hallicrafters

OPERATING AND SERVICE INSTRUCTIONS

COMMUNICATIONS TRANSMITTER MODEL HT-44

Figure 1. Hallicrafters' Model HT-44 Transmitter/Exciter.

156-002699

SECTION 1
GENERAL DESCRIPTION

1-1. INTRODUCTION.

The Hallicrafters' Model HT-44 is a seventeen-tube Transmitter/Exciter capable of SSB (Single Sideband with suppressed carrier), AM (DSB), and CW transmission in the 80, 40, 20, 15, and 10 meter amateur bands. This unit can represent the complete transmitting complement of a station. The only requirements for immediate "on-the-air" operation are a PS-150-120 Power Supply, a 50-ohm terminated antenna system, a key or microphone, and an AC power source.

The unit may be utilized as a complete transmitter, or as an exciter for driving a linear amplifier such as an HT-45, HT-33B, HT-41, or others. If other linear amplifiers are used, they should be capable of supplying a 50-ohm termination for the HT-44.

When used in conjunction with an SX-117 receiver, slave (transceive) operation or independent operation is selectable by a panel switch.

An outstanding feature of the HT-44 is the amplified Automatic Audio Level Control (AALC). The AALC circuitry virtually eliminates splatter commonly caused by excessive audio gain and its resultant "flat-topping." This is accomplished by providing up to 12 DB of compression at the point where flat-topping would normally occur, assuring maximum talk power while maintaining a clean, sharp signal.

IMPORTANT

See paragraph 6-6, SINGLE SIDEBAND OPERATION, for correct MIC GAIN control setting.

1-2. TVI (Television Interference) SUPPRESSION.

The HT-44 has been designed and constructed to suppress spurious radiations that may cause television interference. The TVI problem was given full consideration in the design and layout of the chassis. Components specifically selected to avoid undesired resonances and arranged to prevent parasitic oscillations have been used.

There are, however, some types of TVI that cannot be prevented within the transmitter itself. This is particularly true in fringe reception areas. In such cases, a good commercial low-pass filter connected at the transmitter output is recommended. For a more complete discussion of measures that may be used to handle special problems of this type, refer to the ARRL HANDBOOK.

SECTION II
SPECIFICATIONS

TYPE OF SIDEBAND GENERATION

Phasing at 1650 KC.

TYPES OF EMISSION

SSB: Selectable upper or lower sideband with suppressed carrier.

AM: Double sideband with carrier (amplitude modulation).

CW: Continuous wave.

FREQUENCY SELECTION

Self-contained VFO or slave (transceive) with SX-117 receiver.

FREQUENCY COVERAGE

80, 40, 20, 15 and four 10 meter segments. 28.5 to 29.0 MC crystal supplied with provisions and crystals available for other 10-meter segments.

MAXIMUM POWER INPUT

CW: 200 watts.

SSB: 200 watts PEP.

POWER OUTPUT

SSB: 100 to 130 watts (PEP).

CW: 100 to 130 watts.

AM: 25 to 35 watts (carrier).

AUDIO INPUT

0.005 volt to high-impedance load.

CARRIER SUPPRESSION

50 DB or more below maximum output.

UNWANTED SIDEBAND REJECTION

50 DB or more at 1 KC. 30 DB or more, 500 to 2500 CPS.

THIRD AND FIFTH ORDER DISTORTION PRODUCTS

30 DB or more.

UNWANTED BEAT OUTPUT

55 DB or more below maximum output.

CW KEYING

Manual or break-in. Rear-mounted jack accepts standard 1/4-inch phone plug. Keying point also provided at control outlet.

DIAL CALIBRATION

5-KC increments (500-KC tuning range).

CALIBRATION ACCURACY

Better than 2 KC between 100-KC check points after indexing.

MICROPHONE INPUT

Panel-mounted receptacle accepts Amphenol 80-MC2M connector (high impedance).

CONTROL METHODS

MOX (manual); VOX (voice control), PTT (push-to-talk), and CW break-in.

RF OUTPUT IMPEDANCE

50 ohms. Rear chassis-mounted receptacle accepts RCA-type phono plug (supplied). Chassis punched to accept Amphenol UHF receptacle.

STATION CONTROL

Rear chassis-mounted eleven-pin socket accepts Amphenol 86-PM11 plug (supplied).

TUBES

Seventeen (including one voltage regulator) plus three semiconductor diodes.

TRANSCEIVE CABLE ASSEMBLY

CA-44 (Optional).

POWER SUPPLY

External, remote-control PS-150-120 with receiver speaker built in.

POWER SUPPLY REQUIREMENTS

117 volts, 50/60 cycles, 400 watts.

DIMENSIONS (Overall)

7-3/4 by 14-31/32 by 14-3/4 inches (HWD).

SHIPPING WEIGHT

Approximately 21 pounds (less power supply).

