Newcomers and Elmers Net: Getting the Most from your Radio
12/15/13 Robert AK3Q

This week I want to look at receivers old and new, and highlight features and functions of typical radios.
-- While modern features such as *DSP* (Digital Signal Processing) are extremely useful, they do not tell the whole story when it comes to reception.
-- Some of the old rigs do a fantastic job and are hard to beat. If you are deciding between new technology and older equipment, you may find less is actually more.
-- Depending on your needs and how you will be using your rig, modern technology may give you the boost you need, or it may get in the way.

Older, *Not* Obsolete!
As much as I enjoy tube radios, because of the difficulty of getting parts for these vintage radios, I will exclude them from this discussion, other than to say their audio is some of the best you will ever hear.
-- If you are something of an audiophile, you might want to add one of these vintage rigs to you collection, just for the joy of hearing all the fullness they can deliver.
-- Radios circa 1980s have a lot of useful features such as notch filters, noise blankers, IF shift options, and other signal refinements.
-- Many folks using their radios have patterns to their use of the radio, and often useful features are under-utilized or misunderstood.
-- For example, most folks never use their RF gain adjustment to their advantage. Often this control is left wide open and the AF (volume) control is used to adjust the sound level.
-- What is the problem with this? First of all, it may help to explain just a bit about what is happening when you adjust your RF gain control.
-- Depending on the radio's design, the RF gain control will adjust the RF stage signal voltage, and/or the IF (intermediate frequency) stage voltage. -- Some radios may even label it the IF gain control if it is only adjusting that stage. By changing the voltage of these stages you are in effect adjusting the sensitivity of the receiver.
-- You might wonder why you would want to make your receiver less sensitive, especially when you pay more for good receiver sensitivity?
-- Modern radios (for the last 30-40 years) have an abundance of sensitivity, sometimes so much so that strong signals become distorted or cause off frequency interference.
-- Some radios try to automatically compensate for this by using an Automatic Gain Control, or *AGC*, but depending on the AGC circuit does not always give you the most desirable signal.

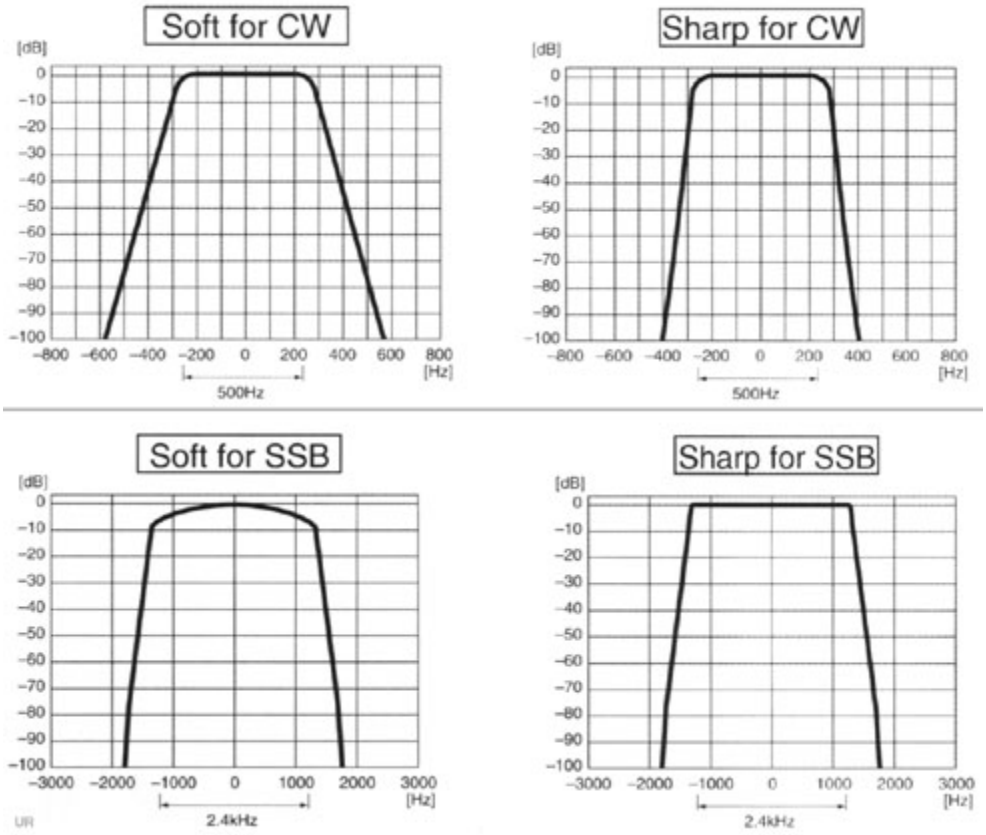
-- Adjusting the RF gain down while raising the AF (audio) gain, you may be able to limit or completely remove the distortion, making the signal much more intelligible.
-- Another use for this control is to increase the signal-to-noise ratio of strong vs. weak signals. By reducing overall noise you may be able to pull out weaker signals.
-- This is particularly useful on the lower bands where there are a number of booming adjacent signals, often drowning out weaker DX signals.
-- If you are unfamiliar with this control, experiment with it a bit the next few times you use your radio; you may just find your radio sounds a whole lot better!

