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Garrett

**NCX-500
TRANSCEIVER**

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W B R Y S
R I C H A R D

SECTION 1 GENERAL DESCRIPTION

The NCX-500 is a 5 band high performance transceiver covering the 80, 40, 20, 15 and 10 meter amateur bands. Three modes of communication are provided: SSB, AM, and CW.

The NCX-500 Main Tuning Dial is calibrated in 7 discrete bands, 4 covering the 80, 40, 20 and 15 meter bands, and 3 bands covering the 10 meter band. This dial controls the VFO of both receiver and transmitter portions of the transceiver, providing a high order of stability and tuning accuracy.

A crystal lattice bandpass filter is incorporated in both the transmit and receiver

sections of the transceiver. The bandwidth is 2.8 KHz at the center frequency of 5.2020 MHz with a 6:50 db shape factor of 2.2 to 1.

ALC (automatic level control) is incorporated in the NCX-500. Effective talk power is thereby increased and microphone gain and speech loudness are made less critical by this system. The 10 db range of the ALC circuit in the NCX-500 minimizes "flat topping" and splatter.

The transceiver operates on LSB on the 80 and 40 meter bands, and USB on the 20, 15 and 10 meter amateur bands.

SECTION 2 INSTALLATION

2.1 The NCX-500 transceiver requires a suitable power supply with excellent regulation and filtering, such as the NCX-B Power Supply/Speaker Console or the AC-500 Supply (supply only). Both of these power units will operate from either 117 or 234 VAC and are supplied with power cables to directly connect to the NCX-500. When the AC-500 Supply is used, an external speaker is required (see paragraph 2.2 for installation detail). Figure 1 illustrates the power connections and power requirements. For use with a 12 volt DC power supply connections to the power supply from the primary 12.6 volt source, and between the power supply and transceiver, should be made in accordance with the wiring instructions included with the 12 volt DC power supply. During mobile operation, make certain that the transceiver VR tube remains lit at all times and does not extinguish during voice peaks or under full TUNE input. Such VR tube extinction will cause severe frequency shift with modulation. Extinction of the VR

tube usually results from improper loading or from low +280 volt output from the DC supply. It is important to use a DC supply which will provide rated power to the transceiver and also to provide adequate voltage to the DC supply.

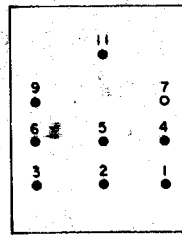
2.2 SPEAKER INSTALLATION

Two terminals on the 12 terminal Jones plug at the rear of the NCX-500 (pins 5 and 7) are provided for a pair of leads to be brought out for speaker connection if the NCX-B Supply is not used (see figure 1). Alternatively, the rear-panel phone jack may be used for a speaker.

When the NCX-500 is installed in an automobile for use with the 12 volt DC supply it will usually be most convenient to use the regular automobile broadcast radio speaker, connected through a DPDT switch mounted under the dash, to allow a choice of speaker operation of either the NCX-500 or the broadcast receiver.

INSTALLATION DIAGRAMS

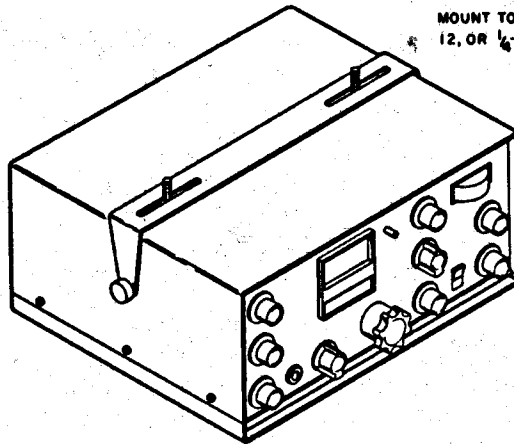
- 1 Power Switch
- 2 Power Switch
- 3 -100 Volt Bias @ 6 Ma.
- 4 12.6 Volt Heater @ 6.3 A
- 5 Speaker Ground
- 6 Common Ground
- 7 Speaker
- 9 +280 Volt @ 200 Ma.
- 11 1100 Volt @ 450 Ma.



POWER CONNECTIONS

FRONT VIEW
MALE PLUG

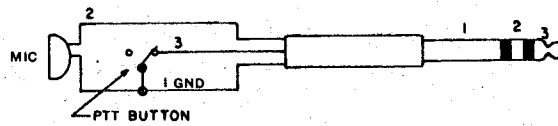
FIGURE 1



MOUNT TO DASH WITH #10,
12, OR 1/4-20 SCREWS

FIGURE 2

REMOVE RUBBER FEET
FOR MOBILE INSTALLATION



MICROPHONE CONNECTIONS

FIGURE 3

2.3 MOBILE MOUNTING

A mounting bracket is included with the NCX-500 transceiver. For mobile operation, this bracket should be mounted under the automobile dashboard with two #10, 12, or 1/4 x 20 screws. For maximum stability, these screws should be located as far apart as possible in the mobile mounting bracket. A pair of large threaded knobs hold the transceiver directly to the bracket. These knobs permit rapid installation or removal of the transceiver from the mount. Mobile operation usually results in considerable vibration and shock. For maximum frequency stability of the NCX-500 transceiver, it is important that all mounting screws used to hold the cabinet to the chassis and panel assembly be in place and firmly tightened. In mobile use, the rubber feet may be removed from the bottom of the NCX-500. (See figure 2.)

2.4 MICROPHONE CONNECTIONS

The microphone input of the NCX-500 is equipped with a three circuit jack providing a ground on the main shank of the three

circuit plug. The audio output of a high-impedance ceramic or dynamic (recommended) microphone (a crystal microphone may be used, but is not recommended for mobile operation) should be connected to the ring of the three circuit jack. If the microphone is equipped with a push-to-talk button, it should be so wired that the tip of the microphone plug is connected to the grounded shank of the plug when the push-to-talk button is pressed. The microphone push-to-talk button is connected to +12 VDC.

CAUTION

Accidental interchange of the wiring on the microphone plug will result in application of +12 volts to the microphone cartridge, which may damage the microphone.

The microphone input jack of the NCX-500 is equipped with a grounding contact so that no modulation of the transceiver is possible when the microphone plug is removed.

Microphone connections are illustrated in figure 3. We recommend the use of a good quality, wide-range microphone, since all necessary restriction of audio bandwidth is accomplished in the NCX-500 crystal lattice filter.

2.5 AUXILIARY RELAY CONTROL TERMINALS

A pair of SPST relay terminals rated at 3 amperes current capacity are provided at the rear of the NCX-500 to allow control of accessory equipment such as the NCL-2000 amplifier. Terminals are open during

receive, and closed during transmit.

CAUTION

The NCX-500 is wired for 12 volt negative ground mobile installations.

For use on positive ground installations the polarity of the 12 volt diode D-6 and the 250 mfd capacitor C-147 must be reversed. Failure to do this will result in damage to the unit.

SECTION 3 OPERATION

3.1 TUNING PROCEDURE

CAUTION

Before attempting to operate the NCX-500 transceiver, the following preliminary connections should be made. A suitable antenna or dummy load presenting 40 to 60 ohms resistive load impedance should be connected to the antenna terminals, a proper power cable should be connected from the transceiver, and a microphone or key should be connected to the appropriate input jacks. The function switch should remain in the OFF position while the connections are being made.

3.1.1 PRELIMINARY ADJUSTMENTS

Set front panel controls as follows:

RF GAIN fully cw (clockwise)

AUDIO GAIN at 9 o'clock

BAND and MAIN TUNING to desired band and frequency

MOX switch: OFF

MIC GAIN fully ccw (counterclockwise)

3.1.2 RECEIVER TUNE-UP (SSB)

Turn the FUNCTION switch from OFF to SSB.

Adjust the PA TUNE and EXCITER TUNE controls for maximum S-Meter reading or background noise. This adjustment automatically sets up approximate transmit tuning since these controls are common for both transmitter and receiver.

Adjust AUDIO GAIN for comfortable listening level.

3.1.3 TRANSMITTER TUNE-UP

CAUTION

Do not prolong tune-up procedures for more than 30 seconds in order to prevent unnecessary overheating of components during out-of-resonance conditions. After experience is gained, tune-up may be accomplished in a matter of a few seconds.

Turn FUNCTION switch to TUNE, and

adjust EXCITER TUNE control for maximum meter reading.

Quickly adjust the PA TUNE control for minimum meter reading (dip) indicating proper tuning of the Pi network. Slowly rotate the PA LOAD control cw and dip meter reading with the PA TUNE control until meter reads 450 ma.

Return the FUNCTION switch to SSB.

NOTE

If this is the first time that the NCX-500 has been placed in operation, the rear panel BIAS control should be adjusted. Place the NCX-500 in transmit with the MOX switch in the MOX position. The rear panel BIAS control should be adjusted until the meter reads between 50 and 60 ma. Return the NCX-500 to the receive condition (MOX switch OFF).

3.1.4 MOX OPERATION

The NCX-500 transceiver will now operate in both the transmit and receive modes using the MOX switch for transmit-receive control.

3.1.5 PTT OPERATION

Place the MOX switch in the OFF position.

Connect a suitable push-to-talk switch as shown in figure 3.

The NCX-500 will operate in both the transmit and receive modes by control from the external push-to-talk switch.

3.1.6 SSB OPERATION

Insert microphone in the front panel MIC jack.

Turn the FUNCTION switch to TUNE, and adjust the transmitter as described in paragraph 3.1.3.

Turn the FUNCTION switch to SSB.

Place the MOX switch in MOX or depress the microphone push-to-talk button.

Advance the MIC GAIN until the meter indicates voice peaks of 200 ma.

The NCX-500 is now adjusted for SSB operation.

3.1.7 CW OPERATION

Insert key plug in the rear panel KEY jack.

Turn the FUNCTION switch to TUNE and adjust transmitter as described in paragraph 3.1.3.

Turn the FUNCTION switch to CW. Place the MOX switch in MOX and depress key. Rotate the rear panel CARRIER INSERTION control clockwise until the meter reads 360 ma. Do not continue to rotate the CARRIER INSERTION control beyond the point at which 360 ma. is reached.

The NCX-500 is now tuned for CW operation and is returned to the receive condition by switching the MOX switch to OFF.

During CW operation, a CW sidetone signal is generated to allow the operator to monitor the CW output. The sidetone signal is automatically generated when the FUNCTION switch is in the CW position. (The sidetone signal can be used for code practice by placing the MOX switch in the OFF position and adjusting the RF GAIN and AUDIO GAIN controls to fully counterclockwise positions.)

3.1.8 AM OPERATION

Turn FUNCTION switch to TUNE, and adjust transmitter as described in paragraph 3.1.3.

Turn the FUNCTION switch to AM. Place the MOX switch in MOX, and rotate the CARRIER INSERTION control clockwise until the meter reads 125 ma.

Advance the MIC GAIN until meter just flickers on voice peaks.

The NCX-500 is now adjusted for AM operation, and the AM detector is automatically in use.

3.2 DETAILED USE OF THE INDIVIDUAL CONTROLS

The operating instructions in paragraph 3.1 of this manual enable rapid set-up of the NCX-500 for SSB, AM, or CW transmission. Careful study of the following

paragraphs will help you get the best performance from your NCX-500 transceiver.

3.2.1 DIAL SET

The dial of the NCX-500 may be adjusted to exact frequency (such as a 100 KHz marker from the optional plug-in XCU-27 calibrator) by tuning to the marker frequency with the receiver and then by turning the DIAL SET control until the fiducial line indicates correct frequency.

3.2.2 RECEIVE VERNIER

A vernier adjustment of the NCX-500 to the received signal can be made by pulling out the REC-VERNIER knob. This control allows the operator to fine-tune to the received frequency over a range of ± 3 KHz without shifting the transmitter frequency.

3.2.3 THE PA TUNE AND PA LOAD CONTROLS

Adjustment of the PA TUNE and PA LOAD controls is interdependent. For normal tune-up, the FUNCTION switch is placed in the TUNE position. The EXCITER TUNE control is set for maximum meter indication. The PA TUNE control is then set for minimum indication, indicating resonance of the Pi network. For a normal 40 to 60 ohm resistive antenna, the PA LOAD control should be rotated clockwise to increase the meter reading. As this is done, there will be some interaction with the PA TUNE control, and it will be necessary to slightly adjust the PA TUNE control for minimum meter indication. As the PA LOAD control is advanced, the minimum meter reading will increase. Proper loading for 500 watts peak input occurs at 450 ma. This loading current should not be exceeded, since the Pi network design is such that additional power input from an 1100 volt supply will not result in additional power output. Above 450 ma. the efficiency of the NCX-500 final amplifier will be impaired and no further output will be obtained.

