TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS)

FOR

GENERATOR, SIGNAL SG-747/U (HEWLETT-PACKARD 3300A) (NSN 6625-00-118-6736)

HEADQUARTERS, DEPARTMENT OF THE ARMY

4 AUGUST 1980

5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. **DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL**

2. **IF POSSIBLE, TURN OFF THE ELECTRICAL POWER**

3. **IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL**

4. **SEND FOR HELP AS SOON AS POSSIBLE**

5. **AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION**

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

WARNING

When the output ground is floated above Power Line Ground, all BNC connectors will be at the offset voltage.

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TECHNICAL MANUAL
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *4 August 1980*

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REPORTING OF ERRORS

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

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

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

TABLE OF CONTENTS

This manual is an authentication of the manufacturer's commercial literature which through usage, has been found to cover the data required to operate and maintain this equipment. The manual was not prepared in accordance with military specifications and AR 310-3, the format has not been structured to consider levels of maintenance.

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION 0
INTRODUCTION

0-1. SCOPE.

This manual describes Generator, Signal SG-747/U (HP-3300A) (fig. 1-1) and provides maintenance instructions. Throughout this manual, SG-747/U is referred to as the Hewlett-Packard HP-3300A Function Generator.

0-2. INDEXES OF PUBLICATIONS.

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

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

0-3. FORMS AND RECORDS.

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

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 735-11-2/NAVSUPINST 4440,127E/AFR 400-54/MCO 4430.3E and DSAR 4140.55.

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

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

EIRs will be prepared using DA Form 2407, Maintenance Request. Instructions for preparing EIRs are provided in TM 38-750, The Army Maintenance Management System. EIRs should be mailed directly to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, New Jersey 07703. A reply will be furnished directly to you.

0-5. ADMINISTRATIVE STORAGE.

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

0-6. DESTRUCTION OF ARMY ELECTRONICS MATERIEL.

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

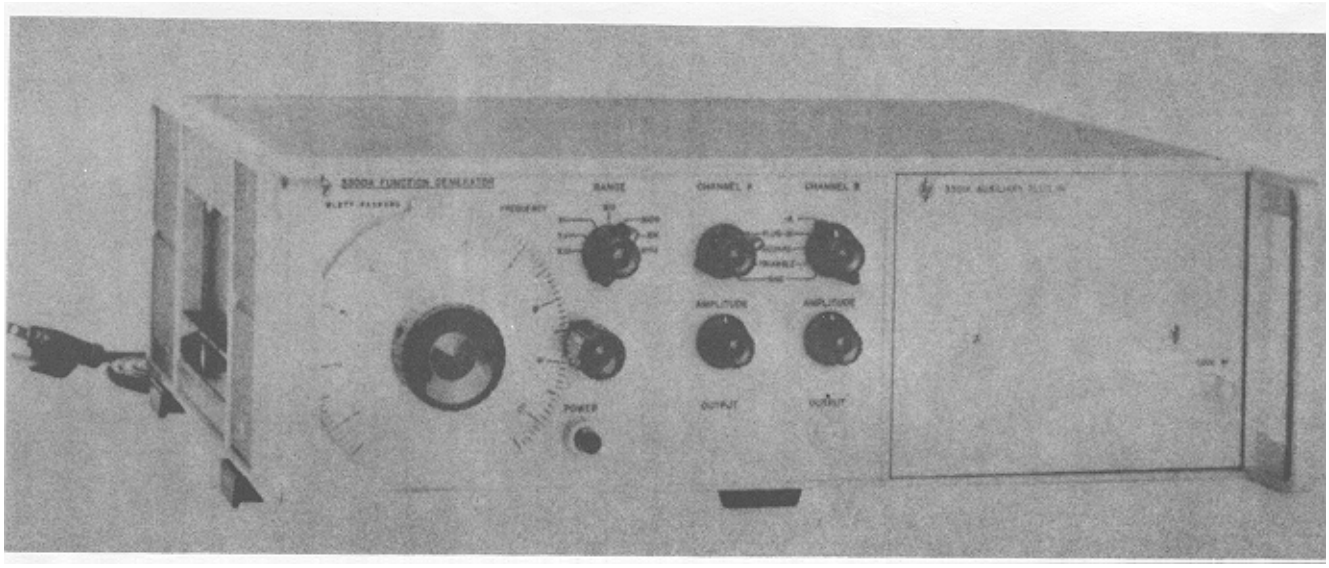


Figure 1-1. Model 3300A Function Generator

Table 1-1. Specifications

AVAILABLE PLUG-IN UNITS:
Model 3301A Auxiliary Plug-In.
Model 3302A Trigger Plug-In.
Model 3304A Sweep/Offset Plug-In.
Model 3305A Sweep Plug-In.

OUTPUT WAVEFORMS: Sinusoidal, square, and triangle selected by panel switch. (Any two outputs available simultaneously.

FREQUENCY RANGE: 0.01 Hz to 100 kHz in seven decade ranges.

FREQUENCY RESPONSE: ± 1%, 0.01 Hz to 10 kHz; ± 3%, 10 kHz to 100 kHz on the X10K range.

DIAL ACCURACY:. ± 1% of maximum dial setting (1 minor division) 0. 01 Hz to 10 kHz; ±2% of maximum dial setting (2 minor divisions) 10 kHz to 100 kHz. T. C. 0. 1%/°C.

MAXIMUM OUTPUT PER CHANNEL: > 35 volts peak-to-peak open circuit; > 15 volts peak-to-peak into 600 ohms; > 2 volts peak-to-peak into 50 ohms.

OUTPUT ATTENUATORS (both channels): 40 dB range.

OUTPUT IMPEDANCE: 600 ohms nominal (both channels) ± 20%.

SINE WAVE DISTORTION: <1%. 0.01 Hz to 10 kHz; <3%, 10 kHz to 100kHz on the X10K range.

SQUARE WAVE RESPONSE: <250 nsec rise and fall time on all ranges; <500 nsec rise and fall time in -A; <1% sag; <5% overshoot at full output; <1% symmetry error.

TRIANGLE LINEARITY: <1% 0.01 Hz to 10 kHz; <2%, 10 kHz to 100 kHz at full output; < 1% symmetry error.

SYNC PULSE OUTPUT: > 10 volts peak-to-peak open circuit, <5 μsec duration. Sync pulse occurs at crest of sine and triangle wave.

DC STABILITY: Drift: <±0.25%6 of peak-to-peak amplitude over a period of 24 hours. (After 30 minute warmup).

REMOTE FREQUENCY CONTROL: 0 to -10 volts will linearly change frequency > 1 decade within a single range. Frequency resetability with respect to voltage ±1% of maximum frequency on range selected.

POWER: 115 or 230 volts ±10%, 48 to 440 Hz. Less than 50 watts.

DIMENSIONS: (inches and millimeters) 5" high (127 mm), 16" wide (406 mm), 11" deep (279 mm).

SECTION I
GENERAL INFORMATION

1-1. GENERAL.

1-2. The Hewlett-Packard Model 3300A Function Generator is a solid state instrument useful for most general purpose frequency testing applications. Three output waveforms are available from front panel connectors; sine, square, and triangle. A sync pulse is also available from a rear panel connector.

1-3. The -hp- Model 3300A Function Generator is a type of relaxation oscillator. The triangle and square wave voltage functions are inherent in the oscillatory system. The sine wave is produced by synthesizing the triangle wave.

1-4. The -hp- Model 3301A Auxiliary Plug-in or another 3300A plug-in is required to provide internal connection for basic unit (main frame) operation.

1-5. ELECTRONIC FREQUENCY CONTROL.

1-6. Frequency of the -hp- Model 3300A can be controlled by either the front panel frequency dial or an external voltage applied to a rear terminal connector. This feature is useful for sweeping filters, amplifiers and other frequency-dependent devices and for externally programming frequencies for production testing. An input voltage of approximately -0. 5 to -10 volts will linearly control the frequency over any one range (one decade).

If desired the frequency can be controlled over more than one decade, by applying a +0.3 to -10 volts to the FREQUENCY CONTROL BNC. A +0. 3 to -10 V input will linearly control the frequency over approximately a 50:1 range.

1-7. OUTPUT SYSTEM.

1-8. The -hp- Model 3300A has two completely separate output channels. Each output is dc coupled and can be fully floating with respect to power line ground. An internal shield reduces radiated interference and provides common mode rejection with floating output. Separate connectors on the rear panel provide terminals for circuit ground ( ), output ground ( ), shield ground ( ), and power line ground ( ). The output ground may be floated from power line ground by up to ±250 volts. Any two of the three waveforms are available simultaneously from the front panel connectors.

1-9. INSTRUMENT AND MANUAL IDENTIFICATION.

1-10. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within this series. If a letter is included with the serial number, it identifies the country in which the instrument was manufactured.

1-11. If the serial prefix of your instrument differs from the one on the title page of this manual, a change sheet will be supplied to make this manual compatable with newer instruments or the backdating information in Appendix C will adapt this manual to earlier instruments. All correspondence with Hewlett-Packard should include the complete serial number.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 3300A Function Generator. Included are initial inspection procedures, power and grounding requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories and test the electrical performance of the instrument using the Performance Checks outlined in Section V.

2-5. POWER REQUIREMENTS.

2-6. The Model 3300A can be operated from any source of 115 or 230 volts (* 109%), at 48 - 440 Hz. With the instrument disconnected from the ac power source, move the slide switch (located on the rear panel) until the desired line voltage appears. Power dissipation is approximately 50 watts.

2-7. GROUNDING REOUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the Instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a three -conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. 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.

2-10. INSTALLATION.

2-11. The Model 3300A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 55°C (131F).

2-12. BENCH MOUNTING.

2-13. The Model 3300A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. The Model 3300A may be rack mounted by using the 5" Rack Mount Kit (-hp- Part No. 5060-0775). Instructions for the conversion are included with the kit. The rack mount for the Model 3300A is a standard width of 19 inches.

2-16. REPACKAGING FOR SHIPMENT.

2-17. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-18 if the original container is to be used: 2-19 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations).

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number and serial number prefix.

2-18. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

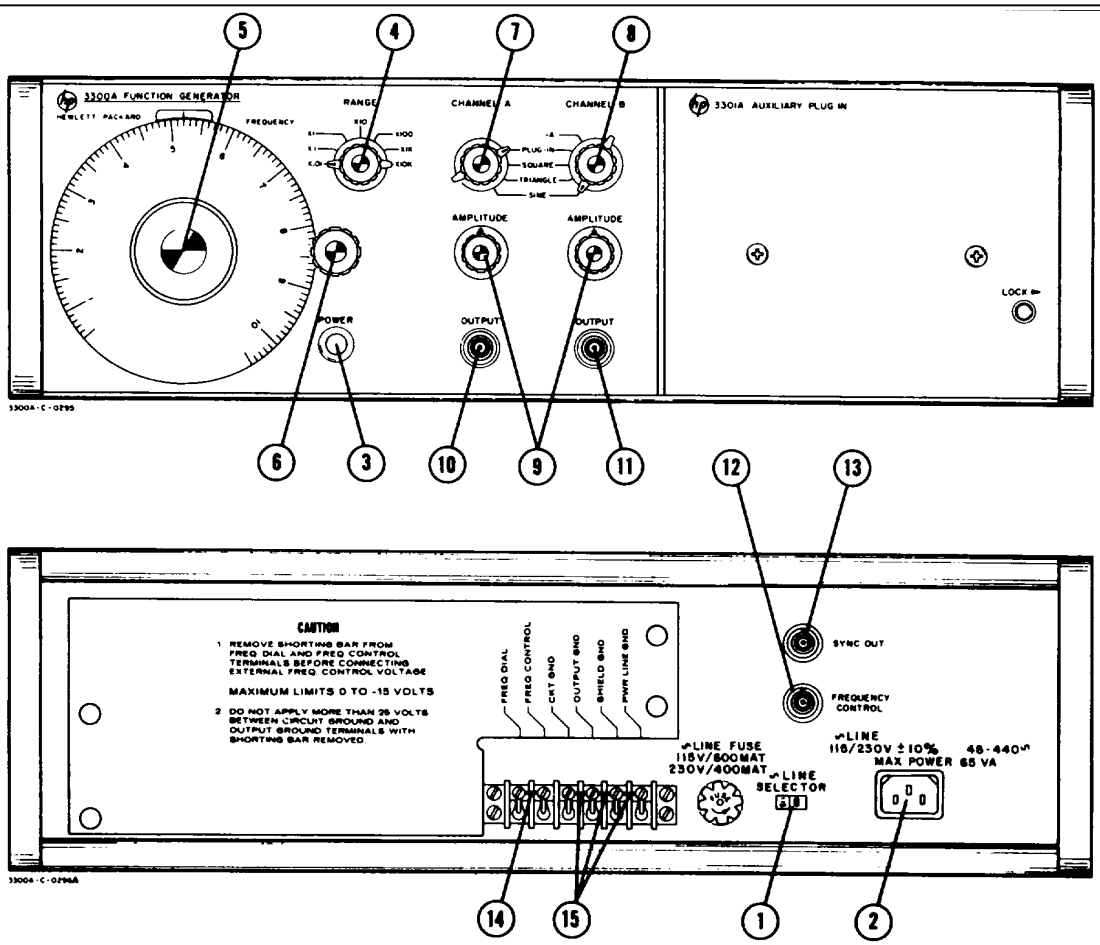
2-19. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT, " "FRAGILE", etc.



(1) 115V/230V Slide Switch: S2 makes proper connections in primary of input transformer for selected input line voltage.

(2) Power Input Jack: J1, male receptacle for input power cable.

(3) POWER Pushbutton: S1, a on-off switch which illuminates when in the on position and power is applied to the instrument.

(4) RANGE Switch: S3, a seven position rotary switch which selects frequency determining feedback parameters in the basic oscillatory circuit.

(5) FREQUENCY Dial: R4, a linear dial which controls frequency within the decade selected by the RANGE Switch (4).

(6) Vernier Frequency Control: a fine frequency adjustment knob.

(7) CHANNEL A Function Switch: S4, a four position rotary switch which selects the desired OUTPUT (10).

(8) CHANNEL B Function Switch: S5, a five position rotary switch which selects the desired OUTPUT (11).

(9) AMPLITUDE Controls: R12 and R9 attenuators which vary the output level of the respective channels.

(10) and (11) OUTPUT Connectors: J2 and J3, BNC jacks for connection to the respective outputs of the function generator.

(12) FREQUENCY CONTROL: J5, a BNC jack for applying external frequency control voltage.

(13) SYNC OUT: J4, a BNC jack for connection to sync pulse which occurs at the crests of the sine and triangle wave.

(14) FREQ DIAL-FREQ CONTROL Shorting Bar: completes the circuits to the FREQUENCY Dial for internal frequency control.

(15) Common Grounding Straps: ties circuit, output, and shield grounds to power-line ground. Should be connected unless otherwise specified.

Figure 3-1. Description of Front and Rear Panel Controls and Connectors

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. This section consists of instructions and information necessary for the operation of the -hp- Model 3300A Function Generator.

3-3. CONTROLS AND INDICATORS.

3-4. Each operating control and connector located on the 3300A is identified and described in Figure 3-1. The description of each component is keyed to an illustration of that component.

3-5. TURN ON PROCEDURE.

NOTE

One of the plug-ins must be in place and locked in before the 3300A is turned on. To remove a plug-in, turn off the 3300A and turn the LOCK knob fully counter-clockwise. This unlocks the plug-in and pushes it part way out for ease of removal. To install a plug-in, turn the LOCK knob fully counter - clockwise and push into place in the 3300A until it hits the stop, then turn the LOCK knob fully clockwise.

3-6. To turn on the Model 3300A, proceed as follows: (Refer to Figure 3-1).

a. Set 115/230 V slide switch (1) to line voltage to be used, and check for proper value fuse (.6 amp slow-blow for 115 volt operation, .4 amp slow-blow for 230 volt operation).

b. Connect Power Input Jack (2) to the ac line voltage with the power cord furnished with instrument.

c. Depress POWER button (3); ensure that light in button illuminates.

3-7. OPERATING INSTRUCTIONS.

NOTE

For small signal applications to obtain optimum signal to noise performance, use an external 20 dB attenuator.

3-8. To operate the Model 3300A locally using the FREQUENCY dial, proceed as follows: (See Figure 3-1).

a. Select desired frequency by settings RANGE Switch (4) and FREQUENCY Dial (5).

b. Select desired function by setting CHANNEL A and/or CHANNEL B Function Switch (7) or (8). PLUG-IN position is used for plug-in function(s).

c. Set AMPLITUDE controls (9) for desired output level at the OUTPUT connectors(10) or (11).

3-9. To control the frequency of the Model 3300A externally (remotely) proceed as follows:

a. Remove FREQ DIAL-to-FREQ CONTROL shorting bar (14).

CAUTION

VOLTAGE APPLIED TO FREQ CONTROL BNC SHOULD BE LIMITED TO A VALUE BETWEEN +0.3 AND -15 VOLTS. VOLTAGES OUTSIDE THIS RANGE WILL DAMAGE THE INSTRUMENT.

b. Apply a negative dc voltage from -0.5 to -10 volts to the FREQUENCY CONTROL BNC (12).

NOTE

-0.5 to -10 volts will linearly control the frequency over one decade of range selected. A +0.3 to -10 volts will linearly control the frequency over 50:1 range.

c. Select desired frequency range and set amplitude of externally applied voltage for desired frequency.

d. All 3300A controls except the FREQUENCY dial are operated in the same manner as in Paragraph 3-8.

3-10. To dc offset the output function of the 3300A with either the 3301A or 3302A Plug-in, proceed as follows:

a. Remove CKT GND-to-OUTPUT GND shorting bar (15).

CAUTION

DO NOT EXCEED ± 25 V DC OFFSET VOLTAGE BETWEEN OUTPUT GROUND AND CIRCUIT GROUND.

b. Connect the desired dc offset voltage, up to

± 25 V, between CKT GND and the common grounds. OUTPUT GND, SHIELD GND, and PWR LINE GND should be shorted together (15).

c. If more than ± 25 V dc offset is desired, short CKT GND. OUTPUT GND, and SHIELD GND together (15). Up to ± 250 V dc may be applied between this common ground and PWR LINE GND.

WARNING

WHEN THE OUTPUT GROUND IS FLOATED ABOVE POWER LINE GROUND. ALL BNC CONNECTORS WILL BE AT THE OFFSET VOLTAGE.

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains a description of the theory of operation of the -hp- Model 3300A Function Generator with the -hp- Model 3301A Auxiliary Plug-in.

4-3. GENERAL DESCRIPTION.

4-4. The Model 3300A contains a frequency control network, two current sources, a triangle integrator, a voltage comparator multivibrator, a sine wave synthesizer and output amplifiers. (Refer to Figure 4-1

4-5. The Model 3301A Auxiliary Plug-in provides internal connections which facilitate Model 3300A operation.

4-6. The voltage comparator multivibrator, current sources and triangle integrator form the basic function generating loop. The voltage comparator multivibrator changes state at predetermined limits on the positive and negative slopes of the output of the triangular integrator. This change of state shuts off the upper current source, reverses the input to the triangle integrator. A cycle is as follows: when the amplitude of the positive slope of the triangle wave reaches the upper predetermined limit of the voltage comparator multivibrator, the multivibrator changes state. This change of state reverses the current into the triangle integrator through control of the upper current source which causes the output of the integrator to decrease. The decrease continues until the amplitude of the negative slope reaches the lower predetermined limit. At this point, the voltage comparator multivibrator changes state and again reverses the direction of current at the input of the integrator and causes the output of the integrator to rise. This rise continues until the voltage comparator multivibrator again changes state thus completing the cycle.

4-7. The frequency control network, governed internally by the FREQUENCY Dial or externally through the FREQUENCY CONTROL, determines the amount of current in the current sources, which varies the frequency as follows: an increase or decrease in input current increases or decreases the slope of the triangle wave, respectively. (A change in direction of input current reverses the slope.) Frequency will increase if the + and - slopes are increased, as less time is required for the + or - slope of the triangle wave to reach the predetermined limits in the voltage comparator multivibrator.

4-8. The sine wave is synthesized from the triangle wave by a nonlinear network. This network consists of resistors and diodes biased so different diodes conduct during different voltage levels of the triangle wave. These diodes, when conducting, provide additional shunt paths within the network. Each additional shunt path changes the slope of the triangle wave so that the wave is shaped to a sine wave.

