WABLSY
Short Course

ELECTRONIC **LINK** ENGINEERS

RADIO TRANSMITTER-RECEIVER TYPE 50-UFS

Consisting of

RADIO TRANSMITTER TYPE 50-UFS Ed. 7

RADIO RECEIVER TYPE 12-UF Ed. 7

and

COORDINATING EQUIPMENT

INSTALLATION INSTRUCTIONS

AND

SERVICE NOTES

LINK RADIO CORP.
125 WEST 17th STREET
NEW YORK 11, N. Y.

866A-816

In addition to the 30-50 megacycle Land Station Equipment described in this Instruction Book the following coordinating equipment is in regular production.

MOBILE EQUIPMENT

Mobile Radio Equipment Type 35-FMTR-7A—Complete two-way mobile assembly with 35-watt transmitter
Mobile Radio Equipment Type 50-FMTR-7A—Complete two-way mobile assembly with 50-watt transmitter
Mobile Radio Equipment Type 75-FMTR-7A—Complete two-way mobile assembly with 75-watt transmitter

MAIN STATION EQUIPMENT

Radio Transmitter-Receiver Type 250-UFS—250 watt land station assembly
Radio Transmitter-Receiver Type 3000-UFS—3000 watt land station assembly
Remote Control Unit Type 886—Simple two-wire control
Remote Control Unit Type 1890—Deluxe two-wire control with carrier indicator. Built-in provision for selective calling or selective squelch.
Coaxial Antenna Type 3CA—Lightweight type
Coaxial Antenna Type 4CA—Heavy duty type
Antenna Array Type 4CA-D—3-element directional type (5 db gain)

SELECTIVE CALLING AND SELECTIVE SQUELCH EQUIPMENT

Selector Unit Type 1779—Selector unit for mobile or fixed stations
Mobile Tone Selector Type 1984—For selective squelch in a mobile unit
Selective Squelch Unit Type 1995—Used in 1890 to provide selective squelch
Mobile Tone Oscillator Type 1939—For selective squelch or selective calling from a mobile unit
Sono Call Unit Type 2231—For fast calling in taxi installations

A similarly complete line of FM equipment is available for the 72-76 megacycle and 152-162 megacycle bands. In addition, a complete stock of automatic relay and repeater stations is maintained. For information write, giving the details of your problem, to:

LINK RADIO CORPORATION
125 WEST 17th STREET
NEW YORK 11, N. Y.

GUARANTEE

The Link Radio Corporation fully guarantees all products of its manufacture and agrees to furnish a new part in exchange for any part of any unit which, under normal installation, use and service, becomes inoperative as a result of any defect in material or workmanship, provided the unit is delivered intact, by the owner or his accredited agent, within ninety days from date of purchase, charges prepaid.

Vibrators and tubes carry only the standard 1000-hour guarantee of their respective manufacturer. Pilot lamps and fuses are not guaranteed for length of service.

All correspondence relative to replacement parts and service matters should be addressed to the Link Radio Corporation, 125 West 17th Street, New York 11, N. Y.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

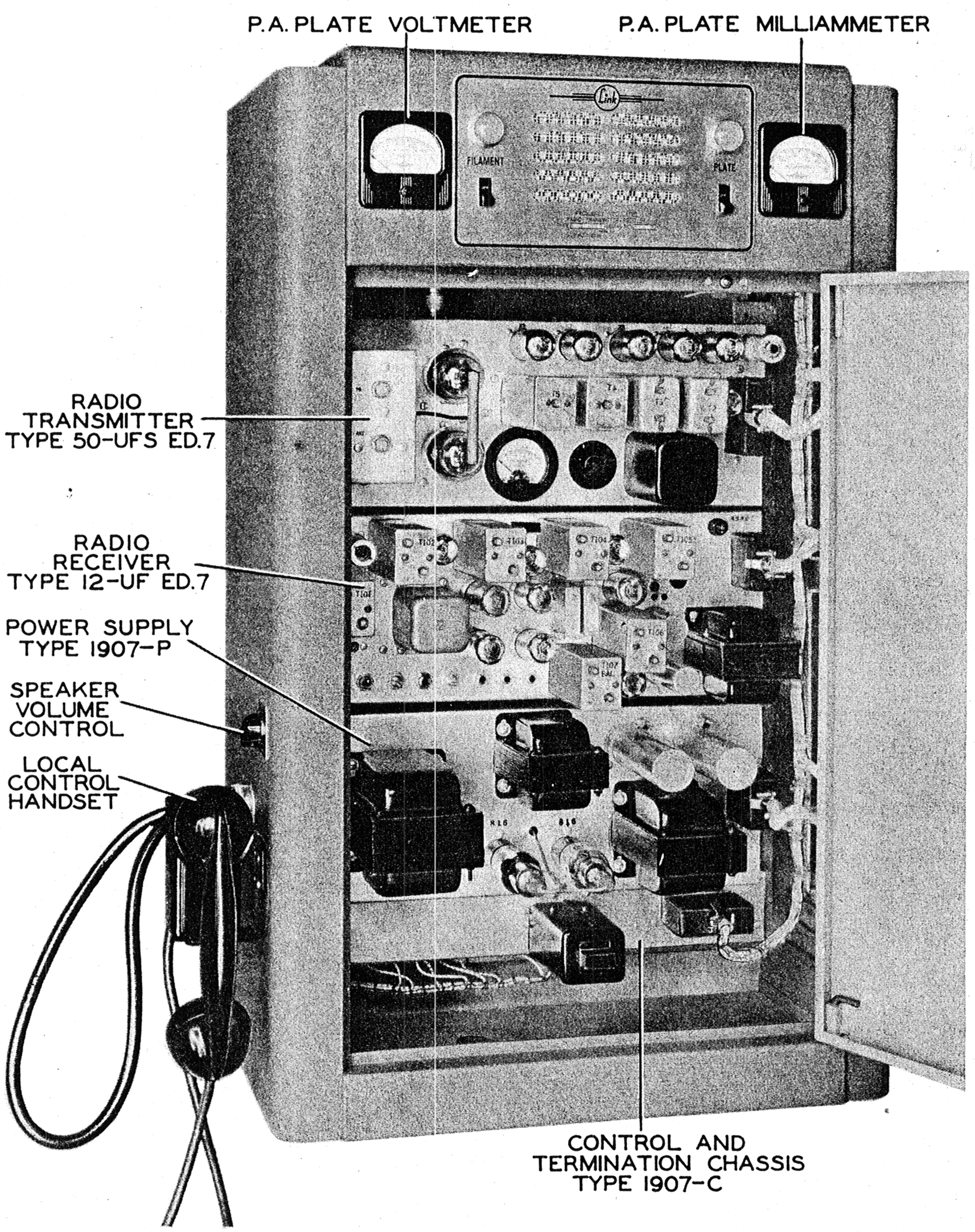


Figure 1. Radio Transmitter-Receiver Type 50-UFS, Open Front View

1. INTRODUCTION.

Radio Transmitter-Receiver Type 50-UFS Ed. 7 is a complete assembly designed for two-way communication in the 30-50 megacycle very-high-frequency band. It consists of the 50-watt Radio Transmitter Type 50-UFS Ed. 7, Radio Receiver Type 12-UF Ed. 7 and all accessories for accomplishing an operating two-way communication system in a fixed station (figs. 1 and 2). The equipment is designed to derive all of its primary energy from 115 volt 50-60 cycle a-c lines.

2. DESCRIPTION.

(a) General.—The transmitter, power supply and receiver chassis are mounted with all the coordinating accessories in a completely enclosed rack cabinet. Front and rear doors give immediate access to any adjustments or circuit components for servicing. At the top front of the cabinet are located two meters, reading P.A. plate voltage and current, filament and plate switches, pilot lamps, and the loudspeaker grill.

Inside the cabinet, in addition to the chassis already mentioned is a Control and Termination Chassis Type 1907-C (see figs. 2 and 11) containing the necessary circuits to provide for local and/or two-wire or four-wire remote control of the complete equipment. Terminals are also provided on this panel for local control wires, remote control pairs and repeater control.

The remote control feature provides receiver-transmitter and control facilities over either one or two telephone pairs when used with a Link Radio Remote Control Unit Type 1890. At the same time complete use of the normal local control handset is retained.

An overload fuse, door switches and all interwiring are built into the rack cabinet, which forms a completely operative unit as shipped from the factory.

Further characteristics appear below:

Overall cabinet size . . . 21" wide, 11" deep, 34¼" high
Overall size (packed for domestic shipment) . . . 27" wide, 16" deep, 38" high
Total weight . . . . . 142 lbs.
Total weight (packed for domestic shipment) . . . 170 lbs.
Supply voltage . . . . . 115 volts, 50-60 cycles
Total input power (including receiver) . . . . Standby: 130 watts
Transmitting: 275-300 watts
Frequency range . . . . . 30-50 mc
System audio response . ± 3db 300-3000 cycles

(b) Radio Transmitter Type 50-UFS Ed. 7—Radio Transmitter Type 50-UFS Ed. 7 is a 50-watt (nominal output) frequency-modulated unit designed for rack mounting. Its more salient characteristics may be listed as follows:

Power output . . . . . 50 watts (nominal)
Type of emission . . . . . Frequency modulated
Frequency deviation . . . . ± 15 kc
Mounting . . . . . 7" of standard 19" relay rack
Power supply . . . . . Separate 7" rack chassis in same cabinet
Power input . . . . . From 115 volt a-c source
Standby: 65 watts
Transmitting: 210-235 watts
Output impedance . . . . . Any—usually fed into 50 to 70 ohm concentric line
Control . . . . . Local or remote by self-contained relays—provisions for coordinated receiver control.

Radio Transmitter Type 50-UFS Ed. 7 utilizes the phase-shift method of obtaining the desired deviation. This permits both direct crystal control of the carrier frequency and a simple circuit design with no critical tuning adjustments. A carrier power of 50 watts is available under normal operating conditions. The transmitter is entirely self-contained except for filament and high-voltage plate supplies for the tubes. Eight tubes are included on the chassis, six of which are of the low-drain receiving type.

The tube types and their uses are as follows:

1 Type 7A4 . . . . . Audio amplifier
1 Type 7F7 . . . . . Crystal oscillator, phase modulator
1 Type 7W7 . . . . . 1st frequency doubler
1 Type 7C5 . . . . . 2nd frequency doubler
1 Type 7C7 . . . . . Frequency quadrupler
1 Type 7C5 . . . . . 3rd frequency doubler
2 Type 807 . . . . . Power amplifiers

From the above list it is seen that the crystal frequency is multiplied 32 times in order to obtain the final operating frequency. A meter and meter switch are provided on the chassis to read the grid current of each stage for convenience in making adjustments. All tuning adjustments are straightforward and small errors in making them will not affect the output frequency, quality or modulation level in any way.

Filament and plate voltages for the transmitter are supplied by Power Supply Type 1907-P which is mounted on a separate 19 inch rack chassis. A filament transformer supplies 6.3 volts ac for the transmitter filaments and filament current for the type 816 rectifiers. The high-voltage rectifier supplies 475 or 550 volts dc at 250 ma.

(c) Radio Receiver Type 12-UF Ed. 7.—Radio Receiver Type 12-UF Ed. 7 is an 11-tube, crystal-controlled, single-frequency, frequency-modulation, superheterodyne receiver designed particularly for the reception of frequency-modulated signals of the type generated by Radio Transmitters Type 35/50/75-UFM, 50-UFS, 250-UFS and 3000-UFS. Some pertinent characteristics follow:

Frequency range . . . . . 30-50 mc
Type of signal . . . . . Frequency modulated
Frequency deviation . . . . . ± 15 kc
Audio response . . . . . ±3 db 300-3000 cycles (system)
(sharp cut-off filter attenuates frequencies above 3000 cycles)
Power supply . . . . . Self-contained
Power input . . . . . 35 watts from 115-volt 50-60 cycle a-c source
Output impedance . . . . . 500 ohms
Mounting . . . . . 7" of standard 19" relay rack
Control . . . . . Coordinated with 50-UFS control
Power output (into 500 ohms) . . . . . Approximately 1 watt

Radio Receiver Type 12-UF Ed. 7 utilizes 11 tubes in a double conversion superheterodyne circuit. The tube

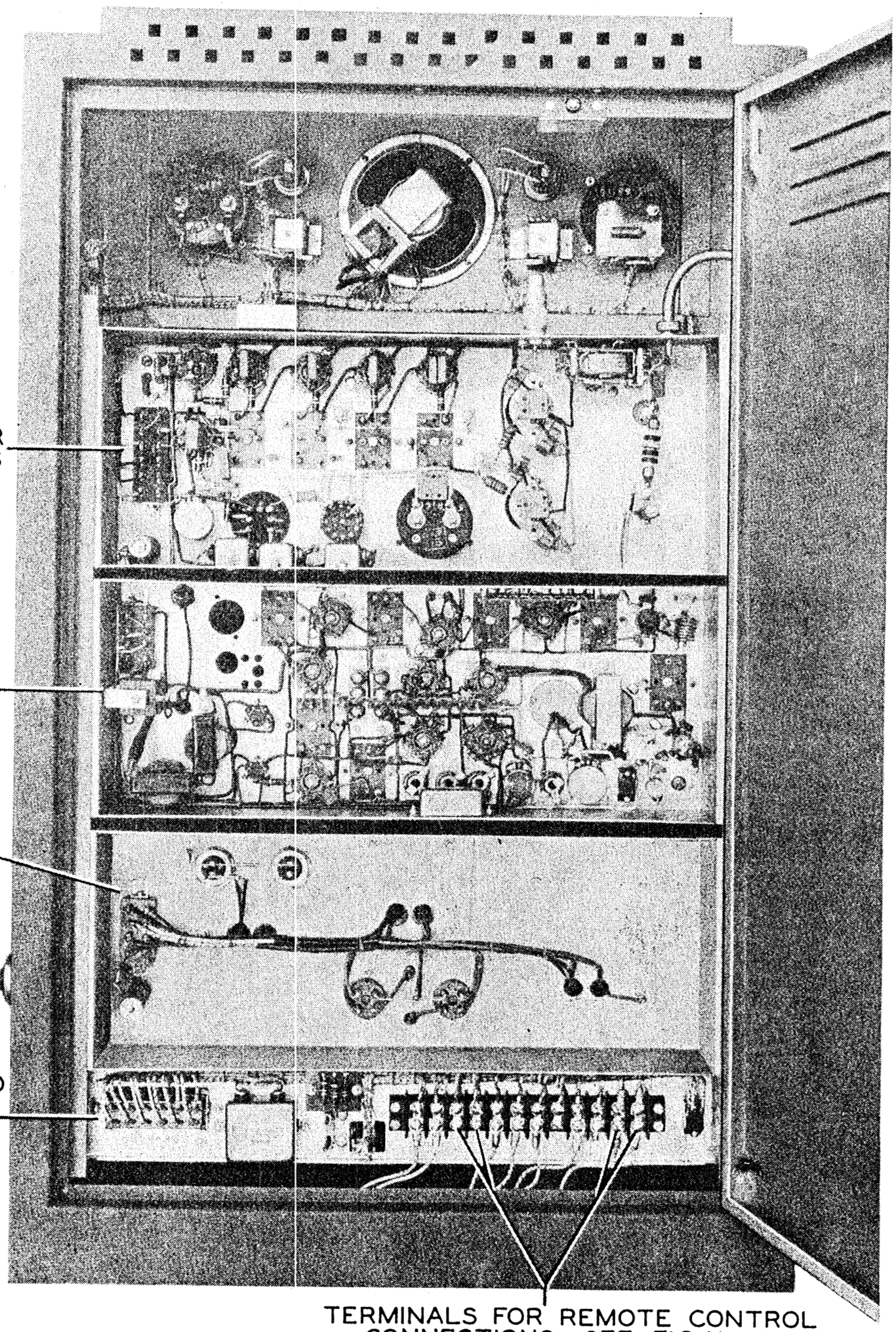


Figure 2. Radio Transmitter-Receiver Type 50-UFS, Open Rear View

types and their uses are as follows:

1 Type 6AG5.....R-f amplifier
1 Type 12AT7.....Mixer and crystal oscillator
1 Type 7C7.....5 mc i-f amplifier
1 Type 7A8.....Converter
1 Type 7C7.....456 kc i-f amplifier
1 Type 7C7.....First limiter
1 Type 7C7.....Second limiter
1 Type 7A6.....Discriminator
1 Type 7F7.....Noise amplifier and rectifier
1 Type 7F7.....First audio and squelch
1 Type 7B5.....Audio output

Two quartz crystals are employed to insure stable receiving conditions under all variations of temperature and humidity. The double i-f system makes possible excellent bandpass characteristics with a very favorable image ratio.

