

PHILCO



SERVICE

HOME RADIO

PHILCO RADIO, MODEL 46-451

CIRCUIT DESCRIPTION

The Philco Model 46-451 is a seven-tube superheterodyne radio, providing reception on the standard broadcast band, 540 to 1720 kilocycles, and on a short-wave band, 9.3 to 15 megacycles, by manual tuning. In addition, five push buttons are included for instant tuning of selected stations in the broadcast band.

The band switch selects either push-button tuning on the broadcast band, or manual tuning of the broadcast or short-wave band.

A low-impedance loop aerial built into the cabinet normally provides adequate signal pickup on both bands. Provision has been made for connecting an external aerial when required.

A dual-triode tube, type 7AF7, is employed as a converter. One triode section of this tube operates as a mixer, and the other as a local oscillator. Oscillator-signal voltage is applied to the mixer section of the tube by capacity coupling between the cathodes of the two sections. On the short-wave band, interlocking between the aerial circuit and the oscillator circuit adjustments (the cause of oscillator-frequency shift) is greatly minimized by a reverse-feedback circuit which neutralizes any oscillator-signal voltage that may appear at the grid of the mixer.

The intermediate-frequency signal is amplified by two i-f stages using type 7H7 high-transconductance pentode tubes. The amplified i-f signal is applied to the input of a double-diode tube, type 6H6GT/G, to develop the audio signal and a-c voltage.

A type 7C6 tube is used in the first audio-amplifier stage, while a type 6K6GT/G is used in the audio-output stage, supplying approximately 2 watts to the electrodynamic speaker.

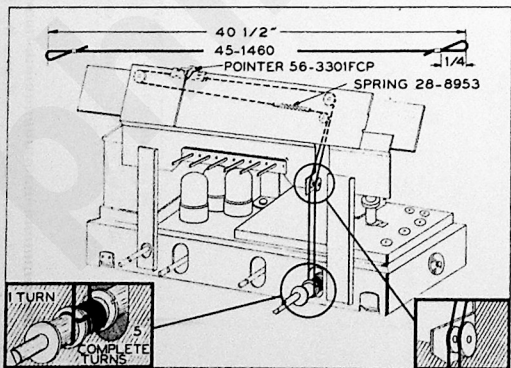


Figure 1. Dial-Cord Installation. TP-2187-A



TP-2022

SPECIFICATIONS

CABINET	Table model, wood, walnut finish
CIRCUIT	Seven-tube superheterodyne
FREQUENCY RANGES	Broadcast: 540 to 1720 kc Short wave: 9.3 to 15 mc
PUSH BUTTONS	Six; 1 for ON-OFF, 5 for broadcast-station selection
OPERATING VOLTAGE	105 to 120 volts, 50-60 cycles, a.c. only
POWER CONSUMPTION	65 watts
AERIAL	Built-in low-impedance loop or external aerial
INTERMEDIATE FREQUENCY	455 kilocycles
AUDIO OUTPUT	2 watts
SPEAKER	4" x 6" oval electrodynamic
PHILCO TUBES (7)	7AF7, 7H7(2), 6H6GT/G, 7C6, 6K6GT/G, 6X5GT/G
PILOT LAMPS (2)	6-8 volt, Part No. 34-2040

PHILCO TROUBLE-SHOOTING PROCEDURE

In this manual, the circuit is divided into four sections, with schematic and chassis layouts, showing test points for each section. The first step in each trouble-shooting chart is a master check, indicating whether trouble exists in that section. Failure to secure "NORMAL INDICATION" in a given step indicates trouble, which should then be located by voltage, resistance or capacitance checks of parts indicated in the step. Components are symbolized according to the letter designations as given on the first page of the service manual for PHILCO RADIO, MODEL 46-350.

PRELIMINARY CHECKS

The following preliminary checks are recommended, before turning on the radio:

- Carefully inspect both top and bottom of the chassis. Make sure all tubes are secure in the proper positions. Look for bad connections, burnt resistors, or other obvious faults.
- Check the resistance between B+ (pin 8 of 6X5GT/G tube) and chassis, with the ohmmeter polarity such that it gives the highest resistance reading; if lower than 50,000 ohms, check condensers C101 and C102 (A and B) for leakage or shorts.

CALIBRATING DIAL BACKPLATE

After the receiver is removed from the cabinet, dial calibration and alignment points should be made with a pencil on the dial-backplate assembly below the pointer. The method of measuring for these points is illustrated in figure 2, which shows the relationship between dial markings and scale backplate. Hold a ruler against the scale backplate in the position shown, and make dots at the proper points for the desired frequency settings. For example: The index mark is $2\frac{1}{2}$ " from the reference line. With the tuning gang fully meshed, the pointer should be adjusted to coincide with the index mark.

