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TECHNICAL MANUAL

for

FREQUENCY STANDARD
AN/URQ-10A

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND

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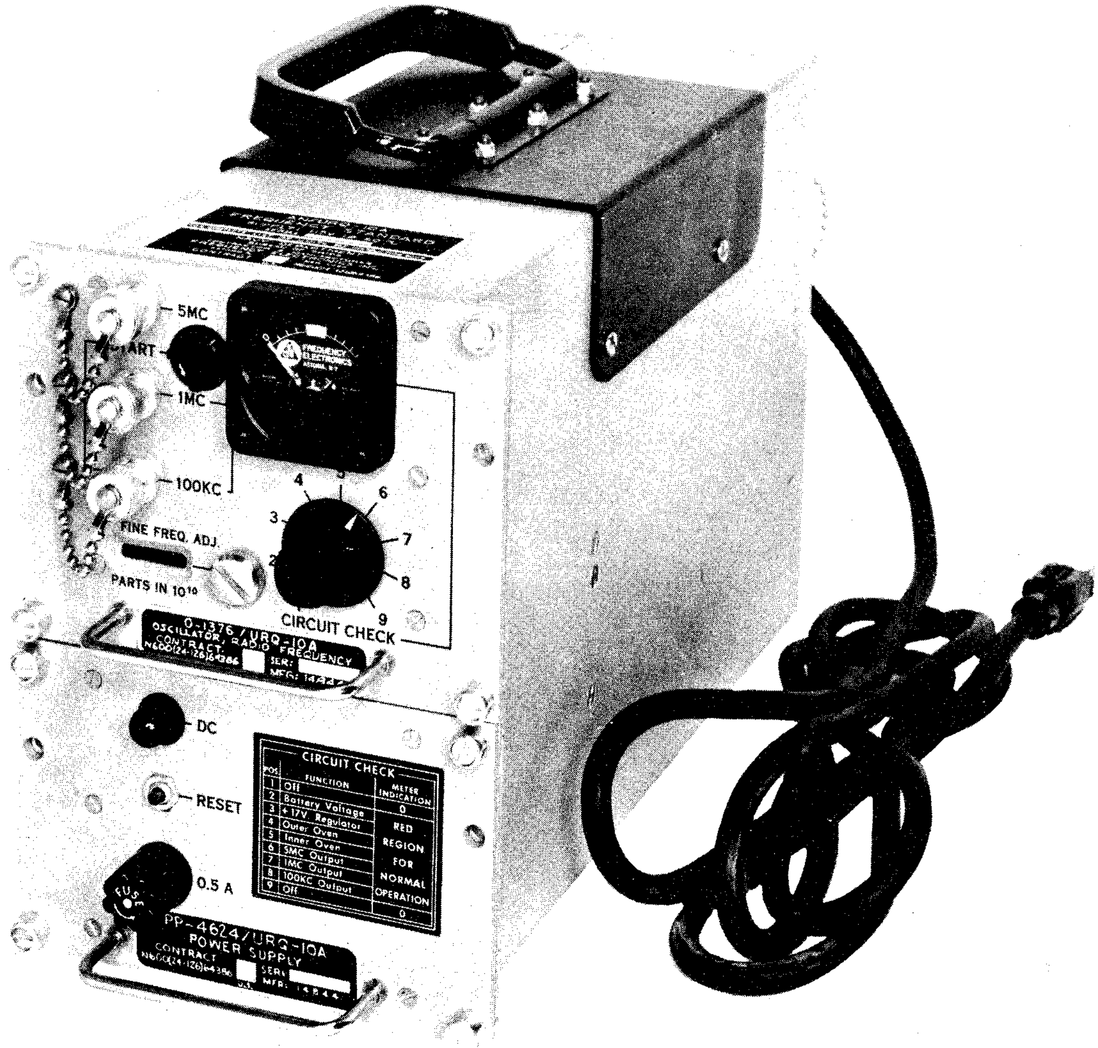


Figure 1-1. Frequency Standard AN/URQ-10A, Front View.

SECTION 1

GENERAL INFORMATION

1-1. SCOPE .

This technical manual provides information necessary to the installation, operation and maintenance of Frequency Standard AN/URQ-10A hereafter referred to as the Frequency Standard (see figures 1-1 and 1-2). The manual also contains information concerning the principles of operation and a maintenance parts list.

1-2. GENERAL DESCRIPTION.

The Frequency Standard is a compact, fully transistorized, highly accurate and stable frequency standard for multipurpose use in shipboard or land-based applications. It provides standard frequencies of 5MC, 1MC, and 100KC.

1-3. DESCRIPTION OF UNITS

a. The Frequency Standard basically comprises three plug-in modules: Radio Frequency Oscillator O-1376/URQ-10A; Power Supply PP-4624/URQ-10A; and Power Supply BB-617/URQ-10A.

b. The oscillator module provides standard frequencies of 5MC, 1MC and 100KC of high stability which are available to the user at rear and front BNC connectors on the panels of the oscillator assembly. The oscillator module also makes provisions for monitoring the operation of critical circuits through the use of a meter and a CIRCUIT CHECK switch. Adjustment of the fine frequency is enabled through an access hole in the front panel which is provided to permit adjustment of the fine frequency variable adjustment capacitor and display counter through a geared drive-coupling mechanism. An internal coarse frequency adjustment is also provided behind the oscillator front panel. The oscillator module contains a 5MC oscillator crystal controlled oscillator circuit, a 5MC to 1MC divider, a 1MC to 100KC divider, an inner and outer oven assembly and a 17 volt regulator. Should the operation of the 5MC signal input to the regenerative dividers be interrupted, the regenerative dividers cease to function. A front panel push-button switch is provided to restart the regenerative dividers. The output circuits are isolated so that a short circuit occurring on one output alone does not interrupt or affect the signals at the other outputs. A status alarm relay is provided for operating an external alarm circuit to indicate whether the Frequency Standard is battery operated, or ac operated. This connection is available at connector J4, located at the rear of the Frequency Standard. Pin A and B of the connector are shorted during ac operation and pins B and C are shorted during battery operation. The oscillator module is normally powered by the power supply or battery pack in the Frequency Standard.

c. The power supply is fused and provides a DC on-off indicator and a resetable overload relay circuit breaker The power supply contains one printed circuit board which mounts the majority of components. The power supply operates on 115V AC, 50-400 CPS, single phase and is adjusted for a 26V DC output level.

TABLE 1-1. REFERENCE DATA

CHARACTERISTIC	SPECIFICATION
Output Frequencies	5mc, 1mc, and 100kc
Output Level	1 volt rms, minimum
Output Impedance	50 ohms
Output Connectors	BNC type UG-625B/U on front and rear panels
Frequency Aging	1-2 parts in 10^{10} per day peak to peak
Stability	
@ 25°C ambient ±25 C	Less than 5 parts in 10^{10}
@ 25 volt supply	within 3 parts in 10^{11}
± 5 volt dc	Within 1 part in 10^{10} on 5MC output
@ 50 ohm load ± 20%	Within 5 parts in 10^{11} on 1 MC and 100 KC outputs
Frequency Adjustment	
Fine Adjust	1000 parts in 10^{10}, 1 part in 10^{10} per revolution
Coarse Adjust	60 parts in 10^{8}, 3 parts in 10^{8} per revolution
Spurious Signals	-80 db
Harmonic Outputs	-40 db minimum
Ambient Operating Temperature	0°C to +50°C (32°F to 122°F)
Ambient Operating Humidity	0 to 95% RH
Input Power	115 volt ac ± 10%, 50-400 cps, single phase
Power Consumption	20 Watts
Battery Operation	24 Hours max - 8 hrs. min.
Failure Alarm Relay Contacts	Connector J4 - Pins A & B AC operation - Pins B & C battery operation

d. The standby battery pack is capable of providing a minimum of eight hours of operation during each 72 hour period. The standby battery pack is rechargeable and explosion proof. During connection to the power line the batteries are automatically charged. A cutout circuit protects the battery pack from completely discharging during extended interruptions of the 115 volt primary power input voltage. The battery pack uses nickel cadmium type batteries. An OR circuit selects the B+ power source of highest potential to operate the Frequency Standard and makes this changeover with no frequency or phase error being introduced into the frequencies generated by the Frequency Standard.

1-4. PHYSICAL DESCRIPTION

a. The Frequency Standard consists of three plug-in modules which slide into their respective mounting spaces in an aluminum housing assembly. All plug-in modules are retained in position with four 1/4 turn type captive fasteners. Modular construction is used to minimize downtime and ease maintenance requirements. All connector receptacles are keyed and staggered to prevent improper insertion of assemblies. In addition the battery pack is provided with guide pins to restrict the movement of the heavy battery pack during shock and vibration. All modules are furnished with handles for ease of handling. Controls are clearly labeled and located for ease of operation and maintenance.

b. The Frequency Standard has a carrying handle for ease of handling and carrying as portable equipment. The Frequency Standard is physically designed for shelf or table mounting and is completely splashproof. The regenerative divider START button is recessed to prevent accidental triggering of the dividers during normal operation of the Frequency Standard. The counter display and fine frequency adjustment capacitor are driven by a precision gear drive mechanism which is screwdriver adjustable through a front panel access hole. This access hole is normally closed through the use of a slotted knurled-head threaded plug. A coarse frequency adjustment and outer and inner oven temperature adjustments are also incorporated in the Frequency Standard.

1-5. REFERENCE DATA.

Table 1-1 contains the technical characteristics of the AN/URQ-10A Frequency Standard.

1-6. EQUIPMENT SUPPLIED.

Table 1-2 contains a list of equipment supplied as part of Frequency Standard AN/URQ-10A.

1-7. FACTORY OR FIELD CHANGES.

No factory or field changes have been made to the Frequency Standard AN/URQ-10A.

TABLE 1-2. EQUIPMENT SUPPLIED, FREQUENCY STANDARD AN/URQ-10A

QTY. PER EQUIP.	NOMENCLATURE		OVERALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT (IN)	WIDTH (IN)	DEPTH (IN)**	(CU.FT.)	(LB.)
1	FREQUENCY STANDARD	AN/URQ-10A	7.75	5.5	14.56	.36	21
	INCLUDES:						
1	OSCILLATOR RADIO FREQUENCY (FREQUENCY OSCILLATOR)*	O-1376/URQ-10A	4.25	5.50	12.38	.17	6.0
1	POWER SUPPLY	PP-4624/URQ-10A	3.47	5.50	4.75	.05	2.7
1	BATTERY POWER SUPPLY (BATTERY PACK)**	BB-617/URQ-10A	4.13	4.37	10.13	.11	8.5
2	TECHNICAL MANUAL NAVSHIPS 0967-170-3010						

*Colloquial Name
** Depth includes protrusions on front panel & rear panel

1-8. PREPARATION FOR RESHIPMENT OR LONG TERM STORAGE

a. The Frequency Standard may be shipped while it is operating on its internal battery pack provided that the total shipment time does not exceed 8 hours when the battery is fully charged.

b. To ship the Frequency Standard for periods exceeding the capacity of the battery pack or to prepare for long term storage, it is necessary to turn off the power switch located behind the power supply module. To gain access to this switch, release the four quarter turn fasteners which retain the power supply module and remove the module. A toggle switch, S1 will be seen through the opening from which the power supply module was removed. Set the toggle switch to its OFF position. Replace the power supply module and latch the four quarter turn fasteners. The unit is now shut down and ready for packing and shipment or storage.

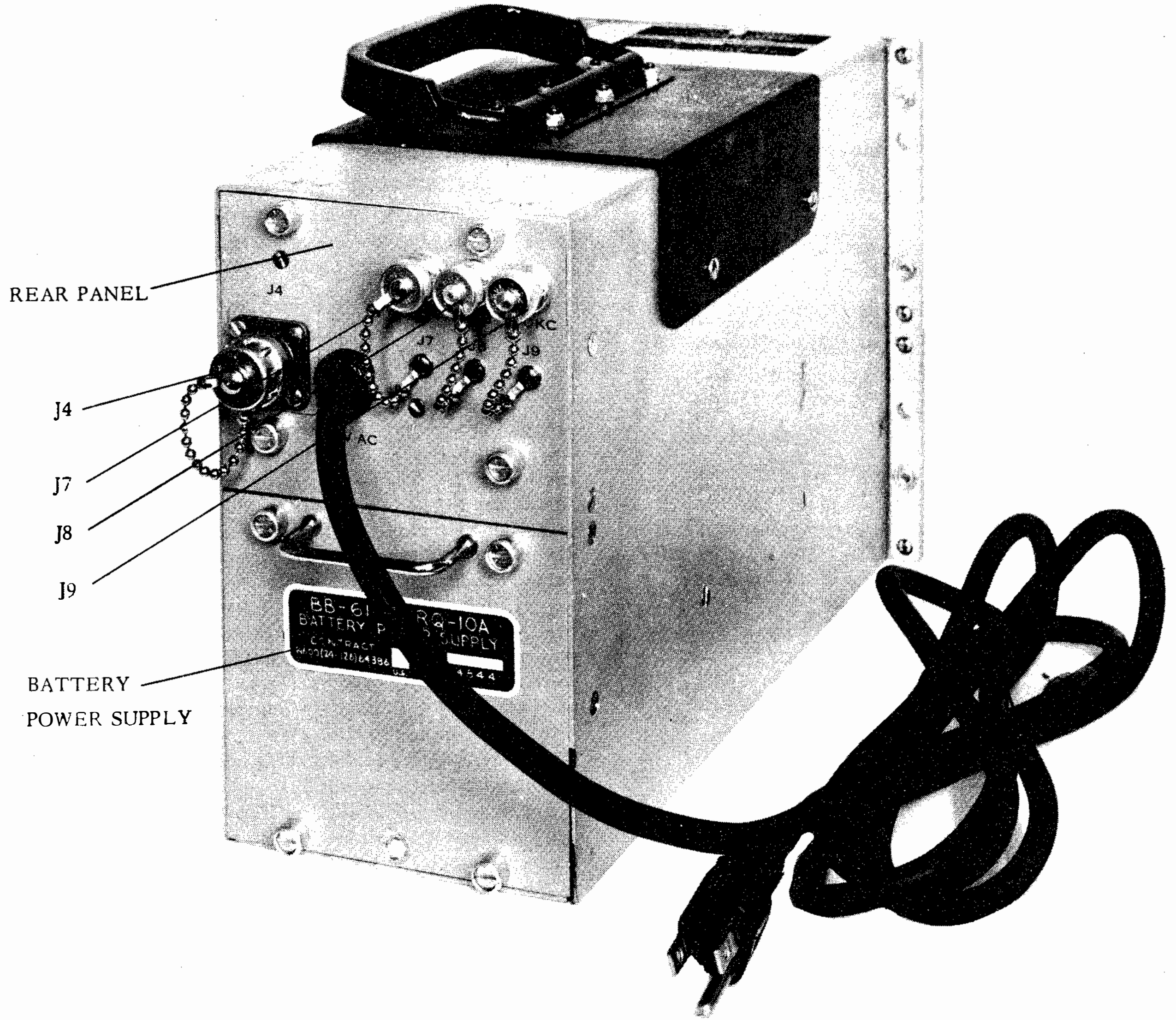


Figure 1-2. Frequency Standard AN/URQ-10A, Rear View.

SECTION 2.

INSTALLATION

2-1. GENERAL

The Frequency Standard and its instruction manual are shipped in one shipping container. Before unpacking the equipment and selecting the installation site, read this section and become thoroughly familiar with the installation requirements.

2-2. UNPACKING

a. Upon receiving the Frequency Standard, carefully open the shipping container and remove the packing material. Before discarding the packing material be sure that the package containing the instruction manual has been located. If reshipment is expected, save all packing material inserts to simplify repacking.

b. After the equipment has been unpacked carefully inspect the Frequency Standard for any damage which may have occurred in shipment. Check the front panel meter, controls and indicators for damage, and the painted surfaces for scratches.

2-3. SITE SELECTION

a. Figure 2-1 contains the outline dimensions of the Frequency Standard and the location of connectors as required for installation. The final selection of a site for installing the Frequency Standard is dependent on adequate:

1) Air circulation
2) Protection from extreme moisture.
3) Availability of sufficient space to enable removal of module drawer, both front and rear.
4) Access to the connectors on the front and rear of the Frequency Standard.

b. Since the Frequency Standard does not generate rf interference this need not be considered in selecting an installation site.

2-4. POWER REQUIREMENTS

a. Under normal operating conditions the power supply requires a 115 volt nominal, 20 watt, 50 to 400 cps, single phase primary source of power. A polarized receptacle is required.

b. In the absence of sufficient dc voltage from the power supply the internal battery pack will provide the operating voltage of 26 volts dc to operate the frequency standard.

2-5. PERMANENT MOUNTING

a. The Frequency Standard may be permanently mounted to an equipment bench or table. Use two #8-32 machine screws, whose length is equivalent to the thickness of the mounting surface plus an additional 1/4 inch, to secure the bottom of the Frequency Standard to the mounting surface. The front panel may be secured to the mounting surface by screwing #10-32 binding head machine screws through holes provided in the panel into a threaded support.

b. If more than one Frequency Standard is used they may be mounted abreast (up to three units) in an 8-3/4 in. high adapter draw (not supplied) which provides three ac convenience receptacles and is suitable for rack mounting, with or without slides.

c. The carrying handle may be removed by removing the four No. 6- 32 x 3/16 Binding Head screws. Replace these screws after removing the handle with No.6 -32 x 1/8 Flat Head screws.

2-6. ENERGIZING THE EQUIPMENT

a. To energize the Frequency Standard insert the three pronged power cord plug into an appropriately grounded power source. The DC indicator light will glow and all sections of the Frequency Standard will be energized. Should the DC front panel indicator lamp not glow this would indicate that switch S1 behind the power supply module is in the OFF position. To gain access to this switch, release the four quarter turn fasteners that retain the power supply module and remove the module. A toggle switch, S1 (figure 5-11) will be seen through the opening from which the power supply module was removed. Set toggle switch S1 to its ON position. The unit is now operating on its internal battery pack. Promptly reinstall the power supply module and latch the quarter turn fasteners. The red DC indicator light is now lit and the unit is operating through its power supply.

b. Rotate the CIRCUIT CHECK switch through all nine positions and observe the indications on the meter. The meter indication for switch positions 2, 3 and 6 should be in the red region. (Table 4-2 shows the function measured at each switch position). Normal readings will not be obtained on all the remaining switch positions until the regenerative frequency dividers are started and the inner and outer ovens have reached their proper operating temperatures. Switch positions 1 and 9 are the "off" positions.

2-7. SIGNAL OUTPUT CONNECTORS

The Frequency Standard signal output frequencies of 5MC, and 1MC and 100KC are available at front panel and rear panel BNC connectors connected in parallel. The front panel connectors are J10 (5MC) J11 (1MC) and J12 (100KC) and the rear panel connectors are J7 (5MC), J8 (1MC) and J9 (100KC). Connect BNC-connector-terminated coaxial cables from the equipment intended to be driven from the frequency standard to these connectors as required.

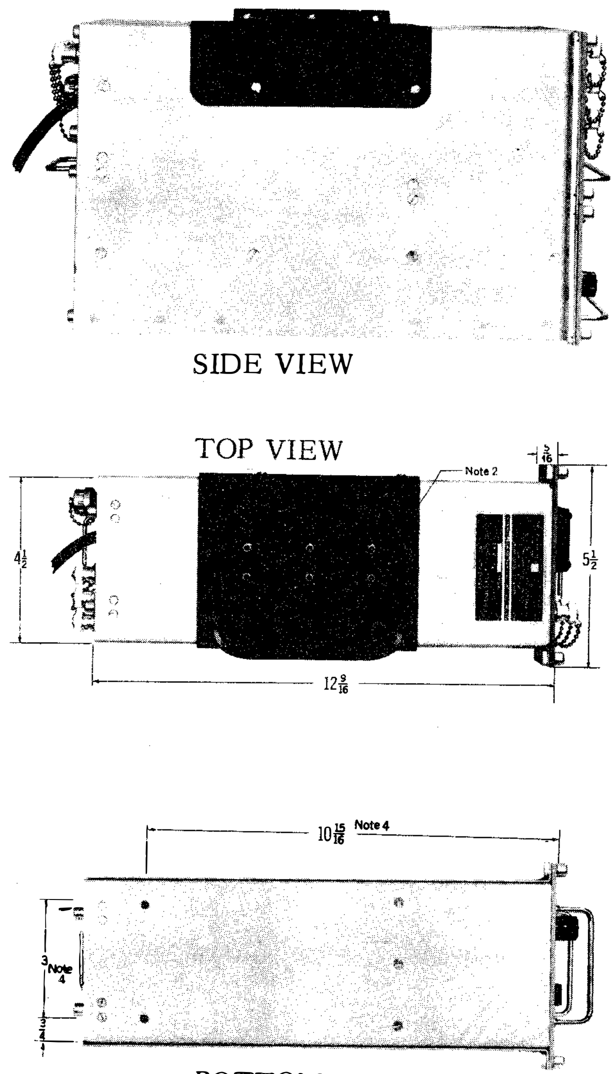
2-8. INITIAL OPERATION

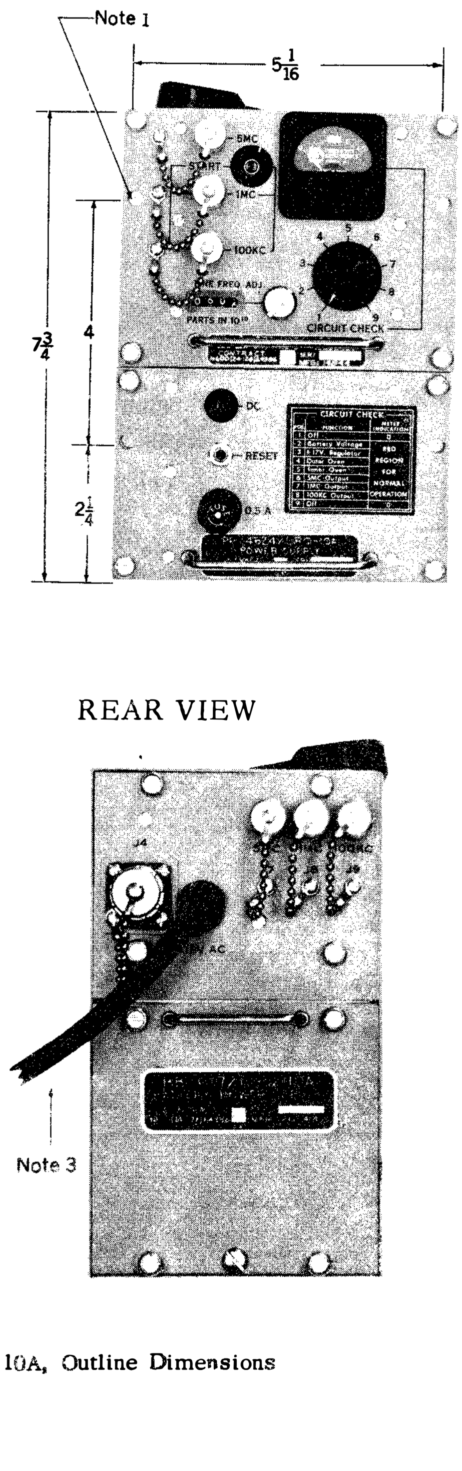
a. After performing the steps described in paragraphs 2-6 and 2-7 the frequency standard is ready for operation. 5MC signals will be available at the output connectors and its presence may be verified by the meter reading in the red region for CIRCUIT CHECK switch position 6.

b. Press the START switch (figure 3-1) to start operating the frequency dividers. With the CIRCUIT CHECK switch in position 7, the meter will indicate that a 1 mc output is available at the 1 MC output connectors on the front and rear of the Frequency Standard. With the switch in position 8, the meter will indicate that a 100kc output is available at the 100 KC output connectors on the front and rear of the standard. All three output signal voltages are 1 volt rms across a 50 ohm load.

c. The correct readings (see Table 4-2) will be obtained in CIRCUIT CHECK switch positions 4 and 5 after a period of about six hours when the outer and inner ovens respectively will have warmed up to their proper operating temperatures.

d. All initial operating procedures are now completed and the Frequency Standard is operating normally. After ten days of continous operation, the output frequencies must be checked for calibration against a VLF tracking receiver, an atomic frequency standard or a previously calibrated precision laboratory standard.





NOTES:

1. Use #10-32 binding head screws in 4 places for rack mounting.
2. If carrying handle is removed, cover mounting holes with #6-32x1/8 binding head screws. Use #6 internal tooth lockwasher.
3. Power required: 115VAC, 1 phase 50 to 400 CPS.
4. These dimensions locate two bottom plate mounting holes. Use #8-32 binding head screws, 1/4 inch deep.
5. All dimensions in inches.

Figure 2-1. Frequency Standard AN/URQ-10A, Outline Dimensions

SECTION 3

OPERATION

3-1. FUNCTIONAL OPERATION.

a. The Frequency Standard furnishes stable frequencies of 100 KC, 1 MC and 5 MC. It is designed for continous operation from an external AC source, or it may be operated for an 8 hour period from its own battery pack. When the battery pack voltage drops to 19 volts because of discharge due to operation or otherwise, the Frequency Standard will automatically shut down. It is not necessary to turn switch S1 to the OFF position unless it is desired to stop the Frequency Standard before the battery pack module is discharged. Upon the application of AC power the battery pack module batteries will be recharged.

b. Basically, the Frequency Oscillator module contains a 5 MC crystal oscillator contained in a proportionally controlled oven. This highly accurate 5MC signal is divided down by a 5MC to 1MC divider to provide a 1MC signal. The 1MC signal is in turn divided down by a 1MC to 100KC divider to provide a 100KC signal. The three resultant signals (5MC, 1MC, and 100KC) are made available for use by the operator via BNC type connectors located on the front and rear panels of the Frequency Standard.

c. The Frequency Standard uses modular construction. Printed circuit board assemblies and/or complete Frequency Oscillator, Power Supply or Battery Pack modules may be individually replaced as necessary to continue operation of the Frequency Standard should any of these components fail.

TABLE 3-1. CONTROLS, INDICATORS, AND CONNECTORS.

FIGURE 3-1 INDEX NO	CONTROL INDICATOR CONNECTOR	REF. SYMBOL NO.	FUNCTION
1	100 KC	J12	Provides connection for 100 KC output signal.
2	1MC	J11	Provides connection for 1 MC output signal.
3	5MC	J10	Provides connection for 5 MC output signal.
4	START	S2	Pushbutton switch to start regenerative divider circuit.
5	Meter	M1	Test meter, enables monitoring of critical circuits —used with CIRCUIT CHECK switch.
6	Switch	S3	CIRCUIT CHECK switch selects 7 critical circuits to ascertain condition of frequency standard using the test meter.
7	FINE FREQ. ADJ.	C106	Adjusts oscillator frequency in steps of 1PP10^{10}
8	0.5 A	F601	Fuse for power supply.
9	RESET	S601	Resets power supply should momentary overload shut it off.
10	DC	DS601	Indicator light indicates that power supply is operating.
(See figure 5-11)	ON-OFF	S1	Turns Frequency Standard on or off.
Rear Panel (See figure 5-10)	100KC 1MC 5 MC	J9 J8 J7 J4	Provides connection for 100 KC output signal. Provides connection for 1 MC output signal. Provides connection for 5 MC output signal. Provides connection for external alarm.

3-2. OPERATING PROCEDURES

After the Frequency Standard is installed and checked out for initial operation as described in Section 2, and calibrated as described in Section 5, there are no operating steps to be followed and an operator is not required. Operation is automatic and an operator is limited to initial operation (see paragraph 2-8) and emergency operating procedures.

CAUTION

Once the Frequency Standard is calibrated and operating it is imperative that operation continue uninterrupted. Should a stoppage of the Frequency Standard be required or occur, the ovens will cool and the operating frequency of the crystal will be altered. If the Frequency Standard is turned off for any reason it must be checked for calibration.

3-3. CONTROLS, INDICATORS, AND CONNECTORS

Table 3-1 describes the front and rear panel controls indicators and connectors. Figure 3-1 shows the front panels and figure 5-10 the rear panel.

3-4. EMERGENCY OPERATION

If the external power fails (indicated by the DC power supply lamp going out) the equipment will automatically switch to battery operation. The presence of external ac power may be indicated by any external alarm device connected to jack J4, pins A and B, found at the rear of the equipment. The frequency standard will operate from each battery pack for approximately 8 to 24 hours.

