

[DXing Techniques](#)

A [discussion of DX reception techniques](#) commenced on the Medium Wave Circle groups.io forum recently, and among the posters was my friend Rick Kunath, K9AO. In one comprehensive and noteworthy post, Rick summarized many of the techniques DXers use to catch their quarry, drawing from his many years of DXing and radio experience. Rick kindly gave me permission to reproduce it here on RADIO-TIMETRAVELLER and I hope you will enjoy it as much as I did.

Question (Damon):

I'm looking for advice on how to sift through the mud on some frequencies where there are many stations simultaneously. The SDR# co-channel canceller really isn't a lot of use in such cases unless there's one particular signal larger than the rest. What are some of the techniques you all use to dig out DX from the cacophony of stations? So far all I've done is listen carefully and hope that a station becomes clear enough to ID.

Rick, K9AO:

Digging deep on a channel with a lot of either regional or graveyard stations can be very rewarding and sometimes frustrating. But there sure are chances to get a new one there if you can only dig them out. And unlike a less populated channel, you won't want to listen only at the top of the hour or the bottom of the hour. You will have times when a station pops up for a bit and sometimes you can get an ID or a telephone number for a local business on a commercial, and that can help you to know what you are hearing. On a regional or graveyard channel there are usually lots of local commercials, unlike the big flamethrower high-power clear channel stations that all run networked programming.

There are a lot of good tips and I use most of them here.

But a few new ones for you in the order of ease of trying them...

Headphones

Phase reversal on one of the sides of your headphones is a good and simple tool. Some headphones have a switch on one of the earpieces to do this. But you can add a small DPDT toggle switch easy enough yourself. I like over the ear headphones for this because I want all room noise to be excluded from what I am hearing. We can talk more about that if there is interest. What reversing the phase of one side of the headset does is to move the apparent source of the sounds from outside your head and around you as you are used to, to seemingly coming from inside your head. The effect is startling when you switch back and forth and there are many times when switching will give your ears just enough more to work with that you can now hear the individual programming better, good enough to get something out of the jumble that you could not before. This is easy enough to test by jumper connecting a standard set of headphones to the radio by connecting the usual sleeve and tip wires to the tip and ring of the headphones instead. That puts the 2 earpieces in series and out of phase. Doing it that way slightly reduces

the volume, but it's a good test. If you like it, modify a set of headphones with a switch. I eventually built up a small box (make it plastic so the jacks are insulated) and placed 2 small audio transformers inside it wired with the 16-ohm primaries in parallel and having 2 separate 8-ohm secondaries. One secondary was hard wired to the sleeves and rings and the other secondary through a DPDT switch to the sleeves and tips of the jacks so I could reverse the phase. I used a 1/4 and a 1/8 inch stereo jack and then any headphones could be used.

AGC (Automatic Gain Control)

Try adjusting the AGC time constant. Faster might be better on rapid fading or slower depending on the ionosphere. You just have to try. Possibly no AGC and then you manually ride the RF gain control and let things fade where they will. There are times when doing that will let the weaker stations in the jumble drop off so much that the stronger ones programming can be heard better. Of course that doesn't help if you were trying for one of the weaker stations.

Rick had some extremely valuable information concerning AGC usage with SDR radios in a secondary post on another group. It is valuable and supplemental to the above tip, and adds depth to the AGC discussion concerning current SDR radio operating technique. I'm going out on a limb here and including it. Thanks, Rick ! ;-). [SDRPlayUsers](#).

On most SDRs do not run the RF gain low and the audio gain up with the IF AGC turned off. Back in the day on a superhet rig that did not have a product detector, or one that did, for CW we would often shut off the AGC (had to on radios without a product detector) set the AF gain to max and then back off the RF gain until we had comfortable copy with no pumping from AGC or very low to no background noise.

On a superhet radio the RF gain functions as a sensitivity control and early receivers were labelled that way. But on an SDR it does not work that way. If you look at the noise floor on your RSP and then reduce the RF gain control the opposite of what happens to a superhet radio happens to your SDR. The noise floor goes up. As you decrease the RF gain more, the noise floor goes even higher. This is not what you want. It drastically affects what you can dig out and you can see why.

So, the question now becomes when to reduce the RF gain on an SDR? If you see the overload indication on the app then you would reduce the RF gain until it goes away. But there is a caveat there. If you are using something like one of the pre-amplified magnetic loop antennas that has excessive gain for your SDR and have to significantly reduce the RF gain, then another solution is needed. In that case reduce the RF gain until you have it set to where it does not overload the SDR. See what that gain value is, you can see that in SDRconnect or SDRUno. Then set the RF gain control to full and see what that gain value is. Subtract the reduced RF gain value from that full RF gain value and now you know how much excess gain the antenna has. Get yourself a cheap outboard attenuator of about this value, or a couple of them if you need to series up a few to get the value that you need and place this on the input for that antenna to the SDR in series with the antenna. Now you can run the RF gain on the SDR to full and have max sensitivity to signals.

