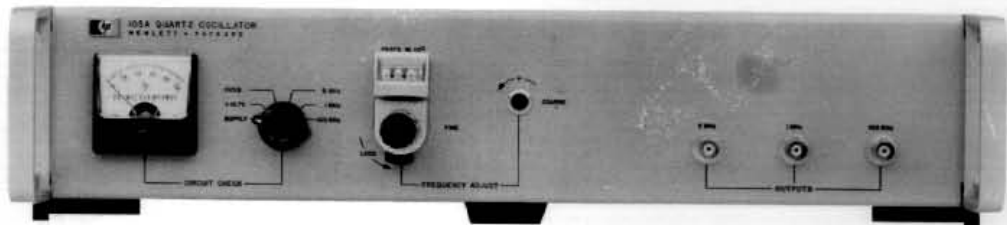


QUARTZ OSCILLATOR

105A/B



HEWLETT  PACKARD

CERTIFICATION

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 facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

QUARTZ OSCILLATORS 105A/B

SERIAL PREFIX: 808-

This manual applies directly to HP Model 105A and Model 105B Quartz Oscillators having serial prefix number 808.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 808, a "manual changes" sheet is included with this manual. For serial prefixes below 808 refer to Section VI, Manual Changes.

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HEWLETT  PACKARD

MANUAL CONTENT

This manual is supplied to help you make the best use of your instrument. The manual covers 7 sections of information as follows:

Section I is an introduction to the instrument. Electrical specifications are given, plus information on accessories.

Section II covers inspection, power, mounting, packing, shipping, connection and operating procedures.

Section III discusses technical details of circuit operation.

Section IV provides performance check, troubleshooting and adjustment procedures.

Section V lists replaceable parts.

Section VI gives information on manual changes.

Section VII contains circuit diagrams with component locations.

HOW TO ORDER

To order an operating and service manual, contact your nearest Hewlett-Packard Sales and Service office. Give complete model, name and eight-digit serial number. The serial number plate is on the rear panel. (See Paragraph 1-3 for serial number system.) Comments on this manual are welcome at any Sales and Service Office.

TABLE OF CONTENTS

I	GENERAL INFORMATION	1-1
	1-1. Introduction	1-1
	1-3. Instrument Identification	1-1
	1-6. Rms Fractional Frequency Deviation	1-1
	1-8. Oscillator Assembly Repair	1-1
II	INSTALLATION	2-1
	2-1. Unpacking and Inspection	2-1
	2-3. Storage and Shipment	2-1
	2-6. Rack Installation	2-1
	2-8. Environment Limits	2-1
	2-12. Operating Procedures	2-1
	2-13. General	2-1
	2-15. Turn-On	2-2
	2-17. Connection to Ac Power	2-2
	2-18. Connection to Dc Power	2-3
	2-19. Initial Indications after Turn-On	2-3
	2-21. Frequency Measurement and Adjustment	2-3
	2-25. Standby Battery (Model 105B Only)	2-4
	2-26. General	2-4
	2-29. Battery Charging	2-4
III	THEORY OF OPERATION	3-1
	3-1. General	3-1
	3-5. 5 MHz Oscillator Assembly A1	3-1
	3-6. General	3-1
	3-8. Oven Temperature Control	3-1
	3-12. 5 MHz Oscillator and AGC Assembly	3-2
	3-19. Power Amplifier Assembly A1A3	3-2
	3-22. 1 MHz Divider Assembly A2	3-2
	3-23. General	3-2
	3-25. Starting the Divider	3-2
	3-30. 100 kHz Divider Assembly A3	3-3
	3-33. Power Supplies	3-3
	3-34. General	3-3
	3-36. Rectifiers and Regulators	3-3
	3-41. Standby Battery Circuits	3-3
IV	MAINTENANCE	
	4-1. Introduction	4-1
	4-3. Recommended Test Equipment	4-1
	4-5. In-Cabinet Performance Checks	4-1
	4-8. Maintenance and Repair	4-8
	4-9. Replacing Power Supply Transistors Requiring Heat Sinks	4-8
	4-11. Servicing Etched Circuit Boards	4-8
	4-15. Repair and Troubleshooting Assembly	4-8
	4-17. Troubleshooting	4-9
	4-19. Frequency Divider Adjustments	4-9
	4-20. General	4-9
	4-22. Tuning Procedure	4-9
	4-27. 5 MHz Filter Tuning	4-9
	4-29. Regulated Power Supply Voltages	4-9
	4-32. Battery Check (105B Only)	4-12
	4-34. Replacing Internal Battery Supply (Model 105B only)	4-12
V	REPLACEABLE PARTS	5-1
	5-1. Introduction	5-1
	5-4. Ordering Information	5-1
VI	MANUAL CHANGES AND OPTIONS	6-1
	6-1. Current Instruments	6-1
	6-2. Newer Instruments	6-1
	6-5. Older Instruments	6-1
	6-7. Options	6-1
VII	CIRCUIT DIAGRAMS	7-1

LIST OF ILLUSTRATIONS

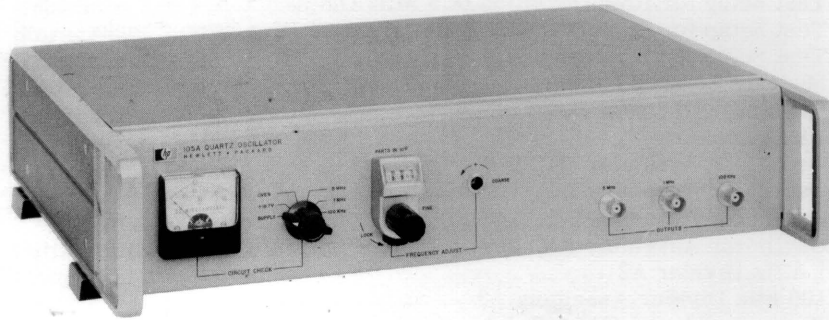
1-1.	Model 105A/B and Accessories	1-1
2-1.	Conversion for Rack Mounting	2-1
2-2.	Front Panel Controls, Connectors and Indicators	2-5
2-3.	Rear Panel Connectors	2-6
4-1.	Test Setup, Signal-to-Noise Ratio	4-4
4-2.	Test Setup for RMS Deviation of 5 MHz Output	4-4
4-3.	Test Setup for Harmonic and Non-Harmonic Distortion Checks	4-5
4-4.	Test Setup for Stability	4-7
5-1.	Modular Cabinet Parts	5-2
7-1.	Schematic Diagram Notes	7-2
7-2.	Block Diagram	7-3
7-3.	Oscillator Assembly A1, Block Diagram	7-5
7-4.	Oscillator Assembly A1, Temperature Control Circuit A1A1, A1A3	7-7
7-5.	Oscillator Assembly A1, 5 MHz Oscillator and AGC A2A1, A2A2	7-9
7-6.	Oscillator Assembly A1, Power Amplifier A1A3	7-11
7-7.	1 MHz Divider A2	7-13
7-8.	100 kHz Divider Assembly A3	7-15
7-9.	Power Supply A5 (105A Only)	7-17
7-10.	Power Supply A5 (105B Only)	7-19

LIST OF TABLES

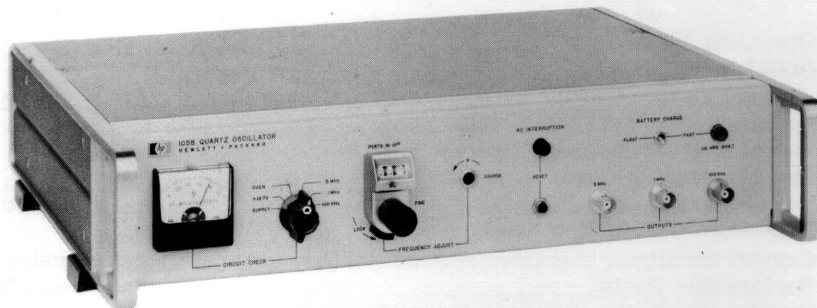
1-1.	Specifications	1-2
2-1.	Operation Record	2-2
2-2.	Initial Indications	2-3
4-1.	Recommended Test Equipment	4-1
4-2.	In-Cabinet Performance Checks	4-2
4-3.	Troubleshooting Chart	4-10
5-1.	Reference Designation Index	5-3
5-1a.	Crystal Oscillator and Oven Assembly, Reference Designation Index	5-13
5-2.	Replaceable Parts	5-19
5-2a.	Crystal Oscillator and Oven Assembly, Parts	5-22
5-3.	Manufacturer's Code List	5-24
6-1.	Manual Changes	6-1

Figure 1-1. Model 105A/B and Accessories

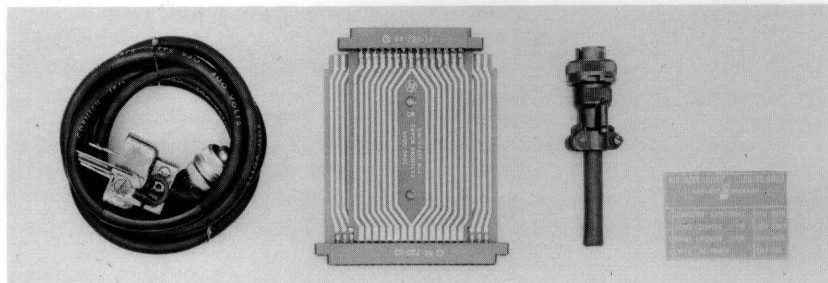
MODEL 105A



MODEL 105B



ACCESSORY KIT



SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 105A or Model 105B Quartz Oscillator is a light and compact precision quartz oscillator for frequency and time standards. Either oscillator may be operated from 115V or 230V ac power or from an external 22 to 30 Vdc source; the Model 105B also has an internal sealed-cell, nickel-cadmium battery that can provide up to 8 hours standby power if ac line power should fail. Complete specifications of both instruments are given in Table 1-1. Hewlett-Packard Application Note 52, "Frequency and Time Standards", (supplied) provides general information about frequency and time standards systems and techniques where the Model 105A/B may be used.

1-3. INSTRUMENT IDENTIFICATION

1-4. Each Model 105A/B is identified by a two-section, eight-digit (000-00000) serial number on the rear panel. The three digit number is a serial prefix number, used to document changes. The five-digit number is an identification number unique to each instrument.

1-5. The title page of this manual lists the serial prefix number to which this instrument directly applies. For newer instruments, if the serial prefix number is different from the one listed on the title page, a manual change sheet will be included, de-

scribing the required changes. If a change sheet is missing, the information can be supplied by any Hewlett-Packard Sales and Service office listed at back of this manual.

1-6. RMS FRACTIONAL FREQUENCY DEVIATION

1-7. The specified values for rms fractional frequency deviation of the 5 MHz output at various times represent the standard deviation of the short term frequency instability due to random noise. For example, the value given for one second averaging corresponds to an rms standard frequency deviation of .00005 Hz. In other words, 68.3% of all observed frequency variations for measurement times of one second will differ from 5 MHz by less than plus or minus that amount; 99.7% of all frequency variations will differ from 5 MHz by less than three times that amount. All statistical data are based on 100 samples.

1-8. OSCILLATOR ASSEMBLY REPAIR

1-9. The oscillator assembly is not a field repairable unit. The instrument warranty is voided if repair within the assembly is attempted. Adjustments other than those provided at the front-end of the oscillator assembly will also void the warranty. A rebuilt oscillator assembly (HP Part No. 00105-6034) is available if trouble is isolated to the A1 5 MHz Oscillator Assembly.

Table 1-1. Specifications

OUTPUT FREQUENCIES: 5 MHz, 1 MHz, 100 kHz sinusoidal; 1 MHz or 100 kHz clock drive.

OUTPUT VOLTAGE: $\geq 1V$ rms into 50Ω ; clock drive $\geq 0.5V$ rms into 1000Ω .

AGING RATE: $< |5 \times 10^{-10}|$ per 10 days.

STABILITY:

As a function of ambient temperature: $< 5 \times 10^{-11}/^{\circ}C$ from $0^{\circ}C$ to $+50^{\circ}C$ ($< 2.5 \times 10^{-9}$ from $0^{\circ}C$ to $+50^{\circ}C$).

As a function of load: $< \pm 2 \times 10^{-11}$ for any of the following loads; open, short, 50Ω resistive, 50Ω inductive, 50Ω capacitive.

As a function of supply voltage: $< \pm 5 \times 10^{-11}$ for 22-30V dc (battery operation, 105B) and for $115/230V \pm 10\%$.

RMS DEVIATION OF 5 MHz OUTPUT* (due to noise and frequency fluctuation):

Averaging Time	Max. Fractional-Freq. Deviation ($\Delta f/f$)	Max. RMS Phase Dev. (milliradians)
1 ms	5×10^{-10}	0.016
10 ms	1×10^{-10}	0.031
0.1 s	1×10^{-11}	0.031
1 s	1×10^{-11}	0.31
10 s	1×10^{-11}	3.1

All data is based on at least 100 samples. Data was taken over a 20-second interval for 1 ms, 10 ms, and 0.1s averaging times, over 200- and 2,000-second intervals respectively for 1 and 10s averaging times. The crystal aging rate has been removed from this data.

SIGNAL-TO-NOISE RATIO (5 MHz): > 90 dB below rated output; (filter bandwidth (3 dB) = 100 Hz).

HARMONIC DISTORTION (5 MHz, 1 MHz, 100 kHz): Down more than 40 dB from rated output.

NON-HARMONIC COMPONENTS (5 MHz, 1 MHz, 100 kHz): Down more than 80 dB from rated output.

OUTPUT TERMINALS: 5 MHz, 1 MHz, 100 kHz front and rear panel BNC connectors, clock drive and electrical frequency control, rear panel BNC connectors.

FREQUENCY ADJUSTMENTS: Fine adjustments: front panel control with 5×10^{-8} range, with digital dial reading parts in 10^{10} . Coarse adjustments: 1×10^{-6} coarse control is screw-driver adjustment at front panel.

*With crystal filter, 100 Hz wide.

PHASE LOCKING CAPABILITY: A voltage control allows > 4 parts in 10^8 frequency control for locking to an external source. $-5V$ to $+5V$ required from phase detector (not supplied).

ENVIRONMENTAL:

Storage Temperature: $-40^{\circ}C$ to $+75^{\circ}C$ (manufacturer specifies $-40^{\circ}C$ to $+50^{\circ}C$ limit for 105B battery storage).

Operating Temperature: $0^{\circ}C$ to $+50^{\circ}C$.

MONITOR METER: Front panel meter and associated selector switch monitors: supply voltage, $+18V$, oven, 5 MHz output, 1 MHz output, 100 kHz output.

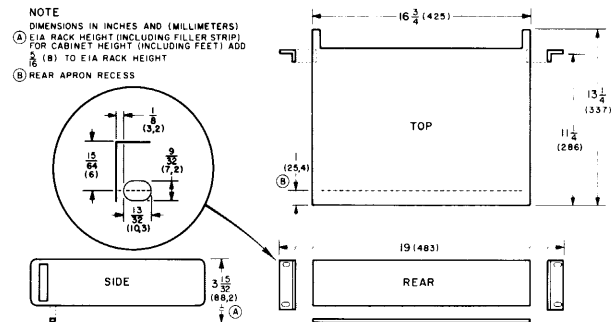
STANDBY SUPPLY CAPACITY: (Model 105B only): 8 hours at $+25^{\circ}C$ ambient temperature.

POWER REQUIREMENTS:

$115/230V \pm 10\%$ at 17W (21W warmup) for 105A; 18W (24W warmup) for 105B float charge. Add 12W for fast charge.

Or 22 to 30V dc at 6.4W (10.3W warmup).

DIMENSIONS:



WEIGHT: 105A - Net, 14.7 lbs (6,7 kg); Shipping, 17.4 lbs (7,9 kg); 105B - Net, 24 lbs (10,9 kg), Shipping, 32 lbs (14, 5 kg).

ACCESSORIES FURNISHED: Rack mounting kit, ac power cord, 2 extender boards, 15-pin: HP 5060-0099, 22-pin: HP 5060-0630.

COMPLEMENTARY EQUIPMENT:

Model 115BR/CR Frequency Divider and Clock. Model 5085A Standby Power Supply with battery for extending standby power capability by 40-70 hours.

SECTION II INSTALLATION

2-1. UNPACKING AND INSPECTION

2-2. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to meet the specifications (see In-Cabinet Performance Checks, Table 4-2), notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. (Sales and Service Offices are listed at the back of this manual.) Retain the shipping carton and the padding material for the carrier's inspection. The Sales and Service Office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-3. STORAGE AND SHIPMENT

2-4. Before storing the Model 105B, disconnect the internal battery by pressing pushbutton switch S5 after unplugging the instrument; this switch is located on the bracket on which regulator transistors Q1, Q2, and Q3 are mounted (see Figure 7-2). For access to S5, remove the two screws that hold the top cover in place, slide the cover toward the rear of the instrument and lift off; replace the cover before packaging the instrument. This procedure is not necessary for the Model 105A.

2-5. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packaging material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

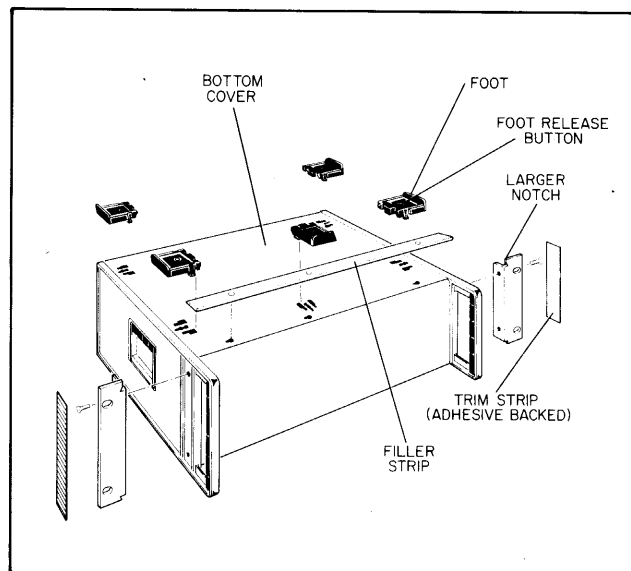
a. **RUBBERIZED HAIR.** Cover the painted surfaces of the instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq. in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. **EXCELSIOR.** Cover painted surfaces of the instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq. in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of instrument.

2-6. RACK INSTALLATION

2-7. The Model 105A/B is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert for rack installation, proceed as follows:

Figure 2-1. Conversion for Rack Mounting



- a. Remove feet (press the foot-release button, slide foot toward center of instrument and lift off).
- b. Remove adhesive-backed trim strips at front end of sides.
- c. Attach filler strip along bottom edge of front panel.
- d. Attach flanges to front end of sides (larger corner-notch toward bottom of instrument). Instrument is now ready to mount in standard rack.

2-8. ENVIRONMENT LIMITS.

2-9. Non-operating and operating limits should normally be limited as listed in Paragraphs 2-10 and 2-11.

2-10. NON-OPERATING.

- a. Maximum temperature: +75°C (+167°F).
- b. Minimum temperature: -40°C (-40°F).

2-11. OPERATING.

- a. Maximum temperature: +50°C (+122°F).
- b. Minimum temperature: 0°C (+32°F).

2-12. OPERATING PROCEDURES

2-13. General

2-14. Operating procedures involve connection to a power source ("turn-on") and measurement of the output levels. In addition, the Model 105B standby battery should be given a "refresher" charge every three to six months, as described in Paragraph 2-29. Os-

Table 2-1. Operation Record

Serial Number _____						Other ID Number _____				
CIRCUIT CHECK METER INDICATIONS ("80" = NORMAL)						MODEL 105B ONLY			By	Date
						AC INTER- RUPTION LIGHT	BATTERY CHARGE			
SUPPLY	+18.7V	OVEN	5 MHz	1 MHz	100 kHz		FAST	FLOAT		

cillator performance should be monitored daily by noting the CIRCUIT CHECK meter indication for each CIRCUIT CHECK switch position; a record of these indications may be useful for maintenance purposes. Typical headings for such a log are given in Table 2-1.

2-15. Turn-On

2-16. GENERAL. The Model 105A/B may be operated from 115- or 230-volt ac ($\pm 10\%$) or 22- to 30-volt dc power. There is no "on/off" switch, so the oscillator is "on" whenever it is connected to a power source. The procedure for connecting the Model 105A/B to an ac power source is given in Paragraph 2-17; connection to dc power is covered in Paragraph 2-18.

2-17. Connection to Ac Power

a. Determine whether the line voltage is 115 volts or 230 volts ($\pm 10\%$).

b. Set the "115/230" volt rear-panel slide switch so the numbers indicating the available line voltage are exposed. A narrow-blade screwdriver is required to slide the switch from one position to the other.

c. Be sure the correct fuse is installed for your line voltage: 1-amp slow-blow (HP Part No. 2110-0001) for 115V line, 0.5 amp normal-blow (HP Part No. 2110-0012) for 230-volt line.

d. Connect ac power to Model 105A/B. The Model 105A/B is supplied with a detachable three-wire ac power cable (HP Part No. 114B-16A) which grounds exposed portions of the instrument when plugged into a three-wire (grounded) power outlet. If the instrument is to be powered from an ac line, connect the ac power cable as follows:

- (1) Connect round three-terminal connector to ac line jack at rear of Model 105A/B.
- (2) Connect plug (two-blade with round grounded pin) to three-wire (grounded) power outlet. When only a two-blade outlet is available, use connector adapter (HP Part No. 1251-0048), then connect short wire from side of adapter to ground. The instrument is now operating from ac power.
- (3) (Model 105B only). Set BATTERY CHARGE switch to FLOAT; the Model 105B battery is fully charged when shipped. If the AC INTERRUPTION light is "on", turn it off by pressing the RESET button. Applying ac power energizes relay A5K1, connecting the internal battery to provide standby power.

Note

When storing the instrument, be sure to disconnect the battery by unplugging the instrument, then pressing internal pushbutton switch S5 (see paragraph 2-3).

2-18. Connection to DC Power

a. The rear-panel connector labeled "24 VDC" is the dc power input connector. A mating connector is supplied with the instrument, so a dc power cable can be made; be sure that the positive input terminal is connected to terminal "A" and the negative input connected to "C" or "E". Hewlett-Packard cable 103A-16A, ordered separately, may be used to connect the Model 105A/B to a Hewlett-Packard Standby Power Supply, such as the Model 5085A.

b. Be sure the dc power source meets the voltage and power requirements of the Model 105A/B (22-30 volts; 10.3 watts during warmup, 6.4 watts under normal operating conditions).

c. Connect Model 105A/B to dc power. There is no dc power connection to the Oscillator Assembly fast warmup heater. Warmup time is longer when operating from dc power than when operating from ac power.

2-19. INITIAL INDICATIONS AFTER TURN-ON

2-20. Table 2-2 lists normal meter and lamp indications for the Model 105A and 105B Oscillators after power is initially applied.

2-21. FREQUENCY MEASUREMENT AND ADJUSTMENT

2-22. GENERAL. The periodic operational checks should include comparison of the Model 105A/B output frequency against a reference standard, and adjustment as required to keep the Model 105A/B "on frequency". Sections II and III of HP Application Note 52 (supplied with this manual) describe several techniques by which the frequency of the Model 105A/B may be compared against a standard frequency, and the difference between them determined; two relatively easy methods are described below.

a. Oscilloscope Pattern Drift. This procedure requires that the Model 105A/B output frequency and the standard frequency must be the same.

- (1) Trigger the oscilloscope sweep with the standard frequency signal.
- (2) Connect Model 105A/B output to oscilloscope vertical amplifier input.
- (3) Adjust the oscilloscope sweep time to display exactly 10 cycles of the Model 105A/B waveform.
- (4) Unless the standard and Model 105A/B output frequencies are identical, the display on the oscilloscope will drift left or right; if the pattern appears to move to the right, the Model 105A/B frequency is lower than the standard frequency; if the pattern appears to drift to the left, the Model 105A/B output frequency is higher than the standard frequency. The rate of movement of the pattern is related to the frequency difference between the Model 105A/B and the standard, as shown in the example below.

EXAMPLE: A 5 MHz frequency is used to trigger the oscilloscope sweep; the oscilloscope vertical amplifier signal is the 5 MHz output from the Model 105A/B. The time required for the pattern to drift the width of one cycle of the display is (in this example) 100 seconds. The frequency error is

$$\frac{\Delta f}{f} = \frac{\Delta t}{t} = \frac{2 \times 10^{-7}}{1 \times 10^2} = 2 \times 10^{-9} = 2 \text{ parts in } 10^9 \text{ error.}$$

Longer measurement periods are required to observe smaller frequency differences.

Table 2-2. Initial Indications

CIRCUIT CHECK Switch Position	MONITOR METER INDICATION (+25°C)
SUPPLY	70 to 90
+18 VOLTS	70 to 90
OVEN	Full-scale for approximately 1/4 hour (70 to 90 after 1/4 hour)
5 MHz	70 to 90 (output connector unterminated)
1 MHz	70 to 90 (output connector unterminated)
100 kHz	70 to 90 (output connector unterminated)
INDICATOR LAMP (105B only)	CONDITION AND ACTION
AC INTERRUPTION	ON when power initially applied. Press RESET switch. Lamp should go off and remain off.
FAST charge (See Paragraph 2-29)	OFF when BATTERY CHARGE switch is set to FLOAT. When BATTERY CHARGE switch is set to FAST, lamp should light and remain lit. Normal setting is FLOAT.

b. Comparison with National Bureau of Standards' WWVB. The Hewlett-Packard Model 117A VLF Comparator may be used to compare the Model 105A/B 100 kHz output frequency (1 MHz or 5 MHz Comparators available on special order) against the 60 kHz standard frequency transmitted by the National Bureau of Standards station WWVB at Boulder, Colorado. With this method, frequency standard comparisons of 1 part in 10^{10} can be approached in an 8-hour period. A more detailed description of this method is given in Application Note 52.

2-23. FREQUENCY ADJUSTMENTS. After determining the frequency error of the Model 105A/B, the basic 5 MHz oscillator frequency can be adjusted as required to obtain the desired frequency. Ordinarily the adjustment is made by the FINE FREQUENCY ADJUST control and the reading on the PARTS IN 10^{10} meter. When the FINE FREQUENCY ADJUST control reaches the end of its range (PARTS IN 10^{10} meter indicates "000" or "500"), set the FINE FREQUENCY ADJUST so the PARTS IN 10^{10} meter reads "250", then use a screwdriver to adjust the COARSE FREQUENCY ADJUST to bring the oscillator "on frequency". Control range of the COARSE FREQUENCY ADJUST is 1 part in 10^6 .

2-24. The Electrical Frequency Control (E. F. C.) capability of the Model 105A/B oscillator allows it to be phase-locked to another signal source. When using this control method, the FINE FREQUENCY ADJUST should be set so the PARTS IN 10^{10} meter reads "250"; this sets the operating point of the varactor diode, allowing maximum control range for the E. F. C. signal. The required control voltage is -5 volts to +5 volts dc (from an external source) connected to the rear-panel "E. F. C." connector; a negative control voltage increases oscillator frequency, a positive control voltage decreases the frequency; overall E. F. C. control range is greater than 4 parts in 10^8 . Since E. F. C. noise affects the oscillator stability, care must be taken to ensure that a relatively noise-free E. F. C. voltage source is used. When external E. F. C. control is not being used, the BNC shorting cap (P3) must be installed.

2-25. STANDBY BATTERY (MODEL 105B ONLY)

2-26. General

2-27. The only difference between the Model 105A and Model 105B Quartz Oscillators is that the Model 105B contains a 24-volt sealed-cell nickel-cadmium battery and the circuitry required for charging it. The battery "floats" across the 24 volt supply line and immediately supplies power if ac line power should fail. The battery can operate the Model 105B for up to 8 hours, after which an additional standby power source will be required to maintain uninterrupted output.

2-28. Relay A5K1 on the power supply board disconnects the internal battery from the load when the battery terminal voltage falls to 20 volts. The battery is automatically re-connected when ac power is applied to the instrument. The AC INTERRUPTION lamp lights whenever the Model 105B is operating from a dc source regardless of whether the source is internal or external; the light is turned off after ac power is restored by pressing the RESET pushbutton.

To prevent battery discharge during storage or shipment after disconnecting the 105B from the ac power, remove the top cover and press the internal switch S5 (see Paragraph 2-3).

2-29. Battery Charging

2-30. To maintain optimum battery standby capacity the battery should be given a "refresher" charge. Refresher charging consists of placing the FLOAT/FAST charging switch in the FAST position:

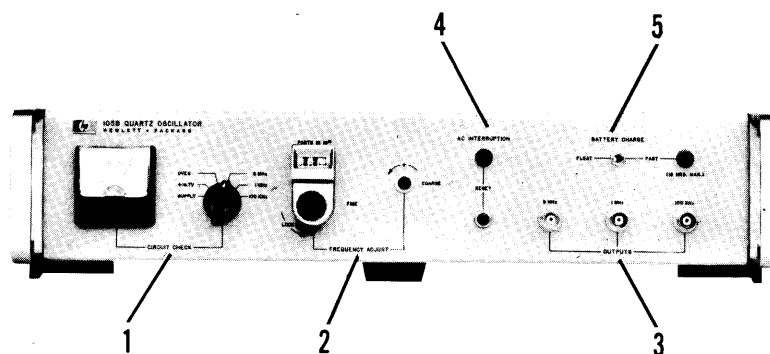
a. Whenever the standby battery has supplied power to the Model 105B. Charging time should be approximately twice the time that battery power was used; the maximum FAST charge time is 16 hours.

b. The standby battery should be checked and recharged every three to six months as part of a regular maintenance cycle (see Paragraph 4-32).

CAUTION

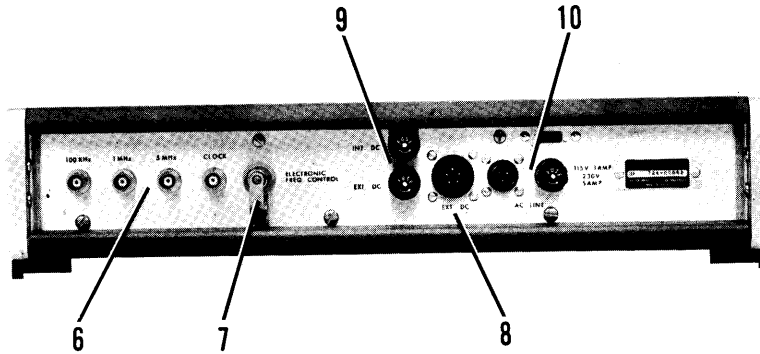
Overcharging may damage the battery; 16 hours is maximum FAST charging time.

