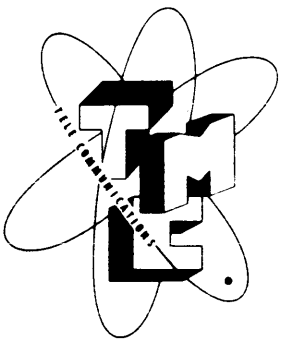
NAVSHIPS 92763 UNCLASSIFIED

INSTRUCTION BOOK

for

PORTABLE MASTER OSCILLATOR MODEL PMO

O-459/URT OSCILLATOR RADIO FREQUENCY



THE TECHNICAL MATERIEL CORPORATION
Mamaroneck, New York

22 JUNE 1956

Correction Notice for Instruction Manual

NAVSHIPS 92763

Errata:

Make pen and ink changes to manuals accompanying all Models PMO-1 with TMC serial numbers above #565 and all Models PMO-2 with TMC serial numbers above #560.

Page	Symbol	Action
1-3	V301	Change 6CL4 to 6ABL4
5-8	V301	Change 6CL4 to 6ABL4
5-9	V301	Change 6CL4 to 6ABL4
5-11	V301	Change 6CL4 to 6ABL4

Illustration Fig.	Symbol	Action
2-1	V301	Change 6CL4 to 6ABL4
2-2	V301	Change 6CL4 to 6ABL4
4-4	V301	Change 6CL4 to 6ABL4

Stock Number Cross Reference	Symbol	Action
1	V301	Change *MIL-T-05624-0055 to MS960-262-0190

Stock Number Identification Page	Symbol	Action
3	V301	Change *MIL-T-05624-0055 to MS960-262-0190

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SECTION I
GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES

The TMC Portable Master Oscillator, Model PMO, is a precision, direct-reading variable device, combining the best electrical characteristics of a highly stable master oscillator, with the compactness and convenient size of conventional portable units.

The Model PMO may be used to perform three important functions:

A. Transmitter Exciter

B. Frequency Meter

C. Source of 100 Kcs for Receiver calibration.

The Model PMO utilizes an accurate mechanical counter-dial system, similar to that used in the TMC Model VOX, Variable Frequency Oscillator. The frequency determining elements are contained in a cast, temperature-controlled oven. The oven assembly contains a large mass of metal and insulating material distributed through its cross section, which produces a high heat inertia with extremely stable oven temperature.

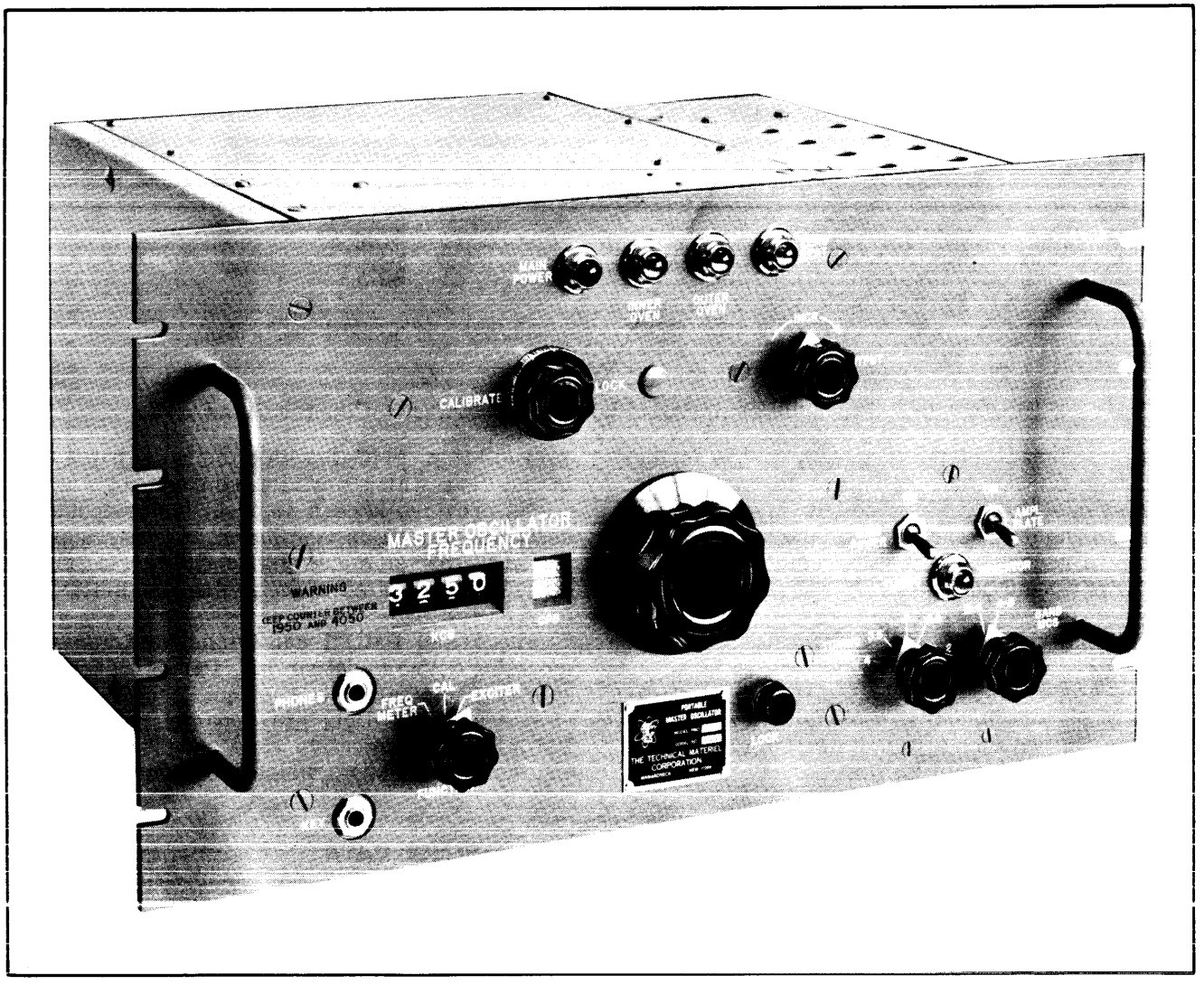

Figure 1-1. Panel Controls, Model PMO-2. (O-459/URT)

Figure 1-2. Portable Master Oscillator, Model PMO , Counter Close-up.

The accuracy of the frequency dial is further improved by internal facilities for calibration against 50 Kc oven-controlled crystal check points. The end result is an instrument of laboratory fineness with the convenience and simplicity of a field unit.

2. DESCRIPTION OF THE UNIT

The Model PMO is electrically and operationally manufactured as a single item, but is provided in two forms to suit certain mechanical requirements, as follows:

A. Model PMO-1, mounted within a fiber-glass reinforced plastic protective case, with carrying handle; 18" wide x 16" deep x 12" high, overall.

B. Model PMO-2, for standard 19" rack mounting, 10-1/2" high x 13" deep.

C. Model PMO-3, 19" x 10-1/2" x 13" mounted in desk type cabinet.

The Model PMO-1, within the case, has a door in the rear which permits removal of vacuum tubes, provides access to input and output connections, as well as ventilation. It is particularly suited for portable use and is easily closed and carried as indicated in the photograph below.

The Model PMO-1 can be adapted for rack mounting with an adapter kit, Part A-804, available at a nominal cost. The equipment is finished in standard TMC light gray enamel. The Model PMO-1, with protective case weighs 58 pounds, and the Model PMO-2 weighs 48 pounds.

3. REFERENCE DATA

FREQUENCY RANGE:
2 to 8 Mcs., continuously variable.

OUTPUT IMPEDANCE:
70 ohms coaxial.

OUTPUT POWER:
Continuously adjustable to at least 3 watts.

OUTPUT CONNECTIONS:
BNC (RG-58, 59/U) coaxial connectors

OUTPUT VOLTAGE:
Sinusoidal.

STABILITY:
20 cycles per megacycle for a 30° change in ambient.

CALIBRATION:
Direct reading in cycles, 2 to 4 Mcs.

RESETABILITY:
30 cycles per megacycle to a previously calibrated frequency.

CALIBRATE ADJUST:
Against 50 Kc check points.

KEYING INPUT:
Provision for On/Off keying through front panel jack, or terminal board on rear panel.

LINE VOLTAGE CHANGE:
Not more than 10 cps for ±10% over the basic range of the unit.

CONTROLS:

Primary power switch	Function Switch
Output Control	Dial Lock
PA Tuning Control	Ampl. Plate Switch
Calibrate Control, w/stops	Bandswitch 2-4, 4-8 Mcs.

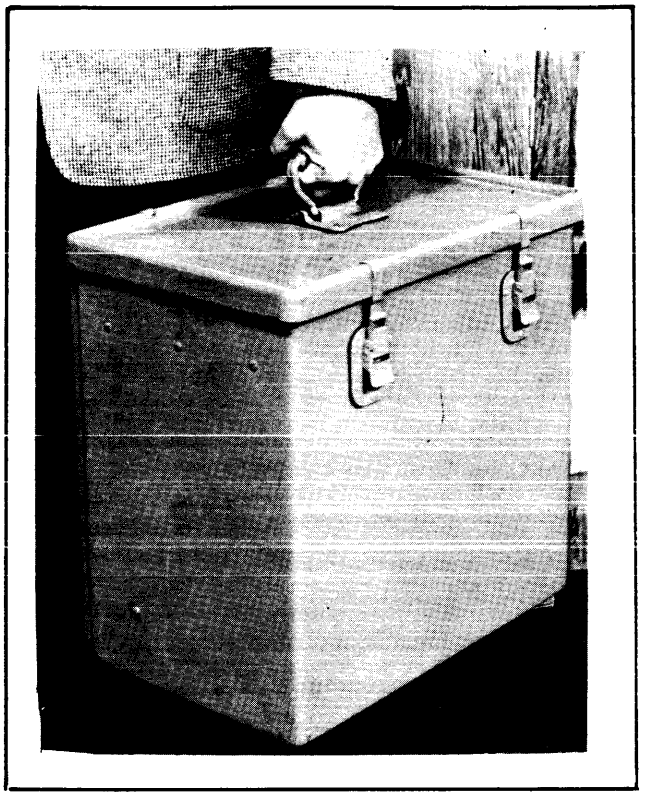

Figure 1-3. Portable Master Oscillator, in Carrying Case.

POWER REQUIREMENT:
110/220 volts, 50/60 cps, 80 watts average, 220 watts at momentary intervals as ovens cycle.

4. TUBE COMPLEMENT

All JAN type miniature or octal.

Symbol	Type	Circuit
V-101	5Y3GT	High Voltage Rectifier
V-102	OA2	Voltage Regulator
V-201	6AH6	RF Amplifier
V-202	6AQ5	RF Amplifier
V-203	6BE6	Mixer
V-204	12AU7	Audio Amplifier
V-301	6C4	VMO
V-302		
V-302	12AU7	Cathode Follower
R-102	4HTF4	Filament Ballast

Components and Construction:
Equipment is manufactured in accordance with JAN/MIL Specifications wherever practicable.

SECTION II
THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS

A. THE OVEN AND OVEN ENCLOSED ELEMENTS:

(1). The Master Oscillator (V301)

In the following discussion, a constant reference to Figure 2-1 which is a block diagram of the Model PMO, will serve to illustrate how the various stages are functionally interconnected.

The Master Oscillator has been designed and is constructed mechanically and electrically with careful regard to those perameters which are necessary to a highly stable device. A prime consideration in its design was temperature coefficient compensation, however, the additional refinement of enclosing virtually the total oscillator unit in a double oven serves to greatly widen the service for which the device may be used. In addition, to compensate for the extreme variations in line voltage frequently encountered in portable service, both plate and filament voltages are regulated before entering the oven.

(2). The Cathode Follower (V302A)

In order to isolate the master oscillator from any external devices which may possibly influence its frequency, a cathode follower has been interposed in its output circuit.

(3). The 100 Kcs. Oscillator (V302B)

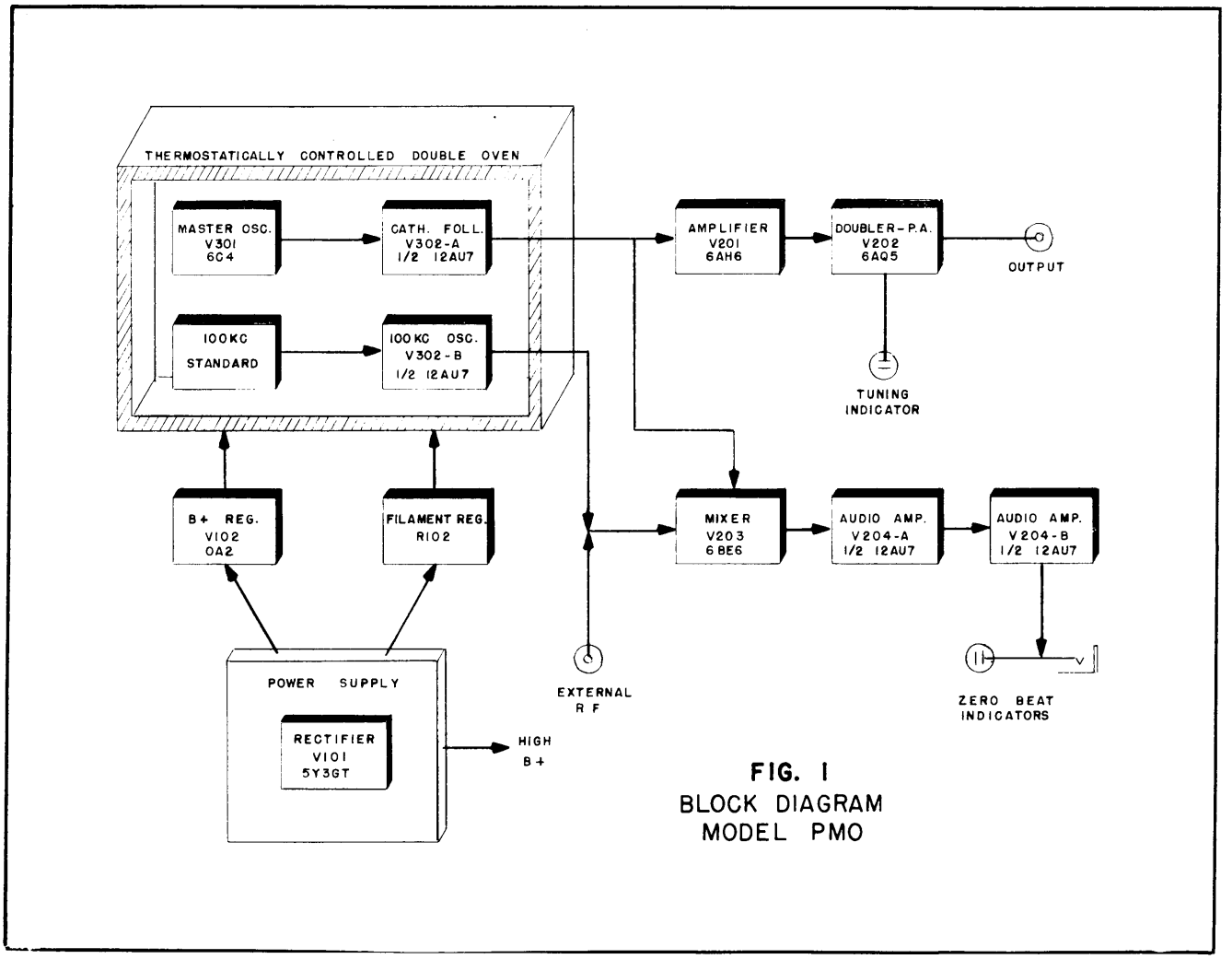

FIG. 1
BLOCK DIAGRAM
MODEL PMO

Figure 2-1. Block Diagram.

The 100 Kcs. Oscillator is a crystal controlled device of extreme long term stability. Since it is utilized to calibrate the master oscillator, the need for such stability is apparent and justifies the many steps which were taken to ensure its remaining on frequency. For this reason, it is also enclosed within the oven and is supplied with regulated filament and plate voltages.

