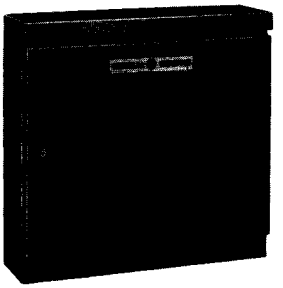
MOBILE RADIO

MASTR
PROGRESS LINE
ROYAL EXECUTIVE

MAINTENANCE MANUAL



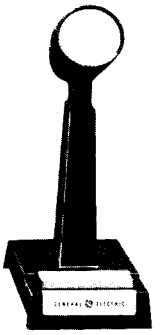
Wall Mount

Desk Top

25—50 MHz

TWO-WAY FM STATION COMBINATIONS

LBI-4004B



Microphone

GENERAL ELECTRIC

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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.

EQUIPMENT INDEX

EQUIPMENT	MODEL OR TYPE NUMBER	
	DESK TOP	WALL MOUNT
Transmitter	ET-82-A	ET-82-A
Receiver	ER-46-A	ER-46-A
Power Regulator	4EP59A10	4EP59A10
Control Unit	4EC69B10-12	4EC70B10
Channel Guard Board	4EK14B10	4EK14B10
Four Freq. Oscillator Board	4EG22A10	4EG22A10
Remote Control Board	4KC20A10-12	4KC20A10-12
Power Cable	19A122527-G2	19A122527-G1
Microphone	4EM28A10	
Top Cover	19A122161-G3	
Bottom Cover	19C311827-G1	
Weatherproof Cabinet		19D402658-G1
Alignment Tools Hex Slug Type Slotted Screw Type	 4038831-P1 4033530-G2	 4038831-P1 4033530-G2
Lock Assembly Key Lock		 5491682-P8 5491682-P14

OPTIONAL EQUIPMENT

OPTION	EQUIPMENT
8401	12-Hour Clock (117-VAC, 60-Hz)
8402	12/24-Hour Clock (117-VAC, 60-Hz)
8481	Test Meter
8483	12-Hour Clock (117-VAC, 60-Hz) and Test Meter
8482	12/24-Hour Clock (117-VAC, 60-Hz) and Test Meter
7610	Carrier Operated Relay
8411	Tone Decoder Relay
8484	Compressor
8485	Power Line Surge Protector (117-VAC)
8486	Power Line Surge Protector (234-VAC)
8487	Remote Control Surge Protector
8309	Carrier Control Timer
8421	Speaker (4EZ16A14) and Microphone (19B209102-P2)
8422 & 8423	Fan (117-VAC, 60-Hz)
8424	Cabinet Heater (117-VAC, 50/60-Hz)
8408 & 8409	234-VAC, 50/60-Hz Modification
8493	Handset (4EM26A10) & Hookswitch
8494	Handset (4EM26A10)
8495	Military Microphone (19B209102-P2)

SPECIFICATIONS *

GENERAL

FREQUENCY RANGE	25—50 MHz
DIMENSIONS (H x W x D)	
Desk Top	6" x 20-3/8" x 13-5/8"
Wall Mount	21-1/4" x 22-1/2" x 6-7/8"
WEIGHT	
Desk Top	46 pounds
Wall Mount	71 pounds
INPUT VOLTAGE	117/234 VAC ±20%, 50/60 Hz
INPUT POWER	
Standby	20 watts
Transmit	250 watts
OPERABLE TEMPERATURE RANGE	-30°C to +60°C (-22°F to 140°F)
DUTY CYCLE	20% transmit, 100% receive
MAXIMUM FREQUENCY SPACING	0.4%

TRANSMITTER

POWER OUTPUT	50 watts
FREQUENCY STABILITY	±.002% (-30°C to 60°C, +25°C reference)
SPURIOUS AND HARMONIC RADIATION	-60 dB
MODULATION	Adjustable from 0 to ±5 kHz swing with instantaneous modulation limiting
AUDIO FREQUENCY CHARACTERISTICS	Within +1 and -3 dB of a 6 dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards.
DISTORTION	Less than 5%
DEVIATION SYMMETRY	0.6 kHz maximum
CRYSTAL MULTIPLICATION FACTOR	12

RECEIVER

AUDIO OUTPUT	5 watts at less than 5% distortion
SENSITIVITY	
12-dB SINAD (EIA Method	0.25 µV
20-dB Quieting Method	0.35 µV
SELECTIVITY	
EIA Two-Signal Method	-75 dB (adjacent channel, 20 kHz channels)
20-dB Quieting Method	-100 dB at ±20 kHz
SPURIOUS RESPONSE	-90 dB
FIRST OSCILLATOR STABILITY	±.002% (-30°C to +60°C, +25°C reference)
MODULATION ACCEPTANCE	±6 kHz
INTERMODULATION	-60 dB
FREQUENCY RESPONSE	+1 and -8 of a standard 6-dB per octave de-emphasis curve from 300 to 3000 Hz
SQUELCH SENSITIVITY	
Critical Squelch	4-dB SINAD (0.9 µV typical)
Maximum Squelch	Greater than 20-dB quieting

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

DESCRIPTION

MASTR Progress Line Royal Executive Desk Top and Wall Mount stations are attractively styled base stations that are designed to meet the most stringent requirements in the field of Two-Way radio. The radios are fully transistorized, utilizing silicon transistors for added reliability. A power regulator assembly provides regulated voltages for the transmitter exciter and receiver, and contains sensing and control circuitry for protection of the transmitter output transistors.

The stations are designed for ease of maintenance. All major modules and tuning adjustments are easily accessible. The Desk Top station transmitter receiver assembly tilts up to provide access to both sides of the unit. In Wall Mount stations, the entire chassis swings out and the transmitter-receiver assembly tilts down to provide access to both sides of the unit.

The transmitter and receiver are equipped with centralized metering jacks for simplified alignment and troubleshooting. The Desk Top station may also be equipped with a built-in test meter to facilitate servicing. The module layout for the stations is shown in Figure 1.

The transmitter and receiver may be used interchangeably with transmitter and receiver modules in MASTR Royal Executive Series mobile combinations.

TRANSMITTER

The transmitter assembly consists of the transistorized exciter board and power amplifier assembly. The standard transmitter may be equipped with:

- One through four frequencies
- Channel Guard (tone squelch)
- Carrier Control Timer Option

RECEIVER

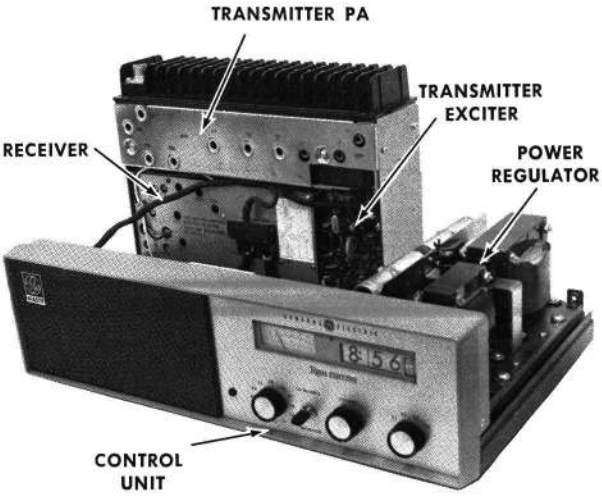
The fully transistorized receiver is mounted on a single printed wiring board for increased reliability. A copper-plated housing and metal cover that completely encloses the receiver provides excellent shielding. The standard receiver may be equipped with:

- One through four frequencies
- Channel Guard
- Noise Blanker

POWER REGULATOR

The transistorized power regulator provides regulated supply voltages for the transmitter exciter and receiver. The power regulator also contains circuitry to protect the transmitter PA stages against sudden increases in battery voltages, excessively high temperatures or a shorted or open antenna.

DESK TOP



WALL MOUNT

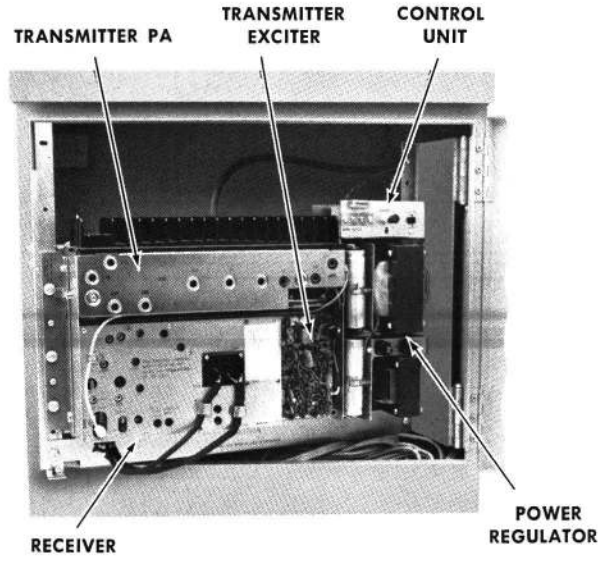


Figure 1 - Module Layout

CONTROL UNITS

Two different control units are used with the stations. The Desk Top control unit is mounted on the front of the station so that the controls will be within convenient reach of the operator. The Wall Mount control unit is mounted within the weatherproof cabinet on the top of the chassis

REMOTE CONTROL BOARD

The remote control board is used with Desk Top and Wall Mount stations in local/remote and remote applications. The remote control board uses transistor switching circuits instead of relays to provide up to four remotely controlled functions.

INITIAL ADJUSTMENT

After the station combination has been installed (as described in the Instruction Manual), the following adjustments should be made by an electronics technician who holds a 1st or 2nd Class FCC Radiotelephone license. Alignment tools are provided with the radio.

Make sure that a RADIO TRANSMITTER IDENTIFICATION form (FCC Form 452-C or General Electric Form ECP-82) has been filled out and attached to the transmitter.

TRANSMITTER ADJUSTMENT

The transmitter adjustment includes loading the power amplifier into the antenna, and checking the frequency and modulation. For the transmitter adjustment, refer to the transmitter ALIGNMENT PROCEDURE (see Table of Contents).

RECEIVER ADJUSTMENT

The initial adjustment for the receiver includes adjusting the receiver to the system operating frequency, and matching the antenna transformer to the antenna. For the initial adjustment procedure, refer to the FRONT END ALINGMENT PROCEDURE (see Table of Contents).

REMOTE CONTROL BOARD

Before setting REMOTE LINE LEVEL control R23 on the remote control board, make sure that all power, telephone line and ground connections have been completed at the station and the remote control console, and the station transmitter and receiver are properly aligned. In Wall Mount stations, set VOLUME CONTROL R701 for not more than 6 volts RMS at TB1-1 and -2 with ±5 kHz deviation at 1000 Hz applied to the station antenna jack. In Desk Top stations with local/remote, adjust VOLUME CONTROL R3002 for 3.1 volts as measured across T-pad R3001.

To set the REMOTE LINE LEVEL control:

1. Apply a 1000 Hz signal to the microphone jack on the remote control console. Use a 30 millivolt signal level for the Transistorized Control Console, Deskon or Radio Control Center, and a 50 millivolt signal level for the RC4.

2. Key the transmitter from the remote control console and set REMOTE LINE LEVEL control R23 for a reading of 120 millivolts at TB3-32 & -20.

OPERATION

The basic procedures for receiving and transmitting messages on the Desk Top station is as follows:

TO RECEIVE A MESSAGE

1. Turn the radio on by turning the OFF-ON switch to the ON position. This lights the green power-on lamp.

2. Press down the MONITOR switch and adjust the VOLUME control for a comfortable listening level. Release the MONITOR switch.

The radio is now ready to receive messages from other radios in the system.

TO TRANSMIT A MESSAGE

1. Apply power to the transmitter by turning the OFF-ON switch to the ON position.

2. Press the push-to-talk button on the microphone and speak in a normal (or softer) voice six inches away from the front of the mike. Release the button as soon as the message has been given. The red signal light on the control panel will glow each time the microphone button is pressed, indicating that the transmitter is on the air. The receiver is muted whenever the transmitter is keyed.

NOTE

For Desk Top Stations equipped with Channel Guard desk-type microphone Model 4EM28B10, press the MONITOR button down before sending a message and listen to make sure that no one is using the channel. To send a message, press down the TRANSMIT button while holding the MONITOR button down. The MONITOR button may be released after the TRANSMIT button is depressed.

MAINTENANCE

POWER REGULATOR ADJUSTMENT

If it should be necessary to replace Sensitivity control R29, Top Limiter control R9 or power regulator board A501, R29 and R9 must be properly adjusted before operating the radio. Complete instructions for setting R29 and R9 are contained in the Power Regulator Adjustment Procedure (see Table of Contents).

PREVENTIVE MAINTENANCE PROGRAM

CHECK THE FOLLOWING ONCE A YEAR	
1. Transmitter frequency and deviation (FCC requires this check-up at least ONCE a year.	☐
2. Measure and record the antenna system V.S.W.R.	☐
3. For 117 VAC operation, check input voltage at TB501-22 on power regulator. Reading should be within 10% of 117 VAC. (Also check during routine service calls).	☐
4. Compare and record transmitter meter readings with voltages taken during initial tune-up. Retune, if necessary.	☐
5. Compare and record receiver meter readings with voltages taken during initial tune-up. Retune, if necessary.	☐
6. Check for positive indication of pressure on transmission line pressure gauge (if pressurized line is used).	☐
7. Clean dust from fan blades and lubricate bearings.	☐

MAKE THE FOLLOWING MAINTENANCE CHECKS DURING ROUTINE CALLS:	
1. Check antenna lines and mast for mechanical stability.	☐
2. Visually check:	
External cables	☐
Internal cables	☐
Plugs	☐
Sockets	☐
Terminal boards	☐
3. Check for tightness of nuts, bolts, and screws to make sure nothing is working loose from its mounting.	☐

PREVENTIVE MAINTENANCE

To insure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts. This preventive maintenance should include the maintenance checks listed above:

TEST AND TROUBLESHOOTING PROCEDURES

Whenever difficult servicing problems occur, the test procedure for transmitter and receiver can be used by the serviceman to compare the actual performance of the unit against the specifications met by the unit when shipped from the factory. The test procedures are located on the back of the applicable Alignment Procedure.

In addition, specific troubleshooting procedures are available for the transmitter, receiver, noise blanker and power regulator (refer to the Table of Contents). For best results, the test procedures should be used in conjunction with the troubleshooting procedures.

CIRCUIT ANALYSIS

TRANSMITTER

Transmitter Type ET-82-A is a crystal controlled, frequency modulated transmitter designed for one-, two- or four-frequency operation in the 25—50 megahertz band. The transmitter consists of the following assemblies:

- Transistorized Exciter Board - Audio, oscillator, modulator and multiplier stages.
- Transistorized PA Assembly - Multiplier, amplifier, power amplifier, power detector, antenna switch or relay and low-pass filter.

The model number and application of each assembly is shown in the following chart.

FREQ. RANGE	PA ASSEMBLY	EXCITER BOARD		NO. OF FREQS.
		Without Channel Guard	With Channel Guard	
25—33 MHz	4EF33A10	4EG21A10 4EG21A12	4EG21A11 4EG21A13	1-Freq. 2-Freq.
33—42 MHz	4EF33B10	4EG21B10 4EG21B12	4EG21B11 4EG21B13	1-Freq. 2-Freq.
42—50 MHz	4EF33C10	4EG21C10 4EG21C12	4EG21C11 4EG21C13	1-Freq. 2-Freq.

The transmitter uses a maximum of 15 transistors to provide a minimum power output of 50 watts. The crystals used range from 2.08 to 4.17 megahertz, and the crystal frequency is multiplied 12 times.

A centralized metering jack (J202) is provided for use with GE Test Set Models 4EX3A10 (Rev. A or later) or 4EX8K11. The test set meters the phase modulator, multiplier, amplifiers, and PA stage, as well as the relative power output, reflected power and PA supply voltages. The metering jack also provides access to receiver audio, microphone and push-to-talk leads.

All input leads to the transmitter are individually filtered by the 20-pin feedthrough by-pass connector J201. Supply voltage, metering and control functions for the exciter board are connected from the PA assembly through a 9-pin miniature connector (P105). Supply voltages for the transmitter are shown in the following chart.

Connection	Voltage	Use
J201-8 and J201-15	+12.5 VDC	Amplifiers and PA supply (Vcc)
J201-3	+12V (Battery)	Relay
J201-11	Keyed +10 VDC	Exciter board, 2nd doubler and differential amplifier supply.

EXCITER BOARD

OSCILLATOR

A transistorized Colpitts oscillator (Q104) is used in the transmitter. The oscillator provides a frequency stability of +.002% without crystal ovens or warmers. Feedback for the oscillator is developed across C115.

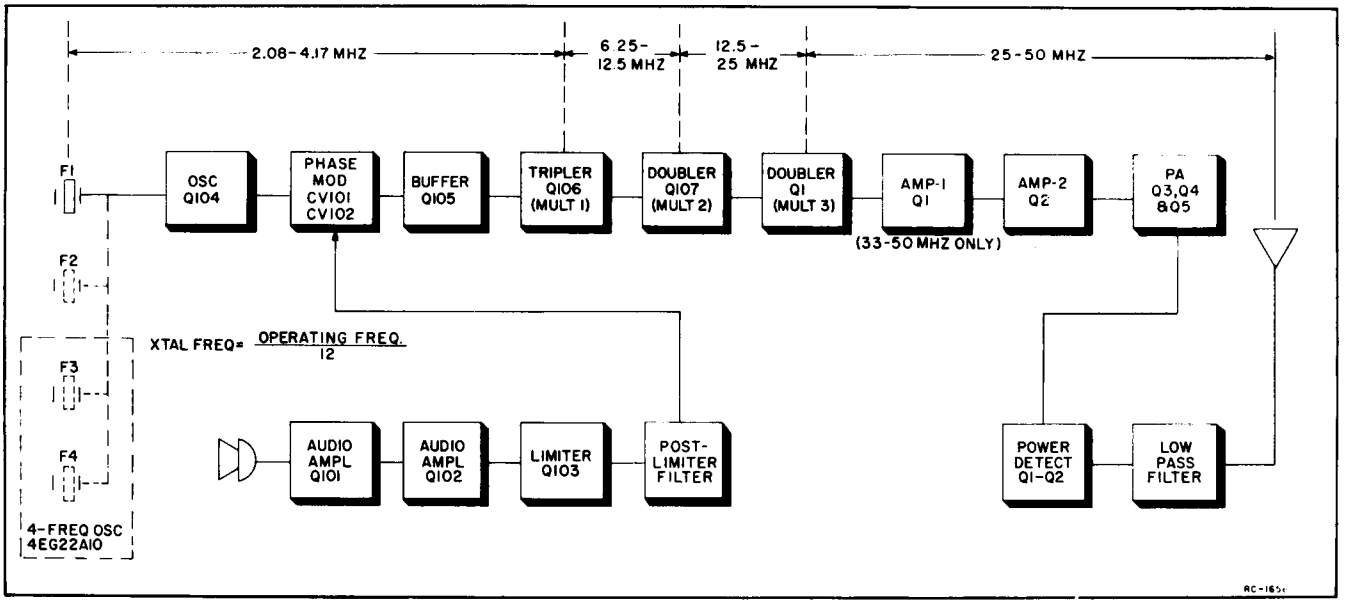


Figure 2 - Transmitter Block Diagram

In single-frequency transmitters, a jumper connects the F1 crystal keying lead to ground and the crystal frequency is applied to the base of oscillator Q104. The oscillator frequency is adjusted by trimmer C107. The oscillator output is applied to the anode of phase modulator CV101.

In two-frequency transmitters, the single oscillator transistor is used, and an additional crystal circuit and two switching diodes (CR101 and CR102) are added. The keying jumper is removed, and the proper crystal frequency is selected by switching the crystal keying lead to ground by means of a frequency selector switch on the control unit. This forward biases the diode in the crystal circuit, reducing its impedance, so that the selected crystal frequency is applied to the base of oscillator Q104.

For four-frequency transmitters, oscillator board Model 4EG22A10 is added. The oscillator board contains two crystal circuits (F3 and F4) identical to the F1 and F2 circuits. In four-frequency transmitters, F3 and F4 crystals are also switched by means of diode biasing. The output of the oscillator board is connected through J2603 to the base of Q104.

AUDIO AMPLIFIERS AND LIMITER

The audio section of the transmitter consists of direct-coupled feedback amplifiers Q101, Q102 and Q103. Q103 also acts as a limiter of high audio input levels. Audio from the microphone is coupled through an input network (C104 and R104) to the audio stages. The input network, in conjunction with the feedback circuit, provides the audio gain and a 6-dB/octave pre-emphasis.

The output of limiter Q103 is connected through modulation adjust potentiometer R115 to a de-emphasis network for 6-dB/octave de-emphasis and post limiter roll-off. The network consists of C101, C137, R101 and R127. Modulation adjust R115 determines the maximum signal level applied to the modulator circuit, and is normally set for ±4.5 kHz (narrow band).

PHASE MODULATOR

The phase modulator uses varactor CV101 (a voltage-variable capacitor) in an R-L-C network that includes R126 and L113. An audio signal applied to the modulator through L112 varies the capacitance of CV101, resulting in a phase modulated output. The modulator output is fed to the base of buffer Q105.

In Channel Guard applications, tone from Channel Guard board Model 4EK14A10 is fed to the modulator circuit through J103 (tone high) and J104 (ground).

BUFFER AND MULTIPLIERS

Buffer stage Q105 isolates the modulator from the loading effects of the tripler stage, and provides some amplification. The output is direct-coupled to the tripler.

Following Q105 are two L-C coupled Class C multiplier stages (Q106 and Q107). Q106 is a tripler stage with the collector tank tuned to three times the crystal frequency. Resistors R132 and R134 are for metering the tripler stage at J202-10 (MULT-1).

Q107 operates as a doubler stage, with the collector tank tuned to six times the crystal frequency. Resistors R136 and R137 are for metering the doubler stage at J202-2 (MULT-2).

PA ASSEMBLY

MULTIPLIER

The exciter output is capacity-coupled to the base of 2nd doubler A201-Q1. This stage operates as a common-emitter doubler, and is metered at J202 (MULT-3) across A201-R1. The 2nd doubler output is coupled through a series-tuned circuit (tuned to 12 times the crystal frequency) to the base of amplifier Q1 in 33 to 50-MHz transmitters, or the base of Q2 in 25 to 33-MHz transmitters.

AMPLIFIERS AND PA

Following the 2nd doubler are two common-emitter, series-tuned RF amplifier stages, Q1 and Q2. When Q1 is used, the base voltage is metered at J202 through metering network CR1, R1 and R2. Q2 is metered at J202 through metering network CR2, R10 and R11 in 25 to 33-MHz transmitters.

Collector current for Q2 is metered across metering resistor R201 and J202 (AMP-2 Ic). The reading is taken on the 1-volt scale (3 amperes full scale) with the GE Test Set in Position F. The amplifier output is coupled through a series-tuned circuit to base-balancing inductors L19-L27, and then to the bases of the power amplifiers.

Q3, Q4 and Q5 operate as parallel-connected, common-emitter power amplifiers to provide a minimum power output of 50 watts. Collector current for the PA transistors is metered across metering resistor R202 at J202 (PA Ic). The reading is taken on the 1-volt scale (10 amperes full scale) with the GE Test Set in Position G, and with the HIGH SENSITIVITY button pressed.

Thermistor RT1 is mounted on the PA board next to the PA transistors. The thermistor, in conjunction with a control circuit on the power regulator board, protects the PA stages against excessively high temperatures. If the temperature of the heatsink starts to rise excessively, RT1 activates the temperature control circuit, which reduces the supply voltage to the PA board. The control circuit keeps the supply voltage reduced until the temperature returns to normal.

The PA output is coupled through a series-tuned circuit to power detector assembly A203.

POWER DETECTOR

Power detector A203 consists of the detector circuitry enclosed in a shielded casting, and a differential amplifier mounted on a printed wiring board. The detector circuit samples both the forward and reflected power on the antenna line, and applies the outputs to the bases of differential amplifier transistors Q1 and Q2. The output of the differential amplifier is proportional to the net power output (forward power minus reflected power). The differential amplifier is connected to a control circuit on the power regulator board which controls the supply voltage applied to the transmitter PA board (see Figure 3).

With normal power output into a 50-ohm load, Q1 conducts and Q2 is turned off. This keeps the power control circuit on the power regulator board turned off. A drop in power output reduced the drive to Q1, which activates the power control circuit and reduced the supply voltage to the transmitter (Vcc).

An increase in the VSWR increases the input to the base of Q2, causing Q2 to start conducting. This causes Q1 to conduct less due to the emitter bias developed by Q2 across R5. Q1 conducting less activates the power control circuit on the power regulator board, reducing the Vcc.

The output of the power detector is coupled through the antenna switch (or optional changeover relay K201) to low-pass filter FL201, and then to the antenna.

SOLID STATE ANTENNA SWITCH

The Solid State Antenna Switch automatically provides antenna changeover for transmitter and receiver operation. During the service mode of operation, the switch isolates the transmitter from the antenna. Application of RF from the transmitter causes the switch to operate, connecting the antenna to the transmitter and isolating the receiver. A continuous external bias voltage (+10 volts) is applied to the switch to prevent spurious antenna power from operating the switch during the receive mode.

When the transmitter is off, signals picked up by the antenna are connected to the receiver through Low Pass Filter FL101 and the filter network in the antenna switch. A parallel LC circuit (collector to base capacitance of Q1 and L2/L3) which is resonant near the receiver frequency provides isolation from transmitter loading.

When the transmitter is keyed and the peak RF voltage exceeds the +10 volt bias voltage, Q1 conducts. This connects RF voltage from the transmitter through Low Pass Filter FL 101 to the antenna. Q2 and CR1 are biased on during transmit to isolate the receiver from the transmitter output. While Q2 is conducting, its collector is near ground potential. This places L4/L5 in parallel with C5/C6 forming a parallel resonant circuit near the transmitter frequency to isolate the receiver. CR1 provides additional isolation.

RECEIVER

Receiver Type ER-46-A is a double conversion, superheterodyne FM receiver designed for one-, two- or four-frequency operation on the 25-50 megahertz band in mobile or station applications.

The receiver is of single-unit construction and is housed in a copper-plated casting for maximum shielding and rigidity. The unit is completely transistorized, using silicon transistors for added reliability. Frequency ranges and the number of frequencies for each receiver model are shown in the chart on this page.

NO. OF FREQS.	FREQUENCY RANGE					
	25—33 MHz		33—42 MHz		42—50 MHz	
	Without Noise Blanker	With Noise Blanker	Without Noise Blanker	With Noise Blanker	Without Noise Blanker	With Noise Blanker
1-Freq	4ER46A10	4ER46A12	4ER46A14	4ER46A16	4ER46A18	4ER46A20
2-Freq	4ER46A11	4ER46A13	4ER46A15	4ER46A17	4ER46A19	4ER46A21
4-Freq	4ER46A22	4ER46A23	4ER46A24	4ER46A25	4ER46A26	4ER46A27

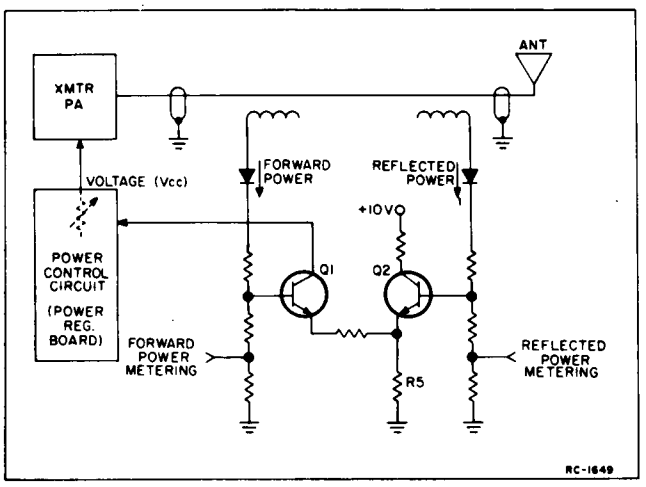


Figure 3 - Power Detector Circuit

A regulated +10 volts is used for all receiver stages except the audio driver and audio PA stages, which operate from the 12-volt system supply. The audio PA stage is mounted on the front casting.

Centralized metering jack J304 is provided for use with GE Test Set Model 4EX3A10 or 4EX8K11. The test set meters the oscillator, 1st and 2nd limiters, discriminator and audio driver bias as well as the voice coil, regulated 10-volts and 12-volt supply.

OSCILLATOR

Q302 is a Colpitts oscillator operating in the 12 to 19 megahertz range. Trimmer capacitor C311 permits the oscillator frequency to be shifted slightly for setting the receiver on the system operating frequency.

For 25 to 33 megahertz operation, collector coil L305 is tuned to two times the crystal frequency with high-side injection. For 33 to 42 megahertz operation, L305 is tuned to two times the crystal frequency with low-side injection. For 42 to 50 megahertz operation, L305 is tuned to three times the crystal frequency with low-side injection.

For two-frequency operation, a second oscillator stage is added. Channels are selected by grounding the emitter to the desired oscillator by means of a two-frequency switch on the control unit.

For four-frequency operation, four-frequency oscillator board Model 4EG22A10 is added. The oscillator board contains three oscillator circuits (F2, F3 and F4) that are similar to the F1 oscillator circuit. The output lead of the oscillator board is plugged into crystal socket XY402,

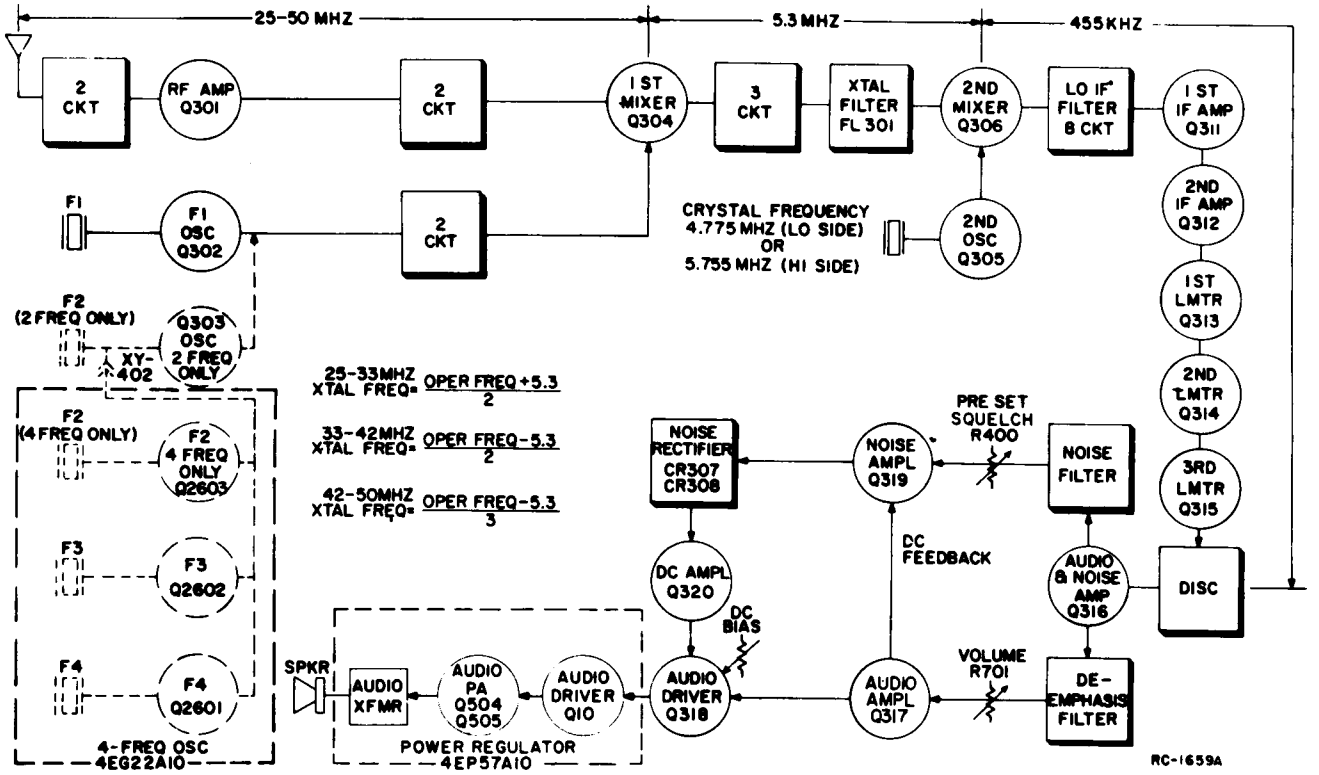


Figure 4 - Receiver Block Diagram

and the F2 oscillator board is modified so that Q 303 can be used as an amplifier stage. Channels are selected by grounding the emitter of the desired oscillator by means of a four-frequency switch on the control unit.

1ST MIXER AND CRYSTAL FILTER

The RF signal from the RF amplifier and the injection voltage from the oscillator are applied to the base of 1st Mixer Q304. The 5.3 megahertz high IF output is coupled through three tuned circuits (L307 and C333, L308 and C336, L309 and C339) which provide Hi-IF selectivity and impedance matching to the crystal filter.

The hi-IF crystal filter (FL301) has ample selectivity to prevent adjacent channel signals from overloading the 2nd mixer, and to reduce intermodulation spurious responses.

2ND OSCILLATOR AND MIXER

Hi-IF from the crystal filter is applied to the base of 2nd mixer Q306 with the 2nd oscillator output to produce the 455-kHz Lo-IF.

The 455-kHz Lo-IF is coupled to an eight-coil Lo-IF filter which provides the main receiver selectivity.

LO-IF AMPLIFIERS AND LIMITERS

Following the Lo-IF filter are two R-C coupled Lo-IF amplifiers (Q311 and Q312). Their amplified output is fed to three R-C coupled limiter stages consisting of Q313, Q314 and Q315, operating as overdriver amplifiers. The 1st and 2nd limiter stages are metered at centralized metering jack J304 thru metering diodes CR302 and CR303.

DISCRIMINATOR

The 3rd limiter output is applied to the Foster-Seely type discriminator, where the audio voltages are recovered from the 455-kHz Lo-IF. A low-pass filter, made up of C422, C423, C424, R377, R379 and R380, removes any 455-kHz signal from the discriminator output.

AUDIO AMPLIFIER AND DRIVER

The audio signal is fed to the base of audio-noise amplifier Q316. Following Q316 is an audio de-emphasis network consisting of C426, C427, C428, R383, R384 and R385.

After the de-emphasis network, the audio signal is fed to the base of audio amplifier Q317 through the VOLUME control mounted on the control unit. The VOLUME control is used to set the amount of drive to audio amplifier Q317, audio driver Q318 and audio PA Q505. DC BIAS trimmer R392 sets the bias on Q318 and audio driver Q10 on the power regulator board, and is adjusted for a 1.3-volt reading at metering jack J304-9. The output of Q10 is applied to the audio PA stage.

SQUELCH

Noise from audio-noise amplifier Q316 is used to operate the squelch circuit. When no carrier is present in the receiver, this noise is coupled through a noise filter (which attenuates any audio frequencies) to the base of noise amplifier Q319. The noise filter consists of C345, C346, C347 and L331. The noise level fed to the noise amplifier is set by SQUELCH control R400. The output of noise amplifier Q319 is rectified by diodes CR307 and CR308, and filtered by C441 and C442 to produce a positive DC voltage. This DC voltage turns on DC amplifier Q320 causing it to conduct. When conducting, the collector voltage of the DC amplifier drops to near ground potential, which lowers the bias on audio stages Q317 and Q318, turning them off.

As audio amplifier Q317 is being turned off, its emitter potential decreases. This results in a positive DC feedback through R406 to the emitter of noise amplifier Q319 which causes an increase in the gain. As the gain of Q319 increases, the positive DC voltage to the DC amplifiers increases, quickly turning the audio stages off.

When the receiver is quieted by a signal, less noise is present in the circuit and the DC amplifier turns off. The audio stages are allowed to conduct, and audio is heard from the speaker. When audio amplifier Q317 is conducting, a positive voltage appears across R406 which helps reduce the gain of noise amplifier Q319. This positive feedback causes a quick, positive switching action in the squelch circuit.

NOISE BLANKER

The noise blanker is used to prevent impulse noise spikes from decreasing the readability of weak signals. The blanker consists of a pulse generator and a blanking gate circuit. No tuned circuits are used in the blanker; therefore no adjustments are required. Aligning the receiver Hi-IF stages provides the correct voltages. A simplified diagram of the noise blanker is shown in Figure 5.

Pulse Generator

An RF signal and noise pulse is taken from the output of the 1st mixer (Q304) and is coupled through C451 to the pulse

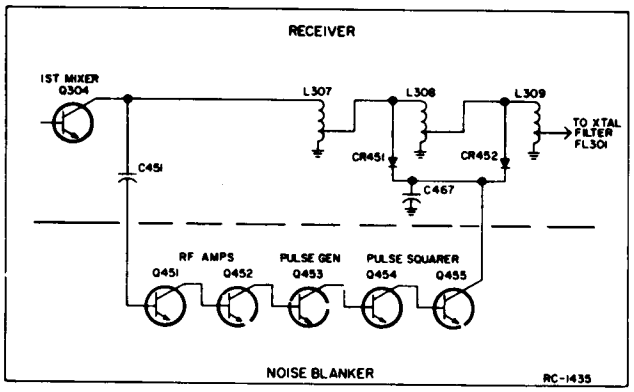


Figure 5 - Simplified Noise Blanker Diagram

generator. The first two stages of the pulse generator consist of RF amplifiers Q451 and Q452. The amplifier stages raise the level of the noise pulse which is fed to the base of pulse generator Q453.

Bias on Q453 is such that it is normally not conducting. Applying a noise pulse to the base of Q453 turns the stage on, and the noise pulse is rectified to produce a DC, negative-going pulse at the collector. Q453 also acts as an RF level shut-off switch. When the carrier amplitude at the base of the stage exceeds 150 microvolts, the transistor saturates and no pulses are produced.

The output of Q453 is fed to an automatic repetition rate switch consisting of C459, CR459 and R475. The time constant of the network is selected so that pulses exceeding 12 to 15 kHz will not be fed to Q454. This prevents degradation of receiver performance due to intermodulation products resulting from two strong signals on adjacent channels.

Following the rep rate switch, the noise pulse is amplified and shaped by pulse squarer stages Q454 and Q455. The output of Q455 is approximately a negative 10 to 12 volt, 20-microsecond square wave blanking pulse.

Blanking Gate

The blanking gate circuit consists of CR451, CR452 and C467. The diodes are not normally conducting due to a positive bias from voltage divider network R473 and R474.

Applying a negative 10-volt blanking pulse to the cathodes of the blanking diodes causes them to conduct. When conducting, they provide an RF short through C467 for Hi-IF coils L308 and L309 for the duration of the blanking pulse.

