PERFORMANCE REQUIREMENTS
TYPE LD-T2 RADIO TRANSMITTER
4 TO 23 MC
GENERAL EQUIPMENT REQUIREMENTS
RADIO SYSTEMS

1. GENERAL

1.01 This section covers the performance requirements which type LD-T2 radio transmitters, 4 to 23 mc, installed by the Western Electric Company, shall meet before turnover to the telephone company. It is expected that the tests will be made by the telephone company. The services of a licensed radio operator are required for certain of the tests.

1.02 This section is reissued:

(a) To add "4 to 23 mc" in the title.

(b) To revise the test equipment requirements.

(c) To revise requirements for filaments of bias rectifier, 550-volt rectifier, and high-voltage (HV) rectifier tubes.

(d) To revise procedure for testing the HV rectifier voltage.

(e) To make minor changes.

1.03 Since this reissue covers a general section revision, the arrows ordinarily used to indicate changes have been omitted.

1.04 Reference shall be made to Section 800-630-180 covering general requirements and definitions for additional information necessary for the proper application of requirements. Reference should also be made to tuning charts and detailed instructions included in Section R10.090.

1.05 ***Test Equipment:*** The requirements are based on the use of the following test equipment, or its equivalent:

—22AK Crystals as determined by the operating frequency assignments

1—DC Voltmeter having a nominal resistance of at least 150,000 ohms and accurate to $\pm$0.75 volt at 45 volts

1—AC Voltmeter magnetically shielded and accurate to $\pm$0.1 volt over the range of 0 to 10 volts (Weston Model 433 with 0 to 10 scale suggested)

1—Distortion Measuring Equipment per J68318D or X-75153 (J68318D is satisfactory although rated Mfr Disc.)

1—Water Manometer for measuring air pressures of approximately 2 inches of water

1—Vacuum Tube Voltmeter equivalent to General Radio Type 726A

1—Oscilloscope, Du Mont Type 208 or 241

1—Stop Watch

1—RPM Counter for rotational speeds of approximately 2000 rpm

1—Electronic Voltmeter equivalent to Ballantine Model 300

1—Volume Indicator KS-16654 or equivalent.

2. REQUIREMENTS

A. General

2.01 A check should be made to ensure that the parts of the transmitter which are shipped separately are properly installed and that all the electron tubes are installed in the sockets. The ground connection should be inspected.

B. Power Tests

2.02 ***Applying Power***

(1) Insert fuses F13, F26, F38, F12, F25, and F37 in the proper positions. Omit fuses from other positions on the fuse panel.

(2) Connect a 3-phase 230-volt 50- or 60-cycle supply to the AC SUPPLY switch and close the switch.

(3) Observe the direction of rotation of the blower. If incorrect, remove power and reverse one phase of the power supply. Again check rotation of blower.

Requirement: The blower shall rotate in a clockwise direction when viewed from the rear of the transmitter.

2.03 ***Blower Speed—Air Pressure HF AMP 5:*** The requirements which follow apply for a 60-cycle power supply and for operation at sea level. For operation at higher elevations or with other power supplies, reference should be made to Section R10.090. For 60-cycle sea-level operation, the motor and blower adjustable V-belt pulleys should be adjusted to a ratio of about 1.1 to 1.0. This is obtained with the impeller pulley one turn from closed and the motor pulley five turns from closed.

(1) With the blower operating in the clockwise direction as viewed from the rear, measure the rpm of the blower rotor using a revolution counter and a stop watch.

Requirement: The blower speed shall not exceed 1950 rpm.

(2) With the blower still operating in the correct direction, measure the air pressure in the HF AMP 5 compartment by connecting a water manometer to the outlet provided.

Note: If the rotation speed is not correct, the pulley must be adjusted. A fine adjustment can be made by closing or opening both pulleys one-half turn. A coarse adjustment is made by opening or closing one pulley one-half turn. Proper belt tension may be obtained by adjusting height of the motor.

Requirement: The measured value shall be between 1.90 and 2.10 inches of water without the air filter in place, or between 1.80 and 2.00 inches with the air filter.

2.04 ***Air Pressure Switch Adjustment (D23 in Common Equipment)***

(1) Insert all fuses for this test. For the period of the test, open the filament circuit to tube V1 in HF AMP 6, to ensure that it will not be damaged because of reduced air flow.

(2) Vary the air pressure in the HF AMP 5 compartment by restricting the air intake to the blower (sliding a sheet of heavy cardboard or equivalent across the blower intake suffices). Lamp L97 (FILAMENTS) should light when the switch is closed and be extinguished under the open condition.

(3) Observe at what pressure the switch opens as the pressure is varied from a high to a low value. For accuracy, the pressure should be varied at a very slow rate since the pressure at the switch does not follow the HF AMP 5 compartment pressure instantaneously. Approximately 10 seconds is required for the switch to fully respond to a change of pressure.

Requirement: The switch shall open at a pressure as close to 1.3 inches of water as obtainable with the adjusting screw detents.

2.05 ***Regulated Rectifiers and Voltage Regulator***

(1) Turn all HARM GEN BIAS potentiometers to the extreme counterclockwise position, all other servo potentiometers to approximately midscale, and the RANGE switches to any position from 1 to 11. Set other switches and controls as shown in Table A.