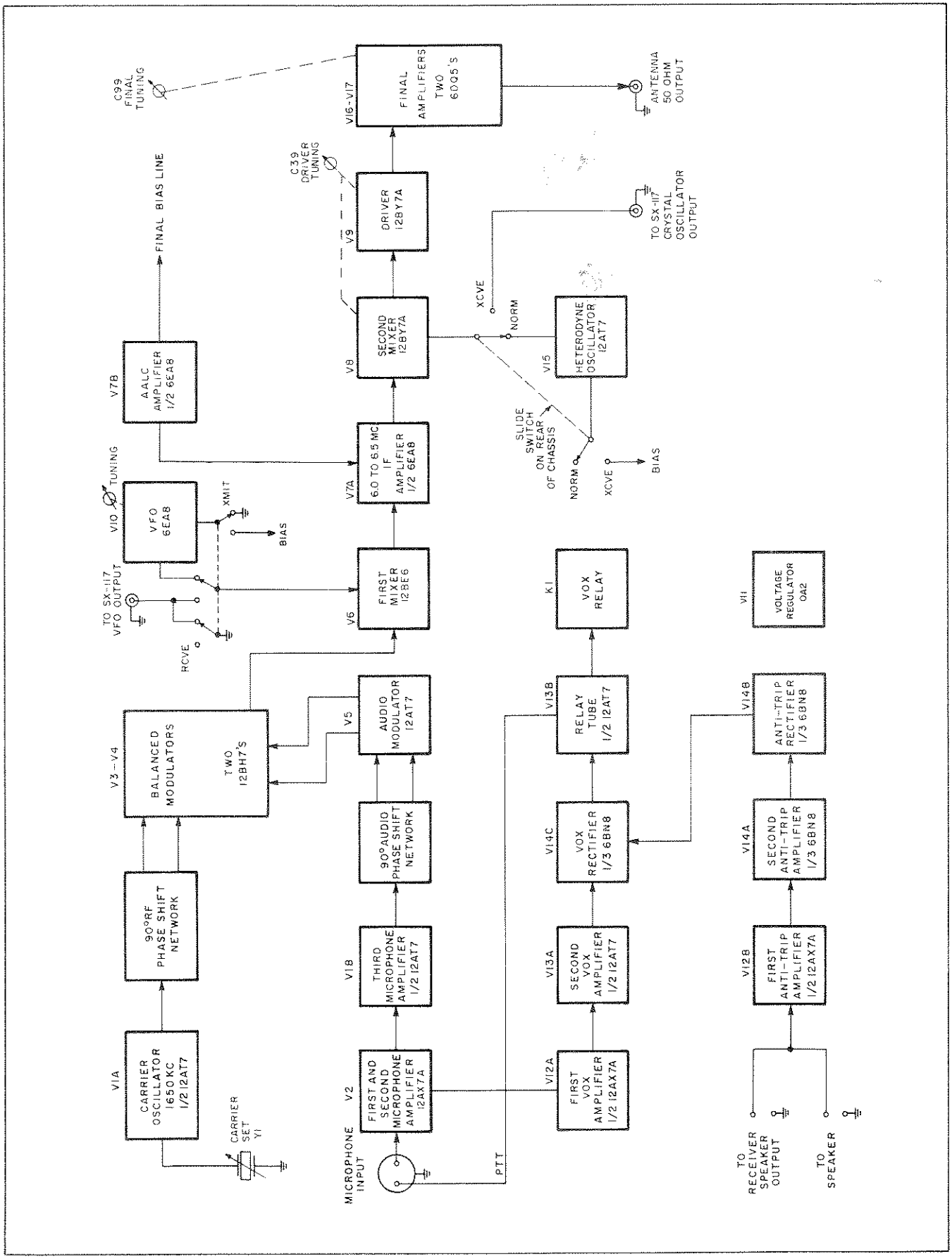

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Figure 7. Block Diagram of the Model HT-44 Transmitter/Exciter.

SECTION V
THEORY OF OPERATION

5-1. GENERAL DESCRIPTION.

The HT-44 utilizes the phasing principle of sideband generation. The circuits are designed so that the sideband signal is generated at a single carrier frequency that is ultimately converted to the desired operating frequency. With this method, carrier and sideband rejection remain constant, regardless of operating frequency, and assure maximum long-term suppression stability. The circuitry also incorporates techniques which permit generation of continuous wave (CW) and double-sideband (AM) signals.

5-2. SIDEBAND GENERATION.

The audio section of the sideband generator consists of three stages of audio amplification, followed by a low-pass audio filter, C85, C86, and L20, which attenuates frequencies above 3000 CPS. The audio voltage is fed in parallel to the combination of the Audio Phase Bal control, R65, and the audio phase-shift network. The Audio Phase Bal control is adjusted so that the outputs of the audio phase-shift network are equal and 90 degrees out of phase with respect to each other. The two voltages are then independently amplified by the dual-triode Audio Modulator, V5, and transformer coupled to the grids of the Balanced Modulators, V3 and V4. The Audio Bal control, R70, provides a means of equalizing the relative gains of the audio modulators to produce equal outputs.

Tube V1A is a 1650-KC, crystal-controlled oscillator which generates the carrier frequency. The output of this oscillator is fed to a 90-degree RF phase-shift network (R5, R6, L1, and C6) where it is split into two equal-amplitude components that are 90 degrees out of phase with respect to each other. These two voltages are fed to the input of the Balanced Modulators, V3 and V4.