IF AGC is needed to prevent the ADC from overloading. Some of the early SDRs and the cheap ones even today use a less sophisticated AGC method. You can Google that if it is of interest. SDRplay however uses a very sophisticated AGC method on its RSPs. These do not suffer from the limitations that some SDRs do. The basic AGC algorithm works by measuring the average ADC input power and comparing this against the desired set point of the ADC. It does this rapidly and as such it is **not** working on any one signal as would be the case in a superhet radio. So no, do not reduce the IF AGC. You can feel free to set the audio AGC as you see fit or to shut it off if you want to. I don't and I find the fast setting works well for digital signals on any of the RSPs that I have here.

DSB (Double Sideband)

The next thing that can (but not always) help is to switch to DSB synchronous detection. This injects a phase locked local carrier and sometimes this extremely strong local carrier (even though it's not locked to any one exact station carrier on a jumbled channel) can help with fading and fading distortion. If a station's carrier fades below the sideband strength you'll get demodulation audio distortion with envelope AM detection.

Synchronous Detection

Also, on synchronous detection Sync upper and Sync lower cut one of the AM sidebands and only detect on the other using a locally generated and phase locked much stronger reinserted carrier. This can be helpful if there is interference on one side of the signal or the other, this would be from strong adjacent stations on the next channel above or below the one you are listening to.

Signal Flutter

On a channel like this pay attention to the slow or fast flutter that you hear on the stations signal levels. This is not really there, i.e. it is not transmitted by any station, rather it is caused by the slight differences in the actual RF carrier frequencies of the stations on the channel mixing together and creating what is called a sub-audible het (heterodyne). If you have a graphing S meter you can actually see this humped waveform and after a while you can tell how many carriers are mixing together to make the mess on the channel very roughly and see the waveform change. Your AGC will try to follow this and that is causing the flutter. So changing the time constant here can help. Even more help is switching from carrier generated AGC to audio generated AGC. This will often almost eliminate the flutter.

Multiple Carriers

Sometimes though the stations carriers are so far off the channel center that when they mix they cause a low audible rumble. This is an audible het. It can really be distracting and make the programming hard to hear. With a lot of carriers on a channel you can imagine what a mess this can be to your ears. To eliminate this simply switch to either Synchronous Upper or Lower sideband and look carefully to see (on an SDR) where the low end of the RF filter is at. Usually for Sync detection it will be very close to the carrier frequency because you want high fidelity on

the recovered audio, close enough though to include these carriers that are causing rumbling. Slide the lower (closest to the carrier) filter edge away from the carrier (either up for USB or down for LSB until the rumble disappears. This works because you have the locally generated reinserted carrier to demodulate the signals and that is stable. You can also use regular non-sync USB or LSB and many find that this works as well as the sync method does. This is because by design the lower edge of the sideband mode filter will already be set above the area where the rumbling carriers are and can mix. If you slide that filter edge down closer to the carriers again you will hear the rumble return.

IF Shift

If you are using a communications receiver not an SDR and can't see the filter edges you can use your IF Shift or Passband tuning to slide the filter up and down to do the same thing. Passband tuning also allows for you to separately adjust the upper and lower sides of the filter. Remember to try this. (Some SDR applications have this IF shift too but I prefer to just drag the filter edges with the mouse.

Sideband Fading

One other thing on sidebands. Sometimes they can fade differently even though they are very close together, a few kHz apart. If this happens you can get distortion too. Sync U or L or USB or LSB eliminates this because you don't have the other sideband there to fade against the one you are listening to. This does not happen often but be aware of it.

Antenna Phasing

The next thing you can do is to use 2 antennas suitable setup to phase together and use the resulting antenna pattern to cancel out many or some of the stations on the channel. You can do this with a passive phaser, or via terminated antennas that get quite complex and need preamplifiers. I have been doing that for many years but my current setup is 2 small flag antennas un-terminated (so I do not need preamplifiers) and those are connected to a dual-channel SDR, the SDRplay RSPduo. This allows for active phasing without the loss of passive phasers and is the entry point to a new world of possibilities for DXing. (A good passive phaser with its limitations would cost more than the price of an RSPduo.) There are a lot of possibilities when you can phase antennas and this can be done dirt cheaply too. We could get into a nice discussion some time on that if you ever have the desire.