(4). The Oven

The oven itself is composed of an inner and outer shell, each of which is a temperature controlled entity in itself. The outer shell is maintained, within small limits, at a given temperature by the combination of S303, which is a bimetallic temperature sensitive switch, and the heating blankets R308A and R308B. The inner shell is a vernier, so to speak, on the outer shell. R307A and R307B, the inner shell heating blankets, are controlled by an accurate bimetallic thermostat (S301). The entire assembly contains a large mass of metal and insulating materials, distributed through its cross section so that its heat inertia is high and, consequently, its temperature is extremely stable.

B. THE R.F. AMPLIFIER CHAIN:

(1). The R.F. Amplifier (V201)

The R.F. Amplifier is a broad banded device whose purpose is to voltage amplify the cathode follower output to the point where sufficient drive is obtained for the doubler-power amplifier.

(2). The Doubler-Power Amplifier (V202)

It is the purpose of this stage to convert the energy from the preceeding voltage source into a power of usable magnitude and at an impedance which approximates that of a coaxial R.F. cable.

C. THE MIXER-AUDIO AMPLIFIER CHAIN

(1). The Mixer (V203)

It is the purpose of this stage to combine an appropriate harmonic of the 100 Kcs. oscillator with the master oscillator output to produce difference products.

The output of the mixer is then passed through a low pass filter so that only when the two signals are within audio frequency range of each other is a voltage output obtained from this stage.

(2). The Audio Amplifiers (V204A, V204B)

The audio amplifiers are resistance coupled stages having good low frequency response. This characteristic, when combined with the glow discharge out-put indicator, results in a system capable of displaying frequency differences down to a cycle per second.

D. THE POWER SUPPLY

(1). The power supply serves as a source of B+ and filament voltages, both regulated and unregulated.

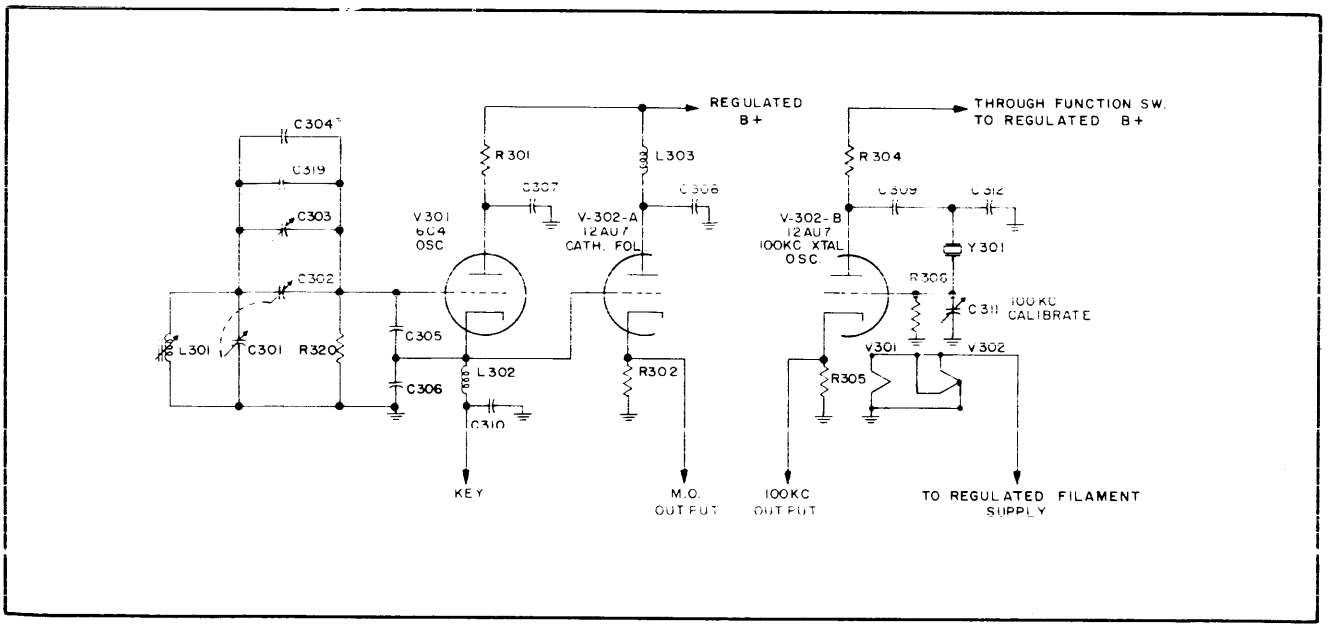

Figure 2-2. The Oven Enclosed Elements.

2. CIRCUIT ANALYSIS:

A. THE OVEN AND OVEN-ENCLOSED ELEMENTS

(1). The Master Oscillator

From observation of Figure, 2-2, it is apparent that the master oscillator is a specially designed oscillator circuit. The resonant frequency, variable from two to four Mcs, is almost totally determined by the parallel combination of L301 and C301; both of these components having been designed and manufactured with extreme care.

By means of the "slug" within L301 this resonant frequency may be slightly altered so that the oscillator is precisely set at each 100 Kcs. interval against the internal standard. However, some device must be employed to automatically alter the main tuning condenser (C301) calibration so the frequencies between check points are accurately set according to a predetermined curve. A special and unique mechanical coupling, in conjunction with the trimmer condenser C302, serves this purpose. C303 is used as a trimmer to adjust the oscillator at its high frequency extreme while C304 and C319 are special compensating condensers which serve to make the unit as insensitive to temperature change as is possible. C 305 and C306 couple the oscillator tube into the resonant circuit and determine the degree of feedback. R320 is the grid leak which established an operating bias for the stage. The load impedance is formed by L302 whose "cold" end is maintained at R.F. ground potential by C310. The presence of C310 prevents R.F. leakage through the keying lead and also isolates distributed capacitance and inductance in the keying leads from the oscillator circuit. C307 places the plate at R.F. ground potential and also, in conjunction with R301, serves to decouple the oscillator from the power supply. Keying is accomplished by lifting the cathode lead from ground. This action, however, is not a disrupting influence because the oscillator tube continues to draw current through the cathode follower grid. Only enough bias is established in this manner to interrupt oscillation.

(2). The Cathode Follower (V302A)

The cathode follower is very simple in its construction. C308 serves as a plate R.F. grounding device and, in conjunction with L303, effective decoupling from the power supply is obtained.

R302 is the load resistor across which an output voltage appears.

(3). The 100 Kcs. Oscillator (V302B)

The calibrating oscillator utilizes a highly stable crystal as a resonant circuit in the feedback path between grid and plate. The ratio of C309 and C312 determines the degree of feedback obtained from across the plate load resistor R304. A form of cathode follower action is obtained, however, by placing another load resistor

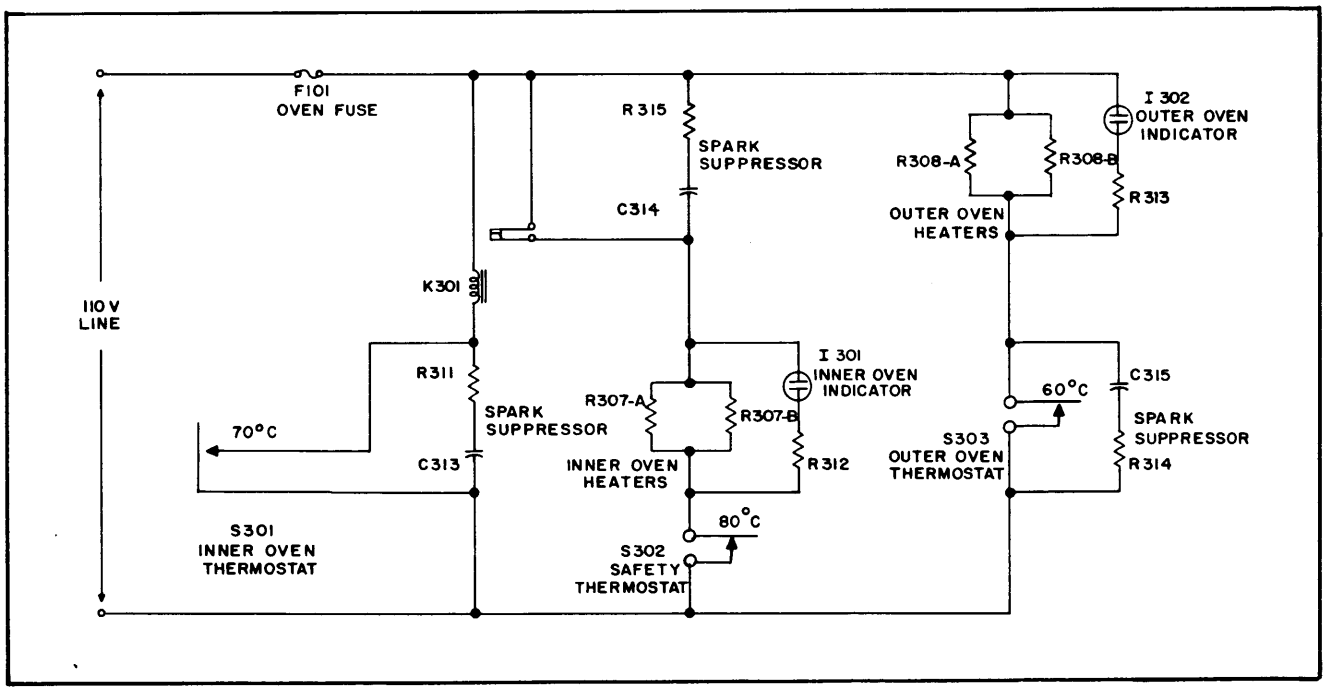

Figure 2-3. Oven Wiring, 110 V. Connection.

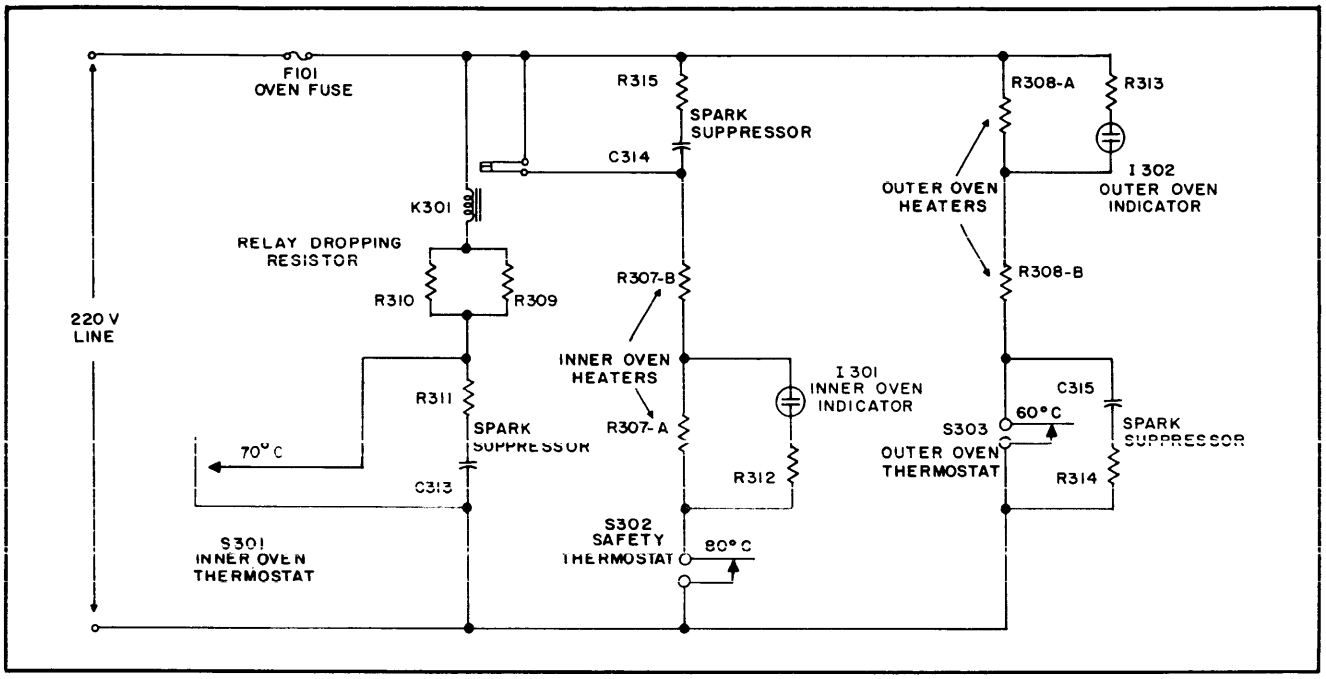

Figure 2-4. Oven Wiring, 220 V. Connection.

(R305) in the cathode circuit and using the voltage appearing there for output purposes. The grid leak bias is obtained from R306 and a precise adjustment of the crystal frequency against some primary standard is made by means of C311.

(4). The Oven

The function of the various components associated with oven operation is made clear by means of Figures 2-3 and 2-4. It must be understood that the inner and outer ovens function electrically independent of each other. They will, of course, effect one another thermally and this will manifest itself in the duty cycle (ratio of on time to off time).

Referring to Figure 2-3, it will be noticed that all cycling contacts are covered by spark suppressors such as R311 and C313. The inner oven heaters are controlled by relay K301 which is, in turn, controlled by the inner oven thermostat S301. When the temperature rises sufficiently (to 70°C) the thermostat closes. This energizes K301 which removes the line voltage from the inner oven heaters and permits the oven to start its downward cycle. Because of the fine construction of S301 the total excursion in temperature is minute. As an added precaution, S302-the inner oven safety thermostat, has been connected in such a manner that an excessive rise in temperature due to a faulty thermostat will never take place. If, by such an accident, the temperature starts to rise, S302 will commence to cycle before damage can be done.

The outer oven assumes the brunt of the heating burden when large ambient temperature changes take place. The heating blanket in this case is controlled by one bi-metallic thermostat, S303.

The underlying principle of operation remains the same for a 220 volt input (Figure 2-4), however, the heaters are arranged in series in this case and an additional dropping resistor (R310 and R309) is used for the relay.

B. THE R.F. AMPLIFIER CHAIN

(1). The R. F. Amplifier (V201)

This stage is essentially a broad band amplifier whose relative flatness is obtained through the combination of the load inductance (L202) with the distributed capacitance. Plate decoupling results from the use of L201 with C202 while coupling to the last stage occurs through the capacitor, C204. R203 constitutes a safety resistor in the screen circuit so that the screen always remains well within its rating even when the output adjustment control (R218) is in its maximum position. Screen and cathode bypass are accomplished by C205 and C203, respectively, while cathode bias is provided by R202. Coupling from the cathode follower results from the use of C201 and the grid leak action occurs in R201.

