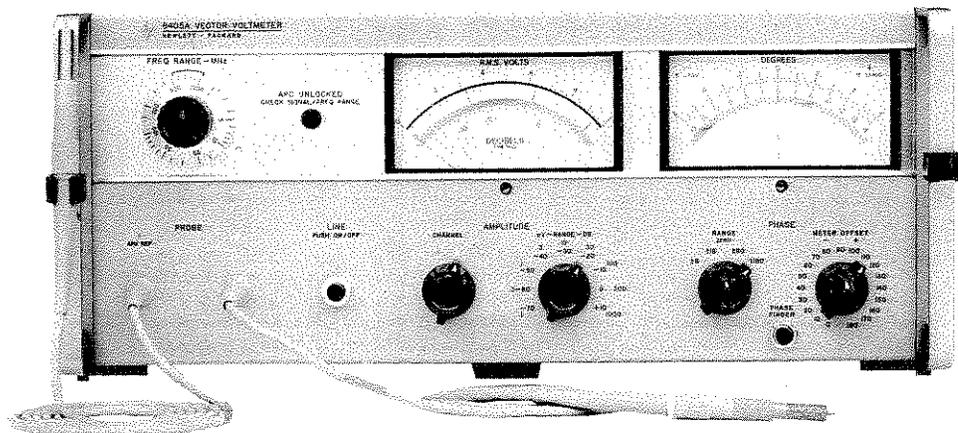


VECTOR VOLTMETER

8405A



HEWLETT  PACKARD



VECTOR VOLTMETER

8405A

Serial Prefix: 946-

This manual applies directly to the HP Model 8405A Vector Voltmeter having serial prefix number 946-.

Serial Prefixes Not Listed

For instruments with serial prefix above 946-, a "Manual Changes" sheet is included with this manual. The necessary changes required to adapt this manual for instruments with serial prefix 838 and below can be found in Appendix I.

NOTE

See inside rear cover for overall schematic.

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HEWLETT  PACKARD

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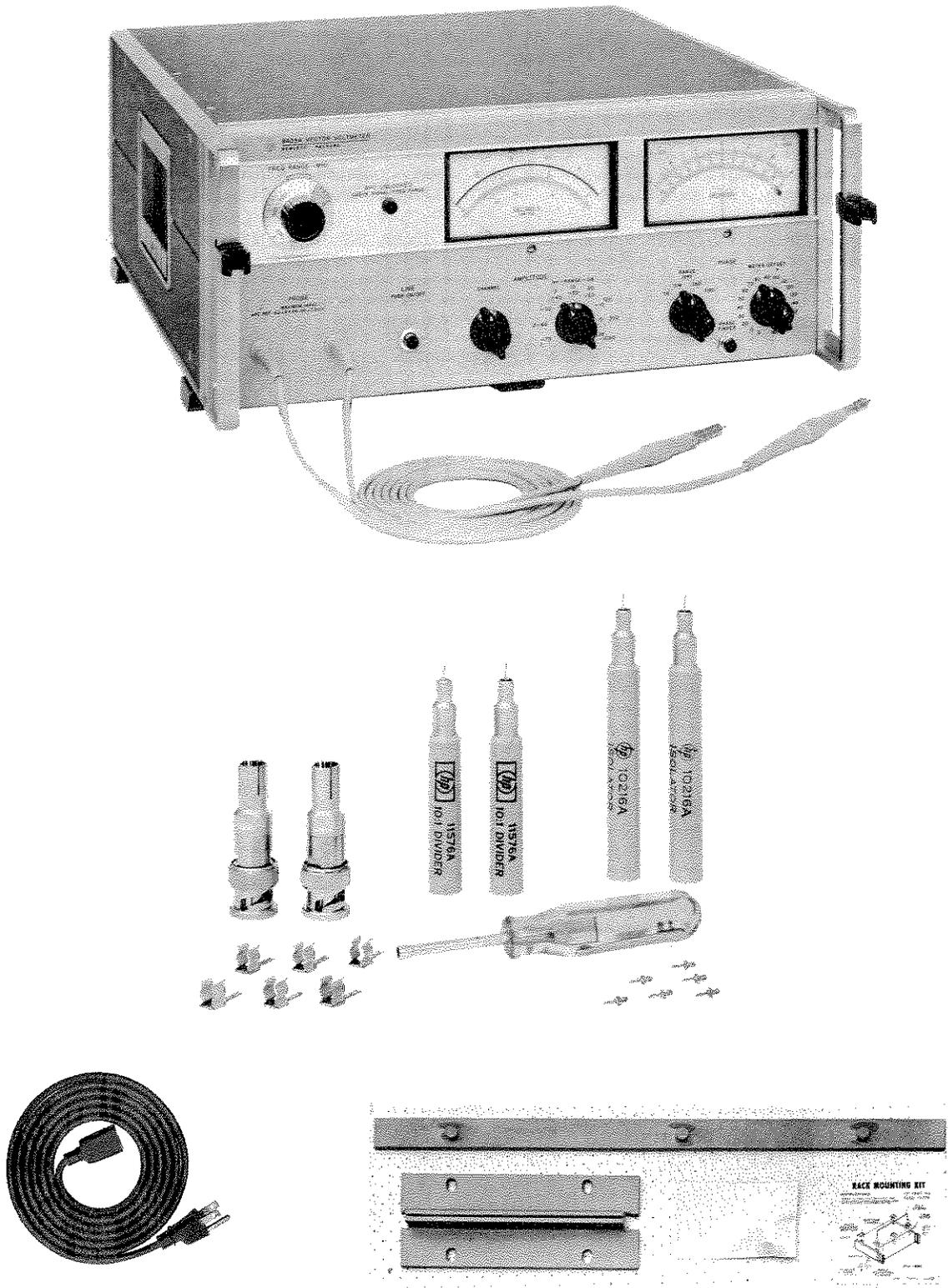
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8405A-A-14B

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 voltages. The RF range is 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 | Accessory | Impedance | Frequency | Accuracy* | |
|---|---|--|------------------|----------------------|-------------------------|
| <p><u>Instrument Type:</u> Two-channel sampling RF millivoltmeter-phasemeter which measures voltage of two signals and simultaneously displays the phase angle between the two signals.</p> <p><u>Frequency Range:</u> 1 MHz to 1 GHz in 21 overlapping octave bands (lowest band covers two octaves).</p> <p><u>Tuning:</u> Automatic within each band. Automatic phase control (APC) circuit responds to the Channel A input signal. Search and lock time, approximately 10 millise.</p> <p><u>Voltage Range</u> 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.</p> <p><u>Input Impedance (nominal):</u> 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.</p> <p><u>Isolation Between Channels:</u> 1 to 300 MHz: greater than 100 dB. 300 to 1000 MHz: greater than 80 dB.</p> <p><u>Maximum AC Input:</u> 2 V peak. <u>Maximum DC Input:</u> ±50 V.</p> | <p>HP 11536A 50Ω Feed-through Tee</p> | 50Ω | 1-100 MHz | ±2% of full scale | |
| | | Freq. | SWR | 100-300 MHz | ±6% of full scale |
| | | 1-750 MHz 1-1000 MHz | < 1.15 < 1.20 | 300-1000 MHz | ±12%** of full scale |
| | <p>HP 11576A 10:1 Divider</p> | 1 MΩ equiv. to  2 pF | 1-100 MHz | ±6% of full scale | |
| | | $Z = \frac{80}{f(\text{MHz})}$ kΩ from 5-100 MHz | | | |
| | <p>HP 10216A Isolator</p> | 100 k equiv. to  5 pF | 1-200 MHz | ±6% of full scale | |
| | | $Z = \frac{32}{f(\text{MHz})}$ kΩ | | | |
| <p>* After one-hour warmup. ** Above 300 mV and 800 MHz add +5%.</p> | | | | | |
| <p><u>Voltage Ratio Accuracy:</u> 1-200 MHz. 0.2 dB for -60 to 0 dB Ranges. 0.5 dB for -70 dB and +10 dB Ranges.</p> <p><u>Voltage Ratio Accuracy:</u> 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.</p> <p><u>Residual Noise:</u> Less than 10 μV as indicated on the meter.</p> <p><u>Bandwidth:</u> 1 kHz.</p> | | | | | |
| <p style="text-align: left;">VOLTMETER CHARACTERISTICS</p> <p><u>Meter Ranges:</u> 100 μV to 1 V rms full scale in 10-dB steps. Meter indicates amplitude of the input signal.</p> <p><u>Voltage Accuracy:</u> When accessories are used on one or both probes.</p> | | | | | |

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.

Phase: 0 to ±0.5 Vdc ±6%, proportional to phase-meter 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 probes. 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).

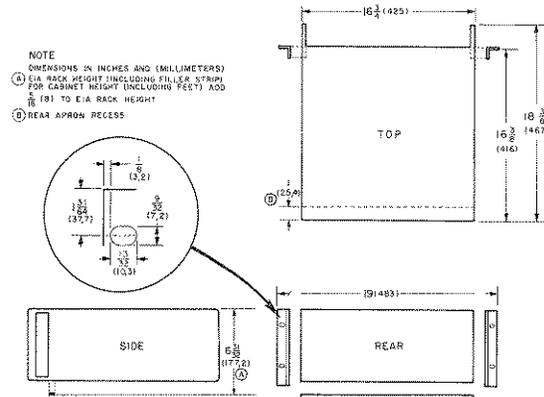
GENERAL

20 kHz IF Output (each channel): Reconstructed signals, with 20 kHz fundamental components, having the 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 ±6% open circuit, proportional to voltmeter reading in volts. Output tracks meter reading within ±0.5% of full scale. Output impedance, 1000 ohms; BNC female connector.

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-through Tee | 10 - 500 | 300 μV to 300 mV | 100 μV to 300 mV | ±3° |
| | 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 dividers, 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 838 (first three numbers of serial number). If the serial prefix of your instrument is other than 838, there are differences between the instrument described in this manual and your instrument. These differences are described in the appendix at the rear of this manual or in a Manual Changes sheet supplied with this manual. If the manual changes sheet is missing, the information can be supplied by your nearest Hewlett-Packard Sales and Service Office (see lists at the rear of this manual). The manual changes sheet may also include an "ERRATA" section which describes manual correction information which applies to the manual for all instruments INCLUDING instruments prefixed 838.

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.

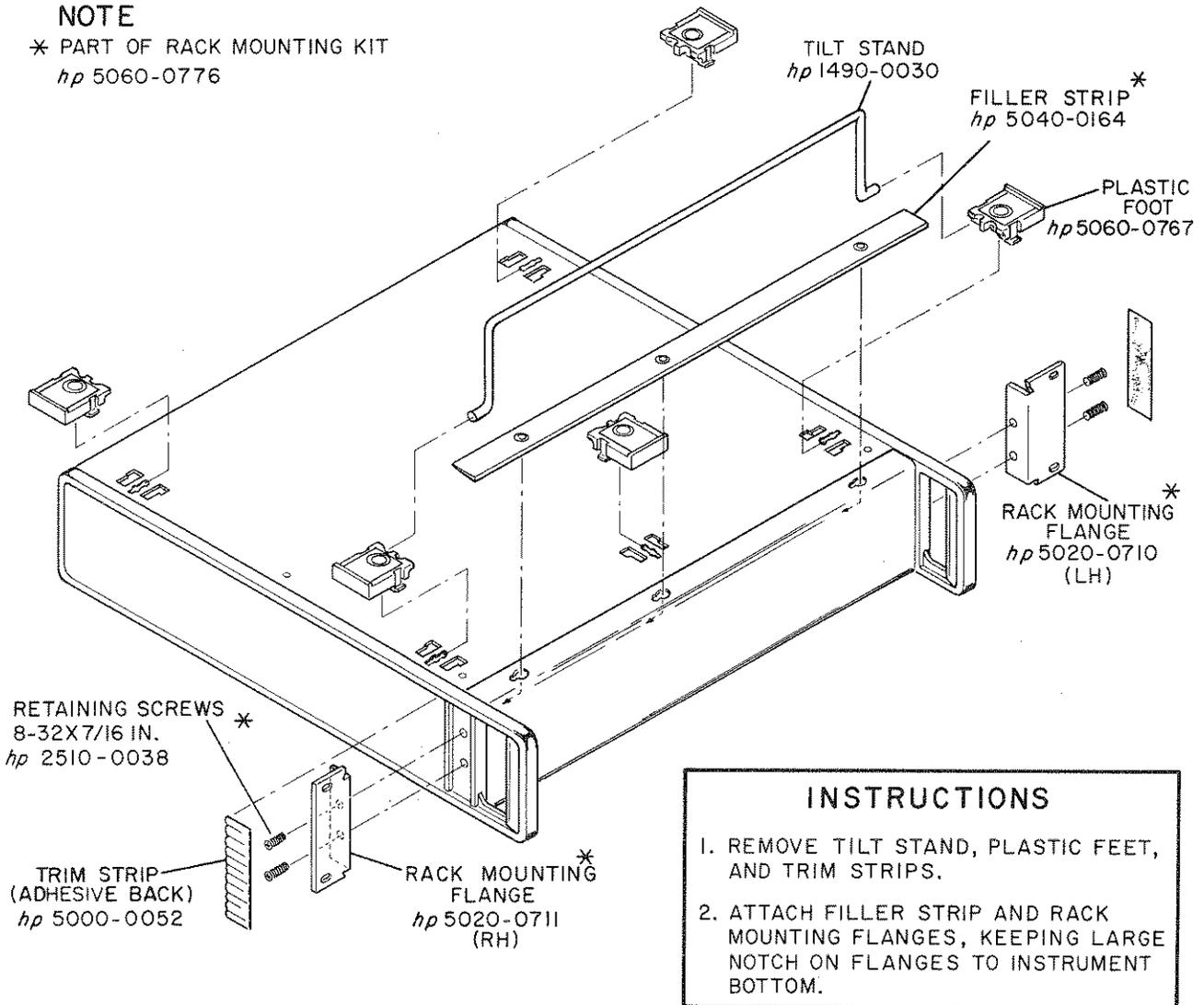


Figure 2-1. Preparation for Rack Mounting

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 (HP offices are listed at the rear of this manual). 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 $\pm 10\%$, 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 listed at the rear of this manual.

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:

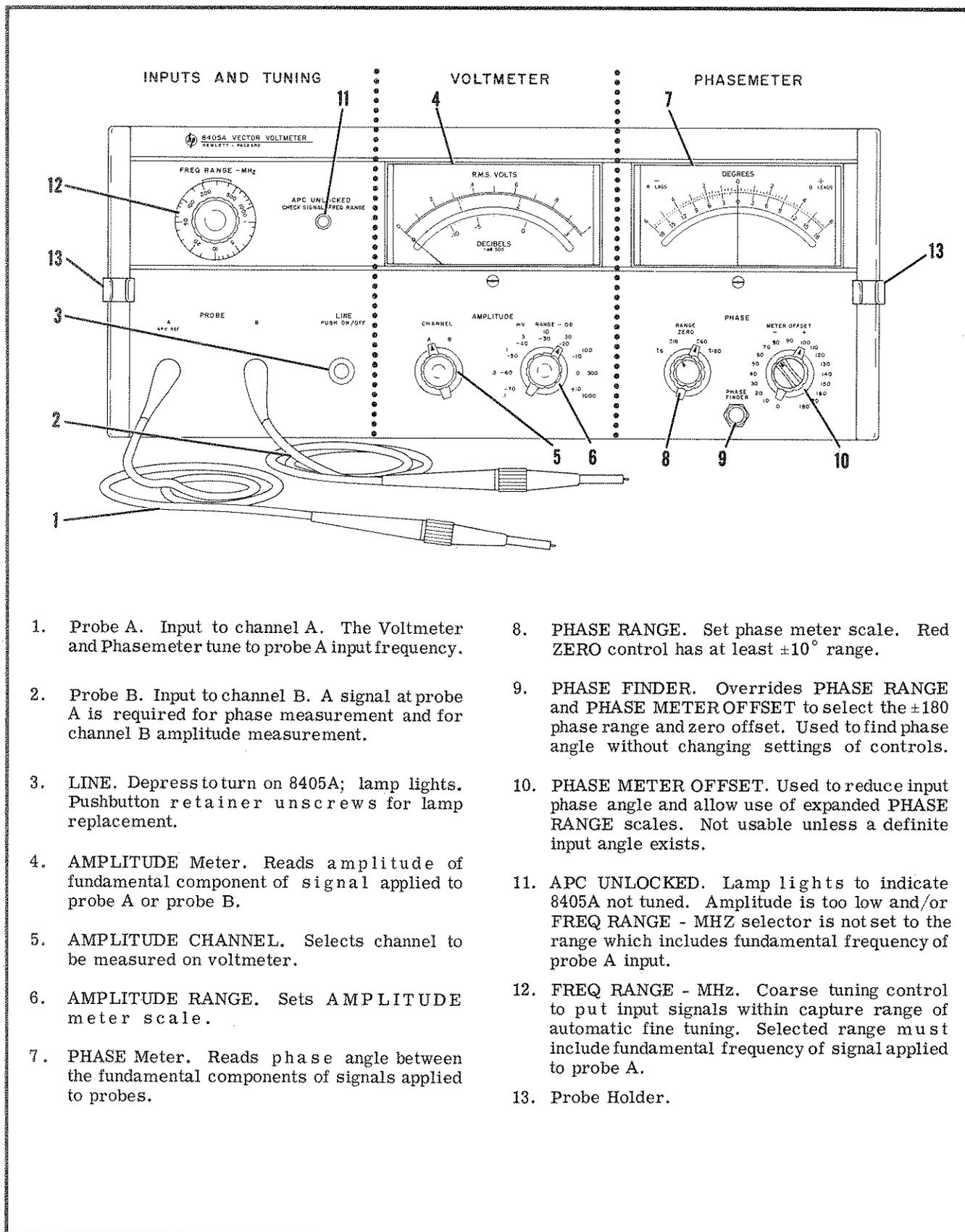
a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard service office or center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

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 amplitude 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 $\pm 10^\circ$ range.
9. PHASE FINDER. Overrides PHASE RANGE and PHASE METER OFFSET 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-phase-meter 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 phase-meter and ac voltmeter which have common inputs 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 LINE 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. Additional 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.

- b. Interaction between channels: Do not connect both probes 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, 1-10 MHz; 300 μ V, 10-500 MHz; and 500 μ V, 500-1000 MHz. For probe B minimum input is 10 μ V for entire range (1-1000 MHz).

3-15. INPUT SIGNALS.

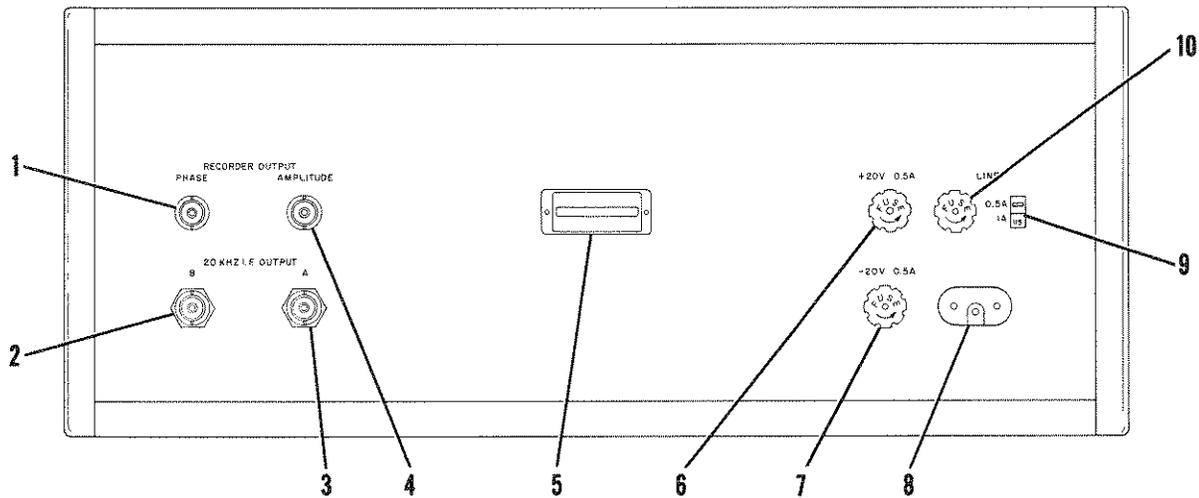
3-16. Phase and amplitude measurements can be made at any frequency between 1 and 1000 MHz. However, the Vector Voltmeter is frequency selective and therefore must be tuned to input signals. Tuning is semi-automatic with manual coarse tuning and automatic fine tuning. The automatic function tunes both channels 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 μ V for 10-500 MHz, and 500 μ V 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 intermittent signal.