TESTS TO ISOLATE TROUBLE WITHIN SECTION 1

Make all tests for this section with a 20,000-ohms-per-volt meter, using the applicable d-c ranges. All voltages given in this manual are average, and were taken with a 117-volt, 60-cycle, a-c input. The volume control was set at minimum, the tuning control at 540 kc, the tone control to extreme counterclockwise position, and the band switch at 'BDC'ST'.

If the "NORMAL INDICATION" is obtained in step 1, proceed to tests for Section 2. If not, isolate and remedy the trouble in this section. It will be noted that certain parts in other sections of the receiver are listed under "POSSIBLE CAUSE OF ABNORMAL OPERATION".

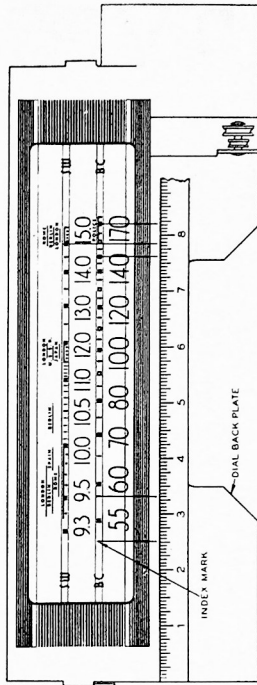


Figure 2. Calibrating Dial Backplate.

1P-2187-B

STEP	TEST POINTS	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	E to C	240 volts	Trouble within this section. Isolate by the following tests.
2	A to C	305 volts	Defective 6X5GT/G, C101, C102A, C102B, R100, or T100.
3	B to C	Negative 15 volts	Open or shorted R101.
4	D to C	185 volts	Open R100, R303, R305, or R404. Shorted C102A, C305, C308, or C412.
5	E to C	240 volts	Defective L100 or T200. Shorted C303, C306, or C309.

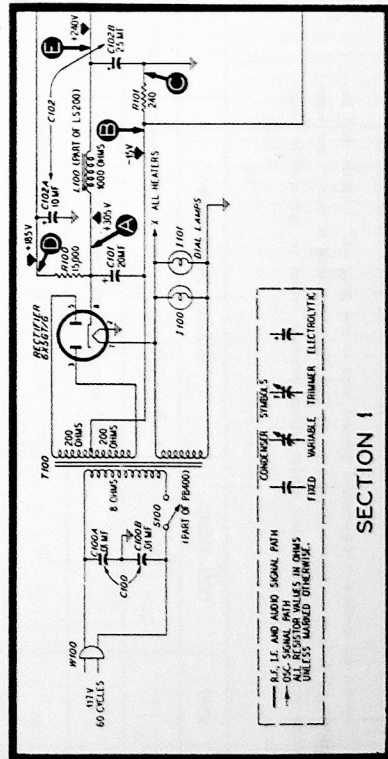


Figure 3. Section 1 Schematic.

1P-2187-C

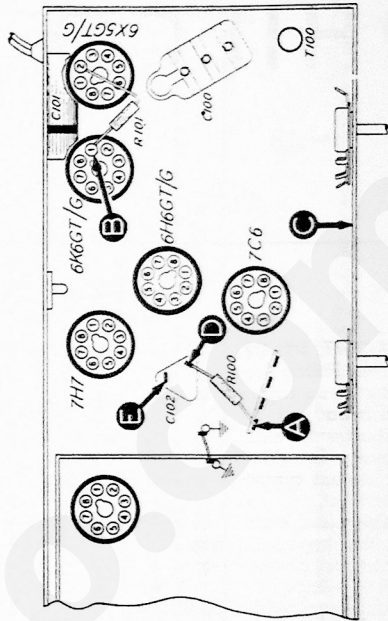


Figure 4. Bottom View, Showing Section 1 Test Points.

1P-2187-D

TESTS TO ISOLATE TROUBLE WITHIN SECTION 2

Connect an audio-signal-generator ground lead to test point "C" (chassis) and the output lead through a .1-mfd condenser to the test points indicated in chart. Set radio volume control to maximum, and adjust signal-generator output as indicated in chart.

If "NORMAL INDICATION" is obtained in step 1, proceed to tests for Section 3. If not, isolate and remedy the trouble in this section.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	A	Loud, clear signal with low signal-generator output.	Trouble within this section. Isolate by the following tests.
2	E	Loud, clear signal with high signal-generator output.	Defective 6K6GT/G tube, T200, LS200, R200 or R201. Shorted or leaky C201. Leaky or shorted C202.
3	D	Loud, clear signal with high signal-generator output.	Open C202. Leaky or shorted C203. Shorted C204 if tone control is in extreme clockwise position.
4	B	Loud, clear signal with low signal-generator output.	Defective 7C6 tube. Open R202.
5	A	Same.	Open C206 or C208. Leaky or shorted C310, or C312.