3-5. OPERATOR'S MAINTENANCE

a. OPERATING CHECKS - Operating checks are limited to use of the CIRCUIT CHECK selector switch and meter, and observation of the DC lamp on the power supply front panel (figure 3-1).

b. EMERGENCY MAINTENANCE - Emergency maintenance is limited to the replacement of the power supply module, the battery pack module, the frequency dividers, the 17 volt regulator board and the lamp and fuse.

(1) To replace the power supply module, release the four quarter-turn fasteners and remove the module. The Frequency Standard will automatically transfer to battery operation. Slide the new power supply module into place and latch the quarter turn fasteners.

CAUTION

Be sure that the battery pack module is in place before removing the power supply module so that no interruption of power takes place.

(2) To replace the battery pack module, release the four quarter turn fasteners and the single #10-32 machine screw (see figure 1-2).

(3) To replace the 5MC to 1MC frequency divider, the 1MC to 100KC frequency divider or the 17 volt regulator, it will be necessary to interrupt power to the oscillator module.

CAUTION

Do not interrupt power to the oscillator module unless an emergency exists or unless it must be turned off for repairs. If the frequency standard is stopped for any reason, it must be rechecked for calibration. Refer to Section 5 for calibration procedures.

Release the four quarter-turns fasteners and remove the oscillator module. Remove the rear-top cover and replace the faulty printed circuit boards.

(4) The Frequency Standard contains one lamp and one fuse on the power supply front panel.

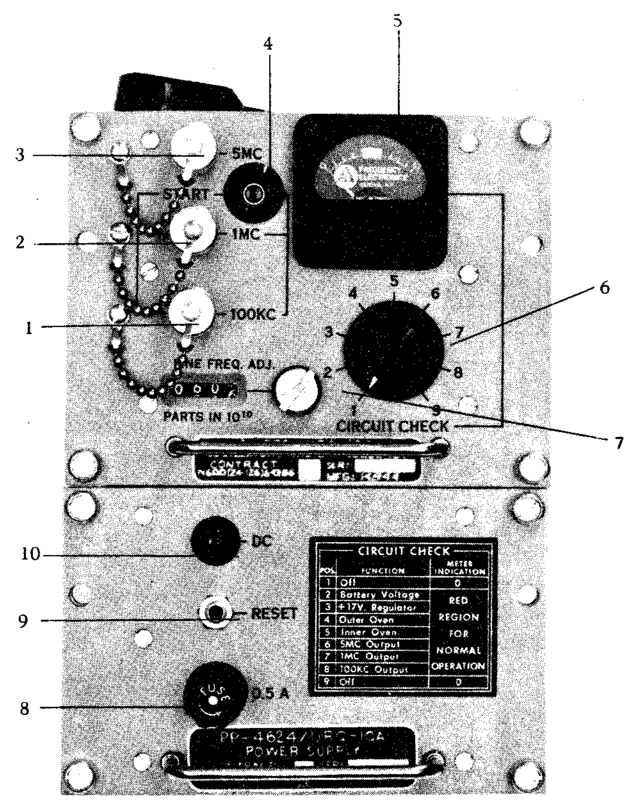


Figure 3-1. Front Panel Controls, Indicators, and Connectors, Frequency Standard AN/URQ-10A.

SECTION 4

TROUBLESHOOTING

4-1. OVERALL FUNCTIONAL DESCRIPTION

a. The Frequency Standard produces fixed frequency outputs of 5MC, 1MC, and 100KC with an output signal level for each frequency of 1 volts rms across a 50 ohm load. Figure 4-1 illustrates the signal flow and functional operation of the AN/URQ-10A.

b. The Frequency Standard consists of three major physical assemblies: a frequency oscillator module, a power supply module and a battery pack module. Functionally, the Frequency Standard consists of nine functional sections:

(1) Power Supply
(2) Battery Pack
(3) 17 Volt Regulator
(4) Ovens
(5) Oscillator
(6) Buffer Amplifiers
(7) 5MC to 1MC frequency divider
(8) 1 MC to 100KC frequency divider
(9) Frequency Output Amplifiers

In addition, as shown in figure 4-14, the Frequency Standard contains monitor circuits, external alarm switching circuits, signal connection circuits to the external coaxial connectors, coarse frequency adjustment, and a fine frequency adjustment geared to a precision variable capacitor and display counter.

c. The oscillator module contains the frequency determining circuits and ovens. Housed in the dual oven assembly is the crystal that produces the primary signal, the oscillator-amplifier board, and temperature control circuits. Besides the dual oven assembly, the oscillator module contains the two frequency dividers, a voltage regulator, monitor circuits and signal and battery voltage cut-off circuit. The 5MC signal is reduced to a 1MC signal by the 5MC to 1MC frequency divider circuit. The 1MC signal is then amplified and a portion is fed to output connectors on the front and rear panels of the standard. The other portion of the IMC signal is carried to the second frequency divider (a 1MC to 100KC frequency divider) where it is reduced to a 100KC signal. The 100KC signal is amplified and fed to output connectors on the front and rear panels of the Frequency Standard.

d. The regulator in the power supply module and the regulator in the oscillator module provide the regulated voltages required by the equipment. The standard normally receives its power through a three-conductor power cable terminated in a polarized three prong male connector connected to an external power source of 115 volts, 50 to 400 cps, single phase. If this power source fails, or is disconnected, or the power supply module develops a fault, the standard is automatically transferred to battery operation with zero frequency or phase error. A single battery pack module will operate the frequency Standard for 8 to 24 hours depending on the state of charge of the battery pack and ambient temperature.

e. A CIRCUIT CHECK switch and meter are provided on the front panel for monitoring the operation of the various circuits in the standard.

4-2. POWER SUPPLY FUNCTIONAL SECTION

a. The power supply receives 115 volt, 50 to 400 cps, single phase input from an external power source through a line filter mounted on the inside of the upper rear panel and power ON-OFF switch S1 in the housing assembly.

b. The power supply provides a regulated output of 25.9 volts dc to the regulator in the oscillator and to the outer oven heater and for charging the battery pack.

c. An auxiliary supply powers circuitry which provides short circuit or overload protection for the main supply.

4-3. BATTERY PACK FUNCTIONAL SECTION

a. The battery pack is connected to the charging circuit from the power supply section. When fully charged, the battery pack voltage is approximately 25.2 volts dc.

b. The battery pack is continuously charged to maintain its fully charged condition. The charging current varies from 10 ma to 300 ma depending on the ambient temperature and the state of charge of the cells. Normally, at room temperature it draws about 20-30 ma.

c. A diode OR gate circuit at the 17 volt regulator input section provides for smooth transfer to battery power in the event that the power supply's dc output fails.

d. When battery pack voltage drops to 19 volts dc a circuit in the 17 volt regulator section deactivates a relay (K1) and opens the battery power input to all circuits, thereby preventing damage to the cells.

4-4. REGULATOR (+17 VOLTS DC) FUNCTIONAL SECTION

The regulator has an input of 25.9 volts dc from the power supply section or 19 to 25 volts dc from the battery pack. It provides a regulated output of 17.00 volts dc to all functional sections of the oscillator section except for the outer oven heater element.

4-5. OVEN FUNCTIONAL SECTION

a. The oven functional section consists of dual proportional ovens that contains the crystal and its drive circuit and the oscillator functional section. The ovens are enclosed in a Dewar Flask with separate temperature control circuits for each oven.

b. The outer oven temperature control circuit receives regulated inputs of 25.9 volts dc from the power supply section and 17 volts dc fromthe regulator section. The 25.9 volts dc is fed through the outer oven heater element (R259). The temperature sensor element (R252) and its associated circuitry are operated by the 17 volt dc regulator.

c. The inner oven temperature control circuit uses a 17 volt dc regulated input from the regulator section to provide current for the inner oven heater element (R215) and to operate the sensor (R202) circuitry .

4-6. OSCILLATOR FUNCTIONAL SECTION

a. The oscillator section is operated from the 17 volt dc.

b. An automatic gain control loop around the oscillator, transistor minimizes crystal aging by allowing the crystal to operate at low current levels and increases stability by maintaining a constant drive level as component characteristics change with time.

c. This functional section produces a 5MC crystal controlled output signal which is fed to the buffer amplifier section. A coarse and a fine frequency adjustment are provided to adjust the output signal frequency, as required.

4-7. BUFFER AMPLIFIER SECTION FUNCTIONAL SECTION

The buffer amplifier operates on regulated 17 volts dc from the regulator section. It receives and further amplifies the 5MC crystal controlled signal from the oscillator section. The buffer-amplifier prevents variation in oscillator frequency due to load variations.

4-8. 5MC TO 1MC FREQUENCY DIVIDER FUNCTIONAL SECTION

a. The 5 MC to 1 MC frequency divider module operates on regulated 17 volts dc. It receives the 5MC signal from the buffer amplifier, in the 5MC oscillator section.

b. A portion of this signal is amplified and fed to the 5MC frequency output amplifier. The remainder of the signal is mixed with a 4MC signal that is generated within this module to produce a 1MC signal.

c. The 1MC signal is fed to the 1MC to 100KC frequency divider and the 1MC output amplifier.

4-9. 1MC TO 100KC FREQUENCY DIVIDER FUNCTIONAL SECTION

a. The 1MC to 100KC frequency divider module operates on regulated 17 volts dc. It receives the lmc signal from the 5MC to 1MC divider.

b. A portion of the signal is amplified and fed to the 1MC frequency output amplifier. The remainder of the signal is mixed with a 900 kc signal that is generated within this module to provide a 100KC signal.

c. The 100KC signal drives the 100KC output amplifier.

4-10. FREQUENCY OUTPUT AMPLIFIERS FUNCTIONAL SECTION

a. The output amplifiers section consists of:

(1) 5MC Output Frequency Amplifier
(2) 1MC Output Frequency Amplifier
(3) 100KC Output Frequency Amplifier

b. Each output amplifier operates on regulated 17 volts dc and consists of a parallel tuned amplifier, series tuned to its respective output.

c. This configuration provides low harmonics and low output impedances. The 5MC and 1MC output amplifiers are mounted on the 5MC to 1MC frequency divider printed circuit board and the 100KC output amplifier is mounted on the 1MC to 100 KC printed circuit board. These printed circuit boards are of modular construction and contained in shielded compartments within the frequency oscillator module.

4-11. AUXILIARY CIRCUITS FUNCTIONAL SECTION

Auxiliary circuits in the Frequency Standard consist of monitor circuits, external power and alarm switching circuits and signal connection circuits to the external coaxial connectors. Refer to the interconnecting wiring diagram of figure 4-14 for additional details.

a. The monitor circuits are integral to the system. They provide indications of key operating parameters on the front panel meter and are used to monitor the operation of the Frequency Standard and aid in maintenance and in trouble-shooting. The CIRCUIT CHECK position switch and meter are mounted on the front panel. Table 4-2 lists the switch positions associated with the equipment function being monitored. Table 4-3 lists possible abnormal meter readings with likely reasons for the abnormality.

b. The external alarm switching circuit consists of one pair of relay transfer contacts which are connected to connector J4, pins A and B, and pins B and C. These contacts are for an external alarm indication of ac operation (pins A and B closed) and battery operation, (pins B and C closed).

c. The signal connecting circuits provide parallel frequency outputs of 5MC, 1MC and 100KC at the BNC coaxial connectors on the front and rear of the standard.

4-12. AGING CHARACTERISTIC

a. The crystals used in Frequency Standards are subject to either positive aging or negative aging characteristics. Statistically, approximately 65 percent of the crystal units age negatively initially and 35 percent age positively.

b. Positive aging is due primarily to the flake-off of particles from the surface of the crystal. The recent improvements in manufacturing techniques of quartz crystals, specifically the improved mounting and polishing techniques of the crystal itself, have reduced the number of particles available for flake-off, thereby eliminating to a large extent the cause of positive aging.

c. The mechanism which produces negative aging is not fully understood, however it is believed to be due primarily to the absorption of gases by the quartz crystals and the lack of factors causing positive aging.

d. The negative and positive aging crystals stabilize in within a period of ten days to three months, depending on the particular Frequency Standard. (See figure 4-2)

4-13. STABILIZATION TIME

a. Stabilization time of a Frequency Standard after start-up (and re-stabilization time required after shut-down for various time periods) generally involves ten days to three months depending on the particular Frequency Standard and other factors which are reviewed below.

b. The crystal is packaged in a high vacuum environment. However, some slight vapor pressure is always present. The absorption and emission of the gas in the quartz crystal itself is intimately associated with the time necessary for stabilization:

(1) When the standard is shut down and stored at an ambient temperature higher than the normal crystal (inner oven) operating temperature, the gases are emitted by the crystal.

(2) In the more usual case of a shut-down standard being stored at an ambient temperature lower than the normal crystal operating temperature, the gases are absorbed by the crystal.

c. The crystal is exposed to a precise temperature environment that is virtually independent of the outside ambient temperature. The inner-outer oven temperature system itself stabilizes within six hours after the unit has been turned on to the required temperature. As long as the ovens control the temperature of the crystal, the crystal temperature has no relation to the overall stabilization time required.

d. However, because the vapor pressure varies widely from crystal to crystal and the process of absorption and emission of gases is an extremely slow process, there is a wide variation of likely stabilization times. Figure 4-2 is a typical stabilization curve for the AN/URQ-10A.

4-14. OSCILLATOR-OVEN FUNCTIONAL DESCRIPTION

a. The oscillator is comprised of transistor Q101 and its associated circuitry (figure 4-3). The oscillations are initiated by the high-Q quartz crystal, Y101, which acts as a parallel resonant tank connected between the collector and base of the oscillator stage. Inductance L101 is added during manufacture to obtain a specific frequency. A coarse frequency adjustment, capacitor C101, and a fine frequency adjustment, capacitor C106, are provided to adjust the output frequency. The 5mc oscillator output signal is amplified in two amplifier stages, transistors Q102 and Q103. Agc is developed to maintain the crystal drive constant by means of a peak detector circuit consisting of diodes CR102 and CR103, capacitor C110 and resistor R115. Transistor Q103 supplies the agc voltage as well as the output signal to the buffer amplifier stage, transistor Q104. The buffer amplifier stage isolates the oscillator from the external circuitry. All the circuitry discussed in this paragraph is located in a double, proportionally controlled oven within a Dewar flask. The purpose of this arrangement is to isolate the oscillator and its related circuitry from ambient temperature variations. Temperature variations and variations in supply voltage will change the frequency of oscillation. The supply voltage is closely regulated by two series type regulators. It is also shunt regulated inside the ovens by zener diode CR101. The double proportionally-controlled oven and Dewar flask provide sufficient thermal isolation from the ambient temperature to stabilize the inner oven temperature to negligible variations about its operating temperature and to minimize oven power requirement.

b. INNER OVEN TEMPERATURE CONTROL. The inner heating element is wound about the outside of the inner oven The temperature sensing element (figure 4-4) is resistor R202 which is connected in a bridge circuit. The sensor has a positive temperature coefficient. Temperature variations produce voltage imbalance in the bridge which are amplified by the differential amplifier, two transistors designated Q201 . The output signals from this stage are applied to another differential amplifier stage comprised of transistors Q202 and Q203, the output of which is applied to emitter follower transistor Q204. Transistor Q204 provides the drive signal for output transistor Q205. The collector current of transistor Q205 flows through the heater element. Provisions are made to monitor the inner oven by means of a front panel meter and selector switch via resistor R216.

c. OUTER OVEN TEMPERATURE CONTROL (figure 4-5) The outer oven temperature control circuitry operates essentially the same as the inner oven control circuitry described in paragraph 4-14b except that all the control circuitry is contained in integrated chip A251. The outer oven temperature sensor resistors R252 and R253 are connected in series and installed in a bridge circuit. This configuration enables greater sensitivity to ambient temperature variations. The ovens are proportionally controlled because the heater current is proportional to the temperature changes detected by the sensor. Heater current flows at all times. The use of dc eliminates noise and harmonic problems inherent in ac heating. The Dewar flask provides thermal insulation for the ovens from the ambient temperature.

4-15. OSCILLATOR-OVEN SECTION TEST DATA

a. If trouble develops in the oscillator oven section the front panel indication will be:

(1) Low or no meter indication with CIRCUIT CHECK switch in position 4, 5, 6, 7 and 8.
(2) A normal meter indication with CIRCUIT CHECK switch in position 2 or 3.

b. Refer to tables 4-2 through 4-4 for a listing of normal meter indications and systematic troubleshooting procedures for the functions to be checked. Primary checks should be made as outlined above to see that the proper inputs are being supplied to the section from the power supply and the 17V regulator and that fuse F601 is not blown. If the fuse is blown, find and repair the trouble before placing another fuse in the circuit.

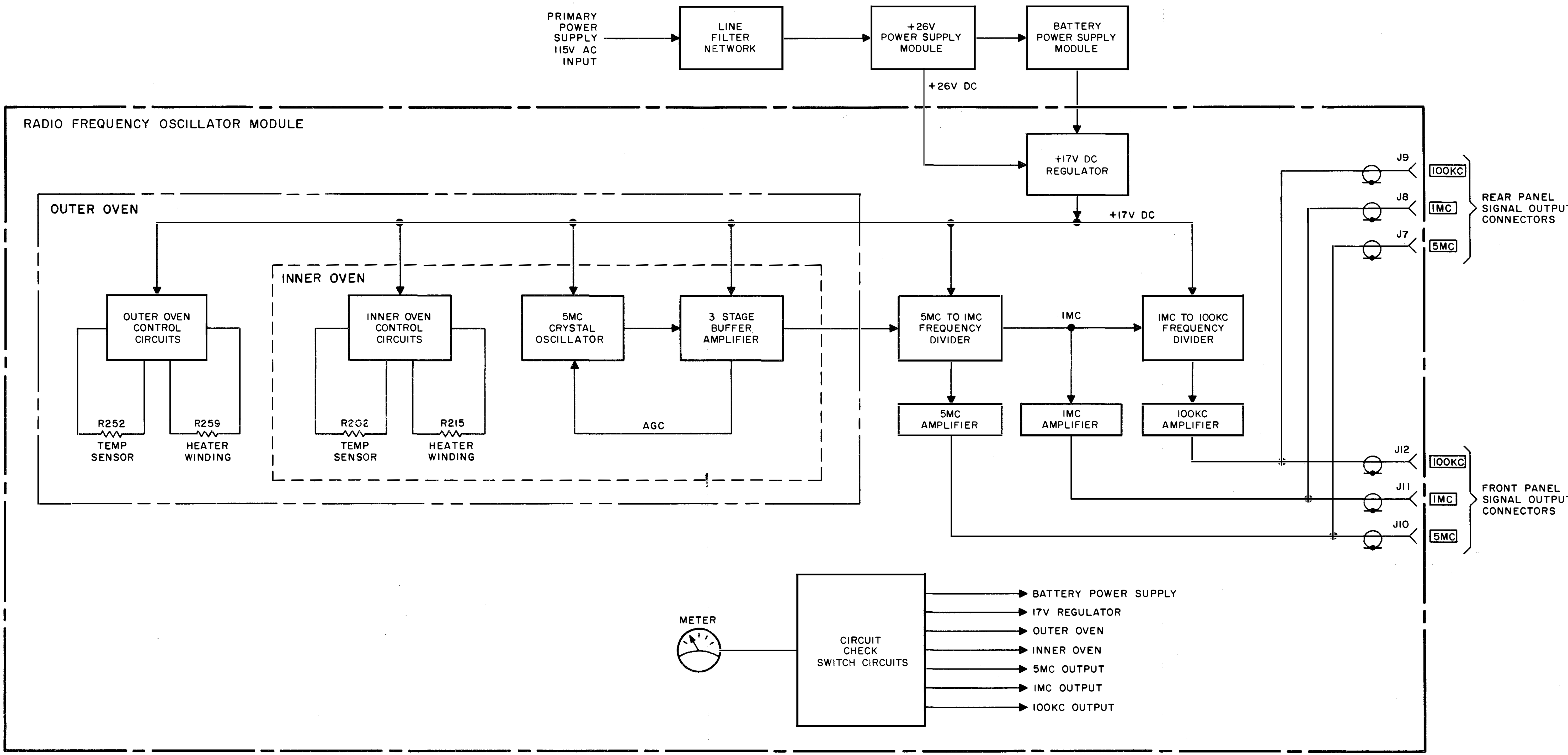


Figure 4-1. Frequency Standard AN/URQ-10A, Overall Functional Block Diagram.

c. ADJUSTMENTS - Refer to Section 5 for all field adjustment instructions relating to the oscillator oven section.

CAUTION

The oscillator oven circuitry is contained in an encapsulated assembly within a fragile dewar flask. These are not serviced and replacement parts, other than a complete assembly, are not listed in Section 6. However, schematic diagrams and circuit discussions are provided for understanding the theory of operation. This assembly provides fine frequency and coarse frequency adjustments which may be made by calibration laboratory personnel. At the end of the coarse frequency adjustment range do not force the adjustment past its stop. The inner and outer oven temperature adjustments are factory-set and will not require further readjustments.

4-16. 5 MC TO 1MC FREQUENCY DIVIDER, FUNCTIONAL DESCRIPTION

a. The 5MC to 1MC divider service block and schematic diagrams are shown in figures 4-6 and 4-7 respectively. The 5 mc output signal from buffer transistor Q104, is applied to amplifier, transistor Q401. The amplified output signal is applied to a tuned amplifier stage, transistor Q402. Capacitor C403 and inductance L401 form a 5 MC resonant circuit whose oscillations are maintained by the collector current of transistor Q402. The 5 mc signal is utilized in two circuits.

b. The 5 mc output driver is a tuned amplifier stage, transistor Q405. The parallel resonant circuit consisting of capacitor C422 and the primary of transformer T401 is tuned to 5 mc. The signal from the secondary of transformer T401 is filtered and provided as the output signal. A sample of the signal is provided to the front panel monitoring circuitry via a peak detector network consisting of diode CR403, capacitor C418, and resistor R422.

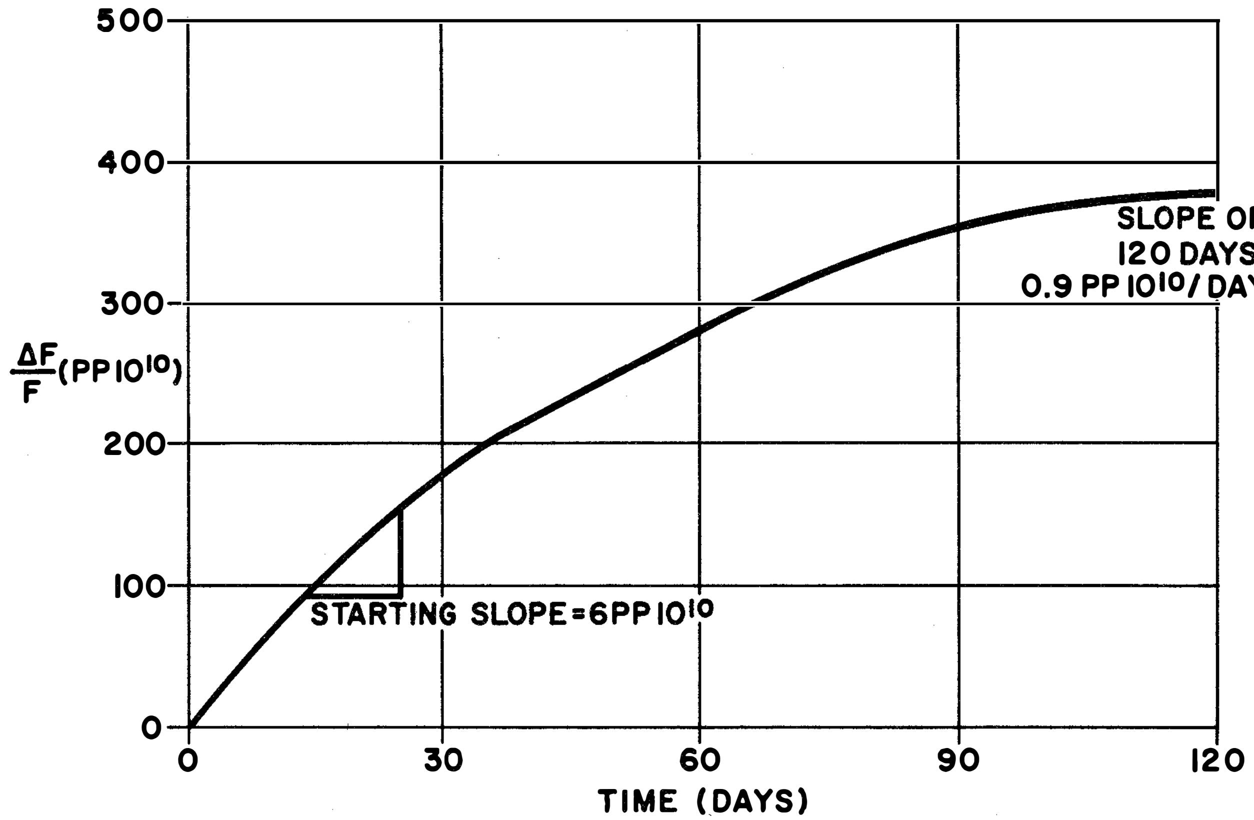


Figure 4-2. Typical Frequency Standard Stabilization Curve.

c. The 5 mc signal from transistor Q402 is applied across capacitor C406. The negative portions of the signal are clipped by diode CR401. A 4 mc signal is applied across CR402. The 1 mc signal obtained by mixing the two input signals is amplified in the tuned 1 mc amplifier stage, transistor Q403, and provided as an input signal to three circuits.

d. The 1 mc signal from the preceding stage is applied to transistor Q404. This transistor and its associated circuitry comprise an amplifier and multiplier stage. The parallel resonant tank, capacitor C417 and inductance L403, is tuned to 4mc. The fourth harmonic component of the 1 mc input signal sustains tank oscillations. The 4 mc signal thus developed is applied as an input signal through diode CR402. The 4 mc signal is initiated by a component of a noise signal applied to transistor Q404 by means of front panel START switch S2. Once started, the 4 mc signal is sustained by the 1 mc signal developed from it. The circuit consisting of the mixer and the two following stages, transistors Q403 and Q404, constitute a regenerative divider.

e. The second circuit to which the 1 mc signal is applied is the 1 mc output driver, transistor Q406. This circuit operates exactly as the 5 mc output driver described above.

4-17. 5MC TO 1MC FREQUENCY DIVIDER SECTION TEST DATA

a. If trouble develops in the 5MC to 1MC frequency divider section the front panel indications will be:

(1) A low or zero meter indication with CIRCUIT CHECK switch positions 6, 7, and 8.
(2) All other positions of CIRCUIT CHECK switch give normal meter readings within the red area.

b. Refer to Tables 4-2 through 4-4 for a listing of normal meter indications and systematic troubleshooting procedures for the function to be checked.

c. Test equipment required to perform checks on the 5MC to 1MC frequency divider section is:

(1) Oscilloscope AN/USM-105A
(2) Multimeter AN/USM-116
(3) Capacitance, Inductance, Resistance Bridge ZM-11A/U or equal

See Table 5-1 for a complete listing of all test equipment.

d. To isolate the trouble within this section to a particular circuit take the voltage and waveform readings at the transistor leads. When the trouble has been traced to a particular circuit use voltage and resistance checks to locate the faulty part. An extension board will be required to make these tests and adjustments to this section. All significant voltages are recorded on the functional service block diagram of figure 4-6. Refer to the schematic diagram of figure 4-7 for all resistance values and circuit information and to the parts location diagram in Section 5 for the physical location of components.

CAUTION

Do not take resistance measurements across the transistors.

e. Primary checks should be made to see that the proper 5 MC input signal is being obtained and that the operating voltages are correct. If these inputs are normal but the 5 MC output and/or the 1 MC output is low, the section may need to be adjusted. Check waveforms throughout the section with an oscilloscope to isolate the trouble to a circuit or transistor stage. (Refer to Section 5 for all adjustments. The service block diagram (figure 4-6) contains waveshapes.

f. When the trouble has been traced to a particular circuit, use voltage and resistance checks to locate the faulty part. Refer to Section 5 of this manual for information on location and replacement of parts.