Proper operation of any linear amplifier depends on proper idling current adjustment and on sufficient drive for adequate peak plate current during an off-resonance condition. The adjustment of the BIAS setting of the NCX-500 final amplifier is discussed in the operating instructions. Assuming this setting has been made for an idling current

between 50 and 60 ma., it should be possible to obtain a momentary maximum off-resonance plate current in excess of 500 ma. when the PA TUNE control is rotated away from the point of minimum indicated current. If 1100 volts are being properly supplied to the plate circuit of the final amplifier and the EXCITER TUNE control is properly adjusted, this off-resonance current should exceed 500 ma. If this current cannot be achieved, the cause should be found. Typical causes may include any of the following: improper BIAS setting, improper EXCITER TUNE adjustment, low plate supply voltage to the final amplifier under full load conditions, low driver B+, defective final amplifier tubes or driver tube, or improper alignment of the exciter stages resulting in low driving signal.

As mentioned above, low plate supply voltage to the final amplifier will frequently result in difficulty in obtaining a suitable off-resonance current. (The AC 500 power supply is rated to deliver 1100 volts to the final amplifier with 117 volt AC input.) If the AC line voltage or the mobile battery supply voltage is low, the power supply output will be reduced. Under these conditions, off-resonance plate current of 500 ma. will probably not occur. This will not impair the operation of the NCX-500 transceiver, provided that the PA LOAD control is not so adjusted as to result in excessive loading for the lower voltage. At no time should the PA LOAD control be advanced so that the plate current at the resonant dip exceeds 85% of the off-resonant plate current (which is noted by momentarily detuning the PA TUNE control).

In many instances an antenna load that is outside the 40 to 60 ohm range of the Pi network will be used with the NCX-500. Antennas presenting this type of impedance should, if at all possible, be adjusted to present a proper load at the NCX-500 antenna terminals. This can be done through the use of matching networks and, in many instances, by simply tailoring the length of the antenna transmission line to modify its terminal impedance.

Generally speaking, if the NCX-500 exhibits a resonant plate current in the dip in excess of 450 ma. with the PA LOAD control rotated to its full counterclockwise position, the antenna load impedance is below 40 ohms. If, on the other hand, the resonant dip is still less than 450 ma. with

the PA LOAD control rotated to its full clockwise position, the antenna load impedance is above 60 ohms. It is possible to modify the Pi network output capacitors of the NCX-500 to take care of some misloading in these directions. With the PA housing removed, a group of four mica capacitors will be seen just below the BAND switch and connected between the BAND switch and chassis. These capacitors, C-1 (3.5 MHz), C-2 (7 MHz), C-3 (14 MHz), and C-5 (21 MHz) are, respectively, 1000, 470, 220, and 220 pF. They appear in parallel with the front panel PA LOAD control as shown on the schematic diagram, and may be altered to extend the range of the Pi network. If the load impedance is too low, the capacitance should be increased. A good quality silver mica capacitor may be used for this purpose. It is advisable to use as large a case size on these capacitors as can be obtained.

There is of course some interaction of tuning between the PA LOAD control and the PA TUNE control. If load matching as described in the preceding paragraph is attempted, it is possible that the tuning of the PA TUNE control will be shifted to a point where this control will no longer cover the entire amateur band. In this event, it will be necessary to use external matching techniques. It is also possible that the antenna line will introduce an inductive or capacitive component to the NCX-500 antenna terminals. In this event, there may be also a shift of the PA TUNE control so that it will not tune over the entire amateur band. Again it will be necessary to alter the antenna impedance by means of an external matching network or correction of the antenna difficulties. SSB operation should not be attempted unless the NCX-500 is properly matched and loaded because severe distortion can result, as with any improperly matched SSB transmitter.

3.2.4 CARRIER INSERTION CONTROL

During tune-up (with the FUNCTION switch in the TUNE position), the CARRIER INSERTION control is inoperative. Full carrier is automatically inserted. In the AM and CW positions, the CARRIER INSERTION control may be preset and will vary the carrier level from zero to full output as indicated by the meter. In the SSB position, the CARRIER INSERTION control is again inoperative, and full carrier suppression is present.

3.2.5 S-METER ADJUSTMENT

Proper S-Meter adjustment of the NCX-500 is obtained by disconnecting the antenna and detuning the EXCITER TUNE control while the NCX-500 is set for SSB reception. With the RF GAIN fully clockwise (maximum gain), the S-Meter adjustment on the rear apron is rotated until the meter indicates between 0 and 1 "S" units. Some "wandering" of S-Meter zero may be experienced during warm-up.

3.2.6 THE MOX SWITCH

The MOX switch in the MOX (manual) operation position places the NCX-500 in the transmit mode, regardless of the position of the FUNCTION switch. This position is useful for manual operation when the microphone is not equipped with a PTT switch and is necessary for CW operation.

3.2.7 MIC GAIN CONTROL

For SSB operation, set up the NCX-500 by proper tuning of the final amplifier and exciter stages (paragraphs 3.1.1 to 3.1.3), and advance the MIC GAIN control until the meter reads between 150 and 200 ma. with modulation. Single sideband audio has a rapidly varying energy content and the meter will rapidly fluctuate between the 50 to 60 ma. idling current and the 150 to 200 ma. meter reading. Actual peak current is about 450 ma. This fluctuation will be affected by the nature of the speech content and individual voice characteristics.

For AM operation with the CARRIER INSERTION control set as described in the operating instructions, there will be a steady meter reading of 125 ma. If the MIC GAIN control is advanced during speech, AM modulation of the final amplifier will occur. When the MIC GAIN control setting reaches a point where the meter just indicates a slight flicker on speech peaks, modulation is 100%. Operation with the MIC GAIN control above this point should be avoided, since excessive drive will cause clipping of the modulation envelope, resulting in unwanted splatter.

3.2.8 TEN-METER SEGMENT SELECTION

If it is desired to operate on other than the 28.5 MHz to 29.1 MHz segment, the 10 meter band crystal (14.6 MHz) must be

changed. Crystals are available from the Service Department of the National Radio Company, Inc. at a cost of \$5.95 each. The optional crystals are 32.1 MHz (covering 28.0 MHz to 28.6 MHz) and 15.2 MHz (covering 29.1 MHz to 29.7 MHz). For operation on the 29.1 MHz to 29.7 MHz segment utilizing the 15.2 MHz crystal, the 14.6 MHz crystal is removed and replaced with the 15.2 MHz crystal. For operation on the 28.0 MHz to 28.6 MHz segment the 180 pF capacitor C-73 across the 10 meter oscillator trimmer must be disconnected at one end and the 32.1 MHz crystal should be inserted in the 14.6 MHz socket.

3.2.9 CARRIER INSERTION CONTROL AND CARRIER BALANCE

The carrier balance control R-56 of the NCX-500 is internal and has been factory adjusted for proper carrier suppression. Readjustment should not be required for normal SSB operation. If desired, it may be set in the following manner:

Allow the transceiver to warm up for approximately 30 minutes; then tune and load as for SSB operation. Set the FUNCTION switch to SSB. Place the NCX-500 in a transmit condition either by means of the push-to-talk button or by the MOX switch. In either event, the MIC GAIN control should be in full ccw position so that no audio modulation will occur. The carrier balance control is then adjusted for minimum meter indication. This meter reading should be between 50 and 60 ma. if the BIAS control is properly adjusted. When the carrier balance control is properly set, it may be left in this position for all subsequent operation. A more precise indication

of carrier balance control setting should be obtained either by using an oscilloscope connected to the antenna line or by listening to the suppressed carrier on a separate receiver. With proper carrier balance and tuning of the transceiver circuits, voltage on the antenna line should not exceed 0.5 volt peak-to-peak as indicated on the oscilloscope.

For AM operation, it is necessary to adjust the CARRIER INSERTION control cw from zero until the meter indicates a final amplifier current of 125 ma. This corresponds to approximately 135 watts input to the final amplifier, thus assuring operation of the tubes within their plate dissipation rating.

For CW operation, it is necessary to adjust the CARRIER INSERTION control cw from its zero setting until a meter indication of 360 ma. is obtained. This assures an input to the final amplifier of approximately 400 watts during key down transmit conditions of CW operation. Normal keying waveforms approximate less than a 50% duty cycle; that is, there is full input for less than one-half of the time and no power for the remaining time. Thus the time-averaged input to the final amplifier assures conservative operation.

In the SSB position the CARRIER INSERTION control is inoperative and full carrier suppression is obtained at all times. When the FUNCTION switch is turned to AM or CW, the CARRIER INSERTION control becomes operative and carrier is automatically inserted according to the preset position of the CARRIER INSERTION control.

SECTION 4 THEORY OF OPERATION

4.1 GENERAL

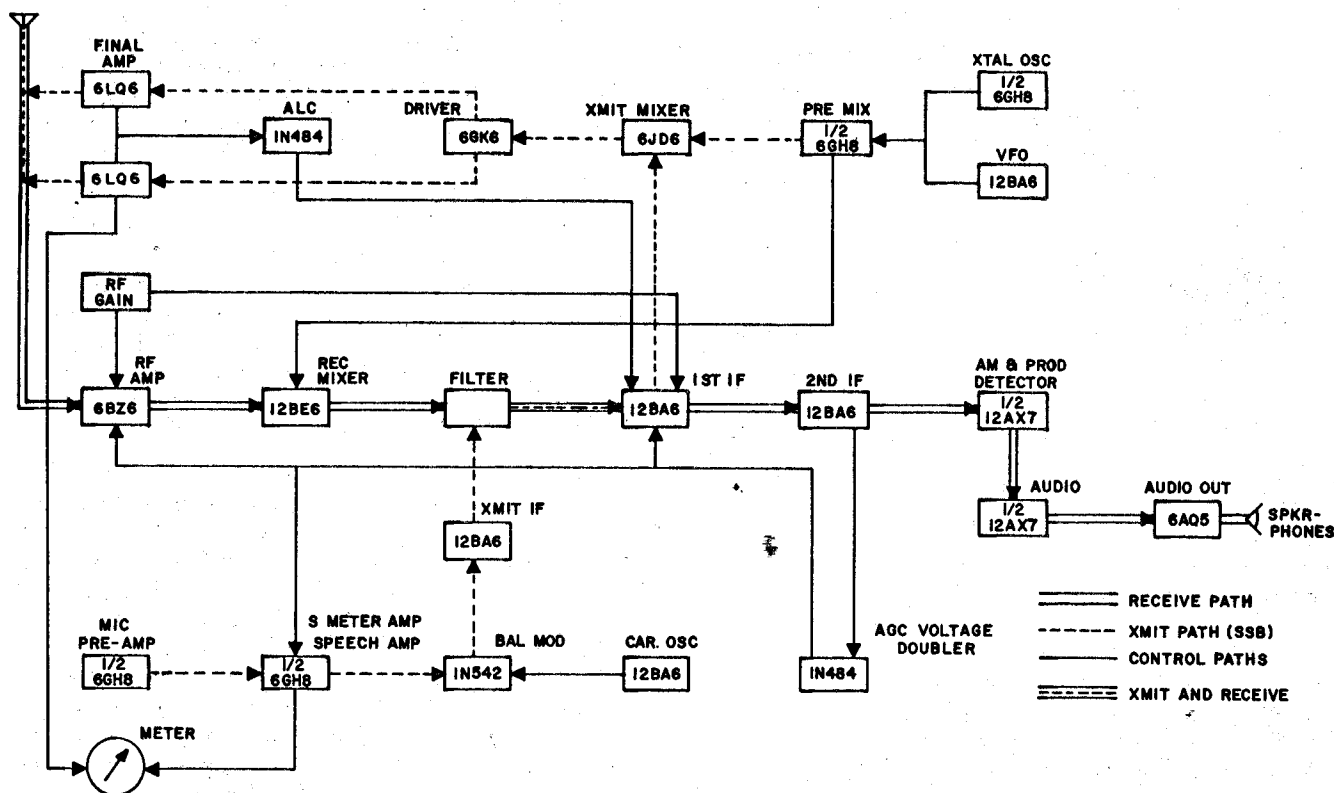
The NCX-500 transceiver, designed to cover the 80 through 10 meter amateur bands, combines a single conversion superheterodyne receiver and single sideband transmitter, both employing a common crystal lattice filter. The final Pi network and driver tuning circuits of the transmitter also serve as RF circuits for the receiver. The carrier oscillator and VFO are com-

mon to the receiver and transmitter circuits while the receiver first IF stage is used as a low level amplifier in the transmitter function. The use of common filter and RF input components results in a sensitive and image-free selective receiver and in a high quality, low distortion SSB transmitter.