POWER REGULATOR

Transistorized Power Regulator Model 4EP59A10 provides all supply voltages for the Desk Top or Wall Mount Station combinations. The power regulator assembly includes the receiver audio PA stage, power transformer and rectifier circuits, filter-limiter, regulator and protective circuits. The power regulator provides the following supply voltages:

- A continuous, regulated +10 volts for the transmitter PA power detector, receiver, multi-frequency board and remote control board.
- A keyed, regulated +10 volts for the transmitter exciter, power regulator protective circuitry, channel guard and multi-frequency boards.
- A keyed, controlled +12.5 volts for the transmitter PA supply.

Supply voltage (+12 volts) for the receiver audio stages, transmitter PA regulator, the 10-volt regulator, antenna switching relay and carrier control timer option is taken from the filter-limiter circuit.

The power regulator will operate from either a 117 VAC or 234 VAC, 50/60 Hz source. The station is normally shipped connected for 117 VAC operation, with the two identical primary windings of T503 connected in parallel. For 234 VAC operation, the transformer primaries are connected in series. Refer to the power regulator Schematic Diagram for 234 VAC transformer connections.

Power is applied to T503 by turning OFF-ON switch S701 to the ON position on the Desk Top station, or by a jumper across AC switching terminals TB501-21 and -22 in Wall Mount stations. A 4-amp fuse in one side of the AC lead protects the power regulator against overloads.

RECTIFIER AND FILTER-LIMITER CIRCUITS

The AC voltage developed across the secondary windings of T503 is rectified by full-wave bridge rectifiers CR501 through CR504. Some filtering of the rectified voltage is provided by L501, C505 and C506. The secondary of T503 is protected by 15-amp fuse F502.

The rectifier output is applied to the collectors of Q506 and Q507 in the filter-limiter circuit. In the transmit condition, Q506 and Q507 operate as a filter for the voltage applied to the transmitter PA regulator Q501. In the receiver condition the circuit acts as a limiter for the receiver supply voltage. If the output of

Q506 starts to rise, Zener diode VR501 (in the base of Q508) breaks down, and Q508 starts conducting. This causes Q506 and Q507 to conduct less, limiting the voltage to the receiver. Potentiometer R511 is set at the factory for a maximum output of 16 volts at the emitter of Q506 with the station in the receive condition.

EMERGENCY BATTERY OPERATION

The power regulator is equipped with an emergency power circuit to permit operation from a 12-volt battery in the event of an AC power failure. The circuit consists of TB502, 15-amp fuse F504, and isolating diode CR505. The battery connects to TB502-2 (+) and TB505-1 (-).

Under normal operating conditions, CR505 is reverse biased by the supply voltage from the limiter-filter circuit, preventing any drain on the battery. An AC power failure removes the reverse bias on CR505, and the battery voltage is automatically applied to the station.

For this application, a heavy duty battery (55 amp-hours or greater) and a trickle charger is recommended. This arrangement will permit operation at rated duty cycle (at slightly reduced power) for a minimum of 12 hours with less than 3 dB loss in RF power output.

AUDIO PA

The output of Q318 on the receiver chassis is applied to the base of audio driver Q10 on the power regulator board. Bias to Q10 is set by DC bias trimmer R392 on the receiver. The trimmer is set for 1.3 volt at receiver metering jack J304-9 (position G on GE Test Set). Audio from Q10 is coupled through transformer T1 on Audio PA board A503 to provide phase inversion for the push-pull audio PA stage.

Q505 and Q504 operate as a push-pull, class AB audio PA stage. The PA output is coupled through audio transformer T501 to the loudspeaker. The yellow and white tortiary windings of T501 supply balanced feedback to the collector of Q10. The feedback winding minimizes distortion and prevents the pick-up of external electrical noise.

The PA stage provides a 5-watt output at less than 5% distortion into a 3.5-ohm load at the receiver output terminals (3.2-ohms at the Control Unit). Base bias for the PA stage and the elimination of cross-over distortion is controlled by potentiometer R4 on the Audio PA board. The potentiometer is set at the factory as shown in STEP 1 of the receiver Test Procedure.

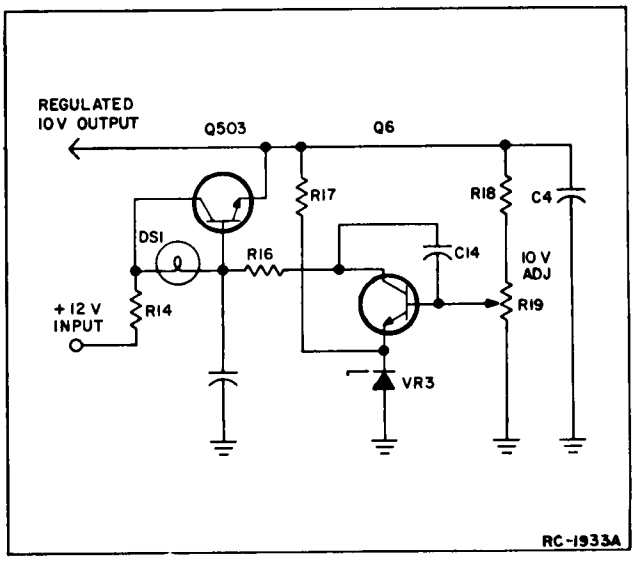


Figure 6 - +10 Volt Regulator Circuit

NOTE

Do not adjust bias adjust potentiometer R4 unless PA transistors Q505 and Q504 have been replaced.

Audio high and low are also present at centralized metering jack J304, and can be used as shown in STEP 1 of the Test Procedure.

+10-VOLT REGULATOR

The +10-volt regulator provides a closely controlled supply voltage for the transmitter, receiver, protective circuitry on the power regulator, channel guard and multi-frequency boards.

Supply voltage from the filter-limiter is applied to the emitter of regulator transistor Q503, causing the transistor to conduct (see Figure 6).

When the supply voltage (or output starts to increase, the voltage at the base of Q6 also increases. This causes Q6 to conduct more, providing less base current for Q503. The voltage drop across Q503 becomes larger and the output remains constand.

When the input voltage starts to drop, the output voltage also tends to drop and Q6 will conduct less. This increases the forward bias on Q503 and reduces the voltage drop across Q503 to keep the output constant.

Potentiometer R19 is used to set the emitter-base voltage of Q6 for the desired

10-volt output. R16 and R18 limit the maximum current through Q6. R17 provides bias current for Zener diode VR3, and lamp DS1 provides bias for Q503. C4 and C14 prevent high frequency oscillation. The output voltage is metered at receiver centralized metering jack J304.

KEYED +10 VOLTS

The keyed +10 volts is used to activate the transmitter and squelch the receiver. Turning the OFF-ON switch on the power regulator to the ON position applies supply voltage to the anode of diode CR3. This forward biases the diode so that the voltage is applied to the base of gating transistor Q9 (see Figure 7).

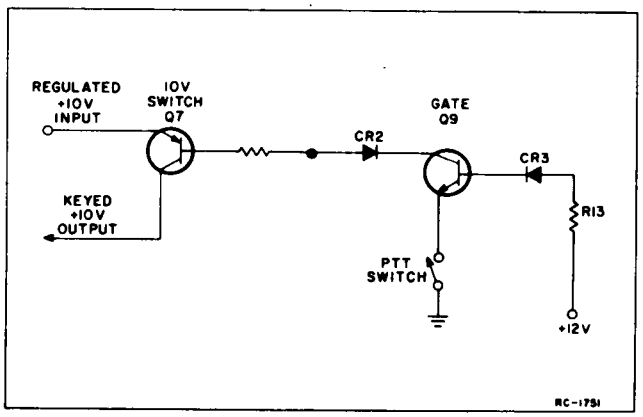


Figure 7 - +10 Volt Keying Circuit

With the supply voltage applied to the base of Q9, keying the microphone grounds the emitter, causing it to conduct. When conducting, the collector voltage of Q9 drops to ground potential which forward biases CR2 and turns on switching transistor Q7. The nominal +10-volt collector output voltage is applied to the exciter board, and to the transmitter PA voltage regulator and protective circuitry to key the transmitter.

The keyed 10 volts is also connected through dropping resistor R503 (on TB3) to the base of receiver DC amplifiers Q320 and Q321. The resultant voltage causes the DC amplifiers to conduct, which turns off the receiver audio amplifiers and squelches the receiver.

Diode CR3 is connected in series with Q9 to provide polarity protection for the 10-volt switching circuit.

PROTECTIVE CIRCUITS

The protective circuits in the power regulator prevent any damage to the transmitter PA transistors that might result from an excessive PA transistor temperature, an excessive output VSWR, or a high input supply voltage. All of the protective circuits affect the action of transmitter PA supply regulator transistor Q501. The transistor acts as a variable resistance in series with the PA supply voltage, and increases or decreases the supply voltage (Vcc) as required. A circuit is also provided to protect Q501 from a short circuit in the PA supply lead.

Temperature Control

Temperature control is provided by thermistor RT1 which is mounted in the heat sink near the transmitter PA transistors. The thermistor is in the emitter biasing circuit of temperature and power control transistor Q2 (see Figure 8).

Under normal operating conditions, Q2 is biased so that it is just below conduction (turned off). When the temperature of the PA heat sink rises, the resistance of thermistor RT1 decreases, decreasing the emitter bias on Q2. If the temperature rises sufficiently, Q2 begins to conduct. When conducting, the collector potential of Q2 becomes more negative, which causes drivers Q1 and Q502 to conduct less.

PA supply regulator Q501 normally operates as a fully saturated stage (minimum resistance across the emitter-collector junction), with the PA supply voltage (Vcc) taken from the collector. When drivers Q1 and Q502 conduct less, the base of Q501 becomes more positive. This reduces the degree of saturation of Q501. Reducing the saturation of Q501 increases the voltage drop from emitter to collector, reducing the Vcc. When the PA heat sink temperature drops, Q2 will conduct less, and drivers Q1 and Q502 will conduct harder. This will cause Q501 to become more fully saturated so that the maximum Vcc will be applied to the transmitter.

Power Control

The power control circuit protects the transmitter PA transistors from the effects of de-tuned amplifier stages, an antenna mismatch or shorted antenna. The circuit is controlled by the differential amplifier in the transmitter power detector assembly.

With normal transmitter power output into a 50-ohm load, Q1 on the differential amplifier conducts and Q2 is turned off. This results in a voltage drop across R6 which reduces the base bias on temperature-power control transistor Q2, keeping it turned off. This causes regulator drivers Q1 and Q502 to conduct heavily (see Fig.9).

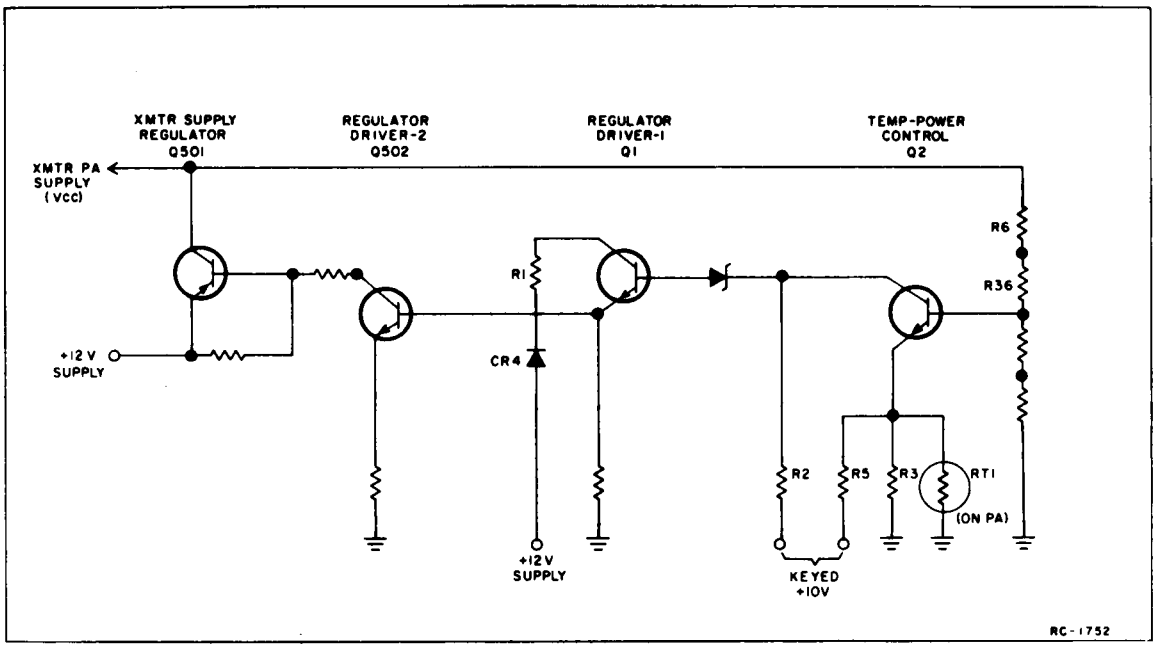


Figure 8 - Temperature Control Circuit

A drop in power output reduces the drive to Q1 so that it conducts less, reducing the voltage drop across R6. This increases the forward bias on the base of temperature-power control transistor Q2 so that it starts to conduct. With Q2 conducting, regulator drivers Q1 and Q502 conduct less, lowering the degree of saturation of Q501 and reducing the Vcc.

An increase in the VSWR increases the reflected power input to the base of Q2 in the differential amplifier so that it starts to conduct. This causes Q1 to conduct less due to the emitter bias developed across R5. With Q1 conducting less, the voltage drop across R6 on the power regulator board decreases. This causes the temperature-power control transistor (Q2) to start conducting, reducing the Vcc.

This limiting effect does not work in very low temperatures due to the increase in resistance of the thermistor in the emitter of control transistor Q2. At very low temperatures, the Vcc is limited by top voltage limiter Q3.

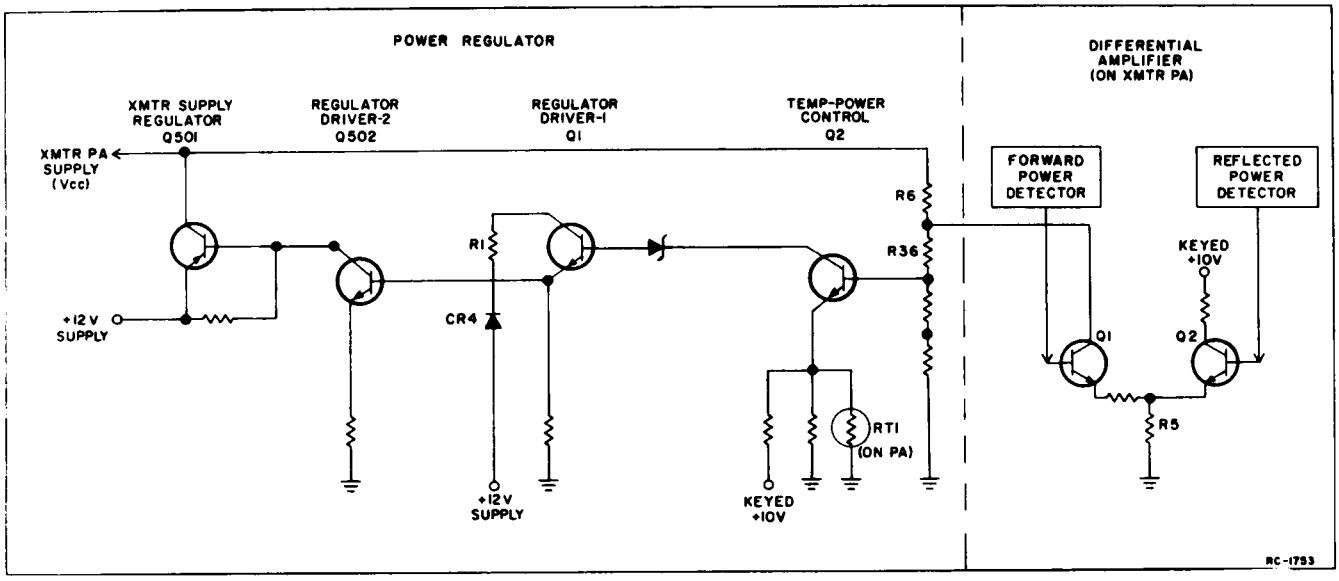


Figure 9 - Power Control Circuit

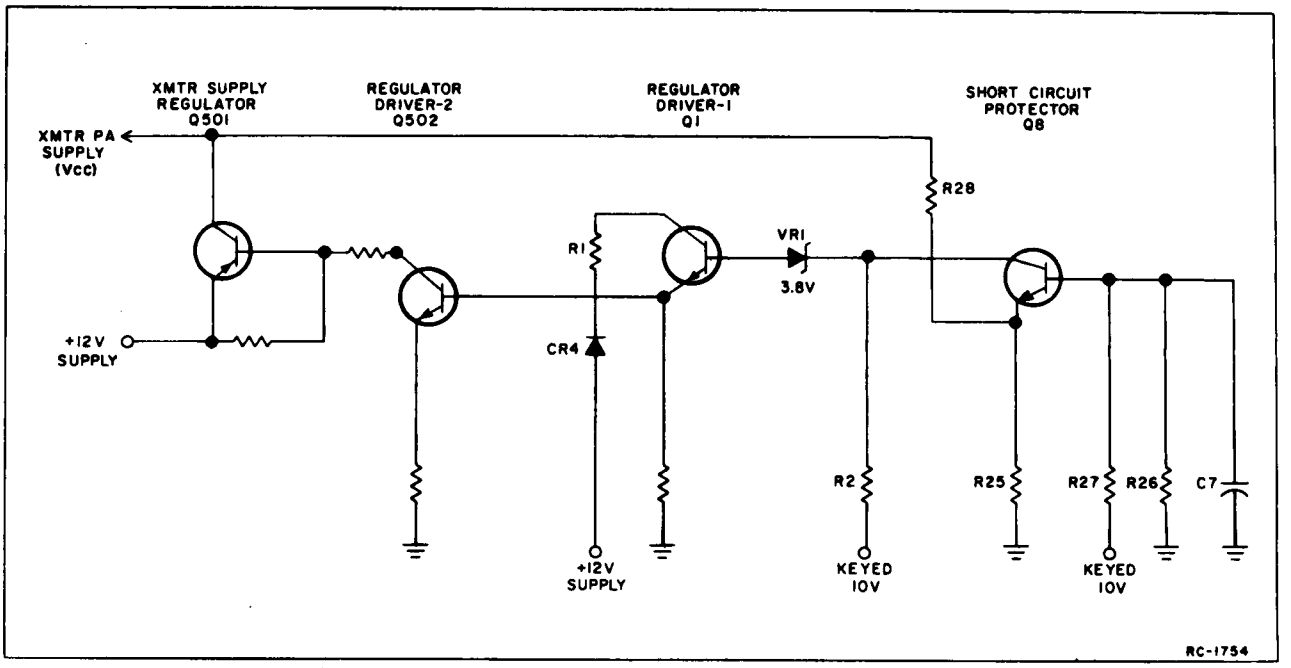


Figure 10 - Short Circuit Protector Circuit

Short Circuit Protector

A short circuit protector is provided to protect Q501 from being damaged by a short in the PA supply line. Keying the transmitter applies +10 volt to the circuit, turning on the regulator drivers and Q501 (see Figure 10). The +10 volts is also applied to the collector and base of Q8. However, Q8 does not turn on immediately. Before Q8 can conduct, its base voltage must exceed its emitter voltage by approximately eight milliseconds. This time delay permits regulator drivers Q1 and Q502 to turn on, and Q501 to become fully saturated. The supply voltage (Vcc) is then applied through a voltage divider network (R28 and R25) to the emitter of Q8, keeping the transistor turned off.

If the supply voltage does not appear at the emitter of Q8, the transistor will turn on as soon as C7 is charged. When conducting, the collector of Q8 drops to near ground potential, removing the breakdown voltage on zener diode VR1. This switches off the regulator drivers and Q501 and removes all power to the transmitter PA. A short in the supply line while the transmitter is keyed also turns on Q8, which switches off Q501 and removes all power to the transmitter PA.

Top Voltage Limiter

With normal power output and moderate ambient temperatures, PA supply transistor Q501 operates fully saturated, so that an increase in battery voltage causes an increase in Vcc. When the Vcc is not high enough for power dissipation to endanger the PA transistors, the power and temperature control circuits will not reduce the Vcc. However, at very low ambient temperature, a high value of Vcc that would not result in excessive power dissipation might permit RF voltages to rise enough to cause secondary breakdown in the PA transistors. Therefore, the voltage limiter places a top limit on the amount that the Vcc can rise under any condition (see Figure 11).

Keying the transmitter applies the output of Q501 to the cathode of zener diode VR4 and to voltage-divider network R37, R2, CR4 and R5. If the voltage at the base of Q2 exceeds the voltage at the cathode of VR4 by more than 0.6 volt, Q2 will begin to conduct. This causes the regulator drivers (Q1 and Q502) to conduct less, reducing the output of Q501. The maximum voltage is set at the factory for approximately 13 volts.

MICROPHONE PRE-AMPLIFIER

Microphone pre-amplifier A502 provides an additional 10-dB gain for use with desk-type microphones. When a military mike or handset is used, the pre-amplifier is disconnected from the circuit by moving lead P1 from J1 to J2 (refer to power regulator Outline Diagram) so that the signal is connected directly to the transmitter.

The audio signal from the desk-type mike is connected to pre-amp transistor Q1 through coupling capacitor C1. The amplifier output is coupled through audio coupling capacitor C2 to the transmitter.

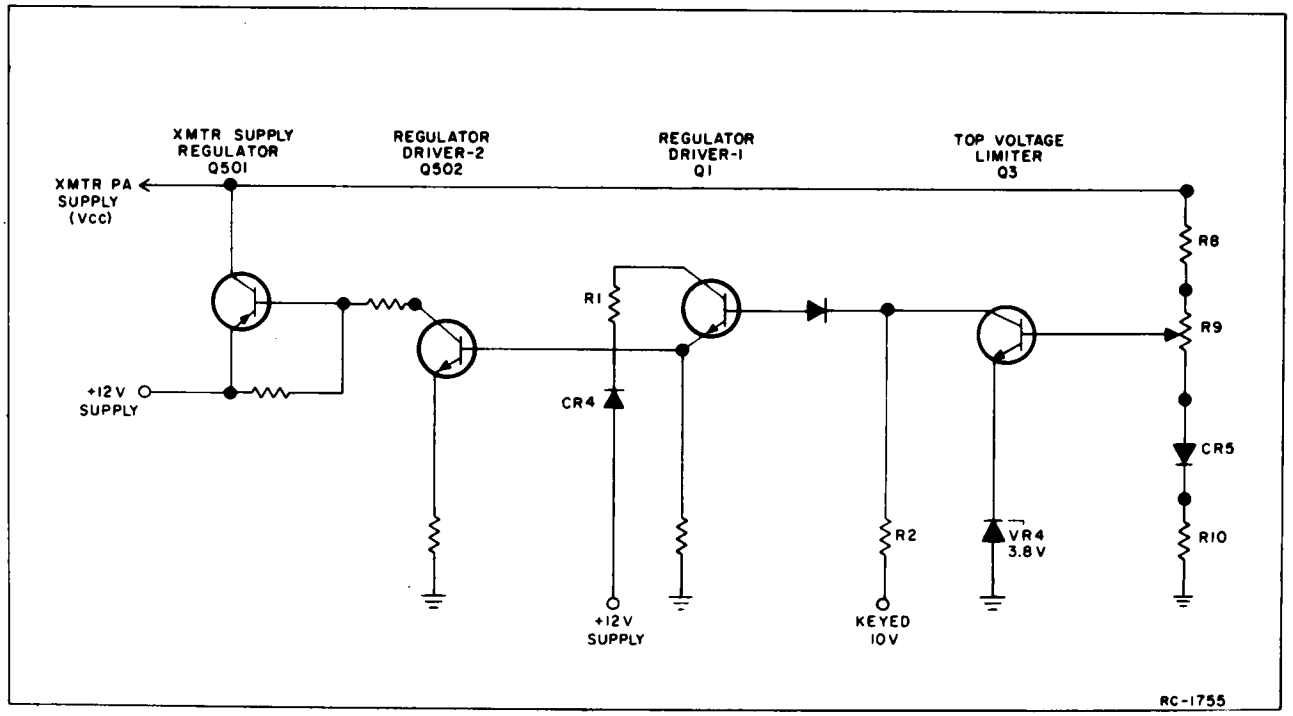


Figure 11 - Top Voltage Limiter Circuit

Base bias for Q1 is provided through voltage divider circuit R1 and R2 from the 10-volt regulated supply.

CHANNEL GUARD MONITORING

In Desk Top stations, Channel Guard monitoring is provided by monitoring transistor Q701. The transistor and biasing resistor R701 are mounted on TB701 on the main chassis.

The base of Q701 is connected to ground through the normally-closed contacts of the MONITOR switch on Channel Guard microphone Model 4EM28B10. The collector is connected to J601-7 on Channel Guard board Model 4EK14B10.

Pressing the MONITOR switch removes the ground on the base of Q701, causing it to conduct. When conducting, the collector of Q701 drops to near ground potential, disabling the decoder circuitry so that the receiver operates on noise squelch only.

HEAT SINK SERVICING

Since the metal envelopes of Q501 through Q508 are at collector potential, they must be electrically isolated from ground. However, there must be a good path for heat from the transistors to reach the cast aluminum radiator (heat sink) in which they are mounted, so that the heat will be dissipated by the heat sink. The insulators used between the transistors and the heat sink not only isolate the transistors electrically, but also act as a good thermal conductor to conduct heat away from them.

Silicone grease is used on each side of the transistor insulators to improve the thermal contact, and allow the heat to be transferred more readily to the heat sink. Always make sure that there is a coating of silicone grease on each side of the insulator whenever one of the transistors is replaced.

CONTROL UNITS

DESK TOP CONTROL UNIT

Three different models of control units are available for use with Desk Top station combinations. All models of the Control Unit have VOLUME CONTROL, a MONITOR switch, a green Power-On light, a red Transmit light and speaker. In addition, control units in multi-frequency combinations are equipped with a frequency selector switch. The application of the different model control units and the frequency selector switch used is shown in the following chart.

CONTROL UNIT MODELS	FREQ.SELECTOR SWITCH ADDED	NO OF FREQUENCIES
4EC69B10	None	One
4EC69B11	S703	Two
4EC69B12	S704	Three or Four

Volume Control

Volume Control R701 is a variable resistor used to control the audio output of speaker LS701. In Local/Remote combinations, R701 is replaced by a 3.5-ohm T-pad, R3001. Potentiometer R3002 is mounted next to the speaker and is used as the Volume Control. R3002 is set for 3.1 volts as measured across R3001 with ±3.3 kHz deviation at 1000 Hz applied to the station antenna jack.

Monitor/CG Disable (S702)

Placing S702 in the MONITOR position disables the noise squelch circuit in the receiver. In radios equipped with Channel Guard, the MONITOR position also disables the receiver Channel Guard. The CG DISABLE position of the switch disables Channel Guard while permitting normal noise squelch operation.

Multi-Frequency Switches (S703 and S704)

In multi-frequency applications, the frequency-selector switch selects the channel desired for both transmit and receive. The switch connects the emitter of the receiver first oscillator and the transmitter oscillator switching diode to ground, so that the radio will operate on the frequency determined by the selected crystal-controlled oscillators. In multi-frequency radios, the transmitter and receiver Channel Guard operates on all frequencies.

Fan Option

An optional fan is available for mounting on the back of the control unit to provide ventilation for the transmitter and receiver. The fan operates on 117 VAC only, and is connected at the factory for continuous operation.

Clock Options

A 12-hour or 12/24-hour electric clock is available for mounting on the Control Unit. The clock operates on 117 VAC, 60 Hz only, and is connected so that it will operate with the power switch On or Off. The clock can be set by turning the indicator wheels until the correct time shows in the window.

Tune-Up Meter Option

A 50 micro-amp tune-up meter (M1) and 12-position meter selector switch (S1) is available for mounting on the control unit. The switch connects to the transmitter and receiver centralized metering jacks by a "Y" cable with two plugs, and permits the following functions to be metered:

UNIT METERED	METERING SWITCH POSITION	FUNCTION METERED
Receiver (at J304)	RA	Discriminator
	RC	Lim 2
	RD	Oscillator
	RG	Audio Bias
Transmitter (at J201)	TA	Mult-1
	TD	Mult-4
	TE	Amp 1 & 2
	TF	Driver Ic
	TG	PA Ic
	TH	Amp 2
	TI	Forward Power
	TJ	Reverse Power

WALL MOUNT CONTROL UNIT

Control Unit Model 4EC70B10 is used with Wall Mount station combinations. The control unit is mounted on the system frame next to the power transformer.

The control unit contains the VOLUME control (R701), MONITOR switch (S701), and the 3.5 ohm audio load resistor (R703) connected across TB701-1 and -2. R703 is removed when the speaker option is used, and the speaker is connected across TB701-1 and -2. Thermostats (S1 and S2) for the fan and heater options plug into TB2.

Volume Control (R701)

When the Wall Mount station is equipped with a speaker option, pressing down the MONITOR switch disables the noise squelch circuit in the receiver. If the radio is equipped with Channel Guard, pressing the MONITOR switch also disables the receiver Channel Guard.

CHANNEL GUARD

Channel Guard Board Model 4EK14B10 is a fully transistorized encoder-decoder for use with Desk Top and Wall Mount station combinations.

The tone frequencies are controlled by plug-in tone networks that are made with precision components for excellent stability and reliability. The tone frequencies range from 71.9 to 203.5 Hz.

Complete instructions for the encoder-decoder are contained in Maintenance Manual LBI-4143.

CARRIER CONTROL TIMER

The Carrier Control Timer option shuts off the transmitter on each transmission after a one-minute timing cycle, and alerts the operator that the transmitter is off by means of an alarm tone in the speaker. The transmitter can be turned on again by releasing and rekeying the push-to-talk switch on the microphone.

The timing cycle (transmitter keyed time) is normally set at the factory for a duration of one minute. An optional potentiometer is available that permits the timing cycle to be adjusted from 15 seconds to 5 minutes. Complete instructions for the Carrier Control Timer are contained in Maintenance Manual LBI-4138.

REMOTE CONTROL

Remote Control Board Models 4KC20A10, 11 and 12 provide up to four remotely controlled functions by the application of different levels and polarities of control current required to select each function.

AUDIO CIRCUITS

With no control current applied to the control pair (TB1-3 and -4), the output of the station receiver audio PA stage is coupled directly through terminals 1 and 2 of audio transformer T1 to the telephone pair (TB1-1 and -2). Audio from the remote control console is developed across terminals T1-2 and -4, and is coupled through REMOTE LINE LEVEL control R23 to the collector of transistors Q5.

Q5 and Q6 operate as an audio switch, with Q5 normally off and Q6 normally on. Keying the microphone at the remote console applies a control current to the control pair on the remote control board, which activates the PTT circuit (Q2, Q3 and Q4). When Q3 is turned on, the positive voltage at the Q3 emitter is coupled by resistor R18 to the base of Q6 and the emitter of Q5. This positive voltage turns Q6 off and Q5 on, and audio is coupled from the emitter of Q5 through C15 to the transmitter mike high input (E1). This switching circuit gives the remote console priority over the station. Un-keying the microphone at the remote console removes the switching voltage to Q5 and Q6, and turns Q5 off and Q6 on.

If the station is equipped with a microphone, audio from the local microphone is coupled through C17 to the collector of the normally on transistor Q6. Audio is taken from the emitter of Q6 and coupled through C16 to the transmitter mike high input (E1).

The adjustment procedure for the REMOTE LINE LEVEL control (R23) is contained in the Initial Adjustment section (see Table of Contents).

BIAS OSCILLATOR

The bias oscillator is the heart of the control circuit, and is used in all models of the remote control board. The oscillator consists of Q1 (and associated circuitry) operating as a free-running Colpitts oscillator at a frequency of approximately 300 kHz. The portion of the oscillator output developed across terminals 1 and 2 of transformer T2 is rectified by CR1 and CR2. The DC output is resistor-coupled to the primary of T3, T4 or T5, and is used to reverse bias diodes CR3, CR6 and CR9. Reverse biasing

FUNCTION	STATION	REMOTE CONTROL MODEL	FUNCTION SELECTED BY CONTROL CURRENT at TB1-3 (relative to TB1-4)			
			0 ma	+6 ma	+15ma	-6ma
1-Freq. Transmit & 1-Freq. Receive	Desk Top or Wall Mount	4KC20A10	Receive	Transmit		
1-Freq. Transmit & Rec with Channel Guard	Desk Top or Wall Mount	4KC20A11	Chan Gd Receive	Monitor (Chan Gd disabled)	Transmit	
2-Freq. Transmit & 1-Freq. Receive	Wall Mount only	4KC20A12	Receive	Transmit F1	Transmit F2	
1-Freq. Transmit & 2-Freq. Receive	Wall Mount only	4KC20A12	Receive F1	Transmit F1		Receive
2-Freq. Transmit & 2-Freq. Receive	Wall Mount only	4KC20A12	Receive F1	Transmit F1	Transmit F2	Receive F2

these diodes prevents any current flow in terminals 3 and 4 of T2.

A bias divider network (R6 and R7) is used to drop the bias voltage for the different applications of the remote control board. Instructions for making the different connections are located on the Schematic Diagram for the board.

CONTROL CIRCUITS

Model 4KC20A10

Remote Control Board 4KC20A10 consists of the bias oscillator circuit, amplifiers Q2 and Q3, PTT switching transistor Q4 and audio switch Q5 and Q6. The board is used to switch a single-frequency station from receive to transmit.

The bias oscillator output voltage is connected from H2 by resistor R8 to the primary of T3, providing approximately +8 volts DC reverse bias to the cathode of CR3.

Keying the microphone at the remote console applies +6 milliamps to the control pair, developing a voltage across R3 and R4. This voltage forward biases CR3, permitting the AC voltage developed across terminals T2-3 and -4 to be coupled through transformer T3 to the base of AC amplifier Q2.

The output of Q2 is rectified by CR4 and CR5, and applied to the base of DC amplifier Q3, turning it on. When conducting, the voltage at the emitter of Q3 rises to approximately +6 volts which turns on switching transistor Q4. This causes the collector of Q4 to drop to ground potential, keying the station transmitter.

The positive voltage at the emitter of Q3 is also applied to the audio switching transistors, turning on Q5 and turning off Q6. This permits audio from the remote control console to be applied to the station transmitter.

Model 4KC20A11

Remote Control Board Model 4KC20A11 consists of the bias oscillator circuit, amplifiers Q2, Q3 and Q7, switching transistors Q4 and Q8 and audio switch Q5 and Q6. This board provides the circuitry for switching a single-frequency station from receive to transmit, and to provide Channel Guard monitoring.

The bias oscillator output voltage is connected from H1 by resistor R40 to the primary of T3, providing approximately +22 volts DC reverse bias to the cathode of CR3.

Keying the microphone at the remote console applies +15 milliamps to the control pair, developing a voltage across R3 and R4. This voltage forward biases CR3, permitting the AC voltage developed across terminals T2-3 and -4 to be coupled through transformer T3 to the base of AC amplifier Q2.

The output of Q2 is rectified by CR4 and CR5, and applied to the base of DC amplifier Q3, turning it on. When conducting, the voltage at the emitter of Q3 rises to approximately +6 volts which turns on switching transistor Q4. This causes the collector of Q4 to drop to ground potential, keying the station transmitter.

The positive voltage at the emitter of Q3 is also applied to the audio switching transistors, turning on Q5 and turning off Q6. This permits audio from the remote control console to be applied to the station transmitter.

In Channel Guard applications, +8 volts from the bias oscillator is taken from the junction of R7 and R6 and coupled to the primary of T4 to reverse bias CR6. Pressing the MONITOR switch at the remote control console applies +6 milliamps to the control pair, developing a voltage across R3 and R4. This voltage forward biases CR6, but does not forward bias CR3 due to the 22 volts reverse bias on CR3.

Forward biasing CR6 permits the AC voltage developed across windings T2-3 and -4 to be coupled through T4 to the base of AC amplifier Q7. The output of Q7 is rectified by CR7 and CR8 and applied to the base of Channel Guard switch Q8, turning it on. When turned on, the collector of Q8 drops to ground potential. This grounds the DC squelch only. Diode CR609 (connected from TB3-30 to TB3-16 on the power regulator) prevents the ground at the collector of Q8 from disabling the receiver noise squelch circuit.

Model 4KC20A12

Remote Control Board Model 4KC20A12 consists of the bias oscillator circuit, amplifiers Q2, Q3, Q7, Q9, switching transistors Q4, Q8, Q10 and Q11, and audio switch Q5 and Q6. This board provides the circuitry for one- or two-frequency transmit and receive.

In multi-frequency applications, the bias oscillator output is used to reverse bias CR3, CR6 and CR9. +8 volts is coupled from H2 by R8 to the primary of T3 to reverse bias CR3. +22 volts is coupled from H3 by R41 to the primary of T4 to reverse bias CR6, and +8 volts is coupled by R30 to the primary of T5 to reverse bias CR9.

+10 volts is normally applied to the emitter of Q10, keeping Q10 and Q11 turned on. When conducting, the collector of Q11 is at ground potential, keeping the trans-

mitter and receiver F1 crystal keying lead grounded.

Keying the microphone at the remote console on the F1 channel applies +6 milliamps to the control pair. The voltage developed across R3 and R4 forward biases CR3, and the AC voltage developed across terminals T2-3 and -4 is coupled through T3 to the base of Q2. The output of Q2 is rectified by CR4 and CR5, and applied to the base of Q3, turning it on. When conducting, the positive voltage (approximately 6 volts) at the emitter of Q3 turns on Q4, keying the station transmitter. The positive voltage at the emitter of Q3 is also applied to audio switching transistors Q5 and Q6, turning Q5 on and Q6 off. This permits audio from the remote console to be applied to the station transmitter.

Keying the microphone at the remote console on the F2 channel applies +15 milliamps to the control pair. The voltage developed across R3 and R4 forward biases CR3 which activates the circuit and keys the transmitter. The voltage developed across R3 and R4 also forward biases CR6 so that the AC voltage developed across terminals T2-3 and -4 is coupled through T4 to the base of amplifier Q7. The output of Q7 is rectified by CR7 and CR8 and applied to the base of F2 switching transistor Q8, turning it on. When turned on, the collector of Q8 drops to ground potential, grounding the transmitter and receiver F2 crystal keying lead. The DC output of CR7 and CR8 is also applied to the base of PNP transistor Q10, turning it off. This turns off Q11 and removes the ground on the F1 keying lead.

Pressing the receiver F2 pushbutton at the remote console applies -6 milliamps to the control pair (+6 milliamps at TB1-4 relative to TB1-3). The voltage developed across R4 and R3 forward biases CR9 so that the AC voltage developed across terminals T2-3 and -4 is coupled through T5 to the base of normally-on transistor Q10, turning if off. This turns off Q11 and removes the ground on the F1 keying lead.

The output of CR10 and CR11 is also applied to the base of F2 switching transistor Q8, turning it on. This grounds the F2 crystal keying lead so that audio from the receiver F2 channel is applied to the audio pair.