Tubes V3 and V4 comprise a double-balanced modulator circuit consisting of two single-balanced modulators with separate input circuits and a common output circuit. Considering the single-balanced modulator V3, it is noted that the plates are connected in push-pull through the tank circuit, T2, C14, and C15. The grids are connected in parallel for RF through C5 and C8, and in push-pull for audio through L21 and L22. The Carrier Bal control, R8, permits equalization of gain between V3A and V3B so that, with an in-phase RF signal at the grids, the resultant output voltages are equal in amplitude and produce essentially zero output. A push-pull audio frequency applied to the grids through L21 and L22 produces sum and difference frequencies (carrier frequency ± audio frequency) which, in the output, are 180 degrees out of phase with respect to each other. This produces a net output at the transformer link of two side frequencies, equal in amplitude, displaced by the frequency of the audio signal from the suppressed carrier.

The operation of the other balanced modulator V4, supplied with input voltages that are 90 degrees out of phase with respect to V3, is such that one of the side frequencies produced is exactly 180 degrees out of phase with the corresponding side frequency of V3, and the other is exactly in phase. Consequently, the in-phase components add, the out-of-phase components cancel, and the net result is a single-sideband suppressed-carrier signal.

Selection of the other sideband is accomplished by reversal of the audio input phase to V4 by means of the FUNCTION switch.

A double sideband (AM) signal is generated by removing the audio from V4 and introducing a fixed amount of unbalance in V3 through R10. V4, therefore, remains balanced at the carrier frequency and does not enter into the resultant. V3, however, produces sum and difference frequencies, along with the now-present carrier frequency. With no opposite-phase components present, the result is a double-sideband signal with carrier.

CW is similar to AM operation, with the exception that the audio signal to both balanced modulators is blocked by cutoff bias applied to the grid of the First Audio Amplifier V2A, resulting in the production of an unmodulated carrier frequency.

Depending on the setting of the FUNCTION and OPERATION switches, the signal is transferred from the link of T2 by either the FUNCTION switch or the OPERATION switch (USB, LSB, and CAL) or through the RF LEVEL control, R18 (CW and AM), to the grid of the First Mixer, V6.

5-3. VFO AND FIRST MIXER.

The VFO (variable frequency oscillator) is a highly-stable, temperature-compensated, series-tuned oscillator, covering the frequency range from 4350 KC to 4850 KC. Coil L2, in the oscillator plate circuit, is used for wave shaping and uniform output over the VFO tuning range.

The oscillator is then fed into a cathode follower to provide isolation and impedance transformation. Normally, the output of the cathode follower is fed through the VFO SELECTOR switch to the First Mixer, V6. The RCVR VFO line is connected to ground when the HT-44 VFO is in operation.

If the RCVR VFO is used (transceive), cutoff bias is applied to the HT-44 VFO tube, V10, and the cathode follower is disconnected from the first mixer. Simultaneously the RCVR VFO is connected to the first mixer.

The VFO frequency (4350 to 4850 KC) is added to the 1650-KC carrier frequency in the first mixer to produce an intermediate frequency of 6.0 MC to 6.5 MC.

It should be noted that with the heterodyning system used, the VFO and first IF frequencies will be highest at the low-frequency end of the dial (reversed tuning).

5-4. 6.0 TO 6.5 MC FIRST IF.

The IF system is comprised of T3, T4, and V7A. T3 and T4 are double-tuned bandpass transformers that accept signals in the 6.0 to 6.5 MC range and reject all others. Tube V7A is used to amplify signals in this range.

5-5. SECOND MIXER AND HETERODYNE CRYSTAL OSCILLATOR.

The output of T4 is fed to the grid of the Second Mixer, V8. Also, the output of the heterodyne crystal oscillator/cathode follower is fed through the rear-mounted slide switch to the grid of V8. With this switch in the NORM (UP) position, the HT-44 crystal oscillator functions in a normal manner to supply injection voltage to the second mixer. With the slide switch in the XCVE (down) position, cutoff bias is applied to the crystal oscillator, the cathode follower is disconnected from the mixer, a new set of gain equalization resistors are selected, and the external Xtal Osc jack is connected to the mixer.

If the HT-44 is used in conjunction with an SX-117 receiver, the slide switch should always be in the XCVE (transceive) position. This means that the SX-117 will supply the necessary crystal-oscillator injection voltage, and transceive (slave) or independent operation will be controlled by the VFO SELECTOR switch on the HT-44 front panel. Obviously, the SX-117 receiver must be turned on to satisfy this condition.

If the HT-44 is not used with an SX-117 receiver, the rear-mounted slide switch must be in the NORM (up) position for internal crystal-oscillator injection.

Injection to the second mixer will be 6.0 MC above the high-frequency end of each band segment; i.e., with the BAND SELECTOR set for 3.5 to 4.0 MC, add 6.0 MC to the high-frequency end (4.0). This gives an injection, or crystal frequency of 10.0 MC.

The output of the second mixer is tuned to the transmitter output frequency by one section of the DRIVER TUNING capacitor, C39A, and its associated coil which is selected by the BAND SELECTOR switch. Also, in the plate circuit of the second mixer, a 6.0 to 6.5 MC trap, L11, is used to prevent these frequencies from appearing in the transmitter output.

