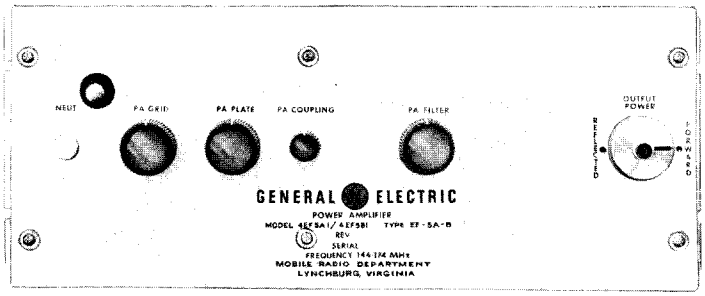
MOBILE RADIO

MASTR Progress Line

POWER AMPLIFIER MODEL 4EF5A1 & 4EF5B1 (OPTION 7045)



POWER AMPLIFIER

SPECIFICATIONS *

FCC Type Number:	EF-5-A & EF-5-B: Power Amplifier
Frequency Range:	144-174 MHz
Used With:	Exciter Type ET-57-A, B and Power Supply Type EP-6-A, B to provide a 250-watt or a 330-watt transmitter
Power Input:	117 VAC, 50/60 Hz Standby: 2 amps Transmit: 9 amps
Power Output: (4EF5A1) (4EF5B1)	 330 Watts (±10%) 250 Watts
Tube Complement:	(1) 4CX250B or 7032/4CX250B
AM Hum and Noise Level:	Down 34 dB
Rated Duty Cycle:	Continuous -- Blower recommended for cabinet ventilation under conditions of high ambient temperatures or continuous duty operation.
Ambient Temperature Range:	-30°C to +60°C (-22°F to +144°F)
Dimensions (H x W x D):	7" x 19" x 11"
Weight:	30 pounds

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

TABLE OF CONTENTS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

General Electric Power Amplifier Models 4EF5A1 (330-watt) and 4EF5B1 (250-watt) were designed for use in fixed stations operating in the 144-174 megahertz band, using an external exciter and power supply. The amplifier employs a 4CX250B as a Power Amplifier tube, with forced-air cooling provided by a blower mounted on the power supply. Standard RETMA rack-mounting dimensions are used. The tuning controls most frequently used are located on the front of the unit.

All the power connections, except the high voltage connection, are made with a 6-pin plug from the front of the unit. High voltage is brought to the plate at the rear of the plate compartment.

Antenna relay keying voltage connections are made behind the Output Power Indicator, using screw connections. The RF drive connection is made by an RG-58/U cable plugged into the exciter from the front of the unit.

CIRCUIT ANALYSIS

Excitation to the Power Amplifier at P482 is fed to coupling loop L482 and coupled to coil L484, which, with C481, forms the grid tank of the amplifier. By adjusting the PA GRID control (C481), the grid tank may be tuned to the operating frequency. Coil L481 isolates RF from the power cable.

Heater voltage on the Power Amplifier tube V481 may be varied on the power supply chassis. C482, C483 and C484 are RF by-pass capacitors and R481 is used as a screen RF de-coupling resistor. Built into the tube socket, XV481, is a ring-type capacitor which is used as a screen grid by-pass.

All input voltage connections to the Power Amplifier, except the B-plus voltage connection, are made at P481 on the front side of the panel. The 2000-volt B-plus lead is connected at terminal PO-2 located in the rear on the plate cavity cover. C485 provides by-passing for the B-plus and L485 is an RF choke. The plate tank is composed of C488 and L494. The plate tank is tuned to the operating frequency by adjusting the PA PLATE control C488.

Adjusting the PA COUPLING control varies the coupling from the plate to the output by controlling the amount of magnetic flux linking the plate line to the filter line. L483 couples energy from the PA FILTER cavity to J481. The signal from J481 is connected to the antenna through P1 and P2 on the Reflectometer and through the contacts on the antenna relay K482.

