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Refer to Appendix I for Instruments
Serial Prefixed 532 - and 541 -

SERIALS PREFIXED: 649- 737-

FREQUENCY COMB GENERATOR

MODEL 8406A

OPERATING AND SERVICE MANUAL



SAFETY CONSIDERATIONS

GENERAL — This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION — BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNINGS

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection. If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard. Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard. Do not install substitute parts or perform any unauthorized modification to the instrument.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.



Indicates hazardous voltages.



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

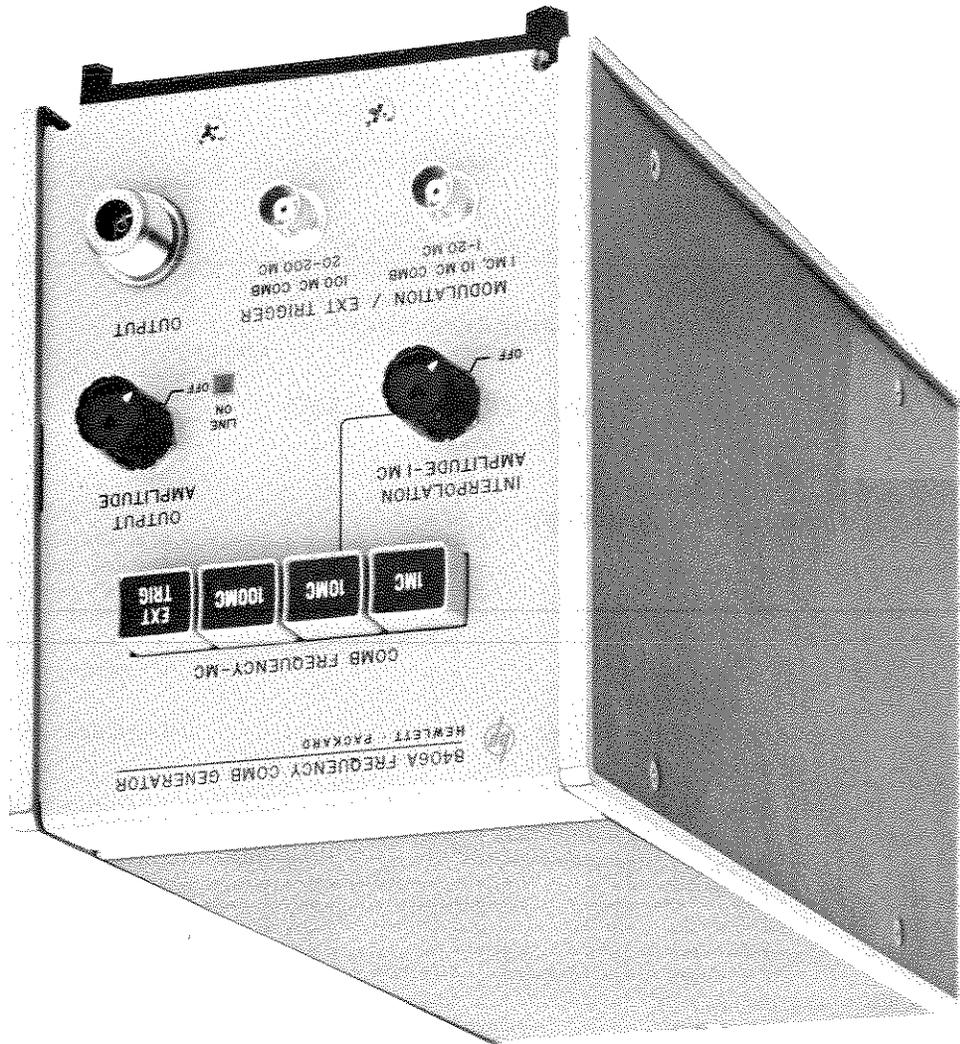
WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Figure 1-1. Frequency Comb Generator



Section I
Figure 1-1

SECTION I GENERAL INFORMATION

I-1. DESCRIPTION.

I-2. The hp Model 8406A supplies a frequency comb with a selectable spectral line spacing of 1 Mc, 10 Mc, 100 Mc, or the frequency of an external trigger signal. The frequency comb generated is usable to at least 4 Gc.

I-3. The Model 8406A provides these additional features:

- a. Output level is continuously variable by a front panel control.
- b. Interpolation amplitude level is continuously variable by a front panel control.
- c. Comb frequency or external trigger frequency is selectable by front panel pushbuttons. This switch will not permit more than one button to be actuated at a time to avoid confusion in the output signal.

- d. Front panel BNC jacks are provided for modulation and external trigger frequencies.
- e. A switch is provided on the rear apron to switch the instrument to 230-volt operation.

I-4. INSTRUMENT IDENTIFICATION.

I-5. Hewlett-Packard uses a two-section, eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix number, and the last five digits refer to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the manual and your instrument which are described in a Manual Change sheet included with this manual or in the Appendix (if any). If this information is missing, it can be supplied by your nearest Hewlett-Packard field office.

Comb Fundamental Frequencies: 1, 10, and 100 Mc, pushbutton selected, generate harmonically related signals usable to beyond 5 Gc.

Comb Frequency Accuracy: $\pm 0.01\%$ (0° to 50°C).

Peak Amplitude*:

1 Mc Comb	10 Mc Comb	100 Mc Comb
> 80 dBm	> 60 dBm	-
> 1.0 Gc	> 45 dBm	-
0.5-2.0 Gc	> 70 dBm	> 50 dBm
1-2 Gc	-	> 35 dBm
2-4 Gc	> 82 dBm	> 62 dBm
	> 47 dBm	> 47 dBm

*Peak signal level defined in terms of equipment CW signal level (as measured on hp 8551B/851B Spectrum Analyzer).

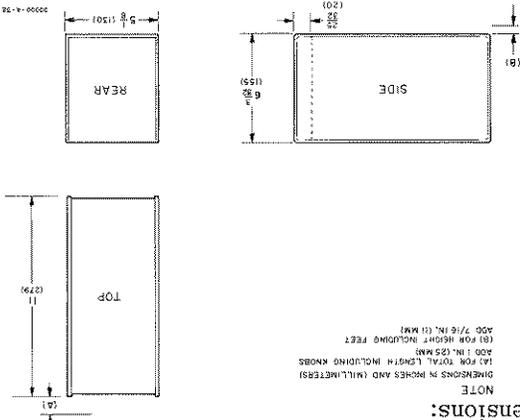
OUTPUT AMPLITUDE control permits continuous level adjustment.

Comb Output Connector: Type N female, source impedance approximately 50 ohm.

Maximum External Signal at Comb Output: Signals exceeding 1 watt (pk and av) may cause damage.

Interpolation Function: 10-Mc and 1-Mc combs can be combined into primary-secondary comb; Interpolation Amplitude control adjusts level of secondary (1 Mc) signal.

Weight: Net 6 lb (2.7 Kg); shipping 9 lb (4.1 Kg)



Power: 115 or 230 volts $\pm 10\%$, 50-400 cps, 2 watts

External Modulation: External modulation signals can be used to phase modulate any of the combs to produce sidebands for interpolation between fixed comb markers¹. BNC female connector.

External Trigger: External signals (normally sine waves) between 1 Mc and 200 Mc can be used to produce combs spaced at frequency of trigger signals². BNC female connector.

External modulation: Modulation frequencies can be as low as 5 kc. Although the level of modulation voltage required varies with modulating frequency and the harmonic number of the comb being modulated, the information here will serve as a guide:

To produce sidebands approximately 20 db below the main comb marker at the 1 Gc harmonic of the appropriate comb (comb output amplitude at maximum), typical modulation voltages are:

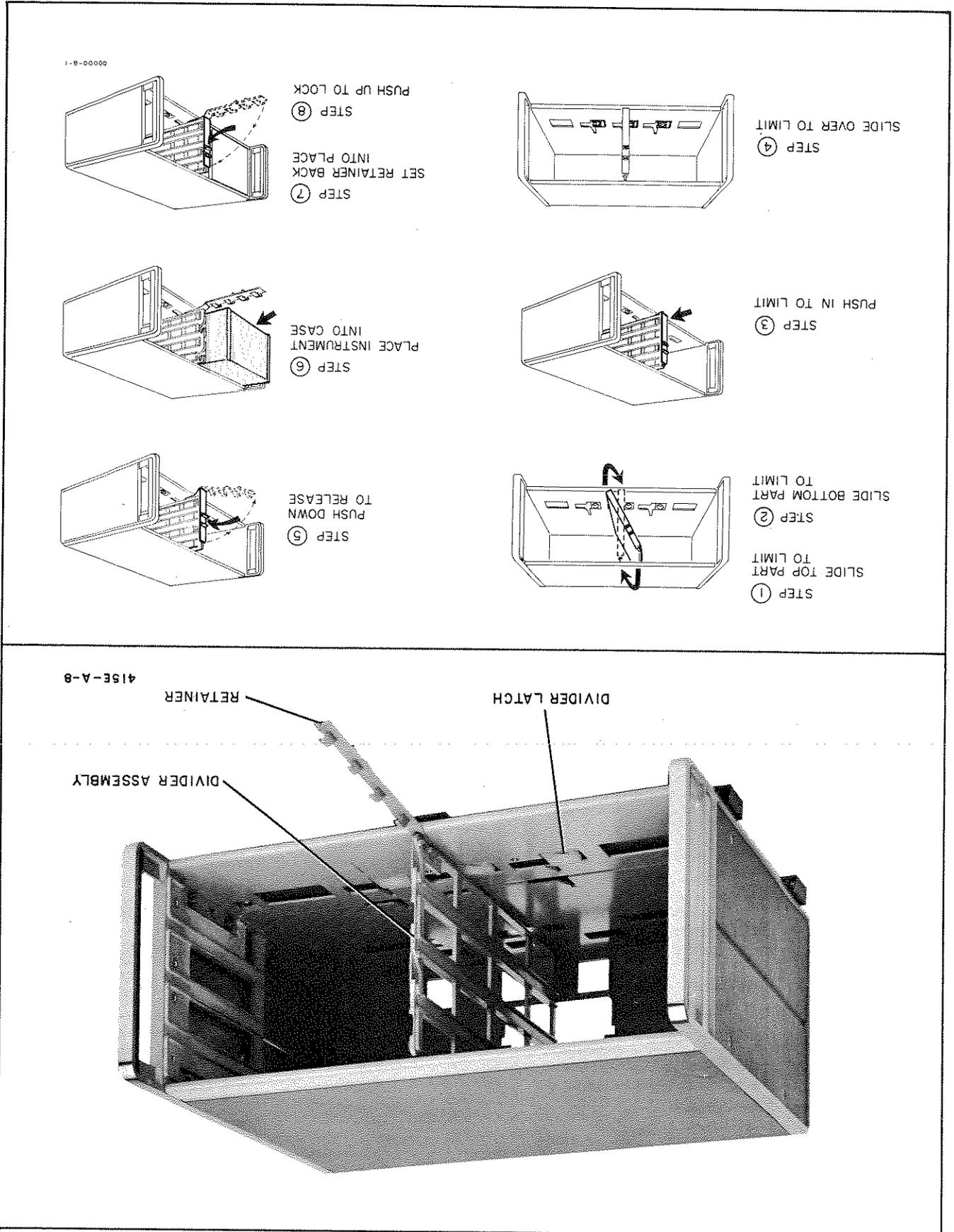
- 1-2 mv rms at 200 kc for the 1 Mc comb
- 5-10 mv rms at 2 Mc for the 10 Mc comb
- 50-100 mv rms at 20 Mc for the 100 Mc comb

Signals greater than 5v rms at modulation input may cause damage.

External Trigger: Typical input signal levels to generate externally triggered combs at the frequency of the external trigger are in the range of 1-3 volts rms. Input signals greater than 5 volts rms may cause damage. With input triggers in the 1-20 Mc frequency span, the OUTPUT AMPLITUDE control of the 8406A can be used to adjust the output comb level.

When using signals in the frequency span from 20-200 Mc, output comb amplitude is a function of the input signal level.

Figure 2-1. Combining Case



Section II
Figure 2-1

SECTION II INSTALLATION

- c. Place end spacer clamps as shown in step 4, and push units into frame.
- d. Insert screws on either side of frame, step 5, and tighten until units are tight in frame.
- e. The complete assembly is now ready for rack mounting.

2-12. OPERATING FROM 115 OR 230 VOLTS.

2-13. The Model 8406 may be operated from either 115- or 230-volt $\pm 10\%$, 50-to-400-cps power lines. A slide switch on the rear panel permits quick conversion for operating from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch to expose "115" marking for 115-volt operation or "230" marking for 230-volt operation. A 1/16 amp fuse is used for both voltages.

CAUTION: Be sure this switch is in proper position before turning on.

2-14. POWER CABLE. The Model 8406 is equipped with a detachable 3-wire power cable. Proceed as follows for installation:

- a. Connect flat plug (three-socket connector) to ac line jack at rear of instrument.

- b. Connect plug (two-blade with round grounding pin) to three-wire (grounded) power outlet. Exposed portions of the instrument are grounded for safety; when only a two-blade outlet is available, use connector adapter (hp part number 1251-0048), and connect short wire from side of adapter to ground.