Three tuning meter jacks are located on the receiver chassis. One is for measuring the grid current of the first limiter, thus indicating resonance in all the preceding stages. The second is for measuring the grid current of the second limiter and the third is to permit adjustment of the balance of the discriminator circuit. The two former require the use of a zero to one milliampere meter while the third requires a fifty or one hundred microampere meter, center-zero type preferred. A monitor jack across the 500-ohm output is located on the receiver chassis to permit aural monitoring of the receiver when the loudspeaker is remotely located.

3. UNPACKING.

(a) Export.—The 50-UFS cabinet is shipped packed in a wooden case. All chassis are removed for shipment and packed separately in cardboard containers to minimize damage during transport. To reassemble the complete unit, unpack all components. Place the chassis in position from the front of the cabinet, hooking them over the heads of the screws already in place on the rack. Tighten these screws securely, and plug the socket on the interconnecting cable onto the connector plug on each chassis. The leads are cabled in position for easy identification.

(b) Domestic.—The 50-UFS is shipped complete in an extra-heavy reinforced cardboard carton. All chassis are left in place with extra mounting screws on the rack chassis to prevent slipping in transit. The power supply chassis is suitably blocked up to remove the strain of the heavy power components from the chassis flanges during shipment. The Type 816 rectifiers, and 807 power amplifier tubes are removed from their sockets, packed in cartons and made fast to a paper-board base in the bottom of the cabinet. The transmitter and receiver crystals, transmission line entrance bushing, and a-c line fuse are also packed in the bottom of the cabinet. The instruction book is tucked inside the cabinet and 2 door keys are tied to the outside of the cabinet door louvres.

To make ready for service, unlock the cabinet doors and remove all packages and bracing from inside the cabinet. Place the tubes and crystals in their proper sockets. Screw the a-c line fuse into its receptacle on the outside of the cabinet.

4. INSTALLATION.

Installation of the 50-UFS consists merely of attaching power, antenna and control cables. All power for the unit is derived from a 115 volt 50-60 cycle a-c source. The a-c power cord is inserted into the receptacle at the side of the cabinet and plugged into a 115-volt outlet. The total drain is low enough so that power may be taken from any convenient outlet.

The control wires are connected to the appropriate terminals on the terminal block (see fig. 11).

NOTE: The handset must always be connected to the equipment cabinet even when operating from a remote control point.

The coaxial line from the antenna is brought into the cabinet through the top and attached to the removable plug fitting at the top of the transmitter chassis. The other fitting is used to interconnect with the receiver antenna circuit using the concentric cable provided.

5. TUNING AND OPERATION.

(a) Tuning and Adjustment.

(1) Radio Receiver Type 12-UF Ed. 7.—To turn on the receiver, advance the VOLUME control on the receiver chassis about half way to its maximum position. The first few degrees of rotation will apply primary power to the receiver power supply.

With the volume control advanced and the SQUELCH switch in the OFF position, a loud rushing noise should be heard in the loudspeaker even with the antenna disconnected. If the SQUELCH switch is placed in the ON position, all output from the loudspeaker should cease because of the action of the squelch circuit.

The loud noise present in the loudspeaker with the SQUELCH switch OFF is entirely normal and characteristic of an FM receiver of adequate sensitivity. Any amount of noise introduced into the receiver or picked up by the antenna will not alter or intensify the characteristic sound of this noise unless a carrier is being received. In the latter case, even a weak signal will greatly reduce or completely suppress the noise.

When shipped from the factory the 12-UF Ed. 7 receiver is equipped with the proper tubes and crystals and is tuned approximately to the specified operating frequency. In addition, the approximate positions of the tuning adjustments are marked with red lines to facilitate tuning. With the antenna connected to the receiver, plug a 100 or 500 μa meter into jack J102 and tune C101, T101, T102, T103, T104 and T105 for maximum current in the meter while receiving a weak signal (0.1 to 0.2 μv) on the desired frequency. Tuning must be made to a signal weak enough so that at resonance, no more than 50 μa deflection is obtained in the tuning meter. To adjust the oscillator (C109), place one finger on top of crystal Y101 and tune for maximum meter current. The additional loading introduced by the finger on the top of the crystal holder insures that the crystal will operate properly under all operating conditions.

Next, plug the tuning meter into jack J103 and adjust the tuning controls on T106 for maximum current in the meter. The primary of T107 should be adjusted for maximum no signal output (rush) as measured across J105 with an a-c voltmeter. To tune the secondary of T107, plug a 50 or 100 μa meter, center-zero type preferred, into jack J104 and, with a non-metallic screwdriver, adjust the secondary tuning control (marked "BAL") for zero reading on the microammeter while receiving a strong signal.

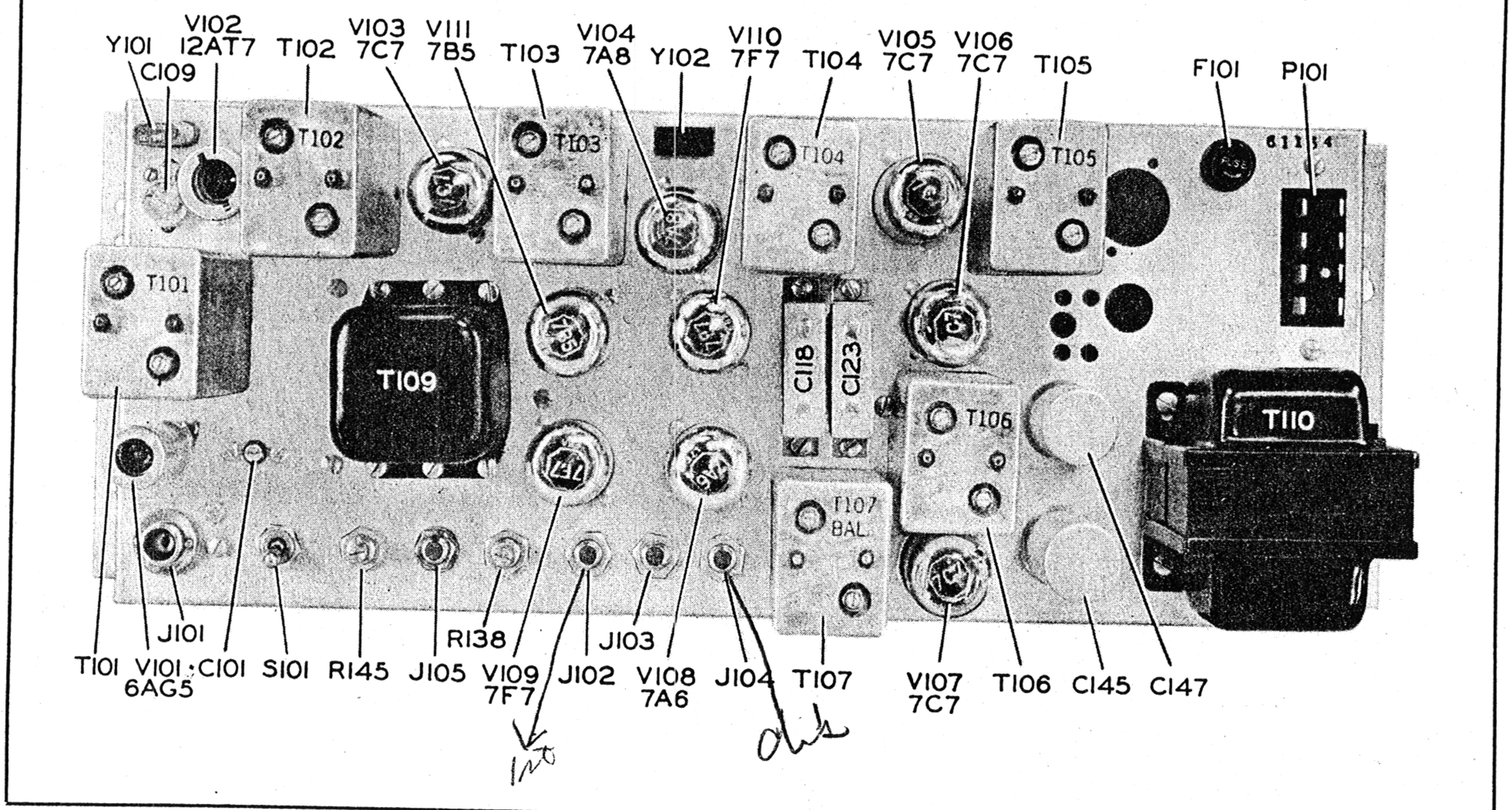


Figure 3. Radio Receiver Type 12-UF Ed. 7, Top of Chassis View

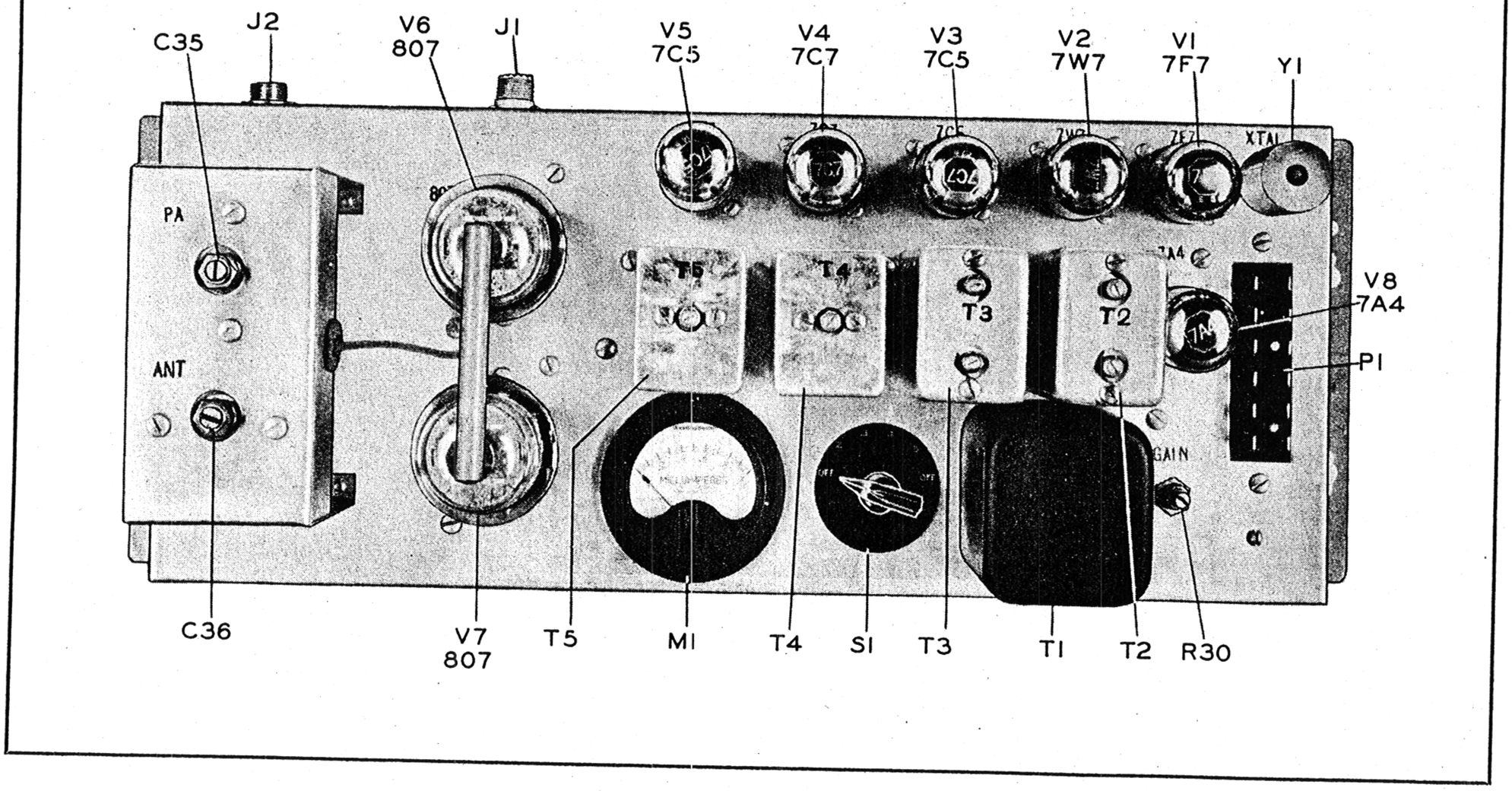


Figure 4. Radio Transmitter Type 50-UFS Ed. 7, Top of Chassis View

After the receiver has been completely tuned, the SQUELCH control may be adjusted. The most sensitive position of this control is completely clockwise. With the adjustment in this position and the SQUELCH switch ON, advance the volume control and observe the output of the receiver with no signal input. Turn the squelch adjustment in a counterclockwise direction until the output of the receiver is entirely silent. This adjustment will hold for most noise conditions, no matter how severe, as a result of the special circuits incorporated in the design of the 12-UF Ed. 7. Note that in its most sensitive position, the squelch sensitivity is better than one-tenth microvolt and that even this very sensitive adjustment may prove sufficient in many cases to silence the receiver between signals.

