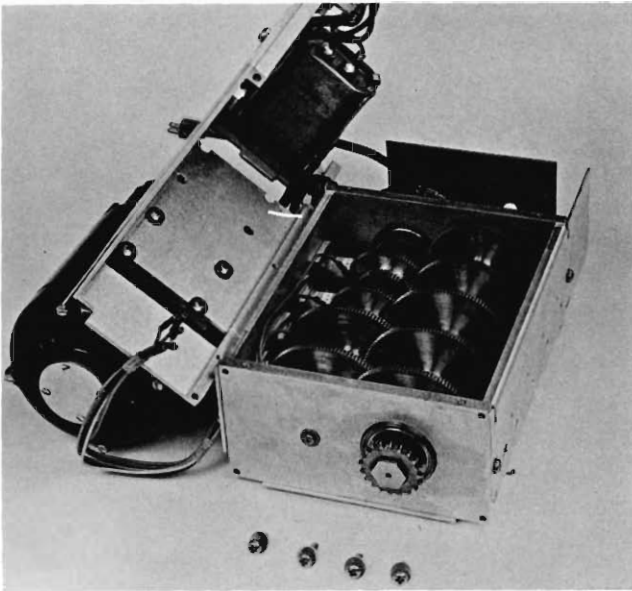
CAUTION

ALWAYS BRUSH NON-PLASTIC PARTS; NEVER IMMERSE THEM IN SOLVENT. DO NOT WASH PLASTIC CLUTCH SLEEVES WITH SOLVENT.

- g. Inspect each part for damage and wear before lubrication. To check for hub wear, drag a fingernail across hub surface and check for grooves.

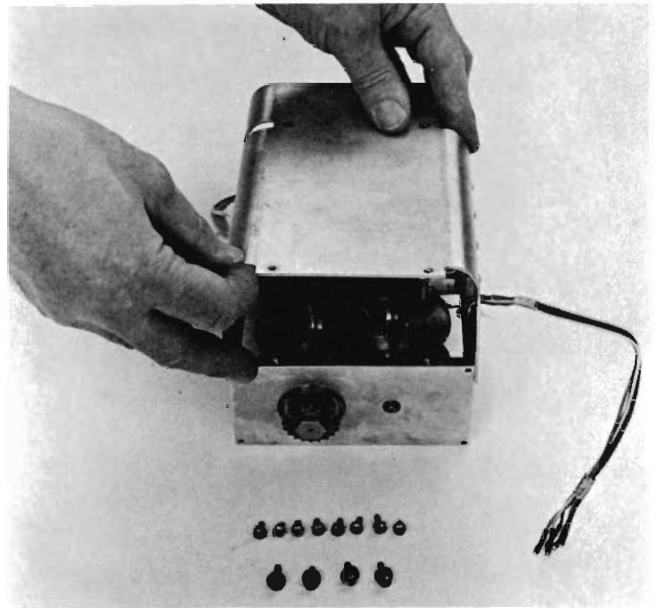
1.

CHASSIS



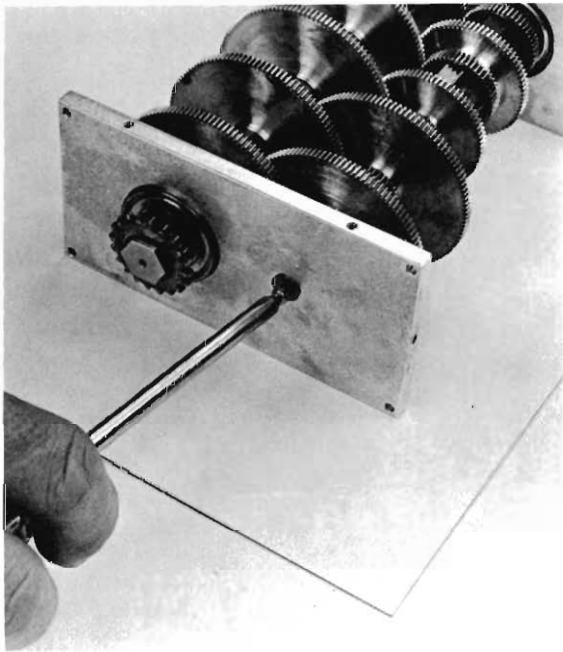
REMOVING MOTOR CHASSIS

2.

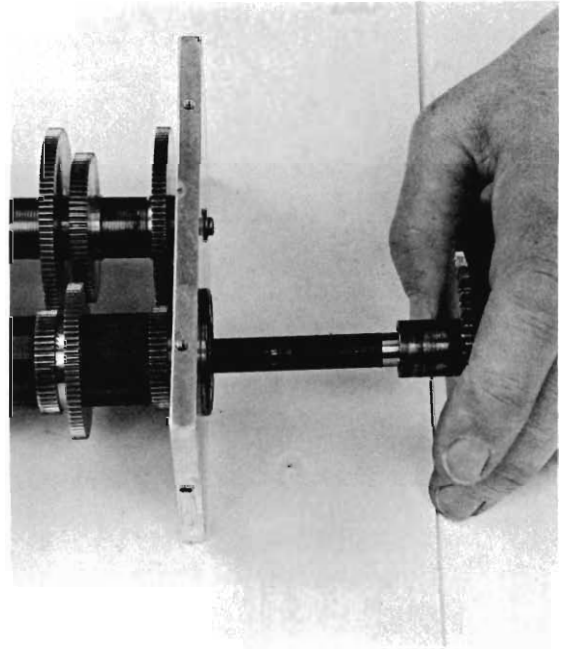


REMOVING GEARBOX COVER

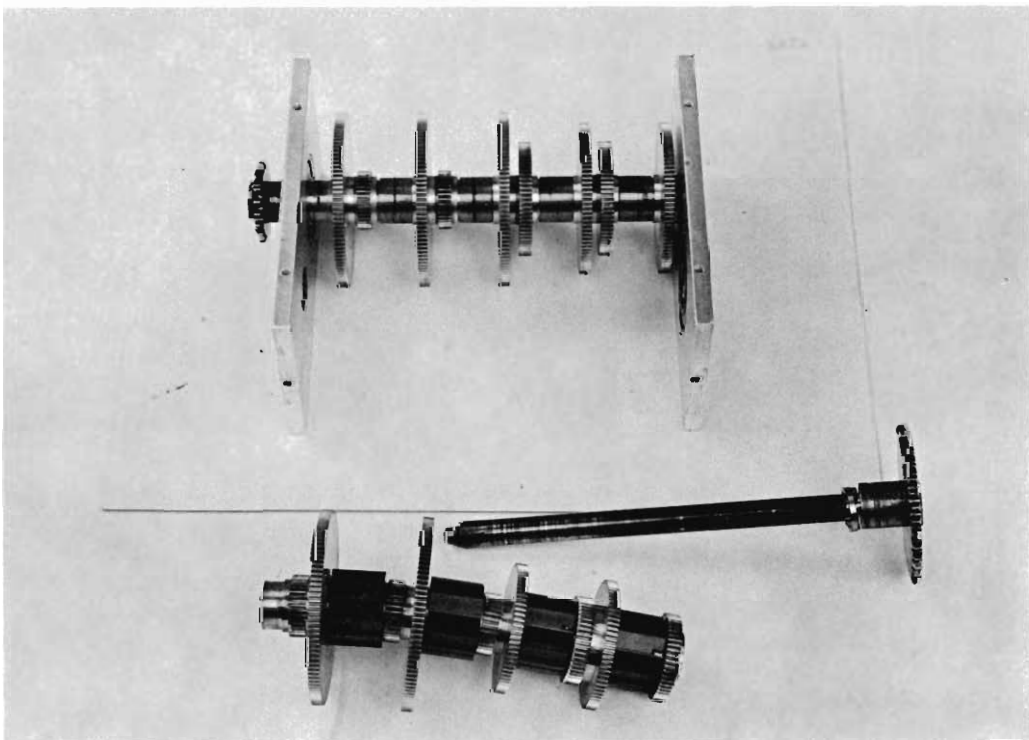
Figure 5-19. Gearbox Cover Removal



1.



2.



3.

Figure 5-20. Gearbox Shaft Removal

h. Arrange each part in order on a wooden dowel for proper position during reassembly on the shaft during lubrication.

5-52. GEARBOX LUBRICATION. After all gears are arranged on the dowel, lubricate as follows:

a. Oil each gear bearing with Mystery Oil (Table 5-2) to soften gum residues.

b. Grease each primary clutch and gear assembly as shown in Figure 5-21, using the following steps to grease each assembly:

(1) Work grease into coils of each spring, and install on one half of clutch hub. Note that spring key must be in proper position (Figure 5-21).

(2) Slip plastic clutch sleeve (with ratchet teeth) over spring; mate sleeve cutout to spring key, and pack more grease into end of sleeve.

(3) Coat mating gear hub with grease and twist hub into assembled clutch and spring. As a test of clutch wear, clutch hub should “grab” spring when twisted in one direction, and slip when twisted in other. If clutch slips in both directions, replace hub and attached gear, or worn spring.

c. When all gears are reassembled onto shaft, slip shaft out as shown in Figure 5-20, leaving gear train as one unit. Oil shaft lightly with No. 10 oil (Table 5-2), and remove excess oil. Reassemble primary shaft between side plates (Figure 5-20), in reverse disassembly procedure, and tighten screw securely. Note that shaft does not rotate. Steel washer on shaft end must be properly positioned.

d. Remove secondary shaft in same way as primary shaft (Paragraph 5-5), clean gears and spring clutches without submerging them in solvent, and arrange them in order (Figure 5-22). Oil with Mystery Oil (Step a).

e. Grease each secondary clutch and gear assembly as shown in Figure 5-22. Inspect each part for damage or wear before greasing, as noted in illustration. Drag a fingernail across hub surface to inspect for wear grooves. Use following steps to grease springs and hubs:

(1) Work grease into the coils of each clutch spring.

(2) Grease each clutch hub.

(3) Twist spring and hub together. Remove excess grease. Test clutch hub by twisting in both directions. Hub should “grab” spring when twisted one way and slip when twisted other way.

When all gears are reassembled onto shaft, slip shaft out, leaving gear train as one unit (Figure 5-20). Oil shaft lightly (do not use grease).

g. Reassemble shaft between side plates and tighten screw securely.

h. Grease gearbox gear teeth with HP 6040-0222 gear grease.

i. Replace bottom cover (eight screws, Figure 5-19).

CAUTION

THIS COVER ACTS AS A SPACER TO KEEP SIDE PLATES A FIXED DISTANCE APART AND PARALLEL, AND THUS SHOULD BE INSTALLED BEFORE ADJUSTING SHAFT END PLAY.

5-53. GEARBOX SHAFT END PLAY ADJUSTMENT. The end play of the primary shaft and the secondary shaft may be adjusted with the gearbox top cover and drive motor removed. Perform the following steps for each shaft:

CAUTION

END PLAY MUST BE NO MORE THAN 0.007 INCH (0,2 mm), OTHERWISE CLUTCH SPRINGS WILL WIND DOWN BETWEEN CLUTCH HUBS AND DISABLE GEARBOX.

a. Tighten sprocket hex nut snug; back off using feeler gage to obtain 0.007 inch end play. Push all gears to one side and measure at side plate (Figure 5-18).

b. While holding hex nut so it cannot move, use a 4-40 Bristol spline wrench to tighten locking setscrew in center of hex nut (Figure 5-23). An Allen wrench will not fit.

5-54. GEARBOX REASSEMBLY. Reassemble the gearbox and adjust the tension of the input chain (transfers torque from the drive motor to the gearbox) as follows:

a. Place input chain on motor sprocket, and install gearbox top cover and motor with four screws (Figures 5-18, 5-19), leaving them loose in oval mounting holes.

b. Suspend gearbox by drive motor as in Figure 5-24. Weight of gearbox sets chain tension. Tighten screws with gearbox hanging by motor, being sure motor and gearbox are aligned.

c. To test chain alignment, sight along chain and inspect for misalignment of motor sprocket with gearbox sprocket. If necessary to straighten chain, readjust motor shaft sprocket toward or away from motor.

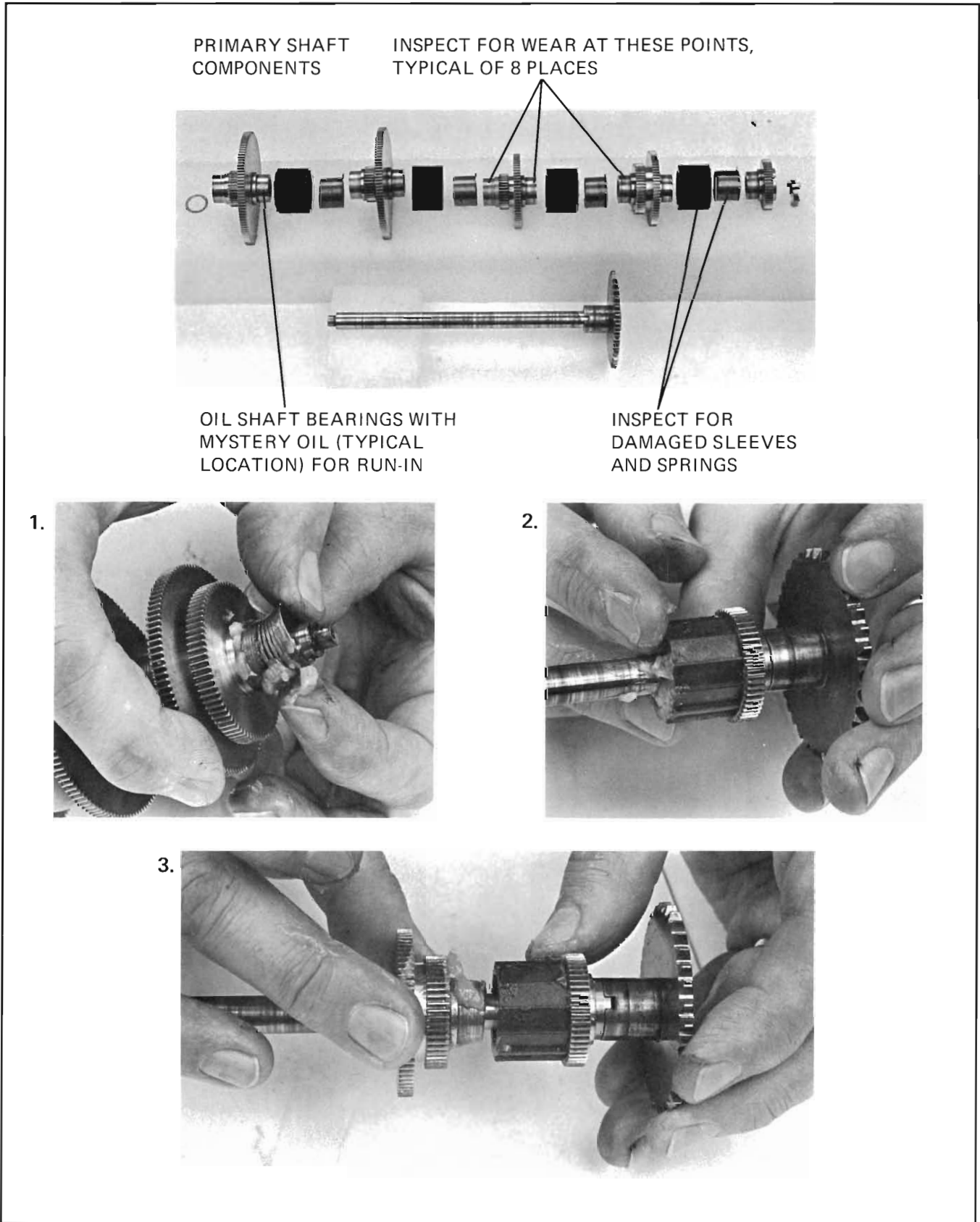
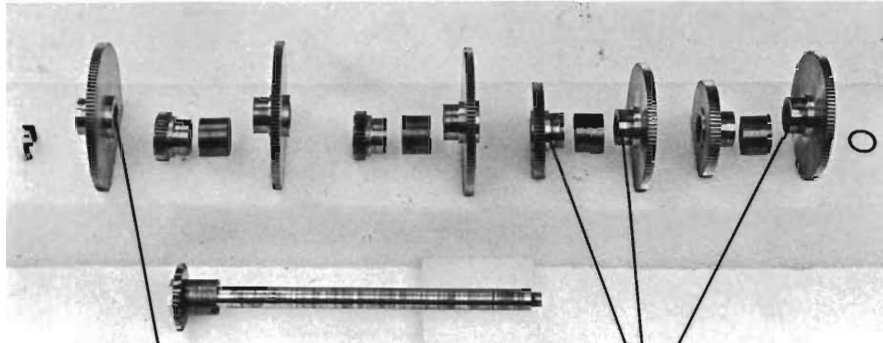


Figure 5-21. Spring Clutch Lubrication (Primary Shaft)

SECONDARY SHAFT COMPONENTS



OIL SINTERED
BEARINGS WITH
MYSTERY OIL

INSPECT FOR WEAR AT THESE POINTS,
TYPICAL OF 8 PLACES

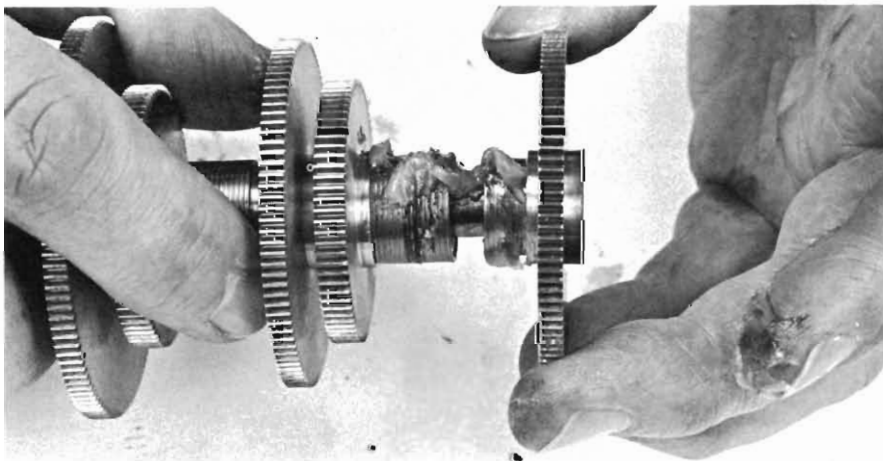
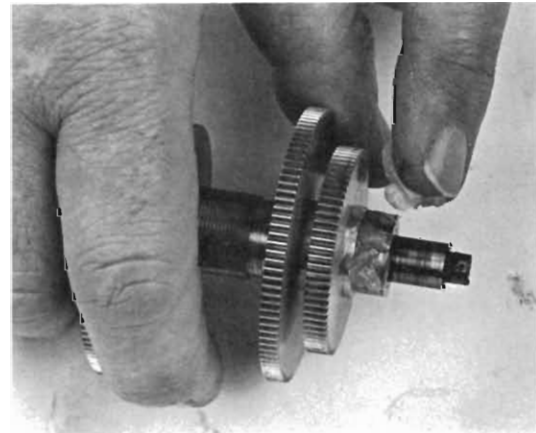
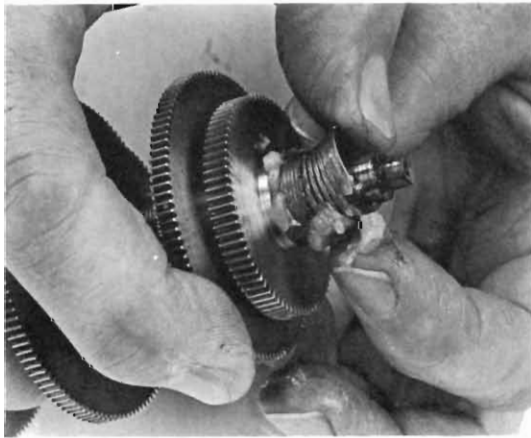


Figure 5-22. Overriding Clutch Lubrication (Secondary Shaft)

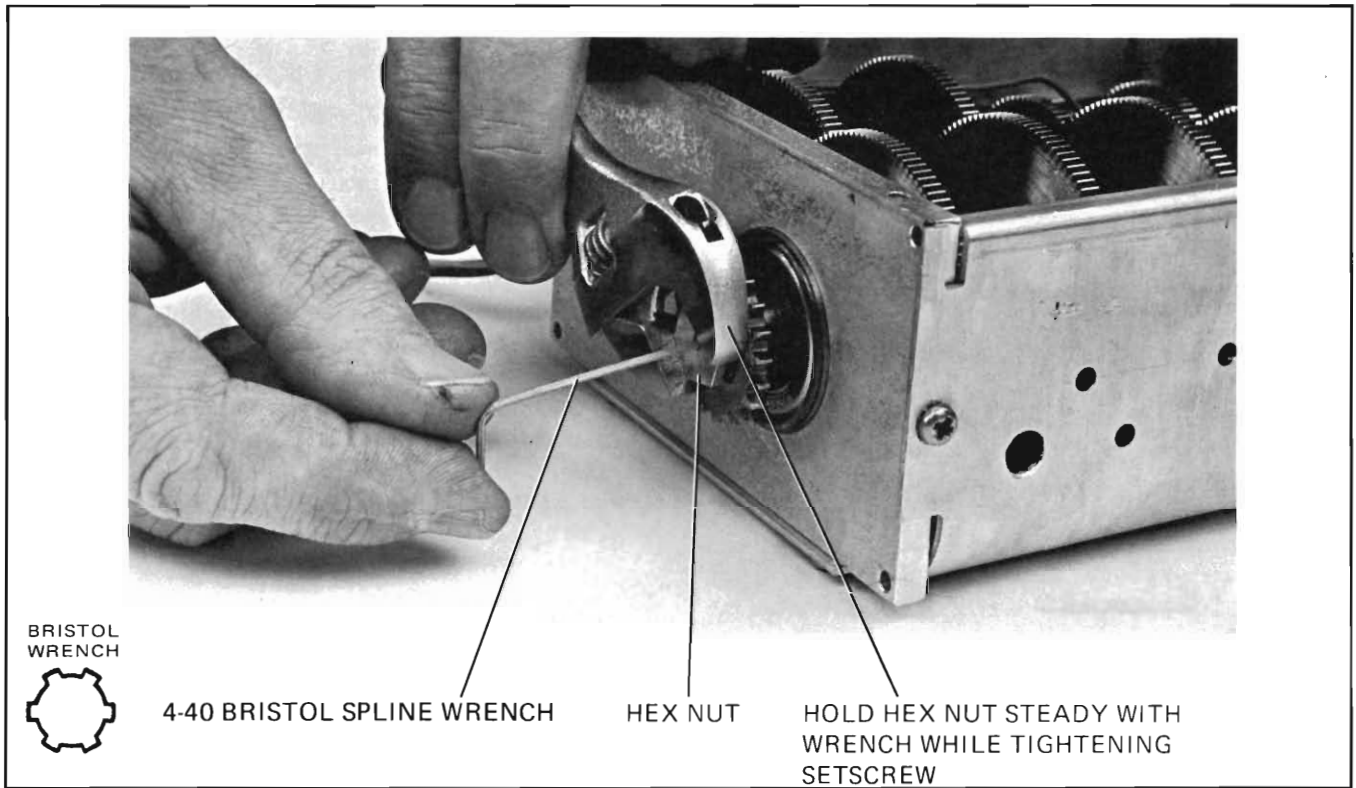


Figure 5-23. Gearbox Shaft End Play Adjustment

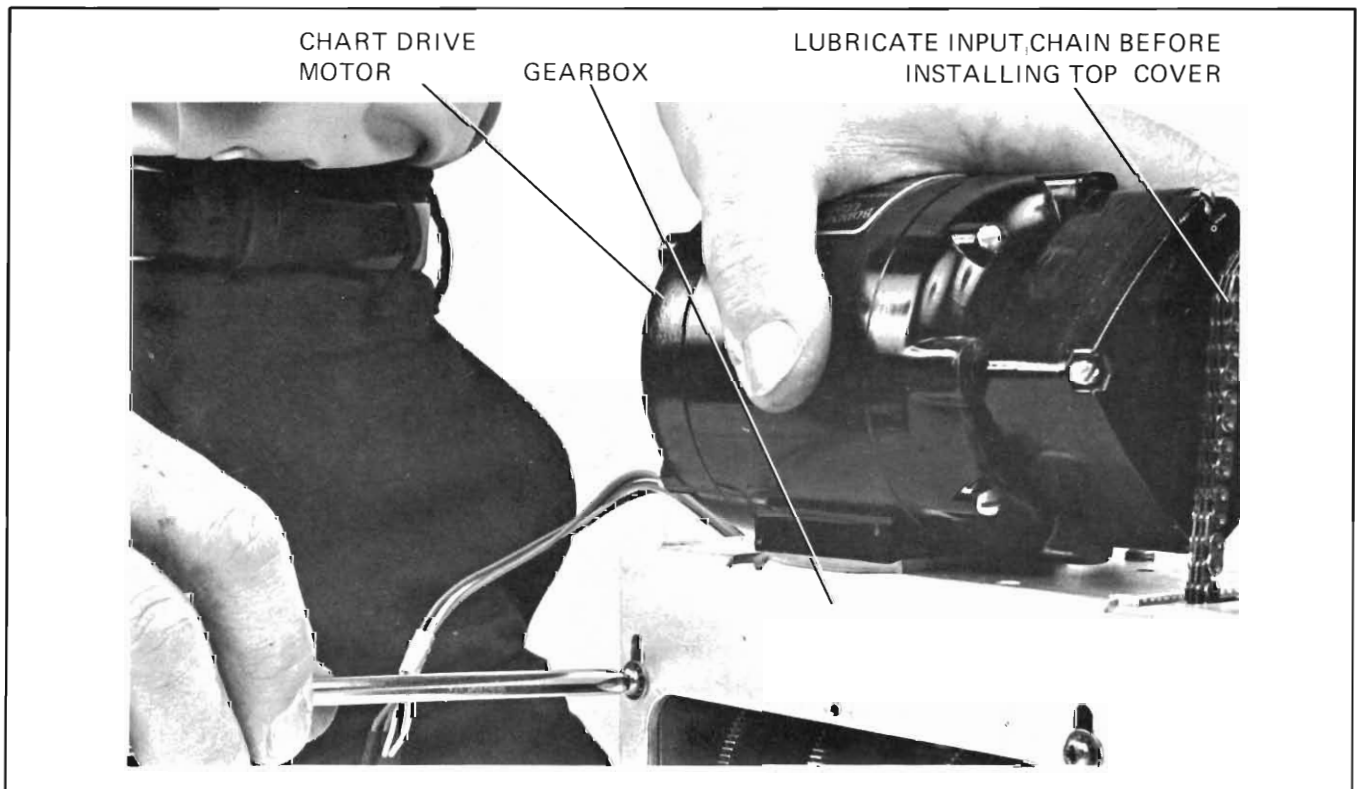


Figure 5-24. Gearbox Input Chain Tension Adjustment

5-55. Solenoid Adjustment.

5-56. Adjust the solenoids (Figure 5-18) using the adjustment screw shown, and check *while energized* with a 0.01 feeler gage between the solenoid clapper and clutch sleeve.

5-57. GEARBOX BENCH RUN-IN. After lubricating the gearbox components, connect the gearbox to a recorder as shown in Figure 5-18. With the inspection plate removed, run the gearbox at lowest speed (selected at the recorder control panel). Excess Mystery Oil, applied in the procedure in Paragraph 5-52 will run out from between the gears, carrying with it dissolved gum and grease residue. Stop the drive motor and wipe away this residue frequently. After 15 minutes of running, run through a complete set of gear changes at the front panel of the recorder while inspecting the action of the gearbox through the inspection hole. All clutches should operate properly and the gears should rotate smoothly. Stop the drive motor and place three or four drops of No. 10 oil (Table 5-2) between the gears to lubricate the gear bearings (typical points are indicated in Figure 5-18). Run the gearbox at its lowest speed for several minutes to ensure that the oil will seep down into the gear bearings and be stored for future lubrication. Then run through the gear changes again to see that all relays are operating properly, retracting the actuators fully, and not hanging up on the clutch sleeves.

5-58. Marker Assembly Maintenance.

5-59. The marker assemblies are attached to adjacent galvanometers. To adjust the stylus position, first set the writing stylus bumpers (Table 5-3) and then loosen the attachment screw (Figure 5-25). Position the marker stylus so that it does not hit either bumper during its excursion, and tighten the attachment screw. Unfasten this screw to remove the stylus, and also remove the heat lead and its attachment screw. To increase stylus pressure, move stylus toward paper by loosening the screw in the slotted hole just above mounting screw for stylus. To remove the marker coil, unfasten the marker leads (Figure 5-1) from the Transfer Board Assembly, and unfasten the two marker mounting screws shown in Figure 5-25. Two stylus heat leads also must be disconnected in the marker frame area.

5-60. If the stylus only, less coil, must be replaced, remove heat leads from standoffs on galvanometer and remove Pozidriv screw from marker mounting bracket (Figure 5-25). Install the new stylus on the mounting bracket with the screw, and reinstall the heat leads. Reset stylus pressure with each new installation, and readjust the marker amplitude moveable stop, if necessary (Figure 5-25).

