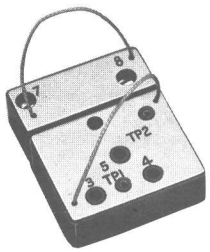
Maintenance Manual LBI 4658E
DATAFILE FOLDER - DF3157

MOBILE RADIO

MASTR® Personal Series
PROGRESS LINE

PE MODELS

138-174 MHz, 100 to 200 MILLIWATT TRANSMITTER TYPE ET-95-A AND KT-19-A
138-174 MHz, 1 to 2 WATT TRANSMITTER TYPE ET-96-A AND KT-20-A



ET-95-A/KT-19-A
ET-96-A/KT-20-A

SPECIFICATIONS *

Type Numbers	ET-95-A & ET-96-A KT-19-A & KT-20-A	
Power Output		
ET-95-A & KT-19-A	100 to 200 milliwatts	
ET-96-A & KT-20-A	1 to 2 Watts	
Modulation Deviation	0 to ±5 kHz	
	ET-95-A	ET-96-A
Spurious	KT-19-A	KT-20-A
Radiated	-43 dB	-50 dB
Conducted	-43 dB	-60 dB
Audio Response	Within +1 and -3 dB of a 6-dB/octave pre-emphasis from 300 to 3000 Hz except for an additional 6-dB/octave roll-off from 2500 to 3000 Hz per EIA.	
Audio Distortion	Less than 8%	
Crystal Multiplication Factor	12	
RF Load Impedance	50 ohms	
Modulation Sensitivity	0.7 to 1.5 millivolts	

*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

ILLUSTRATIONS

WARNING

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

DESCRIPTION

Transmitter Types ET-95-A, ET-96-A, KT-19-A and KT-20-A are crystal controlled, phase modulated transmitters for one- through eight-frequency operation in the 138-174 MHz band. The transmitters utilize both discrete components and Integrated Circuit Modules (IC's). The application of each transmitter type is shown in the following chart:

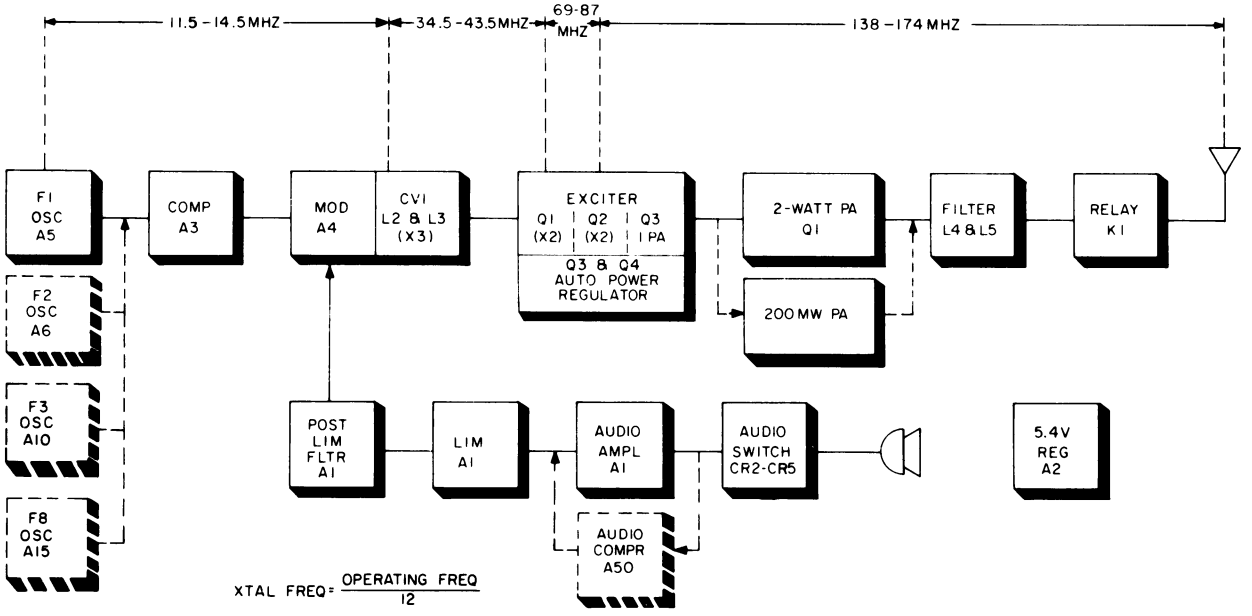
Type No.	Exciter Model No.	PA Model No. or Network No.	Frequency Range	No. Frequencies	Power Output
ET-95-A	4EG29A10	19B219084G1	138-150.8 MHz	2	100 to 200 Milliwatts
	4EG29A11	19B219084G1	150.8-174 MHz		
ET-96-A	4EG29A10	4EF39A10	138-150.8 MHz	2	1 to 2 Watts
	4EG29A11	4EF39A11	150.8-174 MHz		
KT-19-A	4EG29A10	19B219084G1	138-150.8 MHz	8	100 to 200 Milliwatts
	4EG29A11	19B219084G1	150.8-174 MHz		
KT-20-A	4EG29A10	4EF39A10	138-150.8 MHz	8	1 to 2 Watts
	4EG29A11	4EF39A11	150.8-174 MHz		

The transmitters consist of the audio, regulator, oscillator, compensator and modulator IC's, and plug-in Exciter and PA modules.

Transmitter Types ET-95-A and KT-19-A use a matching network as the final stage to provide an RF output of 200 milliwatts. Transmitter Types ET-96-A and KT-20-A use a transistorized PA module to provide an RF power output of over two watts. All of the transmitter modules are mounted on the System Board. Supply voltages for the transmitter are provided by the battery and Regulator. The different transmitter voltages are shown in the following chart:

Voltage	Used for:
Continuous 7.5 Volts	Regulator module
Keyed 7.5 Volts	Regulator 5.4-Volt keying, Exciter and PA modules.
Keyed 5.4 Volts	Compensator, Oscillator, Audio and Modulator modules, and optional Compressor module.

References to symbol numbers mentioned in the following text are found on the Schematic Diagrams, Outline Diagrams and Parts List (see Table of Contents). The typical, simplified circuit diagrams used in the text are representative of the circuits in the IC modules. A block diagram of the transmitter is shown in Figure 1.



RC-2303A

Figure 1 - Transmitter Block Diagram

CIRCUIT ANALYSIS

REGULATOR A2

The Regulator module operates from the 7.5-Volt from the battery, and provides a continuous, regulated 5.4 Volts and a switched 5.4 Volts for operating the transmitter, receiver and tone options. A typical regulator circuit is shown in Figure 2.

Turning on the radio applies the battery voltage to Pin 2 of the Regulator, causing Q2 and then Q1 to conduct. When conducting, the continuous 5.4 Volts at the collector of Q1 is taken from Pin 4 and applied to the receiver Compensator and Oscillator module.

Regulation is provided by Q2 and Q3, which operate as a differential amplifier. If the output of Q1 starts to increase, Q3 conducts harder, causing Q2 to conduct less. This causes Q1 to conduct less, keeping its output at 5.4 Volts. If the output of Q1 starts to decrease, Q3 conducts less, causing Q2 to conduct harder. This causes Q1 to conduct harder, keeping the output constant.

Q4 and Q5 operate as a DC switch. Keying the transmitter applies the battery voltage to Pin 7 and to the base of Q5, turning it on. This turns on PNP transistor Q4, so that the regulated 5.4 volts at Pin 6 is applied to the transmitter Compensator, Modulator, and audio module, and to the optional Compressor module and multi-frequency switch S1.

OSCILLATOR MODULES

Oscillator Model 4EG27A10 consists of a crystal-controlled Colpitts oscillator and a Channel Guard tone modulator. The entire oscillator is contained in a metal can with the transmitter operating frequency printed on the top. The crystal frequency ranges from 11.5 to 14.5 MHz, and the crystal frequency is multiplied 12 times.

The oscillator frequency is temperature compensated to provide instant frequency compensation, with a frequency stability of ±.0002% from 0°C to +55°C and ±.0005% from -30°C to +60°C. The temperature compensation network is contained in Compensator module A3.

A typical oscillator circuit is shown in Figure 3.

In single-frequency transmitters, a jumper from Hole 20 to Hole 21 on the System Board connects the keyed 5.4 Volt supply voltage to the oscillator modules. Keying the transmitter applies the supply voltage to the oscillator, turning it on. The oscillator output is applied to Compensator A3.

In multi-frequency transmitters, additional Oscillator Modules are mounted on the board. The single-frequency supply jumper is removed, and the proper frequency is selected by connecting the keyed 5.4 Volts to the selected oscillator module through frequency selector switch S1 on the control unit.

For Channel Guard applications, tone from the Channel Guard encoder is applied to the oscillator module. The tone is applied through Pin 3 to the voltage-variable capacitor on the oscillator module, which frequency modulates the oscillator output.

