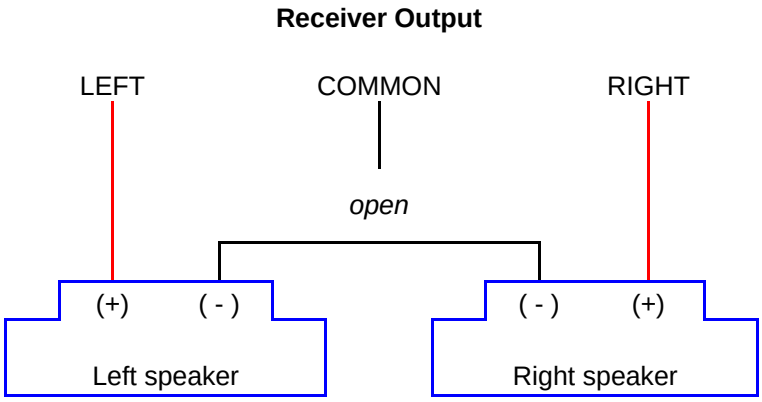
Audio Phasing
Kevin Schanilec

Background

For MW DXing, a new tool that may be effective at reducing or eliminating on-channel stations you don't want to hear is audio phasing. I re-discovered this technique recently after buying my second Sony SRF-59 receiver. The SRF-59 is a surprisingly sensitive and selective DX machine in its own right, and the fact that it is so small and inexpensive ($15-20) makes it even more remarkable. This great receiver is fully reviewed by Gary DeBock at http://www.dxer.ca/content/view/55/78/.

Having two of them got me thinking about experiments I did as a teen in the 1970's with stereo audio sources. While rewiring a pair of headphones one night, I accidentally forgot to reconnect the common (negative) lead to the two speakers, meaning that only the respective positive leads were connected.

This resulted in the following circuit:



The result was a bizarre-sounding version of the music I was listening to, in which the lead vocals, bass and drums were absent, whereas all of the other instruments were still heard.

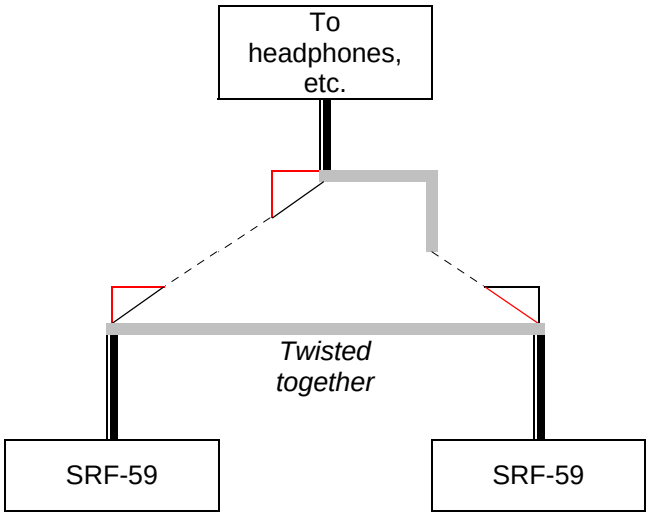
What makes this possible is that, when music is mastered, material common to both channels is EXACTLY the same on both channels. When hooked up like this, the common material EXACTLY cancels out. Electrically, anything common to both channels (i.e., lead vocals, etc.) has the same voltage both positive speaker terminals, and so cancel each other out across the voice coil. It is only audio that is NOT common to both channels that creates a differential voltage across the voice coils so that you actually hear it.

It got me thinking: if I had two DX audio sources, one that had only a dominant "pest" (i.e., point the antenna at a strong local and null the desired DX target) and one that had both the pest and the DX target, in essence I would have a pseudo-stereo source. By using the audio phasing technique described above, I should be able to make the pest disappear by injecting just enough of the first signal (pure pest) onto the second signal so that the pest just disappears, leaving the DX target. I had tried this with two different DX receivers a few months ago, but met with limited success, since the two receivers had slightly different filtering, bass/treble emphases, etc., which meant that virtually nothing in the two audio signals matched up. As a result, almost nothing was cancelled out.

Enter the SRF-59! Since they are identical receivers, the audio from one set to another should be the same when tuned to a given station. With two of them in hand, I decided to give the experiment another try.

Making The Connections

I sacrificed an audio patch cable in order to effect the circuit described above. Specifically, the audio leads from the two receivers' headphone jacks consist of a 1/8" mini stereo male-male audio cable cut in half, with all 3 wires bared on each half. You will also need some way to connect up with your destination, such as a speaker, headphones, recorder, etc. I had a female end of an old 1/8" mini extension cable, which filled the bill.



1. On each half-cable, twist its two positive leads (represented in the drawing by the thin black and red lines) together, resulting in the "positive" lead of a mono source from that receiver (represented by a black dotted line).
2. Next, twist the two negative leads from each half-cable (often braided shielding) together and isolate this union with electrical tape or whatever (represented by the thick gray lines in the drawing).
3. Now take the two positive leads from each half-cable (black dotted line in the drawing) and connect those to either terminal of a single speaker: they form the two leads of a mono source. Alternately, this can be fed to a pair of mono headphones or, with a mono-stereo adapter, to stereo headphones. In the drawing I show it hooked up to the female stereo jack, and so I had to twist its black and red wires together as well.
4. Plug each of the 1/8" mini stereo male plugs into the SRF-59s, plug in your headphones, and you're ready!

If you're going low-tech like me, you final result might look something like this picture.

The Audio Phasing Technique

OK, let's do some audio phasing!