(2). The Doubler-Power Amplifier

The screen, cathode and grid components serve purposes similiar to those already de-

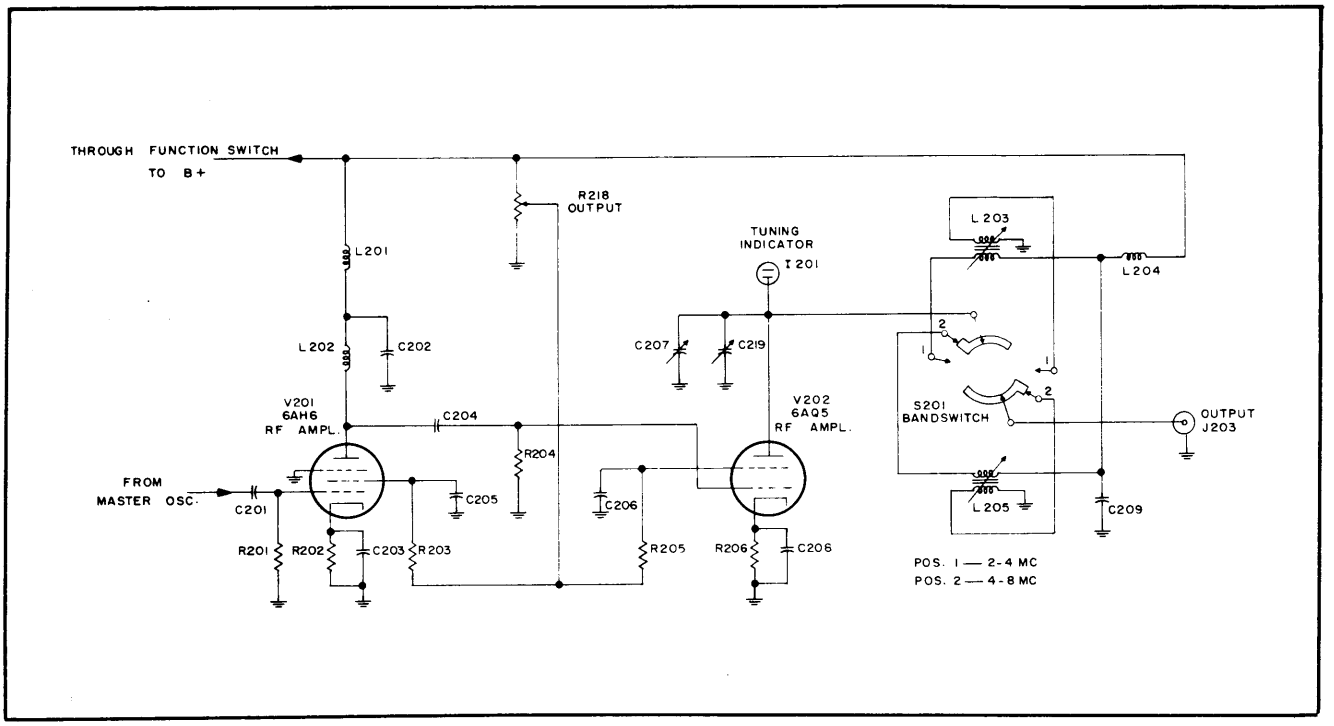

Figure 2-5. The RF Amplifier Chain.

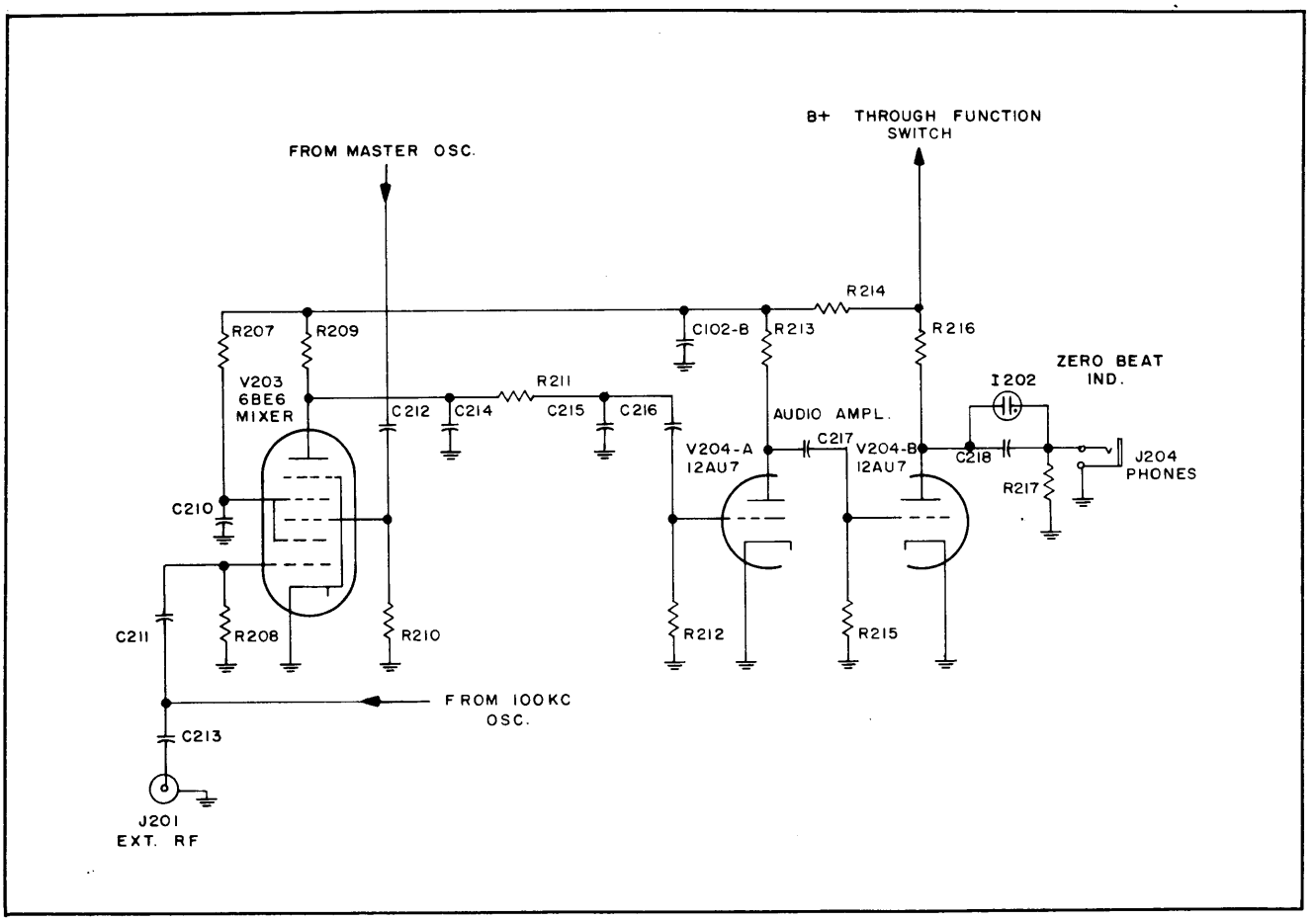

Figure 2-6. The Mixer-Audio Amplifier Chain.

scribed in (1) above. In the plate circuit, L204 and C209 provide decoupling from the power supply and C209 also provides an R.F. ground return for the plate resonant circuits. The resonant circuits for each respective band are then C207 with L203 and C207 with L205. C219 is used to compensate the minimum value of C207 in such a manner that the maximum to minimum ratio of capacitance is correct for proper calibration.

C. THE MIXER-AUDIO AMPLIFIER CHAIN

(1). The Mixer

C212 with R210 and C211 with R208 form a coupling condenser and grid leak resistor combination, respectively, for each injection grid. R207 is the screen dropping resistor and C210 is the screen bypass. The plate load is R209 and the low pass filter combination in the mixer output is composed of C214, R211, and C215. The injection of the 100 Kcs. oscillator output at one grid and the master oscillator output at another grid serves to superimpose these signals upon the electron stream within the mixer tube itself. The result is the appearance of a series of modulation products at the mixer plate - only that product which produces a low audio beat being permitted through the low pass filter.

(2). The Audio Amplifiers (V204A, V204B)

Decoupling and additional hum filtering is obtained, in the first audio stage and mixer, by means of R214 and C102B. C216, R212, and R213 are the coupling capacitor, grid lead, and plate load, respectively. C217, R215, and R216 perform identical functions in the second of the two audio amplifiers. It must be understood that, to obtain a good zero beat indication, these stages must have excellent low frequency response. Even when this requirement is fulfilled some device has to be employed to compensate for the very poor low frequency response of ear phones. For this reason, the last audio stage is heavily driven and the large voltage excursions in its plate circuit are used to turn on and off a gas filled diode (I202). By thus coupling and decoupling the 'phones to the plate circuit, a heavy "thump" is obtained down to a cycle per second. C218 permits passage of higher frequency tones of about two Kcs. and lower to excite the 'phones even though the output is not adequate to flash I202 at this point. R217 acts as a return impedance for the beat indicator when no 'phones are used.

The total result of this design is a device which reproduces a strong and clear zero beat indication and whose output becomes more pronounced as zero beat is approached.

SECTION III
INSTALLATION AND OPERATION

1. INSTALLATION

A. UNPACKING

The TMC Portable Master Oscillator, Model PMO, was designed for ease of installation and simple operation. The Model PMO is ready for immediate service after unpacking. Exercise care in unpacking the equipment. After opening the packing box, remove the inner carton containing the Oscillator. The carton should contain the Oscillator and two instruction manuals. After removal of the Oscillator from the packing, the equipment should be thoroughly inspected for apparent damage. Check to see that all tubes are properly seated and that all outer connections are secure.

B. POWER REQUIREMENTS

The Model PMO leaves the factory wired for 110 V. AC, 50/60 cycles, unless it is specifically ordered for 220 V. AC 50/60 cycles in which case the equipment will be clearly tagged.

110 V. equipment may be converted to 220 V. operation and the changes are clearly indicated at the bottom left hand corner of the schematic diagram. The change involves several jumpers on power transformer T-101, and terminal boards E301 and E302.

The average power requirement for the Model PMO is 80 watts with momentary peaks at 220 watts as the Oscillator ovens cycle.

C. ELECTRICAL CONNECTIONS

The Model PMO has been designed to provide a high degree of long term stability and should be left turned on continuously. In order to prevent the Model PMO from being turned off it should be connected to a power source which is never shut down. If a main switch is used in the

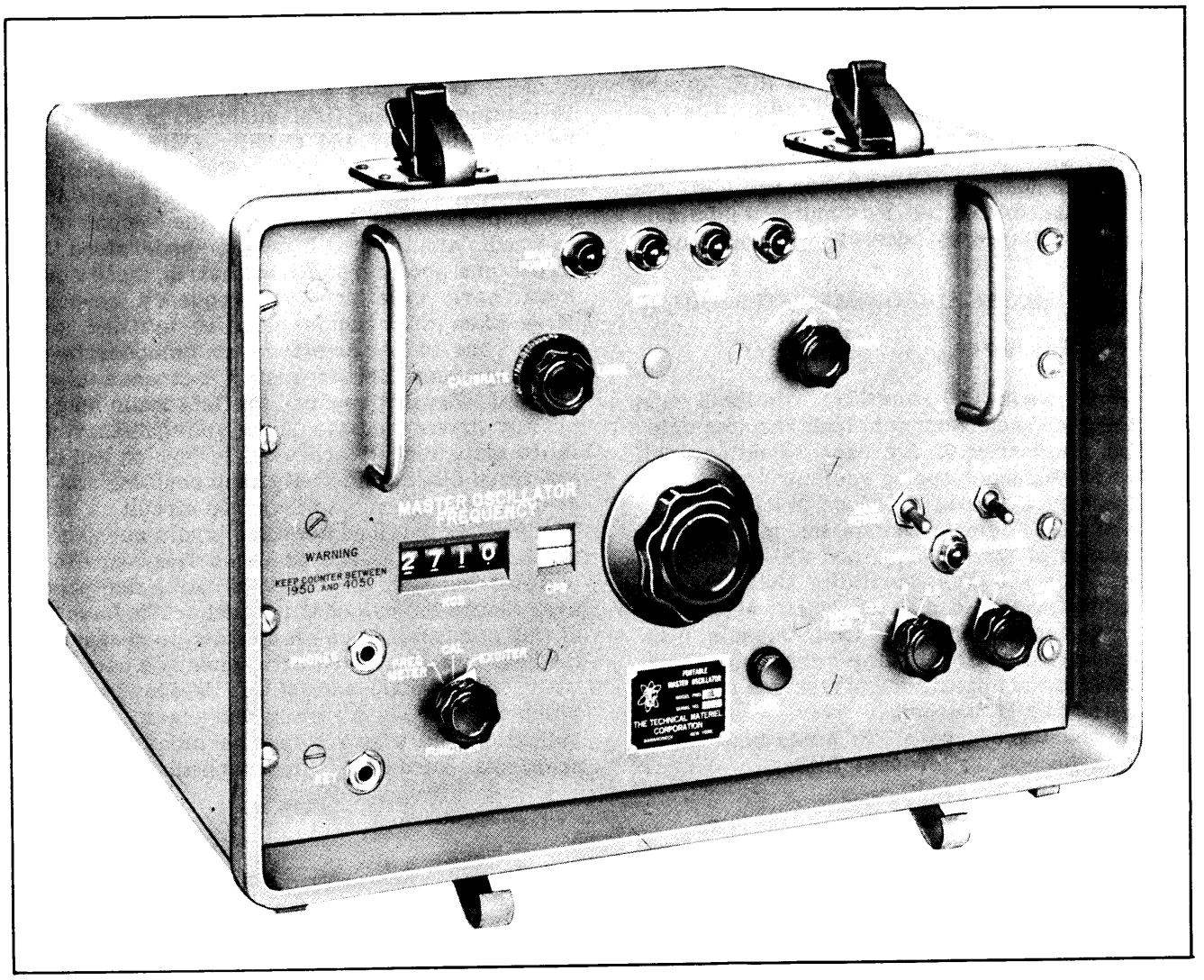

Figure 3-1. Portable Master Oscillator, Model PMO-1, Front View.

primary power circuit it is preferable that the Model PMO power cord be plugged into a receptacle which bypasses this switch.

2. OPERATION

A. GENERAL

(1). TRANSMITTER EXCITER

In this instance the unit is used as a source of high stability radio frequency energy whose frequency may be precisely set. The output power is adjustable to provide maximum flexibility.

(2). FREQUENCY METER

When used as a frequency meter the unit may be used to tune a transmitter to a desired frequency and/or measure its frequency. The unit may also be used to tune a receiver to a desired frequency or measure an unknown received R.F. signal.

(3). SOURCE OF ACCURATE 100 KCS CHECK POINTS FOR RECEIVER CALIBRATION

The 100 Kcs standard oscillator within the Model PMO may be coupled to a receiver for convenient check points.

B. INITIAL ADJUSTMENTS

(1). CALIBRATION OF THE MASTER OSCILLATOR

As mentioned previously, the unit requires a warm-up period to achieve long term stability. Reasonably good stability will be obtained within a few hours after the inner oven commences to cycle. Inner oven cycling starts about three to four hours after the unit is turned

on - depending upon the surrounding ambient temperature. This cycling is indicated by the turning on and off of the pilot light indicator marked "Inner Oven" on the front panel. Accurate short term frequency checks may be made from a cold start.

The unit is turned on by means of the Main Power Switch, located on the front panel. For greatest accuracy, the Oscillator must always be calibrated before use. To calibrate, set the Function Switch, located on the front panel, to the "CAL" position. Set the Oscillator Dial to the 50 KC check point which is closest to the desired frequency and rotate the Calibrate Knob, located on the front panel, until a zero beat is obtained. As zero beat is approached, the pilot light marked "Zero Beat" will light and begin to flash at a rate which indicates the number of cycles the instrument is set away from zero. Initially it is suggested that the operator use a pair of headphones, as well as the light indication for calibration. Note that the flashing indication is extremely accurate and an inexperienced operator should be able to calibrate to within a few cycles without difficulty.

Having calibrated to zero beat at any 50 KC check point accurate correction of the dial 25 KCs each side of the check point has been obtained and the operator is assured of utmost accuracy in this region.

FOR GREATEST ACCURACY, THE CHECK POINT AND THE DESIRED FREQUENCY MUST ALWAYS BE APPROACHED FROM THE SAME DIRECTION.

It is suggested that the check point be approached by a clockwise rotation and the desired frequency should also be approached from this direction. If, by accident, the dial is rotated too fast and the point is passed, the dial should be brought back at least one KC past the desired frequency and the point approached again.

NOTE

TO OBTAIN MAXIMUM LONG TERM STABILITY FROM THE MODEL PMO, THE UNIT SHOULD BE GIVEN A MINIMUM WARM-UP OF AT LEAST TWENTY-FOUR HOURS BEFORE CALIBRATION, AND WHEN CALIBRATED SHOULD NOT BE TURNED OFF UNLESS REPAIRS BECOME NECESSARY.

