TECHNICAL MANUAL

for

STABILIZED CRYSTAL OSCILLATOR MODEL TRX-1

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N.Y. OTTAWA, CANADA

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MAMARONECK, N.Y. OTTAWA, CANADA

IN-4006

Issue Date: 15 OCT 1963

THE TECHNICAL MATERIEL CORPORATION
COMMUNICATIONS ENGINEERS
700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes*, fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.

2. That the defect is not the result of damage incurred in shipment from or to the factory.

3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.

4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes* furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

CHANGE NO. 1 TRX-1

INSTRUCTION BOOK CHANGE NOTICE

Date Feb. 28, 1964

Manual affected: Stabilized Crystal Oscillator, Model TRX-1 IN -4006

The following changes and additions are to be incorporated into Parts List, Section 6.

Page 6-1. Ref. Sym. C126

Change value from 39 uuf to 10 uuf.

Change TMC Part No. to CM15C100k

Ref. Sym. C127

Add to parts list, "Same as C126"

Ref. Sym. C108

Change TMC Part No. to CM15B101K

Page 6-3. Ref. Sym C163 and C164 added to parts list.

C163, Same as C107

C164, Same as C130

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Direct r of Eng. Services.

CHANGE NO. 2 TRX-1

INSTRUCTION BOOK CHANGE NOTICE

Date Feb. 29, 1964

Manual affected: Stabilized Crystal Oscillator, Model TRX-1 IN -4006

The following changes and additions are to be incorporated in Section 5, Maintenance.

5-3c. Change to read:

(3) Tune inductor L114 for a maximum VTVM indication. Tighten locknut and connect VTVM to J107.

(6) Remove crystal from socket "A" and place it in socket "B" (XY112). Place BFO switch S102 to "B".

5-3d. Change to read:

(3) Adjust HFO trimmer C158 for crystal frequency.

(4) Adjust balance control R115 for a maximum indication on VTVM. VTVM should indicate approximately 1.0 vac minimum at J101.

(5) Place HFO switch in position 2. Adjust the proper trimmer to the crystal frequency.

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director of Eng. Services.

CHANGE NO. 3 TRX-1

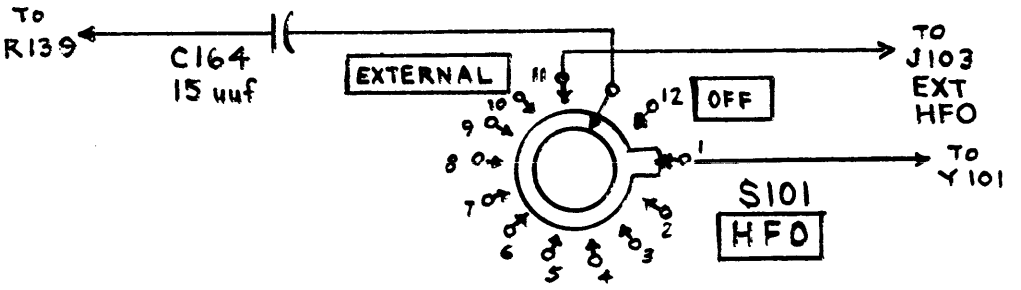
INSTRUCTION BOOK CHANGE NOTICE

Date April 15, 1964

Manual affected: Stabilized Crystal Oscillator, Model TRX-1 IN -4006

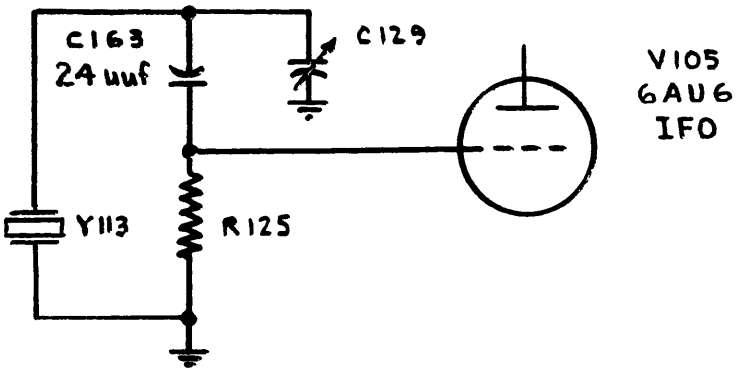
The following circuit changes are to be incorporated in figure 4-3 and figure 7-1. Additional components to circuitry are to be included in Section 6, Parts List.

1. Add capacitor C164 as shown below:



Change HFO switch S101 contacts as shown.

2. Add capacitor C163 as shown below:



SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:

THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New York

Attn.: Director f Eng. Services.

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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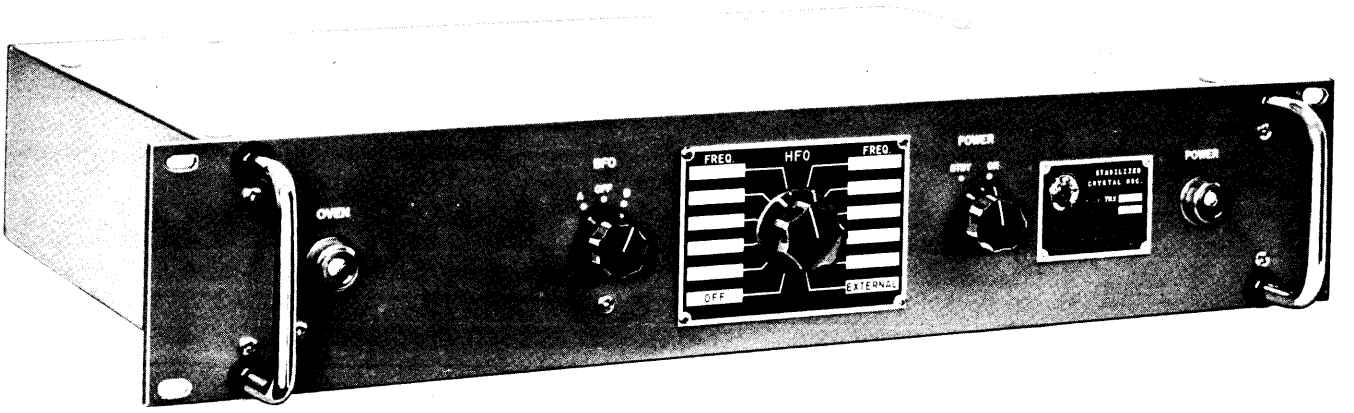


Figure 1-1. Stabilized Crystal Oscillator TRX-1

SECTION 1
GENERAL INFORMATION

1-1. DESCRIPTION OF EQUIPMENT.

The Model TRX-1 Stabilized Crystal Oscillator is a self-contained unit providing 13 oven-regulated, crystal-controlled frequencies with a stability of better than 1 part in 10^6 per day. Of the 13 crystal-controlled outputs, ten are selectable HFO outputs, two are BFO outputs, and one is an IFO output.

This unit finds many applications, especially when it is desirable to replace the various oscillators in a receiver or transmitter in the event of critical frequency control. It also provides translation frequencies for sideband exciters.

1-2. ELECTRICAL AND MECHANICAL CHARACTERISTICS.

Power Input	115/230 vac, single phase, 50/50 cps, 100 watts
Crystals	(11) CR-27/U; (2) CR-45/U
Output Levels	1 volt rms into 50 ohms
Stability	1 part in 10^6 per day between 0 and 50°C
Rear Apron Facilities	2 IFO BNC (connectors) 2 BFO BNC (connectors) 2 HFO BNC (connectors) 1 External Oscillator Input
Dimensions	3-1/2" x 19" x 12-1/2"
Weight	15 lbs.

1-3. ELECTRON TUBE AND DIODE COMPLEMENT.

Table 1-1 lists the electron tubes and diodes found in the TRX-1.

TABLE 1-1. ELECTRON TUBE AND DIODE COMPLEMENT

REFERENCE SYMBOL	TYPE	FUNCTION
V101	6EW6	HFO
V102	6EW6	HFO Amplifier
V103	6AF4	Phase Splitter
V104	7645	HFO Amplifier
V105	6AU6	IFO
V106	6AU6	BFO
CR103-CR106	IN1084A	Rectifier
CR101	DD-102-1	Clipper
CR102	IN34	Rectifier

SECTION 2

INSTALLATION

2-1. INITIAL INSPECTION.

Each TRX-1 Unit has been calibrated at the factory prior to shipment. Upon arrival at the operating site, inspect the packing case and contents for possible damage. Inspect all packing material for parts which may have been shipped as "loose parts." With respect to damage to the equipment, for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

Check the front panel for damage to the knobs. Next, remove the upper and lower dust covers. Once the covers are removed, inspect the chassis for loose wiring and defective parts.

2-2. INSTALLATION.

The TRX-1 is designed for either cabinet or rack installation. With rack installation, no covers are used and the unit is mounted in a standard 19-inch equipment rack.

2-3. POWER REQUIREMENTS.

The unit is designed for either 115 or 230 volts, single phase, 50/60 cycles at 100 watts. Unless specifically ordered for 230-volt operation, the unit is shipped wired for 115 vac. Wiring changes for 230 volts are shown in figure 2-1. With 230-volt operation, change F101 (located at the rear of the equipment) from 1 ampere to 0.5 ampere.

2-4. ELECTRICAL INSTALLATION.

All connections to the TRX-1 are made at the rear apron of the unit. See figure 2-2. The a-c source voltage is connected to jack J108. The IFO outputs are found at jacks J105 and J104; the HFO outputs at jacks J101 and J102; and the BFO outputs at jacks J107 and J106. Should an external HFO source be used, connect it to jack J103.

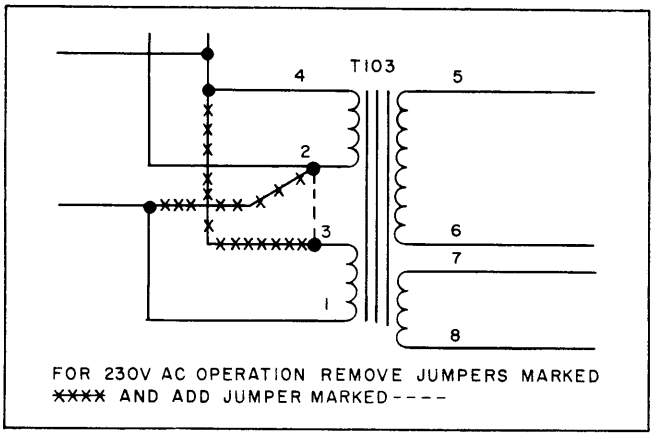


Figure 2-1. Wiring Change For 230-Volt Operation

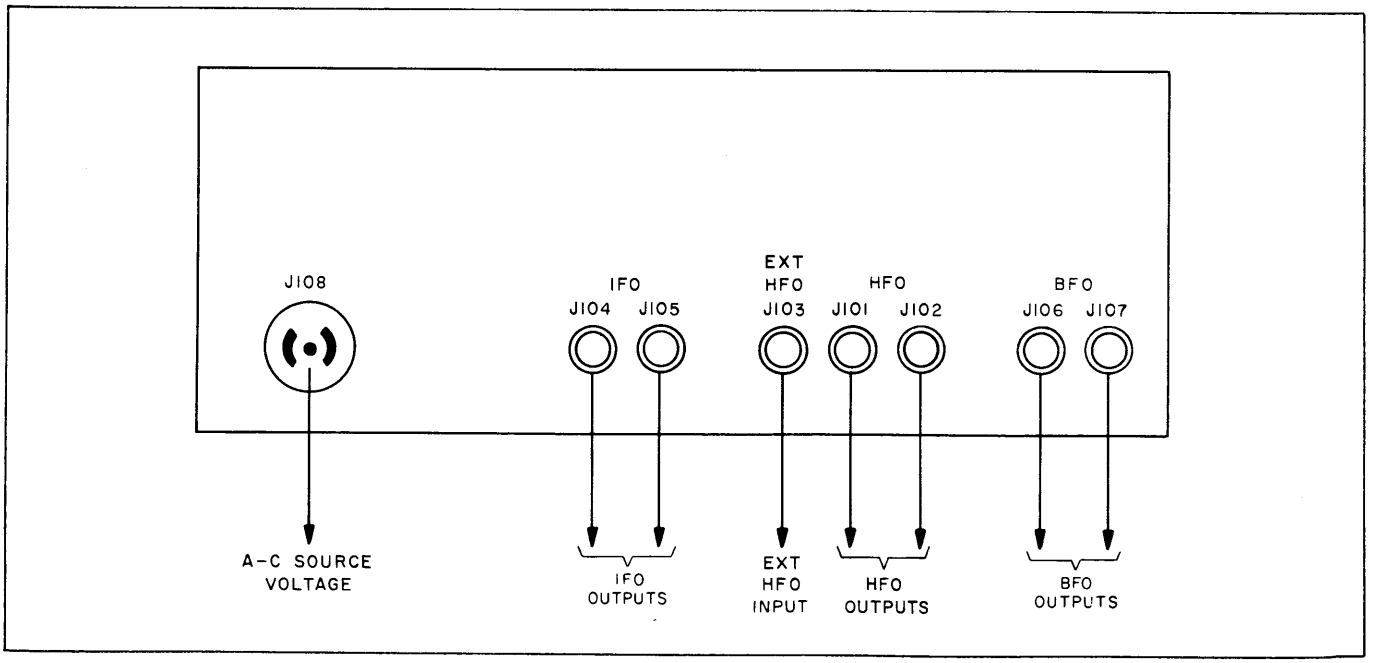


Figure 2-2. Interconnection Diagram

SECTION 3
OPERATOR'S SECTION

3-1. OPERATING CONTROLS.

