



hallicrafters

littlefone

2-WAY FM RADIO-TELEPHONE
152-174 MC

OPERATING and SERVICE
INSTRUCTIONS



the hallicrafters co.

MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 24, U. S. A.

GENERAL DESCRIPTION



92X1744

Hallicrafters HT-22 "littlefone"

Hallicrafters HT-22 "littlefone" is a complete, self-contained radio-telephone station consisting of a standard FM receiver and transmitter operating on a fixed frequency. Being powered by batteries, the unit is completely portable. Any two or more of these units will provide instant, dependable two-way radio communication. These portable "littlefone" units may also be tied in with "littlefone" mobile and central station units, HT-26 and HT-24 as well as existing higher powered FM equipment. Where a tunable receiver is desired, use the economical Hallicrafters Model S-81 which tunes from 152 to 174 megacycles.

The basic model designation system of the "littlefone" series of radio equipment is as follows:

- a. All portable "littlefone" units designed for operation on 152 to 174 megacycles are designated Model HT-22.
- b. To the above model number is added a series of letter designations to indicate low (L) or high (H) power transmitter, dry (D) or wet (W) batteries and (S) for squelch.

OPERATING INSTRUCTIONS

To operate the "littlefone", place the power switch on the right side of the case in the up position. Next, adjust the volume control on the top of the case until the noise just disappears. To transmit, press the button on the handset and talk. To listen, simply release the button. The operating range of the unit will depend upon the geographical and physical characteristics of the operating location. To turn the unit off, return the power switch to the down position.

WARNING

DO NOT USE THIS RADIO EQUIPMENT IN THE IMMEDIATE VICINITY OF BLASTING CAPS OR ELECTRICAL DETONATORS.

IMPORTANT

It is the requirement of the Federal Communications Commission that this radio equipment be licensed. The appropriate application form (F.C.C. Form 401) can be obtained by request from Federal Communications Commission, Washington 25, D.C. or from your local F.C.C. field office. The completed form should be filed with the Federal Communications Commission, Washington 25, D.C.

CIRCUIT DESCRIPTION

RECEIVER

The receiver is a crystal controlled, double conversion type FM receiver employing thirteen tubes and two crystal diodes. All tubes are of the sub-miniature type and are socket mounted. The tube complement is given in the Service Parts List.

A signal at the operating frequency is received at the antenna and is amplified by the 1st and 2nd RF amplifiers, V-1 and V-2. This amplified signal is applied to the 1st mixer, V-3, where it is mixed with the output of the multiplier, V-12. The multiplier supplies mixer voltage to the 1st mixer at the 16th harmonic of the crystal frequency. The resultant first intermediate frequency is less than the crystal frequency by 1.7 megacycles. This IF signal is amplified by the 1st and 2nd IF amplifiers, V-4 and V-5, and then applied to the grid of the 2nd mixer, V-6. Here it is mixed with the output of crystal oscillator, V-11, obtaining the second intermediate frequency of 1.7 megacycles. This IF signal is amplified by the 3rd IF amplifier, V-7, and the 1st and 2nd limiters, V-8 and V-9. After limiting, the signal is applied to the discriminator where the audio is then recovered. The audio signal is then amplified by the audio amplifier, V-10, to supply the audio output of approximately five milliwatts to the earpiece of the handset. A squelch circuit is provided to quiet the receiver when no signal is being received. A 2E41 diode-pentode (V-13) is used as a

noise limiter and rectifier. Noise voltage is taken from the grid of the 1st limiter, V-8, amplified, rectified and applied to the grid of the audio amplifier, V-10, biasing it to cut-off. When a signal is received, the limiter grid voltage increases and cuts off the noise amplifier. Thus, the cut-off voltage is removed and the audio amplifier operates normally.

TRANSMITTER

The transmitter is a standard crystal controlled FM transmitter. All tubes are of the sub-miniature type and are socket mounted. The tube complement is given in the Service Parts List. The crystal oscillator, V-14, supplies RF voltage at the crystal frequency to the grids of the modulators, V-15 and V-16. Phase modulation is developed in the grids of these tubes. The output of the modulators is multiplied 48 times through a series of four multipliers, V-17, V-18, V-19 and V-20, and then applied to the buffer-driver, V-21, which drives the final amplifiers, V-22 and V-23. A pi network serves both as the final tank circuit and as the coupling circuit to the quarter wave whip antenna. A single button carbon microphone is used.

POWER SUPPLY

The power supply is a synchronous vibrator type for model LWS and a nonsynchronous vibrator type for model HWS. Primary power is supplied from two ER-11-2 batteries for the LWS model and from two ERH-25-2 batteries for the HWS model. Both battery types are 2 volt Willard lead-acid storage cells. The two batteries are connected in parallel to supply the vibrator circuit. The filament voltage for all tubes is 1.25 volts. Resistance wire from the relay to the receiver and transmitter filament strings drops the voltage to the proper value.

Dry batteries are used to power model LDS. The battery complement consists of one 1½ volt "A" battery and three 45 volt "B" batteries. (See REPLACEMENT DRY BATTERIES on page 7 for listing of battery types.) Approximately 16 hours of operation may be expected before battery replacement is necessary.

ACCESSORIES

Order parts by Hallicrafters Part Number and Description

Description	Hallicrafters Part Number	Cross Reference
Shoulder carrying case for LDS and LWS	14-317	P-4320
Shoulder carrying case for HWS	14-316	P-4737
Back pack harness for all models	14-315	P-4437
Hand microphone and earpiece assembly with cords and plugs	41X18781	P-4414
Replacement handset assembly with cord and plug	41X18708	P-4197
Hand microphone and cord assembly for use with earpiece or speakers	81B090	-----
4" Loud speaker assembly for all models	41X18786	-----
Shoulder loud speaker (2" x 3") with cord and plug	41X18782	P-4767
Universal AC battery charger (105-125 volts, 50/60 cycles)	21-140	-----
6 Volt battery charger	21-141	-----
Handset holder for back pack harness	41X18783	P-4763
Earpiece assembly complete with cord and plug	85B134	-----

SERVICE

The Hallicrafters Company maintains an extensive system of authorized factory service centers where any required service can be accomplished promptly and efficiently at a nominal charge. These same service centers can also accomplish the semi-annual frequency measurement required by the F.C.C. The sign shown at the right is displayed by all authorized service centers. Any service work performed on this radio equipment must be under the supervision of an F.C.C. commercial licensed operator holding a 2nd Class Radio Telephone or higher grade of license.



ALIGNMENT INSTRUCTIONS

EQUIPMENT REQUIRED

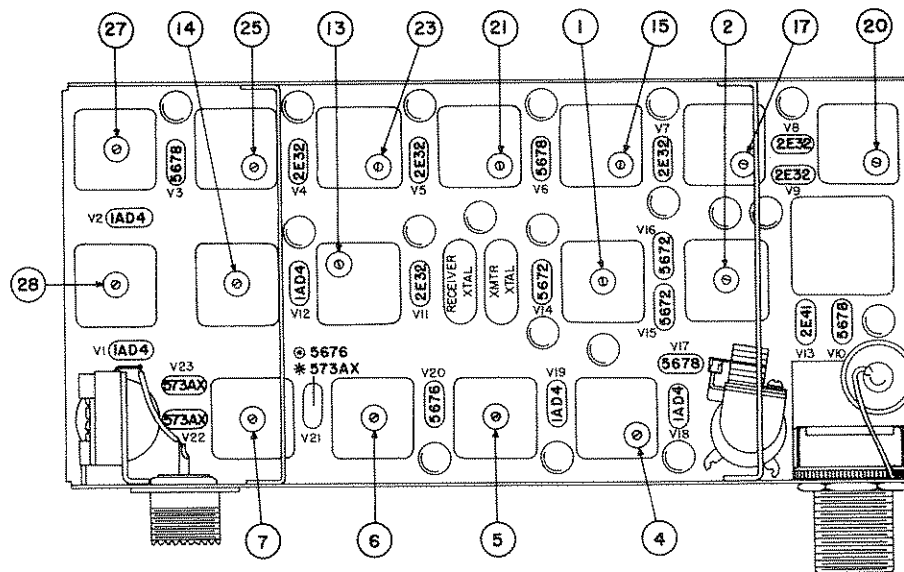
1. Signal generator covering 1.7 MC, 7.3 - 10.4 MC and 152 - 174 MC. Measurements Corp. Model 80 or equivalent.
2. Vacuum tube voltmeter (VTVM) with 0-3 and 0-30 volt DC ranges.
3. 0-50 ma. DC milliammeter.
4. Absorption wavemeters covering 3 to 174 megacycles to determine proper tuning of multiplier stages in transmitter.
5. Frequency measuring equipment capable of measuring the transmitter output frequency to within .005%.
6. A 1 megohm resistor connected in series with the VTVM probe to minimize loading and detuning.

TRANSMITTER ALIGNMENT

Before starting alignment of the transmitter, remove the plate voltage from the buffer and final amplifier stages. This is accomplished on models LWS and HWS by disconnecting the single pin plug on the power supply chassis and on model LDS by disconnecting the connector from the small 45V. "B" battery. Also connect a short circuiting jumper between terminals 1 and 2 of the handset socket to place the filament voltage relay in the energized or transmit position. Refer to Figs. 1 and 2 for location of all alignment adjustments and test points. The adjustment and test points are also shown on the schematic diagram.

1. Connect the VTVM to A or B (modulator grid) and adjust 1 (oscillator plate) for exact frequency and stable oscillation. Approx. -3 volts.
2. Connect the VTVM to C (quadrupler grid) and adjust 2 (modulator plate) for max. neg. volts. Approx. -15 volts.
3. Connect the VTVM to D (tripler grid) and adjust 3 (quadrupler plate) for max. neg. volts. Approx. -5 volts. Then touch up 2 (modulator plate).
4. Connect the VTVM to E (1st doubler grid) and adjust 4 (tripler plate) for max. neg. volts. Approx. -8 volts. Then touch up 3 (quadrupler plate).
5. Connect the VTVM to F (2nd doubler grid) and adjust 5 (1st doubler plate) for max. neg. volts. Approx. -7 volts. Then touch up 4 (tripler plate).
6. Connect the VTVM to G (buffer grid resistor) and adjust 6 (2nd doubler plate) for max. neg. volts. Approx. -7 to to -10 volts. Then touch up 5 (1st doubler plate).
7. Remove the plate voltage from the final amplifiers by disconnecting wire jumper H (see Fig. 2). Then apply plate voltage to the buffer stage by connecting the milliammeter between the single pin plug and jack on models LWS and HWS or in series with the small 45V. "B" battery on model LDS.
8. Adjust 7 (buffer plate) for dip in buffer plate current as indicated on milliammeter.
9. The buffer stage has been neutralized at the factory and should normally not require readjustment. To determine if adjustment is necessary, first remove the plate voltage from the buffer stage by disconnecting the milliammeter. Then connect the VTVM to J (final grid resistor). If the stage is properly neutralized, an indication of approximately -.2 volt or less will be obtained on the VTVM. If neutralization is required, follow the procedure outlined under BUFFER NEUTRALIZATION.
10. The final amplifier stage has also been neutralized at the factory and should normally not require readjustment. A check may be made to determine if adjustment is necessary as follows:
 - (a) Set 9 (output loading capacitor) for maximum capacity as shown in Fig. 2.
 - (b) Connect the VTVM to J (final grid resistor).
 - (c) Apply plate voltage to the buffer stage by reconnecting the milliammeter. Retune 7 (buffer plate) for dip in plate current.
 - (d) Tune 10 (output tuning capacitor) through resonance. If the final amplifier stage is not neutralized, a corresponding dip in grid voltage will be noted as 10 is tuned through resonance; if properly neutralized, no change in grid voltage will be noted. If neutralization is necessary, follow the procedure outlined under FINAL AMPLIFIER NEUTRALIZATION.