The operation of the NCX-500 is best understood by reference to the block diagram, figure 4, and the frequency chart, figure 5.

BLOCK DIAGRAM

FIGURE 4



4.2 THE TRANSMITTER

The transmit signal path of the NCX-500 is indicated on the block diagram by a dashed line starting at the mike jack and carrier oscillator. The microphone input circuit is designed for high-impedance (dynamic or crystal) microphones and provides a push-to-talk microphone circuit. The microphone is connected directly to the grid of the pentode section of a 6GH8 (V-7A) tube which operates as a preamplifier. The signal is then fed through the microphone gain control to the triode section of the 6GH8 (V-7B) speech amplifier. The cathode circuit of this speech amplifier is coupled to the diode balanced modulator.

A 12BA6 (V-8) tube is used for the carrier oscillator. The carrier signal appears across a resistive plate load and is fed to the diode balanced modulator. The ring balanced modulator has both a resistive balance adjustment and a capacitive phase balance adjustment. The balanced primary winding of the output transformer is coupled to a single-ended winding which feeds the

input of the 12BA6 (V-9) which functions as a transmit IF stage. The transmit IF stage feeds a double tuned output circuit. The secondary winding serves as an input source for the four pole crystal lattice filter.

The crystal lattice filter is terminated by the IF input circuit coupled to the grid of the 12BA6 (V-3) first IF stage. The single tuned plate circuit is coupled to the grid of the 6JD6 (V-12) transmit mixer.

The VFO uses a 12BA6 (V-10) tube operating as a grounded cathode Hartley oscillator. The tank circuits of this oscillator use extremely stable capacitors to provide minimum warm-up drift and maximum frequency stability. Output is obtained from the screen grid assuring maximum stability with change in output load.

A crystal controlled band oscillator using the triode section of a 6GH8 (V-11 A) provides crystal frequencies of 21.5 MHz, 25.1 MHz, and 14.6 MHz. This signal is mixed with the VFO output in the pentode section of the 6GH8 (V-11 B) resulting in an

FREQUENCY MIXING CHART

FIGURE 5

BAND	XTAL OSC.	PRE-MIX	VFO OSC.	MIX	CARRIER OSC.	FREQ: RESULTANT OUTPUT
80	NOT USED	+	8.7 to 9.3	-	5.2003	3.5 MHz to 4.1 MHz
40	21.5	-	8.7 to 9.3	-	5.2003	7.0 MHz to 7.5 MHz
20	NOT USED	+	8.7 to 9.3	+	5.2003	13.9 MHz to 14.5 MHz
15	25.1	-	8.7 to 9.3	+	5.2003	21.0 MHz to 21.6 MHz
L 10	32.1	-	8.7 to 9.3	+	5.2003	28.0 MHz to 29.6 MHz
M 10	14.6	+	8.7 to 9.3	+	5.2003	28.5 MHz to 29.1 MHz
H 10	15.2	+	8.7 to 9.3	+	5.2003	29.1 MHz to 29.7 MHz

injection signal for the first receive and transmit mixers. A single tuned circuit is used in the output of the pre-mix circuit to provide for oscillator purity.

The plate circuit of the transmit mixer is single-tuned and feeds the grid of the 6GK6 (V-13) driver. The single tuned plate circuit of the driver feeds the grid of the final amplifier. The coils in the plate circuits of the transmit mixer, driver, and pre-mixer are band switched for the 80, 40, 20, 15, and 10 meter amateur bands. The tuning gang is tracked so that exciter tuning can be accomplished with only one control. The gain of the transmit mixer and driver are such that a driving signal in excess of 100 volts can be obtained at the grid of the final amplifier, thus assuring linear operation of the exciter to well above the level necessary for proper drive.

The final amplifier employs a matched pair of 6LQ6 (V-14 and V-15) tubes operating in parallel. A BIAS control on the rear apron sets proper idling current. The plates of the 6LQ6 final amplifier tubes are coupled to a high efficiency Pi network. The BAND switch selects proper inductance, tuning, and load capacitance to match a 40 to 60 ohm resistive load over the entire 80, 40, 20, 15, and 10 meter amateur bands. The Pi network is designed for continuous operation at a power level of 500 watts input. A small adjustable capacitor coupled from the plate of the 6LQ6 final amplifier to the partially by-passed return of the final grid circuit coils (driver plate coils) provides neutralization. When the final amplifier is properly neutralized, maximum output on a matched antenna or accurate 50 ohm dummy load will occur at the point of plate current dip as indicated on the meter.

An effective ALC (automatic level control) circuit is included. If the final amplifier grids are overdriven on voice peaks, the grids will actually see a driving signal positive with respect to the cathodes, and grid current will result. This current will cause a negative voltage change on the bias circuit. The resulting audio signal on the bias circuit is capacitively coupled to a voltage-doubling rectifier. This rectifier will provide a negative DC output which is coupled to the grid return of the 12BA6 (V-3) first IF amplifier. When overdrive occurs, the gain of the first IF amplifier is reduced, resulting in less driving signal at the final amplifier. Charging takes place rapidly from the low-impedance bias source through the rectifying diodes, but the negative ALC voltage cannot discharge through the reverse biased diodes, resulting in a fast attack-slow release action. A gating diode prevents cross connection of the ALC and AGC circuits at the common IF grid return point. The ALC circuit will provide automatic level control for input signal variations of more than 10 db, and makes the setting of the MIC GAIN control quite noncritical. In addition, sudden changes in voice level or disturbing background noises are controlled without overdrive and distortion of the NCX-500 transmitter signal.

4.3 THE RECEIVER

The receiver circuits are indicated by the double solid lines in the block diagram. The receiver RF circuits are common to the transmitter RF circuits. The high impedance point of the transmitter Pi network is capacitively coupled to the grid of a 6BZ6 (V-1) RF amplifier. The transmit driver and RF amplifier plates are connected

to the same tuned circuit insuring consistency in receive and transmit tuning as well as high selectivity. The output from the RF amplifier is coupled to the signal grid of the first receive mixer, a 12BE6 (V-2). The plate of this mixer is coupled to the secondary of the transmit IF transformer (T-2) which serves as the input coil to the crystal lattice filter,

The output of the crystal lattice filter, as in the transmitter, couples to the input of a two stage single-tuned IF amplifier operating at approximately 5.2 MHz. The detector and AGC circuits are fed through separate voltage dividers. The product detector employs one triode of the 12AX7 (V-5) tube with the signal from one IF voltage divider fed to the grid. A BFO signal is coupled from the crystal controlled 12BA6 (V-8) carrier oscillator to the cathode of the product detector, and the resulting audio signal is obtained across a resistive load in the plate circuit. For AM operation, the cathode of the product detector is grounded to permit operation as a grid leak detector.

The output from the detector is coupled to the audio gain control, and then to the grid of the remaining triode section of the 12AX7 (V-5 B) tube functioning as a grid-leak biased, first audio amplifier. The plate circuit is coupled to the grid of the 6AQ5 (V-6) audio output stage. The audio output stage feeds the output transformer with a 3.2 ohm secondary. This output signal is available on the speaker output pins of the power plug or at the phone jack. The low impedance nature of the phone jack feed permits use of either high or low-impedance phones.

A secondary feed is obtained from the plate circuit of the last IF amplifier and is fed to a voltage-doubling AGC rectifier (D-4 and D-5). The low-impedance driving source provides a rapid charge of the AGC bus. When the signal disappears, the negative AGC bus cannot discharge through the diodes, which provides a long release time, thus giving the AGC a very effective, fast attack-slow release action. The AGC is fed to the grid of the 6GH8 (V-7 B) S-Meter amplifier. AGC voltage is connected to the grid return of the RF stage, through the gating diode (D-3) to the first IF stage, and to the second IF stage for control of receiver gain.

4.4 THE FUNCTION SWITCH

The following paragraphs describe the operation of the various switching circuits with the FUNCTION switch in all possible positions.

4.4.1 FUNCTION SWITCH OFF

In this position the FUNCTION switch interrupts the primary power, either directly in case of the NCX AC 500 power supply or through a remote relay in the case of a 12 volt DC supply.

4.4.2 FUNCTION SWITCH IN SSB POSITION

In this position the following circuits are set up: The product detector and the microphone amplifier are connected into the circuit. The key jack is disconnected to prevent accidental keying. The CARRIER INSERTION control is disconnected, and a negative bias is applied to the 12BA6 (V-9) transmit IF stage to reduce gain. With the MOX switch in the OFF position, the push-to-talk contact is connected across the relay line. When the push-to-talk contact is pushed, the relay line is grounded, closing the relay. With the MOX switch in the MOX position, the relay line is grounded directly. Switching occurs as with push-to-talk operation. Returning the MOX switch to OFF will turn the transmitter off and put the equipment in the receive mode.

4.4.3 FUNCTION SWITCH IN AM POSITION

The AM position of the FUNCTION switch applies bias to the carrier oscillator during receive conditions to silence the BFO signal. The product detector cathode is grounded during receive periods to convert the detector to a grid leak AM detector. In this position, the carrier insertion control is connected, and bias is removed from the 12BA6 (V-9) transmit IF stage, providing full carrier insertion from 60 to 450 ma.

PTT and MOX functions now operate in the same manner as described under SSB.

4.4.4 FUNCTION SWITCH IN CW POSITION

In this position the function switch will ground the plate of the microphone preamplifier to prevent accidental modulation and

will connect the KEY jack to the transmitter bias line. The product detector is connected. The CARRIER INSERTION control is still connected as described in the AM position.

4.4.5 FUNCTION SWITCH IN TUNE POSITION

In this position the FUNCTION switch will ground the relay line, placing the transmitter into operation as described under SSB-PTT Operation. The MOX, PTT, and key circuits are disabled and have no influence on the tuning procedure. The center arm of the CARRIER INSERTION control is switched to the top of the control, providing an unbalanced condition. The bias on V-10 is still at zero. This provides appropriate drive for tune-up.

4.5 RELAY OPERATION

In the foregoing discussion, the exact nature of the relay switching was not described. The six-pole double throw relay is actuated by completing the ground side of the 12 VDC Relay Bus. The NCX-500 is placed in a transmit condition when the relay is energized.

The six poles of the relay are used in the following manner, reading from left to right on the schematic diagram:

1. Connects the S-Meter to the cathode of the S-Meter amplifier tube during receive periods, and grounds the S-Meter so that it will function as a plate current indicator during transmit periods.
2. Closes the external relay terminals during receive periods.
3. Switches the 220V B+ to various receiver stages during receive periods and to various transmitter stages during transmit periods.
4. Removes bias from various receiver stages during receive periods and removes bias from various transmit stages during transmit stages. Transmitter bias is not removed when the FUNCTION switch is placed in the CW position, allowing the key to function through this pole and provide grid block keying.
5. Grounds the RF Gain control bus during transmit periods to remove RF Gain control from the first IF amplifier which is used as a transmitter amplifier.
6. Connects the product detector cathode return during receive periods and grounds the AGC circuit during transmit periods to prevent accidental charge of the AGC bus.

SECTION 5 TEST AND ALIGNMENT

NOTE

Test and alignment of the NCX-500 transceiver should only be performed by competent, qualified personnel.

5.1 EQUIPMENT REQUIRED

1. Signal generator providing output at the following frequencies: 3.5 MHz, 4.1 MHz, 5.2 MHz, 9.0 MHz, 12.5 MHz, 16.1 MHz, 22.8 MHz, 24.5 MHz, 27.9 MHz, 29.2 MHz.
2. Vacuum tube voltmeter (VTVM).
3. Standard audio output meter.
4. High frequency oscilloscope covering the range from DC to 30 MHz with a maximum sensitivity of 50 mv per centimeter or better, and a low capacity input probe (Tektronix type 540 Series with type L preamplifier or equivalent).
5. 50 ohm dummy load with calibrated output meter covering the frequency

range from 3.5 to 30 MHz. (A high frequency vacuum tube voltmeter with a 100 volt full scale range may be substituted for the calibrated output power meter.)

6. Power supply capable of supplying +1100 volts at 450 ma., +280 volts at 200 ma., and -100 volts at 10 ma.
7. 1000 Hz audio generator with an output level of 10 mv.
8. High quality microphone equipped with push-to-talk button.
9. Transmitting key.
10. Suitable alignment tools for adjustment of coils and capacitors.
11. XCU-27 crystal calibrator.