Output Power Meter

The Output Power Meter (Reflectometer) indicates forward and reflected power output when used with a 0-3 VDC meter (use external probe from meter switching unit).

The probe samples the magnetic field caused by current in the transmission line and the electrical field from the voltage on the line. On a properly matched line, these two voltages are equal and cancel each other when reading REFLECTED power ("0" reflected power). When the probe is rotated 180°, these two voltages add to indicate FORWARD power.

When the load is not matched, these two voltages become unequal and provide a ratio of incident (forward) to reflected power. Any significant change in this ratio (if other than 1:1) after initial installation and check out, should be cause for examination of the antenna and feed line. Actual V.S.W.R. as measured on a calibrated bridge, should remain below 1.5:1 at all times.

Antenna Relay

K482, the antenna relay switches the antenna from the receiver to the transmitter when the transmitter is keyed.

MAINTENANCE

PREVENTIVE MAINTENANCE

To obtain optimum performance from the equipment, a program of regular preventive maintenance should be followed. This preventive maintenance should include the following:

1. A check of the operating frequency as required by the Federal Communications Commission.
2. A check of the PA PLATE current, Power Amplifier GRID current and PA PLATE voltage meter readings.
3. A check of the PA plate tuning and reflected power (if any) and realignment if improper operation is indicated.

4. A check for loose nuts, screws, cables and parts.

5. An inspection of the high- and low-voltage connections.

POWER AMPLIFIER TUBE REPLACEMENT

To remove the Power Amplifier tube, proceed as follows:

1. Remove the high-voltage lead from PO-2, located on the rear of the Power Amplifier.

2. Loosen the winged screws holding the rear cover plate to the assembly.

3. Slide off the rear cover plate.

4. Insert the prongs of the tube extractor (included with the station equipment) between the cooling fins of the PA tube plate.

5. Pull the tube straight out from the socket.

To reinsert the Power Amplifier tube, proceed as follows:

1. Insert the prongs of the tube extractor between the cooling fins of the PA tube plate.

2. Push the PA tube all the way into the socket while observing the key on the tube and socket. The tube extractor may be left on the tube cooling fins.

3. Replace the rear cover plate of the Power Amplifier.

4. Tighten the winged screws on the rear cover plate.

5. Replace the high-voltage lead to PO-2 on the rear of the Power Amplifier.

NEUTRALIZING ASSEMBLY REPLACEMENT

If it should become necessary to replace any part of the neutralizing assembly, it is recommended that the entire assembly be replaced.

To replace the assembly, proceed as follows:

1. Remove all four knobs on the front of the power amplifier.

2. Remove the 6 screws holding the outer front plate, and remove plate.

3. Remove the 14 hex-head screws holding the inner front plate (left side), and remove the plate.

4. Unsolder the wire from the solder terminal of the neutralizing assembly.

5. Remove the back cover and remove the nut holding the neutralizing assembly in place.

6. Install the new assembly.

ALIGNMENT PROCEDURE

This Bench Alignment Procedure is provided for completely re-aligning and loading Power Amplifier Model 4EF5A1, B1, using the ET-57-A or B as an Exciter Unit.

Before tuning the Power Amplifier, the Exciter must be aligned according to the ALIGNMENT PROCEDURE.

1. Connect the antenna or some other suitable 50-ohm load to the top jack on the Power Amplifier antenna relay.

2. Turn the PLATE switch OFF on the PA Power Supply.

3. Turn the SCREEN adjust on the PA Power Supply fully counterclockwise.

   Note - If it has not already been done, remove the fuse and make jumper connections on Power Supply EP-38-A as indicated in the maintenance manual for the EP-38-A. This will limit plate voltage on the ET-57-A or B to 300 volts, which is proper for the exciter service.

4. Place the power switches located on the Control Panel and Exciter Power Supply EP-38-A to the ON position. Turn the PA Power Supply CONTROL switch to the ON position. Allow 15-minutes for warmup.