NOTE

If the input signal to a frequency divider circuit is interrupted, the circuit will not automatically resume operation after the signal is returned. To restore operation of the 5 MC to 1 MC frequency divider, press START switch momentarily.

4-18. 1MC to 100KC FREQUENCY DIVIDER FUNCTIONAL DESCRIPTION.

a. The 1MC to 100KC frequency divider is shown in the service block diagram and schematic diagram of figures 4-8 and 4-9 respectively. The third circuit to receive the 1mc signal is the 1mc amplifier stage, transistor Q501. The amplified 1mc signal is then applied to a mixer where it is summed with a 900 kc signal. The difference signal, 100 kc, is used to sustain the oscillations in the tank circuit, L502 and C507, in the collector circuit of transistor Q502. This stage is a 100kc tuned amplifier. The amplified output signal from this stage is applied to the 900 kc multiplier stage and to the 100kc output driver.

b. Transistor Q503 is the 900kc multiplier stage. The tank in its collector circuit is tuned to 900 kc. The signal from the collector of transistor Q503 is applied through the emitter follower stage transistor Q504 to mixer diode CR501. The mixer and the two stages following it constitute a regenerative divider which operates in the same manner as that described in paragraph 4-16.

c. The 100kc output driver stage operates in the same manner as the 5mc divider which was described in paragraph 4-16b. The 100kc output signal is fed to connectors J12 and J9 located on the front and rear panels respectively.

4-19. 1 MC to 100 KC FREQUENCY DIVIDER SECTION TEST DATA

a. If trouble develops in the 1 MC to 100 KC frequency divider section, the front panel indications will be:

(1) A low or zero meter indication with CIRCUIT CHECK switch in position 8.

(2) All other positions of CIRCUIT CHECK switch give normal meter readings within the red area.

b. Refer to Tables 4-2 through 4-4 for a listing of normal meter indications and a systematic troubleshooting procedure for the function to be checked.

c. Test equipment required to perform checks on the 1 MC to 100 KC frequency divider section is:

(1) Oscilloscope AN/USM-105A
(2) Multimeter AN/USM-116
(3) Capacitance, Inductance, Resistance Bridge ZM-11/U or equal.

See Table 5-1 for a complete listing of all test equipment.

d. To isolate the trouble within this section to a particular circuit take the voltage and waveform readings at the transistor leads. When the trouble has been traced to a particular circuit use voltage and resistance checks to locate the faulty part. All significant voltages are recorded on the functional service block diagram of figure 4-8. Refer to the schematic diagram of figure 4-9 for all resistance values and circuit information.

CAUTION

Do not take resistance measurements across the transistors.

4-20. 17 VOLT REGULATOR FUNCTIONAL DESCRIPTION

a. The 17 volt regulator service block diagram and schematic diagram are shown in figures 4-10 and 4-11 respectively. A two diode switch, in OR gate configuration, connects the power source having the highest voltage to the voltage regulator circuit. The power supply module output voltage is applied to diode CR305, and the battery pack's positive terminal connected to diode CR303. The common connection of these diodes is driven to the potential of the highest voltage applied.

b. Transistor Q307 and its associated circuitry disconnects the battery pack if it is in use and its voltage drops to approximately 19 volts. When this potential is reached, zener diode CR304 disconnects and transistor Q307 is cut off. This deenergizes relay K1 and opens the battery pack circuit.

c. The input voltage from the selected power source is applied to the collector of transistor Q305 and is also directly applied to the outer oven heater winding. Transistor Q305 is the series regulating stage and it is driven by transister Q306. This transistor is driven by transistor Q303 during normal operation, and by transistor Q304, a current limiter stage, in the event of overload or short circuit.

d. The bridge circuit, consisting of zener diode CR301, and resistors R301, R306, R307, R308, and R309, senses any variation in output voltage. The change is amplified by a differential amplifier consisting of transistors Q301, and Q302. The amplified variation signal is applied to transistor Q302 which further amplifies it and applies it to the base of transistor Q306, the driver stage. Adjusting potentiometer R309 establishes the regulated output voltage, + 17.00vdc. This output is held constant to within ±0.010 volts regardless of input voltage variation, load variation or temperature variation within the specified limits.

4-21. 17 VOLT REGULATOR SECTION TEST DATA

a. If trouble develops in the 17 volt regulator section the front panel indications will be:

(1) A low or zero or high meter indication with CIRCUIT CHECK switch in positions 3, 4, 5, 6, 7 and 8

(2) All other positions of CIRCUIT CHECK switch give normal meter, readings with the red area.

b. Refer to Tables 4-2 through 4-4 for a listing of normal meter indications and systematic troubleshooting procedures for the function to be checked.

c. Test equipment required to perform checks on the 17 volt regulator section is:

(1) Oscilloscope AN/USM-105A
(2) Multimeter AN/USM-116

See Table 5-1 for a complete listing of all test equipment.

d. To isolate the trouble within this section to a particular circuit take the voltage waveform readings at the transistor leads. When the trouble has been traced to a particular circuit use voltage and resistance checks to locate the faulty part. An extension cable will be required to make these tests and adjustments to this section. All significant voltages are recorded on the functional service block diagram of figure 4-10. Refer to the schematic diagram of figure 4-11 for all resistance values and circuit information.

CAUTION

Do not take resistance measurements across the transistors.

4-22. POWER SUPPLY FUNCTIONAL DESCRIPTION

a. The power supply service block diagram and schematic diagram are shown in figures 4-12 and 4-13 respectively. A plug-in power supply module containing two full wave, solid state, bridge type rectifier and voltage regulator circuits is used in the frequency standard.

b. The first bridge type rectifier provides load supply voltage while the second bridge type rectifier circuit provides for overload protective circuitry. Transistor Q601 is the main supply voltage series regulating stage. It is driven by transistor Q602 which is controlled, in normal operation, by transistor Q602 and, during overload or short circuit conditions, by transistor Q607. A bridge circuit consisting of zener reference diodes CR612 and CR613, and resistors R609, R610, R611 and R617 and a differential amplifier, consisting of transistors Q605, and Q606, are used to sense and amplify any changes in the output voltage level. The amplified voltage variations are used to drive transistor Q603. The output voltage level is initially established by the setting of potentiometer R611.

c. The output voltage of the second bridge type rectifier circuit is shunt regulated by zener diode CR609. A voltage divider circuit consisting of resistors R612, and R616, and zener diode CR614, keep transistor Q608 biased off during normal conditions. When transistor Q608 is biased off, it retains transistor Q607 in a nonconducting condition. In the event of a short circuit or an extreme load current demand, the output voltage will diminish. When it reaches a sufficiently low level, zener diode CR614 will disconnect and transistor Q608 will be driven into conduction. This in turn will drive transistor Q607 into saturation. Conduction through transistor Q607 will place the base of transistor Q602 at a negative potential and drive it to cut off. When transistor Q602 is cut off, the base of the series regulator transistor, Q601, will be placed at ground potential and the output potential will drop to zero volts. A front panel RESET switch is provided to restore the normal output voltage upon the removal of the overload or short circuit. Relay K601 is provided for use with external alarm circuits to indicate conditions of ac or battery operation.

d. Transistor Q604 is the battery charging stage. Its base potential is the regulated output voltage of the power supply module. In order that the battery pack be charged fully, it is imperative that the regulated output voltage be maintained at approximately + 25.9 vdc. To ensure that the battery is fully charged, it is charged to a potential of about +25.2 vdc.

4-23. POWER SUPPLY SECTION TEST DATA

a. If trouble develops in the 26 VDC power supply section the front panel indications will be:

(1) A high meter indication with CIRCUIT CHECK in position 4.

(2) The red DC indicator lamp on the front panel will not be lit or very bright. Refer to tables 4-2 through 4-4 for a listing of normal meter indications and systematic troubleshooting procedures for the function to be checked.

b. Test equipment required to perform checks on the power supply section is:

(1) Oscilloscope AN/USM-105A
(2) Multimeter AN/USM-116
(3) Capacitance, Inductance, Resistance Bridge ZM-11A/U or equal.

See Table 5-1 for a complete list of test equipment.

c. To isolate the trouble within the section to a particular circuit take the voltage and waveform readings at the transistor leads. When the trouble has been traced to a particular circuit, use voltage and resistance checks to locate the faulty part. An extension cable will be required to make these tests and adjustments to this section. All significant voltages are recorded on the functional service block diagram of figure 4-12. Refer to the schematic diagram of figure 4-12 for all resistance values and circuit information.

CAUTION
Do not take resistance measurements across the transistors.

4-24. BATTERY PACK FUNCTIONAL DESCRIPTION

a. The battery pack can supply the necessary operating voltages and current to the oscillator for 24 hours (from a fully charged state) in case of primary power failure. It consists of 18 rechargeable, sealed,explosion-proof, nickel-cadmium cells.

b. The open circuit voltage of a normal cell measures 1.25 to 1.5 volts dc. A discharged cell will measure less than 1.25 volts. A measurement of less than 0.2 volts indicates a marginal cell and is cause for replacement of the cell.

c. The total output voltage of a fully charged battery pack is about 25 volts.

d. Cells must be installed such that the positive end (button end) protrudes through the hole in the battery spring clip and the negative end (flat end) is in contact with the portion of the spring without the hole.

4-25. BATTERY PACK SECTION TEST DATA

a. If trouble develops in the battery pack functional section, and the power supply section is operating normally hold down RESET switch S601. The meter will read out of the red region or zero with the CIRCUIT CHECK switch in position 2.

However if the power supply is malfunctioning (DC indicator not lit) ; and the frequency standard is on battery pack operation and the battery pack is defective or in a discharged state all meter readings will be zero or low depending on the state of charge of the batteries. If the battery voltage is below 19 volts the meter will read zero at all positions of the CIRCUIT CHECK switch since the batteries are cutout at this voltage to prevent deterioration of the batteries due to further discharge. Battery voltage per cell shall be as specified in paragraph 4-3. There are no adjustments to the battery pack section.

b. Test equipment required to perform this check is:

(1) Multimeter AN/USM-116

Refer to Table 5-1 for a complete list of all test equipment.

4-26. ADJUSTMENTS AND TUNING

Table 4-1 lists all critical non-factory adjustments and alignments which may be performed in the field. The table lists the name and reference symbol number of the item to be adjusted or aligned, the circuit function affected and references the adjustment procedure in section 5, as applicable.

4-27. PERFORMANCE INDICATORS

The CIRCUIT CHECK switch and meter located on the frequency standard front panel provide a means for checking the performance of the frequency standard. As shown in Table 4-2 nine switch positions, including two off positions, furnish seven indications indicative of equipment performance. In addition a DC indicator light indicates that the power supply is functioning.

4-28. LOGICAL TROUBLE SHOOTING PROCEDURE

a. Malfunction of the frequency standard is noted by an abrupt change in output frequency or drop in amplitude from the normal level (paragraph 4-1) of the 5 MC, 1 MC and 100 KC outputs, or an abnormal change in CIRCUIT CHECK meter readings.

b. Examining the outside equipment case temperature may point up a malfunction in the battery pack before CIRCUIT CHECK readings become abnormal. Normal case temperature is about 30° C (86°F) for a room temperature of 20°C (68°F). A significantly higher case temperature may be caused by heating due to excessive charging of a faulty cell.

c. Table 4-3 is a reference schedule which associates possible faults with abnormal readings on the CIRCUIT CHECK meter.

d. "Meter readings" refer to the scale on the meter which is divided into 10 units and numbered from 0 - 10. The red region encompasses area 4-6 and represents the normal operating range of the various functional sections in the standard for the following conditions.

(1) The equipment has been warmed-up and stabilized at least six hours.

(2) Ambient temperature of the standard at the time of meter readings is "room" temperature (about 20°C ±5°C or 68°F ±10°F).

TABLE 4-1. LIST OF ADJUSTMENTS AND TUNING

REF. SYMBOL NO.	FUNCTION	ADJUSTMENT PROCEDURE
	5 MC OSCILLATOR	
C106	Adjusts frequency of oscillator in steps of 1PP10 (FINE FREQ. ADJ.)	See para. 5-5 a.
C101	Permits resetting of oscillator frequency when the limits of the fine frequency adjustment are reached (Coarse Freq. Adj.)	See para. 5-5 b.
R205	Sets inner oven temperature range. Do not tamper with this adjustment. It is set at the factory. (Inner Oven Temp. Adj.)	Factory Adjustment
R256	Sets outer oven temperature range. Do not tamper with this adjustment. It is set at the factory. (Outer Oven Temp. Adj.)	Factory Adjustment
	17 VOLT REGULATOR	
R309	Sets DC output level of 17 volt regulator	See para. 5-8
	5 MC TO 1 MC FREQUENCY DIVIDER	
L401	5 MC input tuned amplifier adjustment	See para. 5-6
L402	1 MC tuned amplifier adjustment	See para. 5-6
L403	4 MC multiplier adjustment	See para. 5-6
T401	5 MC output adjustment	See para. 5-6
T402	1 MC output adjustment.	See para. 5-6
	1 MC TO 100 KC FREQUENCY DIVIDER	
L501	100 KC amplifier adjustment.	See para. 5-7
L502	100 KC amplifier adjustment.	See para. 5-7
L503	900 KC multiplier adjustment.	See para. 5-7
T501	100 KC output amplifier adjustment.	See para. 5-7
	26V POWER SUPPLY	
R611	Sets DC output level of 26VDC power supply	See para. 5-9

TABLE 4-2 CIRCUIT CHECK SWITCH AND METER FUNCTIONS

POSITION	FUNCTION	NORMAL READING
1	None	ZERO
2	Indicates state of charge of BATTERY PACK	RED REGION
3	Monitors regulated 17 volts from REGULATOR	RED REGION
4	Monitors OUTER OVEN heater element	Initially ZERO; after warm up, RED REGION if standard at "room" temperature
5	Monitors INNER OVEN heater element	Initially ZERO; after warm up, RED REGION if standard at "room" temperature
6	Indicates 5 MC OUTPUT level	RED REGION
7	Indicates 1 MC OUTPUT level	RED REGION
8	Indicates 100 KC OUTPUT level	RED REGION
9	None	ZERO

TABLE 4-3. PRELIMINARY TROUBLESHOOTING WITH
CIRCUIT CHECK SWITCH AND METER

POSITION-FUNCTION SECTION	ABNORMAL READING	POSSIBLE INTERPRETATION FOR ABNORMAL READING
(DC LIGHT - POWER SUPPLY)	(LIGHT OUT)	(UNIT OPERATING ON BATTERY PACK)
2 - BATTERY PACK	1-4	Battery Pack partially discharged
3 - 17 VOLT REGULATOR	0-4 6-10	Either regulator overloaded or output voltage too low Regulator output voltage too high
4 - OUTER OVEN	0-1 9-10	Outer oven fully on Outer oven fully off
5 - INNER OVEN	0-3 7-10	Inner oven fully on Inner oven fully off
6 - 5 MC OUTPUT	0 1-4 6-10	No output from oscillator Output level less than 1 volt rms Output level more than 1 volt rms
7 - 1 MC OUTPUT	0 1-4 6-10	No output from 5 MC to 1 MC frequency divider Output level less than 1 volt rms Output level more than 1 volt rms
8 - 100 KC OUTPUT	0 1-4 6-10	No output from 5 MC to 1 MC frequency divider Output level less than 1 volt rms Output level more than 1 volt rms

NOTE

The reason for taking meter readings when the standard is at "room" temperature is to relate normal meter readings with normal current requirements of outer and inner oven control circuitry.

At lower than "room" temperatures, the ovens must provide additional heat to the crystal oscillator; at higher than "room" temperatures, the ovens must provide less heat. Therefore, normal meter readings will vary widely with ambient temperature fluctuations.

However, the frequency standard's outputs will change no more than specified over the ambient temperature range specified in Table 1-1.

4-29. INTERCONNECTION SCHEMATIC DIAGRAM

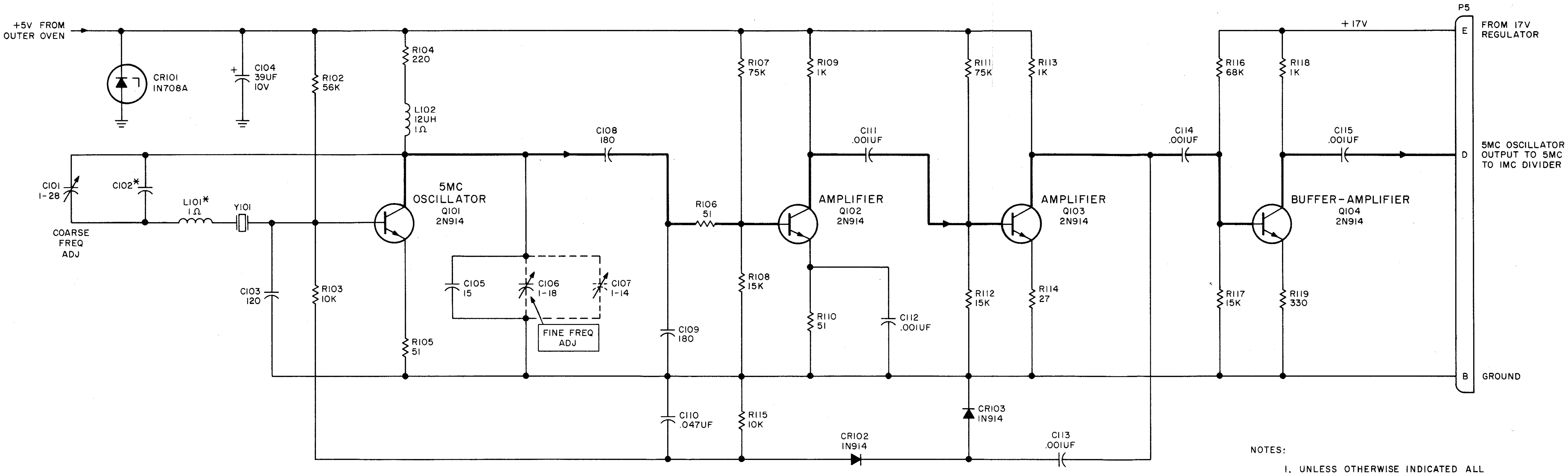
Figure 4-14 contains the interconnection schematic diagram of Frequency Standard AN/URQ-10A.

TABLE 4-4. LOGICAL TROUBLESHOOTING PROCEDURE

STEP	PRELIMINARY ACTION
1	Perform a visual inspection of the front panel of the frequency standard. NORMAL INDICATION: Red DC power on light is illuminated. If the CIRCUIT CHECK switch is in any position except position 1 or 9, there will be some indication on the meter. Assuming that an external alarm has been connected to the frequency standard power supply, the alarm will indicate condition of ac or battery operation.
2	NEXT STEP: If the power on indicator light is not lit (DC) and the alarm indicates no power supply failure, replace the bulb in the power on indicator light.
3	If the power on indicator light is not lighted and the alarm indicates a power supply failure or an ac power interruption, use the CIRCUIT CHECK switch to determine if the frequency standard is functioning. If meter readings are correct for each switch position, the frequency standard is operating on its battery pack. Restore the ac power or reset the power supply, or remove the power supply module if suspect. Repair and/or replace the power supply module.
4	If the frequency standard is operating on its battery pack, a low reading at position 2 of the CIRCUIT CHECK switch indicates that battery pack is discharged or nearly discharged.
5	If no, or very low, readings are obtained on the meter in all positions of the CIRCUIT CHECK switch, there is a short circuit in the dc distribution circuits. It should be located and repaired.
6	If the CIRCUIT CHECK switch is set to position 8 and no reading is obtained on the meter, the 100 kc signal from the frequency standard failed. Set the CIRCUIT CHECK switch to position 7.
7	If a meter reading is obtained in position 7 and not in position 8, the 1 MC to 100 KC regenerative divider output is overloaded, requires tuning or the circuitry has failed. Press the START switch and set the CIRCUIT CHECK switch to position 8. If no signal is obtained at this time replace or repair the 1 MC to 100 KC frequency divider board.
8	If no meter reading is obtained at switch position 7, press the START switch. If meter reading is obtained after the switch has been depressed, some momentary interruption caused the loss of the signals. This frequency standard should be carefully watched for future failure.
9	If no meter reading is obtained at position 7 after the START switch is depressed, set the CIRCUIT CHECK switch to position 6.

TABLE 4-4 LOGICAL TROUBLESHOOTING PROCEDURE (cont'd)

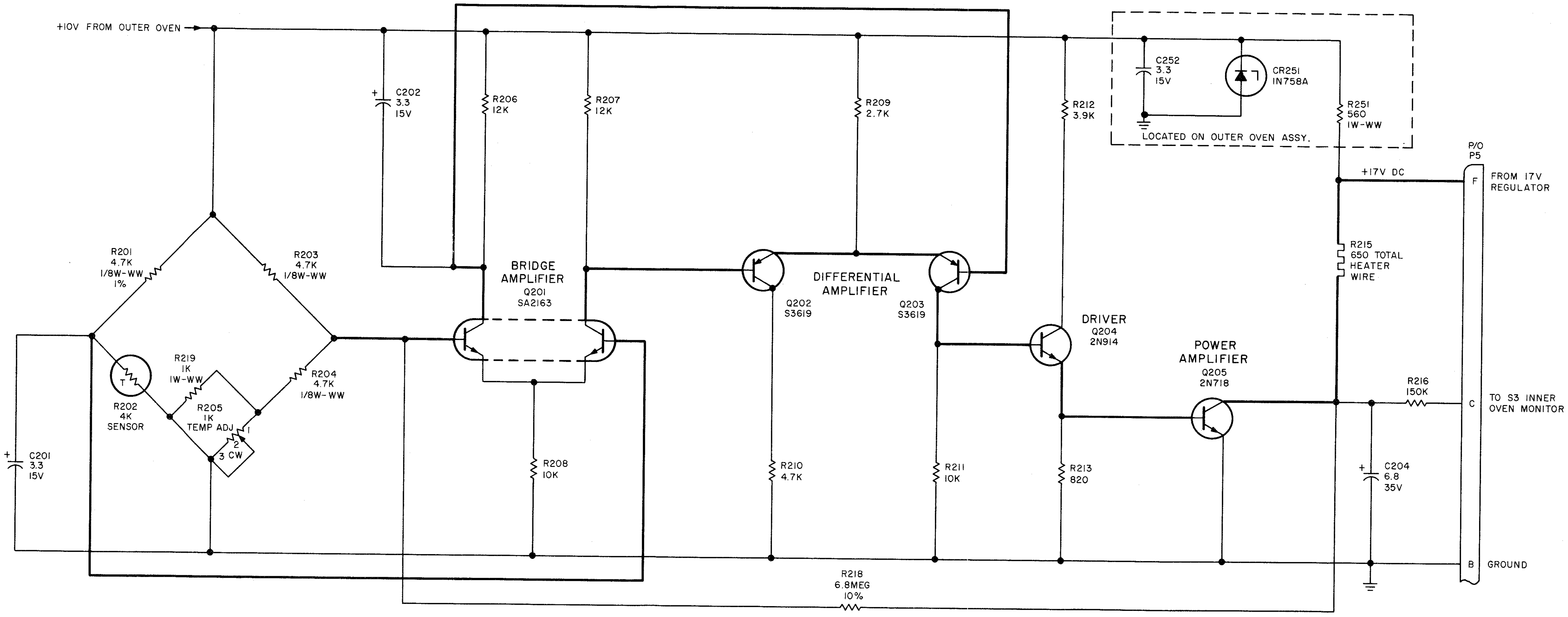
STEP	PRELIMINARY ACTION
10	If a reading is obtained at position 6, the 1MC output is overloaded or requires tuning or the 5MC to 1MC regenerative divider failed. The 5MC to 1MC divider board should be repaired or replaced if defective.
11	If no meter reading is obtained at position 6, the oscillator failed or its dc power failed. Set CIRCUIT CHECK switch to position 3. If no reading is obtained on the meter, the 17 volt voltage regulator is not functioning. Replace the module. If a reading is obtained in position 3, the oscillator module is malfunctioning.
12	Set the CIRCUIT CHECK switch to position 4. If the reading obtained on the meter is zero, it indicates that the oven is fully on. Disconnect the power immediately (disconnect ac line cord and remove battery pack.) If a full scale meter reading is obtained in CIRCUIT CHECK switch position 4, it indicates that the oven is fully off. NOTE The reading of from 7-9 provided as normal for CIRCUIT CHECK switch position 4 (outer oven) is normal at room temperature. At 50°C the normal reading will be closer to 10. Normal readings in all other positions of the CIRCUIT CHECK switch are from 4-6.
13	If the reading obtained on the meter when the CIRCUIT CHECK switch is in position 4 is normal, set CIRCUIT CHECK switch to position 5. If a zero reading is obtained, the oven is fully on. Disconnect the power immediately. If a full scale reading is obtained, the oven is fully off. In either case, if the frequency standard is in use, replace it with a standby frequency standard.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS. (K = 1000 OHMS)
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN PICOFARADS.
3. * INDICATES SELECTED VALUES.
4. ▭ INDICATES FRONT PANEL MARKINGS.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND. (CHASSIS)
6. SIGNAL FLOW DESIGNATIONS. → 5MC

Figure 4-3. 5 MC Oscillator Schematic Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS (K=1000 OHMS).
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN MICROFARADS.
3. * INDICATES SELECTED VALUE.
4. ▭ INDICATES FRONT PANEL MARKING.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND (CHASSIS).

Figure 4-4. Inner Oven, Schematic Diagram.

NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS (K=1000 OHMS).
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN MICROFARADS.
3. * INDICATES SELECTED VALUE.
4. ▭ INDICATES FRONT PANEL MARKING.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND (CHASSIS).

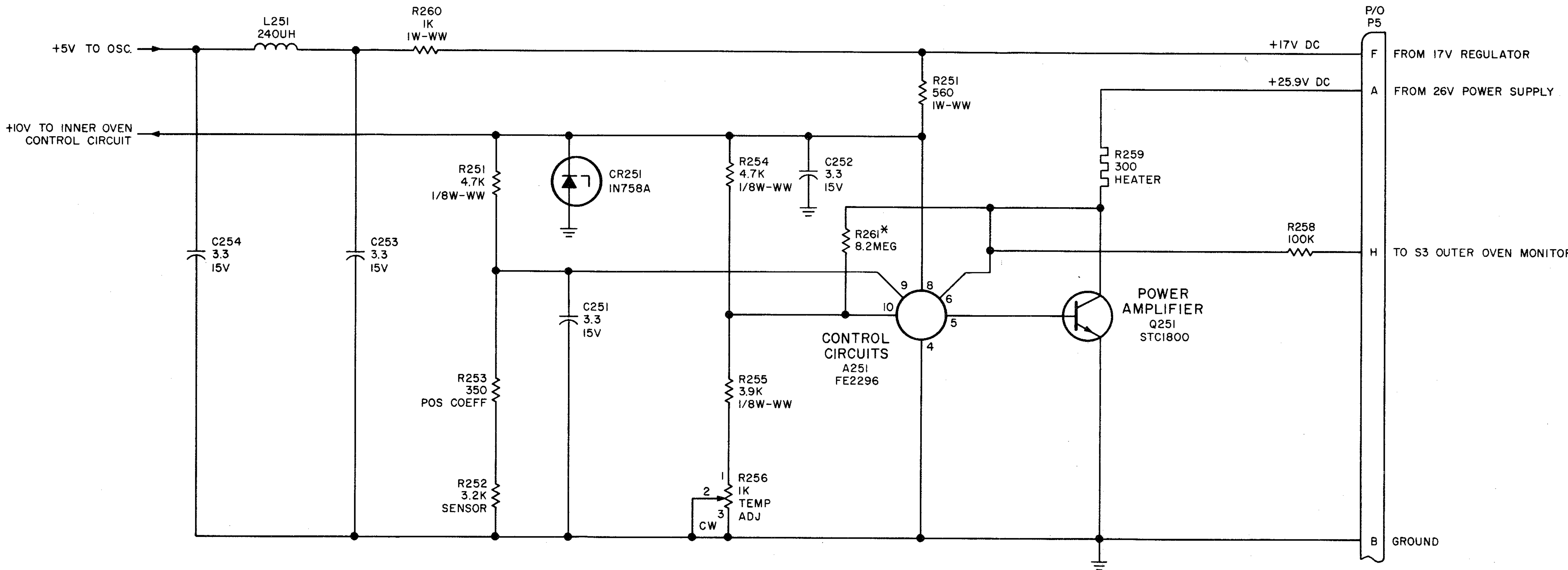


Figure 4-5. Outer Oven, Schematic Diagram.