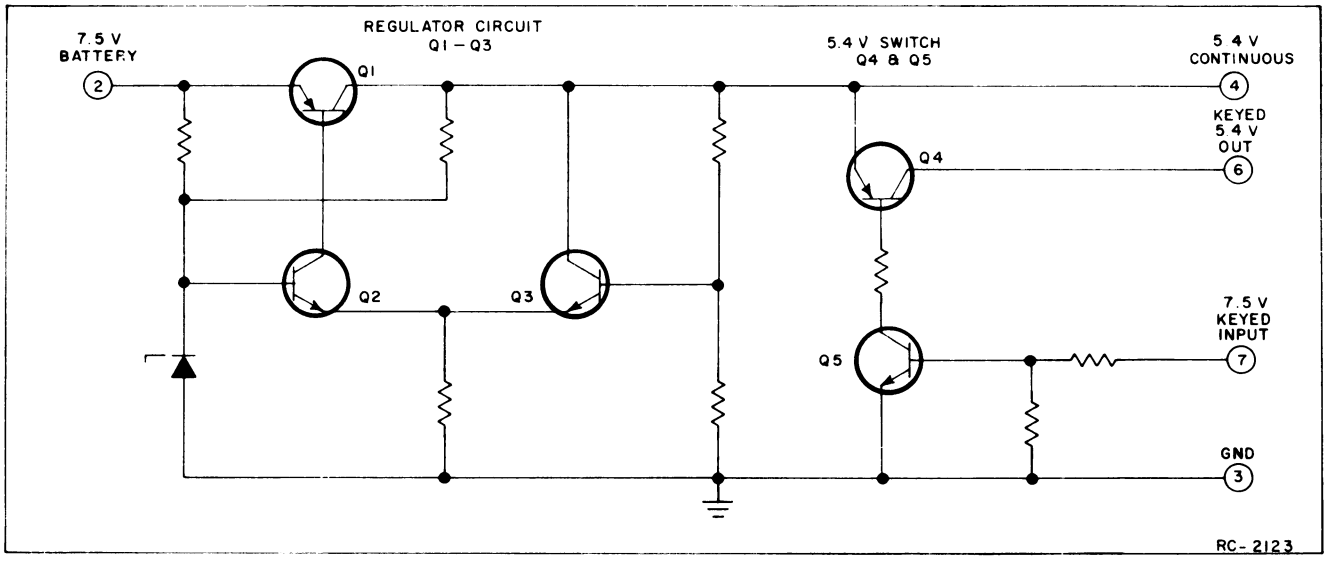


Figure 2 - Typical Regulator Circuit

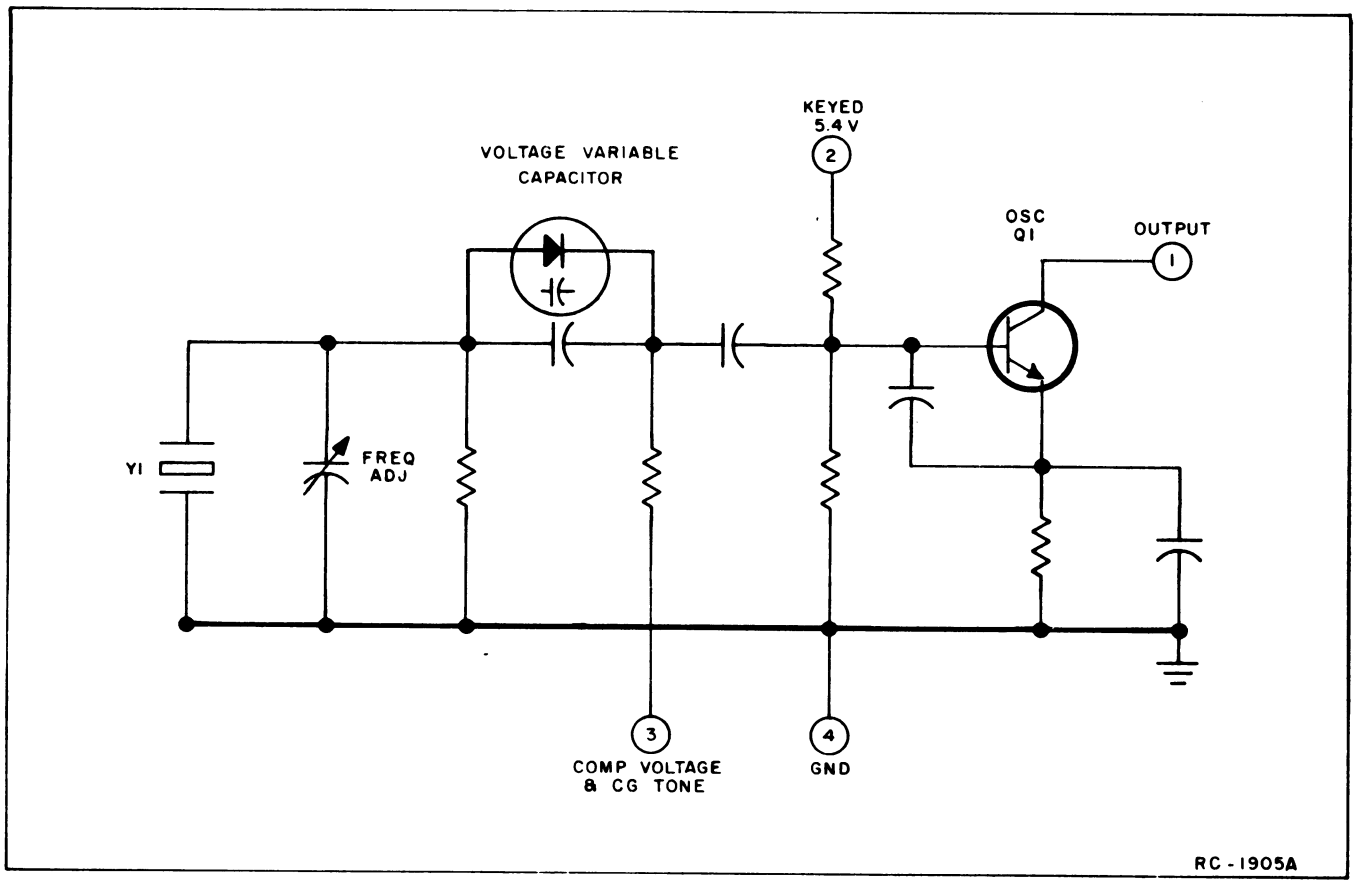


Figure 3 - Typical Oscillator Circuit

NOTE

All oscillator modules are individually compensated at the factory and cannot be repaired in the field. Any attempt to remove the oscillator cover will void the warranty.

COMPENSATOR A3

Compensator module A3 contains a buffer-amplifier, and the temperature compensating network for the oscillator. A typical Compensator circuit is shown in Figure 4.

RF from the oscillator at Pin 7 is coupled through a DC-blocking capacitor to the base of buffer-amplifier Q1. This stage isolates the oscillator from the modulator. The output of Q1 connects from Pin 9 to the modulator.

In the compensation network, the keyed 5.4 Volts at Pin 2 is applied to a thermistor-compensated voltage divider. The output at Pin 3 (2.35 Volts measured with a VTVM) is applied to Pin 3 and to the voltage-variable capacitor in the oscillator module. At temperatures below 10°C, the compensated voltage increases to maintain the proper voltage on the oscillator voltage-variable capacitor.

Service Note: An abnormally low VTVM reading (or no reading) at Pin 3 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 3, raising it off the printed board and taking another reading. If this reading is normal the problem is in the oscillator module. If the reading remains low (or zero) the problem is in the Compensator.

AUDIO AMPLIFIER AND LIMITER A1

Audio from the microphone is coupled through the audio switching circuit to Pin 1 and then to the base of audio amplifier Q1 (see Figure 5). In Type 90 encoder applications, the encode tone is applied to the amplifier at Pin 2.

The amplifier output is applied directly to the transistorized limiter stage (Q2). Following the limiter is a combined post-limiter filter and de-emphasis network. Q3 operates as an active filter. The filter output at Pin 8 is coupled through Mod Adjust potentiometer R8 to the Modulator module A4.

When the Audio Compressor option is used, audio from the microphone is coupled through the compressor and then applied to

