UNCLASSIFIED

TECHNICAL MANUAL

for

GENERAL PURPOSE EXCITER MODEL GPE-1A

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, ONTARIO

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IN-2023 **Issue Date: 1 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

INSTRUCTION BOOK CHANGE NOTICE

Date January 8, 1964

Manual affected: General Purpose Exciter Model GPE-1A IN -2023

1. Page 4-4, Figure 4-2. Page 8-3/8-4, Figure 8-1

   Change value of resistor R1 (located in EXT VFO INPUT jack circuit) from 68 ohms to 50 ohms.

2. Page 7-7

   Change reference symbol R1 to read as follows:

R1	RESISTOR, fixed: wirewound, non-inductive, 50 ohm ± 10%, 5 watt	VFO input ground return	RR-114-50

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

THE TECHNICAL MATERIEL CORP., 700 Fenim re R ad, Mamar neck, New Y rk

Attn.: Director of Eng. Services.

CHANGE NO. 2 GPE-1A

INSTRUCTION BOOK CHANGE NOTICE

Date 6/5/64

Manual affected: General Purpose Exciter Model GPE-1A IN -2023

Page 4-1-4-2 Figure 4-1.

Change function of switch S3 EMISSION from "3" to "11."

Page 8-3-8-4 Figure 8-1.

Change reference symbol for the RF bypass capacitor in the plate circuit of V2 from "C7" to "C17."

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.

CHAN E NO. 3 GPE-1A

INSTRUCTION BOOK CHANGE NOTICE

Date November 12, 1965

Manual affected: General Purpose Exciter, Model GPE-1A IN -2023
(Issue Date: 1 October 1963)

1. Page 2-2. Figure 2-1.

Terminal "B" and "C" of jack J1 should be changed as indicated in figure 1.

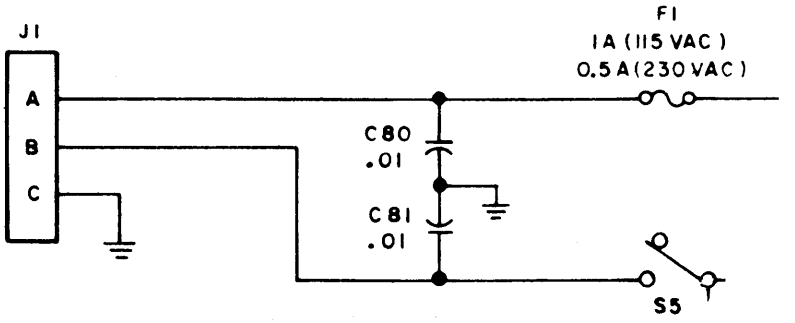
2. Page 4-1/4-2. Figure 4-1.

The power-input portion of figure 4-1 should be changed as indicated in figure 2.

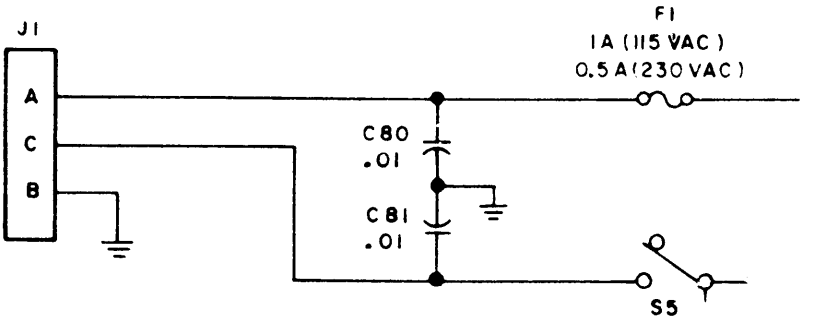
3. Figure 4-10 (page 4-14). Figure 8-1 (page 8-3/8-4).

Change figures 4-10 and 8-1 as indicated in figure 3.

SHOULD ADDITIONAL COPIES OF THIS CHANGE NOTICE BE REQUIRED, PLEASE CONTACT:
THE TECHNICAL MATERIEL CORP., 700 Fenimore Road, Mamaroneck, New Y rk
Attn.: Director of Eng. Services.



BEFORE



NOW

Figure 1.

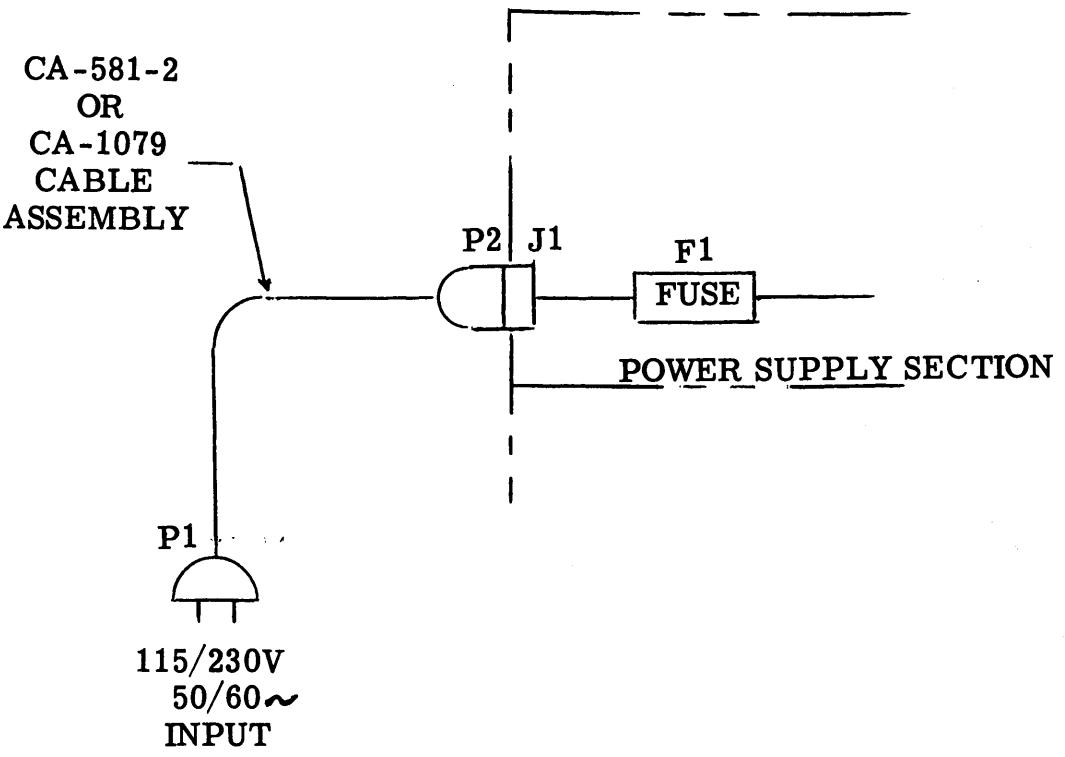
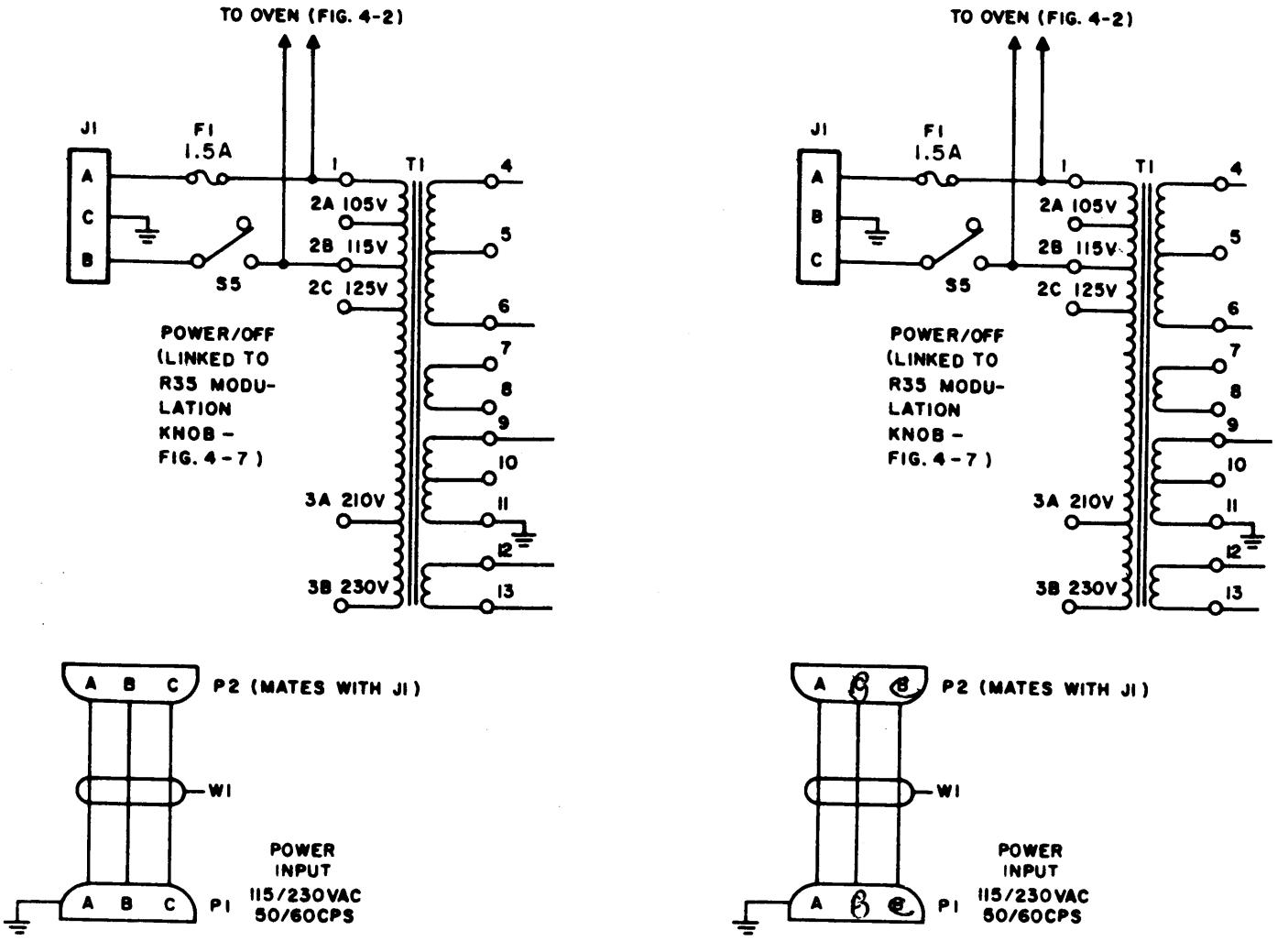

CA-581-2
OR
CA-1079
CABLE
ASSEMBLY
P2
J1
F1
FUSE
POWER SUPPLY SECTION
P1
115/230V
50/60~
INPUT

Figure 2.



Before

Now

Figure 3

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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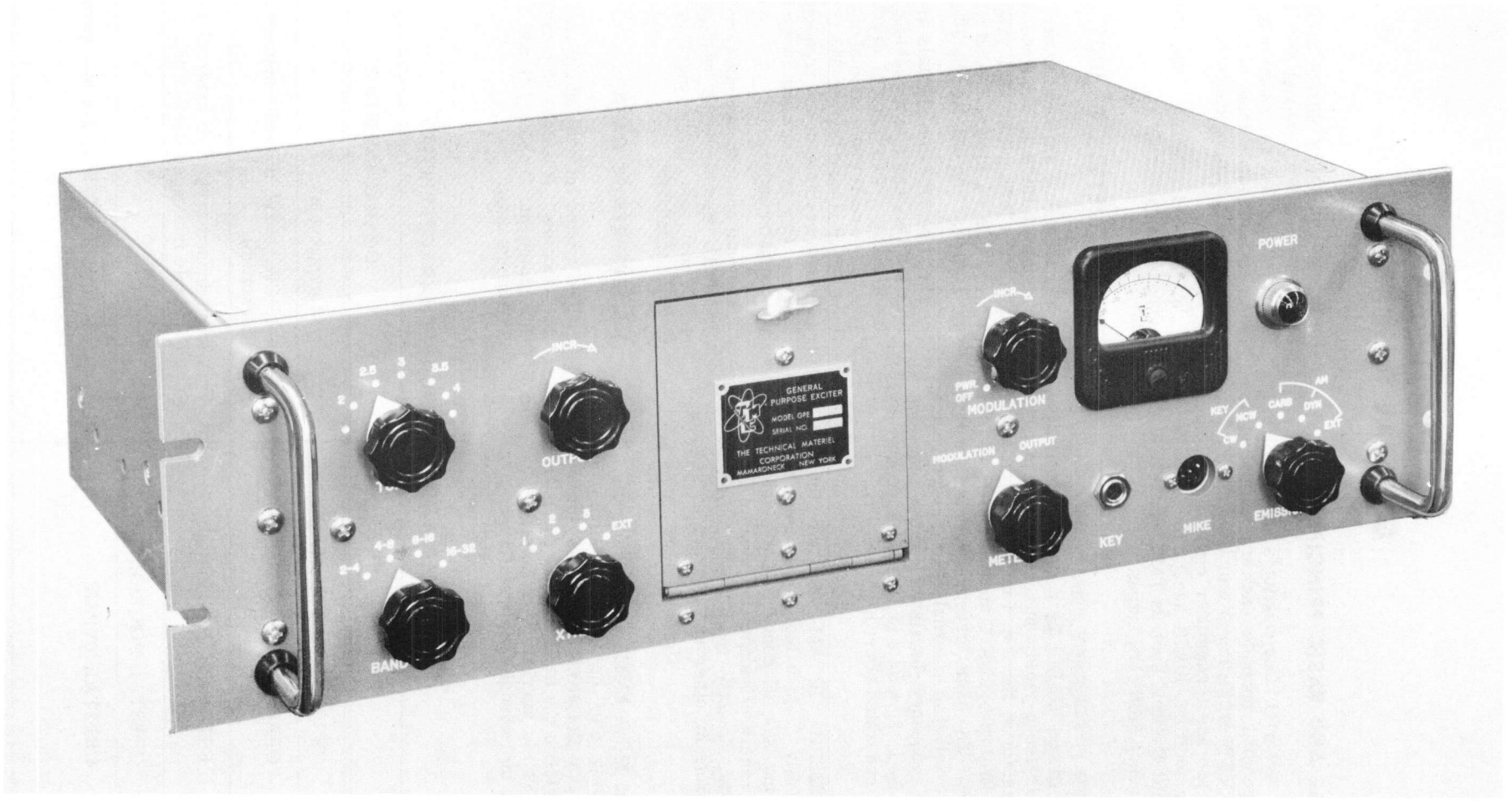


Figure 1-1-a. Front Angle View, General Purpose Exciter, GPE-1.

SECTION 1
GENERAL DESCRIPTION

1-1. PURPOSE AND BASIC PRINCIPLES.

Technical Materiel Corporation's Model GPE-1 Exciter is a general purpose exciter which provides AM, CW and MCW excitation in four bands in the 2 to 32 mc range for any transmitter containing a linear amplifier. In addition, it will accept the output of a Frequency Shift Exciter, such as TMC Model XFK, to provide Frequency Shift (FS) output.

a. CARRIER FREQUENCY. The carrier frequency is generated in the GPE-1 by a crystal controlled oscillator with front panel control selection of 3 replaceable crystals in the 2 to 4 mc range. A bandswitching control provides 4 multiplication factors (1, 2, 4 and 8). The same crystal selector control may be used to select an external 2-4 mc source, such as a variable frequency oscillator, which may then be multiplied by 1, 2, 4 or 8 in the same manner as the internally generated source.

b. AM EMISSION. In AM emission the GPE-1 operates directly from a high impedance or carbon microphone and has all connection provisions for a push-to-talk receiver/transmitter system. In addition it operates directly from a 600 ohm tape recorder, telephone or other 600 ohm audio frequency source.

c. CW and MCW EMISSION. In CW and MCW emission, keying may be controlled from the front panel key jack or a connection provision for an external keying device at the back of the unit. In the MCW mode, the 2-32 mc carrier is modulated 90% with 1000 cps from an internal audio oscillator.

d. FREQUENCY SHIFT EMISSION. A Frequency Shift Exciter (TMC Model XFK or equivalent) with an output in the 2-4 mc range may be attached to external carrier source input of GPE-1 in order to utilize GPE's bandswitching controls and amplifier stages.

e. POWER SUPPLY. The GPE-1 contains its own power supply circuitry.

1-2. DESCRIPTION OF UNIT.

The GPE-1 is shown in figure 1-1. The front panel is 3/16-inch thick by 19 inches long and 5-1/4 inches high and is finished in TMC gray enamel. The chassis extends 14 inches behind the panel and is self-supporting. The unit weighs 30 pounds.

The 3 replaceable crystals are oven controlled for high stability and are accessible through a door in the front panel. Two types of crystal sockets are provided for greater selection of crystal holders. Either type CR-27/U or type FT-243 crystal holder may be used with crystals of any frequency within the 2-4 mc range. Crystals are not furnished with unit unless specified on order.

The equipment is manufactured in accordance with JAN/MIL specifications whenever practicable. All parts and assemblies meet or exceed the highest quality standards.

1-3. REFERENCE DATA.

The crated dimensions of GPE-1 are 20-1/2 by 24 by 10 inches. It weighs 65 pounds gross when packed for shipment. Tables 1-1 and 1-2 contain additional reference data.

TABLE 1-1. ELECTRICAL CHARACTERISTICS

ITEM	CHARACTERISTICS
FREQUENCY RANGE:	2-32 megacycles.
OPERATING MODES:	AM, CW, MCW, FS (with appropriate FS exciter).
FREQUENCY CONTROL:	Oven housed crystal or external VFO (Variable frequency oscillator).
CRYSTAL POSITIONS:	Three.
CRYSTAL TYPES:	CR-27/U or FT-243, 2-4 mc, parallel resonance.

TABLE 1-1. ELECTRICAL CHARACTERISTICS (Cont.)

ITEM	CHARACTERISTICS
CRYSTAL FORMULA:	$Fx = \frac{Fo}{N}$ Fx = Crystal Frequency Fo = Output Frequency N = Multiplication factor which is as follows: Fo — N 2-4 mc — 1 4-8 mc — 2 8-16 mc — 4 16-32 mc — 8
OUTPUT POWER:	Adjustable up to 200 mw.
OUTPUT IMPEDANCE:	70-ohms.
AUDIO INPUT:	1. 600-ohm balanced line, -20 db for 100% modulation. 2. High impedance mike, -50 db for 100% modulation. 3. Carbon mike.
AUDIO RESPONSE:	350 - 3300 cps, flat within 3 db.
STABILITY:	1 part in 10^6 per day.
TEMPERATURE AND HUMIDITY:	Designed to operate in any ambient temperature between the limits of 0 and 50° C and any value of humidity up to 90%.
INPUT CONNECTIONS:	BNC for VFO or FS input. Terminal board for 600-ohm audio input. Terminal board for receiver input. Terminal board for push-to-talk input. High impedance/carbon mike jack. CW keying jack. Terminal board for external keying device connection.
OUTPUT CONNECTION:	BNC for RF output.
PRIMARY POWER REQUIREMENTS:	115/230 volts, 50-60 cps, single phase. Approx. 100 watts - oven off; Approx. 140 watts - oven on.
ASSOCIATED EQUIPMENT:	TMC Part No. HS-100-2C Carbon Handset with cable. TMC Part No. HS-100-2D Dynamic Handset with cable.

TABLE 1-2. VACUUM TUBE COMPLEMENT

SYMBOL	TYPE	FUNCTION
V1	6AW8-A	OSCILLATOR/AMPLIFIER & BUFFER
V2	6EW6	HARMONIC GENERATOR
V3	6EW6	R F AMPLIFIER
V4	6CL6	OUTPUT AMPLIFIER
V5	6AW8-A	AUDIO AMPLIFIER/OSCILLATOR
V6	6BQ5	MODULATOR
V7	OA2	VOLTAGE REGULATOR

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION

Each GPE-1 has been calibrated and tested at the factory before shipment. Upon arrival at the operating site, inspect the packing case and its contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts which may have been shipped as "loose items". 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.

The 2-4 mc crystals, mounted in the oven compartment, are not furnished unless specifically requested.

With the exception of the crystals in the front panel, the GPE-1 is shipped with all tubes and other plug-in components installed. Check that all such components are properly seated in their sockets.

2-2. 115-VS.230-VOLT POWER SUPPLY CONNECTIONS.

The GPE-1 power supply circuit is designed for 115- or 230-volt, 50- or 60-cps single phase power; it is factory wired for 115 volts. If 230-volt operation is required, minor wiring changes may be made at T1 power transformer and E3 terminal board as shown in figure 2-1. F1 1.5-amp fuse cartridge should be replaced by a .75-amp fuse cartridge of similar type, for 230 volt operation.

2-3. CRYSTAL SELECTION.

If a VFO (Variable Frequency Oscillator) is not used, it is necessary to select and install the proper quartz crystal/s for the desired output carrier frequency/frequencies. Sockets for 3 plug-in type crystals are provided in an oven compartment accessible through a door in the control panel. It is preferable to use the hermetically sealed CR-27/U crystal per military specification MIL-C-3098 for longer life and reliability, however, type FT-243 will also serve the purpose. Sockets for both types are provided in the compartment. The parallel resonant frequency of each crystal must be in the 2-4 mc range. To select the proper frequency, the following formula may be used:

$$Fx = \frac{Fo}{N}$$

where Fx = crystal frequency

Fo = output carrier frequency

N = multiplication factor, which is as follows:

Fo	N
2-4 Mc	1
4-8 Mc	2
8-16 Mc	4
16-32 Mc	8

EXAMPLE: If a carrier frequency of 12 Mc is desired, a crystal of 3 Mc resonant frequency is required.

In this way crystals may be installed in the GPE-1, permitting a selection of three different carrier frequencies plus multiples of each frequency while transmitting. To obtain the largest selection of output frequencies, it will be seen that selecting crystals which are exact doubles of one another should be avoided. Crystal frequencies should then be noted for future reference for operating phase of GPE-1.

2-4. INITIAL ADJUSTMENTS.

The GPE-1 has been factory tested and adjusted. No initial adjustments of chassis mounted variable components are necessary before operation, with the possible exception of the following. Trimmers C2, C3 and C4 are factory adjusted against standard crystals of 2-mc, 3-mc and 4-mc respectively for the following frequency tolerances in the output of V1A oscillator.

Xtal Position	Trimmer	Std Xtal Freq.	Tol.
1	C2	2 mc	±10 cps
2	C3	3 mc	±15 cps
3	C4	4 mc	±20 cps

If crystals with different resonant frequency are used or a smaller carrier frequency tolerance is necessary for a particular mode of transmission, the trimmer associated with each crystal should be adjusted upon installing that crystal. Allow at least two hours warm-up time for crystal oven before measuring frequency output.