Table 3-1 below lists the component designations and functions of the controls and indicators found in the TRX-1. The reference designations in the table refer to those in figure 3-1.

3-2. OPERATOR'S INSTRUCTIONS.

The HFO and BFO circuits can be controlled by front panel controls. After making the proper connections at the rear of the equipment, throw POWER switch to the ON position. The POWER indicator should light. To use the HFO, throw the HFO switch into the desired position. If an external source is to be used, rotate the switch to the EXTERNAL position. If HFO operation is not desirable, place the switch in the OFF position.

For BFO operation, turn the BFO switch to either the A or B position, depending on the desired frequency. By adjusting the BFO output control R137, the amplitude of the BFO output can be varied. If no BFO output is desired, place the BFO switch in the OFF position.

The IFO has no controls. An IFO output is obtained by simply connecting a lead to jack J104 or J105.

3-3. OPERATING THE TRX-1 WITH THE GPR-92.

The TRX-1 can readily be used to supply the oscillator injection frequencies for TMC's Model GPR-92 Receiver in the event that oscillator injection frequencies of high stability are needed.

The HFO frequencies are determined as follows: The total frequency range of the HFO should be between .995 and 34.955 mc if the entire frequency range is to be covered. On frequencies below 5.6 mc, the first i-f is at 455 kc; thus the crystal should

TABLE 3-1. OPERATING CONTROLS

REFERENCE DESIGNATION	PANEL AND COMPONENT DESIGNATION	FUNCTION
1	POWER switch S103	Plate voltage applied to tubes when placed in ON position; otherwise plate voltage disconnected in STBY position.
2	POWER Indicator Lamp DS101	Lights when POWER switch is ON.
3	HFO Selector S101	Selects crystal for desired output frequency. In OFF position HFO becomes inoperative. In EXTERNAL position, an external source can be used.
4	BFO Switch S102	Selects one of two crystals by rotating switch to either A or B position. BFO inoperative with S102 in OFF position.
5	OVEN Indicator DS100	Cycles on and off to indicate oven heating.
*	Balance Control R115	A screwdriver adjustment which balances the input signals to the push-pull amplifier.
*	BFO Output R137	Also a screwdriver adjustment which controls output amplitude.

* These controls located on the chassis.

be 455 kc above the desired frequency. On frequencies above 5.6 mc, the i-f is at 3.955 mc. Therefore, the crystal should oscillate 3.955 mc above the input signal.

The IFO frequency is much simpler to determine since it is operative only on the upper three bands (frequencies above 5.6 mc) and it produces a second i-f of 455 kc. The IFO crystal should oscillate at 3.5 mc.

Choice of the BFO crystals are determined by the desired tone of the c-w signals. Usually the two BFO crystals oscillate at 452 kc and 458 kc which is plus and minus 3 kc of the 455 kc signal. Choice of the crystals are determined by the desired frequency.

Figure 3-2 shows a TRX-1 used with two GPR-92 Receivers connected for use in diversity operation.

3-4. OPERATOR'S MAINTENANCE.

Should any malfunction occur, immediately turn off the high voltage (place POWER switch in STBY position). However, don't unplug cord from the a-c line as the stability of the ovens may be affected. If POWER indicator goes out, first check fuse F101 located at the rear of the equipment. If the malfunction still exists, check the tubes. Oven monitoring can be checked by noting the cycling of the OVEN indicator.

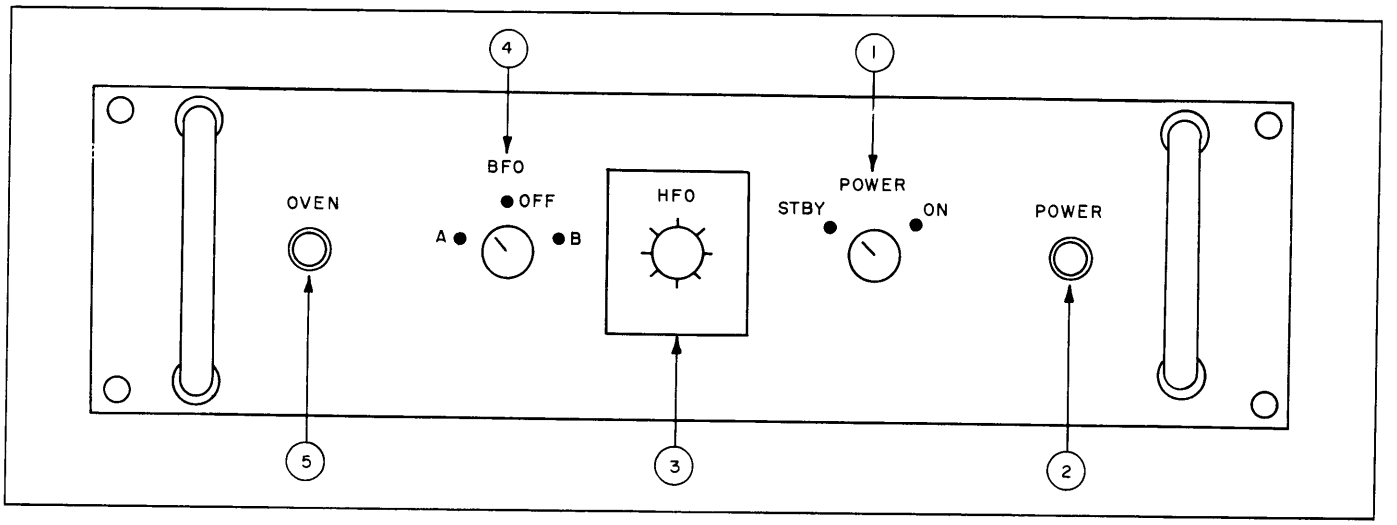


Figure 3-1. Front Panel Controls

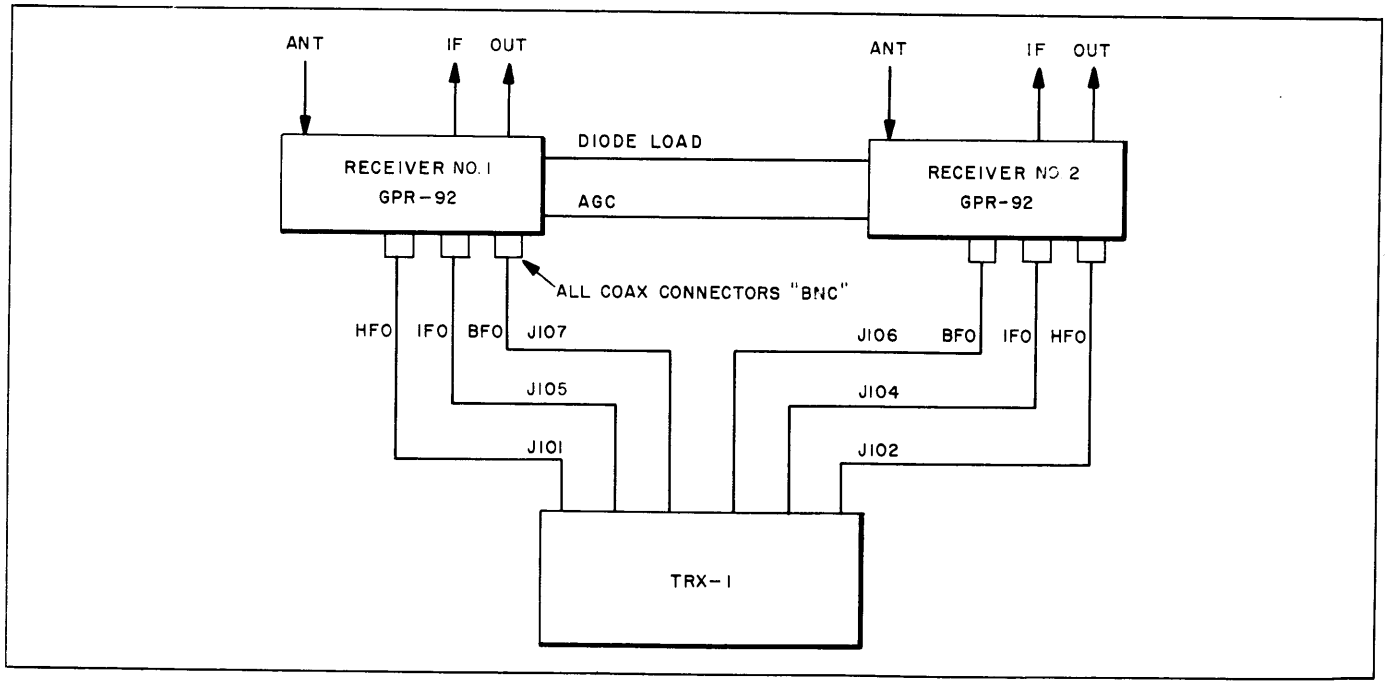


Figure 3-2. TRX-1 Used In Diversity Operation

SECTION 4
TROUBLESHOOTING

4-1. OVERALL FUNCTIONAL DESCRIPTION AND TROUBLESHOOTING OF UNIT.

a. FUNCTIONAL DESCRIPTION. (See figure 4-1.) - The Model TRX-1 Oscillator is composed of three independent oscillators which provide BFO, IFO, and HFO outputs. Although specifically designed for use with the GPR-92 Receiver, it can be used as a master oscillator for any transmitter or receiver. The actual frequencies generated by this oscillator depend on the type crystals inserted into the various circuits. The entire complement of crystals found in this unit are enclosed in a temperature-regulated oven which stabilizes crystal operation thus producing extremely stable output frequencies.

Crystal Y113 (the IFO crystal) with associated IFO tube V105 generates the IFO output. When the unit is to be used with the GPR-92 a 3.5-mc crystal is incorporated. The IFO output is coupled to jacks J104 and J105 at the rear of the unit. BFO oscillator V106 and crystals Y111 and Y112 generate the BFO frequencies; the BFO outputs are usually at plus and minus 3 kc of 455 kc. With BFO switch S102 in the A position, crystal Y112 is placed in the circuit; with S102 in the B position, Y111 is placed in the circuit. The BFO output is connected to jacks J106 and J107 at the rear of the unit.

Crystals Y101 through Y110 generate the HFO outputs. The particular crystal used in HFO V101 depends on the position of HFO switch S101. With HFO switch in OFF position, the HFO circuitry is inoperative and with it in the EXTERNAL position, an external source can be used. The harmonic-rich HFO output from V101 is amplified through wideband R-C coupled amplifiers V102, V103, and V104.

b. OVERALL TEST DATA. - With the first indication of trouble, first check the front panel POWER

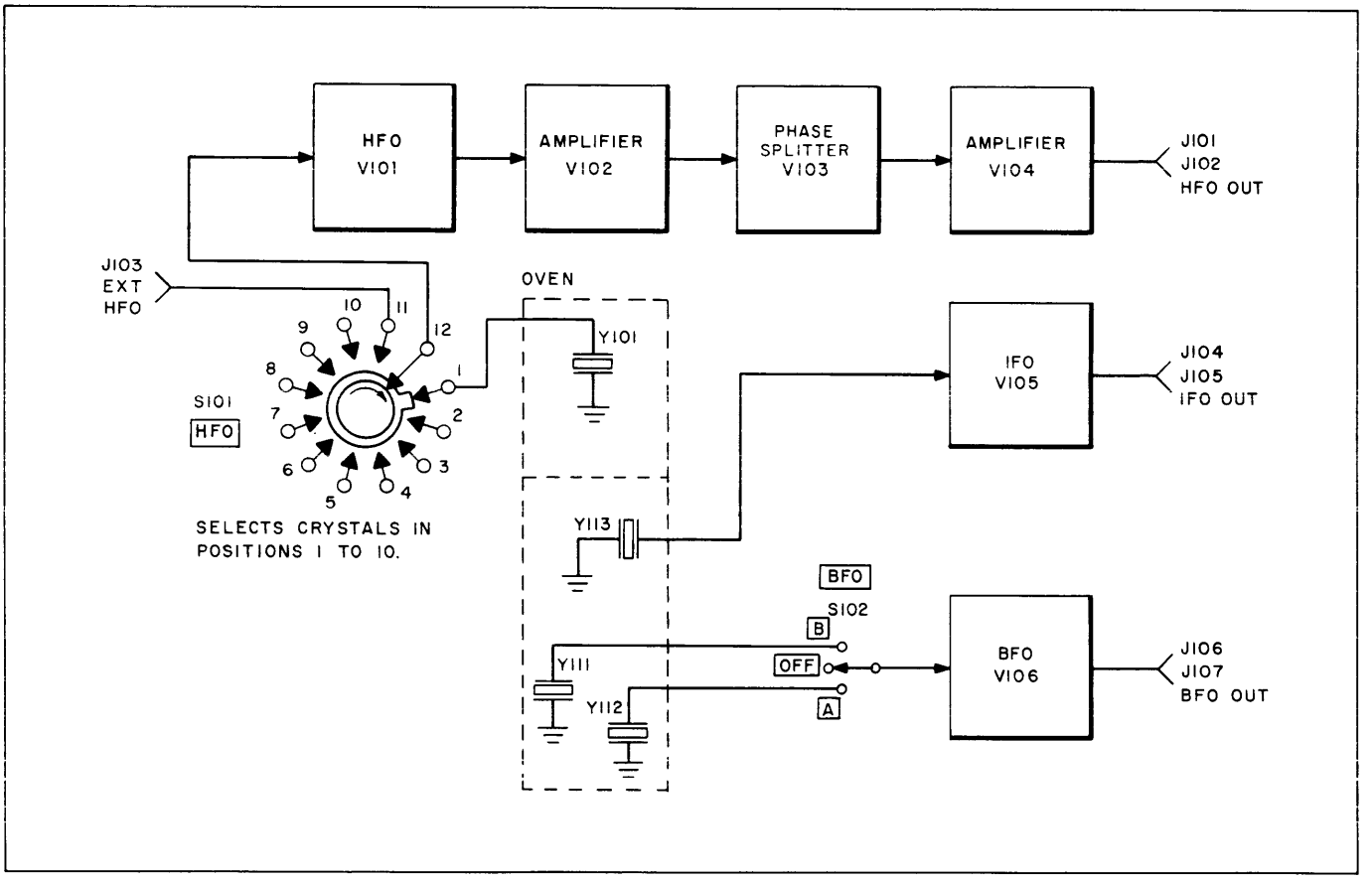


Figure 4-1. Block Diagram of Model TRX-1

switch is thrown into the ON position. If it doesn't light, check fuse F101 located at the rear of the unit. If the trouble is suspected of being in a functional section such as the power supply or IFO, for example, refer to the paragraph dealing with that particular functional section.

