OPERATING AND SERVICE MANUAL

MODEL 310A

WAVE ANALYZER

SERIALS PREFIXED: 436-

SEE APPENDIX I
FOR OTHER SERIALS

02037-1

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. DESCRIPTION.

1-3. The Model 310A Wave Analyzer separates and measures the various frequency components of an input signal so that the fundamental, harmonics, and intermodulation products may be analyzed. Any input signal component between 1 kc and 1.5 Mc may be located and measured. The only requirement is that it be within the 70-db dynamic range of the instrument, and that it be separated from other components by enough more than the selected bandwidth to make an isolated measurment possible (see Table 1-1).

1-4. DISTORTION MEASUREMENTS.

1-5. For measurements analyzing the distortion products in amplifiers, transducers, and other active devices, the Model 310A is provided with a RELATIVE mode of operation in which the reference frequency may be set to an arbitrary level, and the remaining components measured directly with respect to that reference, in either percent or db.

1-6 ABSOLUTE MEASUREMENTS.

1-7. Alternatively, the Model 310A may be operated in an ABSOLUTE mode, under which conditions it acts as an accurate, tuned AF-RF voltmeter, measuring the amplitude of the components of any signal within its range to an accuracy of ±6%.

1-8. RESPONSE MEASUREMENTS.

1-9. In the BFO mode of operation, the Model 310A provides a constant-amplitude sine-wave output, at the frequency of the dial setting, for measuring the response of amplifiers, passive networks, or transmission systems.

1-10. AUTOMATIC FREQUENCY CONTROL.

1-11. In the AFC mode of operation, the Model 310A will lock on to and follow signals which have a drift rate as high as 100 cps/second. The dynamic hold-in range is ±3 kc (at 100 kc).

1-12. RESTORED FREQUENCY OUTPUT.

1-13. The component of the input signal which lies within the passband of the Model 310A is available at the OUTPUT terminal. Using this restored frequency output with an electronic counter makes possible the precise determination of the frequencies of intermodulation and other distortion products.

1-14. RECEIVER FUNCTIONS.

1-15. Single-sideband and amplitude-modulated signals may be received, detected, and monitored at the OUTPUT terminal.

Figure 1-1 Model 310A Wave Analyzer

1-16. APPLICATIONS.

1-17. The Model 310A Wave Analyzer is designed primarily to measure harmonic or intermodulation products in active circuits such as amplifiers, receivers, or transmitters, and carrier telephone systems. The instrument is ideally suited for measuring intermodulation distortion by either the SMPTE (Society of Motion Picture and Television Engineers) or the CCIF (International Telephonic Consultative Committee) method. In addition, the Model 310A conveniently measures the response of amplifiers, passive networks, and transmission systems up to 1.5 Mc. Its linear frequency dial and lack of band-switching make motor drive and automatic plotting a simple procedure.

1-18. INSTRUMENT IDENTIFICATION.

1-19. Hewlett-Packard uses a two-section eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix used to identify instruments to published literature. If the first three digits of the serial number on your instrument are not the same as those which appear on the title page of this manual, there are differences between your instrument and the instrument described in this manual (refer to Appendix 1 of this manual).

1-20. ACCESSORY SWEEP DRIVE.

1-21. The hp Model 297A (Figure 1-2) is a motor drive unit designed to sweep tunable devices such as the Model 310A. The Model 11505A Bench Stand is available for mounting the Model 297A. Two sweep speeds and a neutral are provided, together with an output voltage proportional to dial position for driving X-Y recorders. Also, available is a special bracket kit (hp Model K02-310A) which permits the Model 297A to be mounted directly to the front panel of the Model 310A.

1-22. OPTIONS.

1-23. OPTION 01 CRYSTAL CALIBRATOR.

1-24. The Model 310A Option 01 is a standard hp Model 310A Wave Analyzer which has been modified by replacing the 100-kc calibration multivibrator (A3Q1, A3Q2, and associated components) with a 100-kc crystal oscillator which may be used for both amplitude and frequency calibration. Details of the modification will be found in Appendix II of this manual. A Model 310A Option 01 Modification Kit is available: hp Stock No. 310A-95A.

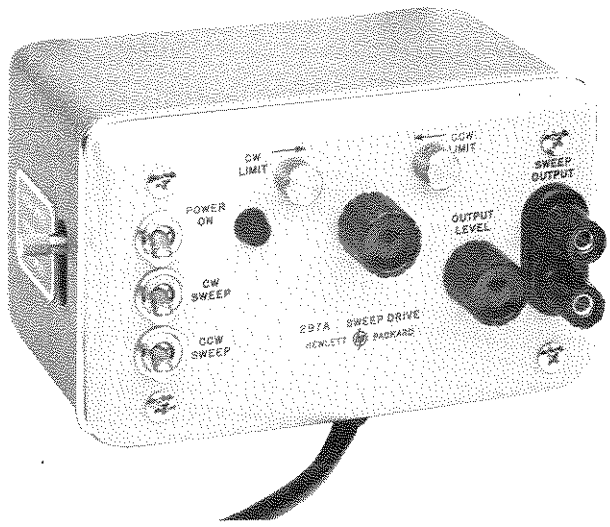


Figure 1-2. hp Model 297A Sweep Drive

1-25. OPTION 02 SPECIAL METER.

1-26. The Model 310A Option 02 is a standard hp Model 310A except that the front-panel meter has an extended db scale, placed uppermost on the face of the meter. The voltage scale is below the db scale.

1-27. WARRANTY.

1-28. The Model 310A carries the standard Hewlett-Packard Warranty against defects in materials or workmanship for one year from date of shipment. A copy of the warranty is included at the back of this manual.

SECTION II
INSTALLATION

2-1. INCOMING INSPECTION.

2-2. MECHANICAL INSPECTION.

2-3. Inspect the Model 310A as soon as possible after receipt of shipment. Should shipping damage be apparent, notify the carrier immediately (see warranty page at the back of this manual). For assistance of any kind, including help with instruments under warranty, consult your nearest Hewlett-Packard field office (see maps at the back of this manual).

2-4. ELECTRICAL INSPECTION.

2-5. A performance check is included in Section V of this manual. Use this check as an incoming inspection procedure, or at any time to verify that the instrument is operating within its specifications.

2-6. INSTALLATION.

2-7. The Model 310A is delivered as a cabinet mount instrument. A kit is supplied with the instrument for

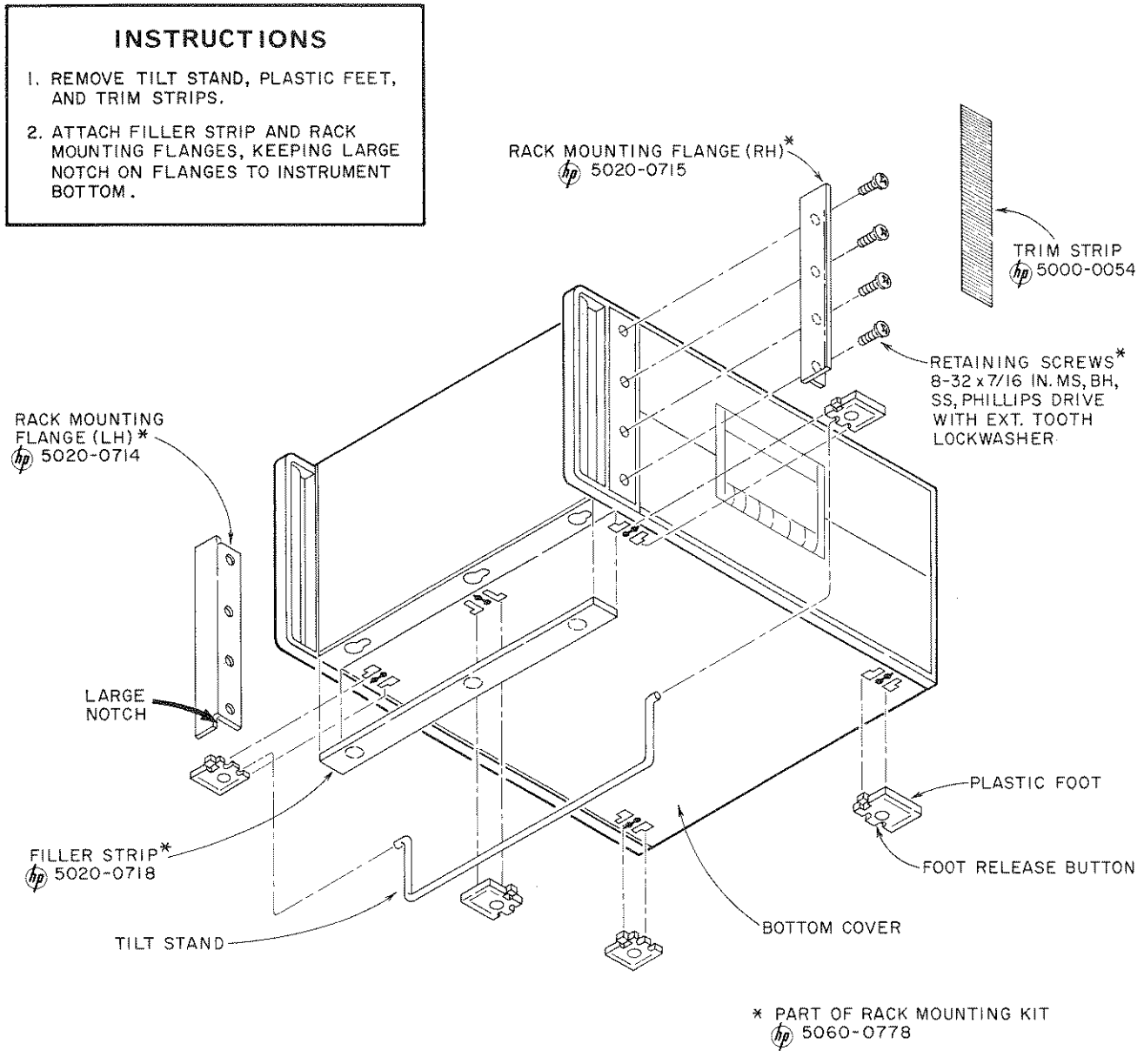


Figure 2-1. Conversion to Rack Mount

conversion to rack mount (refer to Figure 2-1 for rack mounting instructions and list of kit parts).

Note

If the rack is to be subject to shock or vibration, rear support must be provided to bear instrument weight. Alternately, the side handles may be removed and rack slides mounted in their place.

2-8. POWER REQUIREMENT.

2-9. The 310A can be operated from a 115- or 230-volt 50- to 1000-cps source. A two-position slide switch at the rear of the instrument selects AC operation mode. The line voltage at which the instrument is set to operate appears on the slider of the switch. A 0.25-ampere slow-blow fuse is used for either 115- or 230-volt operation.

2-10. SAFETY POWER CORD.

2-11. To protect operating personnel the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor power cord which grounds the instrument cabinet when plugged into an appropriate outlet.

2-12. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-13. REPACKAGING FOR SHIPMENT.

2-14. To protect valuable electronic equipment during shipment, always use the best packing methods available. Your Hewlett-Packard field office can supply packing materials such as those used at the factory. Contract packaging companies in many cities can provide dependable custom packing on short notice. The following steps are a general guide:

a. Wrap instrument in heavy protective paper.

b. Protect panel with cardboard strips.

c. Use a strong cardboard or wooden box.

d. Use ample packing material around all sides of instrument.

e. Seal with heavy tape or metal bands

f. Mark container, "FRAGILE - DELICATE INSTRUMENT".

SECTION III
OPERATING INSTRUCTIONS

3-1. GENERAL.

3-2. The Model 310A is a highly selective AF-RF voltmeter, capable of making accurate measurement of input signal components up to 1.5 Mc. Measurements may be made either in calibrated values of volts and dbm or in relative values of percent and db. A BFO mode of operation is provided, converting the instrument to a signal generator and response meter, suitable for measuring the characteristics of amplifiers or passive elements. In addition, signals containing single-sideband or AM information may be detected and monitored.

3-3. FRONT PANEL CONTROLS.

3-4. FREQUENCY.

3-5. The front panel of the Model 310A is shown in Figure 3-1. Illustrated operating instructions are in Figure 3-2 through 3-8. Operation of the instrument is straightforward. Frequency is controlled by the COARSE and FINE controls of the FREQUENCY indicator, which reads to the nearest 200 cps. The FREQUENCY dial is linear, and tuning is constant from the high end of the range to the low end.

3-6. SENSITIVITY.

3-7. There are three sensitivity controls. The combined settings of MAX INPUT VOLTAGE and RANGE determine the calibrated sensitivity of the instrument, which is indicated in the illuminated range indicator window above the FREQUENCY dial. ZERO SET sets the instrument to the center of the passband.

3-8. FUNCTION.

3-9. The function of the instrument is controlled by the MODE switch. NORMAL is ordinarily used for tuning the instrument to a signal component which is to be measured, after which AFC can be selected to keep the instrument tuned to that component even though its frequency may vary up to ±3 kc. In these two modes, the signal passed by the filters in the Model 310A is restored to its original frequency and delivered to the OUTPUT terminals, where it may be measured with an electronic counter if desired. In the BFO mode, the instrument becomes a signal generator, providing a signal at the OUTPUT terminal which has a frequency equal to that set on the FREQUENCY dial. This signal may be used to test the response of amplifiers or passive circuits, the output of the circuit under test being connected to the Model 310A INPUT terminals, and measured by the narrow-band tuned voltmeter. The remaining positions of the MODE switch, USB, LSB, and AM, select receiver functions, demodulating upper-sideband, lower-sideband, or amplitude-modulated signals respectively, and delivering the modulation to the OUTPUT terminal.

3-10. BANDWIDTH.

3-11. Three BANDWIDTH settings are provided: 3000 cps is for receiving sideband and amplitude-modulated signals, and is also useful during tuning, to make the desired component easier to find; 200 cps, in conjunction with the AFC setting of the MODE control, allows measurement of a component with minimum noise interference, or in the presence of closely adjacent components; 1000 cps simplifies the calculation of noise-power per cycle-bandwidth. For every measurement, there is a notch one cycle wide at the exact center of the band, allowing the signal component to be set with ZERO SET to the center of the band in order to take maximum advantage of the AFC range. The filters have a flat response nearly to band edge, therefore any marked variation of the signal as FREQUENCY is varied will indicate that more than one component is entering the passband. The notch at the center of the band can be used to locate these components.

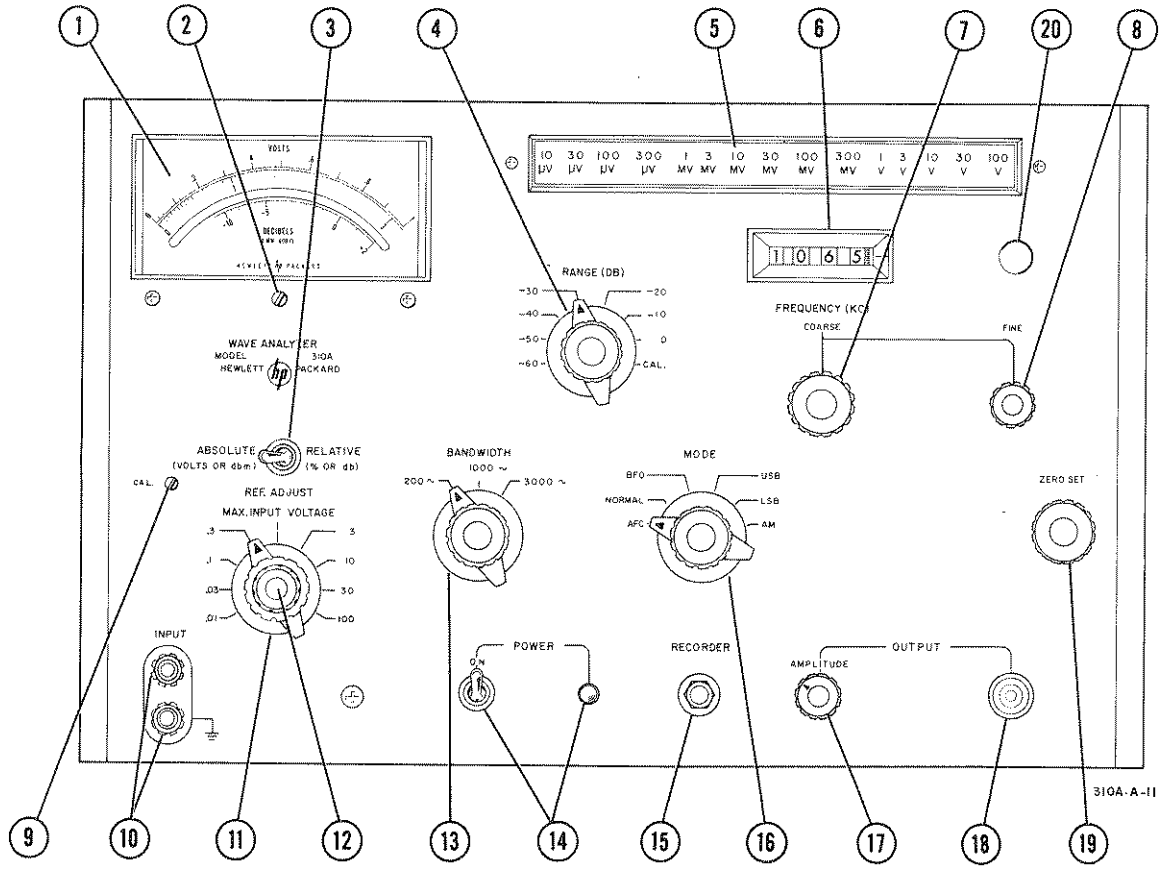
3-12. OPERATING PROCEDURE.

3-13. GENERAL.

3-14. The primary purpose of the Model 310A Wave Analyzer is to locate and measure the harmonic or intermodulation components of a signal connected to the INPUT terminals of the instrument. In most cases, this is accomplished by setting RANGE to 0 DB, selecting RELATIVE, tuning FREQUENCY to the fundamental (or largest component), and adjusting MAX INPUT VOLTAGE and signal level to a meter reading of 1 (for percentage readings) or 0 DB (for decibel readings). Then the remaining components can be found and measured by changing the setting of FREQUENCY and RANGE. In most cases this procedure is satisfactory. However, in some cases a signal larger than the fundamental component of interest may be present (60-cycle hum, for instance). Such a signal may be outside the tuning range of the instrument, yet will overload the amplifiers which precede the filter unless it is attenuated at the input to the instrument. Such overloading will produce intermodulation distortion within the instrument and result in erroneous readings.

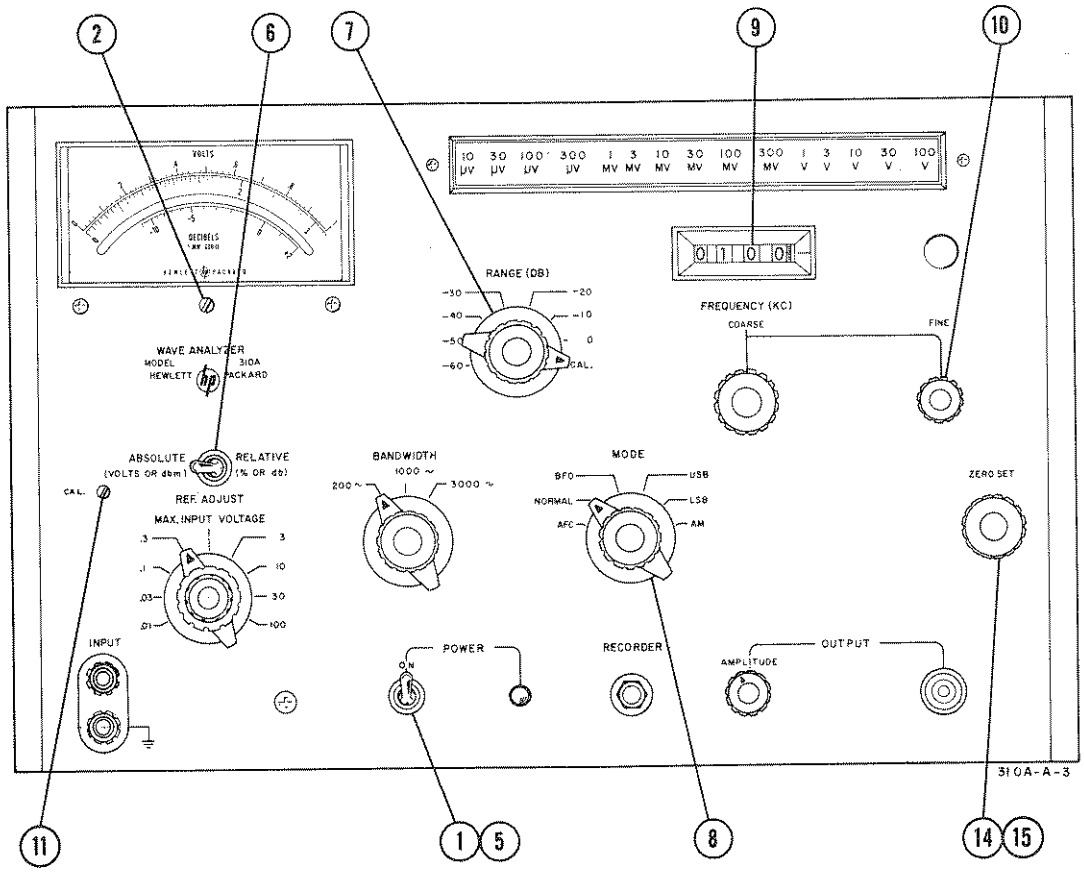
3-15. INPUT OVERLOADING.

3-16. To avoid errors caused by large extraneous signals entering the input amplifier, tune in any component of interest with RANGE at 0 DB, adjust MAX INPUT VOLTAGE for an up-scale reading, note the reading, then rotate MAX INPUT VOLTAGE one step clockwise and RANGE one step counterclockwise. If the meter reading changes more than 6%, input overload is indicated. Repeat the process until no change in reading takes place; then the preceding step is satisfactory. When such overload is present, the reference component cannot be set to 0 DB on the RANGE switch, therefore the dynamic range of the instrument is limited. The only alternative is to eliminate the interfering signal. Once the proper setting of MAX INPUT VOLTAGE has been found, it must not be changed counterclockwise as long as the particular large-amplitude signal is present (unless REF ADJUST is also changed to compensate).



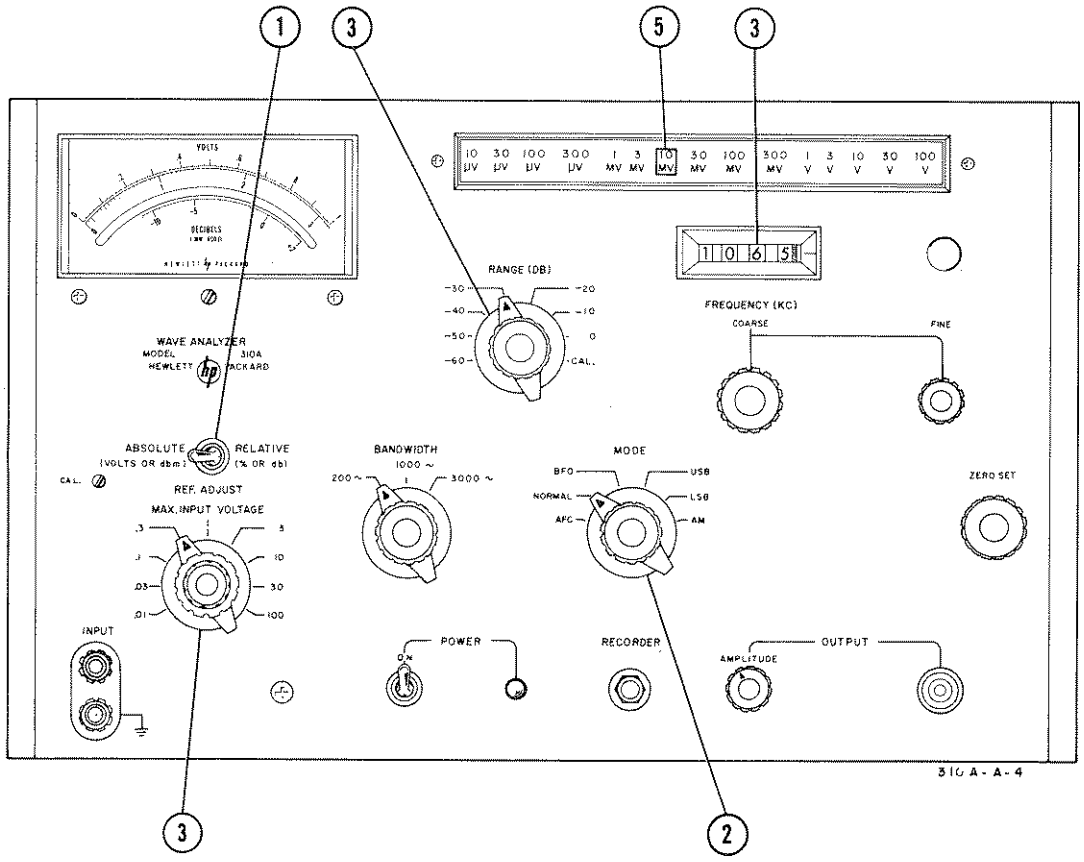
1. Meter indicates either (a) volts or dbm for 600-ohm systems) for ABSOLUTE setting or (b) in per cent (%) or db for RELATIVE setting.
2. Meter mechanical zero set adjust.
3. ABSOLUTE-RELATIVE switch sets 310A input so meter indicates as described in 1 above. In RELATIVE position, a dbm reference may be set for any impedance system.
4. Combined RANGE and MAX INPUT VOLTAGE settings give full scale meter sensitivity.
5. Illuminated range indicator indicates full scale meter sensitivity.
6. Indicates tuned frequency in kilocycles.
7. COARSE control for changing tuned frequency.
8. FINE control for fine setting of tuned frequency.
9. CAL. adjust for full scale deflection (to "1") of meter needle when RANGE is in CAL. and instrument is tuned to approximately 100 kc.
10. INPUT for signal to be measured. The bottom terminal at cabinet ground potential (power line ground when Model 310A is connected to AC line).
11. MAX INPUT VOLTAGE selects maximum input voltage range; see 4 and 5 above.
12. REF ADJUST sets reference component of input signal for relative measurements (see 3 above).
13. BANDWIDTH selects band of frequencies passed by IF filter.
14. Indicator lights when POWER switch is ON and instrument connected to power source.
15. RECORDER. Two-conductor jack supplies 1 ma dc into 1500 ohms or less to drive X-Y or strip chart recorders.
16. MODE switch selects: (a) AFC (Automatic Frequency Control), tunes and locks 310A to input frequency, (b) NORMAL, for tuning and calibrating ing, (c) BFO (Beat Frequency Oscillator), generates same frequency as indicated by FREQUENCY (d) USB (Upper Sideband) and LSB (Lower Sideband), uses a carrier re-insertion oscillator 1450 cycles above or below band center to demodulate normal or inverted signal sideband signales, or (e) AM receives and detects AM signals.
17. AMPLITUDE control sets signal level at OUTPUT.
18. OUTPUT connector is a female BNC connector.
19. ZERO SET is for frequency dial calibration.
20. Location of Option 01 100 kc MARKER switch.

Figure 3-1. Front Panel Controls



1. Turn POWER off.
2. Rotate meter adjustment screw clockwise until pointer is to left of zero.
3. Continue rotating clockwise until pointer coincides with zero mark. If pointer overshoots zero mark, repeat steps 1 and 2.
4. Rotate adjustment screw slightly counterclockwise to free mechanism. If pointer moves off zero mark, repeat steps 3 and 4.
5. Turn POWER on.
6. Select ABSOLUTE.
7. Set RANGE to CAL.
8. Set MODE to NORMAL.
9. Set FREQUENCY to 0100 KC.
10. Trim for maximum deflection on meter. Switch to AFC.
11. Adjust CAL for meter reading of 1.
12. Switch to NORMAL and set FREQUENCY to 0000.
13. Set RANGE for on-scale reading.
14. Adjust to slight meter null in middle of passband.
15. Option 01 only: Omit steps 12, 13, and 14. Depress MARKER, set FREQUENCY and adjust ZERO SET to null on crystal oscillator harmonic nearest frequency of interest.

Figure 3-2. Calibration



1. Select ABSOLUTE,

2. Set MODE to NORMAL.

3. Set FREQUENCY to component to be measured, changing MAX INPUT VOLTAGE and RANGE as required (Paragraph 3-15).

   Note

   Meter reading decreases slightly at center frequency. Increases slightly at either side of center frequency.

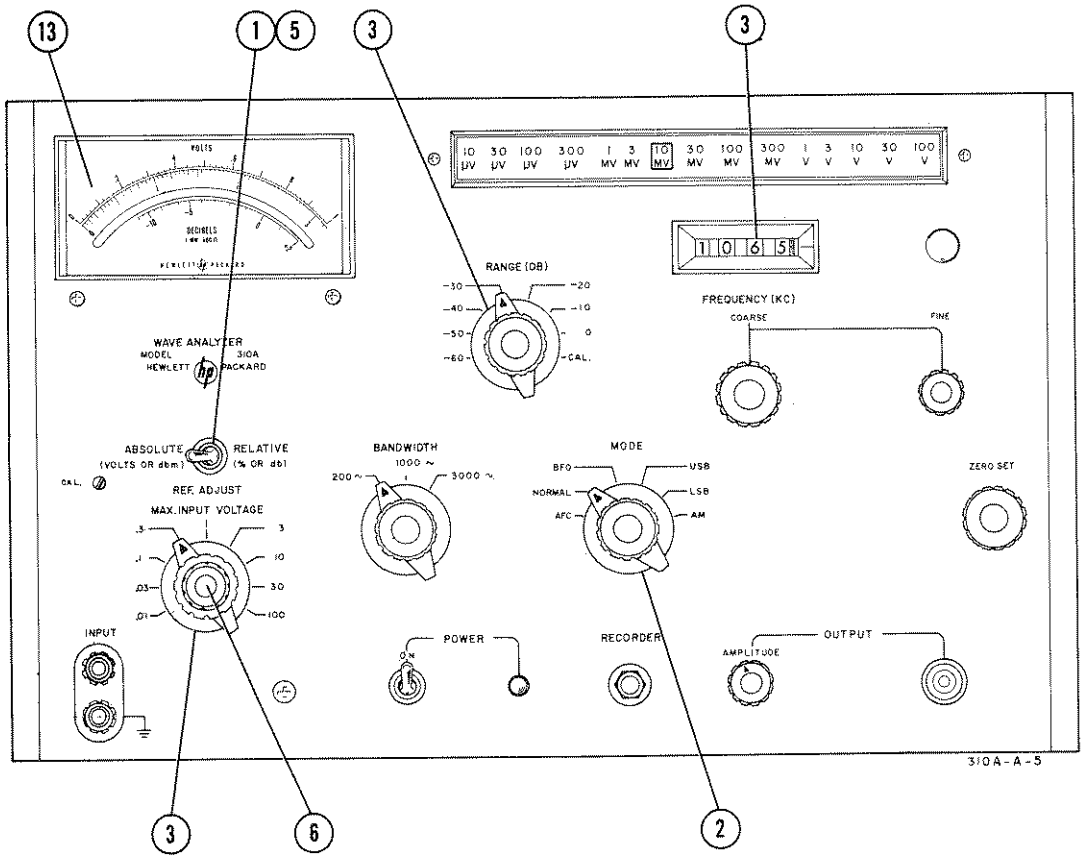
4. Set MODE to AFC.

   Note

   When set to AFC the meter reading will decrease slightly.

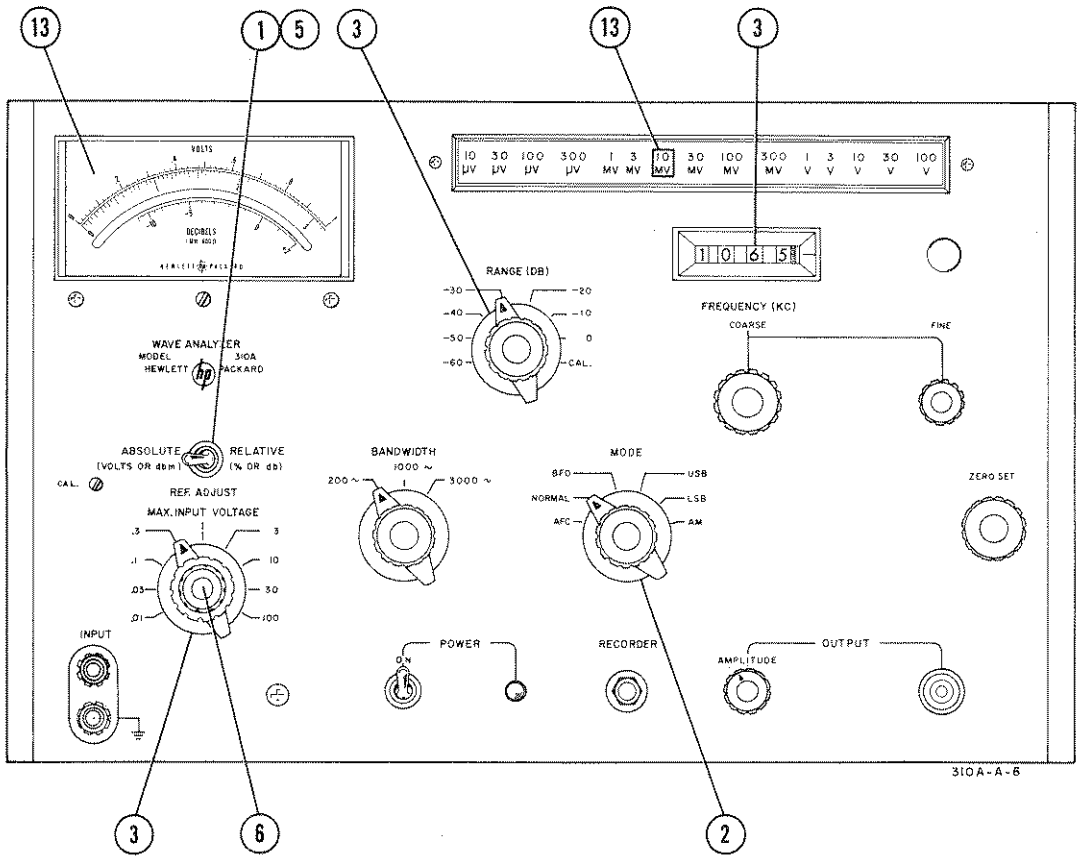
5. The lighted range window now indicates the full-scale voltage range of the meter. To read dbm in a 600-ohm system, subtract 10 dbm from meter reading for each step to the left of 1 V; add 10 dbm for each step to the right. For example, a meter reading of -3 db and a range indication of 10 MV reads -43 dbm.

Figure 3-3. Absolute Measurments



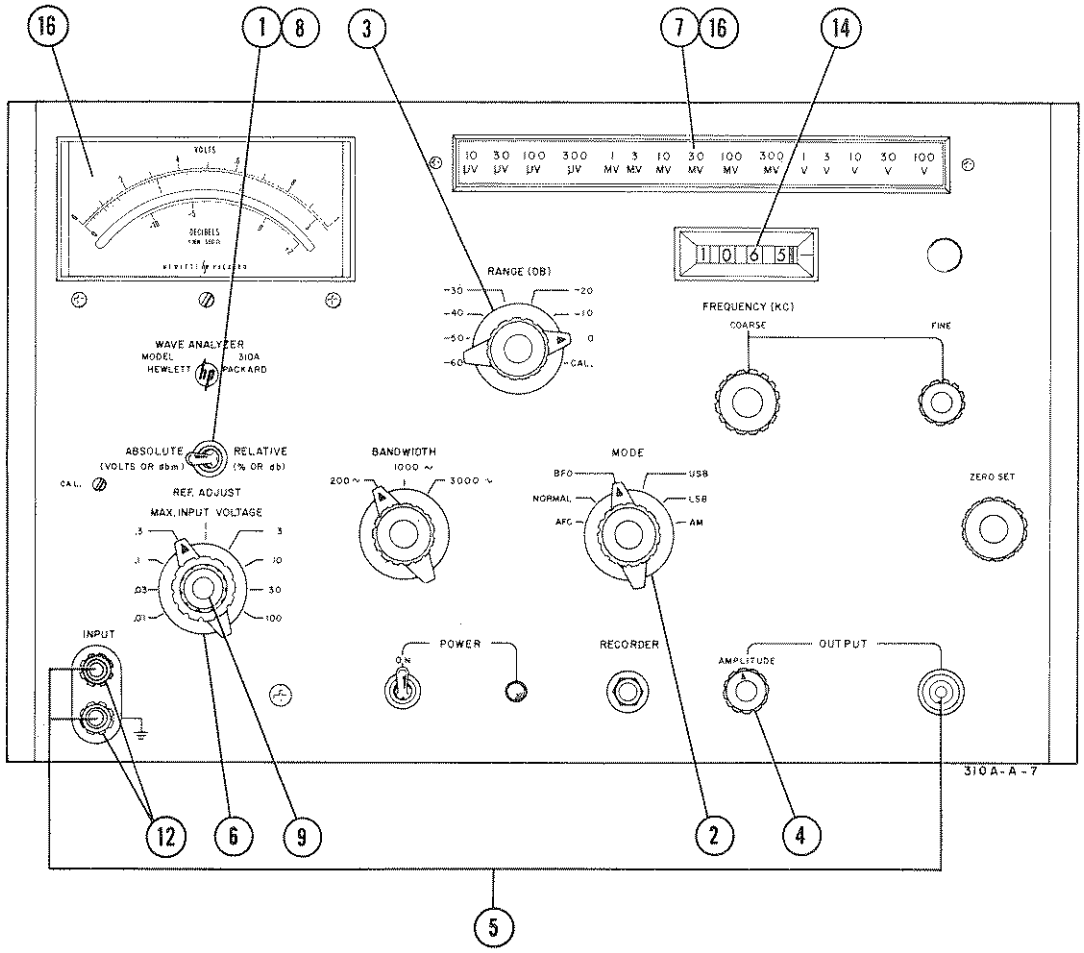
1. Select ABSOLUTE.
2. Set MODE to NORMAL.
3. Select largest component for use as reference. Set FREQUENCY to that component, changing MAX INPUT VOLTAGE and RANGE as required (Paragraph 3-15).
4. Set MODE to AFC.
5. Switch to RELATIVE.
6. Turn REF ADJUST counterclockwise.
7. Switch MAX INPUT VOLTAGE one step counterclockwise.
8. Turn REF ADJUST clockwise for meter reading of 1.
9. Set MODE to NORMAL.
10. Set FREQUENCY to component to be measured.
11. Rotate RANGE counterclockwise if necessary for an up-scale reading.
12. Set MODE to AFC.
13. Read amplitude of component in percent, setting decimal in accordance with reference setting made in step 7. To read voltage, switch MAX INPUT VOLTAGE back to setting of step 3 and select ABSOLUTE, adjusting RANGE for an up-scale reading.