5. Connect a microphone to the MIKE jack on the Exciter Power Supply.

6. Pull the PA COUPLING control out to its limit. Turn control clockwise until it engages with the coupling window. Push control in all the way to its back limit. Withdraw control approximately 1/4-inch from the back limit. Connect the red lead from meter switch panel to grid jack (J452-green on PA power supply) and rotate switch to external probe.

7. While keying the Exciter, tune the PA GRID for maximum PA GRID current at the GRID jack. A reading of 2.5-volts (25-mA of grid drive) should be obtained on the TUNING METER. If the reading is low, refer to the TRANSMITTER ALIGNMENT PROCEDURE for the Exciter.

8. Turn the PLATE switch on the PA Power Supply to the ON position.

9. While keying the Exciter, adjust the PA PLATE control for a minimum reading at the PA PLATE current meter.

10. Connect the red lead from the Meter Switching Panel to the jack on the front of the PA OUTPUT METER. Rotate OUTPUT METER to the FORWARD position.

11. While keying the Exciter, adjust the PA FILTER for maximum meter reading at the OUTPUT METER jack.

12. Increase the SCREEN control approximately one-half turn clockwise. While keying the exciter, the PA PLATE current should not exceed 250-mA (see note).

NOTE

If the power supply is in Revision D or later (or has been modified according to DATA FILE Bulletin 0036-5), both PA screen current (approximately 25 mA) and PA plate current pass through the PA PLATE current meter. To obtain actual PA plate current, subtract 25 mA from the meter reading. For example, 250 mA of plate current will be indicated as 275 mA on the meter. If the power supply is in Revision C or earlier (and has not been modified according to DATA FILE Bulletin 0036-5) the meter measures PA plate current directly.

13. While the Exciter is being keyed, pull the PA COUPLING a small amount, to a maximum of 275 mA at the PA PLATE current meter.

14. While keying the Exciter, readjust the PA PLATE control for minimum reading at the PA PLATE current meter.

15. Repeat steps 11, 13 and 14 above until the licensed power output or power input is reached. Do not exceed 275 mA at the PA PLATE current meter.

16. Carefully turn the PA COUPLING control counterclockwise to disengage it from the internal coupling window. Push the PA COUPLING control in to its back limit.

NEUTRALIZING

1. Turn the PLATE switch OFF on the PA Power Supply.

2. Turn the Power switch OFF on the Exciter Power Supply.

3. Block the contacts closed on the PA antenna relay (Use a piece of tape to hold the contacts).

4. Disconnect the antenna cable from the ANT jack on the PA antenna relay.

5. Disconnect the PA input cable from the output of the Exciter.

6. Connect a short coaxial cable from the ANT jack on the Exciter to the ANT jack on the PA antenna relay.

CAUTION

Failure to have the PLATE switch in the OFF position when performing step 7 through 11 below, can result in damage to the equipment.

7. The Exciter output will now be feeding into the Power Amplifier output for neutralizing the PA.

8. Turn the Exciter Power switch ON. Do not turn on the PLATE switch on the PA Power Supply.

9. Connect a lead from the TUNING METER to the GRID jack J452-green, located on the PA Power Supply.

10. Adjust the PA Grid, PA Filter and the Exciter output for maximum PA Grid current.

11. Using an insulated tuning tool, adjust the NEUTRALIZER adjustment (located under the plug button in the front of the Power Amplifier unit), for minimum PA Grid current.

12. Turn the Power switch OFF on the Exciter Power Supply.

13. Open the rear door on the Station cabinet, remove the block from the relay contacts, disconnect the coaxial cable, replace the PA antenna cable and replace the Exciter output cable.