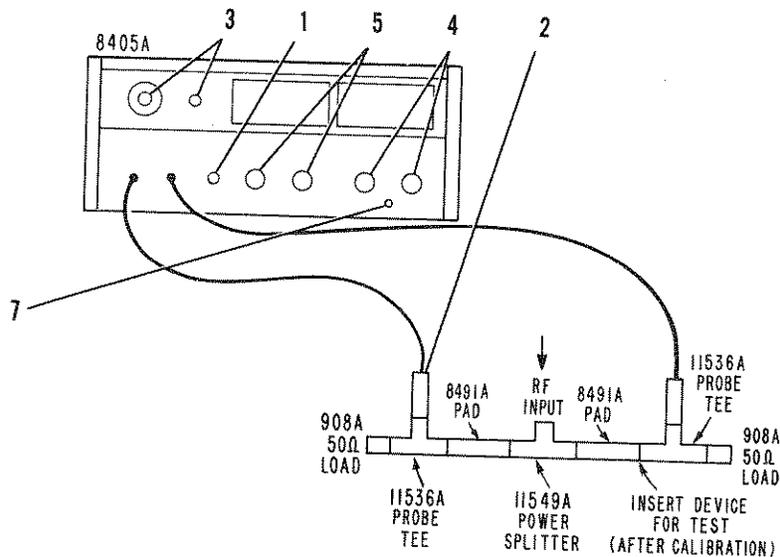
NOTE

With complex waveforms the 8405A tunes to the frequency of the component having the greatest amplitude 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 1.5 mV (1-10 MHz); 300 μ V (10-500 MHz); or 500 μ V (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 ± 180 , PHASE METER OFFSET to 0, 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 recorded 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 $+46^\circ$.

Figure 3-3. Transmission Line Measurements

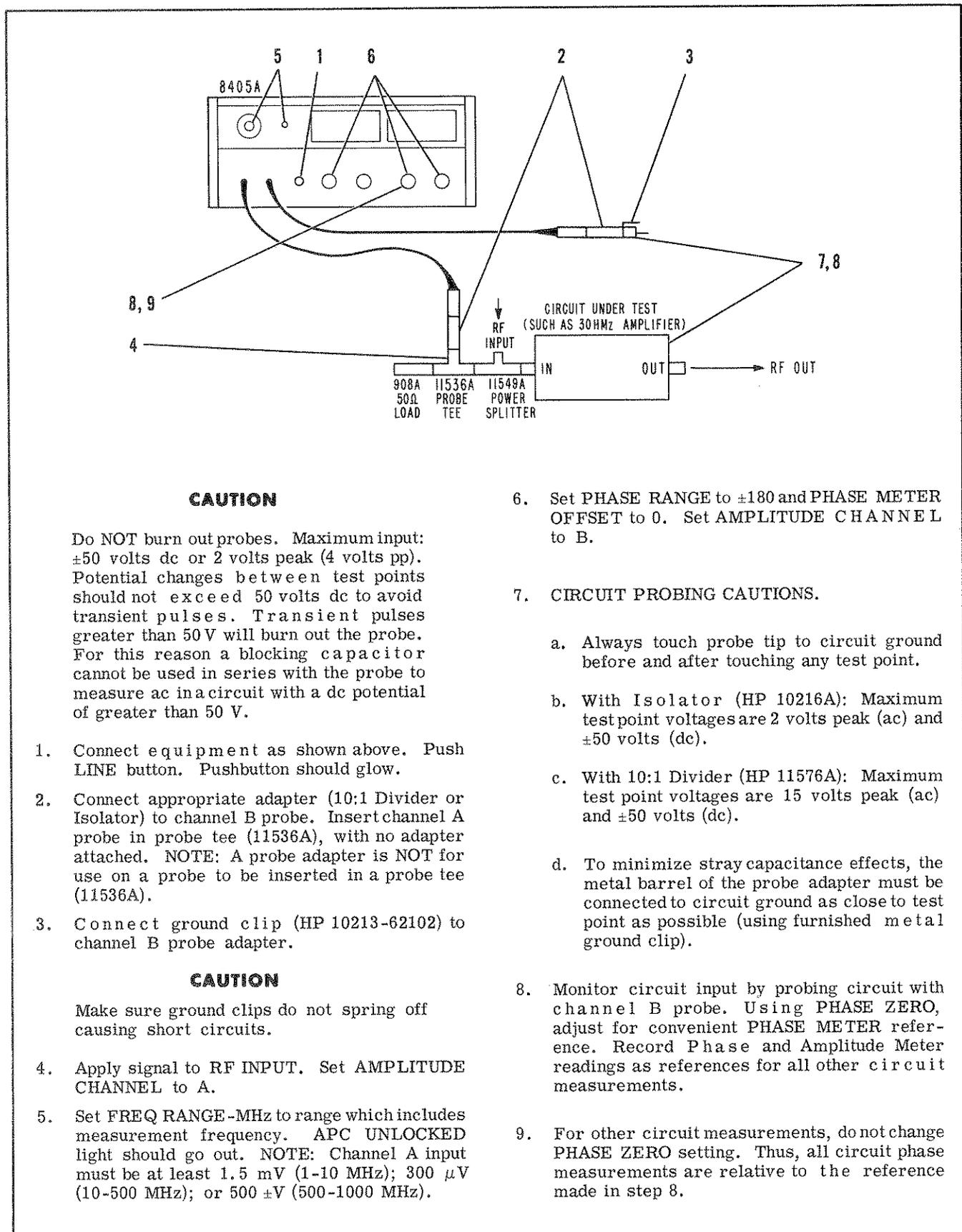


Figure 3-4. In-Circuit Measurements

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 $\pm 2^\circ$ 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 described in Paragraph 3-26.

3-32. SWEEP-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 not produce any measurement uncertainty. Fixed frequency measurements at these frequencies have the same accuracy as measurements at any other frequency. Best operation is achieved sweeping down in frequency.

3-34. ZERO-SETTING 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 path lengths 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 OUTPUTS.

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. The dividers can be used to measure voltages 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 10216A 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. MODEL 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 ϕ . In the phasemeter the clipped sine waves V_C become triggers spaced in time in proportion to the phase difference between sine waves V_{AF} 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 average meter current is governed by the symmetry of the square wave; therefore, the meter indication is proportional to the phase difference ϕ . 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. DETAILED BLOCK DIAGRAM DESCRIPTION.

4-10. CIRCUIT SECTIONS.

4-11. Figure 7-4 is a detailed overall 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 Phasemeter 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

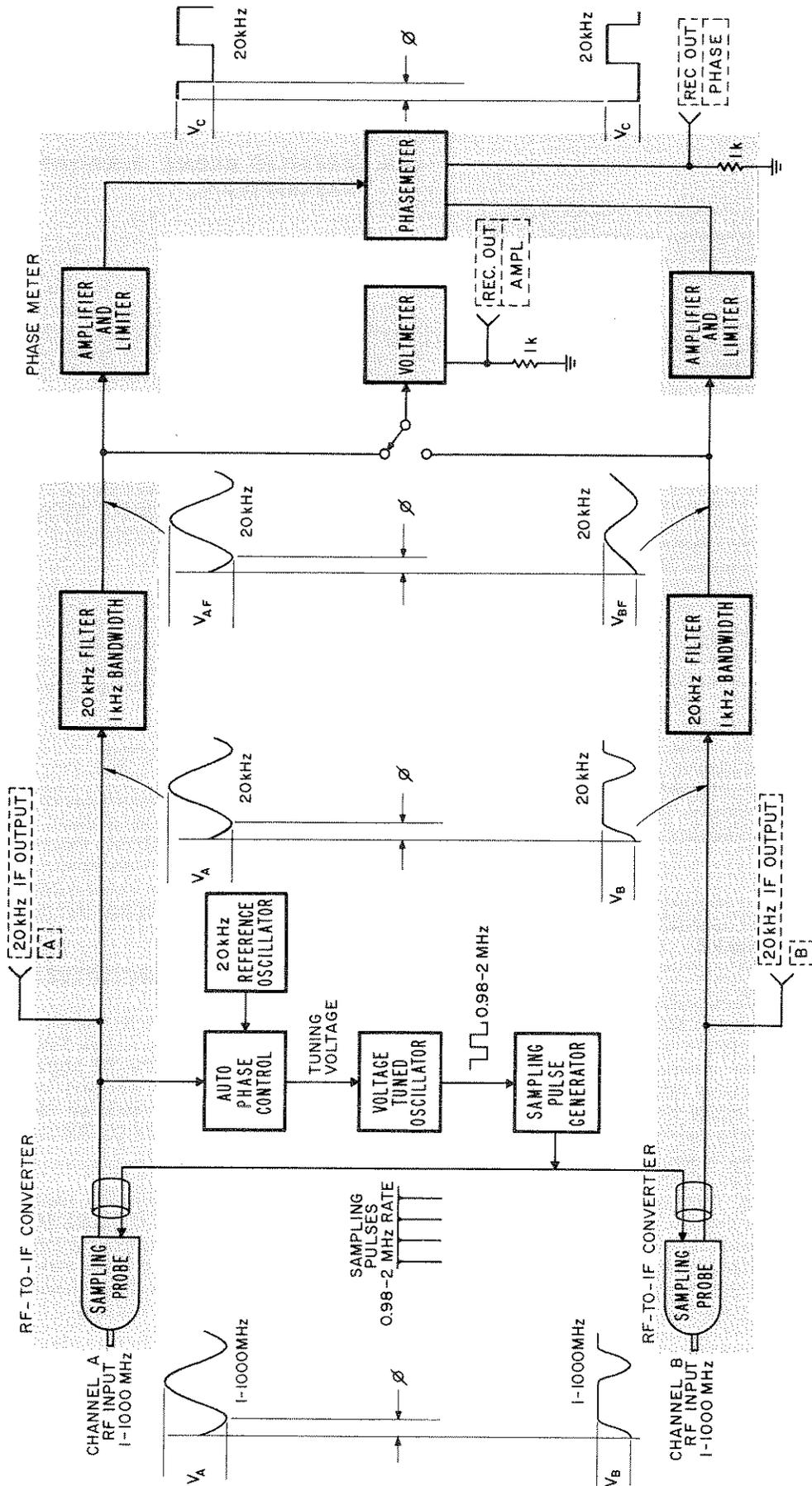


Figure 4-1. Simplified Overall Block Diagram

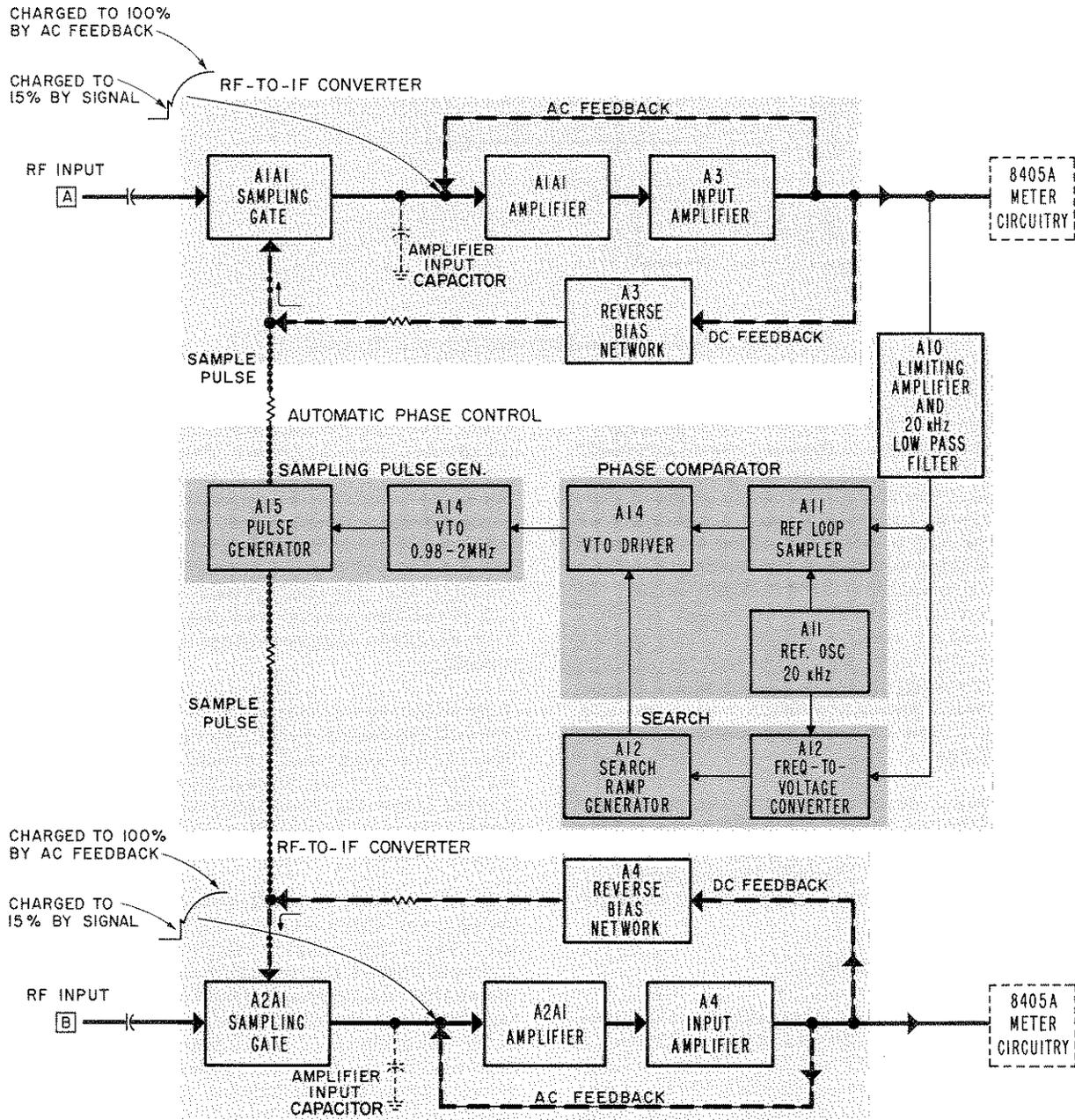


Figure 4-2. Basic Input Circuitry

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

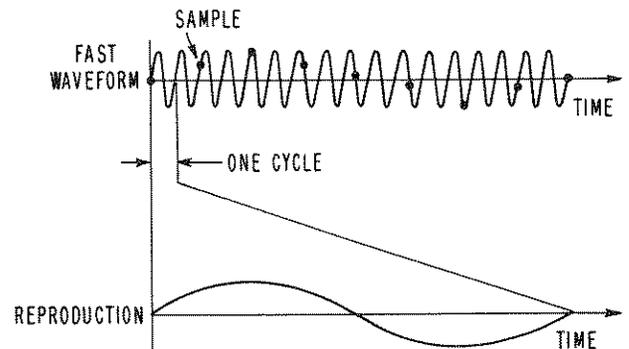


Figure 4-3. Fast Waveform Reproduced on Slower Time Base by Sampling

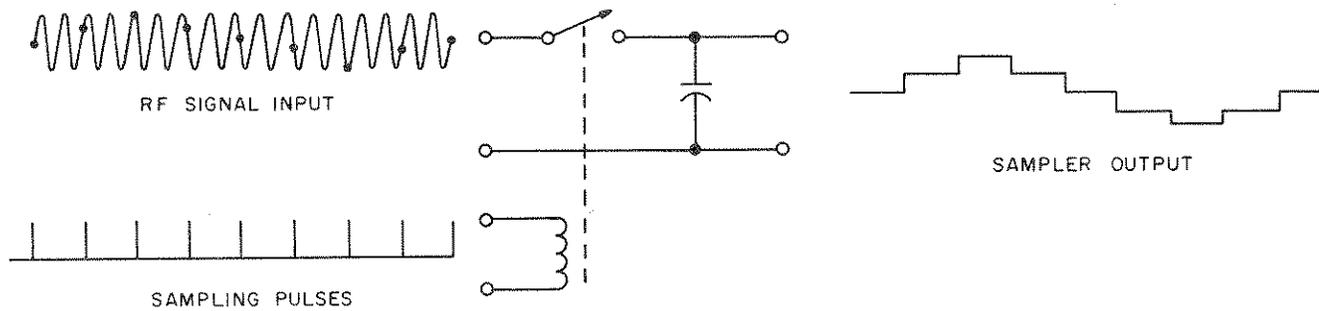


Figure 4-4. Simplified Diagram of a Sampler

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 assemblies A2A1 and 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 range from causing 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 Bias Network. Operation of the reverse bias is as follows: While the diode gate is closed, the Reverse Bias Network shifts the bias voltages applied to either side of the gate so that the sampling gate output voltage is centered between them. This ensures equal levels of reverse bias 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 (VTO) 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 phase with 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 (A11 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.

4-42. 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 the frequency of the fundamental is 20 kHz the voltages of the sampler are 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. The holding circuit is arranged so that two samples 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 $+90^\circ$ 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 A17 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 a forward-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-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 3 mA. See Table 5-1B for safe resistance ranges for some common ohmmeters.

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

| Transistor Type | | Connect Ohmmeter | | Measure Resistance (ohms) |
|---|--------------|------------------|--------------|-----------------------------|
| | | Pos. lead to | Neg. lead to | |
| 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 | Polarity |
| HP 412A HP 427A | R x 1K | 1.0V | 1 mA | Red | + |
| | R x 10K | 1.0V | 100 μA | | |
| | R x 100K | 1.0V | 10 μA | Black | - |
| | R x 1M | 1.0V | 1 μA | | |
| HP 410C | R x 10M | 1.0V | 0.1 μA | Red Black | + - |
| | R x 1K | 1.3V | 0.57mA | | |
| | R x 10K | 1.3V | 57 μA | | |
| | R x 100K | 1.3V | 5.7 μA | | |
| HP 410B | R x 1M | 1.3V | 0.5 μA | Black Red | + - |
| | R x 10M | 1.3V | 0.05 μA | | |
| | R x 100 | 1.1V | 1.1 mA | | |
| | R x 1K | 1.1V | 110 μA | | |
| HP 414A | R x 10K | 1.1V | 11 μA | Black Red | + - |
| | R x 100K | 1.1V | 1.1 μA | | |
| | R x 1M | 1.1V | 0.11 μA | | |
| | 500K | 1.0V | 110 μA | | |
| Simpson 260 | 150K | 0.5V | 110 μA | Black Red | + - |
| | 50K | 0.3V | 110 μA | | |
| | 15K | 0.2V | 110 μA | | |
| | R x 100 | 1.5V | 1 mA | | |
| Simpson 269 | R x 1K | 1.5V | 0.82 mA | Black | + |
| | | | | Red | - |

| TRANSISTOR BIASING | | | |
|--------------------|--------|---------|------------|
| DEVICE | SYMBOL | CUT OFF | CONDUCTING |
| VACUUM TUBE | | | |
| N P N TRANSISTOR | | | |
| P N P TRANSISTOR | | | |

Figure 5-1. Transistor Biasing Characteristics

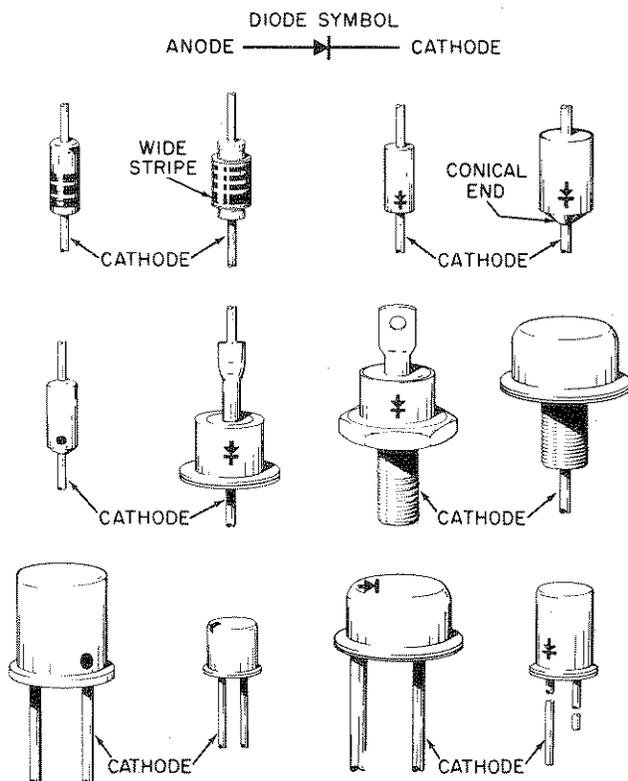


Figure 5-2. Examples of Diode Marking Methods

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 CONDUCTOR REPAIR. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper 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 5-1C for soldering tool specifications.
- b. Use a heat sink such as pliers or hemostat between transistor body and hot soldering iron.
- c. When installing a replacement transistor, ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as 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 listed 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 ma- terial or conductor bonding agent | Freon Acetone 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 insula- tion, 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 μ sec/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: $\pm 3\%$ of full scale (50-120 Hz); $\pm 1\%$ 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: $\pm 3\%$ | 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: $\pm 2\%$ 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: $\pm 0.5\%$ 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: $\pm 0.15\%$ 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 Volt- meter (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) | 1 | HP 1250-0777 (UG 29B/U) |
| 4* | 10 dB coaxial attenuator for 50-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-LK20L |
| 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: ± 0.02 dB at 30 MHz ± 0.05 dB at 100 MHz Connectors: Type N female | 1 | HP H34-355C (See Note 1) |

Table 5-1. Recommended 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. | | | |
| <p>NOTES:</p> <ol style="list-style-type: none"> Nominal impedance is 50 ohms with type N connectors (one male and one female). 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. For USE column: <ol style="list-style-type: none"> Performance check Troubleshooting Adjustment procedure If HP Model 432A Power Meter is used, then Calibrator (8402B) is not required. | | | |

Table 5-2. Performance Tests

I. SPECIFICATIONS TESTED

| | | |
|---------------------------------------|---------------------------|--------|
| 1. ISOLATION BETWEEN CHANNELS: | 1 to 300 MHz | 100 dB |
| | 300 to 1000 MHz | 80 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.