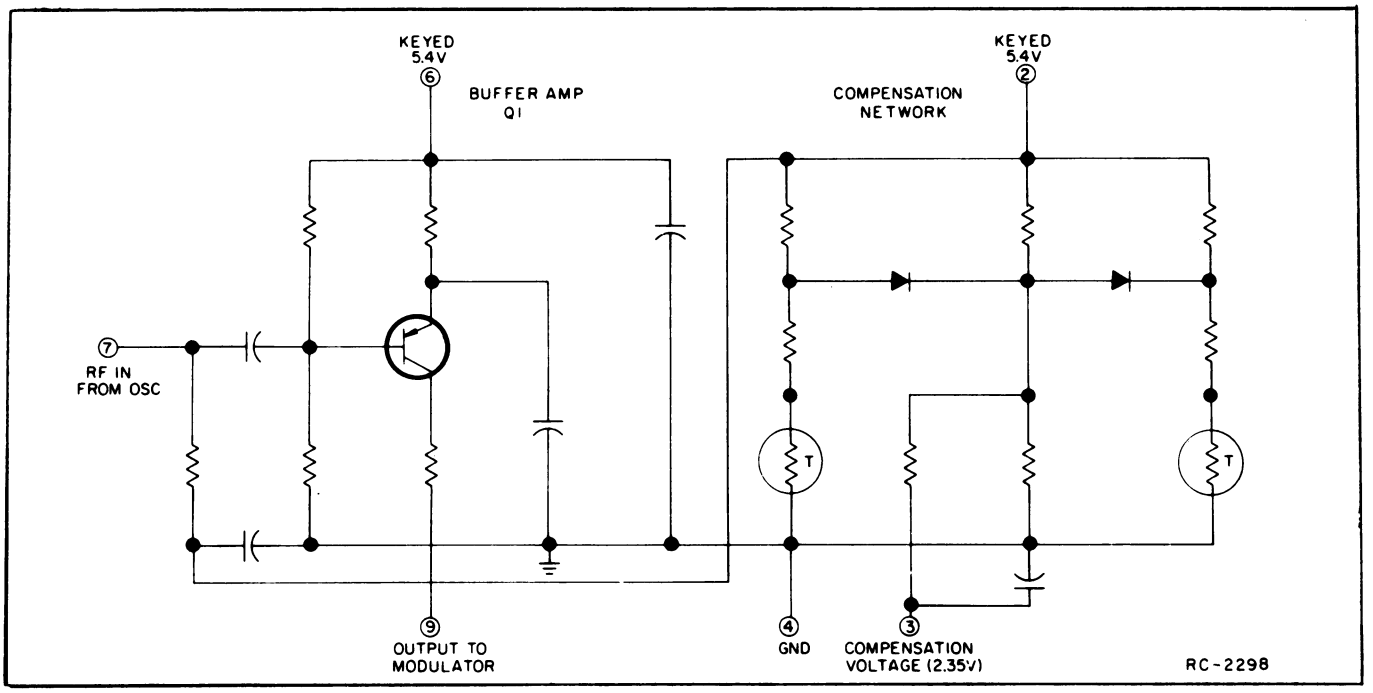


Figure 4 - Typical Compensator Circuit

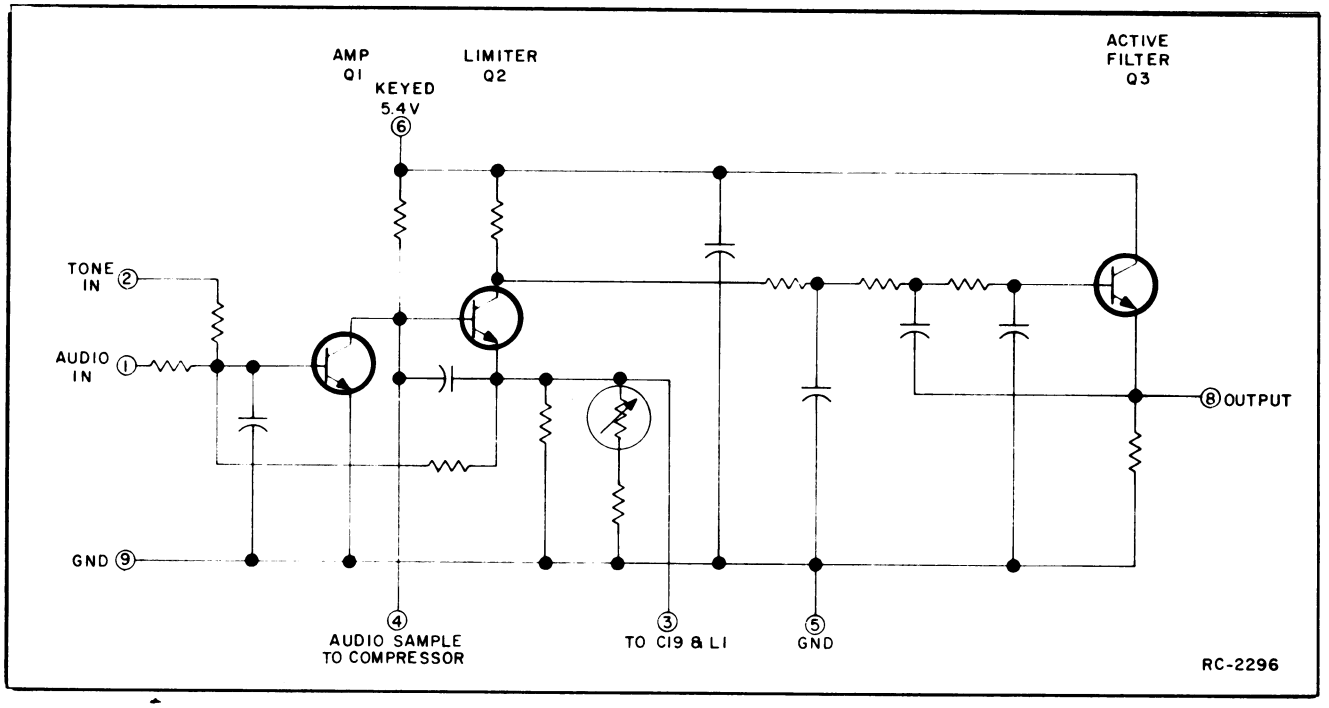


Figure 5 - Typical Audio Amplifier & Limiter Circuit

the audio amplifier stage. An audio sample from the collector of amplifier Q1 is connected from Pin 4 to the compressor circuit, keeping the audio output to the modulator constant.

AUDIO COMPRESSOR A50

The optional Audio Compressor Module provides a relatively constant audio output to the Audio Amplifier-Limiter module over a 30-dB change in input level. The compressor module also provides 13-dB additional gain for increased microphone sensitivity. A typical diagram of the Compressor is shown in Figure 6.

Audio from the microphone is coupled through R52 on the System Board to Pin 1 of the Compressor. The audio is applied to pre-amplifier Q1 which provides the 13 dB gain. The pre-amplifier output at Pin 4 is connected to Pin 1 of Amplifier-Limiter Module A1.

At the same time, an audio sample voltage from Audio module A1 is applied to Pin 9 and to audio amplifier Q3 in the Compressor module. The output of Q3 is rectified by the two diodes, and the resultant voltage applied to the base of DC amplifier Q4. The DC output of Q4 controls the operation of the compressor-control transistor Q2.

An increase in the audio sample voltage increases the DC voltage applied to Q2. This reduces the AC impedance of Q2, which decreases the audio output voltage at Pin 4. A decrease in the audio sample voltage decreases the DC voltage applied to Q2. This increases the AC impedance of Q2, and increases the audio output voltage at Pin 4.

PHASE MODULATOR

The phase modulator circuit consists of Modulator A4, voltage-variable capacitor CV1 and tuneable coil L2. CV1 and L2 are mounted on System Board A703. A typical modulator circuit is shown in Figure 7.

With CV1 in series with L2, the network appears as a series-resonant circuit when RF from the oscillator is applied to Pin 1. Applying audio from Audio Limiter A1 to Pin 4 of Modulator A4 varies the bias of CV1, resulting in a phase modulated output.

Buffer Q1 isolates the modulator from the loading effects of the following multiplier stage, and also provides some amplification. Following the buffer stage is tripler Q2. The output of Q2 is coupled through L3 (on the System Board) to the exciter module. L3 is tuned to three times the crystal frequency.

