GETTING THE MOST OUT OF ECSS

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Many contemporary receivers used by DXers make reception in the ECSS mode very convenient. We switch to USB or LSB and tune through the signal until audio clarity is obtained. In most situations, the ECSS reception achieved in this convenient way is quite adequate, but it will not in every instance yield the most QRM rejection or readibility obtainable in the ECSS mode. And in the case of signals having one sideband QRM free, this approach does not render the full a.f. response obtainable from that sideband in the ECSS mode. The BFO offsets engaged by the USB and LSB switches are not chosen for maximum a.f. response but for typical ham band SSB applications. Yes, there is more to ECSS reception than can be had simply using the USB and LSB mode switches.

To take full advantage of the merits of the ECSS mode, we need to bypass the limitations imposed on our ECSS technique by the USB and LSB switches. Not all receivers allow us this option. Our receiver must have a panel BFO control to vary the BFO frequency through a continuous range of at least 4 to 5 kHz, and preferably 6 to 8 kHz. We must also be able to select manually any of its i.f. voice bandwidths when the receiver is in the CW mode. The JRC receivers - NRD-505, 515, & 525 - possess this flexibility, although the BFO frequency range of 4.5 kHz on the 525, the only one of these I know, is not wide enough to use with the stock "wide" filter for true ECSS. All the vintage "hollow state" radios used by DXers have the necessary flexibility. The current Icoms and the Kenwoods do not.

The purpose of this article is to describe how to use the kind of receiver flexibility just outlined to get the most from ECSS reception. This technique is not new. It was in use four and more decades ago, before USB and LSB mode switches, product detectors, and microprocessors were added to the radios used by DXers and hams. These devices did not create the possibility of ECSS reception. The BFO (also appropriately called a carrier injection oscillator) and i.f filters are what make ECSS reception possible. All receivers capable of CW reception contain a BFO. When the BFO is on, as it must be for CW, SSB and ECSS reception, it generates an unmodulated carrier on or near the receiver's last i.f. The BFO frequency control tunes the BFO carrier to any frequency between the control's endpoints; if properly aligned, at 12 o'clock the control makes the BFO frequency equal the i.f. The USB and LSB mode switches found on contemporary receivers simply activate the BFO at frequencies removed or offset from the i.f. by a preset number of Hz. Each switch is, in effect, a BFO frequency control offering us only one BFO frequency.

In CW, SSB and ECSS reception the BFO carrier is injected into the detector stage where it is mixed with the received signal arriving from the last stage of i.f. amplication. When an AM signal is received in the ECSS mode, only one, or part of one, of its sidebands arrives at the detector unattenuated. Its other sideband and the carrier are attenuated by the i.f. bandwidth filter before they reach the detector. The role of the injected BFO carrier in ECSS reception is to replace or 'exalt' the AM signal's attenuated carrier reaching the detector so that the detection process will not distort the audio of the AM signal. The BFO carrier "pinch hits" for the attenuated carrier of the AM signal.

You can easily experience for yourself the effect of this "pinch hitting". In the AM mode tune "nose on" to the carrier frequency of a QRM free AM signal. Begin gradually detuning from the carrier frequency into the sideband of your selection until the audio distorts. How far you must detune before this occurs depends on the i.f. bandwidth. It should occur detuned from the carrier frequency approximately half as many Hz as the 6 db i.f. bandwidth. Detuned that many Hz, the AM carrier is placed at the edge of the 6 db i.f. passband, which means the carrier strength will be 6 db less than it was when you were tuned to it "nose on"; the rejected sideband of the AM signal lies outside the 6 db passband and is rejected by an even larger factor. Now with the BFO frequency control set at 12 o'clock, switch to the CW mode. Tune the BFO until the heterodyne caused by the mixing of the BFO carrier with the AM signal's attenuated carrier is eliminated; fine tune the BFO within the heterodyne free zone until the audio is clarified. The audio distortion heard earlier at that frequency in the AM mode will now be absent. You have just achieved ECSS reception with the "old timey" technique. Switch back to the AM mode and the distortion will reappear as you withdraw the "pinch hitting" BFO carrier. If in this experiment you could not eliminate the heterodyne, your BFO range is not great enough to achieve ECSS at that i.f. bandwidth. If you are using a vintage receiver like the R-390A, resetting the BFO control knob farther back on its shaft may free the control from a mechanical stop restricting the BFO range. With this trick you can increase the BFO range of the R-390A considerably beyond its normal 7 kHz. If this solution doesn't apply, you will not be able to attain ECSS reception with that bandwidth; switch to your next narrower i.f. bandwidth and start the experiment from the top.

