International Crystal CTZ-440 Owner's Manual

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EXECUTIVE

MODEL 440

OPERATION and MAINTENANCE MANUAL

INTERNATIONAL
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Oklahoma City, Oklahoma

ADDENDUM #1
SERVICE BULLETIN

EXECUTIVE MODELS
440, 660, & 880
4/15/65

The following modification has been incorporated in Units bearing Serial Number NG94174 and later. An additional bypass capacitor is added to the screen circuit of the last IF amplifier tube V5 as follows:

1. Connect the center foil lead of a 1mf paper capacitor to the top of the 56k screen dropping resistor.
2. Place a small piece of fish paper over the exposed ends of resistors located between the 56k resistor and the tube socket of V5. Secure in place with RTV silastic compound.
3. Connect and solder the outside foil lead of the 1mf paper capacitor to the side of the 6BA6 (V5) tube shield.
4. Dress the capacitor close to the side of IF transformer T-3 and secure in place with RTV silastic compound.

The above modification bypasses to ground high peak pulses that may be present at the screen grid of tube V5 under extremely high input signal levels.

ADDENDUM #2
SERVICE BULLETIN

EXECUTIVE MODELS
440, 660, & 880
5/12/65

The following modification has been incorporated in units having Serial Number #PG 46115 and later.

1. Transistor Q3 has been changed from a TI-411 to a Fairchild 3641.

2. Resistor R103 has been changed from 270K ohms to 68K ohms.

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SECTION I

GENERAL

The INTERNATIONAL EXECUTIVE, Model 440 Citizens Band unit combines a sensitive and selective dual conversion receiver with a highly stable and efficient crystal controlled transmitter. The transmit and receive frequency selector circuits are mounted on the front panel.

A frequency synthesizer is provided for the selection of any one of the 23 citizen band channels. A squelch circuit is built in to provide receiver quieting during periods when no signal is being received. The crystals supplied have a frequency tolerance of .005% when used in the EXECUTIVE.

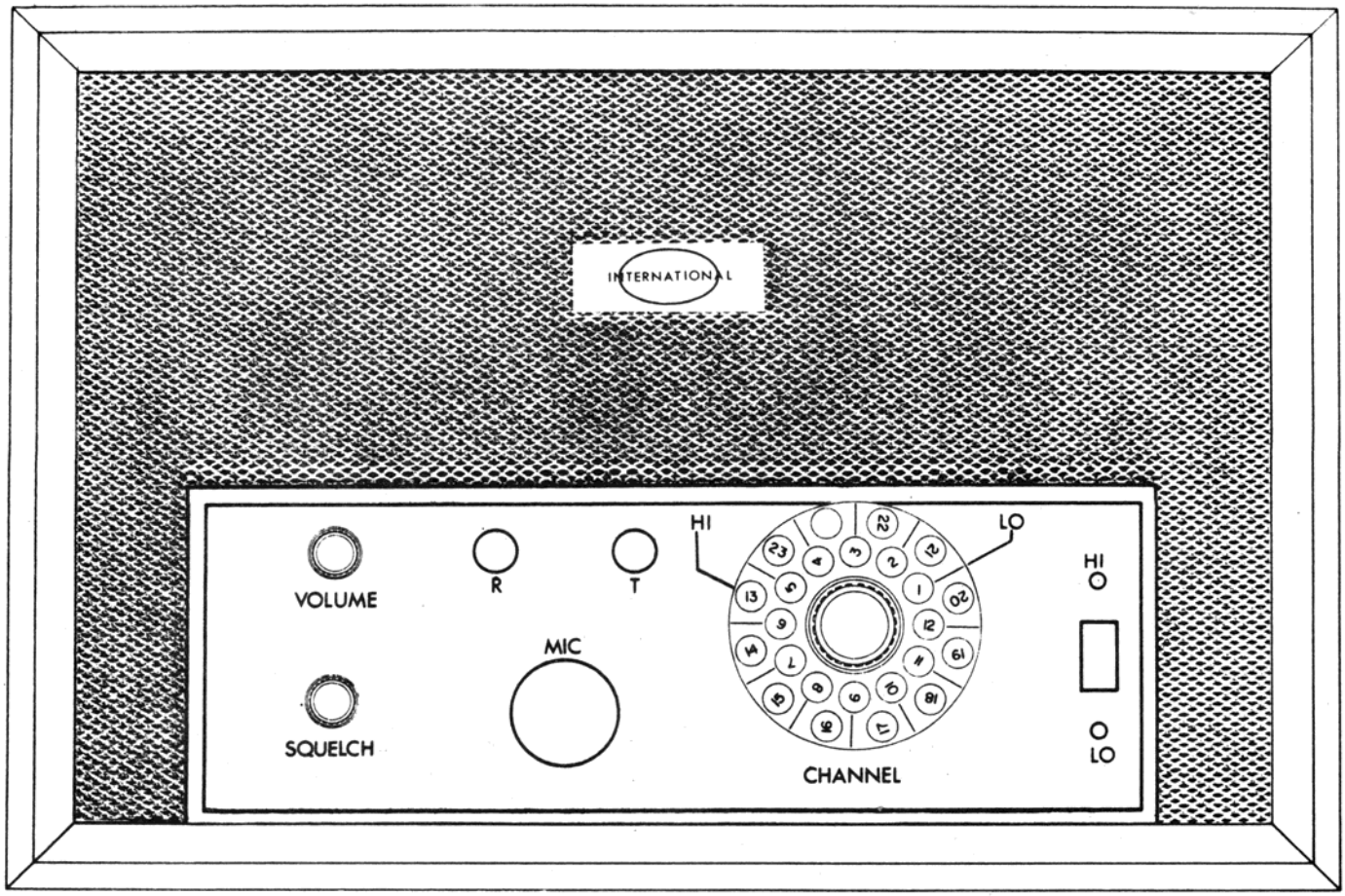
The illuminated 12 position CHANNEL selector dial allows the operator to instantly select the desired channel in two ranges. With the HI-LO switch in the LO position, channels 1 through 12 are selected by the CHANNEL selector dial and when placed in the HI position, channels 13 through 23 are selected by the CHANNEL selector dial.

The EXECUTIVE has been designed with flexibility of installation in mind. It may be used in the home or office, with power secured from the AC line. It may also be used in a car, boat, plane or other mobile and portable applications, wherever there is 6 or 12VDC available. It may be used with a base loaded whip antenna, regular whip, long wire, ground plane, beam and other types of antennas. The attractive case design lends itself to use in the home or office without appearing unsightly or out of place.

Though the unit is very versatile, it is not to be expected that either receiving or transmitting results will be the same in every installation. As in all radio communications and particularly in VHF applications, the type of antenna, its location above ground, the noise present in the area and other factors are bound to affect the results obtained.

SPECIFICATIONS

Receiver:	
Tuning Range	Crystal Controlled-any channel 1 through 23
Sensitivity	Usable to .5 microvolts
Selectivity	50db down at 10kc 60db down at 20kc
Image Rejection	Better than 50db down
Audio Output	2.5 watts into 4-6 ohms
Speaker Impedance	4-6 ohms
Squelch range	.5 to 20,000 microvolts. On-Off differential is approximately 1 microvolt, at 5 microvolt input
Noise Limiter	Automatic, series-gate
Transmitter:	
Tuning Range	Crystal Controlled any Channel 1 through 23
Frequency Stability	± .005% @ 0° to 125°F, when used with INTERNATIONAL high stability crystals
RF Power input	5 watts maximum (FCC rules)
Modulation	Capability - 100%
Power Consumption:	
Transmitting	65 watts (approximately)
Receiving	60 watts (approximately)
Microphone:	High impedance, dynamic type with (push-to-talk switch)



FRONT PANEL CONTROLS

ON-OFF SWITCH

The ON-OFF switch on the VOLUME control completes or breaks the primary 110VAC, 6VDC or 12VDC circuit to the power supply and is fused on the back panel.