Power Connections:

Disconnect the 1100 volt output of the power supply. The heater wire connecting the two 6LQ6 sockets should be removed.

5.2 5.2 MHZ IF ALIGNMENT

Turn the FUNCTION switch to AM. Set the RF GAIN and AUDIO GAIN controls to maximum, fully cw.

Connect the audio output meter to the speaker leads. This may be conveniently done by plugging the meter into the phone jack. Connect the signal generator through a 1000 pF capacitor to the grid (pin #7) of the 12BE6 (V-2) receive mixer tube socket. Set the signal generator output to approximately 5.2 MHz with audio modulation at 30%. Audio output should be audible. Adjust the signal generator frequency to match the center frequency of the band pass filter as indicated by maximum output. Tune the slugs of the 1st and 2nd IF coils L-23, L-24, L-25 and the bottom slug of T2 (transmitter IF) for maximum output, being careful to avoid overload of the receiving channel. The signal generator output should be reduced throughout the alignment procedure so that the output meter reading does not exceed 0.5 watt. After all coils are tuned and peaked the output level of the audio meter should read 0.5 watt with 20 μ v input from signal generator. Disconnect the signal generator and output meter.

5.3 CARRIER OSCILLATOR AND BALANCED MODULATOR ALIGNMENT

Place the FUNCTION switch in TUNE position. Connect the oscilloscope to junction of F-1, C-98, and C-99 (output of the 5.2 MHz crystal filter). Tune the top slugs of T1 and T2 transmitter IF transformer for maximum output on the oscilloscope. Adjust the carrier oscillator trimmer (C-146) until the indicated signal level is 0.4 volt peak-to-peak as indicated on the oscilloscope. Disconnect the oscilloscope from circuit.

5.4 VFO ALIGNMENT

Place the FUNCTION switch in the SSB position. Set the BAND switch to 3.5 MHz. Place the MOX switch in the OFF position. Connect the high frequency signal generator to antenna jack. Set the generator output to 3.5 MHz, and tune the main tuning dial to 3.5 MHz. Tune the VFO coil slug (L-20) for zero beat. Now tune the main tuning dial to 4.1 MHz, and set the generator to hear a signal at the 4.1 MHz dial setting. Check for zero beat. If zero beat occurs higher than 4.1 MHz, adjust the VFO trimmer capacitor (C-86) for more capacity. If zero beat occurs lower than 4.1 MHz, adjust the VFO trimmer capacitor (C-86) for less capacity. Now return the VFO dial to 3.5 MHz, and set the signal generator to 3.5 MHz; repeat this procedure until the 3.5 MHz beat note occurs at the 3.5 MHz dial setting and the 4.1 MHz beat note occurs at the 4.1 MHz dial setting, or until desired accuracy is achieved.

5.5 PRE-MIX AND DRIVER ALIGNMENT

Connect the signal generator output to the grid (pin #2) of the pre-mixer on 6GH8 (V-11) through a 1000 pF capacitor. Remove the 12BA6 (V-10) VFO tube; then remove the 14.6 MHz, 25.1 MHz, and 21.5 MHz crystals from the sockets of the crystal oscillator. Connect the oscilloscope to the grids of the 6GJ5 (V-14 and V-15) final amplifier tubes. Set the FUNCTION switch to the TUNE position and the BAND switch to the 3.5 MHz position. Set the signal generator to 9.0 MHz, and turn the EXCITER TUNE knob to #5 on panel. Adjust the pre-mix trimmer (C-62), the mixer coil (L-11), and driver coil (L-5) for maximum indication on the oscilloscope. This output should exceed 200 volts peak-to-peak.

FOR EACH BAND REPEAT THE PROCESS USED ON THE 80 METER BAND.

40 Meter Band:

Set the signal generator to 12.5 MHz. Then turn the EXCITER TUNE knob to #8 on panel. Adjust the pre-mix trimmer (C-57), the mixer coil (L-12), and the driver coil (L-6) for more than 200 volts on final grids.

20 Meter Band:

Set signal generator to 9.0 MHz. Then turn the EXCITER TUNE knob to #3 on panel. Adjust the mixer coil (L-13) and the driver coil (L-7) for more than 200 volts on final grids.

10 Meter Band:

Set signal generator to 29.2 MHz, and tune the trap (C-152) to minimum signal. Set signal generator to 27.9 MHz, and tune the trap (C-151) for minimum indication. Set the EXCITER TUNE knob to #2 on the panel. Now set the signal generator to 22.8 MHz and align the pre-mix coil (L-16), the mixer coil (L-15), and the driver coil (L-9) for maximum indicated output on oscilloscope. Set signal generator to 24.5 MHz, and turn the EXCITER TUNE knob to #7 on panel. Adjust the pre-mix trimmer (C-60) for maximum reading on oscilloscope. Repeat this procedure until proper tracking is achieved. The indicated output on oscilloscope at both frequencies should read 150 volts peak-to-peak.

15 Meter Band:

Set signal generator to 16.1 MHz. Then turn the EXCITER TUNE knob to #7 on panel. Adjust the pre-mix trimmer (C-59), the mixer coil (L-14), and the driver coil (L-8) for maximum indicated output of 200 volts peak-to-peak.

Remove the signal generator and replace the VFO tube 12BA6 (V-10) and the crystals in their proper sockets. This completes the adjustment of the mixer and driver stages with the exception that a slight misalignment now exists in the driver coil, due to the presence of the oscilloscope probe during previous adjustments and measurements. This error will be corrected during testing of the final amplifier stages to be described later.

5.6 CRYSTAL OSCILLATOR ALIGNMENT

Connect the oscilloscope probe to the grid (pin #2) of the 6GH8 (V-11 B) premixer tube. Turn the BAND switch to 7.0 MHz. Set the FUNCTION switch to the SSB position. The 21.5 MHz crystal oscillator now supplies the signal. Tune the 21.5 MHz crystal trimmer (C-78) to maximum indication on oscilloscope. When this point is reached, add slightly more capacity to reduce the output reading to 80% of the maximum reading. Set the BAND switch to 21.0 MHz. This position uses the 25.1 MHz crystal; tune the 25.1 MHz crystal trimmer (C-76) to maximum indication on the oscilloscope. Then reduce the output reading to 80% of the maximum reading. Now set the BAND switch to 28.0 MHz where the 14.6 MHz crystal is now used. Tune the 14.6 MHz crystal trimmer (C-74) to 2 volts peak-to-peak at this point.

5.7 FINAL AMPLIFIER PRELIMINARY ADJUSTMENTS

Although the NCX-500 does not require any alignment of the final amplifier, it is necessary at this time to check for proper operation at the high and low ends of all bands. In addition, it is necessary to make final adjustments on the driver plate coils and on the neutralizing capacitor. These checks should be made in following sequence: Reconnect the 1100 volts in power supply. Connect heater wire between the 6LQ6 sockets. Place the FUNCTION switch in TUNE position and allow 30 seconds for warm-up of final tubes.

CAUTION

Up to this point there has been no power applied to the final amplifier. All circuits which have been operating and which have been tested are low level, comparatively low voltage circuits. From here on, voltages and currents are present which are particularly dangerous to personnel, to the test equipment, and the unit under test. It is essential to be sure that no piece of test equipment is misconnected to the NCX-500, and that it not be placed into a transmitting condition without proper tuning,

since damage may rapidly result. In a number of the following tests, the transmitter will be operated at full power output. It is important that the unit be returned to a receiving condition if misindications are obtained, if the test is not completed within a period of 30 seconds, or if the unit is not tuned up within a period of 30 seconds. Otherwise, serious and permanent damage may occur in the final output circuit.

Disconnect all previously used test equipment from the NCX-500. Attach the 50 ohm dummy load and calibrated output meter to the antenna connector. Set the BAND switch to 28.0 MHz. Set the main tuning dial to 28.8 MHz. Now turn the FUNCTION switch to TUNE and rapidly peak the EXCITER TUNE for maximum meter reading on the combination S-Meter and cathode current meter. Adjust the 10 meter drive plate coil (L-9) for maximum meter reading while slowly rocking the EXCITER TUNE control. This will correct for the presence of the oscilloscope probe in the previous setting. Now rotate the PA TUNE control and observe whether a dip occurs in plate current reading.

Note the power output recorded by the power output meter. This power output should exceed 150 watts at all frequencies, provided that the PA LOAD control is adjusted so that the final amplifier draws 450 ma. With the PA TUNE control set for a plate current dip, the PA LOAD control is slowly rotated in a clockwise direction. As the PA LOAD control is advanced, it will be necessary to slightly retune the PA TUNE control to stay in the dip. Continue this process until the minimum reading in the dip corresponds to 450 ma. on the meter.

5.8 NEUTRALIZING CAPACITOR

With the FUNCTION switch in the TUNE position, rotate the PA TUNE control to either side of the resonant point and observe the plate current meter. It is necessary that the off resonance current exceed 500 ma. Having noted the off resonance plate current, retune the PA TUNE control to the plate current dip at 450 ma. and observe the power output. It should exceed 150 watts. Carefully rotate the PA TUNE control to either side of the dip and observe

whether the power output rises or falls. With proper setting of the neutralizing capacitor, the power output should fall on either side of the dip. If the power output rises as the PA TUNE control is tuned away from the dip, it will be necessary to adjust the neutralizing capacitor. This can be quickly done on a trial and error basis by rotating the neutralizing capacitor and observing whether maximum power output occurs at the plate current dip. As proper neutralization is achieved, maximum power output will occur at minimum plate current. Return the FUNCTION switch to CW.

5.9 FINAL AMPLIFIER PRELIMINARY ADJUSTMENT (80-15 METERS)

Set the BAND switch to 21.0 MHz and the main tuning dial to 21.250 MHz. Turn the FUNCTION switch to TUNE and rapidly peak the EXCITER TUNE for maximum meter reading. Adjust the 15 meter driver plate coil (L-8) for maximum meter reading while slowly rocking the EXCITER TUNE control. This will correct for the presence of the oscilloscope probe in previous tests. Now rotate the PA TUNE control and observe whether a dip appears in the reading. Advance the PA LOAD in a clockwise direction, and slightly retune the PA TUNE control to stay in dip. Continue this process until the minimum meter reading in the dip corresponds to 450 ma. The power output should exceed 150 watts and proper neutralization should be observed. Repeat this procedure at the following BAND switch and tuning settings, in each case adjusting the proper driver coil for maximum meter indication while rocking the EXCITER TUNE control.

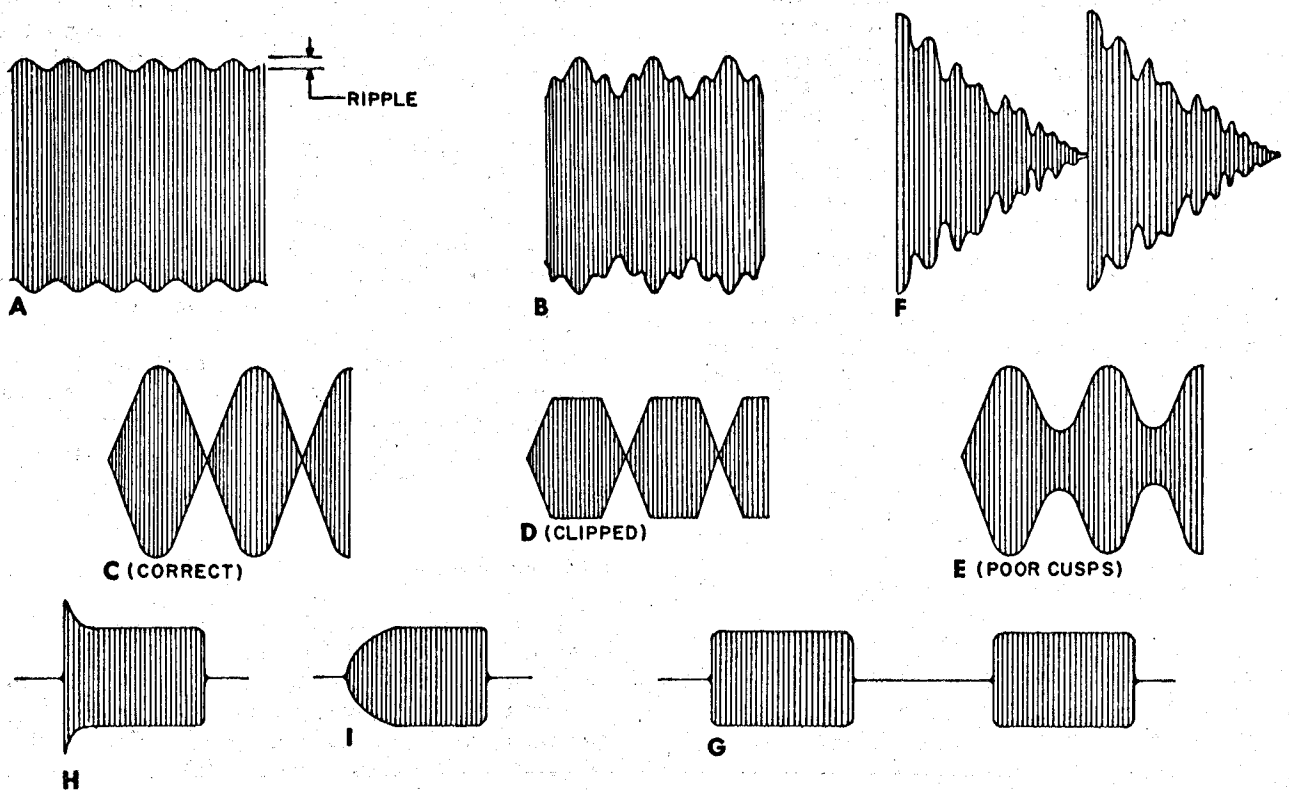
BAND SWITCH	MAIN TUNING DIAL	DRIVER COIL
14.0 MHz	14.2 MHz	L-7
7.0 MHz	7.2 MHz	L-6
3.5 MHz	3.7 MHz	L-5