Since the 12-UF Ed. 7 receiver is powered by a selenium rectifier unit, if it is not used for some time the fuse may blow when first placed in service due to the rush of current which flows only until the rectifier plates have formed themselves.

If this does occur, replace with a one-ampere type fuse as supplied. Since this is a normal occurrence with this type of rectifier, do not replace with a higher value as it will not give the proper protection when in use.

(2) Radio Transmitter Type 50-UFS Ed. 7.—When shipped from the factory Radio Transmitter Type 50-UFS Ed. 7 is equipped with the proper tubes and crystals and is tuned correctly to the specified operating frequency. In addition, the approximate positions of the tuning adjustments are marked with red lines to facilitate tuning.

A meter and meter switch are integral parts of the transmitter and serve to measure the grid current of the various stages. The position numbers on the meter switch correspond with the numbers on the tops of the r-f transformers. Thus r-f transformer T2 is tuned for maximum current in the meter with the meter switch in position 2, etc. For initial tune up it can be assumed that all the circuits are in proper tune except the P. A. and ANTenna tuning adjustments. The transmitter may be energized for tuning or testing purposes from the switches on the unit, or from the local control handset. In either case the FILAMENT switch on the front of the 50-UFS Cabinet must first be turned on. To permit adjustments to be made with the doors open, an INTERLOCK SHORT switch (S301) has been provided on Control and Termination Chassis Type 1907-C. Closing this switch short-circuits the protective door switches. Plate power may then be applied either by the PLATE switch on the front of the cabinet, or from the push-to-talk button on the local control handset, and tuning adjustments made. The protective function of the door switches should be restored when adjustments are completed by throwing the INTERLOCK SHORT switch OFF.

In order to tune the output circuit of the transmitter, disconnect the antenna cable from the transmitter chassis, place the ANTenna tuning capacitor at maximum capacity, and adjust the P.A. tuning capacitor for minimum cathode current as read on the meter on the front of the cabinet. This current should be approximately 75 ma.

Connect the antenna and resonate the P.A. tuning adjustment for minimum current. The loaded P-A cathode current should be approximately 200 ma. If it is less than this value, decrease the ANTenna tuning capacity in small increments, retuning the P.A. adjustment each time for minimum cathode current. Continue this process until the P-A cathode current is 200 ma on the minimum adjustment of the P.A. tuning. Lock nuts are provided to maintain these adjustments.

It is possible, by changing the power supply connections for a higher d-c output voltage (see fig. 7, page 16), to obtain a power output of 60 watts. Under these conditions the P.A. plate current will be 80 ma unloaded and 225 ma loaded.

The unit is shipped with the power supply connected for the lower output voltage.

(3) Adjustment of Transmitter Audio Gain.—The gain of the transmitter audio amplifier (fig. 4) is controlled by potentiometer R30 and its proper adjustment requires the use of a receiver tuned to the same frequency as that of the transmitter. If the Radio Receiver Type 12-UF Ed. 7 in the equipment cabinet is not on the same frequency, it is possible to use a mobile or other receiver which is tuned to receive signals from the transmitter being adjusted.

Plug a test meter into the first limiter metering jack on the receiver. Place the transmitter in operation and note the first limiter grid current reading on the receiver test meter. This should be done with the transmitter audio gain control in the off (fully counterclockwise) position. While talking into the handset in a normal manner, slowly advance the setting of the audio gain control until modulation peaks cause the receiver first limiter grid current to swing downward not more than ten percent of the unmodulated reading. This is the correct setting.

(4) Adjustment of Receiver Audio Gain.—When local operation is employed, the speaker volume control (R402) located on the side of the cabinet (fig. 1) should be rotated to the maximum volume position (fully clockwise). The VOLUME control (R138) on the receiver chassis should then be advanced clockwise until a speaker volume level is reached that is the maximum desired. The receiver gain control should then be left in that position and the speaker volume controlled entirely by the control on the side of the cabinet. The maximum attainable volume will then be limited by the setting of the receiver VOLUME control.

When the receiver output is fed into a telephone line to a remote control unit the speaker volume control may be turned off (counterclockwise). The receiver VOLUME control (R138) should then be advanced (clockwise) until the audio level, on modulation peaks, reads not more than +4 db on the telephone line. A volume indicator or db meter is used to read this level at the line terminals (Nos. 3 and 4) on Control and Termination chassis Type 1907-C with the telephone line connected.

(b) Operation.

(1) Normal Procedure (Local Control).—Radio Transmitter-Receiver Type 50-UFS Ed. 7 in the standby condition has the FILAMENT switch on the front of the cabinet on, and the PLATE switch off. To transmit, lift the handset from the hang-up hook, press the push-to-talk button on the handset and talk into the mouthpiece in a natural tone of voice. Immediately after talking, release the push-to-talk button. The incoming signal will be audible in the handset receiver. At the end of the communication, replace the handset on the hang-up hook.

(2) Emergency Communication with Control Points.—When Radio Transmitter-Receiver Type 50-UFS Ed. 7 is used with a remote control unit, it is possible to converse with the remote location for test or servicing, or during emergencies. The equipment is not designed specifically to perform this function, but in an emergency may be operated in the following manner.

After unlocking and opening the front door of the cabinet, plug a pair of headphones into the AUDIO jack (J105) on the receiver chassis. (See fig. 3.) Throw the INTERLOCK SHORT switch (S301) on Control and Termination Chassis Type 1907-C to the ON position. Pick up the handset, depress the push-to-talk button and talk. The speech will be transmitted on the air, but it will also be carried over the telephone line to the remote control unit where it will be heard in the loudspeaker.

Speech originating in the normal manner at the remote control unit will be carried over the telephone line to the transmitter where it will be heard in the headphones. This speech will not go on the air however, since control of the transmitter from the remote control unit is prevented when the handset at the transmitter is removed from the hang-up hook.

To return the equipment to normal operation, throw the INTERLOCK SHORT switch to the OFF position to restore the protective function of the cabinet door switches, unplug the headphones, close and lock the front cabinet door and replace the handset on the handset hang-up.

(3) Operating Technique.—Good operating technique is characterized by speaking distinctly in a normal voice and by keeping each transmission brief. If there are several instructions to be given, it is better to state them one at a time and have each acknowledged. Avoid long one-sided discussions. Before calling your units, be sure the air is clear. If you can hear one of your units, even though he may not be calling you, don't attempt to put in a call as you may garble the communication already in progress.

6. CIRCUIT DESCRIPTION.

(a) Radio Transmitter Type 50-UFS Ed. 7.

(1) General.—Radio Transmitter Type 50-UFS Ed. 7 is a frequency-modulated (FM) unit utilizing the phase-shift method of obtaining frequency deviations and as such exhibits considerably different characteristics than the usual amplitude-modulated units. Intelligence is conveyed in variations of the constant-amplitude carrier wave. The use of the phase-shift method of frequency modulation allows direct crystal control of the mean carrier frequency, a necessity in unattended equipment. It necessitates, however, considerable frequency multiplication after modulation to generate sufficient frequency deviation. A number of small, low-drain tubes are used for this function, and a total frequency multiplication of 32 times is effected.

In working with FM transmitters certain handicaps are encountered that make unusable many of the rules that have been helpful in servicing amplitude-modulated equipment. Oscilloscopes are of little value in checking since no change of pattern is discernible during modulation. In fact, modulation is accompanied by no readily measurable change of any kind in the r-f output of the transmitter. Methods were shown above, however, how modulation may be checked.

(2) Oscillator-Modulator.—The twin triode V1 (7F7) acts as both crystal oscillator and phase modulator. The first half of the tube operates in a resistance-coupled aperiodic oscillator circuit. The crystal, which is connected between grid and plate, operates on the 32nd sub-harmonic of the output frequency. Since the output frequency range is 30-50 megacycles, the crystal frequency will lie between 937.5 and 1562.5 kc.

The second half of the 7F7 acts as a phase modulator. The r-f output of the crystal oscillator is impressed on the phase-modulator grid by means of the blocking capacitor C4. The cathode circuit is provided with a large amount of degeneration by unbypassed resistor R3. Because of this degenerative feedback, the transconductance of the triode is abnormally low—so low that the plate current is affected about as much by the direct grid-plate capacitance as by the transconductance. The two effects result in plate current vectors almost 180 degrees apart, and the total plate current is the resultant of the two components. In phase it will be about 90 degrees removed from the phase of the voltage impressed on the grid.

When audio is impressed on the grid, thereby periodically changing the bias, and in consequence, the transconductance, the plate current, in both amplitude and phase undergoes a periodic change. The amplitude modulation is unimportant, and is removed in the frequency multipliers which follow, but the phase modulation remains and is the essential element of the transmitted signal.

The phase modulation is modified by the use of a frequency-correcting circuit consisting of resistor R5 and capacitor C5. These elements are connected between the phase modulator grid and audio amplifier V8. The frequency-correcting circuit is introduced because the frequency deviation brought about by phase modulation is linearly proportional to frequency, and pure phase modulation would become troublesome at high audio frequencies. The correcting circuit causes the deviation vs. frequency curve to begin to flatten out above 2000 cycles.

(3) Frequency Multipliers.—The frequency deviation which may be produced in a modulator such as described above is relatively small, usually not more than a value equal to the modulating frequency (otherwise severe distortion is encountered). To get sufficient deviation (±15 kc) the frequency of the modulated wave must be multiplied considerably. (In this case it is multiplied by a factor of 32.) The multiplication is accomplished by a quadrupler and three doublers, which act as class C radio frequency amplifiers with grid-leak bias. The grid drive in each case is well above saturation so that slight changes in tuning or reduction in tube emission can have little effect on succeeding stages. Up to this point, all stages use receiving type tubes working at relatively low plate and filament currents.

(4) Power Amplifier.—The power amplifier utilizes two 807 beam transmitting tubes (V6 and V7) in parallel as a class C amplifier. Grid leak bias is used and, as in the preceding stages, the grid current is metered for alignment and testing. The plate tank and antenna circuit is of the Pi type for harmonic suppression and ease of adjustment. This circuit consists of plate tuning capacitor C35, the tank coil L6, and the antenna loading capaci-

tors C36 and C37. The output is fed through blocking capacitor C38 to antenna relay K1.

(5) Audio Amplifier and Input Circuits.—Audio input to the transmitter is derived either from a single-button carbon microphone or from a remote-control line. Input transformer T1 provides a 50 ohm or a balanced 200/500 ohm termination respectively for these two applications. Actually the transformer is terminated on one half of the secondary in such a manner that the input impedance across the 0-200 terminals is approximately 500 ohms. Microphone current is derived from the cathode circuit of the third doubler V5 and is filtered by capacitor C41.

The output of transformer T1 is amplified in the 7A4 audio amplifier, tube V8, and fed to the phase modulator from the voltage divider R33, R34. R30 is an adjustable gain control.

(6) Control and Power Circuits.—Radio Transmitter-Receiver Type 50-UFS Ed. 7 has sufficient relay circuits for complete local or remote control and, in addition, is designed to provide all necessary relay and control functions for Radio Receiver Type 12-UF Ed. 7 except applying primary power which is done by the switch on the receiver volume control. The normal operating sequence is as follows:

(a) Switch S401 on the cabinet (see fig. 11) applies primary voltage to the filament transformer on the power supply which in turn lights all filaments. The green pilot lamp on the front of the cabinet is lighted at the same time. In order to transmit, the receiver must be turned on to supply voltage for actuating the transmitter control relay K301.

(b) A portion of the "B" voltage of the receiver is applied to the winding of relay K301 through the voltage divider R301-R302, R303, and handset push switch when the local handset is in use. When the local handset is not in use, voltage to actuate K301 (see figs. 8 and 11) is supplied by the two-wire/four-wire remote control unit.

(c) When relay K301 on the control panel is energized, the speech circuit is transferred from the receiver output to the transmitter input, relay K1 on the transmitter chassis is energized and at the same time primary power is applied to the transmitter plate supply.

(d) Relay K1 (transmitter chassis) shorts the receiver audio output, thus muting the receiver, and transfers the antenna from the receiver input to the transmitter output at the same time.

(e) The twelve terminal strip on Control and Termination Chassis Type 1907-C provides facilities for either two-or four-wire control connections. Figure 11 shows the connections to this strip for the control system desired. The instructions supplied with Remote Control Unit Type 1890 show the connections at the control unit for either type of operation.

(b) Radio Receiver Type 12-UF Ed. 7.

(1) General.—While Radio Receiver Type 12-UF Ed. 7 is designed to receive signals wherein the intelligence is conveyed in the variations of carrier frequency about a mean frequency instead of variations in the amplitude of the carrier about a mean level as in amplitude modulation, there are only three fundamental differences between amplitude and frequency modulation receivers.

The first difference is in the bandpass characteristics. Since the carrier frequency varies over a band of plus and minus 15 kc about the mean carrier frequency, the receiver has to accept a band at least 30 kc wide. Thus the intermediate-frequency transformers are designed to pass a relatively wide band compared to an AM receiver.

The second difference is that since only variations in frequency are to be converted into intelligence, amplitude variations of the signal must be removed. This function is accomplished by the limiters. They are, in effect, saturated amplifiers so that increasing the input to them above a certain level will cause no increase in their output. Thus they "limit" the magnitude of the signal applied to the discriminator to a constant level. The excellent signal-to-noise ratio of the 12-UF Ed. 7 receiver is largely due to the use of two cascaded limiters. On signals too weak to effectively saturate the first limiter, the second limiter is already saturated and removing whatever amplitude noise variations the first limiter has permitted to pass.

The third difference is in the method of detection; that is, the conversion of frequency variations into audio frequencies. This function is accomplished in the discriminator stage by transformer T107 and the 7A6 detector.

(2) R-f Amplifier.—The antenna input circuit of Radio Receiver Type 12-UF Ed. 7 is designed to match a 50-70 ohm concentric line. A 6AG5 (V101) serves as a high gain r-f amplifier with both grid and plate circuits tuned for maximum efficiency. The secondary of T101 tunes the grid of the mixer half of the 12AT7 (V102) to the signal frequency.

(3) Mixer and Crystal Oscillator.—The output of the r-f amplifier is converted to the first i-f frequency of 5 megacycles in tube V102 (12AT7) by beating against the output of the oscillator section of the tube.

