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West Mountain Radio

Quarter 1 - 2022

CLRspkr

ClearSpeech® DSP Noise Reduction Speaker

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What is Noise? (Part 1 of 2)

By Dave Ingold WB9SXG

What is noise?

What is noise? The simple answer: If you want to hear it, it's signal. If you don't want to hear it, it's noise. For example, what we hear as atmospheric noise, Doppler weather radar picks up as signal. What we hear as cosmic background noise gets radio astronomers excited.

This is the first part of a two part series. Here we will find out what is noise and sources of noise. The second part we will find out strategies how to locate noise and what to do about it.

Types of noise

Noise fall into 2 general categories: QRN and QRM. QRN is from Nature. QRM is Man-made. Examples of Nature-made noise include cosmic background radiation, lightning, the sun, thermal noise, shot noise, to name just a few sources of QRN.
Examples of Man-made noise include electronic devices, florescent lights, LED lighting, electric motors, automotive ignition and alternators, power lines, electric fences, wireless dog collar fences, radio transmitters, RADAR, broadcast stations and (dare I say it?) ham radio. That's just a few sources of QRM.

Lightning

Anything that generates sparks will cause radio frequency interference (RFI). Remember Marconi and early radio used a spark-gap transmitters? Electric motors that use brushes generate sparks, automotive spark plugs generate sparks (although modern electronic ignition systems minimize the sparky sources and use resistive spark plug cables) arcing power lines, mercury vapor lights, florescent lights, all make sparks. Heck, even a loose AC power plug can create arcing. Lightning is mother nature's spark-gap transmitter on steroids. Lightning sparks all around the world can generate energy that radiates high into the atmosphere and can even reach the ionosphere and bounce back to earth. Just a quick note, if lightning hits an ungrounded antenna connected to your rig, that will make a BIG noise – BANG, POP, BOOM! Lightning noise is a broad spectrum type of noise; it's all over the RF spectrum. You can hear lightning striking the planet almost 24/7.

The Sun

Our Sun is a natural source of radio waves at every frequency. You could call the Earth a natural radio receiver . The sun emits radiation at many wavelengths, heat, light, x-rays, gamma rays, RF radiation; it emits everything under the sun. We are protected from much of the bad stuff coming out of the sun with the earth's Geo-magnetic field. When a lot of that solar energy hits our magnetic field all at once, this creates a Geo-magnetic storm that creates RFI. Hams enjoy solar storms on the surface of the sun called sunspots. Sunspot activity makes for good propagation, but when these storms spit out solar flares and coronal mass ejections (CME's) that can create so much ionospheric disturbances that can knock out even the most powerful TV station signals. During high aurora activity, hams notice a lot of noise. Auroras are due to the sun emitting electrically charged particles (ions). The ions form a stream of plasma (high energy gas) called solar wind and shoots towards earth. These plasma ions are then drawn to the magnetic poles of the Earth. This plasma hits the Earth's magnetic field and become agitated. As these agitated ions bounce around and interact with the ionosphere

and glow. This is the same principle of how a neon sign lights up. All this high energy agitated ionic activity creates radio waves as well as light. In fact, you can hear an aurora with a VLF receiver , but you have to tolerate a lot of 60 cycle hum, submarine radio stations (QRM), and lightning (QRN). Light and radio waves and other radiation from the sun traveling the speed of light take 8 minutes to reach the Earth. A solar flare or CME takes 2 or 3 days to reach the Earth. Solar activity is predictable. The NOAA Space Weather Prediction Center website (www.swpc.noaa.gov/products/solar-cycle-progression) and QRZ (www.qrz.com) have this information.

Thermal noise and shot noise

Thermal noise is caused when heat excites electrons and the electrons escape and create an electric current which gets picked up with a sensitive receiver. This shows up as a white noise at low levels, but more pronounced at wavelengths < 12 meters. Thermal noise increase with temperature. Most of the thermal noise is found in your receiver's first stage RF amplifier. Thus, adding an RF pre-amp may introduce thermal noise. If you want an RF preamp for 12, 10 meters or VHF and above, look for one with the lowest noise figure.

