Customer HERRICK

G. E. Req. No. X 102 3646-3

Customer Order No. _____

communications

MAINTENANCE MANUAL

VOICE COMMANDER

132-174 Megacycles

1-Watt

Personal FM Transmitter-Receiver

LBI-3459

COMMUNICATION PRODUCTS DEPARTMENT

GENERAL ELECTRIC

LYNCHBURG, VIRGINIA

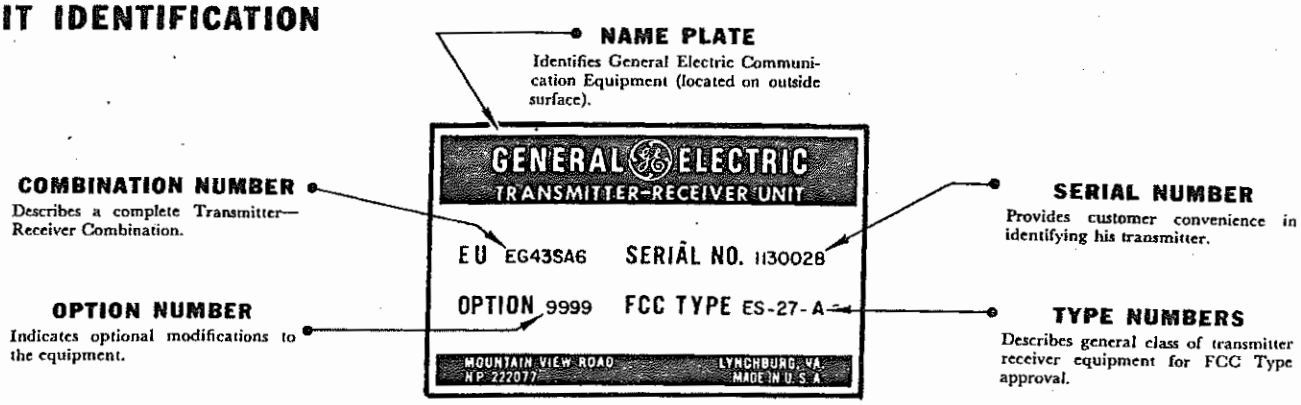
PRINTED IN U.S.A.

5153

INTRODUCTION

The following information has been included to assist the serviceman in the use of this book.

UNIT IDENTIFICATION



Model Number—Describes unit in detail for proper identification (e. g. Transmitter Board Model 4EF20A10)

WARNING

NO ONE SHOULD BE PERMITTED TO HANDLE ANY PORTION OF THE EQUIPMENT THAT IS SUPPLIED WITH HIGH VOLTAGE; OR TO CONNECT ANY EXTERNAL APPARATUS TO THE UNITS WHILE THE UNITS ARE SUPPLIED WITH POWER. **KEEP AWAY FROM LIVE CIRCUITS.**

PRODUCTION CHANGES

Revision Letters—Changes in the equipment to improve performance or simplify circuits are identified by a revision letter stamped after the model number on the Unit Nameplate or Stamping. Any given revision includes all previous revisions.

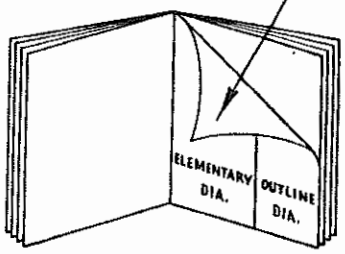
Production Changes—List all changes up to and including the latest revision of the unit. They are found on the service sheets and should be used for checking and/or correcting instructions to correspond with the equipment being serviced.

SERVICE PARTS

1. ***Parts List*** — Gives symbol number, description and part numbers of the principal service parts in each unit.
2. ***Symbol Numbers*** — Each component appearing on the Elementary Diagram and Parts List is identified by the Symbol Number for easier identification.
3. ***Where to Order*** — Service Parts may be obtained from Authorized G.E. Service Stations or through any G.E. Communication Equipment District Sales Office (see list at end of book).
4. ***Ordering*** — When ordering a part, the following information should be given:
   1. Symbol Number
   2. Description
   3. Part Number
   4. Model Number of Unit
   5. Revision letter stamped on Unit.

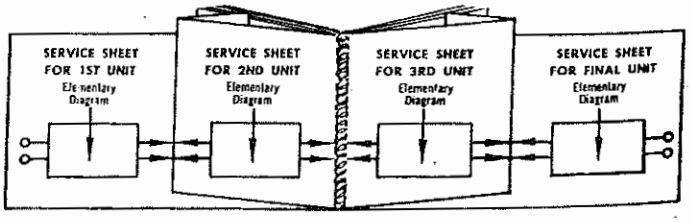
SERVICE SHEETS

Parts List & Production Changes



Each transmitter or receiver consists of several units, each identified by a Model number. Each unit has its own Elementary Diagram, Outline Diagram, Parts List and Production Changes, printed on a Service Sheet as shown on the left.

These Service Sheets can be unfolded to form a complete transmitter or receiver diagram as shown on the right.



EQUIPMENT INDEX

EQUIPMENT	MODEL OR PL NUMBER
FM TRANSMITTER	
Transmitter Board	
132-150 MC	4ET52B10
132-150 MC (Two-Frequency)	4ET52B20
150-174 MC	4ET52B11
150-174 MC (Two-Frequency)	4ET52B21
FM RECEIVER	ER-37-A & B
RF Amplifier	
132-150 MC	4EA19A10
150-174 MC	4EA19A11
Front End Board	
132-150 MC	4EF14A10
150-174 MC	4EF14A11
High IF Gain & Low IF Filter Board	
Narrow Band	4EF29A11
Wide Band	4EF29B11
Low IF Gain & Discriminator Board	4EL13A10
Audio and Squelch Board	
Narrow Band	4EA18A10
Wide Band	4EA18A11
Receiver Can	B-5492085-G1
Front End Cover	A-4036359-G1
Filter Cover	A-4036360-G1
Discriminator Cover	B-5492088-P1
CONTROL UNIT	4EC55A10
Front Case	5499311-P1
POWER SUPPLIES	
Dry Battery	4EP31A10
Bottom Case	5496268-P1
Rechargeable Battery	4EP32A10
Bottom Case	19B204273-P1
BACK CASE	19D402136-P1
ALIGNMENT TOOL	4038831-P1
OPTIONAL EQUIPMENT	
Earpiece Kit--Option 5906	19A121068-G1
Carrying Case--Option 5904	19A400138-P1
Battery Charger--Option 5902	4EP33A10
Lapel Speaker--Option 5914	19B209076-P1
Cord	5495088-P12
Antenna Adapter Cable--Option 5915	19A115219-P1
External Microphone with Push-To-Talk Switch-Option 5918	19C307082-P1