The frequency of the crystal oscillator (and crystal) lies between 35 and 45 mc. The crystal frequency is as follows: 30-40 mc, $Fc = Fs + 5$ mc; 40-50 mc, $Fc = Fs - 5$ mc. The crystal oscillates on its third mechanical harmonic (overtone) and is ground especially for use in this circuit. Capacitor C109 tunes the crystal oscillator circuit. The output of the mixer is fed to tube V103 (7C7) through transformer T102.

(4) I-f Amplifier and Converter.—One stage of amplification on 5000 kc is provided using a 7C7 (V103) as the amplifier. Its output is applied in turn to the 7A8 converter (V104) where the frequency is changed to the final intermediate frequency of 456 kc. This is accomplished by using the oscillator portion of V104 in an aperiodic circuit with a 5456-kc crystal connected between the oscillator grid and cathode. The crystal is of the same high quality as the signal frequency crystal.

The beat between the 5000-kc output of the first i-f stage and the 5456-kc crystal results in the final intermediate frequency of 456 kc which is amplified, passed through the i-f transformer T104 and applied to the grid of the 7C7 i-f amplifier (V105).

(5) Low Frequency I-f Amplifier and Limiters.—The signal is amplified in the 7C7 i-f amplifier stage (V105)

PARTS LIST—RADIO TRANSMITTER TYPE 50-UFS Ed. 7

Cir. Sym.	Description	Part No.
	CAPACITORS	
C1	Fixed, Mica, 2000 μμf, ±20%	CM20-B-202-M
3	Fixed, Ceramic, 50 μμf, ±10%	CMCK-TC-500-K
4	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
5	Fixed, Mica, 1500 μμf, ±10%	CM30-B-152-K
6	Fixed, Mica, 510 μμf, ±20%	CM20-B-511-M
7	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
8	Variable, Air, Dual, 3-54 μμf	CVA-SD2978
8A	Part of C8	
8B	Part of C8	
9	Fixed, Mica, 3900 μμf, ±20%	CM30-B-392-M
10	Fixed, Mica, 100 μμf, ±10%	CM20-B-101-K
11	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
12	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
13	Variable, Air, Dual, 3-54 μμf	CVA-SD2978
13A	Part of C13	
13B	Part of C13	
14	Fixed, Mica, 3900 μμf, ±20%	CM30-B-392-M
15	Fixed, Mica, 100 μμf, ±10%	CM20-B-101-K
16	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
17	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
18	Variable, Air, 3-54 μμf	CVA-SD2833
19	Fixed, Mica, 3900 μμf, ±20%	CM30-B-392-M
20	Fixed, Mica, 100 μμf, ±20%	CM20-B-101-K
21	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
22	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
23	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
24	Fixed, Paper, Oil, .5 μf, 600 Volts	CPO-504-600
25	Variable, Air, 3-76 μμf	CVA-SD3056
26	Fixed, Mica, 5100 μμf, ±20%	CM35-B-512-M
27	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
28	Fixed, Mica, 5100 μμf, ±20%	CM35-B-512-M
29	Fixed, Mica, 10,000 μμf, ±20%	CMB10-B-103-M
30	Fixed, Mica, 2000 μμf, ±20%	CMB10-B-202-M
31	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
32	Fixed, Mica, 10,000 μμf, ±20%	CMB10-B-103-M
33	Fixed, Mica, 2000 μμf, ±20%	CMB10-B-202-M
34	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
35	Variable, Air, 25 μμf	CVA-CS-9524-25
36	Variable, Air, 140 μμf	CVA-CS-9524-140
37	Fixed, Mica, 100 μμf, ±20%	CMB10-B-101-M
38	Fixed, Mica, 2000 μμf, ±20%	CMB10-B-202-M
39	Fixed, Mica, 2000 μμf, ±20%	CM30-B-202-M
41	Fixed, Electrolytic, 25 μf, 50 Volts	CE-256-50A
42	Fixed, Electrolytic, 25 μf, 50 Volts	CE-256-50A
43	Fixed, Mica, 5100 μμf, ±20%	CM35-B-512-M
44	Fixed, Ceramic, 15 μμf, ±10%	CMCK-TC-150-K
	RESISTORS	
R1	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
2	Fixed, Carbon, 470,000 ω, ±10%, ½ Watt	RC20-474-K
3	Fixed, Carbon, 22,000 ω, ±10%, ½ Watt	RC20-223-K
4	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
5	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
6	Fixed, Carbon, 10,000 ω, ±10%, 1 Watt	RC30-103-K
7	Fixed, Carbon, 220,000 ω, ±10%, ½ Watt	RC20-224-K
8	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K
9	Fixed, Carbon, 1000 ω, ±10%, 1 Watt	RC30-102-K
10	Fixed, Carbon, 1000 ω, ±10%, ½ Watt	RC20-102-K
R11	Fixed, Carbon, 220,000 ω, ±10%, ½ Watt	RC20-224-K
12	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
13	Fixed, Carbon, 1000 ω, ±10%, 1 Watt	RC30-102-K
14	Fixed, Carbon, 1000 ω, ±10%, ½ Watt	RC20-102-K
15	Fixed, Carbon, 220,000 ω, ±10%, ½ Watt	RC20-224-K
16	Fixed, Carbon, 10,000 ω, ±10%, 1 Watt	RC30-103-K
17	Fixed, Carbon, 1000 ω, ±10%, 1 Watt	RC30-102-K
18	Fixed, Carbon, 1000 ω, ±10%, ½ Watt	RC20-102-K
19	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
20	Fixed, Carbon, 1000 ω, ±10%, 1 Watt	RC30-102-K
21	Fixed, Carbon, 10,000 ω, ±10%, 1 Watt	RC30-103-K
22	Fixed, Carbon, 1000 ω, ±10%, ½ Watt	RC20-102-K
23	Fixed, Carbon, 10,000 ω, ±10%, 1 Watt	RC30-103-K
24	Fixed, Wire Wound, 2500 ω, ±5%, 25 Watt	RW25-252-J
25	Fixed, Wire Wound, 15,000 ω, ±5%, 10 Watt	RW10-153-J
26	Fixed, Carbon, 100 ω, ±10%, 1 Watt	Part of 1710-130 Assembly
27	Fixed, Carbon, 100 ω, ±10%, 1 Watt	Part of 1710-130 Assembly
28	Fixed, Carbon, 100 ω, ±10%, 1 Watt	Part of 1710-358 Assembly
29	Fixed, Carbon, 100 ω, ±10%, 1 Watt	Part of 1710-358 Assembly
30	Variable, Carbon, 500,000 ω	PC-504SS6Z
31	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K
32	Fixed, Carbon, 2200 ω, ±10%, 1 Watt	RC30-222-K
33	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K
34	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K
35	Fixed, Composition, 5.55 ω, ±2%, ½ Watt	RCPR5-5R55-G
*36	Fixed, Carbon, 25 ω, ±10%, 1 Watt	RC30-250-K
	TUBES	
V1	Osc.-Mod.	7F7
2	1st Doub.	7W7
3	2nd Doub.	7C5
4	Quad.	7C7
5	3rd Doub.	7C5
6	P.A.	807
7	P.A.	807
8	Audio Amp.	7A4
	INDUCTORS AND CHOKES	
L1	2.5 mh choke	12381
2	Parasitic suppressor choke (includes R26)	1710-130

* Used where internal resistance of M1 is 25 ω.

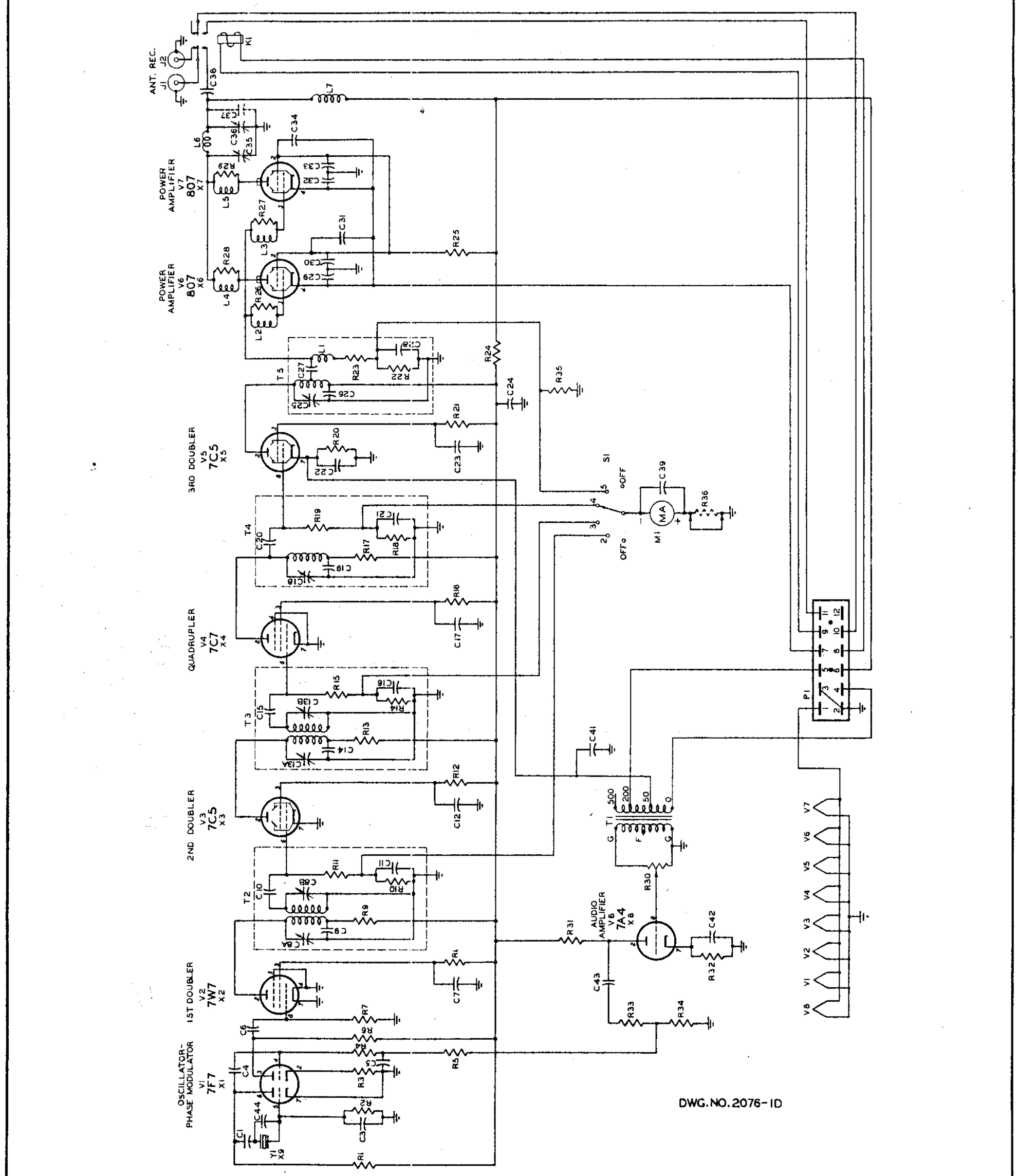


Figure 5. Radio Transmitter Type 50-UFS Ed. 7, Schematic Diagram

PARTS LIST—RADIO TRANSMITTER TYPE 50-UFS Ed. 7 (Cont'd)

Cir. Sym.	Description	Part No.
	INDUCTORS AND CHOKES (Cont'd)	
L3	Parasitic suppressor choke (includes R27)	1710-130
4	Parasitic suppressor choke (includes R28). Assembly consists of plate caps and suppressors	1710-358 Assembly
5	Parasitic suppressor choke (includes R29)	Part of 1710-358 Assembly
6	P.A. tank inductance	
	30-35 mc	1710-97
	35-40 mc	1710-109
	40-44 mc	1710-A3
	44-50 mc	1710-74
7	2.5 mh choke	12381
	RELAYS	
K1	Antenna Relay	1000-LR110
	CONNECTORS	
J1	Antenna, Single Contact, female	SO-239
2	Receiver, Single Contact, female	S-101
P1	12 Contact, male	P-412-AB-1/16"
	TRANSFORMERS	
T2	First doubler plate tuning	1710-519W
3	Second doubler plate tuning	1710-520W
T4	Quadrupler plate tuning	1710-521W
5	Third doubler plate tuning	1710-569W
6	Audio	TR-1061/C-1981
	SOCKETS	
X1	8 Contact, Loctal	52A12355
2	8 Contact, Loctal	52A12355
3	8 Contact, Loctal	52A12355
4	8 Contact, Loctal	52A12355
5	8 Contact, Loctal	52A12355
6	5 Contact	RSS5
7	5 Contact	RSS5
8	8 Contact, Loctal	52A12355
9	4 Contact, Crystal	9827-F
	CRYSTAL	
Y1	1/32 channel frequency	FM-8
	METER	
M1	0-1 ma, 2½" round case	MR24W001DCMA
	SWITCH	
S1	6 Position Meter Switch	SWRE-2P6TNS

PARTS LIST—RADIO RECEIVER TYPE 12-UF Ed. 7

Cir. Sym.	Description	Part No.
	CAPACITORS	
C101	Variable, Air, 3-54 μμf	CVA-SD2833
102	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
103	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
104	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
105	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
105A	Part of C105	
105B	Part of C105	
106	Fixed, Ceramic, 1500 μμf, ±20%	CMCL-152-M
107	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
108	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
109	Variable, Ceramic, 7-45 μμf	CVC-TS2A-7-45
110	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
110A	Part of C110	
110B	Part of C110	
111	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
112	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
113	Fixed, Ceramic, 1500 μμf	CMC-DA-152
114	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
114A	Part of C114	
114B	Part of C114	
115	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
116	Fixed, Ceramic, 1500 μμf	CMC-DA-152
117	Fixed, Ceramic, 5 μμf, ±10%	CMCK-050-K
118	Fixed, Paper, Block, 3 x 0.1 μf, 600 Volts	CPB-3XR1-600
118A	Part of C118, 0.1 μf, 600 Volts	
118B	Part of C118, 0.1 μf, 600 Volts	
118C	Part of C118, 0.1 μf, 600 Volts	
119	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
120	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
120A	Part of C120	
120B	Part of C120	
121	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
C122	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
123	Fixed, Paper, Block, 3 x 0.1 μf, 600 Volts	CPB-3XR1-600
123A	Part of C123, 0.1 μf, 600 Volts	
123B	Part of C123, 0.1 μf, 600 Volts	
123C	Part of C123, 0.1 μf, 600 Volts	
124	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
125	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
125A	Part of C125	
125B	Part of C125	
126	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
127	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
128	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
129	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
129A	Part of C129	
129B	Part of C129	
130	Fixed, Silver Mica, 55 μμf, ±3%	CMS20-D-550-H
131	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
132	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
133	Fixed, Ceramic, 50 μμf, ±10%	CMCK-500-K
134	Fixed, Silver Mica, 107 μμf, ±3%	CMS20-D-1070-H
135	Variable, Air, Dual, 3-34 μμf	CVA-SD2838
135A	Part of C135	
135B	Part of C135	
136	Fixed, Silver Mica, 500 μμf, ±3%	CMS20-D-501-H
137	Fixed, Silver Mica, 83 μμf, ±3%	CMS20-D-830-H
138	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
139	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
140	Fixed, Ceramic, 1000 μμf, ±20%	CMCL-102-M
141	Fixed, Ceramic, 100 μμf, ±10%	CMCK-101-K
142	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
143	Fixed, Ceramic, 5000 μμf	CMC-DA-502
144	Fixed, Paper, Block, 2 x 0.1 μf, 600 Volts	CPB-6BA11