11. Set 9 (output loading capacitor) for maximum capacity as shown in Fig. 2. Apply plate voltage to the final amplifiers by connecting wire jumper H.
12. Connect the VTVM to J (final grid resistor). Tune 10 (output tuning capacitor) for minimum plate current (approx. 16 ma. to 18 ma. on models LDS and LWS and approx. 30 ma. on model HWS). Slightly retune 7 (buffer plate) for maximum grid voltage as indicated on the VTVM. Repeat the procedure several times, tuning 10 for minimum plate current and 7 for maximum grid voltage. Correct adjustment of the final amplifiers is indicated by a VTVM reading of approx. -15 volts for models LDS and LWS and approx. -30 volts for model HWS.
13. Connect the antenna.
14. Adjust 10 (output tuning capacitor) for resonance as indicated by minimum plate current. Then decrease the value of 9 (output loading capacitor) in small steps, each time retuning 10 for minimum plate current. Proper operation with rated power output is obtained with plate currents of approx. 25 ma. for models LDS and LWS and approx. 40 ma. for model HWS.
15. Align the receiver if required.
16. Place the chassis in the case and retune the antenna as outlined in Step 14. To gain access to the output tuning adjustments, 9 and 10, remove the button plugs from the holes in the side of the case.



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Fig. 1. Top View of Chassis Showing Location of Alignment Adjustments and Tubes

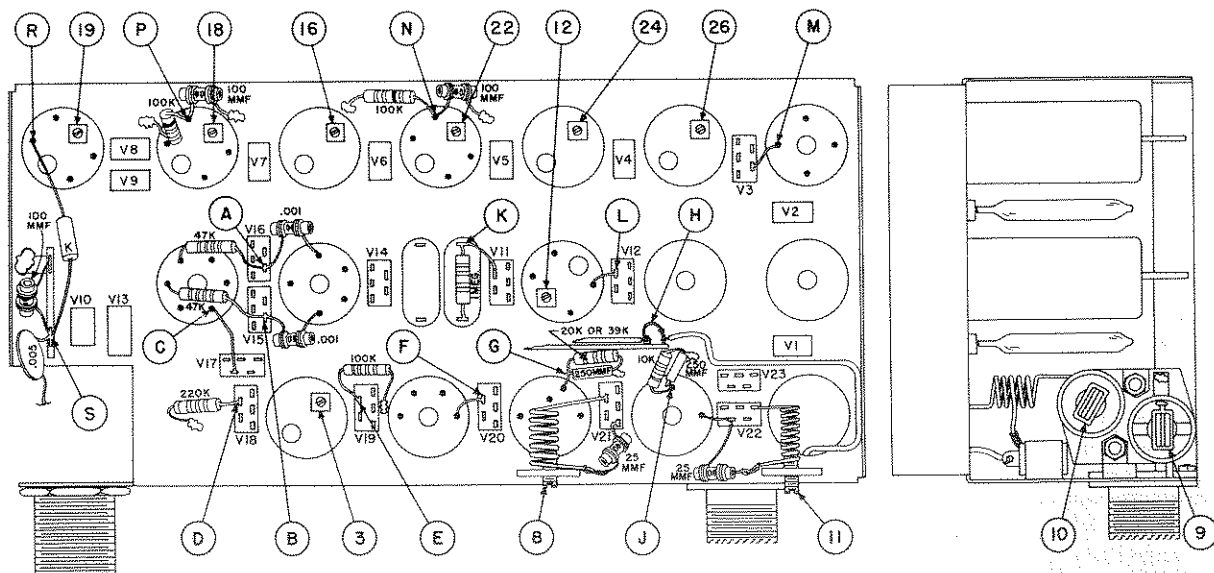


Fig. 2. Bottom and Side Views of Chassis Showing Location of Alignment Adjustments and Test Points

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BUFFER NEUTRALIZATION

1. Before neutralizing the buffer, follow the instructions given in Step 9 on page 4.
2. To neutralize the buffer stage, adjust 8 (buffer neutralizing coil) for a minimum reading on the VTVM. Then retune 7 (buffer plate) and 6 (2nd doubler plate) to provide a maximum reading on the VTVM. Repeat the procedure until a VTVM indication of approximately -.2 volt or less is obtained.
3. Apply plate voltage to the buffer stage by reconnecting the milliammeter. Connect the VTVM to G (buffer grid resistor) and touch up 8 to maximize buffer grid voltage.

FINAL AMPLIFIER NEUTRALIZATION

1. Before neutralizing the final amplifiers, follow the instructions given in Step 10 on page 4.
2. To neutralize the final, make small adjustments of 11 (final neutralizing coil) for minimum reaction in grid voltage as 10 (output tuning capacitor) is tuned through resonance. With each small adjustment of 11, retune 7 (buffer plate) to maximize the VTVM indication. When neutralization is complete, tuning 10 through resonance will not have any appreciable effect upon the VTVM indication.

RECEIVER ALIGNMENT

1. Connect the VTVM to K (oscillator grid) and adjust 12 (oscillator screen) for stable oscillation. Approx. -25 volts.
2. Connect the VTVM to L (multiplier grid) and adjust 13 (oscillator plate) to the 4th harmonic of the crystal. Approx. -10 volts.
3. Connect the VTVM to M (1st mixer grid) and adjust 14 (multiplier plate) to the 16th harmonic of the crystal. Approx. -1 volt.
4. Set the signal generator at 1.7 MC and connect it to N (2nd mixer grid resistor).
 - a. Connect the VTVM to P (1st limiter grid resistor). Adjust 15 and 16 (2nd mixer plate) and 17 and 18 (3rd IF plate) for maximum indication. Approx. -12 volts for 1 volt input.
 - b. Connect the VTVM to R (disc. input) and adjust 19 (disc. primary) for maximum indication. Approx. -10 volts.
 - c. Connect the VTVM to S (disc. output) and adjust 20 (disc. secondary) for zero reading on the VTVM. The correct zero point is between a positive and negative maximum.
5. Set the signal generator at the 1st IF frequency (1st IF = Crystal Freq. - 1.7 MC) and connect it to N. Connect the VTVM to S (disc. output). Carefully adjust the signal generator frequency for a zero reading on the VTVM.
6. Disconnect the generator and connect it to M (1st mixer grid). Disconnect the VTVM and connect it to P (1st limiter grid resistor). Adjust 21 and 22 (2nd IF plate), 23 and 24 (1st IF plate) and 25 and 26 (1st mixer plate) for maximum indication. Approx. -1 volt for 25 microvolt input.
7. Set the signal generator at the operating frequency and connect it to the antenna input. Connect the VTVM to P (1st limiter grid resistor). Adjust 27 (2nd RF plate), 28 (1st RF plate), 14 (multiplier plate) and 13 (oscillator plate) for maximum indication. Approx. -3 volts for 1 microvolt input.
8. Attach the antenna and check the discriminator setting against a transmitter on the receiver operating frequency. The VTVM indication at S (disc. output) should be zero volts, plus or minus .1 volt. If not, readjust 20 (disc. sec.) until a zero reading is obtained. Then connect the VTVM to P (1st limiter grid resistor) and touch up 14 (multiplier plate) for maximum indication.

VOLTAGE DATA

All voltages were measured with a vacuum tube voltmeter between tube socket terminals and chassis. Filament voltage is 1.25 volts.

Tube	Function	HT-22 HWS		HT-22 LWS		**HT-22 LDS	
		Plate	Screen	Plate	Screen	Plate	Screen
V-1	1st RF Amplifier	100	50	90	47	90	47
V-2	2nd RF Amplifier	100	50	90	47	90	47
V-3	1st Mixer	25	25	25	25	25	25
V-4	1st IF Amplifier	100	35	90	32	90	32
V-5	2nd IF Amplifier	100	25	90	22	90	22
V-6	2nd Mixer	100	60	90	57	90	57
V-7	3rd IF Amplifier	100	30	90	27	90	27
V-8	1st Limiter	45	30	44	28	44	28
V-9	2nd Limiter	45	30	44	28	44	28
V-10	Audio Amplifier	100	25	90	22	90	22
V-11	Receiver Oscillator	100	100	90	90	90	90
V-12	Multiplier (Rec.)	50	50	47	47	47	47
*V-13	Squelch	60	25	57	23	57	23
V-14	X'mtr Oscillator	90	35	80	32	90	32
V-15	Modulator	90	20	80	18	74	16
V-16	Modulator	90	20	80	18	74	16
V-17	Quadrupler	90	50	80	46	74	44
V-18	Tripler	90	50	80	46	74	44
V-19	1st Doubler	90	45	80	42	74	40
V-20	2nd Doubler	85		78		70	
V-21	Buffer	120		96		130	
V-22	Final Amplifier	125		100		135	
V-23	Final Amplifier	125		100		135	

* Measured with volume control set fully clockwise.