4-9. The output amplifiers are dc coupled and fully floating with respect to power line ground. CHANNEL A and CHANNEL B amplifiers are identical and use a differential amplifier at the input. To maintain the same peak-to-peak amplitude regardless of function selected, the overall closed loop gain of the amplifier is varied with function selection.

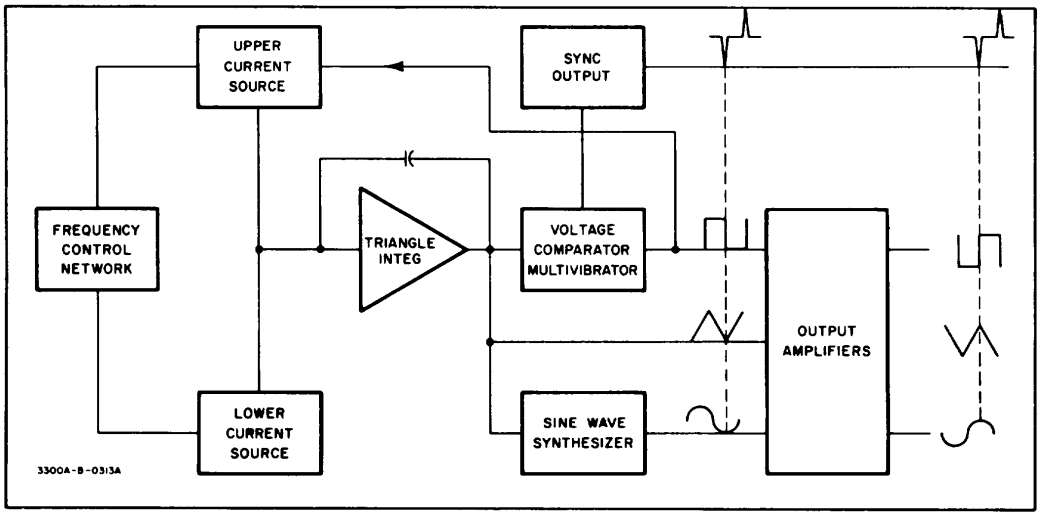


Figure 4-1. Block Diagram

4-10. The sync pulse is produced by an RC differentiating network. The negative pulse at the output is in phase with the positive crest of the sine and triangle wave.

4-11. Power Supply (Refer to Figure 6-5) can operate on either 115 or 230 volts input and delivers 3 pairs of voltages, ±40V, ±26.5V, and ±20V. The 40 volt supply provides power for the oven heater. The 26.5 volt supplies are regulated and the 20 volt supplies are double regulated.

4-12. Critical temperature sensitive components are housed within an oven in which the temperature is maintained at approximately 800 C (1760 F).

4-13. SCHEMATIC THEORY.

4-14. FREQUENCY CONTROL NETWORK.

4-15. (Refer to Figure 6-2) The FREQUENCY dial (R4) in conjunction with the RANGE switch (S3) provides internal frequency control. The basic frequency equation can be expressed as $F=\frac{i}{2C \Delta e_{out}}$ where i is the current to the triangle integrator, C is the triangle integrator feedback capacitor and e out is the peak-to-peak voltage of the triangle wave.

4-16. The position of the RANGE switch determines the integrating capacitor C. The FREQUENCY dial or external control voltage determines the current i. The frequency control voltage is applied to the current control transistor Al IQ5, which establishes the amount of current available to the triangle integrator from the current sources AllQ6 and AllQ7.

4-17. CURRENT SOURCES.

4-18. The state of current source A11Q6 is controlled by the voltage comparator multivibrator, and in turn, controls the direction of the current in the input of the triangle integrator. When A11Q6 is on, a current, 2 i, flows through it and divides, i into the integrator and i through current source A11Q7. When the bi-stable multivibrator changes state and gates A11Q6 off, 2 i no longer flows; however, the current through A11Q7 remains the same. Therefore, a current equal to i but opposite in direction flows from the triangle integrator input.

4-19. TRIANGLE INTEGRATOR.

4-20. The triangle integrator consists of an impedance converter A11Q8 (a field effect transistor), a differential amplifier A13Q1 and A13Q2, an emitter follower A13Q3, diode A13CR1, and the capacitive feedback network: this circuit integrates the constant current inputs into the positive and negative slopes which make up the triangle wave. The triangle wave is applied to the inputs of the output amplifiers, sine wave synthesizer and voltage comparator multivibrator.

4-21. VOLTAGE COMPARATOR MULTIVIBRATOR.

4-22. The voltage comparator multivibrator consists of a voltage comparator switching network, A14Q8, A14CR13 and A14CR14; a bi-stable multivibrator A14Q9 and Q10 and an emitter follower A14Q11. A14CR19 and R45 provide a low resistive path to ensure rapid rise and fall time of the square wave in the event the capacitance of the load is high. When the positive slope of the triangle wave reaches +20 volts, A14CR13 is turned on. A14Q9 is then turned on which turns A14Q10 off. The rise in the collector voltage of A14Q10 is coupled through emitter follower A14Q11 and through A14CR20 and A14CR21 into the emitter circuit of A11Q6, and turns it on. The output slope then becomes negative. A11Q6 remains on until the negative slope reaches zero volts. At the zero point on the negative slope A14CR14 is turned on which causes the bi-stable multivibrator to change state so that A14Q9 is now off and A14Q10 is on. The decrease in A14Q10 collector voltage gates the current source, A11Q6, off which reverses the integrator input current. The positive slope then begins increasing toward the upper limit, +20 volts. The output of the emitter follower is differentiated by A14C7 and A14R48 to provide the sync output. A negative sync pulse occurs at the crest of sine and triangular wave, see Figure 4-1.

4-23. SINE WAVE SYNTHESIZER.

4-24. (See Figure 6-2) The sine wave synthesizer comprises four control transistors, the biased diodes with associated voltage dividers, a differential amplifier A14Q5, A14Q6 and the output amplifier A14Q7. A14R17 andA14R29 adjust the operating points of the voltage dividers to minimize distortion. The diodes are biased by the four control transistors A14Q1 through A14Q4 and the voltage dividers to provide twelve different current paths in the input to the differential amplifier as the triangle wave progresses. Each slope of the triangle wave is modified in twelve steps so that the waveform appearing at the base of A14Q5 approximates a sine wave. The sine wave synthesizing network is isolated by the differential amplifier A14Q5 and A14Q6 and amplifier A14Q7.

4-25. OUTPUT AMPLIFIERS. Figure 6-4).

4-26. The etched circuit assemblies A15 and A16 are identical. CHANNEL A and CHANNEL B differ due to the -A output of CHANNEL B. The input for CHANNEL B with its function switch in -A position, A16 Pin 5, is taken from the junction of A15R20 and R21, XA15 Pin 11. The output amplifiers are variable gain amplifiers. Gain is varied by changing the amount of feedback for the different functions. The following reference designators should be prefixed by applicable assembly number. The feedback is varied by resistors R1 through R5 and R23 C8 combination, to maintain equal peak-to-peak amplitude of the various functions for a given AMPLITUDE control setting. A differential amplifier, Q1 and Q2, make up the first stage followed by two additional amplifiers Q3 and Q4. The trimmer C2 in the feedback network is used to shape the square wave. The AMPLITUDE control provides a nominal 600 ohms output impedance, independent of amplitude control setting.

4-27. POWER SUPPLY (Figure 6-5).

4-28. The power supply consists of two full wave rectifiers CR1 thru CR4 and four series regulated supplies. AllCR1 provides a stable reference for the two negative regulated supplies which in turn are the references for the two positive regulated supplies. The two 20 volt supplies are double regulated. The operation of the four supplies is similar: A differential amplifier senses and amplifies any change. The change is applied through a driver stage to the series regulator which then changes its conduction to oppose the change.

4-29. Operation of the positive and negative supplies is similar. Diodes CR2 thru CR5 and CR7 thru CR9 determine the maximum current permitted to flow in the series regulating transistors. Referring to Figure 6-5, +26.5 volt supply, it can be seen that an increase in current through R5 and R6 increases the overall forward bias on the diode network CR2 thru CR5. The magnitude of this forward bias is determined by the sum of the forward biased base-emitter diode voltage of Q1 and Q2 in addition to the voltage drop across the R5-R6 combination. When this forward bias increases to a level sufficient to allow the diodes to conduct, any increase in the collector current of Q4 will pass through the diodes and not enter the base of Q2. This, in thru, limits the maximum current in the series regulating transistors.

4-30. OVEN.

4-31. (See Figure 6-5.) The desired oven temperature is automatically maintained by a thermal control loop. The loop consists of a thermistor, a signal amplifier, a power amplifier, and the heater resistors. The operation of the loop is as follows: The resistance of RT1 (thermistor) decreases with an increase in temperature which causes the base current of A11Q9 to increase. The corresponding decrease of A11Q9 collector voltage is coupled into the base circuit of the power amplifier Q7. The collector current of Q7 then decreases which decreases the current through the heater resistors generating less heat and the temperature decreases. The response of the loop is improved by the physical location of A11R27 in close proximity to the thermistor.

Table 5-1. Required Test Equipment

Instrument Type	Required Characteristics	Use	Recommended Instrument
Electronic Counter	Range: dc to 100 kHz Accuracy: 0.1%	Performance Checks, Adjustment and Calibration	-hp- 5245L Electronic Counter with 5262A Plug-in Time Interval Unit
Distortion Analyzer	Range: 10 Hz to 100kHz Freq. Accuracy: ±2% Sensitivity: 0.3%fullscale Input: 1 volt rms	Performance Checks	-hp- Model 331A Distortion Analyzer
Oscilloscope	Sensitivity: 50 mV/cm Bandwidth: dc to 30 MHz	Performance Checks, Adjustment Calibration, Repair	-hp- 175A Oscilloscope with -hp- Plug-in 1750B Vertical Amplifier
Probe 10:1	Bandwidth: dc to 30 MHz Division Accuracy: ±2%	Performance Checks, Adjustment and Calibration, Repair	-hp- 10001A Probe 10:1
DC Voltmeter	Accuracy: ± 1% F. S. Range: 10 mV to 50 V Input Impedance: 10 MΩ	Adjustment and Calibration, Repair	-hp- 3440A Digital Voltmeter with Plug-in -hp- Model 3443A
Resistor	600 ohms 1/4 watt +5%	Performance Checks	-hp- Part No. 0730-0010
Resistor	50 ohms 1/4 watt ±5%	Performance Checks	-hp- Part No. 0683-5105
Resistor	20 K 1/4 watt ±5%	Adjustment and Calibration	-hp- Part No. 0686-2035
Capacitor	1 µ F 50 V	Adjustment and Calibration	-hp- Part No. 0160-0859
Variable Line Voltage Transformer	Range: 100 to 130 V	Performance Checks	Superior Type UCIM
DC Power Supply	Range: 0 - 10 volts, 500 mA	Performance Checks, Adjustment and Calibration	-hp- 723A Power Supply
AC Voltmeter	Range:10 Hz to 4 MHz 30 mV to 300 V full scale	Adjustment and Calibration	-hp- 400F/FL Voltmeter
Printed Circuit Extender Board	15 Pin	Repair	-hp- Part No. 5060-0049
Printed Circuit Extender Board	22 Pin	Repair	-hp- Part No. 5060-0630

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary for the proper maintenance of the -hp- Model 3300A Function Generator. The required test equipment is listed in Table 5-1. Test equipment with comparable characteristics can be substituted if recommended equipment is not available.

5-3. PERFORMANCE CHECKS.

5-4. The performance checks are front panel procedures designed to compare the -hp- Model 3300A with its specifications. (See Table 1-1). These checks may be accomplished with either the 3301A Auxiliary Plug-in or Malfunction Isolating Aid Plug (see Figure 5-7) installed in the 3300A. These operations should be completed before any attempt is made to adjust or calibrate the instrument. Allow a 30 minute warm-up period before making performance checks. If a performance check indicates that the instrument does not meet specifications refer to the applicable paragraph in the Adjustment and Calibration procedure contained in this Section. (See Table 5-5).

5-5. DIAL ACCURACY.

a. Test equipment required: Frequency Counter (-hp- Model 5245L).

b. Connect CHANNEL A OUTPUT to the frequency counter and set the 3300A control as follows:

CHANNEL A function switch ..... SINE
CHANNEL A AMPLITUDE ..... mid position

c. Check frequency with dial at 1 and 10 for each position of RANGE switch.

d. Accuracy should be * 1% of maximum dial setting (one minor division) on X. 01 through X1K ranges, and ± 2% of maximum dial setting (two minor divisions) on X10K range.

5-6. Since the specification gives % of maximum dial setting (full scale, the accuracy will always be ± 1 or 2 minor divisions at any point on the dial.

5-7. DISTORTION CHECK.

a. Test equipment required: Distortion Analyzer (-hp- Model 331A).

b. Connect the OUTPUT of CHANNEL A to distortion analyzer and set 3300A controls as follows:

FREQUENCY dial 10
RANGE switch..... X1K
CHANNEL A function switch ..... SINE
CHANNEL A AMPLITUDE control ..... mid position

c. Distortion should be less than 1%.

d. Position the RANGE switch to X10K. Distortion should be less than 3%.

NOTE

The sine function is electronically synthesized from the triangle function. Satisfactory performance of Distortion Check assures symmetry and triangle linearity.

5-8. FREQUENCY RESPONSE:

5-9. Test equipment required: Oscilloscope (-hp- Model 175/1750B).

a. Set up convenient reference level on oscilloscope at 1 kHz.

b. Vary frequency over the entire range except X10K. Amplitude should vary < ± 1%.

c. Vary frequency over the X10K range. Amplitude should vary < ± 3%.

5-10. MAXIMUM OUTPUT LEVEL, NO LOAD.

a. Test equipment required: Oscilloscope (-hp- Model 175A/1750B).

b. Connect the OUTPUT of CHANNEL A to Oscilloscope and set 3300A controls as follows:

CHANNEL A function switch ..... SQUARE
CHANNEL A AMPLITUDE ..... Max. CW

c. The peak-to peak voltage should be > 35 volts over entire frequency range.

5-11. Repeat 5-10 above with CHANNEL A function switch set to SINE and TRIANGLE. The minimum peak-to-peak voltage should remain 35 volts.

5-12. Repeat 5-10 and 5-11 on CHANNEL B.

5-13. MAXIMUM OUTPUT LEVEL, LOADED.

a. Test equipment required: Oscilloscope (-hp- Model 175A/1750B), 600 ohm, and 50 ohm resistor, see Table 5-1.

b. Connect OUTPUT of CHANNEL A and 600 ohm resistor as shown in Figure 5-1. Set the 3300A controls as follows:

FREQUENCY dial 10
RANGE switch X100
CHANNEL A AMPLITUDE ..... control ..... Max. CW
CHANNEL A function switch ... SQUARE

c. Peak-to-peak voltage should be > 15 volts.

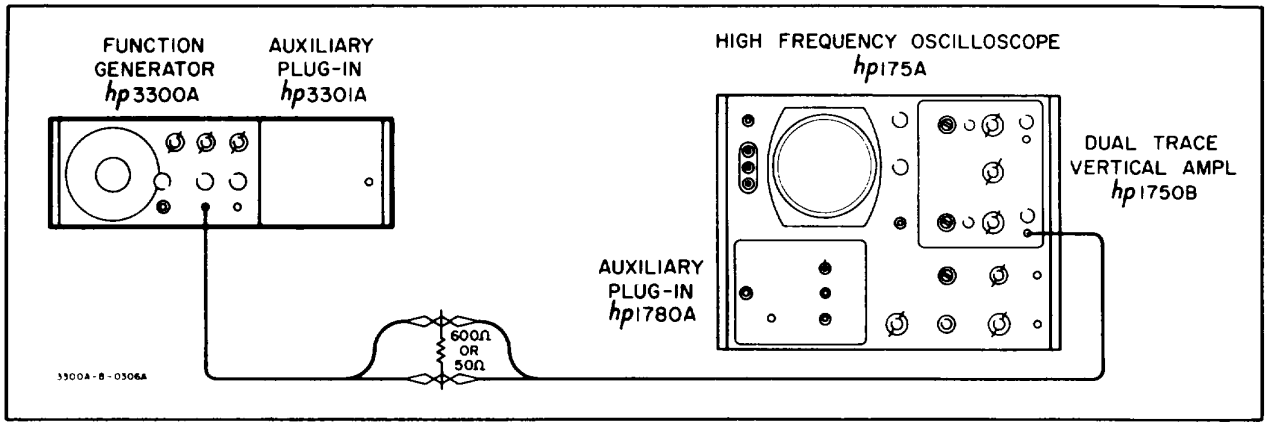


Figure 5-1. 600 ohm or 50 ohm Load Output Test Setup

5-14. Repeat 5-13 on CHANNEL B. Limit should remain > 15 volts peak-to-peak.

5-15. Repeat 5-13 and 5-14 except load the instrument with the 50 ohm resistor. CHANNEL A and CHANNEL B voltage output should be > 2 volts peak-to-peak.

5-16. SQUARE WAVE RESPONSE.

a. Test equipment required: Oscilloscope (-hp- Model 175A/1750B) and 10:1 Probe (-hp- Model 10001A).

b. Connect CHANNEL A OUTPUT without a load to the oscilloscope using the 10:1 Probe, and set the 3300A controls as follows:

CHANNEL A function .....SQUARE
FREQUENCY dial 10
RANGE switch.....X10K

c. Verify: Rise and fall time <250 nano sec.
Sag <1%
Overshoot (full output) <5%
Symmetry error <1%

5-17 Repeat 5-16 on CHANNEL B.

5-18. SYNC OUTPUT.

a. Test equipment required: Oscilloscope (-hp- Model 175A/1750B) and 10:1 Probe (-hp- Model 10001A).

b. Connect SYNC OUTPUT to oscilloscope and set 3300A controls as follows:

FREQUENCY dial.....10
RANGE switch X1K

c. Pulse should be > 10 volts peak-to-peak and < 5 microsecond duration.

5-19. REMOTE FREQUENCY CONTROL CHECK.

a. Test equipment required: DC Power Supply (-hp- Model 723A) and Oscilloscope (-hp- Model 175A/1750B).

CAUTION

VOLTAGE APPLIED TO FREQUENCY CONTROL BNC SHOULD BE LIMITED TO A VALUE BETWEEN 0 AND NEGATIVE 15 VOLTS. VOLTAGES OUTSIDE THIS RANGE WILL DAMAGE THE INSTRUMENT.

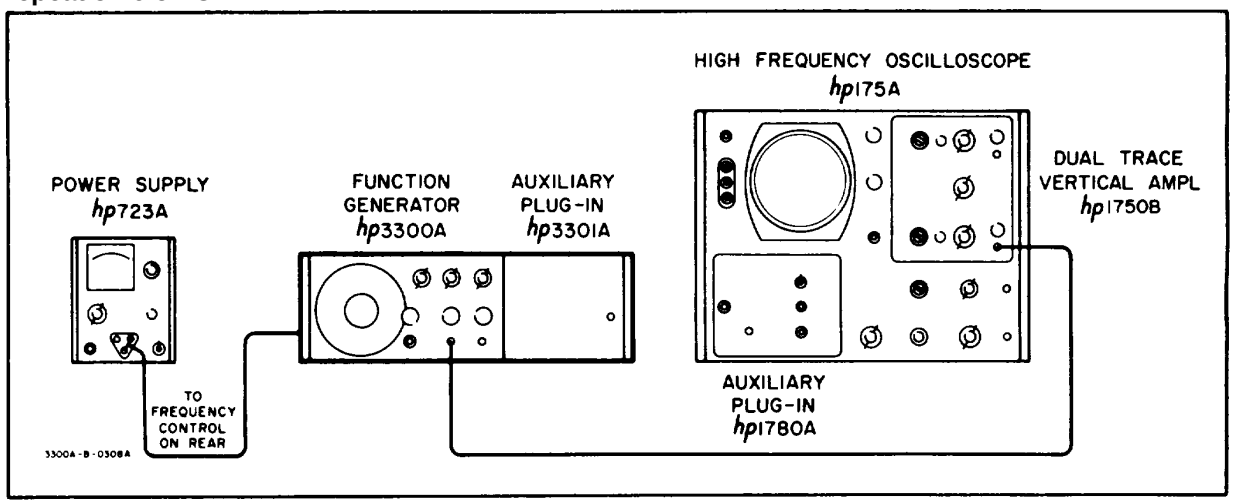


Figure 5-2. Remote Frequency Control Test Setup

b. Connect the instruments as shown in Figure 5-2. Remove FREQ. DIAL-to-FREQ. CONTROL shorting bar.

c. Set 3300A controls as follows:

CHANNEL A function switch .....SINE
RANGE switch.....X10
CHANNEL A AMPLITUDE .....Max. CW

d. Monitor frequency as power supply is varied from 0 to -10 volts. Frequency should vary over the decade, 10 to 100 cycles.