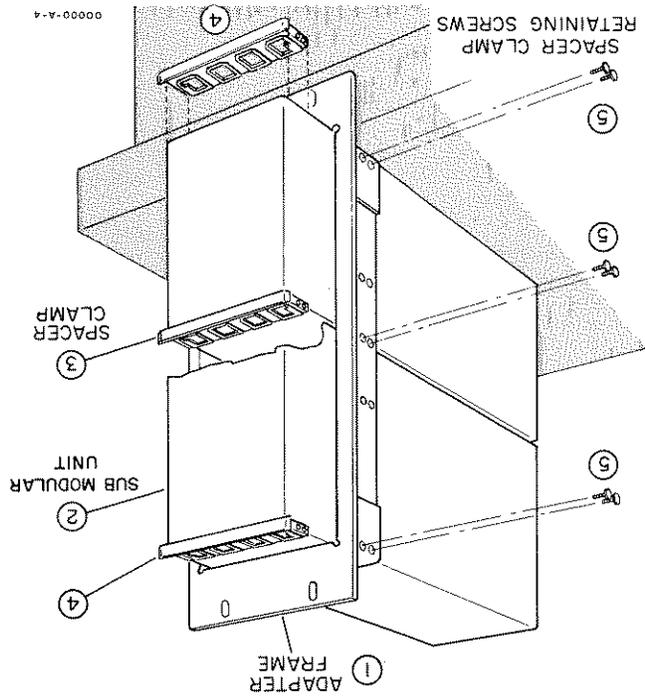


Figure 2-2. Adapter Frame

2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, storage and installation.

2-3. UNPACKING AND INSPECTION.

2-4. Inspect instrument for shipping damage as soon as it is unpacked. Check for broken knobs and connectors; inspect cabinet and panel surfaces for dents and scratches. A performance check is given in Table 5-2. If instrument is damaged in any way or fails to operate properly, notify carrier and your nearest Hewlett-Packard field office. For assistance of any kind, including help with instruments under warranty, contact your Hewlett-Packard field office (see list at rear of this manual).

2-5. STORAGE AND SHIPMENT.

2-6. **PACKAGING.** To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Whatever packing method is used, be sure to attach a tag to the instrument itself giving your name, address, and pertinent details.

2-8. RACK INSTALLATION.

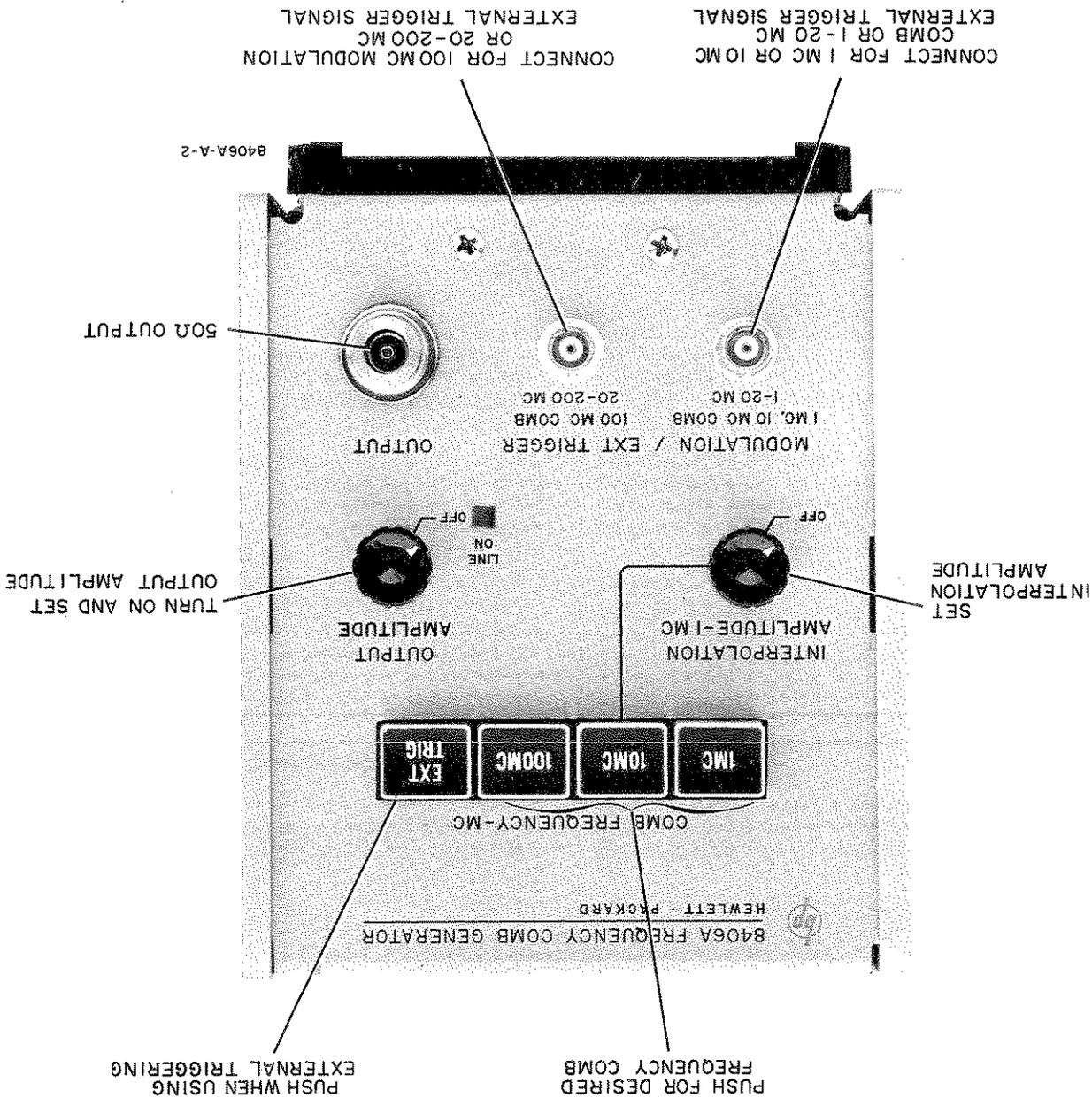
2-9. When the Model 8406A is to be rack-mounted, a combining case (Paragraph 2-10) or adapter frame (Paragraph 2-11) is required. These items are available through your Hewlett-Packard field office. The two methods for rack mounting are discussed in the following paragraphs.

2-10. COMBINING CASE. The combining case (hp 1051A) shown in Figure 2-1 is a full-module unit which accepts varying combinations of sub-module units such as the 1/3 module Model 8406. The combining case can be used as a bench model or it can be rack-mounted. A rack-mounting kit (hp part number 5060-0777) is supplied to rack mount the combining case. Instructions for using the case are given in Figure 2-1. When only one-third of the case is used, a blank filler panel (hp part number 5060-0793) is available to enclose the unused front panel space.

2-11. ADAPTER FRAME. The adapter frame (hp part number 5060-0797) in Figure 2-2 is a rack frame that accepts any combination of sub-module units;

- a. Place adapter frame on edge of bench as shown in step 1, Figure 2-2. (Only two sub-module units are illustrated for clarity. The method of operation is the same for three.)
- b. Stack units in frame as shown in step 2. Place spacer clamp between units, step 3.

Figure 3-1. Operating Controls



SECTION III OPERATION

3-5. FREQUENCY CONSIDERATIONS. At low levels of modulation (phase modulation), a single pair of sidebands appear - variable with modulation for precise frequency determination. At higher levels of modulation more sidebands appear which permit calibration of devices (spectrum analyzers, frequency meters, etc.) in arbitrary frequency increments. As with all modulation, the absolute accuracy of the generator must be increased by the multiple of the harmonic used in order to obtain the required accuracy at the operating frequency (the percentage accuracy is the same for all harmonics).

3-6. EXTERNAL TRIGGER. The external trigger voltage is fed in by means of the EXT TRIGGER jacks, either 1-20 Mc or 20-200 Mc, depending upon frequency. The signal used for external triggering should be adjustable in amplitude around 2 volts. Note that in the EXTERNAL TRIGGER position the signal is fed into the 1-20 Mc EXT TRIGGER jack. The OUTPUT AMPLITUDE control is operable when the signal is fed into the 1-20 Mc EXT TRIGGER jack. The OUTPUT AMPLITUDE control may be used to adjust the output level when this jack is used. If the 20-200 Mc jack is used, the output level must be adjusted by varying the input level of the external trigger signal. The input from this jack does not go through the Diode Driver and therefore the OUTPUT AMPLITUDE control will have no effect. In fact, the instrument does not even have to be on if the 20-200 Mc jack is used. However, more power is needed (10-20 millivolts).

sharpens the transition so that higher amplitude harmonics are generated. The 100-Mc Oscillator-Amplifier generates high-level harmonics without shaping and thus triggers the step-recovery diode directly.

4-5. INDIVIDUAL CIRCUITS.

4-6. 1-MC AND 10-MC OSCILLATORS.

4-7. Since these oscillators are similar they will be described together. Both of these oscillators consist of a Colpitts-type oscillator in a common-emitter configuration. Crystal control is used in both oscillators. The output of the 1-Mc Oscillator goes directly to the Diode Driver. Output of the 1-Mc Oscillator goes either directly to the Diode Driver or to the 5-Mc Harmonic Generator Diode A1C81. The filter following removes all harmonics above 5 Mc when the 1-Mc signal is used for interpolation between the spectral lines of the 10-Mc Oscillator. The Interpolation Oscillator phase-modulates the 10-Mc signal producing upper and lower sidebands. Line overlap would be produced if signals above 5 Mc were used for modulation. To

3-1. INTRODUCTION.

3-2. The Model 8406 Frequency Comb Generator is used to calibrate other instruments which display the frequency domain. It is usually used with Spectrum Analyzers to calibrate their frequency and output characteristics. The illustration on the facing page, Figure 3-1, shows in general the operation of the Model 8406. The following paragraphs discuss special points which are not covered in the general explanation.

3-3. INTERPOLATION MODULATION. Usually to calibrate an instrument, the 10-Mc comb is used first to determine which lines correspond to the 10-Mc markers. If a finer determination is required, the INTERPOLATION AMPLITUDE control is turned on and the amplitude adjusted. This will give ten times more lines, each marking a 1-Mc point, in addition to the 10-Mc lines. If the 1-Mc Oscillator only were used, the same accuracy would be obtained but there is the possibility that a wrong line would be chosen if the instrument being tested is badly out of calibration.

3-4. EXTERNAL MODULATION. If a modulation spectrum other than 1 Mc on the internally generated comb is desired, feed the output from an external oscillator into the appropriate MODULATION jack (1 Mc and 10 Mc or 100 Mc COMB). The level should be adjustable around 10 millivolts. Depress the COMB FREQUENCY pushbutton for the main frequency spectrum desired. The output will now contain major spectral lines spaced at the frequency of the external oscillator.

4-1. GENERAL.

4-2. The Model 8406 generates a train of sharp pulses at a repetition frequency of 1 Mc, 10 Mc, or 100 Mc supplied internally or at the frequency of an external oscillator. The frequency spectrum of the output is a comb with spectral lines spaced by the repetition frequency, 1-Mc, 10-Mc, 100-Mc or the frequency of an external oscillator.

4-3. BLOCK DIAGRAM.

4-4. Figure 4-1 is a block diagram which shows the inter-connections between the main sections of the instrument. Note that only one oscillator is on at any one time, except when the 1-Mc Interpolation Oscillator is used to interpolate between the main spectral lines of the 10-Mc Oscillator. In the case of the 1-Mc and 10-Mc Oscillators the signal is passed through a Diode Driver before it is applied to the Output Harmonic Generator (low-frequency signals do not generate harmonics with sufficient amplitude when applied directly to the Output Harmonic Generator). The Diode Driver

4-17. This attenuator isolates the step-recovery diode from the output connector to give a 50-ohm output impedance.

4-16. ATTENUATOR ASSEMBLY.

not have to be turned on. GER jack. For this application the instrument does situation when using the 20-200 MC EXTERNAL TRIG- conduction takes place. The step-recovery diode may be used by itself for harmonic generation. This is the network (R19, L10) sets the voltage at the diode so that each pulse to replace the stored charge. A biasing The diode must conduct in the forward direction after shorted transmission-line stub at the diode output, function produced is formed into a impulse by the cutoff generates a multitude of harmonics. This sharp of stored carriers it shuts off abruptly. This sharp forward-biased condition they act as any diode. How- somewhat differently than normal diodes. In the harmonic generation. Step-recovery diodes operate 4-15. Diode CR1 is a step-recovery diode used for

4-14. STEP-RECOVERY DIODE.

Driver. As the output of the Diode Driver is varied, the level of the output frequency comb varies.

4-13. The Diode Driver generates a fast-rise pulse for each cycle sine wave fed to the tunnel diode, CR2. This fast-rise pulse produces a large current in the reverse direction of the Output Harmonic Generator, CR1. When the stored charge in the diode is depleted, the diode opens, producing a step of voltage on the transmission line of the Harmonic Generator. The Emitter Follower is used as a source of variable voltage to the Diode

4-12. DIODE DRIVER AND Emitter FOLLOWER.

4-11. This Amplifier is of standard configuration with a tuned input and a tuned output. The Amplifier is energized only in the 100-Mc switch position, since it is not needed otherwise.

4-10. 100-MC AMPLIFIER.

4-9. This oscillator is also of the Colpitts type with a tuned tank circuit. Series tuning of the crystal is used to adjust the frequency.