VOLUME

ON-OFF switch, VOLUME control. To turn receiver on, turn the knob clockwise until the switch clicks on. Further clockwise rotation of the knob will increase the volume level. Allow the set to warm up for about one minute before using.

SQUELCH

The Squelch control is used to iliminate background noise when no signal is being received. Upon intial warmup, turn this control fully counterclockwise until a click is heard. The switch in the squelch control is OFF in this position. To operate, turn squelch control on and fully clockwise. Then slowly turn the control counter-clockwise until the background just disapears. Leave the control set at this point. Do not turn the control too far counterclockwise as this will reduce the receiver performance and weak signals will not be heard.

CHANNEL SELECTOR

The unit contains an illuminated 12 position channel selector. When used in

conjunction with the HI-LO switch this control switches transmit and receive crystals simultaneously to any one of the 23 citizen band channels.

CAUTION: With the HI-LO switch in the HI position DO NOT operate the transceiver with the CHANNEL selector dial on the blank button between channels 22 and 23.

HI-LO SWITCH

This control located to the right of the Channel Selector dial selects the transceiver operating frequency range. With the switch in the LO position channels 1 through 12 are selected by the CHANNEL selector. When placed in the HI position channels 13 through 23 are selected by the CHANNEL selector dial. Pilot lamps are automatically switched to illuminate the proper channel indicating button.

CAUTION: With the switch in the HI position DO NOT operate the transceiver with the CHANNEL selector dial set on the blank button between channels 22 and 23. This will result in operation on an unauthorized frequency.

MICROPHONE

The microphone connector requires a four-prong lock-on plug which is furnished with the unit as part of the microphone. High impedance dynamic microphones may be used with this transceiver.

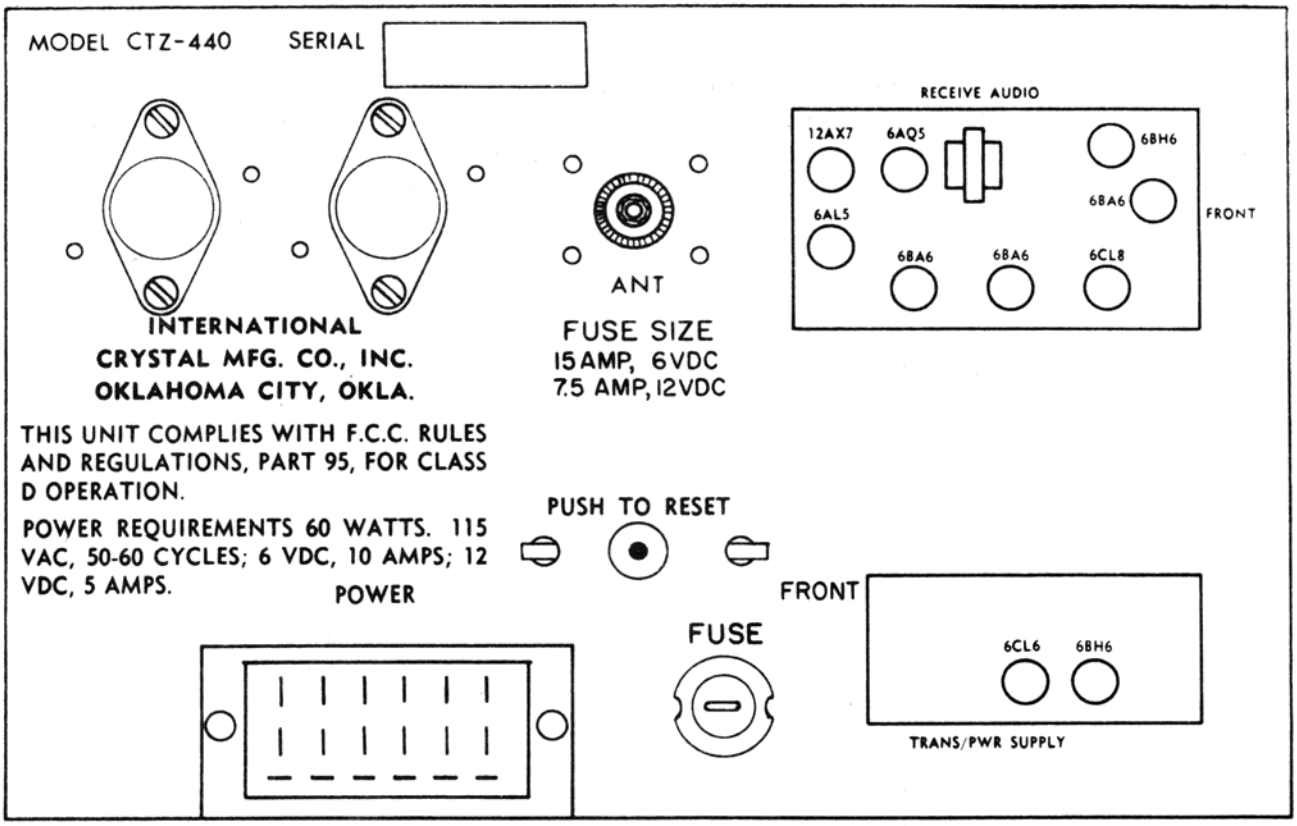
INDICATOR LAMPS

Receive Indicator

This indicator indentified by the letter "R", functions as an on-off (plate voltage) indicator for the receiver section of the transceiver. When the transceiver is operating in Receive position the lamp will glow steadily and go out when the transceiver is placed in the Transmit position.

Transmit Indicator

This indicator identified by the letter "T", functions as an on-off (plate voltage) indicator for the transmitter section of the transceiver. When the transceiver is operating in Transmit position the lamp will glow steadily and go out when the microphone button is released and the transceiver returns to receive position.



BACK PANEL CONTROLS

FUSE

A 15 ampere fuse is installed in the fuse holder and may be changed or replaced if necessary by unscrewing the red insert in the center of the holder. If the transceiver is to be operated on 12 volts dc, the fuse should be replaced with one having a rating of 7.5 amperes.

ANT (Antenna Connector)

This connector is used to connect the antenna transmission line to the transmit-receive relay. The connector is a standard low-loss, VHF type designed for 50-75 ohm coaxial cable.

PUSH TO RESET

This is a thermal cut-out. It protects the unit when it is being operated on 115 VAC. If overload causes it to cut out, it can be reset by pressing in on the red plunger and holding it in for about two seconds.

POWER

An 18-contact plug is used as a power connector. This allows various input voltages to be used without requiring changes within the unit. All necessary connection changes are made on the external plug. Five different cord assemblies are used; 115 VAC, 6 VDC neg. gnd., 6 VDC pos. gnd., 12 VDC neg. gnd., and 12 VDC pos. gnd.

SECTION II

RECEIVER CIRCUIT DESCRIPTION

The receiver section of this transceiver is a double conversion unit employing the superheterodyne principle of frequency conversion. The first conversion is composed of three basic sections; an RF amplifier, mixer and oscillator which is crystal controlled. The crystal controlled oscillator is mounted directly behind the front panel.

A received signal from the antenna is coupled to the control grid of the RF amplifier through a double tuned circuit consisting of coils L1 and L2, their respective shunting capacitors, and coupling capacitor C2. This double tuned circuit aids greatly in the elimination of unwanted signals outside the passband to which it has been tuned. The gain of the RF amplifier is controlled automatically by the receiver's AVC system coupled to the control grid of V1 through a 1 megohm resistor.