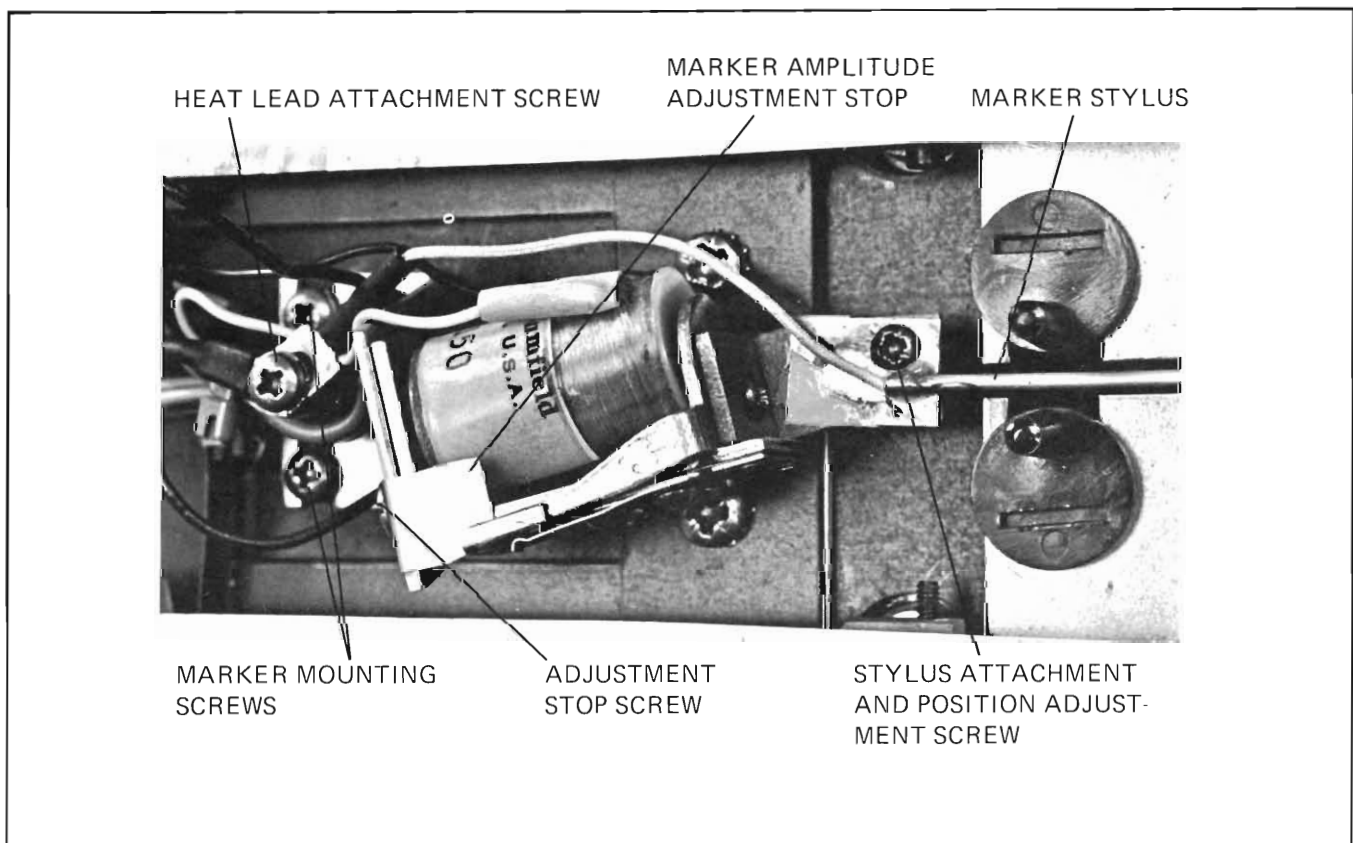


Figure 5-25. Marker Assembly Adjustment and Removal

SECTION VI REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains schematics, figures and information for identifying, locating and ordering replace-ment parts.

6-3. Table 6-1 lists parts in sequential order of the reference designations (circuit references) and provides the following information for each item.

- a. Description of the part (see list of abbreviations on the following page).
- b. Typical manufacturer of the part using a five-digit code. See the code list of manufacturers in Table 6-2.
- c. Manufacturer's part number.
- d. Total quantity used in the instrument (TQ column).

Note: Identification of the attaching parts (screws, nuts, washers, rivets, etc.) used to secure a component in place is entered immediately after the listing of the respective component in Table 6-1.

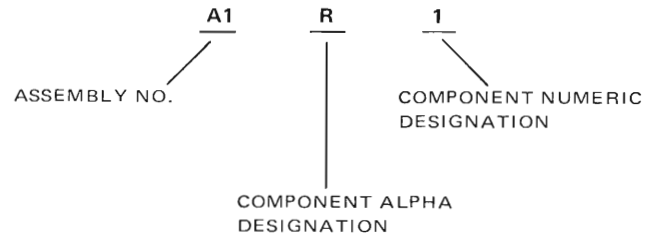
6-4. REFERENCE DESIGNATIONS.

6-5. Table 6-1 uses an alphabetical-numerical (alpha-numeric) method of listing the end item, assemblies, subassemblies and circuit components. These items are defined as follows.

- a. An END ITEM is the instrument with all the supplied accessories. The END ITEM is made up of assemblies to aid in the location of parts.
- b. Each assembly and subassembly is assigned an "A" number (A1, A2, A3, etc). Assemblies and subassemblies that can be purchased have part numbers in the part number column of Table 6-1; those that cannot be purchased have the word "Reference" in the column.
- c. Components within the assembly and subassembly circuits are assigned circuit reference designators (C1 capacitor, R1 resistor, etc.). These parts are prefaced by the assembly number (A1C1, A2C2, A1R1, A2R2, etc.) to indicate the assembly on which the part is located.

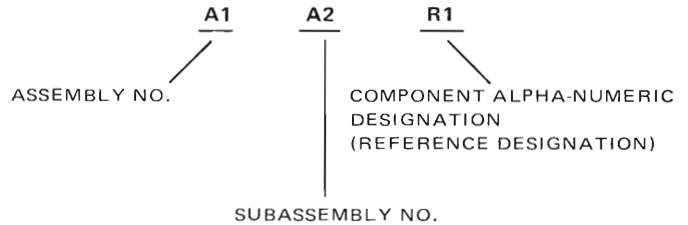
6-6. Examples of the alpha-numeric numbering method used to identify assemblies, subassemblies and circuit components follow:

a.



The complete reference designation is read as the first resistor (R1) of the first assembly (A1).

b.



The complete reference designation is read as the first resistor (R1) of the second subassembly (A2) of the first assembly (A1).

6-7. Partial reference designations are normally used on the equipment and illustrations. The partial reference designation consists of the component alpha designation and numeric designation. The complete reference designations are obtained by placing the proper assembly number (and subassembly number, when applicable) before the partial reference designations.

6-8. In this section, these assembly prefix numbers are usually shown with each reference designation, in the title of the figure or at the bottom of the illustration block following the notation "REF DESIG PREFIX". The complete reference designation should be used to easily locate a part and the description in the Parts List (Table 6-1).

6-9. For example, to determine the value and the part number of resistor R6 in the A2 assembly (A2R6), locate the A2 group listing (the second group) in the parts list. Then refer to the R (resistor) designations in the group and find R6. The value and the part number are in the columns adjacent to the description.

6-10. ORDERING INFORMATION.

6-11. To order a replacement part, address order or inquiry to the local Hewlett-Packard Sales/Service Office (see list of addresses at the rear of this manual) and supply the HP part number of the item from Table 6-1.

6-12. To order a part not listed in the table, provide the following information:

- a. Model number of the instrument.
- b. Complete serial number of the instrument.
- c. Description of the part including function and location.

6-13. To order a part from a manufacturer other than Hewlett-Packard Company provide the complete part description and the manufacturer's part number from Table 6-1.

REFERENCE DESIGNATORS

A = assembly	F = fuse	Q = transistor	U = non repairable assembly
B = motor	FL = filter	R = resistor	V = vacuum tube
BT = battery	HR = heater	RT = thermistor	photocell, etc.
C = capacitor	J = jack	S = switch	W = cable
CP = coupler	K = relay	T = transformer	X = socket
CR = diode	L = inductor	TB = terminal board	XDS = lampholder
DL = delay line	M = meter	TC = thermocouple	XF = fuseholder
D&S = device signaling (lamp)	MP = mechanical part	TP = test point	Y = crystal
E = miscellaneous electronic part	P = plug		Z = network

ABBREVIATIONS *

A = amperes	fil hd = fillister head	n = nano (10^{-9})	rot = rotary
ACC = accessories	flm = film	NC = normally closed	s-b = slow-blow
AFC = automatic frequency control	FR = front	Ne = neon	scon = semiconductor
Al = aluminum	 fwd = forward	NETWRK = network	Se = selenium
AMP = amplifier	fxd = fixed	Ni Pl = nickel plate	sect = section(s)
as ord = as ordered	G c/s = gigacycles per second (see G Hz)	NO = normally open	SEMS = machine screw with washer
Be Cu = beryllium copper	Ge = germanium	NPN = negative positive negative	SEQ = sequential
BFO = beat frequency oscillator	GEN = generator	NPO = negative positive zero (zero temperature coefficient)	Si = silicon
bh = binder head	G Hz = gigacycles per second	nsr = not separately replaceable	sil = silver
bp = bandpass	gl = glass	obd = order by description	sl = slide
brs = brass	grd = ground(ed)	od = outside diameter	SPDT = single-pole double-throw
c/s = cycles/second (see Hz)	h = henry(ies)	ov hd = oval head	spl = special
CALIB = calibration	hex = hexagonal	ox = oxide	SPST = single-pole single-throw
ccw = counterclockwise	Hg = mercury	pc = printed circuit board	sst = stainless steel
cd pl = cadmium plate	Hz = cycle per second	PEMS = circular press fitted nut	SWTCH = switch
cer = ceramic	imp = impregnated	pF = picofarad (10^{-12} farads)	Ta = tantalum
ch = channel	incd = incandescent	PH = phone	td = time delay
cmo = cabinet mount only	ins = insulation(ed)	ph brz = phosphor bronze	Ti = titanium
coef = coefficient	ips = inches per second	Phl hd = Phillips head	tog = toggle
com = common	k, K = kilo (1000)	piv = peak inverse voltage	tol = tolerance
comp = composition	Kc, k c/s = kilocycles (see k Hz)	pk = peak	tol = tolerance
conn = connector	KEPS = hex nut with lockwasher	PNL = panel	trim. = trimmer
CRT = cathode-ray tube	k Hz = kilocycles/second	PNP = positive negative positive	twt = traveling wave tube
cw = clockwise	lin = linear taper	poly = polystyrene	μ or U = micro (10^{-6})
dB = decibel	lkwash = lockwasher	por = porcelain	μA = microamperes
dep C = deposited carbon	log = logarithmic taper	pos = position(s)	μF = microfarads
DISP = display	lp flt = low-pass filter	pot = potentiometer	μV = microvolts
DPDT = double-pole double-throw	m = milli (10^{-3})	pp = peak-to-peak	V = volt(s)
DPST = double-pole single-throw	mA = milliamperes	PREAMP = preamplifier	vac = vacuum
EIA = tubes or transistors meeting Electronic Industries Association standards will normally result in instrument operating within specifications: tubes and transistors selected for best performance will be supplied if ordered by stock numbers	M = megacycles (see M Hz)	prec = precision (temperature coefficient, long term stability, and/or tolerance)	Vacw = volt(s) alternating current working
elect = electrolytic	met flm = metal film	pt = point	var = variable
encap = encapsulated	mfr = manufacturer	rec = recorder	Vdcw = volt(s) direct current working
F = farad(s)	mH = millihenry	rect = rectifier	W = watt(s)
fet = field effect transistor	M Hz = megacycles/second	rev = reverse	w/ = with
fh = flat head	minat = miniature	rf = radio frequency	w/o = without
FIG = figure	mtg = mounting	rh = round head	wiv = reverse working voltage
	mV = millivolt	rmo = rack mount only	ww = wirewound
	mW = milliwatt	rms = root-mean-square	Ω = ohm
	my = mylar (Dupont de Nemours)		

* Electric Accounting Machines (EAM) capitalize all abbreviations

Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	07754-60270	1	UNIT HOUSING(FIG. 6-2)	28480	07754-60270
A2	07754-60240	1	CONTROL PANEL(FIG. 6-3)	28480	07754-60240
A2A1	07754-60120	1	CONTROL SWITCH BOARD(FIG. 6-5)	28480	07754-60120
A2A2	07754-60130	1	HEAT POTENTIOMETER BOARD(FIG. 6-6)	28480	07754-60130
A2A3	07754-60140	1	PREAMPLIFIER POWER SUPPLY(FIG. 6-7)	28480	07754-60140
A3	07754-60050	1	POWER SUPPLY(FIG. 6-9)	28480	07754-60050
A3A1	07754-60150	1	TRANSFER BOARD(FIG. 6-11)	28480	07754-60150
A4	07754-60170	7	DRIVER AMPLIFIER(FIG. 6-13)	28480	07754-60170
A5	07754-60170		DRIVER AMPLIFIER(FIG. 6-13)	28480	07754-60170
A6	07754-60170		DRIVER AMPLIFIER(FIG. 6-13)	28480	07754-60170
A7	07754-60170		DRIVER AMPLIFIER(FIG. 6-13)	28480	07754-60170
A8	07754-60180	1	REGULATOR/OSCILLATOR BOARD:60 HZ (FIG. 6-15)	28480	07754-60180
A9	07754-60181	1	REGULATOR/OSCILLATOR BOARD:50 HZ (OPT 008)	28480	07754-60181
A10	07754-60250	1	DRIVE UNIT(FIG. 6-16)	28480	07754-60250
A10A1	07754-60040	1	GEARBOX(FIG. 6-17)	28480	07754-60040
A11	07754-60070	4	GALVANOMETER(FIG. 6-18)	28480	07754-60070
A11A1	07754-60340	1	STYLUS(FIG. 6-18)	28480	07754-60340
A12	07754-60070		GALVANOMETER(FIG. 6-18)	28480	07754-60070
A13	07754-60070		GALVANOMETER(FIG. 6-18)	28480	07754-60070
A14	07754-60070		GALVANOMETER(FIG. 6-18)	28480	07754-60070
A15	07754-60350	2	MARKER (FIG. 6-19), EVENT	28480	07754-60350
A16	07754-60350		MARKER (FIG. 6-19), TIMED	28480	07754-60350
A17	868-500AC13	1	OSCILLATOR:2400 HZ(OPT 004, FIG. 6-20)	28480	868-500AC13
A18	868-500AC14	1	OSCILLATOR:440 HZ(OPT 005, FIG. 6-21)	28480	868-500AC14
A19	07754-63499		ACCESSORIES (FIG. 6-22)	28480	07754-63499
A20	07754-60350		MARKER (FIG. 6-19), OPTION 015	28480	07754-60350

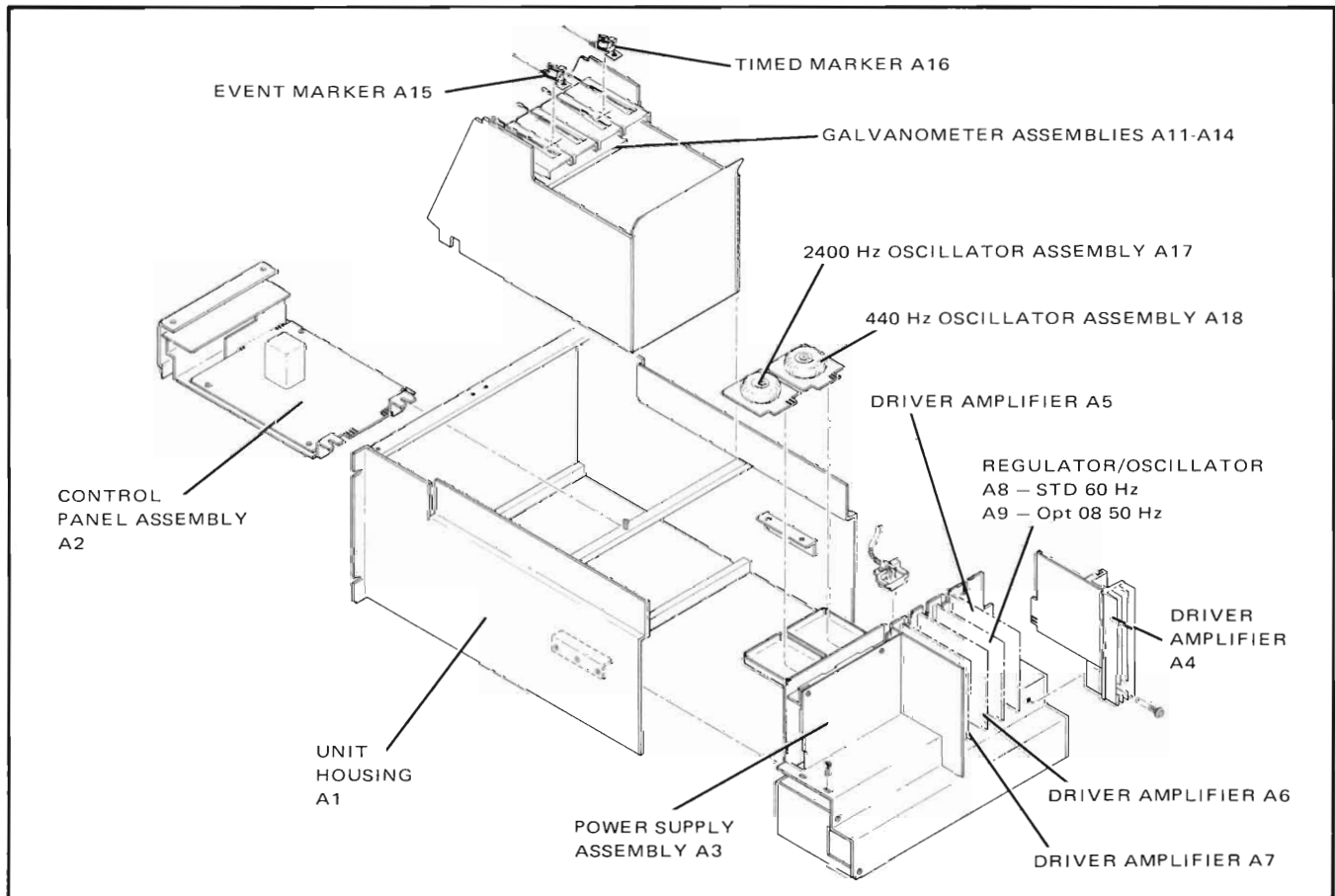


Figure 6-1. Model 7754A Recorder (End Item)

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	07754-60270		UNIT HOUSING(FIG. 6-2)	28480	07754-60270
A1 E1	07754-00411	1	TRIM STRIP	28480	07754-00411
	2360-0182	10	SCREW:FLAT HD POZI DR 6-32 X 0.312" LG	00000	080
A1MP1	07754-00063	1	PANEL:SIDE, LEFT	28480	07754-00063
A1MP2	07754-00064	1	PANEL:SIDE, RIGHT	28480	07754-00064
A1MP3	07754-00070	2	MOUNT:POWER SUPPLY	28480	07754-00070
	2510-0123	17	SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	080
	2580-0006	15	NUT:HEX 8-32 THREAD	78189	KEP511-081800-00
A1MP4	07754-00080	1	GUIDE:AMPLIFIER	28480	07754-00080
	2200-0165	8	SCREW:FLAT HD POZI DR 4-40 X 1/4"	00000	080
A1MP5	07754-20311	1	BAR:CROSS, FRONT	28480	07754-20311
	2510-0123		SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	080
A1MP6	07754-20320	1	BAR:CROSS, TOP	28480	07754-20320
	2510-0123		SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	080
A1MP7	07754-20330	1	BAR:CROSS, REAR	28480	07754-20330
	2510-0123		SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	080
A1MP8	07754-20350	1	BAR:CROSS, CONTROL PANEL	28480	07754-20350
	2360-0182		SCREW:FLAT HD POZI DR 6-32 X 0.312" LG	00000	080
A1MP9	07754-00770	1	BRACKET:CONTROL SWITCH COVER	28480	07754-00770
A2	07754-60240		CONTROL PANEL(FIG. 6-3)	28480	07754-60240
	2360-0185	5	SCREW:FLAT HD POZI DR 6-32 X 0.500" LG	00000	080
	2680-0051	5	SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	080
A2MP1	0370-1005	4	KNOB:JADE GREY	28480	0370-1005
A2MP2	0370-1005		KNOB:JADE GREY	28480	0370-1005
A2MP3	0370-1005		KNOB:JADE GREY	28480	0370-1005
A2MP4	0370-1005		KNOB:JADE GREY	28480	0370-1005
A2MP5	07754-00090	1	BASE:PREAMP BOARD	28480	07754-00090
	2200-0103	6	SCREW:SST PHH POZI DR 4-40 X 1/4"W/LK	00000	080
A2MP6	07754-00101	1	PANEL:CONTROL	28480	07754-00100
	0380-0801	2	SPACER:0.250" OD, 4-40 TAP	00000	080
	2200-0165		SCREW:FLAT HD POZI DR 4-40 X 1/4"	00000	080
A2MP7	0370-2051	16	KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP8	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP9	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP10	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP11	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP12	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP13	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP14	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP15	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP16	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP17	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP18	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP19	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP20	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP21	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2MP22	0370-2051		KNOB:PUSHBUTTON, JADE GRAY	28480	0370-2051
A2A1	07754-60120		CONTROL SWITCH BOARD(FIG. 6-5)	28480	07754-60120
	2200-0103		SCREW:SST PHH POZI DR 4-40 X 1/4"W/LK	00000	080
A2A1C1	0150-0052	18	C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2A1C2	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2A1C3	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2A1C4	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2A1C5	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A2A1C6	0160-3097	1	C: FXD CER 0.47 UF +80% -20%	56289	5C54C2-CM1
A2A1C7	1901-0033	22	DIODE:SILICON 100MA 180V	07263	FD3369
A2A1C8	1901-0033		DIODE:SILICON 100MA 180V	07263	FD3369
A2A1C9	1901-0033		DIODE:SILICON 100MA 180V	07263	FD3369
A2A1J26	1251-2034	1	CONNECTOR:PC EDGE (2 X 10) 20 CONTACT	71785	252-10-30-300
	2340-0001	22	NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	080
	2200-0111	4	SCREW:PAN HD POZI DR 4-40 X 0.500" LG	00000	080
A2A1MP1	516-5	2	BRACKET:RIGHT ANGLE	28480	516-5
	0361-0350	4	RIVET:SEMITUBULAR OVAL HEAD	00000	080
A2A1R1	0683-2705	6	R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R3	0683-4715	5	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A2A1R4	0683-2715	1	R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A2A1R5	0683-1015	17	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2A1R6	0683-2705		R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R7	0683-2705		R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R8	0683-2705		R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R9	0683-2705		R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R10	0683-2705		R:FXD COMP 27 OHM 5% 1/4W	01121	CB 2705
A2A1R11	0683-1005	1	R: FXD COMP 10 OHM 5% 1/4W	01121	CB-1005
A2A1S2	3101-1289	1	SWITCH:PUSHBUTTON	28480	3101-1289
A2A1U1	07754-00120	1	BOARD:BLANK PC	28480	07754-00120
A2A2	07754-60130	1	HEAT POTENTIOMETER BOARD(FIG. 6-6)	28480	07754-60130

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A2J25	1251-0498 2340-0001 2200-0111	1	CONNECTOR:PC EDGE 1 X 22 CONTACT NUT:HEX 4-40 X 0.188" ACROSS FLAT	71785 00000 00000	252-22-30-350 080 080
A2A2R1	2100-3062	4	SCREW:PAN HD POZI DR 4-40 X 0.500" LG	28480	2100-3062
A2A2R2	2100-3062		R:VAR COMP 500 OHM 10% LIN 1/2W	28480	2100-3062
A2A2R3	2100-3062		R:VAR COMP 500 OHM 10% LIN 1/2W	28480	2100-3062
A2A2R4	2100-3062		R:VAR COMP 500 OHM 10% LIN 1/2W	28480	2100-3062
A2A2U1	07754-00130	1	BOARD:BLANK PC	28480	07754-00130
A2A3	07754-60140 2360-0113	6	PREAMPLIFIER POWER SUPPLY(FIG. 6-7) SCREW:PAN HD POZI 6-32 X 1/4 W/LK	28480 00000	07754-60140 080
A2A3CR1	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A2A3CR2	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A2A3F1	2110-0234	1	FUSE:0.1 AMP 250V SLOW-BLOW	75915	313.100/5
A2A3M1	1010-0032	1	METER:INDICATOR	18583	MODEL 120 LC
A2A3MP1	1205-0021	1	HEAT DISSIPATOR FOR T0-3 TRANSISTOR	28480	1205-0021
A2A3MP2	1205-0213	2	HEAT SINK:TRANSISTOR	13103	22288
A2A3MP3	1205-0213		HEAT SINK:TRANSISTOR	13103	22288
A2A3MP4	01250-21720	1	SPACER	28480	01250-21720
A2A3Q1	1853-0066	27	TSTR:SI PNP	80131	2N4250
A2A3Q2	1854-0071	27	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2A3Q3	1854-0063 0340-0464 2190-0008 2360-0119 2500-0001	15 21 14 10 42	TSTR:SI NPN INSULATOR FOR T0-3 TRANSISTOR WASHER:SPLIT LOCK #6 SCREW:SST PAN HD POZ DR 6-32 X 7/16" NUT:HEX 6-32 THREAD	80131 13103 00000 00000 00000	2N3055 43-03-1 080 080 080
A2A3Q4	1853-0045 1200-0181	9 14	TSTR:SI PNP MOUNTING:TRANSISTOR PAD	80131 13103	2N4036 7717-5-N
A2A3Q5	1853-0045 1200-0181		TSTR:SI PNP MOUNTING:TRANSISTOR PAD	80131 13103	2N4036 7717-5-N
A2A3R1	2100-2031	8	R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R2	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R3	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R4	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R5	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R6	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R7	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R8	2100-2031		R:VAR 50K OHM 10% LIN 1/2W	28480	2100-2031
A2A3R9	0683-6815	1	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A2A3R10	2100-1772	1	R:VAR WW 500 OHM 5% TYPE H 1W	28480	2100-1772
A2A3R11	0761-0052	2	R:FXD MET OX 270 OHM 5% 1W	28480	0761-0052
A2A3R12	0686-1515	4	R:FXD COMP 150 OHM 5% 1/2W	01121	EB 1515
A2A3R13	0683-1215	1	R:FXD COMP 120 OHM 5% 1/4W	01121	CB 1215
A2A3R14	0811-1732	14	R:FXD WW 1 OHM 5% 3W	28480	0811-1732
A2A3R15	0686-3325	1	R:FXD COMP 3300 OHM 5% 1/2W	01121	EB 3325
A2A3R16	0686-2215	1	R:FXD COMP 220 OHM 5% 1/2W	01121	EB 2215
A2A3R17	0761-0052		R:FXD MET OX 270 OHM 5% 1W	28480	0761-0052
A2A3R18	0686-1525	5	R:FXD COMP 1500 OHM 5% 1/2W	01121	EB 1525
A2A3R19	0686-3315	2	R:FXD COMP 330 OHM 5% 1/2W	01121	EB 3315
A2A3R20	0683-4705	2	R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A2A3R21	0683-4705		R:FXD COMP 47 OHM 5% 1/4W	01121	CB 4705
A2A3R22	0686-3315		R:FXD COMP 330 OHM 5% 1/2W	01121	EB 3315
A2A3R23	0683-5655	1	R:FXD COMP 5.6 MEGOHM 5% 1/4W	01121	CB 5655
A2A3T1	9100-1925 2190-0757 2530-0004 2580-0006	1 2 2 2	TRANSFORMER:OUTPUT WASHER:FLAT FOR #6 HDW NUT:HEX 6-32 THREAD	28480 00000 00000 00000	9100-1925 080 080 080
A2A3U1	07754-00140	1	BOARD:BLANK PC	28480	07754-00140
A2A3XF1	2110-0269	2	CLIP:FUSE 0.250" DIA	91506	6008-32C
A3	07754-60050 1251-1679 1400-0017	1 6 7	POWER SUPPLY(FIG. 6-9) CONNECTOR BLOCK:14 CONTACT CLAMP,CABLE NYLON 5/16	28480 28480 71616	07754-60050 1251-1679 CPC-1953-5B
	1251-2744 2190-0758 2190-0760 2530-0004 2580-0006	12 2 4 2	CONTACT:R & P CONNECTOR, 16 FEMALE WASHER:FLAT #8 WASHER:FLAT #10 SCREW:FLAT HD SLOT DR 8-32 X 0.625" LG NUT:HEX 8-32 THREAD	00779 00000 00000 00000 78189	66104-1 080 080 080 KEP511-081800-00
	2680-0055 0180-2367 2510-0051	8 2 2	SCREW:SST PAN HD POZI DR 10-32 X 0.500" C:FXD AL ELECT 16000 UF +75-10% 30VDCW SCREW:PAN HD POZI DR 8-32 X 0.625" LG	00000 56289 00000	080 36D163G030BD6A 080
A3C1	0180-2367 2510-0051	2	C:FXD AL ELECT 16000 UF +75-10% 30VDCW	56289	36D163G030BD6A
A3C2	0180-2367 2510-0051	2	C:FXD AL ELECT 16000 UF +75-10% 30VDCW	56289	36D163G030BD6A
A3C3	0180-2366 2360-0123 2480-0006	1 5 11	C:FXD AL ELECT 5400 UF +75-10% 30VDCW SCREW:SST PAN HD POZ DR 6-32 X 5/8" NUT:HEX 6-32 THREAD	56289 00000 00000	32D542G030AD6A 080 080
A3C4	0150-0052 0160-2149	1	C:FXD CER 0.05 UF 20% 400VDCW CLAMP:CAPACITOR	56289 56289	33C17A 4586-97A