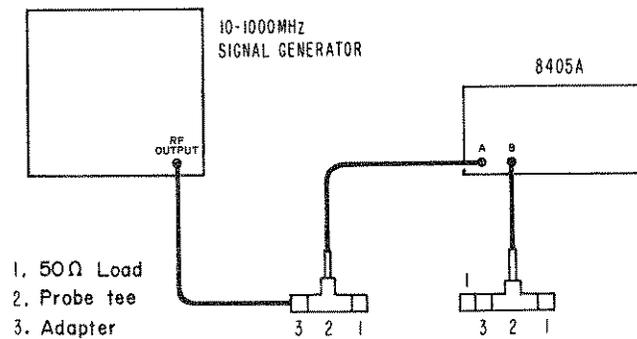


Figure 1. Channel Isolation Check

2. Set 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 should 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 μ V 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)

- 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 $\pm 1\%$. 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 $\pm 2\%$ accuracy; if the 8405A reads 1.00 ± 0.03 , it is probably within $\pm 2\%$ accuracy; if the 8405A reading is $1.00 \pm$ greater than ± 0.03 , it is not within $\pm 2\%$ accuracy.

2. 100 to 1000 MHz.

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

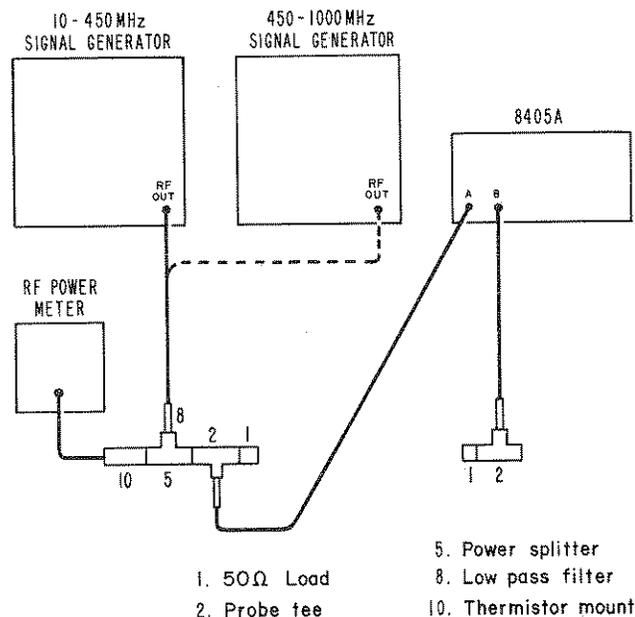


Figure 3. Voltage Accuracy (100 to 1000 MHz)

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 $223.5 \text{ mV} \pm 6 \text{ mV}$.

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 \pm 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 \pm 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.

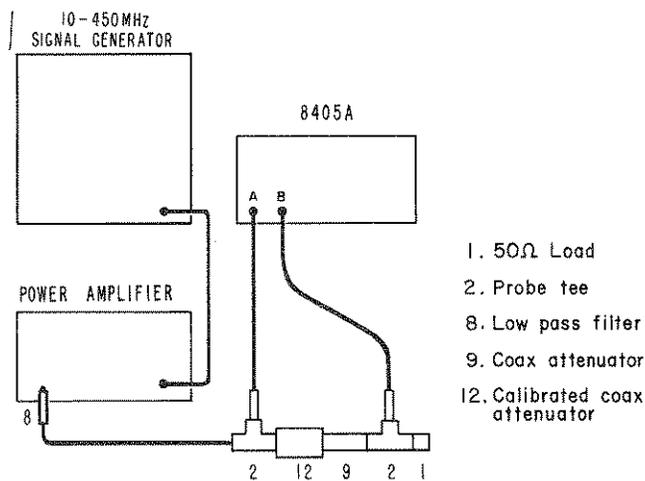


Figure 4. Voltage Ratio Accuracy

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 Test (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 80 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

I. 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 μ V and 300 mV) $\pm 4.5^\circ$.
- b. 500 to 1000 MHz using HP 11536A Probe Tee (Channel A and B voltages between 100 μ V and 100 mV) $\pm 4.5^\circ$.
- c. 1 to 100 MHz using HP 11576A 10:1 Dividers (Channel A and B voltages between 1 mV and 3V) $\pm 5.5^\circ$.
- d. 1 to 200 MHz using HP 10216A Isolator (Channel A and B voltages between 100 mV and 300 mV) $\pm 7.5^\circ$.

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 of the signal generator in Figure 5 is given by

$$\phi = \frac{f_0 - f}{f_0} (360^\circ)$$

where ϕ = phase shift indicated on 8405A
 f_0 = frequency originally set for 0° phase shift.
 f = new frequency causing phase shift.

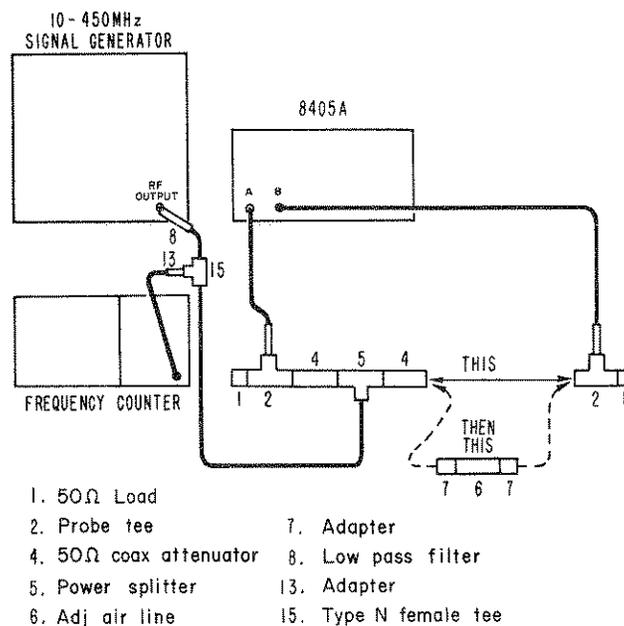


Figure 5. Phase Accuracy Check

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 mV 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 $\pm 180^\circ$ and METER OFFSET (black knob) to 0° . Using ZERO control, adjust for 0° meter reading. Switch RANGE to $\pm 6^\circ$ 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 $\pm 6^\circ$ 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 $\pm 6^\circ$, METER OFFSET to 90° , and +/- switch to +.
 - c. PHASE meter should read $0 \pm 4.5^\circ$ 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/A15R3 | 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.

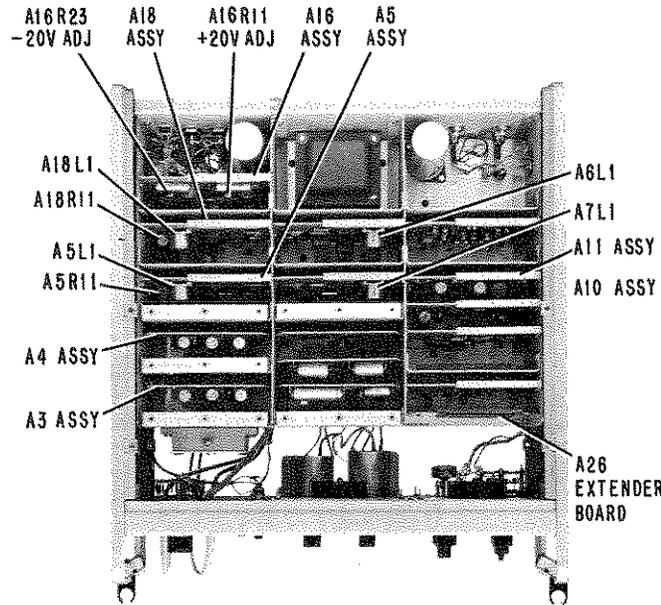


Figure 2A. Adjustment Locations

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.

| <u>Test Point</u> | <u>Measure (Note 1)</u> | <u>Ripple (Note 2)</u> | <u>Adjust</u> | <u>Line Voltage</u> |
|----------------------------|-------------------------|------------------------|---------------|----------------------|
| A16C6 minus to Chassis gnd | -20±0.2 vdc | 1.0mVrms | <u>A16R23</u> | 103 to 127 vac or |
| A16C3 plus to Chassis gnd | +20±0.2 vdc | 1.0mVrms | <u>A16R11</u> | 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 (Cont'd)

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 2A for adjustment and assembly location.

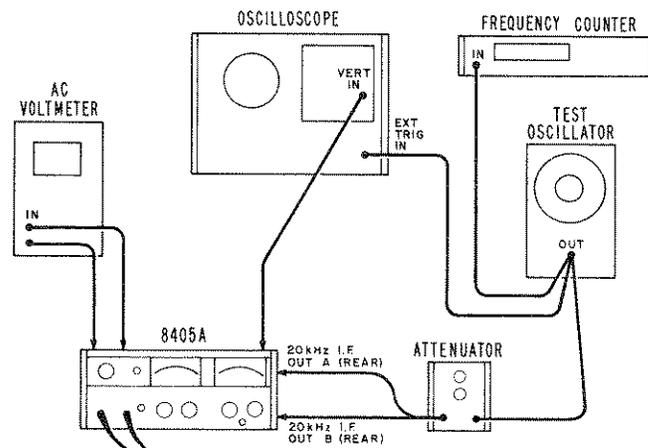


Figure 2B. Setup for IF Tuning, IF Gain and IF Sampler Adjustments

- 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 |
| CHANNEL | 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 \pm 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 (Cont'd)

- 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.

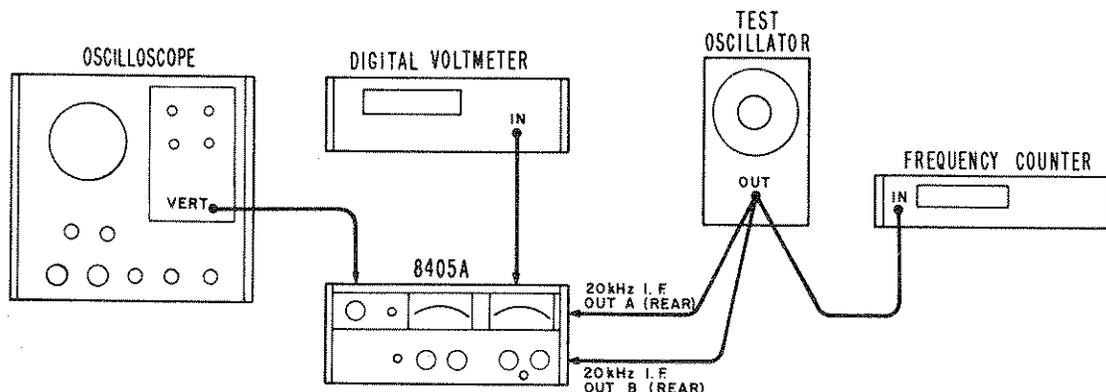


Figure 2C. Setup for Phase Meter Adjustments

NOTE

Refer to Figure 2D for adjustment and assembly location.

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

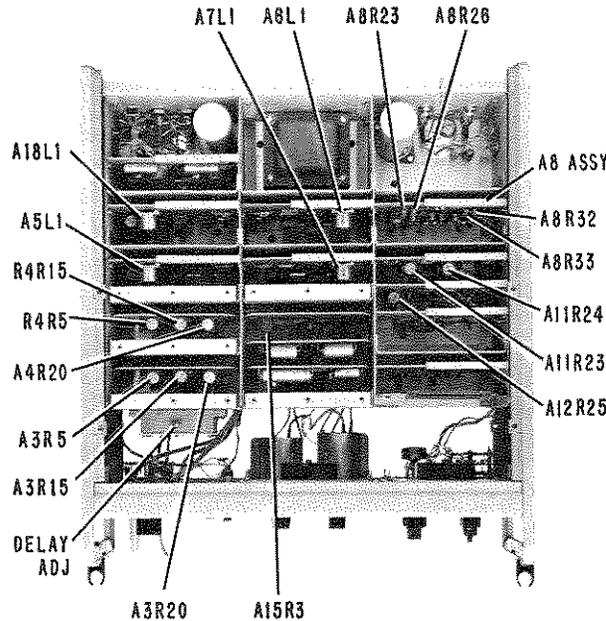


Figure 2D. Adjustment Locations

- 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 $+18^\circ$ 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 $\pm 18^\circ$ 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) Connect 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 (1) 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 $+180^\circ$.
- j. Adjust PHASE ZERO to obtain maximum negative reading on 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.

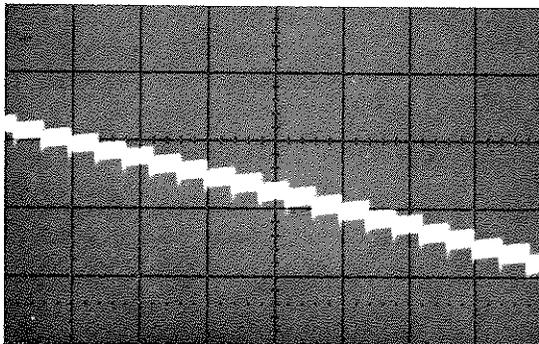
5A. IF SAMPLER.

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

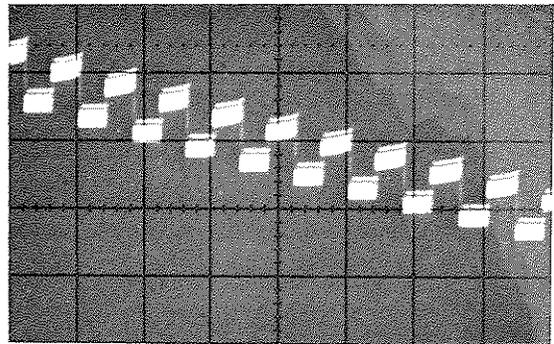
NOTE

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 $20 \text{ kHz} \pm 10 \text{ Hz}$ 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 Waveforms

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

- 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.

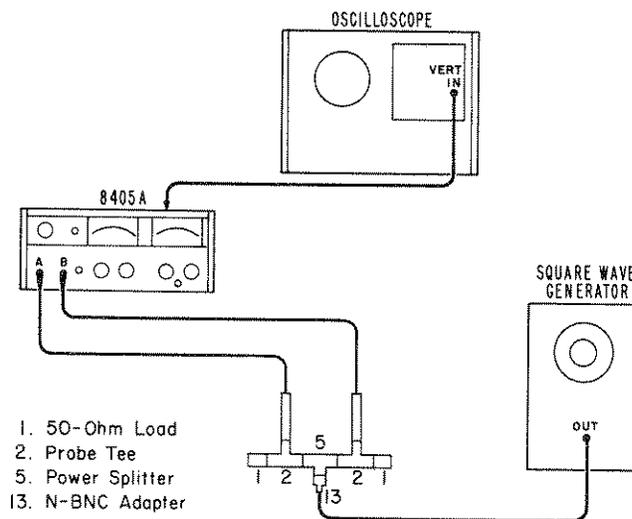


Figure 2F. Setup for Pulse Generator and Sampler Adjustments

- 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.

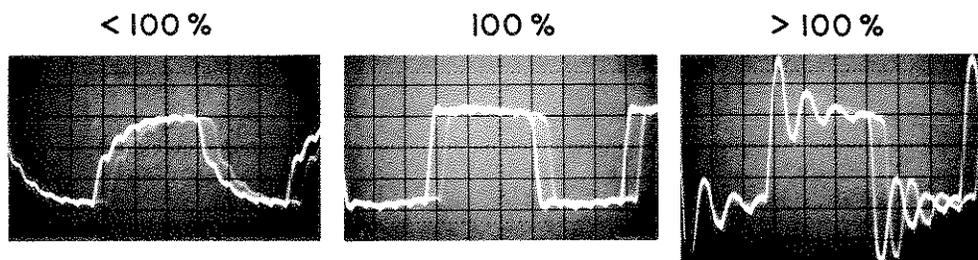


Figure 2G. Typical Sampling Efficiency Waveforms

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.

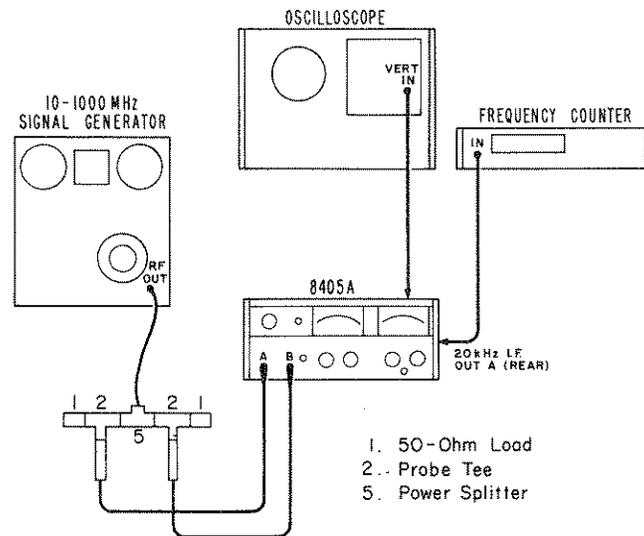


Figure 2H. Setup for Search Speed Adjustment

- b. Put Search assembly A12 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.
- e. 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 \pm 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.

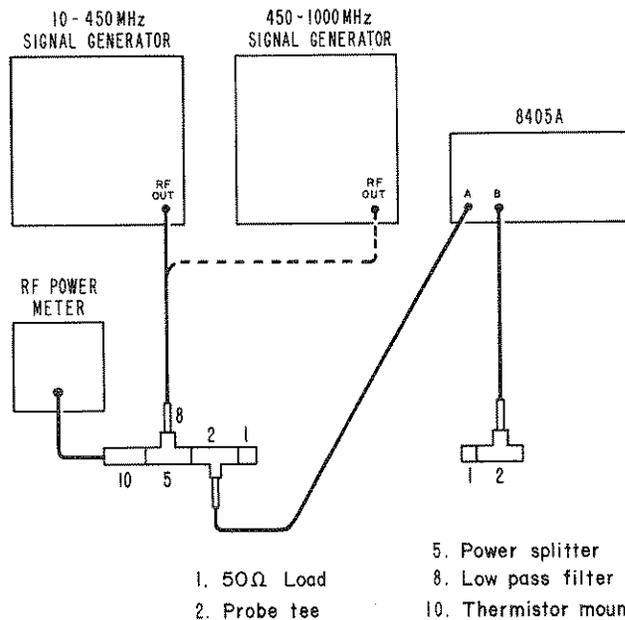


Figure 2J. Setup for RF Gain and Delay Line Adjustments

- b. Set 8405A controls as follows:

| | |
|-----------------------------|---------|
| AMPLITUDE CHANNEL | A |
| FREQ RANGE - MHz | 100 MHz |
| AMPLITUDE RANGE | 300 mV |

Other control settings optional.
- c. Set Signal Generator frequency to 100 MHz and adjust output level to 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 peakmeter 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.

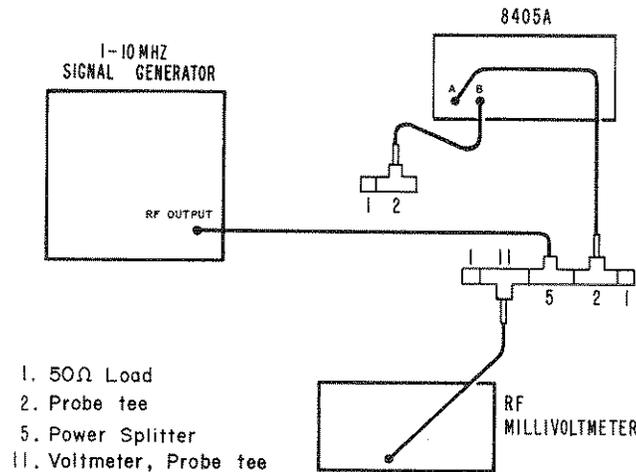


Figure 2K. Setup for RF Gain Adjustment

- 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.