** Measured with fresh batteries.

REPLACEMENT DRY BATTERIES

Schematic Symbol	Type	RCA	Burgess	Ever-easy	Bright Star	General	Mont. Ward	Olin	Philco	Ray O-Vac	Sears	Willard
BA-301	45V. "B"	VS055	XX30	455		W30A		6211	P105			
BA-302,303	45V. "B"	VS015	Z30	738	30-59	V30AA				P7R30		V30AA
BA-304	1½V. "A"	VS004	4F	742	462	4F1	21	4816	P94	P94A	6430	4F1

PREVENTIVE MAINTENANCE

A regular preventive maintenance procedure should be followed to prevent unnecessary interruption in the operation of this equipment. This maintenance procedure should include the following:

- (1) Make a semi-annual check of the operating frequency as required by the F.C.C. to assure that it is within .005% of the assigned operating frequency.
- (2) Take periodic meter readings and, in case of abnormal readings, check tubes.
- (3) Periodically check the receiver sensitivity with the receiver in the case. (Normal sensitivity is approx. -3 volts at P (1st limiter grid resistor) for 1 microvolt at the antenna input.)
- (4) If the receiver sounds distorted, check the discriminator setting against a transmitter on the receiver operating frequency. (See Step 8 under Receiver Alignment.)
- (5) Check the battery electrolyte level and add distilled water if necessary. Keep the level even with the mark on the battery case.
- (6) After approximately 8 hours of operation, remove the batteries from the case and check to determine if charging is required. When removing batteries, be careful not to damage the polystyrene ventilation opening on the side of the case. To check batteries, tilt the battery slightly and observe the position of the ball(s) in the battery. When batteries are fully charged, these balls float at the top of the electrolyte. Willard ER-11-2 batteries require charging if the red ball sinks to the bottom while the Willard ERH-25-2 batteries require charging when both the blue and white balls sink to the bottom. When charging batteries, the power switch on the "littlefone" should be off. Be careful to limit the charging current to the value indicated on the battery.
- (7) Check the antenna loading by observing the combined buffer and final amplifier plate current. This is accomplished on models LWS and HWS by connecting a 50 ma. DC meter between the single pin plug and jack on the power supply chassis and on model LDS by connecting the meter in series with the small 45 volt "B" battery. Proper operation with rated power output is indicated by plate currents of approximately 25 ma. for models LDS and LWS and approximately 40 ma. for model HWS.

BATTERY CHARGERS

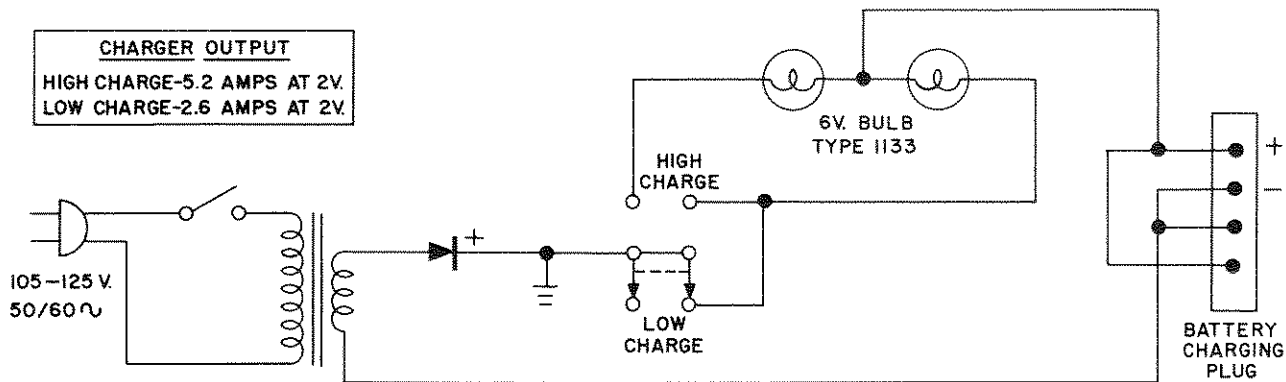


Fig. 3. Universal AC Battery Charger (Hallicrafters Part No. 21-140)

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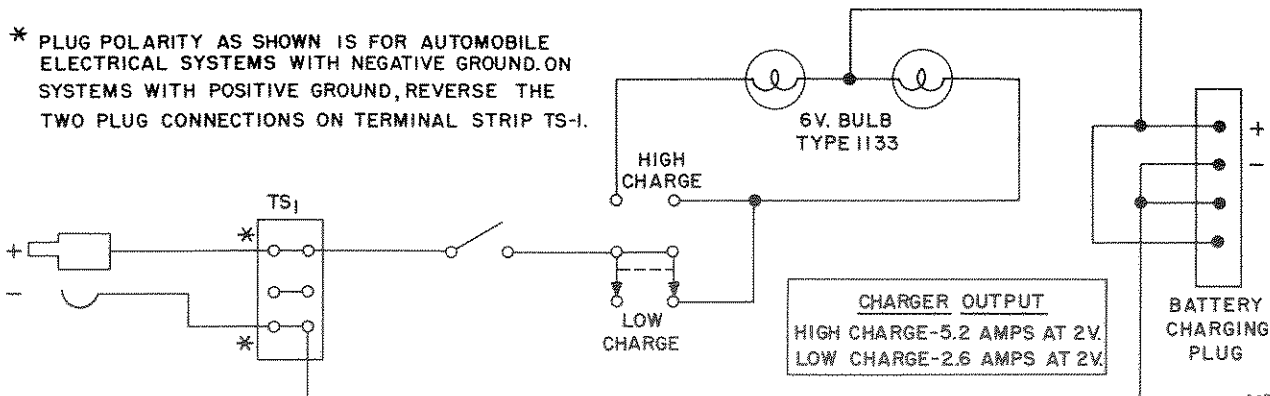


Fig. 4. Six Volt DC Battery Charger (Hallicrafters Part No. 21-141)

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MODEL HT-22 HWS SPECIFICATIONS

TYPE: Portable FM Transmitter - Receiver

FREQUENCY RANGE: 152 to 174 MC

TRANSMITTER:

1. Power Output 1.0 watt
2. Frequency Stability 0.005% from -20° to + 70° Centigrade. Crystal controlled. Crystal frequency multiplied 48 times.
3. Modulation Phase. ± 15 KC deviation (no modulation limiter).
4. Antenna Quarter wave flexible whip. 50 ohm output impedance.
5. Spurious Radiation 60 db down.
6. Pre-emphasis Standard 6 db per octave.
7. Distortion 9% with 100% modulation at 1000 cps.
8. Power Supply 2 volt non-synchronous vibrator plus 2 rechargeable wet storage batteries. Current drain - 6.3 amps at 2 volts.
9. Power Requirements Filament - 1.25 volts at 1.25 amps
Plate - 130 volts at 58 ma.
10. Power Input to Final. 130 volts at 22 ma.
11. Duty Cycle 1 minute on, 1 minute off for 8 hours.
12. Microphone. Telephone handset with single button carbon mike and push to talk button.

RECEIVER:

1. Sensitivity 1 microvolt or better for 20 db signal to noise ratio.
2. Selectivity 60 db at 45 KC. 95 db at 60 KC.
3. Frequency Stability 0.005% from -20° to + 70° Centigrade.
4. Receiver Type. Superheterodyne. Double conversion crystal controlled local oscillator.
5. Spurious Response All more than 75 db down.
6. Audio Output 5 milliwatts with 15% distortion.
3 milliwatts with 5% distortion.
7. Receiver De-emphasis Standard 6 db per octave.
8. Antenna Same as for transmitter.
9. Squelch 0.5 microvolt to open.
10. Power Supply Same as for transmitter. Current drain - 3.0 amps at 2 volts.
11. Power Requirements Filament - 1.25 volts at 0.78 ma.
Plate - 100 volts at 20 ma.
12. Receive Time 14 hours before recharging batteries.

WEIGHT: 14 pounds with case, telephone handset, vibrator power supply and 2 lead acid storage batteries.

MODEL HT-22 LWS SPECIFICATIONS

TYPE: Portable FM Transmitter - Receiver

FREQUENCY RANGE: 152 to 174 MC

TRANSMITTER:

1. Power Output 0.5 watt
2. Frequency Stability 0.005% from -20° to + 70° Centigrade. Crystal controlled. Crystal frequency multiplied 48 times.
3. Modulation Phase. ± 15 KC deviation (no modulation limiter).
4. Antenna Quarter wave flexible whip. 50 ohm output impedance.
5. Spurious Radiation 60 db down.
6. Pre-emphasis Standard 6 db per octave.
7. Distortion 9% with 100% modulation at 1000 cps.
8. Power Supply 2 volt synchronous vibrator plus 2 rechargeable wet storage batteries. Current drain - 4.3 amps at 2 volts.
9. Power Requirements Filament - 1.25 volts at 1.15 amps
Plate - 100 volts at 40 ma.
10. Power Input to Final. 100 volts at 18 ma.
11. Duty Cycle 1 minute on, 1 minute off for 4 hours.
12. Microphone. Telephone handset with single button carbon mike and push to talk button.

RECEIVER:

1. Sensitivity 1 microvolt or better for 20 db signal to noise ratio.
2. Selectivity 60 db at 45 KC. 95 db at 60 KC.
3. Frequency Stability 0.005% from -20° to + 70° Centigrade.
4. Receiver Type. Superheterodyne. Double conversion crystal controlled local oscillator.
5. Spurious Response All more than 75 db down.
6. Audio Output 5 milliwatts with 15% distortion.
3 milliwatts with 5% distortion.
7. Receiver De-emphasis Standard 6 db per octave.
8. Antenna Same as for transmitter.
9. Squelch 0.5 microvolt to open.
10. Power Supply Same as for transmitter. Current drain - 2.8 amps at 2 volts.
11. Power Requirements Filament - 1.25 volts at 0.78 amps
Plate - 100 volts at 20 ma.
12. Receive Time 6 hours before recharging batteries.

WEIGHT: 10 pounds with case, telephone handset, vibrator power supply and 2 lead acid storage batteries.

MODEL HT-22 LDS SPECIFICATIONS

TYPE: Portable FM Transmitter - Receiver

FREQUENCY RANGE: 152 to 174 MC

TRANSMITTER:

- | | | |
|-----|--------------------------------|---|
| 1. | Power Output | 0.5 watt |
| 2. | Frequency Stability | 0.005% from -20° to $+70^{\circ}$ Centigrade. Crystal controlled. Crystal frequency multiplied 48 times. |
| 3. | Modulation | Phase. ± 15 KC deviation (no modulation limiter). |
| 4. | Antenna | Quarter wave flexible whip. 50 ohm output impedance. |
| 5. | Spurious Radiation | 60 db down. |
| 6. | Pre-emphasis | Standard 6 db per octave. |
| 7. | Distortion | 9% with 100% modulation at 1000 cps. |
| 8. | Power Supply | (1) $1\frac{1}{2}$ volt "A" battery and (3) 45 volt "B" batteries (See page 7 for listing of battery types.) |
| 9. | Power Requirements | Filament - 1.25 volts at 0.9 amps.
Plate - 90 volts at 18 ma.
135 volts at 14 ma. |
| 10. | Power Input to Final | 135 volts at 14 ma. |
| 11. | Duty Cycle | 1 minute on, 1 minute off. |
| 12. | Microphone | Telephone handset with single button carbon mike and push to talk button. |

RECEIVER:

- | | | |
|-----|--------------------------------|---|
| 1. | Sensitivity | 1 microvolt or better for 20 db signal to noise ratio. |
| 2. | Selectivity | 60 db at 45 KC. 95 db at 60 KC. |
| 3. | Frequency Stability | 0.005% from -20° to $+70^{\circ}$ Centigrade. |
| 4. | Receiver Type | Superheterodyne. Double conversion crystal controlled local oscillator. |
| 5. | Spurious Response | All more than 75 db down. |
| 6. | Audio Output | 5 milliwatts with 15% distortion.
3 milliwatts with 5% distortion. |
| 7. | Receiver De-emphasis | Standard 6 db per octave. |
| 8. | Antenna | Same as for transmitter. |
| 9. | Squelch | 0.5 microvolt to open. |
| 10. | Power Supply | Same as for transmitter. |
| 11. | Power Requirements | Filament - 1.25 volts at 0.63 amps.
Plate - 90 volts at 12 ma. |

WEIGHT: 10 pounds with case, telephone handset and batteries.