Figure 3-4. Relative Measurements in Percent



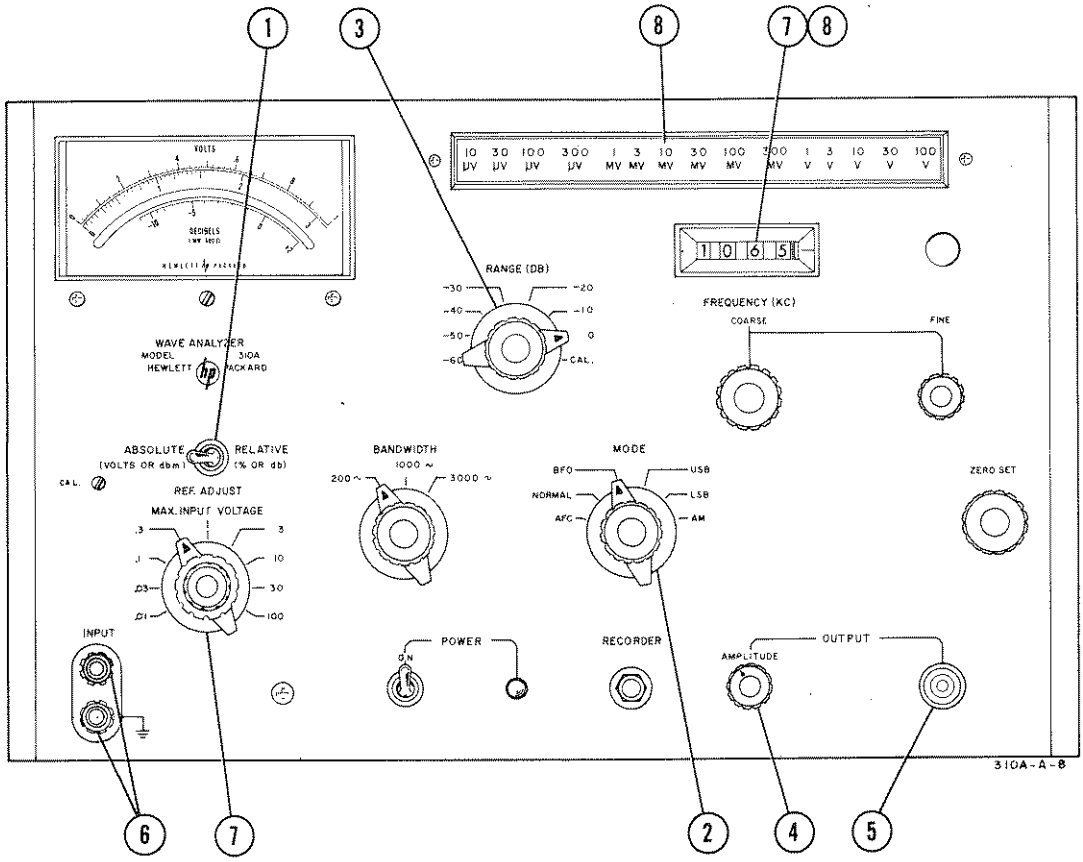
1. Select ABSOLUTE.
2. Set MODE to NORMAL.
3. Select largest component for use as a reference. Set FREQUENCY to that component, changing MAX INPUT VOLTAGE and RANGE as required (Paragraph 3-15).
4. Set MODE to AFC.
5. Switch to RELATIVE.
6. Turn REF ADJUST counterclockwise.
7. Switch MAX INPUT VOLTAGE one step counterclockwise.
8. Turn REF ADJUST clockwise for meter reading of 0 db.
9. Set MODE to NORMAL.
10. Set FREQUENCY to component to be measured.
11. Rotate RANGE counterclockwise if necessary for an up-scale reading.
12. Set MODE to AFC.
13. Subtract RANGE setting of step 3 from that of step 11 and add the difference to meter reading. To read dbm in a 600-ohm system, switch MAX INPUT VOLTAGE one step clockwise and select ABSOLUTE, adjusting RANGE for an on-scale reading. Note indication in range window. Subtract 10 dbm from meter reading for each step to the left of 1 V; add 10 dbm for each step to the right. For example, a meter reading of -3 db and a range indication of 10 MV reads -43 dbm.

Figure 3-5. Relative Measurements in DB



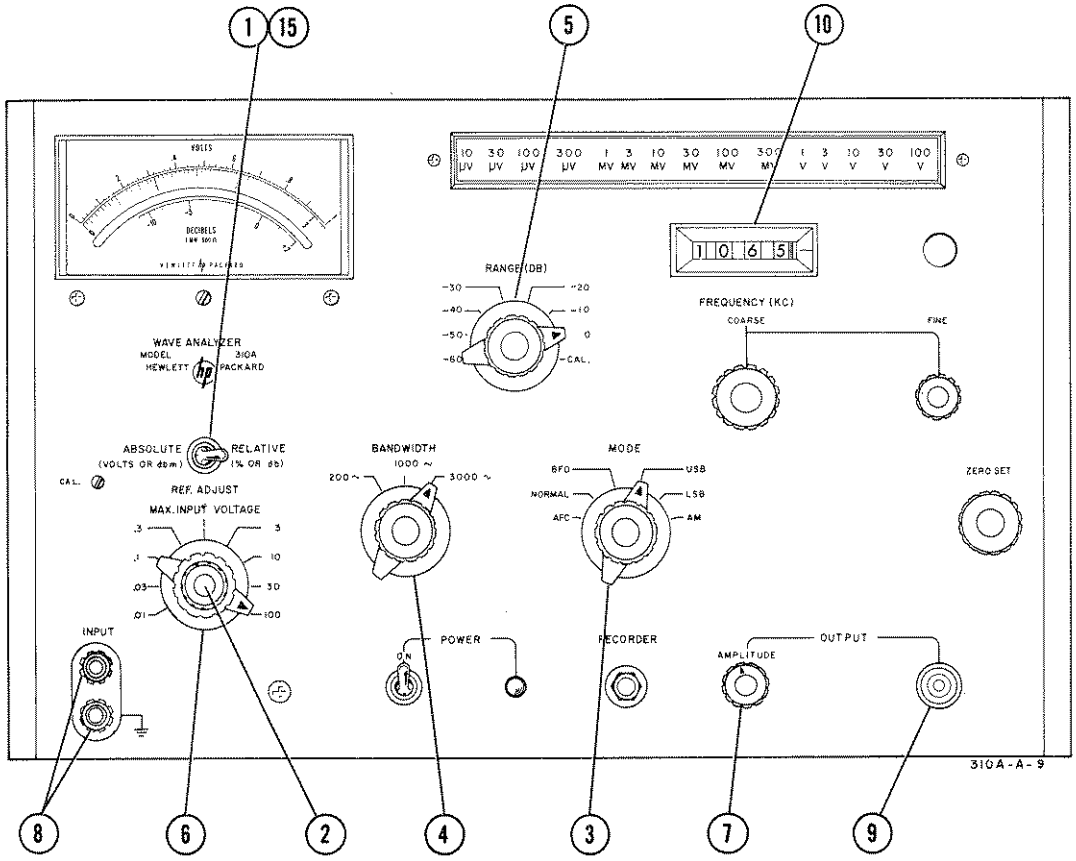
1. Select ABSOLUTE.
2. Set MODE to BFO.
3. Set RANGE to 0 db.
4. Set AMPLITUDE counterclockwise.
5. Connect OUTPUT to INPUT.
6. Adjust MAX INPUT VOLTAGE and AMPLITUDE controls to give a voltage reading which corresponds to one millwatt of power in to the desired impedance system. This voltage may be found by: $v = \sqrt{Z/1000}$ (for example, in a 50-ohm circuit, $\sqrt{50/1000} = 0.224$ volts).
7. Note reading of range indicator.
8. Switch to RELATIVE.
9. Turn REF ADJUST counterclockwise.
10. Switch MAX INPUT VOLTAGE on step counterclockwise.
11. Turn REF ADJUST clockwise for reading of 0 db.
12. Disconnect OUTPUT from INPUT, and connect signal to be measured to INPUT.
13. Set MODE to NORMAL.
14. Set FREQUENCY to component to be measured, changing MAX INPUT VOLTAGE and RANGE as required (Paragraph 3-15).
15. Set MODE to AFC.
16. The lighted range window now indicates full-scale range of meter. To read dbm, subtract 10 dbm for each step to the left of the reading in step 6; add 10 dbm for each step to the right. For example, a meter reading of -3 db and a range indication of 10 MV reads -43 dbm.

Figure 3-6. Reading DBM At Any Impedance Level



1. Select ABSOLUTE.
2. Set MODEL to BFO.
3. Set RANGE to 0 DB.
4. Set AMPLITUDE counterclockwise.
5. Connect circuit to be tested to OUTPUT terminal. Use resistive network to match OUTPUT to input impedance of circuit. OUTPUT impedance is 135 ohms.
6. Connect output of circuit to be tested to INPUT terminal. Terminate circuit with characteristic impedance.
7. Set FREQUENCY to reference value (a point of maximum response), setting MAX INPUT VOLTAGE and AMPLITUDE for a meter reading of 1 (see Paragraph 3-15 for possible overload conditions).
8. Vary FREQUENCY, changing RANGE as required to read relative response. To read response in db, set MAX INPUT VOLTAGE and AMPLITUDE for a meter reading of 0 DB in step 7. Observe indication in range window for each reading. Subtract 10 db from meter reading for each step to the left of 1 V. For example, a meter reading of -3 db and a range indication of 10 MV reads 43 db below reference.

Figure 3-7. Response Measurements



1. Select RELATIVE.
2. Set REF ADJUST to mid-range.
3. Set MODE to USB or LSB or AM.
4. Set BANDWIDTH to 3000 cps.
5. Set RANGE to 0 DB.
6. Set MAX INPUT VOLTAGE to 100.
7. Turn AMPLITUDE full clockwise.
8. Connect signal to INPUT.
9. Monitor OUTPUT with earphones or a audio amplifier.
10. Set FREQUENCY to signal.
11. Set MODE as required (USB, LSB, or AM).
12. Turn RANGE counterclockwise until signal level is satisfactory.
13. If signal level is too low with RANGE set to -60 db, turn MAX INPUT VOLTAGE counterclockwise until a suitable level is reached.
14. Set OUTPUT signal volume with REF ADJUST.
15. To measure signal level, switch the ABSOLUTE and set MAX INPUT VOLTAGE for an up-scale reading. Keep RANGE at -60 db unless MAX INPUT VOLTAGE is on 100.

    Note: For convenience, signals can be monitored with RANGE set to arbitrary levels. Overloading the input will produce audible distortion, and will increase the apparent bandwidth of the signal.

Figure 3-8. Receiver Modes

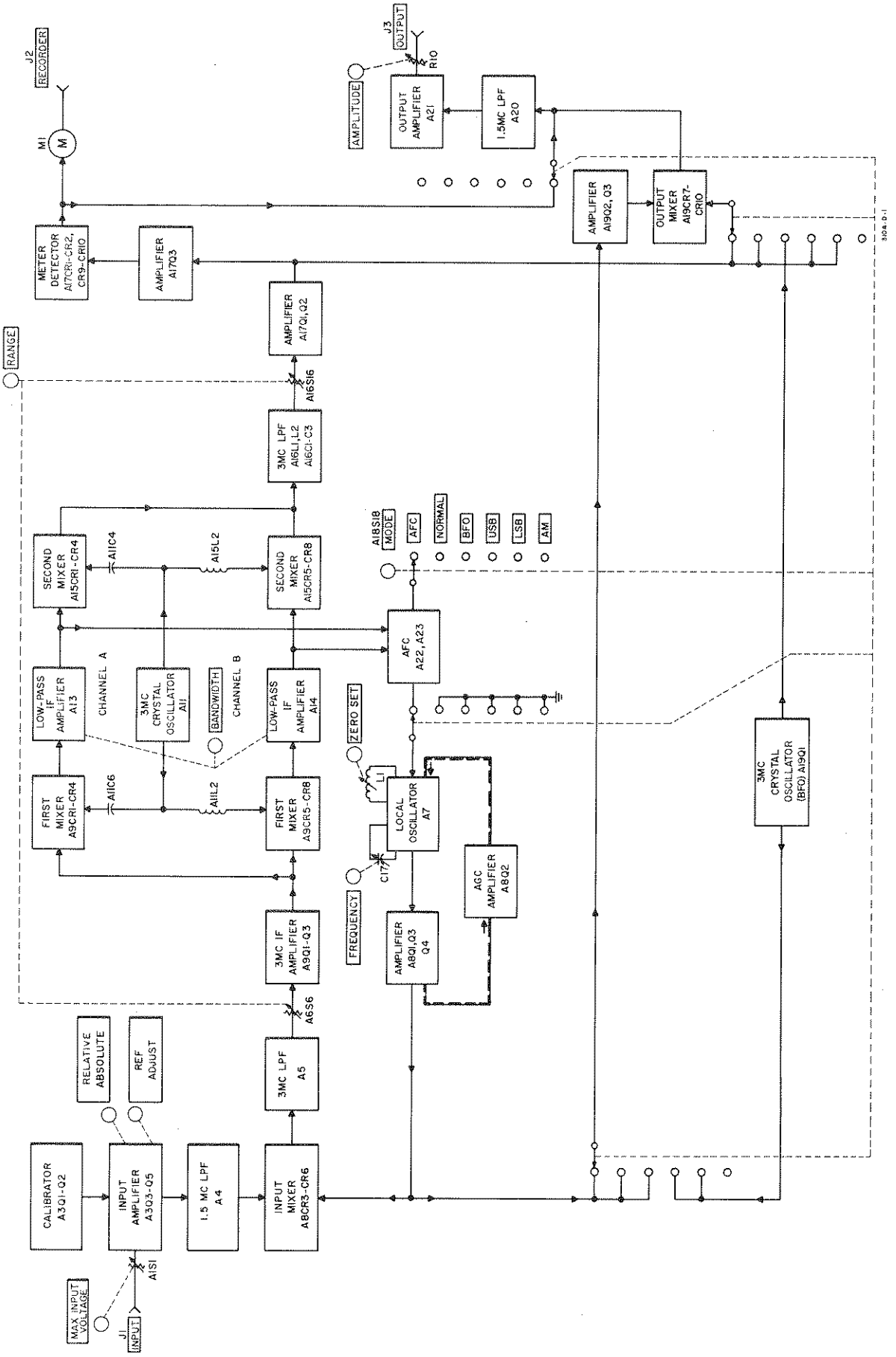


Figure 4-1. Overall Block Diagram

SECTION IV

CIRCUIT DESCRIPTION

4-1. GENERAL.

4-2. The Model 310A Wave Analyzer is a narrow-band AF-RF Voltmeter, tunable to any frequency between 1 kc and 1.5 Mc. Sharp cut-off filtering is accomplished at audio frequencies by a double-heterodyne process. The local Oscillator is above the operating frequency, tunable from 3 to 4.5 Mc. The crystal (BFO) Oscillator, crystal controlled, is at 3 Mc, transferring the components around this frequency to the audio range for filtering and then back again to 3 Mc by a phasing single-sideband technique.

4-3. For single-control tuning without bandswitching, all filters are low-pass. To eliminate unwanted mixer products and extraneous signals, filters are included which cut off at 1.5 Mc, and 3 Mc. The "front end" is essentially "wide open" to all frequencies, therefore an attenuator (MAX INPUT VOLTAGE) is included to attenuate the incoming signal to an acceptable amplitude.

4-4. Accessory circuits include automatic frequency control, a beat-frequency oscillator for carrier insertion and to act as a signal generator, a 100-kc calibrator, regulated power supplies, and a lamp-indicating network to simplify the readout of instrument sensitivity.

4-5. BLOCK DIAGRAM.

4-6. Figure 4-1 shows an overall block diagram of the Model 310A. An examination of the switching functions shown in the block diagram will clarify the various modes of operation. Basically, the signal applied to the INPUT terminals is attenuated to an acceptable level by MAX INPUT VOLTAGE attenuator A1S1, amplified by input amplifier A3Q3-Q4, then filtered by 1.5-Mc low-pass filter (A4) in order to eliminate undesired signals above 1.5 Mc. First local oscillator A7, tunable from 3 to 4.5 Mc, produces a 3-Mc beat-frequency with incoming signals in the 0 to 1.5 Mc range. Other mixer products are attenuated by 3-Mc low-pass filter A5.

4-7. After attenuation and amplification, the signal is delivered to the bandpass filter, where it is heterodyned to audio frequency, filtered, and transferred back again to 3 Mc. Audio signals from the filter, drive the automatic frequency control circuits which control first local oscillator A7. MODE switch A18S18 grounds the automatic frequency control output in all positions except AFC. The filtered 3-Mc signal, attenuated by RANGE attenuator A16 and amplified by meter amplifier A17Q1-Q3, is delivered to the meter detector.

4-8. The meter detector delivers signals to meter M1 and also, in the AM position of the MODE switch, drives output amplifier A21, delivering detected modulation to the OUTPUT connector. In the AFC and NORMAL positions of the MODE switch, the 3-Mc signal from the bandpass filter is applied to the output mixer, where first local oscillator A7 converts it back to its original frequency. Low-pass filter A20 eliminates residual 3 Mc Oscillator signal and the sum frequency from the mixer. The filtered signal (difference frequency) is then delivered to output amplifier A21 and is available at the OUTPUT connector for monitoring and measurement.

4-9. In the BFO position of the MODE switch, the first local oscillator signal is combined with the output of 3-Mc (BFO) crystal oscillator A19 in the output mixer.. This converts the local oscillator signal to the dial frequency, providing a signal at the OUTPUT terminal which is synchronized with the tuned frequency of the instrument. In the USB and LSB positions of the MODE switch, the 3-Mc (BFO) oscillator frequency is altered approximately 1450 cps, low for LSB and high for USB, then fed to the output mixer to demodulate single-sideband signals.

4-10. CIRCUIT DETAILS.

4-11. INPUT ATTENUATOR.

4-12. The input attenuator (Figure 5-15), controlled by MAX INPUT VOLTAGE switch A1S1, is a frequency-compensated resistance-capacitance divider network. This attenuator reduces the input signal level to prevent overloading of the input amplifier. The setting of MAX INPUT VOLTAGE combined with that of RANGE switch A6S6-A16S16 determines the full-scale sensitivity of the Model 310A.

4-13. INPUT AMPLIFIER.

4-14. The input amplifier is a three-stage amplifier with a gain of about 10 db. About 25 db of feedback minimizes distortion as long as the input attenuator is set to prevent overdriving the amplifier. Two back-biased diodes, A3CR4 and A3CR5, prevent an overload signal from damaging the circuit. The diodes will conduct on an excessive signal and will limit the drive to the base of A3Q3. The gain of the amplifier is set by CAL adjustment R3, as long as switch S3 is in the ABSOLUTE position. With S3 in the RELATIVE position, input gain may also be adjusted with REF ADJUST control A1R9.

4-15. INPUT MIXER.

4-16. After extraneous signals (images above 6 Mc) are removed by 1.5 Mc low-pass filter A4, the signal, attenuated by resistance network A8R4-R7, is applied to input mixer A8CR3-CR6, where it is mixed with the local oscillator output. The local oscillator is tunable between 3 and 4.5 Mc, therefore difference frequencies can appear between 1.5 and 4.5 Mc, while sum frequencies can appear between 3 and 6 Mc, depending in each case on local oscillator and signal frequencies. The sum frequencies are filtered out by 3-Mc low-pass filter A5. The input mixer is balanced to suppress the local oscillator frequency.

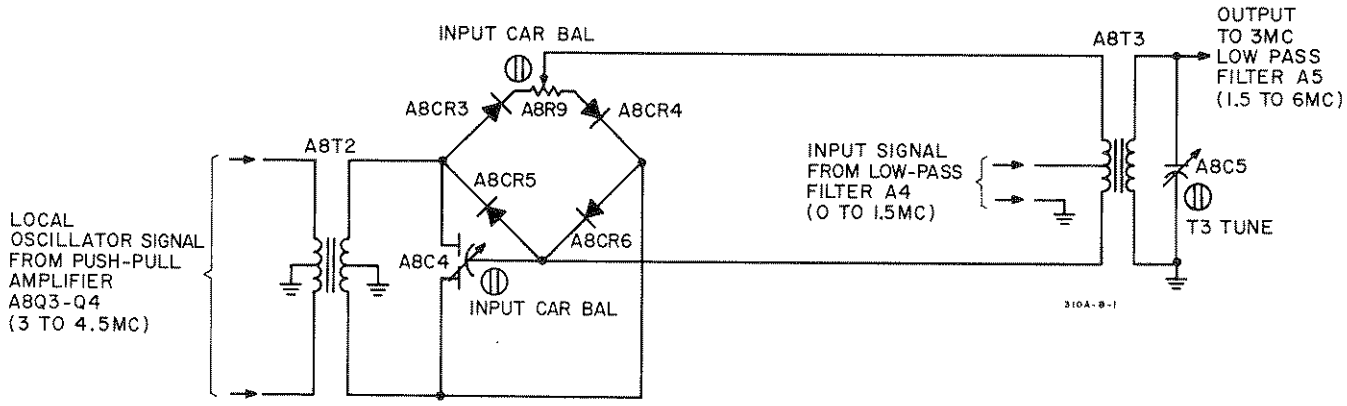


Figure 4-2. Input Mixer

4-17. A simplified schematic of the input mixer is shown in Figure 4-2. The local oscillator signal, applied to the input mixer by the secondary of transformer A8T2, drives the diodes of two adjacent arms of the bridge alternately into conduction. As the diodes conduct, the signal voltage is induced in the secondary of A8T3, with its polarity changed at the rate of the oscillator frequency. Capacitor A8C4 and resistor A8R9 are adjusted to balance out the oscillator voltage. Capacitor A8C5 tunes the secondary of transformer A8T3 to 3 Mc, tending to reject undesired mixer products.

4-18. LOCAL OSCILLATOR.

4-19. The first local Oscillator A7 (Figure 5-15) is basically a Colpitts circuit, generating a frequency between 3 and 4.5 Mc. The variable tuning element is capacitor C17, adjusted by the front-panel FREQUENCY control. Front-panel ZERO SET adjustment L1 sets the local oscillator frequency to 3 Mc when the front-panel indicator reads 0000. Internal adjustments A7C5 (Ratio Adj) sets the oscillator frequency to 4.5 Mc when the front-panel indicator reads 1500 KC. Variable inductor A7L2 allows setting the ZERO SET control to mid-range when the oscillator is properly adjusted. Capacitor A7C4 is a factory-selected part, chosen to properly set the range of A7C5. When the MODE switch is in the AFC position, frequency-control voltage is applied to back-biased diodes A7CR1 and CR2, which acts as voltage sensitive capacitors to modify the frequency of the local oscillator, holding a varying signal within the passband of the Model 310A.

4-20. The output of the first local oscillator is taken from the emitter of A7Q1, amplified by A8Q1, and applied by push-pull common-base amplifier A8Q3-Q4 to the primary of transformer A8T2. The secondary of A8T2 couples the oscillator voltage to input mixer A8CR3-CR6, as explained in Paragraph 4-16. Oscillator output from the secondary of A8T2 is rectified by A8CR2 to maintain a negative charge across A8C10 proportional to the amplitude of the oscillator output. AGC amplifier A8Q2 applies this voltage as bias to the base of oscillator A8Q1, maintaining the oscillator output substantially constant across the tuning range. Oscillator output is also fed from the secondary of A8T2 to the output mixer (Figure 5-17) when MODE is in AFC, NORMAL, or BFO. The output mixer converts the IF signal back to its original frequency after it has been filtered by the active bandpass filter. In the case of BFO, the 3-Mc beat-frequency oscillator is applied to the output mixer, and the local oscillator signal is converted to the dial FREQUENCY setting.

4-21. ACTIVE LOW-PASS FILTER.

4-22. The low-pass filter provides the 200, 1000, or 3000 cps selectivity of the Model 310A. By phasing techniques, the signal is converted to audio frequency, filtered, and returned to 3 Mc. A block diagram of the filter is shown in Figure 4-3.

4-23. After passing through 3-Mc low-pass filter A5, the signal is delivered to RANGE switch A6 (Figure 5-17), where the amplitude is set to a level appropriate for the following stages. 3-Mc amplifier A9Q1-Q3 then amplifies the signal and applies it to the input transformers of the two filter channels, A9T1 in channel A and A9T3 in channel B. Capacitor A9C7 adjusts the frequency response at the output of the 3-Mc amplifier to produce a symmetrical passband at the output of the active bandpass filter. Capacitors A9C11 and C16 resonate the input transformers of the two channels to 3 Mc.

4-24. The output of 3-Mc crystal oscillator A11Q1 (second local oscillator) amplified by A11Q2-A3, is shifted 45° by an RC network to channel A and an RL network to channel B. The RC network is the resistance reflected by autotransformer A9T2 and the capacitance of A11C6. The RL network is the resistance reflected by autotransformer A9T4 and the inductance of A11L2. The autotransformers convert the single-ended oscillator signal to a balanced drive to the two mixers, where the 3-Mc oscillator signals are mixed with the input signal. The result is two audio-frequency voltages which are 90° out of phase (higher frequency components are also present). The phase difference between the two channels is adjusted by A9C13 and C18. If the signal is above dial setting, channel B lags channel A. If the signal is below dial setting, B leads A in phase. Capacitor A11C3 is adjusted for an oscillator

frequency of 3 Mc +25 cps. The 25-cycle detuning prevents the 3-Mc BFO signal from falling in the notch in the center of the passband during response measurements (Figure 3-7).

4-25. The output of each mixer is passed through two positive-feedback RC low-pass filters, each including a three-stage high-gain amplifier. The filters have a maximally flat frequency response to nearly their cut-off frequency, beyond which the response drops off at 24 db per octave. Cut-off is 100, 500, or 1500 cycles per second, depending upon the setting of BANDWIDTH switch A10S10. Therefore, signals 100, 500, or 1500 cycles either side of 3 Mc +25 cps will pass through the filter, resulting in a bandpass of 200, 1000, or 3000 cycles respectively. Signals above and below 3 Mc retain their identity and are later restored to their original frequencies by virtue of the phase relationships between channels. Capacitance coupling between the two sections of the filter limits low-frequency response to approximately one-half cycle, thus creating a notch one cycle wide in the center of the passband (the frequency to which the dial is set).

4-26. The two signals are then applied to the output mixer pair, where they modulate the 3-Mc oscillator output from A15Q1. A 90° phase difference in oscillator voltage is created by capacitor A15C4 and inductor A15L2 in conjunction with the resistance reflected by transformers A15T1 and T3. The audio signal creates two sidebands in each mixer output, equidistant above and below 3 Mc, but with differing phase characteristics between channels. The signals are combined in transformer A15T2. If the original signal was above 3 Mc, the upper sidebands add and the lower one cancels. If the signal was below 3 Mc, the lower sidebands add and the upper ones cancel. The 3-Mc oscillator signal is suppressed by the balanced mixers.

4-27. AFC CIRCUIT.

4-28. The audio signal from each channel of the active low-pass filter is applied to the input of the AFC circuit. A block diagram of this circuit is shown in Figure 4-4. The complete schematic diagram appears in Figure 5-23. The circuit converts phase and frequency information from the two audio channels to a correction voltage which is applied to two back-biased diodes which act as voltage-sensitive capacitors (A7CR1 and CR2) in the plate circuit of local oscillator A7Q1. The change in capacitance coupled into the oscillator plate circuit by A7T1 modifies the oscillator frequency in such a direction as to bring the signal close to the center of the active filter passband (3 Mc +25 cps).

4-29. The signals from the two audio channels are amplified by A22Q1 and Q3. Channel A output from

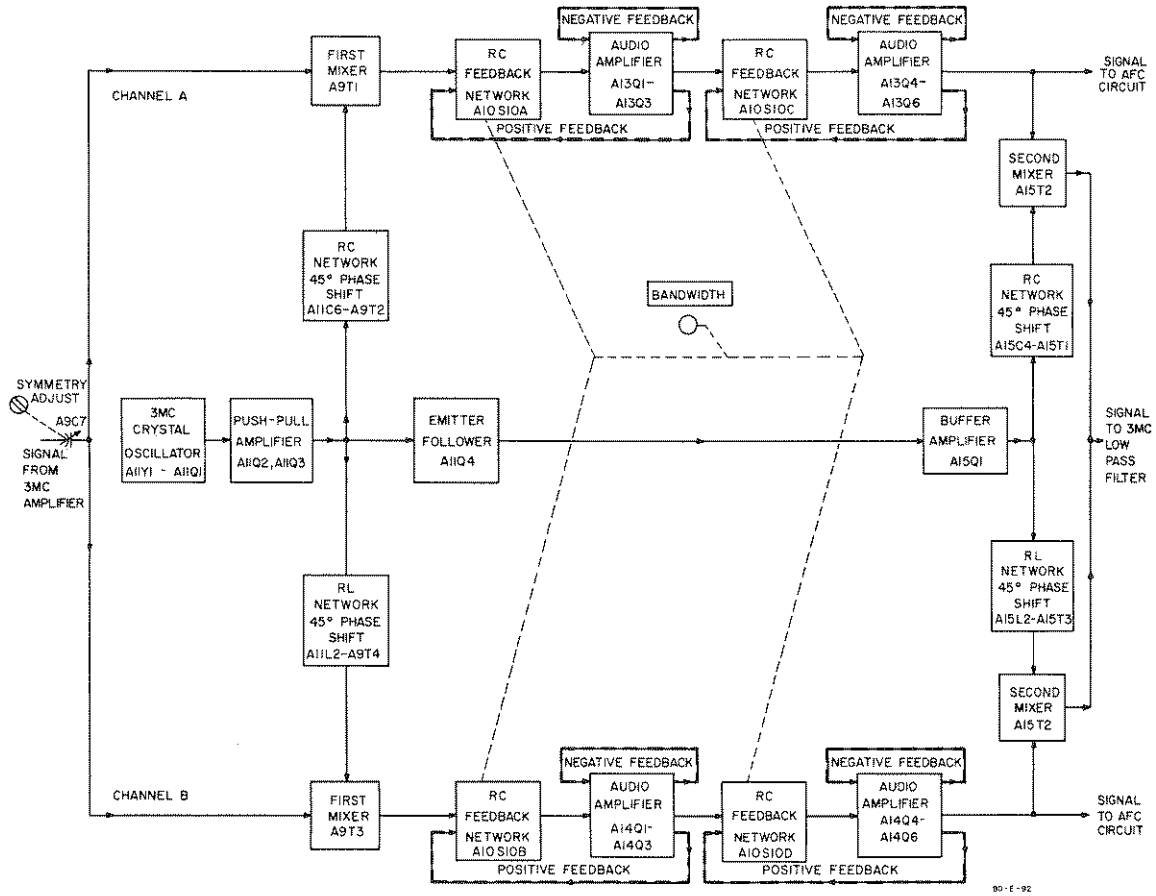


Figure 4-3. Active Low-Pass Filter

A22Q3 is amplified and rectified by AGC amplifier A22Q2, charging capacitor A22C24. When the charge on A22C4 is large enough to turn on diodes A22CR2-CR5, a voltage-driver action takes place between the diodes and resistors A22R5 and R38, reducing the level of the incoming signals.

4-30. SCHMITT TRIGGER. The two amplified signals are combined through diodes A22CR7 and CR9. The diodes allow the negative-going half of the channel B signal to pass, and allow the positive-going half of the channel A signal to pass. The result (with the base of A22Q4 disconnected) is illustrated in Figure 4-5. This signal is applied to the base of A22Q4 in the Schmitt trigger circuit. The Schmitt trigger is a rectangular-wave generator with two triggering levels. When the signal moves negative past the lower switching limit, A22Q4 turns off, its collector voltage goes positive, driving A22Q5 into conduction, and feedback between the cathodes of the two transistors holds the circuit in this condition until the incoming signal moves positive past the upper switching limit. The resulting output is an unsymmetrical square wave, the positive or negative regions being longer depending upon which channel is leading in phase. The wafeform with the base of A22Q4 connected is illustrated in Figure 5-22 (Note: with A22Q4 connected, most of the positive portion of the waveform is clipped by transistor conduction). When channel A is leading (signal below dial setting), the square wave is positive more of the time.

4-31. The output of the Schmitt trigger drives the base of A22Q6. There are two outputs from this stage. The collector output is applied to a positive counter consisting of A22C16, A23CR1, CR2, and R1. A22C16 differentiates the square wave. Diodes A23CR1 and CR2 transfer the positive-going pulses to resistor A23R3. The output of the counter, filtered by A23R3 and C2, is proportional to the frequency of the signal from A22Q6. This voltage moves positive when the tuning error increases in either direction.

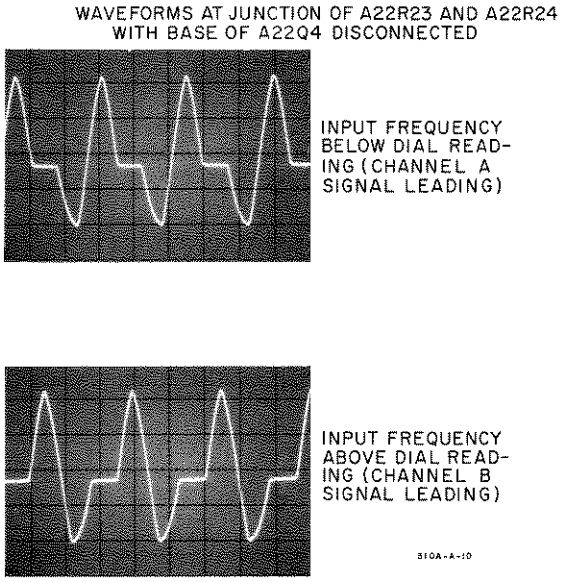


Figure 4-5. Combined Filter Signals

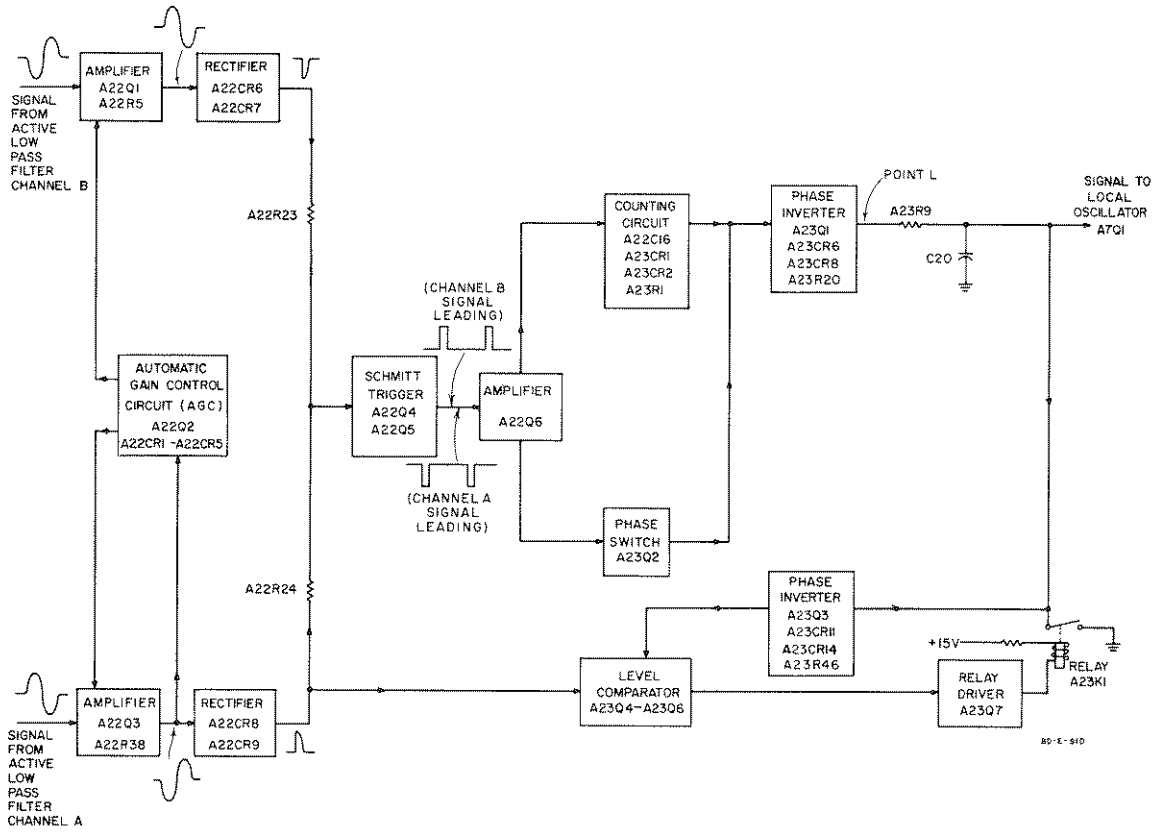


Figure 4-4. Automatic Frequency Control

4-32. The emitter output of amplifier A22Q6, filtered by capacitor A23C5 and resistor A23R15, is positive or negative depending upon the symmetry of the square wave. This DC voltage is amplified by phase switch A23Q2, and applied, along with the counter output, to the base of phase inverter A23Q1.

4-33. PHASE INVERTER. The voltage at point L (Figure 5-23) is such that diodes A23CR6, CR7, and CR8 act as switches, taking the amplified counter output from either the collector or the emitter (180° out of phase) of A23Q1, depending upon the bias level delivered by phase switch A23Q2. Thus the phase switch determines the polarity of the correction voltage, while the counter determines the amplitude. The resulting output is delivered to the local oscillator.

4-34. If a signal is above dial frequency but within the passband of the active low-pass filter, the signal from channel B will lead that from channel A. The square-wave output of Schmitt trigger A22A4-Q5 will then be negative longer than it is positive, and the drive to phase switch A23Q2 will be negative. The phase switch output will be less negative, increasing conduction through phase inverter A23Q1. The collector output switch in the phase inverter circuit, A23CR6-CR7, will turn off, and emitter output switch A23CR8 will turn on, delivering a more positive voltage to voltage-sensitive capacitors A7CR1-CR2 in the local oscillator circuit. This constitutes an increase in the back-bias on these two diodes, decreasing their capacitance, and raising the frequency of the local oscillator. The amplitude of the correction voltage is set by Neg Out control A23R20. As long as the signal is within the passband, the AFC circuit will hold for dial mistuning (or signal drift) up to 3 kc. Beyond this limit, or when the signal measures less than 1/4 scale on the most sensitive range, a disabling circuit grounds the AFC output.

4-35. AFC DISABLING CIRCUIT.