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3CR1	1901-0164	6	DIODE:SILICON 200PIV 3A	04713	1N4721
A3CR2	1901-0164		DIODE:SILICON 200PIV 3A	04713	1N4721
A3CR3	1901-0164		DIODE:SILICON 200PIV 3A	04713	1N4721
A3CR4	1901-0164		DIODE:SILICON 200PIV 3A	04713	1N4721
A3CR5	1901-0164		DIODE:SILICON 200PIV 3A	04713	1N4721
A3CR6	1901-0164		DIODE:SILICON 200PIV 3A	04713	1N4721
A3E1	0360-1092	2	TERMINAL STRIP:8 TERMINALS	71785	326-20-08-001
A3E2	0360-1092		TERMINAL STRIP:8 TERMINALS	71785	326-20-08-001
A3F1	2110-0386	2	FUSE:6 AMP AT 250V	71400	ABC-6-A
A3F2	2110-0380	2	FUSE:2.5 AMP AT 250 V SLOW-BLOW	71400	MDA-2-1/2
A3F3	2110-0381	4	FUSE:3.0 AMP AT 250V SLOW-BLOW	71400	MDA 3
A3F4	2110-0381		FUSE:3.0 AMP AT 250V SLOW-BLOW	71400	MDA 3
A3F5	2110-0381		FUSE:3.0 AMP AT 250V SLOW-BLOW	71400	MDA 3
A3J1	1251-1842	4	CONNECTOR:16 FEMALE CONTACT	28480	1251-1842
	2200-0166	22	SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199	18	NUT:EXT LOCK #4-40	00000	080
	0360-1357	4	TERMINAL:SOLDER LUG FOR #5 SCREW	00000	080
A3J2	1251-1842		CONNECTOR:16 FEMALE CONTACT	28480	1251-1842
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	0360-1357		TERMINAL:SOLDER LUG FOR #5 SCREW	00000	080
A3J3	1251-1842		CONNECTOR:16 FEMALE CONTACT	28480	1251-1842
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	0360-1357		TERMINAL:SOLDER LUG FOR #5 SCREW	00000	080
A3J4	1251-1842		CONNECTOR:16 FEMALE CONTACT	28480	1251-1842
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	0360-1357		TERMINAL:SOLDER LUG FOR #5 SCREW	00000	080
A3J5	9100-3142	1	FILTER:LINE 6A 50-400 HZ	28480	9100-3142
	2200-0107	6	SCREW:POZI DR 4-40 X 3/8 W/LOCK	00000	080
A3J6	1251-2358	1	CONNECTOR:AC POWER, 3 FEMALE CONTACT	28480	1251-2358
	0361-0346	6	RIVET:SEMITUBULAR OVAL HEAD	00000	080
A3J7	1251-1682	2	BODY:R & P CONNECTOR 14 POSITION	00779	201298-1
A3J9	8120-0961	1	CABLE:CONNECTOR 2 FEMALE PIN	28480	8120-0961
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	2200-0107		SCREW:POZI DR 4-40 X 3/8 W/LOCK	00000	080
A3J11	1251-1894	4	CONNECTOR:5 MALE CONTACT	28480	1251-1894
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	1251-1827	4	EXTENSION:GUARD	28480	1251-1827
	1251-1828	4	GUARD FOR SPECIAL PURPOSE CONNECTOR	05245	SM205
A3J12	1251-1894		CONNECTOR:5 MALE CONTACT	28480	1251-1894
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	1251-1827		EXTENSION:GUARD	28480	1251-1827
	1251-1828		GUARD FOR SPECIAL PURPOSE CONNECTOR	05245	SM205
A3J13	1251-1894		CONNECTOR:5 MALE CONTACT	28480	1251-1894
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	1251-1827		EXTENSION:GUARD	28480	1251-1827
	1251-1828		GUARD FOR SPECIAL PURPOSE CONNECTOR	05245	SM205
A3J14	1251-1894		CONNECTOR:5 MALE CONTACT	28480	1251-1894
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	080
	0590-0199		NUT:EXT LOCK #4-40	00000	080
	1251-1827		EXTENSION:GUARD	28480	1251-1827
	1251-1828		GUARD FOR SPECIAL PURPOSE CONNECTOR	05245	SM205
A3J21	1251-1945	4	CONNECTOR:10 FEMALE CONTACT	28480	1251-1945
A3J22	1251-1945		CONNECTOR:10 FEMALE CONTACT	28480	1251-1945
A3J23	1251-1945		CONNECTOR:10 FEMALE CONTACT	28480	1251-1945
A3J24	1251-1945		CONNECTOR:10 FEMALE CONTACT	28480	1251-1945
A3J31	1251-1682		BODY:R & P CONNECTOR 14 POSITION	00779	201298-1
A3J32	1251-1295		BODY:R & P CONNECTOR, 14 POSITION	00779	201335-1
A3K1	0490-0424	1	RELAY:DPDT 2A AT 125 VAC	78277	42R06-2500S-SIL
A3MP1	07754-00050	1	CHASSIS:POWER SUPPLY	28480	07754-00050
A3MP2	7120-0004	1	NAMEPLATE:SERIAL	28480	7120-0004
A3MP3	07754-60440	1	CHASSIS AND TERMINAL STRIP	28480	07754-60440
	2680-0051		SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	080
	2680-0118	1	SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	080
A3MP4	2420-0006	9	NUT:HEX 6-32 THREAD	00000	080
	2360-0197	2	SCREW:SST PAN HD 6-32 X .375	00000	080
A3MP5	0180-0078	2	CLAMP: CAPACITOR MOUNTING	56289	4586-2B
	2510-0045	10	SCREW:PAN HD POZI DR 8-32 X 0.375" LG	00000	080
	2580-0006		NUT:HEX 8-32 THREAD	78189	KEP511-081800-00
A3MP6	01250-21401	2	SPACER:POWER SUPPLY	28480	01250-21401
			(ATTACHING PARTS, NEXT PAGE)		

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	2200-0105	19	SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
	2360-0116	2	SCREW:SST FLAT HD POZI DR 6-32	00000	0BD
	2480-0006		NUT:HEX 6-32 THREAD	00000	0BD
	07754-00340	1	COVER:TRANSFORMER	28480	07754-00340
A3MP8	2200-0105		SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
	07754-00530	1	COVER:BOTTOM	28480	07754-00530
	2200-0166		SCREW:SST FLAT HD POZI DR 4-40 X 0.312"	00000	0BD
A3MP9	07754-00540	1	SHIELD:DRIVER	28480	07754-00540
	2200-0105		SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
A3MP10	07826-40040	1	SHIELD:PC BOARD	28480	07826-40040
	2200-0105		SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
	2200-0191	1	SCREW:PAN HD SLOT DR 4-40 X 1.000" LG	00000	0BD
A3MP11	07754-00870	1	DECAL:POWER SUPPLY, CAUTION(NOT SHOWN)	28480	07754-00870
A3MP12	07826-40050	2	FOOT:RUBBER	28480	07826-40050
A3P7	1251-2446	1	CONNECTOR:12 PIN, MINIATURE	28480	1251-2446
	1400-0018	3	CLAMP:CABLE NYLON 7/16 DIA	71616	CPC-1953-7A
	2360-0185		SCREW:FLAT HD POZI DR 6-32 X 0.500" LG	00000	0BD
	2420-0006		NUT:HEX 6-32 THREAD	00000	0BD
	0360-1458	1	TERMINAL:SOLDER LUG FOR #5 SCREW	00000	0BD
A3P8	1251-0198	7	CONNECTOR:PC EDGE (2 X 6) 12 CONTACT	71785	251-06-30-261
	1251-1005	3	GUIDE:R & P CONNECTOR, SERIES M	00779	200390-4
	1251-1006	2	GUIDE:R & P CONNECTOR, SERIES M	00779	200389-4
	1251-1694	1	CATCHES:R & P CONNECTOR	00779	201673-1
A3R1	0683-2735	6	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A3R2	0683-2225	1	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A3R3	0686-1515		R:FXD COMP 150 OHM 5% 1/2W	01121	EB 1515
A3S1	3101-1395	1	SWITCH:PUSHBUTTON DPDT-DB	76854	53-67280-121/A1H
	2190-0735	1	WASHER:FLAT METALLIC 1/2" ID	00000	0BD
A3S4	3101-1234	1	SWITCH:SLIDE DPDT	82389	11A-1242
	0361-0346		RIVET:SEMITUBULAR OVAL HEAD	00000	0BD
A3T1	9100-2361	1	TRANSFORMER:POWER	28480	9100-2361
	0590-0304	4	NUT:HEX STL 1/4-20 THREAD SIZE	00000	0BD
A3U1	07754-00160	1	BOARD:BLANK PC	28480	07754-00160
A3XF1	1400-0085	5	FUSEHOLDER	75915	342004
A3XF2	1400-0085		FUSEHOLDER	75915	342004
A3XF3	1400-0085		FUSEHOLDER	75915	342004
A3XF4	1400-0085		FUSEHOLDER	75915	342004
A3XF5	1400-0085		FUSEHOLDER	75915	342004
A3XK1	1200-0727	1	SOCKET:TUBE, OCTAL	71785	101-12-10-044
	0361-0346		RIVET:SEMITUBULAR OVAL HEAD	00000	0BD
A3W1	07754-60450	1	CABLE:SIGNAL JUMPER	28480	07754-60450
A3A1	07754-60150	1	TRANSFER BOARD(FIG. 6-11)	28480	07754-60150
	1251-1249	1	KEY:POLARIZING	02660	143-953
	2360-0117	9	SCREW:PAN HD POZI 6-32 X 3/8 W/LK	00000	0BD
	1251-2205	4	KEY:POLARIZING FOR PC CONNECTORS	71785	0BD
A3A1C1	0180-0097	1	C:FXD TANT. 47 UF 10% 35VDCW	56289	1500476X9035S2-DYS
A3A1CR1	1901-0033		DIODE:SILICON 100MA 180MV	07263	FD3369
A3A1CR2	1901-0033		DIODE:SILICON 100MA 180MV	07263	FD3369
A3A1J10	1251-1886	1	CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113	34	SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J15	1251-1962	5	CONNECTOR:PC (2 X 10) 20 CONTACT	71785	252-10-30-330
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J16	1251-1962		CONNECTOR:PC (2 X 10) 20 CONTACT	71785	252-10-30-330
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J17	1251-1962		CONNECTOR:PC (2 X 10) 20 CONTACT	71785	252-10-30-330
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J18	1251-1962		CONNECTOR:PC (2 X 10) 20 CONTACT	71785	252-10-30-330
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J19	1251-1962		CONNECTOR:PC (2 X 10) 20 CONTACT	71785	252-10-30-330
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J20	1251-1887	1	CONNECTOR:PC 44 CONTACTS(2 X 22)	71785	252-22-30-340
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J27	1251-1968	2	CONNECTOR:PC 10 TUNING FORK TYPE CONT	02660	143-010-07-1158
	2340-0001		NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
A3A1J28	1251-1968		CONNECTOR:PC 10 TUNING FORK TYPE CONT	02660	143-010-07-1158

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3A1J29 A3A1J30 A3A1U1	2340-0001	2	NUT:HEX 4-40 X 0.188" ACROSS FLAT	00000	0BD
	2200-0113		00000	0BD	
	1251-2422	1	SCREW: PAN HD POZI DR 4-40 X 0.625" LG	91662	00-8129-012-603-002
	07754-00150		07754-00150	91662	00-8129-012-603-002
A4 A4C1 A4C2	0360-1491	27	CONNECTOR: PC 12 CONTACT	28480	07754-00150
	0403-0063	1	BOARD: BLANK PC	28480	0360-1491
	07754-60170	8	TERMINAL: SOLDER STUD	28480	0360-1491
	0180-0106		28480	FSP 115201	
A4C3 A4C4 A4C5 A4C6 A4C7	0180-0106	4	DRIVER AMPLIFIER (FIG. 6-13)	28480	07754-60170
	0160-0154		56289	0180-0106	
	0160-0165	12	C:FXD ELECT 60 UF 20% 6VDCW	56289	192P22292-PTS
	0160-0165		56289	192P56392-PTS	
	0160-0165	4	C:FXD MY 0.056 UF 10% 200VDCW	56289	192P56392-PTS
	0160-0165		56289	192P56392-PTS	
	0160-0165	4	C:FXD MY 0.056 UF 10% 200VDCW	56289	192P56392-PTS
0160-0165	56289		192P56392-PTS		
A4C8 A4CR1 A4CR2 A4CR3 A4CR4	0160-0207	4	NOT ASSIGNED	28480	0160-0207
	1901-0033		07263	FD3369	
	1901-0033	8	C:FXD MYLAR 0.01UF 5% 200VDCW	07263	FD3369
	1902-3182		28480	1902-3182	
A4CR5 A4MP1	1902-3182	6	DIODE BREAKDOWN: SILICON 12.1V 5%	28480	1902-3182
	1902-3182		28480	1902-3182	
	1901-0033	6	DIODE: SILICON 100MA 180MV	07263	FD3369
	07754-20340		28480	07754-20340	
	2190-0759	6	HEAT SINK	00000	0BD
	2190-0780	6	WASHER: FLAT #10	00000	0BD
2360-0119	6	WASHER: FLAT BLACK FIBER #8	00000	0BD	
A4Q1 A4Q2 A4Q3	2360-0119	6	SCREW: SST PAN HD POZ DR 6-32 X 7/16"	00000	0BD
	2500-0001		00000	0BD	
	2680-0157	6	NUT: HEX 6-32 THREAD	00000	0BD
	1853-0066		80131	2N4250	
A4Q4 A4Q5 A4Q6	1854-0071	4	SCREW: PAN HD SLOT DR 10-32 X 2.250" LG	28480	1854-0071
	1853-0066		80131	2N4250	
	1853-0066	4	TSTR: SI PNP	80131	2N3053
	1854-0039		80131	2N3053	
	1200-0181	4	TSTR: SI NPN (SELECTED FROM 2N3704)	13103	7717-5-N
	1853-0066		80131	2N4250	
A4Q7	1853-0223	4	TSTR: SI PNP	80131	2N4902
	0340-0464		13103	43-03-1	
	2190-0007	18	INSULATOR FOR TO-3 TRANSISTOR	28480	2190-0007
	2360-0201		00000	0BD	
	2500-0001	28	WASHER: INT LOCK #6	00000	0BD
	1853-0045		80131	2N4036	
1200-0181	6	SCREW: SST PHIL POZI DR 6-32 X 0.500	13103	7717-5-N	
1854-0071		28480	1854-0071		
A4Q8 A4Q9	1854-0063	4	TSTR: SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
	0340-0464		80131	2N3055	
	2190-0007	4	INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2360-0201		28480	2190-0007	
A4Q10 A4Q11 A4Q12 A4Q13	2360-0201	4	WASHER: INT LOCK #6	00000	0BD
	2500-0001		80131	2N5210	
	0683-1035	22	SCREW: SST PHIL POZI DR 6-32 X 0.500	80131	2N4250
	0698-6909		28480	1854-0071	
	0757-0452	12	NUT: HEX 6-32 THREAD	80131	2N3055
	0683-6835		28480	2N3055	
0698-6909	4	TSTR: SI NPN (SELECTED FROM 2N3704)	28480	1854-0071	
0683-1055		80131	2N3055		
A4R1 A4R2 A4R3 A4R4 A4R5 A4R6 A4R7 A4R8 A4R9 A4R10 A4R11 A4R12 A4R13 A4R14 A4R15 A4R16 A4R17 A4R18 A4R19 A4R20 A4R21	0340-0464	4	INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2190-0008		00000	0BD	
	2360-0201	22	WASHER: LOCK NO. 6	00000	0BD
	2500-0001		00000	0BD	
	0683-1035	12	SCREW: SST PHIL POZI DR 6-32 X 0.500	00000	0BD
	0698-6909		01121	CB 1035	
	0757-0452	4	NUT: HEX 6-32 THREAD	01121	CB 1035
	0683-6835		01121	CB 1035	
	0698-6909	4	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
	0683-1055		01121	CB 1035	
	0698-5143	4	R:FXD FLM 45.3K OHM 0.5% 1/8W	28480	0698-6909
	0683-1035		28480	0757-0452	
2100-2464	12	R:FXD MET FLM 27.4K OHM 1% 1/8W	01121	CB 6835	
0698-3136		28480	CB 6835		
0683-1035	8	R:FXD COMP 68K OHM 5% 1/4W	28480	0698-6909	
0698-3136		28480	CB 1055		
0683-1035	4	R:FXD FLM 45.3K OHM 0.5% 1/8W	01121	CB 1055	
0683-1035		01121	CB 1055		
0698-5143	4	R:FXD COMP 1 MEGOHM 5% 1/4W	28480	0698-5143	
0683-1035		01121	CB 1035		
2100-2464	12	R:FXD FLM 395K OHM 0.25% 1/8W	28480	2100-2464	
0698-3136		28480	MF4C T-0		
0698-3136	8	R:FXD COMP 10K OHM 5% 1/4W	19701	CB 1035	
2100-2464		01121	CB 1035		
0683-1035	4	R:VAR WW 20K OHM 10% 1W	19701	MF4C T-0	
0698-7382		28480	2100-2464		
0683-5635	4	R:FXD MET FLM 17.8K OHM 1% 2/8W	01121	CB 1035	
0683-5635		01121	CB 1035		
0683-1515	14	R:FXD COMP 10K OHM 5% 1/4W	19701	MF4C T-0	
0686-5605		28480	2100-2464		
0683-1015	8	R:VAR WW 20K OHM 10% 1W	01121	CB 1035	
0811-2619		01121	0698-7382		
0761-0026	4	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 5635	
0761-0026		01121	CB 5635		
0811-2619	4	R:FXD FLM 103.5K OHM 0.1% 1/8W	01121	0698-7382	
0761-0026		01121	CB 5635		
0683-1515	14	R:FXD COMP 56K OHMS 5% 1/4W	01121	CB 1515	
0686-5605		01121	EB 5605		
0683-1015	8	R:FXD COMP 56 OHM 5% 1/2W	01121	CB 1015	
0811-2619		01121	0811-2619		
0761-0026	4	R:FXD COMP 100 OHM 5% 1/4W	28480	0761-0026	
0761-0026		28480	0761-0026		

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R22	0686-2715	4	R:FXD COMP 270 OHM 5% 1/2W	01121	EB 2715
A4R23	0686-1525		R:FXD COMP 1500 OHM 5% 1/2W	01121	EB 1525
A4R24	0686-1825	7	R:FXD COMP 1800 OHM 5% 1/2W	01121	EB 1825
A4R25	0686-5605		R:FXD COMP 56 OHM 5% 1/2W	01121	EB 5605
A4R26	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A4R27	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A4R28	0811-1732		R:FXD WW 1 OHM 5% 3W	28480	0811-1732
A4R29	0683-2235	9	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A4R30	2100-2464		R:VAR WW 20K OHM 10% 1W	28480	2100-2464
A4R31	0757-0123	4	R:FXD MET FLM 34.8K OHM 1% 1/8W	28480	0757-0123
A4R32	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A4R33	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A4R34	0683-1025	7	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R36	0698-6909		R:FXD FLM 45.3K OHM 0.5% 1/8W	28480	0698-6909
A4R37	0683-1065	4	R:FXD COMP 10M OHM 5% 1/4W	01121	CB 1065
A4R38	0757-0869	4	R:FXD MET FLM 681K OHM 1% 1/2W	28480	0757-0869
A4R39	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A4R40	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A4R41	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A4R42	0686-3915	4	R:FXD COMP 390 OHM 5% 1/2W	01121	EB 3915
A4R43	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A4R44	0811-1732		R:FXD WW 1 OHM 5% 3W	28480	0811-1732
A4U1	1820-0203	8	IC:OPERATIONAL AMPLIFIER	07263	SL8940
A4J2	1820-0203		IC:OPERATIONAL AMPLIFIER	07263	SL8940
A4J3	07754-00170	4	BOARD:BLANK PC	28480	07754-00170
A5			SAME AS A4, USE PREFIX A5		
A6			SAME AS A4, USE PREFIX A6		
A7			SAME AS A4, USE PREFIX A7		
A8	07754-60180	1	REGULATOR/OSCILLATOR BOARD:60 HZ (EXCEPT OPT 008, FIG. 6-15)	28480	07754-60180
A8C1	0140-0200	4	C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
A8C2	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C3	0160-2222	4	C:FXD MICA 1500 PF 5% 300VDCW	28480	0160-2222
A8C4	0160-0174	16	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C5	0180-1830	2	C:FXD ELECT 5.6 UF 10% 35VDCW	56289	1500565X9035B2 DYS
A8C5	0180-0291	4	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	1500105X9035A2-DYS
A8C7	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C8	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	1500105X9035A2-DYS
A8C9	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C10	0160-2891	2	C:FXD MICA 33 PF 2% 500VDCW	28480	0160-2891
A8C11	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C12	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C13	0160-0161	2	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A8C14	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C15	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
A8C16	0160-2222		C:FXD MICA 1500 PF 5% 300VDCW	28480	0160-2222
A8C17	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C18	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C19	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C20	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C21	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A8C22	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8C23	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A8CR1	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A8L1	9140-0210	2	COIL/CHOKE 100 UH 5%	82142	15-1315-12J
A8M>1	07754-20340		HEAT SINK	28480	07754-20340
	2190-0759		WASHER:FLAT #10	00000	0B0
	2190-0780		WASHER:FLAT BLACK FIBER #8	00000	0B0
	2360-0119		SCREW:SST PAN HD POZ DR 6-32 X 7/16"	00000	0B0
	2500-0001		NUT:HEX 6-32 THREAD	00000	0B0
	2680-0157		SCREW:PAN HD SLOT DR 10-32 X 2.250"LG	00000	0B0
A8Q1	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q2	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q5	1854-0063		TSTR:SI NPN	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2190-0007		WASHER:INT LOCK #6	28480	2190-0007
	2360-0201		SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	0B0
	2500-0001		NUT:HEX 6-32 THREAD	00000	0B0
A8Q6	1854-0063		TSTR:SI NPN	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2190-0007		WASHER:INT LOCK #6	28480	2190-0007
	2360-0201		SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	0B0
	2500-0001		NUT:HEX 6-32 THREAD	00000	0B0

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8Q7	1854-0071	2	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q9	1854-0022		TSTR:SI NPN	07263	517843
A8Q10	1200-0181		MOUNTING:TRANSISTOR PAD	13103	7717-5-N
A8Q11	1854-0071	2	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q12	1854-0063		TSTR:SI PNP	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2190-0007		WASHER:INT LOCK #6	28480	2190-0007
	2360-0201	2	SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	0BD
	2500-0001		NUT:HEX 6-32 THREAD	00000	0BD
A8Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A8Q15	1853-0066	2	TSTR:SI PNP	80131	2N4250
A8Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A8Q17	1853-0045		TSTR:SI PNP	80131	2N4036
	1200-0181		MOUNTING:TRANSISTOR PAD	13103	7717-5-N
A8R1	0698-6338	6	R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A8R2	2100-1703		R:VAR HW 2K OHM 10% 1W	28480	2100-1703
A8R3	0698-5323		R:FXD FLM 4K OHM 0.5% 1/8W	28480	0698-5323
A8R4	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A8R5	0698-4002	2	R:FXD MET FLM 5K OHM 1% 1/8W	28480	0698-4002
A8R6	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A8R7	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A8R8	0811-1732		R:FXD HW 1 OHM 5% 3W	28480	0811-1732
A8R9	0686-1515	2	R:FXD COMP 150 OHM 5% 1/2W	01121	EB 1515
A8R10	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A8R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A8R12	0698-6338		R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A8R13	0698-6338	4	R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A8R14	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R15	0811-1732		R:FXD HW 1 OHM 5% 3W	28480	0811-1732
A8R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R17	0698-6273	2	R:FXD FLM 1500 OHM 0.1% 1/8W	28480	0698-6273
A8R18	0698-6866		R:FXD FLM 2.182K OHM 0.25% 1/8W	28480	0698-6866
A8R19	0698-5323	2	R:FXD FLM 4K OHM 0.5% 1/8W	28480	0698-5323
A8R20	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R21	0683-1245		R:FXD COMP 120K OHM 5% 1/4W	01121	CB 1245
A8R22	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A8R23	0683-1005	4	R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A8R24	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A8R25	0686-6815		R:FXD COMP 680 OHM 5% 1/2W	01121	EB 6815
A8R26	0811-1830		R:FXD HW 0.5 OHM 10% 3W	28480	0811-1830
A8R27	0683-2735	2	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A8R28	0683-1835		R:FXD COMP 18K OHM 5% 1/4W	01121	CB 1835
A8R29	0683-1825	8	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A8R30	0811-1202		R:FXD HW 50 OHM 5% 3W	28480	0811-1202
A8R31	0683-3335		R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A8R32	0683-3335		R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A8R33	0683-3335	4	R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A8R34	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A8R35	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A8R36	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R37	0683-1545	4	R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A8R38	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A8R39	0683-1825	1	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A8R40	0683-1545		R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A8R41	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A8R42	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A8R43	0757-0460	R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460	
A8T1	07754-60470	1	IC:LINEAR, VOLTAGE REGULATOR	28480	1826-0010
A8U1	1826-0010		IC:LINEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A8U2	1820-0196		IC:TTL DIVIDE BY 12 10 MHZ MIN.	01295	SN7492N
A8U3	1820-0056		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A8U4	1820-0055	2	IC:TTL DIVIDE BY 12 10 MHZ MIN.	01295	SN7492N
A8U5	1820-0056		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A8U6	1820-0055		IC:LINEAR, VOLTAGE REGULATOR 5V	28480	1820-0430
A8U7	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2360-0195	4	SCREW:PAN HD POZI DR 6-32 X 0.312" LG	00000	0BD
	2190-0007		WASHER:INT LOCK #6	28480	2190-0007
	2500-0001	2	NUT:HEX 6-32 THREAD	00000	0BD
A8U8	07754-00180		BOARD:BLANK PC	28480	07754-00180
A9	07754-60181	1	REGULATOR/OSCILLATOR BOARD:50 HZ (OPT 008, FIG. 6-15)	28480	07754-60181

