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VOX-3

INSTRUCTION BOOK

*for*

VARIABLE FREQUENCY  
OSCILLATOR

MODEL VOX SERIES 2

OSCILLATOR  
RADIO FREQUENCY  
0-330/FR

THE TECHNICAL MATERIEL CORP.

Mamaroneck, N. Y.

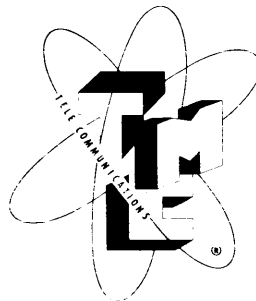
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Series 2



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Mamaroneck, N. Y.

Ottawa, Ontario

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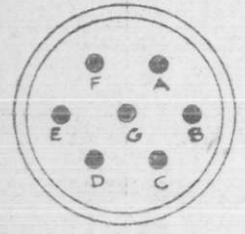
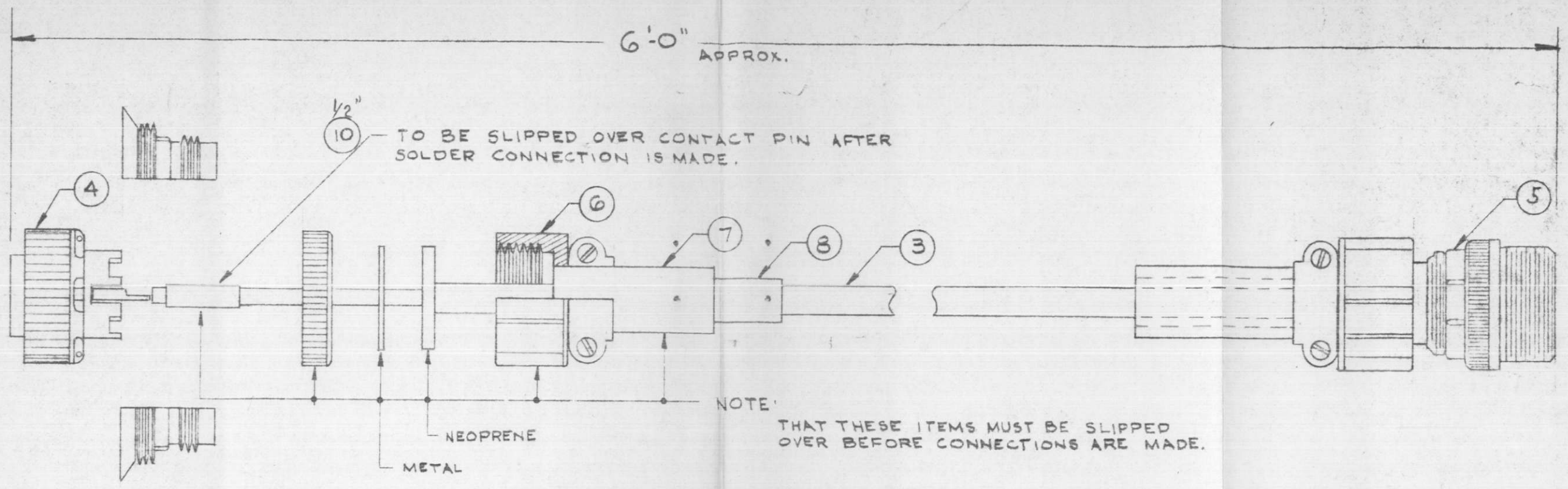
THE TECHNICAL MATERIEL CORP.

Mamaroneck, New York

LATEST CHANGES IN EQUIPMENT

1. Substitute Drawing CK-284, Issue D for Issue C.
2. P301 and J101 on CK-284, Issue D, are amphenol connectors. Drawing CA-502 is the service cable that joins these terminals under servicing cable arrangements (see page 4-1 of instruction book.)

P301 and J101 on CK-284, Issue C, are Jones plug and jacks. Drawing CA-110 is the service cable that joins these terminals under servicing cable arrangements (see page 4-1 of instruction book.)



THIS RING MUST BE IN POSITION SHOWN BEFORE CONNECTIONS ARE MADE.

WIRING CHART		
ITEM 4 PIN #S	COLOR	ITEM 5 PIN #S
A	BLUE (ITEM 1)	A
B	BLACK "	B
C	ORANGE "	C
D	RED "	D
E	GRN. OF ITEM #1; SHIELD ITEM #2	E
F	WHITE OF ITEM 2	F

NOTE:  
WHITE OF ITEM 1 NOT USED.  
(CUT ENDS OFF AT CABLE BREAKOUT)

X	11	BS-100	SOLDER, SOFT
6"	10	PX-100-1-.106	INSULATION, SLEEVING
16"	9	PX-100-1-.208	INSULATION, SLEEVING
2	8	MS-3420-6A	SLEEVING
2	7	MS-3420-8A	"
2	6	MS-3057-B	CLAMP, CABLE
1	5	MS-3101B-16S-1S	CONNECTOR, RECEPTACLE
1	4	MS-3106B-16S-1P	CONNECTOR, PLUG
6'0"	3	PX-100-1-.294	INSULATION, SLEEVING
6'0"	2	WI-101-1	CABLE, 1 CONDUCTOR
6'0"	1	WI-100-5	CABLE, 6 CONDUCTOR

6	ITEM 10 WAS 1/2" PX-100-1-.106						
5	ITEM 8 WAS MS-13420-6A 1REQ						
4	ITEM 7 WAS MS-13420-8A 1REQ						
3	ITEM 6 WAS MS-13057-B 1REQ						
2	ITEM 5 WAS MS-3106B-16S-1S						
1	PICTORIAL OF ITEM 5 CORRECTED						
ISSUE	ITEM	CHANGED FROM	DATE	CH. NO.	DRAFTS	CHECKER	ENG. APP.
			1-28-60	1812			
TOLERANCES		SCALE:					
DEC. DIM. ±	MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND ANY DEVIATIONS WILL BE CAUSE FOR REJECTION.						
FRAC. DIM. ±	REMOVE ALL BURRS AND SHARP EDGES						
ANGULAR DIM. ±							

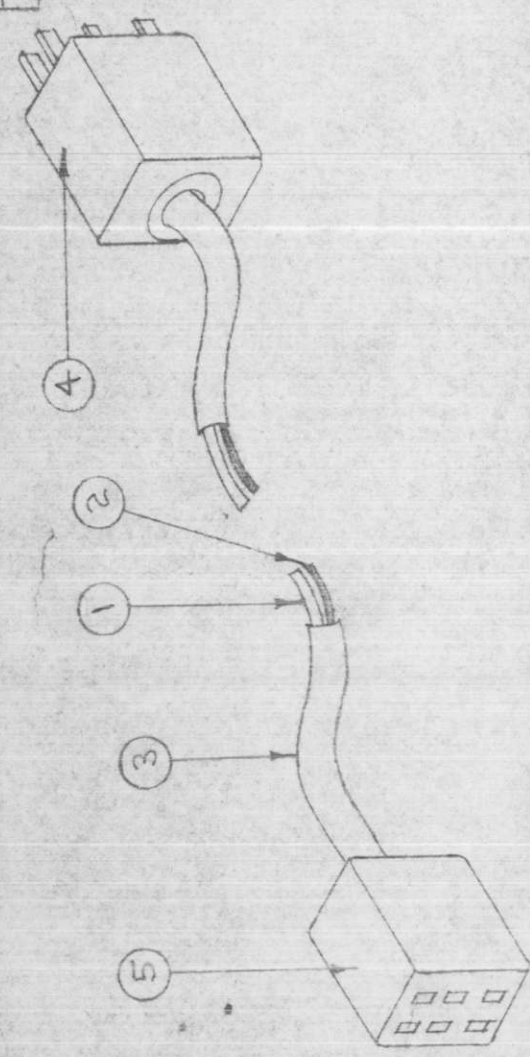
1	VOX-4			
1	VOX-3			
REQ. PER UNIT	MODEL	PROJECT NO.	ASS'Y. NO.	DATE
				11-16-59
USED ON				

REQ.	ITEM	PART NO.	DESCRIPTION	SYMBOL
THE TECHNICAL MATERIEL CORP. MAMARONECK, NEW YORK.				
CABLE, AUX. SEVICE POWER SUP. TO MASTER OSC.				
TYPE & TEMPER		HEAT TREAT. SPEC.	DRAWN	CHECKED
FINISH & SPEC. NO.		ELEC. DES. APP.	MECH. DES. APP.	

CA-502 A

IF IT IS FOUND DESIRABLE TO CHANGE ANY TOLERANCE OR OTHER DETAIL SPECIFIED ON THIS DRAWING NOTIFY THE PURCHASER PROMPTLY.

MAXIMUM ALLOWABLE TOLERANCES HAVE BEEN DETERMINED AND DEVIATIONS WILL BE CAUSE FOR REJECTION. REMOVE ALL BURRS AND SHARP EDGES



CA-110

PER UNIT		USED ON		DATE
MODEL	PROJECT NO.	ASSY. NO.		
VOX	101			6-27-52
VOX-1				2-7-55
VOX-2				

ITEM 5	WIRING TABLE	ITEM 4
1	BLUE	1
2	BLACK	2
3	ORANGE	3
4	RED	4
5	GREEN & SHIELD OF ITEM 2	5
6	CENTER CONDUCTOR OF ITEM 2. DO NOT USE WHITE CONNECTOR OF ITEM 1, BUT CUT ENDS AT CABLE BREAKOUT.	6

1	REDRAWN - NO CHANGE	10/53	1	CDP	VG	PPH
ISSUE ITEM	CHANGED FROM	DATE	CN. NO.	DRAFTS	CHECKER	ENG. APP.
SCALE						
TOLERANCES						

DEC. DIM. ±  
 FRAC. DIM. ±  
 OTHERS ANGULAR DIM. ±

DRILL, PUNCH, COMMERCIAL STOCK SIZES AND MANUFACTURERS TOLERANCES ARE NOT INCLUDED.

REQ. ITEM	PART NO.	DESCRIPTION	SYMBOL
X 6	BS-100	SOLDER, SOFT	
1 5	PL-101-2	CONNECTOR, FEMALE	
1 4	PL-101-1	CONNECTOR, MALE	
6'-0" 3	PX-100-1.29A	INSULATION, SLEEVING	
6'-0" 2	WI-101-1	CABLE, 1 CONDUCTOR	
6'-0" 1	WI-100-5	CABLE, 6 CONDUCTOR	
THE TECHNICAL MATERIEL CORP. MAMARONECK. NEW YORK			
AUXILIARY SERVICE CABLE			
POWER SUPPLY TO MASTER OSC.			
DRAWN		ELEC. DES. APP.	MECH. DES. APP.
E.M.B. 6-27-52		ATT	PPH
CHECKED		FINAL APPROVAL	
V6 1-13-53		ATT	WJC
SUPERCEDES		CA-110	
AEM-003-A			

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## **MODEL VOX, SERIES 2**

In this series the following improvements have been incorporated:

- A. A new larger counter, TMC Part CY-104 showing the first four significant figures of the oscillator output.
- B. The Beat Frequency Oscillator (BFO) has been revised in circuitry to permit (a) the use of a wider range of crystal frequencies, i. e., 300 to 1,000 Kcs., and (b) permit the paralleling of many receiver BFO's from the single oscillator. A 6AQ5 type tube is now used in place of a 6C4.
- C. A visual Zero Beat Indicator has been added in the form of a flashing neon lamp to complement the aural indication also used.
- D. The IFO Crystal Unit Sym Y201, formerly with wire leads, is now plug-in type CR-18/U so that the user may select intermediate oscillator frequency.
- E. A phone jack has been added to the rear panel to permit monitoring of the check points from the rear of the equipment.

# NOTICE

The TMC VARIABLE FREQUENCY OSCILLATOR, MODEL VOX has been made available in two forms in this series, namely, with or without motor drive and associated components as follows:

VOX-1 WITH MOTOR

VOX-2 WITHOUT MOTOR

In the case of the Model VOX-2 the following parts are deleted:

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
B301	MOTOR ASSEMBLY, drive: consists of reversible motor, Part MO-100; 1/4" drive pulley, Part PM-194; drive belt, "O" ring type, Part RY-105; spring, Part SP-115.	VMO Drive	A-1005
C317	CAPACITOR, fixed: paper; .1 mfd, +20, -10%, 400 wvdc; plastic tubular case.	Motor Switch Arc Suppressor	CN-100-4
R316	RESISTOR, fixed: composition; 100 ohms, +10%, 1/2 watt.	Motor Switch Arc Suppressor	RC20GF101K
R322	RESISTOR, fixed: wire wound; 100 ohms, 55 watts.	Motor Series Res.	RW-115-101-55
R323	RESISTOR, fixed: wire wound; 100 ohms, 55 watts.	Motor Series Res.	RW-115-101-55
S304	SWITCH, lever action: two position, two form at each position, center off, momentary contact.	Motor Control	SW-103

# SECTION I GENERAL DESCRIPTION

## 1. PURPOSE AND BASIC PRINCIPLES

The Variable Frequency Oscillator, Model VOX is a precision, direct reading, variable frequency device, designed to provide high frequency and medium frequency oscillator injection voltage for the control of one or more receivers or transmitter exciters with extremely high stability.

The oscillator will provide the following:

- A. High frequency R. F. output voltage, continuously variable over the range of 2 to 64 megacycles.
- B. Crystal controlled high frequency voltage, over the range of 2 to 64 megacycles.

C. Crystal controlled BFO voltage 300 to 1,000 Kcs for dual conversion superheterodynes, such as the Hammarlund 600 series.

Sufficient output is available from any of the foregoing to control up to three receivers in diversity, or the usual requirement of transmitter exciters.

The VOX incorporates a highly-stable variable frequency oscillator, with an extremely accurate counter type dial. Master oscillator frequency determining elements are contained in a temperature stabilized oven, and these components are carefully selected for high-stability operation.



Figure 1-1. Variable Frequency Oscillator, Model VOX-1

In addition to the variable frequency feature, provision is made for up to three crystal controlled positions for high frequency injection. Additional crystal oscillators provide crystal controlled beat frequency oscillator voltage for use with receivers, and a 3.2 to 3.9 Mcs crystal controlled RF output for dual conversion receivers.

## 2. DESCRIPTION OF UNIT

The Variable Frequency Oscillator, Model VOX, is shown in Figure 1-1. The panel is 3/16 inches thick by 19 inches long and 10½ inches high, and is finished in TMC gray enamel. The chassis extends 16 inches behind the panel and is supported to the panel on each side by brackets. The controls most often used are located on the front panel, while seldom used controls and fuses are located behind an access door on the upper left-center of the panel. All vacuum tubes and relays are readily accessible from the rear of the Model VOX and are mounted in a vertical position.

The direct reading calibration of the unit enables the operator to set the output frequency to within 20 cycles per megacycle of any desired frequency within the range of the unit at any checkpoint, and the unit is resettable to the same tolerance. A self-contained 100 Kc. temperature controlled crystal provides 50 Kc. check points for calibration of the VFO. All units are isolated with buffer amplifiers, where necessary, to prevent interaction.

## 3. REFERENCE DATA

The Variable Frequency Oscillator, Model VOX, is composed of three simultaneously available sources of oscillator output, the characteristics of each one are as follows:

### A. HF OSCILLATOR

#### Frequency Range

2 to 64 megacycles continuous.

#### Output Impedance

75 ohms coaxial.

#### Output Level

2 watts throughout basic range of 2 to 4 megacycles and 0.5 watts 4 to 64 megacycles adjustable.

#### Output Connections

Three BNC RF Connectors.

#### Crystal Frequencies

2 to 4 megacycles for output frequencies of 2 to 64 megacycles.

#### Crystal Unit

CR-18/U

#### Crystal Position

3 each, available on front panel switch.

#### Output Voltage

Sinusoidal with no spurious frequencies.

#### Stability

20 cycles per megacycle for 0 to 50 degrees change in ambient temperature.

#### Calibration

Direct reading calibration in cycles per second from 2 to 4 megacycles.

#### Readability

20 cycles per megacycle.

#### Resettability

20 cycles per megacycle to a calibrated frequency.

#### Line Voltage Change Effects

10 cycles for plus/minus 10% change in Line Voltage.

#### Humidity Effects

No appreciable change for 50 to 95% humidity.

#### High Frequency Oscillator Calibration

Against 100 kc crystal oscillator at 50 Kc points.

## B. BEAT FREQUENCY OSCILLATOR

#### Frequency Range

300 to 1000 Kc

#### Output Level

6 volts across 1000 ohms with output level control.

