Philco Model 46-1209 AM/SW Console Radio
Donald R. Sentz
July 2018, Rev. F December 2020

I was given this set around 1968 (when I was about 15 years old) by one of my Dad's co-workers. The radio worked great. The turntable was not functional and had dried-out drive belts. At the time there was no straightforward way (or money) to get replacement parts, and 78 rpm records were obsolete, so I removed the turntable and discarded it. The radio worked great for many years. It has been non-operational since about 1986, when I noticed that the audio output tubes were getting too hot. They were the wrong type anyway, 6F6's instead of 6V6GT's.

The set survived a flooding event in 2014. The cabinet restoration cost, including new speaker grille cloth, was covered by insurance. I had the set moved to our San Diego house in 2016, after we sold my mom's house. I finally started planning in July 2017 for the electrical restoration. I downloaded the schematic and some other information from Antique Electronic Supply web site. I ordered some parts but then postponed the effort due to other priorities.

Chassis Underside Prior to Electrical Restoration

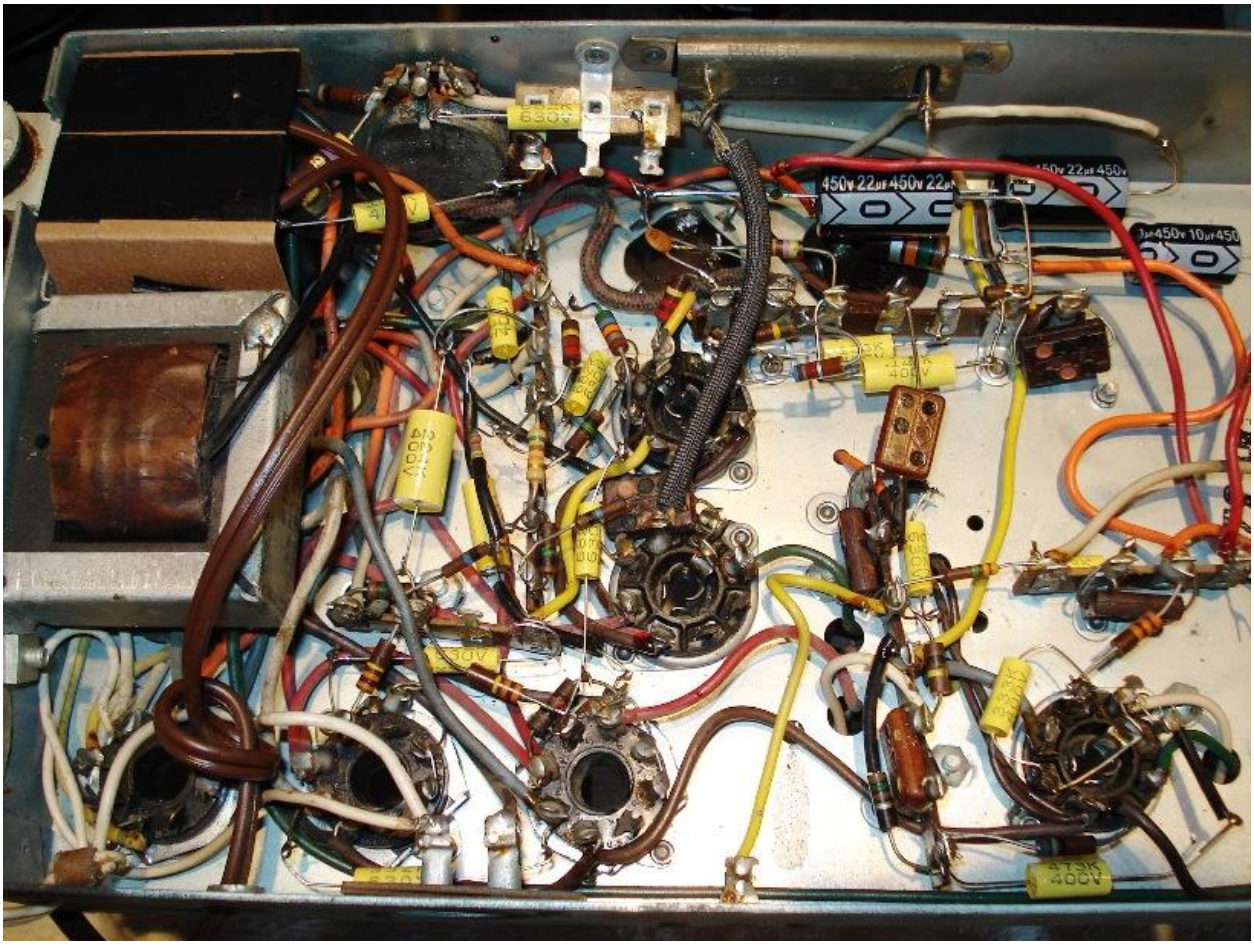
June-July 2018- During cleaning and inspection of the chassis, I saw evidence of prior repairs. I replaced all of the tubular paper capacitors and the three electrolytics. I left the old electrolytic cans in place. The old C49 can is electrically isolated from the chassis, so I used the center post of C49 as a convenient tie point. Note that C49 should not be touched when the set is ON.