WARNING

When servicing the station, always disable the transmitter keying circuit by placing a jumper from TB1-3 to TB1-4. This shorts out the control pair and prevents keying the transmitter from a remote point.

After servicing the station, always remove the short on the control pair.

CONTROL METHODS

Three types of telephone line connections are commonly used in remote control applications. The remote control board is normally shipped with jumpers connected for operation with a single telephone pair with control simplexed line to line (Method 1). Refer to Figure 13 for the three types of telephone line and jumper connections.

Before choosing one of these methods, consider both the cost and performance of each, as one method may be available at a considerably lower rate. Some local telephone companies offer no choice, but will provide only an audio pair and a control pair. The following chart contains information to assist in selecting the Control Method and type of telephone line to be leased.

Method	Description	Advantage or Disadvantage
1	One metallic pair: for both audio and control voltages with control voltage simplexed from line to line.	Economical; dependable where earth currents may be large, or where a good earth ground cannot be obtained; keying clicks will be heard in paralleled Remote Control Units.
2	One metallic pair: for both audio and control voltages with control voltage simplexed from line to ground.	Economical; earth ground currents (encountered near power company sub-stations) may interfere with control functions; keying clicks minimized.
3	Two telephone pairs; one for audio voltage and one for control voltage.	Provides best performance; keying clicks will not be heard; least susceptible to earth ground currents which may interfere with control functions.

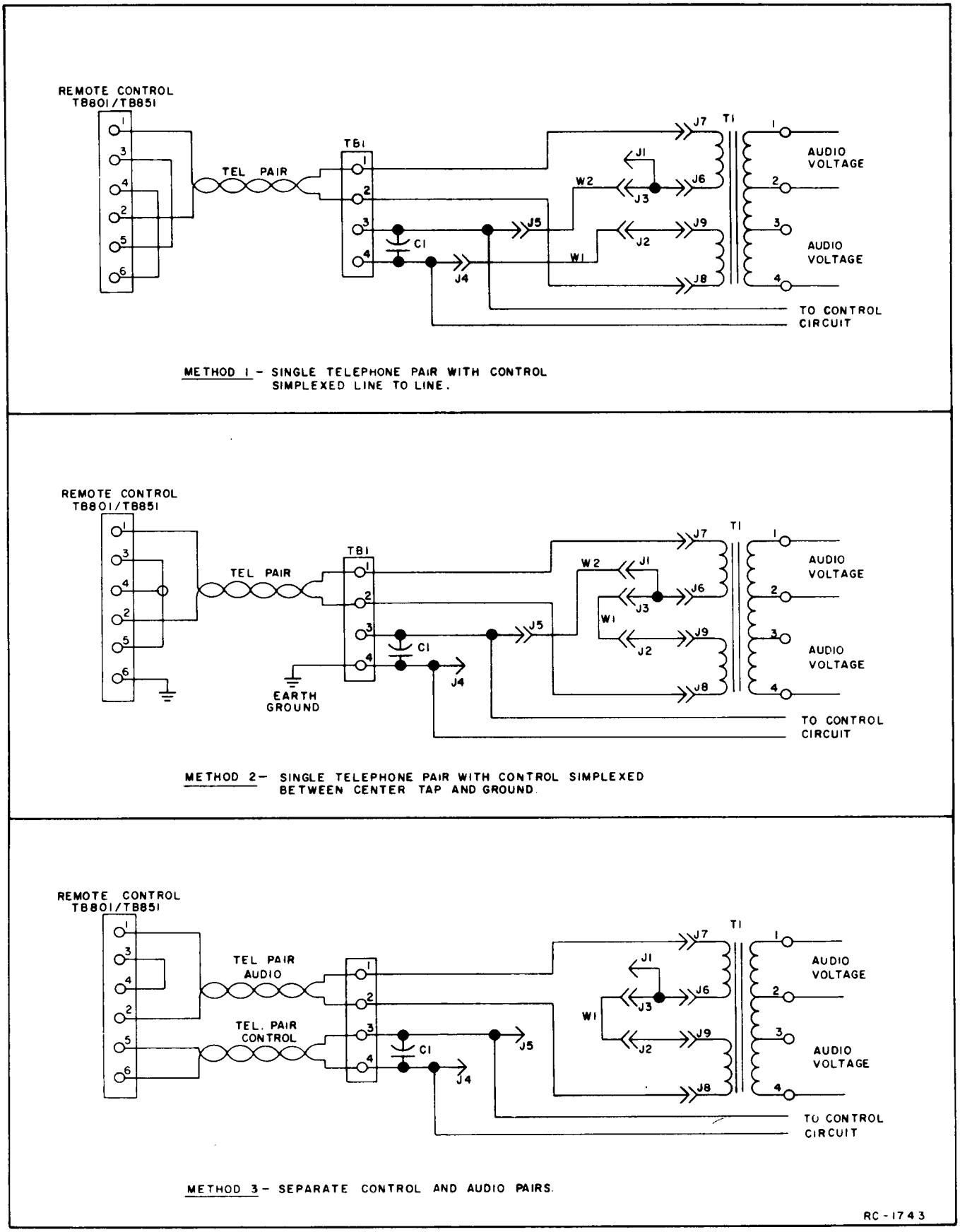


Figure 12 - Telephone Line Connections

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R115) 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 over-modulation are clipped by the modulation limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing over-modulation while preserving intelligibility.

TEST EQUIPMENT

1. Audio Signal Generator Model 4EX6A10
2. Frequency Modulation Monitor
3. AC VTVM or output meter
4. GE Test Set Model 4EX3A10 or 4EX8K11

PROCEDURE

Transmitters without CHANNEL GUARD

1. Connect the audio signal generator and the meter across audio input terminals J5 (green-hi) and J6 (black-lo) on GE Test Set, or across J202-15 (mike-hi) and J202-7 (mike-lo) on the Centralized Metering Jack.
2. Apply a 1.0 volt signal at 1000 Hz to Test Set or across J202-15 and J202-7 on the Centralized Metering Jack.
3. Set MOD ADJUST (R115) for a 4.5 kHz swing with deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.

Transmitters with CHANNEL GUARD

1. Set the Channel Guard TONE ADJUST (R643) for 0.75 kHz tone deviation.
2. Follow Steps 1 thru 3 described above.

Multi-frequency Transmitters

Check all channels for deviation as described in Steps above.

PA POWER INPUT

For FCC purposes, the PA power input can be determined by measuring the PA supply voltage and PA current, and using the following formula:

$$P_i = \text{PA voltage} \times \text{PA current}$$

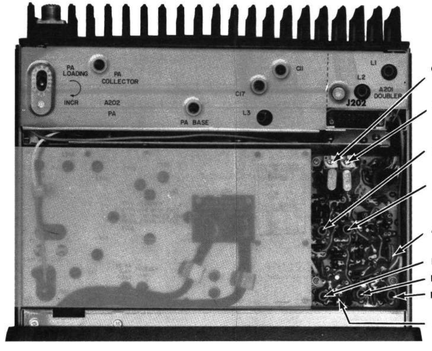
where

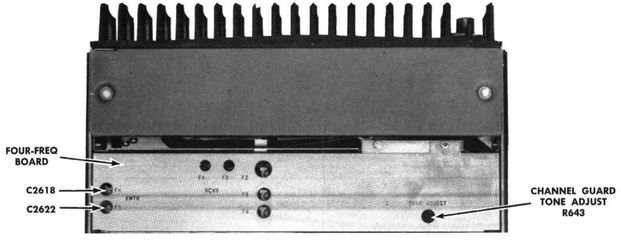
P_i is the power input in watts,

PA voltage is measured with the GE Test Set in Position G on the 15 volt scale, and polarity switch in the (-) position.

PA current is measured with the Test Set in Position G in the Test 1 position, and with the HIGH SENSITIVITY button pressed (10 amperes full scale).

Example: P_i = 12.5 volts x 7 amperes = 87.5 watts





TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Set Model 4EX3A10 (Revision A or later), or Model 4EX8K11.
2. A 50-ohm wattmeter connected to J204.
3. A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place crystal(s) in crystal socket (crystal frequency = operating frequency ÷ 12).
2. Set crystal trimmer C107 to mid-capacity. In multi-frequency transmitters, set all trimmers to mid-capacity and set the channel selector switch to the F1 position.
3. For a large change in frequency or a badly mis-aligned transmitter, turn the slugs in exciter coils L101 thru L105, A201-L1 and -L2, and L3 on PA board (if present) so that the top of the slug is approximately even with the bottom of the coil winding. Next, turn mica compression capacitors C11, C17, PA BASE, PA COLLECTOR, and PA LOADING (on PA board) all the way to the right (clockwise). Then set each capacitor 1-1/2 turns counterclockwise.
4. Connect the GE Test Set to receiver metering jack J302 and check for +10 volts at Position J. If reading is not 10 volts, refer to the power regulator Outline Diagram and set R19 for +10 volts.
5. Connect GE Test Set to metering jack J202. Set the test polarity to + and set the range to the Test 1 (or 1-volt position for 4EX8K11) for all adjustments. Voltage readings at Position "F" may be converted to driver collector current by multiplying the reading by 3 (3 amperes full scale). Voltage readings at Position "G" (with HIGH SENSITIVITY button pressed) may be converted to PA collector current by multiplying the reading by 10 (10 amperes full scale). Readings at Position I indicate relative forward power, and reading at Position J indicate relative reflected power (VSWR).
6. All adjustments are made with the transmitter keyed. Unkey the transmitter between steps to avoid unnecessary heating.

TRANSMITTER ALIGNMENT PROCEDURE

STEP	METER POSITION	TUNING CONTROL	TYPICAL METER READING	PROCEDURE
				EXCITER BOARD
1.	A MULT-1	L101 & L102	Maximum	Carefully tune L101 for maximum meter reading. For transmitters with Channel Guard, alternately tune L101 and L102 for maximum meter reading.
2.	A MULT-1	L103	Minimum	Tune L103 for a small dip in meter reading. For transmitters with Channel Guard, alternately tune L101 and L102 for maximum meter reading.
3.	B MULT-2	L104, L103 and L105	See Procedure	Tune L104 and L103 for maximum meter reading, and then tune L105 for minimum meter reading.
				DOUBLER AND PA
4.	C MULT-3 INPUT	L1, L2 (Doubler) & L105 (Exciter)	See Procedure	Tune L1 and then L105 for maximum meter reading. Then tune L2 for minimum meter reading.
5.	C MULT-3 INPUT	L105 (Exciter) & L1 (Doubler)	Maximum	Tune L105 and then L1 for maximum meter reading.
6.	D MULT-3 OUTPUT	L3 (PA) & L2 (Doubler)	Maximum	Tune L3 (on 33 to 50 MHz transmitters only) for maximum meter reading. Tune L2 (on all transmitters) for maximum meter reading.
7.	F AMP-2	C17	Maximum	Tune C17 for maximum meter reading. If no indication on meter, adjust C11 slightly clockwise and re-tune C17 for maximum meter reading.
8.	F AMP-2	PA BASE	Maximum	Tune PA BASE for maximum power output on wattmeter.
9.	G PA IC		See Procedure	With the HIGH SENSITIVITY switch pressed, check meter reading for 0.7-volt. If reading exceeds 0.7-volt, adjust PA LOADING for a meter reading of 0.6-volt.
10.	G	PA COLLECTOR	Maximum	Tune PA Collector for maximum power output on wattmeter.
11.	F		See Procedure	Repeat Steps 7 & 8 for maximum readings as shown in the following chart:
12	G	PA LOADING & PA COLLECTOR	0.73 Volts maximum	Press the HIGH SENSITIVITY switch. Then adjust PA LOADING slightly clockwise and tune PA COLLECTOR for maximum power output. Repeat until meter reading is 0.73 Volts Maximum.
13.	G	C17, PA BASE PA COLLECTOR	Maximum	Tune C17, PA BASE and PA COLLECTOR for maximum power output on wattmeter.
14.	F		See Procedure	Check for readings obtained in Step 11. If necessary, repeat Steps 7 and 8 until proper readings are obtained.
15.	G		0.73 Volts maximum.	Press HIGH SENSITIVITY switch and check for meter reading of 0.73 Volts maximum. If necessary, repeat Step 12 until proper reading is obtained.
16.		C107 (C108 in 2-freq. units, and C2618 or C2622 in multi-freq. units.		Loosely couple frequency counter to output and adjust C107 for proper frequency output. (Switch to F2 and adjust C108 on 2-frequency units. In 3- or 4-frequency units, adjust C2619 or C2622 as required.)

For PA BOARD	METER READING FROM:	TO:
4EF33A10	0.17 V at 25 MHz	0.4 V at 33 MHz
4EF33B10	0.3 V at 33 MHz	0.5 V at 42 MHz
4EF33C10	0.5 V at 42 MHz	0.65 V at 50 MHz

NOTE

Do not attempt to set PA current by increasing only PA LOADING. Reading will increase only when PA COLLECTOR is re-tuned for maximum power output following each slight clockwise adjustment of PA LOADING.

NOTE

For proper frequency control of the transmitter, it is recommended that all frequency adjustments be made when the equipment is at a temp. of approximately 75°F. In no case should frequency adjustments be made when the equipment is outside the temp. range of 50° to 90°F.

ALIGNMENT PROCEDURE

TRANSMITTER TYPE ET-82-A

RC-1697B

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, low supply voltage, 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 as shown:

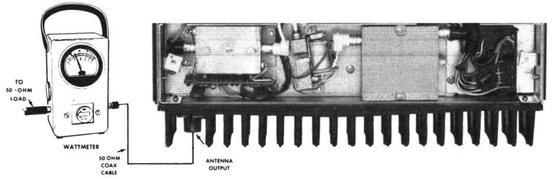
1. Wattmeter similar to:
   Bird #43
   Jones #711N
2. VTVM similar to:
   Triplett #850
   Heath #1M-21
3. Audio Generator
   GE MODEL 4EX6A10
4. Deviation Meter (with a .75 kHz scale) similar to:
   Measurements #140
   Lampkin #205A
5. Multimeter similar to:
   GE TEST SET
   MODEL 4EX3A10 or 4EX8K11

STEP 1

POWER MEASUREMENT

TEST PROCEDURE

A. Connect transmitter output to wattmeter as shown below:



B. Key transmitter and check wattmeter for minimum reading of 50 watts.

SERVICE CHECK

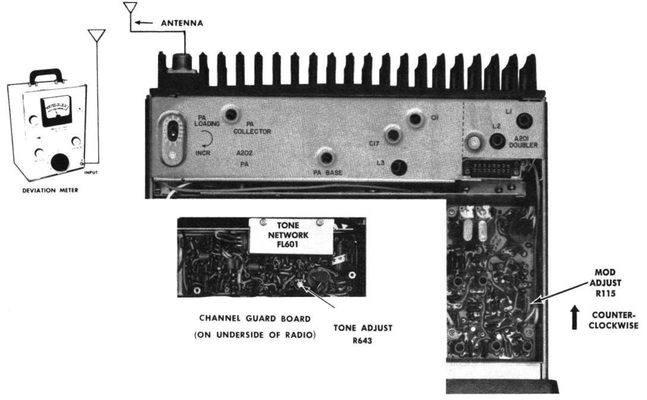
Refer to Service Hints on Transmitter Troubleshooting Procedure.

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 control R115 fully counterclockwise.

C. Key transmitter and check for 0.75 kHz deviation. If reading is low or high, adjust Channel Guard TONE ADJUST (R643 on Channel Guard Board) for a reading of 0.75 kHz.

DEVIATION METER

NOTES:

D. On units supplied with Channel Guard, the Phase Modulator Tuning should be peaked carefully to insure proper performance. (Refer to Step 1 in the Transmitter Alignment Procedure.)

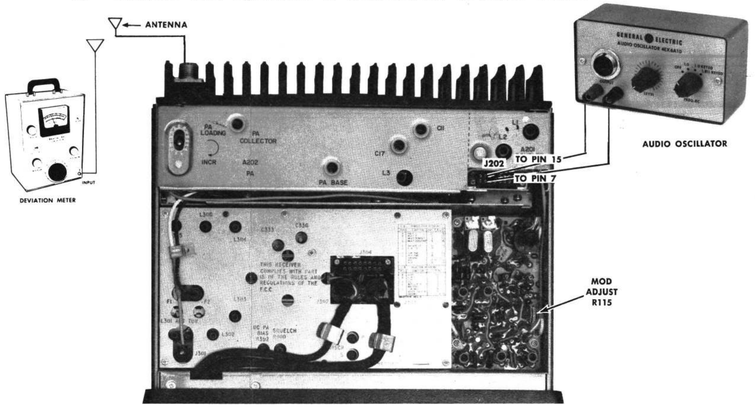
E. The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

STEP 3

VOICE DEVIATION AND SYMMETRY

TEST PROCEDURE

A. Unplug the microphone.
B. Connect test equipment to transmitter as shown below:

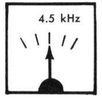


C. Set the generator output to 1.0 VOLTS RMS and frequency to 1 kHz.

D. Key the transmitter by connecting a jumper from J202-18 to J202-16 (GRD).

E. Deviation reading should be ±4.5 kHz.

F. Adjust MOD ADJUST Control R115 until deviation reads 4.5 kHz on plus (+) or minus (-) deviation, whichever is greater. This adjustment should be made with the correct level of tone applied on Channel Guard transmitters.



DEVIATION METER

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 (+) and minus (-) differs by more than 0.5 kHz, check the following:

G. Recheck Step 1 as shown in the Transmitter Alignment Procedure.

H. Check Audio Sensitivity by reducing generator output until deviation falls to 3.0 kHz. Voltage should be LESS than 90 millivolts (typically 75 mv).

METER

FRONT END ALIGNMENT

These instructions are for tuning the oscillator and RF stages of the receiver and may be used when changing the receiver crystal or frequency. When necessary to realign the entire receiver, refer to the COMPLETE RECEIVER ALIGNMENT. For receivers with Noise Blankers, refer to the Noise Blanker Troubleshooting Procedure.

EQUIPMENT REQUIRED

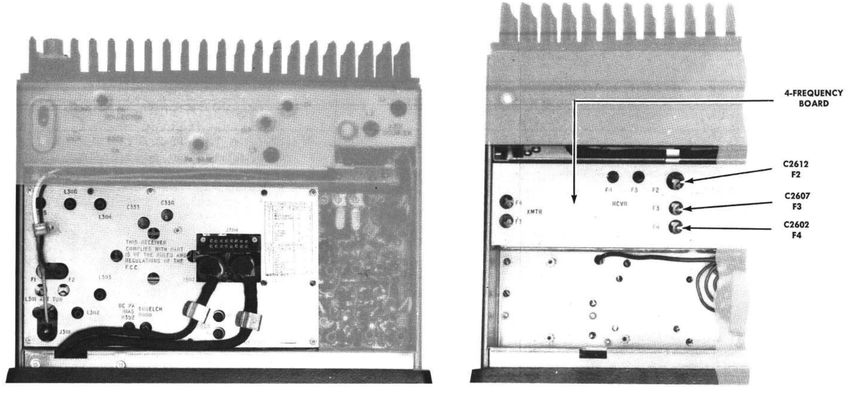
1. GE Test Set Models 4EX3A10 or 4EX8K11 (or 20,000 ohms-per-volt Multimeter).
2. 25-50 MHz signal source (keep signal level below saturation).

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Plug GE Test Set into receiver centralized metering jack J304. Set meter polarity switch on + and meter sensitivity switch to 1. If using Multimeter, connect the negative lead to J304-13 (ground).
2. Turn SQUELCH control (R400) fully clockwise and VOLUME control to minimum. Switch to position "G" or measure at J304-9 with Multimeter. In combinations with Power Regulator Models 4EP57A10 in Rev. G or later or 4EP59A10 in Rev. D or later, set PA Bias R392 for a reading of 1.3 Volts. For Power Regulators Model 4EP57A10 in Rev. F or earlier or 4EP59A10 in Rev. C or earlier, set R392 for a reading of 0.7 Volt. In combinations with Power Regulator Model 4EP76A10, set R392 for a reading of 1.3 Volts. In combinations with Power Regulator 4EP78A10, set R392 for a reading of 0.9 Volt.

ALIGNMENT PROCEDURE

STEP	METERING POSITION 4EX3A10	METERING POSITION MULTIMETER + at J304	TUNING CONTROL	METER READING	PROCEDURE
1.	D OSC	pin 4	L305 and L306	See Procedure	Switch to F1, put in F1 crystal and tune L305 for maximum meter reading and L306 for minimum reading (0.28 v).
2.	D OSC	pin 4	L305 and L306	See Procedure	For multi-frequency receivers, adjust L305 for maximum and L306 for minimum meter reading. Adjust coils for equal readings on highest and lowest frequencies.
3.					Preset L301 thru L304 to approximate-frequency. (Slug at top of coil for highest frequency, and slug centered in coil for lowest frequency. Do not tune slugs below center of coil.)
4.	B LIM 1	pin 3	L301 thru L304	Maximum	Apply on-frequency signal to J301. Tune L301 thru L304 for maximum meter reading. Keep signal below saturation at each stage and on discriminator zero.
5.			L301 and L302		While receiving a weak on-frequency signal from the antenna, tune L301 and L302 for best quieting.
6.	A DISC	pin 4	C311(C316 for 2-freq. or C2612, C2607 and C2602 for 4-freq.)	Zero	Apply the exact channel frequency signal to J301 and tune C311 (C316 for 2-frequency) for zero discriminator reading. In 3- or 4-frequency units, tune C2612, C2607 and C2602 as required. NOTE For proper freq. control or the receiver, it is recommended that all freq. adjustments be made when the equipment is at a temp. of approx. 75°F. In no case should freq. adjustments be made when the equipment is outside the temp. range of 50° to 90°F.
SQUELCH ADJUSTMENT					
7.				30°	Set SQUELCH Control (R400) to open with a 4 db SINAD signal. (Approximately 30° counterclockwise of critical squelch position)



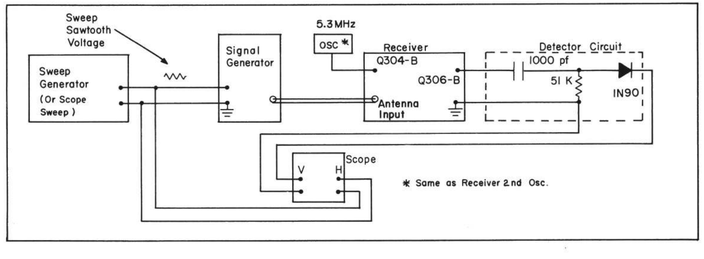


Figure 1 - High and Low IF FILTER TEST Circuit

COMPLETE RECEIVER ALIGNMENT

For receivers with Noise Blankers, refer to page 60 for Noise Blanker Checks.

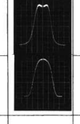
EQUIPMENT REQUIRED

1. GE Test Set Models 4EX3A10 or 4EX8K10, 11 (or 20,000 ohms-per-volt Multimeter).
2. A 5.3 MHz ±200 Hz and a 25-50 MHz signal source. Couple the 5.3 MHz signal through a 0.01-µf capacitor. Keep signal levels below saturation.
3. For Alignment steps 4 thru 8 - Oscilloscope, sweep generator, 5.3 MHz marker generator and construct a detector circuit (see Figure 1 for circuitry).

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Plug GE Test Set into the receiver centralized metering jack J304. Set meter polarity switch on + and meter sensitivity switch to TEST 1. If using multimeter, connect the negative lead to J304-13 (ground).
2. Switch Test Set to Position "I" (or measure at collector of Q318 with multimeter). Reading should be a nominal 13.8 Volts.
3. Switch to Position "J" (or measure at top of C443 with multimeter), and check for a reading of 10 Volts. If reading is not correct, refer to power regulator Outline Diagram and set R19 for +10 Volts.
4. Turn SQUELCH control fully clockwise and VOLUME control to minimum. Switch to Position "G" or measure at J304-9 with multimeter. In combinations with Power Regulator Models 4EP57A10 in Rev. G or later or 4EP59A10 in Rev. D or later, set PA Bias R392 for a reading of 1.3 Volts. For Power Regulators Model 4EP57A10 in Rev. F or earlier or 4EP59A10 in Rev. C or earlier, set R392 for a reading of 0.7 Volt. In combination with Power Regulator Model 4EP76A10, set R392 for a reading of 1.3 Volts. In combinations with Power Regulator 4EP78A10, set R392 for a reading of 0.9 Volt.

ALIGNMENT PROCEDURE

STEP	METERING POSITION TEST SET 4EX3A10	METERING POSITION MULTIMETER + at J304	TUNING CONTROL	METER READING	PROCEDURE
DISCRIMINATOR					
1.					Remove 1st oscillator crystal. Then apply a 5.3 MHz signal to the base of Q306.
2.	A DISC	pin 10	L329	See Procedure	Adjust L329 (discriminator primary) 1/2 turn up from bottom of range.
3.	A DISC	pin 10	L330	Zero	Tune L330 (discriminator secondary) for zero meter reading.
HIGH AND LOW IF FILTER (SEE NOTE 1)					
4.	B LIM 1	pin 2	L321 thru L328	Maximum	Tune L321 thru L328 for maximum meter reading.
5.	B LIM 1	pin 2	C333, C336, C339	Maximum	Tune C333, C336 and C339 for maximum meter reading.
6.			C333, C336 and C339		Disable the 2nd oscillator by grounding the base of Q305 through a 0.01 µf capacitor. Connect scope, signal generator and detector as shown in figure 1. Sweep RF ±50 kHz at 20 Hz. Connect 5.3 MHz marker to the base of Q304. Tune C333, C336 and C339 for scope pattern shown. Keep marker signal centered between humps and signal level below saturation.
7.			L321 thru L328		Disconnect detector, remove short from base of Q305 and connect scope to 1st LIM test point. Adjust L321 thru L328 for symetrical wave form shown, with marker in center.
8.	A DISC	pin 10			Check to see that discriminator idling voltage is within 0.05 volts of zero with no signals applied and the modulation acceptance bandwidth is between ±6 and ±8 kHz.
OSC/MULT					
9.	D OSC	pin 4	L305 & L306	See Procedure	Remove short from base of Q305, if present, then insert 1st oscillator crystal. Adjust L305 for maximum meter reading, and L306 for minimum meter reading (0.28 v).
10.	D OSC	pin 4	L305 & L306	Maximum	For multi-frequency receivers, adjust L305 for maximum meter reading and L306 for minimum meter reading. Adjust coils for equal meter readings on highest and lowest frequencies.
RF					
11.	B LIM 1	pin 3	L301, L302 L303 and L304	Maximum	Apply on-frequency signal to J301, then tune L301 thru L304 for maximum meter reading. Keep signal below saturation at each stage and on discriminator zero. For multi-frequency receivers, adjust coils for best performance on all frequencies.
12.			L301		While receiving a weak on-frequency signal from the antenna, tune L301 and L302 for best quieting.
FREQUENCY ADJUSTMENT					
13.	A DISC	pin 4	C311 (C316 for 2-freq. or C2612, C2607 and C2602 for four-freq.	Zero	Apply the exact channel frequency signal to J301 and tune C311 (and C316 for 2-frequency) for zero discriminator reading. In 3- or 4-frequency units, tune C2612, C2607 or C2602 as required. NOTE 2 For proper frequency control of the receiver, it is recommended that all frequency adjustments be made when the equipment is at a temp. of approx. 75°F. In no case should frequency adjustments be made when the equipment is outside the temp. range of 50° to 90°F.
14.				30°	Set SQUELCH control (R400) to open with a 4 db SINAD signal. (Approximately 30° counterclockwise of critical squelch position.)

NOTE 1 -- High and Low IF coils and capacitors have been set at the factory and will normally require no further adjustment. Do not re-align unless there is positive evidence of a defective filter. For location of components, refer to the Receiver Outline Diagram.

ALIGNMENT PROCEDURE

RECEIVER TYPE ER-46-A

RC-1698D

TEST PROCEDURES

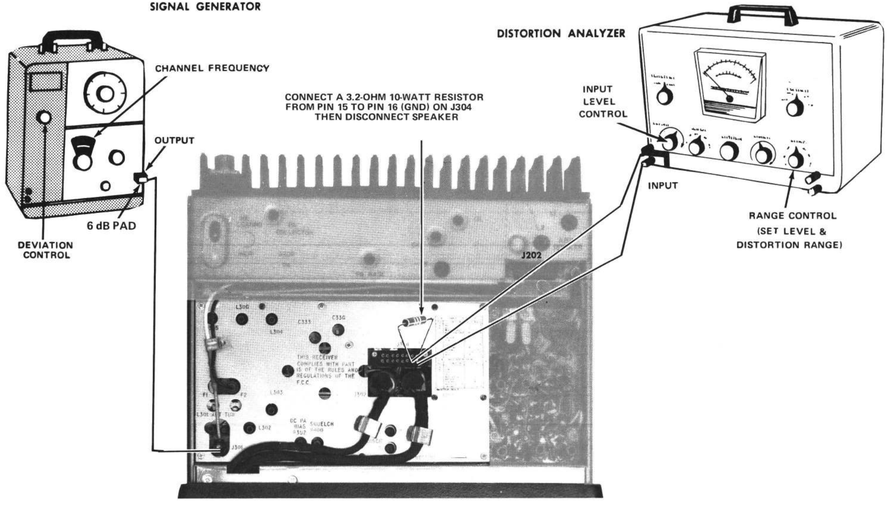
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

- Distortion Analyzer similar to: Heath IM-12
- Signal Generator similar to: Measurements M-800
- 6-dB attenuation pad, and 3.2 ohm, 10-watt resistor

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Connect a 1,000-microvolt test signal modulated by 1,000 hertz with +3.0 kHz deviation to the antenna jack J301.

B. When speaker is used, disconnect speaker (and handset if present). Hook up a 3.2-ohm load resistor from J304-15 to J304-16 as shown.

C. Set VOLUME Control for five-watt output (4.0 VRMS).

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than five watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Set SQUELCH control R400 fully counterclockwise. Then connect a milliammeter in series with the red lead at TB5-1. With no signal in, adjust R4 on the Audio PA board for a reading of 20 milliamperes. This adjustment should not be necessary unless one of the Audio PA transistors has been replaced.

G. Audio Gain (Refer to Receiver Troubleshooting Procedure).

H. Discriminator Alignment (Refer to Receiver Alignment on reverse side of page).

STEP 2
USABLE SENSITIVITY
(12 dB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000-microvolt, on-frequency signal modulated by 1000 Hz with 3.0-kHz deviation to J301.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000-Hz distortion range position (1000-Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12-dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 2.5 watts 2.85 volts RMS across the 3.2-ohm receiver load using the Distortion Analyzer as a VTVM).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD specification, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3
MODULATION ACCEPTANCE
BANDWIDTH (IF BANDWIDTH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12-dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12-dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±6 kHz (but less than ±8 kHz).

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

PARTS LIST

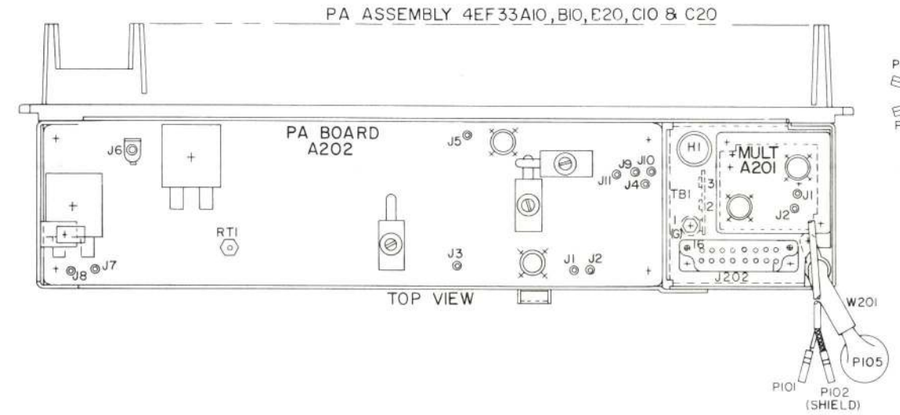
LBI-3904C

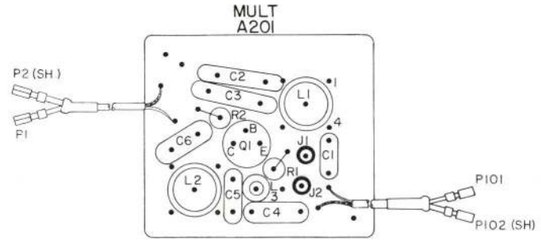
25--50 MHZ TRANSMITTER TYPE ET-82-A

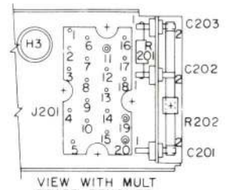
SYMBOL	GE PART NO.	DESCRIPTION
		EXCITER BOARD **4EG21A10-13 19C311008-G1, G2** **19A122220-G3** **4EG21B10-13 19C311008-G3, G4** **19A122220-G3** **4EG21C10-13 19C311008-G5, G6** **19A122220-G3**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	7491395-P114	Ceramic disc: .0022 µf ±10%, 500 VDCW; sim to RMC Type JL.
C102	19B209243-P5	Polyester: 0.047 µf ±20%, 50 VDCW.
C103	19B209243-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C104	7491395-P111	Ceramic disc: .0015 µf ±10%, 500 VDCW; sim to RMC Type JL.
C105	5494481-P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C106	5496267-P9	Tantalum: 3.3 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C107	5491271-P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to EF Johnson 189.
C109	5496219-P39	Ceramic disc: 8.0 pf ±5%, 500 VDCW, temp coef 0 PPM.
C111	5496219-P50	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef 0 PPM.
C115A	5493366-P1000J	Mica: 1000 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C115B	5493366-P680K	Mica: 680 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C116	19B209243-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C117A	5493366-P1000J	Mica: 1000 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C117B	5493366-P680J	Mica: 680 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C118A	5493367-P1500J	Mica: 1500 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-20.
C118B	5493367-P1000J	Mica: 1000 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-20.
C119A	5496372-P350	Ceramic disc: 220 pf ±5%, 500 VDCW, temp coef -4700 PPM.
C119B	5496372-P146	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -3300 PPM.
C120 and C121	5493366-P470J	Mica: 470 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-15.
C122A	5496372-P350	Ceramic disc: 220 pf ±5%, 500 VDCW, temp coef -4700 PPM.
C122B	5496372-P146	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -3300 PPM.
C123A	5493366-P390K	Mica: 390 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C123B	5493366-P330K	Mica: 330 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C124	5493366-P150K	Mica: 150 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C125A	5493367-P2200J	Mica: 2200 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-20.
C125B	5493367-P1000J	Mica: 1000 pf ±5%, 100 VDCW; sim to Electro Motive Type DM-20.
C126	19B209243-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C127A	5493366-P470K	Mica: 470 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C127B	5493366-P330K	Mica: 330 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C127C	5493366-P220K	Mica: 220 pf ±10%, 100 VDCW; sim to Electro Motive Type DM-15.
C128	5494481-P129	Ceramic disc: 3900 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C129	19B209243-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C130A	5496219-P265	Ceramic disc: 120 pf ±5%, 500 VDCW, temp coef -80 PPM.
C130B	5496219-P261	Ceramic disc: 82 pf ±5%, 500 VDCW, temp coef -80 PPM.
C131A	5496219-P265	Ceramic disc: 120 pf ±5%, 500 VDCW, temp coef -80 PPM.
C131B	5496219-P261	Ceramic disc: 82 pf ±5%, 500 VDCW, temp coef -80 PPM.
C132 and C133	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C134A	5496219-P461	Ceramic disc: 82 pf ±5%, 500 VDCW, temp coef -220 PPM.
C134B	5496219-P259	Ceramic disc: 68 pf ±5%, 500 VDCW, temp coef -80 PPM.
C134C	5496219-P255	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -80 PPM.
C135	5494481-P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C136	19B209243-P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C137	7491395-P109	Ceramic disc: 1000 pf ±10%, 500 VDCW.
C138	7130348-P3	Molded, phen: 1.00 pf ±0.050 pf, 500 VDCW, temp coef 0 PPM; sim to Jeffers Type JM-5/32.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CV101 and CV102	5495769-P9	Silicon, capacitive.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J2603		Part of printed board.
J101 thru J104	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J105	19B209303-P1	Plug, phen: 9 pins.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L101A	19C303883-G1	Coil. Includes tuning slug 5491798-P1.
L101B	19C303883-G2	Coil. Includes tuning slug 5491798-P2.
L101C	19C303883-G3	Coil. Includes tuning slug 5491798-P2.
L102A	19C303883-G1	Coil. Includes tuning slug 5491798-P1.
L102B	19C303883-G2	Coil. Includes tuning slug 5491798-P2.
L102C	19C303883-G3	Coil. Includes tuning slug 5491798-P2.
L103A	19C303883-G4	Coil. Includes tuning slug 5491798-P3.
L103B	19C303883-G5	Coil. Includes tuning slug 5491798-P3.
L103C	19C303883-G6	Coil. Includes tuning slug 5491798-P3.
L104A	19C303883-G7	Coil. Includes tuning slug 5491798-P3.
L104B	19C303883-G8	Coil. Includes tuning slug 5491798-P3.
L104C	19C303883-G9	Coil. Includes tuning slug 5491798-P3.
L105A	19C303883-G10	Coil. Includes tuning slug 5491798-P5.
L105B	19C303883-G11	Coil. Includes tuning slug 5491798-P5.
L105C	19C303883-G12	Coil. Includes tuning slug 5491798-P5.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q101	19A115889-P1	Silicon, NPN.
Q102 and Q103	19A115123-P1	Silicon, NPN; sim to Type 2N2712.
Q104 and Q105	19A115330-P2	Silicon, NPN.
Q106 and Q107	19A115328-P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	3R77-P563J	Composition: 56,000 ohms ±5%, 1/2 w.
R102	3R77-P623J	Composition: 62,000 ohms ±5%, 1/2 w.
R104	3R77-P154K	Composition: 0.15 megohms ±10%, 1/2 w.
R105	3R77-P562K	Composition: 5600 ohms ±10%, 1/2 w.
R106	3R77-P683J	Composition: 68,000 ohms ±5%, 1/2 w.
R108	3R77-P153J	Composition: 15,000 ohms ±5%, 1/2 w.
R109	3R77-P473J	Composition: 47,000 ohms ±5%, 1/2 w.
R110	3R77-P681K	Composition: 680 ohms ±10%, 1/2 w.
R111	3R77-P104K	Composition: 0.10 megohms ±10%, 1/2 w.
R112	3R77-P393K	Composition: 39,000 ohms ±10%, 1/2 w.
R113	3R77-P565J	Composition: 5.6 megohms ±5%, 1/2 w.
R114	3R77-P473J	Composition: 47,000 ohms ±5%, 1/2 w.
R115	19B209358-P106	Variable, carbon film: approx 75 to 10,000 ohms ±20%, 0.25 w; sim to CTS Type X-201.
R118	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R120	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R121	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R122	3R77-P681K	Composition: 680 ohms ±10%, 1/2 w.
R123	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R124A	3R152-P473K	Composition: 47,000 ohms ±10%, 1/4 w.
R124B	3R152-P393K	Composition: 39,000 ohms ±10%, 1/4 w.
R124C	3R152-P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R125A	3R152-P154K	Composition: 0.15 megohms ±10%, 1/4 w.
R125B	3R152-P124K	Composition: 0.12 megohms ±10%, 1/4 w.
R125C	3R152-P104K	Composition: 0.10 megohms ±10%, 1/4 w.
R126	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R127	3R77-P683K	Composition: 68,000 ohms ±10%, 1/2 w.
R128	3R77-P153K	Composition: 15,000 ohms ±10%, 1/2 w.
R129	3R77-P393K	Composition: 39,000 ohms ±10%, 1/2 w.
R130	3R77-P102K	Composition: 1000 ohms ±10%, 1/2 w.
R131	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R132	3R77-P181K	Composition: 180 ohms ±10%, 1/2 w.
R133	3R77-P390K	Composition: 39 ohms ±10%, 1/2 w.
R134	3R77-P823K	Composition: 82,000 ohms ±10%, 1/2 w.
R135	3R77-P220K	Composition: 22 ohms ±10%, 1/2 w.
R136	3R77-P473K	Composition: 47,000 ohms ±10%, 1/2 w.
R137A	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R137B	3R77-P680K	Composition: 68 ohms ±10%, 1/2 w.
R137C	3R77-P510J	Composition: 51 ohms ±5%, 1/2 w.
R139	3R152-P330K	Composition: 33 ohms ±10%, 1/4 w.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY101		Crystal socket. Includes the following parts:
	4033089-P1	Clip, spring tension.
	19B200525-P9	Rivet.
	19A115793-P1	Contact.
	19C311172-P1	Socket.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y101	19B206175-P11	Quartz: freq range 2083 to 2750 KHz, temp range -30°C to +85°C.