Notch Filters and Noise Blankers
There seems to be a lot of confusion when it comes to the proper use of noise blankers and notch filters, so I will try to clear up some of the confusion.
-- A noise blanker is designed primarily to assist in removing things like ignition noise or arcing pulses from bleeding into your radio.
-- The more selective the radio circuit, the wider the actual distortion. The wider the distortion, the stronger the effect of a noise blanker upon the received signals, noticeable by the gaps in the reception.
-- The circuitry is designed to "blank" the pulses with minimal affect on the AGC.

The circuit will have no effect on continuous noise products, and may not work on some pulse signals, depending on source and power.
-- While I do not experience much pulse noise at my location, occasionally a neighbor's truck interferes with my low-band reception. Using the noise blanker does a pretty good job of minimizing the interference.
-- Keep in mind noise blankers can distort the good audio, so you will have to judge its effectiveness on a signal-by-signal basis.
-- Check your manual to see if your noise blanker option is adjustable—you may be able to reduce its effect through a menu setting.
-- A notch filter is designed to remove continuous tones (carrier tones) from an intermediate frequency, such as those generated by someone tuning their radio, or those generated by an AM signal.
-- Notch filters do not work for ignition noises, just as noise blankers do not work for carrier tones.
-- Some radios have an automatic notch filter and a manual notch filter. A manual notch filter allows you to adjust how wide the filter is, while the auto filter tries to determine this for you (this is a part of DSP which I will discuss later).
-- With some practice you will be able to determine which type of interference you are hearing, and therefore which filter to use.

-- While different radios will have better or worse noise blankers, just keep in mind the source needs to be a pulse for a noise blanker to work.
-- I have heard more than one person complain that their noise blanker was not working when in fact they were trying to remove a carrier!

IF Shift and Passband Tuning
For many years radios have had something called an IF Shift control which allows the user to shift the intermediate frequency higher or lower to move away from interference.
-- These filters are quite useful when understood properly.
-- The intermediate frequency is an "in-between" frequency used to allow for mixing and filtering specific frequencies, usually lowered from the originally received frequency.
-- By having the capability to shift the IF, one can often "move away" from adjacent interference.
-- For example, if a strong signal is overpowering the desired frequency, adjusting the IF shift control may allow you to move far enough away that the desired signal becomes more intelligible.
-- Another useful feature of an IF Shift is that you can change the tonality of an SSB transmission to one which is more easily copied. Higher tones are generally easier to hear through noise.
-- By adjusting the RF gain and the IF Shift, some signals will be more readable. Related to this is the RIT (receiver incremental tuning) adjustment on most transceivers, sometimes called a clarifier.
-- This adjustment allows for slightly shifting the receive frequency while transmitting on the center frequency.
-- Passband tuning is another method of filtering a smaller section of the receive audio to enhance or separate part of the signal.
-- For example, if your radio has a 2.1 kHz filter option for SSB, passband tuning allows you to shift the placement of that filter anywhere along the ~6 kHz total bandwidth received.
-- Some radios use set filter widths, while others allow varying the filter width as you shift it along the signal, in effect giving you a wide range of filters.
-- You might also be able to choose between soft and sharp filters depending on your needs, if your radio is so equipped.



The advantage to passband tuning is that instead of simply narrowing the passband, and thereby reducing the clarity, a usable filter width can be maintained while cleaning up a signal or moving it away from interference.

Pre-amps, Attenuators, and Trimmers
On most radios you will find an attenuation switch, and many will have a at least one pre-amp stage.
-- These are fairly self-explanatory, but I will mention one element you may not have tried before. On some radios, an Icom 718 being one such example, you can engage both the pre-amp and the attenuation switch to get a moderate mixing of the features which can help some signals.
-- While I will not say this is how the filters were intended to be used, I find situations where the signal shows definite improvement. You will have to experiment for yourself. On some radios these switches cannot be combined, but if your radio allows for it, try it.

--**Trim Control** Older receivers sometimes have an antenna trim control, which is basically a poor man's tuner. By adjusting the trim control as you change bands can improve signal reception.

-- My Realistic DX-160 has such a control, and I find it quite useful. If you have ever used an active antenna or a pre-selector switch, you will be familiar with the basic concept.

Putting All These Features to Work

How you use each control will ultimately be up to you and your preferred operating conditions.

-- Some folks primarily only listen to strong signals, while others try to dig out the faint ones amid the static and hiss of worldwide atmospherics.