C. ADJUSTMENT OF THE MODEL PMO WHEN USED AS A TRANSMITTER EXCITER

When used as a Transmitter Exciter, the Model PMO should be physically located at a point convenient to the transmitter and AC connections. Connection to the transmitter is made through J-203 and a proper BNC connector is provided for connection to a coaxial cable.

First calibrate the oscillator in the manner set forth in Section B above and then set the oscillator to the desired frequency. It should be noted that while the dial reads from 2 to 4 Mcs it has two output ranges, 2 to 4 Mcs and 4 to 8 Mcs. The setting of the PMO dial will be determined by the desired output frequency of the transmitter.

FOR EXAMPLE:

If the desired transmitted frequency is 24 megacycles and the transmitter multiplies four times, the PMO dial setting would be 3,000,000 cps and the bandswitch set to the 4 to 8 Mc range. Since the PMO is capable of doubling within itself the operator has the choice of doing part of the multiplication within the PMO or doing all of it within the transmitter.

Having set the Model PMO on frequency, rotate the FUNCTION SWITCH TO the Exciter position. Turn the AMPLIFIER PLATE SWITCH to the ON position, rotate the OUTPUT CONTROL in a clockwise direction halfway toward the maximum setting. Set the BANDSWITCH to the desired position, 2 to 4 Mcs or 4 to 8 Mcs. Set the TUNING CONTROL to agree with the first two significant figures on the KCS counter, i.e., if the KCS counter reads 2530 set the tuning control to 2.5. It is possible by improperly setting the TUNING CONTROL to triple within the equipment. Therefore, it is important that this TUNING CONTROL setting always agree with the first two digits, approximately, of the master oscillator setting. Note that the pilot light marked TUNING INDICATOR located above the TUNING CONTROL is now lit. The unit is properly tuned when the INDICATOR shows maximum brilliance for a given POWER OUTPUT CONTROL SETTING. Adjust the TUNING CONTROL slightly for maximum brilliance. The TUNING INDICATOR also indicates the degree of power output, rotate the OUTPUT CONTROL back and forth and notice the change of brilliance on the indicator. As the operator becomes more familiar with the operation of the Model PMO the brilliance of the INDICATOR may be used as a relative guide to power output settings.

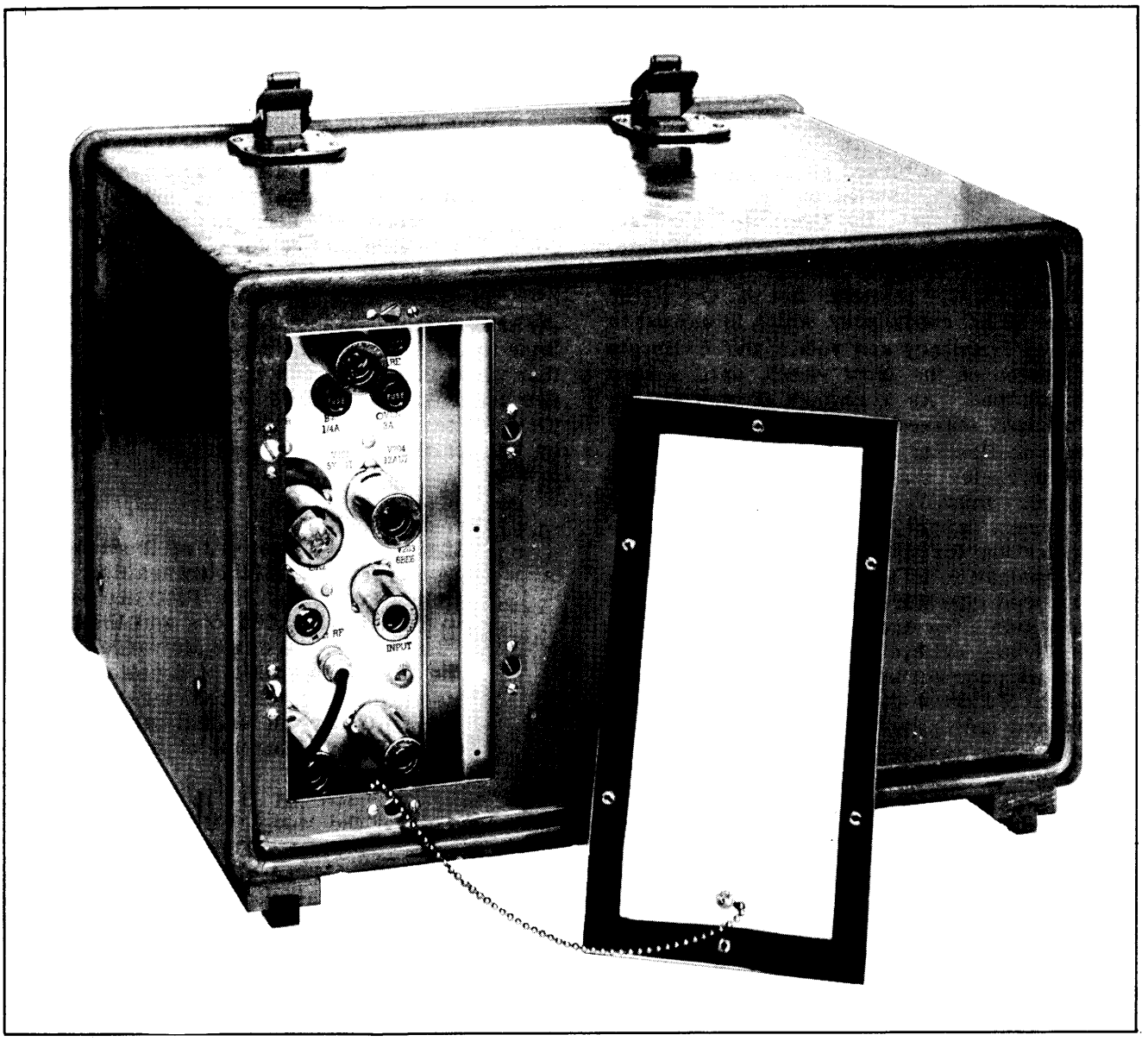

Figure 3-2. Rear View, Model PMO-1.

The Model PMO has now been fully prepared for operation as a source of RF energy. The Model PMO may be keyed by inserting a telegraph key or any other make break automatic keying device directly into the front panel jack marked **KEY**. For more permanent installations the keying line may be substituted for the jumper normally found across E-304 on the rear apron of the Oscillator.

D. ADJUSTMENT OF THE MODEL PMO WHEN USED AS A FREQUENCY METER

The Model PMO has been designed to be used as a conventional heterodyne type frequency meter. Measurement consists of comparing an unknown frequency with the known frequency of the Oscillator. Provision has also been made for the detection of reasonably strong signals, such as that emanating from a nearby transmitter, without the use of a receiver.

Use of the Model PMO as a frequency meter in the field will usually divide into two primary applications, first to tune a transmitter or similar device to a specific frequency and secondly to measure an unknown or received frequency.

(1). To tune a transmitter to a specific frequency:-

a. Determine the subharmonic setting of the Model PMO to be used by dividing the known

frequency by some convenient multiple such as 2, 3, 4, 5, ...10. A Harmonic Relationship Manual is available for the operators convenience.

b. Calibrate the Oscillator in the manner described in Paragraph B, at the nearest 50 KC check point.

c. Loosely couple the Model PMO to the transmitter, either by the rear coaxial jack marked EXT RF in the PMO-2 or by means of the built-in antenna in the Model PMO-1.

d. Set the FUNCTION SWITCH to FREQUENCY METER.

e. Set the Oscillator dial to the subharmonic reading determined in Paragraph above.

f. Tune the transmitter until an audible signal is heard in the headphones plugged into the phone jack of the Model PMO, or the ZERO BEAT INDICATOR lights.

NOTE: The ZERO BEAT INDICATOR requires one to two volts of RF to operate effectively. In cases where there is not sufficient RF available the headphones only must be used for zero beat indication.

g. Retune the transmitter until Zero Beat is obtained. When used in this manner the Model PMO will produce accurate results from 2 to at least 30 megacycles, and is usable beyond this range.

(2). To measure the frequency of an unknown transmitter:-

a. Roughly determine the unknown frequency be means of a conventional receiver or similar device.

b. Roughly determine the subharmonic setting of the Model PMO to be used by dividing the unknown frequency by some convenient multiple such as 2, 3, 4, 5, ...10 or by consulting the Harmonic Relationship Manual.

c. Calibrate to the nearest 50 KC check point.

d. Loosely couple the PMO to the transmitter either by the rear coaxial jack marked EXT RF in the PMO-2 or by means of the built-in antenna in the Model PMO-1. Be sure that the ANT connection in the PMO-1 is connected to the EXT RF jack.

e. Set the FUNCTION SWITCH to FREQUENCY METER.

f. Set the Oscillator dial to the subharmonic reading determined above.

g. Tune the Oscillator carefully until an audible signal is heard in the phones of the ZERO BEAT INDICATOR lights. Tune for zero beat as indicated by the INDICATOR flashing on and off.

h. The exact frequency of the unknown will be the PMO reading multiplied by the harmonic multiplying factor. i.e., if the PMO dial reads 2,555,000 and the multiple is 5, then the unknown frequency is 12,775,000 cps.

(3). To tune a receiver to a specific frequency.

a. Determine the subharmonic setting of the PMO in the manner indicated previously.

b. Calibrate the Oscillator to the nearest check point as described in paragraph 2. B. 1. of this section.

c. Set the FUNCTION SWITCH to EXCITER.

d. Loosely couple the Model PMO to the receiver antenna jack by means of the rear coaxial jack marked OUTPUT in the PMO-2. In the case of the PMO-1, the self-contained antenna should be plugged into the OUTPUT jack and this will produce enough radiation for the receiver to pick up.

e. Set the Oscillator dial to the proper subharmonic of the desired frequency and tune the power amplifier as described in paragraph 2. C. of this section.

f. Tune the receiver until its signal strength meter reads maximum or a maximum amount of noise silencing is obtained when picking up the proper PMO harmonic. This will serve for phone signals.

g. For frequency shift or C.W. signals, turn the receiver BFO on after having tuned as in part f., above. Set the BFO frequency control until the desired beat note is obtained.

(4). To measure the unknown frequency of a received signal:-

a. Roughly determine the unknown frequency by the receiver calibration.

b. Roughly determine the subharmonic setting of the PMO to be used.

c. Calibrate the Model PMO to the nearest 50 KCs check point, as described in paragraph 2.B.(1) of this section.

d. Set the FUNCTION SWITCH to EXCITER.

e. Loosely couple the Model PMO to the receiver antenna jack by means of the rear coaxial jack marked OUTPUT in the PMO-2. In the case of the PMO-1, the self-contained antenna should be plugged into the OUTPUT jack and this will produce enough radiation for the receiver to pick up.

f. Tune the PMO until a beat is heard in the receiver between the unknown being picked up and the master oscillator in the PMO.

g. Reduce the OUTPUT control in the PMO so the receiver is not overdriven and a

clear zero beat can be obtained. (Be sure that the receiver BFO is off).

h. The exact frequency of the unknown will be the PMO reading multiplied by the harmonic multiplying factor.

(5). Use of the Model PMO as a source of 100 KC check Points for receiver calibration:-

a. Loosely couple the Model PMO to the receiver by means of the coaxial jack marked EXT RF in the PMO-2 and the built-in antenna in the PMO-1.

b. Set the FUNCTION CONTROL to the CAL position.

c. The output of the 100 KC standard in the Model PMO will now be heard in the receiver and may be used to calibrate the receiver in the conventional manner. Be sure the master oscillator dial is tuned some distance away from the 100 Kcs harmonic being used, so as to avoid confusion. This can easily be checked by varying the master oscillator dial and noticing if a change takes place in the signal being picked up in the receiver. If this change occurs, the master oscillator dial should be shifted elsewhere.

WARNING

DO NOT CONNECT ANYTHING TO THE REAR COAXIAL JACK MARKED "EXT RF" IN THE MODEL PMO-2 EXCEPT WHEN THE UNIT IS BEING USED AS A FREQUENCY METER.

BE SURE TO DISCONNECT THE BUILT-IN ANTENNA IN THE MODEL PMO-1 FROM THE JACK MARKED "EXT RF" EXCEPT WHEN THE UNIT IS BEING USED AS A FREQUENCY METER.

3. ADDITIONAL CALIBRATION ACCURACY

The calibration accuracy of the Model PMO is more than adequate for most general usage. When a particular need arises for more precise reading, the Model PMO readily lends itself to such use.

Within this instruction manual frequent reference has been made to 50 Kcs check points. After a few minutes of actual experience with the equipment, however, a discerning operator will notice intermediate beats. These beats are lower in audio amplitude than the major check points but are extremely useful. In most cases, the operator will have to use headphones to utilize these beats since the beat amplitude will not be adequate to permit use of the light indicator.

These additional beats result from the mixing of the Master Oscillator (2 to 4 megacycles) and the 100 kilocycle Crystal Oscillator. For additional calibration accuracy it is recommended that the nearest check point listed in the table below be used.

RECOMMENDED CHECK POINTS

This table illustrates the check points to be found between the PMO dial setting of 2,200,000 and 2,300,000. These points occur in the order listed below at any dial setting throughout the 2,000,000 to 4,000,000 cps range of the instrument.

PMO DIAL SETTING	CHECK POINT	PMO DIAL SETTING	CHECK POINT
2,200,000 Cps	100,000 Cps	2,260,000 Cps	60,000 Cps
2,214,286	14,286	2,266,667	66,667
2,216,667	16,667	2,271,428	71,428
2,220,000	20,000	2,275,000	75,000
2,225,000	25,000	2,280,000	80,000
2,228,571	28,571	2,283,333	83,333
2,233,333	33,333	2,285,714	85,714
2,240,000	40,000	2,300,000	100,000
2,250,000	50,000		

SECTION IV
MAINTENANCE

1. GENERAL

The TMC Portable Master Oscillator, Model PMO, has been designed to provide long term trouble free operation under continuous duty conditions. It is recommended that any maintenance to the equipment be done by a competent technician. The oven and the components contained therein have been finely engineered and precision made, should rarely require attention. The two enclosed tubes (V301 and V302) and the mercury thermostat (S301) are readily accessible from the rear of the unit and may, therefore, be replaced when necessary.

2. EMERGENCY MEASURES

A. REPLACEMENT OF FUSES

The Model PMO has been designed with triple fuse protection; the oven heaters, power supply and high voltage all being separately covered. This means that a failure in the power supply will in no way effect the oven temperature. If the nature of the fault is such that it can be corrected without turning the main power off; i.e., a shorted tube, etc., then, since the heaters have been continuously operating, re-stabilization will be unnecessary.