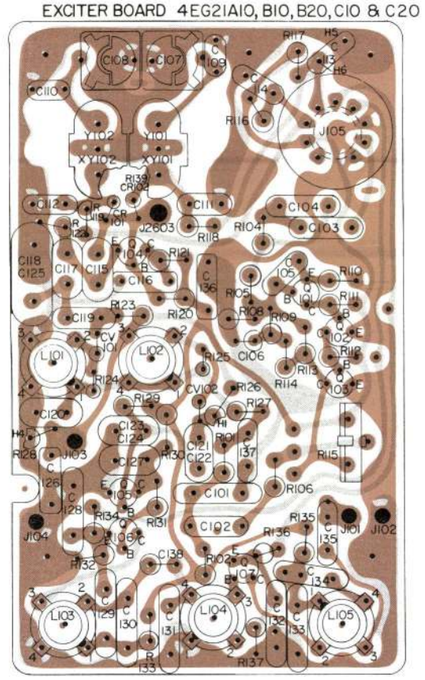
(Cont'd on back of RC-1700

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

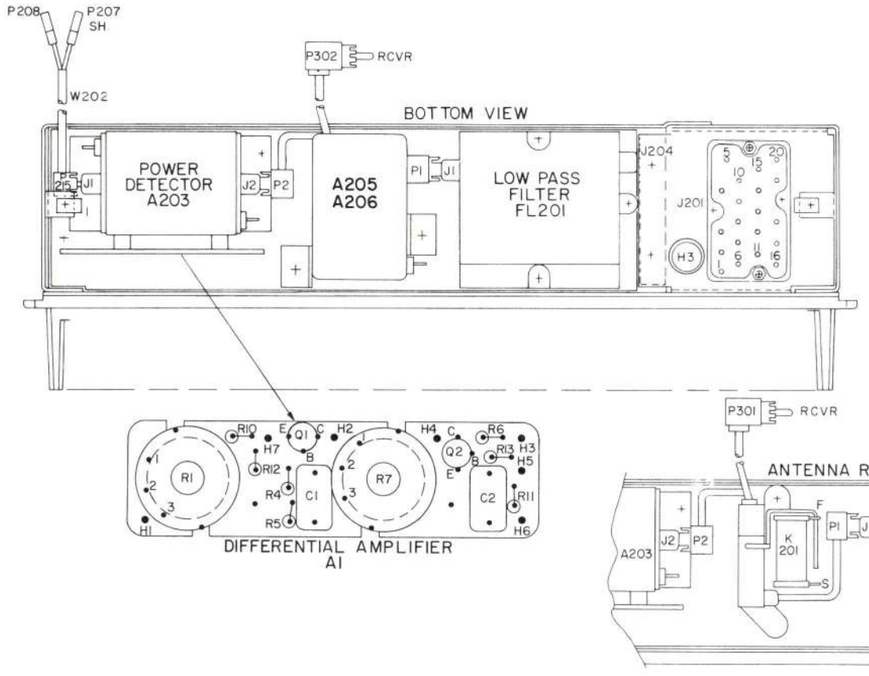


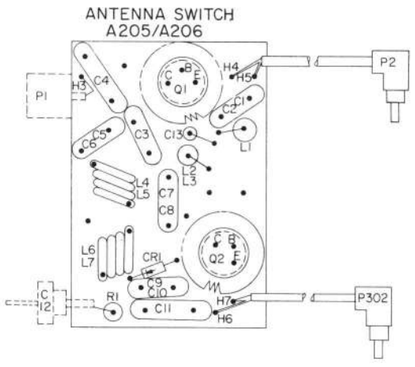






(19B205449, Sh. 1, Rev. 0)
(19B205449, Sh. 2, Rev. 0)





RESISTANCE READINGS

ALL READINGS ARE TYPICAL READINGS MEASURED FROM TRANSISTOR PINS TO GROUND, WITH ALL POWER REMOVED FROM THE TRANSMITTER AND WITH EXCITER +10 V SHORTED FROM J105-2 TO CHASSIS. + OR − SIGNS SHOW METER LEAD GROUNDED

FOR READINGS OF:	USE METER SCALES:
1−50Ω	X1
51−500Ω	X10
510−50K	X1000

EXCITER BOARD

TRANSISTOR SYMBOL #	EMITTER		BASE		COLLECTOR	
	−	+	−	+	−	+
Q101	680	680	13.7K	3.6K	13.5K	2.9K
Q102	0	0	13.5K	2.9K	15.5K	2.9K
Q103	0	0	15.5K	2.9K	7.5K	8.7K
Q104	680	680	15K	2.6K	100	100
Q105	0	0	39K	3.4K	1K	1K
Q106	71	175	1.1K	1.1K	39	39
Q107	10	NOTE-1	0	0	8.8	20

PA ASSEMBLY

TRANSISTOR SYMBOL #		EMITTER		BASE		COLLECTOR	
		−	+	−	+	−	+
A201	Q1	18	7	0	0	200	6.5
A202	Q1	GRD	GRD	5	5	150	4.2
A202	Q2	GRD	GRD	5	5	150	4
A202	Q3	GRD	GRD	3	3	150	3.8
A202	Q4	GRD	GRD	3	3	150	3.8
A202	Q5	GRD	GRD	3	3	150	3.8

NOTE
1. 25−33 MHZ 110Ω 33−42 MHZ 68Ω 42−50 MHZ 51Ω

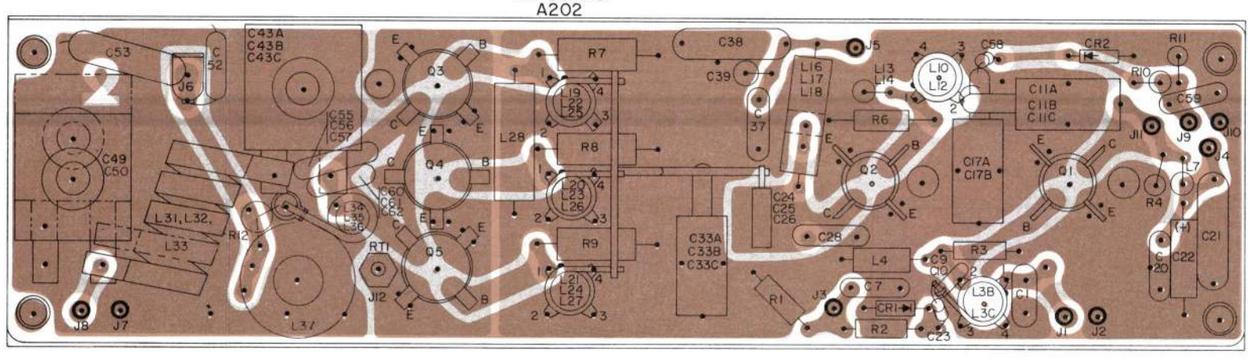
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

25—50 MHZ TRANSMITTER
TYPE ET-82-A

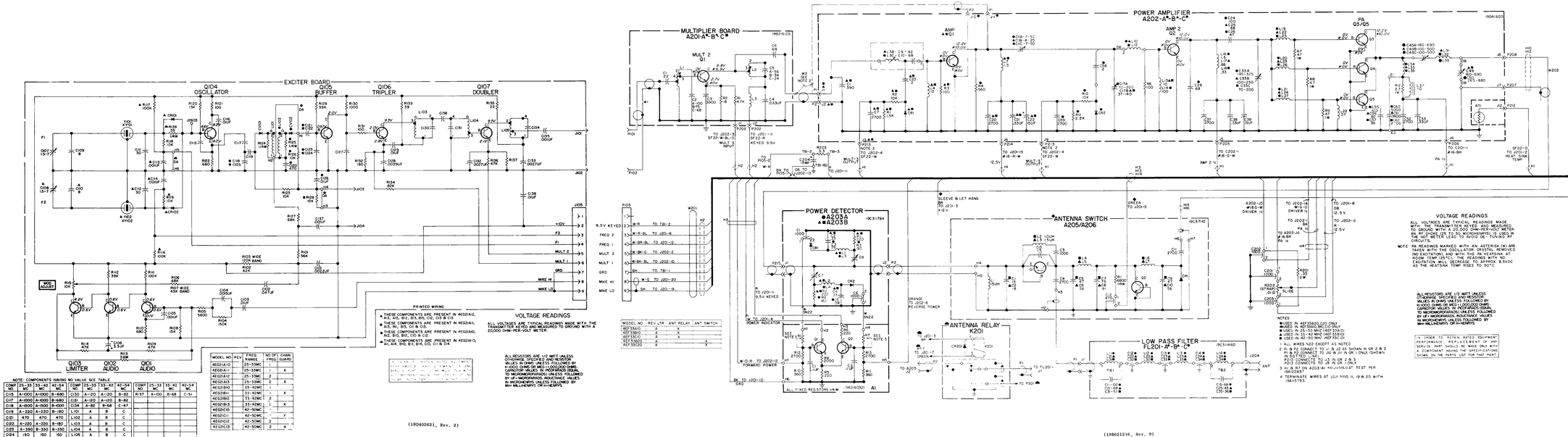
RC-1699C

PA BOARD
A202



(19E500879, Rev. 4)

(19C311783, Sh. 1, Rev. 2)
(19C311783, Sh. 2, Rev. 2)



SCHEMATIC DIAGRAM

25—50 MHZ TRANSMITTER
TYPE ET-82-A
RC-1700D

(Cont'd from front of RC-1699)

SYMBOL	GE PART NO.	DESCRIPTION
		MODIFICATION KIT 19A122220-G3
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C108	5491271-P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to RF Johnson 189.
C110	5496219-P39	Ceramic disc: 8.0 pf ±10%, 500 VDCW, temp coef 0 PPM.
C112	5496219-P50	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef 0 PPM.
C113 and C114	5494481-P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR101 and CR102	19A115603-P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R116 and R117	3R77-P104K	Composition: 0.10 megohm ±10%, 1/2 w.
R119	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY102		Includes the following parts:
	4033089-P1	Clip, spring tension.
	19B200525-P9	Rivet.
	19A115793-P1	Contact.
	19C311172-P1	Socket.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y102	19B206175-P11	Quartz: freq range 2083 to 2750 KHz, temp range -30°C to +85°C.
		POWER AMPLIFIER ASSEMBLY
		4EF33A10 REV A 19D413124-G1
		4EF33B10 REV A 19D413124-G2
		4EF33B20 REV A 19D413124-G5
		4EF33C10 REV A 19D413124-G3
		4EF33C20 REV A 19D413124-G4
		MULTIPLIER BOARD
A201A thru A201C		**A201A 19B216105-G1 (Used in 19D413124-G1)** **A201B 19B216105-G2 (Used in 19D413124-G2, G5)** **A201C 19B216105-G3 (Used in 19D413124-G3,G4)**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496219-P213	Ceramic disc: 22 pf ±10%, 500 VDCW, temp coef -80 PPM.
C2A	5496219-P263	Ceramic disc: 100 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2B	5496219-P260	Ceramic disc: 75 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2C	5496219-P259	Ceramic disc: 68 pf ±5%, 500 VDCW, temp coef -80 PPM.
C3	5494481-P129	Ceramic disc: 3900 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C4	19B209243-P4	Polyester: 0.033 µf ±20%, 50 VDCW.
C5A	5496219-P257	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -80 PPM.
C5B	5496219-P252	Ceramic disc: 36 pf ±5%, 500 VDCW, temp coef -80 PPM.
C5C	5496219-P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C6	5490008-P123	Silver mica: 68 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 and J2	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1A	19D402808-G24	Coil. Includes tuning slug 5491798-P2.
L1B	19D402808-G25	Coil. Includes tuning slug 5491798-P2.
L1C	19D402808-G26	Coil. Includes tuning slug 5491798-P2.
L2A	19D403808-G27	Coil. Includes tuning slug 5491798-P2.
L2B	19D402808-G28	Coil. Includes tuning slug 5491798-P2.
L2C	19D402808-G29	Coil. Includes tuning slug 5491798-P2.
L3	19A115700-P2	Coil.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	4029840-P2	Contact, electrical: sim to Amp 42827-2.
P2	4029840-P1	Contact, electrical: sim to AMP 41854.
P101	4029840-P2	Contact, electrical: sim to Amp 42827-2.
P102	4029840-P1	Contact, electrical: sim to AMP 41854.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115294-P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77-P473K	Composition: 47,000 ohms ±5%, 1/2 w.
R2	3R77-P180J	Composition: 18 ohms ±5%, 1/2 w.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
A202A thru A202C		**PA BOARD** **A202A 19D413120-G1 (Used in 19D413124-G1)** **A202B 19D413120-G2 (Used in 19D413124-G2)** **A202C 19D413120-G3 (Used in 19D413124-G3)**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5490008-P141	Silver mica: 390 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C7	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C9		Part of L3B.
C10		Part of L3C.
C11A	19B209408-P103	Variable, mica: 7-50 pf, 400 VDCW.
C11B	19B209408-P102	Variable, mica: 4-35 pf, 400 VDCW.
C11C	19B209408-P103	Variable, mica: 7-50 pf, 400 VDCW.
C17A	19B209408-P108	Variable, mica: 70-200 pf, 400 VDCW.
C17B	19B209408-P106	Variable, mica: 37-140 pf, 400 VDCW.
C20	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C21	19B209243-P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C22	5496267-P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C23	5491601-P25	Phenolic: 2.0 pf ±10%, 500 VDCW.
C24	7484398-P11	Mica: 100 pf ±10%, 500 VDCW; sim to Underwood J-1-MF.
C25	7484398-P10	Mica: 68 pf ±10%, 500 VDCW; sim to Underwood J-1-MF.
C26	7484398-P2	Mica: 47 pf ±10%, 500 VDCW; sim to Underwood J-1-MF.
C28	5496219-P19	Ceramic disc: 68 pf ±10%, 500 VDCW, temp coef 0 PPM.
C33A	19B209408-P113	Variable, mica: 145-325 pf, 400 VDCW.
C33B	19B209408-P110	Variable, mica: 100-250 pf, 400 VDCW.
C33C	19B209408-P108	Variable, mica: 70-200 pf, 400 VDCW.
C37	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C38	19B209243-P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C39	5496267-P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C43A	19A115917-P5	Variable, compression mica: 180-690 pf, 500 VDCW; sim to Electro Motive Type 30 W.
C43B and C43C	19A115917-P4	Variable, compression mica: 100-500 pf, 500 VDCW; sim to Electro Motive Type 30 W.
C49	19A115917-P5	Variable, compression mica: 180-690 pf, 500 VDCW; sim to Electro Motive Type 30 W.
C50	19A115917-P6	Variable, compression mica: 265-880 pf, 500 VDCW; sim to Electro Motive Type 30 W.
C52	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C53	19SD09243-P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C55	5496219-P21	Ceramic disc: 100 pf ±10%, 500 VDCW, temp coef 0 PPM.
C56	5496219-P20	Ceramic disc: 82 pf ±10%, 500 VDCW, temp coef 0 PPM.
C57	5496218-P52	Ceramic disc: 36 pf ±5%, 500 VDCW, temp coef 0 PPM.
C58	5491601-P25	Phenolic: 2.0 pf ±10%, 500 VDCW.
C59	5494481-P127	Ceramic disc: 2700 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C60	5494481-P26	Ceramic disc: 5000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C61	5494481-P30	Ceramic disc: 3900 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C62	5494481-P28	Ceramic disc: 2700 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 and CR2	19A115250-P1	Silicon.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J3	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J6	4033284-P2	Support.
J7 thru J11	4033513-P4	Contact, electrical: sim to Bead Chain L93-3.
J12		Part of RT1.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L3B		**COIL ASSEMBLY 19D413121-G1**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C9	7489162-P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
	5491798-P2	Tuning slug.
L3C		**COIL ASSEMBLY 19D413121-G2**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C10	7489102-P23	Mica: 68 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
	5491798-P2	Tuning slug.
L4	7488079-P16	Choke, RF: 10 µh ±10%, 0.60 ohms DC res max; sim to Jeffers 4421-2K.
L7	7488079-P7	Choke, RF: 1.50 µh ±10%, 0.50 ohms DC res max; sim to Jeffers 4411-10K.
L10	19D413121-G3	Coil.
L12	19D413121-G4	Coil.
L13	7488079-P16	Choke, RF: 10 µh ±10%, 0.60 ohms DC res max; sim to Jeffers 4421-2K.
L14	7491382-P101	Coil, RF: 100 µh ±10%, 4 ohms DC res max; sim to Delevan Series 3500.
L16	7488079-P52	Choke, RF: 1.50 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4414-2K.
L17	7488079-P32	Choke, RF: 0.68 µh ±10%, 0.10 ohms DC res max; sim to Jeffers 4413-3K.
L18	7488079-P3	Choke, RF: 0.33 µh ±20%, 0.07 ohms DC res max; sim to Jeffers 4411-3K.
L19 thru L21	19D413121-G5	Coil.
L22 thru L24	19D413121-G6	Coil.
L25 thru L27	19D413121-G7	Coil.
L28	7488079-P66	Choke, RF: 27.0 µh ±10%, 0.36 ohms DC res max; sim to Jeffers 4426-2K.
L31	19B216108-P1	Coil.
L32	19B216108-P2	Coil.
L33	19B216108-P3	Coil.
L34	19A122813-P1	Coil.
L35	19A122813-P2	Coil.
L36	19A122813-P3	Coil.
L37	19B216365-G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A116028-P1	Silicon, NPN.
Q3 thru Q5	19A116060-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R77-P152K	Composition: 1500 ohms ±10%, 1/2 w.
R2	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R3	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R4	3R77-P561K	Composition: 560 ohms ±10%, 1/2 w.
R6	3R77-P101K	Composition: 100 ohms ±10%, 1/2 w.
R7 thru R9	3R78-P470K	Composition: 47 ohms ±10%, 1 w.
R10	3R77-P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R11	3R77-P222K	Composition: 2200 ohms ±10%, 1/2 w.
R12	5490205-P15	Composition: 2.7 ohms ±10%, 1 w.
		- - - - - - - - - - THERMISTORS - - - - - - - - -
RT1	19A122944-G1	Thermistor assembly. Includes:
	4033513-P14	Contact, electrical.
	19C300048-P9	Resistor. Disc: 600 ohms ±10%; sim to GE 16D.
A203A and A203B		**POWER DETECTOR** **A203A 19C311784-G2 (Used in 19D413124-G1)** **A203B 19C311784-G1 (Used in 19D413124-G2, G5)** (Includes Differential Amplifier, A1 which is factory calibrated). **ANTENNA SWITCH** **A205 19C317142-G3 42-50 MHz** **A206 19C317142-G4 33-42 MHz** **COMPONENT BOARD** **19C317141-G3 42-50 MHz** **19C317141-G4 33-42 MHz**
A205 and A206		
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5496219-P244	Ceramic disc: 15 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2	5496219-P245	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C3	5494481-P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C4	5494481-P128	Ceramic disc: 2700 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C5	19C300685-P236	Ceramic disc: 47 pf ±2%, 500 VDCW, temp coef -80 PPM.
C6	19C300685-P244	Ceramic disc: 56 pf ±2%, 500 VDCW, temp coef -80 PPM.
C7	19C300685-P352	Ceramic disc: 75 pf ±2%, 500 VDCW, temp coef -150 PPM.
C8	19C300683-P356	Ceramic disc: 91 pf ±2%, 500 VDCW, temp coef -150 PPM.
C9	19C300683-P236	Ceramic disc: 47 pf ±2%, 500 VDCW, temp coef -80 PPM.
C10	19C300685-P244	Ceramic disc: 56 pf ±2%, 500 VDCW, temp coef -80 PPM.
C11	5494481-P128	Ceramic disc: 2700 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C13	5491601-P123	Tubular, molded: 1.5 pf ±5%, 500 VDCW; sim to Quality Component Type MC.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A115250-P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	7488079-P18	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4431-3K.
L2	7488079-P6	Choke, RF: 1.00 µh ±10%, 0.30 ohms DC res max; sim to Jeffers 4411-8K.
L3	7488079-P7	Choke, RF: 1.50 µh ±10%, 0.50 ohms DC res max; sim to Jeffers 4411-10K.
L4	19B216065-P11	Coil.
L5	19B216003-P12	Coil.
L6	19B216065-P11	Coil.
L7	19B216065-P12	Coil.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2	5491689-P56	RF: 500 VDC. Includes 12 inch cable (19B209044-P19).
P302	5491689-P56	RF: 500 VDC. Includes 12 inch cable (19B209044-P19).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A116179-P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152-P682K	Composition: 6800 ohms ±10%, 1/4 w.
		CAN ASSEMBLY 19C317077-G2
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C12	5493392-P10	Ceramic, feed-thru: 470 pf ±20%, 500 VDCW; sim to Allen Bradley Type FA5C.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P1	7104941-P17	Plug, phono: sim to National Tel.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C201 thru C203	5493392-P7	Ceramic, feed-thru: .001 pf ±100%-0%, 500 VDCW; sim to Allen Bradley Type FA5C.
C204	5496267-P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR201	6037822-P1	Silicon.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL201A	19C311460-G2	Filter.
FL201B	19C311460-G3	Filter.
FL201C	19C311460-G4	Filter.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J201	19C303426-G1	Connector: 20 pin contacts.
J202	19B203689-G1	Connector: 18 pin contacts.
J304		Part of FL301.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K201	19B209431-P1	Armature, coaxial: 100 ohms ±10% coil res, 13.6 VDC ±20% operating, 2.2 w, 1 form C contact; sim to Magnecraft 123X-3. (Includes P301).
P105		Part of W201.
P202 and P203	4029840-P2	Contact, electrical: sim to Amp 42827-2.
P205	4029840-P1	Contact, electrical: sim to AMP 41854.
P206	19B209151-P1	Terminal, solderless.
P207 and P208		Part of W202.
P212	4029840-P6	Contact, electrical: sim to AMP 12080-0.
P213	4029840-P2	Contact, electrical: sim to Amp 42827-2.
P214	4029840-P1	Contact, electrical: sim to AMP 41854.
P301		Part of K201.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	19B209022-P3	Wirewound: .33 ohms ±5%, 2 w; sim to IRC Type BWH.
R302	19A127073-P1	Slide.
		- - - - - - - - - - CABLES - - - - - - - - - -
W201		**CABLE ASSEMBLY 19B205268-G2**
		- - - - - - - - - - PLUGS - - - - - - - - - -
P109	19B209341-P2	Socket, tube: 9 pins; sim to Elco 04-720-XX.
	4029840-P2	Contact, electrical: sim to AMP 42827-2.
	19A122138-P1	Knob.
W202		**CABLE ASSEMBLY 19A121948-G2**
		- - - - - - - - - - PLUGS - - - - - - - - - -
P207	4029840-P1	Contact, electrical: sim to Amp 41854.
P208	4029840-P2	Contact, electrical: sim to Amp 42827-2.
P215	5491689-P56	Cable assembly: includes black RG-58-C cable with short phono plug molded on one end.
		MECHANICAL PARTS (SEE RC-1672)
1	7147223-P2	Clip.
2	7160861-P16	Nut, sheet spring.
3	4036655-P1	Insulator, washer: nylon. (Used with Q1 on A201A-A201C, Q1 and Q2 on A205 and A206).
4	19A121252-P1	Heat sink. (Used with Q1 on A201A-A201C).
5	19A121676-P1	Guide pin.
6	4029006-P3	Strap. (Used with Q1 on A201A-A201C).
7	19B216016-G1	Frame.
8	5491541-P305	Spacer, hex.
9	19B216205-G1	Plate.
10	4029851-P16	Clip.
11	19A127181-P1	Plate.
12	4035439-P4	Heat sink. (Used with Q1 and Q2 on A205 and A206).
13	4035306-P2	Washer, fiber. (Used with R1 and R7 on A202A-A202C).

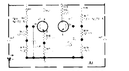
PRODUCTION CHANGES

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.

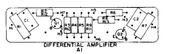
REV. A - Models 4EF33A10, B10 & C10

To incorporate new differential amplifier board. Changed A203-A1.

Schematic Diagram Was:



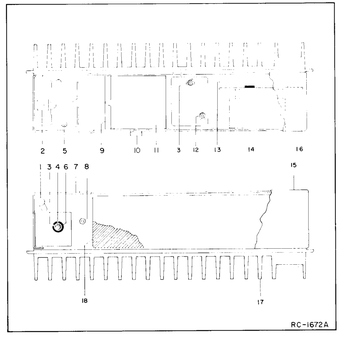
Outline Diagram Was:



REV. A - Models 4EF33B20, C20

To center the pass-band of the antenna switch. Added C13.

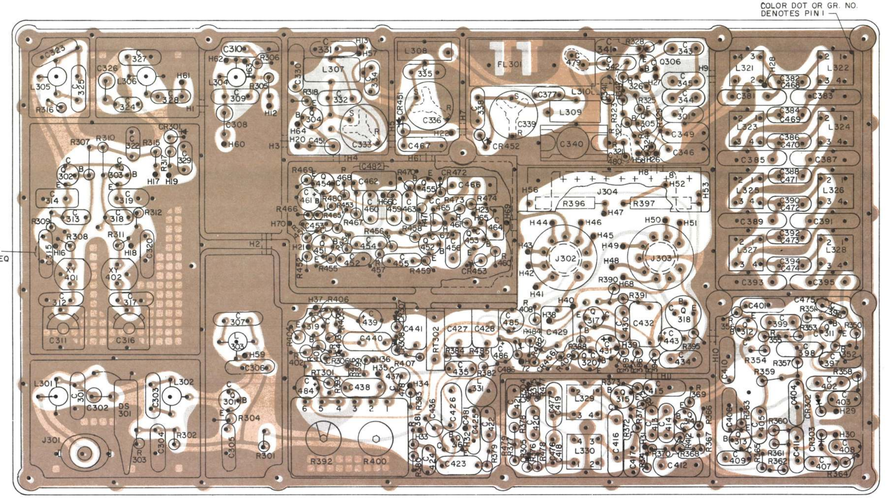
SYMBOL	GE PART NO.	DESCRIPTION
14	19C311665-G1	Frame.
15	19B216017-G1	Top cover.
16	19C311281-G1	Bottom cover.
17	19C311277-P1	Heat sink.
18	19C311816-G1	Heat sink.



25-50 MHZ TRANSMITTER ET-82-A

SYMBOL	GE PART NO.	DESCRIPTION
		In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 earlier than REV A: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV B and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 earlier than REV A:
	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C443*	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV L and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV N and earlier: In Models 4ER46B10, 11, 14, 15, 18 and 19 of REV L and earlier: In Models 4ER46B12, 13, 16, 17, 20 and 21 of REV N and earlier: In Models 4ER46B22, 24 and 26 of REV K and earlier: In Models 4ER46B23, 25 and 27 of REV M and earlier:
	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C451	7130348P14	Molded phenolic: 2.7 pf ±5%, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JM-5/32.
C452 and C453	19A116080P1	Polyester: .01 µf ±20%, 50 VDCW.
C454	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C455	19A116080P1	Polyester: .01 µf ±20%, 50 VDCW.
C456	5490008P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C459 and C460	19A116080P1	Polyester: .01 µf ±20%, 50 VDCW.
C461*	19A134202P7	Tantalum: 2.2 µf ±20%, 20 VDCW.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV L and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV N and earlier: In Models 4ER46B10, 11, 14, 15, 18 and 19 of REV L and earlier: In Models 4ER46B12, 13, 16, 17, 20 and 21 of REV N and earlier: In Models 4ER46B22, 24 and 26 of REV K and earlier: In Models 4ER46B23, 25 and 27 of REV M and earlier:
	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C462	19A116080P5	Polyester: .047 µf ±20%, 50 VDCW.
C463	19A116080P1	Polyester: .01 µf ±20%, 50 VDCW.
C464	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C465	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C466	19A116080P6	Polyester: .068 µf ±20%, 50 VDCW.
C467	19A116080P5	Polyester: .047 µf ±20%, 50 VDCW.
C468	5496219P47	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef 0 PPM.
C469 thru C473	5496219P46	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef 0 PPM.
C474	5496219P47	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef 0 PPM.
C475	5491656P46	Polyester: .0047 µf ±5%, 100 VDCW; sim to GE Type 61F.
C476 and C477	5490008P37	Silver mica: 270 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C478	5491656P46	Polyester: .0047 µf ±5%, 100 VDCW; sim to GE Type 61F.
C479	5496219P34	Ceramic disc: 3.0 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C480	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C481	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C482*	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D. Added in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV A. Added in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV B. Added in Models 4ER46B12, 13, 16, 17, 20, 21, 23 25 and 27 by REV A.
C483*	5496267P5	Tantalum: 4.7 µf ±20%, 10 VDCW; sim to Sprague Type 150D. Added in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV D. Added in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV C. Added in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV F. Added in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV E. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
C484*	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
		In Models 4ER46A10,11,14,15,18,19,22,24 and 26 of REV M: In Models 4ER46A12,13,16,17,20,21,23,25 and 27 of REV P: In Models 4ER46B10,11,14,15,18 and 19 of REV M: In Models 4ER46B12,13,16,17 and 20 of REV P: In Models 4ER46B22, 24 and 26 of REV L: In Models 4ER46B23, 25 and 27 of REV N:
	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
		In Models 4ER46A10,11,14,15,18,19,22,24 and 26 of REV G-L: In Models 4ER46A12,13,16,17,20,21,23,25 and 27 of REV J-N: In Models 4ER46B10,11,14,15,18 and 19 of REV F-L: In Models 4ER46B12,13,16,17 and 20 of REV H-N: In Models 4ER46B22, 24 and 26 of REV F-K: In Models 4ER46B23, 25 and 27 of REV H-M:
	5496267P9	Tantalum: 3.3 µf ±20%, 15 VDCW. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
C485*	19A134202P112	Tantalum: 0.47 µf ±10%, 35 VDCW.
		In Models 4ER46A10,11,14,15,18,19,22,24 and 26 of REV G-L: In Models 4ER46A12,13,16,17,20,21,23,25 and 27 of REV J-N: In Models 4ER46B10,11,14,15,18 and 19 of REV F-L: In Models 4ER46B12,13,16,17 and 20 of REV H-N: In Models 4ER46B22, 24 and 26 of REV F-K: In Models 4ER46B23, 25 and 27 of REV H-M:
	5496267P228	Tantalum: 0.47 µf ±10%, 35 VDCW. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
C486*	19A134202P8	Tantalum: 15 µf ±20%, 20 VDCW.
		In Models 4ER46A10,11,14,15,18,19,22,24 and 26 of REV G-L: In Models 4ER46A12,13,16,17,20,21,23,25 and 27 of REV J-N: In Models 4ER46B10,11,14,15,18 and 19 of REV F-L: In Models 4ER46B12,13,16,17 and 20 of REV H-N: In Models 4ER46B22, 24 and 26 of REV F-K: In Models 4ER46B23, 25 and 27 of REV H-M:
	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
C487	19A116192P10	Ceramic: 1500 pf ±10%, 50 VDCW; sim to Erie 8121-A050-W5R.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR301	7777146P3	Germanium; sim to Type 1N90.
CR302 and CR303	4038056P1	Germanium.
CR304 and CR305	19A115250P1	Silicon.
CR306	5494922P1	Silicon; sim to Type 1N456.
CR307 and CR308	19A115250P1	Silicon.
CR451 and CR452	7777146P16	Germanium; sim to Type 1N68A.
CR453	7777146P3	Germanium; sim to Type 1N90.
CR454	19A115250P1	Silicon.
CR455*	19A115250P1	Silicon. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
CR456*	4036887P6	Silicon, Zener. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV L. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV N. Added to Models 4ER46B10, 11, 14, 15, 18, 19 by REV L. Added to Models 4ER46B12, 13, 16, 17, 20, 21 by REV N. Added to Models 4ER46B22, 24,26 by REV K. Added to Models 4ER46B23, 25, 27 by REV M.
		- - - - - - - INDICATING DEVICES - - - - - - - -
DS301	19B209067P1	Lamp, glow: 0.3 ma; sim to GE NE-2T.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL301	19C304219G2	Bandpass: 5.3 MHz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J301	7104941P9	Jack, phono type: phen; sim to Cinch 14H20958.
J302 and J303	19B209303P1	Connector, phen: 9 pins.
J304	19B205689G2	Connector: 16 contacts.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L301A	19C303960G1	Coil. Includes tuning slug 19B200497P2.
L301B	19C303960G4	Coil. Includes tuning slug 19B200497P2.
L301C	19C303960G6	Coil. Includes tuning slug 19B200497P2.
L302A	19C303960G11	Coil. Includes tuning slug 19B200497P2.
L302B	19C303960G5	Coil. Includes tuning slug 19B200497P2.
L302C	19C303960G7	Coil. Includes tuning slug 19B200497P2.
L303A	19C303960G1	Coil. Includes tuning slug 19B200497P2.
L303B	19C303960G4	Coil. Includes tuning slug 19B200497P2.
L303C	19C303960G6	Coil. Includes tuning slug 19B200497P2.
L304A	19C303960G2	Coil. Includes tuning slug 19B200497P2.
L304B	19C303960G3	Coil. Includes tuning slug 19B200497P2.
L304C	19C303960G8	Coil. Includes tuning slug 19B200497P2.
L305A	19C303960G3	Coil. Includes tuning slug 19B200497P2.
L305B	19C303960G3	Coil. Includes tuning slug 19B200497P2.
L305C	19C303960G9	Coil. Includes tuning slug 19B200497P2.
L306A	19C303960G4	Coil. Includes tuning slug 19B200497P2.
L306B	19C303960G4	Coil. Includes tuning slug 19B200497P2.
L306C	19C303960G10	Coil. Includes tuning slug 19B200497P2.
L307 thru L309	19B205224G1	Coil.
L310	19B204932G3	Coil.
L321* and L322*	19A115711P1	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12670. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L323*	19A115711P2	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12671. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L324*	19A115711P1	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12670. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L325*	19A115711P2	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12671. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L326*	19A115711P1	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12670. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L327*	19A115711P2	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12671. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L328*	19A115711P1	Transformer, freq: 455 KHz; sim to Automatic Mfg EX12670. Deleted in 4ER46B10, 11, 14, 15, 18, 19 by REV G. Deleted in 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G6	Coil. Includes tuning slug 4038368P1.
L329*	19A115711P6	Transformer, freq: 455 KHz; sim to TOKO PEFCN-14733-CX12. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G4	Coil. Includes tuning slug 4038368P1.
L330*	19A115711P7	Transformer, freq: 455 KHz; sim to TOKO PEFCN-14734-BNL2.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV D and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV F and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier:
	19C303062G5	Coil. Includes tuning slug 4038368P1.
L331	19B209405P1	Reactor, audio freq: 142 mh ±5%, at 0.1 v thru 0.27 v; sim to Aladdin 405-101.
L332* and L333*	19C311181G16	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L334*	19C311181G15	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L335*	19C311181G16	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L336*	19C311181G15	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L337*	19C311181G16	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L338*	19C311181G15	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
L339*	19C311181G16	Coil. Includes tuning slug 4038368P1. Added to 4ER46B10, 11, 14, 15, 18, 19 by REV G. Added to 4ER46B12, 13, 16, 17, 20, 21 by REV J.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q301*	19A116860P1	Silicon, NPN; sim to Type 2N4996.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV H and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV K and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV H and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV K and earlier: In Models 4ER46B22, 24, 26 of REV G and earlier: In Models 4ER46B23, 25, 27 of REV J and earlier:
	19A115342P1	Silicon, NPN.
Q302* and Q303*	19A115330P1	Silicon, NPN.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 of REV E and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 of REV G and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 of REV D and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 of REV F and earlier:
	19A115245P1	Silicon, NPN.
Q304*	19A116860P1	Silicon, NPN; sim to Type 2N4996.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV H and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV K and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV H and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV K and earlier: In Models 4ER46B22, 24, 26 of REV G and earlier: In Models 4ER46B23, 25, 27 of REV J and earlier:
	19A115342P1	Silicon, NPN.
Q305	19A115889P1	Silicon, NPN; sim to Type 2N2712.
Q306*	19A115910P1	Silicon, NPN; sim to Type 2N3906.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV H and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV K and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV H and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV K and earlier: In Models 4ER46B22, 24, 26 of REV G and earlier: In Models 4ER46B23, 25, 27 of REV J and earlier:
	19A115245P1	Silicon, NPN.
Q311 thru Q315	19A115889P1	Silicon, NPN.
Q316 and Q317	19A115123P1	Silicon, NPN.
Q318*	19A115300P4	Silicon, NPN.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q319*	19A116774P1	Silicon, NPN; sim to Type 2N5210.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	19A115889P1	Silicon, NPN.
Q320*	19A116774P1	Silicon, NPN; sim to Type 2N5210.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	19A115123P1	Silicon, NPN.
Q321*	19A115123P1	Silicon, NPN; sim to Type 2N2712. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
Q451 and Q452	19A115245P1	Silicon, NPN.
Q453 thru Q455	19A115889P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R301	3R77P471J	Composition: 470 ohms ±5%, 1/2 w.
R302	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R303*	3R77P472J	Composition: 4700 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV J and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV L and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV J and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV L and earlier: In Models 4ER46B22, 24, 26 of REV H and earlier: In Models 4ER46B23, 25, 27 of REV K and earlier:
	3R77P272J	Composition: 2700 ohms ±5%, 1/2 w.
R304	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R305	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w.
R306	3R77P272J	Composition: 2700 ohms ±5%, 1/2 w.
R307*	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 of REV E and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 of REV G and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 of REV D and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 of REV F and earlier:
	3R77P123J	Composition: 12,000 ohms ±5%, 1/2 w.
R308*	3R77P223J	Composition: 22,000 ohms ±5%, 1/2 w. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 of REV E and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 of REV G and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 of REV D and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 of REV F and earlier:
	3R77P123J	Composition: 12,000 ohms ±5%, 1/2 w.
R309	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R310*	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w. In Models 4ER46A11, 15, 19, of REV E and earlier: In Models 4ER46A13, 17, 21, of REV G and earlier: In Models 4ER46B11, 15, 19, of REV D and earlier: In Models 4ER46B13, 17, 21, of REV F and earlier:
	3R77P123J	Composition: 12,000 ohms ±5%, 1/2 w.
R311*	3R77P223J	Composition: 22,000 ohms ±5%, 1/2 w. In Models 4ER46A11, 15, 19, of REV E and earlier: In Models 4ER46A13, 17, 21, of REV G and earlier: In Models 4ER46B11, 15, 19, of REV D and earlier: In Models 4ER46B13, 17, 21, of REV F and earlier:
	3R77P123J	Composition: 12,000 ohms ±5%, 1/2 w.
R312	3R77P202J	Composition: 2000 ohms ±5%, 1/2 w.
R313	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R314	3R152P102J	Composition: 1000 ohms ±5%, 1/4 w.
R315*	3R77P331J	Composition: 330 ohms ±5%, 1/2 w.
		In Models earlier than REV A:
	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R316*	3R77P681J	Composition: 680 ohms ±5%, 1/2 w.
		In Models earlier than REV A:
	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R317	3R77P472J	Composition: 4700 ohms ±5%, 1/2 w.
R318	3R77P272J	Composition: 2700 ohms ±5%, 1/2 w.
R320*	3R77P223J	Composition: 22,000 ohms ±5%, 1/2 w. Deleted in 4ER46A10,11,14,15,18,19,22,24,26 by REV K. Deleted in 4ER46A12,13,16,17,20,21,23,25,27 by REV M. Deleted in 4ER46B10,11,14,15,18,19 by REV K. Deleted in 4ER46B12,13,16,17,20,21 by REV M. Deleted in 4ER46B22,24,26 by REV J. Deleted in 4ER46B23,25,27 by REV L.
R321	3R77P681J	Composition: 680 ohms ±5%, 1/2 w.
R322	3R77P393J	Composition: 39,000 ohms ±5%, 1/2 w.
R323	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R324	3R77P331J	Composition: 330 ohms ±5%, 1/2 w.
R325	3R77P392J	Composition: 3900 ohms ±5%, 1/2 w.
R326	3R77P333J	Composition: 33,000 ohms ±5%, 1/2 w.
R327	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R328*	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV G and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV J and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV G and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV J and earlier: In Models 4ER46B22, 24, 26 of REV F and earlier: In Models 4ER46B23, 25, 27 of REV H and earlier:
	3R77P122J	Composition: 1200 ohms ±5%, 1/2 w.
R329	3R77P331J	Composition: 330 ohms ±5%, 1/2 w.
R350	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R351	3R77P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R352	3R77P222K	Composition: 2200 ohms ±10%, 1/2 w.
R353	3R77P562K	Composition: 5600 ohms ±10%, 1/2 w.
R354	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R355	3R77P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R356	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R357	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R358	3R77P513J	Composition: 51,000 ohms ±5%, 1/2 w.
R359	3R77P562K	Composition: 5600 ohms ±10%, 1/2 w.
R360	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R361	3R77P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R362	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R363	3R77P222K	Composition: 2200 ohms ±10%, 1/2 w.
R364	3R77P513J	Composition: 51,000 ohms ±5%, 1/2 w.
R365	3R77P562K	Composition: 5600 ohms ±10%, 1/2 w.
R366	3R77P123K	Composition: 12,000 ohms ±10%, 1/2 w.
R367	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R368	3R152P181K	Composition: 180 ohms ±10%, 1/4 w.
R369	3R77P512J	Composition: 5100 ohms ±5%, 1/2 w.
R370	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R371	3R77P103K	Composition: 10,000 ohms ±10%, 1/2 w.
R372	3R77P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R373	3R77P102K	Composition: 1000 ohms ±10%, 1/2 w.
R374	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R375 and R376	3R77P513J	Composition: 51,000 ohms ±5%, 1/2 w.
R377	3R152P682J	Composition: 6800 ohms ±5%, 1/4 w.
R378	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
R379	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R380	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
R381	3R77P333K	Composition: 33,000 ohms ±10%, 1/2 w.
R382	3R152P221J	Composition: 220 ohms ±5%, 1/4 w.
R383*	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV L. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV N. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19 by REV L. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21 by REV N. Deleted in Models 4ER46B22, 24, 26 by REV K. Deleted in Models 4ER46B23, 25, 27 by REV M.
R384	3R152P332K	Composition: 3300 ohms ±10%, 1/4 w.
R385	3R152P152K	Composition: 1500 ohms ±10%, 1/4 w.
R386*	3R77P163J	Composition: 16,000 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	3R77P203J	Composition: 20,000 ohms ±5%, 1/2 w.
R387*	3R77P753J	Composition: 75,000 ohms ±5%, 1/2 w. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
R388	3R77P300J	Composition: 30 ohms ±5%, 1/2 w.
R389*	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	3R77P681J	Composition: 680 ohms ±5%, 1/2 w.

