Making connections to an AC tube radio

V1.1 Nov. 2025

This describes how to connect the FM converter to an AC superheterodyne tube radio: One that has a power transformer and has tube heaters in parallel.

The earliest radios ran from batteries. By the end of the 1920's, radios that "plugged in" to the house electrical circuit became very popular. Initially, all of these were "AC-only" sets that employed a power transformer to supply the tube heaters and high voltage. These sets always had the tube heaters in parallel, usually operating from 6.3VAC. Eventually, lower cost transformerless AC-DC "AA5" sets became popular (there is another document that describes how these are converted), but higher-end sets always had a power transformer.

The most common sets (in North America) used octal tubes like the 6SA7 or 6A8, 6SK7 or 6K7, 6SQ7 or 6Q7, 6F6 or 6K6 or 6V6, and a 5Y4 or 5Y3 or 80 or 6X5. Note that most of these tubes start with a "6", indicating a heater voltage of 6V. Some use a 6H6 instead of the diodes in the 6Q7/6SQ7.

A more modern line-up uses miniature tubes like 6BE6, 6BA6, 6AT6 or 6AV6, 6AQ5, and 6X4. (I have seen radios that use 12V tubes like 12BE6, etc., but they are not common)

There are also loktal versions that use tubes like 7A8 or 7B8, 7A7 or 7B7, 7B6 or 7C6, 7B5 or 7C5, 7Y4 or 7Z4. These also all have 6V heaters.

Earlier AC superheterodyne radios used tubes like 6A7, 6D6 or 78, 6B6 or 75 or 85, 42, 80. These used 6V heaters. There ae also radios that use tubes with 2.5V heaters with tubes like 2A7, 58, 55, 2A5, 80.

Some radios had mixtures of different tube types. Some had more tubes, like a push-pull output stage, an eye tube, an RF amplifier or an extra IF amplifier (or no IF amplifier at all). All of these are candidates for the FM converter.

If your radio can be described as a working AC-only superheterodyne tube radio, follow these instructions to connect the FM converter to your radio.

1. Preparing the FM converter board

See the other document that describes assembling the FM converter circuit board at https://rabjohn.ca/gord/projects/fmconversion/ .

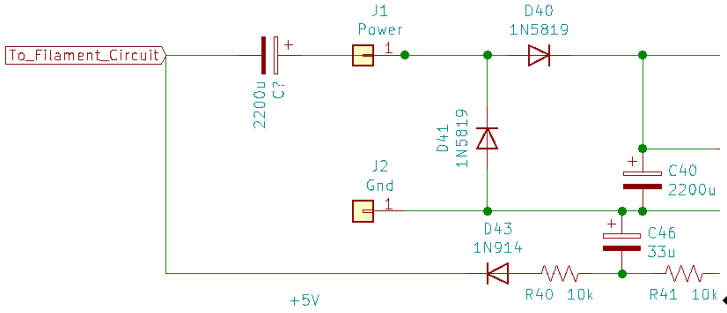
In assembling the board, note that for parallel-heaters radios, generally diodes D41, D42 are not needed.

The negative supply should be populated if it is inconvenient to disconnect the detector diodes (usually done with a socket adaptor); the negative voltage reverse-biases the detector diode and reduces distortion generated by it.

In the rare cases where 12V tubes with parallel heaters are used with AC on the heaters, please make sure capacitor C40, C46 and C47 (if used) are rated at 20V or more.

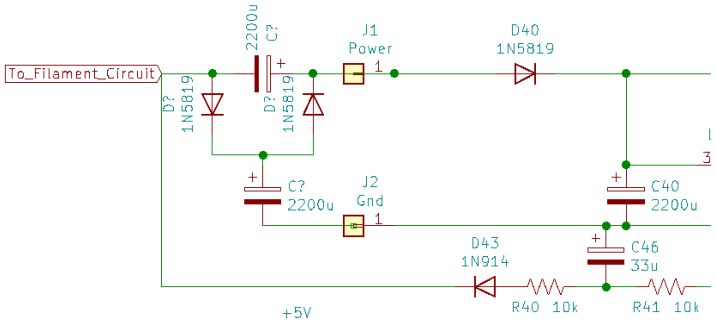
Some AC radios use a center-tapped winding for the filaments, which means that only 3.15VAC (half of the 6.3VAC) is available, and this voltage is not sufficient with a simple half wave rectifier. In cases like

this, a voltage doubler configuration using Schottky barrier diodes (such as 1N5817 - 1N5819) must be used. Not too difficult, requires an additional diode (at D41, on the board), and an external electrolytic cap. If the negative bias circuit is used, D43 must be connected back to the filament, but beware that not much negative voltage will be generated.