R3 measured 3.0K instead of 2.2K spec, but I did not replace it due to inaccessibility and risk of damage to the band switch. I replaced several other resistors that were out-of-spec;

Spec		Measured	Replaced with
R6	4.0K	230K	3.9K
R8	27K	101K	27K
R32	6.8K	29K	6.8K
R60	33K	380K	two 15K in series meas. 34K
R24	33K	41K	[not critical, no replace for now]
R27	47K	86K	51K (within 10%)
R28	4.7K	6.2K	4.7K ¼ watt
R29	56K	244K	56K
R35	220K	289K	[not critical, no replace for now]

The replacement for R28 (4.7KΩ) is ¼ watt instead of ½ watt but I concluded this should be fine after reviewing the circuit.

C53A and C53B measured way out-of-spec. I left C53 in place and fastened a small wooden platform to it. I re-wired that area for the new .01uF capacitors replacing C53A and C53B. I fashioned an insulating cover over the re-wired area for safety.



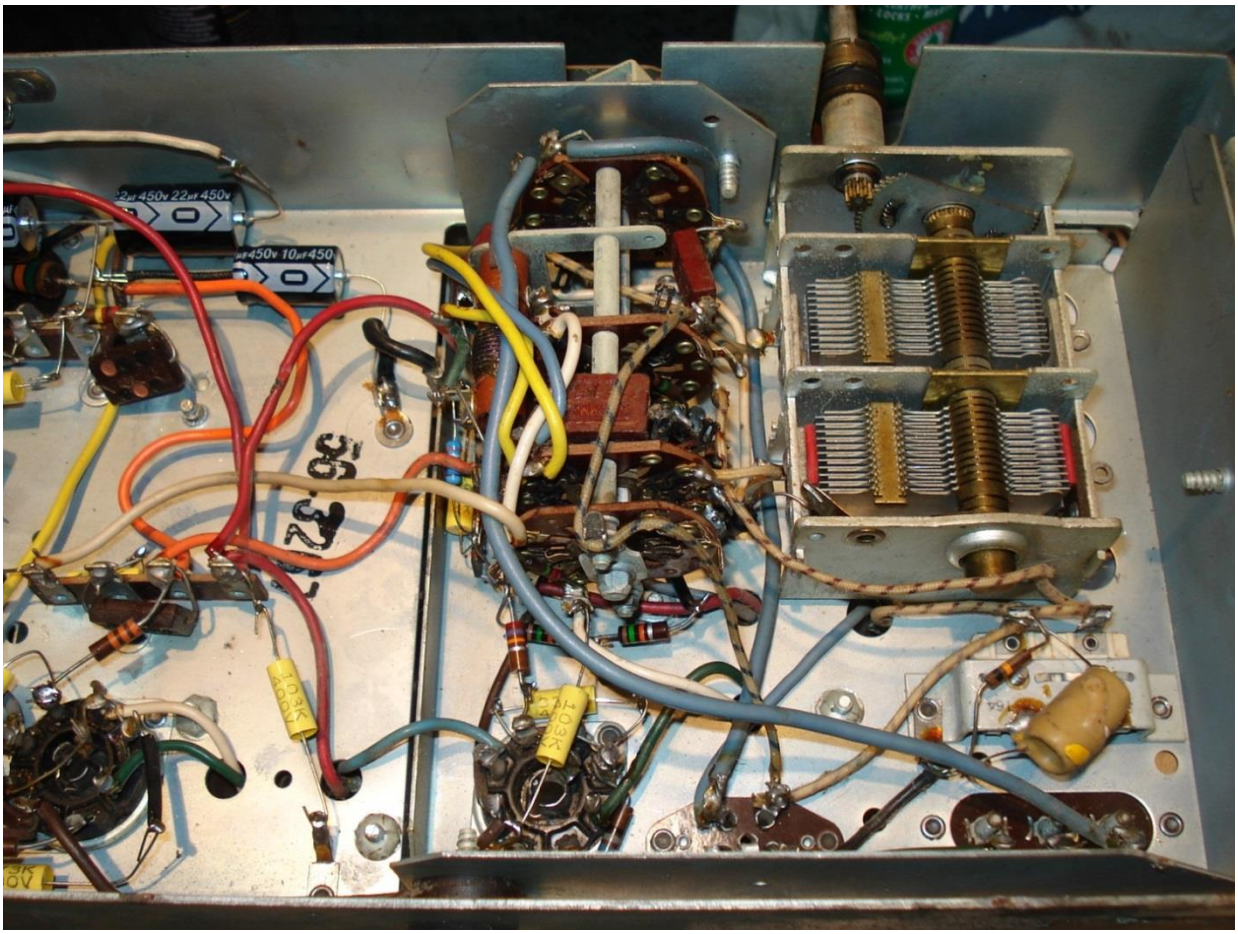
Left Side of Chassis After Installing New Parts

July 17, 2018- I had some trouble with the ON-OFF switch, but after using contact cleaner spray it seems to be working. The power transformer primary winding measured 14Ω instead of the 4Ω marked on the diagram [*Many days later I measured 4.5Ω*]. The transformer B+ winding measured OK, about 220 ohms (vs. 200 on diagram). I applied AC power to the set with two Sovtek 6V6GT and the two panel lamps providing some load (no other tubes plugged in). The ON-OFF switch worked OK. The tube heaters and lamps appeared to have normal brightness.

The cabinet was missing a 1"x1"x 3/8" wood block that is used to support the left side of the pushbutton assembly (as viewed from front of set). I fashioned a replacement and installed it using Elmer's white glue.

There are many "postage stamp" capacitors that I can't measure in place. My experience has been that these capacitors tend not to fail or change value much (however, see Appendix C).

