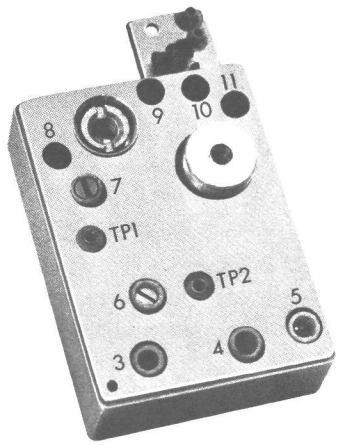
MOBILE RADIO

MASTR® Personal Series
PROGRESS LINE

PE MODEL
406-512 MHz, 4 WATT TRANSMITTER TYPES
KT-104-A, KT-105-A, KT-110-A AND KT-111-A

Maintenance Manual LBI4918E
DATAFILE FOLDER - DF-3169



SPECIFICATIONS *

Type Numbers	KT-104-A, KT-105-A, KT-110-A, and KT-111-A
Power Output	4 Watt
Modulation	0 to ±5 kHz
Spurious	
Radiated	-50 dB
Conducted	-50 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	24
RF Load Impedance	50 ohms
Modulation Sensitivity	0.5 to 1.5 millivolts
Maximum Frequency Spacing	+0.4% of highest frequency no degradation +3.5 MHz 1 dB degradation in power output

KT-104-A, KT-105-A, KT-110-A, KT-111-A

*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 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 KT-104-A, KT-105-A, KT-110-A and KT-111-A are crystal controlled, phase modulated transmitters for one-through eight-frequency operation in the 406-512 MHz band. The transmitter utilizes both discrete components and Integrated Circuit Modules (IC-s). The application of each transmitter type is shown in the following chart:

Type No.	PA Model No.	Frequency Range	No. Frequencies	Power Output
KT-104-A	4EF49A10	406-420 MHz	2	4 Watts
	4EF49A11	450-470 MHz		
KT-105-A	4EF49A10	406-420 MHz	8	4 Watts
	4EF49A11	450-470 MHz		
KT-110-A	4EF49A12	470-494 MHz	2	3.5 Watts
	4EF49A13	494-512 MHz		
KT-111-A	4EF49A12	470-594 MHz	8	3.5 Watts
	4EF49A13	494-512 MHz		

The transmitters consist of the audio, voltage regulator, oscillator, compensator and modulator IC's, and plug-in Exciter/P module. 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.

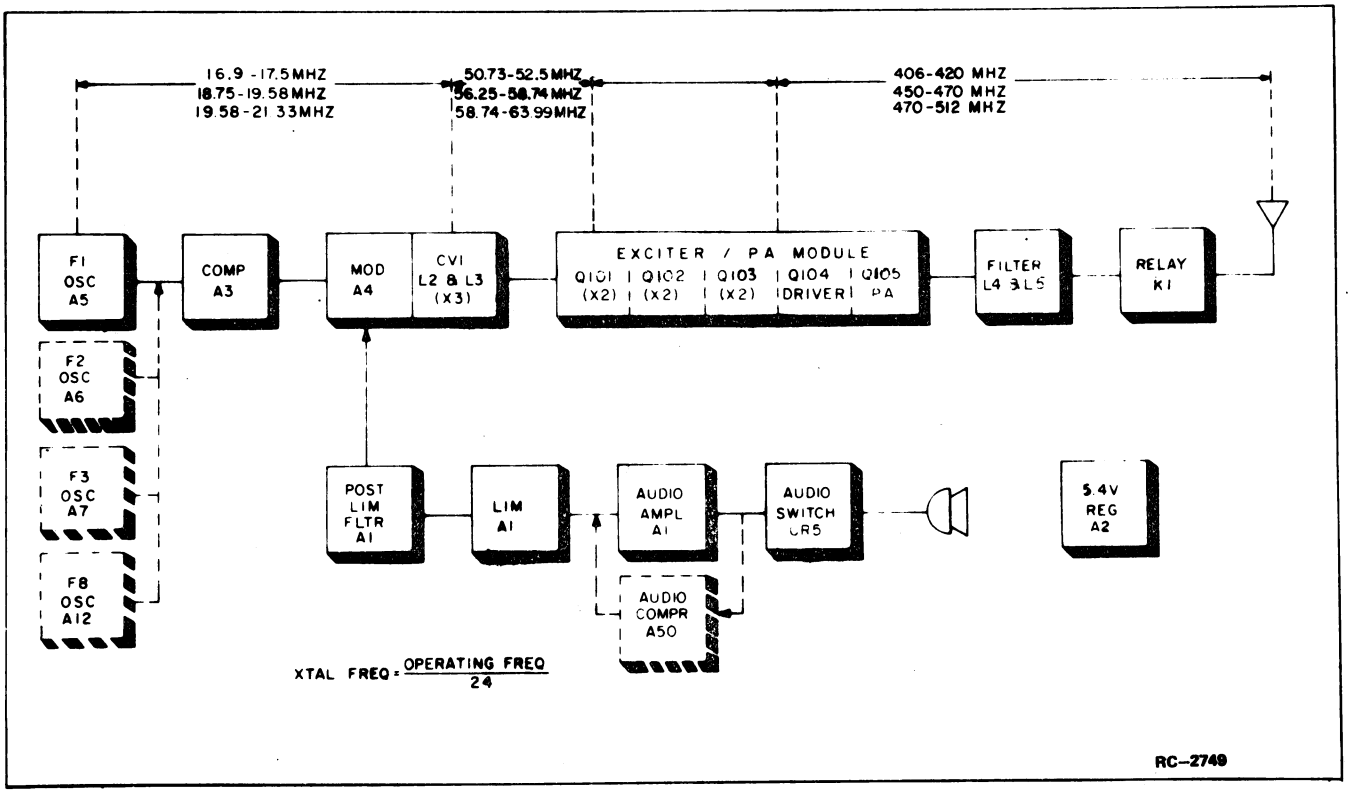


Figure 1 - Transmitter Block Diagram

Reference to symbol numbers mentioned in the following text are found on the Schematic Diagrams, Outline Diagrams and Parts Lists (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.

CIRCUIT ANALYSIS

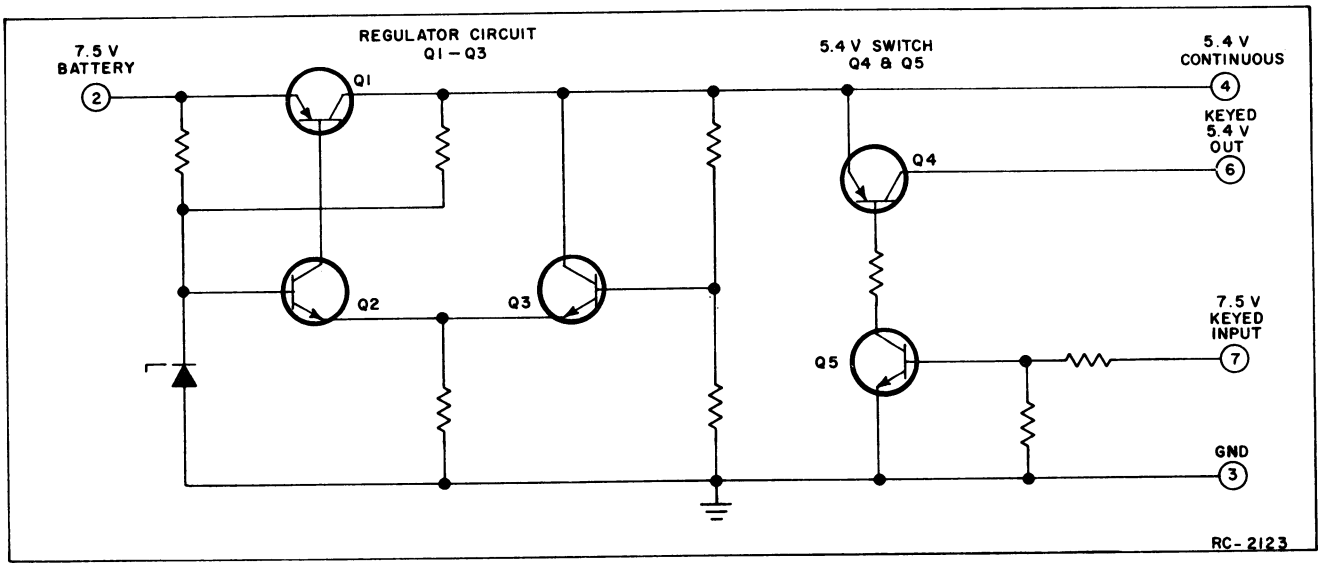


Figure 2 - Typical Regulator Circuit

REGULATOR A2

The Regulator module operates from the 7.5-Volt from the battery, and provides a continuous, regulated 4.5 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 MODULE A5

