TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

VECTOR VOLTMETER, HEWLETT-PACKARD MODEL 8405A (NSN 6625—00—929—1897)

HEADQUARTERS, DEPARTMENT OF THE ARMY
OCTOBER 1978

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the power supplies and their circuits, or on the 230- or 115-volt ac line connections. See safety considerations (para 1-A, app G).

DON'T TAKE CHANCES!

TM11-6625-2856-14

TECHNICAL MANUAL

No.11-6625-2856-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 10 October 1978

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR VECTOR VOLTMETER, HEWLETT–PACKARD MODEL 8405A (NSN 6625–00–929–1897)

REPORTING OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 located in the back of the manual. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 2028-2 in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US *Army* Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703.

In either case a reply will be furnished direct to you.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Contd)

LIST OF TABLES

SECTION 0
INTRODUCTION

0-1. SCOPE

This manual describes Vector Voltmeter, Hewlett-Packard Model 8405A and provides instructions for operation and maintenance. This manual also includes a component of end items list (COEIL) (app B) and a maintenance allocation chart (MAC (app D). Repair parts and special tools lists (RPSTL's) are. included in TM 11-6625-2856-24P. Calibration procedures are contained in TB 11-6625-2856-50.

0-2. INDEXES OF PUBLICATIONS

a. DA Pam 310-4. **Refer to the latest issue of** DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. ***DA Pam*** 910-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

0-3. F O **RMS AND RECORDS.**

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling ***Deficiencies.*** Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 5538/NAVSUPINST 4610.33B/AFR 75-18MCO) P4610.19C and DLAR 4500.15.

0-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

EIR's will be prepared using DA Form 2407, Maintenance Request. Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed direct to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703. A reply will be furnished direct to you.

0-5. **ADMINISTRATIVE STORAGE.**

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-l.

0-6. **DESTRUCTION OF ARMY ELECTRONICS MATERIEL.**

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

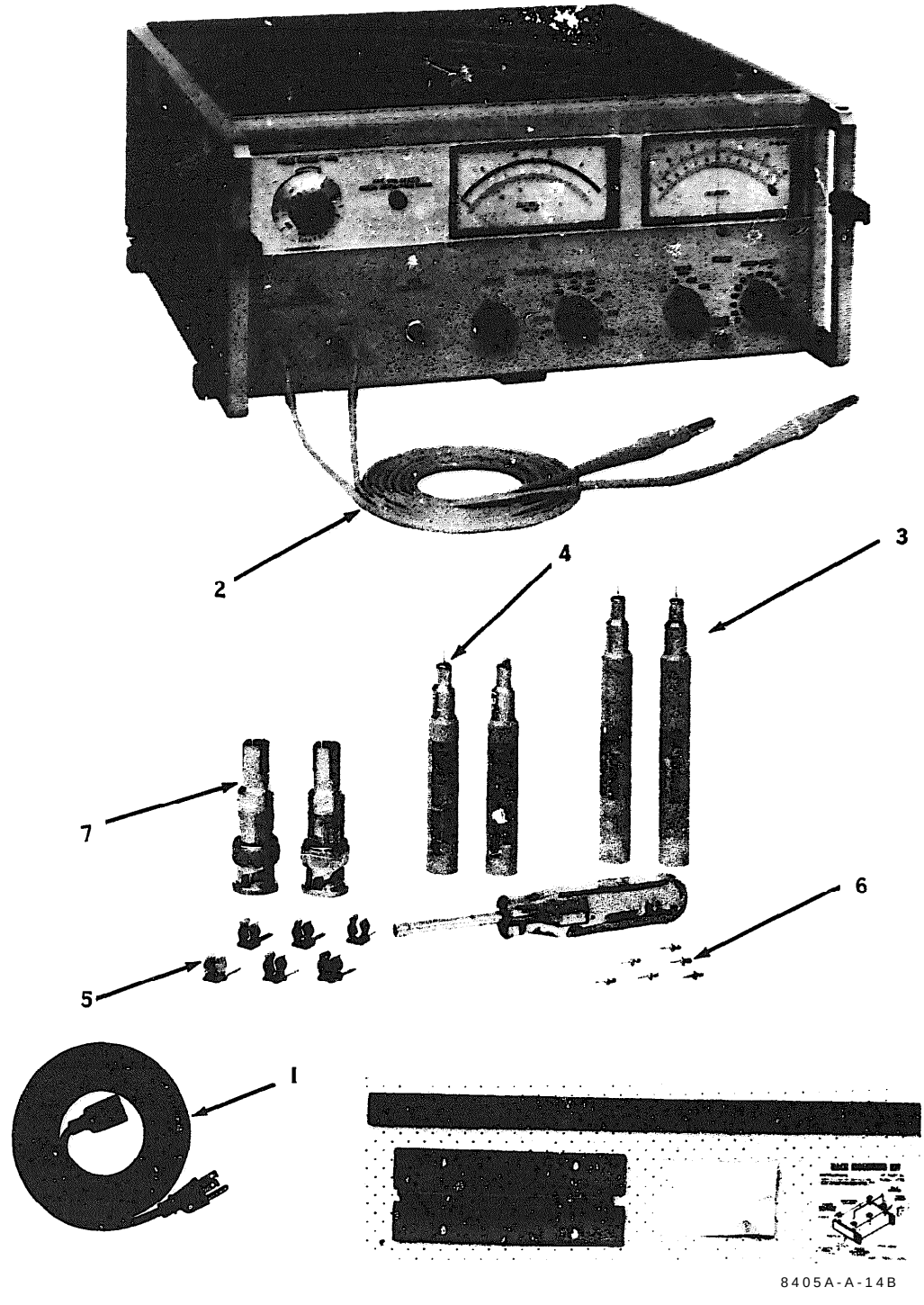


Figure 1-1. Model 8405A Vector Voltmeter and Supplied Accessories

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION

1-2 The Model 8405A Vector Voltmeter (Figure 1-1) has a voltmeter and phasemeter for measuring the amplitude and phase relationship of the fundamental components of two RF voltage. The RF range 1 to 1000 MHz; the phase range is 0 to 360 degrees; and the amplitude ranges are from at least 1.5 millivolts to 1 volt rms for one channel, and 10 microvolts to 1 volt rms for the other.

1-3. Phase relationship is continuously displayed. Angles from 0 to 360 can be measured and read directly from the zero-center meter with ±0.1° resolution.

1-4. Absolute voltage amplitudes read separately can be measured to within ±2% from 1 to 100 MHz, ±6% from 100 to 400 MHz and ±12% from 400 to 1000 MHz. Relative voltage measurements can be made to within 2±% (0.2 dB) of full scale on the -10 through -60 dB Amplitude Ranges.

1-5. Outputs include an intermediate frequency (IF) output for each input, a voltage proportional to amplitude meter voltage reading and a voltage proportional to phase meter reading. The IF outputs are 20 kHz replicas of the RF input waveforms with the same amplitude and phase relationship. Complete specifications of the Model 8405A are given in Table 1-1.

Table 1-1. Specifications

INPUT CHARACTERISTICS

Instrument Type: Two-channel sampling RF millivoltmeter-phasemeter which measures voltage of two signals and simultaneously displays the phase angle between the two signals.

Frequency Range: 1 MHz to 1 GHz in 21 overlapping octave bands (lowest band covers two octaves).

Tuning: Automatic within each band. Automatic phase control (APC) circuit responds to the Channel A input signal. Search and lock time, approximately 10 millisec.

Voltage Range
Channel A:
1 to 10 MHz: 1.5 mV to 1 V rms.
10 to 500 MHz: 300 µV to 1 V rms.
500 to 1000 MHz: 500 µV to 1 V rms.
Can be extended by a factor of 10 with 11576A 10: 1 Divider.
Channel B: 100 µV to 1 V rms full scale (input to Channel A required); can be extended by a factor of 10 with 11576A 10:1 Divider.

Input Impedance (nominal): 0.1 megohm shunted by approximately 2.5 pF; 1 megohm shunted by approximately 2 pF when 11576A 10: 1 Divider is used; 0.1 megohm shunted by approximately 5 pF when 10216A Isolator is used-. AC coupled.

Isolation Between Channels:
1 to 300 MHz: greater than 100 dB.
300 to 1000 MHZ: greater than 80 dB.

Maximum AC Input: 2 V peak.

Maximum DC Input: ±50 V.

VOLTMETER CHARACTERISTICS

Meter Ranges: 100 µV to 1 V rms full scale in 10-dB steps. Meter indicates amplitude of the input signal.

Voltage Accuracy: When accessories are used on one or both probes.

Accessory	Impedance		Frequency	Accuracy*
HP 11536A 50Ω Feed-through Tee	50 Ω		1-100 MHZ	±2% of full scale
	Freq.	SWR	100-300 MHz	±6% of full scale
	1-750 MHz	< 1.15		
	1-1000 MHz	< 1.20	300- 1000 MHZ	±12% ** of full scale
HP 11576A 10:1 Divider	1 MΩ ≷ 2 pF equiv. to $Z = \frac{80}{f_{(MHz)}}$ kΩ from 5-100 MHz		1-100 MHz	±6% of full scale
HP 10216A Isolator	100 k ≷ 5 pF equiv. to $Z = \frac{32}{f_{(MHz)}}$ kΩ		1-200 MHz	±6% of full scale

* After one- -hour warmup.
**Above 300 mV and 800 MHz add ±5%.

Voltage Ratio Accuracy: 1-200 MHz.
0.2 dB for -60 to 0 dB Ranges.
0.5 dB for -70 dB and +10 dB Ranges.

Voltage Ratio Accuracy: 200-1000 MHz.
0.2 dB for -60 to -10 dB Ranges.
0.5 dB for -70 dB and 0 dB Ranges.
1.5 dB for +10 dB Range.

Residual Noise: Less than 10 µV as indicated on the meter.

Bandwidth: 1 kHz.

Table 1-1. Specifications (cont'd)

PHASEMETER CHARACTERISTICS

Phase Range: 360°, indicated on zero-center meter with end-scale ranges of ±180, ±18, and ±6°. Meter indicates phase difference between the fundamental components of the input signals.

Resolution: 0.1° at any phase angle.

Meter Offset: ±180° in 10° steps.

Phase Accuracy: At single frequency 1.5° (equal voltage at Channel A and B).

Phase Accuracy vs. Voltage : See table below.

Phase Jitter vs. Channel B Input Level:
Greater than 700 µV: Typically less than 0.1 ° p-p.
125 to 700 µV: Typically less than 0.5° p-p.
20 to 125 µV: Typically less than 2° p-p.

GENERAL

20 kHz IF Output (each channel): Reconstructed signals, with 20 kHz fundamental components, having tie same amplitude, waveform, and phase relationship as the input signals. Output impedance, 1000 ohms in series with 2000 pF; BNC female connectors.

Recorder Output:

Amplitude: 0 to +1 Vdc ±4% open circuit, proportional to vo1tmeter reading in volts. Output tracks meter reading within ±0.5% of full scale. Output impedance, 1000 ohms; BNC female connector.

Phase: 0 to ±0.5 Vdc ±6%, proportional to phasemeter reading. External load greater than 10,000 ohms affects recorder output and meter reading less than 1%. Output tracks meter reading within ±1.5% end scale; BNC female connector.

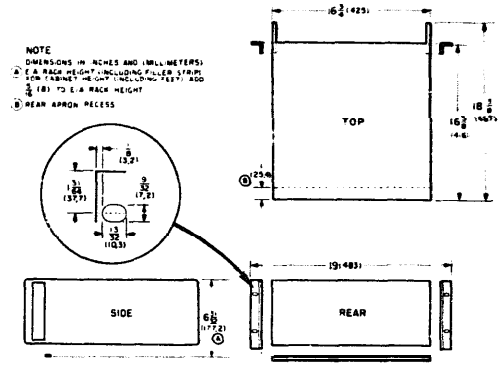
RFI: Conducted and radiated leakage limits are below those specified in **MIL-I-6181D and MIL-I-**16910C except for pulses emitted from [illegible] **Spectral intensity of these pulses is approximately** 60 µV/MHz; spectrum **extends to approximately** 2 GHz. Pulse rate varies from .98 **to 2 MHz.**

Option 02. Linear dB scale uppermost on voltmeter.

Power: 115 or 230 V ±10%, 50 to 400 Hz, 35 watts.

Weight: Net, 30 lbs (13, 5 kg).

Dimensions:



Phase Accuracy Vs. Voltage

Accessory	Frequency (MHz)	Voltage Range Channel A	Voltage Range Channel B	Phase* Accuracy
HP 11536A	1 - 10	1.5 mV to 300 mV	100 µV to 300 mV	±3°
50-Ohm Feed-	10 - 500	300 µV to 300 mV	100 µV to 300 mV	±3°
through Tee	500 - 1000	500 µV to 100 mV	100 µV to 100 mV	±3°
HP 11576A	1 - 10	1.5 mV to 3V	1 mV to 3V	±4°
10:1 Divider	10 - 100	1 mV to 3V	1 mV to 3V	±4°
HP 10216A	1 - 10	1.5 mV to 300 mV	100 µV to 300 mV	±6°
Isolator	10 - 200	300 µV to 300 mV	100 µV to 300 mV	±6°

*To be added to single-frequency accuracy (±1.5°) when the voltages at Channel A and B are not equal.

1-6. ACCESSORIES FURNISHED.

1-7 A detachable power cable, a rack-mounting kit with mounting hardware and several probe accessories are supplied with the Model 8405A. The probe accessories consist of two isolators, two voltage divide- grounding clips, replacement probe tips and wrench, and probe to BNC adapters.

1-8. ISOLATOR. The HP 10216A Isolators attach to the input probes and eliminate the effect of test point impedance.

1-9. DIVIDER. The HP 11576A 10:1 voltage dividers attach to the input probes to increase the maximum input voltage limit to 10 volts rms. The dividers also eliminate the effect of test point impedance.

1-10. GROUNDING CLIPS. The grounding clips fasten to the dividers and isolators near the probe tip for grounding close to the measuring point.

1-11. PROBE TIPS. The probe tips are screw-in replacements for the probe points.

1-12. PROBE-TO-BNC ADAPTER. The HP 10218A adapter converts the probe tip to a male BNC connector.

1-13. ACCESSORIES AVAILABLE.

1-14. PROBE-TO-MICRODOT ADAPTER. Two versions are available: one converts the probe tip to a Microdot screw-on connector, the other converts the tip to a Microdot push-on connector. The adapters are available under accessory numbers 10220A (screw-on-version) and 10223A (push-on-style).

1-15. FIFTY OHM TEE. This connector is specially designed to match the impedance of the Model 8405 probe to permit monitoring signals in a 50-ohm transmission line. The line section has type N connectors and probe coupling is by means of a push-style friction connector. The tee is available under accessory number 11536A.

1-16. ACCESSORY CASE. The accessory case, with two compartmented sections, provides convenient storage for accessories and is available under accessory number 11570-60001.

1-17. ACCESSORY KIT. A kit of accessories and adapters is available under accessory number 11570A. The kit contents are listed in the following table.

Qty.	Description	HP Part Number
2	50-ohm tee, type N to probe	11536A
1	Power splitter, type N	11549A
2	50-ohm termination, type N	908A
1	Shorting plug, type N	11512A
1	Accessory Case	11570-60001

1-18. The items listed as part of the Accessory Kit are also available separately. Order by the HP part number given in the Table.

1-19. INSTRUMENT COVERED BY MANUAL.

1-20. This manual applies directly to instruments having serial numbers prefixed 946- above 03210. If the serial No. of your instrument is other than this there are differences between the instrument described in this manual and your instrument. These differences are described in appendix F or in a Manual Changes sheet (appx G). The manual changes sheet includes an "ERRATA" section which describes manual correction information which applies to the manual for all instruments INCLUDING instruments prefixed 946.

1-21. INSTRUMENT OPTIONS.

1-22. OPTION 02. Model 8405A furnished with the normally installed AMPLITUDE meter replaced with a special logarithmic meter. This special meter has a linear dB scale which is uppermost on meter face. Meter scale is about 12 dB with a calibrated accuracy of ±0.2 dB.

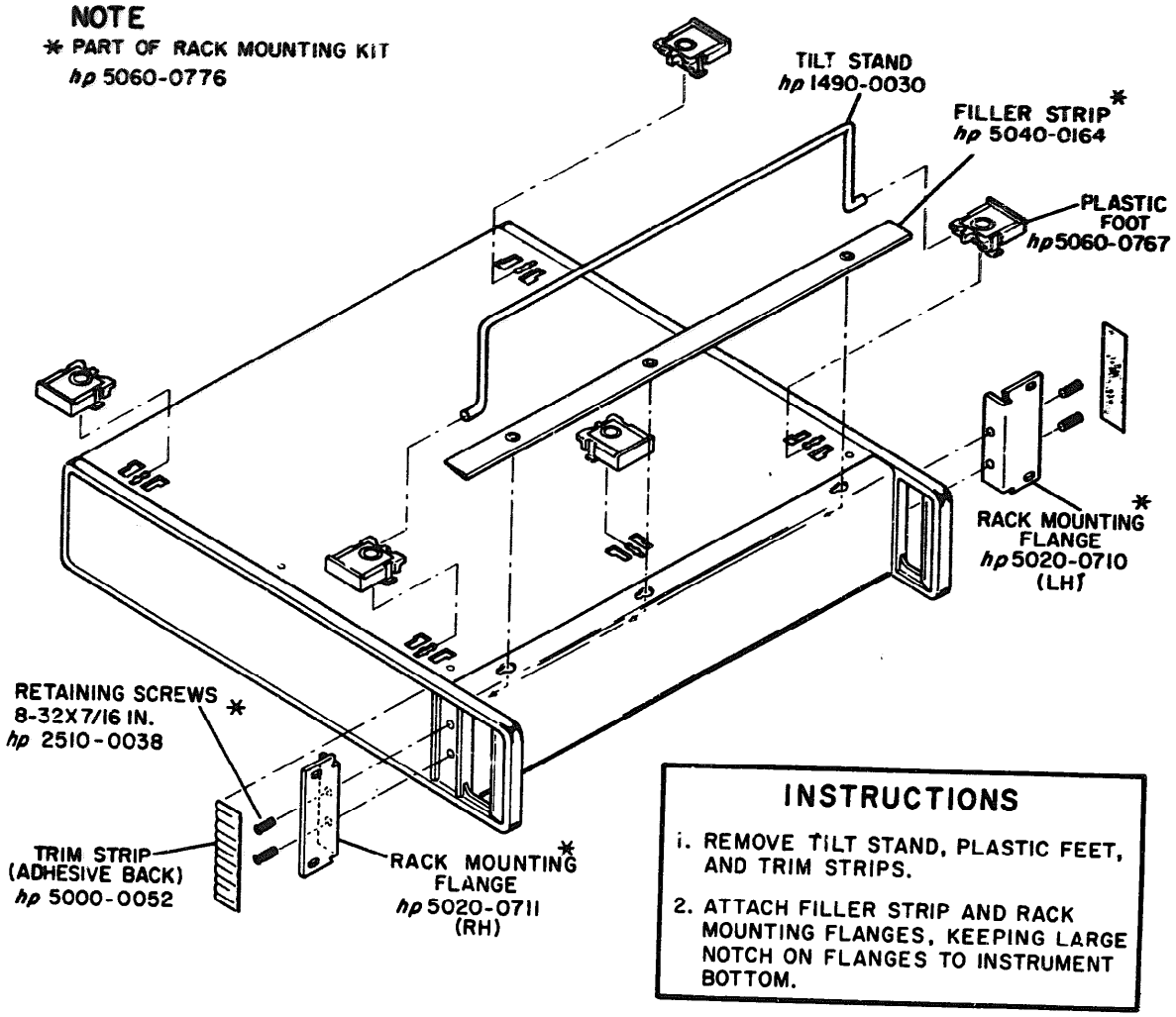


Figure 2-1 Preparation Rack Mounting

SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. The Vector Voltmeter was carefully inspected, mechanically and electrically, prior to shipment. Inspect it for mechanical damage incurred in transit. check for supplied accessories, and test electrical performance. If there is damage or deficiency notify the carrier and the nearest Hewlett-Packard office. In the event of mechanical damage the packing materials and carton should be held for carrier's inspection.

2-3. PREPARATION FOR USE

2-4. POWER REQUIREMENTS.

2-5. The Vector Voltmeter requires a power source of 115 or 230 volts ac ±10%, 50 to 400 Hz, single phase, which can supply approximately 35 watts.

2-6. 115/230 VOLT OPERATION.

2-7. A rear panel two-position slide switch permits operation from either a 115- or 230-volt power source. The number visible on the switch indicates line voltage for which the instrument is connected. Adjacent to switch is correct line fuse rating for each line voltage.

2-8. To prepare the Model 8405A for operation, position the 115-230 volt switch so that the number visible on the slider corresponds to the available line voltage, and install a line fuse of correct rating.

CAUTION

To avoid damage to the instrument, before connecting the power cable, set the 115-230 switch for the line voltage to be used.

2-9. POWER CABLE.

2-10. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that instrument panels and cabinets be grounded. Accordingly, the Vector Voltmeter is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, ground panel and cabinet. The offset pin of the three-prong connector is the **ground pin.**

2-11. To preserve the protection feature when operating the Vector Voltmeter from a two-contact outlet, use a three-prong to two-prong adapter (HP Stock No. 1251-0048) and connect the green pigtail on the adapter **to ground.**

2-12. COOLING.

2-13. The temperature of surrounding air must not exceed 55° C (131°F). Clearances for ventilation should be 3 to 4 inches at the rear of the cabinet and 2 to 3 inches at the sides. The clearances provided by the plastic feet in bench stacking and the filler strips in rack mounting are adequate for the top and bottom cabinet surfaces.

2-14. BENCH OPERATION.

2-15. The Model 8405A cabinet has plastic feet and a foldaway tilt stand for convenience in bench operation, The tilt stand permits inclining the instrument for ease in reading the meters. The plastic feet are shaped to provide clearance for air circulation and to make full-width modular cabinet instruments such as the Vector Voltmeter self--aligning when stacked.

2-16. RACK MOUNTING.

2-17. Preparation for rack mounting is illustrated in Figure 2- 1. All necessary hardware is included in the supplied rack mounting kit.

2-18. REPACKAGING FOR SHIPMENT.

2-19. USING ORIGINAL PACKAGING. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard sales and service offices.

2-20. If the Model 8405A is being returned to Hewlett-Packard for servicing attach a tag indicating the type of service required, return address, model number and full serial number. Also, mark the container FRAGILE to assure careful handling.

2-21. In any correspondence refer to the instrument by model number and full serial number.

2-22. USING OTHER PACKAGING. The following general instructions should be used for repackaging with commercially-available materials:

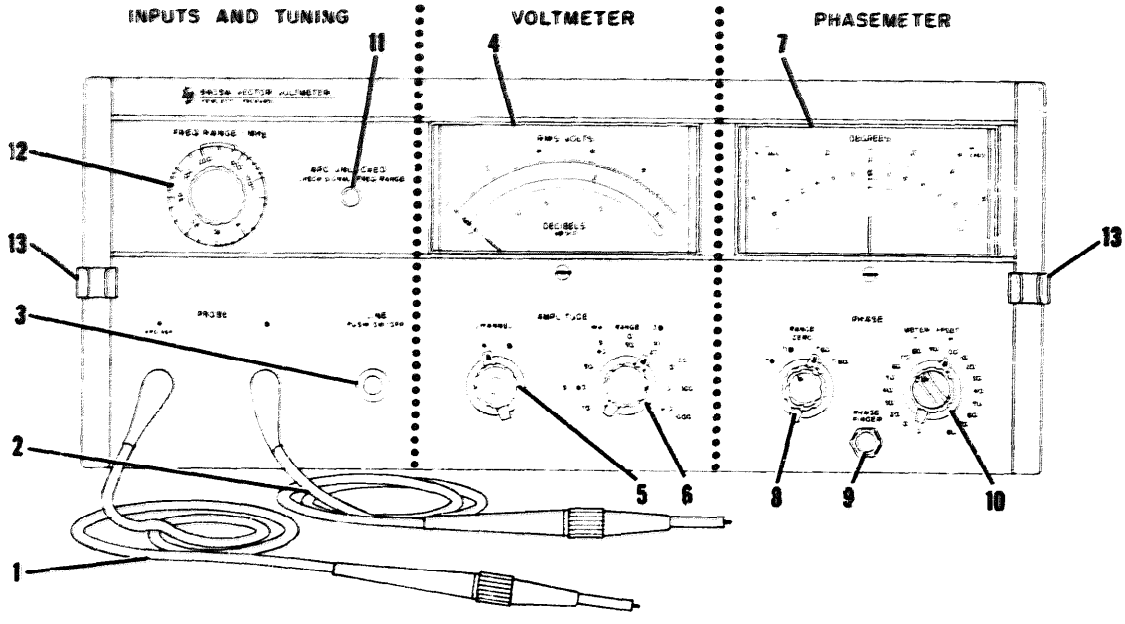
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard service office or center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (3 to 4 inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.



1. Probe A. Input to channel A. The Voltmeter and Phasemeter tune to probe A input frequency.

2. Probe B. Input to channel B. A signal at probe A is required for phase measurement and for channel B amplitude measurement.

3. LINE. Depress to turn on 8405A; lamp lights. Pushbutton retainer unscrews for lamp replacement.

4. AMPLITUDE Meter. Reads amp1itude of fundamental component of signal applied to probe A or probe B.

5. AMPLITUDE CHANNEL. Selects channel to be measured on voltmeter.

6. AMPLITUDE RANGE. Sets AMPLITUDE meter scale.

7. PHASE Meter. Reads phase angle between the fundamental components of signals applied to probes.

8. PHASE RANGE. Set phase meter scale. Red ZERO control has at least $\pm 10^{G}$ range.

9. PHASE FINDER. Overrides PHASE RANGE and PHASE METEROFFSET to select the ±180 phase range and zero offset. Used to find phase angle without changing settings of controls.

10. PHASE METER OFFSET. Used to reduce input phase angle and allow use of expanded PHASE RANGE scales. Not usable unless a definite input angle exists.

11. APC UNLOCKED. Lamp lights to indicate 8405A not tuned. Amplitude is too low and/or FREQ RANGE - MHZ selector is not set to the range which includes fundamental frequency of probe A input.

12. FREQ RANGE - MHz. Coarse tuning control to put input signals within capture range of automatic fine tuning. Selected range must include fundamental frequency of signal applied to probe A.

13. Probe Holder.

Figure 3-1. Front Panel Features

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION

3-2. The Model 8405A Vector Voltmeter is a direct-reading, two-channel, tuned millivoltmeter-phasemeter for measuring the amplitudes of and phase angle between the fundamental components of two radio frequency voltages. The radio frequency range is 1 to 1000 MHz, the phase range is 360 degrees, and the amplitude ranges are from at least 1.5 millivolts to 1 volt rms for reference channel A and from 100 microvolts to 1 volt rms for channel B. Supplied dividers extend the upper limit of the amplitude ranges.

3-3. The Vector Voltmeter consists of a phasemeter and ac voltmeter which have common in puts and tuning. The phasemeter continuously monitors the inputs while the Voltmeter is switched manually to read channel A or channel B.

3 -4. APPLICATIONS.

3-5. Information regarding specific system and measurement usage is provided in the Hewlett-Packard Journal Vol. 17, No. 9, and a series of HP Application Notes numbered 77. Copies of this literature are available from your local sales and service office upon request (see offices listed at the rear of this manual).

3-6. PANEL FEATURES.

3-7. Front and rear panel features are described in Figures 3-1 and 3-2. Description numbers match the numbers on the illustration.

3-8. OPERATING PROCEDURES

3-9. Figures 3-3 and 3-4 give step-by-step operating procedures. The steps of each procedure are numbered, and the illustration is numbered to correspond.

3-10. GENERAL OPERATING AND MEASUREMENT CONSIDERATIONS.

3-11. INITIAL TURN-ON.

a. Set rear-panel LlNE switch to match line voltage.

b. Check line fuse for rating beside number showing on LINE switch (1 amp 3AG for 115 Vac; 1/2 amp slo-blo 250V for 230 Vac).

c. Connect power cable to line voltage.

d. Press LINE button. The line button should glow indicating line power applied to instrument.

3-12. INPUT PROBES.

3-13. MECHANICAL FEATURES.

a. Identifying rings: channel A, blue ring; channel B, white ring.

b. Metal parts: Since probes -attach to accessory adapters by push-on friction couplings, metal parts must be clean and free of defects (i.e., burrs and gouges). Also, pointed tips must be aligned with long axis of probe so that tips are not broken when inserted in adapters.

c. Storage and shipment: to protect probes, adapters such as the probe-to-BNC adapter should be left on when not in use.

d. Tip replacement Tips are removed by turning counterclockwise (use supplied accessory - HP Part No. 8710-0084, Nut Driver). Replacement tips should not be tightened excessively. Additiona1 tips are available under HP Part No. 5020-0457.

3-14. ELECTRICAL FEATURES.

a. Probe burn-out: Maximum input is 1.4 volts rms and 2 volts peak; and ±50 Vdc to avoid probe burn-out.

5. Interaction between channels: Do not connect both probe$_d$ directly to same test point. For common connection, both probes can be fitted with Isolators (HP 10216A) or 10:1 Dividers (HP 11576A).

c. Sensitivity: Minimum input to probe A is 1.5 mV, l-10 MHz; 300 µV, 10-500 MHz; and 500 µV, 500-1000 MHz. For probe B minimum input is 10 µV for entire range (1-1000 MHz).

3-15. INPUT SIGNALS.

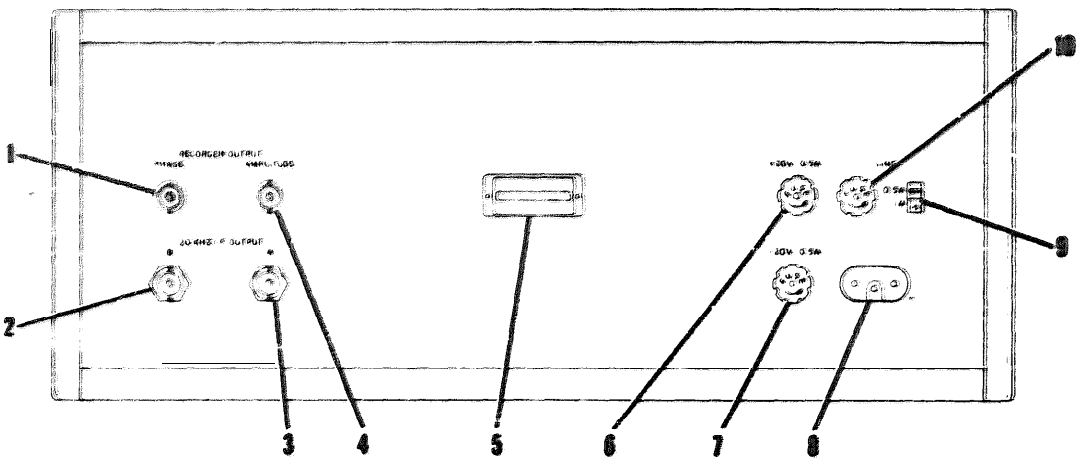
3-16. Phase and amp1itude measurements can be made at any frequency between 1 and 1000 MHz. However, the Vector Voltmeter IS frequency selective and therefore must be tuned to input signals. Tuning is semi-automatic with manual coarse tuning and automatic fine tuning. The automatic function tunes both c hanne1s simultaneously to the channel A signal. Thus, channel A signal determines the frequency at which measurements are made.

3-17. A condition for tuning is that channel A be large enough to trigger tuning. Minimum required channel A amplitude is frequency dependent as follows: 1.5 mV for 1-10 MHz, 300 µV for 10-500 MHz, and 500 µV for 500-1000 MHz.

3-18. The Vector Voltmeter is a tuned device with a very narrow passband (±-1 kHz) at the measurement frequency. Therefore, measurements can be made on complex waveforms, and amplitude-modulated signals as well as sinusoidal signals. Pulse modulated signals, however, cannot be measured as the 8405A cannot tune to an intermitten s.ignal.

NOTE

With complex waveforms the 8405A tunes to the frequency of the component having the greatest amp1itude in the tuning range selected.



1. **PHASE RECORDER OUTPUT. DC voltage proportional to phase meter reading. Zero volts corresponds to zero phase reading, +0.5 Vdc open circuit corresponds to full scale positive phase reading, -0.5 Vdc corresponds to full scale negative phase reading regardless of phase range.**

2. **20 KHZ I. F. OUTPUT B. IF replica of channel B RF waveform. Amplitude is the same as the RF waveform, but the fundamental, frequency is always 20 kHz.**

3. **20 KHZ I. F. OUTPUT A. IF replica of channel A RF waveform, Amplitude is the same as the RF waveform, but fundamental frequency is always 20 kHz. IF signals A and B have the same phase relationship as the RF signals.**

4. **AMPLITUDE RECORDER OUTPUT. DC voltage output proportional to voltage reading. Zero corresponds to zero volts, +1 Vdc open circuit corresponds to full scale reading regardless of amplitude range selected.**

5. **Identification Plate.**

6. **±20V Fuseholder, Fuse is overcurrent protection for the internal +20 Vdc power supply.**

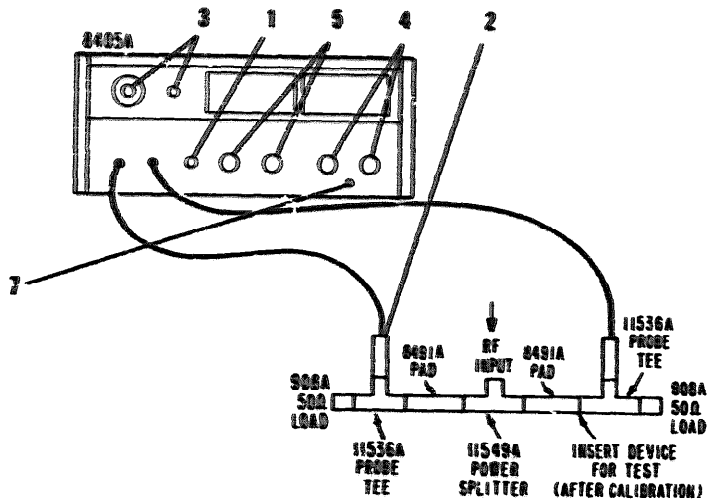
7. **-20V Fuseholder. Fuse is overcurrent protection for the internal -20 Vdc power supply.**

8. **Power Cable Connector.**

9. **LINE Voltage Switch. Permits operation from 115 or 230 volt ac line. Number visible on slider is operating voltage. Adjacent number on panel is correct line fuse rating.**

10. **LINE Fuseholder. Fuse should have rating adjacent to number visible on line switch slider.**

Figure 3-2. Rear Panel Features

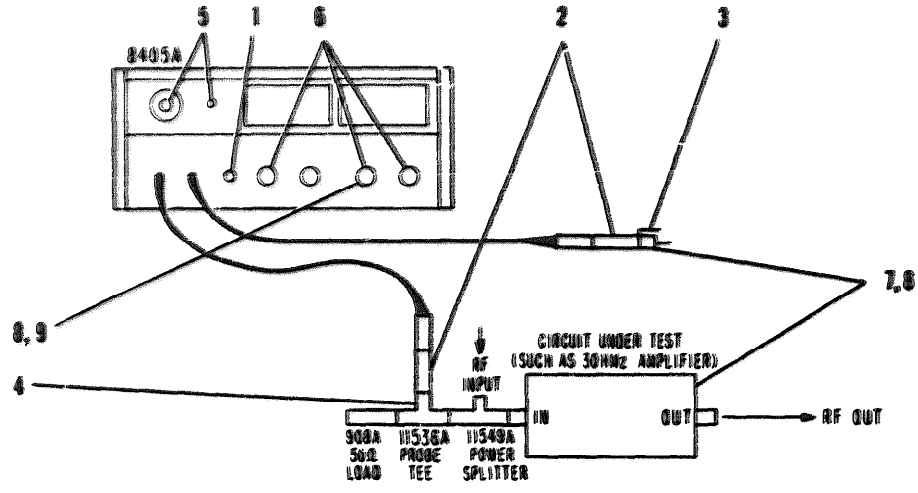


CAUTION

Do NOT burn out probes. Maximum input: ±50 volts dc or 2 volts peak (4 volts pp). Potential changes between test points should not exceed 50 volts dc to avoid transient pulses. Transient pulses greater than 50 V will burn out the probe. For this reason a blocking capacitor cannot be used in series with the probe to measure ac in a circuit with a dc potential of greater than 50 V.

1. Connect **equipment for calibration as shown above. Push LINE switch. Pushbutton should** glow.
2. **Apply signal to RF INPUT. Set AMPLITUDE** CHANNEL to **A.**
3. **Set FREQ. RANGE-MHZ to include measurement frequency. APC UNLOCKED light should go out showing that 8405A is tuned. NOTE: Channel A input must be at least l.5 mV** (1-10 MHz); 300 µV (10-500 MHz); or 500 µV **(500-1000 MHz). (If input frequency** *is changed* **within FREQ RANGE selected, APC** UNLOCKED **may flash every 1.6 MHz. This** is normal, **8405A** is retuning.)
4. **Set PHASE RANGE to 460, PHASE METER** OFFSET to O, and adjust PHASE ZERO for zero phase meter reading. **Switch** RANGE **to ±6 and re-zero as necessary.**
5. Set AMPLITUDE **CHANNEL to B and AMPLITUDE RANGE to obtain on-scale** voltmeter **reading. Record reading.**
6. Insert device under test into circuit as shown **above. Set AMPLITUDE RANGE** to obtain on-**scale voltmeter** reading. Residual attenuation or gain of device is difference between re-**corded reading of** step 5 **and** voltmeter reading.
7. Noting the PHASE Meter, push PHASE **FINDER button. If meter needle goes** to left (-) **set** METER OFFSET (red knob) to -; if to right (+) set METER OFFSET to +. Adjust METER **OFFSET** (black knob) **for** on-scale reading. To **obtain** phase reading, **add** meter reading and offset switch setting. For example, if offset setting is +50, meter **reading** is -4 and RANGE is ±6, then the actual angle is +46°.

Figure 3-3. Transmission Line Measurements



CAUTION

Do NOT burn out probes. Maximum input: ±50 volts dc or 2 volts peak (4 volts pp). Potential changes between test points should not exceed 50 volts dc to avoid transient pulses. Transient pulses greater than 50 V will burn out the probe. For this reason a blocking capacitor cannot be used in series with the probe to measure ac in a circuit with a dc potential of greater than 50 V.

1. **Connect equipment as shownabove. Push LINE button. Pushbutton should glow.**
2. **Connect appropriate adapter (10:1 Divider or Isolator) to channel B probe, Insert channel A probe in probe tee (11536A), with no adapter attached. NOTE: A probe adapter is NOT for use on a probe to be inserted in a probe tee (11536A).**
3. **Connect ground clip (HP 10213-62102) to channel B probe adapter.**

CAUTION

Make sure ground clips do not spring off causing short circuits.

4. **Apply signal to RF INPUT. Set AMPLITUDE CHANNEL to A.**
5. **Set FREQ RANGE-MHz to range which includes measurement frequency. APC UNLOCKED light should go out. NOTE: Channel A input must be at least 1.5 mV (1-10 MHz); 300 µV (10-500 MHz); or 500 ±V (500-1000 MHz).**
6. **Set PHASE RANGE to ±180 and PHASE METER OFFSET to 0. Set AMPLITUDE CHANNEL to B.**

7. CIRCUIT PROBING CAUTIONS

   a. **Always touch probe tip to circuit ground before and after touching any test point.**

   b. **With Isolator (HP 10216A): Maximum test point voltages are 2 volts peak (ac) and ±50 volts (dc).**

   c. **With 10:1 Divider (HP 11576A): Maximum test point voltages are 15 volts peak (ac) and ±50 volts (de).**

   d. **To minimize stray capacitance effects, the metal barrel of the probe adapter must be connected to circuit ground as close to test point as possible (using furnished metal ground clip).**

8. **Monitor circuit input bv probing circuit with channel B probe. Using PHASE ZERO, adjust for convenient PHASE METER reference. Record Phase and Amplitude Meter readings as references for all other circuit measurements.**
9. **For other circuit measurements, do not change PHASE ZERO setting. Thus, all circuit phase measurements are relative to the reference made in step 8.**

Figure 3 -4. In-Circuit Measurements.

3-19. For amplitude measurement of one signal, the signal must be applied to probe A. If the sensitivity of channel B is needed, a signal at the measurement frequency must be applied to channel A for 8405A tuning and the signal to be measured can be applied to channel B probe.

3-20. IN-CIRCUIT MEASUREMENTS

3-21. PROBING IN CIRCUITS. The main considerations for measurements made by probing in circuits are the effects of the input impedance of the probe, the impedance of the circuit at the point of measurement, the injection of sampling signal by the probe, and the method of grounding the probe.

3-22. CIRCUIT LOADING

3-23. Probe input impedance at the measurement frequency can load the circuit under test in a way that alters its performance and so produces erroneous readings. The input impedance of a probe is 0.1 megohm shunted by 2.5 picofarads. With 10:1 divider (HP 11576A) attached input impedance increases to 1 megohm shunted by 2 picofarads. However, use of a divider reduces amplitude sensitivity by a factor of 10, increases amplitude measurement error, and adds phase error when used on one probe only.

3-24. CIRCUIT IMPEDANCE.

3-25. Variations in test point impedance from point to point influence the probes and can cause measurement errors. For instance, amplitude measurement error can be +0 to -2% with a test point impedance of 25 to 1000 ohms. Phase measurement error will be less than ±2° for test point impedance variations of from 0 to 50 ohms, and less than -9° for test point impedance variations of from 25 to 1000 ohms. These errors can be eliminated by the 10:1 divider or isolator probe accessories which are particularly effective in fixed-frequency measurements where their own frequency-dependent error effects are not a consideration.

3-26. SAMPLING SIGNAL.

3-27. The signal from the probes is the same one that down-converts the input frequency to the frequency at which measurements are made. The signal consists of pulses 0.3 nanoseconds wide with a repetition rate between 0.98 and 2 MHz and amplitude determined by the bandwidth and impedance of the circuit under test. The actual pulse rate depends upon the frequency of the signal applied to probe A, but is stable at any given frequency. Into a 50-ohm impedance, pulse amplitude is approximately 60 microvolts per megahertz of circuit bandwidth to a maximum of about 2000 MHz. To prevent these signals from reaching and affecting the circuit-under-test, the 10:1 divider probe adapters should be used.

3-28. PROBE GROUNDING

3-29. The metal barrel at the tip of the probe or accessory if used should be connected to the ground of the circuit under test as close to the test point as possible. The supplied metal clips are for grounding the isolator and divider accessories. The standard probe does not require grounding.

CAUTION

Make sure ground clips do not spring off causing short circuit. Do NOT attempt to use these ground clips with the standard probes.

3-30. COAXIAL MEASUREMENTS

3-31. For measurements in transmission lines the prime considerations are the discontinuities due to the probes and the signal injected by the probes. For monitoring signals in 50-ohm lines, the Model 11536A Tee is convenient. The signals from the probes are

3-32. SWEPT-FREQUENCY OPERATION

3-33. Continuous phase and amplitude measurements can be made on signals which change frequency with time provided that the rate of change does not exceed 15 MHz/second and that the frequency remains within the automatic fine tuning range. As the input frequency changes APC UNLOCKED flashes momentarily about every 1.6 MHz. This is a normal occurrence and does nut produce any measurement uncertainty. Fixed frequency measurements at the se frequencies have the same accuracy as measurements at any other frequency. Best operation is achieved sweeping down in frequency.

3-34. ZERO-SITTING THE PHASEMETER.

3-35. Use accessory isolators or dividers to prevent interaction between the probes. For in-circuit measurements (Figure 3-4) zero phase indication is obtained by placing the probes at the same point and adjusting PHASE ZERO.

3-36. For measurements in 50-ohm transmission lines, to make zero adjustment independent of frequency an arrangement such as that shown in Figure 3-3 can be used. This arrangement is typical of what might be used for a phase, residual attenuation or gain measurement. If the electrical pathlengths between signal source and probe are equal, a zero adjustment is unaffected by change of input frequency. Although standard components may be used to assemble the two path arrangement, like components should be by the same maker and coupling should be done carefully. Small differences in the electrical lengths of the branches do not significantly affect zero accuracy at test frequencies below 500 MHz. For measurements above 500 MHz length differences can be detected by interchanging the probes after initial zeroing. Any change in phase reading indicates the branches do not have equal electrical length. This

condition can be corrected by component substitution or it can be compensated for in the zero adjustment. The purpose of the pads in Figure 3-3 is to reduce measurement errors caused by mismatch between the type N and probe tees.

3-37. 20 kHz IF OUPUTS.

3-38. The rear-panel 20 kHz IF outputs A and B are replicas of the RF signals applied to probes A and B. The IF signals have the same waveform, amplitude (up to 1 volt rms), and phase relationship as the RF signals, but the fundamental frequency of the IF signal is always 20 kHz and the harmonics of the RF signal are corresponding harmonics of 20 kHz. Up to approximately the twelfth harmonic of the RF fundamental can be reproduced in the IF signal, provided that the twelfth harmonic of the RF signal is within the frequency range of the Vector Voltmeter.

3-39. The IF signal is obtained by a sampling process; therefore, the wave displayed by an oscilloscope consists of narrow, shallow steps which closely duplicate the RF waveform. The IF outputs can be used to display RF waveforms with low frequency oscilloscopes and to make distortion measurements of RF signals with low frequency wave analyzers.

3-40. USE OF SUPPLIED PROBE ACCESSORIES.

3-41. **MODEL 11576A 10:1 DIVIDER.** The 10:1 divider accessories decrease probe input sensitivity. The input impedance of the probe-divider combination is 1 megohm shunted by 2 picofarads. Input sensitivity is decreased by a factor of 10.

3-42. of increased amplitude, to effectively eliminate measurement errors due to variations in test point impedance, and to reduce the amplitude of the sampling signal from the probe.

NOTE

The 10:1 Divider and/or Isolator adapters are not for use in a Probe Tee, such as the HP 11536A, HP 11576A, or HP 11063A. These adapters are for use: (1) When 8405A probe is connected to a BNC, Type N, or any other common tee; (2) When 8405A probe is used for in-circuit-type measurements.

3-43. MODEL 10218A ISOLATOR. The isolator accessories eliminate the effects of variations in test point impedance on measurement accuracy. An isolator adds no more than 3 picofarads to probe input capacitance.

3-44. In addition to being used to isolate test point impedance from the probes, the isolators can be used to prevent interaction between the probes when they are applied to the same test point.

3-45. **GROUNDING CLIPS.** The grounding clips are for use with the Divider and Isolator probe accessories. They clip onto the narrower metal barrel just behind the tip, and should be used to connect to circuit ground as near the test point as possible.

3-46. M0DEL 10218A BNC **ADAPTER.** BNC adapter converts probe tip to a conventional BNC male RF connector.

SECTION IV

PRINCIPLES OF OPERATION

4-1. GENERAL

4-2. The Vector Voltmeter converts two RF signals of the same fundamental frequency in the range from 1 to 1000 MHz to two 20-kHz IF signals. The IF signals retain the same amplitudes, waveforms, and phase relationship. Consequently, the fundamental components of the IF signals have the same amplitude and phase relationships as the fundamental components of the RF signals. The IF signals are filtered and then measured by a voltmeter and a phasemeter.

4-3. SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

4-4. The Vector Voltmeter, shown simplified in Figure 4-1, consists of a two-channel RF-to-IF converter, an ac voltmeter, and a phasemeter.

4-5. RF-TO-IF CONVERTER The converter changes two RF signals (V_A and V_B) which have the same fundamental frequency to two IF signals with 20 kHz fundamental frequencies. These IF signals have the same waveforms, amplitudes, and phase relationship (ϕ) as the RF signals. The 20 kHz sinusoidal fundamental components (V_{AF} and V_{BF}) are extracted from the IF signals by narrowband filters. These sinusoids have the same amplitudes and phase relationship as the fundamental components of the RF input signals.

4-6. VOLTMETER. The voltmeter, a conventional ac voltmeter, is switched manually to measure the amplitude of either IF sinusoid.

4-7. PHASEMETER. Before application to the phasemeter the 20 kHz sinusoids are amplified and clipped to remove amplitude difference and retain only the phase difference 4. In the phasemeter the clipped sine waves VC become triggers spaced in time in proportion to the phase difference between sine waves VAF and V_{BF}. The triggers generate a square wave with symmetry proportional to the time between triggers and therefore the phase difference. This square wave controls the current that operates the phase meter. The averagemeter current is governed by the symmetry of the square wave; therefore, the meter indication is proportional to the phase difference ¢. Thus the phasemeter measures the phase angle between the fundamental components of the RF input signals.

4-8. RECORDER OUTPUTS. For external monitoring and recording a voltage proportional to the phase meter reading, a voltage proportional to the amplitude meter reading in volts, and IF replicas of the input RF signals are available at separate rear-panel outputs.

4-9. DETAILS BLOCK DIAGRAM DESCRIPTION

4-10. CIRCUIT SECTIONS

4-11 Figure 7-4 is a detailed overal' block diagram of the Vector Voltmeter which includes the schematic location of circuit sections by page number. As shown in the diagram, there are five main circuit sections: identical channel A and channel B RF-to-IF Converters, an Automatic Phase Control Section, a Phasemeter, and a Voltmeter.

4-12. The RF-to-IF Converters and the Automatic Phase Control section produce two 20 kHz sine waves which have the same amplitudes and phase relationship as the fundamental components of the RF signals applied to channels A and B.

4-13. The Phaseme er section continuously monitors these two 20 kHz sine waves and provides a meter display of the phase angle between them. The Voltmeter section is manually switched to channel A or channel B 20 kHz sine wave and provides a meter display of the amplitude.

4-14. CIRCUIT DESCRIPTIONS.

4-15. Detailed circuit descriptions are given in Figures 7-6 through 7-18 of this manual. The descriptions are in the form of duplicate diagrams with word descriptions in place of circuits or circuit parts. Only those circuit sections which are not fully described on the diagrams are included in this section.

4-16. THE RF-TO-IF CONVERTERS.

4-17 As shown in Figure 4-2, the RF-to-IF converters are the input sections of the Vector Voltmeter. The Converters change any two RF signals of the same fundamental frequency in the range from 1 to 1000 MHz to two 20 kHz sine waves with the same amplitudes and phase relationship as the fundamental components of the RF signals.

4-18. Channel A Converter is the same as channel B Converter. Each Converter consists of a sampler and a tuned amplifier. The sampler produces a 20 kHz waveform replica of the RF input waveform, and the tuned amplifier extracts the 20 kHz fundamental component from this waveform replica.

4-19. SAMPLING.

4-20. As used in the Vector Voltmeter, sampling is a time-stretching process with which a high frequency repetitive signal is duplicated at a much lower frequency. The low frequency signal is obtained by accumulating amplitude samples taken from different

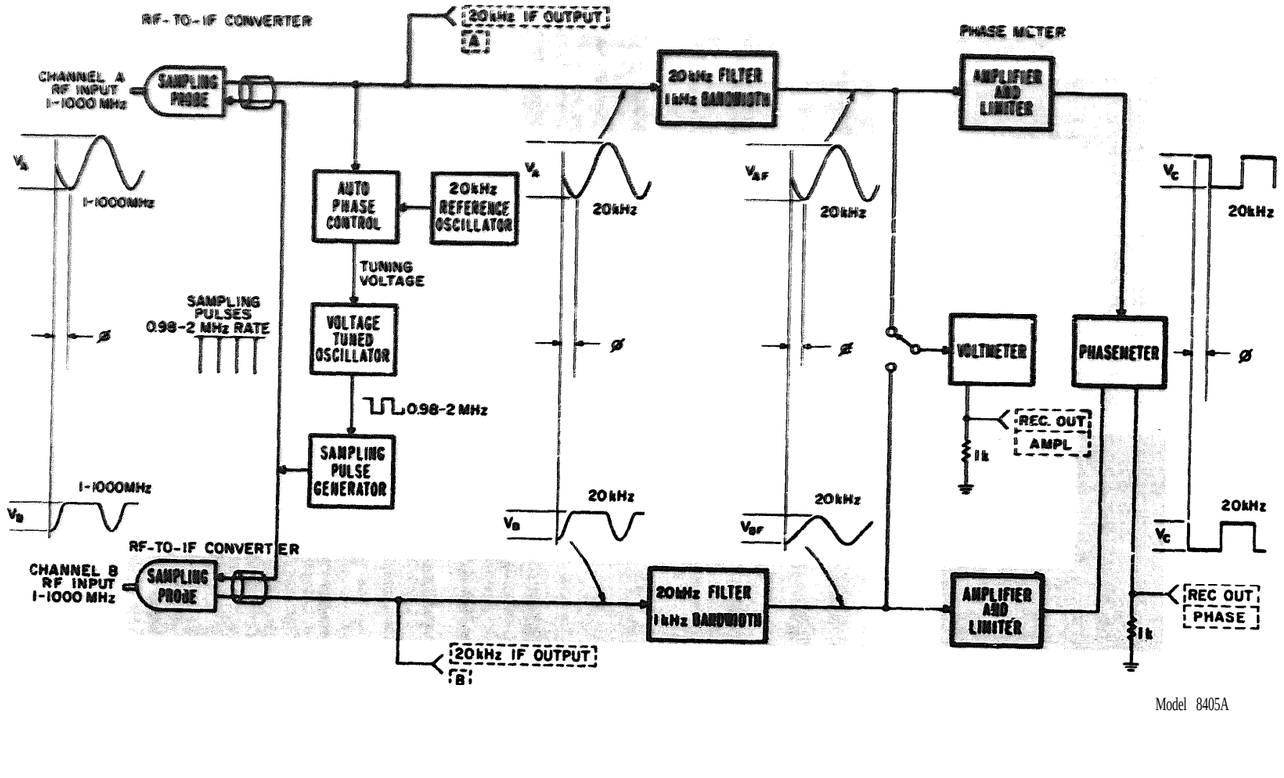


Figure 4-1. Simplified Overall Block Diagram

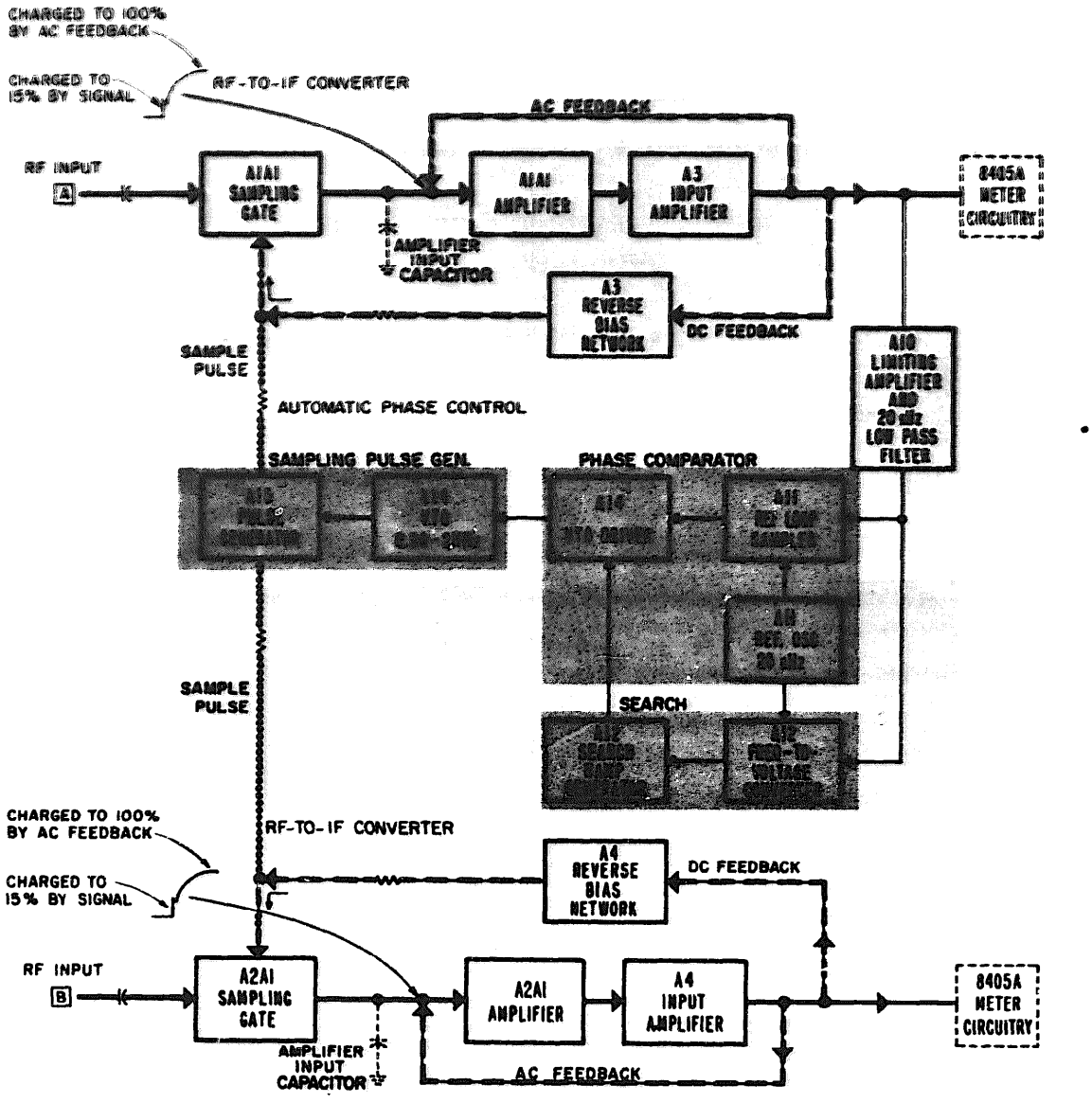


Figure 4-2. Basic Input Circuitry

occurrences of, and at progressively later points on, the high frequency waveform. The time taken to collect enough samples to reconstruct a cycle of the high frequency signal is much longer than the period of one cycle of the sampled waveform. Thus, the high frequency waveform is time-stretched to a low frequency waveform (Figure 4-3).

