QRZ DX?... You can't work'em if you can't hear'em.

If you are hearing impaired or know someone who is, the following information may help you make adjustments to improve your ability to hear DX and the exchange information to put the DX QSO info in your log.

This piece was originally published in THE DX MAGAZINE by N4AA (now SK). I wrote this at Carl's request after exchanging emails with him about my new hearing aids. As this was originally written more than ten years ago and radio and hearing aid technology has evolved as has my radio equipment and hearing aids it is due for updates.

For more than twenty years, I was fortunate to have a vocation in telecommunications, first telephony and then radio-telephony (cell phones, pagers, Blackberry®, and other mobile RF devices) which were based on radio, my hobby amateur radio. My State Farm Insurance supplied business card included my FCC assigned call-sign, AB9M, after my name but before my job title in order to make it easier for me to find other amateur radio operators in the telecommunications industry who understood what audio, electrical, and RF terms meant. I met many who shared my hobby, which made it much easier to explain the requirements of the "wireless" applications being developed to "deliver the promise" and settle insurance claims in a timely manner. Along the way a DX Packet Cluster node at work was created to became part of my laboratory for developing RF applications for State Farm Insurance. DX spots were delivered to my email, pagers, and cell-phones. My DXCC totals climbed!

1. Plain Old Telephone Service or POTS[1] , carries speech (300 Hz to 3000 Hz) in analog electrical form over twisted copper loops. Harvey Fletcher and Wilden A. Munson working at Bell Laboratories in 1933 did research on how our ears hear different frequencies at apparent different loudness levels. Fletcher and Munson in 1937 created a graph of equal – loudness contours. (see illustration 1.) While the Fletcher – Munson curves[2] illustrate an approximate six decibel[3] roll-off in loudness per octave[4] (single tone) as the frequency increases, the first tests were performed with speech... the simple decoding of spoken words or syllables. The normal six decibel loss per octave of natural hearing means that we hear lower frequencies better than higher, a problem for many of us as the speech components providing intelligibility are found at higher frequencies and the response to those frequencies are lost as we age.

This high frequency hearing loss, which seems to be more common in older men, has led to the term "wife or XYL filter" or the common misconception, "he doesn't pay attention to what women say". High frequency hearing loss also makes any radio or telephone communication difficult as there are no visual clues to help one decode what is being said. To compensate for high frequency loss, the most common solution is a hearing amplification device known as a hearing aid. Unfortunately many people do not see an Ear, Nose, and Throat (ENT) Specialist to determine the cause of their hearing loss and a licensed Audiologist for the appropriate solution. In many (most) cases, the Audiologist does not understand the needs of a hearing impaired amateur radio operator are different from the needs of others with hearing loss since we may not be interested in natural speech but rather better received audio or CW.

Most of the hearing aids today have a Telecoil[5] (or T-coil) feature which as originally conceived, would use the magnet and coil of the traditional handset used in Plain Old Telephone Service, to activate a relay in the hearing aid, and then inductively couple the electrical wave form of the received audio of the telephone into the the hearing aid's Telecoil for amplification and reproduction.

The problem for most amateur radio operators using hearing aids with the Telecoil feature is that their Audiologist sets the hearing aid(s) to compensate for their hearing loss using a graphic equalizer and the audio range of 100 Hz to 8000 Hz. In reality, all frequencies below 300 Hz and above 3000 Hz may be attenuated when the Telecoil feature is used for telephone or amateur radio applications (except possibly AM and ESSB) since the typical received band-pass is approximately 300 Hz to 3000 Hz. Since the typical hearing aid will amplify and reproduce speech audio frequencies typically from 100 Hz (or lower) to 8000 Hz (see illustration 2), any standard Telecoil setting for compensated hearing will pass distracting noise (QRM) which will make it more difficult to understand or decode SSB or CW signals. For this reason, I asked my Audiologist to run the equalizer gain sliders for 125 Hz, 250Hz, and 4000 Hz and above down into attenuation (see illustration 3) to pass 300 Hz to 3000 Hz with 3 db gain for 500 Hz to 1000 Hz (for CW) for two positions on my hearing aids, one being for the Telecoil position which is either manually selected or automatically selected when there is a magnetic field present. When in the Telecoil position, the hearing aid microphones amplification is reduced by 6 decibels (standard) or the configuration can be set to Telecoil source only. I choose Telecoil plus microphones down 6 dB so as to be able to hear my station equipment operate (button press tones, computer alerts, etc.).