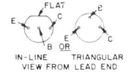
CON'T ON 19R620768



(19D402821, Rev. 16)
(19D402665, Sh. 1, Rev. 11)
(19D402665, Sh. 2, Rev. 11)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

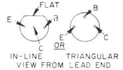
LEAD IDENTIFICATION FOR Q319 & Q320



IN-LINE VIEW FROM LEAD END — TRIANGULAR VIEW FROM LEAD END

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

LEAD IDENTIFICATION FOR Q307, Q311 – Q317



IN-LINE VIEW FROM LEAD END — TRIANGULAR VIEW FROM LEAD END

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

OUTLINE DIAGRAM

25—50 MHZ RECEIVER
TYPES ER-46-A, B

RC-1474P
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PARTS LIST

LBI-3723L

25-50 MHz RECEIVER
MODELS 4ER46A10-27 NARROW BAND
MODELS 4ER46B10-27 WIDE BAND

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C301A and C301B	5496219P255	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -80 PPM.
C301C	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM.
C302	7130348P3	Molded phenolic: 1 pf ±.05 pf, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JW-5/32.
C303A	5496219P255	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -80 PPM.
C303B	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM.
C303C	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM.
C304 thru C306	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C307A and C307B	5496219P255	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -80 PPM.
C307C	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM.
C308A	7130348P4	Molded phenolic: 2.2 pf ±0.11 pf, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JW-5/32.
C308B	7130348P12	Molded phenolic: 0.82 pf ±5%, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JW-5/32.
C308C	7130348P5	Molded phenolic: 1.2 pf ±.06 pf, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JW-5/32.
C309A and C309B	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM.
C309C	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM.
C310	19A116080P1	Polyester: .01 pf ±20%, 50 VDCW.
C311	5491271P106	Variable, air: approx 3.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C312	5490008P6	Silver mica: 10 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C313	19A116656P3927	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C314	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C315	19A116080P1	Polyester: .01 pf ±20%, 50 VDCW.
C316	5491271P106	Variable, air: approx 3.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C317	5490008P6	Silver mica: 10 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C318	19A116656P3927	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C319	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C320 thru C323	19A116080P1	Polyester: .01 pf ±20%, 50 VDCW.
C324	5496219P34	Ceramic disc: 3 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C325A	5496219P455	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -220 PPM.
C325B	5496219P457	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -220 PPM.
C325C	5496219P455	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -220 PPM.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
C326	7130348P3	Molded phenolic: 1 pf ±.05 pf, 500 VDCW, temp coef approx 0 PPM; sim to Jeffers Type JW-5/32.
C327A	5496219P256	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -80 PPM.
C327B	5496219P257	Ceramic disc: 56 pf ±5%, 500 VDCW, temp coef -80 PPM.
C327C	5496219P255	Ceramic disc: 47 pf ±5%, 500 VDCW, temp coef -80 PPM.
C328A	5490008P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C328B	5490008P17	Silver mica: 39 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C328C	5490008P15	Silver mica: 47 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C329 and C330	19A116080P1	Polyester: 0.01 pf ±20%, 50 VDC.
C331	19A116080P5	Polyester: 0.047 pf ±20%, 50 VDC.
C332	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM.
C333	5490446P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0; sim to Erie 537-36.
C334	5496219P34	Ceramic disc: 3 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C335	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM.
C336	5490446P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0; sim to Erie 537-36.
C337	5496219P34	Ceramic disc: 3 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C338	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM.
C339	5490446P2	Variable, ceramic: approx 5-25 pf, 350 VDCW, temp coef 0 PPM; sim to Erie 537-36.
C340	19A115639P1	Variable: approx 16-141 pf, 150 VDCW; sim to El-Menco Type CT.
C341	5496219P751	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -750 PPM.
C342	19A116080P1	Polyester: 0.01 pf ±20%, 50 VDC.
C343	5490008P15	Silver mica: 33 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C344	5490008P31	Silver mica: 150 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C345	5490008P33	Silver mica: 180 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C346	19A116080P7	Polyester: 0.1 pf ±20%, 50 VDC.
C347	19A116080P5	Polyester: .047 pf ±20%, 50 VDC.
C349	19A116080P1	Polyester: 0.1 pf ±20%, 50 VDC.
C351	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C352	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C353	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C354	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C355	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C356	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C357	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C358	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C359	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C360	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C361	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.

SYMBOL	GE PART NO.	DESCRIPTION
C392	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C393	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C394	5496219P41	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C395	5490008P35	Silver mica: 220 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C396	7491395P109	Ceramic disc: 1000 pf ±10%, 500 VDCW; sim to RMC Type JL.
C397	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C398	19A116080P5	Polyester: .047 pf ±20%, 50 VDC.
C399	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C401	19A116080P1	Polyester: .01 pf ±20%, 50 VDCW.
C402	5490008P119	Silver mica: 47 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C403	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C404	19A116080P5	Polyester: .047 pf ±20%, 50 VDC.
C405	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C406	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C407	7491393P1	Ceramic disc: .001 pf +100% -0%, 500 VDCW; sim to Sprague 121NC41.
C408	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C409	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C410	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C411	19A116080P5	Polyester: .047 pf ±20%, 50 VDC.
C412	19A116080P7	Polyester: 0.1 pf ±20%, 50 VDC.
C413	5494481P108	Ceramic disc: 470 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C414	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C415	19A116080P1	Polyester: .01 pf ±20%, 50 VDC.
C416	19A116656P180J1	Ceramic disc: 180 pf ±5%, 500 VDCW, temp coef -150 PPM.
C417	19A116080P5	Polyester: .047 pf ±20%, 50 VDC.
C418 and C419	5490008P137	Silver mica: 270 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C420	5496219P656	Ceramic disc: 51 pf ±5%, 500 VDCW, temp coef -470 PPM.
C421 and C422	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C423	19A116080P109	Ceramic disc: 0.22 pf ±10%, 50 VDC.
C424	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C425*	19A116080P6	Polyester: 0.068 pf ±20%, 50 VDC. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV L and earlier; In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 earlier than REV A. In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 earlier than REV A; In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 earlier than REV A.
C426	19A116080P7	Polyester: 0.1 pf ±20%, 50 VDC.
C427 and C428	19A116080P108	Polyester: 0.15 pf ±10%, 50 VDC.
C429	19A116080P8	Polyester: 0.15 pf ±20%, 50 VDC.
C430	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.

SYMBOL	GE PART NO.	DESCRIPTION
C431*	19A134202P2	Tantalum: 47 µf ±20%, 6 VDCW. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV L and earlier; In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV N and earlier; In Models 4ER46B10, 11, 14, 15, 18 and 19 of REV L and earlier; In Models 4ER46B12, 13, 16, 17, 20 and 21 of REV N and earlier; In Models 4ER46B22, 24 and 26 of REV K and earlier; In Models 4ER46B23, 25 and 27 of REV N and earlier.
	5496267P2	Tantalum: 47 µf ±20%, 6 VDCW; sim to Sprague Type 150D.
C432	19A116080P8	Polyester: 0.15 µf ±20%, 50 VDCW.
C433*	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
C434*	5494481P14	Ceramic disc: 2000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV B and earlier; In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV A and earlier; In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV C and earlier; In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV C and earlier:
	5490008P131	Silver mica: 150 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C435	19A116080P203	Polyester: 0.022 µf ±5%, 50 VDCW.
C436	19C300075P560G02	Polyester: 5600 pf ±5%, 100 VDCW; sim to GE Type 61F.
C437	5491656P71	Polyester: .0039 µf ±5%, 100 VDCW; sim to GE Type 61F.
C438	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C439*	19A134202P14	Tantalum: 1 µf ±20%, 35 VDCW. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, and 26 of REV L; In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, and 27 of REV N. In Models 4ER46B10, 11, 14, 15, 18, 19 of REV L; In Models 4ER46B12, 13, 16, 17, 20, 21 of REV N; In Models 4ER46B22, 24 and 26 of REV K; In Models 4ER46B23, 25 and 27 of REV N.
	5496267P17	Tantalum: 100 µf ±20%, 35 VDCW; sim to Sprague Type 150D. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier; In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV K and earlier; In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier; In Models 4ER46B12, 13, 16, 17, 20, 21 of REV K and earlier; In Models 4ER46B22, 24, 26 of REV J and earlier; In Models 4ER46B23, 25, 27 of REV L and earlier;
	19A116080P9	Polyester: 0.22 µf ±20%, 50 VDCW.
C440	19A116080P5	Polyester: .047 µf ±20%, 50 VDCW.
C441	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C442*	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV B and C; In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV A and B; In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV B and C; In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV A, B, C and D:
	5496267P25	Tantalum: 4.7 µf ±20%, 10 VDCW; sim to Sprague Type 150D. In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV A and earlier;

(DF-1088)

MODEL NO	REV	FREQ RANGE (MHZ)	NO OF	NOISE BLANKER
4ER46A10	N	25-33	1	
4ER46A11	N	25-33	2	
4ER46A12	R	25-33	1	X
4ER46A13	R	25-33	2	X
4ER46A14	N	33-42	1	
4ER46A15	N	33-42	2	
4ER46A16	R	33-42	1	X
4ER46A17	R	33-42	2	X
4ER46A18	N	42-50	1	
4ER46A19	N	42-50	2	
4ER46A20	R	42-50	1	X
4ER46A21	R	42-50	2	X
4ER46A22	N	25-33	4	
4ER46A23	R	25-33	4	X
4ER46A24	N	33-42	4	
4ER46A25	R	33-42	4	X
4ER46A26	N	42-50	4	
4ER46A27	R	42-50	4	X

MODEL NO	REV	FREQ RANGE (MHZ)	NO OF FREQ	NOISE BLANKER
4ER46B10	N	25-33	1	
4ER46B11	N	25-33	2	
4ER46B12	R	25-33	1	X
4ER46B13	R	25-33	2	X
4ER46B14	N	33-42	1	
4ER46B15	N	33-42	2	
4ER46B16	R	33-42	1	X
4ER46B17	R	33-42	2	X
4ER46B18	N	42-50	1	
4ER46B19	N	42-50	2	
4ER46B20	R	42-50	1	X
4ER46B21	R	42-50	2	X
4ER46B22	M	25-33	4	
4ER46B23	P	25-33	4	X
4ER46B24	M	33-42	4	
4ER46B25	P	33-42	4	X
4ER46B26	M	42-50	4	
4ER46B27	P	42-50	4	X

NOTES:

1. JUMPERS USED FOR 1 FREQ ONLY.
2. CONNECTIONS TO H18 USED FOR 2 FREQ ONLY. CONNECTIONS TO H16 USED FOR 2 & 4 FREQ ONLY.
3. ALL COMPONENTS MARKED WITH ASTERISK (*) ARE NOT USED FOR ONE FREQUENCY RECEIVER.
4. COMPONENT NO SUFFIX
   - A = 25-33 MHZ
   - B = 33-42 MHZ
   - C = 42-50 MHZ
5. JUMPER FOR 4 FREQ ONLY.
6. ▲ COMPONENTS MARKED THUS ARE PRESENT IN 4ER46B10-27 ONLY. (WIDE BAND)
7. ■ COMPONENTS MARKED THUS ARE PRESENT IN 4ER46A10-27 ONLY.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO GROUND WITH TEST SET MODEL 4EX3A10 OR A 20,000 OHM-PER-VOLT METER, AND WITH SQUELCH CONTROL R400 FULLY COUNTER-CLOCKWISE. READINGS TAKEN WITH F1 OPERATING

S = NO SIGNAL (SQUELCHED)

US = WITH A 1 MILLIVOLT UN-MODULATED ON-FREQUENCY SIGNAL (UNSQUELCHED).

ALL RESISTORS ARE 1/2 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.

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.

SCHEMATIC DIAGRAM

25—50 MHZ RECEIVER
TYPES ER-46-A, B

19R620768, Rev. 30
****

SYMBOL	GE PART NO.	DESCRIPTION
	Con't. from RC-1474	
R390	3R77P332K	Composition: 3300 ohms ±10%, 1/2 w.
R391	3R77P431J	Composition: 430 ohms ±5%, 1/2 w.
R392	19B209320P1	Resistor assembly. Variable, carbon film, includes: (R392) 20,000 ohms ±20%, 0.25 w; (R400) 5000 ohms ±20%, 0.25 w; sim to Centralab Series 5 (Type 71-2).
R393*	3R77P202K	Composition: 2000 ohms ±10%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	3R77P392K	Composition: 3900 ohms ±10%, 1/2 w.
R394	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R395	3R77P331K	Composition: 330 ohms ±10%. 1/2 w.
R396 and R397	19A116278P444	Metal film: 0.28 megohm ±2%, 1/2 w.
R399	3R77P471J	Composition: 470 ohms ±5%, 1/2 w.
R400		(See R392).
R401	19A116278P357	Metal film: 38,300 ohms ±2%, 1/2 w.
R402	19A116278P313	Metal film: 13,300 ohms ±2%, 1/2 w.
R403	3R152P332J	Composition: 3300 ohms ±5%, 1/4 w.
R404	19A116278P233	Metal film: 2150 ohms ±2%, 1/2 w.
R405	3R152P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R406*	3R152P512J	Composition: 5100 ohms ±5%, 1/4 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV K and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV M and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19 of REV K and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21 of REV M and earlier: In Models 4ER46B22, 24, 26 of REV J and earlier: In Models 4ER46B23, 25, 27 of REV L and earlier:
	3R152P332J	Composition: 3300 ohms ±5%, 1/4 w.
R407	3R77P222K	Composition: 2200 ohms ±10%, 1/2 w.
R408	3R77P822J	Composition: 8200 ohms ±5%, 1/2 w.
R409	3R77P473J	Composition: 47,000 ohms ±5%, 1/2 w.
R410*	3R77P182J	Composition: 1800 ohms ±5%, 1/2 w. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV C and earlier: In Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 of REV B and earlier: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV E and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV D and earlier:
	3R152P362J	Composition: 3600 ohms ±5%, 1/4 w.
R411*	3R77P473J	Composition: 47,000 ohms ±5%, 1/2 w. Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
R412	3R77P561K	Composition: 560 ohms ±10%, 1/2 w.
R451	3R77P473J	Composition: 47,000 ohms ±5%, 1/2 w.
R452	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R453	3R77P221J	Composition: 220 ohms ±5%, 1/2 w.

SYMBOL	GE PART NO.	DESCRIPTION
R454	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
R455	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R456	3R77P473J	Composition: 47,000 ohms ±5%, 1/2 w.
R457	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R458	3R77P332J	Composition: 3300 ohms ±5%, 1/2 w.
R459	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R460	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R461	3R77P104J	Composition: 0.1 megohm ±5%, 1/2 w.
R465*	3R77P912J	Composition: 9100 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 earlier than REV A: In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 of REV A and earlier: In Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 earlier than REV A:
	3R152P103J	Composition: 10,000 ohms ±5%, 1/4 w.
R466	3R77P272J	Composition: 2700 ohms ±5%, 1/2 w.
R467	3R77P471J	Composition: 470 ohms ±5%, 1/2 w.
R468	3R77P472J	Composition: 4700 ohms ±5%, 1/2 w.
R469	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R470	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R471	3R77P102J	Composition: 1000 ohms ±5%, 1/2 w.
R472	3R77P103J	Composition: 10,000 ohms ±5%, 1/2 w.
R473	3R77P433J	Composition: 43,000 ohms ±5%, 1/2 w.
R474	3R77P562J	Composition: 5600 ohms ±5%, 1/2 w.
R475	3R152P105J	Composition: 1 megohm ±5%, 1/4 w.
R476	3R77P911J	Composition: 910 ohms ±5%, 1/2 w.
R477 and R478	3R77P273J	Composition: 27,000 ohms ±5%, 1/2 w.
R479	3R152P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R480*	3R152P102J	Composition: 1000 ohms ±5%, 1/4 w. Added in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV A. Added in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV B. Added in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV A.
R481*	3R77P152J	Composition: 1500 ohms ±5%, 1/2 w. Added in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV D. Added in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV F. Added in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25 and 27 by REV E. Added in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24 and 26 by REV C.
		Deleted in Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Deleted in Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Deleted in Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Deleted in Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
R482*	3R77P273J	Composition: 27,000 ohms ±5%, 1/2 w.
		In Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, and 26 of REV G-K. In Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, and 27 of REV J-M. In Models 4ER46B10, 11, 14, 15, 18, 19 of REV F-K. In Models 4ER46B12, 13, 16, 17, 20, 21 of REV H-M. In Models 4ER46B22, 24, 26 of REV F-J. In Models 4ER46B23, 25, 27 of REV H-L.
	3R77P433J	Composition: 43,000 ohms ±5%, 1/2 w. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.

SYMBOL	GE PART NO.	DESCRIPTION
R483*	3R77P564J	Composition: 0.56 megohm ±5%, 1/2 w. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
R484*	3R77P153J	Composition: 15,000 ohms ±5%, 1/2 w. Added to Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 by REV G. Added to Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27 by REV J. Added to Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26 by REV F. Added to Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27 by REV H.
		- - - - - - - - - - THERMISTORS - - - - - - - - - -
RT301	5490828P38	Rod: 1400 ohms ±5%, 0.38 w max; sim to Carborundum Type 723H-2.
RT302	5490828P35	Rod: 3800 ohms ±5%, 1 w max; sim to Carborundum Type 723B-4.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY401 and XY402	5490277P1	Transistor, phen: 4 contacts; sim to Elco 3303.
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
Y301	19B206356G4	Quartz: freq 5755.00 KHz, temp range -30°C to +85°C.
		NOTE: When reordering, give GE Part number and specify exact frequency needed.
Y401 and Y402		Crystal, Quartz: freq range 12 to 20 MHz, temp range -30°C to +85°C.
	19B206357G17	25-33 MHz crystal frequency = $\frac{OF + 5.3}{2}$
	19B206357G18	33-42 MHz crystal frequency = $\frac{OF - 5.3}{2}$
	19B206357G19	42-50 MHz crystal frequency = $\frac{OF - 5.3}{3}$
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B205369G2	Top cover.
	4036555P1	Insulator, washer: nylon. (Used with Q318).
	4035306P62	Washer, fiber. (Used with Y301, FL301).

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 - Models 4ER46A10-27

To prevent operation of oscillator F1 when F2, F3 and F4 is selected. Changed R315 and R316.

REV. A - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. B - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To eliminate audio coupling into the noise blanker from +12 volt supply line - Changed R465, and added C482 and R480.

REV. A - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. B - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26 & Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. C - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To increase maximum squelch sensitivity. Changed C442. In 4ER46A10-27, C425 was also changed.

REV. C - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. D - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To facilitate noise blanker disable function for test purposes. Added white wire from junction of R467-R468 (on Blanker Pulse Generator) to J302-4 (receiver jack).

REV. B - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. C - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. D - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. E - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To eliminate high frequency oscillations in the receiver PA caused by use of a higher gain PA transistor. Changed C434.

REV. C - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. D - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. E - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. F - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To eliminate undesirable squelch thump that occurs when carrier is received. Changed C442 and R410. Added C483 and R481.

REV. D - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. E - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. F - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. G - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To permit use of different IF coils. Changed printed wiring board and L321 thru L330.

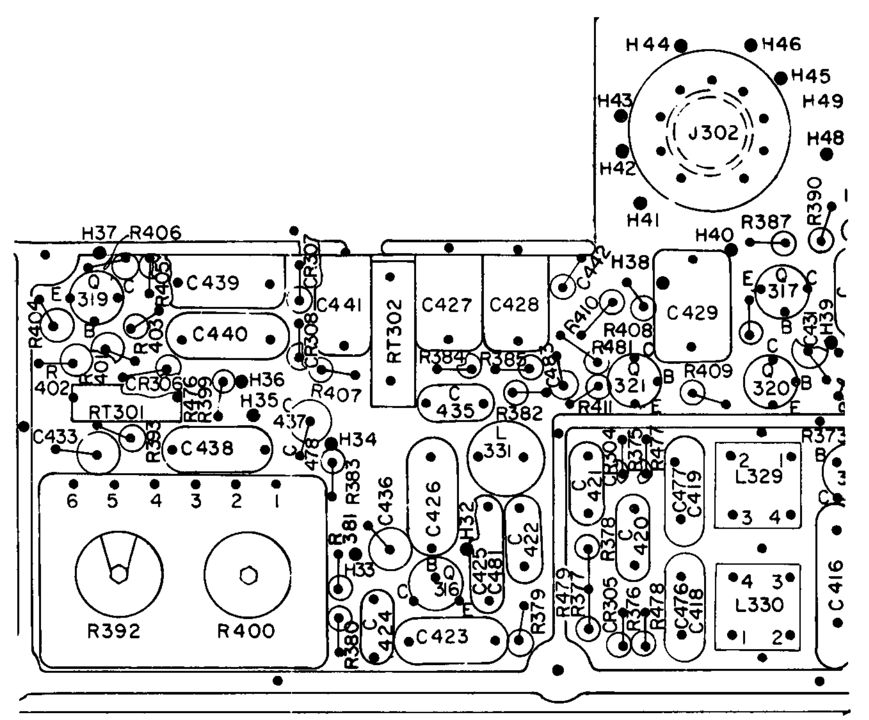
REV. E - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. F - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. G - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. H - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To increase oscillator output. Changed Q302, Q303, R307, R308, R310 and R311.

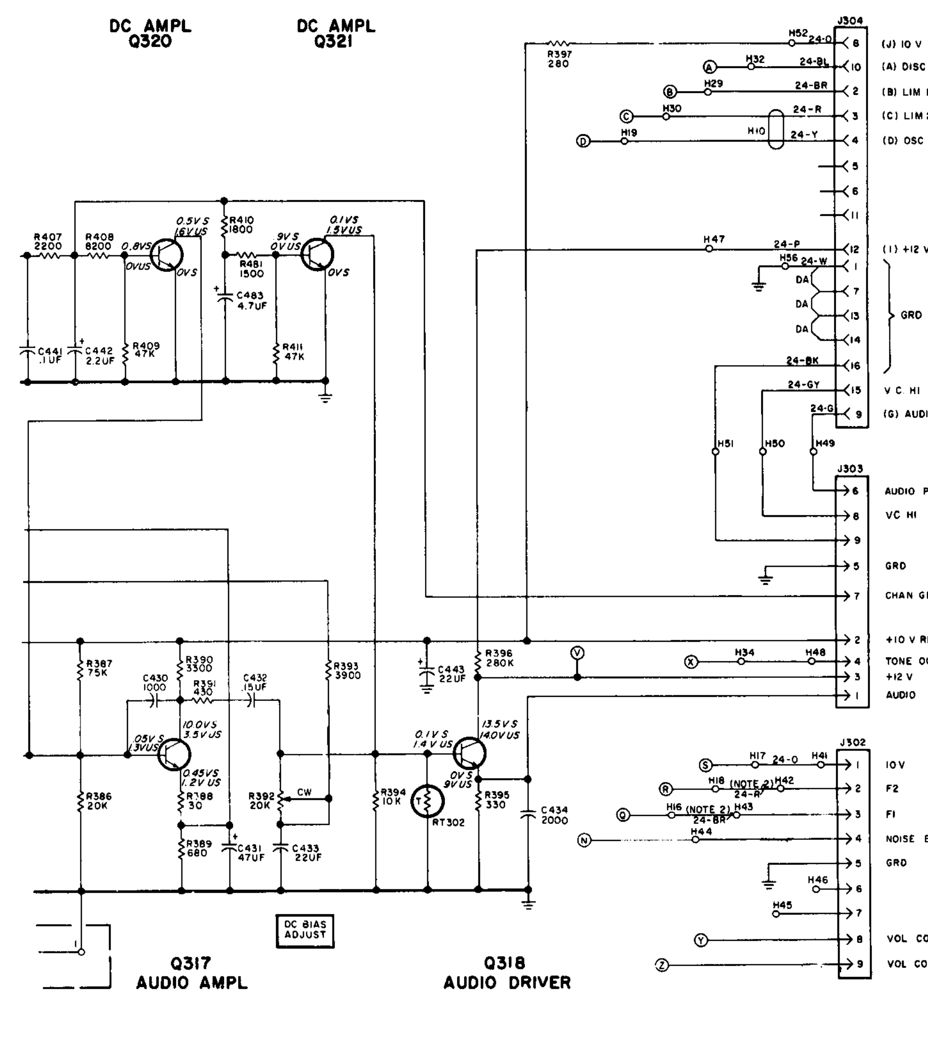
REV. F - Models 4ER46B10, 11, 14, 15, 18, 19, 22, 24, 26
REV. G - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. H - Models 4ER46B12, 13, 16, 17, 20, 21, 23, 25, 27
REV. J - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

To eliminate objectionable squelch thump. Deleted R387, R410, R411, C433, C442, R481, C483 and Q321. Added C484, C485, C486, CR455, R482, R483 and R484.

Outline Diagram Was:



Schematic Diagram Was:



REV. G - Models 4ER46B10, 11, 14, 15, 18, 19

REV. J - Models 4ER46B12, 13, 17, 20, 21

To increase IF bandwidth. Changed L321, L322, L324, L326 and L328 to L332, L333, L335, L337 and L339. Changed L323, L325 and L327 to L334, L336, and L338. Changed C468 and C474. Changed C422 to C487.

REV. H - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. K - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27
REV. H - Models 4ER46B10, 11, 14, 15, 18, 19
REV. K - Models 4ER46B12, 13, 16, 17, 20, 21
REV. G - Models 4ER46B22, 24, 26
REV. J - Models 4ER46B23, 25, 27

To improve audio fidelity. Changed R328.

REV. J - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. L - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27
REV. J - Models 4ER46B10, 11, 14, 15, 18, 19
REV. L - Models 4ER46B12, 13, 16, 17, 20, 21
REV. H - Models 4ER46B22, 24, 26
REV. K - Models 4ER46B23, 25, 27

To incorporate new transistors. Changed Q301, Q304, and Q306.

REV. K - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. M - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27
REV. K - Models 4ER46B10, 11, 14, 15, 18, 19
REV. M - Models 4ER46B12, 13, 16, 17, 20, 21
REV. J - Models 4ER46B22, 24, 26
REV. L - Models 4ER46B23, 25, 27

To improve receiver sensitivity. Deleted R320 and changed R303.

REV. L - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. N - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27
REV. L - Models 4ER46B10, 11, 14, 15, 18, 19
REV. N - Models 4ER46B12, 13, 16, 17, 20, 21
REV. K - Models 4ER46B22, 24, 26
REV. M - Models 4ER46B23, 25, 27

To improve squelch operation and improve audio quality. Changed C439, R386, R389, R393, R406, R482, Q318, Q319, Q320. Deleted R483 and added CR456.

REV. M - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. P - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27

REV. M - Models 4ER46B10, 11, 14, 15, 18, 19
REV. P - Models 4ER46B12, 13, 16, 17, 20, 21
REV. L - Models 4ER46B22, 24, 26
REV. N - Models 4ER46B23, 25, 27

REV. J - Models 4ER47B10, 11, 12

To incorporate new preformed capacitors. Changed C431, C439, C443, C461, C484, C485 and C486.

REV. N - Models 4ER46A10, 11, 14, 15, 18, 19, 22, 24, 26
REV. R - Models 4ER46A12, 13, 16, 17, 20, 21, 23, 25, 27
REV. N - Models 4ER46B10, 11, 14, 15, 18, 19
REV. R - Models 4ER46B12, 13, 16, 17, 20, 21
REV. M - Models 4ER46B22, 24, 26
REV. P - Models 4ER46B23, 25, 27

To eliminate squelch thump when volume control is turned down. Changed C484.

ADJUSTMENT PROCEDURE

POWER REGULATOR BOARD

If it is necessary to replace power regulator board A501, or either Sensitivity control R29 or Top Limiter control R9 on the power regulator board, follow the procedure listed below. If the power regulator board is replaced, both R29 and R9 (in that order) must be adjusted as directed. If only R29 or R9 is replaced, only the new control must be adjusted as directed.

EQUIPMENT REQUIRED

1. VOM with at least 3% accuracy (Triplett 630 or equivalent).
2. Milliammeter with at least 3% accuracy, and a 0 to 5 milliamp range.
3. Variable resistor, 0 to 5000 ohms.
4. Fixed resistor, 300 ohms ±5%.
5. Variable Power source (from 13.6 to 16.3 volts under a 12-ampere load). In mobile applications, connect the power source to the vehicle battery cables. In station applications, connect the power source to the External Battery connector (TB502).
6. Cement for securing R9 or R29 after adjustment (Loctite R404 or equivalent).

NOTE

The transmitter must be properly aligned and drawing at least 7 amperes of load current before making these adjustments.

ADJUSTMENT OF R29

1. Turn R29 fully counterclockwise (in direction of arrow).
2. Disconnect the Orange lead from A501-J9 and the White lead from A501-J11. Connect the 300-ohm fixed resistor from J9 to ground as shown in Figure 1.
3. Adjust the power source for 13.6 volts. Then key the transmitter and re-adjust the power source for 13.6 volts if necessary.
4. Connect the VOM across P201-8 and P201-13 (ground). Then key the transmitter and adjust R29 according to the applicable procedure as follows:
   - For Revision B and earlier of Model 4EP57A10: carefully adjust R29 for a VOM reading of 9.9 volts.
   - For Revision C or later of Model 4EP57A10 and all Revisions of Model 4EP59A10: carefully adjust R29 for a VOM reading of 8.5 volts.

CAUTION

This is a critical adjustment. Failure to adjust R29 correctly may result in damage to the transmitter PA transistors.

5. Apply sufficient cement to secure R29. Then disconnect the 300-ohm resistor from J9, and re-connect the Orange and White leads.

ADJUSTMENT OF R9

1. Turn R9 fully clockwise (in direction of arrow).
2. Disconnect the Orange lead from A501-J9 and the White lead from A501-J11. Connect the 5000-ohm variable resistor in series with the milliammeter, and connect one end of the circuit to J11 and the other end to ground as shown in Figure 1.

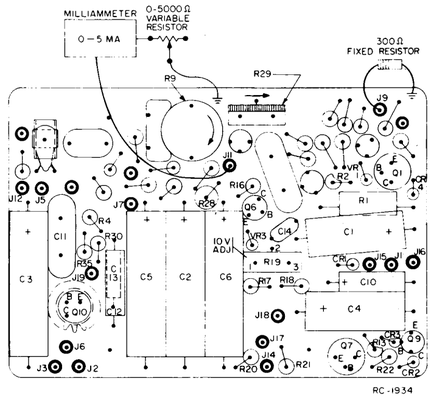


Figure 1 — Power Regulator Board Set-Up

3. Adjust the power source for 16.3 volts. Then key the transmitter and re-adjust the power source for 16.3 volts if necessary.
4. Key the transmitter and adjust the variable resistor for a milliammeter reading of 2.0 milliamps
5. Key the transmitter and carefully adjust R9 for a VOM reading of 13.0 volts as measured from P201-9 to P201-13 (ground) as shown in Figure 2.

CAUTION

This is a critical adjustment. Failure to adjust R9 correctly may result in damage to the transmitter PA transistors.

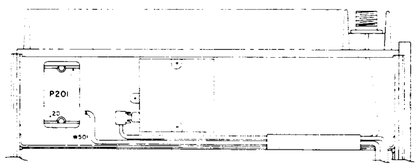


Figure 2 — Location of P201

FILTER-LIMITER CIRCUIT

If it is necessary to replace any components in the Filter-Limiter circuit, re-adjust R511 for 16 volts DC measured at the emitter of Q506 with the radio in the receive mode.

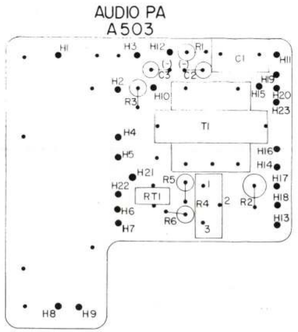
TROUBLESHOOTING PROCEDURE

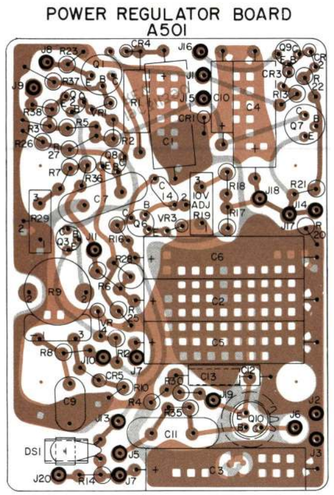
This procedure should be used in conjunction with voltage readings on the power regulator schematic diagram (see Table of Contents).

SYMPTOM	PROCEDURE
No PA supply voltage (Vcc) when transmitter is keyed	1. Check F501, F502 and F503. 2. Check for a short circuit from the collector of Q501 to ground. 3. Check for keyed 9.5 volts at J15 on power regulator board A501. If voltage is present, check for approximately 3.5 volts at A501-J8. If voltage is present on J8, check Q501 and Q502. NOTE: This reading may vary from 1.8 to 3.5 volts when protective circuits are activated by low power output or high PA heatsink temperature. The base-to-emitter voltage of Q2, Q3 and Q8 should be less than 0.6 volts when the circuits are not activated. 4. Check to see if a continuous 9.5 volts (instead of keyed voltage) is present at J15. A continuous voltage will activate short circuit protector Q8. 5. Check voltage readings at Q506.
No regulated +10 volts.	1. Check for approximately +12 volts at emitter of Q503. If voltage is present, check for shorted Q5. 2. Check F503. Check setting of R19.
Vcc applied continuously (transmitter keyed or unkeyed).	1. Check for approximately 12 volts at the emitter of Q9. a. If voltage is present, check for shorted Q7. b. If the voltage is not present, check the Push-To-Talk circuit for a short to ground.
Vcc too low.	1. Check for 3.5 volts at A501-J8. If reading is less than 3.5 volts, check to see that protective circuits are not activated (base-to-emitter voltage of Q2, Q3 and Q8 should be less than 0.6 volt if not activated). 2. If voltage at A501-J8 is greater than 3.5 volts, check Q501, Q502 and associated circuitry.
Vcc too high (greater than 13.0 volts).	1. Check for shorted Q501.
No keyed 9.5 volts. (Vcc persent)	1. Check wiring from A501-J15 to the transmitter.
No keyed 9.5 volts or Vcc	1. Check for a voltage drop of from 12 volts to approximately zero volts on the collector of Q9 when the transmitter is keyed. a. If no voltage drop, check the wiring from A501-J16 through the PTT circuit. b. If the voltage drop is present, check the base circuit of Q7, or for defective Q7.