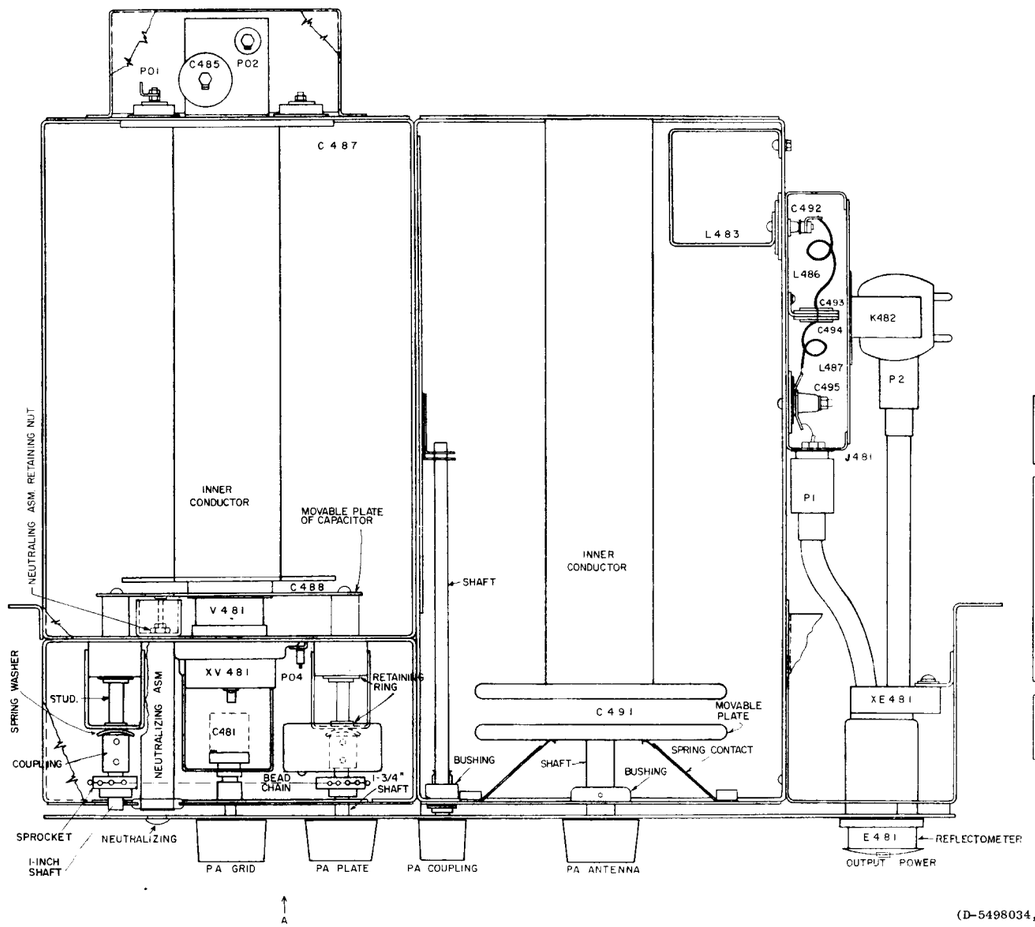
14. Close the rear door.

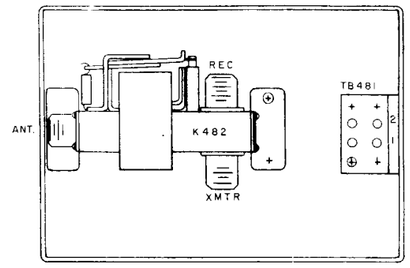
15. Turn the Exciter Power Supply Switch ON.

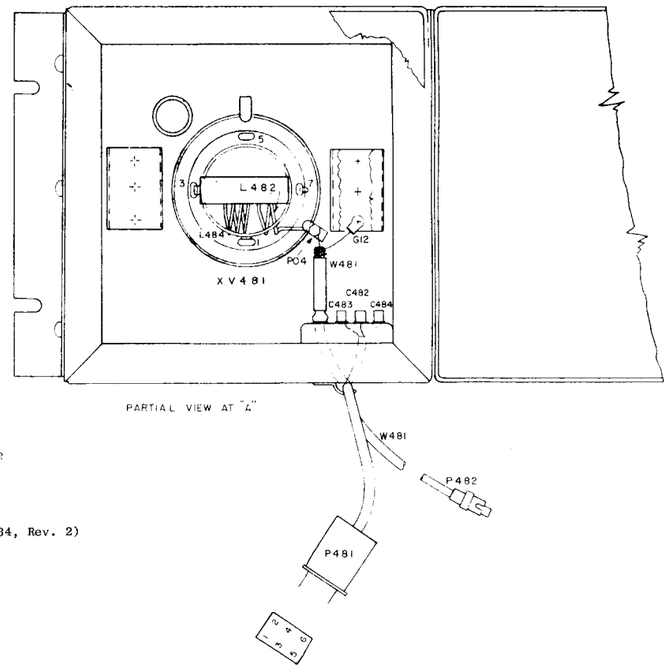
16. Repeat steps 3 through 16 of ALIGNMENT PROCEDURE above until no further gain can be obtained. Do not exceed 275 mA at the PA PLATE current meter.