Figure 2-2. Front Panel Controls, Connectors and Indicators



1. **CIRCUIT CHECK** meter and switch: meter indicates relative operation of circuit selected by CIRCUIT CHECK switch. Normal indication is 80.
2. **FREQUENCY ADJUST** Controls:
 - a. **COARSE**: Adjusts oscillator frequency by large increments.
 - b. **FINE**: Adjusts oscillator frequency by parts in 10^{10} with a maximum range of 500 parts in 10^{10} .
 - c. **PARTS IN 10^{10}** Counter: Indicates oscillator FINE FREQUENCY ADJUST in parts in 10^{10} with a maximum indication of 500 parts in 10^{10} .
3. **OUTPUTS**: 5 MHz, 1 MHz, 100 kHz sine waves; all are 1 volt rms into 50-ohm load, and are also available at rear-panel. Output waveforms will be distorted if not terminated with 50 ohms.
4. **AC INTERRUPTION** indicator lamp and RESET button (Model 105B only):
 - a. **AC INTERRUPTION** lamp. Indicates ac line voltage has been interrupted.
 - b. **RESET** button. Turns off AC INTERRUPTION lamp after power is restored.
5. **BATTERY CHARGE** (Model 105B only): Controls and indicates charge rate of internal standby battery.
 - a. **BATTERY CHARGE** switch. FLOAT and FAST positions determine charging current to internal standby battery.
 - b. **FAST CHARGE** indicator. Lights when BATTERY CHARGE switch is set to FAST position.

Figure 2-3. Rear Panel Connectors



6. **OUTPUTS:** 5 MHz, 1 MHz, 100 kHz sine waves; all are 1 volt rms into 50-ohm load and connected in parallel with similar front-panel outputs.
- CLOCK:** 1 MHz or 100 kHz, 0.5 volt rms into 1000 ohms.
7. **ELECTRICAL FREQ Control:** Allows greater than 4 parts in 10^8 frequency control for phase-locking, by +5 volt to -5 volt dc change from an external source.

Note

Shorting cap P3 must always be in place when not using external EFC. Leaving this cap off degrades Model 105A/B short term stability.

8. **EXT DC Connector.** Connect external standby-battery or power supply here (refer to Paragraph 2-18).

9. **INT DC, EXT DC fuse** (see table below):
- a. **INT DC:** Protects +24-volt dc line when ac line, internal battery or external battery power is used.
 - b. **EXT DC:** Protects +24-volt dc line when an external battery or power supply is used.

10. **AC LINE:**

- a. **Connector:** Connect ac power cord (supplied) here.
- b. **Fuse:** Use correct fuse for line voltage in use (see table below).
- c. **115/230 volt switch:** Set to match the ac voltage source being used (see Paragraph 2-17 for additional information).

Fuse	Rating	HP Part No.
AC LINE	115V: 1 amp., normal-blow	2110-0001
	230V: 0.5 amp., normal-blow	2110-0012
EXT DC	1 amp., normal-blow	2110-0001
INT DC	1 amp., normal-blow	2110-0001

SECTION III THEORY OF OPERATION

3-1. GENERAL

3-2. Except for the power supply differences described in Paragraph 3-35, the Model 105A and Model 105B Quartz Oscillators are identical; the information in Paragraphs 3-3 through 3-40 applies to either instrument.

3-3. All of the Model 105A/B output frequencies are derived from the basic 5 MHz frequency of a quartz crystal oscillator contained in an oven to reduce the effect of ambient temperature on its frequency. The 5 MHz output is connected to front- and rear-panel connectors and to a regenerative pentade divider to produce the 1 MHz output signals. The 1 MHz divider output is fed to front- and rear-panel connectors and to a regenerative decade divider to produce the 100 kHz outputs. The rear-panel CLOCK output connector can be connected to either the 100 kHz or 1 MHz clock output circuit on the 100 kHz Divider Assembly.

3-4. A dc voltage derived from each sine wave output is monitored by the CIRCUIT CHECK meter when the CIRCUIT CHECK switch is set to the position indicated by that output frequency. In the remaining switch positions (SUPPLY, +18.7 V, and OVEN), the meter monitors (respectively) the +24V supply, the +18.7 V supply, or the current through the proportionally controlled oven heater. For all CIRCUIT CHECK switch positions, the normal meter indication is "80", but the OVEN indication may vary slightly from this due to changes in ambient temperature.

3-5. 5 MHz OSCILLATOR ASSEMBLY A1

(Circuit Diagrams: Figures 7-3 through 7-6)

3-6. General

3-7. The 5 MHz Oscillator Assembly that is the "heart" of the Model 105A/B consists of a 5 MHz crystal oscillator and AGC circuit in a controlled-temperature oven, a power amplifier, and the oven temperature control circuits. The oven temperature is set at the factory to operate the crystal at a temperature where its temperature-frequency coefficient is minimum; that is, where changes in crystal temperature have the smallest effect on oscillator frequency. Placing the other oscillator and AGC circuit components inside this oven further improves the oscillator temperature-vs-frequency stability. Shielding, and decoupling networks in all leads except the 5 MHz output leads, reduce the amount of Radio Frequency Interference radiated or received by the Oscillator Assembly. The assembly is sealed at the factory; the only adjustments that can be made are coarse and fine tuning of the oscillator and tuning of the output filter. Any attempt to open the oven voids the warranty. (See Paragraph 4-5 for adjustment procedures, Paragraph 4-15 for repair information). Reference designators in Paragraphs 3-8 through 3-21

are abbreviated; for complete reference designators, add prefix "A1" to reference designator listed.

3-8. Oven Temperature Control

(Circuit Diagram: Figure 7-4)

3-9. GENERAL. Two heaters are used to maintain oven temperature; HR1, which is proportionally controlled to provide a continuous control of oven temperature; and HR2, which is thermostatically controlled, and is used to provide a fast warmup. In a proportionally controlled heater circuit, the heater current is a continuous function of oven temperature; in a thermostat-controlled heater circuit, the heater current is either "on" or "off", depending on oven temperature setting. Each heater circuit contains a thermal fuse to prevent damage to components within the oven due to overheating.

3-10. PROPORTIONAL TEMPERATURE CONTROL CIRCUIT.

Current through HR1 is controlled by A3Q4 in the dc controller, which is driven by amplifier A3Q2 through driver A3Q3. Diodes A3CR1 and A3CR2 are forward-biased, developing a constant 1.2 volts across them. The voltage across A3R8 depends on the heater current through it, and is added to the voltage across the diode pair to form the bias signal for A3Q2; this bias signal is "degenerative", increasing current through A3R8 makes A3Q2 base more positive, increasing A3Q2 conduction, which then causes A3Q4 conduction to decrease, decreasing the current through A3R8. The input signal to the dc controller is a negative-going voltage that increases as oven temperature decreases. (see Paragraph 3-11), causing heater current to increase as oven temperature decreases.

3-11. The ac controller consists of a Wien Bridge oscillator with emitter follower, and a detector to provide a dc signal voltage proportional to oven temperature, to the dc controller. The oscillator frequency (about 3 kHz) is determined by the phase-shifting network of the bridge (A1R1-A1C2 and A1R2-A1C1), which maximize the feedback at the oscillator frequency. The oscillator amplitude is determined by the level of the degenerative feedback signal to A1Q1 base, which depends on the setting of A1R3, the resistance of thermistor A1RT1, and the amplitude of the oscillator output signal. The thermistor resistance increases as its temperature decreases, decreasing the amount of degenerative feedback to A1Q1 base, causing the oscillator output level to increase. The increase in level causes the detector dc output voltage to A3Q2 base to be more negative, A3Q4 conduction increases, and the heater increases oven temperature.

3-12. 5 MHz Oscillator and AGC Assembly (Circuit Diagram: Figure 7-5)

3-13. GENERAL. The internal standard frequency is generated by a 5 MHz crystal-controlled oscillator within the oven. An AGC circuit, also contained within the oven, provides some amplification of the oscillator signal and AGC to the oscillator to prevent the mechanical vibrations of the crystal from becoming so large they would damage it. The crystal oscillator frequency is coarse-tuned mechanically by adjusting A2A1C7, and fine-tuned by applying a reverse-biasing voltage across varactor A2A1CR1. The frequency of the crystal filter in the Power Amplifier circuit can be tuned by adjusting A3R12. These are the only adjustments that can be made in the field, as the Oscillator Assembly is sealed at the factory and must not be opened; the procedure for making these adjustments is given in Paragraphs 4-5 and 4-27.

3-14. OSCILLATOR. Oscillator transistor A2A1Q1 drives the resonant circuit of A2A1L2, A2A1C6, A2A1C7, A2A1C9, and A2A1CR1. The feedback path is through ac voltage divider A2A1C10, A2A1C11, A2A1L3, A2A1C12 to A2A1Q1 base; capacitor A2A1C8 makes the junction of A2A1C11 and A2A1C12 a ground for the 5 MHz signal. Base bias for oscillator transistor A2A1Q1 is developed by the AGC circuit in A3; as the oscillator output level is increased, the forward base-emitter bias decreases, reducing the gain of the transistor.

3-15. The capacitance of varactor A2A1CR1 decreases as the reverse-biasing voltage across it increases, providing the means of controlling the oscillator frequency electrically. Oscillator frequency increases as the reverse-biasing voltage increases.

3-16. AGC ASSEMBLY. This assembly contains two tuned amplifiers, the AGC circuit, and the reference sources for the +6 volt supply for A2A1Q1 and the +15 volt reference used as the bias source for the EFC varactor A2A1CR1.

3-17. The open-loop gain of tuned amplifier stage A2A2Q1 is adjusted by A2A2R3; the closed-loop gain is determined by A2A2R9 and A2A2R10. The output of this amplifier is in phase with its input, and drives the tuned amplifier and AGC circuit A2A2Q2. One secondary winding of A2A2T2 provides an output signal that is in phase with the input signal from the oscillator; this signal is fed back to A2A2Q1 emitter to stabilize the gain of the amplifier pairs, to A2A2Q2 base to provide neutralization, and through A2A2C13 to the AGC detector circuit.

3-18. The AGC signal is a dc voltage, proportional in level to the level of the output signal from A2A2T2; it is subtracted from the bias established by A2A2R11 and A2A2R12 to provide the dc bias voltage that controls the gain of oscillator transistor A2A1Q1, decreasing the forward bias as the sensed output level increases.

3-19. Power Amplifier Assembly A1A3 (Circuit Diagram: Figure 7-6)

3-20. The Power Amplifier Assembly contains a buffer amplifier, crystal filter circuit, the oscillator

assembly output amplifier, and the dc controller that controls current through oven heater HR1 (see Paragraph 3-8).

3-21. The input to the buffer amplifier is the 100 mV 5 MHz signal from the AGC Assembly inside the oven. The buffer amplifier output signal drives the crystal filter, and through ac voltage divider A3C6-A3C8 produces the 70 mV rms output signal that is the input signal for 1 MHz Divider Assembly A3. The crystal filter output is connected to the output amplifier stage, which produces the 1-volt rms output signal. Output amplifier stage gain is adjusted by A3R19. The series capacitor-resistor networks in parallel with the emitter resistors in both the buffer amplifier and output amplifier stages are ac bypass networks used to hold these emitters at lower ac voltages than would be the case if these bypass networks were not present--this increases the ac signal gain of these stages, while the dc current through the transistors is limited by the large value emitter resistors.

3-22. 1 MHz DIVIDER ASSEMBLY A2 (Circuit Diagram: Figure 7-7)

3-23. General

3-24. The 1 MHz Divider circuit is a self-starting, regenerative divide-by-5 divider followed by an amplifier stage. This assembly includes signal-sensing logic circuitry to control the divider start circuits on this and the 100 kHz Divider Assembly, A3.

3-25. Starting the Divider

3-26. Assume that the 5 MHz signal from Oscillator Assembly A1 is present at the Divider Assembly input, but that the 1 MHz output has not started. Producing the 1 MHz output requires a 1 MHz signal at the base of the X4 Multiplier transistor Q2 (this 1 MHz is derived from the output signal once the divider starts). Prior to divider start, the required 1 MHz signal is obtained by converting the tuned amplifier circuit of Q5 into a 1 MHz oscillator by feeding a signal from its output back to its input through the field-effect transistor Q3.

3-27. The 5 MHz input signal is amplified by transistor Q1. Capacitive voltage divider C4-C5 couples a portion of the Q1 collector signal to a detector circuit consisting of CR3-CR4 and C14; the output of the detector circuit is applied to the base of the 5 MHz start transistor Q4, and biases it "on". In the absence of a 1 MHz output signal, the 1 MHz start transistor Q6 is also biased "on", completing a current path through Q6, Q4 and R12 to the +18-volt supply. Only when this condition exists is the positive bias at Q3 gate low enough to allow the transistor to conduct a signal from Q5 output to Q5 input (1 MHz).

3-28. The 1 MHz signal that results from oscillation of the Q5 amplifier circuit is fed to the X4 multiplier, Q2. This 4 MHz output signal is transformer coupled to the input signal line and mixes with the 5 MHz input signal in mixer diode CR2. The resulting 1 MHz signal is coupled to the input of Q5. The output of this stage is coupled through emitter follower Q8 to Q9 input. The output of amplifier Q9 is the signal that

appears at the front and rear panel 1 MHz connectors; this signal is detected by CR7, filtered, and the resultant dc connected to the CIRCUIT CHECK meter and monitored when the CIRCUIT CHECK switch is set to the 1 MHz position. A signal is also coupled through capacitive voltage divider C21-C22 to the 100 kHz divider.

3-29. The presence of a 1 MHz signal at the output of the Q5 amplifier stage is detected by CR5 and the resultant dc voltage is applied to the base of switch transistor Q7, turning it "on". When Q7 turns "on", its collector voltage becomes less positive; this voltage biases Q6 "off", interrupts current flow through Q4 and turns off divider stop transistor Q3. The divider circuits now function in a normal manner, with the 1 MHz signal at the Q2 base being derived from the output of Q5 amplifier stage. Transistor Q10, which is normally conducting, is biased "off" when Q7 turns "on". This causes a more positive voltage at Q10 collector, which is the "turn-on" voltage for the 1 MHz start transistor in the 100 kHz Divider Assembly.

3-30. 100 kHz DIVIDER ASSEMBLY A3

(Circuit Diagram: Figure 7-8)

3-31. The 100 kHz Divider circuit is a regenerative divide-by-10 divider followed by an amplifier stage. The divider circuits function in a manner identical to the 1 MHz Divider Assembly described in Paragraphs 3-22 to 3-29. The only major differences are that the input to the 1 MHz start transistor, Q5, comes from Q10, the 1 MHz switch on A2 (see Paragraph 3-29) and that this assembly contains the clock emitter-follower for both the 100 kHz and the 1 MHz clock outputs.

3-32. The rear-panel CLOCK connector may be connected to either the 1 MHz clock output (pin 5) or to the 100 kHz clock output (pin 14). Either output is at least 0.5V rms into 1000 ohms, and is suitable as a drive signal for an HP Model 115BR or 115CR Frequency Divider and Digital Clock.

3-33. POWER SUPPLIES

(Circuit Diagrams: Figure 7-9).

3-34. General

3-35. The Model 105A and Model 105B Oscillators are identical except for the additional circuitry required by the standby battery included only in the Model 105B. Because the rectifier and regulator portions of the two supplies are identical, the reference designators for similar parts are the same for both the Model 105A and 105B power supplies, and the discussion in Paragraphs 3-36 through 3-40 applies directly to both.

3-36. Rectifiers and Regulators

3-37. The Model 105A/B can be operated from either 115- or 230-volt ac power or 22 to 30-volt dc power. The basic power supply consists of the power transformer, and the +24 and +18 volt regulators. There is no line power switch, so the instrument is operating whenever it is plugged into an operating power source. Rear-panel slide switch S1 connects the power transformer primary windings in parallel for 115-volt op-

eration or in series for 230-volt operation; the oven fast warmup heater (A1HR2) is connected across one primary winding so it is always operating from a 115-volt source. Note that when the Model 105A/B is operating from a dc source no power is applied to the fast warmup heater, so a longer warmup time can be expected; also the 24-volt regulator does not operate when the Model 105A/B is operating from dc power.

3-38. The output of the rectifier circuit is connected to the +24 volt series regulator circuit. Breakdown diode A5CR6 establishes the reference voltage for Q1 base at 32 volts. The series regulator consists of two transistors connected in Darlington configuration for greater current gain than could be achieved with only one; this configuration acts like one transistor with high current gain in an emitter-follower circuit. The series regulator output is connected through CR8 to the +24-volt supply line, and through R7 to the CIRCUIT CHECK meter when the CIRCUIT CHECK switch is set to SUPPLY.

3-39. The +18.7-volt regulator drops the voltage of the +24-volt supply line to a regulated +18.7 volts, whether the Model 105A/B is operating from ac or 22- to -30-volt dc power. This circuit uses a differential amplifier to compare the +18.7 supply output voltage against a reference voltage, and adjust the conduction of transistor Q3 to maintain the level at +18.7V. The voltage at A5Q8 base is established by breakdown diode A5CR10B; the voltage at A5Q6 base is determined by the regulator output voltage level and the voltage drop across A5CR10A (this voltage drop is constant). Changes in regulator output voltage are coupled through A5CR10A to A5Q6 base, and then to A5Q8 emitter; changing conduction of A5Q6, which controls driver A5Q5. For example, if the output level decreases, the voltage at A5Q8 emitter becomes less positive, increasing the conduction of that transistor. This allows A5Q5 base current to increase, increasing the conduction of that transistor, decreasing the voltage drop across it to Q3 base. Since Q3 base is now more positive, and Q3 is operating as an emitter-follower, its emitter voltage (the +18.7-volt supply voltage) can go more positive, changing in a direction opposite to the initial change. The circuit works in a similar manner for increases in output voltage.

3-40. The current limiter in the +18.7-volt supply provides an additional (current-sensing) input for the differential amplifier that controls the supply. As current through A5R13 increases, the forward-biasing voltage across A5Q4 base-emitter junction increases; this makes conduction of the transistor increase and is sensed at A5Q6 base as an increase in output voltage; the circuit compensates for this apparent voltage increase by decreasing conduction of regulator transistor Q3, reducing the output current, opposing the initial change.

3-41. STANDBY BATTERY CIRCUITS

(Model 105B only)

(Circuit Diagrams: Figure 7-10)

3-42. At turn on, when ac power is initially applied, the +24 volt series regulator output forward-biases

Theory

A5Q7, causing AC INTERRUPTION lamp DS2 to light. The line voltage, rectified by A5CR4, and filtered by A5C2 and A5R10 is applied to the cathode of Silicon Controlled Switch A5CR9. When RESET button S2 is pressed, it completes a current path to ground through A5R12. The voltage across A5R11 forward-biases A5CR9 cathode-gate junction. The resulting current through A5CR9 develops a negative-going voltage across A5CR14 which is coupled through A5CR11 and A5CR12 to A5Q7 base, reverse-biasing A5Q7 and turning off the AC INTERRUPTION lamp. If ac power is interrupted, there is no dc voltage from A5CR4, no current flow through A5CR9 and no reverse bias at A5Q7 base; the dc voltage (+22V to +30) from standby battery BT1, coupled through A5CR7 and A5CR8 to the load and to A5Q7, forward-biases A5Q7 and lights the AC INTERRUPTION lamp. Pressing the RESET button will have no effect until ac power is restored.

3-43. Relay K1 is a latching-type relay requiring switching voltages to either of two separate coils in order to change states. The +24 volts output from series regulator Q1 and Q2 is coupled to A5Q3 base, A5Q2 base and A5Q1 base. With ac power applied, transistors A5Q2 and A5Q3 are forward-biased allowing current to flow. The current through A5R4 and the limiting action of A5CR3A reverse-biases A5Q1. Relay K1 energizes, connecting +24 volts to the load and completes the ground connection to standby battery BT1. The relay control circuit now functions as differential amplifier. If ac power is interrupted, the

standby battery continues power to the load. Voltage across the standby battery is monitored through A5CR3B at A5Q2 base. If the battery terminal voltage decreases to less than 20 volts, the change is sensed at A5Q2 base, and collector current decreases. The resulting A5R4 and A5Q1 emitter voltage change is less positive, increasing A5Q1 collector current, causing relay A5K1 to change state, disconnecting the standby battery from ground and the load.

3-44. The battery charging circuit has two charging rates selected by front-panel FAST/FLOAT switch S3. The FLOAT charge rate is 75 to 95 mA, determined by R8 and R9. The FAST position of S3 shorts R9, allowing a higher charging rate (330 to 390 mA). Battery current is controlled by A5Q3. The voltage drop across R8 and R9 is applied across the A5Q3 base-emitter junction. When battery charging current increases, A5Q3 conducts, increasing current through R3, causing Q1 series regulator base voltage to decrease and maintain the +24 volts output voltage below +30 volts, also limiting the series regulator output current.

3-45. Switch S5 is a disable switch to prevent BT1 from discharging when shipping or storing the Model 105A/B. Depressing S5 activates the relay control circuit by simulating a low battery voltage (see Paragraph 3-43) and disconnects BT1. When an external dc supply is connected, the +24 volt regulator circuits are not used.

SECTION IV MAINTENANCE

4-1. INTRODUCTION

4-2. This section contains maintenance and servicing information for the Model 105A and 105B Quartz Oscillators. Included are performance checks that can be made without removing covers.

4-3. RECOMMENDED TEST EQUIPMENT

4-4. Test equipment recommended for maintaining and checking performance of the oscillators is listed in Table 4-1. Test equipment having equivalent characteristics may be substituted for the equipment listed.

4-5. IN-CABINET PERFORMANCE CHECKS

4-6. General

4-7. The performance check in Table 4-2 verifies operation of oscillator circuits, and can be used:

- a. as part of an incoming inspection check of instrument performance;
- b. periodically, to anticipate troubles and ensure oscillator reliability;
- c. as part of a troubleshooting procedure to isolate trouble;
- d. after any repair or adjustment, before returning the instrument to regular service.

Table 4-1. Recommended Test Equipment

Instrument Type	Required Characteristics	Use*	Recommended Instrument
DC Electronic Multi-meter	Resistance Range: 1 ohm to 10 megohms Voltage Range: 0.1 to 30 volts full-scale Voltage Accuracy: $\pm 1\%$ of full scale Resistance Accuracy: $\pm 5\%$ of full scale	1, 2	HP Model 412A
RMS Voltmeter	Voltage Range: 0.3 volt to 3 volts full scale Frequency Range: 10 Hz to 10 MHz Accuracy: $\pm 5\%$ of full scale	1, 2	HP Model 3400A
Oscilloscope	Vertical Amplifier Frequency Response: dc to 10 MHz Maximum Sensitivity: 5 mV/cm Calibrated Sweeps: 0.5 ms/cm to 0.2 μ s/cm	1, 2	HP Model 175A with 1752A Plug-in and 11003A Probe
Electronic Counter	Frequency Range: 0 to 10 MHz Sensitivity: 100 mV rms Accuracy: ± 1 count, \pm time base accuracy	1, 2	HP Model 5245L
Attenuators (3 used)	Range: 120 dB in 10 dB steps Frequency: dc to 5 MHz	1	HP Model 355D
Feed Thru Termination	50 ohms male and female BNC connectors		HP Model 11048B
Signal Generator	Frequency: 50 kHz to 65 MHz Level: Adjustable 0V to 3V rms in 50 ohms	1	HP Model 606A
Tuned Voltmeter	Range: 70 dB in 10 and 2 dB steps Input Frequency: 1000 Hz Bandwidth: 130 Hz maximum	1	HP Model 415E
Mixer	2 inputs, 1 output for balanced mixing Noise: < 7 dB	1	HP Model 10514A
Quartz Oscillator	Frequency: 5 MHz Output Voltage: 1 V rms into 50-ohms Noise-to-Signal Ratio (5 MHz): ≥ 90 dB	1	HP Model 105A/B
Wave Analyzer	Range: 80 dB minimum Frequency: 50 kHz to 30 MHz Sensitivity: 1 microvolt	1	Airmec Type 853

*1, Performance Check; 2, Troubleshooting

Table 4-1. Recommended Test Equipment (cont'd)

Instrument Type	Required Characteristics	Use*	Recommended Instrument
Vector Voltmeter	Frequency: 1 MHz to 1 GHz Voltage Range: 1.5 mV to 1 V rms	1	HP Model 8405A
Recorder	Spans: 10 calibrated spans, 5 mV to 100V full scale Input resistance: 20 k-ohms per volt Accuracy: Better than 0.2% of full scale	1	HP Model 680
Matching Network	50 to 75-ohm Impedance Match	1	AD-YU Model 102A
Schmitt Trigger	<< than 1 μ sec jitter < than 1 μ sec risetime	1	
Digital to Analog Converter	Potentiometer Output: 100 mV full scale. Minimum load resistance 20K. Driving Source: Parallel entry 4-line BCD 1-2-2-4 (9 digits max.) "1" state +4 to +75 volts with reference to "0" state	1	HP Model 581A
Variable Power Transformer	Variable from 103V rms to 127V rms and 206V rms to 254V rms. *1, Performance Check	1	Superior Electric Power Stat 3 PF 116 (115V) 3 PF 216 (230V)

Table 4-2. In-Cabinet Performance Checks

OPERATIONAL CHECK
<p>1. CIRCUIT CHECKS</p> <p>The circuit checks below involve setting the CIRCUIT CHECK switch to its various positions and observing the indications on the instrument meter. The switch positions and "normal" indications are identical for both the Model 105A and 105B Quartz Oscillators. A meter indication of 70 to 90 is normal for all positions of the switch when the ambient temperature is 25°C and all OUTPUT connectors are unterminated. Refer to Section II, Paragraph 2-19, for information on initial conditions after turn-on. Perform the circuit checks as follows: set CIRCUIT CHECK switch to SUPPLY, OVEN, +18.7 VOLTS and to 5 MHz, 1 MHz, and 100 kHz positions. Meter indication should be 70 to 90 for all positions, indicating normal instrument performance (5 MHz OUTPUT should not be terminated).</p>
<p>2. OUTPUT VOLTAGES AND WAVEFORMS</p> <p>In addition to the circuit checks, the following checks can be performed, using equipment listed in Table 4-1, to observe waveforms and voltages of the output signals.</p> <ol style="list-style-type: none"> a. Terminate each output except the CLOCK output with a 50-ohm load and connect an AC Voltmeter to each front-panel OUTPUT jack. The output levels should be at least 1 volt rms. b. Repeat step a, using an Oscilloscope. The signals should all be sine waves with no apparent distortion. c. Terminate the CLOCK output with a 1000-ohm resistor and connect an ac voltmeter to the CLOCK output. Output level should be at least 0.5 volt rms. d. Repeat step c using an oscilloscope. The output should be a 1 MHz sine wave with no apparent distortion.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 105A/B Quartz Oscillator Serial No. ___ - ___	Tests Performed by _____ Date _____
-------------------------------------------------------------------------------	--------------------------------------------

OPERATIONAL CHECKS

Description	Check
(Table 4-2)	
1) Circuit Check Meter	<input type="checkbox"/> 70 to 90, All positions
2) Output Voltage	<input type="checkbox"/> 0.5V RMS CLOCK, all others 1V rms min.
Output Waveforms	<input type="checkbox"/> Clean Sine Waves, all OUTPUTS.
3) Frequency on Oscilloscope	<input type="checkbox"/> Adjusted for zero movement

PERFORMANCE CHECKS

Description	Check
(Table 4-2)	
1) Signal-to-Noise Ratio. > 90 dB below rated output; (filter bandwidth 3 dB = 100 Hz)	<input type="checkbox"/> > 90 dB
2) RMS Fractional Frequency Deviation (due to noise and frequency fluctuations)	<input type="checkbox"/> > 1×10^{-11} for averaging times of 0.1, 1 and 10 seconds
3) Non-Harmonic Distortion; > 80 dB from rated output	<input type="checkbox"/> > 80 dB
4) Harmonic Distortion; > 40 dB from rated output	<input type="checkbox"/> > 40 dB
5) Stability; as a function of load < $\pm 2 \times 10^{-11}$	<input type="checkbox"/> < 2×10^{-11}
as a function of temperature	<input type="checkbox"/> < 2×10^{-11}
as a function of supply voltage, < 2×10^{-11}	

Table 4-2. In-Cabinet Performance Checks (cont'd)

3. OSCILLATOR FREQUENCY CHECK AND ADJUSTMENTS

Application Note 52 is supplied with the instrument and indicates several methods and systems for determining oscillator frequency error. Use the Application Note as a guide in operating your system. Paragraph 2-21 of this operating and service manual outline a daily procedure which includes instructions for calculating frequency error and making adjustments to correct the error.

NOTE: The aging rate of the Model 105A and 105B Oscillators is specified as less than ± 5 parts in 10^{10} per 24 hours; achieved typically within 10 days of continuous operation.