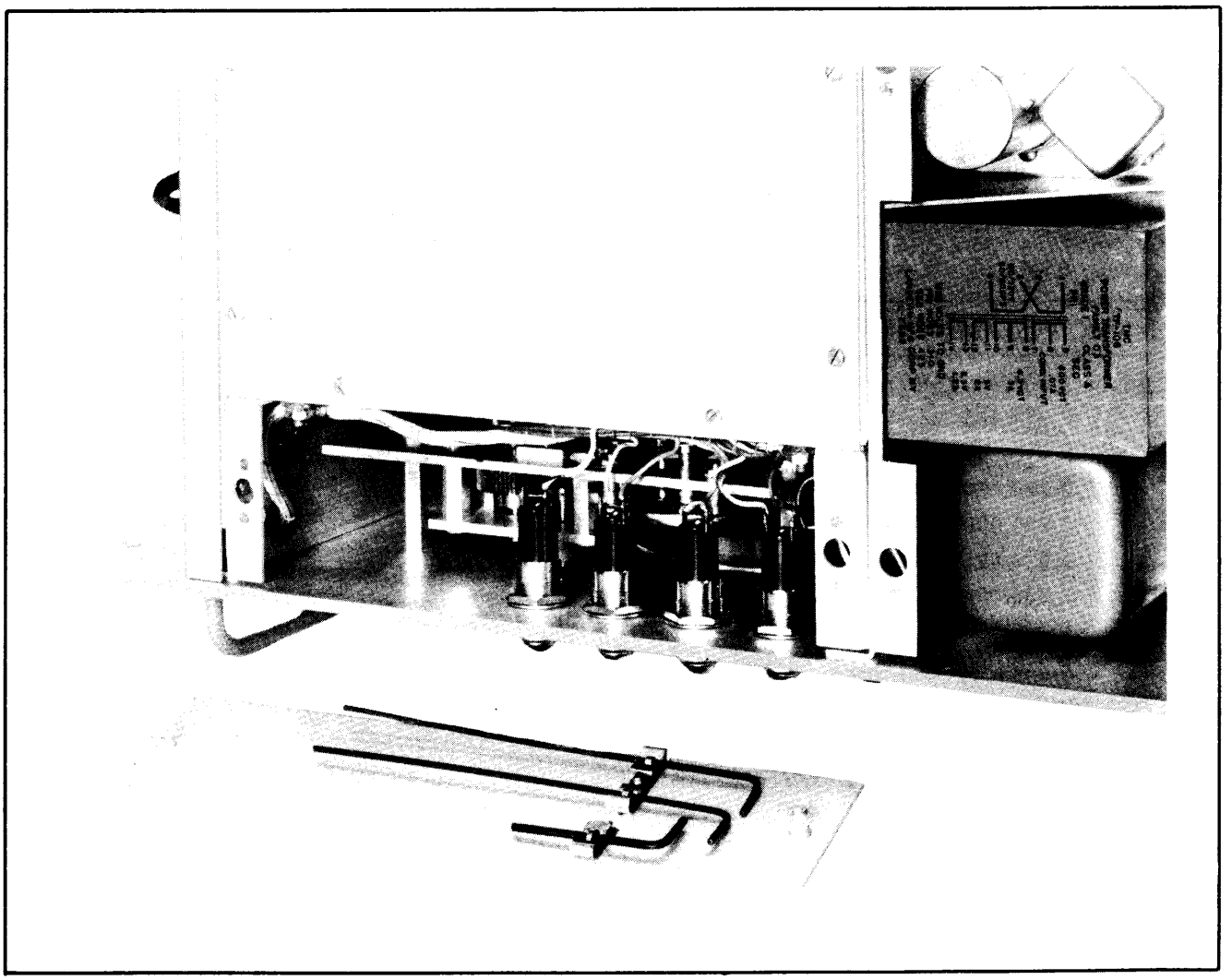

Figure 4-1. Top View, Access Plate Removed.

Since a partial short across the B+ line may not necessarily blow the line fuse, a separate high voltage fuse has been provided. All of the fuses and their spares are located on the rear apron of the unit. If, by means of the inner and outer oven indicator lights, it is noticed that neither oven has cycled for about twelve minutes, then it is evident that the oven fuse has blown. It should be replaced.

If, on the other hand, the main power indicator light goes out, then the main fuse must have blown and it should be replaced. If no output can be obtained in the EXCITER condition or no zero beat can be obtained in the CAL condition, then the B+ fuse is very likely at fault and it should be replaced.

NOTE

NEVER REPLACE A FUSE WITH ONE OF HIGHER RATING! IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE HAS BEEN CORRECTED.

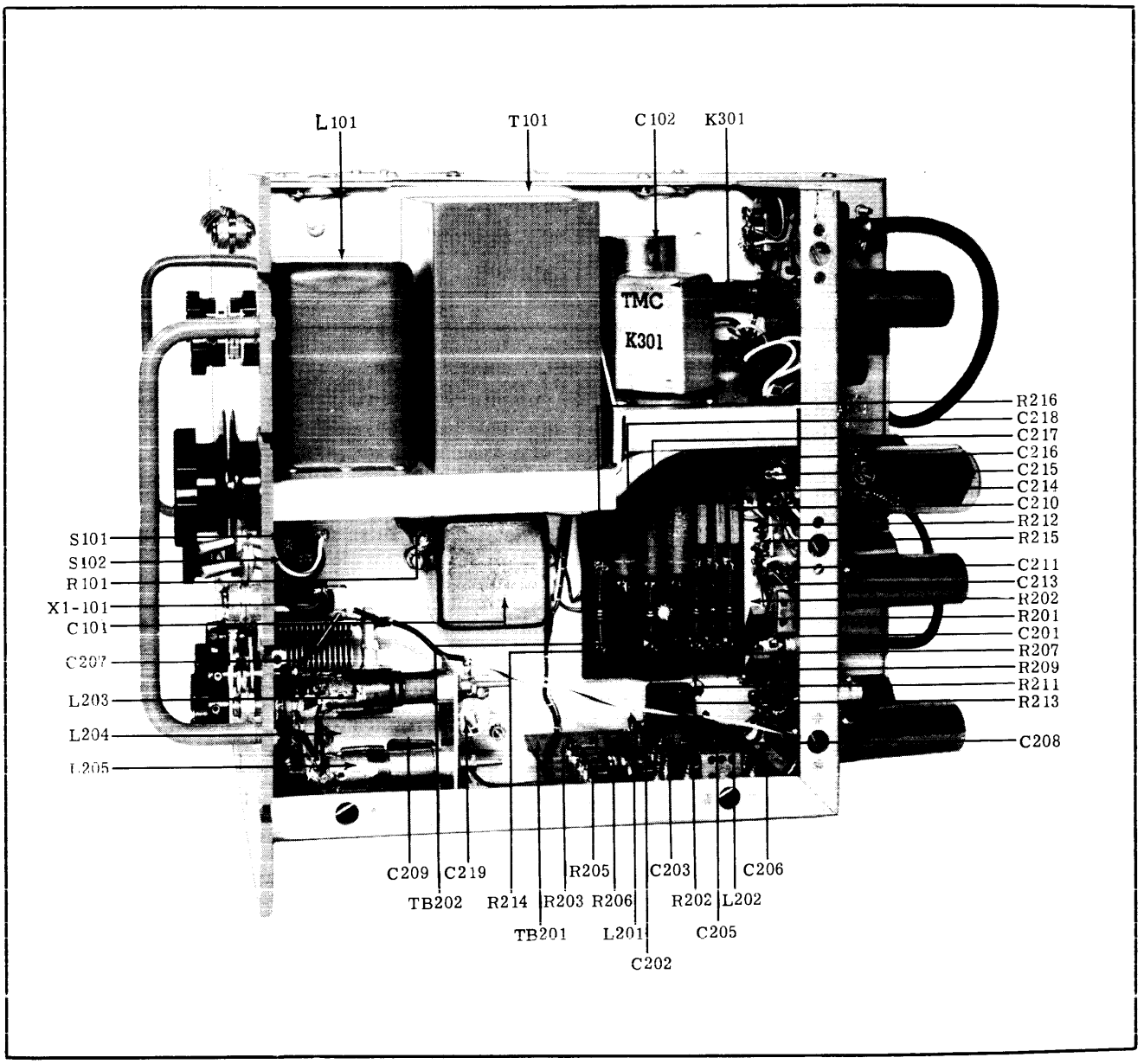

Figure 4-2. Left Side View, Plate Removed.

In each of the cases discussed above, it is assumed that the pilot light itself has not failed. This possibility should, of course, also be investigated before it is assumed that the equipment must be repaired.

B. REPLACEMENT OF TUBES

All of the tubes are accessible from the rear where they are clearly marked for ease of replacement. In the event of a service interruption, all tubes, with the exception of those at the rear of the oven, should be checked. It is rarely necessary to touch V301 and V302, because they are intentionally operated in a very conservative manner. If, however one of these tubes fails or is suspected of being faulty the following precaution shall be taken note of: UNDER NO CIRCUMSTANCES SHOULD EITHER V301 OR V302 BE REMOVED FROM ITS SOCKET WITHOUT FIRST WITHDRAWING P301 FROM ITS SOCKET. This will serve to protect the regulated filament circuitry.

When tubes are removed, tested, and reinserted in place, care should be taken to install all those tube shields which were also removed.

3. PREVENTIVE MAINTENANCE

A. GENERAL

In order to prevent actual failure of the equipment due to corrosion, tube failures, dust or other destructive ambient conditions, it is suggested that a definite schedule of preventive maintenance operations be set up and adhered to. In this manner the greatest percentage of potential failures will be detected and corrected at the users discretion before they can interrupt service at some less opportune moment.

B. DIRT, ETC.

Remove the equipment from the rack, and thoroughly inspect the inside of all chassis, with the exception of the oven enclosed elements, for signs of dirt, dampness, molding, charring, or corrosion. Correct any defect found. Clear carbon tetrachloride (Dry cleaning solvent 140F, F.S.N. WM6850-274-5421) is a good cleansing agent for this purpose.

Recommended time interval: SEMI-ANNUALLY.

C. VOLTAGE CHECKS:

Test all DC and AC voltages with the exception of the oven enclosed elements as indicated on the respective tube voltage data chart (Fig. 4-5) and investigate any serious discrepancies.

Recommended time interval: SEMI-ANNUALLY.

D. TUBE CHECKS

Test one tube at a time in a reliable tube tester, replacing the tube in the socket from which it was removed if its measured characteristics are within the manufacturer's tolerances. Discard only those tubes which are found to be below par.

Recommended interval: QUARTERLY.

E. LUBRICATION

Study all the gears which are contained in the region between the front panel and the oven box. These are the two gears associated with the calibrate control and the two right angle gears connecting the counter with the master oscillator tuning control. If any of these units show signs of becoming dry, coat them heavily with molybdenum disulphide compound such as that made by the Alpha Corporation of Greenwich, Connecticut and referred to by the trade name of Molykote-Type G.

Recommended time interval: EVERY TWO YEARS.

F. MECHANICAL

Carefully inspect for loose screws or components - especially those used to hold down ground terminals or tube socket saddles which are also used for grounding purposes. Tighten all screws which are deemed to be too loose.

Carefully inspect all set screws on all shaft couplings, especially those in the region between the front panel and the oven box. A set of allen wrenches have been clamped to one of the cover plates enclosing this area and these tools should be used to tighten all loose set screws. DO NOT LOOSEN ANY SET SCREWS - BE CAREFUL NOT TO DISTURB THE CALIBRATED RELATIONSHIP BETWEEN THE MASTER OSCILLATOR DIAL AND THE SHAFT FROM THE OVEN BOX.

Recommended time interval: EVERY SIX TO TWELVE MONTHS, DEPENDING UPON THE TYPE OF SERVICE AND THE DEGREE OF VIBRATION ENCOUNTERED IN THAT SERVICE.

4. CALIBRATIONS

A. GENERAL

During its initial calibration the Model PMO

is set so that relatively little rotation of the CAL control is necessary to correct the dial at any particular check point. As the unit continues to age and experiences varying degrees of shock and vibration, some increase in this degree of rotation may occur. If, after the dial has been calibrated at 2 Mcs, more than two complete revolutions of the CAL control are necessary to calibrate any other 50 KCS check point on the dial, then the ends of the dial should be reset by the procedure outlined below.

The continuous natural abuse that a unit receives in the field may also slightly disturb the 100 KCS standard. In order to obtain maximum accuracy a recalibration of the crystal standard should be made regularly as outlined below.

WARNING

THE FOLLOWING OPERATIONS SHOULD BE PERFORMED BY DULY AUTHORIZED AND PROPERLY INSTRUCTED PERSONNEL ONLY.

B. THE 100 KCS STANDARD

In order to correctly perform this operation it is necessary to obtain either a communications receiver or a primary standard. The receiver must be capable of receiving radio station WWV which is operated by the Central Radio Propagation Laboratory, National Bureau of Standards, Washington, D. C. This station emits a carrier of extreme frequency stability at 2.5, 5, 10, 15, 20 and 25 MCS for precisely such purposes as the calibration of communications equipment. Allow at least a SIX HOUR WARM-UP PERIOD and proceed as follows:

(1). Using the receiver, pick up WWV. It is preferable to use the 2.5 or 5 MCS signal, if either can be obtained at the particular location being used.

(2). Set the Model PMO Function Switch to CAL. Coil one end of a piece of hook-up wire around C-201 and couple the other end loosely into the antenna post of the receiver.

(3). Tune the Master Oscillator in the region of 2.5 MCS and obtain a zero beat between the Model PMO and the WWV signal. Since communication receivers are almost never designed for greatly extended low frequency audio response, it is useless to attempt to obtain a beat indication through the use of phones. Instead, it is suggested that some form of "S" meter be used. If the receiver has no such self-contained device, it can readily be made by connecting a micro-ammeter in series with a suitable resistance directly across the detector D.C. output.

When zero beat is approached and the coupling from the Model PMO to the receiver antenna is proper, deep and clearly discernible dips will be seen on the "S" meter.

(4). Now, while observing the beat indicating lamp on the Model PMO front panel, set C311 until a zero beat has been obtained between the Master Oscillator and the 100 KCS standard. C311 can be adjusted through a small port near the mercury thermostat at the rear of the oven box. When both beats can be observed simultaneously to be within a few cycles of the zero point, than a satisfactory calibration has been made. This means, in reality, that the 100 KCS standard has been set against WWV with the Model PMO Master Oscillator serving only the function of intermediary. When a primary standard is available, the 100 KCS oscillator may be adjusted directly against the standard to an accuracy of at least one part per million. In this case, the 100 KCS output may be obtained at J 201 and fed into the standard, thus eliminating the need for a receiver or the master oscillator as an intermediary.

The frequency with which the above operations should be performed is purely a function of the type of service to which the unit is subject. For some base station installations, intervals of six months will be adequate, however, for more rugged conditions experience may indicate the need for a proportionately shorter interval.

C. THE MASTER OSCILLATOR

Before attempting to adjust the Master Oscillator, the full procedure outlined in Part B, above, must be followed.

(1). Put the Function Switch in its CAL position.

(2). Set the Master Oscillator dial at 2,000,000 while being careful to note the direction of approach.

(3). Now, rotate the dial to 4,000,000 and approach this point from the same direction used previously. If, for example, the first point was approached from 2,002,000 then the second point must be approached from 4,002,000.

(4). Insert a screwdriver through the capped hole adjacent to the CAL knob and adjust C303 for zero beat. This operation should be done while picking the Oscillator up on a convenient receiver to make certain that C 303 is being varied in a manner which brings the Oscillator frequency toward the 4 MCS zero beat and not in the direction of a neighboring 50 KCS checkpoint. It should never be necessary to vary the C303 control more than a few complete revolutions.

(5). Repeat the total procedure outlined above, i.e. adjusting the CAL know at 2 MCS and C303 at 4 MCS, until it is possible to obtain a

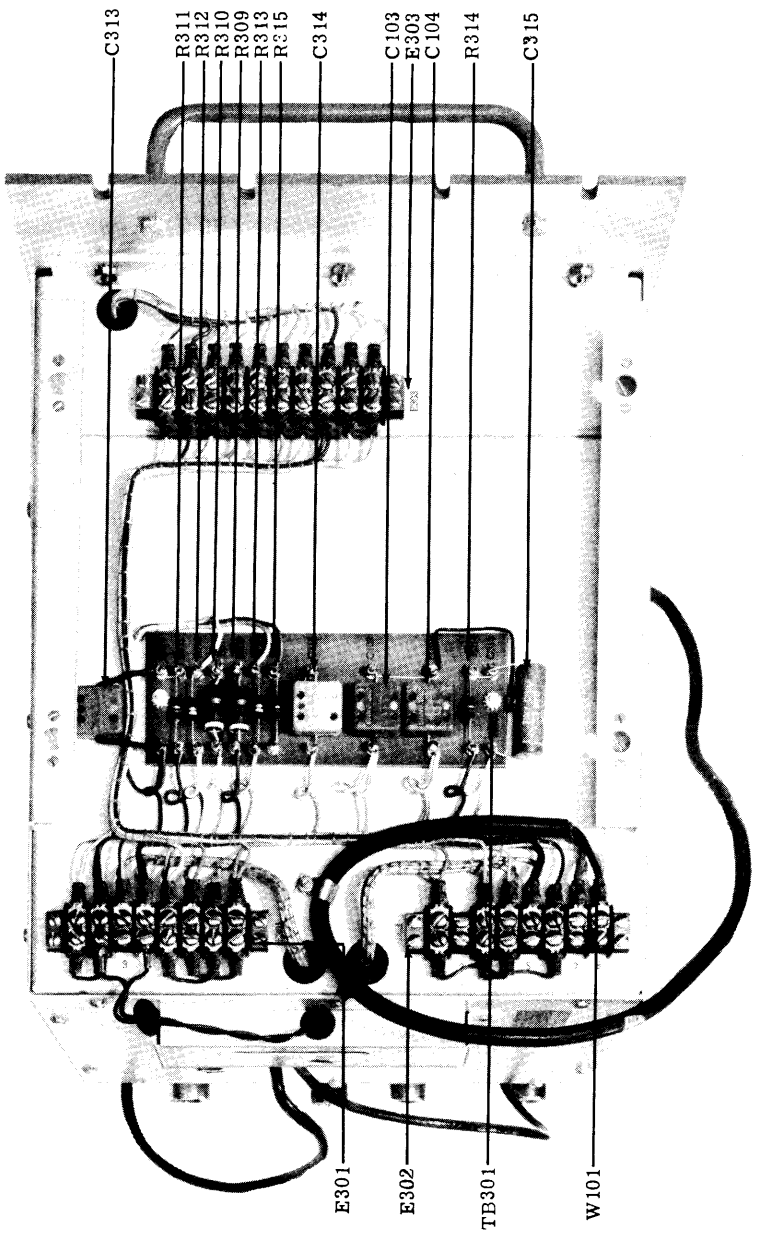

Figure 4-3. Right Side View, Plate Removed.

