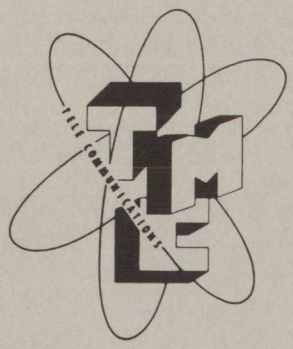
INSTRUCTION BOOK

for

FREQUENCY SHIFT EXCITER MODEL XFK



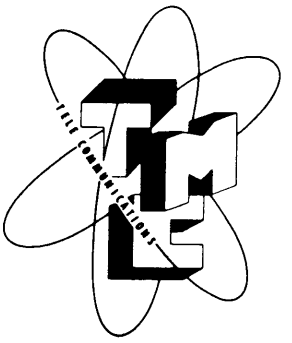
THE TECHNICAL MATERIEL CORPORATION

Mamaroneck, New York

INSTRUCTION BOOK

for

FREQUENCY SHIFT EXCITER MODEL XFK



THE TECHNICAL MATERIEL CORPORATION

Mamaroneck, New York

WARNING!

HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personel fail to observe safety precautions

Be careful not to contact high-voltage connections, 110 or 220 volt power input connections, or r-f output connections when working on or near this equipment. Turn off associated transmitter equipment before working on the Exciter. Ground capacitors in the transmitter in the vicinity of the exciter r-f cable before making connections.

ORDERING INFORMATION

CRYSTALS FOR MODEL XFK (C-2749/URT)

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
Y1 thru Y3	CRYSTAL UNIT, quartz: ±.002%; frequency range 800 to 6700 Kcs. (for output frequencies of 1.0 to 6.9 Mcs.) Supplied only at customers request. See Crystal Selection Formula on Page 3-1 of Instruction Manual.	HF Xtal Osc.	CR-27/U

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE AND BASIC PRINCIPLES

The Model XFK (hereafter referred to as Exciter) is a single unit, Frequency Shift Exciter designed for fixed station use. The Exciter is a high stability radio frequency oscillator which provides a means of shifting an RF carrier in accordance with the variations of an audio or pulse signal.

a. The Exciter replaces the crystal oscillator in a transmitter and provides "mark" and "space" carrier-shift transmission of teleprinter, telegraph, FM telephone, facsimile or telephoto intelligence. Carrier shift up to 1,000 cycles is available either linear with applied voltage or independent of applied voltage amplitude variations within the range of 1.0 to 6.9 megacycles.

b. Carrier-shift has become the most accepted means of transmitting the above mentioned types of intelligence. The transmitter frequency is changed from a low "space" frequency to a higher "mark" frequency in accordance with the input intelligence. At the receiver, the r-f (radio-frequency) signals are detected, and a suitable converter changes the a-f (audio-frequency) variations to an audio or pulse signal, which convey the intelligence to the final terminal equipment. For receiving, a Dual Diversity Receiver such as the TMC Model DDR-2 is recommended in conjunction with a Frequency Shift Converter such as the TMC Model CFA.

2. DESCRIPTION OF UNIT

a. The Exciter, Model XFK is illustrated in Figure 1-1. The panel is 3/16" thick by 19" long by 10 1/2" high, and is finished in TMC Gray enamel. The chassis extends 16" behind the panel including the rear panel control protrusions and is supported to the panel on each side by brackets. Two convenience handles are mounted on the front panel. The Controls most used are located on the Exciter front panel. The crystals are accessible from the front panel through an access door in the center of the panel. Input, output, seldom used controls, and power connections are located at the rear of the Exciter chassis. The dust cover has been designed for quick removal to provide ready

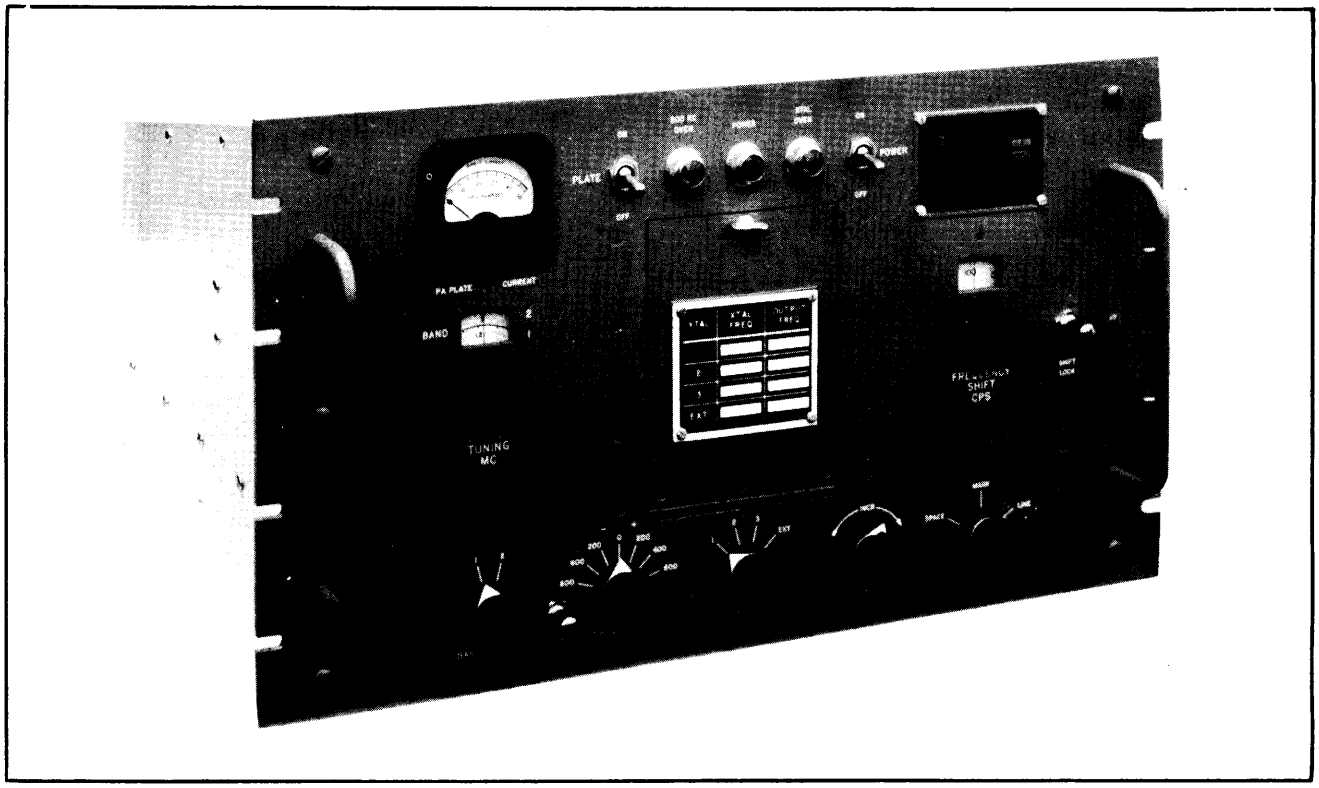


Figure 1-1 Frequency Shift Excitor Model XFK - Front View Showing Controls and Crystal Oven Access Door

access to all vacuum tubes from the rear of the exciter. The power supply for the Exciter is contained within the unit thereby making one simple compact installation.

b. All frequency determining elements are enclosed within a new and highly improved temperature controlled oven. The frequency modulation is accomplished by a newly developed circuit technique offering many advantages over any existing Exciter, some of the details of which are as indicated below.

(1) Crystal and 200 kc oven has fast heating characteristic in order that their temperatures may be stable within approximately 10 minutes after a cold start.

(2) New multiplication circuit provides a means of presetting output shift for all three crystal frequencies. Transmitter multiplications of 1,2,3,4,6,8,9,12 are accomodated. Once set, multiplications and proper output shift are controlled by crystal selector switch.

(3) All control dials are directly calibrated in frequency.

(4) Single Control output tuning eliminates possible error of tuning to lower sideband.

3. REFERENCE DATA

a. Output Frequency Range:
1-2.5 mc on Band 1
2.5-6.9 mc on Band 2

b. Frequency Shift:
Linear to 1,000 cycles.

c. Output Power:
Adjustable to 3 watts.

d. Output Impedance:
50-70 ohms.

e. Keying Sources:
(1) Contact closing to ground.
(2) Polar or neutral positive.
(3) Linear input 30,000 ohms impedance.

f. Keying Speed:
1,000 w.p.m. maximum.

g. Keying Input Impedance:
Polar or neutral operation 100,000 ohms, may be bridged by external 1800 ohms loop resistance. Contact closing to ground must be open circuit.

h. RF Source:
Internal crystal oscillator or external oscillator

i. Input Impedance for External RF Source:
70 ohms, 6 to 8 volts RMS.

j. Frequency Control:
High frequency crystal oscillator 0.8 to 6.7 mc. High stability 200 kc osc.

k. Crystal Holders:
FT-243 three positions and HC-6/U three positions.

l. Oven Temperature:
70 degrees Centigrade held constant within plus or minus 0.1 degrees C.

m. Keying Bias:
Not greater than 10% at 1,000 wpm.

n. Overall Stability:
(1) 10 cps for ambient temperature change of 0 to 50 degrees C.
(2) 10 cps for line voltage change of 10%.
(3) No drift for input signal variations of plus 25 volts to plus 150 volts (mark frequency).

o. Crystal Frequency:
$\left(\frac{\text{Assigned transmitter frequency}}{\text{Transmitter multiplication}}\right)$
minus 200 kc

p. Metering:
PA plate current (tuning)

q. Monitoring:
100 millivolts across 70 ohm coaxial connector.

r. OPERATING CONTROLS: (front panel)
(1) Primary Power Switch.
(2) Plate Power Switch.
(3) Output Tuning Control.
(4) Crystal or External oscillator Selector Switch.

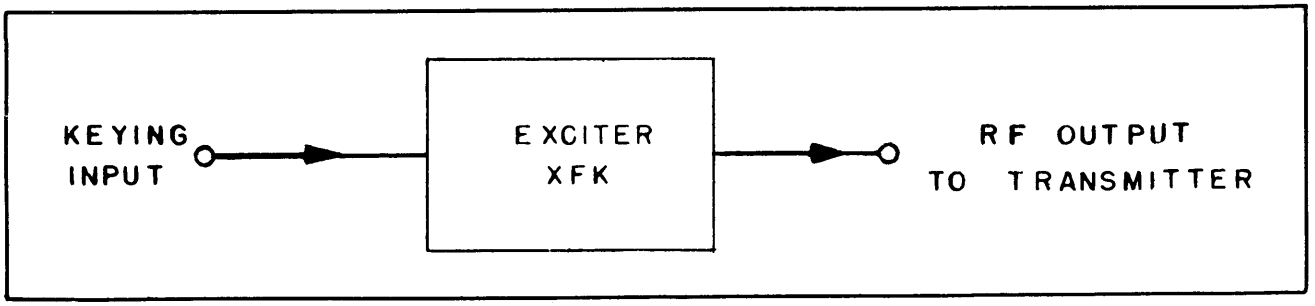


Figure 1-2 Simplified Block Diagram of Application

(5) Bandswitch.
(6) Test Switch.
(7) Frequency Shift Control.
(8) Output Power Control.
(9) Frequency Control.
(10) Crystal Access Door.

s. (rear chassis)
(1) Coarse Frequency Adjust Control
(2) Multiplier Preset Selector
(3) Key - Fax switch.

t. Primary Power:
110/220 v, 50/60 cps
Both ovens off - 100 watts
Each oven - 40 watts.

u. Weight:
40 pounds.

TABLE 1-1 VACUUM TUBE COMPLEMENT

SYMBOL	TYPE	CIRCUIT
V-1	6J6	200 KC Oscillator
V-2	12AU7	Reactance Tube
V-3	6BE6	Mixer
V-4	6BE6	Mixer
V-5	2E26	Power Amplifier
V-6	12AU7	Crystal Oscillator-Buffer
V-7	12AU7	Keyer
V-8	5U4G	High Voltage Rectifier
V-9	6X4	Bias Voltage Rectifier
V-10	OB2/VR	Voltage Regulator
V-11	OB2/VR	Voltage Regulator

SECTION 2
THEORY OF OPERATION

1. GENERAL DESCRIPTION OF CIRCUITS

A. Figure 2-1 illustrates a block diagram of the Exciter showing the routing of a signal from input to output. Constant reference will be made during the following discussion to tubes and points designated in Figure 2-1. Readers' reference to this figure should be made when necessary without further direction.

B. The Exciter, Model XFK will generally be used for radio-teletype operation and for the purpose of this discussion it will be assumed that the Exciter is being used for the transmission of teleprinter signals and that a keyed d-c signal is being applied to the input circuit.

For radio-teletype operation, a sequence of two frequencies is transmitted corresponding to "mark" (closed key) and "space" (open key) conditions of the teletypewriter. The assigned frequency of the radio-transmitter is the mean of the mark and space frequencies. The mark frequency is higher than the assigned frequency, and the space frequency is lower. The difference between the mark and space frequencies is termed "shift". Usually the XFK Exciter will be used to produce a total shift of 850 cycles. The mark frequency will be 425 cycles higher than the assigned frequency and the space frequency will be 425 cycles lower than the assigned frequency.