Frequency adjustments can be made after determining the oscillator frequency error of the Model 105A/B. The basic 5 MHz oscillator frequency can be adjusted as required to obtain the desired frequency. The COARSE FREQUENCY ADJUST has a control range of 1 part in 10^6 . The FINE FREQUENCY ADJUST has a control range of 5 parts in 10^8 , with digital dial reading in parts in 10^{10} . Frequency adjustment is made by comparing the Model 105A/B 5 MHz OUTPUT frequency against a reference 5 MHz frequency standard and displaying the difference on an oscilloscope; then adjusting the Model 105A/B for a stationary pattern. Using test equipment listed in Table 4-1, proceed as follows:

- a. Connect reference 5 MHz to sweep input of oscilloscope.
- b. Connect Model 105A/B 5 MHz to oscilloscope vertical amplifier input.
- c. Adjust oscilloscope sweep time to display 10 cycles of Model 105A/B waveform.
- d. Set the FINE FREQUENCY ADJUST so PARTS IN 10^{10} meter reads "250", then use a screwdriver to adjust the COARSE FREQUENCY ADJUST to bring the oscillator "on frequency."
- e. The rate of movement of the oscilloscope display is related to the frequency difference between the Model 105A/B and the reference source. Model 105A/B can be adjusted to within 2 parts in 10^9 . Example:

$$\text{Frequency error} = \frac{\Delta f}{f} = \frac{\Delta t}{t} = \frac{1 \times 10^{-2}}{5 \times 10^6} = 2 \times 10^{-9}$$

$$\begin{aligned} \text{where } f &= 5 \text{ MHz,} \\ \Delta f &= .01 \text{ Hz/sec} \end{aligned}$$

PERFORMANCE CHECK

1. SIGNAL-TO-NOISE RATIO

Figure 4-1 is the block diagram of a system used to test signal-to-noise ratio. The equipment used is listed in Table 4-1; equipment with equivalent characteristics may be used. Perform the signal-to-noise test as follows:

Note

The Model 415E tuned voltmeter is calibrated for an input from a square law device (output voltage proportional to power input). The 415E RANGE switch setting and the meter readings must be doubled when using the voltmeter in the circuit of Figure 4-1. That is, an indication of 10 dB on the Range switch is actually 20 dB, and a reading of 5 dB on the meter scale is actually 10 dB in this application.

- a. Connect test equipment as in Figure 4-1, but do not connect "Reference" 105A/B to Mixer "R" port at this time.
- b. Set number 2 attenuator to 0 dB.
- c. Connect rms voltmeter to "Tee" connector at Mixer "L" port.
- d. Observe and record rms voltmeter reading.

(Cont'd)

Table 4-2. In-Cabinet Performance Checks (cont'd)

SIGNAL-TO-NOISE RATIO (cont'd)

Figure 4-1
Test Setup, Signal-to-Noise Ratio

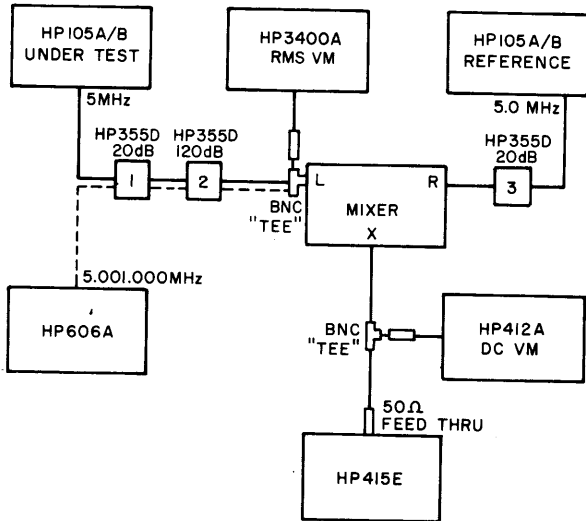
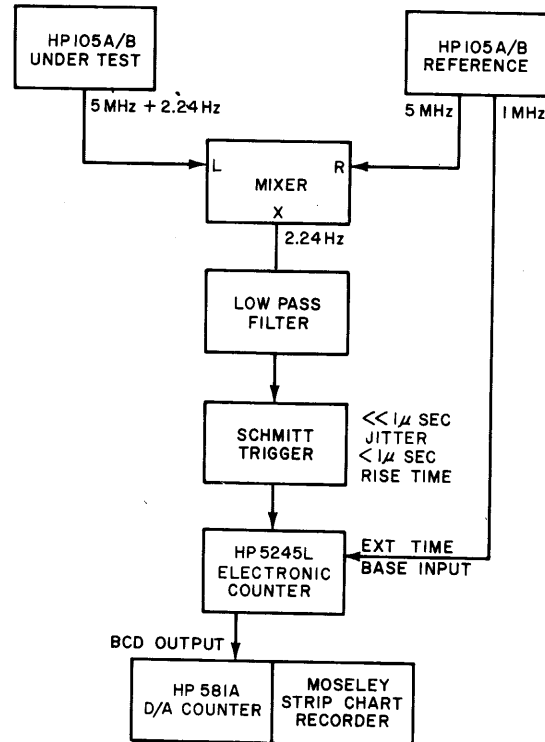


Figure 4-2
Test Setup for RMS Deviation of 5 MHz Output



- e. Replace 105A/B under test with 606A signal generator set to 5.001000 MHz, and adjust its level to that recorded in step d.
- f. Set number 2 attenuator to 100 dB.
- g. Connect the "Reference" 105A/B to Mixer "R" port.
- h. Set 415E RANGE switch to 60 dB.
- i. Tune 415E FINE FREQUENCY control for maximum on 415E meter. When maximum 415E meter reading is obtained, adjust 415E COARSE and VERNIER GAIN controls for 0 dB reading; this is the reference for all signal-to-noise measurements.
- j. Remove 606A and substitute with 105A/B to be tested.
- k. Connect 412A to BNC "Tee" connector at "X" port of Mixer. Adjust the reference 105A/B COARSE and FINE frequency controls for a quadrature-phase condition indicated by zero volt reading on 412A. Disconnect 412A.
- l. Remove attenuation from number 2 attenuator until a reading is obtained on 415E. This will be the signal-to-noise ratio and must be 90 dB or greater.

2. RMS DEVIATION OF 5 MHz OUTPUT

The rms deviation of the 5 MHz OUTPUT (due to noise and frequency fluctuations) is specified as less than 1×10^{-11} for averaging times of 0.1 second, 1 second, and 10 seconds. The system shown in Figure 4-2 checks this rms deviation at averaging times of 0.447 second. For this test a reference Model 105A/B or equivalent, offset +2.24 Hz at 5 MHz is required. Perform test as follows:

(cont'd)

Table 4-2. In-Cabinet Performance Checks (cont'd)

RMS DEVIATION OF 5 MHZ OUTPUT (cont'd)

- a. Connect equipment as shown in Figure 4-2.
- b. Connect reference 105A/B 5 MHz OUTPUT to Mixer R input.
- c. Connect 5 MHz OUTPUT of 105A/B under test to Mixer L input.
- d. Connect Mixer X output to counter input through Schmitt Trigger circuit.
- e. Connect reference 1 MHz OUTPUT to Counter EXT. TIME BASE INPUT.
- f. Connect BCD output from counter to BCD input of D/A Converter.
- g. Connect POTENTIOMETER RECORDER output of Converter to strip chart recorder input.
- h. Set Counter function to 10 PERIOD AVERAGE and TIME BASE to 0.1 μ sec.
- i. Set Converter column selector to columns 2, 3, 4.
- j. Set recorder chart speed to 8 major divisions per hour.
- k. Adjust COARSE frequency of 105A/B under test so counter reads .445 to .449 seconds. Under these conditions the full-scale deflection on the strip chart recorder will be 1×10^{-10} .
- l. Record for 10 minutes and note frequency deviation per major division. The rms fractional frequency deviation for this sampling time must not exceed 1×10^{-11} .

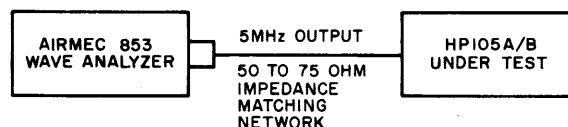
3. NON-HARMONIC DISTORTION

Non-harmonically related distortion at the 5 MHz, 1 MHz and 100 kHz outputs is at least 80 dB below the 1 volt rms output level. To measure non-harmonic distortion, a wave analyzer is tuned to the fundamental frequency to establish a reference level, and then tuned between 4 MHz and 6 MHz to check for spurious signals.

For the non-harmonic distortion check, an Airmec Type 853 Wave Analyzer is used (see Figure 4-3). A wave analyzer with equivalent characteristics may be substituted.

- a. Connect Model 105A/B to a power source and allow it to stabilize.
- b. Connect 5 MHz OUTPUT through a 50- to 75-ohm impedance matching network to the wave analyzer input.

Figure 4-3. Test Setup for Harmonic and Non-Harmonic Distortion Checks



- c. Tune the wave analyzer to 5 MHz and set its attenuators for a red-line indication at 100 dB. The wave analyzer is now calibrated at 100 dB from the 1 volt rms output.

(cont'd)

Table 4-2. In-Cabinet Performance Checks (cont'd)

NON-HARMONIC DISTORTION (cont'd)

- d. Tune the Wave Analyzer from 4 to 6 MHz and remove attenuation from the attenuators until a reading is obtained. All readings throughout this range (except 5 MHz) must be below 80 dB. Verify that the 4 MHz, 4.9 MHz, 5.1 MHz and 6 MHz components are below 80 dB.
- e. Remove the connection from the 5 MHz output and connect wave analyzer to the 1 MHz output.
- f. Tune the Wave Analyzer to 1 MHz and recalibrate for a reference of 100 dB below the output level.
- g. Tune the Wave Analyzer from 900 kHz to 1.1 MHz and remove attenuation until a reading on the wave analyzer meter is indicated. All spurious signals must be at least 80 dB below the output level.
- h. Tune the Wave Analyzer to 100 kHz and recalibrate for a reference of 100 dB below the output level.
- i. Tune the Wave Analyzer from 100 kHz to 1 MHz and remove attenuation until a reading is indicated on the wave analyzer meter. All spurious signals must be at least 80 dB below the output level.

4. HARMONIC DISTORTION CHECKS

Harmonic distortion in the 5 MHz, 1 MHz and 100 kHz outputs is specified as at least 40 dB below the 1 volt rms output. To measure harmonic distortion, a wave analyzer is tuned to the fundamental to establish a reference level. The analyzer is then tuned to the harmonic signals and their amplitude is measured. For this measurement, an Airmec Type 853 Wave Analyzer is used (see Figure 4-3). A wave analyzer with equivalent characteristics may be substituted. The measurements are made as follows:

- a. Connect the Model 105A/B to a power source and allow to stabilize.
- b. Connect the 5 MHz OUTPUT through a 50- to 75-ohm impedance matching network to the INPUT of the wave analyzer (see Figure 4-3).
- c. Tune the wave analyzer to 5 MHz and set its attenuators for a red-line indication at 100 dB. The wave analyzer is now calibrated at 100 dB from the 1 volt rms output.
- d. Tune the wave analyzer to 10 MHz and remove attenuation from the attenuators until a reading is obtained. The level of second harmonic signal must be below 40 dB.
- e. Repeat steps c and d for 15 MHz, and 20 MHz.
- f. Connect wave analyzer INPUT to the 1 MHz OUTPUT through the 50- to 75-ohm matching network. Tune the wave analyzer to 1 MHz and adjust the attenuators for a red-line indication at 100 dB. The wave analyzer is now calibrated at 100 dB from the 1 volt rms output.
- g. Tune the analyzer to 2 MHz and remove attenuation from the attenuators until a reading is obtained. The level of second harmonic signal must be below 40 dB.
- h. Repeat steps f and g for 3 MHz and 4 MHz.
- i. Connect the 100 kHz OUTPUT to the wave analyzer INPUT through the 50- to 75-ohm matching network. Tune the wave analyzer to 100 kHz and adjust the attenuators for a red-line indication at 100 dB. The wave analyzer is now calibrated at 100 dB from the 1 volt rms output.
- j. Tune the analyzer to 200 kHz and remove attenuation until a reading is obtained on the analyzer. The level of second harmonic signal must be below 40 dB.
- k. Repeat steps i and j for 300 kHz, 400 kHz, 500 kHz. This completes the harmonic distortion checks. All readings must be below 40 dB.

Table 4-2. In-Cabinet Performance Checks (cont'd)

5. STABILITY

Stability specifications for the 5 MHz output are as follows:

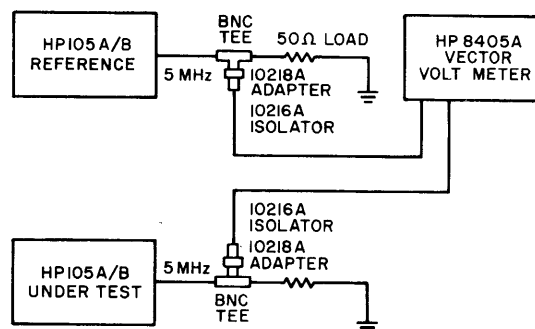
- a. as a function of ambient temperature: less than 2.5×10^{-9} from 0°C to +50°C.
- b. as a function of load: less than $\pm 2 \times 10^{-11}$ for open circuit to short circuit, and 50-ohms, R, L, and C load changes.
- c. as a function of supply voltage: less than $\pm 5 \times 10^{-11}$ for 10% change from nominal (115 or 230 vac) line voltage or a dc voltage change between 22 and 30 volts.

Figure 4-4 is the block diagram of a system used to test the stability as a function of temperature, load, and supply voltage. The equipment used is listed in Table 4-1; equipment with equivalent characteristics may be used.

Perform the stability test as follows:

- a. Connect equipment as shown in Figure 4-4.
- b. Connect channel A of voltmeter to reference source and channel B to oscillator under test.
- c. Set oscillator under test to same frequency as reference source by adjusting Test 105A/B COARSE and FINE frequency for minimum movement on most sensitive range of voltmeter RANGE and METER OFFSET.
- d. Set PHASE METER ZERO and OFFSET for zero.
- e. Record PHASE METER reading after 100 sec.

Figure 4-4. Test Setup for Stability



- f. Determine frequency difference between A and B inputs using following equation:

$$\text{Since } 360^\circ/\text{sec} = 1 \text{ Hz, then } \frac{360^\circ/\text{sec}}{1 \text{ Hz}} = \frac{\Delta \phi / \Delta t}{\Delta f}$$

solving for Δf ,

$$\Delta f = \frac{\Delta \phi}{360^\circ(\Delta t)}$$

Δt = time in seconds, required for the phase change measured.

Δf = frequency difference between input signals.

$\Delta \phi$ = phase change in degrees (8405A reading).

Dividing Δf by the frequency of the reference oscillator then gives the frequency difference in proportional parts. Example:

Standard frequency $f = 5 \text{ MHz}$.

$\Delta \phi$ measured on 8405A = 1.3° .

$\Delta t = 100$ seconds.

$$\frac{\Delta f}{f} = \frac{\Delta \phi}{\Delta t(360^\circ)(f)} = \frac{1.3^\circ}{360^\circ(100)(5 \times 10^6)} = \frac{1.3}{1.8 \times 10^{11}}$$

$$= 7.2 \times 10^{-12} \text{ or } 7.2 \text{ parts in } 10^{12}.$$

- g. Repeat step f after 24 hours; stability should be ≤ 5 parts in 10^{10} .

To check oscillator stability as a function of temperature, place oscillator under test in a controlled temperature chamber. Set temperature to 0°C and after 4 hours perform stability test. Stability should be as stated in Table 1-1. Set temperature to 50°C and after 4 hours repeat the above test. Stability should be as stated in Table 1-1.

(cont'd)

Table 4-2. In-Cabinet Performance Check (cont'd)

STABILITY (cont'd)

To check oscillator stability with load change, leave system connected as for temperature check with the temperature now set to 25°C. Remove all loads from oscillator under test. Perform stability test with the following loads on 5 MHz OUTPUT: open circuit, 50-ohm resistive, inductive and capacitive. To perform stability test with 5 MHz OUTPUT shorted, leave system connected as in temperature check and connect vector voltmeter channel A to reference source 1 MHz OUTPUT and channel B to 1 MHz OUTPUT of unit under test.

To check oscillator stability with supply voltage changes, leave system connected as for temperature test. Without interrupting power, connect oscillator under test to +22 to +30 volt dc source and perform stability test. Stability should be as stated in Table 1-1. Repeat test with oscillator connected to variable line voltage source set to 103 Vac and then to 127 Vac. Stability should be as stated in Table 1-1.

4-8. MAINTENANCE AND REPAIR

4-9. Replacing Power Supply Transistors Requiring Heat Sinks

4-10. When replacing a transistor requiring a heat sink, coat the transistor case and both sides of the heat sink with silicone grease before installing the transistor. Dow Corning No. 5 compound silicone grease (HP Part No. 8500-0059) is recommended. If the transistor installation includes an insulating mica washer, also coat the washer on both sides.

4-11. Servicing Etched Circuit Boards

4-12. When removing etched circuit boards for servicing, always remove ac line power, and external dc power if used. Press BATTERY DISABLE switch S5 to disconnect internal standby battery (Model 105B only). Power should be restored to the instrument quickly to maintain Oscillator Assembly operating temperature.

4-13. To remove plug-in circuit board A2, A3, or A5, grasp the edge opposite the plug and pull with a slight rocking movement. Use caution when removing boards to avoid damaging components. The HP Part number appears on the circuit board for identification. Refer to Section V for replacement parts and HP Part number information.

4-14. The etched circuit boards are a plated-through type. Electrical connections between sides of the boards are made by a layer of metal plated through holes in the boards. When working on etched circuit boards, use a low heat (20 to 50 watts), small tip (1/16 to 3/32 inch diameter) soldering iron and a small diameter rosin core solder. Components can be removed by placing soldering iron on component lead on either side of board, then pulling on lead from component side of board. If a component is obviously damaged or faulty, clip leads close to component and then remove the leads. Excessive or prolonged heat can lift circuit foil from board or damage components. The component lead hole should be cleaned before inserting a new lead. Heat solder in the hole, remove soldering iron, and immediately insert a pointed, non-metallic object such as a toothpick. When hole is clean, shape the new component leads, insert them in

the holes, reheat with soldering iron and add solder as necessary to obtain a good electrical connection. After soldering, clean excess flux from connection and adjoining area.

4-15. Repair and Troubleshooting of Oscillator Assembly

4-16. The oscillator assembly A1 is not field repairable. The instrument warranty is voided if repair is attempted inside the assembly. Adjustments other than those provided at front of the oscillator assembly (see Paragraphs 2-23 and 4-27) will also void warranty. If it is established that a defective component or circuit trouble exists within the oscillator or oven assembly, contact the nearest HP sales and service office for shipping instructions (see Paragraph 2-5 for packaging information). Oscillator assembly failure can be verified by using the front-panel meter and Table 4-3 as a troubleshooting guide. Trouble in the Oscillator Assembly can occur in two areas:

- 1) 5 MHz oscillator circuits;
- 2) Oven temperature circuits.

Oscillator failure can be identified by using checks in Table 4-3. Oven failure (open thermal-links, open heater, etc.) is typically identified by a full-scale or zero meter reading in OVEN position (see Table 2-2 for normal operating indications). Failure of other oven components can be determined by monitoring oscillator performance over a period of time.

4-17. TROUBLESHOOTING

4-18. If performance checks indicate an instrument malfunction, perform a self-check using the front-panel CIRCUIT CHECK switch and MONITOR meter. Table 2-2 lists normal operating values for the meter indications. Table 4-3 lists a logical procedure starting from the 100 kHz, 1 MHz or 5 MHz output for isolating trouble. The numbered waveforms correspond to test points marked on the schematic drawings and component locators. After the trouble has been isolated to a particular section or stage, voltage and resistance checks can be made to determine the defective component.

4-19. FREQUENCY DIVIDER ADJUSTMENTS

4-20. General

4-21. The following tuning procedure can be performed after repair, when the 1 MHz or 100 kHz divider will not start, or when either frequency output level is below 1.0 volt rms. The procedure is outlined in two parts: 1) 1 MHz divider tuning, and 2) 100 kHz divider tuning. When only one of these circuits is suspected, perform that tuning procedure first.

4-22. Tuning Procedure

4-23. ASSEMBLY REMOVAL. The frequency divider assembly must be removed from its position and mounted on extender board provided to expose tuning adjustments. Power must be removed from the instrument during removal, as described in Paragraph 4-12.

4-24. 1 MHz DIVIDER TUNING. To align the 1 MHz divider, use test equipment recommended in Table 4-1 and proceed as follows:

a. Mount the 1 MHz divider board on the 15-pin extender board provided.

b. Connect oscilloscope to Q1 collector and tune T1 for maximum.

c. Connect frequency counter to 1 MHz CLOCK output J10.

d. Tune C19 for 1 MHz readout on counter.

e. Connect oscilloscope probe to CR2 cathode. Tune T2 for same indication as in Table 4-3, item 2. Adjust T2 for maximum on oscilloscope while maintaining 1 MHz output at J10.

f. Connect an ac voltmeter, terminated with 50 ohms, to 1 MHz output connector J6. Adjust T3 for maximum output. Output should be 1.0 volt rms or more.

g. Remove extender board and re-install 1 MHz divider board in 105A/B.

4-25. 100 kHz DIVIDER TUNING. To align the 100 kHz divider, use test equipment recommended in Table 4-1 and proceed as follows:

a. Mount the 100 kHz divider board on the 10-pin extender board provided.

b. Connect oscilloscope probe to Q1 collector and tune T1 for maximum.

c. Connect frequency counter to 100 kHz output jack J8.

d. Tune L6 and T2 for 100 kHz on counter.

e. Connect oscilloscope probe to CR2 cathode. Tune T2 for same indication as in Table 4-3, Item 7. Adjust T2 for maximum on oscilloscope while maintaining 1 MHz output at J8.

4-26. When maintenance has been performed on the 1 MHz or 100 kHz dividers, the Non-Harmonic and Harmonic checks listed in Table 4-2, No. 3 and No. 4 should be performed.

4-27. 5 MHz Filter Tuning

4-28. The 5 MHz filter in oscillator Assembly A1 does not normally require tuning until the instrument has been operated for one year or more. If the 5 MHz OUTPUT level decreases below 1.0 volt rms, the 5 MHz filter may be tuned as follows:

a. Disconnect power from instrument. Remove top and bottom covers. Remove oscillator mounting screws located on bottom of instrument. Lift front of oscillator to expose the 5 MHz Filter tuning access, and reconnect power.

b. Connect a voltmeter or oscilloscope, terminated with 50 ohms, to 5 MHz OUTPUT.

c. Insert an insulated, flat-bit tuning tool into 5 MHz filter tuning access hole exposed in step a and tune trimmer capacitor A1A3C10 for maximum indication on voltmeter or oscilloscope. This completes 5 MHz Filter tuning.

d. To re-install oscillator assembly, reverse procedure of step a.

4-29. Regulated Power Supply Voltages

4-30. MODEL 105A. Regulated power supplies provide +24 (nominal) and +18.7 volts dc. Neither supply is adjustable. To check output voltage and regulation connect instrument to a variable ac voltage source and proceed as follows:

a. Connect a dc voltmeter to series regulator output A5(17), and set ac line voltage to 115 vac. Dc voltmeter should indicate +28 to +32 volts.

b. Vary the ac line voltage from 103 vac to 127 vac. Dc output voltage should remain between +28 and +32 volts.

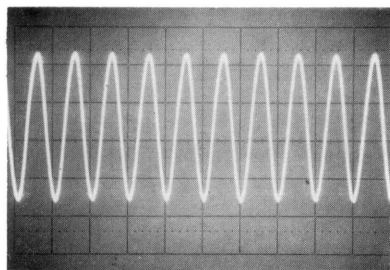
c. Connect dc voltmeter to A5CR10A cathode, +18.7 volt supply and set line voltage to 115 vac. Dc voltmeter should indicate +18.6 to +18.8 volts.

d. Vary the ac line voltage from 103 vac to 127 vac. Dc output voltage should remain between +18.6 and +18.8 volts.

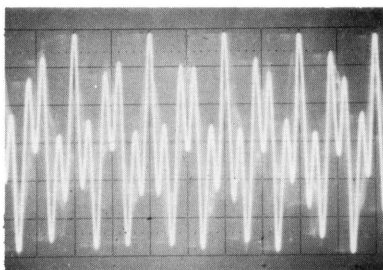
4-31. MODEL 105B. Regulated power supplies provide +24 (nominal) and +18.7 volts dc. An internal battery (when fully charged) provides up to 8 hours operation in case of ac line voltage failure. To check output voltage and regulation of the supplies, connect instrument to variable ac voltage source and proceed as follows:

a. Connect a dc voltmeter to series regulator output A5(17), and set ac line voltage to 115 vac. Dc voltmeter should indicate +26 to +28 volts.

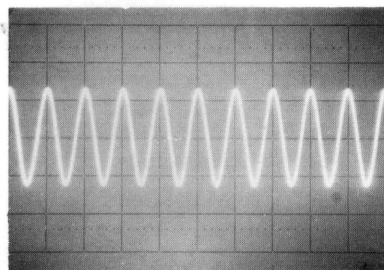
Table 4-3. Troubleshooting Chart



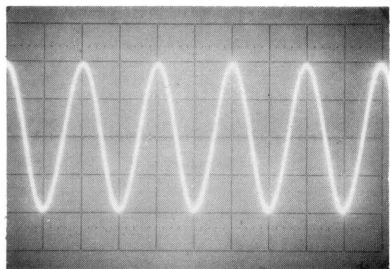
1 5 MHz .2 μ sec/cm
.05 V/cm



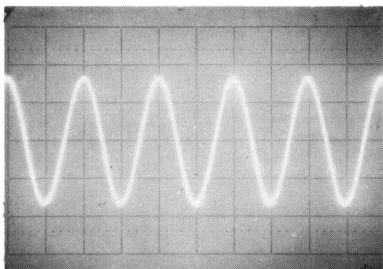
2 .2 μ sec/cm
.5 V/cm
Divider active



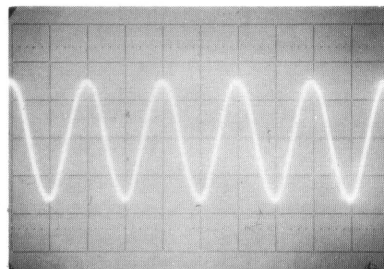
3 .2 μ sec/cm
.5 V/cm
Divider inactive



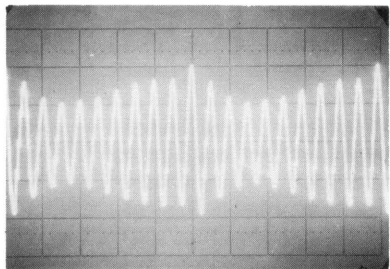
4 .5 μ sec/cm
1 V/cm



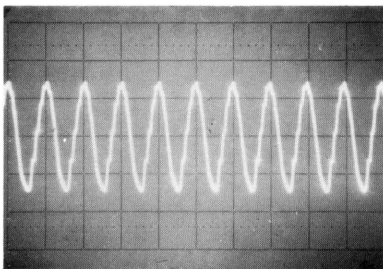
5 .5 μ sec/cm
1 V/cm



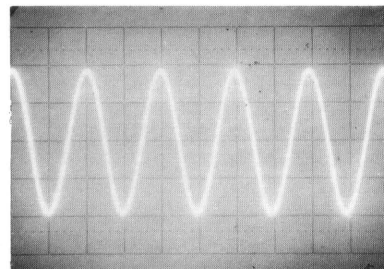
6 .5 μ sec/cm
1 V/cm



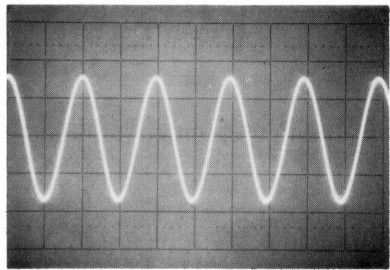
7 2 μ sec/cm
.5 V/cm
Divider active



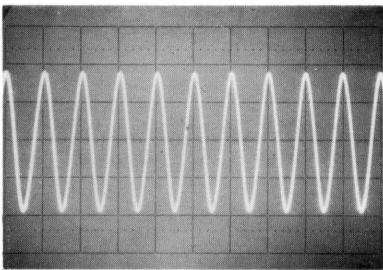
8 1 μ sec/cm
.5 V/cm
Divider inactive



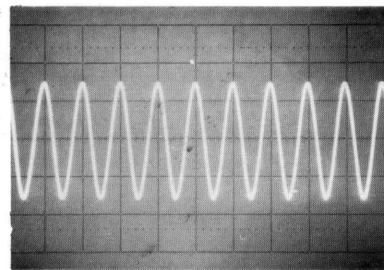
9 5 μ sec/cm
2 V/cm



10 .2 μ sec/cm
1 V/cm

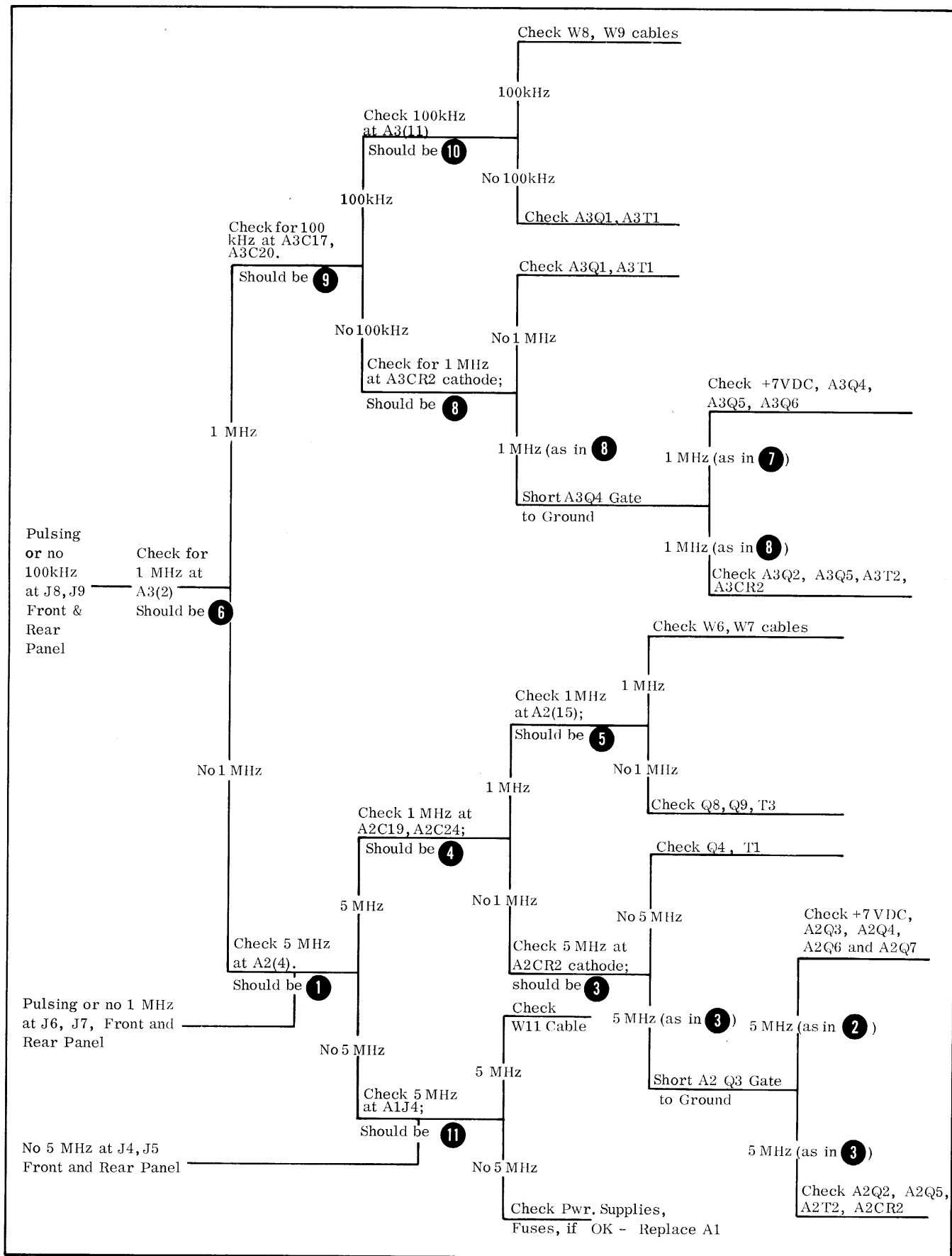


11 .2 μ sec/cm
.05 V/cm



12 .2 μ sec/cm
1 V/cm

Table 4-3. Troubleshooting Chart (cont'd)



Model 105A/B
Maintenance

b. Vary the ac line voltage from 103 to 127 vac. Dc output voltage should remain between +26 and +28 volts.

c. Connect a dc voltmeter to A5CR10A cathode, +18.7 volt supply and set line voltage to 115 vac. Dc voltmeter should indicate +18.6 to +18.8 volts.

d. Vary the ac line voltage from 103 to 127 vac. Dc output voltage should remain between +18.6 and +18.8 volts.