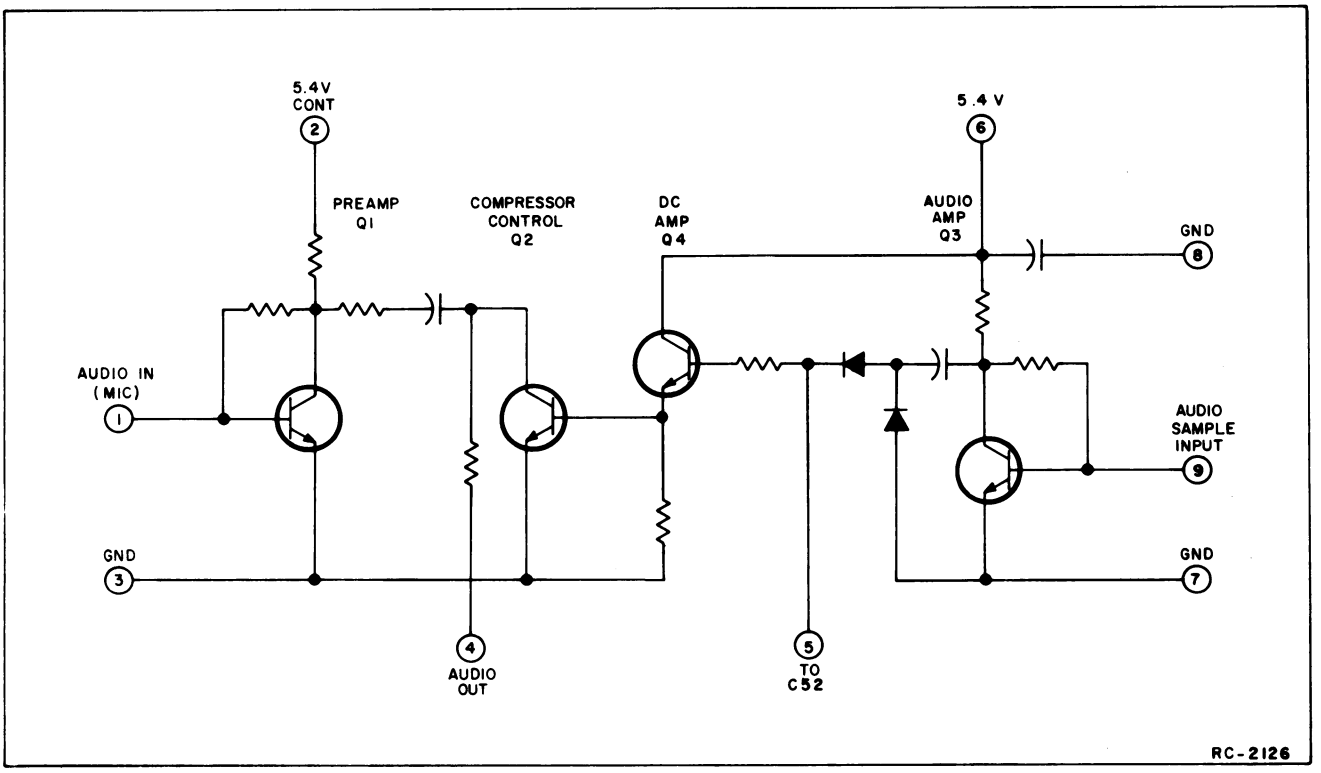


Figure 6 - Typical Audio Compressor Circuit

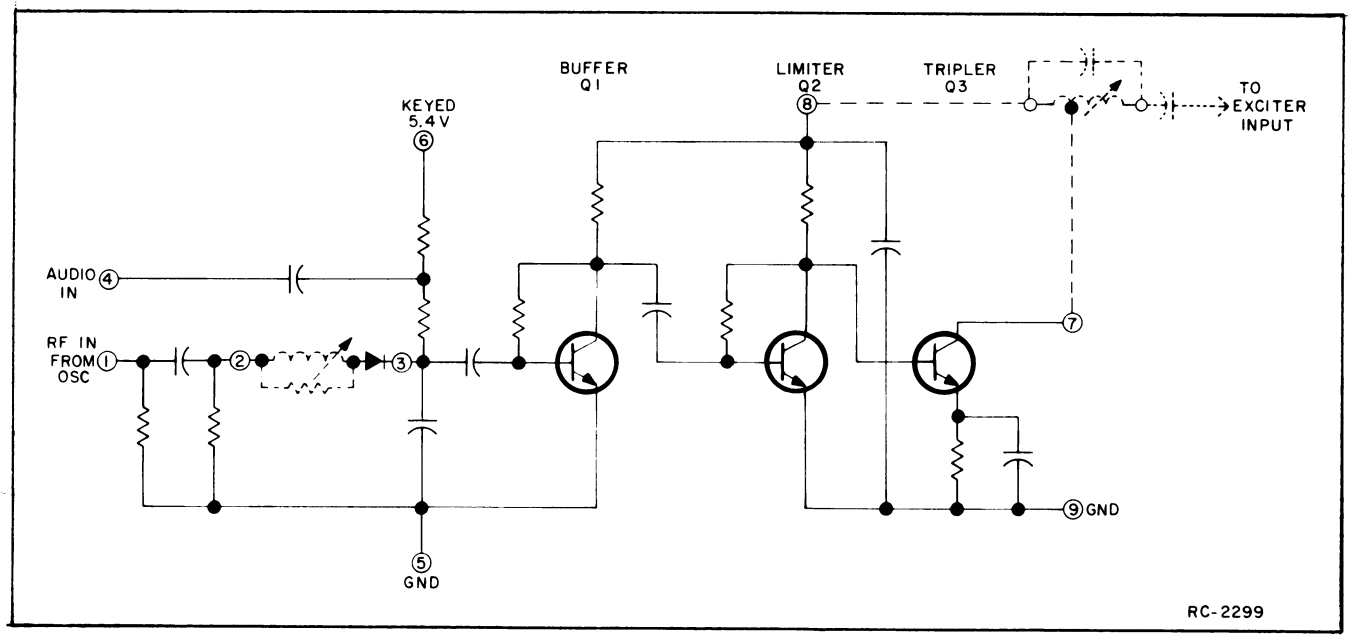


Figure 7 - Typical Phase Modulator Circuit

EXCITER

Exciter Board Model 4EG29A10 (138-150.8 MHz) and Model 4EG29A11 (150.8-174 MHz) consists of two class C doubler stages, a class C amplifier stage, and an Automatic Power Level Control (APLC) circuit.

Doubler & Amplifier Stages

The modulator output is coupled through T1 to the base of 1st doubler Q1. The 1st doubler stage as well as the modulator stage is metered at TP1. The 1st doubler output is coupled through T2 to the base of 2nd doubler Q2. T2 is tuned to six times the crystal frequency.

Following the 2nd doubler is an impedance-matching network consisting of C14, C16, C17, C19 and L2. The network matches the high impedance 2nd doubler output to the low impedance amplifier input. L2 is tuned to 12 times the crystal frequency.

2nd doubler Q2, amplifier Q3 and the PA transistor are tuned by measuring the total current drain of the radio. An Ammeter with a one ampere full scale meter is used in series with the radio 7.5-Volt supply. GE Test Regulator Model 4EX18A10 and Test Set Model 4EX3A10 may be used in place of the ammeter.

A constant-K, DC collector feed network consisting of L1, L7, C4 and C12 provides improved 2nd doubler stability. Similar collector-feed networks are used in the amplifier and PA stages.

The output of amplifier Q3 is applied to the PA module.

APLC Circuit

The APLC circuit (Q4 and Q5) provides a more constant transmitter power output by controlling the output of the 1st and 2nd doubler. The circuit also extends the battery life by regulating the current to amplifier Q3.

When Q3 starts to conduct harder and draw more collector current, the voltage drop across R7 increases, causing Q4 to conduct harder. This increases the voltage at the base of Q5. Increasing the voltage at the base of Q5 causes it to conduct less, which increases the voltage drop across Q5 and reduces the collector voltage of Q1 and Q2. This reduces the drive to amplifier Q3 and reduces the collector current.

In low power transmitters, Power Adjust Potentiometer R8 is used to set the power output in 2-Watt transmitters, R8 can be used to limit the maximum power output.

PA MODULES

Two plug-in PA modules are available for use in the transmitter, depending on the power output required.

In one- to two-Watt transmitters, PA modules 4EF39A10 (138-150.8 MHz) and 4EF39A11 (150.8 to 174 MHz) are used. The output of the exciter is coupled through a tuned circuit to the base of Class C amplifier Q1. The amplifier output is applied through a series-tuned circuit to the low-pass filter.

In 100 to 200 milliwatt transmitters, the PA consists of a "T"-Type matching network. The output of the network is applied to the low-pass filter. An RF adaptor cable is available for connecting the transmitter RF output to a wattmeter. Connecting the RF adaptor cable to J702 opens a set of contacts on the antenna strip line assembly. This disconnects the collapsible antenna and connects the transmitter output to J702-3. Connection to chassis ground is made at J702-4.

LOW-PASS FILTER

The low-pass filter is mounted on Systems Board A703. The filter consists of L4, C5, C8, C10 and C18. The filter output is fed to System switching relay K1, and then coupled through a 50-ohm antenna matching network (L701 and C15) to the antenna.

GENERAL ELECTRIC COMPANY • MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS • LYNCHBURG, VIRGINIA 24502 U.S.A.

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MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R8) was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing overmodulation while preserving intelligibility.

TEST EQUIPMENT

1. Audio oscillator Model 4EX6A10
2. A deviation meter
3. An output meter or a VTVM
4. Test Adaptor Model 4EX12A10

PROCEDURE

1. Connect the equipment as shown in the Test Procedure on the back of this page.
2. Apply a 140 millivolt signal at 1000 Hz to the Test Adaptor. If the Test Adaptor is not used, apply a 14 millivolt signal to Pin 4 (Mike Hi) and Pin 1 of Accessory Jack J701.
3. With the signal applied, adjust Tuning Control 1 for zero modulation symmetry on the lowest channel frequency.
4. For transmitters without Channel Guard, set MOD ADJUST R8 for a 4.5-kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
5. For transmitters with Channel Guard, check the Channel Guard Modulation as shown in Step 2 of the transmitter Test Procedure. With Channel Guard tone applied, set the deviation as described in Step 4 above.
6. For multifrequency transmitters, set the deviation as described in Step 4 on the channel producing the largest amount of deviation.

REDUCED POWER OPERATION

Option 4475 - 1 Watt Output per EIA
Also for Shipboard Marine Applications (FCC Part 83)

In some services, FCC regulations do not permit the use of the two-watt rated output. In addition, operating at a reduced power output will extend the battery life in those applications where the two-watt output is not required. After completing Step 9 of the two-watt Alignment Procedure, reduce the output power as follows:

1. Turn Tuning Control 9 (PWR ADJ) clockwise until the power output is reduced by one-half of the difference between the power output noted in Step 9 and the desired power output. For example: If the output noted in Step 9 was 2 watts and the desired output is 1 watt, adjust Tuning Control 9 for an output of 1.5 watts.
2. Adjust Tuning Control 6 to reduce the output to the desired level. Tuning Control 6 has two positions producing the same power output. Select the position having the lowest current drain.
3. If the limit of adjustment on Tuning Control 6 is reached and the power output or current drain is still too high, detune Tuning Control 8 in the direction resulting in less current drain and power output. Then alternately adjust Tuning Controls 6 and 8 for the desired output and drain.

100-200 MILLIWATT TRANSMITTER ALIGNMENT (ET-95-A & KT-19-A)

EQUIPMENT REQUIRED:

- GE Test Set Model 4EX3A10 (or 4EX8K11) or equivalent 20,000 ohm-per-volt meter.
- GE Test Regulator Model 4EX18A10, or an ammeter capable of measuring 0.25 amperes.
- A 50-ohm, terminating wattmeter connected to external antenna jack J702 thru RF adaptor cable 19C317633G2 (Option 4466).
- A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

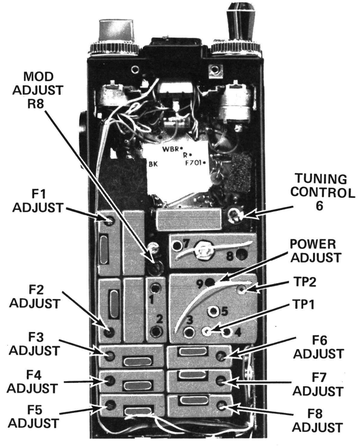
1. In multi-frequency transmitters, set the channel selector switch to the lowest channel frequency.
2. Set the slugs in Tuning Controls 1 thru 5 even with the top of the can. When properly aligned, the slugs will be between the top of the can and the coil.
3. Set Tuning Control 9 (PWR ADJ) fully counterclockwise, and Tuning Control 6 to mid range.
4. If using Test Set 4EX3A10 and Test Regulator 4EX18A10, connect the Test Set to the metering jack on the Test Regulator, and set the Regulator for 7.5 volts. Switch the Test Set range to the Test 1 position. Place the test selector switch on position "I" to check the supply voltage (read on the 1-volt scale as 10-volts full scale. Switch to position "G" for current drain readings (read on the 1-volt scale as 1 ampere full scale).
5. Test Point meter reading made with the (+) meter lead to TP1 and the (-) lead to system ground.
6. All adjustments made with the transmitter keyed.