Electrons are both waves and particles (photons). As particles they create shot noise. Shot noise is low level and very short spikes at wavelengths < 12 meters. Thermal noise and shot noise are not usually a problem at such low levels, especially on HF frequencies.

Man-made noise (QRM)

QRM can be caused by our modern technology: computers, tablets, cell phones and cell phone chargers, LED fixtures, motion senors, universal electric motors, grow-lights, power inverters, name anything electronic and, chances are it will transmit something. Anything that can produce sparks will produce QRM. Examples include lawn mower spark plugs, vacuum cleaners and power tools universal electric motors that use brushes, welders, faulty power lines to name just a few things. So, we have two categories of QRM : sparkies and transmitters ("stealth" transmitters and known transmitters).

Sparkies

Like lightning, anything that produces sparks can produce RF noise. Modern autos have spark suppressing resistive cables and electronic ignitions, so they are not so much of sparkies as say, lawn mowers and snow throwers. Many electric motors are now brushless, so they are less sparky than they once were. Once in a while, older power drills and vacuum cleaners may cause RF interference.

Our friendly local power companies try to do all they can to reduce sparkies and corona discharges from their lines and equipment. Stray voltage and arcing affects their bottom line, so it's in their best interest to reduce sparkies. Corona discharges are found in high voltage power lines and connections. 12 – 120 KV electrons travel only along the surface of a conductor, this is called the "skin effect". Because of the skin effect, some of the electrons may escape into the air and cause interference. When stray voltage and arcing and corona discharges are found, utility companies are required by regulatory agencies to correct these problems. Utility companies don't like to see electricity go anywhere nobody pays for it. Power line noise is a broadband source. It's an equal opportunity RFI.

Transmitters

Broadcast radio stations

AM band broadcast transmitters can sometimes bleed over into the 160 meter band. Sometimes your radio IF can pick up images of strong signal broadcast radio stations. Many times you can adjust the IF bandwidth and notch filters to minimize this

International broadcast stations in ITU regions 1 and 3 transmit on 7.1 – 7.3 MHz. This is in the sweet spot of the 40 meter ham band. You can try to notch it out with a notch filter, but realize they run with megawatts of power. Most of the time you just have to go to another frequency.

RADAR

I hesitate to mention microwave RADAR. This is usually not much of a problem. Microwave RADAR is limited to line of sight propagation. But Over the Horizon RADAR is yet another story! Over the Horizon RADAR uses HF skip from the ionosphere to locate these ships and aircraft over the horizon all around the world.

Over the horizon RADAR is used by super power military countries such as USA, Russia, and China. They have powerful sharp pulses and sharp edge signals. Noise blankers my help a little but these signals are so strong an overpowering, at times they can black out a lot of ham frequencies.

Most motion detectors are a form of microwave RADAR as well. They may or may not be a problem, but they still transmit radio waves. Also, remember garage door openers are transmitters, too.

Switching Power Supplies

I find the most common source of noise in my shack are switching power supplies. These are really bad guys! These are what I call stealth transmitters.

Switching power supply technology is ubiquitous! Cheap switching power supplies are used in LED fixtures, electric fences, desktop and laptop computers, tablets, wi-fi routers, DC to AC power inverters cell phone battery chargers, doorbell cameras, radios. In general, if it powers a USB device, chances are, it's a switching power supply. Switching power supplies uses 50-100KHz square waves which produce odd-order harmonic frequencies. Ham radio switching power supplies are usually pretty clean and minimize noise. Cheap switching power supplies can produce the most nasty and annoying noise.

Older power supplies uses a transformer to change the voltage to approximately what is needed. Then circuitry changes this to DC, ensures that it is clean and remains at the proper level (rectification, filtering and regulation). The problem with this design is that 60 Hz transformers are big, heavy, and expensive.

Switching supplies, on the other hand use transformers at a much higher frequency, 50-100 KHz. At higher frequencies heavy, bulky, and expensive iron core transformers are not used. This makes for a smaller, lighter transformer.

