

## My FM Converter History

Gord Rabjohn, February 2025

Circuits for converting your AM tube radio into an FM radio have been an obsession for me for many years. The AM radio band has become a wasteland; there are fewer and fewer stations broadcasting on this band, and those that remain tend to be talk radio or sports radio. Many AM radios from the 1930's onward can be restored to be safe and reliable, and can be used daily. But they need better programming. The obvious choice is to convert them to FM. Converting an AM radio to FM is more involved than changing the frequency at which it operates. Most of the AM radio circuitry is not useful for FM reception.

My goal has always been to convert the host radio without any permanent modifications; that is, without the necessity for soldering anything to the circuitry in the radio. I want to be able to convert it back to its original condition easily, just by replacing tubes. Therefore, the antique value of the radio is unaffected. Also, I want it to operate very much as it used to; the tuning and volume controls should perform as they did before modification. Fortunately, the tubes in tube radios are always in sockets, so it is possible to either replace the tubes, or use socket adaptors between the tube and its socket.

Of course, an external FM tuner could be used to inject audio into the amplifier. One step further, you can connect your music player, CD player, turntable, streaming service, Bluetooth adaptor, whatever. They all use the radio essentially as an amplifier. I wanted to preserve the radio functionality.

The radios I want to support are the superheterodyne radios that became popular in the early 1930s. This covers the famous "All American 5" (AA5) and its relatives, but many more, including European radios, console radios, car radios, almost any tube radio made after the early 1930's. It could be possible to use these adaptors on TRF radios (make one stage oscillate) or regenerative radios, even transistor radios, but radio modifications would probably be required, and I don't see that as the main market.

All of my converters have the same basic architecture: They are centered on a voltage-tuned FM tuner. The voltage that drives the tuning port is derived from the host radio's Local Oscillator (LO) signal (through a frequency-to-voltage converter), which is dependent on the dial setting of the host radio. I have tackled this several ways, which I will describe below:

### Version 1

Version 1, circa 2003, was designed to be installed by replacing just one tube: the converter (6SA7, 6A8, 6BE6...) It used a HC4046 Phase Locked Loop (PLL) to convert the LO frequency to a voltage, a TDA7088 as the voltage tuned FM tuner, and a NE602 as an oscillator/modulator that generated an AM signal that was injected into the IF strip. It is documented here:

[http://rabjohn.ca/data/documents/FMConverter\\_word\\_built2020.pdf](http://rabjohn.ca/data/documents/FMConverter_word_built2020.pdf) The frequency of the oscillator must be tuned to the IF frequency of the host radio. The IF strip of the host radio limits the high frequency response of the system. And, the TDA7088 is a quirky circuit!

