Natural Radio

News, Comments and Letters About Natural Radio

January 2005

It seems like I just finished last months article and already another deadline is here! By the time you read this the Holidays will be in the past, but right now I am rushing to get out all the last minute Christmas projects that people have ordered. However, I can see light at the end of the tunnel, and I am looking forward to some quiet winter evenings where I can do a little experimenting and maybe even build a vacuum tube front end for a permanently mounted E-Field receiver.

Vacuum Tube Amplifiers for Natural Radio – There has been an active long-term discussion on the VLF_Group list about using vacuum tube amplifiers for Natural Radio reception. I thought it might be interesting to address this concept, but I am going to do it in a somewhat round about way since I don't have any experience using tube Natural Radio receivers.

Obviously, the first Natural Radio receivers used vacuum tubes. Whistlers were heard on the vacuum tube amplifiers used to try and pick up enemy phone signals during the First World War. Barkenhausen suspected that these weird sounds were an oscillation problem in the amplifiers, but couldn't duplicate the effect in his laboratory, and thus began the study of whistlers and other Natural Radio phenomenon. And of course Storey, Helliwell and others did their groundbreaking work on whistlers with vacuum tube amplifiers in the early 50's because solid state amplifiers were still a laboratory curiosity.

In the professional recording industry, vacuum tube microphones and microphone preamplifiers have made an amazing comeback. Vacuum tubes are used in some of the best studio microphones and vacuum tube preamps can sell in the $3500. range for a high end device. Their performance in no way is inferior to solid state units, so it would seem that one could build a very high quality Natural Radio receiver with vacuum tubes.

From a comparison standpoint, the vacuum tube amplifier in a studio condenser microphone and an E-Field receiver has many of the same requirements. It operates from an extremely high impedance source, the signal source may be of very low level, it needs to have frequency response over the audio range, and it should have a high dynamic range and low-noise. An E-Field receiver would have the additional requirement of being able to filter out unwanted signals like LORAN and strong AM Broadcast stations to avoid crosstalk.

The question however, is why would you want to do this? In the recording studio business, people think microphones are magic. If I were to conduct this discussion on one of the pro audio forums, I would probably be flamed to death, but the differences in sound between a good vacuum tube amp and a good solid state amp are minimal. A good amplifier should sound transparent, whether it is solid state or tube. I have both tube and solid state preamplifiers, and tube and solid state condenser microphones. They all sound good. In one listening test we conducted, there was much greater variation in sound between microphones of the same manufacturer and model, than there was between tube and solid state preamplifiers.

Nevertheless, the mystique surrounding tube microphones and preamplifiers goes on and lots of people are making lots of money selling them. (Let me just mention here that tubes have a different type of distortion curve than solid state amplifiers, so in cases where you *want* distortion, like in a guitar amplifier, tubes may provide a warmer and unique sound.)

But, let's get back to back to Natural Radio receivers. Even though it would be possible to build a high quality radio, what would be the advantage? Tubes have many disadvantages for Natural Radio receivers. They need a high-voltage plate supply, they require lots of power to run the filament and they can generate microphonic noise from the vibration of the elements. Other than doing this as a novelty, which is alright because this is a hobby and we're supposed to have fun, what advantages might a tube amplifier provide?

There is one characteristic of vacuum tubes that may make them useful for Natural Radio listening. For other than a direct lightning strike they are pretty much bulletproof when it comes to static electricity. So, they might enjoy some use in permanently mounted outdoor E-Field receivers. I don't have a permanently mounted E-Field receiver, but I have lost several FET front-ends on some of my shortwave receivers due to nearby lightning strikes.

So if you are tired of replacing FET front ends, or just looking for a novel winter project this might be worth the effort. If I were going to do it, I would probably run 12 VDC out to the front end, and build a small switching inverter to supply the plate voltage. If you ran the inverter at 50 kHz or so, any residual noise would be outside the range of received signals and shouldn't be a problem. For those near LORAN or other powerful transmitters, I guess I would be interested to see if it were easier to design a cross-modulation free front-end with tubes as opposed to FETs.

One approach to this design is on Renato Romero's site at:
http://www.vlf.it/accardo/vlf_Tube_eng.html

For vacuum tube data in general, see: www.tubedata.org

Helium Cloud – As if trying to figure out Space Weather conditions wasn't complicated enough, here's another interesting little tidbit to complicate things. According to NASA scientists and for you astrology buffs out there, there is a 13th sign of the Zodiac, the house of Ophiuchus. Because the scientists divide the sky in a different way than the ancients, the sun now passes through 13 constellations during the year.

But beyond astrologic trivia, what's important is what happens when the sun enters this portion of the sky. (In actuality, it's when the earth gets to that part of its orbit around the sun.)

Our solar system is passing through a cloud of debris left over from exploding stars called the Local Interstellar cloud. For a brief period each year, when the sun is in the house of Ophiuchus, it is also between the earth and the Interstellar Helium Wind. At this time the earth passes through what is called a helium focusing cone, which is a concentrated beam of these helium particles focused by gravitational effects of the sun. This interstellar breeze has been studied each year by the SWICS instrument on the ACE satellite since it was launched seven years ago.

This helium ion breeze is not very strong, only 0.264 atoms per cubic centimeter. In fact, the sun's magnetic field has little trouble deflecting this wispy material before it penetrates the Oort clout and crosses the orbit of Pluto. Only a dribble (0.015 atoms per cubic centimeter) penetrates the inner solar system, and crosses earth's orbit.

This low density probably has little effect on Space Weather, but these interstellar gas clouds have wildly varying densities, and we could some day come into a portion of a cloud that is thousands of times as dense as the one we are passing through now. This could compress the sun's magnetic field to within a few AU of the sun. (1 AU or "one astronomical unit" is the distance between the sun and Earth). The outer planets would be fully exposed to interstellar atoms and molecules. Interstellar gas would overwhelm the solar wind in our vicinity, thus transforming the space-environment of earth. I think I feel another dinosaur extinction theory coming on.

Read about it at:
http://science.nasa.gov/headlines/y2004/17dec_heliumstream.htm?list1225521