SHF 3456K "No-Tune" Transverter Conversion Notes

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10 May 2022

In the June 1989 issue of *QST*, WA8LNC described a practical circuit board transverter for 3456 MHz. This board was paired with a local oscillator (LO) as described by KK7B's in the July 1989 issue of *QST*. Some time later SHF Systems of Nashua, NH made available boards and parts for the above in kit form. I have built dozens of these units for various people and suspect some units may still exist.

The recent loss of 3456 MHz band segment has prompted conversations about moving operating activities elsewhere within the band. Based on these discussions I have successfully converted four of the above transverters successfully to 3400 MHz: One incorporating a DIGI-LO synthesizer, and three using a crystal-based oscillator and multiplier circuits. The following article presents comments I believe are important to the conversion process. I hope others will find them useful.

Be sure that you have converted your transverter according to the *2304 and 3456 No-Tune Transverter Updates* by Steve Kostro, N2CEI, of Down East Microwave, Inc. The older MAR-series MMIC devices could not provide sufficient stability for 3456 MHz use so they were replaced with the newer ERA-series devices. Additionally, the x6 diode multiplier was replaced with a ERA-3 harmonic generator, which requires much less 552 MHz drive from the LO board. This allows elimination of the MAV-11 power stage.

The MMICs in my units receive power from an +8 voltage regulators. Good voltage regulation keeps the output level constant when operating from battery supply. For each ERA-1 and ERA-2 stage, I used a 120 Ω, ¼-watt carbon resistor; for the ERA-3 stage I used a 150 Ω resistor. For 9-volt regulator use, the corresponding value for the ERA-1 and ERA-2 stages is 150 Ω. For the ERA-3 stage the value is 180 Ω.

In the *Down East Microwave Design Notes*, dated March 20, 2021 and April 1, 2021, DEMI suggests replacing the multiplier and oscillator circuits with a DIGI-LO synthesizer unit, which can be configured for 3256 MHz output (note 3256 MHz + 144 MHz = 3400 MHz). I did this in one transverter with excellent results.

To replace the multiplier and oscillator circuits with a DIGI-LO, I added a 60-mil (0.060 in) wide soldered copper micro strip line for all the 552 MHz to 3312 MHz x6 multiplier parts. I found the DIGI-LO delivered plenty of drive (-2 dBm) with up to 6 dB additional attenuation. The attenuator didn't offer noticeable improvement so I left it out. The DIGI-LO can be reused for many other programmed frequencies for possible future use, a definite advantage.

The remaining three transverters used 90.44444 MHz crystals. One crystal, now unobtainable, is a HY-Q fifth-overtone unit with a 60° C heater. The other two HC-49/U (wire lead) fifth-overtone, ±3 ppm, 0 to 50° C types came from Krystaly located in the Czech Republic (www.krystaly.cz). Cost was very reasonable, US $15 each, plus $8 shipping.

The HY-Q crystal netted right on frequency, but the Krystaly crystals were <u>high</u> in frequency, meaning that the 144 MHz IF must be tuned <u>lower</u> by 20 to 30 KHz. This a minor inconvenience for a loaner rig—I attached a frequency offset label for operator

convenience. In general, I found attempting to net the Krystaly crystals to the proper frequency sacrificed stability. Note the crystal frequency multiplication factor of 36.

The DEMI transverters use 184 MHz crystals and Micro LO oscillators. This requires a crystal change to 180.88888 MHz to provide the needed 3256 MHz local oscillator frequency. Making these adjustments can be difficult and may lead to unreliable oscillation. The DIGI-LO route is the way to go, all things considered.

An HP 8595E spectrum analyzer provided by KB1QV simplified the conversion. Be sure to note the various spurious responses, LO feed-through, IF image levels, etc. before starting the conversion process. Comparing this information with the converted transverter (3400 MHz) will help determine the new unit's overall performance. The overall frequency shift is about -1.6%.

The KK7B 552 MHz local oscillator board will probably work well at 542.6666 MHz without modification, other than removing the MAV-11 stage. If the local oscillator board will not produce approximately 0 dBm (1 mW), try placing a few copper "snowflakes" on the filter lines. This may increase gain by a couple dB.

Some 5-pole hairpin filters had to be lowered in frequency to work well at 3400 MHz. The DEMI Design Notes describes "snowflake" tuning, but that I found dielectric loading is an easier approach to lowering the microstrip's frequency response. For this I used 1 inch wide, 2 mil (0.020 in) thick orange Kapton tape cut into 1⅛ in x ¾ in rectangles placed on the filters. This size will cover each filter completely. Add or remove tape as required to peak the filter's response. Scotch transparent tape will work as well, but it is harder to remove.

Since no separate port to test the 3256 MHz local oscillator exists, I looked at it though the powered transmit chain and electrically peaked the LO filters for maximum LO signal on the spectrum analyzer. That completed, I applied 0 dBm (1 mW) 144 MHz drive to the transmit mixer port and peaked the transmit filters for maximum 3400 MHz output. The goal here was to place the desired 3400 MHz signal barely into the low-frequency part of the pass band of each filter while attenuating the 3256 MHz local oscillator and 3112 MHz image signals as much as possible. Adding too much dielectric will lower the filter pass band range excessively, thus allowing undesired frequencies to leak through. The actual transmit output level at 3400 MHz differed between transverters since the MMIC lineup was not identical across units. The transverters drive amplifiers, which require only -10 dBm to 0 dBm input.

The receive chain incorporates (unfortunately) only one filter, which is preceded by one or more RF stages. I gained several more dB of noise (and weak 3400.1 MHz signal) with a single layer of added Kapton tape. In all cases, loading the three hairpin filters nearest the mixers and power divider increased performance significantly at 3400 MHz. The transmit output and local oscillator input filters benefited much less.

I hope you are able to resurrect some of these old transverters.

73, Dale, AF1T