

Knight Kit V44 VFO Stabilized by the Cumbria Design X-Lock 3.0

The Knight V44 VFO has a place in history. It was designed in the late 1950's as a self contained VFO intended to plug into the crystal socket of a transmitter of that time period. It was a way for upgrading Novice class hams, now with a General class license, to move from being rock bound to having a real VFO.

The Knight V44 has dial coverage for the ham bands 80-10M, including the CB band. This does not include the WARC bands. The VFO oscillator always operates in the 160m band, and has two ranges:

80M + CB: 1.69-2.0 Mhz

40-20-15-10M: 1.75-1.86 Mhz

The VFO output is doubled to 80M, and from there frequency multiplication is required in the transmitter chain that follows. So any oscillator drift is also multiplied: 2X on 80M, 4X on 40M, 8X on 20M, 12X on 15M, and 16X on CB and 10M. Fortunately the original V44 only drifted about 300Hz over the first hour of operation, but then multiplying that up, that is almost 5 khz on 10M!

So dealing with the drift of a tube based VFO, several factors need to be addressed. This VFO is keyed off and on, so that further complicates things. Here is the sequence of events I went through:

- 1.) Temperature compensation. The VFO always drifted down with increasing temperature. I tried one iteration by adding two capacitors in series from the bottom of L1 to ground. I used a 5pf NPO in series with a 68pf N220. This cut the warm up drift in half. I had to recalibrate the dial afterward.
- 2.) I changed the tube filaments over from 6.3 VAC to 6.0VDC Regulated. This eliminated frequency shifts from AC line voltage changes.

- 3.) I decided to stop keying the oscillator, and let it run all the time. Whenever the oscillator keyed, it had a 5-10 second rapid drift (chirp) before settling down.
- 4.) Now the oscillator was always too strong in my receiver, so I did two things: bypassed the AC power cord to ground with caps, and added a relay. The relay had two jobs: when not energized, it shifted the VFO down 15 KHz, AND disconnected and shorted the VFO output. The VFO output was at least 50 db down, and was shifted away. I cannot hear the VFO now as the level is under the band noise floor. The 15 KHz shift is multiplied as well on the upper bands.
- 5.) In preparation for X-Lock, I added a tuning diode network that shifted the oscillator about 3 KHz over the range of 0-8VDC tuning voltage. Remember the oscillator only drifted a few hundred Hertz, so a 3 KHz range is plenty. With a tube VFO, the signal level is high enough to cause tuning diode rectification, so using dual diodes as I have done is recommended. Using a POT to vary the tuning voltage, I had a stable VFO (with the cover removed) free from any tuning voltage modulation. I could have stopped here and had a nice fine tuning control using the regulated 6 Volt supply for the filaments to also go to the tuning POT. Putting the cover back on resulted in the oscillator heating up again, and the drift returned.
- 6.) Add the X-Lock! This was relatively easy since the ground work was already done. The hardest part was finding 2-56 screws to mount the PCB. It seems that the PCB mounting holes are intended for Metric screws.

With the X-Lock installed, I had issues with my RF sampling. I sample the RF output at 80M, and the loading from the transmitter first stage grid current caused the X-Lock to lose lock, and then re-acquire. This varied from band to band. The solution was to diode clamp the RF sense to make a 1.6v p-p square wave at the X-Lock RF sense input. Now the VFO output can vary over 2:1 in amplitude with no change in the X-Lock RF sense input.

The RIT option on X-Lock 3.0 was necessary to use this V44 when the oscillator is shifted 15 KHz (30 KHz at RF sample input) when I go from

receive to transmit. This works perfectly, and I did not have to wire in the X-Lock "EXT T/R I/P".

The results have been fantastic. I can stay within 10Hz on most bands. I was recently on 20M AM over a few hours, and my frequency meter always came up and said 14.325.0X Mhz where only X varied a bit. The VFO oscillator is multiplied 8X on 20M.

I have added a small 12V DC fan to exhaust the buildup of heat. The internal VFO environment was approaching 50 degrees Celsius. This is probably a bit warm for the poor silicon based X-Lock circuitry.