#### Output connections

Three BNC RF Connectors.

#### Crystal Holders

CR-45/U

#### Crystal Position

2 each, available on rear panel switch.

## C. INTERMEDIATE FREQUENCY OSCILLATOR

#### Frequency Range

3.2 - 3.9 Mcs (crystal oscillator).

Output Level  
2 volts in 75 ohms.

Crystal Type  
CR-18/U

Output Connections  
Three BNC RF Connectors.

#### D. GENERAL

##### Controls

1. Primary Power Switch
2. HFO Plate Switch
3. BFO Plate Switch
4. IFO Plate Switch
5. Beat ON/OFF
6. Meter Switch
7. Multiplier Tuning Control
8. HFO Output Control
9. Band Switch
10. Crystal Padding Condenser
11. HFO Crystal Selector Switch
12. Calibrate Control
13. Master Oscillator Frequency Control
14. Motor Drive Switch
15. BFO Crystal Switch
16. BFO Output Control

##### Metering

1. HFO Output
2. BFO Output
3. VMO Output
4. VFO Output

Zero Beat Indicator  
Flashing neon at check points.

Primary Power: 110/220 volts, 50/60 cps  
Approximately 100 watts average or 250  
watts peak depending upon cycling of oven  
heating elements.

Dimensions 19" x 16" x 10 $\frac{1}{2}$ " high  
Weight 157 lbs Gross, packed for  
shipment.  
Mounting WE Relay Rack Mounting

#### 4. TUBE COMPLEMENT

All JAN type miniature or octal.

**TABLE 1-1 VACUUM TUBE COMPLEMENT**

SYMBOL	TYPE	CIRCUIT
V101	5V4G	High voltage rectifier
V102	OA2	Voltage regulator
V103	6BE6	Mixer
V104	12AU7	Audio Amplifier
V105	6AQ5	BFO
V201	12AU7	IFO and Amplifier
V202	6C4	Crystal HFO or RF amplifier
V203	6AQ5	R.F. Amplifier
V204	6AQ5	Multiplier
V205	6AQ5	Multiplier
V206	6AQ5	Multiplier
V207	6AQ5	Multiplier
V301	6AB4	VMO
V302	12AU7	Crystal oscillator and cathode follower

##### Components and Construction:

Equipment is manufactured in accordance with  
JAN specifications, wherever practicable.

We reserve the right to make changes in the  
design of our equipment consistent with good en-  
gineering practice in order to make improve-  
ments in design and to effect economies in man-  
ufacture.

## SECTION II

### THEORY OF OPERATION

#### 1. GENERAL DESCRIPTION OF CIRCUITS

##### A. THE HFO CHAIN:

In the following discussion reference to Figure 2-1, Block Diagram of the Variable Frequency Oscillator, will serve to show the path of the signal from input to output.

The master oscillator (V301) is a highly stable frequency determining device, due to its enclosure in a finely engineered double oven. As an added precaution, the resonant portion of the circuit is very lightly coupled to its associated vacuum tube element and this, in turn, is isolated from external influences by a cathode follower ( $\frac{1}{2}$  of V302).

The oven itself is composed of an inner and outer shell, each of which is a temperature con-

trolled 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 elements R309 and R310. The inner shell is a vernier, so to speak, on the outer shell. R307 and R308, the inner shell heating elements, are controlled by an accurate mercury 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.

The cathode follower output feeds a dual purpose triode, called the amplifier or crystal oscillator (V202). Depending upon where S201 is set, this stage may become a simple RC amplifier or a conventional oscillator having three crystal positions. The next stage (V203) is also

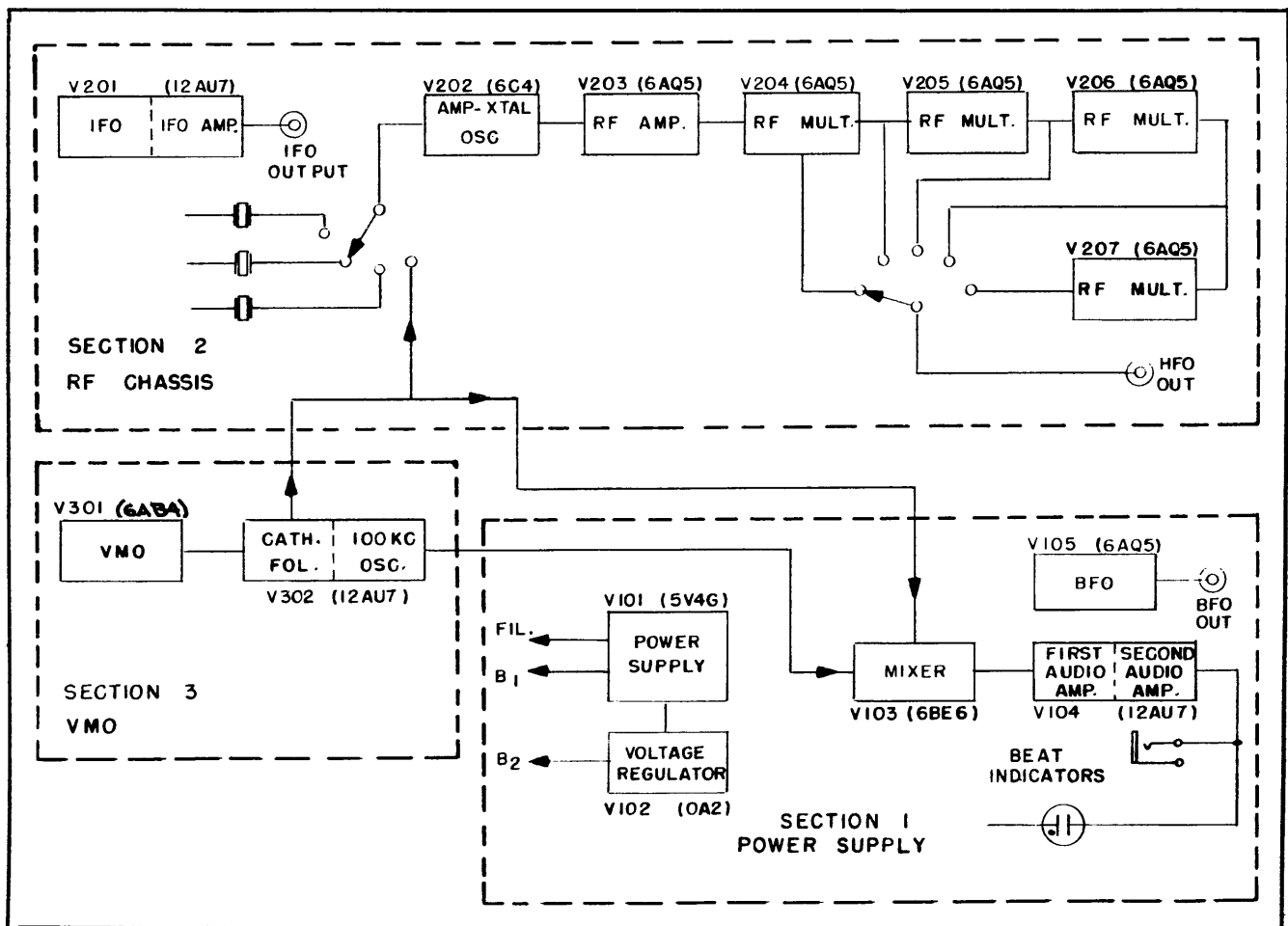


Figure 2-1. Block Diagram of the VFO, Model VOX

an RF amplifier of the RC type, but contains a peaking coil (L202) to make its gain virtually uniform over the entire 2-4 Mc range. A series of four multipliers (V204, V205, V206, V207) then multiply the fundamental 2-4 Mc frequency range continuously up to 64 Mc. All of these stages are gang-tuned and prealigned. The output is metered by means of a rectifying device (CR202) and its associated filter circuits.

#### B. THE IFO:

The IFO uses an oscillator circuit with a socket for a CR-18/U in range 3.2 to 3.9 Mcs. It is followed by a class C power amplifier whose tank is link-coupled to the output jacks. A germanium diode rectifier and its associated filter network produce a D.C. level proportional to the R.F. output voltage. This is fed to a front panel milliammeter, so that an output indication is available to the operator or technician. (Full scale deflection is approximately equivalent to 10 volts RMS of RF voltage.)

#### C. THE BFO:

This stage is also a crystal oscillator but has two crystal positions, either one of which may be chosen by means of a toggle switch. The output jacks are capacitively-coupled to the tank through an output control, which is metered in a manner similar to that discussed in part B, above. In this case, however, full scale deflection is equivalent to 20 volts RMS of R.F. voltage.

#### D. THE CALIBRATING CHAIN:

Contained within the oven enclosure is a highly stable 100 Kcs crystal oscillator, against which the master oscillator is calibrated. Both of these voltages are fed to the mixer (V103), where the difference-frequency between one of the 100 Kc harmonics and the master oscillator output is picked off. This result is obtained because of the presence of a low pass filter, connected between the mixer and first audio amplifier. The audio amplifiers (V104) provide sufficient gain to drive a head-set. These stages are designed for good low frequency response, so that a zero beat may be observed at the "zero beat" indicator on the front panel.

## 2. CIRCUIT ANALYSIS

An understanding of the circuit as a whole may be accomplished by stage by stage signal tracing. Constant reference to the schematic diagrams, is recommended to facilitate understanding of the functions of the individual components.

### A. THE HFO CHAIN

The master high frequency oscillating tube (V301) oscillates at frequencies between 2 & 4 megacycles and is tuned by condensers C301, C302 and C303. R320 provides the necessary tube bias; L302 is an RF choke to ground; R301 and C307 provide the necessary decoupling action, with the latter a low-impedance path for the A.C. Twin Triode V302 performs the double function as a cathode follower to impose less shunting effect on the preceding stage, and as a crystal-controlled 100 Kc oscillator. R302 is the unby-passed cathode resistor, across which the output is taken. R303 and C308 provide filtering action to keep the A.C. out of the power supply by bypassing it through C308 and offering as high a resistance in R303 as practicable for the B+ supply available. The output from the second part of V302 is taken across R305. R306 supplies the necessary grid bias. Crystal Y301 resonates near 100 Kc and may be pulled by means of adjuster capacitor C311, which is not to be disturbed after its initial setting. R304 is the plate load, and C309 is a coupling condenser.

The cathode follower output feeds triode V202, which is used either as an amplifier or as a crystal oscillator. The position of switch S201 is the controlling factor. When it is set on VMO, the tube is an RC amplifier; when set on 1, 2, or 3, the stage is a conventional oscillator having three crystal positions. Crystal Y202, Y203, and Y204 may be inserted into the circuit, according to the necessary operating conditions required. C210 is the crystal trimmer, and R207 provides the necessary grid bias. C243 is a blocking condenser to prevent any D.C. from entering the crystal. R208 is the load resistor, while C211 and R209 provide decoupling action. This stage is capacitively coupled by C212 to the grid of tetrode V203.

Tube V203 is also an RF amplifier, which features a peaking coil (L202), designed to produce uniform gain over the 2-4 Mc range. The output of this tube is controlled by the variable resistor R215, which changes the screen grid bias. R214 and R217 are dropping resistors to provide correct biasing voltage on the screen grids of V203 and also V204. C215 and C216 are A.C. by-pass capacitors, so as to prevent any component of the B+ power from entering the screen grid. R213 and C213 provide decoupling action, while R212 is the plate load resistor. R210 and R211 provide the necessary bias on the grid and cathode, respectively, while C214 is the conventional cathode by-pass to ground. C217 is the coupling capacitor between stages.

Tubes V204, V205, V206 and V207, used in conjunction with Band Switch S202, are voltage multipliers of the second harmonic of each preceding stage.

S202 is a four section, five position, rotary type switch. The "a" position of the switch controls the screen voltage bias on tubes V203 and V204. R216 and R233 are the dropping resistors involved. The "b" position of the switch, throws in either coil L203 or L205, to be used for the proper tank circuit, with variable tuning capacitor C225, the former for 2-4 Mc, and the latter for 4-8 Mc. The coils, L206, L207 and L208, are also used with the variable tuner capacitor C225, to produce outputs of 8-16 Mc, 16-32 Mc and 32-64 Mc, respectively.

The output in milliamperes is metered by the detector circuit, built around crystal CR202. This crystal rectifies the A.C. current; C238 is a coupling capacitor; capacitor C237 provides filtering action; resistor R232 acts as the load resistor of the crystal. C220, C221 and R220, are all de-coupling devices, while L204 is an RF choke to prevent the A.C. from flowing through the d.c. power lines. Position "c" adds more B+ voltage to each successive multiplier, whenever called for in use. The "d" position is the output selec-

tor. The HFO Band may be picked off from 2-4, 4-8, 16-32 and 32-64 Mcs, from positions marked A-F, respectively.

### B. THE IFO

The first half of triode V201 is a crystal oscillator circuit. The crystal is nominally at 3.5 Mcs, C202, C203, and R203 provide a low band pass filter, while C242 is the crystal coupling capacitor. The second half of the tube is a class C amplifier, whose tuned plate circuit is link-coupled to the output jacks. The tank circuit is tuned by L201 near a nominal frequency of 3.5 Mcs. Metering is accomplished in essentially the same manner as described in the HFO circuit above.

### C. THE BFO

Toggel Switch, S105, may throw either one of the two crystals, Y101 and Y102, into the oscillator circuit. The voltage output is controlled by