ADJUSTMENT PROCEDURE

Step	Tuning Control	Typical Meter Reading	Procedure
1	1	Maximum mA	Adjust Tuning Control 1 for maximum transmitter current.
2	2	Minimum mA	Adjust Tuning Control 2 for minimum transmitter current.
3	3		Adjust Tuning Control 3 for maximum meter reading at TP1.
4	1, 2 & 3	0.8 volts	Adjust Tuning Controls 1, 2 and 3 for maximum meter reading at TP1. Repeat the adjustments until no further increase in meter reading is obtained.
5	4 and 5	Maximum mA	Adjust Tuning Controls 4 and 5 for maximum transmitter current.
6	7 and 8	Maximum Power Output	Adjust Tuning Controls 7 and 8 for maximum power output.
7	4, 5, 7, & 8	Maximum Power Output	Adjust Tuning Controls 4, 5, 7 and 8 for maximum power output. Repeat the adjustments until no further increase in power output is obtained.
8	9 (PWR ADJ)		Set Tuning Control 9 (PWR ADJ) for the desired power output (100 to 200 milliwatts)
			FREQUENCY ADJUSTMENT
9			With no modulation, adjust the F1 (and F2 thru F8) crystal trimmer for proper oscillator frequency. Next, refer to the Modulation Adjustment.

NOTE

It is recommended that all frequency adjustments be made when the equipment is at a temperature of approximately 75°F. In no case should frequency adjustments be made when the equipment is outside the temperature range of 60°F to 90°F.



1 to 2 WATT TRANSMITTER ALIGNMENT (ET-96-A & KT-20-A)

LBI-4658

EQUIPMENT REQUIRED:

- GE Test Set Model 4EX3A10 (or 4EX8K11) or equivalent 20,000 ohm-per-volt meter.
- GE Test Regulator Model 4EX18A10, or an ammeter capable of measuring one ampere.
- A 50-ohm, terminating wattmeter connected to external antenna jack J702 thru RF adaptor cable 19C317633G2 (Option 4466).
- A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. In multi-frequency transmitters, set the channel selector switch to the lowest channel frequency.
2. Set the slugs in Tuning Controls 1 thru 5 even with the top of the can. When properly aligned, the slugs will be between the top of the can and the coil.
3. Set Tuning Control 9 (PWR ADJ) fully counterclockwise, and Tuning Control 6 to mid range.
4. If using Test Set 4EX3A10 and Test Regulator 4EX18A10, connect the Test Set to the metering jack on the Test Regulator. Then connect the Regulator output to J704 on the radio, and set the Regulator for 6 volts. Switch the Test Set range to the Test 1 position. Place the test selector switch on position "I" to check the supply voltage (read on the 1-volt scale as 10-volts full scale). Switch to position "G" for current drain readings (read on the 1-volt scale as 1 ampere full scale).
5. Test Point meter reading made with the (+) meter lead to TP1 and the (-) lead to system ground.
6. All adjustments made with the transmitter keyed.

ADJUSTMENT PROCEDURE

Step	Tuning Control	Typical Meter Reading	Procedure
1	1	Maximum mA	Adjust Tuning Control 1 for maximum transmitter current
2	2	Minimum mA	Adjust Tuning Control 2 for minimum transmitter current
3	3		Adjust Tuning Control 3 for maximum meter reading at TP1
4	1, 2 & 3	0.8 volts	Adjust Tuning Controls 1, 2 and 3 for maximum meter reading at TP1. Repeat the adjustments until no further increase in meter reading is obtained.
5	4, 5, & 7	Maximum mA	Adjust Tuning Controls 4, 5 and 7 for maximum transmitter current.
6	8, 6, 7, 5, & 4	Maximum Power Output	Adjust Tuning Controls 8, 6, 7, 5 and 4 in that order for maximum power output.
7	1, 2 & 3		Repeat Step 4
8			Increase the supply voltage to 7.5 volts
9	7	Maximum Power Output	Adjust Tuning Control 7 for maximum power output and note the power output. If the power output is correct, Tuning Controls 6 and 8 can be alternately tuned for the best ratio of current drain to RF power output. If the power output is too low, refer to Step 10. If the power output is too high, refer to REDUCED POWER OPERATION elsewhere on this page.
10	6, 8 & 7	Maximum Power Output	If the power output is too low, readjust Tuning Controls 6, 8 and 7 in that order for maximum power output. Repeat until the desired power output is obtained.
			FREQUENCY ADJUSTMENT
11			With no modulation, adjust the F1 (and F2 thru F8) crystal trimmer for proper oscillator frequency. Next, refer to the Modulation Adjustment.

NOTE

It is recommended that all frequency adjustments be made when the equipment is at a temperature of approximately 75°F. In no case should frequency adjustments be made when the equipment is outside the temperature range of 60°F to 90°F.

ALIGNMENT PROCEDURE
138—174 MHz TRANSMITTER
TYPES ET-95-A, ET-96-A,
KT-19-A & KT-20-A

TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating--but not properly. Problems encountered could be low power output, tone and voice deviation, defective audio sensitivity and modulator adjust control set too high. By following the sequence of test steps starting with Step 1, the defect can be quickly **localized.** Once a defect is pin-pointed, refer to the "Service Check" and the additional corrective measures included in the Transmitter Troubleshooting Procedure. Before starting with the Transmitter Test Procedures, be sure the transmitter is tuned and aligned to the proper operating frequency.

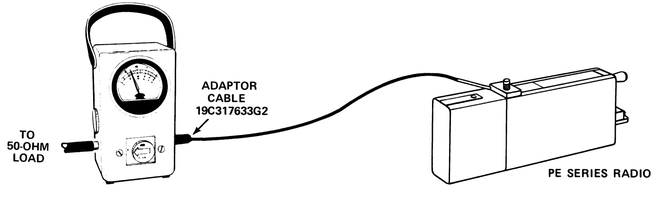
TEST EQUIPMENT REQUIRED
for test hookup shown:

1. Wattmeter similar to:
   Bird # 43
2. VTVM similar to:
   Triplett # 850
   Heath # 1M-21
3. Audio Generator similar to:
   GE Model 4EX6A10 or
   Heath # IG-72
4. Deviation Meter (with a .75 kHz scale) similar to:
   Measurements # 140
   Lampkin # 205A
5. GE Test Adaptor Model 4EX12A10.

STEP 1
POWER MEASUREMENT

TEST PROCEDURE

A. Connect transmitter output to wattmeter as shown below. GE adaptor cable 19C317633G2 is recommended for accurate power output readings.



B. Key transmitter and check wattmeter for desired power output..

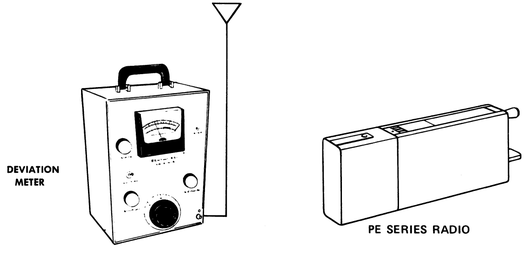
SERVICE CHECK

Refer to Service Hints on Transmitter Troubleshooting Procedure.

STEP 2
TONE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

A. Set up Deviation Meter and monitor output of transmitter as shown below:



B. Set MOD ADJUST R8 fully counterclockwise.

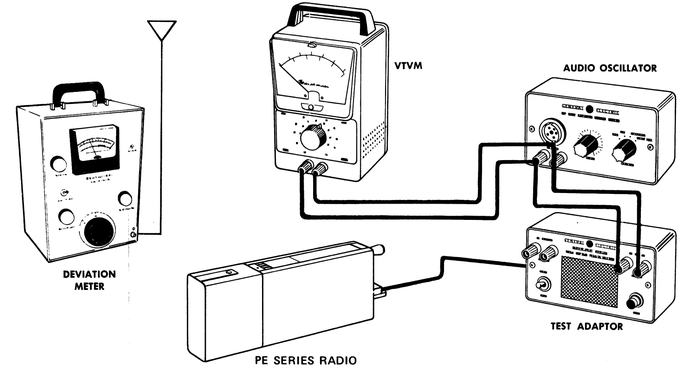
C. Key transmitter and check for approximately 0.75-kHz deviation. If reading is low or high, refer to the Channel Guard Troubleshooting Procedure (see Table of Contents)

NOTES--The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

STEP 3
VOICE DEVIATION AND SYMMETRY

TEST PROCEDURE

A. Connect test equipment to transmitter as shown below:



B. Set the generator output to 140 millivolts RMS and frequency to 1 kHz. If the Test Adaptor is not used, set the generator output for 14 millivolts.