ORIGINAL

NOTE:
ALL VOLTAGE READINGS ARE MEASURED WITH RESPECT TO GROUND WITH A VTVM.

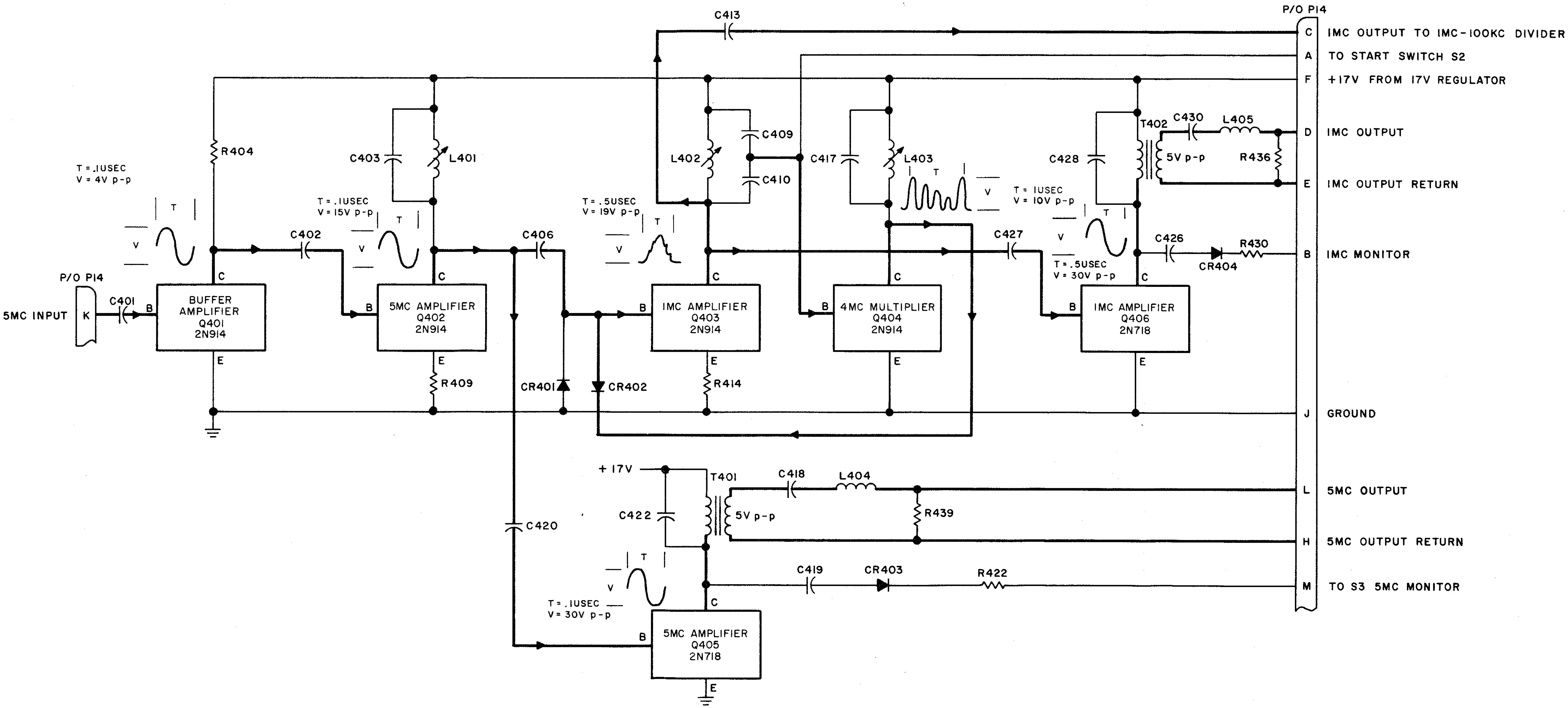
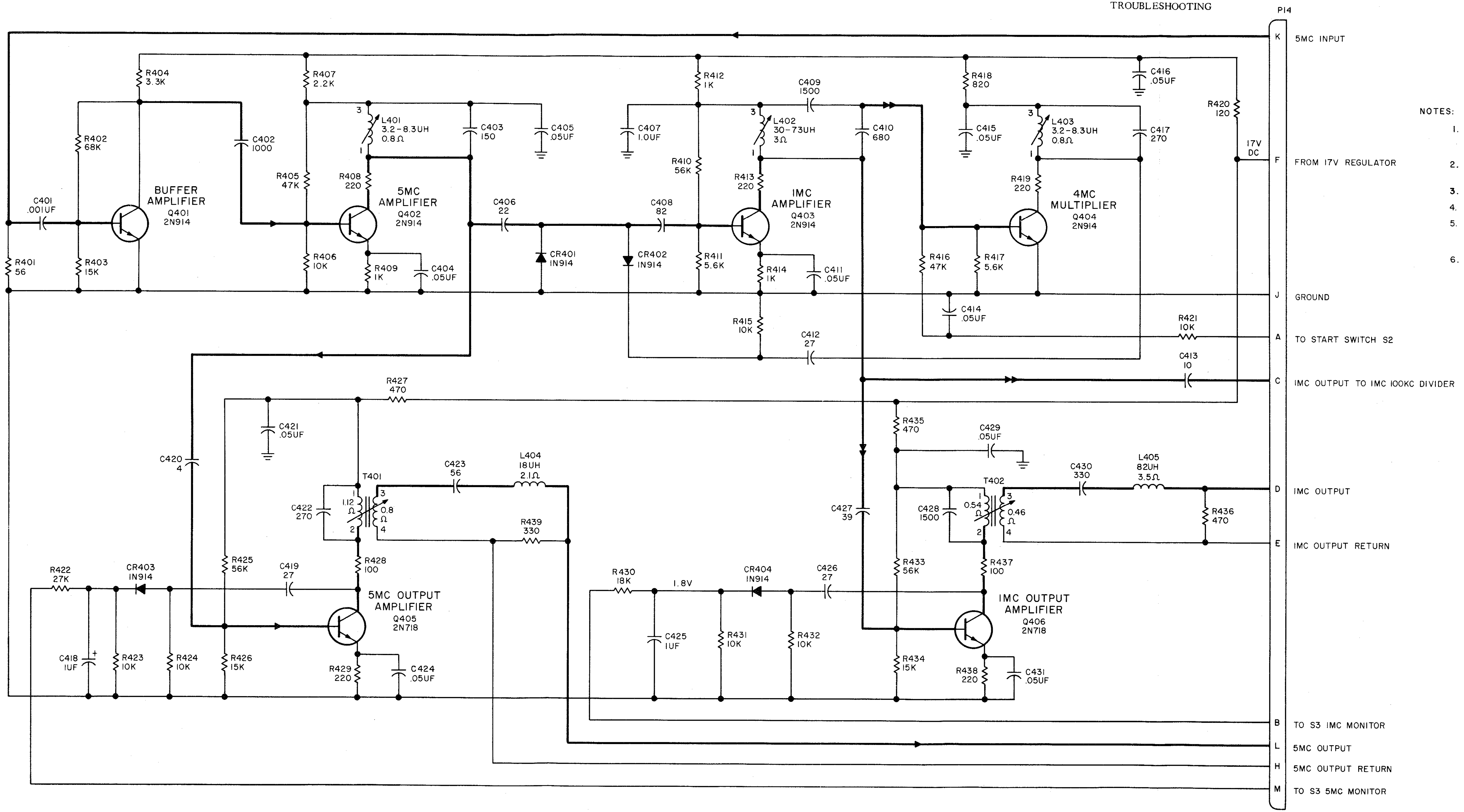


Figure 4-6. 5MC to IMC Frequency Divider, Servicing Block Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS. (K = 1000 OHMS)
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN PICOFARADS.
3. * INDICATES SELECTED VALUES.
4. ▭ INDICATES FRONT PANEL MARKINGS.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND. (CHASSIS)
6. SIGNAL FLOW DESIGNATIONS.
   ─►─ 5MC   ─►►─ 1MC

Figure 4-7. 5 MC To 1 MC Frequency Divider, Schematic Diagram.

NOTE:
ALL VOLTAGE READINGS ARE MEASURED WITH RESPECT TO GROUND WITH A VTVM.

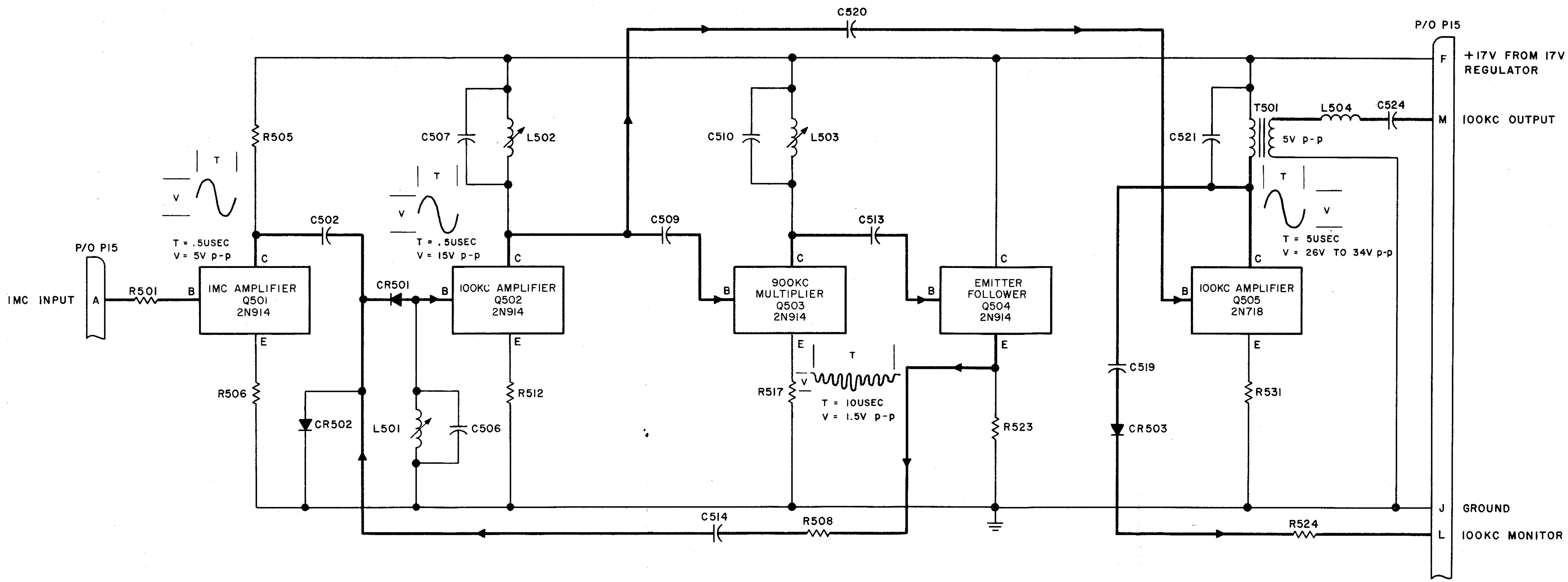
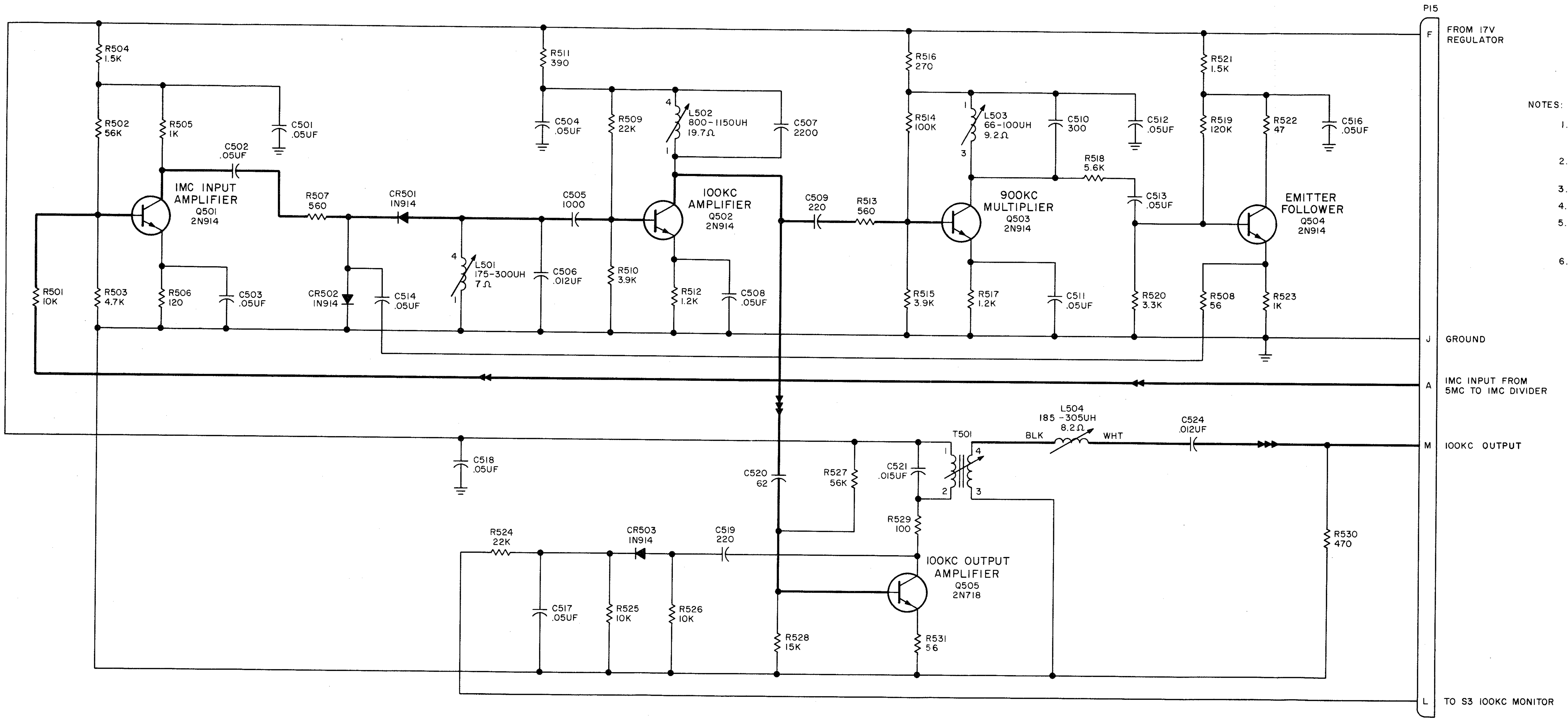


Figure 4-8. 1MC to 100KC Frequency Divider, Servicing Block Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS. (K = 1000 OHMS)
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN PICOFARADS.
3. * INDICATES SELECTED VALUES.
4. ▭ INDICATES FRONT PANEL MARKINGS.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND. (CHASSIS)
6. SIGNAL FLOW DESIGNATIONS.

   ►► 1MC   ►►► 100KC

Figure 4-9. 1 MC To 100 KC Frequency Divider, Schematic Diagram.

NOTE:
ALL VOLTAGE READINGS ARE MEASURED WITH RESPECT TO GROUND WITH A VTVM.

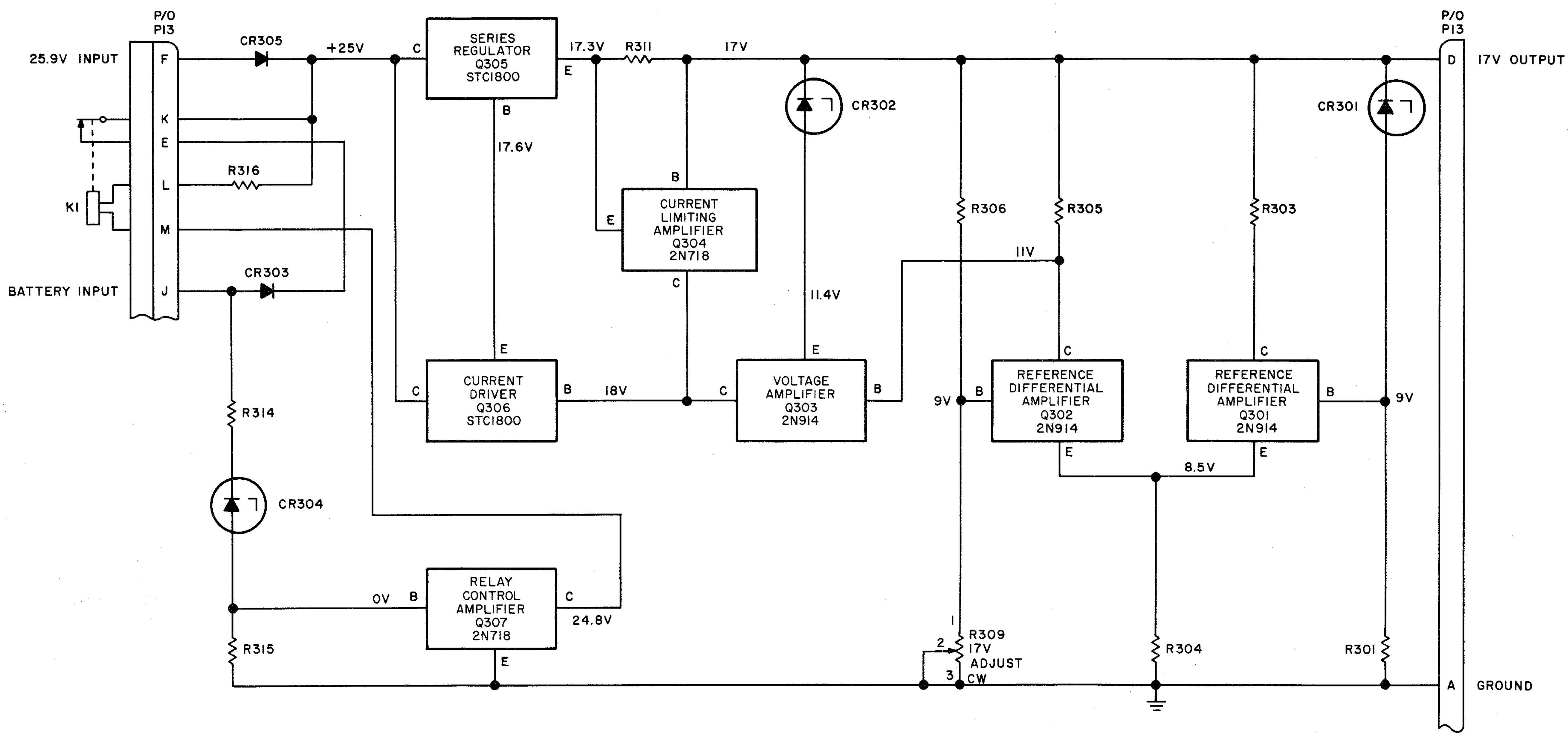
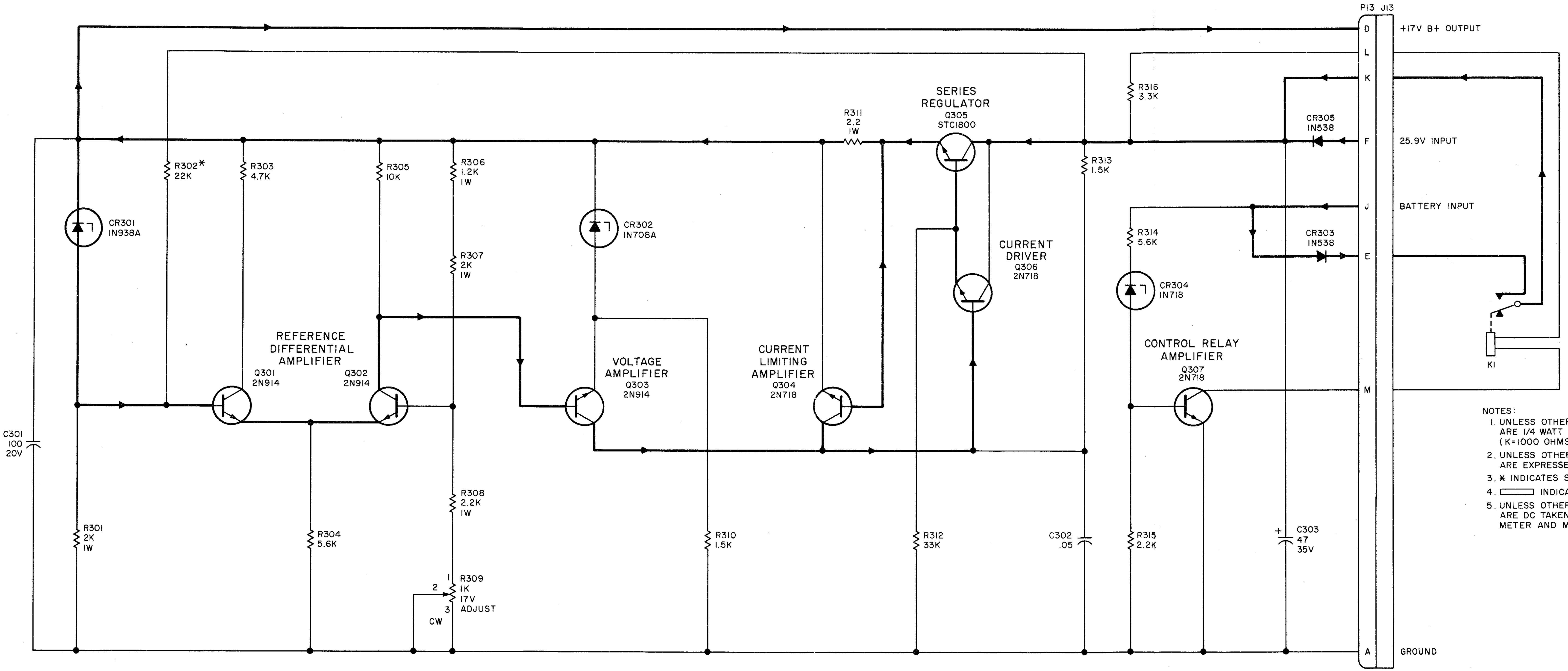


Figure 4-10. 17 Volt Regulator,
Servicing Block Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS (K=1000 OHMS)
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN MICROFARADS.
3. * INDICATES SELECTED VALUE.
4. ▭ INDICATES FRONT PANEL MARKING.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND (CHASSIS).

Figure 4-11. 17 Volt Regulator, Schematic Diagram.

NOTE:

ALL VOLTAGE READINGS ARE MEASURED WITH RESPECT TO GROUND WITH A VTVM.

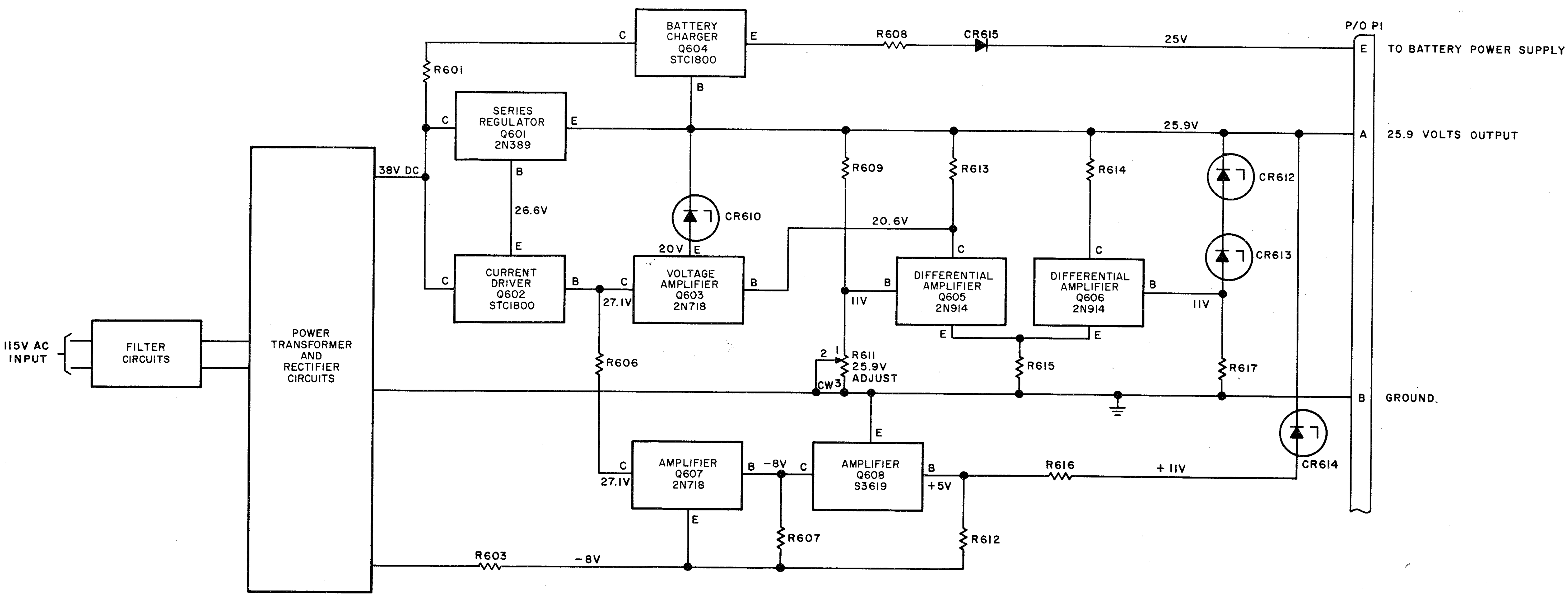
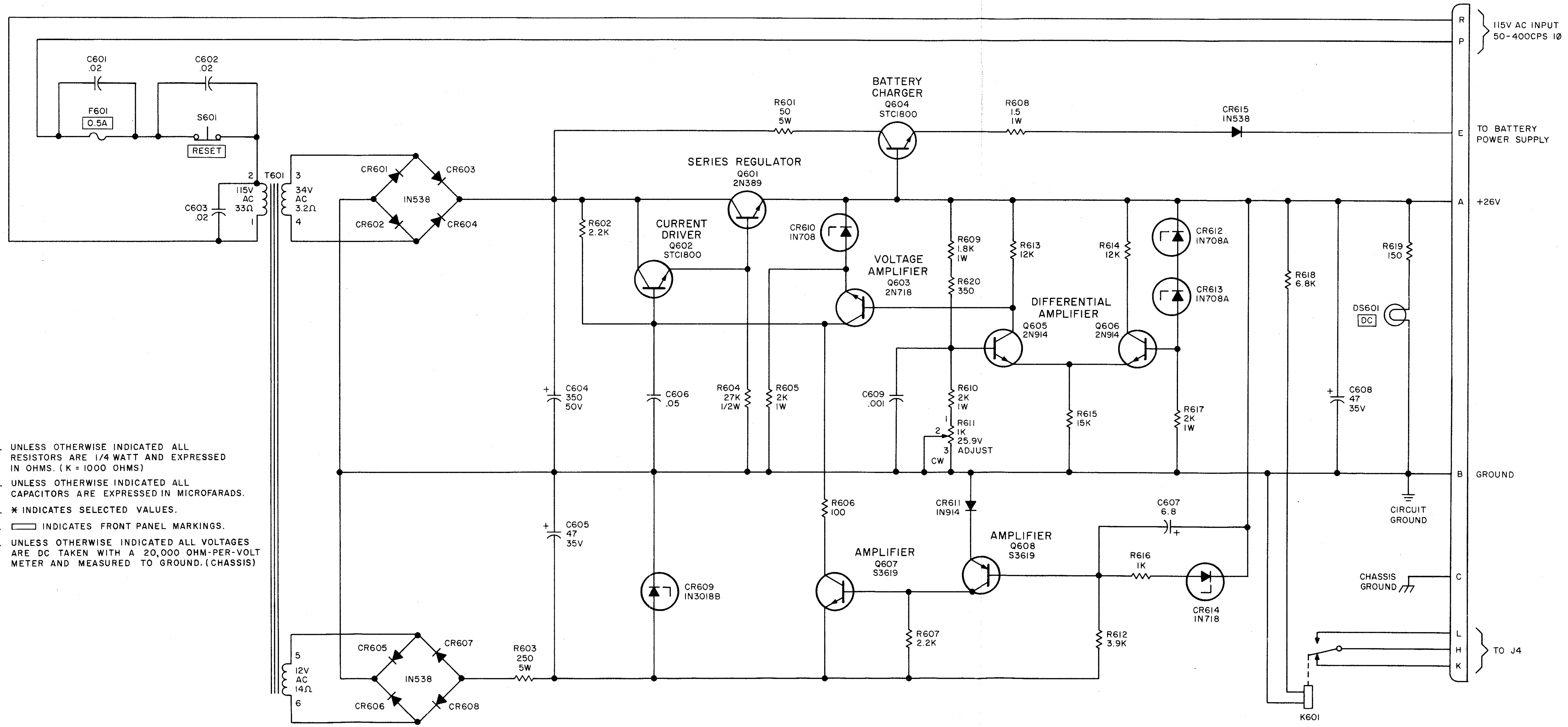


Figure 4-12. 26 Volt Power Supply, Servicing Block Diagram.