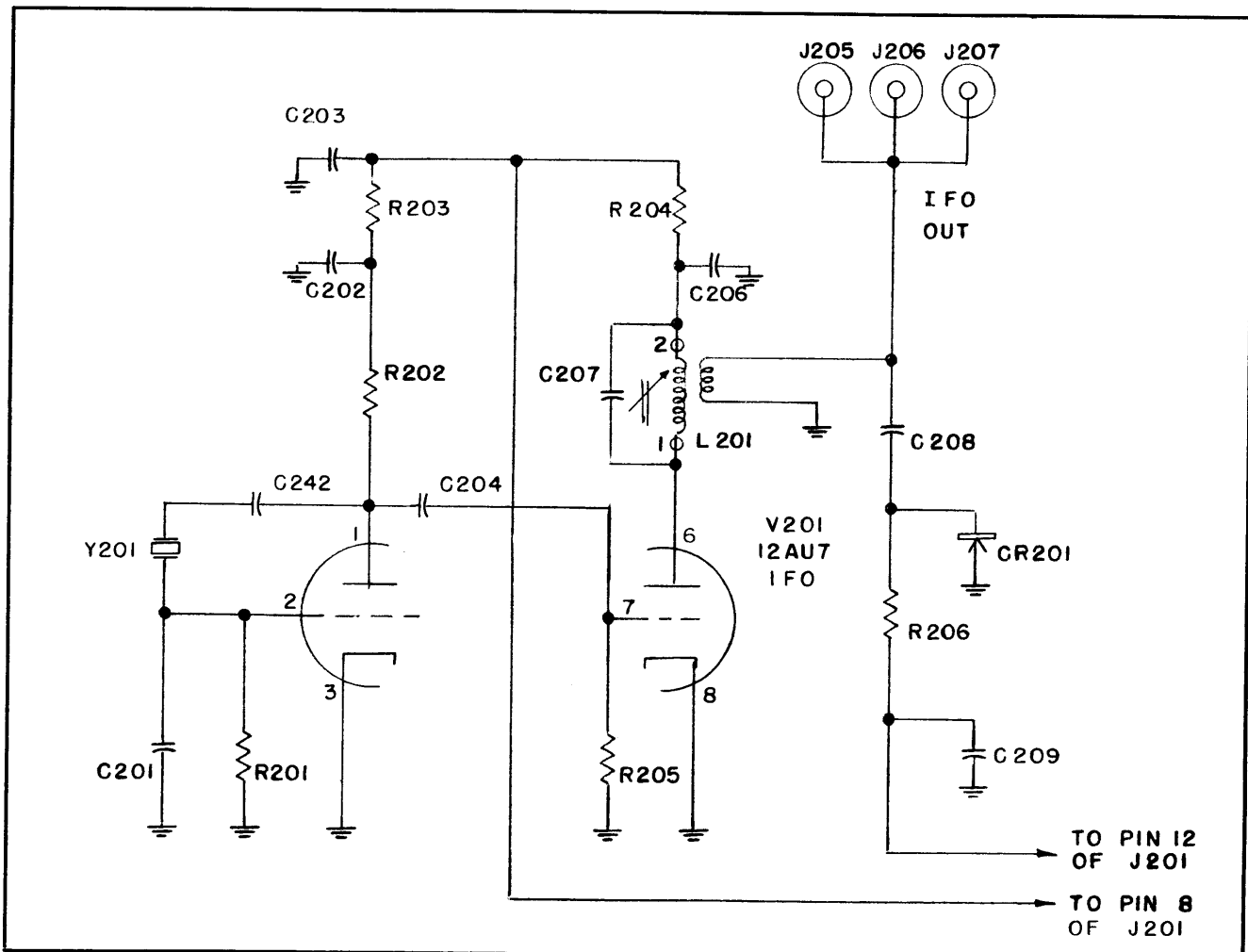


Figure 2-2. IFO Circuit



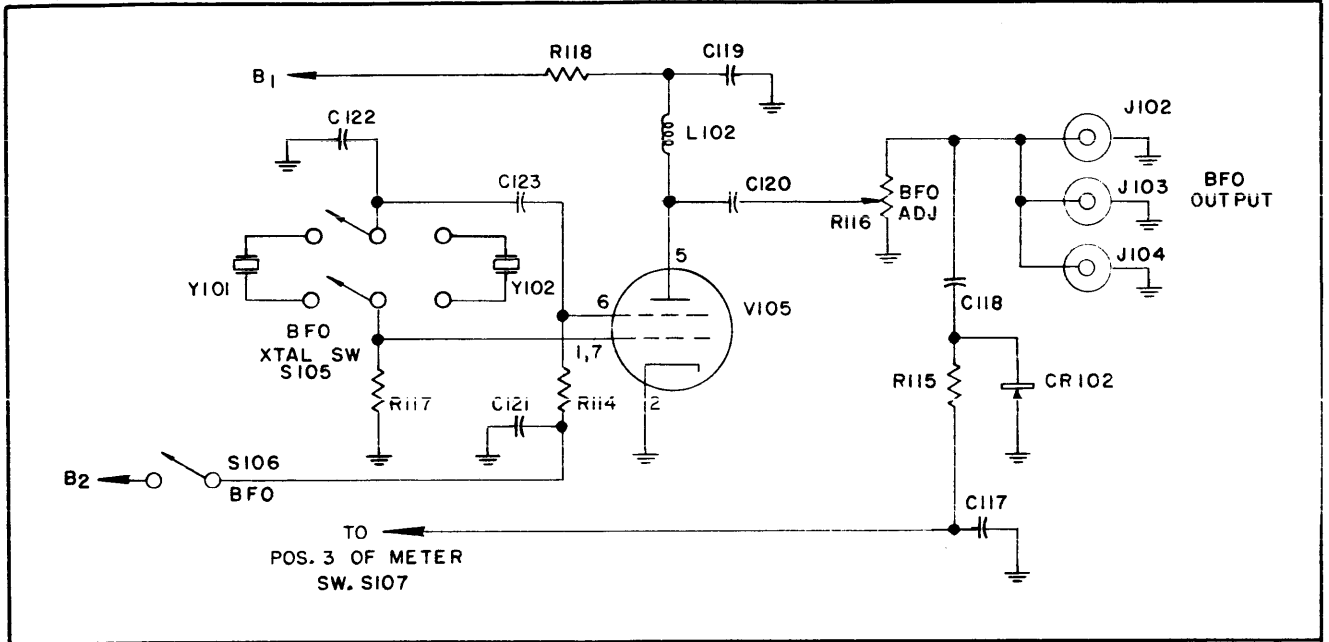


Figure 2-3. BFO Circuit

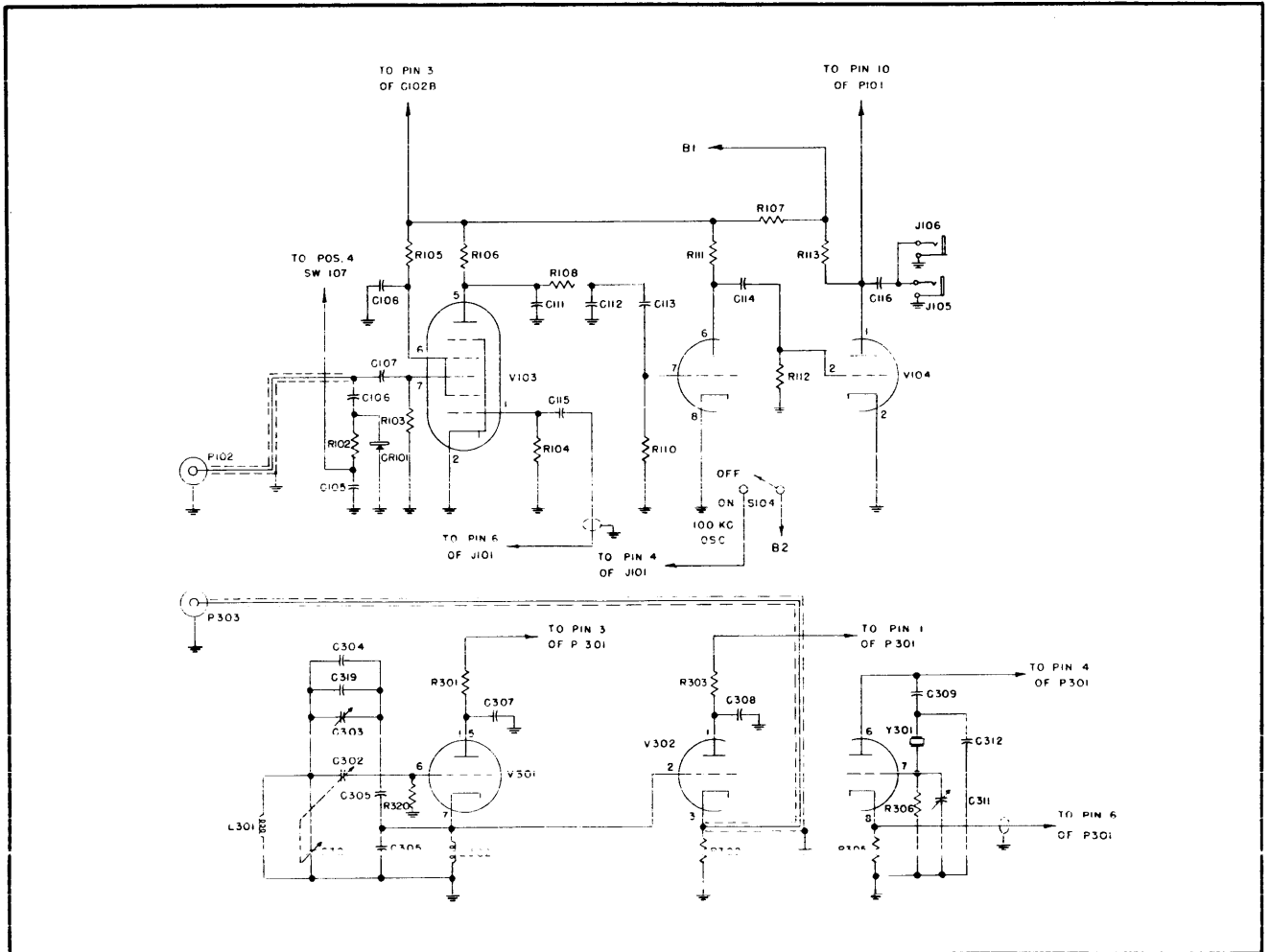


Figure 2-4. Calibrating Chain Circuit

potentiometer R116. Metering of the outputs is accomplished in the same manner as described in section one (1) above.

#### D. THE CALIBRATING CHAIN

The voltage from the 100 Kc crystal, Y301, and the master oscillator tube, V301, are fed via pins 1 and 7, respectively, into the pentagrid converter V103. The difference-frequency is picked off by filter action of capacitors C111, C112, and resistor R108. This is a low pass filter with a rising characteristic at very low frequencies. The audio signal is then amplified successively by the first and second halves of V104. Rotary switch S104, which turns on or off the 100 Kc oscillator. The Zero Beat Indicator I 303 on the front panel is connected into the plate circuit of the final amplifier so that the zero beat may be

seen by the flashing of the neon lamp. Earphones may be plugged in at the output of the final amplifier, at jack J105, or J106, in order to pick up the zero beat frequency. The circuit built around crystal CR101 containing C105, C106, and R102 is for metering the VMO output.

#### E. POWER SUPPLY

The power supply circuit is shown in figure 2-5. Transformer T101 supplies the necessary power and filament voltages. V101 is a fullwave vacuum rectifier with choke (L101) filter input. C104 provides low impedance paths to grounds for any R.F. current, while R101 is used to limit the current passing through tube V102. This tube is a glow discharge regulator type, whose output voltage is held constant and provides +150 volts.

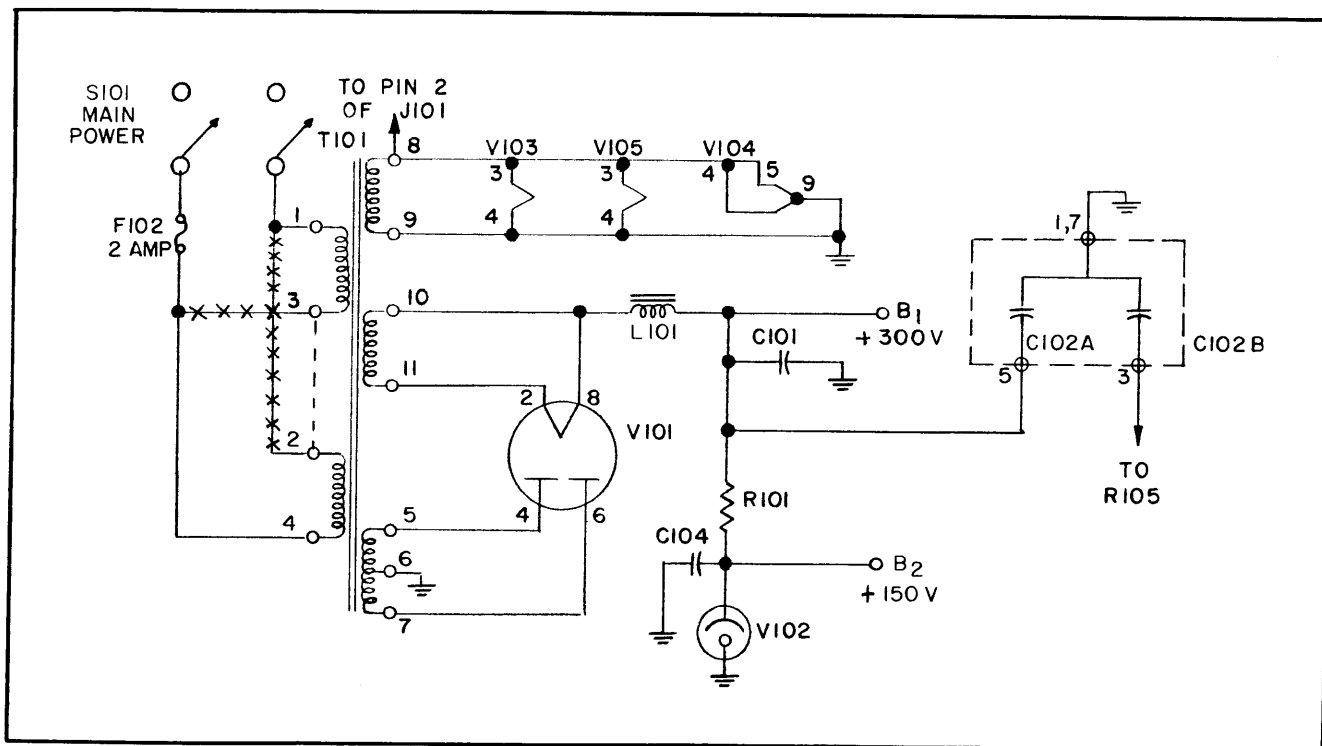


Figure 2-5. Power Supply Circuit

## SECTION III INSTALLATION AND OPERATION

### 1. INSTALLATION

#### A. UNPACKING

The Variable Frequency Oscillator, Model VOX, has been designed for ease of installation and minimum effort in operation. The unit is shipped in a separate container, and extreme care should be taken in unpacking it to avoid any physical damage. After unpacking and before installation into the rack, the operator should remove the right top cover, and then the shipping clamps and screws painted red from the motor drive assembly (When included).

#### B. POWER REQUIREMENTS:

110/220 volt operation - The unit leaves the factory wired for 110 V.A.C., 50/60 cycles unless it is specifically ordered for 220 V.A.C., 50/60 cycles, in which case it will be clearly tagged.

The following changes are required, to convert for use on 220V.A.C., 50/60 cycles:

- (1) Transformer T101 primary windings must be rewired as shown on the schematic diagram. That is, remove the jumpers between terminals 1 and 2, and add a jumper between terminals 2 and 3.

- (2) Rewire the outer oven heating elements, R309 and R310; the inner oven heating elements, R307 and R308; the relay circuit K301; and (when included) the motor circuit B301. This may be accomplished by changing the jumpers on terminal boards E301 and E302, which are located at the rear side of the oven assembly, as indicated on the schematic diagram.

#### C. ELECTRICAL CONNECTIONS

For high oscillator stability, the Model VOX must be left turned on continuously, and should be turned off only in the event of failure. This means that a separate source of primary power must be supplied the unit, so that when or if any associated equipments are turned off, the Model VOX will continue to operate. Inter-connection between the VOX and other units is accomplished through the use of BNC type connectors.

### 2. OPERATION

#### A. ADJUSTMENTS

1. For greater accuracy the Oscillator must always be calibrated before use. To calibrate the Model VOX at any desired frequency. Initially,