I applied contact cleaner spray to each band-switch wafer, the tone and volume controls, and all tube pins. I sparingly lubricated the band-switch shaft, tuning shaft, and dial cord pulleys using Ballistol.



Right Side of Chassis After Installing New Parts

Testing on the Bench-

The speaker field coil doubles as a filter choke for the B+ supply. It is marked 650 ohms on the diagram, but I measured 666 ohms. I have an 8 henry filter choke that measures 122 ohms, plus a 600 ohm 10 watt resistor that measures 567 ohms. together they add up to 689 ohms, a good substitute for the field coil.

July 29, 2018, Sunday- I attached the voltmeter to the B+ output side of the field coil substitute, plugged in all the tubes, attached a 3.2 ohm speaker, attached a small coil of telephone wire as an antenna, and applied AC power. The B+ settled to 257

volts. The 6V6 bias was -16 volts. I tuned in a station and heard good sound from the speaker, for about 10 seconds. Then there was a single "pop" sound from somewhere, and the audio output changed to static. I immediately turned off the set. I did not see any smoke and did not smell anything unusual. I examined the chassis, with close attention to the "postage stamp" capacitors, but did not see anything wrong.

I powered up the set again, while it was still upside down, and it worked fine. I tuned in stations across the dial. I measured the AVC voltage as near 0 volts when no signal to -12 volts on the very strong station around 1200 kHz. I measured the voltage across the field coil substitute as 74.4 volts, corresponding to B+ current of 74.4/689 = 108 mA, a reasonable value.

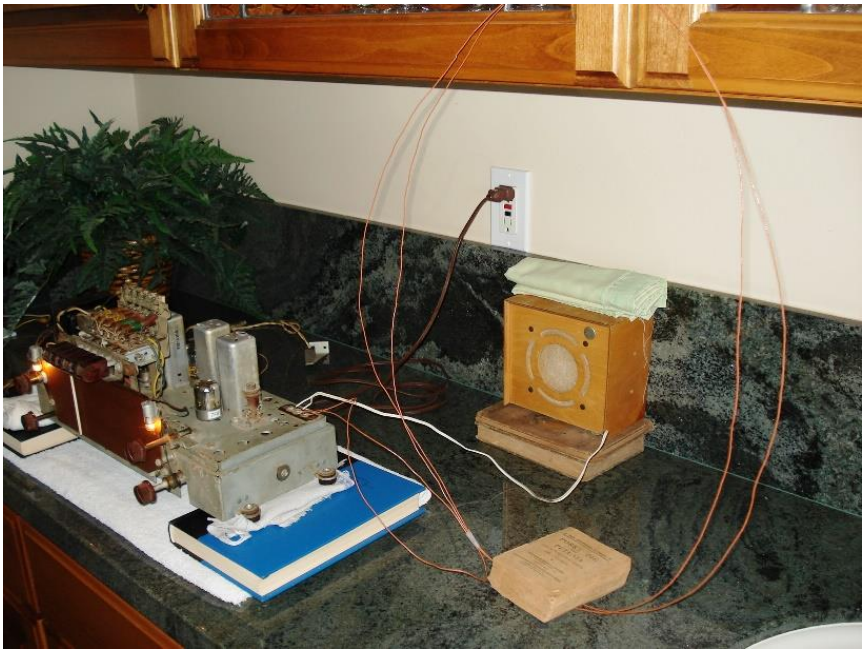
August 2, 2018- Over the next three days I operated the set for an accumulated time of maybe 4 hours. I tried a different antenna consisting of a 2-turn loop about 2 feet in diameter, which is similar to the loop inside the radio cabinet. This made a huge improvement in the performance of the set. I peaked up r.f. trimmer C1. I could occasionally hear some low volume static that seemed internally generated, but it always cleared up after a short while.

The shortwave band appears to be working well. I peaked up r.f. trimmer C12. WWV came in very well at 10 MHz and weak at 15 MHz. I tuned in Radio Australia and several other stations. I picked up a CW signal sending CQ in the 14MHz ham radio band. I did not notice any image responses anywhere across the band, which is better than the radio used to be. One or more of the new resistors and capacitors must have fixed the SW image response problem that I recall.

I used my B+ voltage and current measurements and tube heaters' spec voltage and current data to estimate the AC power consumption of the set to be around 60 watts.

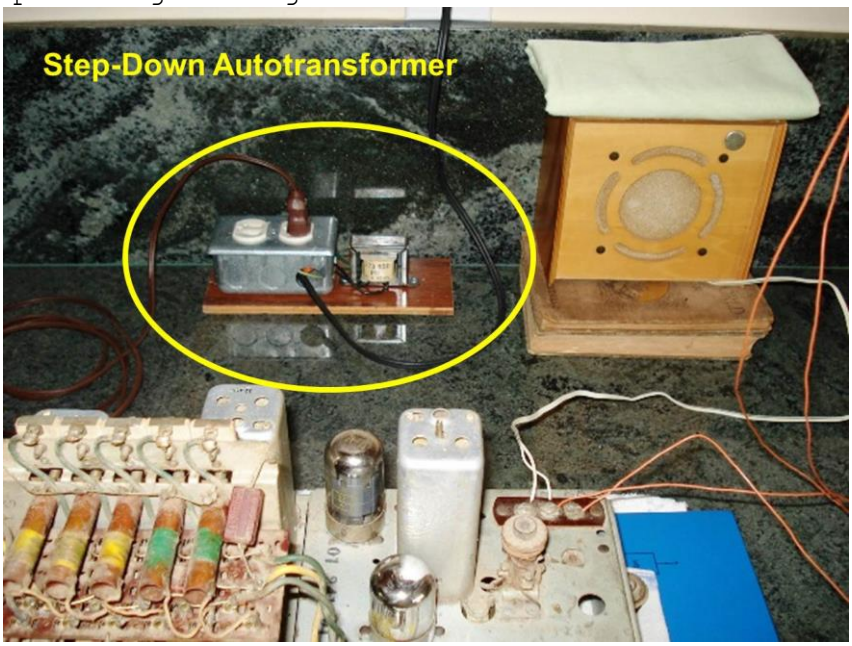
The service sheet for this set stated 240 volts for the B+, while I measured 257 volts. I measured 120 volts on the AC line. If I step down the line from 120 volts to 112 volts, then the B+ should reduce to 240 volts, as stated in the service sheet. I made an autotransformer that will do this handily. This set was probably designed for nominal AC line between 110 and 115 volts.