SPECIFICATIONS

GENERAL

FREQUENCY RANGE	132-174 Megacycles
SIZE (HxWxD)	9.5"x5.3"x1.7"(excluding antenna & hardware)
OPERABLE TEMPERATURE RANGE	-20°C to +50°C
BATTERY LIFE	
Dry Battery	48 Hours (10% EIA duty cycle) 800 Hours (Standby)
Rechargeable Battery	28 Hours (10% EIA duty cycle) 310 Hours (Standby)

TRANSMITTER

FCC TYPE NUMBER	ET-52-B
RF POWER OUTPUT	1 watt minimum at 15 volts
MAXIMUM RECOMMENDED FREQUENCY SPACING	0.7% of Operating frequency
CYRSTAL MULTIPLICATION FACTOR	8
FREQUENCY STABILITY	±.0005% (-10°C to +50°C) ±001% (-30°C to -10°C
SPURIOUS AND HARMONIC RADIATION	-43 db
MODULATION	Wide-Band: Up to ±15 KC (Max) deviation for 100% Narrow-Band: Up to ±5 KC (max) deviation for 100%
AUDIO DISTORTION	10% max.
TRANSISTOR AND DIODE COMPLEMENT	9 Transistors 2 Diodes

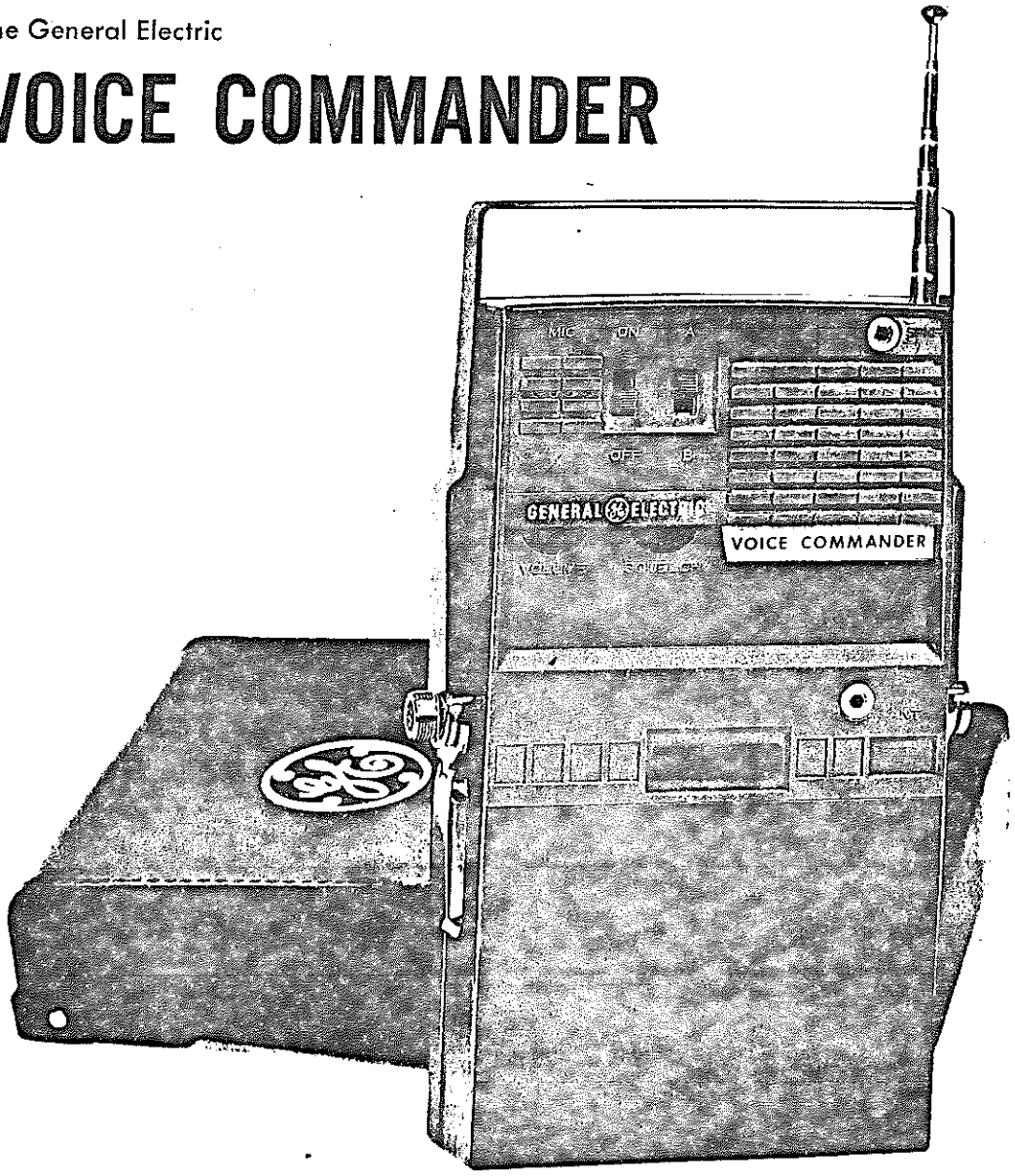
RECEIVER

FCC TYPE NUMBER	ER-37-A,B
CHANNEL SPACING	30 KC (N-B) 60 KC (W-B)
MODULATION ACCEPTANCE	±5 KC (N-B) ±15 KC (W-B)
FREQUENCY STABILITY	.0015%
SELECTIVITY	NB (30 KC) WB (60 KC)
EIA	-45 db -45 db
20 db quieting	-55 db 50 db
SPURIOUS AND IMAGE REJECTION	Greater than 45 db
SENSITIVITY	Narrow-Band: Less than 0.7 uv for 20 db quieting. Less than 0.5 MV for 12 db SINAD. Wide-Band: Less than 1.0 uv for 20 db quieting. Less than 1.7 uv for 12 db SINAD.
AUDIO OUTPUT	500 mv with less than 10% distortion.
SQUELCH SENSITIVITY	Narrow-Band: Less than 0.35 uv Wide-Band: Less than 0.5 uv
TRANSISTOR AND DIODE COMPLEMENT	13 Transistors 5 Diodes

The equipment described above meets or exceeds all applicable EIA (RETMA) and FCC specifications. Specifications are subject to change without notice.

the General Electric

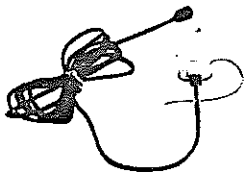
VOICE COMMANDER



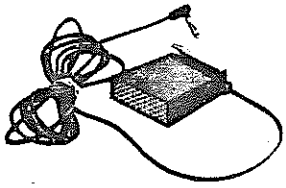
CARRYING CASE
OPTION 5904

VOICE COMMANDER FURNISHED WITH A FLEXIBLE WHIP ANTENNA

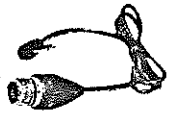
OTHER OPTIONS



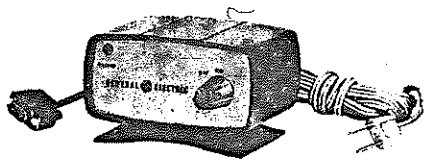
EARPIECE KIT
OPTION 5906



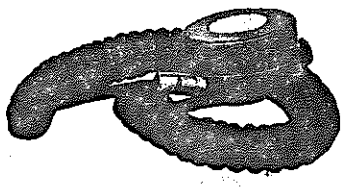
LAPEL SPEAKER
OPTION 5914



ANTENNA ADAPTER
OPTION 5915



BATTERY CHARGER
OPTION 5902



EXTERNAL MIKE
OPTION 5918

GENERAL ELECTRIC
VOICE COMMANDER
PERSONAL FM TRANSMITTER-RECEIVER

DESCRIPTION

The General Electric VOICE COMMANDER Personal Transmitter-Receiver is a high performance, completely self-contained two-way FM radio. Extremely compact and lightweight, the VOICE COMMANDER is simple to operate and easily hand-carried. An optional leather carrying case permits the unit to be carried by a shoulder strap or worn hooked to the belt, leaving the hands free.