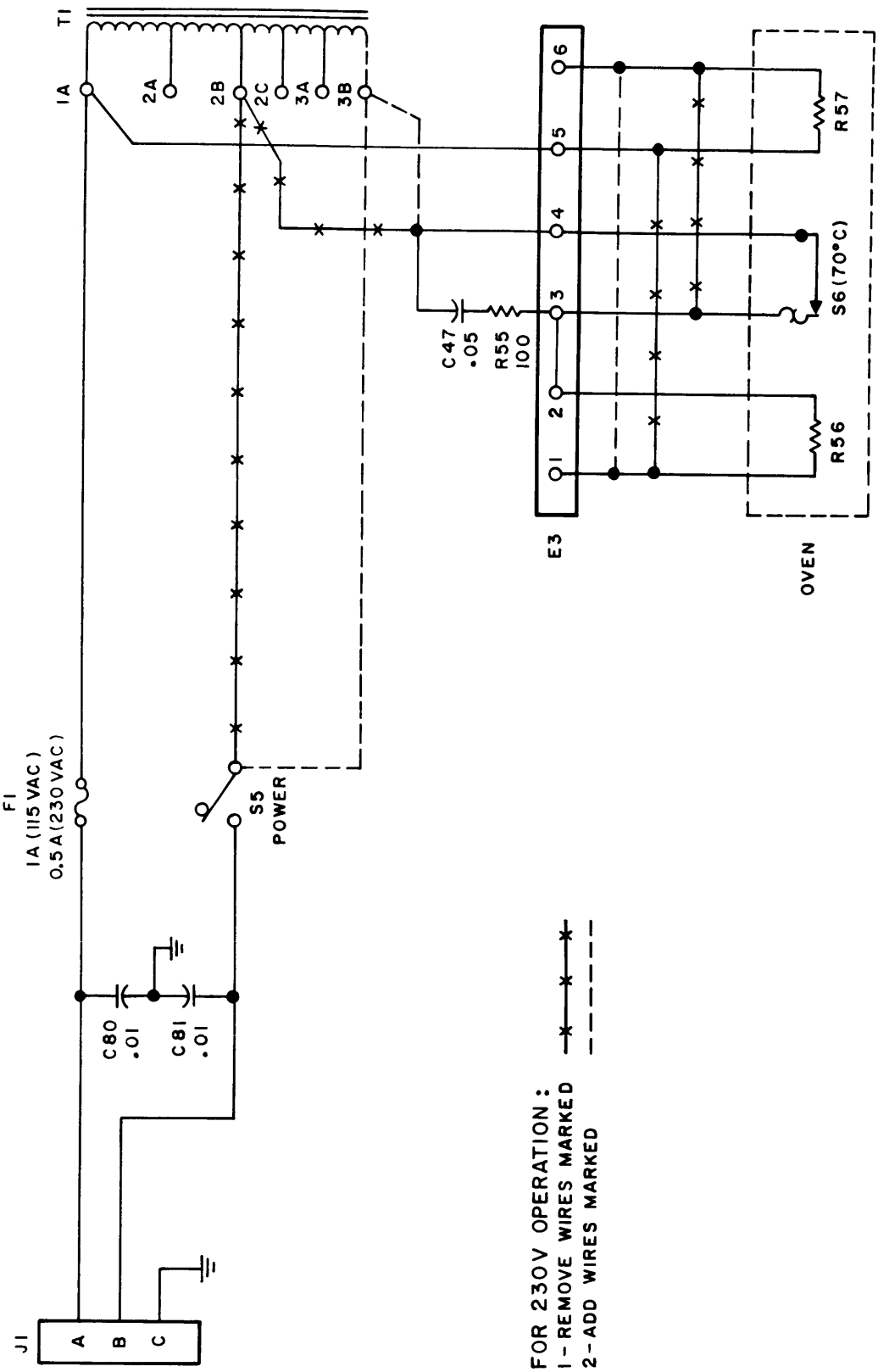


Figure 2-1. Wiring Modification for 230V Line, GPE-1.

2-5. INSTALLATION PROCEDURES.

a. GENERAL. The GPE-1 may be installed in any standard relay rack. For outline dimensions, see Figure 2-2. The procedures outlined in paragraphs b, c, d and e are wiring procedures for the different modes of operation intended for the unit. Any or all wiring arrangements may be made, as required.

b. CW AND/OR MCW (KEY MODES). A key jack is provided on the front panel. However, if it is desirable to connect an external keying device permanently to the GPE, connections may be made at E1 terminal block as shown in Figure 2-5. An internal AF oscillator within the unit supplies the modulating frequency for MCW mode.

c. CARBON MIKE OR HIGH IMPEDANCE MIKE (AM MODE). Either a carbon mike or a high impedance mike may be connected to the equipment at J5 receptacle in the front panel as shown in Figures 2-3 and 2-4. Two mating plugs (TMC #PL-208) are provided, one for a carbon mike cable and the other for a high impedance mike cable. Or, if preferred, a carbon mike may be connected at terminals 9 and 10 of E1 terminal block as shown in figure 2-3.

If a push-to-talk receiver/transmitter system is to be used, the associated receiver output is connected to terminals 11 and 12 of terminal block E1. The linear amplifier driven by the GPE unit is then connected at terminals 6 and 7 in such a way as to interrupt the linear amplifier output. The current from the linear amplifier at this connection should be limited to 5 amperes in order to protect K1 relay contacts. If the mike comes with built-in push-to-talk provisions, pins 2, 3 and 6 of TMC #PL-208 plug may be wired as shown in the figure. Or, if no such provisions exist in the mike, a push-to-talk button may be connected at terminals 8 and 9 of E1 as shown.

TMC #HS-100-2C Carbon Handset and #HS-100-2D Dynamic Handset are designed for use with the GPE Exciter and are available on order. These handsets include TMC #PL-208 plug for J5 MIKE jack, cable and wiring as shown in figures 2-3 and 2-4, respectively.

d. EXTERNAL AUDIO INPUT (AM). A 600-ohm tape recorder, telephone or other 600-ohm audio source may be connected as shown in figures 2-6 or 2-7 for balanced or unbalanced-to-ground conditions respectively. In this case, a switch should be attached to terminals 8 and 9 of E1 to enable and disable GPE-1 and linear amplifier.

e. FS OR ALL MODES WITH EXTERNAL OSCILLATOR. Either a Frequency Shift Exciter (such as TMC Model XFK) or a Variable Frequency Oscillator (such as TMC Models PMO, VOX or CPO) can be connected at J3 receptacle (see figure 4-1). TMC #UG-260/U mating plug is provided for this purpose. Use RG-59/U coaxial cable.

(1) FS MODE. For Frequency Shift emission, connect the output of the Frequency Shift Exciter to J3 RF connector. The Exciter output should contain frequencies in the 2-4 mc range and have an impedance of 50-70 ohms. Maximum FS input voltage into the GPE should be around 1 volt RMS. A "talk" switch should be installed similar to figures 2-6 and 2-7.

(2) ALL AM AND KEY MODES WITH EXTERNAL VFO. In order to extend selection within the 2 to 32-mc range, an external Variable Frequency Oscillator with an output containing the 2-4 mc range may be used in place of (or along with) the 2-4 mc crystal controlled oscillator in the GPE-1, by connecting its output to J3 connector. The VFO output should have an impedance in the area of 50-70 ohms and a maximum voltage of around 1-volt RMS to be fed into the GPE unit.

f. POWER CONNECTION. A power cable is supplied with the GPE unit. Plug P2 female plug into J1 receptacle and P1 male plug into the line voltage supply.

g. OUTPUT CONNECTION. Connect output (J4) of GPE to input of a suitable linear amplifier. TMC #UG-260/U mating plug is provided for this purpose. Use RG-59/U coaxial cable.

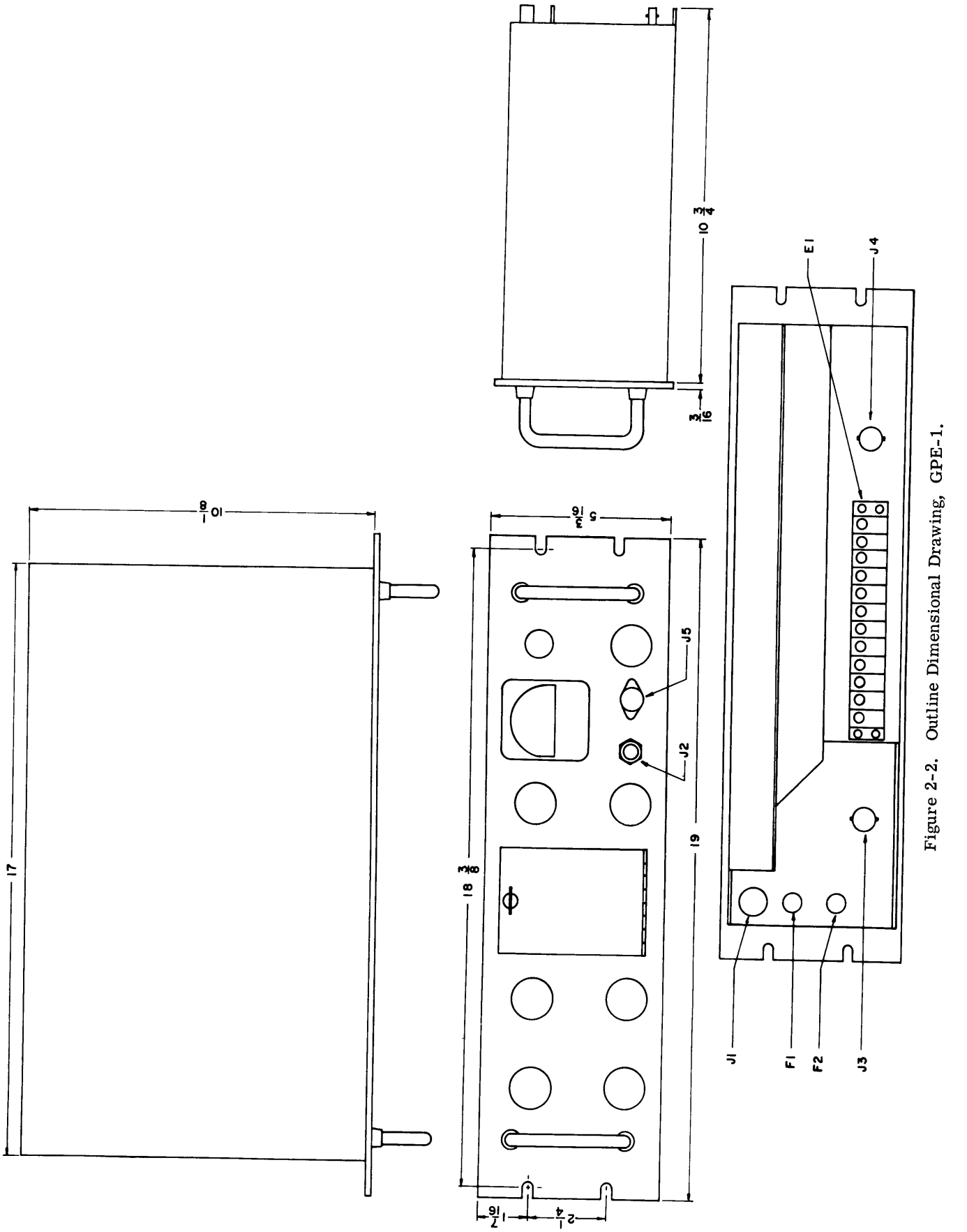


Figure 2-2. Outline Dimensional Drawing, GPE-1.

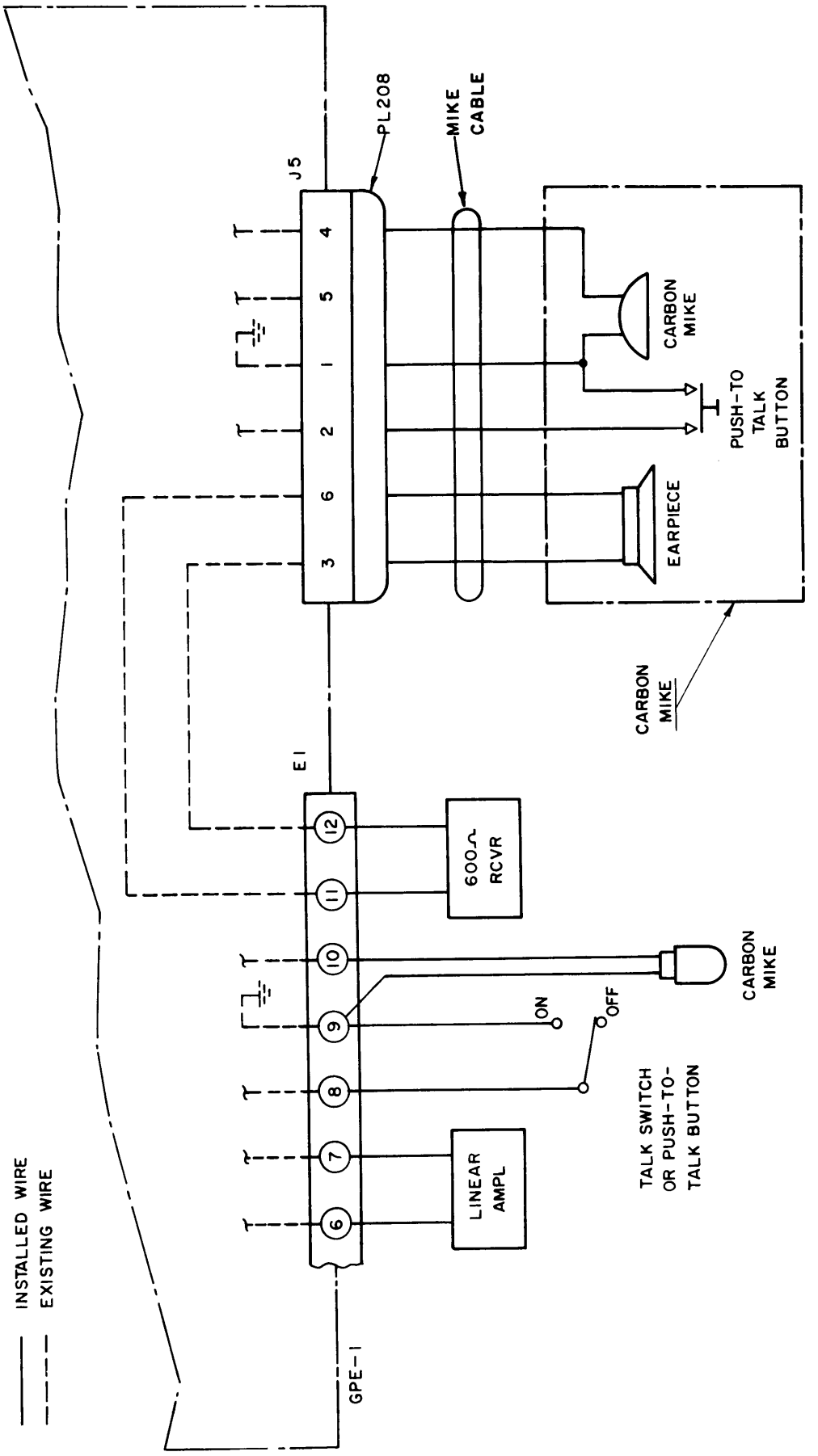


Figure 2-3. Installation Diagram, Carbon Mike, GPE-1.

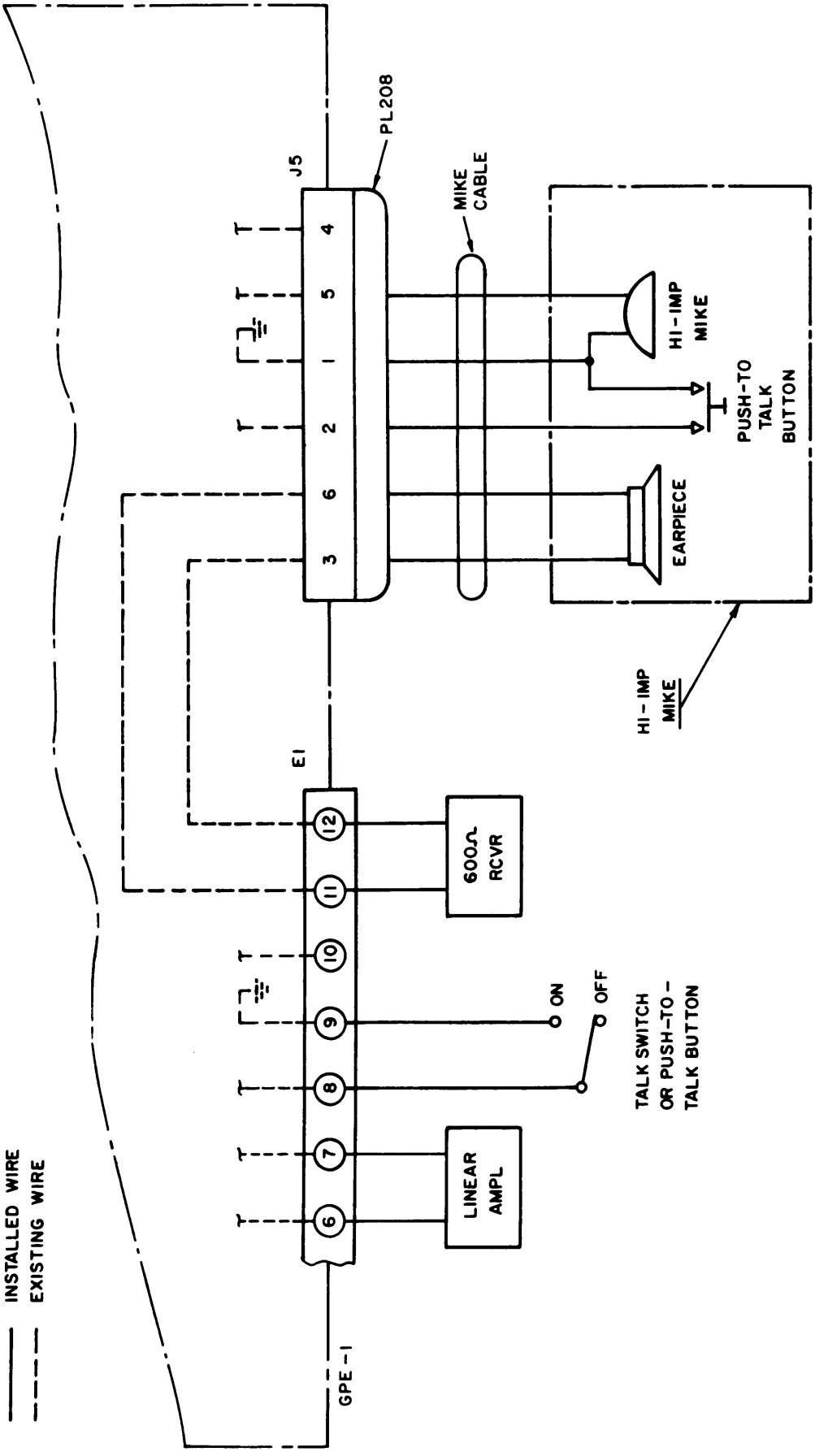


Figure 2-4. Installation Diagram, High Impedance Mike, GPE-1.

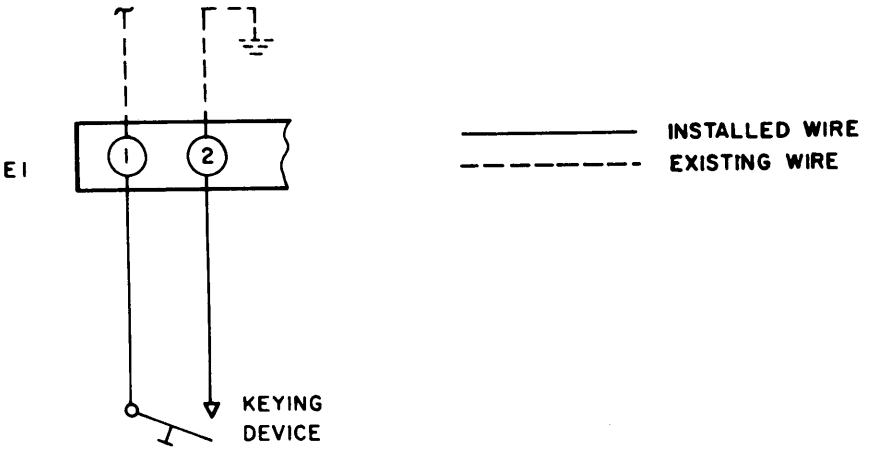


Figure 2-5. Installation Diagram, Keyer, GPE-1.

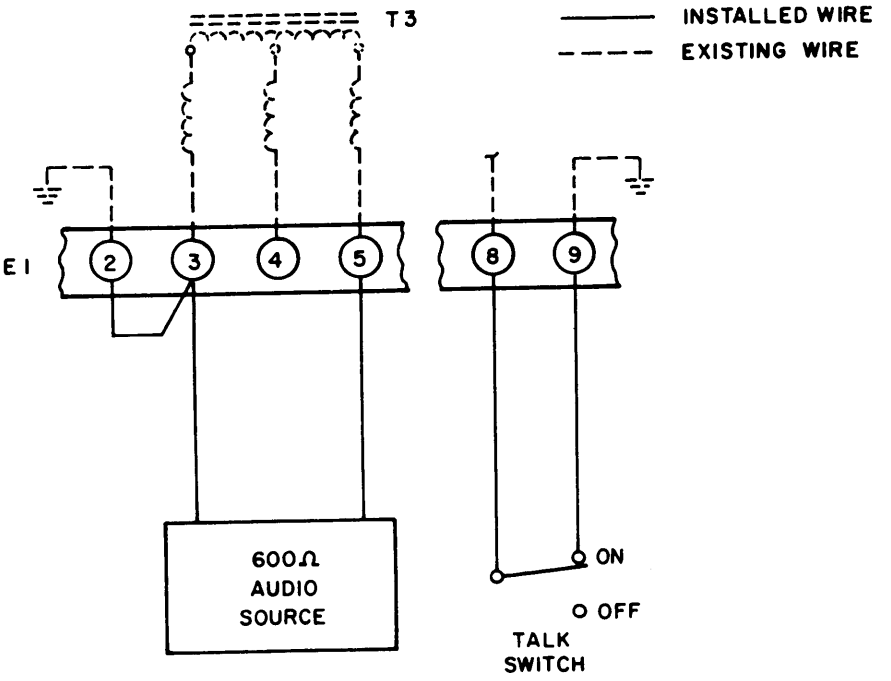


Figure 2-6. Installation Diagram, External Audio Input, Unbalanced to Ground, GPE-1.