4-36. The circuit of phase inverter A23Q3 is much the same as that of A23Q1. If the output of A23Q1 exceeds the range of -0.5 to +1.0 volt, a positive signal is delivered from either the emitter or the collector of A23Q3 through switches CR12 and CR13, or CR14. This signal turns on A23Q6, turning off A23Q5, and delivering a positive voltage to the base of relay driver A23Q7. The resulting conduction through A23Q7 energizes relay A23K1, shorting the output of the AFC circuit. This allows the signal to drift out of passband of the active filter removing negative bias from the base of A23Q4 and allowing A23Q4 to turn on, holding A23Q5 in the non-conducting state, and therefore holding relay A23K1 closed. The bias for this holding circuit is delivered through A23CR8, filtered by resistor A23R40 and capacitor A23C10. If a signal reappears in the passband, Schmitt trigger A23Q4-Q5 will pass its negative switching limit, turning A23Q4 on, releasing A23K1 and restoring AFC control. Hold-Off Level control A23R27 is adjusted so that the AFC will take control of any signal greater than one-quarter scale on the most sensitive range. Neg Cut-Off control R46 adjusts phase inverter A23Q3 to deliver cut-off voltage to A23Q6 when the AFC output exceeds the range of -0.5 to 1.0 volt.

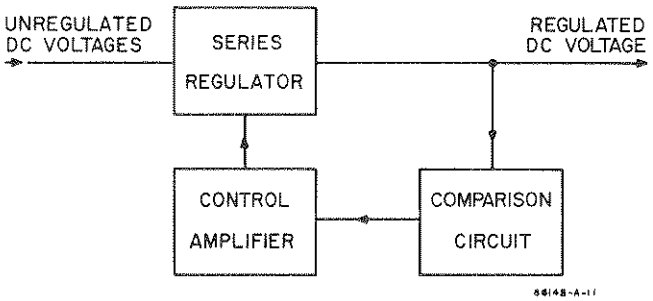


Figure 4-6. Series Regulated Power Supply

4-37. METER AMPLIFIER.

4-38. With RANGE switch A6S6 (Figure 5-17) in positions up to -30 dbm, signals are allowed to pass through the active filter unattenuated. Above that level, they are attenuated before being applied to the input of the filter. The filtered signal is coupled by transformer A15T2 to the input of a 3-Mc low-pass filter A16L1-L2 (Figure 4-1), then further attenuated in the second section of the RANGE switch, A16S16. After two stages of amplification by A17Q1 and A17Q2, the signal is fed to the front-panel meter M1, and also to output amplifier A21 when MODE switch A18S18 is in the AM position.

4-39. BFO.

4-40. Crystal oscillator A19Q1 provides carrier insertion signal for sideband reception, and also a signal at the tuned frequency for testing purposes. Diodes A19CR1-CR6, in conjunction with MODE switch A18S18, control oscillator functions, and also select the signal fed to output amplifier A21. With MODE in AFC or NORMAL, the oscillator is disabled, and diode A19CR6 is turned on, applying the input signal to the output mixer. In the BFO position, -15 volts is applied to the collector of A19Q1, energizing the oscillator, and A19CR1 and A19CR2 are turned on, grounding the crystal tuning circuits. The diode A19CR5 is turned on, coupling the Oscillator output to the output mixer. In the sideband positions of the MODE switch, A19CR6 is on, allowing the input signal to be applied to the output mixer, and oscillator output is coupled through A17R7 to common-base amplifier A19Q2. Diodes A19CR1-CR4 determine whether capacitor A19C7 tunes the crystal (LSB) or whether both A19C7 and A19C6 are used (USB). For USB, the oscillator is tuned approximately 1450 cycles above 3 Mc. For LSB, the frequency is set approximately 1450 cycles low. In the AM position, the oscillator is de-energized, A19CR6 is turned off, and the rectified signal from A17T1 is coupled through the MODE switch to the input of 1.5-Mc filter A20.

4-41. OUTPUT MIXER.

4-42. In the AFC, NORMAL, and BFO positions of the MODE switch, the local oscillator voltage from transformer A8T2 is applied to the balanced input of the output mixer through amplifier A19Q2-Q3. The mixer transfers the 3-Mc signals to their original frequency, and applies them to 1.5-Mc low-pass filter A20. The filter attenuates high-frequency products of the mixer.

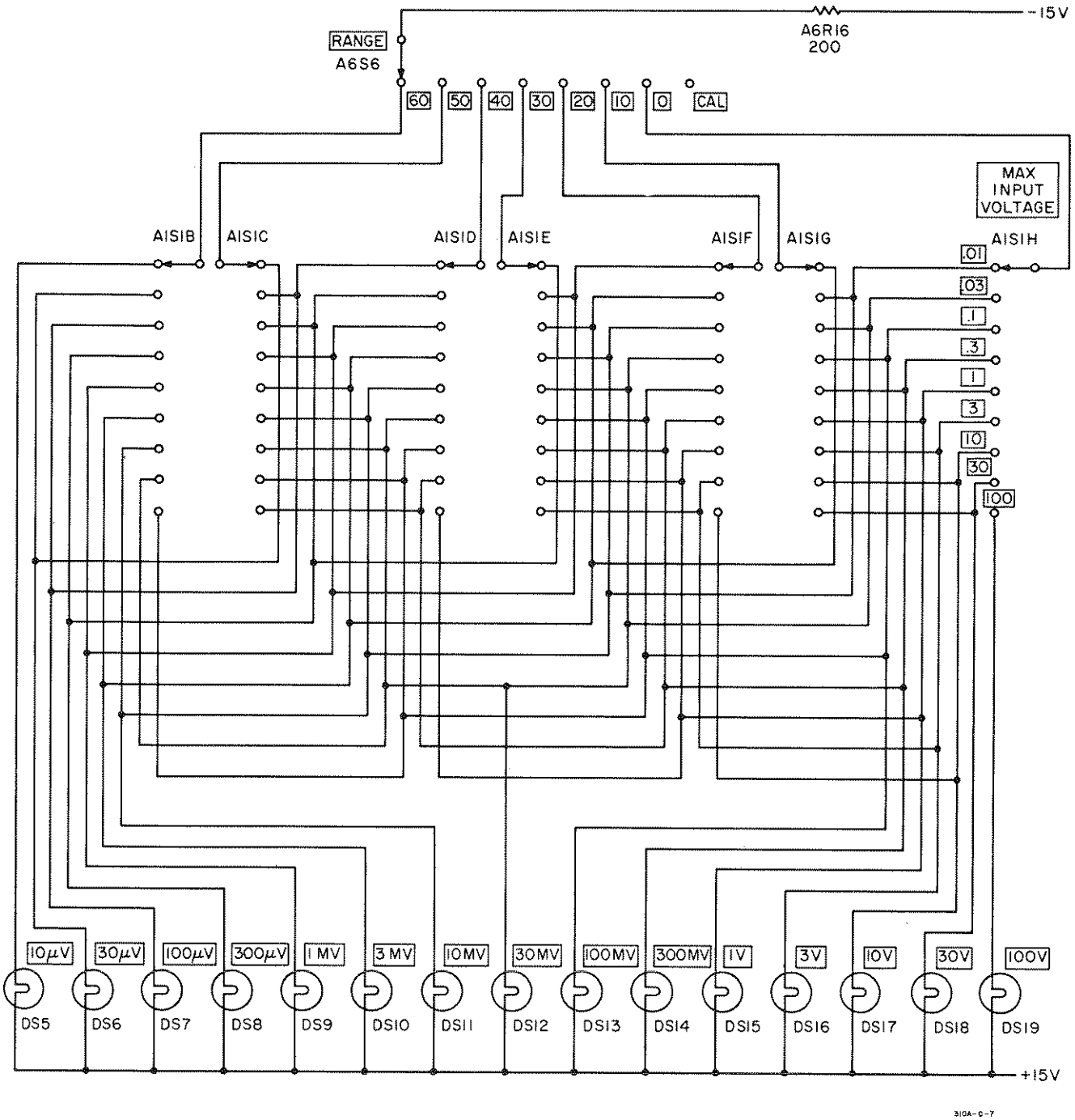


Figure 4-7. Indicator Light Circuit

The signal is finally amplified by output amplifier A21 before being applied to the OUTPUT terminals.

4-43. POWER SUPPLIES.

4-44. There are two regulated power supplies: + 15- and -15-volt. Both supplies are series-regulated types. The series regulator is connected in series with the main load. The output voltage is monitored and compared to a reference voltage. The voltage differential is applied through a control amplifier to the series regulator. This differential voltage changes the effective resistance of the series regulator which in' turn holds the output voltage constant (see Figure 4-6).

4-45. The -15-volt supply is series regulated by Q1 and Q2. The output voltage is sampled at A24R7 and compared to the drop across breakdown diode A24CR4 by control amplifier A24Q2. The amplified error voltage is applied to the base of driver A24Q1, which provides low-impedance drive to series regulator Q2. Breakdown diode A24CR3 provides fixed voltage to the base of Q1, making this stage a constant-current device which tends to isolate the second regulator from changes in the output of rectifiers A24CR1 and A24CR2. The on-off switch grounds C14 when the power is turned off. The positive 15-volt supply is essentially the same as the negative supply except for polarity.

4-46. INDICATOR CIRCUIT.

4-47. The front-panel range indicator includes lamps DS5 through DS19, illuminating one of 15 voltage-range windows from 10 μv through 100 v. The circuit is illustrated in Figure 4-7. Wiring to the lights is connected through RANGE switch A6S6 and through MAX INPUT VOLTAGE switch A1S1. Each row of contacts on A1S1 represents a position of A6S6, and each row is connected to the light chain one position in advance of the previous. Thus a one-position change in either switch will result in a one-position change on the indicator panel. When the RANGE switch is at 0 DB, the most sensitive range available is 10 MV. When RANGE is at -60 DB, the least sensitive range is 100V.

Table 5-1. Recommended Test Equipment

Item No.	Instrument Type	Critical Specifications	Model
1	AC Voltmeter	Voltage Range: 0.1 mv to 100 v Voltage Accuracy: ±3% of full scale Frequency Range: 1 kc to 1.5 Mc Impedance: 10 Megohms	hp 400H
2	Electronic Counter	Frequency Range: 1 kc to 4.8 Mc Accuracy: ±1 count ± time base Accuracy Impedance: 10 Megohm Sensitivity: 1.0 mv RMS	hp 5243L with hp 5261A (plug-in) and hp 10003A (Voltage Divider Probe)
3	Audio Oscillator	Frequency: 1 to 600 kc Output: 3 v into 50 ohms Output Level: variable	hp 200S
4	Oscilloscope	Frequency Range: DC to 7.5 Mc Vertical Sensitivity: 0.1-20v/cm Horizontal Sensitivity: 0.1-2v/cm Input Impedance: 10 Meg	hp 175A (Oscilloscope) hp 1751A (Vertical Ampl.) hp 10001B/D (10:1 voltage Divider Probe)
5	DC Voltmeter/Ohmmeter	Voltage Range: 1 to 35 VDC Voltage Accuracy: ±3% Ohmmeter Range: 1 ohm to 100 Meg Ohmmeter Accuracy: ±5%	hp 412A
6	Soldering Iron	Wattage Rating: 50 watts Max Tip Temp: 800°F Tip Size: 1/16" to 3/32" Round Tip Diameter: 3/4"	Ungar #665 Handle #885-3/4" Cup Tip #PL333 Tiplet
7	Precision Attenuator	Attenuation: 90 db in 10 db steps Accuracy*: ±0.3 db to 1 kc Frequency Range: DC to 10 kc Impedance: 50 ohms	hp 355B/D
8	Resistors	(1) 5.6K ohm ±10% 0.5W	hp 0687-5621
		(1) 2.7K ohm ±10% 0.5 W	hp 0687-2721
		(2) 18 ohm ± 10% 0.5W	hp 0687-1801
		(1) 135 ohm ±1% 0.5W	hp 0727-0466
9	Tuning Screw ADJ (Non-conducting)	Rod (Bakelite or wood): Approx Diameter 1/4" with a screwdriver-type blade at one end and a thin slot at the other	- - - -
10	Channel Filters	Bandpass: 9 to 50 kc Impedance: 600 ohms Rejection: 30 db	Allison Laboratories Incorporated Model 2C
		Bandpass: 250 to 672 kc Impedance: 600 ohms Rejection: 30 db	
11	Frequency Response Test Set	Frequency Range: 300 kc-1.5 mc Output: 3V into 50 ohms Adjustable in 10 db steps by 0 to 70 db Attenuator	hp 739A

* At 10 kc the attenuator must be calibrated to an accuracy of ±0.5% from 0 to -80 db.

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the 310A. The section includes recommended test equipment, performance checks, replacement, repair, and adjustment procedures, and troubleshooting charts. 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 Appendix I).

5-3. TEST EQUIPMENT.

5-4. Table 5-1 lists equipment in number order. Items numbered 1 through 3 are required for performance checks. Items numbered 3 through 6 are required for troubleshooting. Items numbered 1 through 11 are required for adjustment, replacement, and repair procedures. Instruments other than those listed may be used, provided their performance meets the basic requirements listed in Table 5-1.

5-5. PERFORMANCE CHECKS.

5-6. The performance check procedures are used to check the 310A against its specifications. All checks are made from the front panel, thus the instrument panels need not be removed. The procedures are useful as incoming or outgoing quality control, periodic maintenance, or after-repair checks. If the 310A fails any of these checks, refer to Paragraph 5-12 for troubleshooting guides.

5-7. GENERAL CHECK.

a. Check operation of voltage range indicator lamps by switching RANGE and MAX INPUT VOLTAGE controls to all positions except CAL.

b. Check residual meter reading with the 310A set as follows: BFO, -60 DB, 200 cps, 0.01V, and OUTPUT AMPLITUDE fully clockwise. Residual meter reading should be less than 2% of full scale.

c. Check REF ADJUST control with the 310A set to CAL, NORMAL, and RELATIVE. Range of the control should be at least 10 db.

5-8. SELECTIVITY CHECK.

a. Connect equipment as shown in Figure 5-1.

b. Calibrate 310A (refer to Figure 3-2).

c. Switch MODE to NORMAL and BANDWIDTH to 200. Set Oscillator for approximately a 2 volt-10 kc output signal.

d. Tune 310A FREQUENCY (KC) control for center frequency (see Note, Figure 3-3).

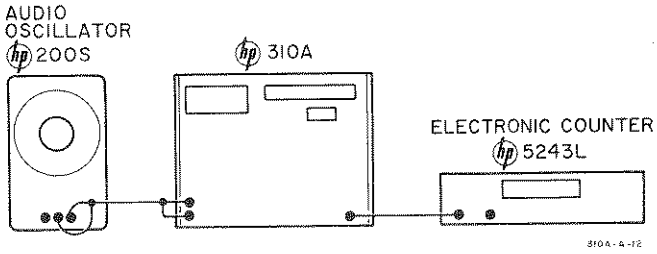


Figure 5-1. Frequency and Sensitivity Check

e. Adjust Oscillator output amplitude for full scale 310A meter reading.

f. Increase Oscillator frequency until 310A meter reading decreases 3 db from maximum and record frequency. Decrease Oscillator frequency until 310A meter reading decreases 3 db from maximum record frequency. Specification: The recorded frequency readings must be within 108 cps of the center frequency.

e. Repeat steps c, d, e, and f for the BANDWIDTH settings of 1000 and 3000, respectively. Specifications: For BANDWIDTH settings of 1000 the 3 db points must be within 540 cps of center frequency for BANDWIDTH setting of 1000 and within 1550 cps of center frequency for BANDWIDTH setting of 3000.

Note

If Frequency Counter will not trigger then connect to INPUT (in parallel with Oscillator).

5-9. BFO AND FREQUENCY CHECK.

a. Connect OUTPUT of 310A to INPUT and setup as follows:

ABSOLUTE-RELATIVE	ABSOLUTE
MAX INPUT VOLTAGE	1
BANDWIDTH	200
MODE	BFO
RANGE	0
FREQUENCY (KC)	0000

b. Adjust AMPLITUDE control near full clockwise and adjust ZERO SET for minimum meter indication.

c. Disconnect INPUT and connect equipment as shown in Figure 5-1 (the Audio Oscillator is unnecessary).

d. Check frequency dial accuracy by comparing dial settings with Counter readings. Specification: Counter readings should be within ±(1% +300 cps). If 310A operation is unsatisfactory refer to Table 5-2.

5-10. AFC DISCRIMINATOR CHECK.

a. Calibrate 310A as shown in Figure 3-2.

b. Connect instruments as shown in Figure 5-1.

Note

Frequency Counter should be connected in parallel with oscillator.

c. Set 310A as follows:

MAX INPUT VOLTAGE 3

RANGE 0

MODE ..... NORMAL

ABSOLUTE/RELATIVE ..... RELATIVE

d. Set Oscillator for an output signal of about 100 kc and tune 310A to input signal.

e. Adjust REF ADJUST for 2.0 volt and switch MODE to AFC.

f. Increase Oscillator frequency slowly so that AFC circuit automatically returns and tracks input signal frequency. The AFC circuit will eventually lose control causing a sudden drop in the meter reading at this point.

g. Repeat steps d and e.

h. Decrease Oscillator frequency slowly and record the counter reading at the point that the AFC circuit loses control.

i. The AFC control range or hold-in range should be ±3 kc minimum. If AFC operation is unsatisfactory, refer to Table 5-3.

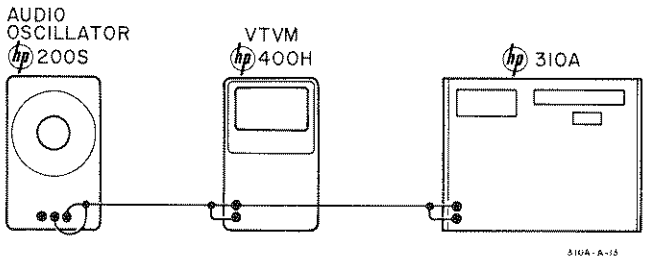


Figure 5-2. Voltage Accuracy Check

5-11. VOLTAGE ACCURACY CHECK.

a. Connect equipment as shown in Figure 5-2.

b. Calibrate 310A as shown in Figure 3-2.

c. Set MODE selector to NORMAL.

d. Set ABSOLUTE/RELATIVE switch to ABSOLUTE.

e. FREQUENCY (KC) to 100 kc Oscillator frequency.

f. Switch MODE to AFC.

g. Compare Voltmeter readings to 310A meter readings. Specification: Meter readings should be correct to within an accuracy of ±6% of full scale sensitivity.

i. If Voltage Accuracy is not satisfactory refer to Table 5-2 and 5-3 and check instrument operation.

5-12. GENERAL MAINTENANCE.

5-13. The Model 310A includes 18 etched circuit board assemblies, 5 switch assemblies, a mechanical tuner assembly, a meter movement, and a few component parts mounted on the instrument chassis (refer to Figure 5-3 for assembly locations). For access to all component parts, the Model 310A is equipped with removable top and bottom covers. Removal of the top and bottom covers exposes about three quarters of the component parts of the instrument. The remaining component parts are located beneath additional covers which act as shields.

5-14. TROUBLESHOOTING.

5-15. LOCATING TROUBLE.

5-16. 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.

5-17. 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 waveforms (located opposite each schematic diagram) and/or using the front panel troubleshooting chart, Table 5-2. Troubleshooting charts, Tables 5-3, 5-4, and 5-5, are additional guides to troubleshooting the power supply and the AFC circuitry.

CAUTION

Be careful when measuring transistor or diode forward or reverse resistance. Almost every ohmmeter has a few ranges that supply enough current or voltage to damage a transistor and some diodes. Always measure ohmmeter open-circuit voltage and short-circuit current on every range that you intend to use. For transistors, ohmmeter open-circuit voltage should not exceed 1.5 volts and short-circuit current should not exceed 3 ma on the ohmmeter range used. For diodes, refer to Table 6-1, Reference Designation Index, which describes diode breakdown and forward bias voltage characteristics.

5-18. TROUBLESHOOTING CHARTS.

5-19. Troubleshooting charts, Tables 5-2 through 5-5, list symptoms and possible causes of various troubles. For simpification, only major components are referenced in the troubleshooting charts, but it should be remembered that associated components are also failure possibilities. When testing the wave analyzer it is recommended that line voltage be applied through a variable transformer, and that the transformer be adjusted to deliver a voltage at the low end of the rated 103- to 127-volt range (207- to 253-volt for 230-volt operation). An instrument in good condition should operate satisfactorily from any line voltage within the rated range, but where there is marginal operation, weaknesses become easier to trace at low line voltages.

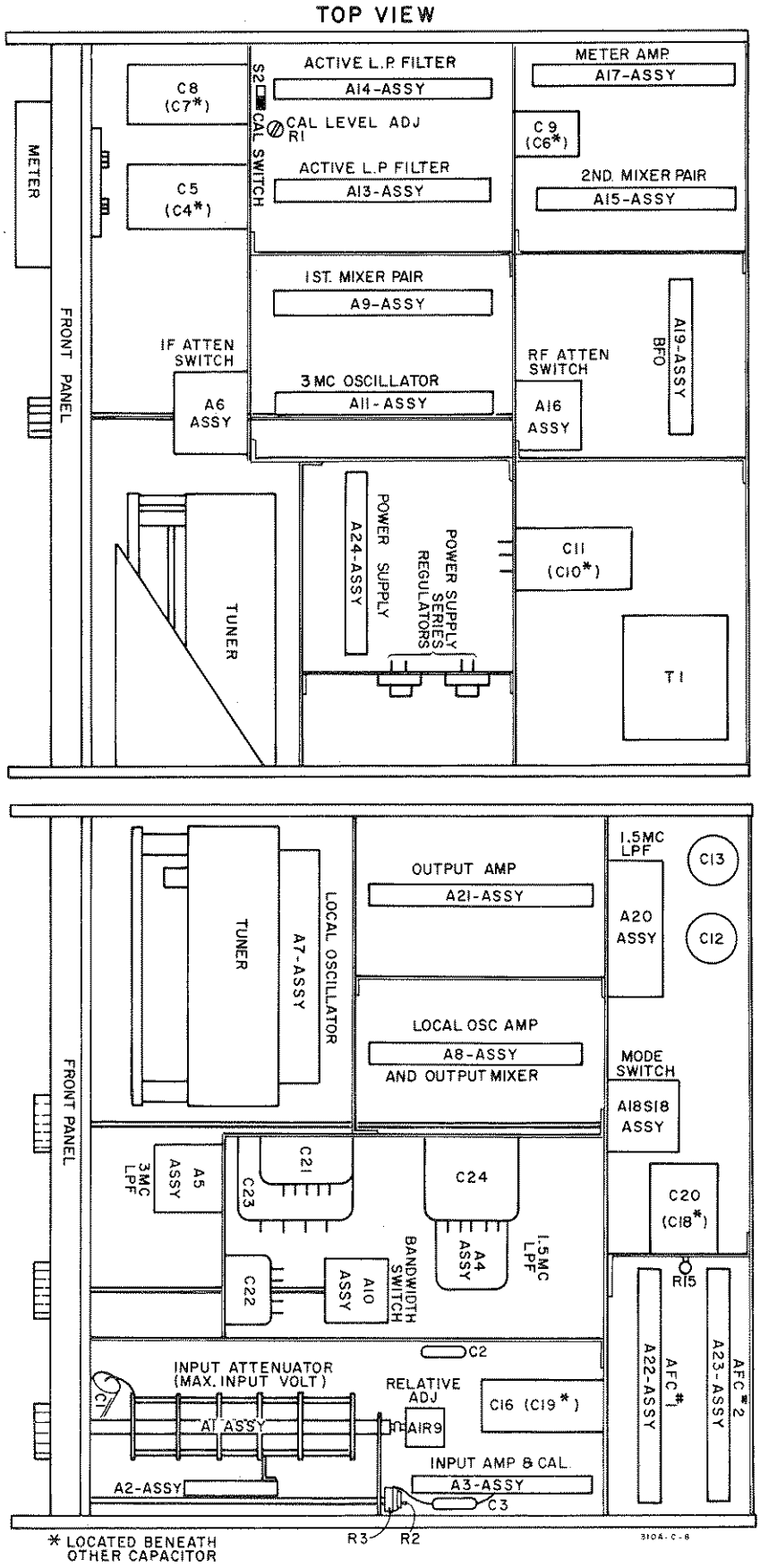


Figure 5-3. Assembly Location

Table 5-2, Front Panel Troubleshooting

Test Equipment and Connections	Important Control Settings (310A)	Indication	Conclusion
- - -	RANGE INDICATOR LAMPS RANGE and MAX INPUT VOLTAGE controls to positions, except CAL	Lamps dim, unlit, or brighter than normal	Power Supply Voltages: low, high, or out Indicator lamp defective
- - -	RESIDUAL METER READING BFO, 200 cps, 0.01V, -60 DB, OUTPUT AMPLITUDE full CW	With no input Meter reading more than 20% of full scale	Position of leads on MODE switch (A18S18) causing regeneration, push around and re-check
- - -	REF ADJUST CONTROL CAL, NORMAL, 3000 cps RELATIVE, tuned for maximum meter indication	REF ADJUST does not vary meter reading at least 10 db	Loss of Gain in Input Amplifier A3Q3, A3Q4, or A3Q5
- - -	ZERO SET CONTROL NORMAL, 200 cps, 1V, 0000, -20DB	ZERO SET tunes meter indication to full scale reading	Carrier balance out-of-adjust, (A8 Assembly)
200S and Calibrated 355B/D, connected to INPUT. Input 10 kc signal varied in 10 DB steps from -60 to -10 DB 739A connected to INPUT. Input 1 Mc signal varied from .003 to 1.0	INPUT ATTENUATOR CHECK AFC, 1000 cps, 1V, tuned to input signal, MAXIMUM INPUT VOLTAGE switch varied from 0.3 to 100 (each step is a 10 DB step).	Meter reading must be set to a near full scale reference. For every 10 DB increase in input signal, switch MAX INPUT VOLTAGE switch one step higher. If meter reading error is greater than ±2% of full scale of reference setting.	MAX INPUT VOLTAGE switch ground leads touching RANGE switch ground leads touching on switch. Bad resistors in MAX INPUT VOLTAGE switch.
200S and Calibrated 355B/D connected to to INPUT	AFC INPUT AMPLITUDE SENSITIVITY AFC, 1V, ODB, 3000cps, tuned to input signal	If AFC circuit does not lock on to an input signal amplitude of 0.3 volts	AFC #2 circuit out of adjust A23Q4 defective A23Q5 defective
200S and 5243L/5261A connected to INPUT	AFC FREQUENCY RANGE AFC, 1V, ODB, 1000 cps, tuned to input signal	If AFC circuit does not remain locked to input signal when input frequency is varied at a very slow rate within ±3 kc of tuned frequency	AFC #1 circuit out of adjust AFC #2 circuit out of adjust A23Q4 defective 2nd Mixer Pair (A15) circuit out of adjust
200S connected to INPUT 5243L/5261A connected to OUTPUT	OUTPUT PHASING NORMAL, 3V, ODB, 1000 cps. tuned to input signal	If OUTPUT frequency changes when 310A FREQUENCY (KC) control is varied within selected BANDWIDTH	IF AMPLIFIER (A9) out of adjust 2nd MIXER PAIR (A15) out of adjust

Table 5-2. Front Panel Troubleshooting (Cont'd)

Test Equipment and Connections	Important Control Settings (310A)	Indication	Conclusion
	BANDWIDTH FLATNESS		
	CAL, NORMAL, 1V, ODB	Tune through 100 kc calibrate signal and observe meter indication of peaks to either side of center frequency. If the amplitude of these two peaks is not the same.	A9C7 is out of adjustment
	BANDWIDTH SELECTIVITY		
200S and 5243L connected to INPUT	NORMAL, 3V, tuned to 10 kc input signal, check performed for all bandwidths	Vary input frequency to each side of tuned frequency and record 5243L reading when 310A meter reads 3, 50, and 75 DB below original reference. If limits are not within specifications	Trouble location A3 Assembly, A8 Assembly, A9 Assembly, A15 Assembly
	TUNER TRACKING		
200S and 5243L connected to INPUT (1 kc to 600 kc) 739A and 5243L connected to INPUT (600 kc to 1 Mc)	NORMAL, 1000 cps, 3V, tuned to input signal	If FREQUENCY (KC) dial readings do not agree with 5243L Counter readings within ±(1% + 300 cps)	Tuner Assembly out of adjust
	DISTORTION		
200S and BANDPASS FILTER (a) with 30 db attenuation at 500 kc, then (b) with 30 db at 25 kc.	NORMAL, ODB, 200 cps, RELATIVE, tuned to input signal, Meter reference of 0 DB	Tune 310A to second and third harmonic of input signal (for 500 kc input signal tune to second harmonic only). Allow 310A to settle down to each new tuning and assume trouble if harmonics are not less than 80 db down from reference set at input frequency	UNBALANCE OR DISTORTION in A8 Assembly, A9 Assembly, A3 Assembly, or A15 Assembly
	BFO OUTPUT AMPLITUDE		
AC VOLTMETER connected to OUTPUT	BFO, 1000 cps, 1V, OUTPUT AMPLITUDE fully clockwise	Output level less than at least 1.0V RMS	A19R5 out of adjust A19C17 out of adjust
	RECOVERED FREQUENCY OUTPUT AMPLITUDE		
a. AC VOLTMETER connected to 135 ohm resistor connected across OUTPUT	a. NORMAL, CAL, ABSOLUTE, 3000 cps, OUTPUT AMPLITUDE fully clockwise	a. Output not at least 0.25 V RMS	a. A17R10 out of adjust
b. AC VOLTMETER connected to OUTPUT (135 ohm resistor removed)	b. USB, CAL, ABSOLUTE, 3000 cps, OUTPUT AMPLITUDE fully CW, tuned for max meter indication	b. Output not at least 0.53 V RMS	b. A19C6 & C7 out of adjust
c. SAME AS Step b.	c. Same as step b, except MODE to LSB	c. Same as step b	c. A19C7 out of adjust

Table 5-3. AFC Troubleshooting

Sympton	Procedure	Indication	Conclusion
AFC will not lock properly. Meter reads about 2/3 Normal	1. Check output in NORMAL and AFC.	Output is DSBSC.* Meter sweep in AFC Output DSBSC.* Meter does not sweep	Channel B of Low-Pass Filter is defective Channel A of Low-Pass Filter is defective
AFC will not lock. Meter reads 1 volt in AFC	1. Check DC at Pin 12 of A23	Voltage changes negative Voltage changes positive	Defective A22Q1, A23Q1 short, A22Q4 open, A22Q5 short, A22Q6 short A22Q4 short, A22Q5 open, A22Q1 bad, A22Q6 open, A23Q1 open
AFC will lock on one side only. Meter reads 1 volt.	Check waveform at test point K in AFC	Frequency of Rect. waveform sweeps when 310A tuned to one side but not other of input signal	Defective phase switch A23Q2
AFC will not lock. Relay A23K1 chatters in AFC	1. Check operation in NORMAL	Sensitivity reduced in NORMAL. Frequency calibration off	A7CR1 or A7CR2 shorted
AFC will lock on one side only. Meter reading greatly reduced	1. Check for slow meter drift when dial frequency is higher than input frequency	Meter reading will increase until A23K1 energizes. Meter reading will drop and then increase again	A7CR1 or A7CR2 open
AFC will not lock. A23K1 energized continuously	1. Switch to NORMAL	Operation same as in AFC	Defective A22Q2, A23Q4 short, A23Q5 open, A23Q7 short A23K1 short
AFC will not lock. Sensitivity ok.	1. Operation ok in NORMAL	1. In AFC 310A appears to search.	Defective A22Q1
NOTE: * Double sideband suppressed carrier: Output looks like a full wave signal.			

Table 5-4. -15 Volt Supply Troubleshooting

Symptom	Procedure	Indication	Conclusion
High Output Voltage	1. Disconnect base of Q1	Output drops Output same	Q1 ok Q1 shorted
	2. Reconnect base of Q1. Measure voltage across A24CR3.	Approximately 22.6V. More than approximately 22.6v	A24CR3 ok A24CR3 open
	3. Disconnect base of Q2	Output drops Output same	Q2 ok
	4. Reconnect base Q2. Short emitter to base A24Q1	Output drops Output same	A24Q1 ok A24Q1 shorted
	5. Measure voltage across A24CR4	Approximately 6.8v More than approximately 6.8v	A24CR4 ok A24CR4 open
	6. Adjust A24R7 so base of A24Q2 goes more negative	Output remains high	A24Q2 open

Table 5-4. -15 Volt Supply Troubleshooting (Cont'd)

Sumptom	Procedure	Indication	Conclusion
Low Output Voltage	1. Measure voltage across A24CR3	Approximately 22.6v Less than approximately 22.6v	A24CR3 ok A24CR3 shorted
	2. Parallel A24R1 with 2.7K resistor	Output rises at emitter Q1 Output same as at emitter of Q1	Q1 ok Q1 open
	3. Short emitter to collector A24Q1	Output rises Output same	Q2 ok Q2 open
	4. Parallel A24R2 with 5.6K resistor	Output rises Output same	A24Q1 ok A24Q1 open
	5. Measure voltage across A24CR4	Approximately 6.8v Less than approximately 6.8v	A24CR4 ok A24CR4 shorted
	6. Measure voltage at collector of A24Q2	Approximately 6.8v (same as A24CR4)	A24Q2 shorted

Table 5-5. +15 Volt Supply Troubleshooting

Symptom	Procedure	Indication	Conclusion
High Output Voltage	1. Disconnect base of Q3	Output drops Output same	Q3 ok Q3 shorted
	2. Reconnect base of Q3 Measure voltage across A24CR13	Approximately 22.6V More than approximately 22.6v	A24CR13 ok A24CR13 open
	3. Disconnect base of Q4	Output drops Output same	Q4 ok Q4 shorted
	4. Reconnect base of Q4 Short emitter to base A24Q11	Output drops Output same	A24Q11 ok A24Q11 shorted
	5. Measure voltage across A24CR14	Approximately 6.8V More than approximately 6.8V	A24CR14 ok A24CR14 open
	6. Adjust A24R7 to base of A24Q12 goes more negative	Output remains high	A24Q12 open
Low Output Voltage	1. Measure voltage across A24CR13	Approximately 22.6V Less than approximately 22.6V	A24CR13 ok A24CR13 shorted
	2. Parallel A24R11 with 2.7K resistor	Output at emitter Q3 rises Output at emitter Q3 same	Q3 ok Q3 open
	3. Short emitter to collector A24Q11	Output rises Output same	Q4 ok Q4 open
	4. Parallel A24R12 with 5.6K	Output rises Output same	A24Q11 or A24Q11 open
	5. Measure voltage across A24CR14	Approximately 6.8V Less than approximately 6.8V	A24CR14 ok A24CR14 shorted
	6. Measure voltage at collector of A24Q12	Approximately 6.8V (same as A24CR14)	A24Q12 shorted

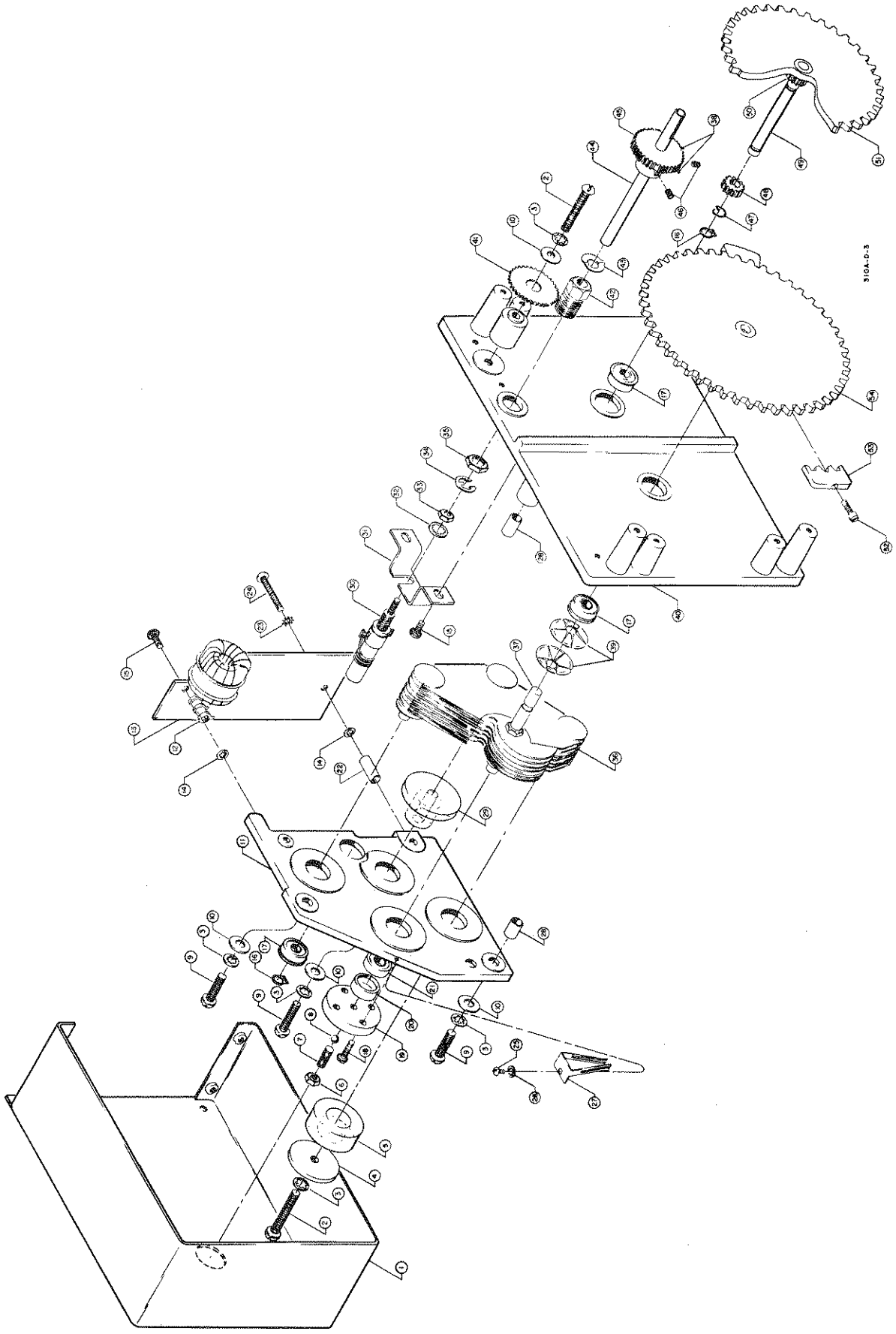


Figure 5-4. Capacitor Tuning Assembly

5-20. REPAIR.

5-21. COVER REMOVAL.

5-22. To remove top or bottom cover merely remove the four #6-32 flathead machine screws from the cover and slide back and off instrument. To remove side covers merely remove retaining screws.