Oscillator Model 4EG27A11 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 16.9 to 19.6 MHz, and the crystal frequency is multiplied 24 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 module. 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

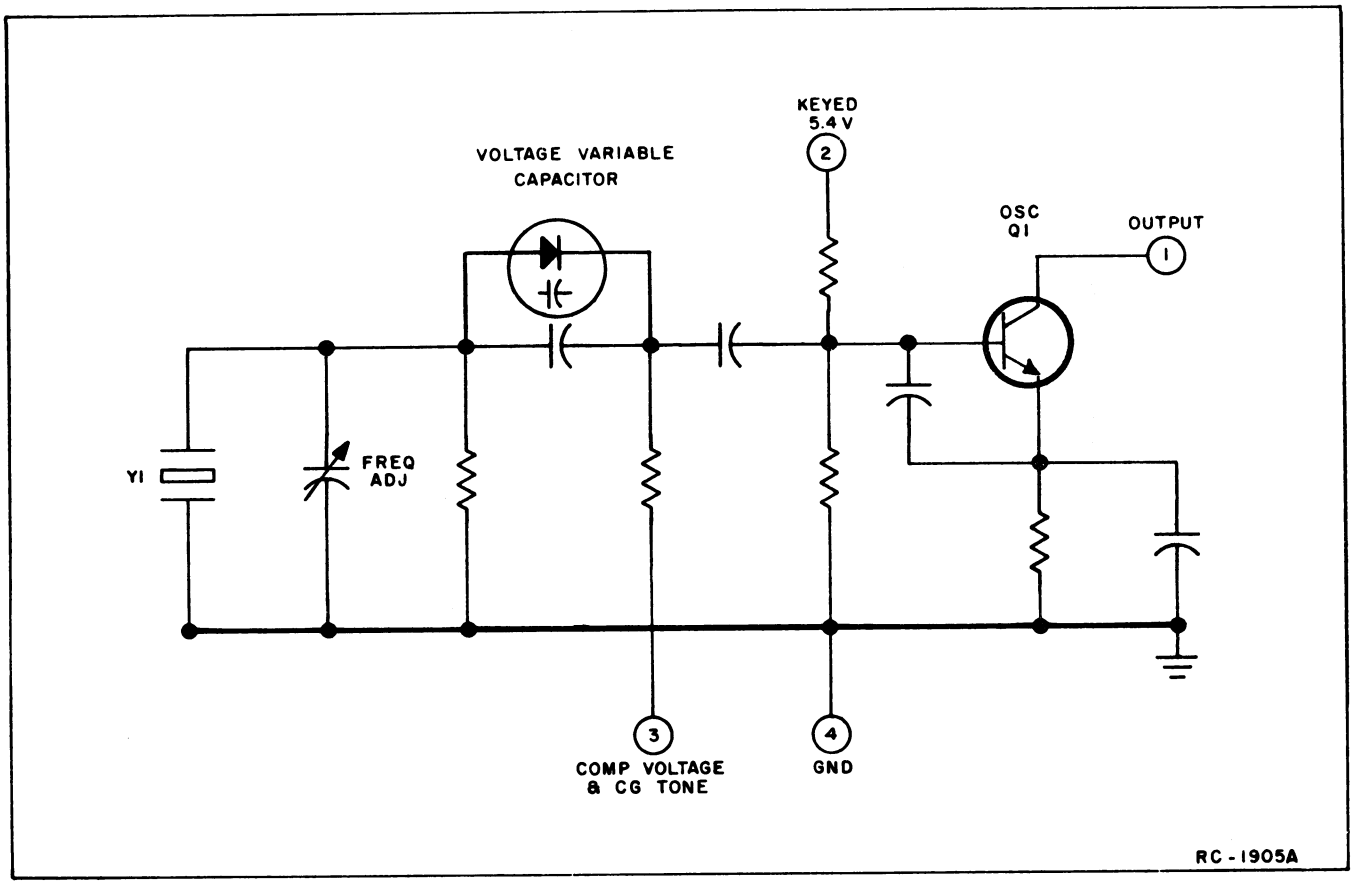


Figure 3 - Typical Oscillator Circuit

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.

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 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.