TABLE A

SWITCH OR POTENTIOMETER	TO POSITION
ADJUST VOLTAGE (HF AMP 5 Compartment)	1
LOAD CONTROL	OUT
LOAD CONTROL AMP GAIN	Extreme ccw
MF GAIN	Extreme ccw
LOAD CONTROL RECT BIAS	Extreme cw
CARRIER RESUPPLY	TEST
25~ OSC ADJUST FEEDBACK (On Servo Panel)	Extreme ccw
25~ OSC ADJUST OUTPUT (On Servo Panel)	Extreme ccw
HF AMP 5 TUNING	REGULAR
TUNING (On Servo Panel)	AUTO
AUD ALARM	OFF
550V RECT	0
E_C HF AMP 6	250
E_C HF AMP 5	Extreme cw
OUTPUT TRANSFER	DUMMY
HIGH VOLTAGE	OFF

(2) Operate the TEST SUPPLY switch to TEST, wait 2 minutes, and adjust the +150V, the −150V, the +300V regulated rectifiers, and the 115V ac voltage regulator to their nominal values.

Requirement: The voltages shall be within ±1 per cent of their nominal value.

2.06 ***48V Rectifier:*** Adjust the taps on the 48V rectifier to obtain as nearly as possible 48 volts.

Requirement: The voltage shall be between 45 and 51 volts.

2.07 ***Adjustment of Filament Voltage, HF AMP 6***

Caution: Make certain that the HIGH VOLTAGE switch is in the OFF position for this test.

(1) Mount a 0- to 10-volt ac voltmeter in the HF AMP 5 compartment and connect it to the filament of V1 HF AMP 6 by clip leads.

(2) Close the doors and operate the AC SUPPLY switch to ON.

(3) Note the reading on the meter; it should be 7.5 ±0.2 volts. If it is not, open the transmitter doors and adjust the ADJUST VOLTAGE switch D12 to a different position. This process should be repeated until the correct filament voltage is obtained.

Requirement: The filament voltage shall be 7.5 ±0.2 volts.

2.08 ***Filament Voltages, HF AMP 4 and HF AMP 5:*** These tests are made in the same manner as in 2.07 except that adjustments are made on the filament transformers instead of with a switch.

Requirement: The filament voltage of HF AMP 4 and HF AMP 5 shall be 5 ±0.2 volts.

2.09 ***Filaments of Bias Rectifier, 550V Rectifier, and HV Rectifier Tubes:*** Operate the AC SUPPLY switch to ON.

Note: Omit this check for equipment using solid-state rectifiers in the bias rectifier, 550V rectifier, and HV rectifier.

Requirement: In equipments using the 249B mercury vapor rectifier tubes in the bias rectifier, 550V rectifier, and HV rectifier, the filaments shall light.

C. Servo System

2.10 ***Servo Indicator Alignment***

(1) Operate the TEST SUPPLY switch to the TEST position and wait 2 minutes.

(2) Depress any FREQUENCY button, for example, button No. 2, and observe that the corresponding FREQUENCY lamp lights. The SERVO lamp should light in 15 ±2 seconds.

(3) After the SERVO lamp lights, move the servo TUNING switch to ADJ and the 25~ OSC ADJUST OUTPUT control to the extreme clockwise position.

(4) Turn the 25 ~ OSC ADJUST FEEDBACK control until relays marked HARM GEN, HF AMP 1-2-3, HF AMP 4 PLATE, HF AMP 5 GRID, HF AMP 5 PLATE, HF AMP 6 GRID, HF AMP 6 PLATE, OUTPUT COUPLING, OUTPUT BALANCE, and HF GAIN vibrate vigorously, and let this control remain in this position.

(5) Next adjust the HARM GEN ADJUST TUNING potentiometer until the SERVO meter reads 50 as closely as possible.

(6) Similarly, adjust the ADJUST TUNING potentiometers for HF AMP 1-2-3, HF AMP 4 PLATE, HF AMP 5 GRID, HF AMP 5 PLATE, HF AMP 6 GRID, HF AMP 6 PLATE, OUTPUT COUPLING, OUTPUT BALANCE, and HF GAIN for readings of 50.

(7) Change the servo TUNING switch to AUTO and remove power from the transmitter.

(8) Open the various compartments of the transmitter and observe the positions of the dial indicators associated with the continuously variable tuning elements.

Requirement: All ten dial indicators shall be between 47 and 53.

2.11 ***Servo—Accuracy of Repetition***

(1) Apply power by operating the TEST SUPPLY switch to the TEST position. Wait 2 minutes.

(2) Depress FREQUENCY button No. 1 and adjust the potentiometers associated with this frequency to obtain readings of approximately 10 on the SERVO meter for all continuously variable tuning elements associated with this frequency.

(3) Depress FREQUENCY button No. 3 and similarly adjust the corresponding potentiometers to obtain a reading of approximately 90 on the SERVO meter.

(4) Frequency No. 2, which had previously been adjusted for an exact reading of 50 on the SERVO meter, will now serve for testing the accuracy with which the servo system will return to preset positions on repeated operations. Depress FREQUENCY button No. 1 and then No. 2, and record the readings obtained on No. 2.

(5) Depress FREQUENCY button No. 3 and then No. 2, and record the readings again. In this way the motors of the servo system will be required to approach the No. 2 positions alternately from opposite directions. Repeat this procedure at least five times.

Requirement: The SERVO meter readings associated with frequency No. 2 shall in all cases be between 49.5 and 50.5.

2.12 ***Servo Switching Motor Indicating Dials***

(1) Select any RANGE switch, for example, the one associated with frequency No. 4, and turn it to position 11.

(2) Depress the FREQUENCY button associated with the RANGE switch, in this case No. 4, and observe on the SERVO meter the readings obtained with the SERVO POSITIONS metering switch turned to CRYSTAL, HF AMP 1-2-3 IND, HF AMP 4 IND, HF AMP 5 IND, HF AMP 6 IND, and CONTACTORS.

(3) Repeat the test on two other positions, for example, ranges 1 and 5 on frequencies 2 and 9 respectively.