4-32. Battery Check (105B Only)

4-33. The condition of the batteries in the Model 105B can be checked using equipment listed in Table 4-1 as follows:

a. Unplug the Model 105B ac line cord so that the internal battery supply is operating with normal load and supplying power to the oscillator.

b. Set CIRCUIT CHECK switch to SUPPLY.

c. The front-panel meter indication should be greater than 55. A meter indication of less than 55 represents a battery voltage of about 20 to 22 volts. Verify the battery voltage with a dc voltmeter connected across terminals D and C of the rear-panel 24 VDC connector.

d. If the monitor meter indication is 45 to 55 and the dc voltmeter check is less than 22 volts, the battery is not fully charged or one or more cells are defective and battery should be charged.

e. To charge battery, plug in the AC line cord, set BATTERY CHARGE switch to FAST, and charge for 16 hours maximum.

f. Repeat steps a through c. If the battery again fails the test of a through c, a new battery should be installed. Refer to Paragraph 4-35 for installation instructions.

g. The battery should be checked and recharged every 3 to 6 months as part of a regular maintenance cycle.

4-34. Replacing Internal Battery Supply (Model 105B Only)

4-35. If the procedure in Paragraph 4-32 establishes that the internal battery does not provide 20 volts minimum after supplying power for 8 hours, replace the battery. The battery must be replaced with ac power removed. Do not short battery leads to each other or to ground when soldering battery connections. Proceed as follows:

a. Remove ac power to instrument.

b. Remove screws in top cover and lift off cover.

c. Press battery disconnect switch S5.

d. Unsolder the wht/vio/blk wire from the negative battery terminal and the wht/red/blk wire from the positive battery terminal.

e. Place the Model 105B on its side with the battery down.

f. Remove four mounting screws securing the battery in place (battery cover and inner plastic spacer will now come loose).

g. Slide battery out of instrument.

h. Slide the new battery into the Model 105B, taking care that the negative and positive leads are not pinched beneath the battery.

i. Solder the wire connections to the new battery, reversing the procedure of step d.

j. When battery has been installed, return instrument to its normal position and install the 4 mounting screws removed in step f and the cover removed in step b, and reconnect to ac power.

SECTION V REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section contains information for ordering replacement parts. Table 5-1 lists parts in alpha-numerical order of their reference designators and indicates the description and HP part number of each part, together with any applicable notes. Table 5-2 lists parts in alpha-numerical order of their HP part number and provides the following information on each part.

- a. Description of the part (see list of abbreviations below).
- b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 5-3.
- c. Manufacturer's part number.
- d. Total quantity used in the instrument (TQ column).

5-3. Miscellaneous parts are listed at the end of Table 5-1.

5-4. ORDERING INFORMATION

5-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Sales and Service office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

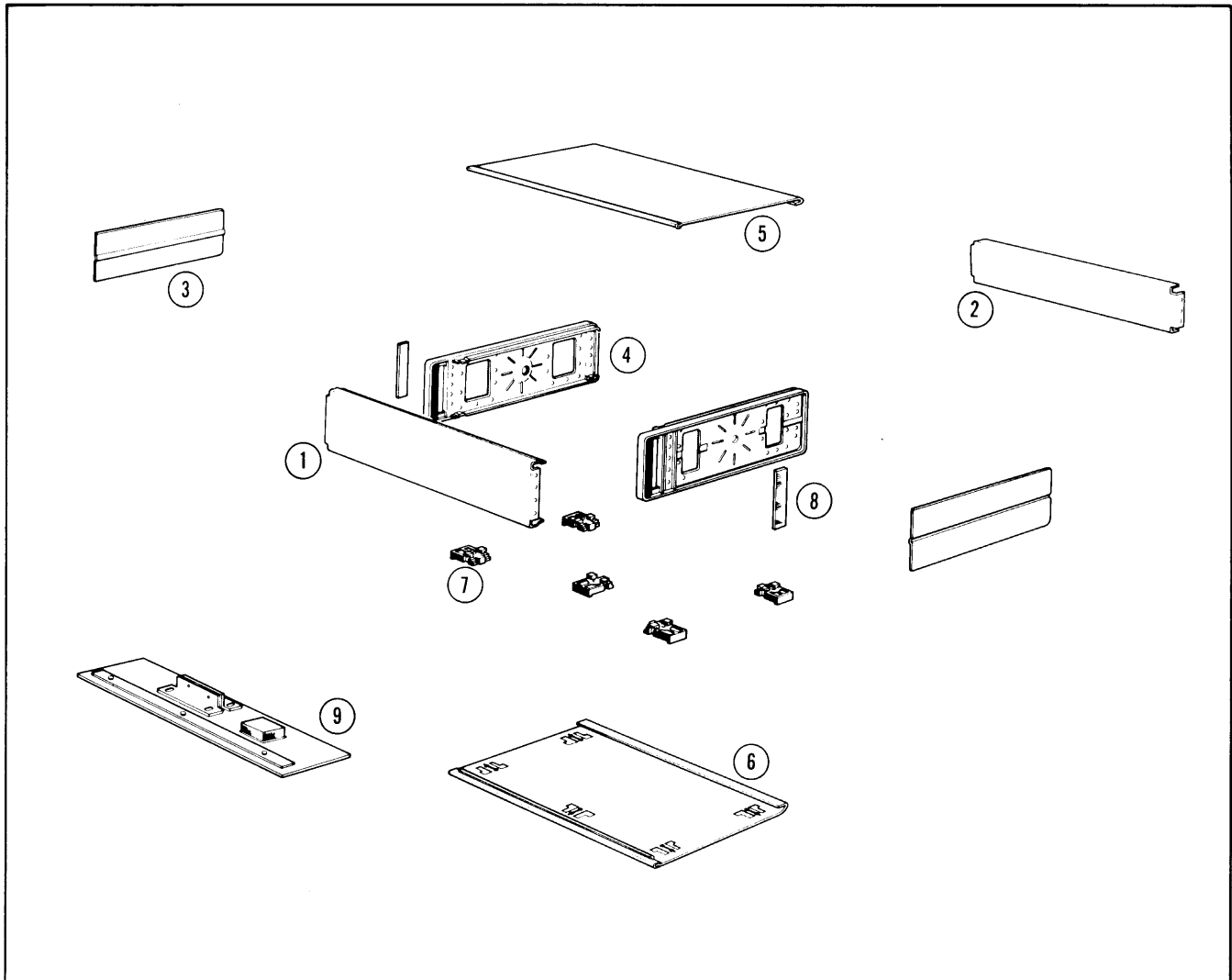
- 5-6. To obtain a part that is not listed, include:
 - a. Instrument model number.
 - b. Instrument serial number.
 - c. Description of the part.
 - d. Function and location of the part.

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

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

01194-13

Figure 5-1. Modular Cabinet Parts



NO.	DESCRIPTION	HP. PART NO.	QTY.
1	Panel: Front 105A 105B	00105-0008 00105-0009	1 1
2	Panel: Rear	00105-0010	1
3	Side Cover	5000-0728	2
4	Frame Assembly, 3'' x 11''	5060-0729	2
5	Cover Assembly: Top	5060-0739	1
6	Cover Assembly: Bottom	5060-0751	1
7	Foot Assembly	5060-0767	5
8	Trim: Sides	5000-0050	2
9	Rack Mount Kit	5060-0774	1

Table 5-1. Reference Designation Index

Reference Designation	Part No.	Description #	Note
A1	00105-6013	OSCILLATOR ASSY:5 MHZ SEE TABLE 5-1A FOR COMPONENTS REBUILT OSC. ASSY AVAILABLE ORDER HP PART # 00105-6034	
A2	00105-6017	BOARD ASSY:1MHZ DIVIDER	
	00105-2017	BOARD:BLANK PC	
A2C1	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A2C2	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW	
A2C3	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C4	0140-0178	C:FXD MICA 560 PF 2%	
A2C5	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A2C6	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A2C7	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A2C8	0140-0176	C:FXD MICA 100 PF 2%	
A2C9	0140-0208	C:FXD MICA 680 PF 5%	
A2C10	0140-0179	C:FXD MICA 1000 PF 2%	
A2C11	0140-0176	C:FXD MICA 100 PF 2%	
A2C12	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C13	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A2C14	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A2C15	0140-0221	C:FXD MICA 220 PF 1%	
A2C16	0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	
A2C17	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C18	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C19	0121-0046	C:VARI CER 9-35 PF	
A2C20	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A2C21	0140-0231	C:FXD MICA 440PF 1% 300VDCW	
A2C22	0140-0154	C:FXD MICA 1300 PF 5%	
A2C23	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A2C24	0140-0179	C:FXD MICA 1000 PF 2%	
A2C25	0140-0159	C:FXD MICA 3000 UUF 2%	
A2C26	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C27	0140-0180	C:FXD MICA 2000 PF 2% 300VDCW	
A2C28	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C29	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2C30	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A2CR1	1902-3125	DIODE:BREAKDOWN 6.98V 2% 400MW	
A2CR2	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR3	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR4	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR5	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR6	1901-0040	DIODE:SILICON 30MA 30WV	
A2CR7	1901-0040	DIODE:SILICON 30MA 30WV	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A2L1	9140-0129	COIL:FXD RF 220 UH	
A2L2	9140-0107	COIL:FXD RF 27 MH 10%	
A2L3	9140-0129	COIL:FXD RF 220 UH	
A2L4	9140-0118	COIL:FXD 500 UH 5%	
A2L5	9140-0118	COIL:FXD 500 UH 5%	
A2L6	9140-0129	COIL:FXD RF 220 UH	
A2Q1	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A2Q2	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A2Q3	1855-0056	TRANSISTOR:FET 2N4342	
A2Q4	1854-0003	TRANSISTOR:NPN SILICON	
A2Q5	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A2Q6	1854-0003	TRANSISTOR:NPN SILICON	
A2Q7	1854-0023	TRANSISTOR:SILICON NPN	
A2Q8	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A2Q9	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A2Q10	1854-0003	TRANSISTOR:NPN SILICON	
A2R1	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A2R2	0757-0940	R:FXD MET FLM 4.7K OHM 2% 1/4W	
A2R3	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2R4	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/4W	
A2R5	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2R6	0757-0897	R:FXD MET FLM 75 OHM 2% 1/4W	
A2R7	0757-0921	R:FXD MET FLM 750 OHM 2% 1/4W	
A2R8	0757-0929	R:FXD MET FLM 1.6K OHM 2% 1/4W	
A2R9	0757-0916	R:FXD MET FLM 470 OHM 2% 1/4W	
A2R10	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2R11	0757-0955	R:FXD MET FLM 20K OHM 2% 1/4W	
A2R12	0757-0957	R:FXD MET FLM 24K OHM 2% 1/4W	
A2R13	0757-0963	R:FXD MET FLM 43K OHM 2% 1/4W	
A2R14	0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W	
A2R15	0757-0944	R:FXD MET FLM 6.8K OHM 2% 1/4W	
A2R16	0757-0958	R:FXD MET FLM 27K OHM 2% 1/4W	
A2R17	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2R18	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2R19	0757-0930	R:FXD MET FLM 1800 OHM 2% 1/4W	
A2R20	0757-0917	R:FXD MET FLM 510 OHM 2% 1/4W	
A2R21	0757-0929	R:FXD MET FLM 1.6K OHM 2% 1/4W	
A2R22	0757-0474	R:FXD MET FLM 243K OHM 1% 1/4W	
A2R23	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2R24	0757-0940	R:FXD MET FLM 4.7K OHM 2% 1/4W	
A2R25	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2R26	0757-0952	R:FXD MET FLM 15K OHM 2% 1/4W	
A2R27	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2R28	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A2R29	0757-0897	R:FXD MET FLM 75 OHM 2% 1/4W FACTORY SELECTED PART	
A2R30	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2R31	0757-0920	R:FXD MET FLM 680 OHM 2% 1/4W	
A2R32	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2R33	0757-0922	R:FXD MET FLM 820 OHM 2% 1/4W	
A2R34	0757-0942	R:FXD MET FLM 5.6K OHM 2% 1/4W FACTORY SELECTED PART	
A2T1	05061-8006	TRANSFORMER:5MHZ INPUT	
A2T2	05061-8005	TRANSFORMER:1MHZ-4MHZ	
A2T3	05061-8007	TRANSFORMER:1MHZ OUTPUT	
A3	00105-6018	BOARD ASSY:100KHZ DIVIDER	
	00105-2018	BOARD:BLANK PC	
A3C1	0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW	
A3C2	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A3C3	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A3C4	0140-0180	C:FXD MICA 2000 PF 2% 300VDCW	
A3C5	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A3C6	0160-0194	C:FXD MY 0.015UF 10%	
A3C7	0140-0170	C:FXD MICA 5600 PF 5% 300VDCW	
A3C8	0160-0301	C:FXD MY 0.012 UF 10% 200VDCW	
A3C9	0140-0228	C:FXD MICA 360 PF 1% 300VDCW	
A3C10	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A3C11	0160-0194	C:FXD MY 0.015UF 10%	
A3C12	0140-0220	C:FXD MICA 200 PF 1% 300VDCW	
A3C13	0160-0194	C:FXD MY 0.015UF 10%	
A3C14	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A3C15	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A3C16	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A3C17	0160-0954	C:FXD MICA 1269 PF 1%	
A3C18	0140-0235	C:FXD MICA 2250PF 1% 300VDCW	
A3C19	0160-0162	C:FXD MY 0.022 UF 10% 200VDCW	
A3C20	0140-0170	C:FXD MICA 5600 PF 5% 300VDCW	
A3C21	0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	
A3C22	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A3C23	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A3C24	0140-0084	C:FXD MICA 4700PF 5% 500VDCW	
A3C25	0140-0084	C:FXD MICA 4700PF 5% 500VDCW	
A3C26	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A3C27	0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	
A3C28	0160-0194	C:FXD MY 0.015UF 10%	
A3C29	0160-0194	C:FXD MY 0.015UF 10%	
A3C30	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A3CR1	1902-3125	DIODE:BREAKDOWN 6.98V 2% 400MW	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A3CR2	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR3	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR4	1901-0040	DIODE:SILICON 30MA 30WV	
A3CR5	1901-0040	DIODE:SILICON 30MA 30WV	
A3L1	9140-0129	COIL:FXD RF 220 UH	
A3L2	9140-0129	COIL:FXD RF 220 UH	
A3L3	9140-0129	COIL:FXD RF 220 UH	
A3L4	9140-0129	COIL:FXD RF 220 UH	
A3L5	9140-0072	COIL:RF 5000 UH 10%	
A3L6	107A-9F	COIL ASSY	
A3Q1	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q2	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q3	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q4	1855-0056	TRANSISTOR:FET 2N4342	
A3Q5	1854-0003	TRANSISTOR:NPN SILICON	
A3Q6	1854-0003	TRANSISTOR:NPN SILICON	
A3Q7	1854-0003	TRANSISTOR:NPN SILICON	
A3Q8	1854-0003	TRANSISTOR:NPN SILICON	
A3Q9	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q10	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3R1	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A3R2	0757-0940	R:FXD MET FLM 4.7K OHM 2% 1/4W	
A3R3	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R4	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R5	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/4W	
A3R6	0757-0947	R:FXD MET FLM 9.1K OHM 2% 1/4W	
A3R7	0757-0927	R:FXD MET FLM 1.3K OHM 2% 1/4W FACTORY SELECTED PART	
A3R8	0757-0927	R:FXD MET FLM 1.3K OHM 2% 1/4W FACTORY SELECTED PART	
A3R9	0757-0915	R:FXD MET FLM 430 OHM 2% 1/4W	
A3R10	0757-0965	R:FXD MET FLM 51K OHM 2% 1/4W	
A3R11	0757-0944	R:FXD MET FLM 6.8K OHM 2% 1/4W	
A3R12	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A3R13	0757-0918	R:FXD MET FLM 560 OHM 2% 1/4W	
A3R14	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R15	0757-0940	R:FXD MET FLM 4.7K OHM 2% 1/4W	
A3R16	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A3R17	0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W	
A3R18	0757-0950	R:FXD MET FLM 12K OHM 2% 1/4W	
A3R19	0757-0966	R:FXD MET FLM 56K OHM 2% 1/4W	
A3R20	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R21	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R22	0757-0930	R:FXD MET FLM 1800 OHM 2% 1/4W	
A3R23	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/4W	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A3R24	0757-0968	R:FXD MET FLM 68K OHM 2% 1/4W	
A3R25	0757-0928	R:FXD MET FLM 1.5K OHM 2% 1/4W FACTORY SELECTED PART	
A3R26	0757-0934	R:FXD MET FLM 2.7K OHM 2% 1/4W	
A3R27	0757-0937	R:FXD MET FLM 3.6K OHM 2% 1/4W	
A3R28	0757-0937	R:FXD MET FLM 3.6K OHM 2% 1/4W	
A3R29	0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/4W	
A3R30	0757-0929	R:FXD MET FLM 1.6K OHM 2% 1/4W	
A3R31	0757-0933	R:FXD MET FLM 2.4K OHM 2% 1/4W	
A3R32	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R33	0757-0930	R:FXD MET FLM 1800 OHM 2% 1/4W	
A3R34	0757-0908	R:FXD MET FLM 220 OHM 2% 1/4W	
A3R35	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A3R36	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W FACTORY SELECTED PART	
A3R37	0757-0912	R:FXD MET FLM 330 OHM 2% 1/4W	
A3R38	0757-0906	R:FXD MET FLM 180 OHM 2% 1/4W	
A3R39	0757-0922	R:FXD MET FLM 820 OHM 2% 1/4W	
A3R40	0757-0942	R:FXD MET FLM 5.6K OHM 2% 1/4W FACTORY SELECTED PART	
A3T1	05061-8005	TRANSFORMER:1MHZ-4MHZ	
A3T2	05061-8008	TRANSFORMER:.9MHZ MULTIPLIER	
A3T3	107A-9C	TRANSFORMER ASSY:100KHZ	
A4	00105-6029	BOARD ASSY:OSC EFC AND 5MHZ	
	00105-2029	BOARD:BLANK PC	
A4C1	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
A4C2	0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	
A4CR1	1901-0040	DIODE:SILICON 30MA 30WV	
A4J1	1250-0257	CONNECTOR:RF 50 OHM PC MOUNT	
A4J2	1250-0257	CONNECTOR:RF 50 OHM PC MOUNT	
A4J3		NOT ASSIGNED	
A4J4	1250-0257	CONNECTOR:RF 50 OHM PC MOUNT	
A4J5	1250-0257	CONNECTOR:RF 50 OHM PC MOUNT	
A4R1	0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	
A4R2	0698-3156	R:FXD MET FLM 14.7K OHM 1% 1/8W	
A4R3	0757-0917	R:FXD MET FLM 510 OHM 2% 1/4W	
A4R4	0757-0938	R:FXD MET FLM 3.9K OHM 2% 1/4W	
A4R5	0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W FACTORY SELECTED PART	
A4R6	0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W FACTORY SELECTED PART	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
		(105A ONLY)	
A5	00105-6026	BOARD ASSY:POWER SUPPLY	
	00105-2026	BOARD:BLANK PC	
A5C1 A5C2	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW NOT ASSIGNED	
A5C3 A5C4 A5C5 A5C6 A5C7	0180-0117 0180-0117 0170-0024 0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW NOT ASSIGNED C:FXD MY 0.022UF 20% 200VDCW C:FXD ELECT TA 2.7UF 10% 35VDCW	
A5CR1	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP	
A5CR2 A5CR3 A5CR4 A5CR5 A5CR6 A5CR7- A5CR9	1901-0028 1901-0026 1902-0073	DIODE:SILICON 400 PIV 0.5 AMP DIODE:SILICON 0.75A 200 PIV NOT ASSIGNED NOT ASSIGNED DIODE BREAKDOWN:32.0V 1% NOT ASSIGNED NOT ASSIGNED	
A5CR10	1902-0676	DIODE BREAKDOWN:18.7V(MATCHED PR.)	
A5Q1 - A5Q3		NOT ASSIGNED NOT ASSIGNED	
A5Q4 A5Q5 A5Q6 A5Q7 A5Q8	1853-0001 1853-0024 1854-0003 1854-0003	TRANSISTOR:PNP SILICON 30V 900MW TRANSISTOR:SILICON 2N3778 TRANSISTOR:NPN SILICON NOT ASSIGNED TRANSISTOR:NPN SILICON	
A5R1 A5R2		NOT ASSIGNED NOT ASSIGNED	
A5R3 A5R4 A5R5 A5R6 A5R7 A5R8 - A5R12	0757-0929 0757-0900 0757-0478	R:FXD MET FLM 1.6K OHM 2% 1/4W NOT ASSIGNED R:FXD MET FLM 100 OHM 2% 1/4W NOT ASSIGNED R:FXD MET FLM 36.5K OHM 1% 1/8W NOT ASSIGNED NOT ASSIGNED	
A5R13 A5R14 A5R15 A5R16 A5R17	0812-0006 0757-0926 0757-0972	R:FXD WW 1.8 OHM 5% 3W NOT ASSIGNED R:FXD MET FLM 1.2K OHM 2% 1/4W R:FXD MET FLM 100K OHM 2% 1/4W NOT ASSIGNED	
A5R18 A5R19 A5R20 A5R21 A5R22	0757-0938 0757-0912 0757-0926 0757-0473	R:FXD MET FLM 3.9K OHM 2% 1/4W NOT ASSIGNED R:FXD MET FLM 330 OHM 2% 1/4W R:FXD MET FLM 1.2K OHM 2% 1/4W R:FXD MET FLM 221K OHM 1% 1/8W	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A5		(105B ONLY)	
	00105-6027	BOARD ASSY:POWER SUPPLY	
	00105-2027	BOARD:BLANK PC	
A5C1	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A5C2	0180-0097	C:FXD ELECT 47UF 10% 35VDCW	
A5C3	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
A5C4	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A5C5	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
A5C6	0170-0024	C:FXD MY 0.022UF 20% 200VDCW	
A5C7	0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	
A5CR1	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP	
A5CR2	1901-0028	DIODE:SILICON 400 PIV 0.5 AMP	
A5CR3	1902-0007	DIODE BREAKDOWN:20V(MATCHED PR.)	
A5CR4	1901-0025	DIODE:SILICON 100WV 100MA	
A5CR5	1901-0025	DIODE:SILICON 100WV 100MA	
A5CR6	1902-0073	DIODE BREAKDOWN:32.0V 1%	
A5CR7	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A5CR8	1901-0026	DIODE:SILICON 0.75A 200 PIV	
A5CR9	1884-0003	SEMICON DEVICE:DIODE 3N58	
A5CR10	1902-0676	DIODE BREAKDOWN:18.7V(MATCHED PR.)	
A5CR11	1901-0025	DIODE:SILICON 100WV 100MA	
A5CR12	1901-0025	DIODE:SILICON 100WV 100MA	
A5K1	0490-0035	RELAY:DPDT 2A @ 28VDC	
A5Q1	1854-0003	TRANSISTOR:NPN SILICON	
A5Q2	1854-0003	TRANSISTOR:NPN SILICON	
A5Q3	1854-0039	TRANSISTOR:SILICON 2N3053	
A5Q4	1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	
A5Q5	1853-0024	TRANSISTOR:SILICON 2N3778	
A5Q6	1854-0003	TRANSISTOR:NPN SILICON	
A5Q7	1854-0003	TRANSISTOR:NPN SILICON	
A5Q8	1854-0003	TRANSISTOR:NPN SILICON	
A5R1	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A5R2	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A5R3	0757-0929	R:FXD MET FLM 1.6K OHM 2% 1/4W	
A5R4	0761-0039	R:FXD MET FLM 680 OHM 5% 1W	
A5R5	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A5R6	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A5R7	0757-0478	R:FXD MET FLM 36.5K OHM 1% 1/8W	
A5R8	0811-0959	R:FXD WW 1.62 OHM 3% 1/2W	
A5R9	0727-0004	R:FXD DEPC 5 OHM 1% 1/2W	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
A5R10	0757-0950	R:FXD MET FLM 12K OHM 2% 1/4W	
A5R11	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A5R12	0757-0950	R:FXD MET FLM 12K OHM 2% 1/4W	
A5R13	0812-0006	R:FXD WW 1.8 OHM 5% 3W	
A5R14	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/4W	
A5R15	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/4W	
A5R16	0757-0972	R:FXD MET FLM 100K OHM 2% 1/4W	
A5R17	0757-0950	R:FXD MET FLM 12K OHM 2% 1/4W	
A5R18	0757-0938	R:FXD MET FLM 3.9K OHM 2% 1/4W	
A5R19	0757-0925	R:FXD MET FLM 1.1K OHM 2% 1/4W	
A5R20	0757-0912	R:FXD MET FLM 330 OHM 2% 1/4W	
A5R21	0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/4W	
A5R22	0757-0473	R:FXD MET FLM 221K OHM 1% 1/8W	
BT1	1420-0019	BATTERY:24V 3.5AH	
C1	0180-1720	C:FXD ELECT 700 UF +75-10% 75VDCW	
C2	0160-3043	C:FXD CER 2 X 0.005 UF 20% 250VAC	
DS1	1450-0350	LIGHT-INDICATOR AMBER (105B ONLY)	
DS2	1450-0093	LAMP:INDIC RED 10V 14MA (105B ONLY)	
F1	2110-0001	FUSE:1A 250V	
F2	2110-0001	FUSE:1A 250V	
F3	2110-0001	FUSE:1A 250V	
J1	1251-0146	INSERT:CONNECTOR 3-RND CONTACTS	
J2	1251-0111	CONNECTOR:RECEPTACLE MALE 5-CONTACT	
J3	1250-0102	CONNECTOR:BNC	
J4	1250-0102	CONNECTOR:BNC	
J5	1250-0102	CONNECTOR:BNC	
J6	1250-0102	CONNECTOR:BNC	
J7	1250-0102	CONNECTOR:BNC	
J8	1250-0102	CONNECTOR:BNC	
J9	1250-0102	CONNECTOR:BNC	
J10	1250-0102	CONNECTOR:BNC	
M1	1120-0337	METER:0-100MA	
P1		NOT ASSIGNED	
P2		NOT ASSIGNED	
P3	1250-0929	CAP:RF CONNECTOR BNC	
Q1	1854-0039	TRANSISTOR:SILICON 2N3053	
	1205-0008	HEAT DISSIPATOR:BODY	
	1205-0007	NUT:HEAT DISSIPATOR	
	0340-0019	INSULATOR:BUSHING NYLON	
	1200-0080	INSULATOR:TRANSISTOR MTG.	
Q2	1854-0020	TRANSISTOR:NPN SILICON	
	1200-0087	CLAMP:TRANSISTOR	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
Q3	1200-0076	INSULATOR:TRANSISTOR	
	1200-0092	BUSHING:TRANSISTOR	
R1	1854-0020	TRANSISTOR:NPN SILICON	
	1200-0087	CLAMP:TRANSISTOR	
	1200-0076	INSULATOR:TRANSISTOR	
	1200-0092	BUSHING:TRANSISTOR	
R2	0757-0970	R:FXD MET FLM 82K OHM 2% (105B ONLY)	
R2	2100-2425	R:VAR WW 20K OHM 3% LIN 1.5W	
S1	3101-0033	SWITCH:SLIDE DPDT	
S2	3101-0052	SWITCH:PUSHBUTTON SPST (105B ONLY)	
S3	3101-0957	SWITCH:TOGGLE DPDT (105B ONLY)	
S4	3100-0260	SWITCH:ROTARY 1 SECT 6 POS	
S5	3101-0124	SWITCH:PUSHBUTTON SPST N/O MOMENTARY (105B ONLY)	
T1	9100-2464	TRANSFORMER	
W1	114B-16A	CABLE:AC POWER	
W2	00105-6023	CABLE ASSY:+EFC	
W3	00105-6016	CABLE ASSY:-EFC	
W4	00105-6021	CABLE ASSY:5MHZ	
W5	00105-6022	CABLE ASSY:5MHZ	
W6	00105-6019	CABLE ASSY:1MHZ	
W7	00105-6020	CABLE ASSY:1MHZ	
W8	00105-6014	CABLE ASSY:100KHZ	
W9	00105-6015	CABLE ASSY:100KHZ	
W10	00105-6030	CABLE ASSY:CLOCK OUTPUT	
W11	00105-6024	CABLE ASSY:1MHZ DIVIDER	
W12		NOT ASSIGNED	
W13	00105-6031	CABLE ASSY:5MHZ	
XF1	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
XF2	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
XF3	1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	
		MISCELLANEOUS	
	0340-0037	POST:TERMINAL	
	0340-0039	INSULATOR:BUSHING	
	0370-0104	KNOB:BLACK BAR W/ARROW 13/16 DIA 1/4 SHAFT CIRCUIT CHECK	
	0370-0478	KNOB:ROUND FINE FREQ ADJUST	
	0510-0123	FASTENER:PUSH-ON TYPE (105B ONLY)	
	0590-0743	INSERT THREADED:4-40 INTERNAL THREAD	
	1140-0046	COUNTER:3 DIGIT	
		PARTS IN 10 ⁻¹⁰	