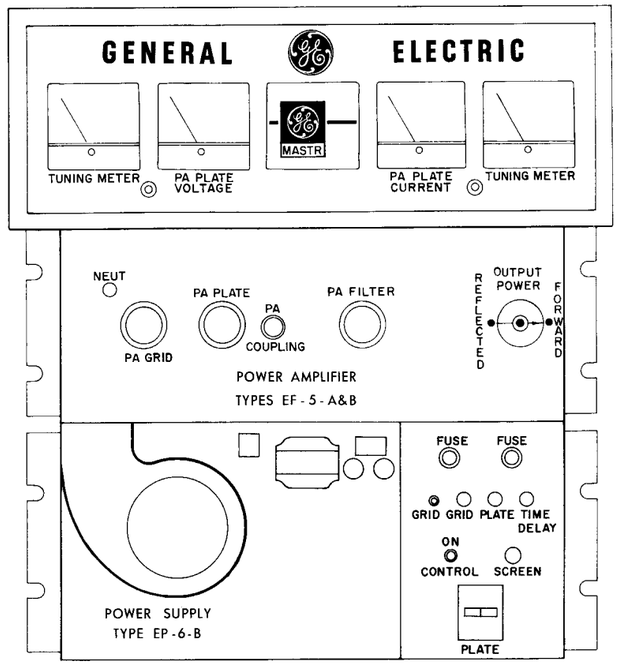
REDUCED POWER OUTPUT

When operation at a reduced power output is desired, reduce the power output by adjusting the SCREEN control (R461) on the power supply 4EP6B1. Do not use the PA COUPLING control on the 4EF5A1 to reduce power output.









(D-5498034, Rev. 2)