NOTES:

1. UNLESS OTHERWISE INDICATED ALL RESISTORS ARE 1/4 WATT AND EXPRESSED IN OHMS. (K = 1000 OHMS)
2. UNLESS OTHERWISE INDICATED ALL CAPACITORS ARE EXPRESSED IN MICROFARADS.
3. ✱ INDICATES SELECTED VALUES.
4. ▭ INDICATES FRONT PANEL MARKINGS.
5. UNLESS OTHERWISE INDICATED ALL VOLTAGES ARE DC TAKEN WITH A 20,000 OHM-PER-VOLT METER AND MEASURED TO GROUND. (CHASSIS)

Figure 4-13. 26 Volt Power Supply, Schematic Diagram.

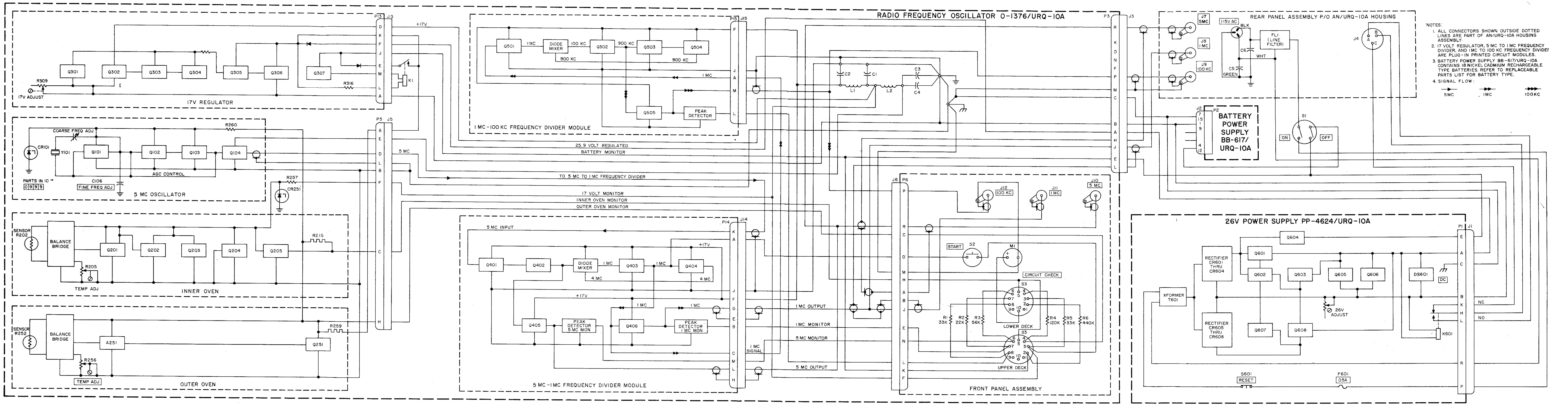


Figure 4-14. Frequency Standard AN/URQ-10A, Interconnection Schematic Diagram.

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

a. MAINTENANCE STANDARDS - The frequency standard is designed to require a minimum amount of maintenance. These tests provide a systematic and efficient method for checking the equipment. When the procedures are performed as directed, the operating efficiency ofthe equipment will be increased due to the detection of impending failures before they occur. The maintenance standard tests are to be performed using the CIRCUIT CHECK switch and meter on the frequency standard front panel. The modular design and operating characteristics of the frequency standard preclude the use of voltage and resistance measurements other than for troubleshooting purposes.

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - Table 5-1 lists the test equipment which is required.

TABLE 5-1 . TEST EQUIPMENT

TEST UNIT	AN TYPE DESIGNATION
Capacitance, Inductance and Resistance Bridge	ZM-11A/U
Frequency Deviation Meter	AN/URM-115
Multimeter	AN/USM-116
Oscilloscope	AN/USM-105A
Variac	CN-16 A/U
Volt-Ohm Micrometer	AN/PSM-4

(2) PRELIMINARY OPERATION. - Before the maintenance standards are established and recorded,the frequency standard should operate continously for eight to eleven days. At the end of this time, the crystal temperature and frequency will have stabilized and the output frequencies will be constant. A quick check by the test meter in all seven active positions of the circuit check switch will indicate a malfunction or proper operation. The frequency standard should be operating normally, but,if adjustment is required, follow the procedure described in paragraph 5-1b.

(3) TEST PROCEDURE AND MAINTENANCE REFERENCES.- The procedures and tests listed in Table 5-2 are the maintenance standards for the frequency standard.They are subdivided by functional sections corresponding to the functional block diagram sections of the set (figure 5-1). The listed procedures consist of the mimimum number of reference standards which will indicate, when completed, the relative performance of the set. Upon completion of each prescribed prevention maintenance procedure, the results are to be recorded and dated on checkoff charts similar to the one shown in figures 5-2.

Note

The procedures are listed in suggested sequence of performance; however, deviation from the listed order will in no way affect the unity or result of the reference standards unless otherwise noted.

(4) PREVENTIVE MAINTENANCE CHECKOFF.- The preventive maintenance tests provide a systematic method for performing preventive maintenance procedures to maintain the high operating efficiency of the frequency standard. The preventive maintenance tests are performed by using the existing front panel circuit check test meter and switch. The test procedures are in table form and are scheduled for regular bi-weekly (Table 5-3) and monthly (Table 5-4) periods.

At the top of each procedure table is a list of operating conditions and control settings which apply to the entire table. The step numbers correspond to the"step number" on accompanying illustration (figure 5-3). Arrows leading from a given "step number" on the illustration present the basic information (points where test equipment is to be connected and the type of test equipment to be used) in the associated step of the procedure table.

It is expected that the meter readings obtained at each step will show nominal variances from time to time. However, this does not necessarily mean that the equipment is operating improperly. If a particular step indicates a reading which varies progressively in the same direction every time the check is made, it is an indication of a malfunction and corrective steps must be taken. Refer to Table 4-2 for acceptable readings.

b. TUNING AND ADJUSTMENT.- The frequency standard has been carefully adjusted by the manufacturer before shipment. Attempting to adjust the equipment when something else is the cause of the malfunction may result in the use of extra time in trouble-shooting and readjustment. No attempt should be made to adjust the equipment until it is certain that the test equipment is trouble-free and adjustment is required.

(1) TEST EQUIPMENT.- The test equipment listed in Table 5-1 is required for troubleshooting tuning and adjustment.

5-2. CALIBRATION PROCEDURES

a. Crystal controlled frequency standards normally require that their output frequencies be checked for calibration against a reference frequency under the following circumstances:

(1) Subsequent to initial installation and a warm up stabilization period of about ten days

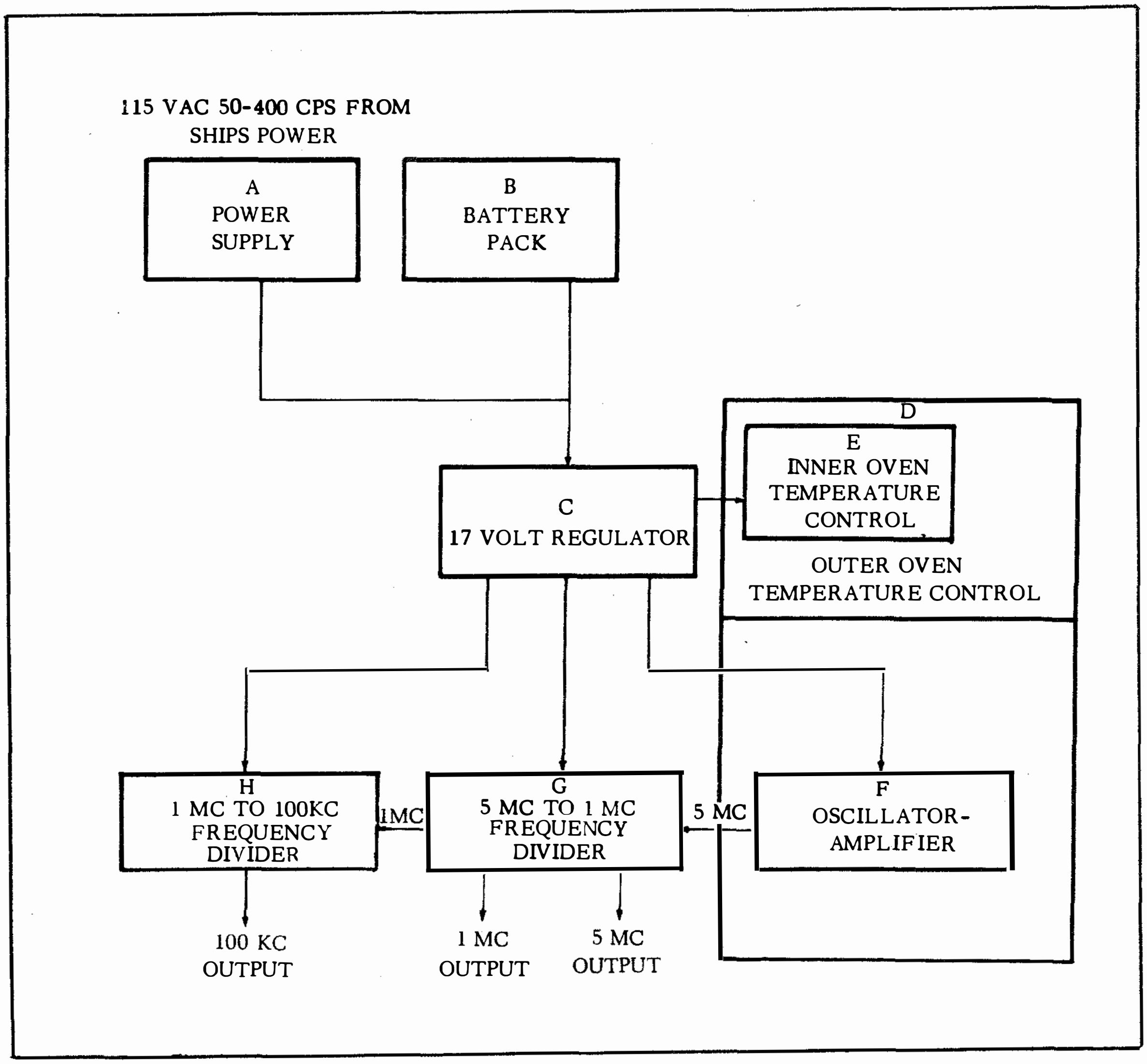


Figure 5-1. Maintenance Standards Block Diagram.

NOTE

The frequency standard has been carefully adjusted by the manufacturer before shipment. No adjustment is likely to be necessary if the equipment was shipped while operating. A minor adjustment may be necessary if equipment was turned off for shipment.

(2) Periodically, during a long run of uninterrupted operation, to take account of the inherent long term frequency drift of the standard caused by natural aging changes in the quartz crystal.

(3) Subsequent to interruption of continous power to the oscillator assembly module due, either, to

(a) The loss of external primary and internal battery pack power, or

(b) The withdrawal of the oscillator assembly module from the main chassis for repair or replacement of parts, or

(c) The power switch S1, figure 5-11 being in the OFF position for any reason.

NOTE

If the power interruption is less than about one hour long, the standard will probably not require recalibration because the ovens will not have cooled appreciably. However, the outputs should be checked.

b. Checking for calibration should proceed only after the following conditions have been met:

(1) The standard is (otherwise) operating properly. Attempting to adjust the equipment when something else is the cause of the malfunction may result in lost time for additional trouble-shooting and re-calibration.

(2) The test equipment is trouble-free.

MONTHLY	1ST MONTH 19__	2ND MONTH 19__	3RD MONTH 19__	4TH MONTH 19__	5TH MONTH 19__	6TH MONTH 19__
STEP 1	Lamp Lit.					
STEP 2	5					
STEP 3	5					
STEP 4	5					
STEP 5	5					
STEP 6	5					
STEP 7	5					
INITIAL						

NOTE: THIS FORM TO BE USED FOR BOTH BI-WEEKLY AND MONTHLY CHECKS

Figure 5-2. Maintenance Standards Sample Checkoff Chart.

5-3. TEST EQUIPMENT

a. A reference frequency is required for checking the frequency outputs of the standard. The reference may be derived from:

(1) An atomic frequency standard.

(2) Transmissions received via a VLF receiver.

(3) A precision frequency standard of known calibration.

b. Depending on the method of checking for calibration, one of the following is required:

(1) Phase Comparator (Model FE 40A or equivalent) or

(2) Frequency Deviation Meter (AN/URM-115 or equivalent.

5-4. CHECKING FOR CALIBRATION

a. Method 1 - Phase Comparison

(1) Connect a 1 MC or 100KC output from the frequency standard under consideration and the same frequency output from the reference frequency source to the proper receptacles on the Phase Comparator (figure 5-4). The frequency error comparison will be plotted on the Phase Comparator recorder.

(a) The horizontal scale of the recorder depends on the frequency (fo) chosen for comparison, as follows:

FULL SCALE = T(sec) = 1/fo(cps)

Thus, comparison at 100KC rate produces a full scale of 10 microseconds; comparison at 1 mc rate produces a full scale of one microsecond.

(b) The vertical scale of the recorder is one inch per hour. The recorder paper is marked as such.

(2) After a period of time of frequency comparison on the recorder, the slope of the trace can be determined by measuring the accumulated time error in microseconds over the observed time period (as shown in figure 5-5). Knowledge of these two quantities permits accurate adjustment of the frequency standard.

(3) The use of figure 5-5 Frequency Error Conversion Chart allows a simple and quick determination of required adjustment, as follows:

(a) Locate the accumulated microseconds error on the abscissa.

(b) Draw a vertical line from the point on the abscissa to the slanted line on the chart which corresponds to the time period over which the slope of the frequency error was observed.

(c) From the point determined in the immediately preceeding step, draw a horizontal line through the ordinate.

(d) The point on the ordinate indicates the fractional frequency adjustment required. (See paragraph 5-5)

(4) This method of frequency comparison has a resolution of parts in 10^{12} and can provide measurements accurate to parts in 10^{10} in less than 5 minutes. In additional, it furnishes a continuous, permanent, and inexpensive record of the performance of a frequency standard. This record will also provide visual representation of such malfunction as momentary stoppages and phase shifts which might otherwise go unnoticed.

b. Method II - Frequency Deviation

(1) Connect the 5 mc frequency output from the frequency standard under consideration and the 5 mc output from the reference frequency standard to the respective receptacles on the frequency deviation meter.

(2) Perform this check until there is a definite indication of which way the frequency is drifting.

(3) Make the necessary adjustment on the standard (paragraph 5-5).

c. Method III - VLF Method

(1) Connect a 100 KC output from the frequency standard to REFERENCE INPUT on a VLF Receiver. The frequency error comparison will be plotted on the VLF recorder.

(2) Refer to VLF manual for interpreting results.

5-5. MAKING THE CALIBRATION

a. Fine Frequency Adjustment

(1) The fine frequency adjustment (C106) is made by removing the screw plug from the front panel and inserting a screw driver into the slot located directly behind the screw plug. The required adjustment in parts in 10^{10}, is added to (or subtracted from) the parts in 10^{10} counter on the front panel depending on whether the frequency of the standard is too low (or too high) compared to the reference frequency.

(2) Clockwise adjustment results in increased frequency.

(3) Results of the adjustment should be observed for several minutes to allow for stabilization (The slope of the trace on the Phase Comparator recorder chart should become more nearly vertical).

(4) If the oscillator frequency can not be corrected with the fine frequency control because the counter is at the lower or upper limit of its range, it is necessary to reset the counter and proceed with the coarse frequency adjustment.

b. Coarse Frequency Adjustment

CAUTION

Before proceeding with coarse frequency adjustment, be sure that both outer and inner oven temperatures, as monitored by the CIRCUIT CHECK switch, are correct. See note in paragraph 4-28 for guide lines in interpreting meter readings for positions 4 and 5 respectively.

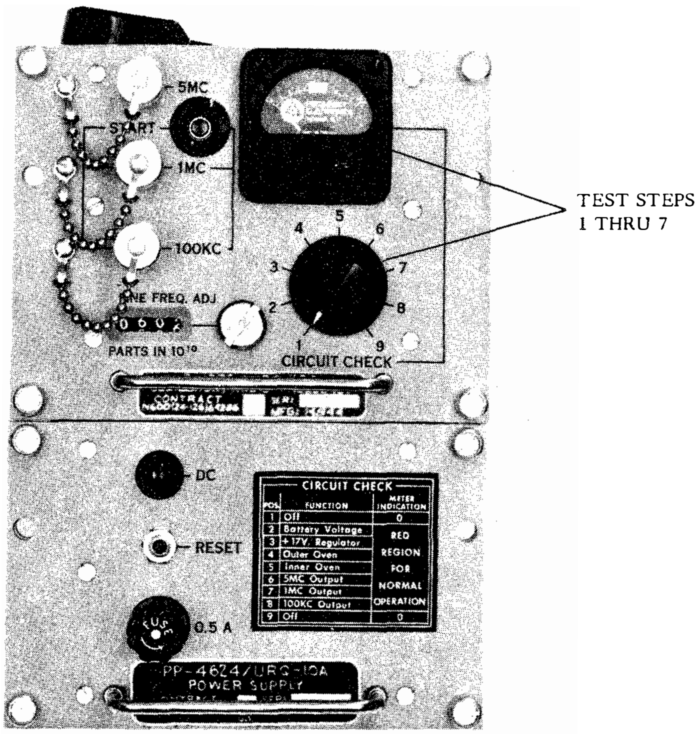
NOTE

Coarse frequency adjustment is normally not required more often than once in 1-1/2 to 2 years of continuous operation.

TABLE 5-2. REFERENCE STANDARDS SUMMARY

SECTION	ACTION REQUIRED	REFER PERIOD	TO STEP
A POWER SUPPLY	Record whether DC lamp is energized.	(M)*	1
B BATTERY PACK	Record battery reading. Clean battery	(BW)** (BW)**	1 2
C 17 VOLT REGULATOR	Record voltage regulator meter reading	(M)*	2
D OUTER OVEN	Record outer oven meter reading	(M)*	3
E INNER OVENS	Record inner oven meter reading	(M)*	4
F OSCILLATOR-AMPLIFIER	Record 5 MC output meter reading	(M)*	5
G 5 MC TO 1MC FREQUENCY DIVIDER	Record 1 MC output meter reading	(M)*	6
H 1 MC TO 100 KC FREQUENCY DIVIDER	Record 100 KC output meter reading	(M)*	7

* Monthly
** Bi-weekly



(1) Reset the fine frequency adjustment counter.

(a) If the unit has been exhibiting positive drift (increasing frequency) reset the counter to 900 by turning the fine frequency adjustment clockwise.

(b) If the unit has been exhibiting negative drift (decreasing frequency) reset the counter to 100 by turning the fine frequency adjustment counter-clockwise.

(2) Remove the six flat head machine screws from the front panel of the oscillator assembly module. Put the screws aside for later reassembly.

(3) Unlatch the four quarter turn fasteners that retain the front panel and gently remove the panel assembly from the opening.

NOTE

The operation of the standard is not affected by removal of the front panel.

(4) Figure 5-8 illustrates the location of the coarse frequency adjustment with front panel assembly removed. Carefully remove the screw plug.

(5) The opening provides access to coarse frequency control capacitor C101. Use a narrow screwdriver to adjust the capacitor.

(a) Turn the capacitor clockwise to decrease the frequency for a unit that is aging positively (fine frequency counter was reset to 900).

(b) Turn the capacitor counter-clockwise to increase the frequency for a unit that is aging negatively (fine frequency counter was reset to 100).

(6) Adjust C101 until the frequency is approximately correct. Observe the results of adjustment after several minutes of stabilization.

NOTE

In the process of adjusting the coarse control capacitor, the regenerative 5 MC to 1 MC and 1 MC to 100 KC frequency dividers may drop out. Restart the dividers by temporarily reinstalling the front panel assembly and pressing START button.

(7) Use the fine frequency adjustment to complete the calibration of the frequency standard. (see paragraph 5-5a)

(8) When the unit has been satisfactorily calibrated, restore the coarse frequency control screw plug, the front panel assembly and the fine frequency control screw plug.

5-6. 5 MC TO 1 MC FREQUENCY DIVIDER ALIGNMENT

a. The alignment procedure which follows shall only be used when it is definitely known that the divider components are not defective and that alignment is required due to component aging and replacement. Refer to figures 4-6, 4-7 and 5-8 for the electrical and physical locations respectively, of the adjustable coils and transformers.

NOTE

Full and proper alignment of this divider can only be made if an extension board is used to provide complete access to the circuit board connections. The frequency standard should be warmed up and stabilized.

b. 5 MC Section

(1) Apply a 5 MC signal to Q401 using the frequency standards own 5 MC oscillator or another frequency standard, or a signal generator.

(2) Connect a 50 ohm load across the 5 MC output connectors.

(3) Tune L401 for a maximum voltage reading at the 5 MC output connector.

(4) Tune T401 for a maximum reading of 1.1 volt rms at the 5 MC output connector. Check the frequency with a counter.

c. 1 MC Section

(1) Use the same setup as in steps 1 and 2 above.

(2) Place START switch S2 in the ON position (a jumper wire may be applied to facilitate this action.)

(3) Tune L403 for a 4 MC signal (see figure 4-6 for the proper waveshape) and L402 for a 1 MC signal, in that order, for maximum voltage readings at the collectors of Q404 and Q403, respectively.

NOTE

It may be necessary to retune L402 and take a maximum output reading at the 1 MC output connector to compensate for the effect of the lead capacitance of the test voltmeter on the collector circuit of Q403.

TABLE 5-3. BI-WEEKLY REFERENCE TESTS

Operating Conditions and Control Settings:

Frequency Standard is operating

Power on-off switch S1: ON

START switch S2: If frequency divider not operating, momentarily depress switch to start frequency dividers.

STEP NO.	FIG. NO.	ACTION REQUIRED	READ INDICATION ON	REFERENCE STANDARD
1	5-3	Check battery operation . PROCEDURE: Set circuit check switch to position 2 and depress RESET switch S601	M1	"Red Region"
2		Check battery cleanliness . PROCEDURE: Remove batteries from the set; visually check the appearance of each battery.	Visual	Clean. No residue or bulging.

(4) Tune T402 for a maximum output voltage of approximately 1. 1 vrms at the 1 MC output connectors. Check the 1 MC output frequency with a counter.

(5) Release START switch S2 (remove jumper, if used). The 1 MC signal should not drop out. If it does, retune L403 and L402 to obtain maximum stability.

(6) Short out the 5 MC output signal. The 1 MC output should not drop out. If it does retune L401 counterclockwise slightly to obtain maximum stability.

(7) Momentarily depress START switch S2, the 1MC signal should recover immediately.

5-7. 1 MC TO 100KC FREQUENCY DIVIDER ALIGNMENT

The alignment procedure which follows shall only be used when it is definitely known that the divider components are not defective and that alignment is required due to component aging and replacement. Refer to figures 4-8, 4-9 and 5-8 for the physical and electrical for the physical and electrical locations of the adjustable coils and transformers.

(1) Apply a 1 MC signal to Q501. If the frequency standard under alignment has a properly operating 1 MC output signal it may be used and no leads or special wiring is required since the normal operation of the frequency standard supplies a 1 MC signal to this board. If desired another frequency standard or signal generator may be used as a 1 MC signal source.

(2) Tune L502 for maximum voltage at collector of Q502. The frequency should be 100KC, 15 to 30 V P-P.

(3) Tune L501 for maximum voltage at the collector of Q502. Check sine wave and frequency at this point (see figure 4-8). Frequency should be 100KC .

(4) Tune L503 for proper ringing frequency 900KC and waveshape (see figure 4-8).

(5) Retune L502 and L501 as described in steps 1 and 2 to obtain maximum voltage.

(6) Tune T501 and L504 for maximum voltage at the 100 KC signal output connector. The signal shall be 100 KC at approximately 1.1 volts rms.

(7) Remove the 1 MC input signal. The 100 KC signal should drop to zero. Reapply the 1 MC input signal and check that the 100 KC output signal returns.

5-8. 17 VOLT REGULATOR ADJUSTMENT.

The 17 volt regulator adjustment R309 is electrically and physically located as shown in figures 4-11 and 5-8.

To adjust R309 perform the following procedure:

(1) Set the CIRCUIT CHECK switch to position 3.

(2) Adjust R309 with a very thin screwdriver until CIRCUIT CHECK meter M1 reads in the "red region".

NOTE

If an extension board is used the positive lead of a voltmeter may be connected to pin D, and the negative lead to pin A of P13. Adjust R309 until the meter reads +17.00 volts dc.

5-9. POWER SUPPLY ADJUSTMENT

The 26V power supply adjustment is electrically and physically located as shown in figures 4-12, 4-13 and 5-12.

To adjust R611 on the power supply use an extension cable and perform the following.

(1) Connect the positive lead of a voltmeter to pin A and the negative lead to pin B of P1, or if not convenient, across the terminals of capacitor C608.

(2) Adjust R611 until the meter reads 25.9 volt dc.

5-10. BATTERY PACK

a. The battery pack does not require any adjustments. Should batteries be replaced observe the polarities indicated in the battery pack. The voltage output should be measured. Refer to paragraph 4-25 for test data.

TABLE 5-4. MONTHLY REFERENCE TESTS

Operating Conditions and Control Settings:

Frequency standard is operating.

Power on-off switch S1: ON

START switch S2: If frequency divider not operating, momentarily depress switch to start frequency divider.

Note

When using the front panel Circuit Check (M1), readings in the "red region" indicate an acceptable standard.

STEP NO.	FIG. NO.	ACTION REQUIRED	READ INDICATION ON	REFERENCE STANDARD
1	5-3	Record presence of energized DC indicator light. PROCEDURE: Visual.	Front panel DC indicator lamp.	Indicator lamp lit
2	5-3	Record Meter reading for +17 volt regulator PROCEDURE: Set CIRCUIT CHECK switch to position 3.	M1	"Red Region" 4-6.
3	5-3	Record meter reading for outer oven PROCEDURE: Set CIRCUIT CHECK switch to position 4.	M1	"Red Region" 4-6 after 4 hour warmup
4	5-3	Record meter reading for inner oven. PROCEDURE: Set CIRCUIT CHECK switch to position 5.	M1	"Red Region" 4-6 after 4 hour warmup
5	5-3	Record meter reading for 5 MC output PROCEDURE: Set CIRCUIT CHECK switch to position 6.	MI	"Red Region" 4-6
6	5-3	Record meter reading for 1 MC output PROCEDURE: Set CIRCUIT CHECK switch to position 7.	M1	"Red Region" 4-6
7	5-3	Record meter reading for 100 KC output PROCEDURE: Set CIRCUIT CHECK switch to position 8.	M1	"Red Region" 4-6

b. An acceptable battery pack will measure between 19.5 and 25 volts dc. Any battery pack measuring less than 19 volts dc will require charging or may have shorted cells.

5-11. REMOVAL, REPAIR AND REPLACEMENT.

a. The design of the frequency standard provides for easy access to the replaceable and adjustable components. However trouble shooting and repairing certain elements will require removal of a pull-out module or the affected subassembly. Special instructions are provided below for the removal, repair and replacement of the following.

(1) front panels and modules.

(2) fine frequency control.

(3) frequency oscillator chassis.

Refer to the components location diagrams 5-6 through 5-17 and the overall interconnecting schematic diagram (figure 4-14) for additional information.

b. FRONT PANELS AND MODULES - For removal, repair or replacement of the frequency oscillator front panel and pull-out modules (power supply and battery pack) proceed as follows:

(1) Turn the four Dzus fasteners, found at each corner of a pull-out panel/module assembly, 1/4 turn in a counter clockwise direction. Unscrew 1 binding head screw located at the lower center of the battery pack.