After reaching the control grid of V1 (6BA6) the signal is amplified and coupled to the control grid of the mixer, V2. Here the signal is heterodyned with a signal in the 16 mc region coupled from the crystal controlled oscillator in the frequency selector. A difference frequency signal of 10350kc or 10500kc is selected by coil L7 in the plate circuit of the mixer, V2 and coupled to the grid of the second mixer in the IF strip. The first IF signal frequency is dependent upon the position of the HI-LO switch. In the LO position channels 1 through 12 are received and the resulting IF frequency is 10350kc. In the HI position channels 13 through 23 are received and the resulting IF frequency is 10500kc.

The second section of the receiver consists of a mixer and crystal controlled oscillator, two 455kc intermediate frequency amplifiers, a second detector and noise limiter, and a special squelch circuit. Additional selectivity is obtained by the use of two lightly coupled transformers between the mixer and 1st IF amplifier stage and also between the 1st and 2nd IF amplifier stages.

The 1st IF signal received at the grid of the second mixer, V3A, is heterodyned with a 10805kc or 10955kc signal from the crystal controlled oscillator, V3B. The difference frequency of 455kc is selected in the plate circuit of V3A and coupled to the control grid of the intermediate frequency amplifier, V4. The gain of this amplifier is also automatically controlled by the AVC system connected to the grid of V4 through the secondary of transformer T2 and a 220K ohm resistor. The signal is further amplified in V4 and coupled to the grid of V5 through transformers T3 and T4. AVC voltage is also applied to this stage through the secondary of transformer T4 and a 220K ohm resistor.

The signal is further amplified in V5 and coupled from the plate through transformer T5 to the plate of the detector, V6A, where the audio component is detected. V6A is also used to produce the AVC voltage. The detected signal is coupled to V6B which acts as a series-type noise limiter removing noise pulses which may ride through on the signal. The squelch circuit consisting of a neon lamp, NE-1, silicon diode, CR-7 and associated components is connected so that the audio section of the receiver of the receiver is cut off and background noise eliminated when no signal is being received. The cut-off level may be varied by use of the squelch control.

The third section of the receiver is a conventional audio amplifier consisting of a twin triode audio voltage amplifier, 12AX7, V7A-V7B followed by a 6AQ5, V8 tetrode power amplifier. When the transceiver is in RECEIVE position only one-half of the 12AX7 is used. The second triode section, V7B, receives the audio signal from the center tap of the volume control. The audio signal is amplified in V7B whose output is RC coupled to the control grid of the power amplifier, V8, through a bandpass circuit consisting of choke AFC-1 and capacitors C71 and C73. The audio signal is further amplified in V8. The plate of V8 is connected to transformer T-6, which performs a dual function. In RECEIVE position this transformer acts as a normal output transformer with its secondary connected to the speaker. In TRANSMIT position, its function is that of a modulation transformer.

In TRANSMIT position, V7A is utilized as a straight voltage amplifier for the microphone. The maximum output level of this stage is regulated by zener diodes CR-8 and CR-9.

TRANSMITTER CIRCUIT DESCRIPTION

The transmitter is a multi-stage unit consisting of a crystal controlled frequency synthesizer signal generator, a buffer amplifier and a neutralized tetrode final amplifier.

The frequency selector contains the necessary crystals and trimmer capacitors to produce twelve channel frequencies in the sixteen megacycle range crystals for channels 1, 2, 4, 6, 8, 10 and 12 are connected to corresponding numbered controls on the CHANNEL selector switch. When the CHANNEL selector is placed in any one of these positions, trimmer capacitor C123 and the crystal determine the oscillator frequency. When the CHANNEL selector is placed in positions 3, 5, 7, 9 or 11 the crystal for the next lower channel and trimmer capacitor C123 together with trimmer capacitors C124, C125, C126 or C127 as the case may be determine the oscillator frequency. The two ten megacycle heterodyning crystals are selected by the HI-LO switch. With the HI-LO switch in the LO position a 10.350mc crystal is placed in the base circuit of oscillator transistor Q5. This signal is capacity coupled to the base of mixer transistor Q6. Also a 16.615mc to 16.755mc (channels 1 through 12) signal is coupled from oscillator transistor Q3 to the base of mixer transistor Q6. The resulting sum frequencies of 26.965mc to 27.105mc (channels 1 through 12) are selected in collector circuit of mixer transistor Q6 and amplified by transistor Q7.

The same procedure is followed for channels 13 through 23 except the HI-LO switch is placed in the HI position and a 10.500mc crystal is switched into the base circuit of oscillator transistor Q5. This signal is heterodyned as before with the 16.615mc to 16.755mc signals from oscillator transistor Q3 and the resulting sum frequencies of 27.115mc (channels 13 through 23) are selected in the collector circuit of mixer transistor Q6 and amplified by transistor Q7. The output of amplifier transistor Q7 is coupled to the grid of buffer amplifier V10 and from V10 to final amplifier V9. Inductive coupling is used between all amplifier stages. The plate circuit of the final amplifier V9 is a shunt fed pi-matching network. Neutralization of the final amplifier is accomplished by capacitor C96, and link coil L13 coupled to the cold end of coil L14.

NOTE: Frequencies mentioned in above description are used in units having serial number NG94125 or later. For crystal frequencies used in earlier units see page 34.

POWER SUPPLY CIRCUIT DESCRIPTION

A three-way power supply is used in this transceiver. It operates as a conventional, full-wave rectifier circuit on all voltage inputs followed by a capacitor input RC filter network. On 6 or 12 volt battery operation, a transistor oscillator circuit is used to provide the necessary AC voltage for the primary circuit of the power transformer. The transceiver is supplied with a power cord kit. The unit may be operated either from 115 VAC, 6 volt negative ground, 6 volt positive ground, 12 volt positive ground or 12 volt negative ground by use of the proper power cord connections. The power supply is equipped with a thermal circuit breaker for protection on AC operation. For protection on 12 volt DC operation a 7.5 ampere fuse is used with the transceiver. Protection on 6 volt DC operation is provided by a 15 ampere fuse which is supplied with the unit. When 12 volt DC operation is desired the 7.5 ampere fuse must be substituted for the 15 ampere fuse.

TRANSMIT-RECEIVE RELAY CIRCUIT DESCRIPTION

By including a transmit-receive relay (TR-1) in this transceiver, the many advantages of "Push-to-talk" operation and maximum transfer of energy to and from the antenna are afforded the operator at no extra cost. The circuit consists of a half-wave rectifier which receives its AC voltage from a 12 volt secondary winding on the power transformer. The rectifier is followed by an RC filter network whose output is connected in series with one end of the relay coil. The other end of the relay coil is connected through the microphone socket to the microphone switch button. This completes the 12 volt DC relay circuit to ground and the relay performs the following switching functions:

RECEIVE - In this position the relay is not energized and the antenna is connected to the receiver input, B+ voltages are furnished to the receiver section and one side of the speaker is grounded. DC voltage is applied to the collector circuit of transistor Q5.

TRANSMIT - The relay is energized and the antenna is switched to the transmitter output circuit B+ voltages are furnished to the screen and plate circuits of V7A, V8, V10 and final amplifier V9. The speaker voice coil is removed from ground. DC voltage is applied to the collector circuits of transistors Q5, Q6 and Q7 and removed from transistor Q4.

WIRING POWER PLUG

The 3-way power supply may be operated from any one of 5 different power systems:

115VAC
6VDC positive ground
6VDC negative ground
12VDC positive ground
12VDC negative ground

Depending upon the voltage to be used, connect the jumper wires to the plug asindicated below. A power cord is included with the kit. If it is desired to connect the plug for battery use, two pieces of #12 or larger battery wire, no longer than three feet, should be used between the plug and battery.

