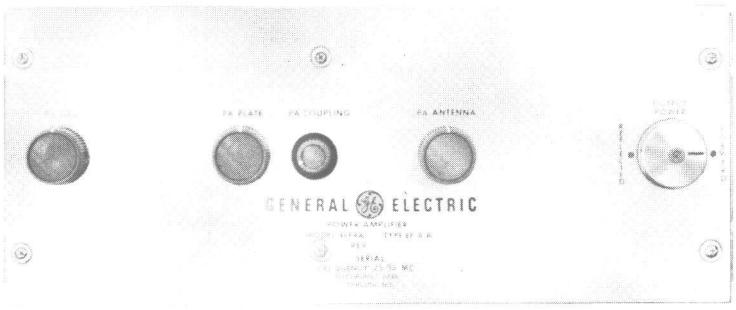
Sun Pipeline

MOBILE RADIO

MASTR Progress Line

POWER AMPLIFIER MODELS 4EF4A1,2,3



POWER AMPLIFIER

EF-4-A

SPECIFICATIONS *

Model Number	4EF4A1, 2, 3
FCC Type Number	EF-4-A: Power Amplifier
Frequency Range	4EF4A1: 25-33 MHz 4EF4A2: 33-42 MHz 4EF4A3: 42-50 MHz
Used With	Exciter Type ET-54-A and Power Supply Type EP-6-A, B to provide 330-watt transmitter
Power Input	117 VAC, 50/60 Hz Standby: 2 amps Transmit: 9 amps
Power Output	330 Watts
Tube Complement	(1) 4CX250B or 7203/4CX250B
AM Hum and Noise Level	Down 34 dB
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	18 pounds

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

GENERAL ELECTRIC

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 keep the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

General Electric Power Amplifier Models 4EF4A1, A2 and A3 have been designed for use in 330-watt stations operating in the 25-54 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 of the Power Amplifier at P428 is fed to coupling loop L482 and coupled to the coil L484, (C498 and L488 in Model 4EF4A3), 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 decoupling 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 bypassing 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 coupling loop to the output loop. The filter consists of L490, L491, L492, L493, C492, C493, L494, and C495. Antenna coupling is adjusted by the PA ANTENNA control C489. The signal is fed from the filter 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 tuning and reflected power (if any) and realignment if improper operation is indicated.
3. A check of the PA PLATE current, Power Amplifier GRID current and PA PLATE voltage meter readings.
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.

Blower

The blower motor bearings are to be lubricated every 2000 hours of operation. A small oil can for this purpose is mounted on the power supply chassis, at the right of the blower motor. Use the oil recommended in the Parts List. (See Parts List on back of Schematic Diagram.)

REDUCED POWER OUTPUT

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

ALIGNMENT PROCEDURE

This Bench Alignment Procedure is provided for completely realigning and loading Power Amplifier Models 4EF4A1, 2, 3 using the ET-54-A as an Exciter unit.

Before tuning the Power Amplifier, the Exciter must be aligned according to the Exciter 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-54-A to 300 Volts, which is proper for exciter service.

4. Place the power switches located on the Control Panel and Exciter Power Supply EP-39-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 jack on the Exciter Power Supply.

6. Loosen the locking ring on the PA COUPLING control and push the control in and turn fully counterclockwise. 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 a maximum PA GRID voltage of 2.5 Volts at the GRID jack. After this adjustment, be sure that the exciter grid voltage indication on the tuning meter is between 0.75 and 1.0 Volts for Models 4EF4A1, A2 and between 2.0 and 2.5 Volts for Model 4EF4A3 as read on 3-Volt scale in order to obtain maximum RF power output and efficiency. (If the reading is not within these limits, 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 the OUTPUT METER to the Forward position.