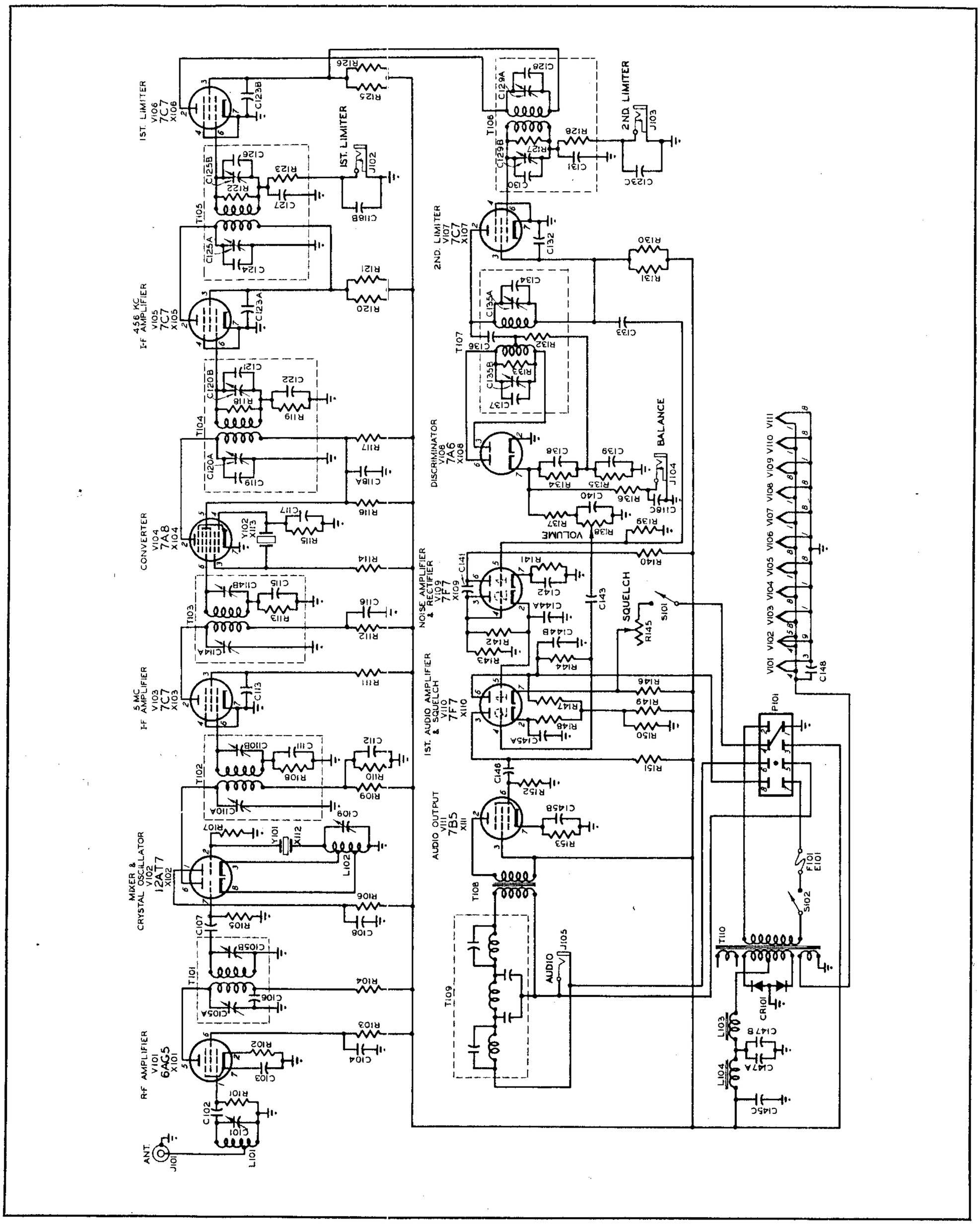


Figure 6. Radio Receiver Type 12-UF Ed. 7, Schematic Diagram

PARTS LIST—RADIO RECEIVER TYPE 12-UF Ed. 7 (continued)

Cir. Sym.	Description	Part No.
	CAPACITORS—Cont.	
C144A	Part of C144, 0.1 μf, 600 Volts	
144B	Part of C144, 0.1 μf, 600 Volts	
145	Fixed, Electrolytic, Block, 2 x 20 μf, 450 Volts, +20 μf, 25 Volts	CEB-FP339
145A	Part of C145, 20 μf, 450 Volts	
145B	Part of C145, 20 μf, 25 Volts	
145C	Part of C145, 20 μf, 450 Volts	
146	Fixed, Ceramic, 5000 μμf	CMC-DA-502
147	Fixed, Electrolytic, Block, 2 x 10 μf, 450 Volts	CEB-8450B
147A	Part of C147, 10 μf, 450 Volts	
147B	Part of C147, 10 μf, 450 Volts	
148	Fixed, Ceramic, 10,000 μμf	CMC-DA-103
	RECTIFIER	
CR101	Selenium	402D3728A
	RELAYS	
*K101	S.P.S.T., 6500 ohm coil	APC
	ELECTRICAL PARTS	
E101	Fuse Holder	HKM/HKP
102	Resistor Mounting Strip, 9 point (blank)	RS-26
103	Resistor Mounting Strip, 14 point (blank)	RS-68
	FUSE	
F101	1 ampere	3AG-1
	CONNECTORS AND JACKS	
J101	Antenna, Single Contact, Female	S-101
102	Jack, 1st Limiter Tuning	IJ-102
103	Jack, 2nd Limiter Tuning	IJ-102
104	Jack, Balance	IJ-102
105	Jack, Audio	IJ-102
*106	8 contacts, Female	51A12272
P101	8 contacts, Male	P-408-AB-1/16"
	INDUCTANCES AND CHOKES	
L101	Coil, Antenna	1710-A15
102	Coil, Osc. Cathode	1710-A14
103	Filter Choke	TR-957
104	Filter Choke	TR-957
	RESISTORS	
R101	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
102	Fixed, Carbon, 100 ω, ±10%, ½ Watt	RC20-101-K
103	Fixed, Carbon, 150,000 ω, ±10%, 1 Watt	RC30-154-K
104	Fixed, Carbon, 22,000 ω, ±10%, 1 Watt	RC30-223-K
105	Fixed, Carbon, 4.7 megohms, ±10%, ½ Watt	RC20-475-K
106	Fixed, Carbon, 68,000 ω, ±10%, 1 Watt	RC30-683-K
107	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
108	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
109	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K
110	Fixed, Carbon, 22,000 ω, ±10%, ½ Watt	RC20-223-K
R111	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
112	Fixed, Carbon, 10,000 ω, ±10%, 1 Watt	RC30-103-K
113	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
114	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
115	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
116	Fixed, Carbon, 68,000 ω, ±10%, 1 Watt	RC30-683-K
117	Fixed, Carbon, 68,000 ω, ±10%, 1 Watt	RC30-683-K
118	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
119	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
120	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
121	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
122	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
123	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
125	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
126	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
127	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
128	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
130	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
131	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
132	Fixed, Carbon, 22,000 ω, ±10%, ½ Watt	RC20-223-K
133	Fixed, Carbon, 47,000 ω, ±10%, ½ Watt	RC20-473-K
134	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
135	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
136	Fixed, Carbon, 1 megohm, ±10%, ½ Watt	RC20-105-K
137	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
138	Variable, Carbon, 250,000 ω, with switch	PC-254DS6Z
139	Fixed, Carbon, 100,000 ω, ±10%, ½ Watt	RC20-104-K
140	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
141	Fixed, Carbon, 3,300 ω, ±10%, ½ Watt	RC20-332-K
142	Fixed, Carbon, 4.7 megohms, ±10%, ½ Watt	RC20-475-K
143	Fixed, Carbon, 470,000 ω, ±10%, ½ Watt	RC20-474-K
144	Fixed, Carbon, 1 megohm, ±10%, ½ Watt	RC20-105-K
145	Variable, Carbon, 6,000 ω	PC-602SS6S
146	Fixed, Carbon, 100,000 ω, ±10%, 1 Watt	RC30-104-K

*This part used only when wired for "B" control.

PARTS LIST—RADIO RECEIVER TYPE 12-UF Ed. 7 (continued)

Cir. Sym.	Description	Part No.
	RESISTORS—Cont.	
R147	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
148	Fixed, Carbon, 3,300 ω, ±10%, 1 Watt	RC30-332-K
149	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
150	Fixed, Carbon, 22,000 ω, ±10%, 1 Watt	RC30-223-K
151	Fixed, Carbon, 220,000 ω, ±10%, 1 Watt	RC30-224-K
152	Fixed, Carbon, 470,000 ω, ±10%, ½ Watt	RC20-474-K
153	Fixed, Carbon, 1,000 ω, ±10%, 1 Watt	RC30-102-K
	SWITCHES	
S101	S.P.S.T., Toggle, Bat Handle	SWT-1P1T-3A
102	S.P.S.T., Part of R138	
	TRANSFORMERS	
T101	R-F Amplifier Plate Tuning	1710-825
102	HF I-F, 5 mc	1710-829
103	HF I-F, 5 mc	1710-829
104	LF I-F, 456 kc	1710-827
105	First Limiter, 456 kc	1710-827
106	Second Limiter, 456 kc	1710-827
107	Discriminator, 456 kc	1710-510
108	Audio Output	TR-1071/6226
109	Audio Filter	TR-1075/7133-A
110	Power	TR-1072/6248

Cir. Sym.	Description	Part No.
	TUBES	
V101	R-F Amplifier	6AG5
102	Mixer and Crystal Oscillator	12AT7
103	HF I-F Amplifier	7C7
104	Converter	7A8
105	LF I-F Amplifier	7C7
106	First Limiter	7C7
107	Second Limiter	7C7
108	Discriminator	7A6
109	Noise Amplifier and Rectifier	7F7
110	First Audio Amplifier and Squelch	7F7
111	Audio Output	7B5
	SOCKETS	
X101	Miniature, 7 Contacts	53B12363
102	Miniature, 9 Contacts	53F12625
103 to 111	Loctal, 8 Contacts	52A12355
112	Crystal, 2 Contacts	9827-J
113	Crystal, 2 Contacts	9827-A
	CRYSTALS	
Y101	Channel Frequency	
	30-40 mc=Fs+5 mc	FM-11
	40-50 mc=Fs−5 mc	FM-11
102	IF, 5456 kc	MC-9
	MISCELLANEOUS PARTS	
(1)	Tube Shield, Miniature	8661
(1)	Tube Shield, Miniature	16G12627
(2)	Standoff, Ceramic, ⅜" x ⅝"	1710-1275C

and passed through transformer T105 to the grid of the first limiter.

The two following stages utilize 7C7 tubes as current limiting amplifiers and the circuits and actions of the two stages are identical. The tubes are operated at low plate and screen voltage and without bias except that derived from the grid leak and capacitor combinations R123, C127 and R128, C131. These stages act as class C amplifiers, giving no increase in output current or voltage once the impressed grid voltage has exceeded a threshold value of about 2 volts RMS. Voltages above this value cause increasing rectification in the grid circuit, automatically setting up a bias to limit the peak plate current. Due to the low plate and screen voltages, saturation occurs at a low level of grid voltage. The time constant of the grid leak and capacitor is chosen to be long compared to the 456-kc intermediate frequency, but short enough to follow rapidly fluctuating high frequency noise peaks.

By cascading two such stages, the limiting effect of one tube is multiplied by the limiting effect of the other and essentially perfect limiting is obtained. Furthermore, by properly proportioning the circuit constants of the first limiter, the input to the second limiter grid is maintained at the optimum voltage for most effective action.

The grid return circuits of all the r-f and i-f tubes contain high resistances. By this means, blocking of any of the stages on strong signals is eliminated due to the bias developed across these resistors as soon as the associated grid draws current. A further advantage of this method is that as the incoming signal's strength is increased, the tubes ahead of the first limiter will also act as limiters as soon as their grids draw current.

Sufficient gain is incorporated in the receiver so that the smallest incoming signal which could be considered comparable with the noise generated in the grid circuit of the first tube causes saturation of the second limiter. The first limiter is in turn saturated by signals of 0.1 μv or over.

(6) Discriminator.—The output of the second limiter, free of amplitude variations, is fed through discriminator transformer T107 to the 7A6 balanced detector (V108). The primary and secondary of the discriminator transformer are coupled both inductively and capacitively. Two voltages of different phase are thus applied to each half of the 7A6. The discriminator is so adjusted that when a steady carrier (456 kc) is received the voltage applied to the two halves of the 7A6 cause equal and opposite currents to flow through the load resistors R134 and R135. Thus the resultant voltage appearing across the two resistors is zero.

If any frequency other than 456 kc appears at the discriminator the out-of-phase components of the 7A6 will be unbalanced and a positive or negative resultant voltage will appear across R134 and R135. The sign and magnitude of this voltage will follow the frequency of the impressed i-f voltage rather than amplitude changes in it. In this manner an audio voltage (varying in amplitude) is derived from the frequency variations of the incoming signals. Since the resultant d-c output voltage of the discriminator and detector should be zero when a carrier of the correct frequency is impressed, the secondary of T107 is tuned for zero output with the correct carrier frequency applied. A jack (J104) is connected through filter resistor R136 to the output of the 7A6 so that a sensitive microammeter (0-100 μa center-zero type preferred) may be plugged in and the necessary adjustments made for zero reading.