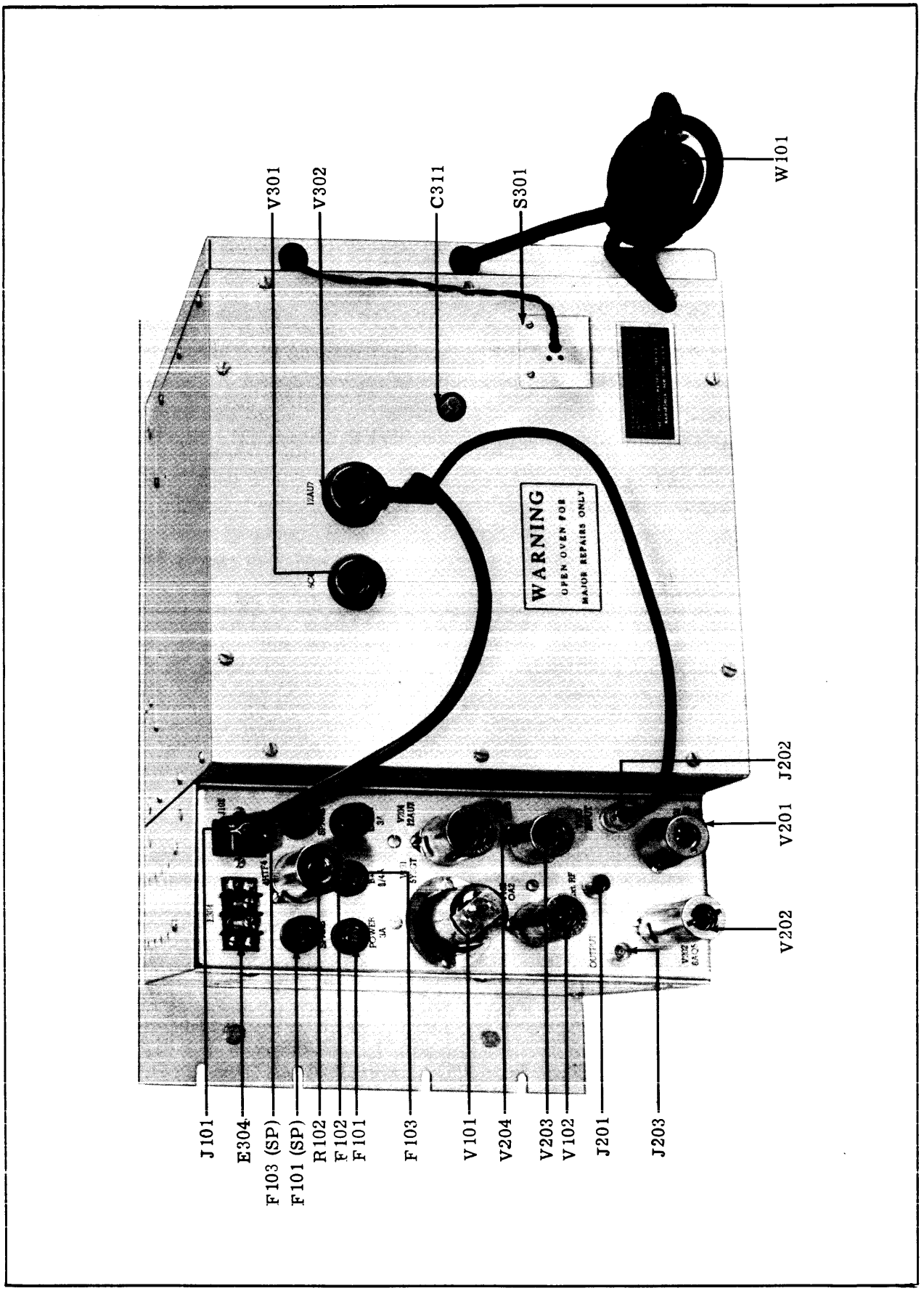

Figure 4-4. Rear View, Model PMO-2.

zero beat at both 2 and 4 MCS without further adjustment being necessary. The ends will then be correct and the CAL knob will be closest to its correct mean position.

Once this procedure has been completed, the button should be replaced and not disturbed again until a re-calibration is deemed necessary. This operation is sometimes required after the first year of service and then seldom performed again, depending once again, upon the type of service.

D. THE POWER AMPLIFIER

Power Amplifier re-alignment is something which need rarely be required as a result of ordinary use. It becomes necessary when one of the components in the output circuit must be replaced.

(1). Take the following steps:

Place a jumper across the terminals of E304 if it is not already there.
Set the Master Oscillator at 2 MCS.
Set the Output Control in the center of its range.
Set the Function Switch in its EXCITER position.
Set the Amplifier Plate Switch in its ON position.
Set the Bandswitch in the 2 - 4 MCS range.
Load J203 with approximately 70 ohms of non-inductive resistance having a rating of at least 10 watts. (Six series connected composition resistors of 12 ohms at 2 watts each or some similar combination)

(2). Arrange the knob on C207 so that the pointer is about 5 degrees below the horizontal to the right when C207 is fully meshed. Tighten the set screws on the knob and rotate it back slightly so that the pointer is on the 2 MCS mark.

(3). Rotate the slug in L203 until maximum output is shown on the Tuning Indicator I201. In order to proceed further and align the opposite end of the band, it is not necessary to change the Master Oscillator from its 2 MCS setting since, for the purposes of alignment, the use of harmonics is adequate. Therefore, continue as follows:

(4). Rotate C207 until the pointer is set at 4 MCS. Tune C219 for a maximum output reading. Repeat the process of tuning the slug at 2 MCS and C219 at 4 MCS several times until the knob pointer is approximately correctly aligned at both ends.

The above process serves to properly determine the ratio of Cmax to Cmin, which in turn produces proper end alignment. Now only the lower end of the 4 - 8 MCS band need be set by means of the slug in L205; the upper end will automatically be correct.

(5). Set the Band Switch in the 4 - 8 MCS range and return C207 to its 2 MCS position. Tune the slug in L205 for maximum output. Tighten the lock nuts on both slugs and the power amplifier alignment will be complete.

5. CORRECTIVE MAINTENANCE

A. GENERAL

It is always best to regard an instrument such as the Model PMO as a series of interrelated blocks. This means, of course, that a disappearance of output in the last stage may be charged to a failure in any one of the stages which preceed the final amplifier. The example stated should serve to show the technician that he must start at the source rather than concentrate his time and effort in the stage at which the fault initially seems to appear.

In general, it is suggested that the outline shown below be followed:

(1). All of the components in the Model PMO have been very conservatively rated, and therefore, in the vast majority of cases difficulty will arise from an easily replaceable tube or fuse. IF THE TUBES AND FUSES ARE ALWAYS CHECKED FIRST, IT WILL FREQUENTLY NOT BE NECESSARY TO INVESTIGATE FURTHER.

If trouble arises in a chain of stages, check all the tubes in that particular line. If a tube tester is not available, a spare tube may be inserted for the purpose of localizing the fault. If the insertion of a new tube accomplishes nothing, the original tube should once again be inserted in the socket.

(2). If the tubes are not at fault, the unit must be removed from its rack mounting and be given a quick inspection for charred resistors or other visually recognizable signs of electrical failure. To localize the fault further, the additional procedures outlined below should be followed. In addition, reference to the voltage chart (Fig. 4-5) should be made.

B. PARTICULAR FAULTS

(1). POOR OSCILLATOR STABILITY - If the Master Oscillator shows signs of rapidly changing frequency after having been given an adequate warm-up period, the inner oven thermostat is very likely at fault. This is usually caused by the appearance of an air bubble or

If this occurs, the temperature will rise until the safety thermostat takes over. In normal operation after at least four or five hours warm-up, the operator will see the Outer Oven indicator blink on for roughly five seconds and off for roughly thirty seconds. The Inner Oven indicator will blink on for approximately 3 to 5 minutes and off for approximately 8 to 12 minutes. All of these figures are, of course, highly dependent upon the ambient temperature conditions. If the inner oven thermostat (S301) sticks, the Inner Oven indicator will cycle very erratically. A faulty unit such as this must be replaced. See Figure 4-5.

(2). NO. R.F. OUTPUT - If the procedures outlined under Operation have been followed and no R.F. output is obtainable, the Function Switch should be placed in its CAL position. If a beat can then be heard this signifies that the Master Oscillator and power supply are functioning properly. The fault must then lie with either the R.F. Amplifier or the Power Amplifier. Make voltage checks, etc. (check I201 first.)

(3). NO BEAT - If more than a volt of R.F. appears at pin 7 of V203 or more than 6 volts of R.F. appears at pin 1 of this same tube, check the mixer and audio amplifier sections. First, however be certain that I202 is not at fault. It will be apparent that such is the case if a beat can be obtained with a pair of headphones without a simultaneous indication from I202.

(4). NO HIGH VOLTAGE - Check the B+ fuse and rectifier. If the fuse continues to blow this is a sign of a short at some point which must be isolated.

Rotating the Function Switch places B+ on various circuits and thus enables the technician to more easily locate the fault. The most likely cause of trouble of this nature is filter capacitor C102.

(5). BALLAST FAILURE - Ballast regulators may be replaced on an expedient basis by inserting any one of the following vacuum tubes in the socket XR102: 6BK7, 6T8, 6U8.

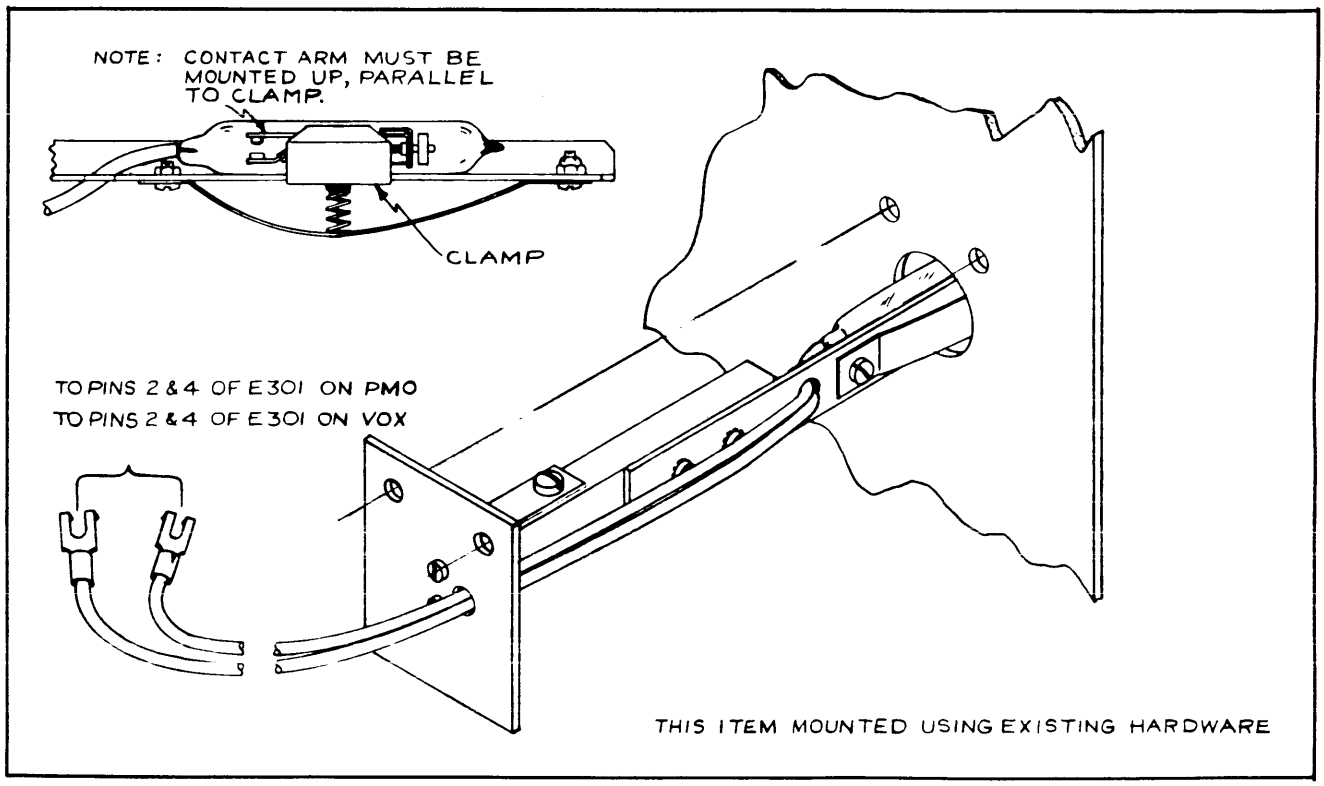

Figure 4-5. Installation, Inner Oven Thermostat.