The second 300 Hz to 3000 Hz position (of my hearing aids) with 3 dB gain for 500 Hz to 1000 Hz is for acoustically coupled hearing via speakers, handsets, headsets, or devices which do not create a magnetic field strong enough to activate the telecoil. This position has all the audio frequency response features of the Telecoil position except that the telecoil does not activate and there is no 6 dB reduction in the microphone gain. For phone and CW I have come to prefer using “J Hooks”[6] and manual selection of the telecoils of my binaural hearing aids to those of hearing aid microphones and an acoustically coupled headset for the following reasons;

1. when copying weak signals, I do not have to be concerned with the audio reproduction quality or resonant frequencies of the headset diaphragms.

2. 2. I do not have to be concerned with the acoustic coupling of the headset to the hearing aid microphones on each ear.

3. With my Receiver In Canal (RIC) binaural hearing aids, the received audio is created in both my ear canals, providing much better clarity and decoding (both CW and phone).

4. The “J Hooks” are extremely light weight and do not cause discomfort as headsets do after long periods of wear. For CW Dxing, I set the side-tone frequency and Zero Beat offset of my transceiver to 650 Hz. I typically set the transceiver to the narrowest CW settings, the DSP[7] audio bandwidth set to 200 Hz which will select the 300 Hz Collins mechanical filter[8] and then set my AOR TDF-370 (outboard audio DSP filter) to stereo CW at 100 Hz. With the the hearing aid Telecoil program manually activated and stereo “J Hooks” on my ears and plugged into the AOR TDF-370, as I tune across the band, I hear CW come in one ear as a high frequency which lowers and becomes 650 Hz in both ears as I tune and then leaves the other ear at 300 Hz or less as I continue to tune. Or as I tune in the other direction, I hear CW come in one ear as a low frequency which increases to becomes 650 Hz in both ears as I tune and then leaves the other ear at 1000 Hz or more as I continue to tune. In either case, when I hear 650 Hz in both ears, I know my radio is at ZERO BEAT and will produce a tone in my QSO partner's radio equal to whatever tone he set for his CW offset. – July 2022 – I cannot find “J Hooks” in any of the specialty shops for the hearing impaired. This may be due to Bluetooth technology becoming the default connection and T-Coils becoming an option in hearing aids.-- Note also

> that communications headsets may or may not activate the T-Coils in your hearing aids, it all depends on the magnets in the headset and the magnetic field created to produce sound. If there isn't a good magnetic field coupled to your T-coils, there is little else you can do.

