Repairing a Sony TR-72 Transistor Radio

Gord Rabjohn, May 2020

The Tokyo Tsushin Kogyo company (which translates to Tokyo Telecommunications Engineering Corporation) was founded in Japan in 1946. They designed and manufactured tape recorders. In 1955, they entered the burgeoning "Transistor Radio" market. Their first model, the TR-55, was a direct response to the world's first transistor radio, the Regency TR-1 introduced in the US the previous year. The TR-55 is very rare in North America. Their second model (there were some smaller earphone-only models in-between), the TR-72, was introduced in December 1955, and is the topic of this article. Tokyo Tsushin Kogyo had a marketing name for their radios, first used on the TR-55: "Sony". The company changed its name to Sony a few years later, and the rest is history! The TR-72 was marketed internationally (though, apparently not in the US; Americans would have to wait for the TR-63, a "Shirt Pocket" transistor radio introduced in 1957. By the way, the TR-63 was very successful, millions were made, and it introduced the "9V battery" to the world) and is not uncommon. In Canada, the TR-72 was imported by Gendis, and my version has "Gendis Sony" printed on the frequency knob.

The TR-72 is substantial 7-transistor portable radio in a wooden cabinet with a large speaker and (unlike the Regency TR1) has good sensitivity and good fidelity. It uses germanium NPN transistors that were fabricated by TTK. This is rather unusual, most radios made over the following 10 years used germanium PNP transistors. The TR-72 must have been one of the first radios to use this now common line-up: 1 RF converter, 2 IF amplifiers, and 3 stages of audio amplification, the last stage being a transformer coupled push-pull stage. (apparently, the earlier Raytheon 8-TP-1 was the first transistor radio to use a push-pull output) The schematic of the TR-72 looks similar to more recent transistor radios, though the AGC circuit is quite strange. The TR-72 is powered by three D-cells, and operates for hundreds of hours on one set of cheap batteries. In fact, this radio takes about 10mA, significantly less power than the filament of just one tube in a typical 4-tube portable radio that were popular at that time.

The TR-72 was in production for about 5 years (estimates vary), and it went through several different iterations, with several different schematic diagrams. There were roughly 50000 made. The size of the transformers changed, the transistors used changed, the layout of the circuit boards changed, parts values changed, and this complicated the repair job.

Figure 1 The radio (one output transistor was removed)

I acquired my TR-72 it in the late 1980's from my Grandfather's estate, and it sat on a shelf until recently. It was fairly early in the production run, with a serial number 12120. My TR-72 is in rough condition, having suffered some external water damage. Inside, there was corrosion, a missing transistor (The RF/IF transistors have sockets, the first IF transistor was missing), and the usual grunge of age. See Figure 1. I powered it up slowly, and it took too much current. I quickly determined that one of the audio output transistors was shorted (using the clamp-on ammeter on the supply lines). Unfortunately, I had only one NPN germanium transistor in a case style that would look right in this radio, and I had already used it in the IF socket. These transistors are in a case style popular at that time (similar to TO-22, but you are forgiven if that designation is unfamiliar to you), and I did not want to put a modern-looking transistor in this radio. The output is push-pull, so one transistor cannot be replaced unless the replacement is very similar. So, I opted to replace both output transistors (and the associated bias diode) with standard silicon NPN transistors (2N3904) disguised as old transistors (I left the old transistors in the radio for future owners to appreciate).

I used epoxy and a mold to disguise the modern transistors. I started by shrinking some heat-shrink tubing around one of the old transistors. I slid this tubing off of the old transistor, and this tubing became a little mold. I placed the smaller modern transistor in this mold and filled the mold with 2-part epoxy. When the epoxy hardened, I cut the mold off and trimmed off excess epoxy. Painting it grey results in a pretty good-looking replica. See Figure 2

Figure 2 Four silicon transistors in disguise, and one original.

Now the current was under control, but I did not have enough audio gain. I discovered that many of the electrolytic capacitors were in rough shape. In particular, by injecting audio into various places in the amplifier, I found that the stage 1 and 2 input coupling capacitors were open. I left them in place (for looks) and mounted small caps in parallel with them under the board. Now the amplifier worked, but there was still no RF sensitivity. The three RF/IF transistors were biased up about right. An oscilloscope showed me that the LO worked, and I could inject a 455kHz signal into the IF strip and hear a faint signal. I discovered that the detector diode had very high series resistance, so I soldered a 1N34 in parallel with it. This radio (confusingly) has two ground nodes, with the "RF ground" (on the variable capacitor among other places) held positive relative to the negative battery terminal with a voltage divider. This voltage was wrong, and the cause was a missing resistor; there was still the stub of a lead remaining. Why someone decided to cut out one resistor remains a mystery to this day. Replacing this resistor brought the radio to life. The AVC diode seemed to be open, so I added another 1N34 in parallel. The volume is still quite loud even when the volume control is at its lowest setting. According to a Japanese web site http://radiokobo.sakura.ne.jp/G/tr-radio-repair/TR-72.html this is quite a common problem. I did not have a replacement pot that would look correct in the radio, so I left it at that. Aside from the limited volume control range, the radio works well, offering better than average sensitivity and sound quality.

The varnish on the wooden cabinet was in rough shape, and parts needed gluing, so I re-glued joints and lightly sanded and shellacked the wood. The metal had been varnished as well, and the varnish was flaking, but I left it alone. I had to fabricate a latch for the back door. There is quite a lot written about this radio on the web and I refer interested readers to the references.

Figure 3. Sony TR-72 after cleaning up.

References:

http://worldphaco.com/uploads/THE_SONY_GENDIS_TR-72_TRANSISTOR_RADIO.pdf

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