4-8. 100-MC OSCILLATOR.

to modulate the 10-Mc signal. modulating frequencies 5 Mc or below are permitted reduce the confusion caused by two sets of signals, only

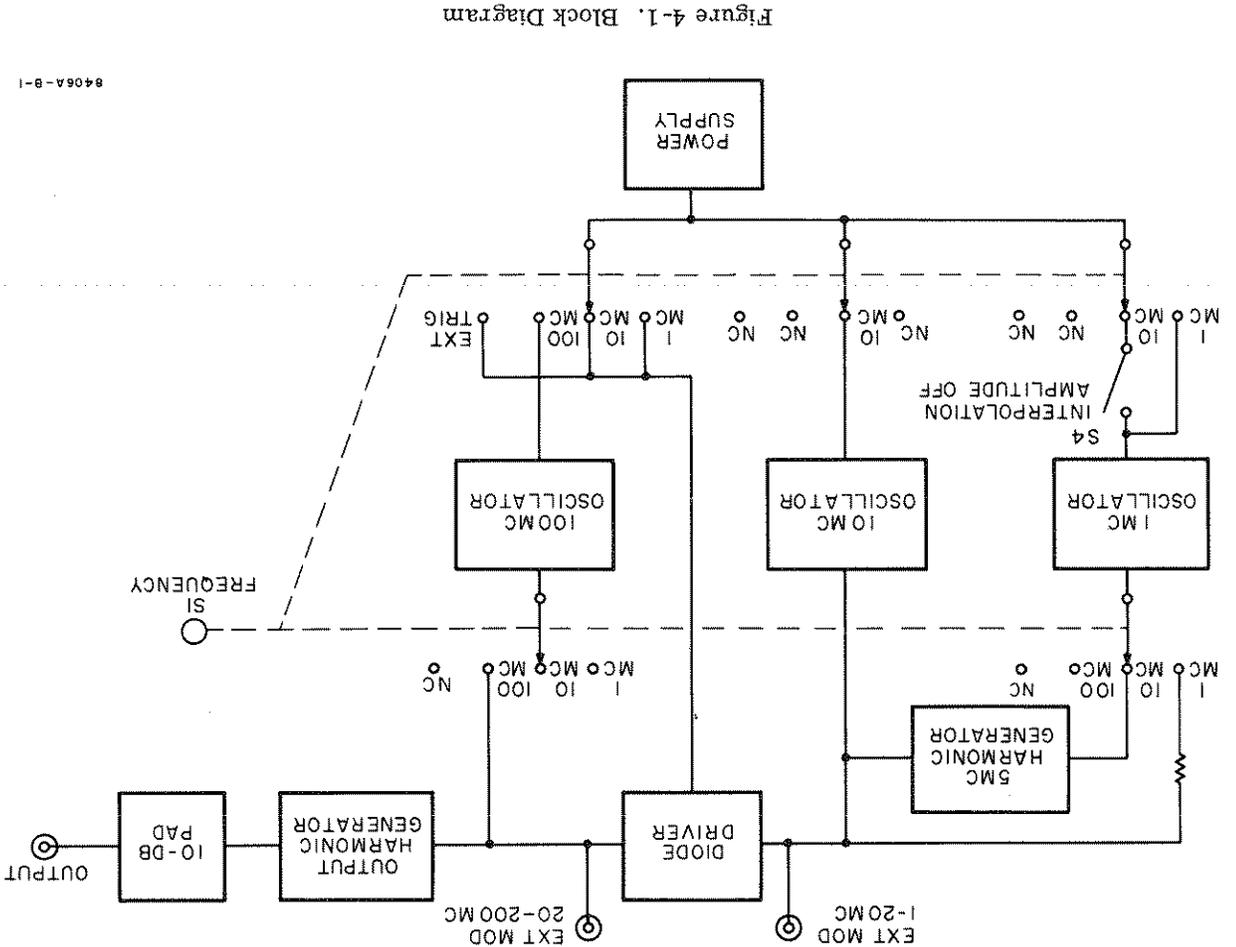


Figure 4-1. Block Diagram

8406A-B-1

SECTION V MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Model 8406 Frequency Comb Generator. Included are a table of recommended test equipment, troubleshooting procedures, repair and adjustment procedures, and an in-cabinet performance check which may be used to verify proper operation of the Generator.

5-3. TEST EQUIPMENT.

5-4. Recommended test equipment for performance checking, troubleshooting, and repair is listed in Table 5-1. Other test instruments may be used if their specifications satisfy the required characteristics.

5-5. IN-CABINET PERFORMANCE CHECK.

5-6. GENERAL. The In-Cabinet Performance Checks, Table 5-2, and Performance Check Test Card (to be filled out during incoming inspection), verify specifications and provide a permanent record of the performance of the instrument. The In-

Cabinet Performance Check verifies the proper operation of all circuits in the Generator and may be used:

- a. As part of an incoming inspection check of instrument specifications;
- b. Periodically, for instruments used in systems where maximum reliability is of utmost importance;
- c. as part of a troubleshooting procedure to locate out-of-tolerance operation;
- d. after any repairs or adjustments, before returning instrument to regular service.

5-7. VARIABLE LINE VOLTAGE.

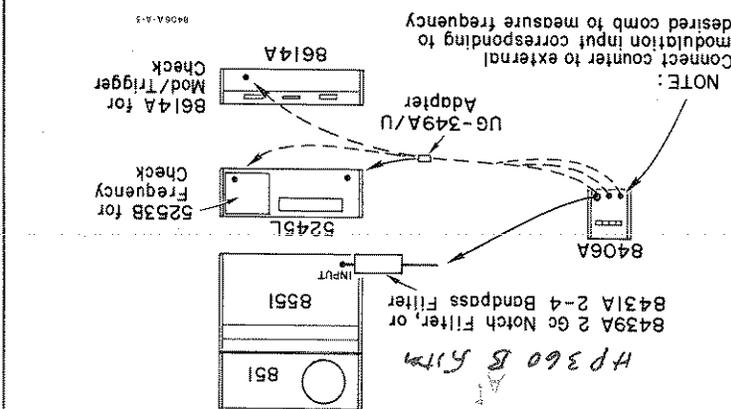
5-8. During the Performance Check, Table 5-2, connect the Generator to a power source through a variable voltage device so that line voltage may be varied $\pm 10\%$ from nominal (115 or 230 Vac) to assure proper operation of the Generator under various supply conditions.

Table 5-1. Test Equipment Required

Instrument Type	Critical Specifications	Instrument Recommended
AC Voltmeter	Range: to 1 mV. Frequency Range: 40-200 cps	hp Model 400D/H/L/E/EL
DC Voltmeter	Range: 14 volts Resolution: 0.2 volts	hp Model 405BR
Electronic Counter	Range: 1 to 100 Mc Accuracy: $\pm 0.005\%$	hp Model 5254L with hp Model 5253B plug-in
Spectrum Analyzer	Range: 10 Mc - 4 Gc	hp Model 8551 with hp Model 851
Notch Filter	Rejects 2 Gc	hp Model 8439A
RF Voltmeter	Range: 100 Mc	hp Model 411A
Variable Autotransformer	Power: 1 amp Voltage: 102 to 128 volts	Ohmite VT8F
Signal Generator	Range: 200 Kc to 50 Mc	hp Model 606
Signal Generator	Frequency: 1-2 Gc	hp Model 8614A
Bandpass Filter	Pass: 2-4 Gc, reject other	hp Model 8431A
ACCESSORIES		
UG-274A/U	BNC T Connector	hp part number 1250-0072
UG-349A/U	Female N-Male BNC connector	hp part number 1250-0077
Tuning Wand		Walisco 2947
Plastic Tuning Wand		General Cement Company GC 8271

Table 5-2. In-Cabinet Performance Check

OUTPUT	
a.	Connect 1-2 Gc Signal Generator to Notch Filter at the input to the Spectrum Analyzer.
b.	Set Spectrum Analyzer controls as follows: TUNE 1 Gc (.01-2 Gc FREQUENCY range) IF 2 Gc VERT DISPLAY LOG SWEEP TIME 1 SEC/CM SPECTRUM WIDTH 200 MC/CM ATTENUATOR 10 DB (to start) IF BANDWIDTH 10 KC
c.	Set Signal Generator for -35-dBm output at 1 Gc.
d.	Adjust the Spectrum Analyzer for a display 6 cm high.
e.	Increase the Signal Generator frequency at approximately 200-Mc intervals to 2 Gc, observing the display amplitude at each frequency. If the amplitude changes, mark the level with a grease pencil on the face of the Spectrum Analyzer.
f.	Connect the 8406A as shown in Figure 5-1.
g.	Leave Spectrum Analyzer controls as in b and d. The frequency comb should be smooth in output with an output level of greater than -35 dBm from 1-2 Gc and greater than -45 dBm from 100 Mc to 1 Gc.
h.	Depress the 10 Mc pushbutton on the 8406A.
i.	The frequency comb should be smooth in output with an output level of greater than -50 dBm from 500 Mc to 2 Gc and greater than -60 dBm from 10 Mc to 500 Mc.
j.	Depress the 1 Mc pushbutton on the 8406A.
k.	Depress the 1 Mc pushbutton on the 8406A.
l.	The frequency comb should be smooth in output with a level of greater than -70 dBm from 500 Mc to 2 Gc and greater than -80 dBm from 10 Mc to 500 Mc (ATTENUATOR may have to be switched to 0 DB).
m.	Connect the counter and measure the frequency. Must be within 100 cycles.
n.	Depress the 10 MC pushbutton on the 8406. The frequency must be within 10 kc.
o.	Depress the 100 MC pushbutton on the 8406. The frequency must be within 10 kc.
p.	Set the Spectrum Analyzer so that two successive 10-Mc harmonics are displayed, widely spaced.
q.	Turn the INTERPOLATION AMPLITUDE control on the 8406 fully clockwise. Ten 1-Mc pulses should appear in the space between the two 10-Mc pulses.
r.	Repeat Analyzer Calibration steps a-d, using a 2-4 Gc Signal Generator with a 8431A Bandpass Filter and set the Spectrum Analyzer controls as follows: TUNE 2.8/3.2 Gc (1.8-4.2 Gc FREQUENCY range) IF 200 Mc VERT DISPLAY LOG SWEEP TIME 1 SEC/CM SPECTRUM WIDTH 200 MC/CM ATTENUATOR 10 DB (to start) IF BANDWIDTH 10 KC



5-15. When troubleshooting transistor circuits certain precautions must be observed. Transistors can be damaged by small voltages or by heat. Be very careful not to short the circuit and thereby apply excessive voltage to the transistors. When using a VTVM measure emitter-to-base voltages to a common point, such as the chassis (there may be enough loop current between the leads of the VTVM to damage transistor). When measuring resistance use only the ranges on the ohmmeter which have 1.5 volts or less between the leads and whose short-circuit current is less than 3 mA. See Table 5-4 for the safe ranges of popular ohmmeters.

5-14. TRANSISTOR TROUBLESHOOTING.

strumment (the block diagram, Figure 4-1, will help here). If marginal, perform the In-cabinet Performance Check to determine the circuit which is causing the marginal performance. The instrument is straight-forward except for the Diode Driver. Note that the Diode Driver is energized in the EXT TRIG position of the COMB FREQUENCY switch in addition to the 1 MC and 10 MC positions. This permits the use of the Diode Driver to "square" up the incoming trigger signal when using external trigger.

5-13. The first step is to decide if the trouble is catastrophic or marginal. If catastrophic, start with the power supply and then trace the signal through the in-

5-12. PRELIMINARY TROUBLESHOOTING.

5-11. TROUBLESHOOTING AND REPAIR.

WARNING: 115/230 VAC AND DC SUPPLY WIRES ARE EXPOSED WHEN EITHER TOP OR BOTTOM INSTRUMENT COVER IS REMOVED. BE CAREFUL DURING TROUBLESHOOTING, ADJUSTMENTS, OR REPAIR.

5-10. To remove top or bottom cover, unscrew and remove the countersunk Phillips-head screws which secure cover to the instrument at the rear. Then slide cover toward rear of instrument.

5-9. INSTRUMENT COVER REMOVAL.

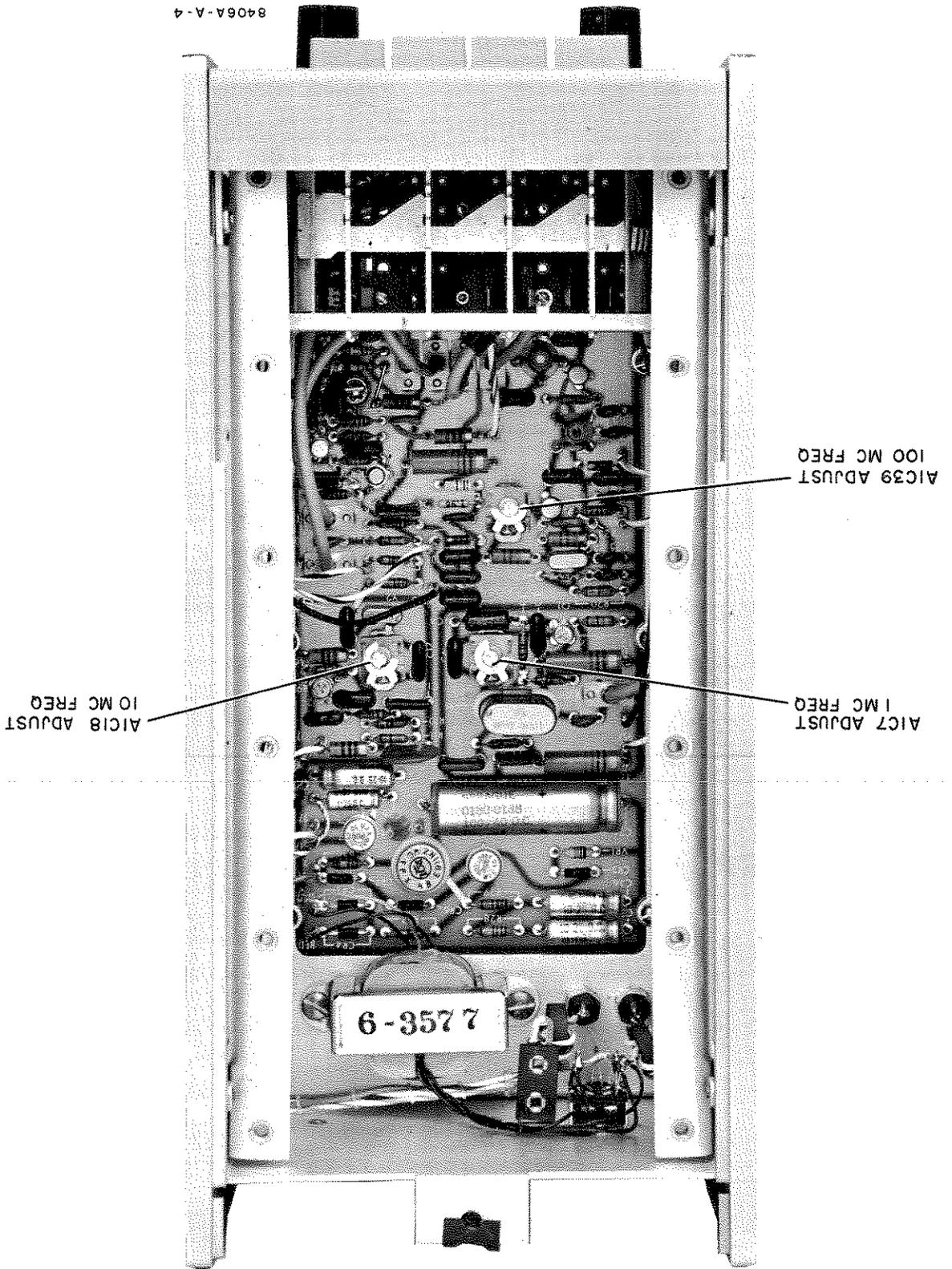
TO AVOID DAMAGE, REMOVE POWER FROM INSTRUMENT BEFORE REMOVING OR REPLACING INSTRUMENT COVERS, ASSEMBLIES, OR COMPONENTS.

