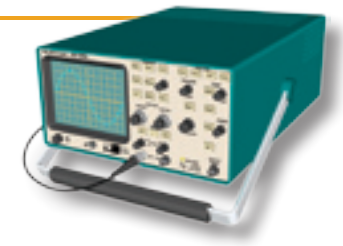
Keeping Your HF Signal Where it Belongs



Being on the "right" frequency takes more than reading that radio dial — you need to know why!

Joel R. Hallas, W1ZR

Amateur Radio operators with a General class license are authorized to operate SSB on parts of all amateur phone bands. It's a great opportunity to explore worldwide HF communication, but it carries with it a responsibility to keep your signal in its authorized segment of each band.

This article was prompted by a question from a new General class operator, authorized to operate from 3800 to 4000 kHz on 75 meters. He was told while he was operating LSB at a dial frequency of 3800 kHz that he was operating out of his authorized band segment. If he needed to know, perhaps others do as well.

The higher class licensees who (I hope politely) told him about this were absolutely right. There are two issues here and we'll cover both.

The Transmitted Signal Spectrum

The FCC rules are very clear on this point. Section 97.307, Emission Standards states: *(b) Emissions resulting from modulation must be confined to the band or segment available to the control operator. Emissions outside the necessary bandwidth must not cause splatter or keyclick interference to operations on adjacent frequencies.* This means that what is important is not the (suppressed) carrier frequency indicated on your radio display, but rather the frequency of your sideband components. If your carrier frequency is at 3800 kHz, your LSB signal extends below that, typically 4 to 6 kHz, to let's say 3794 kHz, depending on the characteristics of your sideband filter as shown in Figure 1. With that filter you will need to set your carrier at least as high as 3804 kHz to be operating within the limits of your license.

The FCC does not specifically say how far down the slope of your filter you must have the edge to be legal. In other sections, however, they require that spurious response be at least 43 dB below the peak level, so that might represent good engineering standards. Many manufacturers specify their filter bandwidth at the 6 and 60 dB points, so the bandwidth at the 60 dB level would represent a reasonable level that I would be comfortable with. Since the carrier frequency is usually set at about the 20 dB point on the (upper for LSB) slope of the curve, that should cover both ends with a bit of safety margin. Check your radio specifications for the 60 dB bandwidth of the sideband filter you are transmitting through and that should be a good number to use.

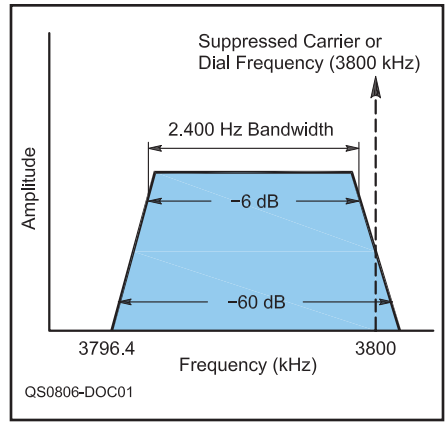


Figure 1 — Spectrum of typical 3800 kHz LSB signal. Note the components below the indicated dial frequency.

At the other end of the filter spectrum, you might find a 2.7 kHz wide filter with a shape factor of 3:1. This would call for staying at least 8.1 kHz from the band edge. Note that for the bands above 40 meters using USB, one needs to leave same amount of space *above* the indicated dial frequency. This situation is potentially even more critical, since instead of just interfering with higher class amateur licensees, you will be interfering with other services — perhaps other governments.

What About Display Accuracy?

All the preceding assumes that your dial calibration is right on. I promised to discuss two aspects of this question — the second has to do with how accurate your frequency readout is. The frequency display on modern transceivers can often read to a single Hz, as in 3800.000 kHz. That is an indication of *precision*, not *accuracy*. The accuracy depends largely on the initial calibration at a factory in which a technician (hopefully) carefully adjusts a trimmer capacitor to make your internal reference clock *almost* exactly line up with their (hopefully recently calibrated) factory frequency standard.

That event probably happened at least 10,000 miles from your current location, was likely followed by an ocean voyage and perhaps five years of crystal and circuit aging. Unless you have recalibrated your internal reference lately, or had it aligned professionally in a standards laboratory, I would allow an additional few kHz at any band or segment edge.

Depending on your receiver architecture, you may be able to get a guess at how close your calibration is by listening to WWV (at 5, 10, 15, 20 or 25 MHz) on both upper and lower sideband. This works only for a radio with a frequency synthesizer that covers the whole range, since other types may have different circuits in play on different bands. Let the radio get up to operating temperature, perhaps for 30 minutes. Now tune the radio carefully to a WWV signal that is strong in your location until the beat note vanishes and the voice sounds natural. Note the frequency on the display. Any difference between, for example, 15,000.000 kHz and the displayed frequency is an indication of possible error in your reference oscillator. I would add at least twice that difference to the allowance for the sideband components described above.

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