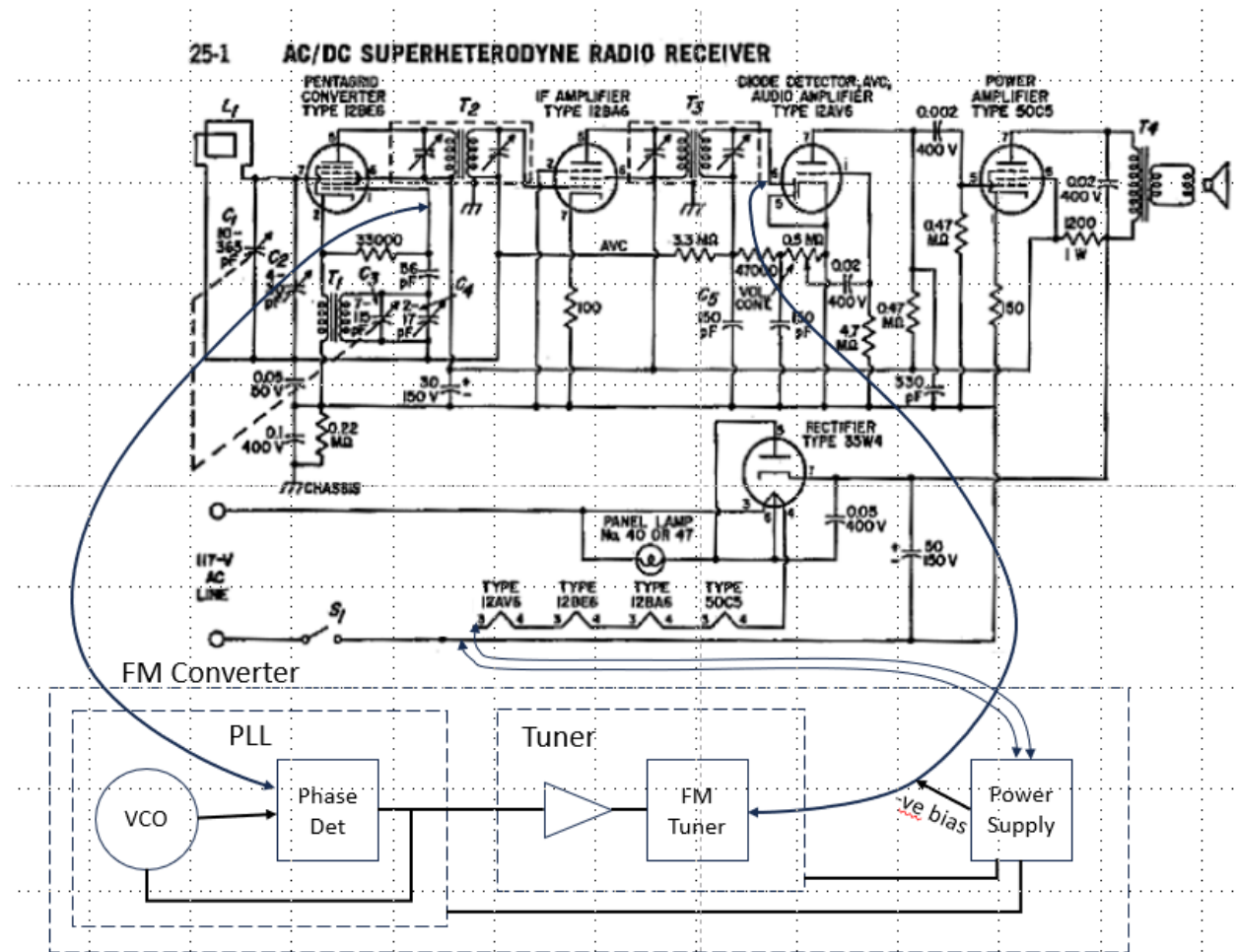
### Version 2

Version 2 was a much more complex system. It plugged into the converter and the detector (6SQ7, 6Q7, 6AT6...) It converts an AM/SW radio into an AM/FM radio. The LO frequency to voltage converter was done with a digital circuit. When the radio was in short wave mode, the output voltage was high enough

that the FM tuner circuit was switched in. The voltage-controlled FM tuner was a standard FM tuner retrofitted with varactor diodes. The output of the FM tuner was injected into the detector directly (no AM modulator was used). It was very complex and I did not properly document it. However, it works very well. The standard FM tuner has high fidelity and tunes nicely, and the full frequency response of the radio is available. It is nice to be able to switch between AM and FM with a front-panel knob. But, it is complex and difficult to reproduce. I have not documented this version properly.

### Version 3

Version 3 (circa 2018) was an attempt to make a simpler, better system than version 1. Like version 1, it used a HC4046 PLL circuit for the frequency to voltage converter, and the TDA7088 for the FM tuner. Like version 2, it injected the resulting audio directly into the detector. So, it needed connections to 2 tube sockets. [http://rabjohn.ca/data/documents/FMConverter\\_2018\\_complete.pdf](http://rabjohn.ca/data/documents/FMConverter_2018_complete.pdf) Physically separating the PLL from the tuner made it a little less “quirky”.



#### Version 4

Version 4 (Circa 2021) was a further simplification. By changing the way the varactor diode in the TDA7088 circuit was driven, it was possible to eliminate an op-amp level shifting circuit. Much of the resulting circuit could be squeezed into adaptors under the octal tube sockets.

<http://rabjohn.ca/data/documents/Notes-on-converting-AM-radio-to-FM-2021-big.pdf>

#### Version 5

Version 5 (Circa 2024, 2025) is a radical departure. It uses the HCT9046 PLL for the frequency to voltage converter (this chip is more stable than the very similar HC4046), with the hope of improved thermal stability. And, it uses the Skyworks (Formerly Silicon Labs) Si48xx family of “Mechanical Tuned” FM radio circuits. This FM tuner is much more sophisticated, and uses fewer components, and works better. The Si4836 has stereo output, opening the possibility for using 2 radios as left and right speakers! As of 2025, it is in production (as opposed to the TDA7088 which is obsolete, though widely available). Furthermore, I had a custom circuit board made to make it by far the tidiest and easiest implementation.

If you are planning to attempt a conversion, please use Version 5. It is a little more complex, but the circuit board makes assembling it very simple, and the circuit will just work with little tuning or tweaking required. It is more stable and works better than the earlier versions. I might sell some boards, or even sell some completed boards. We'll see.

#### The French Connection

I draw your attention to another ingenious approach out of France: <https://radiofil.org/20-modules-et-kits> . (It used to be there, but as of 2025, I do not see it anymore) Their approach does require some modification of the radio.