-- When listening to strong signals you have a lot of leeway to make the signal as pleasing to the ear as you would like.

-- If you are digging signals "out of the mud" you will likely want to employ as many tricks as you can to get a signal you can copy.

-- To that end, I will describe a typical listening experience and how I approach it. You will no doubt find ways to improve on my methods as fits your needs, but this can serve as a starting point.

-- I often listen with headphones on as I am usually trying to catch fairly weak, distant stations. Headphones allow me to block out a lot of extraneous noise, and I find myself better able to concentrate. But that's just me!

-- Once I have identified the presence of a weak signal, I try to evaluate why it is weak.

-- For example, I check to see if the radio is tuned as tightly as possible—is there a point where the signal is slightly more intelligible?

-- I next try the pre-amp circuit to see if the signal improves. Keep in mind a pre-amp circuit raises everything, including the noise! Sometimes the trade-off is worth it, but sometimes it is not.

-- Next I check my RF/AF combinations to see if I can improve on the signal-to-noise ratio. This can be simply trying to reduce the noise to a point where the voice signal comes through more clearly

-- or I might be working to get rid of close-channel interference either from another station or from random man-made noise.

-- This is where playing with some of the filters comes in, such as adjusting the passband or IF filter; engaging a notch filter; or engaging a DSP filter if available.

Of course, I also swap antennas when possible to see if different antenna patterns can pull in a better signal.

-- Sometimes there are subtle differences between signals even when the relative volume sounds the same; one antenna may reduce noise a bit or be more directional.

-- Despite having some great radios for amateur radio use, I often listen to portable radios where filters are limited and antenna choices are limited as well.

-- However, adding a random wire to a portable radio can work wonders, as can using an active antenna. This allows for some gain in directivity by nulling out some of the interfering local noise.

DSP

I have saved Digital Signal Processing for last because it is a good tool in the toolbox when available, but it can produce mixed results.
-- DSP is relatively new to radios, basically coming of age in the last 20 years with the advancement in miniaturized computer chips.
-- Analog audio is converted to a digital signal which is then manipulated by software to achieve some amazing results.
-- When DSP works it can really boost a signal's readability; when overused, or over-processed, signals can become muddied, broken, or distorted beyond recognition.
-- The best DSP systems allow for gradual adjustment of filter effects, allowing the user to apply as little or as much filtering as they want.

There are two common types of DSP: filtering which is applied to the signal at or before the IF stage, and DSP that is applied during the audio/output stage.
-- IF filtering is best, of course, because it deals with the signal before being amplified for output. Signals converted in the audio stage are less effective in that all of the noise products in the signal have already been amplified along the with desirable part.
-- Where audio DSP can work really well is with older radios which do not have DSP built in to the radio;
    -- filtering to reduce adjacent channel interference can make crowded bands more tolerable to be sure, and these units can work well to reduce engine noise and other unwanted signals.
    -- Notch and noise reduction filters are common add-ons for mobile rigs as well as pre-DSP rigs.

However, DSP works best when integrated into the radio as part of the initial processing of the signal.
-- Noise reduction filters, often adjustable by the user, greatly enhance the signal-to-noise ratio of a received signal before it gets to the mixing stages. A cleaner signal in means a cleaner signal out.
-- Digital passband tuning works best for shaping a signal to the desired form, either with sharp drop-offs or with smoother, softer edges.
-- Some of this comes down to personal taste, of course, but sometimes sharp filters are needed on very crowded bands. At other times softer filters can be used to maintain better audio quality.
-- By allowing a gradual application of the desired filter, signal integrity can be maintained over a wider range.

-- On radios where set filters are engaged by the DSP you are pretty well left with whatever comes out of the speaker. With adjustable filters you can find the point where the signal is fully readable yet with at least some of the undesirable elements removed.
-- Over application of a noise filter, for example, will result in gaps or wide distortion to the signal. The same is true with passband filters which are too small. There are times when a 2.4 kHz filter is too wide, but 1.4 kHz filter is too narrow.
-- Judicious use of DSP can really enhance your signal reception, and external units can do wonders for older rigs.
-- Understanding how the digitization process will affect your signal will help you determine how and where it can be used to good effect.
-- Use DSP as your last remedy whenever possible however, as the quality of almost all audio will be affected. Sometimes all you really need is to reduce your RF gain and tweak your AF gain to get a great signal.

Final Thoughts
Work with the range of options open to you as often as you can, so that when you need them you will have a good idea of how to achieve what you want.
-- Complete familiarization with all the controls your radio has to offer will greatly enhance your radio time, and you will likely find more and more interesting stations recorded in your logs.
-- While a great antenna system can bring the world to your radio, the signal is still only as good as what comes out of the speaker! Both halves have to do their part to make the time you spend in front of the radio rewarding!