See introduction to this section for ordering information

Table 5-1. Reference Designation Index (Cont'd)

Reference Designation	Part No.	Description #	Note
	1410-0052	BUSHING:POTENTIOMETER	
	2950-0040	FREQ ADJUST COARSE	
	5000-0230	NUT:HEX 3/8"-32 X 1/2" FOR COARSE FREQ ADJUST	
	5000-0232	INSULATOR:P.C. BOARD	
	5040-4528	INSULATOR:PC BOARD CONNECTOR 22 PIN	
	5060-0774	GUIDE:PC BOARD(GRAY PLASTIC)	
	5951-0052	KIT:RACK MOUNT	
	310A-88A	APPLICATION NOTE #52	
	00105-0007	WASHER:OUTPUT CONNECTOR	
	00105-0011	CHASSIS	
	00105-0012	SHIELD:BOARD	
	00105-0013	SHIELD:BOARD,POWER SUPPLY	
	00105-0014	BRACKET:TRANSFORMER	
	00105-0015	SUPPORT:TRANSFORMER	
	00105-0017	BRACKET:CAPACITOR	
	00105-2028	SHIELD:AC	
	00105-4013	GUIDE FREQ ADJUST GUARD FOR A1HR2	
	00105-6025	CABLE ASSY:LACED (105A ONLY)	
	00105-6028	CABLE ASSY:LACED (105B ONLY)	
	00105-6032	KIT:ACCESSORY	
	1251-0126	CONNECTOR-PLUG	
	5060-0049	BOARD:EXTENDER ASSY	
	5060-0630	BOARD:EXTENDER 22 PIN	
	114B-16A	CABLE:AC POWER	

See introduction to this section for ordering information

Table 5-1a. CRYSTAL OSCILLATOR AND OVEN ASSEMBLY
Reference Designation Index*

Reference Designation	Part No.	Description #	Note
PREFIX REFERENCE DESIGNATIONS WITH A1 TO FORM COMPLETE REFERENCE DESIGNATOR			
A1	00105-6006	AC CONTROLLER ASSY	
	00105-2006	BOARD BLANK	
A1C1	0160-2671	C:FXD MY 0.1 UF 5% 80VDCW	
A1C2	0160-2672	C:FXD MY 0.047 UF 5% 80VDCW	
A1C3	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C4	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C5	0150-0050	C:FXD CER 1000 PF 600VDCW	
A1C6	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C7	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C8	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C9, A1C10	0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	
A1C11	0150-0122	C:FXD CER 2000 PF 20% 500VDCW	
A1CR1	1901-0025	DIODE:SILICON 100WV 100MA	
A1CR2	1901-0025	DIODE:SILICON 100WV 100MA	
A1F1	2110-0254	FUSE:THERMAL 15A	
A1F2	2110-0254	FUSE:THERMAL 15A	
A1Q1	1854-0023	TRANSISTOR:SILICON NPN	
A1Q2	1854-0023	TRANSISTOR:SILICON NPN	
A1R1	0757-0923	R:FXD MET FLM 910 OHM 2% 1/4W	
A1R2	0757-0916	R:FXD MET FLM 470 OHM 2% 1/4W	
A1R3	2100-2224	R:VAR WW 200 OHM 5% LIN 1W	
A1R4	0757-0922	R:FXD MET FLM 820 OHM 2% 1/4W	
A1R5	0757-0939	R:FXD MET FLM 4.3K OHM 2% 1/4W	
A1R6	0757-0939	R:FXD MET FLM 4.3K OHM 2% 1/4W	
A1R7	0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W	
A1R8	0757-0904	R:FXD MET FLM 150 OHM 2% 1/4W	
A1R9	0757-0913	R:FXD MET FLM 360 OHM 2% 1/4W	
A1R10	0757-0913	R:FXD MET FLM 360 OHM 2% 1/4W	
A1R11	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A1RT1	0837-0035	THERMISTOR:DISC TYPE	
A2	00105-6010	ASSY:OSCILLATOR AND AGC 5MHZ	
	00105-2005	BOARD:BLANK	
A2A1	00105-6005	ASSY:OSCILLATOR 5MHZ	
A2A1C1	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A1C2	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
* Parts listed in 5-1A are not recommended for field replacement.			

See introduction to this section for ordering information

Table 5-1a. Crystal Oscillator and Oven Assembly, Reference Designation Index
(continued)

Reference Designation	Part No.	Description #	Note
PREFIX REFERENCE DESIGNATIONS WITH A1 TO FORM COMPLETE REFERENCE DESIGNATOR			
A2A1C3	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A1C4	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A1C5	0160-2669	C:FXD GLASS 100 PF 5% 500VDCW	
A2A1C6	0160-2670	C:FXD GLASS 11 PF 5% 500VDCW	
A2A1C7	0121-0179	C:VARI GLASS 1-28 PF	
A2A1C8	0180-0218	C:FXD ELECT .15 UF 10% 35VDCW	
A2A1C9	0160-3025	C:FXD GLASS 75 PF 5% 500VDCW	
A2A1C10	0160-2668	C:FXD GLASS 300 PF 5% 300VDCW	
A2A1C11	0160-0212	C:FXD GLASS 3000PF 5% 300V	
A2A1C12	0160-2671	C:FXD MY 0.1 UF 5% 80VDCW	
A2A1CR1	0122-0011	DIODE:CAPACITOR VARI 100 PF	
A2A1L1	9140-0019	COIL:FXD RF 200 UH 10%	
A2A1L2	00105-8004	COIL:FREQ PADDING(TYPICAL VALUE 30UH)	
A2A1L3	00105-8005	COIL:MODE SUPPRESSOR .47UH	
A2A1Q1	1854-0073	TRANSISTOR:SILICON NPN	
A2A1R1	0757-0931	R:FXD MET FLM 2.3K OHM 2% 1/4W	
A2A1R2	0757-0909	R:FXD MET FLM 240 OHM 2% 1/4W	
A2A1R3	0721-0025	R:FXD DEPC 4.99 MEGOHM 2% 1/8W	
A2A1R4	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2A1R5	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2A1R6	0721-0025	R:FXD DEPC 4.99 MEGOHM 2% 1/8W	
A2A1Y1	5080-0049	CRYSTAL:5MHZ	
A2A2	00105-6009	ASSY:AGC N.S.R. ORDER ASSY00105-6010	
	00105-6003	ASSY:AGC INPUT BOARD	
	00105-2003	BLANK BOARD	
	00105-6004	ASSY:AGC OUTPUT BOARD	
A2A2C1	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C2	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C3	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C4	0180-0218	C:FXD ELECT .15 UF 10% 35VDCW	
A2A2C5	0121-0046	C:VARI CER 9-35 PF	
A2A2C6	0160-0179	C:FXD MICA 33 PF 5% 300VDCW	
A2A2C7	0180-0218	C:FXD ELECT .15 UF 10% 35VDCW	
A2A2C8	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C9	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C10	0160-0763	C:FXD MICA 5 PF 10%	
A2A2C11	0121-0046	C:VARI CER 9-35 PF	
A2A2C12	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C13	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C14	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A2A2C15	0140-0190	C:FXD MICA 39 PF 5%	
A2A2C16	0180-0218	C:FXD ELECT .15 UF 10% 35VDCW	

See introduction to this section for ordering information

Table 5-1a. Crystal Oscillator and Oven Assembly, Reference Designation Index (cont'd)

Reference Designation	Part No.	Description #	Note
PREFIX REFERENCE DESIGNATIONS WITH A1 TO FORM COMPLETE REFERENCE DESIGNATOR			
A2A2CR1	1902-0049	DIODE,BREAKDOWN: 6.19V 5%	
A2A2CR2	1902-0063	DIODE BREAKDOWN:15V	
A2A2CR3	1901-0040	DIODE:SILICON 30MA 30WV	
A2A2CR4	1901-0040	DIODE:SILICON 30MA 30WV	
A2A2Q1	1854-0073	TRANSISTOR:SILICON NPN	
A2A2Q2	1854-0073	TRANSISTOR:SILICON NPN	
A2A2R1	0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/4W	
A2A2R2	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2A2R3	2100-1738	R:VAR WW 10K OHM 30% LIN 1/2W	
A2A2R4	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2A2R5	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2A2R6	0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	
A2A2R7	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2A2R8	0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W	
A2A2R9	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2A2R10	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A2A2R11	0757-0931	R:FXD MET FLM 2.3K OHM 2% 1/4W	
A2A2R12	2100-2216	R:VARI CERMET FLM 5K OHM 30% LIN 1/2W	
A2A2R13	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A2A2R14	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A2A2R15	0757-0954	R:FXD MET FLM 18K OHM 2% 1/4W	
A2A2R16	0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W	
A2A2R17	0757-0931	R:FXD MET FLM 2.3K OHM 2% 1/4W	
A2A2T1	00105-8001	TRANSFORMER:AGC INPUT	
A2A2T2	0360-1334 00105-8002 1251-1636	TERMINAL:SOLDER STUD TRANSFORMER:AGC OUTPUT CONNECTOR:JACK	
A3	00105-6007	ASSY:POWER AMPLIFIER BOARD	
	00105-2007	BLANK BOARD	
A3C1	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C2	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C3	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C4	0180-0160	C:FXD ELECT 22UF 35VDCW	
A3C5	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C6	0160-2326	C:FXD MICA 150 PF 5%	
A3C7	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C8	0160-2188	C:FXD MY 3900 PF 5%	
A3C9	0160-0178	C:FXD MICA 27PF 5% 300VDCW	
A3C10	0121-0046	C:VARI CER 9-35 PF	
A3C11	0140-0208	C:FXD MICA 680 PF 5%	

See introduction to this section for ordering information

Table 5-1a. Crystal Oscillator and Oven Assembly, Reference Designation Index (cont'd)

Reference Designation	Part No.	Description #	Note
PREFIX REFERENCE DESIGNATIONS WITH A1 TO FORM COMPLETE REFERENCE DESIGNATOR			
A3C12	0121-0046	C:VARI CER 9-35 PF	
A3C13	0160-0145	C:FXD MICA 82PF 2% 100VDCW	
A3C14	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3C15	0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	
A3CR1	1901-0049	DIODE:SILICON 50PIV	
A3CR2	1901-0049	DIODE:SILICON 50PIV	
A3CR3	1901-0025	DIODE:SILICON 100WV 100MA	
A3L1	9100-2430	INDUCTOR:220 UH	
A3L2	9100-2430	INDUCTOR:220 UH	
A3L3	9100-2430	INDUCTOR:220 UH	
A3Q1	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q2	1854-0023	TRANSISTOR:SILICON NPN	
A3Q3	1854-0039	TRANSISTOR:SILICON 2N3053	
A3Q4	1854-0020	TRANSISTOR:NPN SILICON	
A3Q5	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3Q6	1854-0005	TRANSISTOR:SILICON NPN 2N708	
A3R1	0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	
A3R2	0757-0954	R:FXD MET FLM 18K OHM 2% 1/4W	
A3R3	0757-0962	R:FXD MET FLM 39K OHM 2% 1/4W	
A3R4	0757-0956	R:FXD MET FLM 22K OHM 2% 1/4W	
A3R5	0757-0910	R:FXD MET FLM 270 OHM 2% 1/4W	
A3R6	0757-0956	R:FXD MET FLM 22K OHM 2% 1/4W	
A3R7	0757-0937	R:FXD MET FLM 3.6K OHM 2% 1/4W	
A3R8	0698-0001	R:FXD COMP 4.7 OHM 5% 1/2W	
A3R9	0757-0898	R:FXD MET FLM 82 OHM 2% 1/4W	
A3R10	0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	
A3R11	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A3R12	2100-2060	R:VARI CERMET FLM 50 OHM 30% LIN 1/2W	
A3R13	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A3R14	0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/4W	
A3R15	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
A3R16	0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W	
A3R17	0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	
A3R18	0757-0918	R:FXD MET FLM 560 OHM 2% 1/4W	
A3R19	2100-1984	R:VARI CERMET FLM 100 OHM 30% LIN 1/2W	
A3T1	00105-8003	TRANSFORMER:POWER AMP	
CHASSIS PARTS			
C1	0160-3036	C:FXD CER 5000 PF +80-20% 200VDCW	
C2	0160-3036	C:FXD CER 5000 PF +80-20% 200VDCW	
C3	0160-3036	C:FXD CER 5000 PF +80-20% 200VDCW	
C4	0160-3036	C:FXD CER 5000 PF +80-20% 200VDCW	
C5	0160-2437	C:FXD CER 5000 PF +80-20% 200VDCW	
C6	0160-2437	C:FXD CER 5000 PF +80-20% 200VDCW	
C7	0160-2437	C:FXD CER 5000 PF +80-20% 200VDCW	

See introduction to this section for ordering information

Table 5-1A. Crystal Oscillator and Oven Assembly, Reference Designation Index (cont'd)

Reference Designation	Part No.	Description #	Note
PREFIX REFERENCE DESIGNATIONS WITH A1 TO FORM COMPLETE REFERENCE DESIGNATOR			
C8	0160-2437	C:FXD CER 5000 PF +80-20% 200VDCW	
J1	1250-0901	CONNECTOR:RF BULKHEAD	
J2	1250-0901	CONNECTOR:RF BULKHEAD	
J3	1250-0901	CONNECTOR:RF BULKHEAD	
J4	1250-0901	CONNECTOR:RF BULKHEAD	
L1	9100-2430	INDUCTOR:220 UH	
L2	9100-2430	INDUCTOR:220 UH	
R1	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
R2	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
R3	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
R4	0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	
ST1	0440-0055	THERMOSTAT:N.S.R. ORDER ASSY 00105-6002	
Y1	0410-0040	CRYSTAL:QUARTZ	
MISCELLANEOUS			
	1205-0036	HEAT DISSIPATOR	
	00105-0002	COVER:OVEN	
	00105-0006	POWER AMPLIFIER SHIELD	
	00105-2001	COVER:CONNECTOR END	
	00105-2002	COVER:NON-CONNECTOR END	
	00105-2014	BOARD BLANK	
	00105-2015	COVER:CRYSTAL	
	00105-6002	CHAMBER ASSY:INCL HR1 HR2 ST1 &AIRT1	

See introduction to this section for ordering information

Table 5-2. Replaceable Parts

Stock No.	Description #	Mfr.	Mfr. Part No.	105A		105B	
				TQ		TQ	
0121-0046	C:VARI CER 9-35 PF	28480	0121-0046	1		1	
0140-0084	C:FXD MICA 4700PF 5% 500VDCW	28480	0140-0084	2		2	
0140-0154	C:FXD MICA 1300 PF 5%	28480	0140-0154	1		1	
0140-0159	C:FXD MICA 3000 UUF 2%	28480	0140-0159	1		1	
0140-0170	C:FXD MICA 5600 PF 5% 300VDCW	28480	0140-0170	2		2	
0140-0176	C:FXD MICA 100 PF 2%	28480	0140-0176	2		2	
0140-0178	C:FXD MICA 560 PF 2%	72136	RDM15F561G3C	1		1	
0140-0179	C:FXD MICA 1000 PF 2%	28480	0140-0179	2		2	
0140-0180	C:FXD MICA 2000 PF 2% 300VDCW	28480	0140-0180	2		2	
0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	04062	RDM15E470J5C	1		1	
0140-0208	C:FXD MICA 680 PF 5%	28480	0140-0208	1		1	
0140-0220	C:FXD MICA 200 PF 1% 300VDCW	28480	0140-0220	1		1	
0140-0221	C:FXD MICA 220 PF 1%	28480	0140-0221	1		1	
0140-0228	C:FXD MICA 360 PF 1% 300VDCW	28480	0140-0228	1		1	
0140-0231	C:FXD MICA 440PF 1% 300VDCW	04062	RDM15F441F3C	1		1	
0140-0235	C:FXD MICA 2250PF 1% 300VDCW	14655	RDM20F12250QF3C	1		1	
0150-0093	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA	1		1	
0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	56289	5C50A	13		13	
0160-0127	C:FXD CER 1UF 20% 25VDCW	56289	5C13	6		6	
0160-0161	C:FXD MY 0.01 UF 10% 200VDCW	28480	0160-0161	5		5	
0160-0162	C:FXD MY 0.022 UF 10% 200VDCW	28480	0160-0162	1		1	
0160-0163	C:FXD MY 0.033 UF 10% 200VDCW	28480	0160-0163	1		1	
0160-0174	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C1187	5		5	
0160-0194	C:FXD MY 0.015UF 10%	28480	0160-0194	5		5	
0160-0301	C:FXD MY 0.012 UF 10% 200VDCW	28480	0160-0301	1		1	
0160-0954	C:FXD MICA 1269 PF 1%	28480	0160-0954	1		1	
0160-3043	C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH	1		1	
0170-0024	C:FXD MY 0.022UF 20% 200VDCW	56289	192P22302	1		1	
0180-0097	C:FXD ELECT 47UF 10% 35VDCW	56289	150D476X9035S2	1		1	
0180-0113	C:FXD ELECT TA 100UF +20-15% 30VDCW	56289	109D107C 2030T2	2		2	
0180-0117	C:FXD ELECT TA 2.7UF 10% 35VDCW	56289	150D275X9035 B2	4		4	
0180-1720	C:FXD ELECT 700 UF +75-10% 75VDCW	56289	39D SEC.DFP HDW	1		1	
0340-0019	INSULATOR:BUSHING NYLON	28480	0340-0019	1		1	
0340-0037	POST:TERMINAL	28480	0340-0037	1		1	
0340-0039	INSULATOR:BUSHING	28480	0340-0039	1		1	
0370-0104	KNOB:BLACK BAR W/ARROW 13/16 DIA 1/4 SH	28480	20370-0104	1		1	
0370-0478	KNOB:ROUND	28480	0370-0478	1		1	
0490-0035	RELAY:DPTD 2A @ 28VDC	78277	32RJPD-780GD-SIL	1		1	
0510-0123	FASTENER:PUSH-ON TYPE	78553	C12008-014-4	2		2	
0590-0743	INSERT THREADED:4-40 INTERNAL THREAD	46384	LK-440-2	6		1	
0698-3156	R:FXD MET FLM 14.7K OHM 1% 1/8W	28480	0698-3156	1		1	
0727-0004	R:FXD DEPC 5 OHM 1% 1/2W	28480	0727-0004	1		1	
0757-0441	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441	1		1	
0757-0473	R:FXD MET FLM 221K OHM 1% 1/8W	28480	0757-0473	1		1	
0757-0474	R:FXD MET FLM 243K OHM 1% 1/8W	28480	0757-0474	1		1	
0757-0478	R:FXD MET FLM 36.5K OHM 1% 1/8W	28480	0757-0478	1		1	
0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	28480	0757-0893	12		12	
0757-0897	R:FXD MET FLM 75 OHM 2% 1/4W	28480	0757-0897	2		2	
0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	28480	0757-0900	5		5	
0757-0906	R:FXD MET FLM 180 OHM 2% 1/4W	28480	0757-0906	1		1	
0757-0908	R:FXD MET FLM 220 OHM 2% 1/4W	28480	0757-0908	1		1	
0757-0912	R:FXD MET FLM 330 OHM 2% 1/4W	28480	0757-0912	2		2	
0757-0915	R:FXD MET FLM 430 OHM 2% 1/4W	28480	0757-0915	1		1	
0757-0916	R:FXD MET FLM 470 OHM 2% 1/4W	28480	0757-0916	1		1	

See list of abbreviations in introduction to this section

Table 5-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	Parts	
				105A	105E
0757-0917	R:FXD MET FLM 510 OHM 2% 1/4W	28480	0757-0917	2	2
0757-0918	R:FXD MET FLM 560 OHM 2% 1/4W	28480	0757-0918	1	1
0757-0920	R:FXD MET FLM 680 OHM 2% 1/4W	28480	0757-0920	1	1
0757-0921	R:FXD MET FLM 750 OHM 2% 1/4W	28480	0757-0921	1	1
0757-0922	R:FXD MET FLM 820 OHM 2% 1/4W	28480	0757-0922	2	2
0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	28480	0757-0924	3	5
0757-0925	R:FXD MET FLM 1.1K OHM 2% 1/4W	28480	0757-0925		1
0757-0926	R:FXD MET FLM 1.2K OHM 2% 1/4W	28480	0757-0926	3	2
0757-0927	R:FXD MET FLM 1.3K OHM 2% 1/4W	28480	0757-0927	2	2
0757-0928	R:FXD MET FLM 1.5K OHM 2% 1/4W	28480	0757-0928	1	1
0757-0929	R:FXD MET FLM 1.6K OHM 2% 1/4W	28480	0757-0929	4	4
0757-0930	R:FXD MET FLM 1600 OHM 2% 1/4W	28480	0757-0930	3	3
0757-0933	R:FXD MET FLM 2.4K OHM 2% 1/4W	28480	0757-0933	1	1
0757-0934	R:FXD MET FLM 2.7K OHM 2% 1/4W	28480	0757-0934	1	1
0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/4W	28480	0757-0936	2	2
0757-0937	R:FXD MET FLM 3.6K OHM 2% 1/4W	28480	0757-0937	2	2
0757-0938	R:FXD MET FLM 3.9K OHM 2% 1/4W	28480	0757-0938	2	2
0757-0940	R:FXD MET FLM 4.7K OHM 2% 1/4W	28480	0757-0940	4	4
0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W	28480	0757-0941	1	1
0757-0942	R:FXD MET FLM 5.6K OHM 2% 1/4W	28480	0757-0942	2	2
0757-0944	R:FXD MET FLM 6.8K OHM 2% 1/4W	28480	0757-0944	2	2
0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/4W	28480	0757-0946	1	1
0757-0947	R:FXD MET FLM 9.1K OHM 2% 1/4W	28480	0757-0947	1	1
0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	28480	0757-0948	4	6
0757-0950	R:FXD MET FLM 12K OHM 2% 1/4W	28480	0757-0950	1	4
0757-0952	R:FXD MET FLM 15K OHM 2% 1/4W	28480	0757-0952	1	1
0757-0955	R:FXD MET FLM 20K OHM 2% 1/4W	28480	0757-0955	1	1
0757-0957	R:FXD MET FLM 24K OHM 2% 1/4W	28480	0757-0957	1	1
0757-0958	R:FXD MET FLM 27K OHM 2% 1/4W	28480	0757-0958	1	1
0757-0963	R:FXD MET FLM 43K OHM 2% 1/4W	28480	0757-0963	1	1
0757-0965	R:FXD MET FLM 51K OHM 2% 1/4W	28480	0757-0965	1	1
0757-0966	R:FXD MET FLM 56K OHM 2% 1/4W	28480	0757-0966	1	1
0757-0968	R:FXD MET FLM 68K OHM 2% 1/4W	28480	0757-0968	1	1
0757-0970	R:FXD MET FLM 82K OHM 2% 1/4W	28480	0757-0970	1	1
0757-0972	R:FXD MET FLM 100K OHM 2% 1/4W	28480	0757-0972	1	1
0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W	28480	0757-0976	3	3
0761-0039	R:FXD MET FLM 680 OHM 5% 1W	28480	0761-0039		1
0811-0959	R:FXD WW 1.62 OHM 3% 1/2W	28480	0811-0959		1
0812-0006	R:FXD WW 1.8 OHM 5% 3W	28480	0812-0006	1	1
1120-0337	METER:0-100MA	28480	1120-0337	1	1
1140-0046	COUNTER:3 DIGIT	07263	DFD-1	1	1
1200-0076	INSULATOR:TRANSISTOR	02735	DF 14A	1	2
1200-0080	INSULATOR:TRANSISTOR MTG.	71785	294834	1	1
1200-0087	CLAMP:TRANSISTOR	02735	DF-13-A	2	2
1200-0092	BUSHING:TRANSISTOR	02735	495334 1	2	2
1205-0007	NUT:HEAT DISSIPATOR	28480	1205-0007	1	1
1205-0008	HEAT DISSIPATOR:BODY	28480	1205-0008	1	1
1250-0102	CONNECTOR:BNC	28480	1250-0102	8	8
1250-0257	CONNECTOR:RF 50 OHM PC MOUNT	28480	1250-0257	4	4
1250-0929	CAP:RF CONNECTOR BNC	28480	1250-0929	1	1
1251-0111	CONNECTOR:RECEPTACLE MALE 5-CONTACT	71468	MS3102R14S-5P	1	1
1251-0126	CONNECTOR-PLUG	71468	MS3106E-14S-5S	1	1
1251-0146	INSERT:CONNECTOR 3-RND CONTACTS	71468	MS3102R10SL-3P	1	1
1400-0084	FUSEHOLDER:EXTRACTOR POST TYPE	79515	342014	3	3

= See list of abbreviations in introduction to this section

Table 5-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	105A		105B	
				TQ		TQ	
1410-0052	BUSHING:POTENTIOMETER	28480	1410-0052	1		1	
1420-0019	BATTERY:24V 3.5AH	28480	1420-0019			1	
1450-0093	LAMP:INDIC RED 10V 14MA	08717	862-R-1869			1	
1450-0350	LIGHT-INDICATOR AMBER	72765	599-188			1	
1853-0001	TRANSISTOR:PNP SILICON 30V 900MW	28480	1853-0001	1		1	
1853-0024	TRANSISTOR:SILICON 2N3778	07256	2N3778	1		1	
1854-0003	TRANSISTOR:NPN SILICON	28480	1854-0003	9		12	
1854-0005	TRANSISTOR:SILICON NPN 2N708	02735	2N708	10		10	
1854-0020	TRANSISTOR:NPN SILICON	28480	1854-0020	2		2	
1854-0023	TRANSISTOR:SILICON NPN	28480	1854-0023	3		3	
1854-0C39	TRANSISTOR:SILICON 2N3053	02735	2N3053	1		2	
1855-0056	TRANSISTOR:FET 2N4342	07263	2N4342	2		2	
1884-0003	SEMICON DEVICE:DIODE 3N58	03508	3N58			1	
1901-0025	DIODE:SILICON 100WV 100MA	28480	1901-0025			4	
1901-0026	DIODE:SILICON 0.75A 200 PIV	28480	1901-0026	1		2	
1901-0028	DIODE:SILICON 400 PIV 0.5 AMP	28480	1901-0028	2		2	
1901-0040	DIODE:SILICON 30MA 30WV	28480	1901-0040	11		11	
1902-0007	DIODE BREAKDOWN:20V(MATCHED PR.)	28480	1902-0007			1	
1902-0073	DIODE BREAKDOWN:32.0V 1%	28480	1902-0073	1		1	
1902-0676	DIODE BREAKDOWN:18.7V(MATCHED PR.)	28480	1902-0676	1		1	
1902-3125	DIODE:BREAKDOWN 6.98V 2% 400MW	28480	1902-3125	2		2	
2100-2425	R:VAR WW 20K OHM 3% LIN 1.5W	28480	2100-2425	1		1	
2110-0001	FUSE:1A 250V	28480	2110-0001	3		3	
2950-0040	NUT:HEX 3/8"-32 X 1/2"	28480	2950-0040	1		1	
3100-0260	SWITCH:ROTARY 1 SECT 6 POS	28480	3100-0260	1		1	
3101-0033	SWITCH:SLIDE DPDT	79727	6510 C	1		1	
3101-0052	SWITCH:PUSHBUTTON SPST	82389	961 LESS HWD			1	
3101-0124	SWITCH:PUSHBUTTON SPST N/O MOMENTARY	28480	3101-0124			1	
3101-0957	SWITCH:TOGGLE DPDT	28480	3101-0957			1	
5000-0050	TRIM:SIDES	28480	5000-0050	2		1	
5000-0230	INSULATOR:P.C. BOARD	28480	5000-0230	2		1	
5000-0232	INSULATOR:PC BOARD CONNECTOR 22 PIN	28480	5000-0232	1		1	
5000-0728	SIDE COVER	28480	5000-0728	2		1	
5040-4528	GUIDE:PC BOARD(GRAY PLASTIC)	28480	5040-4528	11		1	
5060-0049	BOARD:EXTENDER ASSY	28480	5060-0049	1		1	
5060-0630	BOARD:EXTENDER 22 PIN	28480	5060-0630	1		1	
5060-0729	FRAME ASSY:3 X 11(SIDE)	28480	5060-0729	2		1	
5060-0739	COVER ASSY:TOP 11L FM	28480	5060-0739	1		1	
5060-0751	COVER ASSY:BOTTOM 11L FM	28480	5060-0751	1		1	
5060-0767	FOOT ASSY:FM	28480	5060-0767	5		1	
5060-0774	KIT:RACK MOUNT	28480	5060-0774	1		1	
5951-0052	APPLICATION NOTE #52	28480	5951-0052	1		1	
9100-2464	TRANSFORMER	28480	9100-2464	1		1	
9140-0072	COIL:RF 5000 UH 10%	95265	SA5000-1	1		1	
9140-0107	COIL:FXD RF 27 MH 10%	99800	1840-38	1		1	
9140-0118	COIL:FXD 500 UH 5%	28480	9140-0118	2		2	
9140-0129	COIL:FXD RF 220 UH	28480	9140-0129	7		7	
00105-0007	CHASSIS	28480	00105-0007	1		1	
00105-0008	PANEL:FRONT	28480	00105-0008			1	
00105-0009	PANEL:FRONT	28480	00105-0009			1	
00105-0010	PANEL:REAR	28480	00105-0010	1		1	
00105-0011	SHIELD:BOARD	28480	00105-0011	2		1	
00105-0012	SHIELD:BOARD,POWER SUPPLY	28480	00105-0012	1		1	
00105-0013	BRACKET:TRANSFORMER	28480	00105-0013	1		1	