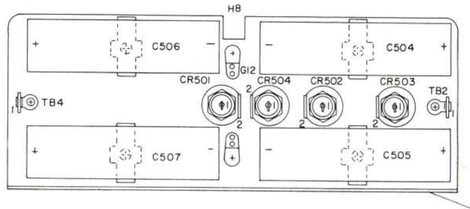
ADJUSTMENT & TROUBLESHOOTING PROCEDURE

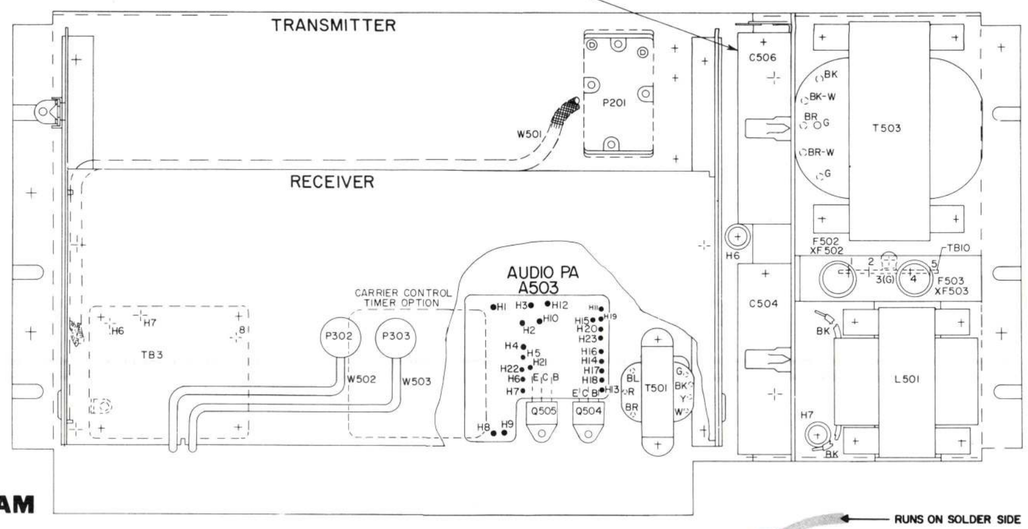
POWER REGULATOR MODEL 4EP59A10

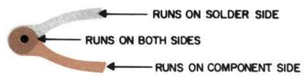


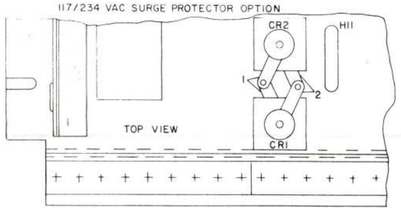


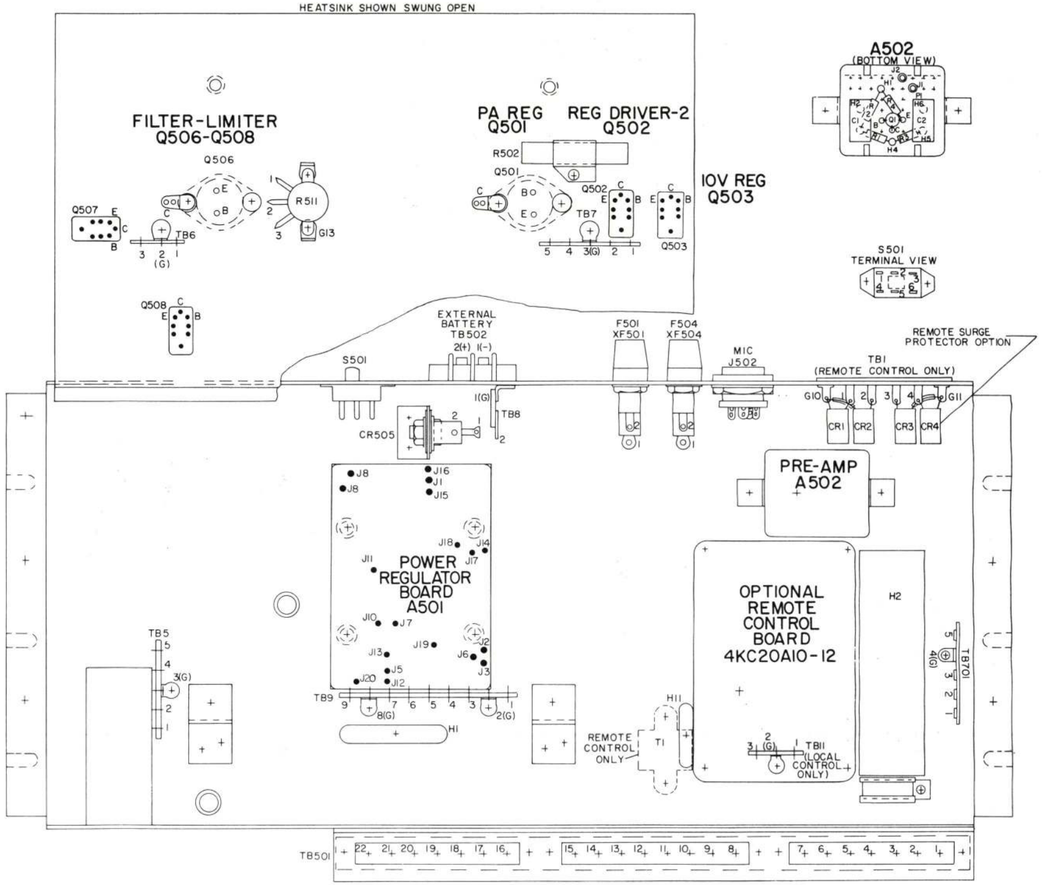
(19B205923, Sh. 1, Rev. 3)
(19B205923, Sh. 2, Rev. 3)







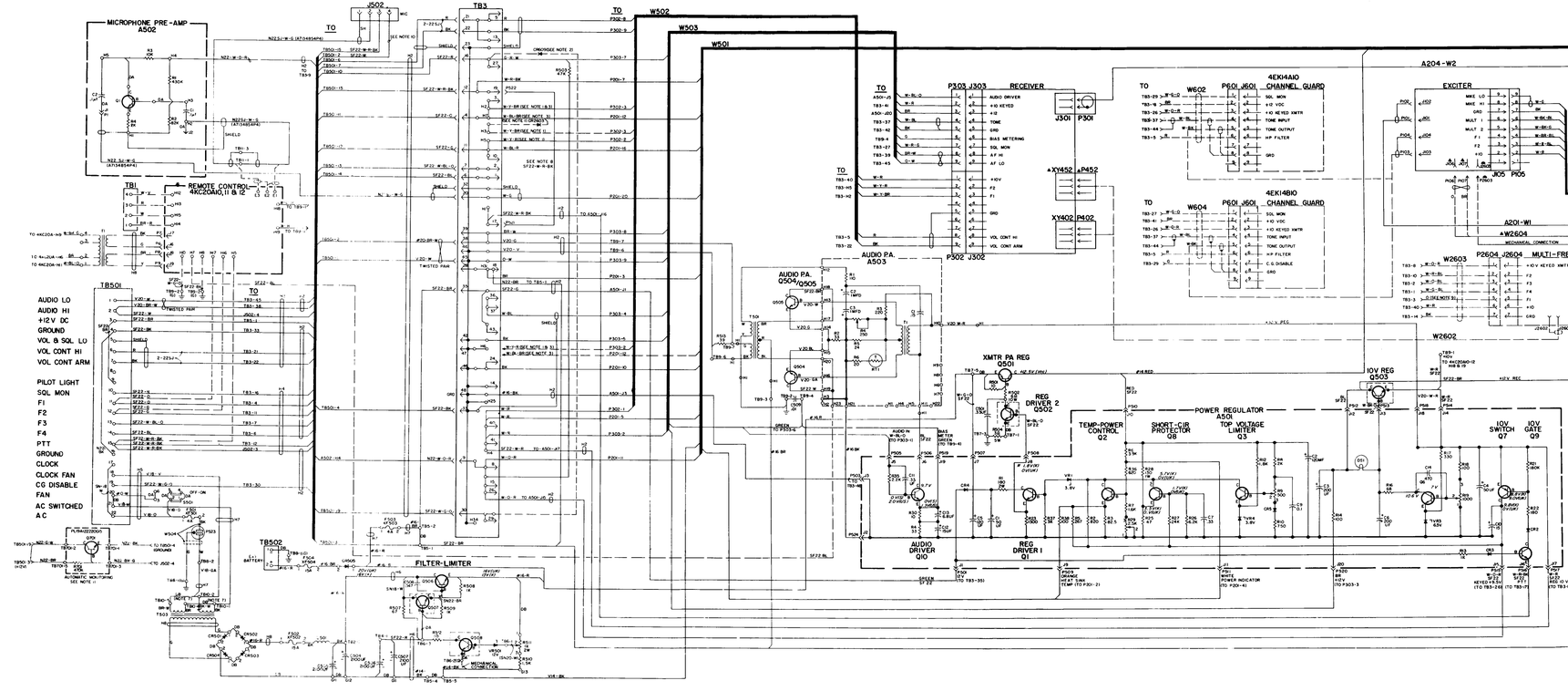




OUTLINE DIAGRAM

POWER REGULATOR MODEL 4EP59A10

19E500888, Rev. 5)



(DF-0067)

SCHEMATIC DIAGRAM

POWER REGULATOR MODEL 4EP59A10

19R640724, Rev. 23

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PARTS LIST

LBI3966F

POWER REGULATOR
MODEL 4EP59A10

SYMBOL	GE PART NO.	DESCRIPTION
		POWER REGULATOR ASSEMBLY 19E500867G1
A501		POWER REGULATOR BOARD 19C311392G2
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1*	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
		Earlier than REV D:
	5496267P20	Tantalum: 47 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C2	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TTX.
C3	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TTX.
C4*	19A115680P4	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
		Earlier than REV D:
	19A115680P5	Electrolytic: 100 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C5	19A115680P9	Electrolytic: 120 µf +150% -10%, 26 VDCW; sim to Mallory Type TTX.
C6	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TTX.
C7	19B209243P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C9	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C10	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C11*	19B209243P14	Polyester: 0.33 µf ±20%, 250 VDCW.
		Earlier than REV D:
	19B209243P5	Polyester: 0.047 µf ±20%, 50 VDCW.
C12*	5496267P14	Tantalum: 15 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
		Earlier than REV D:
	19B209243P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C13*	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D. Added by REV D.
C14*	7774750P1	Ceramic disc: .00047 µf +100% -0%, 500 VDCW. Added by REV D.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1*	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV. Deleted by REV D.
CR2	4037822P1	Silicon, 1000 mA, 400 PIV.
CR3	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR4	4037822P1	Silicon, 1000 mA, 400 PIV.
CR5	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - INDICATING DEVICES - - - - - -
DS1*	4034664P1	Lamp, incandescent: 28 v; sim to GE 2148. Added by REV D.
		- - - - - - - JACKS AND RECEPTACLES - - - - -
J1 thru J3	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J4*	4033513P4	Contact, electrical: sim to Bead Chain L93-3. Deleted by REV D.
J5 thru J20	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q2 and Q3	19A115123P1	Silicon, NPN.
Q5*	19A115706P1	Silicon, PNP; sim to Type 2N3638. Deleted by REV D.
Q6	19A115123P1	Silicon, NPN.
Q7	19A115976P1	Silicon, PNP.
Q8 and Q9	19A115123P1	Silicon, NPN.
Q10	19A115300P4	Silicon, NPN; sim to Type 2N3053.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R78P181K	Composition: 180 ohms ±10%, 1 w.
R2	3R77P821K	Composition: 820 ohms ±10%, 1/2 w.
R3	19A116278P89	Metal film: 82.5 ohms ±2%, 1/2 w.
R4*	3R77P330K	Composition: 33 ohms ±10%, 1/2 w.
		Earlier than REV D:
	3R77P300J	Composition: 30 ohms ±5%, 1/2 w.
R5	19A116278P142	Metal film: 267 ohms ±2%, 1/2 w.
R6	3R77P392J	Composition: 3.9K ohms ±5%, 1/2 w.
R7	3R77P162J	Composition: 1.6K ohms ±5%, 1/2 w.
R8*	3R77P202J	Composition: 2K ohms ±5%, 1/2 w.
		In Models earlier than REV A:
	3R77P162J	Composition: 1.6K ohms ±5%, 1/2 w.
R9	19B209358P2	Variable, carbon film: approx 25 to 500 ohms ±20%, 0.2 w; sim to CTS Type U-201.
R10*	3R77P751J	Composition: 750 ohms ±5%, 1/2 w.
		In Models earlier than REV A:
	3R77P911J	Composition: 910 ohms ±5%, 1/2 w.
R12	3R77P182J	Composition: 1.8K ohms ±5%, 1/2 w.
R13	3R77P102K	Composition: 1K ohms ±10%, 1/2 w.
R14	3R77P101K	Composition: 100 ohms ±10%, 1/2 w.
R15*	3R78P271K	Composition: 270 ohms ±10%, 1 w. Deleted by REV D.
R16*	3R77P680K	Composition: 68 ohms ±10%, 1/2 w.
		Earlier than REV D:
	3R77P471K	Composition: 470 ohms ±10%, 1/2 w.
R17*	3R77P331J	Composition: 330 ohms ±5%, 1/2 w.
		Earlier than REV D:
	3R7P102K	Composition: 1K ohms ±10%, 1/2 w.
R18*	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
		Earlier than REV D:
	3R77P681J	Composition: 680 ohms ±5%, 1/2 w.
R19*	19B209358P103	Variable, carbon film: approx 50 to 1000 ohms ±10%, 0.2 w; sim to CTS Type X-201.
		Earlier than REV D:
	19B209358P102	Variable, carbon film: approx 25 to 500 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R20*	3R77P202J	Composition: 2K ohms ±5%, 1/2 w. Deleted by REV D.
R21	3R77P184K	Composition: 180K ohms ±10%, 1/2 w.
R22	3R77P181K	Composition: 180 ohms ±10%, 1/2 w.
R23	3R77P132J	Composition: 1.3K ohms ±5%, 1/2 w.
R25	3R77P470K	Composition: 47 ohms ±10%, 1/2 w.
R26	3R77P622J	Composition: 6.2K ohms ±5%, 1/2 w.
R27	3R77P243J	Composition: 24K ohms ±5%, 1/2 w.
R28	3R78P131J	Composition: 130 ohms ±5%, 1 w.
R29	19B209358P104	Variable, carbon film: approx 100 to 2500 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R30*	3R77P100K	Composition: 10 ohms ±10%, 1/2 w.
		Earlier than REV D:
	5495948P127	Deposited carbon: 187 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R31*	19B209022P101	Wirewound: .27 ohms ±10%, 2 w; sim to IRC Type BWH. Deleted by REV D.
R32*	3R77P160J	Composition: 16 ohms ±5%, 1/2 w. Deleted by REV D.
R34*	3R77P240J	Composition: 24 ohms ±5%, 1/2 w. Deleted by REV D.
R35*	3R77P222K	Composition: 2.2K ohms ±10%, 1/2 w.
		Earlier than REV D:
	3R77P122K	Composition: 1.2K ohms ±10%, 1/2 w.
R36	3R77P621J	Composition: 620 ohms ±5%, 1/2 w.
R37	3R77P302J	Composition: 3K ohms ±5%, 1/2 w.
R38	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - -
RT1*	5490828P41	Thermistor: 30 ohms ±10%, color code black/white; sim to Carborundum Type B1211J-4. Deleted by REV D.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1	4036887P3	Zener: 500 mw, 3.8 v. nominal.
VR3	4036887P6	Zener: 500 mw, 6.5 v. nominal.
VR4	4036887P3	Zener: 500 mw, 3.8 v. nominal.
A502		MICROPHONE PRE-AMPLIFIER 19B204663G3
		- - - - - - - - - CAPACITORS - - - - - - - -
C1 and C2	19A115028P114	Polyester: 0.1 µf ±20%, 200 VDCW.
		- - - - - - - JACKS AND RECEPTACLES - - - - -
J1 and J2	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - - PLUGS - - - - - - - - -
P1	4029840P2	Contact, electrical: sim to Amp 42827-2.
		- - - - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A115889P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77P434J	Composition: 430K ohms ±5%, 1/2 w.
R2	3R77P823K	Composition: 82K ohms ±10%, 1/2 w.
R3	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R4	3R77P202J	Composition: 2K ohms ±5%, 1/2 w.
A503*		AUDIO PA 19C317339G2 (Added to 4EP59A10 by REV D)
		- - - - - - - - - - CAPACITORS - - - - - - - -
C1	19A116080P8	Polyester: 0.15 µf ±20%, 50 VDCW.
C2 and C3	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
		- - - - - - - - - - RESISTORS - - - - - - - -
R1	3R77P111J	Composition: 110 ohms ±5%, 1/2 w.
R2	19B209022P103	Wirewound: 0.33 ohms ±10%, 2 w; sim to IRC Type BWH.
R3*	3R77P221J	Composition: 220 ohms ±5%, 1/2 w.
		Earlier than REV A:
	3R77P241J	Composition: 240 ohms ±5%, 1/2 w.
R4	19B209358P101	Variable carbon film: approx 25 to 250 ohms ±10%, 0.2 w; sim to CTS Type X-201.
R5	3R77P240J	Composition: 24 ohms ±5%, 1/2 w.
R6	3R77P200J	Composition: 20 ohms ±5%, 1/2 w.
		- - - - - - - - - THERMISTORS - - - - - - - -
RT1	5490828P41	Thermistor: 30 ohms ±10%, color code black/white; sim to Carborundum Type B1211J-4.
		- - - - - - - - - TRANSFORMERS - - - - - - - -
T1	19A116040P1	Audio freq: 300 to 4000 Hz, Pri: 19.3 ohms ±10% DC res, Sec: 23.5 ohms ±10% DC res.
		- - - - - - - - - - - CAPACITORS - - - - - - -
C501	19A116080P14	Polyester: 0.33 µf ±20%, 250 VDCW.
C502*	19B209243P6	Polyester: .068 µf ±20%, 50 VDCW. Deleted by REV D.
C503*	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TTX. Deleted by REV D.
C504 thru C507	19A126770P106	Electrolytic: 2100 µf, 35 VDCW; sim to Sprague Type 34D.
C508*	19A116080P105	Polyester: .047 µf ±10%, 50 VDCW. Added by REV F.
C509*	19A116080P1	Polyester: 0.01 µf ±10%, 50 VDCW. Added by REV G.
		- - - - - - - DIODES AND RECTIFIERS - - - - -
CR501 thru CR505	19A115617P2	Silicon.
CR506*	4037822P1	Silicon, 1000 mA, 400 PIV. Deleted by REV B.
		- - - - - - - - - - FUSES - - - - - - - - - -
F501	1R16P7	Quick blowing: 4 amps at 250 v; sim to Littelfuse 312004 or Bussman MTH-4.
F502	7102673P2	Quick blowing: 15 amps at 32 v; sim to Littelfuse 311015 or Bussmann AGC-15.
F503	1R16P7	Quick blowing: 4 amps at 250 v; sim to Littelfuse 312004 or Bussman MTH-4.
F504	7102673P2	Quick blowing: 15 amps at 32 v; sim to Littelfuse 311015 or Bussman AGC-15.
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J502		Connector. Includes:
	19A116061P2	Receptacle: 4 female contacts; sim to Amphenol 91-PN4F-1000.
	19A116061P4	Lockwasher, internal tooth.
	19A116061P5	Nut, knurled.
		- - - - - - - - - - - INDUCTORS - - - - - - -
L501	19A116038P1	Reactor: 4.5 mh at 11 amps DC, 0.1 ohm DC res max, 58 VDC operating.
		- - - - - - - - - - - PLUGS - - - - - - - - -
P523		Part of W504.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q501	19A115977P1	Silicon, PNP.
Q502	19A116118P1	Silicon, NPN.
Q503*	19A116118P1	Silicon, NPN.
		Earlier than REV D:
	19A115822P1	Silicon.
Q504* and Q505*	19A116203P2	Silicon, NPN.
		Earlier than REV D:
	19A116017P1	Silicon, NPN.
Q506	19A115787P1	Silicon, NPN.
Q507 and Q508	19A116118P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R501	3R77P100K	Composition: 10 ohms ±10%, 1/2 w.
R502	5493035P33	Wirewound: 6 ohms ±5%, 10 w; sim to Hamilton Hall Type HR.
R504	5493035P6	Wirewound: 3 ohms ±5%, 5 w; sim to Hamilton Hall Type HR.
R505*	3R77P751J	Composition: 750 ohms ±5%, 1/2 w. Deleted by REV D.
R506*	3R77P152K	Composition: 1.5K ohms ±10%, 1/2 w. Deleted by REV D.
R507	5493035P19	Wirewound: 67 ohms ±5%, 5 w; sim to Hamilton Hall Type HR.
R508 and R509	3R77P102K	Composition: 1K ohms ±10%, 1/2 w.
R510	3R77P152K	Composition: 1.5K ohms ±10%, 1/2 w.
R511	19B209244P1	Variable, wirewound: 1000 ohms ±20%, 2 w; sim to CTS Type 117.
R512	3R77P100K	Composition: 10 ohms ±10%, 1/2 w.
R513*	3R78P390K	Composition: 39 ohms ±10%, 1 w. Added by REV D.
		- - - - - - - - - - THERMISTORS - - - - - - - - -
RT501*	5490828P42	Thermistor: 300 ohms ±20%, color code yellow x yellow; sim to Carborundum Type C0806H-14. Deleted by REV D.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S501	7145098P1	Slide, DPDT: 0.75 amp at 125 VAC or 0.5 amp at 125 VDC; sim to Stackpole SS-150.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T501*	19A116041P2	Audio freq: 300 to 4000 Hz, Pri: 1.00 ohm ±15% DC res, Sec No. 1: .23 ohms ±10% DC res, Sec No. 2: 10.5 ohms ±15% DC res.
		Earlier than REV D:
	19A116003P1	Audio: freq range 300 to 4000 Hz, Pri: 23.5 ohms ±5% imp, 1 ohm ±15% DC res, Sec: 3.5 ohms imp, 0.22 ohms ±10% DC res.
T502*	19A116004P1	Audio: freq range 300 to 4000 Hz, Pri: 30 ohms ±15% DC res, Sec: 9 ohms ±10% DC res. Deleted by REV D.
T503	19A116037P1	Power, step-down.
		- - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB2	7775500P44	Phen: 2 terminals.
TB4	7775500P44	Phen: 2 terminals.
TB5	7775500P111	Phen: 5 terminals.
TB8	7775500P44	Phen: 2 terminals.
TB9	7775500P25	Phen: 9 terminals.
TB10	7775500P11	Phen: 5 terminals.
TB502	19A116039P1	Phen: 2 terminals.
		- - - - - - - - VOLTAGE REGULATORS - - - - - -
VR501*	4036887P38	Zener: 500 mw, 12 v. nominal.
		In REV G and earlier:
	19A115528P4	Zener.
		- - - - - - - - - - CABLES - - - - - - - - - -
W504	19A122527G1	Power cable: approx 36 inches long. (Wall Mount)
	19A122527G2	Power cable: approx 120 inches long. (Desk Mount)
W602		CABLE ASSEMBLY (CHANNEL GUARD) 19B216090G1
		- - - - - - - - - - PLUGS - - - - - - - - - -
P601	19B209341P2	Socket, tube: 9 pins; sim to Elco 04-920-XX.
P103 and P104	4029840P2	Contact, electrical; sim to Amp 42827-2.
	19A134048P1	Wood screw.
	4029840P2	Contact, electrical: pins 1-6, and 8 of P601; sim to Amp 42827-2.
	4029840P1	Contact, electrical: pins 7 and 9 of P601; sim to Amp 41854.
	19A122138P1	Knob.
W2603		CABLE ASSEMBLY (MULTI-FREQUENCY) 19B205275G2
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2604	19B209341P1	Socket, tube: 7 pins; sim to Elco 04-720-XX.
	4029840P2	Contact, electrical; sim to Amp 42827-2.
	19A134048P1	Wood screw.
	19A122138P1	Knob.
		- - - - - - - - - - SOCKETS - - - - - - - - -
XF501 thru XF504	19B209005P1	Fuseholder, post type, phen: 15 amps at 250 v; sim to Littelfuse 342012.
		HARNESS ASSEMBLY 19E500867G2
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P201		(Part of W501).
P302		(Part of W502).
P303		(Part of W503).
P501	4029840P2	Contact, electrical: sim to Amp 42827-2.
P503*	4029840P3	Contact, electrical: sim to Amp 42101-2.
		Earlier than REV D:
	4029840P1	Contact, electrical: sim to Amp 41854.
P504*	4029840P2	Contact, electrical: sim to Amp 42827-2. Deleted by REV D.
P505		(Part of W503).
P506 thru P508	4029840P2	Contact, electrical: sim to Amp 42827-2.
P509		(Part of W501).
P510	4029840P2	Contact, electrical: sim to Amp 42827-2.
P511		(Part of W501).
P512 thru P518	4029840P2	Contact, electrical: sim to Amp 42827-2.
P519 and P520		(Part of W503).
P521 and P522	4029840P2	Contact, electrical: sim to Amp 42827-2.
P524*	4029840P2	Contact, electrical: sim to Amp 42827-2.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R503	3R77P473K	Composition: 47K ohms ±10%, 1/2 w.
		- - - - - - - - - - TERMINAL BOARDS - - - - - -
TB3	19B205912G1	Terminal board.
TB6	7117710P7	Phen: 7 terminals; sim to Cinch 1770.
TB7	7117710P8	Phen: 8 terminals; sim to Cinch 1780.
TB11	7117710P7	Phen: 7 terminals; sim to Cinch 1770.
TB501		Terminal board. Includes (2) 7117710P7 Phen: 2 terminal boards and (1) 7117710P8 Phen: 8 terminal board.
		- - - - - - - - - - CABLES - - - - - - - - - -
W501		CABLE ASSEMBLY 19C311697G2
		- - - - - - - - - - - PLUGS - - - - - - - - -
P201	19C303506P2	Connector, phen: 20 contacts.
P509	4029840P2	Contact, electrical; sim to Amp 42827-2.
P511	4029840P2	Contact, electrical; sim to Amp 42827-2.
W502		CABLE ASSEMBLY 19B205265G3
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P302	19B209341P2	Socket, tube: 9 pins; sim to Elco 04-920-XX.
	19A122138P1	Knob.
	19A134048P1	Wood screw.
W503		CABLE ASSEMBLY 19B216024G2
		- - - - - - - - - - - PLUGS - - - - - - - - -
P303	19B209341P2	Socket, tube: 9 pins; sim to Elco 04-920-XX.
P505	4029840P2	Contact, electrical; sim to Amp 42827-2.
P519 and P520	4029840P2	Contact, electrical; sim to Amp 42827-2.
	19A122138P1	Knob.
	19A134048P1	Wood screw.
		MONITOR KIT (CHANNEL GUARD) 19A122220G16
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q701	19A115123P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - -
R701	3R77P474K	Composition: 470K ohms ±10%, 1/2 w.
		- - - - - - - - TERMINAL BOARDS - - - - - - - -
TB701	7775500P9	Phen: 3 terminals.
		SURGE PROTECTOR KIT 19A127286G1 117 VAC 19A127286G2 234 VAC
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A115095P3	Diode assembly, selenium.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B216181G1	Angle, includes clips for mounting C504-C507.
	19A127199P1	Angle. (Mounts CR505).
	19A127184G1	Support. (Secures Q501-Q503, Q506-Q508 heat sink).
	19B216183P1	Support. (Mounts F502 and F503).
	19A127192G1	Insulator. (Used with Q501 and Q506).
	19C311826P1	Heat sink. (Used with Q501-Q503, Q506-Q508).
	19C303932P1	Support. (Mounts TB501).
	5491480P7	Clip, cable. (Located by TB1).
	4029974P1	Insulator plate. (Used with Q501, Q504, Q505 and Q506).
	4038930P1	Clip. (Mounts R502).
	19A115222P1	Insulator bushing. (Used with Q502, Q507, Q508).
	19A116023P1	Insulator plate. (Used with Q502, Q507 and Q508).
	19A127515G1	Terminal board. (Used with Q502, Q507 and Q508).
	4036555P1	Insulator disc. (Used with Q1, Q7 and Q9 on A501).
	4035439P1	Heat sink. (Used with Q10 on A501).
	19B201879P1	Clip. (Secures A502 board).
	19A122138P1	Knob. (Used with P302, P303, P601 and P2604).
	N197P408C13	Screw: (Used with P302, P303, P601 and P2604).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

REV. A - To re-center adjustment range of Top Limiter Adjust R9. Changed R8 and R10.

REV. B - To improve performance. Replaced CR506 (connected from TB6-2 to the base of Q507) with wire jumper.

REV. C - To facilitate Channel Guard installation. Moved black ground lead from TB3-44 to TB3-33.

REV. D - To replace audio PA transistors and to improve 10-volt regulation.

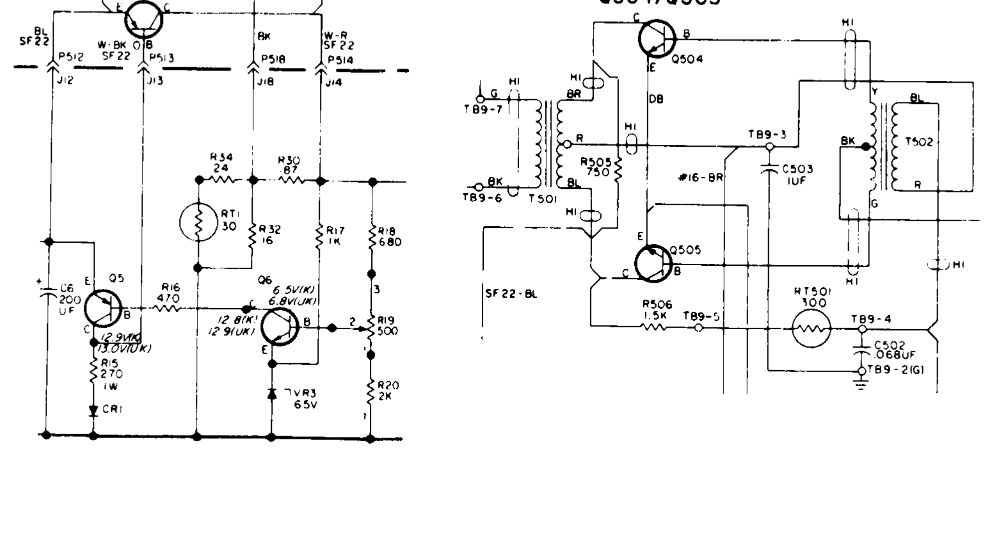
On Power Regulator Board A501 (19C311392-G1):

Changed C1, C4, C11, C12, R4, R16, R17, R18, R19, R30, and R35. Deleted CR1, R15, R20, R31, R32, R34, RT1 and Q5. Added C13, C14, and DS1.

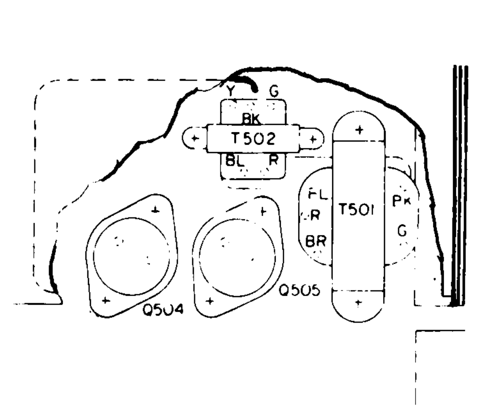
On Power Regulator Chassis 19E500867-G1:

Changed Q503, Q504, Q505 and T501. Deleted C502, R505, R506, RT501 and T502. Added Audio Board A503 and R513.

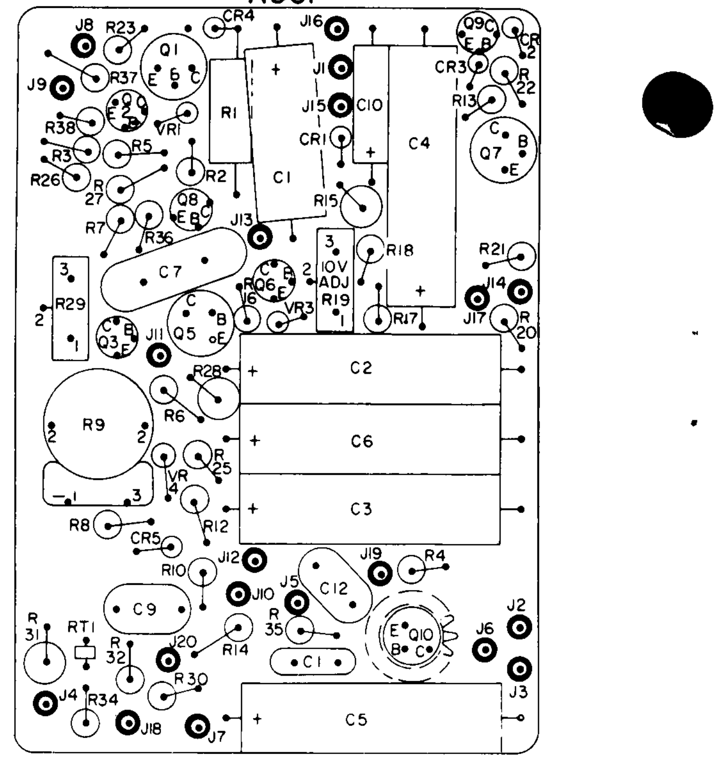
Schematic Diagram Was:



Outline Diagram Was:

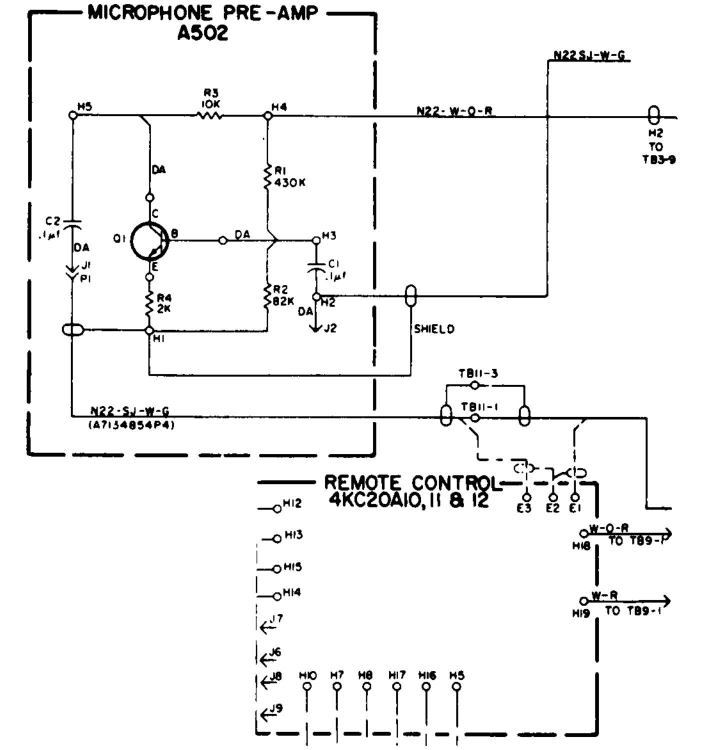


POWER REGULATOR BOARD
A501



REV. E - To increase remote line level sensitivity for use with line levels as low as -20 dBm. Changed wiring to mic Pre-Amp A502.

Schematic Diagram Was:



REV. F - To eliminate oscillation in the Filter-Limiter. Added C508.

REV. G - 4EP59A10

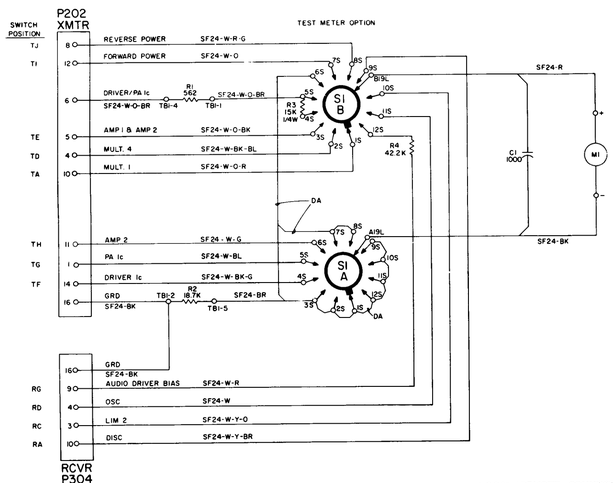
To eliminate oscillations in the audio stage. Added C509 between TB9-2 and TB9-4. Connected Green Bias Meter wire to TB9-4.

REV. H - To incorporate a new Zener diode. Changed VR501.

REV. A - Audio PA Board 19C317339G2

To improve PA bias. Changed R3.