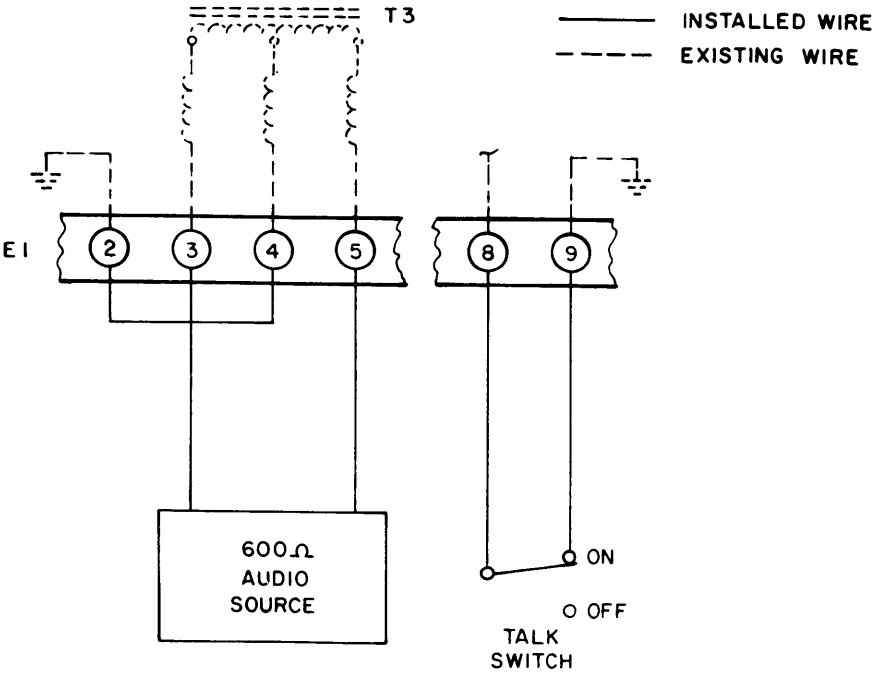


Figure 2-7. Installation Diagram, External Audio Input, Balanced to Ground, GPE-1.

SECTION 3
OPERATOR'S SECTION

3-1. PRELIMINARY CONSIDERATIONS.

Do not operate GPE-1 until desired operating conditions are determined. These are:

a. Mode of transmission

b. Carrier frequency

a. MODE OF TRANSMISSION. There are six modes of transmission available. These are:

(1) CW (Key)

(2) MCW (Key)

(3) Carbon Mike (AM)

(4) High Impedance Mike (AM)

(5) External Audio Source (AM) (600-ohm tape recorder, telephone or other)

(6) Frequency Shift (GPE-1 will accept the output of a Frequency Shift Exciter such as TMC Model XFK)

The operator should inspect the GPE-1 to see if appropriate connections have been made to the associated equipment required for the particular mode of transmission desired. Section 2 (Installation Section) of this manual describes the necessary connections for each mode.

b. CARRIER FREQUENCY. Carrier frequencies are available in four bands. These are:

2-4 Mc
4-8 Mc
8-16 Mc
16-32 Mc

The particular frequencies available from the GPE-1 will depend on the crystal or crystals installed (see paragraph 2-3). The operator should note the frequencies of the crystals installed to determine the carriers that will be available to him. Multiplication factors of 1, 2, 4 and 8 are available for each crystal to produce the final carrier frequency.

EXAMPLE: If the crystal frequencies are 2 Mc, 3 Mc and 3.8 Mc, the available carrier frequencies will be 2 Mc, 4 Mc, 8 Mc and 16 Mc (for the 2 Mc crystal), 3 Mc, 6 Mc, 12 Mc and 24 Mc (for the 3 Mc crystal) and 3.8 Mc, 7.6 Mc, 15.2 Mc and 30.4 Mc (for the 3.8 Mc crystal). Twelve different carrier frequencies would then be available from this particular combination.

If, in addition to or instead of the crystals, a 2-4 Mc VFO (Variable Frequency Oscillator) is hooked up to J3 jack of the GPE-1 as a source of carrier, the output carrier frequency selection of the GPE-1 will be infinite in the 2 to 32 Mc range. Any frequency in the 2-4 Mc range issuing from the VFO may be multiplied by 1, 2, 4 or 8 as desired.

3-2. OPERATOR'S INSTRUCTIONS.

Table 3-6 provides a cross-reference of equivalent controls shown in figure 3-1 and the component designations in figure 8-1. Use figure 3-1 while employing tables 3-1 through 3-5 as operating charts for the GPE-1.

3-3. OPERATOR'S MAINTENANCE.

The operator should note general condition of panel switches, observe whether panel indicator lamps light properly and check the condition of tubes when they appear subnormal.

If, when MODULATION control knob is turned clockwise, the POWER light fails to ignite and there is no reading on the meter, check to see if GPE is receiving power. Check the two fuses located on the rear of the chassis.

If, while the majority of tube filaments light, any tube filament fails to go on, remove tube and test it with a tube tester.

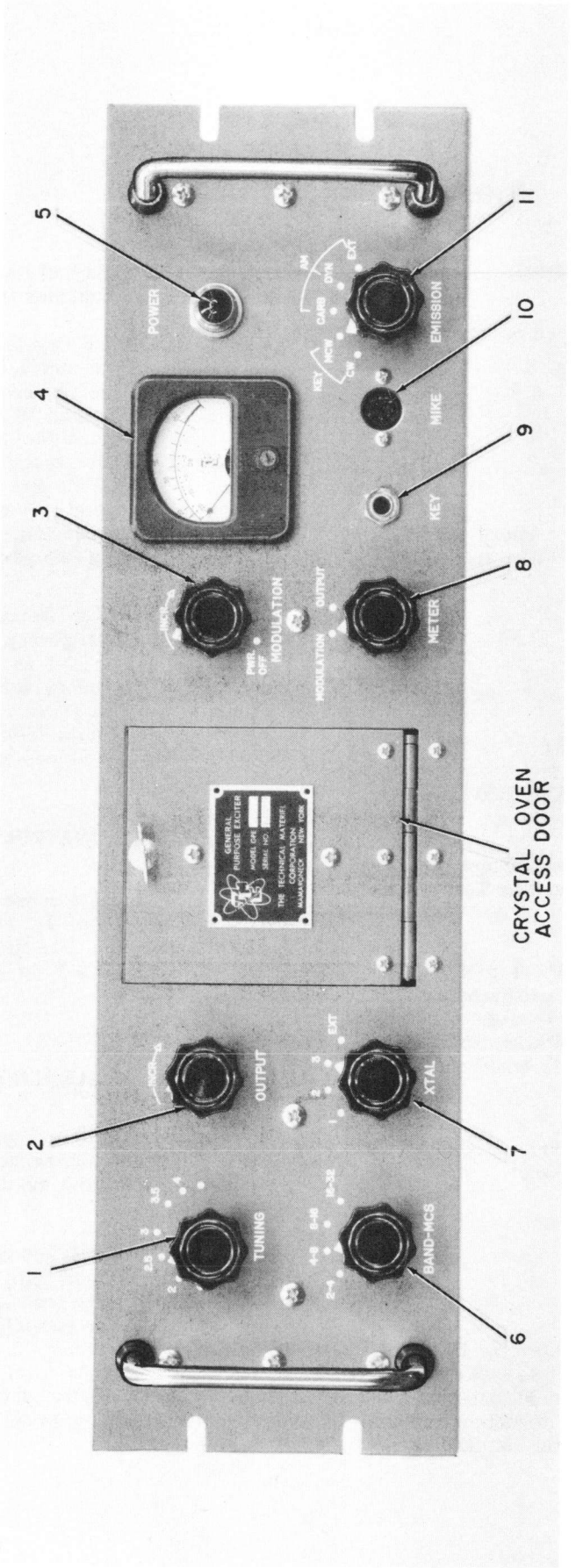


Figure 3-1. Control Panel, GPE-1.

TABLE 3-1. TUNE-UP FOR CW OPERATION

Example: To transmit on 12 Mc continuous wave.

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
1	3, 5	Turn MODULATION knob (3) slightly clockwise until switch snaps on. POWER lamp (5) lights. Allow 15 minutes to warm up. *	Energizes unit.
2	11	Set EMISSION switch (11) at CW position.	Sets up circuitry for CW operation.
3**	7	Turn XTAL switch (7) to select crystal required in crystal position 1, 2, or 3. (Example: 3 Mc crystal in position 1, turn to position 1.)	Determines frequency of internal oscillator.
4	6	Turn BAND-MCS switch (6) to select band desired for output frequency and proper multiplication factor for oscillator. The following band positions give the following multiplication factors: BAND — MULTIPLICATION 2-4 — 1 4-8 — 2 8-16 — 4 16-32 — 8 (Example: Turn switch to 8-16 to get 12 Mc ——— 3 x 4 = 12)	Multiplies oscillator output.
5	8	Turn METER switch (8) to OUTPUT position.	Connects meter (4) to sample carrier output.
6	2, 4	Holding keyer down to close RF circuit, turn OUTPUT knob (2) toward INCR to bring meter (4) needle to middle of dial.	To obtain clear reading for step 7.
7	1, 4	Holding keyer down, turn TUNING knob (1) pointer to vicinity of crystal frequency selected in step 3. (Example: 3 Mc). Adjust to get highest reading on meter (4).	Tunes carrier output.
8	2, 4	Holding keyer down, adjust OUTPUT knob (2) to obtain desired power level of GPE-1 output on meter (4).	Adjusts power output of carrier.

* For maximum frequency stability allow 2 hours for crystal oven temperature to stabilize.

** If it is preferable to use a VFO (Variable Frequency Oscillator) 2-4 Mc source attached to the GPE-1 instead of the internally generated crystal controlled oscillator frequencies, step 3 may be replaced with the following:

3 - Turn XTAL switch (7) to EXT position, and tune VFO for desired frequency in the 2-4 Mc range (Example: 3 Mc).

TABLE 3-2. TUNE-UP FOR MCW OPERATION

Example: To transmit on 12 Mc continuous wave modulated 100% with 1-kc.

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
1	1 thru 9, 11	Repeat steps 1 through 7 in table 3-1 (CW Tune-up)	Tunes carrier.
2	2, 4	Holding keyer down, adjust OUTPUT knob (2) to obtain desired power level of GPE-1 carrier output on meter (4). Note figure.	Adjusts power output of carrier.
3	8	Turn METER switch (8) to MODULATION position.	Connects meter (4) to sample modulating frequency output.
4	11	Turn EMISSION switch (11) to MCW position.	Generates modulating frequency of 1 kc.
5	3, 4	Turn MODULATION knob (3) toward INCR to bring figure on meter (4) that represents 90% of figure noted in step 2.	Adjusts modulation percentage to 90%.

TABLE 3-3. TUNE-UP FOR CARBON OR HIGH IMPEDANCE MIKE AM OPERATION

(Example: To transmit AM on 12 Mc carrier)

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
1	1 thru 9, 11	Repeat steps 1 through 7 in Table 3-1 (CW Tune-up).	Tunes carrier.
2	2, 4	Adjust OUTPUT knob (2) to obtain desired power level of GPE-1 carrier output on meter (4). Note figure.	Adjusts power output of carrier.
3	8	Turn METER switch (8) to MODULATION position.	Connect meter (4) to sample modulating frequency output.
4	11	Turn EMISSION switch (11) to CARB position (for carbon mike) or DYN position (for high impedance mike).	Connects mike input to modulator and sets up push-to-talk system.
5	10	Plug mike cable into MIKE jack (10).	Connects mike to unit.
6	—	To talk, hold down push-to-talk button on mike. If mike does not have button, use push-to-talk button attached to terminals 8 and 9 of E1 terminal block at back of set.	Causes RF Ampl. tube to conduct and completes circuit for linear amplifier fed by GPE-1 in transmitter system. Releasing button disables RF amplifier tube and opens linear amplifier circuit.

TABLE 3-3. TUNE-UP FOR CARBON OR HIGH IMPEDANCE MIKE AM OPERATION (Cont.)

(Example: To transmit AM on 12 Mc carrier)

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
7	3, 4	Observe meter (4) needle while speaking. Needle should peak around 100% of figure noted in step 2. If necessary, adjust MODULATION knob (3) to correct condition.	Adjusts modulation percentage to 100% peaks for clear reception.

TABLE 3-4. TUNE-UP FOR AM OPERATION FROM EXTERNAL AUDIO SOURCE

(Example: To transmit AM on 12 Mc carrier)

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
1	1 thru 9, 11	Repeat steps 1 through 7 in Table 3-1 (CW Tune-up).	Tunes carrier.
2	2, 4	Adjust OUTPUT knob (2) to obtain desired power level of GPE-1 output carrier on meter (4). Note figure.	Adjusts power output of carrier.
3	8	Turn METER switch (8) to MODULATION position.	Connects meter (4) to sample modulating frequency output.
4	11	Turn EMISSION switch (11) to EXT position.	Connects external audio signal to modulator and sets up "talk" switch control of GPE-1 and linear amplifier.
5	—	Throw "talk" switch (ref: Figure 2-7) in "on position".	Turns on GPE-1 and linear amplifier.
6	3, 4	Observe meter (4) needle. Needle should peak around 100% of figure noted in step 2. If necessary, adjust MODULATION knob (3) to correct condition.	Adjusts modulation percentage to 100% peaks for clear reception.

TABLE 3-5. TUNE-UP FOR FS OPERATION FROM EXTERNAL FREQUENCY SHIFT EXCITER

(Example: To transmit FSK on 12 mc center frequency, 850 CPS frequency shift, using TMC Model XFK exciter)

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
1	—	Tune-up FS exciter for a 3 mc center frequency output. *	Tunes up FS input.
2	3, 5	Turn MODULATION knob (3) slightly clockwise until switch snaps on. Allow 15 minutes to warm up. **	Energizes GPE. Indicator (5) should light.
3	7	Turn XTAL switch (7) to EXT position.	Connects FS exciter input to GPE-1 RF amplifier and multiplication circuit.
4	—	If there is an audio signal source connected to terminals 3 and 5 of E1 terminal block, be sure that source is turned off.	Disconnects audio from modulator.
5	11	Turn EMISSION switch (11) to EXT position.	Sets up "talk" switch control of GPE-1 and linear amplifier.
6	—	Throw "talk" switch (ref: Figure 2-7) in "on position".	Turns on GPE-1 and linear amplifier.
7	6	Turn BAND-MCS switch (6) to select band desired for output frequency and proper multiplication factor. The following band positions give the following multiplication factors for the FS output "mark" and "space" frequencies. BAND — MULTIPLICATION 2-4 — 1 4-8 — 2 8-16 — 4 16-32 — 8 (Example: Band position 8-16 would produce mark and space frequencies of 12, 000, 425 CPS and 11, 999, 575 CPS from an FS exciter output of 3, 000, 106. 25 CPS and 2, 999, 893. 75 CPS, respectively.)	Multiplies FS output frequencies.
8	8	Turn METER switch (8) to OUTPUT position.	Connects meter (4) to sample FS output level from GPE.
9	2, 4	Turn OUTPUT knob (2) toward INCR to bring meter (4) needle to middle of dial.	To obtain clear reading for step 10.
10	1, 4	Turn TUNING knob (1) pointer to vicinity of FS exciter center frequency to get highest reading on meter (4).	Tunes multiplication circuit.

TABLE 3-5. TUNE-UP FOR FS OPERATION FROM EXTERNAL FREQUENCY SHIFT EXCITER (C nt.)

(Example: To transmit FSK on 12 mc center frequency, 850 CPS frequency shift, using TMC Model XFK exciter)

STEP	PANEL SERIAL NO. (SEE FIG. 3-1)	OPERATION	PURPOSE
11	2, 4	Adjust OUTPUT knob (2) to obtain desired GPE output level reading on meter (4).	Adjusts GPE output power.

* The output frequency of an XFK unit = f_c + 200 kc ± Δ f.
where f_c = XFK's crystal or VMO input frequency
200 kc = XFK's reactance tube frequency
Δ f = XFK's frequency shift
∴ For 12 mc center frequency, 850 CPS frequency shift output from GPE:
XFK's f_c = 2.8 mc
XFK's Δ f = 212.5 cps

** For rated frequency stability allow 2 hours for crystal oven temperature to stabilize.

TABLE 3-6. CROSS-REFERENCE OF CONTROL DESIGNATIONS

FIG. 3-1	FIG. 8-1	FUNCTION
1	C45	Tunes Carrier
2	R48	Adjusts Carrier Level
3	S5, R35	Pwr. Switch & Mod. Level Adj.
4	M1	Shows Carrier or Mod. Level
5	DS1	Indicates Power on
6	S2	Selects Crystal Multiplication
7	S1	Selects Carrier Crystal
8	S4	Selects Carrier or Mod. Reading
9	J2	Provides Keyer Attachment
10	J5	Provides Mike Attachment
11	S3	Selects Mode of Emission

SECTION 4
PRINCIPLES OF OPERATION

4-1. FUNCTIONAL OPERATION.

As shown in figure 4-1, Functional Block Diagram, the GPE consists of five principal sections:

a. RF section

b. Audio section

c. Push-to-talk section

d. Meter section

e. Power supply section

a. RF SECTION (figure 4-1). The carrier frequencies are generated in the RF section. A frequency in the 2-4 mc range is generated by the crystal controlled oscillator V1A by selecting one of the three oven mounted crystals with S1 XTAL switch. The 2-4 mc is then passed through the buffer amplifier, V1B, to the harmonic generator, V2. Of the harmonics issuing from V2, one is selected by S2 BAND-MCS switch which is 1, 2, 4 or 8 times the fundamental frequency, by routing the V2 output through the appropriate band-pass filter. The resulting frequency is amplified in V3 and V4, passing through two more sets of band-pass filters in their outputs, and issuing at the GPE output connector, J4. R48 OUTPUT potentiometer controls the outputs of V3 and V4. The ganged TUNING capacitor, C45, fine-tunes V2, V3 and V4 outputs for the frequency selected.

S1 XTAL switch will also select an external VFO (variable frequency oscillator), connected at J3, as a 2-4 mc source to enable the operator to use a greater selection of carrier frequencies through the 2-32 mc range, if required. In this switch position (EXT), the crystals are disconnected from the V1A oscillator tube and V1A acts as an amplifier for the VFO 2-4 mc input.

In FS (frequency shift) mode, a frequency shift exciter may be connected at J3. The GPE can then be used to multiply the FS exciter output in the 2-4 mc range by 2, 4 or 8 in the same manner as the GPE carrier.

In CW or MCW modes, an external keying device is connected at J2 or E1. Operation of the keyer will enable and disable V3 and V4.

In CARB, DYN and EXT AM modes V3 and V4 may be enabled by pushing a push-to-talk button in a mike or a talk switch at E1. Modulation occurs at V4 tube.

b. AUDIO SECTION (figure 4-1). The GPE generates a 1-kc signal for MCW mode of transmission. In addition, it amplifies the following three types of external audio signal:

(1) Carbon mike

(2) Dynamic (high impedance) mike

(3) 600-ohm audio input (Tape recorder, telephone etc.)

J5 receptacle is provided for a mike cable connection for either a carbon or dynamic mike. Figure 4-1 shows both for purposes of illustration. J5 has sufficient pins for connecting built-in push-to-talk controls if the mike assembly includes them. Connection points are provided at E1 for the 600-ohm source and a carbon mike without push-to-talk controls.

S3 EMISSION selector switch (together with K1 relay) sets up components of the audio section for the five transmission modes (CW, MCW, CARB, DYN and EXT). In figure 4-1, K1 relay is not shown; S3 switch is shown as representing the connections resulting from S3 and K1 working together.

In CW position of S3, no audio signal can issue from the audio section.

In MCW position of S3, V5A is connected with the necessary circuitry to form a 1-kc oscillator and the resulting signal is amplified through V5B and V6.

In CARB position of S3, the carbon mike signal is amplified through V5B and V6.

In DYN position of S3, the dynamic mike signal is routed through V5A, which now acts as an amplifier, and is further amplified through V5B and V6.

In EXT position of S3, the 600-ohm signal takes the same course as the dynamic mike signal, i. e.: through V5A, V5B and V6 amplifiers.

In all positions of S3, level of modulating signal is controlled by R35 MODULATION potentiometer.

c. PUSH-TO-TALK SECTION (figure 4-1). GPE is wired to provide simple connections for a receiver/transmitter push-to-talk system for CARB, DYN and EXT modes. Pushing the talk button:

(1) Enables V3 and V4 operation.

(2) Enables linear amplifier operation.

As described in section 2 (Installation), a talk-switch may be attached at either J5 or E1. Figure 4-1 shows both attachments. When mike assembly in-

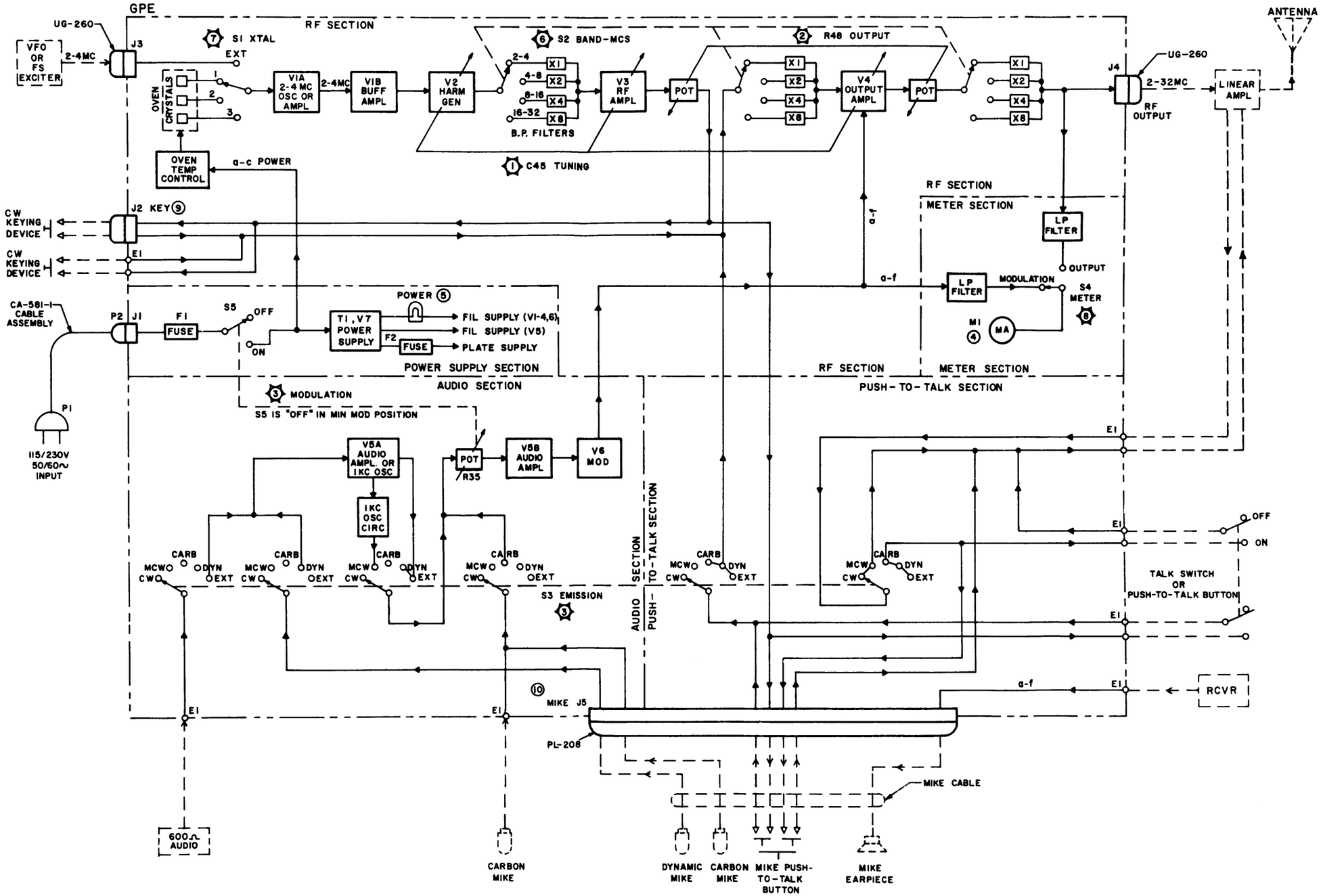


Figure 4-1. Functional Block Diagram, GPE General Purpose Exciter.

cludes an earpiece, a receiver output may be attached at E1.