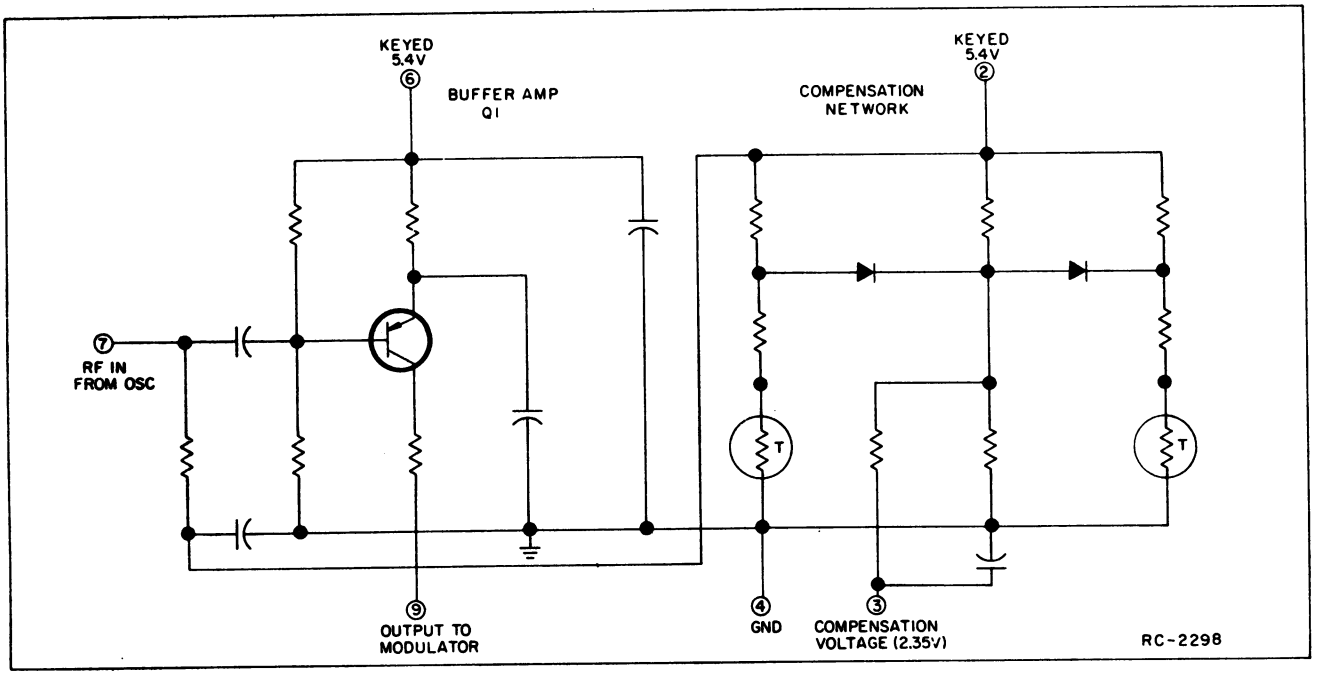


Figure 4 - Typical Compensator Circuit

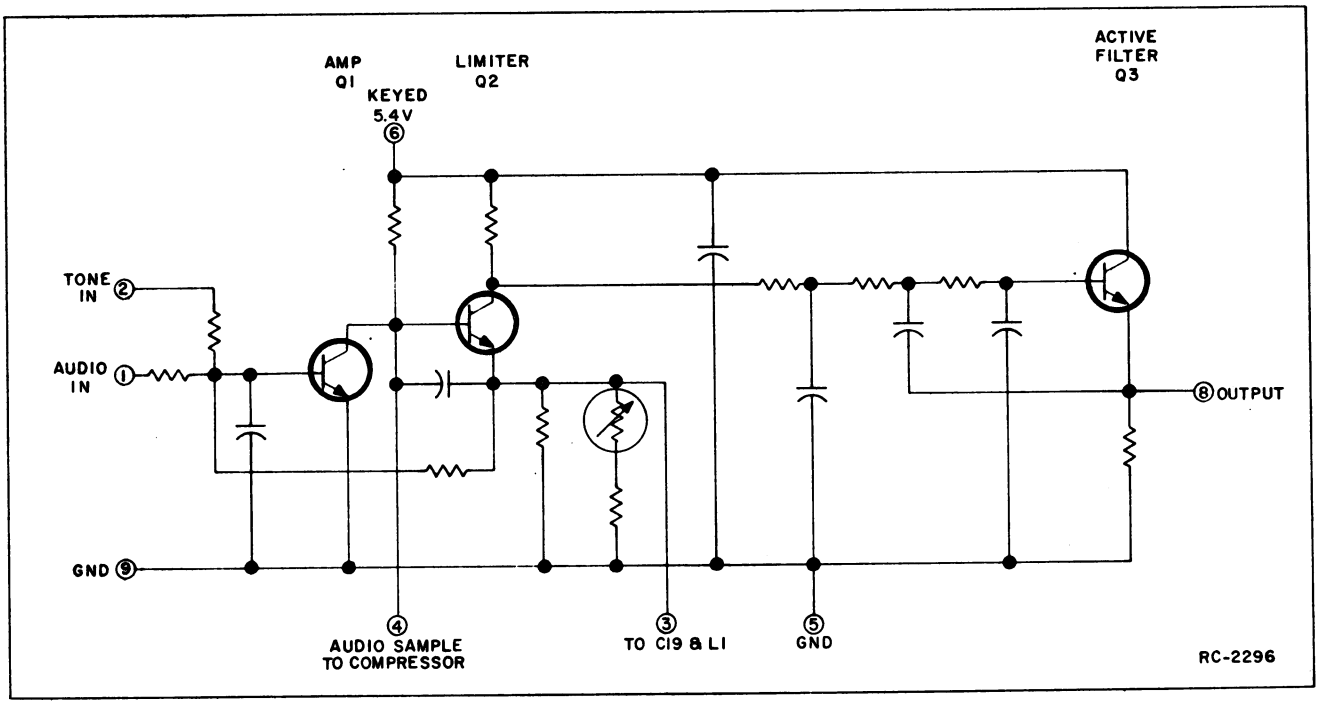


Figure 5 - Typical Audio Amplifier & Limiter Circuit

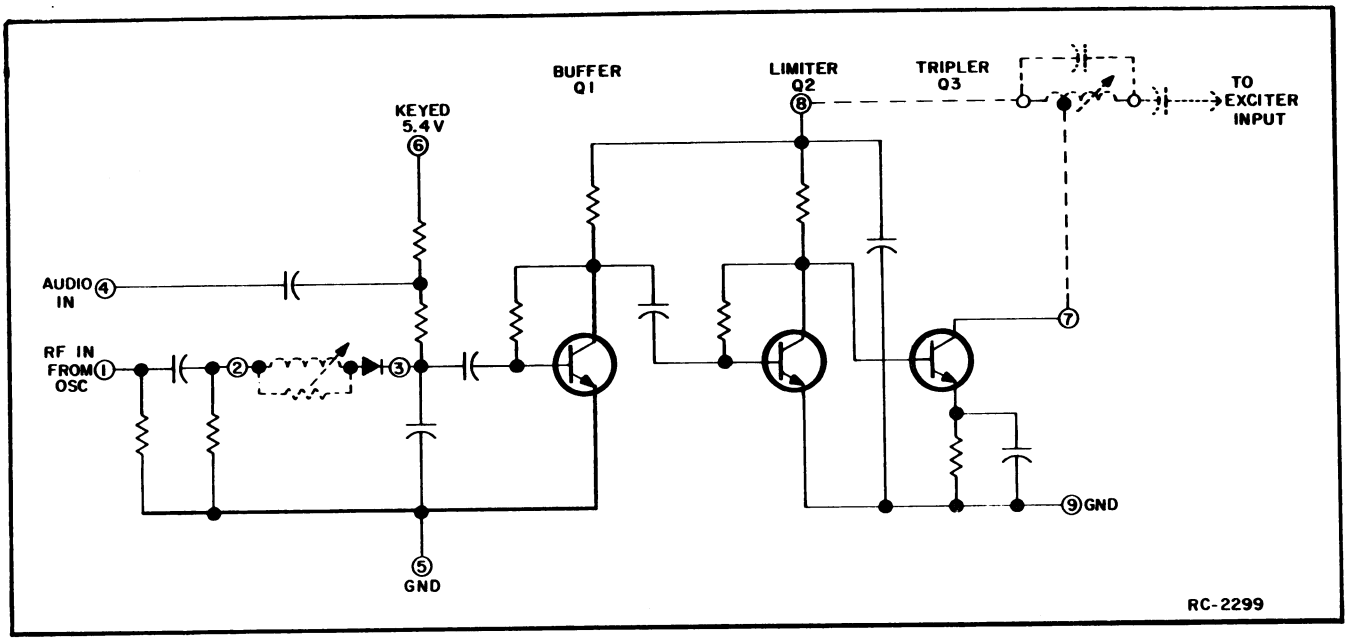


Figure 6 - Typical Phase Modulator Circuit

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. The filter output at Pin 8 is coupled through Mod Adjust potentiometer R8 to the Modulator module A4.

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 A706. A typical modulator circuit is shown in Figure 6.

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.

EXCITER/PA MODULE

Exciter/PA Models 4EF49A10, 11, 12 and 13 (406-512 MHz) consists of three doubler stages,a driver stage and a power amplifier stage.

All of the stages are supplied by a type of constant-K, DC collector feed network.

Doubler Stages

The modulator output is coupled through T101 to the base of 1st doubler Q101. T101 is tuned to three times the crystal frequency. The modulator coils and the 1st doubler base circuit are metered at TP1. The 1st doubler collector circuit is metered at TP2.

The output of the 1st doubler is coupled through T102 (untuned) and T103 to the base of 2nd doubler Q102. T103 is tuned to six times the crystal frequency, and is metered at TP2.

An impedance-matching network couples the output of Q102 to the base of Q103. The network consists of C115, C116, L106/L107, C117/C118 and C119 and also provides some selectivity. L106/L107 is tuned to 12 times the crystal frequency.

3rd doubler Q103, driver Q104 and PA transistor Q105 are tuned by measuring the total PA current. An ammeter with a two ampere full scale meter or greater is used in series with the 7.5 Volt PA supply. The meter is connected in the circuit by removing a jumper between H89 and H90, on the system board, and replacing it with the ammeter. GE Test Regulator Model

4EX19A10 and Test Set Model 4EX3A11 may be used in place of the ammeter.

Driver & PA

Following the third doubler is an impedance-matching network consisting of L109/L125, C125, L110/L126, C126/C150, C129/C149, L111 and L112. The network matches the high impedance doubler output to the low impedance driver input. L110, C129/C149 are tuned to 24 times the crystal frequency.

The driver output is coupled through a similar impedance-matching network to the base of power amplifier Q105. The power amplifier output is applied to the low-pass filter through a series-tuned matching network.

Low-Pass Filter

Low-pass filter L122, L123, C141/C155, C142/C156, C143 and C144 provides for the suppression of harmonics. The filter output is applied to the antenna through system switching relay K1 mounted on the Systems Board.

An RF adaptor cable is available for connecting the transmitter RF output to a wattmeter. In a standard PE Radio, connecting the RF adaptor cable to J702 opens a set of contacts on the antenna strip line assembly. This disconnects the antenna and connects the transmitter output to J702-3. Connection to chassis ground is made at J702-4.

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

GENERAL ELECTRIC*
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MODULATION LEVEL ADJUSTMENT

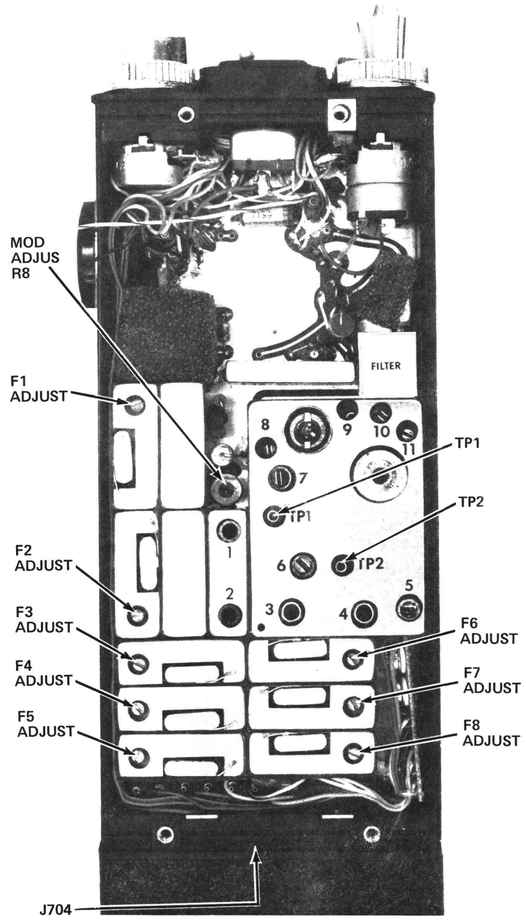
The MOD ADJUST (R8) was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction 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 multi-frequency transmitters, set the deviation as described in Step 4 on the channel producing the largest amount of deviation.



TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED:

- GE Test Set Model 4EX3A11 (or 4EX8K11) or equivalent 20,000 ohm-per-Volt meter.
- GE Test Regulator Model 4EX19A10, or an ammeter capable of measuring one ampere.
- A 50-ohm, terminating wattmeter connected to external antenna jack J702 thru RF adaptor cable 19C317633G1 (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 6 even with the top of the can (there is no slug in Tuning Control 4). When properly aligned, the slugs will be between the top of the can and the coil.
3. If using Test Set 4EX3A11 and Test Regulator 4EX19A10, 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 3-Volt scale as 3 ampere full scale).
4. Test Point meter reading made with the (+) meter lead to TP1 and TP2, and the (-) lead to system ground.
5. All adjustments made with the transmitter keyed.

ADJUSTMENT PROCEDURE

STEP	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
1.	1, 2, and 3	Maximum (at TP1)	Adjust Tuning Controls 1, 2 and 3, for maximum meter reading at TP1. If no reading is obtained, adjust Tuning Control 3 for maximum transmitter current, and then re-adjust 1, 2 and 3 for maximum meter reading at TP1.
2.	5	Maximum (at TP2)	Adjust Tuning Control 5 for maximum meter reading at TP2.
3.	6	Maximum (at TP1)	Adjust Tuning Control 6 for maximum meter reading at TP1.
4.	1, 2, 3, 5		Retune 1, 2, 3, 5, and 6 for maximum meter reading at TP1.
5.	6, 7, 8, 9	Maximum Current	Tune 6, 7, 8, and 9 for maximum transmiter current.
6.	8 and 9	Maximum Power Output	Adjust Tuning Controls 8 and 9 for maximum power output.
7.	10 and 11	Maximum Power Output	Tune 10 and 11 for maximum power output.
8.	2 thru 11	Maximum Power Output	Retune Tuning Controls 2 thru 11 until no further increase in power output is obtained.
9.			Apply 7.5 Volts and check for a power output of 4 Watts (minimum) at 406-470 MHz and 3.5 Watts (minimum) at 470-512 MHz. If the transmitter current is greater than 1.5 amperes at 7.5 Volts, retune controls 10 and 11 to produce minimum rated power or more at no greater than 1.5 amperes transmitter current.
10.			With no modulation, adjust F1 through F8 crystal trimmers for proper oscillator frequencies. 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.

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.

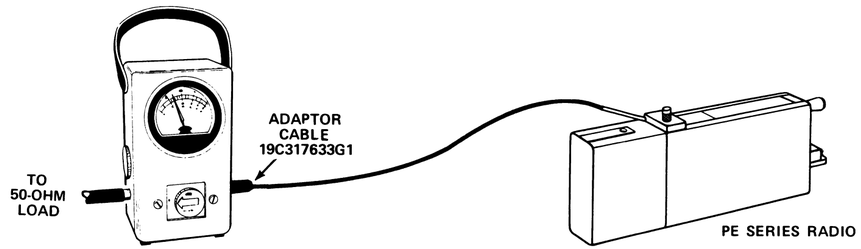
TEST EQUIPMENT REQUIRED
for test hookup shown:

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 19C317633G1 is recommended for accurate power output readings.



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

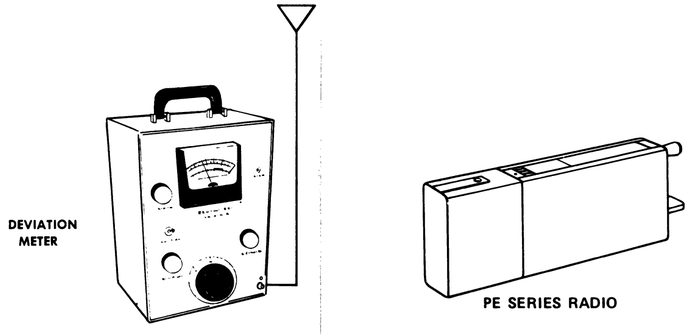
SERVICE CHECK

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.

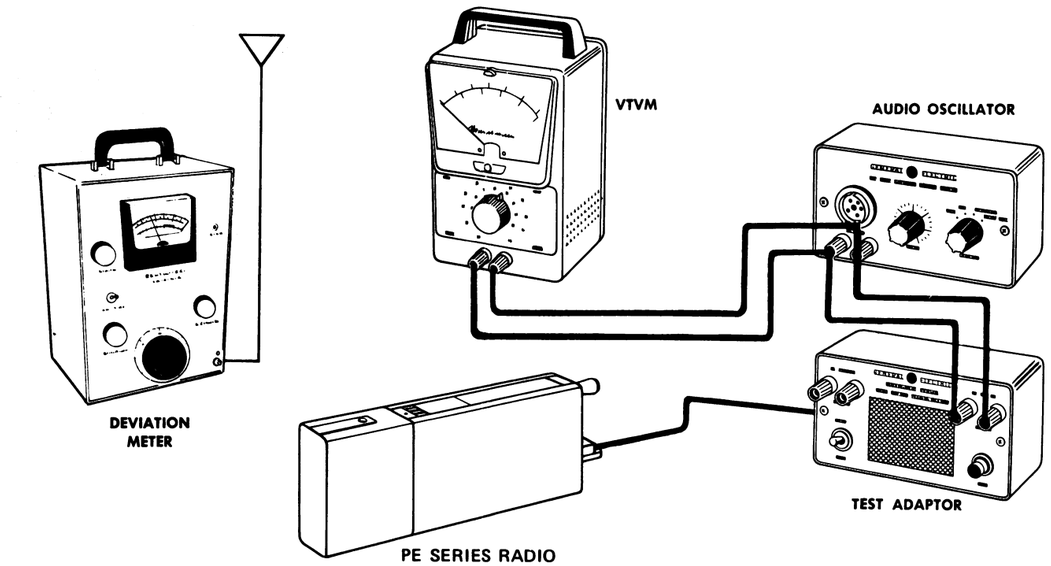
C. Key transmitter and check for approximately 0.75-kHz deviation. If reading is low or high, refer to the Channel Guard Troubleshooting Procedure (see Table of Contents)

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.

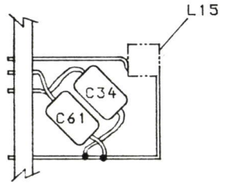
D. Deviation reading should be ±4.5 kHz. If the deviation is not 4.5 kHz, set the deviation as directed on the Transmitter Alignment Procedure (see Table of Contents).

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.**

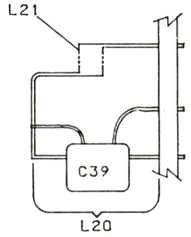
If the deviation reading plus (+) or minus (-) differs by more than 0.5 kHz:

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

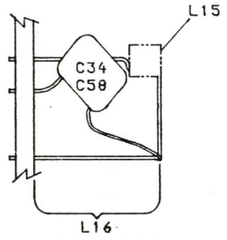
F. Check Audio Sensitivity by reducing generator output until deviation falls to 3 kHz. Voltage should be LESS than 14 millivolts.