5-6. DRIVER STAGE.

The output of the Second Mixer, V8, is coupled to the grid of the Driver, V9, where it is amplified, at the transmitter output frequency, to provide the necessary drive voltage to the final amplifier tubes. The plate circuit of the driver stage is tuned to the transmitter output frequency by the remaining section of the DRIVER TUNING capacitor, C39B, and its associated coil.

5-7. FINAL AMPLIFIER.

The final amplifier stage consists of two 6DQ5 tubes, V16 and V17, connected in parallel, operating as class AB1 linear amplifiers. The output of these tubes is coupled into a pi network designed for 50-ohm fixed termination. The BAND SELECTOR switch selects the correct coil tap and output loading capacity for each tuning range. The final amplifier is tuned to resonance by the FINAL TUNING capacitor, C99.

Bridge neutralization is used in the final amplifier stage to assure stable operation throughout its tuning range.

IMPORTANT

The final amplifier bias must be set before any further checks are made. See paragraph 9-3.

Use only matched 6DQ5 tubes when replacing the final amplifier tubes. The tubes must be matched within 10 MA idling current. See paragraph 9-4.

NOTE

The bias adjustment control is on the rear apron of the PS-150-120 Power Supply.

5-8. VOX AND ANTI-TRIP CIRCUITS.

The VOX and Anti-Trip controls are located at the top, left-front corner of the chassis as illustrated in figure 14. Both controls, as well

as the front panel DELAY control are utilized in conjunction with VOX operation, and are adjusted to provide control of the transmitter and receiver.

1. The VOX control, R80, is an audio sensitivity control which determines the audio level that will trip (energize) the VOX relay and cause the transmitter to operate. This control should be adjusted with the microphone at the normal speaking distance from the mouth. Advance the VOX control to a setting slightly beyond the point that will "trip" the relay (use normal voice). Excessive sensitivity will cause the transmitter to be turned on by random noise. Note that the VOX sensitivity and MIC GAIN controls are separate level adjustments; therefore, turning down the MIC GAIN control will not reduce the VOX sensitivity.

2. The Anti-Trip control, R103, is also used in conjunction with VOX operation to adjust the amount of anti-trip (bucking) voltage fed from the receiver into the VOX diode. It should be noted that excessive anti-trip voltage is capable of completely blocking normal VOX operation. Therefore, minimum anti-trip gain should be used. Adjustment should be made with the receiver running at normal output volume.

3. The DELAY control, R90, should be adjusted in conjunction with the VOX and Anti-Trip controls to control the transmitter "ON" time after modulation has ceased.

It should be noted that all of these controls have some interaction and the adjustments should be repeated until the desired results have been obtained.

The functions of VOX and Anti-Trip are accomplished by sampling the audio signal at the First Audio Amplifier grid, V2. This signal is amplified by V12A and V13A and rectified by diode, V14C, causing the Relay Tube, V13B, to energize the VOX relay; thus placing the transmitter in operation. The anti-trip circuit, supplied with a sample of the receiver's audio output, rectifies this voltage which appears as a "bucking" voltage at the VOX diode. Delay is accomplished by charging capacitor C112 which causes the relay tube to continue to conduct until C112 has discharged. The rate of discharge is controlled by the setting of the DELAY control.

5-9. AALC (AUTOMATIC AUDIO LEVEL CONTROL).

When a small amount of grid current occurs in the final amplifier, an audio signal appears on the amplifier bias line, in proportion to the amount of grid current. This audio signal, which is not present without final amplifier grid current, is coupled to the AALC Amplifier, V7B, whose output is rectified by diodes CR1 and CR2. The resulting DC voltage, after filtering, is applied to the grid of the 6.0 to 6.5 MC Amplifier, V7A, as gain-control bias.

5-10. METER CIRCUIT.

This circuit consists of a voltage-divider network, a diode rectifier with filter, and a meter for visual indication of the relative RF output voltage appearing across the 50-ohm output. This is not a peak reading voltmeter; therefore, the meter reading on voice peaks will be approximately one third of its equivalent CW indication. Any load termination other than 50 ohms resistive will cause the meter to read higher or lower depending on the sign of the reactance present at the HT-44 output. This will be noted as an apparent change of maximum output when tuned across a band as the VSWR of most antenna systems is not constant with frequency. This will be especially noted on the lower frequency bands where the change over the band is greater.

SECTION VI
TUNING PROCEDURE

6-1. GENERAL.

The tuning procedure for the HT-44 is not complicated; however, care should be exercised in tuning to insure peak performance. Tuning (peaking) should be performed on or near the intended operating frequency on all bands.

If the VFO is tuned any appreciable amount away from the frequency at which the transmitter has been previously tuned, it will be necessary to repeak the DRIVER and FINAL TUNING controls for maximum output.

As experience is gained in operating over the various bands, the operator will be able to judge when he has tuned far enough to require repeaking. In general, very little repeaking will be required for operation on the 10, 15, and 20 meter bands with somewhat more frequent retuning being needed on the 40 and 80 meter bands when changing frequency.