I can use almost any stereo headset for acoustically coupled hearing by manually activating a 300 Hz to 3000 Hz hearing aid position with 3 dB gain for 500 Hz to 1000 Hz in a similar fashion while plugged into the AOR TDF-370 and my transceiver set up as in the previous paragraph; when I hear 650 Hz in both ears, I know I'm ZERO BEAT. (It does not matter what audio tone above or below ZERO BEAT my QSO partner has his offset set to.) As long as your Audio Filter can produce a pseudo-stereo effect and direct “low” audio frequencies to the left channel and “high” frequencies to the right channel, and the “center” frequency directed to both channels you can use it in a manner similar to mine. For SSB and AM, I configure the radio for the appropriate bandwidth (1800 Hz to 3000 Hz for SSB and 9000 Hz for the local 160 meter AM net) depending upon conditions. I set the AOR TDF-370 for Voice and usually adjust the FFT[9] for the best readability, using “J Hooks” and the manually selected Telecoil program. While I chose to have my new hearing aids programmed with both a Telecoil position and another position programmed for 300 Hz to 3000 Hz with 3 dB gain for 500 Hz to 1000 Hz, I could have used just the Telecoil position manually selected for acoustic listening, with the hearing aid microphones' audio six db down from the Telecoil if the headset's magnetic field did not activate the Telecoil. My previous hearing aids had automatic Telecoil activation by the magnetic field of a headset or telephone handset but required manual activation of the Telecoil circuit for “J Hooks”. I took both “J Hooks” and my headset along with an audio source to my Audiologist when my hearing aids were delivered and programmed. If your hearing aids are not the newer digital hearing aids[10] with DSP capabilities, you may want replace them in order to take advantage of the features I have described but analog hearing aids can also be programmed to work well. If you have been reading this because of interest in the subject, but have not seen an Audiologist, I recommend A Guide To Hearing Aids[11], by the SoundGuys.

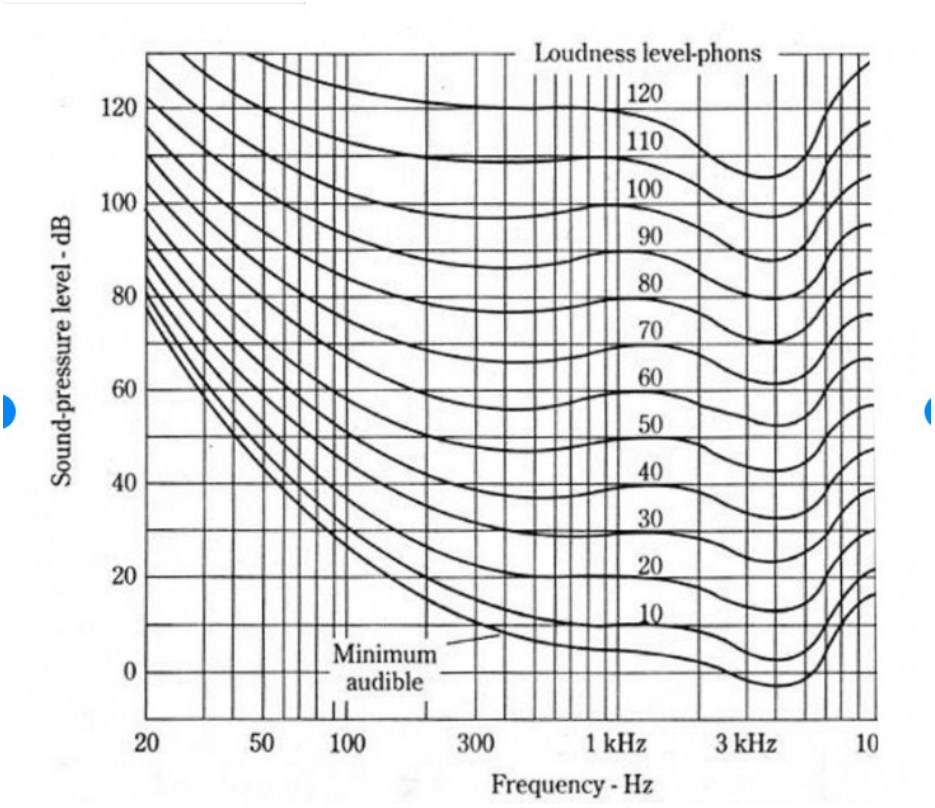
– July 2022-- I no longer have the AOR TDF-370 Digital Signal Processor (DSP) previously mentioned and instead I use a a WOLFWAVE audio DSP to drive a Bluetooth transmitter to stream to my Bluetooth enabled Phonak Audeo P70 RT hearing aids which I acquired a little over a year ago. The only real difference using Bluetooth is that I control the bandwidth and center frequency streamed to my hearing aids with the WOLFWAVE DSP; for CW the bandwidth (BW) is less than 400 Hz and the center frequency (CF) is 650 Hz. (This is just my preference, you may prefer something else.) For SSB the BW will be 1800 Hz to 3300 Hz depending upon conditions with the CF 1500 Hz +/- again depending upon conditions. No cords, no pinched ears, just communications audio in my ears. YMMV...