Requirement: The CRYSTAL reading shall be 40 ±4 on the 0 to 100 scale. The other readings shall be 11 ±0.4 on the 0 to 11 scale. The transmitter should be shut down and the dial attached to the crystal selecting switch inspected to see that it indicates position 4. The dials attached to the tuning inductances in the HF AMP stages and the dial on the multideck switch in HF AMP 5 which controls the contactors shall read 11 ±0.4.

D. Protective Circuits—Gate Switches—HV Rectifier

2.13 ***LF & MF MODS Gate Switch***

(1) Operate the TEST SUPPLY switch to the TEST position and wait 2 minutes.

(2) Remove the cover from the LF & MF MODS panel and observe the output of the +150V rectifier on the LV RECTIFIERS voltmeter.

Requirement: The voltage shall drop to zero when the cover is removed.

2.14 ***Monitor Gate Switch:*** Repeat the test as in 2.13, this time removing the cover from the monitor.

Requirement: Same as in 2.13.

2.15 ***HF MOD GATE Switches:*** Remove the cover from the HF MOD circuit and observe the voltage output of both the +150V rectifier and the +300V rectifier.

Requirement: The voltage of both rectifiers shall be zero with the cover removed.

2.16 ***SERVO Gate Switches:*** Repeat the test as in 2.15, this time opening the door which covers the back of the SERVO panel.

Requirement: Same as in 2.15.

2.17 ***Meter Switch Panel Gate Switches:*** Repeat the test as in 2.15, this time removing the cover of the meter switch panel.

Requirement: Same as in 2.15.

2.18 ***Transmitter Door Switches***

(1) Remove all power from the transmitter by operating the AC SUPPLY switch to OFF and the TEST SUPPLY switch to REGULAR.

(2) Remove fuse F8 and connect a test buzzer between TP8 and TP2. Close the doors of the transmitter.

Requirement: The buzzer shall operate with all the doors closed and shall stop operating when any of the following are opened: the bay 2 rear door, the bay 4 rear door, the front door, or the meter housing cover.

2.19 ***HV Rectifier Voltage***

(1) Set all input keys at SPLIT.

(2) Set the CARRIER RESUPPLY switch at TEST.

(3) Set the HIGH VOLTAGE switch at OFF.

(4) Turn the E_c HF AMP 6 bias Variac in bay 1 to full scale.

(5) Turn the E_c HF AMP 5 control to maximum bias (extreme clockwise) position.

(6) Turn the 550V RECT Variac to zero.

(7) Turn the AC SUPPLY switch to ON.

Note: For equipment using 249B mercury vapor rectifiers, allow 2 minutes for warmup or 10 minutes if mercury vapor tubes have not been heated for this length of time during prior tests. Omit warmup time for equipment using solid-state rectifiers.

(8) Set one of the FREQUENCY pushbuttons and turn the HIGH VOLTAGE switch to ON.

(9) Adjust E_c HF AMP 6 until the HF AMP 6 CATHODE meter reads 0.5 ampere.

(10) Adjust the 550V RECT Variac for 550 volts.

(11) Adjust E_c HF AMP 5 until the current of the HF AMP 5 CATHODE meter is 0.3 ampere.

Requirement: With the transmitter adjusted as above and with an ac supply voltage of 230, the HV RECTIFIER meter shall read 4000 to 4400 volts. If the ac supply voltage is greater or less than 230, the 4000- to 4400-volt limits may be made proportionately greater or less.

2.20 ***Discharge of HV Condensers***

(1) Operate the transmitter as in 2.19.

(2) Throw the HIGH VOLTAGE switch to OFF and observe the HV RECTIFIER meter.

Requirement: The voltage shall decrease rapidly from 4000 to between 2500 and 3000 volts when the HIGH VOLTAGE switch is thrown to OFF. The voltage shall then decrease from that value toward a lower value at a very slow rate.

2.21 ***Discharge of HV Condensers—AC Supply Off***

(1) Again operate the transmitter as in 2.19.

(2) Throw the AC SUPPLY switch to OFF and observe the HV RECTIFIER meter.

Requirement: The voltage shall drop to zero at once when the AC SUPPLY switch is thrown to OFF.

E. Tuning Procedure

2.22 ***General:*** The tuning procedure which follows assumes that the 100- and 2700-kc crystal frequencies are in correct adjustment. A minor readjustment of the 100-kc frequency may be necessary in connection with the carrier alarm operation after the transmitter is adjusted. It is further assumed that reference tone input and test tone as applied to the transmitter input terminals are at 0 dbm. In an actual installation of the transmitter, input levels of different magnitudes may be employed, and the adjustment of the input pads should be modified to accommodate whatever levels it is planned to use as standard at the particular installation. In connection with the tuning of the harmonic generator and the high-frequency amplifier circuits, reference should be made to the tuning charts in Section R10.094.

2.23 ***Adjustment of Input Attenuator Pads***

(1) Throw the TEST SUPPLY switch to TEST. Wait 2 minutes.

(2) Remove the 2700-kc crystal and set the DSB, GROUP A, and GROUP B keys to SPLIT.

(3) Adjust the LF MOD 1 and LF MOD 2 BAL controls to approximately midscale. The final adjustment of these will be made after the entire transmitter is tuned.

(4) Turn the CARRIER RESUPPLY potentiometer approximately two-thirds in the clockwise direction and set the CARRIER RESUPPLY switch (LF & MF MODS panel) to TEST.

(5) Connect a vacuum tube voltmeter to the LF TEST pin jack.

(6) Check that the strapping of pads N13 and N14 (PAD & RELAY panel) includes 8 db.

(7) Apply 1000-cycle test tone at 0 dbm to input terminals 19 and 20.

(8) Operate the GROUP A key to TEST TONE.

(9) Adjust pads N3 and N4 until the vacuum tube voltmeter at the LF TEST pin jack reads between 1.4 and 1.6 volts with the LOAD CONTROL switch at IN.