While testing the phono motor circuit I measured 4.5Ω for the power transformer primary, consistent with the schematic.



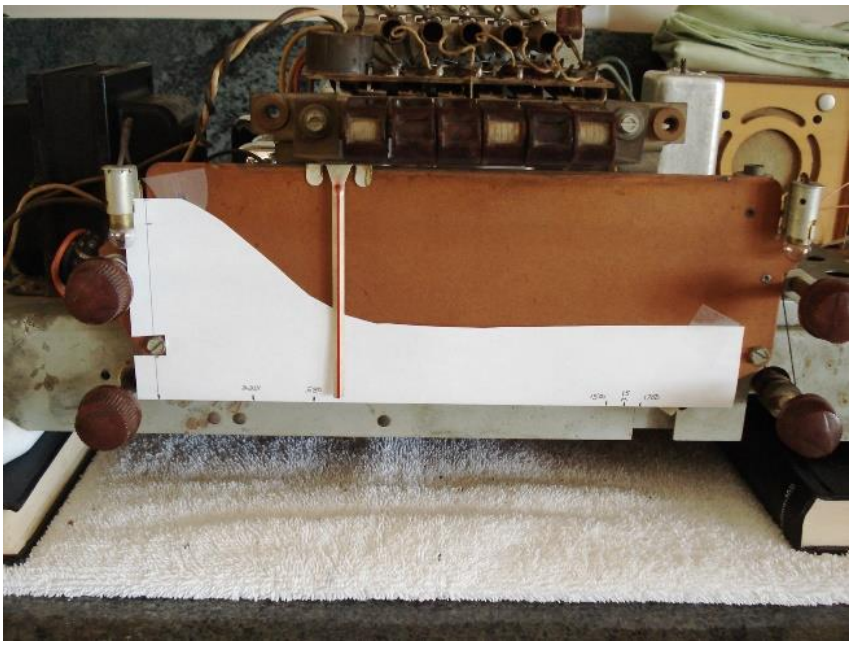
Testing Configuration Using Loop Antenna Substitute

Next steps;
1. Insert autotransformer in AC line, measure B+
DONE August 11, 2018- AC Line = 118.8 VAC
AC In = 110.0 VAC after autoxfmr
B+ Drop = 64.8 VDC across 689 Ohms
B+ = 245.7 VDC @ 94 mA
Total AC Power estimate reduces to 55 watts (plus power transformer loss) w/ autoxfmr. The power transformer gets pretty hot after a while (5 watts or so?), but this is probably normal since all operating voltages and currents look OK.



2. video demo shortwave WWV reception on the bench.
DONE August 11, 2018. Added clip to video demo.

3. Test/adjust dial calibration using the paper template.
DONE August 12, 2018- I checked each frequency by using my Grundig portable set (has digital frequency display) to set the Heathkit signal generator. The dial calibration was great, even the 15MHz mark was right on, which I also confirmed by receiving WWV 15 MHz signal at that dial setting. However, when installed the pointer is slightly high relative to the AM band dial markings over lower ¾ of the band. SW band pointer reads high over lower ¾, and slightly low at top end (15MHz).



Using Dial Calibration Template

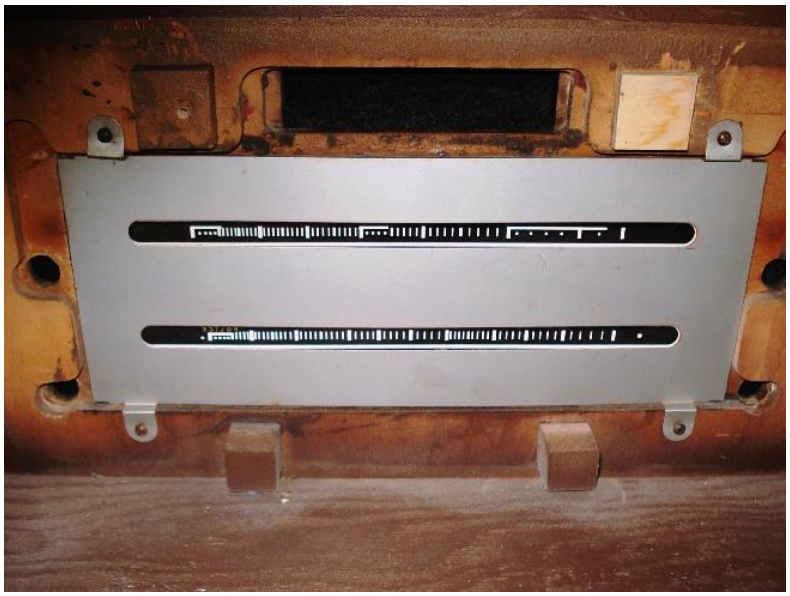
4. Use the RF signal generator to try out /set up the pushbuttons and video demo on the bench.
DONE August 11, 2018- First I used Contact Cleaner on all the switches and made sure the mechanisms were working. Then I tried each in turn. They all worked just fine.