5-23. CIRCUIT BOARD REPAIR.

5-24. The Model 310A uses 13 easily removable plug-in circuit boards and 5 non-plug-in circuit boards (note that these 18 boards are outlined on the schematics and the area within the outline is lightly greyed). To remove a plug-in circuit board, grasp the edge opposite the plug-in and pull with a very slight side movement. To remove the non-plug-in circuit boards, remove the retaining screws and unsolder lead connections to the board. The board stock number appears on the board, and the stock number and assembly number (A3, A8, etc.) are silkscreened on the interior metal deck to identify the circuit on a particular board. This assembly number must be added to the component designation (A3R3, A8C1, etc.) when referring to Section VI for parts replacement information.

5-25. The circuit boards used in the Model 310A are etched, plated-through type consisting of a base board and conductor but, not funneled eyelets. The conductor material is plated to the wall of the holes thus the holes are effectively extended through the board. This type of board can be soldered from either side of the board. When working on these boards uses a low heat, small tip soldering iron and a small diameter rosin core solder. Components may be removed by placing the soldering iron on the component lead on either side of the board, and pulling up on the lead. If the component is obviously damaged or faulty, clip the leads close to the component and then removing the leads. Excessive or prolonged heat can lift the circuit from the board or cause damage to components. The component lead hole should be cleaned before inserting a new lead. To remove components having multiple connections, such as potentiometers, transformers, etc, use a special tip. Refer to Table 5-1 for type of soldering tip required.

5-26. INDICATOR LIGHT REPLACEMENT.

5-27. Individual lights in the front panel illuminated indicator may be easily replaced when defective. With the power switch off, remove instrument top cover and the front panel screws at end of section of lights. This will allow the plate with the numbers and letters to slide up far enough to expose the light bulbs. Using a heavy guage wire, such as lead wire on a large capacitor, push light bulb from center rear of socket until it is loose in socket, then remove and replace.

5-28. TUNING ASSEMBLY REPAIR.

5-29. Under normal operating conditions the tuning assembly should not require maintenance. Shaft bearings are lubricated for the life of the instrument. The following procedures should be followed if replacement of tuning assembly parts becomes necessary. The tuning assembly is three assemblies in one: the LOCAL OSCILLATOR (A7 Assembly) circuit board, the frequency counter drive assembly, and the capacitor tuning assembly. A sketch of the tuning assembly is shown in Figure 5-7. An exploded view of the capacitor tuning assembly and the local oscillator assembly is shown in Figure 5-4. An exploded view of the frequency counter drive assembly is shown in Figure 5-8. Special tool, ℗ Stock No. T9138 alignment tool, is required for rotor adjustment. In addition, a hand press and plastic head hammer is required since all bearings (except the ZERO SET shaft) are pressed into casting plates. Tables 5-6 and 5-7 list parts.

5-30. REMOVAL OF ASSEMBLY.

a. Remove bottom, top, and both side covers.

b. Remove LOCAL OSCILLATOR (A7 Assembly) shield cover (see Figure 5-7). Unsolder leads connected to component side of board (yellow, violet, and two shielded, two conductor, leads).

c. Remove all front panel knobs.

d. To remove tuning assembly from instrument, the front panel and right side frame must be partially removed from instrument.

CAUTION

When removing front panel and right side frame use care not to damage instrument component parts or switch shafts.

e. When right side frame is removed sufficiently from instrument, unscrew the four tuning assembly retaining screws and remove assembly from right side frame.

Note

Before proceeding with further disassembly, determine the necessary steps from inspection of the Tuning Assembly and Figure 5-4 and 5-8.

5-31. ROTOR (STATOR) REPAIR.

a. Refer to Figure 5-4.

b. Disassemble reduction gear shaft (49) from rear casting (11).

c. Disassemble main gear (54) from rotor shaft (37).

d. Disconnect A7-Assembly (13) and clip spring (27) from rear casting (11).

e. Disconnect blue lead from A7-Assembly (13) to insulator stator (4).

f. Remove three round head screws (2) holding rear casting (11) to front casting (40).

g. Tilt tuning assembly with rear casting facing upwards (provide clearance for rotor shaft).

CAUTION

Keep clear of ZERO SET coil (30).

h. Carefully separate rear casting from front casting WITHOUT applying any twisting torque that might damage the stator or rotor.

i. Remove two centering pivots (28).

j. Disassemble the rest of the assembly as necessary, and replace any damaged parts.

k. During reassembly, mount rotor adjusting plate (19), and set rotor centering adjustment screw (7) so that rotor blades clear stator blades while pressing rotor shaft by hand against rotor adjusting plate (19). This is a preliminary adjustment (see Paragraph 5-34).

m. Reassembly is the reverse of disassembly. Rotate rotor fully clockwise and secure rotor position with masking tape across stator blades to prevent damage during reassembly.

5-32. ZERO SET ASSEMBLY REPAIR.

5-33. Zero set coil L1 (30) can be replaced without disengaging the zero set drive. If gears disengage, the proper relationship can be re-established as indicated in step b of Paragraph 5-33.

a. Unsolder white lead and grey lead from coil (refer to Figure 5-5).

b. Turn Zero Set shaft full clockwise (until stopped by gear stop). Secure this gear position by placing a piece of masking tape across the two gears.

c. Remove E-shaped retaining ring (B).

d. Remove coil bracket from casting.

e. Replace damaged coil.

f. Mount replacement coil in bracket.

Note: Insert coil fully into opening of bracket before tightening locking nut. See Figure 5-5.

g. Turn coil slug until spiral pin extends approximately 1/4 inch from coil bushing.

h. Insert coil shaft into Zero Set shaft. Spiral pin should clear the brass bushing surface by approximately 1/64 inch, with coil bracket held tightly against casting. If clearance differs greatly from 1/64 inch, turn coil shaft 1/2 turn clockwise or counterclockwise.

i. Mount coil bracket to casting.

j. Insert E-shaped retaining ring (B).

k. Remove masking tape from zero set gear assembly and turn Zero Set shaft to its counterclockwise stop. While turning Zero Set shaft check mechanical alignment of coil shaft. Check correct number of turns between the two mechanical stops (about 11-1/2 turns).

Note

Check that both stops are positively controlled by the gear drive stops and not by the coil slug. If necessary repeat steps g through k.

m. Reconnect white and gray leads to coil as shown in Figure 5-5.

5-34. TUNING ASSEMBLY MECHANICAL ALIGNMENT.

a. Loosen set screws holding main gear to main gear shaft.

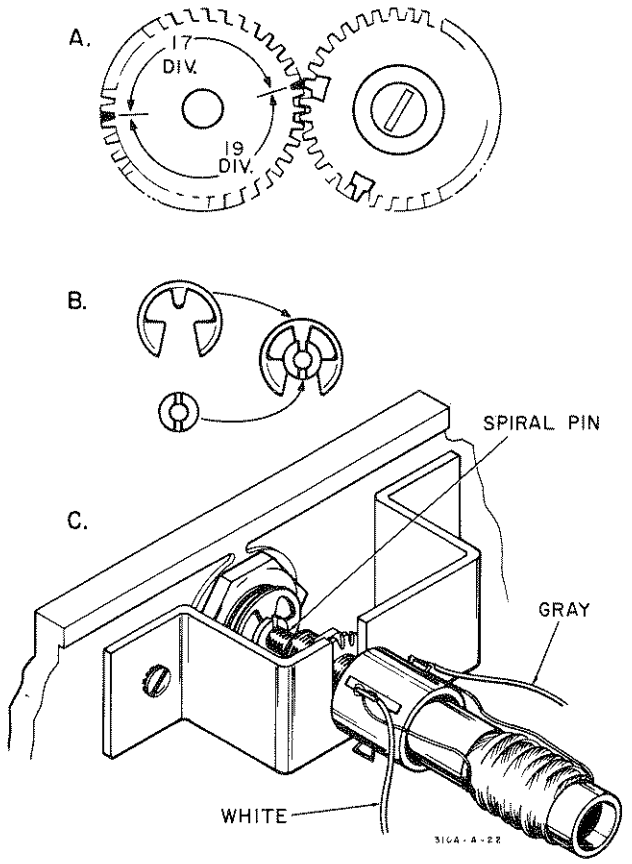


Figure 5-5. Zero Set Assembly

b. Turn gear assembly against clockwise stop. Set frequency counter at 9950 and tighten one set screw in each counter drive miter gear. Next, turn gear assembly against counter-clockwise stop. Counter should now read 1550 +.5, -0. If necessary, reset counter at high end to read 1550 and go back to low end to check for 9950 -.5, +0. reading. When counter has been set correctly, tighten all set screws in miter gears (items number 15 and 12 Figure 5-8).

c. Check alignment of miter gears. The two miter gears must run together as smoothly as possible with a minimum of noise.

d. Set frequency counter to read 1490. Insert alignment tool (℗ Stock No. T9138) into the .281 inch diameter holes of the two castings. Remove tape from rotor and rotate rotor until the flat edge of the plates rests gently against the alignment tool. Refer to Figure 5-6.

e. Holding rotor against tool with counter at 1490, tighten set screws in main gear.

f. Assemble shield (1 - Figure 5-4) to tuner.

5-35. TUNING ASSEMBLY ELECTRICAL TUNING.

5-36. The pre-installation tuning consists of centering the rotor with respect to the stator, adjusting L1 for the correct range of ZERO SET and aligning the assembly for the correct frequency range. Refer to Figure 5-7 throughout procedure.

a. Connect a lead or a short as described to the following points on the circuit board which is part of the tuning assembly:

(1) Connect a lead to point labeled YEL.

(2) Connect a lead to point labeled VIO.

(3) Connect a short between point labeled TO AFC and point beside this point which is labeled with a ground symbol.

(4) Connect a shielded two conductor coaxial cable, one lead to point labeled OUT and one lead to point beside OUT which is labeled with ground symbol.

b. Place A7 shield cover in place with three leads passing through cover as shown in Figure 5-7.

c. With 310A turned off, make the following clip-lead connections:

(1) YEL lead to yellow lead which normally connects to tuning assembly circuit board.

(2) VIO lead to violet lead which normally connects to circuit board.

(3) Center conductor of shielded lead to shielded lead from pin 14 of A8.

(4) Shield of shielded lead to shield of shielded lead from pin 14 of A8.

d. Connect DC Voltmeter positive lead to yellow lead. Connect meter common lead to chassis ground.

e. Connect vertical input of Oscilloscope to test point B of A8 with X10 Voltage Divider Probe.

f. Adjust A7C5 to mid-range.

g. Turn 310A on. Oscilloscope presentation should be a sine wave whose peak-to-peak amplitude is approximately 65 to 70 mv.

h. Disconnect X10 Voltage Divider Probe from Oscilloscope and connect it to Frequency Center. Set frequency dial to 0000.

i. Remove plug button and adjust for maximum Counter reading with set screw. TIGHTEN lock nut: Frequency Counter reading must remain approximately maximum.

j. Replace plug botton. Turn L1 adjust from one stop to the other and adjust for mid-frequency reading. This should be about 5-1/2 turns from either stop.

k. Using non-conducting tool with slot in end (refer to item no. 9, Table 5-1) adjust A7L2 for Frequency Counter reading of 3000000 ±100 cps.

m. Turn frequency dial to 1500.

n. Note difference between Frequency Counter reading and 4500000 cps. If Frequency Counter reading is high, adjust A7C5 (with non-conducting tool) for a Frequency Counter reading which is equal to 4500000 -0.8 times (the difference between 4500000 and the Frequency Counter reading). If the Frequency Counter reading is low, adjust A7C5 for a Frequency Counter reading which is equal to 4500000 +0.8 times (the difference between 4500000 and the Frequency Counter reading).

p. If A7C5 doesn't have enough range, A7C4 must be changed to either an 18, 24, or 27 pf capacitor.

q. If A7C4 had to be changed, allow circuit components 10 to 15 minutes to return to room temperature before proceeding. Then repeat steps e through p before proceeding with this procedure.

r. Return frequency dial to 0000 and adjust A7L2 for a Frequency Counter reading of 3000000 ±50cps.

s. Return frequency dial to 1500. Frequency Counter reading should be 4500000 ±15000 cps.

t. Check oscillator frequencies at dial settings of 0001, 0010, 0050, 0100, 0150, 0200, 0300, 0500, 0700, 0900, 1100, 1300, and 1500. Specification: Frequency Counter reading must be equal to 3000000 cps ±(1% +300 cps) plus dial reading in kilocycles.

u. Corrections for tracking errors can be made at dial settings of 1500 with A7C5. If corrections are made, return frequency dial to 0000 and adjust A7L2 for 3000000 ±50 cps. Repeat step t.

v. Disconnect X10 probe from Frequency Counter and connect to Oscilloscope. Tune frequency dial from 0000 to 1500 and note peak-to-peak amplitude of Oscilloscope wafeform. Peak-to-peak amplitude of the waveform should not vary by more than 10%.

w. Check AGC control voltage variation by tuning frequency dial from 0000 to 1500 and noting DC Voltmeter reading. The AGC control voltage as measured by the DC Voltmeter should not be less than 3.7V or greater than 8 V.

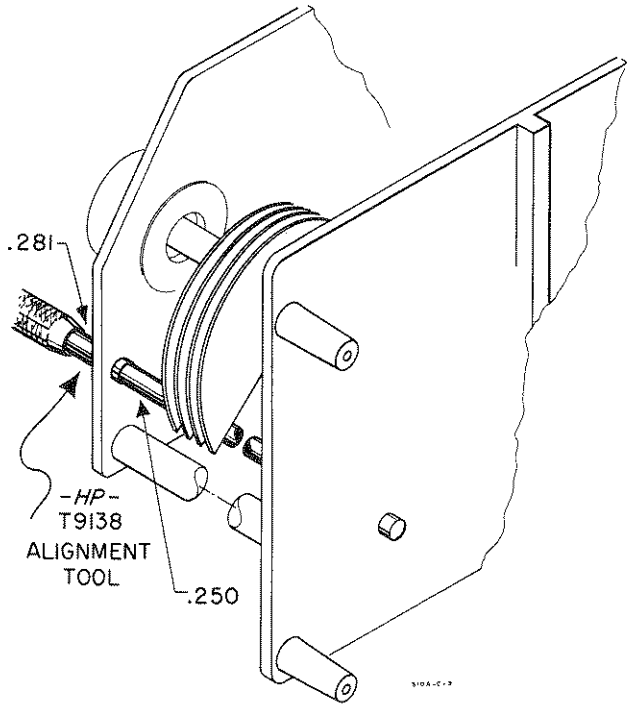


Figure 5-6. Rotor Alignment

5-37. REINSTALLING OF ASSEMBLY.

a. Disconnect all clip lead connections.

b. Fasten assembly to 310A right side frame.

c. Carefully reconnect right side frame and front cover of 310A. Use care not to damage any shafts or instrument parts during re-assembly of instrument.

d. Disconnect leads and the short from component side of the A7 circuit board and connect proper instrument leads to board. Yellow lead to YEL, violet lead to VIO, shielded lead from pin 14 of A8 to OUT and shield to ground point, shielded lead from MODE switch to TO AFC and shield to ground point.

e. Replace front panel knobs.

f. Replace A7 shield cover.

5-38. SWITCH ASSEMBLIES.

5-39. There are five switch assemblies in the 310A:

a. A1 Assembly, Input Attenuator (see Figures 5-9, 5-15 and 5-26);

b. A6 Assembly, IF Attenuator (see Figures 5-10, 5-17 and 5-26);

c. A10 Assembly, Bandwidth Selector (see Figures 5-11, 5-17 and 5-19);

d. A16 Assembly, RF Attenuator (see Figures 5-12 and 5-21);

e. A18 Assembly, Mode Selector (see Figures 5-13 and 5-21). Since the schematic diagrams in this manual fold completely out of the manual, the switch assembly identification pictures and the schematic diagrams are easily compared to the actual instrument switches.

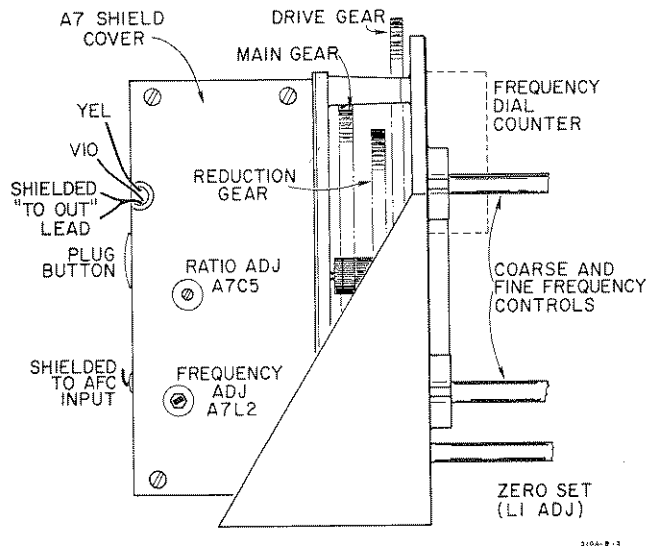


Figure 5-7. Tuning Assembly Adjustment Location

5-40. ADJUSTMENTS.

5-41. POWER SUPPLY ADJUST.

a. Measure the voltage at pin 14 of A21. It should be approximately -22 vdc. This voltage is not critical and may vary by as much as 2 or 3 volts.

b. Measure dc voltage between pin 12 of A24 and ground. It should be -15 ±0.5 volts. Adjust A24R7 if necessary.

c. Measure voltage between pin 1 of A24 and ground. It should be +15 ±0.5 volts. Adjust A24R17 if necessary. The 15 volts supplies are independent of each other.

5-42. CALIBRATOR CIRCUIT ADJUST.

a. Turn instrument on and place RANGE switch to CAL.

b. Use an oscilloscope and 10:1 divider to observe the waveform at the collector of A3Q2. It should be a square wave with about 60/40 symmetry and a minimum amplitude of 6.5 volts peak-to-peak.

c. Place an Oscilloscope probe to the positive side of C3 (blue lead to filter A4). Adjust R1, Cal. Level Adj., for approximately 60 mv peak-to-peak voltage.

5-43. LOCAL OSCILLATOR ADJUST.

a. Refer to Figures 5-3 and 5-7. Remove instrument bottom cover and place instrument on side.

b. Connect Voltage Divider Probe from Frequency Counter to test point B on A8.

c. Set ZERO SET to its mechanical mid-point. Set FREQUENCY (KC) to 0000.

d. Frequency Counter should read 3000000 ±100 cps. If not, adjust A7L2.

e. Turn FREQUENCY (KC) to 1500. Frequency Counter should read 4500000 ±15000 cps. If not, adjust A7C5 as follows:

(1) If Frequency Counter reading is high, adjust A7C5 for a reading which is equal to 4500000 cps minus 0.8 times Frequency Counter reading minus 4500000 cps.

(2) If Frequency Counter reading is low, adjust A7C5 for a reading which is equal to 4500000 cps plus 0.8 times 4500000 cps minus Frequency Counter reading.

Note

If A7C5 does not have enough range to properly adjust frequency reading, then the value of A7C4 must be changed (suggested values for A7C4 are 18, 24, or 27 pf).

f. If A7C4 is changed, allow circuit to return to room temperature before attempting any further adjustment or measurement.

g. Repeat steps d and e.

h. Set FREQUENCY (KC) to 0000. Frequency Counter must read 3000000 ±50 cps. If not, adjust A7L2.

i. Return FREQUENCY (KC) to 1500. Frequency Counter must read 4500000 ±15000 cps. If not adjust A7C5.

j. Repeat steps h and i until no adjust is necessary.

k. Check oscillator frequencies at FREQUENCY (KC) settings of 0001, 0010, 0050, 0100, 0150, 0200, 0300, 0500, 0750, 0900, 1100, 1300, and 1500. Specification: Frequency Counter readings must be equal to 3000000 cps plus dial reading in kilocycles ±(1% +300 cps).

m. Corrections for errors must be made at dial setting of 1500 with A7C5.

n. Observe the waveform at test point B on A8 with an Oscilloscope. The waveform should remain essentially sinusoidal over the tuning range of the instrument.

p. Monitor the voltage at test point B on A8 with a high frequency AC Voltmeter. The amplitude should be at least 2.3 volts rms at 4.5 Mc. The variation in voltage should be less than ±0.3 volts over the frequency range.

5-44. BFO ADJUST.

a. With instrument turned on set MODE to LSB.

b. Connect an Oscilloscope voltage divider probe to test point H on A19. Set BFO Level Adj., A19R5 fully counterclockwise.

c. Adjust A19C3 for minimum Oscillator turn-on time as the MODE is switched from AM to LSB. Switch to USB and BFO and check that oscillation occurs.

d. Disconnect probe from Oscilloscope and connect to Frequency Counter. Monitor the frequency at test point H. Switch MODE to BFO. Note the frequency as f_o.

e. Switch to LSB. Adjust A19C7 to (f_o +1450 cps) ±50 cps.

f. Switch to USB. Adjust A19C6 to (f_o -1450 cps) ±50 cps.

g. Repeat steps e and f for the proper frequencies.

h. Set MODE to BFO. Set AMPLITUDE control fully clockwise. Monitor the OUTPUT voltage with an AC voltmeter. Adjust A19R5 for a reading of 1.1 ±0.02 volts.

5-45. INITAL CRYSTAL OSCILLATOR ADJUST.

a. Connect Oscilloscope Probe to A11C4.

b. Adjust A11C1 and A11C4 for maximum amplitude.

c. Remove Oscilloscope and connect AC Voltmeter to A11C4. Adjust A11R4 for 6.5V RMS.

d. Remove AC Voltmeter.

5-46. FIRST MIXER PAIR ADJUST.

a. Connect Oscilloscope vertical input to test point D on A13. Connect Oscilloscope horizontal input to test point D on A14. Set Oscilloscope sensitivity to 100 mv/cm on each channel.

CAUTION

DO NOT GROUND TEST POINT D. Grounding testpoint D will distroy transistor A13Q6 or A14Q6.

b. Set 310A RANGE to CAL and BANDWIDTH to 1000 cps and FREQUENCY (KC) for maximum meter indication (approximately 100 Kc).

c. Adjust R1 (CAL level adjust) for a reasonable signal amplitude on Oscilloscope (refer to Figure 5-3).

d. Shunt A9C11 and A9C16 each with an 18 ohm resistor. Repeat step c.

e. Adjust A9C13 and A9C18 for symmetrical Lissajous patterns around both horizontal and vertical axes.

f. Connect an RF Voltmeter to A11C4. Adjust A11C1 and A11C4 for maximum indication on the Voltmeter (this checks the adjustment of these two capacitors).

g. Adjust A11R4 to obtain 6.5 volts rms on the RF Voltmeter.

h. Tune A9C11 and A9C16 for maximum circle amplitude on the Oscilloscope.

5-47. ACTIVE FILTER OSCILLATOR.

a. Connect Frequency Counter to A11C4.

b. Adjust A11C3 to (f_o +35 cps) ±5 cps (f_o from paragraph 5-43).

5-48. SECOND MIXER PAIR.

a. Set RANGE to CAL, MODE to BFO, OUTPUT fully clockwise.

b. Connect Oscilloscope to OUTPUT.

c. Adjust A19R5 for maximum output amplitude.

d. Tune A19C7 until Oscilloscope indicates maximum output.

e. Switch MODE to NORMAL. Adjust A17R10 for an output amplitude of approximately 1.5V peak-to-peak.

f. Decrease the Oscilloscope sweep speed to observe the "summing" error.

Note

The "summing" error appears as low frequency signal riding on the 100-kc OUTPUT.

g. Adjust A15C2 and A15C7 and A15R6 for minimum "summing" error on OUTPUT signal.

5-49 ACTIVE FILTER MIXER CARRIER BALANCE.

a. Short test points C on A13 and A14 to ground.

b. Set MODE to NORMAL, and RANGE to -60.

c. Alternately adjust A15C3 and A15C8 for a minimum meter indication (less than 2% of full scale). Remove shorts.

5-50. OUTPUT.

a. Set RANGE to CAL, MODE to NORMAL, OUTPUT amplitude CW.

b. Connect Oscilloscope to OUTPUT.

c. Adjust OUTPUT amplitude for approximately 1.5V peak-to-peak.

d. Adjust A15R6 for minimum "summing" error as indicated on Oscilloscope.

e. Repeat SECOND MIXER PAIR adjustment if necessary for minimum "summing" error.

5-51. BANDWIDTH FLATNESS.

a. Recheck carrier balance as in Paragraph 5-48.

b. Set RANGE to CAL, MODE to NORMAL, tune the FREQUENCY dial through the 100-kc calibrate signal and observe the response characteristics of the filters as indicated on the front panel meter. Check all three bandwidth positions. Switch to RELATIVE and set REF ADJUST if needed to obtain on-scale meter indications.

c. Adjust symmetry of the bandpass flat top with A9C7.

d. Tune A8C5 for maximum meter reading.

5-52. INPUT MIXER CARRIER BALANCE.

a. Set MODE to NORMAL, BANDWIDTH to 200 ∿, RANGE to give an on-scale indication, FREQUENCY to 0000, ZERO SET for maximum meter indication.

b. Balance the mixer for a minimum reading by alternately adjusting A8C4 and A8R9. Temporarily install the metal shield to insure a correct null when adjusting A8C4.

5-53. 3-DB BANDWIDTH CHECKS.

a. Set RANGE to 0 db, MODE to NORMAL, MAX INPUT VOLTAGE to 10 or 3, BANDWIDTH to 200 cps.

b. Connect Oscillator to INPUT. Set Oscillator to 10 kc as monitored on an electronic counter.

c. Turn FREQUENCY dial for maximum indication.

d. Tune Oscillator frequency ±108 cps attenuation should be -3 db.

e. Set BANDWIDTH to 1000 cps. Tune Oscillator ±550 cps attenuation should be -3 db.

f. Set BANDWIDTH to 3000 cps. Tune Oscillator ±1550 cps attenuation should be -3 db.

5-54. OUTPUT AMPLITUDE ADJUST.

a. Set MODE to BFO and OUTPUT AMPLITUDE fully clockwise.

b. Connect an RF Voltmeter, such as the ℌ Model 400H, to the OUTPUT.

c. Adjust A19C17 for maximum output.

d. Adjust A19R5 for a reading of 1.0 ±0.02V RMS.

e. Switch MODE to NORMAL, RANGE to CAL, BANDWIDTH to 3000 cps, ABSOLUTE-RELATIVE to ABSOLUTE. and tune FREQUENCY (KC) for maximum 310A meter indication. Adjust CAL for meter indication of 1.0.

f. Adjust A17R10 for a reading of 0.54 ±0.02 on the RF Voltmeter.

g. Replace Voltmeter with Oscilloscope.

h. Tune for maximum 310A meter indication. Switch MODE to LSB.

i. The OUTPUT signal should be about 1.5 volts peak-to-peak at a frequency of about 1.5 kc.

j. Switch MODE to USB. The output should be the same as measured in step i.

5-55. AFC-AGC LEVEL ADJUST.

a. Set RANGE to 0 db, MODE to NORMAL, MAX INPUT VOLTAGE to 1V, BANDWIDTH to 3000 cps.

b. Connect an Oscillator tuned to 10 kc to the INPUT. Tune the FREQUENCY dial for maximum indication on the meter. Adjust meter reading to full scale with the level control on the Oscillator.

c. Overload the 310A by changing the MAX INPUT VOLTAGE to .3V.

d. Connect an Oscilloscope to junction of A22R22 and and A22R24.

e. With Oscilloscope set to 1 ms/cm (sweep time) and 0.5 v/cm (sensitivity) and the 10X Attenuator Oscilloscope probe connected to junction of A22R22 and A22R24, adjust A22R16 so that the peaks of the half-wave rectifier signal are just clipped.

5-56. AFC TRIGGER LEVEL ADJUST.

a. Set RANGE to 0 db, MODE to NORMAL, MAX INPUT VOLTAGE to 1V, BANDWIDTH to 3000 cps.

b. Connect an Oscillator tuned to 10 kc to the INPUT. Tune the FREQUENCY dial for maximum indication on the meter. Adjust output amplitude control of the Oscillator for a full scale 310A meter reading.

c. Connect an Oscilloscope to test point K on A22 and a DC VTVM (+3V scale) to the junction of A22R19, R20, R21, and R22.

d. Note Oscilloscope presentation, on either side of the center frequency point it is an unsymmetrical square wave. Tune the FREQUENCY (KC) control to one side of center frequency. Adjust A22R18 for a flop of the square wave and record Voltmeter reading. Tune the FREQUENCY (KC) control to the other side of center frequency. Adjust A22R18 for a flip of square square wave. Record Voltmeter reading.

e. Add the two voltage readings of step d together and divide by two to find the average value. Adjust A22R18 to this average value. For example: if the first reading of step d was 3.0 and the second reading was 1.0, set A22R18 for a voltmeter reading of 2.0.

5-57. OUTPUT LEVEL ADJUST.

a. Set RANGE to 0 db, MODE to NORMAL, MAX INPUT VOLTAGE to 1V, BANDWIDTH to 3000 cps.

b. Connect an Oscillator tuned to 10 kc, to the INPUT. Tune the FREQUENCY dial for maximum indication on the meter.

c. Connect DC VTVM to test point L on A23 and an electronic counter to the collector of A22Q1. For Specification H02-310A instruments, capacitor A22C16 has an additional capacitor of equal value connected in parallel with it. Disconnect one lead of either capacitor before performing step d (if this is not done then the frequency measured in step d must be 27.5 cps instead of 55 cps).

d. Decrease the input frequency from the Oscillator until the meter reading starts to drop off. Staying on the same side of the bandpass, increase the frequency until the counter reads 55 cps.

e. Adjust A23R20 so that VTVM reads -0.5V.

5-58. AFC OUTPUT CUTOFF ADJUST.

a. Set RANGE to 0 db, MODE to NORMAL, MAX INPUT VOLTAGE to 1V, BANDWIDTH to 3000 cps.

b. Connect an Oscillator tuned to 10 kc to the INPUT. Tune the FREQUENCY dial for maximum indication on the meter.

c. Set A23R46 full CW.

d. Connect a DC VTVM to C20 (white-green wire).

e. Change the MODE switch to AFC.

f. Decrease the input frequency from the Oscillator until the VTVM reads -0.5V.

g. Slowly adjust A23R46 CCW until the VTVM reading suddenly drops.

5-59. AFC HOLD-OFF LEVEL ADJUST.

a. Set RANGE to 0 db, MODE to NORMAL, BANDWIDTH to 1000 cps, MAX INPUT VOLTAGE to 1V.

b. Connect an Oscillator tuned to 10 kc through an attenuator to INPUT.

c. Tune FREQUENCY dial for maximum meter indication.

d. Attenuate input by 60 db. Set RANGE to -60 db.

e. Tune FREQUENCY dial just above input frequency. Adjust A23R27 so that signal is pulled in at 25% of full scale.

5-60. INITIAL INPUT ATTENUATOR ADJUST.

a. Set RANGE to -30 db, BANDWIDTH to 1000 cps, MODE to NORMAL, MAX INPUT VOLTAGE to 0.01, ABSOLUTE-RELATIVE to ABSOLUTE.

b. Connect Frequency Response Set for 0.3 millivolts at 1 Mc. Tune FREQUENCY (KC) for maximum 310A meter indication and switch MODE to AFC.

c. Adjust input signal amplitude for 310A meter indication of 0.96.

d. Roughly preset the adjustment of the input attenuator compensating capacitors as indicated below to give the same meter reading on each range as INPUT signal is increased in 10-db steps.

Max Input Voltage	Freq Resp Set	Capacitor
.01	- - -	No adjustment
.03	.001	A2C1
.1	.003	A2C2
.3	.01	A2C3
1	.03	A2C4
3	.1	A2C5
10	.3	A1C6
30	1	A1C6
100	3	A1C6

e. Disconnect Frequency Response Set and replace with Osciolator connected to INPUT through Precision Attenuator, such as ℍ Model 355B/D which has been calibrated to an accuracy of ±0.5% from 0 to -80 db at 10 kc.

f. Set RANGE to -30 db, BANDWIDTH to 1000 cps, MODE TO NORMAL, and tune FREQUENCY (KC) for maximum meter indication with the MAX INPUT VOLTAGE switch at .01 and the Precision Attenuator at -80 db.

g. Switch MODE to AFC and adjust input signal amplitude for 310A meter indication of 0.96.

h. Switch MAX INPUT VOLTAGE from .01 to 100 and as indicated below record + and - variation from 0.96 reference meter reading on each range as attenuation is decreased in 10-db steps.

Max Input Voltage	Attenuation (DB)	Max Meter Variation 0.99	0.96	0.93
.01	80		0	
.03	70			
.1	60			
.3	50			
1	40			
3	30			
10	20			
30	10			
100	0			

j. If the maximum meter variation exceeds the limits specified (0.99 to 0.93), the most common cause is ground currents flowing in the MAX INPUT VOLTAGE or RANGE switch assemblies. Ground leads on the switch assemblies should not contact on the switch. Check resistor values, a bad resistor will cause attenuation error. Repeat step h and be sure attenuation is correct before proceeding.

j. Set RANGE to 0 db, MAX INPUT VOLTAGE to 0.3. Set Precision Attenuator to -80 db and adjust input signal amplitude for 310A meter indication of 0.96.

k. Switch RANGE from 0 to -60 and as indicated belo below record + and - variation from 0.96 reference meter reading on each range as attenuation is decreased in 10-db steps.

Range	Attenuation (DB)	Max Meter Variation 0.99	0.96	0.93
0	80		0	
-10	70			
-20	60			
-30	50			
-40	40			
-50	30			
-60	20			

m. If maximum meter variation exceeds the limits specified (0.99 to 0.93), the cause is ground currents flowing in the MAX INPUT VOLTAGE or RANGE switch assemblies or bad resistors. Ground currents are usually caused by contact ON THE SWITCH of ground leads. If excessive error is noted and corrected, repeat entire procedure.

5-61. FINAL INPUT ATTENUATOR ADJUST.

a. Connect Oscillator to input of Frequency Response Set.

b. Connect output of Frequency Response Set to INPUT of 310A.

c. Set Oscillator to 10 kc and set 310 as follows:

RANGE to -30 db, MAX INPUT VOLTAGE to .01 ABSOLUTE-RELATIVE to RELATIVE, MODE to NORMAL, and FREQUENCY (KC) tuned for maximum meter indication.

d. Switch MODE to AFC and adjust amplitude of input signal for 0.96 meter indication. Establish a reference on Frequency Response Set meter.

e. Switch MAX INPUT VOLTAGE switch from .01 to 100 and switch Frequency Response Set attenuator over same range (the reference set on the Frequency Response Set meter must be maintained throughout check). Record 310A meter readings on each step of the MAX INPUT VOLTAGE switch: Record 310A meter readings.

f. Disconnect Oscillator from Frequency Response Set and tune for 0.3 millivolts at 1 Mc.

g. Set 310A RANGE to -30 db, BANDWIDTH to 1000 cps, MODE to NORMAL, MAX INPUT VOLTAGE to .01.

h. Tune FREQUENCY (KC) for maximum meter indication and switch MODE to AFC.

i. Adjust input signal amplitude for 310A meter indication of 0.96.

j. Set and maintain the same reference on the Frequency Response Set meter as in step d, above.

k. Adjust the capacitors to give the same meter reading on each range except as indicated below.

m. Using the Oscillator at 100 kc, repeat steps g through j at frequencies of 100 kc, 400 kc, 600 kc, and 1.5 Mc. Maximum deviation on each range should not exceed ±0.6. If error is excessive at any setting, repeat step k and compensate for attenuator errors by changing capacitor settings.

5-62. FINAL CALIBRATOR ADJUSTMENT.

a. Set RANGE to 0 DB, MAX INPUT VOLTAGE to .01, MODE to NORMAL, BANDWIDTH to 1000 ∿, FREQUENCY to 0100.

b. Connect Oscillator, tuned to 100 kc, to 310A INPUT. Tune Oscillator to obtain indication of 310A. Switch MODE to AFC.

c. Connect AC VTVM to INPUT terminals. Adjust Oscillator to obtain 9.6 mv.

d. Adjust 310A CAL to give 9.6 mv.

e. Switch RANGE to CAL and MODE to NORMAL.

f. Adjust A3C4 for maximum 310A reading.

g. Adjust R1 for full scale meter reading (1.0).

