The Amateur in You, Part 2

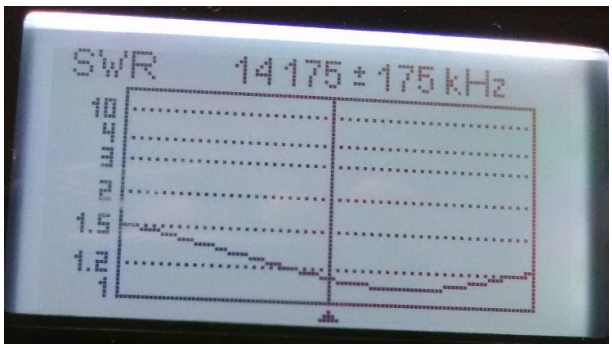
What have you been pondering?

Why a *tuned* HF antenna needs a tuner

I've heard a fair number of amateurs say that one should cut a wire HF antenna to the proper dimensions for resonance, instead of purchasing an unnecessary tuner. After all, they say, that's the *purpose* of a tuner, right?

I'm confining this discussion to antennas intended for transmission on 1.8 MHz through 30.0 MHz, which encompasses all of the HF bands, plus 160 meters. The reasons I'm not going to apply this to VHF or UHF are that 1) store-bought VHF / UHF antennas *tend* to exhibit very low SWR across the bands and 2) many are difficult to tune, while you can easily fashion a hardware match for the rest.

Let's say that I create a dipole for 20 meters, using all the math necessary to cut the elements to the right lengths. Then, once I construct it and examine it with an antenna analyzer, I'm very happy to see that the SWR bandwidth across the entire 20-meter band resembles a smile, like this:



It shows about 1.5 SWR at 14.000 and 1.2 SWR at 14.350, dipping to about 1.1 SWR at the lowest point, about 14.245 MHz. I'm not sure how it could look better! So, because the antenna appears so good on the analyzer, I'm never going to need a tuner with it. Or will I ?

There are two good reasons for me to use a tuner with this antenna, in spite of its stellar-looking SWR: to reduce signal loss and to make better use of the signal that does arrive at the antenna.

One of the biggest reasons I want low SWR is to reduce the amount of signal lost in my coax with each trip through it. So, if I kept my transceiver right at 14.245 MHz, I'll minimizing the signal power lost in the coax. But that's just not reasonable, since I want to make use of the *entire* 20-meter band.

A tuner can help me do just that, and once I select a frequency, I can direct the tuner to match the antenna system at the new frequency, then my antenna system has achieved an optimal SWR once again, minimizing my signal loss through my coax.

Next, the point where the SWR shows the lowest across the band is called the *resonant frequency*, so-called because at that point the antenna system impedance is *resistive*. If I tune away from resonance, my antenna system impedance becomes *reactive* instead of resistive, capacitively reactive below, and inductively reactive above.

Power fed into a reactive load is neither consumed nor dissipated, and so is not transmitted, and is reflected back to the transceiver, and again some of it will be lost in the coax as heat. Adding my tuner to the antenna system will once again allow me to operate on a section of the 20-meter band that's above or below the original resonant frequency, making good use of the signal by providing it with a resistive, instead of reactive, load.

One more (important) reason to use a tuner is to increase your antenna's bandwidth. While the example I gave shows complete band coverage by my 20-meter antenna, if my antenna for some reason does not provide that coverage, a tuner can help compensate.

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