C. Assuming teleprinter operation and a d-c input signal, the keying input signal will cause the keyer tube V-7, to key the reactance tube, V-2, on and off.

(1) 200 kc Oscillator - V1 is a push pull modified Colpitts oscillator operating at 200 kc. The major part (95%) of its tank circuit is located within a temperature stabilized oven with a fast heating characteristic. Even this portion of the tank circuit is temperature compensated and utilizes only components having very uniform retrace characteristics. In addition, the plate voltage is regulated and the oscillator is compensated external to the oven for changes in ambient temperature. External to the oven are two air spaced, ceramic supported, trimmers C7 and C8 used respectively as fine and coarse frequency adjustments.

(2) Reactance Tube - The reactance tube V-2 receives the modulating intelligence (audio or pulse signal) at the grid of section 1 (pins 1,2, 3) and changes the reactance across the 200 kc oscillator tank, and therefor the frequency of the 200 kc oscillator in accordance with this intelligence. The reactance tube is a push push balanced circuit and operates in the following manner. Normally, (i.e.-0 voltage at grid) a small capacitive current flows through section 1 of V2 because of the phase shift through R5 and C14, C2 and the inversion across the 200 kc tank. Conversely, a small inductive current flows through section 2 of V2 because of the phase shift through C12 and R4 and the inversion across the tank.

When a positive voltage is applied to the grid of section 1, this causes an increase in the plate current of section 1 and therefore an increase in

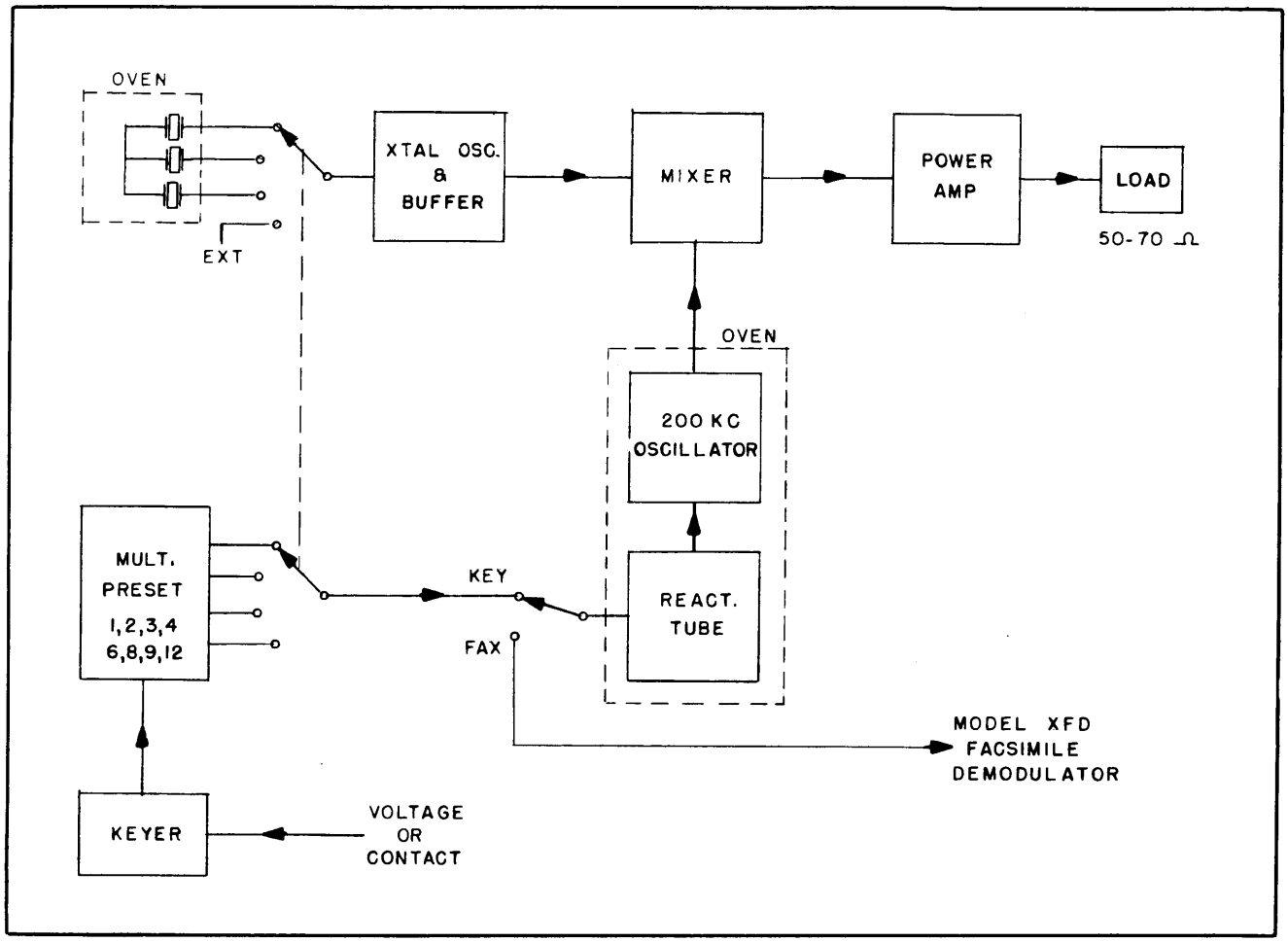


Figure 2-1 Block Diagram

the capacitive current in this section thereby lowering the frequency of the 200 kc OSC. At the same time, the increase in plate current of section 1 causes a decrease in plate current of section 2 of V2 through the mutual cathode resistor R7, thus causing a decrease in the inductive current and therefore also lowering the frequency of the 200 kc OSC. Over a narrow frequency range (200 kc ±500 cps), this frequency change will be linear with respect to applied voltage (pos. or neg.). This system provides the advantage of having the reactance tube currents contribute a negligible amount to the center frequency of the 200 kc oscillator. C2 adjusts the phase shift of section 1 so that for a given positive or negative signal voltage the amount of shift will be equal.

(3) Xtal Osc. & Buffer - One section of V6 is used as a modified "Pierce" crystal controlled oscillator while the second section is used as a cathode follower buffer. Since the output frequency of the frequency shift exciter, Model XFK, is determined by the sum frequency of the 200 kc Osc. and the crystal oscillator, the crystals are temperature controlled in an oven and the plate voltage of the osc. section is stabilized. Crystals may be easily exchanged as the oven is easily accessible through a small door in the front panel. A crystal selector switch allows selection of any one of three crystals or an external signal. The crystals may be either type FT243 or the new CR27/U as sockets are provided for either type. The crystal selector switch also selects the multiplication ratio which is set at the rear of the unit as discussed in paragraph (7) of this section.

(4) Mixer - V3 and V4 together operate as a balanced mixer to add the crystal frequency and the 200 kilocycles from the reactance tube oscillator. Since the crystal frequency is fed in phase to both grids of V3 and V4, it is cancelled in the plates by transformers T2 and T1 on bands 1 and 2 respectively. To obtain exact cancellation in the plates, balancing adjustment R14, which varies the relative gains of V3 and V4, is provided.

The input from the crystal oscillator is tuned by C18A and the output, or sum frequency, is tuned by C18B. Band switching is used to cover two frequency ranges, .8-2.3 mc and 2.3-6.7 mc for the crystal frequencies and 1-2.5 mc and 2.5-6.9 mc for the output frequencies. These are Bands 1 and 2 respectively. Condensers C59 and C40 track the output frequency with the input frequency on Bands 1 and 2 respectively.

(5) Power Amplifier - V5 is a 2E26 class B tuned radio frequency power amplifier fed from the output of Mixers V3 and V4. Fixed bias is used and power output is controlled by adjusting bias voltage by means of potentiometer R22. Plate current is metered and Tuning is indicated by a 50 milliampere meter M1. A small portion of the output voltage is fed back to the grid in proper phase and amplitude to neutralize the amplifier should the load be removed. Its amplitude is adjusted by means of C27. The output is tuned by C18C which is ganged along with C18B and C18A.

(6) Keyer Tube - The keying tube, V7, is used where a definite and fixed amount of frequency shift is desired in accordance with some nature of an on-off signal. The types of on-off signals which the keyer must accomodate are (a) positive voltage, either polar or neutral and (b) contact keying.

For either type of keying it is necessary that the same voltage be consistently impressed upon the reactance tube for any given shift. Since this voltage must be polar and perfectly balanced, the keyer tube V7 generates the actual internal keying voltage for either type of external keying (a) or (b). This is accomplished in the following fashion:

When using voltage keying, space voltage (either O or neg. volt.) is applied to the grid of section 1 of V7 (pin 2). This section will then be cut off due to the cathode bias applied through voltage divider R33 and R34. This in turn impresses a high positive voltage to the grid of section 2 of V7 (pin 7) through R35. This causes the second section to draw current and to act as a low resistance across R36. V7 plate resistance, R37, R38 and R39 in series act as a voltage divider from ±105 volts to -105 volts. This will then apply a small positive voltage to R40 and R41. When Mark voltage (plus 25 to plus 150 volts) is applied to the grid of section 1, the tube will conduct and its plate voltage will drop. Since the grid of section 2 is tied directly to the plate, section 2 will cease to conduct. R36, R37, R38 and R39 in series then act as a voltage divider, this will then apply a small negative voltage to R40 and R41. R38 is an adjustment to balance the pos. and neg. voltage while R40 regulates the amplitude of pos. or neg. voltage fed to the reactance tube.

When using contact keying, the operation of the second section is identical but the grid is directly controlled by grounding for the "mark" condition.

Provision is made for test purposes to set "space" by grounding the grid of Section 1 or "mark" by putting B± on the same grid.

(7) Multiplier Preset Section - The multiplier preset plugs and jacks are a series of voltage dividers which may be inserted between the keyer and the reactance tube. There is a separate jack for each multiplication ratio commonly used between the output frequency of the exciter Model XFK and the output frequency of the associated transmitter, namely 1,2,3,4,6,8,9, and 12. Each divider consists of two resistors, one reducing the output from the keyer tube to the reactance tube by exactly the multiplication ratio, the other resistor shunting the original tap from R40 so as to maintain a constant input resistance of 10,000 ohms. For each position of the crystal selector switch, there is a small cable which may be plugged into any mult. ratio desired. Should it be required that two or more crystals require identical multiplication ratios, a jack is provided in parallel with each cable. If the desired shift at the output of the transmitter is now directly set on the dial, the proper shift of the Model XFK will be set automatically.

(8) Ovens - Two separate ovens are used in Model XFK. One is used for the 200 kc reactance osc. while the other is used for the crystals. They are both very similar in design with the main difference being that the cover of the crystal oscillator is hinged and may be opened from the front panel. The oven design is of a simple and rugged yet highly satisfactory design. Two cartridge type heaters are used in each oven, sunk into a well at the bottom of a thick aluminum casting. The thermostat is sunk in the same well as one of the heaters insuring close thermal coupling. The thermostat is a bimetallic strip with high sensitivity and extremely long life. Replacement of either heaters or thermostats is a very simple operation. The thermostat is set at 70°C to allow for a 15°C rise within the equipment above a 50°C ambient. Heater operation may be observed by means of neon lamps in parallel with either set of heaters.

(9) Power Supply - The power supply is a conventional full wave rectifier supply with condenser input. The unregulated output voltage is approximately 300 volts. R71 and V10, (OB2) supply 105 volts regulated to the 200 kc osc., react., tube, Xtal osc., keyer, and for external use with facsimile demodulator, Model XFD. A negative 105 volts regulated is obtained through a 6X4 half wave rectifier, and RC filter and an OB2 regulator tube. This voltage is used in the keying circuit and also to provide bias for the power amplifier.

SECTION 3
INSTALLATION AND OPERATION

1. INSTALLATION

a. Unpacking - The Model XFK Frequency Shift Exciter has been so designed that its installation and operation will require a minimum of effort by the user. The unit comes in its own shipping container and should be carefully unpacked. A close visual inspection should be made to ascertain any physical damage due to unnecessarily rough handling during shipping.