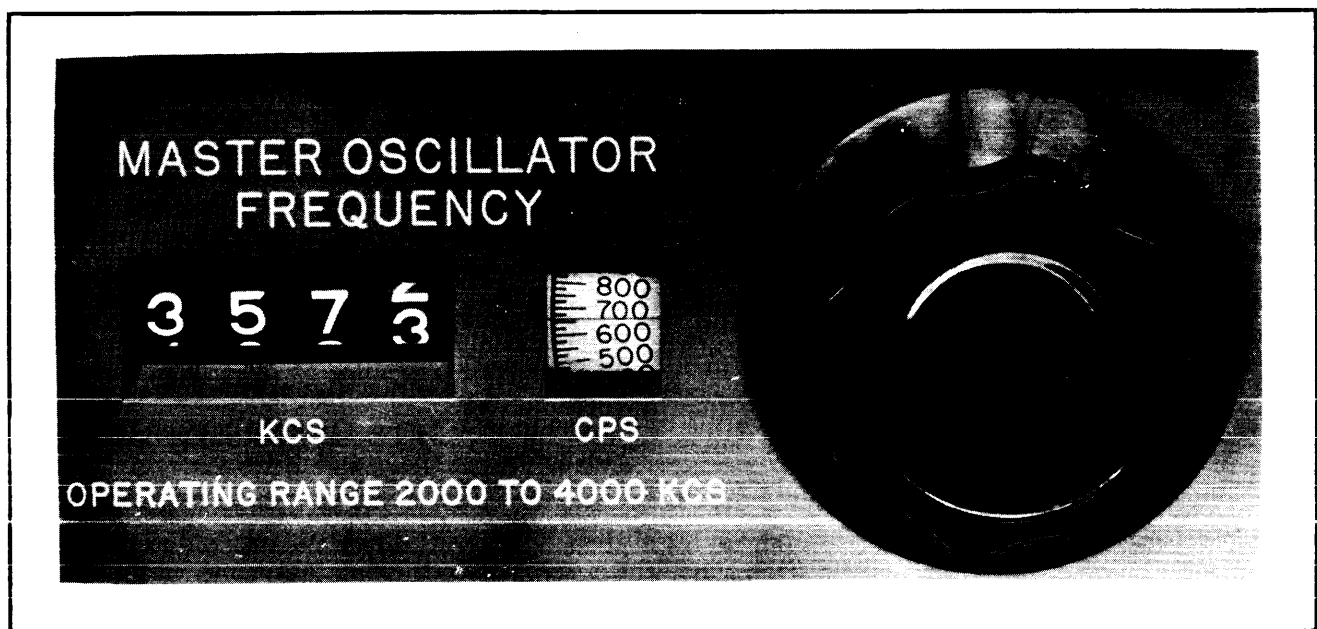


Figure 3-1. Counter Close-Up

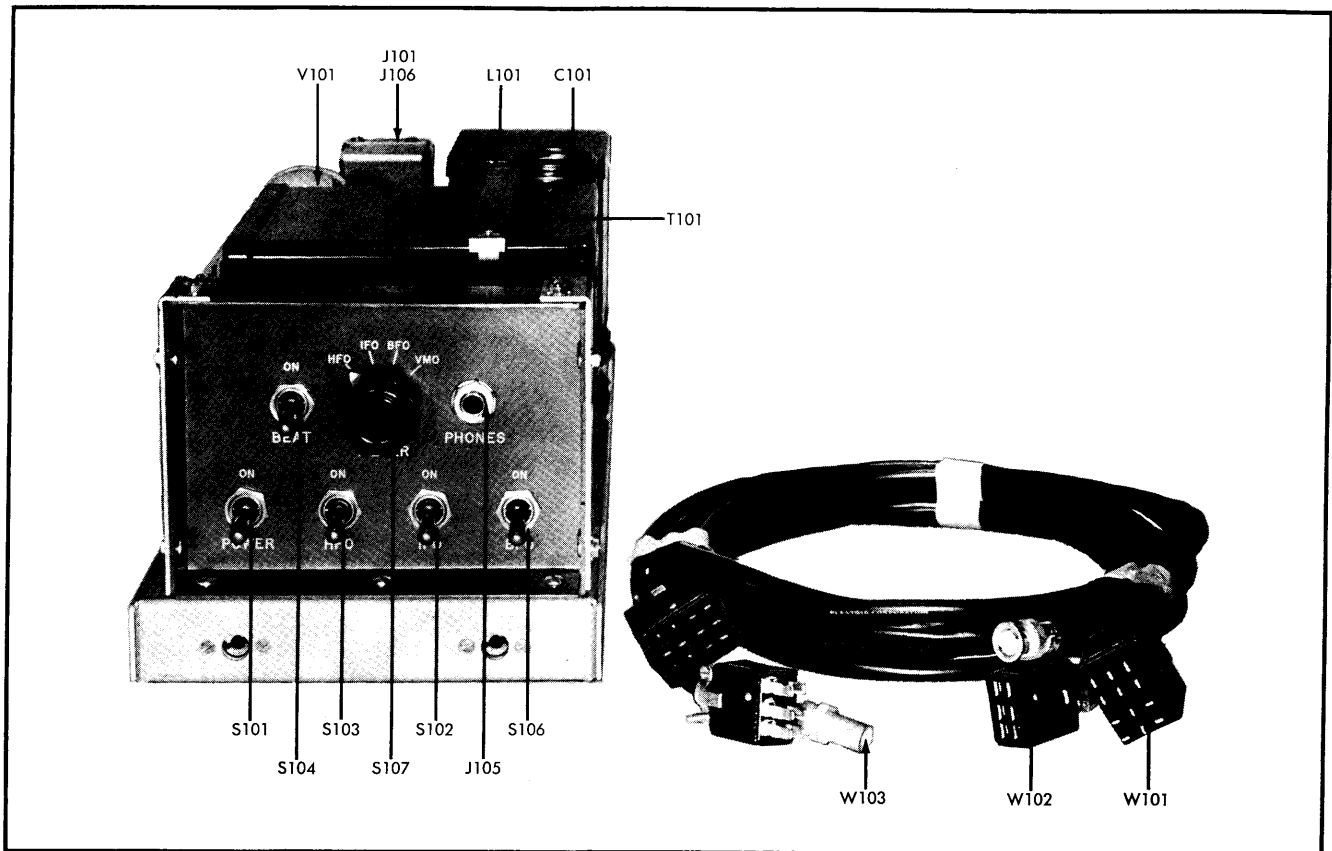


Figure 3-2. Power Supply and Service Cables

the operator should perform the following functions: (Referring to the front sub-panel):

- a. Turn the power switch to the "ON" position.
- b. Turn the beat ON/OFF switch to the "ON" position.
- c. Plug a headset into the jack, marked "Phones".

2. Then, turn the Band-Mcs switch to the desired band and the Xtal switch to the VMO position, both on the front panel. The operator should observe the master oscillator frequency dial, which is marked directly in CPS, and tune by hand or (when included) by use of the motor drive, until the dial reads to the nearest 50kc (see part 3) point of the desired frequency. In order to calculate the correct dial reading, the operator must remember to divide the desired frequency by 2 for the 4-8 Mc band, by 4 for the 8-16 Mc band, by 8 for the 16-32 band, etc. For accurate calibration and resettability, care must be taken to rotate the dial in the same direction (preferably from a lower dial reading to a higher), in order to prevent any error due to backlash. Then, by varying the Calibrate control, a zero beat indication will be obtained in the headset and on the front panel indicator. With a little

experience, the operator will find that the visual indication alone is adequate, although he may continue to use the phones as an added convenience. The Model VOX has now been properly corrected for the dial region to be used, and should be returned to the required frequency setting.

3. When the calibration procedure has been concluded, the operator must be certain that he places the beat ON/OFF switch in the "Off" position. At the same time, the Meter Switch should be tuned to HFO and the HFO Switch to the "ON" position.

4. Then the operator should rotate the Tuning knob to a position roughly approximating the master oscillator frequency dial, at which point he will obtain a reading on the front panel milliammeter with the output control. The Tuning knob will have been set properly when the highest milliammeter reading is obtained.

5. In the event that a HFO Crystal is used in place of the Variable Master Oscillator, then the following procedure must be adhered to:

- a. Turn the Power switch to the "On" position.

**WARNING**

THE MODEL VOX IS A HIGH STABILITY, PRECISION INSTRUMENT AND REQUIRES AN INITIAL WARM-UP PERIOD OF AT LEAST FORTY-EIGHT (48) HOURS OF CONTINUOUS DUTY. THEREAFTER, THE UNIT SHOULD NEVER BE TURNED OFF UNLESS DETAILED REPAIRS BECOME NECESSARY.

- b. Turn the HFO switch to the "On" position.
- c. Turn the Meter switch to the HFO position.
- d. Turn the XTAL switch to the proper position.
- e. Turn the Band-Mcs switch to the proper band.
- f. "Trim" the crystal by tuning XTAL-FREQ trimmer until the exact frequency is set and peak with the tuning knob as described above.

the modified Hammarlund SP-600-JX Receiver, is the one used in the TMC Model DDR-2, Dual Diversity System, and constitutes a good illustration of typical master oscillator operation. Since the receivers are either double or single conversion units, depending upon the operation frequency, then the Model VOX must be set accordingly. Below 7.4 Mc the HFO must be 455 kc above the desired carrier, but above 7.4 Mc the HFO must be 3.955 Mc above the desired carrier. The chart below will serve to minimize the small amount of arithmetic involved.

**B. APPLICATION**

1. For use as a Master Oscillator in any Diversity System:

a. The Model VOX has been designed for use with any properly modified receiver. For Diversity reception in any system, the operator must set the Model VOX frequency dial to a reading equal to the sum of the IFO value of the particular receiver in use, plus the value of the desired signal frequency.

2. For use as a Master Oscillator in the TMC Dual Diversity Receiver, Model DDR-2:

a. The combination of the Model VOX and

b. Diversity System Tuning.

- 1. Turn the Power Switch to "On" position.
- 2. Turn the BFO switch to "On" position (For CW operation BFO XTAL - 455 Kc ± Audio Tone desired. For Frequency Shift operation - using TMC Model CFA - Frequency 455 Kc + 2550 cps)
- 3. Turn the IFO switch to "On" position.
- 4. Plug a headset into the jack marked phones.
- 5. Set the frequency calibration dial at the desired frequency, in accordance with the above table, and proceed with the calibration and peaking instructions as previously described.

DIVERSITY SYSTEM TUNING CHART

<u>Received Signal Frequency</u>	<u>VOX - HFO Output</u>	<u>VOX Band</u>	<u>VOX - VMO Dial Setting</u>
	Fr + 455 Kc	2-4 Mc	Fr + 455
Below 7.4 Mc	Fr + 455 Kc	4-8 Mc	(Fr + 455)/2
	Fr + 3.955 Kc	8-16 Mc	(Fr + 3.955)/4
Above 7.4 Mc	Fr + 3.955 Kc	16-32 Mc	(Fr + 3.955)/8
	Fr + 3.955 Kc	32-64 Mc	(Fr + 3.955)/16

To complete the diversity system tuning, the operator must turn the IFO and HFO controls on both receivers to the Slave position and then tune to the approximate station frequency. Lastly, the BFO Output control (located on the rear - top of the Power Supply Chassis) must be set until a solid beat is obtained with a strong carrier.

3. As a Transmitter Exciter

There is no essential difference in adjusting the Model VOX for this service and the procedure followed in the preceding paragraph. All IFO and BFO referenced may, of course, be neglected and both the plate switches controlling these sections may be turned to the "Off" position.

**3. ADDITIONAL CALIBRATION ACCURACY**

The calibration accuracy of the Model VOX is more than adequate for most general usage.

When a particular need arises for more precise reading, the Model VOX readily lends itself to such use.

Within this instruction manual 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 VOX 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.

VOX DIAL SETTING	CHECK POINT	VOX 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. OPERATOR'S MAINTENANCE

#### A. GENERAL

The Model VOX VARIABLE FREQUENCY OSCILLATOR has been designed to provide long term, trouble free, continuous 24 hour a day operation. 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. The two enclosed tubes and thermionic switch (S301) may be replaced easily at the rear of the unit; but in the event that maintenance to this section of the unit is required, the unit should be returned to the factory for repairs. For maintenance purposes, three service cable assemblies are supplied to enable the operator to service the Model VOX while maintaining primary power to the ovens. The cable assemblies supplied with each VOX are as follows:

- Part No. CA108, Power Supply-Multiplier Interconnect; Twelve Contact.
- Part No. CA109, Power Supply - Master Oscillator Interconnect; Six contact.
- Part No. CA110, R.F. Cable; Power Supply-Multiplier Interconnect; Single Contact.

Figure 4-1 shows the three service cables connected properly for maintenance operation, allowing the ovens to function as usual.

#### B. EMERGENCY MAINTENANCE

**NOTICE TO OPERATORS** - Operators should not perform any emergency measures unless properly authorized to do so. If such authorization is given, it should be preceded by a short course of instruction.

##### 1. REPLACEMENT OF FUSES:

#### WARNING

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.

Two separate fusing systems are incorporated in the Model VOX, one to protect the ovens, and the other to protect the power supply proper. If the front panel pilot light marked Power fails to light when the unit is turned on, then the fuse marked Power, on the rear of the power supply chassis, must be changed. (There is a remote possibility that the pilot lamp itself is faulty, but this seldom happens.)