The number of Hz you detuned the BFO from the i.f. to achieve audio clarity in the above experiment equals the number of Hz you detuned the receiver from the AM signal's carrier frequency. If, for example, you detune to 15067 from the BBC carrier on 15070 to produce audio distortion, then when you switch to the CW mode, you will have to tune the BFO to a frequency 3 kHz higher than the i.f. to eliminate the heterodyne and obtain audio clarity. This follows from the fact that in detuning from 15070 to 15067 you moved the 15070 carrier from the center of the i.f. passband, where its frequency equaled the i.f., to a position 3 kHz higher in the passband. To "pinch hit" for the attenuated AM carrier lying in the passband 3kHz above i.f., the BFO carrier injected at the detector must also have a frequency 3 kHz higher than i.f.

When we use the USB and LSB mode switches for ECSS, we reverse the above procedure: we offset the BFO carrier from the i.f. first; then we tune the receiver so as to place the AM carrier at the same position in the passband as occupied by the BFO carrier. Selecting LSB on the NRD-525, for example, activates the BFO at 456.5 kHz, precisely 1.5 kHz higher than the 455 kHz i.f. Therefore, I must tune 1.5 kHz below an AM signal's carrier to make the frequency of the AM signal's carrier, as it appears in the i.f. passband, equal to the preset bfo frequency. For true ECSS I must also select an i.f. filter which will attenuate by at least 6 db those frequencies 1.5 and more kHz from the receiver's frequency. Only then will the carrier and upper sideband component of the AM signal be sufficiently attenuated for true lower sideband ECSS. Given the 525's stock filters-the "wide" with its 6 kHz 6 db bandwidth and the "intermediate" with its 2.2 kHz 6 db bandwidth, the "intermediate" bandwidth is the only option. It attenuates by at least 6 db frequencies 1.1 kHz and more from the receiver frequency.

Given the "intermediate" filter's bandwidth, it is clear that using the "old timey" technique, ECSS reception can be attained detuned by as little as 1.1 kHz from the AM signal's carrier. Further, experiment will verify that ECSS reception can be obtained with the same bandwidth detuned from the the AM signal's carrier by as much as 2.1 kHz from the carrier frequency. Detuned by that amount you lose some of the bassier audio frequencies contained in those sideband frequencies lying closest to the AM carrier, but the gain in greater attenuation of a QRM source on the other side of the carrier may be worth the sacrifice. Audio becomes unusable when you detune from the carrier frequency by much more than 2.1 kHz with the "intermediate" bandwidth. I summarize this by saying that the "intermediate" bandwidth on the NRD-525 has an ECSS range between 1.1 and 2.1 kHz, meaning that with that bandwidth I can achieve ECSS reception using the "old timey" technique detuned from an AM signal's carrier by any number of Hz between 1.1 and 2.1 kHz. (See illustration at end of article)

Why be restricted by USB and LSB mode switches to detuning from the AM carrier by the same number of Hz in every situation? In some situations detuning by some other number of Hz within the selected bandwidth's ECSS range provides better QRM rejection or readability. "Old timey" ECSS technique allows you to do this. And in situations where one sideband of an AM signal is free of QRM, why settle for the narrow bandwidths required for ECSS reception with the USB and LSB mode switches? If your receiver's bfo range is wide enough, you can use a 6 or 8 kHz 6 db bandwidth and enjoy full range a.f. response. Detune your receiver from the AM signal's carrier frequency into the desired sideband half as many kHz as the selected i.f. filter's 6 db bandwidth. Turn on the BFO and proceed by the "old timey" technique. The only listening better than this on SWBC is phase locked, synchronous ECSS whereby the bfo carrier is phase locked to the attenuated AM carrier.