11. While keying the Exciter, adjust the PA FILTER control 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.

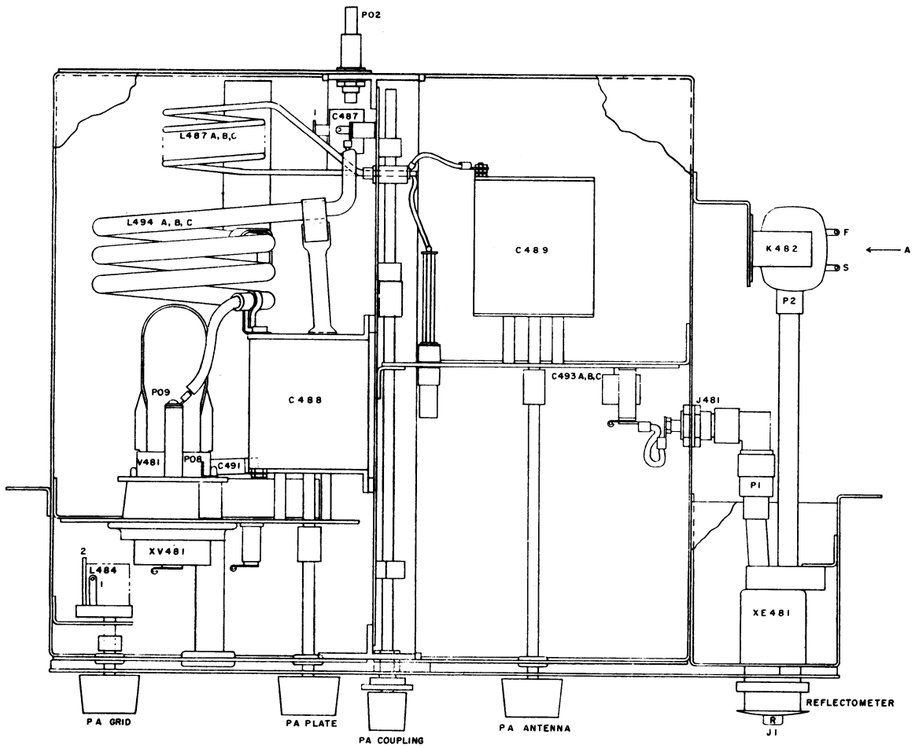
13. Tighten the PA COUPLING control locking nut, just enough to support the control.

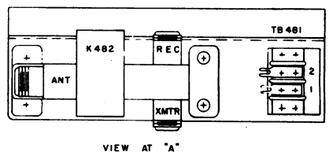
14. While the Exciter is being keyed, rotate the PA COUPLING to a maximum of 275 mA at the PA PLATE current meter. For fine adjustment of coupling, the PA COUPLING control may be pushed or pulled.

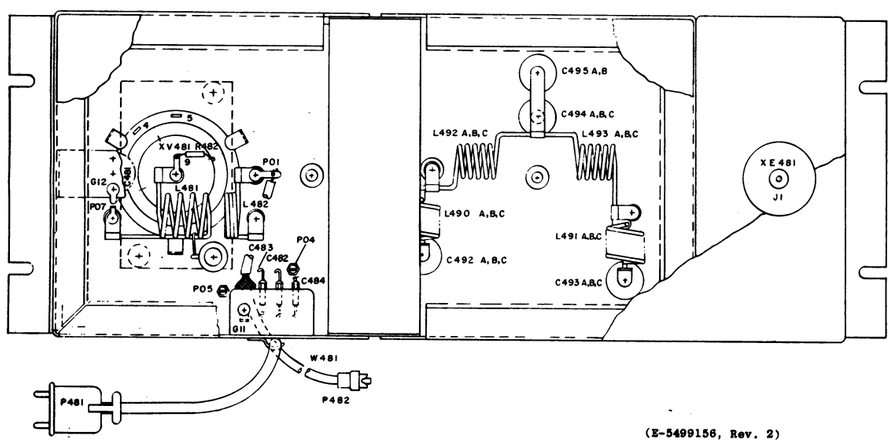
15. While keying the Exciter, readjust the PA PLATE control for minimum reading at the PA PLATE current meter.