#3 was labeled "WBRC" (Birmingham, AL) and #5 was labeled "WMSL" (Huntsville, AL). The other buttons had no labels.

New pushbutton setup;
#1 KOGO 600 San Diego (Bill Cunningham, Rush Limbaugh)
#2 KFI 640 Los Angeles (Brian Suits, Conway, etc.)
#3 KFMB 760 San Diego (Mark Levin)
#4 KCBQ 1170 San Diego (Elder, Sekulow, Hewitt, Gallagher)
#5 KFSD 1450 Escondido (Oldies Pop, 50's & 60's)

5. Attach a 3 ohm speaker (to be used as a microphone) to the phono pickup transformer input to try out and video demo the phono circuits.
DONE August 14, 2018- I measured the phono transformer secondary resistance as 5870 ohms vs. spec 5800 ohms. The speaker-as-microphone experiment worked fine, by manually holding the phono button down (it would not latch). I decided to not make video demo until after I fix the pushbutton. This test verified that the phone-unique circuitry is working.

6. Photograph new wood block support inside cabinet prior to drilling mounting hole for pushbuttons support bracket.
DONE August 11, 2018



New Support Block at Upper Right Prior to Drilling Hole

7. Temporary place chassis in cabinet and mark support bracket and drill hole to take a #6 x ¾" wood screw.
DONE August 12, 2018

8. Final installation in cabinet and video demo.
DONE August 12, 2018- Found where the courtesy lamp socket goes.
https://www.youtube.com/watch?v=S7FhCL4rjis

9. Need approx. 10 #6 flat washers for back cover attach screws.
DONE August 28, 2018

Future; 1) keep eye out for Philco turntable #D-10A, 2)make sliding shelf inside cabinet where turntable is supposed to be.

August 22, 2018- I found three 250uuF silver mica caps in stock. Goals for next trip;

1. Repair the courtesy lamp wiring and test w/ nite-light bulb.
   Done August 27, 2018.

2. AM dial recalibrate, see Appendix C.
   Done August 27, 2018- AM band recalibration successful. Touched up pushbutton tuning after extended warmup.

3. Note pointer readings on AM tuning scale for selected SW settings, in particular 10.0 MHz and 15.0 MHz as a minimum.
   Done August 27, 2018.

SW	9.5	10.0	11.0	12.0	13.0	14.0	15.0
AM	595	690-695	875	1060-1065	1240	1430	1630

4. Replace C15 and C16 and use the data from above to test recalibrate SW scale while still on the bench.
   Done May 7, 2019- After replacing C15 and C16 (255 pF +/- 1% "Micamold" brand) with new 250 pF +/- 5% silver mica units, I attempted to recalibrate the set to its SW band scale, but I still could not get it to even closely match the SW scale on the glass dial plate. The behavior suggests that the values of C15 and C16 are still too large. I may next try 200 pF in parallel with a 50pF trimmer, if there is room.

5. Fix the PHONO push button.
   Done May 7, 2019- sprayed some WD-40 on the latching spring and mechanism while trying to avoid the switch contacts. The push button action was still good the next day. Will continue to monitor this item. May 19, 2019- Still OK. I WD-40'd the other pushbutton mechanisms, action is smoother. I removed, cleaned, and reinstalled the three acetate pushbutton "windows". The windows and paper labels are exactly ½ inch square. The white letters are ¼ inch tall and span 5/16", on dark brown background.

August 26, 2018- Ordered spare tubes 2-7F8, 2-7H7, 1-7AF7 from AES. 7X7 not available from any source (might appear on eBay). I already have a NOS 5Y3GT. Tubes arrived 29 August.

August 28, 2018- Ordered as spare, NOS RCA 7X7 from eBay seller, $7.99 including shipping. I discovered how the courtesy lamp switch supposed to work. Row of 4 #6 screw holes along each edge of speaker door held baffle assemblies that I had removed. The baffle on left side would have had a "catch" or hook to engage the courtesy lamp switch when door is opened. 7X7 arrived 1 Sept.

August 30, 2018- Bought pack of #6 x ½ screws to use for mounting courtesy lamp switch baffle/catch to speaker door.

May 7, 2019- I replaced the 6 "postage stamp" capacitors on main chassis with new silver mica units, and I replaced the two 255 pF "postage stamp" capacitors on the band switch with 250pF silver micas. There was no change to the intermittent static behavior. It continues to be most noticeable when tuned to a strong station, suggesting that a high magnitude of AVC voltage might be aggravating it.

During testing I observed a weak image response between 10.5 and 11 MHz on SW band for a very strong station in the 11.5-12 MHz band. This is consistent with my memory of this set having SW image responses. However this time the response was weaker (i.e., better image rejection) than I recall from long ago.