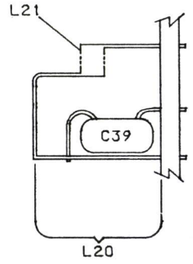
VIEW IN DIRECTION
OF ARROW "C" (FOR GP 6)



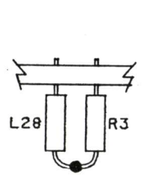
VIEW IN DIRECTION
OF ARROW "B" (FOR GP 6)



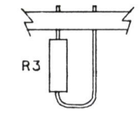
VIEW IN DIRECTION
OF ARROW "C" (FOR GP 5,7 & 8)



VIEW IN DIRECTION
OF ARROW "B"
(FOR GP 5,7 & 8)



VIEW IN DIRECTION
OF ARROW "E"
(GP 6 ONLY)



VIEW IN DIRECTION
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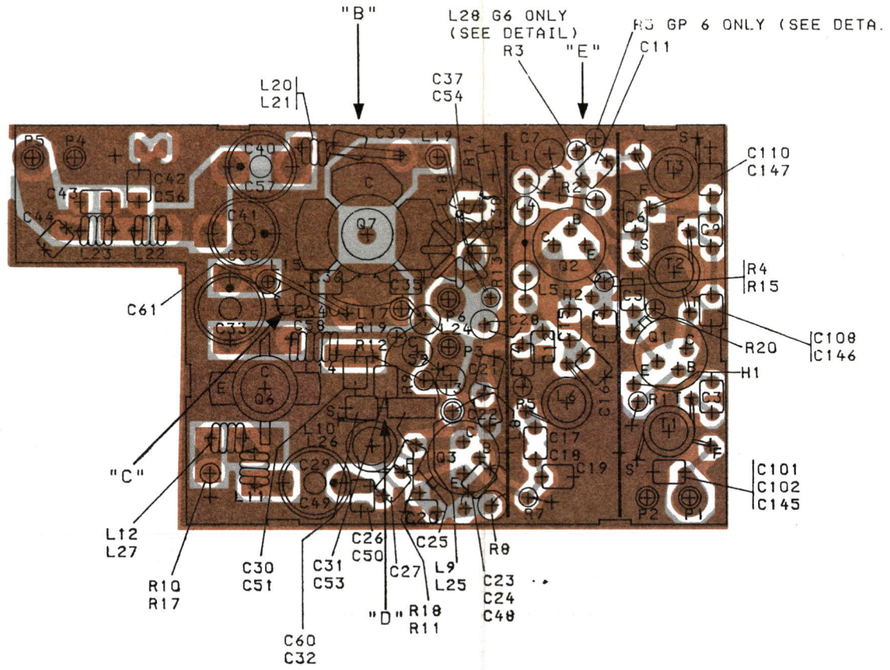
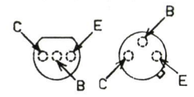
(GP 5,7 & 8)

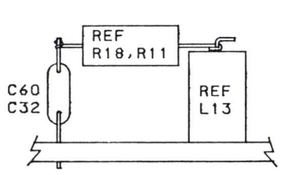


LEAD IDENTIFICATION
FOR Q1 THRU Q3

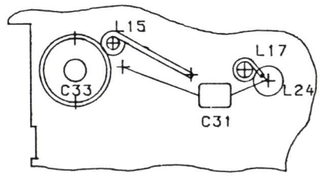


IN-LINE OR TRIANGULAR
TOP VIEW

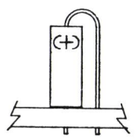
NOTE: LEAD ARRANGEMENT, AND NOT
CASE SHAPE, IS DETERMINING
FACTOR FOR LEAD IDENTIFICATION.



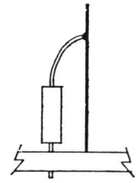
VIEW IN DIRECTION
OF ARROW "D"



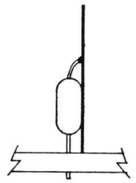
VIEW SHOWING LOCATION
OF C31 IN GPS 5,7&8 ONLY



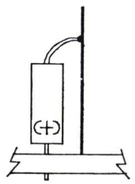
C7 & C59



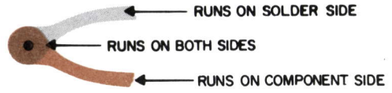
R4,R8 AND R15



C6



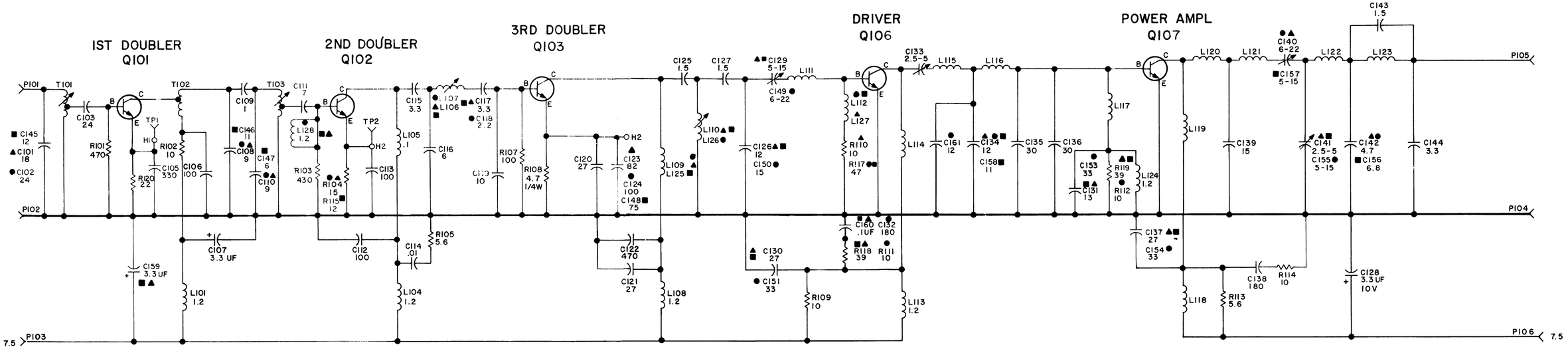
C28



OUTLINE DIAGRAM

406—512 MHz TRANSMITTER
EXCITER/PA ASSEMBLY
19D417909G5-G8

(19D430468, Rev. 8)
(19A142555, Sh. 1, Rev. 3)
(19A142555, Sh. 2, Rev. 3)



● 4EF49A10 --- 406 – 420 MHZ

▲ 4EF49A11 --- 450 – 470 MHZ

■ 4EF49A12 --- 470 – 494 MHZ
■ 4EF49A13 --- 494 – 512 MHZ

ALL RESISTORS ARE 1/8 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.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EF49A10	C
4EF49A11	C
4EF49A12	C
4EF49A13	C

(19R622373, Rev. 7)

SCHEMATIC DIAGRAM

406—512 MHz TRANSMITTER
EXCITER/PA ASSEMBLY
19D417909G5-G8

Issue 3

PARTS LIST

EXCITER/PA MODULE

4EF49A10	(406-420 MHz)	19D417909G6
4EF49A11	(450-470 MHz)	19D417909G5
4EF49A12	(470-494 MHz)	19D417909G7
4EF49A13	(494-512 MHz)	19D417909G8