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9C1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
A9C2	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C3	0160-2222		C:FXD MICA 1500 PF 5% 300VDCW	28480	0160-2222
A9C4	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C5	0180-1830		C:FXD ELECT 5.6 UF 10% 35VDCW	56289	1500565X9035B2 DYS
A9C6	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	1500105X9035A2-DYS
A9C7	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C8	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	1500105X9035A2-DYS
A9C9	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C10	0160-2891		C:FXD MICA 33 PF 2% 500VDCW	28480	0160-2891
A9C11	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C12	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C13	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PMS
A9C14	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C15	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
A9C16	0160-2222		C:FXD MICA 1500 PF 5% 300VDCW	28480	0160-2222
A9C17	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C18	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C19	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C20	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C21	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
A9C22	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9C23	0160-0174		C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML
A9CR1	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A9L1	9140-0210		COIL/CHOKE 100 UH 5%	82142	15-1315-12J
A9MP1	07754-20340		HEAT SINK	28480	07754-20340
	2190-0759		WASHER:FLAT #10	00000	08D
	2190-0780		WASHER:FLAT BLACK FIBER #8	00000	08D
	2360-0119		SCREW:SST PAN HD POZ DR 6-32 X 7/16"	00000	08D
	2500-0001		NUT:HEX 6-32 THREAD	00000	08D
	2680-0157		SCREW:PAN HD SLOT DR 10-32 X 2.250"LG	00000	08D
A9Q1	1853-0066		TSTR:SI PNP	80131	2N4250
A9Q2	1853-0066		TSTR:SI PNP	80131	2N4250
A9Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q5	1854-0063		TSTR:SI NPN	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2360-0201		SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	08D
	2190-0007		WASHER: LOCK NO. 6	00000	08D
	2500-0001		NUT:HEX 6-32 THREAD	00000	08D
A9Q6	1854-0063		TSTR:SI NPN	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2360-0201		SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	08D
	2190-0008		WASHER:SPLIT LOCK #6	00000	08D
	2500-0001		NUT:HEX 6-32 THREAD	00000	08D
A9Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q8	1853-0066		TSTR:SI PNP	80131	2N4250
A9Q9	1854-0022		TSTR:SI NPN	07263	517843
	1200-0181		MOUNTING:TRANSISTOR PAD	13103	7717-5-N
A9Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q11	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q12	1854-0063		TSTR:SI NPN	80131	2N3055
	0340-0464		INSULATOR FOR TO-3 TRANSISTOR	13103	43-03-1
	2360-0201		SCREW:SST PHIL POZI DR 6-32 X 0.500	00000	08D
	2190-0007		WASHER: LOCK NO. 6	00000	08D
	2500-0001		NUT:HEX 6-32 THREAD	00000	08D
A9Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q14	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A9Q15	1853-0066		TSTR:SI PNP	80131	2N4250
A9Q16	1853-0066		TSTR:SI PNP	80131	2N4250
A9Q17	1853-0045		TSTR:SI PNP	80131	2N4036
	1200-0181		MOUNTING:TRANSISTOR PAD	13103	7717-5-N
A9R1	0698-6338		R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A9R2	2100-1703		R:VAR WW 2K OHM 10% 1W	28480	2100-1703
A9R3	0698-5323	2	R:FXD FLM 4K OHM 0.5% 1/8W	19701	NF4C T-2
A9R4	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A9R5	0698-4002		R:FXD MET FLM 5K OHM 1% 1/8W	28480	0698-4002
A9R6	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A9R7	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A9R8	0811-1732		R:FXD WW 1 OHM 5% 3W	28480	0811-1732
A9R9	0686-1515		R:FXD COMP 150 OHM 5% 1/2W	01121	EB 1515
A9R10	0698-4157		R:FXD FLM 10K OHM 0.1% 1/8W	28480	0698-4157
A9R11	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
A9R12	0698-6338		R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A9R13	0698-6338		R:FXD FLM 5K OHM 1% 1/8W	28480	0698-6338
A9R14	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9R15	0811-1732		R:FXD WW 1 OHM 5% 3W	28480	0811-1732
A9R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R17	0698-6273		R:FXD FLM 1500 OHM 0.1% 1/8W	28480	0698-6273
A9R18	0698-6866		R:FXD FLM 2.182K OHM 0.25% 1/8W	28480	0698-6866
A9R19	0698-5323		R:FXD FLM 4K OHM 0.5% 1/8W		NF4C T-2
A9R20	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A9R21	0683-1245		R:FXD COMP 120K OHM 5% 1/4W	01121	CB 1245
A9R22	0683-5625		R:FXD COMP 5600 OHM 5% 1/4W	01121	CB 5625
A9R23	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A9R24	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A9R25	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R26	0811-1830		R:FXD WW 0.5 OHM 10% 3W	28480	0811-1830
A9R27	0683-1835		R:FXD COMP 18K OHM 5% 1/4W	01121	CB 1835
A9R28	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A9R29	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A9R30	0811-1202		R:FXD WW 50 OHM 5% 3W	28480	0811-1202
A9R31	0683-3335		R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A9R32	0683-3335		R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A9R33	0683-3335		R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
A9R34	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A9R35	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A9R36	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A9R37	0683-1545		R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A9R38	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A9R39	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A9R40	0683-1545		R:FXD COMP 150K OHM 5% 1/4W	01121	CB 1545
A9R41	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A9R42	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A9T1	9100-2353	1	TRANSFORMER:OSCILLATOR	28480	9100-2353
A9J1	1826-0010		IC:LINEAR, VOLTAGE REGULATOR	28480	1826-0010
A9J2	1820-0196		IC:LINEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A9J3	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A9J4	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A9J5	1820-0056		IC:TTL DIVIDE BY 12 10 MHZ MIN.	01295	SN7492N
A9J6	1820-0055		IC:TTL DECADE COUNTER 10 MHZ MIN.	01295	SN7490N
A9J7	1820-0430		IC:LINEAR, VOLTAGE REGULATOR 5V	28480	1820-0430
	0340-0464		INSULATOR FOR T0-3 TRANSISTOR	13103	43-03-1
	2360-0195		SCREW:PAN HD POZI DR 6-32 X 0.312" LG	00000	08D
	2190-0008		WASHER:SPLIT LOCK #6	00000	08D
	2500-0001		NUT:HEX 6-32 THREAD	00000	08D
A9U8	07754-00180		BOARD:BLANK PC	28480	07754-00180
A10	07754-60250		DRIVE UNIT(FIG. 6-16)	28480	07754-60250
	2510-0053	4	SCREW:PAN HD POZI DR 8-32 X 0.750" LG	00000	08D
A10B1	3140-0337	1	MOTOR:450 RPM 60HZ (EXCEPT OPTION 08)	28480	3140-0337
	1400-0017		CLAMP,CABLE NYLON 5/16	71616	CPC-1953-5B
	2510-0121	2	SCREW:FLAT HD POZI DR 8-32 X 0.375"LG	00000	08D
	2580-0006		NUT:HEX 8-32 THREAD	78189	KEP511-081800-00
A10C1	0160-3614	1	C:PAPER AND OIL	28480	0160-3614
A10E1	0360-1289	2	BARRIER BLOCK:2 TERMINALS	98410	35002-3523
	0360-1279	1	TERMINAL:JUMPER FOR #6 SCREW	00000	08D
	2360-0123		SCREW:SST PAN HD POZ DR 6-32 X 5/8"	00000	08D
	2480-0006		NUT:HEX 6-32 THREAD	00000	08D
A10MP1	1430-0451	1	SPROCKET:20 TOOTH, 3/16 PITCH (60 HZ UNITS ONLY)	28480	1430-0451
A10MP2	1460-0798	2	SPRING:COMPRESSION	00000	08D
A10MP3	1460-1227	1	SPRING:PRESSURE	28480	1460-1227
A10MP4	1460-1228	1	SPRING:PRESSURE	28480	1460-1228
A10MP5	1500-0290	1	SPROCKET:25 TOOTH	28480	1500-0290
A10MP6	1500-0294	1	CHAIN DRIVE:0.188" PITCH	28480	1500-0294
A10MP7	1500-0295	1	CHAIN DRIVE:0.188" PITCH	28480	1500-0295
A10MP8	07754-00110	1	TRAY	28480	07754-00110
	2510-0121		SCREW:FLAT HD POZI DR 8-32 X 0.375"LG	00000	08D
A10MP9	07754-00220	1	TABLE	28480	07754-00220
A10MP10	07754-00210	1	LINK:TABLE	28480	07754-00210
A10MP11	07754-00261	1	PLATE:SIDE, RIGHT	28480	07754-00261
A10MP12	07754-00330	1	ARM:PIVOT	28480	07754-00330
A10MP13	07754-00350	1	GUIDE:PAPER	28480	07754-00350
	2200-0164	2	SCREW:FLAT HD POZI 4-40 X 3/16	00000	08D
A10MP14	07754-00610	1	CHASSIS	28480	07754-00610
	2510-0045		SCREW:PAN HD POZI DR 8-32 X 0.375" LG	00000	08D
A10MP15	07754-00630	1	BRAKE ARM	28480	07754-00630

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10MP16	07754-00680	1	FELT: BRAKE	28480	07754-00680
A10MP17	07754-00800	1	RETAINER: ROD, PAPER TABLE	28480	07754-00800
A10MP18	07754-00700	1	PLATE: SHIM	28480	07754-00700
A10MP19	07754-00730	3	GUIDE	28480	07754-00730
	2360-0117		SCREW: PAN HD POZI 6-32 X 3/8 W/LK	00000	0BD
	2480-0006		NUT: HEX 6-32 THREAD	00000	0BD
A10MP20	07754-00790	2	SPRING: BRAKE, LEAF TYPE	28480	07754-00790
	0520-0174	5	SCREW: PAN HD POZI DR 2-56 X 0.250" LG	00000	0BD
	0610-0002	6	NUT: HEX, BRASS 2-56 THREAD	00000	0BD
A10MP21	07754-20280	1	CLAMP: FELT	28480	07754-20280
	2360-0182		SCREW: FLAT HD POZI DR 6-32 X 0.312" LG	00000	0BD
A10MP22	07754-20360	1	MOUNT: GALVANOMETER	28480	07754-20360
	2360-0183	4	SCREW: FLAT HD POZI DR 6-32 X 0.375" LG	00000	0BD
A10MP23	07754-20510	1	STRIP NUT (BAR)	28480	07754-20510
A10MP24	07754-20400	1	SHAFT	28480	07754-20400
A10MP25	07754-20410	1	ROD	28480	07754-20410
	0510-0053	2	RING: RETAINING FOR 0.188" DIA SHAFT	79136	5555-18-S-MD
A10MP26	07754-20430	2	SPACER	28480	07754-20430
A10MP27	07754-20440	1	SHAFT	28480	07754-20440
A10MP28	07754-20470	1	SHAFT	28480	07754-20470
A10MP29	07754-20480	1	SHAFT	28480	07754-20480
	0510-0053		RING: RETAINING FOR 0.188" DIA SHAFT	79136	5555-18-S-MD
A10MP30	07754-20500	2	BEARING	28480	07754-20500
A10MP31	07754-20510	1	STRIP NUT (BAR)		
A10MP32	07754-20520	2	SCREW: ADJUSTMENT	28480	07754-20520
A10MP33	07754-20530	4	SPACER: MOTOR MOUNTING, PLASTIC	28480	07754-20530
A10MP34	07754-20590	1	KEY: SHAFT	28480	07754-20590
A10MP35	07754-20660	1	SPACER	28480	07754-20660
	2360-0117		SCREW: PAN HD POZI 6-32 X 3/8 W/LK	00000	0BD
A10MP36	07754-20700	1	BLOCK: GUARD	28480	07754-20700
	2200-0107		SCREW: POZI DR 4-40 X 3/8 W/LOCK	00000	0BD
A10MP37	07754-20750	1	BAR: BRAKE	28480	07754-20750
	2200-0166		SCREW: SST FLAT HD POZI DR 4-40 X 0.312"	00000	0BD
A10MP38	07754-00810	1	SPRING, TABLE	28480	07754-00810
	0520-0174		SCREW: PAN HD POZI DR 2-56 X 0.250" LG	00000	0BD
A10MP39	07754-20800	1	PAD: MOTOR	28480	07754-20800
A10MP40	07754-60300	1	ROLLER: PRESSURE	28480	07754-60300
A10MP41	07754-60400	1	PANEL: LEFT	28480	07754-60400
A10MP42	07754-00850	1	COVER	28480	07754-00850
	2200-0103		SCREW: SST PHH POZI DR 4-40 X 1/4" W/LK	00000	0BD
A10MP43	07754-00820	1	PLATEN	28480	07754-00820
A10MP44	07754-20380	1	ROLLER: DRIVE	28480	07754-20380
	2190-0736	1	WASHER: FLAT FOR 3/8" HDW	00000	0BD
	2190-0754	1	WASHER: FLAT FOR 3/8" HDW	00000	0BD
A10P9	8120-0962	1	PLUG: 2 CONTACT M, MOTOR	28480	8120-0962
A10W1	07754-60200	1	CABLE: INTERLOCK	28480	07754-60200
	1400-0082		CLAMP: CABLE 3/8" WIDE	09922	HP-2N
	2360-0115	13	SCREW: PAN HD POZI 6-32 X 5/16 W/LK	00000	0BD
	2360-0182		SCREW: FLAT HD POZI DR 6-32 X 0.312" LG	00000	0BD
	2480-0006		NUT: HEX 6-32 THREAD	00000	0BD
A10XC1	0160-2729	2	BRACKET: CAPACITOR, CADMIUM PLATED	14655	30744-36
	2740-0003	2	NUT: HEX STL 10-32 X 3/8	78189	510-101810-51
A10A1	07754-60040	1	GEARBOX (FIG. 6-17)	28480	07754-60040
	2360-0121	4	SCREW: POZI DR 6-32 X 1/2" W/LOCK	00000	0BD
A10A1MP1	1410-0974	2	BEARING: BALL, RADIAL	21335	S7KDD
A10A1MP2	1460-1210	4	SPRING: TORSION	28480	1460-1210
A10A1MP3	1460-1211	4	SPRING: TORSION	28480	1460-1211
A10A1MP4	1500-0288	1	GEAR: SPROCKET 20 TOOTH	28480	1500-0288
	2510-0185	4	SCREW: FLAT HD POZI DR 8-32 X 0.437" LG	00000	0BD
A10A1MP5	1500-0291	1	GEAR: SPROCKET 36 TOOTH	28480	1500-0291
A10A1MP6	07754-00590	1	COVER	28480	07754-00590
	2360-0115		SCREW: PAN HD POZI 6-32 X 5/16 W/LK	00000	0BD
A10A1MP7	07754-20060	1	GEAR: 52 TOOTH	28480	07754-20060
A10A1MP8	07754-20070	2	GEAR: 104 TOOTH	28480	07754-20070
A10A1MP9	07754-20080	2	GEAR: 78 TOOTH	28480	07754-20080
A10A1MP10	07754-20090	1	GEAR: 52 AND 78 TOOTH	28480	07754-20090
A10A1MP11	07754-20100	1	GEAR: 36 AND 78 TOOTH	28480	07754-20100
A10A1MP12	07754-20110	2	GEAR: 120 TOOTH	28480	07754-20110
A10A1MP13	07754-20120	2	GEAR: 39 TOOTH	28480	07754-20120
A10A1MP14	07754-20130	2	GEAR: 36 AND 117 TOOTH	28480	07754-20130
A10A1MP15	07754-20140	1	GEAR: 120 TOOTH	28480	07754-20140
A10A1MP16	07754-20190	2	SHAFT: INPUT OR OUTPUT	28480	07754-20190
	2190-0763	2	WASHER: FLAT #6 HDW	00000	0BD
	0570-1009	2	SCREW: SHOULDER PAN HD SLOT DR 4-40 THD	00000	0BD
A10A1MP17	07754-20230	2	PLATE: SIDE	28480	07754-20230

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10A1MP18	2200-0113	2	SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
	07754-20390	2	LOCKNUT:SHAFT END PLAY	28480	07754-20390
A10A1MP19	3030-0441	2	SCREW:SET 4-40 X 0.625" LG	08664	0BD
	01250-21101	2	SPACER: SHAFT LOCK NUT		
A10A1MP20	07754-20720	2	COUPLING	28480	07754-20720
A10A1MP21	0490-0957	4	RELAY:ACTUATOR	28480	0490-0957
A10A1MP22	2200-0113	8	SCREW:PAN HD POZI DR 4-40 X 0.625" LG	00000	0BD
	07754-20760	1	HUB:SPROCKET	28480	07754-20760
A10A1MP23	0570-0174	2	SCREW:SET SOCKET DR 8-32 X 0.250" LG	00000	0BD
A10A1MP24	07754-60420	1	ASSY:COLLAR	28480	07754-60420
A10A1MP25	07754-40010	4	CLUTCH	28480	07754-40010
A10A1MP26	07754-60280	1	ASSY:CABLE	28480	07754-60280
A11	2190-0833	2	WASHER:FLAT 5/16" DIA SHAFT	00000	0BD
A11MP1	07754-00840	4	SPACER:SOLENOID	28480	07754-00840
	2200-0101	6	SCREW:PAN HD POZI 4-40 X 3/16 W/LK	00000	0BD
A11MP2	07754-00880	4	SPRING, SOLENOID ADJUSTMENT	28480	07754-
A11MP3	2200-0111	4	SCREWS, PAN HD POZI 4-40 X 0.5 IN LG	00000	0BD
A11MP4	07754-60070	4	GALVANOMETER(FIG. 6-18)	28480	07754-60070
A11MP5	2680-0055	4	SCREW:SST PAN HD POZI DR 10-32 X 0.500"	00000	0BD
A11MP6	07754-20630	4	ARM:PIVOT	28480	07754-20630
A11MP7	3030-0044	4	SCREW:SOCKET CAP 2-56 X 0.375"	70276	0BD
A11MP8	07754-00550	4	CLIP:STYLUS RETAINER	28480	07754-00550
A11MP9	07754-20600	8	STYLUS BUMPER	28480	07754-20600
A11MP10	07754-20600	8	STYLUS BUMPER	28480	07754-20600
A11MP11	07754-00390	4	RETAINER:BUMPER	28480	07754-00390
A11MP12	2340-0006	8	NUT:HEX 4-40 X 0.250" ACROSS FLAT	00000	0BD
A11MP13	2200-0105	8	SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
A11MP14	3050-0269	4	WASHER:FLAT #5 HDW	00000	0BD
A11MP15	07754-60430	4	PIVOT, TAIL	28480	07754-60430
A11MP16	0520-0173	4	SCREW:PAN HD POZI DR 2-56 X 0.188" LG	00000	0BD
A11MP17	0610-0002	4	NUT:HEX, BRASS 2-56 THREAD	00000	0BD
A11MP18	07754-00040	4	ARM:STYLUS PRESSURE ADJUSTING	28480	07754-00040
A11MP19	2360-0107	4	SCREW:PAN HD PHIL DR 6-32 X 1.875" LG	00000	0BD
A11MP20	2360-0111	4	SCREW:PAN HD POZI DR 6-32 X 0.188" LG	00000	0BD
A11MP21	07754-00600	4	PLATE:SPACER	28480	07754-00600
A11MP22	07754-60080	4	CABLE:GALVANOMETER	28480	07754-60080
A11MP23	07754-00650	4	BRACKET:CONNECTOR	28480	07754-00650
A11MP24	0360-1045	4	LUG:SOLDER FOR #4 SCREW	00000	0BD
A11MP25	1400-0017	4	CLAMP,CABLE NYLON 5/16	71616	CPC-1953-5B
A11MP26	2200-0109	4	SCREW:PAN HD POZI DR 4-40 X 0.438" LG	00000	0BD
A11MP27	2340-0006	4	NUT:HEX 4-40 X 0.250" ACROSS FLAT	00000	0BD
A11MP28	2360-0115	4	SCREW:PAN HD POZI 6-32 X 5/16 W/LK	00000	0BD
A11MP29	2420-0006	4	NUT:HEX 6-32 THREAD	00000	0BD
A11MP30	1251-0198	4	CONNECTOR:PC EDGE (2 X 6) 12 CONTACT	71785	251-06-30-261
A11MP31	07754-60350	4	MARKER(FIG. 6-19)	28480	07754-60350
A11MP32	2200-0105	2	SCREW:PAN HD POZI DR 4-40 X 0.312" LG	00000	0BD
A11MP33	0550-0045	2	SCREW:SST PAN HD SLOT DR 5-40 X 0.125"	00000	0BD
A11MP34	0380-0787	2	STANDOFF:INSULATED, HEX BASE	00000	0BD
A11MP35	2190-0007	2	WASHER:INT LOCK #6	28480	2190-0007
A11MP36	2200-0165	2	SCREW:FLAT HD POZI DR 4-40 X 1/4"	00000	0BD
A11MP37	0520-0185	2	SCREW:PAN HD POZI DR 2-56 X 0.125" LG	00000	0BD
A11MP38	2200-0071	2	SCREW:FIL HD SLOT DR 4-40 X 0.125" LG	00000	0BD
A11MP39	2200-0101	2	SCREW:PAN HD POZI 4-40 X 3/16 W/LK	00000	0BD
A11MP40	0490-0417	2	RELAY:24V 3A @ 115 VAC	77342	KS-1087-1
A11MP41	07754-00440	2	BRACKET:MARKER	28480	07754-00440
A11MP42	07754-00450	2	BRACKET:MARKER	28480	07754-00450
A11MP43	07754-00830	2	BRACKET:LIMIT	28480	07754-00830
A11MP44	07754-60310	2	PEN:MARKER	28480	07754-60310
A11MP45	07754-60360	2	CABLE:MARKER	28480	07754-60360
A11MP46	07754-60360	2	MARKER, TINED, SAME AS A15, USE PREFIX A16		
A11MP47	868-500AC13	1	OSCILLATOR:2400 HZ(OPT 004, FIG. 6-20)	28480	868-500AC13
A11MP48	0160-2838	1	C:FXD PAPER 0.33 UF 10%	28480	0160-2838
A11MP49	0160-2771	1	C:FXD MY 0.022 UF 10% 200VDCW	14655	WMF2522
A11MP50	0160-0158	1	C:FXD MY 0.0056 UF 10% 200VDCW	56289	192P56292-PTS
A11MP51	1902-0551	1	DIODE BREAKDOWN:6.19V 5%	28480	1902-0551
A11MP52	1901-0026	4	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A11MP53	1901-0026	4	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A11MP54	801-157	2	BRACKET	28480	801-157
A11MP55	1853-0045	1	TSTR:SI PNP	80131	2N4036
A11MP56	1205-0095	1	HEAT SINK:TRANSISTOR	13103	22258
A11MP57	1850-0180	2	TSTR:GE PNP	80131	2N1374
A11MP58	1850-0180	2	TSTR:GE PNP	80131	2N1374
A11MP59	0686-6825	2	R:FXD COMP 6800 OHMS 5% 1/2W	01121	EB 6825
A11MP60	0686-1005	1	R:FXD COMP 10 OHM 5% 1/2W	01121	EB 1005
A11MP61	0686-6825	2	R:FXD COMP 6800 OHMS 5% 1/2W	01121	EB 6825

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17340	0686-5615	2	R:FXD COMP 560 OHM 5% 1/2W	01121	EB 5615
A17R41	0686-5615		R:FXD COMP 560 OHM 5% 1/2W	01121	EB 5615
A17342	0686-4715	2	R:FXD COMP 470 OHM 5% 1/2W	01121	EB 4715
A17R43	0686-4715		R:FXD COMP 470 OHM 5% 1/2W	01121	EB 4715
A17T7	9100-1990	1	TRANSFORMER:TOROIDAL OSC.	28480	9100-1990
	710P-1	1	WASHER	28480	710P-1
	0360-1491		TERMINAL:SOLDER STUD	28480	0360-1491
	0362-0215	8	TERMINATION:CRIMP TYPE FOR 0.058" DIA	00779	60598-6
A17TM7	0837-0037	2	THERMISTOR:310 OHM 10%	83186	23E3
A17TM8	0837-0037		THERMISTOR:310 OHM 10%	83186	23E3
A17U1	752-353	1	BOARD:BLANK PC	28480	752-353
A18	868-500AC14	1	OSCILLATOR:440 HZ(OPT 005, FIG. 6-21)	28480	868-500AC14
A18C15	0160-2835	1	C:FXD PAPER 2 UF 20%	28480	0160-2835
A18C16	0180-0183	2	C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	300106G050CB2-DSM
A18C17	0180-0183		C:FXD AL ELECT 10 UF +75-10% 50VDCW	56289	300106G050CB2-DSM
A18CR21	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A18CR22	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
A18CR23	1902-0202	1	DIODE BREAKDOWN:15.0V 5% 1W	28480	1902-0202
A18MP1	801-157		BRACKET	28480	801-157
A18Q12	1850-0181	2	TSTR:GE PNP	80131	2N2552
A18Q13	1850-0181		TSTR:GE PNP	80131	2N2552
A18R21	0686-1815	2	R:FXD COMP 180 OHM 5% 1/2W	01121	EB 1815
A18R22	0811-1983	1	R:FXD WW 7.5 OHM 5% 3W	28480	0811-1983
A18R23	0686-1825		R:FXD COMP 1800 OHM 5% 1/2W	01121	EB 1825
A18R24	0686-1825		R:FXD COMP 1800 OHM 5% 1/2W	01121	EB 1825
A18R25	0686-1815		R:FXD COMP 180 OHM 5% 1/2W	01121	EB 1815
A18R26	0686-1825		R:FXD COMP 1800 OHM 5% 1/2W	01121	EB 1825
A18R27	0686-1025	1	R:FXD COMP 1000 OHM 5% 1/2W	01121	EB 1025
A18T4	9100-1967	1	TRANSFORMER:TOROIDAL OSC.	28480	9100-1967
	0340-0197	1	INSULATOR:WAFER FOR #8 HDW MTG.	76530	294832
	1200-0080	1	INSULATOR:TRANSISTOR MTG.	71785	294834
A18U1	752-363	1	BOARD:BLANK PC	28480	752-363
A19	07754-63499		ACCESSORIES(FIG. 6-22)	28480	07754-63499
A19MP1	2110-0305	1	FUSE:1.25 AMP SLOW BLOW (FOR 230V SERVICE)	71400	MDX-1-1/4A
A19MP2	2110-0380	1	FUSE:2.5 AMP AT 250 V SLOW-BLOW	71400	MDA-2-1/2
A19MP3	2110-0381	1	FUSE:3.0 AMP AT 250V SLOW-BLOW	71400	MDA 3
A19MP4	2110-0386	1	FUSE:6 AMP AT 250V	71400	ABC-6-A
A19MP5	5060-4641	1	KIT:MONITOR CONNECTOR	28480	5060-4641
A19MP6	5060-4642	1	KIT:PNR/REMOTE CONNECTOR	28480	5060-4642
A19MP7	6040-0220	1	OIL:TURBINE 3/4 OZ.	07829	K674L017
A19MP8	6040-0222	1	LUBRICANT(1 OZ.)	00000	OBD
A19MP9	8120-1395	1	CABLE ASSY:AC POWER CORD(8 FT)	70903	KH-7077
A19MP10	8710-0865	1	WRENCH:ALLEN, HEX KEY	00000	OBD
A19MP11	8710-0875	1	SCREWDRIVER	00000	OBD
A19MP12	07754-00760	1	LATCH:CABLE	28480	07754-00760
A19MP13	07414-91999	1	MANUAL:OPERATING AND SERVICE	28480	07414-91999
A19MP14	07850-01520	5	PAPER:STYLUS LAPPING	28480	07850-01520
A19MP15	14023A	1	TESTER:STYLUS PRESSURE	28480	14023A
A19MP16	9270-0878	1	PERMAPAPER, Z-FOLD, GREEN GRID		
A19MP17	1251-1895	4	CONNECTOR:5 FEMALE CONTACT	28480	1251-1895
A19MP18	1251-1895		CONNECTOR:5 FEMALE CONTACT	28480	1251-1895
A19MP19	1251-1895		CONNECTOR:5 FEMALE CONTACT	28480	1251-1895
A19MP20	1251-1895		CONNECTOR:5 FEMALE CONTACT	28480	1251-1895
A19MP21	1251-1944	4	CONNECTOR:HEXAGONAL 10 MALE CONTACT	28480	1251-1944
A19MP22	1251-1944		CONNECTOR:HEXAGONAL 10 MALE CONTACT	28480	1251-1944
A19MP23	1251-1944		CONNECTOR:HEXAGONAL 10 MALE CONTACT	28480	1251-1944
A19MP24	1251-1944		CONNECTOR:HEXAGONAL 10 MALE CONTACT	28480	1251-1944
				28480	07754-60350
A20	07754-60350		MARKER(FIGURE 6-19) EXTRA OPTION 015	28480	07754-60350
			SAME AS A19, EXCEPT PREFIX A20	28480	07754-60350
	2200-0105	2	SCREW:PAN HD PDZI DR 4-40 X 0.312" LG	00000	OBD

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	07754-60600		RACK MOUNT KIT (OPTION 001)		
	1490-0879	4	SLIDE	28480	1490-0879
	2510-0123	24	SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	08D
	01060-00470	11	STRIP NUT	28480	01060-00470
	07754-00380	6	BRACKET:BACK	28480	07754-00380
	2680-0051	28	SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	08D
	07754-00400	6	BRACKET:FRONT	28480	07754-00400
	2680-0051		SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	08D
	07754-00640	3	COVER:RECORDER	28480	07754-00640
	2360-0181	16	SCREW:FLAT HD POZI DR 6-32 X 0.250" LG	00000	08D
	07754-00670	12	PLATE:NUT	28480	07754-00670
	07758-00512	1	BRACKET, PAPER TAKEUP	28480	07758-00512
	07758-20372	1	PANEL, PAPER TAKEUP BRACKET	28480	07758-20372
	07754-60410	1	ASSY:PAPER TAKEUP	28480	07754-60410
			50 HZ: OPTION 008 ADD THE FOLLOWING FOR OPTION 008 C:FXD PAPER 0.84 UF 6% 220 VACW	56289	153P51-0CS
	0160-2554	1			
	2420-0021	2	SCREW:FLAT HD SLOT DR 8-32 X 0.688" LG	00000	08D
	2190-0780	6	WASHER:FLAT BLACK FIBER #8	00000	08D
	2580-0006		NUT:HEX 8-32 THREAD	78189	KEP511-081800-00
	1500-0289	1	SPROCKET:24 TOOTH	28480	1500-0289
	3140-0398	1	MOTOR:SYNCHRONOUS 375 RPM 115V 50HZ	28480	3140-0398
	07754-60181	1	REGULATOR/OSCILLATOR BOARD:50 HZ DELETE FOLLOWING FOR OPTION 008 REF. 07754-60250 1430-0451 SPROCKET 2510-0121 SCREW 3140-0337 MOTOR 07754-60180 OSC. REG.	28480	07754-60181
			MOUNTED IN 1064B MOBILE CART OPTION 054		
	1490-0879	1	SLIDE	28480	1490-0879
	0590-0199	4	NUT:EXT LOCK #4-40	00000	08D
	2200-0107	4	SCREW:POZI DR 4-40 X 3/8 W/LOCK	00000	08D
	2680-0055	3	SCREW:SST PAN HD POZI DR 10-32 X 0.500"	00000	08D
	1490-0960	1	SLIDES:CHASSIS 17.0" LONG	28480	1490-0960
	2190-0702	12	WASHER:SHOULDER 0.500" OD 0.200" ID	00000	08D
	2510-0121	12	SCREW:FLAT HD POZI DR 8-32 X 0.375" LG	00000	08D
	2680-0107	12	SCREW:PAN HD POZI DR 10-32 X 0.750" LG	00000	08D
	2510-0123		SCREW:FLAT HD POZI DR 8-32 X 0.500" LG	00000	08D
	01064-00041	2	BRACKET	28480	01064-00041
	2680-0118	16	SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	01064-00042	1	BRACKET	28480	01064-00042
	2680-0118		SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	01064-00050	2	BRACKET:7 INCH DRAWER	28480	01064-00050
	2680-0055		SCREW:SST PAN HD POZI DR 10-32 X 0.500"	00000	08D
	07754-00711	1	DIVIDER:DRAWER	28480	07754-00711
	07810-00090	1	SPRING:DRAWER	28480	07810-00090
	2480-0006	2	NUT:HEX 6-32 THREAD	00000	08D