(7) Squelch Circuits and Audio Amplifier.—The audio frequency output of the discriminator is passed

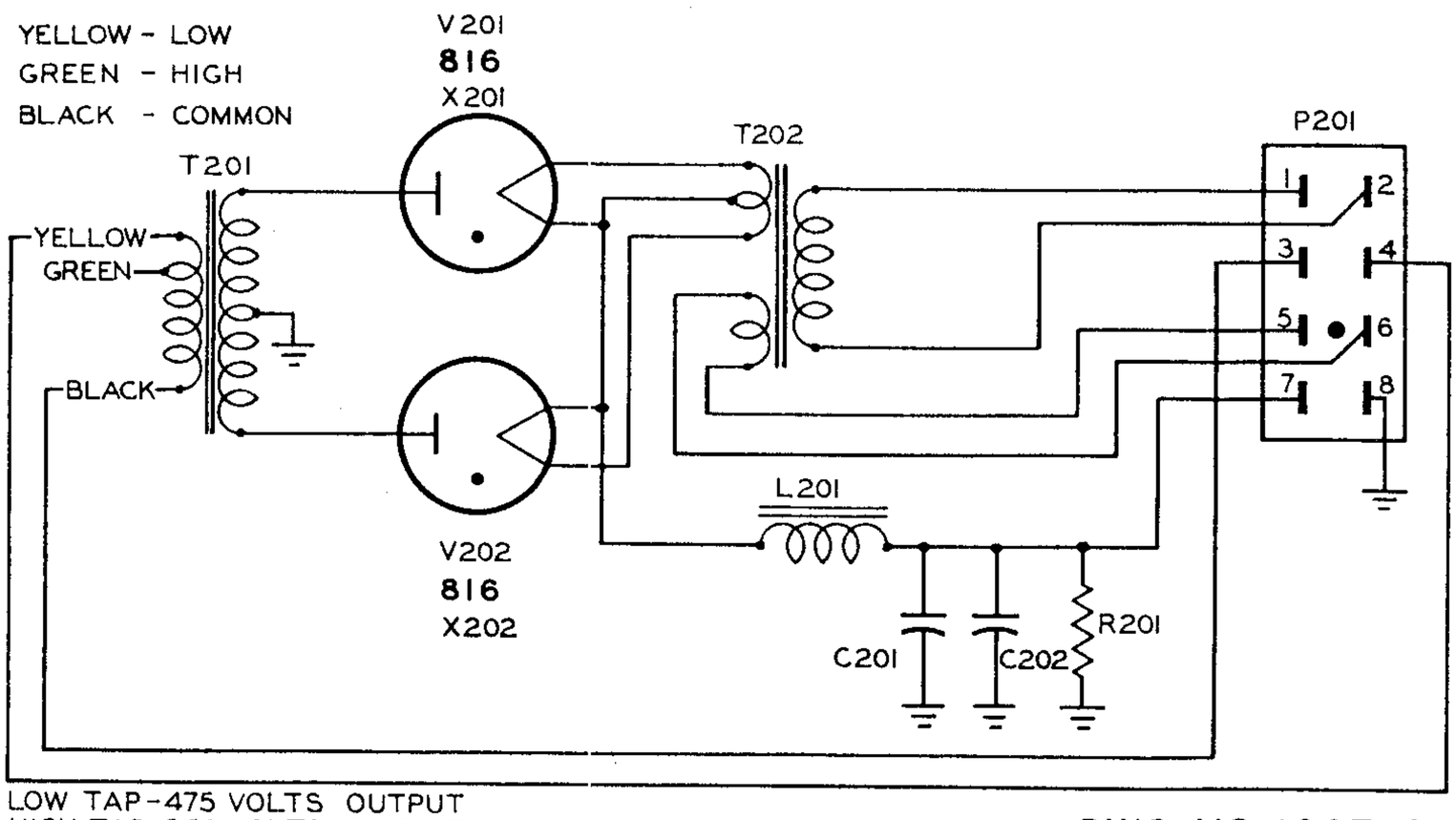


Figure 7. Power Supply Type 1907-P, Schematic Diagram

PARTS LIST—POWER SUPPLY TYPE 1907-P

	CAPACITORS			TRANSFORMERS	
C201	Fixed, Paper, Oil, 4 μf, 600 Volts	CPO-405-600-1	T201	Plate	TR-1054/C-4891
202	Fixed, Paper, Oil, 4 μf, 600 Volts	CPO-405-600-1	202	Filament	TR-1063/7211
	RESISTORS			TUBES	
R201	Fixed, Wire Wound, 40,000 ω, ±5%, 25 Watts	RW25-403-J	V201	Vacuum	816
			202	Vacuum	816
	CONNECTORS			SOCKETS	
P201	8 Contact, Male	P-408-AB-1/16"	X201	4 Contact	MIP4-T
	CHOKES		202	4 Contact	MIP4-T
L201	Filter	TR-1056/0122U			

through a voltage-dropping de-emphasis network consisting of R137 and C140, where the output of the discriminator is reduced to prevent overloading of the audio amplifier $V110_2$ and the standard 6 db per octave de-emphasis introduced. The audio frequency is then applied, through VOLUME control R138, to the second grid (G2) of the 7F7. The first triode section of the 7F7 (V110) is used to disable (squelch) the second triode section when no carrier is received. The actuating voltage for the squelch circuit is obtained from the AM audio noise component present in the second limiter when no signal is being received.

In the absence of a received carrier, noise is impressed on the second limiter grid. This noise, whether generated in the early stages of the receiver or picked up by the antenna, is rectified by the second limiter grid-cathode circuit acting as an AM detector. The resultant AM audio noise is amplified in the second limiter which also acts as an audio amplifier with R130 and R131 acting as the plate load resistors. No FM components appear because there are no frequency selective detecting circuits in the receiver up to this point.

The audio noise voltage present across R130 and R131 in the absence of a carrier is amplified and rectified in V109 to provide a positive voltage which is applied to grid G1 of the squelch section (section 1) of the 7F7 ($V110_1$).

Under this condition the squelch grid (G1) is positive with respect to its cathode, causing plate current to flow through resistor R147 bringing the squelch plate (P1) voltage nearly to the cathode voltage, or about +10 volts. Since the audio grid resistor R144 (grid G2) is returned to plate P1, the grid is at the same potential, while the audio cathode (K2) is held at a relatively high positive potential by the voltage divider R149-R150. Therefore, plate current in the audio section is "cut-off" because of the high grid bias and no signal can be heard.

When a carrier which is greater than whatever noise is present at the second limiter grid is received, the AM noise fluctuations are swamped out by limiter action, and the audio noise voltage across the plate load resistors R130 and R131 rapidly decreases. AM modulation on the carrier wave will not appear because of the limiter action. FM modulation (within the pass band of the receiver) will not appear because of the lack of frequency selective circuits up to this point in the receiver.

The drop in audio output appearing across R130 and R131 causes a reduction in the positive voltage produced

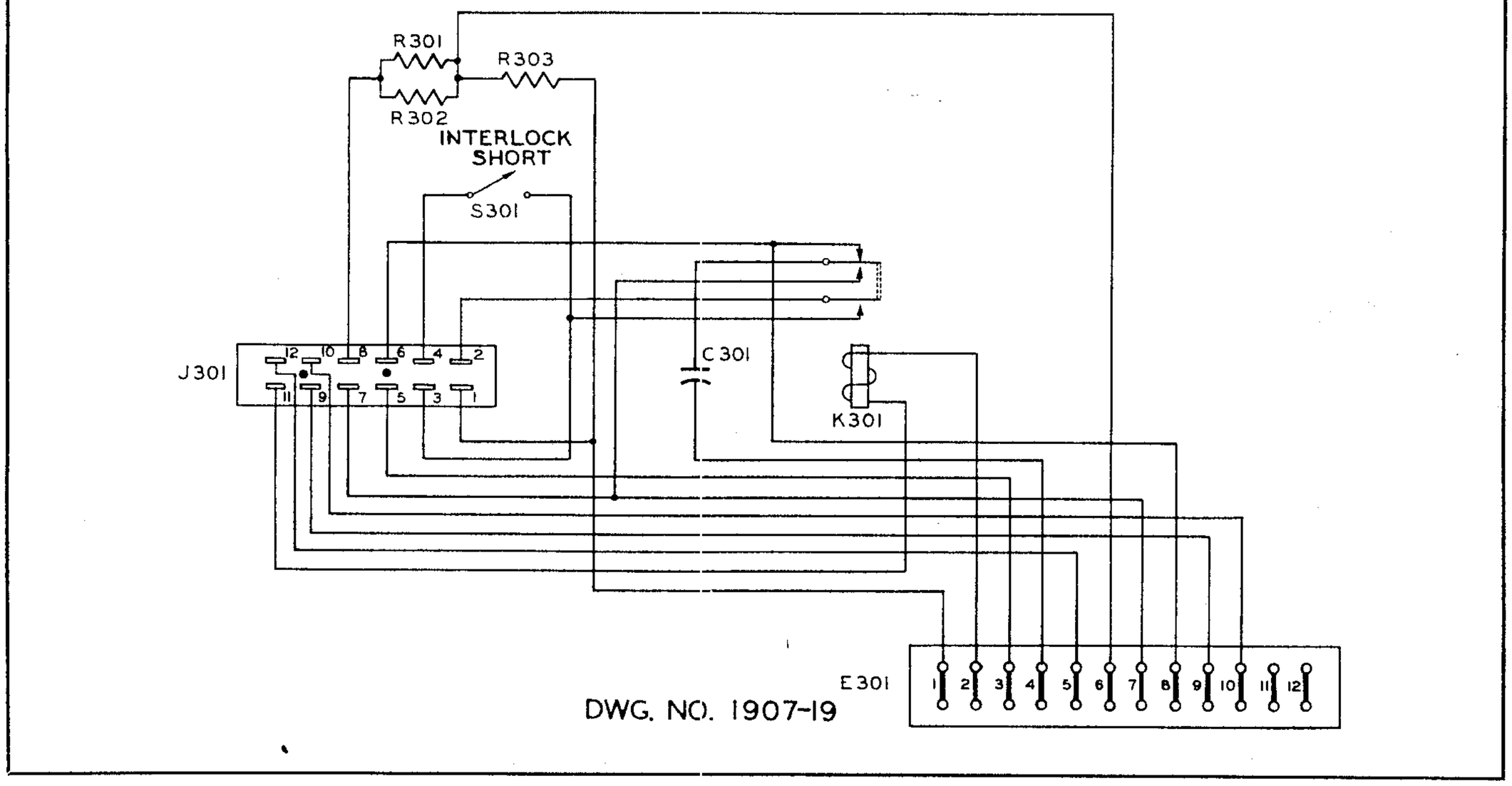


Figure 8. Control and Termination Chassis, Type 1907-C, Schematic Diagram

PARTS LIST—CONTROL AND TERMINATION CHASSIS—TYPE 1907-C

	CAPACITORS	
C301	Fixed, Paper, Oil, 1 μf, 600 Volts	CPO-105-600
	RESISTORS	
R301	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
302	Fixed, Carbon, 47,000 ω, ±10%, 1 Watt	RC30-473-K
303	Fixed, Carbon, 15,000 ω, ±10%, 1 Watt	RC30-153-K
	MISCELLANEOUS	
E301	Terminal Strip, 12 Terminals	12-142
	RECEPTACLES	
J301	12 Contact, Female	S-412-AB-1/16"
	RELAYS	
K301	Control	APQ-T
	SWITCHES	
S301	S.P.S.T., Toggle, Bat Handle	SWT-1P1T-3A

by V109, which in turn causes the grid (G1) of V110 to go negative with respect to its cathode, thus cutting off plate current flow in $V110_1$. Plate P1 and grid G2 now assume the potential existing at the junction of R147, R148, R149, and R150. Thus the audio section functions as a normal self-biased amplifier with cathode resistor R148.

The operating point of the squelch section, and therefore the squelch sensitivity, is controlled by squelch control R145 located on the receiver chassis. Varying R145 in the voltage divider R146 and R145 causes the cathode potential of $V110_1$ to be varied. The potential at which the cathode is set determines the voltages that must be rectified in V109 to operate the squelch circuit.

Capacitor C144A provides an appropriate time constant for the squelch circuit, and a ground return is provided by resistors R142 and R143.

The 7F7 audio amplifier is followed by a 7B5 output pentode (V111) whose output is passed through output transformer T108 and audio filter T109 to pins 5 and 6 on plug P101. T109 is an "M derived" filter with a 3500 cycle cut-off, so as to attenuate the higher audio frequencies. A monitoring jack (J105) is bridged across the 500-ohm line at this point.

7. MAINTENANCE AND SERVICE.

(a) Radio Transmitter Type 50-UFS Ed. 7.

(1) Maintenance.—Radio Transmitter Type 50-UFS Ed. 7 is accurately adjusted at the factory for the specified operating frequency but the brief tuning procedure given in Section 5 should be followed on installation. For routine maintenance checks however, a more thorough check-up of transmitter performance is desirable to locate weak tubes which need replacement.

As has been previously explained, a large factor of safety exists in the output of each stage of the transmitter so that no drop in power output will result from one or more tubes depreciating to a considerable extent. A routine check will, moreover, indicate these weak tubes before any loss in performance is noticed.

