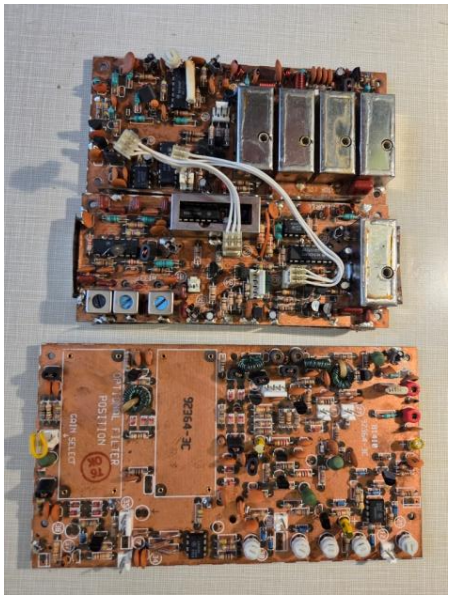
Paragon upgrade

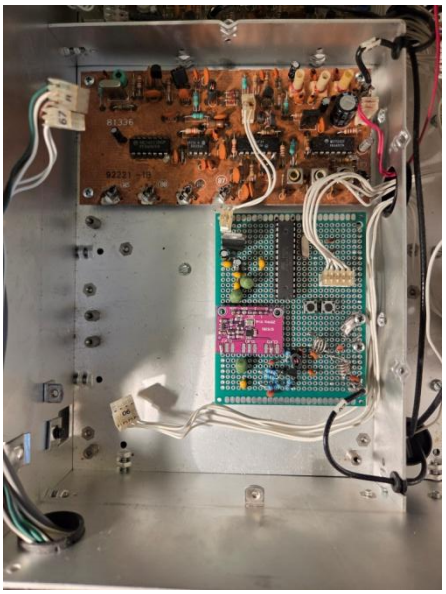
In 1987 Ten Tec, already known for innovative solid state radios with no-tune outputs and full break-in keying, introduced their first PLL-synthesized rig, the Paragon. I loved the look of the radio and the amazing features, but the $1,895 price tag ($5,425 in today's dollars!) was way outside my price range. Still, I kept an eye out for them on eBay listings and at hamfests. In 2003 I picked up one from an estate sale complete with the matching speaker/power supply at a very reasonable price and replaced my Kenwood TS-930S/AT. Over the next years I added accessories like the voice module, all of the filters, the RS-232 interface, and even added DSP noise reduction as a home-made project. The radio was a joy to use, but had an Achilles heel in the PLL boards that affected most of these radios as they aged. From time to time the PLL system would become unstable or totally loose lock altogether. There are 2 PLL boards, the Major Loop board that has 4 sections covering the different bands, and the Minor Loop Board which provided other frequency information for the Local Oscillator section. The fix was simple enough: remove the boards and replace solder on the signal paths, but this needed to be done every 6-12 months to keep the rig working, so mine ultimately got relegated to back-up service.

In 2025 a German Ham, Rolf DL6ZB, decided that his Paragon was worth saving as one of his favorite rigs, and he designed a replacement for the LO system using a modern SI5351 signal generator chip controlled by an ATMega-328P processor. I was familiar with the SI5351 as it is the basis for the VFO in all of the BitX radios that I have. The concept was pretty clever: take the existing signals from the Paragon control board that sends frequency and band information to the Loop boards, translate them with the processor into signals for the SI5351 chip, and filter the output to match the expected LO signals for the rest of the RF chain. He designed the circuit and wrote the software for the translator processor so it would be a direct replacement, using the same plugs and cables, so the mod could easily be reversed if needed. Based on a posting he made on a Ten Tec forum, I started a nine month correspondence with Rolf and set out to collect parts to build my own during the next winter.