CAUTION

<p>b. Measure 8406 comb output level, 100-Mc comb should be greater than -47 dBm over 2-4 Gc range 10-Mc comb should be greater than -62 dBm over 2-4 Gc range 1-Mc comb should be greater than -82 dBm over 2-4 Gc range (may have to reduce ATTENUATOR to 0 DB to see this sensitivity on last measurement).</p>	<p>MODULATION/EXT 1-20 MC Input</p>
<p>a. Connect the instrument as shown in Figure 5-1.</p>	<p>b. Depress the 1 Mc pushbutton.</p>
<p>c. Set the Spectrum Analyzer to a center frequency of 1 Gc and a spectrum width of about 3 Mc with an IF bandwidth of 1 Kc.</p>	<p>d. Connect a Signal Generator to 1 MC, 10 MC COMB MODULATION jack on 8406.</p>
<p>e. Set frequency of signal generator to 200 Kc and adjust output amplitude so that the sidebands displayed on Spectrum Analyzer are 20 db below the amplitude of the 1-Mc comb.</p>	<p>f. Read the output level of the signal generator. This level should be less than 1 mV. (Actual modulating voltage required will be approximately twice this since the input impedance at this jack is high.)</p>
<p>g. Depress the 10 MC pushbutton on the 8406.</p>	<p>h. Set the Spectrum Analyzer to a spectrum width of 100 Mc and an IF bandwidth of 10 Kc.</p>
<p>i. Set the frequency of signal generator to 2 Mc and level so that the sidebands displayed on spectrum analyzer are 20 db below carrier frequency. Signal Generator output level should be less than 6 mV.</p>	<p>j. Insert a BNC T connector at the 1-20 Mc input and connect an RF Millivoltmeter to the open arm of the T to measure the input signal.</p>
<p>k. Depress EXT TRIG pushbutton on 8406, set Signal Generator to 20 Mc and increase output level until 8406 triggers. This level should be less than 4 volts.</p>	<p>m. Connect Signal Generator to the 100 MC COMB MODULATION jack of 8406 with the same set-up as in step k.</p>
<p>n. Depress 100 MC pushbutton on 8406, set Signal Generator to 20 Mc and increase output level until 8406 triggers. This level should be less than 200 mV.</p>	<p>o. Set Signal Generator frequency to 50 Mc, depress EXT TRIG pushbutton on 8406, and increase output level of Signal Generator until Comb Generator triggers. This level should be less than 2 volts.</p>

Table 5-2. In-Cabinet Performance Check (cont'd)

Figure 5-2. Location Diagram



of the transistor and the current carried. Short the emitter to the base. If the transistor is working, the voltage on the collector should go toward the supply voltage.

5-17. **OUT-OF-CIRCUIT TESTING.** While it is not recommended to remove the transistors from the instrument for troubleshooting as a general rule, sometimes it is impossible to isolate troubles to a particular transistor. In such case it may be necessary to remove the suspected transistor and test it on a curve tracer. Do NOT remove a transistor for testing without some indication that this particular transistor is at fault. Use a heat sink, such as a pair of long-nosed pliers, between the soldering iron and the transistor. When soldering a transistor back in the circuit use the same precautions as when unsoldering. If a particular transistor is all right but the circuit still does not work, try the transistor ahead and behind the suspected one. Table 5-5 gives typical resistance measurements of transistors.

5-18. **PRINTED CIRCUIT COMPONENT REPLACE-MENT.** Component lead holes in the Model 8406 circuit board have plated walls to ensure good electrical contact between conductors on the opposite sides of the board. To prevent damage to this plating and to the replacement component, apply heat sparingly and work carefully. The following replacement procedure is recommended:

- a. Remove defective component.
- b. Melt solder in component lead holes. Use clean, dry soldering iron to remove excess solder. Clean holes with toothpick or wooden splinter. Do not use metal tool for cleaning as this may damage through-hole plating.

Table 5-5. Output-of-Circuit Transistor Resistance Measurement

Transistor Type	Connect Ohmmeter		Resistance (ohms)
	Pos. lead to	Neg. lead to	
PNP	Small	emitter	200-500
		collector	10K-100K
	Power	emitter	30-50
		collector	several hundred
NPN	Small	base	1K-3K
		emitter	very high (might read open)
	Signal	collector	emitter
		base	emitter
Silicon	Power	collector	emitter
		base	emitter
	Signal	collector	emitter
		base	emitter

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

Table 5-3. Performance Check Test Card

Description	
Output	100 Mc
Level deviation ±	db
Frequency	1 Mc
Interpolation frequency	1-20 Mc Input
Level deviation ±	db
Frequency	200 Kc
Input level	2 Mc
Input level	20 Mc
Input level	2-200 Mc Input
Trigger voltage	20 Mc

5-16. **IN-CIRCUIT TESTING.** The most common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, the base is the control point of the transistor. The emitter-base voltage should be a fraction of a volt, the polarity and exact value depending upon the material

Table 5-4. Safe Ohmmeter Ranges for Transistor Resistance Measurements

Ohmmeter	Safe Range(s)	Voltage	Current	Color	Polarity	Lead	
						Open Ckt	Short Ckt
HP 412A	R x 1K	1.0V	1 ma	Red	+	100 μ a	10 μ a
	R x 100K	1.0V	1 μ a	Black	-	1 μ a	0.1 μ a
HP 410C	R x 1K	1.3V	0.57 ma	Red	+	57 μ a	5.7 μ a
	R x 10K	1.3V	5.7 μ a	Black	-	5.7 μ a	0.5 μ a
HP 410B	R x 100	1.1V	1.1 ma	Black	+	110 μ a	11 μ a
	R x 100K	1.1V	1.1 μ a	Red	-	1.1 μ a	0.11 μ a
Simpson 260	R x 100	1.5V	1 ma	Red	+	1 ma	1 ma
	R x 1K	1.5V	0.82 ma	Black	-	0.82 ma	0.82 ma
Triplet 269	R x 1K	1.5V	0.82 ma	Black	+	Red	Red
	R x 100	1.5V	3.25 mA	Varies with Serial Number	-	75 μ a	75 μ a
Triplet 630	R x 1K	1.5V	325 μ A	Varies with Serial Number	-	75 μ a	75 μ a
	R x 100	1.5V	1.5V	1.5V	R x 100	1.5V	1.5V
Triplet 310	R x 10	1.5V	1.5V	1.5V	R x 10	1.5V	1.5V
	R x 100	1.5V	1.5V	1.5V	R x 100	1.5V	1.5V

c. Bend lead of replacement component to correct shape and insert component leads into lead holes. Using heat and solder sparingly, solder leads in place. Heat may be applied to either side of the board. Use heat sink (long-nose pliers, commercial heat-sink tweezers, etc.) when replacing transistors and diodes in order to prevent conduction of excessive heat from the soldering iron to the component. Firm application of heat for the shortest possible time is the rule.

d. Through-hole plating breaks are indicated by the separation from the board of the round conductor pad on either side of the board. To repair breaks, press conductor pads against board and solder replacement component lead to conductor pad on both sides of the board.

5-19. ADJUSTMENTS.

5-20. Rarely, if ever, will it be necessary to perform adjustments on a particular instrument. Do NOT perform these adjustments as a performance check. Use the performance check. Test limits given here should not be construed as part of the specifications.

5-21. POWER SUPPLY. Perform the following tests at either 115 or 230 volt 50-400 cps, unless otherwise noted. When line voltage variations are specified, the test limits apply at the following voltages:

115 VOLTS		230 VOLTS	
Low line	103 volts	207 volts	103 volts
Normal line	115 volts	230 volts	115 volts
High line	127 volts	253 volts	127 volts

Proceed as follows:

a. Depress 10 MC COMB FREQUENCY pushbutton. Proceed as follows:

b. Set INTERPOLATION AMPLITUDE fully clockwise.

c. Set OUTPUT AMPLITUDE fully clockwise.

d. Connect a dc and an ac voltmeter to the -14 volt supply. This is a violet wire on top of the printed circuit, third terminal from the rear (see Figure 5-2 for location).

e. Vary the line voltage from low to high while watching the meters. The dc voltage should stay in regulation within 0.5 Vdc and the ac voltage (ripple) should be below 3 millivolts.

5-22. OSCILLATOR FREQUENCIES. Connect the instrument as shown in Figure 5-1. The 2 Gc Notch Filter prevents overloading of 851/851 Spectrum Analyzer at the intermediate frequency, but may not be necessary with all Spectrum Analyzers. Set Generator controls as follows:

COMB FREQUENCY 100 MC
 INTERPOLATION AMPLITUDE OFF
 OUTPUT AMPLITUDE fully clockwise

a. Set Spectrum Analyzer to a center frequency of 1 Gc with spectrum width of 2 Gc. The frequency comb should be smooth in output. If not, tune A1T1 (see location diagram, Figure 5-2) with a Walco 2547 tuning wand for a stable frequency and A1T2 for maximum flat output in the 400-Mc region as the OUTPUT AMPLITUDE control is varied from maximum to minimum.

b. Connect counter and tune A1C39 (see location diagram, Figure 5-2) for 100-Mc frequency.

c. Depress 10 Mc pushbutton and use counter to measure frequency. Tune A1C18 with a General Cement 8271 plastic tuning wand to 10 Mc.

d. Depress 1 Mc pushbutton and use counter to measure frequency. Tune A1C7 to 1 Mc.

SECTION VI REPLACABLE PARTS

6-3. Miscellaneous parts not indexed in Table 6-1 are listed at the end of the table.

6-4. ORDERING INFORMATION.

- 6-5. To order a replacement part, address order or inquiry to your nearest Hewlett-Packard field office.
- 6-6. Specify the following information for each part:
- a. Model and complete serial number of instrument.
 - b. Hewlett-Packard stock number.
 - c. Circuit reference designation.
 - d. Description.
- 6-7. To order a part not listed in Table 6-1 and 6-2, give a complete description of the part and include its function and location.

6-1. INTRODUCTION.

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

- a. Description of the part (see list of abbreviations below).
- b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.
- c. Manufacturer's stock number.
- d. Total quantity used in the instrument (TQ column).