4-21. SAMPLER.

4-22. The sampler is the means of reconstructing a fast waveform on a much longer time base. Very simply, the sampler is an electronic switch between the fast waveform and an input capacitor as shown in

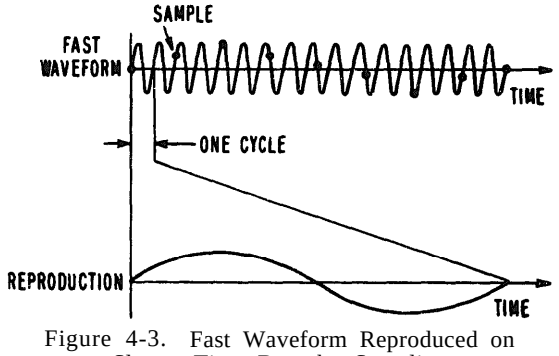


Figure 4-3. Fast Waveform Reproduced on Slower Time Base by Sampling

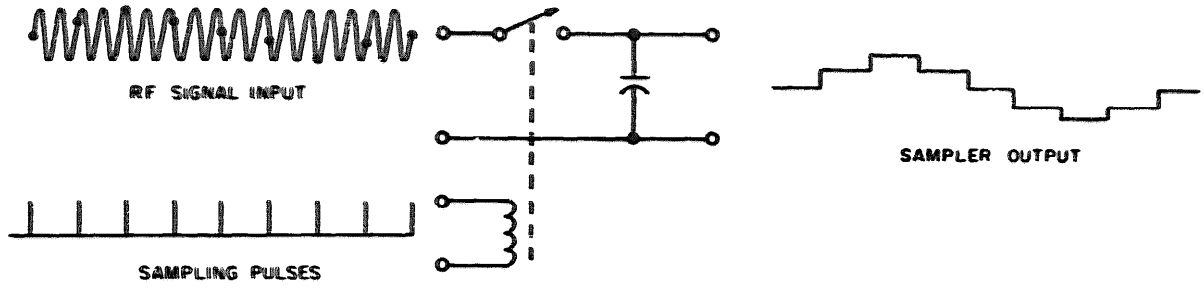


Figure 4-4. Simplified Diagram of a Sampler

Figure 4-4. Each time the switch is closed the capacitor charges to the voltage of the input signal and holds this voltage until the switch closes again. With appropriate timing of the switch the voltage on the capacitor reconstructs the sampled waveform with a series of steps. In this way a cycle of the fast waveform is reproduced in whatever the interval needed to collect enough samples to make a faithful reproduction. In the Vector Voltmeter the switch is electronic and controlled by very short duration pulses. These pulses close the switch for such a short time that the storage capacitor does not fully charge to the voltage of the input signal. Between pulses a feedback circuit supplies enough charge to make the stored voltage equal the input signal voltage.

4-23. One sampler is in each input channel. The sampling switches, or gates, are operated by pulses from the same source; therefore, samples are taken at the same instant in each channel, and the phase relationship of the input signals is preserved in **the IF signals.**

4-24. CIRCUIT DESCRIPTION.

4-25. There are two identical samplers, one at the input to **each channel. The circuits of channel A sampler** are on assemblies A1A1 and A3, and the circuits of channel B sampler are on assembliesA2 A1and A4. Assemblies A1A1 and A2A1 are housed in the input probes of channels A and B, respectively. (See Figure 7-6.)

4-26. As shown in the simplified diagram of Figure 4-2, each sampler consists of **a** sampling gate, an amplifier input capacitor, an ac feedback circuit and a reverse bias circuit. The sampling gate is between the RF input signal and amplifier input capacitor. The gate is a bridge of four fast-switching, hot carrier diodes which are normally back biased, by reverse bias network, so that the input signal does not cause them to conduct. When the input signal is to be sampled, pulses of very short duration momentarily overcome the back bias and switch the diodes into conduction. The amplifier input capacitor then starts to charge toward the voltage of the input signal. However, the sampling pulses are of such short duration that the capacitor charges to only a fraction of the input voltage while the bridge diodes are conducting. The rest of the charging is done between samples.

4-27. The voltage across the input capacitor is the input of a two stage amplifier. Feedback from the output to the input of this amplifier completes the charging of **the input capacitor.** The **amount** of feedback is variable SO that the IF voltage output of the sampler when the input capacitor is fully charged can be set to equal the RF input voltage when the sample was taken. This feedback charging process takes place in a small fraction of the time between samples, and the charge holds **from** sample to sample because there is no discharging **circuit.**

4-28. The reverse biasing of the sampling gate diodes **is a critical** factor in the operation of the samplers. The reverse bias must prevent the largest signals in the input rangefromcausing the.diodes to conduct, **yet it must allow** the **fixed amplitude sampling pulses to** forward bias the diodes in a way that gives best sampling efficiency .

4-29. Sampling efficiency is the measure of how nearly the sampler output voltage duplicates the input voltage. Since the sampler characteristically averages any input voltage change that occurs during the sample, the shorter the sampling time the greater the sampling efficiency. Sampling time is governed by the width of the sampling pulse at the point where it exceeds the back bias on the sampling diodes. Since the sampling pulses are roughly triangular but of fixed amplitude, sampling time depends upon the level of reverse bias. Each sampling gate has a bias control.

4-30. Sampling gate bias is controlled by the Reverse BiasNetwork. Operation of the reverse bias is as follows: While the diode gate is closed, the Reverse BiasNetwork shifts thebias voltages applied to either side of the gate so that the sampling gate output voltage is centered between them. This ensures equal levels of reversebias voltage applied to each diode of the gate. The two turn-on pulses are applied to the diode gate simultaneously. Since these pulses have opposite polarity and should be identical, they will turn on both sides of the gate simultaneously. Also, if they are identical and of opposite polarity they will cancel each other at the input and output of the gate.

4-31. However, due to slight differences in the amplitudes and shapes, the sampling pulses do not quite cancel. Compensation for these effects and proper operation of the sampling gate is as follows: 1. Fine

adjustment of the Reverse Bias Network for proper centering operation is set by the Symmetry Adjust, A3R15 for Probe A A4R15 for Probe B; 2. The on-time, or sampling efficiency of the diode gages, is adjusted by varying the level of reverse bias which the pulses must overcome with the Bias Adjust, A3R20 for Probe A, A4R20 for Probe B; 3. Fine adjustment of AC feedback which ensures that sampling gate output is equal to RF input level, is made with the Gain Adjust, A3R5 for Probe A A4R5 for Probe B.

4-32. THE AUTOMATIC PHASE CONTROL

4-33. The Automatic Phase Control (APC) is a self-tuning local oscillator which generates the sampling pulses for both RF-to-IF Converters and automatically controls the pulse rate to produce 20 kHz IF signals which have the same phase relationship as the RF input signals.

4-34. The APC is operated by the output of channel A sampler and consists of three main sections as shown in Figure 7-4. These are the Sampling Pulse Generator, Search, and Phase Comparator sections, the SPG section produces two in-step pulses. One gates a sample in channel B. The sampling pulse rate is controlled by a voltage tuned oscillator (VT0) for which the tuning voltage is supplied by the search and lock phase-comparator sections.

4-35. The Search and Phase Comparator sections frequency-lock and phase-lock channel A IF signal to a 20 kHz reference oscillator. To get initial locking the search section applies a ramp voltage to the VTO. This ramp voltage sweeps the sampling pulse rate until channel A IF is 20 kHz and in phasewith the reference oscillator. Then the sweep stops and the lock section holds channel A IF in phase with the reference oscillator. The lock section also regulates the sampling rate to follow small changes of frequency at probe A input provided that the rate of change does not exceed 15 MHz per second.

4-36. SEARCH SECTION.

4-37. The search section consists of the circuit sections outlined in Figure 7-4. The section varies the sampling rate until the fundamental frequency of channel A sampler output is 20 kHz with the same phase as the 20 kHz Reference Oscillator and the same polarity as the RF input signal.

4-38. The input to the search section is the output of channel A sampler. If the sampler output does not have a fundamental frequency of 20 kHz the Search Ramp Generator produces a ramp voltage which sweeps the output frequency of the Voltage Tuned Oscillator. Since the VTO controls the rate of the Sampling Pulse Generator, the sampling rate follows the VTO frequency.

4-39. When the sampling rate is such that the fundamental frequency of channel A sampler output is 20 kHz and in phase with the 20 kHz Reference Oscillator (All Assy) searching stops and thus the lock section holds sampling rate.

4-40. The VTO frequency, and therefore the sampling rate can be varied from 0.98 to 2 MHz. For any frequency in the input range of channel A many sampling rates in this range can produce an IF waveform with a 20 kHz fundamental frequency. However, only one sampling rate gives the truest reproduction of the RF waveform, and that is the highest sampling rate for which the resulting IF waveform has the same polarity as the RF waveform. Thus, the main requirements for the signals out of the samplers are a fundamental frequency of 20 kHz, polarity the same as the RF input waveform, and a high sampling rate.

4-41. The 20 kHz fundamental frequency is obtained by locking the fundamental frequency of channel A sampler output to a 20 kHz reference oscillator. Correct IF waveform polarity is obtained with an identifier circuit that stops a search at the highest sampling rate that has a multiple 20 kHz below the input frequency. High sampling rate is assured by having each search sweep the sampling rate from the high to the low end of its range, and by restricting the sweep to the highest range of sampling rates which can produce IF signals for the selected input frequency range.

4-41. To further increase search efficiency the slope of the VTO tuning ramp is automatically varied during the search by the Frequency to Voltage Converter to control the speed of the search: the farther the sampling rate from lock, the faster the sweep.

4-43. The part of the search circuit that assures the same polarity in the sampler output and RF input is the Sideband Identifier which stops the search at the highest sampling rate which has a multiple 20 kHz below the fundamental frequency of the input RF signal. The Sideband identifier operates as follows. Sampler A output is amplified, filtered, and clipped to give a square waveshape. This square wave is converted by Phase Inverter A12Q1 to two square waves with a phase difference of 180°. One of these square waves is the input to the Sideband Identifier. The Identifier is a sampling phase detector triggered by the 20 kHz Reference Oscillator. When the sampling rate in channel A RF-to-IF Converter is producing an IF signal of the correct polarity the output of the Identifier has a polarity that stops the search.

4-44. While searching is in progress Lamp Driver A12Q6 holds the front-panel APC UNLOCKED lamp lighted.

4-45. When the tuning ramp applied to the VTO by the search circuit reaches the voltage that gives the correct sampling rate in the RF-to-IF Converter the search stops and a holding circuit applies an equivalent static voltage to the VTO. The holding circuit consists of the Phase Comparator outlined in Figure 7-4, and operates as follows: Voltage samples timed by the 20 kHz Reference Oscillator are taken from the fundamental component of sampler A output. If thefrequency of the fundamental is 20 kHz the voltages of the sample rare equal and within the tuning voltage range of the VTO. For a particular frequency at the input to sampler A, the voltages of these holding circuit samples tune the

VTO to the frequency which gives the sampling rate which produces a 20 kHz IF. The holding circuit also permits the signal into sampler A to change frequency a small amount without causing a search.

4-46. [illegible] ples are taken from every cycle of sampler A output. This feature gives faster response to any tendency toward IF change. The Limiter Amplifier converts sampler A output to a square waveform. The Low Pass Filter and +90° Phase Shifter extracts the fundamental component from this waveform and shifts it in phase to lead by 90°. Phase Inverter A11Q2 converts this fundamental component to two signals with the same waveshape but different in phase by 180°. Each of these signals is an input to an IF Sampler. The other input to each sampler originates at the 20 kHz Reference Oscillator. The 20 kHz Reference Oscillator has two outputs which approximate square waves and have steep negative-going slopes. These square waves differ in phase 180°; therefore, the negative-going slopes are separated in time by 25 microseconds. These slopes trigger the Pulse Generators to produce negative pulses 25 microseconds apart. The pulses gate the IF Samplers. If the fundamental frequency of sampler A output is 20 kHz the samplers are gated to pass small segments from the negative-going slopes of the signals from the phase Inverter, and these segments all have the same voltage and are within the tuning voltage of the VTO.

4-47. Decoupling diodes A19CR1 and A20CR1 prevent crosstalk between channel A input and channel B input. Delay Line A1? is a section of transmission line which can be mechanically adjusted to equalize the electrical distance from the Sampling Pulse Generator to the samplers.

SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. **This section provides instructions for performance testing, calibrating, troubleshooting, and repairing the Vector Voltmeter. If the serial prefix (the first three numbers of the serial number) of your instrument is different than that listed on the title page of this manual, then there are differences between your instrument and the instrument described in this manual (refer to Paragraph 1-20).**

5-3. PERFORMANCE TESTING

5-4. PURPOSE. **The procedures listed in Table 5-2 check 8405A performance for incoming inspection, periodic evaluation, calibration, and troubleshooting. The tests can be performed without access to the instrument interior. The specifications of Table 1-1 are the performance standards.**

5-5. TEST EQUIPMENT REQUIRED The test instruments and accessories required to make the performance checks are listed in Table 5-1. Test instruments other than the ones listed can be used provided their performance equals or exceeds the Critical Specifications listed.

5-6. ADJUSTMENTS.

5-7. PURPOSE The procedures listed in Table 5-3 outline the adjustments necessary to align the 8405A. The adjustments are sequential and should always be made in the order given. However, realignment of the Power Supply does not normally have to be followed by any of the other adjustment procedures. These adjustments should be made only when it is determined that the instrument is not operating properly. To determine proper operation, refer to Paragraph 5-3.

5-8. TEST EQUIPMENT REQUIRED. The test instruments required for alignment are listed in Table 5-1. Test instruments other than those listed may be used provided their performance equals or exceeds the Critical Specifications listed.

5-9. TROUBLESHOOTING

5-10. LOCATING TROUBLE.

5-11. Always start locating trouble with a thorough visual inspection for burned-out or loose components, loose connections, or any conditions which suggest a source of trouble. Check the fuse to see that it is not open.

5-12 If trouble cannot be isolated to a bad component by visual inspection, the trouble should be isolated to a **Circuit** section. Isolation to a circuit section can be accomplished by using the troubleshooting charts(Table 5-4 through *5-9).* **To** isolate trouble to a definite circuit component, refer to the next paragraph.

5-13. COMPONENT TROUBLE ISOLATION

5-14. **The following procedures and data are given to aid in determining whether a transistor is operational. Tests are given for both in-circuit and out-of-circuit transistors and should be useful in determining whether a particular section trouble is due to a faulty transistor or an associated component.**

5-15. IN-CIRCUIT TESTING,

5-16. **The common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base - emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct. the** diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base-emitter junction. Figure 5-1 shows transistor symbols with terminals labeled. Notice that the emitter arrow points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in transistors and vacuum tubes. If the transistor base-emitter diode (junction) is forward-biased the transistor conducts. If the diode is heavily forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased the transistor is cut off (open). The voltage drop across aforward-biased emitter -base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2-0. 3 volts when collector current is 1-10 ma, and 0.4-0. 5 volts when collector current is 10-100 ma. In contrast, forward-bias voltage for silicon transistors is about twice that for germanium types: about 0.5-0. 6 volts when collector current is low, and about 0.8-0. 9 volts when collector current is high.

5-17. When examining a transistor stage, first determine if the emitter-base diode is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base: there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure each voltage separately with respect to a voltage common point (e.g., chassis). If the emitter-base diode is forward -biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then shift to near the supply volt-

age. Any difference is due to leakage current through the transistor and, in general, the smaller this current. the better the transistor. If collector voltage does not change the transistor has either an emitter-collector short circuit or emitter-base open circuit.

5-18. OUT-OF-ORDER CIRCUIT TESTING.

5-19. The two common causes of transistor failure are internal short- and open-circuits. Remove the transistor from the circuit and use an ohmmeter to measure internal resistance. See Table 5-1A for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check its open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 volts and short-circuit current must be less than : mA. See Table 5-1B for safe resistance ranges for some common ohmmeters.

Table 5-1A. Gut-of-Circuit Transistor Resistance Measurements

Transistor Type		Connect Ohmmeter Pos. lead to	Neg. lead to	Measure Resistance (ohms)
PNP Germanium	Small Signal	emitter	base*	200-250
		emitter	collector	10K-100K
	Power	emitter	base*	30-50
		emitter	collector	several hundred
PNP Silicon	Small Signal	emitter	base*	10K-100K
		emitter	collector	very high (might read open)
NPN Silicon	Small Signal	base	emitter	1K-3K
		collector	emitter	very high (might read open)
	Power	base	emitter	200-1000
		collector	emitter	high, often greater than 1M

* To test for transistor action, add collector-base short. Measured resistance should decrease.

Table 5-1B. Safe Resistance Ranges for Common Ohmmeters

Ohmmeter	Safe Range(s)	Open Ckt Voltage	Short Ckt Current	Lead Color	Lead Polarity
HP 412A, HP 427A	R x 1 K	1.0V	1 mA	Red	+
	Rx 10K	1.0V	100 µA		
	Rx 100K	1.0V	10 µA	Black	-
	Rx 1M	1.0V	1 µA		
	Rx 10M	1.0V	0.1 µA		
HP 410C	R x 1 K	1.3V	0.57mA	Red	+
	Rx 10K	1.3V	57 µA		
	Rx 100K	1.3V	5.7 µA		
	R x 1 M	1.3V	0.5 µA	Black	-
	Rx 10M	1.3V	3.05 µA		
HP 410B	Rx 100	1.1V	1.1 mA	Black	+
	Rx 1K	1.1V	110 µA		
	Rx 10K	1.1V	11 µA	Red	-
	Rx 100K	1.1V	1.1 µA		
	R x 1 M	1.1V	0.11 µA		
HP 414A	500K	1.0V	110 µA	Black	+
	150K	0.5V	110 µA		
	50K	0.3V	110 µA	Red	-
	15K	0.2V	110 µA		
Simpson 260	Rx 100	1.5V	1 mA	Red	+
				Black	-
Simpson 269	Rx 1K	1.5V	0.82 mA	Black	+
				Red	-

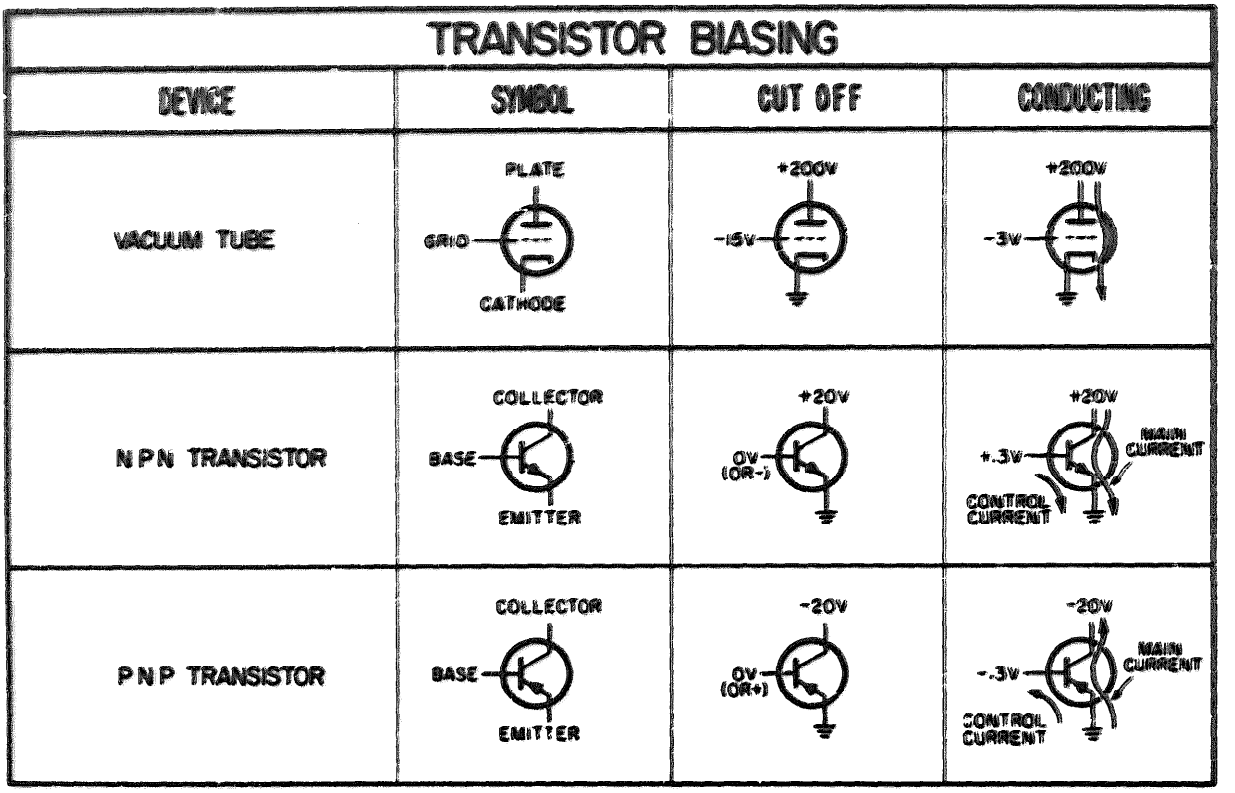


Figure 5-1. Transistor Biasing Characteristics

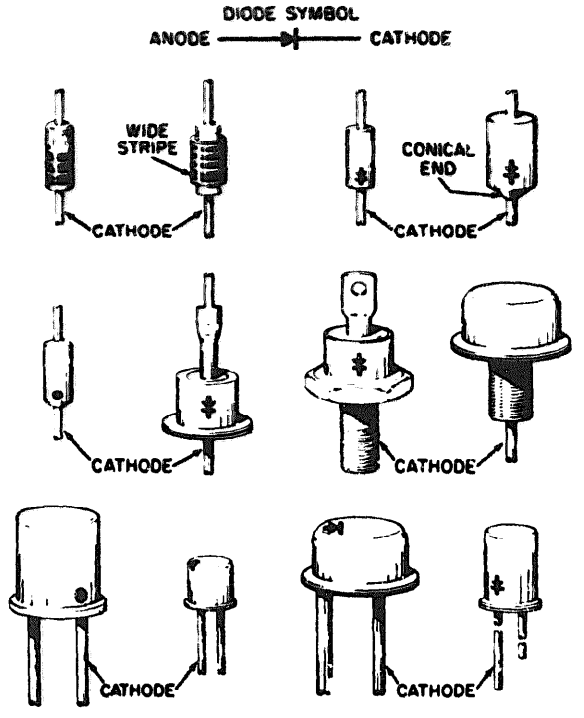


Figure 5-2. Examples of Diode Marking Methods

Figure 5-2. Examples of Diode Marking Methods

5-20. REPAIR AND REPLACEMENT.

5-21. Certain procedures and precautions must be followed when repairing or replacing any component of the 8405A. Most of the amplifier and power supply circuit components are located on the etched circuit board. Instructions for working on the etched circuit board are summarized in Paragraph 5-22. Always disconnect the AC power before replacing or soldering any parts.

5-22. ETCHED CIRCUITS.

5-23. The etched circuit boards in the 8405A are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. Soldering can be done from either side of the board with equally good results. Table 5-1C lists required tools and materials. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution: it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

c. Use a suction device (Table 5-1C) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered area and apply a protective coating to prevent contamination and corrosion. See Table 5-1C for recommendations.

5-24. COMPONENT REPLACEMENT

a. Remove defective component from circuit board.

b. Remove solder from mounting holes using a suction desoldering aid (Table 5-1C) or wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

d. Insert component leads into mounting holes and position component as original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp lead ends may damage plated-through conductor.

Note: Axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection, and clip off excess lead

5-25. ETCHED CONTRATOR REPAIR. A broken or

wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

5-26. TRANSISTOR REPLACEMENT

a. Do not apply excessive heat. See Table for soldering tool specifications.

b. Use a heat sink such as pliers or hemost tween transistor body and hot soldering iron.

c. When installing a replacement transistor, sufficient lead length to dissipate heat of solde maintaining about the same length of exposed used for original transistor.

5-27. DIODE REPLACEMENT

5-28. Solid state diodes are in many physical forms. This sometimes results in confusion as to which lead or connection is for the cathode (negative) or anode (positive), since not all diodes are marked with the standard symbols. Figure 5-2 shows examples of some diode marking methods. If doubt exists as to polarity, an ohmmeter may be used to determine the proper connection. It is necessary to know the polarity of the ohms lead with respect to the common lead for the ohmmeter used. (For the HP Model 410B Vacuum Tube Voltmeter, the ohms lead is negative with respect to the common; for the HP Model 412A DC Vacuum Tube Voltmeter, the ohms lead is positive with respect to the common.) When the ohmmeter indicates the least diode resistance, the cathode of the diode is connected to the ohmmeter lead which is negative with respect to the other lead (see Table 5-1B).

Note: Replacement instructions are the same as those ..... for transistor replacement.

Table 5-1C. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750 - 800°F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip, general purpose	Soldering Unsoldering	Shape: chisel Size: 1/8"	Ungar #PL113
De-soldering aid	Unsoldering multi-connection components (e.g., tube sockets	Suction device to remove molten solder from connection	Soldapult by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Ace tone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	Krylon* #1302 Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp. Woodside 77, New York

*Krylon Inc., Norristown, Pennsylvania

Table 5-1. Recommended Test Equipment

Item	Critical Specifications	Use (Note 3)	Recommended Models
Low Pass Filter (Item 8)*	Cut off Freq: 30 MHz Rejection: 60 dB at 36 MHz	1 3	Telonic TLC-30-6-F-E (See Note 1)
	Cut off Freq: 60 MHz Rejection: 40 dB at 120 MHz	1 3	Telonic TLA-60-3-F-E (See Note 1)
	Cut off Freq: 100 MHz Rejection: 40 dB at 200 MHz	1 3	Telonic TLP-100-3-F-E (See Note 1)
	Cut off Freq: 1200 MHz Rejection: 30 dB at 2000 MHz	1 3	HP 360B (See Note 1)
Oscilloscope	Bandwidth: 50 MHz Sweep Range: 1 to 25 μsec/cm Sweep Trigger: internal or external Input Coupling: ac or dc Vertical Sensitivity: 5 mV/cm, minimum	2 3	HP 175A (Oscilloscope w/HP 1755A (Vert. Amplifier) & HP 10003A (10:1 Divider Probe)
AC Voltmeter	Freq Range: 50-120 Hz, 20 kHz Volt Accuracy: ±3% of full scale (50-120 Hz); ±1% of full scale (20 kHz and 300 mV) Voltage Range: 1 to 300 mV Input Impedance: 2 megohm or greater	3	HP 400 H/E/or EL, or HP 3400A, or HP 741A
Test Oscillator	Output Freq 18-22 kHz Output level (into 600 ohms): 0 to 1 volt rms	3	HP 200 CD, HP 204B, HP 208A, or HP 651A
Variable Attenuator	Attenuation Range: variable in 1 dB steps from 10 to 30 dB Freq Range: 18-20 kHz Nominal Impedance: 600 ohms	3	HP 350D
Square Wave Generator	Output Freq: 160-200 kHz Symmetry: 45/55 Output level (into 25 ohms): 20 mV p-p, minimum	3	HP 211A
Signal Generator	Output Freq: 1-10 MHz Output level (into 50 ohms): 3 volts rms Dial Accuracy: ±3%	2 3	1-10 MHz: HP 651A or HP 606A/B
Signal Generator	Freq Range: 10-450 MHz, 450-1000 MHz, 950-1000 MHz Freq Accuracy: ±2% Output level (into 50 ohms): 10-100 MHz: 3V min. 100-450 MHz and 950-100 MHz: 1.0V min. Auxiliary (second) Output into 50 Ohms: 120 mV minimum	3	10-100 MHz: 8601A Generator or 608E Generator & 230A Amplifier 100-450 MHz: 608E 450-1000 MHz: 612A 950-1000 MHz: 8614B
Power Meter, Thermistor Mount, and Calibrator	Freq Range: 100, 110, and 1000 MHz Meter Readout Accuracy: ±0.5% Power Range: +3 to -10 dBm	1 3	HP 431B/C Meter HP 478A Mount HP 8402B Calibrator & Digital Voltmeter (See Note 2) or HP 432A Meter and HP 478 (See Note 4)

Table 5-1. Recommended Test Equipment (Cont'd)

Item	Critical Specifications	Use (Note 3)	Recommended Models
Frequency Counter	Counting Range: 18-22 kHz Accuracy: ±2 Hz Sensitivity: 100 mV rms	3	18-22 kHz: HP 5212A or HP 5512, or HP 5245L
	Counting Range: 1-410 MHz Accuracy: ±50 Hz Sensitivity: 100 mV rms	1	1-410 MHz: HP 5245L Counter and HP 5253B Converter
Digital Voltmeter	Voltage Range: ±0.1 to ±40 Vdc Accuracy: ±0.15% of reading (±1.1 mV for 0.1 to 3V range) Minimum Input Impedance: 10 Megohm	1 2 3	HP 5264A (DVM plug-in used with 5245L listed above), or HP 3439A/any plug-in, or HP 3440A/any plug-in,
RF Voltmeter	Freq Range: 10-100 MHz Calibrated Readout Accuracy: .5% at 10 MHz; .6% at 30 MHz; 1% at 60 MHz Voltage Range: 0.5 to 1.5 Volt rms	1 3	Standards laboratory Calibrated HP 411A Meter with Probe inserted in HP 11024A (Type N tee) and Digital Voltmeter (see Note 2)
1*	50 ohm load with male type N connector SWR: less than 1.06 (3 required)	1 2 3	HP 908A
2*	50 ohm Probe Tee with type N connectors (2 required)	1 2 3	HP 11536A
3*	50 ohm adapter (type N female to female)		HP 1250-0777 (UC 29B/U)
4*	10 dB coaxial attenuator for 5O-ohm line with type N connectors (2 required)	1	HP 8491A (Option 10)
5*	50 ohm adapter (Tee, all connectors type N female) 3 dB power splitter	1 2 3	HP 11549A
6*	50 ohm adjustable air line (adjustable from 60 to 80 cm with GR type 874 connectors) SWR: Less than 1.06 at 1000 MHz	1	General Radio Co. Type 874-LK2OL
7*	50 ohm adapter (type N male to GR 874) (2 required)	1	HP 1250-0847 (874-QNP)
8*	Low Pass Filter (see beginning of this list)	1 3	
9*	6 dB coaxial attenuator for 50-ohm line with type N connectors	1	HP 8491A (Option 06)
10*	Thermistor Mount (see Power Meter listed)	1 3	
11*	Probe Tee for RF Voltmeter (see RF Voltmeter listed)	1 3	
12* Calibrated Variable Attenuator	Attenuation Range: 1 to 12 dB in 1 dB steps Accuracy: ±.02 dB at 30 MHz ±0.05 dB at 100 MHz Connectors: Type N female	1	HP H34-355C (See Note 1)

Table 5-1. Test Equipment (Cont'd)

Item	Critical Specifications	Use (Note 3)	Recommended Models
13*	50 ohm adapter (BNC male to type N female)	1 3	HP 1250-0077 (UG-349A/U)
14*	BNC to 8405A Probe Adapter	1	HP 10218A
15*	50 ohm tee, type N female connectors	1	HP 1250-0846 (UG-28 A/U)

* Item numbers refer to Performance Check and Adjustment Procedure Test Setups.

NOTES:

1. Nominal impedance is 50 ohms with type N connectors (one male and one female).
2. For required power meter and RF voltmeter readout accuracy, a Digital Voltmeter is required. The Digital Voltmeter in the above list will do the job.
3. For USE column:
   1. Performance check
   2. Troubleshooting
   3. Adjustment procedure
4. If HP Model 432A Power Meter is used, then Calibrator (8402B) is not required.

Table 5-2. Performance Test

I. SPECIFICATIONS TESTED

1. ISOLATION BETWEEN CHANNELS: 1 to 300 MHz . . . . . 100 dB
300 to 1000 MHz . . . . . 60 dB

I. TEST DESCRIPTION

1. **ISOLATION BETWEEN CHANNELS is tested by applying a large amplitude signal to Channel A with no signal applied to B. Crosstalk from Channel A is indicated by the Channel B AMPLITUDE meter reading.**

I. PROCEDURE

1. **With signal source output at a minimum, connect equipment as shown in Figure 1.**

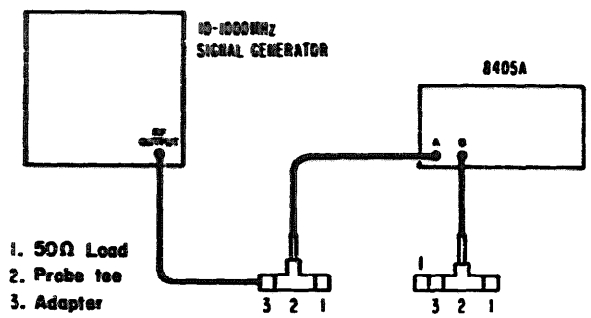


Figure 1. Channel Isolation Check

2. get signal generator **for** unmodulated (CW) RF output of about 0 dBm (about 300 mV) and 410 MHz.
3. **Adjust 8405A** FREQ RANGE-MHz **switch so APC UNLOCKED light goes** out **and** setting includes **measurement frequency,**
4. Set 8405A AMPLITUDE CHANNEL switch **to A.**
5. **Adjust signal generator output for a 0 dB** 8405A meter reading.
6. Set 8405A **AMPLITUDE CHANNEL** switch **to** B **and** measure the amplitude signal present on Channel B: The signal amplitude shouid not **exceed -80** dB.
7. Test isolation between channels **at any** other frequencies between 300 and 1000 MHz.
8. For frequencies 1 to 300 MHz, repeat above procedure with the following exceptions: (a) adjust signal source output for 1 volt **Channel A** reading; (b) Channel B reading should not exceed 10 microvolts.

II, SPECIFICATIONS TESTED

1. VOLTMETER RESIDUAL NOISE:: 10 µV as indicated on meter.

II. TEST DESCRIPTION

1. **VOLTMETER RESIDUAL NOISE** is tested by applying 1 mV to Channel A and reading Channel B with no signal applied to it.

Table 5-2. Performance Tests (Cont'd)

II. PROCEDURE

1. Set up equipment as shown in Figure 1 and adjust signal source for 1 mV output.
2. Set 8405A AMPLITUDE RANGE to -70 and read voltmeter with AMPLITUDE CHANNEL set to B. Meter indication should not exceed 10 microvolts for Channel B.

III. SPECIFICATIONS TESTED

1. VOLTAGE ACCURACY: Using HP 11536A Probe Tee:

a. 1 to 100 MHz	±2% of full scale
b. 100 to 300 MHz	±6% of full scale
c. 300 to 800 MHz	±12% of full scale
d. 800 to 1000 MHz	±12% of full scale for up to 300 mV rms ±12% ± 5% of full scale for 300-1000 mV rms

III. TEST DESCRIPTION

1. 1 to 100 MHz. Voltage accuracy is tested by applying an accurate rms signal to either input probe. Accuracy of the signal is determined using a calibrated RF voltmeter. To ensure an accurate measurement with the RF voltmeter, the harmonic content of the measured signal must be about 60 dB below the fundamental of interest. Therefore, a low-pass filter is required (for some signal sources, a bandpass filter may be required because the signal source output may contain sub-harmonics).
2. 100 to 1000 MHz. Voltage accuracy is tested by applying an accurate rms signal to either input probe. Accuracy of the signal is determined using an RF Power Meter. To ensure an accurate measurement with the Power Meter, the harmonic content of the measured signal must be about 30 dB below the fundamental of interest. Hence, a low-pass filter is required (for some signal sources, a bandpass filter is required because sub-harmonics may be present in RF signal).

III. PROCEDURE

1. 1 to 100 MHz.
   a. With signal source set to minimum, connect test equipment as shown in Figure 2. Allow one-hour warmup.

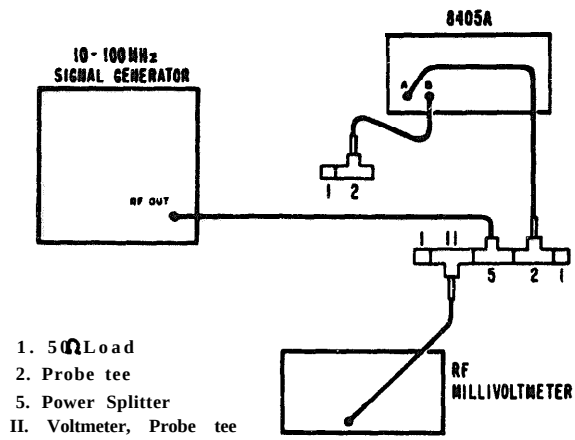


Figure 2. Voltage Accuracy Check (1 to 100 MHz)

Note

For required read-out accuracy, a digital voltmeter should be used with the calibrated RF voltmeter.

b. Set signal source for 10 MHz unmodulated signal and adjust output level for 1 volt rms as indicated by calibrated RF voltmeter.

Table 5-2. Performance Tests (Cont'd)

c. Set 8405A FREQ RANGE so that APC UNLOCKED light goes out with range setting including measurement frequency. Note Channel A amplitude meter reading.

d. Remove 411A Probe and Probe Tee and replace with Channel B Probe Tee. If necessary, adjust signal generator output for Channel A meter reading noted in step c.

e. Set 8405A AMPLITUDE CHANNEL to B and AMPLITUDE RANGE to 1000 mV; amplitude should read 1.00 ± 0.02 volt.

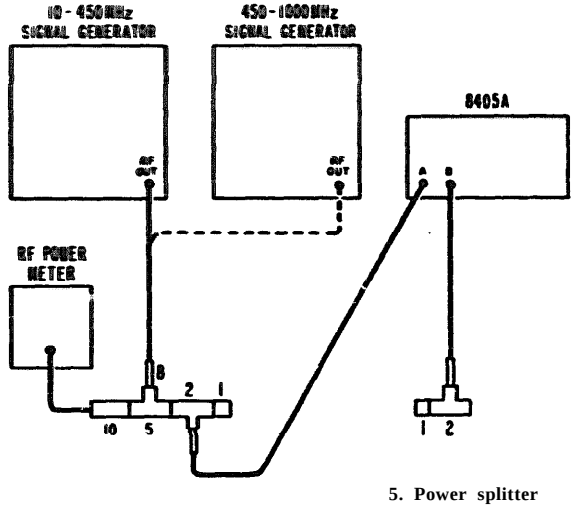
f. Repeat above procedure at 30 and 60 MHz. At 30 MHz the 8405A should read 1.00 ± 0.02 volt. At 60 MHz the 8405A can read 1.00 ± 0.03 volt. This is because the RF millivoltmeter (HP 411A) has a calibration accuracy of ±1%. This means that the HP 411A could be 1% off at 60 MHz while the 8405A could be off 2% causing the 8405A to appear to be off by 3%.

Note

If the 8405A amplitude reads 1.00 ± 0.01, it is definitely within ±2% accuracy; if the 8405A reads 1.00 ± 0.03, it is probably within ±2% accuracy; if the 8405A reading is 1.00 ± greater than ±0.03, it is not within ±2% accuracy.

2. 100 to 1000 MHz.

a. With signal source set to minimum output, connect equipment as shown in Figure 3. **Allow one-hou.r warmup.**



1. 50Ω Load
2. Probe too
5. Power splitter
8. Low pass filter
IO. Thermistor mount

Figure 3. Voltage **Accuracy** (100 to 1000 MHz)

Note

For maximum power meter readout accuracy: a power meter calibrator (HP 8402B) and digital voltmeter should be used with the power meter. Refer to Operating and Service Manual for power meter calibrator. If the Model 432A Power Meter is used, the Calibrator (8402B) is not required.

b. Zero and null power meter, then set to 1 mW range.

c. Set signal source for 100 MHz unmodulated output and adjust for power meter reading which indicates 0.00 dBm level.

d. Note Channel **A** AMPLITUDE meter reading. Disconnect thermistor mount from setup and replace with Channel B probe, probe tee and 50 ohm load.

e. If necessary, readjust signal generator output for Channel A meter reading noted in step d.

f. Set 8405A AMPLITUDE CHANNEL to B and AMPLITUDE RANGE to 300 mV. Channel B AMPLITUDE meter should read 223.5 mV ±6 mV.

Table 5-2. Performance Tests (Cont'd)

g. Set signal source to 200 MHz and repeat steps c, d, and e. Channel B AMPLITUDE meter should read 223.5 mV ±18 mV.

h. Repeat step g for frequencies of interest between 100 and 300 MHz.

i. Set signal generator for frequencies of interest between 300 and 1000 MHz and repeat steps c, d, and e. Channel B AMPLITUDE meter should read 223.5 mV ±36 mV.

IV. SPECIFICATION TESTED

1. VOLTAGE RATIO ACCURACY:

IV. FEATURE TESTED.

VOLTMETER TRACKING.

IV. TEST DESCRIPTION

Range-to-range-voltage tracking is tested by adjusting an input signal for a convenient reference on range of the 8405A Voltmeter. The input signal is then decreased with an accurately calibrated attenuator.

IV. PROCEDURE

1. Set up test equipment as shown in Figure 4.

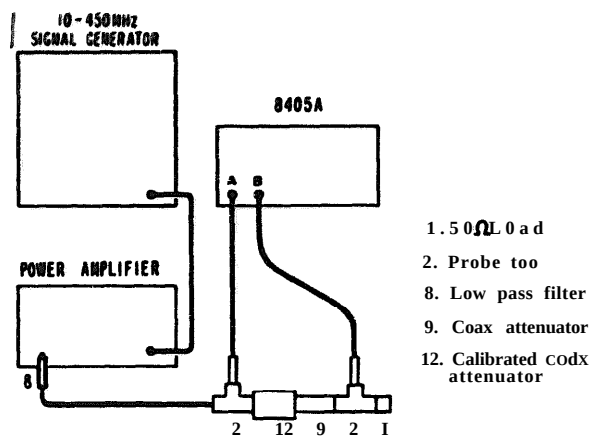


Figure 4. Voltage Ratio Accuracy

2. Set 355C attenuator to 0 dB and set signal source to 30 MHz. Set signal source for about 0 dBm (about 223 mV) output.

3. Set 8405A AMPLITUDE CHANNEL to B and AMPLITUDE RANGE to 0 dB. Adjust FREQ RANGE (MHz) setting to include measurement frequency.

4. Adjust signal source for 0 dB (223.5 mV) 8405A reading.

5. Switch 355C to 1 dB: Amplitude should read 193 to 205 mV + (355C calibration error).

6. Switch 355C to 2 dB: Amplitude should read 172 to 183 mV + (355C calibration error).

7. Switch 355C to 3 dB: Amplitude should read 152 to 164 mV + (355C calibration error).

8. Switch 355C to 4 dB: Amplitude should read 135 to 147 mV + (355C calibration error).

9. Switch 355C to 5 dB: Amplitude should read 120 to 132 mV + (355C calibration error).

Table 5-2. Performance Tests (Cont'd)

10. Switch 355C to 6 dB: Amplitude should read 106 to 118 mV + (355C calibration error).
11. Switch 355C to 7 dB: Amplitude should read 93.8 to 106 mV + (355C calibration error).
12. Set 355C to 0 dB and adjust signal source for 0 dB (223.5 mV) 8405A reading on 300 mV range.
13. Set 355C to 10 dB and 8405A to 100 mV range: amplitude should read 68.7 to 72.7 mV + (355C calibration error).
14. Set 355C to 0 dB and adjust signal source for 30 mV 8405A reading on 100 mV range.
15. Set 355C to 10 dB and 8405A to 30 mV range: amplitude should read 24.7 to 25.9 + (355C calibration error).
16. Repeat steps 1 through 15 for any frequency of interest that variable attenuator is calibrated for.

V. SPECIFICATIONS TESTED

1. PHASE ACCURACY: (including phase accuracy due to unequal signal levels to Channel A & B.

a. Below 500 MHz using HP 11536A Probe Tee (Channel A and B voltages between 100 μV and 300 mV) ±4.5°.

b. 500 to 1000 MHz using HP 11536A Probe Tee (Channel A and B voltages between 100 μV and 100 mV) ±4.5°.

c. 1 to 100 MHz using HP 11576A 10:1 Dividers (Channel A and B voltages between 1 mV and 3V) ±5.5°.

d. 1 to 200 MHz using HP 10216A Isolator (Channel A and B voltages between 100 mV and 300 mV) ±7.5°.

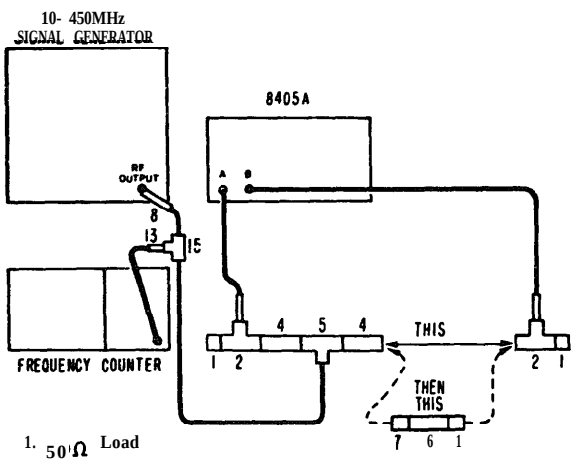
V. TEST DESCRIPTIONS

1. **PHASE ACCURACY is tested by separating the input probes by a known electrical line length equal to one wavelength (360°** phase **shift)** at a given frequency. The frequency is then **changed in exact increments causing a known phase shift.**

NOTE; In **general** the phase shift caused by a change in frequency **Figure 5 is given by**

$$\text{Ø} = \frac{f_o - f}{f_o} (360°)$$

where Ø = phase shift indicated on 8405A
f_o = frequency originally set for 0° phase shift.
f = new frequency causing phase shift.



1. 50Ω Load
2. Probe tee
4. 50Ω coax attenuator
5. Power splitter
6. Adj air line
7. Adapter
8. Low pass filter
13. Adapter
15. Type N female tee

Figure 5. Phase Accuracy Check

Table 5-2. Performance Tests (Cont'd)

V. PROCEDURES

1. Set up equipment as shown in Figure 5.
2. Using Frequency Counter, adjust signal source for RF output of about 100 *m*V and frequency as close to 400.000 MHz as possible.
3. Adjust 8405A FREQ RANGE (MHz) so setting includes measurement frequency.
4. Set PHASE RANGE to ±180° and METER OFFSET (black knob) to 0°. Using ZERO control, adjust for 0° meter reading. Switch RANGE to ±6° and rezero meter as necessary.
5. Insert air line in setup as shown.
6. Adjust air line length for 0° 8405A PHASE meter reading on ±6° scale. Remove air line from setup and recheck PHASE METER zero. If necessary, readjust. Reconnect air line in setup and, if necessary, readjust length for 0° reading.
7. Using the following procedure and the frequency counter to determine exact frequency increments, check phase accuracy of 8405A.
   a. Change frequency to 300 MHz.
   b. Adjust 8405A FREQ RANGE (MHz) to include measurement frequency. Set PHASE RANGE to ±6°, METER OFFSET to 90°, and +/- switch to +.
   c. PHASE meter should read 0 ±4.5° when air line is reinserted.
   d. Change frequency to 200 MHz and repeat steps b and c above except that METER OFFSET should be set to 180°.
   e. Change frequency to 100 MHz and repeat steps b and c above except that METER OFFSET should be 90°, and +/- should be - .
   f. Repeat similar procedure at frequencies and signal levels of interest, using equation given in Note.

Table 5-3. Adjustment Procedure

INTRODUCTION

Adjustments should not be made unless it is determined that the instrument is not operating properly. To determine proper operation, see Table 5-2. This adjustment procedure should be followed sequentially. For a list of instrument adjustments and the front panel functions that they affect, see below. See Table 5-1 for required test equipment.

ADJUSTMENT SUMMARY

Adjustment	Instrument Function
1. Meter Movement Mechanical Zero	**1. Basic accuracy of both meters**
2. Power Supply Adjustments	**2. All functions**
3. IF Section Adjustments	
3A. Channel A IF Tuning and Gain	**3A. All functions except, IF OUTPUTS and Channel B voltmeter**
3B. Channel B IF Tuning and Gain	**3B. All functions except, IF OUTPUTS and Channel A voltmeter**
4. Phase Section Adjustments	**4. Phasemeter and PHASE recorder output**
5. Automatic Phase Adjustments	
5A. **IF Sampler**	5A. All functions. Note: misadjustment is most noticeable as the cause of low voltmeter readings
5B. Pulse Generator and **Sampler**	
(1) A3R20/A3R15/Al5R3	5B(1). All functions
(2) A4R20/A4R15	5B(2). All functions except Channel A voltmeter.
5C. **Search Speed**	5C. All functions or, all functions **at** some frequencies only.
6. RF Section Adjustments	
6A. Channel A RF Gain	6A. Channel A voltmeter
6B. Channel B RF Gain	6B. Channel B voltmeter
NOTE: IF sampler slightly misadjusted (A11R24)	NOTE: Both Channel voltmeters
6C. Delay Line	6C. Phasemeter

Table 5-3. Adjustment Procedure (Cont'd)

1. MECHANICAL METER ADJUST.

a. When meter is properly set, the pointer resets over the calibration (i.e., 0° or 0 volts) on the meter scale when the instrument is (1) in its normal operating position, and (2) turned off. Set pointer as follows to obtain best accuracy and mechanical stability:

NOTE

For Option 02 instruments, the AMPLITUDE meter has no mechanical adjust.

b. Turn instrument off

c. Rotate meter zero-adjust screw clockwise until meter pointer is to left of 0 and moving to right toward 0. Stop pointer at 0. If pointer passes 0, repeat adjustment.

d. Rotate meter zero-adjust screw about 3 degrees counterclockwise to free it from meter suspension. If pointer moves, repeat steps c and d.

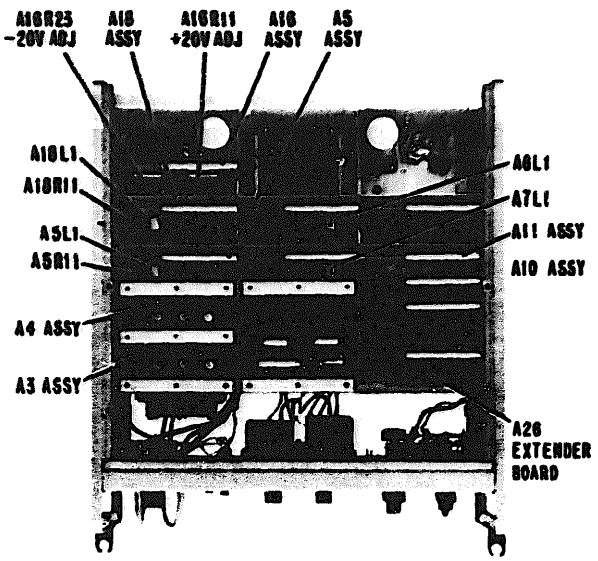


Figure 2A. Adjustment Locations

2. POWER SUPPLY ADJUST.

a. Remove top cover and refer to Figure 2A.

b. Put Power Supply assembly A16 on A26 Extender Assembly.

c. Using a DC Voltmeter and an AC Voltmeter, make the following measurements.

Test Point	Measure (Note 1)	Ripple (Note 2)	Adjust	Line Voltage
A16C6 minus to Chassis gnd	-20±0.2 vdc	1. OmVrms	A16R23	103 to 127 vac or
A16C3 plus to Chassis gnd	+20±0.2 vdc	1. OmVrms	A16R11	207 to 253 vac

Note 1. If either supply has to be adjusted, set output as close to 20.0 volts as possible.

Note 2. If ripple is excessive remove circuit assemblies A3 and A4. Ripple should then be normal. Measure again after Pulse Generator and Sampler Adjustment Procedures.

Table 5-3. Adjustment Procedure

3. IF SECTION ADJUST,

3A. CHANNEL A IF TUNING AND GAIN.

a. Connect test equipment as shown in Figure 2B. Connect AC Voltmeter between A5Q1 base and 8405A Chassis. Connect Oscilloscope vertical input between A5C4-A5R8 junction and 8405A chassis.

NOTE

Refer to Figure 3-A for adjustment and assembly location.