120 volts AC is rectified when it comes in, resulting in a voltage approaching 200 volts. This DC voltage is fed into a high power transistor circuit, which is designed to oscillate at the high frequency (50-100 KHz). The transformer, in addition to being part of the oscillator circuit, does what transformers do, and makes the high frequency, high voltage AC (usually square wave AC, rich in odd harmonics) available through its secondary windings. From the secondary, the AC passes through a rectifier which converts it back to DC. This DC current is then filtered and regulated.
The main idea: Any thing that produces square waves can be rich generating in odd-order harmonics can be a hidden source of QRM.

Ham-generated noise: "We have met the enemy and he is us"
Some hams, I won't mention call signs nor names, just have spurious signals. CW key clicks are caused by short rise times on the "dits". 3-4 milliseconds are ideal rise times to set. Over modulation, or "splatter" is caused by over-driving a mic gain, or just yelling too loud into the mic. If you are on SSB or AM, use that ALC. Some mics just have a strange frequency response. Adjust the EQ so it's as flat as possible. Don't over-do speech compression if your rig has that feature. Pay attention to your output signal. Pay attention to RST reports from your QSO's. Also, be honest with your own RST reports. If other hams say you sound tinny or muddy, fix the EQ. Is someone spattering onto your QSO? Your rig has a tuning knob. Turn that knob it to a clear spot and QSY. Some power-hungry hams over-drive their linear amplifier. Bottom line: Be considerate. Don't be a Lid!

Inter-modulation interference
UHF and VHF bands are suspect to inter-modulation interference. You may have a junction of corroded metal contacts on an antenna or ground connector or a loose connector acting like a "diode of convenience" which may cause non-linear mixing of different frequencies to generate a new frequency of the sum and/or difference of these frequencies. Or you may have 2 VHF/UHF antennae in close proximity with different frequencies mixing to create the inter modulation effect also. You can take a tip from the repeater operators and use unique CTCSS or DCS tones to let your equipment discern a good signal and squelch out the unwanted signal.

Front end overload
Front end overload is just when an adjacent powerful mega signal overpowers the receiver, such that it saturate everything you want to hear. Digital modes are made for QRP operation.. Digital modes use a high duty cycle. They transmit all the time. With phone/CW modes you transmit, you listen. Many hams up their power on digital modes. Doing this can just burn out you transmitter finals, and cause QRM for others.

So, as a ham, let's follow the golden rule and not be a noise source and we can all get along. The next article in the series we will learn strategies to search and destroy noise. Well. At least reduce it!

How to Use the Windows Sound Control Panel in Windows 10 & 11

By Sholto Fisher K7TMG

Using sound card based digital modes and other audio software can be a frustrating experience if you do not know your way around Windows. I frequently get support calls where it is obvious the Windows Sound System and its intricacies are poorly understood. I partly put the blame on Microsoft for making it less than obvious where to find important settings or even worse, removing a known method after a Windows update!

Why do we need access to the sound system?

Most digital mode audio interfaces will have an on-board sound card. Radios with a USB port also usually have a sound card too (often called a “codec”). From the point of view of Windows they are simply a USB sound card attached to the system and managed the same way as any other. Because of this sound card is used to generate audio signals suitable for transmission by radio we need to know how to set the volume, both for RX and for TX.

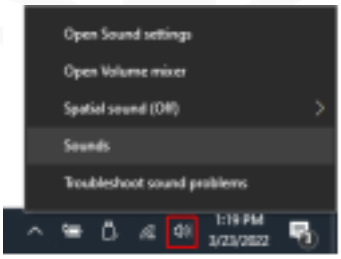
A sound card input channel is used for RX audio. A sound card output channel is used for TX audio. Each channel has a volume level associated with it, so it is important to understand how to adjust both. Too high a volume level and you risk a distorted transmit signal.

Too high or too low volume on receive audio could mean missed decodes or a “missing waterfall”. It is not enough to simply move the volume slider using the main Windows Volume Slider icon.

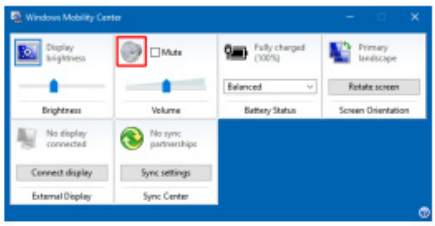
Where can we access the correct sound settings?