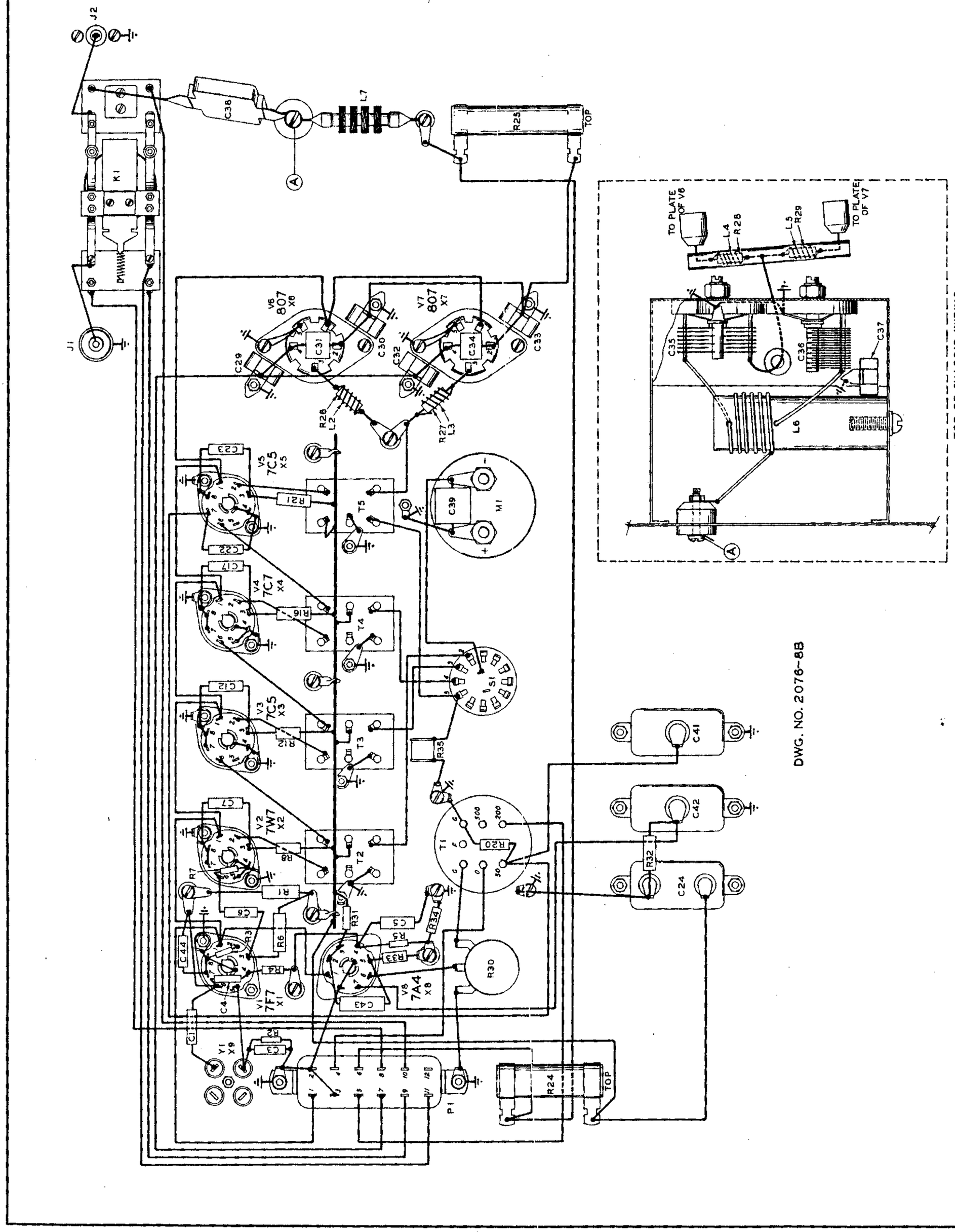


Figure 9. Radio Transmitter Type 50-UFS Ed. 7, Wiring Diagram

A meter and meter switch are located on the front of the transmitter chassis. They afford a complete check-up on the condition of the unit. The numbering of the meter switch and r-f transformers is so coordinated that the meter switch is placed in position 2 to tune transformer T2, etc. The meter reads the grid currents of the second doubler, quadrupler, third doubler, and P. A. respectively. The meter scale is 0-1 ma, and in posit on 5 of the metering switch it is shunted by a multiplier to read 10 ma. The P-A plate current is read on the meter on the front of the cabinet. It is used to adjust the P-A plate and antenna loading circuits as described in Section 5.

All tuning adjustments except for the output circuit are made for maximum grid current in each successive stage, and the following table indicates typical readings. The values given are average at a line voltage of 115 volts. Higher or lower voltages will of course, slightly alter readings.

Switch Position	Trans-former	Circuit	Current
2	T2	7C5 2nd doubler grid	0.3 ma
3	T3	7C7 Quadrupler grid	0.5 ma
4	T4	7C5 3rd doubler grid	0.7 ma
5	T5	807 P.A. grids	*4-4.5 ma

* With a meter having a 0-1 ma scale this value is 0.4 to 0.45.

A substantial decrease below any of these values will indicate a weak tube, probably in the stage whose plate circuit is being tuned, and that tube should be replaced.

(2) Service and Test.

(a) General.—Maintenance of Radio Transmitter Type 50-UFS Ed. 7 will consist primarily of routine tube replacement when necessary. All components are operated under conditions which insure long life, and failures have proven rare in field service. Since every stage is metered, nearly all possible conditions will be reflected in the meter readings and servicing is reduced to simple deduction. Section 7 (a) (1) has covered the routine tuning of the transmitter. By comparison with the table of currents given therein, or by comparison with values known from experience to be normal, trouble may be quickly isolated in a particular tube or stage.

The condition of the tubes in all the low-power stages may readily be observed by the appropriate grid current readings. In the 807 P-A stage, however, another simple method may be used to detect tube deterioration long before replacement is necessary. It should be stated here that in general tube tester readings should not be relied upon to give the full story on whether or not a tube is suitable for service. Tube testers will commonly show a poor tube to be good and vice versa simply because they do not test the tube under its operating conditions in the set. The equipment under discussion has been designed to have an ample factor of safety, and tubes need not necessarily be replaced at the first sign of weakening. Many more hundreds of hours of service may still be left in the tubes without causing any drop in the performance of the set. Furthermore, it has now been well established that there is no sound reasoning behind replacing a tube merely because it has served a certain number of hours. In the case of the P-A stage, tube deterioration may usually be detected long before loss of output is

VOLTAGE CHART—RADIO TRANSMITTER TYPE 50-UFS Ed. 7

PIN NO.	V1 7F7 Osc.-Mod.	V2 7W7 1st Doub.	V3 7C5 2nd Doub.	V4 7C7 Quad.	V5 7C5 3rd Doub.	V6 807 P.A.	V7 807 P.A.	V8 7A4 Audio Amp.
1	±6.3	±6.3	±6.3	±6.3	±6.3	±6.3	±6.3	±6.3
2	22	*	*	*	*	285**	285**	*
3	*	110	125	280	275	X	X	*
4	X	0	0	0	0	X	X	X
5	X	0		0		0	0	X
6	*	X	X	X	X			X
7	0	0	0	0	***			3,8
8	0	0	0	0	0			0

*—Plate supply voltage is 290 volts; not read at tube pin.
**—With P.A. loaded to 200 ma.
***—With handset on switch hook 32 volts; off hook 2.5 volts.
X—No readings on these pins. Tcken between pin and ground.
Plate voltage of 807's should be approximately 450 volts.
Meter resistance: 25,000 ohms per volt.
115 volts a-c input to power supply, and plate transformer on low voltage tap.
If the transmitter is operated with the power transformer on high voltage tap, the P.A. plate voltage is 550 volts and screen 320 volts. The other voltages will also be proportionately higher.

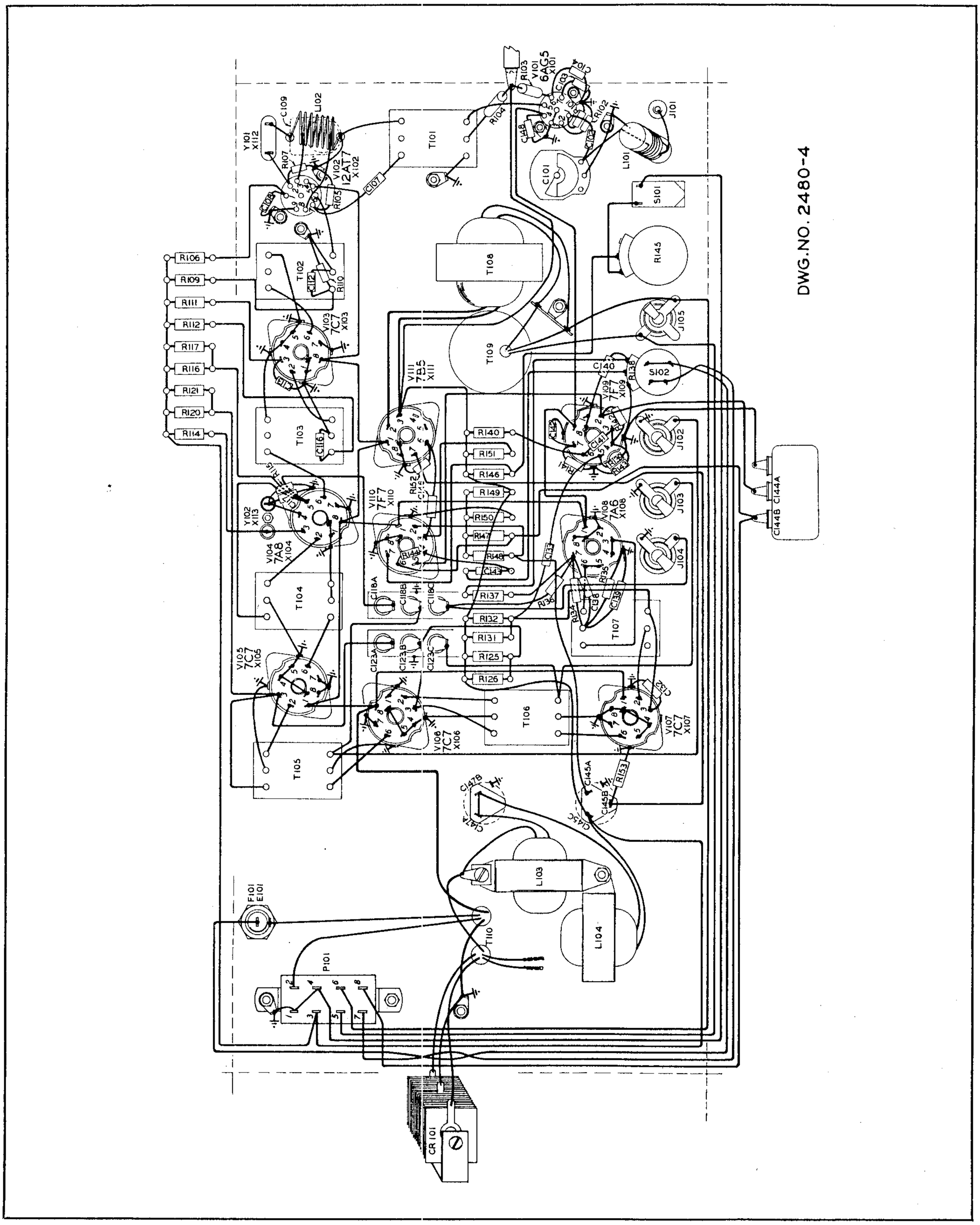


Figure 10. Radio Receiver Type 12-UF Ed. 7, Wiring Diagram

imminent and replacement justified.

This deterioration may be detected by operating the transmitter at normal primary voltage and completely detuning the P-A tank circuit. The P-A plate current will normally rise to 255 ma with new tubes. As the tubes deteriorate, this off-resonance current will approach closer and closer the on-resonance current of 200 ma and the "dip" will accordingly become less. When the off-resonance current becomes so close to the on-resonance current (say 210 ma) that only a slight dip is observable, the r-f output will start to decrease and the need of new 807's is indicated. All these tests assume, of course, that the preceding stages have been checked and found normal.

(b) Changing Frequency.—In tuning Radio Transmitter Type 50-UFS Ed. 7, each transformer is tuned for maximum current in the like numbered meter switch position. In some cases, however, there may be more than one maximum current point in the tuning range of the capacitor, since the necessary range will permit the quadrupler to tune to other than the fourth harmonic. The transmitter tuning adjustments when made to the original frequency at the factory are marked with red lines so that no mistake can normally be made in making routine adjustments. When changing to a new frequency however, care should be taken to insure the proper selection of harmonics.

Transformer T4 will very often show two tunirg points corresponding to the fourth and either the third or fifth harmonics. These may readily be separated by observing the position of the tuning capacitor. All capacitors have stops limiting their rotation to 180 degrees. Maximum capacity is fully clockwise. Since the tuning range corresponds to 30-50 mc, reference to the desired operating frequency will fix approximately the correct position of the capacitor.

(b) Radio Receiver Type 12-UF Ed. 7.

(1) Maintenance.—The receivers are carefully tuned at the factory to the specified operating frequency but should be retuned upon installation as indicated in Section 5. Routine maintenance checks should include realignment of these same circuits. The correct settings of the transformers have been marked with red lines and these markings should be used as a guide when making any adjustments. It should be noted that for these adjustments the signal source must be accurately adjusted to the proper frequency. Signal generator calibration charts are not accurate enough for this purpose. The input signal should either be obtained by direct pickup from a crystal-controlled transmitter or from a signal generator which has been adjusted to zero beat against a crystal controlled transmitter on the correct frequency.

The frequency of the signal generator may be adjusted to that of a crystal controlled transmitter by use of the discriminator, as follows:

1. With no signal being received measure the voltage (rush) across J105 with an a-c voltmeter and adjust the primary of the discriminator transformer T107 for maximum voltage.
2. Plug a test meter (0-100 μa center-zero type preferred) into jack J104 on the front of the receiver chassis.
3. Apply a strong signal from a transmitter on the correct frequency.
4. Note the reading on the meter and, if it is not zero, readjust the secondary tuning (BAL.) capacitor on the top of transformer T107 with a non-metallic screwdriver to obtain a zero reading on the meter.
5. Remove the source of signal from the receiver. The discriminator is now in exact adjustment and may be used as a frequency indicator.
6. Apply a strong signal from the signal generator

VOLTAGE CHART—RADIO RECEIVER TYPE 12-UF Ed. 7

PIN NO.	V101 6AG5 RF	V102 12AT7 Mixer-Osc.	V103 7C7 5 mc IF	V104 7A8 Conv.	V105 7C7 456kc IF	V106 7C7 1st Lim.	V107 7C7 2nd Lim.	V108 7A6 Disc.	V109 7F7 Noise Amp. and Rect.	V110 - 7F7 1st Audio-Squelch		V111 7B5 Audio Out.
										OFF	ON	
1	X	95	0	0	±6.4	0	±6.4	±6.4	0	±6.4	±6.4	±6.4
2	*0.4	X	185	60	75	110	115	0	X	75	65	210
3	0	X	65	35	75	110	115	X	X	145	210	220
4	±6.4	±6.4	0	X	0	0	0	X	X	65	23	-
5	140	±6.4	0	60	0	0	0	X	X	*1.4	*0.4	-
6	60	40	X	X	X	X	X	X	105	70	25	X
7	*0.4	X	0	0	0	0	0	X	*1.4	210	0	20
8	-	X	±6.4	±6.4	0	±6.4	0	0	±6.4	0	0	0
9	-	0	-	-	-	-	-	-	-	-	-	-

X-No readings on these pins. Taken between pin and ground. No signal input
Meter resistance: 25,000 ohms per volt
First column under V110 (7F7) is with squelch switch OFF and second with switch ON
Squelch control fully counterclockwise and squelch switch off except where noted