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C101	19A700221P38	Ceramic: 18 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C102 and C103	19A700221P42	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C105	19A116192P7	Ceramic: 330 pf ±10%, 50 VDCW; sim to Erie 8101-A050-W5R-331K.
C106	19A700227P64	Ceramic: 100 pf ±10%, 100 VDCW.
C107*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		In 4EF49A10 of REV B & earlier: In 4EF49A11-A13 of REV A & earlier:
	5491674P39	Tantalum: 6.8 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C108	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C109	19A700219P1	Ceramic: 1 pf ±10%, 100 VDCW; temp coef 0 PPM.
C110	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C111	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C112 and C113	19A700227P64	Ceramic: 100 pf ±10%, 100 VDCW.
C114	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-SPECIAL.
C115	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C116	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM.
C117	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C118	19A700219P10	Ceramic: 2.2 pf ±5%, 100 VDCW; temp coef 0 PPM.
C119	19A700221P26	Ceramic: 10 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C120 and C121	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C122	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C123	19A700225P62	Ceramic: 82 pf ±5%, 100 VDCW; temp coef -470 PPM/°C.
C124	19A700227P64	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -1500 PPM/°C.
C125	19A700221P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C126	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM.
C127	19A700221P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C128*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		In 4EF49A10 of REV B & earlier: In 4EF49A11-A13 of REV A & earlier:
	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C129	19A116149P2	Variable: 4.5 to 15 pf, 63 VDCW, temp coef -750 PPM.
C130 and C131	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C132	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM/°C.
C133	19A116149P4	Variable: 2.5 to 5 pf,+50-10%, 63 VDCW, temp coef -33 PPM/°C.
C134	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM.
C135 and C136	19A700221P45	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C137	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C138	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM/°C.
C139	19A700221P33	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C140	19A116149P3	Variable: 6 to 22 pf, 63 VDCW; temp coef -1500 PPM.
C141	19A116149P4	Variable: 2.5-5 pf +50-10%, 63 VDCW, temp coef -33 PPM/°C.
C142	19A700219P18	Ceramic: 4.7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C143	19A700219P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C144	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C145	19A700221P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C146	19A700221P27	Ceramic: 11 pf ±10%, 100 VDCW; temp coef -80 PPM/°C.
C147	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C148	19A700225P60	Ceramic: 75 pf ±5%, 100 VDCW; temp coef -470 PPM/°C.
C149	19A116149P3	Variable: 6-22 pf +70-10%, 63 VDCW, temp coef -1500 PPM/°C.
C150	19A700221P33	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C151	19A700221P47	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C153 and C154	19A700221P47	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM/°C.
C155	19A116149P2	Variable: 4.5-15 pf +70-10%, 63 VDCW, temp coef -750 PPM/°C.
C156	19A700219P22	Ceramic: 6.8 pf ±5%, 100 VDCW; temp coef 0±80 PPM/°C.
C157	19A116149P2	Variable: 4.5-15 pf +70-10%, 63 VDCW, temp coef -750 PPM/°C.
C158	19A700221P27	Ceramic: 11 pf ±10%, 100 VDCW; temp coef -80 PPM/°C.
C159*	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		In 4EF49A10 of REV B & earlier: In 4EF49A11-A13 of REV A & earlier:
	5491674P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C160	19A11619214	Ceramic: 0.1 µf ±20%, 50 VDCW; sim to Erie USCC CW20C104-M2.
C161	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L101	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L104	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L105	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K.
L106	19B219526G1	Coil. Includes:
	19A127805P1	Tuning slug.
L107	19B219526G2	Coil. Includes:
	19A127805P1	Tuning slug.
L108	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L109	19A130336P1	Coil.
L110	19B219526G3	Coil. Includes:
	19B209436P1	Tuning slug.
L111	19A130337P1	Coil.
L112	19A130337P2	Coil.
L113	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L114	19A130336P2	Coil.
L115	19A130407P1	Coil.
L116		(Part of L115).
L117	19A130336P3	Coil.
L118	19A130340G1	Coil.
L119	19A130336P4	Coil.
L120	19A130339P1	Coil.
L121		(Part of L120).
L122 and L123	19A129247P1	Coil.
L124	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L125	19A130336P5	Coil.
L126	19B219526G4	Coil. Includes:
	19B209436P1	Tuning slug.
L127	19A130337P3	Coil.
L128	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P101 thru P106	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q101 thru Q103	19A116201P3	Silicon, NPN.
Q106	19B227818G8	Silicon, NPN.
Q107	19B227818G6	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	3R151P471K	Composition: 470 ohms ±10%, 1/8 w.
R102	3R151P100K	Composition: 10 ohms ±10%, 1/8 w.
R103	3R151P431J	Composition: 430 ohms ±5%, 1/8 w.
R104	3R151P150K	Composition: 15 ohms ±10%, /8 w.
R105	3R151P5R6J	Composition: 5.6 ohms ±5%, 1/8 w.
R107	3R151P101K	Composition: 100 ohms ±10%, 1/8 w.
R108	19A700106P7	Composition: 4.7 ohms ±5%, 1/4 w.
R109 thru R112	3R151P100K	Composition: 10 ohms ±10%, 1/8 w.
R113	3R151P5R6J	Composition: 5.6 ohms ±5%, 1/8 w.
R114	3R151P100K	Composition: 10 ohms ±10%, 1/8 w.
R115	3R151P120K	Composition: 12 ohms ±10%, 1/8 w.
R117	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R118 and R119	3R151P390J	Composition: 39 ohms ±5%, 1/8 w.
R120	3R151P220J	Composition: 22 ohms ±5%, 1/8 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T101	19B219527G2	Coil.
T102	19B219523G2	Coil.
T103	19B219523G1	Coil.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4035306P11	Washer: 1/8 dia. (Used with Q101-Q103).
	19A130341P1	Heat sink. (Used with Q105).
	19A129245P1	Nut: thd. size No. 8-32. (Used with Q106).
	19A129255P1	Shield. (Located near C105).
	19A129256P1	Shield. (Located near C128).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

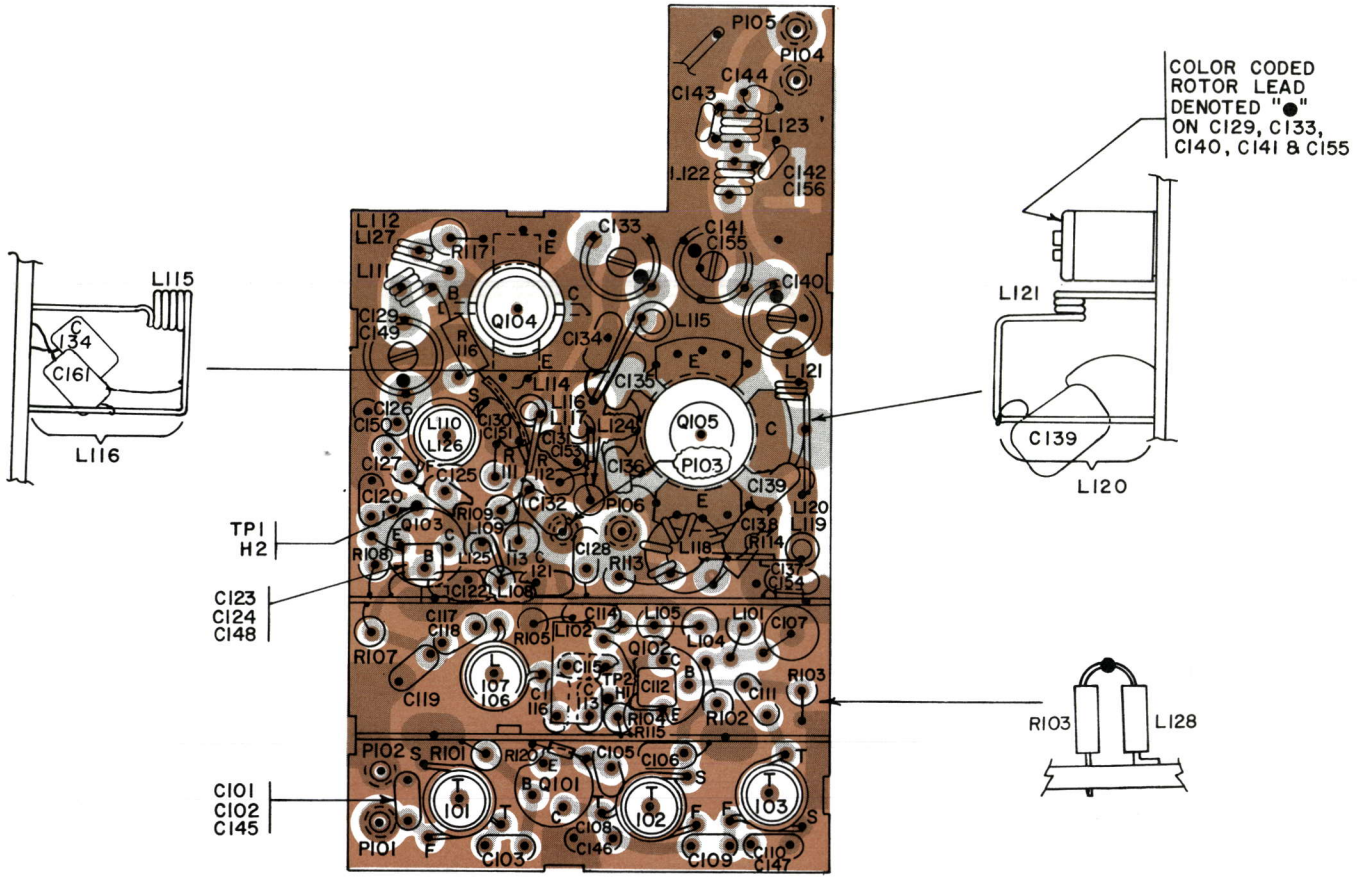
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - 4EF49A11 (19D417909G5)
4EF49A12 (19D417909G7)
4EF49A13 (19D417909G8)
Incorporated into initial shipment when 19D417909G5 replaced G1, 19D417909G7 replaced G3 and 19D417909G8 replaced G4.

REV. A & B - 4EF49A10 (19D417909G6)
Incorporated into initial shipment when 19D417909G6 replaced G2.