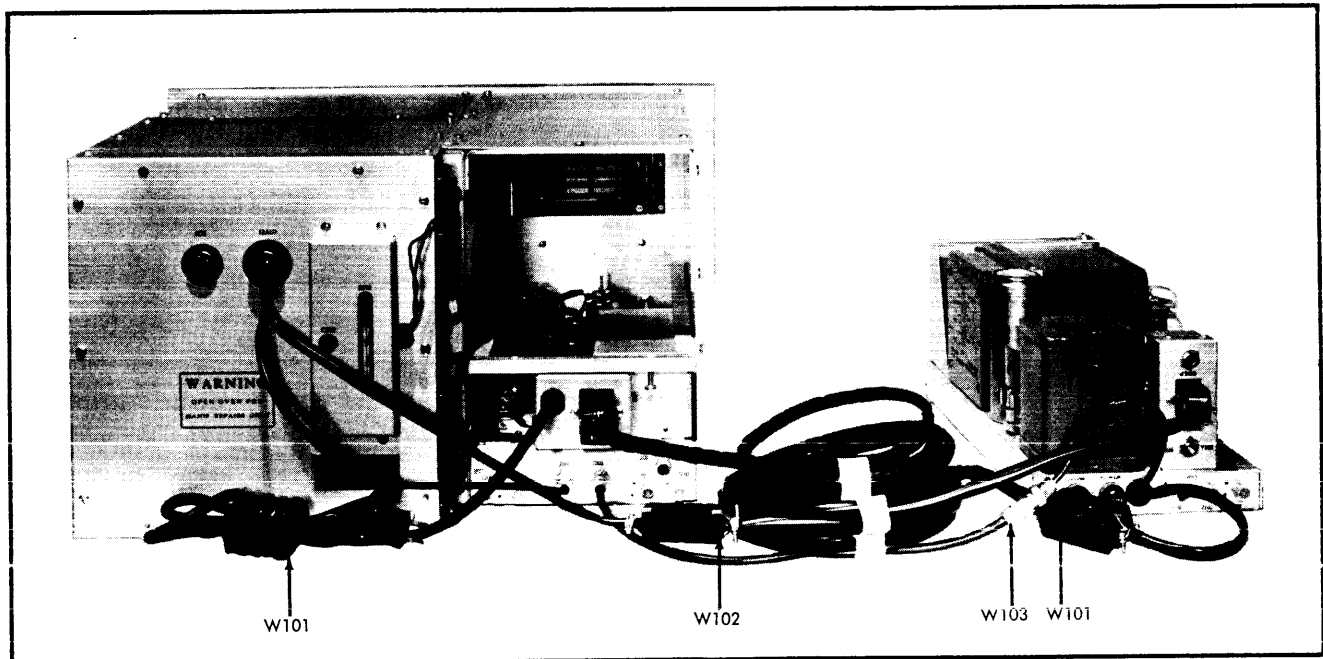


Figure 4-1. Service Cable Arrangement

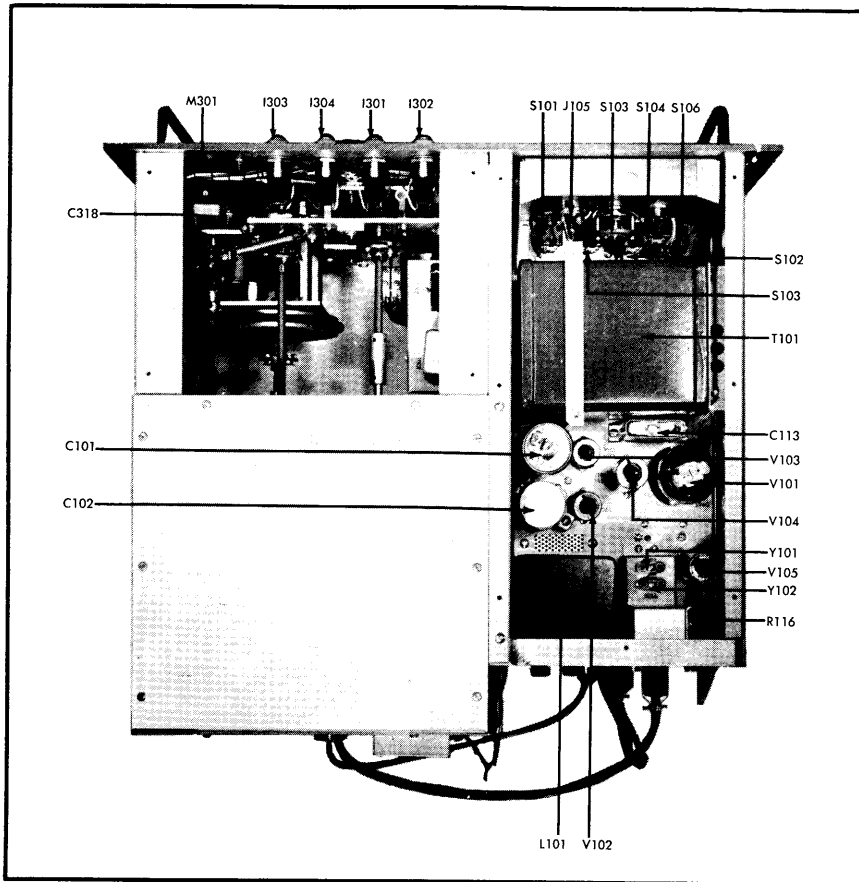


Figure 4-2. Top View, Model VOX-1

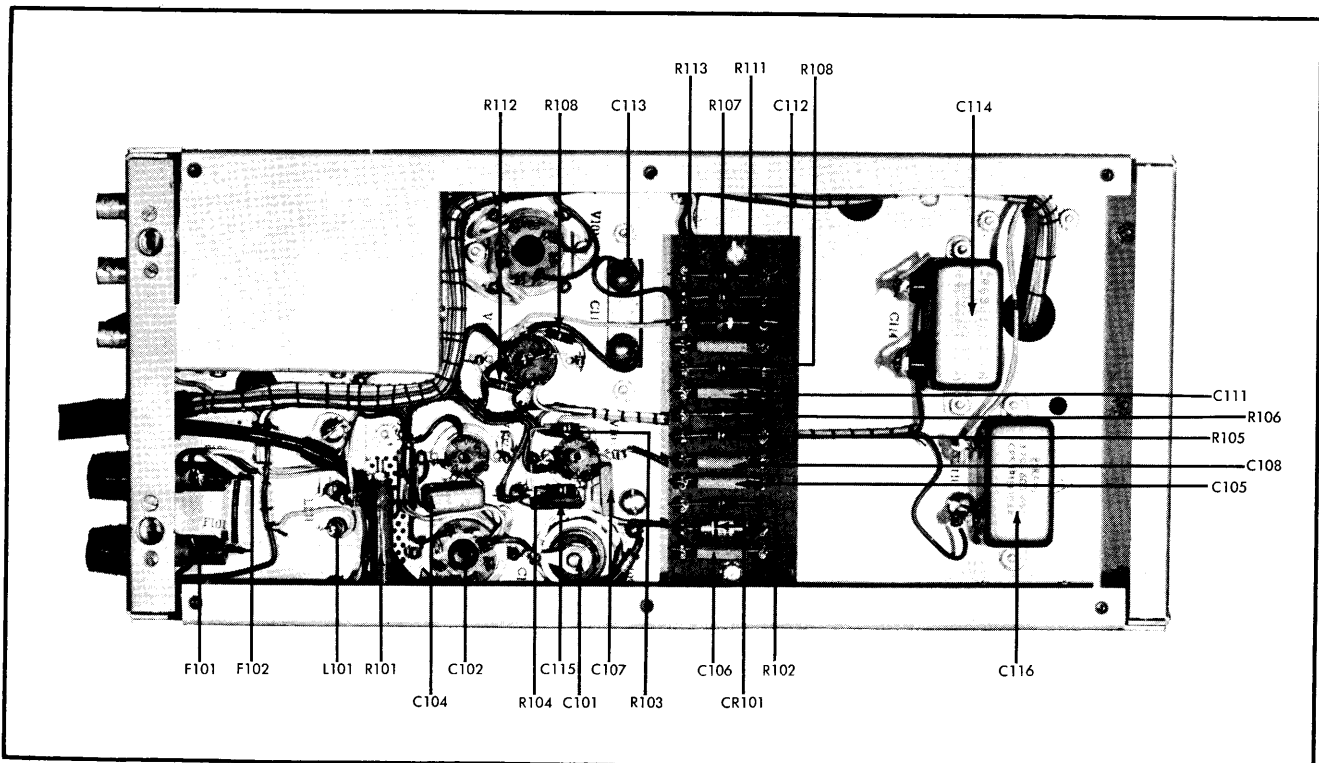


Figure 4-3. Bottom View of Power Supply, Model VOX



In the event of an oven fuse failure, both pilot lights referring to the ovens would not light. The ovens would also commence to cool. In this case, the oven fuse, which is on the power supply chassis rear, must be replaced.

## 2. REPLACEMENT OF TUBES:

The location of all tubes and relay in the Model VOX is indicated in Figure 4-2, 4-4, and 4-5. The tubes may be checked visually to see if they are lighted, or for warmth. The Model VOX has been so designed that the power chassis can be completely withdrawn in a matter of seconds. A set of tracks have been provided for this purpose and the operator can slip the unit out by simply half-turning four snap fasteners, two of which are located on the front panel, and two of which are located under the rear of the power supply chassis.

Tube replacement is accomplished by disconnecting the power supply as described above. Such disconnection, which automatically removes power from the oven, should not last for more than approximately five minutes, if good oven stability must be maintained. If more detailed repairs become necessary, the six foot extension cables must be employed to maintain oven power. Tubes should be carefully removed and tested, and when replaced, care should be taken to install tube shields.

## 2. PREVENTIVE MAINTENANCE

In order to prevent actual failure of the equipment due to corrosion, tube failures, dust and other destructive ambient conditions, it is suggested that the following preventive maintenance be performed:

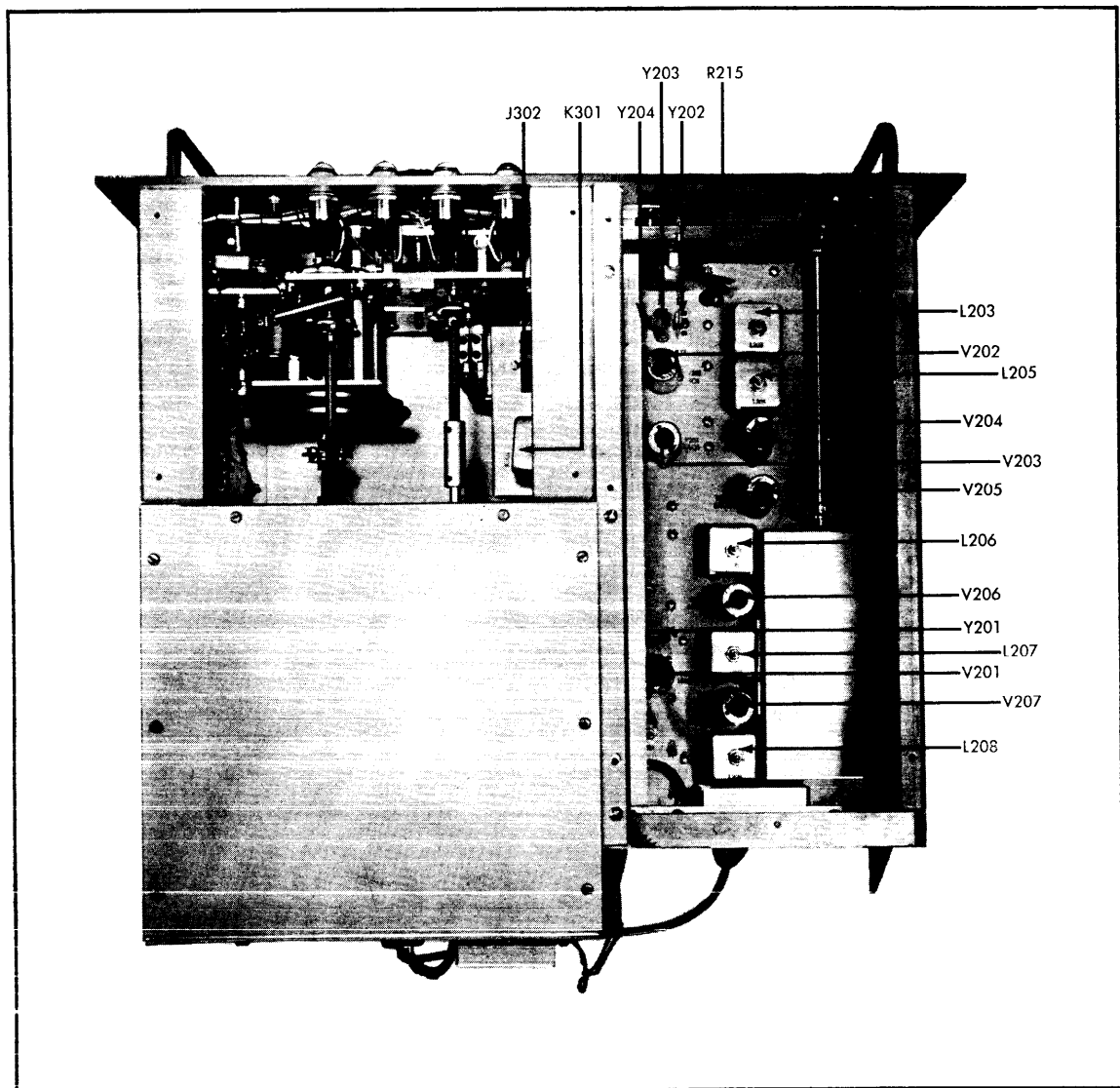


Figure 4-4. Top View Showing the RF Multiplier Section

a. Remove equipment from the rack, and thoroughly inspect the inside of the chassis for signs of dirt, dampness, molding, charring, and corrosion. Correct any defect found. A recommended cleaning agent is clear carbontetrachloride, applied with a soft brush; recommended procedure, semi-annually.

b. Test all DC and AC voltages as indicated on the respective tube voltage data sheets Fig. 5-3, and investigate any serious discrepancies; recommended procedure, semi-annually.

c. Test each tube one at a time in a reliable tube tester, replacing tube in socket from which it was removed, if its measured characteristics are within the manufacturers' tolerances (usually plus or minus 20% from tube manual values.) Replace only those tubes which are found to be below par; recommended procedure, quarterly.

d. When replacing the Model VOX in the rack, be certain that all terminal screw connections at the rear of the equipment are tight.

### 3. CALIBRATIONS

#### A. GENERAL

During its initial calibration the Model VOX 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). Loosely couple the HFO Output 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 VOX 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 VOX 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 VOX 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, then a satisfactory calibration has been made. This means, in reality, that the 100 Kcs standard has been set against WWV with the Model VOX Master Oscillator serving only the function of 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). Turn beat On/Off Switch "On".

(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 C303 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 knob at 2 Mcs and C303 at 4 Mcs, until it is possible to obtain a 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.

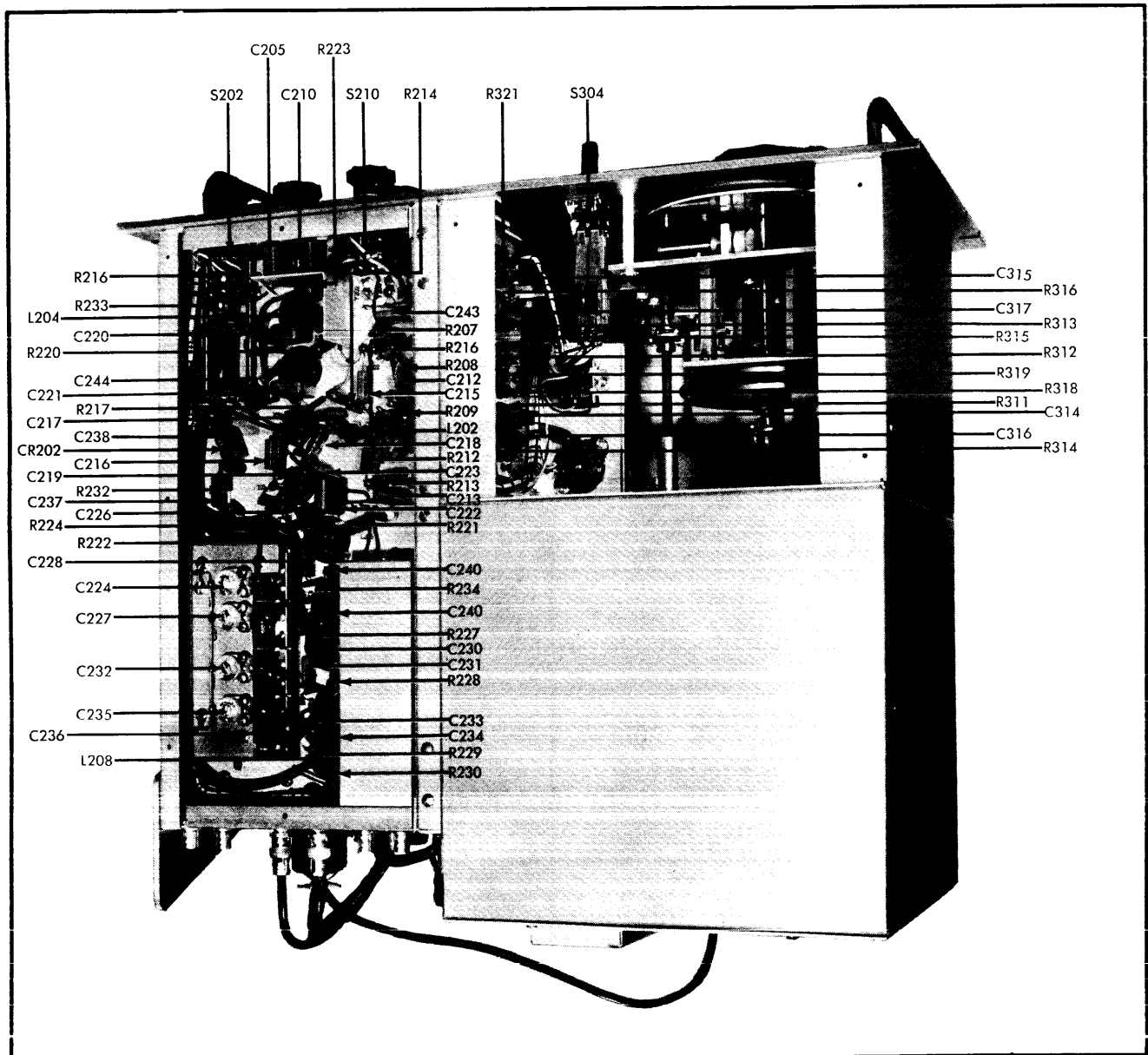


Figure 4-5. Bottom View

## SECTION V CORRECTIVE MAINTENANCE

### 1. SYSTEM TROUBLE SHOOTING

Careful observation while operating the various controls, may sectionalize any faults to a particular stage or circuit. Some faults, such as burned out resistors, r-f arcing, and shorted transformers, can often be located by sight, smell, or hearing. A logical division of the Model VOX would indicate four main operating divisions, and the power supply. The four divisions are the HFO Chain, the IFO, the BFO, and the Calibrating Chain.

A major fault in the power supply would abruptly cut off the B+ supply voltages to all the tubes. If there is no reading on the milliammeter for any position on the meter switch of the front panel, this is a good indication of power

supply failure. The voltages on the transformer T101, and tubes V101 and V102 should be checked, to ascertain if anything is amiss.

### 2. THE TROUBLE SHOOTING PROCEDURE

The Model VOX has been so designed that every stage may be checked, thus facilitating trouble shooting.

#### a. THE HFO CHAIN

The oven is the heart of the Model VOX, and improper functioning will greatly hamper oscillation stability. The inner and outer ovens are thermostically controlled to 70°C and 60°C, respectively. An inner oven safety thermostat, S302, set at 80°C, protects the unit in case of ex-