(10) Operate the LOAD CONTROL switch to OUT and adjust the LOAD CONTROL AMP GAIN control to obtain the same reading as in Step 9. The LOAD CONTROL switch should be left in the OUT position until specified otherwise.

(11) Return the GROUP A key to SPLIT and operate the GROUP B key to TEST TONE.

(12) Adjust pads N7 and N8 to obtain between 1.4 and 1.6 volts at the pin jack.

(13) Connect 1000-cycle test tone at 0 dbm to the group A and group B inputs.

(14) Set the GROUP A key to its normal position and the GROUP B key to SPLIT.

(15) Adjust pads N1 and N2 for 1.4 to 1.6 volts at the pin jack.

(16) Similarly adjust pads N5 and N6 for group B.

(17) The following adjustments of the DSB pads should be made after the entire transmitter is tuned and operating. The percentage modulation can then be observed at the output of the transmitter. Operate the DSB key to TEST

TONE and adjust pads N11 and N12 until 100 per cent modulation is obtained. Operate the DSB key to the center position and adjust pads N9 and N10 until 100 per cent modulation is indicated.

2.24 ***Adjustment of MF Gain***

(1) Reinsert the 2700-kc crystal.

(2) With the pads adjusted as in 2.23, apply test tone to group A.

(3) Depress the MF GAIN TEST key on the HF MOD panel.

(4) Observe the meter reading on the HF MOD DC position of the MOD METER switch and adjust the MF GAIN control until the meter reads between 49 and 51. This corresponds to a 0.5-volt signal applied to the HF MOD.

(5) Check that the same reading is obtained with either reference tone or test tone applied to either group A or group B.

2.25 ***Adjustment of Reference Carrier***

(1) Continuing as in 2.24, remove all tone input.

(2) Turn the CARRIER RESUPPLY switch to 0 DB and adjust the CARRIER RESUPPLY potentiometer until the meter (HF MOD DC on the MOD meter with the MF GAIN TEST key depressed) reads between 49 and 51.

(3) Turn the CARRIER RESUPPLY switch to DSB and adjust the DSB CARRIER potentiometer for the same meter reading.

2.26 ***Adjustment for KEYED CARRIER Operation***

(1) Place the LOAD CONTROL switch to IN, the CARRIER RESUPPLY to 0 DB, and the CARRIER TELEG key K7 to the manual operate position (vertical). Check that the 100-kc voltage at the LF TEST jack is between 1.4 and 1.6 volts.

(2) Turn the CARRIER RESUPPLY switch to −20 DB. Check that the 100-kc voltage at LF TEST is between 0.14 and 0.16 volt.

(3) Close the manual telegraph key K1 and adjust the KEYED CARRIER potentiometer P8 to obtain a reading of 0.26 volt at LF TEST.

(4) Release the telegraph key and return the LOAD CONTROL switch to OUT.

2.27 ***Adjustment of Trimmer Condensers in HF AMP 1-2-3:*** The trimmers are adjusted at the highest operating frequency. Once the adjustment is made at this frequency, no other change is necessary until a change of tubes is made. The HIGH VOLTAGE rectifier switch should be OFF for this test.

(1) Use the proper crystal in position 1, tune the HARM GEN control for the proper harmonic of the crystal, and adjust the HARM GEN BIAS control until the direct current through the HF MOD is 35 to 45 ma.

(2) Set the HF AMP 1 TRIMMER and the HF AMP 2 TRIMMER approximately at midposition.

(3) Set the RANGE switch for frequency 1 on the correct range position as determined from the tuning charts.

(4) Set the metering switches to read I_G HF AMP 4 on the MON-MODS HF AMPS meter.

(5) Set the HF GAIN control to the extreme clockwise position.

(6) Apply test tone to group A or group B and tune HF AMP 1-2-3 for maximum deflection on the MON-MODS HF AMPS meter.

(7) Reduce the HF GAIN until the deflection is approximately 10 ma.

(8) Adjust the HF AMP 1 and HF AMP 2 TRIMMERS for an improved maximum reading.

(9) Readjust the tuning of HF AMP 1-2-3 for a maximum and again adjust HF AMP 1 and HF AMP 2 TRIMMERS for an improved maximum. Repeat this process until it is established that the maximum value of I_G HF AMP 4 is obtained for a given setting of the HF GAIN.

2.28 ***Tuning Procedure—HF AMP 1-2-3:*** The initial tuning of all six stages of the HF

AMP should be made at a frequency as close to 12 mc as the station assignments permit, because the initial mechanical adjustments in HF AMP 6 are advantageously made at this frequency. The following assumes a frequency assignment of 12 mc, and the range switch position and tuning positions indicated correspond to 12 mc. These figures may be different if another frequency is utilized. Use a 7.4-mc crystal in position 8 in the crystal oven.

(1) Set the RANGE switch under frequency 8 to position 7.

(2) Turn the HIGH VOLTAGE switch to OFF, set the CARRIER RESUPPLY switch to 0 DB, set the metering circuit to read I_G HF AMP 4 on the MON-MODS HF AMPS meter, and set the HF GAIN control to the extreme clockwise position.

(3) Tune the HF AMP 1-2-3 control until a maximum reading of I_G HF AMP 4 is obtained. It is desirable, after locating the approximate maximum, to reduce the HF GAIN control until a reading of approximately 10 is obtained on the meter and readjust for maximum under this condition. HF AMP 1-2-3 is now tuned for 12 mc.

2.29 ***Tuning Procedure—HF AMP 4:*** With HF AMP 1-2-3 tuned as in 2.28, the tuning procedure for HF AMP 4 is as follows:

(1) Extinguish HF AMP 5 filaments by removing the key from the FIL INTERLOCK switch, inserting it in HF AMP 5 FIL switch, turning it to extinguish the filament, returning it to FIL INTERLOCK switch, and turning it to the position where the key is locked in.