In CW and MCW positions of S3, linear amplifier operation is continuous and V3 and V4 enabling and disabling is controlled by the keyer alone. The push-to-talk controls are inoperative.

In CARB, DYN and EXT positions of S3, linear amplifiers V3 and V4 are enabled by pushing the talk button.

d. METER SECTION. A panel meter (M1) with METER selector switch (S4) affords a separate reading for MODULATION level and r-f OUTPUT level. Comparisons of the two are made on a calibrated scale in setting up power output level and modulation percentage.

e. POWER SUPPLY SECTION. The GPE operates directly from a 115/230 VAC 50/60 CPS line. Turning MODULATION knob clockwise closes S5 switch and supplies filament and plate power to the tubes and line voltages directly to the crystal oven heaters.

4-2. STAGE-BY-STAGE DESCRIPTION.

a. INTRODUCTION. Figure 8-1 shows the complete schematic diagram for GPE. Figures 4-2 through 4-10 show sections of figure 8-1 in simplified forms, with heavy lines indicating path of signal. Circled numbers at controls refer to control numbers in figure 3-1. The following paragraphs present brief descriptions of circuit action in figures 4-2 through 4-10. Functions of each individual component may be found in section 7 (Parts List).

b. RF SECTION, CRYSTAL OSCILLATOR AND VFO INPUT (figure 4-2). Three 2-4 mc crystals may be mounted in a temperature controlled oven. Sockets XY1 through XY3 are for type CR-27/U crystals; XY4 through XY6 are for type FT-243. When S1 XTAL switch is in position 1, 2, or 3, the corresponding crystal and accompanying capacitors of the C2-4 and C85-87 groups are connected to the grid of V1A to form a modified Colpitts oscillator. The resulting 2-4 mc signal appears at the cathode of V1A. Upon installation of a crystal, C2, C3 and C4 trimmers adjust each branch to the particular frequency within the 2-4 mc range. An oven temperature control circuit consisting of R55, 56 and 57, C47 and S6 maintains crystal temperatures at 70 ± 2°C for frequency stability. Resulting connections are shown for 115V and 230V power inputs.

S1 XTAL switch set in EXT position (4) connects an external VFO directly to the grid of V1A. In this case, V1A performs as an amplifier for the 2-4 mc range, with the output appearing at its cathode as in the crystal oscillator.

c. RF SECTION; BUFFER AMPLIFIER AND HARMONIC GENERATOR (figure 4-3). The output of V1A is coupled to the grid of V1B through C7 capacitor. V1B buffer amplifier serves to protect the crystal oscillator circuit from frequency variations resulting from load variations on the GPE output. V2 harmonic generator is pentode biased and driven to produce the fundamental frequency plus harmonics. C45A fine-tunes the output of V2 to the fundamental frequency and its harmonics.

d. RF SECTION, V3 RF AMPLIFIER (figure 4-4). The tuned output of V2, containing fundamental and harmonics, is routed through a band-pass filter section via S2A BAND-MCS selector switch to V3 r-f amplifier. Position 2-4 of S2A routes 2-4 mc fundamental and harmonics directly to V3. Positions 4-8, 8-16, and 16-32 routes signal through band-pass filters (T4 and C22, T5 and C21, and T6 and C20) passing 2nd, 4th and 8th harmonics respectively. C45B, ganged to C45A, fine-tunes output of V3. V1B and V3 are inoperative until cathode circuit is grounded at either J2 or E1 keyer connection. R17 and C88 serve as a key-click filter to rid the signal of harmonics resulting in on-off operation of V3 from keyer. A B+ voltage, regulated by R48 OUTPUT potentiometer (see figure 4-5) varies the output of V3 at pin 6. The small amount of modulating signal also present in this line has a negligible effect.

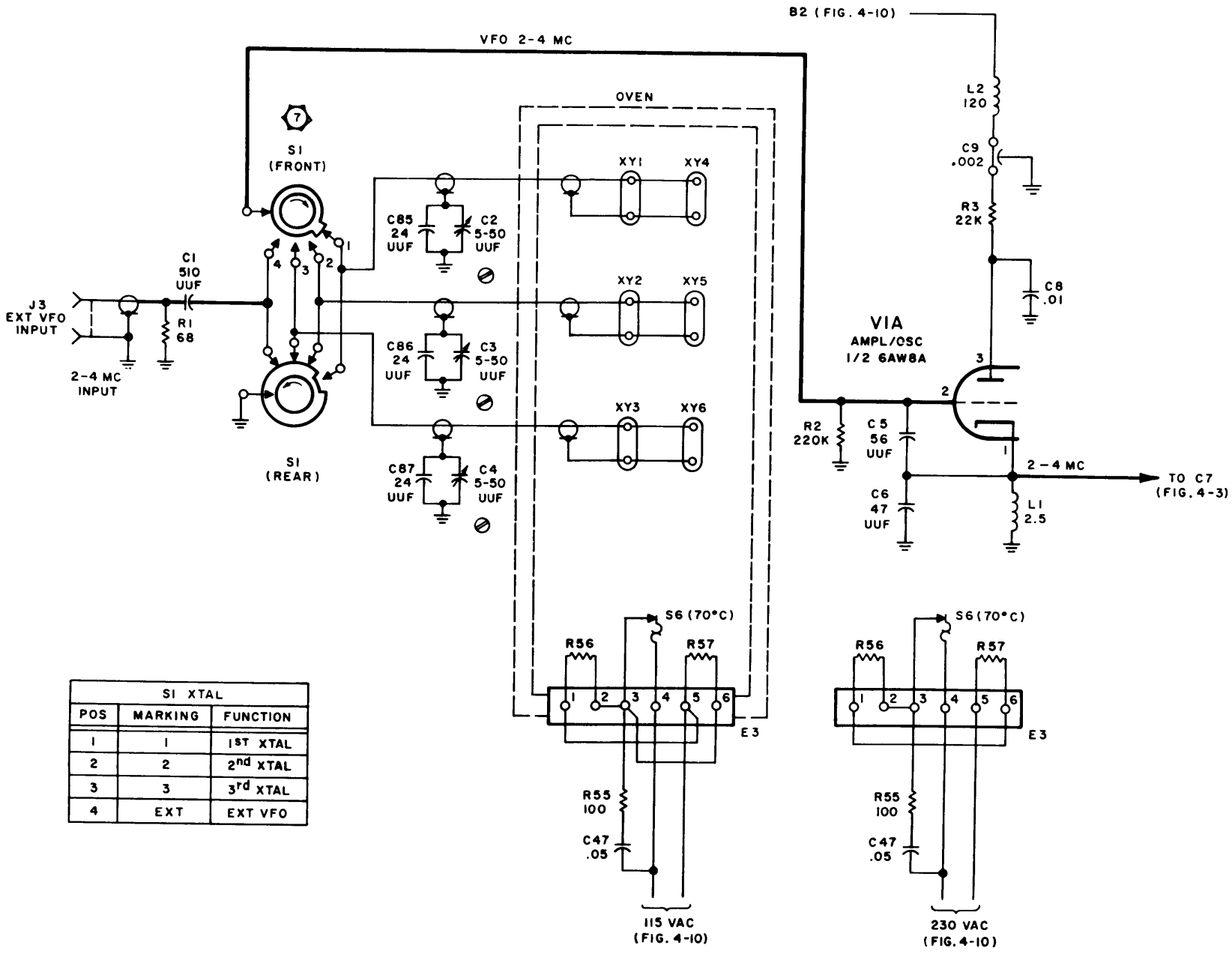
e. RF SECTION, V4 OUTPUT AMPLIFIER (figure 4-5). The tuned output of V3, containing either the fundamental or one of the harmonics as selected by S2A, is routed through another band-pass filter section to V4 via S2B. Positions 2-4, 4-8, 8-16 and 16-32 of S2B send the signal through corresponding band-pass filters. C45C, ganged to C45A and B, fine-tunes the output of V4. Like V3, V4 is inoperative until its cathode circuit is grounded. Connection for this purpose with V3 cathode and keyer is made through R22, C50 and L9. R22 and C35 form the key-click filter for V4. The modulating signal, together with some B+ supply from the audio section (dashed line) is routed to V4 plate through a low-pass filter network. The same signal from the audio section (including modulating signal and B+) is dropped through R49, R48, and R25 and connected to V4 screen grid. The small modulating signal here assists the signal at the plate in the response of the tube and (as in the case of V3) varying R48 varies the output level of V4. In CW operation, only B+ appears at V3 and V4 screen grids and V4 plate since the audio section is not issuing the modulating signal in this case.

f. RF SECTION, OUTPUT (figure 4-6). The tuned output of V4 is routed through a final set of band-pass filters, similar to V3, via S2C switch. The final output of the GPE unit, modulated or unmodulated appears at J4 connector.

g. AUDIO SECTION (figure 4-7). Heavy symboled lines are presented to show the course and direction of each audio signal resulting from the positioning of S3 EMISSION selector switch.

In CW position of S3, V5A and V5B are disabled which, in effect, disables the audio section and prevents a modulating signal from reaching the r-f section of GPE.

In MCW position of S3, V5A is turned into a phase-shift 1-kc oscillator, by connecting R31, R32, R33, R34, C55, C56 and C57 into its plate-grid circuit.



SI XTAL		
POS	MARKING	FUNCTION
1	1	1ST XTAL
2	2	2nd XTAL
3	3	3rd XTAL
4	EXT	EXT VFO

Figure 4-2. Simplified Schematic Diagram, RF Section, Crystal Oscillator and VFO Input, GPE-1.

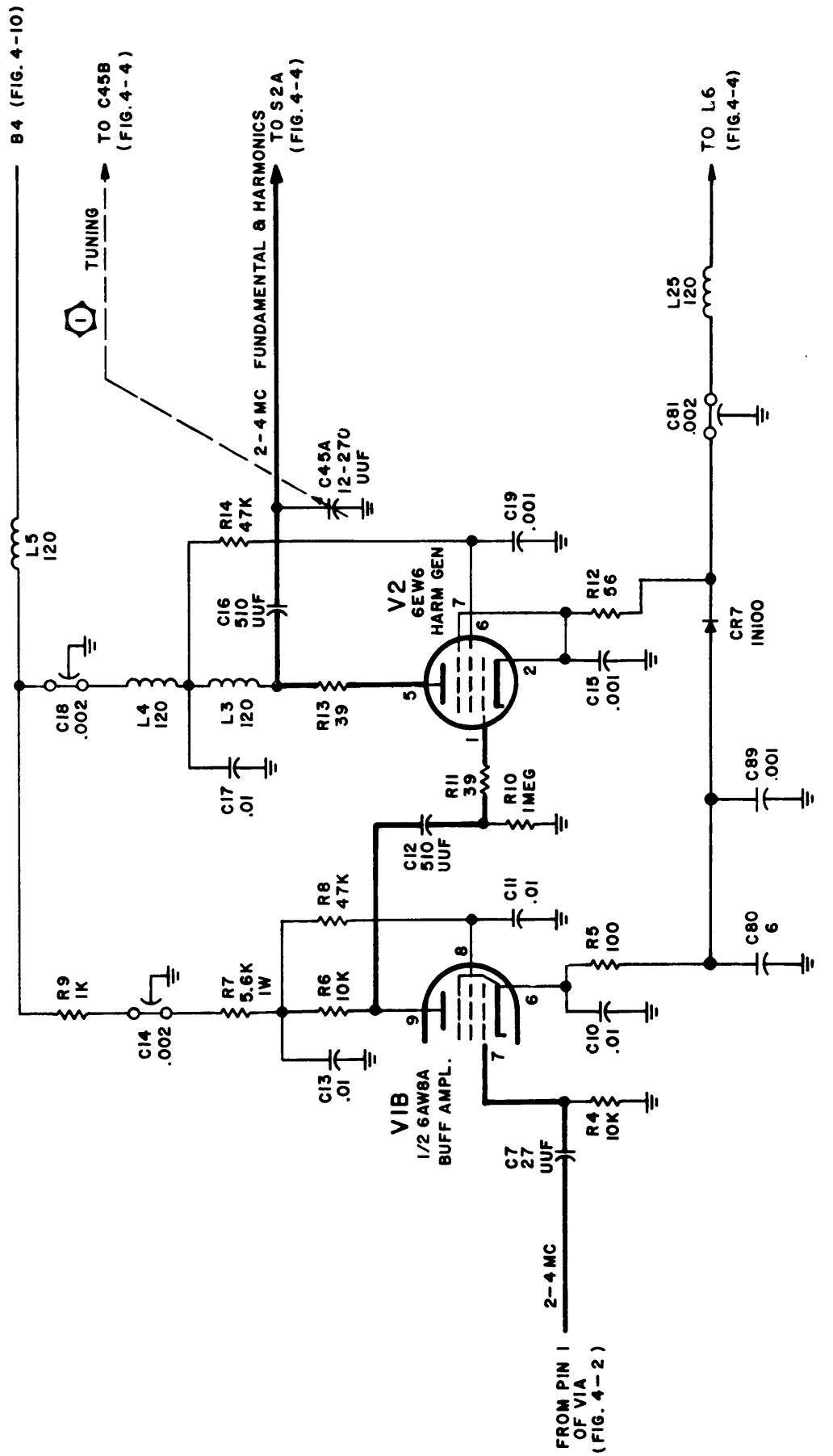


Figure 4-3. Simplified Schematic Diagram, RF Section, Buffer Amplifier and Harmonic Generator, GPE-1.

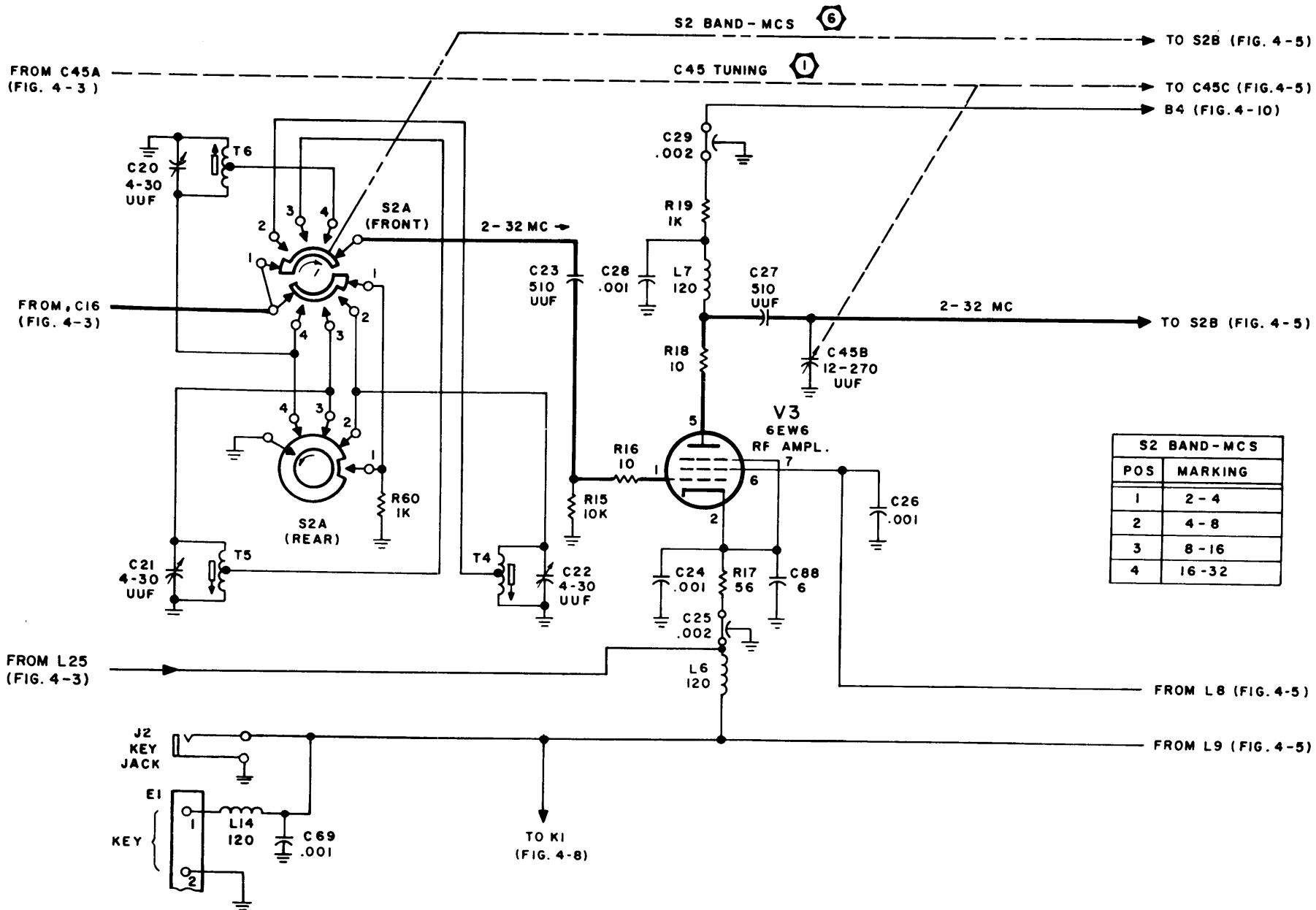


Figure 4-4. Simplified Schematic Diagram, RF Section, V3 RF Amplifier, GPE-1.

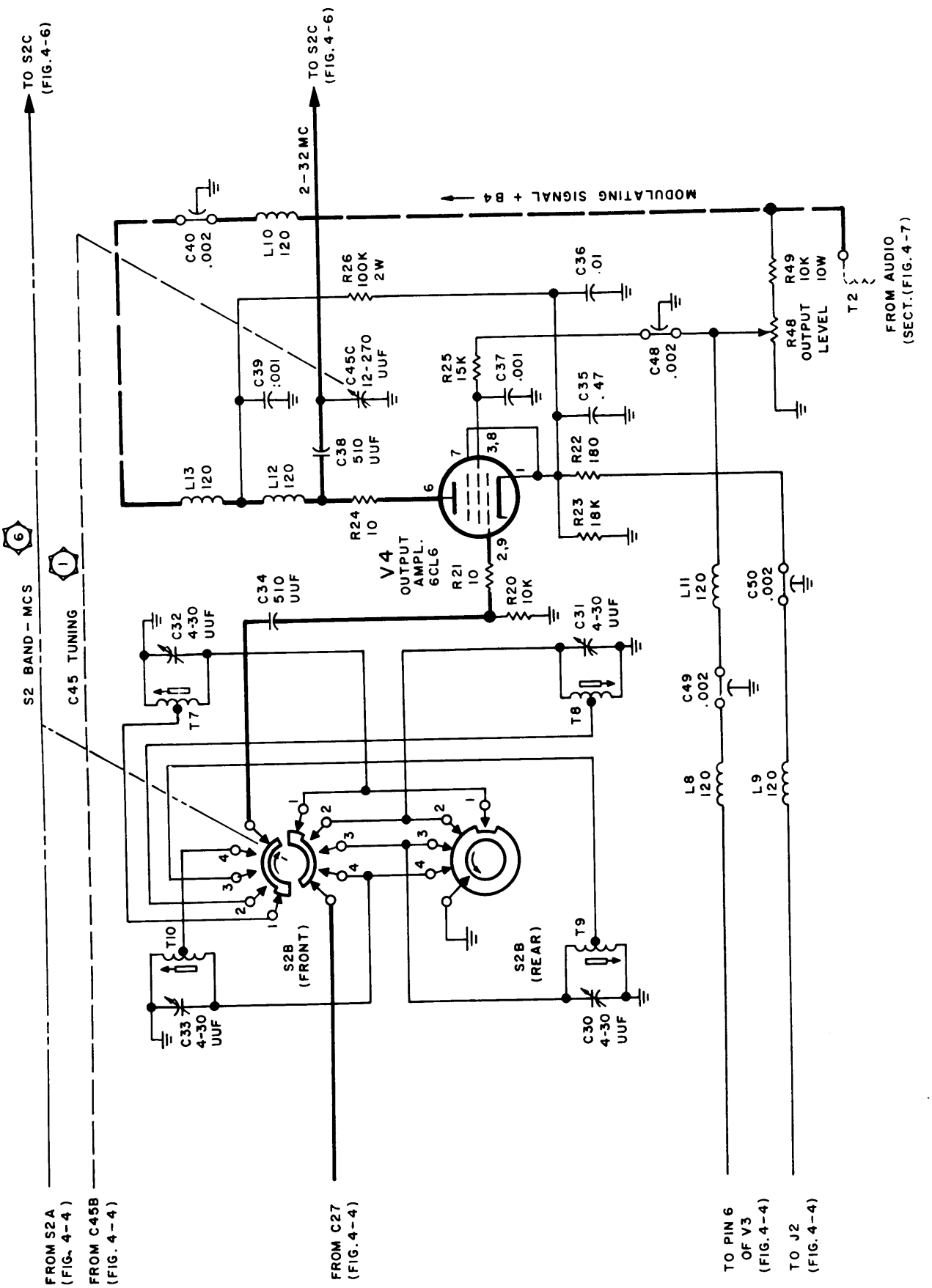


Figure 4-5. Simplified Schematic Diagram, RF Section, V4 Output Amplifier, GPE-1.