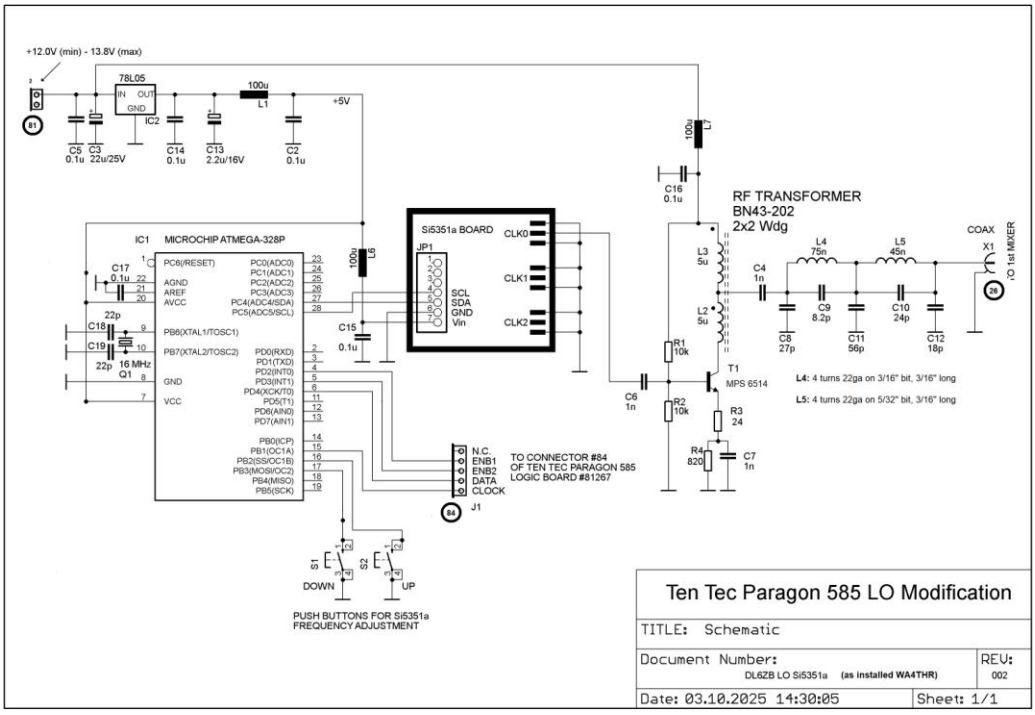
The components were relatively inexpensive and available, except for the plugs and jacks Ten Tec used, but I located a pulled board from a Ten Tec Omni V from the same era that had all of those parts that I could remove, plus a number of others. (The picture shows the Major and Minor Loop boards, and the pulled board from an Omni V). From there I began board layout and construction, working a little at a time through the winter. When it was finally finished, I swapped it for the 2 other boards and powered it up, and…nothing <sigh>. This is not uncommon with homebrew projects, and sometimes figuring out why something doesn't work is more educational than actually building it.



Rolf and I exchanged many emails, sharing voltage information, filter passband plots using a NanoVNA, and oscilloscope traces of the SI5351 and filter outputs, but mine stubbornly was stuck on one frequency far from what was needed and it did not change with the band or tune controls. One day while studying the Ten Tec manual I noted that the Major Loop board I was replacing was an 81338 Rev C, while Rolf's was an earlier version. Further research showed that the software for the older version began with a 3, while mine began with a 4, and the commands being sent to the LO were different. As it turns out, there are upgrades for the Paragon processor chip, which add other features like band-stacking registers and memory scanning, that are still available from N4PY and WB8BFS. They both indicate that you must tell them whether you have a V3 or V4 system. I ordered the version 3 N4PY chip to give the same output commands as expected from the software Rolf wrote, and installed it when it arrived. Now the radio became functional again, and I picked up a few new features with the upgraded processor chip. The next problem was that the radio was deaf above 20m. Again, Rolf & I compared notes in a series of emails and I tried raising the cut off frequency by widening coils on the output filter. Then Rolf noted looking by at a picture I sent that my coils were larger in diameter than what he had used. I cut off the old coils and wound new ones closer to his metric size measurements and then the receiver started working as planned with signal levels equivalent to my other rig all the way up through 10m. The photo shows the new LO board mounted in the cavity where the old loop boards were located. The upper left of the green board is the power supply for 5v and isolation filters for each section, the center is the processor section with push buttons for trimming the oscillator to calibrate the signal, the SI5351 is the red board on the lower left, and the RF output and filter is on the bottom right.



The result of this work is a much better understanding of the radio and the replacement circuit for the old PLL system, some practice measuring circuits with the scope I had rarely used, and a classic rig that has been updated to a modern system, complete with compatible CAT controls for logging or with digital programs. The circled numbers on the schematic are the cables that connect to the existing system.



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