(2) Reduce the HF GAIN by turning the HF GAIN control as far counterclockwise as possible.

(3) Set the metering circuit to read I_G HF AMP 4 on the MON-MODS HF AMPS meter.

(4) Set the CARRIER RESUPPLY switch to +10 DB.

(5) Apply high voltage by moving the HIGH VOLTAGE switch to ON.

(6) Read I_S HF AMP 4. It should be between 120 and 160. Increase the HF GAIN until this reading increases by 10 on the meter, ie, if it reads 150 with the gain at minimum, the gain should be increased until it reads 160.

(7) Set the HF AMP 5 GRID condenser to the value shown for 12-mc operation on range 7 on the tuning chart (see Section R10.090 or the WECo Bulletin for this tuning chart). This will be found to be 50 in this case.

(8) Adjust the HF AMP 4 PLATE tuning until a maximum reading is observed on the HF AMP 4 OUTPUT and the HF AMP 4 SCREEN meters. If it appears that the screen current will exceed 75 ma under tuned conditions, or that the HF AMP 4 OUTPUT meter will go off scale, reduce the HF GAIN before this happens. The HF GAIN should be adjusted until the HF AMP 4 SCREEN current is 20 ma or the HF AMP 4 OUTPUT is 375 ma, whichever occurs first. The objective is to find a setting of HF AMP 5 GRID such that when HF AMP 4 PLATE is tuned and the HF GAIN properly adjusted, the screen current will be between 15 and 25 ma at the same time that the HF AMP 4 OUTPUT is between 350 and 400 ma. The procedure is to adjust HF AMP 5 GRID in small discrete amounts, tune HF AMP 4 PLATE, readjust the gain, and observe the results. The amplifier is properly adjusted when the screen current and the HF AMP 4 OUTPUT are within the above limits.

2.30 ***Tuning Procedure—HF AMP 5:*** The tuning procedure for HF AMP 5 is very similar to that employed for HF AMP 4. However, it differs from HF AMP 4 in that a radio frequency load resistor is temporarily connected into the circuit for the tuning operation. This load resistor simulates the impedance which would be presented to HF AMP 5 by the grounded grid circuit of HF AMP 6 if HF AMP 6 were already adjusted. The procedure for tuning is as follows:

(1) Energize the filaments of HF AMP 5 by operating the key in the HF AMP 5 FIL switch and returning it to the FIL INTERLOCK switch and locking.

(2) Extinguish the HF AMP 6 filament and connect the above-mentioned load resistor

into the circuit by turning the HF AMP 5 TUNING switch to TUNE.

(3) Reduce the HF GAIN to minimum.

(4) Set the CARRIER RESUPPLY switch to +10 DB.

(5) Set HF AMP 6 GRID tuning as indicated on the tuning charts. This will be 50.

(6) Apply high voltage and observe the cathode current of HF AMP 5. It should be approximately 0.3 ampere. Increase the HF GAIN until this current increases to approximately 0.4 ampere.

(7) Tune HF AMP 5 PLATE for maximum reading on the HF AMP 5 TUNING meter.

(8) Increase the HF GAIN until the HF AMP 5 SCREEN current is 50 to 75 ma or the HF AMP 5 CATHODE current is 750 to 800 ma, whichever occurs first. If the screen and cathode current do not fall within the above limits simultaneously, reduce the HF GAIN to a cathode current of 0.4 ampere and readjust HF AMP 6 GRID by a small discrete amount.

(9) Retune HF AMP 5 PLATE and increase the HF GAIN, again observing the screen and cathode currents. It may be necessary to adjust HF AMP 6 GRID and repeat this tuning operation several times before the screen and cathode currents are between the above limits simultaneously. The stage is properly adjusted when this is obtained.

2.31 ***Tuning Procedure—HF AMP 6***

(1) Turn the HF AMP 5 TUNING switch to REGULAR.

(2) Set the HF GAIN to minimum, operate the OUTPUT TRANSFER switch to DUMMY LOAD, set the CARRIER RESUPPLY switch to 0 DB, set the OUTPUT COUPLING and the OUTPUT BALANCE condensers to the values shown on the chart, and close the output indicator circuit by short-circuiting terminals 17 and 18 or by closing the circuit through the OUT IND jacks J9 and J10.

(3) Apply high voltage and observe the HF AMP 6 CATHODE current. It should be 0.5 ampere. Increase the HF GAIN until this current increases to 0.7 ampere.

(4) Tune HF AMP 6 PLATE for maximum indication on the OUTPUT INDICATOR meter or maximum indication on the DUMMY LOAD meter.

(5) Adjust the OUTPUT BALANCE control for equal readings on the DUMMY LOAD meter for all three positions of the DUMMY GROUND switch. If the currents are too small to be accurately observed, increase the HF GAIN but do not exceed 1.0-ampere cathode current for HF AMP 6.

(6) After the output balance is adjusted, retune HF AMP 6 PLATE and increase the HF GAIN until the HF AMP 6 CATHODE current is 1.0 ampere.

(7) Observe the current reading on the DUMMY LOAD meter. On the basis of a 300-ohm dummy, this should be 2.0 amperes (1200 watts). (Calibration of the dummy meter should have been checked previously.) If it is not this value, readjust the OUTPUT COUPLING control a small amount, retune HF AMP 6 PLATE, and readjust HF GAIN. It may be necessary to repeat this procedure several times before the condition of 1.0-ampere cathode current and 2.0-ampere dummy load current is obtained.

(8) After this last adjustment, observe the OUTPUT INDICATOR meter reading. It should read 0.5. If different, adjust the output indicator assembly closer to or farther away from the anode of HF AMP 6 until the reading is 0.5 at the same time that the cathode current is 1.0 ampere and the dummy load current is 2.0 amperes.