5.10 CARRIER SUPPRESSION, SIDEBAND SUPPRESSION, MODULATION AND ALC CHECKS

Connect the audio generator to the MIC jack and supply 10 mv of audio signal to the NCX-500. Rotate the FUNCTION switch to the TUNE position. Connect the high-frequency oscilloscope to the antenna line

WAVEFORMS

FIGURE 6



which is connected to the dummy load. Tune the final amplifier for maximum output at 450 ma. input as described in the previous sections. A level well in excess of 200 volts peak-to-peak should be noted on the oscilloscope. Turn the FUNCTION switch to the SSB position. Place the MOX switch in the MOX position, and set the carrier balance control for minimum indication on the oscilloscope which should correspond to minimum indication on the meter. Adjust the BIAS control for 60 ma. on the meter. The level remaining on the oscilloscope should not exceed 0.5 volt peak-to-peak, thus insuring carrier suppression better than 50 db. If necessary, carefully adjust the balanced modulator phase trimmer (C-6) for minimum indication while rocking the carrier balance control through minimum until the required 0.5 volt level is obtained. Now rotate the MIC GAIN control slowly in a clockwise direction. A signal should again appear on the oscilloscope. The MIC GAIN should be advanced until the cathode current meter reads 450 ma. Output at the scope should be 120-180 volts. The waveform at

this point should appear as indicated in figure 6A. It is necessary to note the level of ripple on the waveform to total waveform level. The ripple should not exceed 1/30 of the total waveform. This indicates that the unwanted sideband suppression with a 1000 cycle tone is in excess of 30 db, the limit of this measuring technique.

It is important to note the difference between carrier balance and unwanted sideband suppression in the previous measurement. If the carrier balance control is rotated slightly, the waveform of figure 6A will be altered to the waveform of figure 6B. If this waveform is present while attempting to make the sideband suppression measurement, the carrier balance control should be slightly adjusted to compensate and return the picture to that of figure 6A.

Place the FUNCTION switch in the AM position. Now further advance the MIC GAIN until the meter just reaches 450 ma. as set by the previous tune-up procedure. Note the oscilloscope level. Slowly advance the CARRIER INSERTION control cw from

the minimum setting. As this occurs, the waveform will begin to develop large cusps and peaks which will tend to exceed the noted oscilloscope level. Slowly reduce the MIC GAIN to keep the peaks at the predetermined level by carefully adjusting both the MIC GAIN and the CARRIER INSERTION control. It should be possible to obtain a picture as illustrated in figure 6C. It is important that the peaks of this figure be at exactly the level determined with the balanced carrier at 450 ma. of cathode current. This is a two-tone test and is useful in indicating distortion in the transmitter channel and performance of the modulating circuits. The waveform which is observed should have a clean sharp cusp and should have a sine wave envelope. There should be no flattening of the peaks and no broadening of the cusps. Typical incorrect waveforms are indicated in figures 6D and 6E.

5.11 ALC AUTOMATIC LEVEL CONTROL

Advance the MIC GAIN control to maximum and readjust the CARRIER INSERTION control for sharp cusps. The final amplifier should now be overdriven and ALC voltage should result. The oscilloscope waveform should remain as shown in figure 6C. Check the ALC output at the junction of D-1, C-25, R-6, and R-29. There should be approximately 5 volts at this point.

The rear ALC jack may now be checked by applying -10 volts at the ALC input jack. The oscilloscope display amplitude should decrease indicating proper external control.

Press the MOX switch to OFF. The set is now ready for push-to-talk operation.

If all of the tests are met satisfactorily, it can be assumed that the transmitter section is working properly, although it is of some value to check the dynamic operation of the transmitter on the microphone. To do this, return the MIC GAIN to zero and place the FUNCTION switch in the SSB position. Now remove the audio generator from the MIC jack and replace it with the test microphone.

Press the push-to-talk switch and speak normally into microphone. Slowly advance MIC GAIN control until peaks of the resulting signal reach the amplitude used for the previous two-tone test. At this point the meter will be fluctuating rapidly with the speech content. The meter should generally average around 200 ma. of current and the output waveform should appear as illustrated in figure 6F.

5.12 CW CHECK

Place the FUNCTION switch in the CW position. Plug the key in the key jack. Load the transmitter as in previous checks. Press the MOX switch to MOX. With key down, rotate the CARRIER INSERTION control until meter reads 360 ma. Now key the transmitter and check the pattern of RF on the oscilloscope. A correct pattern should look like the figure 6G. Remove the oscilloscope.

5.13 RECEIVER IF TRAP ALIGNMENT

Connect the signal generator to antenna jack. Set the signal generator to 5.2 MHz (center frequency of the bandpass filter). Adjust the IF trap capacitor (C-91) for minimum output.

SECTION 6
PARTS LIST

ALL READILY AVAILABLE RESISTORS AND CAPACITORS ARE OMITTED FROM THE FOLLOWING PARTS LIST, BUT ARE COMPLETELY IDENTIFIED ON THE SCHEMATIC:

SYMBOL	DESCRIPTION	PART NUMBER	SYMBOL	DESCRIPTION	PART NUMBER
SOCKETS AND JACKS			TUBES AND DIODES (Cont)		
	Socket Crystal	A-50799	D14	Diode 1N711	
	Socket Novar	A-50802	D15,	Diode	Solitron
	Socket 7 Pin	B-27669-3	D16		TW30
	Socket Octal	B-27674-1	CV-1	Varactor	PSI-V956E
	Socket 9 Pin	B-27669-3	COILS AND CHOKES		
J1	Jack, Microphone, 3 ckt.	A-50793-2	L1	Antenna Choke	C-50523-3
J2	Jack, Key, 2 ckt.	A-50793-1	L2	Pi Network	B-51518-2
J3	Jack, sht. phones, 2 ckt.	A-50793-3	L3	100 μ h Choke	C-50527-4
J4	Connector, Antenna	A-51479	L4	PA Choke	A-51529
J5	Plug Power	A-50791	L5	80 Meter Driver	B-50755
J6	Jack, External ALC In	A-11998	L6	40 Meter Driver	B-50757-2
J7	Strip Term.--Relay	C-19458-6	L7	20 Meter Driver	B-50759-2
MISCELLANEOUS ELECTRICAL			L8	15 Meter Driver	B-51515-2
M	Meter	A-52039	L9	10 Meter Driver	B-51517-2
K1	Relay 6PDT 62.3 Ω	A-52038	L10	220 μ h Choke	A-50206-1
F1	Filter Band Pass 5.2 MHz	A-52004	L11	80 Meter Mixer	B-50756
X1	Crystal 5.2003 MHz	B-50769	L12	40 Meter Mixer	B-50758
X2	Crystal 14.6000 MHz	B-52042-3	L13	20 Meter Mixer	B-50760-2
X3	Crystal 25.1000 MHz	B-52042-2	L14	15 Meter Mixer	B-51514-2
X4	Crystal 21.5000 MHz	B-52042-1	L15	10 Meter Mixer	B-51516-2
	Panel Lamp Socket Assy.	B-52051	L16	Pre-Mix Coil	B-51514
	Panel Lamp	NPL-47	L17	80 Meter Pre-Mix	B-52053
TUBES AND DIODES			L18	Oscillator Coil	B-52047
V1		6BZ6	L19,	220 μ h Choke	A-50206-1
V2		12BE6	L22, L30		
V3, V4,		12BA6	L20	VFO Coil	B-52037
V8, V9,			L21	4.7 μ h Choke RF	C-50750-21
V10			L26,	3.3 μ h Choke	C-50750-19
V5		12AX7	L27		
V6		6AQ5	L28,	Choke, Parasitic	B-51545
V7, V11		6GH8	L29		
V12		6JD6	L31	68 μ h Choke	C-50750-35
V13		6GK6	SWITCHES		
V14, V15*		6LQ6	S1-A, B	PA Band Switch Wafer	A-51523
V16		0A2	S1-C, D	Driver Wafer	A-51525
D1, D2,	Diode 1N484	A-51672	S1-E, F	Mixer Wafer	A-51521
D3, D4,			S1-G, H	Band Switch and Detent	B-52003
D5			S2	Function Switch	B-52002
D6	Diode	A-51294-1	S3	Rocker MOX-ON	A-52004
D7, D8,	Diode 1N542	1N542	S5	Receive Vernier	
D9, D10				Centralab Model 2 with DPDT Slide Switch	
D11	Diode	Solitron 3R130B	KNOBS		
D12,	Diode 1N457A		Main Tuning		A-52045-3
D13			Knob Pointer		A-52045-1
			Knob Round		A-52069

* V14 and V15 are matched 6LQ6 tubes which are available from the Service Dept. of National Radio Company, Inc.