The output of the transmitter should always be connected to a 50 ohm, resistive dummy load or a suitable antenna that is near 50 ohms for the operating frequency.

IMPORTANT

The bias must be adjusted before proceeding to the following steps. It has not been pre-adjusted at the factory. Failure to do so will result in improper operation and possible permanent damage to the final tubes. See paragraph 9-3.

6-2. BASIC TUNING.

Preset the indicated controls as follows:

OPERATION . . . . .MOX
FUNCTION . . . . . .CW
RF LEVEL 0
DRIVER TUNING . .Desired band segment
FINAL TUNING . . .Desired band segment
BAND SELECTOR. .Desired band
TUNING . . . . . .Desired frequency
MIC GAIN 0

1. Adjust the RF LEVEL control until a small indication is observed on the meter.

2. Adjust the FINAL TUNING control for maximum meter reading.

3. Reduce the RF LEVEL control setting as necessary to keep meter below the one-half scale reading.

4. Adjust the DRIVER TUNING control for maximum meter reading.

NOTE

Meter reading should not be allowed to exceed one-half scale during tuning.

6-3. MANUAL CW OPERATION.

Use the procedure as outlined in paragraphs 6-1 and 6-2. If a key is plugged into the key jack, it must be closed.

Advance the RF LEVEL control to a point just below saturation. Saturation is determined by slowly advancing the RF LEVEL control to the point where further advancement does not appreciably increase the output meter reading. The RF LEVEL control should be set slightly below this point.

The transmitter is now ready to key. To receive, it will be necessary to turn the OPERATION switch to STBY.

6-4. BREAK-IN CW OPERATION.

Use the tuning procedure described for manual CW operation and set the OPERATION switch at VOX.

Adjust the DELAY control for the desired drop-out time. Rotating the DELAY control clockwise will increase the drop-out (delay) time. The transmitter is now ready for break-in CW operation.

6-5. AM (DSB) OPERATION.

Use the tuning procedure as described for manual CW operation.

1. Set the FUNCTION switch to AM.

2. Advance the RF LEVEL control to the point of saturation as described in paragraph 6-3 and note the RF output meter reading.

3. Reduce the RF LEVEL control setting until the meter indicates exactly one-half of its original reading. This will be the maximum carrier that can be 100% modulated.

4. Slowly increase the MIC GAIN control setting until a very slight meter indication is observed on loud voice peaks.

5. Because of the larger duty cycle experienced in AM operation (constant carrier with high plate dissipation), either voice-control or push-to-talk operation should be used to reduce the duty cycle to a minimum. This will reduce the amount of heat developed and add to the life of the final amplifier tubes.

6-6. SINGLE-SIDEBAND OPERATION (SSB).

1. Use the basic tuning procedure described in paragraph 6-2.

2. Set the FUNCTION switch to USB or LSB as desired. Note that the RF LEVEL control is disabled in SSB and will have no effect on the output.

3. Advance the MIC GAIN control clockwise. The normal setting will usually be between 3 and 5; however, this will be influenced by the type of microphone used, individual voice characteristics, etc. If possible, a monitor oscilloscope should be used to determine the optimum control setting. If this is not possible, several air checks should be made with other stations using various MIC GAIN control settings.

IMPORTANT

Do not depend on the AALC circuitry to correct for improper MIC GAIN control settings. Even though this circuitry is very effective, it is still possible to drive a low-level stage into distortion. Never advance the MIC GAIN control further than necessary to maintain communication.

SECTION X

PS-150-120 POWER SUPPLY

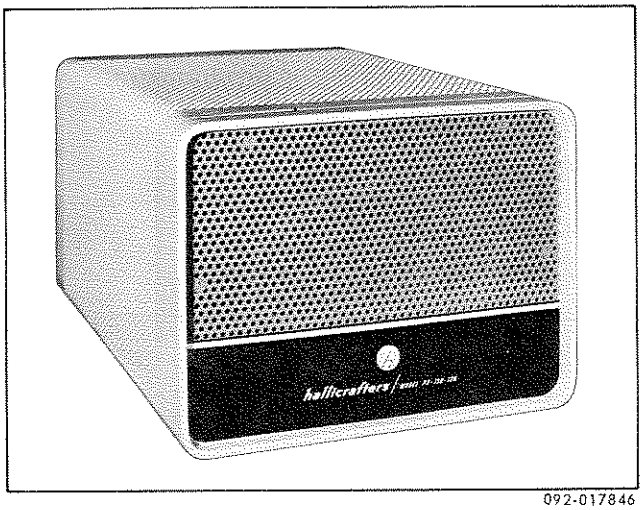

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Figure 17. Hallicrafters' Model PS-150-120 Power Supply.

10-1. SPECIFICATIONS.

INPUT VOLTAGE

105-125 volts, 50/60 cycles AC.

OUTPUT VOLTAGES (Maximum Ratings)

12.6 VAC at 4.5 amperes.
+250 VDC at 175 milliamperes.
+525 VDC at 380 milliamperes.
-125 VDC at 6.5 milliamperes (variable with control).

SPEAKER

Four by six-inch permanent-magnet type with 3.2-ohm voice coil.

CONTROL SWITCHING

Remote.