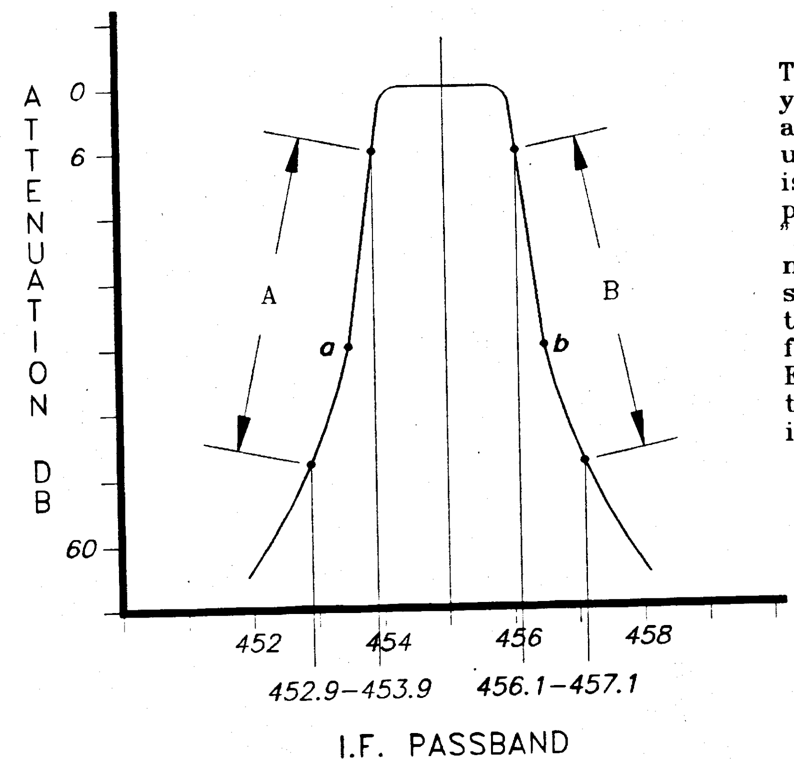
To become adept at the "old timey" ECSS technique and to determine at the same time the ECSS range for each of your receiver's i.f. voice bandwidths, the following procedure will work. Set your receiver for the AM mode and select an i.f. bandwidth for which you want to discover the ECSS range. Find a medium strength QRM free AM signal. Tune "nose on" to its carrier frequency. Then begin detuning in either direction from the signal's carrier frequency until the audio begins to distort as in the earlier experiment. The difference between the frequency at which the distortion begins and the signal's carrier frequency represents the lesser figure in the ECSS range for that bandwidth. Change to the CW mode and obtain ECSS reception by the "old timey" technique of synchronizing the BFO carrier with the AM carrier. You have obtained ECSS reception at the beginning of the ECSS range for that i.f. bandwith.

Remaining in the CW mode, begin detuning farther from the carrier frequency in very small increments (100 Hz or less), stopping at each increment and resynchronizing the BFO's carrier with the attenuated AM signal's carrier. If your receiver doesn't have a product detector, with a moderate to strong signal, as you slide the AM signal's carrier farther down the i.f. filter's response curve with your continued detuning, an audio distortion will begin to appear which you cannot correct by resynchronizing the BFO carrier with attenuated AM carrier. This distortion, due to detector overloading, is remedied by backing off the r.f. gain until the distortion disappears. I don't find the reduction of r.f. gain necessary on weak signals, so there is no sacrifice of maximum sensitivity when it is needed.

As you continue your incremental detuning and resynchronizing of the BFO carrier with the AM signal's carrier, you will reach a frequency at which the AM signal' s carrier is so attenuated it will no longer produce an audible heterodyne against the BFO carrier. At that frequency and beyond, it helps to switch temporarily to a wider i.f. bandwidth after each additional detuning increment. This step allows you to recover an audible heterodyne to assist you in resynchronizing the BFO's carrier with the AM signal's carrier. Once audio clarity is again achieved, switch back to the original i.f. bandwidth and make your next detuning increment. You will reach a frequency at which you will not have usable audio when you switch back to the original bandwidth. The frequency to which you tuned just before you reached this condition represents the end of the ECSS range for that bandwidth.

Follow the above procedure to obatin the ECSS range for each of your available bandwidths. I have learned that the ECSS range for the 2 kHz bandwidth on my R-390A lies between 1 and 2 kHz from the AM carrier frequency; for the 4 kHz bandwidth it lies between 2 and 3 kHz from the AM carrier frequency; for the 8 kHz bandwidth it lies between 4.5 and 6 kHz from the AM carrier.

USB/LSB MODE SWITCH ECSS vs. THE "OLD TIMEY" ECSS TECHNIQUE with NRD-525 "INTERMEDIATE" BANDWIDTH



The USB mode switch compels you to place the AM carrier at position "a" for ECSS, but upper sideband ECSS reception is possible with the AM carrier placed anywhere in ECSS range "A" using the "old timey" technique. Similarly, the LSB mode switch compels you to place the AM carrier at position "b" for ECSS, but lower sideband ECSS reception is possible with the AM carrier placed anywhere in ECSS range "B".

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