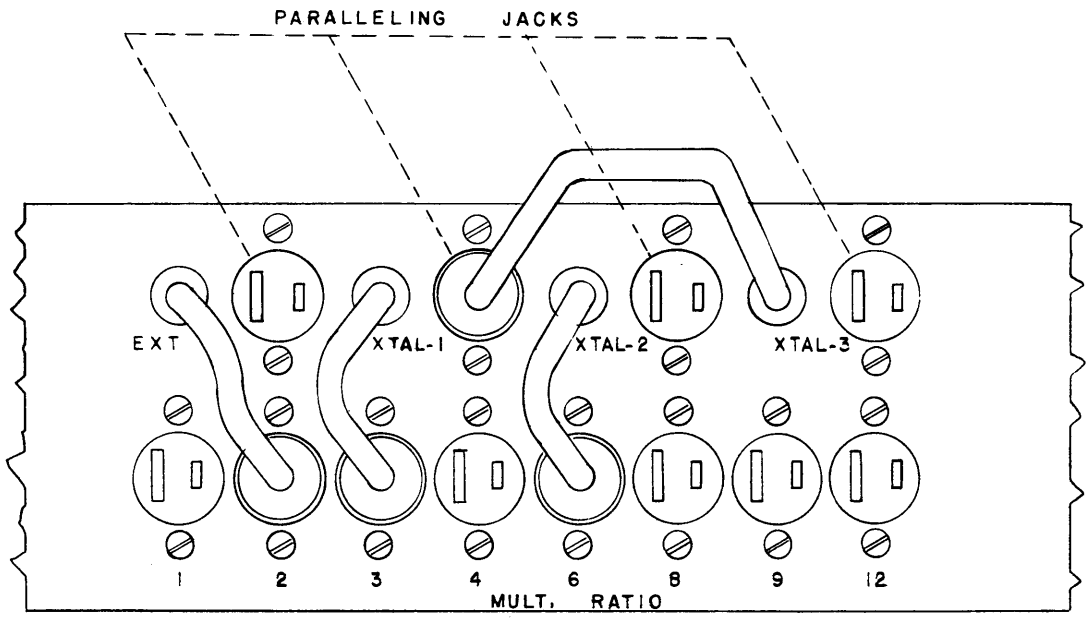
b. 110/220 volt operation - The unit leaves the factory wired for 110 V. A. C. 50/60 cycles unless it is specifically ordered for 220 V. A. C. 50/60 cycles, in which event it would be clearly tagged so.

Should it be necessary at any time to convert the equipment for use on 220 V.A.C., 50/60 cycles, two changes are required.

(1) Transformer T7 primary windings must be rewired as shown on the schematic. Specifically, remove the jumpers between terminals 1 and 2 and between 3 and 4. Add a jumper between terminals 2 and 3.

(2) Each oven must be rewired as shown on the schematic. Specifically, remove the jumpers between terminals 1 and 5 and between 2 and 6. Add jumpers between 1 and 6.

c. Electrical Connections - The unit should be mounted in its operating position in the rack. The input keying line may be a twisted pair of standard telephone type line. The line should be connected between terminals marked "Volt" and "GND" at



A TYPICAL PATCHING ARRANGEMENT

XTAL SELECTOR POSITION	XMTR. MULT. RATIO	XMTR. OUTPUT FREQ. SHIFT (DIAL SET.) CPS	XFK FREQ. SHIFT
EXT	2	850	425
XTAL - 1	3	850	283
XTAL - 2	6	850	142
XTAL - 3	3	850	283

Figure 3-1 Multiplication Preset

the rear of the chassis and should be connected so that a positive voltage appears at "Volt" on "Mark" condition. The input impedance of the keying line is 100,000 ohms.* A twisted pair may be brought in to the terminals marked "CONT" and "GND", This line may be used to key the excitor merely by shorting it ("Mark" condition). Care must be taken, however, to see to it that this line is always absolutely open in order for the regular keying line to function properly.

The facsimile line should be connected to "FAX" and "GND" terminals on the terminal board. When using a facsimile demodulator such as TMC Model XFD, the +105 volts is supplied from the XFK and should be wired along with a ground to the appropriate terminals on the Model XFD.

The "output" jack should be connected by a suitable length of 72 ohm cable to the frequency shift input terminal on the associated transmitter.

Should it be desired that an external oscillator be used to replace the crystal oscillator within the unit, a coaxial cable of 72 ohms with the required signal level and frequency should be connected to the jack labelled "external".

A jack labelled "MONITOR" is also available at the rear of the chassis and taps off a very small portion of the output of the frequency shift exciter. This may be connected through a 72 ohm coaxial cable to any suitable monitoring system available at the transmitter.

2. INITIAL ADJUSTMENTS

a. Crystal Selection - Before operating the equipment it is necessary to select the proper crystal for the desired output frequency. This may be done as per the following formula:

$$f_x = \frac{fo}{n} - 200 \text{ KC}$$

Where fx = crystal frequency in megacycles
fo = output frequency of transmitter in megacycles
n = transmitter multiplication ratio.

The crystal used should preferably be the new hermetically sealed JAN unit CR27/U as per the new specification MIL-C-3098. The crystal should be inserted in one of the appropriate crystal sockets inside the oven. The oven may be reached merely by opening the small thumb adjustment on the door located on the front panel. Writing space for the crystal frequency and output frequency of the Model XFK is available on the front of the oven door to aid in selection of the crystal channel.

b. Multiplication Preset - The proper transmitter multiplication ratio should be set at the rear of the chassis by means of the plug corresponding to the crystal position used on the front panel. Should the jack for any ratio be in use by another position, the plug may merely be inserted into the jack which is in parallel with the plug inserted into this particular ratio. This is illustrated in figure 3-1.

c. Key-Fax Switch - There is one switch located on the rear of the unit which must be set in "KEY" position to work on either voltage or contact keying. In this position, the multiplier preset plugs must be inserted in order that the unit may "shift". In "Fax" position, a facsimile signal may be applied as discussed in Section 3, -3-b.

3. OPERATION

Introduction - To obtain best results with the Model XFK, the ovens should be allowed to run continuously. This means that the power switch on the front panel should always remain on.

a. Tune up Procedure:

(1) Turn on "power" switch on front panel if not already on. The Red light and the two oven cycling lamps on the front panel should go on.

(2) Turn "Plate" switch on and be sure to limit the P.A. plate current to 50 ma with the "POWER" control.

(3) Set the "Xtal" selector switch to the desired crystal. The multiplication ratio should have been set as already discussed in Section 3-2-b.

(4) Set the band change switch to the proper band for the Model XFK output frequency for the Xtal selected.

(5) Set the output dial to the correct output frequency. The P.A. plate current should be set at 50 ma. Only a slight readjustment of this dial should now be required to cause a dip in the P.A. plate current meter. At the higher frequencies on band 2, the incorrect sideband may cause a smaller dip at 400 kc below the proper output frequency. This is of no consequence providing the operator reads the dial correctly.

(6) Increase the "power" control until the desired output power is reached being sure not to increase the P.A. plate current over 50 ma.

(7) Set the "Shift" control at the desired shift of the transmitter. No allowance for frequency multiplication need be made if the patch panel, at the rear of the chassis has been properly connected.

*However, the line should be terminated in as low an impedance as the keying source may operate into. For this reason, a 2000 ohm, 10 watt resistor is supplied with each XFK attached to the appropriate terminals.

(8) Put the test switch on "LINE" and the unit is now ready to operate on keyed or contact signals.

(9) Set "frequency" control to "O" and the unit will now be "on frequency" within ±50 cycles plus the grinding error of the Xtal used. If the frequency is monitored more accurately, the frequency may be changed by as much as ±600 cycles with this control.

(b) Facsimile Operation:

To convert the Model XFK from keyed signals to facsimile it is only necessary to switch the Key-Fax switch to "FAX". The model XFK should be tuned exactly as in preceeding paragraph. It must, however, be kept in mind that the "Shift" dial and the automatic multiplication ratio are now by-passed.

A signal at the "Fax" input of approximately ±4 volts will then shift the carrier ±500 cycles linear with applied voltage. The TMC Model XFD will convert an amplitude modulated tone carrier to the D. C. modulation required to operate the Model XFK and has the required controls on its front panel. Complete instructions are supplied with the Model XFD for proper interconnection and adjustment for use with the Model XFK.

SECTION 4
OPERATOR'S MAINTENANCE

The Model XFK Frequency Shift Exciter 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 maintenance technician.

1. EMERGENCY MAINTENANCE

a. NOTICE TO OPERATORS.- Operators should not perform any of the following emergency maintenance procedures without proper authorization.

b. REPLACEMENT OF TUBES AND FUSES.

(1) Replacement of Fuses.

WARNING

Never replace a fuse with one of higher rating unless continued operation of the equipment is more important than probable damage. If a fuse burns out immediately after replacement, do not replace it a second time until the cause has been corrected.

(a) Power fuse failure in the Exciter would normally be indicated by failure of the red pilot lamp to be on when the power switch is turned on. The pilot lamp in the equipment is operated at $\frac{1}{2}$ voltage and therefore would not ordinarily be the cause of no indication. In addition to the pilot lamp not lighting, the Vacuum tubes in the Exciter would not be lighted. In this case, the 3 ampere power fuse on the rear panel should be checked and replaced if defective.

Oven fuse failure in the Exciter would normally be indicated by failure of two clear pilot lamps to be on, at least intermittently, when the power switch is turned on. In addition to the pilot lamps not lighting, the ovens of the Exciter would be cold. In this case, the 3 ampere oven fuse on the rear panel should be checked and replaced if defective.

(2) REPLACEMENT OF TUBES.- The Location of all tubes in the XFK is indicated in Figure 4-1. The tubes may be checked visually to see if they are lighted, or for warmth. When necessary the tubes should be carefully removed and tested, and when replaced care should be taken to install tube shields.

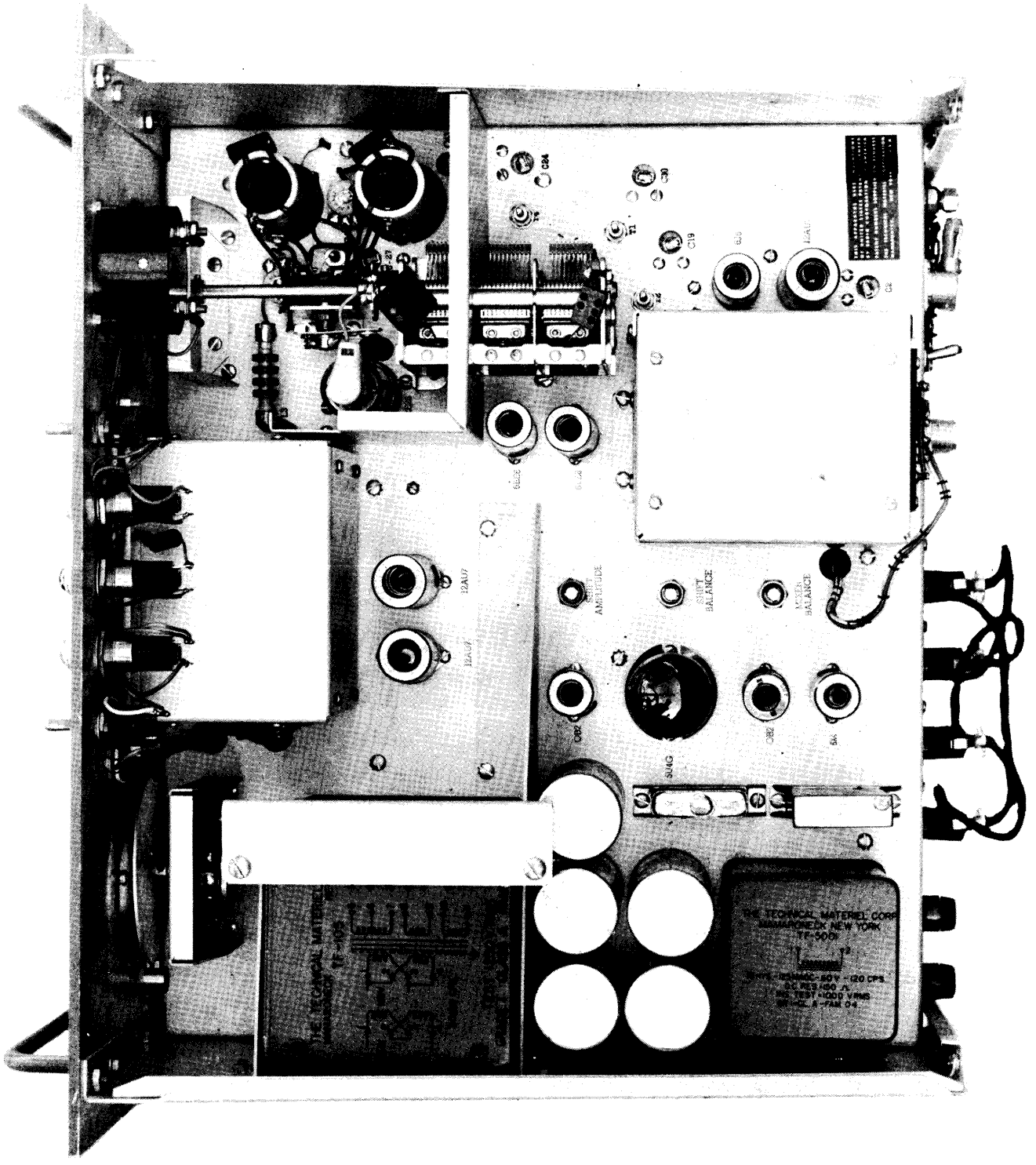


Figure 4-1 Top View

SECTION 5
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.

1. ROUTINE MAINTENANCE

a. Remove equipment from the rack, and thoroughly inspect the insides of chassis for signs of dirt, dampness, moulding, charring and corrosion. Correct any defect found. A recommended cleaning agent is clean carbon tetrachloride applied with a soft brush. Recommended SEMI-ANNUALLY.

b. Test all DC and AC voltages as indicated on the respective tube voltage data sheets and investigate any serious descrepancies. Recommended SEMI-ANNUALLY.