INFORMATION FOR COMPLETING F.C.C. FORM 401, REV. JUNE 1951 MODEL HT-22 HWS

13. Description of transmitting apparatus proposed to be installed			
Make <p style="text-align: center;">Hallicrafters Co.</p>		Type or Model No. <p style="text-align: center;">HT-22 HWS</p>	
Tube complement	Number and type of tubes	Normal plate current per tube	Plate voltage
Oscillator stage	(1) CK-5672	2.6 ma.	90
Intermediate stages	(1) CK-5678 Quad.	1.6 ma.	90
	(1) 1AD4 Trip.	3.5 ma.	90
	(1) 1AD4 Doub.	4.6 ma.	90
	(1) CK-5676 Doub.	5.6 ma.	90
	(1) CK-573AX Driv.	14.0 ma.	130
Final radio stage	(2) CK-573AX	11.0 ma.	130
Modulator	(2) CK-5672	2.0 ma.	90
Type of oscillator circuit <p style="text-align: center;">Crystal controlled electron coupled</p>		Plate power supply for last radio stage Rated Current <u>22 ma.</u>	
Type or class of modulation <p style="text-align: center;">Armstrong, multiplied 48 times</p>		Rated Voltage <u>130 volts</u>	
Which radio stage is to be modulated? <p style="text-align: center;">Modulator stage, acting as a buffer between oscillator and 1st multiplier.</p>		State maximum percentage of modulation <p style="text-align: center;">15 KC @ 1000 cycles</p>	
State maximum rated carrier power <p style="text-align: center;">1.0 watt</p>		Indicate frequency range of transmitter <p style="text-align: center;">152-174 MC</p>	
14. a. What apparatus is included as an integral part of the transmitter for automatically holding the frequency within the allowed frequency tolerance? <p style="text-align: center;">James Knights Co. Type H17 Crystal</p>			
b. Within how many cycles or within what percentage of the assigned frequency is this apparatus designed or guaranteed by the manufacturer to hold the operating frequency? <p style="text-align: center;">.005 %</p>			
c. State type, number, if any, and name of manufacturer of frequency-control apparatus <p style="text-align: center;">James Knights Co. Type H17 Crystal</p>			
d. Is frequency-control apparatus automatically maintained at constant temperature? <p style="text-align: right;">Yes <input type="checkbox"/> No <input checked="" type="checkbox"/></p>			

INFORMATION FOR COMPLETING F.C.C. FORM 401, REV. JUNE 1951 MODEL HT-22 LWS

13. Description of transmitting apparatus proposed to be installed			
Make <p style="text-align: center;">Hallicrafters Co.</p>	Type or Model No. <p style="text-align: center;">HT-22 LWS</p>		
Tube Complement	Number and type of tubes	Normal plate current per tube	Plate voltage
Oscillator stage	(1) CK-5672	2.0 ma.	80
Intermediate stages	(1) CK-5678 Quad.	1.0 ma.	80
	(1) 1AD4 Trip.	3.0 ma.	80
	(1) 1AD4 Doub.	4.0 ma.	80
	(1) CK-5676 Doub.	4.0 ma.	80
	(1) CK-5676 Driv.	7.0 ma.	100
Final radio stage	(2) CK-573AX	9.0 ma.	100
Modulator	(2) CK-5672	1.5 ma.	80
Type of oscillator circuit <p style="text-align: center;">Crystal controlled electron coupled</p>	Plate power supply for last radio stage Rated Current <u>18 ma.</u>		
Type or class of modulation <p style="text-align: center;">Armstrong, multiplied 48 times</p>	Rated Voltage <u>100 volts</u>		
Which radio stage is to be modulated? <p style="text-align: center;">Modulator stage, acting as a buffer between oscillator and 1st multiplier.</p>	State maximum percentage of modulation <p style="text-align: center;">15 KC @ 1000 cycles</p>		
State maximum rated carrier power <p style="text-align: center;">0.5 watt</p>	Indicate frequency range of transmitter <p style="text-align: center;">152-174 MC</p>		
14. a. What apparatus is included as an integral part of the transmitter for automatically holding the frequency within the allowed frequency tolerance? <p style="text-align: center;">James Knights Co. Type H17 Crystal</p>			
b. Within how many cycles or within what percentage of the assigned frequency is this apparatus designed or guaranteed by the manufacturer to hold the operating frequency? <p style="text-align: center;">.005 %</p>			
c. State type, number, if any, and name of manufacturer of frequency-control apparatus <p style="text-align: center;">James Knights Co. Type H17 Crystal</p>			
d. Is frequency-control apparatus automatically maintained at constant temperature? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			

**INFORMATION FOR COMPLETING F.C.C. FORM 401, REV. JUNE 1951
MODEL HT-22 LDS**

13. Description of transmitting apparatus proposed to be installed			
Make <p align="center">Hallicrafters Co.</p>		Type or Model No. <p align="center">HT-22 LDS</p>	
Tube Complement	Number and type of tubes	Normal plate current per tube	Plate voltage
Oscillator stage	(1) CK-5672	2.0 ma.	90
Intermediate stages	(1) CK-5678 Quad.	1.0 ma.	74
	(1) 1AD4 Trip.	3.0 ma.	74
	(1) 1AD4 Doub.	4.0 ma.	74
	(1) CK-5676 Doub.	4.0 ma.	74
	(1) CK-5676 Driv.	6.0 ma.	135
Final radio stage	(2) CK-573AX	7.0 ma.	135
Modulator	(2) CK-5672	2.0 ma.	74
Type of oscillator circuit <p align="center">Crystal controlled electron coupled</p>		Plate power supply for last radio stage Rated Current <u>14 ma.</u>	
Type or class of modulation <p align="center">Armstrong, multiplied 48 times</p>		Rated Voltage <u>135 volts</u>	
Which radio stage is to be modulated? <p align="center">Modulator stage, acting as a buffer between oscillator and 1st multiplier.</p>		State maximum percentage of modulation <p align="center">15 KC @ 1000 cycles</p>	
State maximum rated carrier power <p align="center">0.5 watt</p>		Indicate frequency range of transmitter <p align="center">152-174 MC</p>	
14. a. What apparatus is included as an integral part of the transmitter for automatically holding the frequency within the allowed frequency tolerance? <p align="center">James Knights Co. Type H17 Crystal</p>			
b. Within how many cycles or within what percentage of the assigned frequency is this apparatus designed or guaranteed by the manufacturer to hold the operating frequency? <p align="center">.005 %</p>			
c. State type, number, if any, and name of manufacturer of frequency-control apparatus <p align="center">James Knights Co. Type H17 Crystal</p>			
d. Is frequency-control apparatus automatically maintained at constant temperature? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			

SERVICE PARTS LIST FOR TRANSMITTER-RECEIVER

Order parts by Hallicrafters Part Number and Description

Schematic Symbol	Description	Hallicrafters Part Number	Cross Reference
CAPACITORS			
C-1,29,54,59,63	25 mmf. 500 V., ceramic	47A285	174-0010-00
C-2,3,4,5,20,57,58, 61,62,64,65	250 mmf. 500 V., mica; toothpick type	47A279	172-5000-00
C-6,9,11,13,15,16, 25,31,33,38	.02 mfd. 400 V., tubular	47A277	173-5003-00
C-7,10,12	.1 mmf. gimmick	-----	-----
C-8	.68 mmf. 500 V., gimmick	47A160-1	-----
C-14,18,28,36	100 mmf. 500 V., ceramic	47X30UK101K	174-0017-00
C-17	1 mmf. 500 V., gimmick	47A160-2	174-0001-00
C-19,35,46	2.2 mmf. 500 V., gimmick	47A160-4	174-0002-00
C-21	500 mmf. 500 V., ceramic	47A278	174-0018-00
C-22,23	.01 mfd. 450 V., ceramic disc	47A217	174-0021-00
C-24,47,50	1000 mmf. 500 V., ceramic	47A280	174-0019-00
C-26,34,37,45,52,53, 55,56	.002 mfd. 400 V., tubular	47A276	173-5000-00
C-27,48,49	.005 mfd. 450 V., ceramic disc	47A168	174-0020-00
C-30	10 mmf. 500 V., ceramic	47X20CK100F	174-0005-00
C-32	5 mmf. 500 V., ceramic	47A289	174-0022-00
C-51	250 mfd. 6 V., electrolytic	45A201	170-0003-00
C-60	50 mmf. 500 V., ceramic	47A284	174-0012-00
C-66A & B	Capacitor, variable; 7-45 mmf. each section	44A413	171-0007-00
RESISTORS			
R-1	2 megohms 1/2 watt, carbon	23X20X205K	160-0167-00
R-2,4,13,37,38,41,43	47,000 ohms 1/2 watt, carbon	23X20X473K	160-0128-00
R-3	.868 ohms; #26 nichrome wire	87A2388	-----
R-5,14,16,17,18,19	560,000 ohms 1/2 watt, carbon	23X20X564K	160-0154-00
R-6,8,10,23,24,25,26, 27,35,36,44	100,000 ohms 1/2 watt, carbon	23X20X104K	160-0136-00
R-7,21,22,28,42	220,000 ohms 1/2 watt, carbon	23X20X224K	160-0145-00
R-9,15,40	150,000 ohms 1/2 watt, carbon	23X20X154K	160-0140-00
R-11,12	1 megohm 1/2 watt, carbon	23X20X105K	160-0160-00
R-20	Volume control; 500,000 ohms	25B975	162-0006-00
R-39	27 ohms 1/2 watt, carbon	23X20X270K	160-0001-00
R-45,47	510 ohms 1/2 watt, carbon	23X20X511K	160-0081-00
R-46	22,000 ohms 1/2 watt, carbon (models LDS and LWS)	23X20X223K	-----
R-46	39,000 ohms 1/2 watt, carbon (model HWS)	23X20X393K	160-0126-00
R-48	10,000 ohms 1/2 watt, carbon	23X20X103K	160-0112-00
R-49	.56 ohms; #26 nichrome wire	87A2388	-----
R-50	1000 ohms 1/2 watt, carbon (used only on models LDS and LWS)	23X20X102K	160-0088-00
COILS AND TRANSFORMERS			
L-1,3	Choke, RF	53A256	P-4686-5
L-2	Coil, buffer neutralizing	51A1517	P-4688
L-4	Choke, RF	53-257	P-4447
L-5	Coil, final neutralizing	51A1518	P-4689
L-6	Coil, final plate	51A1516	P-4686-1
T-1	Transformer, 1st RF	50C533	P-4380
T-2	Transformer, 2nd RF	50C534	P-4381
T-3,4,5	Transformer, 1st mixer, 1st IF, and 2nd IF	50C535	P-4374
T-6,7	Transformer, 2nd mixer and 3rd IF	50C536	P-4382
T-8	Transformer, discriminator	50C537	P-4383
T-9	Transformer, modulation and audio output	55C183	P-4282-3
T-10	Transformer, oscillator; receiver	50C538	P-4384
T-11	Transformer, multiplier; receiver	50C539	P-4385
T-12	Transformer, oscillator; transmitter	50C540	P-4401
T-13	Transformer, modulator plate	50C541	P-4402
T-14	Transformer, quadrupler and tripler	50C542	P-4682
T-15	Transformer, 1st doubler	50C543	P-4683
T-16	Transformer, 2nd doubler	50C544	P-4684
T-17	Transformer, buffer	50C545	P-4685
PLUGS AND SOCKETS			
PL-1	Plug, power supply	41B18762	-----
PL-2	Plug, handset	35-022	144-0006-00
SO-2	Socket, handset	10A491	145-0003-00
SO-3	Socket, antenna	10A490	P-4261
	Socket, crystal	6A417	141-0012-00
	Socket, tube; 6 pin	6A418	141-0006-00
	Socket, tube; 5 pin	6A419	141-0004-00

SERVICE PARTS LIST TRANSMITTER-RECEIVER (Cont.)