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	2360-0115	4	SCREW:PAN HD POZI 6-32 X 5/16 W/LK	00000	08D
	07810-60202	1	DRAWER:7 INCH	28480	07810-60202
	2360-0117	2	SCREW:PAN HD POZI 6-32 X 3/8 W/LK	00000	08D
	0590-0499	4	NUT:ACORN BRASS 6-32 THREAD	00000	08D
	2680-0051	6	SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	08D
	2740-0003	2	NUT:HEX STL 10-32 X 3/8	78189	510-101810-51
	0362-0155	2	TERMINATION:CRIMP LUG FOR #10 SCREW	00000	08D
	8160-0018	2	BRAID:COPPER WIRE (22")	70903	8660
	2190-0012	1	WASHER:LOCK PH BRZ #10	00000	08D
	07810-60130	2	GROUND WIRE	28480	07810-60130
	2360-0115		SCREW:PAN HD POZI 6-32 X 5/16 W/LK	00000	08D
	08824-00041	1	BLANK PANEL	28480	08824-00041
	2190-0702		WASHER:SHOULDER 0.500" OD 0.200" ID	00000	08D
	2680-0107		SCREW:PAN HD POZI DR 10-32 X 0.750" LG	00000	08D
	0590-0804	20	NUT:SHEET METAL 10-32 X 0.550" LG	78553	C-31758-10-12-24
	07754-60261	1	BENCH-TOP ENCLOSURE (STANDARD SYSTEM) CASE	28480	07754-60261
	2190-0702		WASHER:SHOULDER 0.500" OD 0.200" ID	00000	08D
	2680-0107		SCREW:PAN HD POZI DR 10-32 X 0.750" LG	00000	08D
	5060-0767	4	FOOT ASSY:FM	28480	5060-0767
	7124-2010	2	INSERT:NAMEPLATE	28480	7124-2010
	07754-00242	1	SHIPPING BRACKET, RIGHT	28480	07754-00242
	07754-00241	1	SHIPPING BRACKET:LEFT	28480	07754-00241
	2680-0051		SCREW:PAN HD POZI DR 10-32 X 0.375" LG	00000	08D
	07754-00511	1	BRACE:FRONT	28480	07754-00511
	07754-00491	1	COVER:UPPER	28480	07754-00491
	2680-0118		SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	07754-00512	1	BRACE:FRONT	28480	07754-00512
	2680-0118		SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	07754-00521	1	BRACE:BACK	28480	07754-00521
	2680-0118		SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	07754-00522	1	BRACE:BACK	28480	07754-00522
	2680-0118		SCREW:FLAT HD POZI DR 10-32 X 0.500" LG	00000	08D
	07754-00561	2	TRIM STRIP	28480	07754-00561
	2360-0181	4	SCREW:FLAT HD POZI DR 6-32 X 0.250" LG	00000	08D
	07754-00570	1	SPRING	28480	07754-00570
	2580-0006	2	NUT:HEX 8-32 THREAD	78189	KEP511-081800-00
	2510-0045	4	SCREW:PAN HD POZI DR 8-32 X 0.375" LG	00000	08D
	07754-20670	4	SCREW:SHOULDER	28480	07754-20670
	07754-20710	1	BLOCK	28480	07754-20710
	2510-0045		SCREW:PAN HD POZI DR 8-32 X 0.375" LG	00000	08D
	07754-60410	1	ASSY:PAPER-TAKE-UP	28480	07754-60410
	07754-60291	1	ASSY:BOTTOM	28480	07754-60291

See introduction to this section for ordering information

Table 6-2. Code List of Manufacturers

CODE	MANUFACTURER NAME	ADDRESS
00303	J.S.A. COMMON	ANY SUPPLIER OF U.S.A.
00779	AMP INC.(AIRCRAFT MARINE PROD.)	HARRISBURG, PA.
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.
01235	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.
02660	AMPHENOL CORP.	BROADVIEW, ILL.
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.
05245	COMPONENTS CORP.	CHICAGO, ILL.
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.
07829	BUDINE ELECTRIC CO.	CHICAGO, ILL.
08664	BRISTOL CO. THE	WATERBURY, CONN.
09927	BURNDY CORP.	NORWALK, CONN.
13103	THERMALLOY CO.	DALLAS, TEX.
14555	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.
18533	CURTIS INSTRUMENTS INC.	MT. KISCO, N.Y.
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.
21335	FAFNIR BEARING CO. THE DIV. TEXTRON INC.	NEW BRITAIN, CONN.
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.
70276	ALLEN MFG. CO.	HARTFORD, CONN.
70903	BELDEN CORP.	CHICAGO, ILL.
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.
71615	COMMERCIAL PLASTICS CO.	MUNDELEIN, ILL.
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.
72135	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.
73734	FEDERAL SCREW PROD. INC.	CHICAGO, ILL.
75915	LITTELFUSE INC.	DES PLAINES, ILL.
76530	CINCH MONADNOCK MILLS DIV. TRW INC.	CITY OF INDUSTRY, CALIF.
76854	DAK MFG. CO. DIV. DAK ELECTRO/NETICS CORP.	CRYSTAL LAKE, ILL.
77342	AMERICAN MACHINE & FOUNDRY CO. POTTER & BRUMFIELD DIV.	PRINCETON, IND.
78139	SHAKEPROOF DIV. ILLINOIS TOOL WORKS	ELGIN, ILL.
78277	SIGMA INSTRUMENT INC.	S. BRAINTREE, MASS.
78553	TINNERMAN PROD. INC.	CLEVELAND, OHIO
79136	WALDES KOHINOOR INC.	LONG IS. CITY, N.Y.
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.
82339	SWITCHCRAFT INC.	CHICAGO, ILL.
83135	VICTORY ENGINEERING CORP.	SPRINGFIELD, N.J.
91525	AUGAT INC.	ATTELBORD, MASS.
91662	ELCO CORP.	WILLOW GROVE, PA.
98410	ETC INC.	CLEVELAND, OHIO

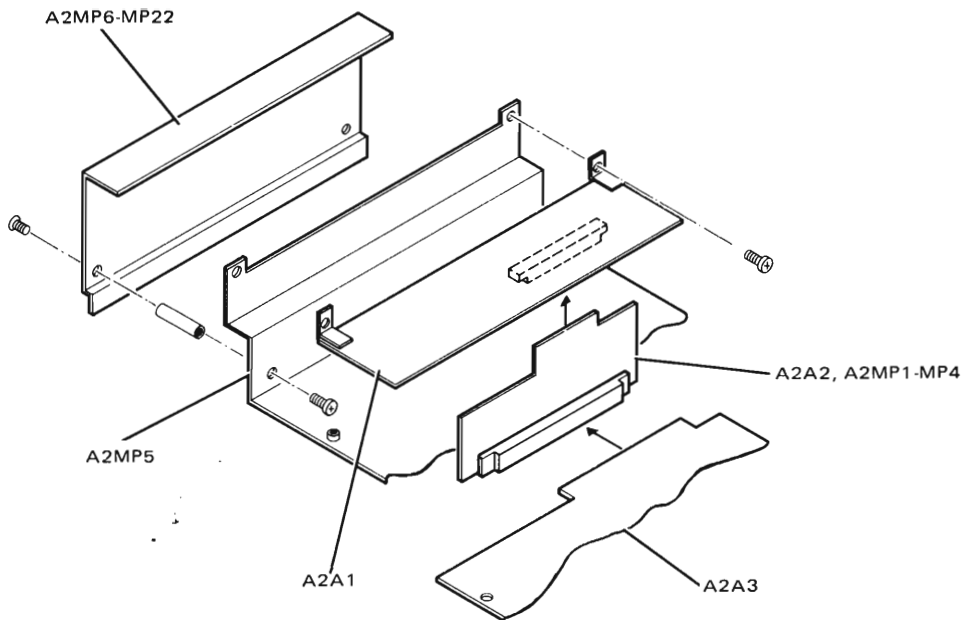


Figure 6-3. Control Panel A2 (07754-60240) Subassemblies, Parts Location Diagram

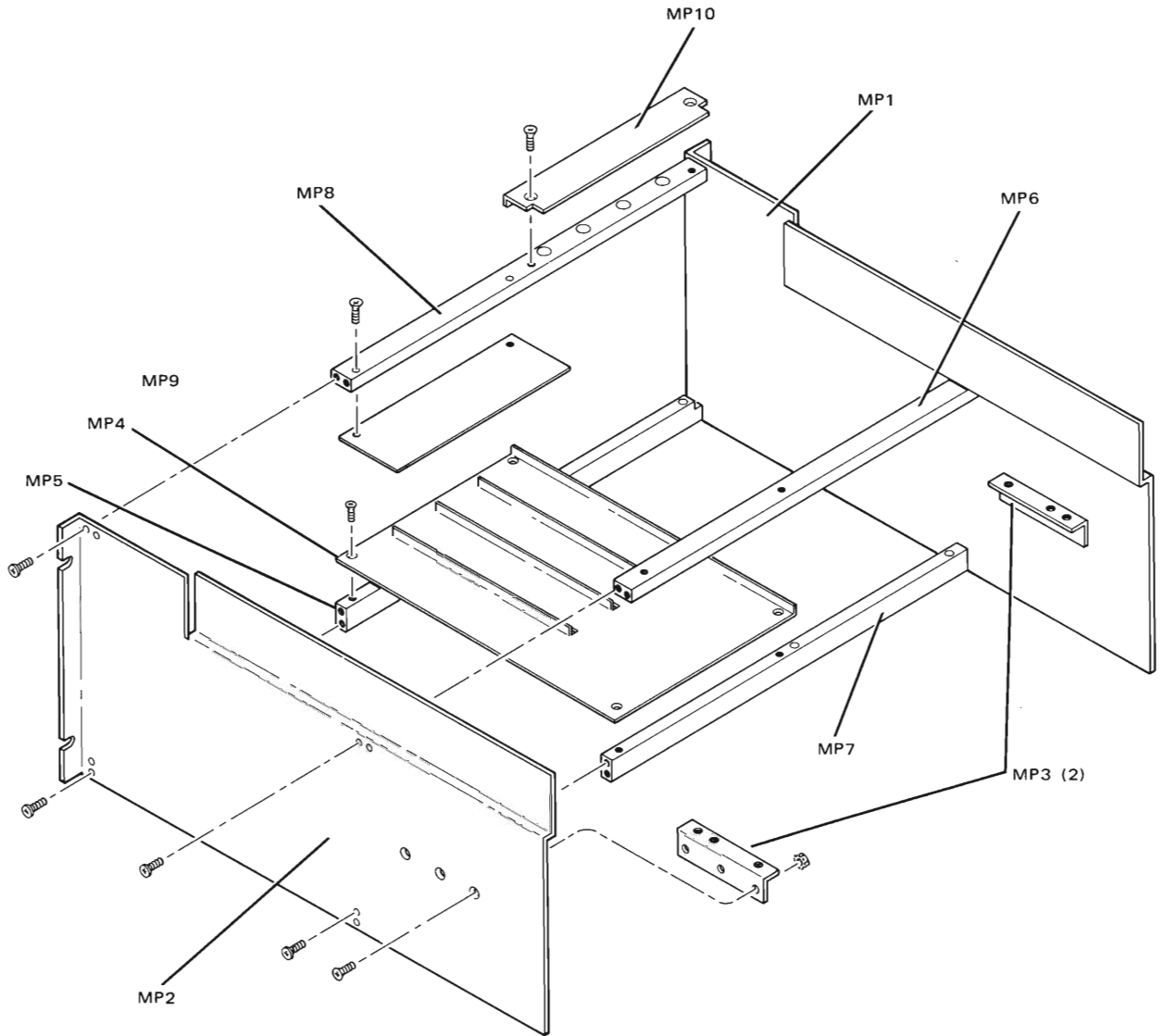
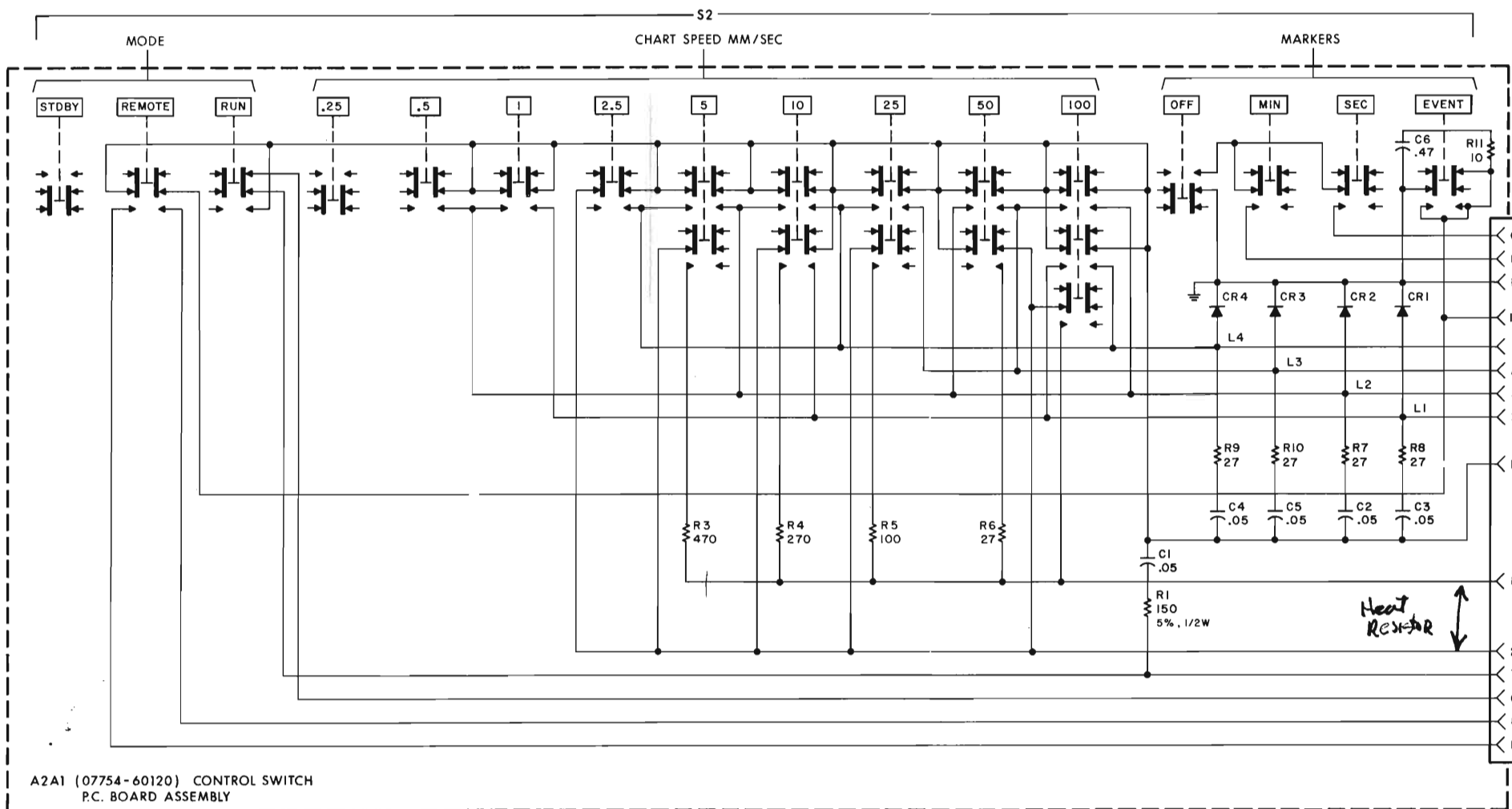
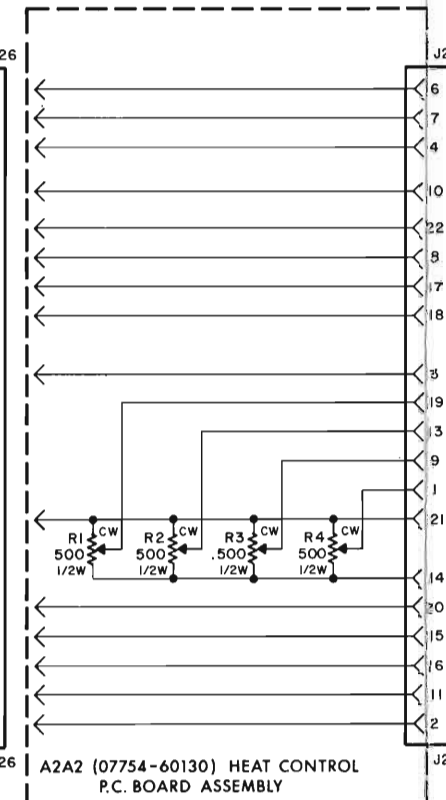


Figure 6-3.

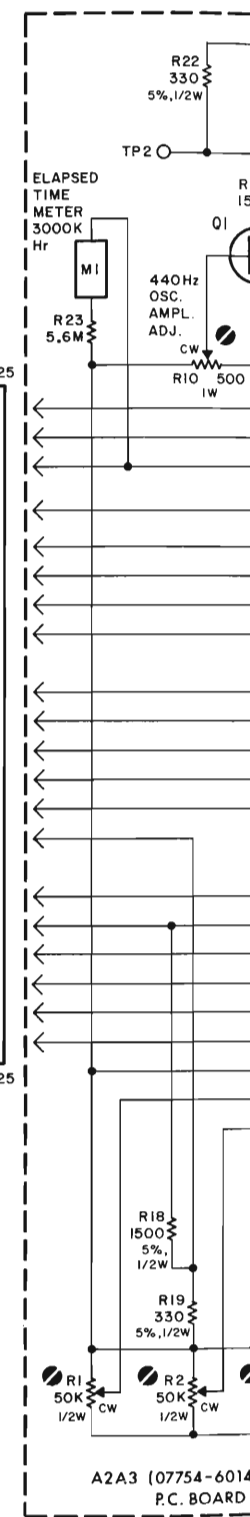
Figure 6-2. Unit Housing A1 (07754-60270), Parts Location Diagram



A2A1 (07754-60120) CONTROL SWITCH
P.C. BOARD ASSEMBLY



A2A2 (07754-60130) HEAT CONTROL
P.C. BOARD ASSEMBLY



A2A3 (07754-6014)
P.C. BOARD

- NOTES:
1. UNLESS OTHERWISE NOTED
ALL RESISTANCE 5%, 1/4W
 2. MODE SWITCH SHOWN IN STANDBY,
CHART SPEED (.25), & MARKERS OFF.
EACH SECTION OF S2 SWITCH
IS INTERLOCKING.

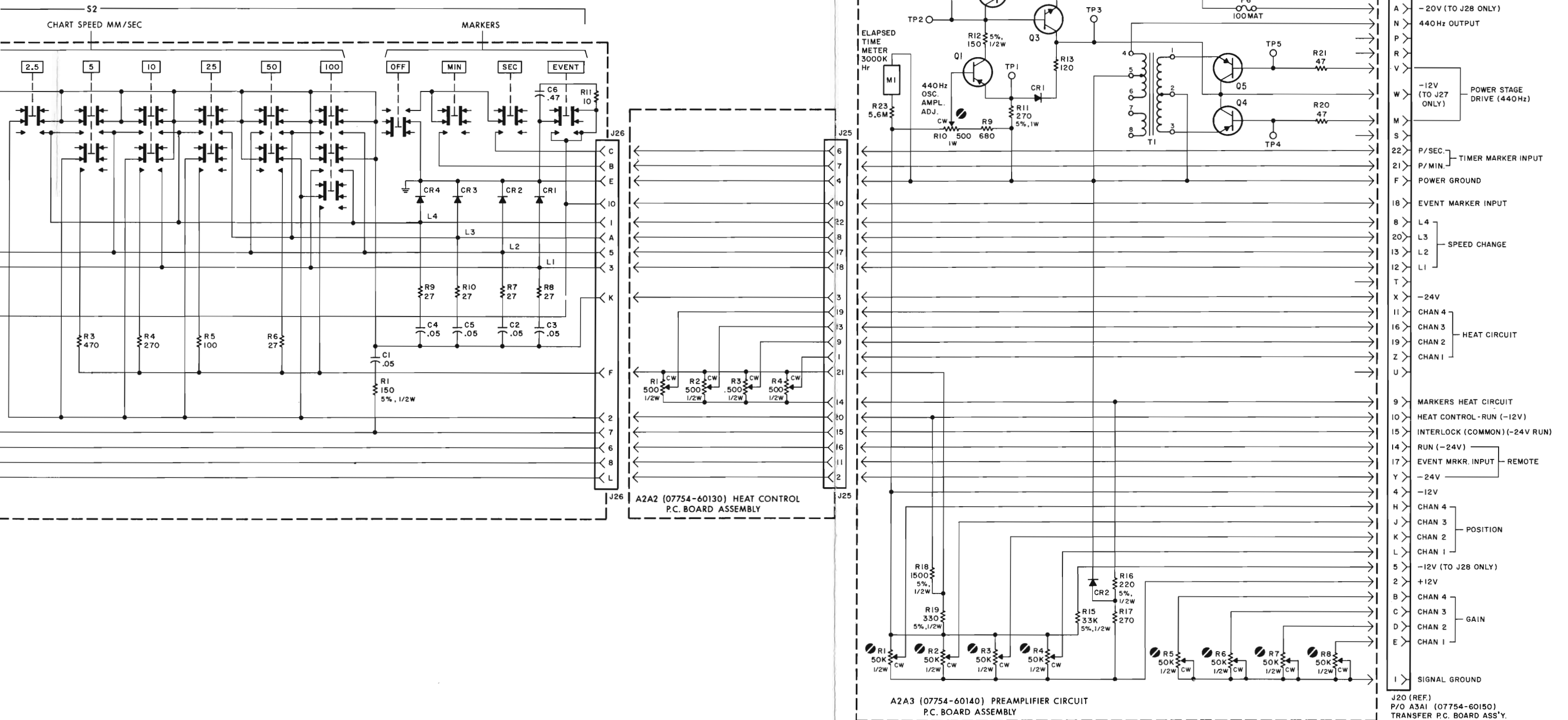


Figure 6-4. Control Panel A2 Schematic Diagram

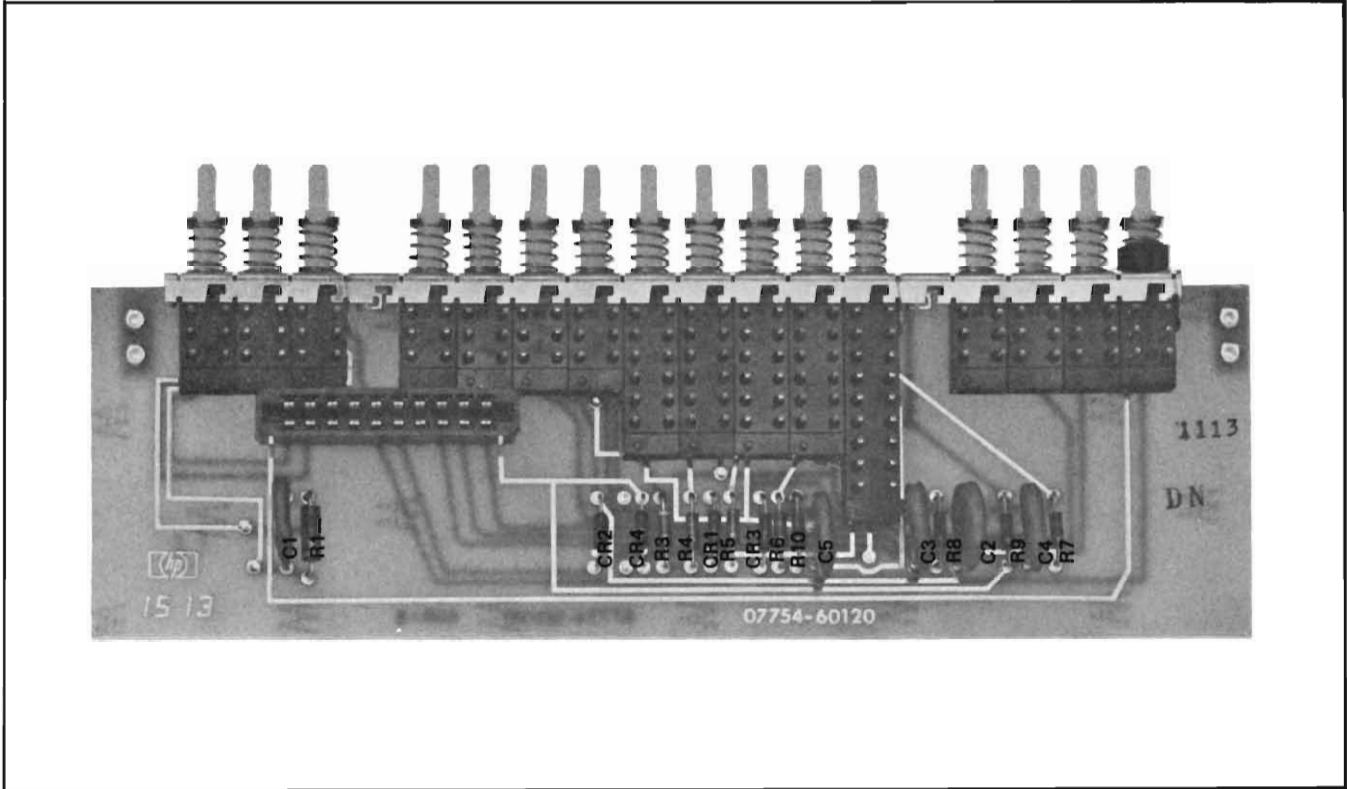


Figure 6-5. Control Switch Board A2A1 (07754-60120) Component Location Diagram

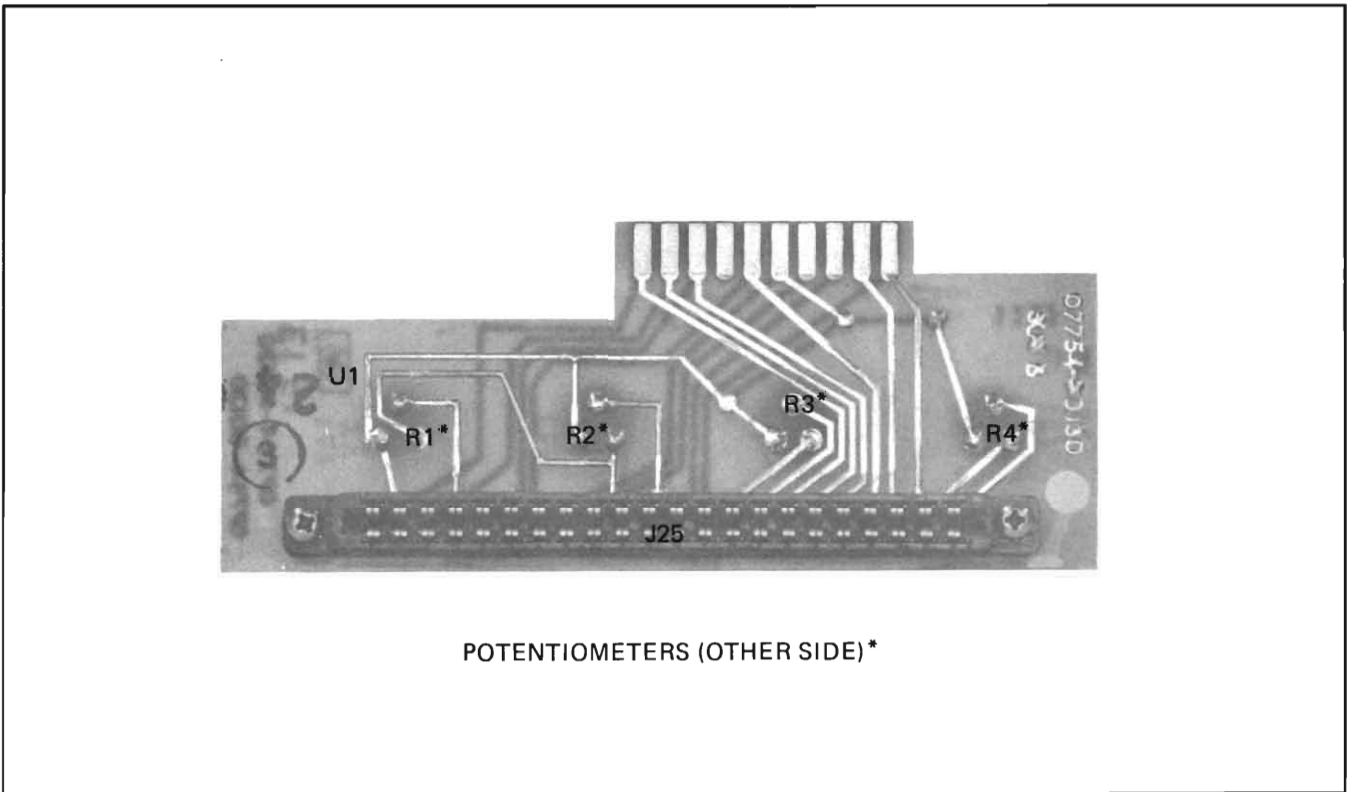


Figure 6-6. Heat Potentiometer Board A2A2 (07754-60130) Component Location Diagram