(2) Using the handle found on each panel, pull out the panel, exerting sufficient pull to withdraw the module gently.

NOTE

The battery pack is heavier than the other pull out panel/modules and requires a greater pull for removal

5-12. FREQUENCY OSCILLATOR PANEL REMOVAL

To separate the frequency oscillator panel and chassis remove six #4-40 flat-head screws from the front panel. When these screws are removed the oscillator front panel and chassis will separate. If it is desired to remove the front panel only while the module is in the frequency standard turn the Dzus fasteners in each corner of the panel 1/4 turn counter clockwose and remove the six #4-40 flat-head screws immediately thereafter. Pull out the panel very gently. The panel components and the adjustments and components on the front of the oscillator chassis are then available.

5-13. GEAR TRAIN DISASSEMBLY PROCEDURE

a. Before disassembling the gear train record the reading on the counter. When disassembling the gears try not to change the setting of the fine frequency trimmer capacitor.

b. To disassemble the counter gear train drive assembly refer primarily to figures 5-6 for disassembly and 5-8 for a general view. Perform the following procedure.

(1) Record the counter reading for reassembly purposes.

(2) Unmesh gears (1) and (2) by loosening allen head screws (3) and (4).

(3) Remove gear (5) by unloosening allen head screw (6) and gently pulling forward on the gear.

(4) Remove mounting plate (7) by removing screws (8) and flat washers (9).

CAUTION

Remove the mounting plate very cautiously. If undue pressure is exerted in other than a forward direction the fine frequency trimmer capacitor may be damaged. Try not to change the setting of the trimmer capacitor.

(5) After the mounting plate is removed, Remove collar (10) by loosening the screw (11). Pull out the shaft (12).

(6) Remove shaft assembly (13) by removing retainer ring (16).

(7) Remove gears (14) and (2) by loosening allen head screws (15) and (4) as required. Pull on the gears very gently and slide them off the shaft.

(8) Remove bushings (17) and (18) if required.

NOTE

The assembly procedure for the gear train drive is the reverse of the disassembly procedure. When assembling the unit be sure that the counter and fine frequency trimmer capacitor are in the same positions as prior to disassembly. Otherwise recalibration of the frequency standard may be required.

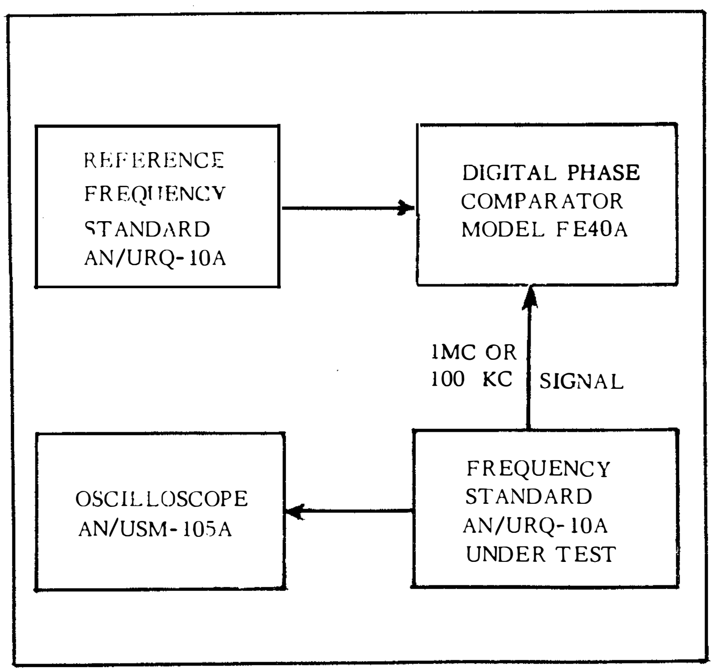


Figure 5-4. Frequency Standard Output Signal Measurement Procedure, Block Diagram.

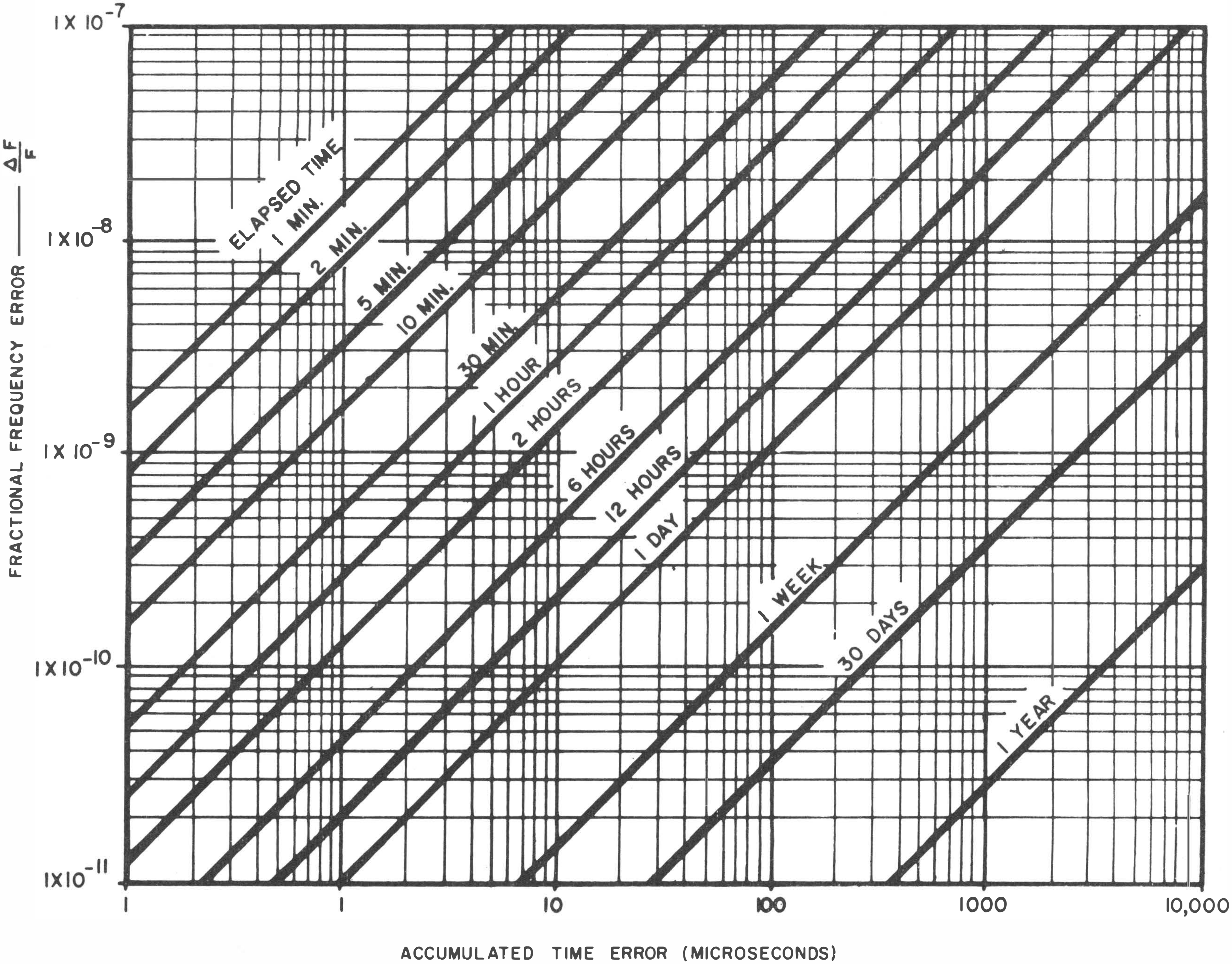


Figure 5-5. Frequency Error Conversion Chart.

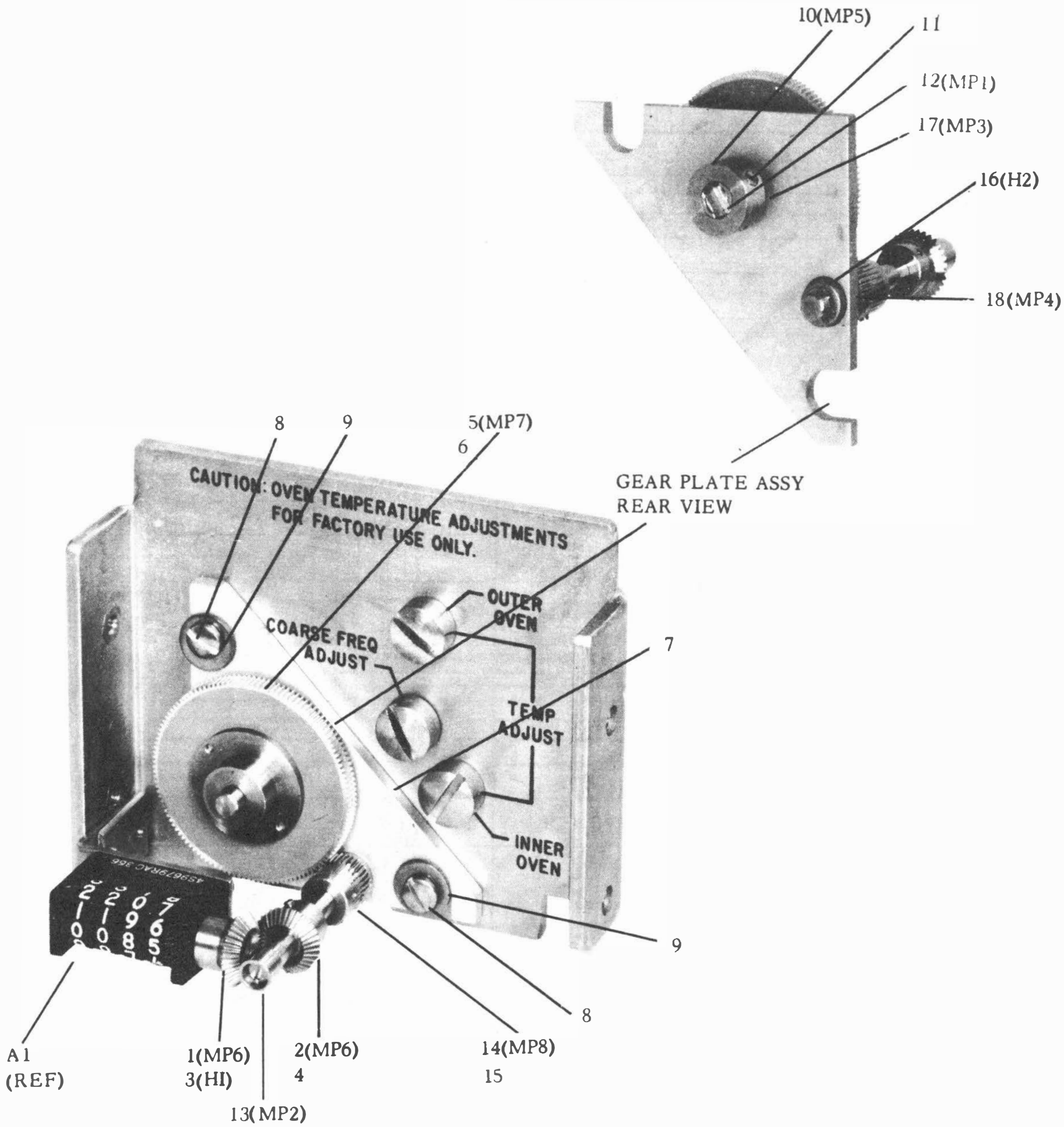


Figure 5-6. Gear Train Assembly.

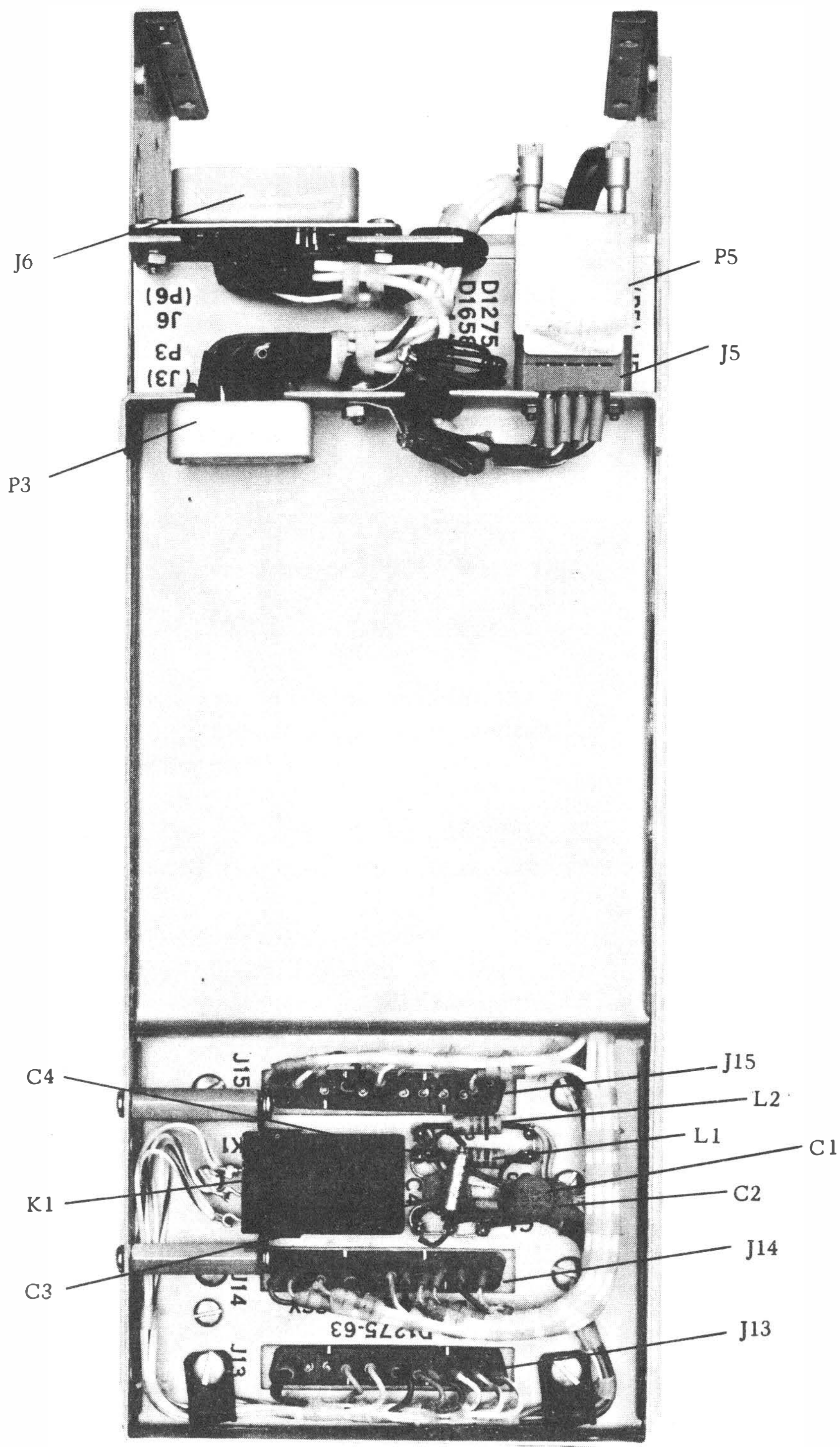


Figure 5-7. Bottom View Components Location, Oscillator Chassis Assembly.

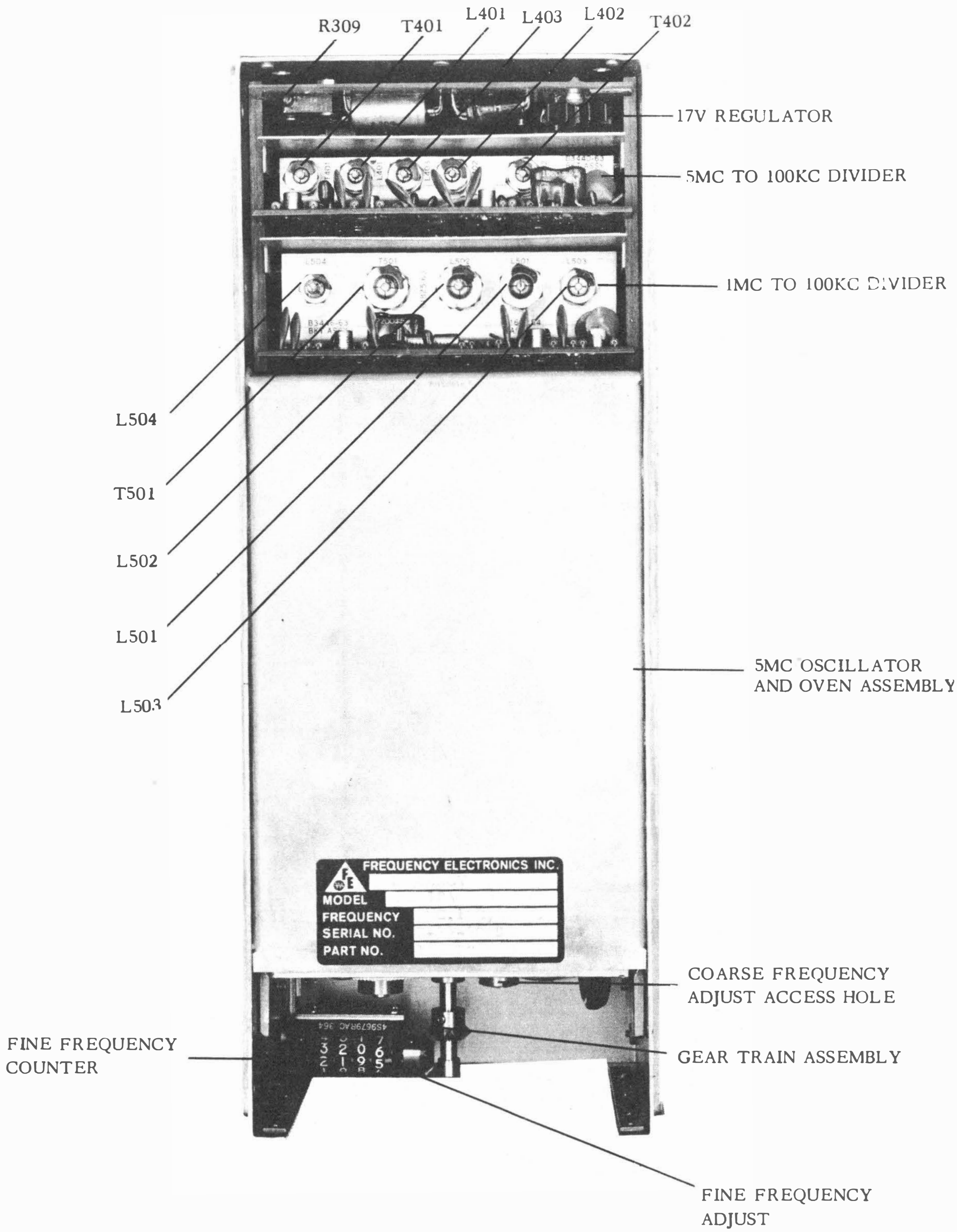


Figure 5-8. Oscillator Chassis Assembly, Components Location.

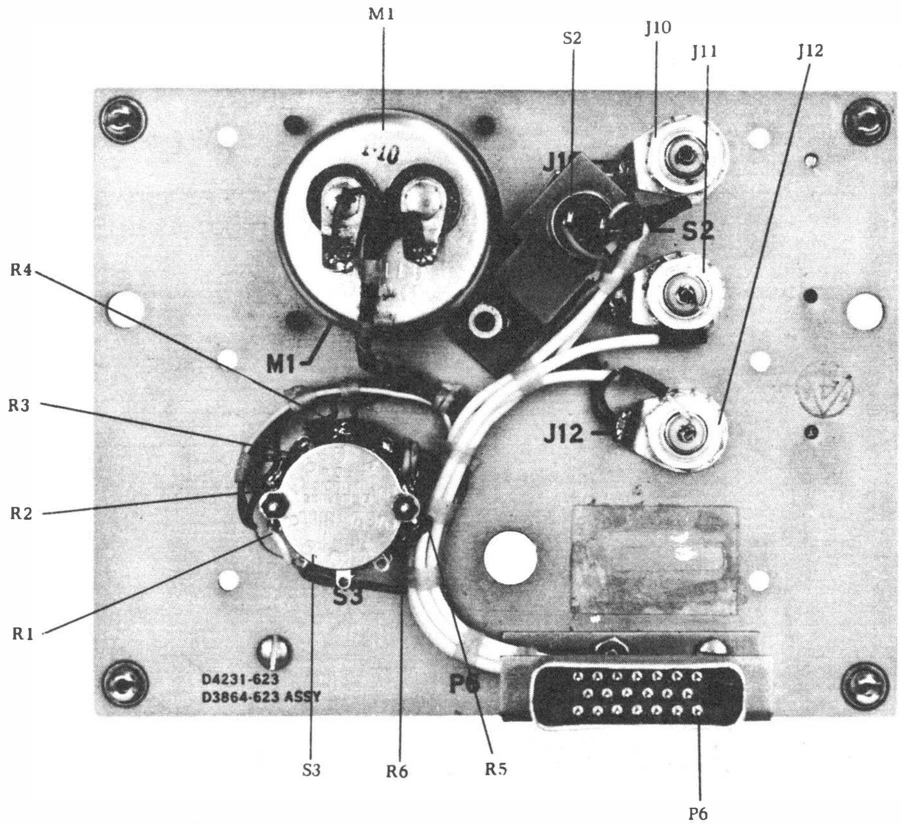


Figure 5-9. Frequency Oscillator Panel, Rear View, Components Location.

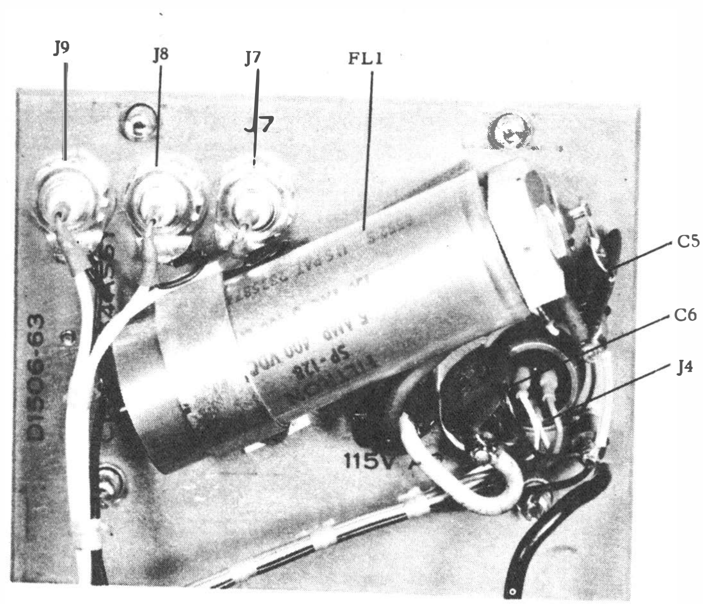


Figure 5-10. Housing Assembly Rear Panel View, Components Location.

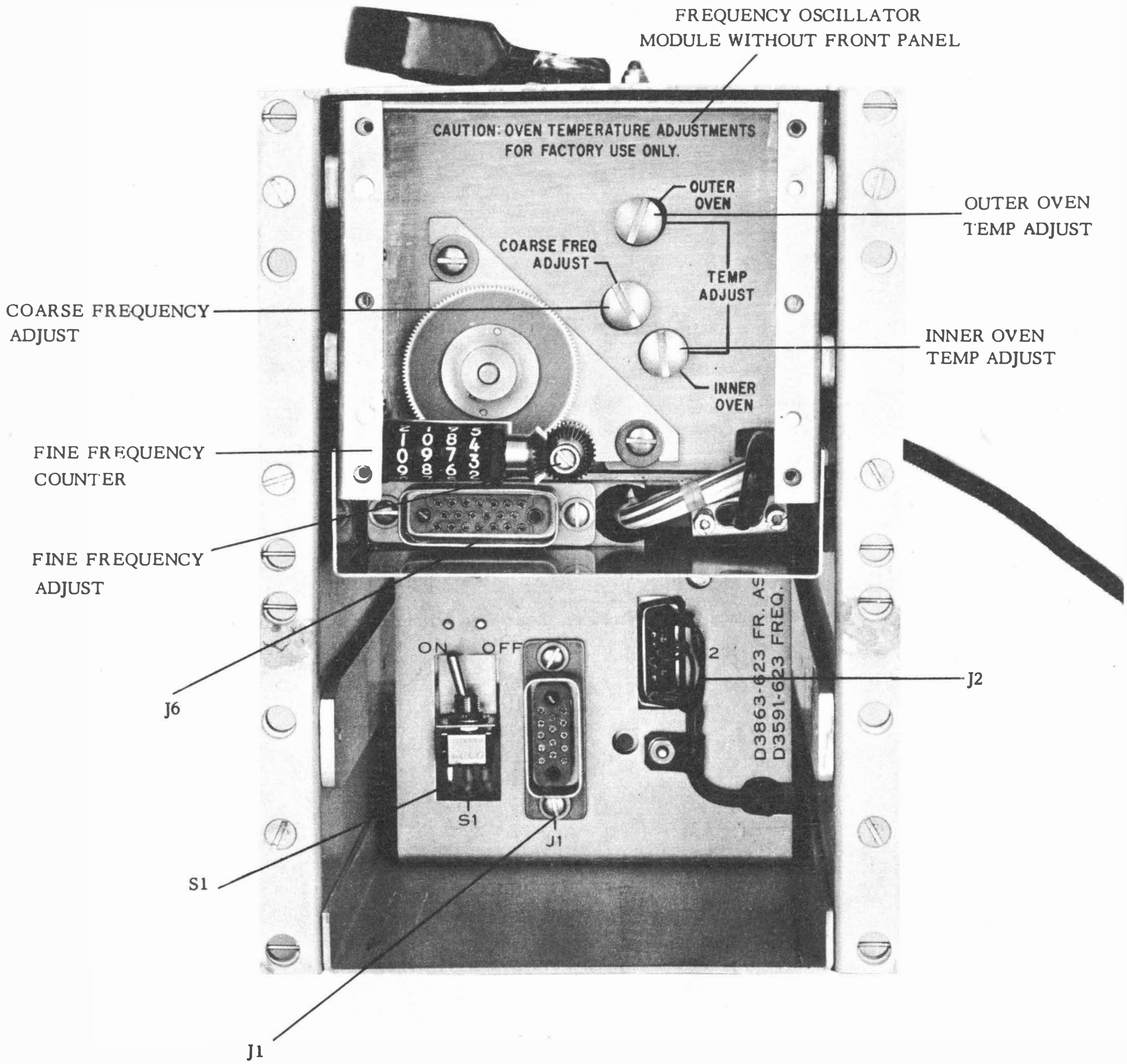
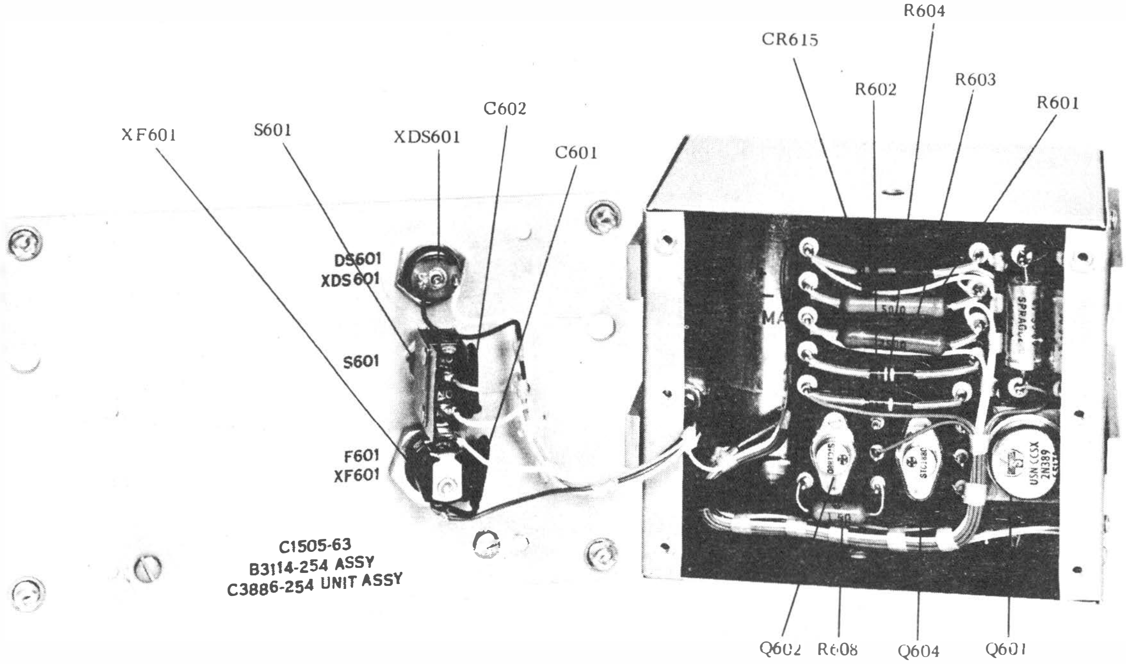


Figure 5-11. Frequency Standard AN/URQ-10A Housing,
Front Internal View- Power Supply Removed.