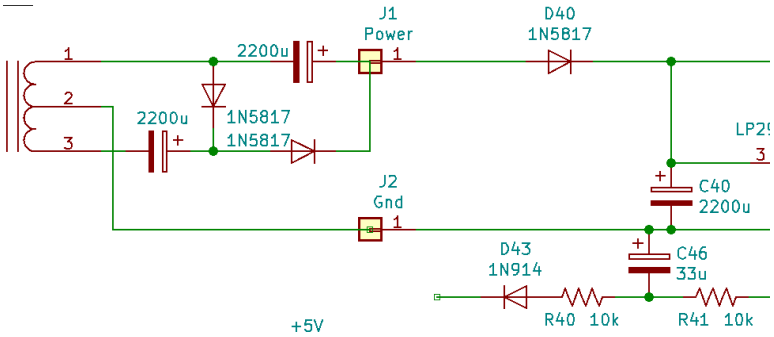
←Doubler

Radios that use tubes with 2.5V filaments actually require a tripler to generate enough voltage. This required 2 additional capacitors and 2 additional diodes.



← Tripler for 2.5V heater tubes

If you have a radio with 2.5V filaments and a center-tapped filament transformer, there is still an option. By using both sides of the centre-tapped filament supply, you can get a tripler to generate enough voltage. 2 additional capacitors and 2 additional diodes. If you need the negative supply, it will need a similar treatment.



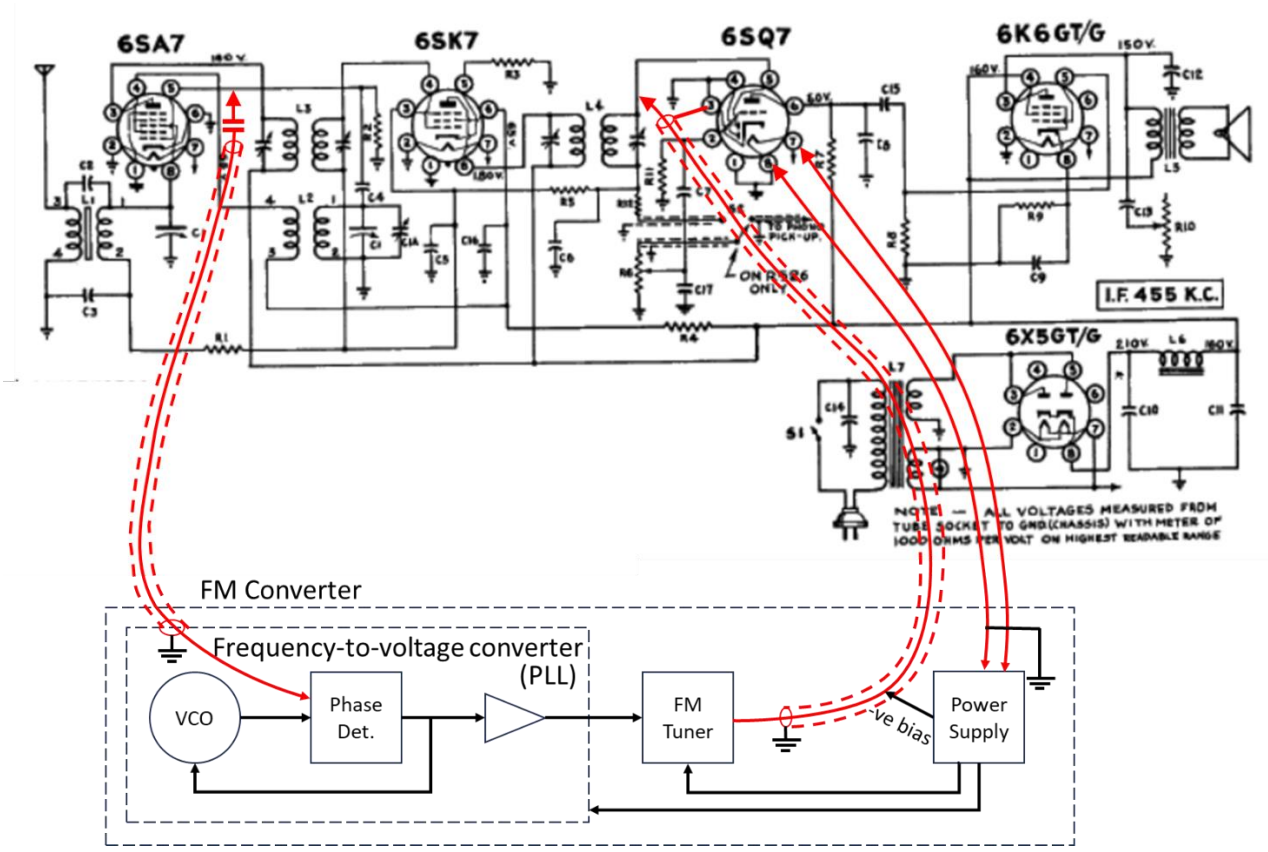
.