Schematic Symbol	Description	Hallicrafters Part Number	Cross Reference
TUBE COMPLEMENT			
V-1, 2, 12, 18, 19	1AD4: 1st RF amplifier, 2nd RF amplifier, multiplier, tripler, and 1st doubler	90X1AD4	140-0002-00
V-3, 6, 10, 17	CK5678: 1st mixer, 2nd mixer, audio amplifier, and quadrupler	90XCK5678	140-0015-00
V-4, 5, 7, 8, 9, 11	2E32: 1st IF amplifier, 2nd IF amplifier, 3rd IF amplifier, 1st limiter, 2nd limiter and oscillator (receiver)	90X2E32	140-0004-00
V-13	2E41: squelch	90X2E41	-----
V-14, 15, 16	CK5672: oscillator (transmitter), modulators	90XCK5672	140-0013-00
V-20	CK5676: 2nd doubler	90XCK5676	-----
V-21	CK5676: buffer (models LDS and LWS)	90XCK5676	140-0014-00
V-21	CK573AX: buffer (model HWS)	90XCK573AX	140-0012-00
V-22, 23	CK573AX: final amplifiers	90XCK573AX	140-0012-00
MISCELLANEOUS PARTS			
	Antenna	57-158	P-4409
	Cord, handset; coiled	87-3567	131-0002-00
GR-1, 2	Crystal diode, germanium	19A1879	149-0005-00
X-1	Crystal, receiver (specify frequency)	19A1880	Knights Type H17
X-2	Crystal, transmitter (specify frequency)	19A1881	Knights Type H17
	Handset	85-125	131-0001-00
	Knob, volume control	15-502	126-0001-00
	Plug, button	17-123	123-0006-00
RY-1	Relay	21B139	150-0001-00
	Ring, retaining; for mtg. 6 pin tube sockets	76A917	130-0004-00
	Ring, retaining; for mtg. 5 pin tube sockets	76A918	130-0003-00

SERVICE PARTS LIST HT-22 HWS POWER SUPPLY

Schematic Symbol	Description	Hallicrafters Part Number	Cross Reference
CAPACITORS			
C-101, 102	250 mmf. 500 V., mica; toothpick type	47A279	172-5000-00
C-103	.5 mfd. 100 V., tubular	46A196	173-0005-00
C-104	.004 mfd. 1600 V., tubular	46A195	173-5001-00
C-105A & B	Dual 20 mfd. 250 V., electrolytic	45A202	170-0002-00
RESISTORS			
R-101	220 ohms 1/2 watt, wirewound	24BX221E	161-0072-00
COILS AND TRANSFORMERS			
L-101	Choke, RF	53A261	136-0003-00
T-101	Transformer, vibrator	52-252	134-0003-00
PLUGS AND SOCKETS			
PL-102	Plug, 1 pin; for test meter	35A023	144-0001-00
PL-103	Plug, battery connector	41X18711	-----
SO-101	Socket, power supply	6A426	P-4756-1
SO-102	Jack, insulated; for test meter	6A424	141-0001-00
SO-104	Socket, battery charging	6A431	141-0002-00
	Socket, battery connector (does not include contacts)	35-024	P-4457-4
	Retainer for battery connector socket	8A1772	P-4457-5
	Contact, small (for battery connector socket)	18-113	128-0002-00
	Contact, large (for battery connector socket)	18-114	128-0001-00
	Socket, vibrator	6A425	141-0007-00
MISCELLANEOUS PARTS			
SR-101, 103, 104, 105	Rectifier, selenium; 50 ma	27A165	149-0003-00
SR-102, 106	Rectifier, selenium; 65 ma	27A166	149-0004-00
E-101	Vibrator	27B177	143-0002-00
S-101	Switch, on-off; spst	60-484	138-0001-00
	Battery, 2 volt storage; Willard ERH-25-2	27B164	121-0002-00
	Tube, battery ventilation; rubber	8A1786	P-4736

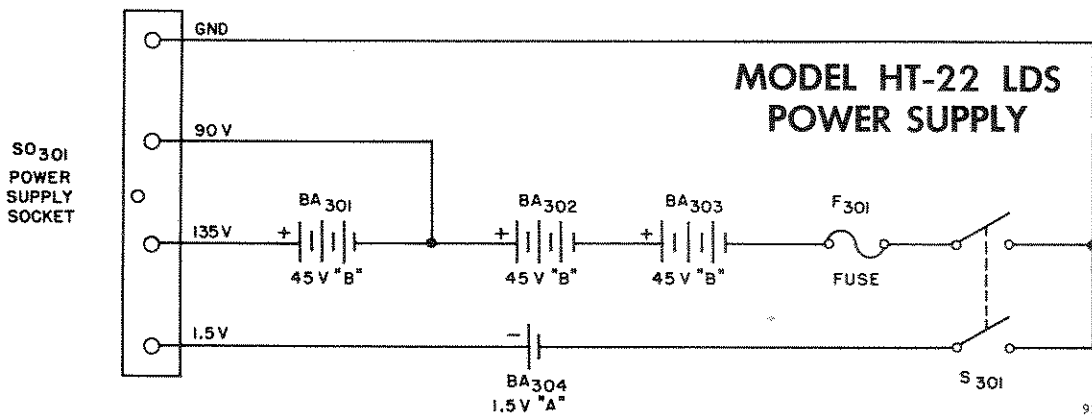
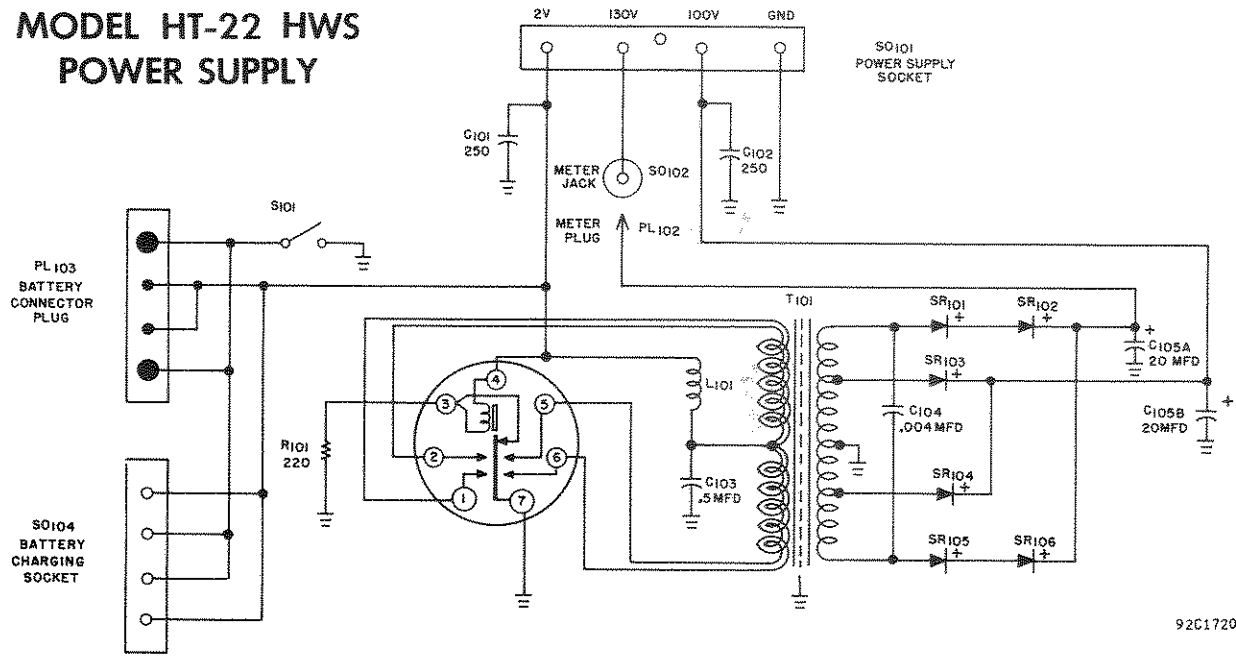
SERVICE PARTS LIST HT-22 LWS POWER SUPPLY

Schematic Symbol	Description	Hallicrafters Part Number	Cross Reference
CAPACITORS			
C-201,202,203	250 mmf. 500 V., mica; toothpick type	47A279	172-5000-00
C-204	.5 mfd. 100 V., tubular	46A196	173-0005-00
C-205	.013 mfd. 600 V., tubular	46A201	173-5002-00
C-206A & B	Dual 20 mfd. 250 V., electrolytic	45A202	170-0002-00
RESISTORS			
R-201	220 ohms 1/2 watt, wirewound	24BX221E	161-0072-00
R-202	510 ohms 1/2 watt, carbon	23X20X511K	160-0081-00
COILS AND TRANSFORMERS			
L-201	Choke, RF	53A261	136-0003-00
T-201	Transformer, vibrator	52-253	134-0004-00
PLUGS AND SOCKETS			
PL-202	Plug, 1 pin; for test meter	35A023	144-0001-00
PL-203	Plug, battery connector	41X18711	-----
SO-201	Socket, power supply	6A426	P-4756-1
SO-202	Jack, insulated; for test meter	6A124	141-0001-00
SO-204	Socket, battery charging	6A431	141-0002-00
	Socket, battery connector (does not include contacts)	35-024	P-4457-4
	Retainer for battery connector socket	8A1772	P-4457-5
	Contact, small (for battery connector socket)	18-113	128-0002-00
	Contact large (for battery connector socket)	18-114	128-0001-00
	Socket, vibrator	6A425	141-0007-00
MISCELLANEOUS PARTS			
E-201	Battery, 2 volt storage; Willard ER-11-2	27B168	121-0001-00
S-201	Vibrator	27B167	143-0001-00
	Switch, on-off; spst.	60-484	138-0001-00
	Tube, battery ventilation; rubber	8A1750	P-4736