PARTS LIST

The Model PMO is composed of three electrical schematic sections, assigned symbol groups as follows:

100 through 199	Power Supply Section
200 through 299	RF and Audio Amplifier Section
300 through 399	Master Oscillator-Oven Section

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C101	CAPACITOR, fixed: oil filled; 2 mfd, +40 - 10%; 600 wvdc.	B+ Filter	CP53B1EF205V
C102	CAPACITOR, fixed: electrolytic; dual unit, 20 mfd ea. section.	B+ Filter	CE52F200R
C103	CAPACITOR, fixed: mica; 5100 mmfd, ±10%; 500 wvdc.	Input Bypass	CM35B512K
C104	CAPACITOR, fixed: mica; 5100 mmfd, ±10%; 500 wvdc; same as C103.	Input Bypass	CM35B512K
F101	FUSE, cartridge: 3.0 amp.	Oven Fuse	FU-100-3
F102	FUSE, cartridge: 3.0 amp.; same as F101.	Main Power Fuse	FU-100-3
F103	FUSE, cartridge: 1/4 amp.	B+ Fuse	FU-100-.250
I101	LAMP, incandescent: 6-8 v; 0.250 amp; bulb T-3-1/4 clear.	Main Power Indicator	BI-101-44
J101	CONNECTOR, female contact: polarized; six contact, chassis mounted.	Osc.-PS	JJ-121-2
L101	INDUCTOR, 15 henries: 85 ma DC; 270 ohms DC res, 2500 volts, RMS Test.	Filter Choke	TF-5000
R101	RESISTOR, fixed: wire wound; 5,000 ohms, ±10%.	Voltage Divider	RW-109-32
R102	RESISTOR, variable: ballast vacuum tube type; .43 to .49 amps, 10.1 to 15.1 volts.	Filament Ballast	RR-109
S101	SWITCH, toggle: DPST; 3 amp, 250 v, phenolic body.	Main Power Switch	ST-22K
S102	SWITCH, toggle: SPST; 3 amp, 250 v, phenolic body.	Amp. Plate Switch	ST-12A
S103	SWITCH, rotary: single sect; 3 pole, 3 pos, phenolic insulation.	Function Switch	SW-148
T101	TRANSFORMER, filament and power: input 110/220 v, 50/60 cps; single phase; four output windings; secdy #1-6.3 v. CT 3 amp; secdy #2-6.3 v. 1.2 amp; secdy #3-300-0-300 v. 70 ma DC into capacity input filter; secdy #4-5 v. 2 amp; all windings insulated against 1,000 v; hermetically sealed metal rect case.	Main Power Transformer	TF-106

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
V101	TUBE, electron: 5Y3GT, duo-diode rectifier, octal.	High Voltage Rectifier	5Y3GT
V102	TUBE, electron: OA2, miniature 7 pin.	Voltage Regulator	OA2
W101	CORDSET, power: consists of molded non-polarized male plug, and six foot 18/2 SJ rubber covered cord, opposite ends stripped.	Main Power Cord	CA-102-2
W101 A,B	CABLE, bulk CONNECTOR, plug electrical.		
XC102	SOCKET, tube: octal.	C102 Socket	TS-101P01
XF101	HOLDER, fuse: extractor post type for single AGC type fuse.	F101 Holder	FH-100-2
XF102	HOLDER, fuse: extractor post type for single AGC type fuse. Same as XF101.	F102 Holder	FH-100-2
XF103	HOLDER, fuse: extractor post type for single AGC type fuse. Same as XF101.	F103 Holder	FH-100-2
XI101	LIGHT, indicator: w/red frosted lens, for miniature bayonet base T-3-1/4 bulb.	I101 Socket	TS-106-1
XI101 A	LENS, frosted red lens.		
XR102	SOCKET, tube: 9 pin miniature.	R102 Socket	TS103P01
XV101	SOCKET, tube: octal. Same as XC102	V101 Socket	TS101P01
XV102	SOCKET, tube: 7 pin miniature.	V102 Socket	TS102P01
C201	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc.	Coil Coupling V201	CM20B102K
C202	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Plate Decoupling V201	CM20B102K
C203	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc.	Cathode Bypass V201	CM35B103K
C204	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201 .	Plate Coupling V201	CM20B102K
C205	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Screen Bypass V201	CM20B102K
C206	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Screen Bypass V202	CM20B102K
C207	CAPACITOR, variable: air dielectric; 10.3 to 200 mmfd; 27 plates.	Plate Tank Tuning V202	CB118MRD200
C208	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc. Same as C203.	Cathode Bypass V202	CM35B103K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C209	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc. Same as C203.	Tank Bypass	CM35B103K
C210	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Screen Bypass V203	CM20B102K
C211	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	100 Kcs Injection V203	CM20B102K
C212	CAPACITOR, fixed: mica; 5 mmfd, ±20%; 500 wvdc.	VMO Injection V203	CM20B050M
C213	CAPACITOR, fixed: mica; 5 mmfd, ±20%; 500 wvdc. Same as C212.	External RF Coupling	CM20B050M
C214	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Low Pass Filter V103	CM20B102K
C215	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Low Pass Filter V103	CM20B102K
C216	CAPACITOR, fixed: paper; .1 mfd, +40 -10%; 400 wvdc; plastic tubular case.	Grid Coupling V204A	CN-100-4
C217	CAPACITOR, fixed: paper; .1 mfd, +40 -10%; 400 wvdc; plastic tubular case. Same as C216.	Grid Coupling V204B	CN-100-4
C218	CAPACITOR, fixed: paper; .1 mfd, +40 -10%; 400 wvdc; plastic tubular case. Same as C216.	Output Coupling V204B	CN-100-4
C219	CAPACITOR, variable: ceramic; 7-45 mmfd; 500 wvdc.	Tank Trimmer V202	CV11C450
I201	LAMP, neon: 105-125 v; bulb T-3-1/4 clear; 1/25 watt; 1-13/16" overall; miniature bayonet base.	Tuning Indicator	BI-100-51
I202	LAMP, neon: 105-125 v; bulb T-3-1/4 clear; 1/25 watt; 1-13/16" overall; miniature bayonet base. Same as I201.	Zero Beat Indicator	BI-100-51
J201	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	External RF Jack	UG-625/U
J202	CONNECTOR, coaxial: female contact; BNC type, single hole mounted. Same as J201.	VMO Input	UG-625/U
J203	CONNECTOR, coaxial: female contact; BNC type, single hole mounted. Same as J201.	PMO Output	UG-625/U
J204	JACK, open circuit.	Phone Jack	JJ034
L201	CHOKE, RF: 750 microhenries, ±20%.	Plate Decoupling V201	CL-100-5
L202	CHOKE, RF: 750 microhenries, ±20%. Same as L201.	Plate Load V201	CL-100-5

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
L203	INDUCTOR, variable: slug tuned 26-44 microhenries.	Plate Tank 2-4 Mcs.	A-245
L204	CHOKE, RF: 750 microhenries, ±20%. Same as L201.	Plate Decoupling V202	CL-100-5
L205	INDUCTOR, variable: slug tuned 7.4-13 microhenries.	Plate Tank 4-8 Mcs.	A-246
R201	RESISTOR, fixed: composition; 4700 ohms, ±10%; 1/2 watt.	Grid Leak V201	RC20GF472K
R202	RESISTOR, fixed: composition; 150 ohms, ±10%; 1/2 watt.	Cathode Bias V201	RC20GF151K
R203	RESISTOR, fixed: composition; 56,000 ohms, ±10%; 1/2 watt.	Screen Drop V201	RC20GF563K
R204	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Grid Leak V202	RC20GF104K
R205	RESISTOR, fixed: composition; 5600 ohms, ±10%; 1 watt.	Screen Drop V202	RC30GF562K
R206	RESISTOR, fixed: composition; 470 ohms, ±10%; 1 watt.	Cathode Bias V202	RC30GF471K
R207	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. Same as R204.	Screen Drop V203	RC20GF104K
R208	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. Same as R204.	Grid Leak V203	RC20GF104K
R209	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	Plate Load V203	RC20GF105K
R210	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. Same as R204.	Grid Leak V203	RC20GF104K
R211	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. Same as R204.	LP Filter V203	RC20GF104K
R212	RESISTOR, fixed: composition; 4.7 megohms, ±10%; 1/2 watt.	Grid Leak V204A	RC20GF475K
R213	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt.	Plate Load V204A	RC20GF224K
R214	RESISTOR, fixed: composition; 56,000 ohms, ±10%; 1/2 watt. Same as R203.	Plate Decoupling V204A	RC20GF563K
R215	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt. Same as R213.	Grid Leak V204B	RC20GF224K
R216	RESISTOR, fixed: composition; 82,000 ohms, ±10%; 2 watts.	Plate Load V204B	RC42GF823K
R217	RESISTOR, fixed: composition; 10,000 ohms, ±10%; 1/2 watt.	Output Load V204B	RC20GF103K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R218	RESISTOR, variable: wire wound; 100,000 ohms, ±10%; 4 watts.	Output Control	RA107TRD104A
S201	SWITCH, rotary: single sect; 2 pole, 2 pos; mycalex insulation.	Band Switch	SW-150
V201	TUBE, electron: 6AH6, min. 7 pin.	RF Amplifier	6AH6
V202	TUBE, electron: 6AQ5, miniature 7 pin beam power amplifier.	RF Amplifier	6AQ5
V203	TUBE, electron: 6BE6, miniature 7 pin.	Mixer	6BE6
V204	TUBE, electron: 12AU7, miniature 9 pin.	Audio Amplifier	12AU7
XI201	LIGHT, indicator: w/clear white lens, for miniature bayonet base T-3-1/4 bulb.	I201 Socket	TS-106-2
XI201A	LENS, clear white lens.		
XI202	LIGHT, indicator: w/clear white lens, for miniature bayonet base T-3-1/4 bulb. Same as XI201.	I202 Socket	TS-106-2
XI202A	LENS, clear white lens. Same as XI201A.		
XV201	SOCKET, tube: 7 pin miniature. Same as XV102.	V201 Socket	TS102P01
XV202	SOCKET, tube: 7 pin miniature. Same as XV102.	V202 Socket	TS102P01
XV203	SOCKET, tube: 7 pin miniature. Same as XV102.	V203 Socket	TS102P01
XV204	SOCKET, tube: 9 pin miniature. Same as XR102.	V204 Socket	TS103P01
C301	CAPACITOR ASSEMBLY: variable; air dielectric; 21.0 to 220 mmfd.	VMO Tuning	A-1000
C302	CAPACITOR, variable: air dielectric; 5.0 to 25.0 mmfd, ±5%.	VMO Correction	CB-105
C303	CAPACITOR, variable: air dielectric; 2.8 to 11.0 mmfd, ±5%.	VMO Trimmer	CB-121
C304	CAPACITOR, fixed: ceramic; 10 mmfd, ±.25 mmfd, 500 wvdc.	VMO Padder	CC107RG100C
C305	CAPACITOR, fixed: mica; 270 mmfd, ±5%, 500 wvdc.	VMO Grid Coupling	CC45LG271J
C306	CAPACITOR, fixed: mica; 270 mmfd, ±5%, 500 wvdc. Same as C305.	VMO Cathode Coupling	CC45LG271J
C307	CAPACITOR, fixed: mica; .01 mfd, ±5%; 300 wvdc.	Plate Coupling V301	CM35C103J
C308	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc. Same as C203.	Cathode Follower Plate Bypass	CM35B103K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
C309	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; 500 wvdc. Same as C201.	Plate Coupling 100 Kc Osc.	CM20B102K
C310	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc. Same as C203.	VMO Keying Bypass V301	CM35B103K
C311	CAPACITOR, variable: air dielectric; 3.5 to 50 mmfd.	100 Kcs. Adjust	CT-103-1
C312	CAPACITOR, fixed: mica; 240 mmfd, ±5%; 500 wvdc.	Plate Coupling 100 Kcs.	CM20C241J
C313	CAPACITOR, fixed: mica, .01 mfd, ±10%, 500 wvdc. Same as C203.	Inner Oven Thermostat Arc Suppressor	CM35B103K
C314	CAPACITOR, fixed: mica; .01 mfd, ±10%; 500 wvdc. Same as C203.	Relay Arc Suppressor	CM35B103K
C315	CAPACITOR, fixed: paper; .1 mfd, +40, -10%; 400 wvdc, plastic tubular case. Same as C216.	Outer Oven Thermostat Arc Suppressor	CN-100-4
C316	Not Used.		
C317	Not Used.		
C318	Not Used.		
C319	CAPACITOR, fixed: ceramic; 8.2 mmfd, 5%, 500 wvdc.	VMO Temperature Compensation	CC-102-5
E301	BOARD, terminal: barrier type; eight 6-32 x 1/4'' binding head machine screws.	Inner Oven Terminal	TM-102-8
E302	BOARD, terminal: barrier type; eight 6-32 x 1/4'' binding head machine screws. Same as E301.	Outer Oven Terminal	TM-102-8
E303	BOARD, terminal: barrier type; ten 6-32 x 1/4'' binding head machine screws.	Oven-PS Interconnect	TM-102-10
E304	BOARD, terminal: barrier type; two 6-32 x 1/4'' binding head machine screws.	Keying Terminal	TM-100-2
I301	LAMP, neon: 105-125 v; bulb T-3-1/4 clear; 1/25 watt; 1-13/16'' lg overall; miniature bayonet base. Same as I201	Inner Oven Indicator	BI-100-51
I302	LAMP, neon: 105-125 v; bulb T-3-1/4 clear; 1/25 watt; 1-13/16'' lg overall; miniature bayonet base. Same as I201.	Outer Oven Indicator	BI-100-51
J301	JACK, closed circuit.	Keying Jack	JJ-089
K301	RELAY, sensitive: 4500 ohms, DC resistor.	Inner Oven Control Relay	A-123

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
L301	INDUCTOR, variable: 27.5-28 microhenries.	VMO Tank	A-243
L302	CHOKE, RF: 1 millihenry, 50 ma.	VMO Cathode Choke	CL-101-2
L303	CHOKE, RF: 750 microhenries, ±20%. Same as L201.	Plate Decoupling V302A	CL-100-5
P301	CONNECTOR, male contact; polarized; six contact.	Oscillator PS Interconnect	PL-101-1
P302	CONNECTOR, coaxial: male contact; BNC type, for RG-58/U cable.	VMO Output	UG-88/U
R301	RESISTOR, fixed: composition; 3900 ohms, ±10%; 1 watt.	Plate Decoupling V301	RC30GF392K
R302	RESISTOR, fixed: composition; 1,000 ohms, ±10%; 1 watt.	Cathode Output V302A	RC30GF102K
R303	Not Used.		
R304	RESISTOR, fixed: composition; 47,000 ohms, ±10%; 1/2 watt.	Plate Load V302B	RC20GF473K
R305	RESISTOR, fixed: composition; 4700 ohms, ±10%; 1/2 watt. Same as R201.	Cathode Output V302B	RC20GF472K
R306	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Grid Leak V302B	RC20GF474K
R307 A,B	RESISTOR, fixed: wire wound; heater element, two sections, 1300 ohms ea. section, insulated.	Inner Oven Heaters	RR-105
R308 A,B	RESISTOR, fixed: wire wound; heater element, two sections, 160 ohms ea. section, insulated.	Outer Oven Heaters	RR-106
R309	RESISTOR, fixed: composition; 9100 ohms, ±5%; 2 watts.	Relay Drop 220 volt oper.	RC42GF912J
R310	RESISTOR, fixed: composition; 9100 ohms, ±5%; 2 watts. Same as R309.	Relay Drop 220 Volt Oper.	RC42GF912J
R311	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Inner Thermostat Arc Suppressor	RC20GF101K
R312	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt. Same as R213.	Inner Oven Indicator Protector	RC20GF224K
R313	RESISTOR, fixed: composition; 220,000 ohms, ±10%; 1/2 watt. Same as R213.	Outer Oven Indicator Protector	RC20GF224K
R314	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt. Same as R311	Outer Oven Thermostat Arc Suppressor	RC20GF101K
R315	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt. Same as R311.	Relay Arc Suppressor	RC20GF101K

SYM.	DESCRIPTION	FUNCTION	TMC PART NO.
R316	RESISTOR, fixed: composition; 56,000 ohms, ±10%; 1/2 watt. Same as R203.	Relay Bleeder	RC20GF563K
R317	Not Used.		
R318	Not Used.		
R319	Not Used.		
R320	RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1/2 watt.	VMO Grid Leak	RC20GF223K
S301	SWITCH, thermostatic: bimetallic; operate at 70° C, ±0.5° C.	Inner Oven Thermostat	SS-103-C-70
S302	SWITCH, thermostatic: bimetallic; operate 80° C, ±2° C.	Inner Oven Safety Thermostat	SS-100-3
S303	SWITCH, thermostatic: bimetallic; operate at 60° C, ±2° C.	Outer Oven Thermostat	SS-100-1
V301	TUBE, electron: 6C4; miniature 7 pin.	VMO	6C4
V302	TUBE, electron: 12AU7; miniature 9 pin. Same as V204.	Cathode Follower 100 Kcs. Osc.	12AU7
XI301	LIGHT, indicator: w/clear white lens, for miniature bayonet base T-3-1/4 bulb. Same as XI201.	I301 Socket	TS-106-2
XI301 A	LENS, clear white lens. Same as XI201A.		
XI302	LIGHT, indicator: w/clear white lens, for miniature bayonet base T-3-1/4 bulb. Same as XI201.	I302 Socket	TS-106-2
XI302 A	LENS, clear white lens. Same as XI201A.		
XK301	SOCKET, tube: octal. Same as XC102.	K301 Socket	TS101P01
XV301	SOCKET, tube: 7 pin miniature. Same as XV102.	V301 Socket	TS102P01
XV302	SOCKET, tube: 9 pin miniature. Same as XR102.	V302 Socket	TS103P01
XY301	SOCKET, crystal: 487'' spacing, for .095'' pins.	Y301 Socket	TS105-1
Y301	CRYSTAL UNIT: quartz; 100 Kcs.	100 Kcs. Crystal	CR-100-1

2. TUBE VOLTAGE DATA

Model PMO in CALIBRATE Operation
Bandswitch 2-4 Mcs, tuned for Maximum Brilliance on "TUNING INDICATOR".