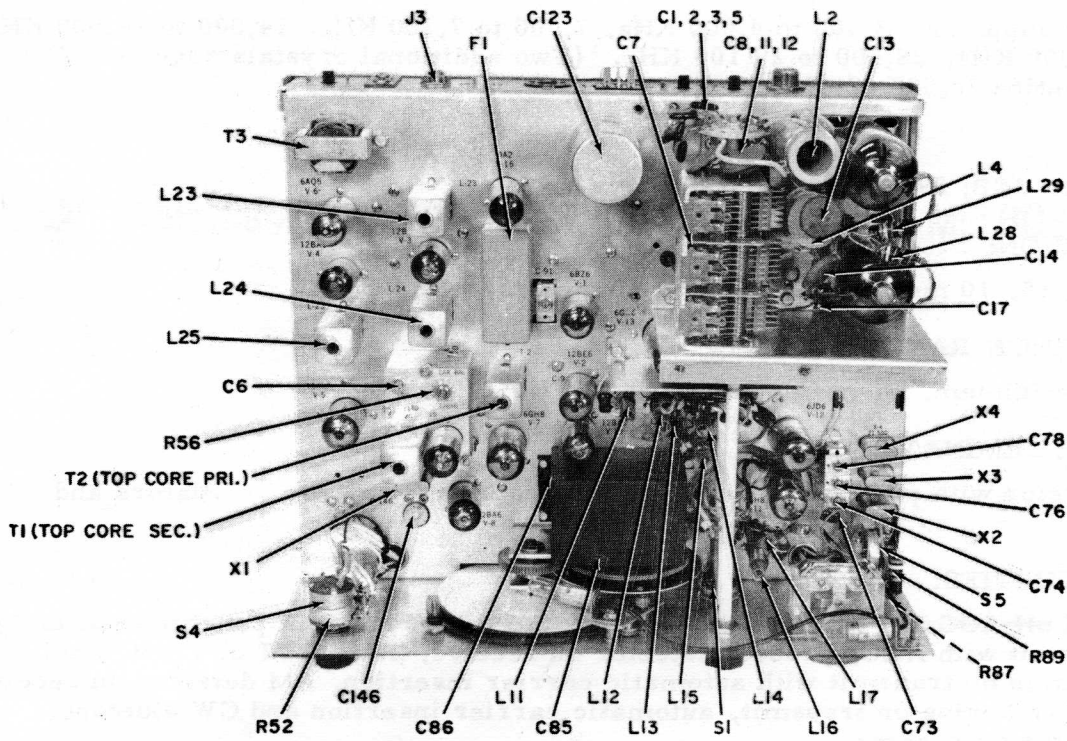
SYMBOL	DESCRIPTION	PART NUMBER	SYMBOL	DESCRIPTION	PART NUMBER
SHAFTS, COUPLINGS, DRIVE TRAIN			TRIMMERS (Cont)		
	Shaft, Band Switch	B-50854	C57,	Trimmer U Bracket	B-51304-7
	Shaft, PA Load	B-50818-3	C59,	Mtd 1.5 - 20 pF	
	Shaft, PA Tune	B-50818-1	C60,		
	Shaft, Exciter Tune	B-50818-9	C62,		
	Set Screws	SS6-RC-3X	C151,		
	Coupling, Rigid	A-12611	C152	Trimmer U Bracket	B-51304-2
	Coupling, Link	B-25000	C74,	Mtd 1.5 - 20 pF	
	Bushing, Panel	A-50840	C75,		
	Palnuts 3/8-32	B-19332-8	C78	Ceramicon 5 - 25 pF	B-19783-4
			C86	NPO	
	COVERS		C91	Mica, 7 - 100 pF	A-52049
	Cover, VFO	B-52007	C146	Ceramicon 5 - 25 pF	A-19783-2
	Cover, PA	C-50815-4		NPO	
	Front Panel Assy.	C-52009-2	CAPACITORS		
	Cabinet Chassis Cover	D-52011	C4	Gang: PA Load	C-50788
	Cabinet Bottom Pan	C-52010	C7	Gang: PA Tune	C-50789
	Hanger Bracket	C-50836-2	C40	Gang: Exciter Tune	C-51011-2
	Hanger Screws	A-50835	C85	Gang: VFO Tune	C-52005
	Rubber Feet	A-52041	C11	Ceramic 75 pF 500 V	A-50849-3
	Bezel	B-50809		±5%	
POTENTIOMETERS AND CONTROLS			C12	Ceramic 51 pF 500 V	A-50849-2
				±5%	
R3	Bias	B-50541-1	C13,	Ceramic 500 pF 3 KV	A-50849-5
R43	Audio Gain	B-50768-4	C14	±5%	
R52	MIC Gain Cal. ON-OFF	B-50986-1	C8	Ceramic 150 pF 500 V	A-50849-10
R56	Carrier Balance	A-51847		±5%	
R62	Carrier Insertion	B-50541-1	C83	Ceramic 330 pF +180	A-52062
R73	RF Gain	B-50768-3		PPM ±1%	
R81	S-Meter	B-50541-10	C84	Ceramic 150 pF - 750	A-52063
R87	Receive Vernier 10 K			PPM	
	Linear		C123	Electrolytic 40-40-20	C-19458-8
				20 Mfd	
	RESISTORS		C165,	.02 mfd 50 W VDC	
R1	3.2 ohms 2 W ±3%	B-17436-10	C166	Erie 855-000-X5J0-2032	
R2	650 ohms 1/2 W ±2%	RC20-	C169	.003 mfd, 500 V	
		BF651G		Erie 811-000-XR5F332K	
R78	2.2 K 10 W ±10%	B-17436-24	TRANSFORMERS		
R79	750 ohms 10 W ±10%	B-17436-16	T1	Balanced Modulator	B-51821
R86, R89	39 K, 2 W, ±10%		T2	Transmit IF	B-50764
			T3	Audio Output	B-19435-4
			L23,	IF Transformers	B-50766
			L24,	5.2 MHz	
			L25		
C6, C9	Piston 1 - 8.0 pF	A-51997			
C17	APC Air,	B-50364			
	Neutralize 4 - 15.0 pF				

NOTE

The parts listed above are shown in figure 7.

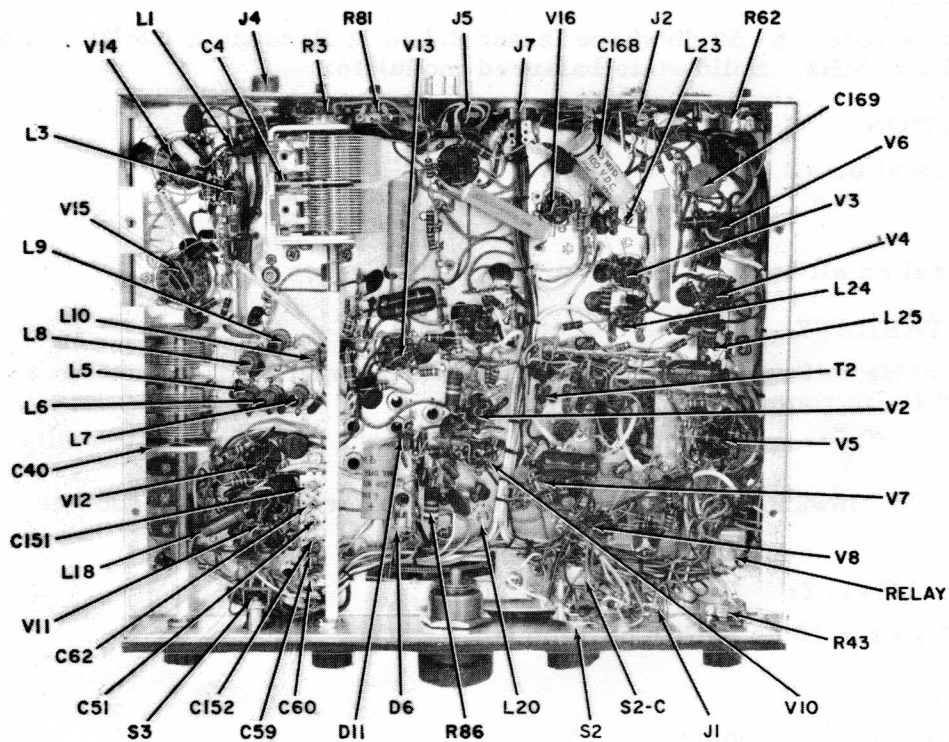
TOP VIEW

FIGURE 7



BOTTOM VIEW

FIGURE 7



NCX-500 SPECIFICATIONS

FREQUENCY RANGE:

With crystals supplied -- 3,500 to 4,000 KHz, 7,000 to 7,300 KHz, 14,000 to 14,500 KHz, 21,000 to 21,500 KHz, 28,500 to 29,100 KHz. (Two additional crystals required if coverage of entire 28,000 - 29,700 KHz band is desired.)

POWER INPUT:

500 watts PEP SSB; 390 watts CW; 125 watts AM.

TYPES OF EMISSION:

SSB (USB 20, 15, 10 meters, LSB 80 and 40 meters), AM, CW.

OUTPUT IMPEDANCE RANGE:

40 - 60 ohms minimum, Pi-network.

FREQUENCY DETERMINATION:

Single conversion with premixed crystal-controlled high frequency oscillators and tunable VFO.

OPERATING FACILITIES:

(All modes) Full AGC and S-Meter on receive; (SSB) PTT or front panel manual operation on transmit with ALC, product detector on receive; (AM) PTT or front panel manual operation on transmit with automatic carrier insertion, AM detector on receive; (CW) grid-block keying on transmit, automatic carrier insertion and CW sidetone, product detector on receive.

RECEIVE FREQUENCY VERNIER:

Front panel control provides a ± 3 KHz vernier of the receiver frequency.

SSB GENERATION:

Crystal lattice filter; 6 - 50 db shape factor 2.2 to 1; Bandwidth 2.8 KHz at 6 db; Center frequency 5.202 MHz. Solid state balanced modulator.

DIAL CALIBRATION:

5 KHz; Identical on all bands.

TUNING RATIO:

45:1; Identical on all bands.

FREQUENCY STABILITY:

Nominal 1500 Hz in first 30 minutes after 5 minute warm-up; long-term stability nominal 400 Hz in room ambient conditions.

SUPPRESSION:

Carrier -50 db, unwanted sideband -40 db, 3rd order distortion products -30 db at full output.

RECEIVER SENSITIVITY:

Nominal 0.5 μ v for 10 db S/N in SSB mode.

AUDIO OUTPUT:

Better than 2 watts; 3.2 ohms.

NATIONAL RADIO COMPANY, INC. • 37 WASHINGTON ST., MELROSE, MASS. 02176

**NCX-500
POWER SUPPLY**

NCX AC 500 POWER SUPPLY

The NCX AC 500 Power Supply is capable of providing all necessary power to operate the NCX-500 Transceiver. The supply is equipped with a power plug and 6' cable so that it may be connected directly to the transceiver, with no other power connections required.

Referring to the schematic diagram, 117 or 234 VAC is supplied from the line cord through the power supply protection fuse. A pair of switching leads is connected through pins 1 and 2 of the cable and plug. A bridge rectifier D1, and the filter capacitors C1, C2, and C6 provide 1100 volts dc to the final amplifier tubes in the transceiver. In order to provide maximum efficiency in the supply, the low voltage dc is taken from the center tap of the high-voltage winding. The low-voltage dc from the center tap is filtered by chokes L1 and L2, and capacitor C3. It is dropped and further filtered by resistor R6 and R9, and a filter capacitor inside the transceiver. This provides 280 volts at 200 ma. at terminal 9 of plug P1. Resistor R8 is a 30,000 ohm bleeder resistor to prevent shock hazard.

The output of the bias winding of T1 is rectified by diodes D2 and D3. This rectified output is filtered by capacitor C4 and provides -100 volts at approximately 10 ma. for bias purposes to terminal 3 of the power plug P1.

NCX AC 500 POWER SUPPLY RATINGS

INPUT:

117 or 234 VAC $\pm 10\%$, 50 - 60 Hz
 150 Watts Receive
 650 Watts CW Transmit

OUTPUT:

High Voltage 1100 VDC at 50 to 500 ma.
 Low Voltage 280 VDC at 200 ma.
 Bias Voltage -100 VDC at 10 ma.
 Filament 12.6 V at 6.3 A.

DIMENSIONS:

7-3/4" W x 6-1/2" H x 11" D

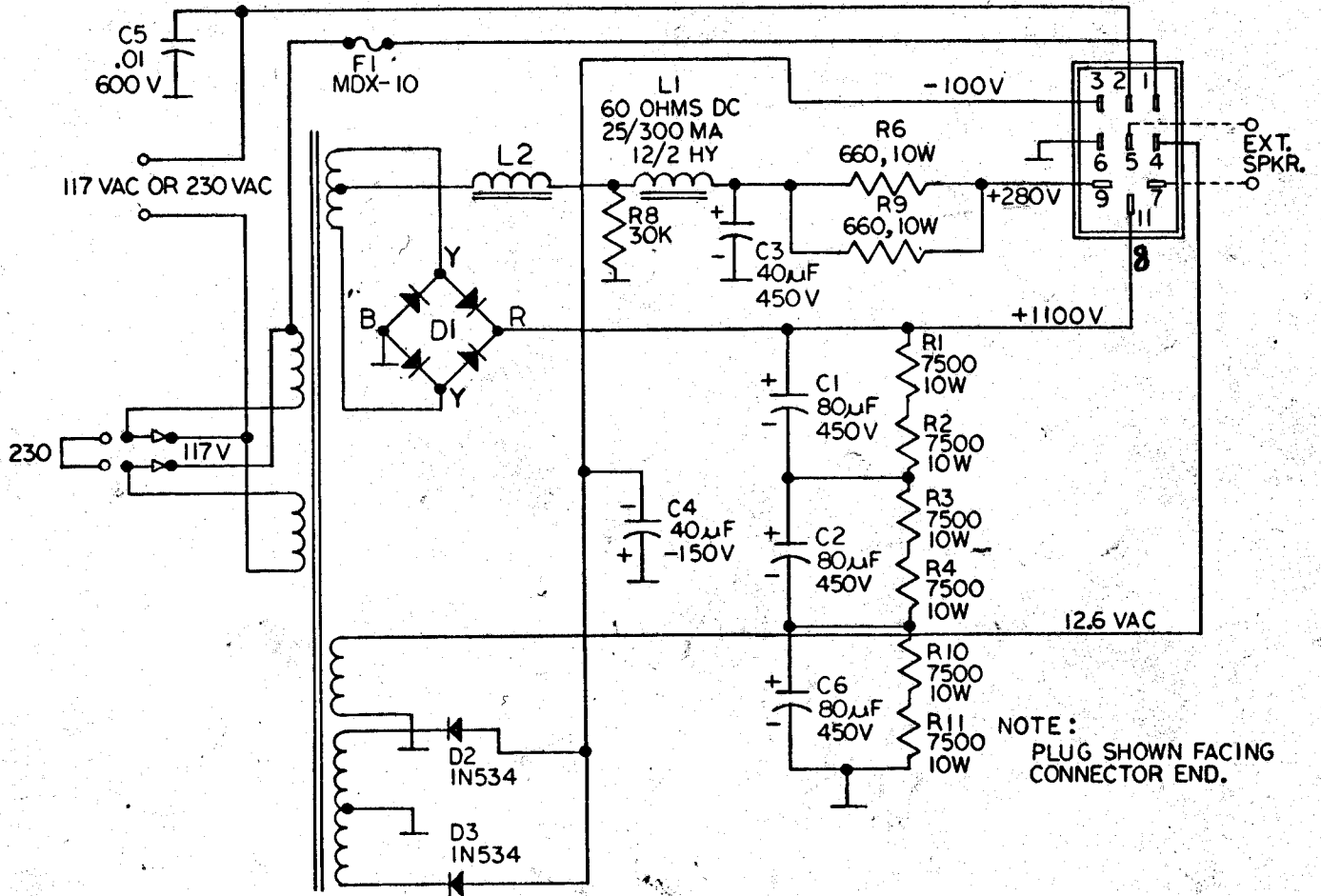
WEIGHT:

21 pounds

ALL READILY AVAILABLE RESISTORS AND CAPACITORS ARE OMITTED FROM THE FOLLOWING PARTS LIST, BUT ARE COMPLETELY IDENTIFIED ON THE SCHEMATIC.