TEST METER OPTION

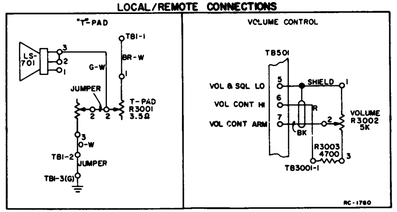


ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

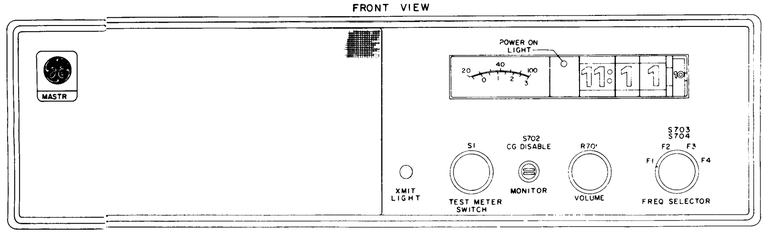
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19C311831, Rev. 3)

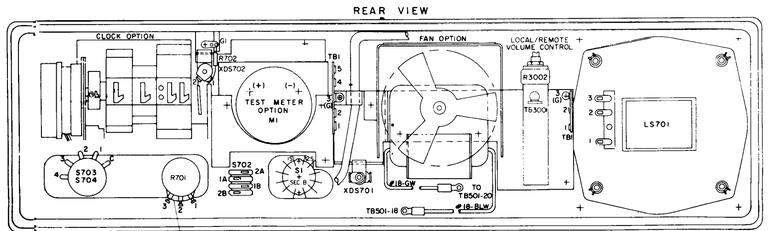
LOCAL/REMOTE CONNECTIONS



FRONT VIEW

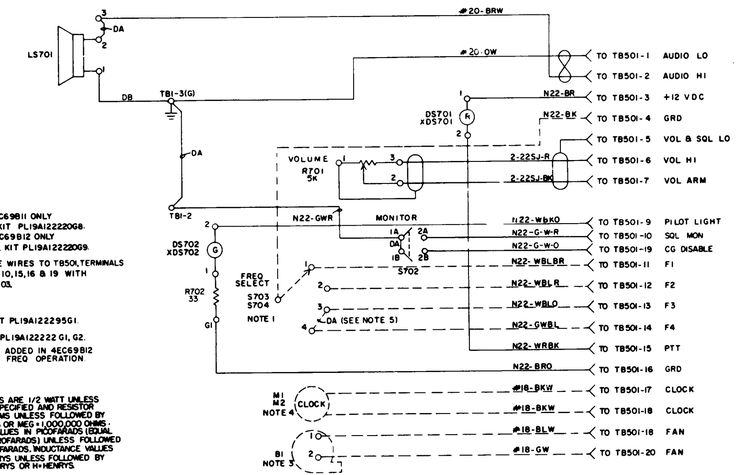


REAR VIEW



(19D413224, Rev. 2)

CONTROL UNIT SCHEMATIC



NOTES:
1. S703 IN 4EC69B11 ONLY
   TWO FREQ. KIT PL19A122220G8.
   S704 IN 4EC69B12 ONLY
   FOUR FREQ. KIT PL19A12222069.
2. TERMINATE WIRES TO TB501, TERMINALS 1-3, 5-7, 9, 10, 15, 16 & 19 WITH 19B209260P103.
3. BLOWER KIT PL19A122295G1.
4. CLOCK KIT PL19A12222 G1, G2.
5. DA JUMPER ADDED IN 4EC69B12 FOR THREE FREQ. OPERATION

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS, 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
4EC69B10	
4EC69B11	
4EC69B12	

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.

(19C311687, Rev. 0)

SCHEMATIC & OUTLINE DIAGRAMS

DESK TOP CONTROL UNIT MODEL 4EC69B10-12

RC-1780C
****

PARTS LIST

LBI-3964A

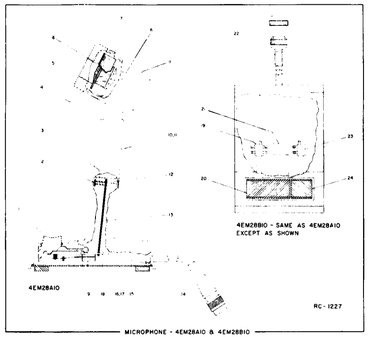
DESK TOP CONTROL UNIT

MODEL 4EC69B10 (19D402947-G1) (1 FREQUENCY)
MODEL 4EC69B11 (19D402947-G1) (2 FREQUENCY)
(19A122220-G8)
MODEL 4EC69B12 (19D402947-G1) (4 FREQUENCY)
(19A122220-G9)

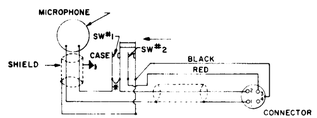
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - INDICATING DEVICES - - - - - -
DS701 and DS702	19C307037-P19	Lamp, incandescent: 14 v; sim to GE 756.
		- - - - - - - - -LOUDSPEAKERS- - - - - -
LS701	5491260-P7	Permanent magnet, 5-inch: 3.2 ohms ±10% voice coil imp, 15 w max operating, 390 Hz ±15% resonance, paper dust cap; sim to Jensen Model P5-VA.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R701	5496870-P23	Variable, carbon film: 5000 ohms ±20%; sim to Mallory LC(5K).
R702	3R77-P330K	Composition: 33 ohms ±10%, 1/2 w.
		- - - - - - - - - - -SWITCHES- - - - - - - - -
S702	19B209139-P6	Lever: 3 amps at 120 VAC, Position up: 1 form A contact, locking, Position Center: no contacts, Position down: 1 form A contact, momentary: sim to Switchcraft 203-1023.
		- - - - - - -TERMINAL BOARDS - - - - - -
TB1	7775500-P2	Phen: 3 terminals.
		- - - - - - - - - - -SOCKETS - - - - - - - - -
XDS701 and XDS702	19B209342-P1	Lampholder: sim to Leecraft 7-04.
		MODIFICATION KIT **19A122220-G8 (MODEL 4EC69B11) (2 FREQ)** **19A122220-G9 (MODEL 4EC69B12) (4 FREQ)**
		- - - - - - - - - - -SWITCHES- - - - - - - -
S703	19B204441-G2	Rotary: 1 pole, 2 positions, non-shorting contacts, 1 amp at 115 VAC or 28 VDC; sim to Grayhill Series 24 (modified).
S704	19B204441-G3	Rotary: 1 pole, 4 positions, non-shorting contacts, 1 amp at 115 VDC; sim to Grayhill Series 24 (modified).
		ASSOCIATED ASSEMBLIES **24 HOUR CLOCK** **19A122222-G1**
		- - - - - - - - - - METERS - - - - - - - - -
M2	19B205374-G4	Clock, direct reading: 110 VAC, 60 Hz; sim to Pennwood Numechron 1P-24H-AM/PM.
		12 HOUR CLOCK **19A122222-G3**
		- - - - - - - - - - METERS - - - - - - - - -
M3	19B205374-G5	Clock, direct reading: 220 VAC, 60 Hz; sim to Pennwood Numechron 1P-12H.
		METER KIT **19A127223-G1**
		- - - - - - - - - - METERS - - - - - - - - -
M1	19A115716-P1	Panel, DC: -10/0/+50 μa mechanism.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

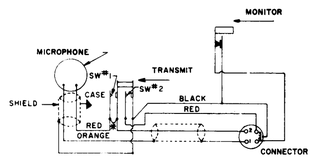
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	5495948-P173	Deposited carbon: 562 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
R2	5495948-P327	Deposited carbon: 18,700 ohms ±1%, 1/2 w; sim to Texas Instrument CD1/2MR.
		- - - - - - - TERMINAL BOARDS - - - - - -
TB1	7775500-P11	Phen: 5 terminals.
		- - - - - - - - - - CABLES - - - - - - - - -
W1		**CABLE ASSEMBLY** **19C311617-G1**
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	5494481-P12	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R3	3R152-P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R4	19A116278-P361	Metal film: 42,200 ohms ±2%, 1/2 w.
		- - - - - - - - - - SWITCHES - - - - - - - - -
S1	5495454-P24	Rotary: 2 sections, 2 poles, 12 positions, non-shorting contacts, 2 amps at 25 VDC or 1 amp at 110 VAC; sim to Oak Type A or Centralab Series 100.
		FAN KIT **19A122295-G1**
		- - - - - - - - - - -MOTORS- - - - - - - - - -
B1	19B205436-G1	AC: 115 VRMS at 60 Hz continuous, .0017 hp, 2400 rpm max; cw rotation.
	19B209068-P1	Impeller, fan: axial, cw rotation. (Part of B1).
		LOCAL/REMOTE MODIFICATION KIT **19A127280-G1**
		- - - - - - - - - - RESISTORS - - - - - - - - -
R3001	19A127278-G1	Attenuator.
R3001	5194774-P153	Variable, carbon film: 5000 ohms ±20%, 0.15 w; sim to CTS Series 70 Control.
R3003	3R77-P472K	Composition: 4700 ohms ±10%, 1/2 w.
		- - - - - - - TERMINAL BOARDS - - - - - -
TB3001	7775500-P44	Phen: 2 terminals.
		MASK PLATE **19B205401-G2 CLOCK AND METER** **19B205401-G3 12/24 HOUR CLOCK** **19B205401-G4 METER**
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A122210-P1	Lens: green.
	19A205291-P1	Plate. (Used in 19B205401-G2).
	19A205291-P2	Plate. (Used in 19B205401-G3).
	19A205291-P3	Plate. (Used in 19B205401-G4).
	19B205292-P1	Window: clear. (Used in front of Clock and meter in 19D402659-G1).
	19A115679-P1	Knob, push-on: black. (Used with R701 and dummies in 19D402659-G1).
	19B204949-P1	Jewel: red. (Used with DS701 in 19D402659-G1).
	4034668-P1	Clip: spring tension: sim to Tinnerman C4154-017-24. (Mounts LS701 in 19D402659-G1).



MICROPHONE - 4EM28AIO & 4EM28BIO



CIRCUIT DIAGRAM
4EM28AIO



CIRCUIT DIAGRAM
4EM28BIO

(RC-302A, Sh. 2)

JUMPER MAY BE REMOVED FOR PARALLEL OR SPECIAL OPERATION

NOTES:

1. SWITCH #1 OF THE MICROPHONE CIRCUIT MUST CLOSE FIRST AND OPEN LAST.

2. MONITOR AND TRANSMIT BUTTONS ARE MECHANICALLY INTERLOCKED, MAKING IT NECESSARY TO PRESS MONITOR BUTTON BEFORE TRANSMITTING. TO MONITOR CONTINUOUSLY, PRESS MONITOR BUTTON DOWN AND SLIDE FORWARD TO "LOCK" POSITION. PRESS AND PUSH BACK BUTTON RELEASE. TO OPERATE MONITOR AND TRANSMIT FUNCTIONS INDEPENDENTLY, REMOVE LOCKING ARM BRACKET (PART 21 SHOWN ABOVE AND IN PARTS LIST).

PARTS LIST

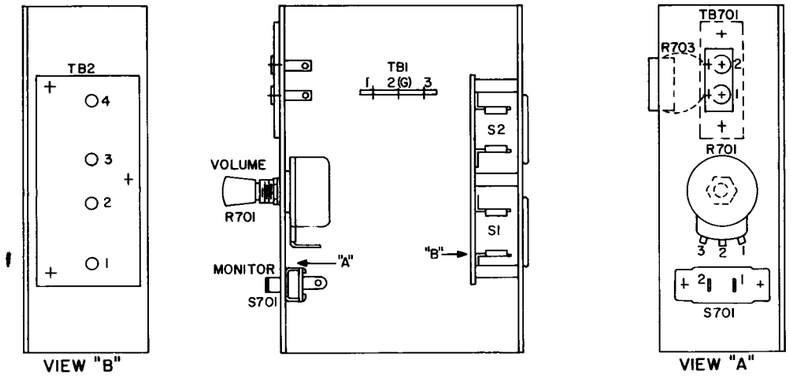
LBI-3623B

MAGNETIC CONTROLLED DESK MICROPHONE

MODEL 4EM28A10 (19C307103-P1)
MODEL 4EM28B10 (19C307106-P1)
(SEE RC-1227)

SYMBOL	G.E PART NO.	DESCRIPTION
		MECHANICAL PARTS
		MODEL 4EM28A10
1		Pushbutton. Shure Brothers RP-68.
2		Washer. Shure Brothers 30A697.
3		Spring. Shure Brothers 44A149.
4		Cap and grille. Shure Brothers RP-72.
5		Magnetic controlled cartridge. Shure Brothers RP-13.
6		Washer. Shure Brothers 34A223.
7		Shield. Shure Brothers 53A528.
8		Damping pad. Shure Brothers 20B33.
9		Housing. (Part of item 4).
10		Base. (Part of item 4).
11		(Not used).
12		Pin. Shure Brothers 31A848.
13		Bracket. Shure Brothers 53A637.
14		Cable and plug. Shure Brothers RP-65.
15		Cable clamp. Shure Brothers 53A532.
16		Bottom plate. Shure Brothers 90A1015.
17		(Not used).
18		Mounting bracket. Shure Brothers 53A633.
19		Switch. Shure Brothers RP-70.
		MODEL 4EM28B10
1		(Not used).
2		Washer. Shure Brothers 30A697.
3		Spring. Shure Brothers 44A149.
4		Cap and grille. Shure Brothers RP-72.
5		Magnetic controlled cartridge. Shure Brothers RP-13.
6		Washer. Shure Brothers 34A223.
7		Shield. Shure Brothers 53A528.
8		Damping pad. Shure Brothers 20B33.
9		Housing. (Part of item 4).
10		(Not used).
11		Base. (Part of item 4).
12		Pin. Shure Brothers 31A848.
13		Bracket. Shure Brothers 53A637.
14		(Not used).
15		Cable clamp. Shure Brothers 53A532.
16		(Not used).
17		Bottom plate. Shure Brothers 90B1015.
18		Mounting bracket. Shure Brothers 53A633.
19		Switch. Shure Brothers RP-71.
20		Pushbutton (Transmit). Shure Brothers RP-69.
21		Locking arm. Shure Brothers 53A667.
22		Cable and plug. Shure Brothers RP-66.
23		Switch. (Part of item 19).
24		Pushbutton (Monitor). (Part of item 20).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



(19C317043, Rev. 0)

ALL RESISTORS ARE 1/2 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.

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

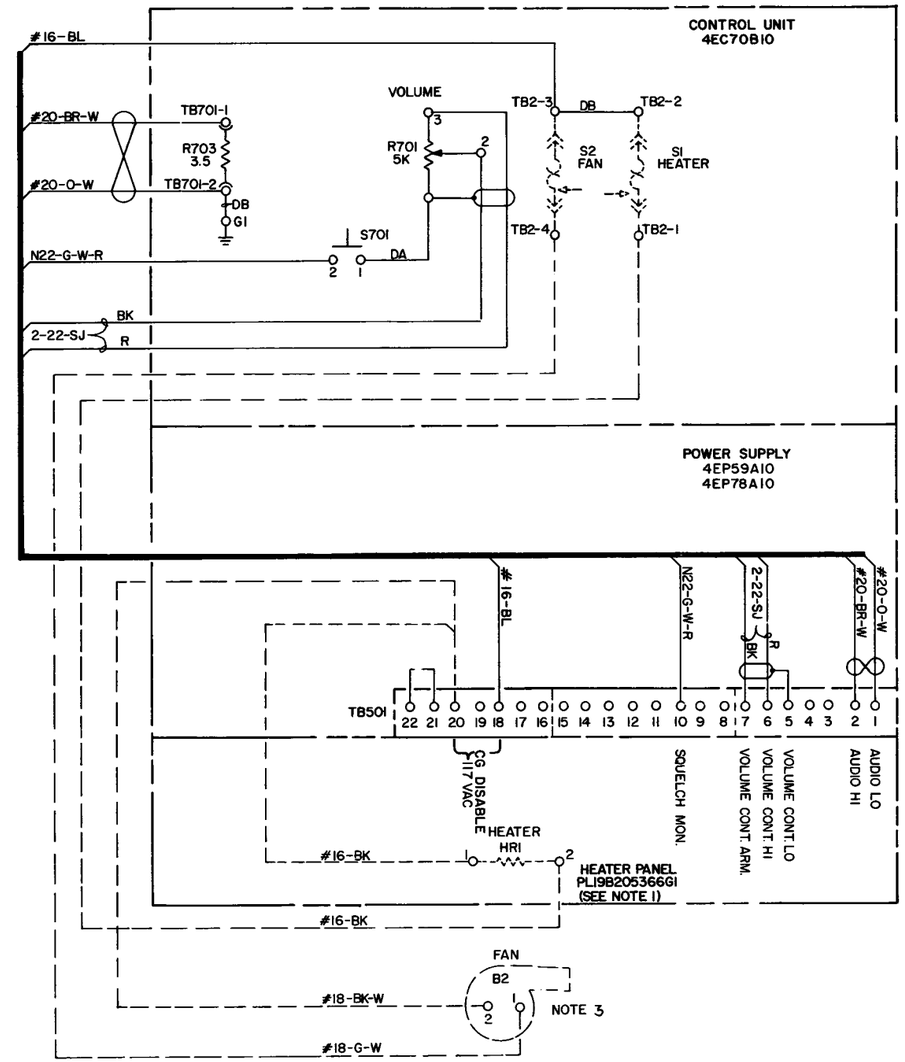
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
4EC70B10	

NOTES:

1. THESE ITEMS PART OF MOD KIT (PLI9AI22203GI).
2. TERMINATE WIRES TO TB501 WITH 19B209260P102, EXCEPT TO NO. 18 TERMINATE WITH 19B209268P101.

3 BLOWER KIT PLI9AI22295G2.



(19C311654, Rev. 3)

SCHEMATIC & OUTLINE DIAGRAMS

WALL MOUNT CONTROL UNIT
MODEL 4EC70B10

RC-1781B
****

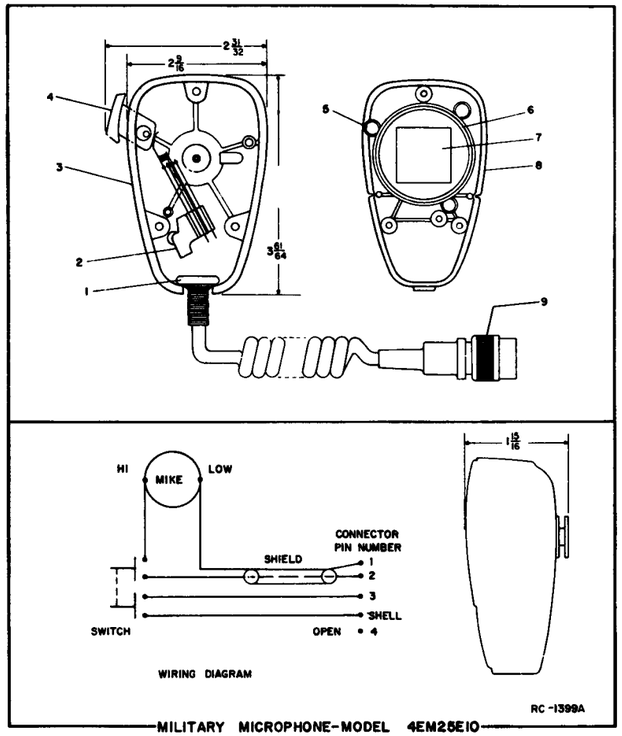
PARTS LIST

LBI3965A

WALL MOUNT CONTROL UNIT
MODEL 4EC70B10
19C303959G2

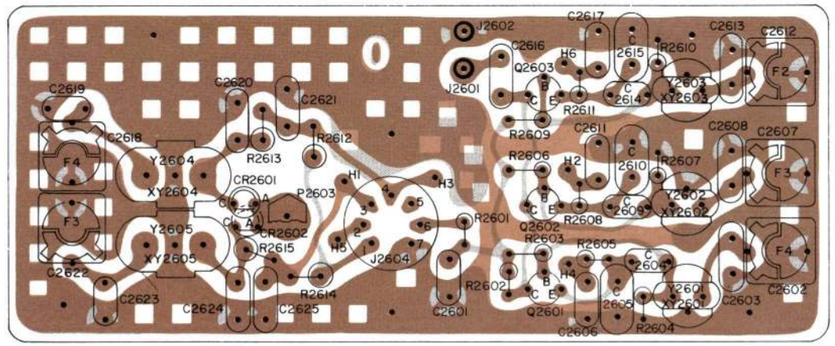
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R701	5496870P14	Variable, carbon film: 5K ohms ±20%, 0.5 w; sim to Mallory LC(5K).
R703	7141971G10	Resistor kit: wirewound, 3.5 ohms ±5%, 5 w; sim to Tru-Ohm Type X-60. (modified)
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S701	4031922P1	Push: SPST, normally open, 1/2 amp at 12 VDC; sim to Stackpole Type SS-15.
		- - - - - - - - - - TERMINAL BOARDS - - - - - - - -
TB2	19A122201G1	Board: 4 terminals.
TB701	7117710P2	Phen: 2 terminals; sim to Cinch 1781.
		ASSOCIATED ASSEMBLIES
		MILITARY MICROPHONE MODEL 4EM25E10 (19B209102P2) (SEE RC1399)
1	RP96	Cable clamp, front and back case.
2	RP26	Switch.
3		(See item 1).
4	RP97	Switch button. (Quantity 5 only).
5	RP16	Spring and internal hardware.
6	RP23	Shield. (Quantity 5 only).
7	RP13	Magnetic controlled cartridge, grille cloth, screen and resonator.
8		(See item 1).
9	RP14	Cable and plug: approx 6 feet long.
		FIVE-WATT SPEAKER MODEL 4EZ16A14 (19D402449G7)
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19B209233P1	Electrolytic, non-polarized: 25 µf ±20%, 25 VDCW; sim to Sprague Type 41D.
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - - - -
LS3	19A116910P1	Permanent magnet: 5 inch, 3.2 ohms ±15% imp, 5 w max operating; sim to Pioneer 002009.
		- - - - - - - - - - CABLES - - - - - - - - - -
W5		CABLE ASSEMBLY 19A122167G1
		- - - - - - - - - - PLUGS - - - - - - - - - -
P702	5493018P2	Connector, phen: 4 contacts; sim to Cinch 204-31-05-010.
	5493018P4	Cap.
		FAN KIT 19A122295G2
		- - - - - - - - - - MOTORS - - - - - - - - - -
B2	19B205437G1	Fan, single phase: 115 VAC, 60 Hz, 14 w, ccw rotation; sim to Rotron "Gold Seal Venturi Muffin Fan".

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S2	19A115687P2	Thermostatic, switch: contacts close at approx 110°F ±6°F and open at approx 90°F ±5°F; sim to Stevens Mfg. 430-1206.
		HEATER 19A122203G1
		- - - - - - - - - - HEATERS - - - - - - - - - -
HR1	4034002P1	Strip: 120 VAC, 150 w nominal; sim to GE 2A425.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1	19A115687P1	Thermostatic, switch: contacts close at approx 3°F ±6°F and open at approx 18°F ±5°F; sim to Stevens Mfg. 430-1205.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	7150186P19	Spacer: No. 4. (Used with TB2).
	19A115308P1	Knob.
	N529P42C13	Button, plug: approx 1-1/8 inch dia.
	19C303500P1	Grille.
	19A121521P1	Support, mounting.
	5490407P33	Grommet, rubber. (Located top of casting).
	19A115470P1	Grommet, rubber. (Located bottom of casting).
	19C303504G3	Housing, speaker.
	7141414G2	Microphone mounting kit.
	19A121521G1	Mounting support.



MILITARY MICROPHONE-MODEL 4EM25E10

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.



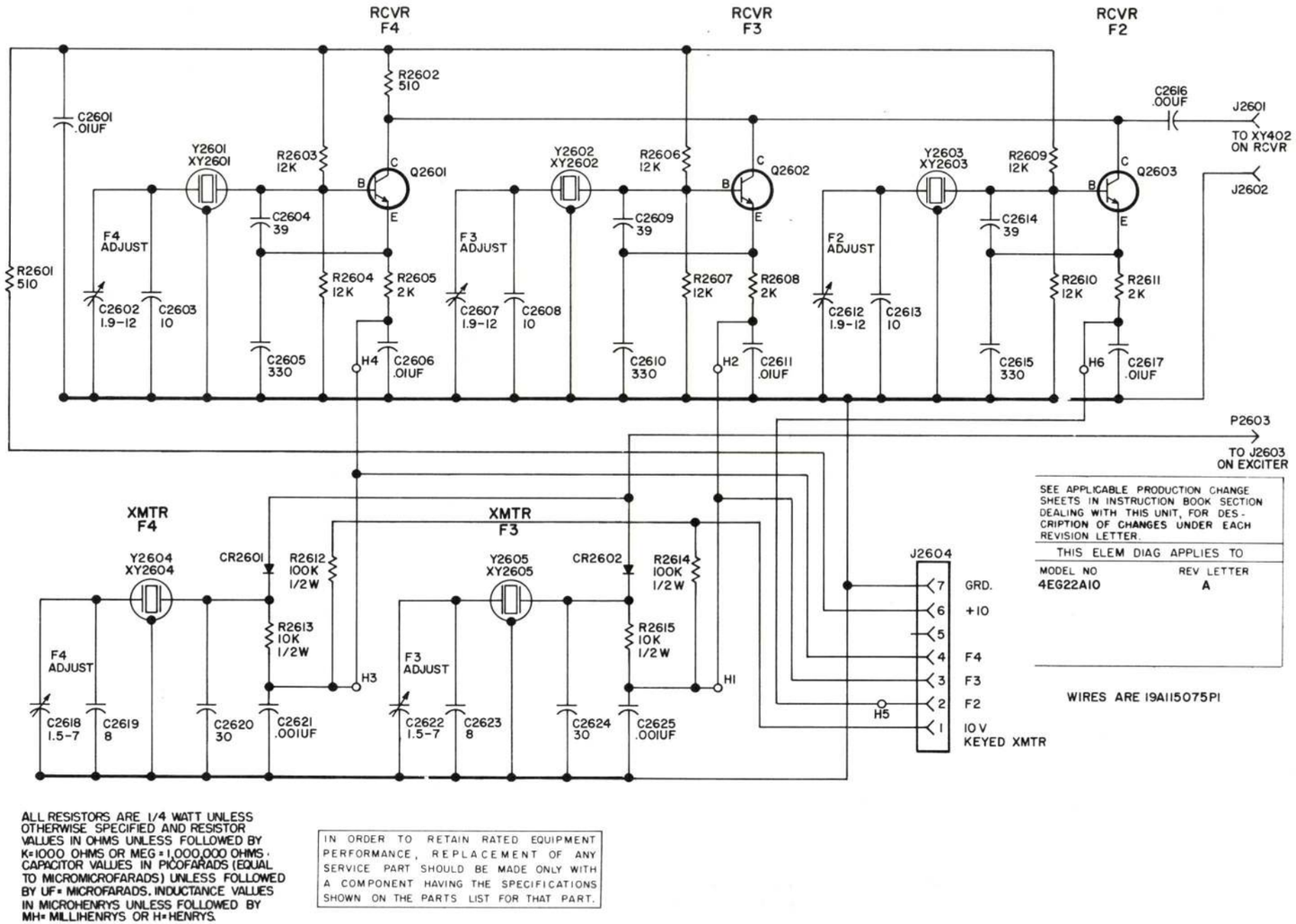
(19C311233, Rev. 1)
(19B205122, Sh. 1, Rev. 0)
(19B205122, Sh. 2, Rev. 0)

RUNS ON SOLDER SIDE

RUNS ON BOTH SIDES

RUNS ON COMPONENT SIDE

(DF-8407)



ALL RESISTORS ARE 1/4 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.

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.

(19C303968, Rev. 2)

SCHEMATIC & OUTLINE DIAGRAM

FOUR-FREQUENCY OSCILLATOR BOARD
MODEL 4EG22A10

RC-1477D
****

PARTS LIST

LBI3725C

25-50 MHz FOUR FREQUENCY OSCILLATOR BOARD
MODEL 4EG22A10
19C303962G1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2601	7491827P2	Ceramic disc: 0.01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C2602	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C2603	5490008P6	Silver mica: 10 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C2604	5496219P753	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C2605	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C2606	7491827P2	Ceramic disc: 0.01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C2607	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C2608	5490008P6	Silver mica: 10 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C2609	5496219P753	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C2610	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C2611	7491827P2	Ceramic disc: 0.01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C2612	5491271P106	Variable, sub-miniature: approx 2.1-12.7 pf, 750 v peak; sim to EF Johnson 189.
C2613	5490008P6	Silver mica: 10 pf ±0.5 pf, 500 VDCW; sim to Electro Motive Type DM-15.
C2614	5496219P753	Ceramic disc: 39 pf ±5%, 500 VDCW, temp coef -750 PPM.
C2615	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C2616	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2617	7491827P2	Ceramic disc: 0.01 µf +80% -30%, 50 VDCW; sim to Sprague 19C180.
C2618	5491271P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to EF Johnson 189.
C2619	5496219P39	Ceramic disc: 8.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C2620	5496219P50	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef 0 PPM.
C2621	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C2622	5491271P103	Variable, sub-miniature: approx 1.7-8.3 pf, 750 v peak; sim to EF Johnson 189.
C2623	5496219P39	Ceramic disc: 8.0 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C2624	5496219P50	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef 0 PPM.
C2625	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR2601 and CR2602	19A115603P1	Silicon.
CR2603	4037822P1	Silicon, 1000 mA, 400 PIV.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - - - -
J2601 and J2602	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
J2604	19B209303P2	Connector, phen: 7 pins.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P2603	4029093P1	Plug, banana type: sim to Ucinite 155296.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q2601 thru Q2603	19A115245P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2601	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R2602*	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
		In Models earlier than REV A:
	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
R2603 and R2604	3R152P123J	Composition: 12K ohms ±5%, 1/4 w.
R2605	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R2606 and R2607	3R152P123J	Composition: 12K ohms ±5%, 1/4 w.
R2608	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R2609 and R2610	3R152P123J	Composition: 12K ohms ±5%, 1/4 w.
R2611	3R152P202J	Composition: 2K ohms ±5%, 1/4 w.
R2612	3R77P104K	Composition: 100K ohms ±10%, 1/2 w.
R2613	3R77P103K	Composition: 10K ohms ±10%, 1/2 w.
R2614	3R77P104K	Composition: 100K ohms ±10%, 1/2 w.
R2615	3R77P103K	Composition: 10K ohms ±10%, 1/2 w.
		- - - - - - - - - - CABLES - - - - - - - - - -
W2601		CABLE 19B205275G1
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B209341P1	Socket: 7 contacts; sim to Elco 04-720-XX.
	19A122138P1	Knob.
	19A134048P1	Wood screw.
W2602		CABLE 19B205263G2
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4029840P1	Contact, electrical: sim to AMP 41854. (1)
	4029840P2	Contact, electrical: sim to Amp 42827-2. (1)
	19A134372P1	Terminal, feed-thru: sim to Greenfield 70-002.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY2601 thru XY2603	5490277P1	Transistor, phen: 4 contacts; sim to Elco 3303.
XY2604 and XY2605		(See Miscellaneous).
		- - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering give GE Part Number and specify exact frequency needed.
Y2601 thru Y2603	19B206357P1	Quartz: 12-20 MHz, temp range -30°C to +80°C. (Receiver).
		25-33 MHz crystal frequency = $\frac{(OF + 5.3\ MHz)}{2}$
		33-42 MHz crystal frequency = $\frac{(OF - 5.3\ MHz)}{2}$
		42-50 MHz crystal frequency = $\frac{(OF - 5.3\ MHz)}{2}$
Y2604 and Y2605	19B206175P31	Quartz: 3500-4500 KHz, temp range -30°C to +85°C. (Transmitter).
		Crystal frequency = $\frac{OF}{12}$

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19C311172P1	Socket: 4 contacts. (Part of XY2604, 2605).
	19A115793P1	Contact, electrical: sim to Malco 2700. (Part of XY2604, 2605).
	4033089P1	Clip. (Part of XY2604, 2605).
	19B200525P9	Rivet, tubular. (Part of XY2604, 2605).
	N80P9005C13	Machine screw: No. 4-40 x 5/16. (Secures Oscillator Board).
	N404P11C13	Lockwasher, internal tooth: No. 4. (Secures Oscillator Board).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

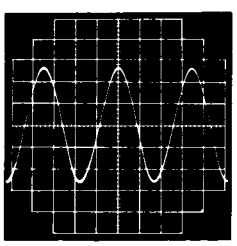
REV. A - To increase the output level of the multi-frequency oscillator.
Changed R2602.

EQUIPMENT REQUIRED:

1. Audio Generator Model 4EX6A10
2. AC-VTVM
3. Milliammeter
4. Oscilliscope

SYMPTOM	DESCRIPTION
No Audio From Receiver	1. Check basic receiver. 2. Check for audio voltage at TB1-1 & TB1-2. (If audio is present, trouble is in telephone line or control console). 3. Check for defective R14, C13, C1 or T1.
Unable To Receive F1	1. Check for 0 milliamps of control current at TB1. 2. Ground TB501-11 and check basic receiver. 3. Check switches Q10 & Q11. In F1 operation, collector of Q11 (measured to ground) should be 0.100 volt maximum. 4. Check for 0 voltage across C28. If not 0, check for shorted CR6 or CR9.
Unable To Receive F2	1. Check for -6 milliamps of control current at TB1. 2. Ground TB501-12 and check basic receiver. 3. Apply -6 milliamps to TB1 and check switch Q8. Collector of Q8 (measured to ground) should be 0.100 volt maximum. 4. Apply -6 mA to TB1 & check for approx. 2.8 volts across C28. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1, (see Fig. A), T5, CR9 and amp Q9.
Unable To Monitor Channel Guard	1. Check for +6 milliamps of control current at TB1. 2. Ground TB501-19 and check receiver Channel Guard. Then follow steps 3 thru 6 of above.
Unable To Key Transmitter	1. Check for proper control current at TB1. 2. Ground TB501-15 and check basic station. 3. Apply proper control current and check for approx. 5.5 V (measured to ground) at emitter of Q3. If present, collector of Q4 should be 0.5 volt maximum. 4. With proper control control current at TB1, check for approx. 6.0 volts at Q3 base. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1 (see Fig. A), T3, CR3, and amp Q2.
Unable To Transmit In F1	1. Check for +6 milliamps of control current at TB1. 2. Ground TB501-11, key transmitter and check basic transmitter F1. 3. Check switches Q10 & Q11. In F1 operation, collector of Q11 (measured to ground) should be 0.100 volt maximum. 4. Check for 0 voltage across C28. If not 0, check for shorted CR6 or CR9.
Unable To Transmit In F2	1. Check for +15 milliamps of control current at TB1. 2. Ground TB501-12, key transmitter by applying +15 milliamps to TB1 and check basic transmitter F2. 3. Apply +15 milliamps of control current to TB1 and check switch Q8. Collector of Q8 (measured to ground) should be 0.100 volt. 4. Apply +15 milliamps of control current to TB1 and check for approx. 2.8 volts across C28. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1 (see Fig. A), T4, CR6 and amp Q7.
No Transmitter Audio When Keying From A Remote Console	1. Apply approx 3 volts of audio at 1000 Hz to TB1-1 & 2 and check for audio at arm of R23. 2. Apply proper transmit control current to TB1 and check for audio at emitter of Q5. 3. Check for approx. 5.5 VDC at junction of R17 & R18 with proper keying current applied at TB1. 4. Check C14, C15 and audio switch Q5.
No Transmitter Audio When Keying From Local Station	1. Apply 0.1 volt of audio at 1000 Hz to local mike jack and check for approx. 0.350 volts at E3. 2. Check for approx. 0.350 volts at E1 with audio applied per Step 1 above. 3. Check C16, C17 and audio switch Q6.

1 μ SEC/DIV



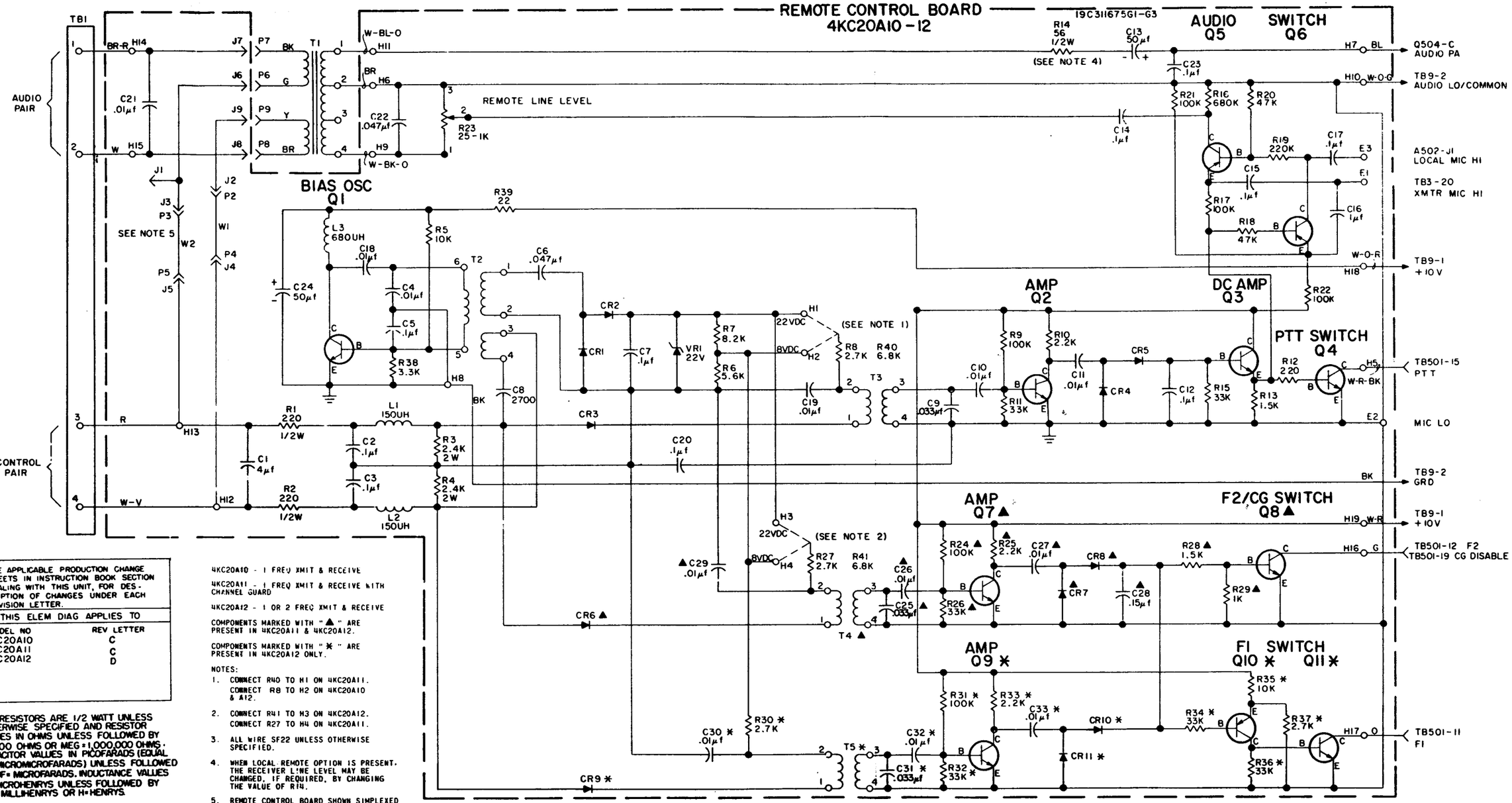
0.2 VOLTS/DIV
(1 VOLT P-P)

Figure A - Waveform at Base of Q1

TROUBLESHOOTING PROCEDURE

REMOTE CONTROL MODEL 4KC20A10-12

DF-4092



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
4KC20A10	C
4KC20A11	C
4KC20A12	D

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN MICROFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

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.

4KC20A10 - 1 FREQ XMIT & RECEIVE

4KC20A11 - 1 FREQ XMIT & RECEIVE WITH CHANNEL GUARD

4KC20A12 - 1 OR 2 FREQ XMIT & RECEIVE

COMPONENTS MARKED WITH "▲" ARE PRESENT IN 4KC20A11 & 4KC20A12.