See list of abbreviations in introduction to this section

Table 5-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	Parts	
				105A TQ	105B TQ
00105-0014	SUPPORT:TRANSFORMER	28480	00105-0014	1	1
00105-0015	BRACKET:CAPACITOR	28480	00105-0015	1	1
00105-0017	SHIELD:AC	28480	00105-0017	1	1
00105-2017	BOARD:BLANK PC	28480	00105-2017	1	1
00105-2018	BOARD:BLANK PC	28480	00105-2018	1	1
00105-2026	BOARD:BLANK PC	28480	00105-2026	1	
00105-2027	BOARD:BLANK PC	28480	00105-2027		1
00105-2028	GUIDE	28480	00105-2028	1	1
00105-2029	BOARD:BLANK PC	28480	00105-2029	1	1
00105-4013	GUARD	28480	00105-4013	1	1
00105-6013	OSCILLATOR ASSY:5 MHZ	28480	00105-6013	1	
00105-6014	CABLE ASSY:100KHZ	28480	00105-6014	1	1
00105-6015	CABLE ASSY:100KHZ	28480	00105-6015	1	1
00105-6016	CABLE ASSY:-EFC	28480	00105-6016	1	1
00105-6017	BOARD ASSY:1MHZ DIVIDER	28480	00105-6017	1	1
00105-6018	BOARD ASSY:100KHZ DIVIDER	28480	00105-6018	1	1
00105-6019	CABLE ASSY:1MHZ	28480	00105-6019	1	1
00105-6020	CABLE ASSY:1MHZ	28480	00105-6020	1	1
00105-6021	CABLE ASSY:5MHZ	28480	00105-6021	1	1
00105-6022	CABLE ASSY:5MHZ	28480	00105-6022	1	1
00105-6023	CABLE ASSY:+EFC	28480	00105-6023	1	1
00105-6024	CABLE ASSY:1MHZ DIVIDER	28480	00105-6024	1	1
00105-6025	CABLE ASSY:LACED	28480	00105-6025	1	
00105-6026	BOARD ASSY:POWER SUPPLY	28480	00105-6026	1	
00105-6027	BOARD ASSY:POWER SUPPLY	28480	00105-6027		1
00105-6028	CABLE ASSY:LACED	28480	00105-6028		1
00105-6029	BOARD ASSY:OSC EFC AND 5MHZ	28480	00105-6029	1	1
00105-6030	CABLE ASSY:CLOCK OUTPUT	28480	00105-6030	1	1
00105-6031	CABLE ASSY:5MHZ	28480	00105-6031	1	1
00105-6032	KIT:ACCESSORY	28480	00105-6032	1	1
05061-8005	TRANSFORMER:1MHZ-4MHZ	28480	05061-8005	2	2
05061-8006	TRANSFORMER:5MHZ INPUT	28480	05061-8006	1	1
05061-8007	TRANSFORMER:1MHZ OUTPUT	28480	05061-8007	1	1
05061-8008	TRANSFORMER:.9MHZ MULTIPLIER	28480	05061-8008	1	1
107A-9C	TRANSFORMER ASSY:100KHZ	28480	107A-9C	1	1
107A-9F	COIL ASSY	28480	107A-9F	1	1
114B-16A	CABLE:AC POWER	28480	114B-16A	2	2
310A-88A	WASHER:OUTPUT CONNECTOR	28480	310A-88A	2	1

See list of abbreviations in introduction to this section

Table 5-2a. Crystal Oscillator and Oven Assembly, Parts*

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
FOLLOWING PARTS NOT RECOMMENDED FOR FIELD REPLACEMENT				
0121-0046	C:VARI CER 9-35 PF	28480	0121-0046	4
0121-0179	C:VARI GLASS 1-28 PF	28480	0121-0179	1
0122-0011	DIODE:CAPACITOR VARI 100 PF	01281	V739	1
0140-0190	C:FXD MICA 39 PF 5%	28480	0140-0190	1
0140-0208	C:FXD MICA 680 PF 5%	28480	0140-0208	1
0150-0050	C:FXD CER 1000 PF 600VDCW	77630	OBD	1
0150-0122	C:FXD CER 2000 PF 20% 500VDCW	72982	801-000-Y5S-202M	1
0160-0145	C:FXD MICA 82PF 2% 100VDCW	04062	RDM15E820G6S	1
0160-0178	C:FXD MICA 27PF 5% 300VDCW	04062	RDM15E270J3S	1
0160-0179	C:FXD MICA 33 PF 5% 300VDCW	04062	DM15E330J 300V	1
0160-0212	C:FXD GLASS 3000PF 5% 300V	07115	CYFM 20C432J	1
0160-0763	C:FXD MICA 5 PF 10%	28480	0160-0763	1
0160-2055	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA	19
0160-2188	C:FXD MY 3900 PF 5%	28480	0160-2188	1
0160-2326	C:FXD MICA 150 PF 5%	28480	0160-2326	1
0160-2437	C:FXD CER 5000 PF +80-20% 200VDCW	72982	2425-000-X5V-502P	4
0160-2668	C:FXD GLASS 300 PF 5% 300VDCW	14674	CYM10C301J	1
0160-2669	C:FXD GLASS 100 PF 5% 500VDCW	14674	CYFM10C101J	1
0160-2670	C:FXD GLASS 11 PF 5% 500VDCW	14674	CYFM10C110J	1
0160-2671	C:FXD MY 0.1 UF 5% 80VDCW	28480	0160-2671	2
0160-2672	C:FXD MY 0.047 UF 5% 80VDCW	28480	0160-2672	1
0160-3025	C:FXD GLASS 75 PF 5% 500VDCW	14674	CYFM10C750J	1
0160-3036	C:FXD CER 5000 PF +80-20% 200VDCW	28480	0160-3036	4
0180-0100	C:FXD ELECT TA 4.7UF 10% 35VDCW	56289	150D475X9035B2	7
0180-0160	C:FXD ELECT 22UF 35VDCW	56289	1500226X0035R2	1
0180-0218	C:FXD ELECT .15 UF 10% 35VDCW	56289	150D154X9035A2	4
0360-1334	TERMINAL:SOLDER STUD	00000	OBD#	1
0410-0040	CRYSTAL:QUARTZ	28480	0410-0040	1
0440-0055	THERMOSTAT:N.S.R. ORDER ASSY 00105-6002	28480	0440-0055	1
0698-0001	R:FXD COMP 4.7 OHM 5% 1/2W	01121	EB 47G5	1
0721-0025	R:FXD DEPC 4.99 MEGOHM 2% 1/8W	28480	0721-0025	2
0757-0346	R:FXD MET FLM 10 OHM 1% 1/8W	28480	0757-0346	1
0757-0893	R:FXD MET FLM 51 OHM 2% 1/4W	28480	0757-0893	2
0757-0898	R:FXD MET FLM 82 OHM 2% 1/4W	28480	0757-0898	1
0757-0900	R:FXD MET FLM 100 OHM 2% 1/4W	28480	0757-0900	4
0757-0904	R:FXD MET FLM 150 OHM 2% 1/4W	28480	0757-0904	1
0757-0909	R:FXD MET FLM 240 OHM 2% 1/4W	28480	0757-0909	1
0757-0910	R:FXD MET FLM 270 OHM 2% 1/4W	28480	0757-0910	1
0757-0913	R:FXD MET FLM 360 OHM 2% 1/4W	28480	0757-0913	2
0757-0916	R:FXD MET FLM 470 OHM 2% 1/4W	28480	0757-0916	1
0757-0918	R:FXD MET FLM 560 OHM 2% 1/4W	28480	0757-0918	1
0757-0922	R:FXD MET FLM 820 OHM 2% 1/4W	28480	0757-0922	1
0757-0923	R:FXD MET FLM 910 OHM 2% 1/4W	28480	0757-0923	1
0757-0924	R:FXD MET FLM 1.0K OHM 2% 1/4W	28480	0757-0924	6
0757-0931	R:FXD MET FLM 2.3K OHM 2% 1/4W	28480	0757-0931	3
0757-0936	R:FXD MET FLM 3.3K OHM 2% 1/4W	28480	0757-0936	1
0757-0937	R:FXD MET FLM 3.6K OHM 2% 1/4W	28480	0757-0937	1
0757-0939	R:FXD MET FLM 4.3K OHM 2% 1/4W	28480	0757-0939	2
0757-0941	R:FXD MET FLM 5.1K OHM 2% 1/4W	28480	0757-0941	3
0757-0946	R:FXD MET FLM 8.2K OHM 2% 1/4W	28480	0757-0946	1
0757-0948	R:FXD MET FLM 10K OHM 2% 1/4W	28480	0757-0948	9
0757-0954	R:FXD MET FLM 18K OHM 2% 1/4W	28480	0757-0954	2
0757-0956	R:FXD MET FLM 22K OHM 2% 1/4W	28480	0757-0956	2
0757-0962	R:FXD MET FLM 39K OHM 2% 1/4W	28480	0757-0962	1

See introduction to this section for ordering information

Table 5-2a. Crystal Oscillator and Oven Assembly, Parts (cont'd)

Part No.	Description #	Mfr.	Mfr. Part No.	TQ
FOLLOWING PARTS NOT RECOMMENDED FOR FIELD REPLACEMENT				
0757-0976	R:FXD MET FLM 150K OHM 2% 1/4W	28480	0757-0976	1
0837-0035	THERMISTOR:DISC TYPE	89473	1D1617	1
1205-0036	HEAT DISSIPATOR	28480	1205-0036	1
1250-0901	CONNECTOR:RF BULKHEAD	15558	1104/D	4
1251-1636	CONNECTOR:JACK	28480	1251-1636	1
1854-0005	TRANSISTOR:SILICON NPN 2N708	02735	2N708	3
1854-0020	TRANSISTOR:NPN SILICON	28480	1854-0020	1
1854-0023	TRANSISTOR:SILICON NPN	28480	1854-0023	3
1854-0039	TRANSISTOR:SILICON 2N3053	02735	2N3053	1
1854-0073	TRANSISTOR:SILICON NPN	28480	1854-0073	3
1901-0025	DIODE:SILICON 100WV 100MA	28480	1901-0025	3
1901-0040	DIODE:SILICON 30MA 30WV	28480	1901-0040	2
1901-0049	DIODE:SILICON 50PIV	28480	1901-0049	2
1902-0049	DIODE,BREAKDOWN: 6.19V 5%	28480	1902-0049	1
1902-0063	DIODE BREAKDOWN:15V	28480	1902-0063	1
2100-1738	R:VAR WW 10K OHM 30% LIN 1/2W	28480	2100-1738	1
2100-1984	R:VARI CERMET FLM 100 OHM 30% LIN 1/2W	28480	2100-1984	1
2100-2060	R:VARI CERMET FLM 50 OHM 30% LIN 1/2W	28480	2100-2060	1
2100-2216	R:VARI CERMET FLM 5K OHM 30% LIN 1/2W	28480	2100-2216	1
2100-2224	R:VAR WW 200 OHM 5% LIN 1W	28480	2100-2224	1
2110-0254	FUSE:THERMAL 15A	15558	1194	2
5080-0049	CRYSTAL:5MHZ	28480	5080-0049	1
9100-2430	INDUCTOR:220 UH	82142	155-221K	5
9140-0019	COIL:FXD RF 200 UH 10%	28480	9140-0019	1
00105-0002	COVER:OVEN	28480	00105-0002	1
00105-0006	POWER AMPLIFIER SHIELD	28480	00105-0006	1
00105-2001	COVER:CONNECTOR END	28480	00105-2001	1
00105-2002	COVER:NON-CONNECTOR END	28480	00105-2002	1
00105-2003	BLANK BOARD	28480	00105-2003	1
00105-2005	BOARD:BLANK	28480	00105-2005	1
00105-2006	BOARD BLANK	28480	00105-2006	1
00105-2007	BLANK BOARD	28480	00105-2007	1
00105-2014	BOARD BLANK	28480	00105-2014	1
00105-2015	COVER:CRYSTAL	28480	00105-2015	1
00105-6002	CHAMBER ASSY:INCL HR1 HR2 ST1 &AIRT1	28480	00105-6002	1
00105-6003	ASSY:AGC INPUT BOARD	28480	00105-6003	1
00105-6004	ASSY:AGC OUTPUT BOARD	28480	00105-6004	1
00105-6005	ASSY:OSCILLATOR 5MHZ	28480	00105-6005	1
00105-6006	AC CONTROLLER ASSY	28480	00105-6006	1
00105-6007	ASSY:POWER AMPLIFIER BOARD	28480	00105-6007	1
00105-6009	ASSY:AGC N.S.R. ORDER ASSY00105-6010	28480	00105-6009	1
00105-6010	ASSY:OSCILLATOR AND AGC 5MHZ	28480	00105-6010	1
00105-8001	TRANSFORMER:AGC INPUT	28480	00105-8001	1
00105-8002	TRANSFORMER:AGC OUTPUT	28480	00105-8002	1
00105-8003	TRANSFORMER:POWER AMP	28480	00105-8003	1
00105-8004	COIL:FREQ PADDING(TYPICAL VALUE 30UH)	28480	00105-8004	1
00105-8005	COIL:MODE SUPPRESSOR .47UH	28480	00105-8005	1

See introduction to this section for ordering information

Table 5-3. Manufacturer's Code List

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

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
00000	U. S. A. Common	Any supplier of U. S.	05397	Union Carbide Corp., Linde Div.	Kemet Dept., Kemet Dept.,	11242	Bay State Electronics Corp.	Waltham, Mass.
00136	McCoy Electronics	Mount Holly Springs, Pa.			* Cleveland, Ohio	11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
00213	Sage Electronics Corp.	Rochester, N. Y.	05593	Illumitronic Engineering Co.	Sunnyvale, Calif.	11314	National Seal	Downey, Calif.
00287	Cemco Inc.	Danielson, Conn.	05616	Cosmo Plastic		11534	Duncan Electronics Inc.	Costa Mesa, Calif.
00334	Humidial	Colton, Calif.		(c/o Electrical Spec. Co.)	Cleveland, Ohio	11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N. J.
00348	Microtron Co., Inc.	Valley Stream, N. Y.	05624	Barber Colman Co.	Rockford, Ill.	11717	Imperial Electronic, Inc.	Buena Park, Calif.
00373	Garlock Inc.	Cherry Hill, N. J.	05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N. Y.	11870	Melabs, Inc.	Palo Alto, Calif.
09656	Aerovox Corp.	New Bedford, Mass.			Westbury, N. Y.	12136	Philadelphia Handle Co.	Camden, N. J.
00779	Amp. Inc.	Harrisburg, Pa.	05729	Metro-Tel Corp.	Santa Cruz, Calif.	12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
00781	Aircraft Radio Corp.	Boonton, N. J.	05783	Stewart Engineering Co.	Wakefield, Mass.	12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N. M.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.	06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.	12697	Clarostat Mfg. Co.	Dover, N. H.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S. C.	06090	Raychem Corp.	Redwood City, Calif.	12728	Elmar Filter Corp.	W. Haven, Conn.
00866	Goe Engineering Co.	City of Industry, Cal.	06175	Bausch and Lomb Optical Co.	Rochester, N. Y.	12859	Nippon Electric Co., Ltd.	Tokyo, Japan
00891	Carl E. Holmes Corp.	Los Angeles, Calif.	06402	E. T. A. Products Co. of America	Chicago, Ill.	12881	Metex Electronics Corp.	Clark, N. J.
00929	Microfab Inc.	Livingston, N. J.	06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N. Y.	12930	Delta Semiconductor Inc.	Newport Beach, Calif.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N. Y.	06555	Beede Electrical Instrument Co., Inc.	Penacook, N. H.	12954	Dickson Electronics Corp.	Scottsdale, Arizona
01009	Alden Products Co.	Brockton, Mass.			Indianapolis, Ind.	13103	Thermolloy	Dallas, Texas
01121	Allen Bradley Co.	Milwaukee, Wis.	06666	General Devices Co., Inc.	Phoenix, Ariz.	13396	Telefunken (GmbH)	Hanover, Germany
01255	Litton Industries, Inc.	Beverly Hills, Calif.	06751	Sencor Div. Components Inc.	Van Nuys, Calif.	13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
01281	TRW Semiconductors, Inc.	Lawndale, Calif.	06812	Torrington Mfg. Co., West Div.	San Carlos, Calif.	14099	Sem-Tech	Newbury Park, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas			Van Nuys, Calif.	14193	Calif. Resistor Corp.	Santa Monica, Calif.
01349	The Alliance Mfg. Co.	Alliance, Ohio	06980	Varian Assoc. Eimac Div.	San Carlos, Calif.	14298	American Components, Inc.	Conshohocken, Pa.
01589	Pacific Relays, Inc.	Van Nuys, Calif.	07088	Kelvin Electric Co.	Van Nuys, Calif.	14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
01930	Amerock Corp.	Rockford, Ill.	07126	Digitran Co.	Pasadena, Calif.	14493	Hewlett-Packard Company	Loveland, Colo.
01961	Pulse Engineering Co.	Santa Clara, Calif.	07137	Transistor Electronics Corp.	Minneapolis, Minn.	14655	Cornell Dublier Electric Corp.	Newark, N. J.
02114	Ferroxcube Corp. of America	Saugerties, N. Y.	07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N. Y.	14674	Corning Glass Works	Corning, N. Y.
02116	Wheelock Signals, Inc.	Long Branch, N. J.	07149	Filmohm Corp.	New York, N. Y.	14752	Electro Cube Inc.	San Gabriel, Calif.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.	07233	Cinch-Graphik Co.	City of Industry, Calif.	14960	Williams Mfg. Co.	San Jose, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.	07261	Avnet Corp.	Culver City, Calif.	15203	Webster Electronics Co.	New York, N. Y.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N. J.	07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.	15287	Scionics Corp.	Northridge, Calif.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.	07322	Minnesota Rubber Co.	Minneapolis, Minn.	15291	Adjustable Bushing Co.	N. Hollywood, Calif.
02777	Hopkins Engineering Co.	San Fernando, Calif.	07387	Birtcher Corp., The	Monterey Park, Calif.	15558	Micron Electronics	Garden City, Long Island, N. Y.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N. Y.	07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.	15566	Amprobe Inst. Corp.	Lynbrook, N. Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio	07700	Technical Wire Products Inc.	Cranford, N. J.	15631	Cabletronics	Costa Mesa, Calif.
03797	Eldema Corp.	Compton, Calif.	07910	Continental Device Corp.	Hawthorne, Calif.	15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.	07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.	15801	Fenwal Elect. Inc.	Frammingham, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N. J.	07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N. J.	15818	Amelco Inc.	Mt. View, Calif.
03954	Singer Co., Diehl Div. Finderne Plant	Sumerville, N. J.	08145	U. S. Engineering Co.	Los Angeles, Calif.	16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	08289	Blinn, Delbert Co.	Pomona, Calif.	16179	Omn-Spectra Inc.	Detroit, Ill.
04013	Taurus Corp.	Lambertville, N. J.	08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada	16352	Computer Diode Corp.	Lodi, N. J.
04062	Arco Electronic Inc.	Great Neck, N. Y.			Los Angeles, Calif.	16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N. Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S. C.	08524	Deutsch Fastener Corp.	Los Angeles, Calif.	16758	Delco Radio Div. of G. M. Corp.	Kokoma, Ind.
04354	Precision Paper Tube Co.	Wheeling, Ill.	08664	Bristol Co., The	Waterbury, Conn.	17109	Thermonetics Inc.	Canoga Park, Calif.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.	08717	Sloan Company	Sun Valley, Calif.	17474	Tranex Company	Mountain View, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.	08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona	17675	Hamlin Metal Products Corp.	Akron, Ohio
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona	08792	CBS Electronics Semiconductor Operations, Div. of C. B. S. Inc.	Lowell, Mass.	17745	Angstrom Prec. Inc.	No. Hollywood, Calif.
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.	08984	Mel-Rain	Indianapolis, Ind.	17870	McGraw-Edison Co.	Manchester, N. H.
04773	Automatic Electric Co.	Northlake, Ill.	09026	Babcock Relays Div.	Costa Mesa, Calif.	18042	Power Design Pacific Inc.	Palo Alto, Calif.
04796	Sequoia Wire Co.	Redwood City, Calif.	09134	Texas Capacitor Co.	Houston, Texas	18083	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.	09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.	18324	Signetics Corp.	Sunnyvale, Calif.
04870	P. M. Motor Company	Westchester, Ill.	09250	Electro Assemblies, Inc.	Chicago, Ill.	18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.	09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada	18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.	10214	General Transistor Western Corp.	Los Angeles, Calif.	18583	Curtis Instrument, Inc.	Mt. Kisco, N. Y.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.	10411	Ti-Tal, Inc.	Berkeley, Calif.	18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
05347	Ultronix, Inc.	San Mateo, Calif.	10646	Carborundum Co.	Niagara Falls, N. Y.	18911	Durant Mfg. Co.	Milwaukee, Wis.
			11236	CTS of Berne, Inc.	Berne, Ind.	19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N. J.
			11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.	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

00015-44
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H4-1 Dated AUGUST 1966
H4-2 Dated NOV. 1962

Table 5-3. Manufacturer's Code List (cont'd)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
20183	General Atomics Corp.	Philadelphia, Pa.	71436	Chicago Condenser Corp.	Chicago, Ill.	77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N. Y.	71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.	77342	American Machine & Foundry Co.	Potter & Blumfield Div. Princeton, Ind.
21335	Fairair Bearing Co., The	New Britain, Conn.	71450	CTS Corp.	Elkhart, Ind.	77630	TRW Electronic Components Div.	Camden, N. J.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.	71468	ITT Cannon Electric Inc.	Los Angeles, Calif.	77636	General Instrument Corp., Rectifier Div.	Brooklyn, N. Y.
23783	British Radio Electronics Ltd.	Washington, D. C.	71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.	77764	Resistance Products Co.	Harrisburg, Pa.
24455	G. E., Lamp Division	Nela Park, Cleveland, Ohio	71482	C. P. Clare & Co.	Chicago, Ill.	77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
24655	General Radio Co.	West Concord, Mass.	71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.	78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.	71616	Commercial Plastics Co.	Chicago, Ill.	78283	Signal Indicator Corp.	New York, N. Y.
26365	Gries Reproducer Corp.	New Rochelle, N. Y.	71700	Cornish Wire Co., The	New York, N. Y.	78290	Struthers-Dunn Inc.	Pitman, N. J.
26462	Grobet Fire Co. of America, Inc.	Carlstadt, N. J.	71707	Coto Coil Co., Inc.	Providence, R. I.	78452	Thompson-Bremer & Co.	Chicago, Ill.
26992	Harrison Watch Co.	Lancaster, Pa.	71744	Chicago Miniature Lamp Works	Chicago, Ill.	78471	Tilley Mfg. Co.	San Francisco, Calif.
28480	Hewlett-Packard Co.	Palo Alto, Calif.	71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.	78488	Stackpole Carbon Co.	St. Marys, Pa.
28520	Heyman Mfg. Co.	Kentilworth, N. J.	71984	Dow Corning Corp.	Midland, Mich.	78493	Standard Thomson Corp.	Waltham, Mass.
33173	G. E. Receiving Tube Dept.	Owensboro, Ky.	72136	Electro Motive Mfg. Co., Inc.	Williamantic, Conn.	78553	Tinnerman Products Inc.	Cleveland, Ohio
35434	Lectron Inc.	Chicago, Ill.	72619	Drahtight Corp.	Brooklyn, N. Y.	78790	Transformer Engineers	San Gabriel, Calif.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada	72656	Indiana General Corp., Electronics Div.	Keasby, N. J.	78947	Ucinite Co.	Newtonville, Mass.
36287	Cunningham, W. H. & Hill, Ltd.	Toronto Ontario, Canada	72699	General Instrument Corp., Cap. Div.	Newark, N. J.	79136	Waldes Kohinor Inc.	Long Island City, N. Y.
37942	P. R. Mattory & Co. Inc.	Indianapolis, Ind.	72765	Drake Mfg. Co.	Harwood Heights, Ill.	79142	Veeder Root, Inc.	Hartford, Conn.
39543	Mechanical Industries Prod. Co.	Akron, Ohio	72825	Hugh H. Eby Inc.	Philadelphia, Pa.	79251	Wenco Mfg. Co.	Chicago, Ill.
40920	Miniature Precision Bearings, Inc.	Keene, N. H.	72928	Gudeman Co.	Chicago, Ill.	79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
42190	Muler Co.	Chicago, Ill.	72964	Robert M. Hadley Co.	Los Angeles, Calif.	79963	Zierick Mfg. Corp.	New Rochelle, N. Y.
43990	C. A. Norgren Co.	Englewood, Colo.	72982	Erie Technological Products, Inc.	Erie, Pa.	80031	Mepco Division of Sessions Clock Co.	Morristown, N. J.
44655	Omrite Mfg. Co.	Skokie, Ill.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.	80120	Schnitzer Alloy Products Co.	Elizabeth, N. J.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.	73076	H. M. Harper Co.	Chicago, Ill.	80131	Electronic Industries Association, Any brand Tube meeting EIA Standards-Washington, DC	Washington, DC
47904	Posatard Corp.	Cambridge, Mass.	73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.	80207	Unimax Switch. Div. Maxon Electronics Corp.	Wallingford, Conn.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.	73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.	80223	United Transformer Corp.	New York, N. Y.
49956	Microwave & Power Tube Div.	Waltham, Mass.	73445	Amperex Elect. Co.	Hicksville, L. I., N. Y.	80246	Gulford Electric Corp.	Chicago, Ill.
52096	Reagan Controller Co.	Westminster, Md.	73506	Bradley Semiconductor Corp.	New Haven, Conn.	80294	Bouins Inc.	Riverside, Calif.
52983	Sanborn Company	Waltham, Mass.	73559	Carlting Electric, Inc.	Hartford, Conn.	80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
54294	Smaltross Mfg. Co.	Selma, N. C.	73586	Circle F. Mfg. Co.	Trenton, N. J.	80486	All Star Products Inc.	Defiance, Ohio
55026	Simpson Electric Co.	Chicago, Ill.	73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.	80509	Avery Label Co.	Monrovia, Calif.
55933	Sonotone Corp.	Elmsford, N. Y.	73734	Federal Screw Products Inc.	Chicago, Ill.	80583	Hammarlund Co. Inc.	New York, N. Y.
55936	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.	73743	Fischer Special Mfg. Co.	Cincinnati, Ohio	80640	Stevens Arnold Co., Inc.	Boston, Mass.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N. Y.	73793	General Industries Co., The	Elyria, Ohio	81030	International Instruments Inc.	Orange, Conn.
56289	Sprague Electric Co.	North Adams, Mass.	73846	Goshen Stamping & Tool Co.	Goshen, Ind.	81073	Grayhill Co.	LaGrange, Ill.
59446	Telex Corp.	Tulsa, Okla.	73899	JFD Electronics Corp.	Brooklyn, N. Y.	81095	Triad Transformer Corp.	Venice, Calif.
59730	Thomas & Betts Co.	Elizabeth, N. J.	73905	Jennings Radio Mfg. Corp.	San Jose, Calif.	81312	Winchester Elec. Div. Litton Ind., Inc.	Dakville, Conn.
60741	Triplet Electrical Inst. Co.	Bluffton, Ohio	73957	Groov-Pin Corp.	Ridgefield, N. J.	81349	Military Specification	
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.	74276	Signalite Inc.	Neptune, N. J.	81483	International Rectifier Corp.	El Segundo, Calif.
62119	Universal Electric Co.	Owosso, Mich.	74455	J. H. Winns, and Sons	Winchester, Mass.	81541	Airpax Electronics, Inc.	Cambridge, Maryland
63743	Ward-Leonard Electric Co.	Owosso, Mich.	74861	Industrial Condenser Corp.	Chicago, Ill.	81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
64959	Western Electric Co., Inc.	Mt. Vernon, N. Y.	74868	R. F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.	82042	Carter Precision Electric Co.	Skokie, Ill.
65092	Western Inst. Inc. Weston-Newark	Newark, N. J.	74970	E. F. Johnson Co.	Waseca, Minn.	82047	Sperli Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N. J.
66295	Wittex Mfg. Co.	Chicago, Ill.	75042	International Resistance Co.	Philadelphia, Pa.	82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.	75378	CTS Knights Inc.	Sandwich, Ill.	82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N. J.
70276	Allen Mfg. Co.	Hartford, Conn.	75382	Kulka Electric Corporation	Mt. Vernon, N. Y.	82209	Maguire Industries, Inc.	Greenwich, Conn.
70329	Allen-Dexter Corp.	New York, N. Y.	75818	Lenz Electric Mfg. Co.	Chicago, Ill.	82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
70331	Allmetal Srew Product Co., Inc.	Garden City, N. Y.	75818	Lenz Electric Mfg. Co.	Chicago, Ill.	82376	Astron Corp.	East Newark, Harrison, N. J.
70465	Atlantic India Rubber Works, Inc.	Chicago, Ill.	75915	Littlefuse, Inc.	Des Plaines, Ill.	82369	Switchcraft, Inc.	Chicago, Ill.
70563	Ampelite Co., Inc.	Union City, N. J.	76005	Loid Mfg. Co.	Erie, Pa.	82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
70674	ADC Products Inc.	Minneapolis, Minn.	76210	C. W. Marwedel	San Francisco, Calif.	82768	Phillips-Advance Control Co.	Joliet, Ill.
70923	Belden Mfg. Co.	Chicago, Ill.	76433	General Instrument Corp., Micamold Division	Newark, N. J.	82866	Research Products Corp.	Madison, Wis.
70998	Bird Electronic Corp.	Cleveland, Ohio	76487	James Millen Mfg. Co., Inc.	Malden, Mass.	82877	Roton Mfg. Co., Inc.	Woodstock, N. Y.
71002	Birnback Radio Co.	New York, N. Y.	76493	J. W. Miller Co.	Los Angeles, Calif.	82893	Vector Electronic Co.	Glendale, Calif.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.	76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.			
71218	Bud Radio, Inc.	Willoughby, Ohio	76545	Mueller Electric Co.	Cleveland, Ohio			
71286	Camloc Fastener Corp.	Paramus, N. J.	76703	National Union	Newark, N. J.			
71313	Cardwell Condenser Corp.	Lindenhurst L. I., N. Y.	76854	Oak Manufacturing Co.	Crystal Lake, Ill.			
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.	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.			