1. Turn both receivers on with zero volume. Note that if both sets aren't on, you won't get any volume in the headphones.
2. Select a suitable frequency, one that you know to have a strong station which dominates and a weaker station which is audible in the background. Alternate turning the volume up on each receiver to tune them to the frequency, making sure you're dead-on.
3. Orient the two receivers so that one receiver is nulling the weaker target, while the other is pointed at the weaker target so that it has both stations. That way, one audio channel will have nothing but the dominant station, while the other will have a mix of the two.
4. Re-zero both volumes, and then adjust the volume of the dominant-only receiver so that it is at an appropriate level for listening.
5. Slowly increase the volume of the dominant/weak target receiver so that the audio signal of the dominant station starts to decrease and eventually reaches a minimum. It may even completely disappear! You should be left with whatever station was lurking underneath, or noise if there was nothing underneath. Increase the volume of both receivers if necessary.

Adjust the beam of one or both sets, since there may be a better pair of nulling directions than those chosen in Step 3. SRF-59s are great for this, since you can hold one in each hand and swing them around to your heart's content to find the best orientation. With my set-up, once I have the two receivers matched up on a given frequency, I ride one of the volume controls and compensate for any occasional fluctuations. Make sure you keep the two receivers away from each other so their antennas don't passively couple with each other. You can use outboard gear, such as a passive loop, but it has to be EXACTLY the same for both, otherwise the two audio signals will be slightly different.

To make things easier, consider plugging the two audio channels into something with a balance control (stereo receiver, etc.), which then feeds your headphones, making it a lot easier than constantly adjusting the individual volume controls on the SRF-59s all the time. A more sophisticated set-up which incorporates this is shown in this picture, where both SRF-59s are mounted on a tripod, and a balance potentiometer is inside the black box. (Thanks to Bruce Bacon)

My Results

In my initial tests, I was rewarded with some interesting results. I first selected my local 630-KCIS, which can be somewhat difficult to null or phase if I want to hear KXFD in Boise, which is usually noticeable in the background. I placed both of the SRF-59s into my two identical Terk loops to get some signal (again, you must have the EXACT same set-up), pointed one straight at my local 630-KCIS and one away from it – worked like a champ! KCIS essentially disappeared, and KFXD-Boise was sitting there virtually all alone.

At my QTH, beleaguered semi-local KXPA-1540 suffers from the IBOC hiss coming from 1530-KFBK. One receiver was pointed straight towards KFBK and was all hiss, and the other half-way towards KXPA, not quite nulling KFBK. Guess what – the IBOC hiss was virtually gone from KXPA!

KXL-750 is essentially a semi-local from Portland. Because of it having both ground and sky wave components, neither electrical phasing nor passive phasing with two loops has ever really worked. However, audio phasing on the SRF-59's worked well enough that I could comfortably hear the conversation underneath from (I think) KOAL in Provo, Utah. KXL's audio null fluctuated a lot, but it was better than I could get with traditional phasing.

Finally, 1210-KWMG directs all of its 10,000 nighttime watts straight at me from about 20 miles away. Phasing with passive loops and electrical phasing has never been very effective with this station. Using the audio phasing technique, I was able to make KWMG almost disappear, and heard 1210-CFYM underneath, running only 1,000 watts almost 700 miles away. I had written off 1210 as a potential source of new loggings, but now there is definitely hope, since there was also another station underneath which faded before I could identify it: it was like having an open frequency! Note that both SRF-59s were barefoot here, testifying to the sensitivity of these little marvels.

Using Audio Phasing

It goes without saying that some stations are easily nulled or phased out of existence (remember, the SRF-59 is a great null producer) so you don't need to go to these lengths. However, this seems to be a valuable tool for many situations when an electrical/magnetic null isn't in the cards. Besides, it is a great excuse to buy another $15 radio! You may not have the resources to buy two Drake R8Bs, but two SRF-59s (and maybe two outboard loops) is probably within reach of most of our pocketbooks.

I can't emphasize enough how the two audio sources have to be identical (same receiver, same antenna, etc.). For example, using one SRF-59 barefoot and the other with a Terk loop produced enough of a sonic difference that there was noticeable bleed-through of the pest - I think the Terk tightens up the audio bandwidth, and the higher frequencies from the barefoot receiver easily bled through. Likewise, using an SRF-59 and my Sony 7600GR was a complete failure, given the markedly different audio characteristics of the two receivers' filters, audio circuitry, etc.

One thing to watch: if you directionally null the pest too well with one receiver, the null may cause the pest signal to flutter, or change/color its audio frequency balance, and it won't match the pest-only audio source very well, resulting in bleed-through of the pest. The technique seems to work best when I null the desired DX target with one receiver (not necessarily maximizing the pest, which still stands alone anyway) to produce the pest signal, and then have the other receiver with more of a mix of the two without necessarily fully nulling the pest; that way you have a similar pest audio signal in both channels, which will more nicely cancel each other out.

Yes, some stations work better than others: for instance, I couldn't do much of anything with some of my strong locals here in the Seattle area, stations which have also been resilient to passive and electrical phasing. In other cases, audio phasing a local out of existence left nothing to hear, since there were no other stations within listening distance that stepped up to take the local's place: using two radios with larger ferrite antennae probably would have worked better.

One thing that traditional electrical and passive phasing have over audio phasing is the elimination of adjacent channel slop, especially when trying for transoceanic frequencies in between domestic channels. I have had essentially no success in this area, since getting the slop to be identical on both receivers is virtually impossible. Therefore, don't throw away your phasers, Beverage and EWE antennas, and other gear! However, for on-channel interference, audio phasing can be very effective.

Good luck!

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