C. Key the transmitter and adjust Deviation Meter to carrier frequency.

D. Deviation reading should be ±4.5 kHz. If the deviation is not 4.5 kHz, set the deviation as directed on the Transmitter Alignment Procedure (see Table of Contents).

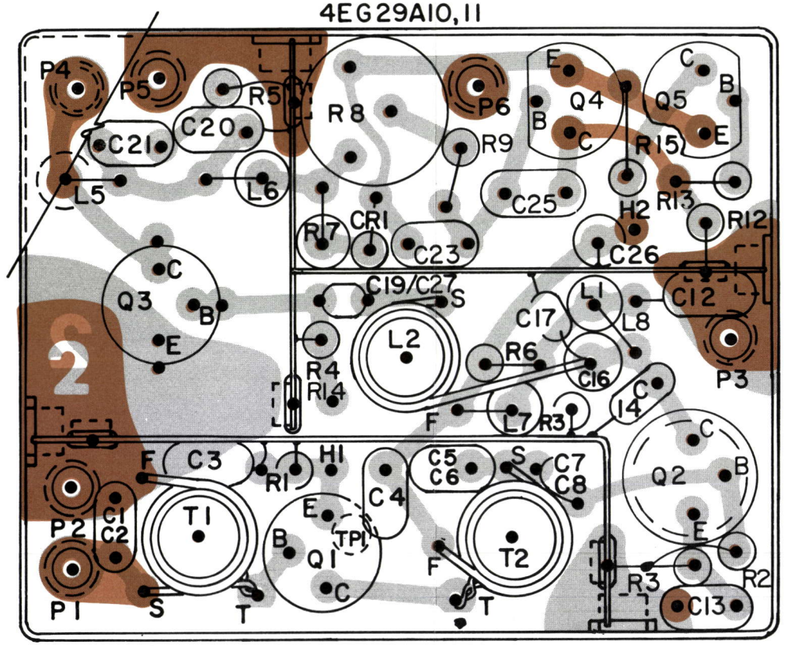
NOTES --These transmitters are adjusted for 4.5 kHz deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 kHz under the worst conditions of frequency, voltage and temperature.

If the deviation reading plus (+) or minus (-) differs by more than 0.5 kHz:

E. Refer to the Modulation Adjustment on the Transmitter Alignment Procedure.

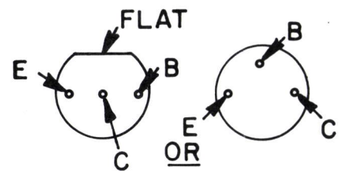
F. Check Audio Sensitivity by reducing generator output until deviation falls to 3 kHz. Voltage should be LESS than 14 millivolts.

EXCITER
4EG29A10,11



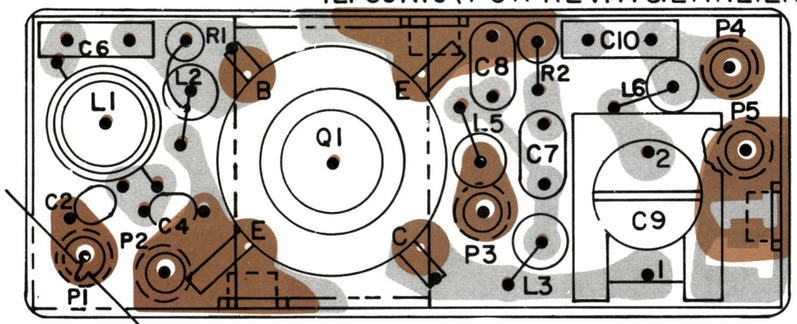
(19C321760, Sh. 2, Rev. 2)
(19C321760, Sh. 3, Rev. 2)

LEAD IDENTIFICATION
FOR EXCITER BD



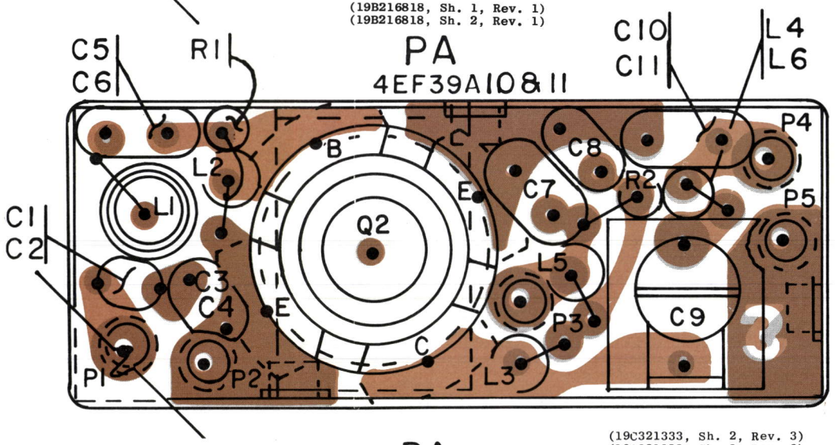
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

PA
4EF39A10 (FOR REV. A & EARLIER BD'S.)



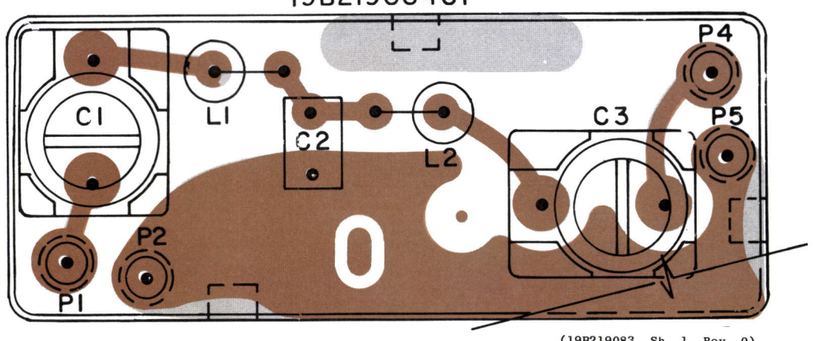
(19B216818, Sh. 1, Rev. 1)
(19B216818, Sh. 2, Rev. 1)

PA
4EF39A10 & 11



(19C321333, Sh. 2, Rev. 3)
(19C321333, Sh. 3, Rev. 2)

PA
19B219084G1



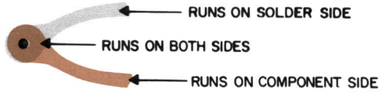
(19B219083, Sh. 1, Rev. 0)
(19B219083, Sh. 2, Rev. 0)

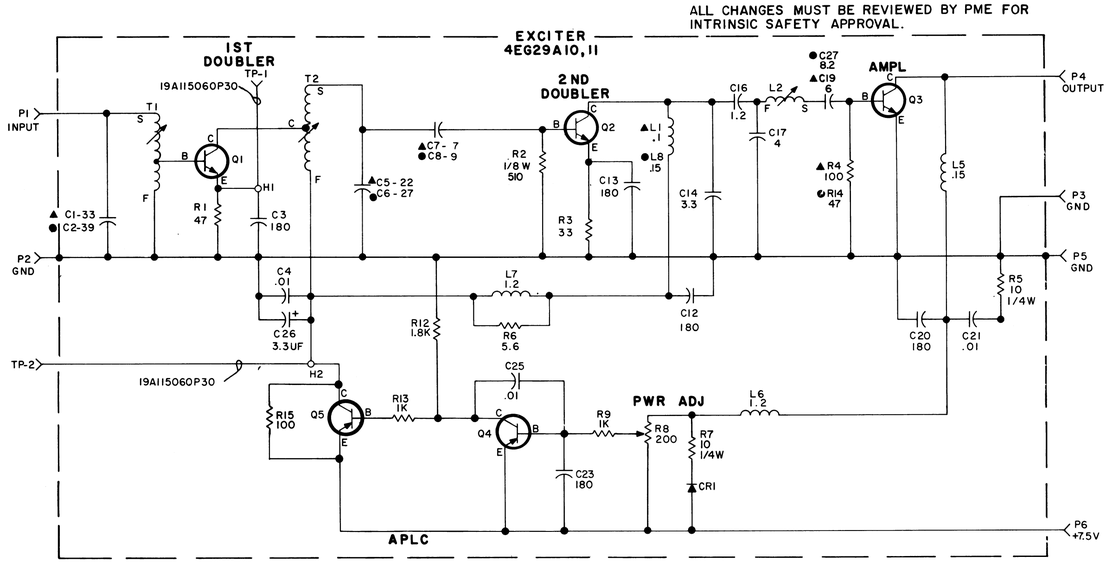
OUTLINE DIAGRAM

(19B219346, Rev. 6)

138—174 MHz TRANSMITTER EXCITER AND PA ASSEMBLY

12 Issue 5





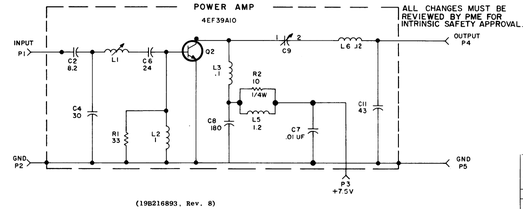
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