I have attempted to describe my transceiver settings and hearing aid configurations in terms which are understandable to the average amateur radio operator. Hearing aids are generally not covered by insurance but the Veterans Administration does provide very good hearing aids to Veterans with service-connected hearing loss. Hearing aids can be expensive (IE. four thousand dollars a pair) so if you qualify, check out the VA offerings which are top of the line hearing aids from the major hearing aid manufacturers. There are also much less costly hearing aids which may be adequate for your hearing loss. See your Audiologist to determine the solution that meets your needs. I have also attempted to avoid suggesting or advertising any brand of hearing aid or radio by revealing the brands and models I was using as I believed, after doing some research, that the Telecoil configuration and audio source settings are brand and model neutral for most hearing aids. While I did mention in this updated version what brand and model of hearing aid I am using, I do believe that you should work with a licensed Audiologist and select the best hearing aids you can afford, suitable for your needs and

your applications rather than taking what is offered without asking a lot of questions. If you have questions on anything I have written in this article or in the footnotes which you do not understand, please contact me via GLHuber@MSN.com.

1..POTS (https://en.wikipedia.org/wiki/Plain_old_telephone_service)
2..Fletcher – Munson curves (Engineering:Fletcher–Munson curves - HandWiki)
3..decibel (Decibel - Wikipedia)
4..octave (Octave - Wikipedia)
5..Telecoil (What is a telecoil and how does it work? - SoundGuys)
6..“J Hooks” (see Illustration 4.)
7..DSP (Digital signal processor - Wikipedia)
8..Mechanical Filter (Mechanical filter - Wikipedia)
9...FFT (Fast Fourier transform - Wikipedia)
10. Digital-hearing-aids (Types of Hearing Aids | FDA)
11. Your Guide To Hearing Aids (A guide to hearing aids: What kind is best for you? - SoundGuys)
12. WOLFWAVE DSP (Sotabeams WOLFWAVE SOTAbeams WOLF-100 WOLFWAVE Advanced Audio Processor | DX Engineering)

Listing of pictures and illustrations



3: Fletcher-Munson's curves of equivalent perceived loudness [9]