5-20. CHANNEL B-A CHECK.

a. Test equipment required: Oscilloscope (-hp- Model 175A/1750B).

b. Connect CHANNEL A OUTPUT to one channel of the oscilloscope and CHANNEL B OUTPUT to the other channel of the oscilloscope.

c. Set 3300A controls as follows:

CHANNEL A function switch .....SINE
CHANNEL B function switch .....-A

d. The output of CHANNEL B should be a sine wave, but 1800 out of phase with the output of CHANNEL A.

5-21. ADJUSTMENT AND CALIBRATION.

5-22. COVER REMOVAL.

When it is necessary to repair or adjust the Model 3300A, one or more covers will have to be removed. To remove either the top or bottom cover, remove the two phillips screws and slide the cover to the rear.

NOTE

Allow a 30-minute warm-up period before making any adjustments.

5-23. POWER SUPPLY ADJUSTMENTS.

5-24. The adjustment and calibration procedures are designed to adjust and calibrate the -hp- Model 3300A and should be undertaken only if the performance checks indicate the instrument does not meet specifications. (See Figure 5-3 for adjustment identification and indication.)

5-25. The measurement points, adjustments and voltage limits are given in Table 5-2. Refer to Figure 5-4 for convenient top and bottom chassis location for monitoring supply voltage. Supplies should be adjusted in the following order: -26. 5V, +26.5 V, -20 V, +20 V. The supplies should be rechecked and, if necessary, readjusted in the same order.

5-26. POWER SUPPLY RIPPLE CHECK.

a. Test equipment required: AC Voltmeter (-hp- Model 400F/FL).

b. With the AC Voltmeter, check the regulated power supplies (i26. 5 V and +20.00 V) for ripple.

c. Ripple should be < 20 millivolts.

5-27. POWER SUPPLY REGULATION CHECK.

a. Test equipment required: DC Voltmeter (-hp- Model 3440A/3443A) and Variable Line Voltage Transformer.

b. Apply power to the 3300Athroughthe variable line voltage transformer.

c. With the DC Voltmeter, check the regulated power supplies as input voltage to the 3300A is varied from 103 to 127 Vac (207 to 253 Vac). Voltage limits are given in Table 5-2.

5-28. OVEN REGULATION.

a. After 3300A has been on approximately 30 min, connect a DC Voltmeter between circuit ground and collector of Q7 (Q9 on instruments Serial prefixed: 519-, 533-, 609-, 616- and 622-.) Voltage noted should be approximately 20 volts.

NOTE

This voltage will vary with oven amplifier transistors.

b. Turn 3300A off for approximately 1 minute, then turn it on. Voltage should have decreased to approximately 15 volts. Voltage should then increase and overshoot that noted in step a but in time damp out to approximately 20 V.

5-29. FREQUENCY SYMMETRY ADJUST.

5-30. Lower Frequency Symmetry Adj. (A13R22).

a. Test equipment required: Electronic Counter (-hp- Model 5245L with 5262A Time Interval Plug-in).

b. Set 3300A controls as follows:

RANGE Switch.....X.1
CHANNEL A Function.....SQUARE
Output Attenuation .....Max. CW
FREQUENCY dial.....1

Table 5-2. Power Supply Adjustments

POWER SUPPLY	MEASUREMENT POINT	ADJUSTMENTS	VOLTAGE LIMITS
+40	ANY RED WIRE (except on S2)	NONE	+40±3 V
-40	ANY VIOLET WIRE	NONE	-40±3 V
-26.5	ANY WHITE/VIOLET WIRE	A12R20	-26.5 ± 02 V
+26.5	ANY WHITE/RED WIRE	A12R7	+26.5 ± .02 V
-20	ANY WHITE/BLACK/VIOLET WIRE	A12R26	-20.00±0.01 V
+20	ANY WHITE/BLACK/RED WIRE	A12R25	+20.00±. 01 V

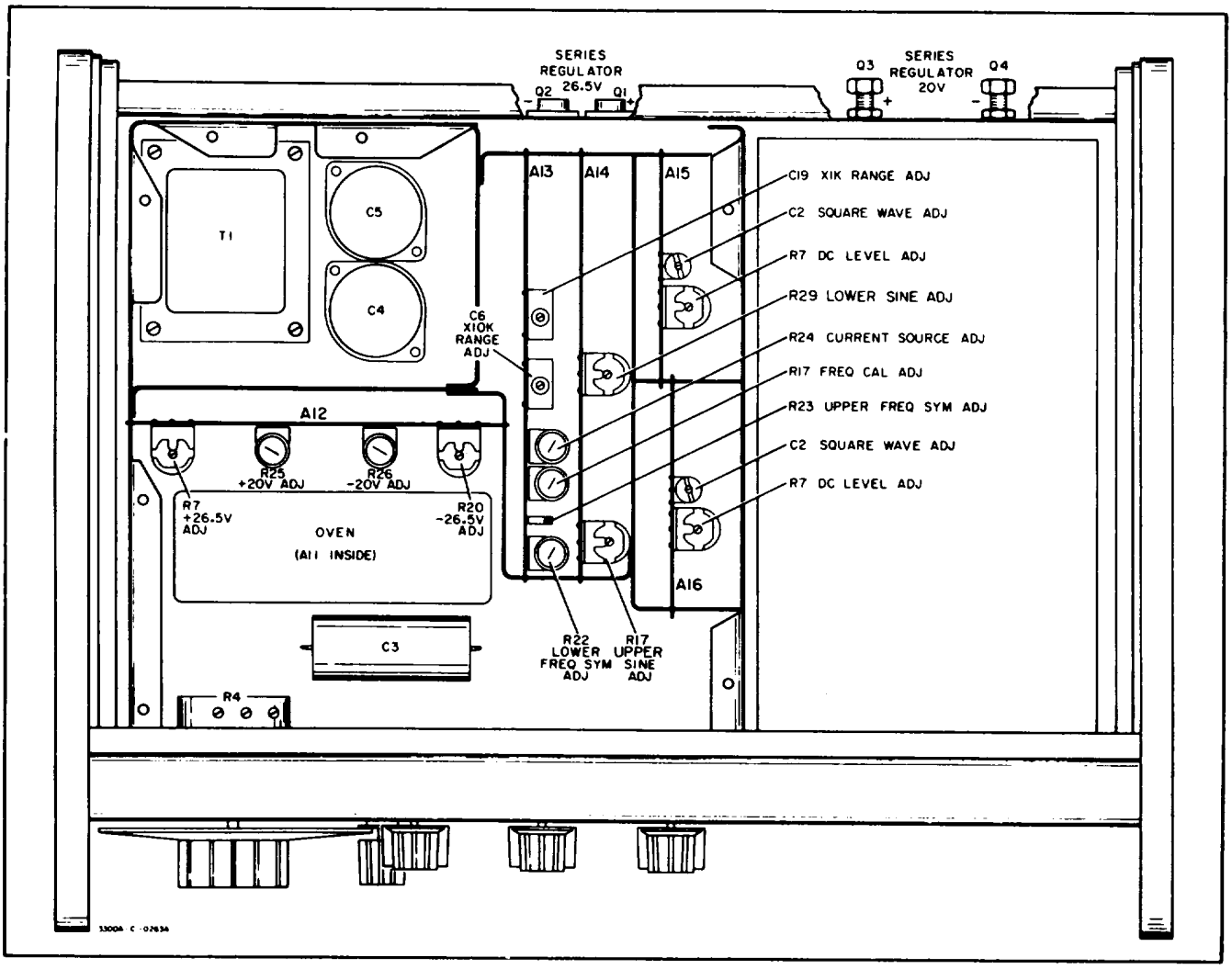


Figure 5-3. Adjustment Point Location

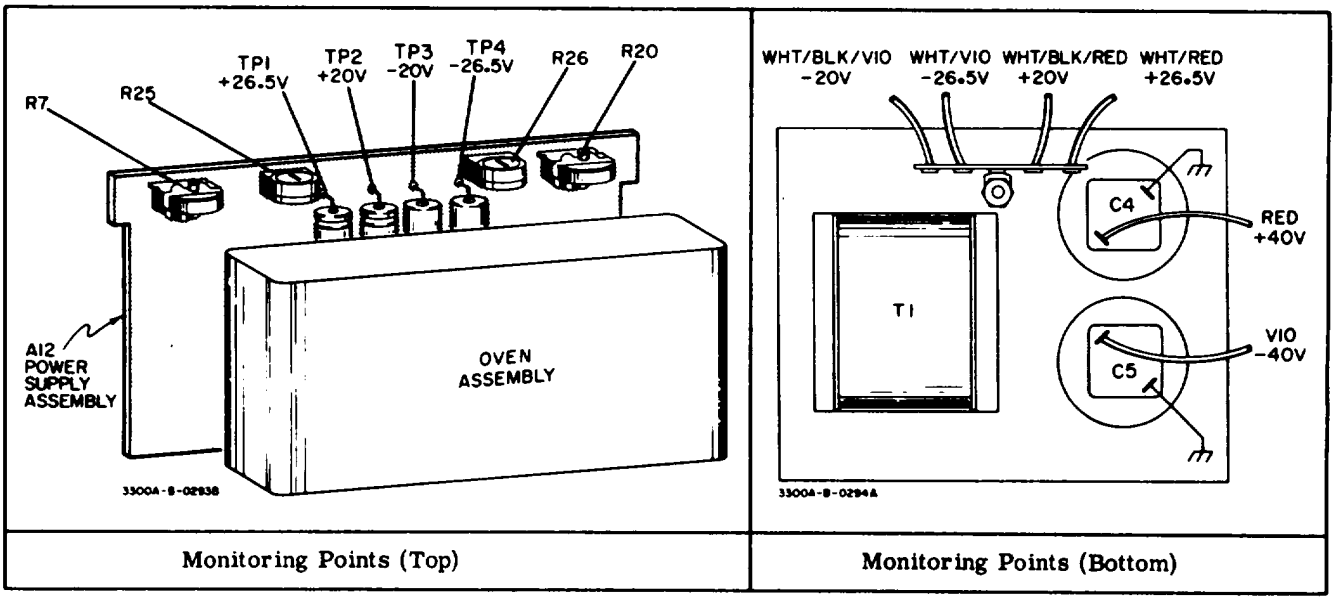


Figure 5-4. Voltage Monitoring Points Top and Bottom

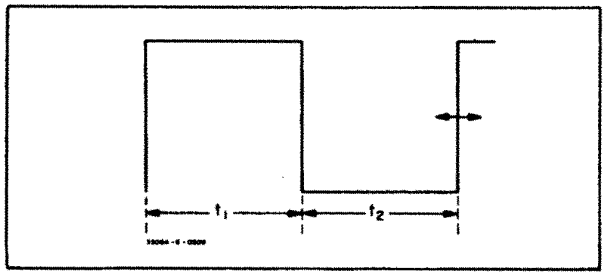


Figure 5-5. Symmetry Adjustment

c. Measure t1 and adjust A13R22, LOWER FREQ. SYM., to made t2 = t1. Ref. Figure 5-5. If A13R22 does not have enough range change A13Q20.

5-31. Upper Frequency Symmetry Adjust. (A13R23).

NOTE

Lower Frequency Symmetry must be set before this adjustment is made.

a. With the same setup as used for the Lower Symmetry Adjust, select X100 RANGE and adjust A13R23 to make t2 equal to t1. The symmetry error should be < 1%.

b. Check the symmetry with the dial set to 3 and then again with the dial set to 10. The symmetry error at both dial settings should be <1%.

$$\% \text{ Symmetry error} = \frac{t1 - t2}{t1 - t2} \times 100$$

5-32. CURRENT SOURCE ADJUST (A13R24).

NOTE

This adjustment interacts with the Frequency Symmetry Adjustments (A13R22 and A13R23): perform the following adjustment only if the frequency is not within specified accuracy(Table 1-1) on the X10 orX.1 RANGE.

a. Test equipment required: Frequency Counter (-hp- Model 5245L).

b. Connect CHANNEL A OUTPUT to Frequency Counter, and set 3300A controls as follows:

RANGE switch X10
FREQUENCY dial 10
CHANNEL A function ..... SINE

c. Output frequency should be 100 Hz, *1 minor division on FREQUENCY dial.

d. Position RANGE switch to X. 1 and measure output frequency (1 Hz *1 minor division on FREQUENCY dial.

NOTE

Repeat Frequency Symmetry Adjust outlined in paragraph 5-29 if A13R24 is adjusted in the following step.

e. If the frequency is not within specifications given in step c or d, adjust A13R24 CURRENT SOURCE ADJ for optimum indication on both X10 and X. I RANGE.

5-33. DIAL ADJUSTMENT.

a. Test equipment required: Frequency Counter (-hp- Model 5245L).

b. Connect CHANNEL A OUTPUT to Frequency Counter, and set 3300A control as follows:

RANGE switch X10
CHANNEL A function ..... SINE

c. Loosen dial from hub and adjust the frequency of 3300A to exactly 100 cps by rotating the hub. Set the dial to read "1" and tighten the dial to the hub. Recheck the frequency.

5-34. DIAL CALUBRATE.

5-35. FREQUENCY CALIBRATION ADJUST. (A13R17).

a. With same setup as used for 5-33, turn FREQUENCY dial to "10".

b. Adjust A13RI7 FREQ CAL ADJ for output frequency of 1 kHz.

5-36. X1K RANGE ADJUST (A13C19).

a. With same setup as used for 5-33, set RANGE switch to X1K and FREQUENCY dial to "10".

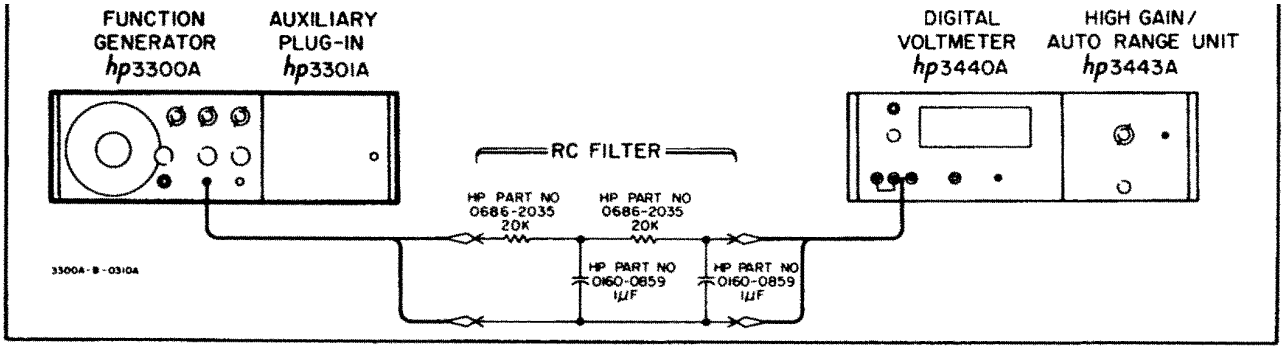


Figure 5-6. DC Output Level Adjust Test Setup

b. Adjust A13C19 X1K RANGE ADJ for output frequency of 10 kHz.

5-37. X10K RANGE ADJUST (A13C6).

a. With same setup as used for 5-33 set RANGE switch to X1OK and FREQUENCY dial to "10".

b. Adjust A3C6, 100 kHz Dial calibrate adjust for an output frequency of 100 kHz.

5-38. DISTORTION ADJUST (A14R17 AND A14R29).

a. Test equipment required: Distortion Analyzer (-hp- Model 331A.)

b. Connect CHANNEL A OUTPUT to distortion analyzer and set Model 3300A controls as follows:

FREQUENCY dial 1
RANGE switch.....X1K
CHANNEL A function .....SINE

c. Adjust A14R17, UPPER SINE ADJ and A14R29 LOWER SINE ADJ for minimum distortion.

d. Distortion should be < 1%.

5-39. DC OUTPUT LEVEL ADJUST (A15R7 AND A16R7).

a. Test equipment required: DC Voltmeter (-hp- Model 3440A) and RC Filter see Figure 5-6, page 5-5.

b. Connect CHANNEL A OUTPUT to DC Voltmeter through a filter as shown in Figure 5-6.

c. Set 3300A controls as follows:

RANGE switch.....X100
FREQUENCY dial 10
CHANNEL A Function .....Vary
CHANNEL A AMPLITUDE .....Max. CW

d. Check dc output level on all three functions. Adjust A15R7 DC LEVEL ADJ for minimum voltage on all functions. DC levels should be ±200 mV.

NOTE

Compromise the adjustment of A15R7 so that all functions are as close to zero volts as possible.

5-40. Repeat 5-39 on CHANNEL B, and adjust A16R7 DC LEVEL ADJ.

5-41. SQUARE WAVE ADJUST (A15C2 AND A16C2).

a. Test equipment required: Oscilloscope (-hp- Model 175A) and 10:1 Probe. (-hp- Model 10001A).

b. Connect the CHANNEL A OUTPUT to the oscilloscope using the 10:1 Probe.

c. Set 3300A controls as follows:

CHANNEL A function.....SQUARE
FREQUENCY dial.....10
RANGE switch X10K

d. Adjust A15C2 SQUARE WAVE ADJ for minimum rise time with less than 5% overshoot on the square wave. Rise time should be < 250 n sec.

5-42. Repeat 5-41 on CHANNEL B, and adjust A16C2 SQUARE WAVE ADJ.

5-43. REPAIR PROCEDURES.

5-44. SERVICING ETCHED CIRCUIT BOARDS.

5-45. The Model 3300A has six etched circuit boards. Use caution when removing them to avoid damaging mounted components. The -hp- Part No. for the assembly is marked on the circuit board to identify it and on the appropriate schematic. Refer to Section VII for replacement -hp- Part No's. The etched circuit boards are of the plated-through type. The electrical connection between the two sides of the board is made by a layer of metal plated-through the component hole. When working on these boards, observe the following rules:

a. Use a low-heat (25 to 30 watts) small-tip soldering iron, and a small diameter rosin core solder.

b. Remove circuit components by placing the soldering iron on the component lead on either side of the board, and pulling up on the lead.

If a component is obviously damaged, clip leads off as close to the component as possible and then remove leads with a soldering iron.

CAUTION

EXCESSIVE HEAT CAN CAUSE THE CIRCUIT AND BOARD TO SEPARATE, OR CAUSE DAMAGE TO THE COMPONENTS.

c. Clean component lead hole by heating the hole with the iron and inserting a wooden toothpick. Remove the toothpick after the solder has cooled and insert the new component lead.

d. Shape the new components leads and insert them in lead holes. Reheat with soldering iron and add a small amount of new solder as required to insure a good electrical connection.

e. Clean excessive flux from the connection and adjoining area.

CAUTION

TO AVOID SURFACE CONTAMINATION OF THE PRINTED CIRCUIT, CLEAN WITH A WEAK SOLUTION OF WARM WATER AND MILD DETERGENT AFTER REPAIR. RINSE THOROUGHLY WITH CLEAN WATER AND ALLOW IT TO DRY COMPLETELY BEFORE OPERATING. DO NOT USE ALCOHOL OR ANY OTHER CLEANING SOLUTION EXCEPT DETERGENT AND WATER. DO NOT APPLY ANY COMMERCIAL MOISTURE SEALING SPRAY TO THE BOARDS. APPLICATION OF THESE AGENTS WILL CAUSE LEAKAGE PATHS AND SUBSEQUENTLY, DETERIORATION TO THE OPERATION OF THE INSTRUMENT.

f. Wear clean, lint free cotton or rubber gloves when handling the circuit boards. Avoid touching the board or components with bare fingers as skin oils can cause contamination and leakage paths.

5-46. SERVICING ROTARY SWITCHES.

5-47. The 3300A has three rotary type switches; RANGE, CHANNEL A, and CHANNEL B. When working on these switches, observe the following rules:

a. Use a low-heat (25 to 50 watts) small tip soldering iron, and a small diameter rosin core solder.
b. When replacing components, attempt to dress them as nearly to their original alignment as possible.
c. Clean excessive flux from the connection and adjoining area.

5-48. REPLACEMENT OF FACTORY SELECTED COMPONENTS.