Both the transmitter and receiver of the VOICE COMMANDER are completely transistorized. Extensive use of transistors provide:

1. Reduced power requirements
2. Smaller size
3. Increased battery life
4. Greater reliability
5. Reduced maintenance costs

All metering points and tuning adjustments are easily accessible, and the modular construction permits rapid replacement of modules for easier maintenance.

The VOICE COMMANDER is housed in a high-impact, scratch resistant, two section plastic case. All external hardware for the unit is polished stainless steel. The top section of the case contains the transmitter and receiver modules, built-in microphone and speaker, antenna, carrying handle, and all switches and controls. The carrying handle may also be used as a support for propping the VOICE COMMANDER upright.

The bottom section of the case contains the battery power supply. All power connections to the top section of the case are made by a plug and jack connection. The batteries are mounted in a battery holding rack that slides out of the bottom section of the case for ease of servicing and maintenance.

OPERATION

Power is applied to the unit by moving the OFF-ON slide switch to the ON position. Depressing the Push-To-Talk switch removes the power from the receiver, applies power to the transmitter and switches the antenna to the transmitter output. When the PTT switch is released, the receiver becomes operative again.

The two adjustable controls marked VOLUME and SQUELCH should be adjusted at the start of operations. The VOLUME control raises or lowers the sound level as heard from the loudspeaker. Adjusting the SQUELCH control eliminates noise from the loudspeaker when no signal is being received.

To transmit a message, the telescoping antenna should be pulled out to its fully extended position. Hold the unit approximately four to six inches from the mouth; then press the PTT switch and speak directly into the microphone at a normal speaking level. It is to the operator's advantage to try a few calls and, through practice and constructive criticism at the receiving end, develop a microphone technique that is best suited to his characteristics of speech.

MAINTENANCE

The VOICE COMMANDER should be placed into operation as soon as possible after receiving the shipment. If the unit is to be stored for a long period of time, the dry batteries should be removed and stored separately in a cool dry place. Dry batteries have a normal shelf life of approximately six to eight months. If stored too long, they may leak electrolyte when placed into the equipment.

The rechargeable nickle-cadium batteries may be stored indefinitely without damage. However, if stored for over 30 days the batteries should be fully recharged (16 hours) before using.

When stored, the unit should be checked every three months. Operate the switches and mike button, and rotate the controls to keep contacts free of dust and corrosion.

PREVENTIVE MAINTENANCE

To insure good electrical continuity and high operating efficiency, routine checks should be made of all mechanical and electrical connections and parts. Battery contacts should be periodically checked for tightness. Loose or poor connections will cause excessive voltage drops and faulty operation may result.

Battery voltages should be checked at regular intervals and the batteries replaced or recharged when voltages fall to 10.5 volts. Measurements should be made with the batteries under transmit conditions.

DISASSEMBLY

To gain access to the transmitter and receiver boards, first detach the power supply section. Then remove the three screws as shown in Figure 1 and lift off the back cover.

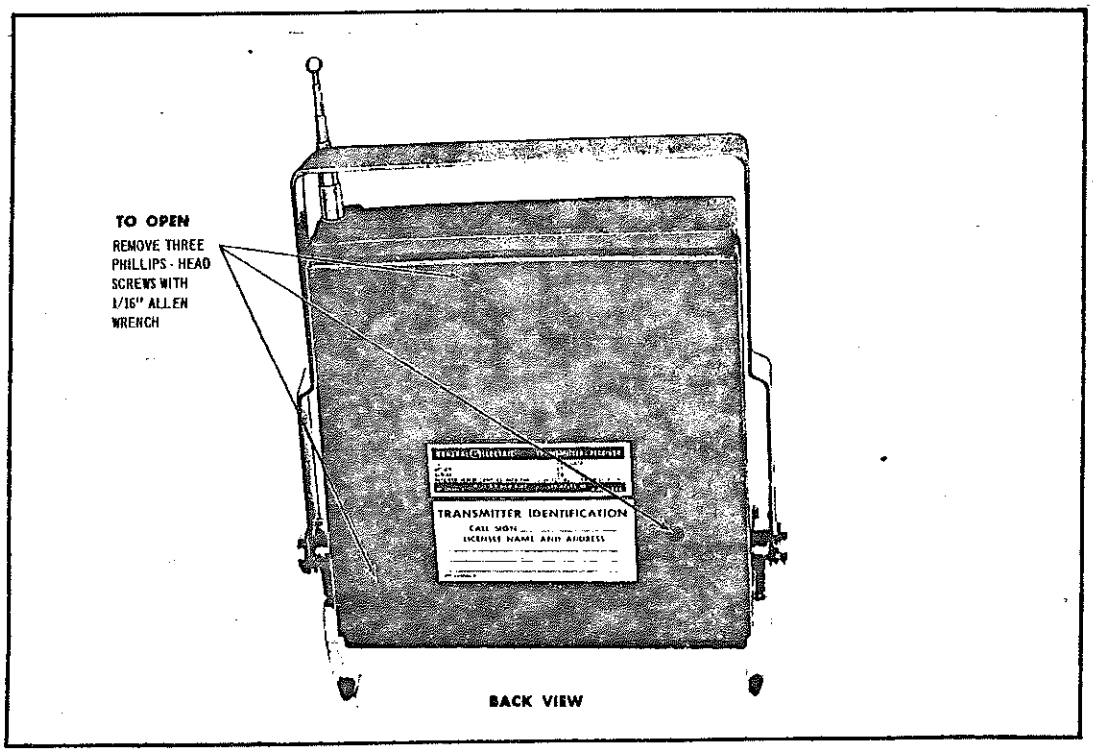


Figure 1 - Disassembly for Alignment or Servicing

The power supply section is easily detached from the top portion of the case. Simply release the two spring clips on the sides of the unit and unplug the power supply section from the main unit. The procedure for disassembling the power supplies is contained in the Circuit Analysis section for the units.