The HFO output can be measured at jack J101 or J102. (The amplitude should be 1.0 volt (rms).) If some suspicion of frequency instability exists, check the output with a frequency meter. Instability can be caused by defective tubes or an unregulated oven. Usually, an unregulated oven can be pin-pointed if the OVEN indicator lamp stops cycling. The IFO output can be measured at jacks J104 and J105; it should be one volt (rms). The BFO outputs can be measured at jacks J106 and J107; they should also be at one volt (rms).

While troubleshooting, see figures 5-1 and 5-2 for location of components within the unit.

4-2. POWER SUPPLY.

a. CIRCUIT ANALYSIS. (See figure 4-2.) - This self-contained power supply produces the operating voltages for the tubes found in this unit and it is designed to work with either a 115- or 230-volt source. For purposes of discussion, however, we'll assume the power supply is working off 115 vac.

The 115-vac input voltage is coupled through rear panel-mounted jack J108 and fuse F101 to the primary (pins 1, 4) of transformer T103. This source voltage is also coupled to terminals A and B at jack J110 where it is used as an oven voltage; it is coupled through filter components L115, L116, C149, and C150 to C152, to jack J108. Plug P101 on the oven chassis connects to jack J109, thus feeding the 115 vac to heat the oven. The oven keeps the temperature surrounding the crystals at 70°C and, after 30 minutes operation, the temperature changes will be held within 1.0°C. OVEN indicator DS100 in series

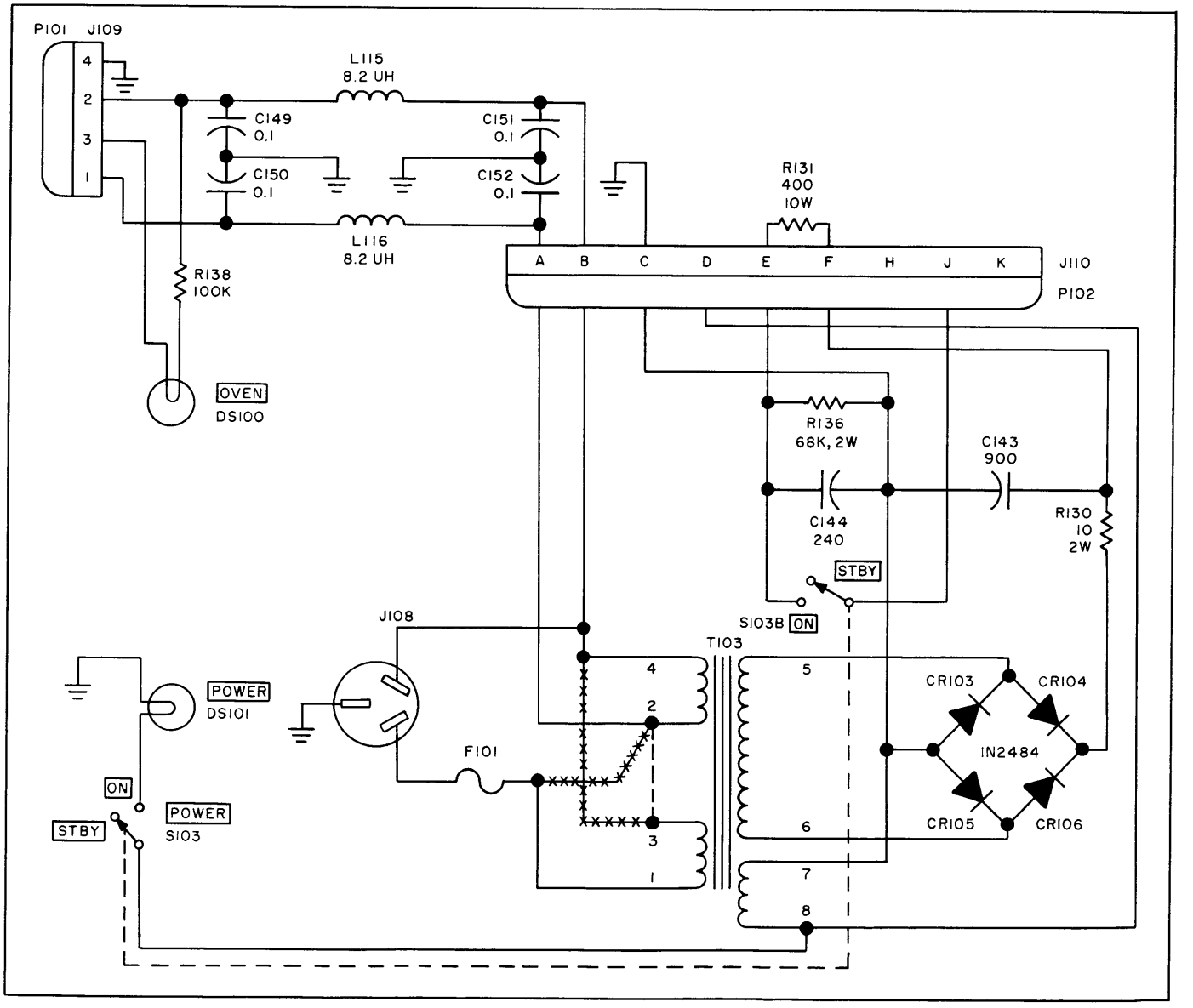


Figure 4-2. Simplified Schematic of Power Supply

with voltage-dropping resistor R138, lights when 115 vac is applied to the oven.

The 115 vac is also coupled across transformer T103 to the secondary high voltage winding (pins 5 and 6) where the voltage is stepped-up and coupled to a full-wave rectifier consisting of diodes CR103 through CR106. The pulsating d-c output from the rectifier network is then coupled through an r-c filter circuit. The r-c filter, composed of resistors R130, R131, R136, and capacitors C143, and C144, flatten out the positive pulsating excursions thus producing a stable 200 vdc. This d-c voltage is then coupled through POWER switch S103 (providing it's in the ON position) to terminal J on jack J110. From here the d-c voltage is distributed to the various stages within the unit.

The voltage induced across the secondary of transformer T103 is also coupled to the low voltage windings (pins 7 and 8). From pin 8 of T103, the 6.3-vac output is coupled to POWER switch S103A and to terminal D of jack J110. With switch S103 in the ON position, POWER indicator DS101 lights. The 6.3-vac output from jack J110 is both coupled to the filaments of the tubes used in this unit and is rectified by diode CR102 and filtered through resistors R122, R123, and capacitors C122, and C123 to be used in the balancing network of driver V103.

b. TEST DATA. (See figure 4-9.) - The most probable cause of trouble in the power supply is a current overload resulting in a blown fuse. First, check fuse F101 located at the rear of the unit. With a VTVM measure the input voltage at pins 1 and 4 of transformer T103. No indication could indicate a defective fuse, wiring, or jack. The power transformer should next be checked since they often burn out because of excessive secondary winding current. The chief cause of a defective transformer can be defective rectifiers or filter capacitors. Also, the plate by-pass capacitors should be checked since they are across the power supply and a short circuit in any of them may cause the same result. Besides checking filter capacitors, C143 and C144, check resistors R130, R131, and R136. Diodes CR103 through CR106 should not normally have to be replaced; however, if excessive hum is present, check them.

An open- or short-circuited filament circuit can be checked with a VTVM. An indication of a defective filament can be caused by the filament in that particular tube; however, should all the tubes not light, connect a VTVM across pins 7 and 8 of T103. The VTVM should indicate 6.3 vac.

4-3. HFO CIRCUITRY.

a. CIRCUIT ANALYSIS. (See figure 4-3.) - The HFO circuitry consists of HFO V101 with its ten associated crystals and amplifiers V102, V103, and V104. The exact operating frequencies of V101 depend on the types of crystals used in place of Y101 through Y110. The HFO range is usually between 4 and 20 megacycles. Variable capacitors C153 to C162 are used as fine tune controls for the ten crystals. With S101 in the EXTERNAL position, an external frequency source can be used; the external source is coupled to J103, located at the rear of the unit. With S101 in the OFF position, the stage is inoperative.

The selected frequency is clipped and distorted at the plate of V101 to generate a highly-rich harmonic pulse output. Since diode CR101 is connected in such a manner that it offers zero impedance to positive signals, the positive excursions at the plate are coupled to ground through resistor R101. The negative excurions developed across inductor L101, however, are coupled to amplifier V102. Capacitor C108 and inductor L102, in V101's cathode circuit, are used as an r-f trap. V101 plate voltage is coupled through resistors R133, R101, and inductor L101 to the tube plate while the screen voltage is coupled through resistor R102. C101, C102, and C106 are decoupling capacitors.

The negative-pulsed output from V101 is coupled to the grid (pin 1) of V102. V102 is a type 6EW6 pentode connected as a conventional r-c coupled amplifier. Plate voltage for the tube is coupled through resistors R103 and R134 while the screen voltage is coupled to the screen grid through resistor R104. C103 and C109 are decoupling capacitors. The amplified output from V102 is coupled to the screen grid through R104. C103 and C109 are decoupling capacitors. The amplified output from V102 is coupled to the grid (pins 2, 6) of phase inverter V103.

V103 provides balanced paraphase outputs to push-pull amplifier V104. The signal developed in the plate circuit of V103 is coupled through d-c blocking capacitor C114 to the grid (pin 1) of V103 while the signal developed in the cathode circuit of V103 is coupled through capacitor C117 to another grid (pin 3) of V104. A balance network composed of balance control R115, decoupling capacitors C115 and C116, and voltage divider resistors R117, R118, and R119, can adjust the signal level at each grid of V104, thus keeping a balanced output. Plate voltage for V103 is coupled to the plate through resistors R111 and R113.

Dual tetrode 7645, connected in a push-pull configuration, is the output amplifier stage. The outputs from V104 are combined in impedance-matching transformer T101. The output induced across the secondary of T101 is coupled to jacks J101 and J102 mounted at the rear of the unit. Plate voltage for V104 is coupled to the plates (pins 6, 8) through inductor L103, the primary of T101, and parasitic suppressors L112 and L113.

The screen voltage is coupled from the primary of T101, dropped across resistor R121 and coupled to the screen grids. C119, C120, and C121 are decoupling capacitors.