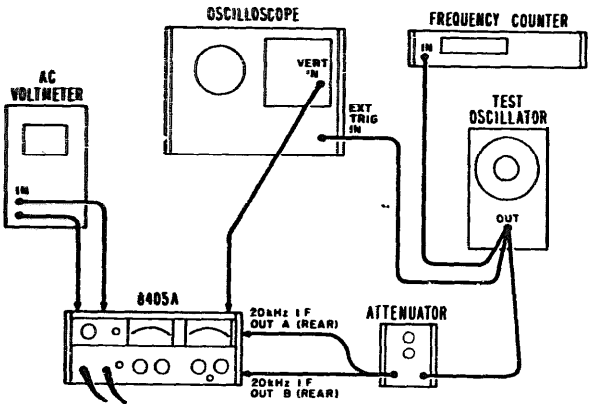


Figure 2B Setup for IF Tuning, IF Gain and PF Sampler Adjustments

b. Unplug circuit Assemblies A3, A4, A8, A10 and A11, but for convenience leave them in the 8405A. Put Isolation Amplifier Assembly A5 on extender A26.

c. Connect 8405A to 115 Vac line.

d. Set 8405A controls as follows:

LINE. . . . . .ON

C H A N N E L . . . . . A

AMPLITUDE RANGE . . . . . 300 mV

Other control settings optional.

e. Adjust Test Oscillator/Attenuator to obtain 300 mV reading on the AC Voltmeter at 20 kHz ±10 Hz.

f. Tune A5L1 to peak the 20 kHz sine wave displayed by the Oscilloscope.

g. Adjust Gain control A5R11 until 8405A AMPLITUDE meter reads 300 millivolts.

h. Reinsert Phase Meter Assembly A8 and Isolation Amplifier Assembly A5 without the extender.

i. Put channel A Phase Shifter Assembly A7 on extender A26.

j. Connect Oscilloscope vertical input between the base of A7Q5 and the 8405A chassis.

Table 5-3. Adjustment Procedure

k. Set AMPLITUDE RANGE to 1000 mV, and adjust Test Oscillator output until AMPLITUDE meter reads 1000 mV.

m. Tune IF adjustment A7L1 to peak the 20 kHz sine wave displayed by the Oscilloscope.

n. Reinsert Phase Shifter Assembly A7 without the extender.

3B. CHANNEL B IF TUNING AND GAIN.

a. With test equipment as shown in Figure 2B, and with Circuit Assemblies A3, A4, A10 and A11 still unplugged, put Channel B Isolation Amplifier A18 on extender A26.

b. Unplug Phase Meter Assembly A8.

c. Connect the Oscilloscope vertical input between A18C4-A18R8 junction and the 8405A chassis. Connect the AC Voltmeter to the base of A18Q1.

d. Set 8405A controls as follows:

CHANNEL . . . . . B
AMPLITUDE RANGE . . . . . 300 mV

Other control settings optional

e. Adjust Test Oscillator Attenuator to obtain 300 mV reading on the AC Voltmeter.

f. Tune IF adjust A18L1 to peak the 20 kHz sine wave displayed by the Oscilloscope.

g. Adjust Gain Control A18R11 until the 8405A AMPLITUDE meter reads 300 mV.

h. Reinsert Phase Meter A8 and Isolation Amplifier Assembly A18 without the extender.

i. Put Channel B 180° Switch Assembly A6 on extender A26.

j. Set 8405A controls as follows:

CHANNEL . . . . . B
AMPLITUDE RANGE . . . . . 1000 mV
PHASE METER OFFSET . . . . . -90°

Other control settings optional.

k. Adjust Test Oscillator output for 8405A AMPLITUDE meter reading of about 1000 mV.

m. Connect Oscilloscope vertical input between A6C12 minus and the 8405A chassis.

n. Tune IF adjust A6L1 to peak 20 kHz sine wave displayed by the Oscilloscope.

o. Reinsert 180° Switch Assembly A6 without the extender.

4. PHASE SECTION ADJUST.

a. Connect test equipment as shown in Figure 2C.

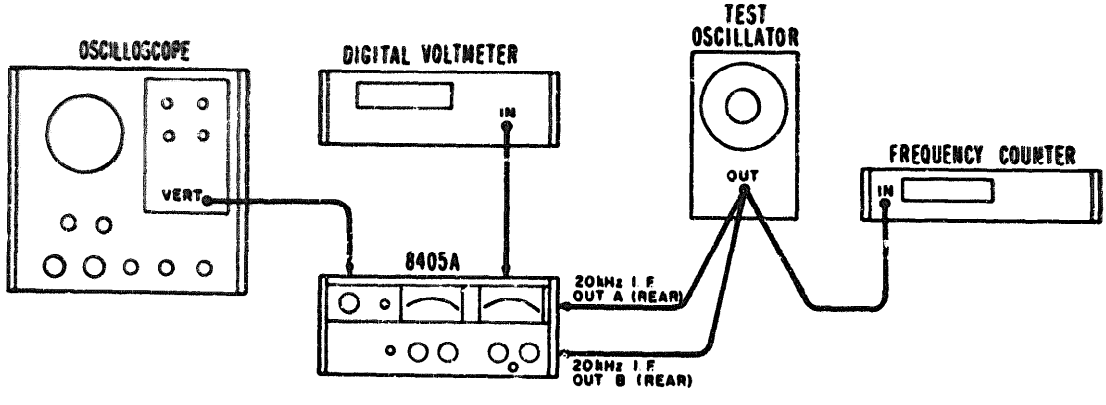


Figure 2C. Setup for Phase Meter Adjustments

NOTE

Refer to Figure 2D for adjustment and assembly location.

Table 5-3. Adjustment Procedure (Cont'd)

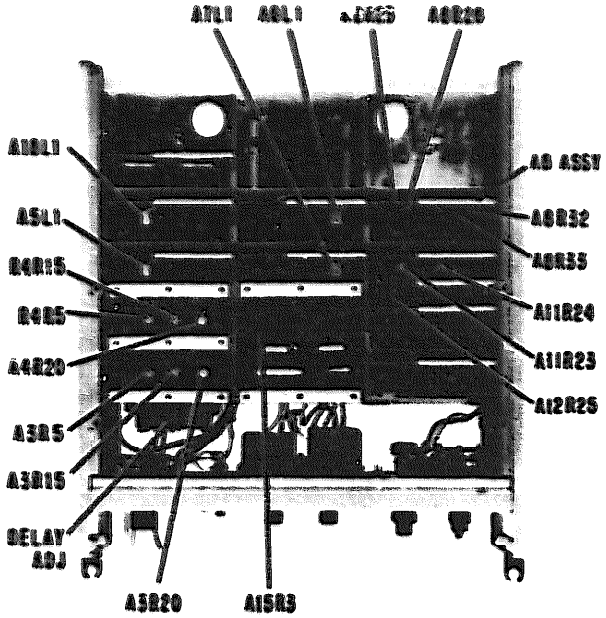


Figure 2D. Adjustment Locations

b. With Circuit Assemblies A3, A4, A10 and A11 still unplugged, put Phase Meter Assembly A8 on extender A26.

c. Set 8405A controls as follows:

PHASE METER OFFSET **0**
PHASE RANGE ..... **±60**
AMPLITUDE RANGE ..... **1000 mV**
Other control settings optional

d. Adjust output of Test Oscillator to obtain 8405A AMPLITUDE meter reading of 1000 mV.

e. Read PHASE METER with PHASE ZERO fully clockwise and fully counterclockwise. Readings of **at least +18° and -18° should be obtained. If not, adjust** A8R32 and A8R24.

NOTE

It may be necessary also to retune IF adjustments A6L1 and A7L1 to **obtain ±18° zeroing** range. **Do** not, however, **obtain** more than a 10° **correction** from any single IF control.

f. For 8405A **Vector Voltmeters** without A8R26 and A8R33 adjustments, go to step g. For instruments with A8R26 and **A8R33 adjusts**, perform steps (1), (2) and (3).

(1) Connect Digital Voltmeter to measure voltage at the junction of A8R33 slider and A8Q16 base. Adjust A8R33 until Digital Voltmeter reads +7.4 volts.

(2) (2) Digital Voltmeter to measure voltage at the junction of A8R26 slider and A8Q12 base. Adjust A8R26 until Digital Voltmeter **reads -7.4 volts.**

(3) connect Oscilloscope X10 Probe to junction of A8CR1 and A8R20. Square wave pattern should have no oscillations present. If oscillations are present on pattern, readjust A8R33 and A8R26 as necessary to eliminate oscillations. **Final** voltages, as measured in steps (l) and(2) **above** should be between 6.0 and 7.5.

g. Set 8405A PHASE RANGE and PHASE METER OFFSET to 180.

h. Adjust PHASE ZERO **to obtain** maximum positive reading on PHASE meter.

i. Adjust A8R32 until PHASE meter reads +180°.

j. Adjust PHASE ZERO to **obtain** maximum negative reading an PHASE meter.

Table 5-3. Adjustment Procedure (Cont'd)

k. Adjust A8R24 until PHASE meter reads -180°.

m. Set 8405A PHASE RANGE to ±60 and PHASE METER OFFSET to 0.

n. Repeat steps e and f.

o. Reinsert Phase Meter Assembly A8 without extender. Also, Assembly A10.

5. AUTOMATIC PHASE CONTROL SECTION ADJUST.

5A. IF SAMPLER.

a. Connect test equipment as shown in Figure 2D: 8405A control settings are optional.

NOTE

Turn test oscillator on and allow one-half hour warmup.

b. With Circuit Assemblies A3 and A4 still unplugged, put IF Sampler Assembly A11 on extender A6.

c. Connect Oscilloscope vertical input and Frequency Counter between A11Q4 Collector (transistor case) and 8405A chassis.

d. With the Oscilloscope internally synchronized, adjust Symmetry Control A11R23 to obtain 50-50 symmetry for the waveform at A11Q4 collector.

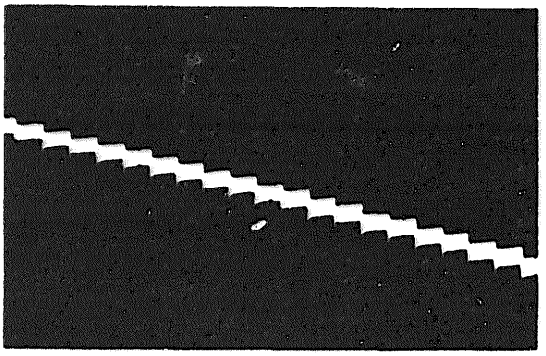
e. Adjust Frequency Control A11R24 to obtain 20 kHz Frequency Counter reading. If control action prevents precise adjustment 20 kHz ± 10 Hz is acceptable.

f. Connect Oscillator to 8405A IF output A. Set Oscillator frequency to 19.9 kHz and amplitude for 10 mV rms at the 8405A IF OUT terminals.

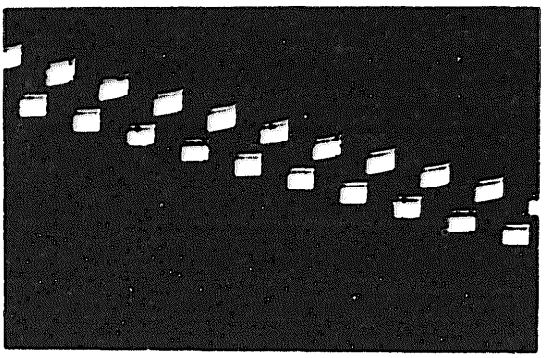
g. Connect Oscilloscope vertical input to ungrounded side of A11C17 (XA11, pin 5).

h. Set Oscilloscope for internal sync and sweep time to display about one cycle of the sampling waveform. Magnify Oscilloscope horizontal display 10X and position the waveform to view the negative-going slope. Trim Test Oscillator frequency to reduce amplitude instability on the display.

i. Adjust Symmetry Control A11R23 until the negative slope of the sampling waveform resembles a staircase. See typical waveforms in Figure 5.



Typical Sampling Waveform When A11R23 Properly Adjusted.



Typical Sampling Waveform When A11R23 Improperly Adjusted.

Figure 2E. Typical Sampling Waveforems

Table 5-3. Adjustment Procedure

j. Reinsert IF Sampler assembly A11 without the extender.

k. Plug in Assemblies A3 and A4 (all circuit boards should now be plugged into their sockets).

NOTE

It is possible to install the A3 and A4 circuit boards in their slot holders and not in their sockets. Whenever installing either circuit board, be sure it is plugged into its socket and not just slot holder.

5B. PULSE GENERATOR AND SAMPLER.

a. Connect test equipment as shown in Figure 2F.

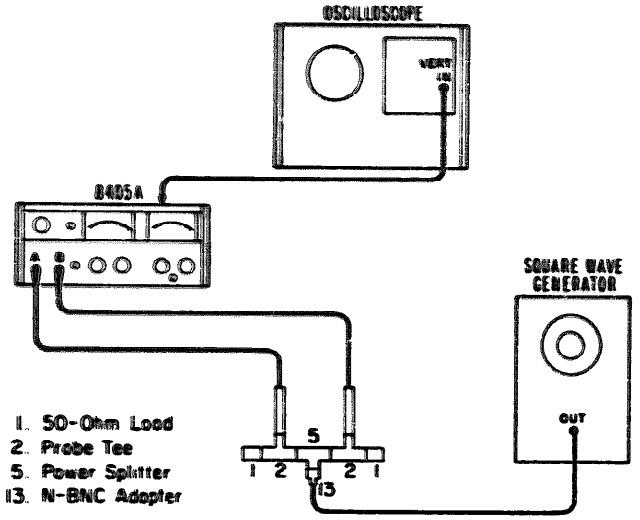


Figure 2F. Setup for Pulse Generator and Sampler Adjustments

b. **Connect Oscilloscope vertical input** to rear-panel 20 kHz IF output A. Set Oscilloscope for internal **triggering on the positive slope** of the waveform.

c. **Set 8405A FREQ RANGE** to the 500-1000 MHz position. Other control settings are optional.

d. **Set Square Wave Generator frequency** to **about** 180 kHz and adjust output amplitude to obtain about **200 mV p-p Oscilloscope display. Adjust** Oscilloscope triggering sensitivity until sweep just triggers. Waveform **should approximate a square** wave as shown below.

e. Adjust pulse generator bias control A15R3 to peak the leading edge of the Oscilloscope waveform.

f. Adjust Channel A sampler bias control A3R20 for 100% sampling efficiency. Sampling efficiency is **100%** when the top of the waveform is nearly flat. See typical waveforms in Figure 2G.

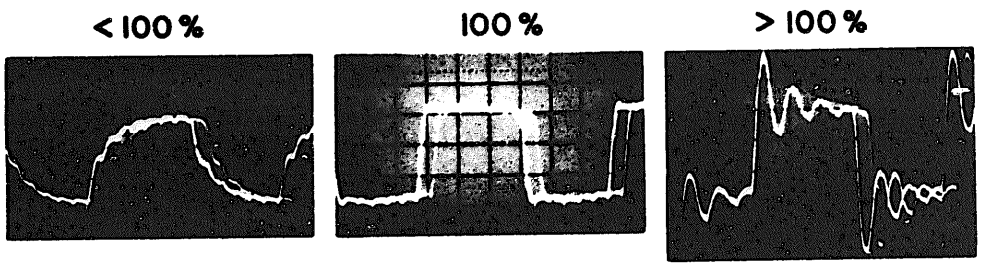


Figure 2G. Typical Sampling Efficiency Waveforms

Table 5-3. Adjustment Procedure (Cont'd)

g. Adjust Channel B sampler bias control A4R20 for 100% sampling efficiency. See typical waveforms in Figure 2G.

h. Minimize sampling signal at probe tips as follows:

(1) Connect the 8405A Channel A probe to the Oscilloscope vertical input with a probe-to-BNC adapter.

(2) Adjust Symmetry control A3R15 to minimize the sampling signal. Minimum signal should not exceed 5 mV p-p.

(3) Repeat steps 1 and 2 for Channel B probe adjusting Symmetry Control A4R15.

i. Repeat procedure of steps a through h to assure sampling efficiency is properly adjusted.

j. If ripple on power supply voltages was excessive at initial measurement, check ripple again. Ripple should be normal.

5C. SEARCH SPEED.

a. Connect test equipment as shown in Figure 2H.

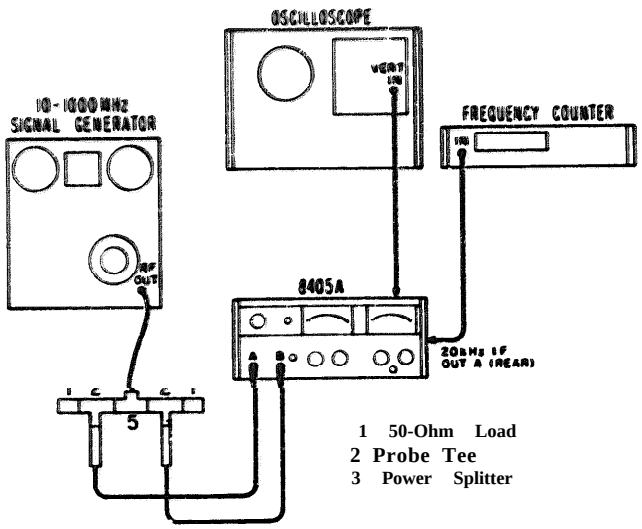


Figure 2H. Setup for Search Speed Adjustment

b. Put Search assembly Al2 on extender A26.

c. Direct couple Oscilloscope vertical input to the junction of A12Q7 base and A12R25 slider.

d. Set Signal Generator frequency to 80 MHz and adjust output amplitude to obtain 100 mV AMPLITUDE meter reading for Channel A.

8. Set 8405A FREQ RANGE to 60-120 MHz other settings are optional.

f. Oscilloscope display should be sawtooth waveform. Adjust Search Speed control A12R25 so average voltage of sawtooth is zero.

Table 5-3. Adjustment Procedure (Cont'd)

g. Reinsert Search assembly A12 without the extender.

h. Readjust the frequency of the 20 kHz internal reference oscillator as follows:

(1) Connect Frequency Counter to 20 kHz IF output A.

(2) Adjust Frequency control A11R24 to obtain Frequency Counter reading of 20 kHz. If control action prevents precise adjustment, 20 kHz ±10 Hz is acceptable.

6. RF SECTION ADJUST.

6A. CHANNEL A AND B LOW FREQUENCY RF GAIN

a. Connect test equipment as shown in Figure 2J using the 10 - 450 MHz Signal Generator.

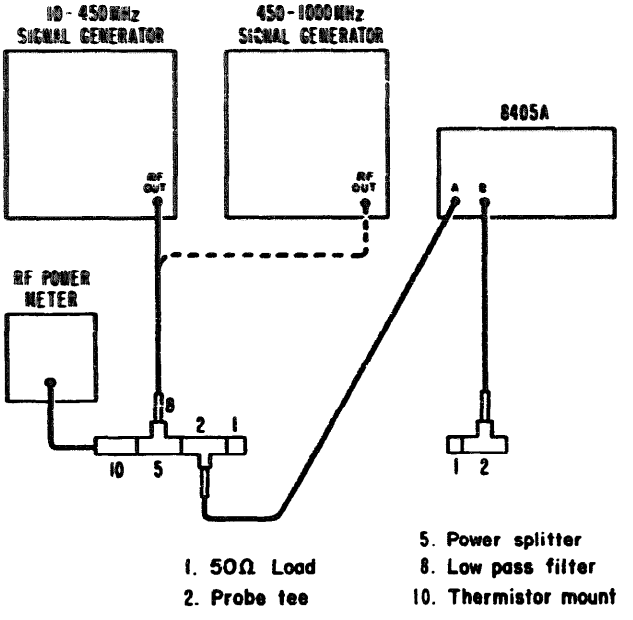


Figure 2J. Setup for RF Gain and Delay Line Adjustments

b. Set 8405A controls as follows:

AMPLITUDE CHANNEL . . . . . A

FREQ RANGE-MHz 100MHz

AMPLITUDE RANGE . . . . . 300 mV

Other control settings optional.

c. Set Signal Generator frequency to 100 MHz and adjust output level Lo obtain 0.0 dBm reading on RF Power Meter. Remove Thermistor Mount and replace with Channel B Probe Tee.

NOTE

Before removing Thermistor Mount from setup, note Channel A AMPLITUDE meter reading. After replacing Thermistor Mount with Channel B Probe Tee, readjust Signal Generator output level for previously noted Channel A AMPLITUDE meter reading.

Table 5-3. Adjustment Procedure (Cont'd)

d. Adjust Gain Control A4R5 to make 8405A AMPLITUDE meter read 0 dBm.

e. Set AMPLITUDE CHANNEL selector to A.

f. Interchange Probes A and B.

g. Adjust Gain Control A3R5 to make 8405A AMPLITUDE meter read 0 dBm.

NOTE

If 8405A Meter will not adjust up to 0 dBm, adjust A11R24 for peak meter reading and repeat step c. If A11R24 is adjusted, repeat Channel B RF Gain adjust. For 8405A instruments, serial numbered 942-02860 and below, it may be necessary to change A3R5 and A4R5 to a 500-ohm potentiometer, HP Part Number 2100-1747 to obtain a greater adjustment range. Also, as part of the change, remove resistors A3R27 and A4R27 and replace each of them with a shorting wire.

h. With signal source set to minimum, connect test equipment as shown in Figure 2K.

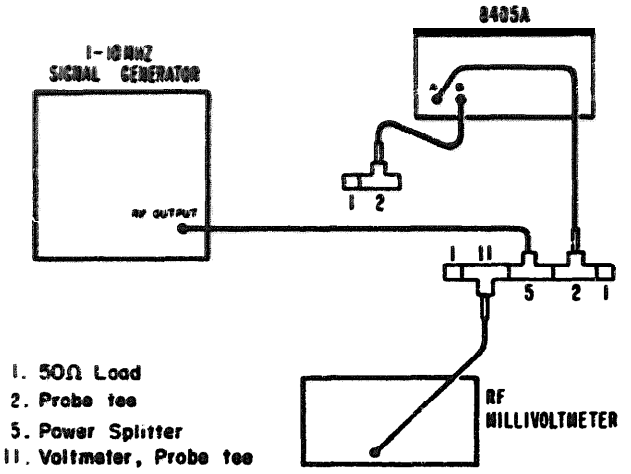


Figure 2K. Setup for RF Gain Adjustment

i. Set signal source for 1 MHz unmodulated signal and adjust output level for 0 dBm as indicated by calibrated RF voltmeter.

j. Set 8405A FREQ RANGE so that APC UNLOCKED light goes out and range setting includes measurement frequency. Note Channel A amplitude meter reading.

k. Remove 411A Probe Tee and replace with Channel B Probe Tee. If necessary, adjust signal generator output for Channel A meter reading noted in step j.

m. Change 8405A AMPLITUDE CHANNEL to B and RANGE to 0 dB.

n. Channel B AMPLITUDE meter will, at 1 MHz, read low. Using gain control A4R5, adjust to about -0.2 dBm.

o. Interchange probes A and B. Channel A AMPLITUDE meter will, at 1 MHz read low. Using gain control A3R5, adjust to about -0.2 dBm.

p. Recheck Channel A and B amplitude meter readings at 100 MHz as described in steps a through g.

q. Channels A and B amplitude meters should now read above 0 dBm, but not more than ±0.2 dBm. If necessary to readjust gain controls A4R5 and A3R5 at 100 MHz, it will be necessary to recheck the amplitude meter readings at 1 MHz.

Table 5-3. Adjustment Procedure (Cont'd)

6B. VOLTAGE ACCURACY (HIGH FREQUENCY).

a. Using 1000 MHz Signal Generator, connect test equipment as shown in Figure 2J.

b. Set 8405A controls as follows:

AMPLITUDE CHANNEL . . . . . A
FREQUENCY RANGE . . . . . 1000 MHz
AMPLITUDE RANGE . . . . . 300 mV

c. Set Signal Generator frequency to 1000 MHz and adjust output level to obtain 0.0 dBm reading on RF Power Meter. Note Channel A AMPLITUDE meter reading.

d. Remove Thermistor Mount and replace with Channel B Probe and Probe Tee. If necessary, readjust Signal Generator output level for Channel A AMPLITUDE meter reading noted in step c.

e. Set AMPLITUDE CHANNEL to B. Channel B AMPLITUDE meter should read high. Note and record reading.

f. Remove Channel B Probe and replace with Channel A Probe. Channel A AMPLITUDE meter should read high. Record reading.

g. Place Channel A Probe back in other Probe Tee and set up equipment as shown in Figure 2J.

h. Set 8405A AMPLITUDE RANGE to +10 dB and switch RF Power Meter to +10 dB range.

i. Adjust Signal Generator output level to obtain +10 dBm reading.

j. Note Channel A AMPLITUDE meter reading.

k. Remove Thermistor Mount and replace with Channel B Probe and Probe Tee. If necessary, readjust Signal Generator output level for Channel A AMPLITUDE meter reading noted in step j.

m. Set AMPLITUDE CHANNEL to B. Note and record AMPLITUDE meter reading.

n. Remove Channel B Probe and replace with Channel A Probe. Set AMPLITUDE CHANNEL to A and note and record AMPLITUDE meter reading.

o. Depending upon your individual 8405A, the greatest amplitude measurement error may be at 0 dBm or at +10 dBm. Having measured the amplitude error for each channel (steps e and m for Channel B; steps f and n for Channel A), set appropriate adjustment so that amplitude error is within specification for each channel: Just within specification at either the 0 or +10 dBm point.

Channel	Adjust	0 dBm Specification	+10 dBm Specification
B	A4R20	188 to 259 mV	.537 to .877 V
A	A3R20	188 to 259 mV	.537 to .877 V

p. Minimize sampling signal at probe tip as follows:

(1) Remove 8405A Probes from test setup, this procedure requires only an Oscilloscope.

(2) Connect 8405A Channel A Probe to Oscilloscope vertical input with a probe-to-BNC adapter.

(3) Adjust Symmetry Control A3R15 to minimize sampling signal. Peak-to-peak signal level should not exceed 5 mV.

(4) Repeat steps 2 and 3 for Channel B Probe adjusting Symmetry Control A4R15-

Table 5-3. Adjustment Procedure (Cont'd)

6C. DELAY LINE

a. Connect test equipment as shown in Figure 2J using the 10 - 100 MHz Signal Generator. Connect Channel B probe in place of Thermistor Mount.

b. Set 8405A controls as follows:

AMPLITUDE CHANNEL . . . . . A

FREQUENCY RANGE - MHz . . . . . 10 MHz

AMPLITUDE RANGE . . . . . -10 dB

c. Set Signal Generator frequency to 10 MHz and adjust output level for -10 dBm 8405A AMPLITUDE meter reading.

d. Adjust PHASE ZERO for 0 PHASE meter reading.

e. Replace the 10 - 100 MHz Signal Generator with the 1000 MHz Generator.

f. Set 8405A FREQ RANGE - MHz to 1000 MHz (fully ccw).

g. Set Signal Generator frequency to 1000 MHz, and adjust output level for -10 dBm AMPLITUDE meter reading.

h. Slowly reduce Signal Generator frequency through 50 MHz noting maximum and minimum PHASE meter readings. Reminder: the PHASE and AMPLITUDE meter pointers will flicker momentarily several times as the input frequency is changed. The flicker is caused by the automatic tuning and is normal.

i. Set Signal Generator to the frequency in the 950-1000 MHz range which gives a PHASE meter reading half way between the maximum and minimum noted in step h.

j. Set Delay Adjust to obtain 0 PHASE meter reading (refer to page 5-18 for Delay Adjust location).

Table 5-4. Front Panel Troubleshooting

GENERAL: Using this procedure, trouble can be isolated to a general circuit section. To isolate trouble within a specific circuit section, refer to schematic diagrams or other trouble-shooting charts.

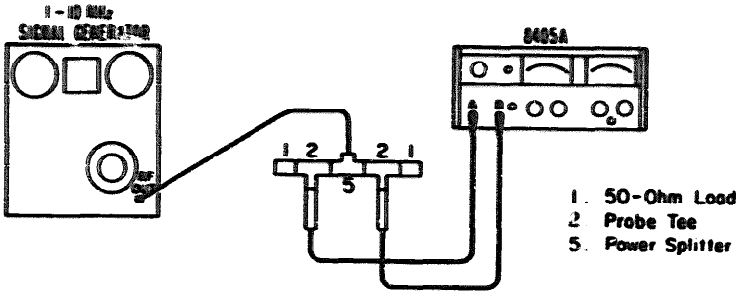


Figure 5-3.

PROCEDURE: a. Using setup shown above, set Signal Source for 1 M Hz, 20 mV RMS output.

b. Set 8405A controls as follows: FREQ RANGE full clockwise (1-4 MHz), 10 mV **(-20 dBm), ±60°, and OFFSET to 0°.**

c. In the indications Table below, an "x" indicates failure and an "ok" indicates **normal operation.**

d. Starting in the upper left-hand corner, if the indication in the instrument agrees with that in the manual, read horizontally. If the indications do not agree, drop **down one line. Repeat for each square.**

Channel A	Channel B	Phasemeter	APC UNLOCKED	APC UNLOCKED	Circuit Section Trouble
ok	ok	X	ok	ok	(Table 5-7) Phasemeter ckts: A5Q4-6, A6, A7, A8, A18Q4-6
ok	X	X	ok	ok	(Table 5-9) Channel B Ckts
X	ok	X	ok	ok	A5Q1-3
X	X	ok	ok	ok	A9, A22
X	X	X	ok	X	Channel A or APC ckts (Table 5-8) or +20V Power Supply (Table 5-5)
X	X	X	X	ok	-20V Power Supply (Table 5-6), or A11, A12 (Table 5-8) or Primary Power ckt.

NOTES: 1. Channels A and B should read 10 mV ±5% depending upon Signal Source output level accuracy. Two channels should read within ±2% of each other.

2. Phase meter, using ZERO control, should be adjustable at least ±15° about 0°.

3. APC unlocked light should be out with FREQ RANGE switch fully clockwise (1-4 MHz).

4. APC unlocked light should be lit with FREQ RANGE switch fully counterclockwise (500-1000 MHz).

Table 5-5. +20 Volt Supply Troubleshooting

Symptom	Procedure	Indication	Conclusion
High Output Voltage	1. Disconnect base of Q1	Output drops	Q1 ok
		Output same	Q1 shorted
	2. Reconnect base of Q1. Measure voltage across A16CR3	Approximately 3.5V	A16CR3 ok
		More than approximately 3.5V	A16CR3 open
	3. Short emitter to base A16Q1	Output drops	A16Q1 ok
		Output same	A16Q1 shorted
	4. Measure voltage across A16CR7	Approximately 6.5V	A16CR7 ok
		More than approximately 6.5V	A16CR7 open
	5. Adjust A16R11 so base of A16Q3 goes more negative	Output remains high	A16Q3 open
		Output lowers but still high	A16Q3 gain too low
Low Output Voltage	1. Measure voltage across A16CR3	Approximately 3.5V	A16CR3 ok
		Less than approximately 3.5V	A16CR3 shorted
	2. Short emitter to collector A16Q1	Output rises	Q1 ok
		Output same	Q1 open
	3. Measure voltage across A16CR7	Approximately 6.5V	A16CR7 ok
		Less than approximately 6.5V	A16CR7 shorted
	4. Measure voltage at collector of A16Q3	Approximately 6.5V (same as A16CR7)	A16Q3 shorted
	5. Measure voltage at collector of A16Q2	Same as voltage at emitter	A16Q2 shorted
		Lower than A16Q2 emitter voltage	A16Q2 ok
High Ripple	1. Measure ripple at base of A16Q3	No ripple	A16C2 shorted A16CR7 shorted
	2. Measure ripple at base of A16Q1	No ripple	A16Q3 open
	3. Measure ripple at base of Q1	No ripple	A16Q1 open

Table 5-6. -20 Volt Supply Troubleshooting

Symptom	Procedure	Indication	Conclusion
High Output Voltage	1. Disconnect base of Q2	Output drops	Q2 ok
		Output same	Q2 shorted
	2. Reconnect base of Q2 Measure voltage across A16CR10	Approximately 3.5V	A16CR10 ok
		More than approximately 3.5V	A16CR10 open
	3. Short emitter to base A16Q4	Output drops	A16Q4 ok
		Output same	A16Q4 shorted
	4. Measure voltage across A16CR14	Approximately 6.1V	A16CR14 ok
		More than approximately 6.1 V	A16CR14 open
	5. Adjust A16R23 so base of A16Q6 goes more negative	Output remains high	A16Q6 open
		Output lower but still high	A16Q6 gain too low
Low Output Voltage	1. Measure voltage across A16CR10	Approximately 3.5V	A16CR10 ok
		Less than approximately 3.5V	A16CR10 shorted
	2. Short emitter to collector A16Q4	Output rises	Q2 ok
		Output same	Q2 open
	3. Measure voltage across A16CR14	Approximately 6.1V	A16CR14 ok
		Less than approximately 6.1V	A16CR14 shorted
	4. Measure voltage at collector of A16Q6	Approximately 6.1V (same as A16CR14)	A16Q6 shorted
	5. Measure voltage at collector of A16Q5.	Same as voltage at emitter	A16Q5 shorted
		Lower than A16Q2 emitter voltage	A16Q5 ok
High Ripple	1. Measure ripple at base of A16Q6	No ripple	A16C5 shorted A16CR14 shorted
	2. Measure ripple at base of A16Q4	No ripple	A16Q6 open
	3. Measure ripple at base of Q2	No ripple	A16Q4 open

Table 5-7. Phase Meter Circuit Troubleshooting

Symptom (See Note 1)	Procedure (See Note 2)	Indication	Conclusion
Meter Pegs + and - 180° As ZERO control is adjusted	1. Check trigger pulses at bases of A8Q9 and A8Q10	Pulses are arriving simultaneously	Phase Inverter, A6Q2-4 is defective
		Pulses are not arriving simultaneously	OFFSET switch, A21, is defective
Meter Pegs +180° regardless of ZERO control. Setting NOTE: -20 Volt DC supply may be missing	1. Check waveform at collector at A8Q9.	Symmetrical square wave present	Switch A8Q11-12 or Current Source A8Q13-15 is defective
	2. Check for trigger pulses at base of A8Q10	Trigger pulses present	Multivibrator, A8Q9-10 is defective
	3. Check for square wave at XA8 (Pin 1).	Square wave at XA8 (Pin 1) and pulses at collector of A8Q1	Driver, A8Q7 is defective
		Square wave at XA8 (Pin 1) but no pulses at collector of A8Q1	Amplifier, A8Q1, or Switch A8Q2-3 is defective
	4. Check for square wave at XA7 (Pin 1)	No square wave	Limiter, A5Q4, A5Q5, or A5Q6 is defective
		XA7 (Pin 1) square wave and sine wave at A7Q2 collector	Limiter A7Q5-6 is defective
		Square waves at XA7 (Pin 1) and A7Q1 collector but no sine wave at A7Q2 collector	Phase shifter A7Q2-4 is defective
		Square wave at XA7 (Pin 1) but not A7Q1 collector	A7Q1 is defective
Meter Pegs -180° regardless of ZERO control setting NOTE: +20 volts DC supply may be missing	1. Check waveform at A8Q9 collector	Symmetrical square wave present	Switch A8Q11-12, or Current Source A8Q16-19, or OFFSET switch is defective
	2. Check for trigger pulses at A8Q9 base	Trigger pulses present	Multivibrator A8Q9-10 is defective
	3. Check for square wave at XA8 (Pin 15)	Square wave at XA8 (Pin 15) and pulses at A8Q4 collector	A8Q8 is defective
		Square wave but no pulses at A8Q4 collector	A8Q4 or A8Q5-6 is defective

Table 5-7. Phase Meter Circuit Troubleshooting (Cont'd)

Symptom (See Note 1)	Procedure (See Note 2)	Indication	Conclusion
	4. Check for square wave at XA6 (Pin 1)	No square wave	A18Q4, A18Q5, or A18Q6 is defective
		XA6 (Pin 1) Square wave and sine wave at A6Q4 collector	Limiter A6Q5-6 is defective
		Square wave at XA6 (Pin 1) and A6Q1 collector but no sine wave at A6Q4 collector	Phase Inverter A6Q2-4 is defective
		Square wave at XA6 (Pin 1) but not A6Q1 collector	A6Q1 is defective
Meter needle, using ZERO control, is adjustable but not symmetrically about 0°	11. Check waveform at A8Q9 collector	Symmetrical Square wave	Phase meter section out of adjustment: Refer to adjustment procedure, Section V.
		Square wave not symmetricai	Phase Inverter A6Q2-4 or Phase Shifter A7Q2-4 is defective
No meter movement, meter reads 0°	11. Remove 8405A power cord and connect ohmmeter across phase meter terminals	No meter deflection	Defective meter
		Meter deflection	One or both wires connecting meter to circuitry must be broken.
Phase meter trouble exists only for OFFSET settings from -90" to -180" and +100° to +180° (See Note 3)	11. Set OFFSET switch to any setting between -90" and -180° or +100° and +180° and measure DC voltage at A6 (Pin 8)	0 volts at A6 (Pin 8)	Phase inverter A6Q3-4 is defective
		+20 volts at A6 (Pin 8)	The section of OFFSET switch A21S1A/B which operates A6Q2- 3 is defective

NOTES:

1. Test setup and 8405A control settings are same as for front panel troubleshooting Table 5-4.

!. All sine waves and square waves are 20 kHz; pulses have 20 kHz repetition rates.

3. The Phase Meter Offset control is intended for use ONLY when a definite phase angle exists between the two input probes. Misuse of the Offset control makes a good 8405A appear bad. For example, with an input phase angle of 0°, setting the Offset control between +100 and +180 or between -90 and -180 will cause the Phase Meter to "peg", this is entirely normal.

Table 5-8. Channel A and APC Troubleshooting

Symptom (Note 1)	Procedure	Indication	Conclusion
APC lamp does not light with FREQ RANGE switch set to 500-1000 MHz	1. Check for -20 volts DC at XA12 (Pin 11)	No -20 Volts DC	Rear panel -20V fuse or -20 Volt Power Supply is defective (Table 5-6)
	2. Check for 20 MHz oscillator signal at XA12 (Pin 10)	No 20 MHz Signal	Reference Oscillator A11Q4-5 is defective
	3. Check for -15 volts DC at XA12 (Pin 7)	No -15 volts DC	Lamp driver A12Q6 is defective
		-15 volts DC ok	APC unlocked lamp is defective
APC lamp remains lit with switch set to 1-4 MHz	1. Check for +20 volts DC at XA12 (Pin 12)	No +20 volts DC	Rear panel +20V fuse or +20 V Power Supply is defective (Table 5-5)
	2. Change Signal Source Frequency and 8405A FREQ RANGE switch to about 8-10 MHz.	APC Lamp goes out and meters indicate readings	A13 Assy is defective (Probably bad capacitor or changed value resistor), or FREQ RANGE switch A24S1 is defective.
	3. Remove Probe A circuit board Assy from probe cable socket and replace with Probe B circuit board Assy.	APC lamp goes out and meters indicate readings.	Probe A circuit board assembly is defective.
	4. Remove Probe board from cable assembly. Turn 8405A off and check cable for open-circuits.		
	5. Replace Probe A board assembly in cable assembly. Check for search ramp at XA12 - Pin 1.	Ramp signal as shown opposite page 7-15.	A14 Assembly, A15 Assembly, A24S1 FREQ RANGE switch or A19 Decoupling Diode is defective.

NOTE:

1. Test setup and 8405A control settings are same as for Table 5-4
2. If a probe board is replaced, the Adjustment Procedure Table 5-3. must be done. Remove board only after some indication that the probe is faulty. To remove board remove set screw marked "Do not remove this screw" in Fig. 7-5. To replace board be sure key on plug is aligned with key on socket.

Table 5-9. Channel B Circuit Troubleshooting

Symptom (See Note 1)	Procedure	Indication	Conclusion
CHANNEL B IF OUTPUT waveform is a 20 kHz sine wave of about 10 mV rms (28 mV pk-pk)	1. Isolate trouble within IF amplifier A18Q1-3 by CHANNEL B IF TUNING AND GAIN Adjustment procedure (Table 5-3 part 3B).		IF Amplifier A18Q1-3 is defective.
CHANNEL B IF OUTPUT is much less than 10 mV or there is no output	Check for pulse output at XA4-Pin 4 (Compare with pulses at XA3-Pin 4). These two pictures should look the same.	No Pulses	Resistor A15R2, or A17 Delay line, A19 or A20 Decoupling Diode Assy is defective
	2. Check for pulse output at probe tip (compare with CHANNEL A probe tip). These two pictures should look the same.	Pulses ok	Probe B amplifier A2A1Q1 or A4 Assy Amplifier A4Q1 is defective
		Pulses much larger than those at CHANNEL A probe tip.	Probe B diodes, or Amplifier A4Q2 defective
		Pulses very small (or no pulses at all)	Probe B Circuit Assy, probe cable, or A4T1 defective, -or- A4 Assy out of adjustment. Refer to PULSE generator and sampler adjust Table 5-3
	3. Remove Probe B circuit board Assy from its socket. Replace Probe A circuit board Assy in Channel A cable with Probe B circuit board Assy. Repeat step 2 above to determine if Probe B circuit board is defective	Pulses ok	Probe B circuit board Assy ok
		Pulses too large, too small, or no pulses at all	Probe B circuit board Assy defective

NOTE:

1. TEST Setup and 8405A control settings are same as for Table 5-4.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designations and indicates the description and HP stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their HP stock number and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard sales and service office. Identify parts by Hewlett-Packard stock number.

6-6 To obtain a part not listed, include:

a. Instrument model number

b. Instrument serial number

c. Description of part

d. Function and location of part.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	V	= vacuum, tube, neon bulb, photocell, etc.
B	= motor	FL	= filter	P	= plug	VR	= voltage regulator
BT	= battery	IC	= integrated circuit	Q	= transistor	W	= cable
C	= capacitor	J	= jack	R	= resistor	X	= socket
CP	= coupler	K	= relay	RT	= thermistor	Y	= crystal
CR	= diode	L	= inductor	S	= switch	Z	= tuned cavity, network
DL	= delay line	LS	= loud speaker	T	= transformer		
DS	= device signaling (lamp)	M	= meter	TB	= terminal board		
E	= misc electronic part	MK	= microphone	TP	= test point		

ABBREVIATIONS

A	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NPO	= negative positive zero (zero temperature coefficient)	RMS	= root-mean square
AMPL	= amplifier	HEX	= hexagonal			RWV	= reverse working voltage
		HG	= mercury				
BFO	= beat frequency oscillator	HR	= hour(s)	NPN	= negative-positive-negative	S-B	= slow-blow
BE CU	= beryllium copper	HZ	= hertz			SCR	= screw
BH	= binder head			NRFR	= not recommended for field replacement	SE	= selenium
BP	= bandpass	IF	= intermediate freq			SECT	= section(s)
BRS	= brass	IMPG	= impregnated	NSR	= not separately replaceable	SEMICON	= semiconductor
BWO	= backward wave oscillator	INCD	= incandescent			SI	= silicon
		INCL	= include(s)			SIL	= silver
CCW	= counter-clockwise	INS	= insulation(ed)	OBD	= order by description	SL	= slide
CER	= ceramic	INT	= internal	OH	= oval head	SPG	= spring
CMO	= cabinet mount only			OX	= oxide	SPL	= special
COEF	= coefficient	K	= kilo = 1000			SST	= stainless steel
COM	= common			P	= peak	SR	= split ring
COMP	= composition	LH	= left hand	PC	= printed circuit	STL	= steel
COMPL	= complete	LIN	= linear taper	PF	= picofarads = 10^{-12} farads	TA	= tantalum
CONN	= connector	LK WASH	= lock washer			TD	= time delay
CP	= cadmium plate	LOG	= logarithmic taper	PH BRZ	= phosphor bronze	TGL	= toggle
CRT	= cathode-ray tube	LPF	= low pass filter	PHL	= Phillips	THD	= thread
CW	= clockwise			PIV	= peak inverse voltage	TI	= titanium
		M	= milli = 10^{-3}	PNP	= positive-negative-positive	TOL	= tolerance
DEPC	= deposited carbon	MEG	= meg = 10^{6}			TRIM	= trimmer
DR	= drive	MET FLM	= metal film	P/O	= part of	TWT	= traveling wave tube
		MET OX	= metallic oxide	POLY	= polystyrene		
ELECT	= electrolytic	MFR	= manufacturer	PORC	= porcelain	U	= micro = 10^{-6}
ENCAP	= encapsulated	MHZ	= mega hertz	POS	= position(s)		
EXT	= external	MINAT	= miniature	POT	= potentiometer	VAR	= variable
		MOM	= momentary	PP	= peak-to-peak	VDCW	= dc working volts
F	= farads	MTG	= mounting	PT	= point		
FH	= flat head	MY	= "mylar"	PWV	= peak working voltage	W/	= with
FIL H	= fillister head					W	= watts
FXD	= fixed	N	= nano (10^{-9})	RECT	= rectifier	WIV	= working inverse voltage
G	= giga (10^{9})	N/C	= normally closed	RF	= radio frequency		
GE	= germanium	NE	= neon	RH	= round head or right hand	WW	= wirewound
GL	= glass	NI PL	= nickel plate			W/O	= without
GRD	= ground(ed)						

01194-13

Table 6-1. Reference Designation Index

Reference Designation	Part No.	Description	Note
A1MP1	5820-0457	PROBE TIP	
	00187-4210	RING =IDENT BLUE	
A1MP2	08405-6057	HOUSING ASSY: PROBE	
A1W1	08405-6047	CABLE ASSY: SPECIAL COAX INCL PROBE &PANEL BOOT & 80 ASSY SOCKET	
A1A1	08405-6094	GUARD ASSY:PROBE NOT RECOMMENDED FOR FIELD REPLACEMENT	
A2MP1	08405-2032	RING:IDENT WHITE	
A2MP2	08405-6055	HOUSING ASSY:PROBE	
A2W1	08405-6047	CABLE ASSY:SPECIAL COAX INCL PROBE &PANEL BOOT & 80 ASSY SOCKET	
A2A1	08405-6054	GUARD ASSY:PROBE NOT RECOMMENDED FOR FIELD REPLACEMENT	
A2A1MP1	5020-0457	PROBE TIP	
A3	08405-6002	GUARD ASSY:SAMPLER	
A3C1	0180-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A3C2	0140-0194	C:FXD MICA 110 PF 5%	
A3C3	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A3C4	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A3C5	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A3C6	0180-0100	C:FXD ELECT 10 UF 10% 20VDCW	
A3C7	0160-2055	C:FXD CER 0.01 UF +80-208 100VDCW	
A3C8	0160-0174	C:FXD CER 0.47 UF +80-208 25VDCW	
A3C9	0160-0174	C:FXD CER 0.47 UF +80-208 25VDCW	
A3C10	0160-2139	C:FXD CER 220 PF +80-208 1000VDCW	
A3C11	0160-2139	C:FXD CER 220 PF +80-208 1000VDCW	
A3C12	0160-2139	C:FXD CER 220 PF +80-208 1000VDCW	
A3C13	0160-2139	C:FXD CER 220 PF +80-208 1000VDCW	
A3Q1	1854-0071	TRANSISTOR:SILICON NPA	
A3Q2	1854-0071	TRANSISTOR:SILICON NPA	
A3R1	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A3R2	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A3R3	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A3R4	0698-3155	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A3R5	2100-1757	R:VAR WW 500 OHM 5% 1W	
A3R6	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A3R7	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A3R8	0698-3438	R:FXD MET FLM 147K OHM 1% 1/8W	
A3R9	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A3R10	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A3R11	0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W	
A3R12	0757-0461	R:FXD MET FLM 100 OHM 1% 1/8W	
A3R13	0698-3407	R:FXD MET FLM 1.96K OHM 1% 1/2W	
A3R14	0757-0440	R:FXD MET FLM 7.50K OHM 1% 1/8W	
A3R15	2100-1761	R:VAR WW 10K OHM 5% 1W	
A3R16	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A3R17	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A3R18	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A3R19	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A3R20	2100-0947	R:VAR FLM 50K OHM 20% 3/4W	
A3R21	0757-0294	R:FXD MET FLM 17.8 OHM 1% 1/8W	
A3R22	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A3R23	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A3R24	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A3R25	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A3R26	0757-0294	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A3R27		DELETED (REPLACED WITH A SHORT)	
A3T1	08405-8001	TRANSFORMER:BALON	
A4	08405-6002	BOARD ASSY:SAMPLER	
A4C1	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A4C2	0140-0194	C:FXD MICA 110 PF 5%	
A4C3	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A4C4	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A4C5	0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	
A4C6	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A4C7	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4C8	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A4C9	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A4C10	0160-2139	C:FXD CER 220 UF +80-20% 1000VDCW	
A4C11	01602139-	C:FXD CER 220 UF +80-20% 1000VDCW	
A4C12	0160-2139	C:FXD CER 220 UF +80-20% 1000VDCW	
A4C13	0160-2139	C:FXD CER 220 UF +80-20% 1000VDCW	
A4C1	1854-0071	TRANSISTOR:SILICON NPN	
A4C2	1854-0071	TRANSISTOR:SILICON NPA	
A4R1	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A4R2	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A4R3	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A4R4	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A4R5	2100-1757	R:FXD MET FLM 500 OHM 1% 1W	
A4R6	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A4R7	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A4R8	0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	
A4R9	0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	
A4R10	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A4R11	0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W	
A4R12	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A4R13	0698-3407	R:FXD MET FLM 1.96K OHM 1% 1/2W	
A4R14	0757-0440	R:FXD MET FLM 7.50K OHM 1% 1/8W	
A4R15	2100-1761	R:VAR WW 10K OHM 5% 1W	
A4R16	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A4R17	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A4R18	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A4R19	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A4R20	2100-0942	R:FXD MET FLM 50K OHM 20% 3/4W	
A4R21	0757-0294	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A4R22	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A4R23	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A4R24	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A4R25	0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	
A4R26	0757-0294	R:FXD MET FLM 17.8 OHM 1% 1/8W	
A4R27		DELETED (REPLACED WITH A SHORT)	
A4T1	08405-8001	TRANSFORMER:BALUN	
A5	08405-6003	BOARD ASSY:ISOLATION AMP.	
A5C1	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A5C2	0150-0121	C:FXD ELECT 0.1 UF +80-20% 35VDCW	
A5C3	0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	
A5C4	0160-2120	C:FXD ELECT MICA 0.01UF 1%	
A5C5	0180-0100	**C:FXD ELECT 4.7 UF 10% 35VDCW**	
A5C6	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A5C7	0180-2071	**C:FXD ELECT 0.022 UF 10% 35VDCW**	
A5C8	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A5C9	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDC	
A5C10	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDC	
A5C11	0100-0100	C:FXD ELECT 4.7 UF 10% 35VDC	
A5C12	0100-0100	C:FXD ELECT 4.7 UF 10% 35VDC	
A5C13	0180-0100	C:FXD ELECT 4.7 UF LO	
A5C14	0180-01000	*C:FXD ELECT 4.7 UF 10% 35VDCW*	
A5C15	0180-0100	C:FXD ELECT 4.7 UF 1035VDCW	
A5C16	0160-2143	C:FXD CER 2000 PF +80-20% 1000VDCW	
A5C17	0160-2201	C:FXD CER 15 PF 5% 500	
A5CR1	08405-8004	**DIODES:SILICON** HATCHED PAIR	
A5CR2		PART 0F **A5CR1**	
A5L1	910C-1719	*COIL:VAR*	
A5L2	914C-0114	COIL:FXD RF 10 UH	
A5MP1	502C-2C45	*CARD EXTRACTOR*	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A5Q1	1854-0071	TRANSISTOR:SILICON NPA	
A5Q2	1854-0071	TRANSISTOR:SILICON NPA	
A5Q3	1854-0071	TRANSISTOR:SILICON NPA	
A5Q4	1854-0071	TRANSISTOR:SILICON NPA	
A5Q5	1854-0071	TRANSISTOR:SILICON NPA	
A5Q6	1854-0071	TRANSISTOR:SILICON NPA	
A5R1	0757-0459	R:FXD MET FLM 54.2K OHM 1% 1/8W	
A5R2	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A5R3	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A5R4	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A5R5	0698-3160	R:FXD MET FLM 31.6K OHM 1% 1/8W	
A5R6	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A5R7	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	
A5R8	0698-0083	R:FXD MET FLM 1.96K OHM 1% 1/8W	
A5R9		NOT ASSIGNED	
A5R10	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A5R11	2100-1760	R: VAR WW 5K OHM 5% 1W	
A5R12	0757-0447	R:FXD MET FLM 16.2K OHM 1% 1/8W	
A5R13	0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W	
A5R14	0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	
A5R15	0757-4428	R:FXD MET FLM 1.62K OHM 1% 1/8W	
A5R16	0757-0288	R:FXD MET FLM 9.09K OHM 1% 1/8W	
A5R17	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A5R18	0757-0280	R:FXD MET FLM 1.K OHM 1% 1/8W	
A5R19	0757-0394	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A5R20	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A5R21	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A5R22	0698-3441	R:FXD MET FLM 215 OHM 1% 1/8W	
A5R23	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A5R24	0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	
A5R25	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A5R26	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A5R27	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A5R28	0698-3406	R:FXD MET FLM 1.33K OHM 1% 1/8W	
A5R29	0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	
A5R30	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A6	08405-6006	BOARD ASSY:180 DEG. SWITCH	
A6C1	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C2	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C3	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C4	0140-0235	C:FXD ELECT 4.7 UF 10% 300VDCW	
A6C5	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C6	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C7	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C8	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C9	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C10	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A6C11	0160-2120	C:FXD MICA 0.01UF 1%	
A6C12	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C13	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C14	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C15	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C16	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C17	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A6C18	0160-2261	C:FXD ELECT 15 UF 5% 500VDCW	
A6C19	0160-2261	C:FXD ELECT 15 UF 5% 500VDCW	
A6C20	0160-2261	C:FXD ELECT 15 UF 5% 500VDCW	
A6CR1	08405-8004	DIODES:SILICON MATCHED PAIR	
A6CR2		PART OF A6CR1	
A6CR3	1901-0040	DIODES:SILICON 30NA 30MV	
A6CR4	1901-0040	DIODES:SILICON 30NA 30MV	
A6L1	9100-1718	COIL:VAR	
A6MP1	5020-2045	CARD EXTRACTOR	
A6Q1	1854-0071	TRANSISTOR SILICON NPN	
A6Q2	1854-0071	TRANSISTOR SILICON NPN	
A6Q3	1854-0071	TRANSISTOR SILICON NPN	
A6Q4	1854-0071	TRANSISTOR SILICON NPN	
A6C5			
A6Q6			
A6R1	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A6R2	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A6R3	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A6R4	0696-3406	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A6R5	0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	
A6R6	0757-0289	R:FXD MET FLM 13.3K OHM 1% 1/8W	
A6R7	0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	
A6R8	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A6R9	0757-1094	R:FXD MET FLM 1.47K OHM 1% 1/8W	
A6R10	0757-0123	R:FXD MET FLM 34.8K OHM 1% 1/8W	
A6R11	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A6R12	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A6R13	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
A6R14	**0698-3161**	R:FXD MET FLM 38.3K OHM 1% 1/8W	
A6R15	0698-3159	R:FXD MET FLM 26.1K OHM 1% 1/8W	
A6R16	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	
A6R17	0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	
A6R18	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A6R19	0757-0466	R:FXD MET FLM 110K OHM 1% 1/8W	
A6R20	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A6R21	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A6R22	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A6R23	0698-0083	R:FXD MET FLM 1.96K OHM 1% 1/8W	
A6R24	0757-0466	R:FXD MET FLM 110K OHM 1% 1/8W	
A6R25	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	HP Part No.	Description #	Note
A6R26	0698-0084	R:FXD MET FLM 2.15k OHM 1% 1/8W	
A6R27	0698-3494	R:FXD MET FLM 28.7K OHM 1% 1/8W	
A6R28	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A6R29	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A6R30	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A7	08405-6005	BOARD ASSY:PHASE SHIFTER	
A7C1	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C2	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C3	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C4	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C5	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C6	0160-2127	C:FXD MICA 4600 PF 1%	
A7C7	0160-2127	C:FXD MICA 4600 PF 1%	
A7C8	0160-2120	C:FXD MICA 0.01UF 1%	
A7C9	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C10	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C11	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C12	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C13	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C14	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C15	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C16	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C17	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A7C18	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A7C19	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A7CR1	08405-8004	DIODES:SILICON HATCHED PAIR	
A7CR2		PART OF A7CR1	
A7CR3	1902-0025	DIODE.BREAKDOWN=10.OV 5% 400 MW	
A7L1	9100-1718	COIL:VAR	
A7MP1	5020-2045	CARD EXTRACTOR	
A7Q1	1854-0071	TRANSISTOR:SILICON NPN	
A7Q2	1854-0071	TRANSISTOR:SILICON NPN	
A7Q3	1854-0071	TRANSISTOR:SILICON NPN	
A7Q4	1854-0071	TRANSISTOR:SILICON NPN	
A7Q5	1854-0071	TRANSISTOR:SILICON NPN	
A7Q6	1854-0071	TRANSISTOR:SILICON NPN	
A7R1	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A7R2	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A7R3	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A7R4	0698-3406	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A7R5	0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	
A7R6	0698-0083	R:FXD MET FLM 1.96 OHM 1% 1/8W	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A7R7	0757-0465	R:FXD MET FLM 100k OHM 1X 1/8W	
A7R8	0757-0200	R:FXD NET FLM 1K OHM 1X 1/2W	
A7R9	0757-0465	R:FXD NET FLM 100K OHM 1X 1/8W	
A7R10	0698-3151	R:FXD NET FLM 2.87K OHM 1X 1/8W	
A7R11	0757-1094	R:FXD NET FLM 1.47K OHM 1X 1/8W	
A7R12	0757-0199	R:FXD NET FLM 21.5K OHM 1X 1/8W	
A7R13	0757-0465	R:FXD NET FLM 100K OHM 1X 1/8W	
A7R14	0757-0465	R:FXD NET FLM 100K OHM 1X 1/8W	
A7R15	0698-3157	R:FXD NET FLM 19.6K OHM 1X 1/8W	
A7R16	0698-3442	R:FXD NET FLM 237 OHM 1X 1/8W	
A7R17	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W	
A7R18	0757-0466	R:FXD NET FLM 110K OHM 1X 1/8W	
A7R19	0698-3162	R:FXD NET FLM 46.4K OHM 1X 1/8W	
A7R20	0698-3153	R:FXD NET FLM 3.83K OHM 1X 1/8W	
A7R21	0757-1094	R:FXD NET FLM 1.47K OHM 1X 1/8W	
A7R22	0698-0085	R:FXD NET FLM 2.61K OHM 1X 1/8W	
A7R23	0698-3447	R:FXD NET FLM 422 OHM 1X 1/8W	
A7R24	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W	
A7R25	0698-3153	R:FXD NET FLM 3.83K OHM 1X 1/8W	
A7R26	0757-0200	R:FXD NET FLM 5.26K OHM 1X 1/8W	
A7R27	07s7-C466	R:FXD NET FLM 110K OHM 1X 1/8W	
A7R28	O&C%-3162	R:FXD NET FLM 46.4K OHM 1X 1/8W	
A7R29	omR-0084	R:FXD NET FLM 2.15K OHM 1X 1/8W	
A7R30	Q?S7-C44I	R:FXD NET FLM 8.25K OHM 1X 1/8W	
A7R31	C&98-3440	R:FXD NET FLM 196 OHM 1X 1/8W	
A7R32	0658-3440	R:FXD NET FLM 196 OHM 1X 1/8W	
A8	084505-6058	BOARD ASSY:PHASE METER	
A8C1	0150-0071	C:FXD CER 400 Pf 5X 500VD	
A8C2	0140-0206	C:FXD MICA 270 PF 5X	
A8C3	0150-0071	C:FXD CER 400 PF St 5OOVDCW	
A8C4		NOT ASSIGNED	
A8C5	0140-0206	C:FXD MICA 270 PF 5X	
A8C6	0160-2055	C:FSC CER O.01 UF +80-20	
A8C7	0160-2055	C:FXD CER 0.01 UF +80-2	
A8C8	0180-0100	C:FXD ELECT 4.7 UF 10X 35V	
A8C9	0180-0098	C:FXD ELECT 100 UF	
A8C10	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A8C11	0160-0127	C:FXD CER 1.0 UF 20X 25VDCW	
A8C12	0160-0127	C:FXD CER 1.0 UF 20X 25VDCW	
A8CR1	1501-0040	DIODE: SILICON 30MA 30	
A8CR2	1902-0018	DIODE BREAKDOWN: 11.7V 5X	
A8CR3	1902-0018	DIODE BREAKDOWN: 11.7V 5X	
A8CR4	1901-0040	DIODE: SILICON 30 MA 30WV	
A8CR5	1902-0048	DIODE BREAKDOWN: 6.81V	
A8L1	9140-0120	COIL:FXD 0.1 UH 20%	
A8L2	9140-0120	COIL:FXD 0.1 UH 20%	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A8L3	9140-0110	COIL:FXD 500 UH 5%	
A8L4	9140-0114	COIL:FXD RF 10 UH	
A8L5	9140-0114	COIL:FXD RF 10 UH	
A8MP1	5020-2045	CARD EXTRACTOR	
A8Q1	1853-0009	TRANSISTOR:SILICON PNP	
A8C2	1853-009	TRANSISTOR:SILICON PNP	
A8C3	1850-005	TRANSISTOR:SILICON NPN 2N708	
A8C4	1853-0009	TRANSISTOR:SILICON PNP	
A8C5	1853-0009	TRANSISTOR:SILICON PNP	
A8C6	1854-0009	TRANSISTOR:SILICON NPN 2N708	
A8C7	1854-0009	TRANSISTOR:SILICON NPN 2N708	
A8Q8	1854-0009	TRANSISTOR:SILICON NPN 2N708	
A8C9	1854-0009	TRANSISTOR:SILICON NPN 2N708	
A8Q10	1854-0009	TRANSISTOR:SILICON NPN 2N708	
A8C11	1854-0003	TRANSISTOR:NPN SILICON	
A8C12	1854-0003	TRANSISTOR:NPN SILICON	
A8Q13	1854-0003	TRANSISTOR:NPN SILICON	
A8Q14	1854-0009	TRANSISTOR:SILICON NPN 2N708	
	1205-0202	HEAT DISSIPATOR:SEMICONDUCTOR	
A8C15	1854-0005	TRANSISTOR:SILICON NPN 2N708	
	1205-0202	HEAT DISSIPATOR:SEMICONDUCTOR	
A8C16	1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	
	1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	
	1853-0005	TRANSISTOR:SILICON PNP	
	1205-0202	HEAT DISSIPATOR:SEMICONDUCTOR	
	1853-0009	TRANSISTOR:SILICON PNP	
	1205-0202	HEAT DISSIPATOR:SEMICONDUCTOR	
	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
	0757-1094	R:FXD MET FLM 1.47K OHM 1% 1/8W	
	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
	0757-0123	R:FXD MET FLM 34.8K OHM 1% 1/8W	
	0698-3441	R:FXD MET FLM 215 OHM 1% 1/8W	
	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
	0757-1094	R:FXD MET FLM 1.47K OHM 1% 1/8W	
	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
	O698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
	0757-0123	R:FXD MET FLM 34.8K OHM 1% 1/8W	
	0698-3441	R:FXD MET FLM 215 OHM 1% 1/8W	
	0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	
	0698-3405	R:FXD MET FLM 422 OHM 1% 1/2W	
	0698-3405	R:FXD MET FLM 422 OHM 1% 1/2W	
	O757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
	0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	
	0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	
	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	