ALL RESISTORS ARE 1/10 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

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
4EG29A10	F
4EG29A11	E

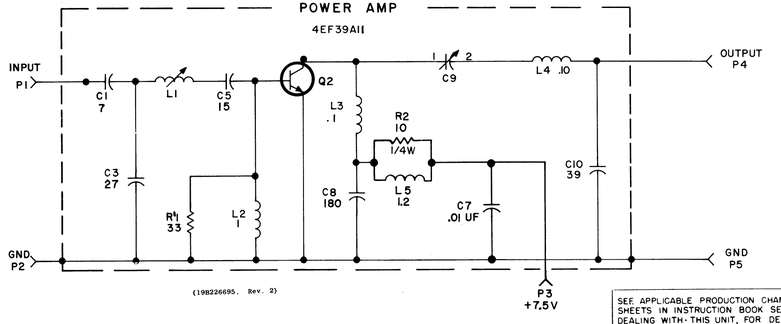
(19C317404, Rev. 10)



(19B216893, Rev. 8)

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

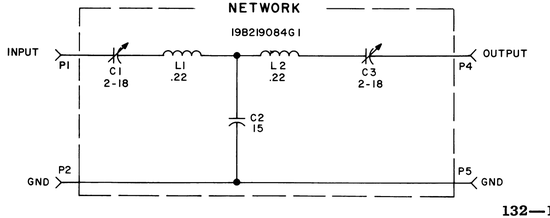
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EF39A10	D



(19B226695, Rev. 2)

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
4EF39A11	D



(19B216892, Rev. 1)

SCHEMATIC DIAGRAM

132—174 MHz TRANSMITTER EXCITER AND PA ASSEMBLY

PARTS LIST

LBI4233G

132-174 MHz TRANSMITTER EXCITER AND PA MODULES

SYMBOL	GE PART NO.	DESCRIPTION
		EXCITER MODULE MODEL 4EG29A10 132-150.8 MHz MODEL 4EG29A11 150.8-174 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116114P2050	Ceramic: 39 pf ±5%, 100 VDCW; temp coef -80 PPM.
C3	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C4	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C5	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C6	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C7*	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM. Earlier than REV A:
	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW; temp coef 0 PPM.
C8*	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW; temp coef 0 PPM. Earlier than REV A:
	19A116114P18	Ceramic: 5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C12 and C13	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C14	19A116114P12	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C16	5491601P122	Phenolic: 1.2 pf ±5%, 500 VDCW.
C17	19A116114P14	Ceramic: 4 pf ±5%, 100 VDCW; temp coef 0 PPM.
C19*	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM. Deleted in 4EG29A10 by REV B.
C20	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDC+; temp coef -3300 PPM.
C21	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C23	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C24*	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 811-A050-X5R. Deleted by REV D in 4EG29A10. Deleted by REV C in 4EG29A11.
C25	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C26	5491674P36	Tantalum: 3.3 µf ±5%, 10 VDC+; sim to Sprague Type 162D.
C27*	19A116114P28	Ceramic: 8.2 pf ±5%, 100 VDCW; temp coef 0 PPM. Added to 4EG29A10 by REV B.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1*	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K. Deleted in 4EG29A10 by REV B.
L2	19B216935G1	Coil. Includes:
	19B209436P1	Tuning slug.
L5	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3K.
L6 and L7	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
L8*	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3K. Added to 4EG29A10 by REV B.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P6	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115328P1	Silicon, NPN.
Q2*	19A116201P3	Silicon, NPN. Earlier than REV A:
	19A116201P1	Silicon, NPN.
Q3	19A116201P1	Silicon, NPN.
Q4* and Q5*	19A115852P1	Silicon, PNP; sim to Type 2N3906. In 4EG29A10 of REV C and earlier; In 4EG29A11 of REV B and earlier:
	19A115768P1	Silicon, PNP; sim to Type 2N3702.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R2*	3R151P511J	Composition: 510 ohms ±5%, 1/8 w. In 4EG29A10 of REV B and earlier; In 4EG29A11 of REV A and earlier:
	3R151P122J	Composition: 1200 ohms ±5%, 1/8 w.
R3	3R151P330J	Composition: 33 ohms ±5%, 1/8 w.
R4*	3R151P101J	Composition: 100 ohms ±5%, 1/8 w. Deleted in 4EG29A10 by REV B.
R5*	19A134564P4	Metal film: 10 ohms ±5%, .25 w; sim to Corning Style FL 4D. In 4EG29A10 of REV E & earlier: In 4EG29A11 of REV D & earlier:
	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R6	3R151P5R6J	Composition: 5.6 ohms ±5%, 1/8 w.
R7*	19A134564P4	Metal film: 10 ohms ±5%, .25 w; sim to Corning Style FL 4D. In 4EG29A10 REV D & E: In 4EG29A11 REV C & D:
	3R151P100J	Composition: 10 ohms ±5%, 1/8 w. In 4EG29A10 of REV C & earlier: In 4EG29A11 of REV B & earlier:
	3R152P160J	Composition: 16 ohms ±5%, 1/4 w.
R8	19A116412P1	Variable, cermet: 200 ohms ±10%, 1/2 w; sim to Helipot Model 62 PF.
R9*	3R151P102J	Composition: 1K ohms ±5%, 1/8 w. In 4EG29A10 of REV C & earlier; In 4EG29A11 of REV B & earlier:
	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R10*	3R151P102J	Composition: 1K ohms ±5%, 1/8 w. Deleted by REV D in 4EG29A10. Deleted by REV C in 4EG29A11.
R11*	3R151P470J	Composition: 47 ohms ±5%, 1/8 w. Deleted by REV D in 4EG29A10. Deleted by REV C in 4EG29A11.
R12*	3R151P182J	Composition: 1.8K ohms ±5%, 1/8 w. In 4EG29A10 of REV C & earlier; In 4EG29A11 of REV B & earlier:
	3R151P222J	Composition: 2.2K ohms ±5%, 1/8 w.
R13*	3R151P102J	Composition: 1K ohms ±5%, 1/8 w. In 4EG29A10 of REV C & earlier: In 4EG29A11 of REV B & earlier:
	3R151P471J	Composition:470 ohms ±5%, 1/8 w.
R14*	3R151P470J	Composition: 47 ohms ±5%, 1/8 w. Added to 4EG29A10 by REV B.
R15*	3R151P101J	Composition: 100 ohms ±5%, 1/8 w. Added to 4EG29A10 by REV E. Added to 4EG29A11 by REV D.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T1	19B216910G2	Coil. Includes:
	19B209436P1	Tuning slug.
T2	19B216934G1	Coil. Includes:
	19B209436P1	Tuning slug.
		2 WATT PA MODULE MODEL 4EF39A10 132-150.8 MHz MODEL 4EF39A11 150.8-174 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C2*	19A116114P28	Ceramic: 8.2 pf ±5%, 100 VDCW; temp coef 0 PPM. In 4EF39A10 REV A & earlier:
	19A116114P30	Ceramic: 9 pf ±5%, 100 VDCW; temp coef 0 PPM.
C3*	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. In REV A & earlier:
	19A116114P36	Ceramic: 15 pf ±5%, 100 VDCW; temp coef 0 PPM.
C4*	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM. In 4EF39A10 REV A & earlier:
	19A116114P38	Ceramic: 18 pf ±5%, 100 VDCW; temp coef 0 PPM.
C5*	19A116114P36	Ceramic: 15 pf ±5%, 100 VDCW; temp coef 0 PPM. In REV A & earlier:
	19A116114P8039	Ceramic: 20 pf ±5%, 100 VDCW; temp coef -80 PPM.
C6*	19A116114P2042	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM. In 4EF39A10 REV A & earlier:
	19A116114P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C7	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C8	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C9	19A116462P3	Variable: less than 2 pf to more than 20 pf, 100 VDCW, -320 PPM/°C.
C10*	19A116114P50	Ceramic: 39 pf ±5%, 100 VDCW; temp coef 0 PPM. Deleted from 4EF39A10 by REV B.
C11*	19A116114P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM. Added to 4EF29A10 by REV B.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 thru P5	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B216921G1	Coil. Includes:
	19B209436P1	Tuning slug.
L2*	19B209420P113	Coil, RF: 1.00 µh ±10%, 0.74 ohms DC res max; sim to Jeffers 4426-6K. Earlier than REV A:
	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4K.
L3*	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K. In REV B & earlier:
	19B209420P105	Coil, RF: 0.22 µh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-5K.
L4	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K.
L5	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L6*	19B209420P2	Coil, RF: 0.12 µh ±5%, 0.09 ohms DC res max; sim to Jeffers 4416-2. In 4EF39A10 REV A & earlier:
	19B209420P103	Coil, RF: 0.15 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4416-3K.

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1*	19A116259P1	Silicon, NPN. Deleted by REV B.
Q2*	19B227818G3	Silicon, NPN. In REV B:
	19A134132P1	Silicon, NPN. Added by REV B.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1*	3R151P330J	Composition: 33 ohms ±5%, 1/8 w. In REV B:
	3R151P560J	Composition: 56 ohms ±5%, 1/8 w. In 4EF39A10 of REV A & earlier:
	3R151P750J	Composition: 75 ohms ±5%, 1/8 w. Deleted in G1 by REV B.
R2*	19A134564P4	Metal film: 10 ohms ±5%, .25 w; sim to Corning Style FL 4D. In REV C & earlier:
	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R3*	3R151P820J	Composition: 82 ohms ±5%, 1/8 w. Added to G1 by REV B. Deleted from 4EF39A11 by REV C.
		200 MILLIWATT PA MODULE 19B216084G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116462P3	Variable: less than 2 pf to 20 pf, 100 VDCW, -320 PPM/°C.
C2	19A116114P36	Ceramic: 15 pf ±5%, 100 VDCW; temp coef 0 PPM.
C3	19A116462P3	Variable: less than 2 pf to 20 pf, 100 VDCW, -320 PPM/°C.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 and L2	19B209420P5	Coil, RF: 0.22 µh ±5%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1 and P2	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
P4 and P5	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19A127337P2	Nut, knurled: 8-32. (Used with Q1 and Q2 in PA Module).
	40353096P11	Washer, fiber. (Used with Q3 on exciter module).
	19A127781P1	Shield. (Located at C12 on exciter module).
	19B216899P1	Shield. (Located at P2 on exciter module).
	19A127853P1	Shield. (Located at R8 on exciter module).