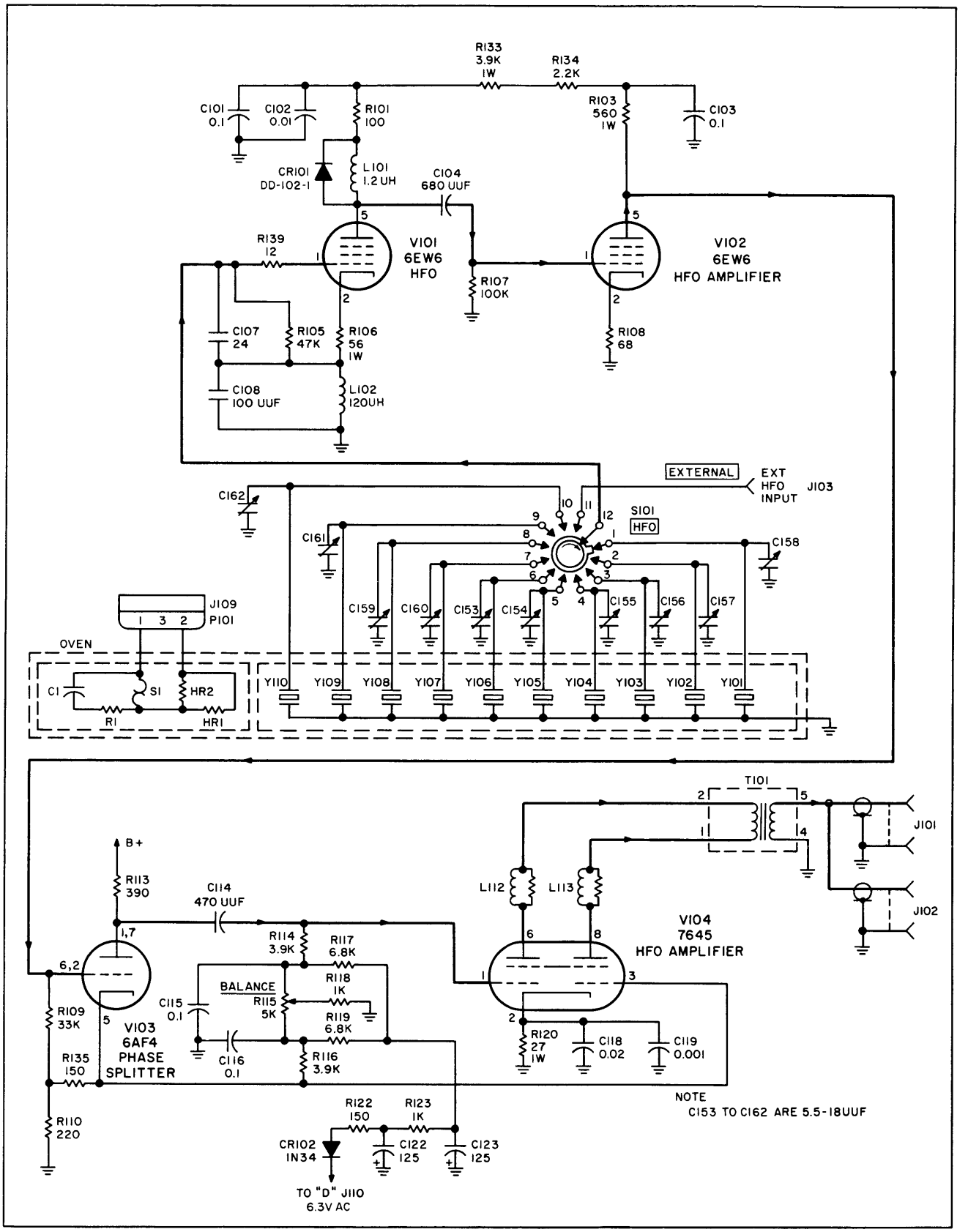


Figure 4-3. Simplified Schematic of HFO Circuitry

b. TEST DATA. (See figure 4-9.) - Should the output cease in any particular position of the HFO switch, check the crystal used in that particular switch position. If an oscillator crystal is suspected to be defective, it can be checked by several methods. One method is to remove the suspected crystal and replace it with a similiar crystal of the same frequency. The second method requires the use of a VTVM. Since a crystal oscillator rectifies grid leak bias when it is oscillating, measure the control grid voltage for a negative reading. This test determines, to some extent, the extent of crystal activity, as well as the condition of the rest of the circuit. While reading the negative voltage at the control grid, remove the crystal and observe the VTVM reading. It should drop to nearly zero. This test, however, does not indicate whether the crystal is operating at its correct frequency. Should no output exist at any of the HFO switch positions, check tubes V101 through V104. Also check inductor L101 and diode CR101 in the plate circuit of V101.

In the case of instability a good method of determining whether the cause of it lies in the oven circuitry or in the following amplifier stages is to use an external oscillator source. Connect the source to jack J103 and place the HFO switch in the EXTERNAL position. One note of caution, make sure that the stability of the external source is equal or better than that of the internal oscillator. Should the stability improve, check the oven circuitry for defective parts or for defective parts or for uneven heating. Should the instability still exist, check the components in the plate and grid circuits making up the amplifier chain. Also check the amplitudes of the signals at the grids of V104; an unbalanced input may be the cause of trouble.

If it is suspected that a crystal is not operating at its appropriate frequency, connect a frequency counter to the output and determine frequency. Each crystal has its particular tuning capacitor which, with the crystal, can vary the output frequency over a small selected range. In this way the capacitors can compensate for varying circuit parameters such as aging crystals.

Oven heaters HR1 and HR2 are always connected to the a-c line. If the oven is not operating, thermostat switch S1, the heater windings, or the wiring is defective. A good indication of a defective oven is the lack of cycling of the oven as indicated on the OVEN front panel indicator. Trouble in these circuits must be corrected by checking the individual parts in each oven.

Figure 4-4 shows the positions and voltages and resistances of the various tubes found in this functional section.

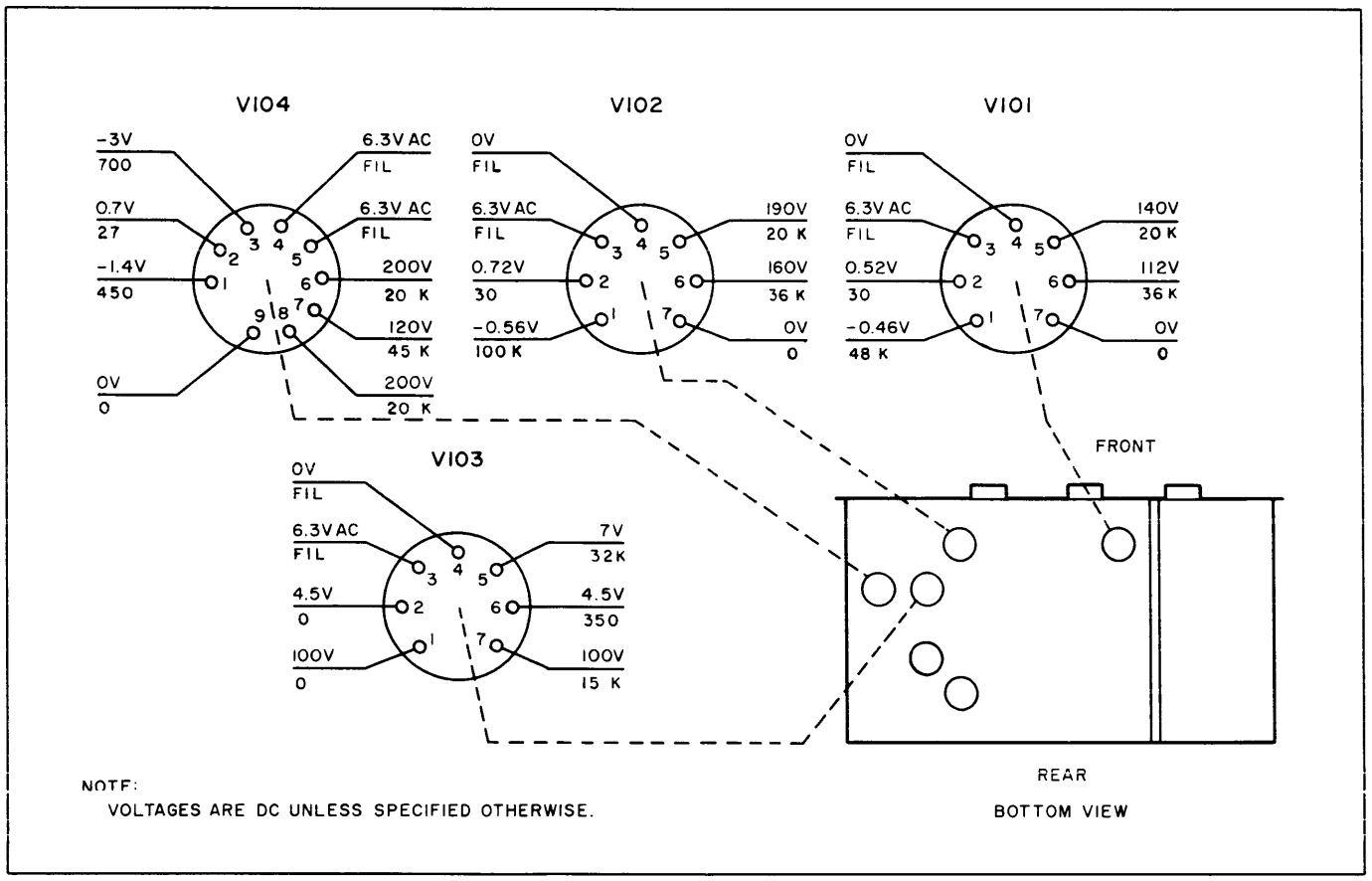


Figure 4-4. Bottom View Showing HFO Tubes

4-4. BFO CIRCUITRY.

a. CIRCUIT ANALYSIS. (See figure 4-7.) - The BFO circuitry consists of BFO tube V106, crystals Y111 and Y112, and BFO switch S102. The exact operating frequencies of the BFO depend on the type crystals used in the circuitry. Typical frequencies are 452 kc and 458 kc.

Pentode V106 is connected into a tuned-plate tuned-grid configuration; Y111 or Y112 replaces the grid tank circuit. With S102 in the A position, Y111 is connected in the circuit while with S102 in the B position, Y112 is connected. In the OFF position, S102 disables circuit operation. Inductor L114 in the plate circuit is tuned to the BFO frequency. The BFO output is adjusted by BFO output control R137; the output is coupled to rear panel jacks J106 and J107.

The operating voltages for V106 are connected through BFO switch S102 in such a manner that no operating voltages are coupled to the tube with the switch in the OFF position. With S102 in the A or B position, plate voltage is coupled through inductors L109 and L114 to the plate while the screen voltage is coupled through resistor R127. Capacitors C139 through C142 are decoupling capacitors. The suppressor grid is grounded.

b. TEST DATA. (See figures 4-5 and 4-9.) - The BFO output at jacks J106 and J107 should be one volt (rms). The frequencies of the crystals can be determined by connecting a frequency counter to one of these jacks. If one of the outputs seem to be defective, check that particular crystal. Trimmer capacitors C125 and C128, located on the side of the oven, can be varied to compensate for varying circuit parameters. A defective output can be caused by a bad tube or circuit components. Check V106 and L114. Faulty oscillator operation can also be caused by defective bypass capacitors C136, C137, or C138. Also check the capacitor (C105) in the plate circuit. If it is necessary to align this particular stage, see paragraph 5-3c in the next section of this manual.

4-5. IFO CIRCUITRY.

a. CIRCUIT ANALYSIS. (See figure 4-6.) - The IFO circuit consists of oscillator V105 and its associated crystal Y113; the operating frequency of V105 depends on the type crystal used. The frequency is 3.5 mc if the TRX-1 is to be used with the GPR-92 Receiver. V105 is connected in a tuned-plate tuned-grid configuration with crystal Y113 replacing the grid tuned circuit. Capacitor C129 is used as a fine tune in this circuitry and is capable of compensating for varying circuit parameters such as an aging crystal. Excitation capacitors C130 through C132 control the voltage applied to Y113. Transformer T102 in the plate circuit of V105 is tuned to the operating frequency of the stage. The output from V105 is coupled through transformer T103 to the IFO jacks J104 and J105 at the rear of the unit.

Plate voltage for V105 is coupled from terminal J at jack J110, through inductor L107 and the primary of T102 to the plate while the screen voltage is coupled from the plate line and filtered and dropped across R124 and C133 and C134. The suppressor grid is grounded.

b. TEST DATA. (See figures 4-8 and 4-9.) - The IFO output at jack J104 or J105 should be one volt (rms). The frequency of the IFO circuitry can be monitored by connecting a frequency counter to either of these jacks. Trimmer capacitor C129 can be varied to compensate for various changing circuit parameters. The trimmer is located at the side of the oven. A defective output can be caused by