RECTIFIERS

Four type 1N3487, and one type 1N3194.

OVERALL DIMENSIONS (HWD)

6-1/4 x 7-1/2 x 10 inches.

NET WEIGHT

22 pounds.

SHIPPING WEIGHT

28-1/2 pounds (approximately).

CAUTION

The HT-44 OPERATION switch should be in the OFF position before connecting the PS-150-120 Power Supply.

10-2. GENERAL.

The PS-150-120 supply is a complete, self-contained unit designed to supply all necessary operating voltages for the HT-44, SR-150, and SR-160 series of equipments, when operated from a nominal 117-volt, AC source. The power supply is remotely switched and all connections, including the built-in speaker connections, are made through a 12-pin power plug and cable.

The PS-150-120 operates from a 105 to 125-volt, 50/60-cycle AC source.

As previously mentioned, a built-in speaker is provided. This speaker is of the permanent-magnet type and has a voice-coil impedance of 3.2 ohms.

Five solid-state rectifiers are used in conjunction with heavy-duty components to give cool, reliable, trouble-free operation.

A BIAS ADJ control is provided on the rear-chassis apron to satisfy the bias requirements of the transmitter.

Two tip jacks are provided on the chassis for measuring the high-voltage plate current with an external meter.

10-3. UNPACKING.

After unpacking the PS-150-120, examine it closely for any possible damage that may have occurred in transit. Should any sign of damage be apparent, file a claim immediately with the carrier stating the extent of damage. Carefully check all labels and tags before removing or destroying them.

To gain access to the power cable, remove the rear cover and pull the cable out. The cover need not be replaced until the bias adjustment has been made.

10-4. LOCATION.

This unit should be placed in a location that provides adequate space around it to permit free circulation of air through the cabinet openings. Avoid excessively warm locations such as those near radiators and heating vents.

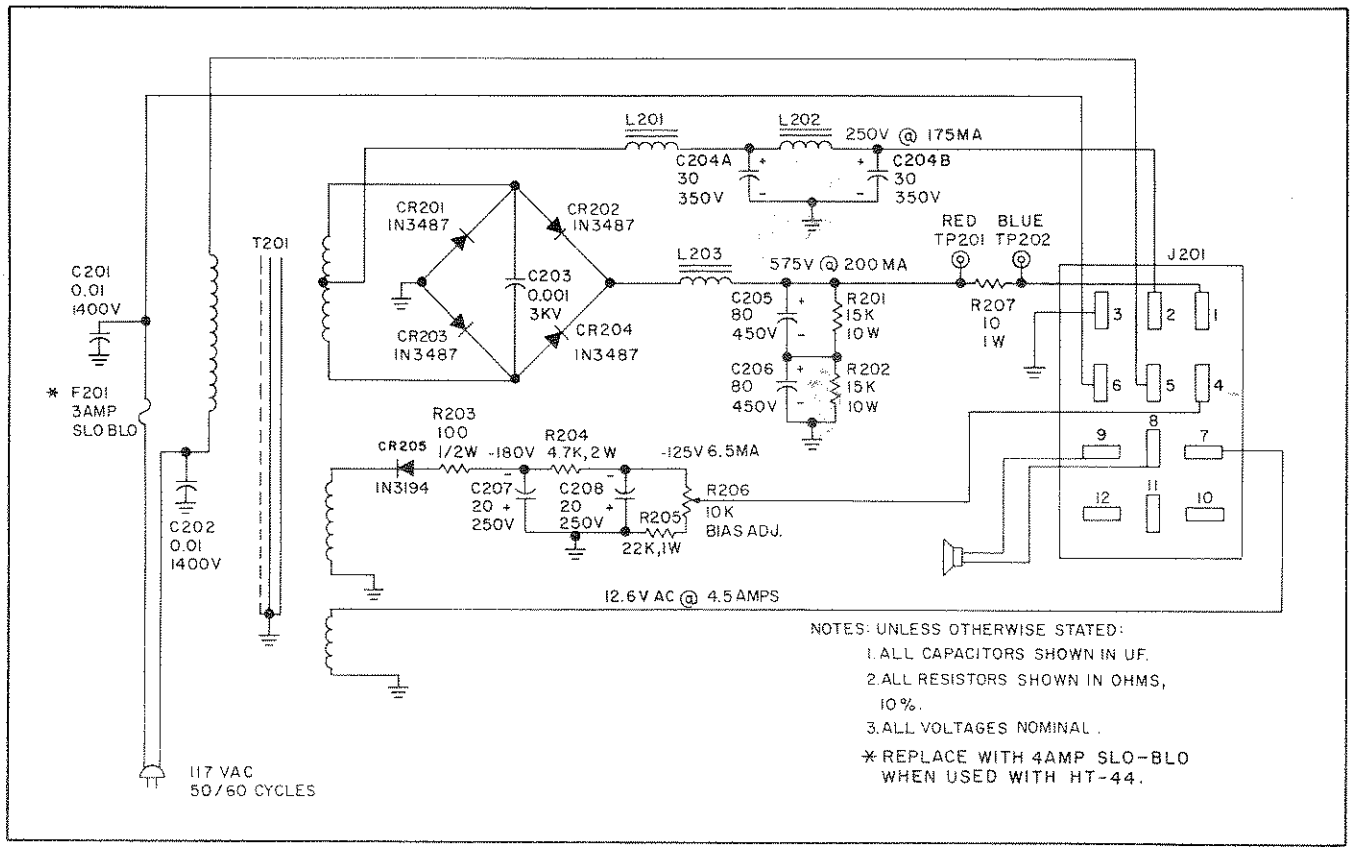

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Figure 19. Schematic Diagram, Model PS-150-120 Power Supply.