←Fancy tripler, for radios with a center tapped 2.5V filament transformer (the transformer at the left is the radio's power transformer).

The IF amplifier and RF amplifier (if present) tubes can be removed in a set with filaments wired in parallel. This will allow the set to run a little cooler, eliminates the possibility of AM stations breaking through, and may give more room to manoeuvre in compact sets.

2. Connections to the host radio

Three connections (local oscillator signal, audio output, power) plus ground must be made to the radio, generally made at the tube sockets. It is very easy to make these connections without any disassembly, modification, or soldering to the host radio by making the connections at the tube sockets with socket adaptors.



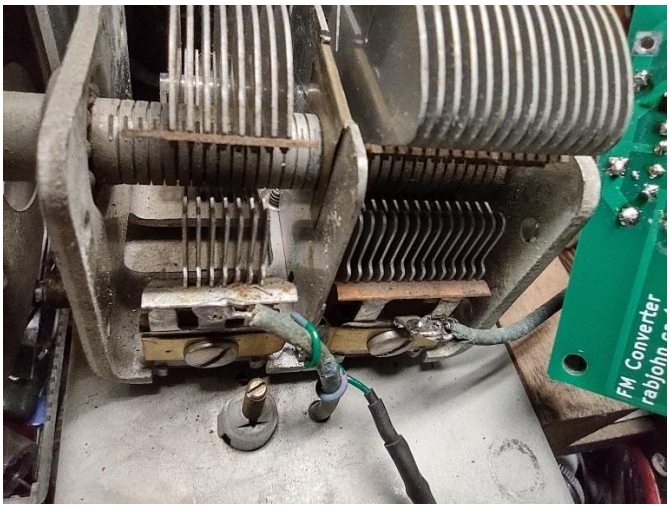
2.1 The local oscillator (LO)

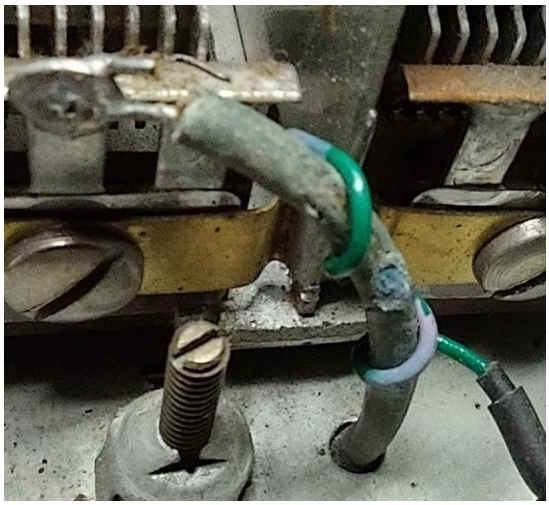
There are 2 ways to do get the LO signal: either use a capacitive link to a LO wire, or connect to a pin on the “Converter” tube (possibly with a socket adaptor).