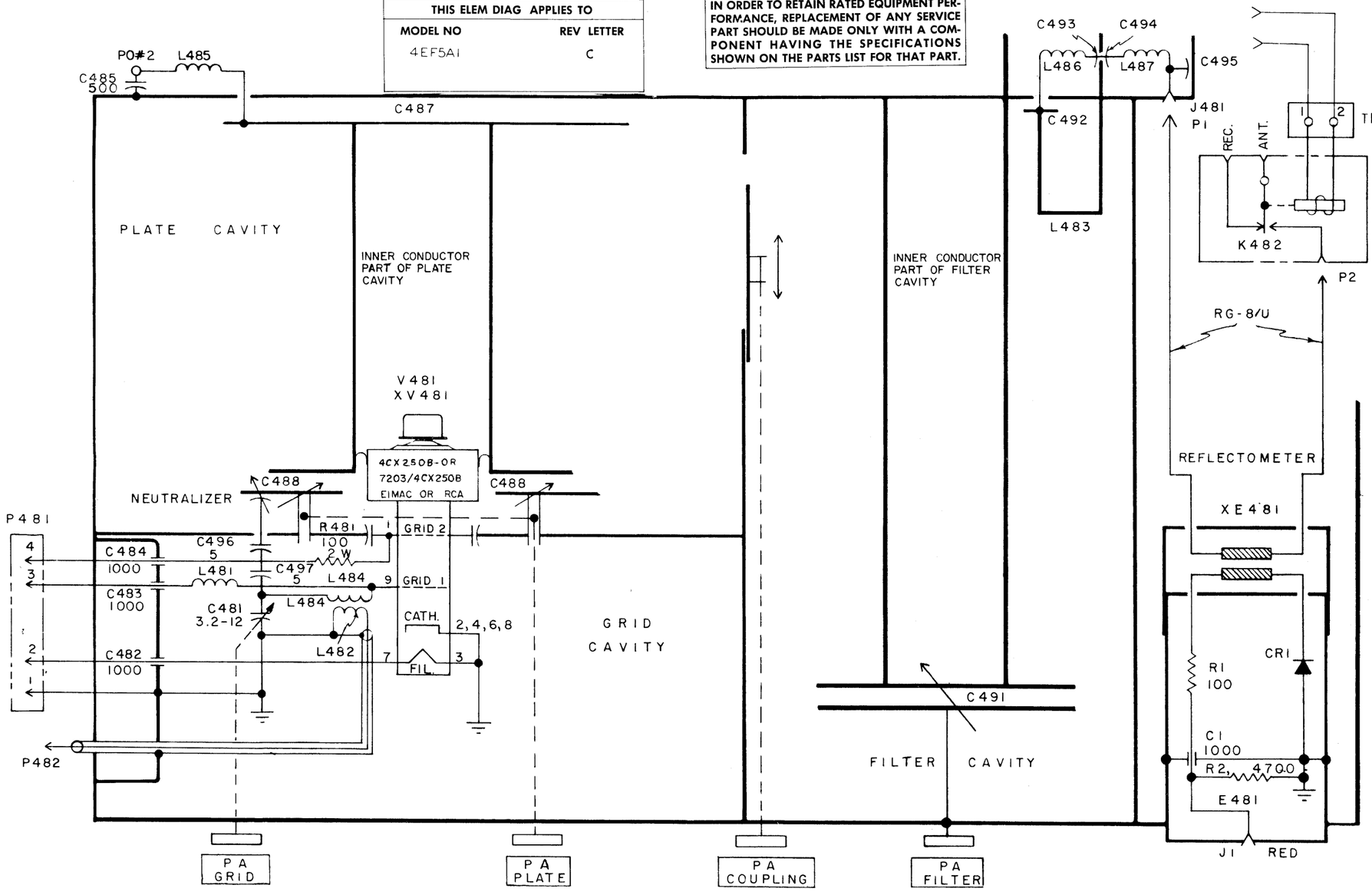
OUTLINE DIAGRAM

144—174 MHZ, 250 & 330 WATT
MASTR POWER AMPLIFIER
MODELS 4EF5A1 & 4EF5B1

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EF5A1	C

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.



(C-5494558, Rev. 12)