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

d. No special selection is necessary in the event of tube replacement. However, for optimum results, the section on corrective maintenance should be carefully read to determine the extent of adjustment necessary in replaceing any particular tube. These adjustments, necessary for changing only four tubes, are unwarranted unless performed by competent technical personal using accurate equipment.

e. When replacing the XFK in the rack, be certain that all terminal board screws at the rear of the equipment are tight.

SECTION 6
CORRECTIVE MAINTENANCE

1. SYSTEM TROUBLE SHOOTING

Complete failure of the Model XFK in service with a transmitter will be of two basic types, i.e. either loss of drive or lack of frequency shift. In either case it should definitely be ascertained that the fault is within the XFK and not in the output line nor in the input to the XFK. This may be quickly ascertained by means of the operating controls on the front panel of the XFK. Thus if there is no R.F. output from the XFK, correct tuning of the R.F. output dial will show no indication on the P.A. plate current meter. The trouble would then be in the XFK unless the Crystal selector switch was on "EXT", and the external signal source had failed. Again, if there is no frequency shift in the transmitter and varying the test switch from "space" to "mark" shows no frequency shift, the trouble would then again be in the XFK providing the terminal marked "Cont" at the rear of the chassis, is open to ground.

These tests preclude, of course, proper operation of all controls and patch cords of the Model XFK equipment.

2. TROUBLE SHOOTING PROCEDURE

The first step in servicing a defective frequency shifter unit is to sectionalize the fault. Sectionalization means tracing the fault to the stage or circuit responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the defective part responsible for the abnormal condition. Some faults such as burned out resistors, r-f arcing, and shorted transformers can often be located by sight, smell, or hearing. The majority of faults must be located by checking voltage and resistance.

a. Sectionalization - Careful observation of the performance of the Model XFK on the different frequencies and while operating the various controls may sectionalize the faults to a particular stage or circuit. A logical division of the Model XFK would indicate three main operating sections

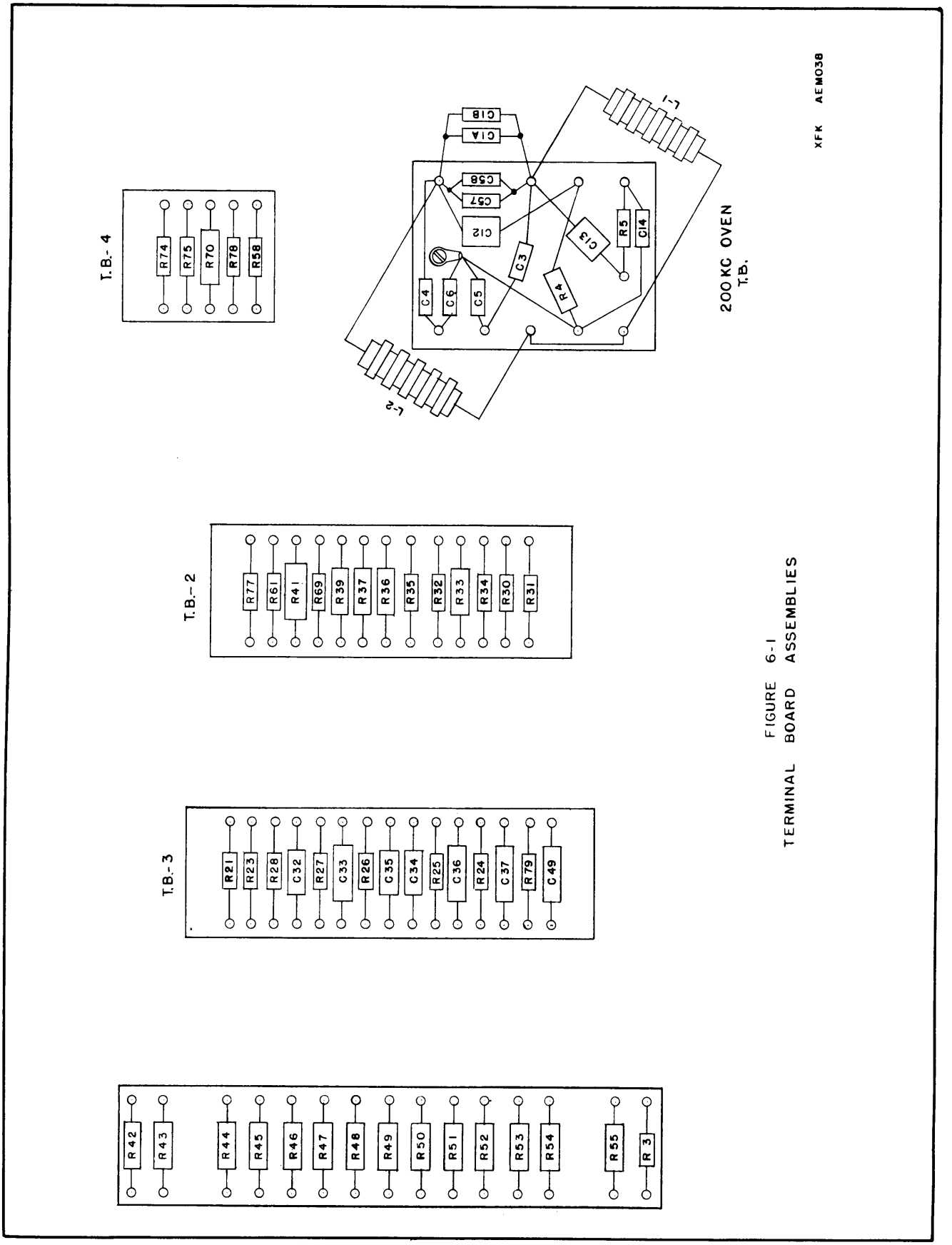


FIGURE 6-1
TERMINAL BOARD ASSEMBLIES

Figure 6-1 Terminal Board Assemblies

VOLTAGE CHART

TUBE SYMBOL	FUNCTION	TYPE	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS	PINS	VOLTS
V1	200 KC Osc.	6J6	1	88	2	88	5	-28	6	-28	4	AC 6.3				
V2	React. Tube	12AU7	1	88	2	0	3	7.8	6	88	7	0	8	7.8	4	AC 6.3
V3	Mixer	6BE6	1	0	2	1.7	5	305	6	88	7	-5.9	4	AC 6.3		
V4	Mixer	6BE6	1	0	2	1.7	5	305	6	72	7	-6.1	4	AC 6.3		
V5	Power Amp.	2E26	CAP	315	3	195	5	-12	7	AC 6.3						
V6	Xtal Osc. & Cath. Foll.	12AU7	1	57	2	0	6	270	7	0	8	9.2	4	AC 6.3		
V7	Keyer Space / Mark	12AU7	1	73 / 14	2	0 / 13	3	12.8 / 13	6	105 / 105	7	72 / 14	8	72 / 22	4	AC 6.3
V8	Rectifier	5U4G	2	340	4	AC 350	6	AC 350	2-8	A.C., 5						
V9	Rectifier	6X4	1	-360	7	AC 350	4	AC 6.3								
V10	Voltage Reg.	OB2	1	105	2	0										
V11	Voltage Reg.	OB2	1	0	2	-105										

CONDITIONS:

1. Line Voltage of 110 @ 60 cps
2. All D.C. voltages should be measured with a VTVM.
3. "Key-Fax" - "KEY" position
4. Shift set at zero.
5. Xtal switch in Xtal position. - No Xtal in socket
6. Output control set so PA plate current is 50 ma.

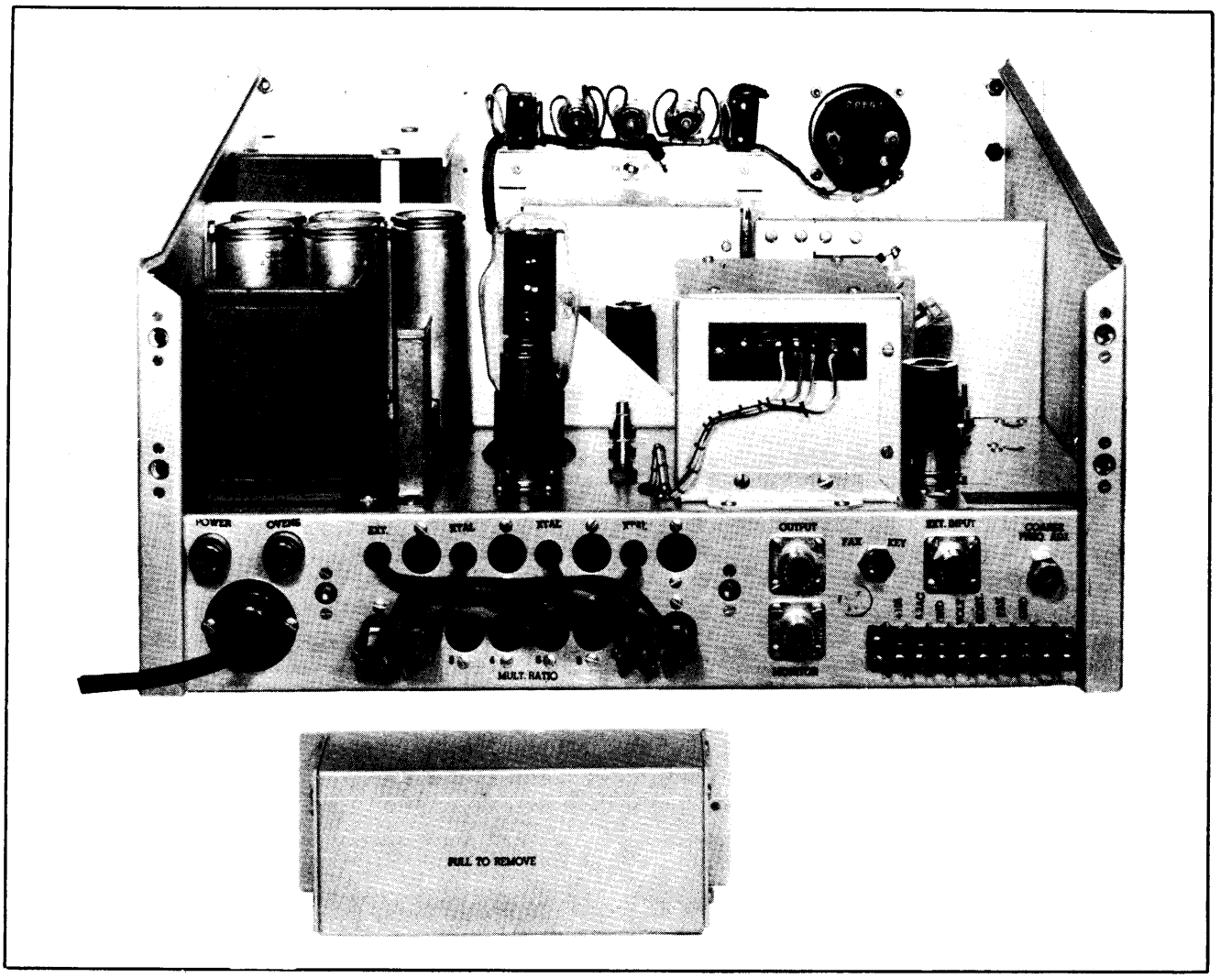


Figure 6-3 Frequency Shift Excitor - Model XFK
Rear View with Top Cover and Patch Cord Cover Removed

and the power supply. The three operating sections consist of the 200 KC oscillator and reactance tube, the keyer circuit including the automatic multiplication, and the radio frequency section. Which section is inoperative will be apparent from the symptoms.

Thus, a major fault in the power supply will be indicated by the P. A. plate current meter. If, there is no plate current when the plate switch is thrown on, the B+ in the power supply is out, while if the plate current reads over 50 m.a. and cannot be controlled, the bias supply is out.

Correct performance in the Keyer circuit may be determined by measuring the D.C. voltage at the grid-pin 2 of the reactance tube V2. With 1000 cycle shift applied the voltage should be approximately ±4 volts with test switch on "space" and -4 volts on "mark".

Proper performance of the 200 kc oscillator and reactance tube may most easily be determined by use of a frequency meter such as the BC221. The frequency should be close to 200 kc and should shift approximately ±500 cps. on the same test as applied to the keyer. If this is working satisfactorily, and there is still no output, the trouble may be traced to the R.F. section.

With any Xtal within the operating range of the XFK, there should be 10 volts of R.F. at the grid of the cathode follower. If the unit has checked satisfactorily to this point, the trouble must then be attributed to the R.F. section. At this point, localization techniques, as mentioned in the following paragraph, should be followed.

b. Localization - Once the section or circuit, which is at fault has been localized, the voltage charts should be checked to see if anything is amiss. If the voltage table fails to give any information, an ohmeter should be used to check out the circuit.