Schematics Section

This is the Original Schematic:

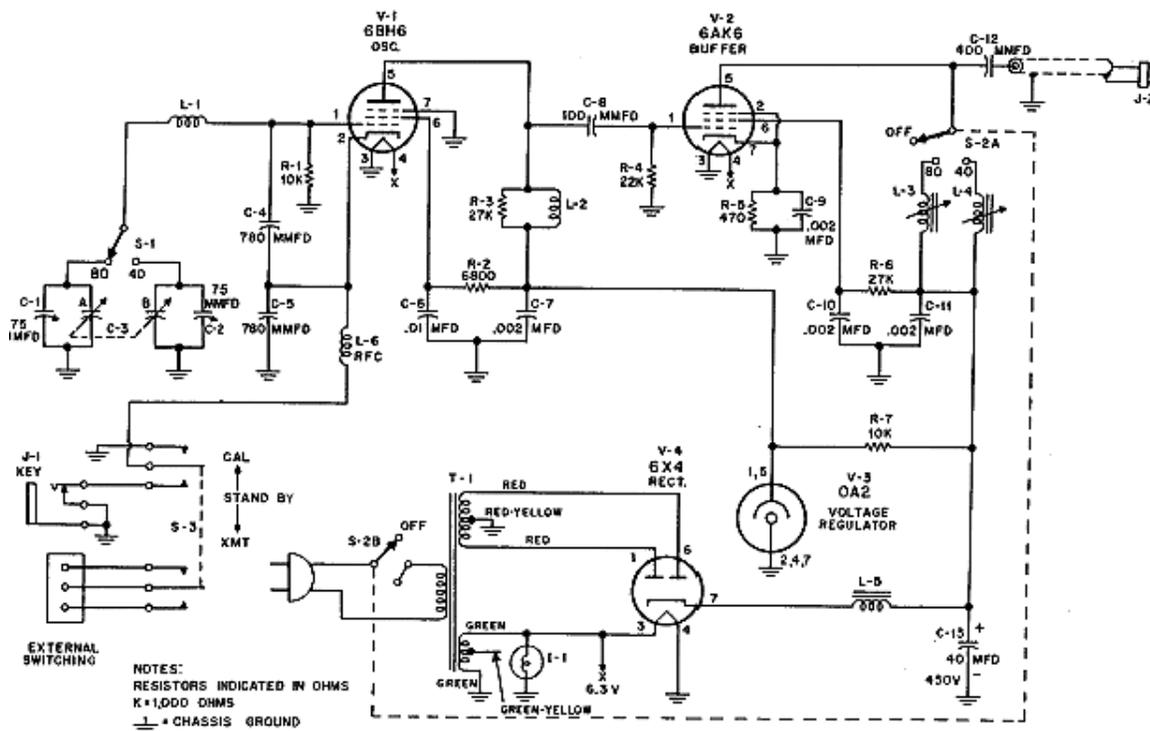
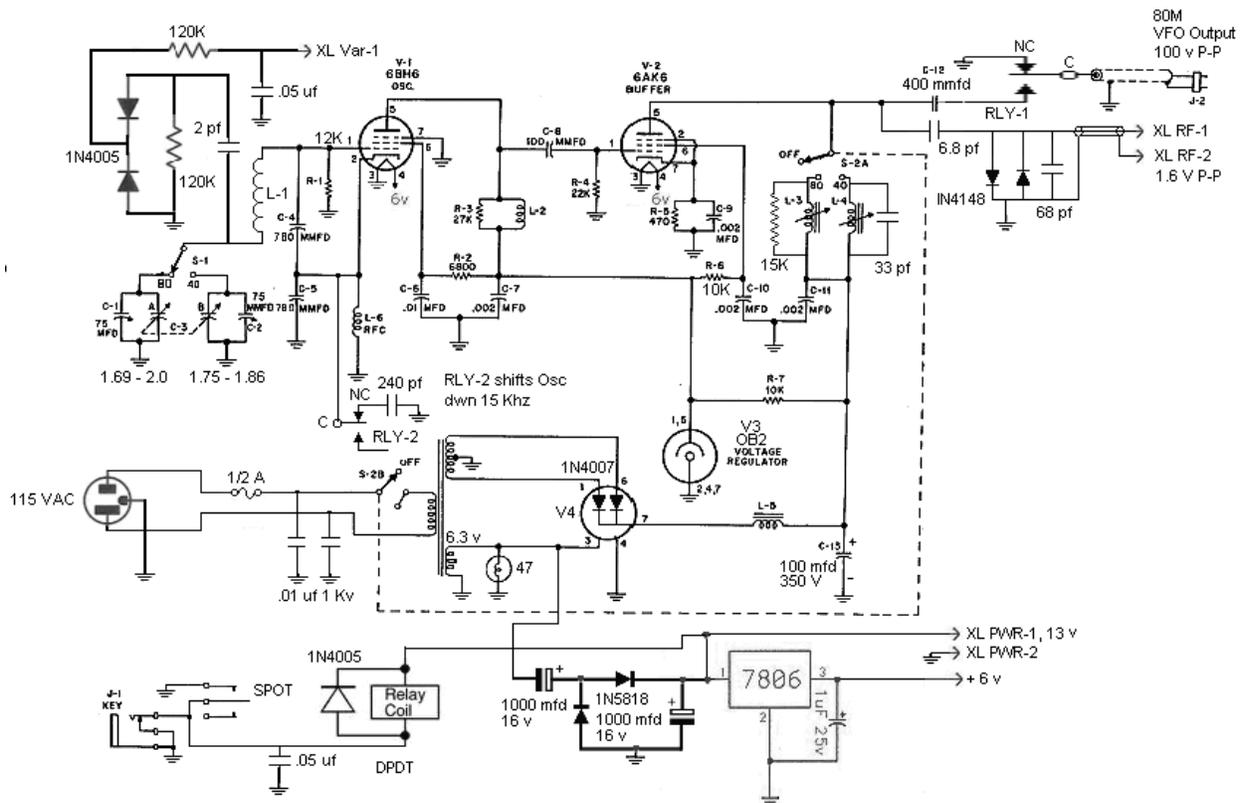