Capacitive link:

The FMC is very sensitive, so only a small LO signal is required, and this can be extracted with a capacitive link. An insulated wire wrapped around a wire provides enough capacitance to extract the LO signal. The link can be made by wrapping insulated copper wire from the FMC LO port to the wire connecting to the LO tuning capacitor in the host radio. These radios have dual (or more) tuning capacitors, and you must pick the right one. If there is a pair and they are of unequal size, then the smaller one is the one you want to couple to. If they are equal size, try this: Turn on the radio and tune to a station at the upper end of the AM band. Touch each variable capacitor (stator) terminal, one at a time, with an insulated screwdriver. Touching the LO side will make it sound like the radio is being tuned away. Touching the other (antenna) side will have a less dramatic effect, may even increase volume.

Shielded wire should be used to get from the board to the tuning capacitor. A solid insulated copper wire should be soldered to the center conductor of the shielded cable, and the outer shield left unterminated. Insulate well with heat-shrink tubing. The insulted copper wire is wrapped around (3 turns should be enough) the wire connecting to the LO variable capacitor that was identified above. No “DC” electrical connection is required.





Coupling to the tuning capacitor.

Connect to the Converter tube:

The LO signal may also be pulled from the “converter” tube. This may be the easier technique if the tuning capacitor is difficult to access. In principle, you could use the signal from either the grid or the plate of the oscillator, but I have found that the grid (which is usually connected to the oscillator coil and tuning capacitor) is more sinusoidal; the plate can have significant harmonics that can fool the phase locked loop. Typical tubes are:

Tube type	LO grid pin number
6SA7, 6SB7	5 (octal)
6A8, 6J8, 6K8	5 (octal)
6L7 (not a converter, just a mixer)	Better to find the local oscillator
2A7, 6A7	5 (7-pin standard)
6BE6	1 (7-pin miniature)
7A8, 7B8, 7J7, 7Q7, 7S7	4 (8 pin loktal)

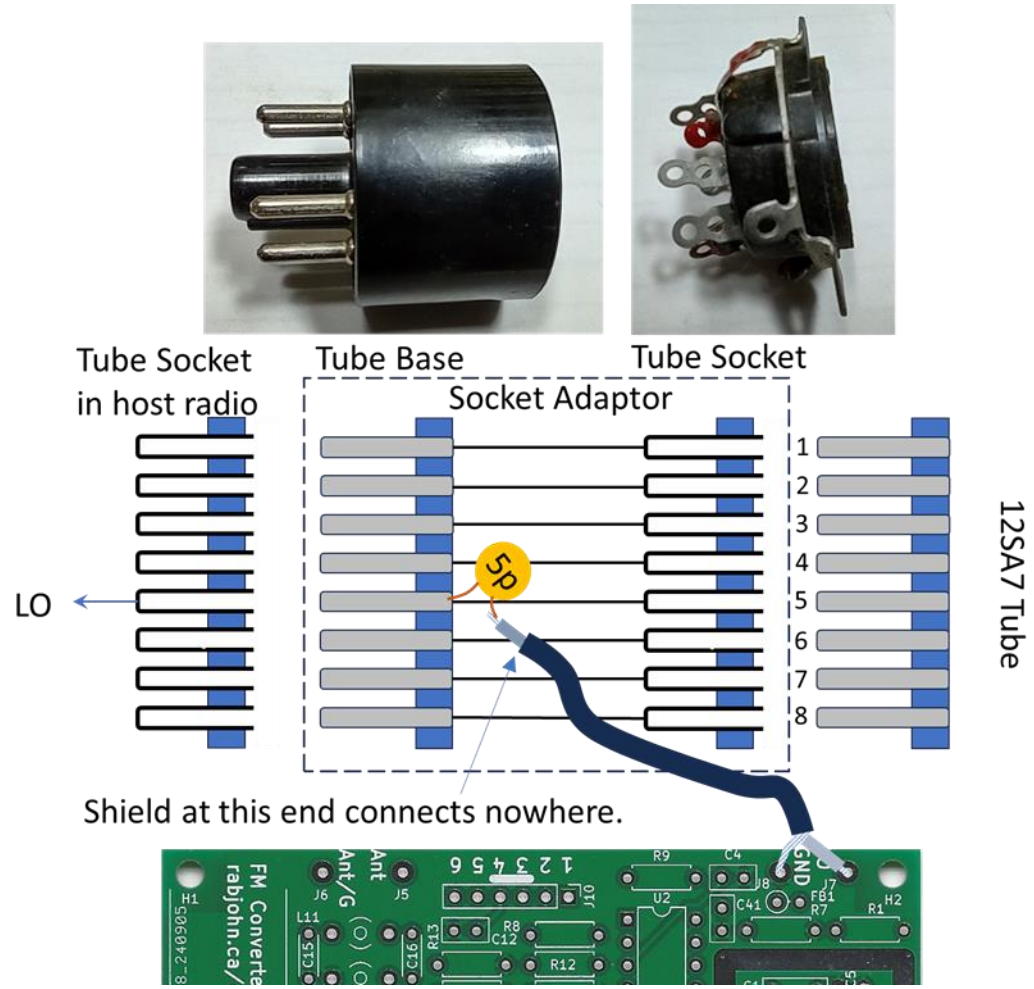
Note that the tube list is not exhaustive; these are the most popular converter tubes. The best way to make this connection is through a tiny capacitor (say 5pF, not critical) mounted very close to the pin. This way, minimal capacitance will be added to the oscillator circuit. The capacitor is connected to the circuit board LO port with shielded cable. A “socket adaptor” is recommended so no soldering is required on the host radio. For octal and “Standard” tubes, this is easily made with the male end taken from an old tube, and a matching tube socket on the female end. The pins are wired up 1 to 1. This gives you access to the nodes required. Miniature tube socket adaptors can be made by soldering rigid AWG18 wires to a miniature socket. Loktal socket adaptors have larger diameter pins but can be approached the same way.