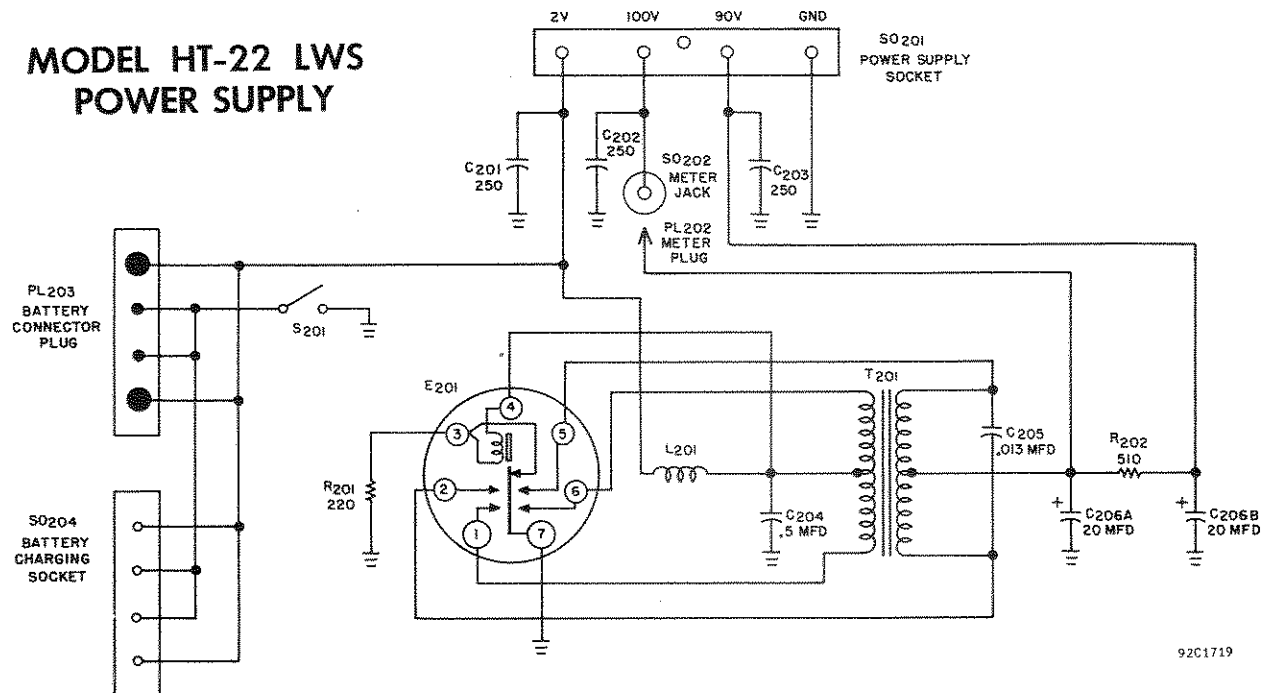
SERVICE PARTS LIST HT-22 LDS POWER SUPPLY

Schematic Symbol	Description	Hallicrafters Part Number	Cross Reference
PLUGS AND SOCKETS			
	Battery connector assembly (for battery BA-301)	87-3587	121-0003-00
	Plug, battery; 2 prong	10A227	132-0003-00
	Plug, battery; 3 prong	10A284	132-0004-00
SO-301	Socket, power supply	6A439	P-4756-1A
MISCELLANEOUS PARTS			
F-301	Fuse, 1/16 amp.	39-374	124-0003-00
S-301	Switch, on-off; dpst.	60-499	138-0007-00

MODEL HT-22 HWS POWER SUPPLY

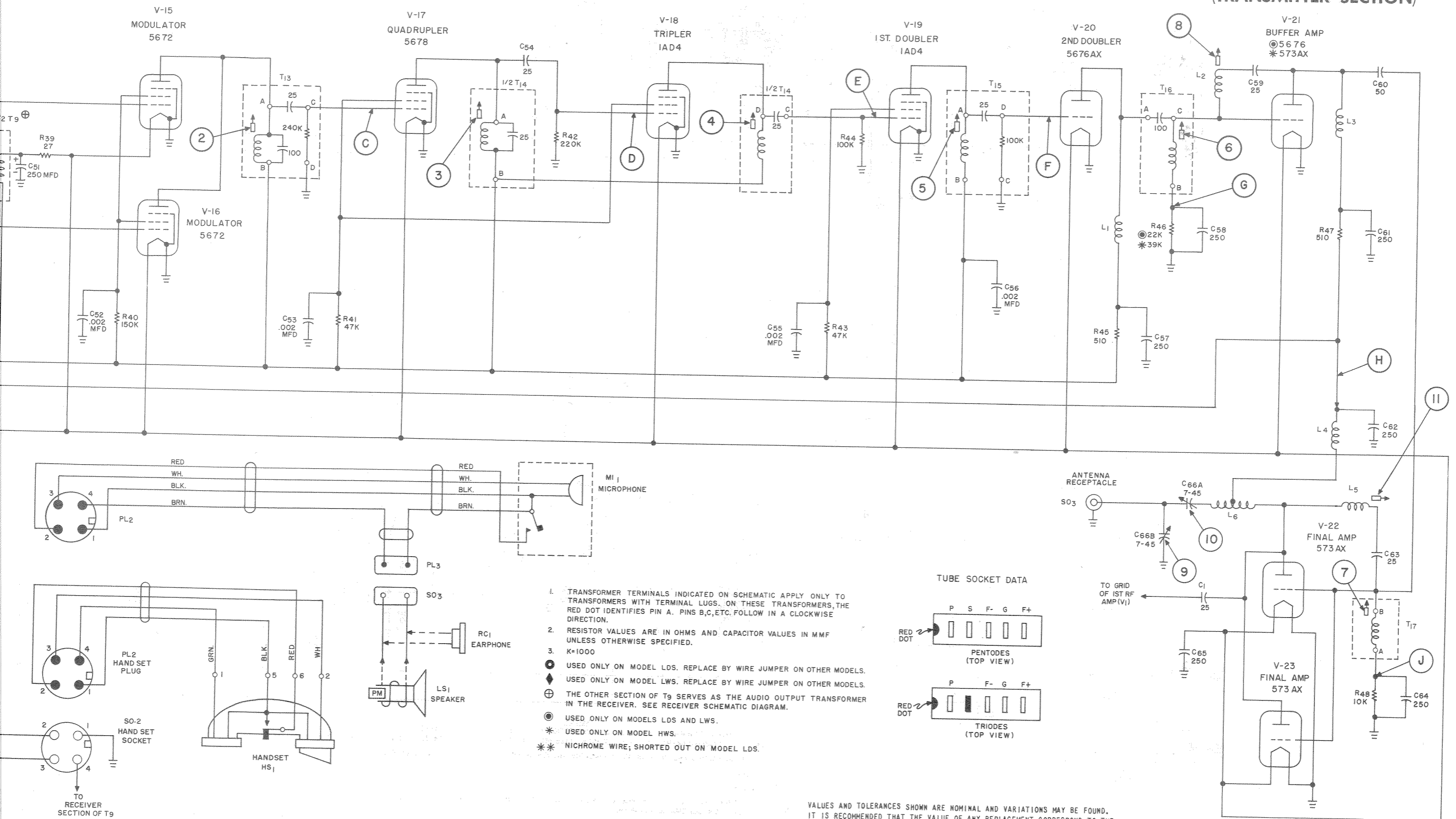


MODEL HT-22 LWS POWER SUPPLY



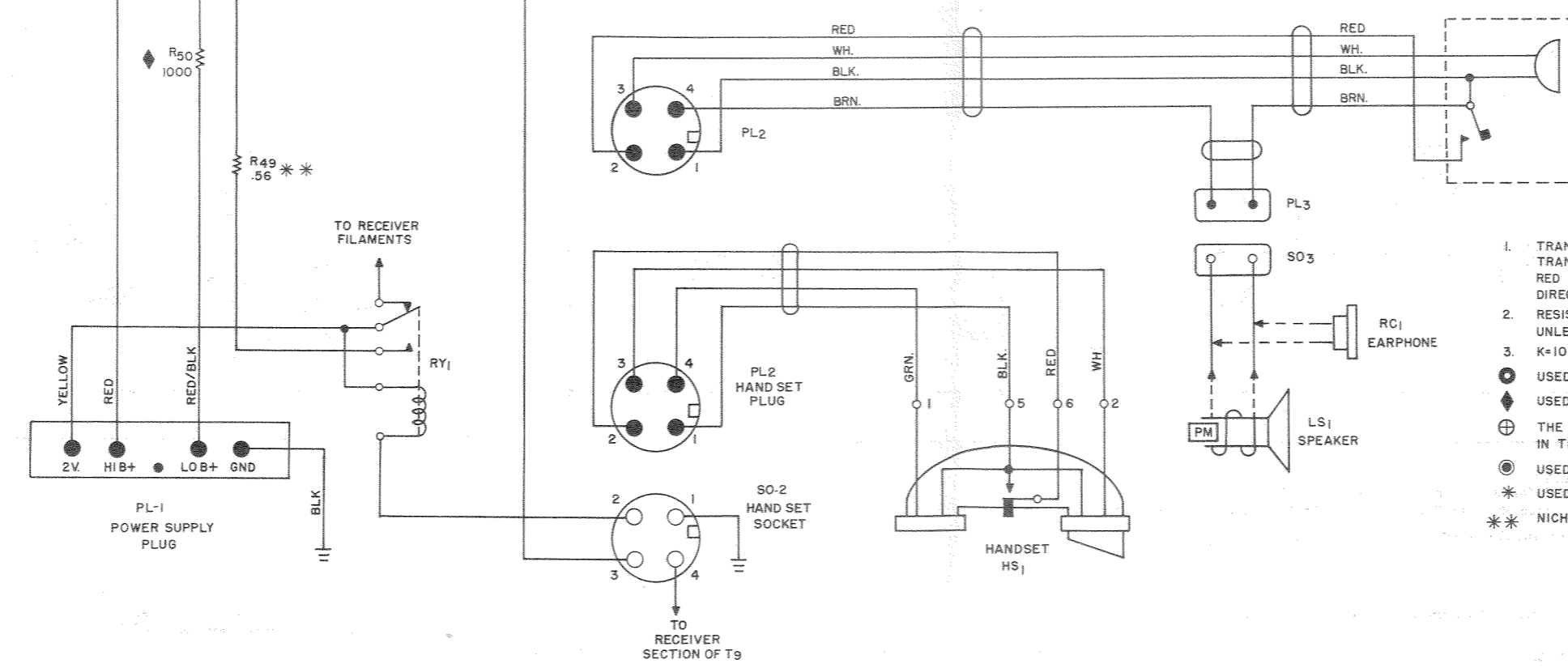
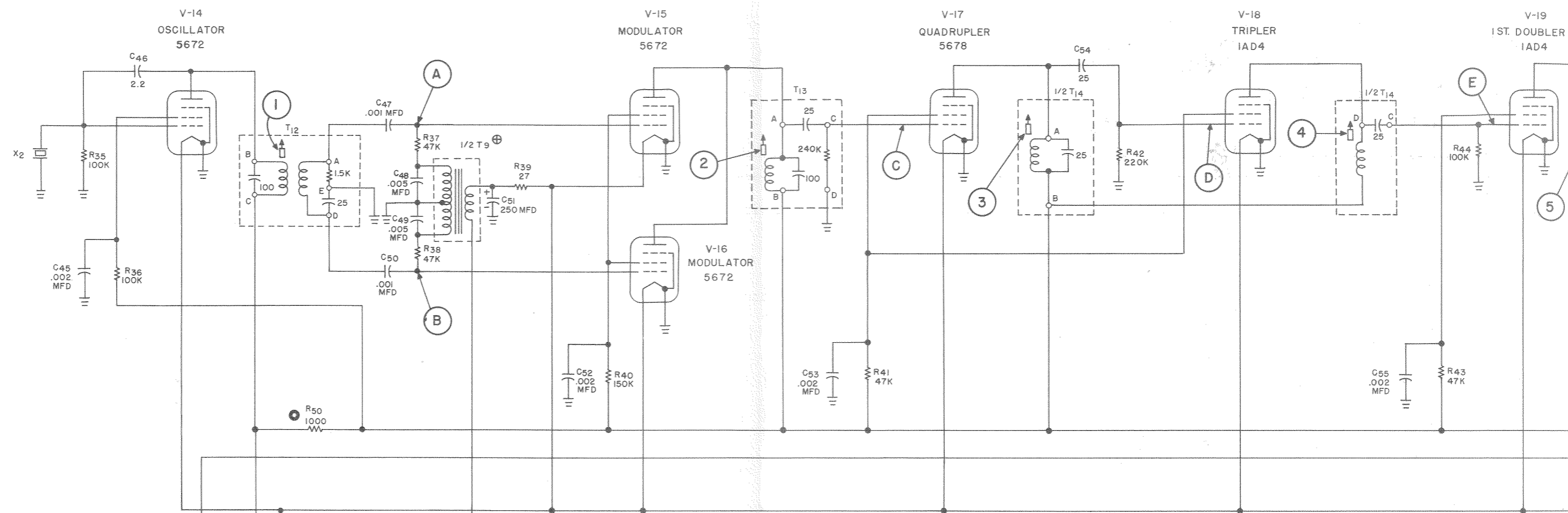
MODELS HT-22 LDS, LWS & HWS