May 19, 2019- I now suspect at least one of R1, R2, or R15 of causing the intermittent but persistent static, crackles, and pops. All three are in the AVC circuit. When I set the band switch between detents the oscillator feedback capacitor, C7, is disconnected on the grid side, and the mixer grid coupling capacitor, C3, should be disconnected at its RF input side. The static, etc. are all still present, so these two capacitors are not causing it. There is no significant DC voltage across any of the remaining original capacitors so they are less suspect. R1 is 1 MΩ, R2 is 2.2 MΩ, R3 is 3.3 MΩ. All three are accessible for replacement. R13 and R14, 100KΩ each, are also suspect. They are on main chassis.

 Test C7 by selecting pushbutton mode and all the pushbuttons OUT (OFF). This completely disconnects C7 RF input side from the circuit. If noise is still present then C7 is exonerated.

June 15, 2019- Noise is still present but greatly reduced volume relative to when a strong station is selected (KCBQ-1170). C7 is exonerated. Effect is same if I off-tune dial to quiet spot. Action: Replace R13 and R14 since they are easy, and out-of-spec high anyway. They might be the noise source.

June 16, 2019- I replaced R13 and R14, no effect on noise. On a lark I unplugged the 7F8 while set was on. Noise went away. I plugged in one of my two spare 7F8s that I ordered last year. No more noise! I put the set back in the cabinet. It is working fine now.

While the chassis was on the bench I sprayed WD-40 on all of the pushbutton mechanisms, while being careful to avoid the switch contacts. This restored the "PHONO" button to its proper latching function (push-ON, push-OFF). Then I connected the audio input cable to output of my stereo-to-monaural adapter, which in turn I connected to the headphone jack of our laptop. I played several songs (Patsy Cline, Dire Straits, the Animals, etc.) from YouTube. Sounded best by setting "Treble" mode on Realtek equalizer panel and then use tone control on radio to rebalance. Otherwise too much base.

June 17, 2019- The set has been working great all day. I made "temporary" station labels for the pushbuttons and put them in.

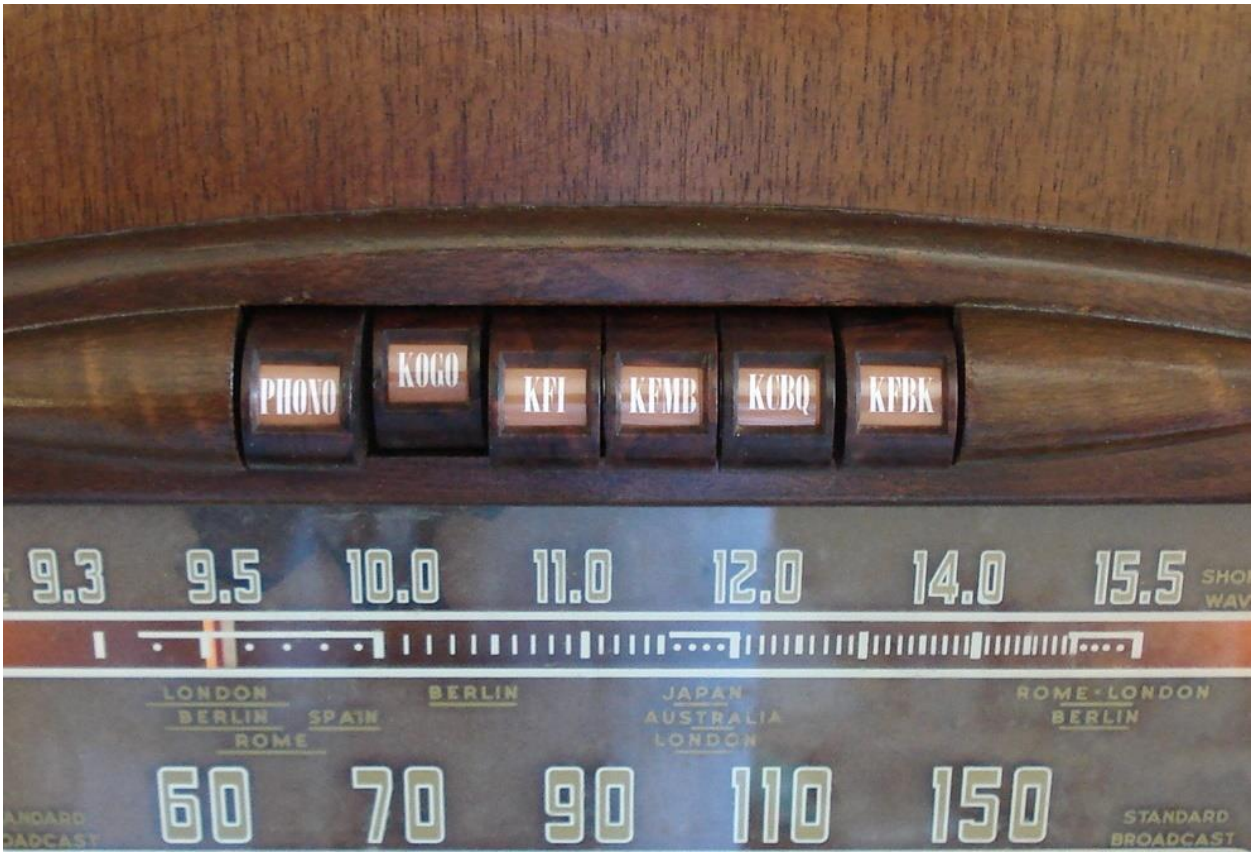
June 19, 2019- Still working great.