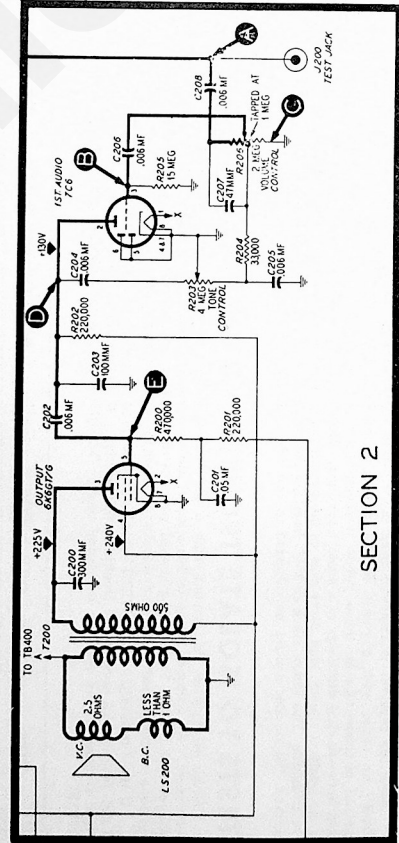
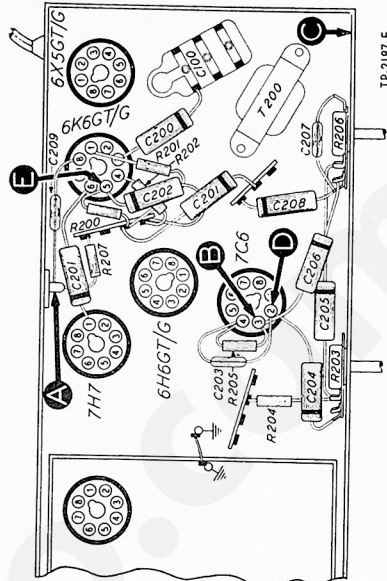


Figure 5. Section 2 Schematic.



TESTS TO ISOLATE TROUBLE WITHIN SECTION 3

For all tests in this section, use an r-f signal generator with a modulated 455-kc signal. Connect signal-generator ground lead to test point "C" (chassis); connect output lead through a .1-mf condenser to test points indicated in chart. Set volume control at maximum, and adjust signal-generator output as indicated in chart. If "NORMAL INDICATION" is obtained in step 1, proceed to tests for Section 4. If not, isolate and remedy the trouble in this section.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	A	Loud, clear signal with low signal-generator output.	Trouble within this section. Isolate by the following tests.
2	E	Loud, clear signal with high signal-generator output.	Defective 6H6GT/G tube. Improperly aligned Z302. Open R307 or R309. Shorted C310.
3	D	Loud, clear signal with moderate signal-generator output.	Defective 7H7 tube or C307. Shorted C308 or C309. Open R304, R305, or R306.
4	B	Loud, clear signal with low signal-generator output.	Defective 7H7 tube or Z301. Improperly aligned Z301. Open R302, C304, or R303. Shorted C305 or C306.
5	A	Same.	Defective or improperly aligned Z300. Open C303.

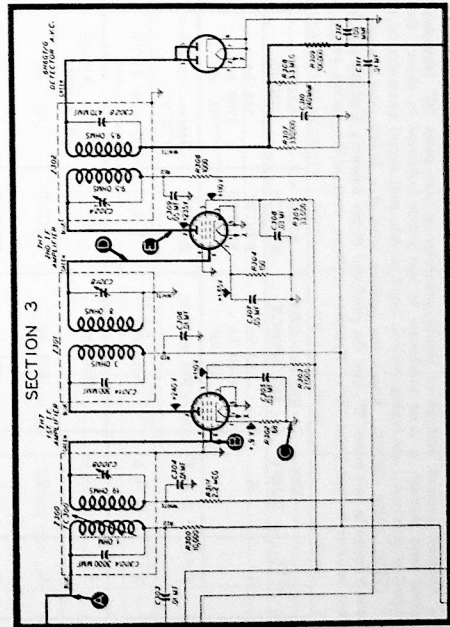


Figure 7. Section 3 Schematic.

1P-2187-G

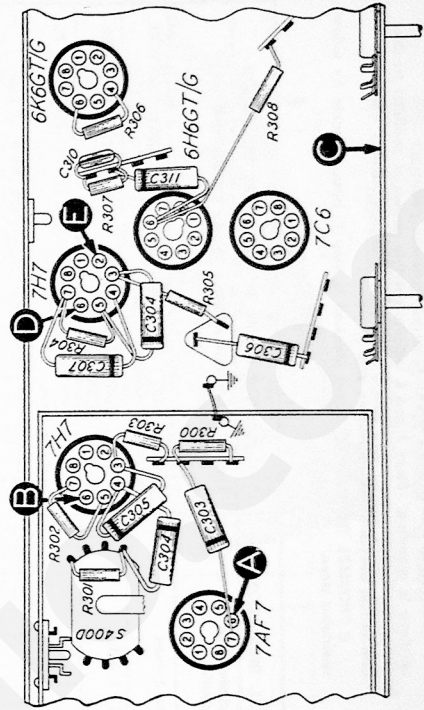


Figure 8. Bottom View, Showing Section 3 Test Points.