CAUTION: DONOT USE SMALL SIZE WIRE OR LONGER LENGTHS WHEN OPERATING FROM BATTERY AS THIS CAUSES EXCESSIVE VOLTAGE LOSS.

Remove the cover from the power plug by removing the two retainer pins and then separating cover and base. The sketches on the reverse side of this sheet are of the connection side of the plug base. Use the #18 buss wire supplied to make jumpers. Where jumpers cross and there is danger of a short, use a length of insulating sleeving over the wire.

Part #150-174
115VAC
115VAC to pins 1 and 4
Jumper pins 2 and 3
Jumper pins 13 and 18
Jumper pins 5 and 6 and 15

Part #150-212
6 VDC Neg. Gnd.

+6VDC Hot to pin 1 red
−6VDC Gnd. to pin 15 brn
Jumper pins 11 to 12 to 14 to 15 to 18
Jumper pins 2 to 5 to 17
Jumper pins 7 to 8
Jumper pins 6 to 9
Jumper pins 10 to 16

Part #150-213
6VDC Pos. Gnd

−6VDC Hot to pin 1 brn
+6VDC Gnd. to pin 15 red
Jumper pins 9 to 12 to 15 to 18
Jumper pins 6 to 11 to 14
Jumper pins 2 to 5 to 17
Jumper pins 7 to 8
Jumper pins 10 to 16

Part #150-214
12VDC Neg. Gnd.

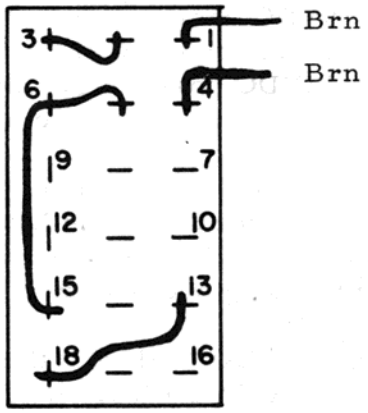
+12VDC Hot to pin 1 red
−12VDC Gnd. to pin 15 brn
Jumper pins 10 to 14 to 15
Jumper pins 7 to 8 to 16
Jumper pins 2 to 5 to 18
Jumper pins 6 to 9

Part #150-215
12VDC Pos. Gnd.

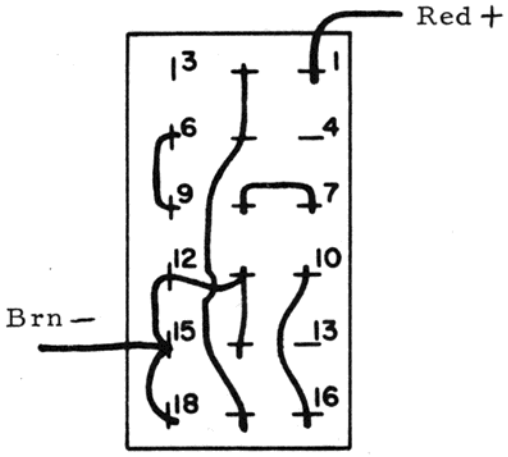
−12VDC Hot to pin 1 brn
+12VDC Gnd. to pin 15 red
Jumper pins 6 to 10 to 14
Jumper pins 7 to 8 to 16
Jumper pins 2 to 5 to 18
Jumper pins 9 to 15

POWER PLUG WIRING
(All views from back of plug)

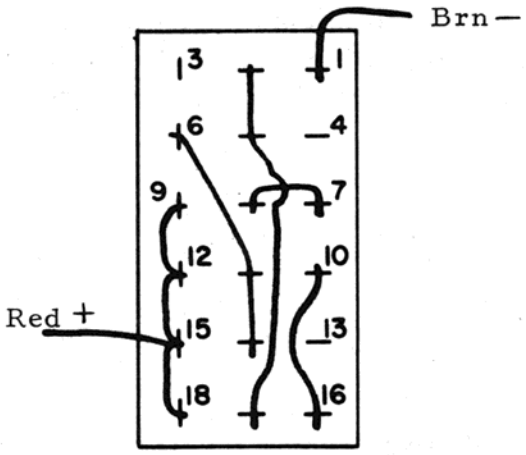
115VAC 150-174



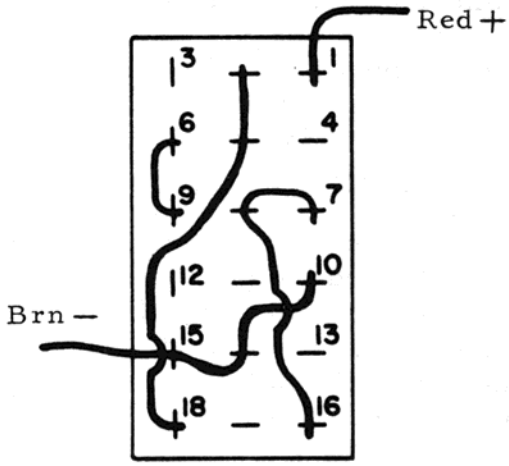
6VDC Neg. Gnd. 150-212



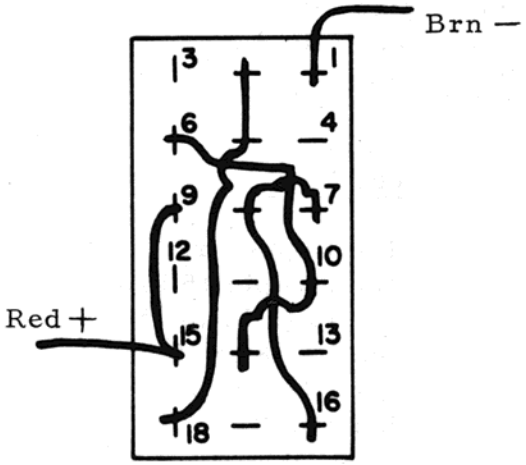
6VDC Pos. Gnd. 150-213



12VDC Neg. Gnd. 150-214



12VDC Pos. Gnd. 150-215



SECTION III

INSTALLATION - General

The actual placement of the Executive Model 440 makes very little if any difference, in its performance. In planning an installation the transceiver should be placed where it will save the most steps. For instance, if the unit is installed in a home to provide communications between the wife at home and her husband in the car, the basement would be a poor location. A more desirable location would be at or near the portion of the house where she spends most of her time, such as in the kitchen, den, or possibly the living room.

FIXED LOCATION INSTALLATION

Operation of the Executive Model 440 from any fixed location such as the home or office will always be best with an outside antenna. A full discussion of antenna selection is given at the end of this section.

MOBILE INSTALLATION

It is possible that the Model 440, when used in a car or other mobile application, may use a short, base loaded whip, mounted on the rear of the unit. It will not however, prove to be very satisfactory. For best results, a whip, mounted outside the vehicle is required. It may be mounted with a bumper mount on the rear bumper, or may be mounted on a rear fender or cowl, using a ball mount.

The Model 440 itself should be mounted under the dash or in some other practical place in the vehicle. A special mobile mount, designed for the Model 440 is available from INTERNATIONAL which allows the unit to be securely mounted to the car, yet be very easily and quickly removed. Various types of antenna mounts and microphones are also available from INTERNATIONAL.

Installations in cars, planes, boats or other locations near gasoline engines present special problems of their own due to noise created by spark plugs, disbtibutor, voltage regulator and generator. A typical mobile installation is shown in Section IV. Measures which help reduce this noise are discussed at the end of this section.

