Letters to the Editor

Exploring Near-End-Fed Wire Antennas (Mar/Apr 2009)

Dear Larry,

An error has been pointed out in my Near-End-Fed Wire Antennas article. On page 34, the first full paragraph on the page says, "The results shown in Figure 3, from modeling a 40 m NEF half wave dipole, are typical of those obtained for other bands. This model was 68 ft long at 40 ft elevation, with the feed point 10.5 ft from one end."

The distance from one end should be about 10.5% instead of 10.5 ft. This makes the position about 7.25 ft from the end.

This was my error, and I am sorry for the confusion this may have caused readers.

— 73, Ron Skelton, W6WO, 4221 Gull Cove Way, Capitola, CA 95010; **w6wo@k6bj.org**

Hi Ron,

Thank you for sending along that correction.

— 73, Larry Wolfgang, WR1B, QEX *Editor;* **lwolfgang@arrl.org**

A Versatile Two-Tone Audio Generator for SSB Testing (Mar/Apr 2009)

Hi Ken,

I read with great interest your article about a versatile two-tone audio generator in the Mar/Apr issue of *QEX*. You did a great job and the finished unit looks very professional. The article took me back 40 years, to when I did quite a bit of work on two-tone testing while building various SSB amplifiers.

The one potential problem I noticed upon studying your circuit was that the balance adjustment range is likely to be too low for many rigs. Your summing circuit has only about a ±1 dB range. It has been my experience that a ±5 dB range is often needed due to irregular frequency response of many rigs. In fact, if you run tones as low as 300 Hz or as high as 2700 Hz, an even bigger range might be needed due to filter roll-offs in various transmitters. I'd increase R10 to about 50 kΩ to provide more range on the balance control.

I question the need to have the frequencies of the two tones variable. It is my experience that for two-tone testing, frequencies of around 800 Hz and around 1800 Hz are satisfactory. Using fixed capacitors simplifies the circuit and makes it much more compact. Also, for those builders without access to variable capacitors (or those wishing to keep the size smaller), the frequency can also be varied using ganged potentiometers.

For those readers interested in building a two-tone test generator, I would like to remind them that there is a much simplified way to do it, which I described in the Aug 1971 issue of *QST* (pp 17-21). The basic idea was to power an audio oscillator with half-wave rectified ac and produce an 8.3 ms audio burst followed by 8.4 ms of silence. By carefully adjusting the feedback in the oscillator, a constant amplitude perfect sine wave is produced during the burst. Obviously, building two such oscillators will produce a burst two-tone generator with a 50% duty cycle, which is better suited to driving an amplifier to its peak without overheating it. Although my circuit of 40 years ago used 709 op-amps and 741s when they came out, I was curious to see if the same pulsed power supply would work with modern JFET op amps. To that end, I built the front end (U1 and U2) of your *QEX* circuit of Figure 6 on page 27, but substituted 270 Ω resistors for the lamps DS1 and DS2. I then adjusted R3 and R7 of each oscillator to get a constant amplitude audio burst at the output of the buffers U1B and U2B. It worked well except that there was a transient during the first and last half cycles of the burst. This was created by the turn on/off of the buffers, so looking at the waveform at the output of each oscillator (pin 1 of U1A and U2A) gave a cleaner waveform. The outputs of the op amps are of low enough impedance so that the buffers are not really needed. For the same reason, U3 is also not needed for a very simple circuit.

If the reader wants a very simple two-tone generator, I would recommend the following simplifications:

1. Use fixed capacitors to determine each frequency by eliminating C1A/B and C2A/B and increase C3, C4, C5 and C6 by about 100 pF.

2. Replace DS1 and DS2 with 270 Ω resistors.

3. Use a single TL082 for U1A and U2A. U1B, U2B, and U3 are all not needed.

4. Eliminate S2 so it is two-tone only.

5. Connect the summing network directly to the outputs of the oscillators. I would change R9 and R11 to 47 kΩ and make R10 a 100 kΩ potentiometer.

6. Connect the top end of R14 (Output Level) to the wiper of the balance pot and the wiper of R14 directly to the output.

7. Modify the power supply by eliminating all capacitors and regulators. Replace the bridge rectifier with oppositely poled diodes at each end of the winding and connect the cathode of one diode to +12 V and the anode of the other diode to –12 V supply. A 10 or 12 V CT transformer will work as well as the 20 V one specified. Don't go over 20 V on the transformer, because the op amp specification is 15 V max.