Max Input Voltage	Frequency Response Set Settings	Adjust to Step E Reading Plus	Capacitor Adjust
.01	- - -	- - -	No Adjustment
.03	.0001	+.01	A2C1
.1	.0003	+.01	A2C2
.3	.01	+.005	A2C3
1	.03	- - -	A2C4
3	.1	- - -	A2C5
10,	.3	+.02, -.00	A1C6
30	1	+.02, -.00	A1C6
100	3	+.02, -.00	A1C6

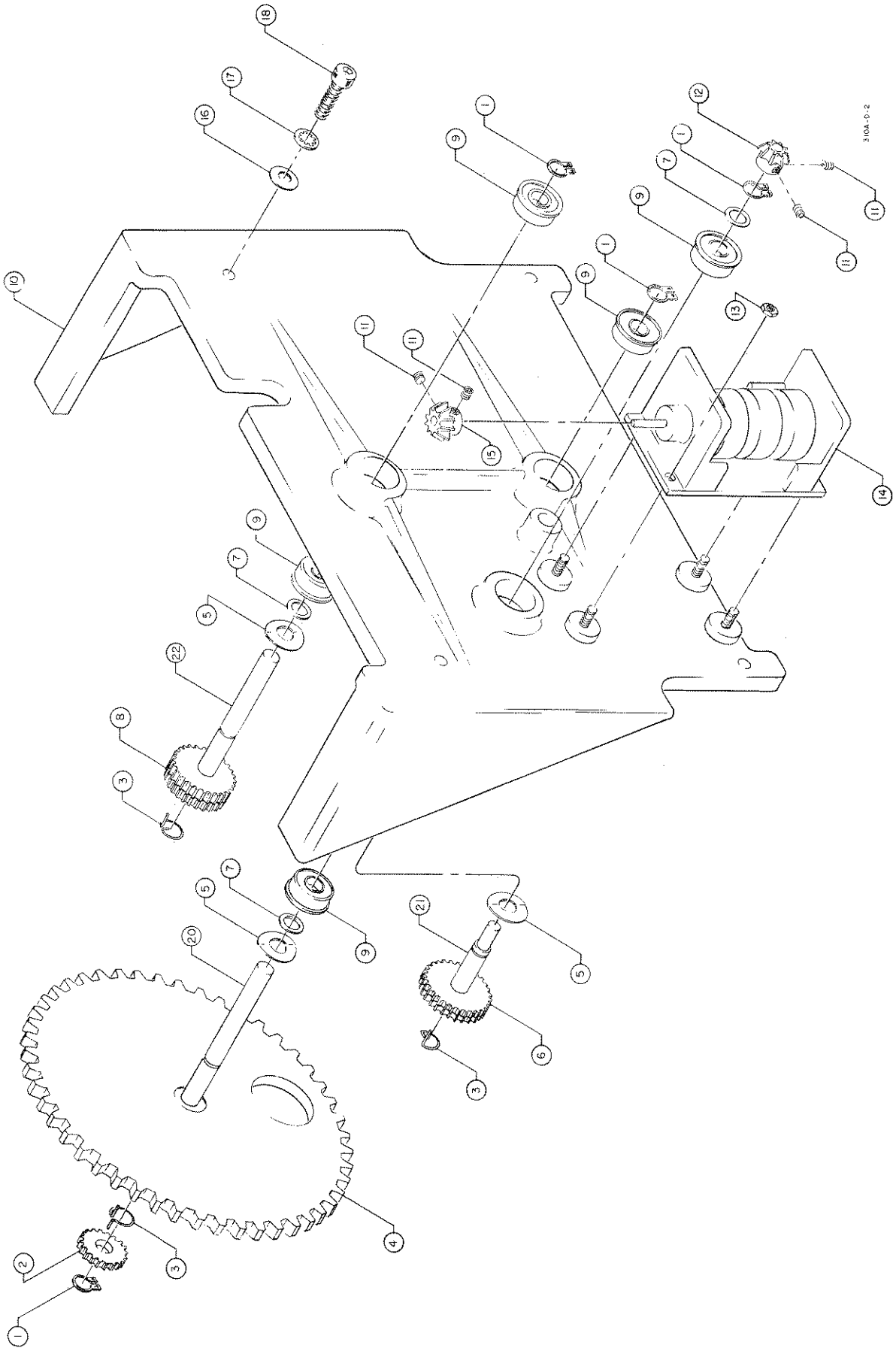


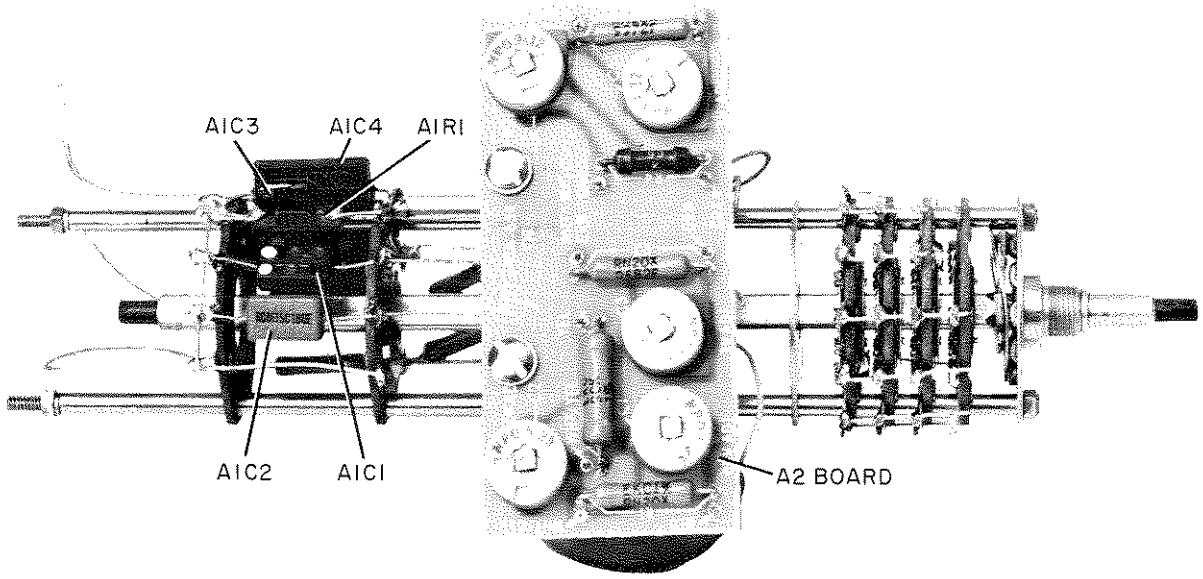
Figure 5-8. Frequency Counter Drive Assembly

Table 5-6. Tuning Assembly Parts Identification

Figure No.	Item No.	Description	Stock No.
5-4	1	Shield, capacitor	302-55E
	2	Machine screw, 10-32 x 1-1/4 in	- - -
	3	Washer #10 int lock	- - -
	4	Washer stator clamp	302A-88B
	5	Washer insulating	302A-88A
	6	Lock nut	2950-0032
	7	Set screw	3010-0025
	8	Ball bearing 1/8 in diameter	1410-0005
	9	Machine screw, 10-32 x 3/4 in	- - -
	10	Washer #10 flat	- - -
	11	Rear casting	302A-82A
	12	Coil - A7L2	
	13	A7 Local Oscillator Board	
	14	Washer #6 int lock	- - -
	15	Machine screw, 6-32 x 3/8 in (with lock washer)	- - -
	16	Retaining ring	0510-0005
	17	Bearing 1/4 in (with flange)	1410-0015
	18	Machine screw, G-32 x 1/2 in (with lock washer)	- - -
	19	Plate, rotor adjust	302A-82F
	20	Slider, rotor adjust	302A-82G
	21	Bearing 1/4 in diameter	1410-0004
	22	Spacer, 5/8 in length	0380-0010
	23	Washer #6 ext lock	- - -
	24	Machine screw 6-32 x 1 in	- - -
	25	Machine screw 4-40 x 3/16 in	- - -
	26	Washer #4 int lock	- - -
	27	Clip spring	1400-0108
	28	Spacer, 0.484 in length	0380-0035
	29	Insulator, stator	302A-88E
	30	Zero set coil - L1	
	31	Bracket, zero set	302A-12H
	32	Washer (1/4 in diameter) int lock	- - -
	33	Machine screw 1/4-28 x 3/8 in	- - -
	34	E ring 1/4 in diameter	0510-0083
	35	Hex nut 1/2-32	0590-0038
	36	Stator assembly	302A-7A
	37	Rotor assembly, variable	302A-7E
	38	Pin drive	1480-0058
	39	Washer, spring	302A-88D
	40	Front casting	302A-L-312
	41	Gear, off set tooth	G-24C-8
	42	Bushing	302A-17D
	43	Washer, spring	M-29A
	44	Shaft, stop gear	310A-32F
	45	Gear, stop	628A-36A-6
	46	Set screw 8-32 x 3/16 in	- - -
	47	Spring, gear loading	1460-0054
	48	Gear B, loading	310A-24H
	49	Shaft, reduction gear	310A-37A
	50	Pinion, reduction gear	310A-24A
	51	Gear, reduction	310A-24G
	52	Machine screw 4-40 x 3/8 in fillister head	- - -
	53	Stop, main gear	302A-113A
	54	Gear, main	310A-24J

Table 5-7. Counter Drive Parts Identification

Figure No.	Item No.	Description	Stock No.
5-8	1	Retaining ring	0510-0005
	2	Gear C, loading	310A-24D
	3	Spring, torsion	1460-0105
	4	Gear, drive	310A-24C
	5	Washer, spring	M-29A
	66	Gear D, loading	310A-24F
	7	Washer, #10 flat	3050-0002
	8	Pinion D	310A-24E
	9	Bearing (with flange)	1410-0015
	10	Front plate	310A-20A
	11	Set screw, G-32 x 1/8 in	3030-0022
	12	Gear, miter	1430-0036
	13	Hex nut, 6-32	2420-0003
	14	Counter	1140-0011
	15	Gear, miter	1430-0037
	16	Washer, #10 flat	3050-0002
	17	Washer, #10 int lock	2190-0011
	18	Screw, cap 10-32 x 3/4 in	3030-0035



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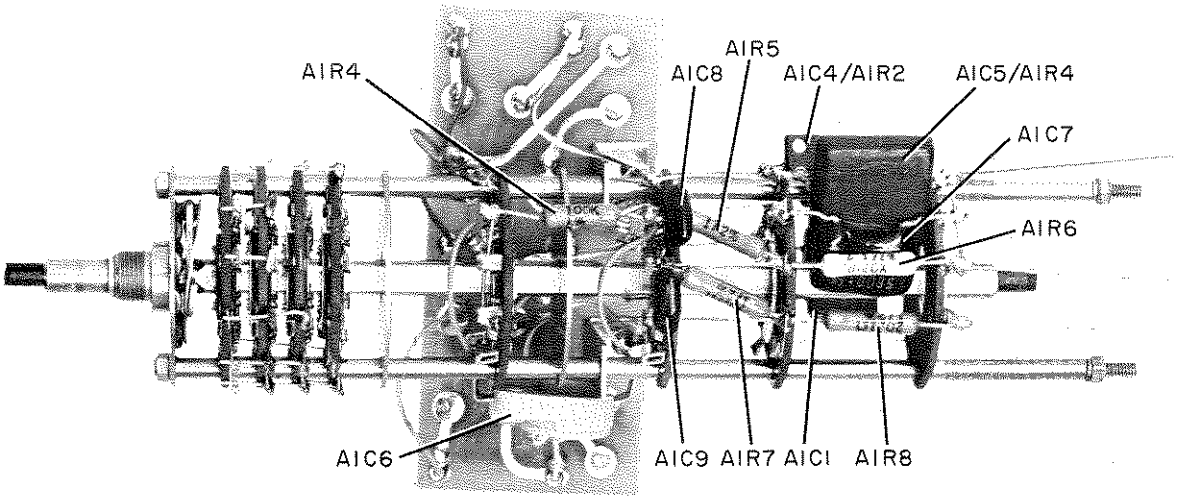

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Figure 5-9. Input Attenuator (Max Input Voltage SW)

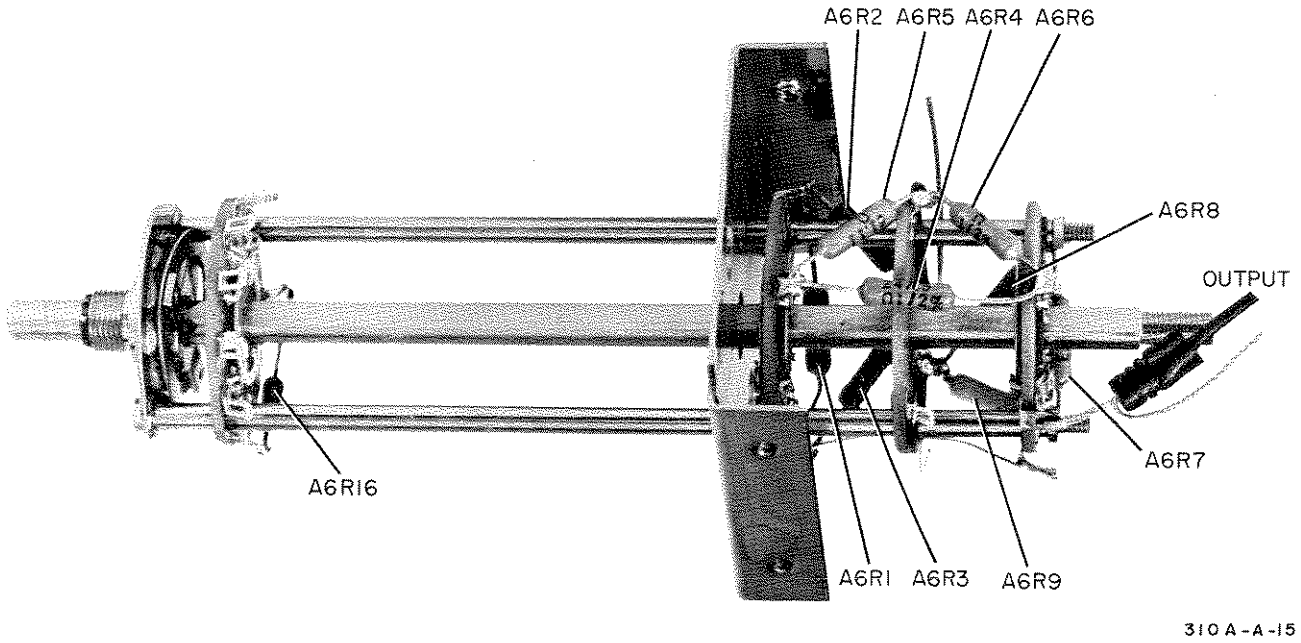
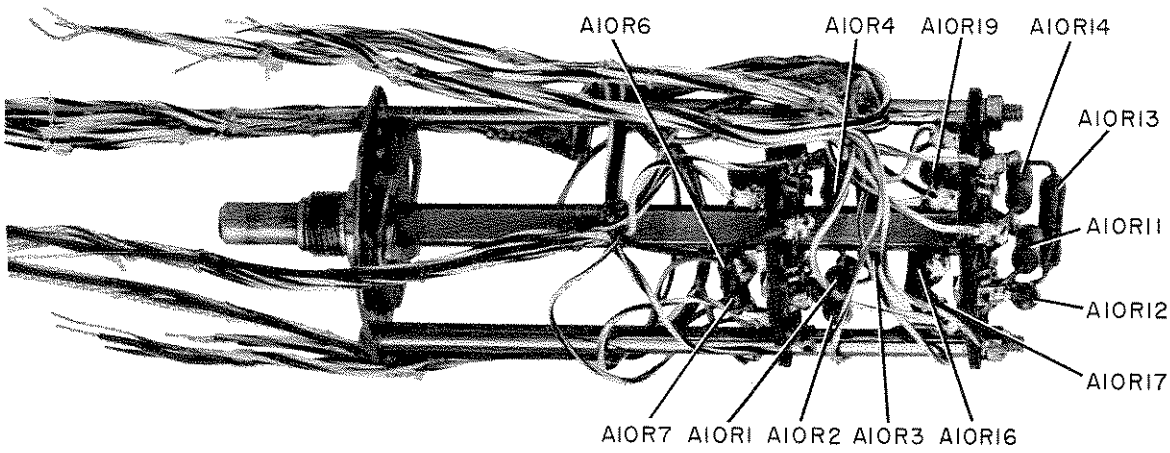


Figure 5-10. IF Attenuator (Half of Range SW)



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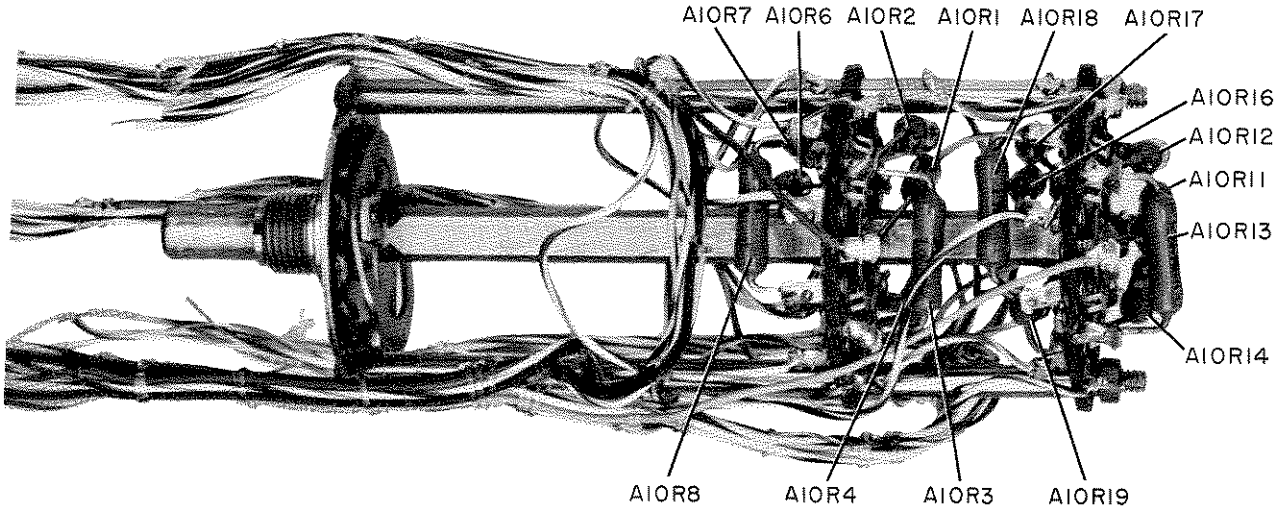

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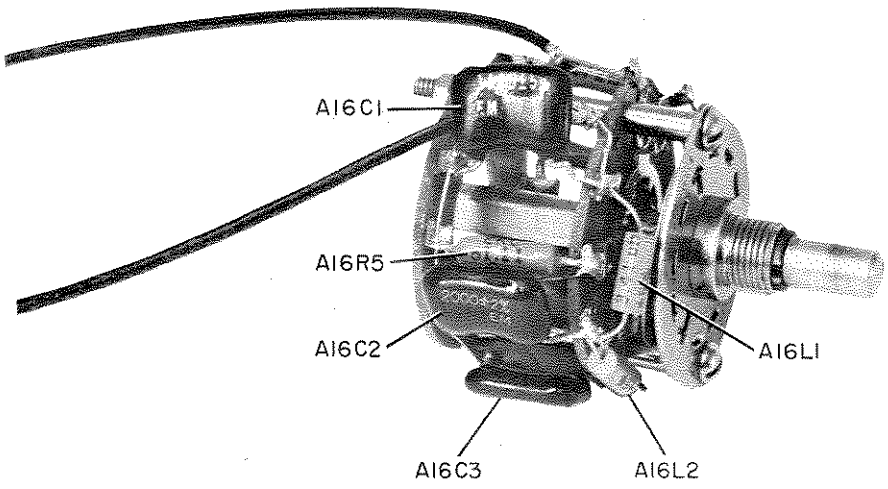
Figure 5-11. Bandwidth Selector (Bandwidth SW)



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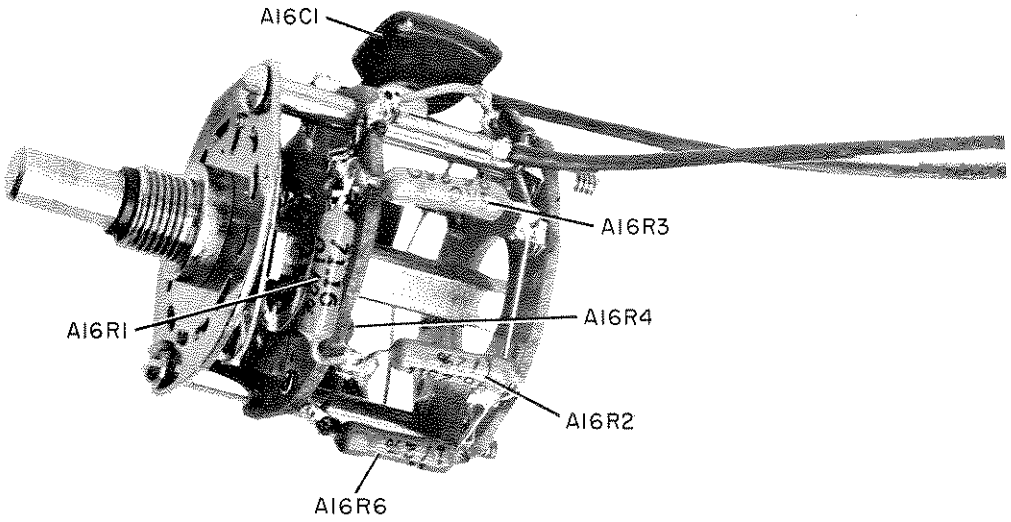

310A-A-19

Figure 5-12. RF Attenuator (Half of Range SW)

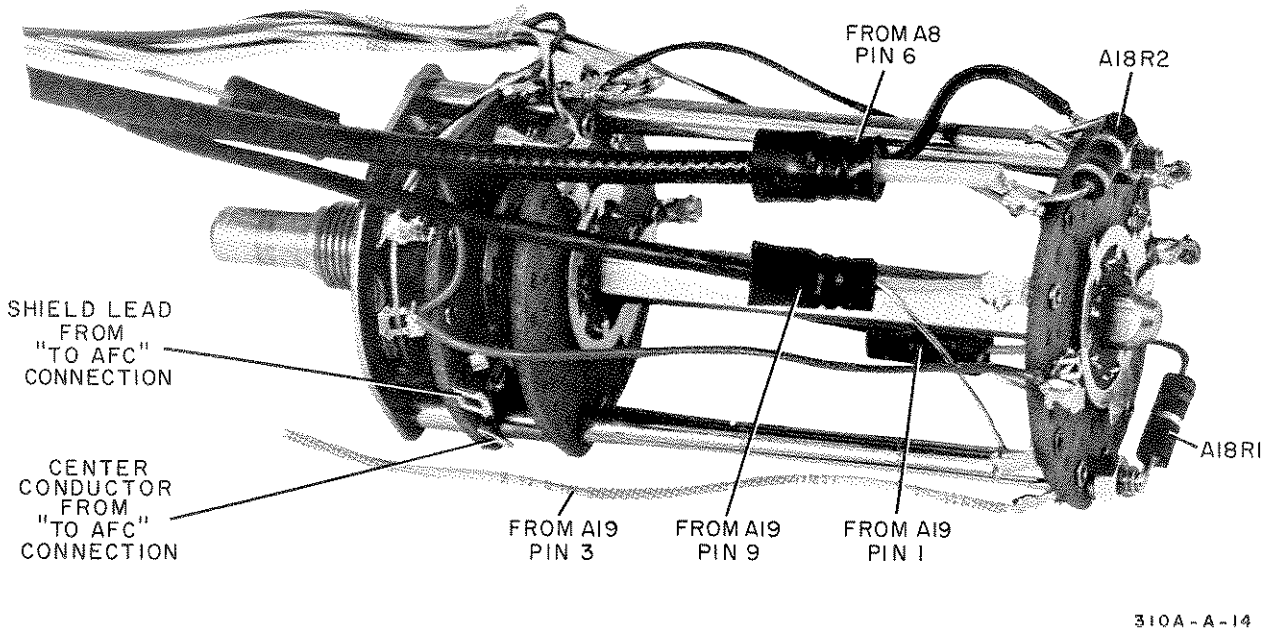

Figure 5-13. Mode Selector (Mode SW)

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 designators 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 Field Office (see maps at rear of this manual for addresses). Identify parts by their Hewlett-Packard stock numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	E = misc electronic part	MP = mechanical part	TB = terminal board
B = motor	F = fuse	P = plug	TP = test point
C = capacitor	FL = filter	Q = transistor	V = vacuum tube, neon bulb, photocell, etc.
CP = coupling	J = jack	R = resistor	
CR = diode	K = relay	RT = thermistor	W = cable
DL = delay line	L = inductor	S = switch	X = socket
DS = device signaling (lamp)	M = meter	T = transformer	Y = crystal

ABBREVIATIONS

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

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Table 6-1. Reference Designation Index

Reference Designation	Stock No.	Description #	Note
A1	310A-19A	SWITCH ASSEMBLY:INPUT ATTENUATOR	
A1C1	0140-0144	C:FXD MICA 18PF 1/2%	
A1C2	0140-0040	C:FXD MICA 75 PF 5% 500 VDCW	
A1C3	0160-0139	C:FXD MICA 270 PF 2%	
A1C4	0140-0091	C:FXD MICA 820 PF 5% 500 VDCW	
A1C5	0140-0024	C:FXD MICA 2200 PF 10% 500 VDCW	
A1C6	0130-0006	C:VAR CER 5-20PF 500VDCW	
A1C7	0140-0170	C:FXD MICA 5600 PF 5% 300 VDCW	
A1C8	0140-0197	C:FXD MICA 180 PF 5% 300 VDCW	
A1C9	0160-0139	C:FXD MICA 270 PF 2%	
A1R1	0727-0420	R:FXD DEPC 4620 OHM 1% 1/2W	
A1R2	0727-0411	R:FXD DEPC 1110 OHM 1% 1/2W	
A1R3	0727-0488	R:FXD DEPC 326 OHM 1/2% 1/2W	
A1R4	0727-0208	R:FXD DEPC 100K OHM 1% 1/2W	
A1R5	0727-0416	R:FXD DEPC 69.0 OHM 1/2% 1/2W	
A1R6	0727-0417	R:FXD DEPC 64.0 OHM 1/2% 1/2W	
A1R7	0727-0418	R:FXD DEPC 43.7 OHM 1/2% 1/2W	
A1R8	0727-0487	R:FXD DEPC 20.1 OHM 1/2% 1/2W	
A1R9	2100-0408	R:VAR COMP 250 OHM 30% 1/2W	
A1S1	3100-0359	SWITCH:ROTARY 8 SECT 9 POS	
A2	310A-65R	ASSY: INPUT ATTENUATOR BOARD	
A2C1	0130-0016	C:VAR CER 5-25 PF NPO	
A2C2	0130-0016	C:VAR CER 5-25 PF NPO	
A2C3	0130-0013	C:VAR CER 3-12 PF NPO	
A2C4	0130-0013	C:VAR CER 3-12 PF NPO	
A2C5	0130-0013	C:VAR CER 3-12 PF NPO	
A2R1	0727-0412	R:FXD DEPC 21.5K OHM 1% 1/2W	
A2R2	0727-0204	R:FXD DEPC 90K OHM 1% 1/2W	
A2R3	0727-0414	R:FXD DEPC 96.8K OHM 1% 1/2W	
A2R4	0727-0207	R:FXD DEPC 99K OHM 1% 1/2W	
A2R5	0727-0413	R:FXD DEPC 99.7K OHM 1% 1/2W	
A3	310A-65T	ASSY: INPUT AMP CAL OPTION 01 ONLY	
A3	310A-65G	ASSY: INPUT AMP AND CALIB NOT USED ON OPTION 01	
A3C1	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A3C2	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
A3C3	0140-0010	C:FXD MICA 33 PF 5% 500 VDCW	
A3C4	0131-0003	C:VAR MICA 170-780 PF 175VDCW	
A3C5	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A3C6	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A3C7	0170-0066	C:FXD MY 0.027UF 10% 200VDCW	
A3C8	0180-0033	C:FXD ELECT 50UF 6VDCW	
A3C9	0180-0033	C:FXD ELECT 50UF 6VDCW	
A3C10	0140-0110	C:FXD MICA SIL 127 PF 2% 300 VDCW	
A3C11	0160-0200	C:FXD MYLAR 0.22UF 20% 200VDCW	
A3C12	0180-0060	C:FXD ELECT 200UF -10%+100% 3VDCW	
A3C13	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	

See list of abbreviations in introduction to this section

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

Reference Designation	℗ Stock No.	Description #	Note
A3C14 THRU A3C50		NOT ASSIGNED	
A3C51	0170-0085	C:FXD MY 0.1UF 20% 50VDCW	
A3C52	0140-0225	C:FXD MICA 300PF 1% 300VDCW	
A3C53	0140-0184	C:FXD MICA 8200 PF 1% 100 VDCW	
A3C54	0131-0004	C:VAR MICA 16-150 PF 175VDCW	
A3C55	0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	
A3C56	0131-0004	C:VAR MICA 16-150 PF 175VDCW	
A3CR1	1910-0016	DIODE: GERMANIUM 100 MA AT 0.85V 60P1V	
A3CR2	1902-0009	DIODE: BREAKDOWN:7.5V 10% 400MW	
A3CR3		NOT ASSIGNED	
A3CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A3CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A3CR6 THRU A3CR50		NOT ASSIGNED	
A3CR51	1910-0016	DIODE: GERMANIUM 100 MA AT 0.85V 60P1V	
A3CR52	1910-0016	DIODE: GERMANIUM 100 MA AT 0.85V 60P1V	
A3L51	9140-0072	INDUCTOR: COIL 5000 UH 10%	
A3Q1	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A3Q2	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A3Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A3Q4	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A3Q5	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A3Q6 THRU A3Q50		NOT ASSIGNED	
A3Q51	1854-0003	TRANSISTOR:NPN SILICON	
A3Q52	1854-0011	TRANSISTOR:2N835 NPN SILICON	
A3Q53	1854-0011	TRANSISTOR:2N835 NPN SILICON	
A3R1	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A3R2	0687-3921	R:FXD COMP 3900 OHM 10% 1/2W	
A3R3	0687-1831	R:FXD COMP 18K OHM 10% 1/2W	
A3R4	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
A3R5	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R6	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R7	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R8	0687-1831	R:FXD COMP 18K OHM 10% 1/2W	
A3R9 THRU A3R10		NOT ASSIGNED	
A3R11	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A3R12	0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	
A3R13	0727-0055	R:FXD DEPC 201 OHM 1% 1/2W	
A3R14	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A3R15	0727-0185	R:FXD DEPC 29.9K OHM 1% 1/2W	
A3R16	0690-1021	R:FXD COMP 1000 OHM 10% 1W	
A3R17	0758-0034	R:FXD MET FLM 2400 OHM 5% 1/2W	
A3R18	0758-0033	R:FXD MET FLM 2000 OHM 5% 1/2W	
A3R19	0727-0168	R:FXD DEPC 15K OHM 1% 1/2W	
A3R20	0758-0079	R:FXD MET FLM 30K OHM 5% 1/2W	
A3R21	0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	
A3R22	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A3R23	0687-2211	R:FXD COMP 220 OHM 10% 1/2W	
A3R24	0687-1821	R:FXD COMP 1800 OHM 10% 1/2W	
A3R25	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A3R26	0687-6801	R:FXD COMP 68 OHM 10% 1/2W	
A3R27 THRU A3R50		NOT ASSIGNED	
A3R51	0687-1231	R:FXD COMP 12K OHM 10% 1/2W	
A3R52	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R53	0687-2221	R:FXD COMP 2200 OHM 10% 1/2W	
A3R54	0727-0176	R:FXD DEPC 20.4K OHM 1% 1/2W	
A3R55	0727-0178	R:FXD DEPC 24.7K OHM 1% 1/2W	
A3R56	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R57	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	
A3R58	0687-1811	R:FXD COMP 180 OHM 10% 1/2W	
A3R59	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A3R60	0687-1531	R:FXD COMP 15K OHM 10% 1/2W	
A3R61	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
A3R62	0687-1531	R:FXD COMP 15K OHM 10% 1/2W	
A3R63	0687-1531	R:FXD COMP 15K OHM 10% 1/2W	
A4	310A-65S	ASSY: 1.5MC L.P.F.	
A4C1	0160-0189	C:FXD MICA 73PF 1% 300VDCW	
A4C2	0160-0187	C:FXD MICA 42PF 1% 300VDCW	
A4C3	0160-0186	C:FXD MICA 10.7PF 1% 300VDCW	
A4C4	0140-0111	C:FXD MICA 101.4 PF 2% NPO 500 VDCW	
A4C5	0160-0190	C:FXD MICA 225PF 1% 300VDCW	
A4C6	0160-0191	C:FXD MICA 272PF 1% 300VDCW	
A4C7	0160-0203	C:FXD MICA 150PF 1% 300VDCW	
A4L1	9140-0153	COIL:FXD RF 36.8 UH	
A4L2	9140-0152	COIL:FXD RF 41.06 UH	
A4L3	9140-0154	COIL:FXD RF 53.8 UH	
A5	310A-65E	ASSY: 3 MC LPF	
A5C1	0140-0228	C:FXD MICA 360PF 1% 300VDCW	
A5C2	0140-0109	C:FXD MICA 209 PF 2% 300 VDCW	
A5C3	0160-0188	C:FXD MICA 53PF 5% 300VDCW	
A5C4	0160-0192	C:FXD MICA 525PF 5% 300VDCW	
A5C5	0160-0193	C:FXD MICA 1125PF 5% 300VDCW	
A5C6	0140-0155	C:FXD MICA 1325 PF 1% 500 VDCW	
A5C7	0140-0150	C:FXD MICA 731.5 PF 1% 300 VDCW	
A5L1	9140-0149	COIL:FXD RF 1.86 UH	
A5L2	9140-0151	COIL:FXD RF 2.07 UH	
A5L3	9140-0150	COIL:FXD RF 2.75 UH	
A6	310A-19B	SWITCH ASSEMBLY: I. F. ATTENUATOR	
A6R1	0727-0037	R:FXD DEPC 71.16 OHM 1/2% 1/2W	
A6R2	0727-0042	R:FXD DEPC 96.25 OHM 1/2% 1/2W	
A6R3	0727-0042	R:FXD DEPC 96.25 OHM 1/2% 1/2W	
A6R4	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A6R5	0727-0034	R:FXD DEPC 61.11 OHM 1/2% 1/2W	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A6R6	0727-0034	R:FXD DEPC 61.11 OHM 1/2% 1/2W	
A6R7	0727-0091	R:FXD DEPC 790 OHM 1/2% 1/2W	
A6R8	0727-0027	R:FXD DEPC 53.3 OHM 1% 1/2W	
A6R9	0727-0027	R:FXD DEPC 53.3 OHM 1% 1/2W	
A6R10 THRU A6R15		NOT ASSIGNED	
A6R16	0758-0062	R:FXD MET FLM 200 OHM 5% 1/2W	
A6S6	3100-0360	SWITCH:ROTARY 4 SECT 8 POS	
A7	310A-65P	ASSY: LOCAL OSCILLATOR	
A7C1	0150-0096	C:FXD CER 0.05UF 100VDCW	
A7C2	0150-0096	C:FXD CER 0.05UF 100VDCW	
A7C3	0170-0055	C:FXD MY 0.1UF 20% 200VDCW	
A7C4	0160-0196	C:FXD MICA 24PF 5% 300VDCW	
A7C5	0121-0031	C:VAR AIR 1.85-10.38PF	
A7C6	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A7C7	0140-0163	C:FXD MICA 4751 PF 1% 300 VDCW	
A7C8	0150-0093	C:FXD CER 0.01UF +80-20 100VDCW	
A7C9	0150-0096	C:FXD CER 0.05UF 100VDCW	
A7CR1	0122-0001	VARICAPACITOR:SI 100PF 20% 20VDCW	
A7CR2	0122-0001	VARICAPACITOR:SI 100PF 20% 20VDCW	
A7L1	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A7L2	9140-0061	COIL:VAR 0.780-1.25 UH	
A7L3	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A7Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A7R1	0758-0006	R:FXD MET FLM 10K OHM 5% 1/2W	
A7R2	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A7R3	0687-1531	R:FXD COMP 15K OHM 10% 1/2W	
A7R4	0758-0078	R:FXD MET FLM 13K OHM 5% 1/2W	
A7R5	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	
A7T1	310A-9P	TRANSFORMER ASSY	
A8	310A-65H	ASSY: LOCAL OSC AMP & INPUT MIXER	
A8C1	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C2	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C3	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C4	0121-0038	C:VAR AIR 1.8-4.6PF INCLUDES A AND B	
A8C5	0131-0003	C:VAR MICA 170-780 PF 175VDCW	
A8C6	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A8C7	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C8	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C9	0150-0096	C:FXD CER 0.05UF 100VDCW	
A8C10	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A8CR1	1910-0016	DIODE: GERMANIUM 100 MA AT 0.85V 60PIV	
A8CR2	1910-0016	DIODE: GERMANIUM 100 MA AT 0.85V 60PIV	
A8CR3	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A8CR6	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A8L1	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A8Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A8Q2	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A8Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A8Q4	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A8R1	0687-2211	R:FXD COMP 220 OHM 10% 1/2W	
A8R2	0687-2201	R:FXD COMP 22 OHM 10% 1/2W	
A8R3	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	
A8R4	0758-0017	R:FXD MET FLM 1500 OHM 5% 1/2W	
A8R5	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A8R6	0727-0036	R:FXD DEPC 71.16 OHM 1% 1/2W	
A8R7	0758-0024	R:FXD MET FLM 100 OHM 5% 1/2W	
A8R8	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A8R9	2100-0360	R:VAR COMP 250 OHM 30% 1/4W	
A8R10	0758-0025	R:FXD MET FLM 160 OHM 5% 1/2W	
A8R11	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A8R12	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A8R13	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A8R14	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
A8R15	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	
A8R16	0758-0035	R:FXD MET FLM 3000 OHM 5% 1/2W	
A8R17	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
A8R18	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A8R19	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A8R20	0687-2201	R:FXD COMP 22 OHM 10% 1/2W	
A8R21	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	
A8R22	0687-2201	R:FXD COMP 22 OHM 10% 1/2W	
A8R23	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	
A8R24	0727-0075	R:FXD DEPC 490 OHM 1% 1/2W	
A8R25	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A8T1	310A-9J	TRANSFORMER ASSY:	
A8T2	310A-9R	TRANSFORMER ASSY:	
A8T3	310A-9H	TRANSFORMER ASSY:	
A9	310A-65B	ASSY: 1ST MIXER PAIR	
A9C1	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A9C2	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
A9C3	0150-0096	C:FXD CER 0.05UF 100VDCW	
A9C4	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
A9C5	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A9C6	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A9C7	0131-0003	C:VAR MICA 170-780 PF 175VDCW	
A9C8 THRU A9C10		NOT ASSIGNED	
A9C11	0131-0003	C:VAR MICA 170-780 PF 175VDCW	
A9C12	0140-0182	C:FXD MICA 5000 PF 2% 300 VDCW	
A9C13	0131-0002	C:VAR MICA 110-580 PF 175 V	
A9C14 THRU A9C15		NOT ASSIGNED	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A9C16	0131-0003	C:VAR MICA 170-780 PF 175VDCW	
A9C17	0140-0182	C:FXD MICA 5000 PF 2% 300 VDCW	
A9C18	0131-0002	C:VAR MICA 110-580 PF 175 VDCW	
A9CR1	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR2	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR3	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR6	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR7	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9CR8	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A9L1	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A9L2	9140-0105	COIL:FXD RF 8.2 UH	
A9Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A9Q2	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A9Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A9R1	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A9R2	0727-0120	R:FXD DEPC 2.25K OHM 1% 1/2W	
A9R3	0727-0023	R:FXD DEPC 50 OHM 1% 1/2W	
A9R4	0758-0071	R:FXD MET FLM 4300 OHM 5% 1/2W	
A9R5	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A9R6	0687-2221	R:FXD COMP 2200 OHM 10% 1/2W	
A9R7	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A9R8	0687-4711	R:FXD COMP 470 OHM 10% 1/2W	
A9R9	0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	
A9R10	0687-2221	R:FXD COMP 2200 OHM 10% 1/2W	
A9R11	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	
A9R12 THRU A9R14		NOT ASSIGNED	
A9R15	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A9R16	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R17	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R18	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R19	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R20	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A9R21	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A9R22 THRU A9R24		NOT ASSIGNED	
A9R25	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A9R26	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R27	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R28	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9R29	0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	
A9T1	310A-9A	TRANSFORMER ASSY:	
A9T2	310A-9B	TRANSFORMER ASSY:	
A9T3	310A-9A	TRANSFORMER ASSY:	
A9T4	310A-9B	TRANSFORMER ASSY:	
A10	310A-19D	SWITCH ASSEMBLY BANDWIDTH	
A10R1	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	