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TESTS TO ISOLATE TROUBLE WITHIN SECTION 4

Connect ground lead of r_f signal generator to test point "C" (chassis); connect output lead through a .1-mf condenser to test points indicated in chart. Set volume control at maximum; set tuning control, band switch, and signal generator as indicated.

OSCILLATOR CHECK: Attach the positive lead of a 20,000-ohms-per-volt meter on 10-volt range to test point "E", and the prod end of the negative lead through a 100,000-ohm resistor to test point "D". Negative voltage over entire tuning range indicates

oscillator is operating. Steps 2 and 3 indicate possible causes of oscillator trouble.

Rotate tuning control; dirt, bent plates, or poor bearing contact will cause noise. Correct this trouble before performing step 1.

If "NORMAL INDICATION" is not obtained in step 1, isolate trouble by following remaining steps.

STEP	TEST POINT	SIGNAL GEN. FREQUENCY	BAND SWITCH	RADIO TUNING	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	A	580 kc 1700 kc 15 mc	E'DC'ST E'DC'ST SW	580 kc 1700 kc 15 mc	Loud, clear signal with low signal-generator output.	Trouble within this section. Isolate by following tests.
2	D to E	Not used	E'DC'ST	Rotate through E'DC'ST	Negative 4 to 5 volts	Defective 7AF7 tube, C410A, C410B, C411, C412, S400C(F,R), L403, R403, R404, or C303.
3	D to E	Not used	P. B.	Operate each push button	Negative 4 to 5 volts	Defective L400A, L400B, L400C, L400D, L400E, C407, C408, or R402, S400C(F,R).
4	D to E	Not used	SW	Rotate through SW range	Negative 2 to 3 volts	Defective 7AF7 tube, C405, C410C, C411, C412, S400C(F,R), L404, or R404.
5	B	1000 kc	E'DC'ST	1000 kc	Loud, clear signal with low signal-generator output.	Defective 7AF7 tube, C303, C311, C409, R400, or R401.
6	A	1000 kc	E'DC'ST	1000 kc	Same	Defective L401, S400A(F,R), S400B(F), C403A, or C404.
7	A	Through range of each push button.	P. B.	Operate each push button	Same	Defective S400A(F), S400B(F), C400A, C400B, C400C, C400D, or C400E.
8	A	15 mc	SW	15 mc	Same	Defective S400A(F,R), L402, S400B(F), C402, C403B, C406.

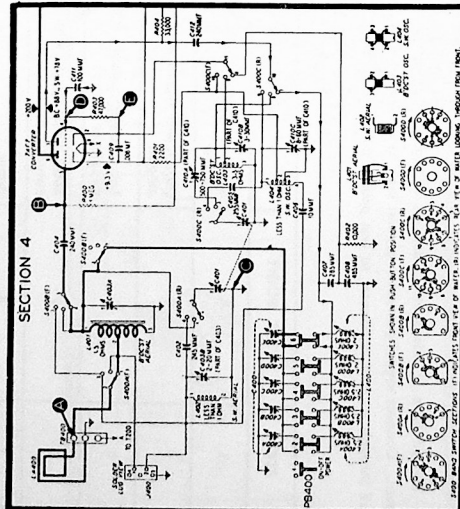


Figure 9. Section 4 Schematic.

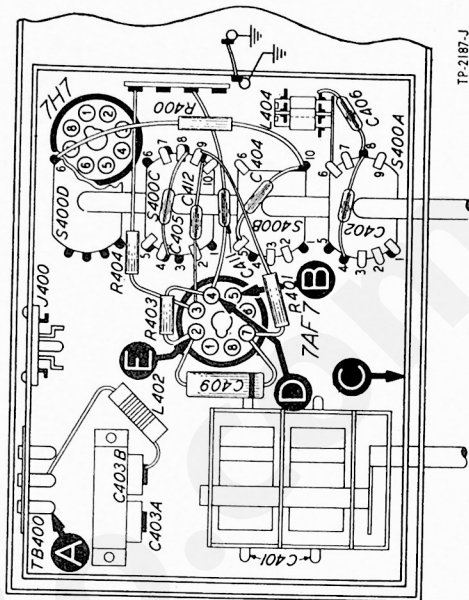


Figure 10. Bottom View, Showing Section 4 Test Points.