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part
B	= motor	FL	= filter	P	= plug
BT	= battery	IC	= integrated circuit	Q	= transistor
C	= capacitor	J	= jack	R	= resistor
CP	= coupler	K	= relay	RT	= thermistor
CR	= diode	L	= inductor	S	= switch
DL	= delay line	LS	= loud speaker	T	= transformer
DS	= device signaling (lamp)	M	= meter	TP	= test point
E	= misc electronic part	MK	= microphone		

ABBREVIATIONS

A	= amperes	H	= henries	N/O	= normally open
AFC	= automatic frequency control	HDW	= hardware	NPO	= negative positive zero
AMP	= amplifier	HEX	= hexagonal		
BFO	= beat frequency oscillator	HG	= mercury	NPN	= negative-positive-negative
BE CU	= beryllium copper	HZ	= hertz		
BH	= binder head	HR	= hour(s)	NRF	= not recommended for
BP	= bandpass	IF	= intermediate freq	NRF	= not recommended for
BRS	= brass	IMP	= impedance	NSR	= not separately
BWO	= backward wave oscillator	INCL	= include(s)	SEMICON	= semiconductor
CW	= counter-clockwise	INT	= internal	SI	= silicon
CER	= ceramic	INS	= insulation(ed)	SIL	= silver
CMO	= cabinet mount only	INCL	= include(s)	SPL	= special
COEF	= coefficient	INCD	= incandescent	SPG	= spring
COMP	= common	IMP	= impedance	SL	= slide
COMP	= composition	IP	= intermediate	SLR	= slider
COMPL	= complete	IH	= left hand	STL	= stainless steel
CONN	= connector	LH	= left hand	STL	= stainless steel
CP	= cadmium plate	LIN	= linear taper	SR	= split ring
CRT	= cathode-ray tube	LK WASH	= lock washer	SST	= stainless steel
CW	= clockwise	LOG	= logarithmic taper	SST	= stainless steel
DEPC	= deposited carbon	LPF	= low pass filter	STL	= stainless steel
DEPC	= deposited carbon	M	= milli = 10 ⁻³	STL	= stainless steel
DR	= drive	MEG	= meg = 10 ⁶	STL	= stainless steel
ELECT	= electrolytic	MET FILM	= metal film	STL	= stainless steel
ENCAP	= encapsulated	MET OX	= metallic oxide	STL	= stainless steel
EXT	= external	MFR	= manufacturer	STL	= stainless steel
F	= farads	MHZ	= mega hertz	STL	= stainless steel
FH	= flat head	MINAT	= miniature	STL	= stainless steel
FIL H	= filister head	MOM	= momentary	STL	= stainless steel
FIXD	= fixed	MTC	= mounting	STL	= stainless steel
G	= giga (10 ⁹)	MY	= "mylar"	STL	= stainless steel
GE	= germanium	N	= nano (10 ⁻⁹)	STL	= stainless steel
GL	= glass	N/C	= normally closed	STL	= stainless steel
GND	= (grounded)	NE	= neon	STL	= stainless steel
		NI PL	= nickel plate	STL	= stainless steel

Table 6-1. Reference Designation Index

Reference Designation	Stock No.	Description #	Note
A1	08406-6001	BOARD ASSY., ETCHED CIRCUIT	
A1C1	0160-0174	C:FXD CER 0.47UF +80-20% 25VDCW	
A1C2	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A1C3	0160-0134	C:FXD MICA 220PF 5% 300VDCW	
A1C4	0160-0194	C:FXD MY 0.015UF 10% 500VDCW	
A1C5	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C6	0140-0145	C:FXD MICA 22 PF 5% 500 VDCW	
A1C7	0121-0127	C:VAR AIR 1.7-14PF	
A1C8	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C9	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW	
A1C10	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A1C11	0160-0179	C:FXD MICA 33PF 5% 300VDCW	
A1C12	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A1C13	0150-0096	C:FXD CER 0.05UF 100VDCW	
A1C14	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C15	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A1C16	0140-0232	C:FXD MICA 460PF 1% 300VDCW	
A1C17	0160-0178	C:FXD MICA 27PF 5% 300VDCW	
A1C18	0121-0127	C:VAR AIR 1.7-14PF	
A1C19	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW	
A1C20	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C21	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A1C22	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW	
A1C23	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C24	0160-0340	C:FXD MICA 600 PF 1% 300VDCW	
A1C25	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C26	0180-0119	C:FXD ELECT 1UF -10+100K 25VDCW	
A1C27	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C28	0140-0209	C:FXD MICA 5PF 10% 500VDCW	
A1C29	0160-2197	C:FXD MICA 5PF 10% 500VDCW	
A1C30	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C31	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C32	0140-0209	C:FXD MICA 5PF 10% 500VDCW	
A1C33	0140-0232	C:FXD MICA 460PF 1% 300VDCW	
A1C34	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C35	0180-0138	C:FXD ELECT 100UF -10+100% 40VDCW	
A1C36	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C37	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C38	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C39	0121-0127	C:VAR AIR 1.7-14PF	
A1C40	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C41	0160-2140	C:FXD CER 470 PF +80-20% 1000VDCW	
A1C42	1912-0007	DIODE:TUNNEL EIA TYPE 1N3714	
A1C43	1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	
A1C44	1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	
A1C45	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
A1C46	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
A1C47	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
ALL1	9140-0131	COIL:FXD RF 10 MH	

See list of abbreviations in introduction to this section

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

Reference Designation	Stock No.	Description #	Note
A1L2	9140-0131	COIL:FXD RF 10 MH	
A1L3	9140-0131	COIL:FXD RF 10 MH	
A1L4	9140-0181	COIL:FXD RF 22UH 5%	
A1L5	9140-0210	COIL:FXD RF 100 UH 5%	
A1L6	9140-0210	COIL:FXD RF 100 UH 5%	
A1L7	9140-0210	COIL:FXD RF 100 UH 5%	
A1L8	9140-0158	COIL:FXD 1.0UH 10%	
A1L9	9100-1612	COIL:FXD RF 0.33 UH 20%	
A1L10	9140-0210	COIL:FXD RF 100 UH 5%	
A1L11	9100-1613	COIL:FXD RF 0.47 UH 20%	
A1Q1	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A1Q2	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A1Q3	1850-0099	TRANSISTOR:GERMANIUM 2N964 PNP	
A1Q4	1854-0019	TRANSISTOR:SILICON NPN	
A1Q5	1854-0073	TRANSISTOR:SILICON NPN 2N3478	
A1Q6	1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	
A1Q7	1854-0073	TRANSISTOR:SILICON NPN 2N3478	
A1Q8	1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	
A1Q9	1850-0064	TRANSISTOR:GERMANIUM PNP 2N1183	
A1R1	0698-3156	R:F XD MET FLM 14.7K OHM 1% 1/8W	
A1R2	0757-0439	R:F XD MET FLM 6.81K OHM 1% 1/8W	
A1R3	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R4	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R5	0698-0083	R:F XD MET FLM 1960 OHM 1% 1/8W	
A1R6	0757-0465	R:F XD MET FLM 100K OHM 1% 1/8W	
A1R7	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R8	0757-0280	R:F XD MET FLM 1.00K OHM 1% 1/8W	
A1R9	0698-3136	R:F XD MET FLM 17.8K OHM 1% 1/8W	
A1R10	0757-0439	R:F XD MET FLM 6.81K OHM 1% 1/8W	
A1R11	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R12	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R13	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R14	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R15	0757-0280	R:F XD MET FLM 1.00K OHM 1% 1/8W	
A1R16	0757-1094	R:F XD MET FLM 1.47K OHM 1% 1/8W	
A1R17	0757-0401	R:F XD MET FLM 100 OHM 1% 1/8W	
A1R18	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R19	0757-0401	R:F XD MET FLM 100 OHM 1% 1/8W	
A1R20	0757-0441	R:F XD MET FLM 8.25K OHM 1% 1/8W	
A1R21	0698-3154	R:F XD MET FLM 4220 OHM 1% 1/8W	
A1R22	0757-0417	R:F XD MET FLM 562 OHM 1% 1/8W	
A1R23	0698-3440	R:F XD MET FLM 196 OHM 1% 1/8W	
A1R24	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R25	0698-3430	R:F XD MET FLM 21.5 OHM 1% 1/8W	
A1R26	0698-3430	R:F XD MET FLM 21.5 OHM 1% 1/8W	
A1R27	0757-0346	R:F XD MET FLM 10.0 OHM 1% 1/8W	
A1R28	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R29	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R30	0757-0346	R:F XD MET FLM 10.0 OHM 1% 1/8W	
A1R31	0698-3445	R:F XD MET FLM 348 OHM 1% 1/8W	
A1R32	0757-0416	R:F XD MET FLM 511 OHM 1% 1/8W	
A1T1	08406-6013	TRANSFORMER:RF (OSCILLATOR)	

See list of abbreviations in introduction to this section

See list of abbreviations in introduction to this section

Reference Designation	Stock No.	Description #	Note
A1T2	08406-6014	TRANSFORMER:RF (AMPLIFIER)	
A1V1	1902-0055	DIODE BREAKDOWN:SILICON 14.7V 10%	
A1X1	1200-0028	SOCKET:CRYSTAL 2-CONTACT	
A1Y1	0410-0013	CRYSTAL UNIT:QUARTZ 100KC	
A1Y2	0410-0109	CRYSTAL:QUARTZ 10 MC	
A1Y3	0410-0108	CRYSTAL:QUARTZ 100 MC	
C1	0150-0097	C:FXD CER 6800 PF 1000 VDCW	
C2	0150-0019	C:FXD CER 1000PF 20%	
C3	0150-0019	C:FXD CER 1000PF 20%	
C4	0150-0097	C:FXD CER 6800 PF 1000 VDCW	
CR1	1901-0169	SEMICON DEVICE: DIODE	
CR1MP1	08406-6002	HOLDER ASSEMBLY, DIODE INCLUDES:	
	1250-0014	CONTACT: OUTER N MALE CONNECTOR	
	1250-0016	RING: LOCKING FOR TYPE N CONNECTOR	
	5020-0306	NUT: CONNECTOR	
	08406-2002	BODY, DIODE HOLDER	
	08406-2003	CENTER CONDUCTOR	
	08406-2005	SPACER	
	08551-2041	POST, DIODE	
CR1MP2	1460-0300	SPRING: COMPRESSION	
DS1	2140-0047	LAMP:GLOW 1/10W 0.8 MA 68K OHM	
F1	2110-0040	FUSE:CARTRIDGE 1/16 AMP SLOW BLOW	
J1	1250-0001	CONNECTOR:BNC	
J2	1250-0001	CONNECTOR:BNC	
J3	1251-0148	CONNECTOR:POWER 3 PIN MALE	
J4		NSR PART OF STEP DIODE ASSY.	
J5	08406-2004	CONNECTOR: PANEL	
L1	9170-0019	CORE:TOROID	
L2	9170-0019	CORE:TOROID	
P1	2100-0350	NSR PART OF ATTENUATOR ASSY	
R1	2100-0350	R:IVAR COMP 1.5K OHM 20% LIN 1/2W	
R2	0687-6831	R:FXD COMP 68K OHM 10% 1/2W	
R3	2100-0350	R:IVAR COMP 1500 OHM 20% LIN 1/2W	
S1	3101-0186	SWITCH:PUSHBUTTON(FREQUENCY)	
S2	3101-0033	SWITCH:SLIDE DPDT	
S3	3101-1248	SWITCH:PUSHBUTTON (LINE)	
S4		NSR PART OF R3	
T1	9100-1680	TRANSFORMER:POWER	
XF1	1400-0084	HOLDER:FUSE POST TYPE 3AG	
Z1	08406-6012	ATTENUATOR PAD ASSEMBLY INCLUDES:	
	1460-0297	SPRING:COMPRESSION	
	08491-6000	CARTRIDGE ASSEMBLY	
	08491-2101	CONNECTOR:FEMALE	
	08491-2102	SPACER (QTY 2)	

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

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

Reference Designation	Stock No.	Description #	Note
08742-0006		SPACER	
08491-2002		BEAD	
08491-4001		PIN, FEMALE	
08491-2009		CONTACT, SLIDING	
MISCELLANEOUS			
08406-0003		BRACKET, BOTTOM COVER	
08406-0004		BRACKET, RIGHT SUPPORT	
08406-0005		BRACKET, LEFT SUPPORT	
08406-0006		BRACKET, SWITCH	
08406-6004		CABLE ASSY., COAX(ORANGE)	
08406-6005		CABLE ASSY., COAX(RED)	
08406-6006		CABLE ASSY., COAX(BROWN)	
08406-6007		CABLE ASSY., COAX(BLACK)	
08406-6009		CABLE ASSY., COAX(YELLOW)	
08406-6010		CABLE ASSY., COAX(GREEN)	
08406-6011		CABLE ASSY., COAX(BLUE)	
8120-0078		CABLE ASSY:POWER	
5040-0235		BASE/LAMPHOLDER	
5040-0234		LAMPHOLDER	
0370-0118		KNOB/GRAY PUSHBUTTON 11/16 IN DIA	
		1MC	
		10MC	
		100MC	
		EXT TRIG	
5000-3227		LABEL:PUSHBUTTON (1 MC)	
5000-3228		LABEL:PUSHBUTTON(10 MC)	
5000-3229		LABEL:PUSHBUTTON(100 MC)	
5000-3248		LABEL:PUSHBUTTON(EXT. TRIG)	
08406-0001		SUPPORT, LEFT	
08406-0002		SUPPORT, RIGHT	
0370-0103		KNOB:BLACK ROUND	
		OUTPUT AMPLITUDE	
		INTERPOLATION AMPLITUDE 1MC	

See list of abbreviations in introduction to this section

See list of abbreviations in introduction to this section

Reference Designation	Stock No.	Description #	Note
1	5060-0703	FRAME ASSEMBLY	
2	1490-0031	STAND: TILT	
3	5040-0700	HINGE	
4	5060-0727	FOOT ASSEMBLY	
5	5020-0700	SPACER	
6	5000-0703	COVER: SIDE	
7	5060-0709	COVER ASSEMBLY: TOP	
8	5000-0711	COVER ASSEMBLY: BOTTOM	
9	5000-0714	COVER ASSEMBLY: UNPERFORATED	
10	SEE MAT'L LIST	PANEL: REAR	
	SEE MAT'L LIST	PANEL: FRONT	