#See introduction to this section for **ordering** information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A8R21	0658-3400	R:FXD MET FLM 147 OHM 18 1/2W	
A8R22	0811-1637	R:FXD WW 344.3 OHM 0.18 1/3W	
A8R23	0757-0442	R:FXD MET FLM 75.0X OHM 18 1/8W	
A8R24	2100-1658	R:VAR WW 28 OHM 108 1W	
A8R25	0811-1641	R:FXD WW 6710 OHM 0.18 1/8W	
A8R26	0757-0405	R:FXD MET FLM 162 OHM 18 1/8W	
A8R27	0698-3101	R:FXD MET FLM 2.87X OHM 18 1/2W	
A8R28		NOT ASSIGNED	
A8R29	0811-1639	R:FXD WW 477.6 OHM 0.18 1/8W	
A8R30	0757-0462	R:FXD MET FLM 75.0K OHM 18 1/8W	
A8R31	0811-1641	R:FXD WW 6710 OHM 0.18 1/8W	
A8R32	2100-1658	R:VAR WW 2X OHM 103 W1	
A8R33	0757-0405	R:FXD MET FLM 162 OHM 18 1/8W	
A8R34	0658-3101	R:FXD MET FLM 2.87X OHM 18 1/2W	
A8R35		NOT ASSIGNED	
A8R36	0811-1642	R:FXD WW 8825 OHM 0.18 1/8W	
A8R37	0757-0280	R:FXD MET FLM 1K OHM 18 1/8W	
A8R38	0698-3153	R:FXD MET FLM 3.83K OHM 18 1/8W	
A9	08405-6009	BOARD ASSY: VOLTMETER	
A9C1	0100-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A9C2	0160-0301	C:FXD MY 0.012 UF 200VDCW	
A9C3	0180-1735	C:FXD ELECT 0.22 UF 108 35VDCW	
A9C4	00180-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A9C5	0180-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A9C6	0180-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A9C7	0180-0098	C:FXD ELECT 100 UF 208 20VDCW	
A9C8	0160-0164	C:FXD MY 0.039 UF 108 200VDCW	
A9C9	0140-0180	C:FXD MICA 2000 PF 28	
A9C10	0180-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A9C11	0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	
A9C12	0180-0100	C:FXD ELECT 4.7 UF 108 35VDCW	
A9C13	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A9C14	0188-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A9C15	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A9C16	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A9C17	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A9CR1	0901-0040	DIODE: SILICON 30MA 30WV	
A9CR2	0901-0040	DIODE: SILICON 30MA 30WV	
A9L1	9140-0072	COIL: RF 5000 OH 10%	
A9MP1	5020-2045	CARD EXTRACTOR	
A9Q1	1854-0071	TRANSISTOR: SILICON NPN	
A9Q2	1853-0020	TRANSISTOR: SILICON PNP	
A9Q3	1856-0071	TRANSISTOR: SILICON NPN	
A9Q4	1856-0071	TRANSISTOR: SILICON NPN	
A9Q5	1853-0020	TRANSISTOR: SILICON PNP	

#See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A9Q6	1854-0071	TRANSISTOR:SILICON NPN	
A9R1	0757-0289	R:FXD MET FLM 13.3K OHM 1% 1/8W	
A9R2	0757-0467	R:FXD MET FLM 121K OHM 1% 1/8W	
A9R3	0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W	
A9R4	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
A9R5	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A9R6	0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	
A9R7	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A9R8	0757-0394	R:FXD MET FLM 51.1K OHM 1% 1/8W	
A9R9	0698-3156	R:FXD MET FLM 14.7K OHM 1% 1/8W	
A9R10	0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	
A9R11	0698-3132	R:FXD MET FLM 261 OHM 1% 1/8W	
A9R12	0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W	
A9R13	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A9R14	0698-3449	R:FXD MET FLM 28.7K OHM 1% 1/8W	
A9R15	0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	
A9R16	0757-0443	R:FXD MET FLM 11.0K OHM 1% 1/8W	
A9R17	0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W	
A9R18	0757-0288	R:FXD MET FLM 9.09K OHM 1% 1/8W	
A9R19	0757-0402	R:FXD MET FLM 110 OHM 1% 1/8W	
A9R20	0757-0316	R:FXD MET FLM 42.2 OHM 1% 1/8W	
A9R21	0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W	
A9R22	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A9R23	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A9R24	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A9R25	0757-0833	R:FXD MET FLM 5.11K OHM 1% 1/2W	
A9R26	0757-0464	R:FXD MET FLM 90.9K OHM 1% 1/8W	
A9R27	0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W	
A9R28	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	

#See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A1G	08405-6010	BOARD ASSY:APC AMPLIFIER	
A1OC1	0160-2146	C:FXD CER 0.02 UF +80-20% 100VDCW	
A1OC2	0180-0100	C:FXD ELECT 4.7	
A1OC3	0180-0100	C:FXD ELECT 4.7	
A1OC4	0180-0100	C:FXD ELECT 4.7 UF	
A1OC5	0180-0100	C:FXD ELECT 4.7 UF	
A1OC6	0180-0100	C:FXD ELECT 4.7 UF	
A1OC7	0180-0100	C:FXD ELECT 4-7 UF 10% 35VDCW	
A1OC8	0180-0100	C:FXD ELECT 4-7 UF 10% 35VDCW	
A1OC9	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A1OC10	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A1OC11	0180-0100	CFXD ELECT 4.7 UF 10% 35VDCW	
A1OC12	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A1OC13	0140-0179	C:FXD MICA 1000 PF 2%	
A1OC14	0140-0155	C:FXD MICA 1325 PF 1% 500VDCW	
A1OC15	0160-2261	C:FXD ELECT 15 UF 5% 500VDCW	
A1OC16	0160-2211	C:FXD ELECT 510 UF 5% 300VDCW	
A1OC17	0160-2211	C:FXD MICA 510 PF 5% 300VDWC	
A1OCR1	08405-8004	DIODES:SILICON MATCH PAIR	
A1OCR2		PART OF A10CR1	
A1OCR3	08405-8004	DIODES:SILICON MATCHED PAIR	
A1OCR4		PART OF A10CR3	
A1OCR5	08405-8004	DIODES:SILICON MATCHED PAIR	
A1OCR6		PART OF A10CR5	
A1OL1	9100-1628	COIL:MOLDED CHOKE 43.0 UH 5%	
A1OMP1	5020-2045	CARD EXTRACTIOR	
A1OQ1	1854-0371	TRANSISTOR:SILICON NPN	
A1OQ2	1854-0371	TRANSISTOR:SILICON NPN	
A1OQ3	1856-0371	TRANSISTOR:SILICON NPN	
A1OQ4	1854-0371	TRANSISTOR:SILICON NPN	
A1OR1	0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	
A1OR2	0751-0288	R:FXD MET FLM 9.09K OHM 1% 1/8W	
A1OR3	0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	
A1OR4	0757-0280	R:FXD MET FL	
A1OR5	0757-0406	R:FXD MET FLM 182K OHM 1% 1/8W	
A1OR6	0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	
A1OR7	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A1OR8	0698-3441	R:FXD MET FLM 215K OHM 1% 1/8W	
A1OR9	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A1OR10	0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	
A1OR11	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A10R12	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A10R13	0698-3405	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A10R14	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A10R15	0698-3430	R:FXD MET FLM 147 OHM 1% 1/8W	
A10R16	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A10R17	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A10R18	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A10R19	0698-3405	R:FXD MET FLM 1.33K OHM 1% 1/2W	
A10R20	0698-3442	R:FXD MET FLM 237K OHM 1% 1/8W	
A10R21	0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	
A10R22	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A10R23	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A10R24	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A11	08405-6057	BOARD ASSY:IF SAMPLER	
A11C1	0160-2276	C:FXD MICA 34000 PF 2%	
A11C2	0160-2276	C:FXD ELECT 4-7 UF 300VDCW	
A11C3	0180-0116	C:FXD ELECT 4-7 UF 35VDCW	
A11C4	0140-0156	C:FXD MICA 1500 PF 2%	
A11C5	0140-2277	C:FXD MICA 15000 PF 2%	
A11C6	0160-2277	C:FXD MICA 15000 PF 2%	
A11C7	0160-0174	C:FXD ELECT 4-7 UF 25VDCW	
A11C8	0140-0170	C:FXD ELECT 4-7 UF 300VDCW	
A11C9		NOT ASSIGNED	
A11C10		NOT ASSIGNED	
A11C11	0140-0179	C:FXD MICA 1000 PF 2%	
A11C12	0160-2917	C:FXD CER 0.05 UF +80-20% 100VDCW	
A11C13		C:FXD MICA 1000 PF 2%	
A11C14		NOT ASSIGNED	
A11C15		NOT ASSIGNED	
A11C16	0140-0170	C:FXD MICA 5600 PF 5% 300VDCW	
A11C17	0140-0179	C:FXD MICA 1000 PF 2%	
A11C18		NOT ASSIGNED	
A11C19	0180-0116	C:FXD ELECT 4-7 UF 35VDCW	
A11C20	0160-0174	C:FXD ELECT 4-7 UF 25VDCW	
A11CR1	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR2	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR3	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR4	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR5	1902-0104	DIODE BREAKDOWN:SILICON 16.2V 5%	
A11CR6	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR7	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR8	1901-0025	DIODE:SILICON 30MA 30MV	
A11CR9	1901-0025	DIODE:SILICON 30MA 30MV	
A11CR10	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR11	1901-0040	DIODE:SILICON 30MA 30MV	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A11CR12	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR13	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR14	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR15	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR16	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR17	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR18	1902-0184	DIODE BREAKDOWN:SILICON 16.2V 5%	
A11CR19	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR20	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR21	1901-0040	DIODE:SILICON 30MA 30MV	
A11CR22	1901-0040	DIODE:SILICON 30MA 30MV	
A11F1	5020-2045	CARD EXTRACTOR	
A11C1	1856-0071	TRANSISTOR:SILICON NPN	
A11C2	1854-0039	TRANSISTOR:SILICON NPN	
	1205-0018	HEAT SINK	
A11C3	1853-0010	TRANSISTOR:SILICON NPN	
A11C4	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A11C5	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A11C6	1853-0010	TRANSISTOR:SILICON PNP	
A11C7	1854-0039	TRANSISTOR:SILICON NPN 23053	
A11R1	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A11R2	0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	
A11R3	0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	
A11R4	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A11R5	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A11R6	0698-3431	R:FXD MET FLM 23.7K OHM 1% 1/8W	
A11R7	0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	
A11R8	0757-0815	R:FXD MET FLM 562K OHM 1% 1/2W	
A11R9	0757-0815	R:FXD MET FLM 562K OHM 1% 1/2W	
A11R10	0757-0401	R:FXD MET FLM 100K OHM 1% 1/8W	
A11R11	0757-0401	R:FXD MET FLM 100K OHM 1% 1/8W	
A11R12	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
A11R13	0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	
A11R14		NOT ASSIGNED	
A11R15	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A11R16		NOT ASSIGNED	
A11R17		NOT ASSIGNED	
A11R18	*0698-0084*	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A11R19	*0698-3450*	R:FXD MET FLM 42.2K OHM 1% 1/8W	
A11R20	*0698-3162*	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A11R21	0698-3154	R:FXD MET FLM 4.22K OHM 1% 1/8W	
A11R22	**0698-3162**	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A11R23	**2100-1761**	R:VAR WW 10K OHM 5% 1W	
A11R24	2100--1760	R:VAR WW 10K OHM 5% 1W	
A11R25	*0698-3450*	R:FXD MET FLM 42.2K OHM 1% 1/8W	
A11R26	*0698-0084*	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A11R27		NOT ASSIGNED	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No. #	Description #	Note
A11R28	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A11R29		NOT ASSIGNED	
A11R30		NOT ASSIGNED	
A11R31	0698-3431	R:FXD MET FLM 23.7 OHM 1% 1/8W	
A11T1	08405-6002	TRANSFORMER:IF	
A11T2	08405-6002	TRANSFORMER:IF	
A12	08405-6012	BOARD ASSY:SEARCH	
A12C1	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A12C2	0140-0193	C:FXD MICA 82 PF 5%	
A12C3	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A12C4	0140-0197	C:FXD MICA 180 PF 5% 300 VDCW	
A12C5	0180-0195	C:FXD ELECT 0.33 UF 20% 35VDCW	
A12C6	0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	
A12C7	0140-0176	C:FXD MICA 100 PF 2%	
A12C8	0150-0070	C:FXD CER 0.02 UF 20% 500VDCW	
A12C9	0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	
A12C10	0160-2917	C:FXD CER 0.05 UF +80-20% 100VDCW	
A12C11	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A12C12	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A12C13	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A12C14	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A12C15	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A12C16	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A12CR1	1901-0025	DIODE:SILICON 100MV 100MA	
A12CR2	1901-0040	DIODE:SILICON 30MA 30MV	
A12CR3	1901-0040	DIODE:SILICON 30MA 30MV	
A12MP1	5020-2045	CARD EXTRACTOR	
A12Q1	1854-0071	TRANSISTOR:SILICON NPN	
A12Q2	1854-0071	TRANSISTOR:SILICON NPN	
A12Q3	1854-0071	TRANSISTOR:SILICON NPN	
A12Q4	1853-0009	TRANSISTOR:SILICON PNP	
A12Q5	1854-0071	TRANSISTOR:SILICON NPN	
A12Q6	1853-0010	TRANSISTOR:SILICON PNP	
A12Q7	1853-0020	TRANSISTOR:SILICON PNP	
A12Q8	1854-0071	TRANSISTOR:SILICON NPN	
A12Q9	1854-0071	TRANSISTOR:SILICON NPN	
A12Q10	1853-0020	TRANSISTOR:SILICON PNP	
A12R1	0698-3459	R:FXD MET FLM 383K OHM 1% 1/8W	
A12R2	0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	
A12R3	0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	
A12R4	0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	
A12R5	0698-3455	R:FXD MET FLM 261K OHM 1% 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #
A12R6	0757-0438	R:FXD NET FLM 5.11K OHM 1X 1/8W
A12R7	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W
A12R8	0757-0290	R:FXD NET FLM 6.19K OHM 1X 1/8W
A12R9	0698-3440	R:FXD NET FLM 196 OHM 1X 1/8W
A12R10	0698-0083	R:FXD NET FLM 196 OHM 1X 1/8W
A12R11	0757-8442	R:FXD NET FLM 10.0K OHM 1X 1/8W
A12R12	0698-0084	R:FXD NET FLM 2.15K OHM 1X 1/8W
A12R13	0757-0290	R:FXD NET FLM 6.19K OHM 1X 1/8W
A12R14	0698-3449	R:FXD NET FLM 28.7K OHM 1X 1/8W
A12R15	0698-3449	R:FXD NET FLM 28.7K OHM 1X 1/8W
A12R16	0757-0461	R:FXD NET FLM 68.1K OHM 1X 1/8W
A12R17	0698-3453	R:FXD NET FLM 196K OHM 1X 1/8W
A12R18	0698-3158	R:FXD NET FLM 3.83K OHM 1X 1/8W
A12R19	0757-0200	R:FXD NET FLM 5.62K OHM 1X 1/8W
A12R20	0757-0465	R:FXD NET FLM 100K OHM 1X 1/8W
A12R21	0757-0441	R:FXD NET FLM 8.25K OHM 1X 1/8W
A12R22	0757-1094	R:FXD NET FLM 1.47K OHM 1X 1/8W
A12R23	0698-3449	R:FXD NET FLM 28.7K OHM 1X 1/8W
A12R24	0757-0460	R:FXD NET FLM 61.9K OHM 1X 1/8W
A12R25	2100-0942	R: VAR FLM 50K OHM 20X 3/4W
A12R26	0698-3152	R:FXD NET FLM 3.48K OHM 1X 1/8W
A12R27	0698-4315	R:FXD COMP 430 OHM 5% 1/2W
A12R28	0698-3158	R:FXD NET FLM 23.7K OHM 1X 1/8W
A12R29	0757-0346	R:FXD NET FLM 10 OHM 1X 1/8W
A12R30	0686-1055	R:FXD COMP 1 MEGOHN 5X 1/2W
A12R31	0698-3449	R:FXD NET FLM 28.7K OHM 1/8W
A12R32	0698-315	R:FXD NET FLM 4.64K OHM 1/8W
A12R33	0757-0462	R:FXD NET FLM 75.0K OHM 1X 1/8W
A12R34	0757-0447	R:FXD NET FLM 16.2K OHM 1/8W
A12R35	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W
A12R36	0698-3150	R:FXD NET FLM 2.37K OHM 1X 1/8W
A12R37	0757-0394	R:FXD NET FLM 51.1 OHM 1X 1/8W
A12R38	0757-0394	R:FXD NET FLM 51.1 OHM 1X 1/8W
A12R39	0698-3454	R:FXD NET FLM 215K OHM 1/8W
A12R40	0698-3440	R:FXD NET FLM 196 OHM 1X 1/8W
A12R41	0698-3440	R:FXD NET FLM 196 OHM 1X 1/8W
A12R42	0698-3440	R:FXD NET FLM 196 OHM 1X 1/8W
A12R43	0698-3440	R:FXD NET FLM 196 OHM 1X 1/8W
A12R44	0757-0280	R:FXD NET FLM 1K OHM 1/8W
A13	08405-6013	BOARD ASSY: EQUALIZER
A13C1	0140-0157	C: FXD NICA 1857 PF 1X
A13C2	0180-1746	C:FXD ELECT 15 UF 10X 20VDCW
A13C3	0160-0168	C:FXD MY 0.1 UP 10X 200VDCW
A13C4	0160-0168	C:FXD MY 0.1 UF 10X 200VDCW
A13C5	0140-0182	C:FXD MICA 5000 PF 2X
A13C6	0160-2279	C:FXD NICA 880 PF 2X 300VDCW

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	# Part No.	Description #	Note
A13C7	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A13C8	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A13C9	0160-2261	C:FXD CER 15 PF 5% 500VDCW	
A13L1	9100-1653	COIL:MOLDED CHOKE 910.0 UH 5%	
A13Q1	1854-0071	TRANSISTOR:SILICON NPN	
A13Q2	1854-0071	TRANSISTOR:SILICON NPN	
A13Q3	1854-0071	TRANSISTOR:SILICON NPN	
A13R1	0698-3460	R:FXD MET FLM 422K OHM 1% 1/8W	
A13R2	0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	
A13R3	0698-0083	R:FXD MET FLM 1.96K OHM 1% 1/8W	
A13R4	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A13R5	0698-3156	R:FXD MET FLM 23.7K OHM 1% 1/8W	
A13R6	0757-0465	R:FXD MET FLM 162 OHM 1% 1/8W	
A13R7	0757-0462	R:FXD MET FLM 110 OHM 1% 1/8W	
A13R8	0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	
A13R9	0698-3132	R:FXD MET FLM 261 OHM 1% 1/8W	
A13R10	0698-3161	R:FXD MET FLM 38.3K OHM 1% 1/8W	
A13R11	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A13R12	0757-0447	R:FXD MET FLM 16.2K OHM 1% 1/8W	
A13R13	0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	
A13R14	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A13R15	0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	
A13R16	0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	
A13R17	0757-0463	R:FXD MET FLM 121 OHM 1% 1/8W	
A13R18	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A13R19	0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	
A13R20	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A13R21	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A13R22	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A14	08405-6014	BOARD ASSY:VTO	
A14C1	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A14C2	0140-0176	C:FXD MICA 100 PF 2%	
A14C3	0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	
A14C4	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A14C5	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A14C6	0140-0176	C:FXD MICA 100 PF 2%	
A14C7	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	
A14C8	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A14C9	0140-0176	C:FXD MICA 100 PF 2%	
A14C10	0150-0051	C:FXD CER 100 PF 600VDCW	
A14C11	0180-0138	C:FXD ELECT 100UF -10+100% 40VDCW	
A14C12	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A14C13	0150-0069	C:FXD CER 1000 PF +100-20% 500VDCW	
A14C14	0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	
A14C15	0180-0116	C:FXD ELECT 6.8 UF 10% 35VDCW	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No. #	Description	Note
A14C16	0160-2055	C:FXD CER 0.01 UF 480-20X 100VDCW	
A14C17	0160-2261	C:FXD CER 15 PF 5X 500VDCW	
A14CR1	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR2	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR3	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR4	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR5	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR6	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR7	1901-0040	DIODE: SILICON 30HA 30WV	
A14CR8	1901-0040	DIODE: SILICON 30HA 30WV	
A14L1	9140-0138	COIL/CHOKE 180 UH 5X	
A14L2	9140-0096	COIL:FXD RF 1 UH	
A14L3	9140-0138	COIL/CHOKE 180 UH 5X	
A14Q1	1854-0071	TRANSISTOR:SILICON NPN	
A14Q2	1854-0071	TRANSISTOR:SILICON NPN	
A14Q3	1854-0071	TRANSISTOR:SILICON NPN	
A14Q4	1854-0003	TRANSISTOR:NPN SILICON	
A1405	1853-0009	TRANSISTOR:SILICON PNP	
A1406	1853-0009	TRANSISTOR:SILICON PNP	
A1407	08405-8003	TRANSISTOR:NPN SILICON SELECTED	
A1408	08405-8003	TRANSISTOR:NPN SILICON SELECTED	
A14R1	0698-0085	R:FXD NET FLM 2.61K OHM 1X 1/8W	
A14R2	0757-0280	R:FXD NET FLM 1K OHM 1X 1/8W	
A14R3	0698-3243	R:FXD NET FLM 178K OHM 1X 1/8W	
A14D4	0757-0443	R:FXD NET FLM 11.0K OHM 1X 1/8W	
A14R5	0757-0199	R:FXD NET FLM 21.5K OHM 1X 1/8W	
A14G6	0757-0317	R:FXD NET FLM 1.33K OHM 1X 1/8W	
A14R7	0757-0465	R:FXD NET FLM 1OOK OHM 1X 1/8W	
A14R8	0757-0442	R:FXD NET FLM 10.0K OH 1X 1/8W	
A14619	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W	
A14R10	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W	
A14P11	0757-0346	R:FXD NET FLM 10 OHM 1X 1/8W	
A14R12	0757-0416	R:FXD MET FLM 511 OHM 1X 1/8W	
A14R13	0698-0083	R:FXD NET FLM 1.96K CHM 1X 1/8W	
A14R14	0698-0083	R:FXD NET FLM 1.96K OHM 1X 1/8W	
A14R15	0698-4037	R:FXD NET FLM 46.4 OHM 1X 1/8W	
A14R16	0757-0442	R:FXD NET FLM 10.0K OHM 1X 1/8W	
A14R17	0757-0442	R:FXD NET FLM 10.0K OHM 1X 1/8W	
A14R18	0698-4037	R:FXD NET FLM 46.4 OHM 1X 1/8W	
A14R19	0698-3153	R:FXD NET FLM 3.83K OHM 1X 1/8W	
A14R20	0698-3155	R:FXD NET FLM 4.64K OHM 1X 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A14R21	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A14R22	0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	
A14R23	0757-0706	R:FXD MET FLM 51.1 OHM 1% 1/4W	
A14R24	0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	
A15	08405-6015	BOARD ASSY:PULSE GENERATOR	
A15C1	0160-0342	C:FXD MICA 800 PF 1% 300VDCW	
A15C2	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A15C3	0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	
A15C4	0140-0206	C:FXD MICA 270 PF 5%	
A15C5	0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	
A15C6	0150-0050	C:FXD CER 1000 PF 600VDCW	
A15C7	0140-0176	C:FXD MICA 100 PF 2%	
A15CR1	1901-0441	DIODE:STEP RECOVERY SILICON 90-160NS	
A15CR2	1901-0047	DIODE JUNCTION:SILICON 20PIV	
A15CR3	1902-0126	DIODE BREAKDOWN:2.61V 5%	
A15CR4	1901-0040	DIODE:SILICON 30MA 30mV	
A15L1	9140-0138	COIL/CHOKE 180 UH 5%	
A15L2	9140-0096	COIL:FXD RF 1 UH	
A15L3	9140-0096	COIL:FXD RF 1 UH	
A15L4	9140-0181	COIL:FXD RF 22UH 5%	
A15L5	9140-0096	COIL:FXD RF 1 UH	
A15Q1	1854-0035	TRANSISTOR:NPN SILICON	
A15Q2	1853-0009 1205-0012	TRANSISTOR:SILICON PNP HEAT DISSIPATOR:SEMICONDUCTOR	
A15R1	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A15R2	0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	
A15R3	2100-1756	R:VAR WW 200 OHM 5% 1W	
A15R4	0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	
A15R5	0698-3403	R:FXD MET FLM 348 OHM 1% 1/2W	
A15R6	0757-0198	R:FXD MET FLM 100 OHM 1% 1/2W	
A15R7	0698-3442	R:FXD MET FLM 237 OHM 1% 1/8W	
A15R8	0698-3405	R:FXD MET FLM 422 OHM 1% 1/2W	
A15R9	0766-0024	R:FXD MET FLM 260 OHM 2% 3W	
A15T1	9100-1698	TRANSFORMER:PULSE	
A16	08405-6016	BOARD ASSY:POWER SUPPLY	
A16C1	0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	
A16C2	0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	
A16C3	0180-0138	C:FXD ELECT 100UF -10+100% 40VDCW	
A16C4	0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	
A16C5	0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A16C6	0180-0138	C:FXD ELECT 100UF -10+100% 40VDCW	
A16CR1	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A16CR2	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A16CR3	1902-0062	DIODE BREAKDOWN:3.75V	
A16CR4	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR5	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR6	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR7	1902-0057	DIODE BREAKDOWN:6.49V	
A16CR8	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A16CR9	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A16CR10	1902-0062	DIODE BREAKDOWN:3.75V	
A16CR11	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR12	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR13	1901-0033	DIODE:SILICON 100MA 180WV	
A16CR14	1902-0057	DIODE BREAKDOWN:6.49V	
A16MP1	5020-2045	CARD EXTRACTOR	
A16Q1	1854-0020	TRANSISTOR:NPN SILICON	
A16Q2	1853-0009	TRANSISTOR:SILICON PNP	
A16Q3	1854-0071	TRANSISTOR:SILICON NPN	
A16Q4	1854-0020	TRANSISTOR:NPN SILICON	
A16Q5	1853-0009	TRANSISTOR:SILICON PNP	
A16Q6	1854-0071	TRANSISTOR:SILICON NPN	
A16R1	0811-0040	R:FXD WW 1 OHM 1% 5W	
A16R2	0757-0198	R:FXD MET FLM 100 OHM 1% 1/2W	
A16R3	0757-0317	R:FXD MET FLM 1.33K OHM 1% 1/8W	
A16R4	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A16R5	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A16R6	0811-0040	R:FXD WW 1 OHM 1% 5W	
A16R7	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A16R8	0757-0077	R:FXD FLM 1.2K OHM 2% 1/4W	
A16R9	0757-0398	R:FXD MET FLM 75 OHM 1% 1/8W	
A16R10	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A16R11	2100-0328	R:VAR WW 500 OHM 10% LIN 1W	
A16R12	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A16R13	0811-0040	R:FXD WW 1 OHM 1% 5W	
A16R14	0757-0198	R:FXD MET FLM 100 OHM 1% 1/2W	
A16R15	0757-0317	R:FXD MET FLM 1.33K OHM 1% 1/8W	
A16R16	0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	
A16R17	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A16R18	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A16R19	0811-0040	R:FXD WW 1 OHM 1% 5W	
A16R20	0757-0077	R:FXD FLM 1.2K OHM 2% 1/4W	
A16R21	0757-0398	R:FXD MET FLM 75 OHM 1% 1/8W	
A16R22	0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	
A16R23	2100-0328	R:VAR WW 500 OHM 10% LIN 1W	
A16R24	0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	
A17	08405-6017	DELAY LINE ASSY	

 # See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A18	08405-6003	BOARD ASSY: ISOLATION AMP.	
A18C1	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C2	0150-0121	C:FXD CER 0.1 UF -80-20X 50VDCW	
A18C3	0180-0137	C:FXD ELECT 100 UF 20X 10VDCW	
A18C4	0160-2120	C:FXD MICA 0.01UF 1X	
A18C5	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C6	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C7	0180-2071	C:FXD ELECT 0.022 UF 10X 35VDCW	
A18C8	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C9	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C10	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C11	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C12	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C13	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C14	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C15	0180-0100	C:FXD ELECT 4.7 UF 10X 35VDCW	
A18C16	0160-2143	C:FXD CER 2000 PF +80-20X 1000VDCW	
A18C17	0160-2261	C:FXD CER 15 PF 5X 500VDCW	
A18CR1	08405-8004	DIODE: SILICON HATCHED PAIR	
A18CR2		PART OF A18CR1	
A18L1	9100-1719	COIL:VAR	
A18L2	9140-00114	COIL:FXD RF 10 UH	
A18PP1	5020-2045	CARD EXTRACTOR	
A18Q1	1854-0071	TRANSISTOR: SILICON NPN	
A18Q2	1854-0071	TRANSISTOR: SILICON NPN	
A18Q3	1854-0071	TRANSISTOR: SILICON NPN	
A18Q4	1854-0071	TRANSISTOR: SILICON NPN	
A18Q5	1854-0071	TRANSISTOR: SILICON NPN	
A18Q6	1854-0071	TRANSISTOR: SILICON NPN	
A18R1	0757-0459	R:FXD MET FLM 56.2K OHM 1X 1/8W	
A18R2	0698-3157	R:FXD MET FLM 19.6K OHM 1X 1/8W	
A18R3	0698-3157	R:FXD MET FLM 19.6K OHM 1X 1/8W	
A18R4	0757-0442	R:FXD MET FLM 10.0K OHM 1X 1/8W	
A18R5	0698-3160	R:FXD MET FLM 31.6K OHM 1X 1/8W	
A18R6	0757-0280	R:FXD MET FLM 1K OHM 1X 1/8W	
A18R7	0757-0444	R:FXD MET FLM 12.1K OHM 1X 1/8W	
A18R8	0698-0083	R:FXD MET FLM 1.96K OHM 1X 1/8W	
A18R9		NOT ASSIGNED	
A18R10	0757-0442	R:FXD MET FLM 10.0K OHM 1X 1/8W	
A18R11	2100-1760	R:VAR WW 5K OHM 5X 1W	
A18R12	0757-0447	R:FXD MET FLM 16.2K OHM 1X 1/8W	
A18R13	0757-0278	R:FXD MET FLM 1.78K OHM 1X 1/8W	
A18R14	0757-0428	R:FXD MET FLM 1.62K OHM 1X 1/8W	
A18R15	0757-0428	R:FXD MET FLM 1.62K OHM 1X 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A18R16	0757-0288	R:FXD NET FLM 9.09K OHM 1X 1/8W	
A18R17	0757-0438	R:FXD NET FLM 5.11K OHM 1X 1/8W	
A18R18	0757-0280	R:FXD NET FLM 1K OHM 1X 1/8W	
A18R19	0757-0394	R:FXD NET FLM 51.1 OHM 1X 1/8W	
A18R20	0698-3444	R:FXD NET FLM 316 OHM 1X 1/8W	
A18R21	0757-0280	R:FXD NET FLM 1K OHM 1X 1/8W	
A18R022	0698-3441	R:FXD NET FLM 215 OHM 1X 1/8W	
	0698-3153	R:FXD NET FLM 3.83K OHM 1X 1/8W	
	0757-0439	R:FXD NET FLM 6.81K OHM 1X 1/8W	
A18R25	0698-0082	R:FXD NET FLM 464 OHM 1X 1/8W	
A18R26	0698-3155	R:FXD NET FLM 4.64K OHM 1X 1/8W	
A10R27	0698-3136	R:FXD NET FLM 17.8K OHM 1X 1/8W	
A18R28	0698-3406	R:FXD NET FLM 1.33K OHM 1X 1/2W	
A18R29	0698-3438	R:FXD NET FLM 147 OHM 1X 1/8W	
A18R30	0698-0084	R:FXD NET FLM 2.15K OHM 1X 1/8W	
A19	08405-6035	CABLE ASSY:OUTPUT DELAY LINE	
A19CR1		NSR PART OF Al9	
A20	08405-6034	CABLE ASSY:PULSE GENERATOR	
A20CR1		MSR PART OF A20	
A21	08405-6052	SWITCH ASSY:PHASE METER OFFSET	
A21R1	0698-4084	R:FXD NET FLM 19.2 OHM 1X 1/8W	
A21R2	0698-4085	R:FXD NET FLM 20.8 OHM 1X 1/8W	
A21R3	0698-4086	Text El FLM 22.6 OHM 1X 1/8W	
A21R4	0698-4087	Text ET FLM 24.6 OHM 1X 1/8W	
A21R5	0698-4088	R:FXD NET FLM 27 1X 1/8W	
A21R6	0698-4089	R:FXD NET FLM 29.7 OHM 1X 1/8W	
A21R7	0698-4090	R:FXD NET FLM 32.8 OHM 1X 1/8W	
A21R8	0757-0390	R:FXD NET FLM 36.5 OHM 1X 1/8W	
A21R9	0698-4091	R:FXD NET FLM 40.8 OHM 1X 1/8W	
A21R10	0698-4092	R:FXD NET FLM 45.9 OHM 1X 1/8W	
A21R11	0698-4093	R:FXD NET FLM 52 OHM 1X 1/8W	
A21R12	0698-4094	R:FXD NET FLM 59.5 OHM 1X 1/8W	
A21R13	0698-4095	R:FXD NET FLM 68.6 OHM 1X 1/8W	
A21R14	0698-4096	R:FXD NET FLM 80.2 OHM 1X 1/8W	
A21R15	0698-4097	R:FXD NET FLM 94.8 OHM 1X 1/8W	
A21R16	0757-0275	R:FXD NET FLM 113 OHM 1X 1/8W	
A21R17	0698-4099	R:FXD NET FLM 139 OHM 1X 1/8W	
A21S1	3100-1834	SWITCH:ROTARY	
A22	08405-6051	SWITCH ASSY:AMPLITUDE RANGE	
A22C1	0140-0210	C:FXD MICA 270 PF 5X	
A22MP1	08405-0013	COVER:SWITCH	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A22MP2	08405-0014	PLATE: SWITCH COVER	
A22MP3	08405-0014	PLATE: SWITCH COVER	
A22R1	0698-0084	R:FXD MET FLM 2.15K OHM 1X 1/8W	
A22R2	0698-5851	R:FXD MET FLM 6.81K OHM 1X 1/8W	
A22R3	0698-5847	R:FXD MET FLM 2150 OHM 0.5X 1/8W	
A22R4	0698-4100	R:FXD MET FLM 1.26K OHM 1X 1/8W	
A22R5	0698-5850	R:FXD MET FLM 681 OHM 0.5X 1/8W	
A22R6	0698-4101	R:FXD MET FLM 1.85K OHM 1X 1/8W	
A22R7	0698-5848	R:FXD MET FLM 215 OHM 0.5X 1/8W	
A22R8	0698-4102	R:FXD MET FLM 2.06K OHM 1X 1/8W	
A22R9	0698-4349	R:FXD MET FLM 99.5 OHM 1% 1/8W	
A22R10	0698-0084	R:FXD MET FLM 2.15K OHM 1X 1/8W	
A22R11	0698-5851	R:FXD MET FLM 6.81K OHM 0.5X 1/8W	
A22R12	0698-5847	R:FXD MET FLM 2150 OHM 0.5X 1/8W	
A22R13	0698-4100	R:FXD MET FLM 1.26K OHM 1X 1/8W	
A22R14	0698-5850	R:FXD MET FLM 6381 OHM 0.5X 1/8W	
A22R15	0698-4101	R:FXD MET FLM 1.85K OHM 1X 1/8W	
A22R16	0698-5848	R:FXD MET FLM 215 OHM 0.5X 1/8W	
A22R17	0698-4102	R:FXD MET FLM 2.06K OHM 1X 1/8W	
A22R18	0698-4349	R:FXD MET FLM 99.5 OHM 1% 1/8W	
A22S1	3100-1833	SWITCH:ROTARY	
A22W1	08405-6039	CABLE ASSY:SHORT AMP RANGE	
A22W2	08405-6040	CABLE ASSY:MED AMP RANGE	
A22W3	08405-6041	CABLE ASSY:LONG AMP RANGE	
A23	08405-6042	SWITCH ASSY:CHANNEL	
A23MP1	08405-0013	COVER:SWITCH	
A23MP2	08405-0014	PLATE:SWITCH COVER	
A23MP3	08405-0014	PLATE:SWITCH COVER	
A23S1	3100-1832	SWITCH:ROTARY	
A23W1	08405-6028	CABLE ASSY	
A23W2	08405-6037	CABLE ASSY	
A23W3	08405-6038	CABLE ASSY	
A24	08405-6053	SWITCH ASSMY:FREQ. RANGE	
A24R1	0698-3446	R:FXD MET FLM 383 OHM 1X 1/8W	
A24R2	0757-0419	R:FXD MET FLM 681 OHM 1X 1/8W	
A24R3	0757-0424	R:FXD MET FLM 1.10K OHM 1X 1/8W	
A24R4	0757-0428	R:FXD MET FLM 1.62K OHM 1X 1/8W	
A24R5	0698-0084	R:FXD MET FLM 2.15K OHM 1X 1/8W	
A24R6	0698-3151	R:FXD MET FLM 2.87K OHM 1X 1/8W	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A24R7	0698-3154	R:FXD MET FLM 4.22K OHM 1X 1/8W	
A24R8	0757-0438	R:FXD MET FLM 5.11K OHM 1X 1/8W	
A24R9	0757-0440	R:FXD MET FLM 7.50K OHM 1X 1/8W	
A24R10	0757-0442	R:FXD MET FLM 10.0K OHM 1X 1/8W	
A24R11	0757-0289	R:FXD MET FLM 13.3K OHM 1X 1/8W	
A24R12	0698-3136	R:FXD MET FLM 17.8K OHM 1X 1/8W	
A24R13	0698-3159	R:FXD MET FLM 26.1K OHM 1X 1/8W	
A24R14	0698-3161	R:FXD MET FLM 38.3K OHM 1X 1/8W	
A24R15	0757-0458	R:FXD MET FLM 51.1K OHM 1X 1/8W	
A24R16	0757-0462	R:FXD MET FLM 75.0K OHM 1X 1/8W	
A24R17	0757-0466	R:FXD MET FLM 110K OHM 1X 1/8W	
A24R18	0698-3453	R:FXD MET FLM 196K OHM 1X 1/8W	
A24R19	0698-3460	R:FXD MET FLM 422K OHM 1X 1/8W	
A24R20	0683-1055	R:FXD COMP 1 MEGOHN 5X 1/4W	
A24R21	0757-0467	R:FXD MET FLM 121K OHM 1X 1/8W	
A24R22	0757-0440	R:FXD MET FLM 750K OHM 1X 1/8W	
A24R23	0757-0441	R:FXD MET FLM 8.25K OHM 1X 1/8W	
A24R24	0698-f	R:FXD MET FLM 4.64K OHM 1X 1/8W	
A24R25	0698-3154	R:FXD MET FLM 4.22K OHM 1X 1/8W	
A24R26	0757-c	R:FXD MET FLM 5.11K OHM 1X 1/8W	
A24R27	0757-0200	R:FXD MET FLM 5.62K OHM 1X 1/8W	
A24R28	0757-0290	R:FXD MET FLM 6.19K OHM 1X 1/8W	
A24R29	0757-0200	R:FXD MET FLM 5.26K OHM 1X 1/8W	
A24R30	0757-0438	R:FXD MET FLM 5.11K OHM 1X 1/8W	
A24S1	3100-1835	SWITCH: ROTARY	
A24W1	08405-6032	CABLE ASSY: COAXIAL	
A24W2	08405-6032	CABLE ASSY: COAXIAL	
A25	08405-6024	SWITCH ASSY: PHASE RANGE	
	5040-0218	COUPLER: SWITCH SHAFT	
A25R1	0811-1638	R:FXD WW 344.8 OHM 0.1X 1/8W	
A25R2	0811-1640	R:FXD WW 1111 OHM 01X 1/8W	
A25R3	0698-3279	R: FXD MET FLM 4990 OHM 1X 1/8W	
A25R4	2100-0024	R:VAR COMP 1000 OHM 10X LIN 2W	
A25S1	3100-1831	SWITCH: ROTARY	
A26	08405-6018	BOARD ASSY: EXTENDER	
		CHASSIS PARTS	
C1	0150-0119	C:FXD CER 2 X 0.01 UF 20X250WVAC	
C2	0180-0369	C:FXD ELECT 2000 UF +75-10X 60VDCW	
C3	0180-0369	C:FXD ELECT 2800 UF +75-10X 60VDCW	
C4	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C5	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C6	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C7	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C8	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C9	0150-0019	C:FXD CER 1000 PF 20X 500VDCW	
C10	0160-2140	C:FXD CER 470 PF +80-20X 1000VDCW	

See introduction to this section for ordering information

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
C11	0160-2140	C:FXD CER 470 PF +80-20X 1000VDCW	
C12	0160-2257	C:FXD CER 10 PF 5X 500VDCW	
DS1	2140-0244	LAMP:GLOW T-2 BULB 1.0W AMP 95VAC	
DS2	1450-0708	LIGHT:INDICATOR AMBER	
F1	2110-0001	FUSE:1A 250V	
F1	2110-0202	FUSE:0.50A 250V	
F2	2110-0202	FUSE:0.50A 250V	
F3	2110-0202	FUSE:0.50A 250V	
J1		NSR PART OF W5	
J2		NSR PART OF W6	
J3	1250-0083		
J4	1250-0083		
L1	9140-0096	COIL:FXD RF 1 UH	
L2	9140-0096	COI:FXD RF 1 UH	
L3	9140-0096	COIL:FXD RF 1 UH	
L4	9140-0096	COIL: 0 RF 1 UH	
L5	9100-1610	COIL: MOLDED CHOKE 0.15 UH 20X	
1-.6	9100-1610	COIL:MOLDED CHOKE 0.15 UH 20X	
L7	9140-0114	COIL:FXD RF 10 UH	
L8	9140-0114	COIL:FXD RF 10 UH	
M1	1120-0394	METER:DEGREES	
M2	1120-0361	METER:RMS VOLTS	
M2	1120-1466	METER:VOLTS LIN LOG OPT 02	
P1	125-A-2357	CONNECTOR:POWER 3 PIN MALE	
01	1854-0063	TRANSISTOR:NPN SILICON 2N3055	
01	1200-0077	INSULATOR:TRANSISTOR, MICA	
02	1854-0063	TRANSISTOR:MPN SILICON 2N3055	
02	1200-0077	INSULATOR:TRANSISTOR, MICA	
R1	0698-3420	R:FXD MET FLM 34.8K OHM 1X 1/2W	
R2	0813-0017	R:FXD WW 5 OHM 10X 5W	
R3	0816-0010	R:FXD WW 12 OHM 10X 10W	
R4	0757-0351	R:FXD MET FLM 402 OHM 1X 1/4W	
S1	3101-1248	SWITCH:PUSHBUTTON SPOT	
S2	3101-1234	SWITCH:SLIDE DPOT 0.5A 125V AC/DC	
S3	3101-0901	SWITCH:PUSHBUTTON 3PDT	
T1	9100-1706	TRANSFORMER:POWER	
W1	08405-6033	CABLE ASSY:COAXIAL	
W2		NOT ASSIGNED	
W3	08405-6027	CABLE ASSY:APC AMP.	
W4		NOT ASSIGNED	
W5	08405-6030	CABLE ASSY: "A" IF OUTPUT	
W6	08405-6029	CABLE ASSY: "B" IN OUTPUT	

See introduction to the section for ordering information

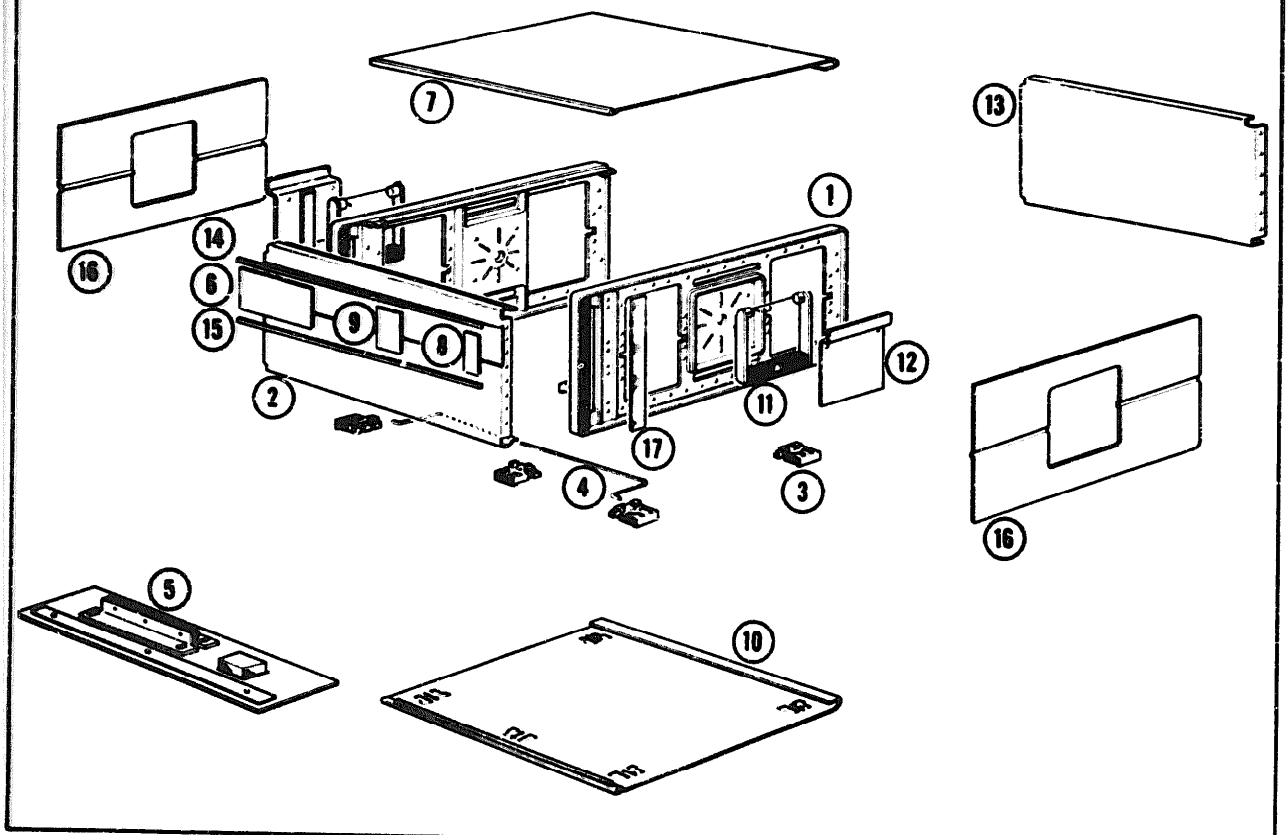
Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
W7	08405-6031	CABLE ASSY: ISOLATION AMP.	
W8	08405-6031	CABLE ASSY: ISOLATION AMP.	
W9	08405-6033	CABLE ASSY: COAXIAL	
W10	08405-6036	CABLE: INPUT DELAY LINE	
W11	81020-1348	CABLE ASSY:POWER CORD	
XA3	1251-0194	CONNTOR:PRINTED CIRCUIT 15-CONTACT	
XA4	1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	
XA5	1251-0135	CONNECTOR:BODY 15 PIN	
XA6	1251-0135	CONNECTOR:BODY 15 PIN	
XA7	1251-0135	CONNECTOR:BODY A5 PAN	
XA8	1251-0135	CONNECCTOR:BODY 15 PAN	
XA9	1251-0135	CONNECTOR:BODY 15 PIN	
XA10	1251-0135	CONNECTOR:BODY A5 PIN	
XA11	1251-0135	CONNECTOR:BODY 15 PA	
XA12	1251-0135	CONNECTOR:BODY 15 PIN	
XA13	1251-0194	CONNECTOR: PRINTED CIRCUIT 15-CONTACT	
XA14	1251-0194	CONNECTOR:PRINTED CIRCUIT IS-CO	
XA15	1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	
XA16	1251-0135	CONNECT:BODY 15 PIN	
XA17		NOT ASSIGNED	
XA18	1251-0135	CONNECTOR:BODY 15 PIN	
XA19		NOT ASSIGNED	
XA25		NOT ASSIGNED	
XA26	1251-0135	CONNECTOR:BODY 15 PAN	
XF1	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
XF2	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
XF3	1400-0084	FUSEHOLOER:EXTRACTOR POST TYPE	
X01	1200-0041	SOCKET:TRANSISTOR	
X02	1200-0041	SOCKET:TRANSISTOR	
		MISCELLANEOUS	
	0370-0112	KNOB:BLACK,RANGE AMPLITUDE RANGE & AMPL CHANNEL	
	0370-0113	KNOB:BLACK,SENSITIVITY PHASE RANGE & METER OFFSET	
	0370-0114	KNOB:RED W/ARROW 5/8" OD 1/8" SHAFT PHASE ZERO	
	0370-0115	KNOB:RED BAR 5/8 DIA 1/8 SHAFT PHASE,POLARITY	
	08405-6020	KNOB:FREQ RANGE,W/DAIL ATTACHED	
	5040-0404	HOLDER:PROBE	
	5020-0457	PROBE TIP	
	10213-62102	CLIP:GROUND	
	10216-60001	ISC:ATOR	
	11576A	DIVIDER: 10:1	
	08405-6048	GROUND CLIP ASSY	
	8710-0084	NUT DRIVER:HEX 3-32 *HEX OPENING	
	08405-2044	PROBE INSULATOR	