8. Make a test point at the output of each oscillator so it is easy to connect a scope to adjust R3 and R7 for a constant amplitude burst.

That's it! The result is a very compact two-tone test oscillator.

There is a lot more I could go into about burst oscillators producing low-distortion sine waves. If there is reader interest in the methods of two-tone testing, I would be glad to write-up some of my observations and experiences over the years.

— 73, Bob Buus, W2OD, 8 Donner St, Holmdel, NJ 07733; **w2od@aol.com**

Hi Bob,

Thanks for your comments regarding my article.

As the title says, I wanted it to be a device whose primary purpose was to be SSB testing, but which was also versatile enough to be used elsewhere in the ham shack or on the experimenter's bench.

I had come by a pair of old vacuum-tube HP200-AB audio generators in very good condition, which would have sufficed, but they took up half of my bench. Anyway, they were the inspiration.

All of the literature and service information that I've seen calls for equal amplitude tones. Hence, the balance trimpot was designed to be set-and-forget. While the circuit was being developed, I came to realize the wisdom of using ganged variable capacitors rather than ganged potentiometers. The potentiometers (commercially-made and from a well-known manufacturer) didn't track well at all, causing the oscillator to drop out and / or change amplitude.

The lamp in the negative feedback loop of each oscillator is not operating as a lamp but rather as a positive temperature coefficient resistor, which keeps the oscillator amplitude very stable. The oscillator buffers may not be needed, but they're the other half of the IC package anyway and were included as a matter of good practice.

I look forward to reading any of your future contributions to *QEX*.

— 73, Ken Grant, VE3FIT, 5 Windrush Trail, West Hill, Ontario, Canada M1C 3Y5; **ve3fit@arrl.net**

Hi Ken,

I received your reply to my comments on your article, and read it carefully. You make some good points.

With regard to the balance trimpot, it is not sufficient to have the amplitudes of the two audio frequencies exactly equal at the microphone input to the transmitter, although it is a good starting point. If the audio gain in the transmitter is not the same at each of the two frequencies (due to equalization, high frequency boost, and so on), then unequal tone amplitudes will be presented to the balanced modulator and you will not get the clean Xs on the cat's-eye pattern. Furthermore, if the sideband filter does not have equal response to the frequency-shifted RF two tones (possibly due to ripple in the filter response), again the Xs will be lost and you will not observe a clean cat's-eye pattern. To observe the clean Xs on the cat's-eye pattern, it is necessary that the amplitude of the two tones at the point of measurement (usually at the output of the transmitter) be of exactly equal amplitude. This is easily accomplished by adjusting the balance control for clean Xs as you observe the transmitter output. It has been my experience in testing many transmitters that you need a balance range of several dB and it must be adjustable for each rig you might be testing.

You are absolutely correct in observing that variable capacitors can give you much better tracking than obtained with run of the mill potentiometers. They are also quieter and, if you use variables with a non-symmetrical pivot on the plates (as used in broadcast radios), you get the high frequency end of the range to be spread out a little (that's why they were used in broadcast radios).

I suggested using dual pots instead of variable capacitors for a number of reasons:

1. Many hams today do not have variable capacitors in their junk box and they are expensive to buy new.

2. Variable capacitors are much larger than potentiometers.

3. Isolating the frame and rotor from ground is difficult while minimizing stray capacitance.

4. You only get 180° of dial instead of the 270° or more with potentiometers.

5. It is difficult to get an oscillator below a few hundred hertz using variable capacitors. When the resistors get much above 1 MΩ, stray capacitances start causing problems.

6. My first Wien bridge oscillator that I built in 1960 (and still use) used dual pots and covered 20 Hz to 200 kHz in four ranges (a decade per range). It's hard to beat past successes.

When I read of your tracking problems with potentiometers, I was puzzled because I hadn't observed such problems. So, I pulled some dual 50 kΩ pots out of my junk box and measured them with a digital ohmmeter. Although the overall resistance was low by about 10% to 15%, the dual pairs were within 1% or 2% of each other. Also, when I put the dual pot at mid-range and measured the resistance of each section, they were still within a few percent of each other. These pots, which are garden variety brand X units, would not result in output level variations like you observed.