After the unit is installed and all connections are made, turn unit on, set Channel Selector to desired channel. Set Volume control for desired listening level.

SHORT FORM OPERATING CHART

FUNCTION	CONTROL or CONNECTOR
Connect antenna	ANT connector on transceiver rear panel
Connect power cord of desired voltage	POWER connector on transceiver rear panel
SQUELCH, off	SQUELCH on front panel
Turn set power on and set volume level	VOLUME on front panel
Connect microphone	MIC connector on front panel
Set HI-LO switch to desired range	HI-LO on front panel (LO-1 thru 12) (HI- 13 thru 23)
Transmit by pushing button on microphone	Push-to-talk button on microphone

ANTENNAE AND THEIR SELECTION

The most common antennae for citizen use are the Ground Plane and Coaxial for base use and the Vertical Whip for mobile use. The Yagi multi-element beam antenna can be used to great advantage where point-to-point communication is required rather than non-directional coverage from the base station. Any antenna with a directional gain will effectively increase the radiated power of the transmitter as well as the received signal applied to the receiver.

It is best to purchase a good commercially built antenna rather than attempt to construct your own. Good commercial antennae have low SWR (standing wave ratio) which is a merit of the radiation efficiency. With home constructed antennae it is sometimes difficult to effect a good match between the antenna and the transmitter causing considerable power to be lost in the system. An antenna should have an SWR of no more than 2:1.

Some power will be lost in the transmission line and therefore long runs should use the larger RG-8U cable. This cable has a lower loss per foot than the smaller RG-58/U. Both types have a characteristic impedance of 53 ohms. Loss per 100 feet at 27 megacycles is 1 db for RG-8/U and 2 db for RG-58/U. For short runs the RG-58/U cable is more easily handled.

Most of the antennae are available in two grades. The lower priced standard grade will not be as mechanically strong as the commercial grade. Electrically both grades are usually about equal. Where ice loads, wind, and salt air are a factor it will be cheaper in the long run to purchase the better antenna.

For extremely short range communication (less than a mile) the base loaded case whip antenna works very well. With two units using case whips, the signals will become quite weak after a block or two and poor squelch operation will be encountered. The outside antenna is by far the best choice and should be mounted as high as practical and still be within F.C.C. regulations. [Paragraph 95.37 (c)]. In brief, the F.C.C. limits antenna height to no more than 20 feet above an existing structure or not to extend above the top of the radiating element on an existing tower. Remember the Yagi type antenna is usually mounted in a horizontal position. This type antenna must be used with another antenna mounted in the same plane. If the Yagi is to be used to communicate with mobile units using a whip antenna, the Yagi should be mounted in a vertical plane. A little thought in antenna installation will greatly improve your coverage.

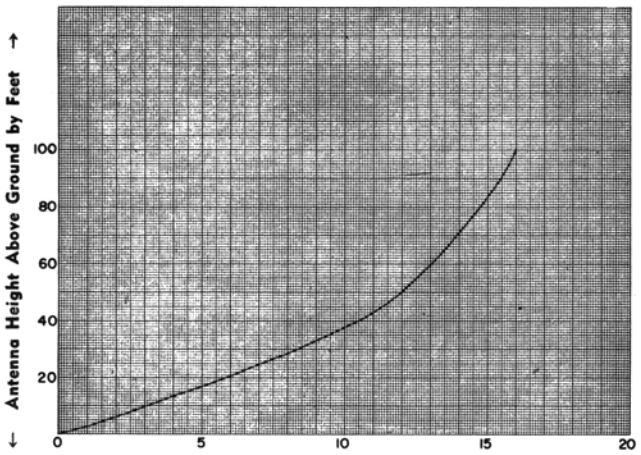
DISTANCE vs ANTENNA

The direct coverage you are able to obtain using Citizen Equipment in the 27 megacycle band will depend a great deal upon the antenna. We shall speak of direct coverage rather than skywave coverage wherein you may communicate 500 to 2000 miles at various times.

The F.C.C. has intended the Citizen use to be for short range communication and all installations should be calculated on this basis. The following charts consider a base station antenna mounted on a mast with the calculated range to a mobile unit using a standard 108" whip. Remember that the antenna may be mounted on an existing structure or mast [reference F.C.C. 95.37 (c)].

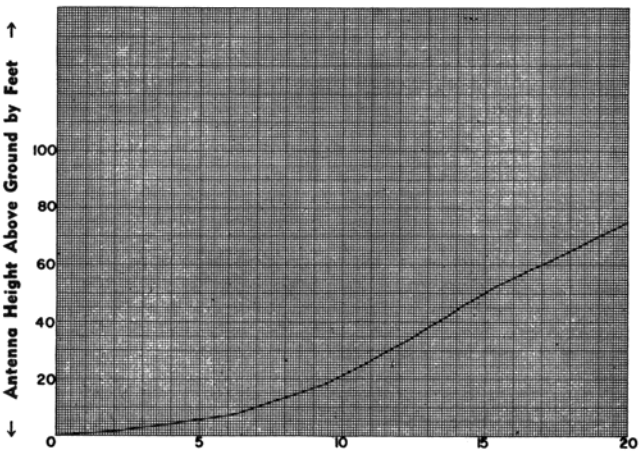
Ground Plane or Coax Antenna For 2 Microvolts at Receiver

Chart #1



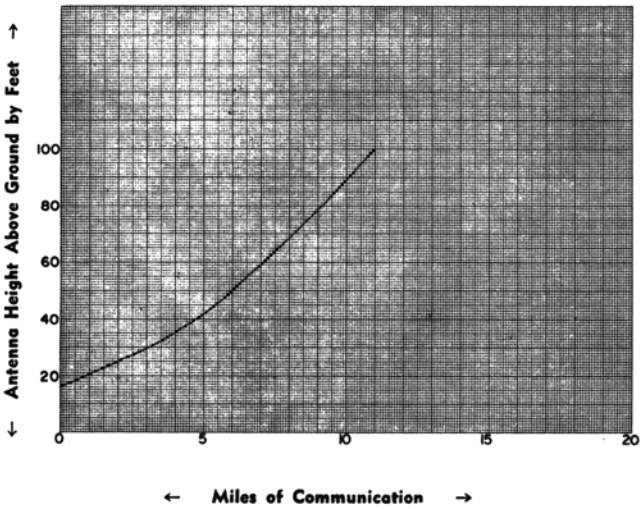
Yagi Antenna Mounted Vertical For 2 Microvolts at Receiver

Chart #2



Ground Plane or Coax Antenna For 15 Microvolts at Receiver

Chart #3



Note how the distance increases with increase height of the antenna for a given installation as in Chart 1. If a direction antenna is used as in Chart 2 you can see how the distance is further increased, however, this reduces the area covered since the Yagi Antenna is quite directional.

Charts 1 and 2 are based on a 2 microvolt signal at the receiver. This signal will not be sufficient for many city areas where high levels of noise exist. Chart 3 considers the coverage for 15 microvolts at the receiver and is more practical for general city use.

When the Citizen frequencies are open to skywave transmission, signals from distant stations will be strong enough to over power weak direct signals. When one is considering communication he should understand that for 100% contact he should base the calculations on 15 microvolts or more.

In mobile communication dead spots will be found at various points as well as locations giving excellent signals. These points should be noted and contacts made from the best possible locations. Vehicle noise and electrical interference will greatly reduce your communicating distance.

ELIMINATE YOUR MOBILE "NOISE GENERATORS"

Now that low cost TWO-WAY radio communication is available to everyone with the opening of the eleven meter band for Citizen use the number of mobile installations will probably exceed the number of base, or control, stations by a factor of 5 to 1 within the near future. It is estimated there are now over 160,000 citizen band mobile installations and approximately 45,000 base, or control, stations in operation. Proper installation and necessary steps towards the elimination of electrical, and mechanical, interference inherent in all motor vehicles is of prime importance if distances of three miles or more are desired to be covered.