See introduction to this section for ordering information

Table 6-l. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
		CABINET PARTS	
1	5060-0734	FRAME ASSY:7 X 16 FM	
	2530-0011	SCREW:SST FLAT HD 8-32 X 3/8	
2	08405-0025	PANEL:FRONT	
	0510-0004	FASTENER	
3	5060-0767	FOOT ASSY:FM	
4	1490-0030	STAND:TILT	
5	5060-0776	KIT:7H RACK MOUNT	
6	08405-0011	SUB-PANEL:FRONT	
7	5060-0740	TOP COVER ASSY:16L FM	
	2530-0011	SCREW:SST FLAT HD 8-32 X 3/8	
8	08405-0015	PLATE-PANEL:RIGHT	
9	08405-0016	PLATE-PANEL:CENTER	
10	5060-0752	BOTTOM COVER ASSY:16L FM	
	2530-0011	SCREW:SST FLAT HD 8-32 X 3/8	
11	5065-0222	HANDLE ASSY-SIDE	
12	5060-0765	RETAINER-HANDLE ASSY.	
	2550-0013	SCREW:SST BH 8-32 X 5/16	
13	08405-0024	PANEL:REAR	
	2515-0017	SCREW:PAN HD PHIL DR 8-32 X 1/4	
14	08405-2021	EXTRUSION:TOP	
15	08405-2022	EXTRUSION:BOTTOM	
16	5000-0742	COVER:SIDE 7 X 16 SM	
	2370-0020	SCREW:SST FH PHIL DR 6-32 X 3/16	
17	5000-0052	PLATE:FLUTED ALUMINUM	



See introduction to this section for ordering information

Table 6-2. Replaceable Parts

Part NO.	Description #	Mfr.	Mfr. Part No.	TQ
0140-0155	C:FXD MICA 1325 PF 1% 500VDCW	28480	0140-0155	1
0140-0156	C:FXD MICA 1500 PF 2%	28480	0140-0156	1
0140-0157	C:FXD MICA 1857 PF 1%	28480	0140-0157	1
0140-0170	C:FXD MICA 5600 PF 5% 300VDCW	28480	0140-0170	2
0140-0176	C:FXD MICA 100 PF 2%	28480	0140-0176	6
0140-0179	C:FXD MICA 1000 PF 2%	28480	0140-0179	4
0140-0180	C:FXD MICA 2000 PF 2%	28480	0140-0180	1
0140-0182	C:FXD MICA 5000 PF 2%	28480	0140-0182	1
0140-0193	C:FXD MICA 82 PF 5%	28480	0140-0193	1
0140-0194	C:FXD MICA 110 PF 5%	28480	0140-0194	2
0140-0197	C:FXD MICA 160 PF 5% 300 VDCW	04062	RDM15F181J3C	1
0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	04062	RDM15E470J5C	2
0140-0206	C:FXD MICA 270 PF 5%	28480	0140-0206	3
0140-0210	C:FXD MICA 270 PF 5%	28480	0140-0210	1
0140-0235	C:FXD MICA 2250PF 1% 300VDCW	14655	RDM20F[illegible]2250UF3C	1
0150-0019	C:FXD CER 1000 PF 20% 500VDCW	72982	[illegible]7005X5U0102M	6
0150-0050	C:FXD CER 1000 PF 600VDCW	77630	080	1
0150-0051	C:FXD CER 100 PF 600VDCW	84411	08D	1
0150-0069	C:FXD CER 1000 PF +100-20% 500VDCW	72982	801-010X5G01022	1
0150-0070	C:FXD CER 0.02 UF 20% 500VDCW	72982	821-011[illegible]5U0203M	1
0150-0071	C:FXD CER 400 PF 5% 500VDCW	56289	19C294A-CDH	2
0150-0119	C:FXD CER 2 X 0.01 UF 20% 250WVAC	56289	36C219A	1
0150-0121	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50B1S-CML	5
0160-0127	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML	3
0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	28480	0160-0161	1
0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	28480	0160-0163	1
0160-0164	C:FXD MY 0.039 UF 10% 200VDCW	28480	0160-0164	1
0160-0168	C:FXD MY 0.1 UF 10% 200VDCW	28480	0160-0168	2
0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C11B7S-CML	4
0160-0301	C:FXD MY 0.012 UF 10% 200VDCW	28480	0160-0301	1
0160-0342	C:FXD MICA 800 PF 1% 300VDCW	04062	RDM15F801F3C	1
0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103Z522	8
0160-2120	C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C	4
0160-2127	C:FXD MICA 4600 PF 1%	28480	0160-2127	2
0160-2139	C:FXD CER 270 PF +80-20% 1000VDCW	91418	TYPE B	8
0160-2140	C:FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B	2
0160-2143	C:FXD CER 2000 PF +80-20% 1000VDCW	91418	TYPE B	2
0160-2146	C:FXD CER 0.02 UF +80-20% 100VDCW	91418	TA	1
0160-2211	C:FXD MICA 510 PF 5% 300VDCW	28480	0160-2211	2
0160-2257	C:FXD CER 10 PF 5% 500VDCW	72982	301-000-C0H0-100J	1
0160-2261	C:FXD CER 15 PF 5% 500VDCW	72982	301-NPO-15 PF	15
0160-2276	C:FXD MICA 2780 PF 2% 300VDCW	28480	0160-2276	1
0160-2277	C:FXD MICA 15000 PF 2%	28480	0160-2277	2
0160-7278	C:FXD MICA 34000 PF 2%	28480	0160-2278	1
0160-2279	C:FXD MICA 480 PF 2% 300VDCW	28480	0160-2279	1
0160-2917	C:FXD CER 0.05 UF +80-20% 100VDCW	84411	TYPE TA	2
0180-0050	C:FXD ELECT 40 UF +75-10% 50VDCW	28480	0180-0050	2
0180-0061	C:FXD ELECT 1000UF +100%-10% 15VDCW	56289	30107G015004	1
0180-0098	C:FXD ELECT 100 UF 20% 20VDCW	28480	0180-0098	2
0180-0100	C:FXD ELECT 4.7 UF 10% 35VDCW	28480	0180-0100	81
0180-0116	C:FXD ELECT 0.8 UF 10% 35VDCW	28480	0180-0116	6
0180-0137	C:FXD ELECT 100 UF 20% 10VDCW	28480	0180-0137	3
0180-0138	C:FXD ELECT 1000UF -10+100% 40VDCW	56289	D36254	3
0180-0195	C:FXD ELECT 0.33 UF 20% 35VDCW	28480	0180-0195	1

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0180-0230	C:FXD ELECT 1.0 UF 20% 50VDCW	28480	0180-0230	2
0180-0291	C:FXD ELECT 1.0 UF 10% 35VDCW	28480	0180-0291	1
0180-0369	C:FXD ELECT 2800 UF +75-10% 60VDCW	56289	D39d23	2
0180-0374	C:FXD ELECT 10 UF 10% 20VDCW	28480	0180-0374	6
0180-1735	C:FXD ELECT 0.22 UF 10% 35VDCW	28480	0180-1735	1
0180-1746	C:FXD ELECT 15 UF 10% 20VDCW	28480	0180-1746	1
0180-2071	C:FXD ELECT 0.022 UF 10% 35VDCW	28480	0180-2071	2
0370-0112	KNOB:BLACK,RANGE	28480	0370-0112	1
0370-0113	KNOB:BLACK,SENSITIVITY	28480	0370-0113	1
0370-0114	KNOB:RED W/ARROW 5/8" OD 1/8" SHAFT	28480	0370-0114	1
0370-0115	KNOB:RED BAR 5/8 DIA 1/8 SHAFT	28480	0370-0115	1
0510-0004	FASTENER	46384	CL-832-2C	1
0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055	1
0686-1055	R:FXD COMP 1 MEGOHM 5% 1/2W	01121	EB 1055	1
0698-0082	R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082	9
0698-0083	R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083	14
0698-0084	R:FXD MET FLM 2.15K OHM 1% 1/8W	28480	0698-0084	15
0698-0085	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085	5
0698-3101	R:FXD MET FLM 2.87K OHM 1% 1/2W	28480	0698-3101	2
0698-3132	R:FXD MET FLM 261 OHM 1% 1/8W	28480	0698-3132	2
0698-3136	R:FXD MET FLM 17.8K OHM 1% 1/8W	28480	0698-3136	11
0698-3150	R:FXD MET FLM 2.37K OHM 1% 1/8W	28480	0698-3150	4
0698-3151	R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151	3
0698-3152	R:FXD MET FLM 3.48K OHM 1% 1/8W	28480	0698-3152	2
0698-3153	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153	17
0698-3154	R:FXD MET FLM 4.22K OHM 1% 1/8W	28480	0698-3154	3
0698-3155	R:FXD MET FLM 4.64K OHM 1% 1/8W	28480	0698-3155	14
0698-3156	R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156	1
0698-3157	R:FXD MET FLM 19.6K OHM 1% 1/8W	28480	0698-3157	16
0698-3158	R:FXD MET FLM 23.7K OHM 1% 1/2W	28480	0698-3158	2
0698-3159	R:FXD MET FLM 26.1K OHM 1% 1/8W	28480	0698-3159	2
0698-3160	R:FXD MET FLM 31.6K OHM 1% 1/8W	28480	0698-3160	2
0698-3161	R:FXD MET FLM 38.3K OHM 1% 1/8W	28480	0698-3161	3
0698-3162	R:FXD MET FLM 46.4K OHM 1% 1/8W	28480	0698-3162	9
0698-3243	R:FXD MET FLM 178K OHM 1% 1/8W	28480	0698-3243	1
0698-3275	R:FXD MET FLM 4990 OHM 1% 1/8W	28480	0698-3275	1
0698-3400	R:FXD MET FLM 147 OHM 1% 1/2W	28480	0698-3400	1
0698-3403	R:FXD MET FLM 348 OHM 1% 1/2W	28480	0698-3403	1
0698-3405	R:FXD MET FLM 422 OHM 1% 1/2W	28480	0698-3405	3
0698-3406	R:FXD MET FLM 1.33K OHM 1% 1/2W	28480	0698-3406	6
0698-3407	R:FXD MET FLM 1.96K OHM 1% 1/2W	28480	0698-3407	2
0698-3420	R:FXD MET FLM 34.8K OHM 1% 1/2W	28480	0698-3420	1
0698-3431	R:FXD MET FLM 23.7 OHM 1% 1/8W	28480	0698-3431	2
0698-3437	R:FXD MET FLM 133 OHM 1% 1/8W	28480	0698-3437	8
0698-3438	R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438	7
0698-3440	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-3440	14
0698-3441	R:FXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441	5
0698-3442	R:FXD MET FLM 237 OHM 1% 1/8W	28480	0698-3442	3
0698-3444	R:FXD MET FLM 316 OHM 1% 1/8W	28480	0698-3444	3
0698-3445	R:FXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445	7
0698-3446	R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446	1
0698-3447	R:FXD MET FLM 422 OHM 1% 1/8W	28480	0698-3447	1
0698-3449	R:FXD MET FLM 28.7K OHM 1% 1/8W	28480	0698-3449	6
0698-3450	R:FXD MET FLM 42.2K OHM 1% 1/8W	28480	0698-3450	7

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0698-3453	R:FXD MET FLM 196K OHM 1% 1/8W	28480	0698-3453	2
0698-3454	R:FXD MET FLM 215K OHM 1% 1/8W	28480	0698-3454	1
0968-3455	R:FXD MET FLM 261K OHM 1% 1/8W	28480	0698-3455	1
0698-3459	R:FXD MET FLM 383K OHM 1% 1/8W	2848C	0698-3459	1
0698-3460	R:FXD MET FLM 402K OHM 1% 1/8W	28480	0698-3460	2
0698-4037	R:FXD MET FLM 40.4 OHM 1% 1/8W	28480	0698-4037	2
0698-4084	R:FXD MET FLM 19.2 OHM 1% 1/8W	28480	0698-4084	1
0698-4085	R:FXD MET FLM 20.8 OHM 1% 1/8W	28480	0698-4085	1
0698-4086	R:FXD MET FLM 22.6 OHM 1% 1/8W	28480	0698-4086	1
0698-4087	R:FXD MET FLM 24.6 OHM 1% 1/8W	28480	0698-4087	1
0698-4088	R:FXD MET FLM 27 OHM 1% 1/8W	28480	0698-4088	1
0698-4089	R:FXD MET FLM 29.7 OHM 1% 1/8W	28480	0698-4089	1
0698-4090	R:FXD MET FLM 32.8 OHM 1% 1/8W	28480	0698-4090	1
0698-4091	R:FXD MET FLM 40.8OHM 1% 1/8W	28480	0698-4091	1
0698-4092	R:FXD MET FLM 45.9 OHM 1% 1/8W	28480	0698-4092	1
00698-4093	R:FXD MET FLM 52 OHM 1% 1/8W	28480	0698-4093	1
0698-4094	R:FXD MET FLM 59.5 OHM 1% 1/8W	28480	0698-4094	1
0698-4095	R:FXD MET FLM 68.6 OHM 1% 1/8W	28480	0698-4095	1
0698-4096	R:FXD MET FLM 80.2 OHM 1% 1/8W	28480	0698-4096	1
0698-4097	R:FXD MET FLM 94.8 OHM 1% 1/8W	2848C	0698-4097	1
0698-4099	R:FXD MET FLM 139 OHM 1% 1/8W	28480	0698-4099	1
0698-4100	R:FXD MET FLM 1.26K OHM 1% 1/8W	28480	0698-4100	2
0698-4101	R:FXD MET FLM 1.85K OHM 1% 1/8W	28480	0698-4101	2
0698-4102	R:FXD MET FLM 2.06K OHM 1% 1/8W	28480	0698-4102	2
0698-4315	R:FXD COMP 430 OHM 5% 1/2W	28480	0698-4315	1
0698-4349	R:FXD MET FLM 99.5 OHM 1% 1/8W	28480	0698-4349	2
0698-5847	R:FXD MET FLM 2150 OHM 0.5% 1/8W	28480	0698-5847	2
0698-5848	R:FXD MET FLM 215 OHM 0.5% 1/8W	28480	0698-5848	2
0698-5850	R:FXD MET FLM 681 OHM 0.5% 1/8W	28480	0698-5850	2
0698-5851	R:FXD MET FLM 6.81K OHM 0.5% 1/8W	28480	0698-5851	2
0757-0077	R:FXD FLM 1.2K OHM 2% 1/4W	28480	0757-0077	2
0757-0123	R:FXD MET FLM 34.8K OHM 1% 1/8W	28480	0757-0123	3
0757-0198	R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198	3
0757-0199	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199	4
0757-0200	R:FXD MET FLM 5.62K OHM 1% 1/8W	28480	0757-0200	7
0757-0274	R:FXD MET FLM 1.21K OHM 1% 1/8W	28480	0757-0274	1
0757-0275	R:FXD MET FLM 113 OHM 1% 1/8W	28480	0757-0275	1
0757-0278	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278	2
0757-0279	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279	6
0757-0280	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280	19
0757-0288	R:FXD MET FLM 9.09K OHM 1% 1/8W	28480	0757-0288	4
0757-0289	R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289	3
0757-0250	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0260	3
0757-0294	R:FXD MET FLM 17.8 OHM 1% 1/8W	28480	0757-0294	4
0757-0316	R:FXD MET FLM 42.2 OHM 1% 1/8W	28480	0757-0316	1
0757-0317	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317	3
0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346	2
0757-0351	R:FXD MET FLM 402 OHM 1% 1/4W	28480	0757-0351	1
0757-0390	R:FXD MET FLM 36.5 OHM 1% 1/8W	28480	0757-0390	1
0757-0394	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394	9
0757-0398	R:FXD MET FLM 75 OHM 1% 1/8W	28480	0757-0398	2
0757-0401	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401	6
0757-0402	R:FXD MET FLM 110 OHM 1% 1/8W	28480	0757-0402	2
0757-0403	R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403	1

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
0757-0405	R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405	5
0757-0406	R:FXD MET FLM 1d2 OHM 1% 1/8W	28480	0757-0406	1
0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416	1
0757-0419	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419	1
0757-0420	R:FXD MET FLM 750 OHM 1% 1/8W	28480	0757-0420	2
0757-0422	R:FXD MET FLM 909 OHM 1% 1/8W	28480	0757-0422	1
0757-0424	R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424	12
0757-0428	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428	7
0757-0438	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438	9
0757-0439	R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439	5
0757-0440	R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440	4
0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441	4
0757-0442	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442	13
0757-0443	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443	2
0757-0444	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444	3
0757-0447	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447	4
0757-0458	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458	1
0757-0459	R:FXD MET FLM 56.2K OHM 1% 1/8W	28480	0757-0459	3
0757-0460	R:FXD MET FLM 61.9K OHM 1% 1/8W	28480	0757-0460	1
0757-0461	R:FXD MET FLM 68.1K OHM 1% 1/8W	28480	0757-0461	1
0757-0462	R:FXD MET FLM 75.0K OHM 1% 1/8W	28480	0757-0462	4
0757-0464	R:FXD MET FLM 90.9K OHM 1% 1/8W	28480	0757-0464	1
0757-0465	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465	10
0757-0466	R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466	5
0757-0467	R:FXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467	2
0757-0706	R:FXD MET FLM 51.1 OHM 1% 1/4W	28480	0757-0706	1
0757-0815	R:FXD MET FLM 562 OHM 1% 1/2W	28480	0757-0815	2
0757-0833	R:FXD MET FLM 5.11K OHM 1% 1/2W	28480	0757-0833	1
0757-1078	R:FXD MET FLM 1.47K OHM 1% 1/2W	28480	0757-1078	2
0757-1094	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094	6
0766-0024	R:FXD MET FLM 260 OHM 2% 3W	28480	0766-0024	1
0811-0040	R:FXD WW 1 OHM 1% 5W	28480	0811-0040	1
0811-1637	R:FXD WW 344.3 OHM 0.1% 1/3W	28480	0811-1637	1
0811-1638	R:FXD WW 344.8 OHM 0.1% 1/8W	28480	0811-1638	1
0811-1639	R:FXD WW 477.6 OHM 0.1% 1/8W	28480	0811-1639	1
0811-1640	R:FXD WW 1111 OHM 0.1% 1/8W	28480	0811-1640	1
0811-1641	R:FXD WW 6710 OHM 0.1% 1/8W	28480	0811-1641	2
0811-1642	R:FXD WW 8825 OHM 0.1% 1/8W	28480	0811-1642	1
0818-0017	R:FXD WW 5 OHM 10% 5W	28480	0813-0017	1
0816-0010	R:FXD WW 12 OHM 10% 10W	28480	0816-0010	1
1120-0361	METER:RMS VOLTS	28480	1120-0361	1
1120-0394	METER:DEGREES	28480	1120-0394	1
1120-1466	METER:RMS VOLTS LIN LOG DPT 02	28480	1120-1466	1
1200-0041	SOCKET:TRANSISTOR	71785	133-32-10-013	2
1200-0077	INSULATOR:TRANSISTOR, MICA	16037	6112	2
1205-0012	HEAT DISSIPATOR:SEMICONDUCTOR	28480	1205-0012	1
1205-0018	HEAT SINK	05820	MF-203	1
1205-0202	HEAT DISSIPATOR:SEMICONDUCTOR	28480	1205-0202	4
1250-0083	CONNECTOR:BNC	28480	1250-0083	2
1251-0135	CONNECTOR:BODY 15 PIN	28480	1251-0135	11
1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	28480	1251-0194	5
1251-2357	CONNECTOR:POWER 3-PIN MALE	82389	EAC-301	1
1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014	3
1450-0708	LIGHT:INDICATOR AMBER	28480	1450-0708	1

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
1490-0030	STAND:TILT	28480	1490-0030	1
1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	28480	1853-0001	2
1853-0009	TRANSISTOR:SILICON PNP	28480	1853-0009	12
1853-0010	TRANSISTOR:SILICON PNP	28480	1853-0010	3
1853-0020	TRANSISTOR:SILICON PNP	28480	1853-0020	4
1854-0003	TRANSISTOR:NPN SILICON	28480	1854-0003	4
1854-0005	TRANSISTOR:SILICON NPN 2N708	02735	2N708	10
1854-0020	TRANSISTOR:NPN SILICON	28480	1854-0020	7
1854-0035	TRANSISTOR:NPN SILICON	28480	1854-0035	1
1854-0039	TRANSISTOR:SILICON NPN 2N3053	02735	2N3053	2
1854-0063	TRANSISTOR:NPN SILICON 2N3055	02735	2N3055	2
1854-0071	TRANSISTOR:SILICON NPN	28480	1854-0071	47
1854-0371	TRANSISTOR:SILICON NPN	28480	1854-0371	4
1901-0025	DIODE:SILICON 100WV 200MA	28480	1901-0025	3
1901-0026	DIODE:SILICON 0.75A 200 PIV	28480	1901-0026	4
1901-0033	DIODE:SILICON 100MA 180WV	28480	1901-0033	6
1901-0040	DIODE:SILICON 30MA 30WV	07263	FDG1088	35
1901-0047	DIODE JUNCTION:SILICON 20PIV	28480	1901-0047	1
1901-0441	DIODE:STEP RECOVERY SILICON 90-160NS	28480	1901-0441	1
1902-0018	DIODE BREAKDOWN:11.7V 5%	04713	1N941	2
1902-0025	DIODE BREAKDOWN:10.0V 5% 400MW	28480	1902-0025	1
1902-0048	DIODE,BREAKDOWN:6.81V	28480	1902-0048	1
1902-0057	DIODE BREAKDOWN:6.49V	28480	1902-0057	2
1902-0062	DIODE BREAKDOWN:3.75V	28480	1902-0062	2
1902-0126	DIODE BREAKDOWN:2.61V 5%	28480	1902-0126	1
1902-0184	DIODE BREAKDOWN:SILICON 16.2V 5%	28480	1902-0184	2
2100-0024	R:VAR COMP 1000 OHM 10% LIN 2W	28480	2100-0024	1
2100-0328	R:VAR WW 500 OHM 10% LIN 1W	28480	2100-0328	2
2100-0942	R:VAR FLM 50K OHM 20% 3/4W	28480	2100-0942	3
2100-1658	R:VAR WW 2K OHM 10% 1W	28480	2100-1658	2
2100-1756	R:VAR WW 200 OHM 5% 2W	28480	2100-1756	1
2100-1757	R:VAR WW 500 OHM 5% 1W	28480	2100-1757	2
2100-1760	R:VAR WW 5K OHM 5% 1W	28480	2100-1760	3
2100-1761	R:VAR WW 10K OHM 5% 1W	28480	2100-1761	3
2110-0001	FUSE:1A 250V	75915	312001.	1
2110-0202	FUSE:0.50A 250V	28480	2110-0202	3
2140-0244	LAMP:GLOW T-2 6VLB 1.0M AMP 95VAC	87034	A1H	1
2370-0020	SCREW:SST FH PHIL DR 6-32 X 3/16	00000	OBD	1
2515-0017	SCREW:PAN HD PHIL DR 8-32 X 1/4	00000	OBD	1
2530-0011	SCREW:SST FLAT HD 8-32 X 3/8	78189	OBD#	3
2550-0013	SCREW:SST BH 8-32 X 5/16	28480	2550-0013	1
3100-1831	SWITCH:ROTARY	28480	3100-1831	1
3100-1832	SWITCH:ROTARY	28480	3100-1832	1
3100-1833	SWITCH:ROTARY	28480	3100-1833	1
3100-1834	SWITCH:ROTARY	28480	3100-1834	1
3100-1835	SWITCH:ROTARY	28480	3100-1835	1
3101-0901	SWITCH:PUSHBUTTON 3PDT	82389	NF-4009	1
3101-1234	SWITCH:SLIDE DPDT	82389	11A-1242	1
3101-1248	SWITCH:PUSHBUTTON SPDT	87034	53-55480-121/A1H	1
5000-0052	PLATE:PLATED ALUMINUM	28480	5000-0052	1
5000-0742	COVER:SIDE 7 X 16 SM	28480	5000-0742	1
5020-0457	PROBE TIP	28480	5020-0457	3
5070-2045	CARD EXTRACTOR	28480	5020-2045	10
5040-0218	COUPLER:SWITCH SHAFT	28480	5040-0218	1
5040-0404	HOLDER:PANEL	28480	5040-0404	1
5060-0222	HANDLE ASSY:SIDE	28480	5060-0222	2
5060-0734	FRAME ASSY:7 X 16 FM	28480	5060-0734	1

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
5060-C740	TOP COVER ASSY:16L FM	28480	5060-0740	1
5060-C752	BOTTOM COVER ASSY:16L FM	28480	5060-0752	1
5060-C765	RETAINER-HANDLE ASSY.	28480	5060-0765	1
5060-C767	FOOT ASSY:FM	28480	5060-0767	1
5060-C776	KIT:7h RACK MOUNT	28480	5060-0776	1
8120-1348	CABLE ASSY:POWER CORD	28480	8120-1348	1
8710-0084	NUT DRIVER:HEX 3-32"HEX OPENING	96508	P-3	1
9100-1610	COIL:MOLDED CHOKE 0.15 UH 20%	28480	9100-1610	2
9100-1628	COIL:MOLDED CHOKE 43.0 UH 5%	28480	9100-1628	1
9100-1653	COIL:MOLDED CHOKE 910.0 UH 5%	28480	9100-1653	1
9100-1658	TRANSFORMER:PULSE	28480	9100-1658	1
9100-1706	TRANSFORMER:POWER	28480	9100-1706	1
9100-1718	COIL:VAR	28480	9100-1718	2
9100-1719	COIL:VAR	28480	9100-1719	2
9140-0072	COIL:RF 5000 UH 10%	95265	SA5000-	1
9140-0096	COIL:FXD RF 1 UH	28480	9140-00	8
9140-0114	COIL:FXD RF 10 UH	28480	9140-01	6
9140-0118	COIL:FXD 500 UH 5%	28480	9140-01	1
9140-0120	COIL:FXD 0.1 UH 20%	28480	9140-01	2
9140-0138	COIL/CHOKE 180 UH 5%	28480	9140-01	3
9140-0181	COIL:FXD RF 22UH 5%	78526	L2201M	1
C	2106	RING:IDENT BLUE	28480	08167-4	1
C	0011	SUB-PANEL:FRONT	28480	08405-0	1
C	0013	COVER:SWITCH	28480	08405-0	2
C	0014	PLATE:SWITCH COVER	28480	08405-0	4
C	0015	PLATE:PANEL, RIGHT	28480	08405-0015	3
C	0016	PLATE:PANEL, CENTER	28480	08405-0016	
C	0024	PANEL:REAR	28480	08405-0024	
C	0025	PANEL:FRONT	28480	08405-0025	
C	2021	EXTRUSION:TOP	28480	08405-2021	
C	2022	EXTRUSION:BOTTOM	28480	08405-2022	
C	2044	PROBE INSULATOR	28480	08405-2044	
C	2032	RING:IDENT WHITE	28480	08405-2032	
C	6002	BOARD ASSY:SAMPLER	28480	08405-6002	
C	6003	BOARD ASSY:ISOLATION AMP.	28480	08405-6003	
C	6004	BOARD ASSY:PHASE SHIFTER	28480	08405-6004	
C8405-60		:180 DEG.			
C	60	:VOLTMETER			
C	60	:APC AMPL			
C	60	:SEARCH			
C	60	:EQUALIZE			
C	6014	BOARD ASSY:XTU			
C	6015	BOARD ASSY:			
C	6016	BOARD ASSY:			
C	6017	DELAY LINE			
C	6018	BOARD ASSY:			
C	60				
C	60				
C	60				
C	60				
C	60				Ot
C	60	SY:"A" IF			
C	60	SY:ISOLATI			
C	60	SY:COAXIAL			
08405-6033	CABLE ASSY:COAXIAL				

30-f t
08382

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
08405-6034	CABLE ASSY:PULSE GENERATOR	28480	08405-6034	1
08405-6035	CABLE ASSY:OUTPUT DELAY LINE	28480	08405-6035	1
08405-6036	CABLE ASSY:INPUT DELAY LINE	28480	08405-6036	1
08405-6037	CABLE ASSY	28480	08405-6037	1
08405-6038	CABLE ASSY	28480	08405-6038	1
08405-6039	CABLE ASSY:SHORT AMP RANGE	28480	08405-6039	1
08405-6040	CABLE ASSY:MED AMP RANGE	28480	08405-6040	1
08405-6041	CABLE ASSY:LONG AMP RANGE	28480	08405-6041	1
08405-6042	SWITCH ASSY:CHANNEL	28480	08405-6042	1
08405-6047	CABLE ASSY:SPECIAL COAX	28480	08405-6047	2
08405-6048	GROUND CLIP ASSY	28480	08405-6048	1
08405-6051	SWITCH ASSY:AMPLITUDE RANGE	28480	08405-6051	1
08405-6052	SWITCH ASSY:PHASE METER OFFSET	28480	08405-6052	1
08405-6053	SWITCH ASSY:FREQ. RANGE	28480	08405-6053	1
08405-6054	BOARD ASSY:PROBE	28480	08405-6054	2
08405-6055	HOUSING ASSY:PROBE	28480	08405-6055	2
08405-6057	BOARD ASSY:IF SAMPLER	28480	08405-6057	1
08405-6058	BOARD ASSY:PHASE METER	28480	08405-6058	1
08405-8001	TRANSFORMER:BALUN	28480	08405-8001	2
08405-8002	TRANSFORMER:IF	28480	08405-8002	2
08405-8003	TRANSISTOR:NPN SILICON SELECTED	28480	08405-8003	2
08405-8004	DIODES:SILICON MATCHED PAIR	28480	08405-8004	7
10213-67102	CLIP:GROUND	28480	10213-67102	1
10718-60001	ISOLATOR	28480	10216-60001	1
11576A	DIVIDER 10:1	28480	11576A	1

See introduction to this section for ordering information

TABLE 6-3.
CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cenco Inc.	Danielson, Conn.
00334	Numedal	Colton, Calif.
00348	Hickman Co., Inc.	Valley Stream, N.Y.
00373	Gaslock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Perkins Div.	Pickens, S.C.
00866	Goe Engineering Co	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Allen Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	San Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02115	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vorsaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02875	Hudson Tool & Die Co	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co	Dayton, Ohio
03797	Eldema Corp	Compton, Calif.
03818	Parker Seal Co	Los Angeles, Calif.
03877	Transition Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp	Londonville, N.J.
04062	Aero Electronic Inc	Great Neck, N.Y.
04222	H-Q Division of Aerovox	Myrtle Beach, S.C.
04264	Precision Paper Tube Co.	Wheeling, Ill.
04606	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div	Mountain View, Calif.
04673	Baker Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Precision Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co	Redwood City, Calif.
04811	Precision Coil Spring Co	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04909	Component Mfg. Service Co	S. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co	Santa Cruz, Calif.
05820	wakefield Engineering Inc	Wakefield, Mass
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West D	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvan Electric Co	Van Nuys, Calif.
07126	Digitran Co	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp Electronic Tube Div.	Elmira, N.Y.
07149	Fulmonn Corp.	New York, N.Y.
07233	Couch-Graphik Co	City of Industry, Calif.
07245	Silicon Transistor Corp	Carle Place, N.Y.
07261	Avnet Corp	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp Semiconductor Div	Mountain View, Calif.
07322	Minnesota Rubber Co	Minneapolis, Minn.
07387	Butcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc	Mt. View Operations Mountain View, Calif.
07700	Technical Wire Products Inc	Cranford, N.J.
07829	Bodine Elect. Co	Chicago, Ill.
07910	Continental Device Corp	Hawthorne, Calif.
07933	Raytheon Mfg. Co Semiconductor Div	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div	Rockaway, N.J.
08145	U.S. Engineering Co	Los Angeles, Calif.
08289	Blinn, Delbert Co	Pomona, Calif.
08358	Burgess Battery Co	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp	Los Angeles, Calif.
08554	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Wes-Cam	Indianapolis, Ind.
09021	Barnes Relays Div	Costa Mesa, Calif.
09154	T... s Capacitor Co	Houston, Texas
09145	Tech Ind. Inc. Atohm Elect	Burbank, Calif.
09250	Electro Assemblies, Inc	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Tri-Tal, Inc	Berkeley, Calif.
10646	Carborundum Co	Niagara Falls, N.Y.
10736	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc	Buena Park, Calif.
11870	Melabs, Inc	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div	Albuquerque, N.M.
12697	Clarostat Mfg. Co	Dover, N.H.
12728	Elmar Fuller Corp	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp	Scottsdale, Arizona
13103	Thermalloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sen-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell-Dubilier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc	San Gabriel, Calif.
14936	Williams Mfg. Co	San Jose, Calif.
15203	Webster Electronics Co	New York, N.Y.
15287	Sconics Corp	Northridge, Calif.
15291	Adjustable Bushing Co	N. Hollywood, Calif.
15568	Micron Electronics	Garden City, Long Island, N.Y.
15666	Amprobe Inst. Corp	Lynbrook, N.Y.
15681	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co	Santa Ana, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Ametek Inc	Mt. View, Calif.
16037	Spruce Pine Mica Co	Spruce Pine, N.C.
16179	Omni Spectra Inc	Farmington, Mich.
16257	Computer Diode Corp	Lodi, N.J.
16525	Boots Aircraft Nut Corp	Pasadena, Calif.
16608	Ideal Prec. Meter Co., Inc De Bar Switch Div.	Brooklyn, N.Y.
16758	Delco Rad. Div. of G.M. Corp	Kokomo, Ind.
17105	Thermonetics Inc.	Canoga Park, Calif.
17474	Trance Company	Mountain View, Calif.
17550	Components Inc.	Biddeford, Me.
17675	Hamlin Metal Products Corp	Akron, Ohio
17745	Angstrohm Prec. Inc.	N. Hollywood, Calif.

TABLE 6-3.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
17870	McGraw-Edison Co.	Manchester, N. H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N. J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N. J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Pareico Inc.	San Juan Capistrano, Calif.
26365	Cries Reproducer Corp.	New Rochelle, N.Y.
26462	Globet File Co. of America, Inc.	Carlstadt, N. J.
26851	Compac Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialties Mfg. Co., Inc	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N. J.
30817	Instrument Specialties Co., Inc.	Little Falls, N. J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36195	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36237	Cunningham, W. H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43998	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
45384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polarad Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shakeproof Inc.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
56930	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
56845	Talley Corp.	Tulsa, Okla.
56730	Thomas & Betts Co.	Elizabeth, N. J.
56749	Triplett Electrical Inst. Co.	Bluffton, Ohio
56779	Union Switch and Signal Div. of Westinghouse Air Brake Co	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N. J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N. J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bisley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N. J.
71313	Cardwell Condenser Corp.	Lindenhurst L. I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71709	Cornish Wire Co., The	New York, N.Y.
71707	Cole Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N. J.
72699	General Instrument Corp., Cap. Div. Newark, N. J.	
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N. J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.H. Hanger Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L. I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N. J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73803	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73905	Gosher Stamping & Tool Co	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N. J.
74276	Signalite Inc.	Neptune, N. J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Berg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N. J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Monitor Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N. J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N. J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Stackpole Carbon Co.	Penna, N. J.
78424	Specialty Leather Prod. Co.	Newark, N. J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Talley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Uvarite Co.	Newbanville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Weston Instr. Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N. J.
80120	Schinzer Alloy Products Co.	Elizabeth, N. J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio

SECTION VII
SCHEMATIC DIAGRAMS

7-1. INTRODUCTION

7-2. This section contains schematic and component locations diagrams. Figure 7-2 lists notes and symbols which apply to all schematic diagrams. For clarity, some of the symbols used are also explained here. Figure 7-4 is a functional block diagram which includes the schematic location of circuit sections by page number. Each schematic diagram has been presented following the general guide lines listed below.

a. Schematics in this manual show electrical circuit operation and are not intended as wiring diagrams. Switch and circuit board assemblies often appear in part on several different schematics. To find a specific instrument component or circuit section, refer to Figure 7-4 or the "REFERENCE DESIGNATION" box on each schematic where the reference designators are listed for all components.

b. Special notes that only refer to one circuit section of the instrument are given on the schematic of the circuit section only.

c. Circuit assemblies are outlined and shown as shaded areas. The component reference designations within these shaded assemblies are abbreviated. Full component designation includes assembly number (see Schematic Information illustration shown below).

7-3. REPLACEMENT INFORMATION

7-4. For repair and replacement information, refer to the REPAIR AND REPLACEMENT information which is included in Section V. For specific component descriptions and/or ordering information refer to page 6-1.

NOTE

See inside rear cover for overall schematic.

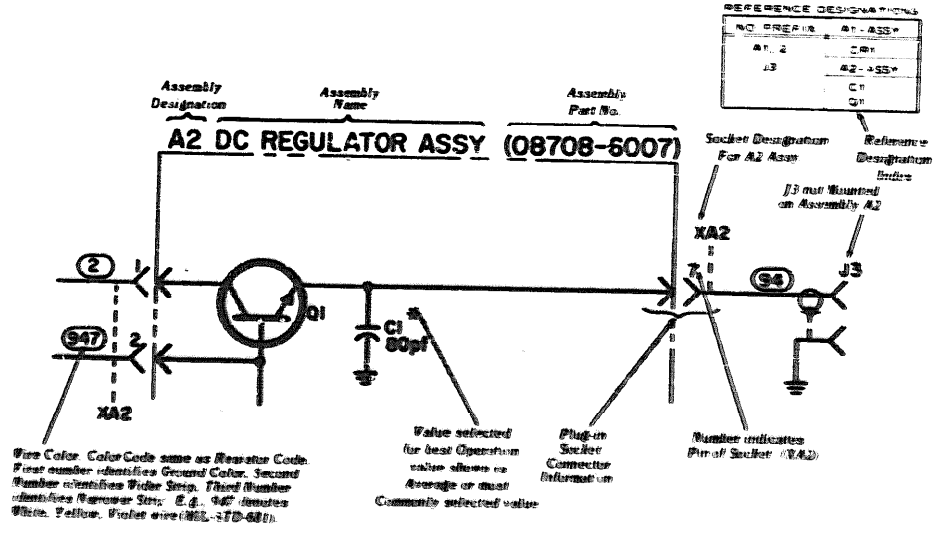


Figure 7-1. Explanations of General Information on Schematic Diagram

1. Resistance in ohms, capacitance in microfarads unless otherwise noted.

* asterisk denotes a factory selected part.

2. screwdriver adjustment

panel control

3. encloses front panel designation

encloses rear panel designation

4. circuit assembly borderline

other assembly borderline

5. encloses wire color code. Wire color code (MIL-STD-681) same as resistor color code. First number identifies ground color, second number identifies wide stripe, third number identifies narrow stripe. E.g., (947) denotes white ground, yellow wide stripe, violet narrow stripe.

6. heavy line with arrows indicates path and direction of main signal.

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

heavy dotted line indicates path and direction of sampling pulse.

7. CW wiper moves toward CW with clockwise rotation of control as viewed from shaft or knob.

small triangle indicates a matched set of diodes.

voltage regulator (breakdown) diode

step recovery diode

field effect transistor with P-material base

8. CONDITIONS FOR MEASUREMENTS

a. Power Supply Currents

(1) For +20V supplies:

FREQ RANGE-MHz . . . . . 1-4MHz range
PHASE METER OFFSET . . . . . -80
Other control settings optional

(2) For -20V supplies: control settings optional

(3) For both +20V and -20V supplies:
ac line voltage - 115
current meter - HP 428B
no connection to input probes

b. Dual Voltages in Equalizer and VTO

(1) FREQ RANGE MHz . . . . . 1-4MHz range
probe A input . . . . 1MHz (2MHz for voltages in parenthesis) and (2MHz) at level that extinguishes APC UNLOCKED

(2) Voltages taken with HP 414A DC Voltmeter

c. All Other DC Voltages

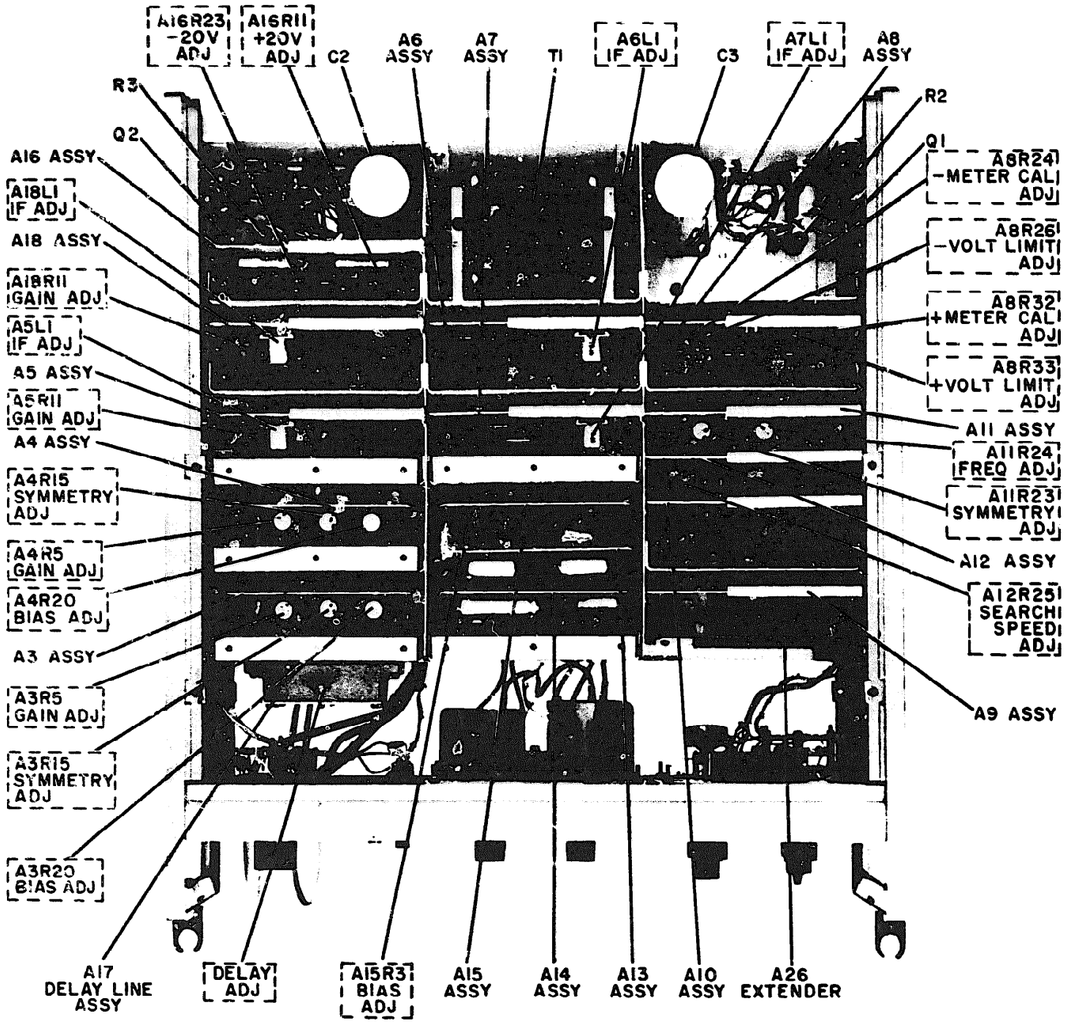
(1) No RF signal applied to input probes, probes unterminated.

(2) Control settings optional.

(3) Line voltage: 115.

(4) Voltages taken with HP 414A DC Voltmeter.

Figure 7-2. Schematic Diagram Notes



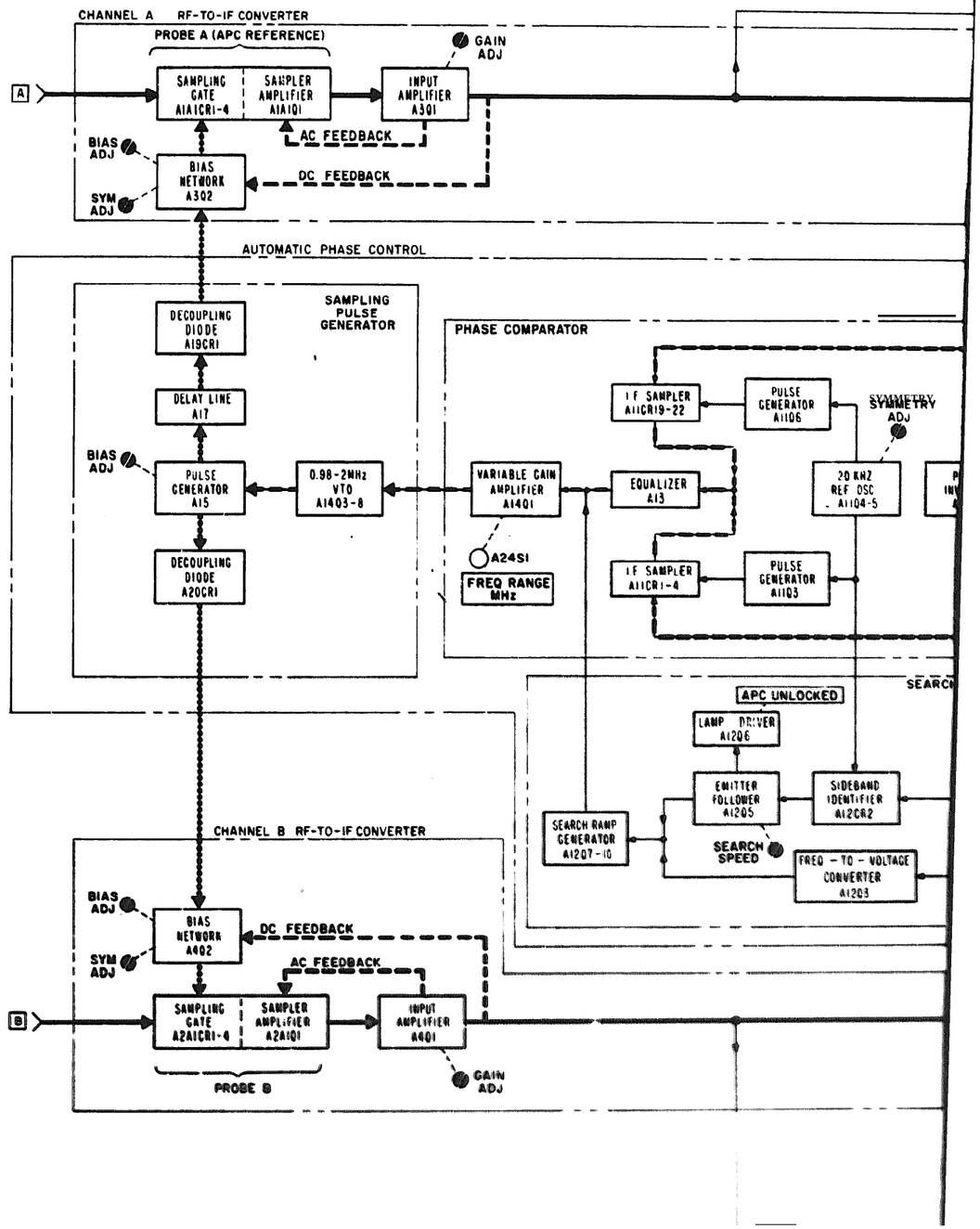


Figure 7-3. Component Identification, Top View

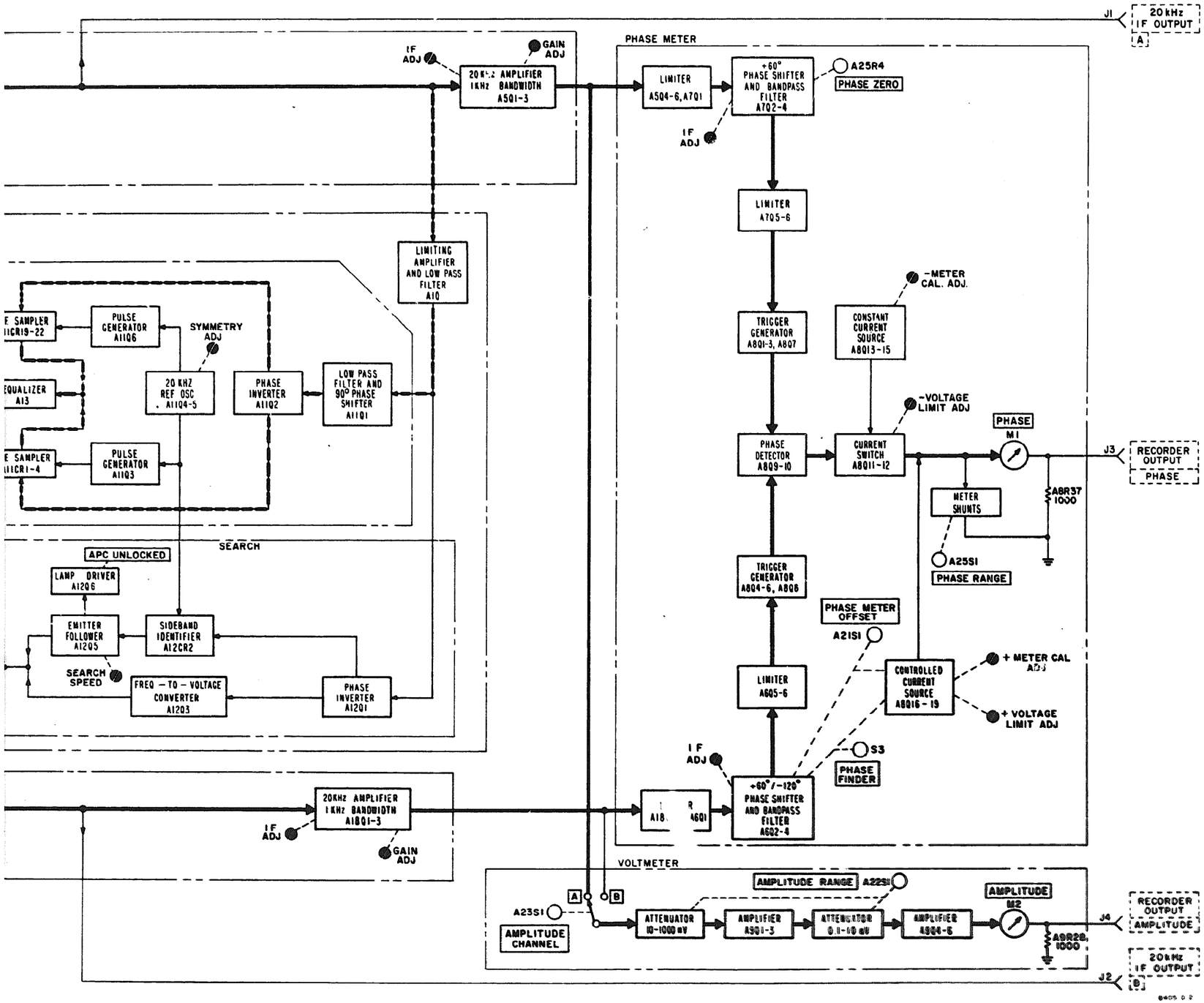
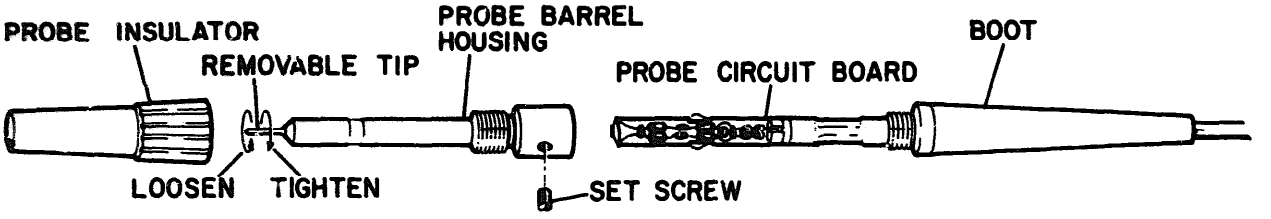
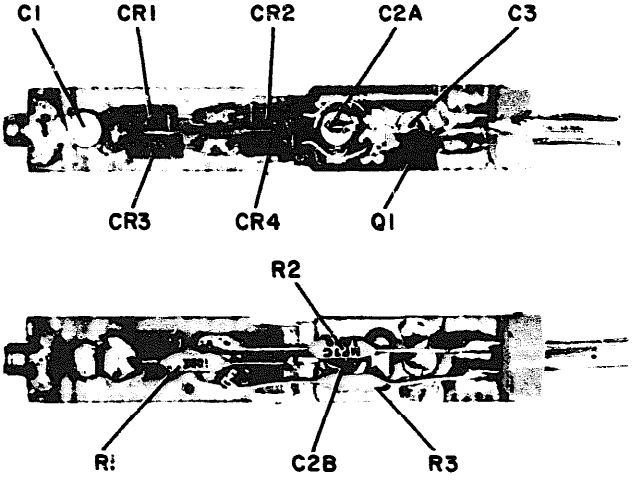


Figure 7-4. Functional Block Diagram

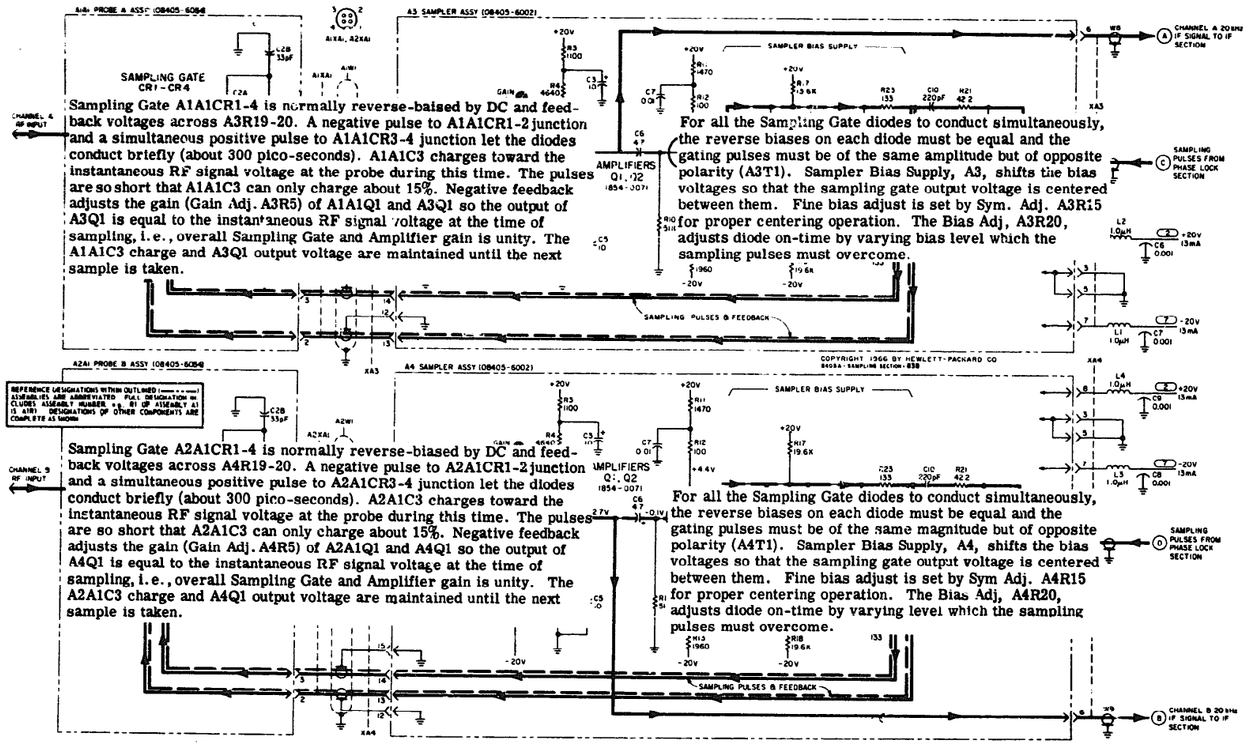


(a.) Probe Housing Assy



(b.) Probe Board Assy

Figure 7-5. Probe Assembly; (a.) Probe Housing Assy, (b.) Probe Board Assy



Sampling Gate A1A1CR1-4 is normally reverse-baised by DC and feedback voltages across A3R19-20. A negative pulse to A1A1CR1-2 junction and a simultaneous positive pulse to A1A1CR3-4 junction let the diodes conduct briefly (about 300 pico-seconds). A1A1C3 charges toward the instantaneous RF signal voltage at the probe during this time. The pulses are so short that A1A1C3 can only charge about 15%. Negative feedback adjusts the gain (Gain Adj. A3R5) of A1A1Q1 and A3Q1 so the output of A3Q1 is equal to the instantaneous RF signal voltage at the time of sampling, i.e., overall Sampling Gate and Amplifier gain is unity. The A1A1C3 charge and A3Q1 output voltage are maintained until the next sample is taken.