RUN 1 (TRANSMITTER SECTION)



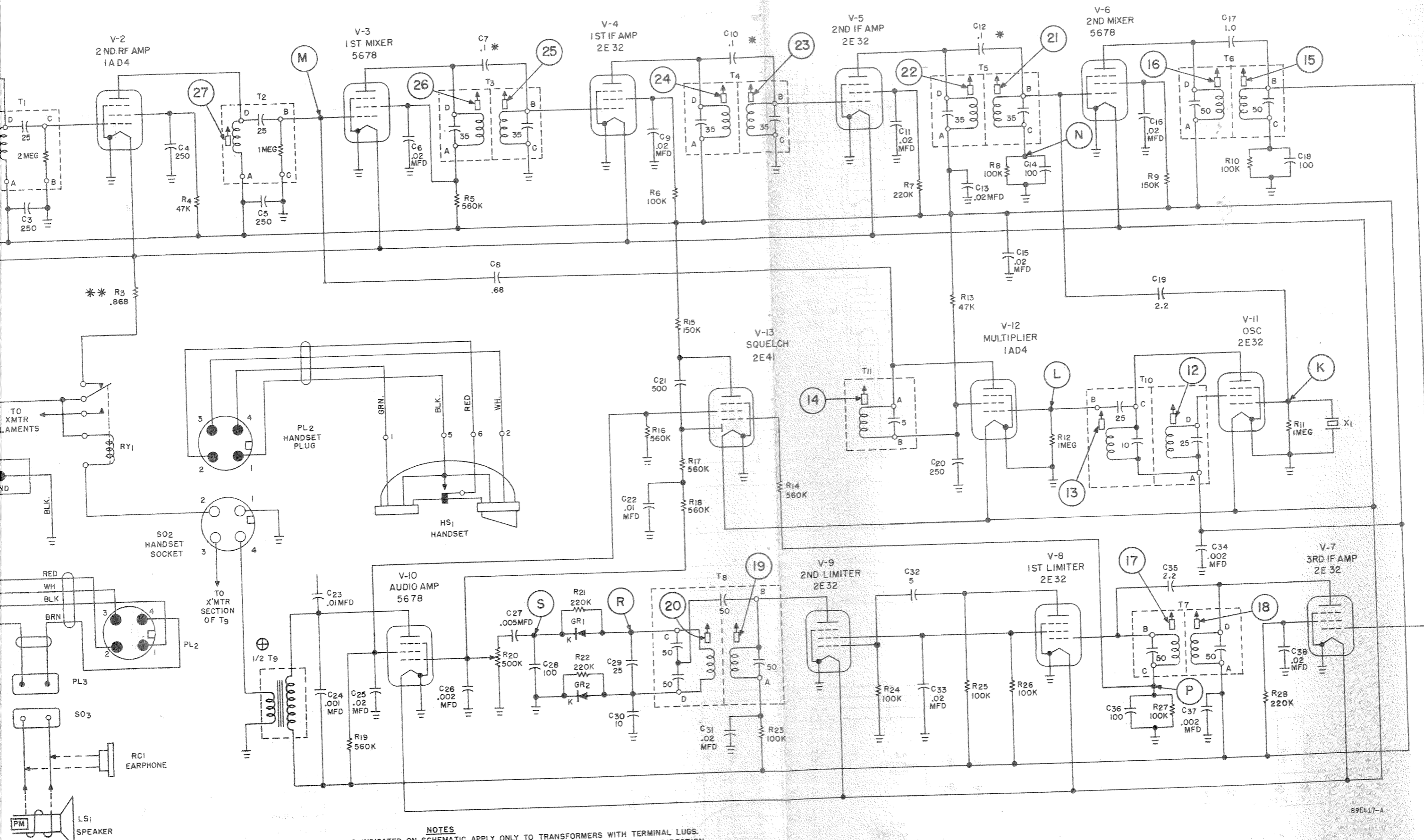
1. TRANSFORMER TERMINALS INDICATED ON SCHEMATIC APPLY ONLY TO TRANSFORMERS WITH TERMINAL LUGS. ON THESE TRANSFORMERS, THE RED DOT IDENTIFIES PIN A. PINS B,C,ETC. FOLLOW IN A CLOCKWISE DIRECTION.
2. RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES IN MMF UNLESS OTHERWISE SPECIFIED.
3. K=1000
- ⊙ USED ONLY ON MODEL LDS. REPLACE BY WIRE JUMPER ON OTHER MODELS.
- ◆ USED ONLY ON MODEL LWS. REPLACE BY WIRE JUMPER ON OTHER MODELS.
- ⊕ THE OTHER SECTION OF T₉ SERVES AS THE AUDIO OUTPUT TRANSFORMER IN THE RECEIVER. SEE RECEIVER SCHEMATIC DIAGRAM.
- ⊙ USED ONLY ON MODELS LDS AND LWS.
- * USED ONLY ON MODEL HWS.
- ** NICHROME WIRE; SHORTED OUT ON MODEL LDS.

VALUES AND TOLERANCES SHOWN ARE NOMINAL AND VARIATIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE VALUE OF ANY REPLACEMENT CORRESPOND TO THE NOMINAL VALUE OF THE PART BEING REPLACED.



1. TRANSFORMER TERMINALS INDICATED ON SCHEMATIC APPLY ONLY TO TRANSFORMERS WITH TERMINAL LUGS. ON THESE TRANSFORMERS, THE RED DOT IDENTIFIES PIN A. PINS B,C,ETC. FOLLOW IN A CLOCKWISE DIRECTION.
2. RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES IN MMF UNLESS OTHERWISE SPECIFIED.
3. K=1000
- ⊙ USED ONLY ON MODEL LDS. REPLACE BY WIRE JUMPER ON OTHER MODELS.
- ◆ USED ONLY ON MODEL LWS. REPLACE BY WIRE JUMPER ON OTHER MODELS.
- ⊕ THE OTHER SECTION OF T₉ SERVES AS THE AUDIO OUTPUT TRANSFORMER IN THE RECEIVER. SEE RECEIVER SCHEMATIC DIAGRAM.
- ⊙ USED ONLY ON MODELS LDS AND LWS.
- * USED ONLY ON MODEL HWS.
- ** NICHROME WIRE; SHORTED OUT ON MODEL LDS.