For short range coverage the simple installation of a "radio condenser" on the generator and the "interference suppressor" installed in the top of the distributor, or coil, is usually sufficient noise suppression. But when maximum distances of three or more miles must be covered, great pains must be taken and all known means of noise suppression must be used. Different makes and models of vehicles will require different means of noise suppression. Some models only the very simple, others will need the "all out" method.

As there are numerous "generators" of radio interference in every motor vehicle the elimination of one source may not be noticeable as it's noise level may be below one you have not located so the proper way to approach your "noise" problem is by a systematic process of first suppressing all known offenders, namely the generator, voltage regulator, distributor and spark plugs.

We will explain throughout this article what is considered to be the proper vehicle noise suppression methods. The volume of noise you can, or will, tolerate in your receiver will depend upon the amount of suppression applied. Few installations will require the "all out" method and the user must decide when he is satisfied.

The purpose for eliminating your own "noise generators" is the fact that your receiver's automatic volume control (AVC) will react to these random noise pulses the same as though a strong station was tuned-in and will cut the receiver's sensitivity way down which will eliminate the weak stations you normally wish to copy. There's an old saying "if you can't hear them, you can't work them."

Let's start our "noise elimination" with the generator and voltage regulator. The generator is the item that causes the whine as the speed of the motor is increased. It is very easily detected by speeding up the engine and then cutting the ignition off. The instant the switch is turned off ONLY the generator and voltage regulator can cause the noise as all other "noise generators" are eliminated when the switch is off EXCEPT the generator as it is still in operation and is still trying to charge the battery through the voltage regulator. Even though it will operate only a few seconds after the switch is off this is time enough for you to hear the terrific amount of noise it is generating. As the speed of the engine decreases the whine will decrease in unison.

Practically all vehicle manufacturers cable the two leads from the voltage regulator to the generator in a harness with other wires. It is recommended that both of these wires be run in **separate** tinned copper braid. Just disconnect the present wires from the generator and the other end of them at the voltage regulator's "A" and "F" terminals. They can be cut-off where they enter the harness or just taped down out of the way.

A Sprague 48P18 coaxial capacitor, or a similar .5 mfd coaxial capacitor, should be installed directly ON the generator and the lead from the condenser to the battery armature terminal of the generator must be as short as possible. In fact a length of one inch is sometimes too long. A .001 mfd mica capacitor should now be installed from the same battery terminal to the frame of the generator, here again lead length is extremely important and they should be no longer than one-quarter inch. Be sure to remove paint and grease on the generator where the capacitor is bolted as a "good" ground at this point is necessary.

Dress the cable from the coaxial capacitor on the generator against the body of the car. Use speed clips to keep in place or run through presently installed cable clamps. This cable is usually the longest "noise generator" we must suppress and it is preferred to shield this wire in tinned copper braid. The end of the braid must be soldered directly to the coaxial capacitor's body. Be sure to use size #12 copper stranded wire when making-up this new lead. Connect a new cable to the generators' "F" (field) terminal and run this lead in a tinned copper braid shield and dress it along side the battery lead. This new lead may be of size #16 copper stranded wire.

The voltage regulator is next and the "job" from here on is usually easy compared to the one just completed. Remove the cover from the voltage regulator and clean off any paint that may insulate the cover from the frame. Check the mounting screws and be sure the regulator is being grounded directly to the firewall. If necessary remove and clean away any paint so you may secure a "perfect" ground connection.

Use two 48P3 of 48P5 Sprague coaxial capacitors or similar .1 to .5 mfd coaxial capacitors and install at the "A" and "B" terminals of the regulator. The capacitors metal body must be grounded directly to the firewall. This can be easily accomplished by using a piece of cadimun plated metal about 4" x 4" bent to a 90° angle. Drill two holes for the capacitors and two holes to pass sheet metal screws to bolt to the firewall. Attach the capacitors to the angle with screws and nuts and **also** solder. Locate the assembly so the lead from each capacitor to the "A" and "B" regulator terminals are extremely short. Be sure to clean the paint from the firewall so the bracket will make a good solid ground connection. Attach the cable from the generator's "F" terminal to the voltage regulator's "F" terminal. Connect a .002 mfd capacitor and a 4 ohm resistor, in series, from this point to ground. Again, lead length is important and the overall length of the capacitor-resistor combination must be as short as possible. Attach the lead from the generator's armature terminal to the coaxial capacitor connected to the voltage regulator's "A" terminal. The shielding braid on these leads must be grounded to the capacitor bracket or to the firewall by soldering or with the use of washers and sheet metal screws. Attach the "B" battery lead to the coaxial capacitor connected to the "B" terminal of the voltage regulator. This is the lead coming through the firewall and usually goes direct to the battery charging indicator on the vehicles dash panel.

The next superb "noise generators" of them all are the spark plugs. But here we have available to us years of research for only a few dollars. Just go to your local auto supply store and purchase a complete set of AUTO-LITE RESISTOR spark plugs that are direct replacements for your particular brand and model of vehicle. CAUTION: We own no stock in Auto-Lite, but please accept no "substitute" as some **resistor** plugs will actually increase your noise problem. Be patient, if your dealer does not stock your size just ask him to get them for you. When installing the new plugs be sure to have the gap properly set.

After **properly** installing the "recommended" suppression to these trouble makers you should be able to drive comfortably and communicate with stations you never heard before with your engine running. However, in most cases this is only the beginning of the job in order for you to say that you have a good mobile installation.

If you have been checking your "noise elimination" progress as you complete each step we know you will be extremely pleased with your work. But from here on each suppression job will not be very noticeable until you hit the one big joker that's causing a lot of trouble. The little "noise generators" will be obscured by this one and wouldn't have showed up until it was eliminated. All-in-all the little ones can really add up and must be taken care of in due time.

Have your distributor checked to see that the capacitor across the breaker points has the proper capacitance and the points are properly set. If the vehicle has been driven 30,000 to 40,000 miles or more it is recommended that the distributor cap and rotor be replaced. This will usually not only reduce the ignition noise, but also improve the overall performance of the engine. At the same time have the timing checked and properly adjusted.

When purchasing your new AUTO-LITE resistor spark plugs also buy enough 4,000 ohm-per-foot ignition cable to make up a new wiring harness from the distributor to the spark plugs. Be sure that the new terminals (ferrules) are installed whereby they make **good** contact with the center conductor of the new cable. It is preferred that the ferrules be soldered rather than crimped on as there is danger of a poor contact causing another "noise generator" to appear.

Check your ignition wiring by shorting out each plug, in turn, while listening to the receiver. Any reduction in the noise level will usually indicate that the ferrules are not making good contact in the distributor head, or the ferrule and center conductor should be soldered.

Install a 10,000 ohm carbon suppressor in the distributor's center terminal and make up a new lead to run to the coil. Here again be sure the ferrules are soldered and are making a "tight" connection inside the coil and distributor. A new lead is recommended here as any breaks what-so-ever in the ignition system's wiring insulation could be a source of "ignition noise." With very short leads connect a .001 mfd disc ceramic capacitor from the coil's battery terminal to the coil's case.

Bonding braid should now be run from the fire wall, coil, and the distributor to the engine. Use as short a piece of braid as possible in each case. If the ground lead of the battery is attached to the fire wall it should be removed and attached to the starter mounting bolt. The power cable ground lead for your transceiver should also be connected at this same point. Usually the hot and ground leads from the battery go direct to the starter's

solenoid which is mounted on the starter and this is a good place to connect the transceiver's power cable. CAUTION: Remove the hot cable from the battery before making connections to the starter as there is danger of the hot battery cable getting loose and shorting out the battery or even starting a fire.