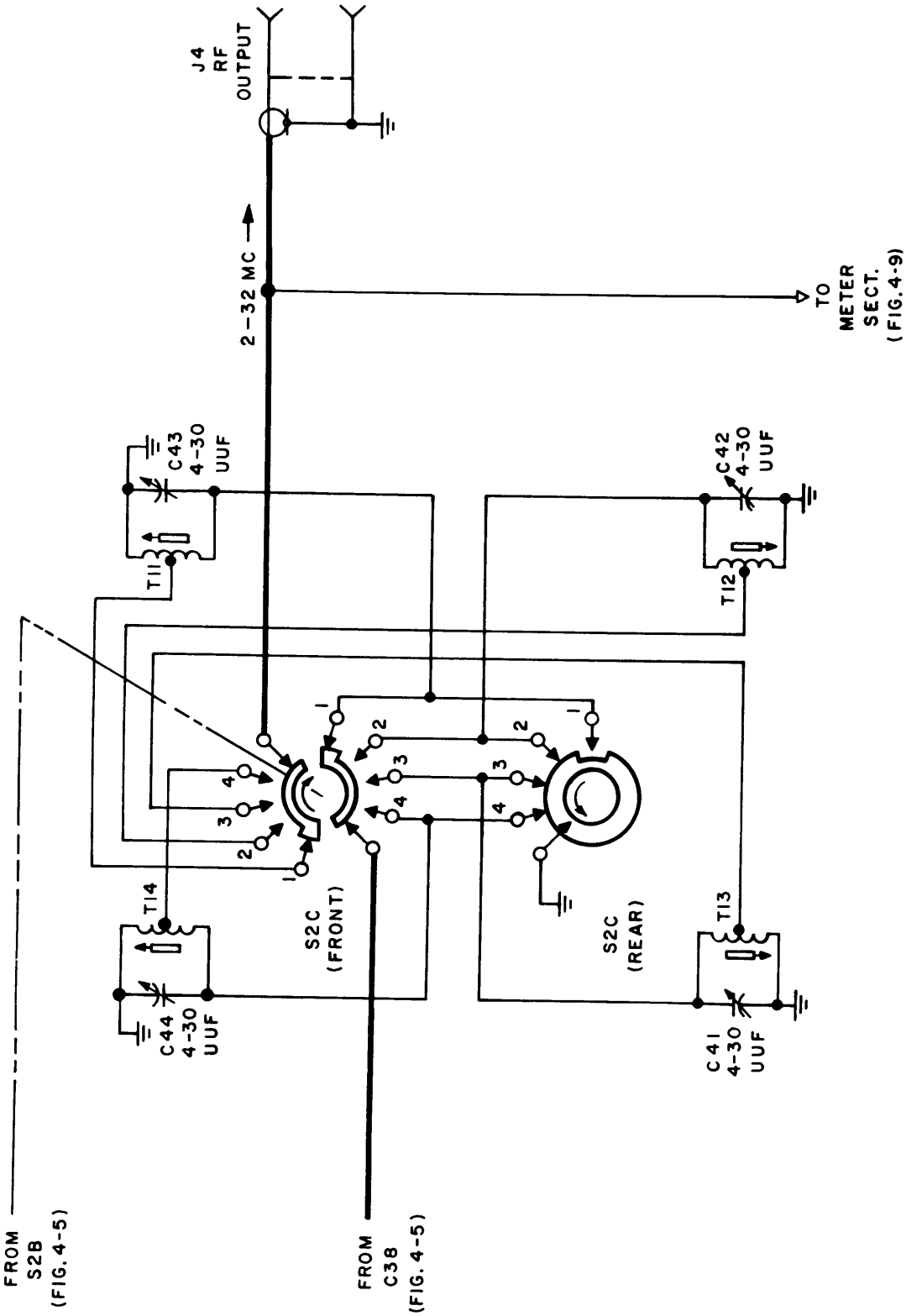
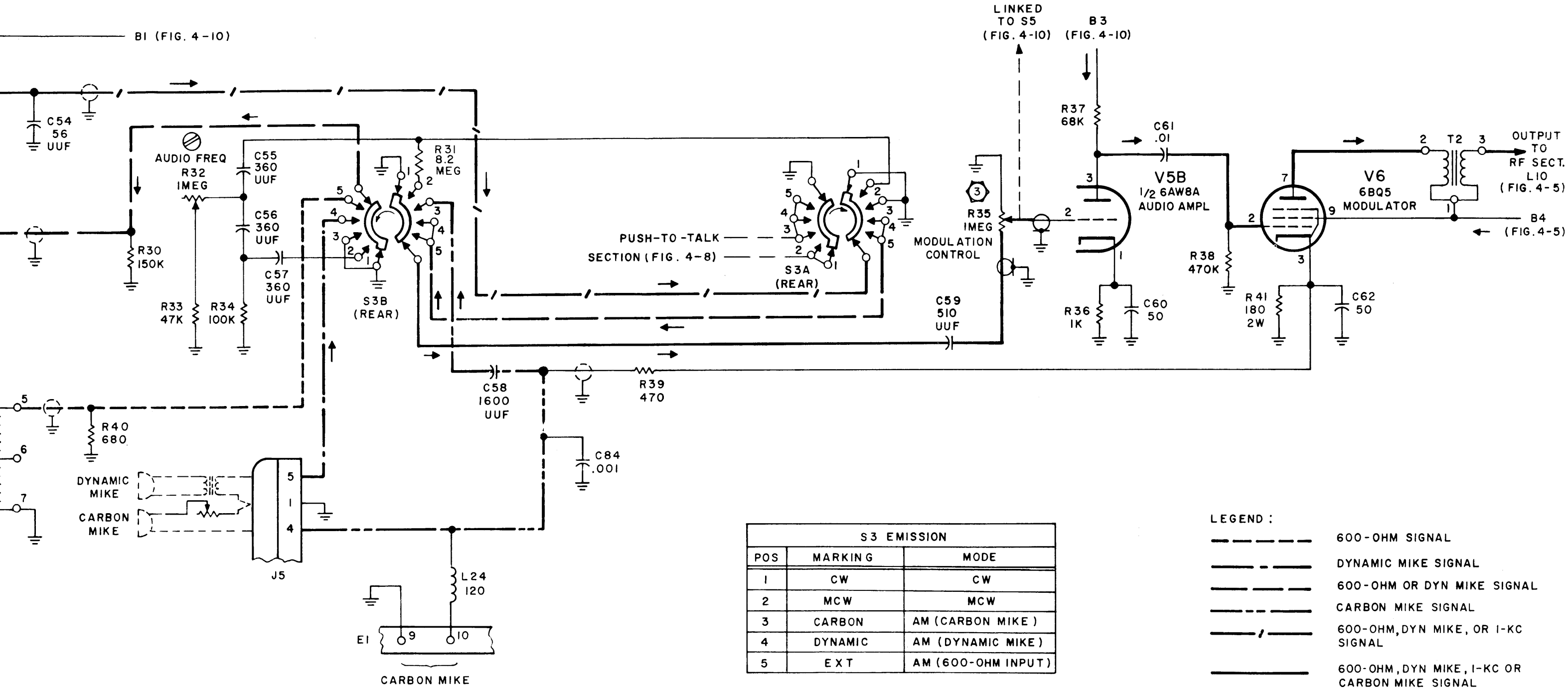


Figure 4-6. Simplified Schematic Diagram, RF Section, Output, GPE-1.

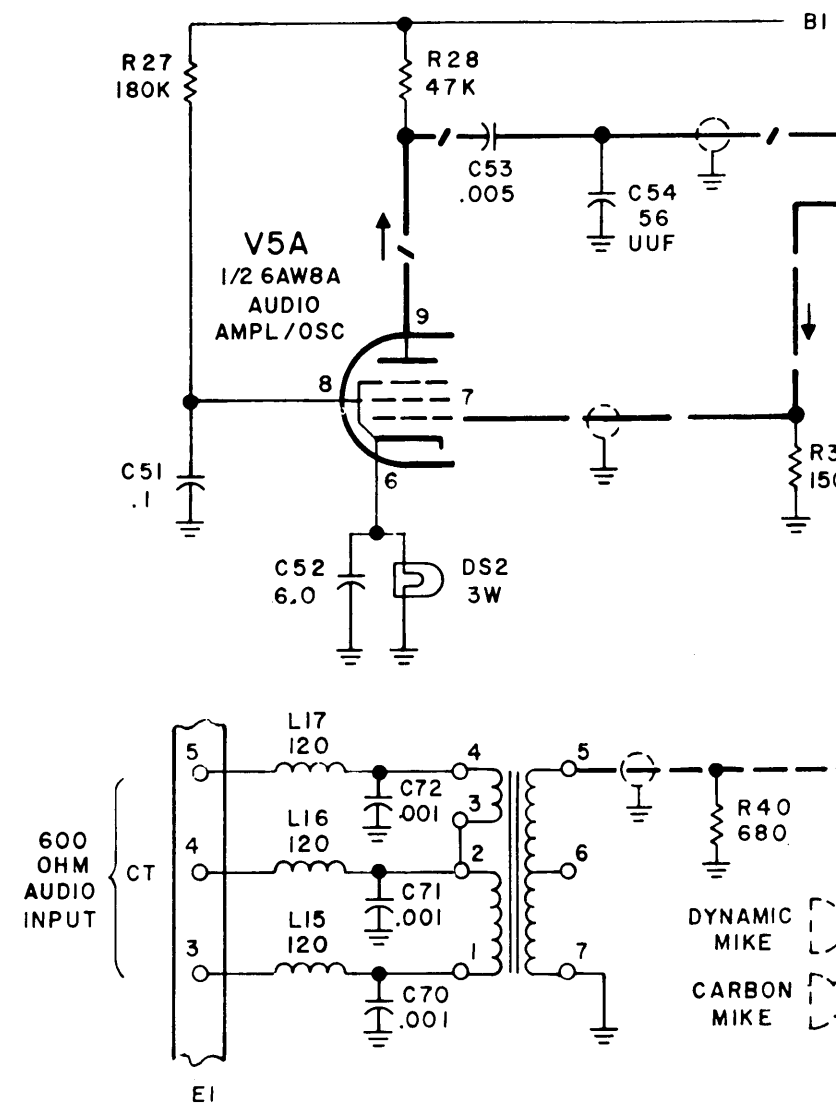


S3 EMISSION		
POS	MARKING	MODE
1	CW	CW
2	MCW	MCW
3	CARBON	AM (CARBON MIKE)
4	DYNAMIC	AM (DYNAMIC MIKE)
5	EXT	AM (600-OHM INPUT)

LEGEND :

- 600-OHM SIGNAL
- DYNAMIC MIKE SIGNAL
- 600-OHM OR DYN MIKE SIGNAL
- CARBON MIKE SIGNAL
- 600-OHM, DYN MIKE, OR 1-KC SIGNAL
- 600-OHM, DYN MIKE, 1-KC OR CARBON MIKE SIGNAL

Figure 4-7. Simplified Schematic Diagram, Audio Section, GPE-1.


R27
180K
R28
47K
C53
.005
C54
56
UUF
V5A
1/2 6AW8A
AUDIO
AMPL/OSC
9
8
7
6
C51
.1
C52
6.0
DS2
3W
L17
120
L16
120
L15
120
C72
.001
C71
.001
C70
.001
600
OHM
AUDIO
INPUT
CT
5
4
3
2
1
6
7
R40
680
DYNAMIC
MIKE
CARBON
MIKE
E1

These components present an in-phase feedback from plate to grid, causing V5A to oscillate. Adjustment of R32 tunes the output to 1-kc. Output appearing at pin 9 of V5A is routed to pin 2 (grid) of V5B.

In CARB position of S3, the carbon mike (represented as a variable resistor) signal appears between C58 and R39 and is connected through C58, C59 and R35 to V5B grid. Pin 3 of V6 furnishes the negative d-c voltage for the carbon mike through R39.

In DYN position of S3, the high impedance dynamic mike signal is connected to V5A control grid (pin 7). The amplified signal appears at the plate and is routed to V5B grid.

In EXT position of S3, the signal from the 600-ohm source is routed to V5A control grid along the same route as the dynamic mike signal, amplified and sent to V5B grid.

In all S3 switch positions, the a-f signal proceeds from S3B (rear) wafer, through C59, through R35 MODULATION potentiometer to V5B grid. It receives two stages of amplification from V5B and V6. T2 modulation transformer couples the output of the audio section to the RF section. Actual modulation occurs in V4 in the RF section.

h. PUSH-TO-TALK SECTION (figure 4-8). The half-sector of S3A rear wafer shown solid in figure 4-8 together with K1 relay, make connections necessary for push-to-talk control.

In the CW and MCW positions of S3A, K1 relay coil is grounded, energizing relay. This closes the circuit at terminals 6 and 7 of E1, enabling the linear amplifier to operate. Enabling and disabling of V3 and V4 (see figure 4-4) by grounding their cathode circuits, remains controllable at the keyer only.

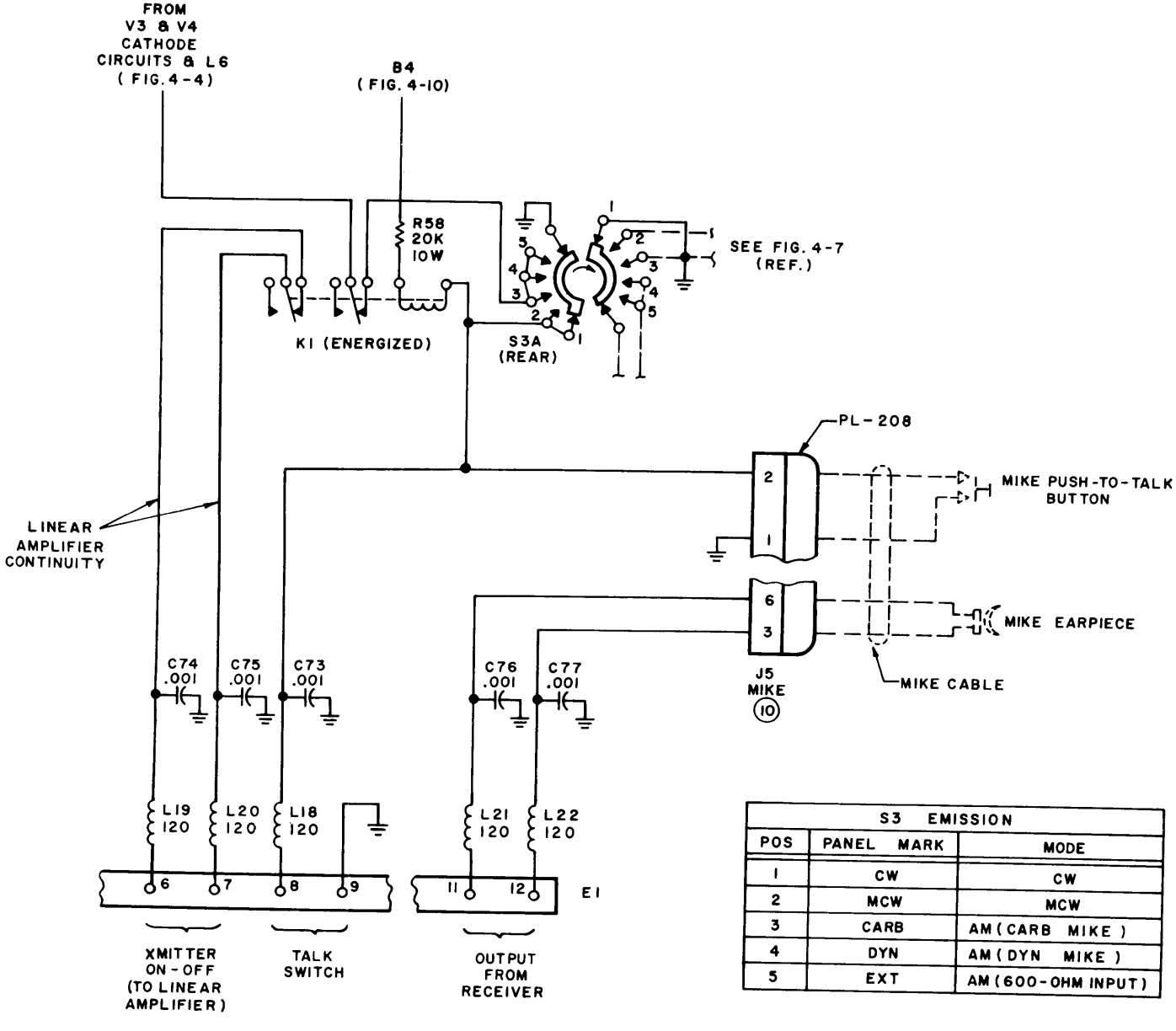
In CARB, DYN and EXT positions of S3, only pushing talk-button or switch at J5 or E1 will ground relay coil, thereby grounding V3 and V4 cathode circuits and enabling these tubes to operate. The momentarily energized relay also closes the linear amplifier circuit, enabling it while the talk button is held down.

i. METER SECTION (figure 4-9). Output of the modulating signal is sampled at terminal 3 of T2 modulation transformer; final output of GPE is sampled at J4. The two separate samples are converted into half-wave rectified current and brought through S4 METER selector switch and M1 microammeter. When S4 is in OUTPUT position meter reads representative level of GPE final output voltage made up of unmodulated or modulated carrier. In MODULATION position of S4, meter reads only representative level of modulating signal voltage. Under the following conditions:

3-mc crystal
BAND-MCS at 2-4
EMISSION at CW
70-ohm load at J4

When OUTPUT knob is turned to bring 0 DB reading on meter, the GPE is issuing a nominal 4 VRMS carrier. When an audio source is attached to the GPE, with S4 METER switch in MODULATION position, and MODULATION knob turned to bring 0 DB reading on meter, a nominal 200 VRMS modulating signal is present at terminal 3 of T2 modulation transformer. The 200 VRMS will produce a 100% modulation of the nominal 4 VRMS carrier.

j. POWER SUPPLY SECTION (figure 4-10). Line voltage is brought in at J1 through power cable. Figure 4-10 schematic shows connections for a 115 VAC 50/60 CPS line voltage. Figure 8-1 shows modifications for a 230 VAC 50/60 CPS line voltage. The power supply circuitry is a conventional type, supplying a regulated +150 VDC, and unregulated +260 VDC and +270 VDC (keyer down), and 6.3 VAC for tube filaments. Turning MODULATION knot (R35 in figure 4-7) clockwise closes S5 switch.



S3 EMISSION		
POS	PANEL MARK	MODE
1	CW	CW
2	MCW	MCW
3	CARB	AM (CARB MIKE)
4	DYN	AM (DYN MIKE)
5	EXT	AM (600-OHM INPUT)

Figure 4-8. Simplified Schematic Diagram, Push-to-Talk Section, GPE-1.

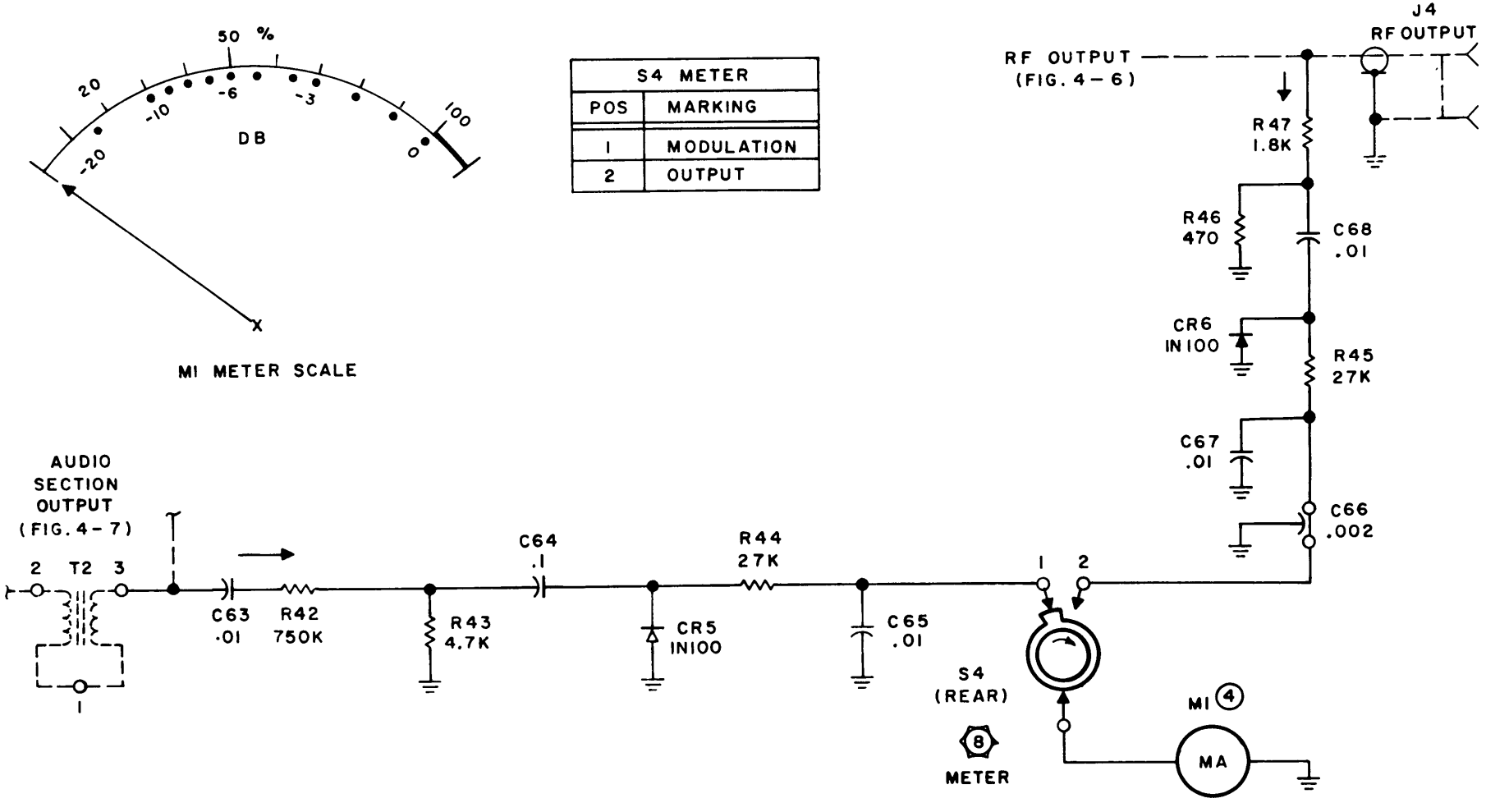


Figure 4-9. Simplified Schematic Diagram, Meter Section, GPE-1.

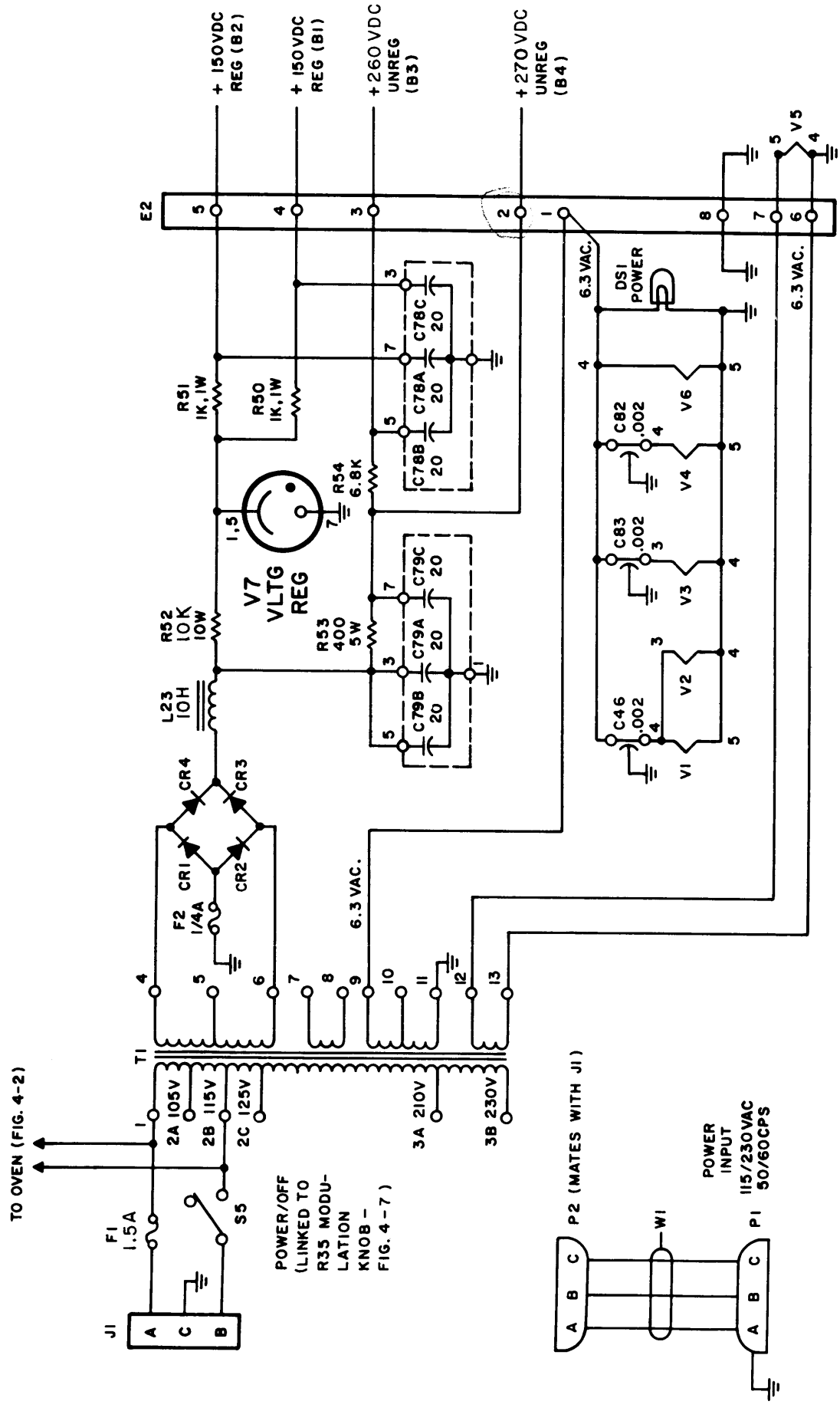


Figure 4-10. Simplified Schematic Diagram, Power Supply Section, GPE-1.