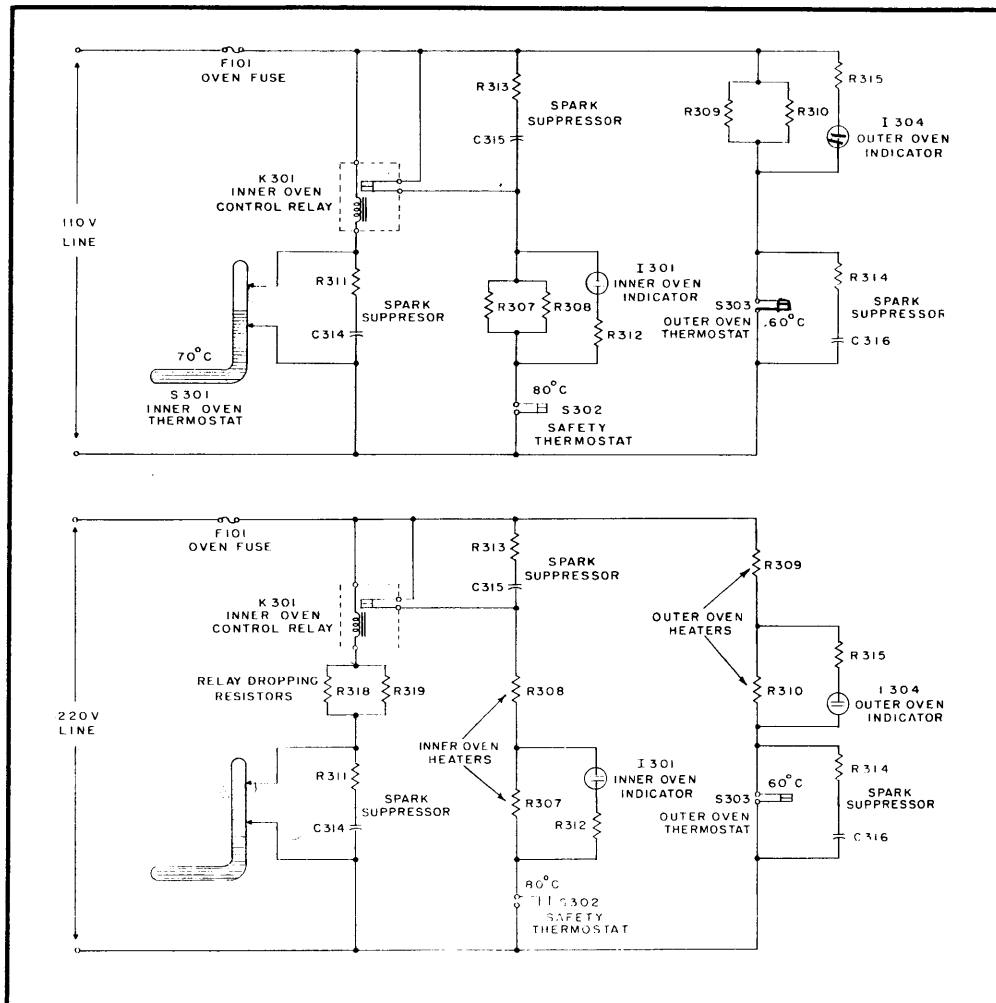


Figure 5-1. Thermostatic Switch Circuits

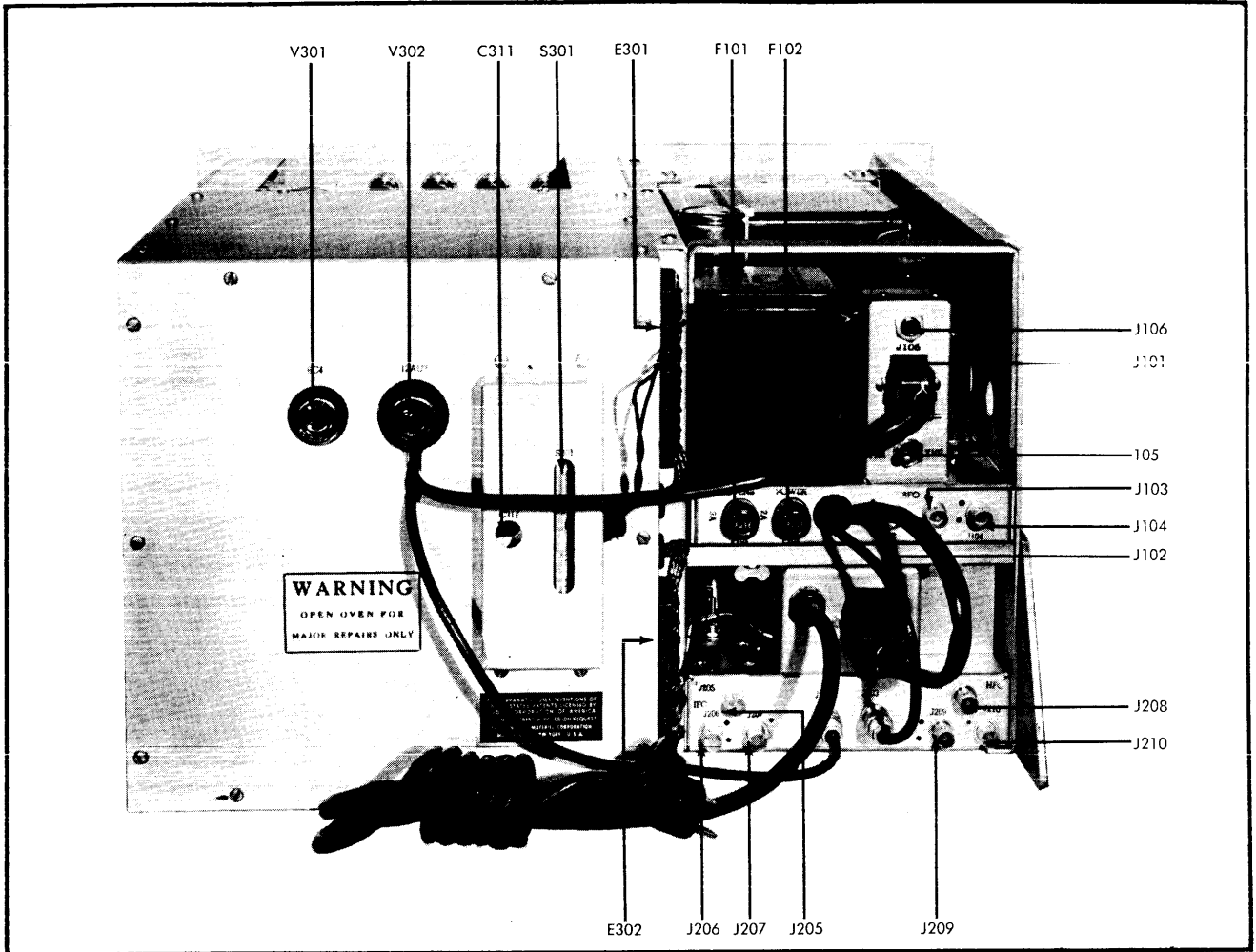


Figure 5-2. Rear View

cessive temperatures, due to sticking or mechanical failure of the Mercury thermostat, S301. Figure 5-1 illustrates the operation of the thermostat switch circuits, both for 110 and 220 volts. In normal operation, relay S301 is open and K301 would be closed. When the temperature reaches 70°C, S301 closes, thus energizing the coil of relay K301, which in turn, opens up the contacts of the relay. In the event that S301 should fail, due to sticking, etc., at 80°C safety switch S302 would open, thus preventing further current from passing through the heating elements, R307 and R308. The oven neon bulbs on the front panel give good indication as to normal operation of the inner and outer ovens. In normal operation, the operator should see the Outer oven pilot lamp blink alternately "On" for approximately 5 seconds, and "Off" for approximately 30 seconds, depending on the ambient temperature. The Inner oven pilot light should blink alternately "On" for approximately 90 seconds, and "Off" for approximately 90 seconds. In the event that relay S301 is malfunctioning, the inner oven will continue to heat

until safety switch S302 opens up at 80°C. When the temperature reaches 80°C, the Inner oven pilot blinks erratically at short intervals, instead of the usual 90 seconds, in normal operation. At this point, the operator should check the thermometer on S301 in the rear of the unit and replace S301, if the thermometer reads well over 70°C.

To check the VMO output, simply turn the meter switch dial to VMO, and notice the deflection of the milliammeter on the front panel, which should read approximately .9 milliamperes. Then, check the voltages and resistances on tubes V301 and V302, and lastly, the circuit components, for proper voltages and resistances. R302 is a critical resistor.

Once it has been established that the VMO is operating properly, than any succeeding stage to the HFO Output may be checked and traced, stage by stage, to its fault. This may be accomplished by the following means:

1. Turn the meter switch to HFO.

2. Turn the Band dial to the desired output frequency.

Then, notice the deflection in the needle of the milliammeter of the front panel. If, for example, the user wishes to operate on 20 Mc, a null reading on the meter indicates a fault somewhere between the 16-32 stage, (V206, L207, and C225) and each preceding stage to the initial amplifier V202. Then, the operator must change his dial reading for the 8-16 Mc band, switch to the 8-16 Mc band, and notice any output on the milliammeter. The usual test procedure is recommended for checking the two amplifier output tubes, V203 and V204.

**b. THE IFO:**

The output of the IFO may be checked again by switching the Meter Switch to the IFO position and observing the output reading on the milliammeter. The critical components in this circuit are variable condenser C207, coil L201, crystal Y201, and the grid bias resistor R205.

**c. THE BFO:**

The BFO output may be checked again in the manner described above for the IFO. Critical components are C120, L102, R117, and variable resistor R116, together with the crystals Y101 and Y102.

**d. THE CALIBRATING CHAIN:**

The calibrating chain has been designed for stable and trouble-free operation and is the least likely circuit in the unit to develop trouble. The main components of this chain are the VMO output and the 100 Kc oscillator circuit. The VMO output may be checked in the manner already described. The 100 Kc output may be checked by connecting an oscilloscope to pin 1 of tube V103. Improper mixer action by V103 and faulty low pass filtering components also contribute to trouble.

**NOTE**

The front panel milliammeter circuits have been so adjusted that the following relationships exist in each of the Meter switch positions:

- HFO position-meter reads 20 volts full scale.
- IFO position-meter reads 10 volts full scale.
- BFO position-meter reads 20 volts full scale.
- VFO position-meter reads 10 volts full scale.

TUBE NO.	TUBE TYPE	FUNCTION	PIN #1	PIN #2	PIN #3	PIN #4	PIN #5	PIN #6	PIN #7	PIN #8	PIN #9
V101	5U4-G	Rectifier	0	+300	0	AC-378	0	AC-378	0	+300	
V102	OA2	Regulator	+147	0	0	0	+147	0	Gnd		
V103	6BE6	Mixer	-13	Gnd	AC6.3	Gnd	+50	+32	-.3		
V104	12AU7	Audio Amp.	+55	-11	Gnd	AC6.3	AC6.3	+25	-.55	Gnd	Gnd
V105	6AQ5	BFO	-9.6	Gnd	AC6.3	Gnd	+36	+100	Gnd		

ALL VOLTAGES TAKEN TO GROUND WITH HP-410B VTVM

Audio Gain of 12AU7 at Highest Frequency Tone - 32.5 V. AC

Figure 5-3A. Voltage Data - VOX Power Supply Chassis

TUBE	FUNCTION	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	
DC	6C4	120 V	0	0	6.3	120 V	3.3 V	.13 V			
	Voltage 12AU7	162 V	.13V	6.4V	6.3	6.3	72 V	16 V	4.5 V	0	
RF	6C4	.25 V	0	0	6.3	.25 V	7.1V	4.5V			
	Voltage 12AU7	1.6 V	4.3V	4.3V	6.3	6.3	17.5V	18 V	2V	0	
RF VOLTAGE AT PINS #2 and #3		RF VOLTAGE AT TOP OF TANK COIL									
2.0 Mcs.	4.3V	4.3V		2.0 Mcs.	34V						
2.6 Mcs.	4.6V	2.3V		2.6 Mcs.	43V						
4.0 Mcs.	9.0V	3.4V		4.0 Mcs.	82V						
RF VOLTAGE AT 100 Kc Osc. Output											
3.6V											

Figure 5-3B. Voltage Data - VOX Oscillator Chassis

FUNCTION	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	
V201 12AU7	Xtal Osc.	1	60	2	11	6	120	7	11	9	6.3
V202 6C4	HFO & RF AMP.	1	90	6	10	4	6.3				
V203 6AQ5 Band 2-4	RF Amp.	1	11	2	6	5	95	6	110	4	6.3
V204 6AQ5 Band 4-8	RF Amp. & Mult.	1	30	2	14	5	270	6	260	4	6.3
V205 6AQ5 Band 8-16	RF Mult.	1	30	2	12	5	250	6	170	4	6.3
V206 6AQ5 Band 16-32	RF Mult.	1	20	2	13	5	275	6	175	4	6.3
V207 6AQ5 Band 32-64	RF Mult.	1	35	2	13	5	265	6	225	4	6.3
ALL VOLTAGE TO GROUND WITH VTVM											
2 MC Xtal Tuning at 2 MC      Output at Maximum											
70 ohm Load at RF output											
70 ohm Load at IFO output											

Figure 5-3C. Voltage Data - VOX Multiplier Chassis

**NOTE: See addition to last page of Parts List.**



## PARTS LIST

The Model VOX is comprised of three component chassis, schematic symbol groups as follows:

100 through 199	Power Supply Chassis
200 through 299	Multiplier (RF) Chassis
300 through 399	Master Oscillator Chassis

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C101	CAPACITOR, fixed: paper; 4 mfd, $\pm 10\%$ , 600 wvdc, oil-filled and impregnated, hermetically sealed metal case.	B+ R.F. Bypass	CP40C2DF405K
C102	CAPACITOR, fixed: electrolytic; dual unit, 20 mfd ea. section, 600 wvdc.	B+ Filter	CE52F200R
C103	NOT USED.		
C104	CAPACITOR, fixed: mica, .01 mfd, $\pm 10\%$ , char B, 300 wvdc.	REG. R.F. Bypass	CM35B103K
C105	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	VMO Meter Bypass	CM20B102K
C106	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	VMO Meter, R.F. Coupling	CM20B102K
C107	CAPACITOR, fixed: mica; 5 mmfd, $\pm 20\%$ , char B, 500 wvdc.	VMO Mixer Coupling	CM20B050M
C108	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	Mixer Screen Bypass	CM20B102K
C109	NOT USED.		
C110	NOT USED.		
C111	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	Mixer Plate Filter	CM20B102K
C112	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	Mixer Plate Filter	CM20B102K
C113	CAPACITOR, fixed: paper; .5 mfd, $\pm 10\%$ , 600 wvdc, oil-filled and impregnated, hermetically sealed metal case.	Mixer Output Coupling	CP69B1EF504K
C114	CAPACITOR, fixed: paper; .5 mfd, $\pm 10\%$ , 600 wvdc, oil-filled and impregnated, hermetically sealed metal case.	Audio Output Coupling	CP53B1EF504K
C115	CAPACITOR, fixed: mica; 1000 mmfd, $\pm 10\%$ , char B, 500 wvdc.	100 Kc Mixer Coupling	CM20B102K
C116	CAPACITOR, fixed: paper; .1 mfd, $\pm 10\%$ , 600 wvdc, oil-filled and impregnated, hermetically sealed metal case.	Phones Coupling	CP53B1EF104K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C117	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	Bypass BFO Meter Decoupling	CM20B102K
C118	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	BFO Meter Coupling	CM20B102K
C119	CAPACITOR, fixed: mica, .01 mfd, ±10%, char B, 300 wvdc.	BFO Plate Filter	CM35B103K
C120	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	BFO Tank	CM35B103K
C121	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char C, 500 wvdc.	BFO Voltage Divider	CM20C102K
C122	CAPACITOR, fixed: mica; 150 mmfd, ±5%, char C, 500 wvdc.	BFO Xtal Load	CM20C151J
C123	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	BFO Xtal Coupling	CM20B102K
CR101	CRYSTAL UNIT: rectifying; germanium.	VMO Output Rectifier	IN34
CR102	CRYSTAL UNIT: rectifying; germanium.	BFO Output Rectifier	IN34
F101	FUSE, cartridge: 3.0 amp.	Oven Fuse	FU-100-3
F102	FUSE, cartridge: 2.0 amp.	Power Fuse	FU-100-2
J101	CONNECTOR, female contact: polarized; six contact, chassis mounted.	Power Supply Oven Interconnect	JJ-121-2
J102	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	BFO Output	UG-625/U
J103	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	BFO Output	UG-625/U
J104	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	BFO Output	UG-625/U
J105	JACK, open circuit:	Phone Input	JJ-034
J106	JACK, open circuit:	Phone Input	JJ-034
L101	REACTOR, filter: 10 henries, 125 ma DC, 1000 volts RMS test.	B+ Filter Choke	TF-5001
L102	INDUCTOR, fixed: 10 millihenries.	BFO Tank Coil	CL-101-4
P101	CONNECTOR, male contact: polarized; twelve contact, w/cable clamps.	PS-RF Interconnect	PL-102-1
P102	CONNECTOR, coaxial: male contact; BNC type for RG-58/U cable.	VMO Input	UG-88/U