PARTS LIST—EQUIPMENT ASSEMBLY RADIO TRANSMITTER-RECEIVER TYPE 50-UFS Ed. 7

Cir. Sym.	Description	Part No.
	MISCELLANEOUS ELECTRICAL PARTS	
E401	Incandescent Lamp, 120 Volts, 6 Watts	S6
402	Incandescent Lamp, 120 Volts, 6 Watts	S6
403	Fuse Holder	GE-172
404	Handset Hang-up Box, with switch	G-2-3
(1)	Knob	2300-A
	FUSES	
F401	6 Amperes, Plug Type	PY-6
	HANDSET	
HS401	Handset, with cord	F3H
	INDICATOR LIGHT ASSEMBLIES	
I401	Green	147-1002-G
402	Red	147-1002-R
	CONNECTORS	
J401	8 Contact, Female	P08F-1
402	12 Contact, Female	S-412-CCT-⅝"
403	8 Contact, Female	S-408-CCT-⅝"
404	8 Contact, Female	S-408-CCT-⅝"
405	2 Contact, Female	7259
	SPEAKER	
LS401	5", permanent magnet type	SP5-T500
	METERS	
M401	0-1 ma, 750 Volt Scale	MS34W750DCVV (1ma)
402	0-250 ma	MS34W250DCMA
	TRANSFORMERS	
T401	Part of LS401	
	CONNECTORS	
P401	Single Contact, Male	PL-259-A
402	Single Contact, Male	P101-¼"
403	Single Contact, Male	P101-¼"
404	8 Contact, Male	08M
405	2 Contact, Male	6808
406	12 Contact, Male	P-412-CCT-⅝"
407	2 Contact, Male	R-311B
	RESISTORS	
R401	Fixed, Carbon, 750,000 ω, ±10%, 1 Watt	RC30-754-K
402	Variable, Wire Wound, 6 ω, "L" Pad	PWD-060SS6LP
403	Fixed, Carbon, 1,000 ω, ±10%, ½ Watt	RC20-102-K
	SWITCHES	
S401	S.P.S.T., Despard	SWD-1P1T-3A
402	S.P.S.T., Despard	SWD-1P1T-3A
403	S.P.S.T., Interlock	SWPB-1P1T-3A
404	S.P.S.T., Interlock	SWPB-1P1T-3A
	CABLES	
W401	R-F Cable, Transmitter to Receiver, with P402 one end and P403 other end.	CB-27
402	Handset Hang-up, goes between P404 and E404.	CB-49
403	Handset Cable, goes between HS401 and E404.	H4J
404	A-C Power Cord, with P408 one end and P409 other end.	CB-50

to the receiver antenna connector (J101) and note the reading on the "balance" meter. As the frequency of the signal generator is adjusted slightly above and below the proper operating frequency, the "balance" meter should swing sharply to opposite sides of the zero position. When the signal generator is adjusted in this manner for zero meter reading, its output is on the correct frequency.

When any of the tubes associated with the foregoing circuits are changed, those circuits should be retuned. The variations encountered in tubes may cause a marked detuning at very-high frequencies.

(2) Sensitivity Check.—If a signal generator whose output is calibrated in microvolts, (or one whose output can be attenuated to a low level) and whose output impedance is approximately 50 ohms (see note on page 24) is available, the sensitivity of the receiver can be checked. When the receivers are shipped from the factory their sensitivity is such that a signal of one microvolt or less, when applied to antenna connector J101, will cause a meter reading at jack J102 of at least 100 microamperes. If a signal generator whose output can be attenuated but which is directly calibrated is available, it can be checked against a new receiver. The attenuator setting for some particular tuning meter reading can be noted and other receivers checked for sensitivity against this criterion.

(3) Service and Test.—The following section is offered to assist the service engineer in quickly localizing and remedying failures that may arise during the operation of the receiver. A circuit diagram, parts list and voltage chart are included.

(a) In setting up the receiver for operation on a frequency in the 30 to 50 megacycle band other than that for which it was tuned at the factory, or if a complete realignment of the receiver is desired, a crystal of the right frequency for the new operating frequency is inserted into the crystal socket beside the 12AT7 mixer and crystal oscillator tube (V102).

The frequency of the crystal oscillator (and crystal) lies between 30 mc and 45 mc. The crystal frequency is as follows: 25 to 40 mc: Fc=Fs+5 mc; 40 to 50 mc: Fc=Fs—5 mc. The crystal oscillates on its third mechanical harmonic (overtone) and is ground especially for use in this circuit.

(b) After the crystal has been inserted into the crystal socket, adjust capacitor C109 (near crystal Y101) for maximum plate voltage as measured on pin 1 of the mixer-crystal oscillator tube V102. This voltage should be approximately 95 volts. (It will, however, vary somewhat between crystals.)

After the oscillator has been set roughly, transformer T102 may be adjusted. While feeding a strong signal on the new signal frequency into antenna connector J101, plug a tuning meter into jack J102 and tune T102 for maximum current. The antenna transformer may next be adjusted for maximum current in the tuning meter. Once the approximate setting of the tuning controls is determined, the signal input is decreased until

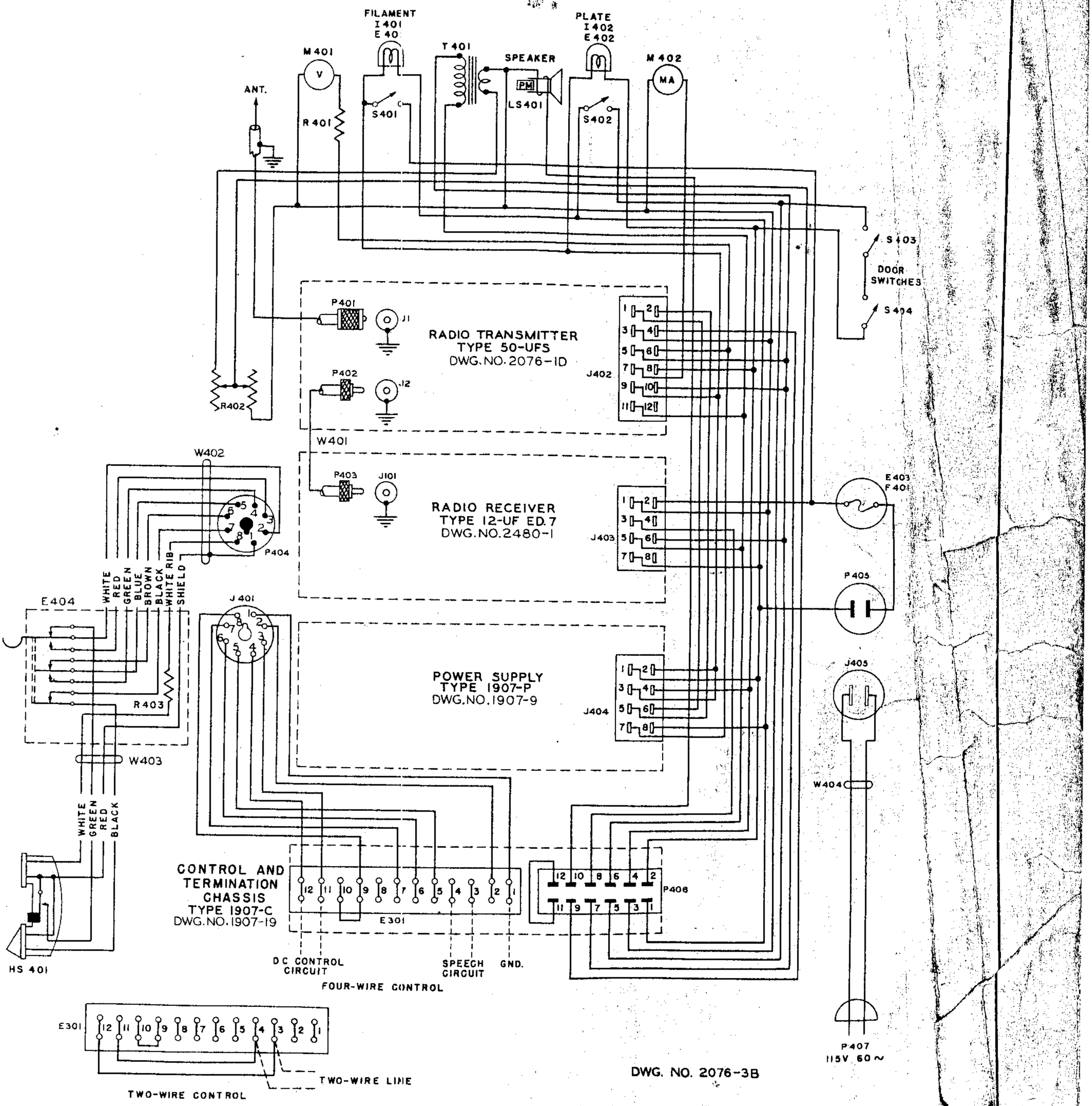


Figure 11. Radio Transmitter-Receiver Type 50-UFS Ed. 7, Equipment Assembly, Schematic Diagram

only a slight indication is obtained on the tuning meter and the adjustments on T101, T102, T103, T104 and T105 set carefully for maximum current in the tuning meter. For final adjustment of the oscillator tuning (C109) place one finger on the top of crystal Y10 and adjust C109 for maximum meter current.

(c) The last i-f transformer (T106) is past the first limiter grid circuit and the tuning meter will give no indication of proper tuning in jack J102. To tune T106, plug the tuning meter into jack J103 and tune for maximum current. The discriminator transformer (T107) is adjusted by removing the signal from the antenna connector and adjusting the primary for maximum voltage (rush) appearing across J105 as read on an a-c voltmeter. Next, plug a 0-100 μa center-zero microammeter into jack J104 and while receiving a signal strong enough to saturate the receiver adjust the secondary (marked BAL.) with a non-metallic screwdriver for zero reading. After the discriminator transformer has been balanced, the signal should be removed from the receiver and the balance meter reading noted. It should stay within 4 μa of center-zero reading. If it does not, the indication is that the bandpass characteristics are not accurately centered on the carrier frequency. A careful check on the tuning adjustments using a weak signal should correct the difficulty. The receiver is now in tune except for the antenna tuning which must be adjusted upon installation.

(4) Receiver Failures.—With the squelch switch in the off position the receiver normally emits a loud hiss when no carrier is being received. The r-f amplifier, and mixer-crystal oscillator can be removed without appreciably affecting the hiss. Removing the h-f i-f amplifier or converter causes the hiss to disappear almost completely. It then is a simple matter to determine whether a failure is in the stages preceding the h-f i-f amplifier or in those following it.

The operation of the entire receiver up to the grid circuit of the first limiter may be checked by noting the tuning meter readings with a signal applied to the input. A test meter should be plugged into the first limiter jack J102 and the grid current of the first limiter measured.

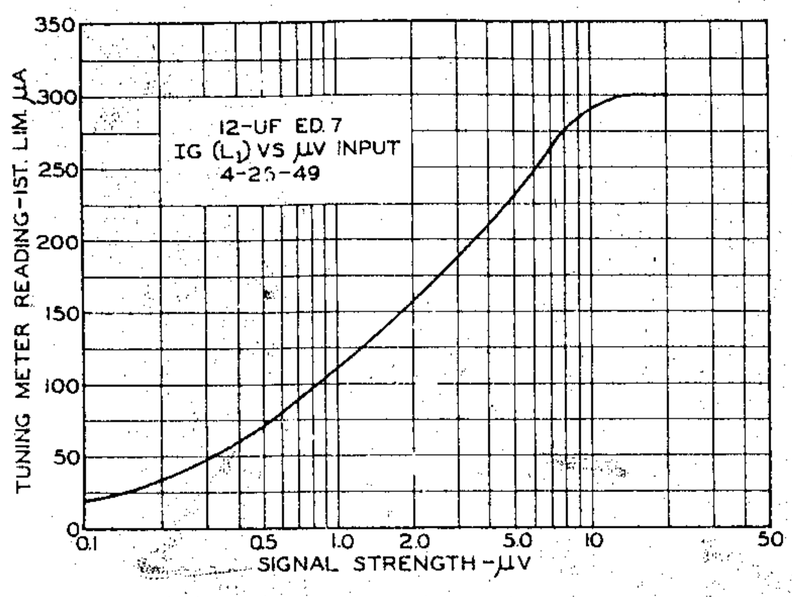
Increase of the tuning meter reading with increased signal input indicates that the receiver is operative up to that stage. Sensitivity of the receiver to that point may be measured if a calibrated source of signal is available. It should require approximately one microvolt input to the antenna to cause a 100 microampere deflection in the tuning meter.

When the receiver is properly adjusted, 0.4 microvolt (or less) at antenna connector J101 should produce 20 db quieting in its audio output (20 db quieting represents a reduction of the audio noise voltage to one-tenth its previous value). This measurement may be made across jack J105 with an a-c voltmeter.

NOTE: Since signal generators are calibrated in terms of open-circuit output voltage the voltage actually applied to the receiver input connector will vary depending on the generator impedance. For proper results an impedance matching device must be used to properly match the 50-ohm input of a 12-UF Ed. 7 receiver. This will vary with different signal generators, but in general requires the insertion of a resistor in series with the load side of the output. For example, if the internal resistance of the signal generator is 37 ohms insert a 13 ohm resistor in series with the output lead. After the matching is completed, the actual voltage appearing at the antenna terminals of the receiver will be ½ the value read on the signal generator attenuator.

The graph below indicates the approximate first limiter grid current to be expected at various signal levels. It will be noticed from this graph that by the use of a more sensitive tuning meter (i. e., 0-50 or 0-100 microamperes) very weak signals may be more accurately judged. The meter used for balance may be used for this purpose.

TUNING GRAPH 12-UF Ed. 7



Vacuum tubes may vary considerably in efficiency at very-high frequencies, therefore a check on the gain of the receiver should be made whenever one of them is changed. Tubes testers offer no sure method of testing tubes for operation at high frequencies and a much more rapid and satisfactory method of determining tube deterioration is by substituting a tube known to be good in place of the suspected tube and noting the difference in receiver operation.

Weakening of the squelch tube generally manifests itself in failure of the squelch circuit to close and therefore a need to change the setting of the squelch control in a counterclockwise direction. Here, too, the best criterion for judging the efficiency of the tube is to substitute a tube known to be good in place of the one suspected.

Other failures that may arise would be of the well known resistor or capacitor failure type that should be easily localized by the service engineer since they manifest the same symptoms in an FM receiver as in an amplitude modulated one. Reference to the voltage chart, circuit diagram and parts list should simplify the solution of this type of failure. However, if any difficulty is encountered, our service department is ready to extend its full cooperation.

8. CONCLUSION.

The Engineering Department of the Link Radio Corporation is anxious to cooperate with users of LINK radio equipment to insure continued, high grade service from it. To this end we welcome inquiries or reports of unusual service problems. Write the Engineering Department, Link Radio Corporation, 125 West 17th Street, New York 11, N. Y.