CABINET PARTS

MODULE
SIZE 29

000-B-29

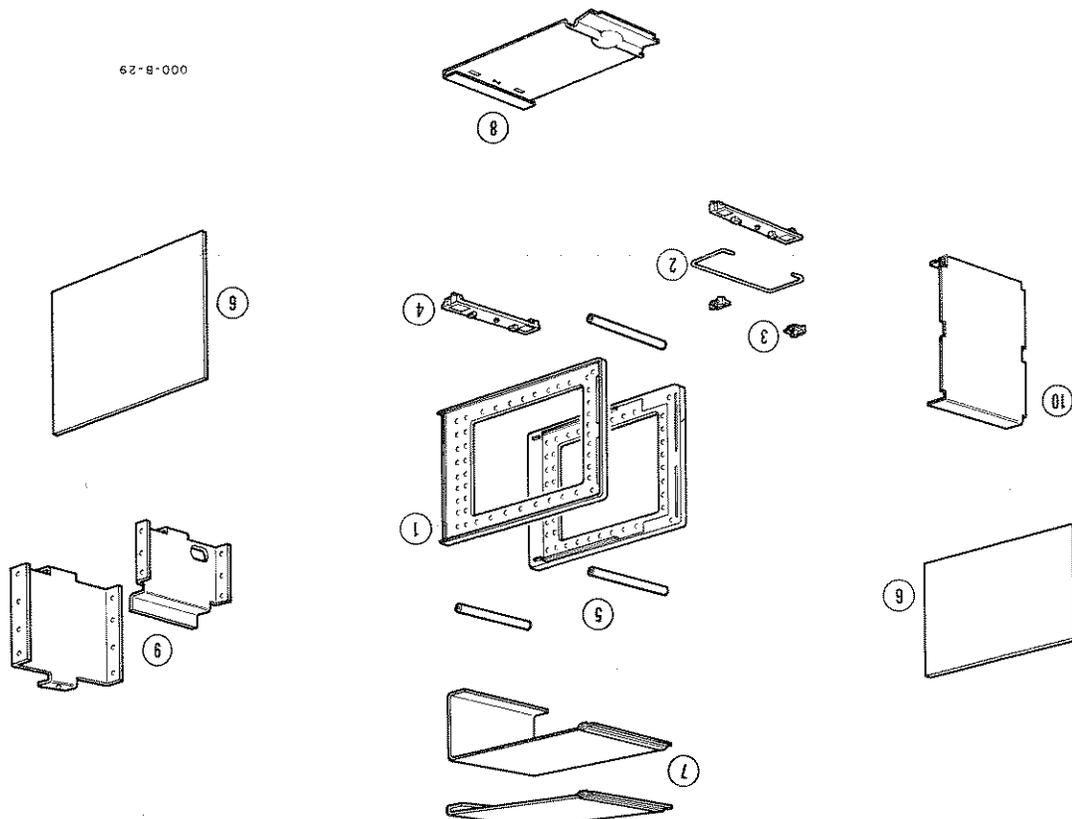


Table 6-1. Reference Designation Index (Cont'd)

See list of abbreviations in introduction to this section

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0121-0127	CVAR AIR 1.7-14PF	28480	0121-0127	3
0140-0145	CIFXD MICA 22 PF 5% 500 VDCW	04062	RDMS15C220J5C	1
0140-0176	CIFXD MICA 100 PF 2% 300 VDCW	04062	RDMS15F101G3C	1
0140-0192	CIFXD MICA 68PF 5% 300VDCW	04062	RDMS15E680J3C	2
0140-0204	CIFXD MICA 47PF 5% NP0 500VDCW	04062	RDMS15E470J5C	2
0140-0209	CIFXD MICA 5PF 10% 500VDCW	04062	RDMS15C050D5C	2
0140-0232	CIFXD MICA 460PF 1% 300VDCW	04062	RDMS15F461F3C	2
0150-0019	CIFXD CER 1000PF 20%	72982	327005X5U0102M	2
0150-0050	CIFXD CER 1000PF 600 VDCW	84411	TYPE E	2
0150-0093	CIFXD CER 0.01UF +80-20% 100VDCW	91418	TA	8
0150-0096	CIFXD CER 0.05UF 100VDCW	91418	-TA	1
0150-0097	CIFXD CER 6800 PF 1000 VDCW	91418	B	2
0150-0121	CIFXD CER 0.1UF +80%-20% 50VDCW	56289	5C50A	3
0160-0127	CIFXD CER 1UF 20% 25VDCW	56289	5C13	1
0160-0134	CIFXD MICA 220PF 5% 300VDCW	14655	RDMS15F221J3C	1
0160-0174	CIFXD CER 0.47UF +80-20% 25VDCW	56289	5C11A	1
0160-0178	CIFXD MICA 27PF 5% 300VDCW	04062	RDMS15E270J35	1
0160-0179	CIFXD MICA 33PF 5% 300VDCW	04062	RDMS15E330J35	1
0160-0194	CIFXD MY 0.015UF 10%	28480	0160-0194	1
0160-0340	CIFXD MICA 600 PF 1% 300VDCW	04062	RDMS15F601F3C	1
0160-2140	CIFXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B	1
0160-2197	CIFXD MICA 10PF 5%	28480	0160-2197	3
0180-0059	CIFXD ELECT 10UF -10%+100% 25VDCW	56289	30D1066025B84	1
0180-0119	CIFXD ELECT 1UF -10%+100% 25VDCW	56289	30D1056025A44	1
0180-0138	CIFXD ELECT 100UF -10+100% 40VDCW	56289	036254	1
0370-0103	KNOB:BLACK ROUND	28480	0370-0103	2
0370-0118	KNOB:GRAY PUSHBUTTON 11/16" DIA	28480	0370-0118	4
0410-0013	CRYSTAL UNIT:QUARTZ 100KC	28480	0410-0013	1
0410-0108	CRYSTAL:QUARTZ 100 MC	28480	0410-0108	1
0410-0109	CRYSTAL:QUARTZ 10 MC	28480	0410-0109	1
0687-6831	RIFXD COMP 68K OHM 10% 1/2W	01121	EB-6831	3
0698-0082	RIFXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082	1
0698-0083	R:FXD MET FLM 1960 OHM 1% 1/8W	28480	0698-0083	3
0698-0084	RIFXD MET FLM 2150 OHM 1% 1/8W	28480	0698-0084	4
0698-2136	RIFXD MET FLM 17.8KOHM 1% 1/8W	28480	0698-2136	1
0698-2154	RIFXD MET FLM 4220 OHM 1% 1/8W	28480	0698-2154	1
0698-2156	RIFXD MET FLM 14.7KOHM 1% 1/8	28480	0698-2156	1
0698-2430	RIFXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-2430	1
0698-2470	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-2470	2
0698-3441	RIFXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441	2
0698-3445	RIFXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445	4
0698-3455	RIFXD MET FLM 348 OHM 1% 1/8W	28480	0698-3455	2
0757-0280	RIFXD MET FLM 1.0KOHM 1% 1/8W	28480	0757-0280	2
0757-0246	RIFXD MET FLM 10.0 OHM 1% 1/8W	28480	0757-0246	2
0757-0401	RIFXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401	2
0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416	2
0757-0417	RIFXD MET FLM 562 OHM 1% 1/8W	28480	0757-0417	1
0757-0439	RIFXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439	1
0757-0441	RIFXD MET FLM 8.25KOHM 1% 1/8W	28480	0757-0441	1
0757-1094	RIFXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094	1
1200-0028	SOCKET:CRYSTAL 2-CONTACT	91662	430 BC	1
1250-0014	CONTACT:OUTER N MALE CONNECTOR	28480	1250-0014	1
1250-0016	RING:LOCKING FOR TYPE N CONNECTOR	28480	1250-0016	1
1250-0083	CONNECTOR:BNB	28480	1250-0083	2
1251-0148	CONNECTOR:POWER 3 PIN MALE	60427	H-1061-2	1
1400-0084	HOLDER:FUSE POST TYPE 3AG	75915	342014	1

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

See list of abbreviations in introduction to this section

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
1460-0297	SPRING:COMPRESSION	28480	1460-0297	2
1490-0031	STAND:TILT	28480	1490-0031	2
1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	28480	1850-0062	2
1850-0064	TRANSISTOR:GERMANIUM PNP 2N1183	28480	1850-0062	2
1850-0099	TRANSISTOR:GERMANIUM 2N964 PNP	28480	2N964	1
1854-0005	TRANSISTOR:2N708 NPN SILICON	07263	2N708	2
1854-0019	TRANSISTOR:SILICON NPN	28480	1854-0019	1
1854-0075	TRANSISTOR:SILICON NPN 2N3478	93332	2N3478	2
1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	28480	1901-0025	2
1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	28480	1901-0026	2
1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	28480	1901-0040	1
1901-0169	SEMICON DEVICE:DIODE	28480	1901-0169	1
1902-0055	DIODE BREAKDOWN:SILICON 14.7V 10%	28480	1902-0055	1
1912-0007	DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPEC	1
2100-0350	RIVAR COMP 1500 OHM 20% LIN 1/2W	28480	2100-0350	1
2100-1624	RIVAR COMP 2.5K OHM 20% LIN 1/2W	28480	2100-1624	1
2110-0040	FUSE:CARTRIDGE 1/16 AMP SLOW BLOW	75915	313.062	1
2140-0047	LAMP:GLOW 1/10W 0.8 MA 68K OHM	24455	A1C	1
3101-0033	SWITCH:SLIDE DPDT	42190	4633	1
3101-0186	SWITCH:PUSHBUTTON(FREQUENCY)	28480	3101-0186	1
5000-0011	CLIP:ELECTRICAL RETAINING	28480	5000-0011	1
5000-3227	LABEL:PUSHBUTTON (1 MC)	28480	5000-3227	1
5000-3228	LABEL:PUSHBUTTON(10 MC)	28480	5000-3228	1
5000-3229	LABEL:PUSHBUTTON(100 MC)	28480	5000-3229	1
5000-3248	LABEL:PUSHBUTTON(EXT. TRIG)	28480	5000-3248	1
5020-0306	NUT:CONNECTOR	28480	5020-0306	1
5040-0234	LAMPHOLDER(FOR 4 LAMPS)	28480	5040-0234	1
5040-0235	BASE:LAMPHOLDER	28480	5040-0235	1
5040-0700	HINGE	28480	5040-0700	1
5060-0703	COVER:6 X 11 SIDE	28480	5060-0703	1
5060-0709	COVER ASSY:TOP 5 X 11 SM	28480	5060-0709	1
8120-0078	CABLE ASSY:POWER	70903	KH-4147	1
9100-1612	COIL:FWD RF 0.33 UH 20%	28480	9100-1612	1
9100-1678	TRANSFORMER:OSCILLATOR	28480	9100-1678	1
9100-1679	TRANSFORMER:RF AMPL	28480	9100-1679	1
9100-1613	COIL:FWD RF 0.47 UH 20%	28480	9100-1613	1
9100-1680	TRANSFORMER:POWER	28480	9100-1680	1
9140-0131	COIL:FWD RF TO MH	28480	9140-0131	1
9140-0158	COIL:FWD 1.0UH 10%	28480	9140-0131	1
9140-0181	COIL:FWD RF 22UH 5%	75226	12201M	1
9140-0210	COIL:FWD RF 100 UH 5%	28480	9140-0210	4
9170-0019	CORE:TOROID	72656	CF104 Q-1	2
08406-0001	SUPPORT: LEFT	28480	08406-0001	1
08406-0002	SUPPORT: RIGHT	28480	08406-0002	1
08406-0003	BRACKET: BOTTOM COVER	28480	08406-0003	1
08406-0004	BRACKET: RIGHT SUPPORT	28480	08406-0004	1
08406-0005	BRACKET: LEFT SUPPORT	28480	08406-0005	1
08406-0006	BRACKET: SWITCH	28480	08406-0006	1
08406-0007	COVER: TOP	28480	08406-0007	1
08406-0008	COVER: BOTTOM	28480	08406-0008	1
08406-0009	PANEL: REAR	28480	08406-0009	1

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

See list of abbreviations in introduction to this section

Stock No.	Description #	Mtr.	Mtr. Part No.	TQ
08406-0010	PANEL: FRONT	28480	08406-0010	1
08406-0011	CHASSIS	28480	08406-0011	1
08406-2002	BODY: DIODE HOLDER	28480	08406-2002	1
08406-2003	CENTER CONDUCTOR	28480	08406-2003	1
08406-2004	CONNECTOR: PANEL	28480	08406-2004	1
08406-2104	CONNECTOR: PANEL	28480	08406-2104	1
08406-6001	BOARD ASSY.: ETCHED CIRCUIT	28480	08406-6001	1
08406-6002	HOLDER ASSEMBLY: DIODE	28480	08406-6002	1
08406-6004	CABLE ASSY.: COAX (ORANGE)	28480	08406-6004	1
08406-6005	CABLE ASSY.: COAX (RED)	28480	08406-6005	1
08406-6006	CABLE ASSY.: COAX (BROWN)	28480	08406-6006	1
08406-6007	CABLE ASSY.: COAX (BLACK)	28480	08406-6007	1
08406-6009	CABLE ASSY.: COAX (YELLOW)	28480	08406-6009	1
08406-6010	CABLE ASSY.: COAX (GREEN)	28480	08406-6010	1
08406-6011	CABLE ASSY.: COAX (BLUE)	28480	08406-6011	1
08406-6012	ATTENUATOR PAD ASSEMBLY	28480	08406-6012	1
08491-2101	CONNECTOR: FEMALE	28480	08491-2101	1
08491-2002	BEAD	28480	08491-2002	2
08491-2004	PIN: FEMALE	28480	08491-2004	2
08491-2005	CONTACT: SLIDING	28480	08491-2005	2
08491-6000	CARTRIDGE ASSEMBLY	28480	08491-6000	1
08551-2041	POST: DIODE	28480	08551-2041	1
08742-0006	SPACER	28480	08742-0006	1
5000-0703	COVER: SIDE 6X11 SM	28480	5000-0703	2
5000-0711	COVER: BOTTOM 5X11 SM	28480	5000-0711	1
5060-0727	FOOT ASSY.: 1/3 MOD	28480	5060-0727	1

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

TABLE 6-3.
CODE LIST OF MANUFACTURERS (cont'd)