A tried and true method of dealing with the sound system is to use the Sound Control Panel. This is a holdover from earlier versions of Windows and once understood is probably the most useful of all of the audio settings screens. Finding the Sound Control Panel can be difficult but here is a few ways you can do it in Windows 10 and Windows 11.

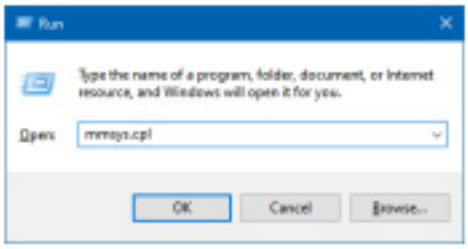
Method 1: Windows 10 only. Right-Click the main volume icon and choose ‘Sounds’:



Method 2: Windows 10 & 11. Right-Click the Start button and choose ‘Mobility Center’. When this appears, click the grey speaker icon:

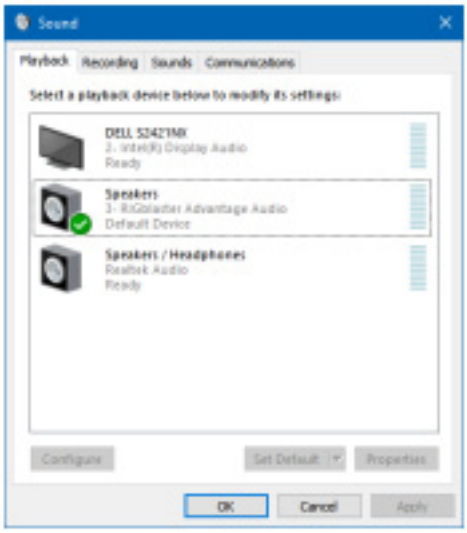


Method 3: Windows 10 & 11. Hold down the Windows logo key on your keyboard and tap the letter R. Paste mmsys.cpl into the run-box and press the Enter key:



This last method could be improved upon by creating a new shortcut on your desktop which points to mmsys.cpl. Then you will always have an icon which can be double-clicked instead.

Whichever method you use the Sound Control Panel will open and you will see this:



The Sound Control Panel as it appears in Windows 10 with three playback devices including a RIGblaster Advantage.

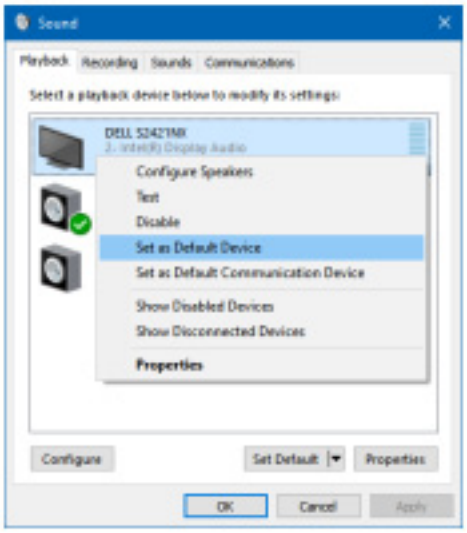
You will notice that the RIGblaster has been given a green check which means Windows has decided (usually chosen upon first connection) that the RIGblaster should be the default playback device. I really wish it would not do that!

A default device actually indicates to Windows programs which device they should use for audio if not specifically configured to use a certain device. So if you left these settings alone and started to play a movie, or listen to your music playlist, the Advantage would be the audio device it would try to use.

Obviously we do not want that to happen. The first thing we should do is to tell Windows which is the correct device, i.e. which sound card to use for default playback.

Looking at this list we can see two other audio devices listed. One is the sound card built into the Dell monitor and the other is the on-board RealTek sound card in the PC itself.