See list of abbreviations in introduction to this section

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

Reference Designation	℔ Stock No.	Description #	Note
A10R2	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R3	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R4	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A10R5		NOT ASSIGNED	
A10R6	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R7	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R8	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R9	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A10R10		NOT ASSIGNED	
A10R11	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R12	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R13	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R14	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A10R15		NOT ASSIGNED	
A10R16	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R17	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R18	0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	
A10R19	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A10S10	3100-0363	SWITCH:ROTARY 2 SECT 3 POS	
A11	310A-65F	ASSY: 3 MC OSCILLATOR	
A11C1	0131-0004	C:VAR MICA 16-150 PF 175VDCW	
A11C2	0150-0096	C:FXD CER 0.05UF 100VDCW	
A11C3	0131-0001	C:VAR MICA 50 TO 380 PF 175VDCW	
A11C4	0131-0001	C:VAR MICA 50 TO 380 PF 175VDCW	
A11C5		NOT ASSIGNED	
A11C6	0140-0111	C:FXD MICA 101.4 PF 2% NPO 500 VDCW	
A11C7	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A11C8	0150-0096	C:FXD CER 0.05UF 100VDCW	
A11C9	0150-0096	C:FXD CER 0.05UF 100VDCW	
A11L1	9140-0032	COIL:FXD 10 UH	
A11L2	9140-0155	COIL:FXD RF 28 UH	
A11L3	9140-0053	COIL:FXD 1MHY 10%	
A11L4	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A11Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A11Q2	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A11Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A11Q4	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A11R1	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
A11R2	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A11R3	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A11R4	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A11R5	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A11R6	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A11R7 THRU A11R9		NOT ASSIGNED	
A11R10	0758-0037	R:FXD MET FLM 5100 OHM 5% 1/2W	
A11R11	0758-0010	R:FXD MET OX 3300 OHM 5%	
A11R12	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	
A11R13	0687-8211	R:FXD COMP 820 OHM 10% 1/2W	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A11R14	0758-0002	R:FXD MET FLM 560 OHM 5% 1/2W	
A11T1	310A-9E	TRANSFORMER-ASSY	
A11T2	310A-9F	TRANSFORMER-ASSY	
A12		NOT ASSIGNED	
A13	310A-65D	ASSY: ACTIVE LPF	
A13C1	0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	
A13C2	0160-0362	C:FXD MICA 510 PF 5%	
A13C3	0140-0017	C:FXD MICA 4700 PF 5% 500VDCW	
A13CR1	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A13CR2	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A13Q1	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A13Q2	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A13Q3	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A13Q4	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A13Q5	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A13Q6	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A13R1	0758-0039	R:FXD MET FLM 20K OHM 5% 1/2W	
A13R2	0727-0072	R:FXD DEPC 403 OHM 1% 1/2W	
A13R3	0758-0073	R:FXD MET FLM 24K OHM 5% 1/2W	
A13R4	0758-0049	R:FXD MET FLM 33K OHM 1/2W	
A13R5	0758-0074	R:FXD MET FLM 27K OHM 5% 1/2W	
A13R6	0727-0116	R:FXD DEPC 2030 OHM 1% 1/2W	
A13R7	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A13R8	0727-0044	R:FXD DEPC 120 OHM 1% 1/2W	
A13R9	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
A13R10	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A13R11 THRU A13R14		NOT ASSIGNED	
A13R15	0758-0078	R:FXD MET FLM 13K OHM 5% 1/2W	
A13R16	0727-0066	R:FXD DEPC 312 OHM 1% 1/2W	
A13R17	0758-0038	R:FXD MET FLM 9100 OHM 5% 1/2W	
A13R18	0758-0049	R:FXD MET FLM 33K OHM 1/2W	
A13R19	0758-0047	R:FXD MET FLM 7500 OHM 5% 1/2W	
A13R20	0727-0153	R:FXD DEPC 9.1K OHM 1% 1/2W	
A13R21	0727-0101	R:FXD DEPC 1.03K OHM 1% 1/2W	
A13R22	0727-0017	R:FXD DEPC 37.35 OHM 1/2% 1/2W	
A13R23	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A13R24	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A14	310A-65D	ASSY: ACTIVE LPF	
A14C1	0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	
A14C2	0160-0362	C:FXD MICA 510 PF 5%	
A14CR1	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A14CR2	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A14Q1	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	
A14Q2	1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	

See list of abbreviations in introduction to this section

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

Reference Designation	℗ Stock No.	Description #	Note
A14Q3	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A14Q4	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A14Q5	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A14Q6	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A14R1	0758-0039	R:FXD MET FLM 20K OHM 5% 1/2W	
A14R2	0727-0072	R:FXD DEPC 403 OHM 1% 1/2W	
A14R3	0758-0073	R:FXD MET FLM 24K OHM 5% 1/2W	
A14R4	0758-0049	R:FXD MET FLM 33K OHM 1/2W	
A14R5	0758-0074	R:FXD MET FLM 27K OHM 5% 1/2W	
A14R6	0727-0116	R:FXD DEPC 2030 OHM 1% 1/2W	
A14R7	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A14R8	0727-0044	R:FXD DEPC 120 OHM 1% 1/2W	
A14R9	0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	
A14R10	0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	
A14R11 THRU A14R14		NOT ASSIGNED	
A14R15	0758-0078	R:FXD MET FLM 13K OHM 5% 1/2W	
A14R16	0727-0066	R:FXD DEPC 312 OHM 1% 1/2W	
A14R17	0758-0038	R:FXD MET FLM 9100 OHM 5% 1/2W	
A14R18	0758-0049	R:FXD MET FLM 33K OHM 1/2W	
A14R19	0758-0047	R:FXD MET FLM 7500 OHM 5% 1/2W	
A14R20	0727-0153	R:FXD DEPC 9.1K OHM 1% 1/2W	
A14R21	0727-0101	R:FXD DEPC 1.03K OHM 1% 1/2W	
A14R22	0727-0017	R:FXD DEPC 37.35 OHM 1/2% 1/2W	
A14R23	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A14R24	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A15	310A-65C	ASSY: 2ND MIXER PAIR	
A15C1	0150-0096	C:FXD CER 0.05UF 100VDCW	
A15C2	0131-0001	C:VAR MICA 50 TO 380 PF 175VDCW	
A15C3	0121-0038	C:VAR AIR 1.8-4.6PF INCLUDES A ANDB	
A15C4	0140-0175	C:FXD MICA 39 PF 2% 300 VDCW	
A15C5	0140-0018	C:FXD MICA 1000 PF 5% 500VDCW	
A15C6	0150-0096	C:FXD CER 0.05UF 100VDCW	
A15C7	0131-0001	C:VAR MICA 50 TO 380 PF 175VDCW	
A15C8	0121-0038	C:VAR AIR 1.8-4.6PF INCLUDES A ANDB	
A15CR1	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR2	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR3	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR6	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR7	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15CR8	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A15L1	9140-0029	COIL:FXD 100 UH 2.6 OHMS	
A15L2	9140-0156	COIL:FXD R: 72.3 UH	
A15Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A15R1	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A15R2	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R3	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R4	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R5	0687-6801	R:FXD COMP 68 OHM 10% 1/2W	
A15R6	2100-0360	R:VAR COMP 250 OHM 30% 1/4W	
A15R7 THRU A15R9		NOT ASSIGNED	
A15R10	0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	
A15R11	0758-0046	R:FXD MET FLM 6200 OHM 5% 1/2W	
A15R12	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R13	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R14	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R15	0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	
A15R16	0687-2701	R:FXD COMP 27 OHM 10% 1/2W	
A15T1	310A-9C	TRANSFORMER	
A15T2	310A-9D	TRANSFORMER- ASSY	
A15T3	310A-9G	TRANSFORMER- ASSY	
A16	310A-19C	SWITCH ASSEMBLY:R.F. ATTENUATOR	
A16C1	0160-0193	C:FXD MICA 1125PF 5% 300VDCW	
A16C2	0140-0180	C:FXD MICA 2000 PF 2% 300 VDCW	
A16C3	0160-0193	C:FXD MICA 1125PF 5% 300VDCW	
A16L1	9140-0148	COIL:FXD RF 3.41 UH	
A16L2	9140-0148	COIL:FXD RF 3.41 UH	
A16R1	0727-0037	R:FXD DEPC 71.16 OHM 1/2% 1/2W	
A16R2	0727-0042	R:FXD DEPC 96.25 OHM 1/2% 1/2W	
A16R3	0727-0042	R:FXD DEPC 96.25 OHM 1/2% 1/2W	
A16R4	0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	
A16R5	0727-0034	R:FXD DEPC 61.11 OHM 1/2% 1/2W	
A16R6	0727-0034	R:FXD DEPC 61.11 OHM 1/2% 1/2W	
A16S16	3100-0361	SWITCH:ROTARY 2 SECT 8 POS	
A17	310A-65J	ASSY: METER AMPLIFIER	
A17C1	0150-0096	C:FXD CER 0.05UF 100VDCW	
A17C2	0150-0096	C:FXD CER 0.05UF 100VDCW	
A17C3	0150-0096	C:FXD CER 0.05UF 100VDCW	
A17C4	0160-0187	C:FXD MICA 42PF 1% 300VDCW	
A17C5	0160-0200	C:FXD MYLAR 0.22UF 20% 200VDCW	
A17C6	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A17C7	0150-0096	C:FXD CER 0.05UF 100VDCW	
A17C8	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
A17C9	0150-0024	C:FXD CER 0.02UF +80%-20% 600VDCW	
A17C10	0150-0024	C:FXD CER 0.02UF +80%-20% 600VDCW	
A17C11	0180-0060	C:FXD ELECT 200UF -10%+100% 3VDCW	
A17CR1	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A17CR2	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A17L1	9140-0029	COIL:FXD 100 UH 2.6 OHMS	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A17L2	9140-0053	COIL:FXD 1MHY 10%	
A17L3	9140-0154	COIL:FXD RF 53.8 UH	
A17Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A17Q2	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A17Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A17R1	0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	
A17R2	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A17R3	0758-0006	R:FXD MET FLM 10K OHM 5% 1/2W	
A17R4	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A17R5	0727-0027	R:FXD DEPC 53.3 OHM 1% 1/2W	
A17R6	0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	
A17R7	0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	
A17R8	0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	
A17R9	0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	
A17R10	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A17R11 THRU A17R14		NOT ASSIGNED	
A17R15	0687-1211	R:FXD COMP 120 OHM 10% 1/2W	
A17R16	0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	
A17R17	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
A17R18	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A17R19	0687-4701	R:FXD COMP 47 OHM 10% 1/2W	
A17R20	0687-5611	R:FXD COMP 560 OHM 10% 1/2W	
A17T1	310A-9N	TRANSFORMER- ASSY:	
A18	310A-19E	SWITCH ASSY: MODE	
A18R1	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A18R2	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A18S18	3100-0362	SWITCH:ROTARY 3 SECT 6 POS	
A19	310A-65N	ASSY: BFO	
A19C1	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A19C2	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C3	0131-0004	C:VAR MICA 16-150 PF 175VDCW	
A19C4	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C5	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C6	0131-0004	C:VAR MICA 16-150 PF 175VDCW	
A19C7	0132-0003	C:VAR POLY 0.7-3.0 PF	
A19C8	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C9 THRU A19C10		NOT ASSIGNED	
A19C11	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C12	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C13	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C14	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C15	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C16	0150-0096	C:FXD CER 0.05UF 100VDCW	
A19C17	0131-0003	C:VAR MICA 170-780 PF 175VDCW	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A19CR1	1901-0047	DIODE: JUNCTION. 20 PIV	
A19CR2	1901-0047	DIODE: JUNCTION. 20 PIV	
A19CR3	1901-0047	DIODE: JUNCTION. 20 PIV	
A19CR4	1901-0047	DIODE: JUNCTION. 20 PIV	
A19CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19CR6	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19CR7	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19CR8	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19CR9	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19CR10	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A19L1	9140-0072	INDUCTOR: COIL 5000 UH 10%	
A19L2	310A-60A	INDUCTOR: 175MH	
A19Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A19Q2	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A19Q3	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A19R1	0684-1021	R:FXD COMP 1000 OHM 10% 1/4W	
A19R2	0684-1031	R:FXD COMP 10K OHM 10% 1/4W	
A19R3	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R4	0683-6825	R:FXD COMP 6800 OHM 5% 1/4W	
A19R5	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A19R6	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R7	0684-4711	R:FXD COMP 470 OHM 10% 1/4W	
A19R8	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R9 THRU A19R10		NOT ASSIGNED	
A19R11	0684-1031	R:FXD COMP 10K OHM 10% 1/4W	
A19R12	0684-1031	R:FXD COMP 10K OHM 10% 1/4W	
A19R13	0684-1011	R:FXD COMP 100 OHM 10% 1/4W	
A19R14	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R15	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R16	0684-1031	R:FXD COMP 10K OHM 10% 1/4W	
A19R17	0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	
A19R18	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A19R19	0727-0105	R:FXD DEPC 1200 OHM 1%	
A19R20	0727-0105	R:FXD DEPC 1200 OHM 1%	
A19R21	0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	
A19T1	310A-9M	TRANSFORMER:	
A19T2	310A-9K	TRANSFORMER:	
A19T3	310A-9L	TRANSFORMER:	
A20	310A-65S	ASSY: 1.5MC L.P.F.	
A20C1	0160-0189	C:FXD MICA 73PF 1% 300VDCW	
A20C2	0160-0187	C:FXD MICA 42PF 1% 300VDCW	
A20C3	0160-0186	C:FXD MICA 10.7PF 1% 300VDCW	
A20C4	0140-0111	C:FXD MICA 101.4 PF 2% NPO 500 VDCW	
A20C5	0160-0190	C:FXD MICA 225PF 1% 300VDCW	
A20C6	0160-0191	C:FXD MICA 272PF 1% 300VDCW	
A20C7	0160-0203	C:FXD MICA 150PF 1% 300VDCW	
A20L1	9140-0153	COIL:FXD RF 36.8 UH	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A20L2	9140-0152	COIL:FXD RF 41.06 UH	
A20L3	9140-0154	COIL:FXD RF 53.8 UH	
A21	310A-65K	ASSY: OUTPUT AMPLIFIER	
A21C1	0160-0174	C:FXD CER 0.47UF 80% 25VDCW	
A21C2	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A21C3	0170-0064	C:FXD MY 0.47UF 10% 100VDCW	
A21C4	0180-0104	C:FXD ELECT 200UF 15VDCW	
A21C5	0180-0060	C:FXD ELECT 200UF -10%+100% 3VDCW	
A21C6	0180-0104	C:FXD ELECT 200UF 15VDCW	
A21C7	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A21C8	0180-0076	C:FXD ELECT 20UF 25VDCW	
A21C9	0140-0090	C:FXD MICA 200 PF 5%	
A21C10	0180-0060	C:FXD ELECT 200UF -10%+100% 3VDCW	
A21C11	0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	
A21C12	0180-0104	C:FXD ELECT 200UF 15VDCW	
A21C13	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A21CR1	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A21CR2	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A21L1	9140-0072	INDUCTOR: COIL 5000 UH 10%	
A21L2	9140-0072	INDUCTOR: COIL 5000 UH 10%	
A21Q1	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A21Q2	1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	
A21Q3	1853-0003	TRANSISTOR:SILICON PNP	
A21R1	0758-0030	R:FXD MET FLM 510 OHM 5% 1/2W	
A21R2	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
A21R3	0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	
A21R4	0687-6811	R:FXD COMP 680 OHM 10% 1/2W	
A21R5	0687-4701	R:FXD COMP 47 OHM 10% 1/2W	
A21R6	0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	
A21R7	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
A21R8	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
A21R9	0727-0004	R:FXD DEPC 5 OHM 1% 1/2W	
A21R10	0758-0070	R:FXD MET FLM 1200 OHM 5% 1/2W	
A21R11 THRU A21R13		NOT ASSIGNED	
A21R14	0687-1011	R:FXD COMP 100 OHM 10% 1/2W	
A21R15	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A21R16	0687-3311	R:FXD COMP 330 OHM 10% 1/2W	
A21R17	0687-2211	R:FXD COMP 220 OHM 10% 1/2W	
A21R18	0727-0466	R:FXD DEPC 135 OHM 1% 0.5W	
A21R19	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A21R20	0687-1511	R:FXD COMP 150 OHM 10% 1/2W	
A21R21	0758-0031	R:FXD MET FLM 680 OHM 5% 1/2W	
A21R22	0687-1031	R:FXD COMP 10K OHM 10% 1/2W	
A21R23	0758-0054	R:FXD MET FLM 330 OHM 5% 1/2W	
A21R24	0686-3305	R:FXD COMP 33 OHM 5% 1/2W	
A22	310A-65L	ASSY: AFC #1	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A22C1	0180-0045	C:FXD ELECT 20UF 25VDCW	
A22C2	0180-0033	C:FXD ELECT 50UF 6VDCW	
A22C3	0180-0144	C:FXD ELECT 200UF -10+100% 25VDCW	
A22C4	0180-0145	C:FXD ELECT 500UF -10+100% 10VDCW	
A22C5	0180-0144	C:FXD ELECT 200UF -10+100% 25VDCW	
A22C6 THRU A22C10		NOT ASSIGNED	
A22C11	0180-0045	C:FXD ELECT 20UF 25VDCW	
A22C12	0180-0033	C:FXD ELECT 50UF 6VDCW	
A22C13	0180-0124	C:FXD ELECT 200UF 6VDCW	
A22C14 THRU A22C15		NOT ASSIGNED	
A22C16	0170-0018	C:FXD MY 1UF 5% 200VDCW	
A22CR1	1902-0017	DIODE, BREAKDOWN:6.81V 10% 400MW	
A22CR2	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A22CR3	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A22CR4	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A22CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A22CR6	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A22CR7	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A22CR8	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A22CR9	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A22Q1	1850-0101	TRANSISTOR:GERMANIUM PNP SPL 2N582	
A22Q2	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A22Q3	1850-0101	TRANSISTOR:GERMANIUM PNP SPL 2N582	
A22Q4	1854-0003	TRANSISTOR:NPN SILICON	
A22Q5	1854-0003	TRANSISTOR:NPN SILICON	
A22Q6	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A22R1	0687-2701	R:FXD COMP 27 OHM 10% 1/2W	
A22R2	0687-2701	R:FXD COMP 27 OHM 10% 1/2W	
A22R3	0758-0037	R:FXD MET FLM 5100 OHM 5% 1/2W	
A22R4	0758-0006	R:FXD MET FLM 10K OHM 5% 1/2W	
A22R5	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A22R6	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A22R7	0758-0017	R:FXD MET FLM 1500 OHM 5% 1/2W	
A22R8	0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	
A22R9	0687-1811	R:FXD COMP 180 OHM 10% 1/2W	
A22R10 THRU A22R14		NOT ASSIGNED	
A22R15	0758-0034	R:FXD MET FLM 2400 OHM 5% 1/2W	
A22R16	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A22R17	0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	
A22R18	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A22R19	0758-0019	R:FXD MET FLM 18K OHM 5% 1/2W	
A22R20	0758-0019	R:FXD MET FLM 18K OHM 5% 1/2W	
A22R21	0758-0019	R:FXD MET FLM 18K OHM 5% 1/2W	
A22R22	0758-0019	R:FXD MET FLM 18K OHM 5% 1/2W	
A22R23	0758-0040	R:FXD MET FLM 47K OHM 5% 1/2W	
A22R24	0758-0040	R:FXD MET FLM 47K OHM 5% 1/2W	
A22R25		NOT ASSIGNED	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A22R26	0758-0072	R:FXD MET FLM 16K OHM 5% 1/2W	
A22R27	0758-0032	R:FXD MET OX 820 OHM 5%	
A22R28	0758-0010	R:FXD MET OX 3300 OHM 5%	
A22R29	0758-0032	R:FXD MET OX 820 OHM 5%	
A22R30	0758-0021	R:FXD MET FLM 51K OHM 5% 1/2W	
A22R31	0758-0072	R:FXD MET FLM 16K OHM 5% 1/2W	
A22R32	0727-0109	R:FXD DEPC 1470 OHM 1% 1/2W	
A22R33	0727-0101	R:FXD DEPC 1.03K OHM 1% 1/2W	
A22R34 THRU A22R35		NOT ASSIGNED	
A22R36	0758-0037	R:FXD MET FLM 5100 OHM 5% 1/2W	
A22R37	0758-0006	R:FXD MET FLM 10K OHM 5% 1/2W	
A22R38	0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	
A22R39	0758-0017	R:FXD MET FLM 1500 OHM 5% 1/2W	
A22R40	0687-3331	R:FXD COMP 33K OHM 10% 1/2W	
A23	310A-65M	ASSY: AFC #2	
A23C1	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A23C2	0180-0111	C:FXD ELECT 2UF 25VDCW	
A23C3 THRU A23C4		NOT ASSIGNED	
A23C5	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A23C6 THRU A23C9		NOT ASSIGNED	
A23C10	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A23C11	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A23C12	0160-0174	C:FXD CER 0.47UF 80% 25VDCW	
A23C13	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A23CR1	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A23CR2	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A23CR3 THRU A23CR4		NOT ASSIGNED	
A23CR5	1902-0025	DIODE:BREAKDOWN:10.0V 5% 400MW	
A23CR6	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A23CR7	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A23CR8	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A23CR9 THRU A23CR10		NOT ASSIGNED	
A23CR11	1902-0025	DIODE:BREAKDOWN:10.0V 5% 400MW	
A23CR12	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A23CR13	1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	
A23CR14	1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60P1V	
A23K1	0490-0044	RELAY:REED SPST NO 12VDC	
A23Q1	1854-0003	TRANSISTOR:NPN SILICON	
A23Q2	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A23Q3	1854-0003	TRANSISTOR:NPN SILICON	
A23Q4	1854-0003	TRANSISTOR:NPN SILICON	
A23Q5	1854-0003	TRANSISTOR:NPN SILICON	
A23Q6	1854-0003	TRANSISTOR:NPN SILICON	
A23Q7	1851-0017	TRANSISTOR:2N1304	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A23R1	0727-0131	R:FXD DEPC 3920 OHM 1% 1/2W	
A23R2	0727-0336	R:FXD DEPC 314.5 OHM 1/2% 1/2W	
A23R3	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A23R4	0727-0356	R:FXD DEPC 5800 OHM 1% 1/2W	
A23R5	0727-0129	R:FXD DEPC 3.60K OHM 1% 1/2W	
A23R6 THRU A23R7		NOT ASSIGNED	
A23R8	0727-0134	R:FXD DEPC 4.44K OHM 1% 1/2W	
A23R9	0758-0050	R:FXD MET FLM 39K OHM 5% 1/2W	
A23R10	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
A23R11 THRU A23R14		NOT ASSIGNED	
A23R15	0727-0152	R:FXD DEPC 9000 OHM 1% 1/2W	
A23R16	0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	
A23R17	0730-0036	R:FXD DEPC 15.8K OHM 1% 1W	
A23R18	0758-0051	R:FXD MET FLM 43K OHM 5% 1/2W	
A23R19	0727-0144	R:FXD DEPC 6750 OHM 1% 1/2W	
A23R20	2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	
A23R21	0727-0148	R:FXD DEPC 7.842K OHM 1% 1/2W	
A23R22 THRU A23R25		NOT ASSIGNED	
A23R26	0687-2241	R:FXD COMP 220K OHM 10% 1/2W	
A23R27	2100-0362	R:VAR COMP 100K OHM 30% LIN 1/4W	
A23R28	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A23R29	0758-0012	R:FXD MET FLM 12K OHM 5% 1/2W	
A23R30	0758-0057	R:FXD MET FLM 5600 OHM 5% 1/2W	
A23R31 THRU A23R34		NOT ASSIGNED	
A23R35	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A23R36	0758-0055	R:FXD MET FLM 360 OHM 5% 1/2W	
A23R37	0758-0070	R:FXD MET FLM 1200 OHM 5% 1/2W	
A23R38	0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	
A23R39	0727-0279	R:FXD DEPC 1.15 MEGOHM 1% 1/2W	
A23R40	0727-0233	R:FXD DEPC 333K OHM 1% 1/2W	
A23R41 THRU A23R44		NOT ASSIGNED	
A23R45	0687-3341	R:FXD COMP 330K OHM 10% 1/2W	
A23R46	2100-0362	R:VAR COMP 100K OHM 30% LIN 1/4W	
A23R47	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
A23R48	0758-0073	R:FXD MET FLM 24K OHM 5% 1/2W	
A23R49	0687-1811	R:FXD COMP 180 OHM 10% 1/2W	
A23R50	0758-0079	R:FXD MET FLM 30K OHM 5% 1/2W	
A23R51	0758-0076	R:FXD MET FLM 66K OHM 5% 1/2W	
A24	310A-65U	ASSY: POWER SUPPLY	
A24C1	0160-0174	C:FXD CER 0.47UF 80% 25VDCW	
A24C2	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A24C3	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A24C4 THRU A24C10		NOT ASSIGNED	
A24C11	0160-0174	C:FXD CER 0.47UF 80% 25VDCW	
A24C12	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	

See list of abbreviations in introduction to this section

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

Reference Designation	ℌ Stock No.	Description #	Note
A24C13	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
A24CR1	1901-0028	DIODE:SILICON 0.5A 400 PIV	
A24CR2	1901-0028	DIODE:SILICON 0.5A 400 PIV	
A24CR3	1902-0227	DIODE, BREAKDOWN:22.6V 5% 1.5W	
A24CR4	1902-0017	DIODE, BREAKDOWN:6.81V 10% 400MW	
A24CR5	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A24CR6 THRU A24CR10		NOT ASSIGNED	
A24CR11	1901-0028	DIODE:SILICON 0.5A 400 PIV	
A24CR12	1901-0028	DIODE:SILICON 0.5A 400 PIV	
A24CR13	1902-0227	DIODE, BREAKDOWN:22.6V 5% 1.5W	
A24CR14	1902-0017	DIODE, BREAKDOWN:6.81V 10% 400MW	
A24CR15	1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	
A24Q1	1850-0048	TRANSISTOR:GERMANIUM 2N650 PNP	
A24Q2	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A24Q3 THRU A24Q10		NOT ASSIGNED	
A24Q11	1850-0048	TRANSISTOR:GERMANIUM 2N650 PNP	
A24Q12	1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	
A24R1	0687-6811	R:FXD COMP 680 OHM 10% 1/2W	
A24R2	0687-1821	R:FXD COMP 1800 OHM 10% 1/2W	
A24R3	0687-2721	R:FXD COMP 2700 OHM 10% 1/2W	
A24R4	0687-5611	R:FXD COMP 560 OHM 10% 1/2W	
A24R5	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
A24R6	0687-2721	R:FXD COMP 2700 OHM 10% 1/2W	
A24R7	2100-0360	R:VAR COMP 250 OHM 30% 1/4W	
A24R8	0687-5611	R:FXD COMP 560 OHM 10% 1/2W	
A24R9	0687-3301	R:FXD COMP 33 OHM 10% 1/2W	
A24R10	0687-3301	R:FXD COMP 33 OHM 10% 1/2W	
A24R11	0687-6811	R:FXD COMP 680 OHM 10% 1/2W	
A24R12	0687-2221	R:FXD COMP 2200 OHM 10% 1/2W	
A24R13	0687-2721	R:FXD COMP 2700 OHM 10% 1/2W	
A24R14	0687-5611	R:FXD COMP 560 OHM 10% 1/2W	
A24R15	0687-1041	R:FXD COMP 100K OHM 10% 1/2W	
A24R16	0687-2721	R:FXD COMP 2700 OHM 10% 1/2W	
A24R17	2100-0360	R:VAR COMP 250 OHM 30% 1/4W	
A24R18	0687-5611	R:FXD COMP 560 OHM 10% 1/2W	
A24R19	0687-3301	R:FXD COMP 33 OHM 10% 1/2W	
C1	0160-0018	C:FXD MY 0.22UF 10% 400VDCW	
C2	0160-0018	C:FXD MY 0.22UF 10% 400VDCW	
C3	0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	
C4	0180-0028	C:FXD ELECT 2X1500UF 15VDCW	
C5	0180-0028	C:FXD ELECT 2X1500UF 15VDCW	
C6	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C7 THRU C8		NOT ASSIGNED	
C9	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C10	0180-0056	C:FXD ELECT 1000UF 50VDCW	
C11	0180-0056	C:FXD ELECT 1000UF 50VDCW	
C12	0180-0056	C:FXD ELECT 1000UF 50VDCW	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
C13	0180-0056	C:FXD ELECT 1000UF 50VDCW	
C14		NOT ASSIGNED	
C15	0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	
C16	0180-0143	C:FXD ELECT 2X500UF 25VDCW	
C17	310A-7C	CAPACITOR) VAR. AIR 90-300PF	
C18	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C19	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C20	0180-0057	C:FXD ELECT 1000UF 25VDCW	
C21	0160-0124	C:FXD POLY 0.864UF 0.115UF 0.735UF 9800PF	
C22	0160-0124	C:FXD POLY 0.864UF 0.115UF 0.735UF 9800PF	
C23	0160-0125	C:FXD POLY 2.08UF 0.278UF 0.304UF 0.0405UF	
C24	0160-0125	C:FXD POLY 2.08UF 0.278UF 0.304UF 0.0405UF	
DS1	1450-0048	LAMP:NEON	
DS2 THRU			
DS4		NOT ASSIGNED	
DS5	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS6	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS7	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS8	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS9	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS10	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS11	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS12	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS13	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS14	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS15	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS16	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS17	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS18	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
DS19	2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	
F1	2110-0018	FUSE:CARTRIDGE 0.25 AMP SLOW BLOW	
J1	1510-0008	BINDING POST:RED	
J1	1510-0009	BINDING POST:BLACK	
J2	1251-0066	JACK:TELEPHONE 2-CONDUCTOR NC RECORDER	
J3	1250-0102	CONNECTOR:BNC OUTPUT	
J4	1251-0148	CONNECTOR:POWER 3 PIN MALE	
L1	310A-6C	COIL:ZERO SET	
L2	9140-0129	COIL:FXD RF 220 UH	
L3	9140-0129	COIL:FXD RF 220 UH	
M1	1120 0307	METER NOT USED IN OPTION 02	
M1	310A-81B	METER OPTION 02 ONLY	
MP1	5060-0737	FRAME ASSY: 10X16 FM	
MP2	310A-2A	PANEL:FRONT	
MP3	5060-0763	HANDLE ASSY-SIDE	
MP4	5060-0765	RETAINER-HANDLE ASSY.	
MP5	5060-0767	FOOT ASSY-FM	

 # See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
MP6 THRU			
MP7		NOT ASSIGNED	
MP8	5060-0778	KIT: RACK MOUNT	
MP9		NOT ASSIGNED	
MP10	5060-0740	TOP COVER ASSY. 16L FM	
MP11	5060-0752	BOTTOM COVER ASSY 16L FM	
MP12	310A-2B	PANEL:REAR HALF RECESS	
MP13	310A-2C	PANEL:REAR HALF UNRECESSED	
P1		N.S.R. PART OF W1	
P2 THRU			
P3		NOT ASSIGNED	
P4		N.S.R. PART OF W1	
Q1	1850-0038	TRANSISTOR:PNP GE	
Q2	1850-0038	TRANSISTOR:PNP GE	
Q3	1850-0038	TRANSISTOR:PNP GE	
Q4	1850-0038	TRANSISTOR:PNP GE	
R1	2100-0076	R:VAR COMP 75 OHM 10% LIN 2W	
R2	0727-0077	R:FXD DEPC 500 OHM 1% 1/2W	
R3	2100-0019	R:VAR COMP 500 OHM 10% LIN 1/2W	
R4 THRU			
R9		NOT ASSIGNED	
R10	2100-0234	R:VAR COMP 10K OHM 20% LIN 2W	
R11 THRU			
R14		NOT ASSIGNED	
R15	0813-0028	R:FXD WW 1 OHM 10% 1W	
R16 THRU			
R19		NOT ASSIGNED	
R20	0687-3331	R:FXD COMP 33K OHM 10% 1/2W	
R21	0812-0019	R:FXD WW 0.33 OHM 5% 3W	
R22	0812-0022	R:FXD WW 0.56 5% 3W	
S1		NOT ASSIGNED	
S2	3101-0011	SWITCH:SLIDE DPDT 0.5 AMP 125 VDC	
S3	3101-0037	SWITCH TOG SPST 3 AMP 125V	
S4 THRU			
S23		NOT ASSIGNED	
S24	3101-0038	SWITCH TOG DPDT 3 AMP 125 V	
S25	3101-0033	SWITCH:SLIDE DPDT	
S26 THRU			
S49		NOT ASSIGNED	
S50	3101-0051	SWITCH PUSHBOTTON DPDT MOMENTARY OPTION 01 MARKER	
T1	9100-0168	TRANSFORMER-POWER	
W1	8120-0078	CABLE POWER 7.5FT.	
XF1	1400-0084	FUSEHOLDER EXTRACTOR POST TYPE	
XY51	1200-0020	SOCKET:OCTAL BASE	
Y1	0410-0025	CRYSTAL:QUARTZ 3MC	
Y2 THRU			
Y50		NOT ASSIGNED	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
Y51	0410-0088	CRYSTAL: QUARTZ 100KC OPTION 01 ONLY	
		MISCELLANEOUS	
	0340-0089	BINDING POST:SINGLE RECORDER JACK	
	5060-0049	BOARD:EXTENDER ASSY	
	1200-0081	BUSHING:INSULATOR NYLON TRANSISTOR	
	6960-0001	BUTTON-PLUG NOT ON OPTION 01	
	1400-0033	CLAMP:TUBE OPTION 01 ONLY	
	1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	
	5000-0748	COVER:SIDE 10X16 FM	
	0510-0123	FASTENER:PUSH-ON TYPE	
	1200-0043	INSULATOR:TRANSISTOR ANODIZED ALUMINUM	
	0340-0090	INSULATOR:BINDING-POST DOUBLE INPUT BINDING POSTS	
	0370-0025	KNOB: FINE FREQUENCY	
	0370-0026	KNOB: AMPLITUDE	
	0370-0028	KNOB: COARSEFREQUENCY ZERO SET	
	0370-0035	KNOB: RANGE BANDWIDTH MODE	
	0370-0037	KNOB: MAX INPUT VOLTAGE	
	0370-0063	KNOB: REF ADJUST	
	310A-95B	LAMPHOLDER: 3 POSITION	
	1520-0001	PLATE:MOUNTING ELECTROLYTIC CAPACITOR	
	1460-0060	SPRING:LEAF 3/8 X 15/16 X 11/16 IN	
	1460-0115	SPRING:LEAF	
	1450-0053	SPRING:TORSION	
	1490-0030	STAND:TILT	
	310A-88A	WASHER:OUTPUT CONNECTOR	
	310A-99A	WINDOW:RANGE	
	1500-0002	YOKE:COUPLER BANDWIDTH SWITCH	

 # See list of abbreviations in introduction to this section

Table 6-2. Replaceable Parts

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ	
310A-2A	PANEL:FRONT	28480	310A-2A	1	
310A-2B	PANEL:REAR HALF RECESS	28480	310A-2B	1	
310A-2C	PANEL:REAR HALF UNRECESSED	28480	310A-2C	1	
310A-6C	COIL:ZERO SET	28480	310A-6C	1	
310A-7C	CAPACITOR VAR. AIR 90-300PF	28480	310A-7C	1	
310A-9A	TRANSFORMER ASSY:	28480	310A-9A	2	
310A-9B	TRANSFORMER ASSY:	28480	310A-9B	2	
310A-9C	TRANSFORMER	28480	310A-9C	1	
310A-9D	TRANSFORMER- ASSY	28480	310A-9D	1	
310A-9E	TRANSFORMER-ASSY	28480	310A-9E	1	
310A-9F	TRANSFORMER-ASSY	28480	310A-9F	1	
310A-9G	TRANSFORMER- ASSY	28480	310A-9G	1	
310A-9H	TRANSFORMER ASSY:	28480	310A-9H	1	
310A-9J	TRANSFORMER ASSY:	28480	310A-9J	1	
310A-9K	TRANSFORMER:	28480	310A-9K	1	
310A-9L	TRANSFORMER:	28480	310A-9L	1	
310A-9M	TRANSFORMER:	28480	310A-9M	1	
310A-9N	TRANSFORMER- ASSY:	28480	310A-9N	1	
310A-9P	TRANSFORMER ASSY	28480	310A-9P	1	
310A-9R	TRANSFORMER ASSY:	28480	310A-9R	1	
310A-19A	SWITCH ASSEMBLY:INPUT ATTENUATOR	28480	310A-19A	1	
310A-19B	SWITCH ASSEMBLY: I. F. ATTENUATOR	28480	310A-19B	1	
310A-19C	SWITCH ASSEMBLY:R.F. ATTENUATOR	28480	310A-19C	1	
310A-19D	SWITCH ASSEMBLY:BANDWIDTH	28480	310A-19D	1	
310A-19E	SWITCH ASSY: MODE	28480	310A-19E	1	
310A-60A	INDUCTOR: 175MH	28480	310A-60A	1	
310A-65B	ASSY: 1ST MIXER PAIR	28480	310A-65B	1	
310A-65C	ASSY: 2ND MIXER PAIR	28480	310A-65C	1	
310A-65D	ASSY: ACTIVE LPF	28480	310A-65D	2	
310A-65E	ASSY: 3 MC LPF	28480	310A-65E	1	
310A-65F	ASSY: 3 MC OSCILLATOR	28480	310A-65F	1	
310A-65G	ASSY: INPUT AMP AND CALIB	28480	310A-65G	1	
310A-65H	ASSY: LOCAL OSC AMP & INPUT MIXER	28480	310A-65H	1	
310A-65J	ASSY: METER AMPLIFIER	28480	310A-65J	1	
310A-65K	ASSY: OUTPUT AMPLIFIER	28480	310A-65K	1	
310A-65L	ASSY: AFC #1	28480	310A-65L	1	
310A-65M	ASSY: AFC #2	28480	310A-65M	1	
310A-65N	ASSY: BFO	28480	310A-65N	1	
310A-65P	ASSY: LOCAL OSCILLATOR	28480	310A-65P	1	
310A-65R	ASSY: INPUT ATTENUATOR BOARD	28480	310A-65R	1	
310A-65S	ASSY: 1.5MC L.P.F.	28480	310A-65S	2	
310A-65T	ASSY: INPUT AMP CAL	28480	310A-65T	1	
310A-65U	ASSY: POWER SUPPLY	28480	310A 65U	1	
310A-81B	METER OPTION 02 ONLY	28480	310A-81B	1	
310A-88A	WASHER:OUTPUT CONNECTOR	28480	310A-88A	1	
310A-95B	LAMPHOLDER: 3 POSITION	28480	310A-95B	1	
310A-99A	WINDOW:RANGE	28480	310A-99A	1	
0121-0031	C:VAR AIR 1.85-10.38PF	74970	U 189 5	1	
0121-0038	C:VAR AIR 1.8-4.6PF INCLUDES A AND B	74970	160303	3	
0122-0001	VARICAPACITOR:SI 100PF 20% 20VDCW	28480	0122-0001	2	