5-49. Replacement components are identified in Table 5-3 and 5-6. Should it become necessary to replace any of the capacitors in the feedback circuit of the Triangle Integrator, the replacement capacitor (a good quality polycarbonate or mica film type) must be selected so that the approximate parallel capacitance is as indicated in Table 5-3. If after capacitor replacement, the resultant frequency is not correct, the necessary capacitor change can be determined by the following formula:

$$C_{correction} = \frac{C\ feedback}{\frac{(Freq - desired\ Freq}{desired\ Freq} \times 100}$$

Example: X1K range inaccurate
Freq of 9.8 kHz (Range X1K dial 10)

$$C_{correction} = \frac{0.011\ \mu F}{\frac{(9.8K - 10K) \times 100}{10K}}$$

$$= \frac{-0.011\ \mu F}{8} = -.00137\ \mu F$$

5-50. TROUBLESHOOTING PROCEDURE.

5-51. This section contains procedures designed to assist in the isolation of a malfunction. These procedures are based on a systematic analysis of the instrument in an effort to localize the problem. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the adjustment and calibration procedures outlined in Paragraph 5-21.

5-52. Conduct a visual check of the 3300A for possible burned or loose components, loose connections, or any other obvious condition which might be a source of trouble. An investigation should also be made to ensure that the trouble is not a result of conditions external to the 3300A.

5-53. The checks outlined in this section are not designed to measure all circuit parameters, rather only to localize the malfunction. Therefore, it is highly probable that additional checks and measurements will be required to completely isolate the faulty component. Amplifier gain may also vary slightly between instruments; therefore, it is not necessary to precisely duplicate waveforms or voltages described.

5-54. MALFUNCTION ISOLATION PLUG.

5-55. A malfunction isolating tool can be fabricated for isolating a malfunction to the 3300A or the plug-in unit. A 50 pin connector -hp- Part No. 1251-0099 can be fitted with 4 jumpers (see Figure 5-7 for

Table 5-3. Integrator Feedback Capacitance

DESIGNATED CAPACITORS	PADDING CAPACITORS	RANGE VALUE	
C3	C16, C17, and possible C18	X.01, X1	11 µF
A13C13	C14 and C15	X.1, X10	1.1 µF
A13C10	C11 and C12	X100	0.11 µF
A13C7	C8 and C9	X1K	0.011 µF
A13C6	C5	X10K	0.0011 µF

jumper location). If 3300A operation is normal with this plug mated with J6, the trouble is in the plug-in unit.

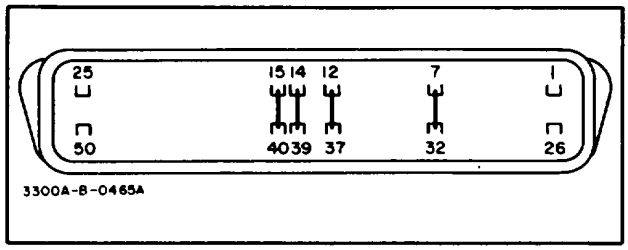


Figure 5-7. Malfunction Isolating Plug

5-56. PRECAUTIONS.

5-57. In the event the -20 volt supply is inoperative, the oven heater should be disabled while troubleshooting. A point to disable the oven is to disconnect the smaller diameter red wire (26 gage) from XA12 Pin 1. The larger diameter redwire (22 gage) should be left connected to XA12 Pin 1. When the -20 volt power supply is left out, the oven remains in full heat condition. Thermal fuse A11F1 will melt and open if this heat condition exists for any extended period.

5-58. When troubleshooting Power Supply Assembly, remove the Output Amplifier Assemblies A15 and A16.

5-59. TROUBLESHOOTING TREE.

5-60. In the event of a malfunction which causes the oscillatory system to cease functioning; the output of the triangle integrator emitter follower would most likely stabilize at either one of voltages as indicated in Figure 5-8. Approximately +25 volts is the upper limit of the positive slope, and -2.5 volts is the lower

Table 5-4. Troubleshooting Aid

SYMPTOM	POSSIBLE CAUSE
No output either channel. Power Lamp lit.	Use Figure 5-8 Troubleshooting Tree.
Output on only one channel.	Check applicable amplifier board A15 CHANNEL A or A16 CHANNEL B.
Frequency incorrect. Specific range.	Check feedback capacitor of effected range on Triangle Integrator A12; for example, Range X100 check C10, C11, and C12.
Two of the three functions normal, only one channel effected.	Check input resistor of missing function; on amplifier assembly; for example, no SINE on CHANNEL A. Check A15R1.
Frequency and symmetry incorrect at low end of dial, all ranges.	Check oven heating voltage J6 pin 42 20 volts.
Frequency will not vary with FREQ dial.	Check Freq shorting bar rear chassis; A11Q5 and associated circuit parameters.
No sync output.	Check A14C7, A14R46 and A14R48.
Power supply voltage incorrect.	Begin troubleshooting by substituting a well-regulated 12.1 volt source for A11CR1. Remove Output Amplifiers when trouble-shooting Power Supply.
Frequency out of tolerance on 1 or 2 ranges which are not adjacent.	Change A11Q8. Use caution in soldering and use a clip-on heat sink.
Distortion at 100 kHz.	Check A13Q1.
Dc level off on square wave.	Check A14CR18 for open.
Symmetry erratic at low frequencies.	Check A14Q8.
Lower half of sine wave clipped on one channel only.	Check A15Q5 or A16Q5.
Will not oscillate.	Check Triangle Integrator A13Q1 thru A13Q3.

Table 5-4. Troubleshooting Aid (Cont'd)

SYMPTOM	POSSIBLE CAUSE
Half of sine wave clipped on both channels.	Check A14Q5 and A14Q7. The synthesizer waveform is symmetrical about 10 volts at the base of A14Q5 and at the corresponding junctions along the voltage divider R10 to R15 and R25 to R20.
Loss of square wave symmetry at lowest range.	Inoperative oven, open thermal fuse.
No oscillation on X.1 and X.01 RANGE; dial at 1.	Check A11Q8.
+20 volts ok when oven cold, high when oven hot.	Check A11Q1, A11Q2.
Slow symmetry drift.	Check A14CR21, A14CR20, A11Q6, A11Q7.

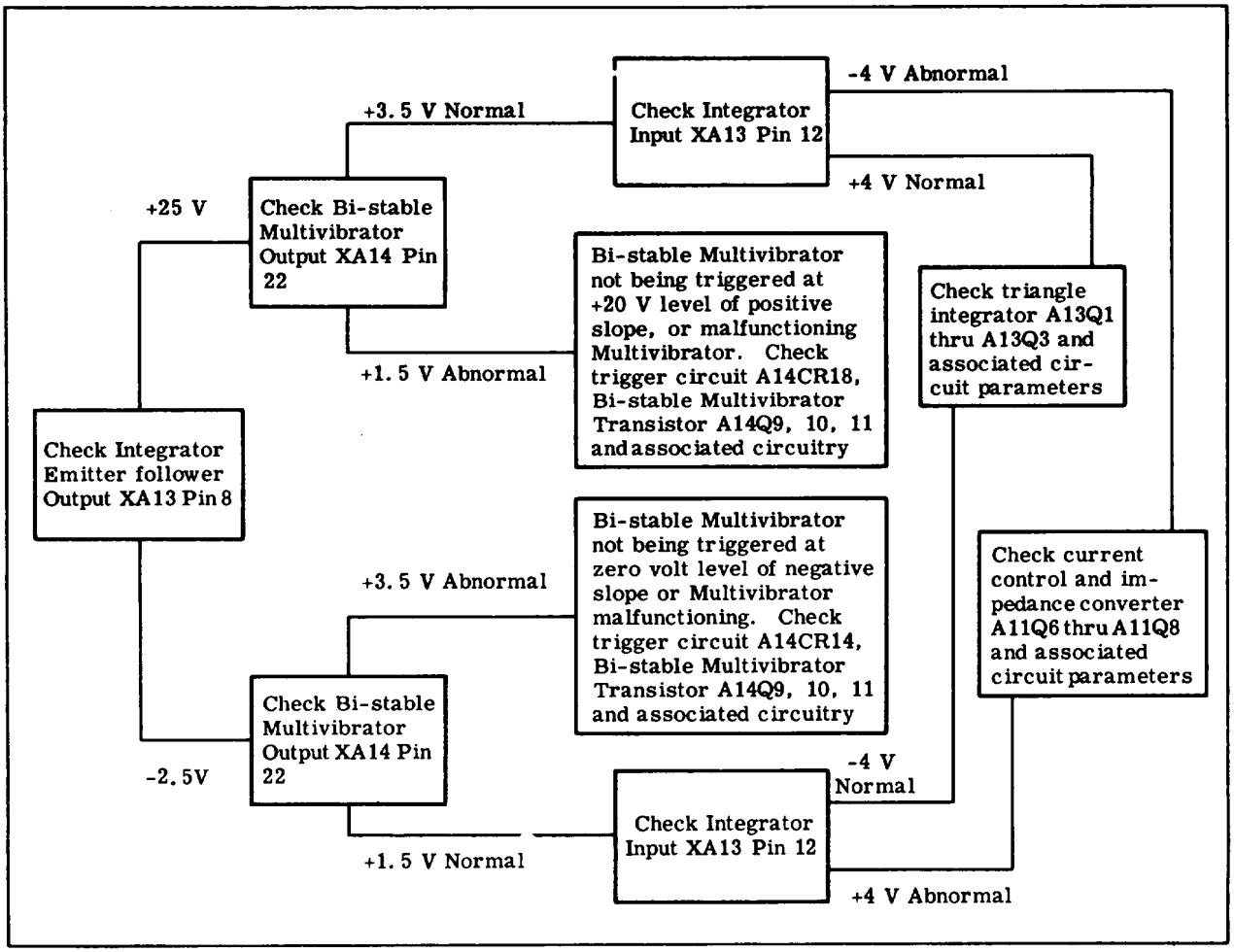


Figure 5-8. Troubleshooting Tree

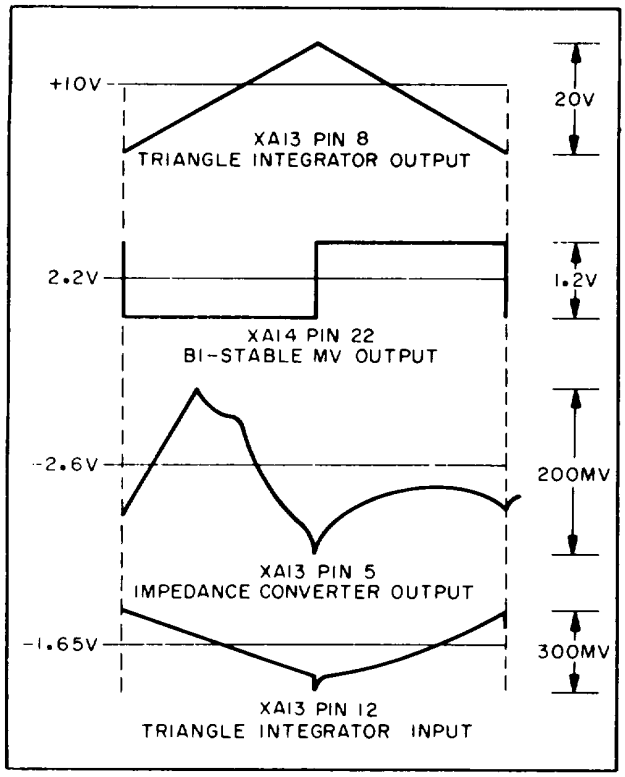


Figure 5-9. Normal Oscillator Wave Forms

limit of the negative slope out of the integrator circuit. The condition of the other major circuits in the basic oscillating loop, the Voltage Comparator Bi-stable Multivibrator and current source, can, in most instances, be used to isolate the malfunction to a given circuit as outlined in Figure 5-8. The term normal, as applied to the results obtained at the different points tested, refers to the output at that point which would reverse the slope at the output of the triangle integrator and sustain oscillation. Abnormal refers to that output which would produce the same slope and prevent oscillation.

5-61. Figure 5-9 contains the normal voltages and waveforms which should be present at the points indicated. Voltage levels are approximate and may vary from instrument to instrument due to differences in transistors.

5-62. TROUBLESHOOTING TABLES.

5-63. Table 5-4 gives additional information to assist in the isolation of a malfunction. Symptoms and possible causes are listed. Table 5-5, Maintenance Correlation Table, lists various 3300A functions and gives the corresponding performance checks and adjustments.

Table 5-5. Maintenance Correlation Table

FUNCTION	PERFORMANCE CHECK	ADJUSTMENT AND CALIBRATION	TROUBLESHOOTING
Dial Accuracy	Paragraph 5-5	Paragraph 5-34 thru 5-37	Para. 5-23, All assy
Distortion	Paragraph 5-7	Paragraphs 5-38, 5-30 and 5-31	Oven, All assembly
Output	Paragraph 5-10thru 5-15	Paragraphs 5-39 thru 5-42	A15 or A16 assembly Q5 thru Q8
Square Wave	Paragraph 5-16 and 5-17	Paragraph 5-41 and 5-42	Isolate trouble to specific board or chassis by interchanging A15 and A16 boards.
Sync Output	Paragraph 5-18	None	A14C7, A14R46 and A14R48
Remote Freq control	Paragraph 5-19	None	J6 or plug-in pins 32, 7
Channel B-A Check	Paragraph 5-20	None	Continuity A15 pin 11 to S5AF pin 5, 11, to 16R5
Power Supplies	None	Table 5-2 Figure 5-4	Remove PC boards; see para. 5-55;Check A12 components

Table 5-5. Maintenance Correlation Table (Cont'd)

FUNCTION	PERFORMANCE CHECK	ADJUSTMENT AND CALIBRATION	TROUBLESHOOTING
DC Output	None	Paragraph 5-39 and 5-40	Change A15 or A16 Q1 and/or Q2, if all functions negative increase value of R10* not to exceed 3K
Oven Regulation	Paragraph 5-28	None	Oven temperature should be 70 to 80ºC Check Q7, check + 40 volt line

Table 5-6. Factory Selected Components

DESIGNATOR	FUNCTION	VALUE		
		LOW	NORMAL	HIGH
A11R11	Adjust frequency error between X.01 and X1 range or X.1 and X10 range	---	130K	---
A11R17	Adjust oven temp to between 70º and 80ºC	8.2K	8.87K	9.09K
A13C5	Adjust 10 on dial on X10K range		*	
A13C9	Adjust 10 on dial on X1K range		*	
A13C12	Adjust 10 on dial on X100 range		*	
A13C15	Adjust 10 on dial on X10 and X0.1 range		*	
A13C18	Adjust 10 on dial on X1 and X0.01 range		*	
A13R9	Reduce switching transients	---	15	---
A13R18 A13R19	Center R23, upper freq sym	0	49.9	---
A13R20	Center R22, lower freq sym	3	5760	No limit
A14R46	Adjust dc output level for less than 200 mV	---	47	56
A15C1 and A16C1	Prevent oscillation	---	200pF	---
A15C4 and A16C4	Reduce switching transients	12pF	39pF	56pF
A15C9 and A16C9	Reduce switching transients	39pF	59pF	68pF
A15R3 and A16R3	Adjust square wave dc level	---	5360	---
A15R10 and A16R10	Adjust dc output level	2200	3300	3600

*See Table 5-3 for value selection.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3300A Function Generator Serial No. _____	**Test Performed by** _____ **Date** _____	
CHECK DESCRIPTION	**SPECIFICATION**	**INDICATION**
1. Dial Accuracy		
1 x .01	between 90.9 and 111.1 sec	_____
10 x .01	between 9.90 and 10.1 sec	_____
1 x .1	between 9.09 and 11.1 sec	_____
10 x .1	between 990 and 1010 ms	_____
1 x 1	between 909 and 1111 ms	_____
10 x 1	between 99.0 and 101.0 ms	_____
1 x 10	between 90.9 and 1111 ms	_____
10 x 10	between 99 Hz and 101 Hz	_____
1 x 100	between 90 Hz and 110 Hz	_____
10 x 100	between .99 kHz and 1.01 kHz	_____
1 x 1K	between .9 kHz and 1.1 kHz	_____
10 x 1K	between 9.9 kHz and 10.1 kHz	_____
1 x 10K	between 8 kHz and 12 kHz	_____
10 x 10K	between 98 kHz and 102 kHz	_____
2. Distortion		
X1K Range	< 1%	_____
X10K Range	< 3%	_____
3. Frequency Response		
X.01 thru X1K Range	< 1%	_____
X10K Range	< 3%	_____
4. Maximum Output Level		
No load Channel A	> 35 V p-p	_____
No load Channel B	> 35 V p-p	_____
600ê load Channel A	> 16 V p-p	_____
600ê load Channel B	> 16 V p-p	_____
50ê load Channel A	> 2 V p-p	_____
50ê load Channel B	> 2 V p-p	_____
5. Square Wave Response		
a. Channel A		
Rise time	< 250 ns	_____
Fall time	< 250 ns	_____
Sag	< 1%	_____
Overshoot	< 5%	_____
Symmetry	< 1%	_____
b. Channel B		
Rise time	< 250 ns	_____
Fall time	< 250 ns	_____
Sag	< 1%	_____
Overshoot	<5%	_____
Symmetry	< 1%	_____
6. Sync Output		
Amplitude	> 10 V p-p	_____
Duration	< 5*m*s	_____
7. Remote Frequency Control Check	vary from 10 to 100 Hz	_____
8. -A Output Channel B	180º shift	_____

SECTION VI
CIRCUIT DIAGRAMS

6-1. INTRODUCTION.

6-2. This section contains schematics and component location diagrams for the Model 3300A Function Generator. An adjustment Point Location diagram is also included.

6-3. SCHEMATIC DIAGRAMS.

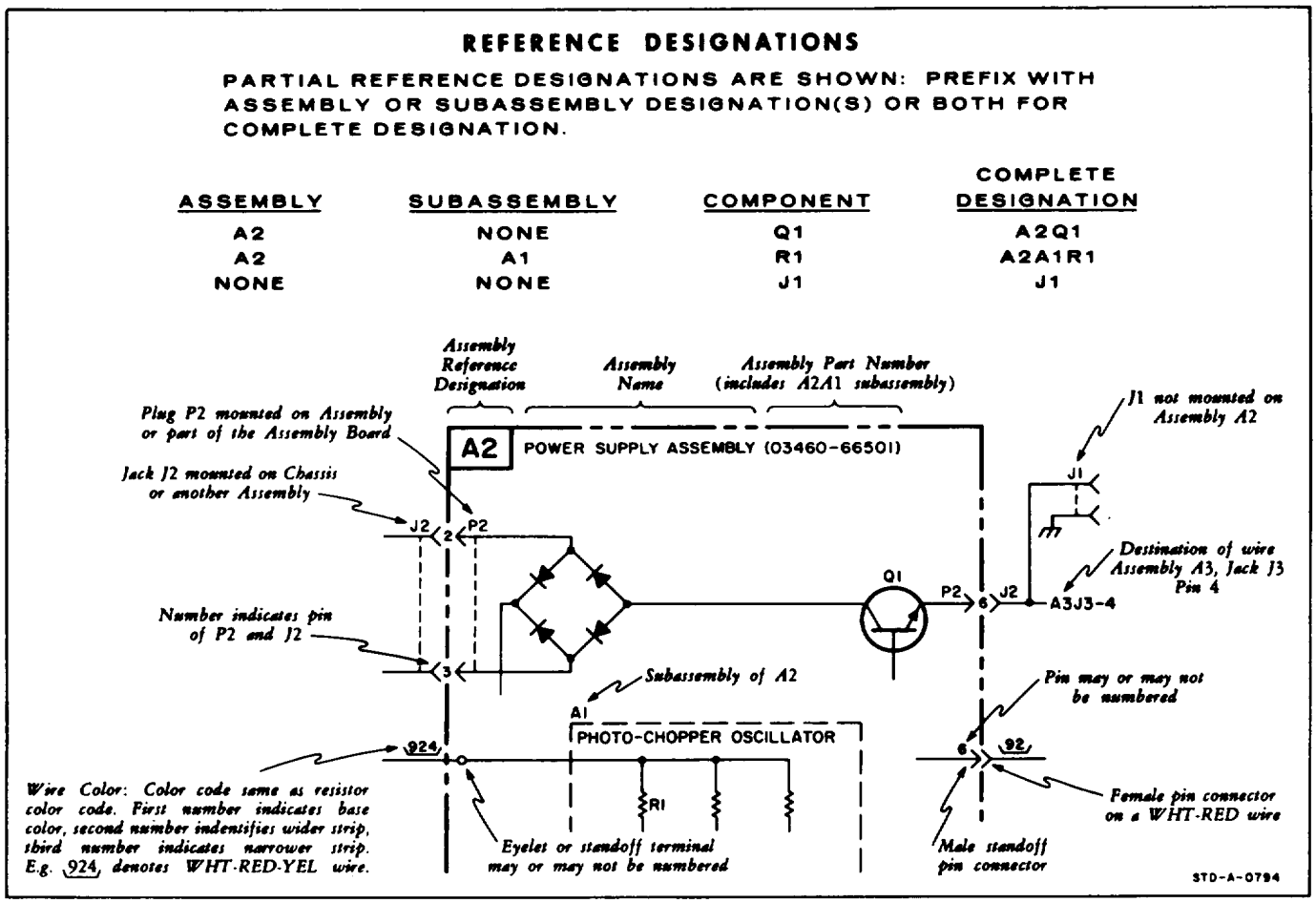
The schematic diagrams are laid out to facilitate ease of following signal flow and for developing an understanding of the detailed theory of operation. Etched circuit board integrity is maintained whenever possible.