FRONT PANEL REAR VIEW

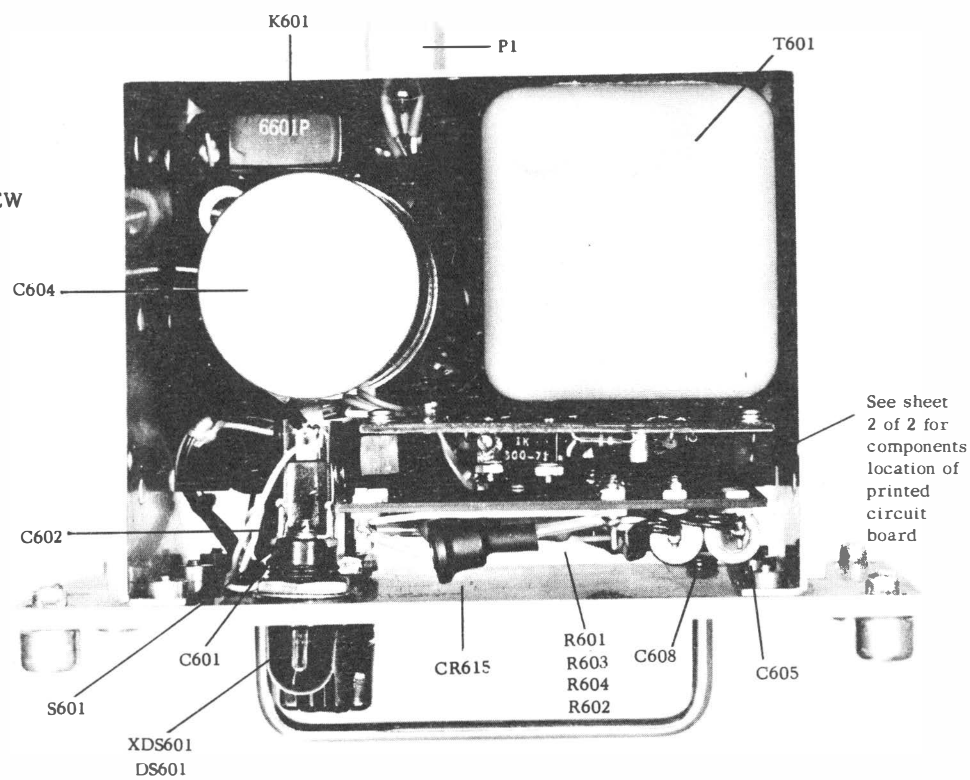
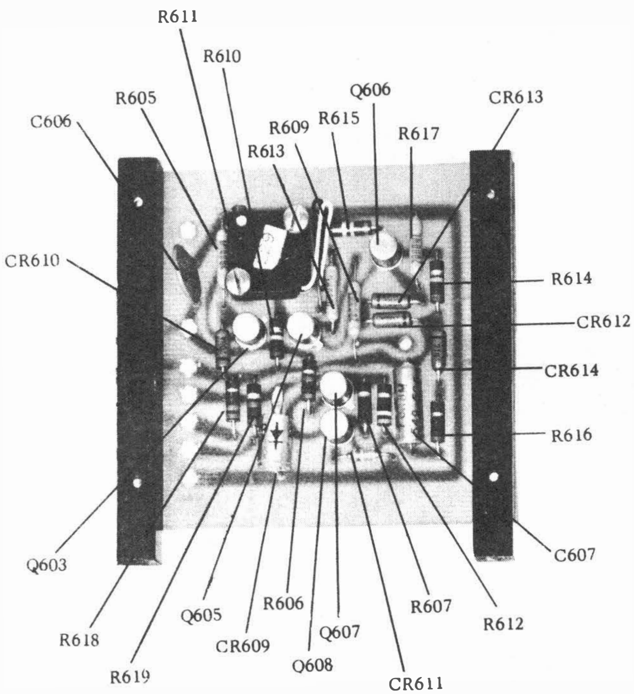
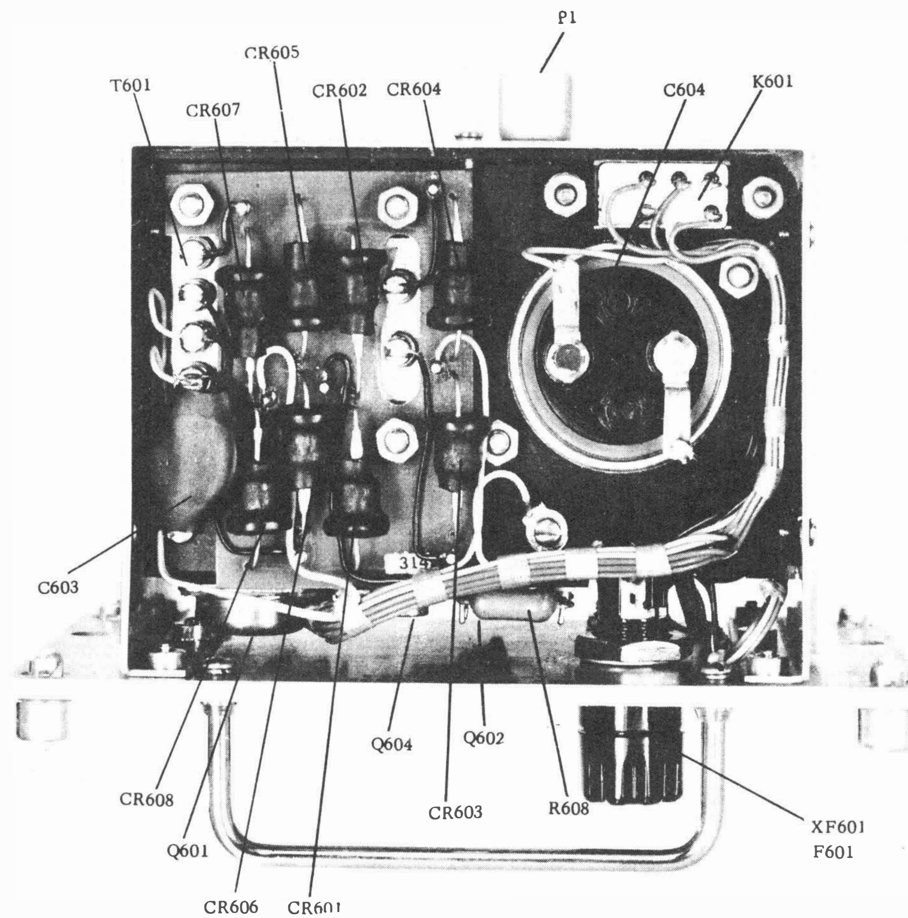


Figure 5-12. Power Supply Components Location (Sheet 1 of 2).



PRINTED CIRCUIT BOARD



BOTTOM VIEW

Figure 5-12. Power Supply Components Location (Sheet 2 of 2).

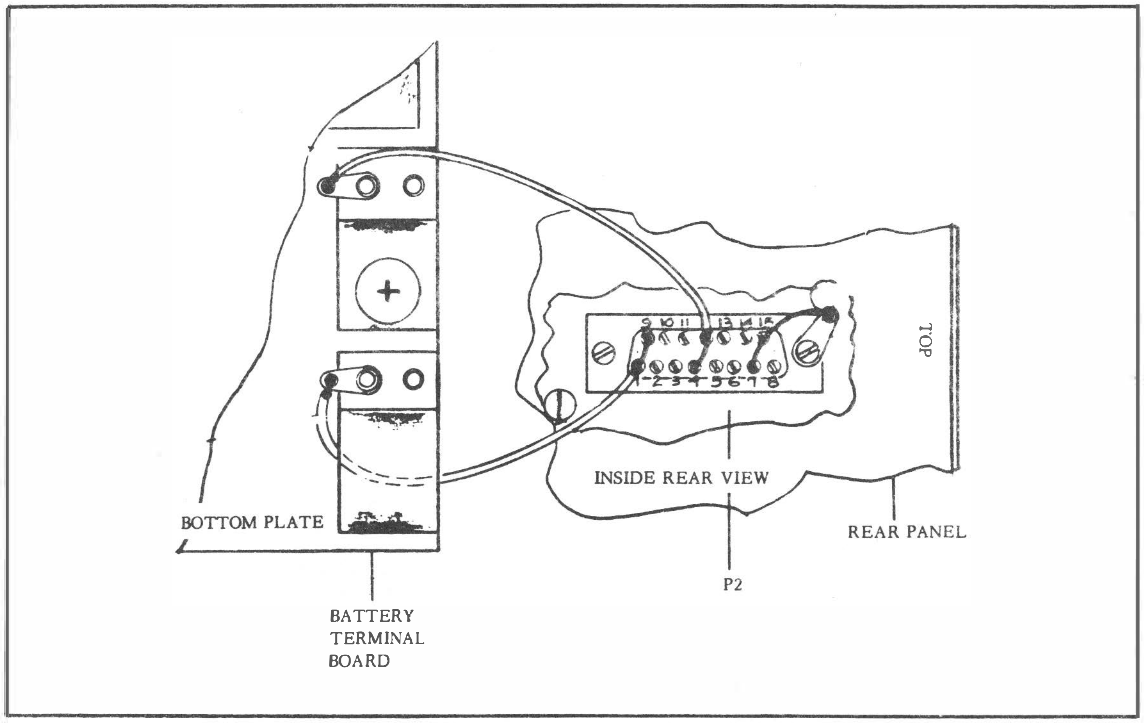


Figure 5-13. Battery Pack, Internal View - Wiring

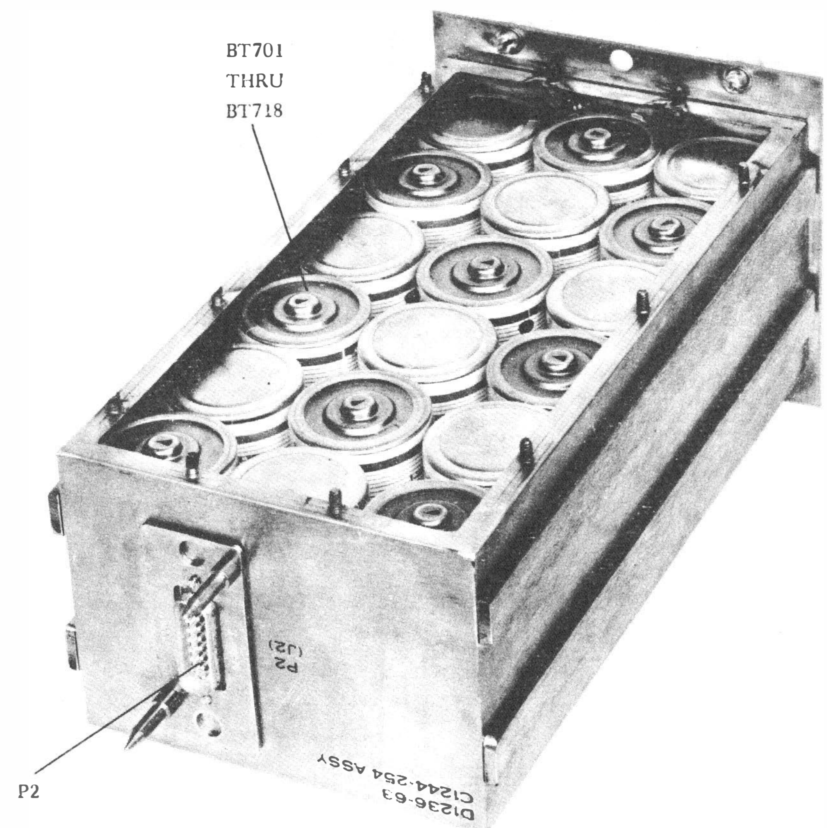


Figure 5-14. Battery Pack Components Location.

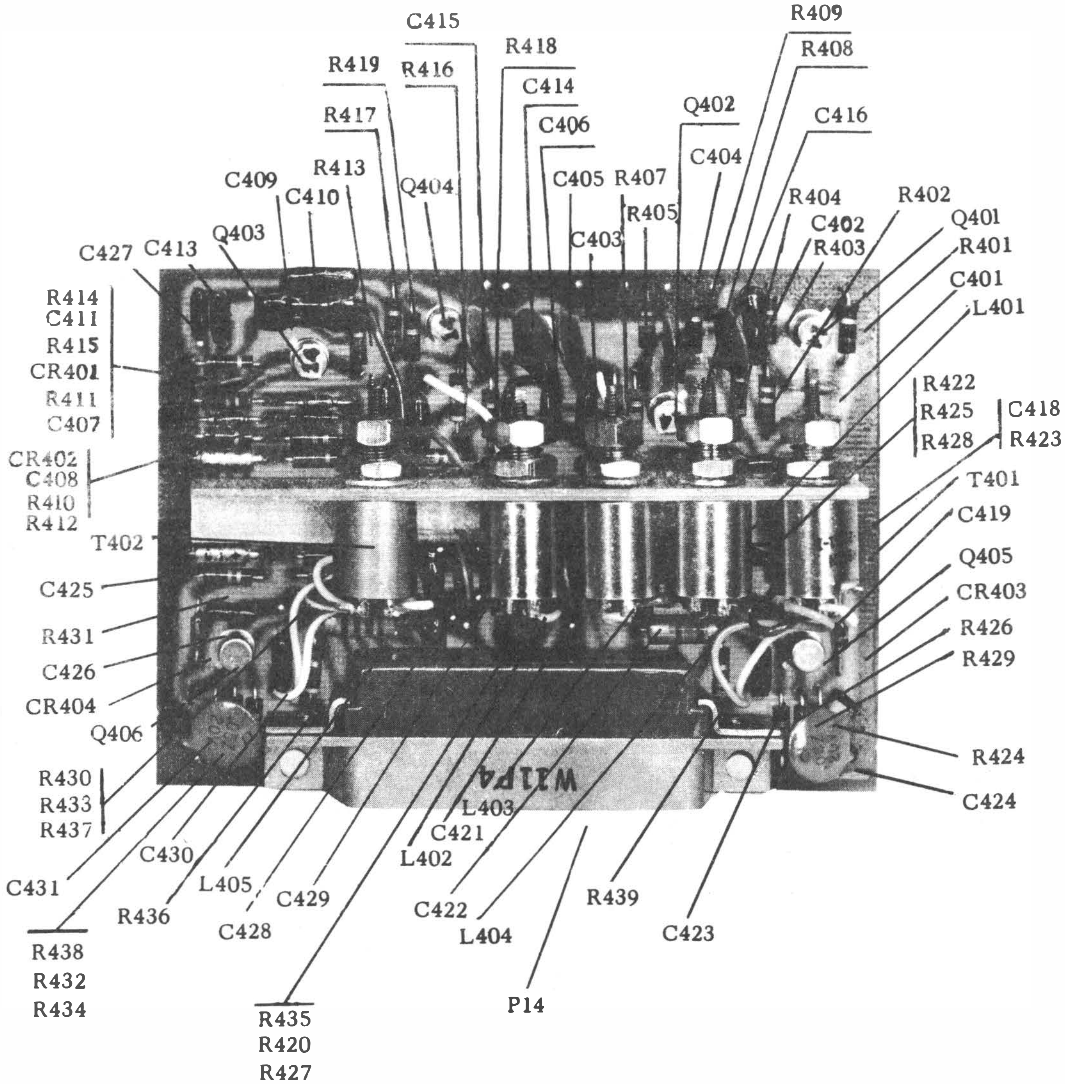


Figure 5-15. 5 MC To 1 MC Frequency Divider Components Location.

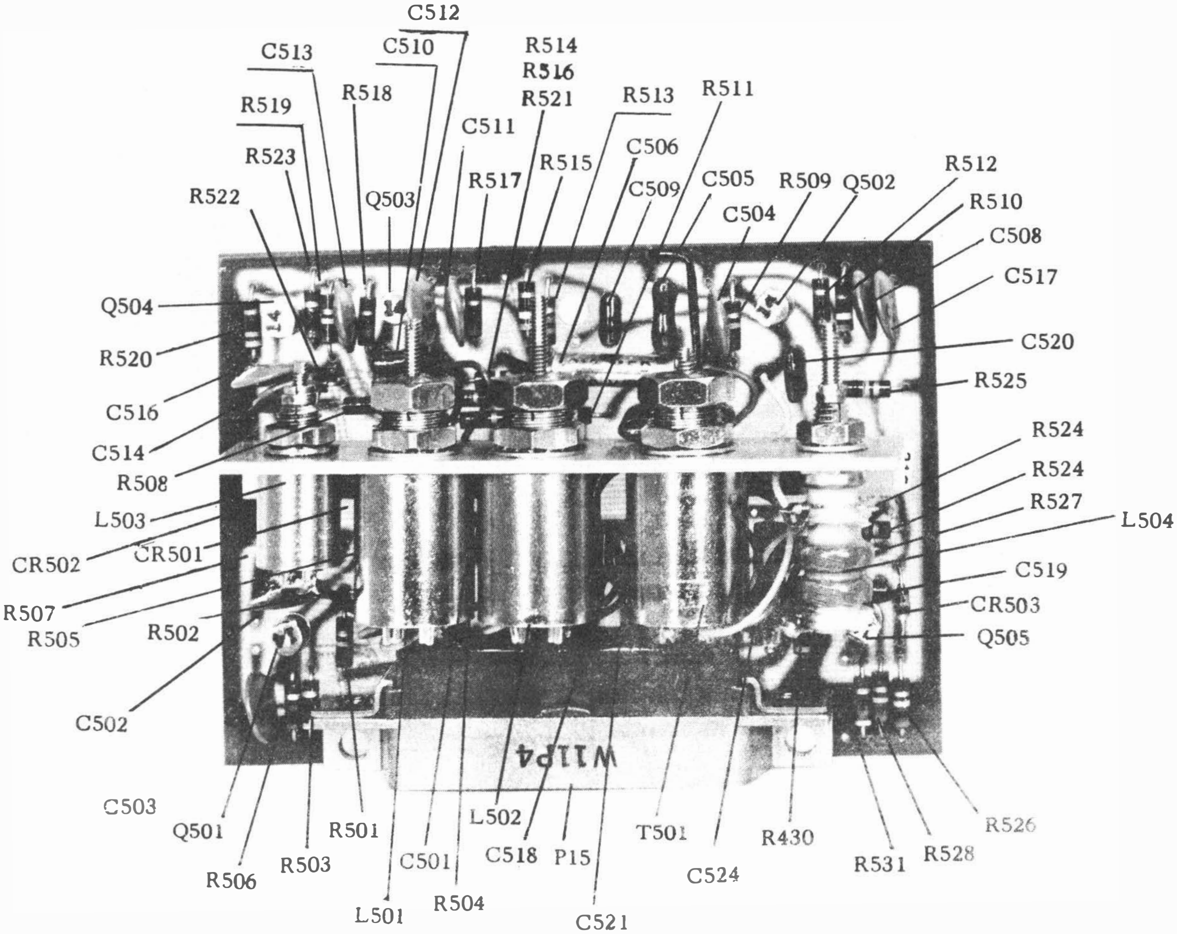


Figure 5-16. 1 MC To 100 KC Frequency Divider Components Location.

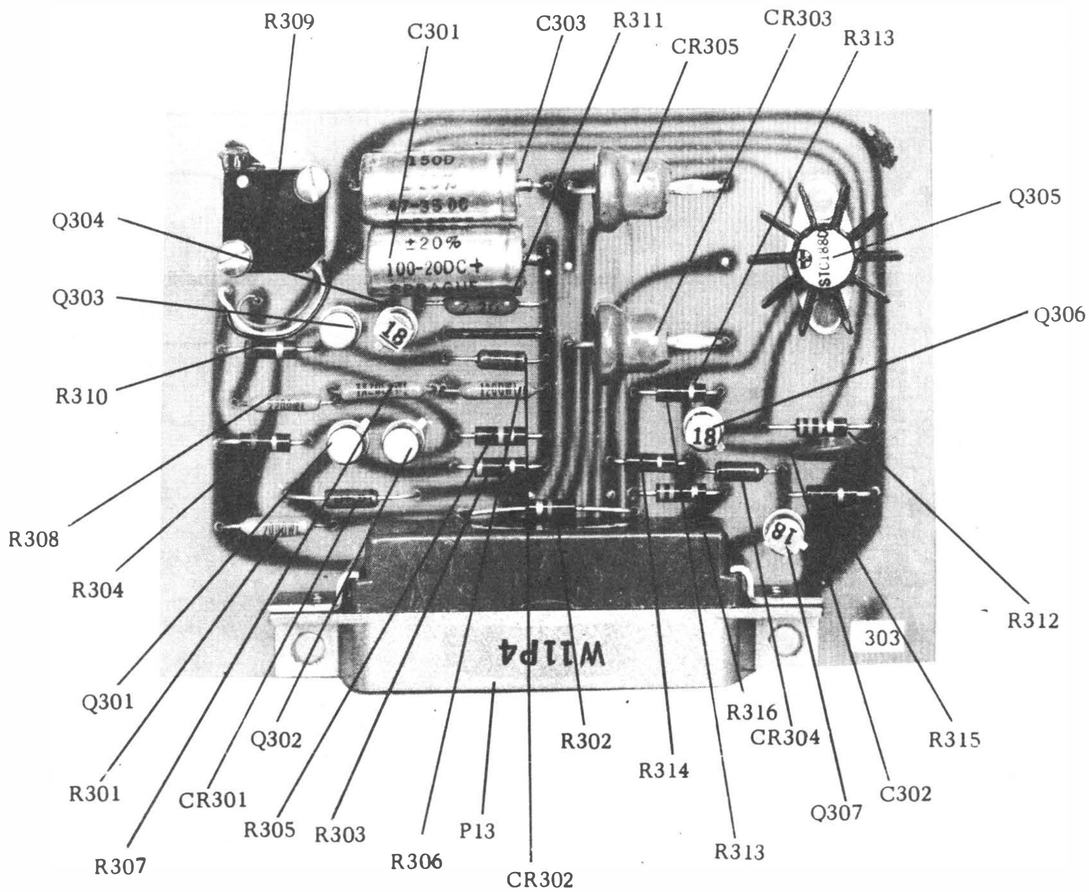


Figure 5-17. 17 Volt Regulator, Components Location.

SECTION 6

PARTS LIST

6-1. INTRODUCTION.

The block numbering method of assigning reference designation has been used to identify the various assemblies and subassemblies of the frequency standard. Block numbers are assigned as follows:

1 thru 99	INTERCONNECTING CABLE, PANEL, AND CHASSIS ASSEMBLIES
101 thru 199	5MC OSCILLATOR ASSEMBLY
201 thru 249	INNER OVEN TEMPERATURE CONTROL
251 thru 299	OUTER OVEN TEMPERATURE CONTROL.
501 thru 599	1 MC TO 100 KC FREQUENCY DIVIDER.
401 thru 499	5MC TO 1MC FREQUENCY DIVIDER.
301 thru 399	+ 17 VOLT REGULATOR.
601 thru 699	POWER SUPPLY.
701 thru 799	BATTERY POWER SUPPLY

6-2. LIST OF UNITS.

Table 6-1 is a list of units contained in Frequency Standard AN/URQ-10A. It includes official nomenclature and colloquial name for each unit.

6-3. MAINTENANCE PARTS LIST.

Table 6-2 lists all assemblies and subassemblies and their maintenance parts. These units are listed in numerical sequence as outlined in paragraph 6-1. Maintenance parts are listed immediately following the unit to which they apply. The following information is provided by Table 6-2: (1) the complete reference designation of each part, (2) reference to explanatory notes in paragraph 6-5, (3) noun name and brief description, and (4) the figure number of the illustration which will pictorially locate the part.

NOTE

A brief description is given for all keys parts (parts differing from any parts previously listed in Table 6-2) and sub-key parts (parts identical with a key part but appearing for the first time for a unit). The names and descriptions are omitted for other parts, but reference is made to the key or sub-key for the data.

6-4. LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The table includes the code numbers used in Table 6-2 to identify the manufacturers.

6-5. STOCK NUMBER IDENTIFICATION.

Allowance Parts Lists (APL's) issued by the Electronics Supply Office (ESO) include Federal Stock Number and Source Maintenance and Recoverability Codes. Therefore, reference should be made to the APL prepared for the equipment for stock numbering information.

6-6. NOTES.

The following note provides information as referenced in Table 6-2:

(1) The value given is approximate. The actual value is determined by manufacturer's final tests. For replacement, use same value as that removed unit.