ALIGNMENT PROCEDURE

PRELIMINARY ADJUSTMENTS AND CONNECTIONS

SIGNAL GENERATOR: When aligning the i-f circuit, step 1, connect the signal-generator ground lead to the chassis, and the output lead through a .1-mf condenser as indicated in the alignment chart. When aligning r-f circuits, connect the signal generator to a coil of insulated wire (6 to 8 turns, about 6 inches in diameter). Suspend coil near the radio loop.*

OUTPUT METER: Connect to terminals 2 and 3 on TB400. Signal-generator input signal must be attenuated to maintain the radio output below 1.5 volts on the output meter.

CONTROL SETTINGS: Set volume control to maximum, tone control to counterclockwise position and band switch as indicated in the alignment chart.

DIAL-POINTER ADJUSTMENT: With tuning condenser plates fully meshed, adjust dial pointer to coincide with index mark at low-frequency end of the dial scale. If the chassis has been removed from the cabinet, this pointer adjustment may be made after the required calibration points have been marked on the dial backplate, as described in "CALIBRATING DIAL BACKPLATE".

* NOTE: During alignment, the loop aerial should be connected to the radio.

ALIGNMENT CHART

SIGNAL GENERATOR				RADIO			
STEP	CONNECTIONS TO RADIO	DIAL SETTING	BAND SWITCH POSITION	DIAL SETTING	SPECIAL INSTRUCTIONS	ADJUST	
1	Terminal 1 of TB400	455 kc	B'DC'ST	540 kc	Adjust for maximum once only in order	C302A C301B C300B TC300	
2	6" coil loosely coupled to loop	580 kc	B'DC'ST	580 kc	Adjust for maximum	CA10A	
3	Same	1700 kc	B'DC'ST	1700 kc	Adjust for maximum	CA10B	
4	Same	1500 kc	B'DC'ST	1500 kc	Adjust for maximum	CA403A	
5	Same	580 kc	B'DC'ST	580 kc (approx.)	Rock tuning condenser while adjusting for maximum	CA10A	
6	Repeat steps 3, 4, 5, and 4, in order until no further improvement results						
7	Same	15 mc	SW	15 mc	Adjust for maximum on first peak from loose position. Image should be heard at 14.1 mc.	CA10C	
8	Same	15 mc	SW	15 mc	Adjust for maximum	CA403B	

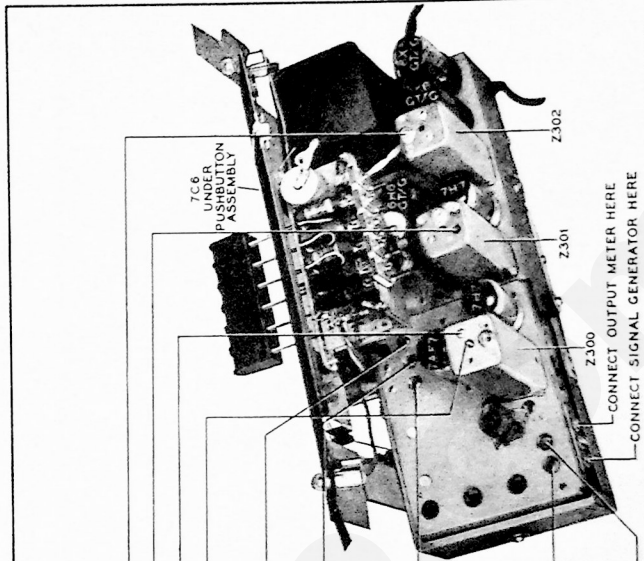


Figure 11. Chassis View, Showing Trimmer Locations.