SECTION 5
TROUBLE-SHOOTING

5-1. GENERAL.

Trouble-shooting is the art of locating and diagnosing equipment troubles and maladjustments; the information necessary to remedy the equipment troubles and maladjustments is reserved for section 6 of the manual under the heading "Maintenance".

Trouble-shooting tools may, for convenience, be divided into the following six categories:

a. Accurate schematic diagrams

b. Tables of voltage and resistance waveform data

c. Location data (photographs with callouts of the major electronic equipment elements)

d. Trouble-shooting techniques

e. Trouble-shooting charts based on operating procedures

f. Trouble-shooting procedures based on circuit sectionalization.

Trouble-shooting techniques are about the same for all types of electronic equipment and are covered briefly in the following paragraph.

5-2. TROUBLE-SHOOTING TECHNIQUES.

a. GENERAL CONSIDERATIONS. When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In this case, it is unnecessary to follow a lengthy and orderly course of trouble-shooting in order to localize and isolate the faulty part.

A second short cut in trouble-shooting is to ascertain that all tubes and fuses are in proper working order; also that the equipment receives proper supply voltages. Many times this eliminates further investigation.

A third short cut is to examine the equipment section by section for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

It is important to recognize that defective elements may have become defective due to their own weaknesses or to some contributing cause beyond their control.

In general, re-alignment of any electrical equipment should not be attempted unless, in the final analysis, it is concluded to be necessary. Section 6 describes the alignment of the GPE.

b. TROUBLE-SHOOTING CHARTS BASED ON OPERATING PROCEDURES. The general purpose of these charts is to narrow the area of trouble to one or more sections of the equipment in order to minimize the labor of locating the source of trouble. These charts present a prescribed order to "turn on" the equipment, indicate what to expect as each step is taken, and give clues as to possible "troubled areas" when some expectation is not realized.

c. TABLES OF VOLTAGE AND RESISTANCE; WAVEFORM DATA. These tables give nominal values of voltage-to-frame and resistance-to-frame, generally at tube elements and sometimes at connectors and terminal boards. Large deviations from the nominal values should be carefully investigated. During this process accurate schematic diagrams and location data are highly essential. Schematic diagrams of equipment are found in Section 8.

A good oscilloscope is a good trouble-shooting tool. It may be connected to a number of critical points along a circuit to detect extraneous voltages, distorted waveforms, and other symptoms of trouble.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. Equipment usually consists of a number of subassemblies or sections. It is frequently helpful to treat these subassemblies or sections as independent entities. In so doing, however, they must be properly powered. Observations may then be made with VTVM's, CRO's or other test equipment at selected points under given types and magnitudes of injection voltages. Again, the subassemblies or sections may be examined for rated performance, according to specification, for the presence of extraneous grounds, for opens, or unusual voltages.

5-3. GENERAL PURPOSE EXCITER, GPE.

a. GENERAL. In any procedure involving accurate r-f frequency measurements in the GPE, such measurements should be made with the crystal oven door closed if crystals are used. A two-hour warm-up time is required for crystals to reach their rated stability in the oven.

b. VOLTAGE AND RESISTANCE DIAGRAMS. Figure 5-1 shows nominal voltage- and resistance-to-chassis measurements at vacuum tube pins on the

main and power supply chassis. Figures 5-2 and 5-3 are photographs showing top and bottom view locations of main components on the main chassis. Figure 5-4 is a photograph showing inside view locations of main components on the vertical power supply chassis.

c. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. Table 5-1 estimates faulty section of GPE upon encountering malfunctions during operation of unit. See figure 3-1 for interpretation of control designations in parentheses.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. The following paragraphs present selected factory checkout performance data of the GPE unit. Test equipment required is as follows; equivalents may be used if specific equipment is not available.

75-ohm, 2 watt non-reactive load resistor

Voltmeter (Simpson Model 260)

RF Generator (Boonton Measurements Model 82)

RF Voltmeter (Hewlett-Packard Model 410B)

CR27/U 3,000,000P crystal

Audio Generator (Hewlett Packard Model 200)

Oscilloscope (Tektronix Model 545A)

(1) POWER SUPPLY SECTION. Connect a 75-ohm, 2 watt load at J4. With MODULATION knob in POWER OFF position, connect cable CA-581-1 to J1. OUTPUT knob should be in the fully counterclockwise position. Turn MODULATION knob clockwise to approximately midway position. Positions of other controls are optional. Adjust line voltage to 115 VAC RMS. Using Simpson Voltmeter, the following nominal measurements should be read at terminal block E2.

Terminal No.	Voltage
1	6.3 VAC
2	251 VDC
3	238 VDC
4	143 VDC
5	142 VDC
6	0 VAC
7	6.3 VAC

(2) RF SECTION. Install jumper across terminals 1 and 2 of E1 terminal board. Connect a 75-ohm, 2 watt load at J4. Position GPE panel controls as follows:

TUNING at 3

OUTPUT fully clockwise

MODULATION at PWR OFF

BAND MCS at 2-4

XTAL at EXT

METER at OUTPUT

EMISSION at CW

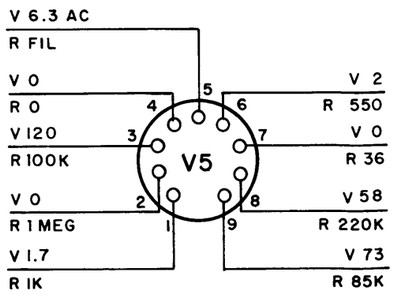
Connect CA-581-1 cable to J1 and 115 VAC line. Turn MODULATION knob slightly clockwise to switch on power. Using a 70-ohm coaxial cable, connect RF Generator at J3 and set at 3-mc and 1-volt. Adjust TUNING knob to obtain maximum reading on GPE meter. The following nominal voltages should be read at J4 on the RF Voltmeter with BAND-MCS knob in positions listed:

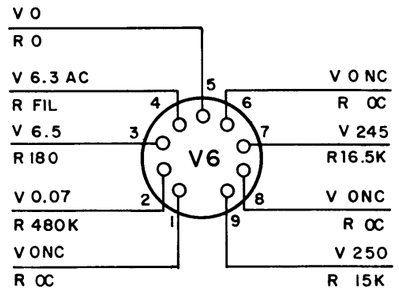
BAND-MCS knob position	RF Voltage at J4
2-4	11.0
4-8	8.1
8-16	7.4
16-32	4.2

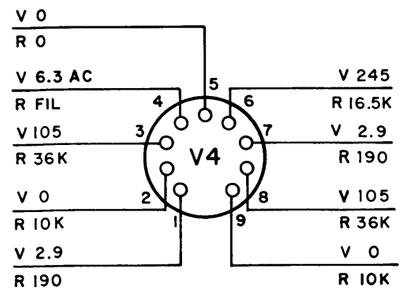
Remove RF Generator from J3. Position XTAL knob at "2". Insert CR27/U 3,000,000P crystal in middle socket in oven. Adjust TUNING knob to obtain maximum reading on GPE meter. The following nominal voltages should be read at J4 on the RF Voltmeter with BAND-MCS knob in positions listed:

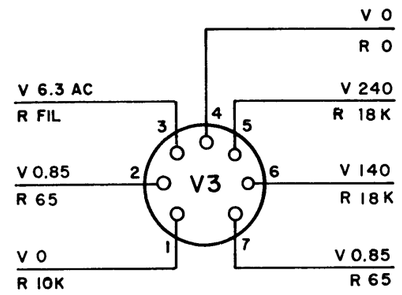
BAND-MCS knob position	RF Voltage at J4
2-4	11.0
4-8	8.1
8-16	7.4
16-32	5.2

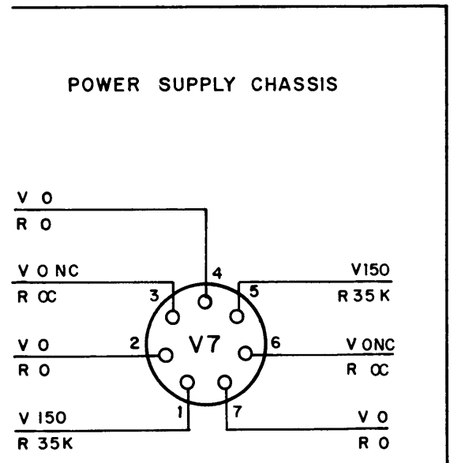
With BAND-MCS knob in the 4 settings above, check the waveform at J4 with the Oscilloscope for 3 mc, 6 mc, 12 mc and 24 mc, respectively. Distortion should not exceed ± 10%.





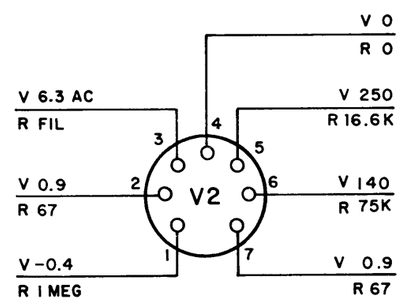






CONDITIONS:

1- POWER ON FOR VOLTAGES; POWER OFF FOR RESISTANCES
2- 70-OHM LOAD AT J4.
3- LINE VOLTAGE 115 VAC.
4 PANEL CONTROL SETTINGS:
TUNING-OPTIONAL
OUTPUT-FULLY CLOCKWISE
MODULATION-FULLY CLOCKWISE
BAND-MCS-2-4
XTAL-EXT
METER-OUTPUT
EMISSION-EXT
5- ALL MEASUREMENTS WITH RESPECT TO GROUND.
6- TEMPORARY JUMPER BETWEEN TERMINALS 1 AND 2 OF E1
7- ALL VOLTAGES DC UNLESS OTHERWISE NOTED.
8- VOLTAGES MEASURED WITH VTVM.



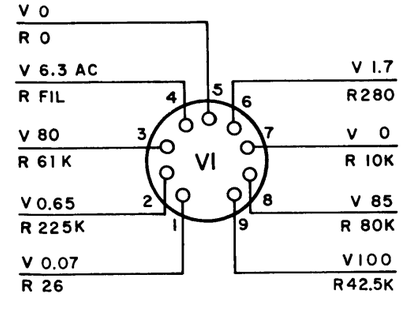


Figure 5-1. Voltage and Resistance Diagram, GPE-1.

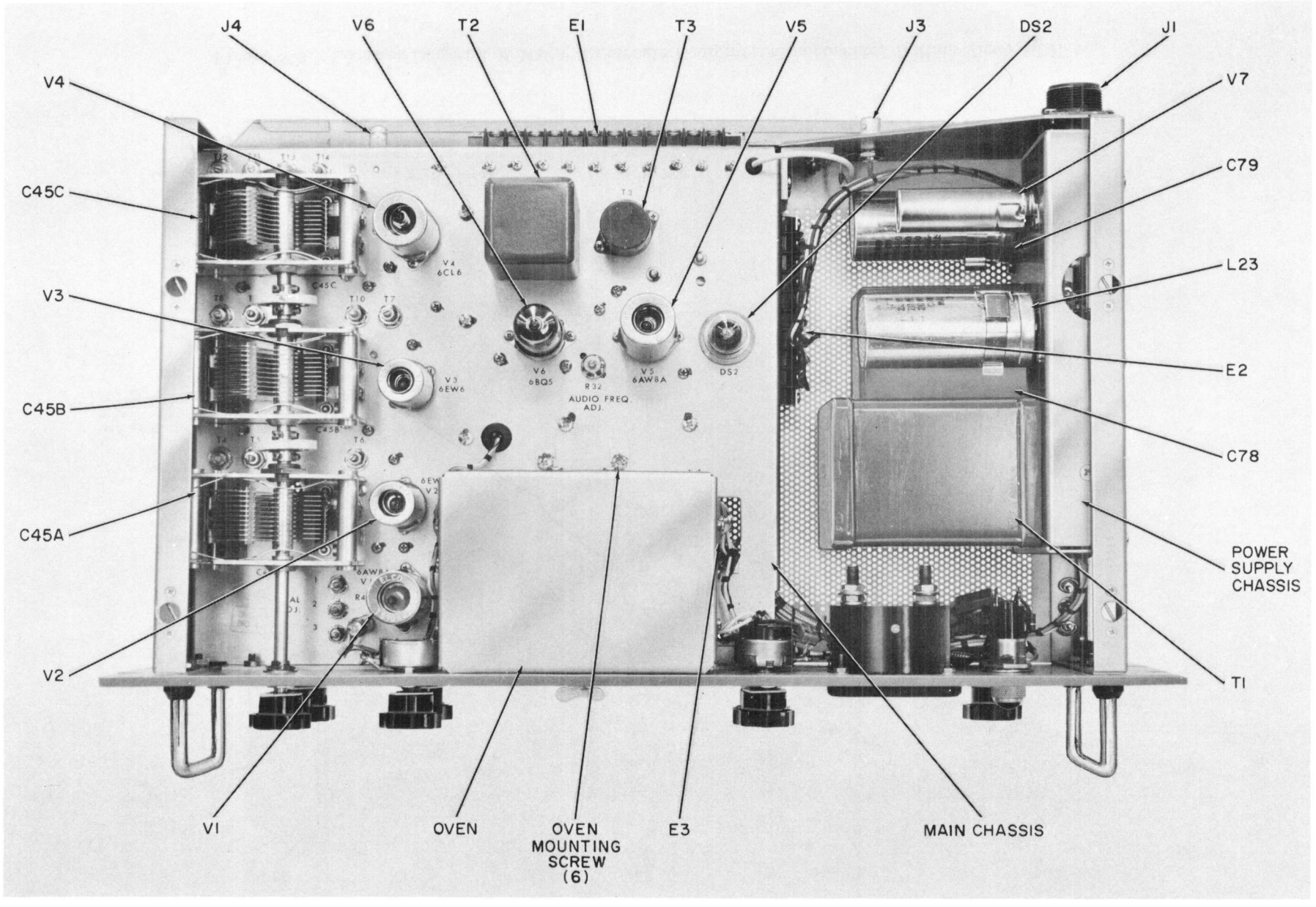


Figure 5-2. Location Diagram of Major Electronic Equipment Components, Top View, GPE-1.

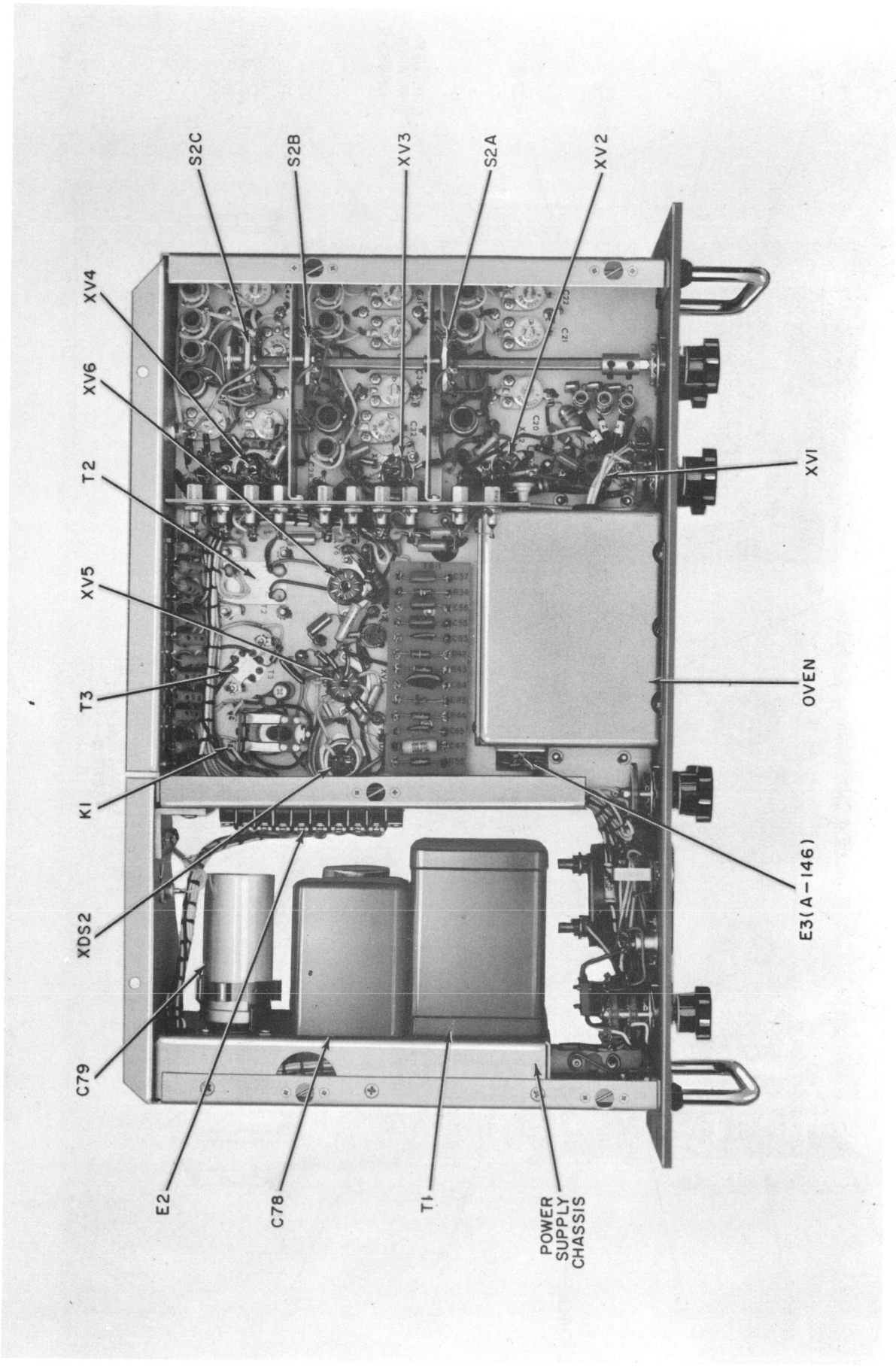


Figure 5-3. Location Diagram of Major Electronic Equipment Components, Bottom View, GPE-1.

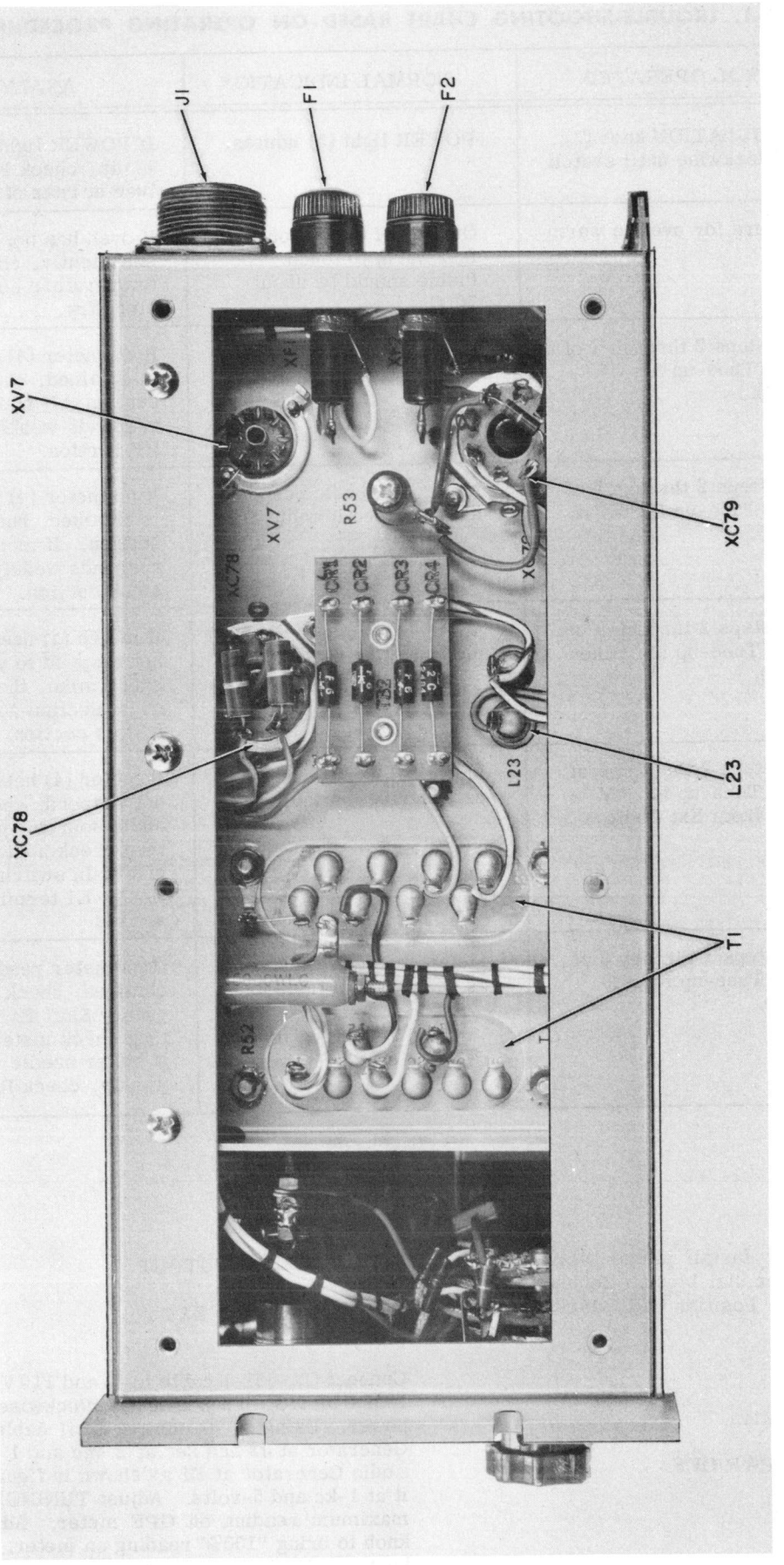


Figure 5-4. Location Diagram of Major Electronic Equipment Components, Power Supply Chassis, Inside View, GPE-1.