REV. C - 4EF49A10 (19D417909G6)
REV. B - 4EF49A11 (19D417909G5)
REV. B - 4EF49A12 (19D417909G7)
REV. B - 4EF49A8 (19D417909G8).
To improve reliability of Teledyne relay. Changed C107, C128 and C159.

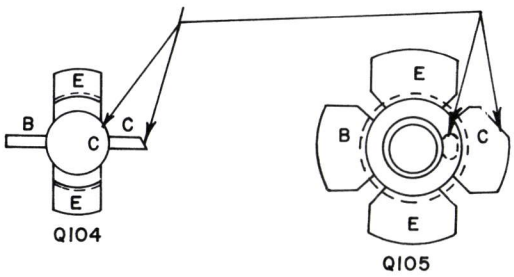
REV. C - 4EF49A11 (19D417909G5)
REV. C - 4EF49A12 (19D417909G7)
REV. C - 4EF49A13 (19D417909G8)
To improve quality of RF output signal changed C131 from 19A700221P44 (27pf) to 19A700221P32 (13pf)



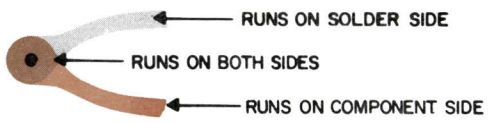
LEAD IDENTIFICATION
FOR Q101 THRU Q103

LEAD IDENTIFICATION
FOR Q104 & Q105

DENOTES COLLECTOR

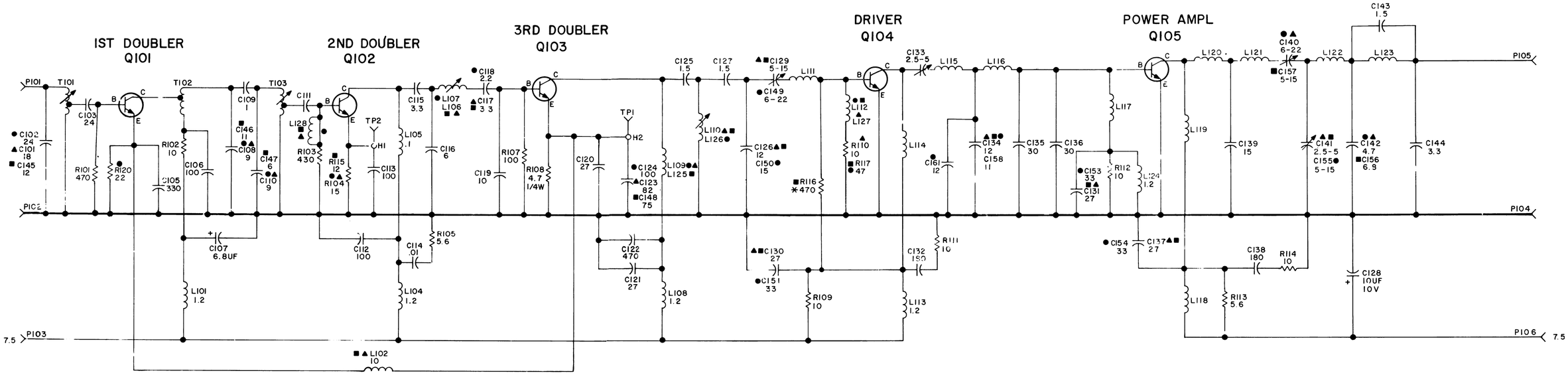


(19C321649, Rev. 3)
(19D417648, Sh. 2, Rev. 1)
(19D417648, Sh. 3, Rev. 1)



SERVICE SHEET

406—512 MHz TRANSMITTER
EXCITER/PA ASSEMBLY
19D417909G1-G4
Sheet 1



● 4EF49A10 --- 406 – 420 MHZ
▲ 4EF49A11 --- 450 - 470 MHZ
■ {4EF49A12 --- 470-494 MHZ
{4EF49A13 --- 494 - 512 MHZ
* APPEARS ONLY ON 470-494 & 494-512 VERSIONS

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 1/8 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
4EF49A10	B
4EF49A11	A
4EF49A12	A
4EF49A13	A

(19R622100, Rev. 8)

SERVICE SHEET

406—512 MHz TRANSMITRER
EXCITER/PA ASSEMBLY
19D417909G1-G4
Sheet 2

PARTS LIST

LBI4917B

EXCITER/PA MODULE
4EF49A10 (406-420 MHz) 19D417909G2
4EF49A11 (450-470 MHz) 19D417909G1 REV C
4EF49A12 (470-494 MHz) 19D417909G3 REV C
4EF49A13 (494-512 MHz) 19D417909G4 REV C

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C101	19A700221P38	Ceramic: 18 pf ±5%, 100 VDCW; temp coef -80 PPM.
C102 and C103	19A700221P42	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM.
C105	19A116192P7	Ceramic: 330 pf ±10%, 50 VDCW; sim to Erie 8101-A050-W5R-331K.
C106	19A700227P64	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -1500 PPM.
C107	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C108	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C109	19A700219P1	Ceramic: 1 pf ±5%, 100 VDCW; temp coef 0 PPM.
C110	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C111	19A116114P24	Ceramic: 7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C112 and C113	19A700227P64	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -1500 PPM.
C114	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-SPECIAL.
C115	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C116	19A116114P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM.
C117	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C118	19A700219P10	Ceramic: 2.2 pf ±5%, 100 VDCW; temp coef 0 PPM.
C119	19A700221P26	Ceramic: 10 pf ±5%, 100 VDCW; temp coef -80 PPM.
C120 and C121	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C122	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C123	19A700225P62	Ceramic: 82 pf ±5%, 100 VDCW; temp coef -470 PPM.
C124	19A700225P64	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -1500 PPM.
C125	19A700221P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef -80 PPM.
C126	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM.
C127	19A700221P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef -80 PPM
C128	5491674P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C129	19A116149P2	Variable: 4.5 to 15 pf, 63 VDCW, temp coef -750 PPM.
C130	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C131	19A700221P32	Ceramic: 13 pf ±5%, 100 VDCW; temp coef -80 PPM.
C132	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C133	19A116149P4	Variable: 2 to 5 pf, 63 VDCW, temp coef -33 PPM.
C134*	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM. Added to G2 by REV A.
C135 and C136	19A700221P45	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C137	19A700221P44	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C138	19A700229P73	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C139	19A700221P33	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C140	19A116149P3	Variable: 6 to 22 pf, 63 VDCW; temp coef -1500 PPM.
C141	19A116149P4	Variable: 2 to 5 pf, 63 VDCW, temp coef -33 PPM.
C142	19A700219P18	Ceramic: 4.7 pf ±5%, 100 VDCW; temp coef 0 PPM.
C143	19A700219P6	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C144	19A700219P14	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM.
C145	19A700221P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM.
C146	19A700221P27	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM.
C147	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C148	19A700225P60	Ceramic: 75 pf ±5%, 100 VDCW; temp coef -470 PPM.
C149	19A116149P3	Variable: 6 to 22 pf, 63 VDCW, temp coef -1500 PPM.
C150	19A700221P33	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C151	19A700221P47	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C152*	19A116114P2038	Ceramic: 18 pf ±5%, 100 VDCW; temp coef -80 PPM. Deleted by REV A.
C153 and C154	19A700221P47	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C155	19A116149P2	Variable: 4.5 to 15 pf, 63 VDCW, temp coef -750 PPM.
C156	19A700219P22	Ceramic: 6.8 pf ±5%, 100 VDCW; temp coef 0 PPM.
C157	19A116149P2	Variable: 4.5 to 15 pf, 63 VDCW, temp coef -750 PPM.
C158	19A700221P27	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM.
C161*	19A700219P30	Ceramic: 12 pf ±5%, 100 VDCW; temp coef 0 PPM. added by REV A.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L101	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L102	19A700024P25	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max;
L103 and L104	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L105	19B209420P101	Coil, RF: 0.10 µh ±10%, 0.08 ohms DC res max; sim to Jeffers 4416-1K.
L106	19B219526G1	Coil. Includes:
	19A127805P1	Tuning slug.
L107	19B219526G2	Coil includes:
	19A127805P1	Tuning slug.
L108	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L109	19A130336P1	Coil.
L110	19B219526G3	Coil. Includes:
	19B209436P1	Tuning slug.
L111	19A130337P1	Coil.
L112	19A130337P2	Coil.
L113	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L114	19A130336P2	Coil.
L115	19A130407P1	Coil.
L116		(Part of L115).
L117	19A130336P3	Coil.
L118	19A130340G1	Coil.
L119	19A130336P4	Coil.
L120	19A130339P1	Coil.
L121		(Part of L120).
L122 and L123	19A129247P1	Coil.
L124	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K.
L125	19A130336P5	Coil.
L126	19B219526G4	Coil. Includes:
	19B209436P1	Tuning slug.
L127	19A130337P3	Coil.
L128*	19B209420P114	Coil, RF: 1.20 µh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1K. Added by REV A.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P101 thru P106	19A11534P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q101 thru Q103	19A116201P3	Silicon, NPN.
Q104	19B227818G4	Silicon, NPN.
Q105	19B227818G6	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	3R151P471J	Composition: 470 ohms ±5%, 1/8 w.
R102	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R103	3R151P431J	Composition: 430 ohms ±5%, 1/8 w.
R104	3R151P150J	Composition: 15 ohms ±5%, 1/8 w.
R105	3R151P5R6J	Composition: 5.6 ohms ±5%, 1/8 w.
R107	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R108	19A700106P7	Composition: 4.7 ohms ±5%, 1/4 w.
R109	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R110*	3R151P100J	Composition: 10 ohms ±5%, 1/8 w. Deleted in G2 by REV A.
R111 and R112	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R113	3R151P5R6J	Composition: 5.6 ohms ±5%, 1/8 w.
R114	3R151P100J	Composition: 10 ohms ±5%, 1/8 w.
R115	3R151P120K	Composition: 12 ohms ±10%, 1/8 w.
R116	3R151P471J	Composition: 470 ohms ±5%, 1/8 w.
R117*	3R151P470J	Composition: 47 ohms ±5%, 1/8 w. Added to G2 by REV A.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T101	19B219527G2	Coil.
T102	19B219523G2	Coil.
T103	19B219523G1	Coil.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4035306P11	Washer: 1/8 dia. (Used with Q101-Q103).
	19A130341P1	Heat sink. (Used with Q105).
	19A129255P1	Partition. (INNER).
	19A129256P1	Partition. (OUTER).