I then thought that maybe your use of the 327 lamp as a regulator might not be optimum. So, I measured the voltage-resistance characteristic of the lamp and found that its most sensitive range (highest change in resistance to smallest change in voltage) was right around 1.2 V RMS, which is reached when the oscillator output is 10 V p-p. Thinking I might be missing something, I built your circuit but substituted dual 50 kΩ pots for the resistors and used fixed capacitors. When I varied the frequency from 200 Hz to 3000 Hz, the amplitude variations in the output were at most a few tenths of a dB (a few percent). I then raised the value of one of the capacitors by 15% and still couldn't see an output variation greater than a few percent. Your circuit seems very robust! I see no reason why the use of potentiometers would give you so much trouble.

The one thing I did observe about varying the frequency with the dual pots was that noise is introduced as you rotate the pots. It takes the 327 lamp regulator a fraction of a second to calm the output to its regulated output amplitude after changing the frequency. I haven't yet tried squirting some cleaner into my potentiometers to see if that would reduce the noise. Is it possible that when you tried potentiometers, the problem was noise rather than a tracking problem?

In looking at the feasibility of using variable capacitors to get a large (15:1) frequency range, I looked carefully at the minimum capacitance in your circuit. In your article, you attributed 18 pF of stray capacitance to the input capacitance of the FET op amps. I doubt if the FET inputs are even close to this value. Instead, the stray capacitance, which should be compensated as you have done, is due to the stray capacitance to ground of the variable capacitor frame and shaft. Without care, this could easily exceed 20 pF. This stray is a little tricky to measure accurately and I am wondering how you found it to be 18 pF?

Anyway, I'm still playing with Wien bridge oscillators and the jury is still out as to whether I'll use dual pots or dual section variable capacitors to vary the output frequency. There are a lot of factors to be considered on both sides but I think either one would work okay for amateur purposes.

— 73, Bob Buus, W2OD

Larry

Your readers should be aware that a truly inexpensive two or more tone generator is available free on the Internet if they are using Windows computers. The program, NCH Tone, generates sine and other waveforms using the computer sound card. Running the program twice simultaneously will allow two tone generation, with frequency control over each tone. Both tones will have equal amplitude, and the combination can be adjusted with the computer volume control. See the URL, **www.world-voices.com/nchtone.HTML**.

The purchased version of the program only requires one program execution, and allows many tones, each of which is independently adjustable in frequency and volume. The price of a license for home use is less than $20, still a pretty good deal for what is a flexible function generator from 1 Hz to 20 kHz ,with sine, square, triangle, sawtooth, impulse and white and pink noise outputs.

For most two tone applications, the free version is satisfactory since equal tones are generally desired anyway and it also includes other waveforms.

— Bob Hicks W5TX, 1737 Midcrest Dr, Plano, TX 75075; **w5tx@verizon.net**

NimbleSig III — A Dual Output DDS RF Generator and Low Level RF Power Meter — Part 3 (May/Jun 2009)

Dear Thomas,

One point about the calibration of the power meter should be born in mind. Years ago, when Plessey Semiconductors were the world's leading supplier of log amp ICs, we found that it was very easy to have a log amp that had better linearity than the signal generator attenuators. We ended up with specially calibrated H-P attenuators external to the generator to ensure we had monotonicity and linearity in terms of the dB changes. Before we did that, we had a lot of anomalous results. The checks against a known power meter that Thomas Aldread, VA7TA, used is the way to go, but for anyone without a calibrated power meter, relying on a signal generator, I would recommend caution, especially if there is a "step" in the calibration. If that happens, try another generator or an external attenuator.

— 73, Peter E. Chadwick, G3RZP; **peter.chadwick@Zarlink.Com**

Greetings Peter:

I agree with your comments and maybe I should have expanded on possible calibration pitfalls within my NimbleSig III (NS3) article. The use of a step attenuator with known good accuracy for controlling the generator output level is probably the best

method for calibrating the NS3 detector tracking. My 1990s vintage 1 GHz class commercial signal generator happens to have a pair of electronically controlled step attenuators built into it that use hermetically sealed relays for switching. Fortunately it seems to have retained good accuracy.

The AD8307 specification provides a typical 80 dB dynamic range logarithmic conformance spec of ± 0.5 dB, which certainly sets a high standard for a variable attenuator to improve upon. In contrast the AD8307 specification indicates the logarithmic intercept point, which directly affects the absolute level calibration, can vary by as much as 10 dB. Although typically I have found this variation between devices to be less than a couple of dB it justifies the need for the detector calibration routine. The calibration procedure also provides assurance that the power detector is functioning properly.