Illustration 1 – standard loudness curves (Fletcher – Munson), DxwHA-IL-FMC

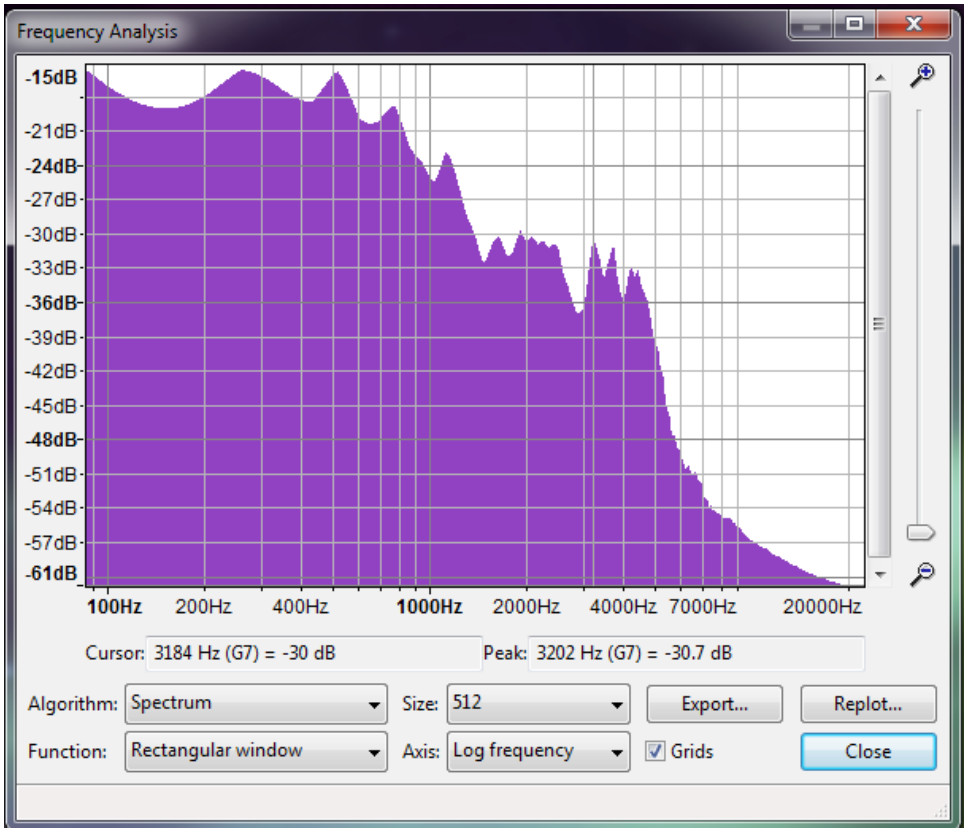


Illustration 2 - 6db roll-off analysis of electret microphone using Audacity by AB9M, DxwHA-IL2

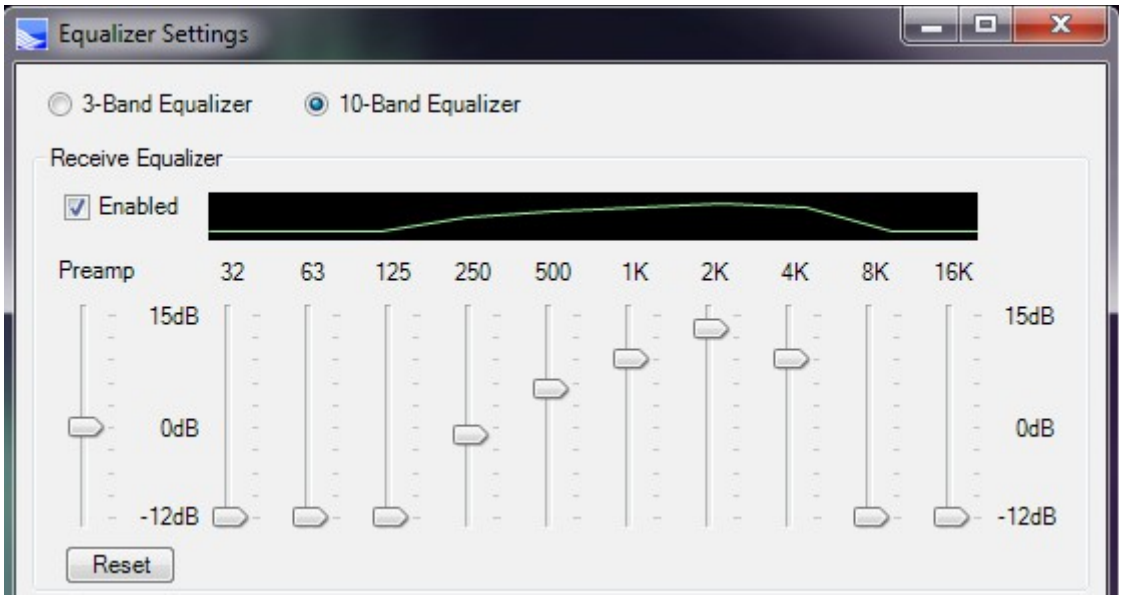


Illustration 3 - Flex PowerSDR RX audio graphic equalizer by AB9M, DxwHA-IL3

Illustration 4 - hearing aids and J hooks with dime by AB9M, DXwHA-BX5&J-hooks