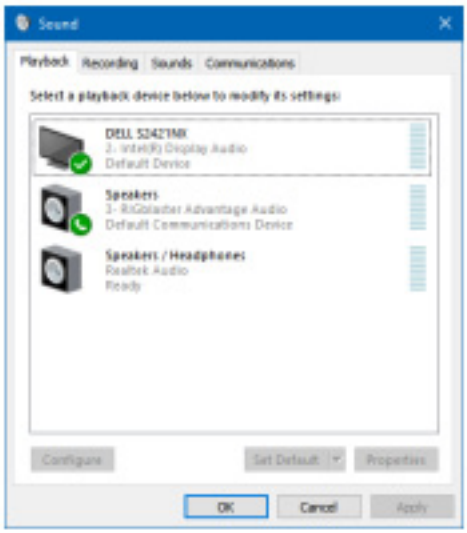
Either could be chosen for the default device but on this particular PC there are high quality speakers plugged into the Dell monitor



If we right-click over the Dell device we get a pop-up menu with an option to make it the default device instead of the RIGblaster.

Tip: You will also notice there is an option to Show Disabled Devices. Occasionally a device can be disabled accidentally and might be missing from this list. Choose this option so you can see all devices whether enabled or disabled.

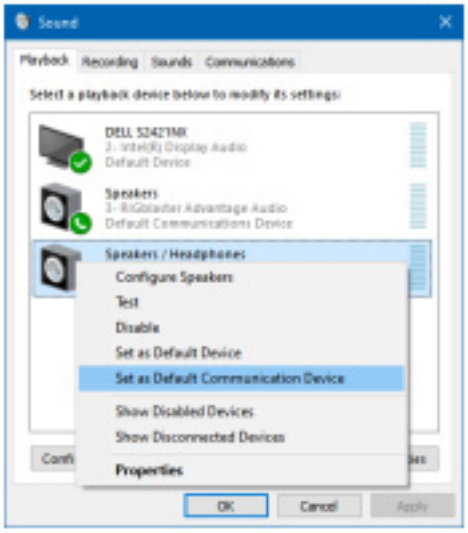
Once we have set the Dell device to be used for default playback you should see the green check has now jumped from the RIGblaster to the Dell.



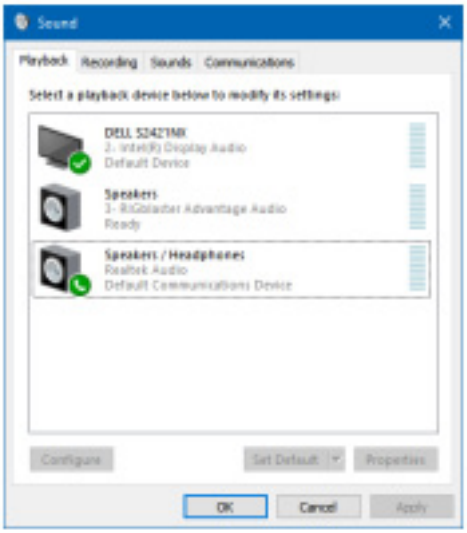
But wait! What is that? We now have another green icon on the RIGblaster that looks like a telephone. This icon indicates which device should be used as the default communication device.

What's a default communication device? This tells programs which use VoIP (such as Zoom, or Skype) which device to use for its playback. Again, we do not want the RIGblaster to be used for this so we need to move that icon too.

In this system there is a wired headset connected to the RealTek sound card and this is used with VoIP software so we want to make the RealTek the default communication device.



Now we will end up with a device list which looks like the following (hopefully!)

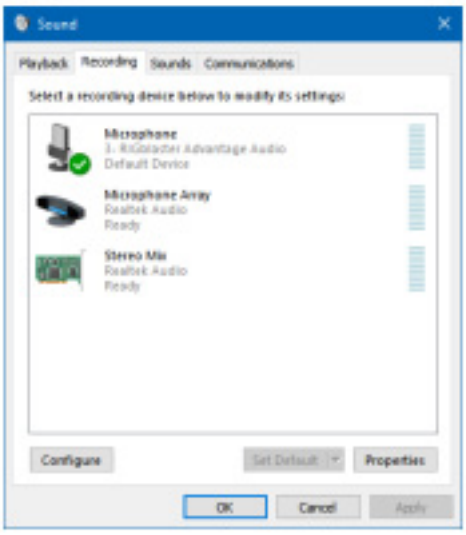


Now we can see that the Dell is the default device and the RealTek is the default communications device. There are no longer any icons on the RIGblaster device which is exactly what we wanted to achieve. This means that only the software we specifically configure to use the RIGblaster will have access to it.