TABLE 5-1. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES

STEP	CONTROL OPERATED	NORMAL INDICATION	ANALYSIS
1	Turn MODULATION knob (3) slightly clockwise until switch snaps on.	POWER light (5) ignites.	If POWER light fails to ignite, check F1 (1 amp) fuse at rear of chassis.
2	Wait 2 hours for oven to warm up.	Outside of oven should feel warm to touch. Inside should be about 70° C.	If oven has not heated sufficiently, check oven temperature control circuitry.
3	Perform steps 2 through 7 of table 3-1 (Tune-up for CW Operation).	Meter (4) needle responds as described in table 3-1.	If no meter (4) reading is obtained, check meter section. If meter needle responds weakly, check RF section.
4	Perform steps 2 through 5 of table 3-2 (Tune-up for MCW Operation).	Meter (4) needle responds as described in table 3-2.	If no meter (4) reading is obtained, check meter section. If meter needle responds weakly, check audio section.
5	Perform steps 2 through 9 of table 3-3 (Tune-up for Mike Operation).	Meter (4) needle responds as described in table 3-3.	If meter (4) needle does not respond to voice, check mike, then check audio section and push-to-talk section.
6	Perform steps 2 through 6 of table 3-4 (Tune-up for AM Operation from Ext Audio Source).	Meter (4) needle responds as described in table 3-4.	If meter (4) needle does not respond, check audio source equipment, then check audio section and "talk switch" connection at E1 terminals #8 and #9.
7	Perform steps 1 through 8 of table 3-5 (Tune-up for FS Operation).	Meter needle (4) responds as described in table 3-5.	If no meter reading is obtained, check Frequency Shift Exciter, then check meter section. If meter needle responds weakly, check RF section.

(3) AUDIO SECTION. Install jumper across terminals 1 and 2 of E1 terminal block. Connect a 75-ohm, 2-watt load at J4. Position GPE panel controls as follows:

TUNING at 2

OUTPUT mid-position

MODULATION at PWR OFF

BAND-MCS at 2-4

XTAL at EXT

METER at OUTPUT

EMISSION at EXT

Connect CA-581-1 cable to J1 and 115 VAC line. Turn MODULATION knob slightly clockwise to switch on power. Using a 70-ohm coaxial cable, connect RF Generator at J3 and set at 2 mc and 1 volt. Connect Audio Generator at E1 as shown in figure 5-5 and set it at 1-kc and 5-volts. Adjust TUNING knob to obtain maximum reading on GPE meter. Adjust OUTPUT knob to bring "100%" reading on meter. Turn METER knob to MODULATION position. Adjust MODULA-

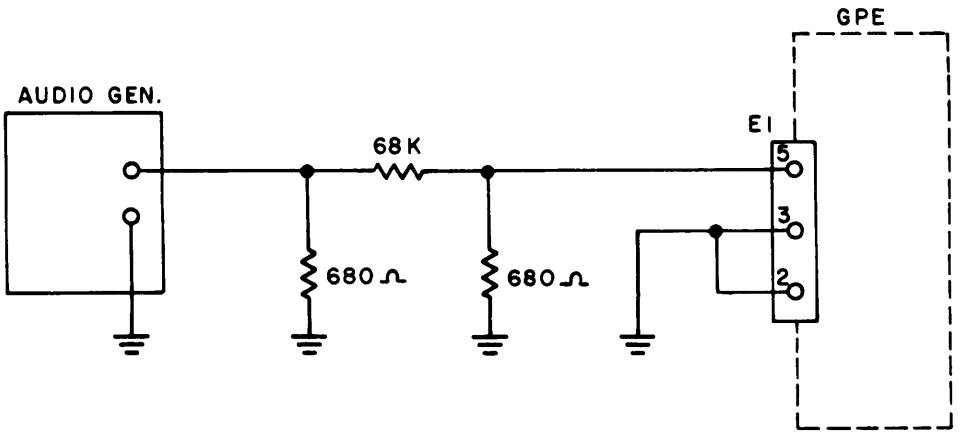


Figure 5-5. Connection of Audio Generator, Audio Section Test

TION knob to bring "90%" reading on meter. Take a-c voltage reading at pin 7 of V6 with RF Voltmeter. Reading should be about 84V RMS. Set EMISSION knob at MCW position. Adjust MODULATION knob to bring "90%" reading on GPE meter. Take a-c voltage reading at pin 7 of V6 with RF Voltmeter. Reading should be about 84V RMS. Attach oscilloscope at J4 and observe modulation envelope. Maximum distortion of envelope should represent about 10%.

SECTION 6
MAINTENANCE

6-1. GENERAL. Maintenance may be divided into three categories: operator's maintenance, preventive maintenance and corrective maintenance. Operator's maintenance for this unit is described in Section 3. Preventive maintenance is included in Section 6. Corrective maintenance is sometimes considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments, existing and/or pending, and information necessary to remedy the equipment troubles and maladjustments. For reasons stated in Section 5, the remedial type of information is presented under corrective maintenance (Section 6) while the diagnosis of information is presented under trouble-shooting (Section 5).

The GPE 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 radio techniques. Otherwise, advantage may be taken of the required specialized test equipment and personnel trained in its use in the Test Department of Technical Materiel Corporation. If trouble develops which cannot be corrected by the procedures outlined in the following paragraphs, it is recommended that the instrument be returned to Technical Materiel Corporation for servicing. To expedite the return of the serviced equipment to you, it is recommended that the equipment be shipped to us by Air Freight and that we be authorized to return it the same way.

In replacing TMC #SS-100-2 Thermal Switch (S6) or either of TMC #RR-102-1 Heater Elements (R56 and R57), the following procedure is recommended. TMC #A-146 Heater Element Terminal Board Assembly consists of S6, R56 and R57 mounted on a terminal board. The terminal board is mounted on the side of the oven, with the components protruding into the oven. Referring to figure 5-2, remove the 6 mounting screws attaching the 3 oven mounting flanges to the main chassis. Open oven door and lift oven up sufficiently to gain screw-driver access to lower mounting screw attaching TMC #A-146 assembly to oven. Then remove this screw and the upper mounting screw and pull out the complete #A-146 assembly. TMC #SS-100-2 Thermal Switch or #RR-102-1 Heater Element may then be replaced individually or the complete #A-146 assembly may be replaced. The latter procedure is recommended for a saving of time and labor. If it is elected to replace the individual component, however, care should be used in handling the component in order to prevent lead breakage at the point where the leads join the body of the component.

6-2. PREVENTIVE MAINTENANCE.

a. GENERAL. 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.

b. AT PERIODIC INTERVALS. At periods of 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; in particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichloroethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichloroethylene or carbon tetrachloride, make sure that adequate ventilation exists. These are toxic substances. Avoid prolonged contact with skin.

c. TUBE CHECK. While unit is out of the rack and covers are removed, it is advisable to check the tubes, all of which are accessible from the top of the chassis.

CAUTION

Tubes should be removed and checked one at a time to eliminate the danger of replacing a tube in the wrong socket. Do not fail to replace tube shields.

d. LOOSE PARTS. Carefully inspect for loose solder connections or screws, especially those on solder lugs. Recommended time interval is every 6 to 12 months, depending on the amount of vibration encountered in service.

6-3. CORRECTIVE MAINTENANCE.

The corrective maintenance procedure presented below is essentially Technical Materiel Corporation's factory alignment procedure for the GPE. In general, however, re-alignment should not be performed indiscriminately.

The following test equipments or their equivalents are required:

RF Signal Generator (Boonton Measurement Model 82)
RF Voltmeter (Hewlett Packard Model 410B)
CR27/U 2,000,000P Crystal
CR27/U 3,000,000P Crystal
CR27/U 4,000,000P Crystal
75-ohm, 2 watt, non-reactive load resistor
Frequency Counter (Hewlett Packard Model 524C)
Oscilloscope (Tektronics Model 545A)

Alignment of the GPE is comprised of the 6 following adjustments and should be performed as shown in table 6-1 and in that order if an overall re-alignment is required.

1. 2-4 mc band tuning
2. 4-8 mc band tuning
3. 8-16 mc band tuning
4. 16-32 mc band tuning
5. Crystal tuning
6. 1-kc oscillator tuning

TABLE 6-1. ALIGNMENT PROCEDURE, GPE-1

ADJUSTMENT	STEP	OPERATION
		NOTE Attach the 75-ohm, 2 watt load resistor at J4 and install jumper between terminals 1 and 2 of E1.
1	1	Position panel controls as follows: TUNING at 2 OUTPUT fully clockwise MODULATION at PWR OFF BAND-MCS at 2-4 XTAL at EXT METER at OUTPUT EMISSION at CW
	2	Connect GPE to line voltage and turn MODULATION knob slightly clockwise until POWER light comes on. Allow 2 hours for oven temperature stabilization.
	3	Observe TUNING capacitor action as TUNING knob is turned clockwise. Check to see that capacitor is fully opened when TUNING knob pointer falls on reference dot on panel (see figure 3-1). Adjust if necessary. Return TUNING knob to "2" position.
	4	Connect RF Signal Generator to J3 and set at 2-mc with sufficient voltage to produce clear reading on GPE panel meter.
	5	Attach RF Voltmeter at J4.

TABLE 6-1. ALIGNMENT PROCEDURE, GPE-1 (Cont.)

ADJUSTMENT	STEP	OPERATION
1 (Cont.)	6	With TUNING knob set at 2 and RF Generator set at 2-mc, tune T7 and T11 transformers for maximum reading on RF Voltmeter.
	7	Set TUNING knob at 4. Set RF Generator for 4 mc. Tune C32 and C43 capacitors for maximum reading on RF Voltmeter.
	8	Repeat steps 6 and 7 to obtain maximum readings in both cases. Lock adjustments.
2	9	Set BAND-MCS knob at 4-8 position.
	10	Set TUNING knob at 2. Set RF Generator for 4-mc. Tune T8, T4 and T12 transformers for maximum reading on RF Voltmeter.
	11	Set TUNING knob at 4. Set RF Generator for 8 mc. Tune C22, C31 and C42 capacitors for maximum reading on RF Voltmeter.
	12	Repeat steps 10 and 11 to obtain maximum readings in both cases. Lock adjustments.
3	13	Set BAND-MCS knob at 8-16 position.
	14	Set TUNING knob at 2. Set RF Generator for 8 mc. Tune T5, T9 and T13 transformers for maximum reading on RF Voltmeter.
	15	Set TUNING knob at 4. Set RF Generator for 16 mc. Tune C21, C30 and C41 capacitors for maximum reading on RF Voltmeter.
	16	Repeat steps 14 and 15 to obtain maximum readings in both cases. Lock adjustments.
4	17	Set BAND-MCS knob at 16-32 position.
	18	Set TUNING knob at 2. Set RF Generator for 16 mc. Tune T6, T10 and T14 transformers for maximum reading on RF Voltmeter.
	19	Set TUNING knob at 4. Set RF Generator for 32 mc. Tune C20, C33 and C44 capacitors for maximum reading on RF Voltmeter.
	20	Repeat steps 18 and 19 to obtain maximum readings in both cases. Lock adjustments.
5	21	Insert 2-mc crystal into position #1 socket in oven (left side). Insert 3-mc crystal into position #2 socket and 4-mc crystal into position #3.

TABLE 6-1. ALIGNMENT PROCEDURE, GPE-1 (C nt.)

ADJUSTMENT	STEP	OPERATION
5 (Cont.)	22	Position panel controls as follows: TUNING at 2 OUTPUT fully counterclockwise MODULATION for power on BAND-MCS at 2-4 XTAL at EXT METER at OUTPUT EMISSION at CW
	23	Set RF Generator (at J3) for 2-mc and 1-volt RMS. Adjust GPE OUTPUT knob to obtain 3.8 V RMS reading on RF Voltmeter (at J4).
	24	Remove RF Voltmeter from J4 and replace with Frequency Counter.
	25	Set XTAL knob in 1 position. Adjust C2 capacitor for an indication of 2,000,000 ± 10 CPS on Frequency Counter. Lock C2.
	26	Set XTAL knob in 3 position. Adjust C4 capacitor for an indication of 4,000,000 ± 20 CPS on Frequency Counter. Lock C4.
	27	Set XTAL knob in 2 position. Adjust C3 capacitor for an indication of 3,000,000 ± 15 CPS on Frequency Counter. Lock C3.
	28	Remove Frequency Counter from J4 and RF Generator from J3.
6	29	Position panel controls as follows: EMISSION at MCW METER at MODULATION TUNING at 3 OUTPUT at mid position BAND-MCS at 8-16 XTAL at 2 MODULATION to obtain "100%" reading on GPE panel meter
	30	Attach Frequency Counter at pin 9 of V5 tube socket. Adjust R33 Audio Frequency Adj. potentiometer to obtain a 1000 CPS indication on Frequency Counter. Lock R33. **NOTE** Upon completion of alignment, remove jumper between terminals 1 and 2 of E1 and load resistor from J4.

SECTION 7
PARTS LIST

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. Parts of the GPE unit are numbered in the 1 to 99 series. A socket associated with a particular plug-in device, such as electron tube or fuse, is identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F1 is designated XF1. 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 names 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 the major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C1	CAPACITOR, fixed: mica, 510 uuf ±5%, 300 WVDC	D-c blocking, VFO input	CM15C511J
C2	CAPACITOR, variable: ceramic, 5-50 uuf	Xtal oscillator tuning	CV-107-1
C3	CAPACITOR, variable: same as C2	Xtal oscillator tuning	CV-107-1
C4	CAPACITOR, variable: same as C2	Xtal oscillator tuning	CV-107-1
C5	CAPACITOR, fixed: mica, 56 uuf ±5%, 300 WVDC	Xtal oscillator coupling	CM15C560J
C6	CAPACITOR, fixed: mica, 47 uuf ±5%, 300 WVDC	V1A cathode bypass	CM15C470J
C7	CAPACITOR, fixed: mica, 27 uuf ±5%, 300 WVDC	D-c blocking, V1B	CM15C270J
C8	CAPACITOR, fixed: ceramic, disc type, .01 uf, 500 WVDC	V1A RF bypass	CC-100-16
C9	CAPACITOR, fixed: ceramic, feed-thru type, 2000 uuf ±20%, 500 WVDC	V1A RF bypass	CK70A202M
C10	CAPACITOR, fixed: same as C8	V1B cathode bypass	CC-100-16
C11	CAPACITOR, fixed: same as C8	V1B RF bypass	CC-100-16
C12	CAPACITOR, fixed: same as C1	D-c blocking, V1B	CM15C511J
C13	CAPACITOR, fixed: same as C8	V1B RF bypass	CC-100-16
C14	CAPACITOR, fixed: same as C9	V1B RF bypass	CK70A202M
C15	CAPACITOR, fixed: ceramic, disc type, .001 uf, 500 WVDC	V2 cathode bypass	CC-100-29
C16	CAPACITOR, fixed: same as C1	D-c blocking, V2	CM15C511J
C17	CAPACITOR, fixed: same as C8	V2 RF bypass	CC-100-16
C18	CAPACITOR, fixed: same as C9	V2 RF bypass	CK70A202M
C19	CAPACITOR, fixed: same as C15	V2 RF bypass	CC-100-29
C20	CAPACITOR, variable: ceramic, 4-30 uuf	Trimmer, 16-32mc band	CV11C300
C21	CAPACITOR, variable: same as C20	Trimmer, 8-16mc band	CV11C300
C22	CAPACITOR, variable: same as C20	Trimmer, 4-8mc band	CV11C300
C23	CAPACITOR, fixed: same as C1	D-c blocking, V3	CM15C511J
C24	CAPACITOR, fixed: same as C15	V3 cathode bypass	CC-100-29

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C25	CAPACITOR, fixed: same as C9	V3 RF bypass	CK70A202M
C26	CAPACITOR, fixed: same as C15	V3 RF bypass	CC-100-29
C27	CAPACITOR, fixed: same as C1	D-c blocking, V3	CM15C511J
C28	CAPACITOR, fixed: mica, button type, 1000 uuf ±5%, 300 WVDC	V3 RF bypass	CB21PD102J
C29	CAPACITOR, fixed: same as C9	V3 RF bypass	CK70A202M
C30	CAPACITOR, variable: same as C20	Trimmer, 8-16mc band	CV11C300
C31	CAPACITOR, variable: same as C20	Trimmer, 4-8mc band	CV11C300
C32	CAPACITOR, variable: same as C20	Trimmer, 2-4mc band	CV11C300
C33	CAPACITOR, variable: same as C20	Trimmer, 16-32 mc band	CV11C300
C34	CAPACITOR, fixed: same as C1	D-c blocking, V4	CM15C511J
C35	CAPACITOR, fixed: metallized paper, .47 uf ±20%, 200 WVDC	P/O key-click filter, V4	CP106C474-2
C36	CAPACITOR, fixed: same as C8	V4 RF bypass	CC-100-16
C37	CAPACITOR, fixed: same as C15	V4 RF bypass	CC-100-29
C38	CAPACITOR, fixed: same as C1	D-c blocking, V4	CM15C511J
C39	CAPACITOR, fixed: same as C15	V4 RF bypass	CC-100-29
C40	CAPACITOR, fixed: same as C9	V4 RF bypass	CK70A202M
C41	CAPACITOR, variable: same as C20	Trimmer, 8-16mc band	CV11C300
C42	CAPACITOR, variable: same as C20	Trimmer, 4-8 mc band	CV11C300
C43	CAPACITOR, variable: same as C20	Trimmer, 2-4mc band	CV11C300
C44	CAPACITOR, variable: same as C20	Trimmer, 16-32mc band	CV11C300
C45A	CAPACITOR, variable: air, 12.5-270 uuf 2-7/8 inch and 7/16 inch shaft lengths	V2 output tuning	CB-159-3
C45B	CAPACITOR, variable: air, 12.5-270 uuf, 7/16 inch and 1/2 inch shaft lengths	V3 output tuning	CB-159-2
C45C	CAPACITOR, variable: air, 12.5-270 uuf 1/2 inch and 1/4 inch shaft lengths	V4 output tuning	CB-159-1

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C46	CAPACITOR, fixed: same as C9	RF bypass, V1 and V2	CK70A202M
C47	CAPACITOR, fixed: mylar, .05 uf ±5%, 400 WVDC	S6 arc suppressor	CN-113-1
C48	CAPACITOR, fixed: same as C9	V4 RF bypass	CK70A202M
C49	CAPACITOR, fixed: same as C9	V4 RF bypass	CK70A202M
C50	CAPACITOR, fixed: same as C9	V4 RF bypass	CK70A202M
C51	CAPACITOR, fixed: ceramic, disc type, 0.1 uf, 500 WVDC	V5A RF bypass	CC-100-32
C52	CAPACITOR, fixed: tantalum, electrolytic, 25 WVDC, 6.0 uf, -15% +75%	V5A time constant	CE-107-3
C53	CAPACITOR, fixed: ceramic, disc type, .005 uf, 500 WVDC	D-c blocking, V5A	CC-100-15
C54	CAPACITOR, fixed: same as C5	V5A RF bypass	CM15C560J
C55	CAPACITOR, fixed: mica, 360 uuf ±5%, 300 WVDC	V5A phase shift	CM15C361J
C56	CAPACITOR, fixed: same as C55	V5A phase shift	CM15C361J
C57	CAPACITOR, fixed: same as C55	V5A phase shift	CM15C361J
C58	CAPACITOR, fixed: mica, 1,600 uuf ±5%, 500 WVDC	Mike input, d-c blocking	CM20C162J
C59	CAPACITOR, fixed: same as C1	Mike input, coupling	CM15C511J
C60	CAPACITOR, fixed: tantalum electrolytic, 50 uf +50% -15%, 60 WVDC	V5B time constant	CE-107-1
C61	CAPACITOR, fixed: same as C8	D-c blocking, V5B	CC-100-16
C62	CAPACITOR, fixed: same as C60	V6 time constant	CE-107-1
C63	CAPACITOR, fixed: same as C8	D-c blocking, meter	CC-100-16
C64	CAPACITOR, fixed: same as C51	D-c blocking, meter	CC-100-32
C65	CAPACITOR, fixed: same as C8	RF bypass, meter	CC-100-16
C66	CAPACITOR, fixed: same as C9	RF bypass, meter	CK70A202M
C67	CAPACITOR, fixed: same as C8	RF bypass, meter	CC-100-16
C68	CAPACITOR, fixed: same as C8	D-c blocking, meter	CC-100-16
C69	CAPACITOR, fixed: same as C28	V3 and V4 RF bypass	CB21PD102J
C70	CAPACITOR, fixed: same as C28	Audio input RF bypass	CB21PD102J
C71	CAPACITOR, fixed: same as C28	Audio input RF bypass	CB21PD102J

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
C72	CAPACITOR, fixed: same as C28	Audio input RF bypass	CB21PD102J
C73	CAPACITOR, fixed: same as C28	RF bypass, talk switch	CB21PD102J
C74	CAPACITOR, fixed: same as C28	RF bypass, Xmitter on-off	CB21PD102J
C75	CAPACITOR, fixed: same as C28	RF bypass, Xmitter on-off	CB21PD102J
C76	CAPACITOR, fixed: same as C28	RF bypass, receiver output	CB21PD102J
C77	CAPACITOR, fixed: same as C28	RF bypass, receiver output	CB21PD102J
C78	CAPACITOR, fixed: electrolytic, 20-20-20 ufd, 450 WVDC, octal socket plug-in type	Ripple filter, plate supply	CE-108-1
C79	CAPACITOR, fixed: same as C78	Capacitor-input filter	CE-108-1
C80	CAPACITOR, fixed: tantalum electrolytic, 6 uf ± 20%, 100 WVDC	P/O key-click filter, V1B	CE-107-2
C81	CAPACITOR, fixed: same as C9	V1B RF bypass	CK70A202M
C82	CAPACITOR, fixed: same as C9	RF bypass, V4 filament	CK70A202M
C83	CAPACITOR, fixed: same as C9	RF bypass, V3 filament	CK70A202M
C84	CAPACITOR, fixed: same as C28	RF bypass, carbon mike	CB21PD102J
C85	CAPACITOR, fixed: mica, 24 uuf ±5%, 300 WVDC	P/O Xtal osc. tuning	CM15C240J
C86	CAPACITOR, fixed: same as C85	P/O Xtal osc. tuning	CM15C240J
C87	CAPACITOR, fixed: same as C85	P/O Xtal osc. tuning	CM15C240J
C88	CAPACITOR, fixed: same as C80	P/O key-click filter, V3	CE-107-2
C89	CAPACITOR, fixed: same as C28	V1B RF bypass	CB21PD102J
CR1	DIODE, silicone: rectifier, 600V max. peak inverse	Power supply rectifier	DD-101-1
CR2	DIODE, silicone: same as CR1	Power supply rectifier	DD-101-1
CR3	DIODE, silicone: same as CR1	Power supply rectifier	DD-101-1
CR4	DIODE, silicone: same as CR1	Power supply rectifier	DD-101-1