PARTS LIST

DESCRIPTION	PART NUMBER	DESCRIPTION	PART NUMBER
Plug, Jones, Female	A50828	Rectifier Bridge	A52116
Strain Relief Bushing	A50892-3	Rectifier, Silicon, 500 PIV	A50874
Capacitor, Electrolytic, 40 μ fd 450 VDCW	C19458-7	Similar to 1N534	
Capacitor, Electrolytic, 40 μ fd 150 VDCW Tubular	C19411-3	Resistor, 7,500 ohms, <i>18w $\pm 10\%$ - 12w - 74ea.</i>	B17436-13
Capacitor, Electrolytic, 80 μ fd 450 VDCW Tubular	C19411-4	Resistor, 30,000 ohms, <i>10w $\pm 10\%$ - 12w - 87ea.</i>	B17436-14
Fuse Holder	A50862	Resistor, 660 ohms, 10 w $\pm 10\%$	B17436-22
Transformer, Power	C51325	Line Cord	B22132-6
Choke, Swinging	B52068	Cable, 7-Conductor	B52065
Choke, Filter	B52067	Foot, Rubber	A50851
Switch, Transfer	B27662		



NOTE:
PLUG SHOWN FACING
CONNECTOR END.

NCX AC 500 Power Supply Schematic

STANDARD WARRANTY

National Radio Company, Inc., (hereinafter called "Manufacturer") warrants that the equipment delivered under this sale is free from defects in workmanship or materials in normal use and operation. Manufacturer's only responsibility under this warranty is to repair or replace, without extra charge, any components or products of which Manufacturer is notified in writing within ninety (90) days after delivery to Buyer of defects in such components or products. Repairs hereunder may, at Manufacturer's option, be made at its plant or at Buyer's location.

The Manufacturer shall have the right, at its sole option, to inspect, either at its plant or at Buyer's location, any goods concerning which a claim is made hereunder, and the result or findings of such inspection(s) shall, in the absence of proof or arbitrary and capricious conduct by Manufacturer, be conclusive on the obligations of Manufacturer in connection herewith.

Any repair, alteration or replacement of components without the express written consent of the Manufacturer will be a violation of this warranty and will serve to remove all liability from the Manufacturer. Any misuse, neglect, accident, incorrect wiring, or use in violation of instructions furnished by the Manufacturer, or the removal, defacing or changing of any serial number(s) shall release the Manufacturer from all liability under this warranty and any other warranty express or implied.

Manufacturer makes no warranty in connection herewith whether of MERCHANTABILITY OR FITNESS, express or implied,

and no representative or person is authorized to assume for the Manufacturer any other liability in connection with the sale of this equipment or to alter, amend or waive this warranty.

Manufacturer reserves the right to make any change in design or to make addition to, or improvements in, this equipment without imposing any obligations upon itself to install them in any equipment previously manufactured, provided that Manufacturer, at its sole option, may repair or replace components with such improved components.

Under no circumstances shall Manufacturer be responsible for consequential or foreseeable damages, so-called.

All claims under this warranty must be made in writing in or within ninety (90) days from delivery of the goods here involved to the Buyer. No suit shall be brought hereunder unless the same is commenced within fifteen (15) months from date of delivery of the goods here involved to the Buyer.

No item shall be returned to Manufacturer except with its prior written authorization, and any item so returned shall be marked or tagged to show the serial number of the machine from which it was removed.

Regarding goods returned to Manufacturer for repair under this warranty, the Buyer shall ship the same freight prepaid, and the Manufacturer shall return the same upon completion of appropriate repairs hereunder, freight collect. Time is of the essence for any and all notices, claims or actions for which a time limit is set forth herein.

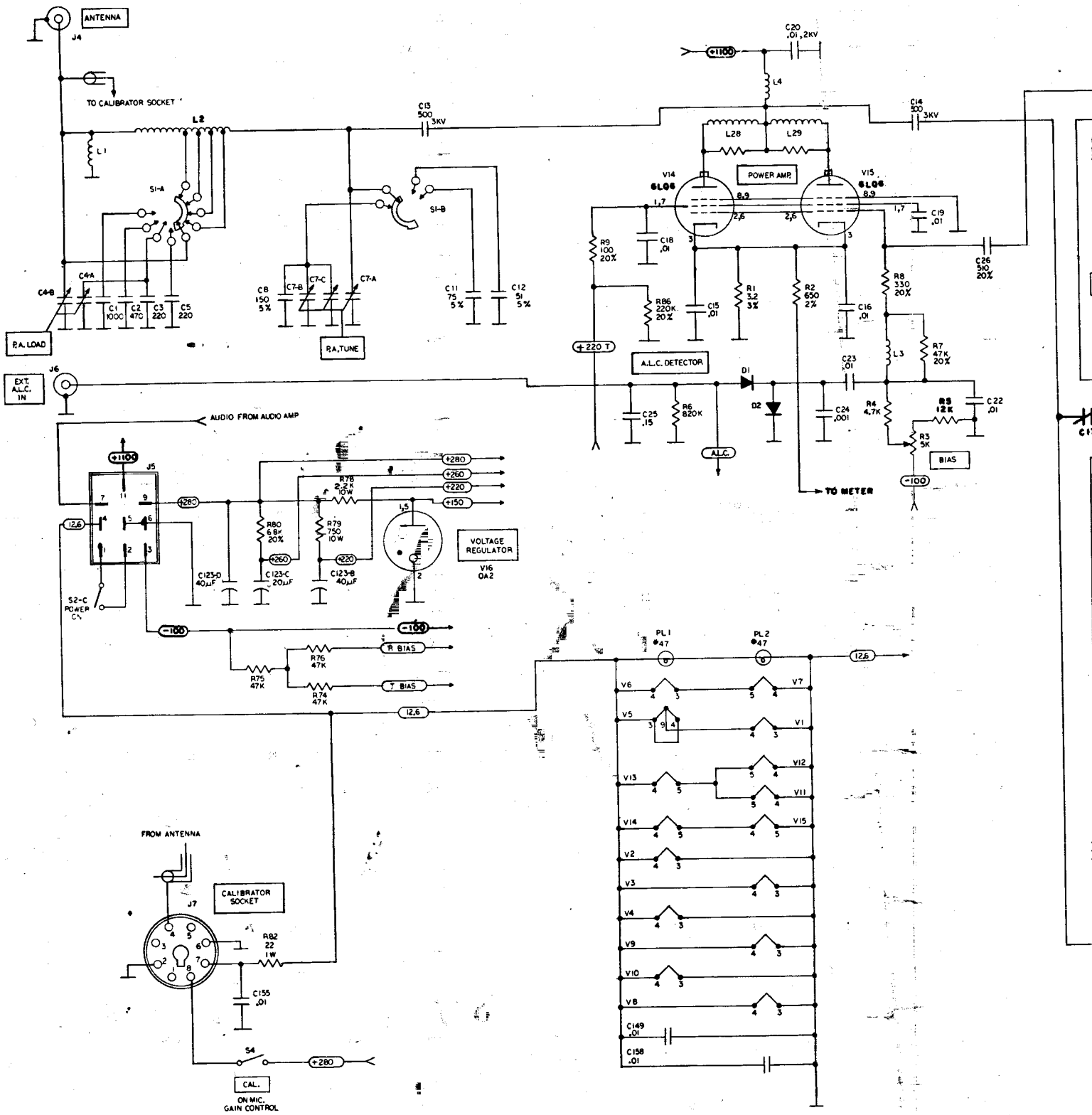
NATIONAL RADIO COMPANY, INC.