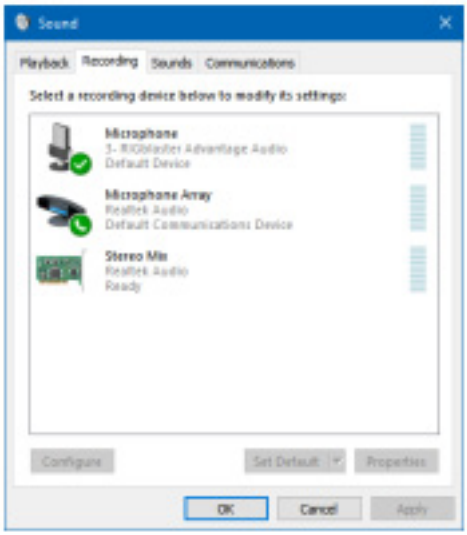
Tip: If you do not use software like Zoom, or Skype then don't worry about the default communications device. You can leave the icon alone.

Background: Windows has become much more sophisticated than earlier versions and by telling it which device to use for communications it can automatically reduce the volume on other devices when a call is received. The default communications device is specified so Windows knows which other devices to change volume on.

Unfortunately we are not done yet with the Sound Control Panel. We have the Recording devices too. Clicking on the Recording tab at the top of the screen will list all the recording devices.



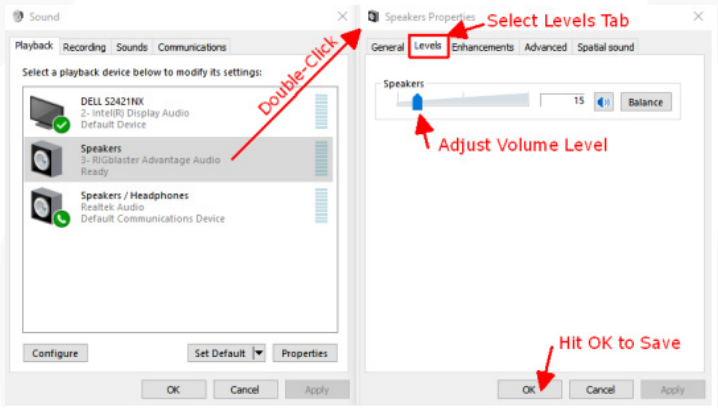
Currently you can see that the Advantage is set to be the default recording device. This is usually fine left as is but if you do use VoIP software you will want to make another device the default communications device.



Right-clicking on the RealTek device allows it to be set as the default communication device.

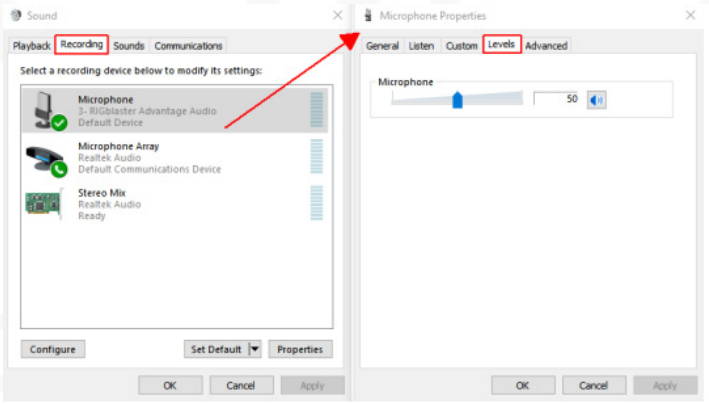
So now we have ordered our sound devices correctly we should set the volume levels on the RIGblaster. Remember we need to do this for both playback (TX) and recording (RX) audio.

Select the Playback tab and then double-click the RIGblaster device. Doing so brings up a properties dialog where you can set the TX volume.



I find a value of around 10-15% is about right for modern radios with a RIGblaster Advantage but you may need to experiment a little with your particular set up.

Do not forget to do the same for the RX (recording) audio!



50% seems to be pretty typical and is not as critical as playback volume.

So that covers how to find the Windows Sound Control Panel, figure out your default devices, and set volume levels.