TP-2425

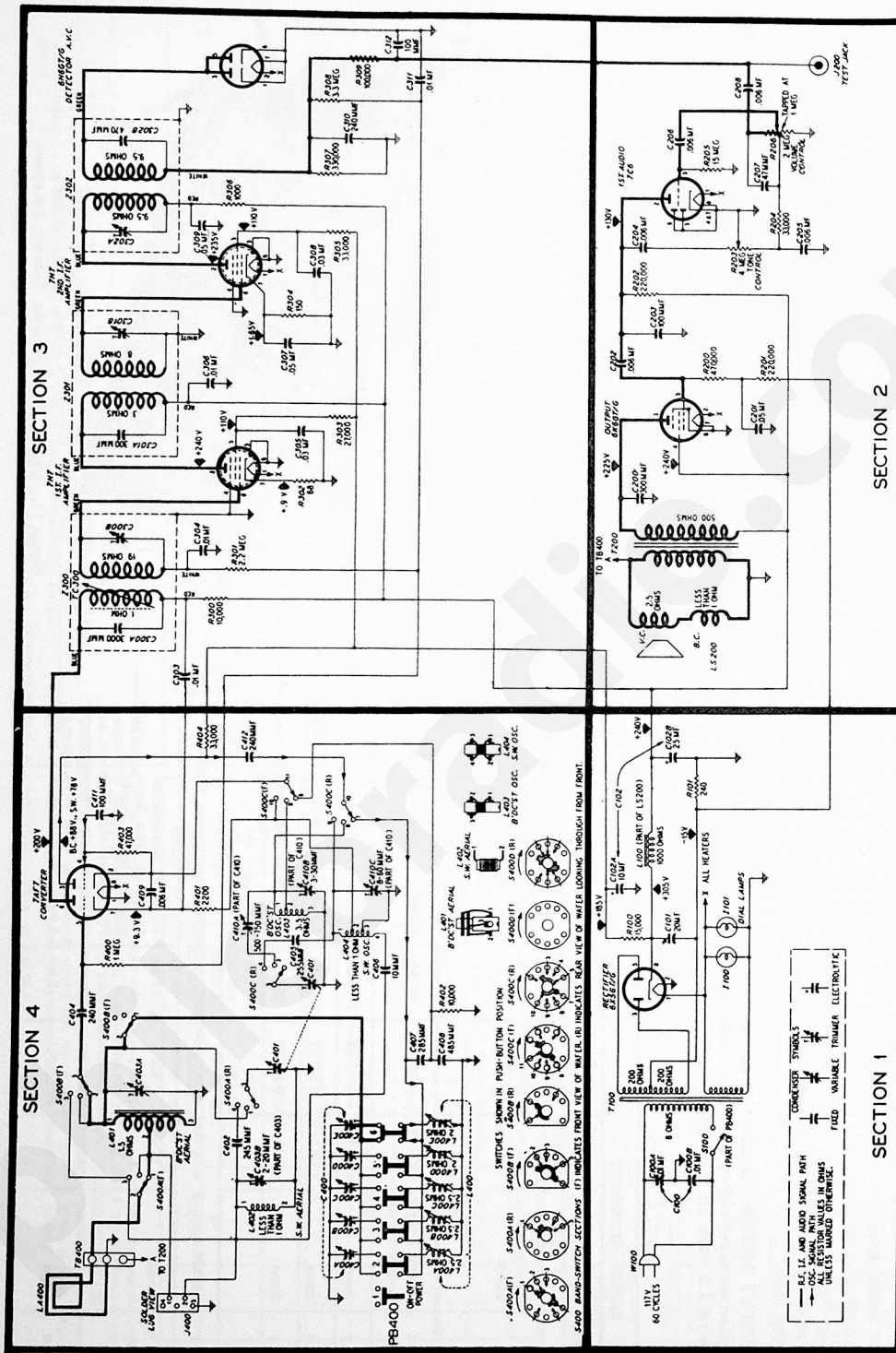


Figure 12. Complete Schematic of Model 46-451.

NOTE: All voltage, capacity and resistance values shown are average. The voltages were measured between the points indicated and the chassis, using a 20,000-ohms-per-volt meter, with a 117-volt, 60-cycle, a-c input to the radio power supply. The volume control was set at minimum, the tone control to maximum counterclockwise position, and the band switch in push-button position unless shown otherwise.

SETTING PUSH BUTTONS

1. Connect the output meter between terminals 2 and 3 on aerial terminal panel.
2. Turn the radio volume control to maximum and the tone control to its counterclockwise position.
3. Couple the signal generator loosely through a coil of wire to the radio loop aerial. (See ALIGNMENT PROCEDURE, PRELIMINARY ADJUSTMENTS AND CONNECTIONS.)
4. Turn on the power and allow the radio to warm up for 15 minutes before starting the adjustments.

5. Starting with the lowest frequency desired, set the signal generator to the desired frequency (modulation on), push the station-selector button and adjust the associated oscillator tuning core and aerial trimmer condenser (marked on rear of push-button assembly) for maximum indication on the output meter. Reset the signal-generator frequency and repeat the procedure for each remaining station-selector push button.
6. Turn off the signal generator and make a final adjustment of all tuning cores and trimmer condensers while listening to the stations for which the adjustments are being made.

REPLACEMENT PARTS LIST — MODEL 46-451

NOTE: Parts marked with an asterisk (*) are general replacement items, and the numbers may not be identical with those on factory assemblies; also, the electrical value of some replacement items furnished may differ from the values indicated in the schematic and parts list. The values substituted in any case are so chosen that the operation of the instrument will be either unchanged or improved. When ordering replacements, use only the "Service Part No." in this parts list.