VALUES AND TOLERANCES SHOWN
IT IS RECOMMENDED THAT THE
NOMINAL VALUE OF THE PART BE



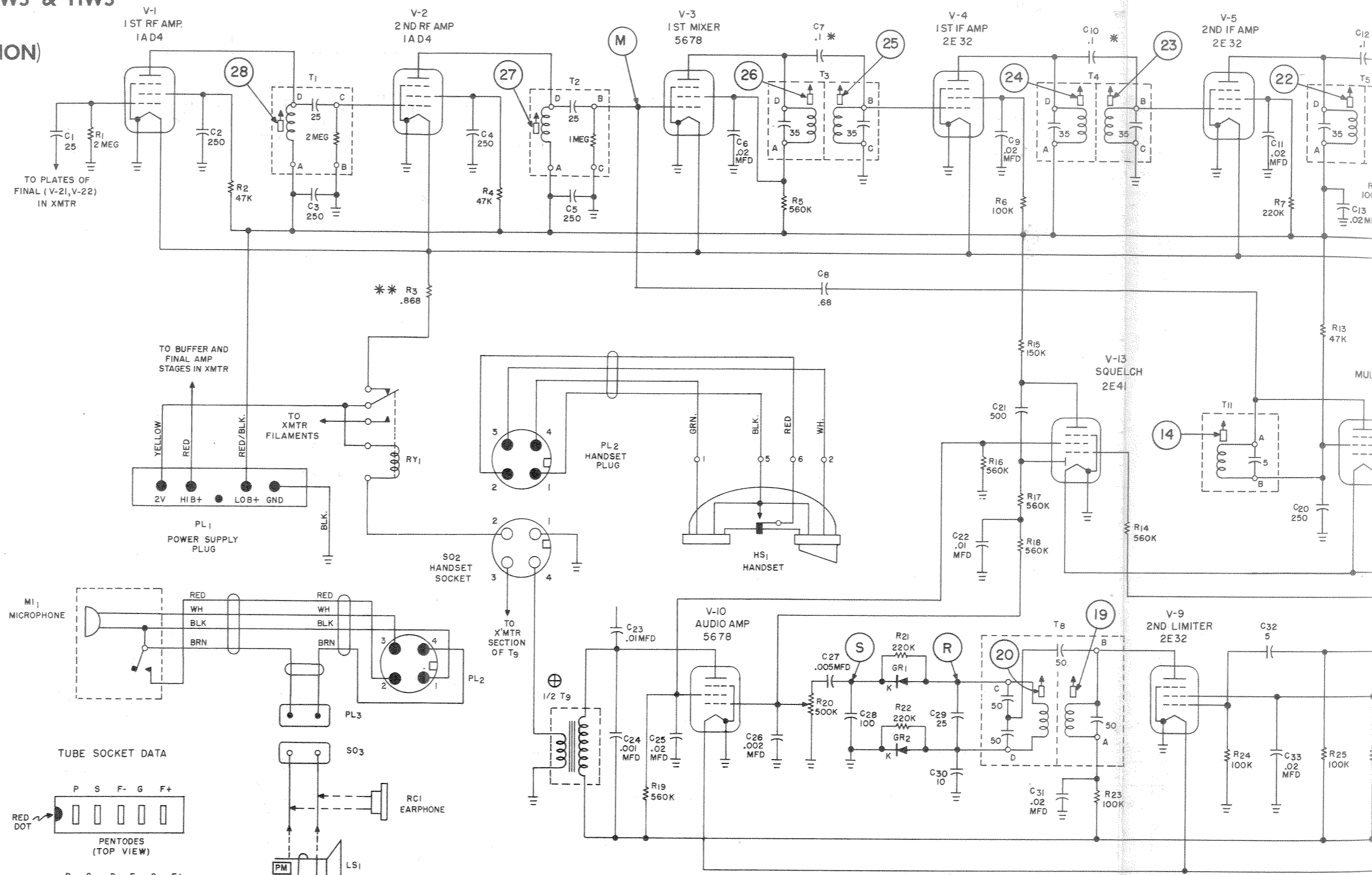
NOTES

1. TRANSFORMER TERMINALS INDICATED ON SCHEMATIC APPLY ONLY TO TRANSFORMERS WITH TERMINAL LUGS. ON THESE TRANSFORMERS, THE RED DOT IDENTIFIES PIN A. PINS B, C, ETC. FOLLOW IN A CLOCKWISE DIRECTION.
2. RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES IN MMF UNLESS OTHERWISE SPECIFIED.
3. K=1000
- * GIMMICK
- ⊕ THE OTHER SECTION OF T9 SERVES AS A MODULATION TRANSFORMER IN THE TRANSMITTER. SEE TRANSMITTER SCHEMATIC DIAGRAM.
- ** NICHROME WIRE; SHORTED OUT ON MODEL LDS.

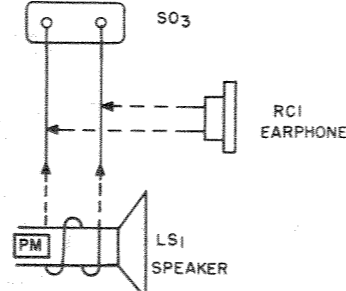
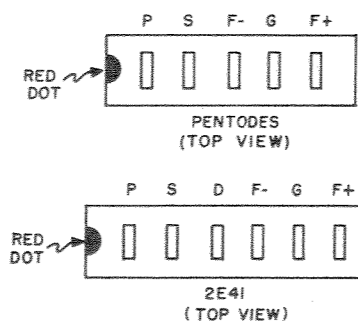
VALUES AND TOLERANCES SHOWN ARE NOMINAL AND VARIATIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE VALUE OF ANY REPLACEMENT CORRESPOND TO THE NOMINAL VALUE OF THE PART BEING REPLACED.

MODELS HT-22 LDS, LWS & HWS

RUN 1 (RECEIVER SECTION)



TUBE SOCKET DATA



- NOTES**
1. TRANSFORMER TERMINALS INDICATED ON SCHEMATIC APPLY ONLY TO TRANSFORMERS WITH TERMINAL LUGS. ON THESE TRANSFORMERS, THE RED DOT IDENTIFIES PIN A. PINS B, C, ETC. FOLLOW IN A CLOCKWISE DIRECTION.
 2. RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES IN MMF UNLESS OTHERWISE SPECIFIED.
 3. K=1000
 - * GIMMICK
 - ⊕ THE OTHER SECTION OF T9 SERVES AS A MODULATION TRANSFORMER IN THE TRANSMITTER. SEE TRANSMITTER SCHEMATIC DIAGRAM.
 - ** NICHROME WIRE; SHORTED OUT ON MODEL LDS.

VALUES
IT IS
NOMINAL

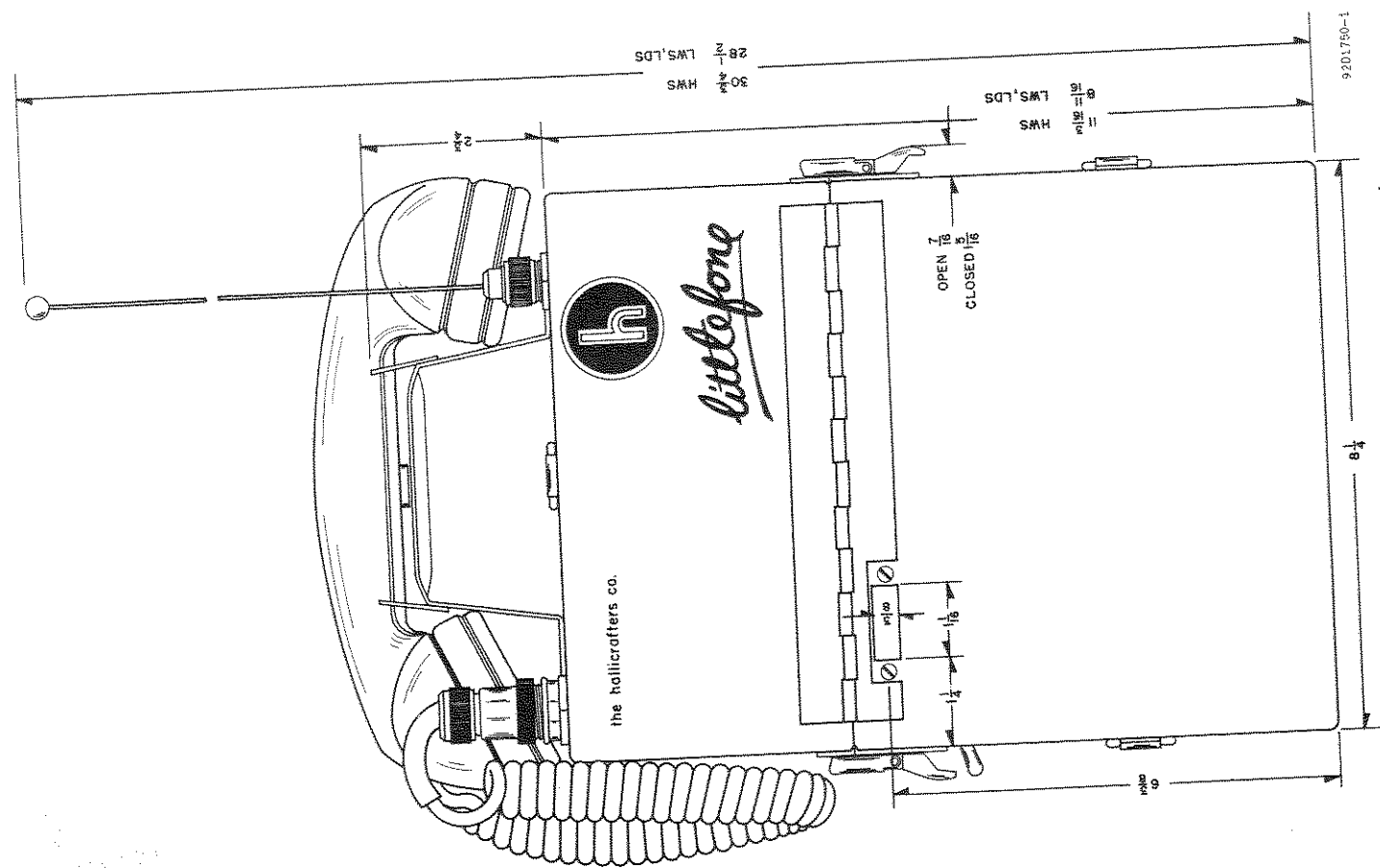


Fig. 5. Front View of Model HT-22 Showing Dimensions

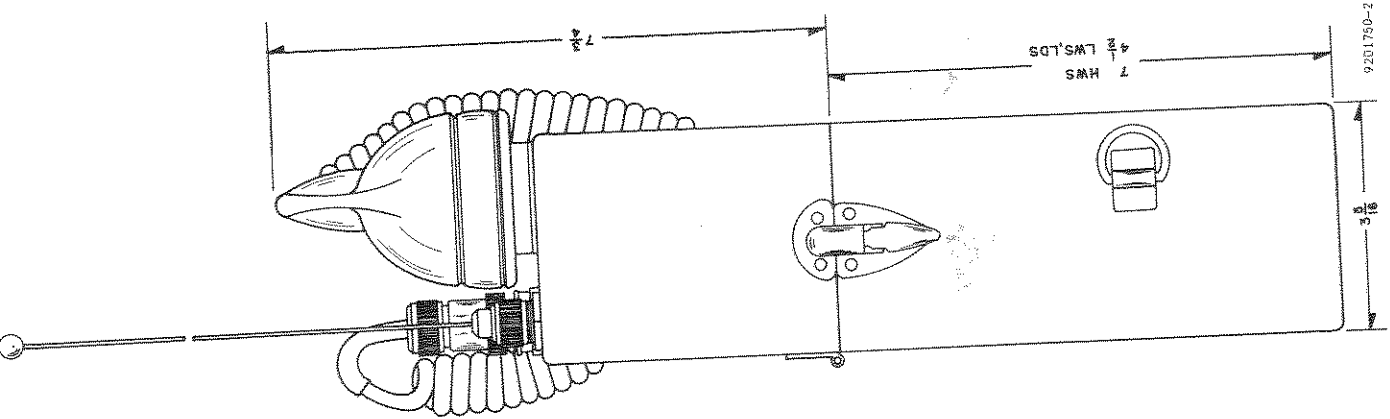


Fig. 6. Side View of Model HT-22 Showing Dimensions

Warranty

"The Hallicrafter's Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to our authorized radio dealer, wholesaler, from whom purchased, or, authorized service center, intact, for examination, with all transportation charges prepaid within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory or authorized service center, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products."

Form No. 94X622

the Hallicrafters co.