See list of abbreviations in introduction to this section

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

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0130-0006	C:VAR CER 5-20PF 500VDCW	72982	B2P026R	1
0130-0013	C:VAR CER 3-12 PF NPO	28480	0130-0013	3
0130-0016	C:VAR CER 5-25 PF NPO	28480	0130-0016	2
0131-0001	C:VAR MICA 50 TO 380 PF 175VDCW	72136	465	4
0131-0002	C:VAR MICA 110-580 PF 175 V	72136	467	2
0131-0003	C:VAR MICA 170-780 PF 175VDCW	72136	T52910 REV.D	6
0131-0004	C:VAR MICA 16-150 PF 175VDCW	28480	0131-0004	5
0132-0003	C:VAR POLY 0.7-3.0 PF	72982	535-016-4R	1
0140-0010	C:FXD MICA 33 PF 5% 500 VDCW	00853	CM15E330J	1
0140-0017	C:FXD MICA 4700 PF 5% 500VDCW	00853	RCM30E472K	1
0140-0018	C:FXD MICA 1000 PF 5% 500VDCW	00853	TYPE KR120 E5	1
0140-0024	C:FXD MICA 2200 PF 10% 500 VDCW	00853	TYPE C C1222 B10	1
0140-0040	C:FXD MICA 75 PF 5% 500 VDCW	00853	TYPE DR1475 E5	1
0140-0090	C:FXD MICA 200 PF 5%	28480	0140-0090	1
0140-0091	C:FXD MICA 820 PF 5% 500 VDCW	00853	TYPE KR1382 ED	1
0140-0109	C:FXD MICA 209 PF 2% 300 VDCW	04062	CM15E(209PF) G	1
0140-0110	C:FXD MICA SIL 127 PF 2% 300 VDCW	11711	MCM 15E(127)G	1
0140-0111	C:FXD MICA 101.4 PF 2% NPO 500 VDCW	14655	RCM15E 101.4G	3
0140-0144	C:FXD MICA 18PF 1/2%	28480	0140-0144	1
0140-0150	C:FXD MICA 731.5 PF 1% 300 VDCW	04062	DM15F731.5DF	1
0140-0155	C:FXD MICA 1325 PF 1% 500 VDCW	04062	DM20F1325F	1
0140-0163	C:FXD MICA 4751 PF 1% 300 VDCW	04062	DM20F4751F	1
0140-0170	C:FXD MICA 5600 PF 5% 300 VDCW	04062	DM20F562J	1
0140-0175	C:FXD MICA 39 PF 2% 300 VDCW	04062	DM15E390G (300V)	1
0140-0180	C:FXD MICA 2000 PF 2% 300 VDCW	04062	DM19F202G (300V)	1
0140-0182	C:FXD MICA 5000 PF 2% 300 VDCW	04062	DM20F502G 300V	2
0140-0184	C:FXD MICA 8200 PF 1% 100 VDCW	04062	DM20F822F 100V	1
0140-0196	C:FXD MICA 150 PF 5% 300 VDCW	04062	DM15F151J 300V	1
0140-0197	C:FXD MICA 180 PF 5% 300 VDCW	04062	DM15F181J 300V	1
0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	04062	DM15E470J	1
0140-0225	C:FXD MICA 300PF 1% 300VDCW	04062	DM15F301F 300V	1
0140-0228	C:FXD MICA 360PF 1% 300VDCW	04062	DM15F361F 300V	1
0150-0012	C:FXD CER 0.01UF 20% 1000VDCW	56289	H 1038	5
0150-0024	C:FXD CER 0.02UF +80%-20% 600VDCW	71590	DD203	2
0150-0084	C:FXD CER 0.1UF +80-20% 50VDCW	56289	33C41	7
0150-0093	C:FXD CER 0.01UF +80-20 100VDCW	91418	TA	1
0150-0096	C:FXD CER 0.05UF 100VDCW	91418	-TA	29
0160-0018	C:FXD MY 0.22UF 10% 400VDCW	56289	160P22494	2
0160-0124	C:FXD POLY 0.864UF 0.115UF 0.735UF 9800PF	28480	0160-0124	2
0160-0125	C:FXD POLY 2.08UF 0.278UF 0.304UF 0.0405UF	28480	0160-0125	2
0160-0127	C:FXD CER 1UF 20% 25VDCW	56289	5C13	2
0160-0139	C:FXD MICA 270 PF 2%	04062	RDM19E271G3S	2
0160-0174	C:FXD CER 0.47UF 80% 25VDCW	56289	5C11A	4
0160-0186	C:FXD MICA 10.7PF 1% 300VDCW	04062	DM19C 10.7PF F 30V4	2
0160-0187	C:FXD MICA 42PF 1% 300VDCW	04062	DM19C420F 300V	3
0160-0188	C:FXD MICA 53PF 5% 300VDCW	04062	DM19C530J 300V	1
0160-0189	C:FXD MICA 73PF 1% 300VDCW	04062	DM19C730F 300V	2
0160-0190	C:FXD MICA 225PF 1% 300VDCW	04062	DM19E 225PF F 300V	2
0160-0191	C:FXD MICA 272PF 1% 300VDCW	04062	DM19E 272PF F 300V	2
0160-0192	C:FXD MICA 525PF 5% 300VDCW	04062	DM19E 525PF J 300V	1

See list of abbreviations in introduction to this section

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

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0160-0193	C:FXD MICA 1125PF 5% 300VDCW	04062	DM19F 1125PF J 300V	3
0160-0196	C:FXD MICA 24PF 5% 300VDCW	04062	DM15C240J	1
0160-0200	C:FXD MYLAR 0.22UF 20% 200VDCW	28480	0160-0200	2
0160-0203	C:FXD MICA 150PF 1% 300VDCW	04062	DM19E151F(300V)	2
0160-0362	C:FXD MICA 510 PF 5%	04062	RDM15F511J3C	2
0170-0018	C:FXD MY 1UF 5% 200VDCW	84411	HEW 4	1
0170-0055	C:FXD MY 0.1UF 20% 200VDCW	56289	192P10402	1
0170-0064	C:FXD MY 0.47UF 10% 100VDCW	24446	61F39AA474	1
0170-0066	C:FXD MY 0.027UF 10% 200VDCW	56289	192P27392	1
0170-0085	C:FXD MY 0.1UF 20% 50VDCW	84411	601PE STYLE 3	1
0180-0028	C:FXD ELECT 2X1500UF 15VDCW	56289	D32442	2
0180-0033	C:FXD ELECT 50UF 6VDCW	56289	30D133A1	4
0180-0045	C:FXD ELECT 20UF 25VDCW	56289	TYPE 30D	2
0180-0056	C:FXD ELECT 1000UF 50VDCW	56289	D32429	4
0180-0057	C:FXD ELECT 1000UF 25VDCW	56289	D32606	5
0180-0058	C:FXD ELECT 50UF -10%+100% 25VDCW	56289	TYPE 30D186A1	13
0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	56289	30D182A1	4
0180-0060	C:FXD ELECT 200UF -10%+100% 3VDCW	56289	30D116A1	4
0180-0061	C:FXD ELECT 100UF +100%-10% 15VDCW	56289	30D172A1	2
0180-0076	C:FXD ELECT 20UF 25VDCW	56289	40D 181 A2	1
0180-0104	C:FXD ELECT 200UF 15VDCW	56289	30D174A1	3
0180-0111	C:FXD ELECT 2UF 25VDCW	56289	40D173A2	1
0180-0124	C:FXD ELECT 200UF 6VDCW	56289	30D137A1	1
0180-0143	C:FXD ELECT 2X500UF 25VDCW	56289	13844	1
0180-0144	C:FXD ELECT 200UF -10+100% 25VDCW	56289	41D D31334	2
0180-0145	C:FXD ELECT 500UF -10+100% 10VDCW	56289	41D D31335	1
0340-0089	BINDING POST:SINGLE	28480	0340-0089	1
0340-0090	INSULATOR:BINDING-POST DOUBLE	28480	0340-0090	1
0370-0025	KNOB:	28480	0370-0025	1
0370-0026	KNOB;	28480	0370-0026	1
0370-0028	KNOB:	28480	0370-0028	1
0370-0035	KNOB:	28480	0370-0035	1
0370-0037	KNOB;	28480	0370-0037	1
0370-0063	KNOB:	28480	0370-0063	1
0410-0025	CRYSTAL:QUARTZ 3MC,MATCHED PAIR	28480	0410-0025	1
0410-0088	CRYSTAL: QUARTZ 100KC,OPTION 02 ONLY	28480	0410-0088	1
0490-0044	RELAY:REED SPST NO 12VDC	78290	MRR-1A(MOD)	1
0510-0123	FASTENER:PUSH-ON TYPE	78553	C12008-014-4	1
0683-1225	R:FXD COMP 1200 OHM 5% 1/4W	01121	CB 1225	2
0683-6825	R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825	1
0684-1011	R:FXD COMP 100 OHM 10% 1/4W	01121	CB 1011	1
0684-1021	R:FXD COMP 1000 OHM 10% 1/4W	01121	CB 1021	1
0684-1031	R:FXD COMP 10K OHM 10% 1/4W	01121	CB 1031	4
0684-4711	R:FXD COMP 470 OHM 10% 1/4W	01121	CB 4711	1
0684-4721	R:FXD COMP 4700 OHM 10% 1/4W	01121	CB 4721	6
0686-3305	R:FXD COMP 33 OHM 5% 1/2W	01121	EB 3305	1
0687-1011	R:FXD COMP 100 OHM 10% 1/2W	01121	EB 1011	8
0687-1021	R:FXD COMP 1000 OHM 10% 1/2W	01121	EB 1021	5
0687-1031	R:FXD COMP 10K OHM 10% 1/2W	01121	EB 1031	6
0687-1041	R:FXD COMP 100K OHM 10% 1/2W	01121	EB 1041	4

See list of abbreviations in introduction to this section

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

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0687-1211	R:FXD COMP 120 OHM 10% 1/2W	01121	EB 1211	1
0687-1221	R:FXD COMP 1200 OHM 10% 1/2W	01121	EB 1221	2
0687-1231	R:FXD COMP 12K OHM 10% 1/2W	01121	EB 1231	1
0687-1511	R:FXD COMP 150 OHM 10% 1/2W	01121	EB 1511	1
0687-1521	R:FXD COMP 1500 OHM 10% 1/2W	01121	EB 1521	2
0687-1531	R:FXD COMP 15K OHM 10% 1/2W	01121	EB 1531	4
0687-1811	R:FXD COMP 180 OHM 10% 1/2W	01121	EB 1811	3
0687-1821	R:FXD COMP 1800 OHM 10% 1/2W	01121	EB 1821	2
0687-1831	R:FXD COMP 18K OHM 10% 1/2W	01121	EB 1831	2
0687-2201	R:FXD COMP 22 OHM 10% 1/2W	01121	EB 2201	3
0687-2211	R:FXD COMP 220 OHM 10% 1/2W	01121	EB 2211	3
0687-2221	R:FXD COMP 2200 OHM 10% 1/2W	01121	EB 2221	4
0687-2241	R:FXD COMP 220K OHM 10% 1/2W	01121	EB 2241	1
0687-2701	R:FXD COMP 27 OHM 10% 1/2W	01121	EB 2701	3
0687-2721	R:FXD COMP 2700 OHM 10% 1/2W	01121	EB 2721	4
0687-2731	R:FXD COMP 27K OHM 10% 1/2W	01121	EB 2731	2
0687-3301	R:FXD COMP 33 OHM 10% 1/2W	01121	EB 3301	3
0687-3311	R:FXD COMP 330 OHM 10% 1/2W	01121	EB 3311	6
0687-3321	R:FXD COMP 3300 OHM 10% 1/2W	01121	EB 3321	5
0687-3331	R:FXD COMP 33K OHM 10% 1/2W	01121	EB 3331	2
0687-3341	R:FXD COMP 330K OHM 10% 1/2W	01121	EB 3341	1
0687-3921	R:FXD COMP 3900 OHM 10% 1/2W	01121	EB 3921	1
0687-4701	R:FXD COMP 47 OHM 10% 1/2W	01121	EB 4701	2
0687-4711	R:FXD COMP 470 OHM 10% 1/2W	01121	EB 4711	1
0687-4721	R:FXD COMP 4700 OHM 10% 1/2W	01121	EB 4721	11
0687-5611	R:FXD COMP 560 OHM 10% 1/2W	01121	EB 5611	5
0687-5621	R:FXD COMP 5600 OHM 10% 1/2W	01121	EB 5621	5
0687-6801	R:FXD COMP 68 OHM 10% 1/2W	01121	EB 6801	2
0687-6811	R:FXD COMP 680 OHM 10% 1/2W	01121	EB 6811	3
0687-8211	R:FXD COMP 820 OHM 10% 1/2W	01121	EB 8211	5
0690-1021	R:FXD COMP 1000 OHM 10% 1W	01121	GB 1021	1
0727-0002	R:FXD DEPC 3.0 OHM 1% 1/2W	19701	DC 1/2 CR5	1
0727-0004	R:FXD DEPC 5 OHM 1% 1/2W	19701	DC 1/2 CR5	1
0727-0013	R:FXD DEPC 24.3 OHM 1% 1/2W	19701	DC 1/2C R5	2
0727-0017	R:FXD DEPC 37.35 OHM 1/2% 1/2W	19701	DC 1/2 CR5	2
0727-0023	R:FXD DEPC 50 OHM 1% 1/2W	19701	DC-1/2C R5	1
0727-0027	R:FXD DEPC 53.3 OHM 1% 1/2W	19701	DC 1/2 CR5	3
0727-0034	R:FXD DEPC 61.11 OHM 1/2% 1/2W	19701	DC 1/2 CR5	4
0727-0036	R:FXD DEPC 71.16 OHM 1% 1/2W	19701	DC 1/2 CR5	1
0727-0037	R:FXD DEPC 71.16 OHM 1/2% 1/2W	19701	DC 1/2 CR5	2
0727-0042	R:FXD DEPC 96.25 OHM 1/2% 1/2W	19701	DC 1/2 CR5	4
0727-0044	R:FXD DEPC 120 OHM 1% 1/2W	19701	DC 1/2 CR5	2
0727-0055	R:FXD DEPC 201 OHM 1% 1/2W	19701	DC 1/2 CR5	1
0727-0062	R:FXD DEPC 247.5 OHM 1/2% 1/2W	19701	DC 1/2 CR5	6
0727-0066	R:FXD DEPC 312 OHM 1% 1/2W	19701	DC 1/2 BR5	2
0727-0072	R:FXD DEPC 403 OHM 1% 1/2W	19701	DC 1/2 CR5	2
0727-0075	R:FXD DEPC 490 OHM 1% 1/2W	19701	DC 1/2C R5	1
0727-0077	R:FXD DEPC 500 OHM 1% 1/2W	19701	DC 1/2 BR5	1
0727-0091	R:FXD DEPC 790 OHM 1/2% 1/2W	19701	DC 1/2C SPEC	1
0727-0100	R:FXD DEPC 1000 OHM 1% 1/2W	19701	CD 1/2CR5	12

See list of abbreviations in introduction to this section

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

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0727-0101	R:FXD DEPC 1.03K OHM 1% 1/2W	19701	CD 1/2CR5	3
0727-0105	R:FXD DEPC 1200 OHM 1%	28480	0727-0105	2
0727-0109	R:FXD DEPC 1470 OHM 1% 1/2W	19701	DC 1/2CR5	1
0727-0115	R:FXD DEPC 2000 OHM 1% 1/2W	19701	DC 1/2CR5	9
0727-0116	R:FXD DEPC 2030 OHM 1% 1/2W	19701	DC 1/2CR5	2
0727-0120	R:FXD DEPC 2.25K OHM 1% 1/2W	19701	DC 1/2CR5	1
0727-0128	R:FXD DEPC 3.60K OHM 1% 1/2W	19701	DC 1/2BR5	1
0727-0131	R:FXD DEPC 3920 OHM 1% 1/2W	19701	DC 1/2CR5	1
0727-0134	R:FXD DEPC 4.44K OHM 1% 1/2W	19701	DC 1/2BR5	1
0727-0144	R:FXD DEPC 6750 OHM 1% 1/2W	19701	DC1/2B R5	1
0727-0148	R:FXD DEPC 7.842K OHM 1% 1/2W	19701	DC 1/2CR5	1
0727-0152	R:FXD DEPC 9000 OHM 1% 1/2W	19701	DC 1/2BR5	1
0727-0153	R:FXD DEPC 9.1K OHM 1% 1/2W	19701	DC 1/2CR5	2
0727-0168	R:FXD DEPC 15K OHM 1% 1/2W	19701	DC 1/2CR5	1
0727-0176	R:FXD DEPC 20.4K OHM 1% 1/2W	19701	CF 1/2	1
0727-0178	R:FXD DEPC 24.7K OHM 1% 1/2W	19701	DC 1/2AR5	1
0727-0185	R:FXD DEPC 29.9K OHM 1% 1/2W	28480	0727-0185	1
0727-0203	R:FXD DEPC 90K OHM 1% 1/2W	19701	DC 1/2B R5	1
0727-0207	R:FXD DEPC 99K OHM 1% 1/2W	19701	DC 1/2C R5	1
0727-0208	R:FXD DEPC 100K OHM 1% 1/2W	19701	DC1/2CR5	1
0727-0233	R:FXD DEPC 333K OHM 1% 1/2W	19701	DC 1/2A R5	1
0727-0279	R:FXD DEPC 1.15 MEGOHM 1% 1/2W	19701	DC 1/2C R5	1
0727-0336	R:FXD DEPC 314.5 OHM 1/2% 1/2W	19701	DC 1/2 A R5	1
0727-0356	R:FXD DEPC 5800 OHM 1% 1/2W	19701	DC 1/2C R5	1
0727-0411	R:FXD DEPC 1110 OHM 1% 1/2W	19701	DC 1/2 AR5	1
0727-0412	R:FXD DEPC 21.5K OHM 1% 1/2W	19701	DC 1/2 AR5	1
0727-0413	R:FXD DEPC 99.7K OHM 1% 1/2W	19701	DC 1/2 AR5	1
0727-0414	R:FXD DEPC 96.8K OHM 1% 1/2W	19701	DC 1/2 AR5	1
0727-0416	R:FXD DEPC 69.0 OHM 1/2% 1/2W	19701	DC 1/2 AR5	1
0727-0417	R:FXD DEPC 64.0 OHM 1/2% 1/2W	19701	DC 1/2 AR5	1
0727-0418	R:FXD DEPC 43.7 OHM 1/2% 1/2W	19701	DC 1/2 AR5	1
0727-0420	R:FXD DEPC 4620 OHM 1% 1/2W	19701	DC 1/2 AR5	1
0727-0466	R:FXD DEPC 135 OHM 1% 0.5W	19701	DC1/2CR5	1
0727-0487	R:FXD DEPC 20.1 OHM 1/2% 1/2W	28480	0727-0487	1
0727-0488	R:FXD DEPC 326 OHM 1/2% 1/2W	28480	0727-0488	1
0730-0036	R:FXD DEPC 15.8K OHM 1% 1W	19701	DC1 R5	1
0757-0158	R:FXD MET FLM 619 OHM 1% 1/2W	75042	CEC T-0	8
0757-0159	R:FXD MET FLM 1000 OHM 1% 1/2W	75042	CEC T-0	12
0758-0002	R:FXD MET FLM 560 OHM 5% 1/2W	07115	C 20	1
0758-0003	R:FXD MET FLM 1000 OHM 5% 1/2W	07115	C 20/1K-5%-1/2W	6
0758-0004	R:FXD MET FLM 2700 OHM 5% 1/2W	07115	C 20	1
0758-0005	R:FXD MET OX 4700 OHM 5% 1/2W	28480	0758-0005	6
0758-0006	R:FXD MET FLM 10K OHM 5% 1/2W	07115	C 20	4
0758-0010	R:FXD MET OX 3300 OHM 5%	28480	0758-0010	2
0758-0012	R:FXD MET FLM 12K OHM 5% 1/2W	07115	C 20	1
0758-0017	R:FXD MET FLM 1500 OHM 5% 1/2W	07115	C 20	3
0758-0019	R:FXD MET FLM 18K OHM 5% 1/2W	07115	C 20	4
0758-0021	R:FXD MET FLM 51K OHM 5% 1/2W	07115	C 20/51K-5%	1
0758-0024	R:FXD MET FLM 100 OHM 5% 1/2W	07115	C 20	1
0758-0025	R:FXD MET FLM 160 OHM 5% 1/2W	07115	C 20	1

See list of abbreviations in introduction to this section

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

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0758-0030	R:FXD MET FLM 510 OHM 5% 1/2W	07115	C 20	1
0758-0031	R:FXD MET FLM 680 OHM 5% 1/2W	07115	C 20	1
0758-0032	R:FXD MET OX 820 OHM 5%	28480	0758-0032	2
0758-0033	R:FXD MET FLM 2000 OHM 5% 1/2W	07115	C 20	1
0758-0034	R:FXD MET FLM 2400 OHM 5% 1/2W	07115	C 20	2
0758-0035	R:FXD MET FLM 3000 OHM 5% 1/2W	07115	C 20	1
0758-0037	R:FXD MET FLM 5100 OHM 5% 1/2W	07115	C 20	3
0758-0038	R:FXD MET FLM 9100 OHM 5% 1/2W	07115	C 20	2
0758-0039	R:FXD MET FLM 20K OHM 5% 1/2W	07115	C 20	2
0758-0040	R:FXD MET FLM 47K OHM 5% 1/2W	07115	C 20	2
0758-0044	R:FXD MET FLM 2200 OHM 5% 1/2W	07115	C 20	5
0758-0046	R:FXD MET FLM 6200 OHM 5% 1/2W	07115	C 20	1
0758-0047	R:FXD MET FLM 7500 OHM 5% 1/2W	07115	C 20	2
0758-0049	R:FXD MET FLM 33K OHM 1/2W	07115	C20	4
0758-0050	R:FXD MET FLM 39K OHM 5% 1/2W	07115	C 20	1
0758-0051	R:FXD MET FLM 43K OHM 5% 1/2W	07115	C 20	1
0758-0054	R:FXD MET FLM 330 OHM 5% 1/2W	07115	C 20	1
0758-0055	R:FXD MET FLM 360 OHM 5% 1/2W	07115	C 20	1
0758-0057	R:FXD MET FLM 5600 OHM 5% 1/2W	07115	C 20	1
0758-0062	R:FXD MET FLM 200 OHM 5% 1/2W	07115	C 20	1
0758-0070	R:FXD MET FLM 1200 OHM 5% 1/2W	07115	C 20	2
0758-0071	R:FXD MET FLM 4300 OHM 5% 1/2W	07115	C 20	1
0758-0072	R:FXD MET FLM 16K OHM 5% 1/2W	07115	C 20	2
0758-0073	R:FXD MET FLM 24K OHM 5% 1/2W	07115	C 20	3
0758-0074	R:FXD MET FLM 27K OHM 5% 1/2W	07115	C 20	2
0758-0076	R:FXD MET FLM 68K OHM 5% 1/2W	07115	C 20	1
0758-0078	R:FXD MET FLM 13K OHM 5% 1/2W	07115	C 20	3
0758-0079	R:FXD MET FLM 30K OHM 5% 1/2W	07115	C 20	2
0812-0019	R:FXD WW 0.33 OHM 5% 3W	35434	VTA3	1
0812-0022	R:FXD WW 0.56 5% 3W	35434	VTA 3	1
0813-0028	R:FXD WW 1 OHM 10% 1W	91637	CS 1A	1
1120 0307	METER	28480	1120-0307	1
1200-0020	SOCKET:OCTAL BASE	02660	1200-0020	1
1200-0043	INSULATOR:TRANSISTOR ANODIZED ALUMINUM	76530	294457	1
1200-0081	BUSHING:INSULATOR NYLON	26365	974SPECIAL	1
1250-0102	CONNECTOR:BNC	91737	1250-0102	1
1251-0066	JACK:TELEPHONE 2-CONDUCTOR NC	82389	2J-1339	1
1251-0148	CONNECTOR:POWER 3 PIN MALE	60427	H-10611G-3L	1
1251-0194	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	95354	SD-615TS	13
1400-0033	CLAMP:TUBE	91506	120D5-63AHS	1
1400-0084	FUSEHOLDER EXTRACTOR POST TYPE	75915	342014	1
1450-0048	LAMP:NEON	08717	858-R	1
1450-0053	SPRING:TORSION	28480	1450-0053	1
1460-0060	SPRING:LEAF 3/8 X 15/16 X 11/16 IN	28480	1460-0060	1
1460-0115	SPRING:LEAF	28480	1460-0115	1
1490-0030	STAND:TILT	28480	1490 0030	1
1500-0002	YOKE:COUPLER	76487	39006(SINGLE YOKE)	1
1510-0008	BINDING POST:RED	28480	1510-0008	1
1510-0009	BINDING POST:BLACK	28480	1510-0009	1
1520-0001	PLATE:MOUNTING ELECTROLYTIC CAPACITOR	28480	1520-0001	1

See list of abbreviations in introduction to this section

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

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
1850-0038	TRANSISTOR:PNP GE	86684	1850-0038	4
1850-0040	TRANSISTOR:GERMANIUM 2N383 PNP	94154	2N383	4
1850-0048	TRANSISTOR:GERMANIUM 2N650 PNP	04713	2N650	2
1850-0062	TRANSISTOR:GERMANIUM PNP SELECTED	28480	1850 0062	16
1850-0096	TRANSISTOR:GERMANIUM 2N2189 PNP	01295	2N2189	23
1850-0101	TRANSISTOR:GERMANIUM PNP SPL 2N582	28480	1850-0101	2
1851-0017	TRANSISTOR:2N1304	01295	2N1304	1
1853-0003	TRANSISTOR:SILICON PNP	28480	1853-0003	1
1854-0003	TRANSISTOR:NPN SILICON	28480	1854-0003	8
1854-0011	TRANSISTOR:2N835 NPN SILICON	04713	2N835	2
1901-0025	DIODE, JUNCTION:50 MA AT 1V 100 PIV	28480	1901-0025	8
1901-0028	DIODE:SILICON 0.5A 400 PIV	28480	1901-0028	4
1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	28480	1901-0040	38
1901-0047	DIODE, JUNCTION. 20 PIV	28480	1901-0047	4
1902-0009	DIODE, BREAKDOWN:7.5V 10% 400MW	01281	1N755	1
1902-0017	DIODE, BREAKDOWN:6.81V 10% 400MW	28480	1902.0017	3
1902-0025	DIODE:BREAKDOWN:10.0V 5% 400MW	28480	1902-0025	2
1902-0227	DIODE, BREAKDOWN:22.6V 5% 1.5W	28480	1902-0227	2
1910-0016	DIODE, GERMANIUM 100 MA AT 0.85V 60PIV	93332	02361	13
2100-0019	R:VAR COMP 500 OHM 10% LIN 1/2W	28480	2100-0019	1
2100-0076	R:VAR COMP 75 OHM 10% LIN 2W	28480	2100-0076	1
2100-0234	R:VAR COMP 10K OHM 20% LIN 2W	28480	2100-0234	1
2100-0360	R:VAR COMP 250 OHM 30% 1/4W	28480	2100-0360	4
2100-0361	R:VAR COMP 2000 OHM 30% LIN 1/4W	28480	2100-0361	6
2100-0362	R:VAR COMP 100K OHM 30% LIN 1/4W	28480	2100-0362	2
2100-0408	R:VAR COMP 250 OHM 30% 1/2W	28480	2100-0408	1
2110-0018	FUSE:CARTRIDGE 0.25 AMP SLOW BLOW	75915	313.250	1
2140-0027	LAMP:INCANDESCENT 24V 35-45 MA	94991	24ESB	15
3100-0359	SWITCH:ROTARY 8 SECT 9 POS	28480	3100-0359	1
3100-0360	SWITCH:ROTARY 4 SECT 8 POS	28480	3100-0360	1
3100-0361	SWITCH:ROTARY 2 SECT 8 POS	28480	3100-0361	1
3100-0362	SWITCH:ROTARY 3 SECT 6 POS	28480	3100-0362	1
3100-0363	SWITCH:ROTARY 2 SECT 3 POS	28480	3100-0363	1
3101-0011	SWITCH:SLIDE DPDT 0.5 AMP 125 VDC	42190	4603	1
3101-0033	SWITCH:SLIDE DPDT	42190	4633	1
3101-0037	SWITCH TOG SPST 3 AMP 125V	04009	83050-A	1
3101-0038	SWITCH TOG DPDT 3 AMP 125 V	04009	83054-B	1
3101-0051	SWITCH PUSHBOTTON DPDT MOMENTARY	82389	3S-1431 LESS HDWE	1
5000-0748	COVER:SIDE 10X16 FM	28480	5000-0748	1
5060-0049	BOARD:EXTENDER ASSY	28480	5060-0049	1
5060-0737	FRAME ASSY: 10X16 FM	28480	5060-0737	1
5060-0740	TOP COVER ASSY. 16L FM	28480	5060-0740	1
5060-0752	BOTTOM COVER ASSY 16L FM	28480	5060-0752	1
5060-0763	HANDLE ASSY-SIDE	28480	5060-0763	1
5060-0765	RETAINER-HANDLE ASSY.	28480	5060-0765	1
5060-0767	FOOT ASSY-FM	28480	5060-0767	1
5060-0778	KIT: RACK MOUNT	28480	5060-0778	1
6960-0001	BUTTON-PLUG	80112	7308	1
8120-0078	CABLE POWER 7.5FT.	70903	KH4147	1
9100-0168	TRANSFORMER-POWER	28480	9100-0168	1

See list of abbreviations in introduction to this section

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

℗ Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
9140-0029	COIL:FXD 100 UH 2.6 OHMS	99848	310015101	7
9140-0032	COIL:FXD 10 UH	28480	9140-0032	1
9140-0053	COIL:FXD 1MHY 10%	28480	9140-0053	2
9140-0061	COIL:VAR 0.780-1.25 UH	28480	9140-0061	1
9140-0072	INDUCTOR: COIL 5000 UH 10%	95265	SA-5000-I	4
9140-0105	COIL:FXD RF 8.2 UH	28480	9140-0105	1
9140-0129	COIL:FXD RF 220 UH	28480	9140-0129	2
9140-0148	COIL:FXD RF 3.41 UH	28480	9140-0148	2
9140-0149	COIL:FXD RF 1.86 UH	28480	9140-0149	1
9140-0150	COIL:FXD RF 2.75 UH	28480	9140-0150	1
9140-0151	COIL:FXD RF 2.07 UH	28480	9140-0151	1
9140-0152	COIL:FXD RF 41.06 UH	28480	9140-0152	2
9140-0153	COIL:FXD RF 36.8 UH	28480	9140-0153	2
9140-0154	COIL:FXD RF 53.8 UH	28480	9140-0154	3
9140-0155	COIL:FXD RF 28 UH	28480	9140-0155	1
9140-0156	COIL:FXD R: 72.3 UH	28480	9140-0156	1

See list of abbreviations in introduction to this section

Table 6-3. Code List Of Manufacturers

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

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N. Y.
00334	Humidail Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N. J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N. J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Fulton Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04777	Automatic Electric Sales Corp.	Northlake, Ill.
04796	Sequoia Wire & Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04879	P. M. Motor Company	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metropolitan Telecommunications Corp., Metro Cap. Division	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
05004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co. Inc.	New Rochelle, N. Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06751	U. S. Semcor Division of Nuclear Corp. of America	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N. Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada.
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09664	The Bristol Co.	Waterbury, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hannover, Germany
13835	Midland Mfg. Co.	Kansas City, Kansas
14099	Semi-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
14936	Williams Mfg. Co.	San Jose, Calif.
15909	The Daven Co.	Livingston, N.J.
16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
16352	Computer Diode Corp.	Lodi, N. J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
16873	E.I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24555	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36186	Stanwyck Corp.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
53743	Ward Leonard Electric	Mt. Vernon, N.Y.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth 1, N.J.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70319	Allmetal Screw Prod. Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71285	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71700	The Corcoran Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
71707	Coto Coil Co., Inc.	Providence, R.I.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72699	General Instrument Corp., Semiconductor Div.	Newark, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.W. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co. Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	So. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73845	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N. Y.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77250	Phoeli Mfg. Co.	Chicago, Ill.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association. Any brand tube meeting EIA standards	Washington, D.C.
80267	Unimax Switch, Div. of W.L. Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.
80583	Hammerland Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.
81349	Military Specification	.....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.

00015-37
Revised: July 31, 1964

From: FSC. Handbook Supplements
H4-1 Dated OCTOBER 1963
H4-2 Dated MARCH 1962

Table 6-3. Code List Of Manufacturers (Cont'd)

Code No.	Manufacturer	Address
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
83186	Victory Engineering Corp.	Union, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83385	Central Screw Co.	Chicago, Ill.
83503	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Eveready Battery	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
84171	Arco Electronis, Inc.	New York, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	Good All Electric Mfg. Co.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Koiled Kords, Inc.	New Haven, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	Seattle, Wash.
87930	Tower Mfg. Corp	Providence, R. I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Gaybar Electric Inc. Co.	Oakland, Calif.
89473	General Electric Distributing Corp.	Schenectady, N.Y.
89636	Carter Parts Div. of Economy Baler Co.	Chicago, Ill.
89665	United Transformer Co.	Chicago, Ill.
90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Brothers', Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Philadelphia, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91929	Minneapolis-Honeywell Regulator Co., Microswitch Div.	Freeport, Ill.
92180	Tru-Connector Corp.	Peabody, Mass.
92196	Universal Metal Prod., Inc.	Bassett Puente, Calif.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co.	Tarrytown, N.Y.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins and Myers, Inc.	New York, N.Y.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93788	Howard J. Smith Inc.	Port Monmouth, N. J.
93929	G. V. Controls	Livingston, N. J.
93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Mfg. Co., Industrial Components Div., Receiving Tube Operation	Quincy, Mass.
94145	Raytheon Mfg. Co., Semiconductor Div., California Street Plant	Newton, Mass.
94148	Scientific Radio Products, Inc.	Loveland, Colo.
94154	Tung-Sol Electric, Inc.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Paterson, N.J.
94222	Southco Div. of S. Chester Corp.	Lester, Pa.
94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
95023	Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.	Miami, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	New York, N.Y.
95264	Lerco Electronics, Inc.	Burbank, Calif.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordas Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Chicago, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Division of Aerovox	Olean, N.Y.
96256	Thordarson-Meissner Div. of Maguire Industries, Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.
97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.
97979	Reon Resistor Corp.	Yonkers, N.Y.
98141	Axel Brothers Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Francis L. Mosley	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98405	Carad Corp.	Redwood City, Calif.
98731	General Mills	Minneapolis, Minn.
98821	North Hills Electric Co.	Mineola, N.Y.
98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99515	Marshall Industries, Electron Products Division	Pasadena, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.

Code No.	Manufacturer	Address
THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.		
00000	JFD Electronics Corp.	Van Nuys, Calif.
00000	Tranex Company	Mountain View, Calif.
00000	Western Devices, Inc.	Inglewood, Calif.
00000	Winchester Electronics, Inc.	Santa Monica, Calif.
0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000N	Nabm-Bros. Spring Co.	San Leandro, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000W	Webster Electronics Co. Inc.	New York, N.Y.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	England
000AC	Indiana General Corp., Elect. Div.	Indiana
000AD	Curtis Instrument Inc.	Mt. Kisco, N.Y.
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Manufacturing Co.	San Jose 27, Calif.
000QQ	Cooltron	Oakland, Calif.
000RR	Radio Industries	Des Plaines, Ill.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000WW	California Eastern Lab.	Burlingame, Calif.
000XX	Methode Electronics, Inc.	Chicago 31, Ill.
000YY	S.K. Smith Co.	Los Angeles 45, Calif.

APPENDIX I

MANUAL CHANGES

This manual applies directly to the 310A Wave Analyzer having serial numbers prefixed 436. This manual with the following changes also applies to 310A Wave Analyzers having serial numbers prefixed 312, 325, 404, and 415. For 310A Wave Analyzers with a serial prefix larger than 436 a change sheet should be included with this manual. If the change sheet is missing, the information can be supplied by your nearest Hewlett-Packard Company field office (see maps at the rear of this manual).

To adapt this manual to instruments with serial numbers prefixed other than 436, make manual changes as indicat- indicated below.

INSTRUMENT SERIAL NO. PREFIX	CHANGE NO.
415-	1
404-	1, 2
325-	1, 2, and 3
312-	1, 2, 3, and 4
other prefix numbers	Refer to MANUAL CHANGE Sheet

Change 1: (See Note 1)

Figure 5-19, Active LPF, Second Mixer Pair,
Delete: A13C3, A13C4, A13R23, A13R34, A14C3, A14C4, Ai4R23, and A14R34.

Change: A13C2 and A14C2 from 510 pf to 220 pf.

Table 6-1, Reference Designation Index,

Delete: A13C3, A13C4, A13R23, A13R34, A14C3, A14C4, A14R23, and A14R34.

Change: A13C2 and A14C2 to ℗ Stock No. 0140-0083; C: fxc mica 220 pf 5% 300 VDCW.

Table 6-2, Replaceable Parts,
Delete: ℗ Stock No. 0140-0017, and ℗ Stock No. 0160-0362.

Change:"the "TQ" for ℗ Stock No. 0687-3311 from 4 to 2.
Add: ℗ Stock No. 0140-0083; C: fxd mica 220 pf 5% 300 VDCW; Mfr 28480; Mfr Part No. 0140-0083; TQ 2.

NOTE I

The manufacturer of the transistors used in the LOW PASS IF AMPLIFIER CIRCUITS (A13 and A14 Assemblies) has changed the Alpha Cutoff Frequency characteristic. In the event that any transistors are changed, in either of these two circuits, oscillations may occur. If oscillation occurs, add resistors R23, R34, and capacitors C3 and C4 as shown in Figure 5-19. Also, change the value of C2 to 510 pf. If oscillations do not occur, let circuit remain as indicated above.

Change 2: (see Note 2)

Figure 5-25, Power Supply,
Replace with Figure 1A.

Table 6-1, Reference Designation Index,

Delete: A24CR5, A24CR15, A24R9, A24R19, R21, R22.

Change: A24C1, A24C3, and A24C11 to ℗ Stock No.0150-0084; C: fxd ceramic 0.1 μf +80%, -20% 50 VDCW.

Add: C14; ℗ Stock No. 0180-0056; C: fxd electr 1000 μf 50 VDCW.

Table 6-2, Replaceable Parts,
Delete: ℗ Stock Numbers 0687-3301, 0812-0019, 0812-0022, and 1901-0026.