Reference No.	Description	Service Part No.
C100	Condenser, line filter, 2-section C100A: condenser, .01 mf. C100B: condenser, .01 mf.	3903-ODG Part of C100 Part of C100
C101	Condenser, electrolytic, 20 mf, power-supply filter	30-2568-8*
C102	Condenser, electrolytic, 2-section C102A: condenser, 10 mf, power-supply filter C102B: condenser, 25 mf, power-supply filter	30-2570* Part of C102 Part of C102
I100	Lamp, pilot	34-2040*
I101	Lamp, pilot	34-2040*
L100	Field, speaker	Part of LS200
R100	Resistor, 15,000 ohms, voltage dropping	66-3154340*
R101	Resistor, bias, 240 ohms	66-1224340*
S100	Switch, power	Part of PB400
T100	Transformer, power	32-8234
W100	Cord, a-c	L3199

SECTION 2

C200	Condenser, .003 mf, audio high-pass	61-0109*
C201	Condenser, .05 mf, bias filter	61-0122*
C202	Condenser, .006 mf, coil blocking	45-3500-7*
C203	Condenser, 100 mmf, audio high-pass	60-10105407*
C204	Condenser, .006 mf, tone control/high-cut	45-3500-7*
C205	Condenser, .006 mf, bass boost	45-3500-7*
C206	Condenser, .006 mf, grid blocking	45-3500-7*
C207	Condenser, 47 mmf, audio high-pass	60-00151307*
C208	Condenser, .006 mf, d-c blocking	45-3500-7*
J200	Socket, (test jack)	27-6180
LS200	Speaker	36-1585
R200	Resistor, 470,000 ohms, grid return	66-4473340*
R201	Resistor, 220,000 ohms, bias filter	66-4223340*
R202	Resistor, 220,000 ohms, plate load	66-4223340*
R203	Control, tone, 4 megohms	33-5539-2
R204	Resistor, 33,000 ohms, bass deemphasis	66-3333340*
R205	Resistor, 15 megohm, grid return	66-6153340*
R206	Control, volume, 2 megohms	33-5535-2*
T200	Transformer, output	32-8278

SECTION 3

C303	Condenser, .01 mf, plate return, r-f by-pass	61-0120*
C304	Condenser, .01 mf, grid return, r-f by-pass	61-0120*
C305	Condenser, .01 mf, screen r-f by-pass	45-3500-1*
C306	Condenser, .01 mf, plate r-f by-pass	61-0120*
C307	Condenser, .05 mf, cathode r-f by-pass	61-0122*
C308	Condenser, .03 mf, screen r-f by-pass	45-3500-1*
C309	Condenser, .05 mf, plate return r-f by-pass	61-0122*
C310	Condenser, 240 mmf, diode return r-f by-pass	60-10245307*
C311	Condenser, .01 mf, a-v-c filter	61-0120*
C312	Condenser, .001 mf, r-f by-pass	60-10105407*
R300	Resistor, 10,000 ohms, decoupling	66-3103340*
R301	Resistor, 2.2 megohms, a-v-c decoupling	66-5223340*
R302	Resistor, 68 ohms, cathode bias	66-0683340*
R303	Resistor, 27,000 ohms, screen-voltage dropping	66-03273340*
R304	Resistor, 150 ohms, cathode bias	66-1153340*
R305	Resistor, 33,000 ohms, screen-voltage dropping	66-3333340*
R306	Resistor, 1,000 ohms, decoupling	66-2103340*
R307	Resistor, 330,000 ohms, 2nd det. diode load	66-4333340*
R308	Resistor, 3.3 megohms, a-v-c filter	66-5333340*
R309	Resistor, 100,000 ohms, r-f decoupling	66-4103340*
Z300	Transformer, 1st i-f	32-4106
	C300A: condenser, fixed padder	Part of Z300
	C300B: condenser, trimmer	Part of Z300
Z301	Transformer, 2nd i-f	32-4107
	C301A: condenser, fixed padder	Part of Z301
	C301B: condenser, trimmer	Part of Z301
Z302	Transformer, 3rd i-f	32-4108
	C302A: condenser, trimmer	Part of Z302
	C302B: condenser, fixed padder	Part of Z302

SECTION 4

C401	Condenser, main tuning gang	31-2719-1
C402	Condenser, silvered mica, 245 mmf, short-wave aerial coil band tracking	30-1220-34
C403	Condenser, trimmer assembly, two section C403A: condenser, B'DC/ST aerial coil trimmer C403B: condenser, SW aerial coil trimmer	31-6476 Part of C403 Part of C403
C404	Condenser, 240 mmf, mixer grid	60-10245307*
C405	Condenser, silvered mica, 255 mmf, SW oscillator coil band tracking	30-1220-24
C406	Condenser, mica, 10 mmf, feedback	60-00105407*
C407	Condenser, silvered mica, 285 mmf, r-f voltage divider	30-1224-14
C408	Condenser, silvered mica, 485 mmf, r-f voltage divider	30-1224-15

SECTION 4 (Continued)