6-4. COMPONENT LOCATION DIAGRAMS.

The component location diagrams (for each PC Board) depicts the physical location of components on the etched circuit board. Figure 6-3 shows the range switch connections from the main frame of the 3300A to the plug-in unit.

6-5. PLUG-IN RECEPTACLE.

6-6. Figure 6-6 shows the connections brought out from the main frame of the 3300A for use with plug-in units.



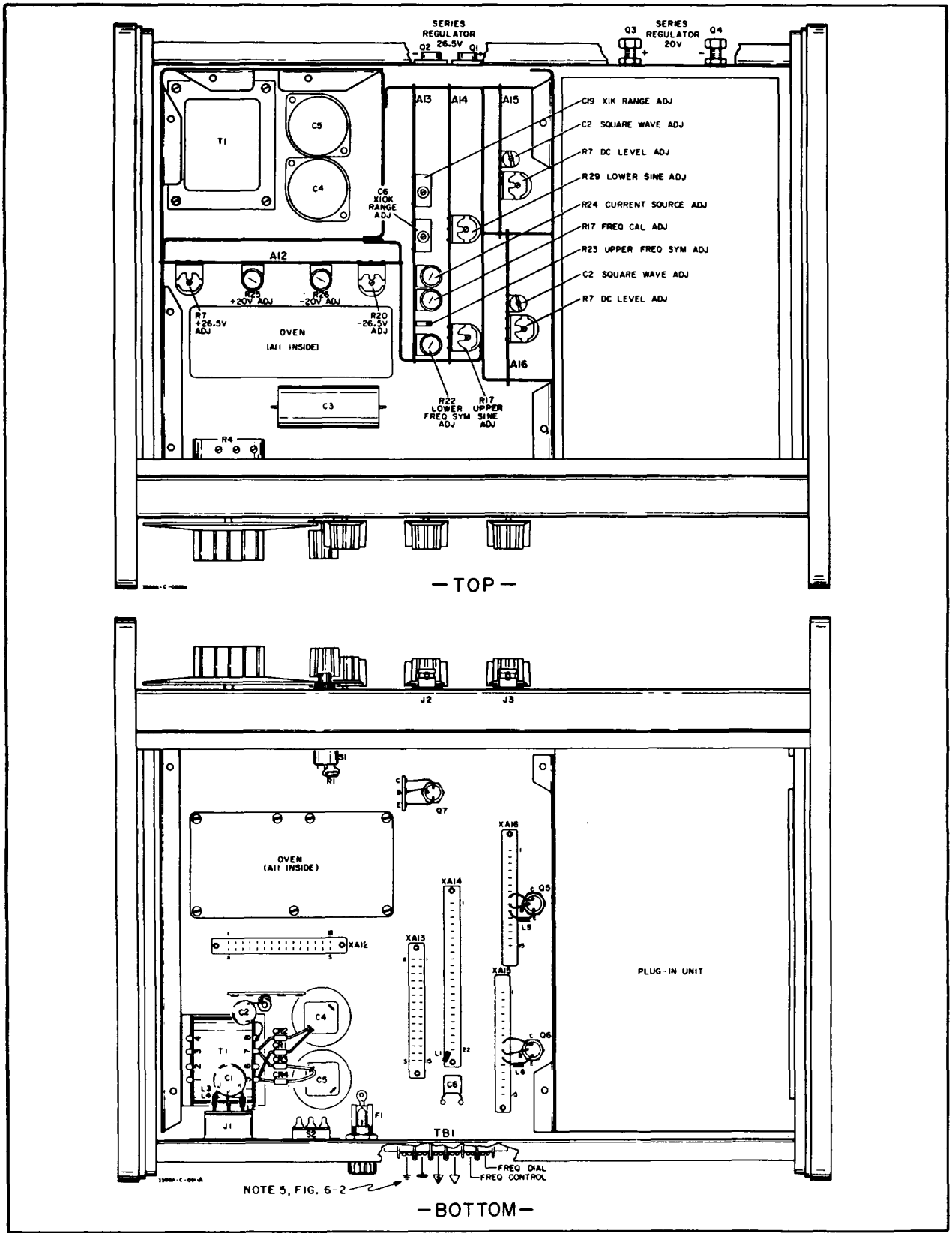
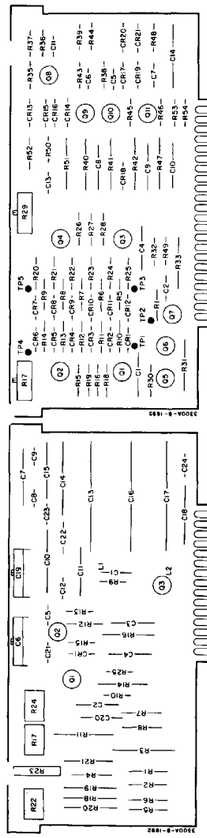


Figure 6-1. 3300A Top and Bottom Views.

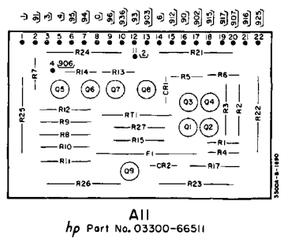


A13 SCHEMATIC COMPONENT LOCATIONS

	C	CR	L	Q	R		C	R		C	R
1	D11	F11	D11	G11	L5	10	D13	G11	19	E12	D5
2	H12		F14	G13	L5	11	E13	H12	20	J11	E4
3	J11			F14	L6	12	E13	G13	21	E13	J2
4	H11				E5	13	D12	G13	22	E13	E4
5	E13				E8	14	D12	F11	23	D12	E5
6	E13				E8	15	D12	F13	24	C13	L6
7	D12				K8	16	D13	G14			
8	E12				J8	17	C13	D2			
9	E12				D11	18	C13	D5			

A14 SCHEMATIC COMPONENT LOCATIONS

	C	CR	Q	R		CR	R		R		R
1	J20	J20	H20	K19	16	B22	H21	31	K24	46	C23
2	J24	J20	H23		17	C22	H21	32	J24	47	D23
3		J21	L20		18	B22	H21	33	K25	48	C24
4	F20	J21	L23		19	B23	H21	34		49	H25
5	C22	J22	K23	J20	20		K23	35	B21	50	D19
6	C21	J22	K25	J21	21		K22	36	B21	51	D20
7	B24	K22	J25	J21	22		K22	37	B21	52	D20
8	E19	K22	B21	J22	23		K21	38	C22	53	B25
9	E19	K21	C20	J22	24		K21	39	D21	54	C25
10	F19	K21	C23	J20	25		K20	40	C20		
11	B20	K20	B24	J21	26		L22	41	B22		
12		K20		J21	27		L21	42	B23		
13	C19	A20		J22	28		L21	43	C21		
14	C25	D20		J22	29		L21	44	D22		
15		B22		J23	30		H23	45	C23		



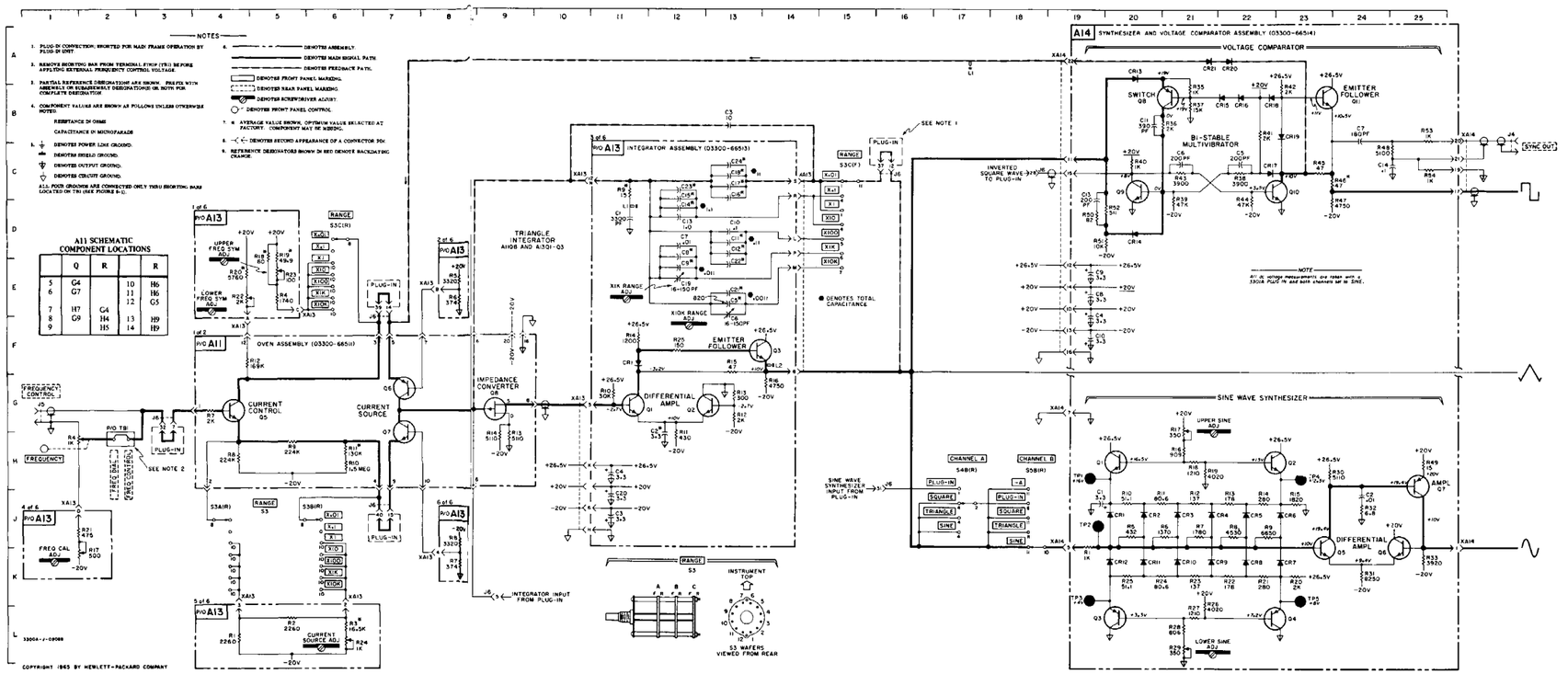


Figure 6-2. Oscillator Circuit Schematic (A11, A13 and A14).

A15 SCHEMATIC COMPONENT LOCATIONS

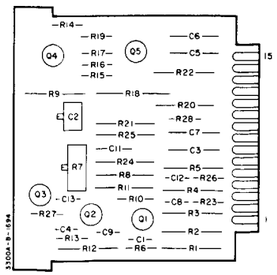
	C	Q	R		R
1	C10	C11	D9	16	B13
2	D12	C13	C10	17	D14
3	D9	C14	C9	18	A14
4	C12	B14	C10	19	D15
5	E9	D15	B9	20	C16
6	E9		C10	21	C16
7	D9		B11	22	B16
8	C9		B11	23	C9
9	C13		D12	24	A10
10	N/A		B12	25	B10
11	B9		B13	26	B10
12	C10		C13	27	D13
13	D13		C13	28	A14
14			C13		
15			A13		

A16 SCHEMATIC COMPONENT LOCATIONS

	C	Q	R		R
1	J10	H11	J9	16	G13
2	K12	H13	J10	17	J14
3	K9	J14	J9	18	G14
4	J12	G14	H10	19	K15
5	L9	J15	H9	20	J16
6	L9		H10	21	J16
7	K9		H11	22	H16
8	J9		H11	23	J9
9	J13		K12	24	G10
10	N/A		H12	25	G10
11	G9		H13	26	H10
12	H10		H13	27	J13
13	K13		J13	28	G14
14			J13		
15			G13		

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ⏚ DENOTES POWER LINE GROUND.
   ▬ DENOTES SHIELD GROUND.
   ▽ DENOTES OUTPUT GROUND.
   ▽ DENOTES CIRCUIT GROUND.
   ALL FOUR GROUNDS ARE CONNECTED ONLY THRU SHORTING BARS LOCATED ON TB1 (SEE FIGURE 6-1).
4. ——— DENOTES ASSEMBLY.
   ——— DENOTES MAIN SIGNAL PATH.
   ▭ DENOTES FRONT PANEL MARKING.
   ▬⊘ DENOTES SCREWDRIVER ADJUST.
   ◯– DENOTES FRONT PANEL CONTROL.
5. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY. COMPONENT MAY BE MISSING.
6. REFERENCE DESIGNATORS SHOWN IN RED DENOTE BACKDATING CHANGE.



A15 or A16
hp Part No. 03300-66515

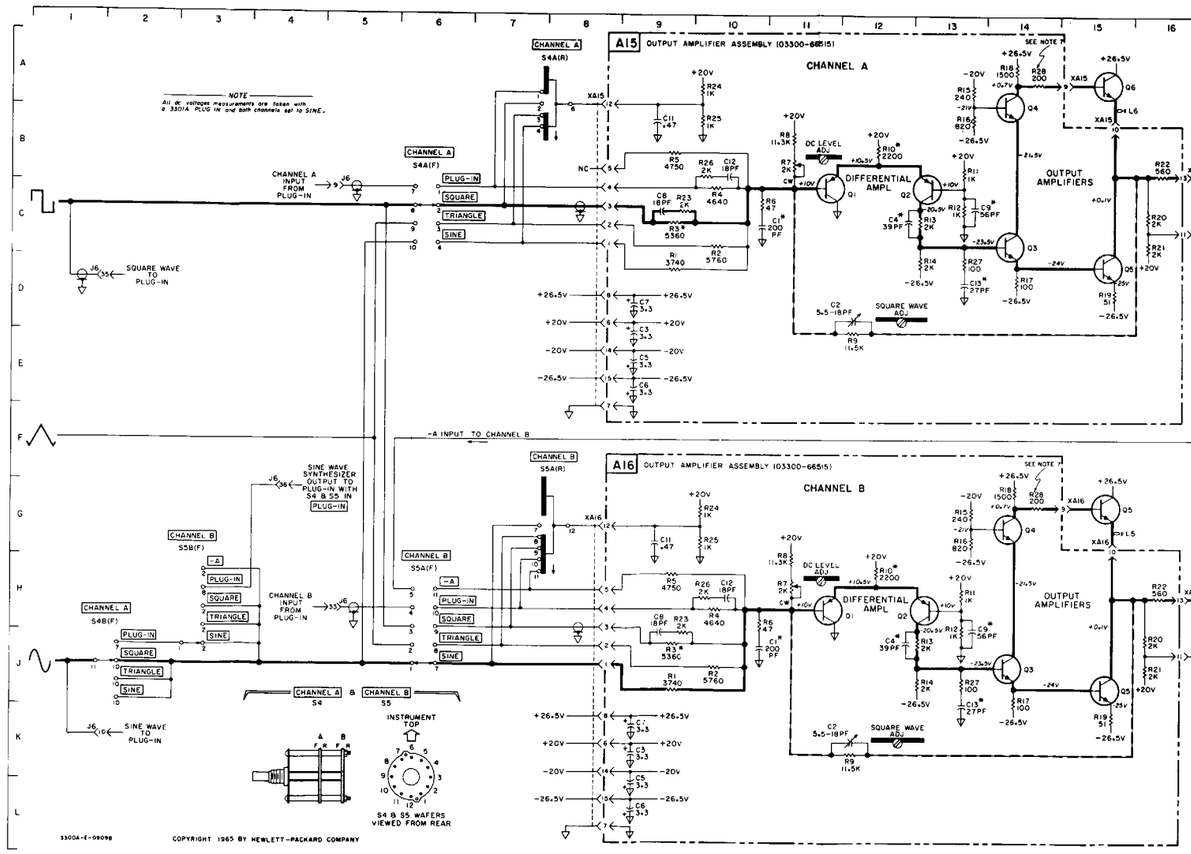


Figure 6-4. Output Amplifiers Schematic (A15 and A16).

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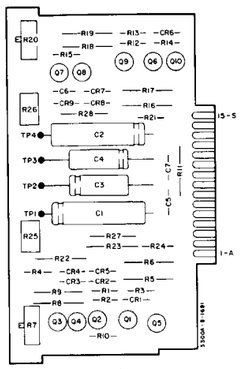
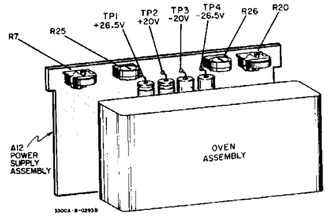
Figure 6-3.

6-4





NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. DENOTES POWER LINE GROUND.
   DENOTES SHIELD GROUND.
   DENOTES OUTPUT GROUND.
   DENOTES CIRCUIT GROUND.
   ALL FOUR GROUNDS ARE CONNECTED ONLY THRU SHORTING BARS LOCATED ON TB1 (SEE FIGURE 8-1).
4. DENOTES ASSEMBLY.
   DENOTES FEEDBACK PATH
   DENOTES FRONT PANEL MARKING.
   DENOTES REAR PANEL MARKING.
   DENOTES SCREWDRIVER ADJUST.
5. * AVERAGE VALUE SHOWN. OPTIMUM VALUE SELECTED AT FACTORY. COMPONENT MAY BE MISSING.
6. DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.
7. REFERENCE DESIGNATORS SHOWN IN RED DENOTE BACKDATING CHANGE.
8. REFER TO APPENDIX C FOR BACKDATING.

A11 SCHEMATIC COMPONENT LOCATIONS

	CR	F	Q	R	RT		R
1	F16	F20	D16	D16	F19	16	G19
2	G18		D16	D17		17	
3			G16	D17		18	
4			G17	G16		19	
5				G17		20	
6				G17		21	G20
7						22	G20
8			F18			23	F20
9						24	G20
10						25	G20
11						26	F20
12						27	G20
13							
14							
15				F19			

A12 SCHEMATIC COMPONENT LOCATIONS

	C	CR	Q	R		R
1	B11	C7	C7	C8	16	J10
2	J11	C10	C8	C7	17	J10
3	B14	C10	D9	C7	18	F11
4	J14	B10	D10	E10	19	G11
5	J18	B10	C13	B10	20	G11
6	G9	H7	G8	B10	21	J12
7	H13	H10	P9	C11	22	H18
8		H10	F10	D11	23	H19
9		H10	H9	D11	24	J19
10			H13	B12	25	B17
11				E14	26	H17
12				H8	27	B17
13				H7	28	H17
14				G7		
15				F10		

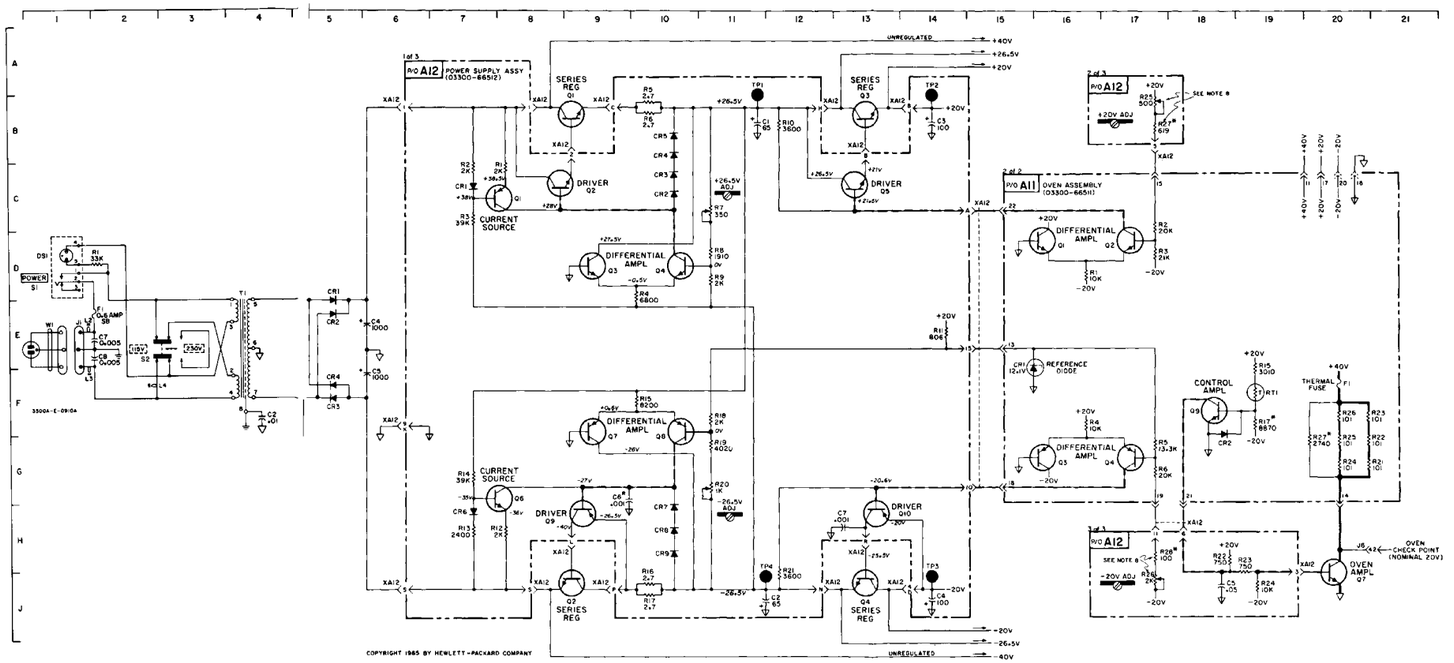


Figure 6-5. Power Supply Schematic (A12 and A11).