For all the Sampling Gate diodes to conduct simultaneously, the reverse biases on each diode must be equal and the gating pulses must be of the same amplitude but of opposite polarity (A3T1). Sampler Bias Supply, A3, shifts the bias voltages so that the sampling gate output voltage is centered between them. Fine bias adjust is set by Sym. Adj. A3R15 for proper centering operation. The Bias Adj, A3R20, adjusts diode on-time by varying bias level which the sampling pulses must overcome.

Sampling Gate A2A1CR1-4 is normally reverse-biased by DC and feedback voltages across A4R19-20. A negative pulse to A2A1CR1-2 junction and a simultaneous positive pulse to A2A1CR3-4 junction let the diodes conduct briefly (about 300 pico-seconds). A2A1C3 charges toward the instantaneous RF signal voltage at the probe during this time. The pulses are so short that A2A1C3 can only charge about 15%. Negative feedback adjusts the gain (Gain Adj. A4R5) of A2A1Q1 and A4Q1 so the output of A4Q1 is equal to the instantaneous RF signal voltage at the time of sampling, i.e., overall Sampling Gate and Amplifier gain is unity. The A2A1C3 charge and A4Q1 output voltage are maintained until the next sample is taken.

For all the Sampling Gate diodes to conduct simultaneously, the reverse biases on each diode must be equal and the gating pulses must be of the same magnitude but of opposite polarity (A4T1). Sampler Bias Supply, A4, shifts the bias voltages so that the sampling gate output voltage is centered between them. Fine bias adjust is set by Sym Adj. A4R15 for proper centering operation. The Bias Adj, A4R20, adjusts diode on-time by varying level which the sampling pulses must overcome.

Figure 7-6(a). RF Sampling (Circuit Description)

Figure 7-6 (a). RF sampling (Circuit description)

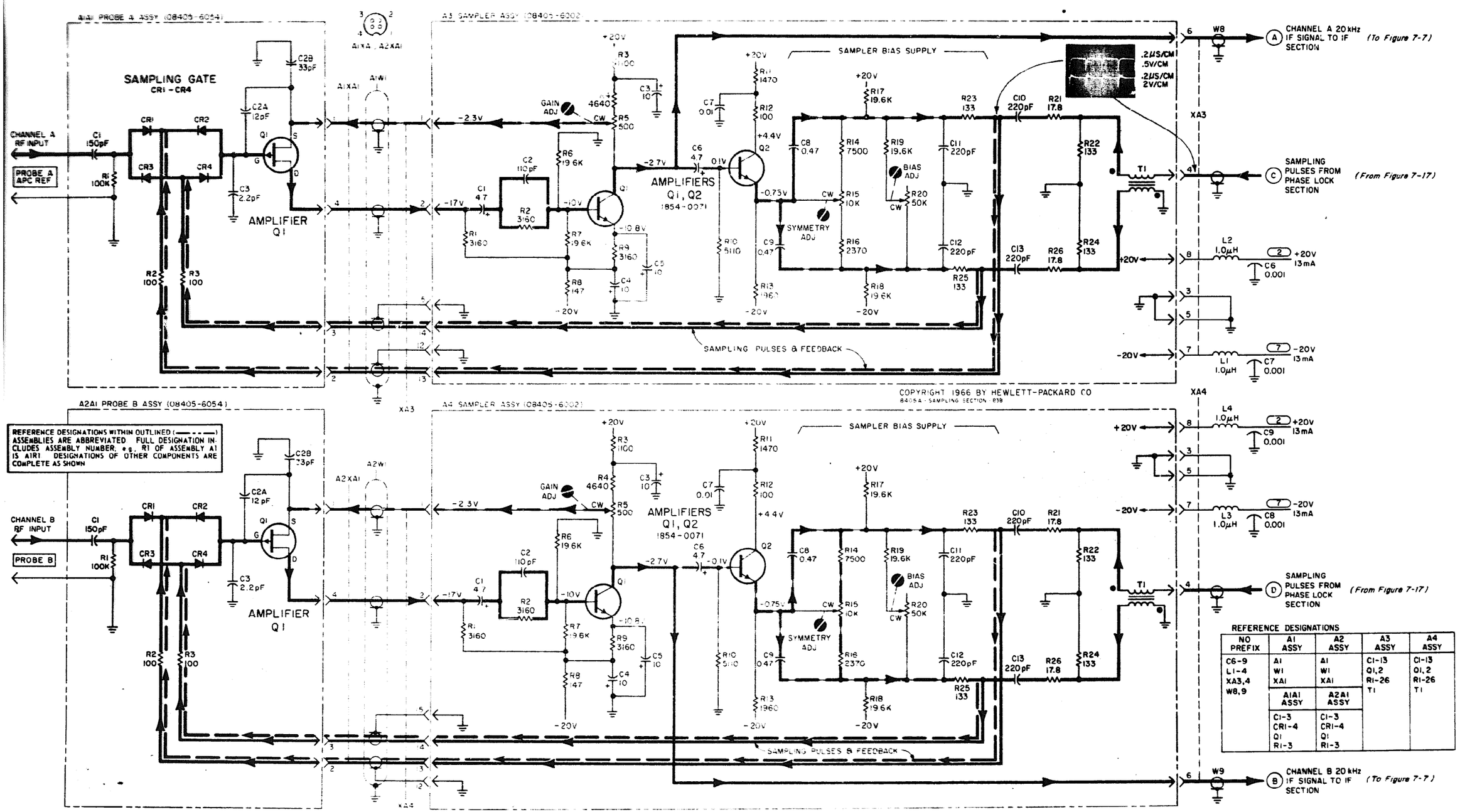


Figure 7-6(b). Schematic Diagram. RF sampling Section

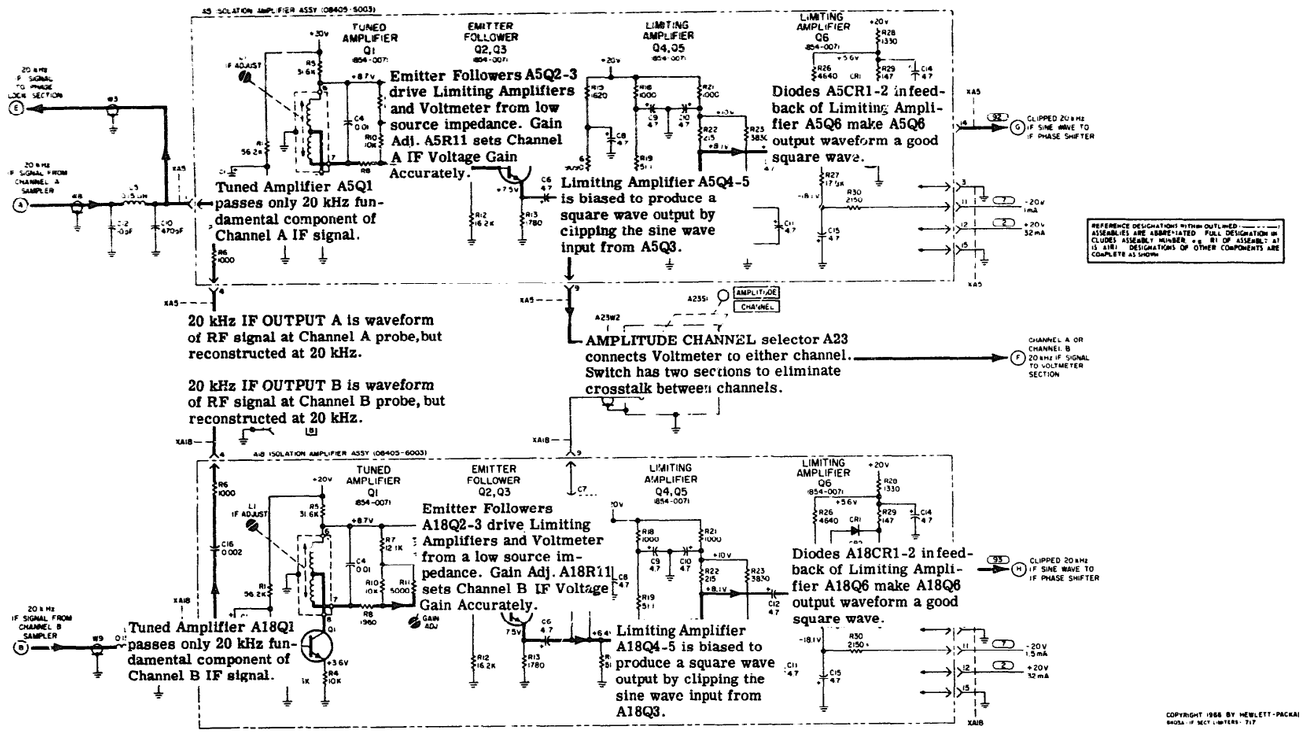


Figure 7-7(a). If section limiters circuit description

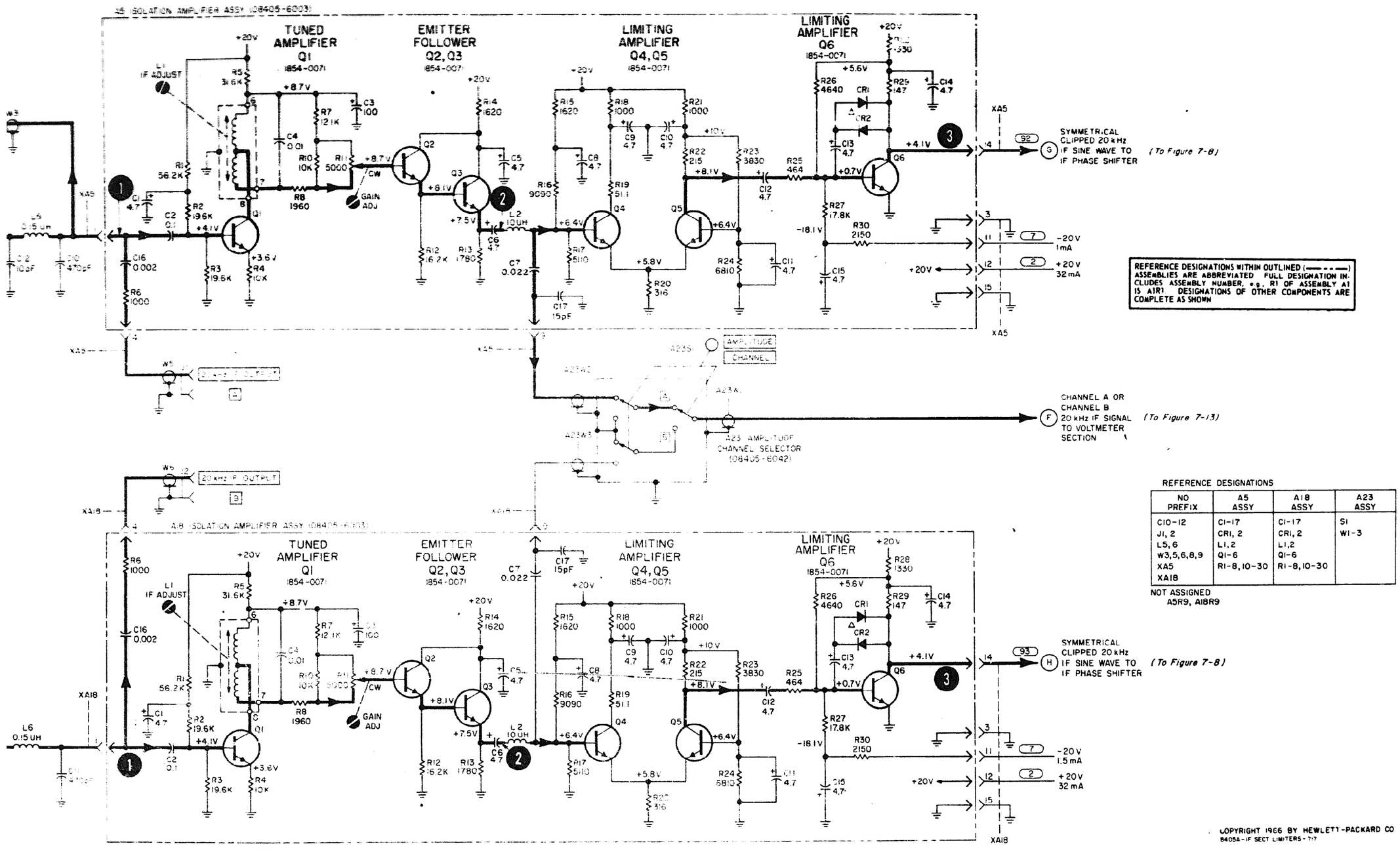
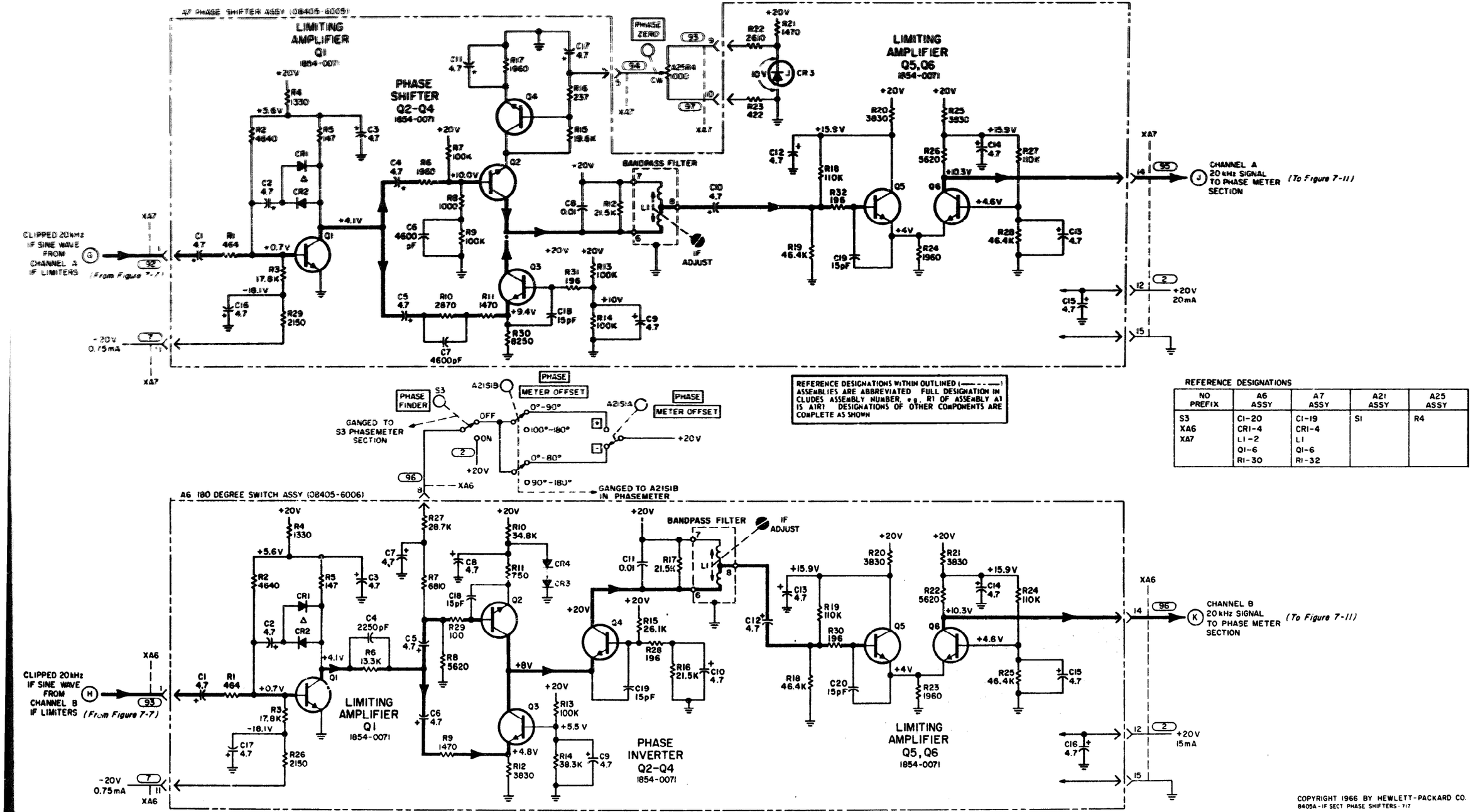


Figure 7-7(b). Schematic Diagram, IF Section Limiters



REFERENCE DESIGNATIONS WITHIN OUTLINED (——— ——) ASSEMBLIES ARE ABBREVIATED FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g. R1 OF ASSEMBLY A1 IS A1R1 DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A6 ASSY	A7 ASSY	A21 ASSY	A25 ASSY
S3	C1-20	C1-19	S1	R4
XA6	CR1-4	CR1-4		
XA7	L1-2	L1		
	Q1-6	Q1-6		
	R1-30	R1-32		

Figure 7-8(a).

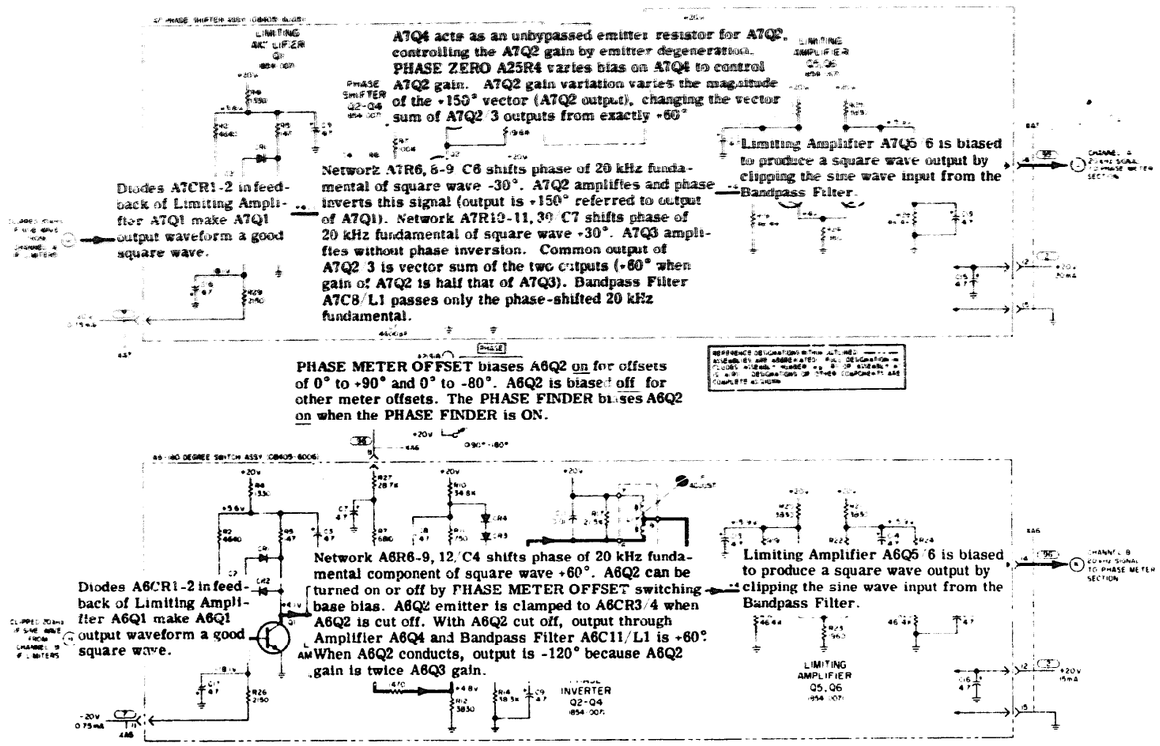

A7Q4 acts as an unbypassed emitter resistor for A7Q2, controlling the A7Q2 gain by emitter degeneration. PHASE ZERO A25R4 varies bias on A7Q4 to control A7Q2 gain. A7Q2 gain variation varies the magnitude of the +150° vector (A7Q2 output), changing the vector sum of A7Q2 3 outputs from exactly +60°
Diodes A7CR1-2 in feedback of Limiting Amplifier A7Q1 make A7Q1 output waveform a good square wave.
Network A7R6, 6-9 C6 shifts phase of 20 kHz fundamental of square wave -30°. A7Q2 amplifies and phase inverts this signal (output is +150° referred to output of A7Q1). Network A7R10-11, 30 C7 shifts phase of 20 kHz fundamental of square wave +30°. A7Q3 amplifies without phase inversion. Common output of A7Q2 3 is vector sum of the two outputs (+60° when gain of A7Q2 is half that of A7Q3). Bandpass Filter A7C8/L1 passes only the phase-shifted 20 kHz fundamental.
Limiting Amplifier A7Q5 6 is biased to produce a square wave output by clipping the sine wave input from the Bandpass Filter.
PHASE METER OFFSET biases A6Q2 on for offsets of 0° to +90° and 0° to -80°. A6Q2 is biased off for other meter offsets. The PHASE FINDER biases A6Q2 on when the PHASE FINDER is ON.
Diodes A6CR1-2 in feedback of Limiting Amplifier A6Q1 make A6Q1 output waveform a good square wave.
Network A6R6-9, 12, C4 shifts phase of 20 kHz fundamental component of square wave +60°. A6Q2 can be turned on or off by PHASE METER OFFSET switching base bias. A6Q2 emitter is clamped to A6CR3/4 when A6Q2 is cut off. With A6Q2 cut off, output through Amplifier A6Q4 and Bandpass Filter A6C11/L1 is +60°. When A6Q2 conducts, output is -120° because A6Q2 gain is twice A6Q3 gain.
Limiting Amplifier A6Q5/6 is biased to produce a square wave output by clipping the sine wave input from the Bandpass Filter.
LIMITING AMPLIFIER Q5, Q6
INVERTER Q2-Q4

Figure 7-8(b).

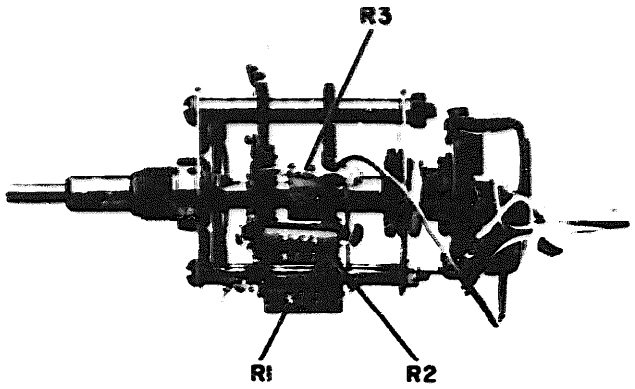
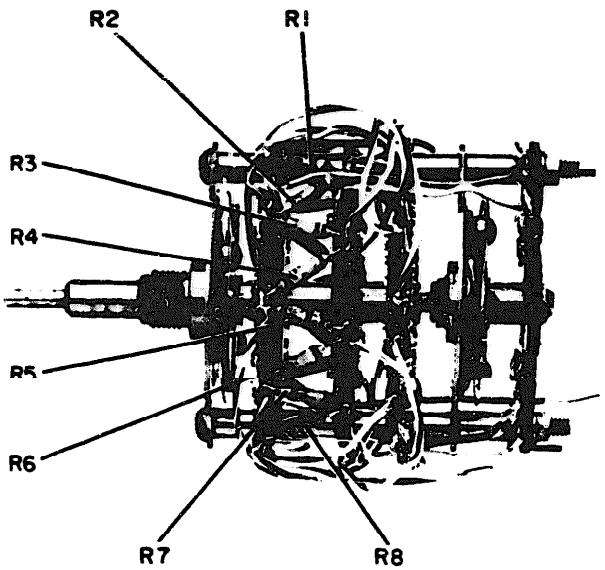


Figure 7-9. Phase Range Switch Component location



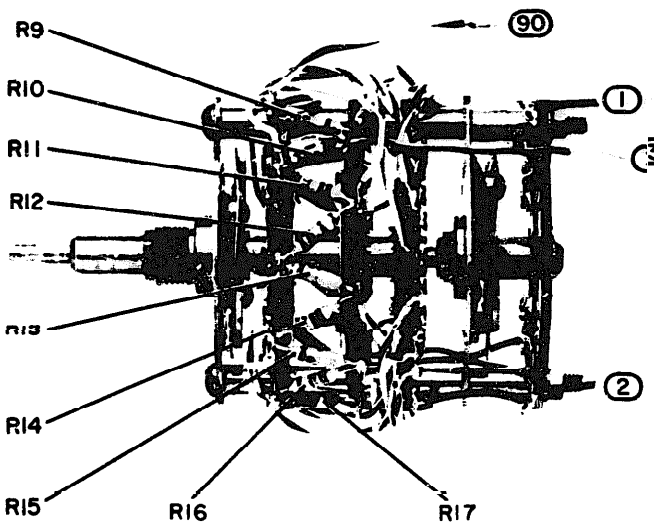


Figure 7-10. Phase Offset Switch Component Location

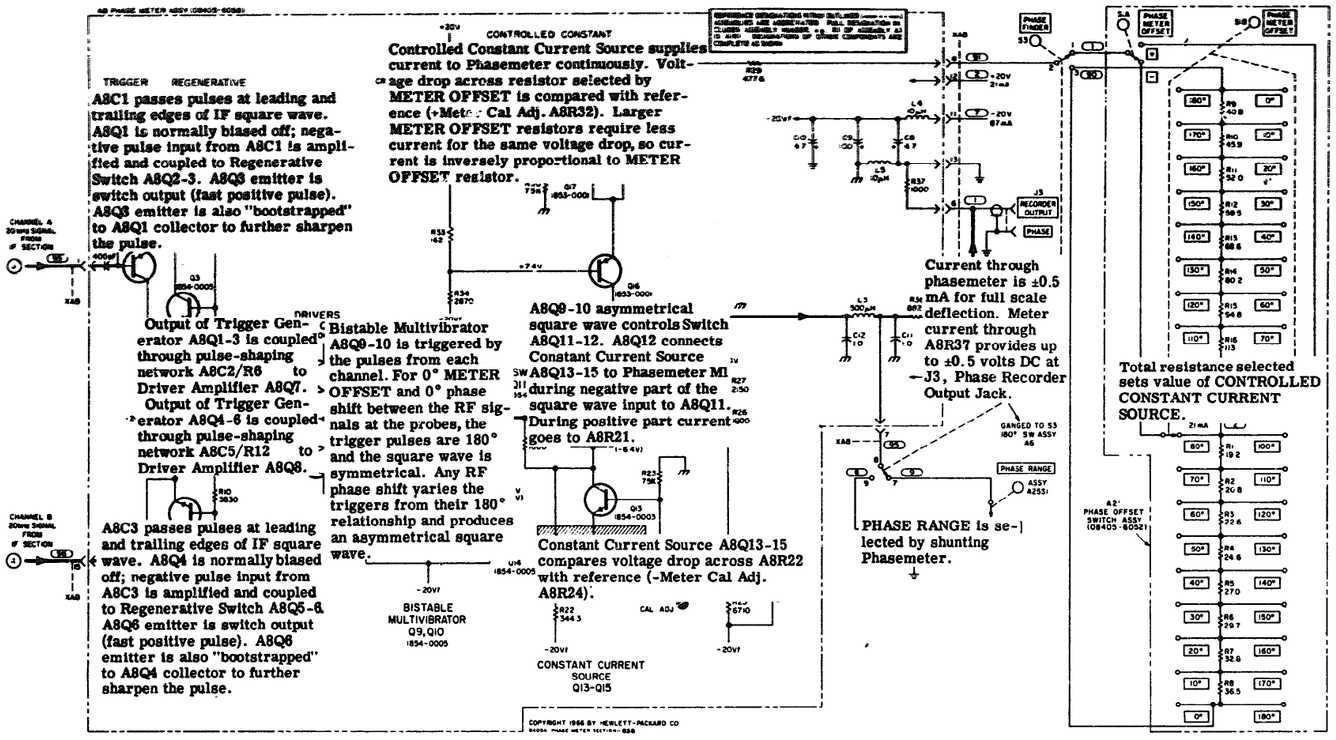
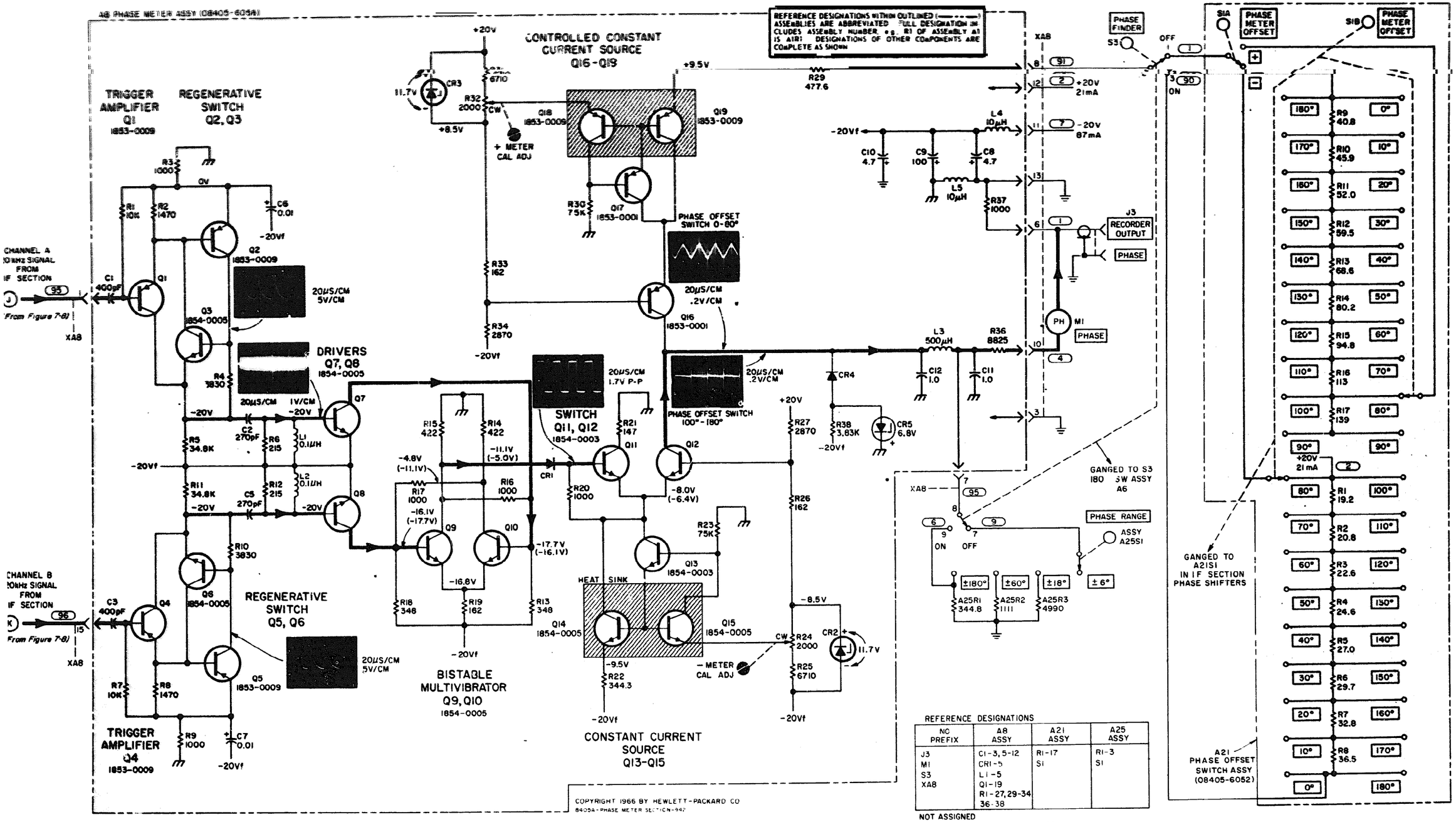


Figure 7-11(a). Phase Meter (Circuit Description)



REFERENCE DESIGNATIONS

NC PREFIX	A8 ASSY	A21 ASSY	A25 ASSY
J3	C1-3, 5-12	R1-17	R1-3
M1	CR1-5	S1	S1
S3	L1-5		
XA8	Q1-19		
	R1-27, 29-34		
	36-38		

NOT ASSIGNED
A8C4, A8L1, A8L2, A8R28, A8R35

Figure 7-11(b). Schematic Diagram, Phase Meter

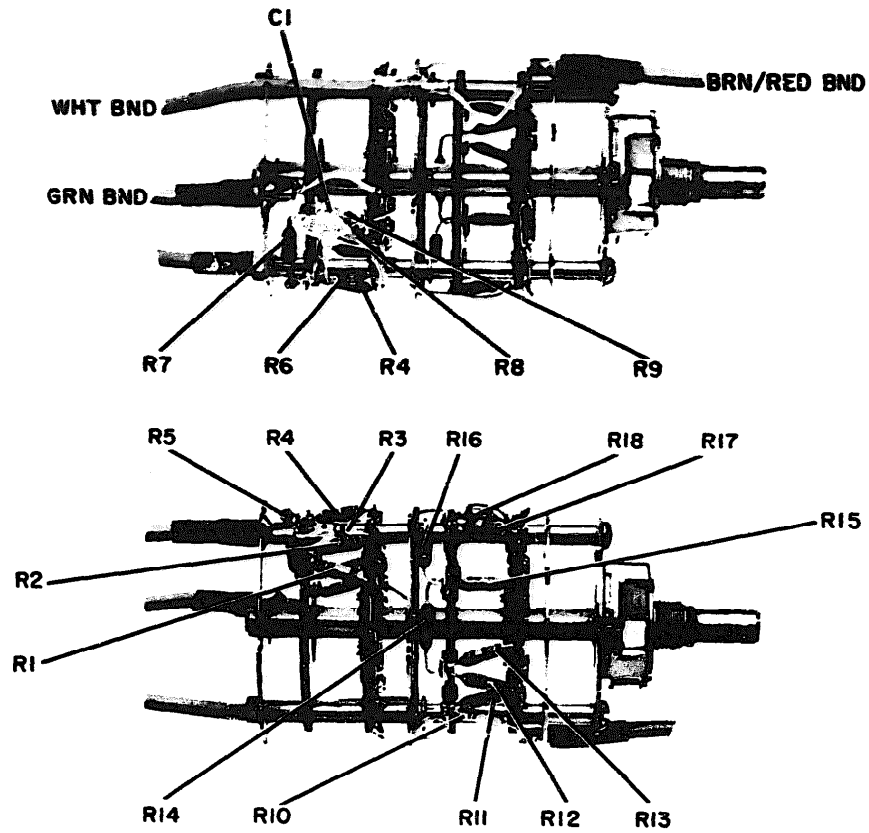


Figure 7-12. Amplitude Range Switch Component Location

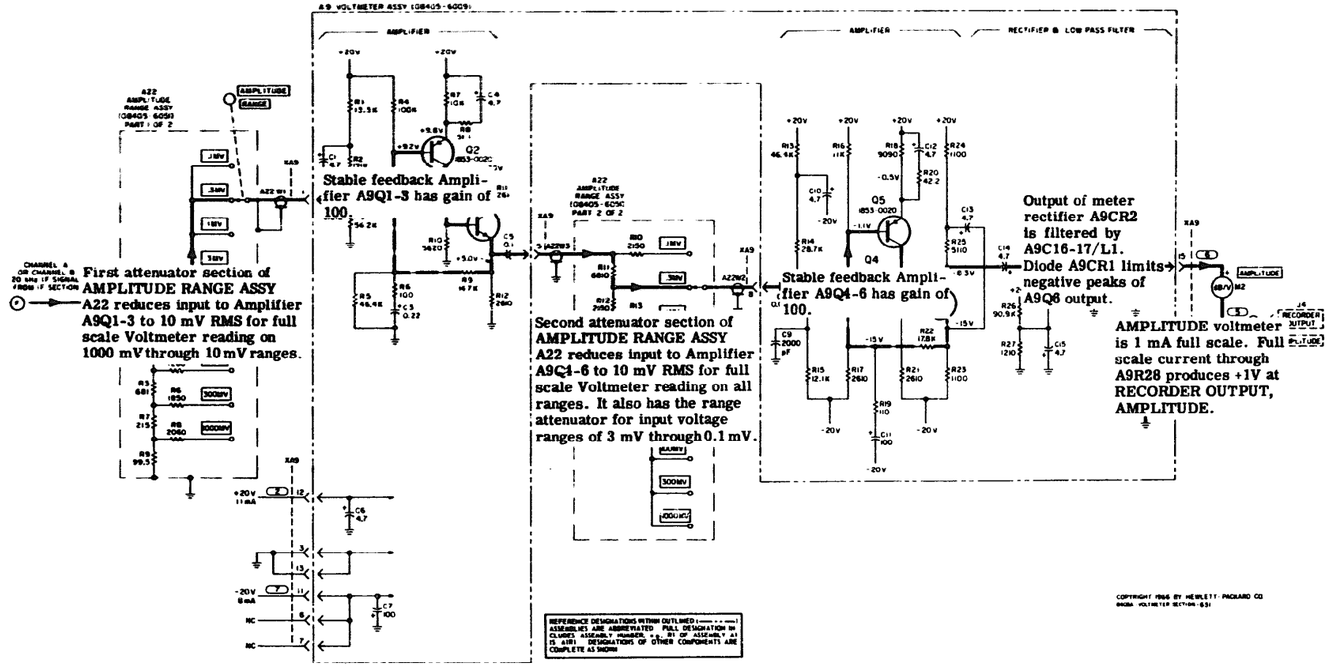
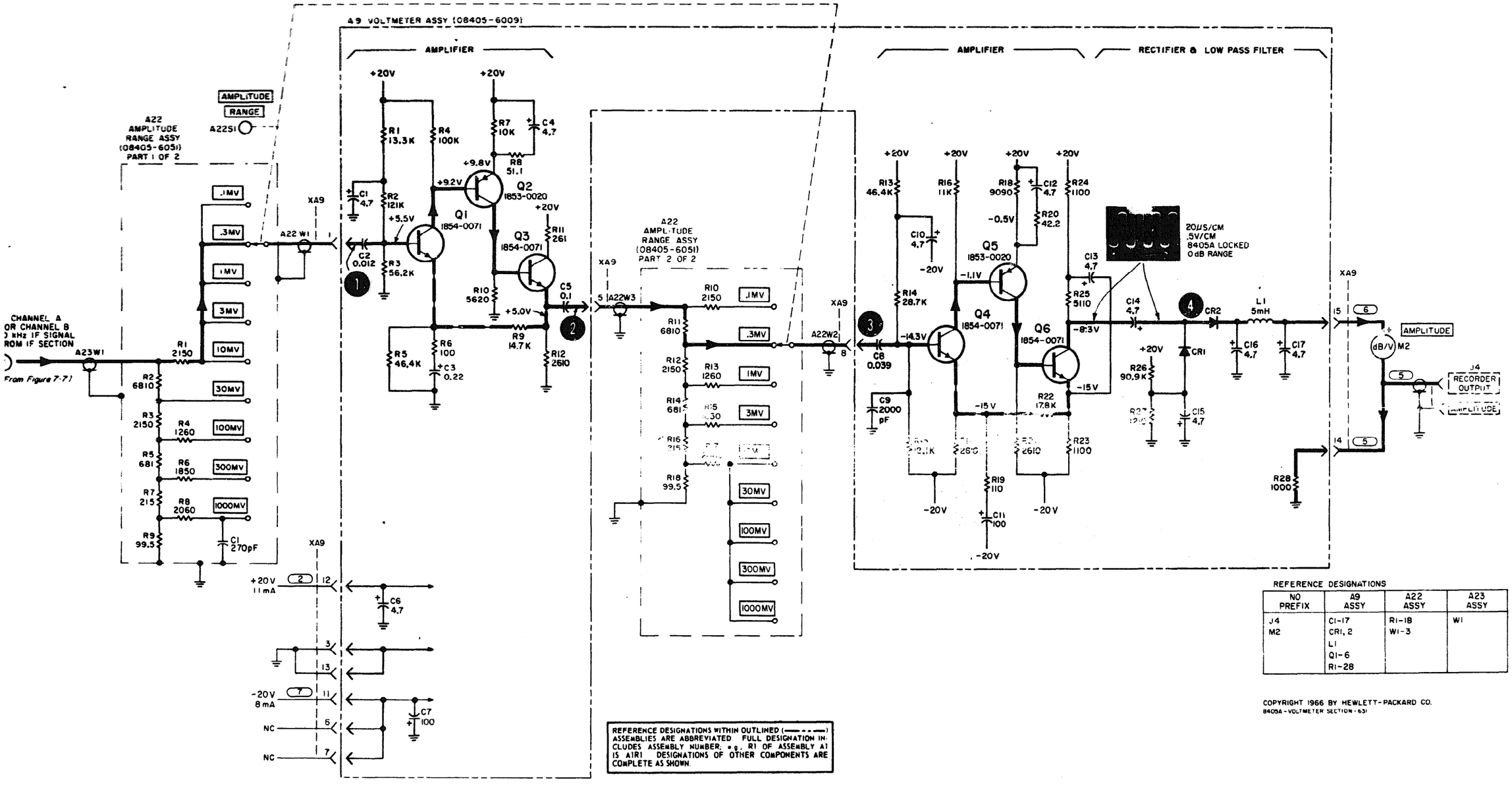


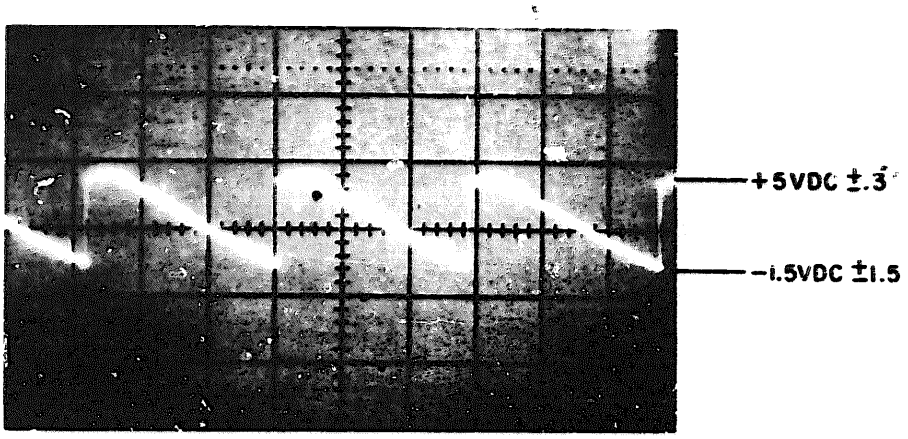
Figure 7-13(a). Voltmeter (circuit description)



REFERENCE DESIGNATIONS

NO PREFIX	A9 ASSY	A22 ASSY	A23 ASSY
J4	C1-17	R1-18	W1
M2	CR1, 2	W1-3	
	L1		
	Q1-6		
	R1-28		

Figure 7-13(b). Schematic Diagram, Voltmeter



APC UNLOCKED LIGHT "ON"

XA1 PIN I

8 V P - P
(SWEEP: 20MSEC/CM)

Figure 7-14. Search Section Output Waveform

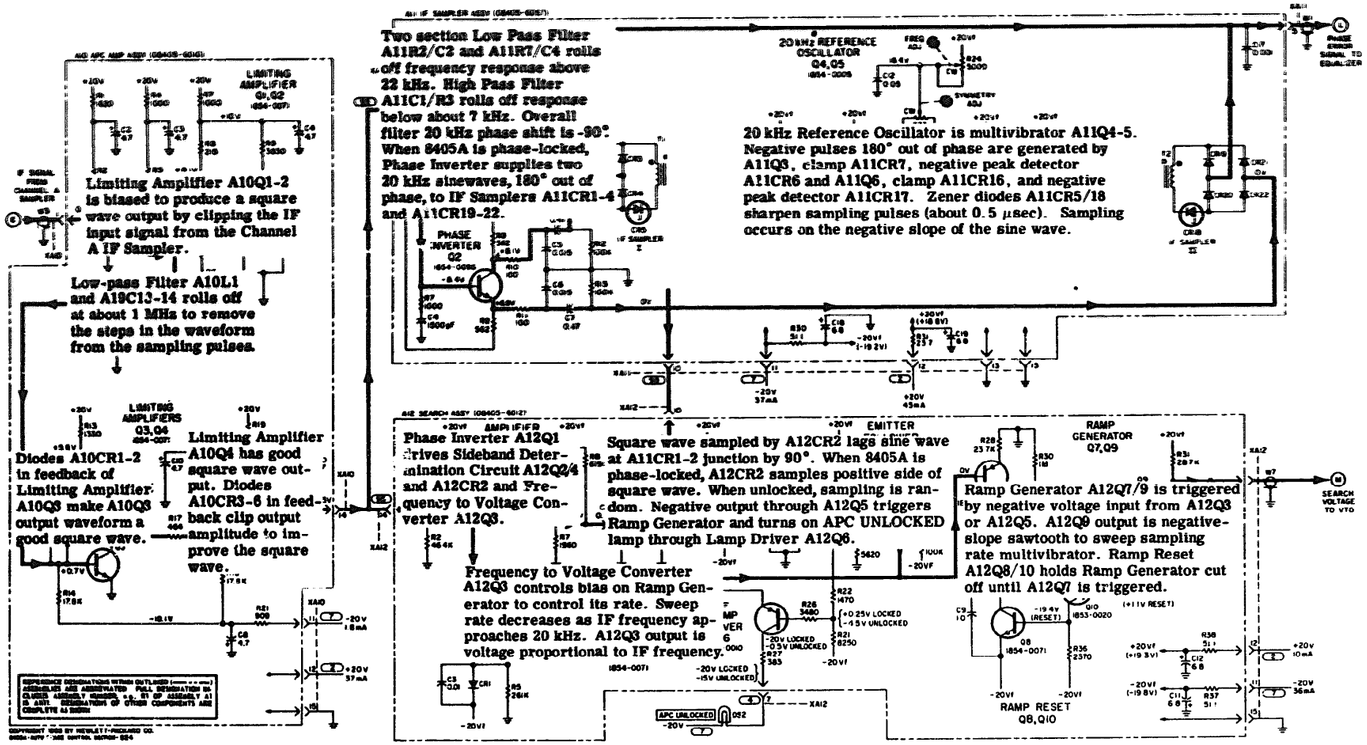
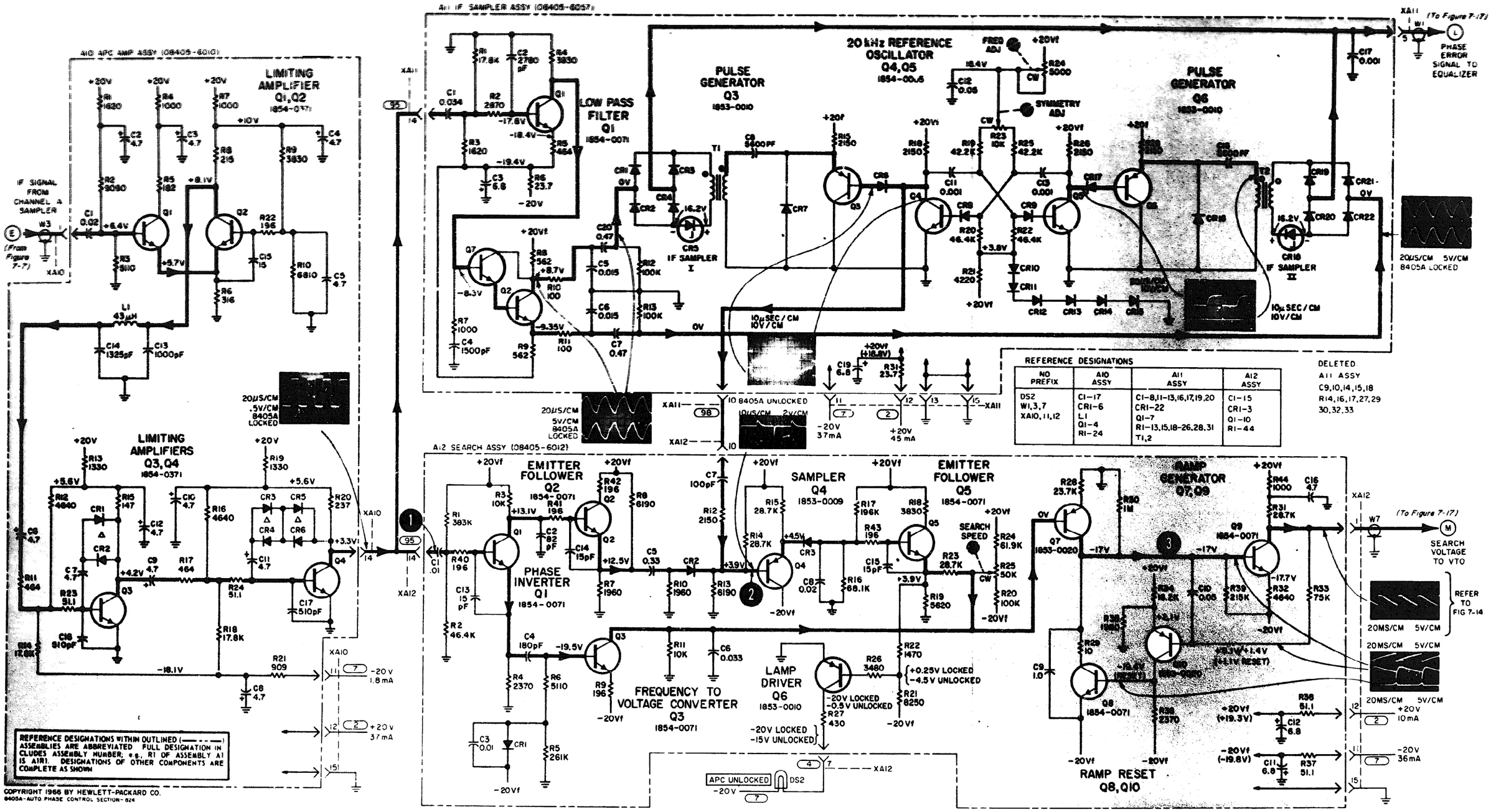


Figure 7-15 (a). Automatic Phase Control Section (Circuit description)

Figure 7-15(a). Automatic Phase Control Section (Circuit Description)



REFERENCE DESIGNATIONS

NO PREFIX	A10 ASSY	A11 ASSY	A12 ASSY
DS2 W1,3,7 XA10,11,12	C1-17 CR1-6 L1 Q1-4 R1-24	C1-8,11-13,16,17,19,20 CR1-22 Q1-7 R1-13,15,18-26,28,31 T1,2	C1-15 CR1-3 Q1-10 R1-44

DELETED
A11 ASSY
C9,10,14,15,18
R14,16,17,27,29
30,32,33

Figure 7-15(b). Schematic Diagram. Automatic Phase Control Section (Part 1)