Once you have a dual-channel SDR then your recordings take on a new value. You can play back the recording and adjust the phasing after the fact and have it different for each channel's needs. It's the Holy Grail of mediumwave DXing, not to mention time-shifted DXing. Right now the only SDR application that can do dual-channel coherent recording is [Linrad](#).

SDR Applications

And lastly, the SDR application itself. There are many good ones out there for mediumwave, SDRUno, SDRconnect, SDR Console, HDSDR, SDR#. But the very best there is right now is

Linrad (Linrad runs on Linux and Windows). Nothing else is in the same ballpark as it is, though the co-channel canceller on SDR# is nice. I don't need that since I can phase the 2 tuners on the RSPduo and get a null I can control even on a recording and then do more with Linrad. Linrad has several coherent detection modes that no other application has. One lets you lock to one and only one carrier on a channel with millihertz accuracy and then creates a 3D soundscape of the rest of the stations on the channel spread around you. This is the ultimate in cleaning up a jumbled channel as best as can be done. That has to be heard to be believed. Of course all of the above can be done too and much more. 2 fantastic noise blankers, polarization control to enhance a signal (linear V and H, circular R and L, elliptical R and L and combinations), adaptive polarization, notches, and on and on. But it is not something someone can just install and have any hope it'll work as expected. It takes an investment in learning the app and a critical first step is proper installation and understanding how it works. It'll support a wide variety of SDR hardware. AirSpy, Perseus, SDRplay (dual-channel mode and dual-channel recording with the RSPduo), Afedri (also Afedri in dual-channel mode including dual-channel recording) and more. Linrad can likely improve any SDR you might be using whether it is a single or dual-channel SDR. But I'd suggest digging into your current SDR application of choice and getting the most out of it first before trying something very complex. You shouldn't move directly into the cockpit of an F16 fighter after only having Piper Cub experience. It's not quite that bad, but there is a steep learning curve, but worth it I'd say after using Linrad for several decades.

Recording

Making recordings is critical to being able to loop on something to hear it more than once to get an ID. Audio recordings are useful but to really do this well you need an IQ recording so that you can play with SDR application settings over and over to get the best out of any possible ID. On some channels I make 10 minute top and bottom of the hour recordings. But on a busy regional or graveyard channel I'll record continuously because you never know when something will pop up for a few seconds. It takes more of a listening commitment on channels like these but it can be very rewarding. And this is where wireless over the ear headphones can help so you can be doing other things in the workshop while still listening to a recording. If you get a couple of new logs out of a few hours of listening to a graveyard channel, and either jot them down or jot down the time to go play with the SDR app later to clarify something, it's worth it.

Carrier Sleuthing

And that's a perfect segue to Chris Smolinski's Black Cat Systems software. I use his [Carrier Sleuth](#) application to look over recordings to see where in them is a good place to concentrate on and give a listen. You can get these Carrier Sleuth charts on a per channel basis (10 kHz, 9 kHz, or both), and also save them once made economically. So it also gives you a way to take a quick look at what the channel usually looks like and see what the latest recording looks like and know right off something interesting is going on. Then you go listen. Chris' [sdrRewind](#) application works well for that. It'll let you easily get to any section you need to listen to and play it back. If I need to dig deeper I can fire up Linrad and replay and loop the recording there and adjust phasing and a myriad of things to dig as deep as can be dug. Chris' software works with single and dual-channel recordings on the SDRplay SDRduo as well as about any other SDR app's recordings out there. I can search either channel on a dual-channel recording. I highly

recommend both of his applications.

Of course if you have an original Perseus SDR then you can use [Jaguar Pro](#) to do the above with recordings. But it does not have the other features I talked about in fancy demodulation and such farther up the post.

Grayline DX

The other thing to try is to understand and use the gray-line (terminator) as sunrise or sunset happens. This line changes angle throughout the year so there are chances for various parts of the world to fall along it in different seasons. Check this out and use it to advantage when you are planning for some particular area to hear. This can quickly affect stations on a channel, as can the time of the month because the switch from night to day antenna pattern and power or day antenna pattern to night antenna pattern and power is set for the middle of the month. So depending where you are in the world and the rising or setting sun, and the time of the month, you can get some legal enhancement as a station still in the dark goes to day pattern and power or a station gets into daylight and fades leaving others underneath it. Or as a station gets into the dark and stays on day power and pattern for a bit still, while other stations that usually would overpower at night it are still in daylight and have high D layer absorption. Solar events are also helpful. Aurora can wipe out stations due to absorption on northern paths and northern ionospheric refraction paths while more southern stations are beyond the Auroral oval and can at low angles sneak under the higher auroral absorption. I'm pretty far south for that now but when I lived the north these events would have all the usual stations gone and southern stations listenable. We have been having a lot of these events of late with the solar cycle position we are at now. So it is worth paying attention to this and what is going on with the Sun and knowing when to make time to listen.