All that is left is to configure your digital mode software to use the RIGblaster sound device for both playback (TX) and recording (RX).

CLRspkr Review

By Dave Ingold WB9SXG

For openers, this is more than an external speaker, it is even more than an amplified external speaker. It contains artificial intelligence algorithms and logic circuits that digitally sample the audio input into the speaker and "learns" what is noise and what is signal, then separates the signal from the noise, and dumps the noise.

There are only two knobs on the speaker: on/off/volume and filtering. Simple. A headphone jack is provided. Plug the speaker cable in the external speaker output of the radio and the other end into the top jack of the CLRspkr. Then plug the power cable into a 13.8 volt power system using Anderson® power pole connectors.

You'll need to adjust both the speaker volume and your radio's AF gain. Whatever you do, avoid clipping. This is indicated by the power on LED changing from green (indicating it is on) to orange (or red). When this happens, you over drive the speaker and your signal gets the top part clipped off. This generates sharp edges on the amplified audio wave form. Since the speaker digitally samples the input, you get bad input sampling and it processes the signal as distorted. As they say in computer circles, "garbage in, garbage out. Trust me, when clipping occurs, the sound is really bad. There's even more distortion than if it were a simple amplified speaker. You want just enough AF gain to drive the speaker but avoid clipping. Then you want to adjust the speaker volume control to a comfortable listening level. At 7.5 Watts RMS, it provides plenty of volume to hear anyone you want to work. As they say "if you can't hear 'em, you cant work 'em."

The magic in the CLRspkr lies with the ClearSpeech® adaptive digital signal processing algorithm. Adaptive digital filters are self learning filters. It listens to the incoming signal, goes through a short "training" period, then adapts its operation based on the signal's noise content. During the training period the filter will pass the complete noisy signal. As each noise component is identified, the filter goes through a subtractive process to minimize the power of each component. What remains is the desired signal with only a small amount of noise.
I tested the CLRspkr on a Yaesu FT891 using three modes: AM, SSB,and CW. I tested it on 80M 40M 20M, 10M and 6M. For AM modes, I tuned into WWV on 2.5, 5, 10 and 15 MHz. For CW, I used W1AW as my standard, and slow speed CW nets and contests. For SSB, I used various stations. I noticed on SSB and AM modes, when turning the filtering almost fully clockwise, the audio sounds like someone is talking into an empty oil drum. On CW, I noticed the first note of a transmission had a noticeable chirp. This even sounds on my monitor sidetone as well. All other elements sound fine after the first note of a transmission.

In general, the QRM on 80 meters is painful for me to listen to, but combining the radio's IF DNR and the CLRspkr DNR makes it tolerable. For 40 Meters, I found the CLRspkr to be a game changer! It brought out some contest CQ's on SSB and CW that I wasn't able to hear above the noise floor. For crowded frequencies, the CLRspkr is no substitute for adjusting the bandwidth. The Clrspkr, unfortunately, does not distinguish crosstalk as noise. Therefore, you still need to adjust your bandwidth and notch filters on your receiver. For CW, I had to significantly lower my monitor sidetone level and also the level of the"beeps" as I change modes or go in and out of menu settings. They came through the speaker as very loud.