PRINTED WIRING CIRCUITS

Printed circuits have definite advantages in servicing and troubleshooting. All components and metering points are accessible, and leads can be easily seen. Readings can be taken directly at the socket pins and at most component leads on either the top or bottom of the printed boards.

Replacing Components

Replacing components on printed boards is relatively simple. Damage can be done to the printed board, however, by either excessive heat applied during soldering or in replacing a component. Overheating can cause the bond between the board and the copper foil to break. Use a low wattage soldering iron to prevent this damage. Make certain any splashes of solder are removed to prevent shorts.

Capacitors and Resistors

There are two methods recommended for replacing capacitors and resistors in printed boards. Method 1 can be used to replace a component without removing the board from its mounting.

Method 1 - Follow steps A, B, C & D shown in Figure 2:

An easy way to replace a component without exposing the board to excessive heat.

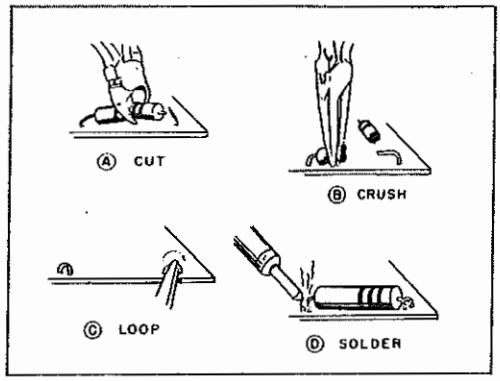


Figure 2 (Method 1)

Method 2 - Cut the leads on the old component as close as possible to the printed board. Heat the solder joint at the bottom side of the board and pull the remainder of the old leads through the bottom. Clean the holes and insert the new component. Bend the leads over the bottom of the board and clip the excess. Solder the joints.

Replacement of a component using a jig made of two small slotted wooden blocks. This jig prevents broken connections which might result from bending flexing the board.

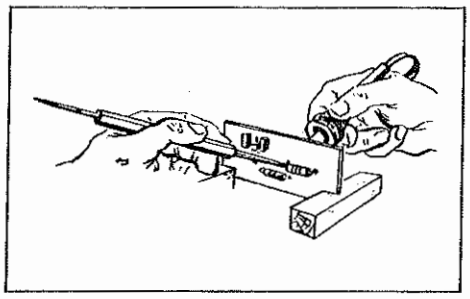


Figure 3 (Method 2)

Coils, Shields, Printed Sub-Assemblies and Controls

While applying the soldering iron to each individual lug, brush off any molten solder with a small brush. Take care not to spread solder in order to avoid shorts. When lugs and holes are clean, straighten lugs (while solder is melted) and free the lugs from the board. When all lugs are free, the component can be lifted out.

Repairing Printed Boards

In the event that the copper foil has been damaged, the break can be repaired by flowing solder across the gap, or if the gap is too large, it can be bridged by soldering a piece of hook-up wire across the gap.

If the copper foil becomes raised from the board, clip off the raised portion and replace it with a section of wire.

Small "hairline" breaks in the continuity of printed wiring can normally be found by visual examination or with the aid of a magnifying glass. Through the use of printed circuits, the possibility of intermittents occurring has been greatly reduced. When encountered, however, moving of component leads should be used to locate the point, rather than flexing of the board.

TRANSISTORIZED CIRCUITS

Servicing transistorized equipment requires some special techniques that are easily acquired. The following service tips are intended as a guide in developing these techniques.

Trouble Shooting

Transistorized circuits require essentially the same troubleshooting techniques as conventional vacuum-tube circuits. The usual order for locating troubles is still:

1. Use of symptoms discovered by eye and ear, simple realignment, and test jack readings to localize trouble.
2. Substitution of components in suspected stages.
3. Use of voltage readings, resistance readings, signal injection, realignment, sensitivity measurements, and gain measurements to further identify faulty components.
4. Replacement of suspected component.
5. Check out and adjustment of affected circuits.

Transistor Checking and Replacement

A transistor suspected to be defective can either be checked by the substitution method or by the use of a suitable transistor checker.

Equipment using transistors soldered directly to terminals or printed board require special treatment. Care must be taken to avoid overheating the transistor while soldering. Even other transistors near the one being soldered can be damaged.

Always check the circuit for defects which could damage the new transistor being placed into the circuit.

A heavy duty soldering iron should not be used. Make certain that the iron to be used does not have current leakage. An isolation transformer can be used to prevent current leakage.

A transistor should never be removed or replaced while power is on, as a surge of current may damage the transistor.

If the leads from a transistor are disconnected, make sure that each wire is reconnected to the proper place. Otherwise, voltages of reversed polarity may be applied across a transistor which may damage it.

EU PB630A6

S/N 323 0530

ET-52B

ER-37A NARROW BAND

CIRCUIT ANALYSIS

TRANSMITTER

BOARD 4EA18A10 REV A

Transmitter Type ET-52-B was designed for use with the General Electric VOICE COMMANDER for operation of fixed frequencies within the 132-174 megacycle band. The following chart shows the number of frequencies and frequency range of each transmitter model.

4EF29A11

4EF14A11

132-150 Megacycles	
Single-Freq.	Two-Freq.
4ET52B10	4ET52B20

150-174 Megacycles	
Single-Freq.	Two-Freq.
4ET52B11	4ET52B21

These transmitters employ three transistors in the oscillator and multiplier stages, two transistors in the audio stages, and four transistors in the driver, IPA and power amplifier stages. An additional oscillator-doubler transistor is used in two-frequency units.

The complete transmitter is assembled on one board. Although extremely compact, all alignment adjustments and metering points are readily accessible on one side of the printed circuit board.

Reference to symbol numbers mentioned in the text below are found on the Service Sheet, Alignment Chart and Block Diagram.

Transmitter Type ET-52-B is a crystal-controlled, frequency-modulated transmitter having a minimum RF power output of 1-watt. The crystals used fall in a range from 16.5 to 21.6 megacycles. The multiplier stages multiply the crystal frequency 8 times.

AUDIO PREAMPLIFIER AND LIMITER

An audio signal from the microphone is coupled through C139 to the base of the Class A audio preamplifier Q109. The design of the microphone and its enclosure produces an inherent 6-db audio pre-emphasis.

The amplified audio signal is coupled directly to the base of the audio limiter Q110. Q110 is biased so that any audio peaks that might produce overmodulation drive the transistor into saturation and limiting results. When the signal isn't strong enough to cause limiting, the transistor acts as an audio amplifier.

Following the limiter is a post-limiter filter consisting of R125, L127 and C136. The post-limiter filter reduces unwanted side-band energy developed as a result of the limiter range.