Pattern Maps

A couple of other tools that are helpful is the [Medium Wave Circle's](#) RDMW Map. This is a map that displays station antenna patterns and expected coverage and it can ray-trace to your location. It's helpful to see what is out there on a channel and depending on the pattern and any pattern nulls to protect other stations, whether you might even get enough of a signal on a station you are stalking to be able to hear it. The [National Radio Club's](#) NRC Log is also very helpful and is an offline listing of stations. They have an Antenna Pattern book, also offline, and that is also extremely useful for planning listening sessions, along with their offline grayline maps. I have all of these in 3-ring binders for easy grabbing when I want to DX away from home. No Internet needed. The IRCA has a jingle list that they distribute for North American stations and this can be very helpful to get a handle on what you might be hearing and whether it's worth hanging around for a real ID or not.

Remote SDRs

There are a lot more things to be done when you get deep into digging as deep as you can. Multiple terminated antenna arrays and multiple SDRs doing recording duty. Remote VACTROL antenna terminations that are shack adjustable, preamps, and more. Remote SDRs as

many use in the Arctic. And also the use of online SDRs that are shared to try to confirm an ID or get another listen more clearly to a station jingle etc. But for me I never count these as heard, I only count stations I hear and ID locally on my equipment, but I do use remote SDRs to assist but never confirm.

Community DXing

There is the communal listening aspect. There are online lists like this one and also online venues where DXers can talk back and forth live. This can be helpful too. I often DX live like with others and it is rewarding and fun. DX Central (by Loyd Van Horn) is a good place to learn more about this if you are interested. Loyd Van Horn of DX Central also has a new site up for collecting audio clips of central and South American stations IDs and jingles. This can make an ID easier. [MWLIST](#) is another site for not only North American info but South American and World info too.

Databases

I do things on paper and here is what I do (although I now transfer these to individual text files per channel in the same format...

Years ago I was using (and I still do use) the NRC Radio Log and the NRC Night Pattern book and their grayline charts and I had these in separate 3-ring binders so I could have them open to the page for the channel I was DXing at the time. It seemed logical to add yet another 3-ring binder to the desk and to use that for loggings. So I looked at the NRC log and made up a lined paper page for each channel and labelled it at the top with the frequency and what it was, i.e. US Clear, Regional, Graveyard, Cuban Clear, etc. Then I started writing in the loggings for that channel first with the callsign, the location, then the power, then the time and date I received them, then the network or the slogan, the programming type, and any comments like whether they were something that faded up over a channel regular or some oddity, or a usual sub-dominant station. I wrote them down in the order I logged them. And I never alphabetized this at all. Of course now with the move to Florida in 2021 I have had to start over, but back in Wisconsin and Michigan the long lists got to be very useful. I didn't know it at the time, but the logging list order turned out to be more useful than I thought. I now had a list of stations logged on the channel listed by the difficulty I had to log them from my location. So, the usual suspects were at the top, the rare stuff at the bottom as the list grew. I'd like to have something electronic that would do that and then let me see based on some search terms what else might be achievable on that channel yet. What do I need to look for at sunset or get up real early for (the benefit of being retired) or stay up late for, or plan when to dig for that station based on the seasonal change in the shape of the grayline or the grayline shape and the time of the month for power and pattern changes. Somehow the RDMW application could be very useful for this if it could talk to the database. And I always have the RDMW open whenever I am DXing as well as the MWLIST (US and SA pages for me here in Florida) on a channel. All of these tools are essential.

Then later on as I logged things, along came post-it notes. We got these at work and a light bulb went off over my head. Ah, yes. Add a post-it to any channel page of a station you thought you heard, or are trying for, or want to try later in the season or something. So the 3-ring binder got

to be a colorful controlled semi-chaotic treasure trove of a tool. I'd love to find a digital tool that would do all of that and make for helping look for possible targets of opportunity easier too. I can't do post-it notes on a text file though :(

There is some work on this going on over at DX Central by Loyd Van Horn. Loyd works professionally with big data, so he is a database engineer and really understands this stuff. Maybe someone someday will get something like this together that we can use. Already there are things in place for listening challenges and more. But nothing quite like I described above.

Rick Kunath, K9AO