In radios that have a separate oscillator tube and mixer tube (radios that use a 6L7 mixer, or early radios that use some other tube (perhaps a 24)), it is best to find the associated local oscillator (which can be many different tube types) and tap the signal from its grid.

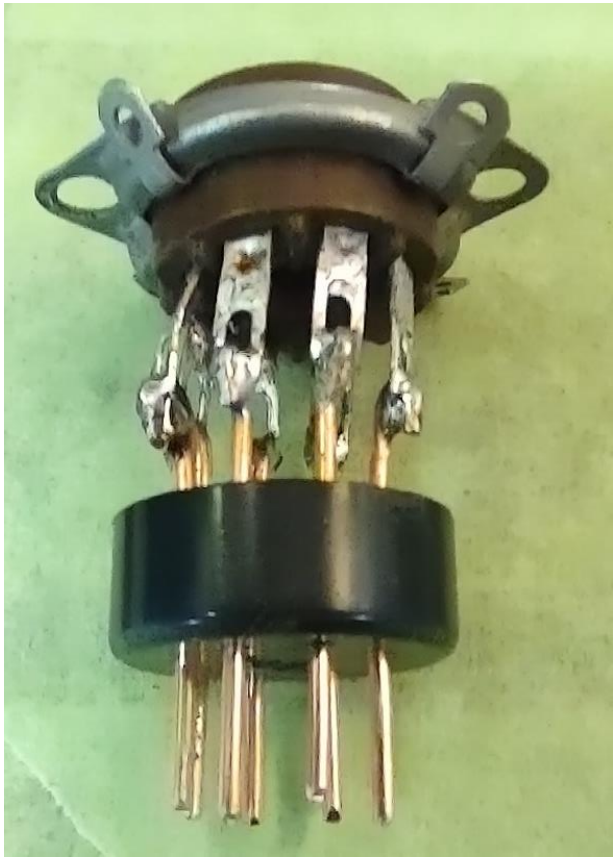
Above: a socket adaptor. It plugs into the radio, and the tube plugs into it.

Another option is just to wrap a piece of solid wire around the tube pin.

Wrap a wire around a tube pin. For the LO, the 5-10pF capacitor should be close to the tube. It is located under the heat shrink tubing.



Socket Adaptor for a 6SA7 or 12SA7 tube.