Test 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.

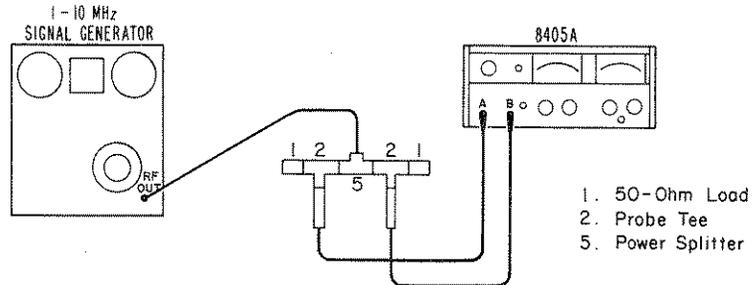
h. Slowly reduce Signal Generator frequency through 50 MHz noting maximum and minimum PHASE meter readings. Reminder: the PHASE and AMPLITUDE meter pointers will flicker momentarily several times as the input frequency is changed. The flicker is caused by the automatic tuning and is normal.

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 troubleshooting charts.



- PROCEDURE:
- Using setup shown above, set Signal Source for 1 MHz, 20 mV RMS output.
 - Set 8405A controls as follows: FREQ RANGE full clockwise (1-4 MHz), 10 mV (-20 dBm), $\pm 60^\circ$, and OFFSET to 0° .
 - In the indications Table below, an "X" indicates failure and an "ok" indicates normal operation.
 - 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:
- Channels A and B should read 10 mV $\pm 5\%$ depending upon Signal Source output level accuracy. Two channels should read within $\pm 2\%$ of each other.
 - Phase meter, using ZERO control, should be adjustable at least $\pm 15^\circ$ about 0° .
 - APC unlocked light should be out with FREQ RANGE switch fully clockwise (1-4 MHz).
 - 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 |
| 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 |
| 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° regard- less 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 |
| | 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° regard- less 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 |
| | 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° | 1. Check waveform at A8Q9 collector | Symmetrical Square wave | Phase meter section out of adjustment: Refer to adjustment procedure, Section V. |
| | | Square wave not symmetrical | Phase Inverter A6Q2-4 or Phase Shifter A7Q2-4 is defective |
| No meter movement, meter reads 0° | 1. 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) | 1. 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: | <ol style="list-style-type: none"> 1. Test setup and 8405A control settings are same as for front panel troubleshooting Table 5-4. 2. 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. |
| <p>NOTE:</p> <ol style="list-style-type: none"> 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 setscrew 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

| Sympton (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 | 1. 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 |
| | | 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 (see lists at rear of this manual). 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 | NPN = negative-positive-negative | RWW = reverse working voltage |
| BFO = beat frequency oscillator | HG = mercury | NRFR = not recommended for field replacement | S-B = slow-blow |
| BE CU = beryllium copper | HR = hour(s) | NSR = not separately replaceable | SCR = screw |
| BH = binder head | HZ = hertz | OBD = order by description | SE = selenium |
| BP = bandpass | IF = intermediate freq | OH = oval head | SECT = section(s) |
| BRS = brass | IMPG = impregnated | OX = oxide | SEMICON = semiconductor |
| BWO = backward wave oscillator | INCD = incandescent | P = peak | SI = silicon |
| CCW = counter-clockwise | INCL = include(s) | PC = printed circuit | SIL = silver |
| CER = ceramic | INS = insulation(ed) | PF = picofarads = 10 ⁻¹² farads | SL = slide |
| CMO = cabinet mount only | INT = internal | PH BRZ = phosphor bronze | SPG = spring |
| COEF = coefficient | K = kilo = 1000 | PHL = Phillips | SPL = special |
| COM = common | LH = left hand | PIV = peak inverse voltage | SST = stainless steel |
| COMP = composition | LN = linear taper | PNP = positive-negative-positive | SR = split ring |
| COMPL = complete | LK WASH = lock washer | P/O = part of | STL = steel |
| CONN = connector | LOG = logarithmic taper | POLY = polystyrene | TA = tantalum |
| CP = cadmium plate | LPF = low pass filter | PORC = porcelain | TD = time delay |
| CRT = cathode-ray tube | M = milli = 10 ⁻³ | POS = position(s) | TGL = toggle |
| CW = clockwise | MEG = meg = 10 ⁶ | POT = potentiometer | THD = thread |
| DEPC = deposited carbon | MET FLM = metal film | PP = peak-to-peak | TI = titanium |
| DR = drive | MET OX = metallic oxide | PT = point | TOL = tolerance |
| ELECT = electrolytic | MFR = manufacturer | PWV = peak working voltage | TRIM = trimmer |
| ENCAP = encapsulated | MHZ = mega hertz | RECT = rectifier | TWT = traveling wave tube |
| EXT = external | MINAT = miniature | RF = radio frequency | U = micro = 10 ⁻⁶ |
| F = farads | MOM = momentary | RH = round head or right hand | VAR = variable |
| FH = flat head | MTG = mounting | | VDCW = dc working volts |
| FIL H = fillister head | MY = "mylar" | | W/ = with |
| FXD = fixed | N = nano (10 ⁻⁹) | | W = watts |
| G = giga (10 ⁹) | N/C = normally closed | | WIV = working inverse voltage |
| GE = germanium | NE = neon | | WW = wirewound |
| GL = glass | NI PL = nickel plate | | W/O = without |
| GRD = ground(ed) | | | |

Table 6-1. Reference Designation Index

| Reference Designation | Part No. | Description # | Note |
|-----------------------|---------------------------|---|------|
| A1MP1 | 5020-0457 | PROBE TIP | |
| A1MP2 | 00187-42106 08405-6055 | RING:IDENT BLUE HOUSING ASSY:PROBE | |
| A1W1 | 08405-6047 | CABLE ASSY:SPECIAL COAX INCL PROBE & PANEL BOOT & BD ASSY SOCKET | |
| A1A1 | 08405-6054 | BOARD 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 & BD ASSY SOCKET | |
| A2A1 | 08405-6054 | BOARD ASSY:PROBE NOT RECOMMENDED FOR FIELD REPLACEMENT | |
| A2A1MP1 | 5020-0457 | PROBE TIP | |
| A3 | 08405-6002 | BOARD ASSY:SAMPLER | |
| A3C1 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 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 4.7 UF 10% 35VDCW | |
| A3C7 | 0160-2055 | C:FXD CER 0.01 UF +80-20% 100VDCW | |
| A3C8 | 0160-0174 | C:FXD CER 0.47 UF +80-20% 25VDCW | |
| A3C9 | 0160-0174 | C:FXD CER 0.47 UF +80-20% 25VDCW | |
| A3C10 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A3C11 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A3C12 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A3C13 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A3Q1 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A3Q2 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| 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 4.64K 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 147 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 | 0757-0401 | 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 | 2100-0942 | 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 17.8 OHM 1% 1/8W | |
| A3R27 | | DELETED (REPLACED WITH A SHORT) | |
| A3T1 | 08405-8001 | TRANSFORMER: BALUN | |
| 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 PF +80-20% 1000VDCW | |
| A4C11 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A4C12 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A4C13 | 0160-2139 | C:FXD CER 220 PF +80-20% 1000VDCW | |
| A4Q1 | 1854-0071 | TRANSISTOR: SILICON NPN | |
| A4Q2 | 1854-0071 | TRANSISTOR: SILICON NPN | |
| 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:VAR WW 500 OHM 5% 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 FLM 19.6K OHM 1% 1/8W | |
| A4R20 | 2100-0942 | R:VAR FLM 50K OHM 20% 3/4W | |
| A4R21 | 0757-0294 | R:FXD MET FLM 17.8 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 CER 0.1 UF +80-20% 50VDCW | |
| A5C3 | 0180-0137 | C:FXD ELECT 100 UF 20% 10VDCW | |
| A5C4 | 0160-2120 | C:FXD 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% 35VDCW | |
| A5C10 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C11 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C12 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C13 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C14 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C15 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A5C16 | 0160-2143 | C:FXD CER 2000 PF +80-20% 100VDCW | |
| A5C17 | 0160-2261 | C:FXD CER 15 PF 5% 50VDCW | |
| A5CR1 | 08405-8004 | DIODES: SILICON MATCHED PAIR | |
| A5CR2 | | PART OF A5CR1 | |
| A5L1 | 9100-1719 | COIL:VAR | |
| A5L2 | 9140-0114 | COIL:FXD RF 10 UH | |
| A5MP1 | 5020-2045 | 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 NPN | |
| A5Q2 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A5Q3 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A5Q4 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A5Q5 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A5Q6 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A5R1 | 0757-0459 | R:FXD MET FLM 56.2K 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 | 0757-0428 | 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 1K OHM 1% 1/8W | |
| A5R19 | 0757-0394 | R:FXD MET FLM 51.1 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% 1/2W | |
| 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 MICA 2250PF 1% 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 NICA 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 CER 15 PF 5% 500VDCW | |
| A6C19 | 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | |
| A6C20 | 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | |
| A6CR1 | 08405-8004 | DIODES:SILICON MATCHED PAIR | |
| A6CR2 | | PART OF A6CR1 | |
| A6CR3 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A6CR4 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A6L1 | 9100-1718 | COIL:VAR | |
| A6MP1 | 5020-2045 | GARD 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 | |
| A6Q5 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A6Q6 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| 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 | 0698-3406 | 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 | Part No. | Description # | Note |
|-----------------------|------------|---------------------------------|------|
| A6R26 | 0698-0084 | R:FXD MET FLM 2.15K OHM 1% 1/8W | |
| A6R27 | 0698-3449 | 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 SWIFTER | |
| 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 MATCHED PAIR | |
| A7CR2 | | PART OF A7CR1 | |
| A7CR3 | 1902-0025 | DIODE,BREAKDOWN:10.0V 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 1.96K 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 1% 1/8W | |
| A7R8 | 0757-C280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A7R9 | 0757-0465 | R:FXD MET FLM 100K OHM 1% 1/8W | |
| A7R10 | 0698-3151 | R:FXD MET FLM 2.87K OHM 1% 1/8W | |
| A7R11 | 0757-1094 | R:FXD MET FLM 1.47K OHM 1% 1/8W | |
| A7R12 | 0757-C199 | R:FXD MET FLM 21.5K OHM 1% 1/8W | |
| A7R13 | 0757-0465 | R:FXD MET FLM 100K OHM 1% 1/8W | |
| A7R14 | 0757-0465 | R:FXD MET FLM 100K OHM 1% 1/8W | |
| A7R15 | 0698-3157 | R:FXD MET FLM 19.6K OHM 1% 1/8W | |
| A7R16 | 0698-3442 | R:FXD MET FLM 237 OHM 1% 1/8W | |
| A7R17 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A7R18 | 0757-0466 | R:FXD MET FLM 110K OHM 1% 1/8W | |
| A7R19 | 0698-3162 | R:FXD MET FLM 46.4K OHM 1% 1/8W | |
| A7R20 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A7R21 | 0757-1094 | R:FXD MET FLM 1.47K OHM 1% 1/8W | |
| A7R22 | 0698-0085 | R:FXD MET FLM 2.61K OHM 1% 1/8W | |
| A7R23 | 0698-3447 | R:FXD MET FLM 422 OHM 1% 1/8W | |
| A7R24 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A7R25 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A7R26 | 0757-0200 | R:FXD MET FLM 5.62K OHM 1% 1/8W | |
| A7R27 | 0757-0466 | R:FXD MET FLM 110K OHM 1% 1/8W | |
| A7R28 | 0698-3162 | R:FXD MET FLM 46.4K OHM 1% 1/8W | |
| A7R29 | 0698-0084 | R:FXD MET FLM 2.15K OHM 1% 1/8W | |
| A7R30 | 0757-0441 | R:FXD MET FLM 8.25K OHM 1% 1/8W | |
| A7R31 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A7R32 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A8 | 08405-6058 | BOARD ASSY:PHASE METER | |
| A8C1 | 0150-0071 | C:FXD CER 400 PF 5% 500VDCW | |
| A8C2 | 0140-0206 | C:FXD MICA 270 PF 5% | |
| A8C3 | 0150-0071 | C:FXD CER 400 PF 5% 500VDCW | |
| A8C4 | | NOT ASSIGNED | |
| A8C5 | 0140-0206 | C:FXD MICA 270 PF 5% | |
| A8C6 | 0160-2055 | C:FXD CER 0.01 UF +80-20% 100VDCW | |
| A8C7 | 0160-2055 | C:FXD CER 0.01 UF +80-20% 100VDCW | |
| A8C8 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A8C9 | 0180-0098 | C:FXD ELECT 100 UF 20% 20VDCW | |
| A8C10 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A8C11 | 0160-0127 | C:FXD CER 1.0 UF 20% 25VDCW | |
| A8C12 | 0160-0127 | C:FXD CER 1.0 UF 20% 25VDCW | |
| A8CR1 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A8CR2 | 1902-0018 | DIODE BREAKDOWN:11.7V 5% | |
| A8CR3 | 1902-0018 | DIODE BREAKDOWN:11.7V 5% | |
| 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% | |

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

| Reference Designation | Part No. | Description # | Note |
|-----------------------|-----------|----------------------------------|------|
| A8L3 | 9140-0118 | 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 | |
| A8Q2 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A8Q3 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q4 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A8Q5 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A8Q6 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q7 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q8 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q9 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q10 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q11 | 1854-0003 | TRANSISTOR:PNP SILICON | |
| A8Q12 | 1854-0003 | TRANSISTOR:PNP SILICON | |
| A8Q13 | 1854-0003 | TRANSISTOR:PNP SILICON | |
| A8Q14 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A8Q15 | 1205-0202 | HEAT DISSIPATOR:SEMICONDUCTOR | |
| A8Q16 | 1853-0001 | TRANSISTOR:PNP SILICON 30V 900MH | |
| A8Q17 | 1853-0001 | TRANSISTOR:PNP SILICON 30V 900MH | |
| A8Q18 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A8Q19 | 1205-0202 | HEAT DISSIPATOR:SEMICONDUCTOR | |
| A8R1 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A8R2 | 0757-1094 | R:FXD MET FLM 1.47K OHM 1% 1/8W | |
| A8R3 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A8R4 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A8R5 | 0757-0123 | R:FXD MET FLM 34.8K OHM 1% 1/8W | |
| A8R6 | 0698-3441 | R:FXD MET FLM 215 OHM 1% 1/8W | |
| A8R7 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A8R8 | 0757-1094 | R:FXD MET FLM 1.47K OHM 1% 1/8W | |
| A8R9 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A8R10 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A8R11 | 0757-0123 | R:FXD MET FLM 34.8K OHM 1% 1/8W | |
| A8R12 | 0698-3441 | R:FXD MET FLM 215 OHM 1% 1/8W | |
| A8R13 | 0698-3445 | R:FXD MET FLM 348 OHM 1% 1/8W | |
| A8R14 | 0698-3405 | R:FXD MET FLM 422 OHM 1% 1/2W | |
| A8R15 | 0698-3405 | R:FXD MET FLM 422 OHM 1% 1/2W | |
| A8R16 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A8R17 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A8R18 | 0698-3445 | R:FXD MET FLM 348 OHM 1% 1/8W | |
| A8R19 | 0757-0405 | R:FXD MET FLM 162 OHM 1% 1/8W | |
| A8R20 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |

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

| Reference Designation | Part No. | Description # | Note |
|-----------------------|------------|---------------------------------|------|
| A8R21 | 0698-3400 | R:FXD MET FLM 147 OHM 1% 1/2W | |
| A8R22 | 0811-1637 | R:FXD WW 344.3 OHM 0.1% 1/3W | |
| A8R23 | 0757-0462 | R:FXD MET FLM 75.0K OHM 1% 1/8W | |
| A8R24 | 2100-1658 | R:VAR WW 2K OHM 10% 1W | |
| A8R25 | 0811-1641 | R:FXD WW 6710 OHM 0.1% 1/8W | |
| A8R26 | 0757-0405 | R:FXD MET FLM 162 OHM 1% 1/8W | |
| A8R27 | 0698-3101 | R:FXD MET FLM 2.87K OHM 1% 1/2W | |
| A8R28 | | NOT ASSIGNED | |
| A8R29 | 0811-1639 | R:FXD WW 477.6 OHM 0.1% 1/8W | |
| A8R30 | 0757-0462 | R:FXD MET FLM 75.0K OHM 1% 1/8W | |
| A8R31 | 0811-1641 | R:FXD WW 6710 OHM 0.1% 1/8W | |
| A8R32 | 2100-1658 | R:VAR WW 2K OHM 10% 1W | |
| A8R33 | 0757-0405 | R:FXD MET FLM 162 OHM 1% 1/8W | |
| A8R34 | 0698-3101 | R:FXD MET FLM 2.87K OHM 1% 1/2W | |
| A8R35 | | NOT ASSIGNED | |
| A8R36 | 0811-1642 | R:FXD WW 8825 OHM 0.1% 1/8W | |
| A8R37 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A8R38 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A9 | 08405-6009 | BOARD ASSY:VOLTMETER | |
| A9C1 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C2 | 0160-0301 | C:FXD MY 0.012 UF 10% 200VDCW | |
| A9C3 | 0180-1735 | C:FXD ELECT 0.22 UF 10% 35VDCW | |
| A9C4 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C5 | 0150-0121 | C:FXD CER 0.1 UF +80-20% 50VDCW | |
| A9C6 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C7 | 0180-0098 | C:FXD ELECT 100 UF 20% 20VDCW | |
| A9C8 | 0160-0164 | C:FXD MY 0.039 UF 10% 200VDCW | |
| A9C9 | 0140-0180 | C:FXD MICA 2000 PF 2% | |
| A9C10 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C11 | 0180-0137 | C:FXD ELECT 100 UF 20% 10VDCW | |
| A9C12 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C13 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A9C14 | 0180-0100 | 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 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A9CR2 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A9L1 | 9140-0072 | COIL:RF 5000 UH 10% | |
| A9MF1 | 5020-2045 | CARD EXTRACTOR | |
| A9Q1 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A9Q2 | 1853-0020 | TRANSISTOR:SILICON PNP | |
| A9Q3 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A9Q4 | 1854-0071 | 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 51.1 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 |
|-----------------------|------------|-----------------------------------|------|
| A10 | 08405-6010 | BOARD ASSY:APC AMPLIFIER | |
| A10C1 | 0160-2146 | C:FXD CER 0.02 UF +80-20% 100VDCW | |
| A10C2 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C3 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C4 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C5 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C6 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C7 | 0186-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C8 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C9 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C10 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C11 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C12 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A10C13 | 0140-0179 | C:FXD MICA 1000 PF 2% | |
| A10C14 | 0140-0155 | C:FXD MICA 1325 PF 1% 500VDCW | |
| A10C15 | 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | |
| A10C16 | 0160-2211 | C:FXD MICA 510 PF 5% 300VDCW | |
| A10C17 | 0160-2211 | C:FXD MICA 510 PF 5% 300VDCW | |
| A10CR1 | 08405-8004 | DIODES:SILICON MATCHED PAIR | |
| A10CR2 | | PART OF A10CR1 | |
| A10CR3 | 08405-8004 | DIODES:SILICON MATCHED PAIR | |
| A10CR4 | | PART OF A10CR3 | |
| A10CR5 | 08405-8004 | DIODES:SILICON MATCHED PAIR | |
| A10CR6 | | PART OF A10CR5 | |
| A10L1 | 9100-1628 | COIL:MOLDED CHOKE 43.0 UH 5% | |
| A10MP1 | 5020-2045 | CARD EXTRACTOR | |
| A10Q1 | 1854-0371 | TRANSISTOR:SILICON NPN | |
| A10Q2 | 1854-0371 | TRANSISTOR:SILICON NPN | |
| A10Q3 | 1854-0371 | TRANSISTOR:SILICON NPN | |
| A10Q4 | 1854-0371 | TRANSISTOR:SILICON NPN | |
| A10R1 | 0757-0428 | R:FXD MET FLM 1.62K OHM 1% 1/8W | |
| A10R2 | 0757-0288 | R:FXD MET FLM 9.09K OHM 1% 1/8W | |
| A10R3 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 1/8W | |
| A10R4 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A10R5 | 0757-0406 | R:FXD MET FLM 182 OHM 1% 1/8W | |
| A10R6 | 0698-3444 | R:FXD MET FLM 316 OHM 1% 1/8W | |
| A10R7 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A10R8 | 0698-3441 | R:FXD MET FLM 215 OHM 1% 1/8W | |
| A10R9 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A10R10 | 0757-0439 | R:FXD MET FLM 6.81K OHM 1% 1/8W | |
| A10R11 | 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 | 0698-3406 | R:FXD MET FLM 1.33K OHM 1% 1/2W | |
| A10R14 | 0698-3136 | R:FXD MET FLM 17.8K OHM 1% 1/8W | |
| A10R15 | 0698-3438 | 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 | 0698-3406 | R:FXD MET FLM 1.33K OHM 1% 1/2W | |
| A10R20 | 0698-3442 | R:FXD MET FLM 237 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 | 0160-2278 | C:FXD MICA 34000 PF 2% | |
| A11C2 | 0160-2276 | C:FXD MICA 2780 PF 2% 300VDCW | |
| A11C3 | 0180-0116 | C:FXD ELECT 6.8 UF 10% 35VDCW | |
| A11C4 | 0140-0156 | C:FXD MICA 1500 PF 2% | |
| A11C5 | 0160-2277 | C:FXD MICA 15000 PF 2% | |
| A11C6 | 0160-2277 | C:FXD MICA 15000 PF 2% | |
| A11C7 | 0160-0174 | C:FXD CER 0.47 UF +80-20% 25VDCW | |
| A11C8 | 0140-0170 | C:FXD MICA 5600 PF 5% 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 | 0140-0179 | 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 6.8 UF 10% 35VDCW | |
| A11C20 | 0160-0174 | C:FXD CER 0.47 UF +80-20% 25VDCW | |
| A11CR1 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR2 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR3 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR4 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR5 | 1902-0184 | DIODE BREAKDOWN:SILICON 16.2V 5% | |
| A11CR6 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR7 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR8 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| A11CR9 | 1901-0025 | DIODE:SILICON 100WV 100MA | |
| A11CR10 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR11 | 1901-0040 | DIODE:SILICON 30MA 30WV | |