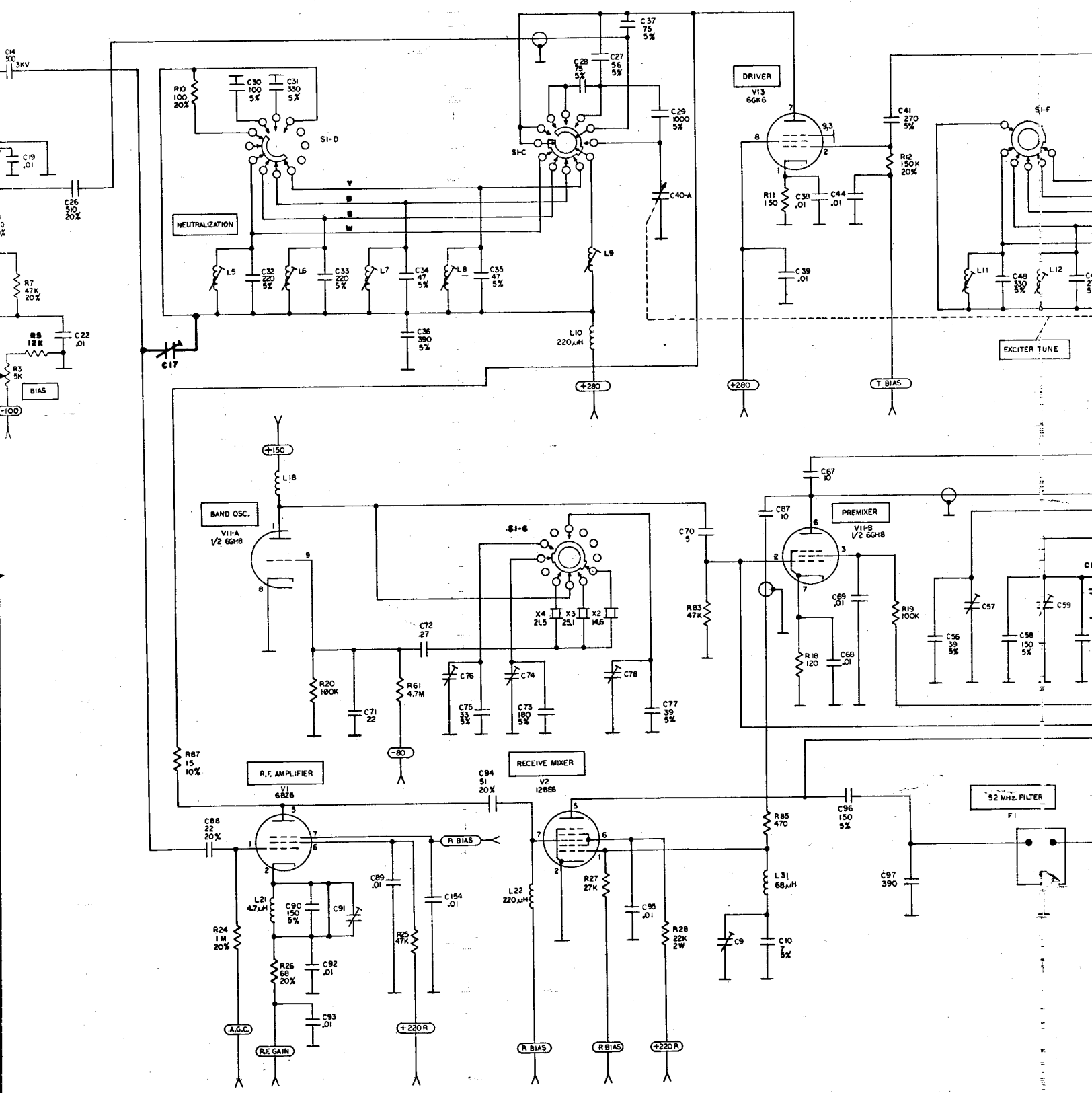
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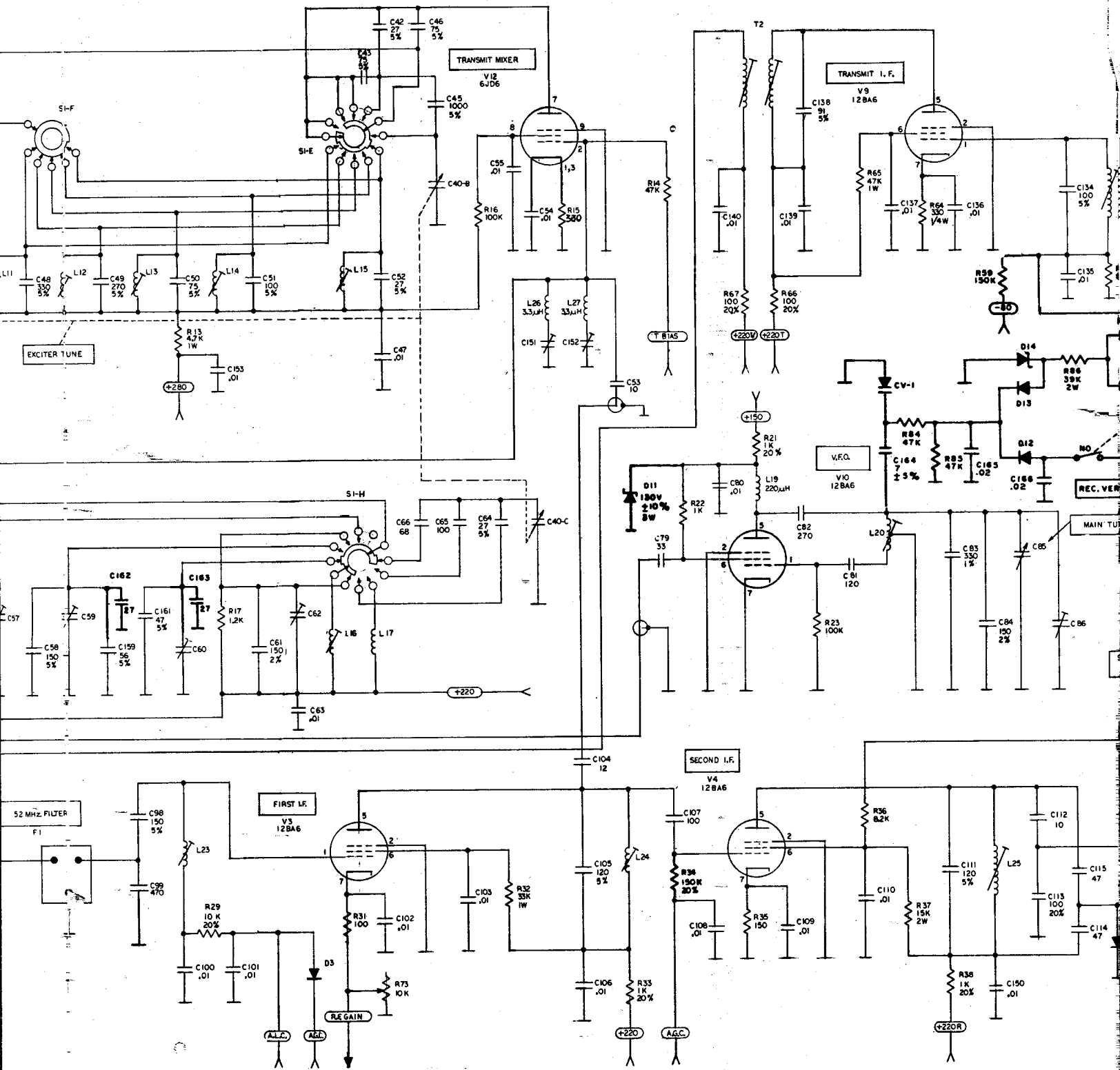
Should your new National Radio Company, Inc. equipment require servicing please do one of the following, whichever is most convenient:

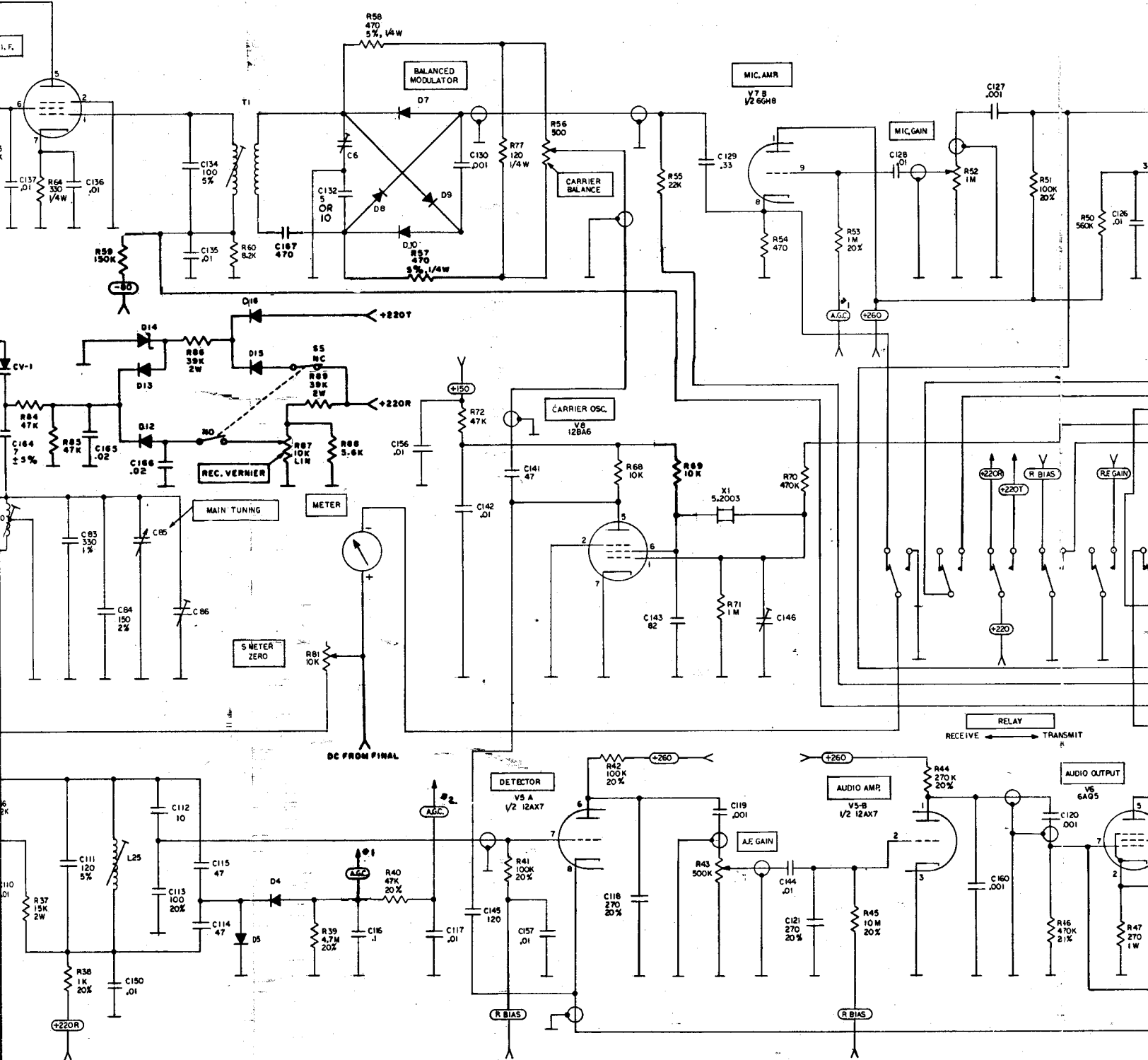
1. Return it to the dealer from whom you purchased it.
2. Bring it to one of our authorized service agencies.
3. Write to the Service Manager, National Radio Company, Inc., 37 Washington Street, Melrose, Mass. 02176 (telephone 617-662-7700) and describe the difficulty. State type of unit and serial number. Describe as completely as possible the apparent defect.

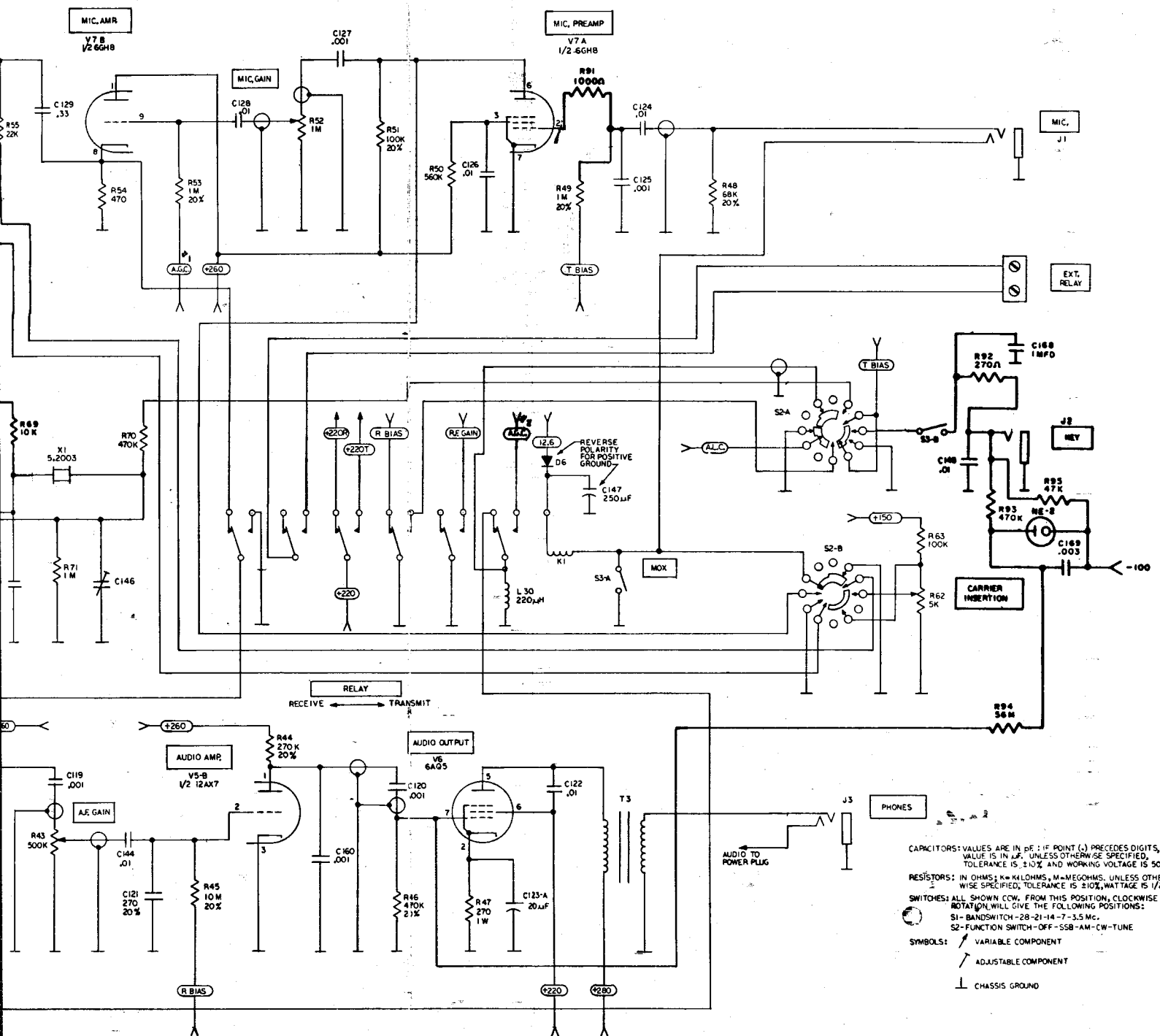
If we feel that the unit should be returned to the factory, we will give you written authorization to ship the unit to us. Notify us that you are returning the unit and ship prepaid and fully insured in the original specially designed shipping carton. NRCI shall thereupon act in accordance with the "Standard Warranty" a copy of which is printed above.











NCX-500 Transceiver, Schematic Diagram