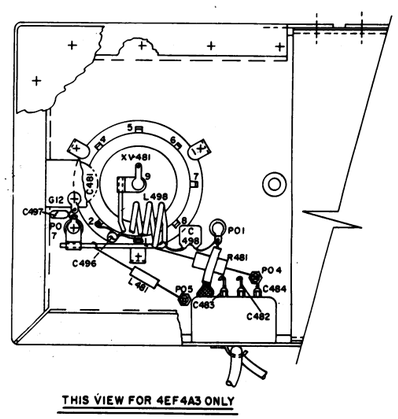
16. Repeat steps 11, 14 and 15 above until the licensed power output or power input is reached. Do not exceed 275 mA at the PA PLATE current meter.

17. Finger tighten the PA COUPLING control locking nut.







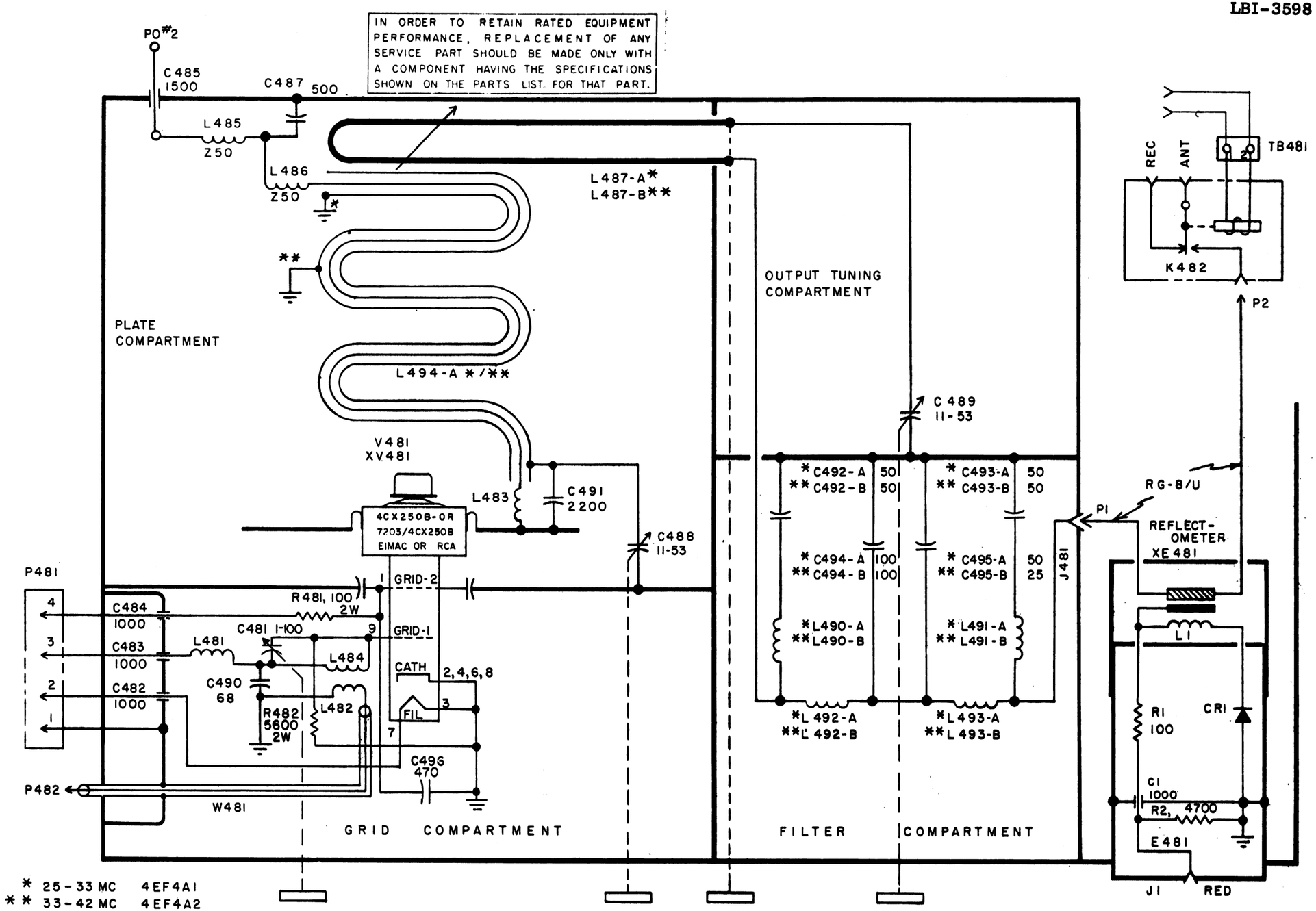


(E-5499156, Rev. 2)

OUTLINE DIAGRAM

25—50 MHz, 330-WATT MASTR
POWER AMPLIFIER MODELS 4EF4A1, 2 & 3

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.



* 25 - 33 MC 4EF4A1
** 33 - 42 MC 4EF4A2

ALL CAPACITORS ARE IN MICROMICROFARADS

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
4EF4A1 & 2	C

(C-5494633, Rev. 14)