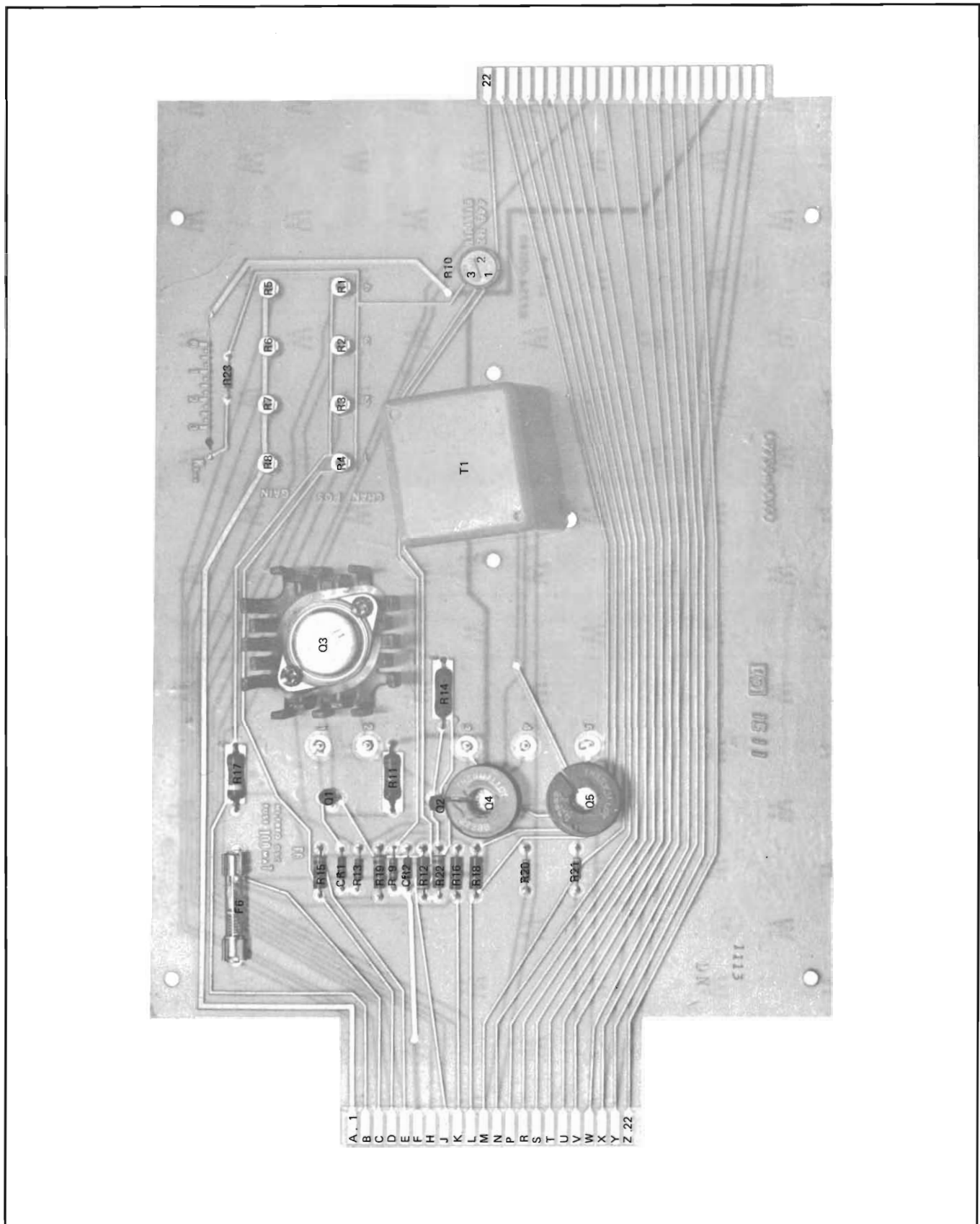


Figure 6-7. Preamplifier Power Supply Board A2A3 (07754-60140) Component Location Diagram

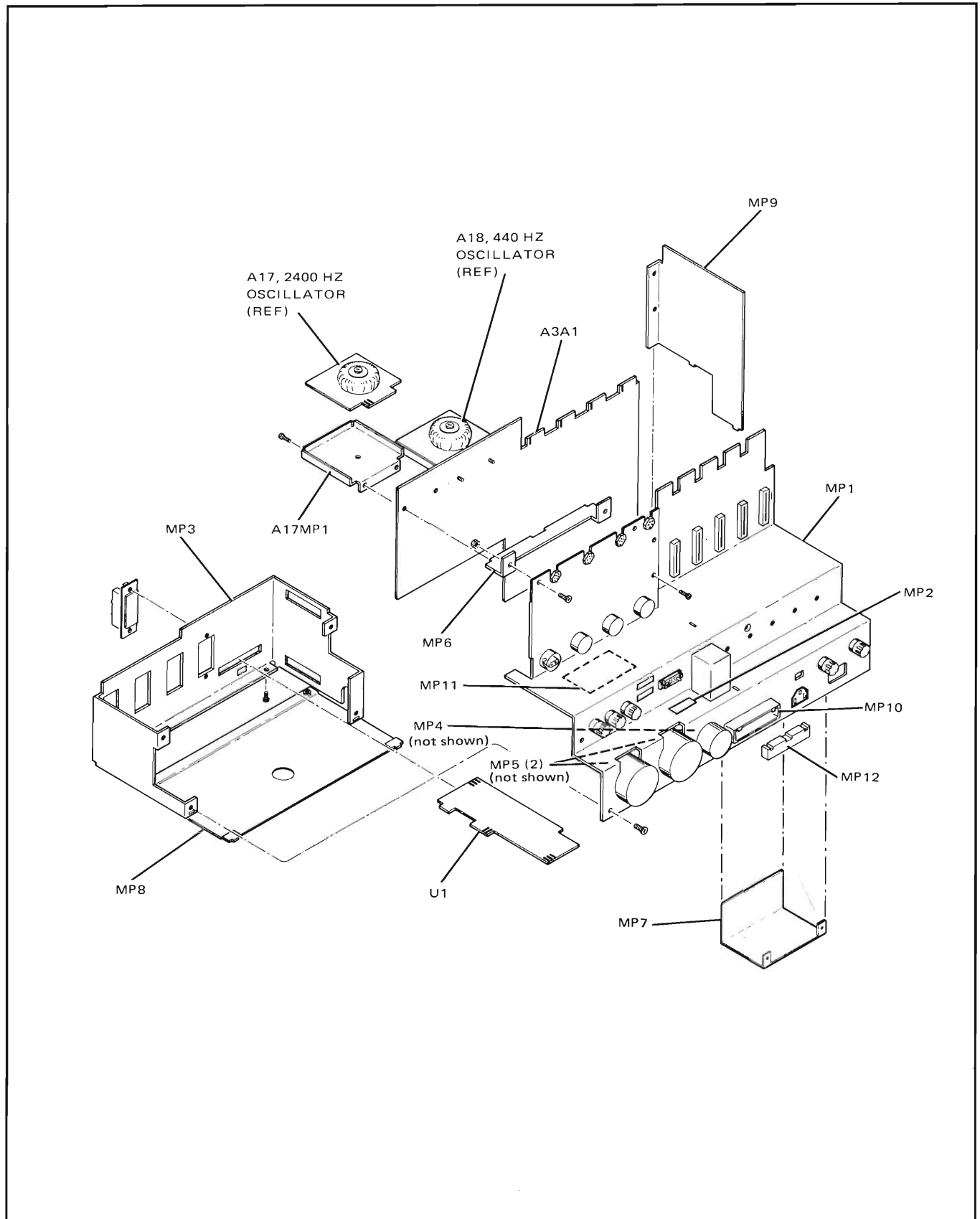


Figure 6-8. Power Supply A3, Exploded View

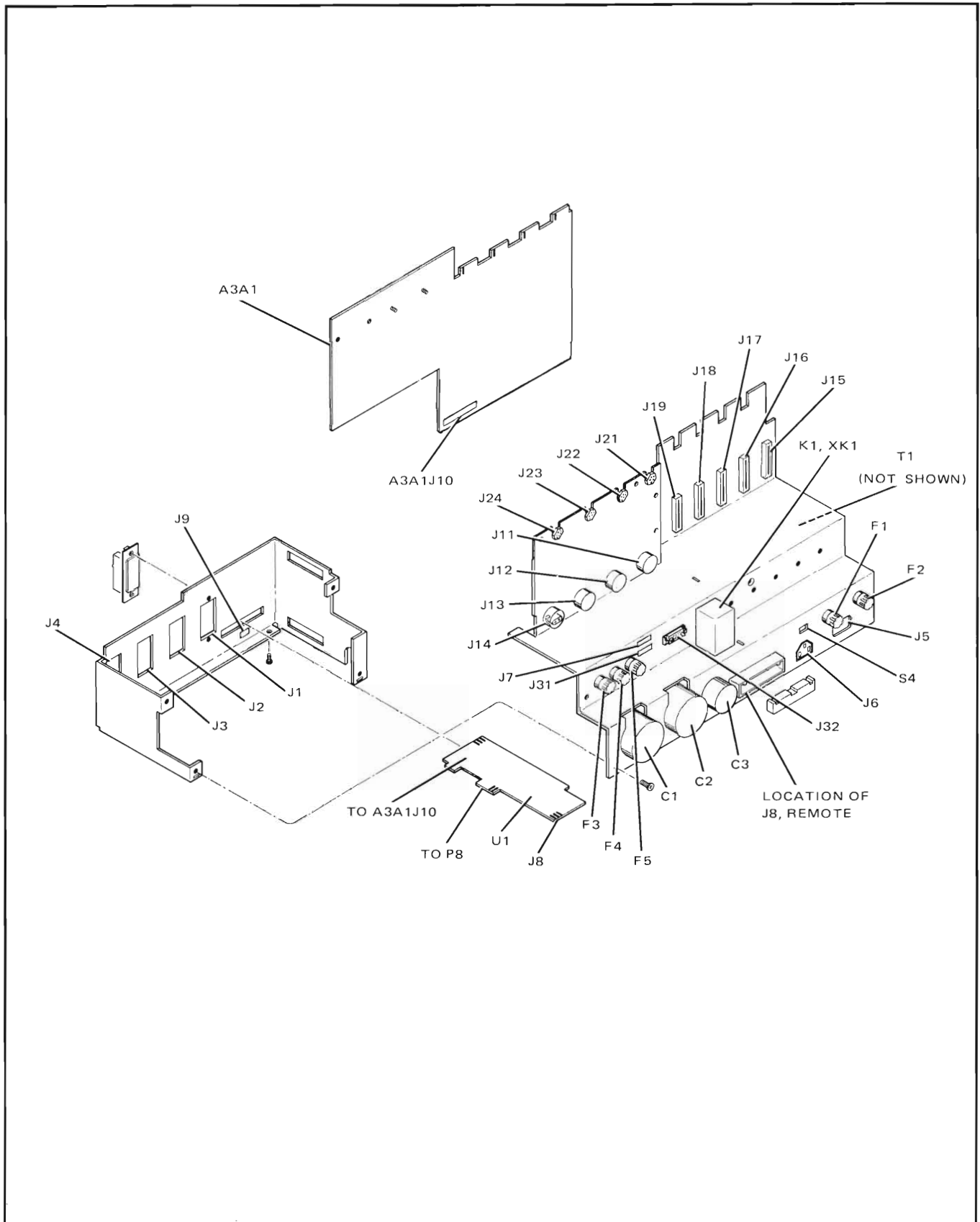


Figure 6-9 Power Supply A3, Electrical Parts

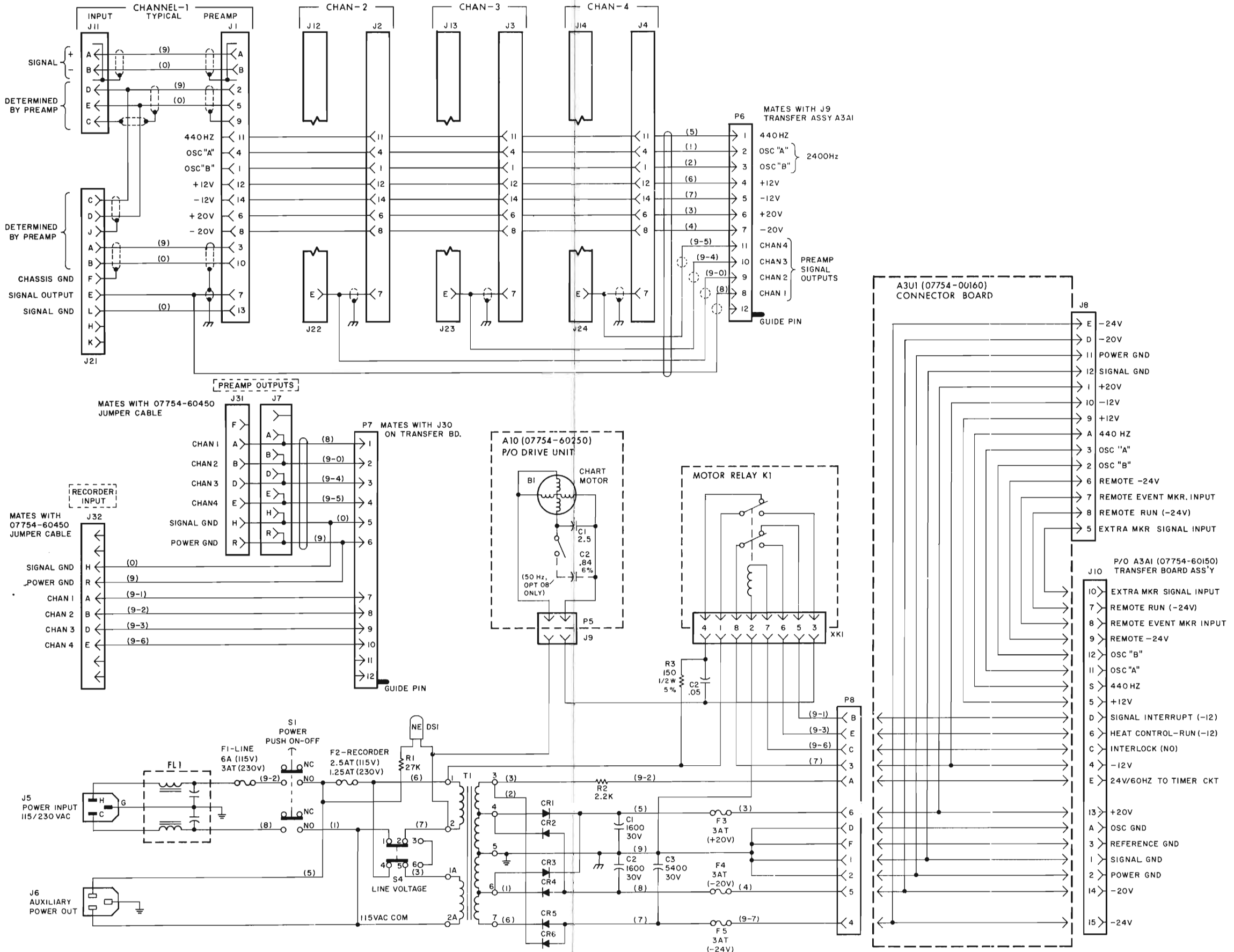


Figure 6-10. Power Supply A3, Schematic Diagram (Less A3A1)

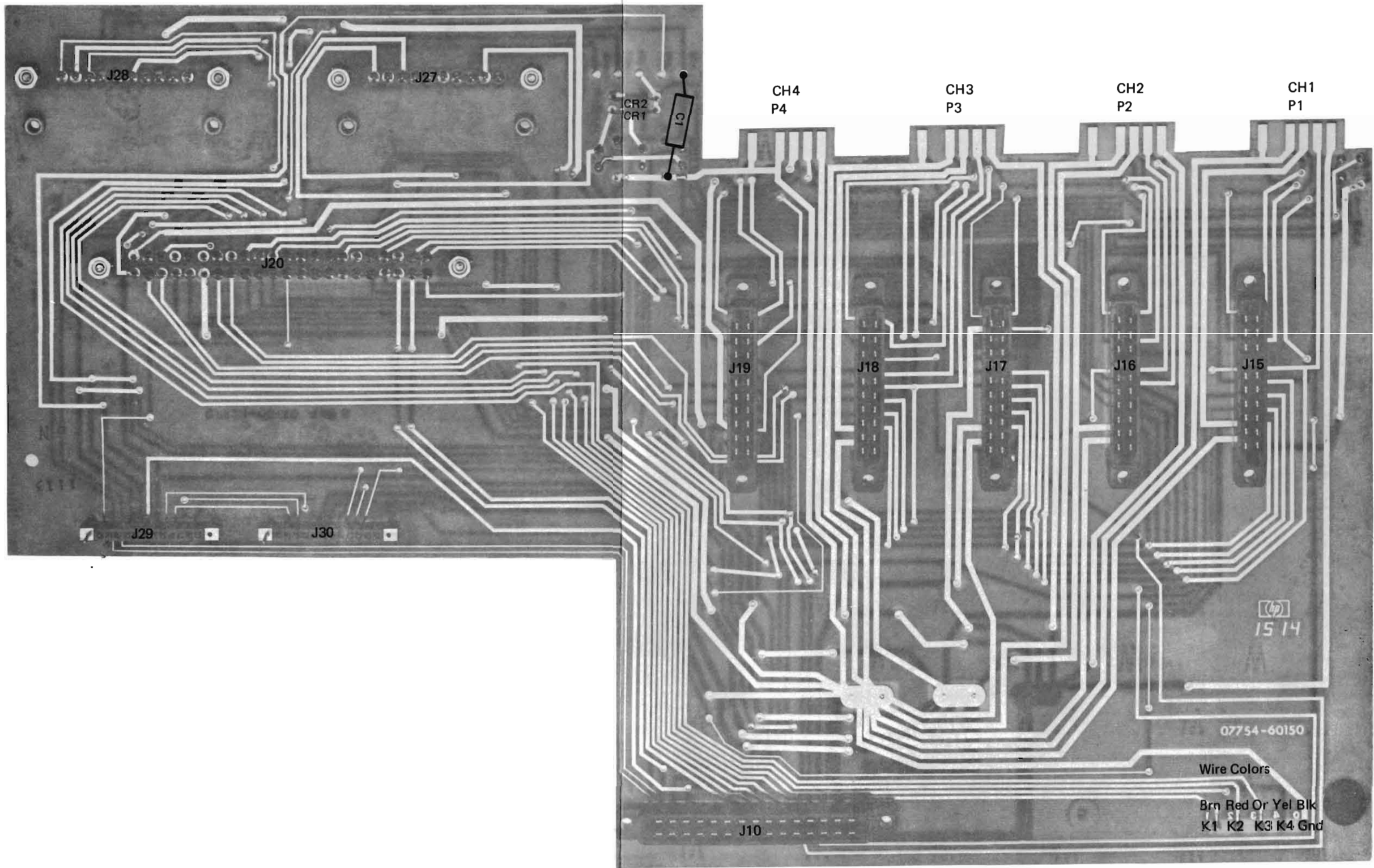


Figure 6-11. Transfer Board A3A1 (07754-60150) Component Location Diagram

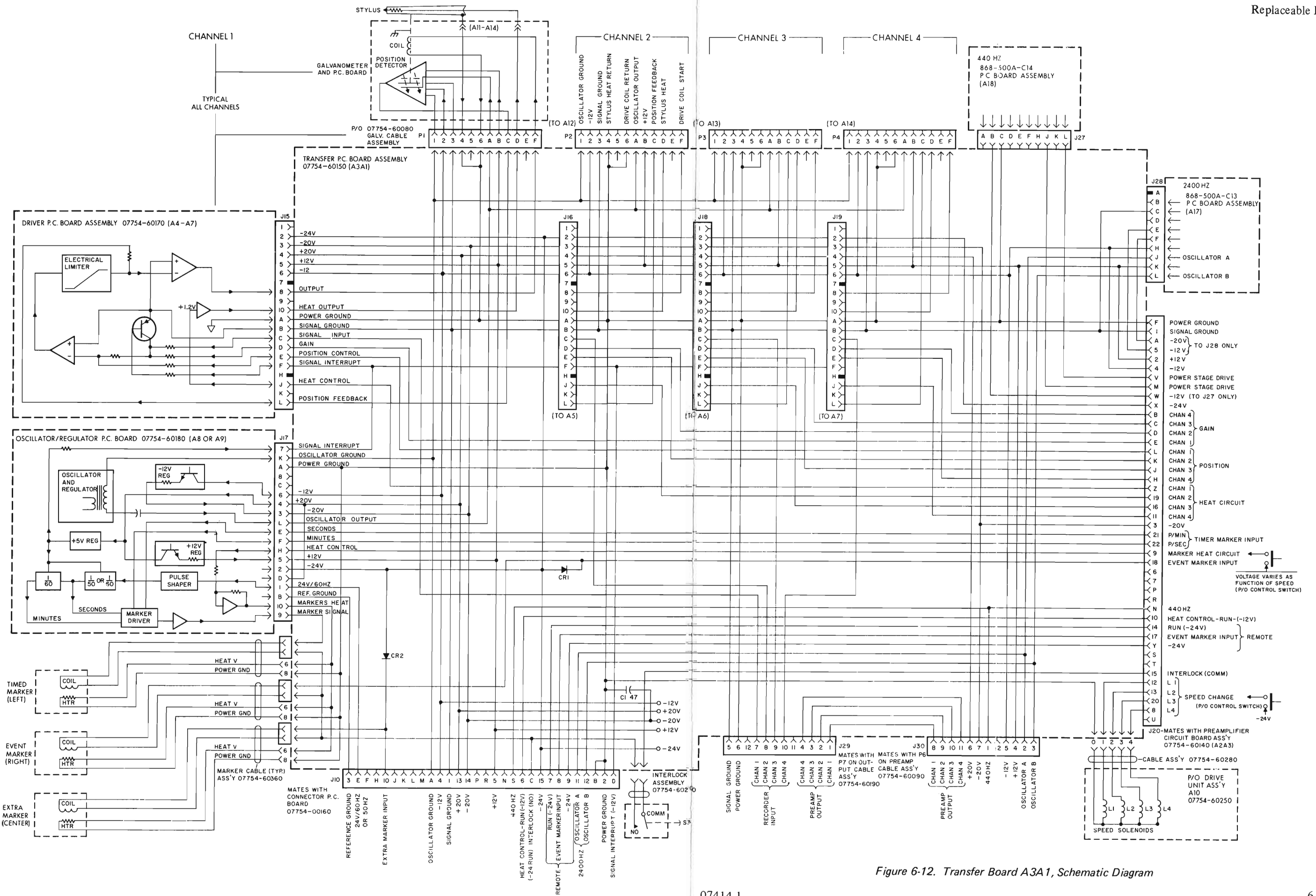


Figure 6-12. Transfer Board A3A1, Schematic Diagram

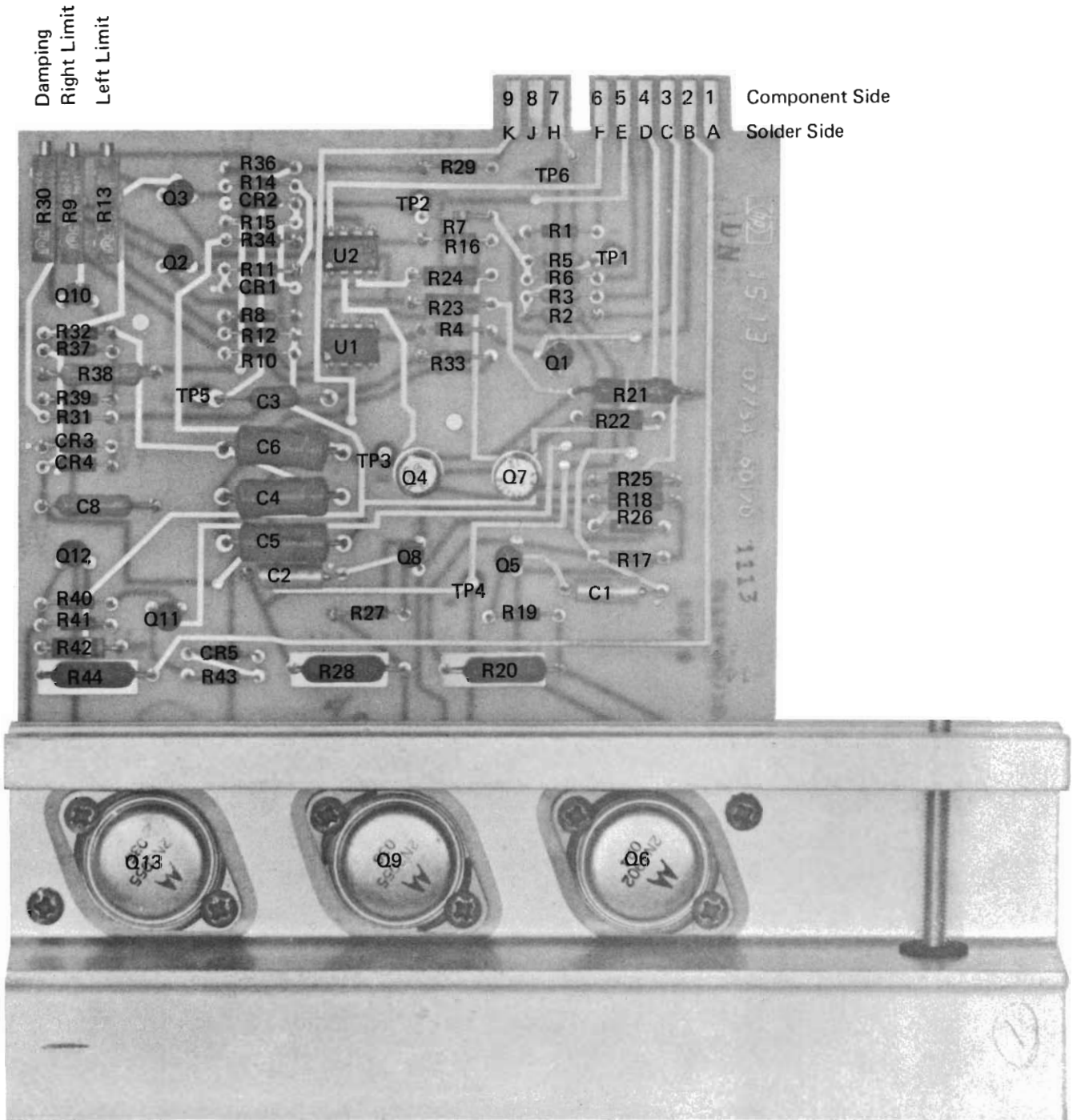


Figure 6-13. Driver Amplifier A4, A5, A6, A7 (07754-60170) Component Location Diagram