Code	Manufacturer	Address	Code	Manufacturer	Address
82866	Research Products Corp.	Madison, Wis.	91345	Milner Dial & Rameplate Co.	El Monte, Calif.
82877	Rotom Mfg. Co., Inc.	Woodstock, N.Y.	91448	Radio Materials Co.	Chicago, Ill.
82893	Vector Electronic Co.	Glendale, Calif.	91506	Argal Inc.	Chicago, Ill.
83053	Western Washer Mfg. Co.	Los Angeles, Calif.	91637	Date Electronics, Inc.	Columbus, Neb.
83058	Cair Fastener Co.	Cambridge, Mass.	91662	Eico Corp.	Willow Grove, Pa.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.	91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
83125	General Instrument Corp., Capacitor Div.	Dartington, S.C.	91827	K F Development Co.	Redwood City, Calif.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.	91886	Honeywell Inc., Micro Switch Div.	Chicago, Ill.
83186	Victory Eng. Corp.	Springfield, N.J.	91929	Micro Switch Div.	Chicago, Ill.
83298	Bonix Corp., Red Bank Div.	Red Bank, N.J.	92180	Tu-Con Connector Corp.	Peabody, Mass.
83315	Hubble Corp.	Mundelein, Ill.	92196	Universal Industries, Inc.	City of Industry, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.	92207	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
83332	Tech Labs	Pittsides Park, N.J.	92272	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
83350	General Screw Co.	Chicago, Ill.	92332	Hudson Lamp Co.	Kearney, N.J.
83354	Gavitt Wire and Cable Co.	Brookfield, Mass.	92339	Sylvania Electric Prod. Inc.	Paterson, N.J.
83359	Burreughs Corp., Electronic Tube Div.	Brookfield, Mass.	92369	Robbins and Myers, Inc.	Woburn, Mass.
83372	Model Eng. and Mfg., Inc.	Huntington, Ind.	92389	Semiconductor Div.	Woburn, Mass.
83377	Lloyd Scruggs Co.	Festus, Mo.	92410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
83394	Aeronautical Inst. & Radio Co.	Leoti, N.J.	92429	G. V. Controls	Livingston, N.J.
84176	Arco Electronics Inc.	Great Neck, N.Y.	92437	General Cable Corp.	Bayonne, N.J.
84191	A. J. Giesener Co., Inc.	San Francisco, Calif.	92444	Raytheon Co., Comp. Div., Ind.	Bayonne, N.J.
84411	TRW Capacitor Div.	Qgalatala, Neb.	92448	Scientific Electronics Products, Inc.	Quincy, Mass.
84420	Sarkes Tarzeman, Inc.	Bloomington, Ind.	92454	Tung-Sol Electric, Inc.	Loveland, Colo.
84421	Federal Telephone & Radio Corp.	Clifton, N.J.	92457	Curtiss-Wright Corp., Electronics Div.	Newark, N.J.
84422	Gold-National Batteries, Inc.	St. Paul, Minn.	92458	Waco Electronics, Inc.	Woodside, N.Y.
84423	General Mills, Inc.	Buffalo, N.Y.	92466	Magnecraft Electric Co.	Chicago, Ill.
84424	Graybar Electric Co.	Oakland, Calif.	92468	George A. Philbrick Researchers, Inc.	Boston, Mass.
84425	United Transformer Co.	Chicago, Ill.	92472	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84426	US Rubber Co., Consumer Ind. & Plastics	Chicago, Ill.	92473	Wire Cloth Products, Inc.	Bellwood, Ill.
84427	United Transformer Co.	Chicago, Ill.	92474	Tu-Ohm Products Memcor Components Div.	Huntington, Ind.
84428	General Mills, Inc.	Buffalo, N.Y.	92475	South Chester Corp.	Chicago, Ill.
84429	Graybar Electric Co.	Oakland, Calif.	92476	East Paterson, N.J.	Paterson, N.J.
84430	United Transformer Co.	Chicago, Ill.	92477	Curts-Wright Corp., Electronics Div.	Newark, N.J.
84431	General Mills, Inc.	Buffalo, N.Y.	92478	Waco Electronics, Inc.	Woodside, N.Y.
84432	Graybar Electric Co.	Oakland, Calif.	92479	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84433	United Transformer Co.	Chicago, Ill.	92480	Waco Electronics, Inc.	Woodside, N.Y.
84434	General Mills, Inc.	Buffalo, N.Y.	92481	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84435	Graybar Electric Co.	Oakland, Calif.	92482	Waco Electronics, Inc.	Woodside, N.Y.
84436	United Transformer Co.	Chicago, Ill.	92483	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84437	General Mills, Inc.	Buffalo, N.Y.	92484	Waco Electronics, Inc.	Woodside, N.Y.
84438	Graybar Electric Co.	Oakland, Calif.	92485	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84439	United Transformer Co.	Chicago, Ill.	92486	Waco Electronics, Inc.	Woodside, N.Y.
84440	General Mills, Inc.	Buffalo, N.Y.	92487	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84441	Graybar Electric Co.	Oakland, Calif.	92488	Waco Electronics, Inc.	Woodside, N.Y.
84442	United Transformer Co.	Chicago, Ill.	92489	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84443	General Mills, Inc.	Buffalo, N.Y.	92490	Waco Electronics, Inc.	Woodside, N.Y.
84444	Graybar Electric Co.	Oakland, Calif.	92491	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84445	United Transformer Co.	Chicago, Ill.	92492	Waco Electronics, Inc.	Woodside, N.Y.
84446	General Mills, Inc.	Buffalo, N.Y.	92493	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84447	Graybar Electric Co.	Oakland, Calif.	92494	Waco Electronics, Inc.	Woodside, N.Y.
84448	United Transformer Co.	Chicago, Ill.	92495	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84449	General Mills, Inc.	Buffalo, N.Y.	92496	Waco Electronics, Inc.	Woodside, N.Y.
84450	Graybar Electric Co.	Oakland, Calif.	92497	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84451	United Transformer Co.	Chicago, Ill.	92498	Waco Electronics, Inc.	Woodside, N.Y.
84452	General Mills, Inc.	Buffalo, N.Y.	92499	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84453	Graybar Electric Co.	Oakland, Calif.	92500	Waco Electronics, Inc.	Woodside, N.Y.
84454	United Transformer Co.	Chicago, Ill.	92501	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84455	General Mills, Inc.	Buffalo, N.Y.	92502	Waco Electronics, Inc.	Woodside, N.Y.
84456	Graybar Electric Co.	Oakland, Calif.	92503	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84457	United Transformer Co.	Chicago, Ill.	92504	Waco Electronics, Inc.	Woodside, N.Y.
84458	General Mills, Inc.	Buffalo, N.Y.	92505	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84459	Graybar Electric Co.	Oakland, Calif.	92506	Waco Electronics, Inc.	Woodside, N.Y.
84460	United Transformer Co.	Chicago, Ill.	92507	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84461	General Mills, Inc.	Buffalo, N.Y.	92508	Waco Electronics, Inc.	Woodside, N.Y.
84462	Graybar Electric Co.	Oakland, Calif.	92509	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84463	United Transformer Co.	Chicago, Ill.	92510	Waco Electronics, Inc.	Woodside, N.Y.
84464	General Mills, Inc.	Buffalo, N.Y.	92511	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84465	Graybar Electric Co.	Oakland, Calif.	92512	Waco Electronics, Inc.	Woodside, N.Y.
84466	United Transformer Co.	Chicago, Ill.	92513	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84467	General Mills, Inc.	Buffalo, N.Y.	92514	Waco Electronics, Inc.	Woodside, N.Y.
84468	Graybar Electric Co.	Oakland, Calif.	92515	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84469	United Transformer Co.	Chicago, Ill.	92516	Waco Electronics, Inc.	Woodside, N.Y.
84470	General Mills, Inc.	Buffalo, N.Y.	92517	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84471	Graybar Electric Co.	Oakland, Calif.	92518	Waco Electronics, Inc.	Woodside, N.Y.
84472	United Transformer Co.	Chicago, Ill.	92519	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84473	General Mills, Inc.	Buffalo, N.Y.	92520	Waco Electronics, Inc.	Woodside, N.Y.
84474	Graybar Electric Co.	Oakland, Calif.	92521	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84475	United Transformer Co.	Chicago, Ill.	92522	Waco Electronics, Inc.	Woodside, N.Y.
84476	General Mills, Inc.	Buffalo, N.Y.	92523	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84477	Graybar Electric Co.	Oakland, Calif.	92524	Waco Electronics, Inc.	Woodside, N.Y.
84478	United Transformer Co.	Chicago, Ill.	92525	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84479	General Mills, Inc.	Buffalo, N.Y.	92526	Waco Electronics, Inc.	Woodside, N.Y.
84480	Graybar Electric Co.	Oakland, Calif.	92527	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84481	United Transformer Co.	Chicago, Ill.	92528	Waco Electronics, Inc.	Woodside, N.Y.
84482	General Mills, Inc.	Buffalo, N.Y.	92529	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84483	Graybar Electric Co.	Oakland, Calif.	92530	Waco Electronics, Inc.	Woodside, N.Y.
84484	United Transformer Co.	Chicago, Ill.	92531	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84485	General Mills, Inc.	Buffalo, N.Y.	92532	Waco Electronics, Inc.	Woodside, N.Y.
84486	Graybar Electric Co.	Oakland, Calif.	92533	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84487	United Transformer Co.	Chicago, Ill.	92534	Waco Electronics, Inc.	Woodside, N.Y.
84488	General Mills, Inc.	Buffalo, N.Y.	92535	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84489	Graybar Electric Co.	Oakland, Calif.	92536	Waco Electronics, Inc.	Woodside, N.Y.
84490	United Transformer Co.	Chicago, Ill.	92537	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84491	General Mills, Inc.	Buffalo, N.Y.	92538	Waco Electronics, Inc.	Woodside, N.Y.
84492	Graybar Electric Co.	Oakland, Calif.	92539	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84493	United Transformer Co.	Chicago, Ill.	92540	Waco Electronics, Inc.	Woodside, N.Y.
84494	General Mills, Inc.	Buffalo, N.Y.	92541	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84495	Graybar Electric Co.	Oakland, Calif.	92542	Waco Electronics, Inc.	Woodside, N.Y.
84496	United Transformer Co.	Chicago, Ill.	92543	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84497	General Mills, Inc.	Buffalo, N.Y.	92544	Waco Electronics, Inc.	Woodside, N.Y.
84498	Graybar Electric Co.	Oakland, Calif.	92545	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84499	United Transformer Co.	Chicago, Ill.	92546	Waco Electronics, Inc.	Woodside, N.Y.
84500	General Mills, Inc.	Buffalo, N.Y.	92547	Worcester Pressed Aluminum Corp.	Worcester, Mass.

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

Code	Manufacturer	Address
0000F	Matic Tool and Die	Los Angeles, Calif.
0009Z	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.
000QO	Cooltron	Dakland, Calif.
000W	California Eastern Lab.	Burlington, Calif.
009Y	S. K. Smith Co.	Los Angeles, Calif.

SECTION VII SCHEMATIC DIAGRAMS

7-1. INTRODUCTION.

7-2. This section contains schematic diagrams. Figure 7-1 lists notes and symbols which apply to all schematic diagrams. Each diagram follows the guide lines listed below.

a. Schematics in this manual are meant to show electrical circuit operation and not intended as wiring diagrams.

b. Assembly sections of schematics may or may not be shaded as in the example shown.

7-3. REPLACEMENT INFORMATION.

7-4. For repair and replacement information, refer to the MAINTENANCE section of this manual which is Section V. For specific component descriptions and/or ordering information refer to page 6-1.

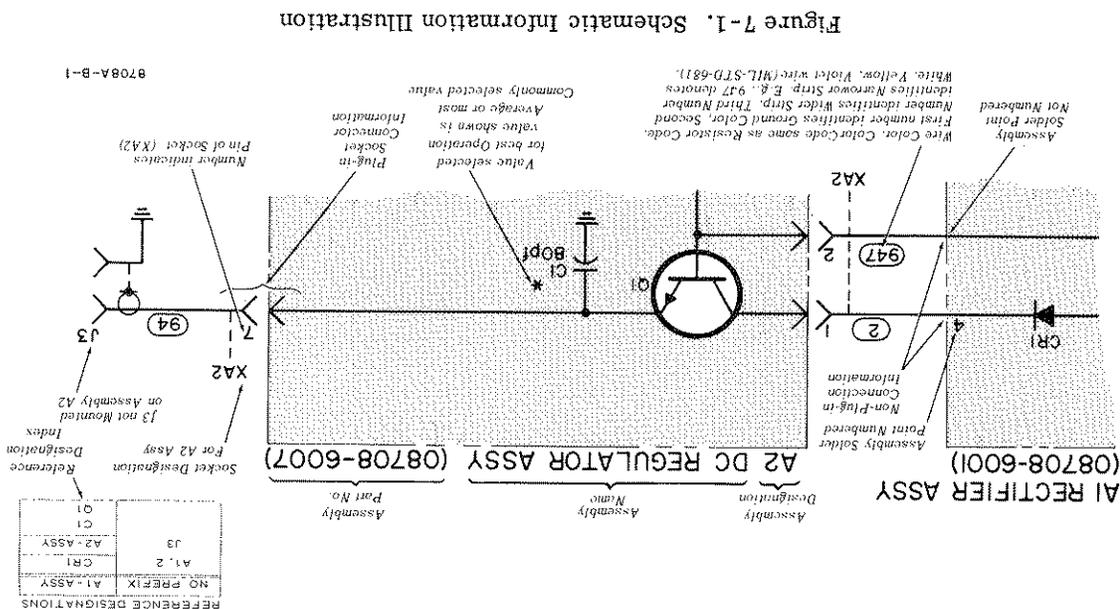


Figure 7-1. Schematic Information Illustration

MANUAL CHANGES

MANUAL IDENTIFICATION
 Model Number: 8406A
 Date Printed: JUNE 1967
 Part Number: 08406-90001

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

To use this supplement:

Make all ERRATA corrections

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

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
737-00386 thru 737-00555	1, 2	1441A01266 thru 1441A01275	3, 4, 5, 6, 7
737-00556 thru 737-00585	1, 2, 3	1441A01276 thru 1441A Prefix	3, 4, 5, 6, 7, 8
737-00586 thru 737-00675	2, 3, 4	1628A, 1632A	3, 4, 5, 6, 7, 8, 9
961, 0961A	3, 4, 5	1711A	3, 4, 5, 6, 7, 8, 9, 10
1145A	3, 4, 5, 6	1915A	3 - 11

NEW ITEM

ERRATA

Inside front cover:

Insert new information regarding SAFETY, CERTIFICATION, and WARRANTY AND ASSISTANCE immediately inside front cover of manual (new information sheet supplied in this Manual Changes Supplement).