SCHEMATIC DIAGRAM

25—42 MHz, 330-WATT
MASTR POWER AMPLIFIER
MODEL 4EF4A1, 2

PARTS LIST

EBI-41737F

POWER AMPLIFIER
MODEL 4EF4A1 25-30 MHz
MODEL 4EF4A2 30-42 MHz
MODEL 4EF4A3 40-54 MHz

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C481	3R47P12	Variable, air: 6.1 to 100 pf, 850 v peak; sim to Hammarlund APC-100-B.
C482 thru C484	7485975P19	Ceramic, feed-thru: 1000 pf ±20%, 500 VDCW; sim to Erie Style 327.
C485	5490846P1	Ceramic, feed-thru: 1500 pf ±20%, 3000 VDCW; sim to Erie 320-02.
C487	5490306P2	Ceramic: 500 pf +50% -20%, 20,000 VDCW; sim to Sprague 20D.
C488 and C489	7770519P12	Variable, air: approx 11-53 pf, 4500 v peak; sim to EF Johnson Type 154.
C490*	7489162P23	Silver mica: 68 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Deleted by REV E in 4EF4A3.
C491	3R31P61	Mica: 2200 pf ±10%, 2500 VDCW; sim to RMA RCM50B222K.
C492A and C492B	7488281P2	Ceramic, double cup: 50 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C492C	7488281P1	Ceramic, double cup: 25 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C493A and C493B	7488281P2	Ceramic, double cup: 50 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C493C	7488281P1	Ceramic, double cup: 25 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C494A and C494B	7488281P6	Ceramic, double cup: 100 pf ±10%, 5000 VDCW, temp coef -750 PPM.
C494C	7488281P5	Ceramic, double cup: 75 pf ±10%, 7500 VDCW, temp coef -750 PPM.
C495A	7488281P2	Ceramic, double cup: 50 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C495B	7488281P1	Ceramic, double cup: 25 pf ±10%, 7500 VDCW, temp coef 0 PPM.
C496*	5494481P7	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap. Deleted in 4EF4A2 by REV A. Added in 4EF4A3 by REV B.
C497* and C498*	7489162P41	Silver mica: 390 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15. Added by REV E in 4EF4A3.
E481		REFLECTOMETER PROBE 4029629G2
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	7160807P1	Ceramic, feed-thru: 1000 µf +100%-0%, 500 VDCW.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	7777146P22	Germanium.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	7150763P2	Jack, tip, stake-in: red nylon body; sim to Alden Products 110BC1.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	4031131G1	Coil.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R2	3R77P472J	Composition: 4700 ohms ±5%, 1/2 w.
R3	3R77P151J	Composition: 150 ohms ±5%, 1/2 w.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J481	2R22P4	Adapter, junction: coaxial. Signal Corps PL-258 or sim to Amphenol 83-1J.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K482	7479680P2	Armature, coaxial: 7000 ohms ±10% coil res, 115 VDC +10% -20%; pick up 90 v or less, max 170 VDC; sim to Price Electric 6350.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L481	7488079P47	Choke, RF: 22 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4422-8K.