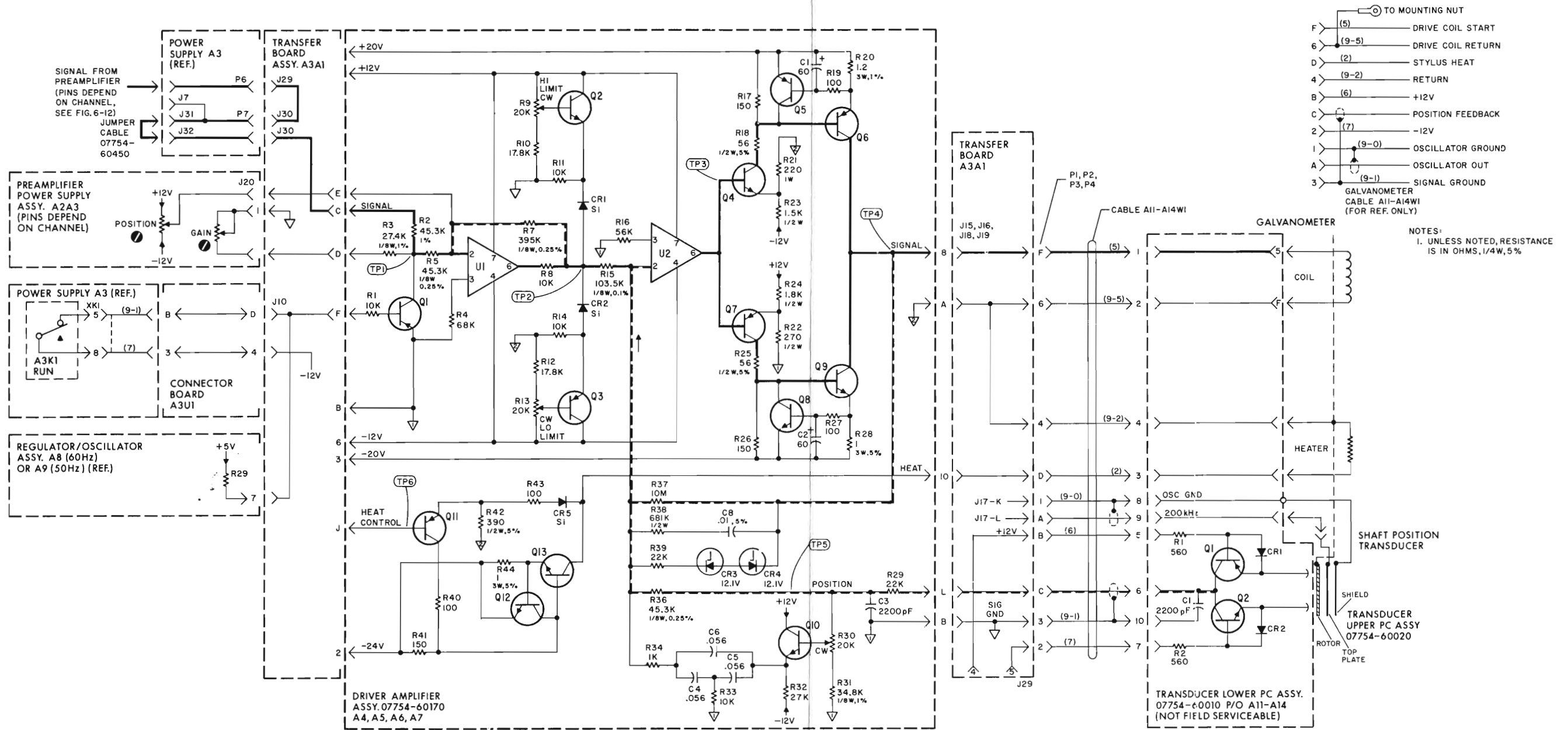
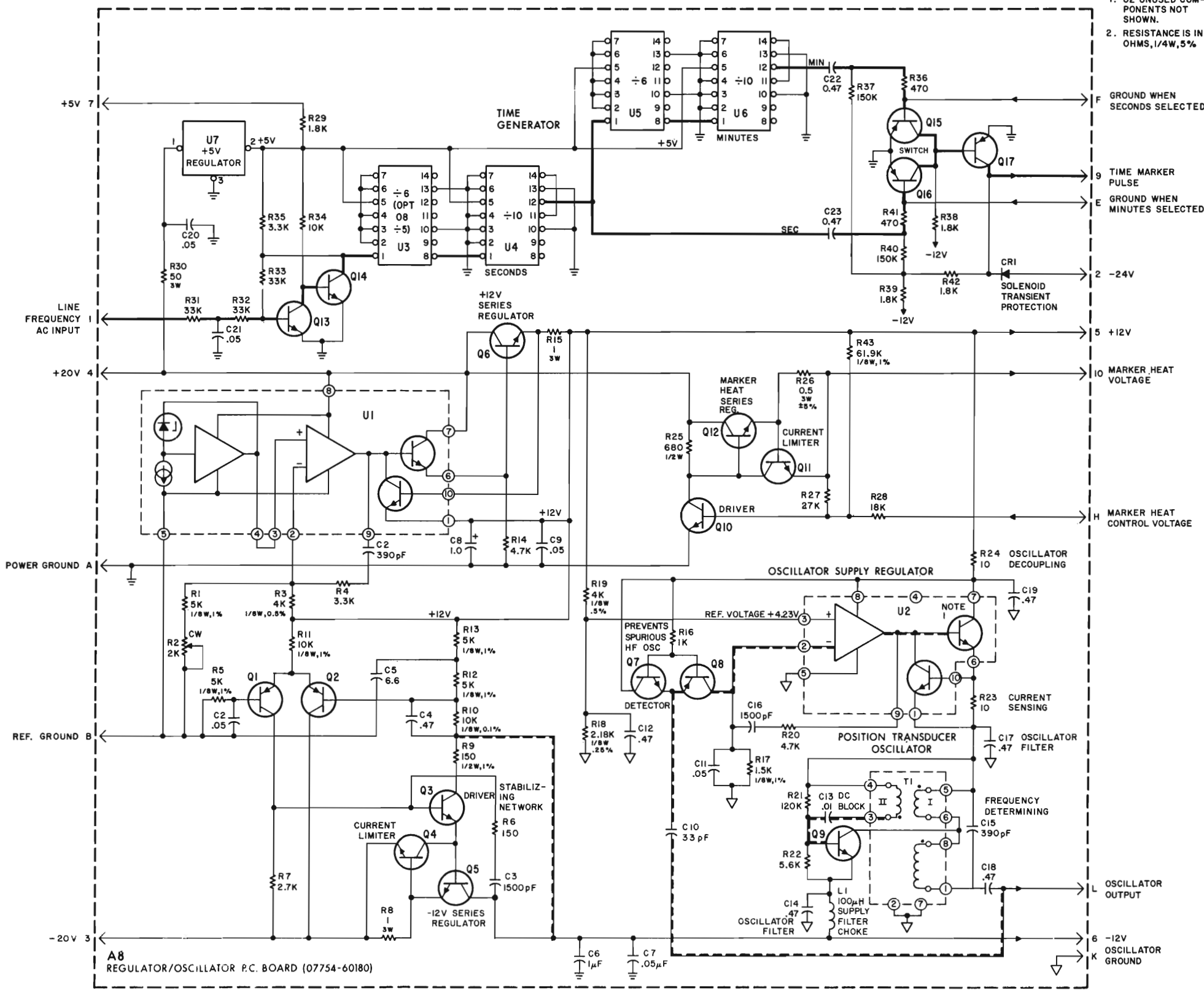


Figure 6-14. Driver Amplifier A4, A5, A6, A7; Schematic Diagram

- NOTES:
 1. U2 UNUSED COMPONENTS NOT SHOWN.
 2. RESISTANCE IS IN OHMS, 1/4W, 5%



A8
 REGULATOR/OSCILLATOR P.C. BOARD (07754-60180)

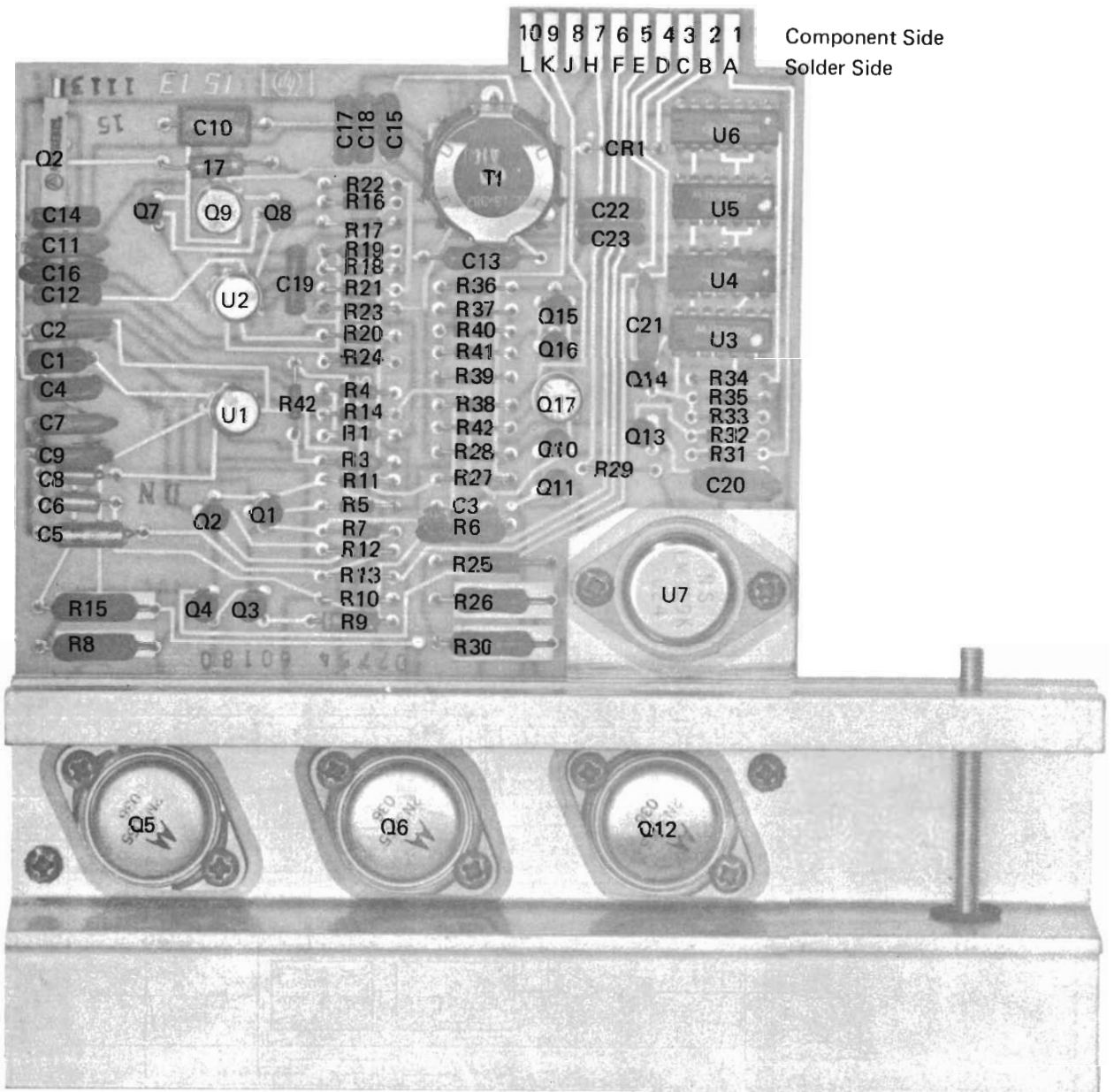


Figure 6-15. Regulator/Oscillator A8 (60 Hz, 07754-60180) or A9 (50 Hz, 07754-60181)
 Component Location and Schematic Diagrams

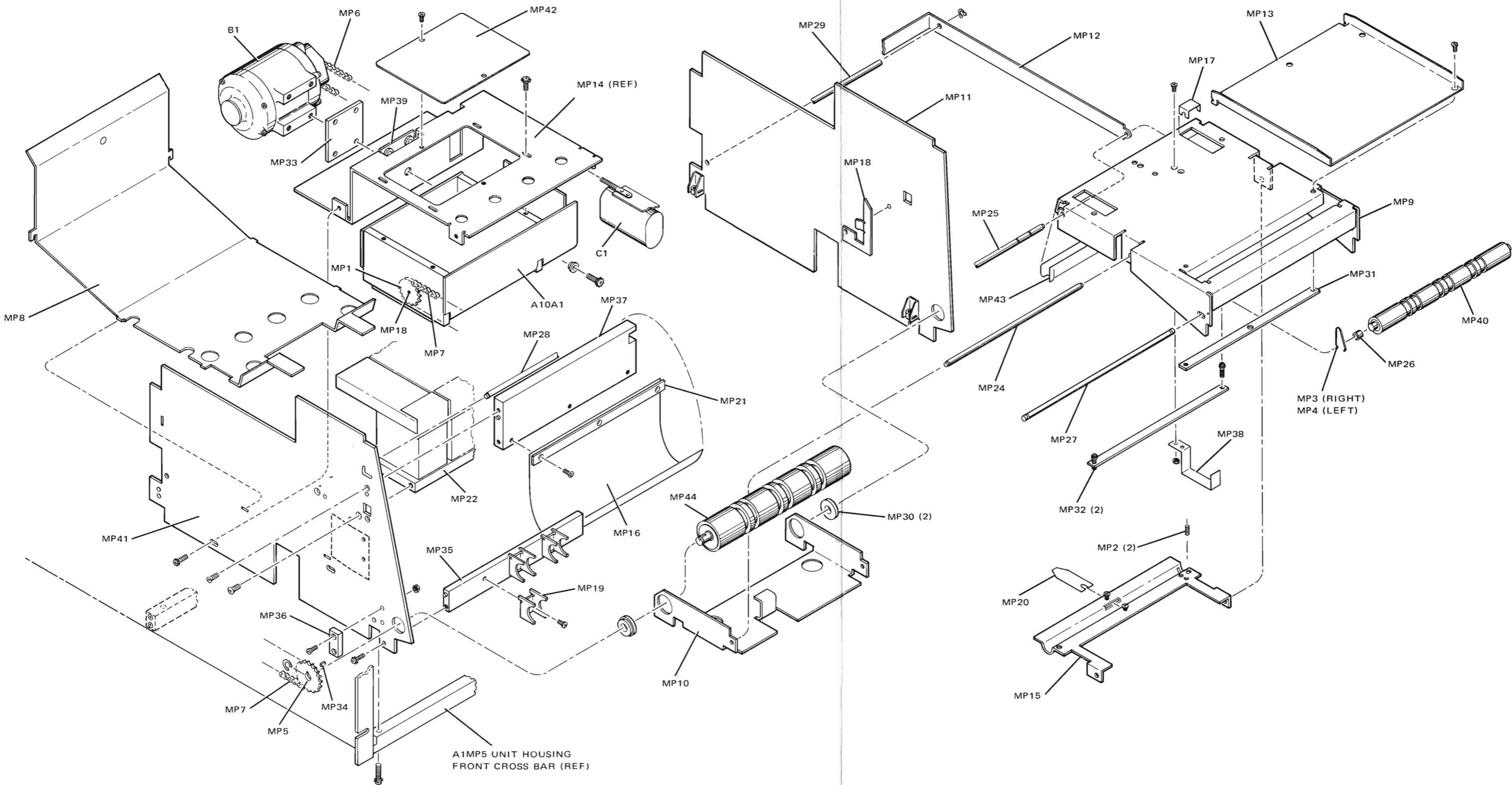
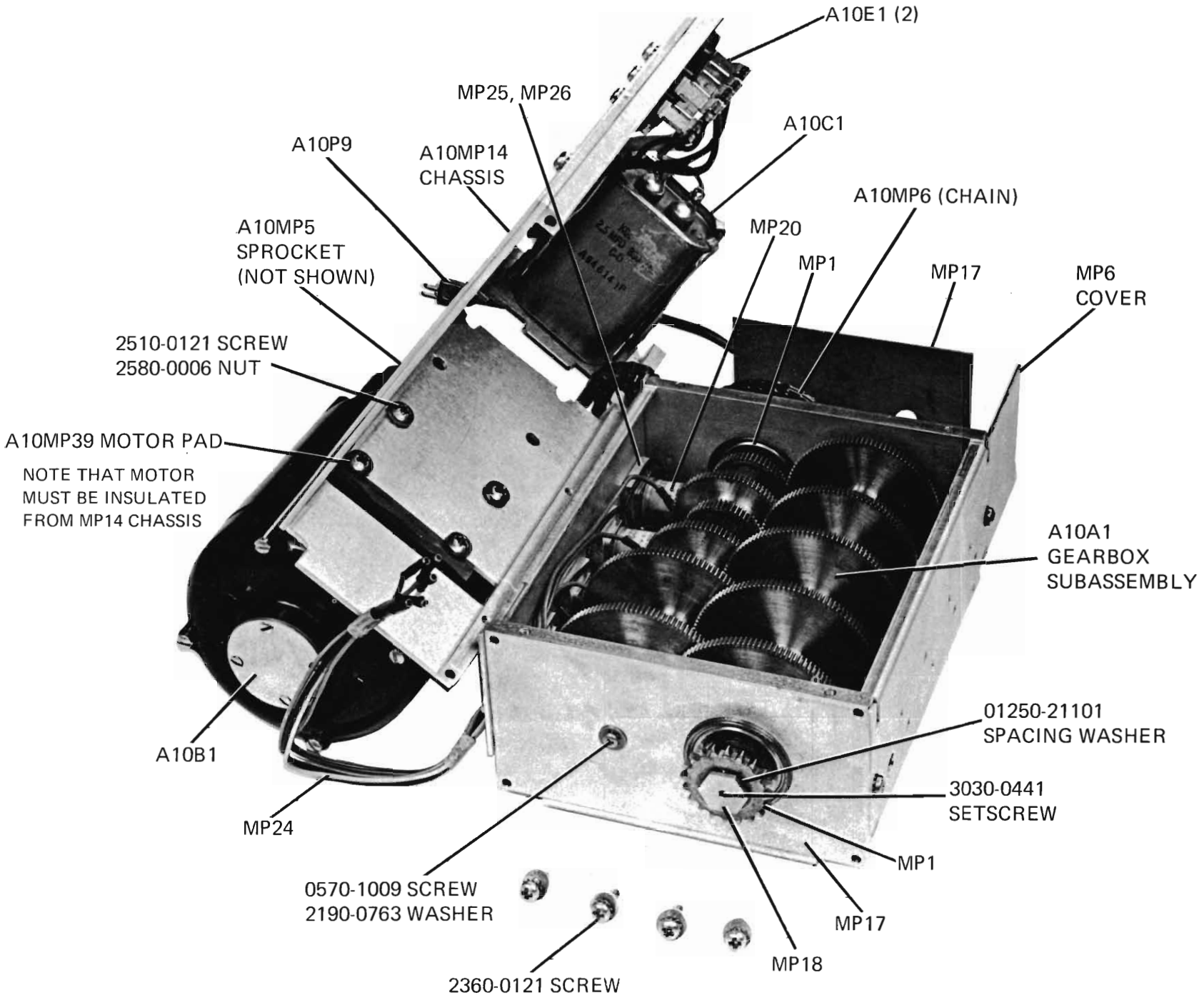


Figure 6-16. Drive Unit A10 (07754-60250) Subassemblies, Parts Location Diagram



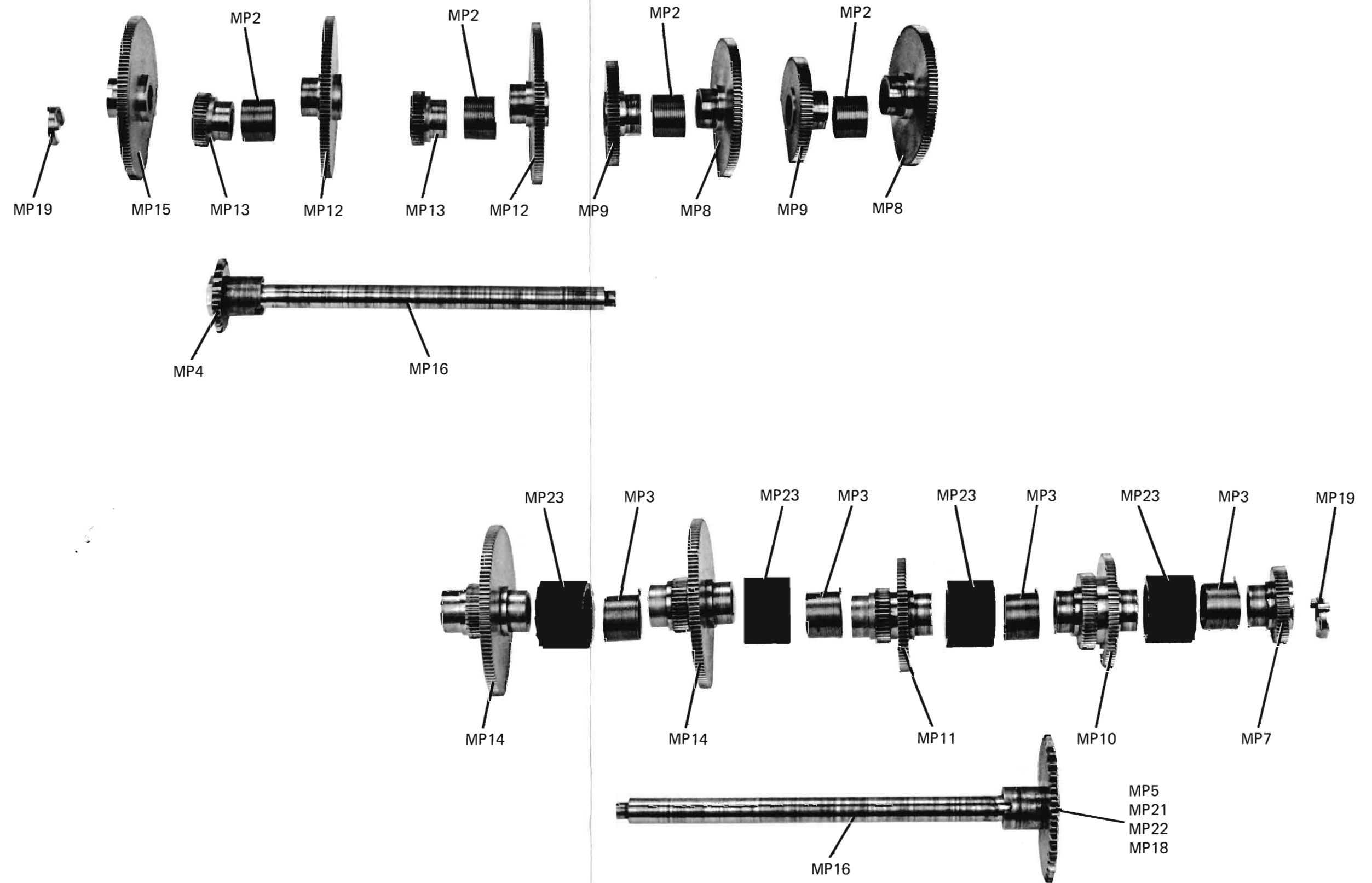
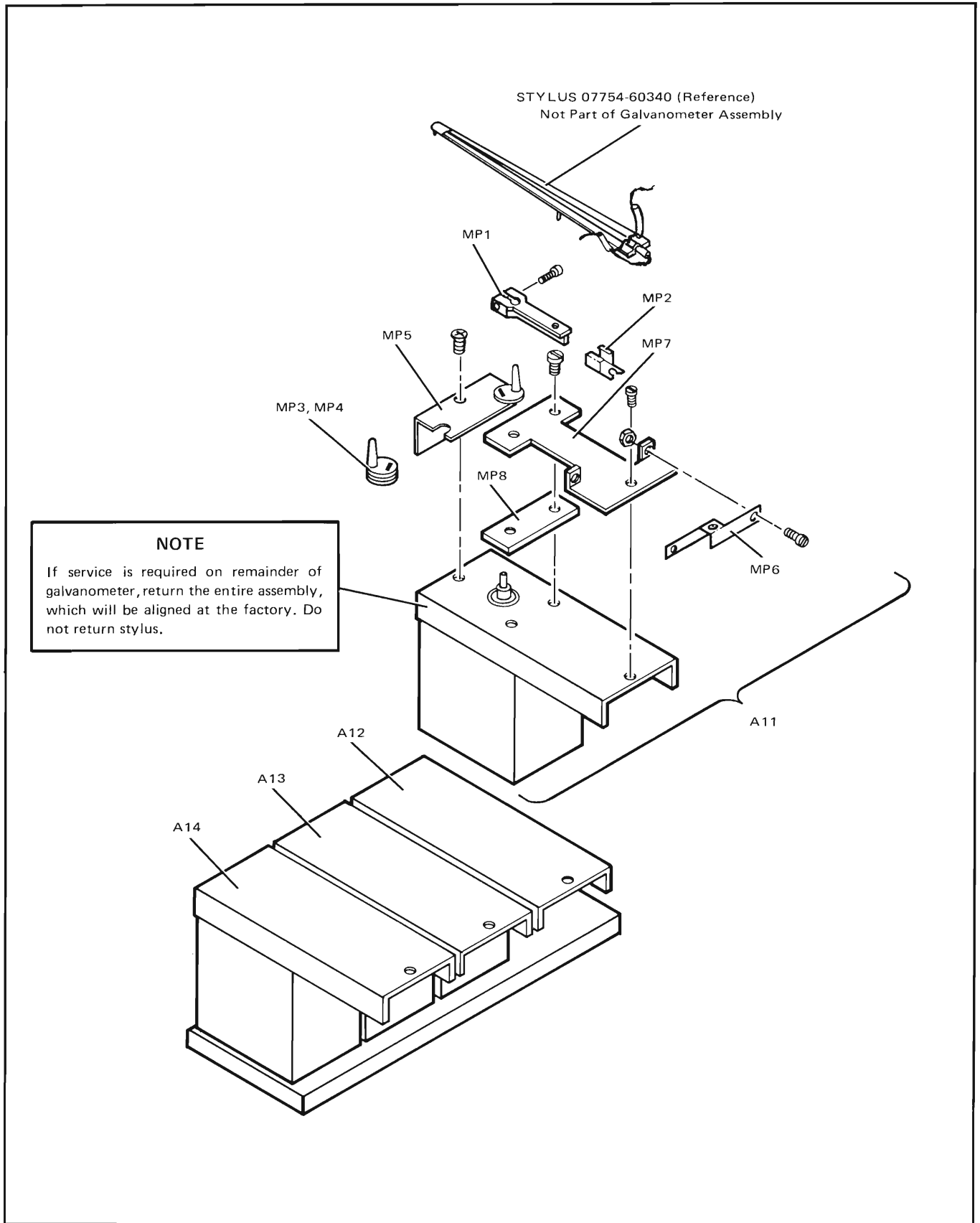


Figure 6-17. Gearbox A10A1 (07754-60040), Parts Location Diagrams



NOTE
If service is required on remainder of galvanometer, return the entire assembly, which will be aligned at the factory. Do not return stylus.