FIGURE 19. SCHEMATIC DIAGRAM, KNIGHT VFO

Here is the schematic with all the changes listed including the X-Lock:



Schematic Diagram, Knight V44 VFO, Modified to use X-Lock 3.0 Stabilizer. WD5JKO June 2013

There are many small changes made that are not described in the earlier text. One area that needed work was the high voltage B+ where the VR tube was not always idled between 5-30ma, so the regulation suffered, and sometimes the VR tube would extinguish. I solved this by going from an OA2 (150V) to an OB2 (105V). This also turned down the oscillator power which enhanced stability. The regulated B+ was also changed to include the buffer stage screen grid.

The concept here could be applied to other keyed "Boat Anchor" VFO's with some considerations. First, the VFO will need good isolation from a varying load, so without a buffer stage between the VFO and a tunable stage, adding X-Lock is not a good idea. Another consideration is that some vintage VFO's suffer from RF feedback. These typically will "pull"

from the “spot” frequency, and are not good candidates for X-Lock unless the issue(s) are resolved.

With the advent of SDR receivers, it has become apparent that many vintage AM transmitters do in fact “pull” the VFO with modulation. My Gonset G-76 Transceiver with the internal VFO was reported to me by multiple folks using SDR receivers, that when on 15M AM, my LSB was 30DB weaker than the USB. Here is a link describing this effect:

http://www.cliftonlaboratories.com/am_modulation.htm

Go to the bottom under, “Detecting Incidental FM”.

So a vintage VFO that suffers from lack of load isolation, RF feedback, or suffers from “Incidental FM” are not good candidates for X-Lock unless those issues are RESOLVED FIRST.

Here is an excellent article by W8JI describing some of these issues:

http://www.w8ji.com/johnson_vfo_chirp_jump.htm

Photograph Section