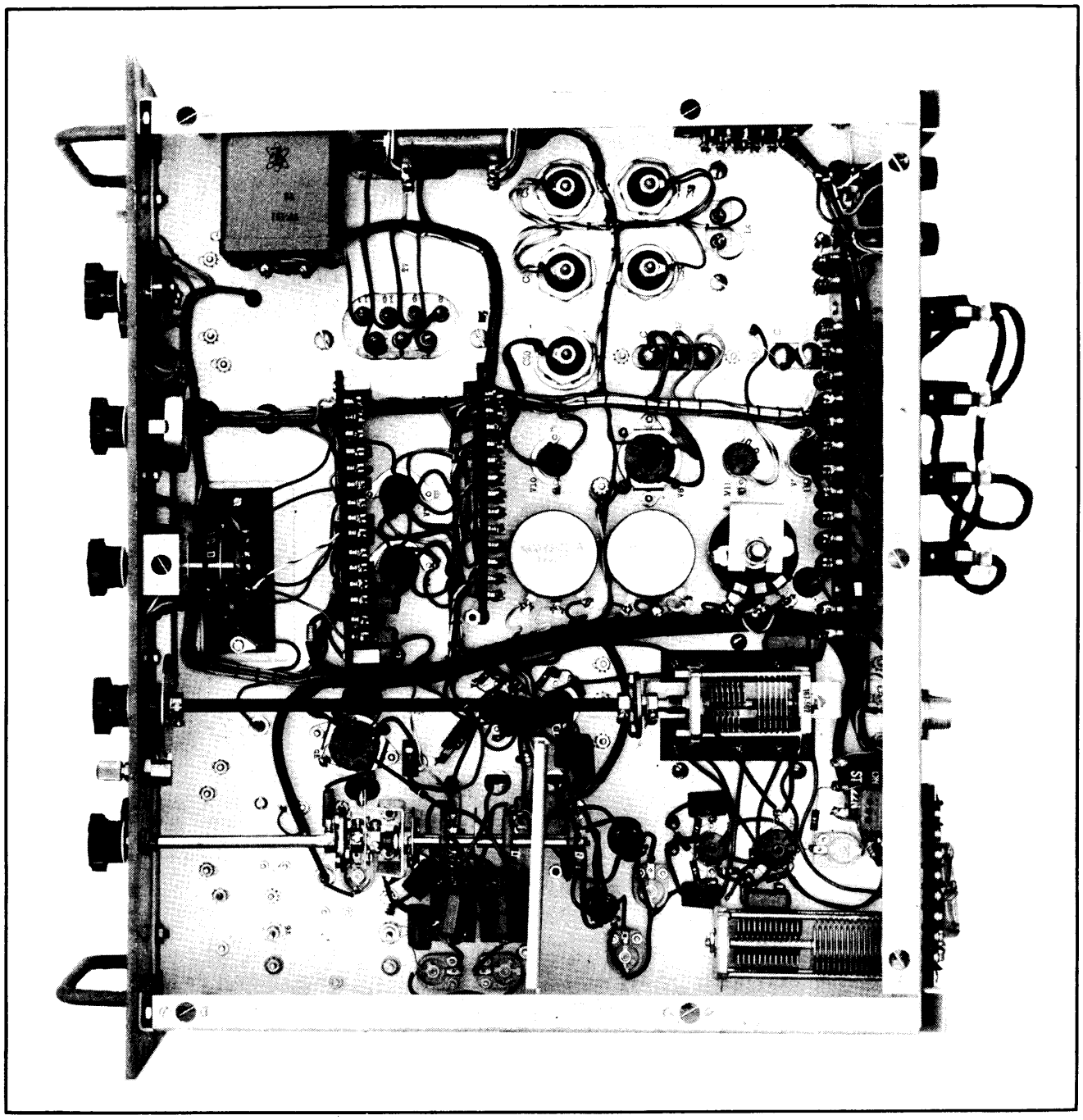


Figure 6-4 Bottom View

In localizing trouble, a correct schematic should be used at all times. Should localization fail to detect the proper fault, the alignment procedure and the theory of operation should be given careful consideration. If this seems to indicate realignment, and only as a last resort, the defective sections should be aligned as per the following paragraphs.

3. ADJUSTMENTS AND ALIGNMENTS

a. - WARNING - Only competent technical personnel using proper equipment should attempt to tamper with any adjustments and only if there is specific reason to suspect that the adjustment is the cause of the difficulty. If unit is to be worked on, it should be removed from its rack and placed on a convenient work bench. The dust covers should be removed. All controls and adjustments should now be readily available.

b. Radio frequency alignment - The least likely source of trouble should be the misalignment of the R. F. section. Should this be sus-

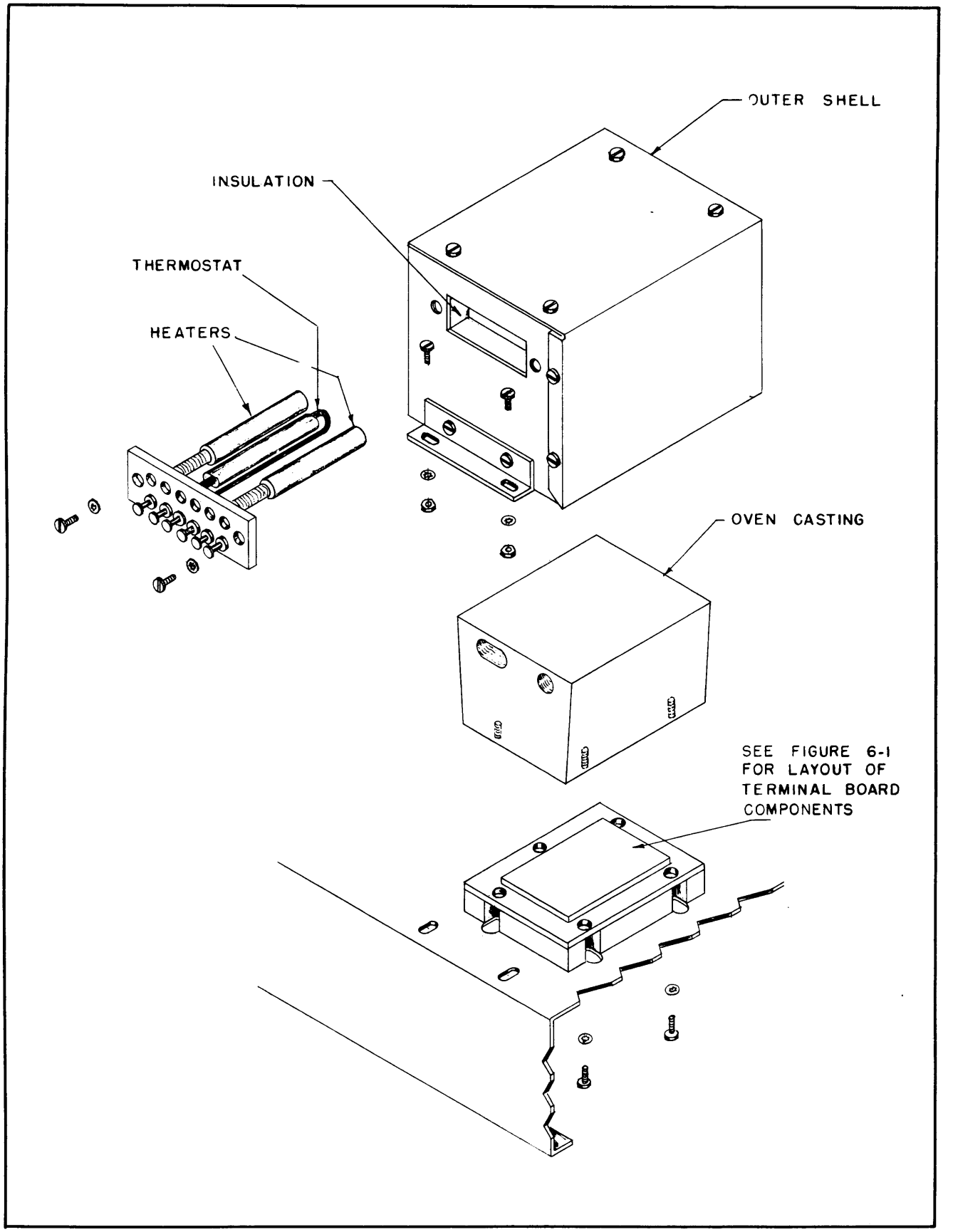


Figure 6-5 200 Kc Oven Assembly

pected, due to either reduced power output or the output frequency dial showing a marked deviation from the indicated frequency calibration, the following procedure is recommended.

(1) Alignment of Band 2

(a) Connect a 50 to 70 ohm load to the output jack. Meter either the current through the load with an R.F. thermocouple or connect an R.F. voltmeter across the load.

(b) Set band switch to band 2, Rotate main tuning condenser to full mesh position (lowest frequency) note that the hairline on the dial matches the indicator line. If this is not so, leave the condenser in the same position and rotate the dial until they line up by loosening the set screws fastening the flexible coupling to the condenser.

(c) Set ceramic trimmers, C30, C43, C46, to minimum capacity.