*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 - 4EF49A10
To increase RF power output by increasing drive to driver transistor.
Deleted C152, L103 and R110.
Added C134, C161, L128, R117 and R120.

REV. B - To increase RF power output.
Changed Exciter/PA Module from 19D417909G2 to 19D417909G6.

REV. A - 4EF4911
To increase RF power output.
Changed Exciter/PA Module from 19D417909G1 to 19D417909G5.

REV. A - 4EF49A12
To increase RF power output.
Changed Exciter/PA Module from 19D417909G3 to 19D417909G7.

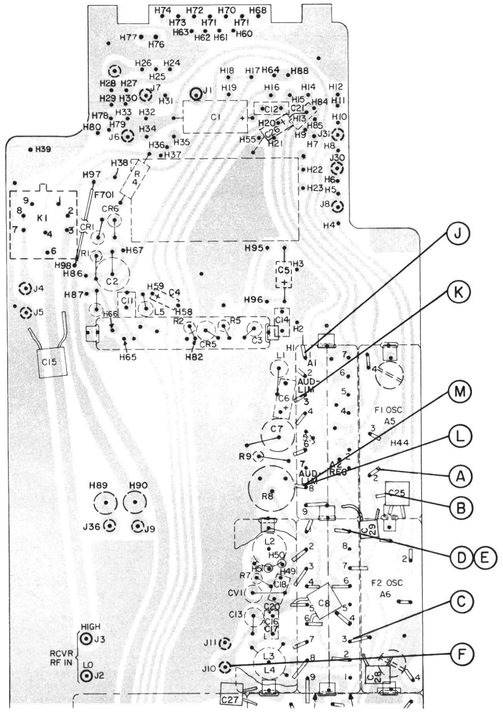
REV. A - 4EF49A13
To increase RF power output.
Changed Exciter/PA Module from 19D417909G4 to 19D417909G8.

STEP 2 - TYPICAL VOLTAGE READINGS

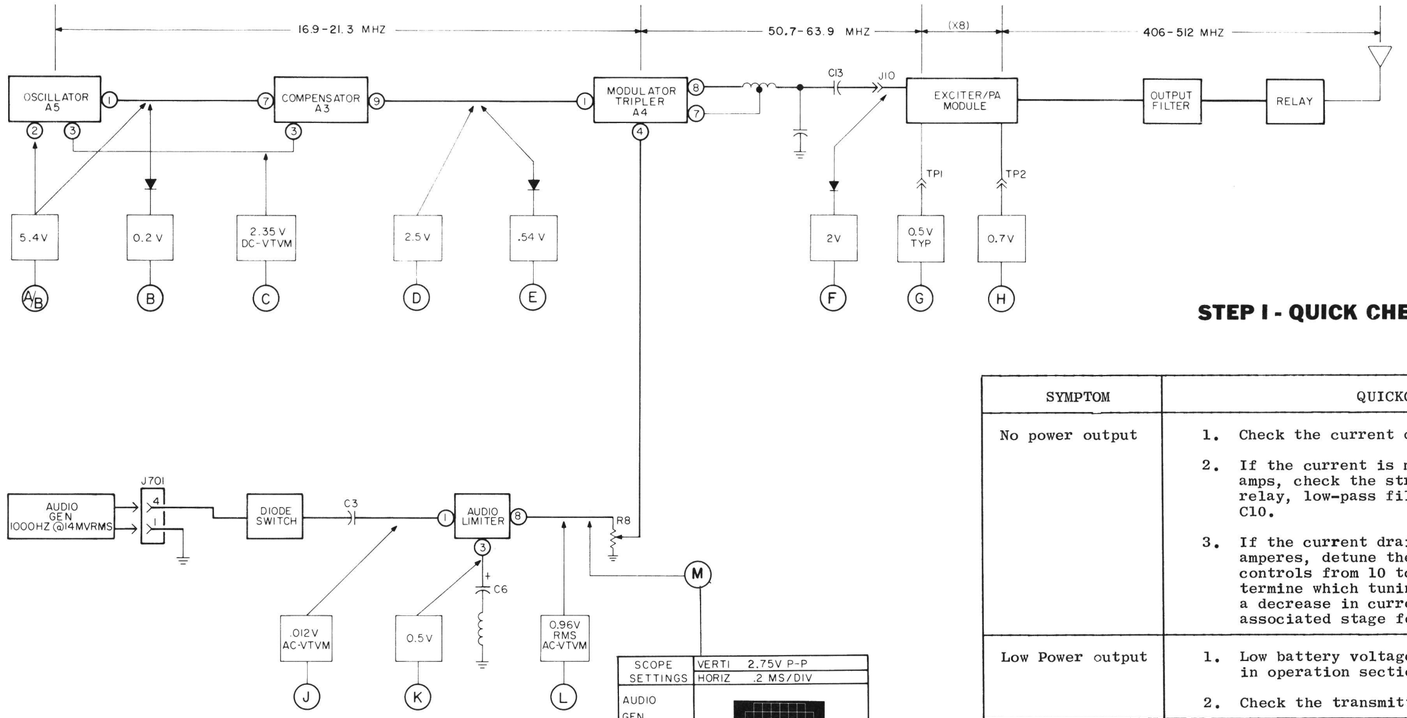
D.C. READINGS MADE WITH GE TEST SET MODEL 4EX3A10,11 OR EQUIVALENT. READINGS SHOWN IN SERIES WITH A DIODE ARE RF READINGS TAKEN WITH RF PROBE 19C311370G1 AND TEST SET MODEL 4EX3A10,11 ON 3 VOLT SCALE.

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

SOLDER SIDE



(RC-2331)
(19D417309, Rev. 15)
(19D416614, Sh. 2, Rev. 12)



RC-2837

STEP 1 - QUICK CHECKS

SYMPTOM	QUICKCHECK
No power output	1. Check the current drain. 2. If the current is more than 900 milliamps, check the stripline switch, antenna relay, low-pass filter and for a shorted C10. 3. If the current drain is less than 500 milliamperes, detune the transmitter tuning controls from 10 to 1 in that order to determine which tuning control doesn't cause a decrease in current. Then check the associated stage following that control.
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. Check Mod coil L2. 4. Shorted C3 or C6 on Audio Board. 5. Bad microphone.
No reading at TP1.	Check voltage readings at (A), (B), (D), (E) and (F).