Change the "TQ" for ℗ Stock No. 0180-0056 from 4 to 5
0160-0174 from 6 to 4
0180-0058 from 14 to 13

APPRENDIX I (Cont'd)

MANUAL CHANGES

NOTE 2

The power supply described in this manual is protected against short circuits. This change (change 2) reflects the power supply circuit withoug short circuit protection. Without short circuit protection a short circuit will probably destroy the power supply. This circuit should be changed so that short circuit protection is provided. The Power Supply (310A-65A) may be modified (see Service Note #310A-2 which is included in this Appendix) or replaced with a new Power Supply (310A-65U) which should be ordered as part of power supply modification kit ℗ Stock No. 00310-600.

Change 3: (see Note 3)

Figure 5-21, Meter, BFO, Restored Frequency Output,
Change A21C9 from 200 pf to 82 pf

Table 6-1, Reference Designation Index,
A21C8: Change ℗ Stock No. from 0180-0076 to 0180-0045 (however, note that 0180-0076 is the recommended replacement).

Change: A21C9 to ℗ Stock No. 0140-0006; C: fxd 82 pf 10% 300 VDCW.

Table 6-2, Replaceable Parts,
Delete: ℗ Stock No. 0140-0090.
Change the "TQ" for ℗ Stock No. 0180-0076 to 1.
Add: ℗ Stock No. 0140-0006; C: fxd 82 pf 10% 300 VDCW; Mfr 00853; Mfr Part No. RCM15E820K; TQ 1.

NOTE 3

12 to 20 Mc oscillations are sometimes found in the output amplifier....the solution to this problem is to replace A21C9 with 200 pf capacitor (℗ Stock No. 0180-0076). See Table 6-2 for description.

Change 4: For instruments serial numbered 312-00181 to 312-00285 a 3/8 inch diameter hole is not provided and must be drilled or punched for the addition of Option 01 100 Kc Crystal Calibrator. Refer to Appendix II (Service Note 310A-1 details the exact location of this hole).

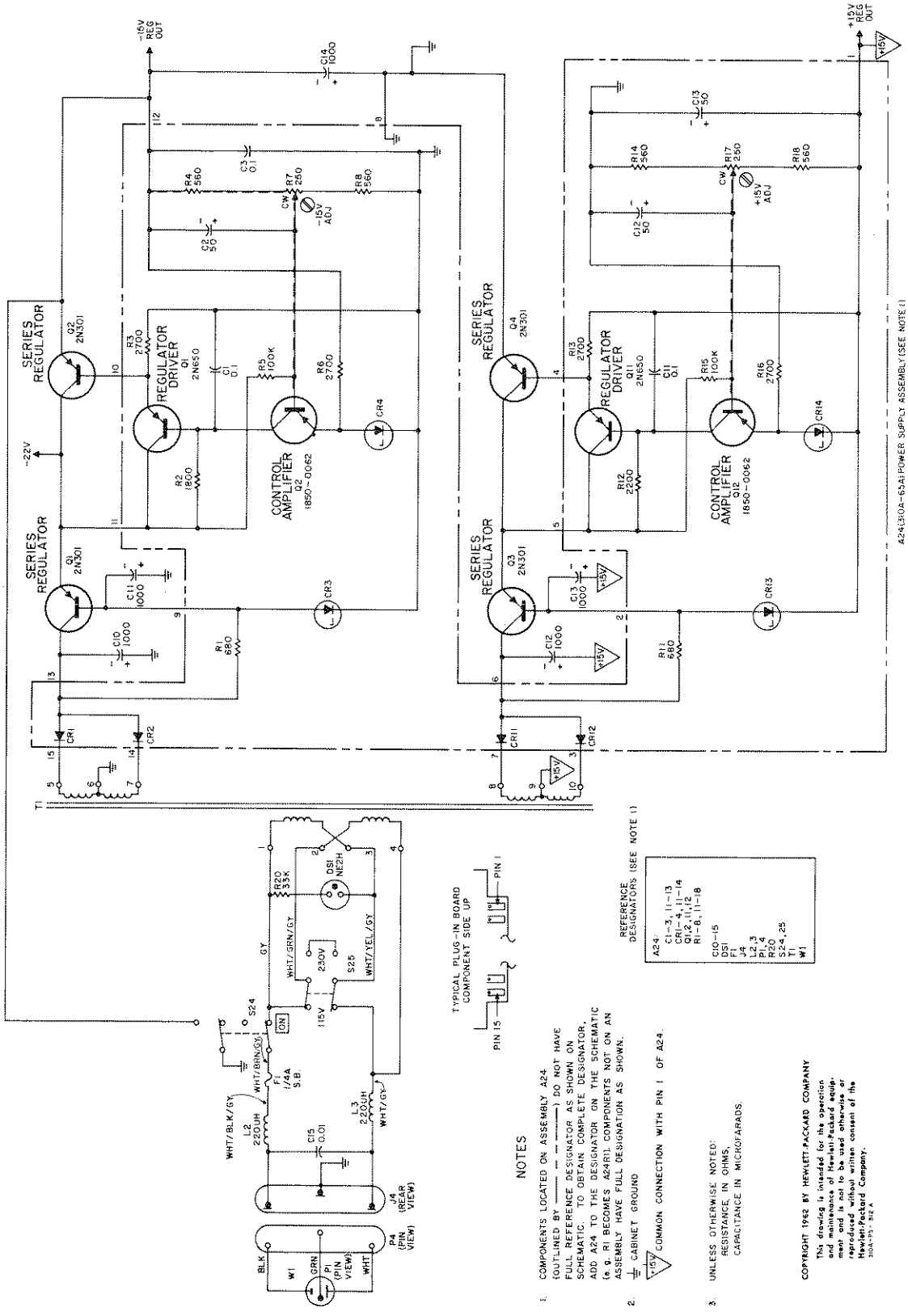

Figure 1A. Power Supply (for serial numbers 404-00560 through 312-)

SERVICE NOTE

310A-2

MODEL 310A WAVE ANALYZERS
SERIALS BELOW 415-00561

POWER SUPPLY MODIFICATION KIT
Stock No. 00310-601

This Service Note provides the information necessary for modifying the Power Supplies in Model 310A Wave Analyzers, serials below 415-00561 for improved short circuit protection.

The modification consists of changing the values of three capacitors and adding four resistors and two diodes.

Upon completion of the modification the power supplies will have to be adjusted in accordance with the instructions in the Operating and Service Manual for your Model 310A. No special tools are required for this modification.

Parts Furnished in Power Supply Mod Kit
00310-601

Quantity	Description	Stock Number
2	CAPACITOR, Fixed Ceramic, 0.47 +80%, -20%, 25VDCW For C1 and C11	0160-0174
2	RESISTORS, Fixed Composition, 33 ohms ±10%, 1/2 watt For R9 and R19	0687-3301
1	RESISTOR, Fixed Wire Wound 0.33 ohms ±5%, 3 watts For R21	0812-0019
1	RESISTOR, Fixed Wire Wound 0.56 ohms, ±5%, 3 watts For R22	0812-0022
2	DIODE, Silicon, 200 PIV, 0.5 ma. For CR5 and CR15	1901-0026
1	CAPACITOR, Fixed Electrolytic 50μf, -10% +100%, 25 VDCW For C3	0180-0058

MODIFICATION PROCEDURE

1. Disconnect power, remove top and bottom covers.
2. Remove the Power Supply Board 310A-65A.
3. On 310A-65A, remove and discard C1, C11, and C3.
4. Install the 50 μf, 25v Electrolytic in place of C3.
5. Install the two 0.47 μf, 25v ceramic capacitors in place of C1 and C11.
6. On the foil side of 310A-65A remove approximately 1/4 inch of foil connecting C1 to Q1, and 1/4 inch of foil connecting C11 to Q11.
7. Solder the two 33 ohm resistors to the foil side of the board between C1 and Q1 and between C11 and Q11.
8. Remove and discard wire between emitter of Q1 and collector of Q2.
9. Connect the 0.33 ohm resistor R21 between the emitter of Q1 and the collector of Q2.

CP
01967-1

HEWLETT-PACKARD COMPANY
1501 PAGE MILL ROAD
PALO ALTO, CALIFORNIA, U.S.A.
CABLE: "HEWPACK" TEL. (415) 326-7000
54 ROUTE DES ACACIAS
GENEVA, SWITZERLAND
CABLE: "HEWPACKSA" TEL. (022) 42.81.50

10. Connect Diode CR5 cathode to the base of Q1. Connect the Anode to the collector of Q2.

11. Remove and discard wire between the emitter of Q3 and collector of Q4.

12. Connect the 0.56 ohm resistor R22 between emitter of Q3 and collector of Q4.

13. Connect CR15 cathode to base of Q3. Connect Anode to collector of Q4.

14. Remove and discard the black wire and the purple wire connecting C14 to the terminal strip next to the Power Supply Assembly.

15. Remove and discard C14.

This completes the modification. The Power Supplies should be adjusted in accordance with the instructions in the Operating and Service Manual for your Wave Analyzer.

Note

The Modified Power Supply is now equivalent to the hp Stock Number 310A-65U Power Supply Assembly. The only difference is that Diodes CR5 and CR15 are mounted on the hp 310A-65U Assembly.

Save this Service Note for future reference when servicing the Power Supply in your Wave Analyzer.

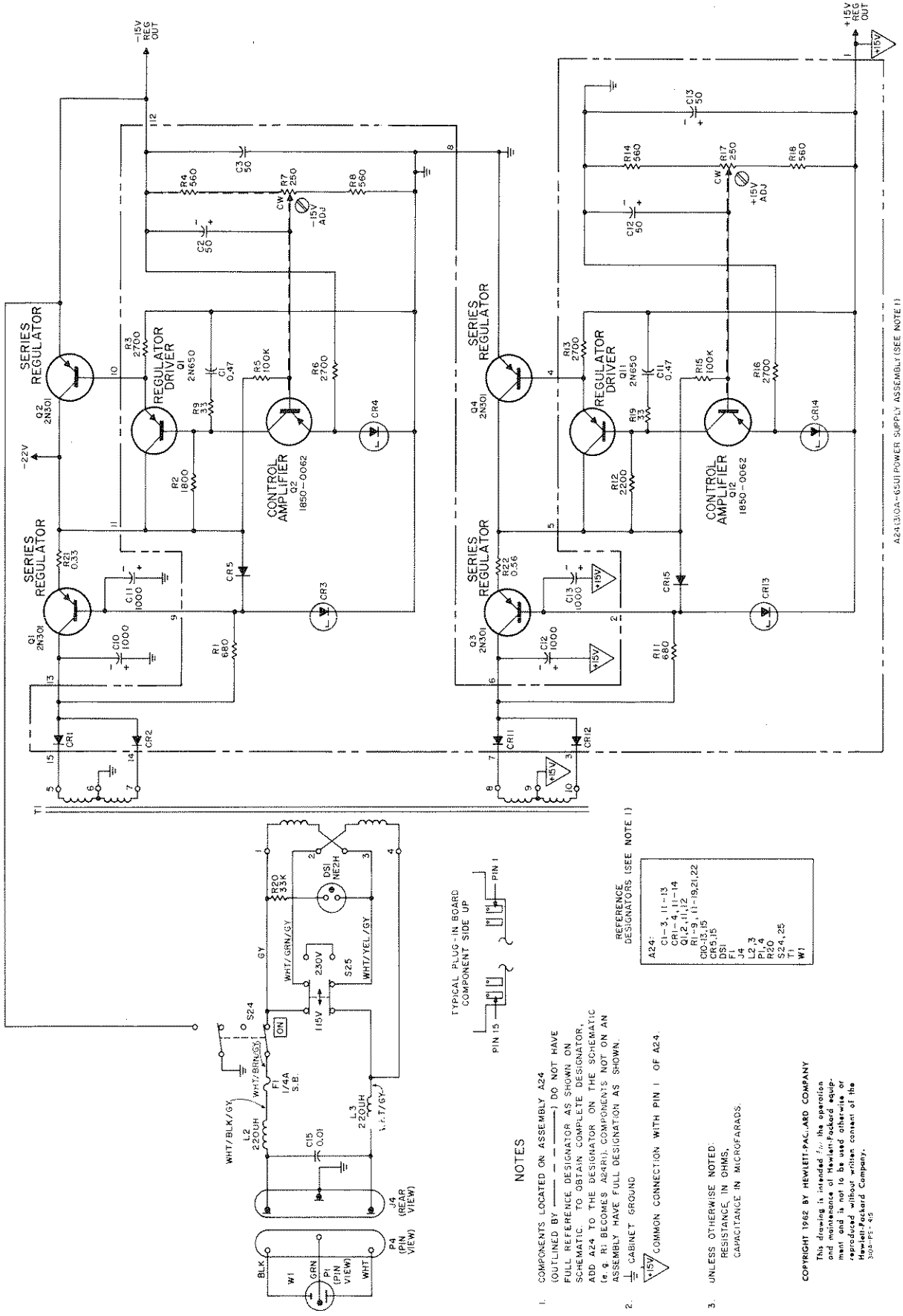

Figure 1. Power Supply After Modification

APPENDIX II

OPTION 0I

The 310A-Option 01 instruments use a 100 Kc Crystal Oscillator in place of the 100 Kc calibration multivibrator (A3Q1, A3Q2, and associated components). The 100 Kc Crystal Oscillator may be used for both amplitude and frequency calibration.

The Option 01 calibration oscillator circuit, with the exception of push-button switch S50 and crystal Y51, is mounted on the same circuit board (A3) as is the standard circuit. The Option 01 details of special wiring, crystal mounting location, testing procedures, replaceable parts identification, and circuit schematic diagram are included in the Service Note (#310A-1A) which is printed into this appendix.

SPECIFICATIONS

The specifications for the Model 310A Option 01 are the same as those of the standard Model 310A except for the frequency accuracy of the calibrator, which is as follows:

FREQUENCY ACCURACY
± 2 KC to 1.4 Mc
± 3 Kc to 1.5 Mc

OPERATION

Whe MARKER switch S50 is depressed, the harmonics of the 100 kc Oscillator may be observed on the output meter. Select the one closest to the frequency of interest. With MODE at NORMAL and BANDWIDTH at 200 cps, adjust ZERO SET for maximum meter indication. Set RANGE for an on-scale reading.

SERVICE NOTE

310A-1A

MODEL 310A WAVE ANALYZER
All Serials

INSTALLATION OF 100 KC CRYSTAL CALIBRATOR KIT
Stock No. 310A-95A

This Service Note outlines the procedure for installing a 100 KC Crystal Calibrator Kit in Model 310A Wave Analyzers, all serials.

Installation of this kit converts your regular Model 310A to an Model 310A, Option 01 instrument which has the following calibrator specifications: CALIBRATOR FREQUENCY ACCURACY: ±2 KC to 1.4 mc; ±3 KC to 1.5 mc.

This modification includes replacement of the 100 KC calibration multivibrator with a 100 KC crystal oscillator which may be used for both frequency and amplitude calibration of your Model 310A.

No special tools or test equipment are required for modification.

PARTS SUPPLIED IN KIT, STOCK NO. 310A-95A

Quantity	Description	Stock No.
1	Board assembly, input amplifier calibrator	310A-65T
1	Crystal, 100 KC	0410-0088
1	Bracket, crystal mounting	310A-12H
1	Cable assembly, marker	310A-16W
1	Tube socket	1200-0020
1	Tube clamp	1400-0033
1	Switch, pushbutton	3101-0051
1	Plate, identification	7120-0170
1	Wire, 26 gauge stranded, yellow, 9 inch length	8150-0065
1	Wire, 26 gauge stranded, green, 9 inch length	8150-0052
1	Wire, 26 gauge stranded, white-black-violet, 4 inch length	8150-0193
3	Machine screw, 6-32 x 3/8 inch with lockwasher	2390-0007
3	Nut, 6-32 x 1/4 inch	2420-0003
3	Lockwasher, #6, internal	2190-0007
1	Lockwasher, 3/8" internal	2190-0016
1	Nut, lamp indicator	1450-0044
1	Nut, hex	2950-0030

abcfg$_3$p
01688-2

8/63

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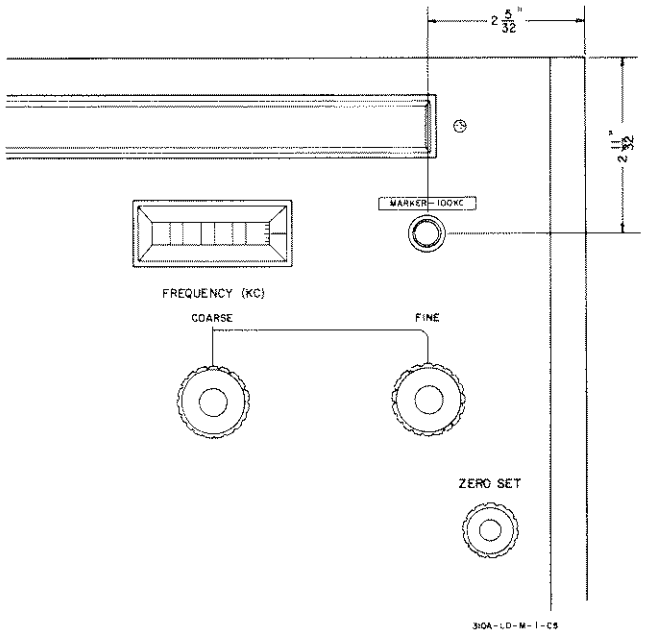

Figure 1. Ⓗ Model 310A, Pushbutton Switch Location

INSTALLATION PROCEDURE

1. Disconnect power and remove power cord.

2. Remove top, bottom and both side covers.

3a. Instrument Serial No. 312-00285 and below:

Drill or punch a 3/8'' diameter hole in the front panel. Refer to Figure 1 for hole location.

b. Instrument Serial No. 325-00286 and above:

Remove plug button from 3/8'' diameter hole in front panel.

4. Solder the 24 inch long 4-wire cable assembly (310A-16W) to the pushbutton switch assembly. Refer to inset in Figure 2.

5. Mount the pushbutton switch to the panel as illustrated in Figure 2 inset.

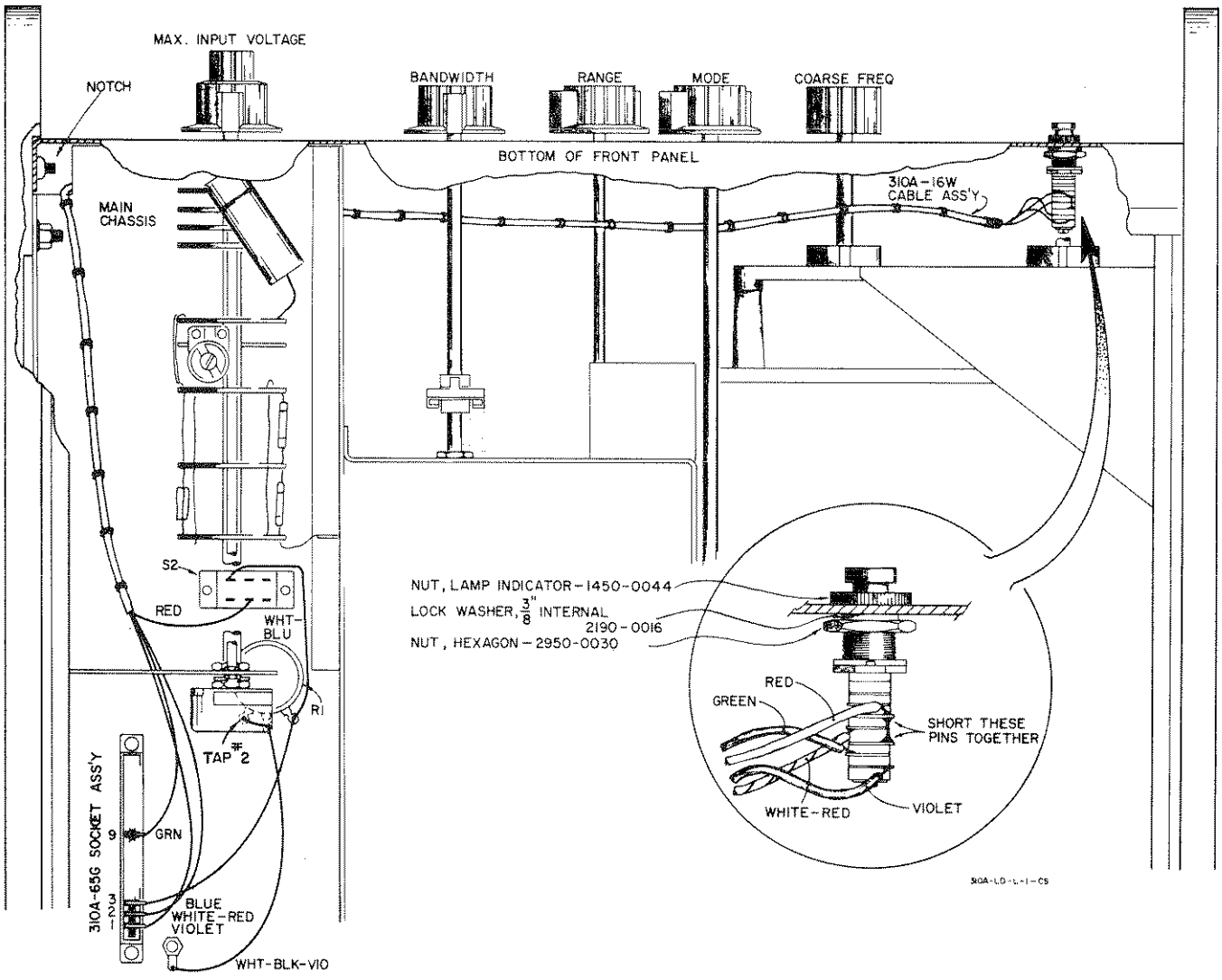

Figure 2. Ⓗ Model 310A, Pushbutton Switch Assembly, Wiring and Cable Layout

6. Dress the cable assembly behind the front panel to the left side of the 310A, then through the notch in the main chassis next to the left side frame. Continue dressing cable to location of 310A-65G socket assembly. Refer to Figure 2.

7. Remove and retain board assembly, 310A-65G.

8a. Instrument Serial No. 312-00285 and below:

1. Remove the white-blue wire from the center tap of R1, 75 ohm pot, and connect it to the same tap on R1 to which the blue wire from pin 3 of the 310A-65G socket is connected.

2. Remove and discard the violet wire connected between tap #2 (see Figure 2) on R1 and Pin 1 of the 310A-65G socket.

3. Short the center tap and #2 tap on R1 and connect the #26 white-black-violet 4 inch wire from this point to the ground lug near pin 1 of the 310A-65G socket.

b. Instrument Serial No. 325-00286 and above:

Remove the white-black-violet wire (connecting the center tap and tap #2 of R1 with pin 1 of the 310A-65G socket) from pin 1 of the 310A-65G socket and connect it to the ground lug near pin 1. See Figure 2.

9. Connect the 4-wire cable assembly (310A-16W) from the pushbutton switch as follows:

a. Violet to pin 1 on the 310A-65G socket assembly.

b. White-red to pin 2 on the 310A-65G socket assembly.

c. Green to pin 9 on the 310A-65G socket assembly.

d. Red to terminal on S2 indicated in Figure 2.

10. Mount the tube socket and the tube clamp on the crystal mounting bracket as shown in Figure 3.

11. Short pin 2 to pin 3 on the tube socket and connect the nine inch green wire to this point.

12. Short pin 6 to pin 7 on the tube socket and connect the nine inch yellow wire to this point.

13. Remove the extender board assembly, M-65A (new Stock No. 5060-0049) shown in Figure 3. Retain the board and the mounting hardware.

14. Using the hardware removed in step 13, mount the crystal socket assembly bracket to the chassis as shown in Figure 3.

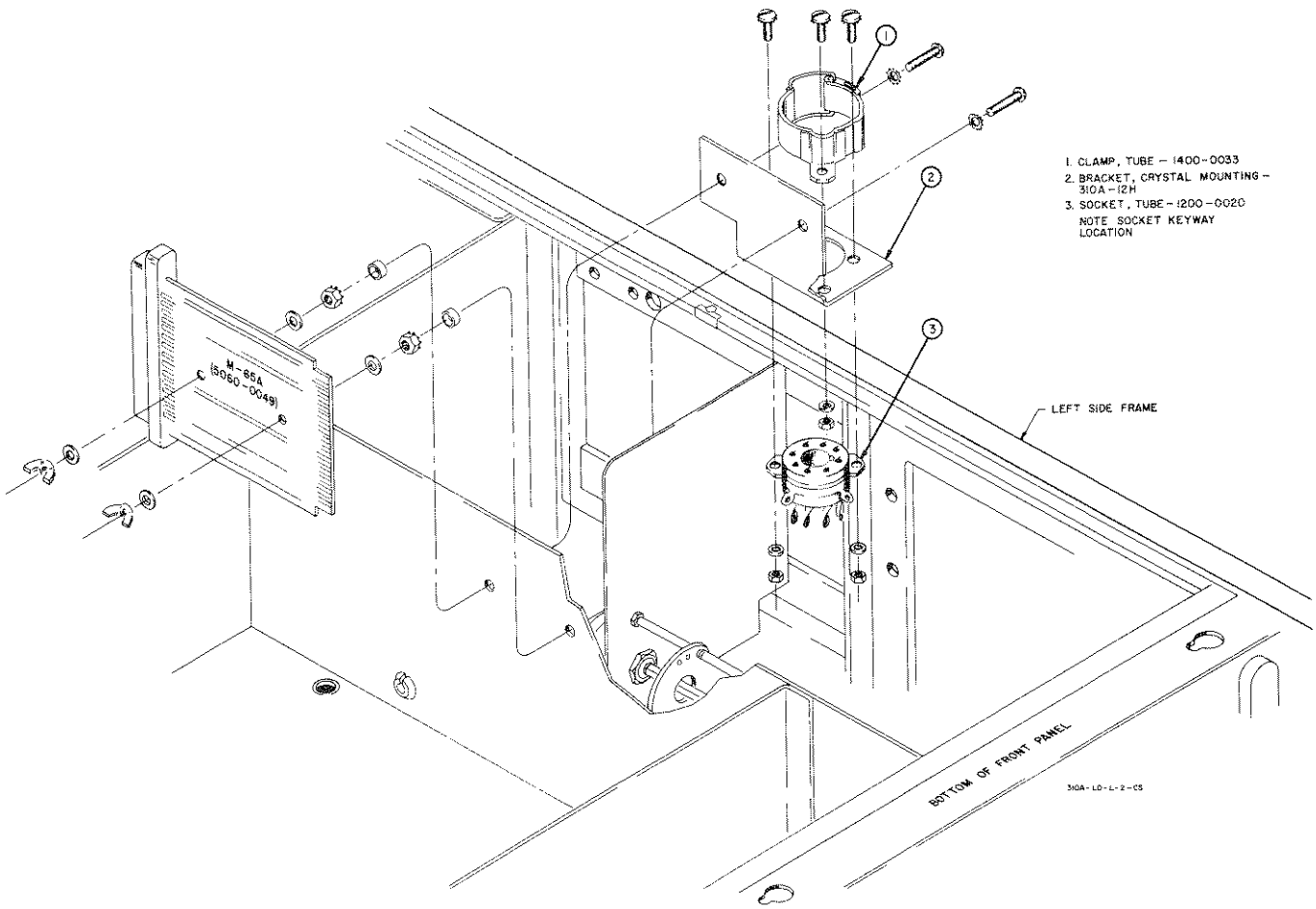

Figure 3. Model 310A, Crystal Socket Assembly

15. Insert the extender board assembly in the 310A-65G socket.

16. Insert the new board assembly, 310A-65T in the extender board socket.

17. Remove the "quick disconnect" connectors attached to the two long pins protruding from the "solder" side of the 310A-65T board assembly and solder to the yellow and green wires from the tube socket.

18. Slip the connectors over the long pins on the board assembly.

Note

They can be connected either way.

19. Insert the crystal (0410-0088) into the tube socket.

20. Check wiring to ensure conformance with the schematic Figure 4.

Note

After the modification has been completed, the 310A-65G Board Assembly can be re-inserted in place of the 310A-65T and the 310A can be operated as a regular instrument if the white-black-violet wire connected between R1 and the ground lug is returned to pin 1 of the 310A-65G socket.

TEST PROCEDURE

1. Connect a 100 K ohm variable resistor, ℗ Stock No. 2100-0063, as a rheostat in parallel with capacitor C54. (Use short jumper wires.)

2. Connect a X50 (low capacitance) oscilloscope probe in parallel with Capacitor C54. Use any oscilloscope with better than 100 KC bandwidth vertical amplifier.

3. Connect power cord and turn 310A on.

4. Set RANGE switch to CAL and adjust C54 for maximum sine wave amplitude on the oscilloscope. Vary the rheostat as necessary to maintain a sine wave with no clipping visible on the oscilloscope pattern.

5. Remove the oscilloscope probe and rheostat.

6. Connect the oscilloscope probe between the collector of Q53 and ground. A square wave with 40% - 60% symmetry should be observed. If not, troubleshoot Schmitt Trigger circuit.

7. Depress the pushbutton. The square wave should be differentiated into sharp marker pulses. If not, troubleshoot circuit between Schmitt Trigger and Q5 amplifier.

8. Release pushbutton and disconnect oscilloscope probe.

9. Set FREQUENCY to 100 KC and the ABSOLUTE-RELATIVE switch to ABSOLUTE.

10. Adjust Cal Level Adj. (R1) for full scale meter reading.

11. Depress pushbutton and adjust C56 for approximately 90% full scale meter reading.

12. Repeat steps 10 and 11 until a 100% reading is obtained with the pushbutton released and a 90% reading is obtained with the pushbutton depressed.

13. With the pushbutton depressed, tune the FREQUENCY through the full range. The meter reading should be 30% of full scale or greater at each 100 KC harmonic. If not, troubleshoot all associated circuitry.

14. Turn 310A off. Remove the extender board and remount it on the screws holding the crystal socket assembly bracket.

15. Insert the board assembly 310A-65T in the 310A-65G socket.

16. Replace the top, bottom and side covers.

17. Attach "Marker 100 KC" metal tag to front panel. See Figure 1. A small amount of "Xylene"* will activate the adhesive on the tag.

18. Attach this Service Note to the Operating and Service Manual for your ℗ 310A Wave Analyzer for future reference to the schematic, test procedure, and replaceable parts list.

* Xylene, one gallon can, ℗ Stock No. 8500-0041.

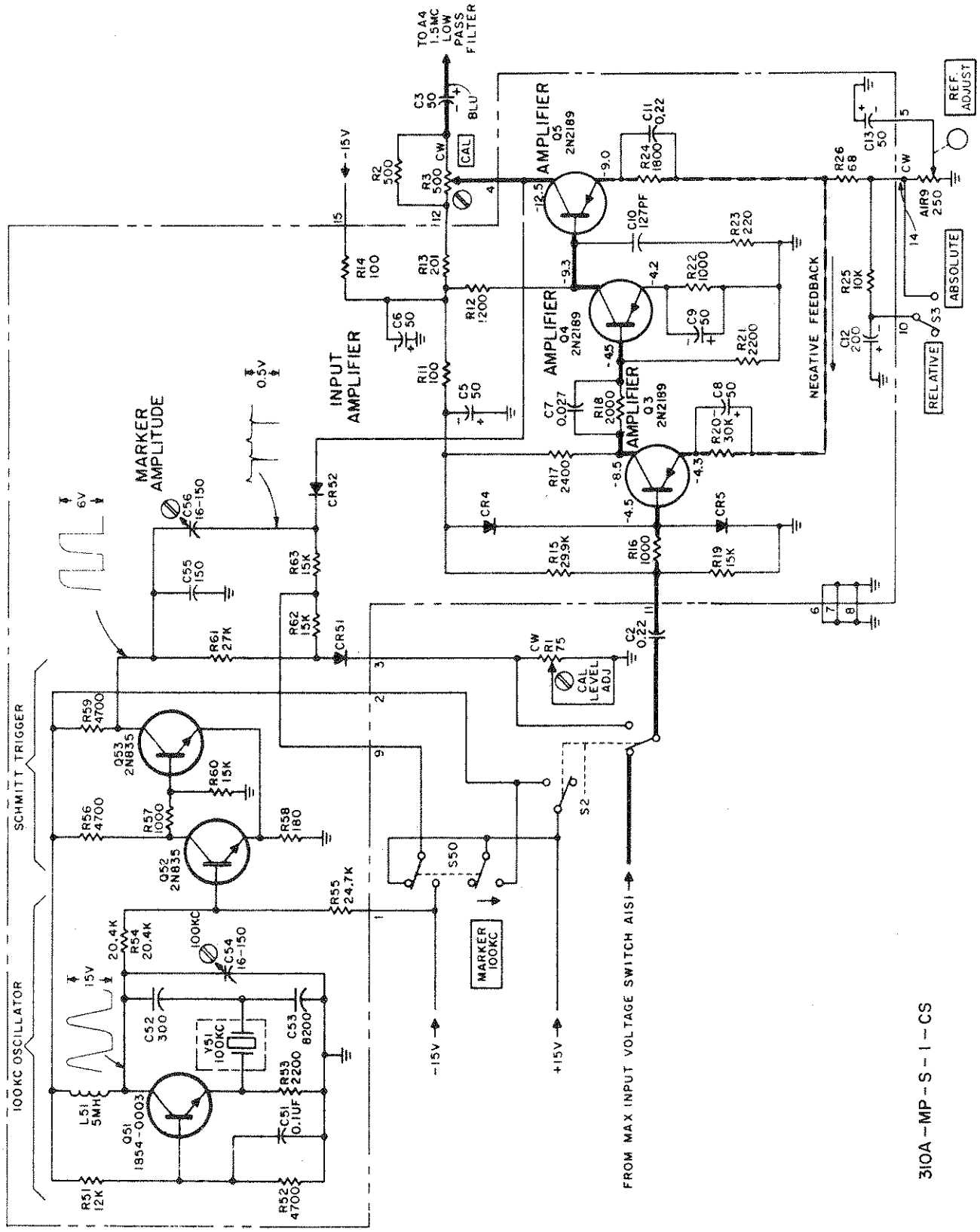

Figure 4. Ⓟ Model 310A Option 01 Input Amplifier-Frequency and Amplitude Calibrator Assembly, Ⓟ Stock No. 310A-65T

REPLACEABLE PARTS LIST

Ckt. Ref.	℗ Stock No.	Description
	310A-65T	Board assy, Input amplifier and calibrator (this assembly consists of the following parts).
C5, 6, 13	0180-0058	Capacitor, fixed 50 μf 25V
C7	0170-0066	Capacitor, fixed .027 μf 10%
C8, 9	0180-0033	Capacitor, fixed 50 μf 6V
C10	0140-0110	Capacitor, fixed 127 pf 2%
C11	0160-0200	Capacitor, fixed .22 μf
C12	0180-0060	Capacitor, fixed 200 μf 3V
C51	0170-0085	Capacitor, fixed 0.1 μf
C52	0140-0225	Capacitor, fixed 300 pf
C53	0140-0184	Capacitor, fixed 8200 pf
C54, 56	0131-0004	Capacitor, variable 16-150 pf
C55	0140-0196	Capacitor, fixed, 150 pf
CR4, 5	1901-0040	Diode Si: 30 ma 13.5 PIV
CR51, 52	1910-0016	Diode, Ge: 100 ma at 1V, 60 PIV
L51	9140-0072	Coil, RF 5000 mh 100 ma
Q3, 4, 5	1850-0096	Transistor, Ge: 2N2189
Q51	1854-0003	Transistor, Si: Special
Q52, 53	1854-0011	Transistor, Si: 2N835
R11, 14	0687-1011	Resistor, fxd, comp, 100 ohms, ±10%, 1/2W
R12	0687-1221	Resistor, fxd, comp, 1.2K ohms ±10%, 1/2W
R13	0727-0055	Resistor, fxd, carbon, 201 ohms, ±1.0%, 1/2W
R15	0727-0185	Resistor, fxd, carbon, 29.9K ohms, ±1.0%, 1/2W
R16	0690-1021	Resistor, fxd, comp, 1000 ohms, ±10%, 1/2W
R17	0758-0034	Resistor, fxd, metal film, 2.4K ohms, ±5%, 1/2W
R18	0758-0033	Resistor, fxd, metal film 2.0K ohms, ±5%, 1/2W
R19	0727-0168	Resistor, fxd, carbon, 15K ohms, ±1.0%, 1/2W
R20	0758-0079	Resistor, fxd, metal film, 30K ohms, ±5%, 1/2W
R21	0758-0044	Resistor, fxd, metal film, 2.2K ohms, ±5%, 1/2W
R22	0687-1021	Resistor, fxd, comp, 1K ohm, ±10%, 1/2W
R23	0687-2211	Resistor, fxd, comp, 220 ohms, ±10%, 1/2W
R24	0687-1821	Resistor, fxd, comp, 1.8K ohms, ±10%, 1/2W
R25	0687-1031	Resistor, fxd, comp, 10K ohms, ±10%, 1/2W
R26	0687-6801	Resistor, fxd, comp, 68 ohms, ±10%, 1/2W
R51	0687-1231	Resistor, fxd, comp, 12K ohms, ±10%, 1/2W
R52, 56, 59	0687-4721	Resistor, fxd, comp, 4.7K ohms, ±10%, 1/2W
R53	0687-2221	Resistor, fxd, comp, 2.2K ohms, ±10%, 1/2W
R54	0727-0176	Resistor, fxd, carbon, 20.4K ohms, ±1.0%, 1/2W
R55	0727-0178	Resistor, fxd, carbon, 4.7K ohms, ±1.0%, 1/2W
R57	0687-1021	Resistor, fxd, comp, 1K ohms, ±10%, 1/2W
R58	0687-1811	Resistor, fxd, comp, 180 ohms, ±10%, 1/2W
R60, 62, 63	0687-1531	Resistor, fxd, comp, 15K ohms, ±10%, 1/2W

REPLACEABLE PARTS LIST (Cont'd)

Ckt. Ref.	℗ Stock No.	Description
R61	0687-2731	Resistor, fxd, comp, 27K ohms, ±10%, 1/2W
Y51	0410-0088	Crystal, 100KC
	1251-0162	Connector, male, printed ckt
	1251-0163	Connector, female, printed ckt
	1200-0020	Socket, tube, octal
	1400-0033	Clamp, tube
	3101-0051	Switch, pushbutton, DPDT
	7120-0170	Plate, identification
	310A-12H	Bracket, crystal mtg
	310A-16W	Cable assy, marker

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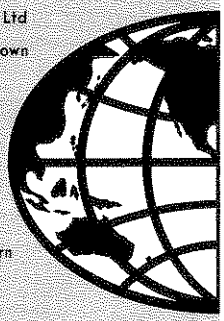

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