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R101	RESISTOR, fixed: wire wound; 4500 ohms, ±10%, 10 watts.	B+ Dropping	RW-104
R102	RESISTOR, fixed: composition; 12,000 ohms, ±5%, 1/2 watt.	Diode Load (CR101)	RC20GF123J
R103	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt.	Mixer Grid Leak	RC20GF104K
R104	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt.	Mixer Grid Leak	RC20GF104K
R105	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt.	Mixer Screen Dropping	RC20GF104K
R106	RESISTOR, fixed: composition; 1 megohm, ±10%, 1/2 watt.	Mixer Plate Load	RC20GF105K
R107	RESISTOR, fixed: composition; 56,000 ohms, ±10%, 1/2 watt.	Mixer Plate Filter	RC20GF563K
R108	RESISTOR, fixed: composition; 100,000 ohms, ±10%, 1/2 watt.	Mixer Output Filter	RC20GF104K
R109	NOT USED.		
R110	RESISTOR, fixed: composition; 1 megohm, ±10%, 1/2 watt.	Audio Grid Leak	RC20GF105K
R111	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt.	Audio Plate Load	RC20GF224K
R112	RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt.	Grid Leak	RC20GF224K
R113	RESISTOR fixed: composition; 82,000 ohms, ±10%, 2 watts.	Audio Cathode	RC42GF823K
R114	RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt.	Audio Plate Load	RC20GF223K
R115	RESISTOR, fixed: composition; 43,000 ohms, ±5%, 1/2 watt.	BFO Output Diode Load	RC20GF433J
R116	RESISTOR, variable: composition potentiometer, 50,000 ohms, ±20%, 2 watts.	BFO Output Control	RV4ATSA503B
R117	RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt.	BFO Grid Leak	RC20GF474K
R118	RESISTOR, fixed: wire wound; 25,000 ohms, ±10%, 10 watts.	BFO Plate Filter	RW-109-38
S101	SWITCH, toggle: DPST; 3 amp, 250 volts, phenolic body.	Main Power	ST22K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
S102	SWITCH, toggle: SPST; 3 amp, 250 volts, phenolic body.	IFO - Plate	ST12A
S103	SWITCH, toggle: SPST; 3 amp, 250 volts, phenolic body.	HFO Plate	ST12A
S104	SWITCH, toggle: SPST; 3 amp, 250 volts, phenolic body.	100 Kc Osc. On - Off	ST12A
S105	SWITCH, toggle: DPDT; 3 amp, 250 volts, phenolic body.	BFO - Crystal	ST22N
S106	SWITCH, toggle: SPST; 3 amp, 250 volts, phenolic body.	BFO - Plate	ST12A
S107	SWITCH, rotary: non-shorting; single section, one pole, 4 position.	Meter Switch	SW-105
T101	TRANSFORMER, filament & power: primary; 110/220 volts, 50/60 cps, Secdy #1, 5 volts, 3 amps, Secdy #2, 350-0-350 volts, 125 ma, Secdy #3, 6.3 volts, 4.0 amps, hermetically sealed case.	Main Power	TF-105
V101	TUBE, electron: 5V4G; octal.	HV Rectifier	5V4G
V102	TUBE, electron: OA2; miniature 7 pin.	Voltage Regulator	OA2
V103	TUBE, electron: 6BE6; miniature 7 pin.	Mixer	6BE6
V104	TUBE, electron: 12AU7; miniature 9 pin.	Audio Amplifier	12AU7
V105	TUBE, electron: 6AQ5, miniature 7 pin.	BFO	6AQ5
W100	CABLE ASSEMBLY, power: male, non-polarized plug one end, opposite end secured to equipment.	AC Line Cord	CA-102-2
W101	CABLE ASSEMBLY, twelve contact; male polarized one end, female polarized opposite end. (For servicing only)	Power Supply-Multiplier Interconnect	CA-109
W102	CABLE ASSEMBLY, six contact; male polarized, one end, female polarized opposite end. (For servicing only)	Power-Supply-Master Oscillator Interconnect	CA-110
W103	CABLE RF: single contact; male connector one end, female opposite end. (For servicing only)	Power Supply Multiplier Interconnect	CA-108
XC102	SOCKET, tube: octal.	Socket for C102	TS-101-P01
XF101	HOLDER, fuse: extractor post type for single AGC type fuse.	F101 Socket	FH-100-2
XF102	HOLDER, fuse: extractor post type for single AGC type fuse.	F102 Socket	FH-100-2

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XV101	SOCKET, tube: octal.	Socket for V101	TS101P01
XV102	SOCKET, tube: 7 pin miniature.	Socket for V102	TS102P01
XV103	SOCKET, tube: 7 pin miniature.	Socket for V103	TS102P01
XV104	SOCKET, tube: 9 pin miniature.	Socket for V104	TS103P01
XV105	SOCKET, tube: 7 pin miniature.	Socket for V105	TS102P01
XY101	SOCKET, crystal: .487" spacing, for .050" pins.	Socket for Y101	TS-104-1
XY102	SOCKET, crystal: .487" spacing, for .050" pins.	Socket for Y102	TS-104-1
Y101	CRYSTAL UNIT: quartz; 300 to 1,000 Kcs. (Supplied only on customer request).	BFO Crystal	CR-25/U
Y102	CRYSTAL UNIT: quartz; 300 to 1,000 Kcs. (Supplied only on customer request)	BFO Crystal	CR-25/U
C201	CAPACITOR, fixed: mica; 27 mmfd, ±5%, char C, 500 wvdc.	IFO Xtal Load	CM20C270J
C202	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	IFO Plate Filter	CM20B102K
C203	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	IFO Plate Filter	CM20B102K
C204	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	IFO Grid Coupling	CM20B102K
C205	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	VMO Coupling	CM35B103K
C206	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	IFO Amplifier Plate	CM35B103K
C207	CAPACITOR, fixed: mica; 150 mmfd, ±5%, char C, 500 wvdc.	IFO Amplifier Tank	CM20C151J
C208	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	IFO Meter Coupling	CM20B102K
C209	CAPACITOR, fixed: mica, .01 mfd, ±10%, char B, 300 wvdc.	IFO Meter Bypass	CM35B103K
C210	CAPACITOR, variable: air dielectric 3.5-54 mmfd, 500 wvdc.	HFO Xtal Trimmer	CT-100-1
C211	CAPACITOR, fixed: mica, 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Plate Filter	CM20B102K
C212	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Grid Coupling	CM20B102K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C213	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Plate Filter	CM20B102K
C214	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Cathode Bypass	CM20B102K
C215	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Screen Bypass	CM20B102K
C216	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Screen Bypass	CM20B102K
C217	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Grid Coupling	CM20B102K
C218	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Ampl Cathode Bypass	CM20B102K
C219	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Mult Grid Coupling	CM20B102K
C220	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	2-4 Mc Plate Filter	CM35B103K
C221	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	4-8 Mc Plate Filter	CM25B103K
C222	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	8-16 Mc Plate Filter	CM35B103K
C223	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Mult Screen Bypass	CM20B102K
C224	CAPACITOR, variable: ceramic; 1.5-7 mmfd, 500 wvdc.	4-8 Mc Trimmer	CV11A070
C225	CAPACITOR, variable: air dielectric; four section.	HFO Tuning	CB-100
C226	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Mult Cathode Bypass	CM20B102K
C227	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	8-16 Mc Trimmer	CV11A120
C228	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	16-32 Mc Grid Coupling	CM20B102K
C229	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	16-32 Mc Screen Bypass	CM20B102K
C230	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	16-32 Mc Plate Filter	CM35B103K
C231	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	32-64 Mc Grid Coupling	CM20B102K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C232	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	16-32 Mc Trimmer	CV11A120
C233	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	32-64 Mc Screen Bypass	CM20B102K
C234	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	32-64 Mc Plate Filter	CM35B103K
C235	CAPACITOR, variable: ceramic; 1.5-7 mmfd, 500 wvdc.	32-64 Mc Trimmer	CV11A070
C236	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	32-64 Mc Coupling	CM20B102K
C237	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	HFO Meter Filter	CM20B102K
C238	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	HFO Meter Coupling	CM20B102K
C239	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	RF Chassis Filament Bypass	CM20B102K
C240	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	16-32 Cathode Bypass	CM20B102K
C241	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	32-64 Mc Cathode Bypass	CM20B102K
C242	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	IFO Xtal Coupling	CM20B102K
C243	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	HFO Xtal DC Blocking	CM20B102K
C244	CAPACITOR, fixed: ceramic; 2.5 mmfd, ±.25 mmfd, 500 wvdc.	4-8 Mc Trimmer	CC-101-1
CR201	CRYSTAL UNIT: rectifying; germanium.	IFO Output Rectifier	IN34
CR202	CRYSTAL UNIT: rectifying; germanium.	HFO Output Rectifier	IN34
J201	CONNECTOR, female contact; polarized; twelve contact, chassis mounted.	Power Supply & RF Chassis	JJ-118-2
J202	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	VMO Interconnect	UG-625/U
J203	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	VMO Interconnect	UG-625/U
J204	NOT USED.		
J205	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	IFO Output	UG-625/U

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
J206	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	IFO Output	UG-625/U
J207	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	IFO Output	UG-625/U
J208	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	HFO Output	UG-625/U
J209	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	HFO Output	UG-625/U
J210	CONNECTOR, coaxial: female contact; BNC type, single hole mounted.	HFO Output	UG-625/U
L201	INDUCTOR, variable: Slug Tuned, 15-11 microhenries.	IFO Tank Coil	A-242
L202	INDUCTOR, fixed: .168 millihenries.	RF Ampl Peaking Coil	A-244
L203	INDUCTOR, variable: slug tuned, 26-44 microhenries.	Tank(2-4 Mc)	A-245
L204	CHOKE, RF: 765 microhenries, +20%.	RF Choke	CL-100-5
L205	INDUCTOR, variable: slug tuned, 7.4-13 microhenries.	Tank (4-8 Mc)	A-246
L206	INDUCTOR, variable: slug tuned, 1.84-3 microhenries.	Tank (8-16 Mc)	A-247
L207	INDUCTOR, variable: slug tuned, .5-.84 microhenries.	Tank (16-32 Mc)	A-248
L208	INDUCTOR, variable: slug tuned, .18-.26 microhenries.	Tank (32-64 Mc)	A-249
R201	RESISTOR, fixed: composition; 470,000 ohms, +10%, 1/2 watt.	IFO Grid Leak	RC20GF474K
R202	RESISTOR, fixed: composition; 100,000 ohms, +10%, 1/2 watt.	IFO Plate Load	RC20GF104K
R203	RESISTOR, fixed: composition; 47,000 ohms, +10%, 1/2 watt.	IFO Decoupling	RC20GF473K
R204	RESISTOR, fixed: composition; 3300 ohms, +10%, 1/2 watt.	IFO Decoupling	RC20GF332K
R205	RESISTOR, fixed: composition; 47,000 ohms, +10%, 1/2 watt.	IFO Ampl Grid Leak	RC20GF473K
R206	RESISTOR, fixed: composition; 12,000 ohms, +5%, 1/2 watt.	IFO Output Diode Load	RC20GF123J
R207	RESISTOR, fixed: composition; 470,000 ohms, +10%, 1/2 watt.	HFO Grid Leak	RC20GF474K



SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R208	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$ , 1/2 watt.	HFO Plate Load	RC20GF103K
R209	RESISTOR, fixed: composition; 82,000 ohms, $\pm 10\%$ , 2 watts.	HFO Decoupling	RC42GF823K
R210	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$ , 1/2 watt.	RF AMPL Grid Leak	RC20GF104K
R211	RESISTOR, fixed: composition; 470 ohms, $\pm 10\%$ , 1/2 watt.	RF Ampl Cathode	RC20GF471K
R212	RESISTOR, fixed: composition; 10,000 ohms, $\pm 10\%$ , 2 watts.	RF Ampl Plate Load	RC42GF103K
R213	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$ , 1 watt.	RF Ampl Decoupling	RC30GF102K
R214	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$ , 1/2 watt.	RF Ampl Screen Drop	RC20GF104K
R215	RESISTOR, variable: wire wound; 50,000 ohms, $\pm 10\%$ , 3 watts.	HFO Output Control	RA100ASRD503A
R216	RESISTOR, fixed: composition; 2200 ohms, $\pm 10\%$ , 2 watts.	Screen Dropping	RC42GF222K
R217	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$ , 1/2 watt.	Screen Dropping	RC20GF102K
R218	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$ , 1/2 watt.	Mult. Grid Leak	RC20GF104K
R219	RESISTOR, fixed: composition; 470 ohms, $\pm 10\%$ , 1/2 watt.	Mult. Cathode Bias	RC20GF471K
R220	RESISTOR, fixed: composition; 1200 ohms, $\pm 10\%$ , 2 watts.	Multi Decoupling	RC42GF122K
R221	RESISTOR, fixed: composition; 2200 ohms, $\pm 10\%$ , 2 watts.	8-16 Mc Mult Decoupling	RC42GF222K
R222	RESISTOR, fixed: composition; 47,000 ohms, $\pm 10\%$ , 1/2 watt.	8-16 Mc Mult Screen Drop	RC20GF473K
R223	RESISTOR, fixed: composition; 680 ohms, $\pm 10\%$ , 2 watts.	Ampl Parasitic Suppressor	RC42GF681K
R224	RESISTOR, fixed: composition; 100,000 ohms, $\pm 10\%$ , 1/2 watt.	8-16 Mc Mult Grid Leak	RC20GF104K
R225	RESISTOR, fixed: composition; 470 ohms, $\pm 10\%$ , 1/2 watt.	8-16 Mc Mult Cathode Bias	RC20GF471 K
R226	RESISTOR, fixed: composition; 33,000 ohms, $\pm 10\%$ , 1/2 watt.	16-32 Mc Mult Grid Leak	RC20GF333K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R227	RESISTOR, fixed: composition; 47,000 ohms, +10%, 1/2 watt.	16-32 Mc Mult Screen Drop	RC20GF473K
R228	RESISTOR, fixed: composition; 1200 ohms, +10%, 2 watts.	16-32 Mc Mult Decoupling	RC42GF122K
R229	RESISTOR, fixed: composition; 24,000 ohms, +5%, 1/2 watt.	32-64 Mc Mult Screen Drop	RC20GF243J
R230	RESISTOR, fixed: composition; 1200 ohms, +10%, 2 watts.	32-64 Mc Mult Decoupling	RC42GF122K
R231	RESISTOR, fixed: composition; 100,000 ohms, +10%, 1/2 watt.	32-64 Mc Mult Grid Leak	RC20GF104K
R232	RESISTOR, fixed: composition; 24,000 ohms, +5%, 1/2 watt.	HFO Output Diode Load	RC20GF243J
R233	RESISTOR, fixed: composition; 82,000 ohms, +10%, 2 watts.	Band Change Screen Drop	RC42GF823K
R234	RESISTOR, fixed: composition; 470 ohms, +10%, 1/2 watt.	16-32 Mc Mult Cathode Bias	RC20GF471K
R235	RESISTOR, fixed: composition; 470 ohms, +10%, 1/2 watt.	32-64 Mc Mult Cathode Bias	RC20GF471K
S201	SWITCH, rotary: non-shorting; two section, two poles, four position.	Crystal Switch	SW-106
S202	SWITCH, rotary: four section, five position.	HFO Band Switch	SW-108
V201	TUBE, electron: 12AU7; miniature 9 pin.	IFO & IFO Ampl	12AU7
V202	TUBE, electron: 6C4; miniature 7 pin.	HFO & RF Ampl	6C4
V203	TUBE, electron: 6AQ5; miniature 7 pin.	RF Ampl	6AQ5
V204	TUBE, electron: 6AQ5; miniature 7 pin.	RF Ampl - Mult	6AQ5
V205	TUBE, electron: 6AQ5; miniature 7 pin.	8-16 Mc Multiplier	6AQ5
V206	TUBE, electron: 6AQ5; miniature 7 pin.	16-32 Mc Multiplier	6AQ5
V207	TUBE, electron: 6AQ5; miniature 7 pin.	32-64 Mc Multiplier	6AQ5
XV201	SOCKET, tube: 9 pin miniature.	Socket for V201	TS103P01
XV202	SOCKET, tube: 7 pin miniature.	Socket for V202	TS102P01
XV203	SOCKET, tube: 7 pin miniature.	Socket for V203	TS102P01
XV204	SOCKET, tube: 7 pin miniature.	Socket for V204	TS102P01
XV205	SOCKET, tube: 7 pin miniature.	Socket for V205	TS102P01
XV206	SOCKET, tube: 7 pin miniature.	Socket for V206	TS102P01