(9) Once the mechanical position of the output indicator assembly is properly adjusted, further tuning of the HF AMP 6 circuit should use an OUTPUT INDICATOR reading of 0.5 and a cathode current of 1.0 ampere as a reference tone tuning criterion, instead of utilizing the dummy antenna current value.

(10) The transmitter is now tuned for operation into the dummy antenna. To tune for an

external load (which is required for some later tests in this section), it is necessary to change the OUTPUT TRANSFER switch to OPEN WIRE, where the external load is connected, and readjust the OUTPUT COUPLING and HF AMP 6 PLATE controls until a reading of 0.5 is obtained on the OUTPUT INDICATOR at the same time that the cathode current is 1.0 ampere. These figures apply for single sideband operation. For double sideband operation, a higher efficiency for HF AMP 6 is necessary, and the adjustment should be to obtain a reading of 0.5 on the OUTPUT INDICATOR when the cathode current is 0.85 ampere.

2.32 ***Adjustment of LOAD CONTROL RECT BIAS***

(1) Tune the transmitter for single sideband operation as in 2.31.

(2) Set the CARRIER RESUPPLY switch to −20 DB and the LOAD CONTROL switch to IN.

(3) Apply two tones of 1000 and 1580 cycles, each tone at −11 dbm, to group A or group B input. Alternately apply and remove the two tones by operating a GROUP key and adjust the LOAD CONTROL RECT BIAS control until the IsV3 or IsV4 current in the LF & MF MODS decreases 1 ma when the two tones are applied.

2.33 ***Adjustment of LF MOD 1 and LF MOD 2 BAL***

(1) Adjust the transmitter for single sideband operation.

(2) Set the CARRIER RESUPPLY switch to −20 DB.

(3) Apply test tone to group A or group B.

(4) Terminate the output of the monitor in a 600-ohm volume indicator or equivalent.

(5) Adjust the HF INPUT control on the monitor until the output level is between −8 and −9 dbm.

(6) Remove tone and set the CARRIER RESUPPLY switch on TEST.

(7) Raise the CARRIER ALARM GAIN control until a deflection is obtained on the MON-MODS HF AMPS meter with the MON METER switch set to read IsV8B. Adjust the 100 KC FREQ control to maximize this deflection.

(8) Adjust alternately the LF MOD 1 BAL and LF MOD 2 BAL controls to minimize the deflection. The modulators are balanced when the minimum deflection is obtained.

Note: It may be necessary to temporarily raise the gain at the HF INPUT control to obtain sufficient deflection.

2.34 ***Adjustment of Monitor and Carrier Alarm Circuit:*** With the adjustment of the HF input to the monitor remaining the same as in 2.33, set the CARRIER RESUPPLY switch to −20 DB and adjust the CARRIER ALARM GAIN control until IsV8B reads 5 ma. This is a minimum value and will not be exactly the same for all operating frequencies. The entire transmitter is now adjusted for single sideband operation.

2.35 ***Meter Readings:*** The functioning of the meter circuits shall be checked by taking meter readings as listed below. The readings shown are not requirements but are typical for normal operation. They are given here only for checking meter circuit operation and as a help in locating troubles encountered on other tests. The readings are with the transmitter adjusted for single sideband operation with the CARRIER RESUPPLY switch at −20 DB, the LOAD CONTROL at OUT, and with connection to the dummy antenna.

(a) ***AC SUPPLY Meter***

230V ±5%—the three phases balanced to 4 volts

(b) ***LV RECTIFIERS Meter***

−48V RECT—43.5 to 52.5 volts

Ec AMP 5—68 to 92 volts

Ec AMP 6—127.5 to 172.5 volts

−150V RECT—150 volts

+150V RECT—150 volts

+300V RECT—300 volts

+550V RECT—545 to 555 volts

(c) ***Monitor—Read on MON-MODS HF AMPS Meter***

IsV2—4 to 7 ma

IsV1—5 to 12 ma

IsV3—4 to 7 ma

IsV4—5 to 12 ma

IsV5—5 to 12 ma

IsV6—5 to 12 ma

IsV7—5 to 12 ma

IsV8A—0.02 to 0.1 ma

IsV8B—1 to 5 ma

(d) ***Modulators—Read on MON-MODS HF AMPS Meter***

IgV1—0.005 to 0.05 ma

IsV1—5 to 12 ma

IgV6—0.05 to 0.2 ma

IsV6—5 to 12 ma

EcV3,V4—3 to 5 volts

IsV3—4 to 6 ma

IsV4—4 to 6 ma

IsV5—5 to 12 ma

IsV7—5 to 12 ma

IsV8—5 to 12 ma

IsV9—25 to 35 ma

IsV2—25 to 35 ma

E 100 KC—2.6 to 3.4 volts

MF MOD DC—2 to 7 ma

IgV10—0.005 to 0.15 ma

IsV10—5 to 12 ma

IsV11—45 to 75 ma

IsV12—45 to 75 ma

HF MOD DC—40 to 50 ma

EcV12—15 to 150 volts

With the MOD METER switch set on the HF MOD DC position, press the MF GAIN TEST button on the HF MOD panel. Under reference tone condition, the meter will read 45 to 55 scale, corresponding to 0.45 to 0.55 volt. With no tone applied, the reading will be about one-tenth of these values and will be difficult to read accurately.

(e) ***HF Amplifiers—Read on the MON-MODS HF AMPS Meter***

IsAMP 1—50 to 75 ma

IsAMP 2—50 to 75 ma

IsAMP 3—50 to 75 ma

IsAMP 4—250 to 320 ma

IgAMP 4—0

IgAMP 5—0

(f) ***HV RECTIFIER Meter***

At normal line voltage (230 volts) this meter reads between 3850 and 4250 volts under reference tone conditions.