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

| Reference Designation | Part No. | Description # | Note |
|-----------------------|------------------------|--|------|
| A11CR12 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR13 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR14 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR15 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR16 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR17 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR18 | 1902-0184 | DIODE BREAKDOWN:SILICON 16.2V 5% | |
| A11CR19 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR20 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR21 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11CR22 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A11MP1 | 5020-2045 | CARD EXTRACTOR | |
| A11Q1 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A11Q2 | 1854-0039 1205-0018 | TRANSISTOR:SILICON NPN 2N3053 HEAT SINK | |
| A11Q3 | 1853-0010 | TRANSISTOR:SILICON PNP | |
| A11Q4 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A11Q5 | 1854-0005 | TRANSISTOR:SILICON NPN 2N708 | |
| A11Q6 | 1853-0010 | TRANSISTOR:SILICON PNP | |
| A11Q7 | 1854-0039 | TRANSISTOR:SILICON NPN 2N3053 | |
| 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 23.7 OHM 1% 1/8W | |
| A11R7 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A11R8 | 0757-0815 | R:FXD MET FLM 562 OHM 1% 1/2W | |
| A11R9 | 0757-0815 | R:FXD MET FLM 562 OHM 1% 1/2W | |
| A11R10 | 0757-0401 | R:FXD MET FLM 100 OHM 1% 1/8W | |
| A11R11 | 0757-0401 | R:FXD MET FLM 100 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 5K 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 | 08405-8002 | TRANSFORMER:IF | |
| A11T2 | 08405-8002 | 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 100WV 100MA | |
| A12CR2 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A12CR3 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| 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 # | Note |
|-----------------------|------------|---------------------------------|------|
| A12R6 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 1/8W | |
| A12R7 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A12R8 | 0757-0290 | R:FXD MET FLM 6.19K OHM 1% 1/8W | |
| A12R9 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A12R10 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A12R11 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A12R12 | 0698-0084 | R:FXD MET FLM 2.15K OHM 1% 1/8W | |
| A12R13 | 0757-0290 | R:FXD MET FLM 6.19K OHM 1% 1/8W | |
| A12R14 | 0698-3449 | R:FXD MET FLM 28.7K OHM 1% 1/8W | |
| A12R15 | 0698-3449 | R:FXD MET FLM 28.7K OHM 1% 1/8W | |
| A12R16 | 0757-0461 | R:FXD MET FLM 68.1K OHM 1% 1/8W | |
| A12R17 | 0698-3453 | R:FXD MET FLM 196K OHM 1% 1/8W | |
| A12R18 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A12R19 | 0757-0200 | R:FXD MET FLM 5.62K OHM 1% 1/8W | |
| A12R20 | 0757-0465 | R:FXD MET FLM 100K OHM 1% 1/8W | |
| A12R21 | 0757-0441 | R:FXD MET FLM 8.25K OHM 1% 1/8W | |
| A12R22 | 0757-1094 | R:FXD MET FLM 1.47K OHM 1% 1/8W | |
| A12R23 | 0698-3449 | R:FXD MET FLM 28.7K OHM 1% 1/8W | |
| A12R24 | 0757-0460 | R:FXD MET FLM 61.9K OHM 1% 1/8W | |
| A12R25 | 2100-0942 | R:VAR FLM 50K OHM 20% 3/4W | |
| A12R26 | 0698-3152 | R:FXD MET FLM 3.48K OHM 1% 1/8W | |
| A12R27 | 0698-4315 | R:FXD COMP 430 OHM 5% 1/2W | |
| A12R28 | 0698-3158 | R:FXD MET FLM 23.7K OHM 1% 1/8W | |
| A12R29 | 0757-0346 | R:FXD MET FLM 10 OHM 1% 1/8W | |
| A12R30 | 0686-1055 | R:FXD COMP 1 MEGOHM 5% 1/2W | |
| A12R31 | 0698-3449 | R:FXD MET FLM 28.7K OHM 1% 1/8W | |
| A12R32 | 0698-3155 | R:FXD MET FLM 4.64K OHM 1% 1/8W | |
| A12R33 | 0757-0462 | R:FXD MET FLM 75.0K OHM 1% 1/8W | |
| A12R34 | 0757-0447 | R:FXD MET FLM 16.2K OHM 1% 1/8W | |
| A12R35 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A12R36 | 0698-3150 | R:FXD MET FLM 2.37K OHM 1% 1/8W | |
| A12R37 | 0757-0394 | R:FXD MET FLM 51.1 OHM 1% 1/8W | |
| A12R38 | 0757-0394 | R:FXD MET FLM 51.1 OHM 1% 1/8W | |
| A12R39 | 0698-3454 | R:FXD MET FLM 215K OHM 1% 1/8W | |
| A12R40 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A12R41 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A12R42 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A12R43 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W | |
| A12R44 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A13 | 08405-6013 | BOARD ASSY:EQUALIZER | |
| A13C1 | 0140-0157 | C:FXD MICA 1857 PF 1% | |
| A13C2 | 0180-1746 | C:FXD ELECT 15 UF 10% 20VDCW | |
| A13C3 | 0160-0168 | C:FXD MY 0.1 UF 10% 200VDCW | |
| A13C4 | 0160-0168 | C:FXD MY 0.1 UF 10% 200VDCW | |
| A13C5 | 0140-0182 | C:FXD MICA 5000 PF 2% | |
| A13C6 | 0160-2279 | C:FXD MICA 880 PF 2% 300VDCW | |

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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:MOLED CHOKE 910.0 OHM 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 | 0698-3158 | R:FXD MET FLM 23.7K OHM 1% 1/8W | |
| A13R6 | 0757-0405 | R:FXD MET FLM 162 OHM 1% 1/8W | |
| A13R7 | 0757-0402 | 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 | 0757-0403 | 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 | |

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

| Reference Designation | Part No. | Description # | Note |
|-----------------------|------------|-----------------------------------|------|
| A14C16 | 0160-2055 | C:FXD CER 0.01 UF +80-20% 100VDCW | |
| A14C17 | 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | |
| A14CR1 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR2 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR3 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR4 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR5 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR6 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR7 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14CR8 | 1901-0040 | DIODE:SILICON 30MA 30WV | |
| A14L1 | 9140-0138 | COIL/CHOKE 180 UH 5% | |
| A14L2 | 9140-0096 | COIL:FXD RF 1 UH | |
| A14L3 | 9140-0138 | COIL/CHOKE 180 UH 5% | |
| A14C1 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A14C2 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A14C3 | 1854-0071 | TRANSISTOR:SILICON NPN | |
| A14C4 | 1854-0003 | TRANSISTOR:NPN SILICON | |
| A14C5 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A14C6 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| A14Q7 | 08405-8003 | TRANSISTOR:NPN SILICON SELECTED | |
| A14Q8 | 08405-8003 | TRANSISTOR:NPN SILICON SELECTED | |
| A14R1 | 0698-0085 | R:FXD MET FLM 2.61K OHM 1% 1/8W | |
| A14R2 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A14R3 | 0698-3243 | R:FXD MET FLM 178K OHM 1% 1/8W | |
| A14R4 | 0757-0443 | R:FXD MET FLM 11.0K OHM 1% 1/8W | |
| A14R5 | 0757-0199 | R:FXD MET FLM 21.5K OHM 1% 1/8W | |
| A14R6 | 0757-0317 | R:FXD MET FLM 1.33K OHM 1% 1/8W | |
| A14R7 | 0757-0465 | R:FXD MET FLM 100K OHM 1% 1/8W | |
| A14R8 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A14R9 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A14R10 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A14R11 | 0757-0346 | R:FXD MET FLM 10 OHM 1% 1/8W | |
| A14R12 | 0757-0416 | R:FXD MET FLM 511 OHM 1% 1/8W | |
| A14R13 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A14R14 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A14R15 | 0698-4037 | R:FXD MET FLM 46.4 OHM 1% 1/8W | |
| A14R16 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A14R17 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A14R18 | 0698-4037 | R:FXD MET FLM 46.4 OHM 1% 1/8W | |
| A14R19 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A14R20 | 0698-3155 | R:FXD MET FLM 4.64K OHM 1% 1/8W | |

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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 30WV | |
| 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 | |
| A15G1 | 1854-0035 | TRANSISTOR:NPN SILICON | |
| A15Q2 | 1853-0009 | TRANSISTOR:SILICON PNP | |
| | 1205-0012 | 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 | |

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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 | |
| A16MF1 | 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 | |

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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 10% 35VDCW | |
| A18C2 | 0150-0121 | C:FXD CER 0.1 UF +80-20% 50VDCW | |
| A18C3 | 0180-0137 | C:FXD ELECT 100 UF 20% 10VDCW | |
| A18C4 | 0160-2120 | C:FXD MICA 0.01UF 1% | |
| A18C5 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C6 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C7 | 0180-2071 | C:FXD ELECT 0.022 UF 10% 35VDCW | |
| A18C8 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C9 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C10 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C11 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C12 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C13 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C14 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C15 | 0180-0100 | C:FXD ELECT 4.7 UF 10% 35VDCW | |
| A18C16 | 0160-2143 | C:FXD CER 2000 PF +80-20% 1000VDCW | |
| A18C17 | 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | |
| A18CR1 | 08405-8004 | DIODES:SILICON MATCHED PAIR | |
| A18CR2 | | PART OF A18CR1 | |
| A18L1 | 9100-1719 | COIL:VAR | |
| A18L2 | 9140-0114 | COIL:FXD RF 10 UH | |
| A18MP1 | 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 1% 1/8W | |
| A18R2 | 0698-3157 | R:FXD MET FLM 19.6K OHM 1% 1/8W | |
| A18R3 | 0698-3157 | R:FXD MET FLM 19.6K OHM 1% 1/8W | |
| A18R4 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A18R5 | 0698-3160 | R:FXD MET FLM 31.6K OHM 1% 1/8W | |
| A18R6 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A18R7 | 0757-0444 | R:FXD MET FLM 12.1K OHM 1% 1/8W | |
| A18R8 | 0698-0083 | R:FXD MET FLM 1.96K OHM 1% 1/8W | |
| A18R9 | | NOT ASSIGNED | |
| A18R10 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A18R11 | 2100-1760 | R:VAR WW 5K OHM 5% 1W | |
| A18R12 | 0757-0447 | R:FXD MET FLM 16.2K OHM 1% 1/8W | |
| A18R13 | 0757-0278 | R:FXD MET FLM 1.78K OHM 1% 1/8W | |
| A18R14 | 0757-0428 | R:FXD MET FLM 1.62K OHM 1% 1/8W | |
| A18R15 | 0757-0428 | R:FXD MET FLM 1.62K OHM 1% 1/8W | |

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

| Reference Designation | Part No. | Description # | Note |
|-----------------------|------------|---------------------------------|------|
| A18R16 | 0757-0288 | R:FXD MET FLM 9.09K OHM 1% 1/8W | |
| A18R17 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 1/8W | |
| A18R18 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A18R19 | 0757-0394 | R:FXD MET FLM 51.1 OHM 1% 1/8W | |
| A18R20 | 0698-3444 | R:FXD MET FLM 316 OHM 1% 1/8W | |
| A18R21 | 0757-0280 | R:FXD MET FLM 1K OHM 1% 1/8W | |
| A18R22 | 0698-3441 | R:FXD MET FLM 215 OHM 1% 1/8W | |
| A18R23 | 0698-3153 | R:FXD MET FLM 3.83K OHM 1% 1/8W | |
| A18R24 | 0757-0439 | R:FXD MET FLM 6.81K OHM 1% 1/8W | |
| A18R25 | 0698-0082 | R:FXD MET FLM 464 OHM 1% 1/8W | |
| A18R26 | 0698-3155 | R:FXD MET FLM 4.64K OHM 1% 1/8W | |
| A18R27 | 0698-3136 | R:FXD MET FLM 17.8K OHM 1% 1/8W | |
| A18R28 | 0698-3406 | R:FXD MET FLM 1.33K OHM 1% 1/2W | |
| A18R29 | 0698-3438 | R:FXD MET FLM 147 OHM 1% 1/8W | |
| A18R30 | 0698-0084 | R:FXD MET FLM 2.15K OHM 1% 1/8W | |
| A19 | 08405-6035 | CABLE ASSY:OUTPUT DELAY LINE | |
| A19CR1 | | NSR PART OF A19 | |
| A20 | 08405-6034 | CABLE ASSY:PULSE GENERATOR | |
| A20CR1 | | NSR PART OF A20 | |
| A21 | 08405-6052 | SWITCH ASSY:PHASE METER OFFSET | |
| A21R1 | 0698-4084 | R:FXD MET FLM 19.2 OHM 1% 1/8W | |
| A21R2 | 0698-4085 | R:FXD MET FLM 20.8 OHM 1% 1/8W | |
| A21R3 | 0698-4086 | R:FXD MET FLM 22.6 OHM 1% 1/8W | |
| A21R4 | 0698-4087 | R:FXD MET FLM 24.6 OHM 1% 1/8W | |
| A21R5 | 0698-4088 | R:FXD MET FLM 27 OHM 1% 1/8W | |
| A21R6 | 0698-4089 | R:FXD MET FLM 29.7 OHM 1% 1/8W | |
| A21R7 | 0698-4090 | R:FXD MET FLM 32.8 OHM 1% 1/8W | |
| A21R8 | 0757-0390 | R:FXD MET FLM 36.5 OHM 1% 1/8W | |
| A21R9 | 0698-4091 | R:FXD MET FLM 40.8 OHM 1% 1/8W | |
| A21R10 | 0698-4092 | R:FXD MET FLM 45.9 OHM 1% 1/8W | |
| A21R11 | 0698-4093 | R:FXD MET FLM 52 OHM 1% 1/8W | |
| A21R12 | 0698-4094 | R:FXD MET FLM 59.5 OHM 1% 1/8W | |
| A21R13 | 0698-4095 | R:FXD MET FLM 68.6 OHM 1% 1/8W | |
| A21R14 | 0698-4096 | R:FXD MET FLM 80.2 OHM 1% 1/8W | |
| A21R15 | 0698-4097 | R:FXD MET FLM 94.8 OHM 1% 1/8W | |
| A21R16 | 0757-0275 | R:FXD MET FLM 113 OHM 1% 1/8W | |
| A21R17 | 0698-4099 | R:FXD MET FLM 139 OHM 1% 1/8W | |
| A21S1 | 3100-1834 | SWITCH:ROTARY | |
| A22 | 08405-6051 | SWITCH ASSY:AMPLITUDE RANGE | |
| A22C1 | 0140-0210 | C:FXD MICA 270 PF 5% | |
| A22MP1 | 08405-0013 | COVER:SWITCH | |

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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 1% 1/8W | |
| A22R2 | 0698-5851 | R:FXD MET FLM 6.81K OHM 0.5% 1/8W | |
| A22R3 | 0698-5847 | R:FXD MET FLM 2150 OHM 0.5% 1/8W | |
| A22R4 | 0698-4100 | R:FXD MET FLM 1.26K OHM 1% 1/8W | |
| A22R5 | 0698-5850 | R:FXD MET FLM 681 OHM 0.5% 1/8W | |
| A22R6 | 0698-4101 | R:FXD MET FLM 1.85K OHM 1% 1/8W | |
| A22R7 | 0698-5848 | R:FXD MET FLM 215 OHM 0.5% 1/8W | |
| A22R8 | 0698-4102 | R:FXD MET FLM 2.06K OHM 1% 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 1% 1/8W | |
| A22R11 | 0698-5851 | R:FXD MET FLM 6.81K OHM 0.5% 1/8W | |
| A22R12 | 0698-5847 | R:FXD MET FLM 2150 OHM 0.5% 1/8W | |
| A22R13 | 0698-4100 | R:FXD MET FLM 1.26K OHM 1% 1/8W | |
| A22R14 | 0698-5850 | R:FXD MET FLM 681 OHM 0.5% 1/8W | |
| A22R15 | 0698-4101 | R:FXD MET FLM 1.85K OHM 1% 1/8W | |
| A22R16 | 0698-5848 | R:FXD MET FLM 215 OHM 0.5% 1/8W | |
| A22R17 | 0698-4102 | R:FXD MET FLM 2.06K OHM 1% 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 ASSY:FREQ. RANGE | |
| A24R1 | 0698-3446 | R:FXD MET FLM 383 OHM 1% 1/8W | |
| A24R2 | 0757-0419 | R:FXD MET FLM 681 OHM 1% 1/8W | |
| A24R3 | 0757-0424 | R:FXD MET FLM 1.10K OHM 1% 1/8W | |
| A24R4 | 0757-0428 | R:FXD MET FLM 1.62K OHM 1% 1/8W | |
| A24R5 | 0698-0084 | R:FXD MET FLM 2.15K OHM 1% 1/8W | |
| A24R6 | 0698-3151 | R:FXD MET FLM 2.87K 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 |
|-----------------------|------------|------------------------------------|------|
| A24R7 | 0698-3154 | R:FXD MET FLM 4.22K OHM 1% 1/8W | |
| A24R8 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 1/8W | |
| A24R9 | 0757-0440 | R:FXD MET FLM 7.50K OHM 1% 1/8W | |
| A24R10 | 0757-0442 | R:FXD MET FLM 10.0K OHM 1% 1/8W | |
| A24R11 | 0757-0289 | R:FXD MET FLM 13.3K OHM 1% 1/8W | |
| A24R12 | 0698-3136 | R:FXD MET FLM 17.8K OHM 1% 1/8W | |
| A24R13 | 0698-3159 | R:FXD MET FLM 26.1K OHM 1% 1/8W | |
| A24R14 | 0698-3161 | R:FXD MET FLM 38.3K OHM 1% 1/8W | |
| A24R15 | 0757-0458 | R:FXD MET FLM 51.1K OHM 1% 1/8W | |
| A24R16 | 0757-0462 | R:FXD MET FLM 75.0K OHM 1% 1/8W | |
| A24R17 | 0757-0466 | R:FXD MET FLM 110K OHM 1% 1/8W | |
| A24R18 | 0698-3453 | R:FXD MET FLM 196K OHM 1% 1/8W | |
| A24R19 | 0698-3460 | R:FXD MET FLM 422K OHM 1% 1/8W | |
| A24R20 | 0683-1055 | R:FXD COMP 1 MEGOHM 5% 1/4W | |
| A24R21 | 0757-0467 | R:FXD MET FLM 121K OHM 1% 1/8W | |
| A24R22 | 0757-0440 | R:FXD MET FLM 7.50K OHM 1% 1/8W | |
| A24R23 | 0757-0441 | R:FXD MET FLM 8.25K OHM 1% 1/8W | |
| A24R24 | 0698-3155 | R:FXD MET FLM 4.64K OHM 1% 1/8W | |
| A24R25 | 0698-3154 | R:FXD MET FLM 4.22K OHM 1% 1/8W | |
| A24R26 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 1/8W | |
| A24R27 | 0757-0200 | R:FXD MET FLM 5.62K OHM 1% 1/8W | |
| A24R28 | 0757-0290 | R:FXD MET FLM 6.19K OHM 1% 1/8W | |
| A24R29 | 0757-0200 | R:FXD MET FLM 5.62K OHM 1% 1/8W | |
| A24R30 | 0757-0438 | R:FXD MET FLM 5.11K OHM 1% 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 | |
| A25MP1 | 5040-0218 | COUPLER:SWITCH SHAFT | |
| A25R1 | 0811-1638 | R:FXD WW 344.8 OHM 0.1% 1/8W | |
| A25R2 | 0811-1640 | R:FXD WW 1111 OHM 0.1% 1/8W | |
| A25R3 | 0698-3279 | R:FXD MET FLM 4990 OHM 1% 1/8W | |
| A25R4 | 2100-0024 | R:VAR COMP 1000 OHM 10% 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 20% 250VDCW | |
| C2 | 0180-0369 | C:FXD ELECT 2800 UF +75-10% 60VDCW | |
| C3 | 0180-0369 | C:FXD ELECT 2800 UF +75-10% 60VDCW | |
| C4 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C5 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C6 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C7 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C8 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C9 | 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | |
| C10 | 0160-2140 | C:FXD CER 470 PF +80-20% 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 +80-20% 1000VDCW | |
| C12 | 0160-2257 | C:FXD CER 10 PF 5% 500VDCW | |
| DS1 | 2140-0244 | LAMP:GLOW T-2 BULB 1.0M 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 | CONNECTOR:8NC | |
| J4 | 1250-0083 | CONNECTOR:8NC | |
| L1 | 9140-0096 | COIL:FXD RF 1 UH | |
| L2 | 9140-0096 | COIL:FXD RF 1 UH | |
| L3 | 9140-0096 | COIL:FXD RF 1 UH | |
| L4 | 9140-0096 | COIL:FXD RF 1 UH | |
| L5 | 9100-1610 | COIL:MOLDED CHOKE 0.15 UH 20% | |
| L6 | 9100-1610 | COIL:MOLDED CHOKE 0.15 UH 20% | |
| 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:RMS VOLTS LIN LOG OPT 02 | |
| P1 | 1251-2357 | CONNECTOR:POWER 3 PIN MALE | |
| Q1 | 1854-0063 | TRANSISTOR:NPN SILICON 2N3055 | |
| Q1 | 1200-0077 | INSULATOR:TRANSISTOR, MICA | |
| Q2 | 1854-0063 | TRANSISTOR:MPN SILICON 2N3055 | |
| Q2 | 1200-0077 | INSULATOR:TRANSISTOR, MICA | |
| R1 | 0698-3420 | R:FXD MET FLM 34.8K OHM 1% 1/2W | |
| R2 | 0813-0017 | R:FXD WW 5 OHM 10% 5W | |
| R3 | 0816-0010 | R:FXD WW 12 OHM 10% 10W | |
| R4 | 0757-0351 | R:FXD MET FLM 402 OHM 1% 1/4W | |
| S1 | 3101-1248 | SWITCH:PUSHBUTTON SPDT | |
| S2 | 3101-1234 | SWITCH:SLIDE DPDT 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" IF OUTPUT | |