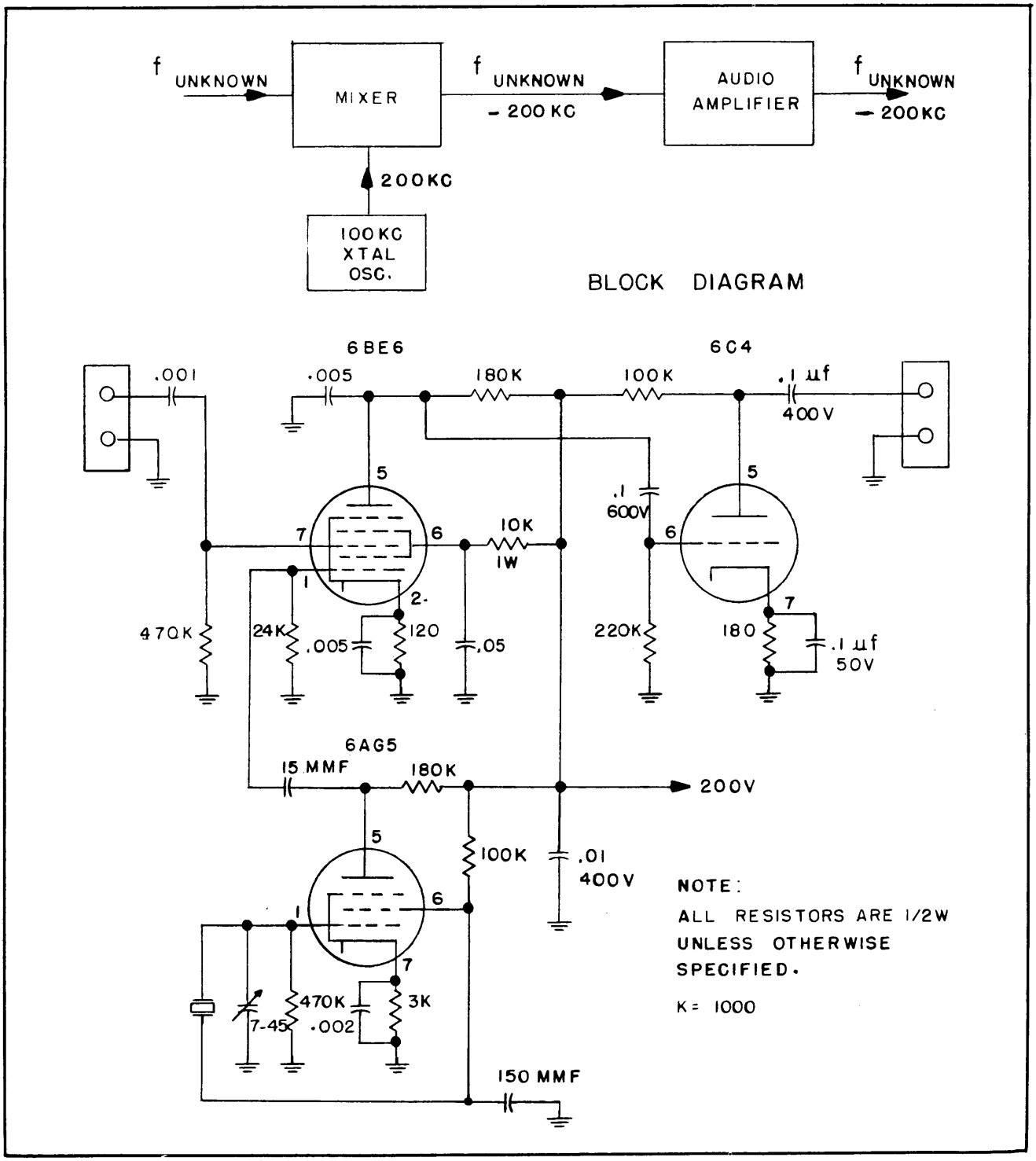


Figure 6-6 Test Chasis

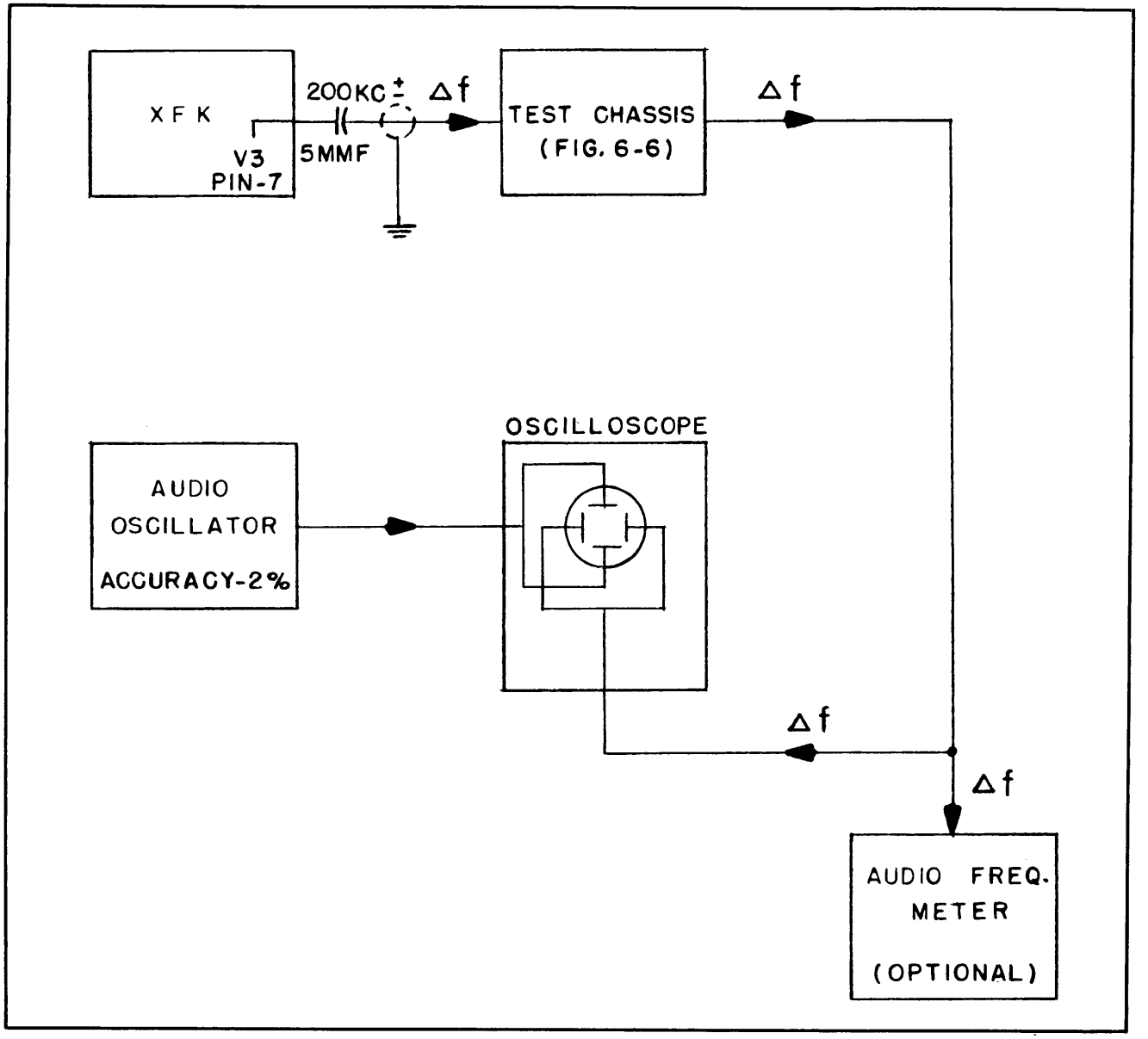


Figure 6-7 Block Diagram

(d) The following indicated frequencies should either be supplied by means of crystals or an external source. To simplify procedure it will be assumed that crystals will be used. If an external source is used, connect the signal source to the EXT. jack on the rear of the chassis and switch the crystal selector switch to EXT.

(e) Insert 2.6 mc. crystal in socket #1, 6.3 mc. crystal in socket #2.

(f) Switch crystal selector switch to xtal #1. Set tuning dial to 2.8 mc. Place R.F. voltmeter on Pin 1 V4, tune T1 for maximum voltage. Place R.F. voltmeter at pin 5 V5 and tune T3 for maximum voltage. Select first peak going in from minimum inductance. Tune T5 for maximum output indication in load. Remove R.F. voltmeter and retrim T1, T3, T5 for maximum output in load.

(g) Switch to crystal position 2. Set tuning dial to 6.5 mc. Tune C30, C43, C46 for maximum output indication in load.

(h) Remove V1, 200kc osc. tube. Tune main tuning condenser for maximum output indication in load. This will occur at the crystal frequency. Trim "Mixer Balance" potentiometer for minimum indication in load.

(i) Remove load. Remove crystal or external excitation. Set P. A. plate current to 50 M. A. Rotate tuning condenser over entire upper range of band and note spurious excitation, if any. Parasitics may be evidenced by dip in plate current of final amplifier when tuning main tuning condenser. If parasitics are evidenced, neutralize same by tuning C27.

(j) Replace V1, Repeat steps (f), and (g).

(k) Check tuning dial for proper sideband selection. If the above procedure has been done

properly, there will be no indication above 6.5 mc. and the lower sideband will appear at 6.1 mc.

(2) Alignment of Band 1

(a) Set band switch to band 1. Insert 1.0 mc. crystal in socket #1 and 2.1 mc. crystal in socket #2.

(b) Set ceramic trimmers C19, C24 and C28 to minimum capacity.

(c) Switch Crystal selector to xtal #1. Set tuning dial to 1.2 mc. Place R.F. voltmeter to pin 1 V4. Tune T2 for maximum voltage. Place R.F. voltmeter to pin 5 V5. Tune T 4 for maximum voltage, select first peak going in from minimum inductance. Tune T6 for maximum output indication in load. Remove R.F. voltmeter and retrim T2, T4, and T6 for maximum output indication in load.

(d) Switch to crystal position 2. Set tuning dial to 2.3 mc. Tune C19, C24, C28 for maximum output indication in load.

(e) Repeat (c) and (d).

(f) Check tuning dial for proper sideband selection. If the above proce dure has been done properly, there will be no indication above 2.3 mc and the lower side band will appear at 1.9 mc.

c. Adjustment of Reactance Tube and 200 kc Osc.

The proper alignment of this section of the Model XFK Exciter requires accurate frequency measurements. It is recommended that the equipment and method outlined in Fig 6-6 and Fig 6-7 be adopted for best accuracy and ease of measurement.

(1) Set up equipment as shown in Fig 6-7

(2) Observe that the pointer on the frequency knob reads minus 600 cycles when the capacitor C7 is approximately 7 deg. from being fully meshed. C7 should then move towards decreasing capacity as the knob is turned toward the plus 600 cycles position.

(3) Set "FAX-KEY" switch to "FAX". Return frequency knob to 0 cycles. By means of the course frequency adjust on the rear of the chassis zero beat 200 kc osc. with 100kc crystal in mixer.

(4) Connect a small variable voltage source (6v) to the "FAX" terminals on terminal board at rear of chassis. This source should be capable of alternately impressing equal positive and negative voltages at the "FAX" terminal.

(5) Set C2 at one-half its capacity. With zero voltage at "FAX" input terminal, zero beat 200 kc osc. with mixer xtal. Apply sufficient positive voltage to cause a 500 cycle shift (app. 4 volts). Reverse polarity maintaining same amplitude. Note shift. If second shift is over 500 cycles slightly increase capacity of C2. RE-zero beat 200 kc osc. with no input voltage, then repeat above procedure until both shifts are equal.

d. Adjustment of Keyer Circuit.

(1) Set "FAX-KEY" switch to "KEY". With power "OFF" set ohmmeter to center arm of shift potentiometer. When dial reads 50 cycles resistance to ground should be 400 ohms.

(2) Set crystal selector switch to "xtal #1" and plug in to multiplication ratio 1 on rear of chassis.

(3) Re-zero 200 Kc osc. Set shift dial to 500 cycles. Vary test switch from "Mark" to "Space" and note shift. Adjust "Shift Balance" potentiometer until shifts are equal. Adjust "Shift Amplitude" potentiometer until shift on either side is 250 cycles. Recheck "shift balance". The total shift is now 500 cycles, 250 cycles on either side of carrier.

4. ELECTRICAL PARTS LIST

SYM	DESCRIPTION	FUNCTION	TMC PART NUMBER
C1	CAPACITOR, fixed: fired ceramic; 1000 mmfd, ±1%, 500 wvdc (matched pairs, 500 mmfd each)	200 Kc Osc tank.	CC-102-4
C2	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	React tube linear adj.	CV11A120
C3	CAPACITOR, fixed: fired ceramic; 68 mmfd, ±5%; 500 wvdc.	Output Coupling	CC-102-1
C4	CAPACITOR, fixed: fired ceramic; 68 mmfd, ±5%; 500 wvdc.	Output coupling	CC-102-1
C5	CAPACITOR, fixed: mica; 680 mmfd, ±2%; 500 wvdc.	Output divider	CM20E681G
C6	CAPACITOR, fixed: mica; 680 mmfd, ±2%; 500 wvdc.	Output divider	CM20E681G

SYM	DESCRIPTION	FUNCTION	TMC PART NUMBER
C7	CAPACITOR, variable: air dielectric dual unit 4.6-51 mmfd, each section.	200 Kc Osc fine control	CB-103-2
C8	CAPACITOR, variable: air dielectric dual unit 6.8-99 mmfd, each section.	200 Kc Osc coarse adj.	CB-103-3
C9	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	200 Kc plate bypass	CM35A103K
C10	CAPACITOR, fixed: mica; 100 mmfd, ±5%; char C; 500 wvdc.	200 Kc grid coupling	CM20C101J
C11	CAPACITOR, fixed: mica; 100 mmfd, ±5%; char C; 500 wvdc.	200 Kc grid coupling	CM20C101J
C12	CAPACITOR, fixed: mica; 27 mmfd, ±2%; char. E; 500 wvdc.	Reactance tube phase	CM20E270G
C13	CAPACITOR, fixed: mica; 1000 mmfd, ±10%; char A; 500 wvdc.	Reactance tube phase shift	CM20A102K
C14	CAPACITOR, fixed: mica; 27 mmfd, ±5%; char. C; 500 wvdc.	Reactance tube phase shift	CM20C270J
C15	CAPACITOR, fixed: mica; 5 mmfd, ±10%; char. A; 500 wvdc.	Mixer input padder	CM20A050M
C16	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	200 Kc plate bypass	CM35A103K
C17	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	200 Kc plate bypass	CM35A103K
C18	CAPACITOR, variable: air dielectric; three sect., 11 to 362 mmfd each sect.	Mixer input, Mixer output, Amp output tuning	CB-107
C19	CAPACITOR, variable: ceramic 3-12 mmfd, 500 wvdc.	Band 1 Mixer input trimmer	CV11A120
C20	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; char A; 500 wvdc.	Bal modulator screen bypass	CM20A102K
C21	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; char A; 500 wvdc.	Bal modulator screen bypass	CM20A102K
C22	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	200 Kc plate bypass	CM35A103K
C23	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; char A; 500 wvdc.	Bal modulator screen bypass	CM20A102K
C24	CAPACITOR, variable: ceramic 3-12 mmfd, 500 wvdc.	Band 1 mixer output trimmer	CV11A120
C25	CAPACITOR, fixed: mica; .01 mfd, ±5%; char C, 300 wvdc.	Mixer output grid bypass	CM35C103J

SYM	DESCRIPTION	FUNCTION	TMC PART NUMBER
C26	CAPACITOR, fixed: mica; 5 mmfd, ±10%; char A; 500 wvdc.	Amp Neutralizing	CM20A050M
C27	CAPACITOR, variable: ceramic; 1.5-7 mmfd, 500 wvdc.	Amp Neutralizing	CV11A070
C28	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	Band 1 Amp tuning	CV11A120
C29	CAPACITOR, fixed: mica; .01 mfd, ±5%; char C, 300 wvdc.	Amp plate pad	CM35C103J
C30	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	Band 2 Mixer input trimmer	CV11A120
C31	CAPACITOR, fixed: mica; 1500 mmfd, ±2%, char C, 500 wvdc.	Band 1 amp padder	CM30C152G
C32	CAPACITOR, fixed: mica; 50 mmfd, ±10%; char A; 500 wvdc.	Xtal osc grid cap	CM20A510K
C33	CAPACITOR, fixed: mica; 1,000 mmfd, ±10%; char A; 500 wvdc.	Xtal osc grid cap	CM20A102K
C34	CAPACITOR, fixed: mica; 27 mmfd, ±10%; char A; 500 wvdc.	Xtal osc output coupling	CM20A270K
C35	CAPACITOR, fixed: mica; 10 mmfd, ±10%; char A; 500 wvdc.	Xtal osc output divider	CM20A100K
C36	CAPACITOR, fixed: mica; 1,000 mmfd; ±10%; char A; 500 wvdc.	Cath follower plate bypass	CM20A102K
C37	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	Cath follower output coupling	CM35A103K
C38	CAPACITOR, fixed: mica; 100 mmfd, ±5%; char C, 500 wvdc.	Mixer Xtal input coupling	CM20C101J
C39	CAPACITOR, fixed: mica; 1500 mmfd, ±2%; char C, 500 wvdc.	Band 1 amp padder	CM30C152G
C40	CAPACITOR, fixed: mica; 5100 mmfd, ±2%; char C, 500 wvdc.	Band 2 amp input padder	CM35C512G
C41	CAPACITOR, fixed: mica; 5100 mmfd, ±2%; char C, 500 wvdc.	Band 2 amp output padder	CM35C512G
C42	CAPACITOR, fixed: mica; 1000 mmfd, ±10%; char A; 500 wvdc.	Amp screen bypass	CM20A102K
C43	CAPACITOR, variable: ceramic; 1.5-7 mmfd, 500 wvdc.	Mixer output tuning trimmer band 2.	CV11A070
C44	CAPACITOR, fixed: ceramic; 15 mmfd, ±.5 mmfd, N750 characteristic, 600 wvdc.	200 Kc Osc compensator	CC-103-1