From: FSC Handbook Supplements
H4-1 Dated AUGUST 1966
H4-2 Dated NOV. 1962

00015-44
Revised: September, 1967

Table 5-3. Manufacturer's Code List (cont'd)

Code No.	Manufacturer	Address	Code No.	Manufacturer	Address	Code No.	Manufacturer	Address
83058	Carr Fastener Co.	Cambridge, Mass.	91418	Radio Materials Co.	Chicago, Ill.	97464	Industrial Retaining Ring Co.	Irvington, N. J.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N. H.	91506	Augat Inc.	Attleboro, Mass.	97539	Automatic & Precision Mfg.	Englewood, N. J.
83125	General Instrument Corp., Capacitor Div.	Darlington, S. C.	91637	Dale Electronics, Inc.	Columbus, Nebr.	97979	Reon Resistor Corp.	Yonkers, N. Y.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.	91662	Elco Corp.	Willow Grove, Pa.	97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N. Y.
83186	Victory Eng. Corp.	Springfield, N. J.	91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.	98141	R-Tronics, Inc.	Jamaica, N. Y.
83298	Bendix Corp., Red Bank Div.	Red Bank, N. J.	91827	K F Development Co.	Redwood City, Calif.	98159	Rubber Teck, Inc.	Gardena, Calif.
83315	Hubbell Corp.	Mundelein, Ill.	91886	Malco Mfg. Co., Inc.	Chicago, Ill.	98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N. Y.	91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.	98278	Microdot, Inc.	So. Pasadena, Calif.
83332	Tech Labs	Palisade's Park, N. J.	91961	Nahm-Bros. Spring Co.	Oakland, Calif.	98291	Sealectro Corp.	Mamaroneck, N. Y.
83385	Central Screw Co.	Chicago, Ill.	92180	Tru-Connector Corp.	Peabody, Mass.	98376	Zero Mfg. Co.	Burbank, Calif.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.	92367	Elgeet Optical Co. Inc.	Rochester, N. Y.	98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N. J.	92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N. Y.	98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N. Y.	92702	IMC Magnetics Corp.	Wesbury Long Island, N. Y.	98821	North Hills Electronics, Inc.	Glen Cove, N. Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.	92966	Hudson Lamp Co.	Kearney, N. J.	98978	International Electronic Research Corp.	Burbank, Calif.
83821	Loyd Scruggs Co.	Festus, Mo.	93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.	99109	Columbia Technical Corp.	New York, N. Y.
83942	Aeronautical Inst. & Radio Co.	Lodi, N. J.	93369	Robbins & Myers Inc.	Palisades Park, N. J.	99313	Varian Associates	Palo Alto, Calif.
84171	Arco Electronics Inc.	Great Neck, N. Y.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio	99378	Atlee Corp.	Winchester, Mass.
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.	93929	G. V. Controls	Livingston, N. J.	99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.	94137	General Cable Corp.	Bayonne, N. J.	99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.	94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.	99800	Delevan Electronics Corp.	East Aurora, N. Y.
85454	Boonton Molding Company	Boonton, N. J.	94148	Scientific Electronics Products, Inc.	Loveland, Colo.	99848	Wilco Corporation	Indianapolis, Ind.
85471	A. B. Boyd Co.	San Francisco, Calif.	94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N. J.	99934	Renbrandt, Inc.	Boston, Mass.
85474	R. M. Bracamonte & Co.	San Francisco, Calif.	94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N. J.	99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
85660	Koried Kords, Inc.	Hamden, Conn.	94222	South Chester Corp.	Chester, Pa.	99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.
85911	Seamless Rubber Co.	Chicago, Ill.	94330	Wire Cloth Products, Inc.	Bellwood, Ill.			
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.			
86579	Precision Rubber Products Corp.	Dayton, Ohio	94696	Magnecraft Electric Co.	Chicago, Ill.			
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N. J.	95023	George A. Philbrick Researchers, Inc.	Boston, Mass.			
87034	Marco Industries	Anaheim, Calif.	95236	Allies Products Corp.,	Dania, Fla.			
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.	95238	Continental Connector Corp.	Woodside, N. Y.			
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.	95263	Leecraft Mfg. Co., Inc.	Long Island, N. Y.			
87664	Van Waters & Rogers Inc.	San Francisco, Calif.	95265	National Coil Co.	Sheridan, Wyo.			
87930	Tower Mfg. Corp.	Providence, R. I.	95275	Vitramon, Inc.	Bridgeport, Conn.			
88140	Cutler-Hammer, Inc.	Lincoln, Ill.	95348	Gordos Corp.	Bloomfield, N. J.	0000F	Malco Tool and Die	Los Angeles, Calif.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.	95354	Methode Mfg. Co.	Rolling Meadows, Ill.	0000Z	Willow Leather Products Corp.	Newark, N. J.
88698	General Mills, Inc.	Buffalo, N. Y.	95566	Arnold Engineering Co.	Marengo, Ill.			
89231	Graybar Electric Co.	Oakland, Calif.	95712	Dage Electric Co., Inc.	Franklin, Ind.	000AB	ETA	England
89473	G. E. Distributing Corp.	Schenectady, N. Y.	95984	Stemon Mfg. Co.	Wayne, Ill.	000BB	Precision Instrument Components Co.	Van Nuys, Calif.
89665	United Transformer Co.	Chicago, Ill.	95987	Weckesser Co.	Chicago, Ill.	000CS	Hewlett-Packard Co.,	Colorado Springs
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N. J.	96067	Huggins Laboratories	Sunnyvale, Calif.			
90970	Bearing Engineering Co.	San Francisco, Calif.	96095	Hi-Q Div. of Aerovox Corp.	Olean, N. Y.	000MM	Rubber Eng. & Development	Hayward, Calif.
91146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.	96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.	000NN	A "N" D Mfg. Co.	San Jose, Calif.
91260	Connor Spring Mfg. Co.	San Francisco, Calif.	96296	Solar Manufacturing Co.	Los Angeles, Calif.	000QQ	Cooltron	Oakland, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.	96330	Carlton Screw Co.	Chicago, Ill.	000WW	California Eastern Lab.	Burlington, Calif.
			96501	Excel Transformer Co.	Oakland, Calif.	000YY	S. K. Smith Co.	Los Angeles, 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.

From: FSC. Handbook Supplements
H4-1 Dated AUGUST 1966
H4-2 Dated NOV 1962

SECTION VI MANUAL CHANGES

6-1. MANUAL CHANGES

6-2. This manual applies directly to Model 105A and to Model 105B Quartz Oscillators having serial number prefix 808 (refer to Paragraph 1-3).

6-3. NEWER INSTRUMENTS

6-4. As changes are made, newer instruments may have serial numbers not listed in this manual. The manuals for these instruments will be supplied with an additional "Manual Changes" sheet containing the required information; contact your nearest Hewlett-

Packard Sales and Service office for information if this sheet is missing.

6-5. OLDER INSTRUMENTS

6-6. This manual with the changes listed in Table 6-1 also applies to Model 105A/B Quartz Oscillators having serial prefix numbers 804 and below.

6-7. OPTIONS

6-9. There are no options offered for the Model 105A and 105B.

Table 6-1. Manual Changes

Instrument Serial Prefix No.	Manual Changes
724	1, 2, 3
736	2, 3
804	3

- CHANGE 1: Page 7-11, Figure 7-6, A1A3. Delete CR3.
 Page 5-16, Delete A1A3CR3.
 Change A1 Oscillator Assembly (HP Part No. 00105-6013) Series Number to 724.
 Page 7-17, Figures 7-9 and 7-10. Delete C2A and C2B at AC LINE input 7-19 connector.
 Page 5-10, delete C2. Make appropriate changes in Table 5-2 and 5-2a.
- CHANGE 2: Page 7-11, Figure 7-6 A1A3. Change Q2 from HP Part No. 1854-0023 to HP Part No. 1854-0071.
 Page 5-16, A1A3Q2: Change to HP Part No. 1854-0071. Change A1 Oscillator Assembly (HP Part No. 00105-6013) Series Number to 736. Make appropriate changes in Table 5-2a.
- CHANGE 3: Page 7-7, Figure 7-4 A1A1. Delete C12 and R12.
 Add: C5, 1000 pF from Q1 base to Q1 emitter.
 Page 5-13, A1A1: Delete C12, HP Part No. 0160-0182, and R12: HP Part No. 0757-0924. Change Q1 and Q2 from HP Part No. 1854-0023 to HP Part No. 1854-0071.
 Page 7-11, Figure 7-6 A1A3. Delete R20.
 Page 5-16, delete A1A3R20. Change A1 Oscillator Assembly Series Number to 804. Make appropriate changes in Table 5-2a.



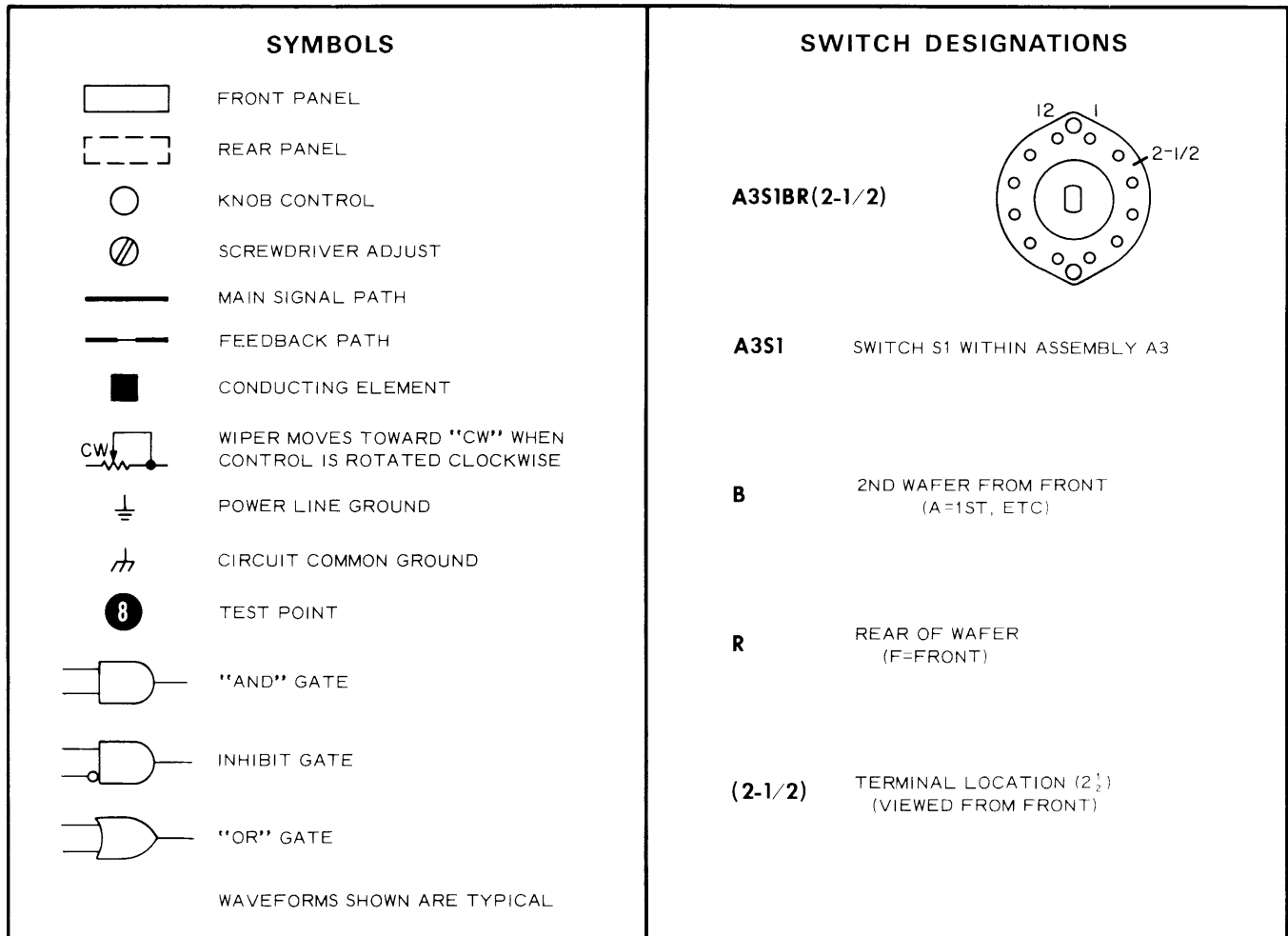
SECTION VII CIRCUIT DIAGRAMS

7-1. This section includes the following:

- a. Schematic Diagram Notes, Figure 7-1.
- b. Block Diagram, Figure 7-2.
- c. Schematic diagrams and component location illustrations in order of their designation (A1 through A5, Figures 7-3 through 7-10).

7-2. Shaded areas on the schematic diagrams indicate printed circuit board assemblies. All components within the shaded areas are mounted on the boards.

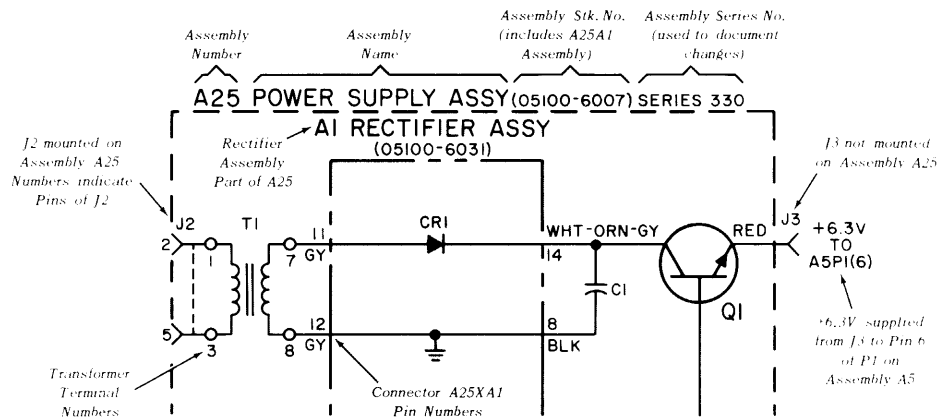
Figure 7-1. Schematic Diagram Notes



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3



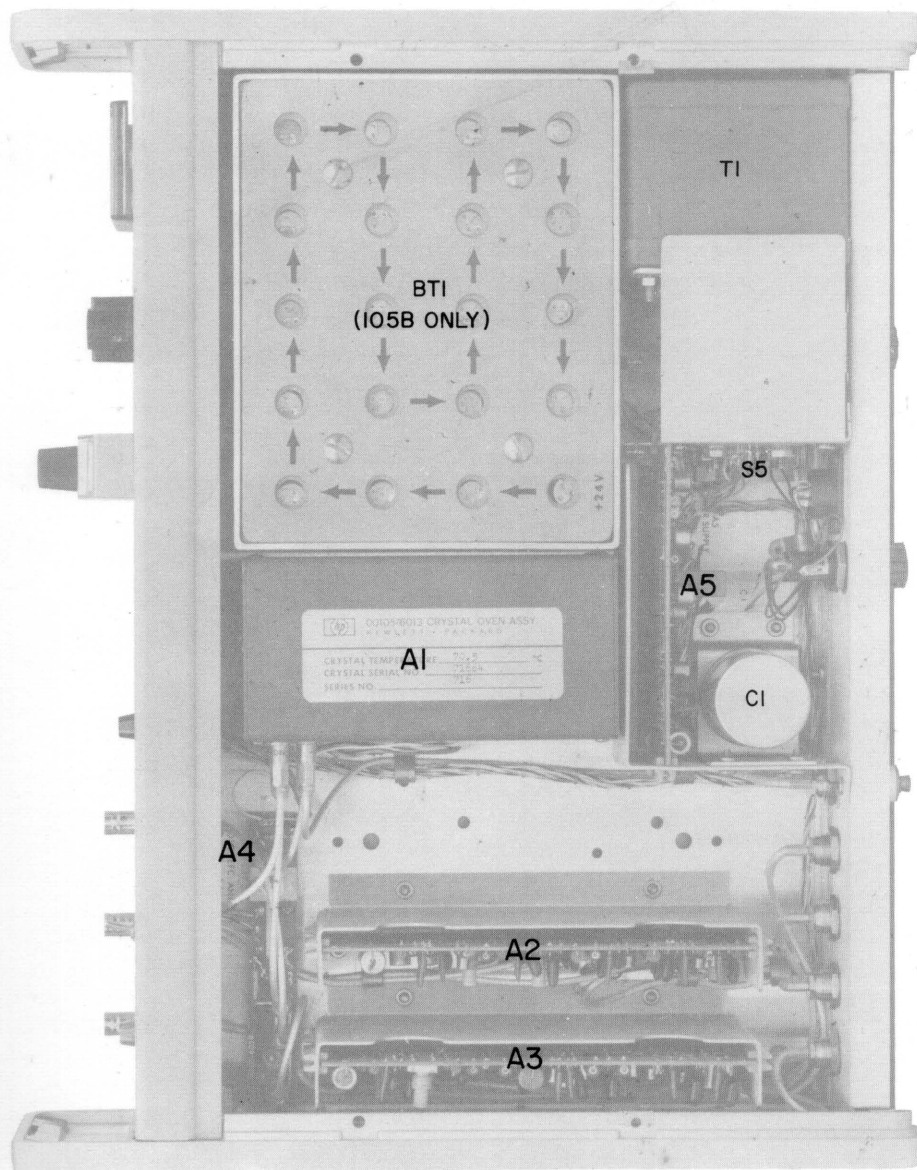


Figure 7-2
BLOCK DIAGRAM
7-3

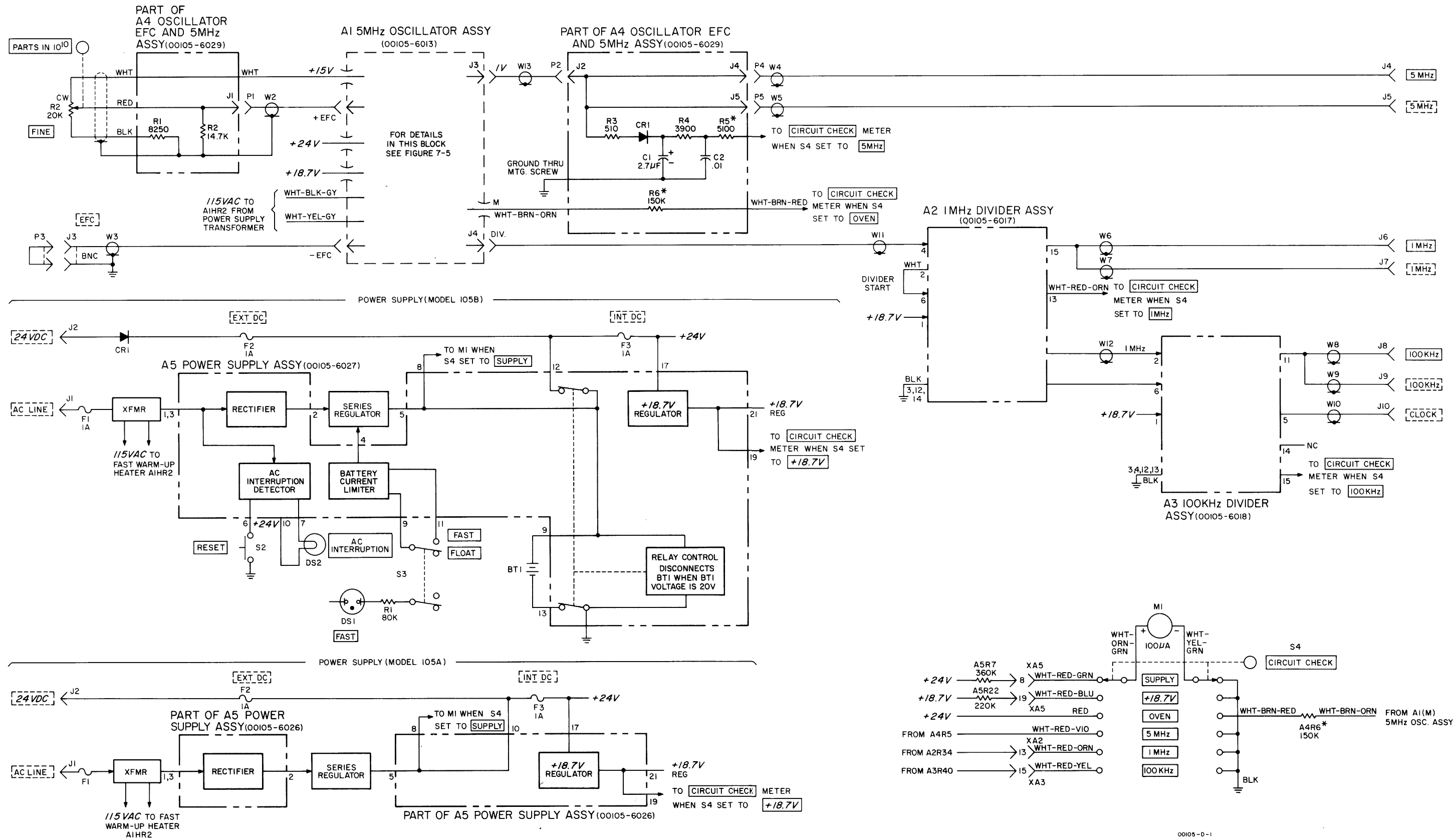


Figure 7-2. Block Diagram

Figure 7-3
**OSCILLATOR ASSEMBLY A1
BLOCK DIAGRAM**

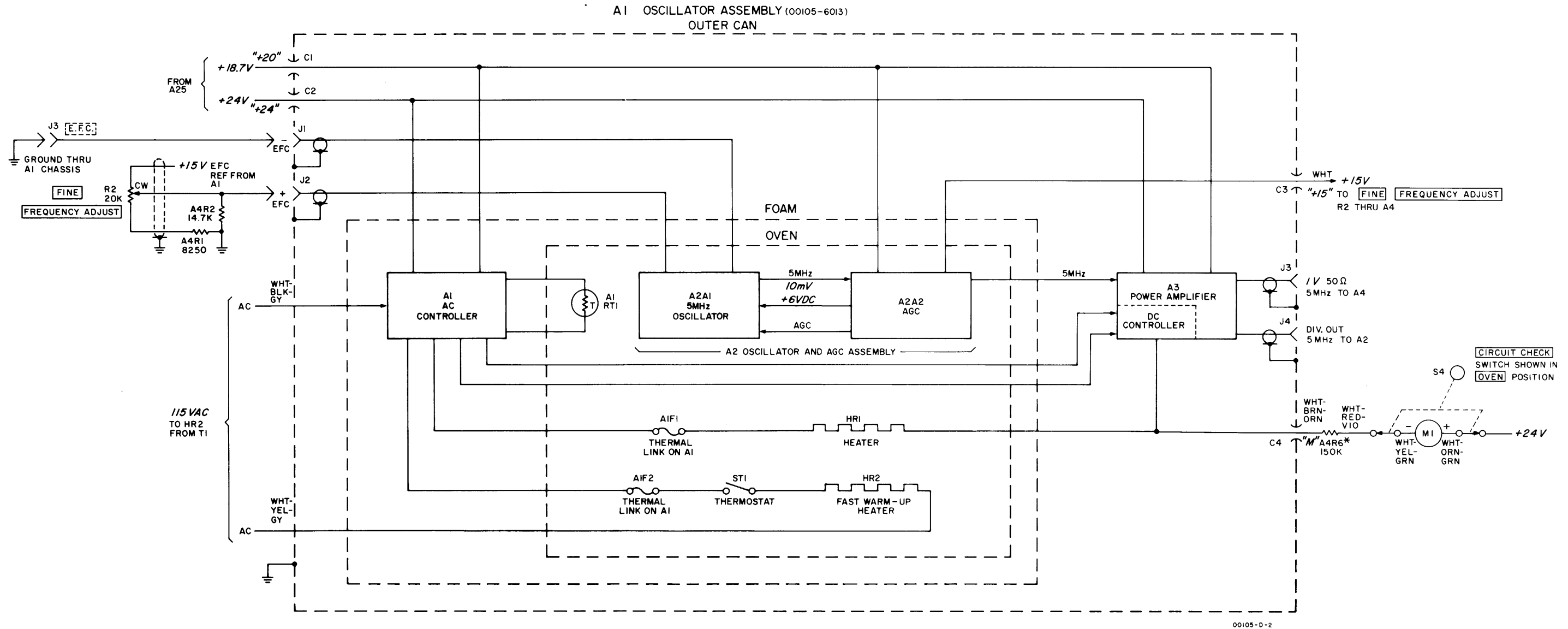
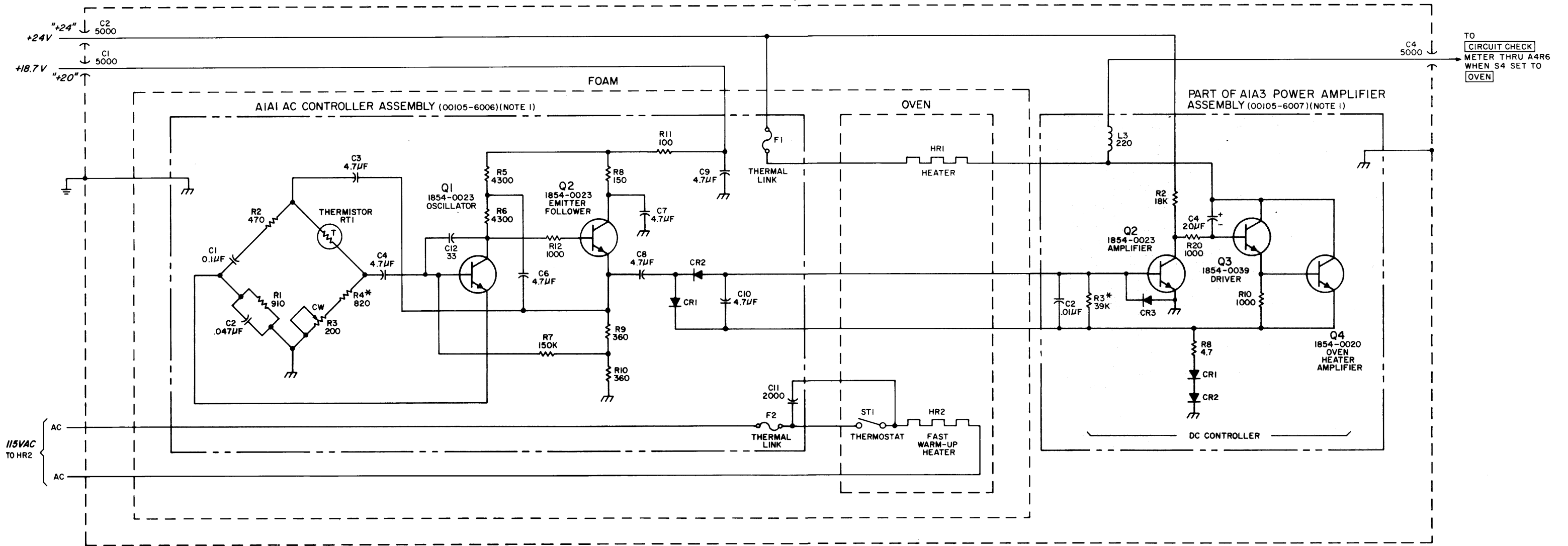


Figure 7-3. Oscillator Assembly A1, Block Diagram

Figure 7-4
OSCILLATOR ASSEMBLY A1
TEMPERATURE CONTROL CIRCUIT A1A1, A1A3

PART OF A1 OSCILLATOR ASSEMBLY (00105-6013) (NOTE 1)
OUTER CAN



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A1	A1A1	A1A3
C1, 2, 4	C 1-12 CR1, 2 F1, 2	C2, 4 CR1-3
HRI, 2		L3
ST1	Q1, 2 R 1-12 RT1	Q 2-4 R2, 3, 8, 10, 20