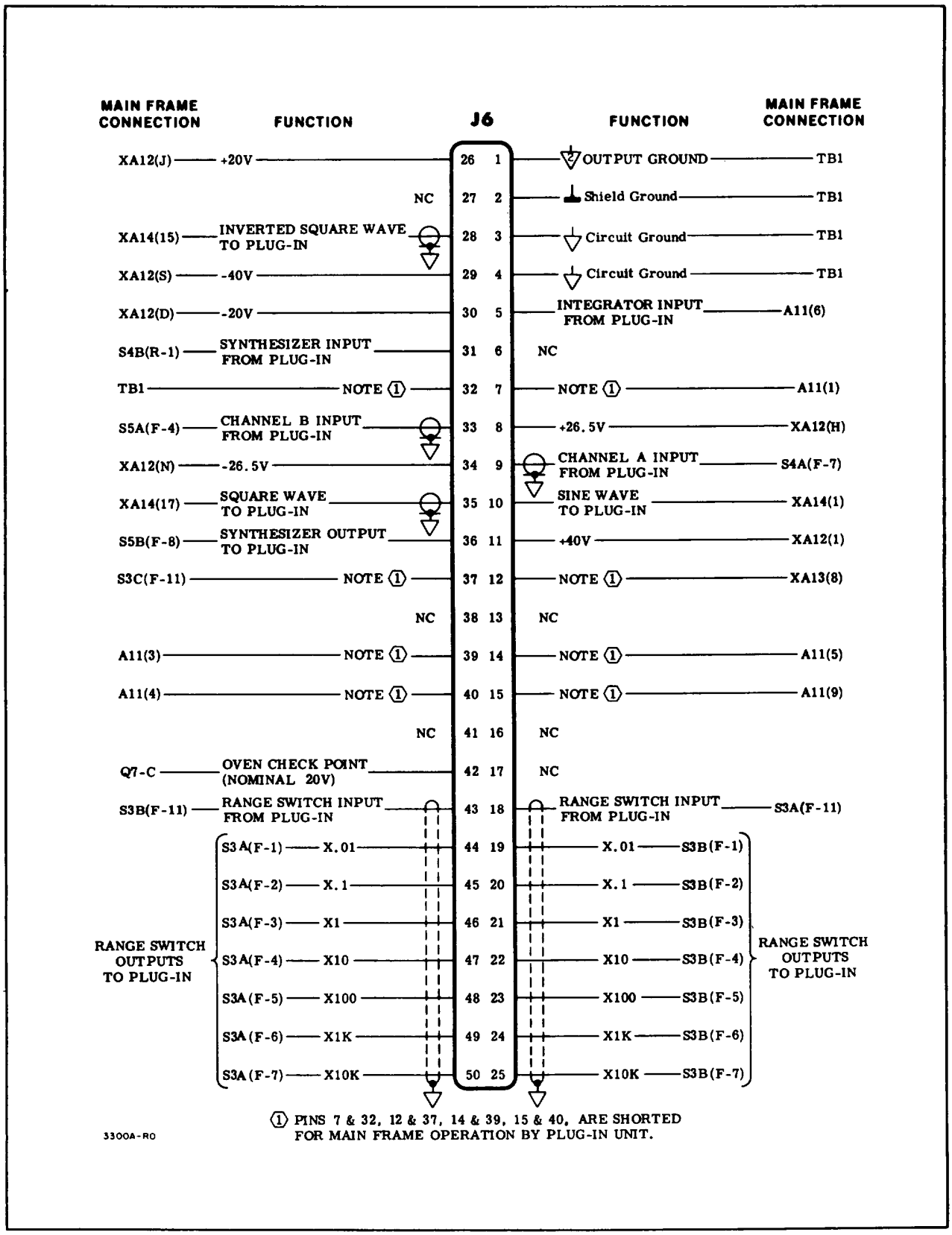
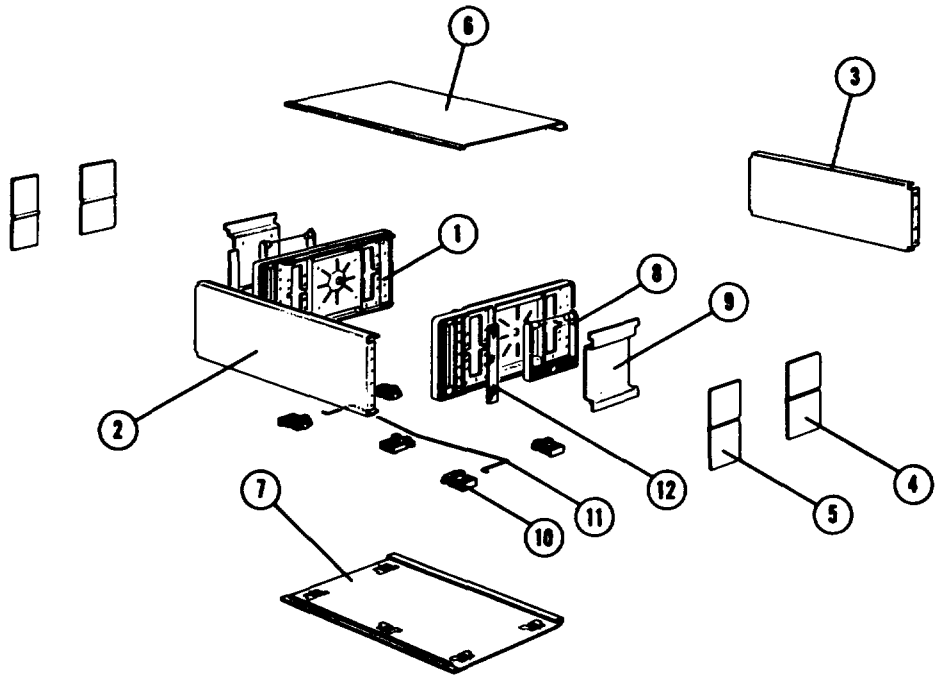


Figure 6-6. J6 Plug-In Receptacle.



INDEX NO.	DESCRIPTION	QUANTITY	PART NO.
1	ASSEMBLY: FRAME 5 x 11 F.M.	2	5060-0731
2	PANEL: FRONT	1	03300-00201
3	PANEL: REAR	1	03300-00203*
4	COVER: REAR SIDE	2	5000-0732
5	COVER: FRONT SIDE	2	5000-0733
6	COVER: TOP ASSEMBLY	1	5060-0739
7	COVER: BOTTOM ASSEMBLY	1	5060-0751
8	HANDLE: SIDE ASSEMBLY	2	5060-0222
9	RETAINER: HANDLE ASSEMBLY	2	5060-0766
10	ASSEMBLY: FOOT	5	5060-0767
11	STAND: TILT	1	1490-0030
12	PLATE: FLUTED AL	2	5000-0051

* See backdating information in Appendix C.

Figure 7-1. Modular Cabinet Parts.

SECTION VII
REPLACEABLE PARTS

7-1. INTRODUCTION.

7-2. This section contains information for ordering replacement parts. Table 7-1 lists parts in alphanumeric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

a. Hewlett-Packard number.

b. Total quantities of each part used in the instrument(TQ column).

c. Descriptions (abbreviations are listed below).

d. Table 7-2 is a part number-national stock number cross reference index. The items on this cross reference index are source coded PHAZZ. Items that do not appear on this index are source coded XD and shall be procured using the FSCM and the MPN at the nearest wholesale level.

7-4. ORDERING INFORMATION.

7-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See field office location list). Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

7-6. NON-LISTED PARTS.

7-7. 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.

DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	TC	= thermocouple
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	HR	= heater	Q	= transistor		
C	= capacitor	IC	= integrated circuit	QCR	= transistor-diode	W	= cable
CR	= diode	J	= jack	R	= resistor	X	= socket
DL	= delay line	K	= relay	RT	= thermistor	XDS	= lampholder
DS	= lamp	L	= inductor	S	= switch	XF	= fuseholder
E	= misc electronic part	M	= meter	T	= transformer	Z	= network

ABBREVIATIONS

Ag	= silver	ID	= inside diameter	ns	= nanosecond (s) = 10^{-9} seconds	sl	= slide
Al	= aluminum	impg	= impregnated			SPDT	= single-pole double-throw
A	= ampere (a)	incd	= incandescent	nsr	= not separately replaceable		
Au	= gold	ins	= insulation (ed)			SPA.T	= single-pole single-throw
C	= capacitor	kΩ	=kilohm (s) = 10^{+3} ohms	Ω	= ohm (s)	Ta	= tantalum
cer	= ceramic			obd	= order by description	TC	= temperature coefficient
coef	= coefficient	kHz	= kilohertz = 10^{+3} hertz	OD	= outside diameter	TiO_2	= titanium dioxide
com	= common						
comp	= composition	L	= inductor			tog	= toggle
conn	= connection	lin	= linear taper	p	= peak	tol	= tolerance
dep	= deposited	log	= logarithmic taper	pc	= printed circuit	trim	= trimmer
DPDT	= double-pole double-throw	m	= milli =10^{-3}	pF	= picofarad (s) = 10^{-12} farads	TSTR	= transistor
DPA.T	= double-pole single-throw	mA	= milliampere (s) = 10^{+3} amperes	piv	= peak inverse voltage	V	= volt (s)
		MHz	= megahertz =10^{+6} hertz	p/o	= part of	vacw	= alternating current working voltage
elect	= electrolytic	MΩ	= megohm (s) = 10^{+6} ohms	pos	= position (s)		
encap	= encapsulated	met flm	= metal film	poly	= polystyrene	var	= variable
		mfr	=manufacturer	pot	= potentiometer	vdcw	= direct current working voltage
F	= farad (s)	mtg	= mounting	p-p	= peak-to-peak		
FET	= field effect transistor	mV	= millivolt (s) = 10^{-3} volts	ppm	= parts per million		
fxd	= fixed	μ	micro = 10^{-6}	prec	= precision (temperature coefficient, long term stability, and/or tolerance)	W	= watt (s)
GaAs	= gallium arsenide	μV	= microvolt (s) = 10^{-6} volts			w/	= with
GHz	= gigahertz = 10^{+9} hertz	my	= Mylar®			wlv	= working inverse voltage
						w/o	= without
						ww	= wirewound
gd	= guard (ed)	nA	= nonoampere (s) = 10^{-9} amperes	R	= resistor	*	= optimum value selected at factory, average value shown (part may be omitted)
Ge	= germanium			Rh	= rhodium		
grd	= ground (ed)	NC	= normally closed	rms	= root-mean-square		
		Ne	= neon	rot	= rotary		
H	= henry (ies)	NO	= normally open				
Hg	= mercury	NPO	= negative positive zero (zero temperature coefficient)	Se	= selenium	**	= no standard type number assigned (selected or special type)
Hz	= hertz (cycle (s) per second)			sect	= section (s)		
				Si	= silicon		

REV G

® Dupont de Nemours

Table 7-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1 thru A6				Used in instruments serial prefixed 519-, 533-, 609-, 616- and 622-. See Supplement B for replaceable parts.			
A7 thru A10				Not assigned			
A11	03300-66511			Assembly-Oven Board	-hp-		
A11CR1	1902-3182		1	Diode: breakdown zener 12.1 V ± 5%400mW	04713	SZ10930-206	
A11CR2	1901-0025		14	Diode: Si junction 100 mA at 1V 100 piv 12 pF	93332	D 6238	
A11F1	2110-0287		1	Fuse: Link thermal melts at 225° F 4 amp cont at 175° F	71400	TGH	
A11Q1, A11Q2	1854-0087		8	TSTR: Si NPN	-hp-		
A11Q3, A11Q4	1853-0010		13	TSTR: Si PNP**	-hp-		
A11Q5	1854-0307		2	TSTR: Si NPN**	-hp-		
A11Q6	1853-0066		1	TSTR: Si PNP 2N4250	07263	obd	
A11Q7	1854-0307			TSTR: Si NPN**	-hp-		
A11Q8	1855-0082		1	TSTR: P channel FET	04713	SS 3723	
A11Q9	1854-0087		2	TSTR: Si NPN	-hp-		
A11R1	0757-0442		2	R: fxd prec met flm 10K ± 1% 1/8 W	75042	CEA T-O	obd
A11R2	0757-0190		1	R: fxd prec met flm 20K ± 1% 1/2 W	19701	MF7C T-O	obd
A11R3	0757-1085		1	R: fxd prec met flm 21K ± 1% 1/2 W	75042	CEC T-O	obd
A11R4	0757-0442			R: fxd prec met flm 10K ± 1% 1/8 W	75042	CEA T-O	obd
A11R5	0757-0289		1	R: fxd prec met flm 13. 3K ± 1% 1/8 W	19701	MF5C T-O	obd
A11R6	0757-0449		1	R: fxd prec met flm 20 kΩ ± 1% 1/8 W	19701	MF5C T-O	obd
A11R7	0757-0283		2	R: fxd prec met flm 2 kΩ ± 1% 1/8 W	19701	MF5C T-O	obd
A11R8, A11R9	0698-3482		2	R: fxd prec met flm 224K ± 1/4% 1/2 W	75042	CEC T-O	obd
A1R10	0698-3355		1	R: fxd prec met flm 1.5 MΩ ± 1/4% 1/2 W	75042	CEC T-O	obd
A11R11*	0757-0861		1	R: fxd prec met flm 130 kΩ ± 1% 1/2 W	75042	CEC T-O	obd
A11R12	0698-6683		1	R: fxd prec met flm 169K ± 0. 25% 1/4 W	19701	MF6C T-8	obd
A11R13, A11R14	0757-0438		3	R: fxd prec met flm 5. 11K ± 1% 1/8 W	19701	MF5C T-O	obd
A11R15	0757-0828		1	R: fxd prec met flm 3.01 kΩ ± 1% 1/2 W	75042	CEC T-O	obd
A11R16				Not assigned			
A11R17*	0698-4135		1	R: fxd prec met flm 8.87K ± 1% 1/2 W	75042	CEC T-O	obd
A11R18 thru A11R20				Not assigned			
A11R21 thru A1R26	0766-0025		6	R: fxd prec met flm 101Ω ± 2% 3 W	76055	3MOL	obd
A11R27	0757-0827		1	R: fxd prec met flm 2. 74K ± 1% 1/2 W	75042	CEC T-O	obd
A11RT1	0839-0012		1	Thermistor: 50K ± 10%	83186	45R1	obd
A12	03300-66512			Assembly-Power Supply Board	-hp-		
A12C1, A12C2	0180-0149		2	C: fxd Al elect 65 µF 60 vdcw	56289	(Type 30D) D36978	
A12C3 A12C4	0180-0094		2	C: fxd Al elect 100 µF +75% -10% 25 vdcw	56289	30D107G025DD2-DSM	
A12C5	0150-0096		1	C: fxd cer 0.05 µF +80% -20% 100 vdcw	72982	845-Y5V-503Z	
A12C6*, A12C7	0160-0195		2	C: fxd cer 1000 pF ± 20%	56289	19C251A	
A12CR1 thru A12CR9	1901-0025			Diode: Si junction 100 mA at 1 V 100 piv	03877	SG-817	obd
A12Q1	1853-0016		1	TSTR: Si PNP 2N3638	72354	2N3638	
A12Q2	1854-0039		8	TSTR: Si NPN 2N3053	86684	2N3053	

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A12Q3, A12Q4	1854-0087			TSTR: Si NPN	-hp-		
A12Q5	1854-0039			TSTR: Si NPN 2N3053	86684	2N3053	
A12Q6	1854-0087			TSTR: Si NPN	-hp-		
A12Q7, A12Q8	1853-0010			TSTR: Si PNP**	-hp-		
A12Q9	1853-0001		1	TSTR: Si PNP**	-hp-		
A12Q10	1853-0010			TSTR: Si PNP**	-hp-		
A12R1, A12R2	0683-2025		12	R: fxd prec comp 2K ± 5% 1/4 W	01121	CB 2025	
A12R3	0683-3935		2	R: fxd prec comp 39K ± 5% 1/4 W	01121	CB 3935	
A12R4	0683-6825		1	R: fxd prec comp 6.8K ± 5% 1/4 W	01121	CB 6825	
A12R5, A12R6	0689-0275		4	R: fxd prec comp 2.7Ω ± 5% 1 W	01121	CB 0275	
A12R7	2100-0865		3	R: var prec comp lin 350Ω ± 30% 1/8 W	71450	XQS-200	obd
A12R8	0698-3341		1	R: fxd prec met flm 1. 91K ± 1% 1/2 W	75042	CEC T-O	obd
A12R9	0757-0824		4	R: fxd prec met flm 2. 0K ± 1% 1/2 W	75042	CEC T-O	obd
A12R10	0683-3625		2	R: fxd prec comp 3. 6K ± 5% 1/4 W	01121	CB 3625	
A12R11	0698-3478		1	R: fxd prec met flm 806Ω ± 1% 1/2 W	75042	CEC T-O	obd
A12R12	0683-2025			R: fxd comp 2K ± 5% 1/4 W'	01121	CB 2025	
A12R13	0683-2425		1	R: fxd prec comp 2.4K ± 5% 1/4 W	01121	CB 2425	
A12R14	0683-3935			R: fxd comp 39K ± 5% 1/4 W	01121	CB 3935	
A12R15	0683-8225		1	R: fxd prec comp 8.2K ± 5% 1/4 W	01121	CB 8225	
A12R16, A12R17	0689-0275			R: fxd comp 2. 7Ω ± 5% 1 W	01121	CB 0275	
A12R18	0757-0824			R: fxd prec met flm 2. 0K ± 1% 1/2 W	75042	CEC T-O	obd
A12R19	0757-0085		1	R: fxd prec met flm 4. 02K ± 1% 1/2 W	75042	CEC T-O	obd
A12R20	2100-1434		1	R: var prec comp 1K ± 30% 1/8 W	71450	XQS 200	obd
A12R21	0683-3625			R: fxd comp 3. 6K ± 5% 1/2 W	75042	CEC T-O	obd
A12R22, A12R23	0757-0817		2	R: fxd prec met flm 750Ω ± 1% 1/2 W	75042	CEC T-O	obd
A12R24	0683-1035		1	R: fxd prec comp 10K ± 5% 1/4 W	01121	CB 1035	
A12R25	2100-1757		2	R: var ww lin 500Ω ± 10% 1/2 W	75042	Type 506	obd
A12R26	2100-1759		2	R: var ww lin 2K ± 10% 1/2 W	75042	Type 506	obd
A12R27	0757-0728		1	R: fxd met flm 619Ω ± 1% 1/4 W	19701	MF6C T-O	obd
A12R28	0757-0178		1	R: fxd met flm 100Ω ± 1% 1/4 W	19701	MF6C T-O	obd
	1205-0033		7	Heat dissipator-semiconductor for A12Q9	05820	NF-207	obd
A13	03300-66513			Assembly-Integrator Board	-hp-		
A13C1	0160-0155		1	C: fxd 0.0033 μF ± 10%	56289	192P33292	
A13C2* thru A13C4	0180-0161		16	C: fxd Ta elect 3.3 μF ± 20% 35 vdcw	05397	K3R3J35S	
A13C5*	0160-2009		1	C: fxd mica 820 μF ± 5%	72136	RDM15F821J3C	
A13C6	0121-0142		2	C: var mica 16-150 pF 175 vdcw	72136	T51410-11	
A13C7	0160-3123		1	C: fxd poly 0.01 pF ± 10% 50 vdcw	84412	463UW	
A13C8*, A13C9*				Padding capacitor Refer to Section V for replacement			
A13C10	0160-3131		1	C: fxd my 0.1 μF ± 10% 50 vdcw	84412	463UW	
A13C11*, A13C12*				Padding capacitor Refer to Section V for replacement			
A13C13	0160-3122		1	C: fxd my 1 μF ± 10% 50 vdcw	84412	463UW	obd
A13C14*, A13C15*				Padding capacitor Refer to Section V for replacement			
A13C16*, A13C17*, A13C18*				Padding capacitor Refer to Section V for replacement			
A13C19	0121-0142			C: var mica 16-150 pF 175 vdcw	72136	T5 1410-11	
A13C20	0180-0161			C: fxd Ta elect 3.3 μF ± 20% 35 vdcw	05397	K3R3J35S	
A13C21 thru A13C24*			4	Padding capacitor Refer to Section V for replacement			