(g) ***HF AMP 4 SCREEN Meter***

4 to 8 ma

(h) ***HF AMP 4 OUTPUT Meter***

90 to 130 ma under reference tone conditions. The reading is too small to be observed without tone.

(i) ***HF AMP 5 SCREEN Meter***

−5 to +5 ma

(j) ***HF AMP 5 CATHODE Meter***

360 to 430 ma under reference tone conditions
300 ma with no tone

(k) ***HF AMP 6 GRID Meter***

−10 to +30 ma

(l) ***HF AMP 6 CATHODE Meter***

0.9 to 1.0 ampere under test tone conditions
0.5 ampere with no tone

(m) ***OUTPUT INDICATOR Meter***

0.45 to 0.55 under test tone conditions
0.045 to 0.055 with no tone

(n) ***SERVO Meter***

The SERVO POSITIONS indications will depend upon the operating frequency. The SERVO RELAY CURRENTS indications should be observed with the TUNING switch in the ADJ position. All relay currents should be between 0.7 and 1.5 ma when observed this way.

IsV1A—1 to 2 ma

IsV1B—5 to 10 ma

F. Tuning Range

2.36 ***General:*** With the procedure outlined in E above, the transmitter should tune satisfactorily to any frequency in the range of 4 to 23 mc. This has been checked at the factory as part of the manufacturing test specification. It is not practical to check completely the tuning range in the field, as 12 special crystals would be necessary for the test. However, it should be determined that the transmitter tunes satisfactorily to all of the frequencies which have been assigned to it.

2.37 ***Assigned Frequencies:*** Tune the transmitter for all its assigned frequencies.

Requirement: The transmitter should tune to any frequency in the range of 4 to 23 mc.

G. Distortion, Noise, Frequency Characteristic

2.38 ***Signal-to-Distortion Ratio—Single Sideband Operation:*** The signal-to-distortion ratio shall be checked at the lowest and highest assigned frequencies and at another frequency approximately midway between.

(1) Switch the load-limiting amplifier to OUT, the OUTPUT TRANSFER switch to DUMMY, and the CARRIER RESUPPLY switch to −20 DB.

(2) Apply two tones of 1000 and 1580 cycles, each tone at reference amplitude, to group A or group B input.

(3) Measure the ratio of one tone to that of the 420-cycle third-order distortion product appearing at the output of the monitor. Measure the power in the dummy antenna.

Requirement: The signal-to-distortion ratio shall be 30 db or better and the power at least 2 kw (4-kw envelope peak) into the dummy.

(4) Reduce the tones to 1, 2, 3, 4, 6, 8, 10, and 12 db below reference and measure the distortion at each level. The antenna power need not be measured.

Requirement: The signal-to-distortion ratios at the reduced input values shall be as in Table B or better.

TABLE B

INPUT	SIGNAL-TO-DISTORTION RATIO
db	
0	30
−1	31
−2	32
−3	33
−4	34
−6	36
−8	38
−10	40
−12	40

2.39 ***Signal-to-Distortion Ratio—Double Sideband Operation:*** The second- and third-order signal-to-distortion ratios shall be checked at a frequency approximately midway between the lowest and highest operating frequencies.

(1) Set the CARRIER RESUPPLY switch to DSB and adjust HF AMP 6 for double sideband operation into the dummy.

(2) Measure the carrier power into the dummy.

Requirement: The carrier power shall be between 0.9 and 1.1 kw.

(3) Apply two tones of 1000 and 1580 cycles, each tone 6 db below reference, to the group A input, and measure the ratio of one tone to the 420-cycle third-order distortion product at the output of the output indicator circuit.

Requirement: The signal-to-distortion ratio with respect to the third-order product shall be at least 25 db for all tone amplitudes up to and including that which produces a 100 per cent modulated wave.

(4) Similarly apply two tones of 1000 and 1420 cycles and measure the second-order 420-cycle product.

Requirement: The same requirement as under Step 3 applies to the second-order product.

2.40 ***Signal-to-Noise Ratio—Single Sideband Operation:*** The signal-to-noise ratio for single sideband operation shall be measured at a frequency midway between the lowest and highest assigned frequencies.

(1) Set the LOAD CONTROL switch to OUT, the CARRIER RESUPPLY switch to −10 DB, and the OUTPUT TRANSFER switch to DUMMY LOAD.

(2) Apply a 1000-cycle tone 20 db below reference to group A or group B input and measure the amplitude of the signal at the output of the OUTPUT INDICATOR. Call this ***A*** db.

(3) Remove the input tone and measure the amplitude of the noise signal at the output of the OUTPUT INDICATOR. Call this ***B*** db.

(4) Calculate the signal-to-noise ratio as follows:

$$SNR = A - B + 26.$$

Requirement: The signal-to-noise ratio shall be 50 db or better.

2.41 ***Signal-to-Noise Ratio—Double Sideband Operation:*** The signal-to-noise ratio shall be checked at the frequency used in 2.39 for double sideband operation.

(1) Set the CARRIER RESUPPLY switch to DSB, tune HF AMP 6 for double sideband operation into the dummy, and apply reference tone at 1000 cycles to the group A input.

(2) Measure the tone amplitude at the output of the output indicator circuit.

(3) Remove tone and again measure the noise amplitude. The difference in db is the signal-to-noise ratio.

Requirement: The signal-to-noise ratio shall be at least 40 db.

2.42 ***Frequency Characteristic—Single Sideband Operation:*** The frequency characteristic test shall be made at the frequency used in 2.39.

(1) Set the CARRIER RESUPPLY switch to −20 DB and the LOAD CONTROL switch to OUT.