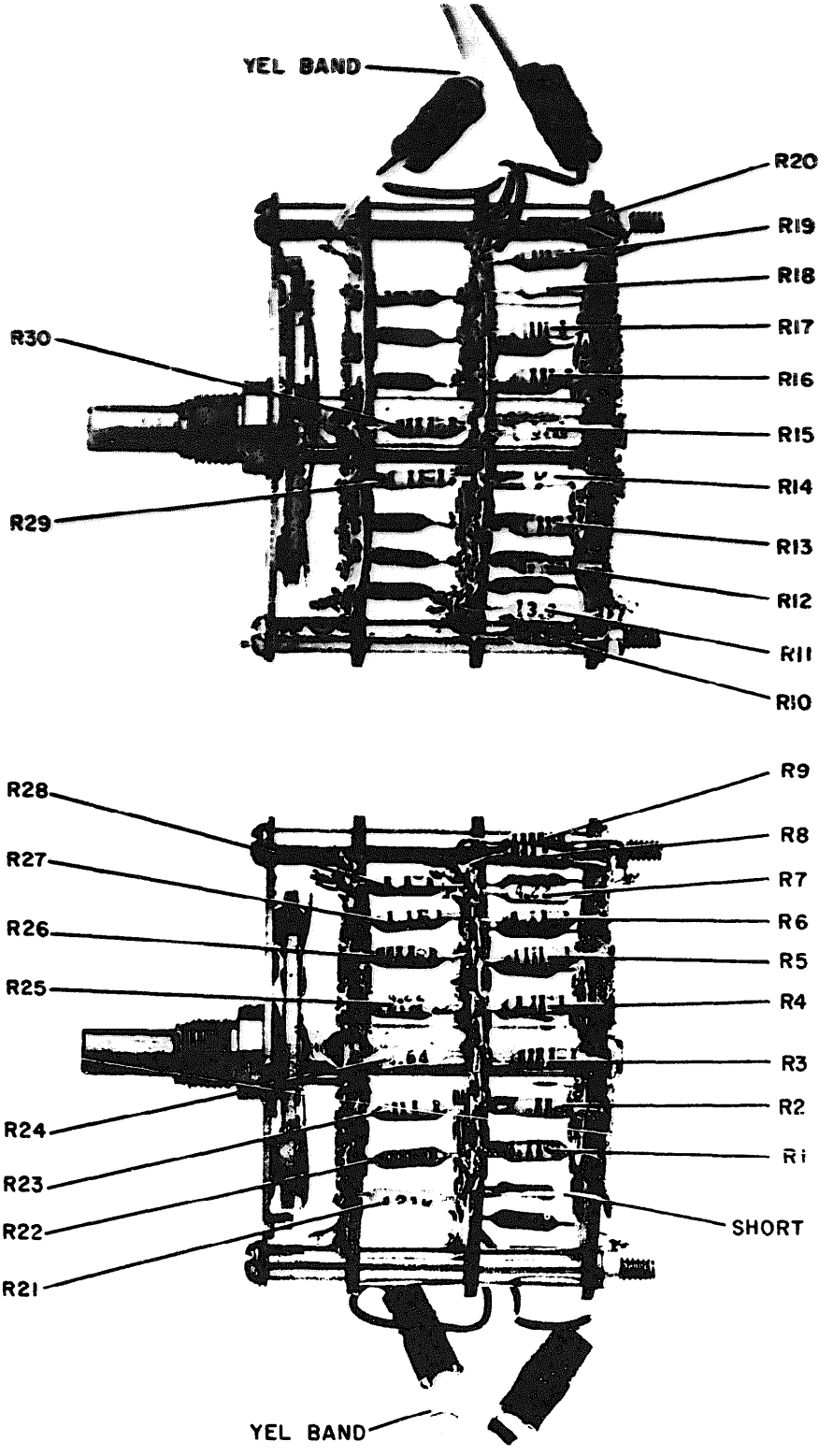


Figure 7-16. Frequency Range Switch Component Location

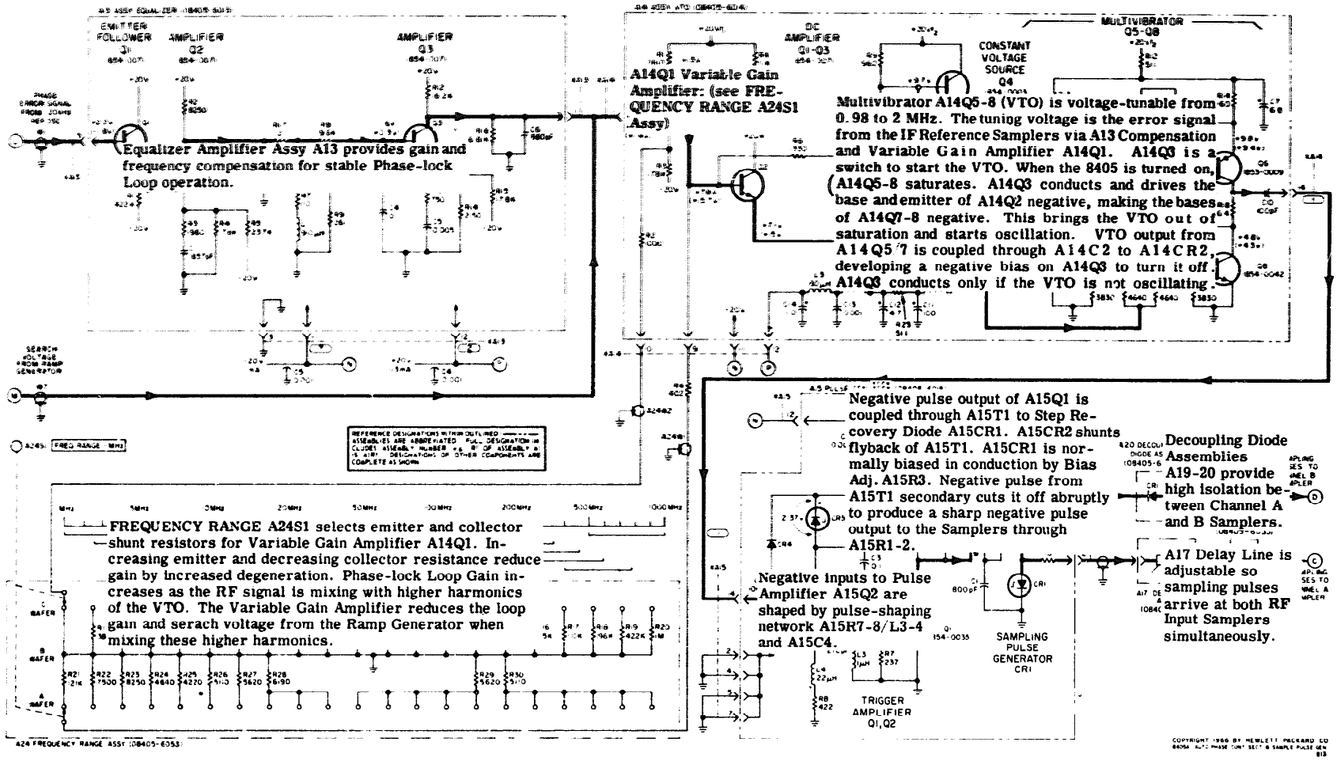
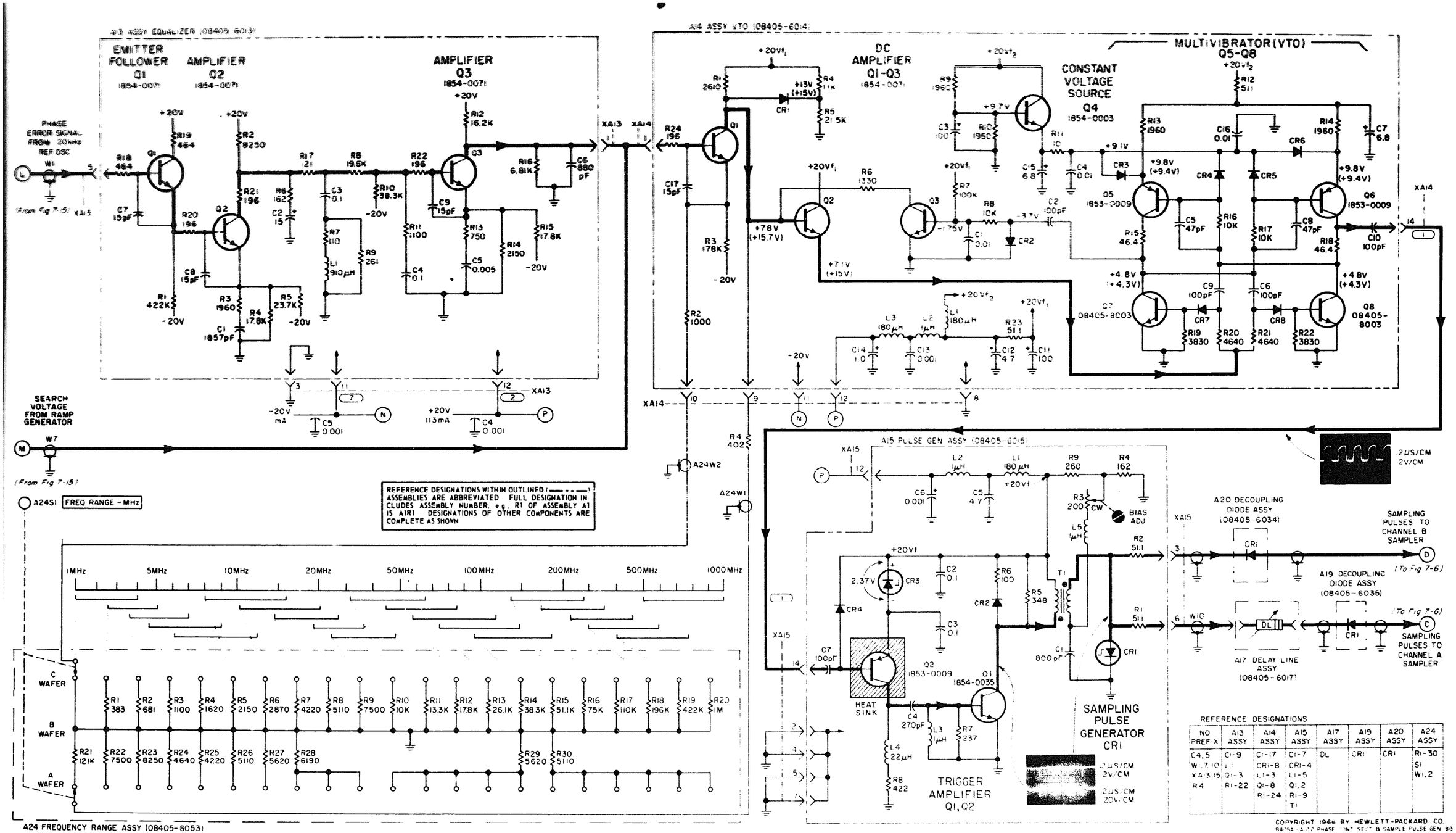


Figure 7-17(a). Automatic phase Control Section (Circuit Description)



REFERENCE DESIGNATIONS

NO PREF X	A13 ASSY	A14 ASSY	A15 ASSY	A17 ASSY	A19 ASSY	A20 ASSY	A24 ASSY
C4,5	C1-9	C1-17	C1-7	DL	CR1	CR1	R1-30
W1,7,10	L1	CR1-8	CR1-4				S1
XA3,15	Q1-3	L1-3	L1-5				W1,2
R4	R1-22	Q1-8	Q1,2				
		R1-24	R1-9				
			T1				

Figure 7-17(b). Schematic Diagram. Automatic Phase Control Section [Part 2) Sampling Pulse Generator

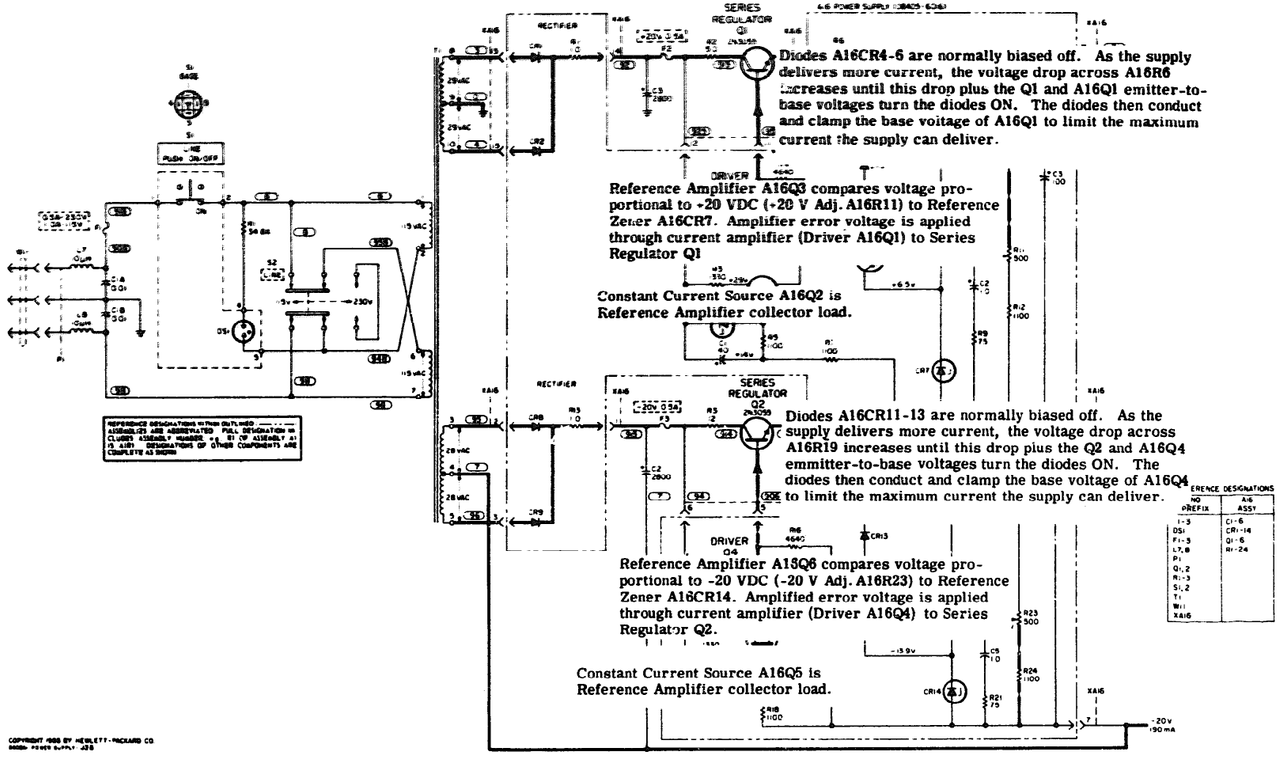
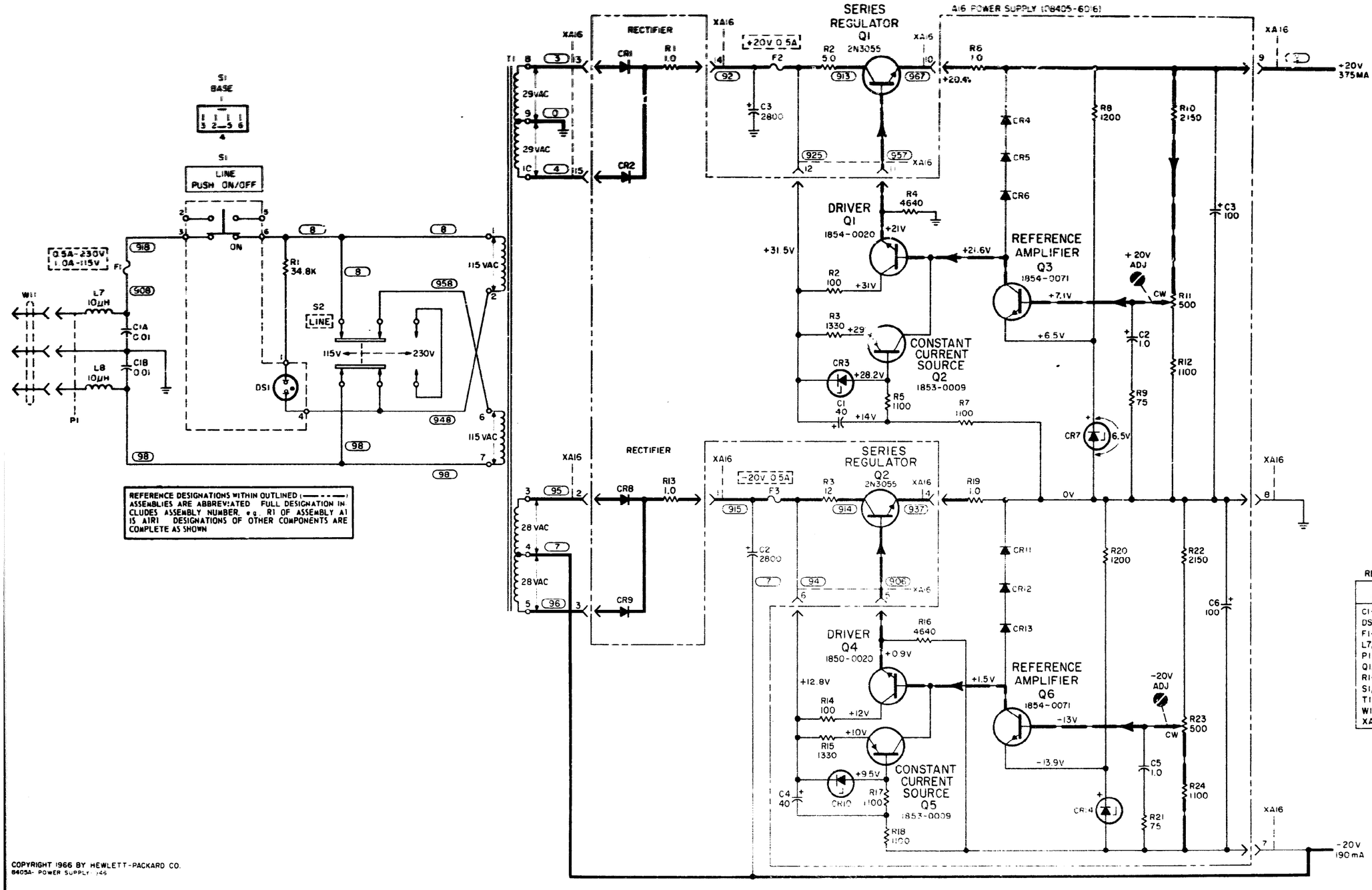


Figure 7-18(a). Power Supplies (Circuit Description)



REFERENCE DESIGNATIONS WITHIN OUTLINED ASSEMBLIES ARE ABBREVIATED FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g. R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A16 ASSY
C1-3	C1-6
DS1	CR1-14
F1-3	Q1-6
L7, 8	R1-24
P1	
Q1, 2	
R1-3	
S1, 2	
T1	
W11	
XA16	

Figure 7-18(b). Schematic Diagram. Power Supplies

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	Index of Modification Work Orders.
TB 11-6625-2856-50	Calibration Procedures for Vector Voltmeter, Hewlett-Packard Model 8405A. (NSN 6625-00-929-1897)
TM 11-6625-2856-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Repair Parts and Special Tools) for Vector Voltmeter, Hewlett-Packard Model 8405A.
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B
COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

B-1. Scope

This appendix lists integral components of and basic issue items for the 8405A to help you inventory items required for safe and efficient operation.

B-2. General

This Components of End Item List is divided into the following sections:

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the 8405A and must accompany it whenever it is transferred or turned in. The illustrations will help you identify these items.

b. Section III. Basic Issue Items. Not applicable.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows:

(1) *Figure number.* Indicates the figure number of the illustration on which the item is shown.

(2) Item number. The number used to identify item called out in the illustration.

b. National Stock Number. Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Description. Indicates the Federal item name and, if required, a minimum description to identify the item. The part number indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items. Following the part number, the Federal Supply Code for Manufacturers (FSCM) is shown in parentheses.

d. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

e. Usable on Code. Not applicable.

f. Quantity Requirred (Qty Reqd). This column lists the quantity of each item required for a complete major item.

g. Quantity. This column is left blank for use during an inventory. Under the Rcvd column, list the quantity you actually receive on your major item. The Date columns are for your use when you inventory the major item.

SECTION II INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION (A) FIG NO.	(1) ILLUSTRATION (B) ITEM NO.	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION PART NUMBER (FSCM)	(4) LOCATION	(5) USABLE ON CODE	(6) QTY REQD	(7) QUANTITY RCVD	(7) QUANTITY DATE
1-1		6625-00-929-1897	VOLTMETER, VECTOR HP 8405A (28480)			1		
			ACCESSORY KIT HP 11570A (28480) C/O			1		
			TEE, TYPE N TO PROBE, 50-OHM. HP 11536A (28480)	ACCESSORY KIT		2		
			POWER SPLITTER, TYPE N HP 11549A (28480)	ACCESSORY KIT		1		
			TERMINATION, TYPE N, 50-OHM. HP 908A (28480)	ACCESSORY KIT		2		
			SHORTING PLUG, TYPE N HP 11512A (28480)	ACCESSORY KIT		1		
			ACCESSORY CASE HP 11570-60001 (28480)	ACCESSORY KIT		1		
1-1	1	6150-00-351-3405	CABLE ASSEMBLY, POWER CORD HP 8120-1348 (28480)			1		
1-1	2		CABLE ASSEMBLY, SPECIAL COAXIAL HP 08405-6047 (28480)			2		
1-1	3		ISOLATOR HP 10216A (28480)			2		
1-1	4		DIVIDER 10:1 HP 11576A (28480)			2		
1-1	5		GROUNDING CLIP HP 10213 (28480)			6		
1-1	6		PROBE TIP HP 5020-0457 (28480)			6		
1-1	7		PROBE TO BNC ADAPTER HP 10218A (28480)			2		
			FUSE, 1A, 250 V 31200.1 (75915)			1		
			FUSE .50A, 250 V HP 2110-0202 (28480)			1		

DRSEL-MA Form 6010, (1 Mar 77) (Edition of 1 Jun 76 is obsolete) HISA-FM 545-77

APPENDIX D
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

D-1. General.

This appendix provides a summary of the maintenance operations for the 8405A. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function.

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipments/components.

D-3. Column Entries.

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assemably. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for pur-

pose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of task-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C-Operator/Crew
O-Organizational
F-Direct Support
H-General Support
D-Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Column 6 contains an alphabetic code which leads to the remark in section IV, Remarks, which is pertinent to the item opposite the particular code.

D-4. Tool and Test Equipment Requirements (Sect. III).

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. *Tool Number.* This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

D-5. Remarks (Sect.IV). I

a. Reference Code. This code refers to the appropriate item in section II, column 6.

b. Remarks. This column provides the required explanatory information necessary to clarify items appearing in section II.

(Next printed page is D-3)

SECTION II MAINTENANCE ALLOCATION CHART FOR VECTOR VOLTMETER, HEWLETT PACKARD MODEL 8405A

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQPT.	(6) REMARKS
00	VECTOR VOLTMETER, HEWLETT PACKARD MODEL 8405AR	Inspect		0.2					
		Test			0.3				
		Service			0.4				
		Align			1.5				
		Calibrate			1.5				
		Install		0.1				1	
		Replace		0.1				1	
		Repair			0.6			1 thru 9	
		Repair		0.1					A
01	PROBE ASSEMBLY, A1	Inspect			0.1			1	
		Replace			0.1			1	
02	PROBE ASSEMBLY, A2	Inspect			0.1			1	
		Replace			0.2			1	
03	CIRCUIT CARD ASSEMBLY, SAMPLER, A3, A4	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
04	CIRCUIT CARD ASSEMBLY, ISOLATION AMPLIFIER, A5, A18	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
05	CIRCUIT CARD ASSEMBLY, 180 DEGREE SWITCH, A6	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
06	CIRCUIT CARD ASSEMBLY, PHASE SHIFTER, A7	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
07	CIRCUIT CART ASSEMBLY, PHASE METER, A8	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
08	CIRCUIT CARD ASSEMBLY, VOLTMETER, A9	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
09	CIRCUIT CARD ASSEMBLY, APC AMPLIFIER, A10	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
10	CIRCUIT CARD ASSEMBLY, IF SAMPLER, A11	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
11	CIRCUIT CARD ASSEMBLY, SEARCH, A12	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
12	CIRCUIT CARD ASSEMBLY, EQUALIZER, A13	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
13	CIRCUIT CARD ASSEMBLY, VTO, A14	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
14	CIRCUIT CARD ASSEMBLY, PULSE GENERATOR, A15	Inspect			0.3				
		Replace			0.4			1	
		Repair					1.0	1 thru 9	
15	POWER SUPPLY ASSEMBLY, A16	Inspect			0.3				
		Adjust			0.4			1	
		Replace			0.4			1	
		Repair					1.5	1 thru 9	
16	DELAY LINE ASSEMBLY, A17	Inspect			0.4				
		Replace			0.5			1 thru 9	
17	SWITCH ASSEMBLY, PHASE METER OFFSET, A21	Inspect			0.3				
		Replace			1.0			1	
		Repair			1.0			1 thru 9	

SECTION II MAINTENANCE ALLOCATION CHART -- CONTINUED
FOR
VECTOR VOLTMETER, HEWLETT PACKARD MODEL 8405A

(1) GROUP NUMBER	(2) COMPONENT ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY					(5) TOOLS AND EQPT.	(6) REMARKS
			C	O	F	H	D		
18	SWITCH ASSEMBLY, AMPLITUDE RANGE, A22	Inspect			0.3				
		Replace			1.0			1	
		Repair			1.0			1 thru 9	
19	SWITCH ASSEMBLY, CHANNEL, A23	Inspect			0.3				
		Replace			1.0			1	
		Repair			1.0			1 thru 9	
20	SWITCH ASSEMBLY, FREQUENCY RANGE, A24	Inspect			0.3				
		Replace			1.0			1	
		Repair			1.0			1 thru 9	
21	SWITCH ASSEMBLY, PHASE RANGE, A25	Inspect			0.3				
		Replace			1.0			1	
		Repair			1.0			1 thru 9	
22	ACCESSORY KIT, HEWLETT-PACKARD MODEL 11570A	Inspect		0.3					
		Replace		0.3					

SECTION IV TOOL AND TEST EQUIPMENT REQUIREMENTS FOR

VECTOR VOLTMETER, HEWLETT-PACKARD MODEL 8405A

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	O.F.D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
2	O.F.D	MULTIMETER, AN/USM-223A	6625-00-999-7465	
3	O.F.D	OSCILLOSCOPE AN/USM-281C	6625-00-106-7497	
4	O.F.D	DUAL CHANNEL PLUG-IN TEKTRONIX MODEL 7A18N	6625-00-253-5009	
5	O.F.D	SIGNAL GENERATOR, HEWLETT-PACKARD 8616A	6625-00-254-6671	
6	O.F.D	SIGNAL GENERATOR, HEWLETT-PACKARD 8660C	6625-00-003-7414	
7	O.F.D	DIGITAL MULTIMETER ME-496/U	6625-00-010-5090	
8	O.F.D	FREQUENCY COUNTER TD-1225(V)1/U (HP5340A)	6625-00-498-8946	
9	O.F.D	DIGITAL VOLTMETER AN/GSM-64B	6625-00-022-7894	

SECTION IV. **REMARKS**

REFERENCE CODE	REMARKS
A	Repair By Replacement of Panel Lamps and Fuses.

APPENDIX F

BACKDATING

MANUAL CHANGES

MODEL 8405A

VECTOR VOLTMETER

Manual Serial Prefixed: 946-
HP Part No. 08405-90022

To adapt this manual to instruments with Serial Numbers listed in the table below, make the indicated manual **changes.**

Information for adapting this manual to instruments with Serial Numbers not listed in the table below may **be included in a yellow MANUAL CHANGES insert supplied** with this manual. Information about serial numbers **not covered in any of these ways can be obtained from** your nearest Hewlett-Packard office.

Instrument Serial Prefix	Make Manual Changes	Instrument Serial Prefix	Make Manual Changes
946-03210 thru 946-02911	1	805-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
942-02910 thru 942-02861	1, 2	742-, 741-, 732-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
942-02860 thru 942-02811	1, 2, 3	725-, 724-, 717-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
942-02810 thru 942-02780 838-02779 thru 838-02711	1, 2, 3, 4	645-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
838-02710 thru 838-02211	1, 2, 3, 4, 5	631-	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 15
838-02210 thru 838-02161	1, 2, 3, 4, 5, 6		
838-02160 thru 838-02111	1, 2, 3, 4, 5, 6, 7	626-	1,2,3,4,5,6,7,8,9,10,11,12,13,14 15, 16
838-02110 thru 838-02061	1, 2, 3, 4, 5, 6, 7, 8		
824-	1,2,3,4, 5,6,7,8,9	611- and below	1,2,3,4,5,6,7,8,9,10,11,12,13,14 15, 16, 17
813-	1,2,3,4,5,6,7,8,9,10		

CHANGE 1: Page 6-25:
Change DS2 to 1450-0138, LIGHT, INDICATOR, RED

CHANGE 2: Page 6-25:
Change P1 to Part No. 1251-0148
Change S1 to Part No. 3101-0100
Change S2 to Part No. 3 101-0033

Page 6-26:
Change W11 to Part No. 8120-0078

Page 6-27:
Change Item 2 to Part No. 08405-0001
Change Item 13 to Part No. 08405-0002

Page 7-19/7-20
Change S1 pin numbers from 3 to 1, from 6 to 2, from 1 to 4, and from 4 to 5.

CHANGE 3:

Page 6-2:

Change A3R5 to HP Part No. 2100-0783, VAR: WW 200 OHM 5% 1W.

Page 6-3:

Change A3R27 to HP Part No. 0757-0401, R: FXD) MET FLM 100 OHM 1% 1/8W FACTORY SELECTED PART.

Change A4R5 to HP Part No. 2100-0783, R: VAR WW 200 OHM 5% 1W.

Page 6-4:

Change A4R27 to HP Part No. 0757-0401, R: FXD MET FLM 100 OHM 1% 1/8W, FACTORY SELECTED PART

CHANGE 4:

Page 6-6:

Delete A8CR4, A8CR5, A8L1, and A8L2.

Page 6-9:

Change Part No. of Heat Dissipator under A8Q14, A8Q15, A8Q18 and A8Q19 to 1205-0041.

Page 6-10:

Delete A8R38.

Page 7-11/7-12:

Delete A8CR4, A8CR5, A8L1, A8L2 and A8R38.

CHANGE 5:

Page 6-3:

Change A3R19 to HP Part No. 0698-3153, R: FXD MET FLM, 3.83K OHM 1% 1/8W.
Change A4819 to HP Part No. 0698-3153, R: FXD MET FLM, 3.83K OHM 1% 1/8W.

Page 7-5/7-6:

Change A3R19 and A4R19 to 3.83K OHM.

CHANGE 6:

To reduce Residual Noise level caused by power supply, it is recommended that resistors A16R8 and A16R20 be changed.

From: 0698-3150 R: FXD MET FLM, 2.37K OHM 1% 1/8W.
To: 0757-0077 R: FXD MET FLM 1.2K OHM 2% 1/4W.

CHANGE 7:

To reduce the amplitude error of the voltmeter above 800 MHz and on the 0 dB range, it is recommended that resistors A3R21, A3R25, A4R21 and A4R26 be changed.

From: 0757-0316 R: FXD MET FLM 42.2 OHM 1% 1/8W.
To: 0757-0294 R: FXD MET FLM 17.8 OHM 1% 1/8W.

CHANGE 8:

This change applies ONLY to the A8 Phase Meter Assy with HP Part Number 08405-6058. To eliminate spurious or erratic phase meter indications, it is recommended that inductors A8L1 and A8L2 be removed.

Delete: A8L1, L2 9140-0120 COIL: FMD) 0.10 UH 20%.

CHANGE 9 **A8 Phase Meter Assy is different (see Figure 1 below) than shown in Figure 7-11.**

Table 6-1, Pages 6-8, 6-9 and 6-10,

Add: A8CR4, 6; 1901-0040; DIODE SILICON 30 MA 30 MV
A8CR5, 7; 1902-3106; DIODE BREAKDOWN 5.76 V
A8R28, R35; 0757-0279; R:FXD 3.16K ohm 1% 1/8 W

Change: A8 Phase meter assembly part number to 08405-6008.

Change Resistors A8R26, R33,

To: 2100-1657 R:VAR WW 1K OHM 10% 1 W
From: 0757-0405 R:FXD MET FLM 162 OHM 1% 1/8 W

Change Resistors A8R27, R34,

To: 0698-0084 R:FXD MET FLM 2.15K OHM 1% 1/8 W
From: 0698-3101 R:FXD MET FLM 2.87K OHM 1% 1/2 W

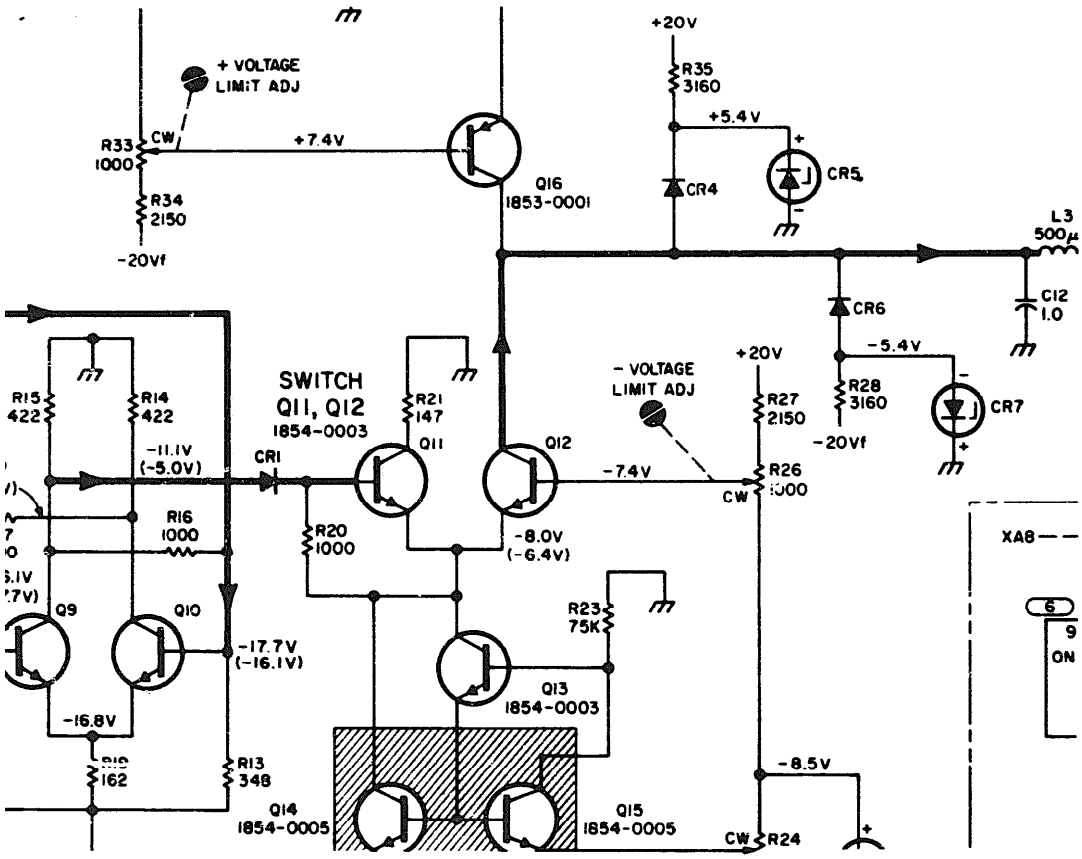


Figure 1. Partial Schematic of A8 Phase Meter Assy (08405-6008)

CHANGE 9: **(Cont.)**

Table 6-2, pages 6-29 thru 6-32,

HP Part Number 0698-3101 change TQ to 0.
HP Part Number 0698-0084 change TQ to 17.
HP Part Number 0751-0279 change TQ to 8.
HP Part Number 0757-0405 change TQ to 3.
HP Part Number 1901-0040 change TQ to 36.

Add the following:

HP Part Number 19023106; Diode breakdown 5.76 volts; 28480; 'IQ 2.
HP Part Number 2100-1657; R:VAR WW 1000 ohm 10% 1 W; 28480; TQ 2.

CHANGE 10: a.) All Sampler Assy 08405-6011 is different (see Figure 2) than shown in Figure 7-15.

Table 6-1, pages 6-13 thru 6-15,

Add:

A11C9	0150-0050	C:FXD CER 1000 PF 6OOVDCW
A11C10	0140-0176	C:FKD MICA 100 PF 2%
A11C14	0140-0176	C:FKD MICA 100 PF 2%
A11C15	0150-0050	C:FKD CER 1000 PF 6OOVDCW
A11C18	0180-0116	C:FKD ELECT 6.8 UF 10% 35VDCW
A11R14	0757-0346	C:FKD MET FLM 10 OHM 1% 1/8W
A11R16	0698-3157	C:FKD MET FLM 19.6K OHM 1% 1/8W
A11R17	0757-0440	R:FXD MET FLM 7.5K OHM 1% 1/8W
A11R27	0757-0440	R:FXD MET FLM 7.5K OHM 1% 1/8W
A11R29	0698-3157	R:FKD MET FLM 19.6K OHM 1% 1/8W
A11R30	0757-0394	C:FKD MET FLM 51.1 OHM 1% 1/8W
A11R32	0757-0346	C:FKD MET FLM 10 OHM 1% 1/8W
A11R33	0698-3440	C:FXD MET FLM 196 OHM 1% 1/8W

Change:

A11lCR17 and A11CR6; 1903-0006; Diode 4 layer silicon
A11Q2; 1854-0087; Transistor; NPN Silicon 2N3417
A11Q3; 1854-0071; Transistor; NPN Silicon
A11Q6; 1854-0071; Transistor; NPN Silicon
A11R8 & R9; 0757-0417; R:FXD 562 OHM 1% 1/8W
A11R15 & R28; 0757-0279; R:FXD 3.16K OHM 1% 1/8W

Delete: A11Q7

Table 6-2, Pages 6-28 thru 6-32,

HP Part Number 0140-0176 change TQ to 8
HP Part Number 0150-0050 change TQ to 3
HP Part Number 0180-0116 change TQ to 7
HP Part Number 0698-0084 change TQ to 15
HP Part Number 0698-3157 change TQ to 16
HP Part Number 0698-3440 change TQ to 15
HP Part Number 0757-0394 change TQ to 10
HP Part Number 0757-0440 change TQ to 6
HP Part Number 0757-0346 change TQ to 4
HP Part Number 0757-0279 change TQ to 10
HP Part Number 0757-0815 change TQ to 0
HP Part Number 1853-0010 change TQ to 1
HP Part Number 1854-0039 change TQ to 0
HP Part Number 1854-0071 change TQ to 49
HP Part Number 1901-0040 change TQ to 34

Add the following:
0757-0417; R:FXD 562 OHM 1% 1/8W; TQ 2
1854-0987; Transistor NPN Silicon 2N3417; **TQ1**
1903-0006; Diode 4 Layer Silicon; TQ 2

b.) In the event of A12R27 failure, it is recommended that the value be changed.
From: 0698-3446 R:FXD 3830HM 1% 1/8W
To: 0686-4315 R:FXD 43052 5% 1/2W

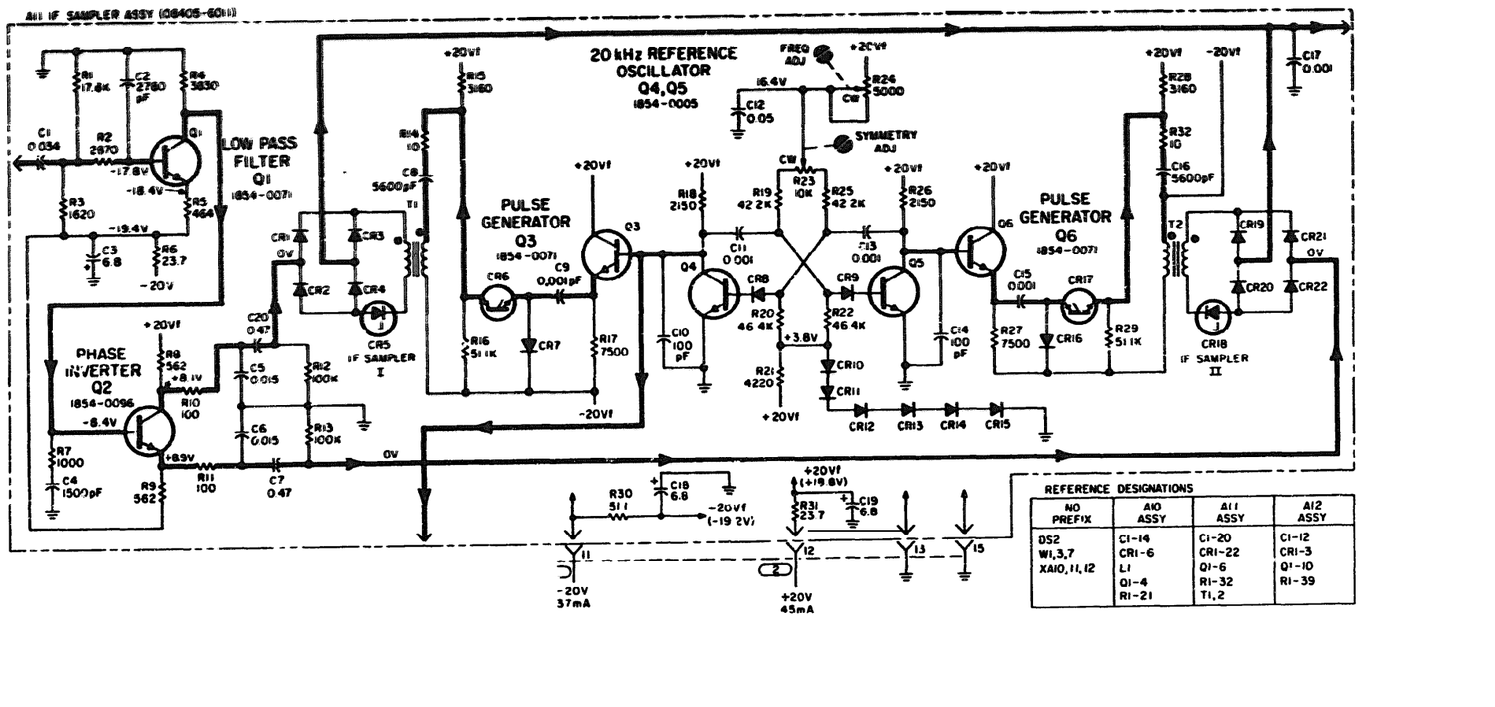


Figure 2. Schematic of All IF Sampler Assy (08405-6011)

CHANGE 11: To improve reliability of the A13 EQUALIZER Assy (08405-6013) it is recommended that capacitors A13C3 and A13C4 be changed.

From: 0170-0069 C:FXD Poly 0.1 µf 2% 50 VDCW
To: 0160-0168 C:FXD MY 0.1 µf 10% 200 VDCW

CHANGE 12: a.) To improve circuit performance of the A15 Pulse Generator Assy (08405-6015) it is recommended that Resistors A15R1 and A15R2 be changed.

From: 0757-0346 R:FXD MET FLM 10 OHM 1% 1/8W
To: 0757-0396 R:FXD MET FLM 51.1 OHM 1% 1/8W

b.) To improve circuit performance of the A11 Sampler Assy (08405-6011), it is recommended that Resistors A11R16 and A11R29 be changed.

From: 0698-3157 R:FXD MET FLM 19.6K OHM 1% 1/8W
To: 0757-0458 R:FXD MET FLM 51.1K OHM 1% 1/8W

CHANGE 13: a.) An improved probe Assy 08405-6054 (item "C" of Figure 3 of this Appendix) was designed for use with all 8405A Vector Voltmeters, regardless of prefix serial number.

NOTE

Type "A" probes (08405-6001) or type "B" probes (08405-6046) are no longer available. In the event of a type "A" or type "B" probe failure, both probe assemblies CHANNEL A and CHANNEL B will have to be replaced. Replacement Kit 08405-6056 supplies (2) complete type "C" probe assemblies and Service Note (P-08405-6056) supplies the necessary replacement and adjustment procedures. Replacement Kits or Service Notes are available through the nearest HP Office.

b.) If the APC Light (DS2) fails, it is recommended that diode A12CR2 be changed (see Parts List for description).

CHANGE 14: For increased accuracy of the voltmeter, it is recommended that resistors A5R31 and A18R31 be removed and replaced with inductors A5L2 and A18L2 (see Parts List for description).

CHANGE 15: a.) To eliminate possible oscillations of A6Q4, the recommended replacement is (HP Part Number 1854-0371).

b.) To improve range to range tracking of the VOLTMETER, add capacitor A22C1 to A22 Amplitude Range Switch Assy (see Figures 7-12 and 7-13).

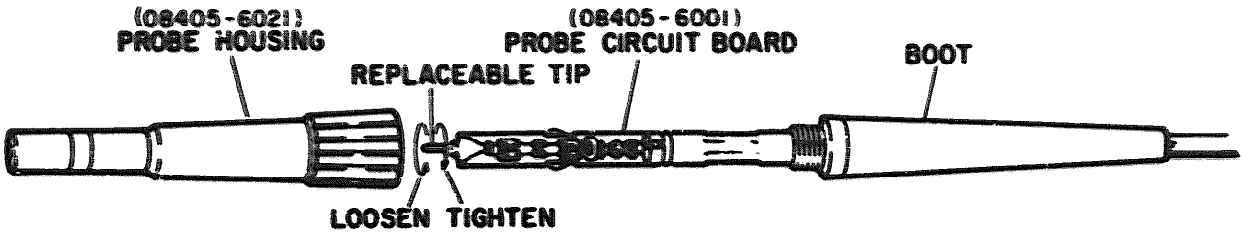
CHARGE 16: a.) To surpress oscillations which may occur on A10 APC Amplifier Assy (08405-6010) it is recommended that A10R5 be changed.

From: 0757-0394 R:FXB MET FLM 51.1 OHM 1% 1/8W
To: 0757.0406 R:FXD MET FLM 182 OHM 1% 1/8W

b.) To dampen oscillations on the A6 180° Switch Assy (08405-6006), it is recommended that a ferrite bead A6L2 be added in the base lead of A6Q4.

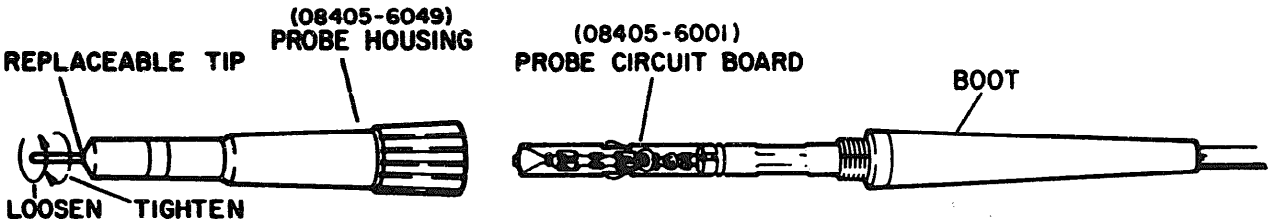
Add: A6L2 9170-0016 Ferrite Bead

CHARGE 17: To improve performance of the Al4 VTO Assy (08405-6014), it is recommended that resistors A14R23 and R4 be added. R4 is to be inserted between pin 9 of XA14 and wiper A of A24 Frequency Range Switch Assy (see Figures 7-16 and 7-17).



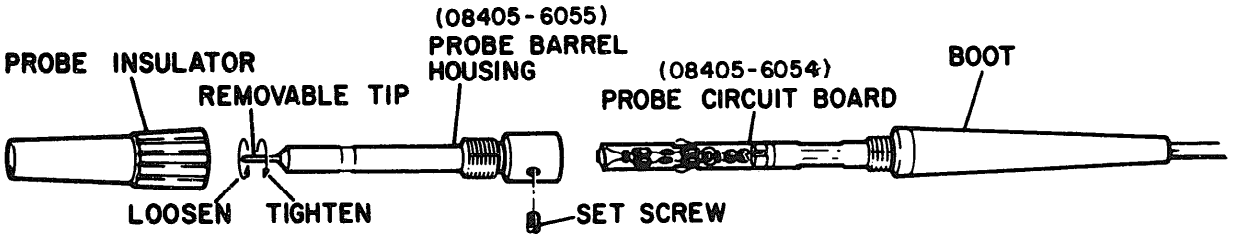
"A" Type Probe: The Original Probe

Shipment Dates: May 1966 through December 1966
Serial Numbers: 611-00101 through 645-00660
Identifying Feature: Probe tip screws into probe board



"B" Type Probe: The Second Generation Probe

Shipment Dates: January 1967 through August 1967
Serial Numbers: 645-00661 through 725-01110
Identifying Feature: Probe tip screws into probe housing



"C" Type Probe: The Final Probe

Shipment Dates: September 1967 to Present
Serial Numbers: 732-01111 and up
Identifying Feature: Probe housing consists of two parts, barrel and insulator

Figure 3. Three Types of Probes

APPENDIX G

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 8405A
Date Printed: May 1971
Part Number: 08405-90024

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

To use this supplement:

Make all ERRATA corrections

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

Serial Prefix or Number	Make Manual Changes
1144A03896 to 05110	1
1144A05111 thru 1144A05685	1, 2
1144A05686 thru 1144A Prefix	1, 2, 3

Serial Prefix or Number	Make Manual Changes
1527A05868 thru 1527A06185	1 thru 4
1527A06186 thru 1527A prefix	1 thru 5
► 1621A	1 thru 6

► NEW ITEM

ERRATA

►Page 1-1. GENERAL INFORMATION:

Add the attached Paragraph 1-A preceding Paragraph 1-1:

Page 5-18. Figure 2D. Adjustment Locations:

Change callouts A8R23 to A8R24

Page 5-13. Table 5-3. Adjustment Procedure Number 4:

Change step f first two sentences to read as follows:

f. For 8405A Vector Voltmeters having fixed resistors for A8R26 and A8R33. go to step g.
For instruments having potentiometers for A8R26 and A8R33. perform steps (I). (2) and (3).

Table 6-1:

Change the HP Part Number of the following components to 1901-0040:

On page 64 A5CR1 and 2. on page 6-6 A6CR1 and 2. on page 6-7 A7CR1 and 2. on page 6-12 A1OCR1 thru 6. and on page 6-2 I A18CR1 and 2.

Page 6-13. Table 6-1.

Change A11CR8 and A11CRC, to HP Part No. 1901-0040. DIODE: SILICON 30 MA 30WV.
Also. add the following note:

NOTE

HP Part No. 1901-0040 is the recommended replacement for A11CR8 and A11CR9. If 20 kHz oscillator drifts, replace these diodes, also replace A11Q4 and A1105.

Page 6-18. Table 6-1:

►**Change A14Q5 and A14Q6 to HP Part No. 1853-0034 (Recommended Replacement).**
Change A14Q7 and A14Q8 to HP Part No. 1854-0005 (Recommended Replacement).

Page 6-26. Table 6-1 :

Change ISOLATOR part number from 10216-60001 to 10216A.

Page 6-32. Table 6-2 :

Change quantity of 1901-0040 to 42.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

AY 1976
ges

HEWLETT hp PACKARD

ERRATA (cont'd)

Page 6-34, Table 6-2:
Delete 08405-8004:

Page 7-4:
Add Figure 7-5A attached.

Page 7-7:
Add Figure 7-6A attached.

Page 7-9.
Add Figure 7-7A attached-Add Figure 7-7B attached.

Page 7-9, Figure 7-8 (b):
Reverse reference designators tars A6R28 and A6R30.

Page 7-10:
Add Figure 7-10A attached.

Page 7-12:
Add Figure 7-12A Attached.

Page 7-14:
Add Figure 7-14A attached-Add Figure 7-14B attached-Add Figure 7-14C attached.

Page 7-15, Figure 7-15 (b):
Move A12 Test Point 3 to Q9 collector.

Page 7-16:
Add Figure 7-16A attached - Add Figure 7-16B attached - Add Figure 7-16C attached.

Page 7-17, Figure 7-17 (b):
Change A14Q5 and A14Q6 to HP Part No. 1853-0034 (Recommended Replacement).
Change A14Q7 and A14Q8 to HP Part No. 1854-005 (Recommended Replacement).

Page 7-19:
Add Figure 7-17A attached.

Page I-3. Paragraph I-7:
Delete all references to Rack Mounting Kit.

Page I-3. Paragraph l-1 3:
Add: "A Rack Mounting Kit is available to install the instrument in a 19-inch rack. Rack Mounting Kits may be obtained through your nearest Hewlett-Packard Office by ordering HP Part Number 5060-8741."

CHANGE 1

Page 6-27. Table 6-l :
Add the following note to Reference Designation Index under Cabinet Parts to explain the 8405A color scheme.

NOTE

This change implements a different color scheme for the standard instrument. The color scheme prior to this change is now available as an option. Refer to listing below.

8405A STANDARD - Indicates 8405A color scheme beginning with this change. (Includes MINT GRAY front panel and OLIVE GRAY cabinet).

8405A OPTION A85 - Indicates LIGHT **GRAY front panel.**

8405A OPTION X95 - Indicates complete 8405A color scheme prior to this change. (Includes LIGHT GRAY front panel and BLUE GRAY cabinet).

Add to Item 2:
08405-00026 Panel. Front: MINT GRAY (STANDARD). 08405-0025 Panel. Front: LIGHT GRAY (OPTION A85 and X95).

Add to Item 5:
5060-8741 Kit 7H Rack Mount: MINT GRAY (STANDARD). 5060-0776 Kit 7H Rack Mount: LIGHT GRAY (OPTION A85 and X95).

Add to Item 10:
5060-8713 Bottom Cover Assy. 16LFM: OLIVE GRAY (STANDARD). 5060-0752 Bottom Cover Assy. 16LFM: BLUE GRAY (OPTION X95)

Add to Item 12:
5060-8735 Retainer Handle Assy: OLIVE GRAY (STANDARD). 5060-0765 Retainer Handle Assy: BLUE GRAY (OPTION X95)

Add to Item 16:
5000-8717 Cover, Side 7X16SM: OLIVE GRAY (STANDARD). 5000-0742 Cover, Side 7X16SM: BLUE GRAY (OPTION X95)

CHANGE 2

Page 6-25, Table 6-1:
Change R1 0698-3162 R:FXD MET FLM 46.4K OHM 1% 1/8W.

Page 7-19, Figure 7-18:
Change R1 to 46.4KΩ.

CHANGE 3

Page 6-20. Table 6-1:
Add A16C7 HP Part No. 0180-0230 C: FXD ELECT 1.0 uf 20% 50 VDCW.

Page 7-19, Figure 7-18:
Add C7 (Connect positive end to C7 to base of Q5 and negative end to ground).

CHANGE 4

Page 6-2, Table 6-1:
Add A3CR1 HP Part No. 1901-0179 DIODE-SWITCHING 15V 50NA 750PS DO-7.

Page 6-3. Table 6-1:
Add A4CR1 HP Part No. 1901-0179 DIODE-SWITCHING 15V 50NA 750PS DO-7.

Page 7-5. Figure 76- (b):
Add A3CR1 between A3T1 and XA3 pin 4 with the anode connected to A3T1.
Add A4CR1 between A4T1 and XA4 pin 4 with the anode connected to A4T1.

CHANGE 5

Page 6-3, Table 6-1:
Change A3R19 HO Part Number to 0698-3156, and value in Description column to 14.7K.

Page 6-4, Table 6-1:
Change A4R19 HP Part Number to 0698-3156, and value in Description column to 14.7K.

Page 7-5, Figure 7-6 (b):
Change A3R19 value to 14.X - Change A4R19 value to 14.7K.

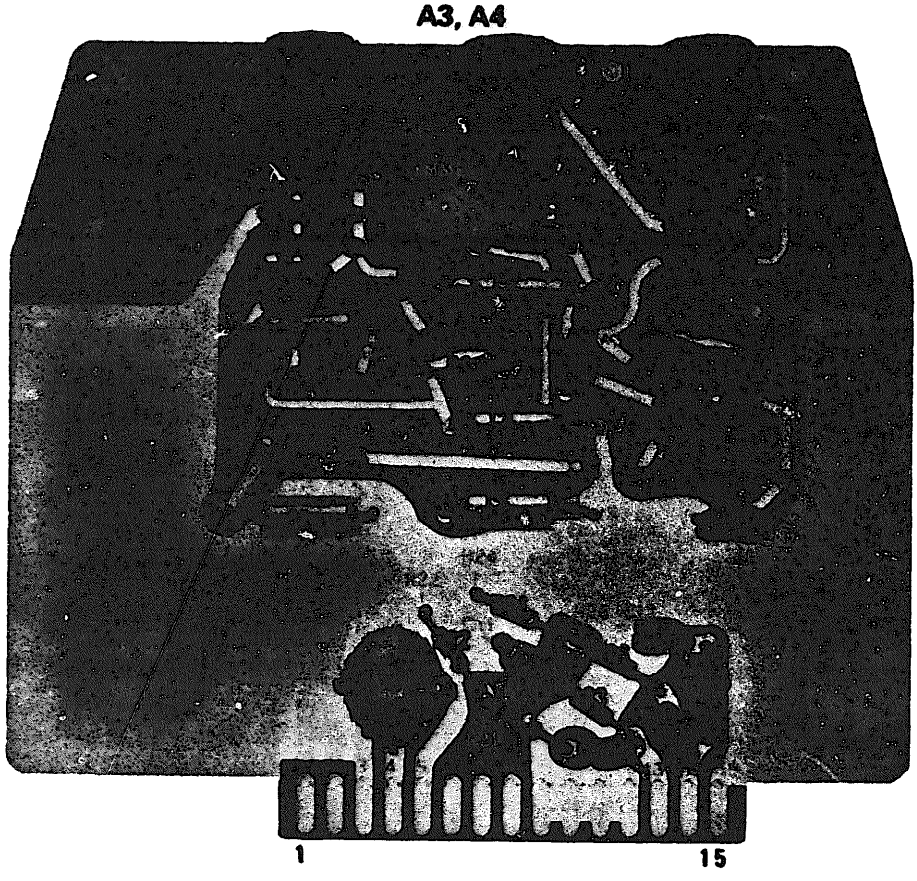


*Figure 7-5A. A3 and A4 **Sampler Assembly Component Identification***

►CHANGE 6

Page 6-26, Table 6-2:
Change KNOB: FREQ RANGE, W/DIAL ATTACHED to HP Part No. 08405-6020.