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XV207	SOCKET, tube: 7 pin miniature.	Socket for V207	TS102P01
XY201	SOCKET, crystal: .487" spacing for .050" pins.	Socket for Y201	TS-104-1
XY202	SOCKET, crystal: .487" spacing for .050" pins.	Socket for Y202	TS-104-1
XY203	SOCKET, crystal: .487" spacing for .050" pins.	Socket for Y203	TS-104-1
XY204	SOCKET, crystal: .487" spacing for .050" pins.	Socket for Y204	TS-104-1
Y201	CRYSTAL UNIT, quartz: 3.2 to 3.9 Mcs., (Supplied only on customer request)	IFO Crystal	CR-18/U
Y202	CRYSTAL UNIT, quartz; 2 to 64 Mcs., (supplied only on customer request).	HFO Crystal	CR-18/U
Y203	CRYSTAL UNIT: quartz; 2 to 64 Mcs., (Supplied only on customer request).	HFO Crystal	CR-18/U
Y204	CRYSTAL UNIT: quartz; 2 to 64 Mcs., (Supplied only on customer request)	HFO Crystal	CR-18/U
B301	MOTOR ASSEMBLY, drive: consists of reversible motor, Part MO-100; 1/4" drive pulley, Part PM-194; drive belt, "O" ring type, Part RY-105; spring, Part SP-115.	VMO Drive	A-1005
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 mmfd.	VMO Correction	CB-105
C303	CAPACITOR, variable: air dielectric; 2.8 to 11.0 mmfd, ±5 mmfd.	VMO Trimmer	CB-102-1
C304	CAPACITOR, fixed: ceramic; 10 mmfd, ±.25 mmfd.	VMO Padder	CC107RG100C
C305	CAPACITOR, fixed: ceramic; 270 mmfd, ±5%, 500 wvdc.	VMO Grid Coupling	CC45LG271J
C306	CAPACITOR, fixed: ceramic; 270 mmfd, ±5%, , 500 wvdc.	VMO Cathode Coupling	CC45LG271J
C307	CAPACITOR, fixed: mica; .01 mfd, ±5%, char C, 300 wvdc.	VMO Plate Bypass	CM35C103J
C308	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	Cathode Follower Plate Bypass	CM35B103K
C309	CAPACITOR, fixed: mica; 1000 mmfd, ±10%, char B, 500 wvdc.	100 Kc Plate Coupling	CM20B102K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C310	NOT USED.		
C311	CAPACITOR, variable: air dielectric; 3.5 to 50 mmfd.	100 Kc Adjust	CT-103-1
C312	CAPACITOR, fixed: mica; 240 mmfd, ±5%, char C, 500 wvdc.	100 Kc Output	CM20C241J
C313	NOT USED.		
C314	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	Inner Oven Thermostat Arc Suppressor	CM35B103K
C315	CAPACITOR, fixed: mica; .01 mfd, ±10%, char B, 300 wvdc.	Relay Arc Suppressor	CM35B103K
C316	CAPACITOR, fixed: paper; .1 mfd, +40, -10%, 400 wvdc; plastic tubular case.	Outer Oven Thermostat Arc Suppressor	CN-100-4
C317	CAPACITOR, fixed: paper; .1 mfd, +40, -10%, 400 wvdc; plastic tubular case.	Motor Switch Arc Suppressor	CN-100-4
C318	CAPACITOR, fixed: mica; .1 mfd, ±10%, char B, 300 wvdc.	Meter Bypass	CM35B103K
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 Connections	TM-102-8
E302	BOARD, terminal: barrier type; nine 6-32 x 1/4" binding head machine screws.	Outer Oven Connections	TM-102-9
I301	LAMP, neon: 105-125 volts, 1/25 watt, bayonet base.	Inner Oven Indicator	BI-100-51
I302	LAMP, incandescent: 6-8 volts, 250 ma DC, bayonet base.	Power Indicator	BI-101-44
I303	LAMP, neon: 105-125 volts, 1/25 watt, bayonet base.	Zero Beat Indicator	BI-100-51
I304	LAMP, neon: 105-125 volts, 1/25 watt, bayonet base.	Outer Oven Indicator	BI-100-51
J301	NOT USED.		
J302	CONNECTOR, female contact: polarized; twelve contact, chassis mounted.	Internal VMO Connector	JJ-118-2
K301	RELAY, sensitive: 4500 ohms, DC res.	Thermostat Control	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
M301	METER, millimeter: 0-1, DC, 2-1/2" sq. case.	Testmeter	MR-100-1
P301	CONNECTOR, male contact: polarized; six contact.	VMO Power Connector	PL-101-1
P302	CONNECTOR, male contact: polarized; twelve contact, w/cable clamps.	VMO Connector	PL-102-1
P303	CONNECTOR, coaxial: male contact; BNC type for RG-58/U cable.	VMO Output	UG-88/U
R301	RESISTOR, fixed: composition; 3900 ohms, $\pm 10\%$ , 1 watt.	VMO Plate Filter	RC30GF392K
R302	RESISTOR, fixed: composition; 1000 ohms, $\pm 10\%$ , 1/2 watt.	Cathode Follower Load	RC20GF102K
R303	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$ , 2 watts.	Cathode Follower Plate Filter	RC42GF223K
R304	RESISTOR, fixed: composition; 47,000 ohms, $\pm 10\%$ , 1/2 watt.	100 Kc Plate Filter	RC20GF473K
R305	RESISTOR, fixed: composition; 4700 ohms, $\pm 10\%$ , 1/2 watt.	100 Kc Cathode Load	RC20GF472K
R306	RESISTOR, fixed: composition; 470,000 ohms, $\pm 10\%$ , 1/2 watt.	100 Kc Grid Leak	RC20GF474K
R307, 308	RESISTOR, fixed: wire wound; heater element, two sections, 1300 ohms each section, insulated.	Inner Heater Element	RR -105
R309, 310	RESISTOR, fixed: wire wound; heater element, two sections, 160 ohms each section, insulated.	Outer Oven Heater	RR-106
R311	RESISTOR, fixed: composition; 100 ohms, $\pm 10\%$ , 1/2 watt.	Inner Thermostat Arc Supp	RC20GF101K
R312	RESISTOR, fixed: composition; 240,000 ohms, $\pm 5\%$ , 1/2 watt.	Inner Oven Indicator Protector	RC20GF244J
R313	RESISTOR, fixed: composition; 100 ohms, $\pm 10\%$ , 1/2 watt.	Relay Arc Supp	RC20GF101K
R314	RESISTOR, fixed: composition; 100 ohms, $\pm 10\%$ , 1/2 watt.	Outer Oven Thermostat Arc Supp	RC20GF101K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R315	RESISTOR, fixed: composition; 240,000 ohms, $\pm 5\%$ , 1/2 watt.	Outer Oven Indicator Protector	RC20GF244J
R316	RESISTOR, fixed: composition; 100 ohms, $\pm 10\%$ , 1/2 watt.	Motor Switch Arc Suppressor	RC20GF101K
R317	RESISTOR, fixed: composition; 56,000 ohms, $\pm 10\%$ , 1/2 watt.	Relay Bleeder	RC20GF563K
R318	RESISTOR, fixed: composition; 9100 ohms, $\pm 5\%$ , 2 watts.	Voltage Dropping Resistor	RC42GF912J
R319	RESISTOR, fixed: composition; 9100 ohms, $\pm 5\%$ , 2 watts.	Voltage Dropping Resistor	RC42GF912J
R320	RESISTOR, fixed: composition; 22,000 ohms, $\pm 10\%$ , 2 watts.	VMO Grid Leak	RC20GF223K
R321	RESISTOR, fixed: composition; 12 ohms, $\pm 10\%$ , 2 watts.	Power Indicator Series Dropping	RC42GF120K
R322	RESISTOR, fixed: wire wound; 100 ohms, 55 watts.	Motor Series Resistor	RW-115-101-55
R323	RESISTOR, fixed: wire wound; 100 ohms, 55 watts.	Motor Series Resistor	RW-115-101-55
S301	SWITCH, thermostatic: bimetallic; operate at 70° C, $\pm 0.5^\circ$ C.	Inner Oven Thermostat	SS-103-C-70
S302	SWITCH, thermostatic: bimetallic; operates 80° C, $\pm 2^\circ$ C.	Inner Oven Safety Thermostat	SS-100-3
S303	SWITCH, thermostatic: bimetallic; operates 60° C, $\pm 2^\circ$ C.	Outer Oven Thermostat	SS-100-1
S304	SWITCH, lever action: two position; two form at each position, center off, momentary contact.	Motor Control	SW-103
V301	TUBE, electron: 6AB4; miniature 7 pin.	VMO	6AB4
V302	TUBE, electron: 12AU7; miniature 9 pin.	Cathode Follow & 100 Kc Crystal Oscillator	12AU7
XI301	LIGHT, indicator: with clear white lens, for min. bayonet base T-3-1/4 bulb.	Socket for I301	TS-106-2
XI302	LIGHT, indicator: with red frosted lens, for min. bayonet base T-3-1/4 bulb.	Socket for I302	TS-106-1
XI303	LIGHT, indicator: with clear white lens, for min. bayonet base T-3-1/4 bulb.	Socket for I303	TS-106-2

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XI304	LIGHT, indicator: with clear white lens, for min. bayonet base T-3-1/4 bulb.	Socket for I304	TS-106-2
XK301	SOCKET, tube: octal.	Socket for K301	TS101P01
XV301	SOCKET, tube: 7 pin miniature.	Socket for V301	TS102P01
XV302	SOCKET, tube: 9 pin miniature.	Socket for V302	TS103P01
XY301	SOCKET, crystal: .487" spacing, for .095" pins.	Socket for Y301	TS-105-1
Y301	CRYSTAL UNIT: quartz; 100 Kcs	100 Kcs Osc	CR-100-1

C245	CAPACITOR, fixed: mica; .01 mfd, +5%; 300 wvdc.	RF Bypass	CM35C103J
C246	CAPACITOR, fixed: mica; .01 mfd, +5%; 300 wvdc.	RF Bypass	CM35C103J

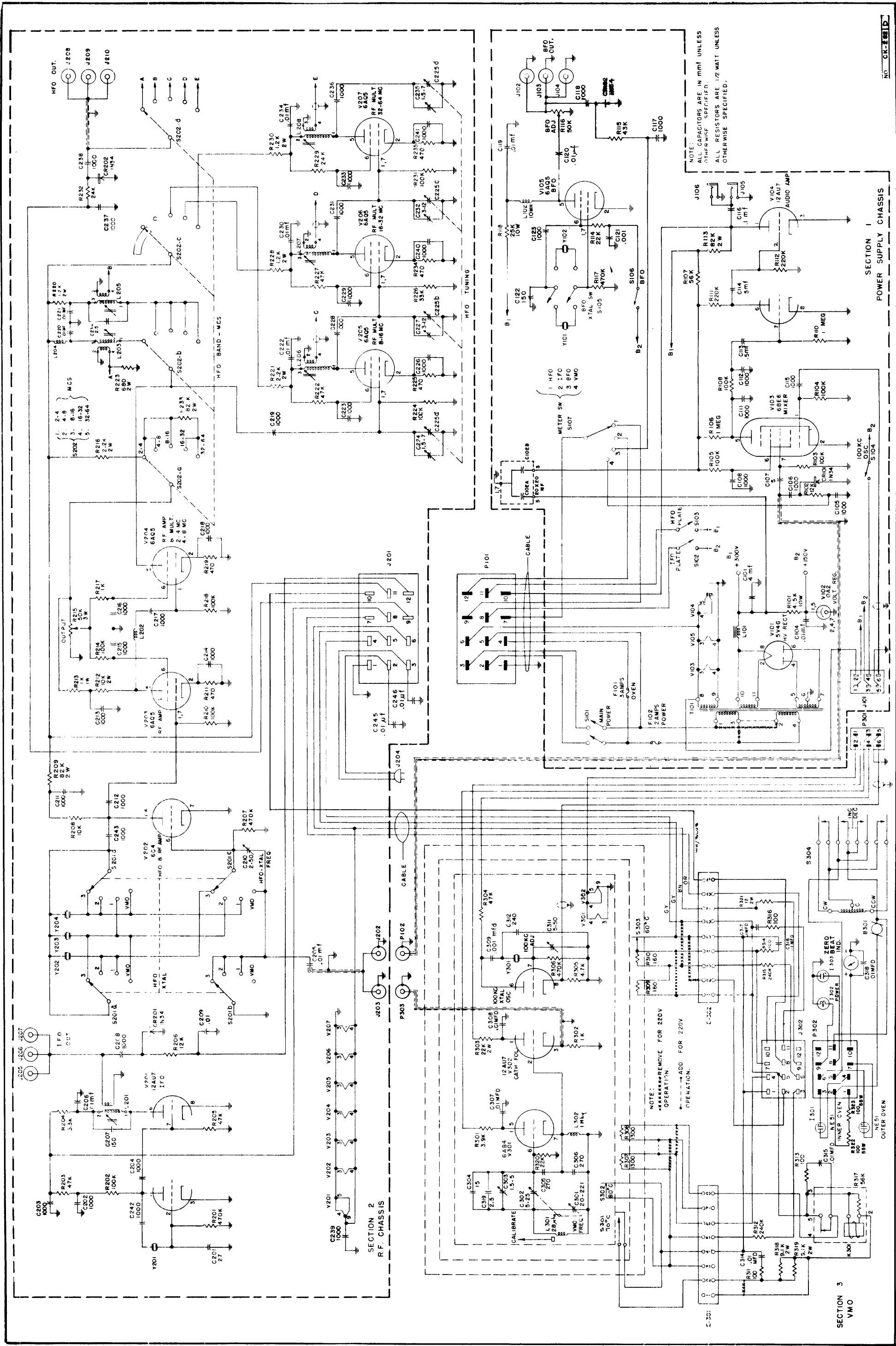
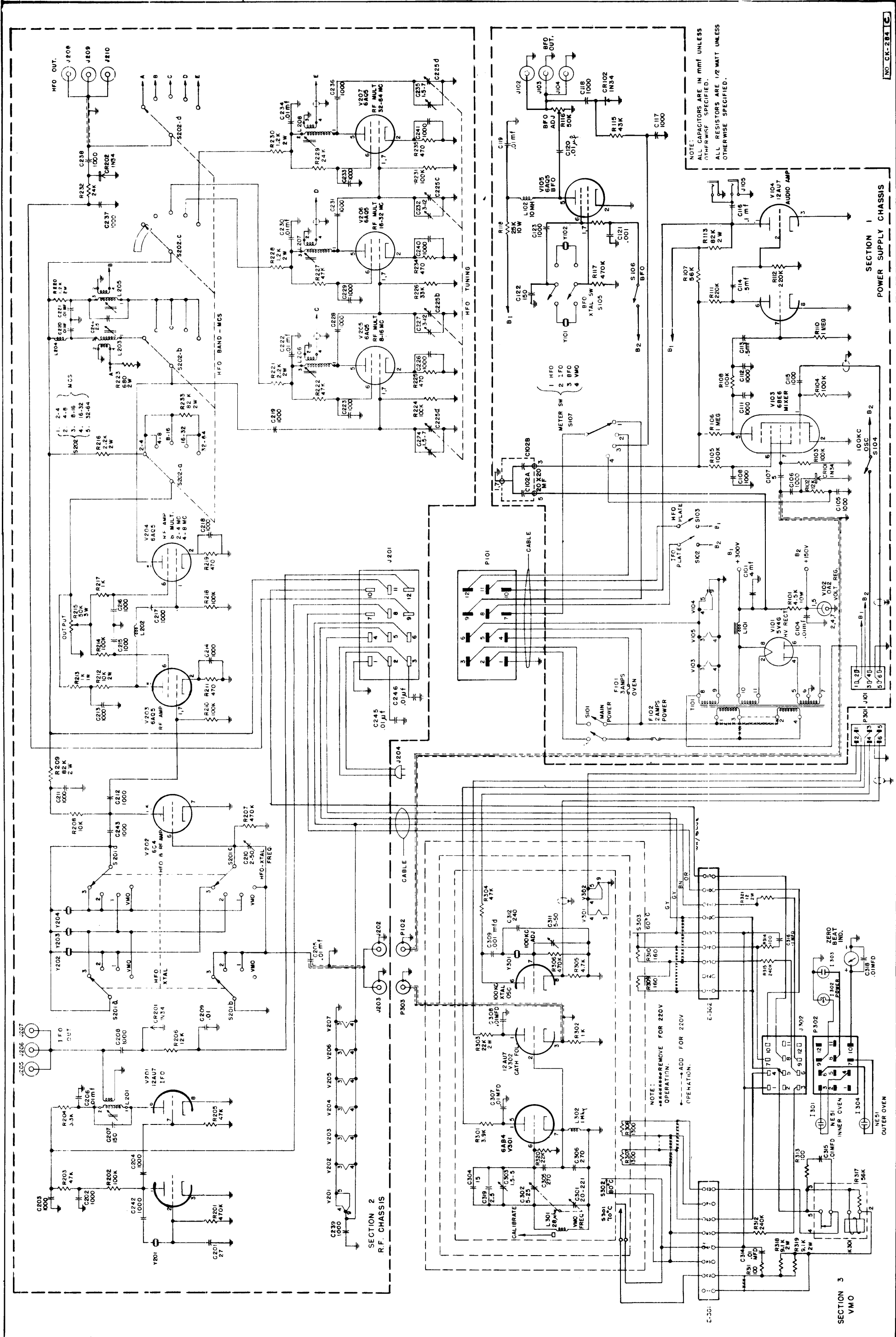


Figure 5-3 Schematic Diagram, Model VOX-1

NO. CK-111D





NOTE: ALL CAPACITORS ARE IN MMF UNLESS OTHERWISE SPECIFIED.  
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED.

NOTE: REMOVE FOR 220V OPERATION.  
ADD FOR 220V OPERATION.

Figure 5-4 Schematic Diagram, Model VOX-2

NO. CK-284 C