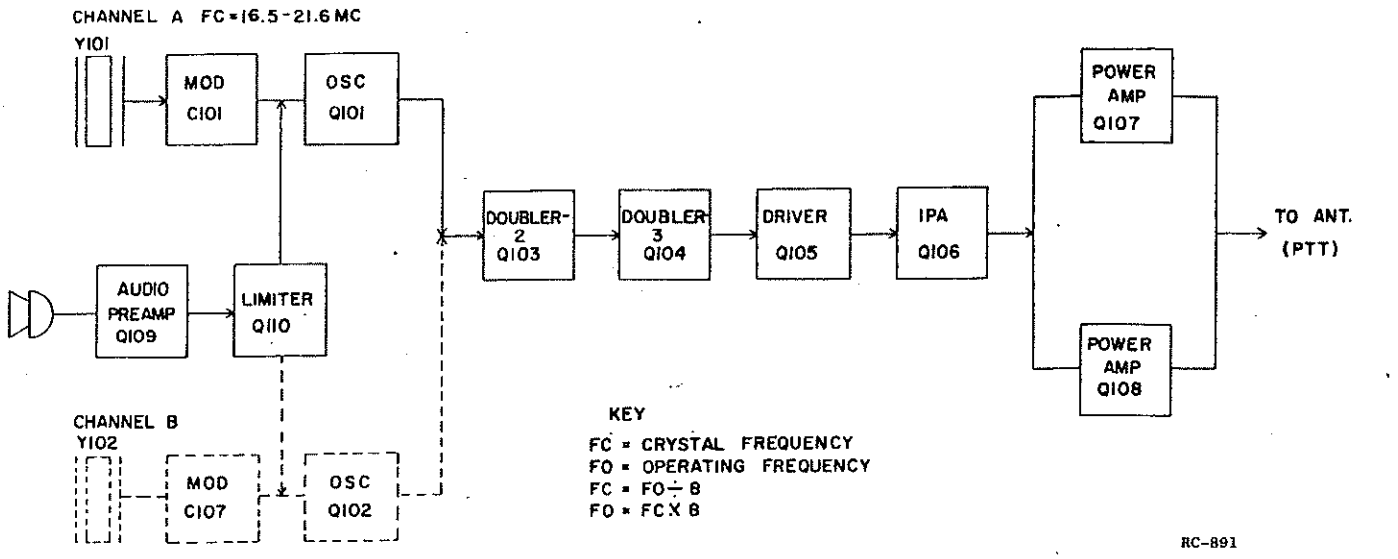


Figure 4 - Transmitter Block Diagram

The MODULATION ADJUST control R125 determines the maximum signal level applied to the oscillator and modulator stage.

OSCILLATOR-DOUBLER AND MODULATOR

Transistor Q101 operates in a grounded collector, Colpitts oscillator circuit. Feedback for the oscillator is developed across C104. A regulated 6-1/2-volt supply for the oscillator and voltage sensitive capacitor C101 is derived from the -15-volt supply by means of Zener diode VR101. The frequency of the oscillator is adjusted by L103/L104 in series with the crystal. Adjusting L101/L102 changes the series resonance of the crystal circuit and causes rubbering of the oscillator frequency.

For two-frequency transmitters, a second oscillator stage identical to the one described above is added.

An audio signal from the limiter is applied through RF decoupling resistor R103 to the voltage sensitive capacitor C101. The audio voltage varies the capacitance of C101 at an audio rate. As C101 is in series with the crystal, this variation in capacitance causes the output of the modulator to be frequency modulated. The oscillator-doubler collector tank is tuned to twice the crystal frequency. This stage is metered at J101.

DOUBLERS

Following the oscillator-doubler, the RF signal undergoes two more stages of multiplication by means of Class C, grounded emitter doublers Q103 and Q104. The collector tank of doubler Q103 is tuned to four times the crystal frequency and is metered at J102. The collector tank of the third doubler (Q104) is tuned to eight times the crystal frequency. This stage is metered at J103.

DRIVER, IPA AND POWER AMPLIFIER

The third doubler output is coupled to driver Q105 through a double-tuned circuit. Q105 operates in a common base circuit with the collector grounded directly to the printed wiring board, using the board as a heat sink. The driver tank is tuned by C119 and is metered at J104.

The driver output is impedance-coupled to the base of the IPA Q106. The IPA provides the necessary drive for the power amplifier stage. The IPA collector tank is tuned by C122. Drive to the power amplifier is metered at J105.

The power amplifier stage consists of transistors Q107 and Q108 operating in parallel. The PA tank is "parallel tuned" to the transmitter operating frequency by PA TUNING capacitor C126. The RF output of the transmitter is metered at J107, by means of an "RF sniffer" circuit. With the "RF sniffer", a small portion of the RF output is detected (rectified) by diode CR101, so that the relative power output can be read with a 0-3 volt DC meter.

The RF output of the power amplifier stage is fed to a low-pass RF filter consisting of L124, C128, C129 and C130, which attenuates any harmonics in the transmitter output. The RF signal is then fed to the Push-To-Talk relay located in the Control Unit.

RECEIVER

Receiver Types ER-37-A (Narrow-Band) and ER-37-B (Wide-Band) are designed for use with the General Electric VOICE COMMANDER for operation on fixed frequencies within the 132-174 megacycle band. The receiver is a double-conversion superheterodyne, utilizing two crystals.

This receiver is of miniature modular construction and is completely transistorized--employing 13 transistors and 5 diodes.

The receiver consists of the following modules:

1.	RF Amplifier	Model 4EA19A10 (132-150 MC) ✓Model 4EF19A11 (150-174 MC)
2.	Front End Board	Model 4EF14A10 (132-150 MC) ✓Model 4EF14A11 (150-174 MC)
3.	High IF Gain and Low IF Filter Board	✓Model 4EF29A11 (Narrow Band) Model 4EF29B11 (Wide Band)
4.	Low IF Gain and Discriminator Board	Model 4EL13A10
5.	Audio and Squelch Board	✓Model 4EA18A10 (Narrow Band) Model 4EA18A11 (Wide Band)

All modules except the RF Amplifier and the Audio and Squelch Board are housed in individually shielded compartments of a copper shield case. Provisions for metering are available at the 1st-Limiter and the Discriminator.

References to symbol numbers mentioned in the text below are found on the Service Sheet, Alignment Chart and Block Diagram.