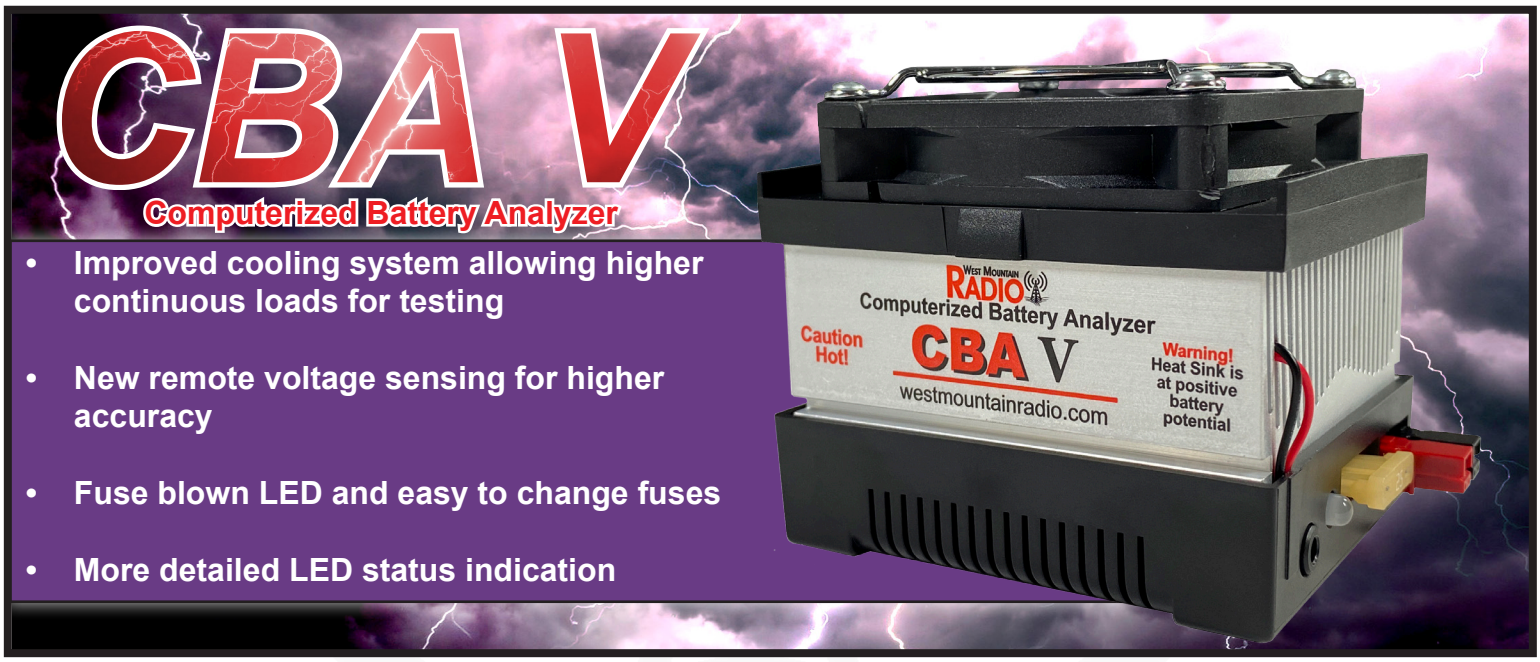
Test Results:

Band	CW	SSB	AM	
AM Broadcast	n/a	n/a	great	
WWV 2.5	n/a	n/a	fair	Normally the noise floor is too high to hear Combined with radio DNR the time signals are detectable but no so much of the voice announcements
80 m	W1AW readable	good	good	Combine with radio DNR not painful but tolerable
WWV 5.0	n/a	n/a	great	Time signals and voice announcements are audible
40 m	W1AW good	Game changer!	WBCQ 7.490MHz	Fair on AM. Great for SSB!
WWV 10.0	n/a	n/a	great	Very clear for time signals, ticks and voice
20 m	great	great	?	No AM stations were found on 20M QRP POTA stations heard clearly on CW
WWV 15.0	n/a	n/a	great	I even heard WWVH clearly
WWV 25 MHz (experimental)	n/a	n/a	Amazing!	Operates at 2.5kW. All signals very clear!
10 m	good	?	Fair	10M is usually not very noisy for me for AM test, I actually used 11 meters.
6 m	No difference	?	?	Slow speed CW net

Conclusion:

- Avoid clipping: “garbage in, garbage out”. The CLRspkr is only as good as what you feed into it
- Combined with your rig IF DNR, notch filters and filter bandwidth, the CLRspkr can make painful QRM tolerable.
- For stations buried under your rig’s noise floor, the CLRspkr is a game changer.
- The ClRspkr works great and in some cases, it’s a game changer for SSB. There seems to be better performance for SSB than for AM phone modes.
- It was difficult to find AM stations on ham bands, therefore WWV and nearby SWL and 11M CB stations were used.
- Turning the filter too high can result in unnatural sound on SSB and AM.

Full disclosure: The CLRspkr was on loan to me for reviewing. I was never influenced by West Mountain Radio as to content. My opinions are my own.



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