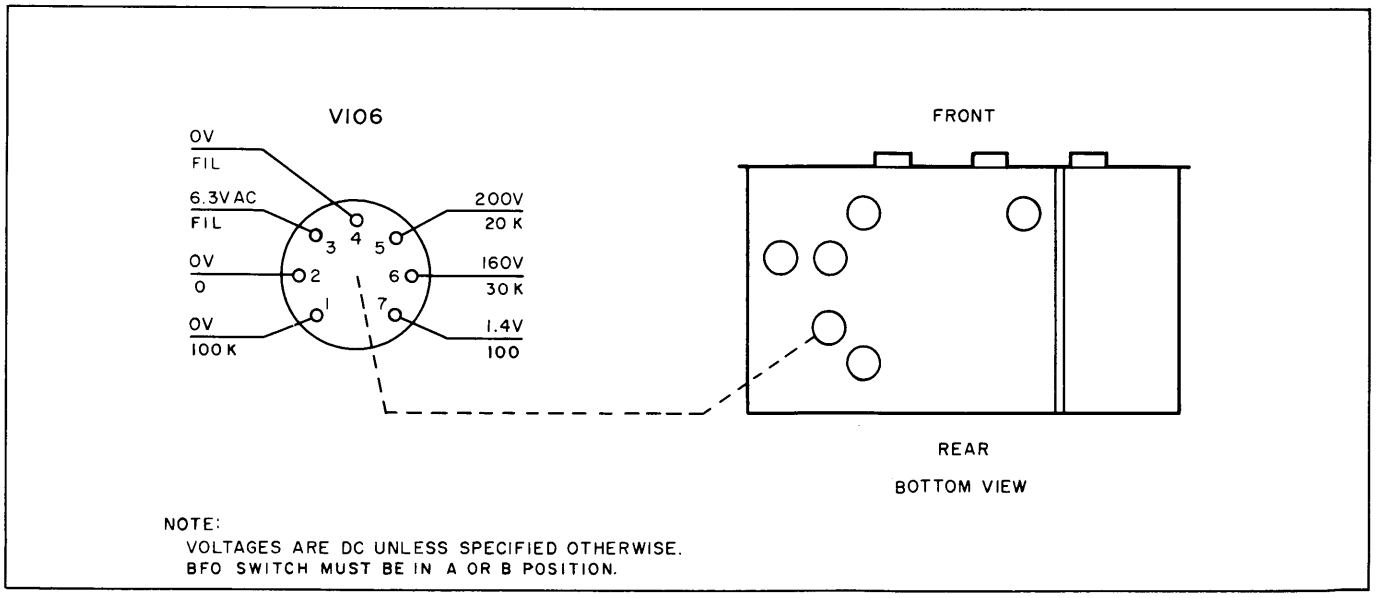


Figure 4-5. Bottom View Showing BFO Tubes

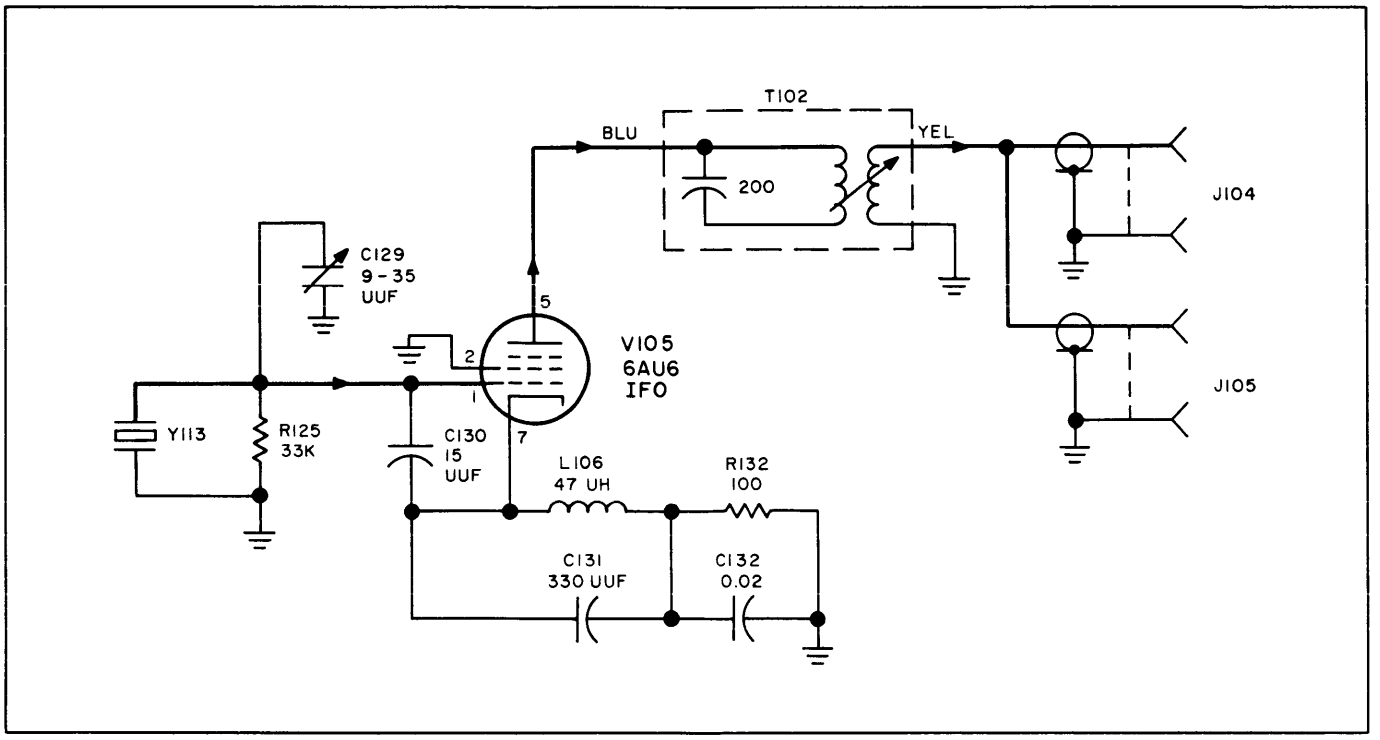


Figure 4-6. Simplified Schematic of IFO Circuitry

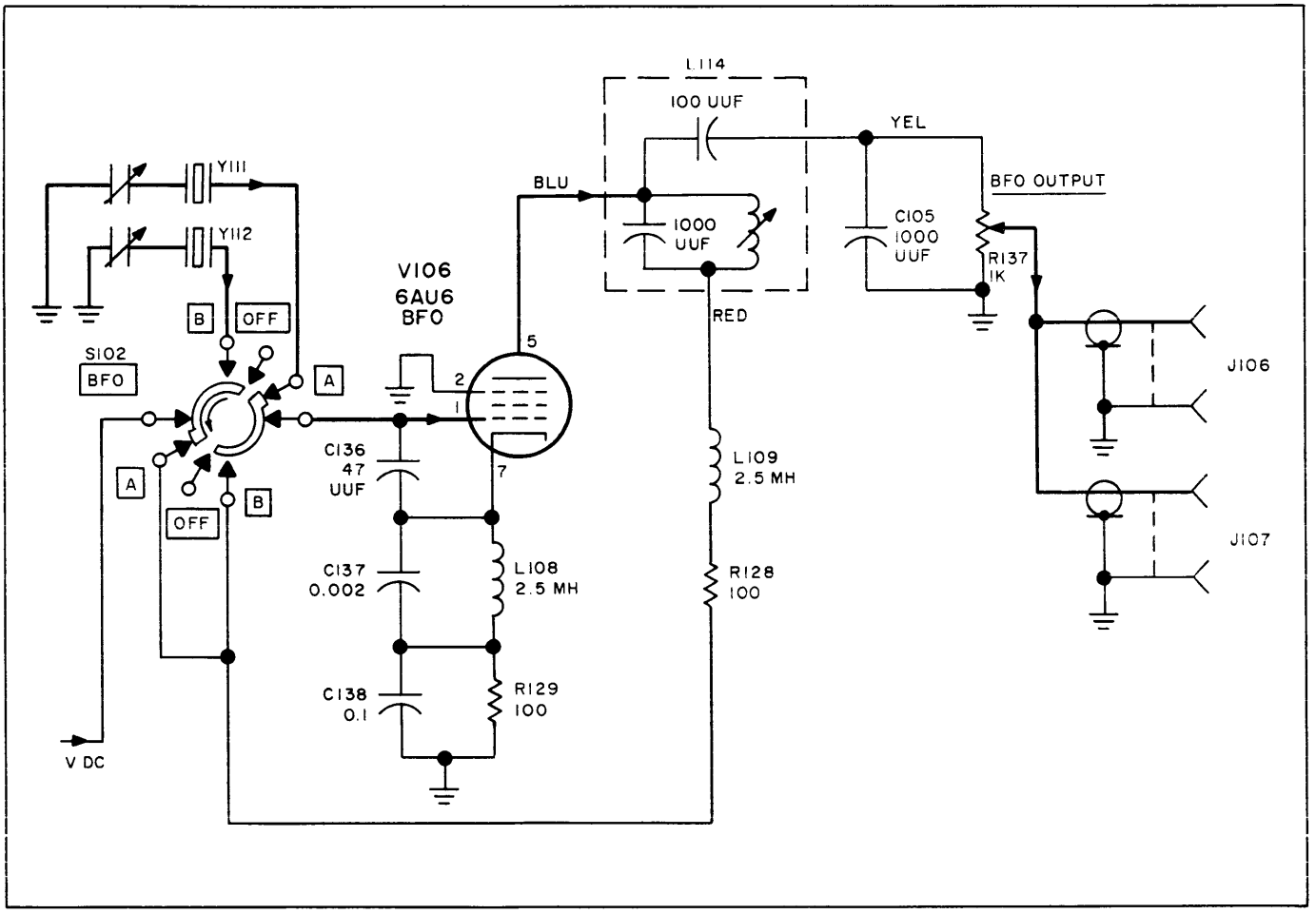


Figure 4-7. Simplified Schematic of BFO Circuitry

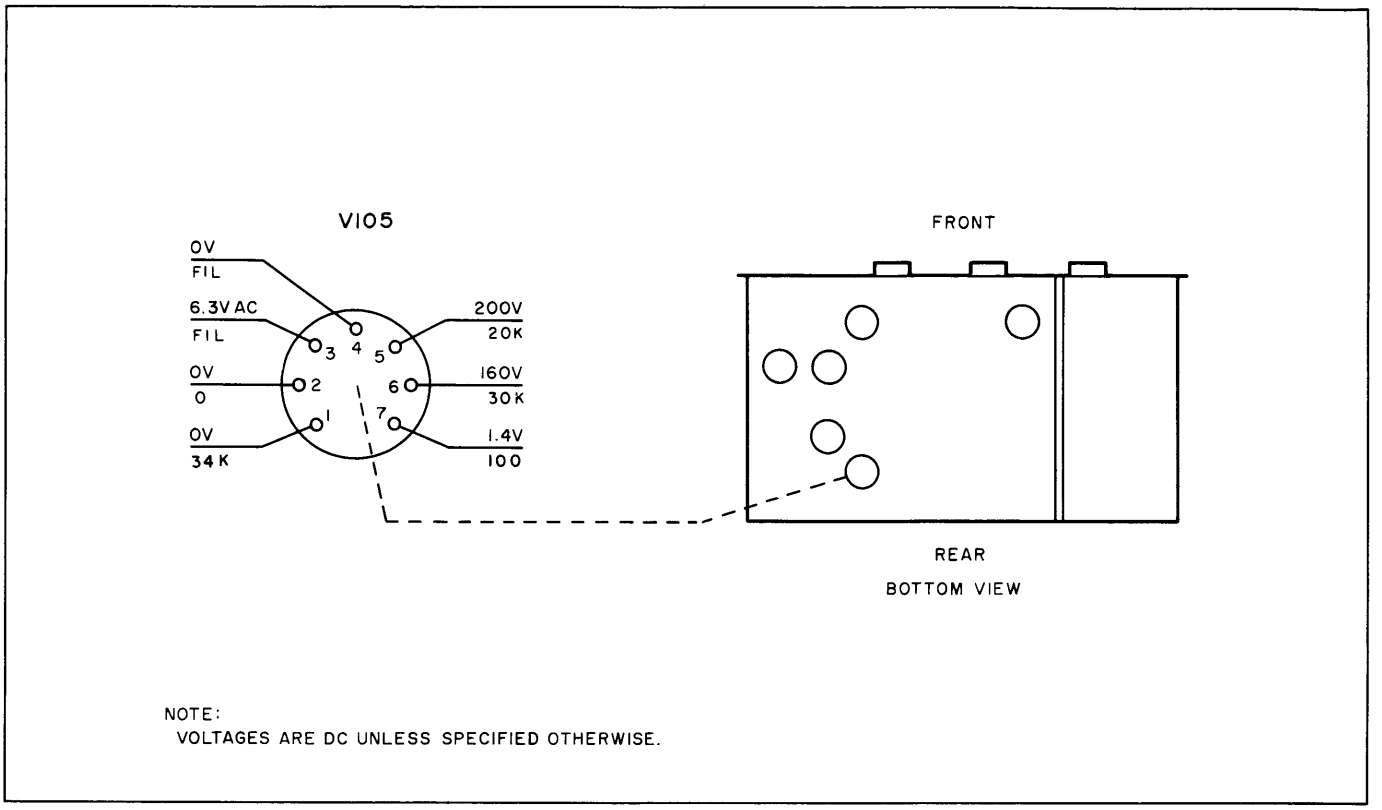


Figure 4-8. Bottom View Showing IFO Tube

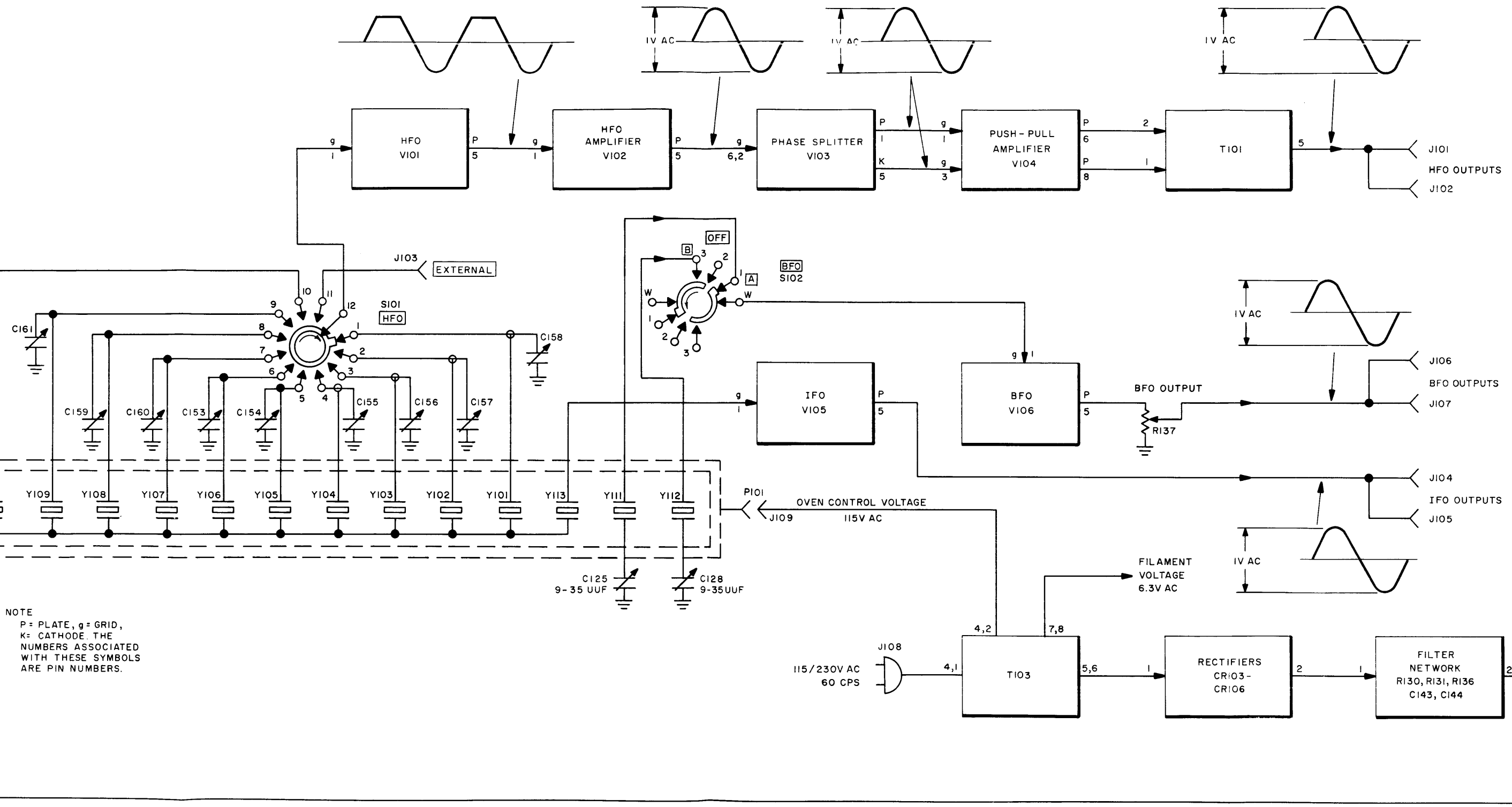
a bad tube or circuit components. Check V105 and its plate load (transformer T102). A bad output can also be caused by a defective excitation capacitor: check C130, C131, and C132. If it is necessary to align this particular circuit, see paragraph 5-3 in section 5 of this manual. Voltage and resistance measurements are found in figure 4-8.