SECTION XI
CUSTOMER ADDITION OF ANTENNA RELAY

Provisions have been made in the HT-44 design for possible future addition of an antenna changeover relay and the other components necessary for the operation of this relay. The following list of parts are required and are available at most radio parts merchandise stores.

PARTS REQUIRED.

1. Relay, Antenna changeover; Potter-Brumfield type KT11D 12VDC or equivalent.

2. Electrolytic Capacitor, 100 μF @ 25V; Mallory type TC-2501, Cornell-Dubilier type BBR-100-25, Sprague type TVA-1207, or equivalent.

3. Connector, Pin plug type; Cinch-Jones type 81A or equivalent.

4. Carbon Resistor 2.7 ohms, 2 watts.

5. Silicon Diode; RCA type 1N3193 or equivalent.

These parts may be installed as shown in figures 20 and 21. If any questions should arise with regard to the installation contact your local Hallicrafters' dealer.

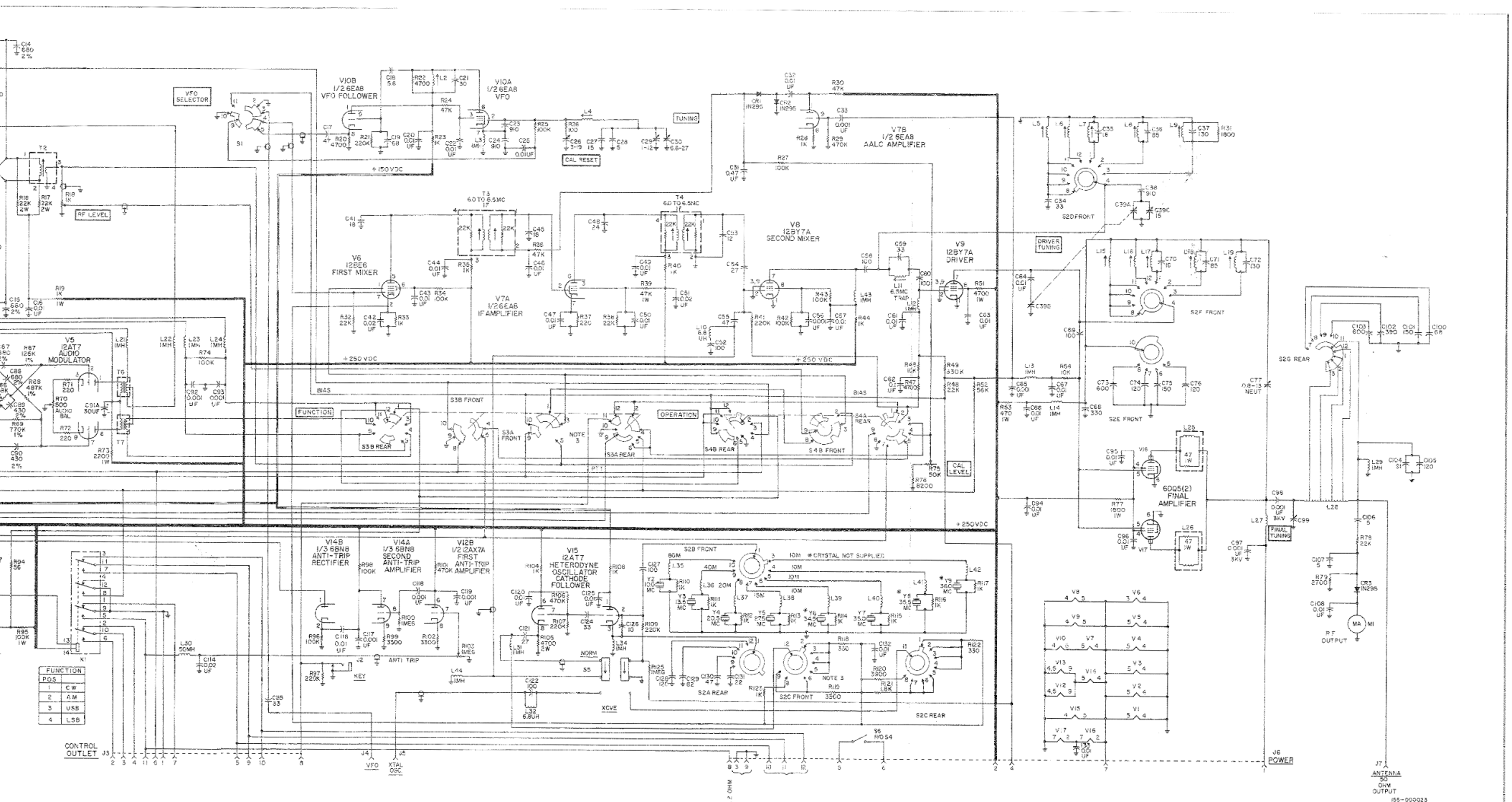
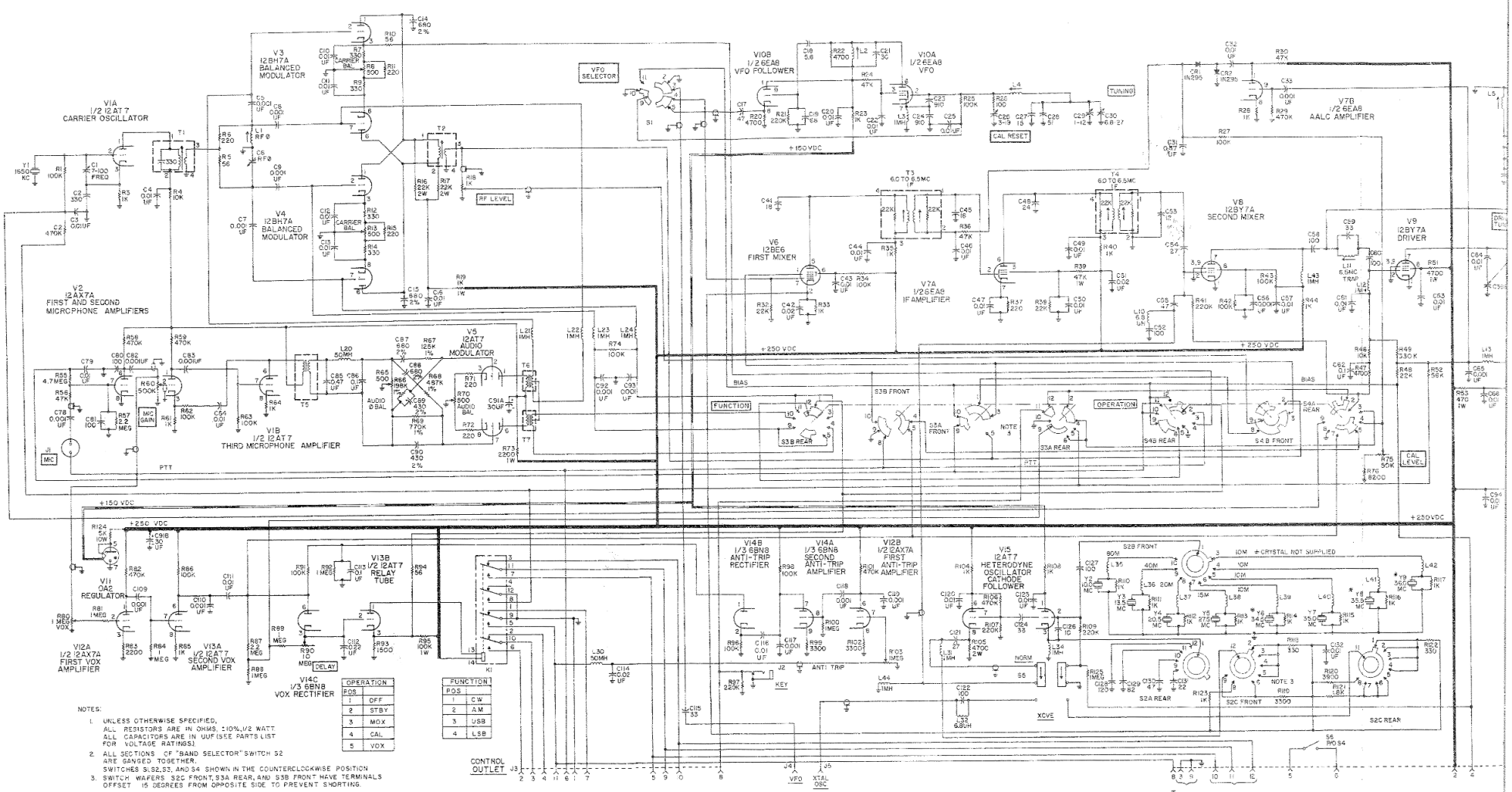


Figure 22. Schematic Diagram, Model HT-44 Transmitter.



OPERATION	
POS	
1	OFF
2	STBY
3	MOX
4	CAL
5	VOX

FUNCTION	
POS	
1	CW
2	AM
3	USB
4	LSB

NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTORS ARE IN OHMS, ±10%, 1/2 WATT. ALL CAPACITORS ARE IN μUF (SEE PARTS LIST FOR VOLTAGE RATINGS).
2. ALL SECTIONS OF "BAND SELECTOR" SWITCH S2 ARE GANGED TOGETHER. SWITCHES S1, S2, S3, AND S4 SHOWN IN THE COUNTERCLOCKWISE POSITION.
3. SWITCH WAFERS S2C FRONT, S3A REAR, AND S3B FRONT HAVE TERMINALS OFFSET 15 DEGREES FROM OPPOSITE SIDE TO PREVENT SHORTING.

Figure 22. Schematic Diagram, Model HT-44 Transmitter.