Reference No.	Description	Service Part No.
C409	Condenser, .006 mf, oscillator-cathode coupling	45-3500-7*
C410	Condenser, trimmer assembly, 3-section C410A: condenser, series trimmer, B'DC/ST osc. coil C410B: condenser, shunt trimmer, B'DC/ST osc. coil C410C: condenser, shunt trimmer, SW osc. coil C410D: condenser, shunt trimmer, SW osc. coil	31-6464 Part of C410 Part of C410 Part of C410
C411	Condenser, 100 mmf (special) osc. grid	30-1225-2
C412	Condenser, 240 mmf, osc. plate blocking	60-10245307*
J400	Socket, external aerial connection	27-6214-1
L401	Coil, B'DC/ST aerial	32-4033
L402	Coil, SW aerial	32-4050-3
L403	Coil, B'DC/ST oscillator	32-4019-2
L404	Coil, SW oscillator	32-4113
LA400	Loop assembly Push-button switch, padder, and coil assembly Switch, push-button assembly C400, push-button padder-strip assembly C400A, C400B, C400C, C400D, C400E: condenser, push-button padder	76-2236-1 42-1758 31-6479-1 Part of C400
L400	Scale, push-button coil assembly	
L400A, L400B, L400C:	coil, push button osc.	32-4059-2
L400D, L400E:	coil, push button osc.	32-3779
R400	Resistor, 1 megohm, mixer grid	66-5103340*
R401	Resistor, 2,200 ohms, mixer cathode	66-2223340*
R402	Resistor, 10,000 ohms, osc. cathode	66-3103340*
R403	Resistor, 47,000 ohms, osc. grid	66-3473340*
R404	Resistor, 33,000 ohms, osc. plate	42-1793
S400	Switch, band S400A, S400B, S400C, S400D: switch, band, (sections)	42-1793 Part of S400
TB400	Panel, loop-aerial terminal	38-9942

MISCELLANEOUS

Description	Service Part No.
Bolt, chassis mounting	IW1732FA3
Cabinet and Cabinet Parts:	
Cabinet, complete	10636A
Bolt, speaker mounting	W2123
Cloth and baffle	40-6764
Feet, felt	W2190
Rubber band, scale-mounting	54-4168
Scale, glass, dial	27-5939
Screw, scale-mounting	IW2489FE11
Nut, speaker-mounting	IW1988FA3
Clip, arched	28-5002FA1
Clip, B'DC/ST oscillator	IW1988FA3
Clip, SW oscillator	56-2927FE7
Dial-Scale Assembly:	56-2927FE7
Scale backplate and pulley assembly	76-2195
Rear mounting bracket and lug assembly	76-2194
Cord, pointer-drive (25-ft. spool)	45-8750*
Spring, pointer	28-8953
Pointer	IW19670FA3
Screw, mounting	56-3301ECP
Grommet, sub-chassis	27-4526
Knob, tuning	54-4115
Knob, push-button	54-4217
Lock washer, line-filter mounting	IW24257FA3
Mounting-Foot Assembly:	
"T" nut	W2502FA3
Grommet, rubber	54-4122
Washer	W2271FA3
Sub-base mounting foot	56-2293
Palnut, volume and tone control mounting	IW29091FA3
Pilot-lamp-socket assembly, right	76-2153
Pilot-lamp-socket assembly, left	76-2154
Plug, speaker	27-4419-22
Push-Button Assembly:	
Grommet, push-button switch mounting	27-4596
Sleeve, push-button switch mounting	28-5665FA3
Cover assembly, a-c push-button switch	76-1343
Strip, coil terminal	56-2250
Core, push-button tuning	56-6100
Stabilizers, iron-core screw	56-2249
Tab kit, push-button	40-6766
Tab, cover	27-5737
Screw, loop-assembly mounting	2W25468FE26
Screw, sub-chassis mounting	IW25376FA3
Shield, pilot lamps	54-7150
Shield, push-button light	54-7245
Socket, Loktal	27-6138*
Socket, Loktal (7AF7)	27-6213*
Socket, octal	27-6174*
Spacer, r-f unit mounting	IW52224FA3
Spacer, sub-chassis mounting	IW29184FA3
Speaker cable and plug assembly	41-3703
Strap, electrolytic-condenser mounting	56-1452

CRITICAL LEAD DRESS AND PARTS PLACEMENT FOR MODEL 46-451

CODE 121

1. For the best tracking of the short-wave tuning, the s-w aerial coil, L402, must be dressed parallel to, and approximately $\frac{1}{8}$ " from, the end plate of the tuning-condenser gang, C401.
2. The following lead dress insures a sufficiently low minimum capacitance in the broadcast aerial coil circuit to bring the circuit constants within the range of the aerial-coil trimmer, C403A.
 - a. The lead between the broadcast aerial coil, L401, and the trimmer, C403A, should be dressed upward from the chassis.
 - b. The lead between C403A and the band switch should be dressed upward from the chassis and away from the end plate of the tuning-condenser gang.
3. The lead from the audio test jack, J200, to the front wiring panel should be dressed down to the chassis and away from the 6K6GT/G socket and associated wiring, to prevent audio regeneration.