4-6. EQUIPMENT INSPECTION.

The equipment should be inspected regularly both to prevent future troubles and to locate existing troubles. It is also a good idea to examine the equipment upon breakdown; quite possible a visual inspection will show the defective part. Table 4-1 shows an inspection procedure to follow.

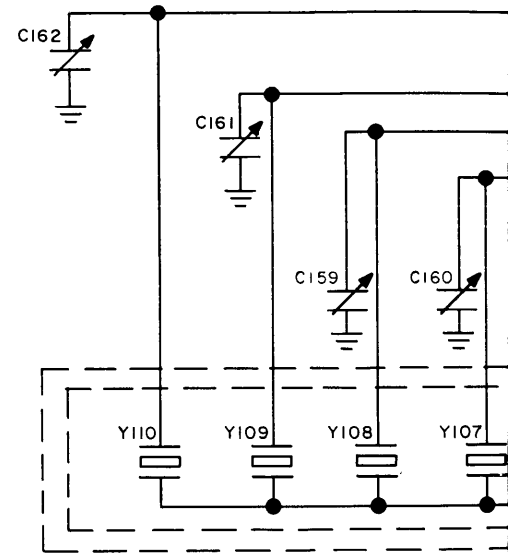
TABLE 4-1. INSPECTION PROCEDURES

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDY
Solder joints	Defective solder joints	Resolder
Resistors	Cracks, chipping, blistering and other signs of overheating	Replace defective resistor
Capacitors	Leaks, bulges, discoloration	Replace defective capacitor
Fuse	Open fuse	Replace
Cabling	Proper connections	Fix as necessary
Wiring	Loose or frayed	Fix as necessary
Indicator lamps	Burned out bulbs	Replace if defective
Crystals	Loose fitting	Secure in socket



NOTE
P = PLATE, g = GRID, K = CATHODE. THE NUMBERS ASSOCIATED WITH THESE SYMBOLS ARE PIN NUMBERS.

Figure 4-9. TRX-1, Service Block Diagram



NOTE
P = PLATE, g = GRID,
K= CATHODE. THE
NUMBERS ASSOCIATED
WITH THESE SYMBOLS
ARE PIN NUMBERS.

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SECTION 5
MAINTENANCE

5-1. INTRODUCTION.

Maintenance may be divided into three categories: operators, preventive and corrective maintenance. The operators maintenance, normally the maintenance carried out by the operator as he works with the equipment, is in Section 3 of this manual. Preventive and corrective maintenance procedures are given in this section.

The TRX-1 has been designed to provide long-term, trouble free operation under continuous duty conditions. It is recommended that any necessary maintenance be done by a competent maintenance technician familiar with troubleshooting techniques. If the trouble cannot be corrected by following the procedures in this section and Section 4, it is recommended that the TRX-1 be returned to TMC for servicing.

5-2. PREVENTIVE MAINTENANCE.

In order to prevent failure of the equipment due to corrosion, tube failure, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to. At periodic intervals (at least every six months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring, or grease. Dust may be removed with a soft brush. Remove dirt or grease from electrical parts with trichlorethylene. Remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichlorethylene, make sure that adequate ventilation exists. Avoid prolonged contact with skin.

5-3. CORRECTIVE MAINTENANCE.

The corrective maintenance procedures are essentially TMC's factory alignment procedures modified for use in the field. See figures 5-1 and 5-2 for location of components.

a. TEST EQUIPMENT NEEDED. - The test equipment needed for these alignment procedures are given in table 5-1, below.

TABLE 5-1. TEST EQUIPMENT

NAME	MODEL
VTVM	Hewlett-Packard 410BR or equivalent
RC Counter	Hewlett-Packard 524C or equivalent
Dummy Load	TMC No. DL-100-51 or equivalent
Crystals	3.5 mc, 4.0 mc, 10.0 mc, 455 kc*

*A Model 82 RF Generator or the equivalent may be used instead of this crystal.

b. ALIGNMENT OF IFO. - If the IFO is misaligned, proceed as follows:

(1) Insert a 3.5 mc crystal into crystal socket XY113.

(2) Connect a dummy load and frequency counter to jack J104.

(3) Connect VTVM to pin 5 of V105 and tune transformer T102 for a maximum indication of meter.

(4) Tune capacitor C129 until counter indicates 3500 kc.

c. ALIGNMENT OF BFO. - If the BFO is misaligned, proceed as follows:

(1) Insert a 455-kc crystal in socket "A" (XY111) and place BFO switch in "A".

NOTE

A 455-kc crystal is used in the BFO for alignment purposes unless otherwise specified by the customer, in which case the BFO test crystal frequency is calculated as follows: frequency A (kc) + frequency B (kc) /2.

(2) Connect a frequency counter to jack J106 and the VTVM to pin 5 of V106.

(3) Tune inductor L114 for a maximum VTVM indication.

(4) Rotate BFO output control R137 to a maximum clockwise position.

(5) Tune capacitor C125 until the counter reads 455 kc.

(6) Remove crystal from socket "A" and place it in socket "B" (XY112).

(7) Tune capacitor C128 until the counter reads 455 kc.

d. ALIGNMENT OF HFO. - If the HFO is misaligned, proceed as follows:

(1) Insert 4.0 mc and 20.0 mc crystals in crystal holders XY101 and XY102.

These crystal holders correspond to HFO switch positions 1 and 2. Place switch in position 1.

(2) Connect a VTVM and dummy load to jack J101.

(3) Adjust trimmer C153 for a maximum VTVM indication.

(4) Adjust balance control R115 for a maximum indication on the VTVM. VTVM should indicate approximately 1 vac.

(5) Place HFO switch in position 2. Adjust capacitor C154 for maximum VTVM indication.

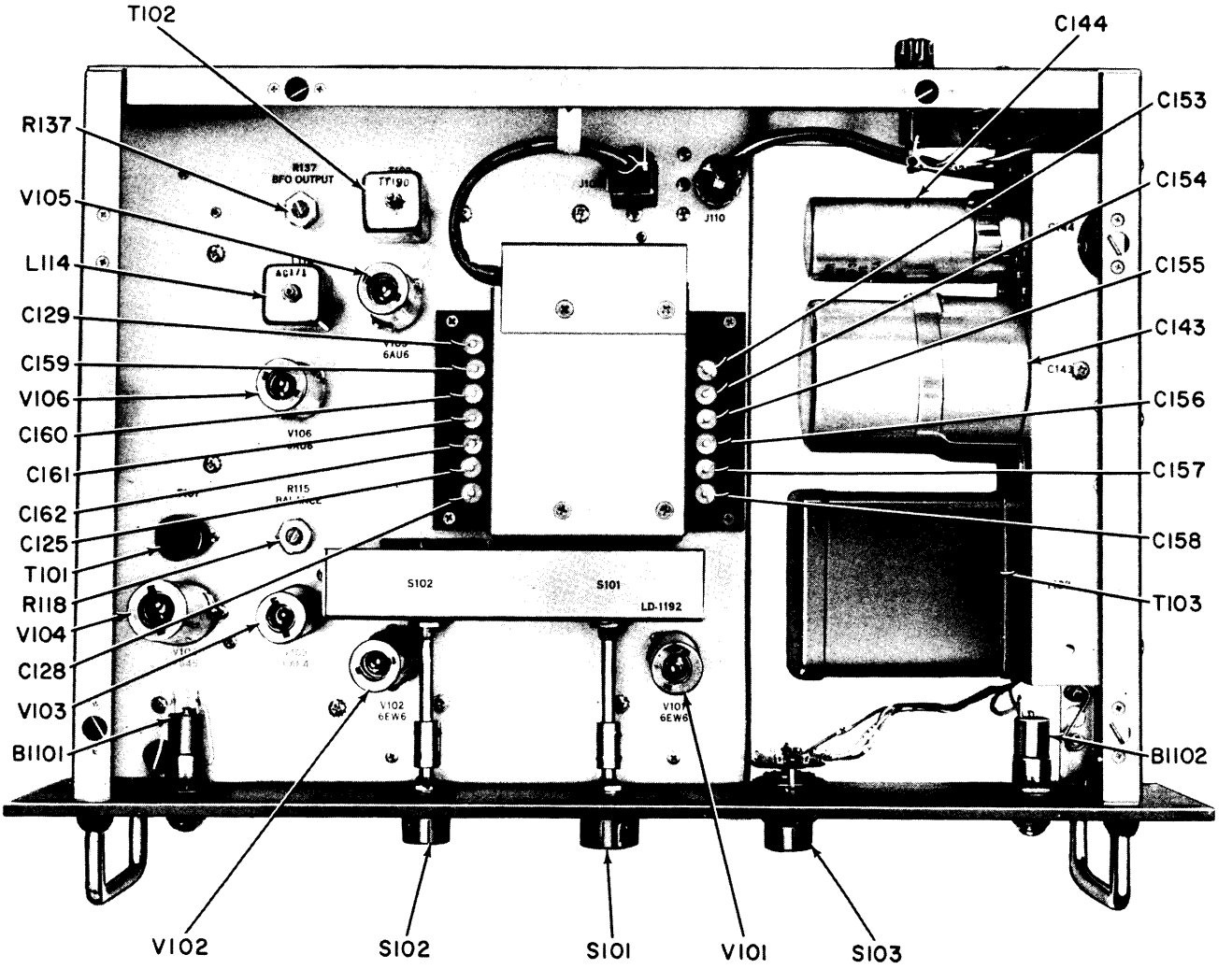


Figure 5-1. Top View of TRX-1

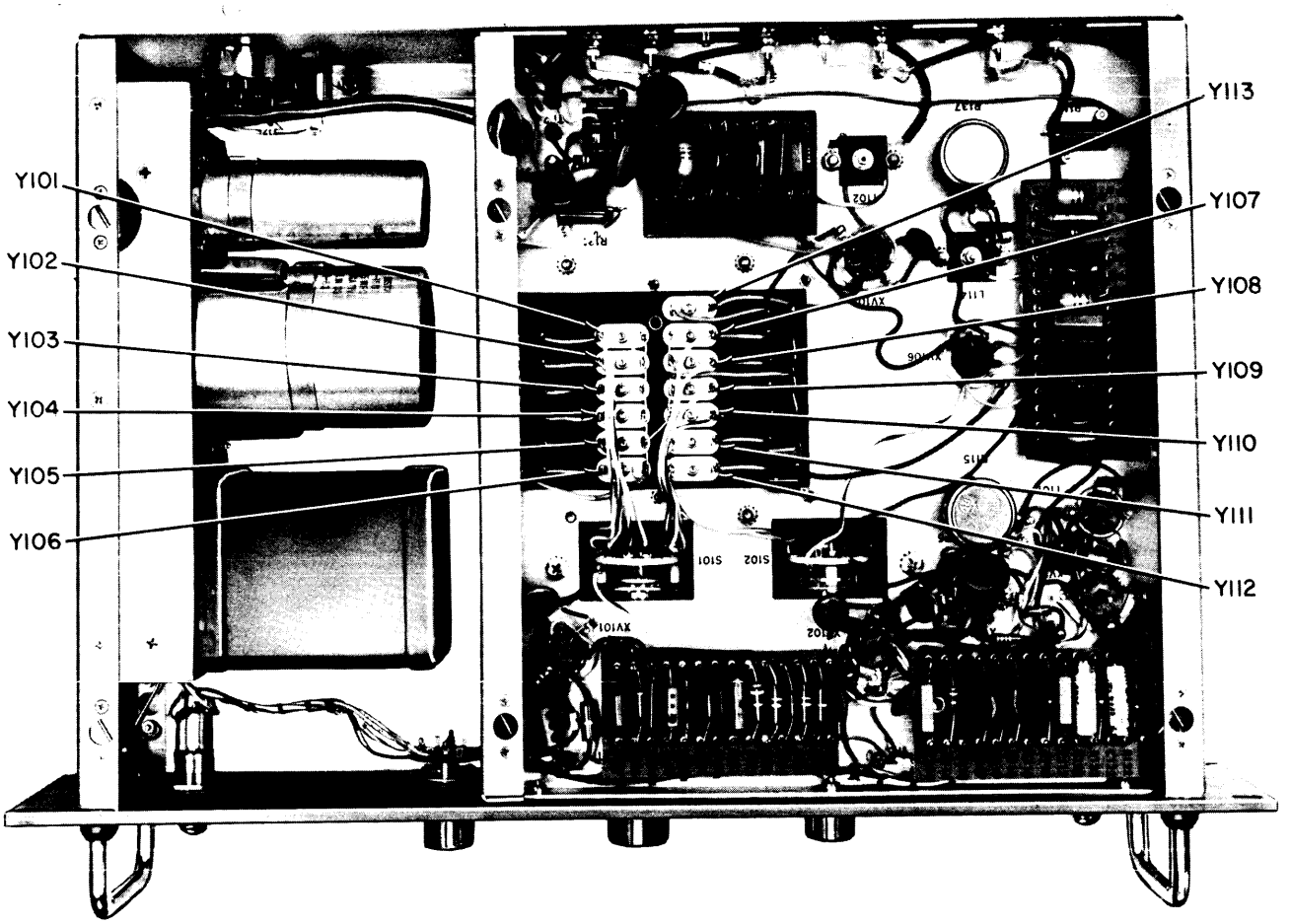


Figure 5-2. Bottom View of TRX-1

SECTION 6
PARTS LIST

6-1. INTRODUCTION.