Page 1-1, General Information:

Add the following information preceding Paragraph 1-1:

1-A. SAFETY CONSIDERATIONS

Operation

General BEFORE APPLYING POWER, make sure the instrument's ac input is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken.

Service

Although the instrument has been designed in

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in safe condition. This is a Safety Class I instrument.

NOTE

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

ERRATA (Cont'd)

accordance with international safety standards, the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. Service and adjustments should be performed only by qualified service personnel.

Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when inevitable, should be performed only by a skilled person who knows the hazard involved.

Capacitors inside the instrument may still be charged even though the instrument has been disconnected from its source of supply.

Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short circuit the fuse holders.

Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

WARNING

If this instrument is to be energized through an autotransformer (for voltage reduction), make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall only be inserted in a socket outlet provided with protective earth contact. The protection must not be

negated by using an extension cord (power cable) without a protective grounding conductor.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

With the ac power cable connected, the ac line voltage is present at the terminals of the power line module and at the LINE power switch. Be very careful. Bodily contact with this voltage can be fatal.

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument's ac input is set to the voltage of the ac power source.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure that all devices connected to the instrument are connected to the protective earth ground.

make sure the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the ac line fuse is of the required current rating and type (normal-blow, time-delay, etc.).

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery. Hewlett-Packard will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

WARRANTY AND ASSISTANCE

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facilities, or to the calibration facilities of other International Standards Organization members.

CERTIFICATION

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring apparatus," and has been supplied in safe condition. This is a Safety Class I instrument. To ensure safe operation and to keep the instrument safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this instrument.

SAFETY

ERRATA (Cont'd)

Page 5-3, Table 5-2, step e:
Change 10-MC to read 1 MC.

Page 6-3, Table 6-1:
Change to read:
A1T1 08406-6013 Transformer: RF (Oscillator)

Page 6-4, Table 6-1:
Change to read:

- ▲ A1T2 08406-6014 Transformer: RF (Amplifier)
- ▲ C2 Refer to Change 11 for **PREFERRED REPLACEMENT**
- ▲ C3 Refer to Change 11 for **PREFERRED REPLACEMENT**
- ▲ CRI 1901-0169 SEMICON DEVICE: DIODE
- ▲ CRIMP1 08406-6002 HOLDER ASSEMBLY, DIODE; INCLUDES:

08551-2041 POST, DIODE
 1250-0014 CONTACT: OUTER N MALE CONNECTOR
 1250-0016 RING: LOCKING FOR TYPE N CONNECTOR
 5020-0306 NUT: CONNECTOR
 08406-2002 BODY: DIODE HOLDER
 08406-2003 CENTER CONDUCTOR
 Add to Z1 Attenuator Pad Assy: Spacer 2 ea 08491-2102

Page 6-4, Table 6-1 and Page 6-7, Table 6-2:
Change J1, J2 to read: 1250-0001 Connector: BNC

Page 6-4, Table 6-1; Page 6-7, Table 6-2; Page 7-3/7-4, Figure 7-2:
Change R1 to read: 2100-0350 R: VAR COMP 1.5K OHM 20% L1N 1/2W

Page 6-9, Table 6-2:

Add: 08406-6013 Transformer: RF (Oscillator)
 08406-6014 Transformer: RF (Amplifier)
 08491-2102 Spacer: Attenuator Pad Assy

Page 7-3, Figure 7-2:

Change **906** at wiper of R3 (top part of schematic) to **904**

Page 7-5, Figure 7-3:

Change **908** to **918** at line input.
 Change **908** to **918** at line input.

CHANGE 1

Page 6-2, Table 6-1; Page 6-7, Table 6-2; Page 7-3/7-4, Figure 7-2:
Change A1C17 to C: FXD MICA 33 pF 300 V 5% 0160-0179

CHANGE 2

Page 6-4, Table 6-1; Page 6-8, Table 6-2; Page 7-3/7-4, Figure 7-2:
Change R1 to R: VAR COMP 1500 OHM 20% L1N 1/2W 2100-0350

CHANGE 3

Page 6-3, Table 6-1; Page 7-5/7-6, Figure 7-3:

A1Q8 1850-0040 Transistor: Germanium PNP
 A1Q9 1853-0051 Transistor: Silicon 2N4037
 A1R30 0683-0395 R: FXD COMP 3.9 OHM 5% 1/4W

Page 6-4, Table 6-1:

Change to read:
 A1VR1 1902-3203 DIODE BREAKDOWN: SILICON 14.7V 5% 400 mW
 Add:
 A1MP1 1205-0011 HEAT DISSIPATOR: TO-5/9 CASE USED ON A1Q9

CHANGE 4

Page 6-2, Table 6-1; Page 7-3/7-4, Figure 7-2:

Change to read: A1C7 0121-0166 C:VAR AIR, 2.4 TO 24.5 PF
A1C17 0160-2263 C:FXD CER, 18 PF 5% 500 VDCW
A1C18 0121-0166 C:VAR, AIR 2.4 TO 24.5 PF

CHANGE 5

Page 6-4, Table 6-1:

Change to read: DS1 2140-0244 LAMP: GLOW 1.0 mA TYPE A1H P/O S3
F1 2110-0311 FUSE: CARTRIDGE 1/16 AMP TYPE MDL-1/16
J3 1251-2357 CONNECTOR: POWER 3 PIN MALE
R1 2100-0067 R:VAR COMP 2.5K OHM 20% LIN 1/2W
S2 3101-1234 SWITCH: SLIDE DPDT 115/230V
S3 3101-1248 SWITCH: PUSHBUTTON (LINE)

Page 6-5, Table 6-1:

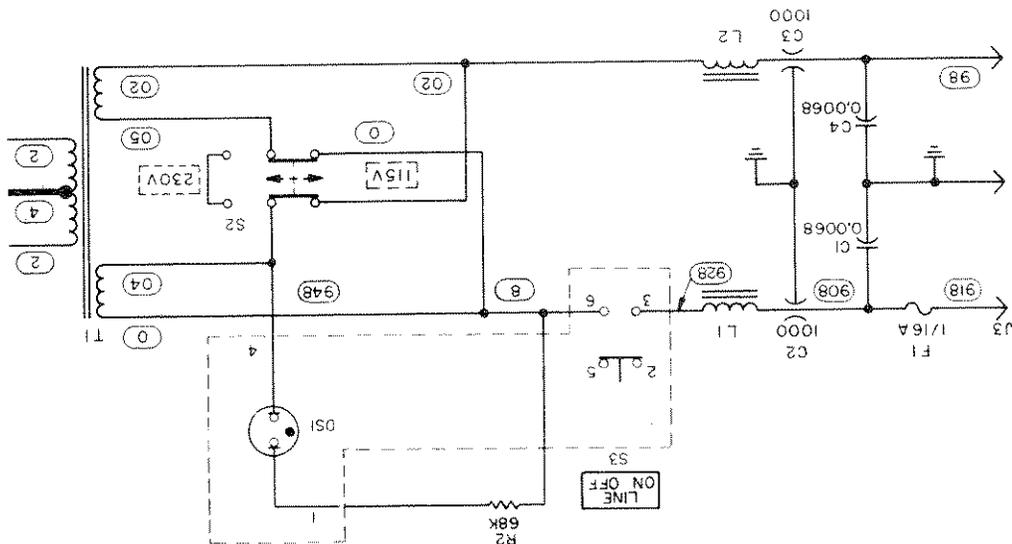
Change 8120-0078 to read: 8120-1348 CABLE ASSY: POWER
Delete: 5040-0234 LAMPHOLDER
5040-0235 BASE: LAMPHOLDER

Page 6-6, Table 6-1:

Change to read: 9 08406-0015 PANEL: REAR
10 08406-00016 PANEL: FRONT

Page 7-5/7-6, Figure 7-3:

Change schematic as indicated below:



P/O Figure 7-3, (Change 5)

Page 1-1, Table 1-1:
Change "Peak amplitude*" to "Typical amplitude*";

CHANGE 9

Page 6-2, Table 6-1:
Change A1C6 to 0160-2306, C:FXD CER 27 pF 5% 300 V, Factory Selected Part.
Change A1C17 to 0140-0145, C:FXD MICA 22 pF 5% 500 VDCW, Factory Selected Part.
Page 7-3, Figure 7-2:
Change the value of A1C6 to A1C6 * 27 pF.
Change the value of A1C17* to 22 pF.

CHANGE 8

Page 6-4, Table 6-1:
Change R1 to 2100-2769, R:VAR 2.5K OHM 20% 2W.

CHANGE 7

10	08406-00017	PANEL:FRONT (MINT GRAY)
9	08406-00015	PANEL:REAR
8	5000-8571	COVER ASSEMBLY:BOTTOM (OLIVE GRAY)
7	5060-8555	COVER ASSEMBLY:TOP (OLIVE GRAY)
6	5000-8565	COVER:SIDE (OLIVE GRAY)

Page 6-6, Table 6-1 Cabinet Parts:
Change items 6 through 10 to read:

Page 6-5, Table 6-1:
Add: 0370-1400 KNOB, MINT GRAY PUSHBUTTON 11/16 IN DIA 1MC, 10MC, 100MC EXT TRIG.

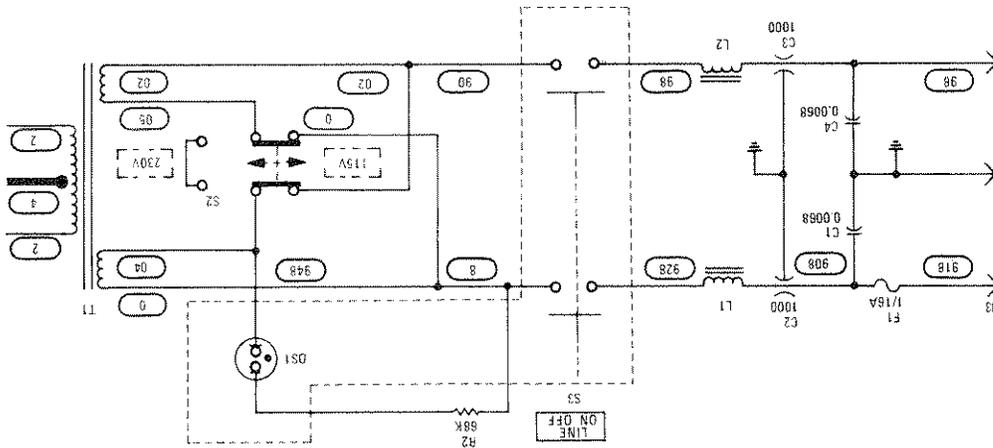
Page 6-2, Table 6-1 and Page 7-3/7-4, Figure 7-2:
Change A1C17 to C:FXD MICA 60 pF 300 V 5% 0140-0214 (*) Factory Selected Component.

CHANGE 6

CHANGE 11

Page 6-4, Table 6-1: Change C2 and C3 to 0160-3484 C:FXD 1000PF 20% 2100 VDCW (PREFERRED REPLACEMENT; REQUIRES NEW BOTTOM COVER BRACKET).
 Page 6-5, Table 6-1: Change 08406-0003 to 08406-00018; BRACKET, BOTTOM COVER.

P/O Figure 7-3. (Change 10)



Page 7-5, Figure 7-3: Change schematic as indicated below:

Change XF1 to 2110-0470 BODY: FUSEHOLDER
 Add the following parts under XF1:
 2110-0465, CAP: FUSEHOLDER
 2110-0467, NUT: HEX
 1400-0090, WASHER: FLAT NEOPRENE

For instruments with serial prefix 1632A or below, HP Part Number for replacement of line switch S3 is 3101-1248.

NOTE

Page 6-4, Table 6-1: Change S3 to 3101-1957, SWITCH: PUSHBUTTON DPST (LINE).

CHANGE 10

APPENDIX I

BACKDATING INFORMATION

This manual applies to instruments with Serial Prefixes 649-, and 737-. Listed below are changes to be made to the manual so that it will apply directly to Prefixes 532-, and 541-.

Instrument Serial No. Prefix		Change Number
541-		1
532-		1 and 2

CHANGE 1:

Table 6-1 Page	Table 6-2 Page	Schematic Page	Delete, Change, or add	Circuit Ref.	Stk No.	Item Description
6-2	6-7	7-3/7-4	Change	A1C7	0121-0031	C: Var 1.85-10.38 pF
"	"	"	"	A1C18	"	"
"	"	"	"	A1C39	"	"

CHANGE 2:

6-7	6-7	7-3/7-4	Change	A1C29	0160-0370	20 pF 5%
6-3		"	"	A1L11	9100-1612	0.33 μ H
"		"	"	A1Q5	1854-0031	2N2865
"		"	"	A1Q7	1854-0031	2N2865
"		"	"	A1R20	0698-3156	14.7 K Ω
"		"	"	A1R21	0698-3155	4640 Ω
"		"	"	A1R22	0698-0084	2150 Ω
6-2		"	Delete	A1C41	-	-
6-3		"	"	A1R31	-	-
"		"	"	A1R32	-	-

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