SCHEMATIC DIAGRAM

144—174 MHZ, 250 & 330 WATT
MASTR POWER AMPLIFIER
MODELS 4EF5A1 & 4EF5B1

PARTS LIST

EBI-41738E

POWER AMPLIFIER 144-174 MHz
MODEL 4EF5A1
MODEL 4EF5B1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C481	7491398P1	Variable, air: approx 3.6 to 12 pf; sim to Teleradio T-9476.
C482 thru C484	7485975P19	Ceramic, feed-thru: 1000 pf ±20%, 500 VDCW; sim to Erie Style 327.
C485	7481652P23	Ceramic: 500 pf +50% -20%, 20 000 VDCW; sim to Centralab DA208.
C487		Capacitor, feed-thru: Quantity
	4029766G1	Inner Conductor Assembly (Plate Cavity Inner Conductor) 1
	5490189P1	Printed Wiring Board 1
	4035306P50	Fibre washer: 0.875 inches od, 0.719 inches id. 4
	4029112P1	Ceramic bushing. 4
		Fibre washer: 0.500 inches od, 0.188 inches id. 4
	401P8	Plain washer: No. 8. 5
	7135118P2	Terminal. 1
	N414P16	Lockwasher: No. 8. 4
	N207P15	Nut: No. 8. 5
	N83P15012	Screw: No. 8. 4
C488		Capacitor, PA Plate, Tuning: Quantity
	4029766G1	Inner Conductor Assembly (see C487) (Plate Cavity Inner Conductor)
	4029712G2	Movable capacitor plate. 1
	4029361P1	Bracket. 2
	4029605G1	Block. 2
	N900P50C	Retaining ring: 0.770 in. od, 0.461 in.id 2
	4029601P1	Stud. 2
	7109043P3	Retaining ring: 0.339 in. od, 0.260 in.id 2
	7160815P3	Spring washer. 2
	4029810P2	Coupling sleeves. 2
	4029870P1	Bead chain. 1
	4029056P1	Sprocket (Bead Chain Pulley). 2
	4031997P1	Set screw: No. 8 (Set Screw for Pulley). 2
	4029955P1	Plate. 1
	4029954P1	Shaft: 1.060 inches long. 1
	4029954P2	Shaft: 1.760 inches long. 1
	AN70P1503C13	Set screw: No. 8. 1
	7487773P6	Control knob. 1
C491		Capacitor, PA Filter, Tuning: Quantity
	4029763G1	Inner Conductor Assembly. (Plate Cavity Inner Conductor) 1
	4029670P1	Movable capacitor plate. 1
	N83P150008	Screw: No. 8, 0.500 inches long. 1
	4039772G1	Spring contact: (Finger stock to Capacitor plate). 1
	4029424P1	Shaft: (NOTE: Attached to Capacitor plate by Screw No. 8). 1
	4029939P1	Nut plate. 2
	N414P13	Lockwasher: No. 6. 1
	N81P13005	Screw: No. 6, 1
	N83P13006C13	Screw: No. 6, 0.500 inches long. 1
	4029422P1	Bushing for Shaft. 1
	4031104P1	Spring Plunger. 1
	N83P9004	Screw: No. 4. 1
	N401P41	Plain washer: 0.250 inches in dia. 1
	AN70P1503C13	Set screw: No. 8. and 1
	7487773P6	Control knob. 1
C492		Capacitor, feed-thru: Quantity
	N81P13016	Machine screw: No. 6. 1
	4029693P1	Aluminum Plate. 1
	4029691P1	Teflon Plate. 1
	5495049P1	Outer Conductor. 1
	4035237P1	Nylon washer. 1
	5491426G1	Box Assembly. 1
	N401P41	Plain washer: No. 6. 1
	7479752P11	Ceramic bushing. 1
	7872492P1	Fibre washer: No. 6. 1
	7135118P2	Terminal. 1
	207P13	Nut: No. 6. 2
C493 and C494		Capacitor, Stand-off: Quantity
	4029887P1	Angle. 1
	N81P9010	Machine screw: No. 4. 2
	N414P11	Lockwasher: No. 4. 4
	N401P5	Plain washer: No. 4. 4
	7135118P1	Terminal. 2
	4029886P1	Aluminum Plate. 2
	4029889P1	Teflon Plate. 2
	4035237P2	Nylon washer. 2
	N207P9	Nut: No. 4. 2