Connect a short piece of bonding braid across each engine hood hinge. NOTE: The hood will act as a shield to help keep the engine noise inside the engine compartment and away from your antenna. Next connect a short length of bonding braid across each trunk lid hinge, front of the engine to the frame, exhaust tail pipes to the frame, and a piece of wire braid from the air cleaner to the fire wall. It is very important that we caution you to be sure that you clean away all paint, grease or insulation material when installing the grounding braid as **good,** low resistance, ground connections must be made.

Noisy tires should be treated with an anti-static powder, brake shoes grounded to the backup plates with bonding braid and static collectors installed inside the front wheel grease retainer cups. Heat and oil indicator sending units on the engine must be by-passed with .1 to .5 mfd capacitors, again using very short leads. All instrument panel gauges and accessories should be by-passed using .5 mfd capacitors. Heater and defroster motors, electric windshield wiper motors and any other accessory motors by-passed with a .25 to .5 mfd capacitor. The gasoline sending unit mounted on the gasoline tank must be by-passed with a .1 to .5 mfd capacitor. An inspection plate is usually provided in the trunk compartment over the tank.

For the person who desires the "ultimate" in mobile "noise elimination" there are available for some vehicles marine and aviation spark plugs that could be used and the complete ignition system shielded by using these plugs and making metal boxes to enclose the distributor and coil, and shielding all wiring associated with the ignition system. By having the ignition system **completely** shielded most of the "suppression" can be eliminated and the normal high engine performance will be maintained.

You should set aside a week-end for your "noise elimination" project and have all necessary parts and tools available. You may visit your local two-way radio communications company and secure most of the parts required in kits furnished by some manufacturers of two-way radios. The other parts required are available from radio parts supply and auto parts supply firms.

Lay out your line-of-attack and as each "noise generator" is suppressed it should be noted and checked by listening to the receiver or noting the receiver's "S" meter indication before and after the suppression. This indicates the noise level entering the receiver that is being picked-up by the antenna. To check the noise level entering the receiver by the antenna connecting cable disconnect the cable where it connects to the antenna and short the cable's terminals. If noise is still noticeable it will be necessary to re-route the cable under the vehicle and up through the fire wall to the transceiver. Check the noise level entering the receiver through the power cable by disconnecting the antenna connecting cable at the receiver. All noticeable noise in the receiver is now being picked-up by the power cable and fed to the receiver. This can usually be eliminated by installing a Sprague 48P3 feed-thru coaxial capacitor on the fire wall and the hot battery lead from the transceiver connected through the capacitor to the battery terminal.

We sincerely hope that we have been of some help to you and assure you that when you finish your "noise elimination" project you will consider yourself an "**expert.**" But just as a parting reminder, remember that all of those cars along side of you, up front, behind and the ones passing have not been through the "elimination" process and it will be up to your receiver's built-in noise limiter to cut **their** noises down to a listening level that is bearable.

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SECTION IV
ACCESSORIES

ANTENNAS

Without an efficient antenna, operation of your Executive is not as enjoyable as can be experienced with a well designed antenna system. INTERNATIONAL has available antennas for almost any installation. Base Station end fed vertical antenna, Stock No. 160-133 price $35.00
Roof Top Mobile Antenna, Stock No. 160-119 price $15.68
Roof Top Mobile Antenna, Stock No. 160-134 price $24.66

POWER PLUGS

For our customers who have only one unit and wish to use it in several different locations, INTERNATIONAL offers five different power plugs which will allow the Executive unit to be used anywhere.

6VDC	plug	-gnd	Part N0. 150-212	Price ea.	$ 7.50
6VDC	plug	+gnd	Part N0. 150-213	Price ea.	$ 7.50
12VDC	plug	-gnd	Part N0. 150-214	Price ea.	$ 7.50
12VDC	plug	+gnd	Part N0. 150-215	Price ea.	$ 7.50
115VAC	plug		Part N0. 150-174	Price ea.	$ 7.50

SECTION V

SERVICE AND MAINTENANCE

GENERAL

As is the case with all types of electronic equipment, the EXECUTIVE should be checked periodically by a qualified technician to insure optimum performance at all times and to correct any condition which might later result in equipment failure due to improper adjustment, tube aging or component failure. Since the EXECUTIVE series receiver differs somewhat in its design from conventional Citizen Band radio sets, no attempt should be made to service this equipment until the technician has become completely familiar with the basic circuitry and has a thorough understanding of the charateristics of dual conversion equipment.

In general, maintenance can be simplified by seeking a definite sympton of a fault and establishing, by reference to the block and schematic diagrams, a condition or series of conditions which migh cause the symptom. This will usually help to localize the source of trouble and eliminate those sections of the equipment which are operating properly.

Many technicians tend to overlook the very simple and more obvious sources of touble in their service work. This may be brought about by a nontechnical operators description of a particular fault. For example, a Citizen Band operators complaint of intermittent operation may immediately suggest relay trouble or any number of things to a technician. Yet, upon checking further, the trouble may actually be caused by a defective antenna connector or loose microphone plug or some other condition completely external to the set. For this reason, always quickly check the entire installation for potential trouble before actually removing the set for maintenance work.

DISASSEMBLY OF THE CABINET

The front and rear panels of the unit are fastened to the chassis. The cabinet is of wrap-around construction divided into two pieces and a front panel escutcheon. Disassembly is accomplished by removing 2 screws on the bottom of the escutcheon and slipping the escutcheon forward until it is clear of the front panel.

The perforated top section may be removed for easy access to the tubes without removing the bottom section. Remove the six (three on each side) large sheet metal screws and fibre washers and lift off the top section.

To remove the bottom section, remove the four sheet metal screws located inside the rubber feet and 2 additional sheet metal screws on the bottom.

To re-assemble, simply reverse the procedure outlined above.

TEST EQUIPMENT

A properly equipped Citizen Band service shop will probably have most of the basic test equipment for servicing the INTERNATIONAL EQUIPMENT. Because of the much closer frequency tolerance used on Citizen Band radio equipment, greater precision is required of all alignment generators and frequency measuring equipment. A good HF signal generator will be most helpful when alignment of the receiver is necessary. Hewlett-Packard type 606-A signal generator is a good example of the type and quality of instrument which has the inherent stability and accuracy that is desirable for servicing Citizen Band radio equipment. An accuracy calibrated attenuator with an auxiliary pad to reduce the generator output to 0.25 microvolts or less is very desirable for absolute receiver sensitivity measurements.

For receiver audio recovery measurements, the Heath Model AV-3 Audio Vacuum Tube Voltmeter will provide the necessary accuracy required in this test.

For frequency measurement and modulation percentage checks, the INTERNATIONAL Model C-12B Frequency meter is highly recommended. This versatile instrument specifically designed for use on the Citizen Band Channels, allows the technician to make accurate frequency and modulation checks with the minimum of set up time. The instrument can also be used as an accurate frequency standard for calibration of other equipment on Citizen Band channels.

An adequate source of well filtered low-voltage DC which can be varied over a minimum range of 5 to 15 volts with ample current capacity for good regulation is extremely desirable for service work. Although several automobile batteries can be used with taps at each cell to provide a crude range of adjustment, the upkeep and long range maintenance cost will invariably prove to be more costly than a good battery type of DC supply. One unit of this type is the Heath Model BE-5. Regulation and filtering are adequate for use directly without the need for batteries.