A socket adaptor for a 7-pin miniature tube. This is made with 18AWG wire soldered onto a 7-pin socket. The black plastic thing is a pin protector that is sometimes shipped with a tube, but it could be made by drilling 7 holes (perhaps using a tube socket as a template) into a plastic disc, perhaps a button.

2.2 The Audio

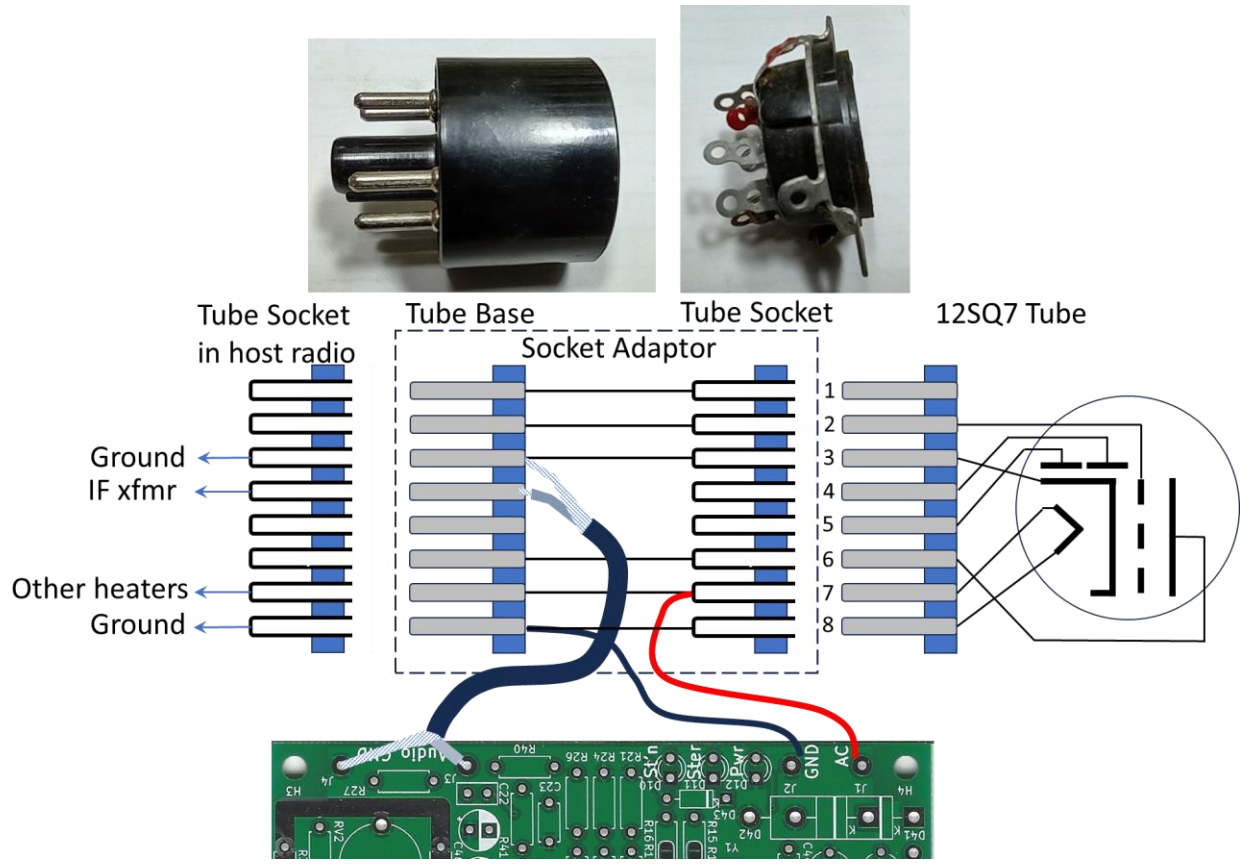
The audio is injected at the detector. Detector diodes in tubes tend to come in pairs, and either or both diodes could be used as the detector, and the other diode could be open or shorted or used elsewhere. You will need to determine which diode to use, either by consulting the schematic, or looking under the chassis, or simple trial and error. The diode you want connects to the IF transformer. Typical detector tubes are:

Tube type	Pin #: Audio	Pin #: Ground	Pin #: Power
6SR7, 6SQ7	3 or 4 (octal)	3	7 or 8
6Q7	4 or 5 (octal)	8	2 or 7
75, 85, 2A6	3 or 4 (6-pin standard)	5	1 or 6
6AT6, 6AV6	5 or 6 (7-pin miniature)	2	3 or 4
6H6	3 or 5 (octal)	4 or 8 or 1 *	2 or 7
7B6, 7C6, 7E6	5 or 6 (8 pin loktal)	7	1 or 8

* Best to just use the chassis ground

Note that the tube list is not complete; these are the most popular tubes. This connection should be made with grounded shielded cable to avoid hum pick-up. The shield of the shielded cable should connect to ground at the socket as well. Be careful when selecting ground; the detector cathode is usually a good choice. Also, one of the heater pins will usually be at ground (unless a center-tapped heater winding is used at the transformer).

If you have room (height), a socket adaptor is the best way to make the connection. If you do not have enough head room for a tube adaptor, you can try connecting directly to the socket pins. The socket adaptor should preferably be wired so that the diodes in the tube are disconnected; the audio signal from the FM converter goes into the radio, not into the tube. Keeping the detector diodes connected will introduce a small amount of distortion unless the negative supply is populated on the board; this will reverse bias the detector (eliminating distortion) and lower the gain of the IF amplifier (which may prevent noise and instability). Mind you, in an AC set, the IF amplifier tubes(s) and RF amplifier tubes, (if present) can be removed, saving power, heat and eliminating the possibility of noise or oscillation.



(Above) An example of the wiring of a socket adaptor for a 6SQ7 or 12SQ7. The diodes on the tube (pins 4 and 5) are disconnected, and audio is injected into the host radio at pin 4. Some radios may need this audio to be injected at pin 5. Ground is shown at pin 8, but it could also be at pin 7 in some radios, making it necessary to swap the red and black wires.

Radios with a switched “Phono Input” can receive audio through that connection. But, beware, radios like this sometimes remove power from the RF section and might disconnect the coils when the radio is switched to “phono” mode, so tuning would be impossible. If the connections are maintained, then you may be able to turn your radio into a true AM-FM radio!

There is a third option: The detector is usually a dual-diode + triode tube. The diodes are not needed when used with the FM adaptor. The triode can be replaced with a FET, making the tube unneeded. I have used a LND150 D-mode high voltage MOSFET with a potentiometer in the source (to adjust the drain current) to replace the triode. This can be built on a socket recovered from a burnt-out tube, resulting in an assembly that is smaller and cooler than the original tube. (see the article on converting AA5 radios for details)

2.3 Power

This version of the converter takes about 35mA (and, with half-wave rectification, this is 70mA half the time) from the heater circuit. Any transformer in an AC-only set will have adequate capacity for the extra current required by this board. The connection can be made at any of the 6V tubes, but I find the detector/first audio tube most convenient. (not the rectifier! Please not the rectifier!) The heater power pins are listed in the chart above, but you will need to determine which is power and which is ground. For example, for a 6SQ7, the heater power could be on pin 7 (with pin 8 ground) as shown in the picture, or the heater power could be on pin 8 (with pin 7 ground). In the rare cases where 12V tubes with paralleled heaters are used with AC on the heaters, please make sure capacitor C40, C46 and C47 (if used) are rated at 20V or more. See the notes on page 2 regarding radios that use 2.5V tubes or radios with centre-tapped heater supplies.

2.4 Other AC Radios

Some AC radios could use a separate LO tube; this should not pose a problem. Some very old radios do not use a diode detector; it may be necessary to inject the audio into some other form of detector. It may be necessary to bias that tube differently.

I do not have direct experience with converting European radios, but they should pose no particular difficulty. Most AC sets use the “E” series of 6V heater tubes. “A” series heaters (4V) will need a voltage doubler. European radios may have the detector diode in with the IF amplifier (…AF..BF… tubes) or with the audio output (.BL.. tubes.) The detector in with the IF amplifier makes for a very easy conversion since neither IF amplifier nor the detector are needed when using the converter. The converters are usually triode-hexode types, with the local oscillator being the triode. Couple to either the grid or the plate (it seems that the LO tuned circuit can appear in either the grid or plate circuit), or just capacitive couple to the LO tuning capacitor.