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
CR5	DIODE, germanium: JEDEC type 1N-100	Rectifier, meter	1N-100
CR6	DIODE, germanium: same as CR5	Rectifier, meter	1N-100
CR7	DIODE, germanium: same as CR5	Rectifier, V1B bias	1N-100
DS1	LAMP, incandescent: min. bayonet base, 6-8v, 0.15 amp, brown T-3-1/4 bulb	POWER indicator light	BI-101-47
DS2	LAMP, incandescent: min. double bayonet base, 120v, 3 watts, S-6 bulb	V5A cathode current control	BI-102-3
E1	BOARD, terminal: barrier type, 12 #6-32 binding head machine screws, bakelite body	External connections	TM-100-12
E2	BOARD, terminal: barrier type, 8 #6-32 binding head machine screws, bakelite body	Power supply output connection	TM-100-8
E3	BOARD ASSEMBLY, component: consists of R56, R57, S6 and terminal board	Oven heater circuit assembly	A-146
F1	FUSE, cartridge: 1.5 amp., slow blow	Input power fuse	FU-102-1.5
F2	FUSE, cartridge: 1/4 amp., slow blow	Rectifier protection	FU-102-.250
J1	CONNECTOR, receptacle: MIL type MS3102A16S5P	Power input connector	MS3102A16S5P
J2	CONNECTOR, receptacle: telephone jack, JAN type JJ-034	KEY JACK panel connector	JJ-034
J3	CONNECTOR, receptacle: RF coaxial, series BNC, type UG-625/U	EXT VFO connector	UG-625/U
J4	CONNECTOR, receptacle: same as J3	RF output connector	UG-625/U
J5	CONNECTOR, receptacle: 6 contact, female, screened multi-pole, panel mounting	MIKE input connector	JJ-212
K1	RELAY, DPDT: make-break, d-c current coil, 120v	Push-to-talk relay	RL-116-DC-2C-120
L1	COIL, RF: 2.5 mh ±10%, 100 ma	RF choke, V1A	CL-140-1
L2	COIL, RF: 120 uh ±10% min., Q=55 @ 790-kc	Low pass filter, V1A	CL-240-120
L3	COIL, RF: same as L2	Low pass filter, V2	CL-240-120
L4	COIL, RF: same as L2	Low pass filter, V2	CL-240-120
L5	COIL, RF: same as L2	Low pass filter, V2	CL-240-120
L6	COIL, RF: same as L2	Low pass filter, keyer	CL-240-120

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
L7	COIL, RF: same as L2	Low pass filter, V3	CL-240-120
L8	COIL, RF: same as L2	Low pass filter, V3	CL-240-120
L9	COIL, RF: same as L2	Low pass filter, keyer	CL-240-120
L10	COIL, RF: same as L2	Low pass filter, V4	CL-240-120
L11	COIL, RF: same as L2	Low pass filter, V3	CL-240-120
L12	COIL, RF: same as L2	Low pass filter, V4	CL-240-120
L13	COIL, RF: same as L2	Low pass filter, V4	CL-240-120
L14	COIL, RF: same as L2	Low pass filter, keyer	CL-240-120
L15	COIL, RF: same as L2	Low pass filter, 600-ohm input	CL-240-120
L16	COIL, RF: same as L2	Low pass filter, 600-ohm input	CL-240-120
L17	COIL, RF: same as L2	Low pass filter, 600-ohm input	CL-240-120
L18	COIL, RF: same as L2	Low pass filter, talk switch	CL-240-120
L19	COIL, RF: same as L2	Low pass filter, Xmitter on-off	CL-240-120
L20	COIL, RF: same as L2	Low pass filter, Xmitter on-off	CL-240-120
L21	COIL, RF: same as L2	Low pass filter, receiver input	CL-240-120
L22	COIL, RF: same as L2	Low pass filter, receiver input	CL-240-120
L23	CHOKE, filter:10 henries min., 250-ohms d-c, 150 ma.	Power supply choke	TF-232
L24	COIL, RF: same as L2	Low pass filter, mike input	CL-240-120
L25	COIL, RF: same as L2	Low pass filter, keyer	CL-240-120
M1	METER, microamp: 0-25 ua.	Modulation carrier level indicator	MR-151
P1	CONNECTOR, plug: AC power, 3-prong, male, (integral part of W1)	Mates with line voltage	PL-171

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
P2	CONNECTOR, plug: MIL type MS3106A16S5S (P/O W1)	Mates with J1	MS3106A16S5S
	CONNECTOR, plug: 6 contact, male, pressure moulded for round cable (2 included in shipment)	Mates with J5 - for making mike cables	PL-208
	CONNECTOR, plug: RF coaxial, series BNC, for RG-59/U cable (2 included in shipment)	Mates with J3 and J4 - for making RF cables	UG-260/U
R1	RESISTOR, fixed: composition, 68-ohms ±10%, 1/2 watt	VFO input ground return	RC20GF680K
R2	RESISTOR, fixed: composition, 220K ±10%, 1/2 watt	V1A grid detector	RC20GF224K
R3	RESISTOR, fixed: composition, 22K ±10%, 1/2 watt	V1A plate voltage drop	RC20GF223K
R4	RESISTOR, fixed: composition, 10K ±10%, 1/2 watt	V1B grid detector	RC20GF103K
R5	RESISTOR, fixed: composition, 100-ohms ±10%, 1/2 watt	V1B cathode bias	RC20GF101K
R6	RESISTOR, fixed: composition, 10K ±10%, 2 watt	V1B plate load	RC42GF103K
R7	RESISTOR, fixed: composition, 5.6K ±10%, 1 watt	V1B voltage drop	RC32GF562K
R8	RESISTOR, fixed: composition, 47K ±10%, 1/2 watt	V1B screen load	RC20GF473K
R9	RESISTOR, fixed: composition, 1K ±5%, 1/2 watt	V1B voltage drop	RC20GF102J
R10	RESISTOR, fixed: composition, 1 MEG ±10%, 1/2 watt	V2 grid detector	RC20GF105K
R11	RESISTOR, fixed: composition, 39-ohms ±10%, 1/2 watt	Suppressor, V2	RC20GF390K
R12	RESISTOR, fixed: composition, 56-ohms ±10%, 1/2 watt	V2 cathode bias	RC20GF560K
R13	RESISTOR, fixed: same as R11	V2 plate load	RC20GF390K
R14	RESISTOR, fixed: composition, 47K ±10%, 1/2 watt	V2 screen load	RC20GF473K
R15	RESISTOR, fixed: same as R4	V3 grid detector	RC20GF103K
R16	RESISTOR, fixed: composition, 10-ohms ±10%, 1/2 watt	Suppressor, V3	RC20GF100K
R17	RESISTOR, fixed: composition, 56-ohms ±10%, 1/2 watt	P/O key-click filter, V3	RC20GF560K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R18	RESISTOR, fixed: same as R16	V3 plate load	RC20GF100K
R19	RESISTOR, fixed: same as R9	V3 voltage drop	RC20GF102J
R20	RESISTOR, fixed: same as R4	V4 grid detector	RC20GF103K
R21	RESISTOR, fixed: same as R16	Suppressor, V4	RC20GF100K
R22	RESISTOR, fixed: composition, 180-ohms ±10%, 1/2 watt	P/O key-click filter, V4	RC20GF181K
R23	RESISTOR, fixed: composition, 18K ±10%, 1/2 watt	V4 cathode bias	RC20GF183K
R24	RESISTOR, fixed: same as R16	V4 plate load	RC20GF100K
R25	RESISTOR, fixed: composition, 15K ±10%, 1/2 watt	V4 voltage drop	RC20GF153K
R26	RESISTOR, fixed: composition, 100K ±10%, 2 watt	V4 cathode-to-plate bias	RC42GF104K
R27	RESISTOR, fixed: composition, 180K ±10%, 1/2 watt	V5A screen load	RC20GF184K
R28	RESISTOR, fixed: same as R8	V5A plate load	RC20GF473K
R29	NOT USED		
R30	RESISTOR, fixed: composition, 150K ±10%, 1/2 watt	V5A grid detector/ phase shift	RC20GF154K
R31	RESISTOR, fixed: composition, 8.2 MEG ±10%, 1/2 watt	V5A voltage drop, oscillator feedback	RC20GF825K
R32	RESISTOR, variable: composition, 1 MEG ±10%, linear taper	Frequency adj., V5A oscillator	RV106UX10-C105A
R33	RESISTOR, fixed: same as R8	Phase shift, V5A	RC20GF473K
R34	RESISTOR, fixed: composition, 100K ±10%, 1/2 watt	Phase shift, V5A	RC20GF104K
R35	RESISTOR, variable: composition, 1 MEG ±10%, linear taper, 2 watt, with SPST switch	MODULATION level potentiometer	RV4BTRD105A
R36	RESISTOR, fixed: same as R9	V5B cathode bias	RC20GF102J
R37	RESISTOR, fixed: composition, 68K ±10%, 1/2 watt	V5B plate load	RC20GF683K
R38	RESISTOR, fixed: composition, 470K ±10%, 1/2 watt	V6 grid detector	RC20GF474K
R39	RESISTOR, fixed: composition, 470-ohms ±10%, 1/2 watt	Voltage drop, carbon mike supply	RC20GF471K
R40	RESISTOR, fixed: composition, 680-ohms ±10%, 1/2 watt	Terminating resistor, T3	RC20GF681K

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
R41	RESISTOR, fixed: composition, 180-ohms ±10%, 2 watts	V6 cathode bias	RC42GF181K
R42	RESISTOR, fixed: composition, 750K ±10%, 1/2 watt	Voltage dropping, meter	RC20GF754J
R43	RESISTOR, fixed: composition, 4.7K ±10%, 1/2 watt	Meter voltage divider	RC20GF472K
R44	RESISTOR, fixed: composition, 27K ±10%, 1/2 watt	Voltage dropping, meter	RC20GF273K
R45	RESISTOR, fixed: same as R44	Voltage dropping, meter	RC20GF273K
R46	RESISTOR, fixed: same as R39	Meter voltage divider	RC20GF471K
R47	RESISTOR, fixed: composition, 1.8K ±10%, 1/2 watt	RF voltage drop, meter	RC20GF182K
R48	RESISTOR, variable: WW, 25K ±10%, linear taper, 5 watts	OUTPUT level adjustment, T2	RA-109TRD-253A
R49	RESISTOR, fixed: WW, 10K, 32 ma, 10 watts	Terminating, T2 output	RW-109-34
R50	RESISTOR, fixed: composition, 1K ±10%, 1 watt	Voltage divider, power supply	RC32GF102K
R51	RESISTOR, fixed: same as R50	Voltage divider, power supply	RC32GF102K
R52	RESISTOR, fixed: WW, 10K, 25.5 ma, 10 watts	Voltage divider, power supply	RW-109-34
R53	RESISTOR, fixed: WW, 400-ohms, 112 ma, 5 watts	Voltage divider, power supply	RW-107-26
R54	RESISTOR, fixed: composition, 6.8K ±5%, 1/2 watt	Voltage dropping, power supply	RC20GF682J
R55	RESISTOR, fixed: same as R5	S6 arc suppressor	RC20GF101K
R56	ELEMENT, heater: 20 watts, cartridge type, flexible leads	Heating element for oven	RR-102-1
R57	ELEMENT, heater: same as R56	Heating element for oven	RR-102-1
R58	RESISTOR, fixed: WW, 20K, 22 ma, 10 watts	Voltage drop, K1 coil	RW-109-37
R59	NOT USED		
R60	RESISTOR, fixed: same as R9	V3 loading	RC20GF102J
S1	SWITCH, rotary: 1 section, 4 positions, non-shorting	XTAL and EXT VFO selector	SW-286

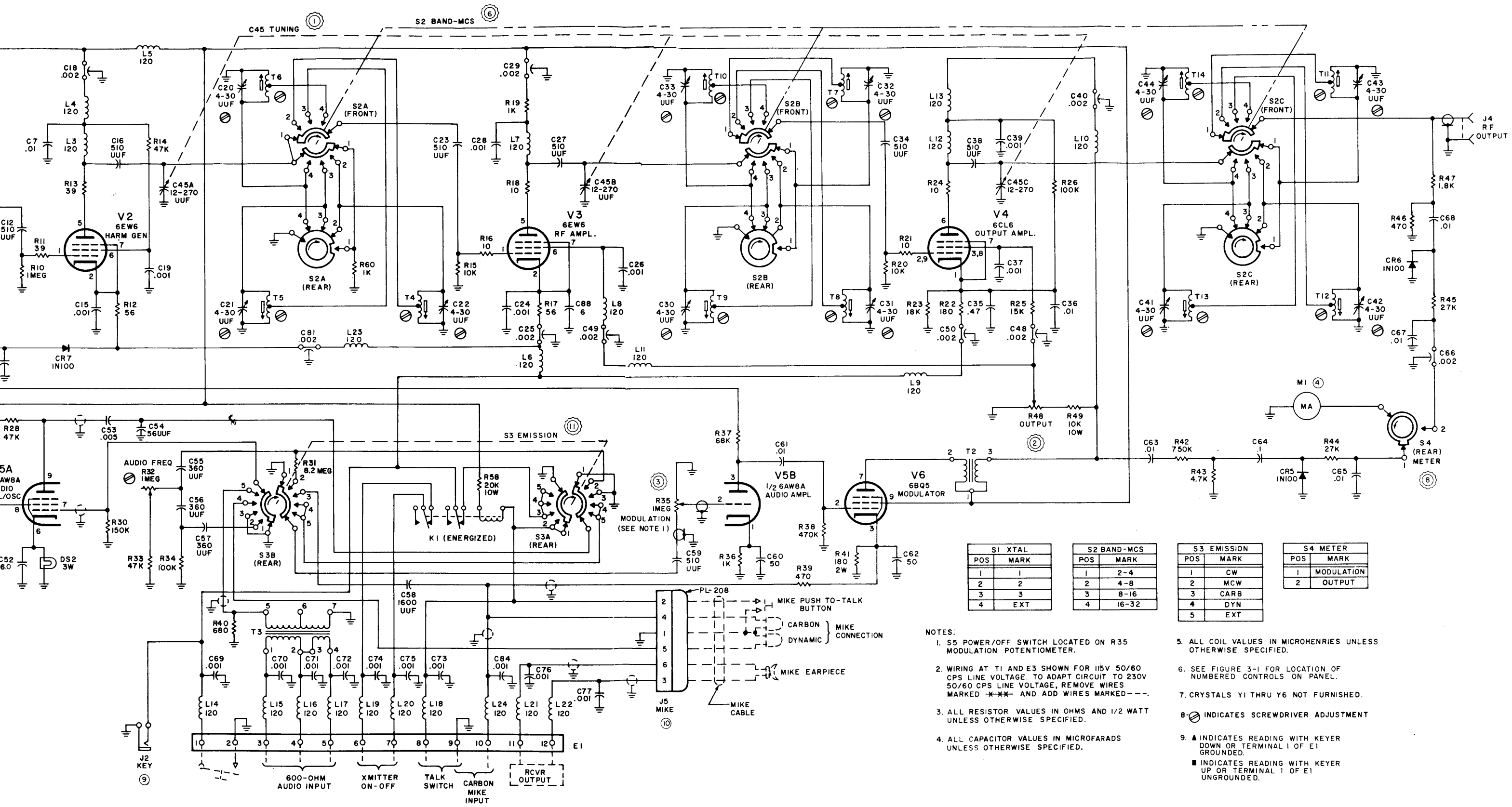
SYM	DESCRIPTION	FUNCTION	TMC PART NO.
S2A	SWITCH, rotary: 1 wafer, 4 positions, shorting	BAND-MCS selector, 1st RF stage	*WS-101
S2B	SWITCH, rotary: same as S2A	BAND-MCS selector, 2nd RF stage	*WS-101
S2C	SWITCH, rotary: same as S2A	BAND-MCS selector, 3rd RF stage	*WS-101
S3	SWITCH, rotary: 2 sections, 5 positions, non-shorting	EMISSION selector	SW-285
S4	SWITCH, rotary: 1 section, 2 positions, non-shorting	METER reading selector	SW-287
S5	SWITCH, SPST: part of R35	POWER/OFF switch	
S6	SWITCH, thermal: bimetallic, opening temp. 70°C ± 2°C	Oven thermostat	SS-100-2
T1	TRANSFORMER, power: Prim: 105V, 115V, 125V, 210V, 230V, 50/60 CPS 1Ø. Sec: 175-0-175 VRMS at 125 ma, 6.3V at 3.6 amps, 6.3V at 1.0 amp, 6.3V at 2.5 amp.	Plate and filament supply	TF-227
T2	TRANSFORMER, modulation: Prim: 5K at 45 ma dc ±10%, Sec: 10K at 30 ma dc ±10%, Freq. Response, 300 CPS to 10,000 CPS within 3db., Power 5 watts	Impedance match	TF-233
T3	TRANSFORMER, audio: Prim imp. 150/600-ohms, Sec imp. 600-ohms C.T., Response 50-10,000 CPS ±2db	Impedance match	TF-170
T4	TRANSFORMER, RF tuned: 4-8 Mcs, 3.7 uh, Q = 70 at 7.9 Mcs	4-8 mc band tuning	TT-137
T5	TRANSFORMER, RF tuned: 8-16 Mcs, 1.1 uh, Q = 70 at 7.9 Mcs	8-16 mc band tuning	TT-135
T6	TRANSFORMER, RF tuned: 16-32 Mcs, 0.4 uh, Q = 170 min. at 25 Mcs	16-32 mc band tuning	TT-139
T7	TRANSFORMER, RF tuned: 2-4 Mcs, 25.5 uh, Q = 40 at 2.5 Mcs	2-4 mc band tuning	TT-138
T8	TRANSFORMER, RF tuned: same as T4	4-8 mc band tuning	TT-137
T9	TRANSFORMER, RF tuned: same as T5	8-16 mc band tuning	TT-135
T10	TRANSFORMER, RF tuned: same as T6	16-32 mc band tuning	TT-139

*WS-101 is part number for wafer only.

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
T11	TRANSFORMER, RF tuned: 2-4 Mcs, 25.5 uh, Q = 40 at 2.5 Mcs	2-4 mc band tuning	TT-134
T12	TRANSFORMER, RF tuned: same as T4	4-8 mc band tuning	TT-137
T13	TRANSFORMER, RF tuned: 8-16 Mcs, 1.1 uh, Q = 70 at 7.9 Mcs	8-16 mc band tuning	TT-136
T14	TRANSFORMER, RF tuned: 16-32 Mcs., 0.4 uh, Q = 170 min. at 25 Mcs	16-32 mc band tuning	TT-140
V1	TUBE, electron: triode-pentode	RF Amplifier/ Oscillator	6AW8A
V2	TUBE, electron: pentode	Harmonic Generator	6EW6
V3	TUBE, electron: same as V2	RF Amplifier	6EW6
V4	TUBE, electron: power amplifier pentode	Output Amplifier	6CL6
V5	TUBE, electron: same as V1	Audio Amplifier/ Oscillator	6AW8A
V6	TUBE, electron: power pentode	Modulator	6BQ5
V7	TUBE, electron: glow-discharge diode voltage regulator	Voltage regulator, power supply	0A2
W1	CABLE ASSEMBLY, a-c power: consists of 6-foot a-c cable, P1 and P2	A-c power cable	CA-385
XC78	SOCKET, tube: octal, low crown	C78 socket	TS-101-P01
XC79	SOCKET, tube: same as XC78	C79 socket	TS-101-P01
XDS1	SOCKET, lamp: miniature bayonet base, red frosted lens, solder terminals	DS1 socket	TS-106-1
XDS2	SOCKET, lamp: miniature double bayonet base, solder terminals	DS2 socket	TS-108-2
XF1	HOLDER, fuse: extractor post type	F1 holder	FH-100-2
XF2	HOLDER, fuse: same as XF1	F2 holder	FH-100-2
XV1	SOCKET, tube: 9-pin miniature	V1 socket	TS-103-P01
XV2	SOCKET, tube: 7-pin miniature	V2 socket	TS-102-P01
XV3	SOCKET, tube: same as XV2	V3 socket	TS-102-P01
XV4	SOCKET, tube: same as XV1	V4 socket	TS-103-P01
XV5	SOCKET, tube: same as XV1	V5 socket	TS-103-P01

SYM	DESCRIPTION	FUNCTION	TMC PART NO.
XV6	SOCKET, tube: same as XV1	V6 socket	TS-103-P01
XV7	SOCKET, tube: 7-pin miniature	V7 socket	TS-102-P01
XY1	SOCKET, crystal: for type CR-27/U crystal	Y1 socket	TS-104-1
XY2	SOCKET, crystal: for type CR-27/U crystal	Y2 socket	TS-104-1
XY3	SOCKET, crystal: for type CR-27/U crystal	Y3 socket	TS-104-1
XY4	SOCKET, crystal: for type FT-243 crystal	Y4 socket	TS-105-1
XY5	SOCKET, crystal: for type FT-243 crystal	Y5 socket	TS-105-1
XY6	SOCKET, crystal: for type FT-243 crystal	Y6 socket	TS-105-1
Y1	CRYSTAL, quartz: type CR-27/U, parallel resonant frequency in 2-4 Mc range. Not furnished with GPE-1	Frequency Control, Xtal oscillator	
Y2	CRYSTAL, quartz: same as Y1	Frequency Control, Xtal oscillator	
Y3	CRYSTAL, quartz: same as Y1	Frequency Control, Xtal oscillator	
Y4	CRYSTAL, quartz: type FT-243, parallel resonant frequency in 2-4 Mc range. Not furnished with GPE-1	Frequency Control, Xtal oscillator	
Y5	CRYSTAL, quartz: same as Y4	Frequency Control, Xtal oscillator	
Y6	CRYSTAL, quartz: same as Y4	Frequency Control, Xtal oscillator	

SECTION 8
SCHEMATIC DIAGRAMS



S1 XTAL	
POS	MARK
1	1
2	2
3	3
4	EXT

S2 BAND-MCS	
POS	MARK
1	2-4
2	4-8
3	8-16
4	16-32

S3 EMISSION	
POS	MARK
1	CW
2	MCW
3	CARB
4	DYN
5	EXT

S4 METER	
POS	MARK
1	MODULATION
2	OUTPUT

NOTES:

1. S5 POWER/OFF SWITCH LOCATED ON R35 MODULATION POTENTIOMETER.
2. WIRING AT T1 AND E3 SHOWN FOR 115V 50/60 CPS LINE VOLTAGE. TO ADAPT CIRCUIT TO 230V 50/60 CPS LINE VOLTAGE, REMOVE WIRES MARKED ~~XXX~~ AND ADD WIRES MARKED - - -.
3. ALL RESISTOR VALUES IN OHMS AND 1/2 WATT UNLESS OTHERWISE SPECIFIED.
4. ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
5. ALL COIL VALUES IN MICROHENRIES UNLESS OTHERWISE SPECIFIED.
6. SEE FIGURE 3-1 FOR LOCATION OF NUMBERED CONTROLS ON PANEL.
7. CRYSTALS Y1 THRU Y6 NOT FURNISHED.
8. ⊘ INDICATES SCREWDRIVER ADJUSTMENT
9. ▲ INDICATES READING WITH KEYER DOWN OR TERMINAL 1 OF E1 GROUNDED.
   ■ INDICATES READING WITH KEYER UP OR TERMINAL 1 OF E1 UNGROUNDED.

Figure 8-1. Schematic Diagram, General Purpose Exciter, GPE-1.

REF. CK-510 REV J