TABLE 6-1. LIST OF UNITS

UNIT NO.	QTY.	NAME OF UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
1	1	OSCILLATOR RADIO FREQUENCY	0-1376/URQ-10A	FREQUENCY OSCILLATOR	0-1
2	1	POWER SUPPLY	PP-4624/URQ-10A	POWER SUPPLY	0-1
3	1	BATTERY POWER SUPPLY	BB-617/URQ-10A	BATTERY PACK	1-3

TABLE 6-2. MAINTENANCE PARTS LIST

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
		INTERCONNECTING CABLE, PANEL, AND CHASSIS ASSEMBLIES	
A1		COUNTER, ROTATING: Four wheel counter reading from 0000 to 0999: 14844 Part No. A1583-63B.	5-6
C1		CAPACITOR, FIXED, CERAMIC: .05 uf, +80 % - 20 % 20wvdc; 71590 Part No. UK-20-503	5-7
C2		Same as C1	5-7
C3		Same as C1	5-7
C4		CAPACITOR, FIXED TANTALUM: 6.8 uf, ± 20%, 35 wvdc; per MIL-C-26655 81349, Part No. CS13BF685M	5-7
C5		CAPACITOR, FIXED, CERAMIC, .02 uf, + 80% - 20%, 500 wvdc; 72982, Part No. 841-203P-Z5V	5-10
C6		Same as C5	5-10
FL1		FILTER. RADIO INTERFERENCE: hermetically sealed 0.5 amperes, 130 volts AC, 0 - 400 cps, -55°C to + 85°C; 81831, Part No. SP-128	5-10
H1		SCREW, SET: Cup point socket head, #2-56 thread, stainless steel: 00141 Part No. BE-1B	5-6
H2		RING, RETAINING: Flat, external basic type, maximum gaging diameter ring installed in groove 0.218 in; 79136 Part No. 5100-18	5-6
J1		CONNECTOR, RECEPTACLE, ELECTRIC; 14 Pins. Female, Per MIL-C-8384; 13550 Part No. SM14S20GD-MP	5-11
J2		CONNECTOR, RECEPTACLE, ELECTRIC: 15 Pin, Female: 71468, Part No. DAMF15S	5-11
J3		Same as J1	
J4		CONNECTOR, RECEPTACLE, ELECTRIC: 3 Pins, Male; 96906, Part No. MS3102R10SL-3P	5-10
J5		CONNECTOR, RECEPTACLE, ELECTRIC: 11 Pins, Female per MIL-C-8384; 13550, Part No. SM11S20FSL-GD	5-7
J6		CONNECTOR, RECEPTACLE, ELECTRIC: 20 Pins, Female, Per MIL-C-8384; 13550, Part No. SM20S20GD-P-MD	5-11
J7		CONNECTOR, RECEPTACLE, ELECTRIC: BNC Receptacle Per MIL-C-8384; 80058, Part No. UG-625B/U	5-10
J8		Same as J7	5-10
J9		Same as J7	5-10
J10		Same as J7	5-9

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
J11		Same as J7	5-9
J12		Same as J7	5-9
J13		CONNECTOR, RECEPTACLE, ELECTRIC: 11 Pins, Female; 81312, Part No. W11S	5-7
J14		Same as J13	5-7
J15		Same as J13	5-7
K1		RELAY, ARMATURE: Single pole-double throw (SPDT), 2.2 ma, 5000 OHMS; 70309, Part No. WJS-3D-2.2 MA	5-7
L1		COIL, RADIO FREQUENCY: 82 Microhenries, ± 5% iron core, 3.9 ohms DC resistance minimum; 99800, Part No. 1537-72	5-7
L2		Same as L1	5-7
MP1		SHAFT, PRECISION ASSY: Gear train coupler 3/16 in. diameter X 1 in. long, #303 stainless steel, passivate finish, .02x45° chamfer both ends; 14844 Part No. B1845-63A	5-6
MP2		SHAFT PRECISION ASSY: Fine frequency adjust, 3/16 in. diameter x 1-3/4 in. long, #303 stainless steel, passivate finish, .02x45° chamfer both ends; 14844 Part No. A1642-63B	5-6
MP3		BEARING, FLANGED, BRONZE: Oil-less, Type 1 Composition A per MIL-B-5687, 0.250 in. long, 0.188 in. I.D., 0.314 in. shaft O.D., 0.371 in. flange O.D.; 00141 Part No. B11-5	5-6
MP4		Same as MP3	
MP5		COLLAR, SET-SCREW: 0.250 in. long x 0.2498 I.D.X 0.5 in. O.D., #303 stainless steel, clear passivate finish supplied with #6-32 slotted head set screw; 00141 Part No. C1-3	5-6
MP6		GEAR, BEVEL: Set, 1:1 Ratio, stainless steel; 01351 Part No. MBG-21	5-6
MP7		GEAR, SOLID HUB: 80 pitch, 20° pressure angle, aluminum; 01351 Part No. 451-124/HA 187	5-6
MP8		GEAR, SPUR: 80 pitch, 20° pressure angle, #303 stainless steel, 31 teeth, 3/16 in bore, 0.3875 pitch diameter, 0.4125 in. O.D.; 01351 Part No. 455-31	5-6
P1		CONNECTOR, PLUG, ELECTRIC: 14 Pins, Male, Per MIL-C-8384; 13550, Part No. SM14P20GD-C	5-12
P2		CONNECTOR, PLUG, ELECTRIC: 15 Pins, Male, Guide Pin Plate, Male; 71468, Part No. DAH15P101	5-14
P3		Same as P1	5-7
P4		Not Used	
P5		CONNECTOR, PLUG, ELECTRIC: 14 Pins, Male, Per MIL-C-8384; 13550, Part No. SM11P20SKH-GD	5-7

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
P6		CONNECTOR PLUG, ELECTRIC: 20 Pins, Male, Per MIL-C-8384; 13550, Part No. SM20P20GD-C	5-9
P7		Not Used	
P8		Not Used	
P9		Not Used	
P10		Not Used	
P11		Not Used	
P12		Not Used	
P13		CONNECTOR, PLUG, ELECTRIC: 11 Pins, Male; 81312, Part No. W11P4	5-17
P14		Same as P13	5-15
P15		Same as P13	5-16
R1		RESISTOR, FIXED, COMPOSITION: 33,000 OHMS, ±10 %, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF333K	5-9
R2		RESISTOR, FIXED, COMPOSITION: 22,000 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF223K	5-9
R3		RESISTOR, FIXED, COMPOSITION: 56,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF563K	5-9
R4		RESISTOR, FIXED, COMPOSITION: 120,000 OHMS, ± 10 % 1/4 watt, Per MIL-R-11E, 81349 Part No. RC07GF124K	5-9
R5		RESISTOR, FIXED, COMPOSITION: 330,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF334K	5-9
R6		RESISTOR, FIXED, COMPOSITION: 470,000 OHMS ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF474K	5-9
S1		SWITCH, TOGGLE: DPDT; 95146, Part No. MST205N	5-11
S2		SWITCH, PUSH: 81073, Part No. 23-1	5-9
S3		SWITCH, ROTARY: 2 Deck, 9 Positions; 81073, Part No. 24802-9	5-9
		RADIO FREQUENCY OSCILLATOR 0-1376/URQ-10A	
A101		OSCILLATOR, CHASSIS ASSEMBLY: 14844, Part No. D1658-254	5-8
A102		OSCILLATOR, FRONT PANEL ASSEMBLY: 14844, Part No. D3864-623	5-9
		17 V REGULATOR	
C301		CAPACITOR, FIXED, TANTALUM· 100 uf, ± 10 %, 20 wvdc Per MIL-C-26655; 81349 Part No. CS13BE107K	5-17
C302		Same as C1	5-17

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C303		CAPACITOR, FIXED, TANTALUM: 47 uf, 35 wvdc Per MIL-C-26655; 81349, Part No. CS13BF476K	5-17
CR301		SEMICONDUCTOR, DEVICE, DIODE: 9.0 V ; 82260, Part No. IN938A	5-17
CR302		SEMICONDUCTOR, DEVICE, DIODE: 5.6 V 13480, Part No. IN708A	5-17
CR303		SEMICONDUCTOR, DEVICE, DIODE: 03508, Part No. IN538 JAN	5-17
CR304		SEMICONDUCTOR, DEVICE, DIODE: 15V ; 13480, Part No. IN718	5-17
CR305		Same as CR303	5-17
Q301		TRANSISTOR: 07263, Part No. 2N914	5-17
Q302		Same as Q301	5-17
Q303		Same as Q301	5-17
Q304		TRANSISTOR: 07263, Part No. 2N718	5-17
Q305		TRANSISTOR: 07256, Part No. STC1800	5-17
Q306		Same as Q304	5-17
Q307		Same as Q304	5-17
R301		RESISTOR, FIXED, WIRE WOUND: 2000 OHMS, ±5%, 1watt; 56289, Part No. 239E2025	5-17
R302		RESISTOR, FIXED, COMPOSITION: 22,000 OHMS, ±10 %, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF223K	5-17
R303		RESISTOR, FIXED, COMPOSITION: 4700 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF472K	5-17
R304		RESISTOR, FIXED, COMPOSITION: 5600 OHMS, ± 10 %, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF562K	5-17
R305		RESISTOR, FIXED, COMPOSITION: 10,000 OHMS, ± 10 %, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF103K	5-17
R306		RESISTOR, FIXED, WIRE WOUND: 1200 OHMS, ± 5 %, 1 watt; 56289 Part No. 239E1225	5-17
R307		Same As R301	5-17
R308		RESISTOR, FIXED, WIRE WOUND: 2200 OHMS, ± 5%, 1 watt; 56289, Part No. 239E2225	5-17
R309		RESISTOR, VARIABLE, WIRE WOUND: 1000 OHMS, ±5%,1 watt, 94271, Part No. 300-71-1K	5-17
R310		RESISTOR, FIXED, COMPOSITION: 1500 OHMS, ± 10% 1/4 watt; Per MIL-R-11E; 81349, Part No. RC07GF152K	5-17
R311		RESISTOR, FIXED, WIRE WOUND: 2.2. OHMS, ±5 % 1 watt; 56289, Part No. 239E2R25	5-17

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R312		Same as R1	5-17
R313		Same as R310	5-17
R314		Same as R304	5-17
R315		RESISTOR, FIXED, COMPOSITION: 2200 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF222K	5-17
R316		RESISTOR, FIXED, COMPOSITION: 3300 OHMS, ± 10%, 1/4 watt, Per MIL-R11E: 81349, Part No. RC07GF332K	5-17
		5MC TO 1MC FREQUENCY DIVIDER	
C401		CAPACITOR, FIXED, CERAMIC: .001 uf, ± 20%, 50 WVDC; 93958, Part No. 1E1000RM	
C402		CAPACITOR, FIXED, MICA: 1000 pf, ± 5 %, 500 WVDC; 84171 Part No. DM15F102J	5-15
C403		CAPACITOR, FIXED, MICA: 150pf, ± 5 %, 500 WVDC; 84171 Part No. DM10F151J	5-15
C404		Same as C1	5-15
C405		Same as C1	5-15
C406		CAPACITOR, FIXED, MICA: 22 pf, ± 5 %, 500 WVDC; 84171 Part No. DM10F220J	5-15
C407		CAPACITOR, FIXED, TANTALUM: 1.0 uf, ± 20%, 35 WVDC, 81349, Part No. CS13BF105M, per MIL-C-26655	5-15
C408		CAPACITOR, FIXED, MICA: 82 pf, ± 5%, 500 WVDC, 84171, Part No. DM10F820J	5-15
C409		CAPACITOR, FIXED, MICA: 1500 pf, ± 5%, 500 WVDC; 84171, Part No. DM19F152J	5-15
C410		CAPACITOR, FIXED, MICA: 680 pf, ± 5%, 500 WVDC; 84171, Part No. DM15F681J	5-15
C411		Same as C1	5-15
C412		CAPACITOR, FIXED, MICA: 27 pf, ± 5%, 500 WVDC; 84171, Part No. DM10F270J	5-15
C413		CAPACITOR, FIXED, MICA: 10 pf, ± 5%, 500 WVDC, 84171, Part No. DM10F100J	5-15
C414		Same as C1	
C415		Same as C1	
C416		Same as C1	

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C417	1	CAPACITOR, FIXED , MICA: 270 pf, ±5 %, 500 WVDC; 84171, Part No. DM10F271J	5-15
C418		Same as C407	5-15
C419		Same as C412	5-15
C420	1	Same as C406	5-15
C421		Same as C404	5-15
C422	1	Same as C417	5-15
C423	1	CAPACITOR, FIXED, MICA: 51 pf, ± 5 %, 500 WVDC; 84171, Part No. DM10F510J	5-15
C424		Same as C1	5-15
C425		Same as C407	5-15
C426		Same as C412	5-15
C427		CAPACITOR, FIXED, MICA: 39 pf, ±5%, 500 WVDC; 84171, Part No. DM10F390J	5-15
C428		Same as C409	5-15
C429		Same as C1	5-15
C430		CAPACITOR, FIXED, MICA: 330 pf, ± 5%, 500 WVDC 84171, Part No. DM10F331J	5-15
C431		Same as C1	
CR401		SEMICONDUCTOR, DEVICE, DIODE: 07263, Part No. IN914	5-15
CR402		Same as CR401	
CR403		Same as CR401	
CR404		Same as CR401	
L401		COIL, RADIO, FREQUENCY: Variable, Min. Inductance - 3.2 uh, Max. Inductance - 8.3 uh, Min. Q - 50, Max Q - 75 D.C. Ma - 50; 71279, Part No. 1505-4	5-15
L402		COIL, RADIO, FREQUENCY: Variable, Min. Inductance 30 uh, Max. Inductance - 73 uh, Min. Q - 25, Max. Q - 50, D.C. Ma - 50; 71279, Part No. 1505-7	5-15
L403		Same as L401	5-15
L404		COIL, RADIO, FREQUENCY: 18 uh, ± 5%, 1/4 watt, 2.25 OHMS DC resistance; 99800, Part No. 1537-42	5-15
L405		Same as L1	

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
Q401		Same as Q301	5-15
Q402		Same as Q301	5-15
Q403		Same as Q301	5-15
Q404		Same as Q301	5-15
Q405		Same as Q304	5-15
Q406		Same as Q304	5-15
R401		RESISTOR, FIXED, COMPOSITION: 56 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF560K	5-15
R402		RESISTOR, RIXED, COMPOSITION: 68,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF683K	5-15
R403		RESISTOR, FIXED, COMPOSITION: 15,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF153K	5-15
R404		Same as R316	5-15
R405		RESISTOR, FIXED, COMPOSITION: 47,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF473K	5-15
R406		Same as R305	5-15
R407		Same as R315	5-15
R408		RESISTOR, FIXED, COMPOSITION: 220 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF221K	5-15
R409		RESISTOR, FIXED COMPOSITION: 1000 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF102K	5-15
R410		Same as R3	5-15
R411		Same as R304	5-15
R412		Same as R409	5-15
R413		Same as R408	5-15
R414		Same as R409	5-15
R415		Same as R305	5-15
R416		Same as R405	5-15
R417		Same as R304	5-15
R418		RESISTOR, FIXED, COMPOSITION: 820 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF821K	5-15
R419		Same as R408	5-15
R420		RESISTOR, FIXED, COMPOSITION: 120 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF121K	5-15

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R421		Same as R305	5-15
R422		RESISTOR, FIXED, COMPOSITION: 27,000 OHMS, ±10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF273K	5-15
R423		Same as R305	5-15
R424		Same as R305	5-15
R425		Same as R3	5-15
R426		Same as R403	5-15
R427		RESISTOR, FIXED, COMPOSITION: 470 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E, 81349, Part No. RC07GF471K	5-15
R428		RESISTOR, FIXED COMPOSITION: 100 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No.RC07GF101K	5-15
R429		Same as R408	5-15
R430		RESISTOR, FIXED, COMPOSITION: 18,000 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349 , Part No. RC07GF183K	5-15
R431		Same as R305	5-15
R432		Same as R305	5-15
R433		Same as R305	5-15
R434		Same as R403	5-15
R435		Same as R427	5-15
R436		Same as R427	5-15
R437		Same as R428	5-15
R438		Same as R408	5-15
R439		RESISTOR, FIXED, COMPOSITION: 330 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF331K	5-15
T401		TRANSFORMER, RADIO, FREQUENCY: 98821, Part No. 5284	5-15
T402		TRANSFORMER, RADIO, FREQUENCY: 98821, Part No. 5285	5-15
		1MC TO 100KC FREQUENCY DIVIDER	
C501		Same as C1	5-16
C502		Same as C1	5-16
C503		Same as C1	5-16
C504		Same as C1	5-16

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
C505		Same as C402	5-16
C506		CAPACITOR, FIXED, FILM: .012 uf, ± 10%, 200 WVDC; 56289, Part No. 192P12392	5-16
C507		CAPACITOR, FIXED, MICA: 2200 pf, ± 5%, 500 WVDC; 84171, Part No. DM19F222J	5-16
C508		Same as C1	5-16
C509		CAPACITOR, FIXED, MICA: 220 pf, ± 5%, 500 WVDC: 84171, Part No. DM10F221J	5-16
C510		CAPACITOR, FIXED, MICA: 300 pf, ± 5%, 500 WVDC; 84171, Part No. DM10F301J	5-16
C511		Same as C1	5-16
C512		Same as C1	5-16
C513		Same as C1	5-16
C514		Same as C1	5-16
C515		Not Used	
C516		Same as C1	5-16
C517		Same as C1	5-16
C518		Same as C1	5-16
C519		Same as C1	5-16
C520		CAPACITOR, FIXED, MICA: 62 pf, ± 5%, 500 WVDC; 84171, Part No. DM10F620J	5-16
C521		CAPACITOR, FIXED, FILM: .015 uf, ± 10%, 200 WVDC, 56289, Part No. 192P15392	5-16
C522		Not Used	
C523		Not Used	
C524		Same as C506	
CR501		Same as CR401	5-16
CR502		Same as CR401	5-16
CR503		Same as CR401	5-16
L501		COIL, RADIO, FREQUENCY, VARIABLE: Min. Inductance - 175 uh, Max. Inductance - 300 uh, Q - 80; 98821, Part No. 1500B	5-16
L502		COIL, RADIO, FREQUENCY, VARIABLE: Min. Inductance - 800 uh, Max. Inductance - 1150 uh, Q - 55; 98821, Part No. 1500E	5-16
L503		COIL, RADIO, FREQUENCY, VARIABLE: Min. Inductance - 66 uh, Max. Inductance - 100 uh, Q - 70: 98821, Part No. 900J	5-16

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
L504		COIL, RADIO, FREQUENCY, VARIABLE: Min. Inductance - 185 uh, Max. Inductance - 305 uh, Q-85; 98821, Part No. 1000K	5-16
Q501		Same as Q301	5-16
Q502		Same as Q301	5-16
Q503		Same as Q301	5-16
Q504		Same as Q301	5-16
Q505		Same as Q304	5-16
R501		Same as R305	5-16
R502		Same as R3	5-16
R503		Same as R303	5-16
R504		Same as R310	5-16
R505		Same as R409	5-16
R506		Same as R420	5-16
R507		RESISTOR, FIXED, COMPOSITION: 560 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF561K	5-16
R508		Same as R401	5-16
R509		Same as R2	5-16
R510		RESISTOR, FIXED, COMPOSITION: 3900 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF392K	5-16
R511		RESISTOR, FIXED, COMPOSITION: 390 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF391K	5-16
R512		RESISTOR, FIXED, COMPOSITION: 1200 OHMS, ± 10%, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF122K	5-16
R513		Same as R507	5-16
R514		RESISTOR, FIXED, COMPOSITION: 100,000 OHMS, ± 10 %, 1/4 watt, Per MIL-R-11E 81349, Part No. RC07GF104K	5-16
R515		Same as R 510	
R516		RESISTOR, FIXED, COMPOSITION: 270 OHMS, 10%, 1/4 watt, per MIL-R-11E 81349, Part No. RC07GF271K	5-16
R517		Same as R512	5-16
R518		Same as R304	5-16
R519		Same as R4	5-16

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R520		Same as R316	5-16
R521		Same as R310	5-16
R522		RESISTOR, FIXED, COMPOSITION: 47 OHMS, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF470K	5-16
R523		Same as R409	5-16
R524		Same as R2	5-16
R525		Same as R305	5-16
R526		Same as R305	5-16
R527		Same as R3	5-16
R528		Same as R403	5-16
R529		RESISTOR, FIXED, COMPOSITION: 100 OHMS, ± 10 %, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF101K	5-16
R530		Same as R427	5-16
R531	1	Same as R 401	5-16
T501		TRANSFORMER RADIO FREQUENCY: 98821, Part No. 5286	5-16
		POWER SUPPLY PP-4624/URQ-10A	
C601		Same as C5	5-12
C602		Same as C5	5-12
C603		Same as C5	5-12
C604		CAPACITOR, FIXED, ELECTROLYTIC: 350uf, ± 20%, 50 WVDC, and Mounting Clamp; 76433, Part No. CE31C351G	5-12
C605		Same as C303	5-12
C606		Same as C1	5-12
C607		CAPACITOR, FIXED, TANTALUM: 6.8 uf ± 10%, 35 WVDC Per MIL-C-26655; 81349 Part No. CS13BF865K	5-12
C608		Same as C303	5-12
C609		Same as C401	
CR601		Same as CR303	5-12
CR602		Same as CR303	5-12
CR603		Same as CR303	5-12
CR604		Same as CR303	5-12
CR605		Same as CR303	5-12

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
CR606		Same as CR303	5-12
CR607		Same as CR303	5-12
CR608		Same as CR303	5-12
CR609		SEMICONDUCTOR DEVICE DIODE: Zener, 8.2V, ± 5%, 1 watt; 82260, Part No. IN3018B	5-12
CR610		Same as CR302	5-12
CR611		Same as CR401	5-12
CR612		Same as CR302	5-12
CR613		Same as CR302	5-12
CR614		Same as CR304	5-12
CR615		Same as CR303	5-12
DS601		LAMP, INCANDESCENT: 28 volts, 0.04 amperes; 08108, Part No. MS25237327	5-12
F601		FUSE, CARTRIDGE: 0.5A, 250 volts, 1/4 in. x 1 1/4 in.; 75915, Part No. 3133AG	5-12
K601		Same as K1	5-12
Q601		TRANSISTOR: 07256, Part No. 2N389	5-12
Q602		Same as Q305	5-12
Q603		Same as Q304	5-12
Q604		Same as Q305	5-12
Q605		Same as Q301	5-12
Q606		Same as Q301	5-12
Q607		Same as Q304	5-12
Q608		TRANSISTOR: 07263, Part No. S3619	5-12
R601		RESISTOR, FIXED, WIRE WOUND: 50 ohms ± 5%, 5 watts; 56289 Part No. 243E5005	5-12
R602		RESISTOR, FIXED, COMPOSITION: 2200 ohms ± 10%, 1/2 watt; Per MIL-R-11E, 81349, Part No. RC20GF222K	5-12
R603		RESISTOR, FIXED, WIRE WOUND: 250 ohms, ± 5%, 5 watts, 56289, Part No. 243E2515	5-12
R604		RESISTOR, FIXED, COMPOSITION: 27000 ohms ±10%, 1/2 watt, Per MIL-R-11E, 81349, Part No. RC20GF273K	5-12
R605		Same as R301	5-12

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
R606		Same as R529	5-12
R607		Same as R315	5-12
R608		RESISTOR, FIXED, WIRE WOUND: 1.5 ohm ±5 %, 1 watt; 56289, Part No. 239E1R55	5-12
R609		Same as R430	5-12
R610		Same as R301	5-12
R611		Same as R309	5-12
R612		Same as R510	5-12
R613		RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±10%, 1/4 watt; Per MIL-R-11E, 81349, Part No. RC07GF123K	5-12
R614		Same as R613	5-12
R615		Same as R403	5-12
R616		Same as R409	5-12
R617		Same as R301	5-12
R618		RESISTOR, FIXED, COMPOSITION: 6,800 ohms, 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF682K	5-12
R619		RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%; 1/4 watt, Per MIL-R-11E; 81349, Part No. RC07GF151K	5-12
S601		SWITCH, PUSH: With Red Nylon Actuator; 04426, Part No. 76-2222/404	5-12
T601		TRANSFORMER, POWER: Primary: 115V ± 10% VRMS, 50-400 CPS, 1 Φ. Secondary : (1) 34VRMS at 0.5A, (2) 12VRMS at .05A; 14844, Part No.A1270-63	5-12
XDS601		LAMP SOCKET: Red Lens, 1-3/32 in. x 5/8 in.; 08108, Part No. MS252566	5-12
XF601		FUSE HOLDER: 75915, Part No. 342004	5-12
		BATTERY POWER SUPPLY BB-617/URQ-10A	
BT701		BATTERY NICKEL CADMIUM: 55933, Part No. S103	5-14
BT702		Same as BT701	5-14
BT703		Same as BT701	5-14
BT704		Same as BT701	5-14
BT705		Same as BT701	5-14
BT706		Same as BT701	5-14
BT707		Same as BT701	5-14

TABLE 6-2. MAINTENANCE PARTS LIST (cont'd)

REF. DES.	NOTES	NAME AND DESCRIPTION	FIG. NO.
BT708		Same as BT701	5-14
BT709		Same as BT701	5-14
BT710		Same as BT701	5-14
BT711		Same as BT701	5-14
BT712		Same as BT701	5-14
BT713		Same as BT701	5-14
BT714		Same as BT701	5-14
BT715		Same as BT701	5-14
BT716		Same as BT701	5-14
BT717		Same as BT701	5-14
BT718		Same as BT701	5-14

TABLE 6-3. LIST OF MANUFACTURERS

MFR CODE	MANUFACTURER
00141	PIC Design Corp. East Rockaway, N.Y.
01121	ALLEN BRADLEY CO. Milwaukee, Wisconsin
01281	TRW Semiconductors, Inc. Lawndale, Calif.
01351	Dynamic Gear Corp. Amityville, N.Y.
01686	RCL Electronics Maplewood, N.J.
02606	FENWAL Electronics, Inc. Framingham, Mass.
02660	AMPHENOL-BORG Chicago, Ill.
02735	RCA Somerville, N.J.
03508	GENERAL ELECTRIC Co. Schenectady, N.Y.
04009	ARROW HART &Hegeman Elect.Co.. Hartford, Conn.
04426	LICON Division Chicago, Ill.
04713	MOTOROLA Semiconductor Prod. Phoenix, Ariz.
05397	UNION CARBIDE Corp. Cleveland, Ohio
05464	INDUSTRIAL Electronics Eng. Hollywood, Calif.
05720	OMARK Industries South Hackensack, N.J.

MFR CODE	MANUFACTURER
07256	SILICON Transistor Corp. Carle Place, N.Y.
07263	FAIRCHILD Semiconductor Mountain View, Calif.
07910	CONTINENTAL Device Corp. Hawthorne, Calif.
08988	SKOTTIE Electronics Inc. Peckville, Pa.
11453	PRECISION CONNECTORS Div. Danbury, Conn.
12323	PRESIN Co. Inc. Bridgeport, Conn.
13327	SOLITRON Devices Inc. Norwood, N.J.
13480	HUGHES Electronics Co. Los Angeles, Calif.
13550	ATLAS Connector Corporation S. El Monte, Calif.
14655	CORNELL DUBILIER Electronics Newark, N.J.
14844	FREQUENCY ELECTRONICS Inc. New Hyde Park, N.Y.
14869	RUSTRAK Instrument Co. Manchester, N.H.
15605	CUTLER HAMMER, Inc. Milwaukee, Wisconsin
15818	AMELCO Corporation Mountain View, Calif.
16179	OMNI-SPECTRA, Inc. Detroit, Mich.

TABLE 6-3. LIST OF MANUFACTURERS (con't'd)

MFR CODE	MANUFACTURER
16299	CORNING ELECTRONICS DIV. Raleigh, N.C.
16556	SPECTROL Electronics Corp. Plainview, N.Y.
18736	VOLTRONICS Corp. Hanover, N.J.
18909	BURNDY ESCON Pelham, N.Y.
20093	ELECTRICAL INDUSTRIES Murray Hill, N.J.
25244	CENTRALAB Electronics Div. Milwaukee, Wisconsin
48615	PRECISION RESISTOR Co. Inc. Hillside, N.J.
55933	SONOTONE Corporation Elmsford, N.Y.
56289	SPRAGUE ELECTRIC CO. N. Adams, Mass.
63743	WARD LEONARD Electric Co. Mt. Vernon. N.Y.
70309	ALLIED Control Co. Inc. New York, N.Y.
71034	BLILEY Electronics Co. Erie, Pa.
71279	CAMBRIDGE Thermionic Corp. Cambridge, Mass.
71400	BUSSMAN Mfg. Div. St. Louis, Mo.
71468	CANNON Mfg. Co. Inc. Placentia, Calif.
72619	DIALIGHT Corporation Brooklyn, N.Y.
72982	ERIE Resistor Corp. State College, Pa.
73899	JFD ELECTRONICS Corp. Brooklyn, N.Y.
74306	PIEZO Crystal Corp. Carlisle, Pa.
75915	LITTLEFUSE, Inc. Des Plaines, Ill.
76433	GENERAL INSTRUMENT Corp. Newark, N.J.
76493	J.W. MILLER Co. Los Angeles, Calif.
77342	POTTER & BRUMFIELD Princeton, Ind.
77820	BENDIX Corporation Sidney, N.Y.
79136	WALDES KOHINOOR Long Island City, N.Y.

MFR CODE	MANUFACTURER
80223	UNITED TRANSFORMER Corp. New York, N.Y.
80294	BOURNS, Inc. Riverside, Calif.
81073	GRAYHILL, Inc. La Grange, Ill.
81095	TRIAD Transformers Venice, Calif.
81312	WINCHESTER Electronics, Inc. Norwalk, Conn.
81483	INTERNATIONAL RECTIFIER Corp. El Segundo, Calif.
81831	FILTRON Co., Inc. Flushing, N.Y.
82260	HOFFMAN Electronics Corp. El Monte, Calif.
84171	ARCO Electronics, Inc. Great Neck, N.Y.
88978	PHILIPS Electronics , Inc. Mt. Vernon, N.Y.
90634	GULTON Industries, Inc. Metuchen, N.J.
91637	DALE ELECTRONICS Columbus, Nebraska
91662	ELCO Corporation Willow Grove, Pa.
91812	JANCO Corp. Burbank, Calif.
91836	KINGS Electronics Co. Tuckahoe, N.Y.
93332	SYLVANIA Woburn, Mass.
93958	MUCON Corporation Newark, N.J.
94271	DAYSTROM Potentiometer Div. Archibald, Pa.
94916	WACLINE, Inc. Dayton, Ohio
95275	VITRAMON , Inc. Bridgeport, Conn.
95598	PHILMORE Manufacturing Co. Richmond Hill, N.Y.
96214	TEXAS INSTRUMENTS, Inc. Dallas, Texas
99800	DELAVAN Electronics Corp. E. Aurora, N.Y.
98821	NORTH HILL Electronics , Inc. Glen Cove, N.Y.

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