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Two consecutive series of numbers have been assigned to major units in which there are more than 100 parts of the same generic group. Sockets associated with a particular plug-in device, such as electron tube or fuse, are identified by a reference designation which includes the reference designation of the plug-in device. The parts for each major unit are grouped together. Column 1 lists the reference series of each major unit, followed by the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C1	CAPACITOR, FIXED, CERAMIC: .1 uf, +80-20%; 500 vdcw.	Part of Voltage Regulator	CC-100-32
P101	CONNECTOR, PLUG, ELECTRICAL: 4 flat male contacts, straight type; with cable clamp.		PL-106-1
R1	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%; 1/2 watt.	Part of Voltage Regulator	RC20GF100K
R2	HEATING ELEMENT, ELECTRICAL: 110/220 volts, 20 watts; 2 wire lead type terminals.	Heater	RR-102-1
R3	Same as R2	Heater	
S1	SWITCH, THERMOSTATIC: SPST; normally closed, opening temperature +72° C ±4°; 60 watts at 30 volts ac/dc; 150 watts at 120 volts ac/dc; hermetically sealed brass case with coating of film type; 2 copper wire leads.	Oven Heater	SS-106-1
C101	CAPACITOR, FIXED, PLASTIC DIELECTRIC: .10 uf, ±5%; 400 vdcw.	Decoupling	CN-114R10-4J
C102	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10,000 uuf, GMV; 500 vdcw.	Decoupling	CC-100-16
C103	Same as C102	Decoupling	
C104	CAPACITOR, FIXED, MICA DIELECTRIC: 680 uuf, ±10%; 500 vdcw.	Coupling	CM20C681K
C105	CAPACITOR, FIXED, MICA DIELECTRIC: 1,000 uuf, ±10%; 100 vdcw.	Output	CM-111C102K1S
C106	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20,000 uuf, +80-20%; 500 vdcw.	Screen Decoupling	CC-100-24

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C107	CAPACITOR, FIXED, MICA DIELECTRIC: 24 uuf, ±5%; 500 vdcw.	Oscillator Tank	CM15C240J
C108	CAPACITOR, FIXED, MICA DIELECTRIC: 100 uuf, ±10%; 500 vdcw.	Oscillator Tank	CM20C101K
C109	Same as C102	Screen Decoupling	
C110	Same as C104	Coupling	
C111	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .1 uf, +80-20%; 2000 vdcw.	Plate Voltage Decoupling	CC-100-32
C112	Same as C101	Plate Voltage Decoupling	
C113	Same as C106	Plate Decoupling	
C114	CAPACITOR, FIXED, MICA DIELECTRIC: 470 uuf, ±10%; 500 vdcw.	Coupling	CM20C471K
C115	CAPACITOR, FIXED, CERAMIC DIELECTRIC: . 1 uf, +80-20%; 100 vdcw.	Balance Network	CC-100-28
C116	Same as C115	Balance Network	
C117	Same as C114	Coupling	
C118	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 20, 000 uuf, +60-40%; 150 vdcw.	Grid Bias	CC-100-35
C119	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1, 000 uuf, GMV; 500 vdcw.	Grid Bias	CC-100-29
C120	Same as C102	Screen Decoupling	
C121	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 5000 uuf, GMV; 500 vdcw.	Screen Decoupling	CC-100-15
C122	CAPACITOR, FIXED, ELECTROLYTIC: 125 uf; 15 vdcw; polarized, hermetically sealed aluminum case.	Filter Network	CE-105-125-15
C123	Same as C122	Filter Network	
C124	Not Used		
C125	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 9-35 uuf; 100 vdcw.	Trimmer	CV-112-2
C126	CAPACITOR, FIXED, MICA DIELECTRIC: 39 uuf, ±10%; 500 vdcw.	Padder	CM15C390K
C128	Same as C125	Trimmer	
C129	Same as C125	Trimmer	
C130	CAPACITOR, FIXED, MICA DIELECTRIC: 15 uuf, ±10%; 500 vdcw.	Oscillator	CM15C150K
C131	CAPACITOR, FIXED, MICA DIELECTRIC: 330 uuf, ±10%; 500 vdcw.	Oscillator	CM20C331K

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C132	Same as C106	Oscillator	
C133	Same as C102	Screen Decoupling	
C134	Same as C106	Screen Decoupling	
C135	Same as C102	Plate Decoupling	
C136	CAPACITOR, FIXED, MICA DIELECTRIC: 47 uuf, ±5%; 500 vdcw.	Oscillator	CM15C470J
C137	CAPACITOR, FIXED, MICA DIELECTRIC: 2000 uuf, ±10%; 500 vdcw.	Oscillator	CM20C202K
C138	Same as C101	Oscillator	
C139	Same as C106	Screen Decoupling	
C140	Same as C101	Screen Decoupling	
C141	Same as C106	Plate Decoupling	
C142	Same as C106	Plate Decoupling	
C143	CAPACITOR, FIXED, ELECTROLYTIC: 975 uf, -10+75%; 300 vdcw.	Filter	CE-112-5
C144	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf, -10+75%; 300 vdcw.	Filter	CE-112-4
C145	Same as C102	Filament Bypass	
C146	Same as C102	Filament Bypass	
C147	Same as C102	Filament Bypass	
C148	Same as C102	Filament Bypass	
C149	Same as C111	Bypass	
C150	Same as C111	Bypass	
C151	Same as C111	Bypass	
C152	Same as C111	Bypass	
C153	CAPACITOR, VARIABLE, CERAMIC DIELECTRIC: 5.5-18 uuf; 200 vdcw.	Crystal Trimmer	CV-112-1
C154	Same as C153	Crystal Trimmer	
C155	Same as C153	Crystal Trimmer	
C156	Same as C153	Crystal Trimmer	
C157	Same as C153	Crystal Trimmer	
C158	Same as C153	Crystal Trimmer	
C159	Same as C153	Crystal Trimmer	

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C160	Same as C153	Crystal Trimmer	
C161	Same as C153	Crystal Trimmer	
C162	Same as C153	Crystal Trimmer	
CR101	SEMICONDUCTOR DEVICE, DIODE: germanium; 0.5 volts max forward voltage at 10 ma; 10 ua max, inverse current at 6 volts; 15 volts max, inverse voltage; temperature range -55 to +75° C; average power dissipation 50 mw; wire lead type terminals.	Clipper	DD-102-1
CR102	SEMICONDUCTOR DEVICE, DIODE: germanium; max peak inverse voltage 60 volts; continuous average forward current 50 ma; max peak forward recurrent 150 ma; max surge current 500 ma; max inverse current 500 ua at -50 volts or 30 ua at -10 volts.	Rectifier	1N34A
CR103	SEMICONDUCTOR DEVICE, DIODE: silicon; max peak inverse voltage 400 volts; max rms voltage 280 volts; current rating at 100° C; max dc load 625 ma; max peak recurrent 5 amps; max surge at 4 milli-seconds; 30 amps; polarized.	Rectifier	1N1084A
CR104	Same as CR103	Rectifier	
CR105	Same as CR103	Rectifier	
CR106	Same as CR103	Rectifier	
DS100	LAMP, GLOW: 105/125 volts, 1/25 watt; bayonet base; T-3-1/4 bulb.	Oven Indicator	BI-100-51
DS101	LAMP, INCANDESCENT: 6-8 volts, 0.25 amp; bayonet base; T-3-1/4 bulb.	Power Indicator	BI-101-44
EV101	SHIELD, ELECTRON TUBE: brass or copper, nickel plated; 1-3/4 inch high x 0.930 inch diameter; tension spring, twist lock.	Shield for V101	TS102U02
EV102	Same as EV101	Shield for V102	
EV103	SHIELD, ELECTRON TUBE: brass or copper, nickel plated; 1-3/8 inch high x 0.930 inch diameter; tension spring, twist lock.	Shield for V103	TS102U01
EV104	SHIELD, ELECTRON TUBE: brass or copper, nickel plated; 1-5/16 inch high x 1.079 inch diameter, tension spring, twist lock.	Shield for V104	TS103U02
EV105	Same as EV101	Shield for V105	
EV106	Same as EV101	Shield for V106	
F101	FUSE, CARTRIDGE: 250 volts, lamp; 1-1/4 inch long x 1/4 inch diameter. FOR 115 VOLT OPERATION	Main Line	FU-102-1
F101	FUSE, CARTRIDGE: 250 volts, 1/2 amp; 1-1/4 inch long x 1/4 inch diameter. FOR 230 VOLT OPERATION	Main Line	FU-102-.5

PARTS LIST (CONT)

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
J101	CONNECTOR, RECEPTACLE, ELECTRICAL: RF type; 1 round female contact; straight type;	HFO Output	UG-625B/U
J102	Same as J101	HFO Output	
J103	Same as J101	External HFO	
J104	Same as J101	IFO Output	
J105	Same as J101	IFO Output	
J106	Same as J101	BFO Output	
J107	Same as J101	BFO Output	
J108	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 male 1/2 round contact; polarized, twist lock type; rated at 250 volts 10 amps; 125 volts 15 amps.	Power	JJ-175
J109	CONNECTOR, RECEPTACLE, ELECTRICAL: 4 female contacts; flat straight type.	Oven Connect	JJ-120-2
J110	CONNECTOR, RECEPTACLE, ELECTRICAL: 9 round male #20 contacts; polarized; straight type; 2000 volts rms, rated at 7.5 amps.	Power	JJ-193-9P
L101	COIL, RADIO FREQUENCY: fixed; 1.2 uh, ±20%; 0.14 ohms dc resistance; molded case.	Haromic Generator	CL-240-1.2
L102	COIL, RADIO FREQUENCY: fixed; 120.0 uh, ±10%; 3.2 ohms dc resistance; molded case.	Part of Oscillator Tank	CL-240-120
L103	COIL, RADIO FREQUENCY: fixed; .560 mh, ±10%; 100 ma; molded case.	RF Choke	CL-140-5
L104A, B, C	CORE, TOROID: head type; powdered iron;	Bypass	CI-120-1
L105A, B, C	Same as L101 A, B, C	Filament Choke	
L106	COIL, RADIO FREQUENCY: fixed; 47.0 uh, ±10%; 2.3 ohms dc resistance; molded case.	Part of Oscillator Circuit	CL-240-47
L107	COIL, RADIO FREQUENCY: fixed; 2.5 mh ±10%; 26 ohms dc resistance; molded case.	RF Filter	CL-140-1
L108	Same as L107	Part of Oscillator	
L109	Same as L107	RF Choke	
L110A, B, C	Same as L104 A, B, C	Filament Choke	
L111A, B, C	Same as L104 A, B, C	Filament Choke	
L112	COIL, RADIO FREQUENCY: tuned; 1.1 uh inductance, ±20%; dc resistance approximately zero.	Parasitic Suppressor	CL-303

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
L113	Same as L112	Parasitic Suppressor	
L114	COIL, RADIO FREQUENCY: tuned; 1.1 uh inductance, 2.7 ohms dc resistance; 15 ma current rating; aluminum case.	BFO Tuned Circuit	AC-171
L115	COIL, RADIO FREQUENCY: fixed; 8.2 uh, ±10%; 2.1 ohms dc resistance; molded case.	Power Line Filter	CL-240-8.2
L116	Same as L115	Power Line Filter	
L117A, B, C	Same as L104 A, B, C	Filament Choke	
L118A, B, C	Same as L104 A, B, C	Filament Choke	
P101	See A0-111 LIST		
P102	CONNECTOR, PLUG, ELECTRICAL: miniature type; 9 female contacts, straight type; with cable clamp.	Part of W102	PL-189-9S
R101	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±5%; 1/2 watt.	Plate Load	RC20GH101J
R102	RESISTOR, FIXED, COMPOSITION: 15,000 ohms, ±10%; 1 watt.	Screen Dropping	RC32GF153K
R103	RESISTOR, FIXED, COMPOSITION: 560 ohms, ±10%; 1 watt.	Load	RC32GF561K
R104	Same as R102	Screen Dropping	
R105	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±5%; 1/2 watt.	Grid Bias	RC20GF473J
R106	RESISTOR, FIXED, COMPOSITION: 56 ohms, ±10%; 1 watt.	Cathode	RC32GF560K
R107	RESISTOR, FIXED, COMPOSITION: 1 megohm, ±10%; 1/2 watt.	Grid Coupling	RC20GF104K
R108	RESISTOR, FIXED, COMPOSITION: 68 ohms, ±10%; 1/2 watt.	Cathode	RC20GF680K
R109	RESISTOR, FIXED, COMPOSITION: 33,000 ohms, ±10%; 1/2 watt.	Grid Coupling	RC20GF333K
R110	RESISTOR, FIXED, COMPOSITION: 220 ohms, ±10%; 1/2 watt.	Grid Coupling	RC20GF221K
R111	RESISTOR, FIXED, WIREWOUND: 3480 ohms, ±1%; 10 watts.	Load	RE65G3481
R112	Same as R102	Load	