SYMBOL	GE PART NO.	DESCRIPTION
C495		Capacitor, Stand-off: Quantity
	N81P13016	Machine screw: No. 6. 1
	N401P67	Plain washer: No. 6. 1
	5490426G1	Box Assembly. 1
	4029691P1	Teflon Plate. 1
	4029692P1	Aluminum Plate. 1
	4035237P1	Nylon washer. 1
	7875267P1	Terminal. 2
	7479752P11	Ceramic bushing. 1
	7872492P1	Fibre washer: No. 6. 1
	N207P13	Nut: No. 6. 1
C496 and C497	3R122P27	Silver mica: 5 pf ±10%, 500 VDCW; sim to Electro Motive Mfg. CM15.
		- - - - - - MISCELLANEOUS ELECTRICAL PART - - - -
E481	4029629G1	Reflectometer Probe: consists of the following components with E481 prefix.
E481-C1	7160807P1	Ceramic, feed-thru: 1000 pf +100% -0%, 500 VDCW.
E481-CR1	7777146P2	Diode, Germanium.
E481-J1	7150763P2	Test Point, jack, tip, stake-in: red nylon body, sim to Alden Products 110BC1.
E481-R1	3R77P101J	Resistor, composition: 100 ohms ±5%, 1/2 w.
E481-R2	3R77P472J	Resistor, composition: 4700 ohms ±5%, 1/2 w.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J481	2R22P3	Receptacle, coaxial: sim to Amphenol 83-1R.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K482	7479680P2	Relay, coax: 140 VDC nominal, 7000 ohms ±10% coil res, 1 form C contact; sim to Amphenol 300-11294.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L481	7772834P5	Choke, RF: 1.8 μh ±10%, 0.33 ohms ±15% DC res, freq range 80-200 MHz; sim to Ohmite Z-144.
L482	4029883P1	Coil: 2 turns, left hand wound.
L483	4029694P1	Loop, output.
L484	4031669G1	Coil assembly.
L485*	19B228007P1	Coil.
		In REV B and earlier:
	7772834P5	Choke, RF: 1.8 μh, 1000 ma, freq range 75 to 190 MHz; sim to Ohmite Z-144.
L486 and L487	4029693P1	Coil.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P481	7473192P25	Plug: 6 male contacts, cable clamp in cap; sim to HB Jones P-306-CCT.
P482		Plug: included in W481.
		- - - - - - - - - - POST - - - - - - - - - -
P02		Post, insulated.
	7133855P35	Stud: No. 6, Quantity 1
	N207P13	Nut: No. 6, 3
	7878453P2	Terminal, lug. 1
	4035306P10	Fibre washer: 0.50 in. od, 0.156 in. id. 2
	4035306P2	Fibre washer: 0.50 in. od, 0.266 in. id. 2
	7479752P11	Ceramic bushing. 1
	7479752P1	Ceramic bushing. 1
	7867274P1	Wing nut. 1
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R481	3R79P101K	Composition: 100 ohms ±10%, 2 w.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - -
TB481	4029538P1	Terminal board, phen: 2 terminals; sim to HB Jones 2-164-3/4W-EP.
		- - - - - - - - - - TUBES - - - - - - - - - -
V481	4039217P1	Tube: sim to EIMAC or RCA Type 4CX250B or 7203/4CX250B.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CABLES - - - - - - - - - -
W481	7488600P16	Cable assembly: Includes 32.75 in. of RG-58A/U cable, short phono plug molded on one end.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XE481	5490188G2	Reflectometer housing: Includes the following with XE481 prefix:
XE481P1 and XE481P2	2R22P1	Plug, coaxial: 2 piece straight plug; sim to Signal Corps PL-259 or Amphenol 83-1SP. 2 sections of RG-8/U Cable.
XV481	5490373P2	Tube: octal; sim to Eitel-McCullough SK610.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	4029892P1	Tube extractor: steel, 4 inches long; sim to Eitel-McCullough SK601.
	5490363G2	Front plate. (Used with 4EF5A1).
	5490363G4	Front plate. (Used with 4EF5B1).
	19B216740G1	Neutralizing Assembly.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A & B - 4EF5A1
Incorporated into initial shipment.

REV. C - To incorporate a new choke.
Changed L485.

FIG.1 - PARTS BREAKDOWN: C492 THRU C495

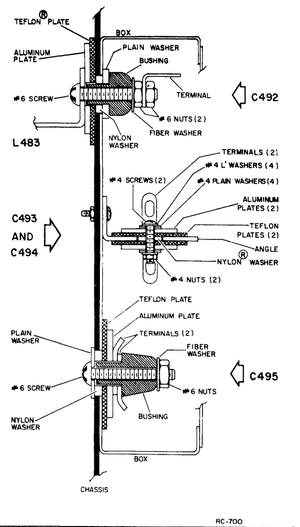


FIG. 2 - PARTS BREAKDOWN: C487, P01 & P02