COMPONENTS MARKED WITH "*" ARE PRESENT IN 4KC20A12 ONLY.

NOTES:

1. CONNECT R40 TO H1 ON 4KC20A11. CONNECT R8 TO H2 ON 4KC20A10 & A12.
2. CONNECT R41 TO H3 ON 4KC20A12. CONNECT R27 TO H4 ON 4KC20A11.
3. ALL WIRE SF22 UNLESS OTHERWISE SPECIFIED.
4. WHEN LOCAL-REMOTE OPTION IS PRESENT, THE RECEIVER LINE LEVEL MAY BE CHANGED, IF REQUIRED, BY CHANGING THE VALUE OF R14.
5. REMOTE CONTROL BOARD SHOWN SIMPLEXED LINE-TO-LINE.

(19D413156, Rev. 7)

SCHEMATIC DIAGRAM

ROMOTE CONTROL MODEL 4KC20A10—12

RC-1783E

****

PARTS LIST

LBI-3967C

REMOTE CONTROL BOARD
4KC20A10-12

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	7486445P5	Electrolytic, non polarized: 4 µf +150% -10%, 150 VDCW.
C2 and C3	7491930P9	Polyester: .1 µf ±20%, 100 VDCW; sim to GE Type 61F.
C4	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C5	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C6	19A116080P5	Polyester: .047 µf ±20%, 50 VDCW.
C7	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C8	5194481P128	Ceramic disc: 2700 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C9*	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
		In REV A and earlier:
	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C10 and C11	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C12	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C13	19A115680P104	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C14 thru C17	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C18	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C19	7491930P5	Polyester: .01 µf ±20%, 100 VDCW; sim to GE Type 61F.
C20	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C21	7491393P2	Ceramic disc: .01 µf +100% -0%, 500 VDCW; sim to Sprague 1219C4.
C22	19A116080P5	Polyester: .047 µf ±20%, 50 VDCW.
C23	19A116080P7	Polyester: 0.1 µf ±20%, 50 VDCW.
C24	19A115680P104	Electrolytic: 50 µf +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C25*	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
		In REV A and earlier:
	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C26 and C27	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C28	19A116080P8	Polyester: 0.15 µf ±20%, 50 VDCW.
C29 and C30	7491930P5	Polyester: .01 µf ±20%, 100 VDCW; sim to GE Type 61F.
C31*	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
		In REV A and earlier:
	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C32 and C33	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C34* and C35*	5496267P1	Tantalum: 6.8 µf ±20%, 6 VDCW; sim to Sprague Type 150D. Added to 4KC20A12 by REV C.
		- - - - - - - DIODES AND RECTIFIERS - - - - -
CR1 and CR2	19A115250P1	Silicon.
CR3*	4037822P1	Silicon.
		In 4KC20A10,All of REV A and B, 4KC20A12 of REV A-C:
	19A115100P2	Silicon; sim to Type 1N459A.
		Earlier than REV A:
	19A115250P1	Silicon.
CR4 and CR5	19A115250P1	Silicon.
CR6*	4037822P1	Silicon.
		In 4KC20A10, All of REV A and B: In 4KC20A12 of REV A-C:
	19A115100P2	Silicon; sim to Type 1N459A.
		Earlier than REV A:
	5494922P3	Silicon.
CR7 and CR8	19A115250P1	Silicon.
CR9*	4037822P1	Silicon.
		In 4KC20A10, All of REV A and B: In 4KC20A12 of REV A-C:
	19A115100P2	Silicon; sim to Type 1N459A.
		Earlier than REV A:
	5494922P3	Silicon.
CR10 and CR11	19A115250P1	Silicon.
		- - - - - - - - - - TERMINALS - - - - - - - - -
E1 thru E3	4036053P2	Solder terminal.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J9	4033513P4	Contact, electrical: sim to Bead Chain L83-3.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1 and L2	7491382P102	Coil, RF: 150 µh ±10%, 6 ohms DC res max; sim to Delevan 4500 Series.
L3	7491382P106	Coil, RF: 680 µh ±10%, 12 ohms DC res max; sim to Delevan 4500 Series.
L4* and L5*	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max: sim to Jeffers 4446-4. Added to 4KC20A12 by REV C.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19C300114P1	Silicon, NPN; sim to Type 2N706.
Q2	19A115123P1	Silicon, NPN.
Q3 and Q4	19A115300P2	Silicon, NPN; sim to Type 2N3053.
Q5 and Q3	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q7	19A115123P1	Silicon, NPN.
Q8	19A115552P1	Silicon, NPN; sim to Type 2N2714.
Q9	19A115123P1	Silicon, NPN.
Q10	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q11	19A115552P1	Silicon, NPN; sim to Type 2N2714.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1 and R2	3R77P221K	Composition: 220 ohms ±10%, 1/2 w.
R3 and R4	3R79P242J	Composition: 2400 ohms ±5%, 2 w.
R5	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R6	3R152P562K	Composition: 5600 ohms ±10%, 1/4 w.
R7	3R152P822K	Composition: 8200 ohms ±10%, 1/4 w.
R8	3R152P272K	Composition: 2700 ohms ±10%, 1/4 w.
R9	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
R10	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R11	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R12	3R152P221K	Composition: 220 ohms ±10%, 1/4 w.
R13	3R152P152K	Composition: 1500 ohms ±10%, 1/4 w.
R14	3R77P560K	Composition: 56 ohms ±10%, 1/2 w.
R15	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R16	3R152P684K	Composition: 0.68 megohms ±10%, 1/4 w.
R17	3R152P104K	Composition: 0.1 megohms ±10%, 1/4 w.
R18	3R152P473K	Composition: 47,000 ohms ±10%, 1/4 w.
R19	3R152P224K	Composition: 0.22 megohm ±10%, 1/4 w.
R20	3R152P473K	Composition: 47,000 ohms ±10%, 1/4 w.
R21 and R22	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
R23	19B209358P3	Variable, carbon film: approx 50 to 1000 ohms ±20%, 0.2 w; sim to CTS Type U-201.
R24	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
R25	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R26	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R27	3R152P272K	Composition: 2700 ohms ±10%, 1/4 w.
R28	3R152P152K	Composition: 1500 ohms ±10%, 1/4 w.
R29	3R152P102K	Composition: 1000 ohms ±10%, 1/4 w.
R30	3R152P272K	Composition: 2700 ohms ±10%, 1/4 w.
R31	3R152P104K	Composition: 0.1 megohm ±10%, 1/4 w.
R32	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R33	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R34	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R35	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R36	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R37	3R152P272K	Composition: 2700 ohms ±10%, 1/4 w.
R38	3R152P332K	Composition: 3300 ohms ±10%, 1/4 w.
R39	3R152P220K	Composition: 22 ohms ±10%, 1/4 w.
R40 and R41	3R152P682K	Composition: 6800 ohms ±10%, 1/4 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	19A127262G1	Transformer assembly. Includes:
	19A115731P1	Transformer, audio freq: 300 to 6000 Hz.
P6 thru P9	4029840P2	Contact, electrical; sim to Amp 42827-2.
T2	19B216257G1	Transformer.
T3 thru T5	19B216258G1	Transformer.
		- - - - - - - - - TERMINAL BOARDS - - - - - - - - -
TB1	7117710P4	Phen: 4 terminals; sim to Cinch 1774.
TB6*	7487424P26	Miniature, phen: 6 terminals. Added to 4KC20A12 by REV C.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR1	4036887P18	Silicon, Zener.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W1	19A127095G5	Cable assembly; approx 9 inches long. Includes:
P2	4029840P2	Contact, electrical; sim to Amp 42827-2.
P4	4029840P2	Contact, electrical; sim to Amp 42827-2.
W2	19A127095G5	Cable assembly; approx 9 inches long. Includes:
P3	4029840P2	Contact, electrical; sim to Amp 42827-2.
P5	4029840P2	Contact, electrical; sim to Amp 42827-2.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	4036555P1	Insulator, disc. (Used with Q3 and Q4).
	4034252P6	Can. (Used with T2).
	19C311675G4	Harness. (Used with Single Frequency Tx and Rx).
	19C311675G5	Harness. (Used with Single Frequency Tx and Rx with Channel Guard).
	19C311675G6	Harness. (Used with 1 or 2 Freq. Tx and 1 or 2 Freq. Rx).
		SURGE PROTECTOR KIT 19A127290G1
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR4	19A116062P1	Selenium.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

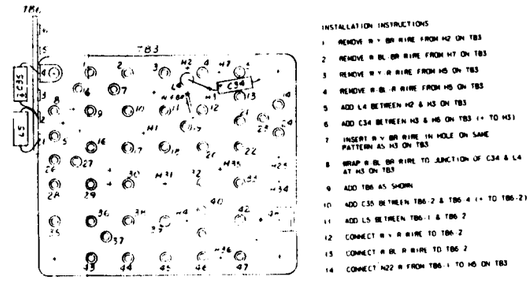
PRODUCTION CHANGES

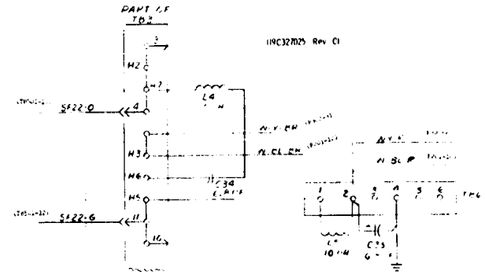
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A - To improve lightning protection.
Changed CR3, CR6 and CR9.

REV. B - To improve operation.
Changed C9, C25 and C31.

REV. C - 4KC20A12
To improve operation.
Added C34, C35, L4, L5, and TB6, on TB3.





REV. C - 4KC20A10, A11

REV. D - 4KC20A12
To improve operation.
Changed diodes CR3, CR6 and CR9 to 4037822P1.

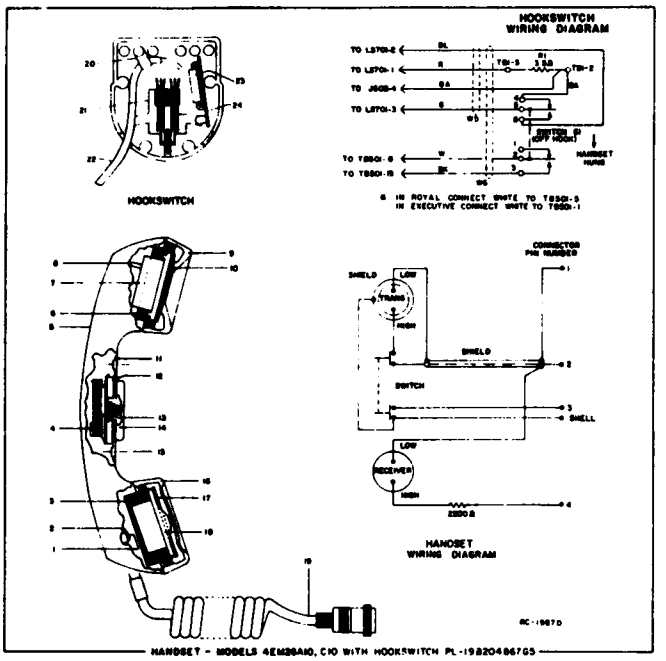
PARTS LIST

LBI-41208

HANDSET MODEL 4EM26A10
HANDSET MODEL 4EM26C10
HOOKSWITCH 19B204867G5
AND ASSOCIATED ASSEMBLIES

SYMBOL	GE PART NO.	DESCRIPTION
		(Refer to RC-1987)
1		Self tap screw, bind head: No. 4 x 5/16. Shure Brothers 30C640C.
2		Cable clamp. Shure Brothers 53A532.
3		Shield. Shure Brothers RP19.
4		Switch. Shure Brothers RP81.
5		Case. Shure Brothers RP48. (Used with 4EM26A10).
		Case. Shure Brothers 21RP809F. (Used with 4EM26C10).
6		Adapter. Shure Brothers 65A230.
7		Magnetic controlled cartridge, Receiver. Shure Brothers RP41.
8	3R77P822K	Resistor, composition: 2200 ohms ±10%, 1/2 w.
9		Receiver cap. (Part of item 5).
10		Washer. Shure Brothers 34A321.
11		Escutcheon. Shure Brothers 53A536A.
12		Actuator. Shure Brothers 53A556.
13		Spring. Shure Brothers 44A140.
14		Plunger bar. Shure Brothers RP62.
15		Flat head screw, socket cap: No. 4-40 x 1/4. Shure Brothers 30C557B.
16		Transmitter cap. (Part of item 8).
17		Washer. Shure Brothers 34A309.
18		Magnetic controlled cartridge, Transmitter. Shure Brothers RP13.
19		Cable and plug. Shure Brothers RP48. (Used with 4EM26A10).
		Cable and plug. Shure Brothers 21RP738F. (Used with 4EM26C10).
		HOOKSWITCH 19B204867G5
20	4029851P6	Cable clamp; sim to WEC Kenser 2/16-4.
21	19A121612P1	Holder and switch: thermoplastic case, contact rating 1 amp at 125 v.
22	19B205467G1	Cable: approx 8-1/2 feet long.
23	5493035P10	Resistor, wirewound, ceramic: 3.5 ohms ±5%, 5 w; sim to Tru-Ohm Type X-50.
24	7775500P65	Terminal board, phen: 5 terminals.
		ASSOCIATED ASSEMBLIES EXTENSION CABLE 19B204988G4
	7478736P6	Plug: 4 contacts, sim to Amphenol 91-MC4M.
	4034669P4	Cable, 6 ft.
	19A116061P1	Receptacle: 4 contacts; sim to Amphenol 91-PM4F-1000.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



(DF-4075)

SCHEMATIC & OUTLINE DIAGRAM

HANDSET MODELS 4EM26A10, C10
HOOKSWITCH 19B204867G5

RC-1784G

PA TRANSISTOR REPLACEMENT

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

To replace the PA transistors (Q2 through Q6):

1. Unsolder one lead at a time with a 50-watt soldering iron. Use a scribe to hold the lead away from the printed circuit board until the solder cools.

2. Turn the transmitter over and remove the unpainted Phillips-head screws holding the multiplier-filter, power detector, and output filter mounting assembly to the transmitter heatsink. Then swing the entire assembly away from the heatsink to expose transistor mounting holes.

3. Hold the body of the transistor to prevent it from turning. Next, remove the transistor hold-down nut and springwasher through the hole in the heatsink with an 11/32-inch nut-driver. Lift out the transistor, and remove the old solder from the printed circuit board.

4. Trim the new transistor leads (if required) to approximately 3/8-inch lengths (3/16 - inch lengths for Q3, Q4 and Q5 on 25-50 MHz transmitters). Cut the collector lead at a 45° angle for future identification (see Fig. 1). The letter "C" on the top of the transistor indicates the collector.

5. Apply a coating of silicone grease around the transistor mounting surface, and place the transistor in the mounting hole. Align the leads as shown in the Outline Diagram. Then hold the body of the transistor and replace the hold-down nut and spring washer, using moderate torque (7 to 9 inch-pounds maximum).

6. Make sure that the transistor is mounted as shown in Figure 2 so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.

7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor.

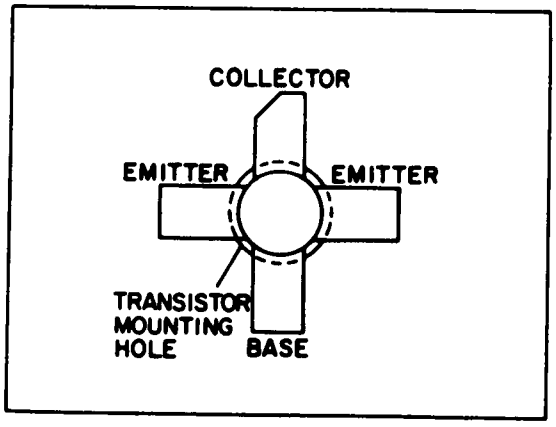


Figure 1 - Lead Identification

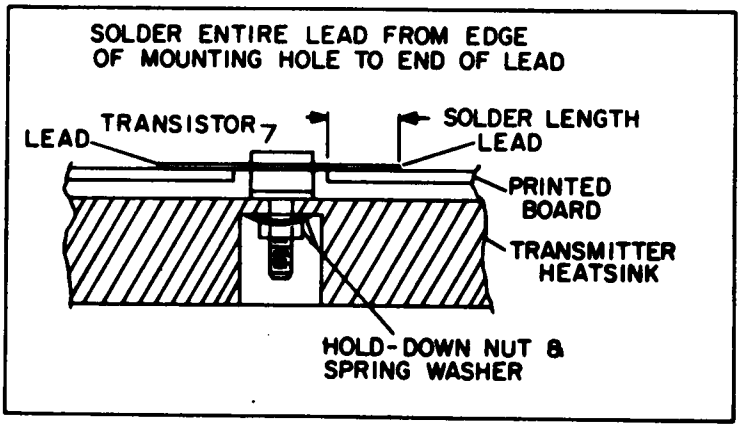
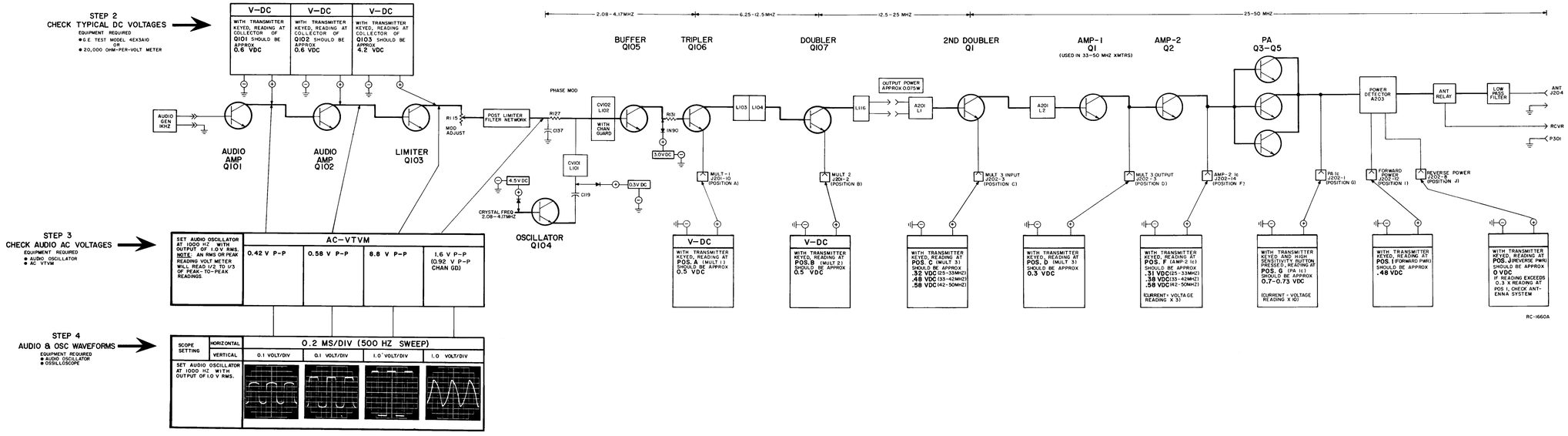


Figure 2 - Transistor Mounting

STEP 1 - QUICK CHECKS

Meter Position	Probable Defective Stage		
	High Meter Reading	Low Meter Reading	Zero Meter Reading
A (MULT-1)	Q104, Q105 or Q106 10-Volt Regulator	Q104, Q105, Q106 10-Volt Regulator	10-volt regulator, osc. crystal or Q104, Q105, Q106, F1 or F2 Keying Leads
B (MULT-2)	Q107, A201-Q1	Q107, MULT-1 Tuning	Q107
C (MULT-3) Input	A201-Q1	10-volt regulator, A201-Q1	10-volt regulator, A201-Q1
F (DRIVER Ic)	Top Voltage limiter, C11 Adjustment	Q1, Q2 or protective circuits activated* C11 Adjustment	Keyed 12.5 volts, short circuit protector, Q1, Q2
G (PA Ic)	Mis-aligned PA. Check Step 15 of Alignment Procedure	Q3, Q4, Q5 or protective circuits activated* Mis-aligned PA. Check Step 15 of Alignment Procedure	Keyed 12.5 volts, short circuit protector, Q3, Q4, Q5
I (Forward Power)	High power output. Check Step 15 of Alignment Procedure. Check Antenna System and Relay	Mis-aligned PA Check Step 15 of Alignment Procedure. Check Antenna System and Relay	No Power Output. W202 Connections
J (Reflected Power)	High VSWR- Check antenna system and relay	Low VSWR (NORMAL)	

* Refer to the power regulator Troubleshooting Procedure for check of protective circuits.



TROUBLESHOOTING PROCEDURES

25—50 MHZ TRANSMITTER TYPE ET-82-A

RC-1660A

STEP 1 - QUICK CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	Check power connections and continuity of supply leads, and check fuses. If fuse is blown, check for short circuits by disconnecting all plugs in the unit. Reconnect plugs one at a time until a fuse blows.
NO REGULATED 10 VOLTS	Check the 12-volt supply. Then check Q303 in 10-volt regulator and regulator circuit. Disconnect all plugs from the receiver, exciter board and option boards, and take resistance readings from jack pins to ground (Refer to Outline Diagrams).
LOW 2ND LIM READING	Check supply voltages and then check oscillator reading at J304-4 as shown in STEP 2A. Make SIMPLIFIED VTVM GAIN CHECKS from 2nd Mixer through 2nd Limiter stages as shown in STEP 2A. Check receiver RF alignment (refer to Receiver Alignment Procedure.
LOW OSCILLATOR READING	Check alignment of Oscillator (Refer to Front End Alignment Procedure). Check voltage readings of Q302 and Q303. Check resistance readings on J302-1, -2 and -3. Check crystals Y401 and Y402.
LOW RECEIVER SENSITIVITY	Check Front End Alignment (Refer to Receiver Alignment Procedure). Check input signal required for 0.2-volt reading at LIM-1. Reading should be less than 20 µv. Check antenna connections, cable and relay. Check voltage readings of 1st and 2nd RF Amps and 1st and 2nd Mixers. Make SIMPLIFIED GAIN CHECKS (STEP 2A).
LOW AUDIO	Check Audio PA (Q504 and Q505) output current at J304-9. If reading is low -- a. Check BIAS ADJ for 1,3 VDC at J304-9. If incorrect, set for 1,3 v with R392 (Position G on Test Set). b. If correct, check for minimum bias current reading of 14 milliamps at J4. Make SIMPLIFIED GAIN and WAVEFORM CHECKS (STEPS 2A and 2B) of Audio and Squelch Stages. Check unsquelched DC voltage readings in Audio section (Refer to Receiver Service Sheet). Check voltage readings on Channel Guard receiver. Check setting of SQUELCH control R400 (Refer to Receiver Alignment Procedure).
IMPROPER SQUELCH OPERATION	Make GAIN and WAVEFORM CHECKS (STEPS 2A and 2B) of Audio and Squelch stages. Check voltage readings of Squelch circuit (Refer to Receiver Service Sheet).
DISCRIMINATOR IDLING TOO FAR OFF ZERO	See if discriminator zero is in the center of IF bandpass.

STEP 3- GAIN-PER-STAGE READINGS-

EQUIPMENT REQUIRED:

1. RF VOLTMETER (SIMILIAR TO BOONTON MODEL 91-CA OR HELLYAC TYPE HV-18 C.
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). CORRECT FREQUENCY CAN BE DETERMINED BY ZEROING THE DISCRIMINATOR.

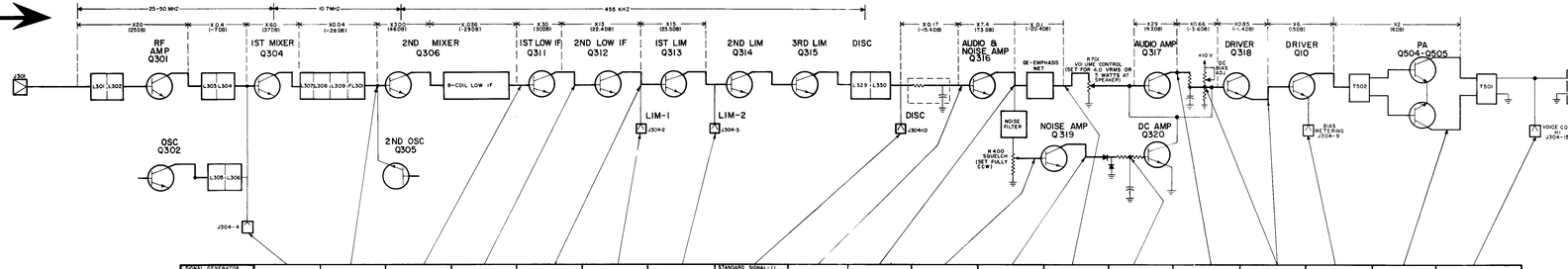
PROCEDURE

1. APPLY PROBE TO INPUT OF STAGE (FOR EXAMPLE, BASE OF RF AMP), PEAK RESONANT CIRCUIT OF STAGE BEING MEASURED AND TAKE VOLTAGE READING (E_1).
2. MOVE PROBE TO INPUT OF FOLLOWING STAGE (1ST MIXER*). REPEAK FIRST RESONANT CIRCUIT THEN PEAK CIRCUIT BEING MEASURED AND TAKE READING (E_2).
3. CONVERT READINGS (BY SUBTRACTING E_1, FROM E_2 ON THE DB SCALE OF RF VOLTMETER, OR) BY MEANS OF THE FOLLOWING FORMULA:

   AMP FACTOR- $\frac{E_2}{E_1}$

4. CHECK RESULTS WITH TYPICAL GAINS SHOWN ON DIAGRAM BELOW.
5. USE PROCEDURE LISTED ABOVE TO FIND GAIN OF EACH STAGE.

* NOTE: REMOVE CRYSTAL OR SHORT OUT OSC. BASE BEFORE MEASURING MIXER STAGES TO ELIMINATE INJECTION VOLTAGE.



STEP 2A- SIMPLIFIED VTVM GAIN CHECKS

EQUIPMENT REQUIRED:

1. VTVM-AC&DC
2. SIGNAL GENERATOR (MEASUREMENTS M560 EQUIV.)

PRELIMINARY STEPS:

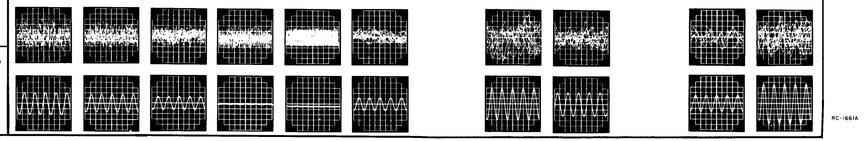
1. SET VOLUME CONTROL FULLY CLOCKWISE.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. RECEIVER SHOULD BE PROPERLY ALIGNED.

SIGNAL GENERATOR INPUT IN .22 MICROVOLTS AT DISCRIMINATOR ZERO		UNMODULATED	UNMODULATED	UNMODULATED	UNMODULATED	10 MICROVOLTS UNMODULATED	1 MICROVOLT UNMODULATED	STANDARD SIGNAL (1 MICROVOLT MODULATED AT 1KHZ WITH 3.5KHZ DEVIATION)	STANDARD SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL	NO SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL	NO SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL
PROCEDURE		INCREASE GENERATOR OUTPUT UNTIL VTVM READING INCREASES BY 50 MV	INCREASE SIGNAL GENERATOR OUTPUT FROM ZERO UNTIL VTVM READING INCREASES BY 5%	INCREASE SIGNAL GENERATOR OUTPUT FROM ZERO UNTIL VTVM READING INCREASES BY 5%	INCREASE SIGNAL GENERATOR OUTPUT FROM ZERO UNTIL VTVM READING INCREASES BY 5%														AFTER CHECKING WAVEFORMS ADJUST VOLUME CONTROL FOR RATED 5 WATT OUTPUT ACROSS 3.2 Ω LOAD
READING	0.28 VDC EX-3-A ON VDC MULTIMTR 0.1 VDC	GENERATOR OUTPUT SHOULD BE APPROX 3 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 400 MICROVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 70 MICROVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 5 MICROVOLTS	0.82 VDC EX-3-A 0.2 VDC MULTMTR 0.4 VDC	1.6 VDC EX-3-A 0.4 VDC MULTMTR 0.8 VDC	0.57 VAC	0.05 VAC	0.89 VAC	0.045 VAC	1.2 VAC	.03 VAC	0.56 VDC	0.34 VAC	0.5 VAC	1.3 VDC	5.8 VAC (COLLECTOR TO GROUND)	4.0 VAC

SCOPE SETTING	HORIZONTAL	0.5 MS/DIV (APPROX 200 Hz)	0.5 MS/DIV	0.5 MS/DIV	0.5 MS/DIV	0.5 MS/DIV	0.5 MS/DIV		0.5 MS/DIV	0.5 MS/DIV		0.5 MS/DIV	0.5 MS/DIV
	VERTICAL	0.5 VOLT/DIV	100 MILLIVOLTS/DIV	1 VOLT/DIV	100 MILLIVOLTS/DIV	1 VOLT/DIV	100 MILLIVOLTS/DIV		200 MILLIVOLTS/DIV	500 MILLIVOLTS/DIV		5 VOLTS/DIV	2 VOLTS/DIV
PEAK-TO-PEAK VOLTAGE		2.2 V P-P	340 MV P-P	2.6 V P-P	0.4 V P-P (NOISE)	3.0 V P-P (NOISE)	0.24 V P-P		1.2 V P-P	1.4 V P-P		16 V P-P	11.5 V P-P

NOISE WAVE FORM

STANDARD SIGNAL (1 MILLIVOLT AT RECEIVER FREQ MODULATED BY 1 KHZ WITH 3.5 KHZ DEVIATION)



RC-1661A

TROUBLESHOOTING PROCEDURES

25—50 MHZ RECEIVER TYPE ER-46-A

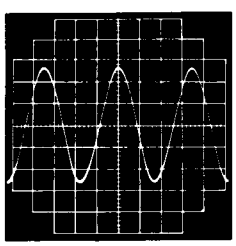
RC-1661A

EQUIPMENT REQUIRED:

1. Audio Generator Model 4EX6A10
2. AC-VTVM
3. Milliammeter
4. Oscilliscope

SYMPTOM	DESCRIPTION
No Audio From Receiver	1. Check basic receiver. 2. Check for audio voltage at TB1-1 & TB1-2. (If audio is present, trouble is in telephone line or control console). 3. Check for defective R14, C13, C1 or T1.
Unable To Receive F1	1. Check for 0 milliamps of control current at TB1. 2. Ground TB501-11 and check basic receiver. 3. Check switches Q10 & Q11. In F1 operation, collector of Q11 (measured to ground) should be 0.100 volt maximum. 4. Check for 0 voltage across C28. If not 0, check for shorted CR6 or CR9.
Unable To Receive F2	1. Check for -6 milliamps of control current at TB1. 2. Ground TB501-12 and check basic receiver. 3. Apply -6 milliamps to TB1 and check switch Q8. Collector of Q8 (measured to ground) should be 0.100 volt maximum. 4. Apply -6 mA to TB1 & check for approx. 2.8 volts across C28. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1, (see Fig. A), T5, CR9 and amp Q9.
Unable To Monitor Channel Guard	1. Check for +6 milliamps of control current at TB1. 2. Ground TB501-19 and check receiver Channel Guard. Then follow steps 3 thru 6 of above.
Unable To Key Transmitter	1. Check for proper control current at TB1. 2. Ground TB501-15 and check basic station. 3. Apply proper control current and check for approx. 5.5 V (measured to ground) at emitter of Q3. If present, collector of Q4 should be 0.5 volt maximum. 4. With proper control control current at TB1, check for approx. 6.0 volts at Q3 base. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1 (see Fig. A), T3, CR3, and amp Q2.
Unable To Transmit In F1	1. Check for +6 milliamps of control current at TB1. 2. Ground TB501-11, key transmitter and check basic transmitter F1. 3. Check switches Q10 & Q11. In F1 operation, collector of Q11 (measured to ground) should be 0.100 volt maximum. 4. Check for 0 voltage across C28. If not 0, check for shorted CR6 or CR9.
Unable To Transmit In F2	1. Check for +15 milliamps of control current at TB1. 2. Ground TB501-12, key transmitter by applying +15 milliamps to TB1 and check basic transmitter F2. 3. Apply +15 milliamps of control current to TB1 and check switch Q8. Collector of Q8 (measured to ground) should be 0.100 volt. 4. Apply +15 milliamps of control current to TB1 and check for approx. 2.8 volts across C28. 5. Check for approx. 22 VDC across VR1. 6. Check bias osc Q1 (see Fig. A), T4, CR6 and amp Q7.
No Transmitter Audio When Keying From A Remote Console	1. Apply approx 3 volts of audio at 1000 Hz to TB1-1 & 2 and check for audio at arm of R23. 2. Apply proper transmit control current to TB1 and check for audio at emitter of Q5. 3. Check for approx. 5.5 VDC at junction of R17 & R18 with proper keying current applied at TB1. 4. Check C14, C15 and audio switch Q5.
No Transmitter Audio When Keying From Local Station	1. Apply 0.1 volt of audio at 1000 Hz to local mike jack and check for approx. 0.350 volts at E3. 2. Check for approx. 0.350 volts at E1 with audio applied per Step 1 above. 3. Check C16, C17 and audio switch Q6.

1 μ SEC/DIV



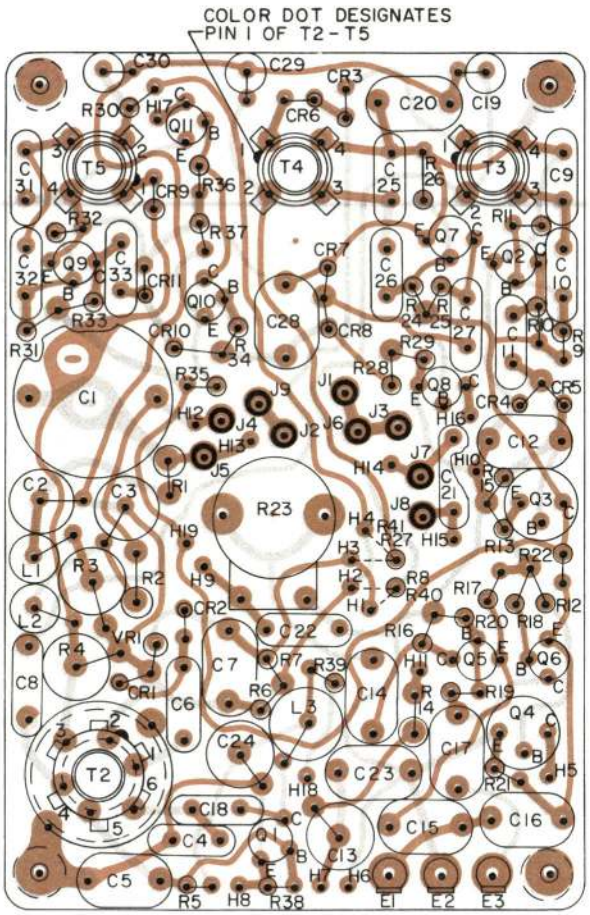
0.2 VOLTS/DIV
(1 VOLT P-P)

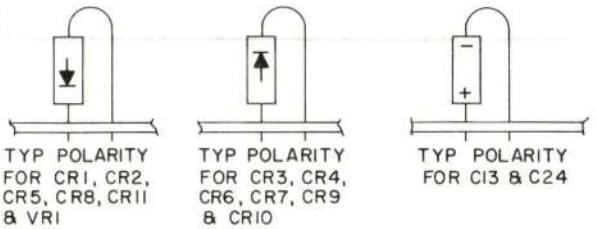
Figure A - Waveform at Base of Q1

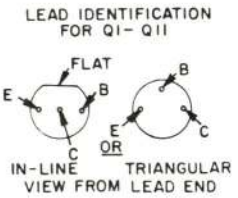
DF-4092

TROUBLESHOOTING PROCEDURE

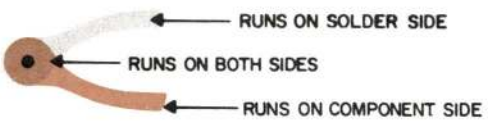
REMOTE CONTROL MODEL 4KC20A10-12







(19C317059, Rev. 0)
(19B216220, Sh. 1, Rev. 0)
(19B216220, Sh. 2, Rev. 0)



REMOTE CONTROL ADJUSTMENT

Before setting REMOTE LINE LEVEL control R23 on the remote control board, make sure that all power, telephone line and ground connections have been completed at the station and the remote control console, and the station transmitter and receiver are properly aligned. In Wall Mount stations, set VOLUME CONTROL R701 for not more than 6 volts RMS at TB1-1 and -2 with ±5 kHz deviation at 1000 Hz applied to the station antenna jack. In Desk Top stations with local/remote, adjust VOLUME CONTROL R3002 for 3.1 volts as measured across T-pad R3001.

To set the REMOTE LINE LEVEL control:

1. Apply a 1000 Hz signal to the microphone jack on the remote control console. Use a 30 millivolt signal level for the Transistorized Control Console, Deskon or Radio Control Center, and a 50 millivolt signal level for the RC4.

2. Key the transmitter from the remote control console and set REMOTE LINE LEVEL control R23 for a reading of 120 mV at TB3-20 & 32.

OUTLINE DIAGRAM & ADJUSTMENT PROCEDURE

REMOTE CONTROL MODEL 4KC20A10-12

RC-1782A
****

EQUIPMENT REQUIRED:

RF Signal Generator
Pulse Generator Model 4EX4A10
DC-VTVM
Oscilloscope

CHECK FOR THE FOLLOWING	PROCEDURE
Check for noise blanker operation	1. Connect the signal generator and pulse through a tee connector to the receiver antenna jack. 2. Set the signal generator for on onfrequency, one microvolt unmodulated output, and set the pulse generator for a 1.5 kHz output. 3. Disable the blanker by shorting J302-4 to ground (see Outline Diagram), and listen for noise in the receiver output. 4. Remove the short from J302-4 and listen for noise blanking.
IF BLANKER IS NOT OPERATING:	
Check DC voltages	Check voltage readings on Q451 through Q455, and bias voltage on CR451 and CR452 (refer to the Receiver Schematic Diagram). NOTE To avoid damaging the casting, use a heavy-duty soldering iron to melt the the solder connections as quickly as possible. Then insert a knife blade and carefully pry lid off of blanker compartment.
Check RF amplifier and pulse generator stages	1. With no signal in, check the collector of Q453 for a reading of 13 volts DC. 2. Apply an on-frequency signal to the antenna jack. Increase the signal level until the meter reading at Q453 collector drops rapidly to zero. This should occur with a signal input of 100 to 150 microvolts.
Check pulse squarer stages	1. Connect the pulse generator to the receiver antenna jack and set the output for 1.5 kHz. 2. Check with oscilloscope at the collector of Q455 for negative square wave pulses from 10 to 12 volts.

ORDERING SERVICE PARTS

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

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

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

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

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

MAINTENANCE MANUAL
LBI-4004

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GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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