PARTS LIST (CONT)

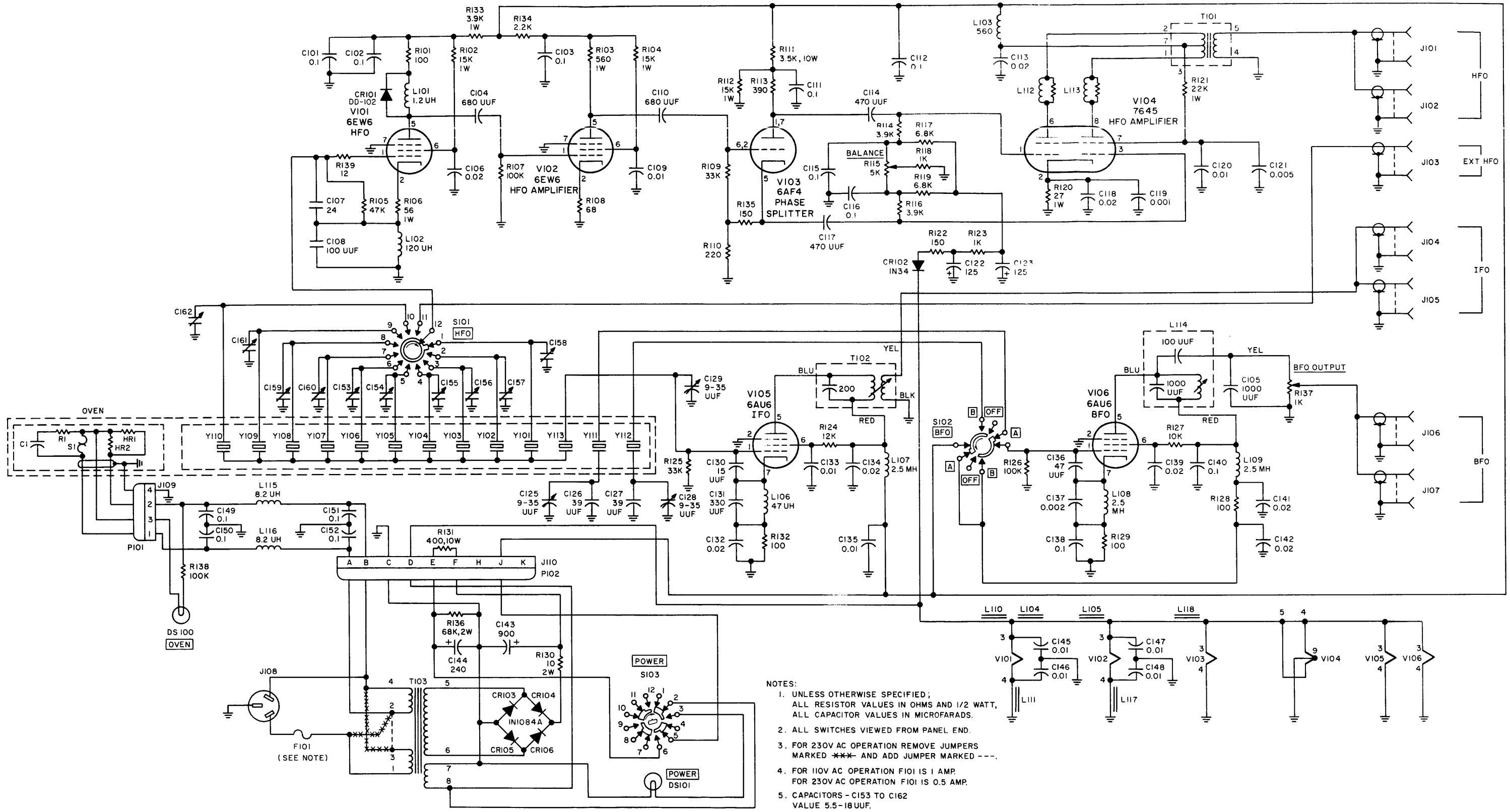
REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R113	RESISTOR, FIXED, COMPOSITION: 390 ohms, ±10%; 1/2 watt.	Load	RC20GF391K
R114	RESISTOR, FIXED, COMPOSITION: 3900 ohms, ±10%; 1/2 watt.	Balance Network	RC20GF392K
R115	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms, ±10%; 2 watts.	Balance Network	RV4ATXA502A
R116	Same as R114	Balance Network	
R117	RESISTOR, FIXED, COMPOSITION: 6800 ohms, ±10%; 1/2 watt.	Balance Network	RC20GF682K
R118	RESISTOR, FIXED, COMPOSITION: 1000 ohms, ±10%; 1/2 watt.	Balance Network	RC20GF102K
R119	Same as R117	Balance Network	
R120	RESISTOR, FIXED, COMPOSITION: 27 ohms, ±10%; 1 watt.	Grid Bias	RC32GF270K
R121	RESISTOR, FIXED, COMPOSITION: 22,000 ohms, ±10%; 1 watt.	Screen Voltage	RC32GF223K
R122	RESISTOR, FIXED, COMPOSITION: 150 ohms, ±10%; 1/2 watt.	Filter	RC20GF151K
R123	Same as R118	Filter	
R124	RESISTOR, FIXED, COMPOSITION: 12,000 ohms, ±10%; 1/2 watt.	Screen Dropping	RC20GF123K
R125	Same as R109	Grid Coupling	
R126	Same as R107	Grid Coupling	
R127	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt.	Screen Voltage Dropping	RC20GF103K
R128	RESISTOR, FIXED, COMPOSITION: 100 ohms, ±10%; 1/2 watt.		RC20GF101K
R129	Same as R128	Part of Oscillator Circuit	
R130	RESISTOR, FIXED, COMPOSITION: 10 ohms, ±10%; 2 watts.	B+ Filter	RC42GF100K
R131	RESISTOR, FIXED, WIREWOUND: 402 ohms, ±1%; 10 watts.	B+ Filter	RE65G4020
R132	Same as R101	Part of Oscillator Circuit	
R133	RESISTOR, FIXED, COMPOSITION: 3900 ohms, ±10%; 1 watt.	Load	RC32GF392K
R134	RESISTOR, FIXED, COMPOSITION: 2200 ohms, ±5%; 1/2 watt.	Load	RC20GF222J

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R135	Same as R122	Grid Coupling	
R136	RESISTOR, FIXED, COMPOSITION: 68,000 ohms, ±10%; 2 watts.	B+ Filter	RC42GF683K
R137	RESISTOR, VARIABLE, COMPOSITION: 1000 ohms, ±10%; 2 watts.	BFO Output Control	RV4ATXA102A
R138	Same as R107	Part of Oven Lamp Circuit	
R139	RESISTOR, FIXED, COMPOSITION: 12 ohms, ±10%; 1/2 watt.	Grid Bias	RC20GF120K
S101	SWITCH, ROTARY: 1 section, 3 position; non-shorting contacts; contact rating lamp 28 volts dc, or 5 amp 110 volts ac.	HFO Crystal Selector	SW-314
S102	SWITCH, ROTARY: 1 section, 12 position; non-shorting contacts; contact rating 1 amp 28 volts dc, or 5 amp 110 volts ac.	BFO Crystal Selector	SW-315
S103	SWITCH, ROTARY: 1 section, 2 position; non-shorting contacts; contact rating lamp 28 volts dc, or 5 amp 110 volts ac.	Power ON, OFF	SW-119
T101	TRANSFORMER, RADIO FREQEUNCY: operating frequency range 2-40 mc, tuned; input impedance 1650 ohms center tapped, output impedance 50 ohms balanced; epoxy resin hermetically sealed case; plug-in type.	HFO Output Tank Circuit	TR-178
T102	TRANSFORMER, RADIO FREQUENCY: operating frequency 3.5 mc, tuned; nominal inductance 5.7 uh; aluminum case.	3.5 MC Tank Circuit	TT-190
T103	TRANSFORMER, STEP DOWN AND STEP UP: primary, 115/230 volts 50/60 cps; secondary, (a) 175 volts RMS at 100 ma dc; (b) 6.3 volts ac at 2.5 amps; 1500 volt insulation to all windings, steel case.	Power	TF-238
V101	ELECTRON TUBE: sharp-cutoff pentode; 7 pin miniature.	HFO	6EW6
V102	Same as V101	HFO Amplifier	
V103	ELECTRON TUBE: medium-mu triode; 7 pin miniature.	Phase Splitter	6AF4
V104	ELECTRON TUBE: twin tetrode; 9 pin miniature.	HFO Amplifier	7645
V105	ELECTRON TUBE: sharp-cutoff pentode; 7 pin miniature.	IFO	6AU6
V106	Same as V105	BFO	
W101	WIRING HARNESS, BRANCHED: consists of, various lengths and colors of MIL type MWC insulated wire and one length of RF cable RG-174/U.	Main Power	CA-717

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
W102	WIRING HARNESS, BRANCHED: consists of, various lenghts and colors of MIL type MWC insulated wire and one connector symbol P102.	Power Supply	CA-719
XCR101	Not Used		
XCR102	Not Used		
XCR103 4, 5, 6	HOLDER, RECTIFIER: polarized; 1-3/8 inches x 2-1/4 inches; mounting facilities for 4 rectifiers.	Holder for CR103, 4, 5, 6	CU-138
XDS100	LIGHT, INDICATOR: miniature bayonet base; with white clear lens.	Socket for DS100	TS-106-2
XDS101	LIGHT, INDICATOR: miniature bayonet base; with red frosted lens.	Socket for DS101	TS-106-1
XF101	FUSEHOLDER: extractor post type; accommodates cartridge; overall length 1-3/4 inch; bushing mounted.	Holder for F101	FH-103
XT101	SOCKET, ELECTRON TUBE: 7 pin miniature.	Socket for T101	TS-130MPW
XV101	SOCKET, ELECTRON TUBE: 7 pin miniature, with shield mounting facilities.	Socket for V101	TS102P01
XV102	Same as XV101	Socket for V102	
XV103	Same as XV101	Socket for V103	
XV104	SOCKET, ELECTRON TUBE: 9 pin miniature.	Socket for V104	TS103P01
XV105	Same as XV101	Socket for V105	
XV106	Same as XV101	Socket for V106	
XY101	SOCKET, CRYSTAL: 2 contacts; 0.050 inch dia., spaced 0.486 C to C.	Socket for Y101	TS-104-1
XY102	Same as XY101	Socket for Y102	
XY103	Same as XY101	Socket for Y103	
XY104	Same as XY101	Socket for Y104	
XY105	Same as XY101	Socket for Y105	
XY106	Same as XY101	Socket for Y106	
XY107	Same as XY101	Socket for Y107	
XY108	Same as XY101	Socket for Y108	
XY109	Same as XY101	Socket for Y109	
XY110	Same as XY101	Socket for Y110	
XY111	Same as XY101	Socket for Y111	
XY112	Same as XY101	Socket for Y112	

REF SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XY113	Same as XY101	Socket for Y113	
Y101	CRYSTAL UNIT, QUARTZ: as per customer requirements.	HFO	CR27/U
Y102	Same as Y101	HFO	
Y103	Same as Y101	HFO	
Y104	Same as Y101	HFO	
Y105	Same as Y101	HFO	
Y106	Same as Y101	HFO	
Y107	Same as Y101	HFO	
Y108	Same as Y101	HFO	
Y109	Same as Y101	HFO	
Y110	Same as Y101	HFO	
Y111	CRYSTAL UNIT, QUARTZ: .458 mc; ±.002%, 70 to 80° C operating temperature range; parallel resonance; 20.0 uuh ±0.5 uuh load capacitance; fundamental operation; type HC-6/u holder.	BFO	CR47A/U-.458P
Y112	CRYSTAL UNIT, QUARTZ: .452 mc, ±.002%, 70 to 80° C operating temperature range; parallel resonance; 20.0 uuf ±0.5 uuf load capacitance; fundamental operation; type HC-6/u holder.	BFO	CR47A/U-.452P
Y113	CRYSTAL UNIT, QUARTZ: 3.500 mc; ±.002%, 70 to 80° C operating temperature range; parallel resonance; 32.0 uuh, ±0.5 uuf load capacitance; fundamental operation; type HC-6/u holder.	IFO	CR27/U-3.500P
Z010	OVEN, OSCILLATOR: 115 volts ac, 20 watts; 70°C after 30 minutes, ±5°C tolerance after 30 minutes, outer case, aluminum; oven, cast aluminum, overall dimensions 5 inches long, 2 inches high, 3-3/16 inches wide. SEE SEPERATE LIST FOR BREAKDOWN	Crystal Oven	A0-111

SECTION 7
SCHEMATIC DIAGRAMS



NOTES:

1. UNLESS OTHERWISE SPECIFIED; ALL RESISTOR VALUES IN OHMS AND 1/2 WATT, ALL CAPACITOR VALUES IN MICROFARADS.
2. ALL SWITCHES VIEWED FROM PANEL END.
3. FOR 230V AC OPERATION REMOVE JUMPERS MARKED ~~XXX~~ AND ADD JUMPER MARKED ---.
4. FOR 110V AC OPERATION F101 IS 1 AMP. FOR 230V AC OPERATION F101 IS 0.5 AMP.
5. CAPACITORS - C153 TO C162 VALUE 5.5-18 UUF.

Figure 7-1. Stabilized Crystal Oscillator TRX-1, Detailed Schematic Diagram