As you point out there are probably many RF generators around that do not track the dynamic range as well as a typical AD8307 detector chip without any response calibration correction. Some legacy generators used analog mechanisms for the output attenuator design where tracking errors can occur as the dials are not resettable to fine accuracy and/or the log conformance of the mechanical mechanisms may not have been as good as that provided by modern day logarithmic amplifiers to start with. I have also encountered step attenuators with inaccurate step sizes or step sizes with frequency response issues. In some cases the switch/relay contacts had become resistive or in other cases the attenuator had changed value (possibly damaged from exposure to too much power). The availability of an RF signal source with accurate absolute level that can cover the dynamic range and frequency spectrum of interest is needed to achieve improved calibration. If the level accuracy of the RF signal source is questionable then possibly the NS3 power meter should be left with the default calibration data until confidence in the reference standard can be established.

One can usually get an indication of attenuator step size inaccuracy by reviewing the NS3 calibration data prior to saving it to non-volatile memory. The calibration data should closely follow the AD8307 nominal step size of 25 mV/dB throughout the calibration range. If there is a significant deviation from 25 mV/dB between calibration points which follows the insertion or bypass of a particular pad the attenuator accuracy should be considered suspect. Additionally multiple attenuator sections of similar loss can be compared to detect inconsistencies.

Of interest is that the NS3 DDS generator output, which can be adjusted in 0.1 dB steps over a 10 dB range, can be used to confirm the accuracy of attenuator sections up to 200 MHz. Within NS3 the level steps are defined digitally and are then created by the DDS digital to analog converter thus step size relative accuracy limited only by the DAC resolution is assured. The NS3 DDS DAC resolution with 10 dB of level reduction is reduced from the full output level of 1024 steps to 323. This results in a remaining single step voltage scale accuracy of 0.31% or < 0.03 dB when operating with a 10 dB output level reduction.

DDS technology provides a useful tool for checking the loss accuracy of attenuators. NS3 can be used to check the loss of pad values up to 10 dB directly by simply comparing the loss of the attenuator to the level shift provided from the DDS. Once a 10 dB pad value is established the loss of 20 dB sections can also be checked by comparing to the level shift from the DDS plus the loss of the previously measured 10 dB section.

Note however that the 10 bit resolution of the NS3 power meter is about 0.13 dB thus worst case relative measurement accuracy, when using the built in NS3 power detector, would be limited to about 0.2 dB. There is room for improvement in this resolution limitation.

Also note that should one wish to check the attenuator under test for inaccuracies caused by possible stray RF coupling the output level of the NS3 generator might need to be amplified to extend the measurement dynamic range. Stray coupling is most significant when the attenuator is set to high overall insertion loss values with all attenuator sections switched in. Quality of test lead shielding can become an important factor during high insertion loss tests.

— 73, Tom Alldread, VA7TA, 7056 Railway Ave, Coutenay, BC V9J 1N4, Canada; **va7ta@telus.net**

Appalachian Golden Packet Attempt

On Sunday, 26 July some hams in thirteen eastern states will attempt the first annual Appalachian Golden Packet attempt. The objective is to locate 15 drive-up or hike-up sites where simple APRS packet mobiles or hand-held radios can be used as emergency digipeaters to demonstrate emergency communications capabilities. The APRS stations and other hikers along the 2000 mile area will be able to exchange APRS text messages live during the 6 hour event. The temporary RF links zig-zag across the trail to take advantage of the height above average terrain across valleys. Fifteen excellent sites have been identified so that all messages can be accomplished using a dual 7-hop digipeater path.

Although hikers along the trail can already get into the global APRS system from anywhere on the high parts of the trail using the national 144.39 MHz frequency, such routine operation depends on Internet gateways and is highly dependent on the established infrastructure. This golden packet event will use all portable equipment and an alternate frequency for 6 hours, to attempt the 2000 mile all-RF packets. For details and current information see WB4APR's Web page: **www.aprs.org/ at-golden-packet.html**.

— 73, Bob Bruninga, WB4APR, 115 Old Farm Ct, Glen Burnie, MD 21401; **410-293-6417 days; bruninga@usna.edu**.

Hi Bob,

Thanks for sending us this information. Perhaps some *QEX* readers will be interested in participating in the effort.

— 73, Larry, WR1B