L482*	4029993P1	Coil. Deleted by REV E in 4EF4A3.
L483*	7772834P8	Choke, RF: 7.0 µh ±10%, 0.36 ohms DC res, freq range 35-110 MHz.
		In 4EF4A1, A2 of REV B and earlier: In 4EF4A3 of REV C and earlier:
	7772834P4	Choke, RF: 7.0 µh, 1000 ma; sim to Ohmite Z-50.
L484*	4031026P1	Coil. Deleted by REV E in 4EF4A3.
L485* and L486*	7772834P8	Choke, RF: 7.0 µh ±10%, 0.36 ohms DC res, freq range 35-110 MHz.
		In 4EF4A1, A2 of REV B and earlier: In 4EF4A3 of REV C and earlier:
	7772834P4	Choke, RF: 7.0 µh, 1000 ma; sim to Ohmite Z-50.
L487A	4031036P1	Coil.
L487B	4031035P1	Coil.
L487C	4031034P1	Coil.
L488*	4031026P2	Coil. Added by REV E in 4EF4A3.
L490A	7143797P1	Coil.
L490B	7143798P1	Coil.
L490C	7143799P1	Coil.
L491A	7143797P1	Coil.
L491B	7143798P1	Coil.
L491C	7143799P1	Coil.
L492A	4031027P1	Coil.
L492B	4029951P2	Coil.
L492C	4029952P2	Coil.
L493A	4029950P1	Coil.
L493B	4039951P1	Coil.
L493C	4029952P1	Coil.
L494A	5490530G1	Coil.
L494B	5490620G1	Coil.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P481	7473192P25	Plug: 6-pin male, cable clamp in cap; sim to HB Jones 306-CCT.
P482		(Part of W481).
		- - - - - - - - - - RESISTORS - - - - - - - - -
R481	3R79P101K	Composition: 100 ohms ±10%, 2 w.
R482*	3R79P562K	Composition: 5600 ohms ±10%, 2 w. Added in 4EF4A1 and 4EF4A2 by REV B. Added in 4EF4A3 by REV C. Deleted by REV E in 4EF4A3.
		- - - - - - - - TERMINAL BOARDS - - - - - - - -
TB481	19C301088P9	Phen: 2 terminals; sim to GE CR151D.
		- - - - - - - - - - - TUBES - - - - - - - - - -
V481	4039217P1	Type EIMAC Ceramic 7203/4CX250B.
		- - - - - - - - - - CABLES - - - - - - - - - - -
W481	5491689P54	Cable, RF: coaxial, approx 32.75 inches long with phono plug molded on one end.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XE481	5490188G3	Reflectometer housing.
XV481	5490373P2	Tube: octal; sim to Eitel McCullough SK-610.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	4031130G1	Plate contact 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 - To improve RF keying. Deleted C496.

REV. B - Model 4EF4A3 only.
To prevent oscillations at the high end of the frequency split.
Added C496.

REV. B - Models 4EF4A1 & 2

REV. C - Models 4EF4A3
To improve stability. Added grid-loading resistor R482.

Step 7 of ALIGNMENT PROCEDURE was:

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.

REV. C - Models 4EF4A1 & A2

REV. D - Model 4EF4A3
To improve PA reliability. Changed L483, L485 and L486.

REV. E - Model 4EF4A3
To improve stability and tuning. Deleted L482, L484, R482, C490 and added C497, C498 and L488.