(2) Apply reference tone at 1000 cycles to the group A input. Observe the deflection of the OUTPUT INDICATOR. Determine the input level necessary to produce this deflection at 100, 200, 500, 1000, 2000, 3000, 4000, 5000, and 6000 cycles.

(3) Repeat, utilizing the group B input.

Requirement: The maximum and minimum input levels required shall not differ by more than 2 db over the range of 100 to 6000 cycles for either group A or group B input.

2.43 ***Frequency Characteristic—Double Sideband Operation:*** The frequency characteristic shall be measured at the frequency used in 2.39, with the transmitter adjusted for double sideband operation.

(1) Apply reference tone to the group A input. Observe the audio level at the output of the output indicator circuit. Determine the input level necessary to produce this output level at 100, 200, 500, 1000, 2000, 3000, 4000, 5000, and 6000 cycles.

Requirement: The maximum and minimum input levels required shall not differ by more than 2 db over the range of 100 to 6000 cycles.

H. Lamps

2.44 ***Normal Operation***

(1) Operate the OUTPUT TRANSFER switch to OPEN WIRE and connect the output terminals of the transmitter to an antenna of 300- or 600-ohm nominal impedance. Adjust the transmitter for single sideband operation at the highest, the lowest, and a midrange frequency on frequencies 1, 2, and 3.

(2) Throw the CARRIER COMPENSATOR switch on the monitor to the SSB position, the CARRIER RESUPPLY switch on the LF & MF MODS panel to −20 DB, the AUD ALARM switch to ON, and the HF INPUT SELECTOR switch on the monitor to AMP 6.

(3) Operate the transmitter on frequency 2 or the midrange frequency and observe the lamps on the meter panel.

Requirement: All the lamps shall be lighted.

(4) Repeat the test on the highest and lowest operating frequencies. The requirement is the same.

2.45 ***MONITORING Lamp***

(1) Operate the transmitter as in 2.44.

(2) Turn the HF INPUT SELECTOR switch on the monitor to AMP 3.

Requirement: The MONITORING lamp shall be extinguished.

2.46 ***AUD ALARM Lamp***

(1) Operate the transmitter as in 2.44.

(2) Operate the AUD ALARM switch to OFF.

Requirement: The AUD ALARM lamp shall be extinguished.

2.47 ***CARRIER Alarm Lamp***

(1) Operate the transmitter as in 2.44. Perform the following as separate nonrelated operations. Observe the CARRIER alarm lamp and listen for the audible alarm for each operation.

(2) Move the HF INPUT switch on the monitor panel to the AMP EX position momentarily.

(3) Turn the HIGH VOLTAGE switch to OFF momentarily.

(4) Move the CARRIER RESUPPLY switch on the LF & MF MODS panel to the TEST position momentarily.

(5) Depress the MF GAIN TEST key on HF MOD panel momentarily.

Requirement: The CARRIER alarm lamp shall be extinguished and the audible alarm shall sound for each operation.

2.48 ***HF AMP 5 FIL Lamp***

(1) Operate the transmitter as in 2.44.

(2) Remove the key from FIL INTERLOCK. Insert and turn the key in HF AMP 5 FIL.

Requirement: The high voltage shall be de-energized and the HF AMP 5 FIL lamp shall be extinguished.

2.49 ***HF AMP 4-5 and HF AMP 6 OVERLOAD Lamps***

(1) With power removed from the transmitter, locate the overload relays S6 and S7 on the power relay panel. Release the mechanical latches on these relays and apply power to the transmitter.

(2) Observe the HF AMP 4-5 and HF AMP 6 OVERLOAD lamps.

(3) Depress the RESET button.

Requirement: The lamps shall be extinguished with the relays in the unlatched condition. Depressing the RESET button shall cause the relays to latch and the lamps to light.

2.50 ***FILAMENTS and DELAY RELAY Lamps***

(1) Apply power to the transmitter.

(2) Observe the lamps designated FILAMENTS and DELAY RELAY.

Requirement: The lamp designated FILAMENTS shall light immediately when the AC SUPPLY switch is thrown to the ON position. The lamp designated DELAY RELAY shall light 15 $\pm$2 seconds after the switch is thrown.

2.51 ***SERVO Lamp***

(1) Operate the transmitter as in 2.44.

(2) Depress the STANDBY button and observe that the SERVO lamp extinguishes.

(3) Depress FREQUENCY button No. 1 and observe that the SERVO lamp lights.

Requirement: The SERVO lamp shall be extinguished when the STANDBY button is depressed. It shall light in 15 $\pm$2 seconds when any FREQUENCY button is depressed.

2.52 ***OVEN OPR Lamp on HF MOD***

(1) Operate the transmitter as in 2.44.

(2) Observe the crystal oven lamp which is designated OVEN OPR on the HF MOD panel.

Requirement: After 5 minutes the lamp shall cycle on and off at regular intervals. The period will depend somewhat on the room temperature but should be about 90 seconds.

I. Load Control Amplifier

2.53 ***Bias***

(1) Operate the transmitter on a midrange frequency as in 2.44.

(2) Adjust the LOAD CONTROL RECT BIAS control as described in 2.32.

(3) Connect a dc voltmeter having a nominal resistance of at least 150,000 ohms across terminals 25 and 26 of the LF & MF MODS. Read the voltmeter.

Requirement: The voltage shall be between 20 and 55 volts.

2.54 ***Limiting Action***

(1) Continuing as in 2.53, apply two tones, each 11 db below reference, and observe the power in the dummy.

(2) Increase the tones 12 db, ie, to 1 db above reference, and observe the power in the dummy.

Requirement: When the input tones are increased 12 db, the power in the dummy shall increase not more than 50 per cent and shall be between 750 and 1500 watts.

3. TEST REPORTS AND RECORDS

3.01 The required record of these tests shall be entered on the proper form.