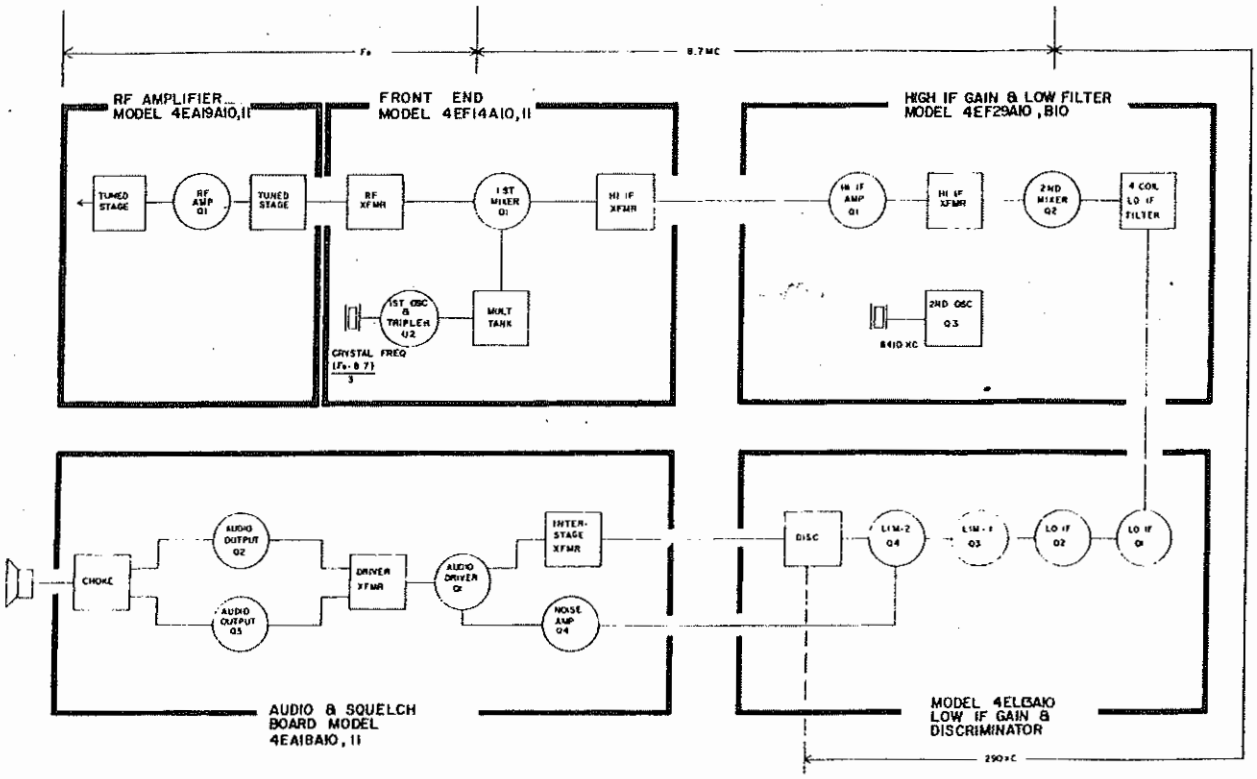


Figure 5 - Receiver Block Diagram RC-999

RF AMPLIFIER AND 1st MIXER

The sensitivity of the receiver is increased by means of an RF Amplifier stage between the antenna and Front End Board.

RF input from the antenna is fed through a tuned circuit to the base of Q1, a common emitter amplifier. The amplifier output is coupled through a second tuned circuit to RF transformer T1. The tank coils of T1 (L1 and L2) are tuned to resonance at the incoming signal frequency by capacitors C2 and C4. Coupling between L1 and L2 is through C3.

The signal from T1 is coupled through C6 to the base of the 1st mixer Q1. The collector of Q1 is directly coupled to the primary of High IF transformer T2.

1st Oscillator

The 1st Oscillator uses a mode crystal cut so its third mode is in the 41 to 55 megacycle region. The crystal is connected to the base of the 1st Oscillator Q2.

The collector of Q2 is connected to the collector tank formed by L6, C15 and C16. This tank is tuned to three times the mode frequency. Injection voltage is coupled to the base tank of the 1st mixer by means of a low impedance tap on L6.

High IF

Output from the 1st Mixer (8.7 megacycles) is fed to a highly selective transformer, T2. C10 and C12 are used to tune L3 and L4 of T2 for resonance at 8.7 megacycles. Coupling between L3 and L4 is through C11. L5 couples the output of T2 to the input of the High IF Gain and Low IF Filter Board.

HIGH IF GAIN AND LOW IF FILTER BOARD

High IF Amplifier

The 8.7 megacycle signal from the Front End Board is fed to the base of the high IF amplifier Q1. The output of Q1 is link-coupled by means of L1 and L2 to the base of the 2nd mixer (Q2).

2nd Oscillator

The 2nd oscillator (Q3) operates as a Pierce oscillator with the crystal connected between the base and collector of Q3. A common emitter configuration is used to provide the 180° phase shift necessary for oscillation. Feedback for the oscillator is controlled by C9.

The 8.410 megacycle oscillator output is coupled through C10 to the emitter of the 2nd mixer, Q2.

2nd Mixer and Low IF Filter

In the 2nd mixer, the 8.7 megacycle high IF signal is heterodyned with the 8.410 megacycle oscillator signal to produce the 290 kilocycle low IF frequency. The output of the 2nd mixer is fed to a capacity-coupled, four circuit IF filter consisting of L3-C12, L4-C14, L5-C16 and L6-C18. Coupling between L4-C14 and L5-C16 is through C15 (C20 in WB). Coupling between L3-C12 and L4-C14 is through C13 (C19 in WB), and coupling between L5-C16 and L6-C18 is through C17 (C21 in WB).

The output of the four-circuit IF filter is coupled to the Low IF Gain and Discriminator Board through L7 which provides low impedance coupling.

LOW IF GAIN AND DISCRIMINATOR BOARD

Low IF Amplifier/Limiters

The low IF filter output is fed through C1 to the base of low IF amplifier Q1. The Low IF Amplifier/Limiters (Q1 through Q4) are RC coupled instead of transformer coupled to prevent the detuning of the transformers that would occur under varying drive levels. AM noise present at the emitter of the last limiter (Q4) is filtered by L3 and C11, and fed to the base of the Noise Amplifier on the Audio and Squelch Board.

Provision is made for metering the 1st Limiter at TP-1 on the printed circuit board. CR3 rectifies the signal for DC metering.

Discriminator

A Foster-Seely type discriminator is used. The output of the final IF limiter Q4 (collector) is coupled to the primary L1 of the discriminator. CR1 and CR2 in the secondary L2 of the discriminator are germanium diodes for rectifying the IF signals in the discriminator. The DC output of the discriminator is metered at TP-2.

AUDIO AND SQUELCH BOARD

Audio

Audio from the discriminator is coupled through transformer T1 and VOLUME Control R701 to the base of the Class A Audio Driver (Q1). Bias for Q1 is provided by R1, CR1, CR2, and R2 (or R13 on 4EA18A11). R9, in series with the VOLUME Control, prevents the volume from being completely turned off. C1 is a DC blocking capacitor.

Following the Audio Driver is a Class B, push-pull Audio Output stage which consists of Q2 and Q3. The cross-over bias required for the Class B stage is picked up at the junction of RT1 and R3. Thermistor RT1 reduces cross-over distortion in the Audio Output stage at extreme temperatures. R3 is an isolating resistor for keeping SQUELCH noise from the Audio Stage. Audio de-emphasis is provided by C2 and C5. DC collector voltage for the output stage is supplied through the center-tapped choke L1.

Output from the Class B stage (Q1 and Q2) drives the speaker (LS701) located on the Control Unit.