See introduction to this section for ordering information

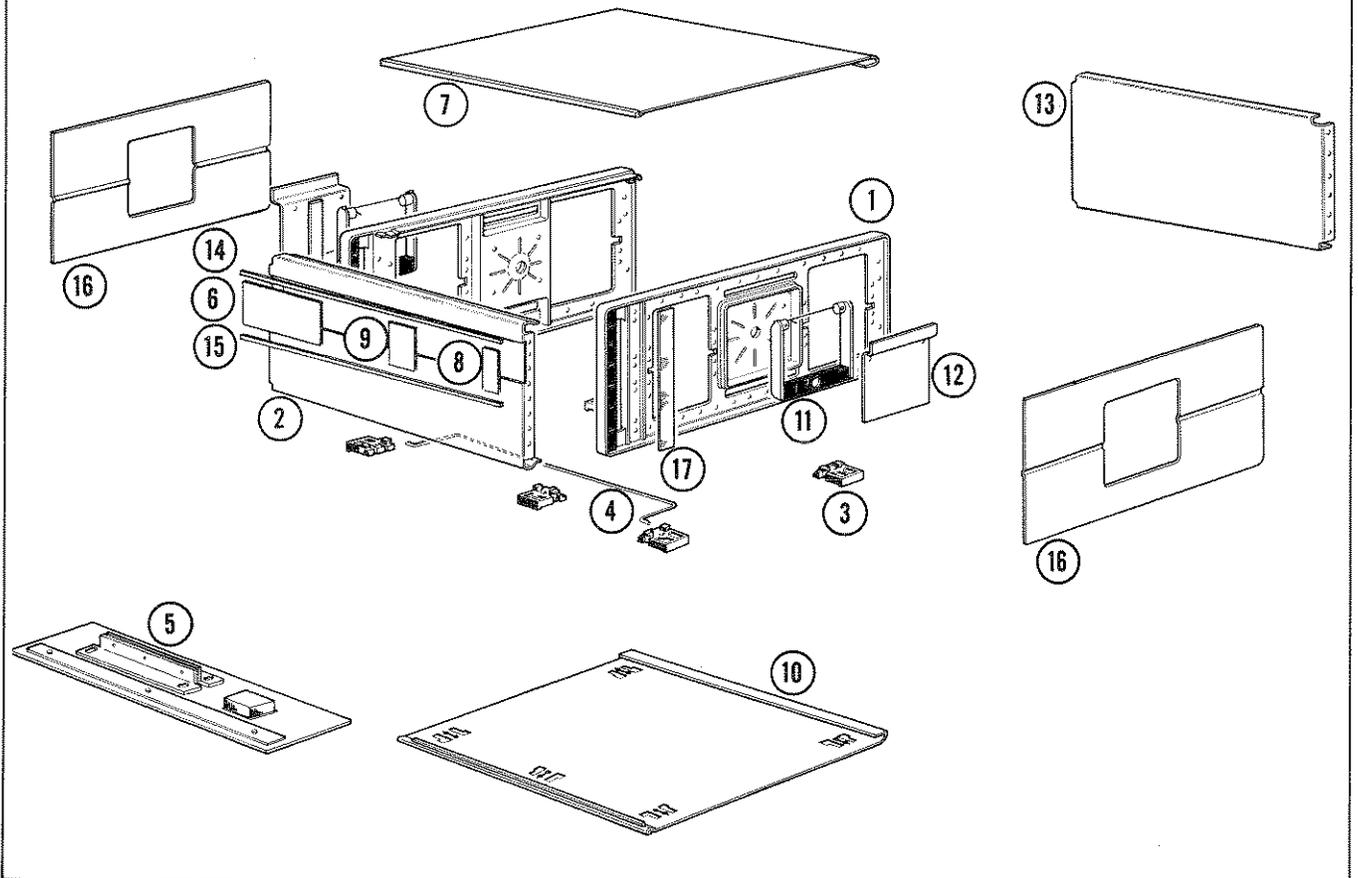
Table 6-1. Reference Designation Index (Cont'd)

| 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 ASSY: INPUT DELAY LINE | |
| W11 | 8120-1348 | CABLE ASSY: POWER CORD | |
| XA3 | 1251-0194 | CONNECTOR: 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 15 PIN | |
| XA8 | 1251-0135 | CONNECTOR: BODY 15 PIN | |
| XA9 | 1251-0135 | CONNECTOR: BODY 15 PIN | |
| XA10 | 1251-0135 | CONNECTOR: BODY 15 PIN | |
| XA11 | 1251-0135 | CONNECTOR: BODY 15 PIN | |
| XA12 | 1251-0135 | CONNECTOR: BODY 15 PIN | |
| XA13 | 1251-0194 | CONNECTOR: PRINTED CIRCUIT 15-CONTACT | |
| XA14 | 1251-0194 | CONNECTOR: PRINTED CIRCUIT 15-CONTACT | |
| XA15 | 1251-0194 | CONNECTOR: PRINTED CIRCUIT 15-CONTACT | |
| XA16 | 1251-0135 | CONNECTOR: 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 PIN | |
| XF1 | 1400-0084 | FUSEHOLDER: EXTRACTOR POST TYPE | |
| XF2 | 1400-0084 | FUSEHOLDER: EXTRACTOR POST TYPE | |
| XF3 | 1400-0084 | FUSEHOLDER: EXTRACTOR POST TYPE | |
| XQ1 | 1200-0041 | SOCKET: TRANSISTOR | |
| XQ2 | 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/DIAL ATTACHED | |
| | 5040-0404 | HOLDER: PROBE | |
| | 5020-0457 | PROBE TIP | |
| | 10213-62102 | CLIP: GROUND | |
| | 10216-60001 | ISOLATOR | |
| | 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 6-1. Reference Designation Index (Cont'd)

| Reference Designation | Part No. | Description # | Note |
|-----------------------|------------|----------------------------------|------|
| CABINET PARTS | | | |
| 1 | 5060-0734 | FRAME ASSY:7 X 16 FM | |
| 2 | 2530-0011 | SCREW:SST FLAT HD 8-32 X 3/8 | |
| | 08405-0025 | PANEL:FRONT | |
| 3 | 0510-0004 | FASTENER | |
| | 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 | 5060-0222 | 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 180 PF 5% 300 VDCW | 04062 | RDM15F181J3C | 1 |
| 0140-0204 | C:FXD MICA 47PF 5% NPD 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 | RDM20F122500F3C | 1 |
| 0150-0019 | C:FXD CER 1000 PF 20% 500VDCW | 72982 | 327005X5U0102M | 6 |
| 0150-0050 | C:FXD CER 1000 PF 600VDCW | 77630 | 08D | 1 |
| 0150-0051 | C:FXD CER 100 PF 600VDCW | 84411 | 08D | 1 |
| 0150-0069 | C:FXD CER 1000 PF +100-20% 500VDCW | 72982 | 801-010X5G0102Z | 1 |
| 0150-0070 | C:FXD CER 0.02 UF 20% 500VDCW | 72982 | 821-011Z5U0203M | 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% 250VAC | 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 | 6 |
| 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 | C023F101F103ZS22 | 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 220 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-C0HD-100J | 1 |
| 0160-2261 | C:FXD CER 15 PF 5% 500VDCW | 72982 | 301-NPG-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 |
| 0160-2278 | C:FXD MICA 34000 PF 2% | 28480 | 0160-2278 | 1 |
| 0160-2279 | C:FXD MICA 880 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 100UF +100%-10% 15VDCW | 56289 | 30107G015DD4 | 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 6.8 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 100UF -10+100% 40VDCW | 56289 | D36254 | 3 |
| 0180-0195 | C:FXD ELECT 0.33 UF 20% 35VDCW | 28480 | 0180-0195 | 1 |

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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 | D39823 | 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 | 1 |
| 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% 1/8W | 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 |
| 0698-3279 | R:FXD MET FLM 4990 OHM 1% 1/8W | 28480 | 0698-3279 | 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 | 2 |
| 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 | 2 |

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 |
| 0698-3455 | R:FXD MET FLM 261K OHM 1% 1/8W | 28480 | 0698-3455 | 1 |
| 0698-3459 | R:FXD MET FLM 383K OHM 1% 1/8W | 28480 | 0698-3459 | 1 |
| 0698-3460 | R:FXD MET FLM 422K OHM 1% 1/8W | 28480 | 0698-3460 | 2 |
| 0698-4037 | R:FXD MET FLM 46.4 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 40.80OHM 1% 1/8W | 28480 | 0698-4091 | 1 |
| 0698-4092 | R:FXD MET FLM 45.9 OHM 1% 1/8W | 28480 | 0698-4092 | 1 |
| 0698-4093 | 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 | 28480 | 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 |
| 0757-0290 | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 | 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 182 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 | 4 |
| 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 |
| 0813-0017 | 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 OPT 02 | 28480 | 1120-1466 | 1 |
| 1200-0041 | SOCKET:TRANSISTOR | 71785 | 133-32-10-013 | 2 |
| 1200-0077 | INSULATOR:TRANSISTOR, MICA | 16037 | #112 | 2 |
| 1205-0012 | HEAT DISSIPATOR:SEMICONDUCTOR | 28480 | 1205-0012 | 1 |
| 1205-0018 | HEAT SINK | 05820 | NF-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 | 79515 | 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 | 2 |
| 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 100MA | 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 BULB 1.0M AMP 95VAC | 87034 | A1H | 1 |
| 2370-0020 | SCREW:SST FH PHIL DR 6-32 X 3/16 | 00000 | 08D | 1 |
| 2515-0017 | SCREW:PAN HD PHIL DR 8-32 X 1/4 | 00000 | 08D | 1 |
| 2530-0011 | SCREW:SST FLAT HD 8-32 X 3/8 | 78189 | 08D# | 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:FLUTED ALUMINUM | 28480 | 5000-0052 | 1 |
| 5000-C742 | COVER:SIDE 7 X 16 SM | 28480 | 5000-0742 | 1 |
| 5020-0457 | PROBE TIP | 28480 | 5020-0457 | 3 |
| 5020-2045 | CARD EXTRACTOR | 28480 | 5020-2045 | 10 |
| 5040-0218 | COUPLER:SWITCH SHAFT | 28480 | 5040-0218 | 1 |
| 5040-0404 | HOLDER:PROBE | 28480 | 5040-0404 | 1 |
| 5060-0222 | HANDLE ASSY:SIDE | 28480 | 5060-0222 | 1 |
| 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 | CCIL:MOLDED CHOKE 0.15 UH 20% | 28480 | 9100-1610 | 2 |
| 9100-1628 | CCIL:MOLDED CHOKE 43.0 UH 5% | 28480 | 9100-1628 | 1 |
| 9100-1653 | CCIL:MOLDED CHOKE 910.0 UH 5% | 28480 | 9100-1653 | 1 |
| 9100-1698 | TRANSFORMER:PULSE | 28480 | 9100-1698 | 1 |
| 9100-1706 | TRANSFORMER:POWER | 28480 | 9100-1706 | 1 |
| 9100-1718 | CCIL:VAR | 28480 | 9100-1718 | 2 |
| 9100-1719 | CCIL:VAR | 28480 | 9100-1719 | 2 |
| 9140-C072 | CCIL:RF 5000 UH 10% | 95265 | SA5000-1 | 1 |
| 9140-C096 | CCIL:FXD RF 1 UH | 28480 | 9140-C096 | 8 |
| 9140-C114 | CCIL:FXD RF 10 UH | 28480 | 9140-0114 | 6 |
| 9140-0118 | CCIL:FXD 500 UH 5% | 28480 | 9140-0118 | 1 |
| 9140-0120 | CCIL:FXD 0.1 UH 20% | 28480 | 9140-0120 | 2 |
| 9140-0138 | COIL/CHOKE 180 UH 5% | 28480 | 9140-0138 | 3 |
| 9140-0181 | CCIL:FXD RF 22UH 5% | 78526 | 12201M | 1 |
| 00187-42106 | RING:IDENT BLUE | 28480 | 00187-42106 | 1 |
| 08405-0011 | SUB-PANEL:FRONT | 28480 | 08405-0011 | 1 |
| 08405-0013 | COVER:SWITCH | 28480 | 08405-0013 | 2 |
| 08405-0014 | PLATE:SWITCH COVER | 28480 | 08405-0014 | 4 |
| 08405-0015 | PLATE:PANEL, RIGHT | 28480 | 08405-0015 | 1 |
| 08405-0016 | PLATE:PANEL, CENTER | 28480 | 08405-0016 | 1 |
| 08405-0024 | PANEL:REAR | 28480 | 08405-0024 | 1 |
| 08405-0025 | PANEL:FRONT | 28480 | 08405-0025 | 1 |
| 08405-2021 | EXTRUSION:TOP | 28480 | 08405-2021 | 1 |
| 08405-2022 | EXTRUSION:BOTTOM | 28480 | 08405-2022 | 1 |
| 08405-2044 | PROBE INSULATOR | 28480 | 08405-2044 | 1 |
| 08405-2032 | RING:IDENT WHITE | 28480 | 08405-2032 | 1 |
| 08405-6002 | BOARD ASSY:SAMPLER | 28480 | 08405-6002 | 2 |
| 08405-6003 | BOARD ASSY:ISOLATION AMP. | 28480 | 08405-6003 | 2 |
| 08405-6005 | BOARD ASSY:PHASE SHIFTER | 28480 | 08405-6005 | 1 |
| 08405-6006 | BOARD ASSY:180 DEG. SWITCH | 28480 | 08405-6006 | 1 |
| 08405-6009 | BOARD ASSY:VOLTMETER | 28480 | 08405-6009 | 1 |
| 08405-6010 | BOARD ASSY:APC AMPLIFIER | 28480 | 08405-6010 | 1 |
| 08405-6012 | BOARD ASSY:SEARCH | 28480 | 08405-6012 | 1 |
| 08405-6013 | BOARD ASSY:EQUALIZER | 28480 | 08405-6013 | 1 |
| 08405-6014 | BOARD ASSY:VTD | 28480 | 08405-6014 | 1 |
| 08405-6015 | BOARD ASSY:PULSE GENERATOR | 28480 | 08405-6015 | 1 |
| 08405-6016 | BOARD ASSY:POWER SUPPLY | 28480 | 08405-6016 | 1 |
| 08405-6017 | DELAY LINE ASSY | 28480 | 08405-6017 | 1 |
| 08405-6018 | BOARD ASSY:EXTENDER | 28480 | 08405-6018 | 1 |
| 08405-6020 | KNCB:FREQ RANGE,W/DIAL ATTACHED | 28480 | 08405-6020 | 1 |
| 08405-6024 | SWITCH ASSY:PHASE RANGE | 28480 | 08405-6024 | 1 |
| 08405-6027 | CABLE ASSY:APC AMP. | 28480 | 08405-6027 | 1 |
| 08405-6028 | CABLE ASSY | 28480 | 08405-6028 | 1 |
| 08405-6029 | CABLE ASSY:"B" IF OUTPUT | 28480 | 08405-6029 | 1 |
| 08405-6030 | CABLE ASSY:"A" IF OUTPUT | 28480 | 08405-6030 | 1 |
| 08405-6031 | CABLE ASSY:ISOLATION AMP. | 28480 | 08405-6031 | 2 |
| 08405-6032 | CABLE ASSY:COAXIAL | 28480 | 08405-6032 | 2 |
| 08405-6033 | CABLE ASSY:COAXIAL | 28480 | 08405-6033 | 2 |