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A13CR1	1901-0025			Diode: Si 100 mA at 1V 100 piv 12 pF	07263	FD 2387	
A13L1	9170-0016		8	Bead: ferrite	02114	56-590-65/3B	
A13L2							
A13Q1, A13Q2	1854-0087			TSTR: Si NPN	-hp-		
A13Q3	1854-0039			TSTR: Si NPN 2N3053	86684	2N3053	
A13R1, A13R2	0811-1548		2	R: fxd 2.26K ± 1/4% 1/3 W	15909	DAX1	obd
A13R3	0811-1550		1	R: fxd ww 16. 5K ± 1/4% 2/3 W	15909	DAX2	obd
A13R4	0811-1547		1	R: fxd ww 1. 74K ± 1/4% 1/3 W	15909	DAX1	obd
A13R5	0811-1549		2	R: fxd ww 3. 32K ± 1/4% 1/3 W	15909	DAX1	obd
A13R6, A13R7	0811-1546		2	R: fxd ww 374Ω ± 1/4% 1/3 W	15909	DAX1	obd
A13R8	0811-1549			R: fxd ww 3. 32K ± 1/4% 1/3 W	15909	DAX1	obd
A13R9*	0683-1505		2	R: fxd comp 15Ω ± 5% 1/4 W	01121	CB1005	
A13R10	0683-3035		1	R: fxd comp 30K ± 5% 1/4 W	01121	CB3035	
A13R11	0764-0024		1	R: fxd met oxide flm 430Ω ± 5% 2 W	07115	C425	obd
A13R12	0686-2025		1	R: fxd comp 2K ± 5% 1/2 W	01121	EB2025	
A13R13	0683-3015		1	R: fxd comp 300Ω ± 5% 1/4 W	01121	CB3015	
A13R14	0761-0009		1	R: fxd met oxide flm 1.2K ± 5% 1 W	07115	C32	obd
A13R15	0683-4705		3	R: fxd comp 47Ω ± 5% 1/4 W	01121	CB 4705	
A13R16	0757-0832		4	R: fxd prec met flm 4. 75K ± 1% 1/2 W	75042	CEC T-O	obd
A13R17	2100-1757			R: var ww lin 500Ω ± 10% 1/2 W	75042	Type 506	obd
A13R18*	0757-1042		1	R: fxd met flm 60Ω ±1% 1/4 W	91637	MF-1/8-44	obd
A13R19*	0698-4410		1	R: fxd met flm 49. 9Ω ± 1% 1/2 W	75042	CEC T-O	obd
A13R20*	0698-4652		1	R: fxd met flm 5.76K ± 1% 1/4 W	91637	MFF-1/8-32 obd	
A13R21	0757-0813		1	R: fxd met flm 475Ω ± 1.0% 1/2 W	91637	MFF-1/2-10 T-1	
A13R22	2100-1759			R: var ww lin 2K ± 10% 1/2 W	75042	Type 506	obd
A13R23	2100-1702		1	R: var ww 100Ω ± 10% 1 W	88874	2600 Series	obd
A13R24	2100-1758		1	R: var ww lin 1K ± 10% 1/2 W	75042	Type 506	obd
A13R25	0683-1515		1	R: fxd comp 150Ω ± 5% 1/4 W	01121	CB 1515	
	1205-0033			Heat dissipator semi-conductor for Q1 and Q3	05820	NF-207	obd
A14	03300-66514			Assembly: Synthesizer and voltage comparator board	-hp-		
A14C1	0180-0161			C: fxd Ta elect 3.3 µF ± 20% 35 vdcw	05397	K3R3J35S	
A14C2	0150-0012		2	C: fxd disc cer durez coated 0.01 µF ± 20% 100 vdcw	71590	13C Disc	obd
A14C3				Not assigned			
A14C4	0180-0161			C: fxd Ta elect 3.3 µF ± 20% 35 vdcw	05397	K3R3J35S	
A14C5, A14C6	0140-0198		5	C: fxd mica 200 pF ± 5%	00853	RDM15F201J3C	
A14C7	0140-0197		1	C: fxd mica 180 pF ± 5%	00853	RDM15F181J3C	
A14C8 thru A14C10	0180-0161			C: fxd Ta elect 3.3 µF ± 20% 35 vdcw	05397	K3R3J35S	
A14C11	0140-0200		1	C: fxd mica 390 pF ± 5%	00853	RDM15F391J3C	
A14C12				Not assigned			
A14C13	0140-0198			C: fxd mica 200 pF ± 5%	00853	RDM15F201J3C	
A14C14	0170-0022		1	C: fxd my 0.1 µF ± 20% 600 vdcw	56289	148 P175A	
A14CR1 thru A14CR14	1901-0040		17	Diode: Si 30 mA at +1 V 30 piv 2 pF 2 ns	03877	SG5050	obd
A14CR15, A14CR16	1901-0025			Diode: Si junction 100 mA at 1 V 100 piv 12 pF	93332	D3072	obd
A14CR17, A14CR18	1901-0040			Diode: Si 30 mA at 1 V 30 piv 2 pF 2 ns	03877	SG5050	obd
A14CR19	1901-0025			Diode: Si junction 100 mA at 1 V 100 piv 12 pF	93332	D3072	obd
A14CR20	1901-0040			Diode: Si 30 mA at +1 V 30 piv 2 pF 2 ns	03877	SG5050	obd
A14CR21	1901-0033		1	Diode: Si 100 mA at 1 V 180 piv 13 pF	93332	D6238	obd

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A14Q1, A14Q2	1854-0071		5	TSTR: Si NPN 2N3391	04713	MPA. 3391	obd
A14Q3, A14Q4	1853-0010			TSTR: Si PNP**	-hp-		
A14Q5, A14Q6	1854-0071			TSTR: Si NPN 2N3391	04713	MPA. 3391	obd
A14Q7, A14Q8	1853-0010			TSTR: Si PNP**	-hp-		
A14Q9, A14Q10	1854-0005		4	TSTR: Si NPN 2N708	01295	2N798	obd
A14Q11	1854-0071			TSTR: Si NPN 2N3391	04713	MPA. 3391	obd
A14R1	0757-0280		1	R: fxd prec met flm 1 KΩ ±1% 1/8W	75042	CEA T-O	obd
A14R2, A14R3, A14R4				Not assigned			
A14R5	0757-0414		1	R: fxd prec met flm 432Ω ±1% 1/8W	19701	MF5C T-O	obd
A14R6	0698-4423		1	R: fxd prec met flm 1. 37K ±1% 1/8W	75042	CEA T-O	obd
A14R7	0757-0278		1	R: fxd prec met flm 1.78 KΩ ±1% 1/8W	75042	CEA T-O	obd
A14R8	0698-4443		4	R: fxd prec met flm 4. 53K ±1% 1/8W	75042	CEA T-O	obd
A14R9	0698-3484		1	R: fxd prec met flm 6.65K ±1% 1/8W	75042	CEA T-O	obd
A14R10	0757-0394		2	R: fxd prec met flm 51. 1Ω ±1% 1/8W	19701	MF5C T-O	obd
A14R11	0698-4396		2	R: fxd prec met fin 80. 6Ω ±1% 1/8W	19701	MF5C T-O	obd
A14R12	0698-4410		2	R: fxd prec met flm 137Ω ±1% 1/8W	75042	CEA T-O	obd
A14R13	0698-3439		2	R: fxd prec met flm 178Ω ±1% 1/8W	75042	CEA T-O	obd
A14R14	0698-4447		2	R: fxd prec met flm 280Ω ± 1% 1/8W	75042	CEA T-O	obd
A14R15	0757-0429		1	R: fxd prec met flm 1.82 KΩ ± 1% 1/8W	19701	MF5C T-O	obd
A14R16	0757-0422		1	R: fxd prec met flm 909Ω ±1% 1/8W	75042	CEA T-O	obd
A14R17	2100-0865			R: var comp lin 350Ω ±30% 1/8W	71450	XQS-200	obd
A14R18	0757-0274		2	R: fxd prec met flm 1. 21K ±1% 1/8W	75042	CEA T-O	obd
A14R19	0698-3558		2	R: fxd 4.02K ±1% 1/8W	75042	CEA T-O	obd
A14R20	0757-0283			R: fxd prec met flm 2.00 KΩ ±1% 1/8W	19701	MF5C T-O	obd
A14R21	0698-4447			R: fxd prec met flm 280Ω ±1% 1/8W	75042	CEA T-O	obd
A14R22	0698-3439			R: fxd prec met flm 178Ω ±1% 1/8W	75042	CEA T-O	obd
A14R23	0698-4410			R: fxd prec met flm 137Ω ±1% 1/8W	75042	CEA T-O	obd
A14R24	0698-4396			R: fxd prec met flm 80. 6Ω ±1% 1/8W	19701	MFSC T-O	obd
A14R25	0757-0394			R: fxd prec met fin 51. 1Ω ±1% 1/8W	19701	MF5C T-O	obd
A14R26	0698-3558			R: fxd 4.02K ±1% 1/8W	19701	MF5C T-O	obd
A14R27	0757-0274			R: fxd prec met flm 1.21K ±1% 1/8W	75042	CEA T-O	obd
A14R28	0698-3557		1	R: fxd prec met flm 806Ω ±1% 1/8W	19701	MF5C T-O	obd
A14R29	2100-0865			R: var comp lin 350Ω ±30% 1/8W	71450	XQS-200	obd
A14R30	0757-0438			R: fxd prec met flm 5. 11K ±1% 1/8W	19701	MF5C T-O	obd
A14R31	0757-0837		1	R: fxd prec met flm 8.25 KΩ ±1% 1/2W	19701	MF7C T-O	obd
A14R32	0683-0685		1	R: fxd comp 6. 8Ω ±5% 1/4W	01121	CB0685	
A14R33	0757-0830		1	R: fxd prec met flm 3.92K ±1% 1/2W	75042	CEC T-O	obd
A14R34				Not assigned			
A14R35	0683-1025		3	R: fxd comp 1K ±5% 1/4W	01121	CB1025	
A14R36	0683-2025			R: fxd comp 2K ±5% 1/4W	01121	CB2025	
A14R37	0683-1535		1	R: fxd comp 15K ±5% 1/4W	01121	CB1535	
A14R38	0683-3925		2	R: fxd comp 3.9K ±5% 1/4W	01121	CB3925	
A14R39	0683-4735		2	R: fxd comp 47K ±5% 1/4W	01121	CB4735	
A14R40	0757-0159		1	R: fxd prec met flm 1K ±1% 1/2 W	19701	MF7C T-O	obd
A14R41, A14R42	0757-0824		2	R: fxd prec met flm 2. 0K ±1% 1/2W	75042	CEC T-O	obd
A14R43	0683-3925			R: fxd comp 3.9K ±5% 1/4W	01121	CB3925	
A14R44	0683-4735			R: fxd comp 47K ±5% 1/4W	01121	CB4735	
A14R45, A14R46*	0683-4705		2	R: fxd comp 47Ω ±5% 1/4W	01121	CB4705	
A14R47	0757-0832			R: fxd prec met flm 4. 75K ±1% 1/2W	75042	CEC T-O	obd
A14R48	0683-5125		1	R: fxd comp 5. 1K ±5% 1/4W	01121	CB5125	
A14R49	0683-1505			R: fxd comp 15Ω ±5% 1/4W	01121	CB1505	
A14R50	0683-8205		1	R: fxd comp 82Ω ±5% 1/4W	01121	CB8205	
A14R51	0757-0839		1	R: fxd prec met flm 10 KΩ ±1% 1/2W	19701	MF7C T-O	obd

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A14R52	0757-0416		1	R: fxd prec met flm 511Ω ±1% 1/8 W	19701	MF5C T-O	obd
A14R53, A14R54	0683-1025			R: fxd comp 1K ±5% 1/4 W	01121	CB1025	
A15	03300-66515			Assembly: Output Amplifier Board	-hp-		
A15C1*	0140-0198			C: fxd mica 200 pF ±5%	00853	RDM15F201J3C	
A15C2	0121-0036		2	C: var 5.5 pF to 18 pF	72982	538-006	obd
A15C3	0180-0161			C: fxd Ta elect 3.3 µF ±20% 35 vdcw	05397	K3R3J35S	
A15C4*	0140-01902			C: fxd mica 39 pF ±5%	04062	RDM15E390J3C	
A15C5, A15C6, A15C7	0180-0161			C: fxd Ta elect 3.3 µF ±20% 35 vdcw	05397	K3R3J35S	
A15C8	0160-0356		5	C: fxd mica 18 pF ±5%	14655	RDM15C180J3C	
A15C9*	0140-0191		2	C: fxd mica 56 pF ±5%	04062	RDM15E390J3C	
A15C10				Not assigned			
A15C11	0180-0376		2	C: fxd Ta elect 0.47 µF ±10% 35 vdcw	56289	Type 150D474X90 35A2	
A15C12	0160-0356			C: fxd mica 18 pF ±5%	14655	RDM15C180J3C	
A15C13*	0160-0378		2	C: fxd mica 27 pF ±5%	04062	RDM15E270J5S	
A15Q1, A15Q2	1853-0010			TSTR: Si PNP**	-hp-		
A15Q3	1854-0005			TSTR: Si NPN 2N708	01295	2N798	
A15Q4, A15Q5	1854-0039		4	TSTR: Si NPN 2N3053	86684	2N3053	
A15R1	0698-3480		2	R: fxd prec met flm 3. 74K ±1% 1/2 W	75042	CEC T-O	obd
A15R2	0698-3349		2	R: fxd prec met flm 5. 76K ±1% 1/2 W	75042	CEC T-O	obd
A15R3*	0698-4901		2	R: fxd prec met flm 5. 36K ±1% 1/2 W	19701	MF7C T-O	obd
A15R4	0698-3348		2	R: fxd prec met flm 4. 64K ±1% 1/2 W	75042	CEC T-O	obd
A15R5	0757-0832			R: fxd prec met flm 4. 75K ±1% 1/2 W	75042	CEC T-O	obd
A15R6	0683-4705			R: fxd comp 47Ω ±5% 1/4 W	01121	CB 4705	
A15R7	2100-0361		2	R: var comp 2K ±30% 1/8 W	71450	XQS-200	obd
A15R8	0757-0041		2	R: fxd prec met flm 11. 3K ±1% 1/2 W	75042	CEC T-O	obd
A15R9	0698-3352		2	R: fxd prec met flm 11. 5K ±1% 1/2 W	75042	CEC T-O	obd
A15R10*	0686-2225		2	R: fxd comp 2. 2K ±5% 1/2 W	01121	EB2225	
A15R11, A15R12	0698-5483		8	R: fxd prec met flm 1K 0. 5% 1/2 W	19701	MF7C T-O	obd
A15R13, A15R14	0683-2025			R: fxd comp 2K ±5% 1/4 W	01121	CB2025	
A15R15	0683-2415		2	R: fxd comp 240Ω ±5% 1/4 W	01121	CB2415	
A15R16	0683-8215		2	R: fxd comp 820Ω ±5% 1/4 W	01121	CB8215	
A15R17	0683-1015		4	R: fxd comp 100Ω ±5% 1/4 W	01121	CB1015	
A15R18	0698-3338		2	R: fxd met oxide flm 1. 5K ±5% 2 W	07115	C425	obd
A15R19	0683-5105		2	R: fxd comp 51Ω ±5% 1/4 W	01121	CB5105	
A15R20, A15R21	0698-3342		4	R: fxd prec met flm 2. 0K ±1/4% 1/2 W	75042	CEC T-O	obd
A15R22	0761-0057		2	R: fxd met oxide flm 560Ω ±5% 1 W	07115	C32	obd
A15R23	0683-2025			R: fxd comp 2K ±5% 1/4 W	01121	CB2025	
A15R24, A15R25	0698-5483			R: fxd prec met flm 1K ± 0. 5% 1/2 W	19701	MF7C T-O	obd
A15R26	0683-2025			R: fxd comp 2K ±5% 1/4 W	01121	CB2025	
A15R27	0683-1015			R: fxd comp 100Ω ±5% 1/4 W	01121	CB1015	
A15R28	0683-2015		2	R: fxd comp 200Ω ±5%o 1/4 W	01121	CB 2015	
	1205-0033			Heat dissipator: semiconductor for TO-5	05820	NF-207	obd
A16	03300-66505			Output Amplifier Assembly (Components same as A15)	-hp-		

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
				Chassis Mounted Components			
C1				Not Assigned			
C2	0150-0012			C: fxd disc cer durez coated 0. 01 µF ±20% 1000 vdcw	56289	29CZ14A3	
C3	0160-2050		1	C: fxd my 10 µF ±10% 30 vdcw	56289	127P1069R354	
C4, C5	0180-0056		2	C: fxd elect 1000 µF 50 vdcw	56289	D32429	
C6	0160-0127		1	C: fxd cer 1.0 µF ±20% 25 vdcw	56289	5C13C	obd
C7, C8	0160-3333		2	C: fxd cer .005 µF ±20% 250 vac	08988	THD-8-502M-1. 4kv	
CR1, CR2, CR3, CR4	1901-0158		4	Diode: Si 200 piv 0.75 A	04713	SR1358-3	
F1	2110-0339		1	Fuse: cartridge slow-blow 0.6 amp for 115 V	71400	2B250V. 60A	
F1	2110-0340		1	Fuse: cartridge slow-blow 0.4 amp for 230 V	714002	B250V. 4A	
J1	1251-2357	1		Connector: Power cord chassis	82389	EAC-301	obd
J2 thru J5	1250-0118		4	Connector: BNC UG-1094A/U	91737	8427	obd
J6	1251-0101		1	Connector: 50 pin	71785	57-20500-375	
L1 thru L6	9170-0016			Bead: ferrite	02114	56-590-65/3B	
Q1, Q2	1854-0072		2	TSTR: Si NPN 2N3054	86684	2N3054	
Q3, Q4, Q5 Q6, Q7	1854-0039		5	TSTR: Si NPN 2N3053	86684	2N3053	
R1	0683-3335		1	R: fxd 33K ±5% 1/4 w	01121	CB3335	
R2, R3				Not Assigned			
R4	2100-1563		1	R: var ww lin 1K ±5% 3 W (FREQUENCY)	12697	Series 42	obd
R5, R6, R7, R8				Not Assigned			
R9	2100-1548		2	R: var comp molded C attenuator 600Ω ±20% 5 W	12687	53M	obd
R10, R11	0686-6215		4	R: fxd comp 620Ω ±5% 1/2 W	01121	EB6215	
R12	2100-1548			R: var comp molded C attenuator 600Ω ±20% 5 W	12687	53M	obd
R13, R14	0686-6215			R: fxd 620Ω ±5% 1/2 W	01121	EB6215	
R15				Not assigned			
R16*, R17*	0699-0002		2	R: fxd comp 6. 8Ω ±10% 1/2 W	01121	EB68G1	
S1	3101-0100		1	Switch: pushbutton lighted SPDT 2 amp at 125 vacw (POWER)	87034	SW-624-109	
DS1	1450-0106		1	Lamp: neon	87034	A1C	
S2	3101-1234		1	Switch: slide DPDT non-shorting 0. 5 amp 125 vdc 3 amp 125 vac	82389	11A-1009B	
S3	3100-1709		1	Switch: rotary (RANGE)	76854	Type F	obd
S4	3100-1710		1	Switch: rotary (function CHANNEL A)	76854	obd	
S5	3100-1711		1	Switch: rotary (function CHANNEL B)	76854	obd	
T1	9100-1306		1	Transformer: power	-hp-		
TB1	0360-0126		1	Terminal strip: barrier black 6 terminals (on rear panel)	71785	353-18-06-001	
W1	8120-1348		1	Cable assembly: ac power cord 7.5 feet long	70903	KHS-7041	
XA12, XA13	1251-0159		2	Connector: printed circuit 30 pin ribbon type	75173	251-15-30-261	
XA14	1251-0172		1	Connector: printed circuit 22 pin ribbon type	07233	250-22-30-210	
XA15, XA16	1251-0160		2	Connector: printed circuit 15 pin ribbon type	07233	250-15-30-210	
				Miscellaneous			
	03300-21201		1	Bar: support (for front panel)	-hp-		
	0400-0111		5	Bushing: nylon insulator (for front panel controls)	28520	SB-427-5	
	1410-0110		1	Bushing: threaded 3/8" OD - .280" ID hex flange 1/2" long	28520	obd	
	1410-0003		1	Bushing: 3/8" 0.252" ID (for vernier shaft)	28520	obd	
	1400-0041		2	Clip: capacitor steel cadmium plated (for C3)	14655	#21368-2	
	03300-00605		1	Cover: chassis bottom inner shield	-hp-		