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
C45	Not used.		
C46	CAPACITOR, variable: ceramic; 3-12 mmfd, 500 wvdc.	Amp output tuning trimmer band 2	CV11A120
C47, C48	CAPACITOR, fixed: paper; dual unit, .05 mfd, ±15%, each section; 600 wvdc.	Thermostat osc suppressors	CP69B4EF503L
C49	CAPACITOR, fixed: mica; .01 mfd, ±10%; char A; 300 wvdc.	External osc coupling	CM35A103K
C50	CAPACITOR, fixed: paper dielectric; 4 mfd, ±10%; 600 wvdc.	Power supply filter	CP40C2FF405K
C51	CAPACITOR, fixed: paper dielectric; 4 mfd, ±10%; 600 wvdc.	Power supply filter	CP40C2FF405K
C52	CAPACITOR, fixed: paper dielectric; 4 mfd, ±10%; 600 wvdc.	Power supply filter	CP40C2FF405K
C53	CAPACITOR, fixed: paper dielectric; 4 mfd, ±10%; 600 wvdc.	Power supply filter	CP40C2FF405K
C54	CAPACITOR, fixed: paper dielectric; 4 mfd, ±10%; 600 wvdc.	Power supply filter	CP40C2FF405K
C55, C56	CAPACITOR, fixed: paper dielectric; dual unit; .5 mfd, ±15%, each section; 600 wvdc.	Line filter	CP69B4EF504L
C57	CAPACITOR, fixed: ceramic; 110 mmfd; ±2%; N750 characteristic; 500 wvdc.	200 Kc osc temp compositor	CC26UJ111G
C58	CAPACITOR, fixed: ceramic; 110 mmfd; ±2%; N750 characteristic; 500 wvdc.	200 Kc osc temp compositor	CC26UJ111G
C59	CAPACITOR, fixed: mica; 10 mmfd; ±10%; char. A; 500 wvdc.	Coupling	CM20B100K
E1	BOARD, terminal: general purpose barrier type; eight brass nickel plated 6-32 x 1/4" BH screws.	Input-output terminals	TM-100-8
F1	FUSE, cartridge: 3 amp; oper in one hour at 135% load and in 25 sec at 200% load; rated continuous at 110% load; 250 volts; one time.	Power supply fuse	FU-100-3
F2	FUSE, cartridge: 3 amp; oper in one hour at 135% load and in 25 sec at 200% load; rated continuous at 110% load; 250 volts; one time.	Power supply fuse	FU-100-3
I1	LAMP, incandescent: 6-8 volts; 0.250 amp; bulb T-3-1/4 clear; 1-1/8" lg overall; miniature bayonet base.	Power indicator	BI-101-44

SYM	DESCRIPTION	FUNCTION	TMC PART NUMBER
I2	LAMP, neon: 105-125 v; bulb T-3 1/4 clear; 1/25 watt; 1 13/16'' lg overall; miniature bayonet base.	200 Kc osc oven indicator	BI-100-51
I3	LAMP, neon: 105-125 v; bulb T-3 1/4 clear 1/25 watt; 1 13/16'' lg overall; miniature bayonet base.	Xtal oven indicator	BI-100-51
J1	JACK, connector: 75 ohm, coaxial female receptacle mica filled bakelite dielectric.	Output jack	SO-239
J2	JACK, connector: 75 ohm, coaxial female receptacle mica filled bakelite dielectric.	Test jack	SO-239
J3	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 1 patch jack	JJ-119-2
J4	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 2 patch jack	JJ-119-2
J5	CONNECTOR, female contact: polarized; two contact bracket type socket	Mult Ratio 3 patch jack	JJ-119-2
J6	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 4 patch jack	JJ-119-2
J7	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 6 patch jack	JJ-119-2
J8	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 8 patch jack	JJ-119-2
J9	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 9 patch jack	JJ-119-2
J10	CONNECTOR, female contact: polarized; two contact bracket type socket.	Mult Ratio 12 patch jack	JJ-119-2
J11	CONNECTOR, female contact: polarized; two contact bracket type socket.	External patch jack	JJ-119-2
J12	CONNECTOR, female contact: polarized; two contact bracket type socket.	External patch jack	JJ-119-2
J13	CONNECTOR, female contact: polarized; two contact bracket type socket.	Crystal #1 patch jack	JJ-119-2
J14	CONNECTOR, female contact: polarized; two contact bracket type socket.	Crystal #1 patch jack	JJ-119-2
J15	JACK, connector: 75 ohm, coaxial female receptacle mica filled bakelite dielectric.	Output jack	SO-239
J16	CONNECTOR, assembly: male contact; flush motor plug type.	Line input connector	JJ-100
L1	INDUCTOR, fixed: 250 microhenries.	200 Kc osc tank	A-337

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
L2	INDUCTOR, fixed: 250 microhenries.	200 Kc osc tank	A-337
L3	CHOKE, RF: 2.5 millihenries, 125 ma.	Amp. plate choke	CL-104-1
L4	REACTOR, filter: 10 henries, 125 ma DC, 1,000 volts RMS test.	Power supply filter	TF-5001
M1	METER, milliameter: DC; 0-50 ma.	Output tuning	MR-100-2
P1	CONNECTOR, male contact; polarized; two contact plug type 10 amp cap.	External Mult. patch plug	PL-105-1
P2	CONNECTOR, male contact; polarized; two contact plug type 10 amp cap.	Xtal 1 Mult. patch plug	PL-105-1
P3	CONNECTOR, male contact; polarized; two contact plug type 10 amp cap.	Xtal 2 Mult. patch plug	PL-105-1
P4	CONNECTOR, male contact: polarized; two contact plug type 10 amp cap.	Xtal 3 Mult. patch plug	PL-105-1
R1	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	200 Kc osc grid leak	RC20GF104K
R2	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	200 Kc osc grid leak	RC20GF104K
R3	RESISTOR, fixed: composition; 1800 ohms, ±10%; 1 watt.	200 Kc osc plate load	RC20GF182K
R4	RESISTOR, fixed: metallized film; 5800 ohms, ±1%; 1/2 watt.	Reactance tube phase shift	RR-104-582
R5	RESISTOR, fixed: metallized film; 67,000 ohms, ±1%; 1/2 watt.	Reactance tube phase shift	RR-104-673
R6	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	200 Kc osc grid leak	RC20GF104K
R7	RESISTOR, fixed: composition; 3900 ohms, ±5%; 1/2 watt.	Reactance tube cathode bias	RC20GF392K
R8	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	FS Control	RA100ASRL103A
R9	RESISTOR, fixed: composition; 24,000 ohms, ±10%; 1/2 watt.	Mixer grid leak	RC20GF243J
R10	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Mixer cathode bias	RC20GF101K
R11	RESISTOR, fixed: composition; 39,000 ohms, ±10%; 1/2 watt.	Screen voltage divider	RC20GF393K
R12	RESISTOR, fixed: composition; 39,000 ohms, ±10%; 1/2 watt.	Screen voltage divider	RC20GF393K

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
R13	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	Mixer balance	RA100ASSC103A
R14	RESISTOR, fixed: wire wound; 10,000 ohms, ±10%; 10 watts.	Mixer screen dropping	RW-109-34
R15	RESISTOR, fixed: composition; 4,700 ohms, ±10%; 1 watt.	Mixer plate filter	RC30GF472K
R16	RESISTOR, fixed: composition; 39 ohms, ±10%; 1/2 watt.	Power amp parasitic suppressor	RC20GF390K
R17	RESISTOR, fixed: composition; 15,000 ohms, ±10%; 2 watts.	P.A. screen dropping	RC42GF153K
R18	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1 watt.	P.A. screen bleeder	RC30GF104K
R19	RESISTOR, fixed: composition;, 6800 ohms, ±10%; 1/2 watt.	Monitor voltage divider	RC20GF682K
R20	RESISTOR, fixed: composition; 39 ohms, ±10%; 1/2 watt.	Monitor voltage divider	RC20GF390K
R21	RESISTOR, fixed: composition; 4700 ohms, ±10%; 1/2 watt.	P.A. bias divider	RC20GF472K
R22	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	P.A. bias divider	RA100ASRD103A
R23	RESISTOR, fixed: composition; 2700 ohms, ±10%; 1/2 watt.	P.A. bias divider	RC20GF272K
R24	RESISTOR, fixed: composition; 1000 ohms, ±10%; 1/2 watt.	Cathode foll. bias resistor	RC20GF102K
R25	RESISTOR, fixed: composition; 4700 ohms, ±10%; 1 watt.	Cathode foll. plate filter	RC30GF472K
R26	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Cathode foll. grid leak	RC20GF104K
R27	RESISTOR, fixed: composition; 10,000 ohms, ±10%; 1/2 watt.	Xtal osc. plate load	RC20GF103K
R28	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Xtal osc grid leak	RC20GF104K
R29	RESISTOR, fixed: composition; 12 ohms, ±10%; 2 watts.	Xtal osc input short	RC42GF120K
R30	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Voltage divider	RC20GF474K
R31	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Voltage divider	RC20GF474K

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
R32	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Voltage divider	RC20GF474K
R33	RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1 watt.	Voltage divider	RC30GF223K
R34	RESISTOR, fixed: composition; 3300 ohms, ±10%; 1/2 watt.	Keyer fixed bias	RC20GF332K
R35	RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt.	Keyer plate load	RC20GF105K
R36	RESISTOR, fixed: composition; 47,000 ohms, ±5%; 1 watt.	Voltage divider	RC30GF473J
R37	RESISTOR, fixed: composition; 15,000 ohms, ±5%; 1 watt.	Voltage divider	RC30GF153J
R38	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	Shift balance	RA100ASSC103A
R39	RESISTOR, fixed: composition; 33,000 ohms, ±10%; 1 watt.	Voltage divider	RC30GF333K
R40	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	Shift amplifier	RA100ASSC103A
R41	RESISTOR, fixed: composition; 6800 ohms, ±10%; 2 watts.	Voltage divider	RC42GF682K
R42	RESISTOR, fixed: metallized film; 10,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 2 series divider	RR-104-103
R43	RESISTOR, fixed: metallized film; 20,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 2 shunt divider	RR-104-203
R44	RESISTOR, fixed: metallized film; 20,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 3	RR-104-203
R45	RESISTOR, fixed: metallized film; 15,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 3 shunt divider	RR-104-153
R46	RESISTOR, fixed: metallized film; 30,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 4 series divider	RR-104-303
R47	RESISTOR, fixed: metallized film; 13,300 ohms, ±1%; 1/2 watt.	Mult. Ratio 4 shunt divider	RR-104-1332
R48	RESISTOR, fixed: metallized film; 50,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 6 series divider	RR-104-503
R49	RESISTOR, fixed: metallized film; 12,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 6 shunt divider	RR-104-123
R50	RESISTOR, fixed: metallized film; 70,000 ohms, ±1%; 1/2 watt.	Mult. Ratio 8 series divider	RR-104-703