July 2, 2019- Well, I thought it was working great. There was always some popping/crackling noise that would occur at power-up but then go away after a few minutes. So I tried the 2nd spare 7F8 yesterday, and now there is no more popping/crackling at all. I made notes on Post-Its regarding all this and attached them to the 7F8 boxes. The 2nd spare 7F8 (also Sylvania) appears to be the newest one, per the date printed on its box.

July 4, 2019- I used PowerPoint to make a set of labels for the pushbuttons; PHONO, KOGO, KFI, KFMB, KCBQ, and KFBK;

August 1, 2019- The 2nd spare 7F8 is still working fine. Radio station KFSD-1450 ceased operation some time before July 4. I retuned the KFSD button to KFBK-1530 which is in Sacramento, CA. KFBK is about 400 miles away but comes in fairly well from dusk to dawn. I installed the labels along with new clear plastic covers that I cut from a binder cover. The labels and covers are all exactly ½ inch square. I trimmed their corners to make them easier to install.

I found the name of the furniture restorer who worked on the cabinet after the 2014 flood; Mr. Joe Henderson of Florence, AL., wife's name is Judy. (she endorsed the check). I found addresses and phone numbers for him and Judy on internet but unclear if they are still good addresses/numbers.



September 13, 2019- It is possible that the popping/crackling symptom might have been caused by corrosion and poor contact of the 7F8 tube pins, and especially so for the mixer grid pin. This might explain why noise was louder on strong stations; increased AVC voltage magnitude applied to 7F8 grid would increase such noise amplitude directly. I should try cleaning the tube pins on the extra 7F8s if I have to use them again.

October 22, 2019- On Saturday evening 19 Oct. one of the Sovtek 6V6GTs decided to put on a fireworks display just as the set was warming up. Within 10 minutes I had the set back up and running. I replaced both Sovteks with the pair of NOS RCA 6V6GTs that I had on hand for just such an emergency. I have no memory of when or where I acquired them. I ordered a pair of JJ brand 6V6S and a 7F8 from AES today, $14.95 each for the JJs.

November 5, 2019- I installed the two JJ 6V6S. They seem to be working fine. I sent a picture of them in my set to AES and it is on their website now. One has some very dim blue glow. I will try to get a good photograph of the glow.

November 15, 2019- No luck photographing the glow. I waited until nightfall, turned off room lights, put on my reading

glasses, and used a hand-held mirror to observe both 6V6-S tubes in operation from different angles. After my eyes adjusted to the dark I observed faint, cobalt-blue glow as localized streaks between the glass envelope and the plate, in BOTH tubes. The 6V6-S closest to the 5Y3 also exhibited a dim blue haze localized to just above the surface of the lower support wafer. The other 6V6-S may have this haze also, but it was much more faint and I am not 100% sure of it.

Two JJ Electronic 6V6-S Installed November 2, 2019. The one in the middle has some dim blue glow. See also notes added to Appendix B, Sub-Section 3.

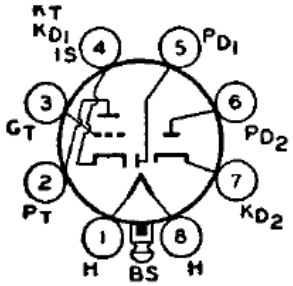
Update December 7, 2020- The JJ 6V6S pair have been working great for well over a year now. The RCA NOS pair are back to spares. Also KFSD-1450 is back on the air again.

Appendix A: Resistor Measurement Results July 2018

DIAG.	SPEC	MEASURED	NOTES
R1	1.0M	1.0M	~~Suspected noisy May2019~~-CLEARED
R2	2.2M	2.5M	~~Suspected noisy May2019~~-CLEARED
R3	2.2K	**3.0K**	TOO RISKY TO ACCESS & REPLACE
R4	100K	90K	
R5	15K	13.9K	
R6	4.0K	**230K**	REPLACED W/ 3.9K MEAS. 3.9K
R7	68	78	
R8	27K	**101K**	REPLACED W 27K MEAS. 27K
R9	10K	9.8K	
R10	68	66	
R11	33K	28.5K	
R12	1.0K	1.16K	
R13	100K	**120K**	REPLACED 16JUN2019 -MEAS. 99K
R14	100K	**117K**	REPLACED 16JUN2019 -MEAS. 99K
R15	3.3M	3.35M	~~Suspected noisy May2019~~-CLEARED
R16	10M	10.8M	
R17	1.0M	1.0M	
R18	10M	-	INFERRED OK FROM OTHER MEAS.
R19	VOL.	WORKS OK	
R20	68	-	INFERRED OK FROM OTHER MEAS.
R21	4.7	-	INFERRED OK FROM OTHER MEAS.
R22	150K	159K	
R23	TONE	WORKS OK	
R24	33K	41K	MARGINAL, NOT CRITICAL
R25	220K	215K	
R26	1.0M	1.3M	
R27	47K	**86K**	REPLACED W/ 51K MEAS.50.9K
R28	4.7K	**6.2K**	REPLACED W/ 4.7K MEAS. 4.7K
R29	56K	**244K**	REPLACED W/ 56K MEAS. 53.7K
R30	4.7M	4.64M	
R31	220K	219K	
R32	6.8K	**29K**	REPLACED W/ 6.8K MEAS. 7.2K
R33	150K	175K	
R34	470K	514K	
R35	220K	289K	MARGINAL, NOT CRITICAL
R36	150K	150K	
R37	150	141	(WIREWOUND, >2W)
R38	15K 2W	17.1K	
R48	150	165	
R49	330K	410K	
R50	330K	392K	
R60	33K	**380K**	REPLACED W/ TWO@15K MEAS. 34K
R88	10K	-	CANNOT MEASURE IN CIRCUIT

Appendix B; Tube Substitutions.