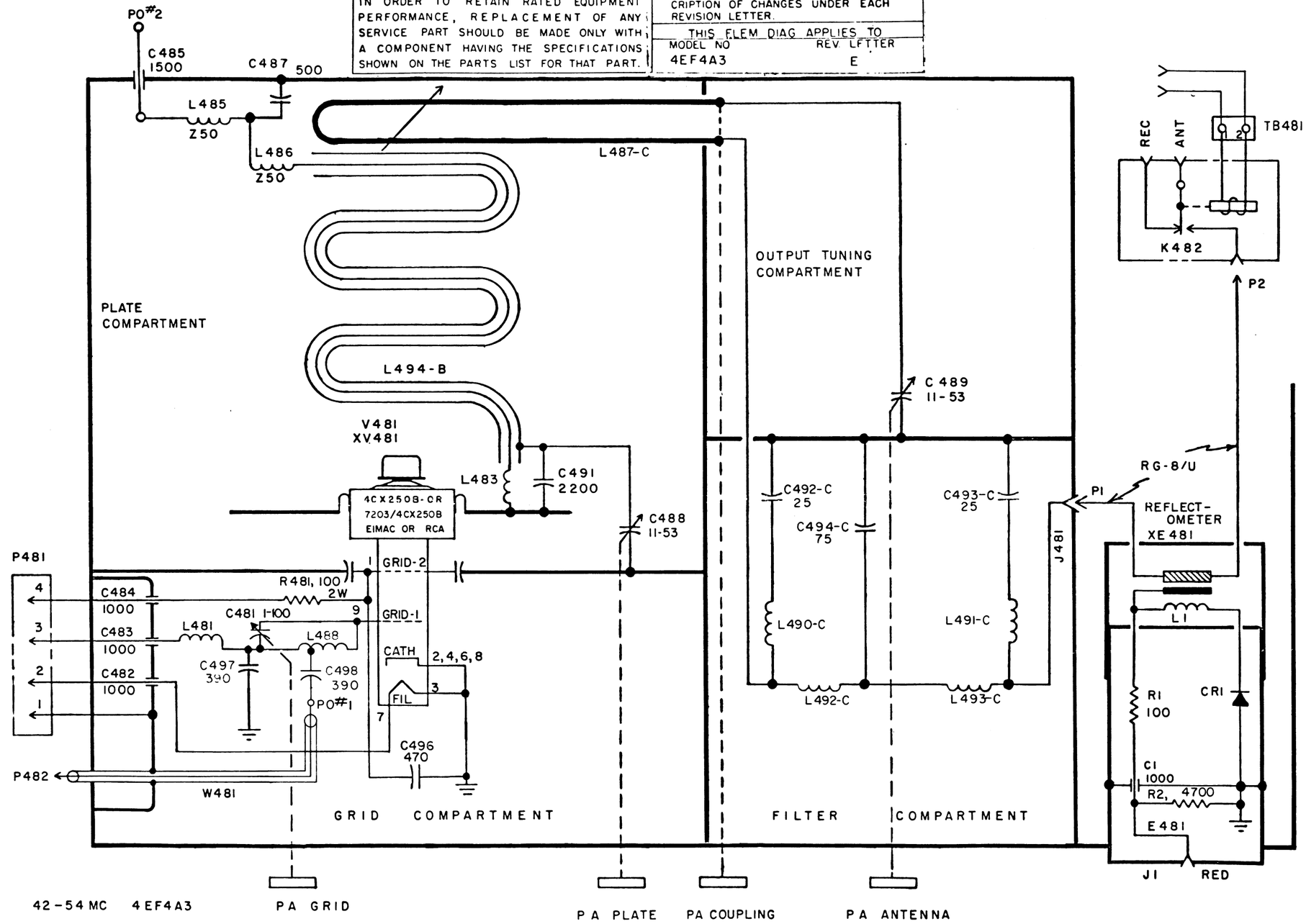
Sun Pipeline

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.

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
4EF4A3	E



ALL CAPACITORS ARE IN MICROMICROFARADS

(19C321427, Rev. 0)

SCHEMATIC DIAGRAM

42—54 MHz, 330-WATT
MASTR POWER AMPLIFIER
MODEL 4EF4A3

ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number, to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

MAINTENANCE MANUAL

LBI-3598

DF-3060

MOBILE RADIO DEPARTMENT
GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

GENERAL ELECTRIC

PRINTED IN U.S.A.