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 |
| 10213-62102 | CLIP:GROUND | 28480 | 10213-62102 | 1 |
| 10216-60001 | ISOLATOR | 28480 | 10216-60001 | 1 |
| 11576 A | 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 | Code No. | Manufacturer | Address | Code No. | Manufacturer | Address |
|----------|--|--------------------------|----------|---|------------------------------------|----------|---|---------------------------------|
| 00000 | U. S. A. Common | Any supplier of U. S. | 05245 | Components Corp. | Chicago, Ill. | 09145 | Tech. Ind. Inc. Atohm Elect. | Burbank, Calif. |
| 00136 | McCoy Electronics | Mount Holly Springs, Pa. | 05277 | Westinghouse Electric Corp. | | 09250 | Electro Assemblies, Inc. | Chicago, Ill. |
| 00213 | Sage Electronics Corp. | Rochester, N. Y. | | Semi-Conductor Dept. | Youngwood, Pa. | 09353 | C & K Components Inc. | Newton, Mass. |
| 00287 | Cemco Inc. | Danielson, Conn. | 05347 | Ultronix, Inc. | San Mateo, Calif. | 09569 | Mallory Battery Co. of | |
| 00334 | Humidial | Colton, Calif. | 05397 | Union Carbide Corp., Elect. Div. | | | Canada, Ltd. | Toronto, Ontario, Canada |
| 00348 | Microtron Co., Inc. | Valley Stream, N. Y. | | | New York, N. Y. | 09922 | Burdry Corp. | Norwalk, Conn. |
| 00373 | Garlock Inc. | Cherry Hill, N. J. | 05574 | Viking Ind. Inc. | Canoga Park, Calif. | 10214 | General Transistor Western Corp. | |
| 00656 | Aerovox Corp. | New Bedford, Mass. | 05593 | Icove Electro-Plastics Inc. | Sunnyvale, Calif. | | | Los Angeles, Calif. |
| 00779 | Amp. Inc. | Harrisburg, Pa. | 05616 | Cosmo Plastic | | 10411 | Ti-Tai, Inc. | Berkeley, Calif. |
| 00781 | Aircraft Radio Corp. | Boonton, N. J. | | (c/o Electrical Spec. Co.) | Cleveland, Ohio | 10646 | Carborundum Co. | Niagara Falls, N. Y. |
| 00815 | Northern Engineering Laboratories, Inc. | Burlington, Wis. | 05624 | Barber Colman Co. | Rockford, Ill. | 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 00853 | Sangamo Electric Co., Pickens Div. | | 05728 | Tiffen Optical Co. | | 11237 | Chicago Telephone of California, Inc. | |
| | | Pickens, S. C. | | | Roslyn Heights, Long Island, N. Y. | | | So. Pasadena, Calif. |
| 00866 | Goe Engineering Co. | City of Industry, Cal. | 05729 | Metro-Tel Corp. | Westbury, N. Y. | 11242 | Bay State Electronics Corp. | Waltham, Mass. |
| 00891 | Carl E. Holmes Corp. | Los Angeles, Calif. | 05783 | Stewart Engineering Co. | Santa Cruz, Calif. | 11312 | Teledyne Inc., Microwave Div. | Palo Alto, Calif. |
| 00929 | Microfab Inc. | Livingston, N. J. | 05820 | Wakefield Engineering Inc. | Wakefield, Mass. | 11314 | National Seal | Downey, Calif. |
| 01002 | General Electric Co., Capacitor Dept. | | 06004 | Bassick Co., Div. of Stewart Warner Corp. | | 11453 | Precision Connector Corp. | Jamaica, N. Y. |
| | | Hudson Falls, N. Y. | | | Bridgeport, Conn. | 11534 | Duncan Electronics Inc. | Costa Mesa, Calif. |
| 01009 | Alden Products Co. | Brockton, Mass. | 06090 | Raychem Corp. | Redwood City, Calif. | 11711 | General Instrument Corp., Semiconductor | |
| 01121 | Allen Bradley Co. | Milwaukee, Wis. | 06175 | Bausch and Lomb Optical Co. | Rochester, N. Y. | | Div., Products Group | Newark, N. J. |
| 01255 | Litton Industries, Inc. | Beverly Hills, Calif. | 06402 | E. T. A. Products Co. of America | Chicago, Ill. | 11717 | Imperial Electronic, Inc. | Buena Park, Calif. |
| 01281 | TRW Semiconductors, Inc. | Lawndale, Calif. | 06540 | Anatom Electronic Hardware Co., Inc. | | 11870 | Melabs, Inc. | Palo Alto, Calif. |
| 01295 | Texas Instruments, Inc., Transistor Products Div. | | | | New Rochelle, N. Y. | 12040 | National Semiconductor | Danbury, Conn. |
| | | Dallas, Texas | 06555 | Beede Electrical Instrument Co., Inc. | | 12136 | Philadelphia Handle Co. | Camden, N. J. |
| 01349 | The Alliance Mfg. Co. | Alliance, Ohio | | | Penacook, N. H. | 12361 | Grove Mfg. Co., Inc. | Shady Grove, Pa. |
| 01589 | Pacific Relays, Inc. | Van Nuys, Calif. | 06666 | General Devices Co., Inc. | Indianapolis, Ind. | 12574 | Gulton Ind. Inc. Data System Div. | |
| 01670 | Gudebrod Bros. Silk Co. | New York, N. Y. | 06751 | Components Inc., Ariz. Div. | Phoenix, Ariz. | | | Albuquerque, N. M. |
| 01930 | Amerock Corp. | Rockford, Ill. | 06812 | Torrington Mfg. Co., West Div. | | 12697 | Glarostat Mfg. Co. | Dover, N. H. |
| 01961 | Pulse Engineering Co. | Santa Clara, Calif. | | | Van Nuys, Calif. | 12728 | Elmar Filter Corp. | W. Haven, Conn. |
| 02114 | Ferroxcube Corp. of America | Saugerties, N. Y. | 06980 | Varian Assoc. Eimac Div. | San Carlos, Calif. | 12859 | Nippon Electric Co., Ltd. | Tokyo, Japan |
| 02116 | Wheelock Signals, Inc. | Long Branch, N. J. | 07088 | Kelvin Electric Co. | Van Nuys, Calif. | 12881 | Metex Electronics Corp. | Clark, N. J. |
| 02286 | Cole Rubber and Plastics Inc. | Sunnyvale, Calif. | 07126 | Digitran Co. | Pasadena, Calif. | 12930 | Delta Semiconductor Inc. | Newport Beach, Calif. |
| 02560 | Amphenol-Borg Electronics Corp. | Broadview, Ill. | 07137 | Transistor Electronics Corp. | Minneapolis, Minn. | 12954 | Dickson Electronics Corp. | Scottsdale, Arizona |
| 02735 | Radio Corp. of America, Semiconductor and Materials Div. | | 07138 | Westinghouse Electric Corp. Electronic Tube Div. | | 13103 | Thermolloy | Dallas, Texas |
| | | Somerville, N. J. | | | Elmira, N. Y. | 13396 | Telefunken (GmbH) | Hanover, Germany |
| 02771 | Vocaine Co. of America, Inc. | | 07149 | Filmohm Corp. | New York, N. Y. | 13835 | Midland-Wright Div. of Pacific Industries, Inc. | |
| | | Old Saybrook, Conn. | 07233 | Cinch-Graphik Co. | City of Industry, Calif. | | | Kansas City, Kansas |
| 02777 | Hopkins Engineering Co. | San Fernando, Calif. | 07256 | Silicon Transistor Corp. | Carle Place, N. Y. | 14099 | Sem-Tech | Newbury Park, Calif. |
| 02875 | Hudson Tool & Die Co. | Newark, N. J. | 07261 | Avnet Corp. | Culver City, Calif. | 14193 | Calif. Resistor Corp. | Santa Monica, Calif. |
| 03508 | G. E. Semiconductor Prod. Dept. | Syracuse, N. Y. | 07263 | Fairchild Camera & Inst. Corp. | | 14298 | American Components, Inc. | Conshohocken, Pa. |
| 03705 | Apex Machine & Tool Co. | Dayton, Ohio | | | Mountain View, Calif. | 14433 | ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp. | West Palm Beach, Fla. |
| 03797 | Eldema Corp. | Compton, Calif. | 07322 | Minnesota Rubber Co. | Minneapolis, Minn. | 14493 | Hewlett-Packard Company | Loveland, Colo. |
| 03818 | Parker Seal Co. | Los Angeles, Calif. | 07387 | Bitcher Corp., The | Monterey Park, Calif. | 14655 | Cornell Dublier Electric Corp. | Newark, N. J. |
| 03877 | Transitron Electric Corp. | Wakefield, Mass. | 07397 | Sylvania Elect. Prod. Inc., Mt. View Operations | | 14674 | Corning Glass Works | Corning, N. Y. |
| 03888 | Pyrofilm Resistor Co., Inc. | Cedar Knolls, N. J. | | | Mountain View, Calif. | 14752 | Electro Cube Inc. | San Gabriel, Calif. |
| 03954 | Singer Co., Diehl Div. | | 07700 | Technical Wire Products Inc. | Cranford, N. J. | 14960 | Williams Mfg. Co. | San Jose, Calif. |
| | | Sumerville, N. J. | 07829 | Bodine Elect. Co. | Chicago, Ill. | 15203 | Webster Electronics Co. | New York, N. Y. |
| 04009 | Arrow, Hart and Hegeman Elect. Co. | | 07910 | Continental Device Corp. | Hawthorne, Calif. | 15287 | Scionics Corp. | Northridge, Calif. |
| | | Hartford, Conn. | 07933 | Raytheon Mfg. Co., Semiconductor Div. | | 15291 | Adjustable Bushing Co. | N. Hollywood, Calif. |
| 04013 | Taurus Corp. | Lambertville, N. J. | | | Mountain View, Calif. | 15558 | Micron Electronics | |
| 04062 | Arco Electronic Inc. | Great Neck, N. Y. | 07980 | Hewlett-Packard Co., Boonton Radio Div. | | | | Garden City, Long Island, N. Y. |
| 04222 | Hi-Q Division of Aerovox | Myrtle Beach, S. C. | | | Rockaway, N. J. | 15566 | Amprobe Inst. Corp. | Lynbrook, N. Y. |
| 04354 | Precision Paper Tube Co. | Wheeling, Ill. | 08145 | U. S. Engineering Co. | Los Angeles, Calif. | 15631 | Cabletronics | Costa Mesa, Calif. |
| 04404 | Dymec Division of Hewlett-Packard Co. | | 08289 | Blinn, Delbert Co. | Pomona, Calif. | 15772 | Twentieth Century Coil Spring Co. | |
| | | Palo Alto, Calif. | 08358 | Burgess Battery Co. | | | | Santa Clara, Calif. |
| 04651 | Sylvania Electric Products, Microwave Device Div. | | | | Niagara Falls, Ontario, Canada | 15891 | Fenwal Elect. Inc. | Framingham, Mass. |
| | | Mountain View, Calif. | 08524 | Deutsch Fastener Corp. | Los Angeles, Calif. | 15818 | Amelco Inc. | Mt. View, Calif. |
| 04673 | Dakota Engr. Inc. | Culver City, Calif. | 08664 | Bristol Co., The | Waterbury, Conn. | 16037 | Spruce Pine Mica Co. | Spruce Pine, N. C. |
| 04713 | Motorola, Inc., Semiconductor Prod. Div. | | 08717 | Sloan Company | Sun Valley, Calif. | 16179 | Omni-Spectra Inc. | Farmington, Mich. |
| | | Phoenix, Arizona | 08718 | ITT Cannon Electric Inc., Phoenix Div. | | 16352 | Computer Diode Corp. | Lodi, N. J. |
| 04732 | Filttron Co., Inc. Western Div. | | | | Phoenix, Arizona | 16585 | Boots Aircraft Nut Corp. | Passadena, Calif. |
| | | Culver City, Calif. | 08727 | National Radio Lab. Inc. | Paramus, N. J. | 16688 | Ideal Prec. Meter Co., Inc. | |
| 04773 | Automatic Electric Co. | Northlake, Ill. | | | Paramus, N. J. | | De Jur Meter Div. | Brooklyn, N. Y. |
| 04796 | Sequoia Wire Co. | Redwood City, Calif. | 08792 | CBS Electronics-Semiconductor Operations, Div. of C. B. S. Inc. | | 16758 | Delco Radio Div. of G. M. Corp. | Kokoma, Ind. |
| 04811 | Precision Coil Spring Co. | El Monte, Calif. | | | Lowell, Mass. | 17109 | Thermonetics Inc. | Canoga Park, Calif. |
| 04870 | P. M. Motor Company | Westchester, Ill. | 08806 | General Electric Co. Miniatur. Lamp Dept. | | 17474 | Tranex Company | Mountain View, Calif. |
| 04919 | Component Mfg. Service Co. | | | | Cleveland, Ohio | 17554 | Components Inc. | Biddeford, Ma. |
| | | W. Bridgewater, Mass. | 08984 | Mel-Rain | Indianapolis, Ind. | 17675 | Hamlin Metal Products Corp. | Akron, Ohio |
| 05006 | Twentieth Century Plastics, Inc. | | 09026 | Babcock Relays Div. | Costa Mesa, Calif. | 17745 | Angstrom Prec. Inc. | No. Hollywood, Calif. |
| | | Los Angeles, Calif. | 09134 | Texas Capacitor Co. | Houston, Texas | | | |

TABLE 6-3.
CODE LIST OF MANUFACTURERS (Continued)

| Code No. | Manufacturer | Address | Code No. | Manufacturer | Address | Code No. | Manufacturer | Address |
|----------|---|-----------------------------|----------|---|--------------------------|----------|---|-------------------------|
| 17870 | McGraw-Edison Co. | Manchester, N. H. | 62119 | Universal Electric Co. | Owosso, Mich. | 73899 | JFD Electronics Corp. | Brooklyn, N. Y. |
| 18042 | Power Design Pacific Inc. | Palo Alto, Calif. | 63743 | Ward-Leonard Electric Co. | Mt. Vernon, N. Y. | 73905 | Jennings Radio Mfg. Corp. | San Jose, Calif. |
| 18083 | Clevite Corp., Semiconductor Div. | | 64959 | Western Electric Co., Inc. | New York, N. Y. | 73957 | Groov-Pin Corp. | Ridgefield, N. J. |
| 18324 | Signetics Corp. | Palo Alto, Calif. | 65092 | Weston Inst. Inc. Weston-Newark | Newark, N. J. | 74276 | Signalite Inc. | Neptune, N. J. |
| 18476 | Ty-Car Mfg. Co., Inc. | Sunnyvale, Calif. | 66295 | Wittek Mfg. Co. | Chicago, Ill. | 74455 | J. H. Winns, and Sons | Winchester, Mass. |
| 18486 | TRW Elect. Comp. Div. | Holliston, Mass. | 66346 | Minnesota Mining & Mfg. Co. | Revere Mincom Div. | 74861 | Industrial Condenser Corp. | Chicago, Ill. |
| 18583 | Curtis Instrument, Inc. | Des Plaines, Ill. | | | | 74868 | R. F. Products Division of Amphel-Borg Electronics Corp. | Danbury, Conn. |
| 18612 | Vishay Instruments Inc. | Mt. Kisco, N. Y. | 70276 | Allen Mfg. Co. | Hartford, Conn. | 74970 | E. F. Johnson Co. | Waseca, Minn. |
| 18873 | E. I. DuPont and Co., Inc. | Malvern, Pa. | 70309 | Allied Control | New York, N. Y. | 75042 | International Resistance Co. | Philadelphia, Pa. |
| 18911 | Durant Mfg. Co. | Wilmington, Del. | 70318 | Almetal Screw Product Co., Inc. | Garden City, N. Y. | 75263 | Keystone Carbon Co., Inc. | St. Marys, Pa. |
| 19315 | The Bendix Corp., Navigation & Control Div. | Milwaukee, Wis. | | | | 75378 | CTS Knights Inc. | Sandwich, Ill. |
| | | Teterboro, N. J. | 70417 | Amplex, Div. of Chrysler Corp. | Detroit, Mich. | 75382 | Kulka Electric Corporation | Mt. Vernon, N. Y. |
| 19500 | Thomas A. Edison Industries, Div. of McGraw-Edison Co. | West Orange, N. J. | 70485 | Atlantic India Rubber Works, Inc. | Chicago, Ill. | 75818 | Lenz Electric Mfg. Co. | Chicago, Ill. |
| 19589 | LRC Electronics | Baldwin Park, Calif. | 70563 | Amperite Co., Inc. | Union City, N. J. | 75915 | Littlefuse, Inc. | Des Plaines, Ill. |
| 19644 | Electra Mfg. Co. | Independence, Kansas | 70674 | ADC Products Inc. | Minneapolis, Minn. | 76005 | Lord Mfg. Co. | Erie, Pa. |
| 20183 | General Atronics Corp. | Philadelphia, Pa. | 70903 | Belden Mfg. Co. | Chicago, Ill. | 76210 | C. W. Marwedel | San Francisco, Calif. |
| 21226 | Executone, Inc. | Long Island City, N. Y. | 70998 | Bird Electronic Corp. | Cleveland, Ohio | 76433 | General Instrument Corp., Micamold Division | Newark, N. J. |
| 21335 | Fafnir Bearing Co., The | New Britain, Conn. | 71002 | Birnbach Radio Co. | New York, N. Y. | | | |
| 21520 | Fansteel Metallurgical Corp. | N. Chicago, Ill. | 71034 | Bliley Electric Co., Inc. | Erie, Pa. | 76487 | James Millen Mfg. Co., Inc. | Malden, Mass. |
| 23042 | Texscan Corp. | Indianapolis, Ind. | 71041 | Boston Gear Works Div. of Murray Co. of Texas | Quincy, Mass. | 76493 | J. W. Miller Co. | Los Angeles, Calif. |
| 23783 | British Radio Electronics Ltd. | Washington, D. C. | 71218 | Bud Radio, Inc. | Willoughby, Ohio | 76530 | Cinch-Monadnock, Div. of United Carr Fastener Corp. | San Leandro, Calif. |
| 24455 | G. E. Lamp Division | | 71279 | Cambridge Thermionics Corp. | Cambridge, Mass. | 76545 | Mueller Electric Co. | Cleveland, Ohio |
| | | Nela Park, Cleveland, Ohio | 71286 | Camloc Fastener Corp. | Paramus, N. J. | 76703 | National Union | Newark, N. J. |
| 24655 | General Radio Co. | West Concord, Mass. | 71313 | Cardwell Condenser Corp. | Lindenhurst L. I., N. Y. | 76854 | Oak Manufacturing Co. | Crystal Lake, Ill. |
| 24681 | Memcor Inc., Comp. Div. | Huntington, Ind. | 71400 | Bussmann Mfg. Div. of McGraw-Edison Co. | St. Louis, Mo. | 77068 | The Bendix Corp., Electrodynamics Div. | |
| 24796 | Pareloco Inc. | San Juan Capistrano, Calif. | | | | 77075 | Pacific Metals Co. | San Francisco, Calif. |
| 26365 | Gries Reproducer Corp. | New Rochelle, N. Y. | 71436 | Chicago Condenser Corp. | Chicago, Ill. | 77221 | Phanotron Instrument and Electronic Co. | South Pasadena, Calif. |
| 26462 | Grobel File Co. of America, Inc. | | 71447 | Calif. Spring Co., Inc. | Pico-Rivera, Calif. | | | |
| | | Carlstadt, N. J. | 71450 | CTS Corp. | Elkhart, Ind. | 77252 | Philadelphia Steel and Wire Corp. | Philadelphia, Pa. |
| 26851 | Compac/Hollister Co. | Hollister, Calif. | 71468 | ITT Cannon Electric Inc. | Los Angeles, Calif. | | | |
| 26992 | Hamilton Watch Co. | Lancaster, Pa. | 71471 | Cinema, Div. Aerovox Corp. | Burbank, Calif. | 77342 | American Machine & Foundry Co. Potter & Brunfield Div. | Princeton, Ind. |
| 27251 | Specialties Mfg. Co., Inc. | Stratford, Conn. | 71482 | C. P. Clare & Co. | Chicago, Ill. | 77630 | TRW Electronic Components Div. | Camden, N. J. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Calif. | 71590 | CentriTab Div. of Globe Union Inc. | | 77638 | General Instrument Corp., Rectifier Div. | |
| 28520 | Heyman Mfg. Co. | Kenilworth, N. J. | | | | | | |
| 30817 | Instrument Specialties Co., Inc. | Little Falls, N. J. | 71616 | Commercial Plastics Co. | Chicago, Ill. | 77764 | Resistance Products Co. | Brooklyn, N. Y. |
| 31373 | G. E. Receiving Tube Dept. | Owensboro, Ky. | 71700 | Cornish Wire Co., The | New York, N. Y. | 77969 | Rubbercraft Corp. of Calif. | Harrisburg, Pa. |
| 35434 | Lectrohm Inc. | Chicago, Ill. | 71707 | Coto Coil Co., Inc. | Providence, R. I. | 78189 | Shakeproof Division of Illinois Tool Works | Torrance, Calif. |
| 36196 | Stanwyck Coil Products Ltd. | | 71744 | Chicago Miniature Lamp Works | Chicago, Ill. | | | |
| | | Hawkesbury, Ontario, Canada | 71785 | Cinch Mfg. Co., Howard B. Jones Div. | Chicago, Ill. | 78277 | Sigma | So. Braintree, Mass. |
| 36287 | Cunningham, W. H. & Hill, Ltd. | | 71984 | Dow Corning Corp. | Midland, Mich. | 78283 | Signal Indicator Corp. | New York, N. Y. |
| | | Toronto Ontario, Canada | 72136 | Electro Motive Mfg. Co., Inc. | Williamantic, Conn. | 78290 | Struthers-Dunn Inc. | Pitman, N. J. |
| 37942 | P. R. Mallory & Co. Inc. | Indianapolis, Ind. | 72619 | Dialight Corp. | Brooklyn, N. Y. | 78424 | Speciality Leather Prod. Co. | Newark, N. J. |
| 39543 | Mechanical Industries Prod. Co. | Akron, Ohio | 72656 | Indiana General Corp., Electronics Div. | Keasby, N. J. | 78452 | Thompson-Bremer & Co. | Chicago, Ill. |
| 40920 | Miniature Precision Bearings, Inc. | Keene, N. H. | | | | 78471 | Tilley Mfg. Co. | San Francisco, Calif. |
| 42190 | Muter Co. | Chicago, Ill. | 72699 | General Instrument Corp., Cap. Div. | Newark, N. J. | 78488 | Stackpole Carbon Co. | St. Marys, Pa. |
| 43990 | C. A. Norgren Co. | Englewood, Colo. | 72765 | Drake Mfg. Co. | Harwood Heights, Ill. | 78493 | Standard Thomson Corp. | Waltham, Mass. |
| 44655 | Ohmite Mfg. Co. | Skokie, Ill. | 72825 | Hugh H. Eby Inc. | Philadelphia, Pa. | 78553 | Tinnerman Products, Inc. | Cleveland, Ohio |
| 46384 | Penn Eng. & Mfg. Corp. | Doylestown, Pa. | 72928 | Gudeman Co. | Chicago, Ill. | 78790 | Tinnerman Transformer Engineers | San Gabriel, Calif. |
| 47904 | Polaroid Corp. | Cambridge, Mass. | 72962 | Elastic Stop Nut Corp. | Union, N. J. | 78947 | Ucinite Co. | Newtownville, Mass. |
| 48620 | Precision Thermometer & Inst. Co. | | 72964 | Robert M. Hadley Co. | Los Angeles, Calif. | 79136 | Waldes Kohinor Inc. | Long Island City, N. Y. |
| | | Southampton, Pa. | 72982 | Erie Technological Products, Inc. | Erie, Pa. | 79142 | Veeder Root, Inc. | Hartford, Conn. |
| 49956 | Microwave & Power Tube Div. | Waltham, Mass. | 73061 | Hansen Mfg. Co., Inc. | Princeton, Ind. | 79251 | Wenco Mfg. Co. | Chicago, Ill. |
| 52090 | Rowan Controller Co. | Westminster, Md. | 73076 | H. M. Harper Co. | Chicago, Ill. | 79727 | Continental-Wirt Electronics Corp. | Philadelphia, Pa. |
| 52983 | Sanborn Company | Waltham, Mass. | 73138 | Helipot Div. of Beckman Inst., Inc. | Fallerton, Calif. | | | |
| 54294 | Shallcross Mfg. Co. | Selma, N. C. | | | | 79963 | Zierick Mfg. Corp. | New Rochelle, N. Y. |
| 55026 | Simpson Electric Co. | Chicago, Ill. | 73293 | Hughes Products Division of Hughes Aircraft Co. | Newport Beach, Calif. | 80031 | Mepeco Division of Sessions Clock Co. | |
| 55933 | Sonotone Corp. | Elmsford, N. Y. | 73445 | Amperex Elect. Co. | Hicksville, L. I., N. Y. | | | |
| 55938 | Raytheon Co. Commercial Apparatus & Systems Div. | So. Norwalk, Conn. | 73506 | Bradley Semiconductor Corp. | New Haven, Conn. | 80120 | Schnitzer Alloy Products Co. | Morristown, N. J. |
| 56137 | Spaulding Fibre Co., Inc. | Tonawanda, N. Y. | 73559 | Carlting Electric, Inc. | Hartford, Conn. | 80131 | Electronic Industries Association. Tube meeting EIA Standards-Washington, DC. | |
| 56289 | Sprague Electric Co. | North Adams, Mass. | 73586 | Circle F Mfg. Co. | Trenton, N. J. | 80207 | Unimax Switch, Div. Maxon Electronics Corp. | Wallingford, Conn. |
| 59446 | Telex Corp. | Tulsa, Okla. | 73682 | George K. Garrett Co., Div. MSL Industries Inc. | Philadelphia, Pa. | 80223 | United Transformer Corp. | Chicago, Ill. |
| 59730 | Thomas & Betts Co. | Elizabeth, N. J. | 73734 | Federal Screw Products Inc. | Chicago, Ill. | 80248 | Oxford Electric Corp. | Chicago, Ill. |
| 60741 | Triplet Electrical Inst. Co. | Bluffton, Ohio | 73743 | Fischer Special Mfg. Co. | Cincinnati, Ohio | 80294 | Bourns Inc. | Riverside, Calif. |
| 61775 | Union Switch and Signal, Div. of Westinghouse Air Brake Co. | Pittsburgh, Pa. | 73793 | General Industries Co., The | Elyria, Ohio | 80411 | Acro Div. of Robertshaw Controls Co. | Columbus, Ohio |
| | | | 73846 | Goshen Stamping & Tool Co. | Goshen, Ind. | | | |



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.