NOTE: Detailed information and prices on the instruments mentioned above may be obtained by contacting the appropriate manufacturer at the address listed below:

Hewlett-Packard Co., 275 Page Mill Road, Palo Alto, California
Bird Electronic Corp., 1800 East 38th Street, Cleveland 14, Ohio
International Crystal Manufacturing Co., Inc., 18 North Lee
Oklahoma City, Oklahoma 73102
Heath Company, Benton Harbor, Michigan

PREVENTATIVE MAINTENANCE

Wherever possible, a routine program of preventive maintenance should be set up on all INTERNATIONAL Executive radio installations in order to insure maximum equipment utilization with the least number of interruptions for service work. The following list has been prepared as a guide to indicate items which should be included in a preventive program. Unusual environmental or installation conditions may make it necessary to expand or alter this list to meet individual requirements in the field.

GENERAL

Check all plugs, connectors, tubes and fasteners for proper seating. Where equipment is subjected to extremely dusty conditions, occasionally remove the set from its case and dust with a clean, dry brush or with a clean, DRY source of compressed air. Clean the relay contacts only by drawing a small strip of ordinary bond letter paper between the contacts while holding gentle pressure on the relay armature. Do not use a file, sandpaper or any abrassive on relay contacts. The contacts are gold-plated and need only occasional cleaning to remove dust or foreign material. Vacuum or brush out any dust in the case before reinstalling the set.

MOBILE INSTALLATIONS

Check the battery connections. These must be clean and tight at all times. Check the battery at frequent intervals for condition and electrolyte level. Add water, as required, to keep the electrolyte at the proper level.

Inspect the power cable for evidence of physical damage. Check the microphone plug, cable and hanger bracket. Check all plugs and connectors for proper seating and security. Inspect the antenna system carefully. Remove the antenna plug from the set and check for continuity between the center contact of the plug and the actual antenna rod with a low range ohmmeter. Straighten or replace any bent or damaged antenna rods.

Check the voltage regulator for proper operation with the engine running. Adjust the regulator, if necessary, to prevent a voltage in excess of 7.5 volts on 6 volt systems or 14.5 volts on 12 volt systems when the generator is operating at its maximum output.

Inspect the distributor and spark plug wiring. Be sure all terminals are clean, bright and fit securely.

BASE STATION INSTALLATIONS

Check the primary line voltage to make certain it is within its normal limits. If the line voltage is subject to very large fluctuations, install a constant voltage transformer of appropriate capacity.

Inspect the microphone plug, cable and hanger bracket for evidence of excessive wear or damage. Check the antenna system, including the mast or tower, guy wires and coaxial cable. Be sure to inspect the ground wire for the mast or tower. All connections at the tower and ground rod should be clean and tight.

MINIMUM PERFORMANCE

The following routine measurements should be made at periodic intervals. If within the range indicated below, the set can be considered in good operating condition.

1. Check the receiver as follows with no signal input. This can be measured with a VTVM and audio output meter. The Volume control should be wide open, Squelch control OFF, Channel Selector set at Channel 9. The AVC voltage at terminal #3 on the 1st IF unit should be from -.1 to -.3 and Audio Output across speaker terminals .5 VAC or less. Typical meter readings with a luv 400cps 30% modulated signal are -1.5 or more volts AVC and 1.75 volts AC or better on the audio output meter.

2. Check the transmitter power output with an RF wattmeter. Rated output at standard input voltages of 7.1, 13.6 and 115 volts should be measured. (2.5 watts min.)

3. If a reflected power meter is available, check the reflected power when transmitting. The reflected power ratio should be 2.0 to 1 or better if the antenna, coax and transmitter are properly matched.

4. Check transmitter output frequency. Frequency should be .005% or better.

TROUBLE LOCALIZATION

To correct any trouble which may occur in the equipment, first try to isolate the section of the set which causes the trouble. In many instances a good visual inspection of the set will clearly indicate where the defective component is located. Reference to the block diagram of circuit functions and the schematic diagrams on the various sections of the receiver, transmitter and power supply, together with the following list of typical symtoms with probable sources of faults will be helpful in servicing the equipment.

When tubes are indicated as being the cause of the trouble, substitute a new tube of the same type for the one suspected of failure. If no improvement is noted, the original may be reinstalled. It should be noted that where tubes are referred to as trouble possibilities, the circuit components immediately associated with that particular tube may also be the source of trouble.

In trouble shooting the equipment, first check the power supply on 6 and 12 volts DC and 115 volts AC. If trouble is not in the power supply, all further checks can be made on 115 volts AC.

Connect a 115 volt power cord to the unit and remove the antenna and connect a dummy load. The dummy load can be made by connecting a #47 pilot lamp across a spare antenna plug and plugging this into the antenna jack of the unit.

VOLTAGE MEASUREMENTS

The voltage measured at pertinent tube socket pins as well as power pin terminals are shown in the table just preceeding the sectional schematic diagrams at the back of this manual.

The receiving condition voltages are preceeded by the letter 'R'. Transmitting condition voltages are preceeded by the letter 'T'. The filament voltages are not marked AC or DC, as this will depend on whether or not the unit is being operated on the AC line or on battery input voltage.

All voltage readings were taken with unit operating from 115 volta AC. Voltages measured when using battery input voltage will differ somewhat from those shown for 115 volt operation.

POSSIBLE TROUBLE CHART

COMPLAINT	POSSIBLE TROUBLE	REMEDY
POWER SUPPLY		
No B+ voltage (AC or DC)	fuse, switch, rectifiers	replace defective parts
No B+ voltage (DC)	fuse, transistors, Q1 & Q2	replace defective parts
	bad connection on power cable	repair cable
	defective transistor	replace defective parts
	transformer 512-118A	replace defective parts
	resistors R79 and R80	replace defective parts
B+ Low (DC)	battery output low	charge battery
	loss in power cable	correct defect in cable
	defective transistors Q1 & Q2	replace defective parts
	resistors R79 and R80	replace defective parts
B+ Low (AC or DC)	short in B+ line	remove short
	low resistance B+ line to gnd.	remove defective part
	defective rectifiers	replace defective parts
	defective power transformer	replace defective parts
TRANSMITTER SECTION		
No RF output	defective V9, V10, Q3, Q5, Q6 or Q7	replace tube/s or transistor/s
	open RFC-7	replace RF choke
	open C93	replace capacitor
	open secondary winding of modulation transformer T-6	replace transformer
	defective transmitting crystals	replace crystals
	poor relay contacts	clean contacts

COMPLAINT	POSSIBLE TROUBLE	REMEDY
Low RF output	L14, L15, L18, L19 or Q7 output circuit C106 & C107 improperly tuned	readjust coils as per recommended procedure
	C91 & C92 improperly tuned	readjust capacitors
	weak Q3, Q5, Q6, Q7, V9 or V10	replace tube/s or transistor/s
No modulation	defective V7 or V8	replace tube/s
	defective modulation transformer T-6	replace transformer
	mike gain control R55 on audio board improperly adjusted	readjust as per recommended procedure
Low modulation	defective microphone	replace microphone
	improperly adjusted mike gain control	readjust as per recommended procedure
	low grid drive to V9	check RF drive level to V10 and adjustment of Q7 output circuit
RECEIVER SECTION		
Dead (no sound)	defective V1, V2, V3, V4, V5, V6, V7 or V8	replace tube/s
	defective Q3 or Q4	replace transistor/s
	open Audio Filter Choke AFC-1	replace choke
	shorted capacitors C71 or C73	replace capacitor/s
	defective crystals	replace crystals
	dirty relay contacts	clean contacts
Low volume	defective tubes or transistors as listed above	replace tube/s or transistor/s
	receiver requires alignment	align as required