Page 6-27, Table 6-1:
Change Item 6 to HP Part No. 08405-00027.
Change Item 8 to HP Part No. 08405-00028.
Change Item 9 to HP Part No. 08405-00029.

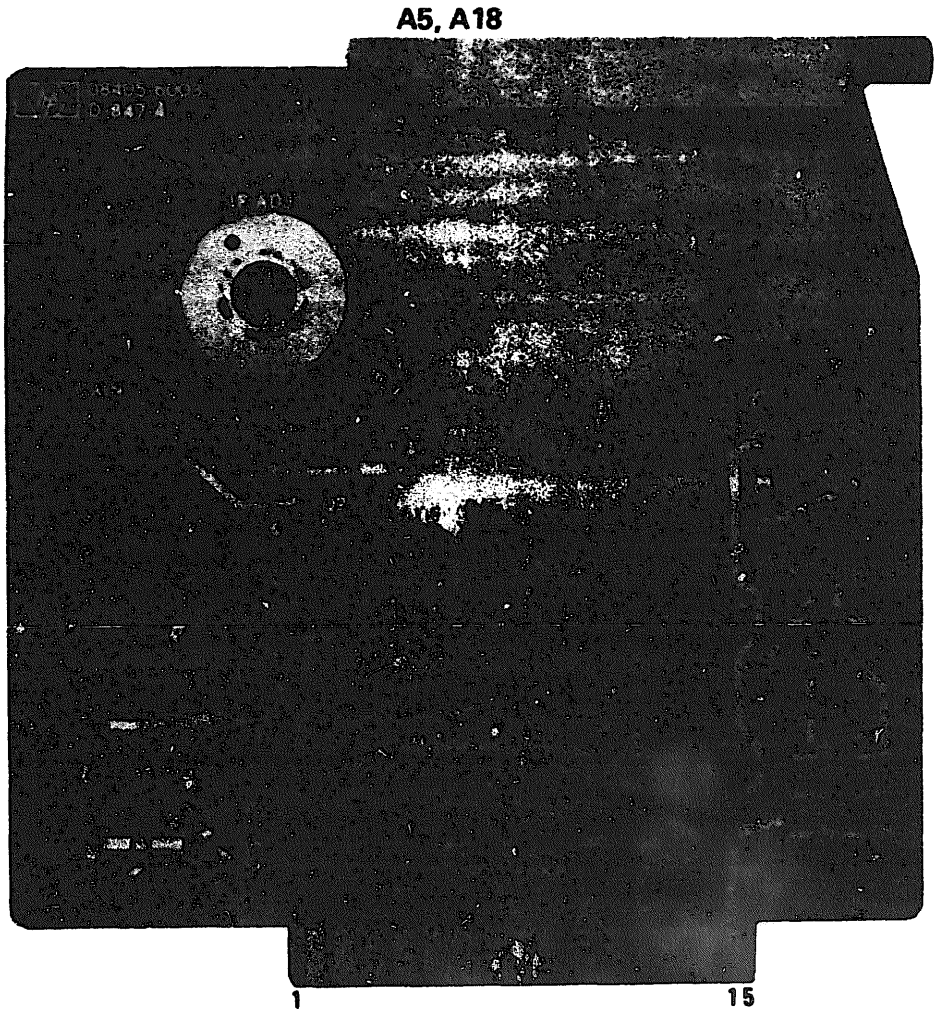


Figure 7-6A. A5 and A18 Isolation Amplifier Assembly Component Identification

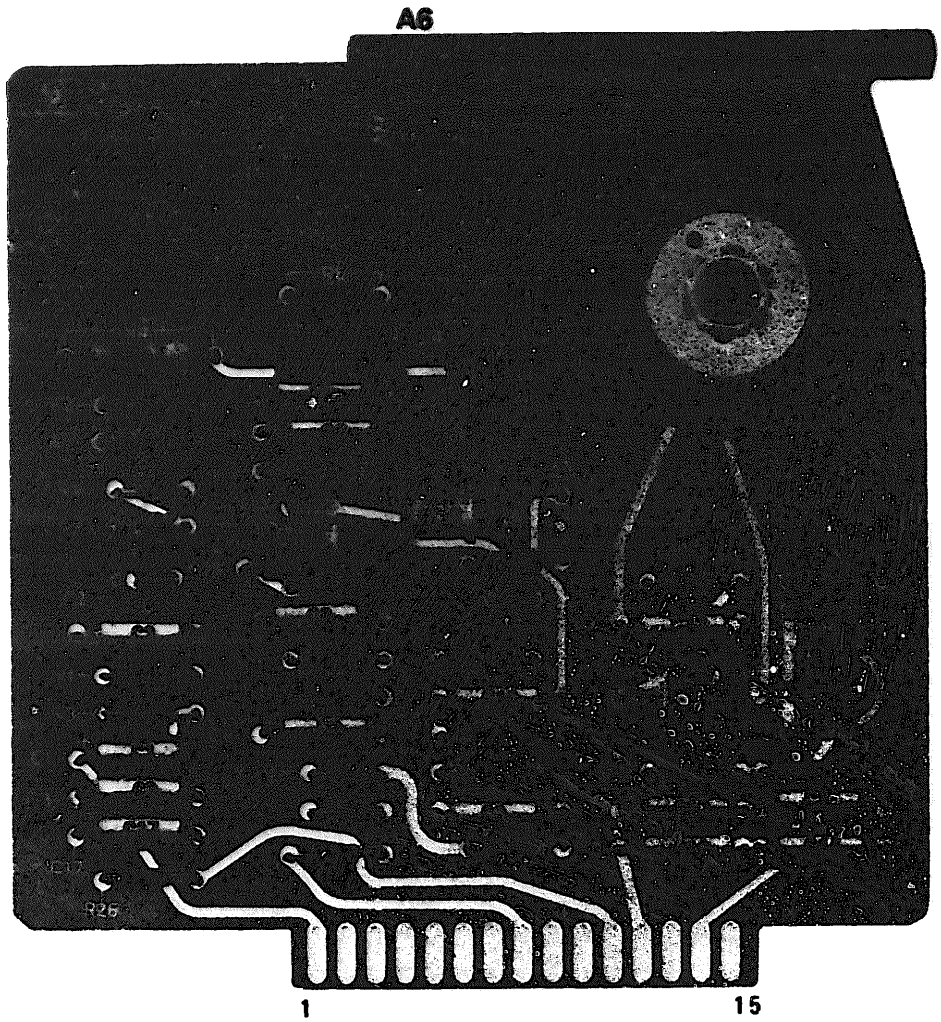


Figure 7-7A. A6 180 Degree Switch Assembly Component Identification

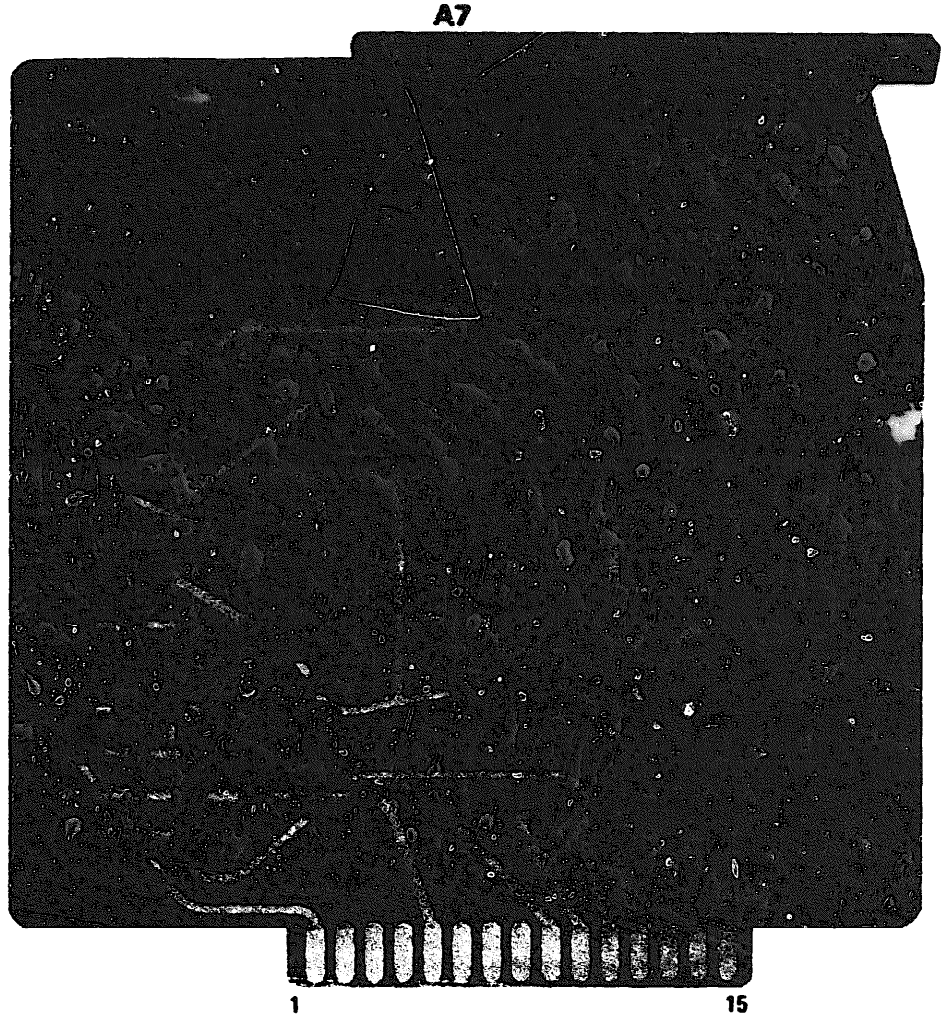


Figure 7-7B. A7 Phase Shifter Assembly Component Identification

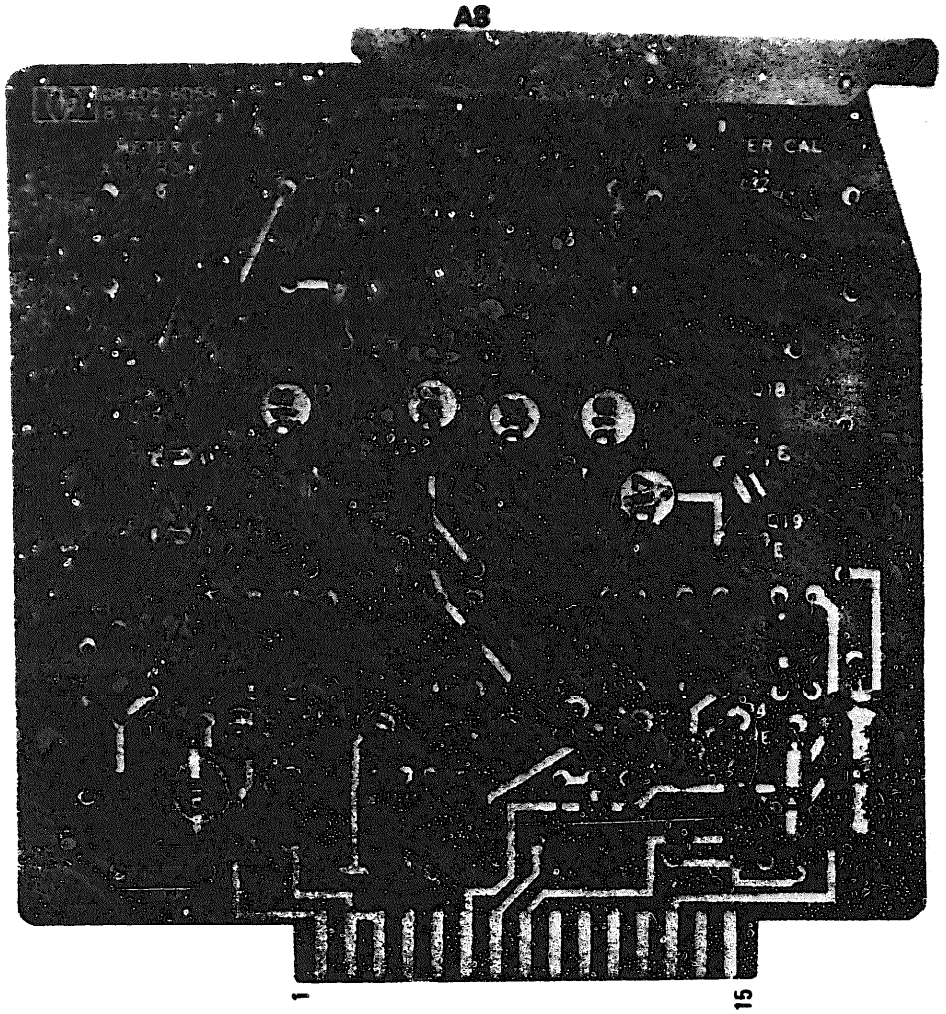


Figure 7-10A. A8 Phase Meter Assembly Component Identification

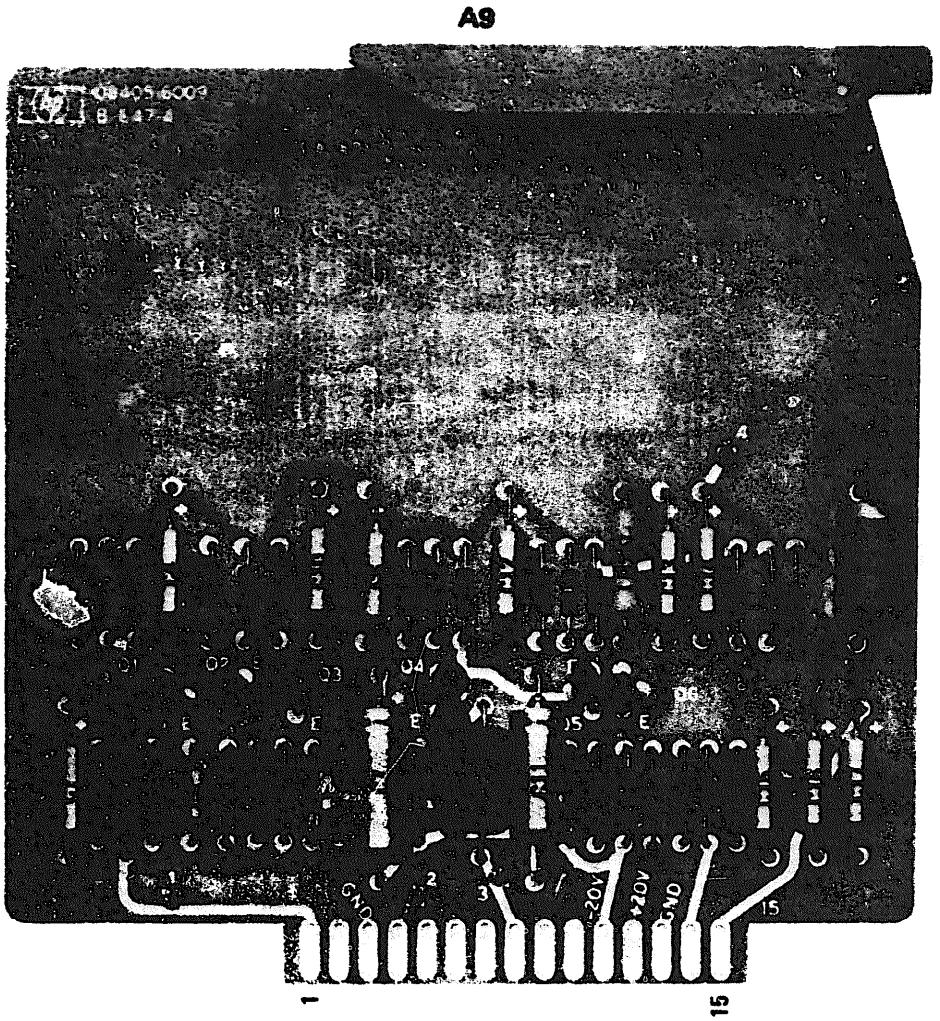


Figure 7-12A. A9 Voltmeter Assembly Component Identification

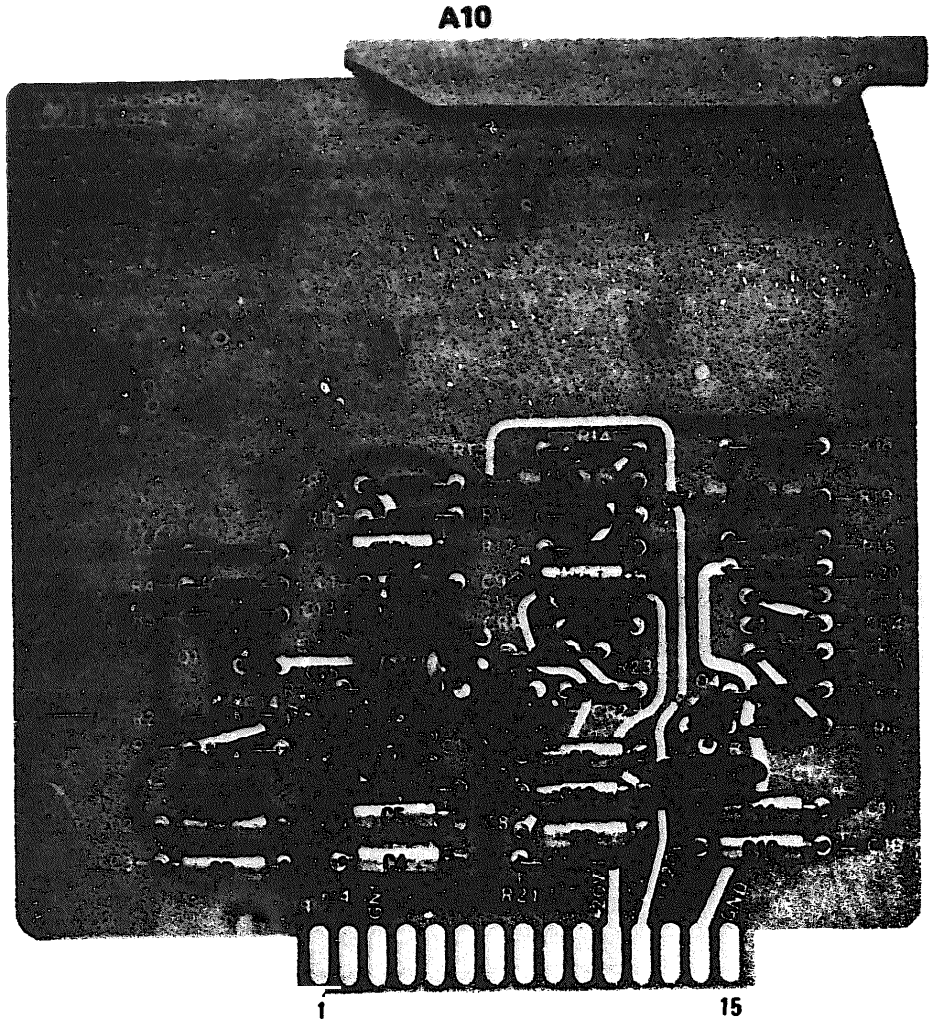


Figure 7-14A. A10 APC Amplifier Assembly Component Identification

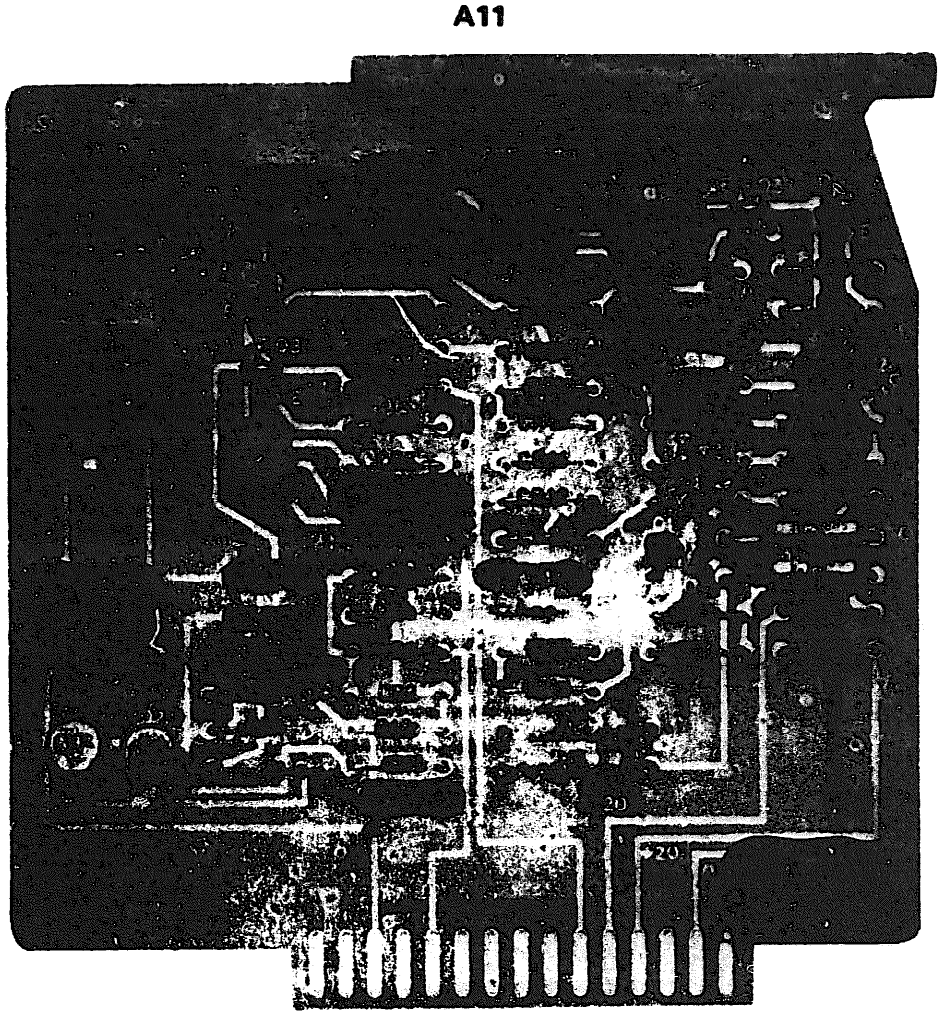


Figure 7-14B. A11 IF Sampler Assembly Component Identification

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and
Electronics Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

TEAR ALONG DOTTED LINE

FOLD BACK

REVERSE OF DA FORM 2028-2

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2856-14	10 Oct 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FINDS," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

TEAR ALONG DOTTED LINE

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and
Electronics Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

TEAR ALONG DOTTED LINE

FOLD BACK

REVERSE OF DA FORM 2028-2

TEAR ALONG DOTTED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM. TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2856-14	10 Oct 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE AND TELEPHONE NUMBER

SIGN HERE:

DA FORM 2028-2

P.S.—IF YOUR OUTFIT WANTS TO KNOW [illegible] YOUR MANUAL "FOULED UP" MAKE A CARBON COPY OF THIS AND SEND [illegible] YOUR HEADQUARTERS.

FILL IN YOUR UNIT'S ADDRESS

FOLD BACK

DEPARTMENT OF THE ARMY

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD-314

Commander
US Army Communications and
Electronics Materiel Readiness Command
ATTN: DRSEL-MA-Q
Fort Monmouth, New Jersey 07703

TEAR ALONG DOTTED LINE

FOLD BACK

REVERSE OF DA FORM 3025-R

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)

DATE

PUBLICATION NUMBER	DATE	TITLE
TM 11-6625-2856-14	10 Oct 78	

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE:

DA FORM AUG 74 2028-2

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FIND," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOU'S HEADQUARTERS

TEAR ALONG DOTTED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)
Commander
Stateside Army Depot
ATTN: AMSTA-US
Stateside, N.J. 07703

DATE 10 July 1975

PUBLICATION NUMBER	DATE	TITLE
TM 11-5840-340-14&P	23 Jan 74	Radar Set AN/MPQ-76

BE EXACT...PIN-POINT WHERE IT IS				IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:
PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.	
2-25	2-28			Recommend that the installation antenna alignment procedure be changed throughout to specify a 2° IFF antenna lag rather than 1°. REASON: Experience has shown that with only a 1° lag, the antenna servo system is too sensitive to wind gusting in excess of 25 knots, and has a tendency to rapidly accelerate and decelerate as it hunts, causing strain to the drive train. Hunting is minimized by adjusting the lag to 2° without degradation of operation.
3-10	3-3		3-1	Item 5, Function column. Change "2 db" to "3dt." REASON: The adjustment procedure for the TRANS POWER FAULT indicator calls for a 3 db (500 watts) adjustment to light the TRANS POWER FAULT indicator.
5-6	5-8			Add new step f.1 to read, "Replace cover plate removed in step e.1, above." REASON: To replace the cover plate.
		FO3		Zone C 3. On J1-2, change "+24 VDC to "+5 VDC." REASON: This is the output line of the 5 VDC power supply. + 24 VDC is the input voltage.

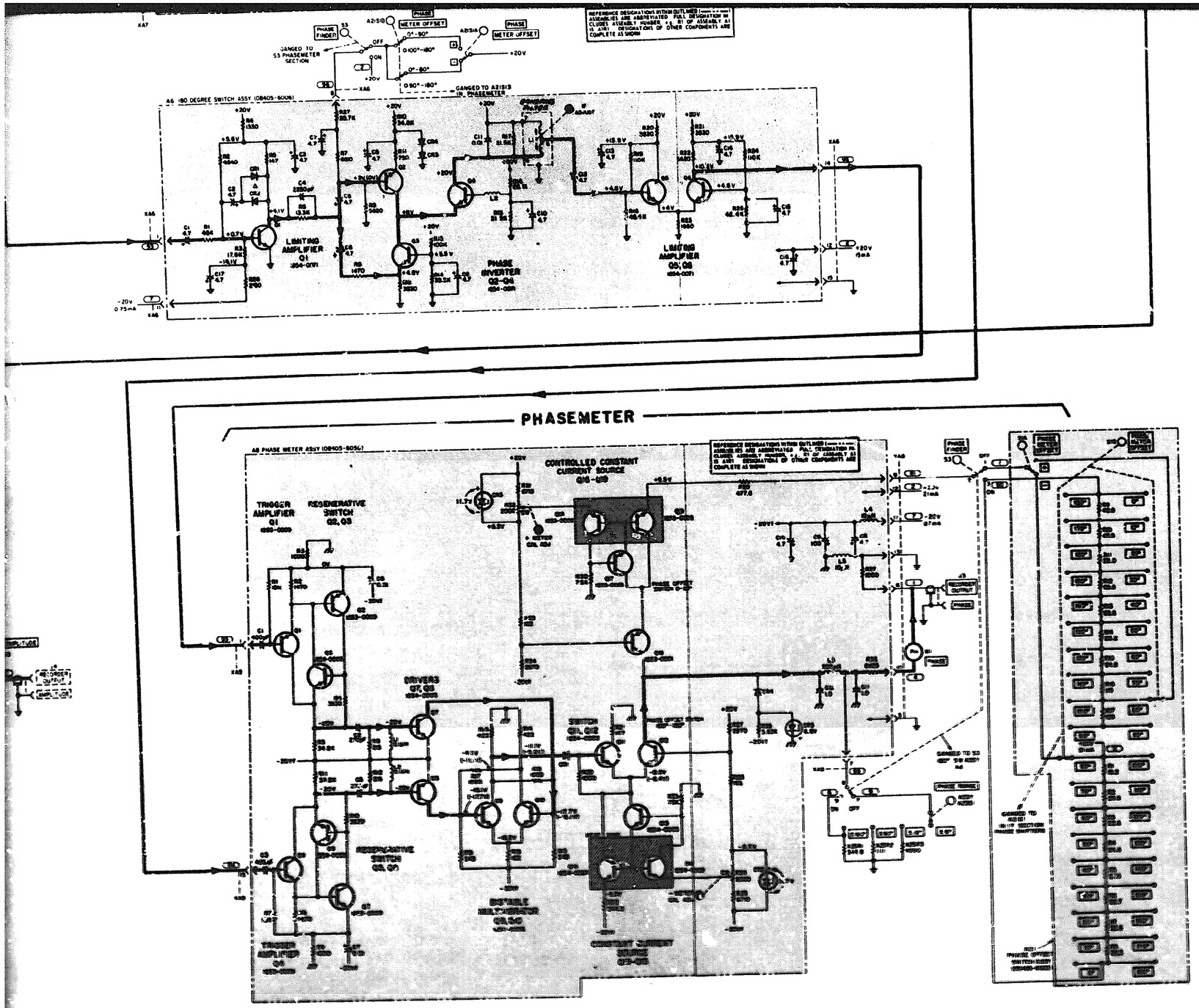
TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER	SIGN HERE:
SSG I. M. DeSpiritof 999-1776	SSG I. M. DeSpiritof

DA FORM 2028-2

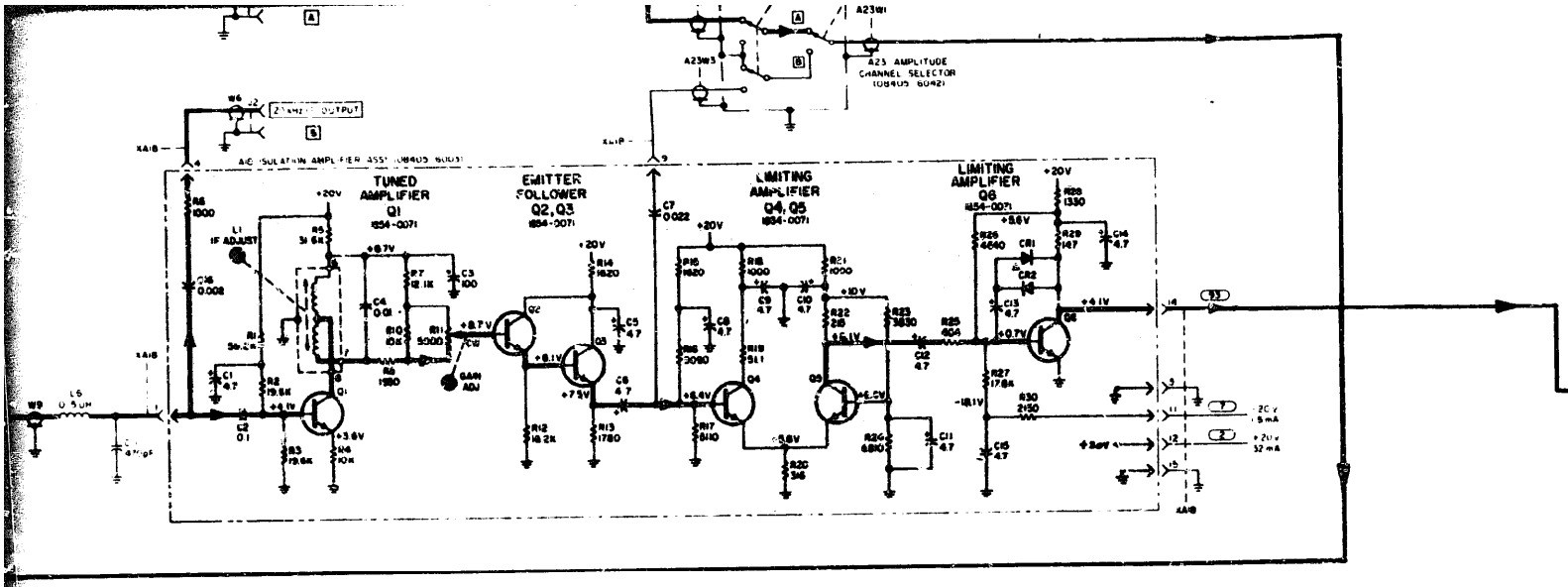
P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR MANUAL "FIND," MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

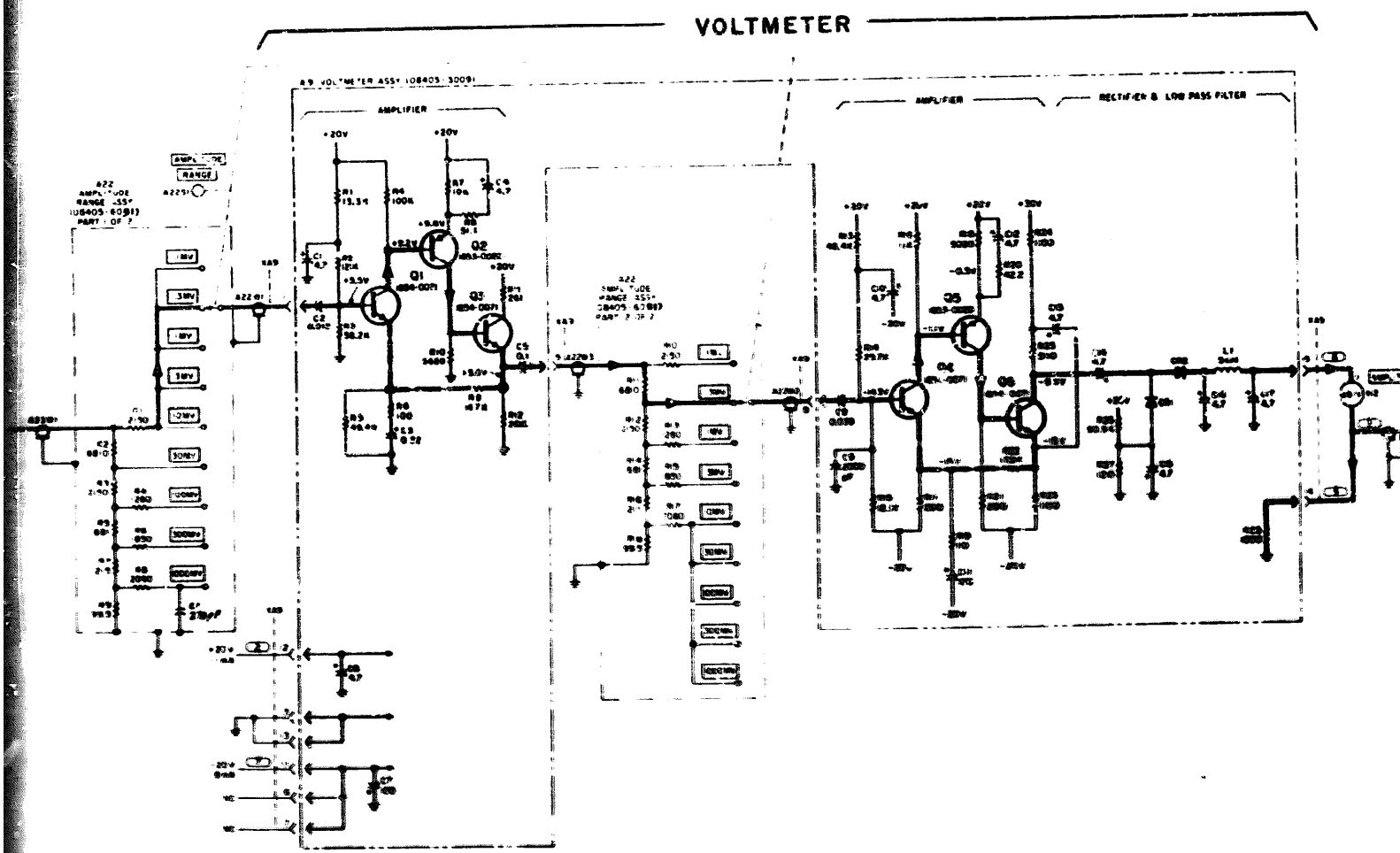
HISA 1686-75

TEAR ALONG DOTTED LINE



Overall Schematic Diagram





MODEL 8405A VECTOR VOLTMETER

OVERALL SCHEMATIC DIAGRAM

HP PART NO. 08405-90026

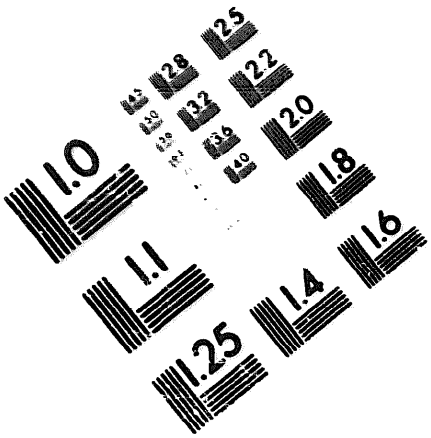
DISTRIBUTION:

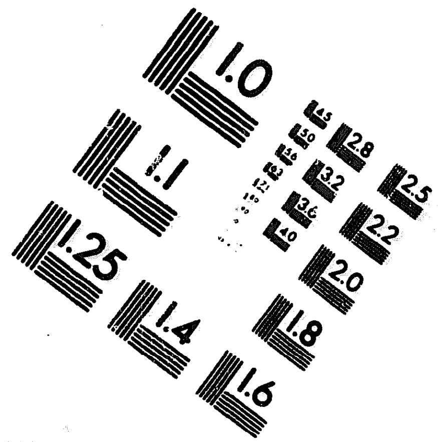
Active Amy:
- TSG (1)
- USAARENBD (1)
- USAINSCOM (2)
- TRADOC (2)
- DARCOM (1)
- TECOM (2)
- OS Maj Cmd (2)
- USACC (2)
- HISA (Ft Monmouth) (21)
- Armies (1)
- USASIGS (10)
- Svc Colleges (1)
- Ft Richardson (CERCOM Ofc) (1)
- Ft Carson (5)
- Ft Gillem (10)
- WSMR (1)
- USAERDAA (1)
- USAERDAW (1)
- Army Dep (1) except:
  - LBAD (10)
  - SAAD (30)
  - TOAD (14)
  - SHAD (3)
- USA Dep (1)
- Sig Sec USA Dep (1)
- Units Org under fol TOE:
  - 29-134 (1)
  - 29-136 (1)
  - 264207 (2)
  - 29-610 (2)

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 310-50.

DEPARTMENT OF THE ARMY

MICROFORM TEST TARGET





150 MM

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

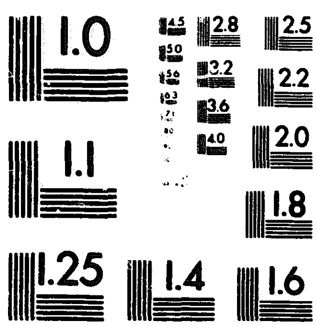
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

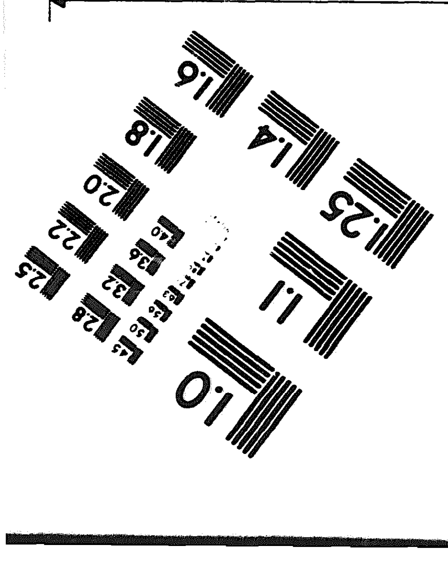
2.0 mm (e= 1.37 mm)

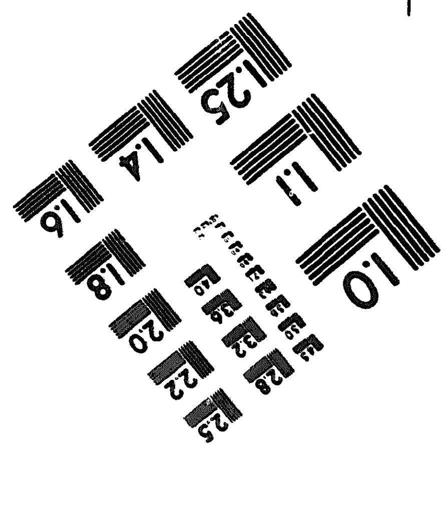
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM





250 MM

TM 11-6625-2856-14
C 1

CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *17 October 1979*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

VECTOR VOLTMETER, HEWLETT-PACKARD MODEL 8405A (NSN 6625-00-929-1897)

TM 11-6625-2856-14, 10 October 1978, is changed as follows:

1. New or changed material is indicated by a vertical bar in the margin of the page.
2. Remove and insert pages as indicated in the page list below:

Remove	Insert
i and ii	i and ii
O-lend 1-0	0-1
none	1-0
A-l	A-1

3. File this change sheet in the front of the publication for reference purposes.

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

TM 11-6625-2856-14

TECHNICAL MANUAL
No. 11-6625-2856-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *10 October1978*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR VECTOR VOLTMETER, HEWLETT–PACKARD MODEL 8405A (NSN 6625–00–929–1897)

REPORTING 'OF ERRORS

You can improve this manual by recommending improvements using DA Form 2028-2 located in the back of the matrial. Simply tear out the self-addressed form, fill it out as shown on the sample, fold it where shown, and drop it in the mail.

If there are no blank DA Form 2028-2 in the back of your manual, use the standard DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forward to the Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth. Sew Jersey 07703.

In either case a reply will be furnished direct to you.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION O
INTRODUCTION

0-1. SCOPE.

This manual describes Vector Voltmeter, Hewlett-Packard Model 8405A and provides instructions for operation and maintenance. This manual also includes a component of end items (COEI) list (app B) and a maintenance allocation chart (MAC) (app D). Repair parts and special tool lists (RPSTL's) are included in TM 11-6625-2856-24P. Calibration procedures are contained in TB 11-6625-2856-50.

0-2. INDEXES OF PUBLICATIONS.

a *DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

0-3. MAINTENANCE FORMS, RECORDS AND REPORTS.

a. Reports of Maintenance and Unsatisfactory Equipment. Department of the Army forms and procedures used for equipment maintenance will be those described by TM 38-750, The Army Maintenance Management System.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report1 as prescribed in AR 700-58/ NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DLAR 4145.8.

c. Discrepancy in Shipment Report (DLSREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33B/AFR 75-18/MCO P4610.19C and DLAR 4500.15.

0-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your Vector Voltmeter, Hewlett-Packard Model 8405A needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

0-5. ADMINISTRATIVE STORAGE.

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-I.

0-6. DESTRUCTION OF ARMY ELECTRONICS MATERIEL.

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

0-7. HAND RECEIPTS.

Hand receipts for Components of End Item (COEI), Basic Issue Items (BII, and Additional Authorization List (AAL) items are published in a Hand Receipt manual, TM 11-6625-2856-14-HR. This manual is published to aid in property accountability. Additional copies of the Hand Receipt manual may be requisitioned from the Adjutant General Publications Center, 1655 Woodson Road, St. Louis, MO 63114 in accordance with chapter 3, AR 310-2.

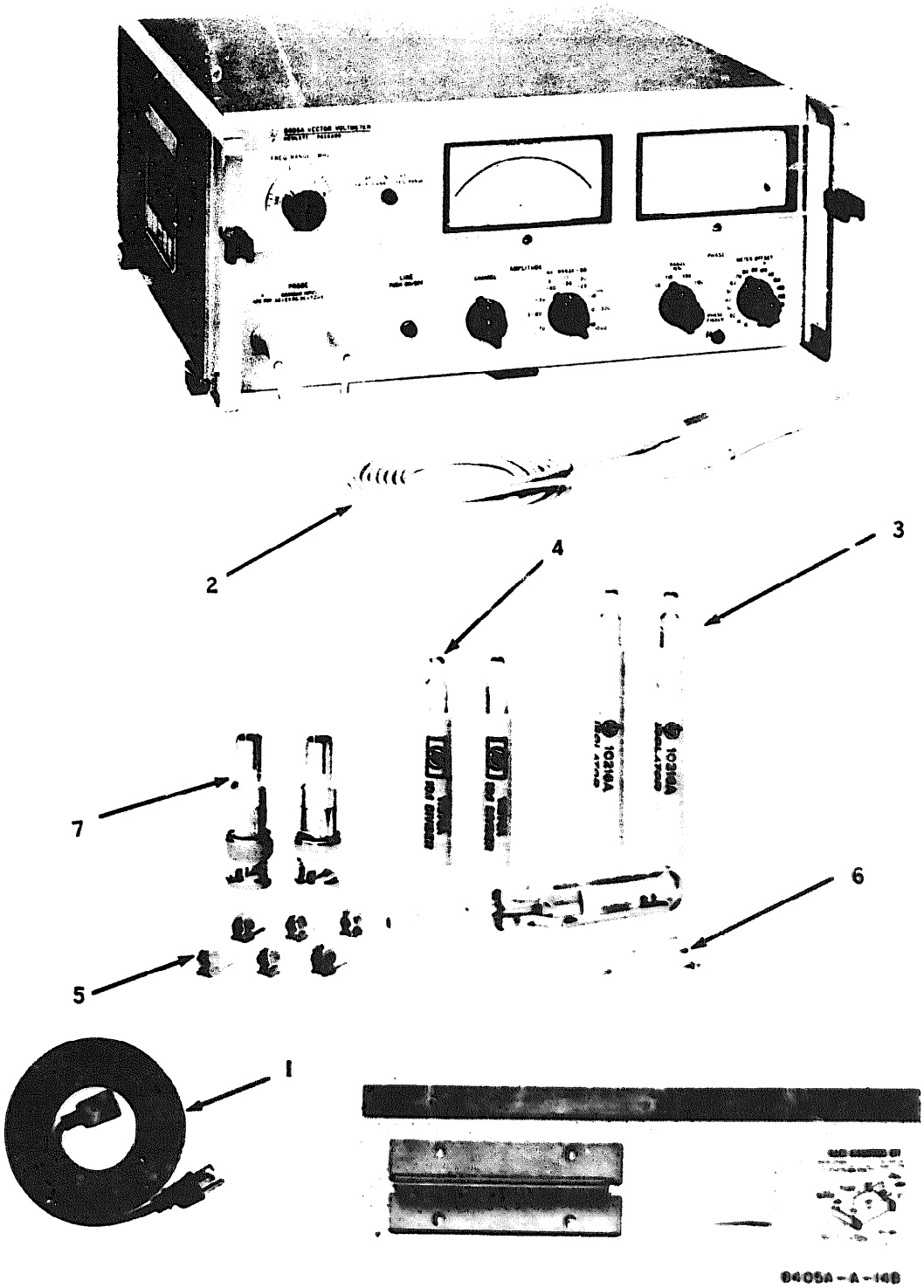


Figure 1-1. Model 8405A Vector Voltmeter and Supplied Accessories

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Publications: Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	Index of Modification Work Orders.
TB 11-6625-2856-50	Calibration Procedures for Vector Voltmeter, Hewlett-Packard Model 8405A (NSN 6625-00-929-1897)
TM 11-6625-2856-14-HR	Hand Receipt Manual Covering End Item/Components of End Item (COEI, Basic Issue Items (BII), and Additional Authorization List (AAL) for Vector Voltmeter, Hewlett-Packard Model 8405A (NSN 6625-00-929-1897).
TM 11-6625-2856-24P	Organizational, Direct Support and General Support Maintenance Repair Parts and Special Tools List (Including Depot Repair Parts and Special Tools) for Vector Voltmeter, Hewlett-Packard Model 8405A (NSN 6625-60-929-1897).
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 740-96-l	Administrative Storage of Equipment.
TM 756-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

END

8-1-83

DATE

DEPARTMENT OF THE ARMY
US ARMY AG PUBLICATIONS CENTER
1655 WOODSON ROAD
ST. LOUIS, MISSOURI 63114

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

POSTAGE AND FEES PAID
DEPARTMENT OF THE ARMY
DOD 314

DISTRIBUTION:

Active Army:

TSG (1)
USAARENBD (1)
USAINSCOM (2)
TRADOC (2)
DARCOM (1)
TECOM (2)
OS Maj Cmd (2)
USACC (2)
HISA (Ft Monmouth) (21)
Armies (1)
USASIGS (10)
Svc Colleges (1)
Ft Richardson CERCOM Ofc) (1)
Ft Carson (5)
Ft Gillem (10)
WSMR (1)
USAERDAA (1)
USAERDAW (1)
Army Dep (1) except:
LBAD (10)
SAAD (30)
TOAD (14)
SHAD (3)
USA Dep (1)
Sig See USA Dep (1)
Units Org under fol TOE:
29-134 (1)
29-136 (1)
29-207 (2)
29-610 (2)

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 310-50.

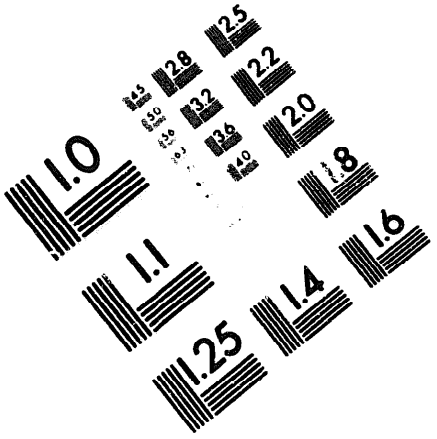
END

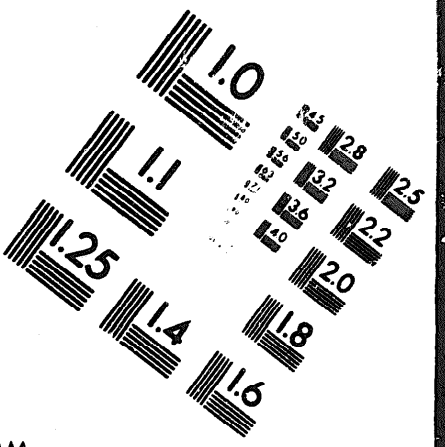
8-1-83

DATE

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

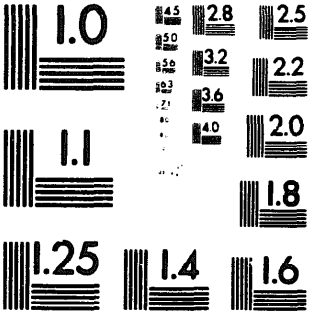
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



1.0 mm (e= .81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

1.5 mm (e= 1.09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

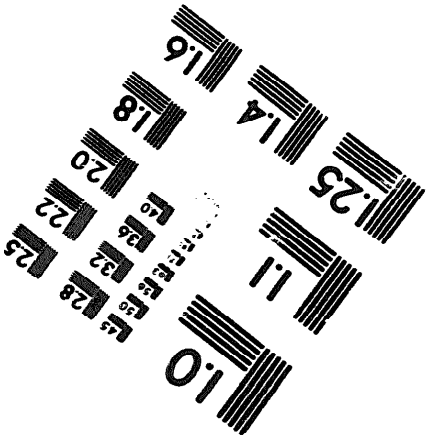
2.0 mm (e= 1.37 mm)

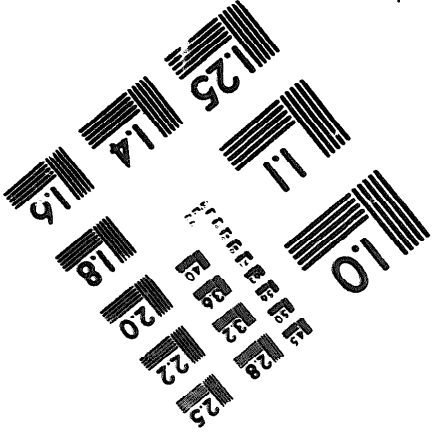
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM

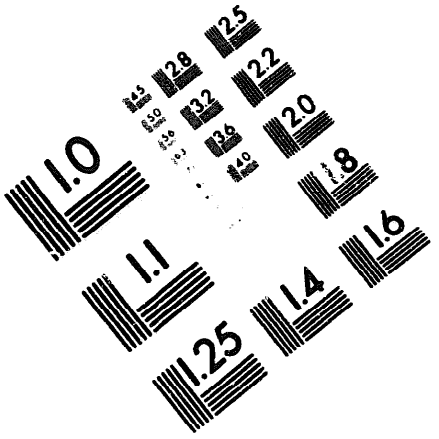


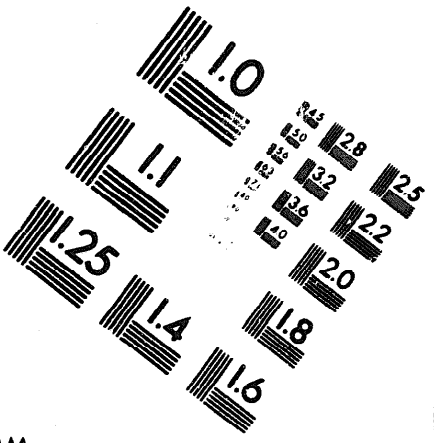


250 MM

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

1.5 mm (e= 1.09 mm)

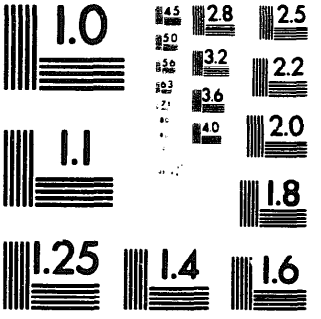
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

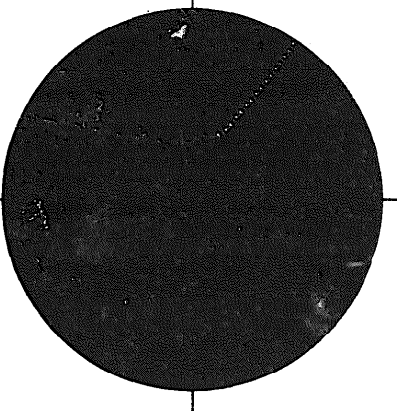
2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

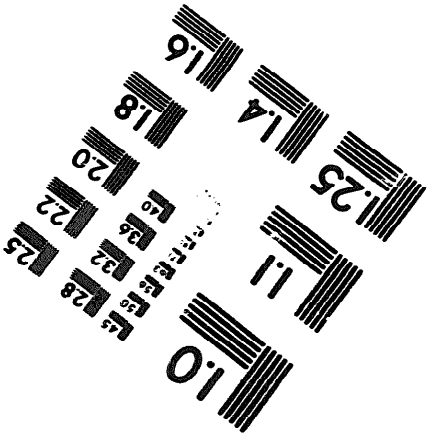
2.5 mm (e= 1.77 mm)

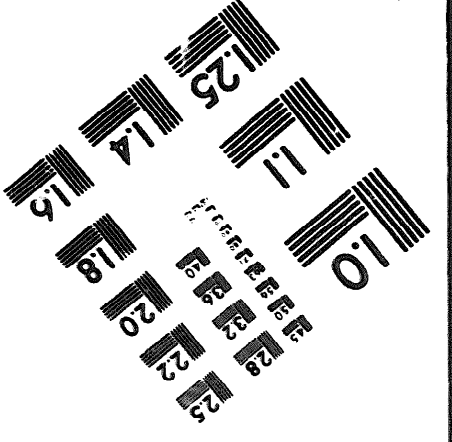
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*





200 MM





250 MM