1. 6AV6 may be a good substitute for 7X7 but will require making a socket adapter. This set does not use the separate diode in the 7X7.



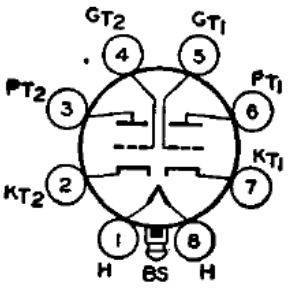
TWIN DIODE—HIGH-MU TRIODE

Glass lock-in type used as combined detector, amplifier, and avc tube in circuits which require diodes with separate cathodes. Outline 20, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Ratings and characteristics of triode unit as class A_1 amplifier: plate volts, 250 (300 *max*); grid volts, −1; amplification factor, 100; plate resistance, 67000 ohms; transconductance, 1500 μmhos; plate ma., 1.9.

7X7

Triode Parameter	7X7	6AV6	
Heater Volts	6.3	6.3	
Heater Amps	0.3	0.3	
Plate volts	250	250	
grid volts	-1	-2	(No changes requierd)
amp. factor	100	100	
Plate resistance	67000	62500	
Transconductance	1500	1600	
plate ma.	1.9	1.2	

2. 12AU7 may be a good substitute for 7AF7 but will require making a socket adapter. Wire the 12AU7 for 6.3 volts heater.



MEDIUM-MU TWIN TRIODE

Glass lock-in type used as voltage amplifier or phase inverter in radio equipment. Outline 15, OUTLINES SECTION. Tube requires lock-in socket. Heater volts (ac/dc), 6.3; amperes, 0.3. Ratings and characteristics as class A_1 amplifier (each section): plate volts, 250 (300 *max*); cathode resistor, 1100 ohms; plate ma., 9; transconductance, 2100 μmhos; amplification factor, 16; plate resistance, 7600 ohms.

7AF7

Triode Parameter	7X7	12AU7	
Heater Volts	6.3	6.3	
Heater Amps	0.3	0.3	
Plate volts	250	250	
Cathode resistor	1100	809	(No changes required)
[Grid voltage]	-9.9	-8.5	(Close enough)
amp. factor	16	17	
Plate resistance	7600	7700	
Transconductance	2100	2200	
plate ma.	9	10.5	

3. For this restoration I put in a matched pair of Sovtek 6V6GTs (Russian, 1990's vintage). There is controversy in various on-line forums regarding the quality of these tubes, but they seem to be working fine. I have another matched pair of these in my Bell 2122C Hi-Fi amplifier. 6V6GTs that should work OK in this set are still manufactured in Russia and maybe China, as of 2018.

Update October 30, 2019- One of the Sovtek tubes failed in spectacular glory on 19 October. I ordered a pair of JJ Electronic brand 6V6-S to replace both Sovtek tubes, along with another 7F8 (25% off sale) for spare. It happened to be Philco brand. I installed the new JJ tubes

02Nov2019- The two JJ 6V6-S tubes work fine, but one has a very dim blue glow that seems to be emanating from the top of the lower support wafer. When I look through the cutouts in the plate I do not see any blue glow in the space above that wafer and inside the plate cylinder. There are two other very small blue glows that appear to be on the glass and in the vicinity of those cutouts. These "glass glows" mostly disappear after the set has been on for a while. The other JJ tube has no visible blue glows.

4. As of 2018, 7F8 and 7H7 are still available from Antique Electronic Supply. 12AT7 could be a substitute for 7F8 with suitable rewiring and tube socket.

5. I have available a spare new-old-stock (NOS) 5Y3GT. Any new manufacture 5Y3 may damage this set (excessive B+) due to much lower internal resistance than original 5Y3. As a last resort, a pair of 1000PIV @ 1Amp HV silicon rectifier diodes plus 400 ohms, 15-watts, power resistor may be installed in place of 5Y3. You may have to experiment with the resistor value to get correct B+ (about 245 volts DC when AC line input is 110 volts). The resistor and diodes must be above the chassis, to get air flow.

Appendix C: Dial Calibration Discussion updated May 2019

I believe the AM band dial calibration can be improved with proper adjustments of C8 and C6. The SW band dial calibration is not very good when the set is in the cabinet. I suspect that oscillator capacitor C15, nominally 255 uuF according to the schematic, has aged to a significantly higher (and out-of-spec) value. The effect would be most significant at lower frequencies, just as I observed, and gradually less noticeable at higher frequencies, again just as I observed. Note that 255 uuF is not a standard value, but 250uuF is. This makes me wonder if C15 had

to be chosen by select-in-test, or if perhaps a 250uuF might be good enough. If I can access C15 I will try replacing it with 250uuF silver mica, preferably one that has been measured. Another possibility is more complex; namely replace C15 with 200uuF in parallel with a small trimmer, say 10-100uuF, and calibrate SW band same way as AM band.

C16, which is in the SW RF tuning circuit, is subject to all these same considerations, so it also may need replacement.

I examined the photo of the band switch assembly, it appears that C15 and C16 are easily accessible. May 19, 2019- After replacing C15 and C16 I still could not achieve decent SW band dial calibration. Try 220 pF?