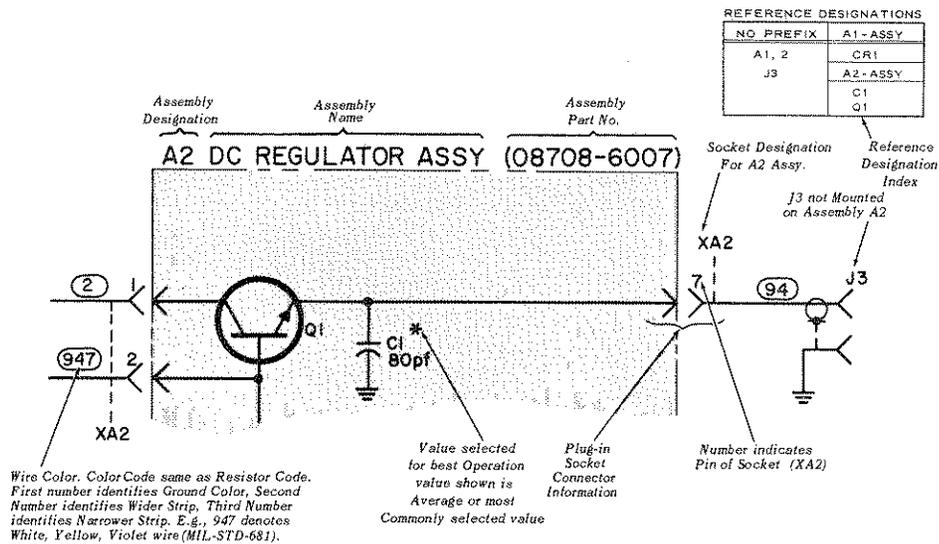


Figure 7-1. Explanations of General Information on Schematic Diagrams

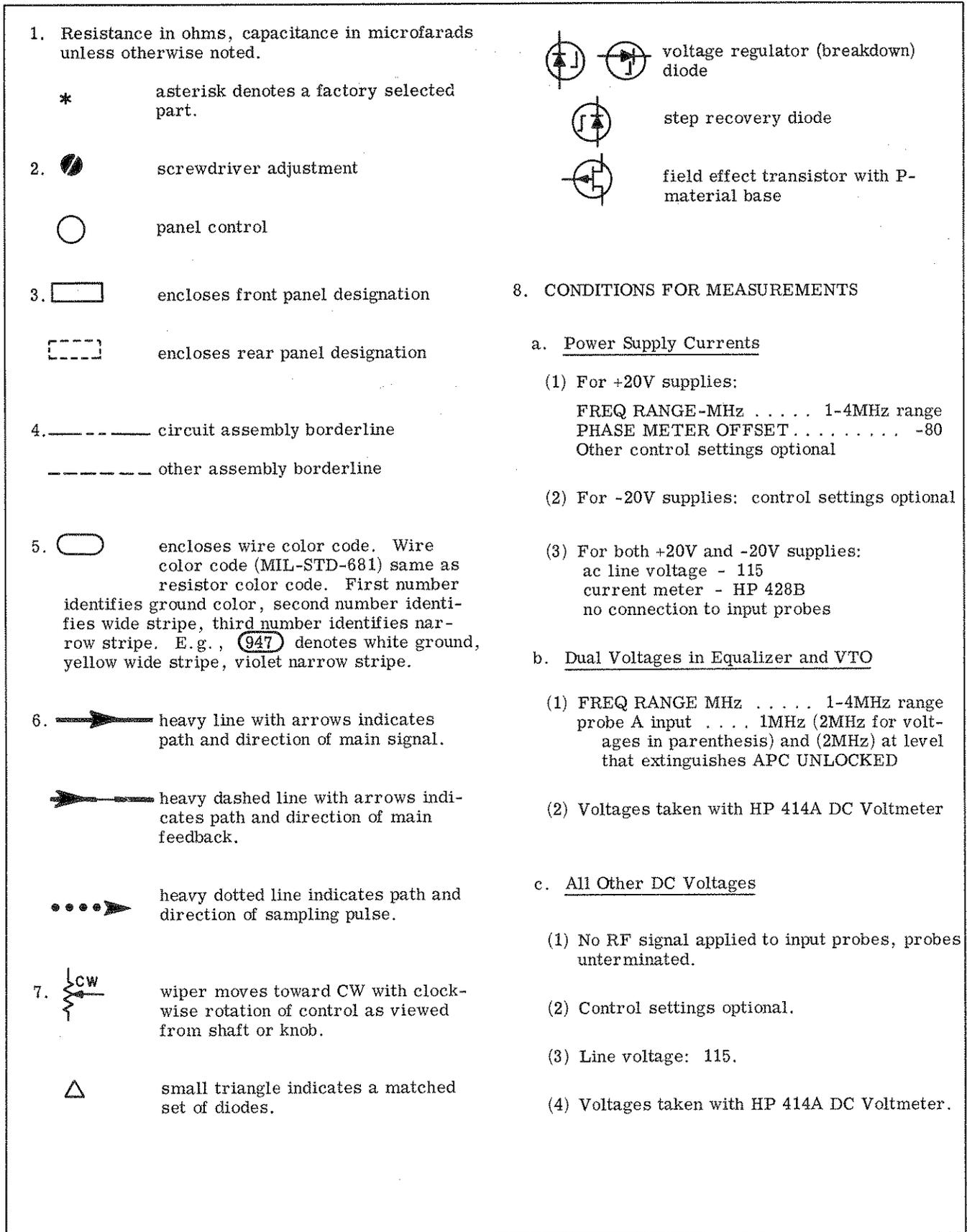


Figure 7-2. Schematic Diagram Notes

APPENDIX I

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 | 626- | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 15, 16 |
| 838-02160 thru 838-02111 | 1, 2, 3, 4, 5, 6, 7 | 611- and below | 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 15, 16, 17 |
| 838-02110 thru 838-02061 | 1, 2, 3, 4, 5, 6, 7, 8 | | |
| 824- | 1, 2, 3, 4, 5, 6, 7, 8, 9 | | |
| 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. 3101-0033

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, R: 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 6-8:

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 A4R19 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 induc-
tors A8L1 and A8L2 be removed.

Delete: A8L1, L2 9140-0120 COIL: FXD 0.10 μ H 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

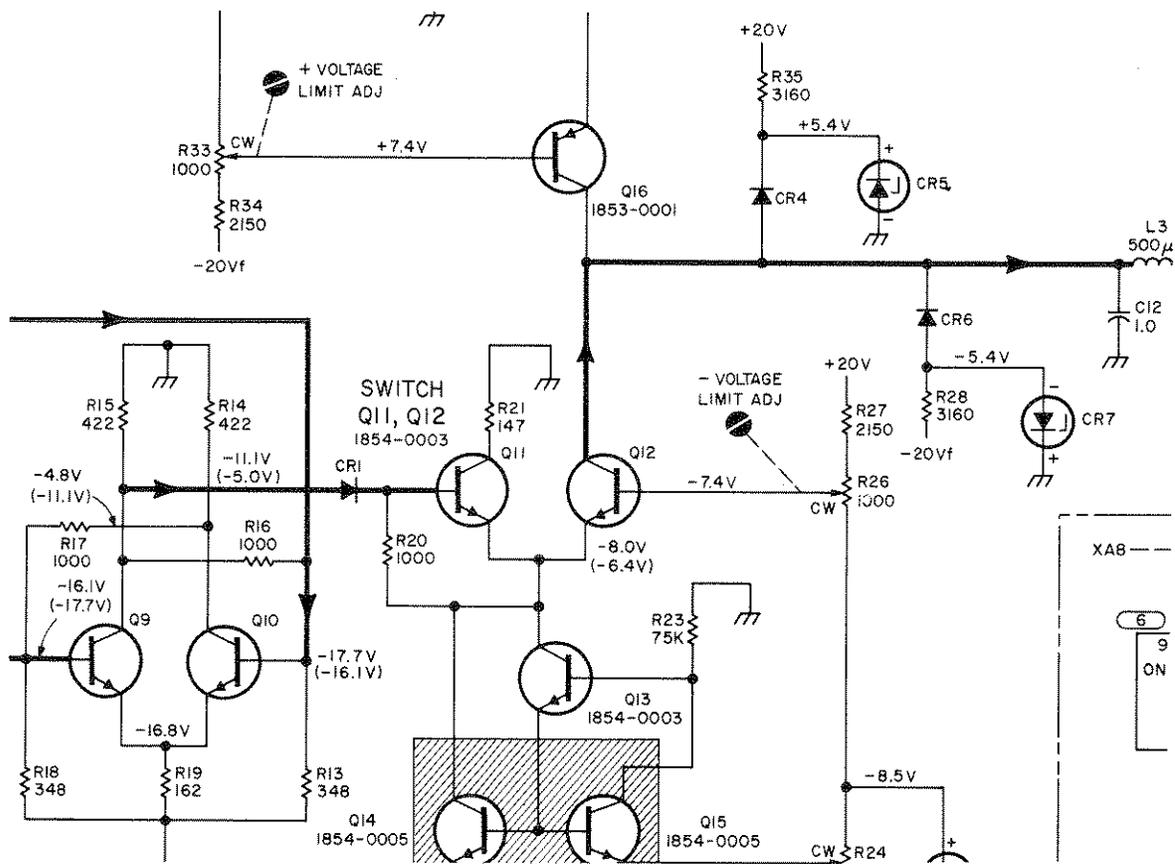


Figure 1. Partial Schematic of A8 Phase Meter Assy (08405-6008)

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 0757-0279 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 1902-3106; Diode breakdown 5.76 volts; 28480; TQ 2.
 HP Part Number 2100-1657; R:VAR WW 1000 ohm 10% 1 W; 28480; TQ 2.

CHANGE 10: a.) A11 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 600VDCW |
| A11C10 | 0140-0176 | C:FXD MICA 100 PF 2% |
| A11C14 | 0140-0176 | C:FXD MICA 100 PF 2% |
| A11C15 | 0150-0050 | C:FXD CER 1000 PF 600VDCW |
| A11C18 | 0180-0116 | C:FXD ELECT 6.8 UF 10% 35VDCW |
| A11R14 | 0757-0346 | R:FXD MET FLM 10 OHM 1% 1/8W |
| A11R16 | 0698-3157 | R:FXD 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:FXD MET FLM 19.6K OHM 1% 1/8W |
| A11R30 | 0757-0394 | R:FXD MET FLM 51.1 OHM 1% 1/8W |
| A11R32 | 0757-0346 | R:FXD MET FLM 10 OHM 1% 1/8W |
| A11R33 | 0698-3440 | R:FXD MET FLM 196 OHM 1% 1/8W |

Change:

A11CR17 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
 1854-0087; 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 383OHM 1% 1/8W
 To: 0686-4315 R:FXD 430Ω 5% 1/2W

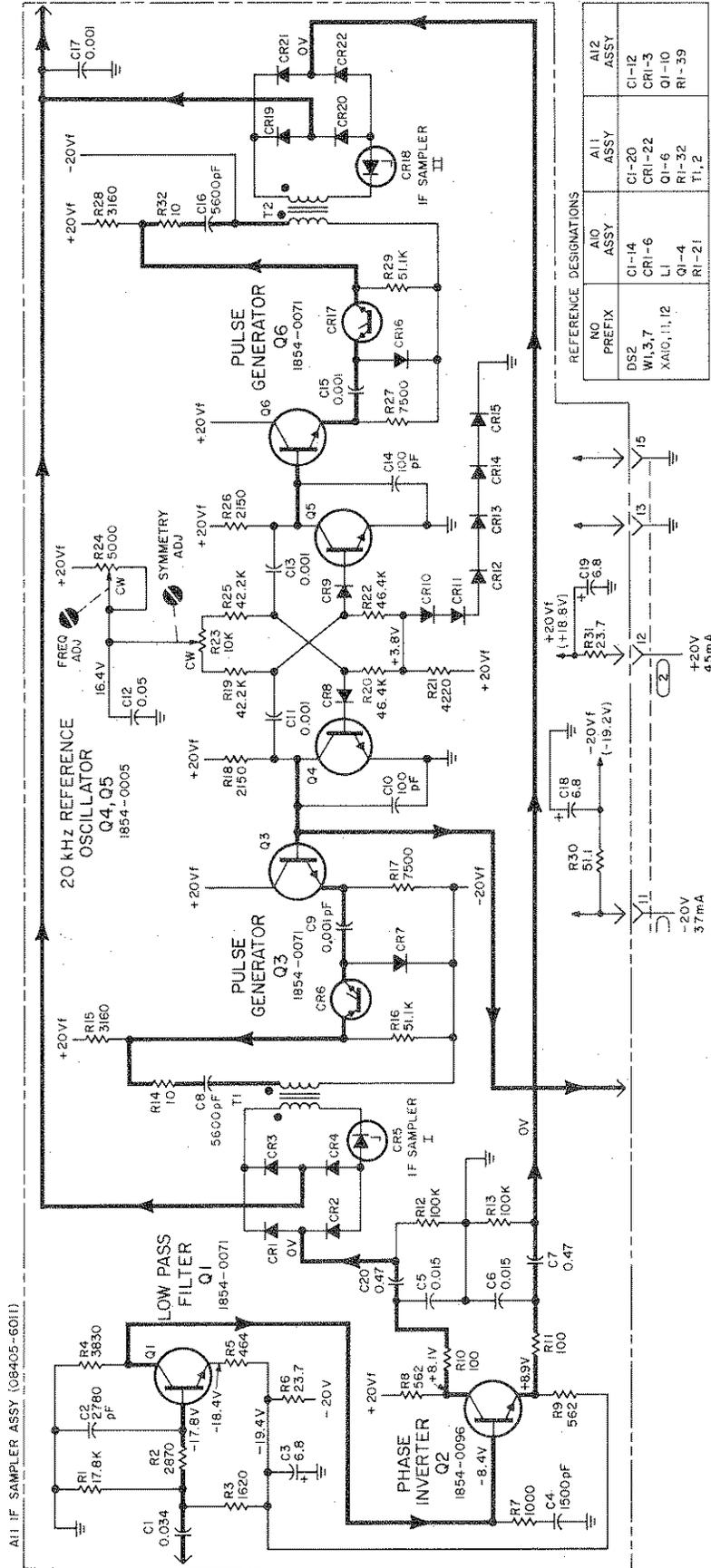


Figure 2. Schematic of A11 IF Sampler Assy (08405-6011)

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 μ f 2% 50 VDCW
 To: 0160-0168 C:FXD MY 0.1 μ f 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).

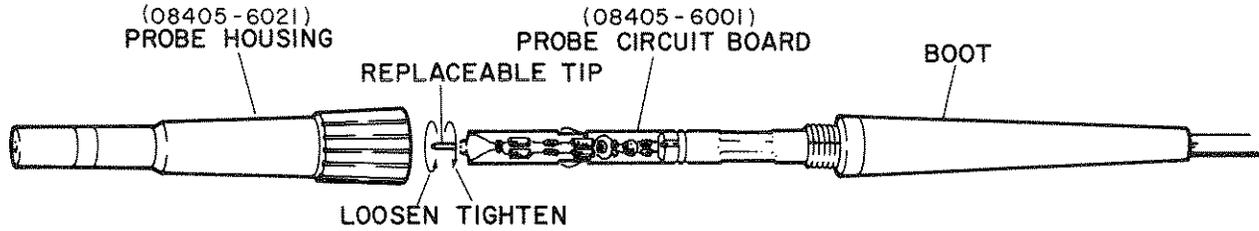
CHANGE 16: a.) To suppress oscillations which may occur on A10 APC Amplifier Assy (08405-6010), it is recommended that A10R5 be changed.

From: 0757-0394 R:FXD 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.

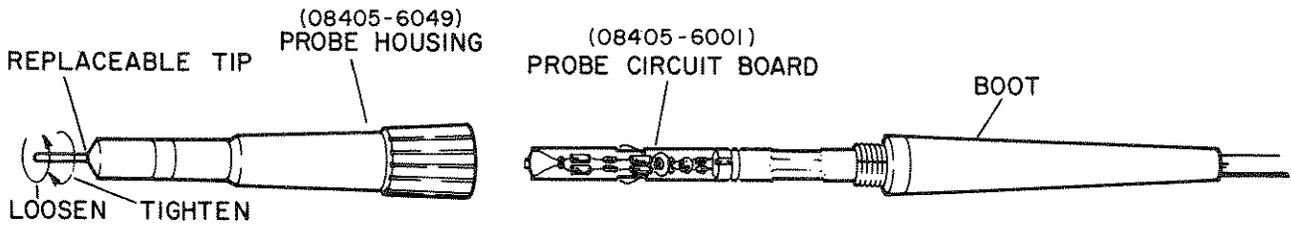
Add: A6L2 9170-0016 Ferrite Bead

CHANGE 17: To improve performance of the A14 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).



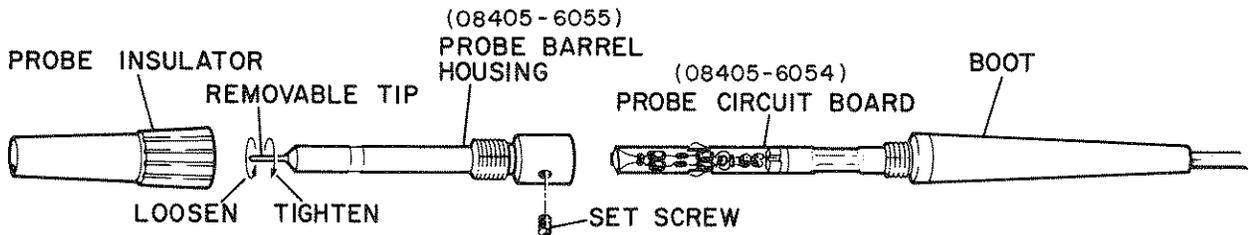
"A" Type Probe: The Original Probe

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

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