Squelch

The squelch circuit is operated by noise from the last limiter stage. Under no-carrier conditions, noise is coupled to the base of the Noise Amplifier Q4 through DC blocking capacitor C6. The gain of the Noise Amplifier is adjusted by Squelch Control R702 (located on the Control Unit), which changes the base bias of Q4. The output of Q4 is rectified by CR1 and CR2 and filtered by C3, producing a positive DC output. This DC voltage back-biases the base-to-emitter junction of the Audio Driver, cutting off the flow of emitter current.

As no emitter current is flowing in RT1, no forward bias is applied to Q2 and Q3 which cuts off the flow of collector current in the output stage.

Whenever the receiver is quieted by a signal, no output comes from the Noise Amplifier. The Audio Driver (Q1) is allowed to conduct, and cross-over bias is applied to the output stage. Audio can now be heard from the speaker.

POWER SUPPLIES

Two power supplies are available for use with the VOICE COMMANDER; a dry battery supply Model 4EP31A10, or a rechargeable supply Model 4EP32A10. These power supplies are interchangeable, and all power connections to the transmitter and receiver are made through a plug and jack connection.

Reference to symbol numbers mentioned in the text below are found on the Service Sheet for the applicable unit.

POWER SUPPLY MODEL 4EP31A10

Power Supply Model 4EP31A10 consists of four, 9-volt Eveready #2709 batteries (or equivalent) mounted on a battery holder rack that fits into the bottom section of the case. The entire assembly slides out of the case for replacing the batteries or servicing (Fig. 6).

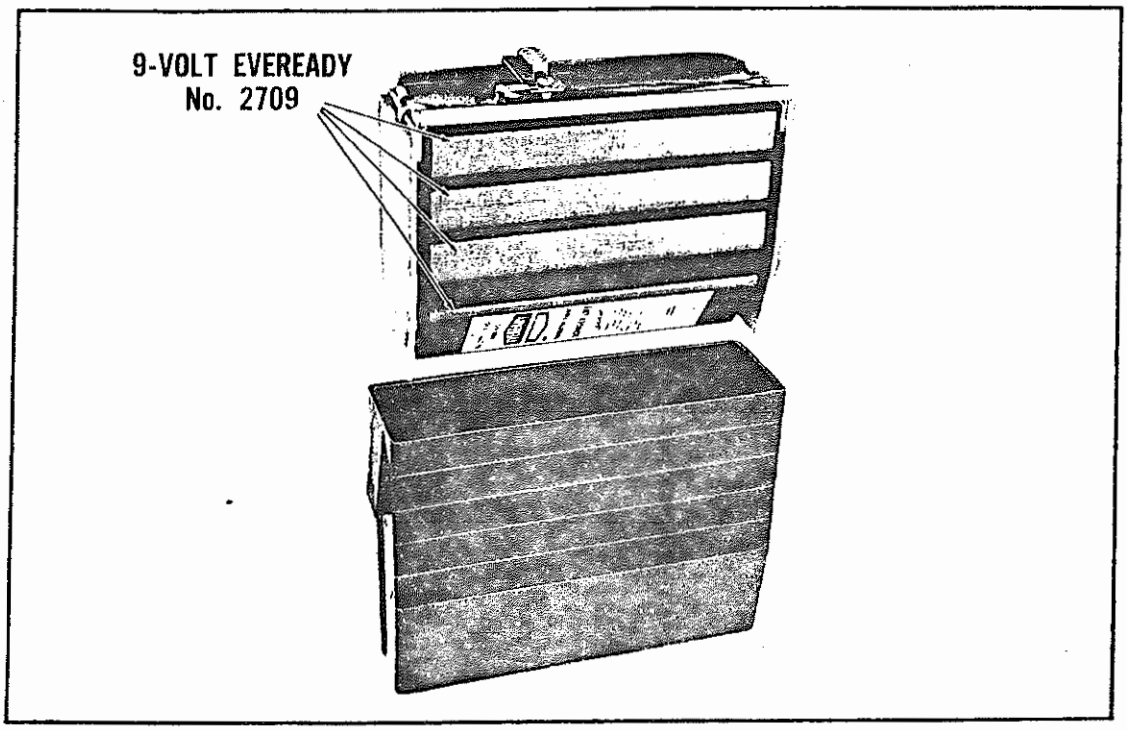


Figure 6 - Power Supply Model 4EP31A10

Batteries BT551 and BT552 are connected in parallel, and BT553 and BT554 are connected in parallel, and the two parallel pairs are operated in parallel to provide the 7-1/2 volt receiver supply.

When the transmitter is keyed, 7-1/2 volts from BT553 and BT554 is applied to the anode of switching diode CR551. This back bias in effect causes the diode to cut off. With the switching diode off, the two sets of batteries now are connected in series to provide the 15-volt transmitter supply.

Releasing the Push-To-Talk switch removes the back bias from CR551, and the batteries are switched back into parallel operation to supply the receiver.

POWER SUPPLY MODEL 4EP32A10

Power Supply Model 4EP32A10 employs two rechargeable batteries (BT501 and BT502) to supply all necessary voltages for the transmitter and receiver. Each battery is made up of six 1-14/-volt rechargeable nickle-cadmium cells connected in series. To disassemble the power supply, follow the procedure shown in Figure 7.