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 - Exciter Model 4EG29A10, 11

To increase Power Output. Changed C7, C8 and Q2.

REV. B - Exciter Model 4EG29A10

To improve operation. Added C27, R14 and L8. Changed R6. Deleted C19, L1 and R4.

REV. C - To reduce current drain in exciter. Changed R2.

REV. B - Exciter Model 4EG29A11

To reduce current drain in exciter. Changed R2.

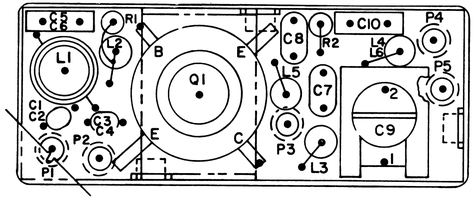
REV. A - Power Amplifier Models 4EF39A10 & 11

To improve power output. Changed L2.

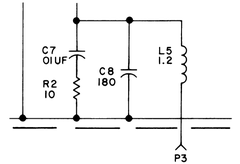
REV. B - Power Amplifier Model 4EF39A11

To incorporate new transistor. Deleted Q1 and R1. Changed PWB, C3 and C5. Added Q2 and R3.

Outline Diagram was:



Schematic Diagram was:



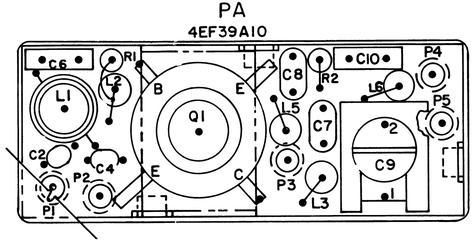
REV. D - Exciter Model 4EG29A10
REV. C - Exciter Model 4EG29A11

To increase range and stability of Power Adjust Circuit. Deleted C24, R10, and R11. Changed Q4, Q5, R7, R9, R12 and R13.

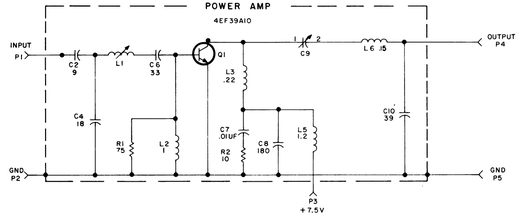
REV. B - Exciter Model 4EF39A10

To incorporate a new transistor. Deleted Q1 and C10. Changed C2, C4, C9, R1 and L6. Added Q2 and C11.

Outline Diagram was:



Schematic Diagram was:



REV. C - To improve stability. Changed Q2, R1 and L3. Deleted R3.

REV. E - Exciter Module 4EG29A10
REV. D - Exciter Module 4EG29A11

To improve stability. Added R15.

REV. F - Exciter Model 4EG29A10
REV. E - Exciter Model 4EG29A11

To provide flame-proof resistors. Changed R5 and R7.

REV. D - Exciter Model 4EF39A10 & 11

To provide flame-proof resistors. Changed R2.

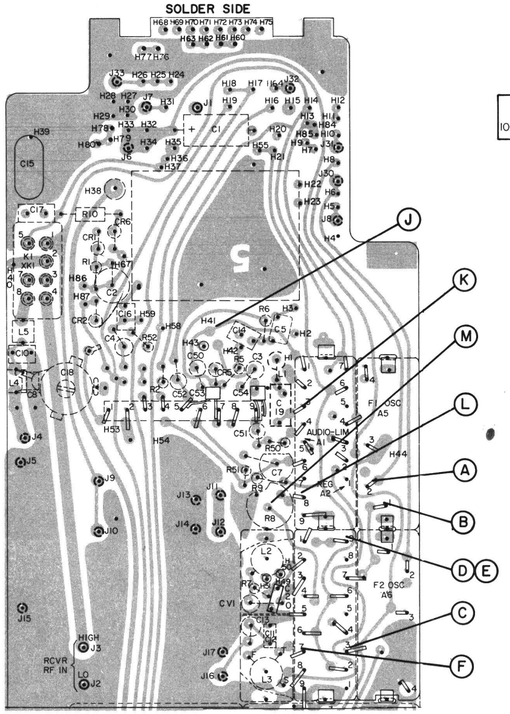
STEP - 1 QUICK CHECKS

SYMPTOM	QUICKCHECK
No power output	1. Replace the PA module unit with Network 19B219084G1. Realign the transmitter and check for 200 milliwatt output. 2. If the proper output is obtained, replace the PA module. 3. If no power output is obtained after performing Step 1, check the reading at TP1. If no reading is obtained at TP1, check readings at (P), (R) and (B). If TP1 reading is correct, replace the Exciter module.
Low power output	1. Low battery voltage (refer to Battery Checks in operation section of the manual). 2. Check the transmitter alignment.
Distorted or no audio with normal RF output.	1. Check voltage readings at (J), (K), (L) and (M) 2. Improper setting of Mod Adjust R8. 3. Shorted C3 or C6 on Audio Board. 4. Bad microphone.
No reading at TP1	Check voltage readings at (A), (B), (D), (E) and (F).

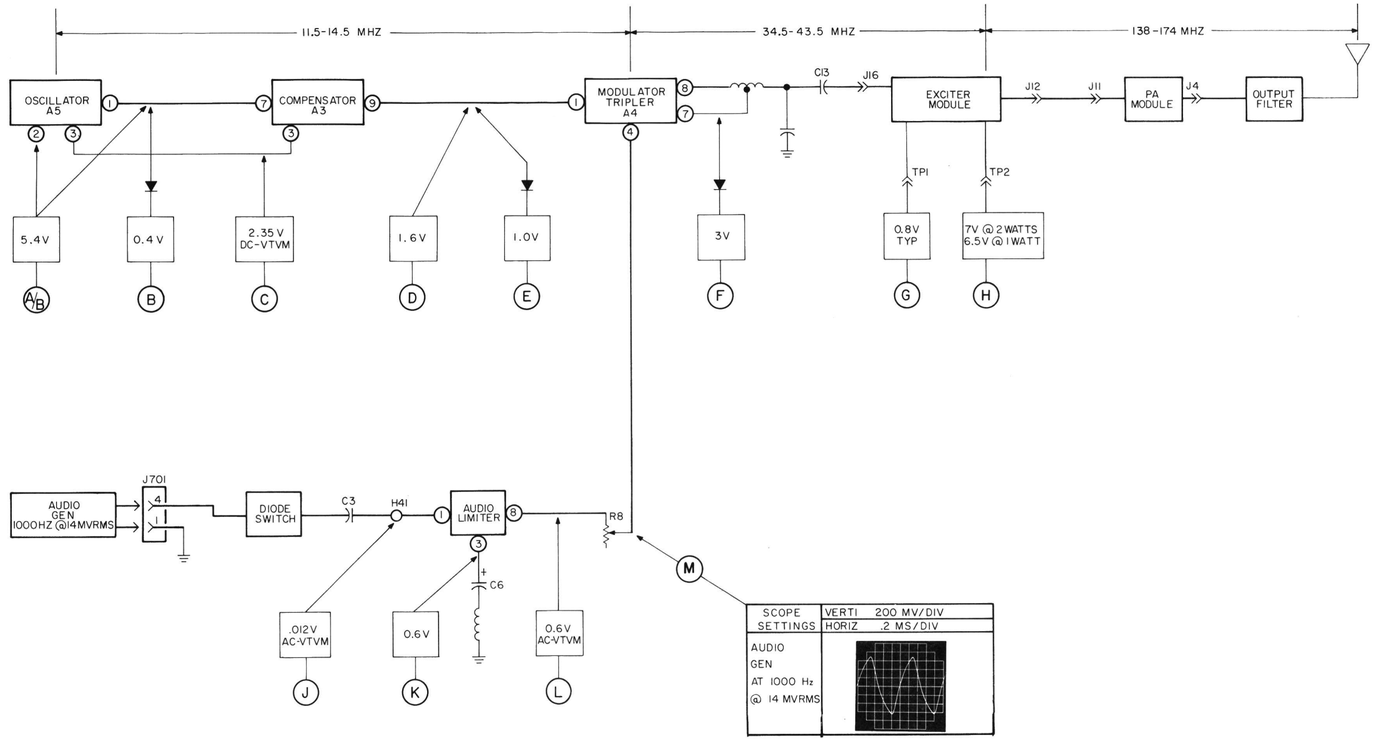
STEP 2 - TYPICAL VOLTAGE READINGS

DC READINGS MADE WITH GE TEST SET MODEL 4EX3A10 OR EQUIVALENT. READINGS SHOWN IN SERIES WITH A DIODE ARE RF READINGS TAKEN WITH RF PROBE 19C311370-G1 AND TEST SET MODEL 4EX3A10 ON 3 VOLT SCALE.

EXCEPTION: READINGS FOLLOWED BY VTVM WERE MEASURED WITH A VTVM WITH 11 MEG OHM OR GREATER METER INPUT.



(RC-2156)
(19D416845, Rev. 4)
(19D416505, Sh. 2, Rev. 5)



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