Table 7-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO		TQ	DESCRIPTION	MFR.	MFR. PART NO.
				Miscellaneous (Cont'd)		
	03300-00608		1	Cover: chassis top inner shield	-hp-	
	03300-46904		1	Cover: oven	-hp-	
	03300-00606		1	Cover: rear panel protection plate	-hp-	
	03300-01203		1	Clamp: holding	-hp-	
	5000-0910		4	Clamp: panel trim	-hp-	
	03300-04001		1	Dial: frequency	-hp-	
	5020-0630		1	Dial: hub (for R4)	-hp-	
	03440-48301		4	Guides: (for plug-in unit)	-hp-	
	1205-0007		5	Heat dissipator: nut (for Q3 thru Q7)	13103	1101-24-1 (SPL)
	1205-0220		5	Heat dissipator: body (for Q3 thru Q7)	-hp-	
	1400-0084		1	Holder: fuse extractor post type for single 3AC cartridge fuse	75915	342014
	5040-0619		1	Indicator: for frequency dial	-hp-	
	0340-0039		2	Insert: teflon bushing insulator for stand-off terminals	00866	HP-3000T-1
	5040-0425		8	Insulator: BNC panel connector	-hp-	
	0340-0140		2	Insulator: transistor (for Q1 and Q2)	86684	DF31A
	1200-0080		10	Insulator: washer #10 (for Q3 thru Q7)	000LB	294834
	03300-84401		1	Kit: accessory	-hp-	
	0370-0160		1	Knob: dial round 1/58" diam black (FREQUENCY DIAL)	-hp-	
	0370-0025		1	Knob: round 3/4" diam black for 1/4" diam shaft (VERNIER)	-hp-	
	0370-0077		3	Knob: skirted bar 5/8" diam black for 1/4" diam shaft (RANGE and FUNCTION)	-hp-	
	0370-0133		2	Knob: skirted 5/8" diam black for 1/4" diam shaft (AMPLITUDE)	-hp-	
	03300-01201		1	Latch: plug-in	-hp-	
	03300-90005		1	Manual: operating and service	-hp-	
	2950-0039		1	Nut: hexagonal 3/8-32 by 1/2" across flats by 9/16" thick brass (for mounting R4)	28520	obd
	03300-46902		1	Oven: assembly	-hp-	
	5020-0900		1	Panel: trim bottom	-hp-	
	5020-0901		1	Panel: trim top	-hp-	
	61B-40D-4		1	Plate: frequency dial	-hp-	
	5040-0607		1	Shaft: vernier drive disk assembly	-hp-	
	0360-1044		4	Shorting bar: (for rear panel terminal strip)	71785	422-13-11-013-201
	1200-0168		2	Socket: transistor (for Q1 and Q2)	000LB	294834
	03300-09101		1	Spring: vernier	-hp-	
	5020-0882		1	Support: front panel	-hp-	
	0340-0059		2	Terminal: stand-off (for C6) use with 0340-0039 teflon insert	00866	obd
	0360-1327		3	Terminal strip: tie point (for Q3, Q4 and Q7)	71002	1355
			2	Terminal strip: tie point (for R16 and R17)	-hp-	

Table 7-2.

PART NUMBER - NATIONAL STOCK NUMBER CROSS REFERENCE INDEX

PART NUMBER	FSCM	NATIONAL STOCK NUMBER
A1C	87034	6240-00-951-3376
CB1005	01121	5905-00-960-0099
CB1015	01121	5905-00-102-5294
CB1025	01121	5905-00-097-9533
CB1505	01121	5905-00-905-6277
CB1515	01121	5905-00-904-5685
CB1535	01121	5905-00-904-5689
CB2015	01121	5905-00-909-3919
CB2025	01121	5905-00-102-5289
CB2415	01121	5905-00-435-1718
CB2425	01121	5905-00-911-3811
CB3015	01121	5905-00-686-3122
CB3035	01121	5905-00-909-3954
CB3335	01121	5905-00-909-3967
CB3625	01121	5905-00-104-8369
CB3925	01121	5905-00-141-0743
CB3935	01121	5905-00-907-4119
CB4705	01121	5905-00-909-3798
CB4735	01121	5905-00-960-0126
CB5105	01121	5905-00-909-3834
CB5125	01121	5905-00-911-3754
CB6825	01121	5905-00-577-9455
CB8205	01121	5905-00-104-8363
CB8215	01121	5905-00-918-6522
CB8225	01121	5905 00-104-8358
DF31A	86684	5970-00-088-5074
D32429	56289	5910-00-087-6817
EAC-301	82389	5935-00-233-6728
EB2025	01121	5905-00-909-4137
EB2225	01121	5905-00-195-5533
EB6215	01121	5905-00-807-7506
KHS-7041	70903	6150-01-004-8773
RDM15F201J3C	00853	5910-00-852-2656
RDM15F391J3C	00853	5910-00-914-4732
SS3723	04713	5961-00-442-9470
TGH	71400	5920-00-489-2202
19C251A	56289	5910-00-852-2644
192P33292	56289	5910-00-719-4370
2N3053	86684	5961-00-985-9073
2N3054	86684	5961-00-401-2831
250-15-30-210	07233	5935-00-833-9866
30D107G025DD2DSM	56289	5910-00-082-5119
342014	75915	5920-00-881-4636
353-18-06-001	71785	5940-00-997-5693
45R1	83186	5905-00-893-1151
5C13C	56289	5910-00-809-5484
56-590-65/3B	02114	5950-00-784-0475
8427	91737	5935-00-897-9351

CODE LIST OF MANUFACTURERS

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

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microtron Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01509	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, III.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, III.
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.
02875	Hudson Tool & Die Co.	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transition Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Summerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, III
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, III.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, III.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, III.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05703	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, III.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07307	Birtcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, III.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08	Blinn, Delbert Co.	Pomona, Calif.
08	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, III.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	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.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermolloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dublier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15556	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amprobe Inst. Corp.	Lynbrook, N Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computer Diode Corp.	Lodi, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokoma, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Ma.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Concoa	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Parelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialties Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G. E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W. H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P. R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C. A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Belts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L. I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C. P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H. M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect. Co.	Hicksville, L. I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J. H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R. F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E. F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co. Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C. W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp. Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J. W. Miller Co.	Los Angeles, Calif.
76530	Cinch Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phanostran Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78424	Speciality Leather Prod. Co.	Newark, 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	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford. Conn.
79251	Wenco Mfg. Co.	Chicago, III.
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 Co.	Elizabeth, N.J.
80131	Electronic Industries Association.	Any brand Tube meeting EIA Standards-Washington, D.C.
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co. Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp. , Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	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.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
85660	Koiled Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
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	Graybar Electric Co.	Oakland, Calif.
89473	G. E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Malco Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G. V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Dania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomson Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, 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.
99928	Branson Corp.	Whippany, N.J.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Cooltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S. K. Smith Co.	Los Angeles, Calif.

SUPPLEMENTAL CODE LIST OF MANUFACTURERS

Code No.	Manufacturer	Address
08988	Skottie Electronics Inc.	Archbald, Pa.

SALES & SERVICE OFFICES

UNITED STATES

ALABAMA
P.O. Box 4207
2003 Byrd Spring Road S.W.
Huntsville 35802
Tel: (205) 881-4591
TWX: 810-726-2204

ARIZONA
3009 North Scottsdale Road
Scottsdale 85251
Tel: (602) 945-7601
TWX: 910-950-1282

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

CALIFORNIA
1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000

3939 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

1101 Embarcadero Road
Palo Alto 94303
Tel: (415) 327-6530
TWX: 910-373-1280

2220 Watt Ave
Sacramento 95825
Tel: (916) 482-1463
TWX: 910-367-2092

1055 Shatter Street
San Diego 9210F
Tel: (714) 223-6103
TWX: 910-335-2000

COLORADO
7965 East Prentice
Englewood 80110
Tel: (303) 771-3455
TWX: 910-935-0705

CONNECTICUT
508 Tolland Street
East Hartford 06108
Tel: (203) 289-9394
TWX: 710-425-3416

111 East Avenue
Norwalk 06851
Tel: (203) 853-1251
TWX: 710-468-3750

DELAWARE
3941 Kennett Pike
Wilmington 19807
Tel: (302) 655-6161
TWX: 510-666-2214

FLORIDA
P.O. Box 24210
2806 W. Oakland Park Blvd.
Ft. Lauderdale 33307
Tel: (305) 731-2020
TWX: 510-955-4099

P.O. Box 20007
Herndon Station 32814
621 Commonwealth Avenue
Orlando
Tel: (305) 841-3970
TWX: 810-850-0113

P.O. Box 8128
Madeira Beach 33708
410 150th Avenue
St. Petersburg
Tel: (513) 391-0211
TWX: 810-863-0366

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-1613

INDIANA
3839 Meadows Drive
Indianapolis 46205
Tel: (317) 546-4891
TWX: 810-341-3263

LOUISIANA
P.O. Box 856
1942 Williams Boulevard
Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel: (301) 944-5400
TWX: 710-862-0850

P.O. Box 1648
2 Choke Cherry Road
Rockville 20850
Tel: (301) 948-6370
TWX: 710-828-9684

MASSACHUSETTS
32 Hartwell Ave
Lexington 02173
Tel: (617) 861-8960
TWX: 720 326-6904

MICHIGAN
24315 Northwestern Highway
Southfield 48075
Tel: (313) 353-9100
TWX: 810-224-4882

MINNESOTA
2459 University Avenue
St. Paul 55114
Tel: (612) 645-9461
TWX: 910-563-3734

MISSOURI
11131 Colorado Ave.
Kansas City 64137
Tel: (816) 763-8000
TWX: 910-771-2087

2812 South Brentwood Blvd.
St. Louis 63144
Tel: (314) 962-5000
TWX: 910-760-1670

NEW JERSEY
W. 120 Century Road
Paramus 07652
Tel: (201) 265-5000
TWX: 710-990-4951

1060 N. Kings Highway
Cherry Hill 08034
Tel: (609) 667-4000
TWX: 710-892-4945

NEW MEXICO
P.O. Box 8366
Station C
6501 Lomas Boulevard N.E.
Albuquerque 87108
Tel: (505) 265-3713
TWX: 910-989-1665

156 Wyatt Drive
Las Cruces 88001
Tel: (505) 526-2485
TWX: 910-983-0550

NEW YORK
1702 Central Avenue
Albany 12205
Tel: (518) 869-8462
TWX: 710-441-8270

1219 Campville Road
Endicott 13760
Tel: (607) 754-0050
TWX: 510-252-0890

82 Washington Street
Pougkeepsie 12601
Tel: (914) 454-7330
TWX: 510-248-0012

39 Saginaw Drive
Rochester 14623
Tel: (716) 473-9500
TWX: 510-253-5981

1025 Northern Boulevard
Roslyn, Long Island 11576
TWX: 510-223-0811

5858 East Molloy Road
Syracuse 13211
Tel: (315) 454-2486
TWX: 710-541-0482

NORTH CAROLINA
P.O. Box 5188
1923 North Main Street
High Point 27262
Tel: (919) 855-8101
TWX: 510-926-1516

OHIO
25575 Center Ridge Road
Cleveland 44145
Tel: (216) 835-0300
TWX: 810-427-9129

3460 South Dixie Drive
Dayton 45439
Tel: (513) 298-0351
TWX: 810-459-1925

1120 Morse Road
Columbus 43229
Tel: (614) 846-1300

OKLAHOMA
2919 United Founders Boulevard
Oklahoma City 73112
Tel: (405) 848-2801
TWX: 910-830-6862

OREGON
Westhills Mall, Suite 158
4475 S.W. Scholls Ferry Road
Portland 97225
Tel: (503) 292-9171
TWX: 910-464-6103

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MANUAL BACKDATING CHANGES

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes
630-01950 and below	1 thru 6
702-02675 and below	2 thru 6
809-03350 and below	3 thru 6
809-03475 and below	4 thru 6

Instrument Serial Prefix	Make Manual Changes
939-04925 and below	5, 6
939-04950 and below	6

CHANGE #1 Replace R16 and R17 with pieces of wire.

CHANGE #2 Replace A12R27 with a piece of wire.
Change A12R25 to 2 kΩ ± 10% 1/2 W.
Replace A12R28 with a piece of wire.
Change A12R26 to 5 kΩ ± 10% 1/2 W.

CHANGE #3 Replace A15R28 and A16R28 with pieces of wire.

CHANGE #4 Replace A13R25 with a piece of wire.

CHANGE #5 For instruments with serial number 939-04925 and below, change the following part numbers:
J1 should be 1251-0148.
W1 should be 8120-0078.
Rear Panel should be 03300-00202.
These parts are not directly interchangeable with the ones listed in Table 7-1. If any one is changed, all should be changed.

CHANGE #6 (RECOMMENDED INSTRUMENT CHANGE)
Solder a short jumper wire between the shield ground (⊥ in this manual and ⏚ in older manuals) and power line ground ⏚. This connection should be made on the terminal strip on the inside of the rear panel. This connection will prevent the instrument shafts and set screws in the control knobs from being above power line ground. Instruments with serial number 939-04950 and below did not have this change (see note 1).

NOTE 1

Some instruments between serial number 939-04851 and 939-04950 already have this change. Check your instrument to see if it has this change.

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7	Military Publications: US Army Equipment Index of Modification Work Orders.
TB 43-180	Calibration Requirements for the Maintenance of Army Materiel.
TM 11-6625-433-15	Organizational, Direct Support, General Support, and Depot Maintenance Manual: Wattmeters, AN/URM-98 and AN/URM-98A (NSN 6625-00-566-4990).
TM 11-6625-444-14-1	Operator's Organizational, Direct Support and General Support Maintenance Manual (Including Repair Parts and Special Tools Lists): Volt-meter, Digital AN/GSM-64B (NSN 6625-00-022-7894), Including Plug-In, Electronic Test Equipment PL-1370/GSM-64B (NSN 6625-00-137-8366).
TM 11-6625-700-14-1	Operator, Organizational, Direct Support and General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tools Lists): Digital Readout Electronic Counter AN/USM-207A (Serial Nos. 1A through 1100A) (NSN 6625-00-044-3228).
TM 11-6625-1548-15	Organizational, Direct Support, General Support, and Depot Maintenance Manual: Counter, Electronic, Digital, CP-772/U (Hewlett-Packard Model 5245L).
TM 38-750	The Army Maintenance Management System (TAMMS).
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX D
MAINTENANCE ALLOCATION

SECTION I. INTRODUCTION

D-1. General

This appendix provides a summary of the maintenance operations for SG-747/U. It authorizes categories of maintenance for specific maintenance functions on repairable items and components an the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

D-2. Maintenance Function.

Maintenance functions will be limited to and define as follows:

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

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

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

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

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

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

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

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

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

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

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

D-3. Column Entries.

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

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

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4

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

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

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

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

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

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

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

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

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

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

D-5. Remarks (Sec IV)

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

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

(Next printed page is D-3)

SECTION II. MAINTENANCE ALLOCATION CHART
FOR
GENERATOR, SIGNAL SG-747/U
(HP 3300A)

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY		(3) MAINTENANCE FUNCTION	(4) MAINTENANCE CATEGORY C	O	F	H	D	(5) TOOLS AND EQUIP.	(6) REMARKS
00	Generator, Signal SG-747/U		Inspect		.5				16	A
			Test		2.0				1-4, 6, 7, 11	B
			Test				3.0		1-14	
			Adjust				2.0		1-5, 10, 12	
			Calibrate				*		*	
			Repair				3.0		15, 16	
			Overhaul				4.0		1-16	
01	Oven Assembly	A11	Test				1.0		1-5, 12-14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
02	Power Supply Assembly	A12	Test				1.0		1-5, 12, 14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
03	Antegrator Assembly	A13	Test				1.0		1-5, 12-14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
04	Synthesizer and Voltage Comparator Assembly	A14	Test				1.0		1-5, 12-14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
05	Output Amp Assembly	A15	Test				1.0		1-5, 12-14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
06	Output Amp Assembly	A16	Test				1.0		1-5, 12-14	
			Repair				1.0		15, 16	
			Replace					.5	15, 16	
07	Cable Assemblies		Repair				2.0		15, 16	

*As per test equipment and procedure listed in the appropriate TB.

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS FOR GENERATOR, SIGNAL G-747/U (HP 3300A)

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	H, D	Electronic Counter CP-772A/U	6625-00-973-9837	
2	H, D	Distortion Analyzer AN/URM-180	6625-00-089-4227	
3	H, D	Oscilloscope OS-261/U	6625-00-127-0079	
4	H, D	Probe 10:1 H.P. 10001A or equivalent		
5	H, D	D.C. Voltmeter AN/USM-451	6625-01-060-6804	
6	H, D	Resistor 600 OHM .25 watt ±5% H.P. 0730-0010 or equivalent		
7	H, D	Resistor 50 drm, .25 watt ±5% H.P. 0683-5105 or equivalent		
8	H, D	Resistor 20K OHM, .25 watt ±5% H.P. 0686-2035 or equivalent		
9	H, D	Capacitor 1 micro f 50V. H.P. 0160-0859 or equivalent		
10	H, D	Variable Line Voltage Transformer CN-16/U	5950-00-235-2086	
11	H, D	D.C. Power Supply PP-6647/U (HP 723A)	6130-00-171-0801	
12	H, D	A.C. Voltmeter KE-459/U	6625-00-329-0457	
13	H, D	Printed Circuit Board Extender 15 Pin H.P. 5060-0049 or equivalent		
14	H, D	Printed Circuit Board Extender 22 Pin H.P. 5060-0630 or equivalent		
15	H, D	Tool Kit Elec Repair TK-101/G	5180-00-064-5178	
16	O	Tools and test equipment as authorized to the repairman user to complete his authorized mission.		

SECTION IV. REMARKS

REFERENCE CODE	REMARKS
A	Visuals
B	Performance checks

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Chief of Staff

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- HISA (Ft Monmouth) (21)
- Armies (1)
- USASIGS (10)
- Svc Colleges (1)
- Ft Richardson (CERCOM Ofc) (1)
- Ft Carson (5)
- Ft Gillem (10)
- WSMR (1)
- USAERDAA (1)
- USAERDAW (1)
- Army Dep (1) except
  - SAAD (30)
  - TOAD (14)
  - SHAD (2)
- USA Dep (1)
- Sig See USA Dep (1)
- Units org under fol TOE:
  - (2 copies each unit)
  - 29-207
  - 29-610
  - (1 copy each unit)
  - 29-134
  - 29-136

ARNG: None

USAR: None

For explanation of abbreviations used, see AR 310-50.

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