TUBE NO	TUBE TYPE	FUNCTION	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V203	6BE6	MIXER	-11 7 RF	GND	6.3 AC	GND	+40	+40	-.2 .75 RF	—	—
V204	12AU7	AUDIO AMPLIFIER	+25	-.8	GND	6.3 AC	6.3 AC	+45	-1.5	GND	GND
V301	6C4	MASTER OSCILLATOR	+120	NC	6.3 AC	GND	+120	-3.3 4.1 RF	+.13 1.4 RF	—	—
V302	12AU7	CATHODE FOLLOWER & XTAL OSCILLATOR	+150	+.2 3 RF	+5.2 1.4 RF	6.3 AC	6.3 AC	+75 17.5 RF	-12 18 RF	+7 8.2 RF	GND

Model PMO in EXCITER Operation
Amplifier Plate Switch - ON
Output Control - Maximum

TUBE NO	TUBE TYPE	FUNCTION	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V101	5Y3	RECTIFIER	NC	+320	—	310 AC	—	310 AC	—	+320	—
V102	0A2	VOLTAGE REGULATOR	+150	GND	NC	GND	+150	NC	GND	—	—
V201	6AH6	RF AMPLIFIER	-.5 1.4 RF	GND	6.3 AC	GND	+255 32 RF	+145	+1.7	— —	— —
V202	6AQ5	POWER AMPLIFIER	-28 32 RF	+5	6.3 AC	GND	+255 180 RF	+230	-28 32 RF	— —	— —

References, both charts:
NC: No connection
Line Voltage: 110 volts, 60 cps
Master Oscillator Frequency: 2.022 Mcs (Approx)
Termination: 72 ohms, 10 watt; non-inductive at J203
Readings: H-P 610B or equivalent.
Voltages: All readings are DC to Gnd, except where indicated RF or AC.

Figure 5-1. Voltage Data Chart

STOCK NUMBER CROSS REFERENCE

OSCILLATOR, RADIO FREQUENCY 0-459/URT FSN-F5840-699-9753

FEDERAL	REF. DESIG.
G5395-280-2374	W101B
G5920-010-6652	F101,102
G6145-191-3588	W101A
G6240-057-2887	I101
G6240-223-9100	I201, 202, 301, 302
N4540-142-2612	R308A, B
N4540-142-2614	R307A, B
N5905-642-4393	R218
N5905-643-9460	R102
N5910-112-8248	C219
N5910-509-9969	C301
N5910-668-6587	C311
N5910-668-6595	C303
N5910-668-6659	C319
N5910-668-6675	C304
N5910-699-9867	C302
N5930-509-9944	S201
N5930-513-6073	S303
N5930-513-6074	S302
N5930-513-6075	S301
N5930-695-6911	S103
N5945-259-1370	K301
N5950-509-9854	L301
N5950-509-9861	L201, 202, 204, 303
N5950-513-6508	L203
N5950-695-7153	L205
N5955-511-0414	Y301

STANDARD NAVY	REF. DESIG.
N16-C017804-4171	C305, 306
N16-C021837-9845	C102
N16-C025107-8756	C212, 213
*N16-C029449-8806	C312
N16-C031090-2513	C201, 202, 204, 205, 206, 210, 211, 214, 215, 309
N16-C032725-8038	C103, 104
N16-C033617-4746	C307
*N16-C033617-4758	C203, 208, 209, 308, 310, 313, 314,
*N16-C045773-8071	C216, 217, 218, 315
*N16-C049197-3878	C101
N16-C061474-2373	C207
N16-C064133-6581	C219
N16-C071408-5333	P302
N16-C071581-1110	L302
N16-R029318-5633	L101
N16-R049580-0766	R311, 314, 315
N16-R049625-0818	R202
N16-R049770-0233	R206
*N16-R049921-0349	R302
*N16-R050092-0717	R301
N16-R050129-0815	R201, 305
N16-R050166-0238	R205
*N16-R050264-0131	R309, 310
*N16-R050281-0438	R217
N16-R050372-0833	R320
N16-R050479-0440	R304
N16-R050516-0818	R203, 214, 316
*N16-R050588-0131	R216
N16-R050633-0785	R204, 207, 208, 210, 211
N16-R050714-0818	R213, 215, 312, 313
N16-R050822-0761	R306
N16-R050975-0725	R209
N16-R051173-0818	R212
*N16-R066251-1061	R101
N16-S054548-7001	XY301
N16-S062603-6702	XV102,201, 202,203, 301
N16-S063515-4151	XC102, XK301, XV101
N16-S064063-6713	XR102, XV204,302
*N16-T052001-0003	V102
*N16-T055735-0000	V101
N16-T056185-0000	V201
*N16-T056214-0055	V301
N16-T058241-0000	V204, 302
*N16-T075750-0000	V203
*N16-T076005-0000	V202
N17-C071515-8115	P301
N17-C073108-7477	J201, 202, 203
N17-C073224-1604	J101
N17-F016302-0040	F103
N17-F074266-9392	XF101,102, 103
N17-J039248-4418	J204
N17-J039253-3043	J301
*N17-L076854-4141	XI101
N17-L250856-0626	XI201A, 202A, 301A, 302A
N17-S070777-8626	S102
N17-S073082-9028	S101
N17-T073895-2592	T101
**	W101
#	E301, 302
#	E303
#	E304
#	XI201, 202, 301, 302

* Indicates: "For replacement use SNSN- "
** Indicates: "Assemble from component parts"
# Indicates: "Low failure item. If required requisition from ESO referencing NAVSHIPS 900, 180A."

STOCK NUMBER IDENTIFICATION

OSCILLATOR, RADIO FREQUENCY 0-459/URT FSN-F5840-699-9753

REF. DESIGN.	STOCK NUMBERS			
	FEDERAL	STANDARD NAVY	SIGNAL CORPS	USAF
C101		*N16-C049197-3878		
C102		N16-C021837-9845		
C103,104		N16-C032725-8038		
F101,102	G5920-010-6652			8870-112000822
F103		N17-F016302-0040		
I101	G6240-057-2887			8870-938000445
J101		N17-C073224-1604		
L101		N16-R029318-5633		3340-062454170
R101		*N16-R066251-1061		
R102	N5905-643-9460			
S101		N17-S073082-9028		3360-395853000
S102		N17-S070777-8626		3360-395852800
S103	N5903-695-6911			
T101		N17-T073895-2592		
V101		*N16-T055735-0000		3370-3040005265
V102		*N16-T052001-0003		3370-3310001615
W101		**		
W101A	G6145-191-3588			
W101B	G5395-280-2374			
XC102, XK301, XV101		N16-S063515-4151		8850-889946
XF101,102, 103		N17-F074266-9392		8870-556000555
XI101		*N17-L076854-4141		7700-548615
XR102, XV204, XV302		N16-S064063-6713		8850-896590
XV102,201, 202,203, 301		N16-S062603-6702		8850-882880
C201,202, 204,205, 206,210, 211,214, 215,309		N16-C031090-2513		
C203,208, 209,308, 310,313, 314		*N16-C033617-4758		
C207		N16-C061474-2373		
C212,213		N16-C025107-8756		
C216,217, 218,315		*N16-C045773-8071		3330-056200857
C219	N5910-112-8248	N16-C064133-6581		
I201,202, 301,302	G6240-223-9100			8870-696000725
J201,202, 203		N17-C073108-7477		3330-490135

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** Indicates: "Assemble from component parts"
*** Indicates: "Low failure item. If required requisition from ESO referencing NAVSHIPS 900, 180A."

REF. DESIGN.	STOCK NUMBERS			
	FEDERAL	STANDARD NAVY	SIGNAL CORPS	USAF
J204		N17-J039248-4418		8850-749430
L201,202, 204,303	N5950-509-9861			3340-060716760
L203	N5950-513-6508			3340-064152340
L205	N5950-695-7153			3340-064152350
R201,305		N16-R050129-0815		3350-1030003981
R202		N16-R049625-0818		
R203,214, 316		N16-R050516-0818		3350-1030005616
R204,207, 208,210, 211		N16-R050633-0785		3350-1030005866
R205		N16-R050166-0238		
R206		N16-R049770-0233		
R209		N16-R050975-0725		
R212		N16-R051173-0818		
R213,215, 312,313		N16-R050714-0818		3350-0980005771
R216		*N16-R050588-0131		
R217		*N16-R050281-0438		
R218	N5905-642-4393			
S201	N5930-509-9944			
V201		N16-T056185-0000		
V202		*N16-T076005-0000		3370-2980006155
V203		*N16-T075750-0000		3370-7830006255
V204,302		N16-T058241-0000		3370-3160001375
XI201,202, 301,302		***		
XI201A, 202A,301A, 302A		N17-L250856-0626		7700-53506624
C301	N5910-509-9969			3330-058100221
C302	N5910-699-9867			3330-058700154
C303	N5910-668-6595			
C304	N5910-668-6675			
C305,306		N16-C017804-4171		
C307		N16-C033617-4746		3330-376144110
C311	N5910-668-6587			3330-058100059
C312		*N16-C029449-8806		3330-376018800
C319	N5910-668-6659			
E301,302		***		8880-5008213265
E303		***		
E304		***		
J301		N17-J039253-3043		
K301	N5945-259-1370			3330-5520506415
L301	N5950-509-9854			3340-060716930
L302		N16-C071581-1110		3340-060081770
P301		N17-C071515-8115		
P302		N16-C071408-5333		8850-468450
R301		*N16-R050092-0717		
R302		*N16-R049921-0349		
R304		N16-R050479-0440		3350-1030005461
R306		N16-R050822-0761		3350-1030007416
R307A,B	N4540-142-2614			1760-047563010

* Indicates: "For replacement use SNSN- "
** Indicates: "Assemble from component parts"
*** Indicates: "Low failure item. If required requisition from ESO referencing NAVSHIPS 900, 180A."

REF. DESIG.	STOCK NUMBERS			
	FEDERAL	STANDARD NAVY	SIGNAL CORPS	USAF
R308A,B	N4540-142-2612			1760-047563020
R309,310		*N16-R050264-0131		3350-1460004357
R311,314, 315		N16-R049580-0766		
R320		N16-R050372-0833		3350-1030004941
S301	N5930-513-6075			
S302	N5930-513-6074			3360-033943625
S303	N5930-513-6073			3360-073943626
V301		*N16-T056214-0055		
XY301		N16-S054548-7001		8850-866284
Y301	N5955 511-0414			2100-2X910100

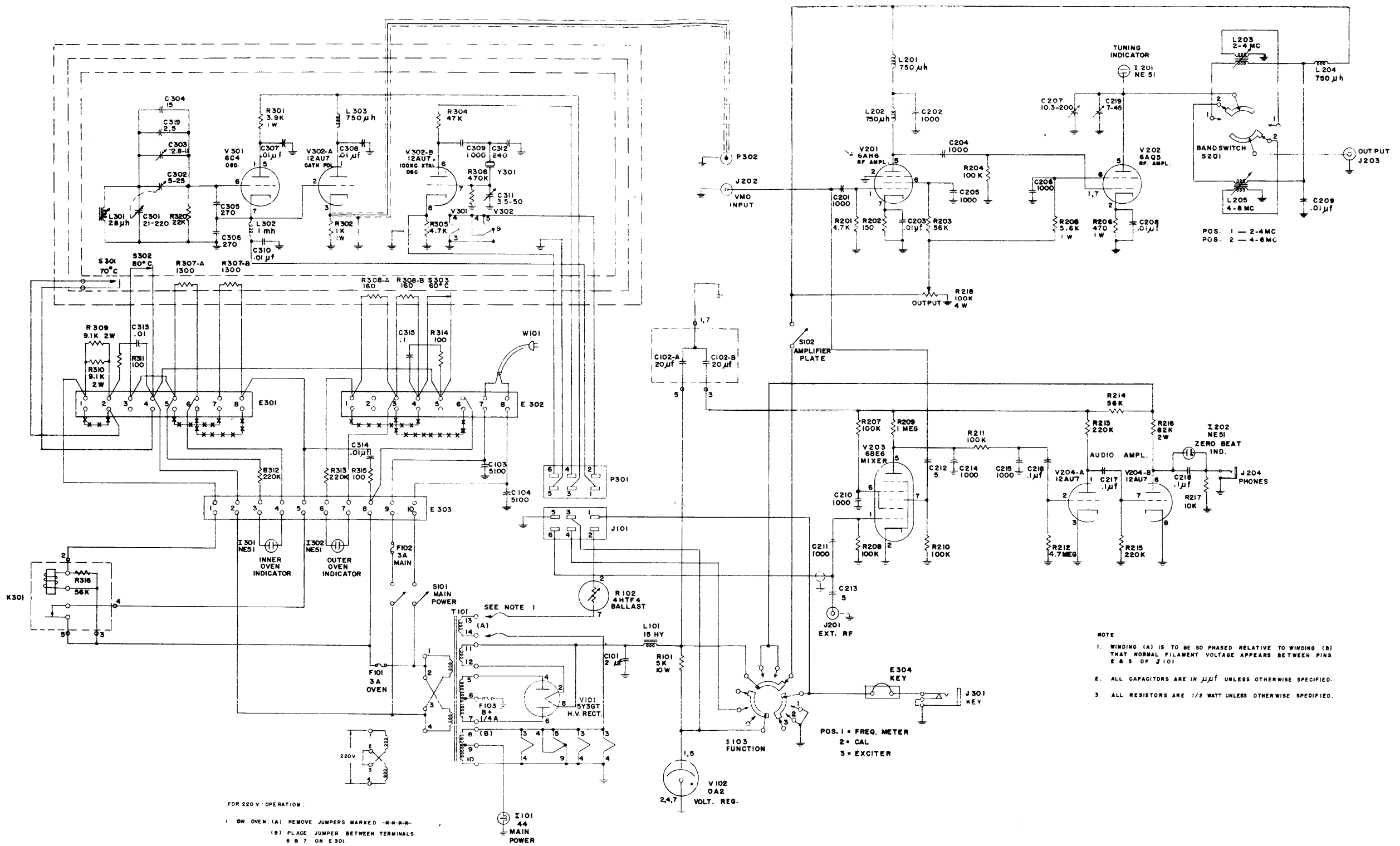
* Indicates: "For replacement use SNSN- "
** Indicates: "Assemble from component parts"
*** Indicates: "Low failure item. If required requisition from ESO referencing NAVSHIPS 900, 180A."

One V7A
V302 = 6AB4
V303 = 12AU7

V-202 = 0A2
V204 = 12AT7
V205 = 6146

V201 = 6CL6
V204 = 6BF5

V-202 = 12AT7



FOR 220 V. OPERATION:

1. ON OVEN: (A) REMOVE JUMPERS MARKED ~~- - - -~~
(B) PLACE JUMPER BETWEEN TERMINALS 6 & 7 ON E 301.
(C) PLACE JUMPER BETWEEN TERMINALS 1 & 6 ON E 302.

2. REWIRE T 101 AS SHOWN.

NOTE

1. WINDING (A) IS TO BE SO PHASED RELATIVE TO WINDING (B) THAT NORMAL FILAMENT VOLTAGE APPEARS BETWEEN PINS 2 & 5 OF J 101
2. ALL CAPACITORS ARE IN µµf UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.

CK-254 E

Schematic Diagram, Model PMO

L 214 . 23 1/4 T - 1" dia = 14 Gm
Spac. 2/wire dia