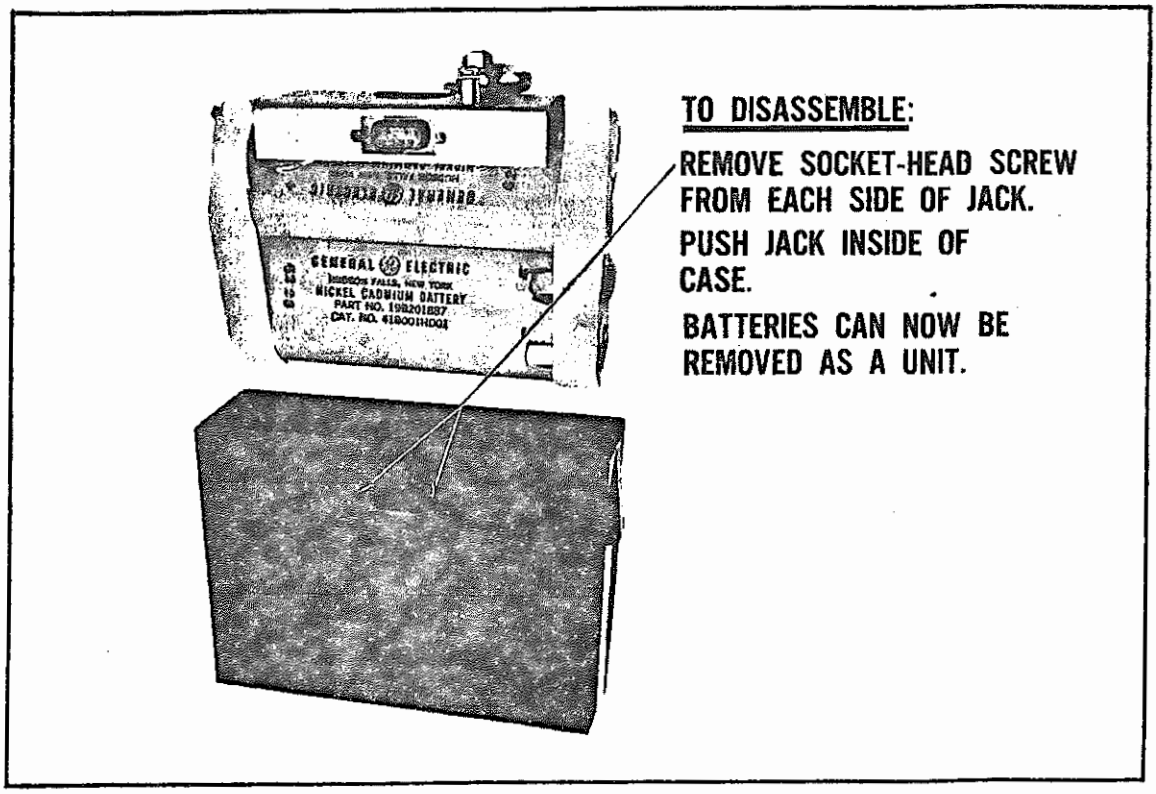


Figure 7 - Disassembly of Power Supply Model 4EP32A10

The batteries are operated in parallel to provide the 7-1/4-volt receiver supply. Diodes CR551 and CR552 are in series with BT551 and BT552 to prevent one battery from discharging into the other if one has a higher charge than the other.

When the transmitter is keyed, 7-1/2-volts from BT501 is applied to switching diode CR552, causing it to cut off. With the switching diode off, the two batteries operate in series to provide the 15-volt transmitter supply. When the Push-To-Talk switch is released, the bias is removed from CR552 and the batteries are switched back into parallel for operating the receiver.

BATTERY CHARGER MODEL 4EP33A10

Battery Charger Model 4EP33A10 was designed for use with the rechargeable Power Supply Model 4EP32A10. The battery charger consists of two half-wave, constant current charging circuits, one for each of the two rechargeable batteries. The battery charger plugs into a charging jack on the back of the power supply case and will fully charge the power supply batteries within sixteen hours from a 117-volt AC source.

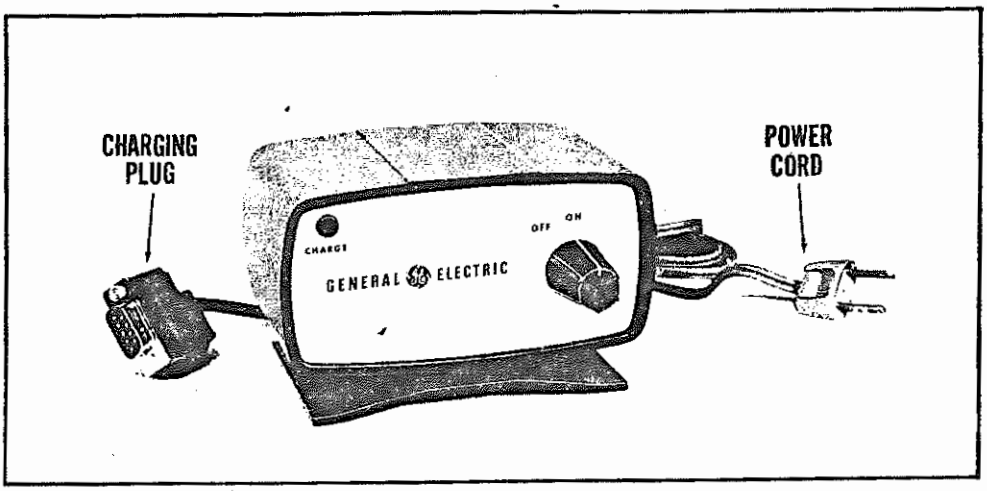


Figure 8 - Battery Charger Model 4EP33A10

Power is applied to the charger by turning the OFF-ON switch S501 to the ON position. Power from the 117-volt source is stepped down by transformer T502, and each half cycle is rectified by CR501 and CR502. Resistors R503 and R504, in series with charge light indicator DS501, provide the charging current for the batteries.

The charge light will light up when the charger is plugged into a 117-volt source, and the charging plug is connected to the charging jack on the power supply. If the charge light should burn out, the battery charger will still charge the batteries, but at a reduced rate. An additional five or six hours will be needed to obtain a full charge due to the reduction in charging current.

In addition to indicating normal operation, the charging light will burn more brightly than normal if a short appears in the secondary of the charger or if the transmitter is keyed while the batteries are being charged. The charging light (in parallel with R505) prevents the charger from being overloaded as the circuit will not draw more current than the current rating of the bulb and R505.

CAUTION

Always replace the bulb of the charge light with the type bulb listed in the Parts List for the Battery Charger. Substituting the wrong bulb may result in damage to the charger or batteries.

FREQUENCY ADJUSTMENT

Single Frequency

With no modulation, key the transmitter and tune CHAN A ADJ (L101/L102) for correct operating frequency.

Two Frequency

Switch to Channel A. With no modulation, key the transmitter and adjust CHAN A ADJ (L101/L102) for correct operating frequency. Then switch to Channel B. With no modulation, key the transmitter and adjust CHAN B ADJ (L103/L104) for correct operating frequency.

MODULATION ADJUSTMENT

The MOD ADJ control (R126) was adjusted to the proper setting before shipment and will not normally require readjustment. When adjustment is necessary, follow the procedure outlined below:

Test Equipment

1. An audio oscillator.
2. A frequency modulation monitor.
3. An output meter.

Procedure

1. Connect the audio oscillator and the output meter to the external microphone jack P702-B (Mike Hi) and P702-C (Mike Low).
2. Adjust the oscillator to produce .05-volt, 1000 cycle signal.
3. Key the transmitter and set the MOD ADJ (R126) for 5 KC (narrow band) or up to 15 KC (wide band) swing as indicated on the frequency modulation monitor. Use the polarity that gives maximum deviation.

FREQUENCY ADJUSTMENT

If necessary to net an otherwise properly tuned receiver to the system operating frequency, follow the procedure outlined below. For Narrow-Band receivers, use Steps 1 through 3. For Wide-Band receivers, use Step 1 only.

PROCEDURE

1. Key a transmitter whose output frequency is known to be on the system frequency. Monitor this output frequency with the receiver and with sufficient signal strength to saturate the limiter, tune L2 (4EL13A10) for zero discriminator reading at TP-2. (For Wide-Band Receivers (using 4EF29B10) do not use Steps 2 and 3).

2. Connect signal generator at ANT jack on front of unit. With sufficient signal strength to saturate the limiter, adjust the generator frequency to produce zero discriminator output. (This matches the generator frequency to the system frequency.)

3. Reduce generator signal level to below saturation at LIM-1 and carefully tune L6, L5, L4 and L3 (in that order) for maximum reading at LIM-1 (TP-1). Repeat Step 3.