DELETED
C5

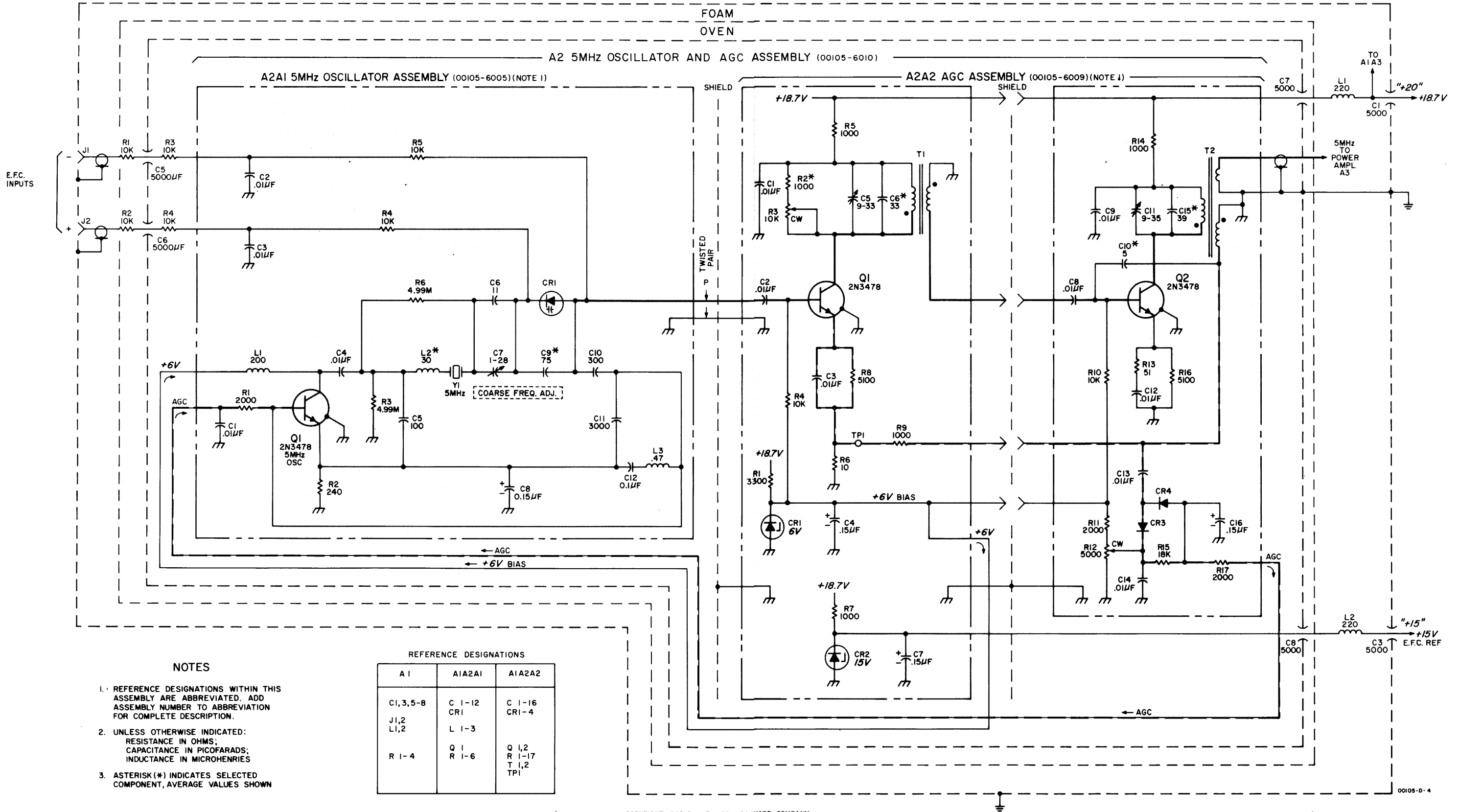
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00105-D-3

Figure 7-4. Oscillator Assembly A1, Temperature Control Circuit A1A1, A1A3

Figure 7-5

OSCILLATOR ASSEMBLY A1
5 MHZ OSCILLATOR AND AGC A2A1, A2A2

A1 OSCILLATOR ASSEMBLY (00105-6013) (NOTE 1)
OUTER CAN



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A 1	A1A2A1	A1A2A2
C1,3,5-8	C 1-12	C 1-16
J1,2	L 1-3	CR1-4
L1,2	Q 1	Q 1,2
R 1-4	R 1-6	R 1-17
		T 1,2
		TP1

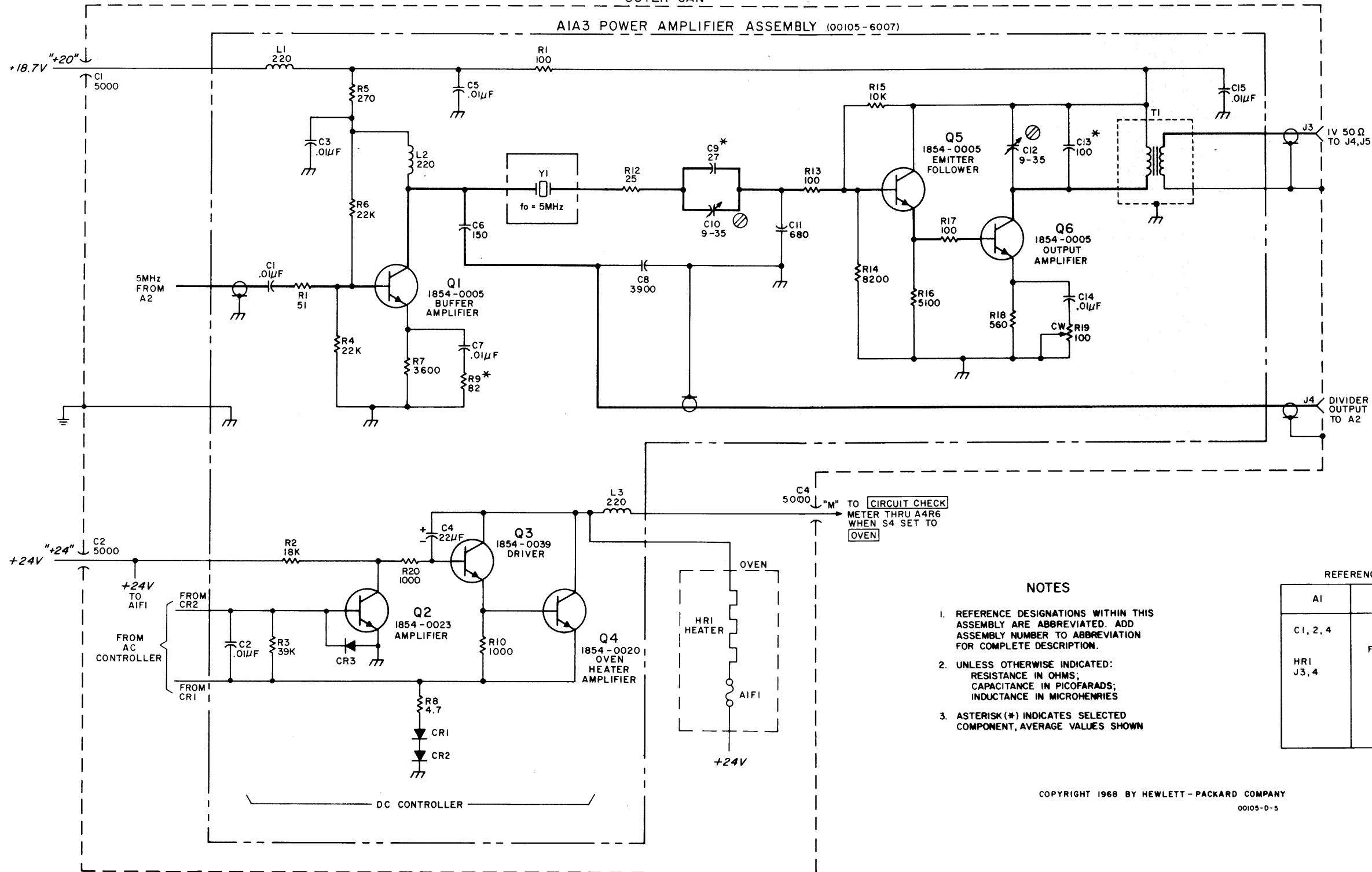
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Figure 7-5. Oscillator Assembly A1
5 MHz Oscillator and AGC A2A1, A2A2

PART OF A1 OSCILLATOR ASSEMBLY (00105-6013) (NOTE 1)

OUTER CAN

A1A3 POWER AMPLIFIER ASSEMBLY (00105-6007)



- NOTES**
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
 2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICO FARADS;
INDUCTANCE IN MICROHENRIES
 3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A1	A1A1	A1A3
C1, 2, 4		C1 - 15 CR1 - 3
HRI J3, 4	FI	L1 - 3 Q1 - 6 R1 - 20 T1

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00105-0-5

Figure 7-6. Oscillator Assembly A1
Power Amplifier A1A3

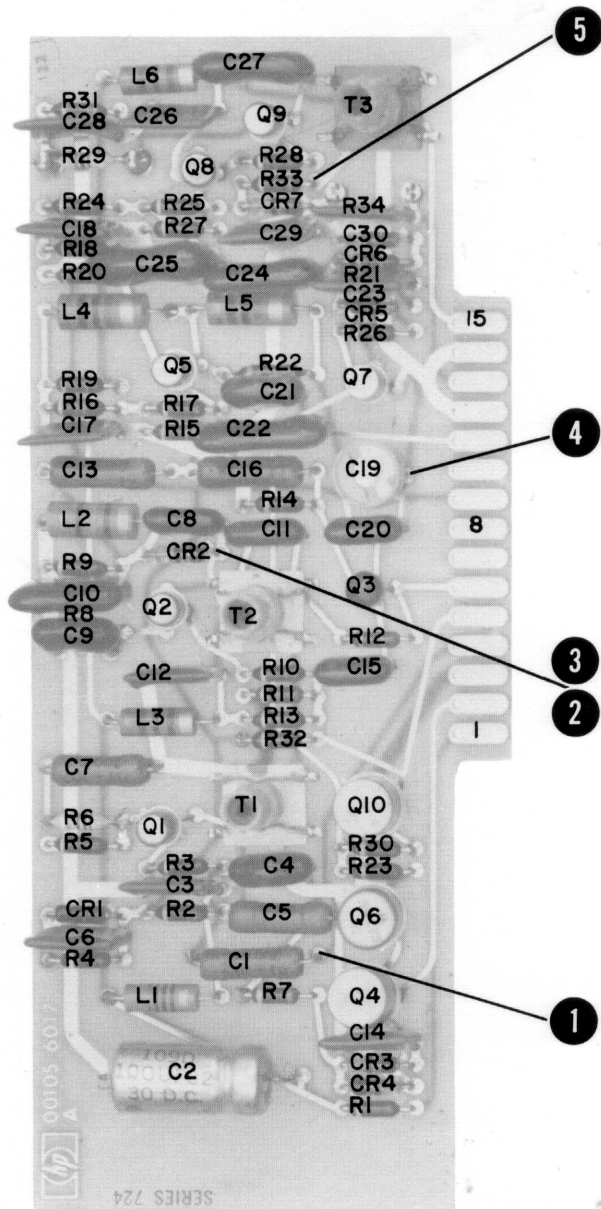
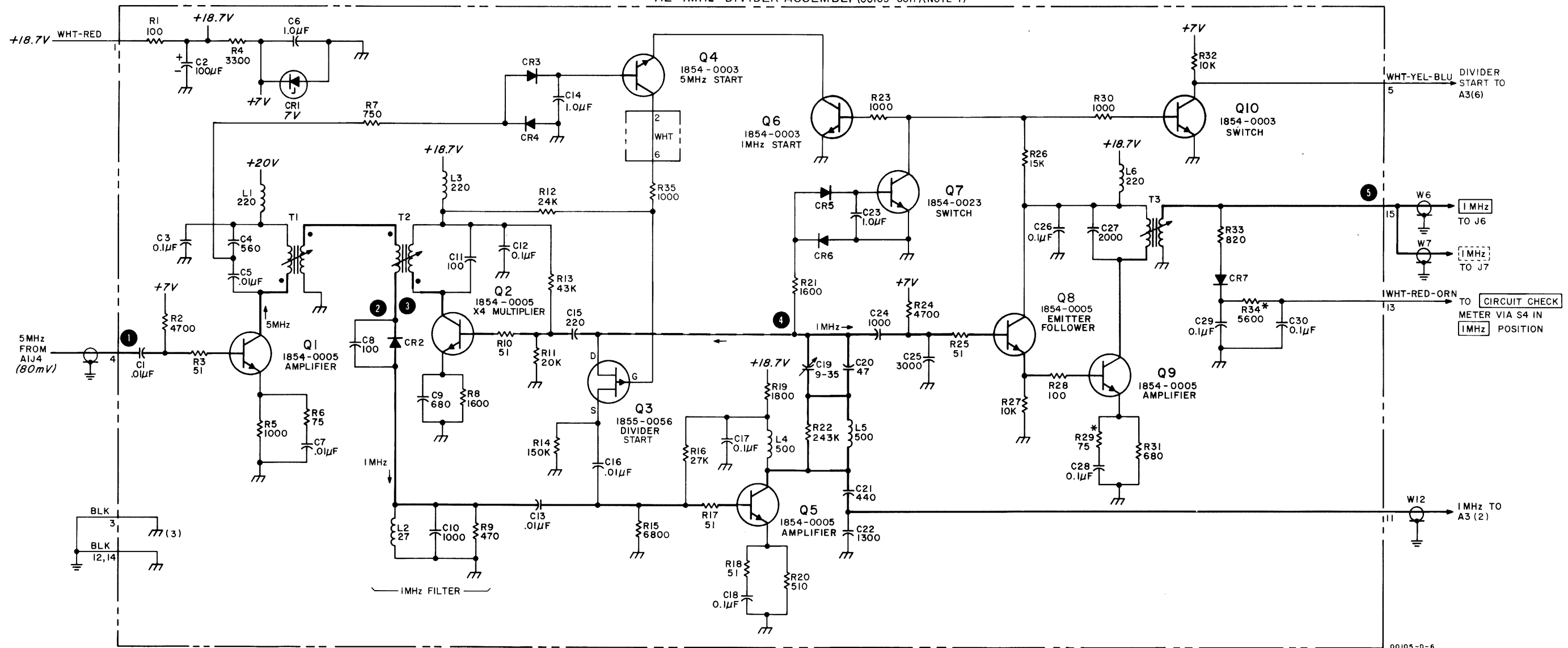


Figure 7-7
1 MHz DIVIDER A2

A2 1MHz DIVIDER ASSEMBLY (00105-6017)(NOTE 1)



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATION

NO PREFIX	A2
	C1-30
	CR1-7
	L1-6
	Q1-10
	R1-35
	T1-3
W6,7,12	

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Figure 7-7. 1 MHz Divider A2

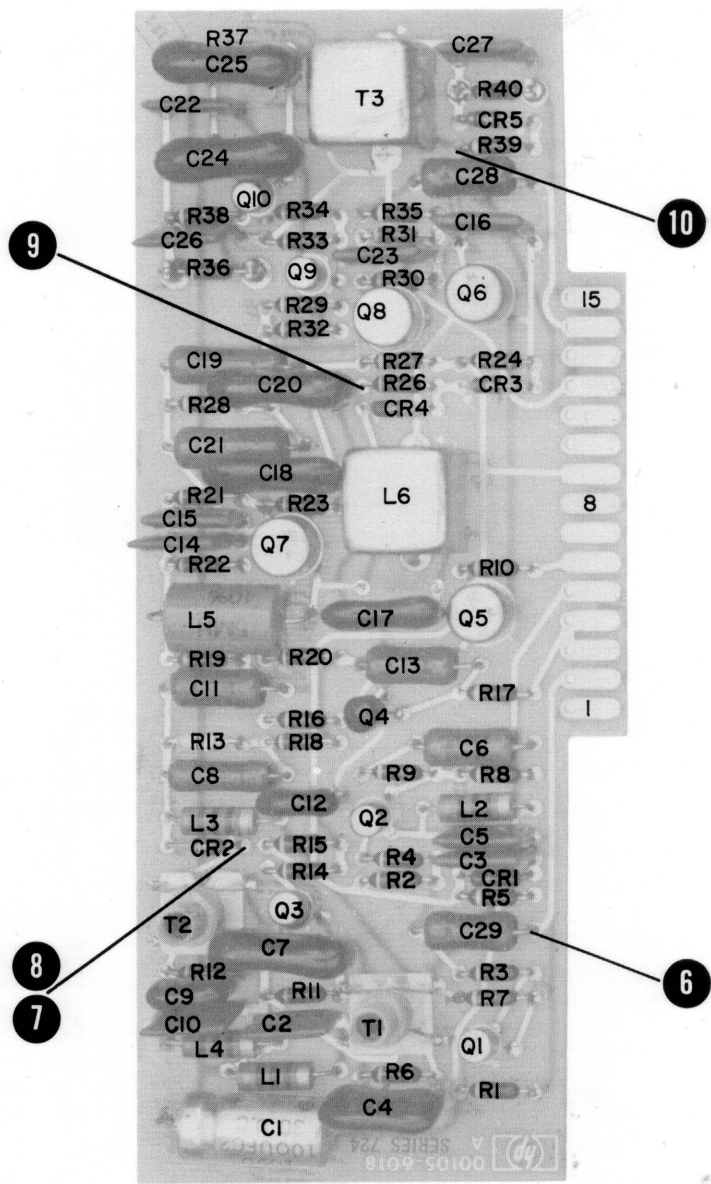
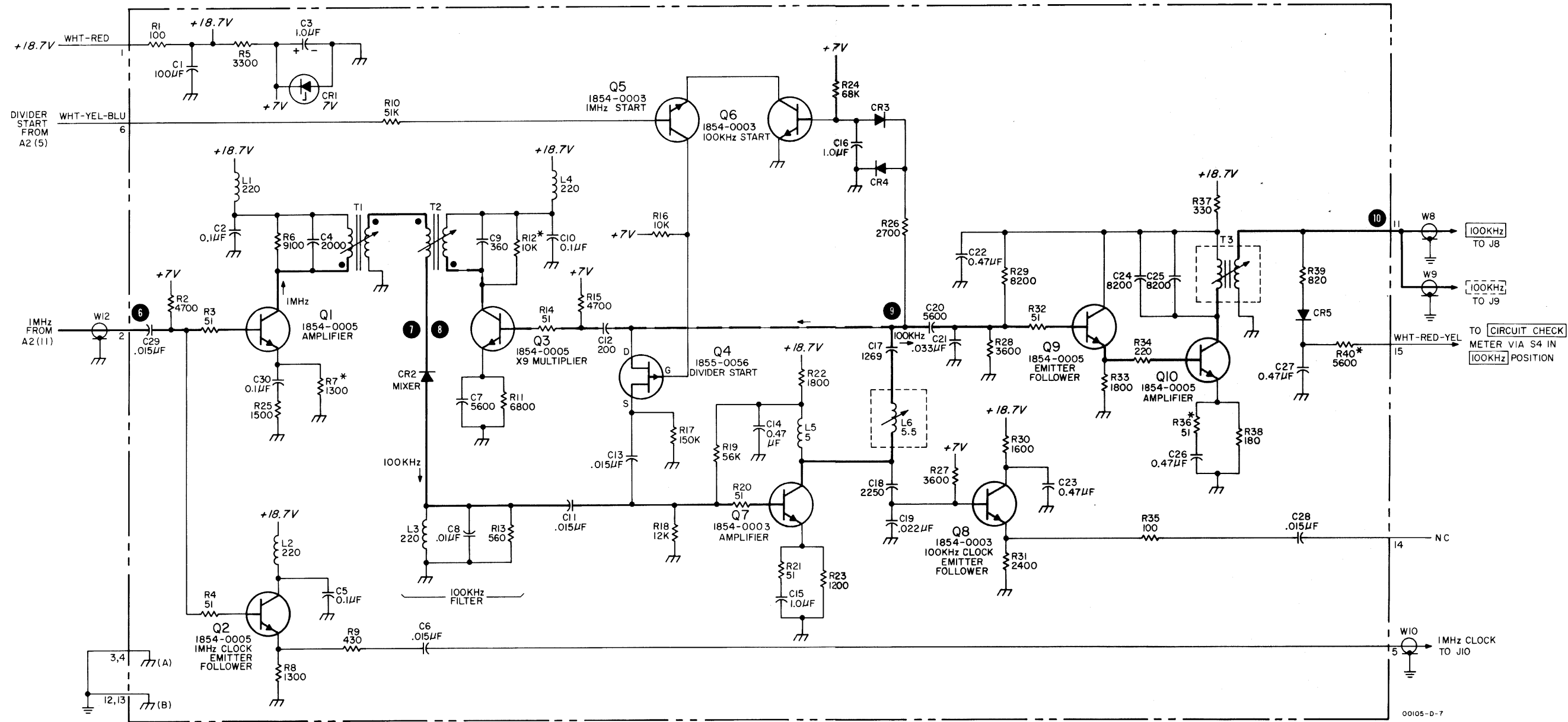


Figure 7-8. 100 kHz Divider Assembly A3

A3 100kHz DIVIDER ASSEMBLY (00105-6018) (NOTE 1)



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A3
	C1-30
	CR1-5
	L1-6
	Q1-10
	R1-40
	T1-3
W8-10,12	

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Figure 7-8. 100 kHz Divider Assembly A3

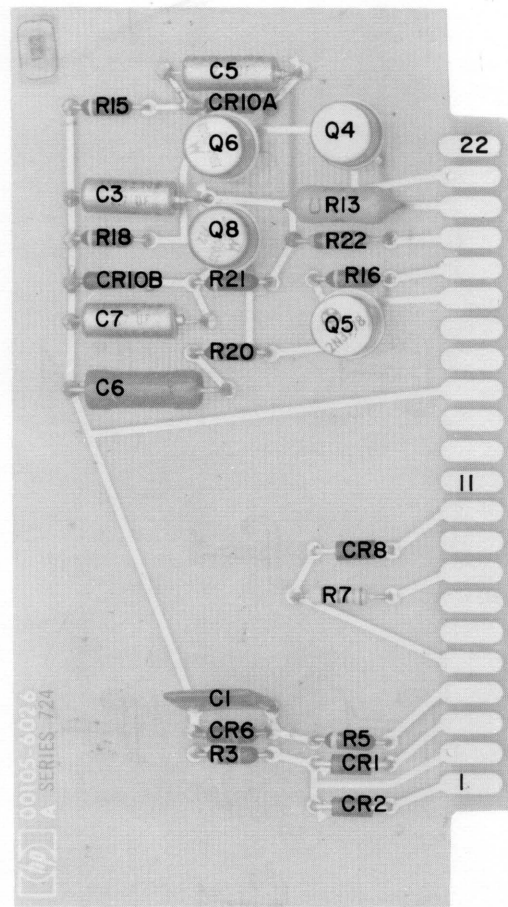
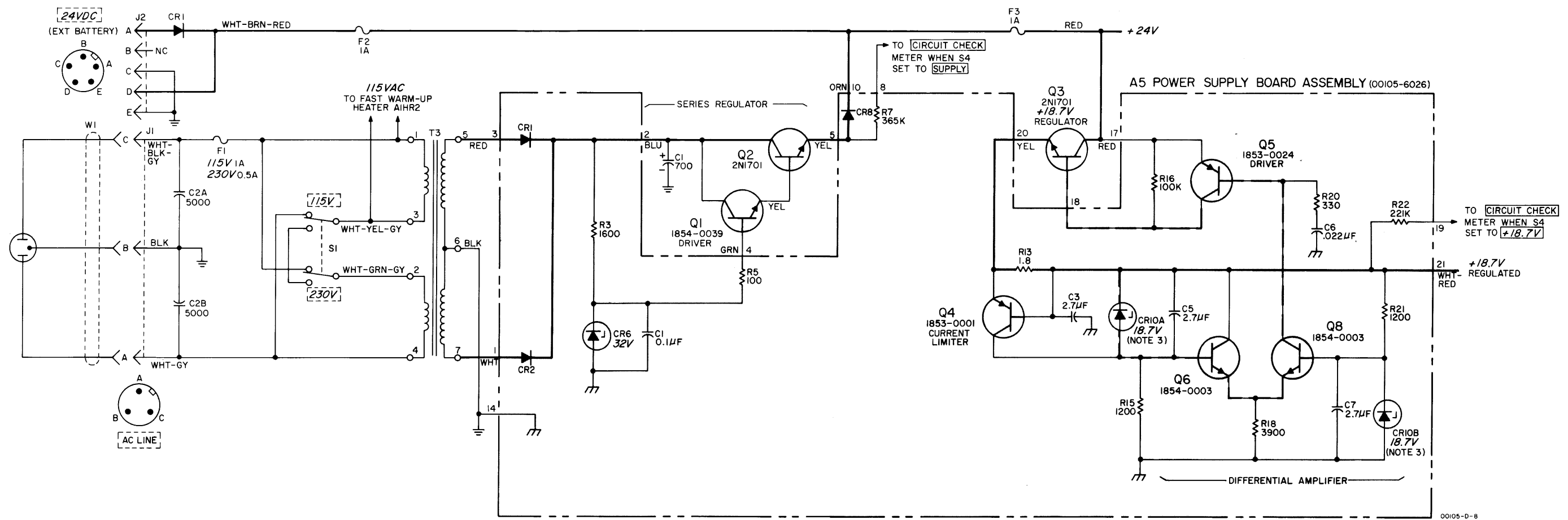


Figure 7-9

POWER SUPPLY A5 (105A ONLY)



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS;
CAPACITANCE IN PICOFARADS;
INDUCTANCE IN MICROHENRIES
3. CR10A AND CR10B ARE A MATCHED PAIR.

REFERENCE DESIGNATIONS

NO PREFIX	A5
C1, 2	C1, 3 5-7
CR1	CR1, 2, 6, 8, 10
F1-3	
J1, 2	Q4-6, 8
Q1-3	R3, 5, 7, 13, 15, 16, 18, 20, 21, 22
S1	
T3	
W1	

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Figure 7-9. Power Supply A5 (105A Only)

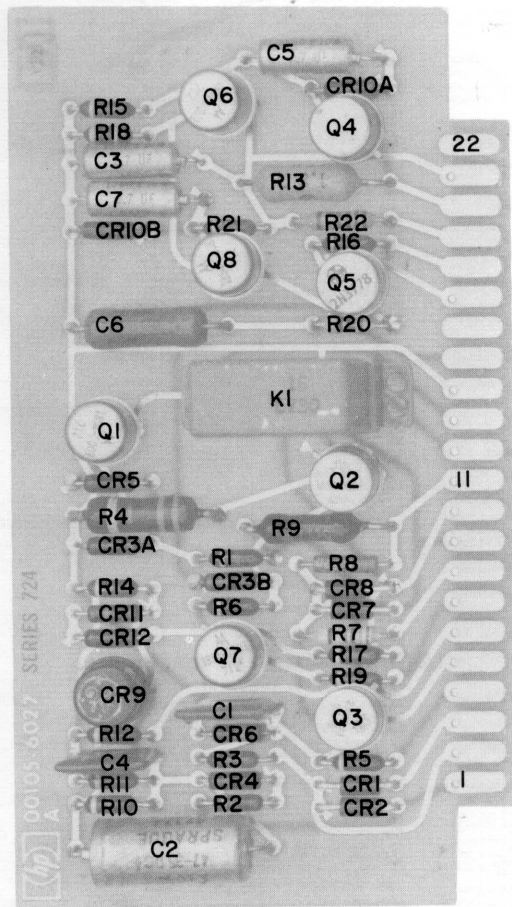
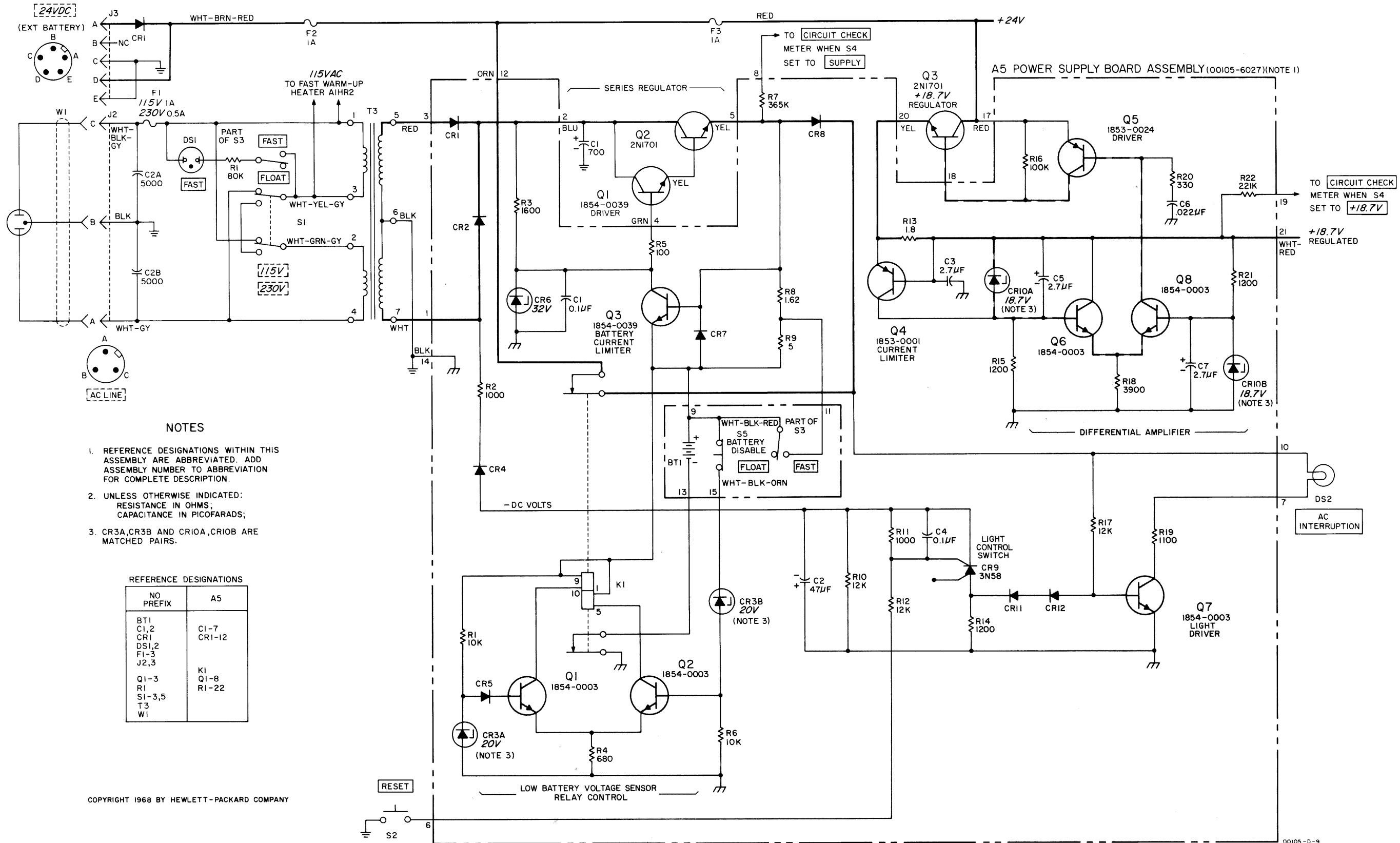


Figure 7-10
POWER SUPPLY A5 (105B ONLY)



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Figure 7-10. Power Supply A5 (105B Only)

HEWLETT · PACKARD
ELECTRONIC INSTRUMENTATION SALES AND SERVICE
UNITED STATES, CENTRAL AND SOUTH AMERICA, CANADA

UNITED STATES

ALABAMA
P.O. Box 4207
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