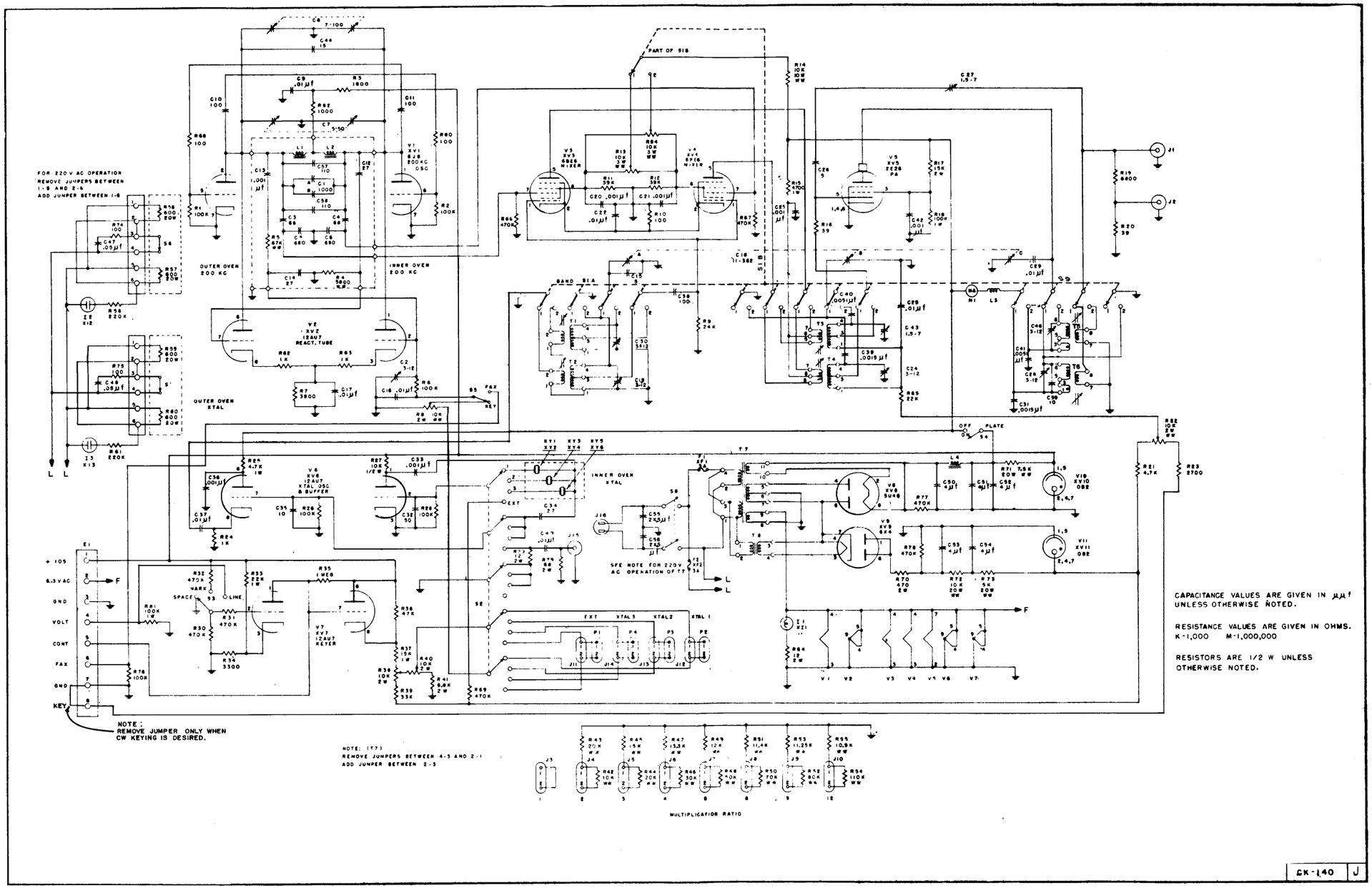
SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
R51	RESISTOR, fixed: metallized film; 11,400 ohms, ±1%; ½ watt.	Mult. Ratio 8 shunt divider	RR-104-1142
R52	RESISTOR, fixed: metallized film; 80,000 ohms, ±1%; ½ watt.	Mult. Ratio 9 series divider	RR-104-803
R53	RESISTOR, fixed: metallized film; 11,250 ohms, ±1%; ½ watt.	Mult. Ratio 9 shunt divider	RR-104-11251
R54	RESISTOR, fixed: metallized film; 110,000 ohms, ±1%; ½ watt.	Mult. Ratio 12 series divider	RR-104-114
R55	RESISTOR, fixed: metallized film; 10,900 ohms, ±1%; ½ watt.	Mult. Ratio 12 shunt divider	RR-104-1092
R56	RESISTOR, fixed: wire wound; cartridge heater type; 20 watts, at 115 volts AC ±10%; 1,000 v. insulated to shell.	200 Kc osc oven heater	RR-102-1
R57	RESISTOR, fixed: wire wound; cartridge heater type; 20 watts, at 115 volts AC ±10%; 1,000 v. insulated to shell.	200 Kc osc oven heater	RR-102-1
R58	RESISTOR, fixed: composition; 220,000 ohms, ±10%; ½ watt.	Neon current limiter	RC20GF224K
R59	RESISTOR, fixed: wire wound; cartridge heater type; 20 watts, at 115 volts AC ±10%; 1,000 v. insulated to shell.	200 Kc osc oven heater	RR-102-1
R60	RESISTOR, fixed: wire wound; cartridge heater type; 20 watts, at 115 volts AC ±10%; 1,000 v. insulated to shell.	200 Kc osc oven heater	RR-102-1
R61	RESISTOR, fixed: composition; 220,000 ohms, ±10%; ½ watt.	Neon current limiter	RC20GF224K
R62	RESISTOR fixed: composition; 1000 ohms, ±10%; ½ watt.	Reactance tube cathode bias	RC20GF102K
R63	RESISTOR, fixed: composition; 1000 ohms, ±10%; ½ watt.	Reactance tube cathode bias	RC20GF102K
R64	RESISTOR, fixed: composition; 12 ohms, ±10%; 2 watts.	Pilot current limiter	RC42GF120K
R65	RESISTOR, fixed: composition; 22,000 ohms, ±10%; ½ watt.	Amp grid leak	RC20GF223K
R66	RESISTOR, fixed: composition; 470,000 ohms, ±10%; ½ watt.	Mixed grid leak	RC20GF474K
R67	RESISTOR, fixed: composition; 470,000 ohms, ±10%; ½ watt.	Mixed grid leak	RC20GF474K
R68	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Parasitic suppressor	RC20GF101K

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
R69	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Voltage divider	RC20GF474K
R70	RESISTOR, fixed: composition; 470 ohms, ±10%; 2 watts.	Bias supply resistor	RC42GF471K
R71	RESISTOR, fixed: wire-wound; 7500 ohms, ±10%; 25 watts.	Series supply filter	RW-110-32
R72	RESISTOR, fixed: wire-wound; 10,000 ohms, ±10%; 20 watts.	Bias supply filter	RW-110-33
R73	RESISTOR, fixed: wire-wound; 5000 ohms, ±10%; 20 watts.	Bias supply filter	RW-110-30
R74	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Thermostat arc suppression	RC20GF101K
R75	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Thermostat arc suppression	RC20GF101K
R76	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt.	Fax input load	RC20GF104K
R77	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Power supply bleeder	RC20GF474K
R78	RESISTOR, fixed: composition; 470,000 ohms, ±10%; 1/2 watt.	Bias supply bleeder	RC20GF474K
R79	RESISTOR, fixed: composition; 68 ohms, ±10%; 2 watts.	External osc load	RC42GF680K
R80	RESISTOR, fixed: composition; 100 ohms, ±10%; 1/2 watt.	Parasitic suppressor	RC20GF101K
R81	RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1 watt.	Keying line load	RC30GF104K
R82	RESISTOR, fixed: composition; 1000 ohms, ±10%; 1/2 watt.	Plate filter	RC20GF102K
R83	RESISTOR, adjustable: wire wound; 2000 ohms, ±10%; 10 watts.	Keying Bridging Resistor	RA108-202-10
R84	RESISTOR, variable: wire wound; 10,000 ohms, ±10%; 3 watts.	Mixer balance	RA100ASSC103A
S1	SWITCH, rotary: non-shorting; three sections, four poles, two position each section, 1-5/16'' wafers.	Xtal selector	SW-110
S2	SWITCH, rotary: non-shorting; three sections; two poles, four position each section, 1-5/16'' wafers.	Band switch	SW-109
S3	SWITCH, rotary: non-shorting; single section, one pole, three position, 1-5/16'' wafers.	Test switch	SW-111
S4	SWITCH, toggle: SPST, 3 amp, 250 volts, phenolic body.	Plate power switch	ST-12A

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
S5	SWITCH, toggle: DPDT, 3 amp, 250 volts, phenolic body.	Kay-Fax Input	ST-22N
S6	SWITCH, thermostatic: operate at 70°C, ±2°C.	200 Kc oven control	SS-100-2
S7	SWITCH, thermostatic: operate at 70°C, ±2°C.	Xtal oven control	SS-100-2
S8	SWITCH, toggle: DPST; 3 amp, 250 volts, phenolic.	Power ON-OFF	ST-22K
S9	SWITCH, rotary: non-shorting; single sections; four poles, 2 position, 1-5/16'' wafers.	P.A. Band switch	SW-116
T1	TRANSFORMER, RF: impedance matching 2.3-6.7 mcs.	Band 2 mixer input	A-338
T2	TRANSFORMER, RF: impedance matching, .8 - 2.3 mcs.	Band 1 mixer input	A-339
T3	TRANSFORMER, RF: impedance matching, 2.5 - 6.9 mcs.	Band 2 mixer output	A-340
T4	TRANSFORMER, RF: impedance matching, 1.0 - 2.5 mcs.	Band 1 mixer output	A-341
T5	TRANSFORMER, RF: slug tuned, two coil forms, unenclosed 2.5 - 6.9 mcs.	Band 2 amp output	A-752
T6	TRANSFORMER, RF: slug tuned, two coil unenclosed, 1.0 - 2.5 mcs.	Band 1 amp output	A-753
T7	TRANSFORMER, power: primary 110/220 v, 50/60 cps; Secdy #1, 5 volts, 3 amp; Secdy #2 350-0-350 volts, 125 ma; Secdy #3 6.3 volts, 4.0 amps.	Power transformer	TF-105
T8	TRANSFORMER, filament: primary, 110 volts, 50/60 cycle, secdy, 6.3 v, 1.2 amps.	Filament transformer	TF-111
V1	TUBE, electron: 6J6; miniature 7 pin.	200 Kc osc	6J6
V2	TUBE, electron: 12AU7; miniature 9 pin.	Reactance tube	12AU7
V3	TUBE, electron: 6BE6; miniature 7 pin.	Mixer	6BE6
V4	TUBE, electron: 6BE6; miniature 7 pin.	Mixer	6BE6
V5	TUBE, electron: 2E26, octal.	Amp.	2E26
V6	TUBE, electron: 12AU7, miniature 9 pin.	Xtal osc cathode foll.	12AU7
V7	TUBE, electron: 12AU7, miniature 9 pin.	Keying tube	12AU7

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
V8	TUBE, electron: 5U4G, octal	Rectifier	5U4G
V9	TUBE, electron: 6X4, dual diode.	Rectifier	6X4
V10	TUBE, electron: OB2/VR105.	Regulator	OB2
V11	TUBE, electron: OB2/VR105.	Bias regulator	OB2
XF1	HOLDER, fuse: extractor post type for single AGC type fuse.	F1 socket	FH-100-2
XF2	HOLDER, fuse: extractor post type for single AGC type fuse.	F2 socket	FH-100-2
X11	LIGHT, indicator, w/red frosted lens, for miniature bayonet base T-3-1/4 bulb.	Socket for I1	TS-106-1
X12	LIGHT, indicator, w/clear white lens, for miniature bayonet base T-3-1/4 bulb.	Socket for I2	TS-106-2
X13	LIGHT, indicator, w/clear white lens, for miniature bayonet base T-3-1/4 bulb.	Socket for I3	TS-106-2
XV1	SOCKET, tube: 7 pin miniature.	Socket for V1	TS102P01
XV2	SOCKET, tube: 9 pin miniature.	Socket for V2	TS103P01
XV3	SOCKET, tube: 7 pin miniature.	Socket for V3	TS102P01
XV4	SOCKET, tube: 7 pin miniature.	Socket for V4	TS102P01
XV5	SOCKET, tube: octal.	Socket for V5	TS101P01
XV6	SOCKET, tube: 9 pin miniature.	Socket for V6	TS103P01
XV7	SOCKET, tube: 9 pin miniature.	Socket for V7	TS103P01
XV8	SOCKET, tube: octal.	Socket for V8	TS101P01
XV9	SOCKET, tube: 7 pin miniature.	Socket for V9	TS102P01
XV10	SOCKET, tube: 7 pin miniature.	Socket for V10	TS102P01
XV11	SOCKET, tube: 7 pin miniature.	Socket for V11	TS102P01
XY1	SOCKET, crystal: 487'' spacing, for .095'' pins.	Xtal socket A for Xtal #1.	TS-105-1
XY2	SOCKET, crystal: 487'' spacing, for .050'' pins.	Xtal socket B for Xtal #1.	TS-104-1
XY3	SOCKET, crystal: 487'' spacing, for .095'' pins.	Xtal socket A for Xtal #2.	TS-105-1
XY4	SOCKET, crystal: 487'' spacing, for .050'' pins.	Xtal socket B for Xtal #2.	TS-104-1

SYM.	DESCRIPTION	FUNCTION	TMC PART NUMBER
XY5	SOCKET, crystal: 487'' spacing, for .095'' pins.	Xtal socket A for Xtal #3	TS-105-1
XY6	SOCKET, crystal: 487'' spacing, for .050'' pins.	Xtal socket B for Xtal #3	TS-104-1
W1	CABLE ASSEMBLY: power: consists of molded non-polarized male plug, and 6 foot 18/2 SJ rubber covered cord and phenolic twist lock female connector with cord grips.	Power cord	CA-103
Y*	CRYSTAL UNIT, quartz: 800-6,700 Kcs, ±0.002% (Specify frequency - Supplied only on customers request).	Xtal	CR-27/U



EK-140 | J

SCHEMATIC DIAGRAM
FREQUENCY SHIFT EXCITER, MODEL XFK.