Figure 6-18. Galvanometer A11, A12, A13, A14 (07754-60070), Parts Location Diagram

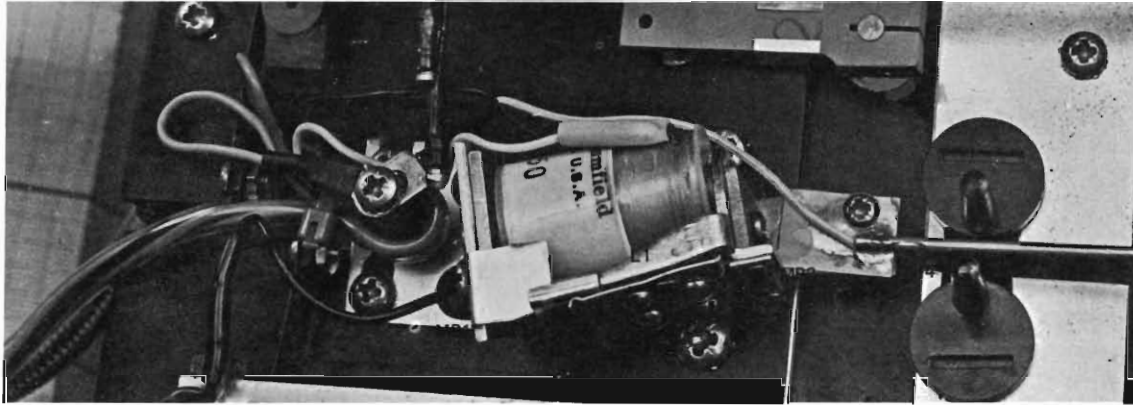


Figure 6-19. Marker A15, A16 (07754-60350) Component Location Diagram

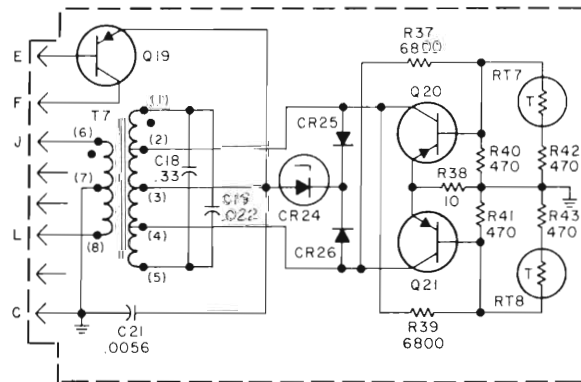
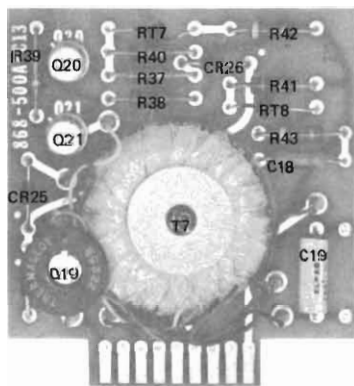


Figure 6-20. Oscillator, 2400 Hz A17 (868-500AC13)

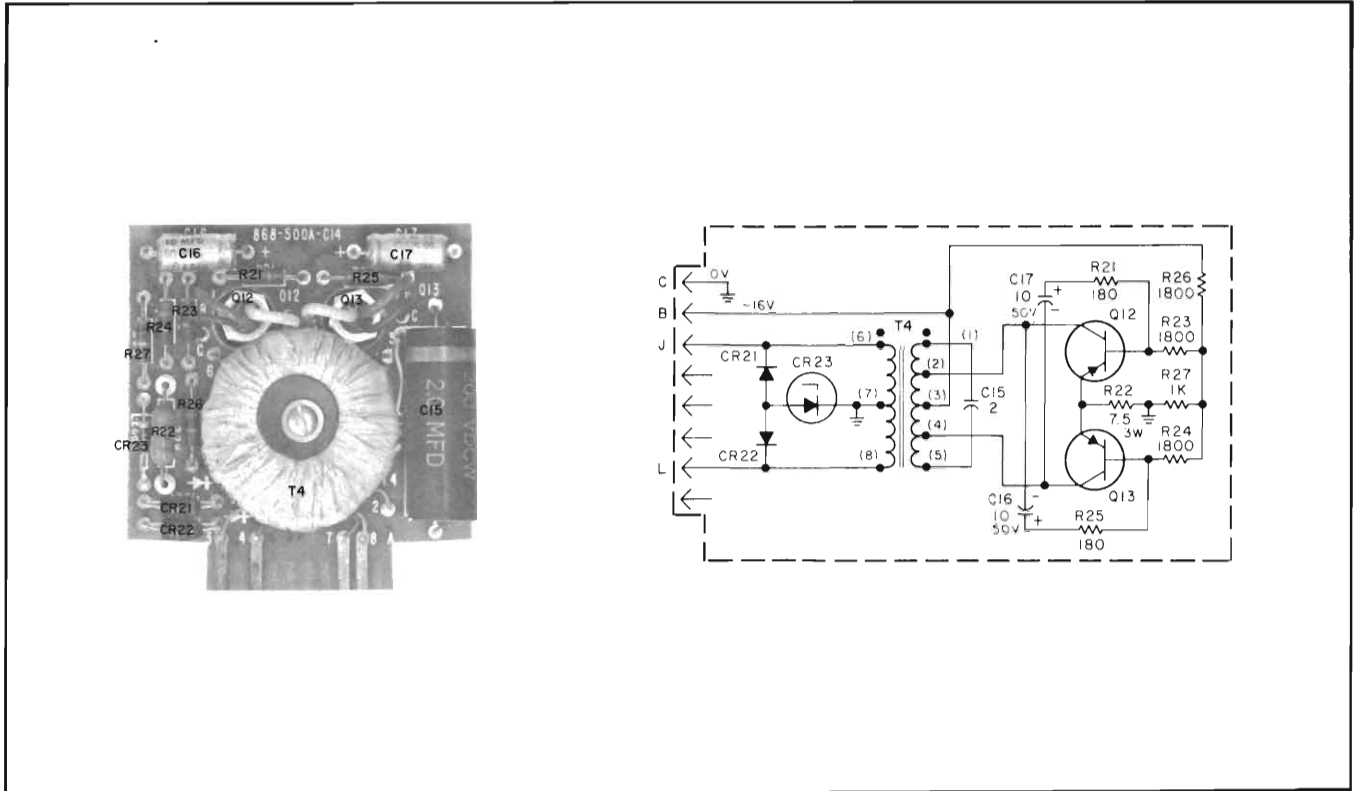
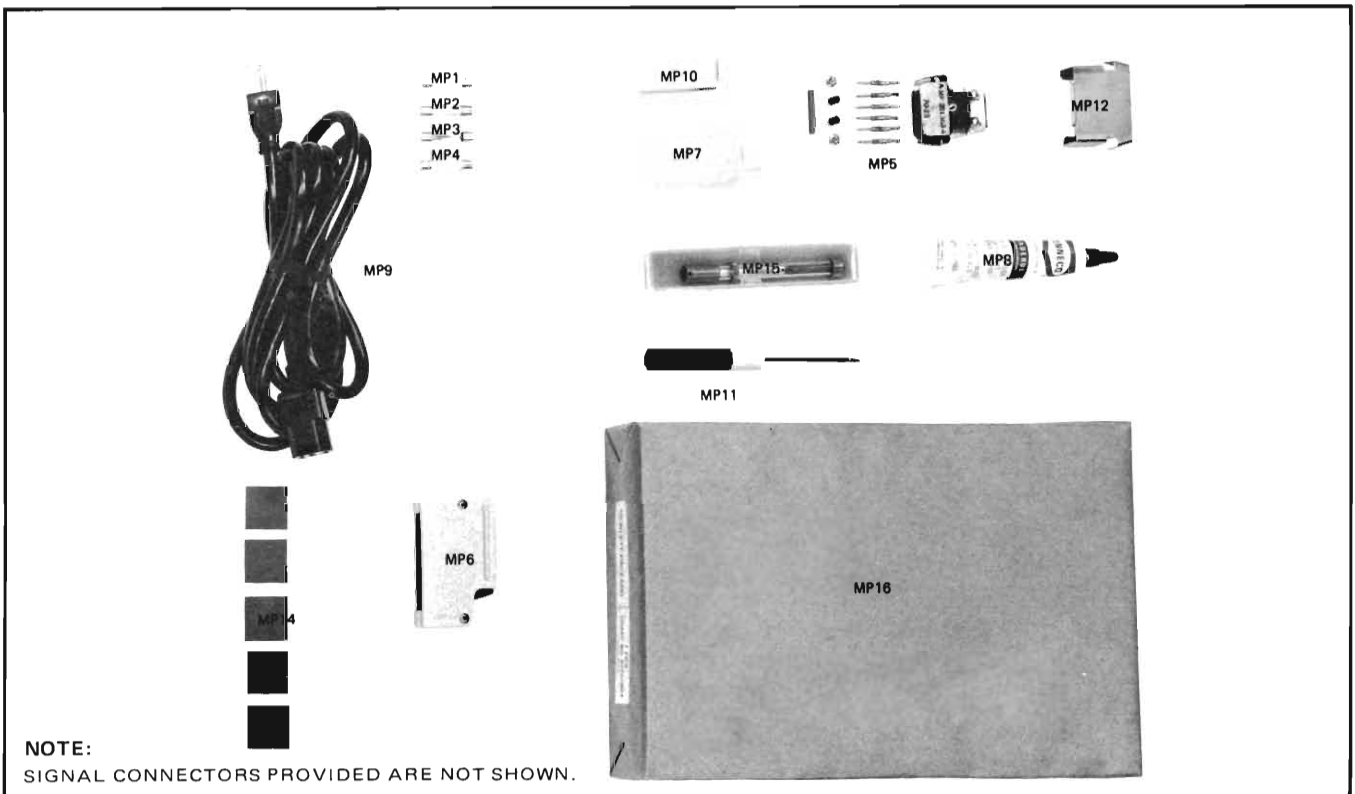


Figure 6-21. Oscillator, 440 Hz A18 (868-500AC14)



NOTE:
SIGNAL CONNECTORS PROVIDED ARE NOT SHOWN.

Figure 6-22. Accessories, A19 (Reference)



APPENDIX I
BACKDATING INFORMATION

This backdating sheet makes the Operating and Service Manual applicable to instruments with serial prefix numbers lower than **1145A**. Check the following table for your instrument serial prefix (first five digits of a ten digit serial number) and make any listed changes in the manual. For instruments with other serial prefix numbers, a MANUAL CHANGES or PUBLICATION CHANGE NOTICE sheet should be included with this manual. If not, the information can be supplied by your nearest Hewlett-Packard Sales and Service office (see list at the rear of this manual).

SERIAL PREFIX	MAKE MANUAL CHANGES	SERIAL PREFIX	MAKE MANUAL CHANGES
1145A	NONE		
1135A	CHANGE 1		
1113A	CHANGE 1, 2		

CHANGE 1: Page 6-4, Table 6-1; A2A1C6 and A2A1R11 were not present.
 Page 6-9, Table 6-1; A4U1 and A4U2 were Integrated Circuit 1820-0217.
 Page 6-10, Table 6-1; A8T1 was 9100-2353.
 Page 6-12, Table 6-1; A9T1 was 9100-2353.
 Page 6-14, Table 6-1; (3) 07754-00860 Shim was Quantity (1).
 Page 6-20, Figure 6-4; C6 and R11 (A2A1 top right corner) were not present.

CHANGE 2: Page 6-7, Table 6-1; A3A1C1 was not present.
 Page 6-26, Figure 6-11; A3A1C1 was not present.



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Phoenix 85034
Tel: (602) 252-5061
TWX: 910-951-1330

5737 East Broadway
Tucson 85716
Tel: (602) 298-2313
TWX: 910-952-1162

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111 East Avenue
Norwalk 06851
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TWX: 710-468-3750

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621 Commonwealth Avenue
Orlando
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TWX: 810-850-0113

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Orlando 32809
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Syracuse 13211
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TWX: 710-511-0482

I Crossways Park West
Woodbury 11797
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TWX: 610-831-2431

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4519 Canada Way
North Burnaby 2
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Tel: (204) 786-7581
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2745 Dutch Village Rd.
Suite 206
Halifax
Tel: (902) 455-0511
TWX: 610-271-4482

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880 Lady Ellen Place
Ottawa 3
Tel: (613) 225-6180, 225-6530
TWX: 610-562-1952

Hewlett-Packard (Canada) Ltd.
50 Galaxy Blvd.
Rexdale
Tel: (416) 677-9611
TWX: 610-492-4246

QUEBEC

Hewlett-Packard (Canada) Ltd.
275 Ymca Boulevard
Pointe Claire
Tel: (514) 697-4232
TWX: 610-422-3022
Telex: 01-20607

FOR CANADIAN AREAS NOT LISTED:

Contact Hewlett-Packard (Canada) Ltd. in Pointe Claire, at the complete address listed above.

CENTRAL AND SOUTH AMERICA

ARGENTINA

Hewlett-Packard Argentina
S.A.C. e.l.
Lavalle 1171 - 3
Buenos Aires
Tel: 35-0436, 35-0431, 35-0627
Telex: 012-1009
Cable: HEWPACK ARG

BRAZIL

Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua Frei Caneca 1119
Sao Paulo - 3. SP
Tel: 288-7111, 287-5858
Cable: HEWPACK Sao Paulo

Hewlett-Packard Do Brasil
Praca Dom Feliciano 78
Salas 806/808
Porto Alegre
Rio Grande do Sul (RS)-Brasil
Tel: 25-8470
Cable: HEWPACK porto alegre

Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua da Matriz 29
Botafogo ZC-02
Rio de Janeiro, GB
Tel: 246-4417
Cable: HEWPACK Rio de Janeiro

CHILE

General Machinery Co., Ltda.
Paraguay 494
Casilla 13910
Santiago
Tel: 31123, 31124
Cable: GEMCO Santiago

COLOMBIA

Instrumentacion
Henrik A. Langebaek & Kier Ltda.
Carrera 7 No. 48-59
Apartado Aereo 6287
Bogota, 1 D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogota
Telex: 44400 INSTCO

COSTA RICA

Lic. Alfredo Gallegos Gudián
Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San Jose

ECUADOR

A.F. Vizcaino Compania Ltda.
Av. Rio Amazonas No. 239
P.O. Box 2925
Quito
Tel: 527-088; 527-804
Cable: ASTOR Quito

EL SALVADOR

Electronic Associates
Apartado Postal 1682
Centro Comercial Gigante
San Salvador, El Salvador
Paseo Escalon 4649—4th Piso
Tel: 23-44-60
Cable: ELECAST

MEXICO

Hewlett-Packard Mexicana.
S.A. de C.V.
622 Adolfo Prieto
Col. del Valle
Mexico 12, D.F.
Tel: 543-4232; 523-1874
Telex: 0017-74507

NICARAGUA

Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable: ROTERAN Managua

PANAMA

Electrónico Balboa, S.A.
P.O. Box 4929
Ave. Manuel Espinosa No. 13-50
Bldg. Alina
Panama City
Tel: 230833
Telex: 3481003, Curundu,
Canal Zone
Cable: ELECTRON Panama City

PARAGUAY

Z.T. Melamed S.R.L.
Division: Aparatos y Equipos
Medicos
Salon de Exposicion y Escritorio:
Chile 482
Edificio Victoria—Planta Baja
Asuncion, Paraguay
Tel: 4-5069, 4-6272
Cable: RAMEL

PERU

Compañía Electro Medica S.A.
Ave. Enrique Canaval 312
San Isidro
Casilla 1030
Lima
Tel: 22-3900
Cable: ELMED Lima

PUERTO RICO

San Juan Electronics, Inc.
P.O. Box 5167
Ponce de Leon 154,
PDA, 3-PTA, de Tierra
San Juan, 00906
Tel: (809) 725-3342, 722-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

SURINAME

Surtel-Radio Holland N.V.
P.O. Box 155
Paramaribo
Tel: 72118
Cable: Treurniet Paramaribo

URUGUAY

Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RADIUM Montevideo

VENEZUELA

Hewlett-Packard de
Venezuela C.A.
Apartado 50933
Caracas
Tel: 71.88.05, 71.88.69, 72.99.30
Cable: HEWPACK Caracas
Telex: 39521146

FOR AREAS NOT LISTED, CONTACT:

Hewlett-Packard
INTERCONTINENTAL
3200 Hillview Avenue
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8461

EUROPE

AUSTRIA
Hewlett-Packard Ges.m.b.H.
Innstrasse 23/2
Postfach 45
A-1204 Vienna
Tel: (0222) 33 66 06-09
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1
B-1170 Brussels
Tel: (02) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

DENMARK
Hewlett-Packard A/S
Datavej 38
DK-3460 Birkerød
Tel: (01) 81 66 40
Cable: HEWPAK AS
Telex: 16640 hp as

Hewlett-Packard A/S
Torvet 9
DK-8600 Silkeborg
Tel: (06)-82-71-66
Telex: 16640 hp as
Cable: HEWPAK AS

FINLAND
Hewlett-Packard Oy
Bulevardi 26
P.O. Box 12185
SF-00120 Helsinki 12
Tel: 13 730
Cable: HEWPAK OYS Helsinki
Telex: 12-1563

FRANCE
Hewlett-Packard France
Quartier de Courtaboeuf
Boite Postale No. 6
F-91 Orsay
Tel: (1) 907 78 25
Cable: HEWPAK Orsay
Telex: 60048

Hewlett-Packard France
4 quai des Etoiles
F-69 Lyon 5ème
Tel: 78-42-63-45
Cable: HEWPAK Lyon
Telex: 31617

Hewlett-Packard France
29 rue de la Gare
F-31 Blagnac
Tel: (61) 85 82 29
Telex: 51957

GERMAN FEDERAL REPUBLIC
Hewlett-Packard Vertriebs-GmbH
Berliner Strasse 117
Postfach 560 140
D-6 Nieder-Eschbach/Ffm 56
Tel: (0611) 50 04-1
Cable: HEWPAKSA Frankfurt
Telex: 41 32 49 FRA

Hewlett-Packard Vertriebs-GmbH
Herrenbergerstrasse 110
D-7030 Boblingen, Württemberg
Tel: (07031) 66 72 86
Cable: HEPAK Boblingen
Telex: 72 65 739

Hewlett-Packard Vertriebs-GmbH
Vogelsanger Weg 38
D-4 Düsseldorf
Tel: (0211) 63 80 11/35
Telex: 85/86 533

Hewlett-Packard Vertriebs-GmbH
Wendenstr. 23
D-2 Hamburg 1
Tel: (0411) 24 05 51/52
Cable: HEWPAKSA Hamburg
Telex: 21 53 32

Hewlett-Packard Vertriebs-GmbH
Unterhagering Strasse 28
ISAR Center
D-8012 Ottobrunn
Tel: (0811) 6013 061-7
Cable: HEWPAKSA München
Telex: 52 19 85

(West Berlin)
Hewlett-Packard Vertriebs-GmbH
Wilmersdorfer Strasse 113/114
D-1000 Berlin W. 12
Tel: (0311) 3137046
Telex: 18 34 05

GREECE
Etanem Electro-Medical
Company
5-7, Skoufa Street
Athens 136
Tel: 626-972
Cable: ETANEM Athens

ICELAND
Elding Trading Company Inc.
Hafnarholi - Tryggvagotú
Reykjavik
Tel: 1 58 20
Cable: ELDING Reykjavik

IRELAND
Hewlett-Packard Ltd.
224 Bath Road
Slough, SL1 4 DS, Bucks
Tel: (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

ITALY
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
I-20124 Milan
Tel: (2) 6251 (30 lines)
Cable: HEWPAKIT Milan
Telex: 32 0 46

Hewlett-Packard Italiana S.p.A.
Via Marocco, 7
I-00144 Rome - Eur
Tel: (6) 5912544/5, 5915947
Cable: HEWPAKIT Rome
Telex: 61 514

LUXEMBURG
Hewlett-Packard Benelux
S.A./N.V.
Avenue du Col-Vert, 1
B-1170 Brussels
Tel: (03) 72 22 40
Cable: PALOBEN Brussels
Telex: 23 494

NETHERLANDS
Hewlett-Packard Benelux, N.V.
Weerdesteijn 117
P.O. Box 7825
Amsterdam, Z 11
Tel: (020) 42 77 77
Cable: PALOBEN Amsterdam
Telex: 13 216

NORWAY
Hewlett-Packard Norge A/S
Box 149
Nesveien 13
N-1344 Haslum
Tel: (02)-53 83 60
Telex: 16621

PORTUGAL
Munditer
Intercambio Mundial de
Comércio S.a.r.l.
P.O. Box 2761
Avenida Antonio Augusto
de Aguiar 138
P.O. Box 2761
Lisbon
Tel: 53 21 31/7
Cable: INTERCAMBIO Lisbon

SPAIN
Hewlett-Packard Española, S.A.
Jerez No 8
Madrid 16
Tel: 458 26 00

SWEDEN
Hewlett-Packard Sverige AB
Enighetsvägen 1-3
Fack
S-16120 Bromma 20
Tel: (08) 98 12 50
Cable: MEASUREMENTS Stockholm
Telex: 10 721

Hewlett-Packard Sverige AB
Hagäckersgatan 9C
S-431 41 Malmö
Tel: (031) 27 68 00/01
Telex: 21 312 hpmindis

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zürcherstrasse 20
CH-8952 Schlieren Zürich
Tel: (01) 98 18 21/24
Cable: HPAG CH
Telex: 53933 hpag ch

Hewlett-Packard (Schweiz) AG
Rue du Bois-du-Lan 7
1217 Meyrin 2 Geneva
Tel: (022) 41 54 00
Cable: HEWPAKSA Geneva
Telex: 27333 HPSA CH

TURKEY
Dr. Faruk Komili
Vali Konagi Caddesi No. 35
Harbiye, Istanbul
Tel: 48 18 07
Cable: PIKTRON Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
224 Bath Road
Slough, SL1 4 DS, Bucks
Tel: Slough (0753) 33341
Cable: HEWPIE Slough
Telex: 84413

Hewlett-Packard Ltd.
"The Graftons"
Stamford New Road
Aldrich, Cheshire
Tel: 061 928-8626
Telex: 668068

YUGOSLAVIA
Belram S.A.
83 Ave. des Mimosas
Brussels 1150, Belgium
Tel: 34 33 32, 34 26 19
Cable: BELRAMSL Brussels
Telex: 21790

SOCIALIST COUNTRIES PLEASE CONTACT:
HEWLETT-PACKARD Ges. m.b. H
Innsstrasse 23/2
Postfach 45
A-1204 Vienna, Austria
Tel: (0222) 33 66 06-09
Cable: HEWPAK Vienna
Telex: 75923

ALL OTHER EUROPEAN COUNTRIES CONTACT:
Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
1217 Meyrin 2 Geneva
Switzerland
Tel: (022) 41 5400
Cable: HEWPAKSA Geneva
Telex: 224.86

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra Empresa Técnica de
Equipamentos Eléctricos SAR
Rua de Barbosa Rodrigues
42-1°
Box 6487
Luanda
Cable: TELETRA Luanda

AUSTRALIA
Hewlett-Packard Australia Pty.
Ltd.
22-26 Weir Street
Glen Iris, 3146
Victoria
Tel: 20.1371 (6 lines)
Cable: HEWPAK Melbourne
Telex: 31024

Hewlett-Packard Australia Pty.
Ltd.
61 Alexander Street
Crows Nest 2065
New South Wales
Tel: 43.7866
Cable: HEWPAK Sydney
Telex: 21561

Hewlett-Packard Australia Pty.
Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 65.2366
Cable: HEWPAK Adelaide

Hewlett-Packard Australia
Pty. Ltd.
2nd Floor, Suite 13
Casablanca Buildings
196 Adelaide Terrace
Perth, W.A. 6000
Tel: 21-3330
Cable: HEWPAK Perth

Hewlett-Packard Australia
Pty. Ltd.
10 Woolley Street
Dickson A.C.T. 2602
Tel: 49-8194
Cable: HEWPAK Canberra ACT

Hewlett-Packard Australia
Pty. Ltd.
6 Harvard Street
P.O. Box 135
Kenmore 4069 Queensland
Tel: 78 6069

CEYLON
United Electricals Ltd.
P.O. Box 681
Yahala Building
Staples Street
Colombo 2
Tel: 5496
Cable: HOTPOINT Colombo

CYPRUS
Kypronics
19 Gregorios & Xenopoulos Road
P.O. Box 1152
Nicosia
Tel: 6282-75628
Cable: HE-I-NAMI

ETHIOPIA
African Salespower & Agency
Private Ltd., Co.
P.O. Box 718
58/59 Cunningham St.
Addis Ababa
Tel: 12285
Cable: ASACO Addisababa

HONG KONG
Schmidt & Co. (Hong Kong) Ltd.
P.O. Box 297
1511 Prince's Building 15th Floor
10, Chater Road
Hong Kong
Tel: 240168, 232735
Cable: SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd.
Kasturi Buildings
Jamsheji Tata Rd.
Bombay 20BR, India
Tel: 29 50 21
Telex: 2156
Cable: BLUEFROST

Blue Star Ltd.
Band Box House
Prabhadevi
Bombay 25DD, India
Tel: 45 73 01
Telex: 2156
Cable: BLUESTAR

Blue Star Ltd.
14/40 Civil Lines
Kanpur, India
Tel: 6 88 82
Cable: BLUESTAR

Blue Star Ltd.
7 Hare Street
P.O. Box 508
Calcutta 1, India
Tel: 2-0131
Telex: 655
Cable: BLUESTAR

Blue Star Ltd.
Blue Star House
34 Ring Road
Lajpat Nagar
New Delhi 24, India
Tel: 62 32 76
Telex: 463
Cable: BLUESTAR

Blue Star Ltd.
23/24 Second Line Beach
Madras 1, India
Tel: 2 39 55
Telex: 379
Cable: BLUESTAR

Blue Star Ltd.
17-C Ulsoor Road
Bangalore-8

Blue Star Ltd.
18 Kaiser Bungalow
Dindli Road
Jamshejpur, India
Cable: BLUEFROST
Tel: 38 04

INDONESIA
Bah Bolon Trading Coy. N.V.
Djalan Merdeka 29
Bandung
Tel: 4915, 51560
Cable: ILMU
Telex: 08-809

IRAN
Telecom, Ltd.
P.O. Box 1812
240 Kh. Saba Shomali
Teheran
Tel: 43850, 48111
Cable: BASCOM Teheran
Telex: 2664 Teheran

ISRAEL
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Amnadav Street
Tel-Aviv
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: Bastel Tv 033-569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Ohashi Building
1-59-1 Yayoi
Shibuya-ku, Tokyo
Tel: 03-370-2281/7
Telex: 232-2034YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nisei Jbaragi Bldg.
2-2-8, Kasuga
Ibaragi-shi
Osaka
Tel: (0726) 23-1641
Telex: 385-5332 YHPOSACA

Yokogawa-Hewlett-Packard Ltd.
Ito Building
No. 59, Kotari-cho
Nakamura-ku, Nagoya City
Tel: (052) 551-0215

Yokogawa-Hewlett-Packard Ltd.
Nitto Bldg.
2300 Shinohara-cho
Kohoku-ku
Yokohama 222
Tel: (045) 432-1504/5

JORDAN
Constantin E. Macridis
Clemenceau Street
P.O. Box 7213
Beirut, Lebanon
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

KENYA
International Aeradio (E.A.), Ltd.
Nairobi Airport
P.O. Box 19012
Nairobi
Tel: 82111
Cable: INTAERIO Nairobi

KOREA
American Trading Co.,
Korea, Ltd.
Seoul P.O. Box 1103
7th & 8th floors, Daekyung Bldg.
107 Sejong Ro
Chongro-Ku, Seoul
Tel: 75-5841 (4 lines)
Cable: AMTRACO Seoul

LEBANON
Constantin E. Macridis
Clemenceau Street
P.O. Box 7213
Beirut
Tel: 220846
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya,
Selangor
Cable: MECOMB Kuala Lumpur

MOZAMBIQUE
A. N. Goncalves, LDA.
4-1 Apt. 14 Av. D. Luis
P.O. Box 107
Lourenco Marques
Cable: NEGON

NEW ZEALAND
Dental & Medical Supply
Co. Ltd.
76-80 Adelaide Road
P.O. Box 1994
Wellington, C. I.
Tel: 50-793
Cable: DENTAL Wellington

Dental & Medical Supply
Co. Ltd.
Scientific Division
321 Queen Street
P.O. Box 1234
Auckland
Tel: 78-255
Cable: DENTAL, Auckland

Dental & Medical Supply Co. Ltd.
809 Colombo Street
P.O. Box 509
Christchurch
Tel: 68-414
Cable: DENTAL Christchurch

Dental & Medical Supply Co. Ltd.
303 Great King Street
P.O. Box 232
Dunedin
Tel: 88-817
Cable: DENTAL Dunedin

PAKISTAN (EAST)
Mushko & Company, Ltd.
1, Jinnah Avenue
Dacca - 2
Tel: 280058
Cable: NEWDEAL Dacca

PAKISTAN (WEST)
Mushko & Company, Ltd.
Osman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi

Mushko & Company, Ltd.
38B, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex Inc.
5th Floor, Architects
Center Bldg.
Ayala Ave., Makati, Rizal
C.C.P.O. Box 1028
Makati, Rizal
Tel: 86-18-87, 87-76-77
Cable: ELEMEX Manila

SINGAPORE
Mechanical & Combustion
Engineering Company, Pte., Ltd.
9, Jalan Kilang
Red Hill Industrial Estate
Singapore 3
Tel: 642361-3, 632611
Cable: MECOMB Singapore

Hewlett-Packard Far East
Area Office
P.O. Box 87
Alexandra Post Office
Singapore 3
Tel: 633022
Cable: HEWPAK SINGAPORE

SOUTH AFRICA
Hewlett-Packard South Africa
(Pty) Ltd.
P.O. Box 31716
Braamfontein Transvaal
Minerton
30 De Beer Street
Johannesburg
Tel: 725-2080, 725-2090
Telex: 0226 IH
Cable: HEWPAK Johannesburg

Hewlett-Packard South Africa
(Pty) Ltd.
Breechwater House
Bree Street
Cape Town
Tel: 3-6019 3-6595
Cable: HEWPAK Cape Town
Telex: 5-0006

Hewlett-Packard South Africa
(Pty) Ltd.
541 Ridge Road, Durban
P.O. Box 99
Overport, Natal
Tel: 88-6102
Telex: 567954
Cable: HEWPAK

SYRIA
Sawah & Co.
Place Azmé
B.P. 2308
Damascus
Tel: 16367, 19697, 14268
Cable: SAWAH Damascus

TAIWAN
Hewlett-Packard Taipei
39 Chung Shia West Road Sec. I
Overseas Insurance Corp.
Bldg., 7th Floor
Taipei
Tel: 389160, 1, 2, 375211,
Ext. 240
Telex: TP 828 HEWPAK
Cable: HEWPAK Taipei

TANZANIA
International Aeradio (E.A.), Ltd.
P.O. Box 861
Dar-es-salaam
Tel: 21251
Cable: INTARIO DAR-ES-SALAAM

THAILAND
Chalermmas
39 Prapithuck Road
Bangkok
Tel: 217508, 229057
Cable: CHALERMMAS Bangkok

UGANDA
International Aeradio (E.A.), Ltd.
P.O. Box 2577
Kampala
Tel: INTAERIO Kampala
Tel: 54388

VIETNAM
Peninsular Trading Inc.
P.O. Box H-3
216 Hein-Vuong
Saigon
Tel: 20805, 93398
Cable: PENIRA, SAIGON 242

ZAMBIA
R. J. Tibbony Ltd.
P.O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 72793
Cable: ARVAFREE, Lusaka

MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:
Hewlett-Packard
Co-Ordination Office for
Mediterranean and Middle East
Operations
Via Marocco, 7
I-00144 Rome-Eur, Italy
Tel: (6) 59 40 29
Cable: HEWPAKIT Rome
Telex: 61514

OTHER AREAS NOT LISTED, CONTACT:
Hewlett-Packard
INTERCONTINENTAL
3208 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPAK Palo Alto
Telex: 034-8461

